

CHAPTER

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17	Jul 25/2018		19	May 05/2015	
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9	May 05/2015		33	May 05/2015	
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48	May 05/2015		70	May 05/2015	
49	May 05/2015		71	May 05/2015	
50	May 05/2015		72	May 05/2015	
51	Sep 05/2016		73	May 05/2015	
52	Sep 05/2016		74	May 05/2015	
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55	May 05/2015		77	May 05/2015	
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62	May 05/2015		84	May 05/2015	
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65	May 05/2015		87	May 05/2018	
66	May 05/2015		88	May 05/2018	
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92	May 05/2015		8	May 05/2015	
93	May 05/2015		9	May 05/2015	
94	May 05/2015		10	May 05/2015	
95	May 05/2015		11	May 05/2015	
96	May 05/2015		12	May 05/2015	
97	May 05/2015		13	May 05/2015	
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3	May 05/2015		27	May 05/2015	
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32	Sep 05/2016		14	May 05/2015	
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34	May 05/2015		16	May 05/2015	
35	May 05/2015		17	May 05/2015	
36	May 05/2015		18	May 05/2015	
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R 5	Sep 05/2018		28	May 05/2015	
6	May 05/2015		29	May 05/2015	
7	May 05/2015		30	May 05/2015	
8	May 05/2015		31	May 05/2015	
9	May 05/2015		32	May 05/2015	
10	May 05/2015				

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37	May 05/2015		R 59	Sep 05/2018	
38	May 05/2015		60	May 05/2015	
39	May 05/2015		61	May 05/2015	
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41	May 05/2015		34-32-00		
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46	Sep 05/2016		5	May 05/2015	
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50	May 05/2015		9	May 05/2015	
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53	May 05/2015		12	May 05/2015	
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17	May 05/2015		17	May 05/2016	
18	May 05/2015		18	May 05/2016	
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5	Jan 05/2018		28	May 05/2016	
6	May 05/2018		29	May 05/2016	
7	May 05/2018		30	May 05/2018	
8	May 05/2016		31	Jan 05/2018	
9	May 05/2016		32	May 05/2018	
10	May 05/2016		33	May 05/2018	
11	May 05/2016		34	May 05/2018	
12	May 05/2016		35	May 05/2018	
13	May 05/2016		36	May 05/2018	
14	May 05/2018				

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13	May 05/2016		37	May 05/2017	
14	May 05/2018		38	May 05/2017	
15	May 05/2018		39	May 05/2017	
16	May 05/2017		40	Sep 05/2016	
17	May 05/2017		41	Sep 05/2016	
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45	May 05/2018		68	Sep 05/2016	
46	May 05/2018		69	Sep 05/2016	
47	May 05/2018		70	Sep 05/2016	
48	Sep 05/2016		71	Sep 05/2016	
49	Sep 05/2016		72	May 05/2018	
50	Sep 05/2016		73	Sep 05/2016	
51	Sep 05/2016		74	BLANK	
52	Sep 05/2016		34-45-00		
53	Sep 05/2016		1	May 05/2015	
54	Sep 05/2016		2	May 05/2018	
55	Sep 05/2016		3	May 05/2015	
56	May 05/2018		4	May 05/2015	
57	May 05/2018		5	May 05/2018	
58	Sep 05/2016		6	May 05/2015	
59	Sep 05/2016		7	May 05/2015	
60	Sep 05/2016		8	May 05/2015	
61	Sep 05/2016		9	May 05/2015	
62	Sep 05/2016		10	May 05/2015	
63	May 05/2018		11	May 05/2018	
64	Sep 05/2016		12	May 05/2018	
65	Sep 05/2016		13	May 05/2018	
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17	May 05/2016		40	Sep 05/2016	
18	May 05/2016		41	Sep 05/2016	
19	May 05/2016		42	Sep 05/2016	
20	May 05/2016		43	May 05/2018	
21	May 05/2016		44	May 05/2018	
22	Sep 05/2017		45	May 05/2018	
23	May 05/2016		46	Sep 05/2016	
24	Sep 05/2016		47	Sep 05/2016	
25	Sep 05/2016		48	Sep 05/2016	
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27	Sep 05/2016		50	Sep 05/2016	
28	Sep 05/2016		51	Sep 05/2016	
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34	Sep 05/2016		4	May 05/2018	
35	Sep 05/2016		5	May 05/2017	
36	Sep 05/2016		6	May 05/2016	
37	Sep 05/2016		7	May 05/2016	
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13	Jan 05/2018		35	May 05/2016	
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18	May 05/2016		40	May 05/2016	
19	May 05/2016		41	May 05/2016	
20	May 05/2016		42	Jan 05/2018	
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22	May 05/2018		44	May 05/2016	
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24	May 05/2016		46	Jan 05/2018	
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26	May 05/2016		48	Jul 25/2018	
27	May 05/2016		49	May 05/2016	
28	May 05/2016		50	Jan 05/2018	
29	May 05/2016		51	May 05/2016	
30	May 05/2016		52	Jan 05/2018	
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56	Jan 05/2018		79	May 05/2016	
57	Jan 05/2018		80	May 05/2016	
58	Jan 05/2018		81	May 05/2016	
59	May 05/2016		82	May 05/2016	
60	May 05/2016		83	May 05/2016	
61	May 05/2016		84	May 05/2016	
62	Jan 05/2018		85	May 05/2016	
63	May 05/2017		86	May 05/2016	
64	May 05/2016		87	May 05/2016	
65	May 05/2016		88	May 05/2016	
66	May 05/2016		89	May 05/2016	
67	May 05/2016		90	May 05/2016	
68	May 05/2016		91	May 05/2016	
69	May 05/2016		92	May 05/2016	
70	May 05/2016		93	Sep 05/2016	
71	May 05/2016		94	Sep 05/2016	
72	May 05/2016		95	May 05/2017	
73	May 05/2017		96	May 05/2016	
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98.3	May 05/2017		17	May 05/2015	
98.4	May 05/2016		18	May 05/2015	
98.5	May 05/2016		19	May 05/2015	
98.6	May 05/2016		20	May 05/2015	
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5	May 05/2015		28	May 05/2017	
6	May 05/2015		29	May 05/2017	
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8	May 05/2015		31	May 05/2015	
9	May 05/2015		32	May 05/2015	
10	May 05/2015		33	May 05/2015	
11	May 05/2015		34	May 05/2015	
12	May 05/2015		35	May 05/2015	
13	May 05/2015		36	May 05/2015	
14	May 05/2015				

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39	May 05/2015		15	Jul 25/2018	
40	May 05/2015		16	Jul 25/2018	
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R 1	Sep 05/2018		24	Jul 25/2018	
O 2	Sep 05/2018		25	Jul 25/2018	
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4	May 05/2015		27	Jul 25/2018	
5	May 05/2018		28	Jul 25/2018	
6	Jul 25/2018		29	Jul 25/2018	
7	Jul 25/2018		30	Jul 25/2018	
8	Jul 25/2018		31	Jul 25/2018	
9	Jul 25/2018		32	Jul 25/2018	
10	Jul 25/2018		33	Jul 25/2018	
11	Jul 25/2018		34	Jul 25/2018	
12	Jul 25/2018				

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38	Jul 25/2018		18	May 05/2018	
39	Jul 25/2018		19	May 05/2018	
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41	Jul 25/2018		21	May 05/2018	
42	BLANK		22	May 05/2018	
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5	May 05/2018		28	May 05/2018	
6	May 05/2018		29	May 05/2018	
7	May 05/2018		30	May 05/2018	
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9	May 05/2018		32	May 05/2018	
10	May 05/2018		33	May 05/2018	
11	May 05/2018		34	May 05/2018	
12	May 05/2018		35	May 05/2018	
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40	May 05/2018		11	Sep 05/2017	
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46	May 05/2018		17	Sep 05/2017	
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4	Sep 05/2017		28	Sep 05/2017	
5	Sep 05/2017		29	Sep 05/2017	
6	Sep 05/2017		30	Sep 05/2017	
7	Sep 05/2017				

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31	Sep 05/2017		8	May 05/2015	
32	Sep 05/2017		9	May 05/2015	
33	Sep 05/2017		10	May 05/2015	
34	Sep 05/2017		11	May 05/2015	
35	Sep 05/2017		12	May 05/2017	
36	Sep 05/2017		13	May 05/2017	
37	Sep 05/2017		14	May 05/2017	
38	Sep 05/2017		15	May 05/2017	
39	Sep 05/2017		16	May 05/2015	
40	Sep 05/2017		17	May 05/2015	
41	Sep 05/2017		18	Sep 05/2016	
42	Sep 05/2017		19	Sep 05/2016	
43	Sep 05/2017		20	Sep 05/2016	
44	Sep 05/2017		21	Sep 05/2016	
45	Sep 05/2017		22	Sep 05/2016	
46	BLANK		23	Sep 05/2016	
34-58-00			24	Sep 05/2016	
1	May 05/2015		25	Sep 05/2016	
2	May 05/2017		26	May 05/2017	
3	May 05/2015		27	May 05/2017	
4	May 05/2017		28	May 05/2017	
5	May 05/2017		29	May 05/2017	
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7	May 05/2017				

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33	Sep 05/2016		17	Jul 25/2018	
34	Sep 05/2016		18	Jul 25/2018	
35	Sep 05/2016		19	Jul 25/2018	
36	May 05/2017		20	Jul 25/2018	
37	Sep 05/2016		21	Jul 25/2018	
38	BLANK		22	Jul 25/2018	
34-61-00			23	Jul 25/2018	
1	May 05/2015		24	Jul 25/2018	
2	May 05/2015		25	Jul 25/2018	
3	May 05/2015		26	Jul 25/2018	
4	May 05/2015		27	Jul 25/2018	
5	May 05/2015		28	Jul 25/2018	
6	May 05/2015		29	Jul 25/2018	
7	Jul 25/2018		30	Jul 25/2018	
8	Jul 25/2018		31	Jul 25/2018	
9	Jul 25/2018		32	Jul 25/2018	
10	Jul 25/2018		33	Jul 25/2018	
11	Jul 25/2018		34	Jul 25/2018	
12	Jul 25/2018		35	Jul 25/2018	
13	Jul 25/2018		36	Jul 25/2018	
14	Jul 25/2018				

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38	Jul 25/2018		61	Jul 25/2018	
39	Jul 25/2018		62	Jul 25/2018	
40	Jul 25/2018		63	Jul 25/2018	
41	Jul 25/2018		64	Jul 25/2018	
42	Sep 05/2016		65	Jul 25/2018	
43	Jul 25/2018		66	Jul 25/2018	
44	Jul 25/2018		67	Jul 25/2018	
45	Jul 25/2018		68	Jul 25/2018	
46	Jul 25/2018		69	Jul 25/2018	
47	Jul 25/2018		70	Jul 25/2018	
48	Jul 25/2018		71	Jul 25/2018	
49	Jul 25/2018		72	Jul 25/2018	
50	Jul 25/2018		73	Jul 25/2018	
51	Jul 25/2018		74	Jul 25/2018	
52	Jul 25/2018		75	Jul 25/2018	
53	Jul 25/2018		76	Jul 25/2018	
54	Jul 25/2018		77	Jul 25/2018	
55	Jul 25/2018		78	Jul 25/2018	
56	Jul 25/2018		79	Jul 25/2018	
57	Jul 25/2018		80	Jul 25/2018	
58	Jul 25/2018		81	Jul 25/2018	
59	Jul 25/2018		82	Jul 25/2018	

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84	Jul 25/2018		98.8	Jul 25/2018	
85	Jul 25/2018		98.9	Jul 25/2018	
86	Jul 25/2018		98.10	Jul 25/2018	
87	Jul 25/2018		98.11	Jul 25/2018	
88	Jul 25/2018		98.12	Jul 25/2018	
89	Jul 25/2018		98.13	Jul 25/2018	
90	Jul 25/2018		98.14	Jul 25/2018	
91	Jul 25/2018		98.15	Jul 25/2018	
92	Jul 25/2018		98.16	Jul 25/2018	
93	Jul 25/2018		98.17	Jul 25/2018	
94	Jul 25/2018		98.18	Jul 25/2018	
95	Jul 25/2018		98.19	Jul 25/2018	
96	Jul 25/2018		98.20	Jul 25/2018	
97	Jul 25/2018		98.21	Jul 25/2018	
98	Jul 25/2018		98.22	Jul 25/2018	
98.1	Jul 25/2018		98.23	Jul 25/2018	
98.2	Jul 25/2018		98.24	Jul 25/2018	
98.3	Jul 25/2018		98.25	Jul 25/2018	
98.4	Jul 25/2018		98.26	Jul 25/2018	
98.5	Jul 25/2018		98.27	Jul 25/2018	
98.6	Jul 25/2018		98.28	Jul 25/2018	

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98.30	Jul 25/2018		98.53	Jul 25/2018	
98.31	Jul 25/2018		98.54	Jul 25/2018	
98.32	Jul 25/2018		98.55	Jul 25/2018	
98.33	Jul 25/2018		98.56	Jul 25/2018	
98.34	Jul 25/2018		98.57	Jul 25/2018	
98.35	Jul 25/2018		98.58	Jul 25/2018	
98.36	Jul 25/2018		98.59	Jul 25/2018	
98.37	Jul 25/2018		98.60	Jul 25/2018	
98.38	Jul 25/2018		98.61	Jul 25/2018	
98.39	Jul 25/2018		98.62	Jul 25/2018	
98.40	Jul 25/2018		98.63	Jul 25/2018	
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98.42	Jul 25/2018		98.65	Jul 25/2018	
98.43	Jul 25/2018		98.66	Jul 25/2018	
98.44	Jul 25/2018		98.67	Jul 25/2018	
98.45	Jul 25/2018		98.68	Jul 25/2018	
98.46	Jul 25/2018		98.69	Jul 25/2018	
98.47	Jul 25/2018		98.70	Jul 25/2018	
98.48	Jul 25/2018		98.71	Jul 25/2018	
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98.75	Jul 25/2018				
98.76	Jul 25/2018				
98.77	Jul 25/2018				
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98.79	Jul 25/2018				
98.80	BLANK				

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34-11-00	PITOT-STATIC/AIR DATA STANDBY INSTRUMENTS - GENERAL DESCRIPTION	4	ARO ALL
34-11-00	PITOT-STATIC/AIR DATA STANDBY INSTRUMENTS - FLIGHT DECK COMPONENT LOCATION	6	ARO ALL
34-11-00	PITOT-STATIC/AIR DATA STANDBY INSTRUMENTS - MEC COMPONENT LOCATION - 1	8	ARO ALL
34-11-00	PITOT-STATIC/AIR DATA STANDBY INSTRUMENTS - MEC COMPONENT LOCATIONS - 2	10	ARO ALL
34-11-00	PITOT-STATIC/AIR DATA STANDBY INSTRUMENTS - FWD CARGO COMPARTMENT COMPONENT LOCATIONS	12	ARO ALL
34-11-00	PITOT-STATIC/AIR DATA STANDBY INSTRUMENTS - EXTERNAL COMPONENT LOCATION	14	ARO ALL
34-11-00	PITOT-STATIC/AIR DATA INSTRUMENTS - PITOT PROBES AND STATIC PORTS	16	ARO ALL
34-11-00	PITOT-STATIC/AIR DATA STANDBY INSTRUMENTS - STANDBY AIR DATA MODULE	18	ARO ALL
34-11-00	PITOT-STATIC/AIR DATA STANDBY INSTRUMENTS - PITOT PROBE - HEAT	20	ARO ALL
34-20-00	AIR DATA INERTIAL REFERENCE SYSTEM - INTRODUCTION	2	ARO ALL
34-20-00	ADIRS - GENERAL DESCRIPTION	4	ARO ALL
34-20-00	ADIRS - COMPONENT LOCATION - FLIGHT DECK	6	ARO ALL
34-20-00	ADIRS - COMPONENT LOCATION - EQUIPMENT CENTERS	8	ARO ALL
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34-20-00	ADIRS - COMPONENT LOCATION - CENTER AND RIGHT PITOT ADM	14	ARO ALL
34-20-00	ADIRS - COMPONENT LOCATION - STATIC ADM AND STATIC SADM	16	ARO ALL
34-20-00	ADIRS - ADIRU, AOA AND SENSOR, SAARU, STANDBY ATTITUDE INDICATOR POWER	18	ARO ALL
34-20-00	ADIRS - AIR DATA MODULES POWER	20	ARO ALL
34-20-00	ADIRS - DIGITAL INTERFACES	22	ARO ALL
34-20-00	ADIRS - ADIRU	24	ARO ALL
34-20-00	ADIRS - ADIRU REMOVAL AND LOCK BAR OPERATION	26	ARO ALL
34-20-00	ADIRS - ADIRU INSTALLATION	28	ARO ALL
34-20-00	ADIRS - ADIRU RELIABILITY AND FAULT TOLERANCE	30	ARO ALL
34-20-00	ADIRS - ADIRU POWERUP, ON BATTERY, POWERDOWN	32	ARO ALL
34-20-00	ADIRS - ADIRU AIR DATA FUNCTION - 1	35	ARO ALL
34-20-00	ADIRS - ADIRU AIR DATA FUNCTION - 2	38	ARO ALL
34-20-00	ADIRS - ADIRU AIR DATA FUNCTION - 3	40	ARO ALL
34-20-00	ADIRS - ADIRU INERTIAL REFERENCE DATA FUNCTION - 1	42	ARO ALL
34-20-00	ADIRS - ADIRU INERTIAL REFERENCE DATA FUNCTION - 2	45	ARO ALL
34-20-00	ADIRS - ADIRU INERTIAL REFERENCE DATA FUNCTION - 3	48	ARO ALL
34-20-00	ADIRS - AIR DATA MODULE	51	ARO ALL
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34-20-00	ADIRS - SAARU AIR DATA FUNCTION - 3	64	ARO ALL
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34-20-00	ADIRS - TOTAL AIR TEMPERATURE PROBE	70	ARO ALL
34-20-00	ADIRS - TAT PROBE FUNCTIONAL DESCRIPTION	72	ARO ALL
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34-20-00	ADIRS - AOA SENSOR FUNCTIONAL DESCRIPTION	76	ARO ALL
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34-20-00	ADIRS - AIR DATA/ATTITUDE SOURCE SWITCH	80	ARO ALL
34-20-00	ADIRS - AIR DATA/ATTITUDE SOURCE SWITCHING-NON NORMAL	82	ARO ALL
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34-20-00	ADIRS - ALIGNMENT	87	ARO ALL
34-20-00	ADIRS - ALIGNMENT - POS INIT CDU PAGE	90	ARO ALL
34-20-00	ADIRS - ND AND PFD INDICATIONS DURING ALIGNMENT	92	ARO ALL
34-20-00	ADIRS - PFD AND ND INDICATIONS AFTER ALIGNMENT	94	ARO ALL
34-20-00	ADIRS - PFD AND ND INVALID IRS DATA	96	ARO ALL
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34-24-00	STANDBY ATTITUDE REFERENCE SYSTEM - INTERFACE	8	ARO ALL
34-24-00	STANDBY ATTITUDE REFERENCE SYSTEM - INTEGRATED STANDBY FLIGHT DISPLAY	10	ARO ALL
34-24-00	STANDBY ATTITUDE REFERENCE SYSTEM - ADM POWER SUPPLY	12	ARO ALL
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34-24-00	STANDBY ATTITUDE REFERENCE SYSTEM - OPERATION - POWER-UP	20	ARO ALL
34-24-00	STANDBY ATTITUDE REFERENCE SYSTEM - OPERATION - ATTITUDE	22	ARO ALL
34-24-00	STANDBY ATTITUDE REFERENCE SYSTEM - OPERATION - AIRSPEED AND ALTITUDE	24	ARO ALL
34-24-00	STANDBY ATTITUDE REFERENCE SYSTEM - OPERATION - HEADING	26	ARO ALL
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34-24-00	STANDBY ATTITUDE REFERENCE SYSTEM - TIP - BITE MENU	30	ARO ALL
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34-45-00	TCAS - SELF-TEST	48	ARO ALL
34-45-00	TCAS - GROUND TESTS	50	ARO ALL
34-46-00	GPWS - INTRODUCTION	2	ARO ALL
34-46-00	GPWS - GENERAL DESCRIPTION	4	ARO ALL
34-46-00	GPWS - FLIGHT DECK COMPONENT LOCATIONS	8	ARO ALL
34-46-00	GPWS - MAIN EQUIPMENT CENTER COMPONENT LOCATIONS	10	ARO ALL
34-46-00	GPWS - INTERFACE	12	ARO ALL
34-46-00	GPWS - DISPLAY RELAY INTERFACE	18	ARO ALL
34-46-00	GPWS - GROUND PROXIMITY WARNING COMPUTER	21	ARO ALL
34-46-00	GPWS - CONTROL - EFIS CONTROL PANEL	26	ARO ALL
34-46-00	GPWS - CDU SELECTIONS	28	ARO ALL
34-46-00	GPWS - CONTROL COMPONENTS	30	ARO ALL
34-46-00	GND PROX RUNWAY OVERRIDE SWITCH	32	ARO ALL
34-46-00	GPWS - MODE 1 DESCRIPTION	34	ARO ALL
34-46-00	GPWS - MODE 1 OPERATION	36	ARO ALL
34-46-00	GPWS - MODE 2A DESCRIPTION	38	ARO ALL
34-46-00	GPWS - MODE 2B DESCRIPTION	40	ARO ALL
34-46-00	GPWS - MODE 2 OPERATION	42	ARO ALL
34-46-00	GPWS - MODE 3 DESCRIPTION	44	ARO ALL
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<u>CH-SC-SU</u>	<u>SUBJECT</u>	<u>PAGE</u>	<u>EFFECT</u>
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34-46-00	GPWS - MODE 4 OPERATION	50	ARO ALL
34-46-00	GPWS - MODE 5 DESCRIPTION	54	ARO ALL
34-46-00	GPWS - MODE 5 OPERATION	56	ARO ALL
34-46-00	GPWS - MODE 6 DESCRIPTION	58	ARO ALL
34-46-00	GPWS - MODE 7 DESCRIPTION	60	ARO ALL
34-46-00	GPWS - MODE 7 OPERATION	62	ARO ALL
34-46-00	GPWS - TERRAIN AWARENESS	66	ARO ALL
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34-46-00	GPWS - NORMAL DISPLAYS	70	ARO ALL
34-46-00	GPWS - MODE DESCRIPTION SUMMARY	72	ARO ALL
34-46-00	GPWS - SPEECH PROM	76	ARO ALL
34-46-00	GPWS - ENVELOPE MODULATION	80	ARO ALL
34-46-00	GPWS - OVERRIDE CAPABILITIES	82	ARO ALL
34-46-00	GPWS - PFD AND MASTER WARNING LIGHT ANNUNCIATIONS	84	ARO ALL
34-46-00	GPWS - NON-NORMAL DISPLAYS	86	ARO ALL
34-46-00	GPWS - SELF TEST - LEVEL 1	89	ARO ALL
34-46-00	GPWS - SELF TEST - LEVELS 2-5	93	ARO ALL
34-46-00	GPWS - SELF TEST - LEVEL 6	98	ARO ALL
34-46-00	GPWS - STATUS LEDS	98.2	ARO ALL

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<u>CH-SC-SU</u>	<u>SUBJECT</u>	<u>PAGE</u>	<u>EFFECT</u>
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34-51-00	VHF OMNIDIRECTIONAL RANGING (VOR) SYSTEM	2	ARO ALL
34-51-00	VOR - GENERAL DESCRIPTION	4	ARO ALL
34-51-00	VOR - FLIGHT DECK COMPONENT LOCATION	6	ARO ALL
34-51-00	VOR - ANTENNA AND MAIN EQUIPMENT CENTER COMPONENT LOCATION	8	ARO ALL
34-51-00	VOR - POWER, ANALOG, AND DISCRETE INTERFACE	10	ARO ALL
34-51-00	VOR - SYSTEM INTERFACE	12	ARO ALL
34-51-00	VOR - VOR/MB RECEIVER	14	ARO ALL
34-51-00	VOR - ANTENNA	16	ARO ALL
34-51-00	VOR - VOR/MB RECEIVER FUNCTIONAL DESCRIPTION	18	ARO ALL
34-51-00	VOR - TUNE INPUTS	20	ARO ALL
34-51-00	VOR - AUDIO CONTROLS	22	ARO ALL
34-51-00	VOR - CDU TUNING	24	ARO ALL
34-51-00	VOR - EFIS CONTROLS	26	ARO ALL
34-51-00	VOR - ND VOR DISPLAYS	30	ARO ALL
34-51-00	VOR - ND VOR AUTOTUNE DISPLAY	32	ARO ALL
34-51-00	VOR - ND VOR MAP MODE DISPLAYS	34	ARO ALL
34-51-00	VOR - ND VOR NCD DISPLAYS	36	ARO ALL
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34-51-00	VOR - VOR/MB RECEIVER FRONT PANEL TEST DISPLAYS	42	ARO ALL
34-51-00	VOR - GROUND TEST	44	ARO ALL
34-53-00	AIR TRAFFIC CONTROL/MODE S TRANSPONDER SYSTEM	1	ARO ALL
34-53-00	ATC/MODE S TRANSPONDER SYSTEM - GENERAL DESCRIPTION	4	ARO ALL
34-53-00	ATC/MODE S TRANSPONDER SYSTEM - COMPONENT LOCATIONS	8	ARO ALL
34-53-00	ATC/MODE S TRANSPONDER SYSTEM - ANTENNA LOCATION	10	ARO ALL
34-53-00	ATC/MODE S TRANSPONDER SYSTEM - ANTENNA INTERFACE	12	ARO ALL
34-53-00	ATC/MODE S TRANSPONDER SYSTEM - POWER, IDENTITY, CONTROL, AND AIR DATA INTERFACES	14	ARO ALL
34-53-00	ATC/MODE S TRANSPONDER SYSTEM - MAINTENANCE INTERFACE	16	ARO ALL
34-53-00	ATC/MODE S TRANSPONDER SYSTEM - TCAS INTERFACE AND PROGRAM PINS	18	ARO ALL
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34-53-00	ATC/MODE S TRANSPONDER SYSTEM - ATC/MODE S TRANSPONDER	22	ARO ALL
34-53-00	ATC/MODE S TRANSPONDER SYSTEM - TRANSPONDER PANEL	24	ARO ALL
34-53-00	ATC/MODE S TRANSPONDER SYSTEM - ATC ANTENNA	26	ARO ALL
34-53-00	ATC/MODE S TRANSPONDER SYSTEM - ATC COAX RELAY	28	ARO ALL
34-53-00	ATC/MODE S TRANSPONDER SYSTEM - INPUTS AND CONTROL	30	ARO ALL
34-53-00	ATC/MODE S TRANSPONDER SYSTEM - TRANSPONDER RECEIVE FUNCTION	32	ARO ALL
34-53-00	ATC/MODE S TRANSPONDER SYSTEM - TRANSPONDER TRANSMIT AND CMCF FUNCTION	34	ARO ALL

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34-55-00	DME SYSTEM - GENERAL DESCRIPTION	4	ARO ALL
34-55-00	DME SYSTEM - COMPONENT LOCATIONS - FLIGHT DECK	8	ARO ALL
34-55-00	DME SYSTEM - COMPONENT LOCATION - MAIN EQUIPMENT CENTER AND ANTENNAS	10	ARO ALL
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34-55-00	DME SYSTEM - ARINC 429 INTERFACES	14	ARO ALL
34-55-00	DME SYSTEM - INTERROGATOR	16	ARO ALL
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34-55-00	DME SYSTEM - TUNING	22	ARO ALL
34-55-00	DME SYSTEM - AUDIO CONTROL PANEL	25	ARO ALL
34-55-00	DME SYSTEM - MANUAL AND ALTERNATE TUNING	28	ARO ALL
34-55-00	DME SYSTEM - EFIS CONTROLS	30	ARO ALL
34-55-00	DME SYSTEM - PRIMARY FLIGHT DISPLAY	32	ARO ALL
34-55-00	DME SYSTEM - ND APPROACH MODE DISPLAY	34	ARO ALL
34-55-00	DME SYSTEM - MAP MODE DISPLAY	36	ARO ALL
34-55-00	DME SYSTEM - VOR MODE DISPLAY	38	ARO ALL

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34-55-00	DME SYSTEM - SELF-TEST	46	ARO ALL
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34-57-00	AUTOMATIC DIRECTION FINDER SYSTEM - INTRODUCTION	2	ARO ALL
34-57-00	ADF SYSTEM - GENERAL DESCRIPTION	4	ARO ALL
34-57-00	ADF SYSTEM - FLIGHT DECK COMPONENT LOCATION	8	ARO ALL
34-57-00	ADF SYSTEM - MAIN EQUIPMENT CENTER AND FUSELAGE COMPONENT LOCATION	10	ARO ALL
34-57-00	ADF SYSTEM - POWER, ANALOG, AND DISCRETE INTERFACES	12	ARO ALL
34-57-00	ADF SYSTEM - DIGITAL INTERFACE	14	ARO ALL
34-57-00	ADF SYSTEM - ADF RECEIVER	16	ARO ALL
34-57-00	ADF SYSTEM - ADF ANTENNA	20	ARO ALL
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34-58-00	GPS - GENERAL DESCRIPTION	4	ARO ALL
34-58-00	GPS - MAIN EQUIPMENT CENTER COMPONENT LOCATIONS	8	ARO ALL
34-58-00	GPS - ANTENNA LOCATIONS	10	ARO ALL
34-58-00	GPS - INTERFACES	12	ARO ALL
34-58-00	GPS - GPS ANTENNA	16	ARO ALL
34-58-00	GPS - THEORY OF OPERATION - 1	18	ARO ALL
34-58-00	GPS - THEORY OF OPERATION - 2	20	ARO ALL
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34-61-00	FLIGHT MANAGEMENT COMPUTING SYSTEM - INTRODUCTION	1	ARO ALL
34-61-00	FMCS - GENERAL DESCRIPTION	7	ARO ALL
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34-61-00	FMCS - FMCF INTERFACES - 2	22	ARO ALL
34-61-00	FMCS - FMCF INTERFACES - 3	24	ARO ALL
34-61-00	FMCS - FMCF INTERFACES - 4	26	ARO ALL
34-61-00	FMCS - CONTROL DISPLAY UNIT	30	ARO ALL
34-61-00	FMCS - INSTRUMENT SOURCE SELECT PANELS AND F/O DISPLAY SWITCHING PANEL	34	ARO ALL
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34-61-00	FMCS - NAV RADIO PAGE	81	ARO ALL
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34-61-00	FMCS - POSITION REPORT PAGE	98.18	ARO ALL
34-61-00	FMCS - FIX INFO PAGE	98.20	ARO ALL
34-61-00	FMCS - ACT ALTN NAV LEGS PAGE	98.22	ARO ALL
34-61-00	FMCS - ALTN NAV PROGRESS PAGE	98.24	ARO ALL
34-61-00	FMCS - ALTN NAV RADIO PAGE	98.27	ARO ALL
34-61-00	FMCS - COMM PAGE	98.30	ARO ALL
34-61-00	FMCS - CDU CONFIGURATION PAGE	98.32	ARO 014-999; ARO 001-013 WITH CDU CONFIGURATION PAGE
34-61-00	FMCS - FMC F FUNCTIONAL DESCRIPTION - INTRODUCTION	98.34	ARO ALL
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34-61-00	FMCS - FMC F FUNCTIONAL DESCRIPTION - VNAV SUB-FUNCTION	98.47	ARO ALL
34-61-00	FMCS - FMC F FUNCTIONAL DESCRIPTION - GUIDANCE SUB-FUNCTION	98.51	ARO ALL
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34-61-00	FMCS - FMC F FUNCTIONAL DESCRIPTION - VNAV SPEED AND ALTITUDE INTERVENTION ENGAGE LOGIC	98.58	ARO ALL
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34-61-00	FMCS - AIRLINE MODIFIABLE INFORMATION	98.66	ARO ALL
34-61-00	FMCS - CDU FUNCTIONAL DESCRIPTION	98.71	ARO ALL
34-61-00	FMCS - SYSTEM TESTS	98.76	ARO ALL
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PITOT-STATIC/AIR DATA STANDBY INSTRUMENTS - INTRODUCTION

Pitot-Static System

The pitot-static system uses pitot probes and flush static ports to sense total and static air pressures. These pressures go to the air data inertial reference system (ADIRS) to calculate flight parameters such as air speed and altitude.

Air Data Standby Instruments

The integrated standby flight display (ISFD) is the air data standby instrument which supplies the the flight crew alternate indications of airplane altitude and indicated airspeed (IAS). The ISFD is described in section 34-24-02.

Abbreviations and Acronyms

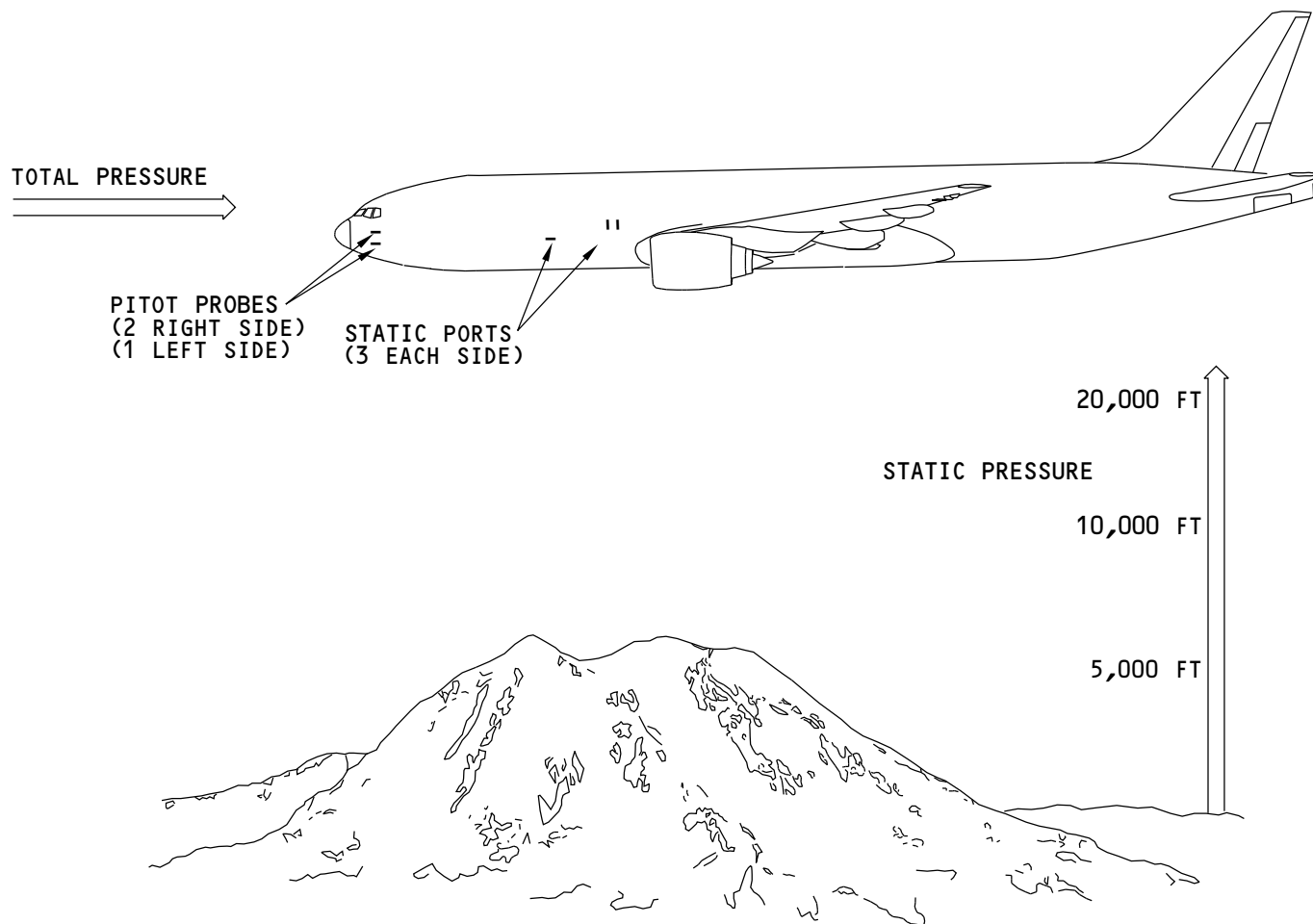
- ADIRU - air data inertial reference unit
- ADM - air data module
- alt - altitude
- BITE - built-in test equipment
- CAS - calibrated air speed
- ELMS - electrical load management system
- ISFD - integrated standby flight display
- LCD - liquid crystal display
- IAS - indicated air speed
- SAARU - secondary attitude air data reference unit
- SADM - standby air data module
- SALT - standby altimeter
- typ - typical

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PITOT-STATIC/AIR DATA STANDBY INSTRUMENTS - INTRODUCTION

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PITOT-STATIC/AIR DATA STANDBY INSTRUMENTS - GENERAL DESCRIPTION

Pitot-Static System

The pitot-static system gets air pressure inputs from three pitot probes and six flush static ports on the airplane fuselage.

These are the two types of air pressure:

- Static air pressure. This is the ambient air pressure around the airplane
- Pitot air pressure. This is the air pressure on the pitot tube as a result of the forward motion of the airplane.

The pitot-static system has:

- 3 pitot probes
- 6 flush static ports
- Pneumatic lines.
- 6 air data modules (ADMs)
- 2 standby air data modules (SADMs).

The 777 has short flexible hoses that connect pitot probes to the pitot ADMs and pitot SADM. There is cross-fuselage hard tubing that connects pairs of static ports with the static ADMs and static SADM. The static ADMs and static SADM are in the center of the airplane and tubing runs. This reduces the amount of pressure lines and possible leaks from connections that occur in long tubing runs.

The pitot probes and static ports send the air pressures through lines to the ADMs and SADMs. The ADMs change the air pressures to electrical signals and send them to the air data inertial reference unit (ADIRU) and secondary attitude air data reference unit (SAARU) on the flight controls ARINC 629 data buses.

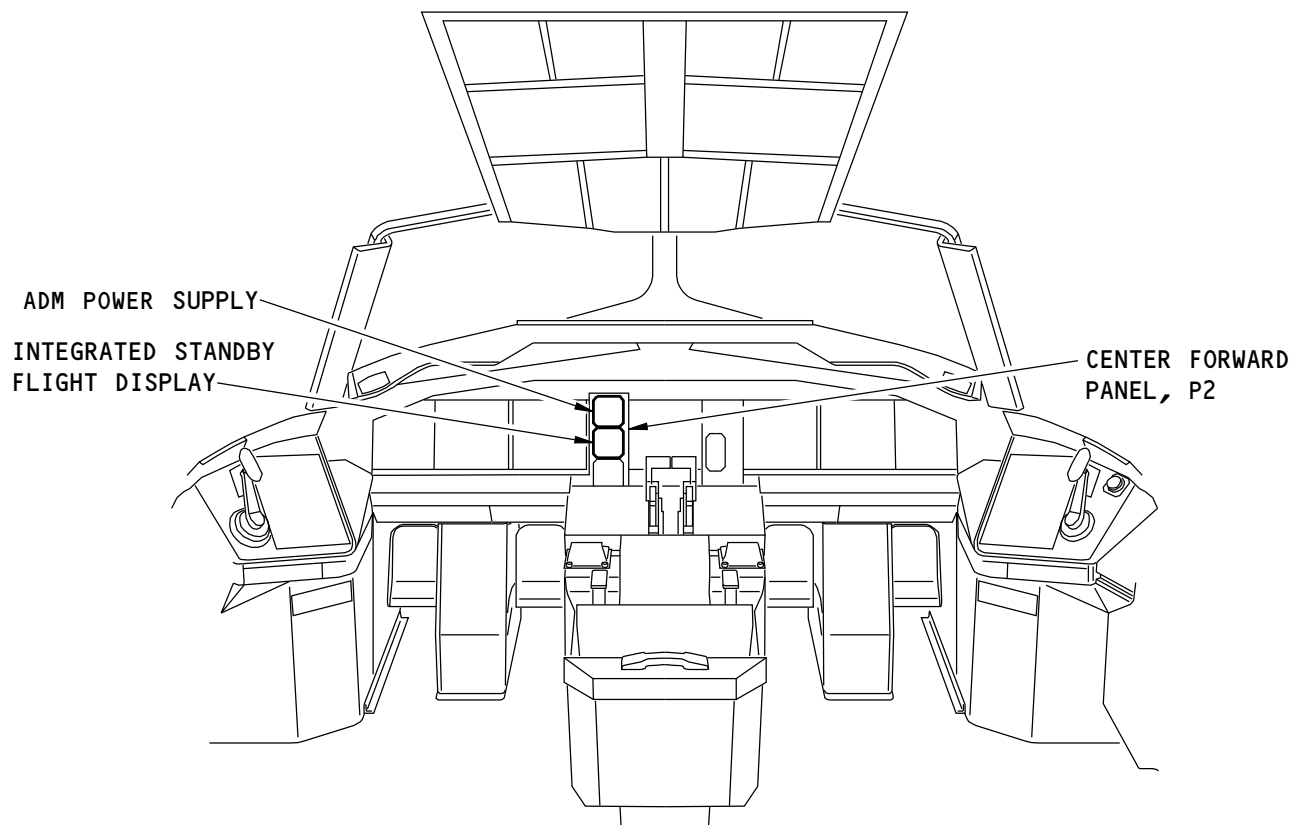
The ADIRU and SAARU use static air pressure and pitot air pressure to calculate airplane altitude and airspeed.

The integrated standby flight display (ISFD) receives information from the SADMs by ARINC 429 transmitters and receivers. The ISFD system is described in section 34-24-02.

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FLIGHT COMPARTMENT

PITOT-STATIC/AIR DATA STANDBY INSTRUMENTS - GENERAL DESCRIPTION

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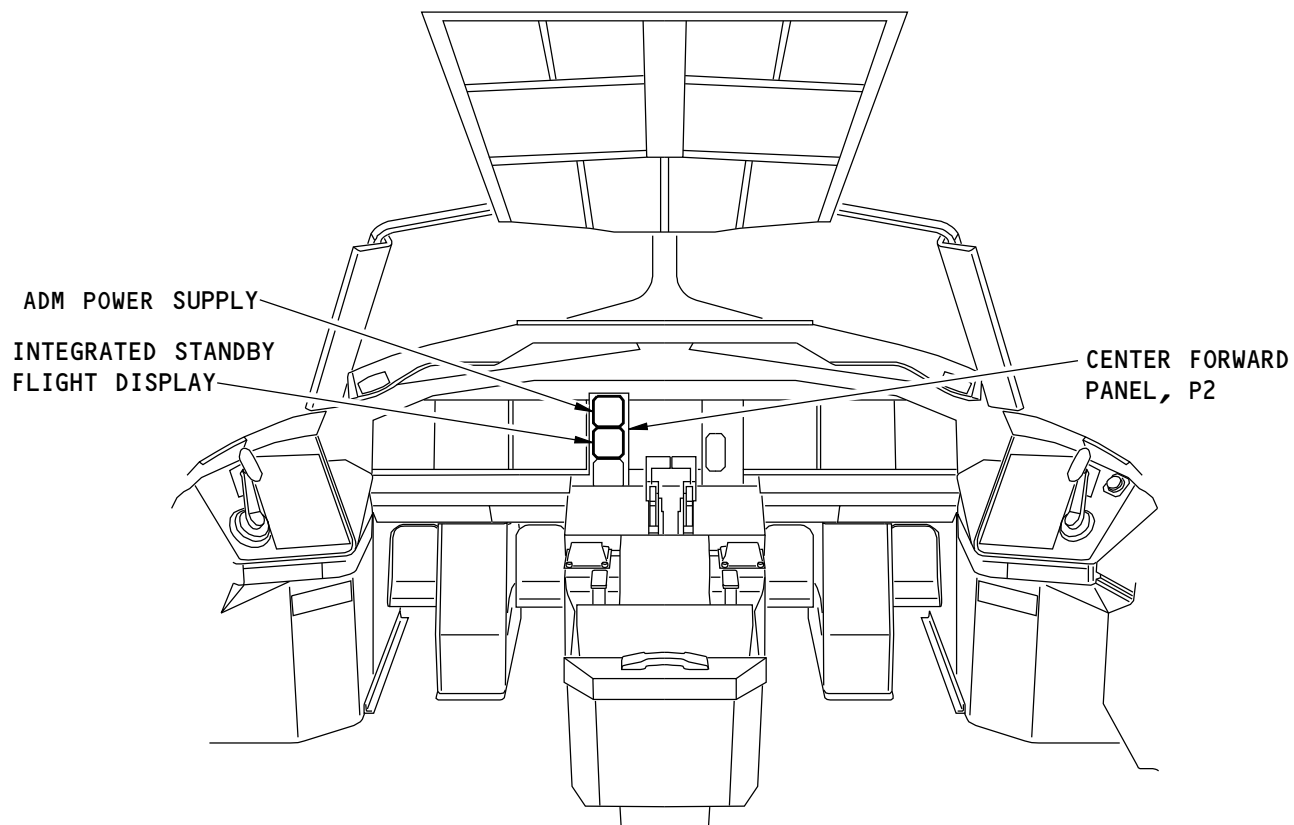


PITOT-STATIC/AIR DATA STANDBY INSTRUMENTS - FLIGHT DECK COMPONENT LOCATION

Air Data Standby Instruments

The integrated standby flight display (ISFD) is in the flight deck. The subject 34-24-02 describes the ISFD system.

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FLIGHT COMPARTMENT

PITOT-STATIC/AIR DATA STANDBY INSTRUMENTS - FLIGHT DECK COMPONENT LOCATION

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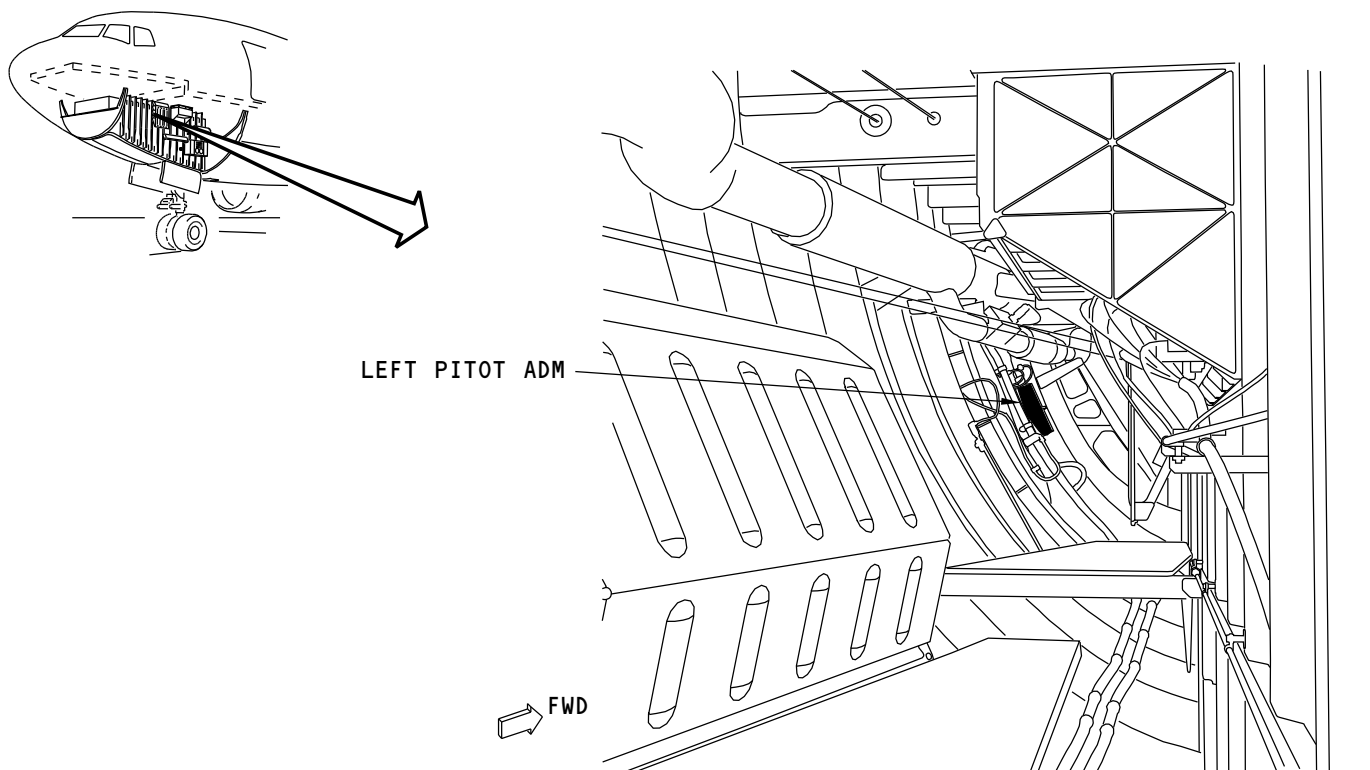


PITOT-STATIC/AIR DATA STANDBY INSTRUMENTS - MEC COMPONENT LOCATION - 1

General

The location of the left pitot air data module (ADM) is in the left forward section of the main equipment center.

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FORWARD SECTION - LEFT OF NOSE WHEEL WELL

PITOT-STATIC/AIR DATA STANDBY INSTRUMENTS - MEC COMPONENT LOCATION - 1

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PITOT-STATIC/AIR DATA STANDBY INSTRUMENTS - MEC COMPONENT LOCATIONS - 2

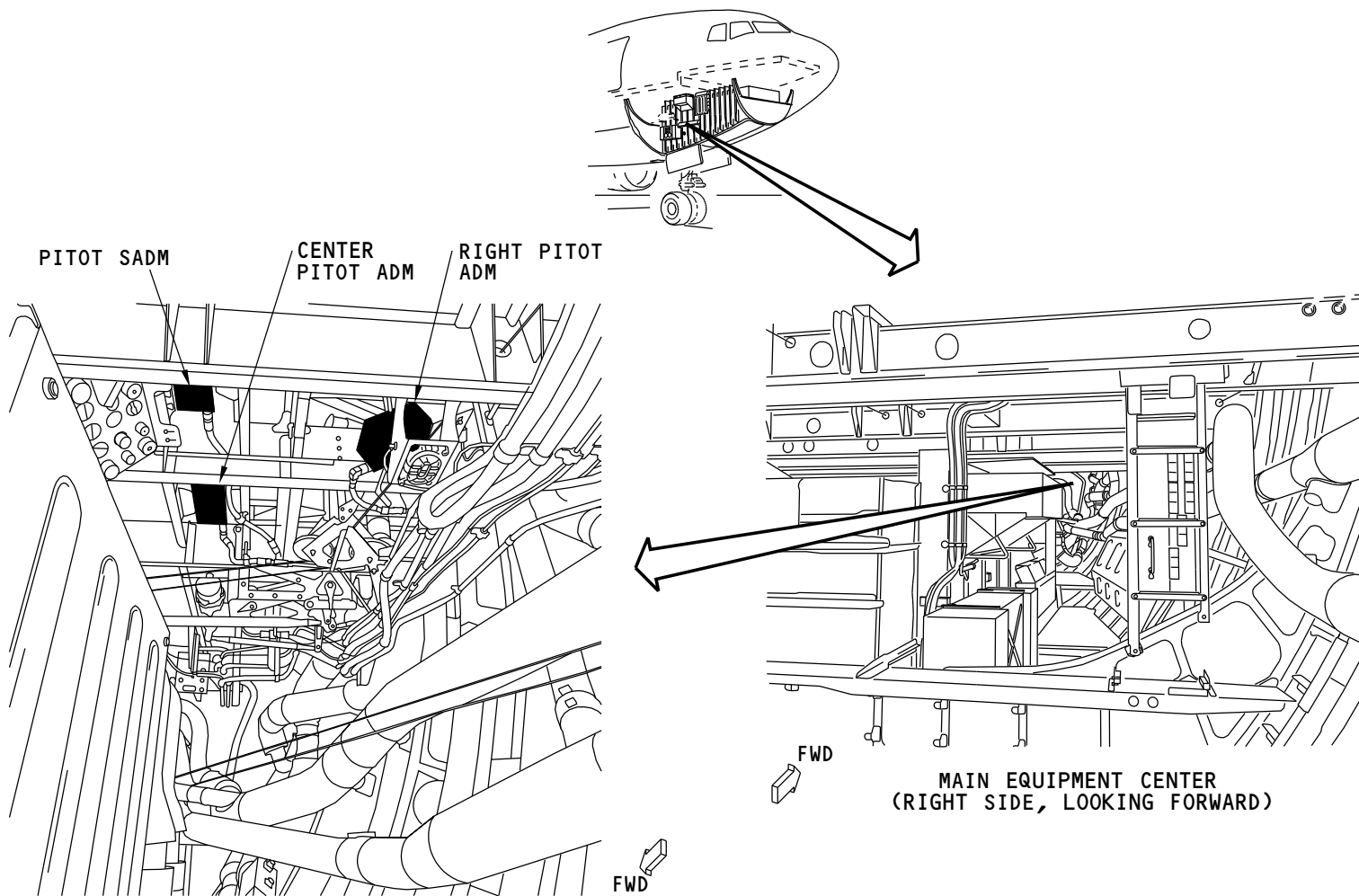
Right and Center Pitot ADM Locations

The right and center pitot ADMs are in the MEC, to the right of the nose wheel well and under the flight deck.

Pitot SADM

The pitot SADM is in the MEC, under the flight deck and aft of the center pitot ADM.

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PITOT-STATIC/AIR DATA STANDBY INSTRUMENTS - MEC COMPONENT LOCATIONS - 2

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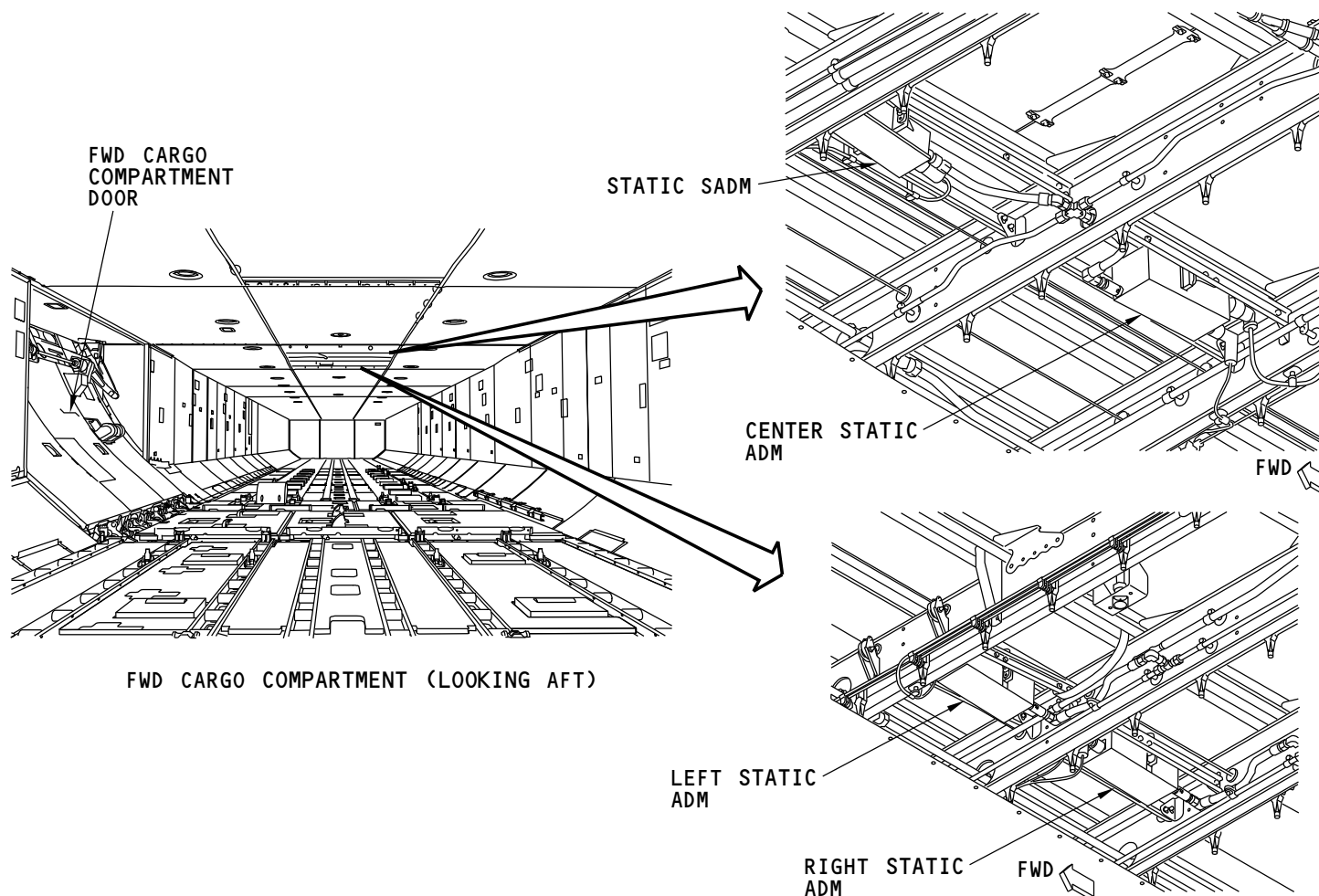


PITOT-STATIC/AIR DATA STANDBY INSTRUMENTS - FWD CARGO COMPARTMENT COMPONENT LOCATIONS

Static SADM and Static ADMs

The static SADM and the three static ADMs are in the forward cargo compartment ceiling, above the cargo liner.

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PITOT-STATIC/AIR DATA STANDBY INSTRUMENTS - FWD CARGO COMPARTMENT COMPONENT LOCATIONS

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PITOT-STATIC/AIR DATA STANDBY INSTRUMENTS - EXTERNAL COMPONENT LOCATION

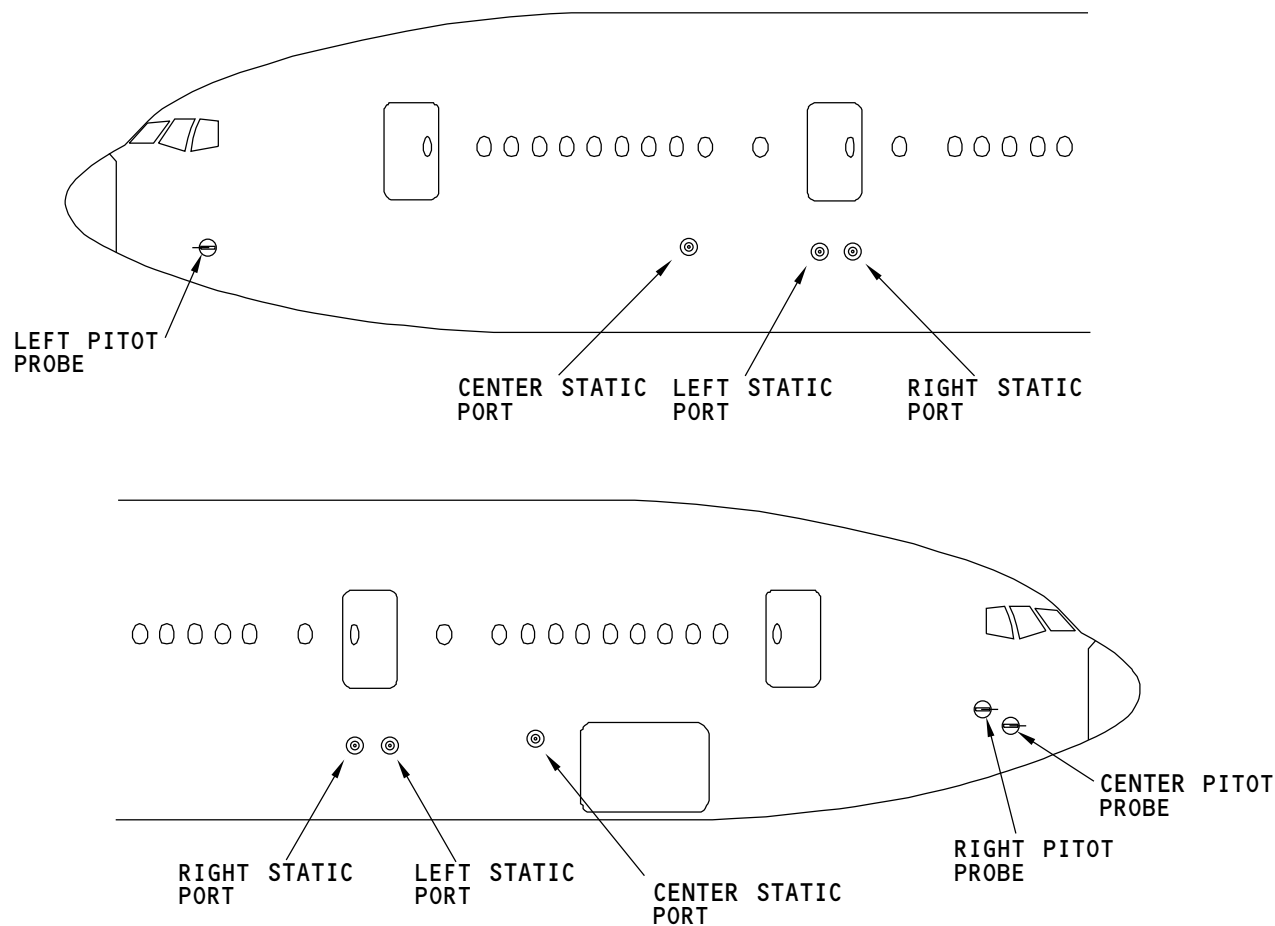
Pitot Probes Location

There are 3 pitot probes on the airplane. The left pitot probe is on the left side of the airplane. The right and center pitot probes are on the right side of the airplane.

Static Ports Location

There are six static ports on the airplane. There is a left, center, and right static port on each side of the airplane.

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PITOT-STATIC/AIR DATA STANDBY INSTRUMENTS - EXTERNAL COMPONENT LOCATION

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PITOT-STATIC/AIR DATA INSTRUMENTS - PITOT PROBES AND STATIC PORTS**Static Ports**

The static ports supply static pressure to the static air data modules (ADMs).

Pitot Probes

The pitot probes supply total pressure to the pitot ADMs.

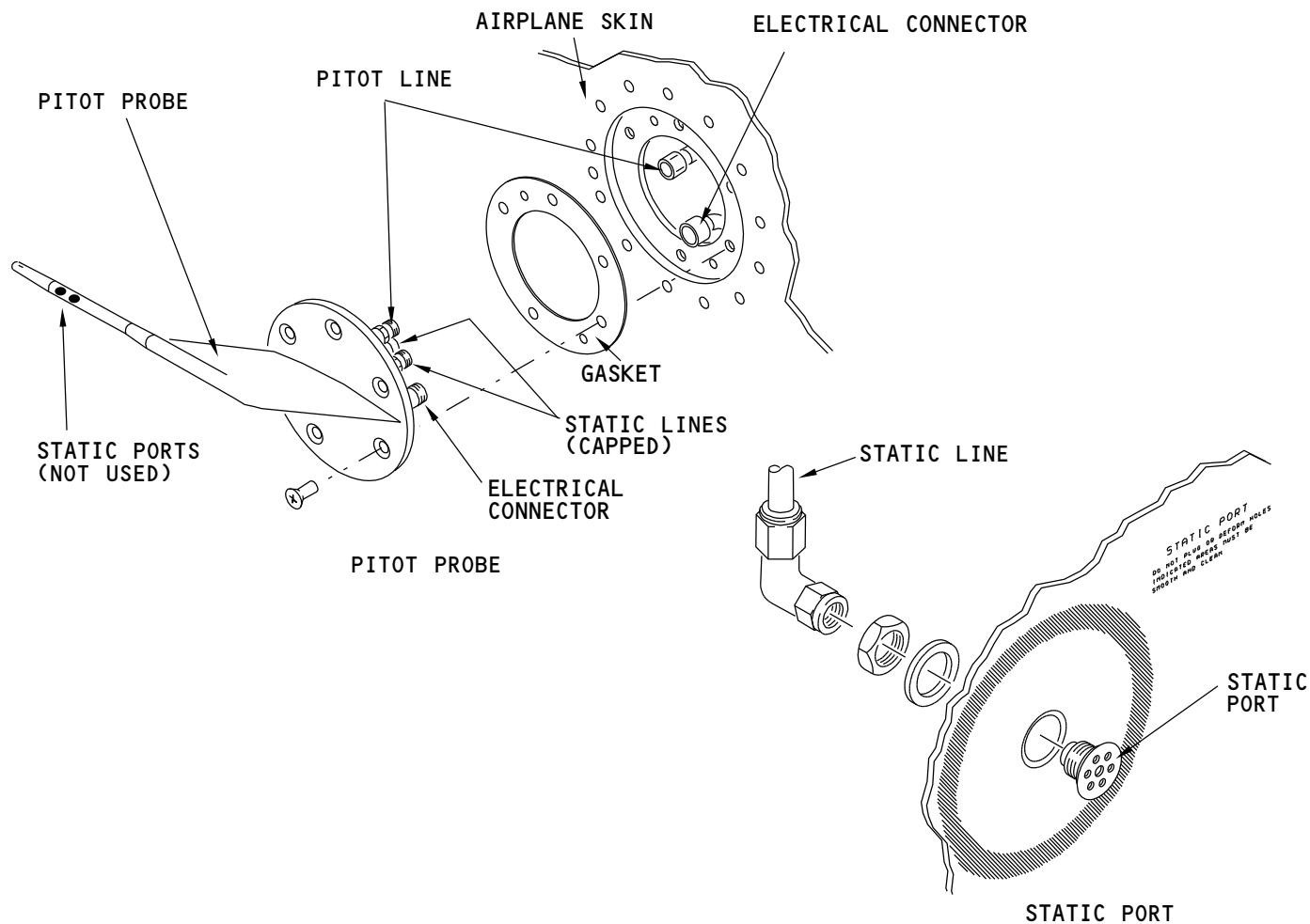
Before you remove a pitot probe, obey this warning.

**WARNING**

MAKE SURE THAT THE PITOT PROBE HEAT IS OFF. INJURY TO PERSONS CAN OCCUR.

Training Information Point

The pitot probes have static ports. However, the 777 does not use the static ports on the pitot probes. The static lines from the probes are capped.



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PITOT-STATIC/AIR DATA INSTRUMENTS - PITOT PROBES AND STATIC PORTS

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**PITOT-STATIC/AIR DATA STANDBY INSTRUMENTS - STANDBY AIR DATA MODULE****General**

There are two standby air data modules (SADMs) on the airplane.

The SADMs and the ADMs are different in size and shape. Since they send data on different ARINC formats, they are not interchangeable.

There is one ADM power supply on the airplane. The ADM power supply is installed in the P2 panel in the flight deck, and provides power for the pitot and static standby air data modules. The ADM power supply is described in section 34-24-03.

SADM Hardware

The SADM is rectangular, 6 in. deep x 3 in. wide x 2.5 in. tall (15.24 cm. x 7.62 cm. x 6.35 cm.). The SADM mounts directly to the airframe by the two flanges on the sides of the unit. The SADM weighs less than 2 lbs. and it has passive cooling. There is a pitot SADM and a static SADM. There is one electrical and one pneumatic connector on the front of each SADM. The SADMs are interchangeable. The SADMs are higher than the pitot probes and static ports to make sure that moisture does not enter the system.

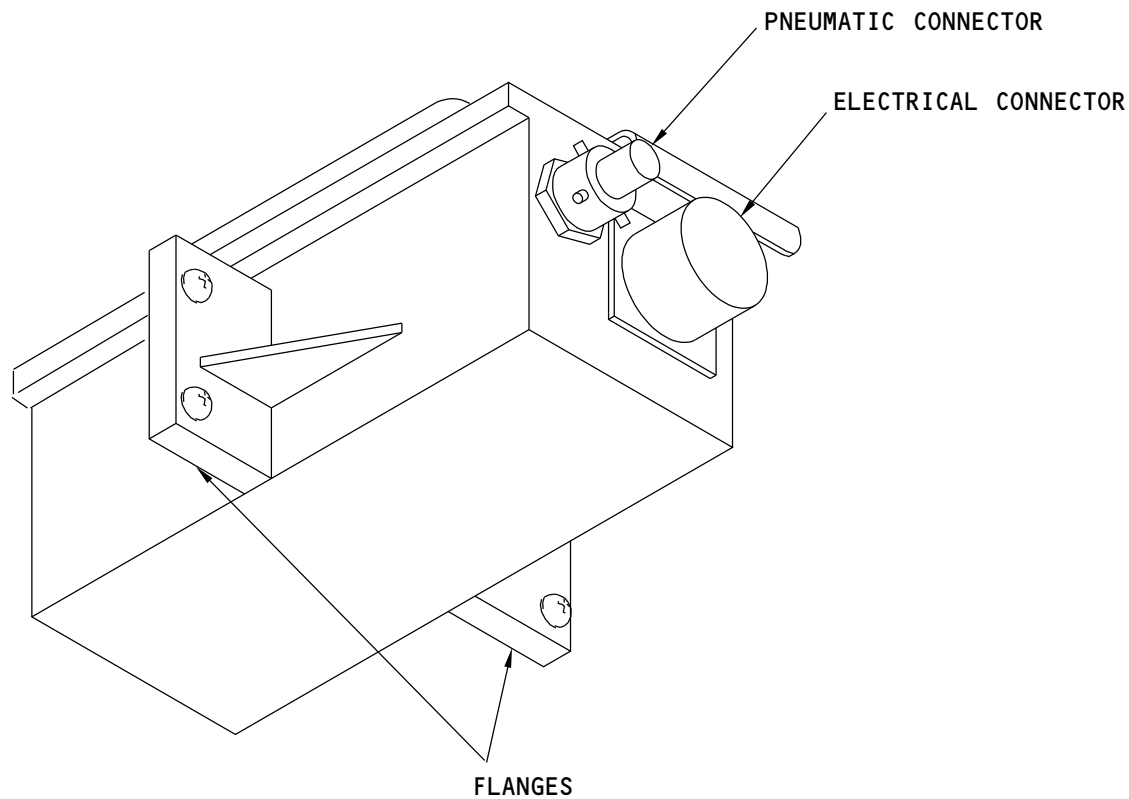
SADM Data

The SADMs are part of the standby air data system. They are independent of the primary flight instrument system and isolated from all ARINC 629 buses. The SADMs receive pressure inputs from the center static ports or the center pitot probe. It converts these pressures to ARINC 429 data and sends this data to the air data standby instruments.

Training Information Point

The SADM is not software loadable.

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PITOT-STATIC/AIR DATA STANDBY INSTRUMENTS - STANDBY AIR DATA MODULE

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PITOT-STATIC/AIR DATA STANDBY INSTRUMENTS - PITOT PROBE - HEAT

General

The pitot air data modules (ADMs) control the heat control relays in the power management panels. The heat control comes from data the ADMs receive from the primary flight computers (PFCs) through the flight controls ARINC 629 bus. If the PFCs are not valid, the ADMs use data from the autopilot/flight director computers (AFDCs). The AFDC data also comes through the flight controls ARINC 629 bus.

The pitot ADMs control the pitot heaters for the onside pitot probes.

The pitot probes have these two heat levels for anti-ice:

- Ground mode - low power heat
- Air mode - full power heat.

Ground Mode

The pitot heat is at low power during these conditions:

- The airplane is on the ground
- An engine is running.

The low power level comes from the 115v ac transfer bus phase B. This low power ground mode results in a lower probe temperature. It also extends the life of the units and maintains an ice-free operation.

Air Mode

Pitot heat goes to full power when any of these conditions are true:

- The computed airspeed (CAS) is more than 50 knots
- The airplane is in the air.

The full power level comes from the 115v ac transfer bus phase B on one side of the heater element and from the 115v ac transfer bus phase C on the other side of the heater element.

Pitot Heater Current Monitor

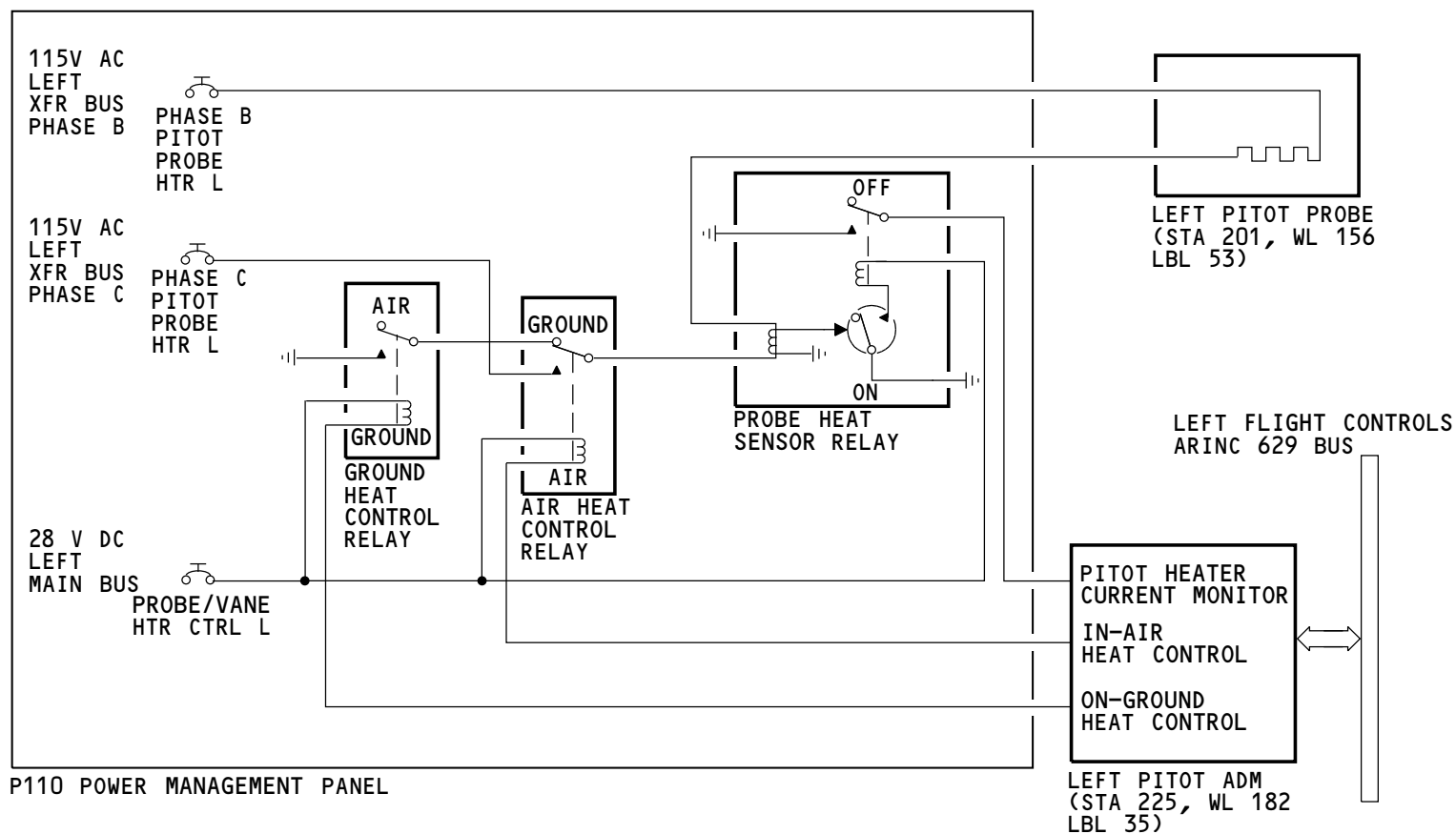
The probe heat sensor relay detects current when the pitot probe heat is on, and sends a ground signal to the pitot ADMs. The pitot ADMs send the status of the pitot heat to these units:

- ADIRU
- SAARU
- AIMS cabinets.

Training Information Point

Full power pitot heat is approximately 200v ac, and low power pitot heat is 115v ac.

See the ice and rain protection chapter for information on how to do a test of the pitot probe heat (CHAPTER 30).



NOTE: LEFT PITOT PROBE HEAT SYSTEM SHOWN.
RIGHT AND CENTER SYSTEMS ARE SIMILAR.

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PITOT-STATIC/AIR DATA STANDBY INSTRUMENTS - PITOT PROBE - HEAT

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**AIR DATA INERTIAL REFERENCE SYSTEM - INTRODUCTION****General**

These are the two functions of the air data inertial reference system (ADIRS):

- Air data
- Inertial reference data.

These are examples of some of the systems that use ADIRS data:

- Primary flight control system (PFCS)
- Autopilot flight director system (AFDS)
- Airplane information management system (AIMS).

- LCD - liquid crystal display
- MAT - maintenance access terminal
- NCD - no computed data
- ND - navigation display
- NVM - non-volatile memory
- OPAS - overhead panel ARINC 629 system
- PFC - primary flight computer
- PFCS - primary flight control system
- PSEU - proximity sensor electronics unit
- SAARU - secondary attitude air data reference unit
- TAT - total air temperature

Abbreviations and Acronyms

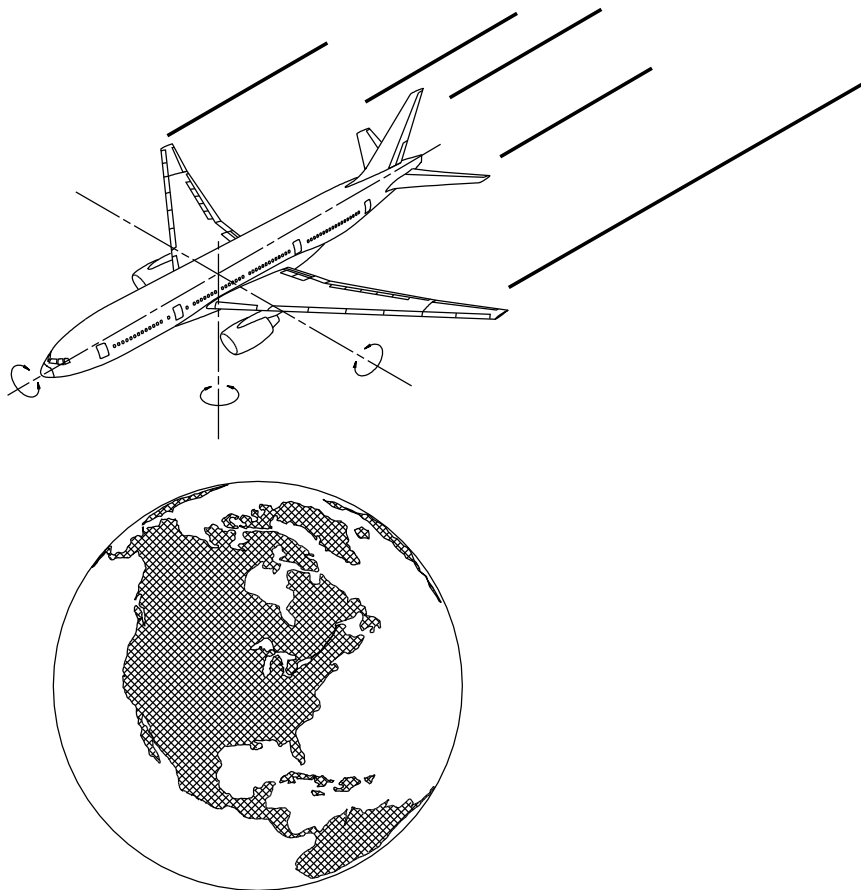
- ADIRS - air data inertial reference system
- ADIRU - air data inertial reference unit
- ADM - air data module
- AFDC - autopilot flight director computer
- AFDS - autopilot flight director system
- AIMS - airplane information management system
- AOA - angle of attack
- ARINC - Aeronautical Radio, Inc.
- CDU - control display unit
- CMCF - central maintenance computing function
- CPU - central processing unit
- FCA - fault containment area
- FCM - fault containment module
- FCDC - flight controls direct current
- FMCF - flight management computing function
- FPA - flight path angle
- FSEU - flap/slat electronics unit
- GPS - global positioning system

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AIR DATA INERTIAL REFERENCE SYSTEM - INTRODUCTION

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ADIRS - GENERAL DESCRIPTION

General

The air data inertial reference system (ADIRS) has these components:

- Pitot probes
- Static port
- Air data modules
- Air data inertial reference unit (ADIRU)
- Total air temperature (TAT) probe
- Angle of attack (AOA) sensors
- Secondary attitude air data reference unit (SAARU)

Air Data Modules

The air data modules (ADMs) get air pressures from the pitot probes or the static ports. The ADMs convert the air pressures into ARINC 629 data. The ADMs send this data to the ADIRU and the SAARU.

Airplane Information Management System

The airplane information management system (AIMS) cabinets receive TAT and AOA analog inputs. The AIMS cabinets change this data to digital and send it to the ADIRU and the SAARU.

The AIMS cabinets receive display data from the ADIRS. The AIMS shows ADIRS data on the primary flight displays (PFDs) and the navigation displays (NDs).

Air Data Inertial Reference Unit

The air data inertial reference unit (ADIRU) uses these inputs to calculate and supply air data to user systems:

- Pitot pressure
- Static pressure
- Total air temperature
- Angle of attack.

The ADIRU uses six ring laser gyros and six accelerometers to calculate and supply inertial reference and navigation data to user systems.

Secondary Attitude Air Data Reference Unit

The secondary attitude air data reference unit (SAARU) is a back-up source of attitude, heading and air data. The SAARU uses these inputs to calculate and supply air data to user systems:

- Pitot pressure
- Static pressure
- Total air temperature
- Angle of attack.

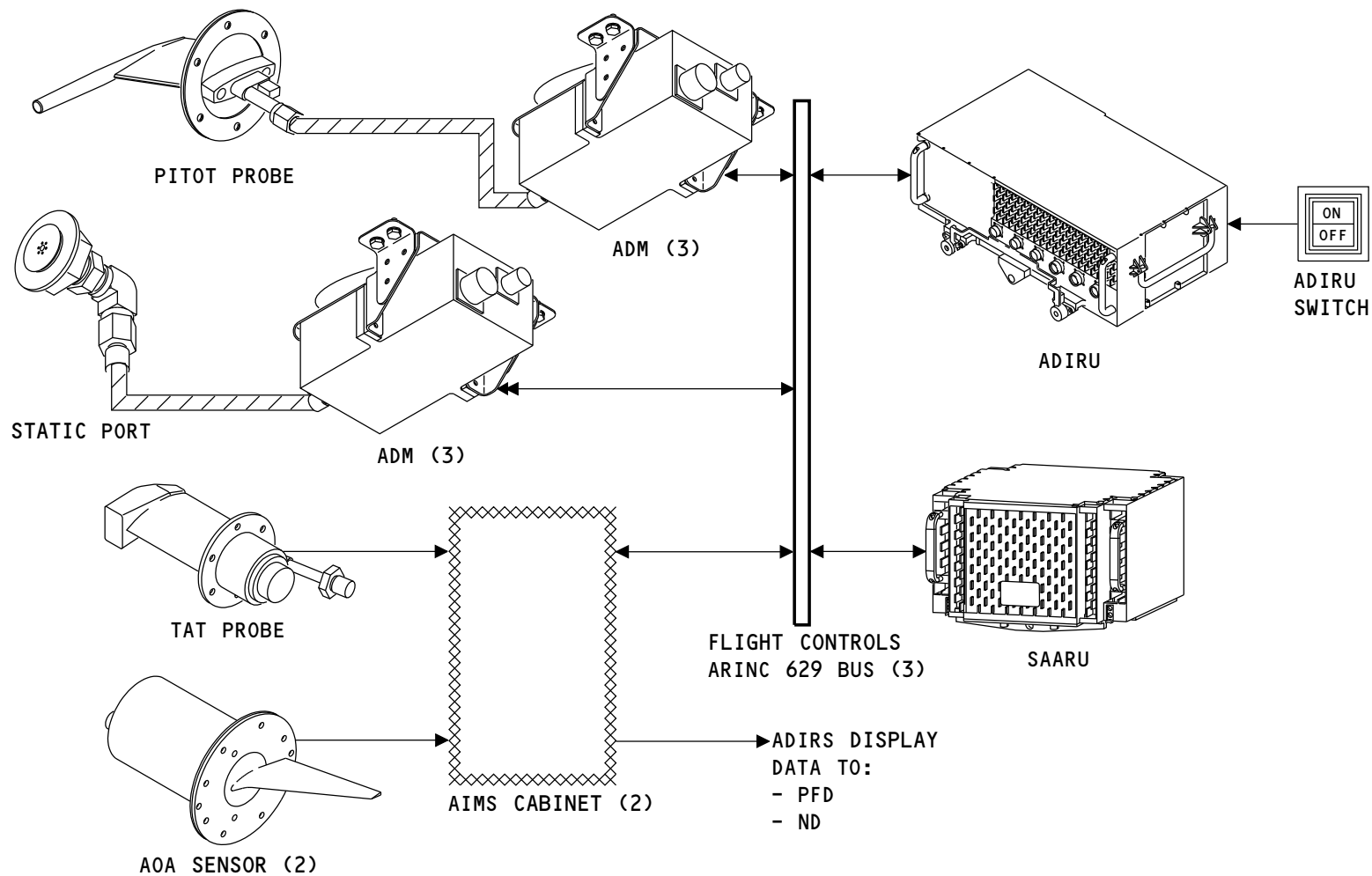
The SAARU uses four ring laser gyros and four accelerometers to calculate and supply inertial reference data to user systems.

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ADIRS - GENERAL DESCRIPTION

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**ADIRS - COMPONENT LOCATION - FLIGHT DECK****ADIRS Component Location**

The ADIRS components in the flight deck are:

- ADIRU switch
- ADIRU on battery light
- Integrated Standby Flight Display
- ADM Power Supply

Other Systems Component Location

The components in the flight deck that have an interface with the ADIRS are:

- Left and right control display units (CDUs)
- Left and right air data/attitude source switches.

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PRIMARY FLIGHT COMPUTERS/ADIRU PANEL
(P5 OVERHEAD PANEL)

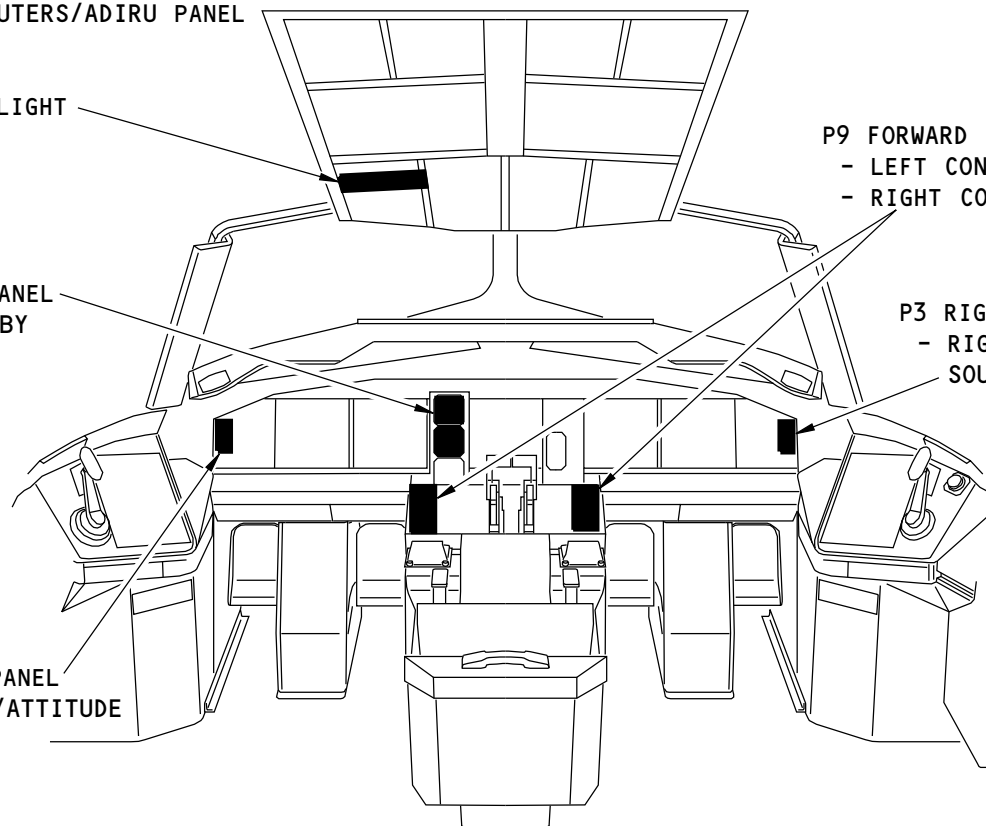
- ADIRU SWITCH
- ADIRU ON BATTERY LIGHT

P9 FORWARD AISLE STAND PANEL
- LEFT CONTROL DISPLAY UNIT
- RIGHT CONTROL DISPLAY UNIT

P2 CENTER FORWARD PANEL
- INTEGRATED STANDBY
FLIGHT DISPLAY
- ADM POWER SUPPLY

P3 RIGHT FORWARD PANEL
- RIGHT AIR DATA/ATTITUDE
SOURCE SWITCH

P1 LEFT FORWARD PANEL
- LEFT AIR DATA/ATTITUDE
SOURCE SWITCH



ADIRS - COMPONENT LOCATION - FLIGHT DECK

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**ADIRS - COMPONENT LOCATION - EQUIPMENT CENTERS****ADIRS Component Locations**

These air data inertial reference system (ADIRS) components are in the equipment centers:

- Air data inertial reference unit (ADIRU)
- Secondary attitude air data reference unit (SAARU)
- ADIRU BAT PWR L, C, R circuit breakers
- ADIRU PRI PWR L, C, R circuit breakers.

Other Systems Component Location

These components in the equipment centers have an interface with the ADIRS:

- Left power supply assembly
- Center power supply assembly
- Right power supply assembly.

The left power supply assembly has these circuit breakers:

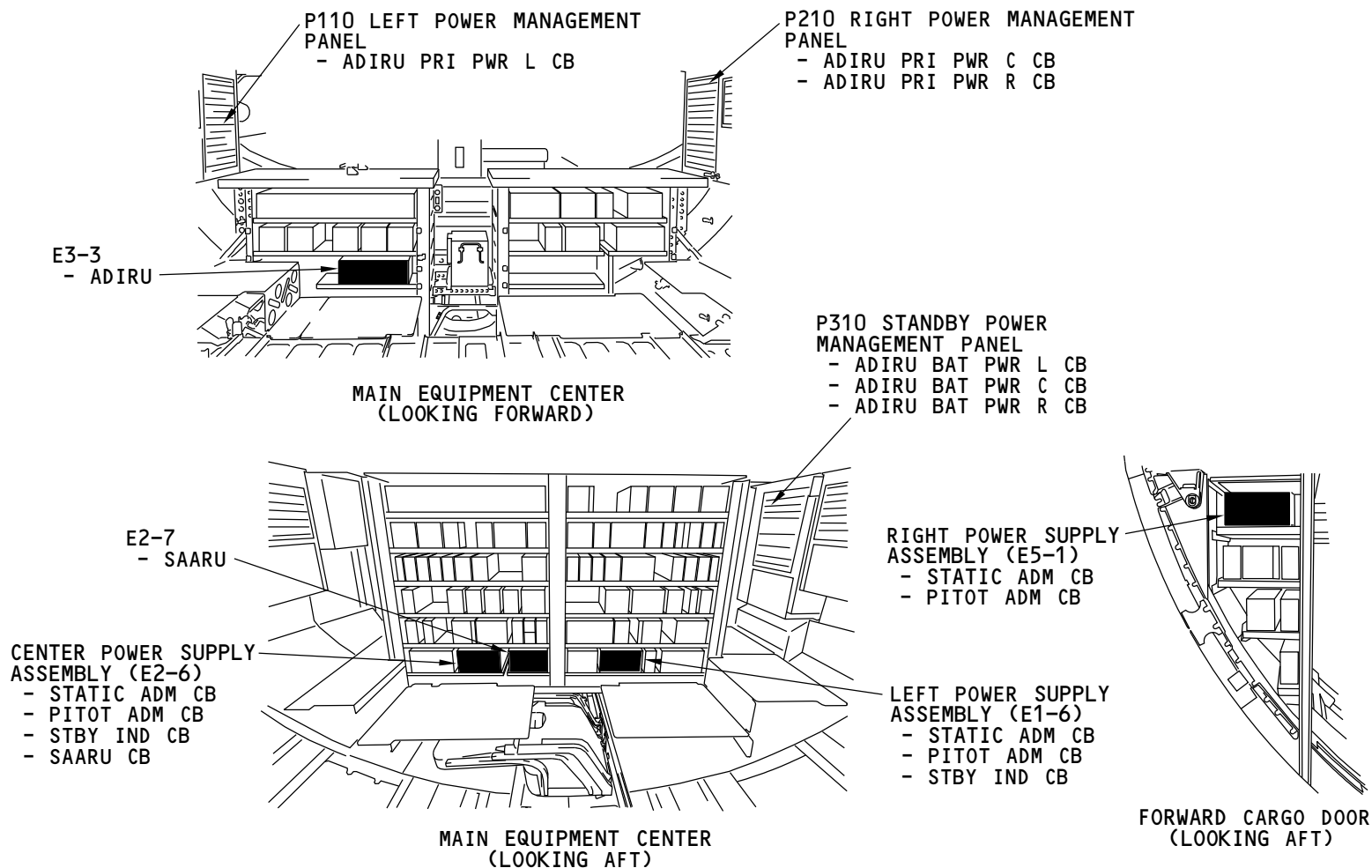
- STATIC ADM
- PITOT ADM
- STBY IND.

The center power supply assembly has these circuit breakers:

- STATIC ADM
- PITOT ADM
- STBY IND
- SAARU.

The right power supply assembly has these circuit breakers:

- STATIC ADM
- PITOT ADM.



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ADIRS - COMPONENT LOCATION - EQUIPMENT CENTERS

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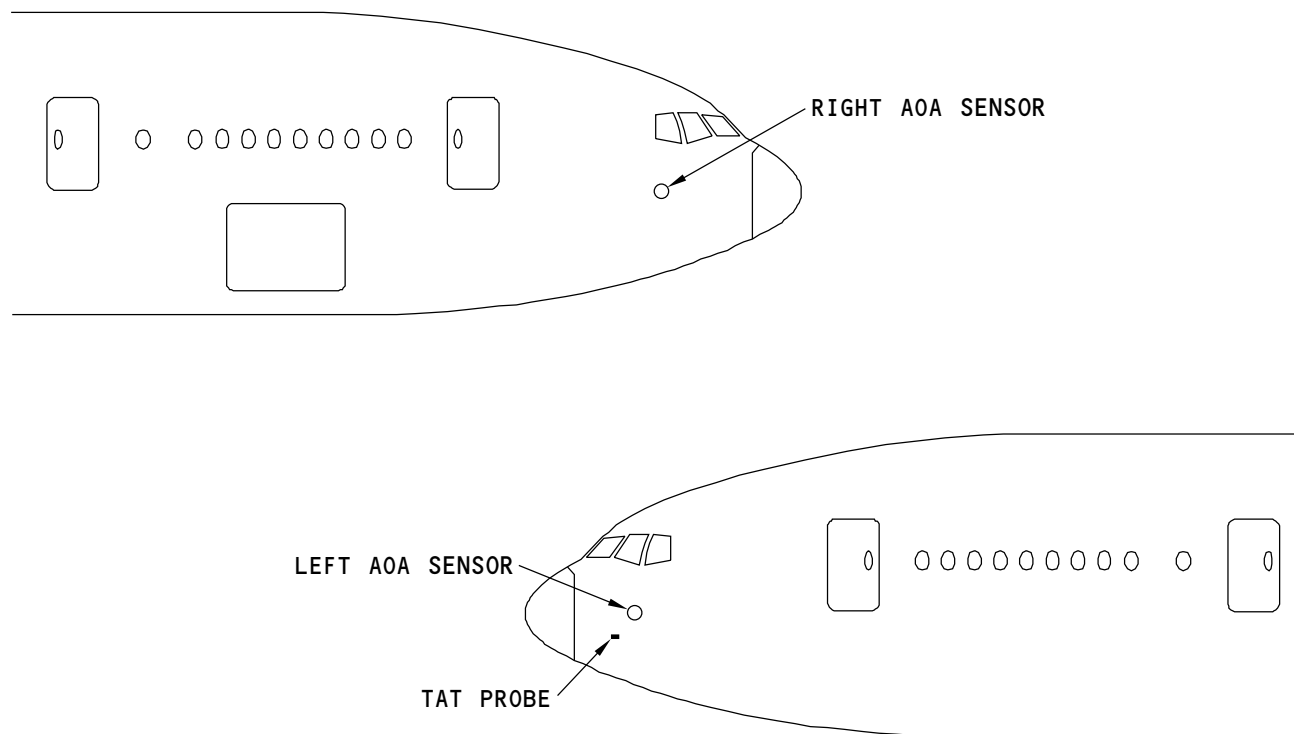


ADIRS - COMPONENT LOCATION - AOA SENSORS AND TAT PROBE

General

The angle of attack (AOA) sensors are on both sides of the fuselage and the TAT probe is on the left side.

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ADIRS - COMPONENT LOCATION - AOA SENSORS AND TAT PROBE

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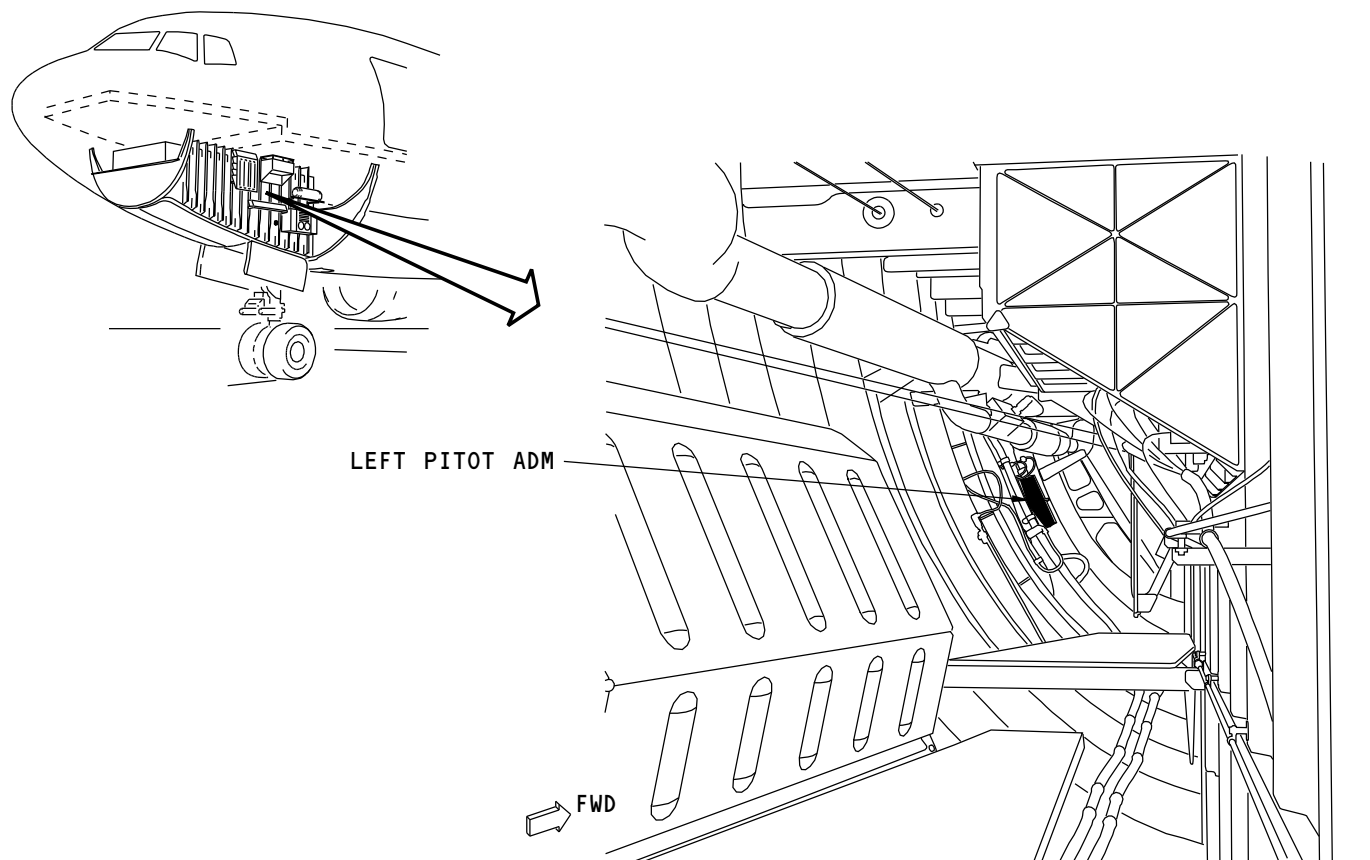


ADIRS - COMPONENT LOCATION - LEFT PITOT ADM

General

The left pitot ADM is in the left forward section of the main equipment center.

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LEFT PITOT ADM

FWD

FORWARD SECTION - LEFT OF NOSE WHEEL WELL

ADIRS - COMPONENT LOCATION - LEFT PITOT ADM

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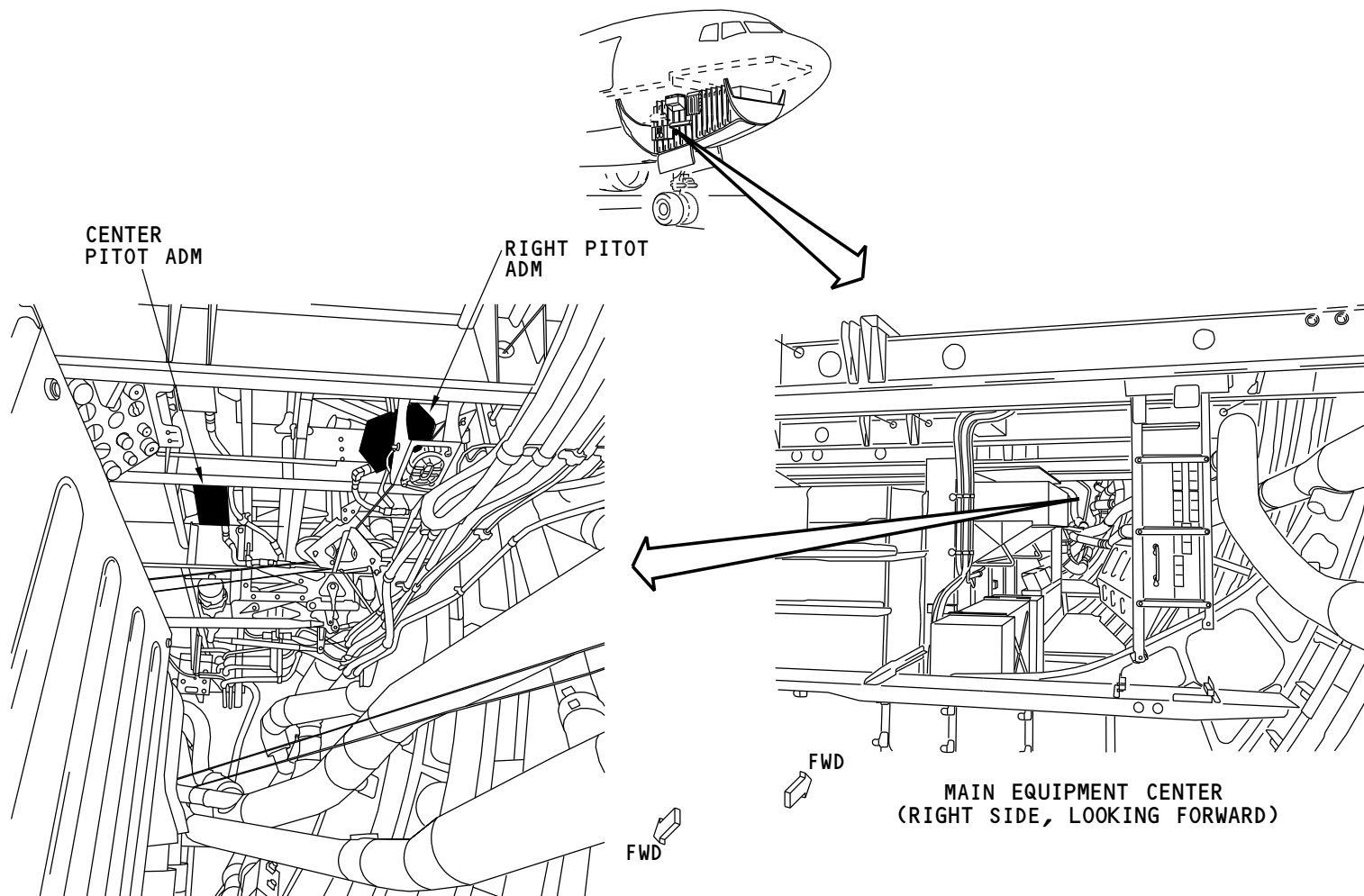


ADIRS - COMPONENT LOCATION - CENTER AND RIGHT PITOT ADM

Right and Center Pitot Air Data Modules (ADMs)

The right and center pitot ADMs are in the MEC, to the right of the nose wheel well and under the flight deck.

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ADIRS - COMPONENT LOCATION - CENTER AND RIGHT PITOT ADM

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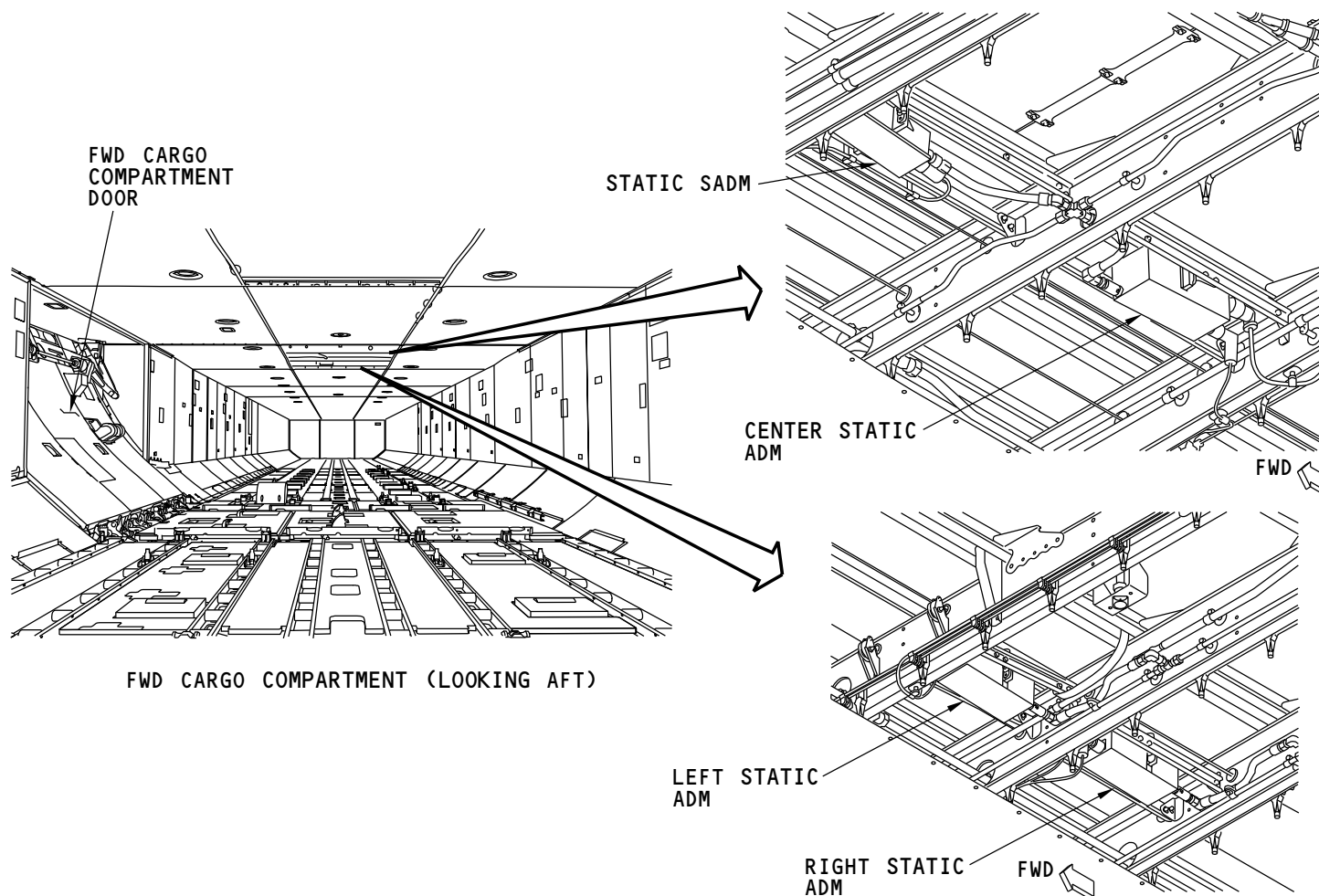


ADIRS - COMPONENT LOCATION - STATIC ADM AND STATIC SADM

Static Air Data Modules (ADM)

The static ADMs are in the forward cargo compartment ceiling above the cargo liner.

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ADIRS - COMPONENT LOCATION - STATIC ADM AND STATIC SADM

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**ADIRS - ADIRU, AOA AND SENSOR, SAARU, STANDBY ATTITUDE INDICATOR POWER****Air Data Inertial Reference Unit**

The air data inertial reference unit (ADIRU) gets power from these sources:

- Right 28 volt DC bus
- Left 28 volt DC bus
- Hot battery bus.

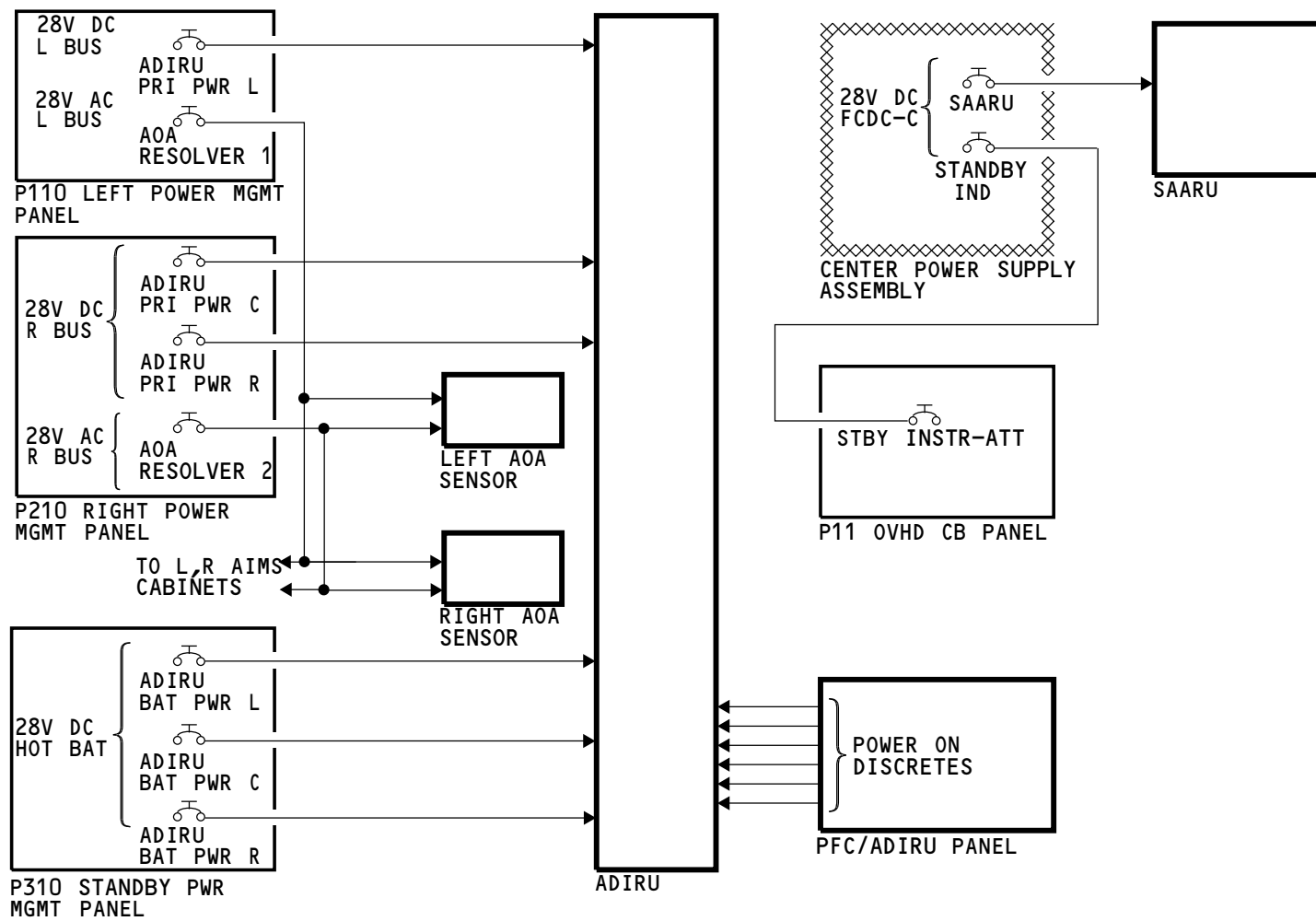
The PFC (primary flight computer)/ADIRU panel supplies on/off discretes to the ADIRU. The ADIRU uses these discretes to turn the ADIRU on and off.

AOA Sensors

One resolver in each AOA receive 28v ac power from the left (P110) and one resolver in each AOA receive 28v ac from the right (P210). The AIMS cabinets receive the same 28v ac for resolver reference.

SAARU

The secondary attitude air data reference unit (SAARU) gets 28v dc power from the SAARU circuit breaker on the center power supply assembly.



ADIRS - ADIRU, AOA AND SENSOR, SAARU INDICATOR POWER

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**ADIRS - AIR DATA MODULES POWER****General**

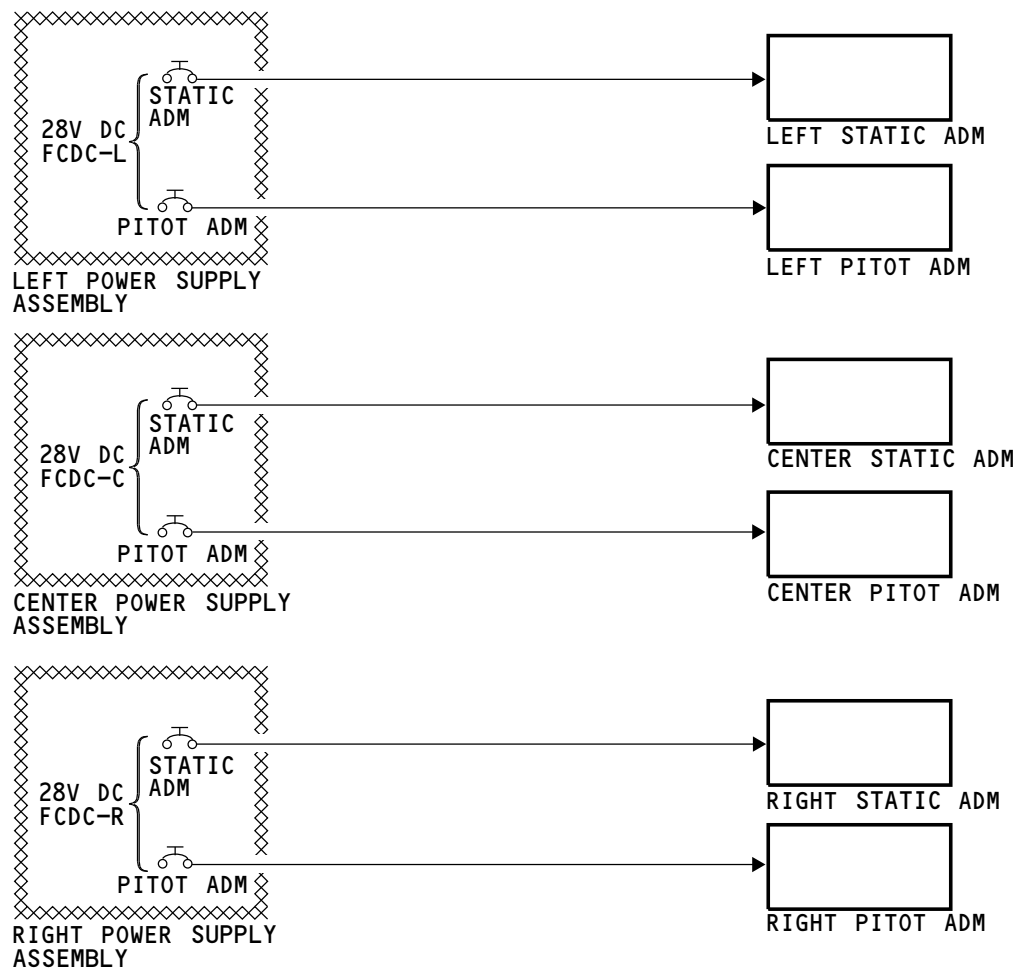
The power supply assemblies supply power to their onside pitot and static air data modules (ADMs).

The left power supply assembly supplies power to the left static and pitot ADMs.

The center power supply assembly supplies power to the center static and pitot ADMs.

The right power supply assembly supplies power to the right static and pitot ADMs.

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ADIRS - AIR DATA MODULES POWER

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ADIRS - DIGITAL INTERFACES

General

These components send data to the ADIRU and the SAARU through the flight controls ARINC 629 buses:

- Left and right AIMS cabinets
- Left, center, right pitot air data modules (ADMs)
- Left, center, right static ADMs
- Left, center, right PFC.

Total Air Temperature (TAT) Probe

The TAT probe sends analog temperature data to the left and right AIMS cabinets. The AIMS cabinets change the temperature data to ARINC 629 data. The AIMS cabinets send the temperature data to the ADIRU and the SAARU.

Angle of Attack (AOA) Sensors

The AOA sensors send the AOA resolver data to the left and right AIMS cabinets. The AIMS cabinets change the resolver data to ARINC 629 data. The AIMS cabinets send the AOA resolver data to the ADIRU and the SAARU.

FSEU and PSEU Data

The flap/slat electronic units (FSEUs) supply flap data and the proximity sensor electronic units (PSEUs) supply landing gear position to the AIMS cabinets. The AIMS cabinets send this data to the ADIRU and SAARU. The ADIRU and SAARU use this data to calculate corrected AOA data.

Pitot Probes

The pitot probes send total pressure to the pitot air data modules (ADMs). The pitot ADMs change the total pressure to ARINC 629 data. The pitot ADMs send the pitot pressure data to the ADIRU and the SAARU.

Static Ports

The static ports measure the static air pressure and send it through lines to the static ADMs. The static ADMs receive this pressure information and change it to ARINC 629 data. The static ADMs send the static air pressure data to the ADIRU and the SAARU.

PFC Data

The ADIRU and SAARU use speed brake position and air/ground data that comes from the PFCs. The ADIRU and SAARU use this data to calculate corrected AOA data. The AFDCs are the alternate source of air/ground and brake position if the PFCs fail.

ADIRU

The ADIRU receives data on all flight control ARINC 629 buses. The ADIRU has two connections to each flight control ARINC 629 bus.

The ADIRU sends air data and inertial reference data to user systems through the left and right flight control ARINC 629 buses.

SAARU

The SAARU receives data on all flight control ARINC 629 buses. The SAARU has one connection to each flight control ARINC 629 bus.

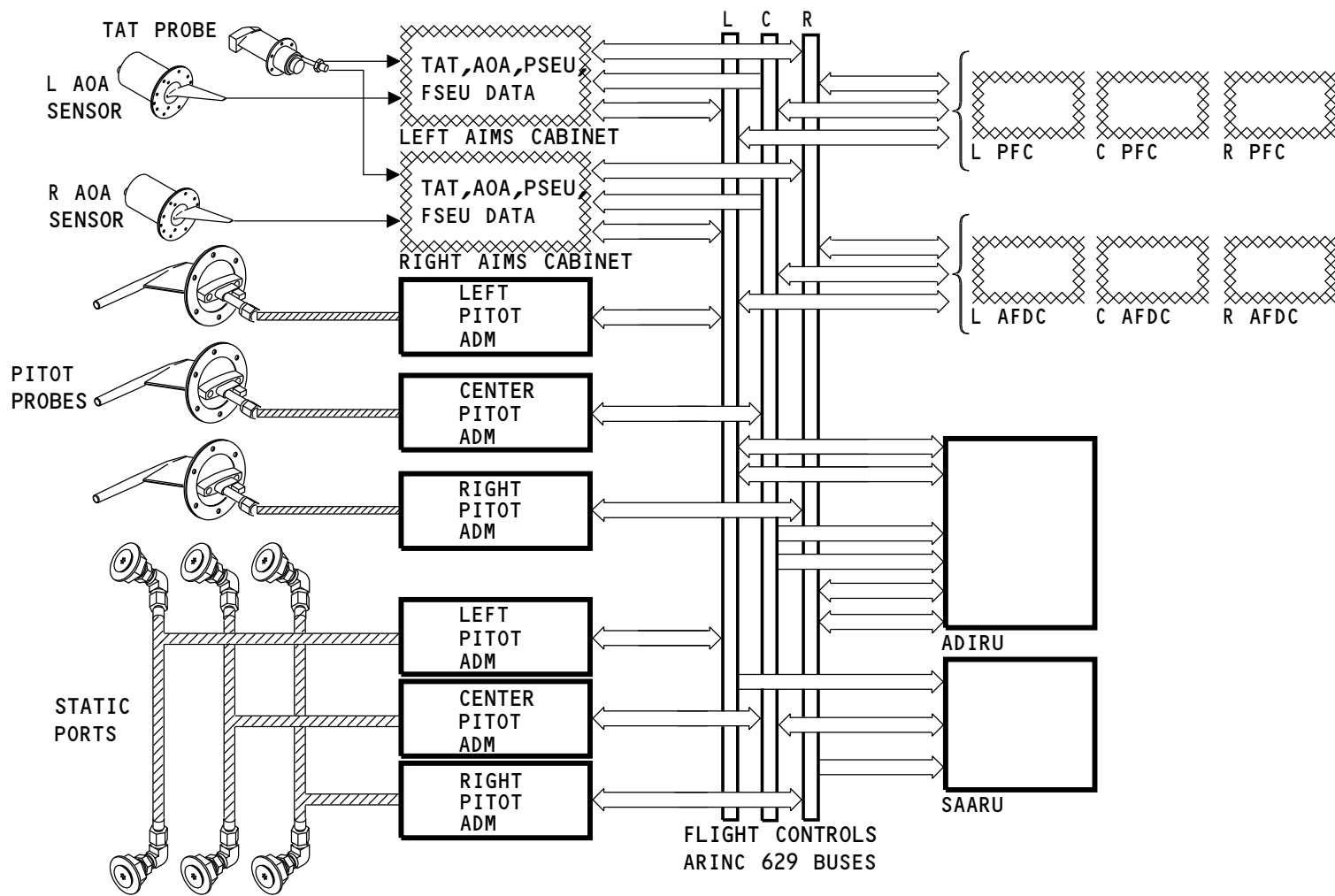
The SAARU sends inertial reference and air data to user systems through the center flight control ARINC 629 bus.

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ADIRS - DIGITAL INTERFACES

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**ADIRS - ADIRU****General**

The air data inertial reference unit (ADIRU) has two functions:

- Air data
- Inertial reference data.

The ADIRU has internal redundancy and automatically makes allowances for failures to keep its complete function.

Physical Description

The ADIRU weighs 68 pounds. The ADIRU is 22.75 inches wide, 7.64 inches high, and 13.61 inches deep.

The ADIRU has these features:

- 2 front handles
- Passive cooling fins
- A locking bar
- 2 installation screws
- Installation guide
- 3 ARINC 629 connectors
- 3 power connectors
- 2 side handles.

The ADIRU has these internal components:

- Six laser gyros
- Six linear accelerometers
- Four processors
- Three power supplies
- Three dual channel ARINC 629 input/output interfaces.

Software Loading

The ADIRU can receive operational program software (OPS) from the AIMS cabinets through the flight controls ARINC 629 buses.

Air Data Function

The ADIRU uses data from the air data sensors to make air data calculations.

Inertial Reference Data Function

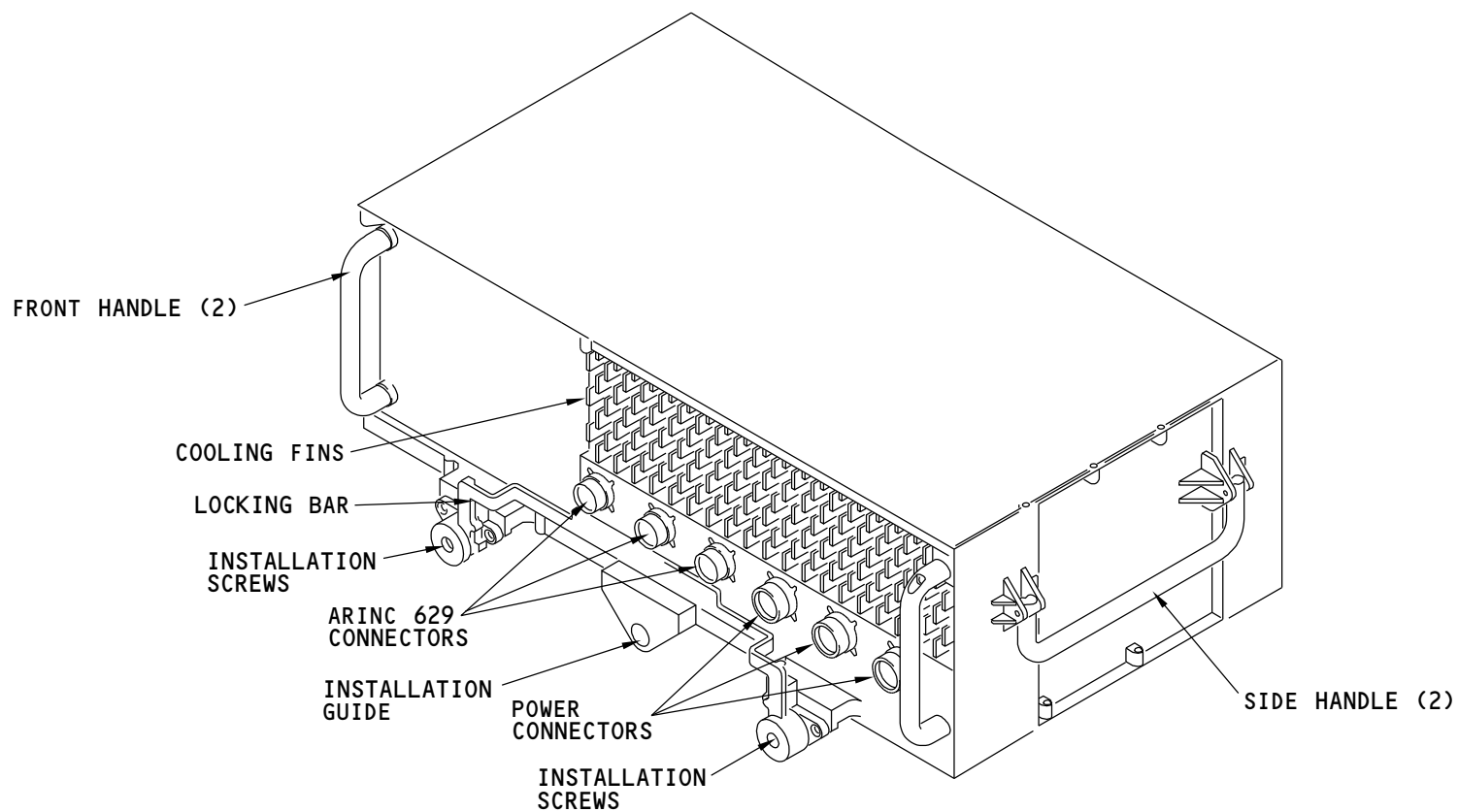
The ADIRU uses the data from the accelerometers and gyros to calculate inertial navigation data.

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ADIRS - ADIRU

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**ADIRS - ADIRU REMOVAL AND LOCK BAR OPERATION****Locking Bar**

The locking bar prevents these:

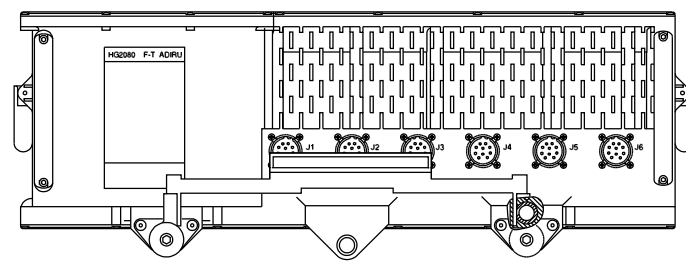
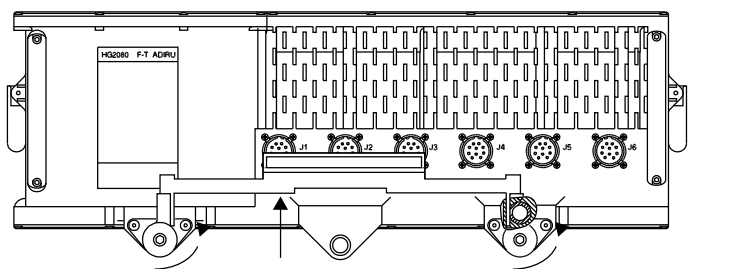
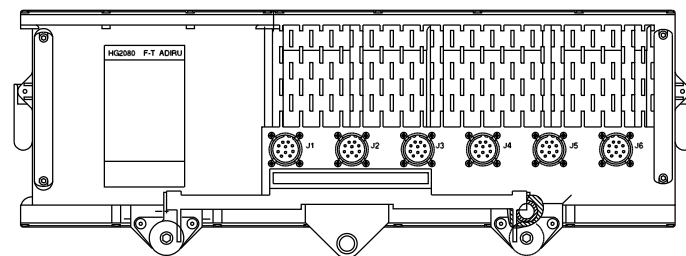
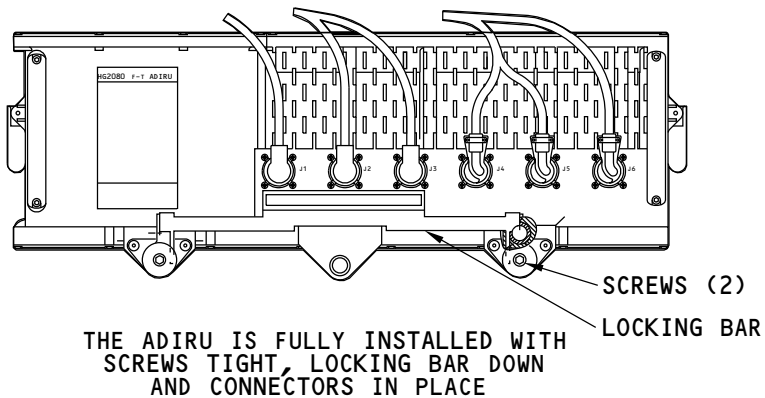
- Removal of the ADIRU until you disconnect the ARINC 629 connections
- Connection of the ARINC 629 interfaces until you install and secure the ADIRU.

Training Information Point

You must use a 1/4 inch hex wrench to turn the ADIRU installation screws.

Do these steps to remove the ADIRU and operate the locking bar:

- Remove all six connectors
- Slide the locking bar up until it covers the three connectors
- Use a hex wrench to loosen the installation screws
- After you loosen the screws, a spring moves them out and they hold the locking bar up
- Remove the ADIRU.



ADIRS - ADIRU REMOVAL AND LOCK BAR OPERATION

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ADIRS - ADIRU INSTALLATION**ADIRU Installation**

Put the ADIRU on the rack and align the two alignment pins in the back of the ADIRU and one pin in the front of the ADIRU.

Do these steps to install the ADIRU:

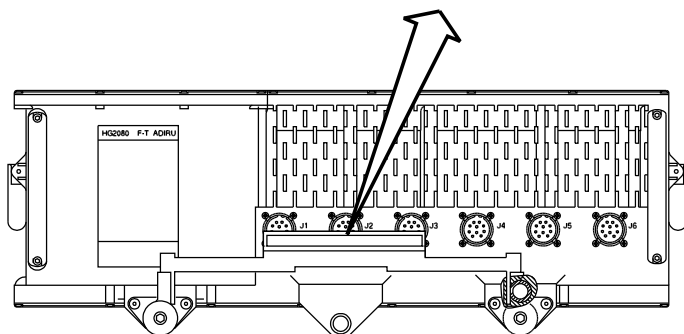
- Install the ADIRU in the rack
- Tighten the screws
- Slide the locking bar down
- Install the six connectors and make sure they are in the full lock position.

Training Information Point

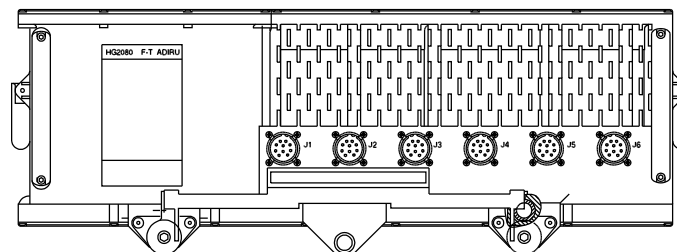
When the ADIRU is secured to the mounting tray, the locking bar is in the down position. Make sure all connectors are in the full lock position before you apply power. You cannot operate the ADIRU if it is not properly installed.

NOTICE: INSTALL THE ADIRU ON THE AIRPLANE MOUNTING SHELF, THEN LOWER THE LOCKING BAR BEFORE YOU ATTACH THE CONNECTORS.

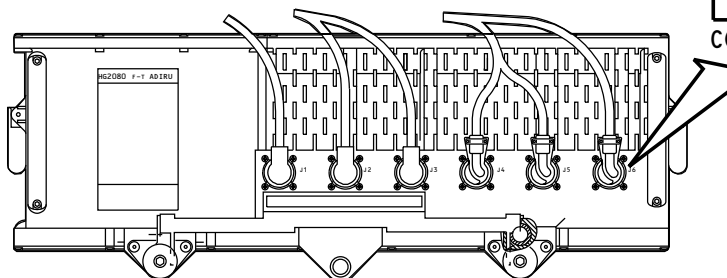
LOCKING BAR NOTICE



① INSTALL THE ADIRU ON THE SHELF



② TIGHTEN THE SCREWS
MOVE THE LOCK BAR DOWN



MAKE SURE ALL CONNECTORS ARE IN THE FULL LOCK POSITION.

CONNECTOR NOTICE

③ INSTALL THE CONNECTORS

ADIRS - ADIRU INSTALLATION

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ADIRS - ADIRU RELIABILITY AND FAULT TOLERANCE**General**

The ADIRU has fault containment areas (FCAs). The FCAs have fault containment modules (FCMs).

The ADIRU has redundancy features that make it more reliable. If a module fails, the ADIRU adjusts itself to use only those components that are good.

Fault Containment Areas and Fault Containment Modules

There are seven FCAs in the ADIRU. In each FCA there are FCMs. These are the FCAs and their FCMs:

- Gyro: 6 laser gyro FCMs
- Accelerometer: 6 accelerometer FCMs
- Power supply: 3 power supply FCMs
- Processor: 4 processor FCMs
- Left, center, and right ARINC 629 interface: 2 ARINC 629 I/O modules in each.

Each FCM is physically and electrically separate from all other like FCMs.

FCMs in the same FCA are the same and interchangeable by shop personnel only.

Single Failures In A Fault Containment Area

If a single FCM fails in one FCA or if there are single FCM failures in more than one FCA, the ADIRU sends data to AIMS to make a maintenance memo show on the maintenance access terminal (MAT). The maintenance memo is ADIRS and it shows on the maintenance planning page.

The flight crew will not see a flight deck effect.

Multiple Failures In The Same FCA

If there are two FCM failures in the same FCA, the ADIRU sends data to AIMS to make a maintenance message show on the MAT, and the status message ADIRU shows on the EICAS display.

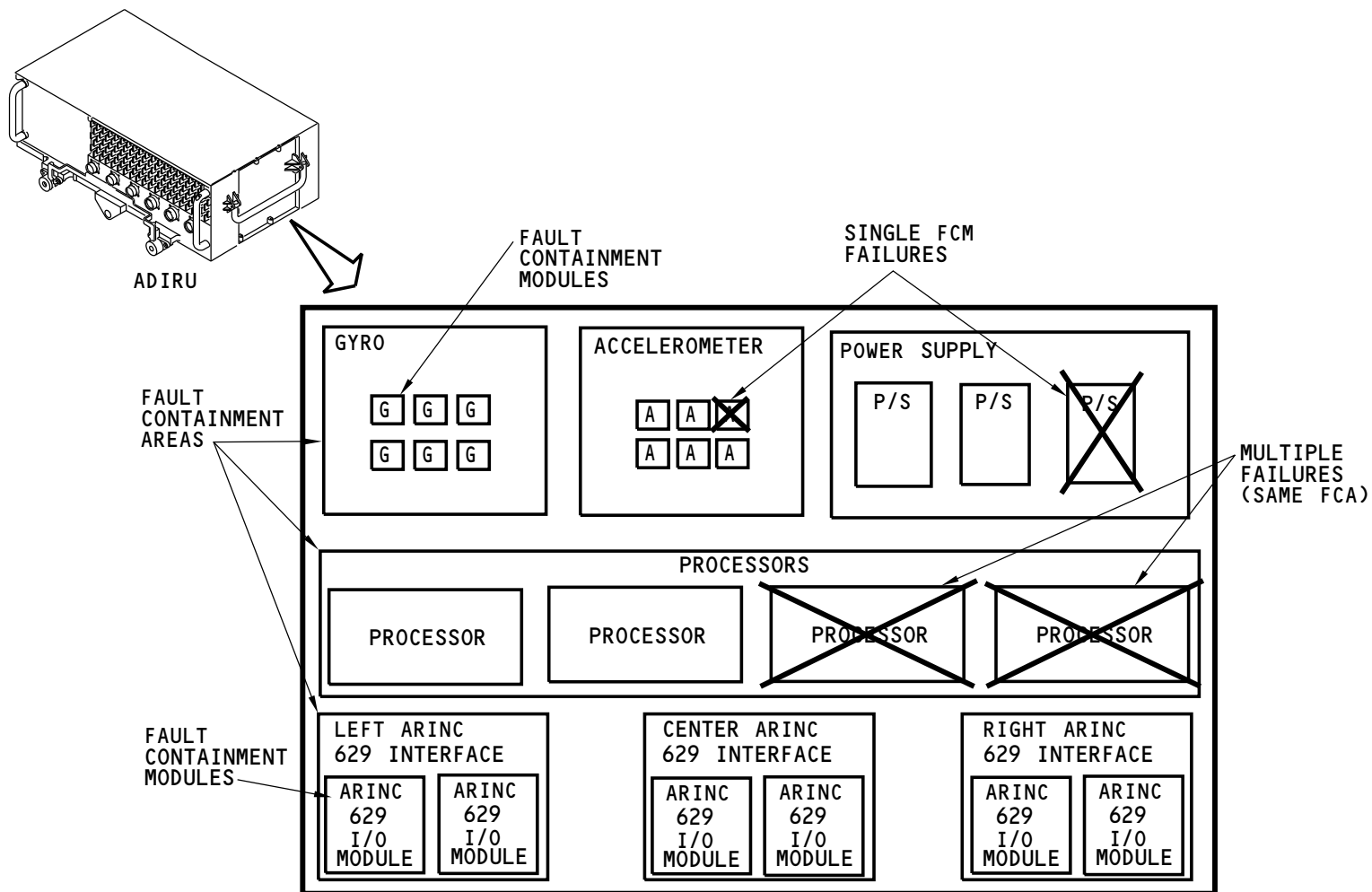
More Failures

The ADIRU must have at least these components in order to supply inertial reference data:

- 4 gyros
- 4 accelerometers
- 1 power supply
- 2 processors
- 1 ARINC 629 I/O module in the left and right FCA.

This happens if there are more than two failures in an FCA:

- The ADIRU does not supply inertial reference data
- The status message ADIRU shows
- The EICAS caution message NAV ADIRU INERTIAL shows
- The ADIRU sends data to AIMS to make a maintenance message show on the MAT.



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ADIRS - ADIRU RELIABILITY AND FAULT TOLERANCE

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ADIRS - ADIRU POWERUP, ON BATTERY, POWERDOWN**PFC/ADIRU Panel**

The primary flight computer (PFC)/ADIRU panel has the ADIRU switch and the ADIRU on battery (ON BAT) light.

The ADIRU switch has five sets of contacts. Three of these contacts send discrete inputs to the ADIRU power and monitor circuit. One contact supplies a ground for the ADIRU OFF light, or a ground to energize the relay to make the ground crew call horn come on. The last contact makes the ADIRU ON light come on.

ADIRU Power Source

All the ADIRU power inputs go to the ADIRU power supply. This power goes to the power and I/O (input/output) monitor. The power and I/O monitor verifies the ADIRU switch inputs. If the ADIRU switch is in the on position, the power and I/O monitor permits the power to go to the ADIRU processors.

Ground Crew Alert

If the ADIRU loses primary power, it uses the airplane battery and the ADIRU ON BAT light comes on. The ground crew call horn comes on when the airplane is on the ground and the only source of power for the ADIRU is the hot battery bus. The ground crew call horn comes on to alert the ground crew that the hot battery bus is the only source of power for the ADIRU.

The ADIRU ON BAT light and the ground crew call horn come on if all these conditions are true:

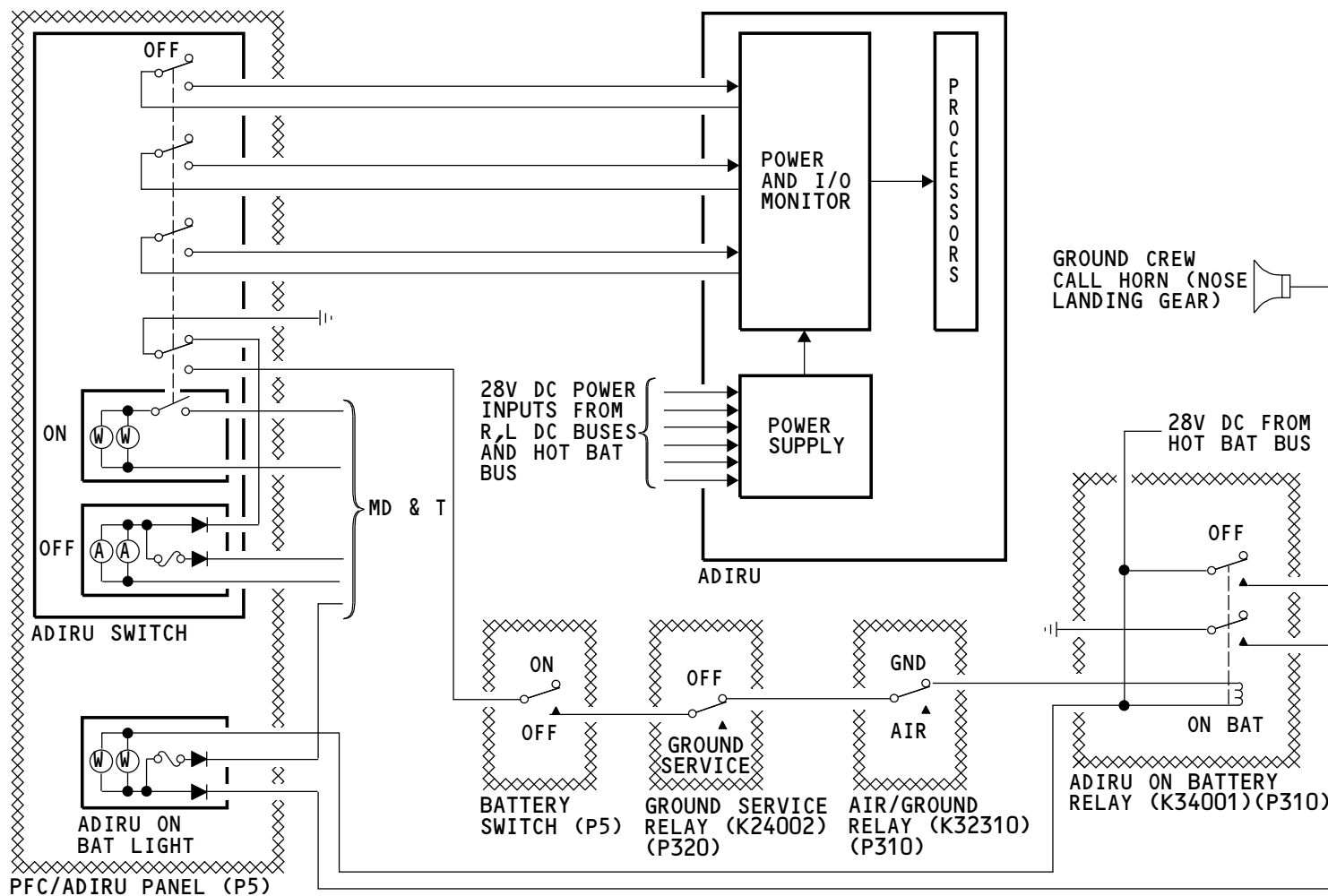
- Battery switch is in the off position
- Ground service relay is in the off position
- Air/ground relay is in the ground position
- The ADIRU switch is in the on position.

Power Down

With the ADIRU switch in the off position, one of these conditions must be present before the ADIRU will power down:

- Ground speed is less than 20 kts
- Computed airspeed is less than 30 kts.

All three power off discretes from the ADIRU on/off switch must be present for shutdown.



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ADIRS - ADIRU POWERUP, ON BATTERY, POWERDOWN

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ADIRS - ADIRU AIR DATA FUNCTION - 1

General

Redundancy management logic in the ADIRU selects a value from the inputs that come from more than one source. This makes sure that the ADIRU uses only valid data.

Total Air Temperature

The total air temperature (TAT) redundancy management logic calculates an average of the TAT values from TAT inputs 1 and 2.

Pitot Pressure

Pitot pressure comes from the left, center, and right pitot air data modules (ADMs). The pitot ADM redundancy management logic uses mid-value selection to choose one of the pitot pressure inputs. The redundancy management logic also finds if any of the signals are not valid.

AOA Heater Valid

The angle of attack (AOA) heater valid signals go to the AOA redundancy management logic. The AOA redundancy management logic uses the AOA heater valid signal to find if the AOA sensors are valid.

AOA Input

The AOA values go to the calculate corrected AOA function.

Speedbrake Lever Past Arm Signal

The primary flight computers (PFCs) supply the speedbrake lever angle signals to the ADIRU. An input data redundancy management logic selects one of the PFC signals. The speedbrake lever past arm signal goes to the AOA redundancy management logic.

Air/Ground, Nose Gear Position, and Flap Angle

The proximity sensor electronics units (PSEUs) supply the air/ground and the nose gear position signals to the AIMS cabinets.

The flap/slat electronic units (FSEUs) supply the flap angle signals to the AIMS cabinets. The AIMS cabinets supply the signals to the ADIRU.

The input data redundancy management logic chooses the left PFC input data first, then center if the left fails, then the right if the left and center fail. The redundancy management also chooses PSEU and FSEU number 1 input first. If the number 1 input fails, then it chooses the number 2 input.

The air/ground, nose gear position, and flap angle signals go to the calculate corrected AOA function.

Calculate Corrected AOA

The calculate corrected AOA function calculates the left and right corrected AOA. The calculate corrected AOA function receives these additional signals:

- Mach from the calculate mach and airspeed logic
- True airspeed (TAS) from the calculate true airspeed logic.

The corrected AOA goes to the AOA redundancy management logic.

AOA Redundancy Management

The AOA redundancy management logic uses a modified mid-value selection. The modified mid-value selection chooses the mid-value of these three AOA values:

- Left corrected AOA
- Right corrected AOA
- Calculated AOA.

The AOA redundancy management logic receives inputs from the inertial and air data systems to calculate the calculated AOA.

Static Pressure

Static pressure comes from the left, center, and right static air data modules (ADMs). The static source error correction (SSEC) function uses mach and corrected AOA plus flap position to compensate for errors in measurement of static pressure. The static pressure goes to the static ADM redundancy management logic.

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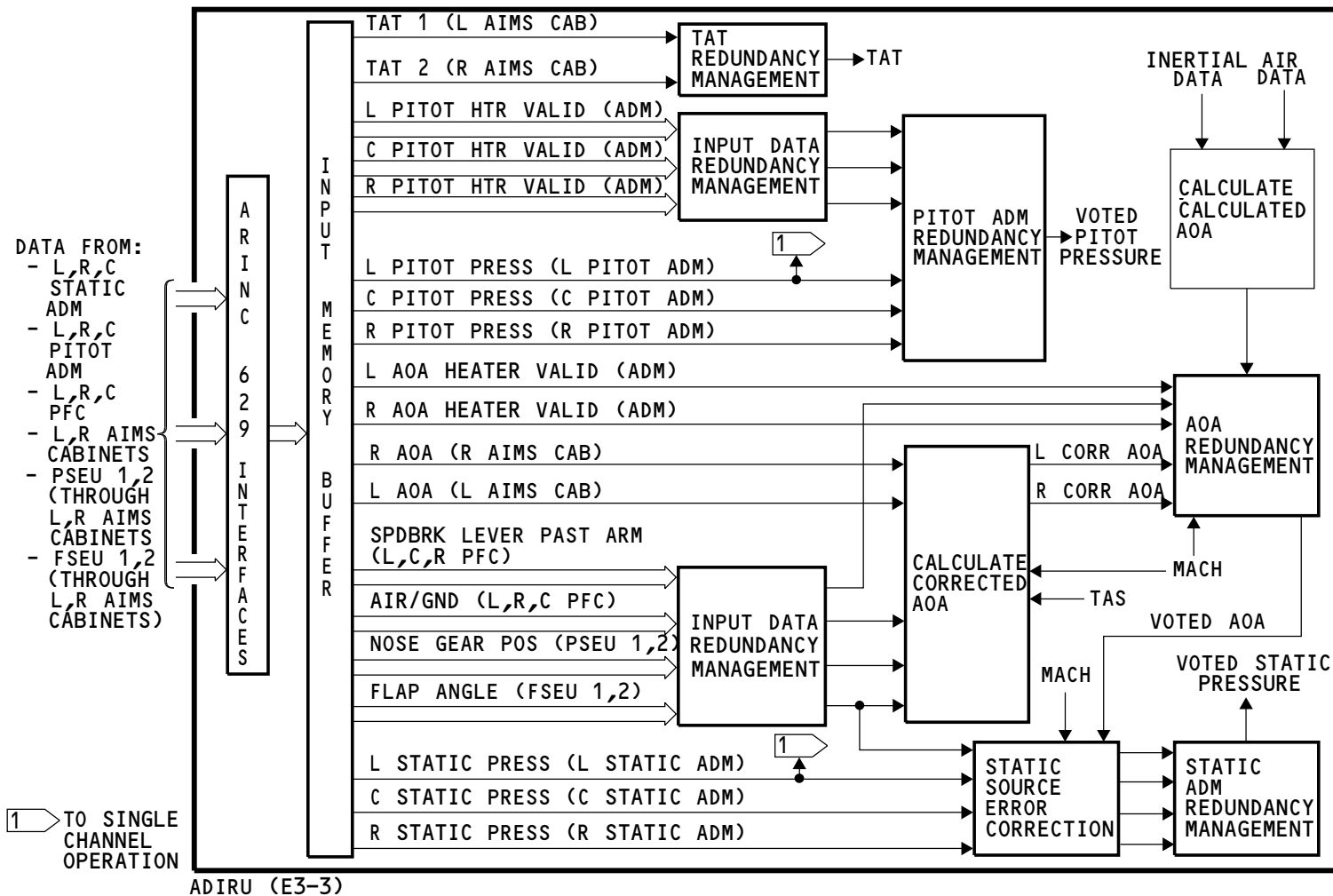
**ADIRS - ADIRU AIR DATA FUNCTION - 1**

The static ADM redundancy management logic uses mid-value selection to choose one of the static pressures from the SSEC logic. The static ADM redundancy management logic uses body accelerations from the ADIRU inertial reference section to adjust fault detection thresholds.

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ADIRS - ADIRU AIR DATA FUNCTION - 1

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ADIRS - ADIRU AIR DATA FUNCTION - 2

Total Air Temperature (TAT)

The TAT correction function receives TAT and calculated mach and computed air speed (CAS). Mach and CAS correct the TAT.

Static Air Temperature (SAT)

The calculate static air temperature function receives TAT, mach and CAS inputs. The SAT signal goes to the output memory buffer.

True Air Speed (TAS)

The calculate TAS function uses static air temperature CAS to calculate TAS. The corrected TAS is invalid when the CAS is less than 30 knots.

Mach Bias

The Mach Bias function modifies the ADIRU Mach number output to improve agreement between the flight deck instruments derived fuel mileage and performance manual predicted fuel mileage. The function adds a Mach bias to the ADIRU Mach output at speeds above 0.83 Mach to more closely match actual airplane Mach at cruise speeds. Mach Bias will allow maintenance personnel to input a Mach factor between 0.000 and 0.005 Mach, in 0.001 increments. The input will consist of a CDU entry of a single digit from 0 to 5, corresponding to the entered bias value in units of Milli-Mach. The applied bias will decrease linearly from the entered value at 0.83 Mach, to 0.000 at 0.75 Mach, with no bias applied below 0.75 Mach.

Corrected Angle of Attack (AOA)

The corrected AOA, from the AOA redundancy management logic is invalid when the CAS is less than 30 knots.

Mach and Computed Air Speed (CAS)

The calculate mach and CAS function uses impact pressure to calculate mach and CAS. The corrected mach and CAS are invalid when the CAS is less than 30 knots.

Impact Pressure

The calculate impact pressure function receives static pressure inputs from the static ADM redundancy management logic. The calculate impact pressure function also receives pitot pressure from the pitot ADM redundancy management. The impact pressure signal goes to the output memory buffer.

Altitude and Altitude Rate.

The calculate altitude and altitude rate function gets signals from the static and pitot ADM redundancy management logic. Altitude and altitude rate goes to the output memory buffer.

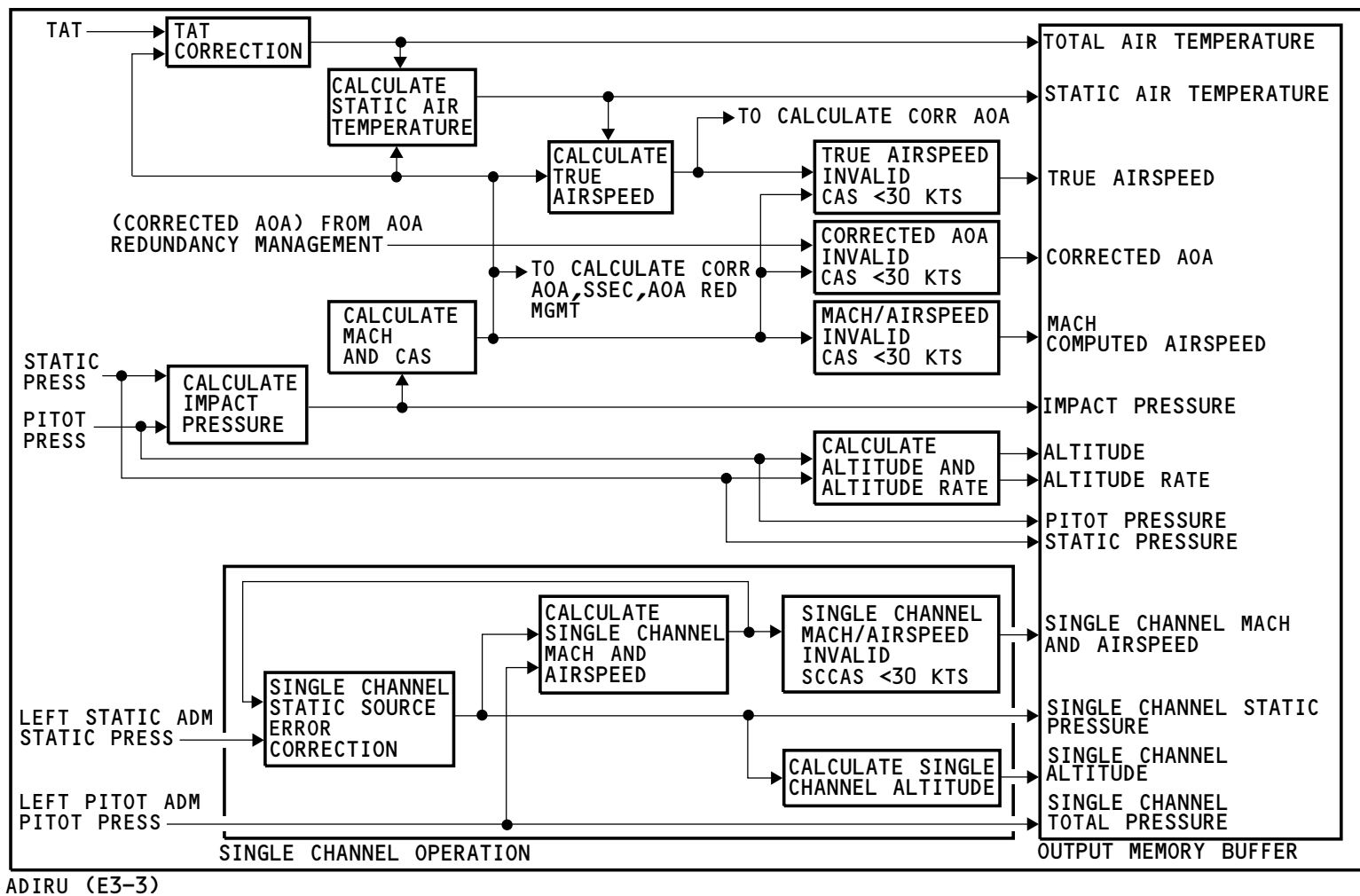
Pitot Pressure and Static Pressure

Pitot and static pressure come directly from the pitot and static ADM redundancy management logic. These pressures go to the output memory buffer.

Single Channel Operation

If the ADIRU and SAARU air data parameters from the redundancy management logic are invalid, the flight deck displays show single channel air data from the ADIRU and SAARU. Single channel air data parameters bypass the redundancy management logic that the flight displays show during normal operation. Air data from the left pitot ADM and left static ADM goes to the ADIRU single channel operation function. This function calculates these single channel quantities:

- Mach
- Airspeed
- Static pressure
- Barometric altitude
- Total pressure.



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ADIRS - ADIRU AIR DATA FUNCTION - 2

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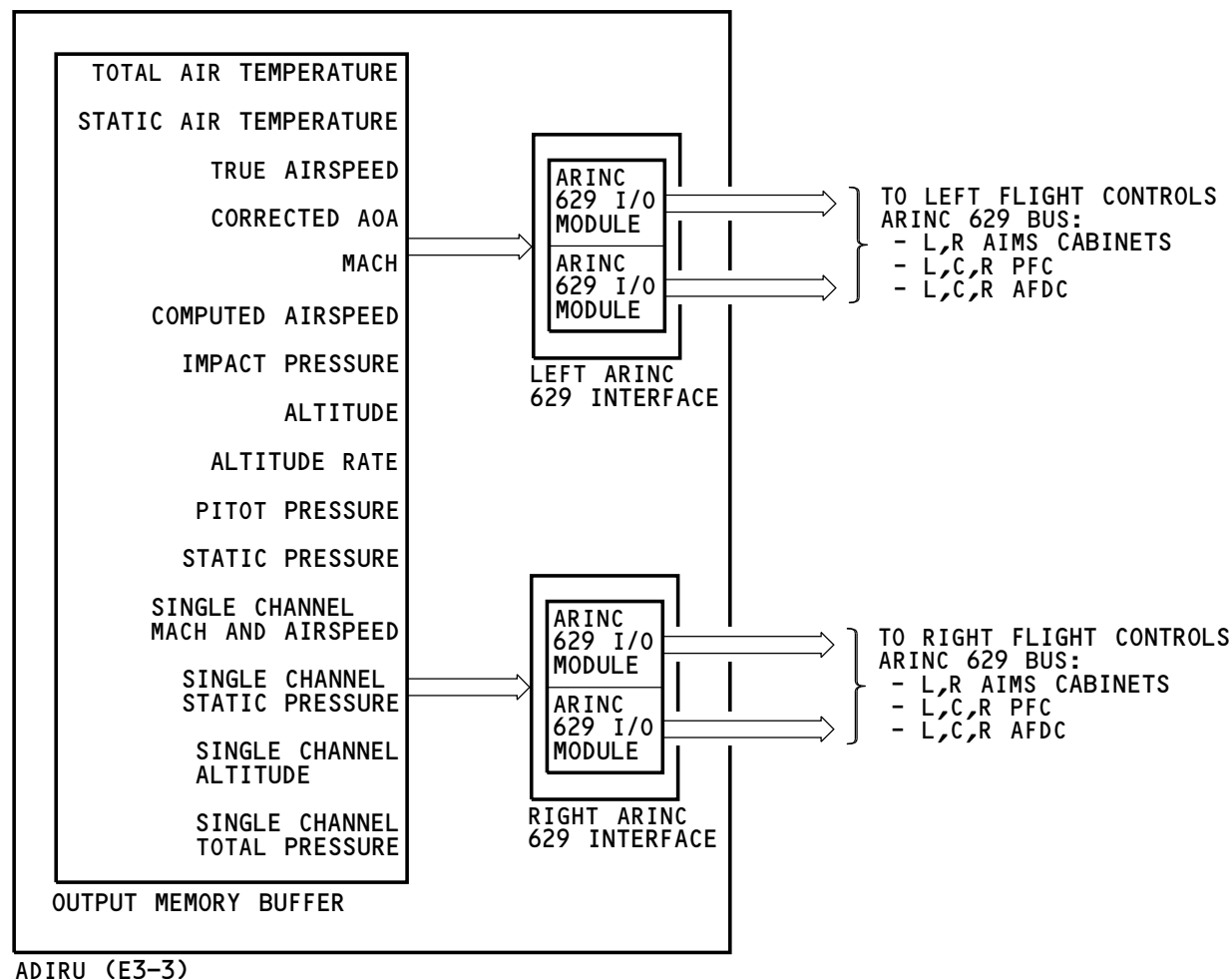
ADIRS - ADIRU AIR DATA FUNCTION - 3

Outputs

The ADIRU transmits air data to the left and right flight controls ARINC 629 buses. The air data goes to these components:

- Left and right AIMS cabinets
- Left, center, and right primary flight computers (PFCs)
- Left, center, and right autopilot flight director computers (AFDCs).

Only one of the two connections to each flight controls ARINC 629 bus is active at a time.



ADIRS - ADIRU AIR DATA FUNCTION - 3

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**ADIRS - ADIRU INERTIAL REFERENCE DATA FUNCTION - 1****General**

The ADIRU uses data from the flight management computing function (FMCf) in the AIMS cabinets to do these functions:

- Initialize the airplane position
- Calibrate the gyros and accelerometers.

Inputs

The FMCf sends this data to the inertial reference function in the ADIRU:

- Initial position
- Airplane type
- Global positioning system (GPS) position (longitude and latitude)
- GPS velocity (north, east, and vertical).

Initial Position

When the flight crew enters the initial position on the control display unit (CDU), the position goes to the FMCf of the AIMS. The AIMS sends the entered initial position to the ADIRU. The ADIRU's initial position validation logic does this:

- Verifies the validity of the entered initial position
- Compares the entered initial position to the global position system (GPS) position or the last ADIRU stored position if GPS data is not available.

If the entered initial position is good, the ADIRU uses it as the initial position for alignment.

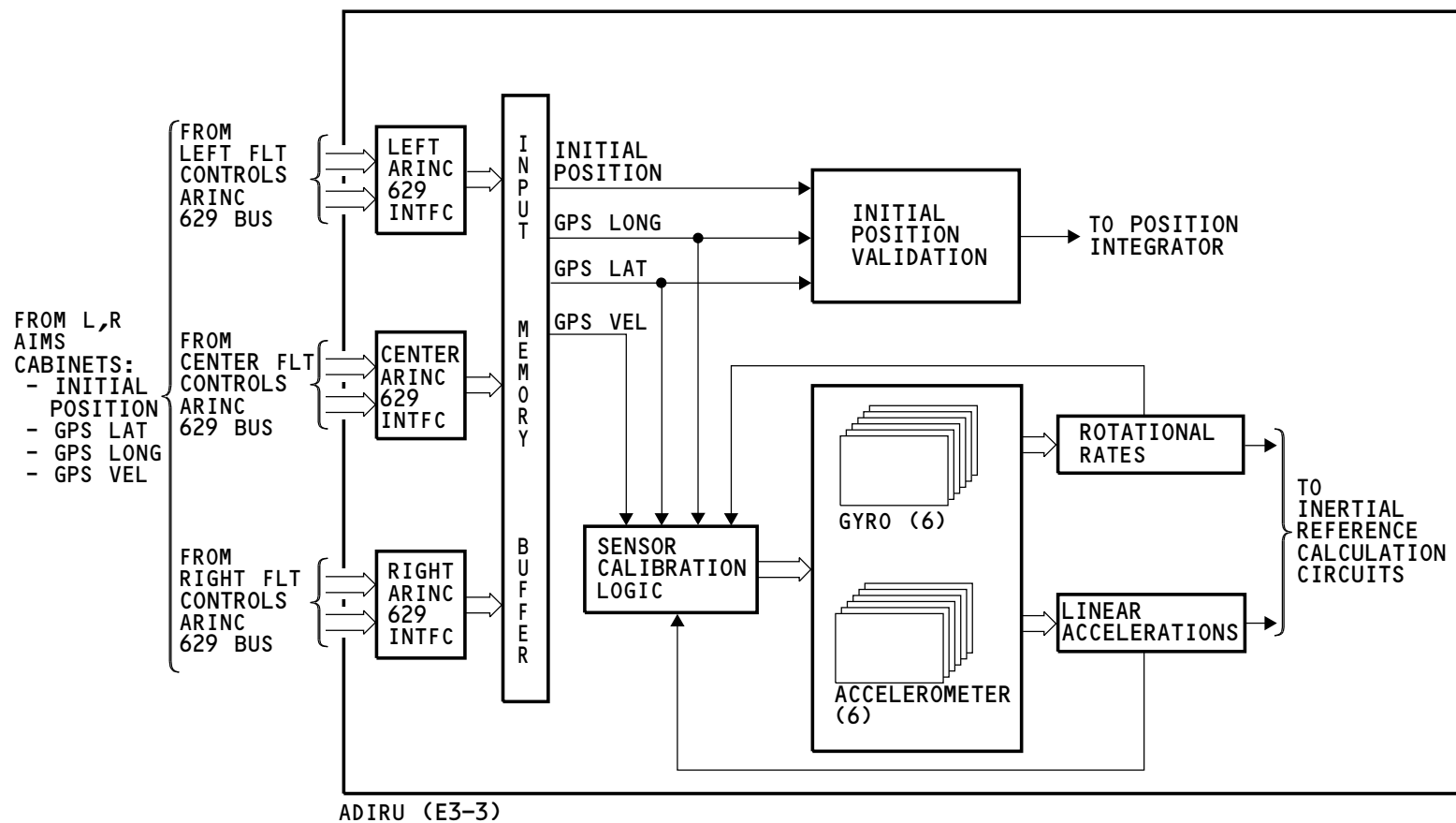
Gyro and Accelerometer Calibration

The GPS position and velocity go to the sensor calibration logic. The sensor calibration logic supplies calibration data to the gyros and accelerometers. The calibration does not correct the ADIRU errors. It only reduces ADIRU drift errors as the airplane flies.

If the GPS position is not valid, there is no source of calibration data for the gyros and accelerometers.

Gyros and Accelerometers

The gyros send rotational rate data to the inertial reference calculation. The accelerometers send linear accelerations to the inertial reference calculation.



ADIRS - ADIRU INERTIAL REFERENCE DATA FUNCTION - 1

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**ADIRS - ADIRU INERTIAL REFERENCE DATA FUNCTION - 2****Wind Speed and Wind Direction**

True airspeed data from the ADIRU air data function goes to the calculate wind speed and calculate wind direction function.

Pitch Rate, Roll Rate, Yaw Rate

The ADIRU uses the rotational rates from the six gyros to calculate:

- Pitch rate
- Roll rate
- Yaw rate.

Pitch Angle, Roll Angles, True Heading, Air data Function

The rotational rates from the six gyros go to the angles integrator. The angles integrator function calculates the airplane:

- Pitch angle
- Roll angle
- True heading.

Magnetic Heading And Magnetic Track

Rotational rates and linear accelerations go to the rotate accelerations to earth reference function. The rotate accelerations to earth reference function calculates accelerations in relation to the earth.

The accelerations in relation to the earth go to the velocities integrator. The velocities integrator calculates velocities. The velocities go to the position integrator and the calculate magnetic parameters function.

The position integrator calculates airplane position.

The calculate magnetic parameters uses the following data:

- Position integrator
- Velocities integrator
- Angles integrator.

The magnetic heading and magnetic track go to the output memory buffer only when the magnetic track is valid, and the ground speed is more than 20 knots.

Drift Angle

The velocities integrator sends data to the calculate drift angle circuit.

The drift angle goes to the output memory buffer only when the drift angle is valid and the groundspeed is more than 20 knots.

Latitude and Longitude

The velocities integrator sends velocities to the position integrator. The position integrator sends latitude and longitude to the output memory buffer.

Ground Speed, True Track, and Track Rate

The velocities integrator calculates:

- Ground speed
- True track
- Track rate.

This data goes to the output memory buffer only when the track is valid and the ground speed is more than 20 knots.

Vertical, Along Track, and Cross Track Accelerations

The rotate accelerations to earth reference circuit calculates:

- Vertical acceleration
- Along track acceleration
- Cross track acceleration.

This data goes to the output memory buffer only when the accelerations are valid and the ground speed is more than 20 knots.

**ADIRS - ADIRU INERTIAL REFERENCE DATA FUNCTION - 2****Body Normal, Body Longitudinal, and Body Lateral Accelerations**

The accelerometers supply these linear accelerations to the output memory buffer:

- Body normal
- Body longitudinal
- Body lateral.

Flight Path Angle

The air data function of the ADIRU supplies barometric altitude to the calculate flight path angle logic through vertical blending filters.

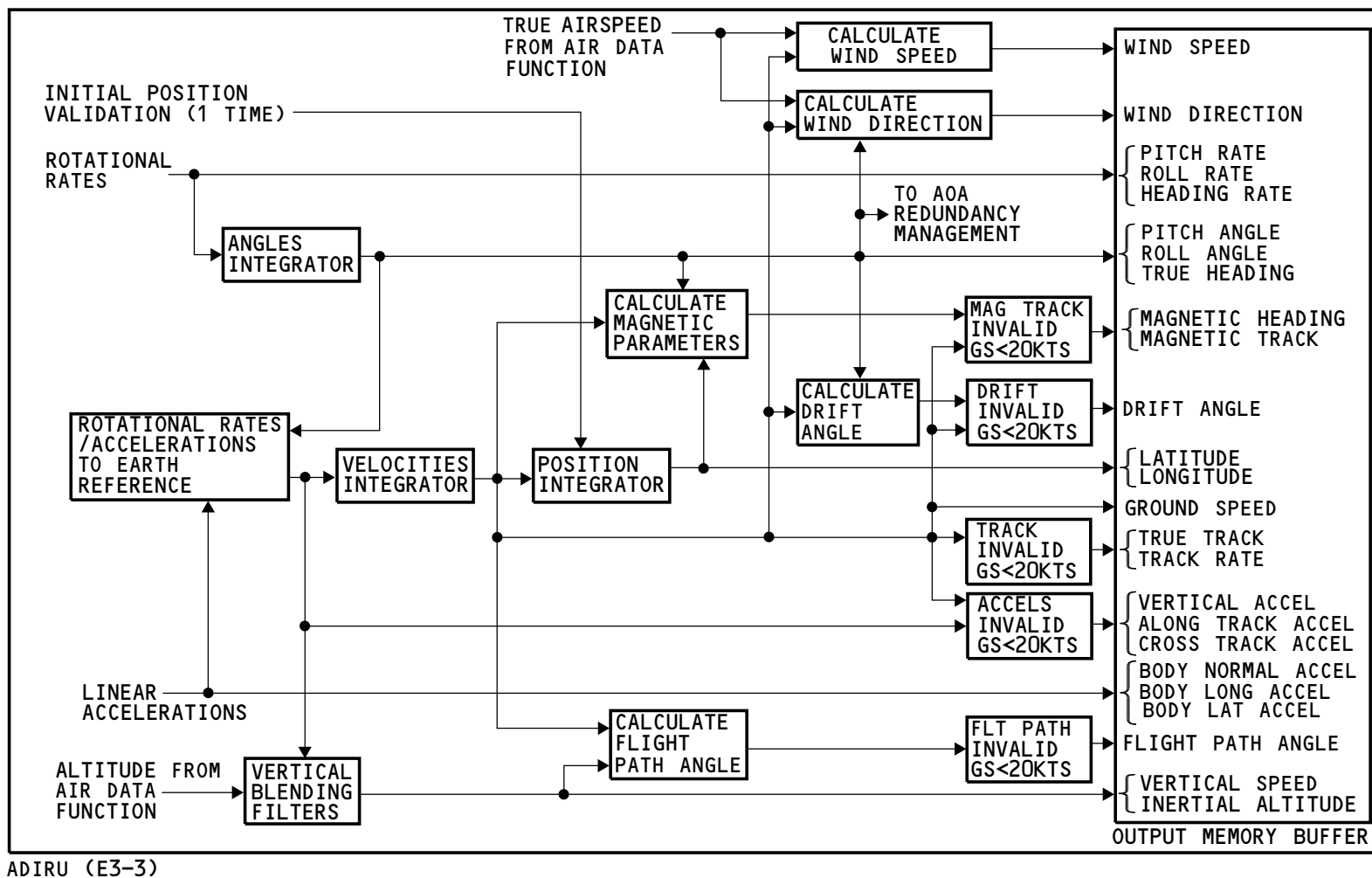
The calculate flight path angle logic also gets data from the velocities integrator.

The flight path angle goes to the output memory buffer only when the flight path is valid and the ground speed is more than 20 knots.

Vertical Speed and Inertial Altitude

Altitude from the ADIRU air data computing function combine with the rotational rates and linear accelerations through vertical blending filters. This data goes to the output buffer as vertical speed and inertial altitude.

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ADIRS - ADIRU INERTIAL REFERENCE DATA FUNCTION - 2

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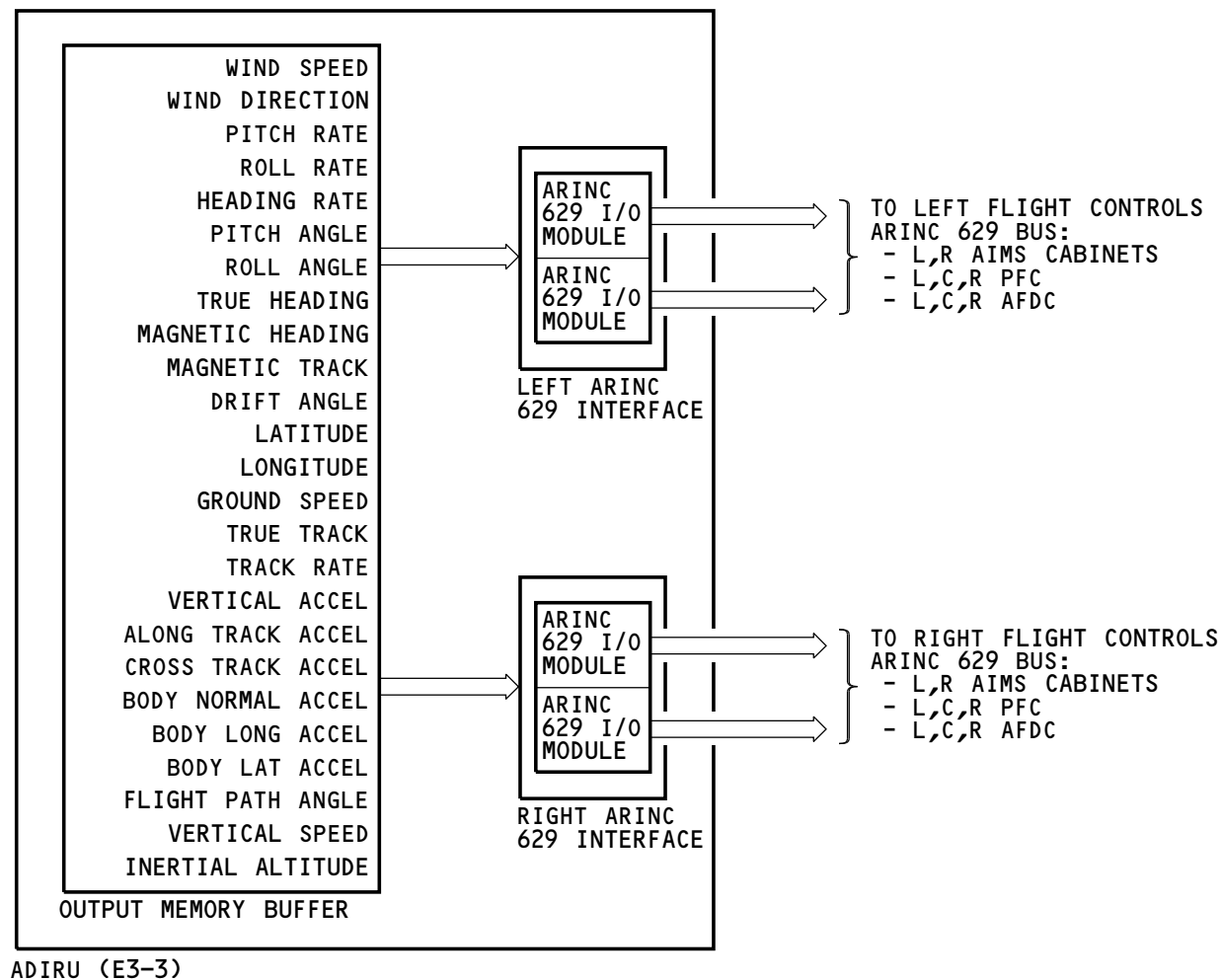
**ADIRS - ADIRU INERTIAL REFERENCE DATA FUNCTION - 3****Output**

The ADIRU transmits inertial reference data to the left and right flight control ARINC 629 buses. The inertial reference data goes to these components:

- Left and right AIMS cabinets
- Left, center, and right primary flight computers (PFCs)
- Left, center, and right autopilot flight director computers (AFDCs).

Only one of the two connections to each flight controls ARINC 629 bus is active at a time.

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ADIRS - ADIRU INERTIAL REFERENCE DATA FUNCTION - 3

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ADIRS - AIR DATA MODULE

ADM General

There are six air data modules (ADMs) in the air data inertial reference system (ADIRS). Three are for pitot pressure and three are for static pressure. All the ADMs operate in the same manner.

The air data module (ADM) measures absolute pressure. This pressure comes from a pitot probe or static pressure port. The ADM transmits this pressure on a flight controls ARINC 629 bus for use by the ADIRU and SAARU. All ARINC 629 ADMs are interchangeable and can be a pitot or a static ADM.

The pitot ADMs control the heat for the pitot probes and the angle of attack (AOA) sensors.

ARINC 629 Interface

The left ADM transmits and receives on the left flight controls ARINC 629 bus.

The center ADM transmits and receives on the center flight controls ARINC 629 bus.

The right ADM transmits and receives on the right flight controls ARINC 629 bus.

ADM Physical Description

The ADM weighs 2.6 pounds. The ADM has one pneumatic connector and two electrical connectors.

The ADM has a flange on each side. Each flange has two captive screws. The ADM mounts directly to the mounting tray flanges.

The pneumatic connector seals itself when removed from the ADM. You do not need to plug the pneumatic line when you remove the ADM.

One electrical connector is for program pins and power. The other electrical connector is for ARINC 629.

ADM Operation

The ADM gets 28v dc for power.

The ADM receives pneumatic pressure from a pitot probe or static ports. The pressure sensor changes the pressure value to an analog signal. The analog signal goes through an analog to digital converter. The ADM calibrates the pressure and compensates for temperature. The ARINC 629 transmitter/receiver sends the data on a flight controls ARINC 629 bus.

Program pins define the location of the ADM. The input/output decoder logic sends the program pin ADM location data to the processor.

This location information goes to the ADIRU and SAARU on a flight controls ARINC 629 bus.

Pitot Probe and AOA Sensor Heat Control

The left pitot ADM controls the heat for the left pitot probe. The center pitot ADM controls the heat for the center pitot probe. The right pitot ADM controls the heat for the right pitot probe.

The left pitot ADM controls the heat for the left AOA sensor. The right pitot ADM controls the heat for the right AOA sensor.

The pitot ADMs control the heat control relays in the power management panels. The heat control comes from data the ADMs receive from the primary flight computers (PFCs) through the flight controls ARINC 629 bus. If the PFCs are not valid, the ADMs use data from the autopilot flight director computers (AFDCs). The AFDC data also comes through the flight controls ARINC 629 bus.

The ADMs supply a ground heat signal to the power management panels when the PFCs report these two conditions are true:

- The airplane is on the ground
- An engine running.

The ADMs supply an air heat signal to the power management panels when any of these conditions is true:

- The airplane is in the air

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ADIRS - AIR DATA MODULE

- Computed airspeed (CAS) is more than 50 kts.

The power management panels connect the ground heat and the air heat signals to current sense relays to control the voltage to the pitot probes. The ADMs monitor the pitot probe and AOA heaters through three electrical input discretes. The ADM transmits heater fault data on the flight controls bus.

For information on how to do a test of the pitot probe and the AOA sensor heat operation, see Ice and Rain Protection. (CHAPTER 30)

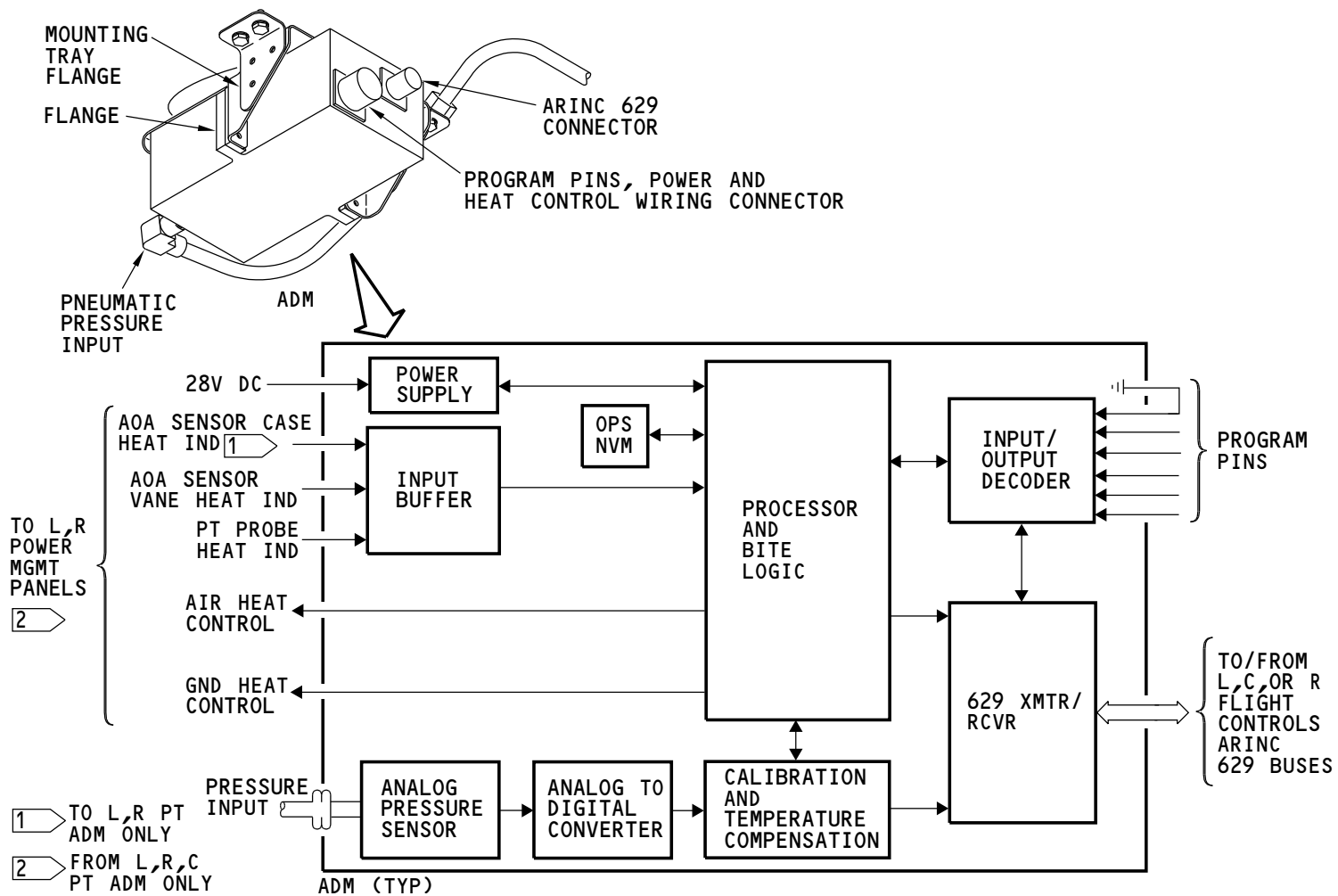
ADM Software Loading

The ADM can receive operational program software (OPS) from the AIMS cabinets through the flight controls ARINC 629 bus. You load the same software for pitot and static ADMs.

The ADM keeps the OPS in non-volatile memory (NVM).

Fault Data

The ADM sends fault and operational status data to the central maintenance computing function (CMCF) of the AIMS. The CMCF can command the ADM to test the pitot heaters and AOA heaters.



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ADIRS - AIR DATA MODULE

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**ADIRS - SECONDARY ATTITUDE AIR DATA REFERENCE UNIT****General**

The secondary attitude air data reference unit (SAARU) is a backup source of attitude and air data.

Physical Description

The SAARU weighs 30 pounds. It uses passive cooling. Cooling fins take heat away from the SAARU.

Software Load

The SAARU can receive new software from the flight controls ARINC 629 data bus. The software data modifies the operational program of the SAARU.

Sensors and Circuits

The SAARU has these components:

- Four ring laser gyros
- Four linear accelerometers
- Two central processing units (CPUs)
- Three ARINC 629 interface modules.
- Two power supplies.

Three ring laser gyros and three accelerometers are aligned with the roll, pitch, and yaw axis. The fourth ring laser gyro and fourth accelerometer allow the SAARU to detect any faults in the other three.

Standby Instruments

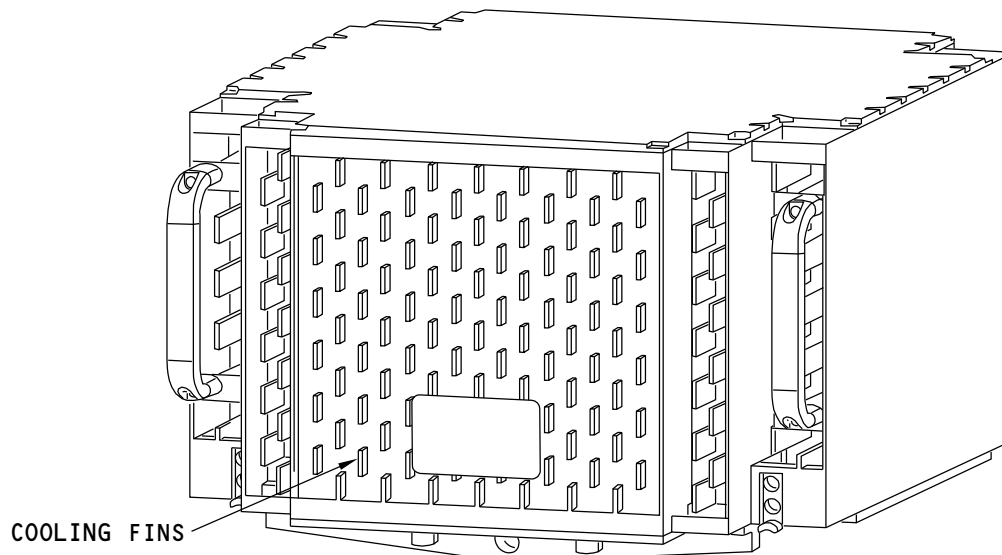
The SAARU supplies attitude data to the standby attitude indicator through the ARINC 429 bus.

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COOLING FINS

ADIRS - SECONDARY ATTITUDE AIR DATA REFERENCE UNIT

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**ADIRS - SAARU INERTIAL REFERENCE DATA FUNCTION****General**

The secondary attitude air data reference unit (SAARU) uses gyros and accelerometers to calculate inertial reference data. The inertial reference data goes to airplane systems.

Power

The SAARU gets power from a circuit breaker in the center power supply assembly. The circuit breaker gets power from the center flight control DC bus.

Gyros and Accelerometers

The gyros and accelerometers measure rotation rates and accelerations. The rotation rates and accelerations go to buffers. The buffers supply the rotation rates and accelerations to the central processing unit which calculate SAARU data.

SAARU Data

The SAARU calculates this inertial reference data:

- Body frame accelerations
- Body frame angular rates
- Attitude (roll and pitch)
- Horizontal and vertical accelerations
- Inertial altitude
- Wander heading
- Vertical speed.

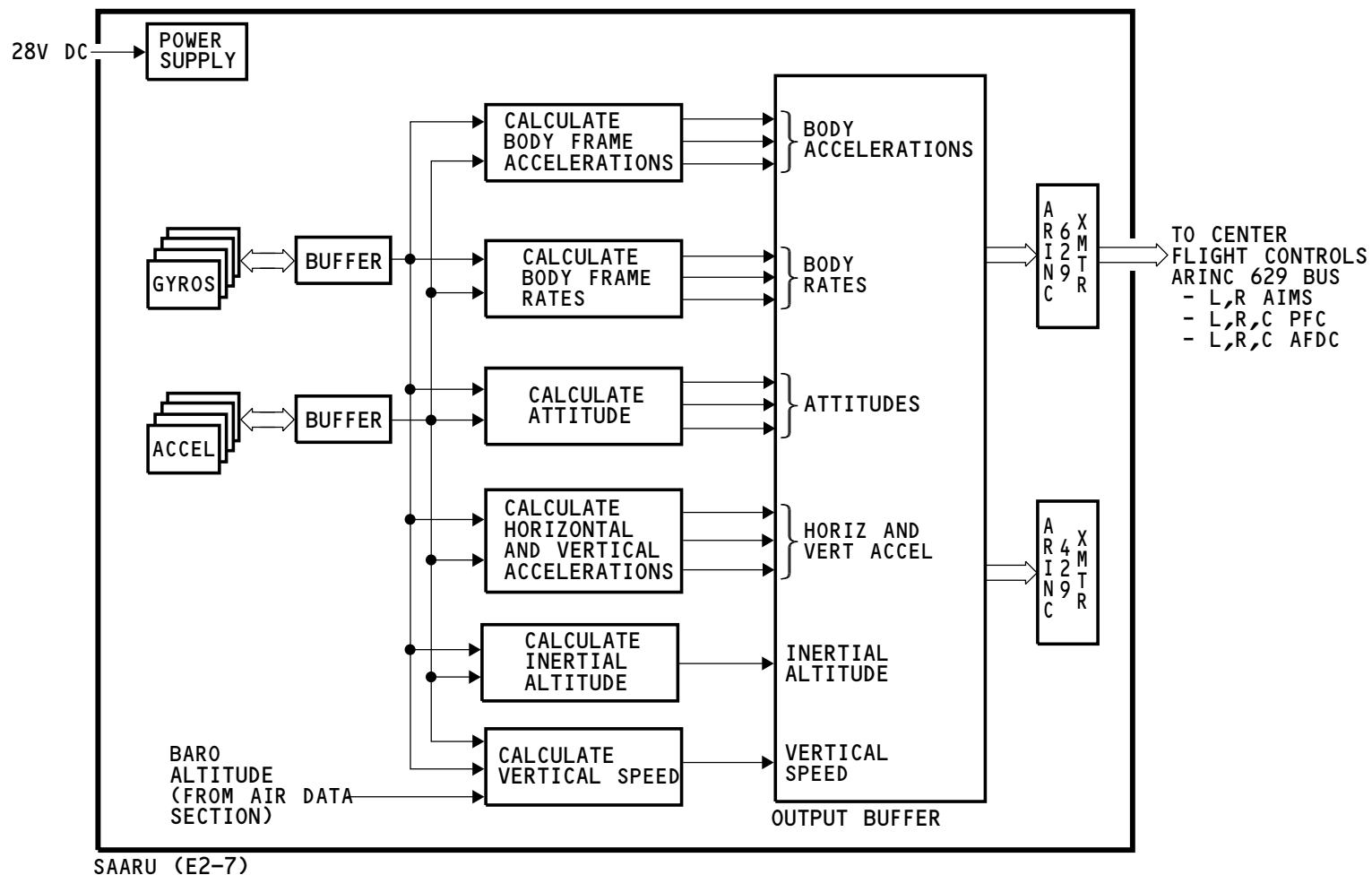
Barometric Altitude Input

The SAARU uses barometric altitude from its air data section to calculate vertical speed. This barometric altitude prevents fast changes in vertical speed.

ARINC 629 Output

The SAARU sends inertial data on the center flight controls ARINC 629 bus. The SAARU data goes to the:

- Left and right AIMS cabinets
- Left, right, and center primary flight computers (PFCs)
- Left, right, and center autopilot flight director computers.



ADIRS - SAARU INERTIAL REFERENCE DATA FUNCTION

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**ADIRS - SAARU AIR DATA FUNCTION - 1****General**

Redundancy management logic in the SAARU selects or votes a value for the inputs that come from the redundant air data sensors.

Total Air Temperature

The total air temperature (TAT) redundancy management logic calculates an average of the TAT values from TAT inputs 1 and 2.

Pitot Heater Valid

Pitot heater valid signals come from the left, center, and right pitot air data modules (ADMs). The pitot heater valid signals go to the pitot ADM redundancy management logic.

Pitot Pressure

Pitot pressure comes from the left, center, and right pitot air data modules (ADMs). The pitot ADM redundancy management logic calculates an average of the pitot pressures from the ADMs.

AOA Heater Valid

The angle of attack (AOA) heater valid signals go to the AOA redundancy management logic. The AOA redundancy management logic uses the AOA heater valid signal to find out if the AOA sensors are valid.

AOA Input

The AOA values go to the function that calculates the corrected AOA.

Speedbrake Lever Past Arm Signal

The primary flight computers (PFCs) supply the air ground speedbrake lever past arm signals to the SAARU. Input data redundancy management logic selects one of the PFC signals. The speedbrake lever past arm signals go to the AOA redundancy management logic.

Air/Ground, Nose Gear Position, and Flap Position

The proximity sensor electronics units (PSEUs) supply the air/ground and the nose gear position signals to the AIMS cabinets.

The flap/slat electronics units (FSEUs) supply the flap position signals to the AIMS cabinets.

The AIMS cabinets supply the signals to the SAARU. An input data redundancy management logic selects one of the PSEU signals, and one of the FSEU signals.

The air/ground signal, nose gear position, and flap position signals go to the calculate corrected AOA function.

Calculate Corrected AOA

The calculate corrected AOA logic calculates the left and right corrected AOA. The calculate corrected AOA function receives these additional signals:

- Mach
- Pitch rate
- True airspeed
- Flap position
- Nose gear position.

The corrected AOAs go to the AOA redundancy management logic.

AOA Redundancy Management

The AOA redundancy management logic uses a modified average calculation. The modified average calculation calculates an average of three AOA values, the left corrected AOA, the right corrected AOA, and a calculated AOA. The calculated AOA logic receives inputs from the inertial and air data systems to calculate the calculated AOA.



ADIRS - SAARU AIR DATA FUNCTION - 1

Static Pressure

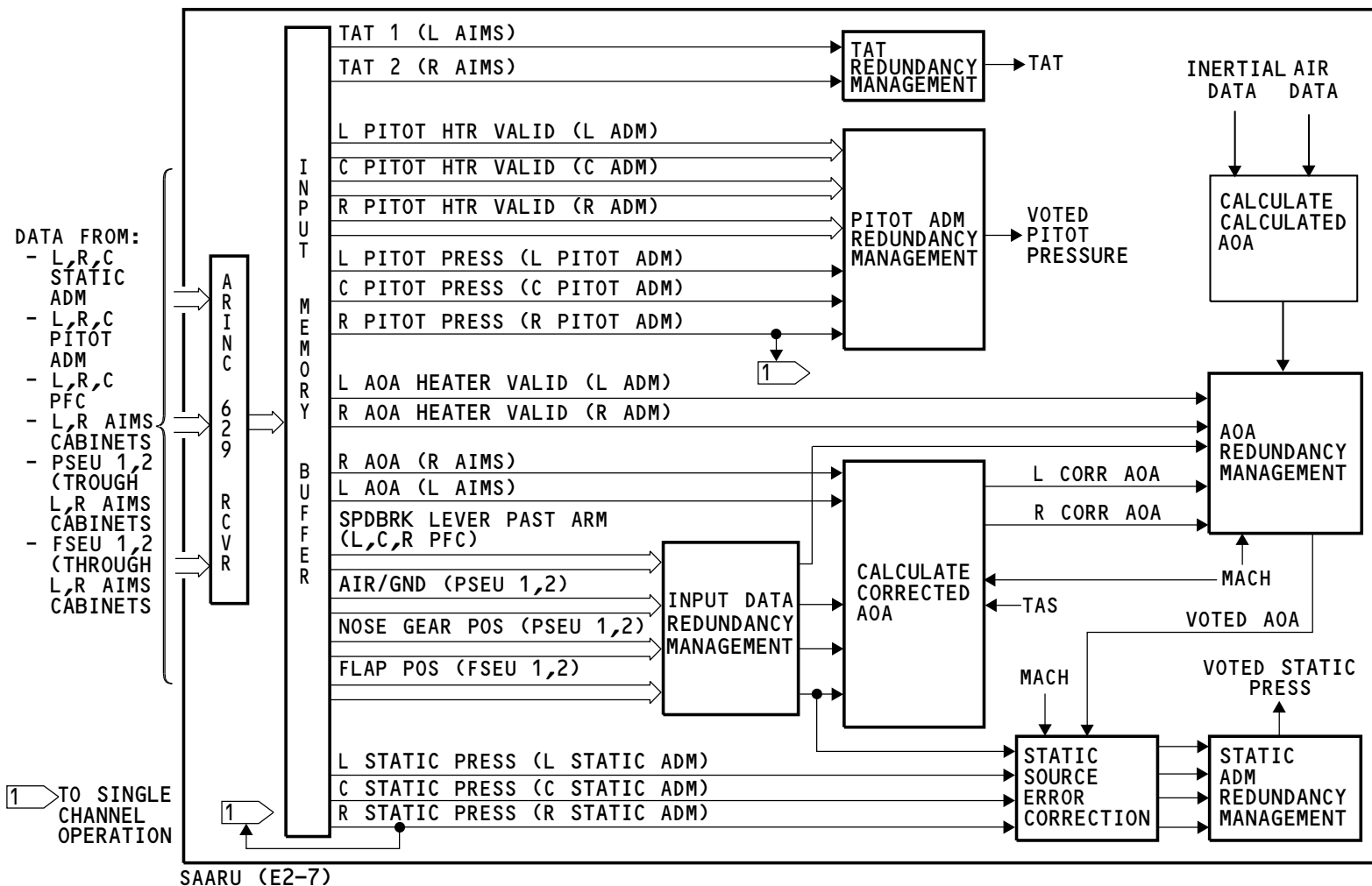
Static pressure comes from the left, center, and right static air data modules (ADMs). The static source error correction (SSEC) uses Mach and corrected AOA to compensate for errors in measurement of static pressure. The static pressure goes to the static ADM redundancy management logic.

The static ADM redundancy management logic calculates an average of the static pressures from the ADMs. The static ADM redundancy management logic uses body accelerations from the SAARU inertial reference section to determine error thresholds.

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ADIRS - SAARU AIR DATA FUNCTION - 1

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ADIRS - SAARU AIR DATA FUNCTION - 2**Total Air Temperature (TAT)**

The TAT signal is corrected for the small temperature rise that occurs when the air flow through the probe slows down.

Static Air Temperature (SAT)

The calculate static air temperature function receives TAT, mach and CAS inputs. The SAT signal goes to the output memory buffer.

True Air Speed (TAS)

The calculate TAS function uses static temperature CAS to calculate TAS. The corrected TAS goes invalid when the CAS is less than 50 knots.

Corrected Angle Of Attack (AOA)

The corrected AOA, from the AOA redundancy management, goes invalid when the CAS is less than 50 knots.

Mach and Computed Air Speed (CAS)

The calculate mach and CAS function uses impact pressure to calculate mach and CAS. The corrected mach goes invalid when the CAS is less than 50 knots.

Impact Pressure

The calculate impact pressure function receives static pressure inputs from the static ADM redundancy management logic. The calculate impact pressure function also receives pitot pressure from the pitot ADM redundancy management. The impact pressure signal goes to the output memory buffer.

Altitude and Altitude Rate.

The calculate altitude and altitude rate function gets signals from the static and pitot ADM redundancy management logic. Altitude and altitude rate signals go to the output memory buffer.

Pitot Pressure and Static Pressure

Pitot and static pressure come directly from the pitot and static ADM redundancy management logic. These pressures go to the output memory buffer.

Single Channel Operation

If the ADIRU and SAARU air data parameters from the redundancy management logic are invalid, the flight deck displays show single channel air data from the ADIRU and SAARU. Single channel air data parameters bypass the redundancy management logic that the flight displays show during normal operation. Air data from the right pitot ADM and right static ADM goes to the SAARU single channel operation function. This function calculates these single channel quantities:

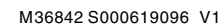
- Mach
- Airspeed
- Static pressure
- Barometric altitude
- Total pressure.

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ADIRS - SAARU AIR DATA FUNCTION - 2

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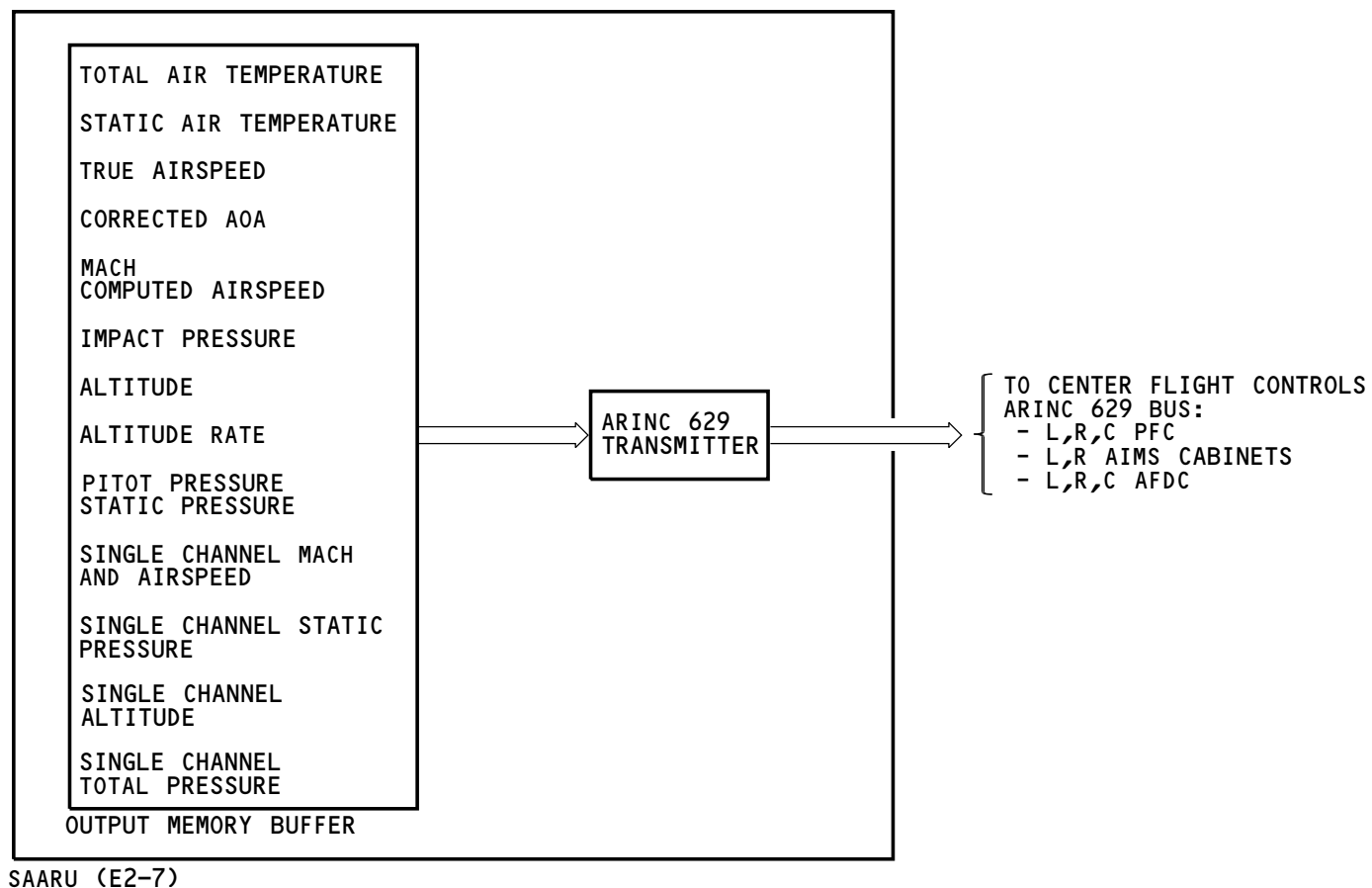


ADIRS - SAARU AIR DATA FUNCTION - 3

Air Data Outputs

The secondary attitude air data reference unit (SAARU) sends data on the center flight control ARINC 629 bus. The data goes to the:

- Primary flight computers (PFCs)
- AIMS cabinets
- Autopilot flight director computers (AFDCs).



ADIRS - SAARU AIR DATA FUNCTION - 3

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ADIRS - SAARU BACKUP NAVIGATION

General

The ADIRU supplies navigation data to the autopilot flight director system (AFDS) and the primary flight control system (PFCS). The AFDS uses the SAARU backup navigation data if the ADIRU fails.

ADIRU Tracking

When the ADIRU data from the SAARU input memory buffer is valid, the SAARU tracks the ADIRU navigation outputs. This makes the SAARU backup navigation data the same as the ADIRU.

If the ADIRU data goes invalid, the SAARU does not follow the ADIRU outputs. The SAARU continues to calculate backup navigation data independent of the ADIRU. The ring laser gyros do not supply sufficiently accurate data for autopilot operation for extended periods of time, therefore, the backup navigation function goes invalid after 3 minutes.

ADIRU Inputs

The ADIRU supplies these inputs to the SAARU:

- Roll angle
- Pitch angle
- Magnetic heading
- True heading
- Along-track horizontal acceleration
- Cross-track horizontal acceleration
- North velocity
- East velocity.

The SAARU monitors the ADIRU inputs. If one or more inputs are invalid and the true airspeed (TAS) from the SAARU is more than 80 knots, the SAARU starts to calculate backup navigation data independent of the ADIRU.

Tracking Loops

The tracking loops make the SAARU follow the ADIRU data. If the ADIRU is valid, the SAARU backup navigation data out of the tracking loops and into the output buffer follows the ADIRU data. If the ADIRU fails, the tracking loops let the SAARU data go to the output memory buffer.

Calculate Magnetic Track Angle

The calculate magnetic track angle logic uses magnetic and true heading.

Calculate True Track Angle

The calculate true track angle logic uses north and east velocities.

Calculate Ground Speed

The calculate ground speed logic uses north and east velocities.

Calculate Flight Path Acceleration

The calculate flight path acceleration logic uses these inputs:

- Along track horizontal acceleration
- Ground speed
- Vertical speed
- Vertical acceleration.

SAARU Backup Navigation Outputs

The SAARU backup navigation outputs go to the autopilot flight director computers (AFDCs) and the primary flight computers (PFCs). These are the SAARU backup navigation outputs:

- Roll angle
- Pitch angle
- Magnetic heading
- Magnetic track
- True heading

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ADIRS - SAARU BACKUP NAVIGATION

- Along-track horizontal acceleration
- Cross-track horizontal acceleration
- True track angle
- Ground speed
- Flight path acceleration.

Training Information Point

The autopilot flight director system (AFDS) can use ADIRU or SAARU data. The AFDS uses ADIRU data first. If the ADIRU fails, the AFDS uses SAARU data. Some AFDS modes do not operate when the ADIRU fails and SAARU backup navigation is not available. These are the AFDS modes that do not operate in this condition:

- Approach (APP)
- Flight path angle (FPA)
- Takeoff/go-around (TO/GA)
- Track hold (TRK HLD)
- Track select (TRK SEL)
- Vertical navigation (VNAV)
- Lateral navigation (LNAV).

If the ADIRU fails when the APP mode is armed or engaged, the AFDS automatically selects the SAARU backup navigation data. If the airplane does not land within 3 minutes, the autopilot pitch and roll modes fail. The flight crew must select another autopilot mode or disengage the autopilot.

If the ADIRU fails when the FPA mode is engaged, the AFDS will automatically select the SAARU backup navigation data. If the autopilot does not go into another mode or if the flight crew does not select another mode within 3 minutes, the autopilot pitch mode fails. The flight crew must select another autopilot mode or disengage the autopilot.

If the ADIRU fails when the TO/GA mode is engaged, the AFDS will automatically select the SAARU backup navigation data. If the autopilot does not go into another mode or if the flight crew does not select another mode within 3 minutes, the autopilot roll mode fails. The flight crew must select another autopilot mode or disengage the autopilot.

If the ADIRU fails when the TRK HLD or TRK SEL mode is engaged, the AFDS will automatically select the SAARU backup navigation data. If the flight crew does not select another mode within 3 minutes, the autopilot roll mode fails. The flight crew must select another autopilot mode or disengage the autopilot.

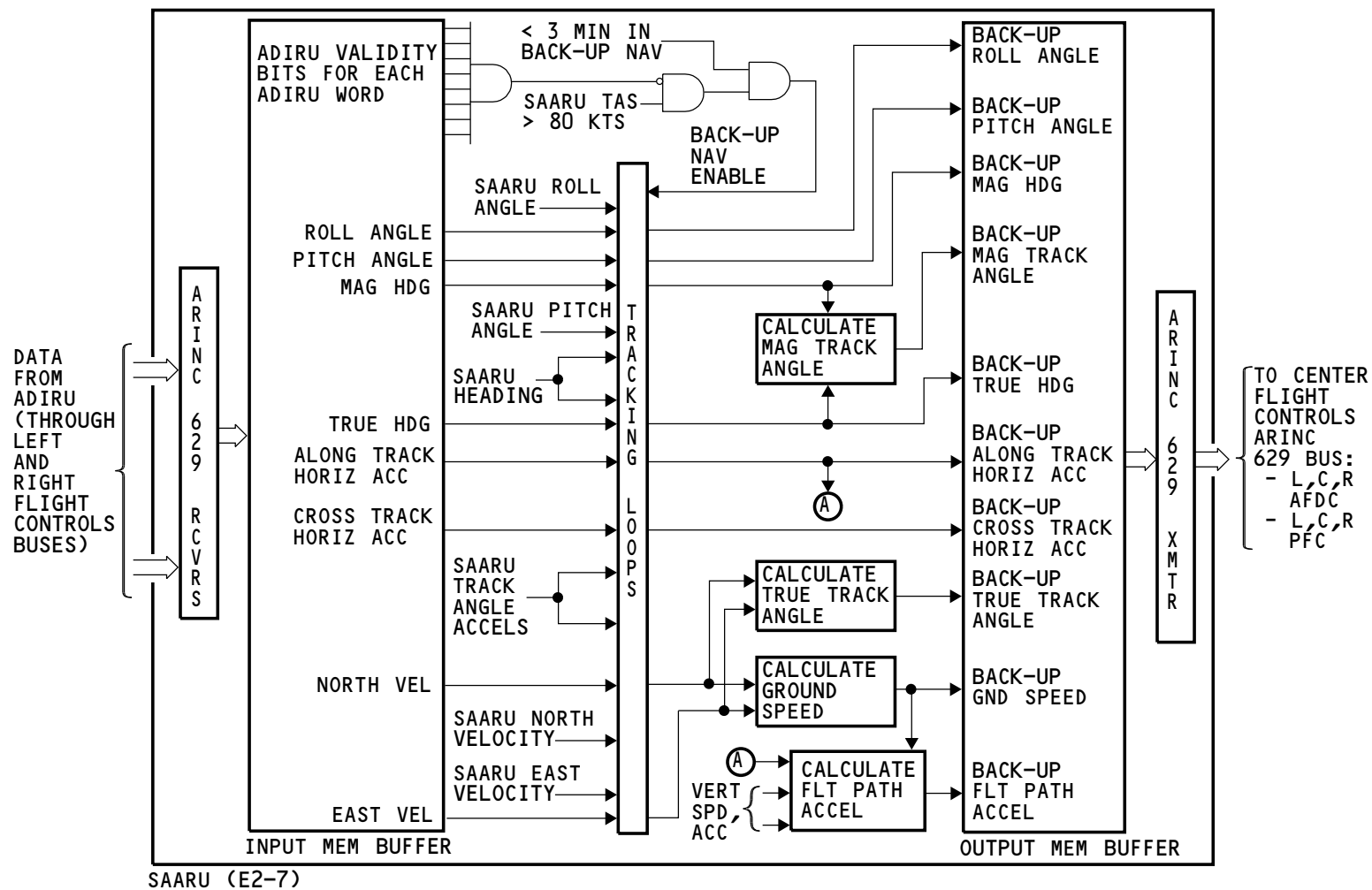
VNAV and LNAV are not AFDS modes. VNAV and LNAV are flight management computing system (FMCS) modes that go through the AFDCs. VNAV and LNAV do not operate when the FMCS does not have valid ADIRU data. If the ADIRU fails, the autopilot pitch and roll modes immediately fail. The flight crew must select another autopilot mode or disengage the autopilot.

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ADIRS - SAARU BACKUP NAVIGATION

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**ADIRS - TOTAL AIR TEMPERATURE PROBE****Purpose**

A total air temperature (TAT) probe measures temperature outside the airplane.

Sensing Elements

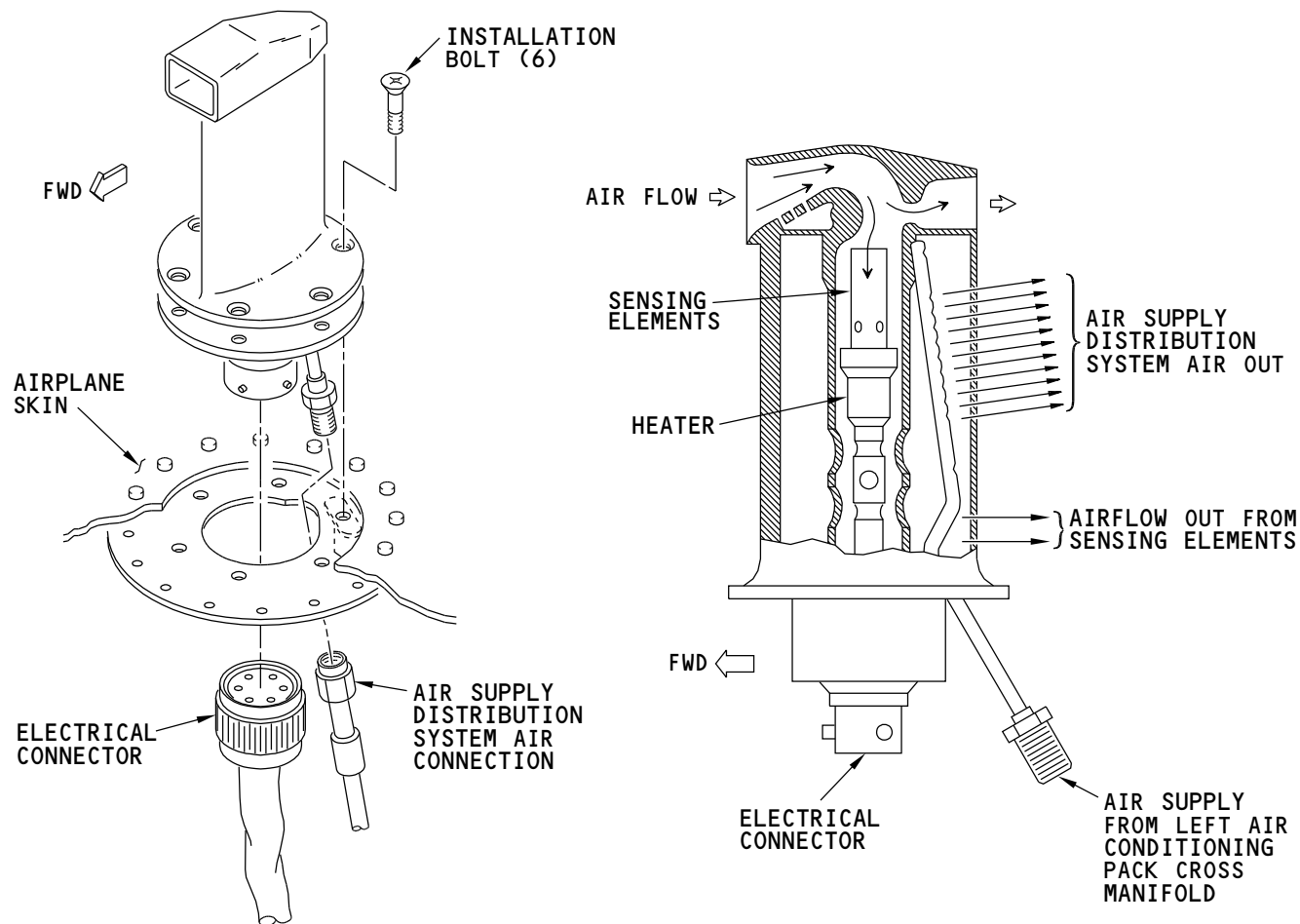
There are two sensing elements in a TAT probe. Each sensing element is a resistive element. The value of resistance changes when the temperature of the air flow across the element changes.

Air from the left air conditioning pack cross manifold makes a negative pressure inside the probe. The negative pressure pulls outside air across the sensing elements. This gives an accurate temperature measurement when the airplane is on the ground or moving at low speed.

Electrical Connector

The analog connection to AIMS and the heater power connection comes through the electrical connector. The heater in the TAT probe prevents ice buildup.

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ADIRS - TOTAL AIR TEMPERATURE PROBE

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**ADIRS - TAT PROBE FUNCTIONAL DESCRIPTION****Probe Heater**

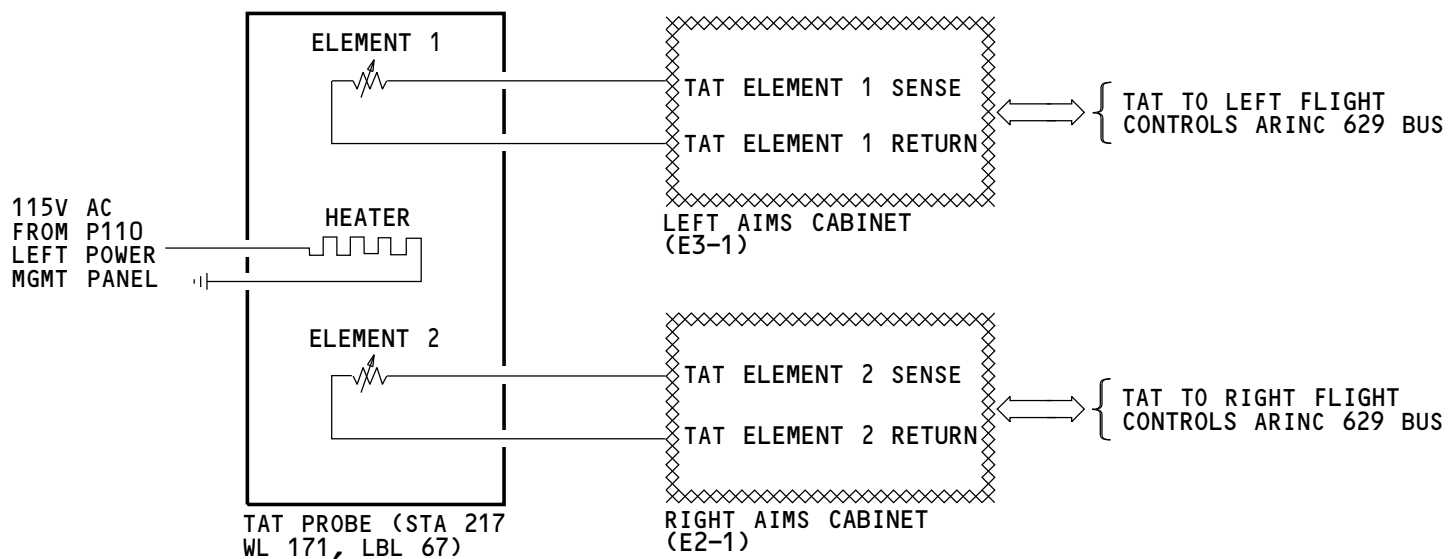
The TAT probe heater gets 115v ac from the P110 left power management panel. The TAT probe has heater power only when the airplane is in the air.

Total Air Temperature (TAT)

TAT element 1 connects to the TAT element 1 sense and return in the left AIMS cabinet. TAT element 2 connects to the TAT element 2 sense and return in the right AIMS cabinet.

The AIMS cabinets change the analog TAT probe data to ARINC 629 data. AIMS sends TAT temperature data from element 1 to the left flight controls ARINC 629 bus. AIMS sends TAT data from element 2 to the right flight controls ARINC 629 bus.

The ADIRU and SAARU receive TAT data to calculate air data.



ADIRS - TAT PROBE FUNCTIONAL DESCRIPTION

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ADIRS - ANGLE OF ATTACK SENSOR

Electrical Connector

The angle of attack (AOA) sensor sends AOA data to the AIMS cabinet and receives heater power through the electrical connector.

Resolvers

There are two resolvers in each AOA sensor.

The AOA data from the two resolvers in the left AOA sensor goes to the left AIMS cabinet. The AOA data from the two resolvers in the right AOA sensor goes to the right AIMS cabinet.

AOA Heaters

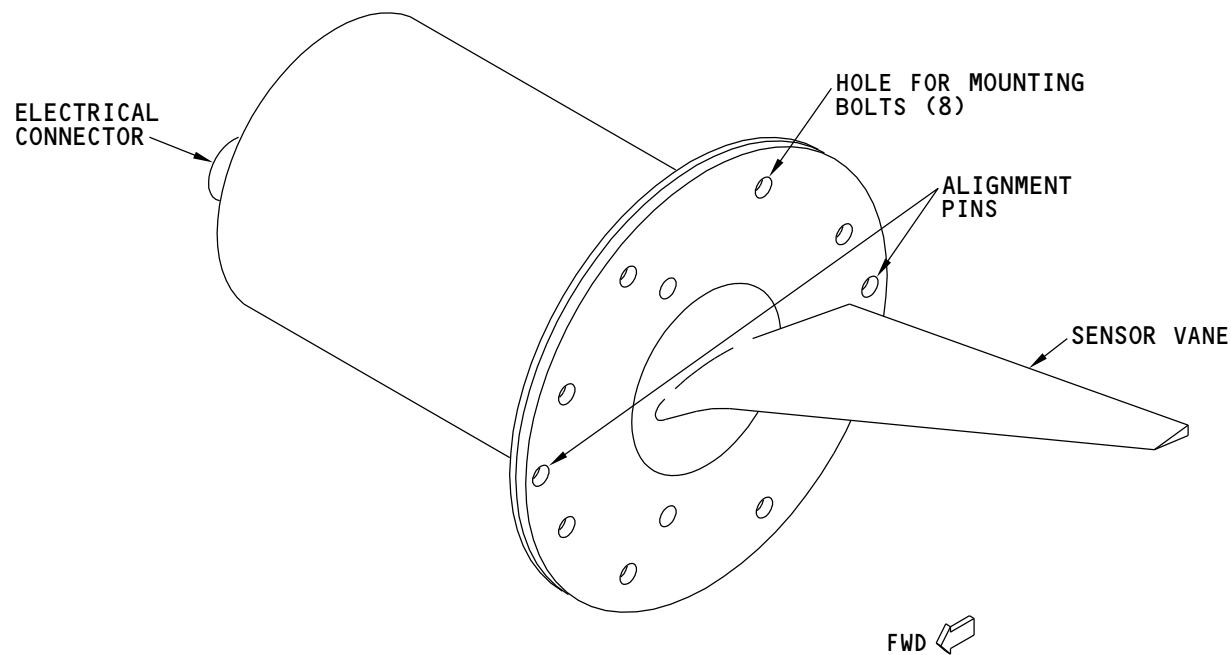
There are two heaters in each AOA sensor, one from the case and one for the vane.

Installation

You install the AOA sensor from the outside of the airplane.

Training Information Point

There are two alignment pins on the AOA sensor. Make sure the pins fit in their holes when you install the AOA sensor.



ADIRS - ANGLE OF ATTACK SENSOR

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**ADIRS - AOA SENSOR FUNCTIONAL DESCRIPTION****AOA Heaters**

The case and the vane heaters in the angle of attack (AOA) sensors receive 115v ac from the power management panels for power.

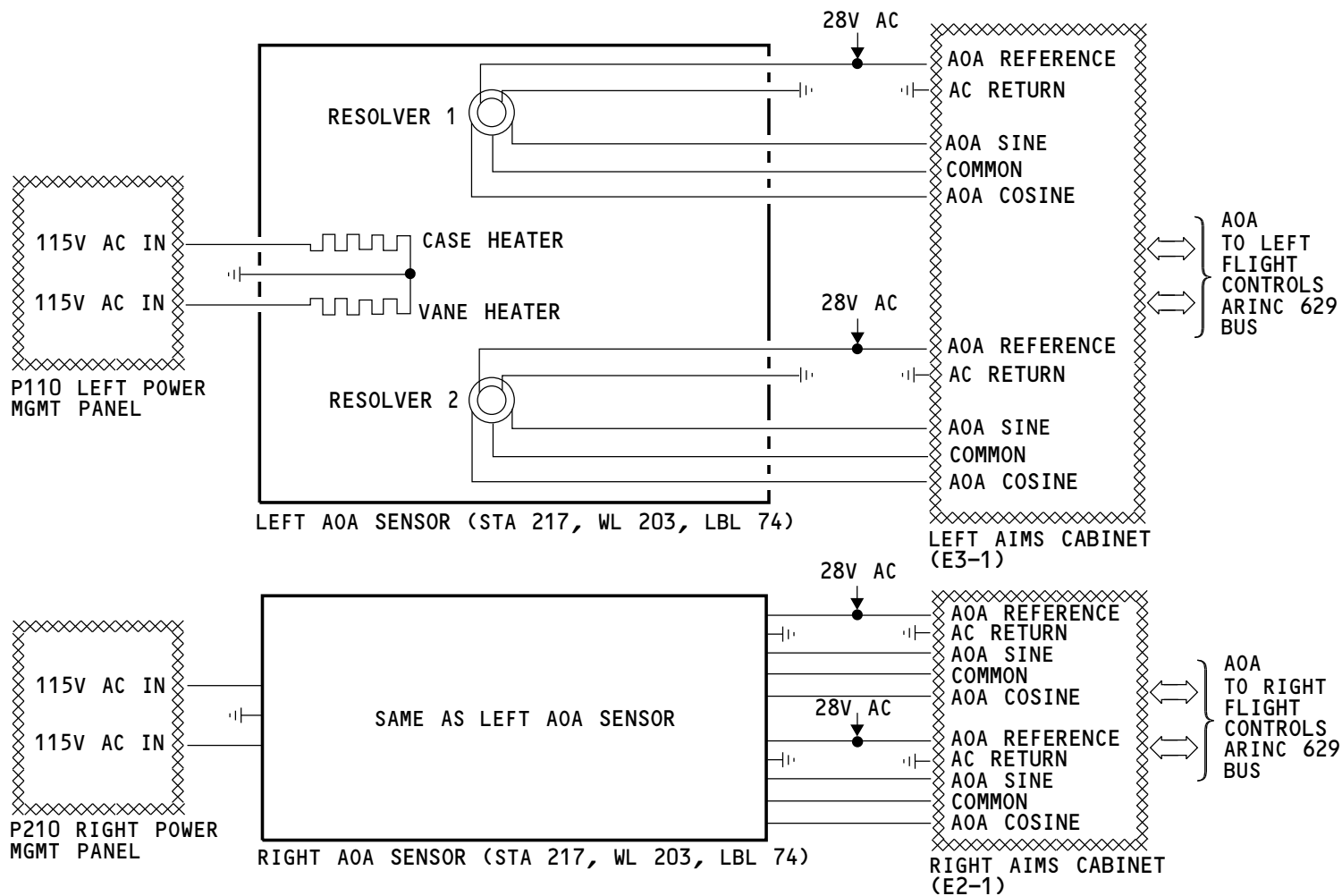
AOA Measurement and Transmission

The resolvers in the left AOA sensor send the AOA to the left AIMS cabinet. The resolvers in the right AOA sensor send the AOA to the right AIMS cabinet.

The AIMS cabinets change the AOA sensor data to ARINC 629 format. The AOA sensor data goes to the left and right flight controls ARINC 629 buses.

The air data inertial reference unit (ADIRU) and the secondary attitude air data reference unit (SAARU) use AOA sensor data to calculate the corrected AOA.

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ADIRS - AOA SENSOR FUNCTIONAL DESCRIPTION

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ADIRS - ADM CONTROL OF AOA SENSOR HEAT**Functional Description**

The angle of attack (AOA) sensor has two heaters, one for the AOA vane and one for the AOA case. Power for the heaters comes through the ground heat control relay or the air heat control relay.

The pitot air data modules (ADMs) control the relays.

There are two heat sensor relays, one for the vane heater and one for the case heater. The heat sensor relays supply a ground signal to the ADMs when the AOA heat is on.

Power goes through the ground heat control relay when both of these conditions are true:

- The airplane is on the ground
- Left or right engine is running.

Power goes through the air heat control relay when either of these conditions are true:

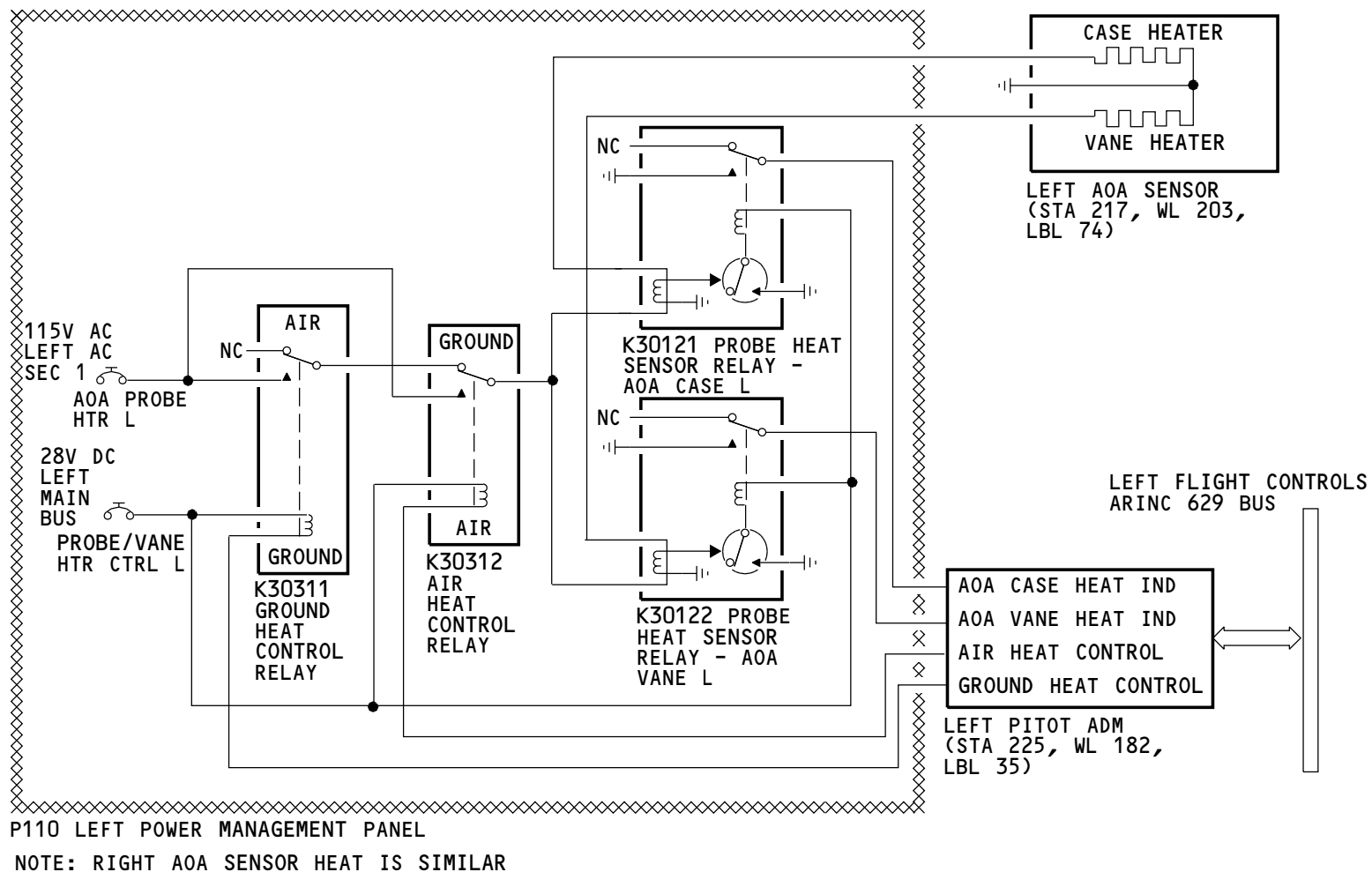
- The airplane is in the air
- CAS is more than 50 kts.

The primary flight computers (PFCs) are the source of air/ground, engine running, and CAS inputs. If the PFCs are not valid, the inputs come from the autopilot flight director computers (AFDCs).

Training Information Point

The air AOA heat and ground AOA heat is 115v ac.

See the ice and rain protection chapter for information on how to do a test of the AOA sensor heat operation (CHAPTER 30).



ADIRS - ADM CONTROL OF AOA SENSOR HEAT

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**ADIRS - AIR DATA/ATTITUDE SOURCE SWITCH****General**

The captain and first officer air data/attitude switches on the instrument source select panels control the source of attitude and air data that shows for the onside PFD and ND.

Air Data/Attitude Switch in the Normal Position

When the air data/attitude switches are in the normal position, the ADIRU is the source of attitude and air data for the captain and first officer PFDs and NDs. The ADIRU is the source for heading and track data.

Air Data/Attitude Switch in the Alternate (ALTN) Position

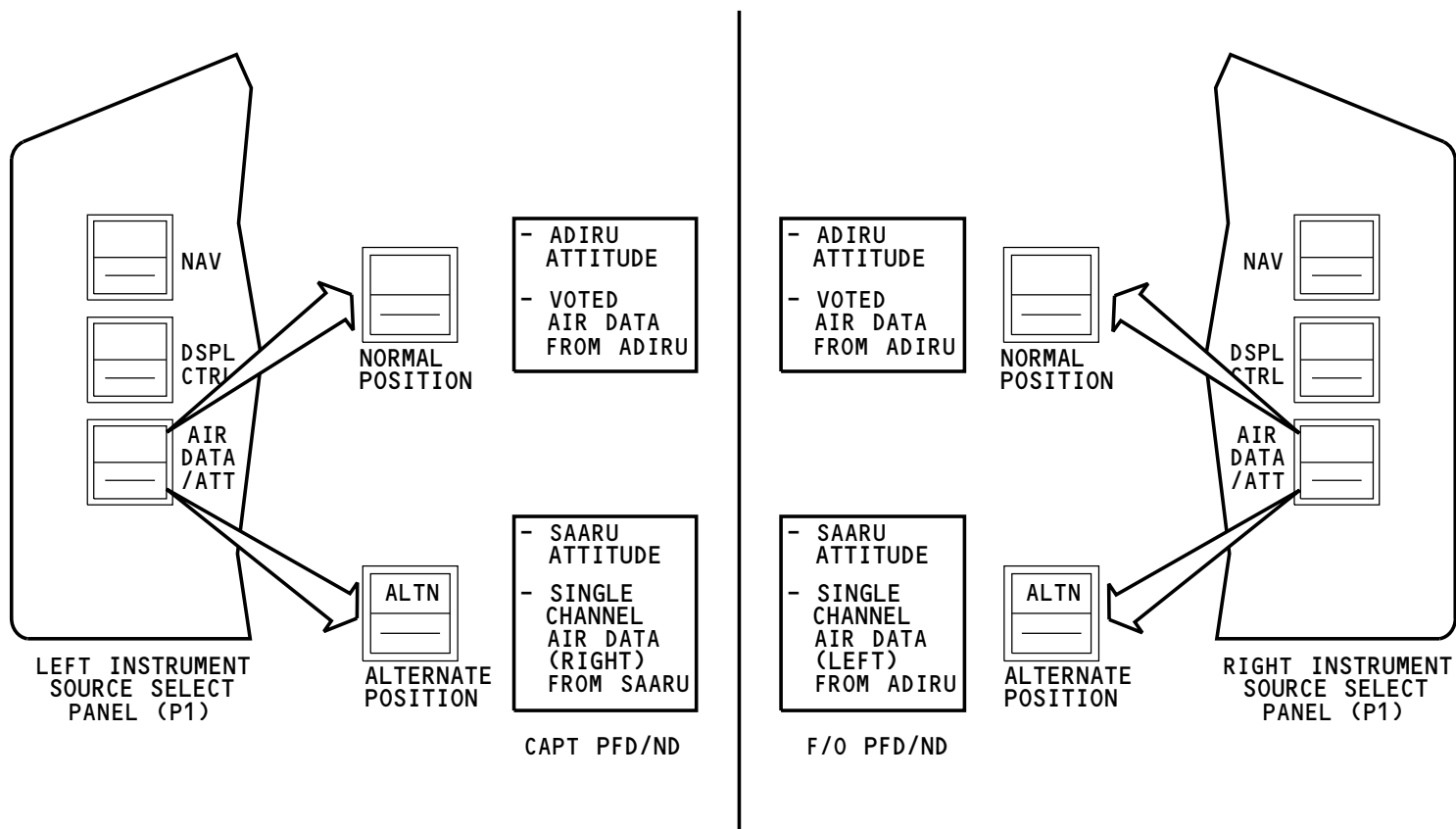
When the captain air data/attitude switch is in the ALTN position, the source for the captain displays is the SAARU for attitude and SAARU single channel (right) for air data. The ADIRU remains the source for heading and track data.

When the first officer air data/attitude switch is in the ALTN position, the sources for the first officer displays are the SAARU for attitude and the ADIRU single channel (left) for air data. The ADIRU remains the source for heading and track data.

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ADIRS - AIR DATA/ATTITUDE SOURCE SWITCH

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**ADIRS - AIR DATA/ATTITUDE SOURCE SWITCHING-NON NORMAL****General**

The table shows the normal and alternate positions for the captain and first officer air data/attitude switch during normal and non-normal conditions.

The fail condition means that all output data to the buses are invalid.

Display Switching Priorities

These are the priorities for the source of the captain attitude and air data displays:

- ADIRU left flight controls ARINC 629 bus (air data and attitude)
- ADIRU right flight controls ARINC 629 bus (air data and attitude)
- SAARU center flight controls ARINC 629 bus (air data and attitude)
- ADIRU left flight controls ARINC 629 bus (single channel air data)
- ADIRU right flight controls ARINC 629 bus (single channel air data).

These are the priorities for the source of the first officer attitude and air data displays:

- ADIRU right flight controls ARINC 629 bus (air data and attitude)
- ADIRU left flight controls ARINC 629 bus (air data and attitude)
- SAARU center flight controls ARINC 629 bus (air data and attitude)
- ADIRU right flight controls ARINC 629 bus (single channel air data)
- ADIRU left flight controls ARINC 629 bus (single channel air data).

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CONDITION AIR DATA/ATT SWITCH POSITION	ADIRU NORMAL SAARU NORMAL	ADIRU FAIL SAARU NORMAL	ADIRU NORMAL SAARU FAIL	ADIRU FAIL SAARU FAIL
CAPT - NORMAL	ADIRU L BUS ATTITUDE AND VOTED AIR DATA	SAARU C BUS ATTITUDE AND VOTED AIR DATA	SAME AS ADIRU NORMAL SAARU NORMAL	NO DISPLAY DATA AVAIL
CAPT - ALTERNATE	SAARU C BUS SINGLE CHANNEL AIR DATA AND SAARU ATT	SAARU C BUS SINGLE CHANNEL AIR DATA AND SAARU ATT	ADIRU L BUS HEADING AND TRACK DATA ONLY	NO DISPLAY DATA AVAIL
F/O - NORMAL	ADIRU R BUS ATTITUDE AND VOTED AIR DATA	SAARU C BUS VOTED AIR DATA AND SAARU ATT	SAME AS ADIRU NORMAL SAARU NORMAL	NO DISPLAY DATA AVAIL
F/O - ALTERNATE	ADIRU R BUS SINGLE CHANNEL AIR DATA AND SAARU C BUS ATT	SAARU C BUS ATT AND LOSS OF AIR DATA	ADIRU R BUS SINGLE CHANNEL AIR DATA AND LOSS OF ATTITUDE	NO DISPLAY DATA AVAIL

NOTE: VOTED DATA MEANS DATA SELECTED THROUGH THE
INPUT DATA REDUNDANCY MANAGEMENT LOGIC.

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ADIRS - AIR DATA/ATTITUDE SOURCE SWITCHING-NON NORMAL

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**ADIRS - ADIRU SWITCH, ADIRU ON BATTERY LIGHT****General**

The primary flight computers/ADIRU panel has the ADIRU switch and the ADIRU on battery light.

ADIRU On Battery Light

The ADIRU on battery light comes on when the airplane is on the ground and the only source of power for the ADIRU is the hot battery bus.

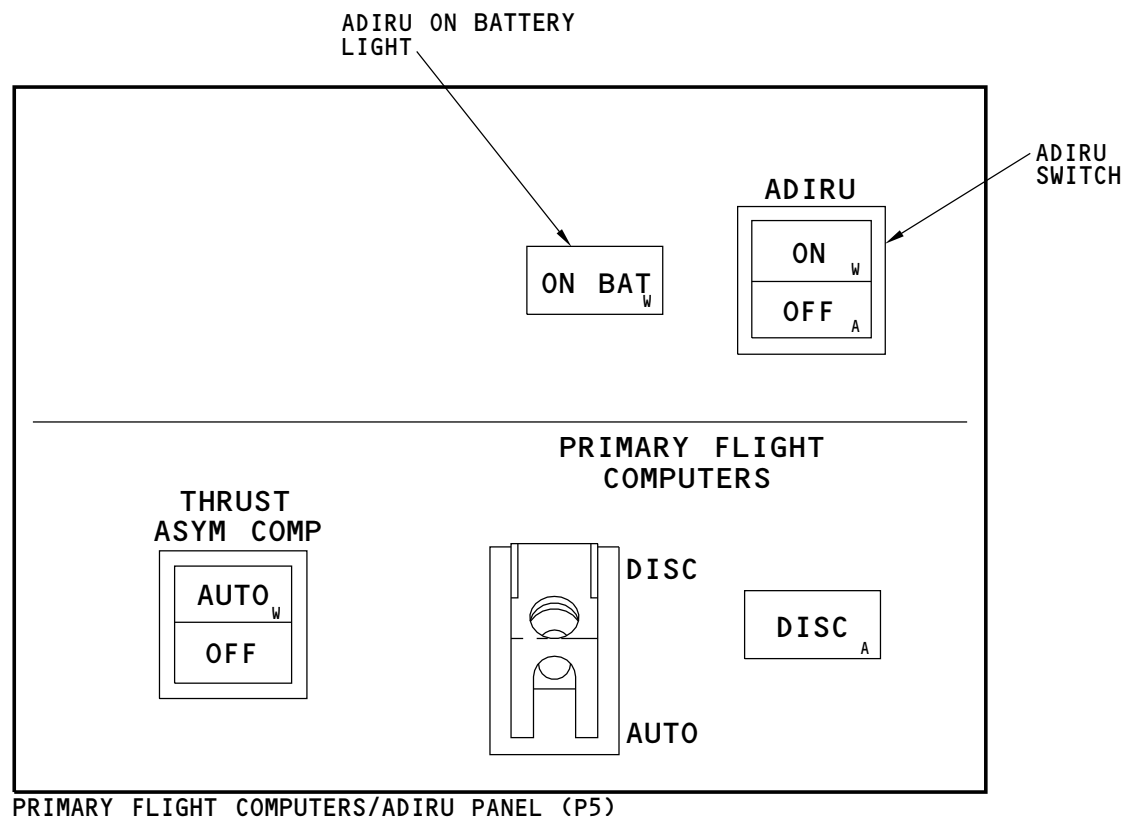
ADIRU Switch

Push the ADIRU switch to make the ADIRU go on. About thirty seconds after you push the ADIRU switch to the ON position, the ADIRU begins alignment. During the initial alignment, the attitude indications on the PFDs show as no computed data (NCD).

Push the ADIRU switch again to make the ADIRU go off.

The ADIRU goes off only when:

- Ground speed (GS) < 20 kts
- Computed airspeed (CAS) < 30 kts.



ADIRS - ADIRU SWITCH, ADIRU ON BATTERY LIGHT

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ADIRS - ALIGNMENT

General

To supply inertial position data, the ADIRU must be in the navigation (NAV) mode. Before the ADIRU enters the NAV mode, it must go through alignment and position initialization. Both of these occur during the align mode. The ADIRU goes to the align mode from one of these modes:

- Initialization mode
- Align reset mode
- Auto nav realign mode.

Initialization Mode

Within one minute after you push the ADIRU switch to the ON position, the ADIRU enters the align mode. While the ADIRU is in the align mode, the CDU shows box prompts on line data field 5R of the POS INIT page. This shows that the ADIRU is ready to accept an inertial position entry. Also, the EICAS memo message ADIRU ALIGN MODE shows.

ADIRU alignment takes between six and fifteen minutes to complete. The time depends on the latitude of the airplane position. If you do not enter a position during this time, the CDU message ENTER INERTIAL POSITION shows.

To decrease the chance of an initial position entry error, the ADIRU does a position compare test. This test compares the entered inertial position with GPS position or the last stored position if GPS data is not available. The last stored position comes from the nonvolatile memory (NVM) of the ADIRU.

If the ADIRU fails the position compare test, the CDU message ENTER INERTIAL POSITION shows. Enter the new position again to override the position compare test and force the ADIRU to accept the new position.

The ADIRU also does a latitude compare test. This test compares the latitude of the entered position with the ADIRU sensed latitude. If the ADIRU fails the latitude compare test, the CDU message ENTER INERTIAL POSITION shows.

These are two conditions that cause the ADIRU to fail the latitude compare test:

- Entered latitude does not match ADIRU sensed latitude
- ADIRU internal fault.

If the ADIRU fails the latitude compare test and you enter the same position again, the ADIRU goes back into the align mode. The CDU message REALIGNMENT INITIATED shows.

When the ADIRU completes the alignment and goes into the NAV mode, line data field 5R on the CDU POS INIT page goes blank.

Align Reset Mode

If the airplane moves during alignment, the ADIRU senses the movement and goes into the align reset mode. When airplane movement stops, the ADIRU align mode starts over. In the align reset mode, you may not enter inertial position data. Line data field 5R on the CDU POS INIT page is blank.

Auto Nav Realign Mode

If the ADIRU is in the NAV mode and the airplane does not move for six to fifteen minutes, the ADIRU enters the auto nav realign mode. This mode lets the crew update the ADIRU inertial position after a flight leg. When the ADIRU goes into the auto nav realign mode, dash prompts show on line data field 5R of the CDU POS INIT page. The dash prompts show that you may enter a new position. It is not necessary to enter a new position.

During auto nav realign, the ADIRU sets any velocity errors to zero and corrects this data:

- Pitch attitude
- Roll attitude
- Heading.

If the crew enters a new position, the ADIRU does position and latitude compare tests. These tests are the same tests as the initialization mode. The only difference is the position compare test uses current ADIRU position and not NVM stored position if GPS data is not available.

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**ADIRS - ALIGNMENT**

Two seconds after the crew enters a position, line data field 5R on the CDU POS INIT page goes back to dashes. This lets the crew enter position updates as necessary.

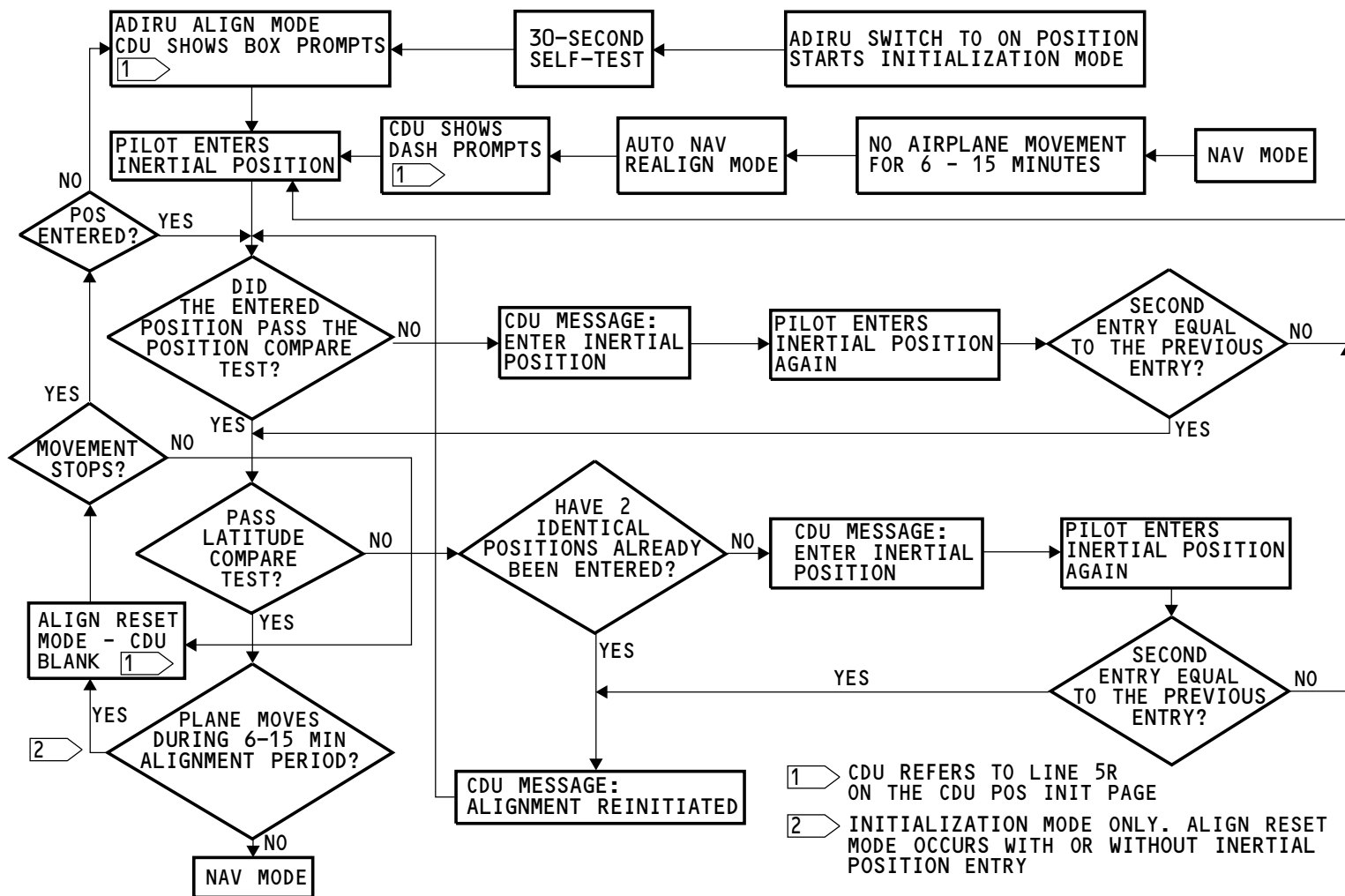
If the position compare and latitude compare tests pass, the ADIRU uses the last entered position as the start point for the next flight.

If the ADIRU detects motion before the six to fifteen minute period ends, the ADIRU does not go into the auto nav realign mode and goes back to the NAV mode. The ADIRU then uses the last calculated position as the start point for the next flight leg.

Inertial Origin Disagree

If the flight management computer system (FMCS) has an origin airport in the active flight plan, the ADIRU compares the entered position with the position of the airport from the navigation data base. If the two positions are different by more than six NM, the CDU message INERTIAL/ORIGIN DISAGREE shows.

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ADIRS - ALIGNMENT

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ADIRS - ALIGNMENT - POS INIT CDU PAGE**General**

To begin alignment, access the POS INIT page on the CDU. Thirty seconds after the ADIRU powers up, the POS INIT page shows box prompts under the SET INERTIAL POS. At this time you can line select an inertial position into the SET INERTIAL POS line. You can use one of these positions:

- The inertial position you entered into the scratchpad
- GPS position
- Last position
- Reference airport
- Gate position.

To get the airport and gate position, line select the airport identifier and gate identifier into the appropriate line and the position shows on that line.

Enter Inertial Position

During alignment, the box prompts show until you enter an inertial position. If there is no entered inertial position when the ADIRU is ready to go into the NAV mode, the CDU shows the ENTER INERTIAL POS message.

As part of the alignment and when there is an entered inertial position, the ADIRU goes through an inertial position comparison test and the latitude comparison test. If both of the tests pass, the ADIRU can complete the alignment and go into the NAV mode. If either of the tests fail, the CDU shows box prompts and the ENTER INERTIAL POS message. Enter the same inertial position again and the ADIRU uses that position to complete alignment and goes into the NAV mode.

Alignment Reinitiated

If the alignment cannot finish due to airplane movement or an invalid inertial position entered twice, the CDU shows dashes and the ALIGNMENT REINITIATED message.

Auto Nav Realign Mode

Dash prompts show during the auto nav realign (ANR) mode. The dashes tell that the ADIRU is ready to accept an inertial position. Also, the dashes tell that inertial input is optional.

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```

      POS INIT          1 / 3
                        LAST POS
      N40°38.0 W073°46.4
REF AIRPORT
-----
GATE

UTC      GPS POS
1530z N40°38.1 W073°46.0
      SET INERTIAL POS
      □□°□□.□ □□□°□□.□
-----
<INDEX          ROUTE>

```

BOX PROMPTS SHOW 30 SECONDS AFTER POWER UP. ENTER THE INERTIAL POSITION ANY TIME.

```

      POS INIT          1 / 3
                        LAST POS
      N40°38.0 W073°46.4
REF AIRPORT
-----
GATE

UTC      GPS POS
1530z N40°38.1 W073°46.0
      SET INERTIAL POS
      N40°38.1 W073°46.0
-----
<INDEX          ROUTE>

```

THE INERTIAL POSITION REPLACES THE BOX PROMPTS WHEN YOU LINE SELECT A VALUE INTO THE SET INERTIAL POS LINE.

```

      POS INIT          1 / 3
                        LAST POS
      N40°38.0 W073°46.4
REF AIRPORT
-----
GATE

UTC      GPS POS
1530z N40°38.1 W073°46.0
      SET INERTIAL POS
      □□°□□.□ □□□°□□.□
-----
<INDEX          ROUTE>
ENTER INERTIAL POS

```

BOX PROMPTS SHOW AND THE ENTER INERTIAL POS MESSAGE SHOWS WHEN:

- ENTERED POSITION DID NOT PASS THE ENTERED INERTIAL POSITION TEST OR THE LATITUDE COMPARISON TEST
- OR THE ADIRU IS READY TO GO INTO THE NAV MODE BUT AN INERTIAL POSITION IS NOT ENTERED

```

      POS INIT          1 / 3
                        LAST POS
      N40°38.0 W073°46.4
REF AIRPORT
-----
GATE

UTC      GPS POS
1530z N40°38.1 W073°46.0
      SET INERTIAL POS
      -----
-----
<INDEX          ROUTE>
ALIGNMENT REINITIATED

```

DASHES REPLACE THE BOX PROMPTS AND ALIGNMENT REINITIATED SHOWS WHEN ALIGNMENT FAILS.

DASHES ALSO SHOW WHEN THE ADIRU IS READY TO ACCEPT A NEW POSITION DURING AUTO NAV REALIGN.

M36855 S000619109_V1

ADIRS - ALIGNMENT - POS INIT CDU PAGE

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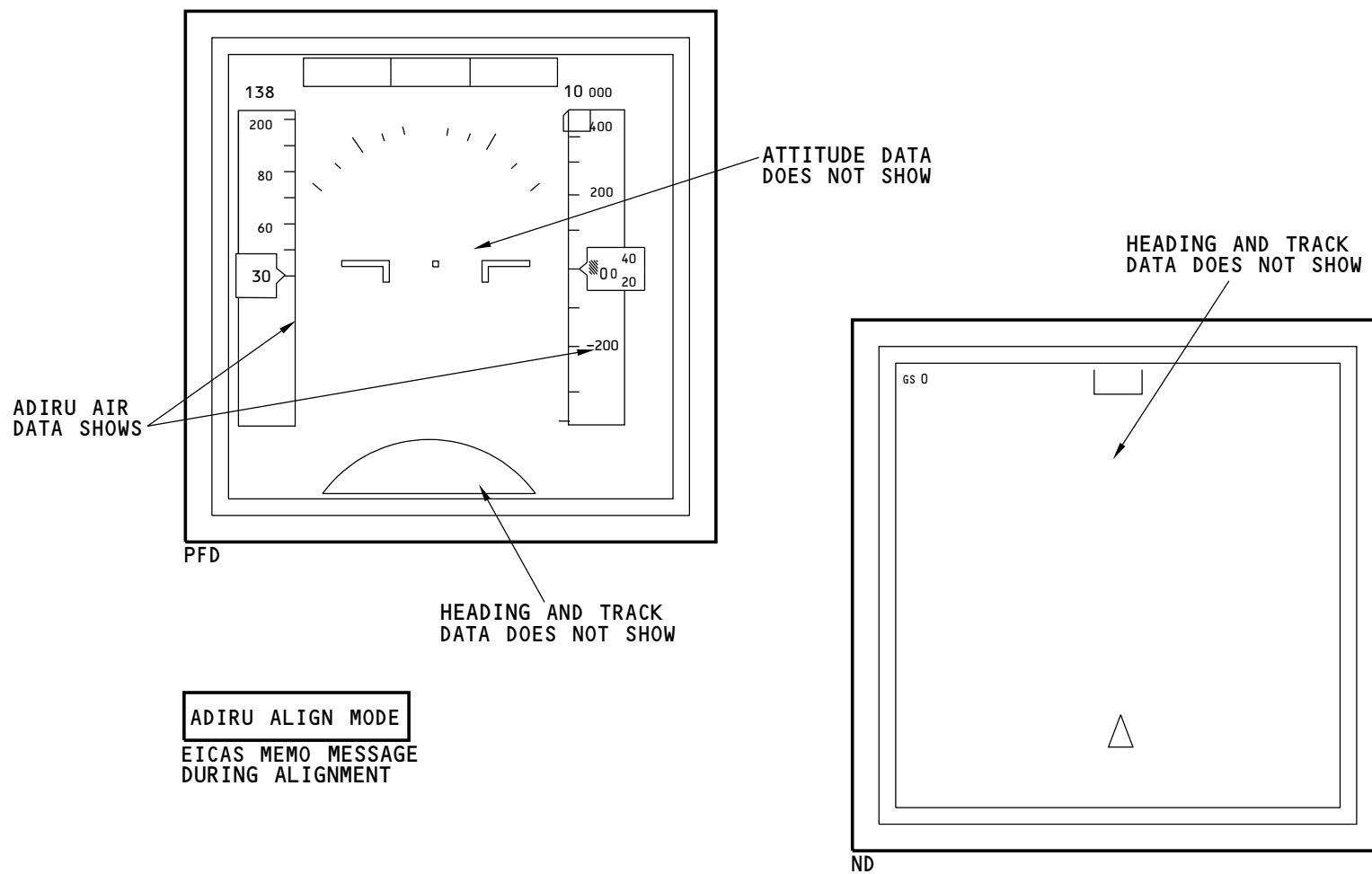
ADIRS - ND AND PFD INDICATIONS DURING ALIGNMENT

General

These are the indications when the ADIRU is in the align mode:

- The PFDs show no computed data (NCD) attitude, track and heading data
- The PFDs show ADIRU air data
- The NDs show NCD track and heading data
- ADIRU ALIGN MODE memo message shows on the EICAS display.

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ADIRS - ND AND PFD INDICATIONS DURING ALIGNMENT

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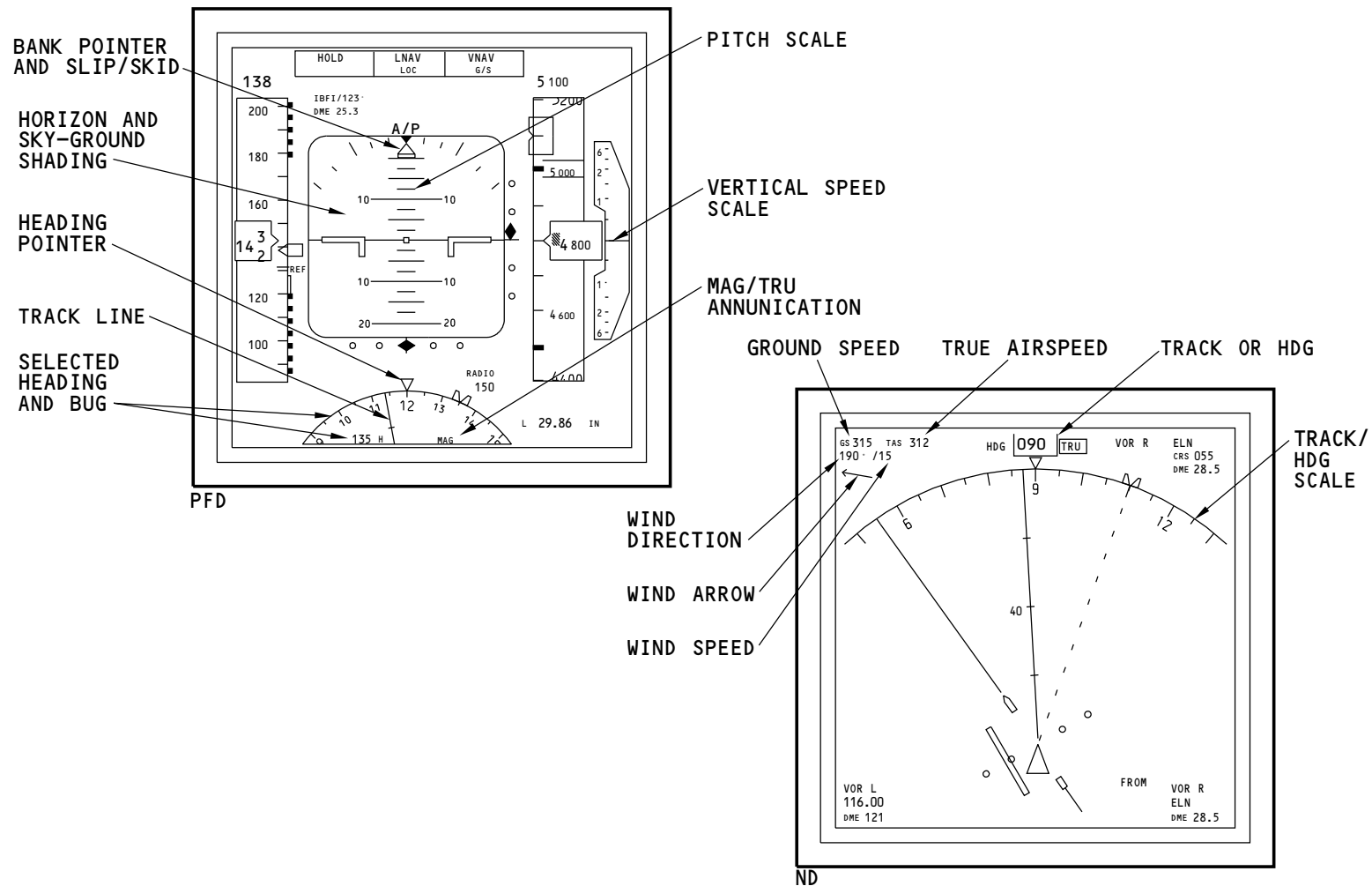


ADIRS - PFD AND ND INDICATIONS AFTER ALIGNMENT

General

When the ADIRU alignment completes and the ADIRU is in the NAV mode, the PFD AND ND show attitude and air data from the ADIRU.

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ADIRS - PFD AND ND INDICATIONS AFTER ALIGNMENT

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ADIRS - PFD AND ND INVALID IRS DATA

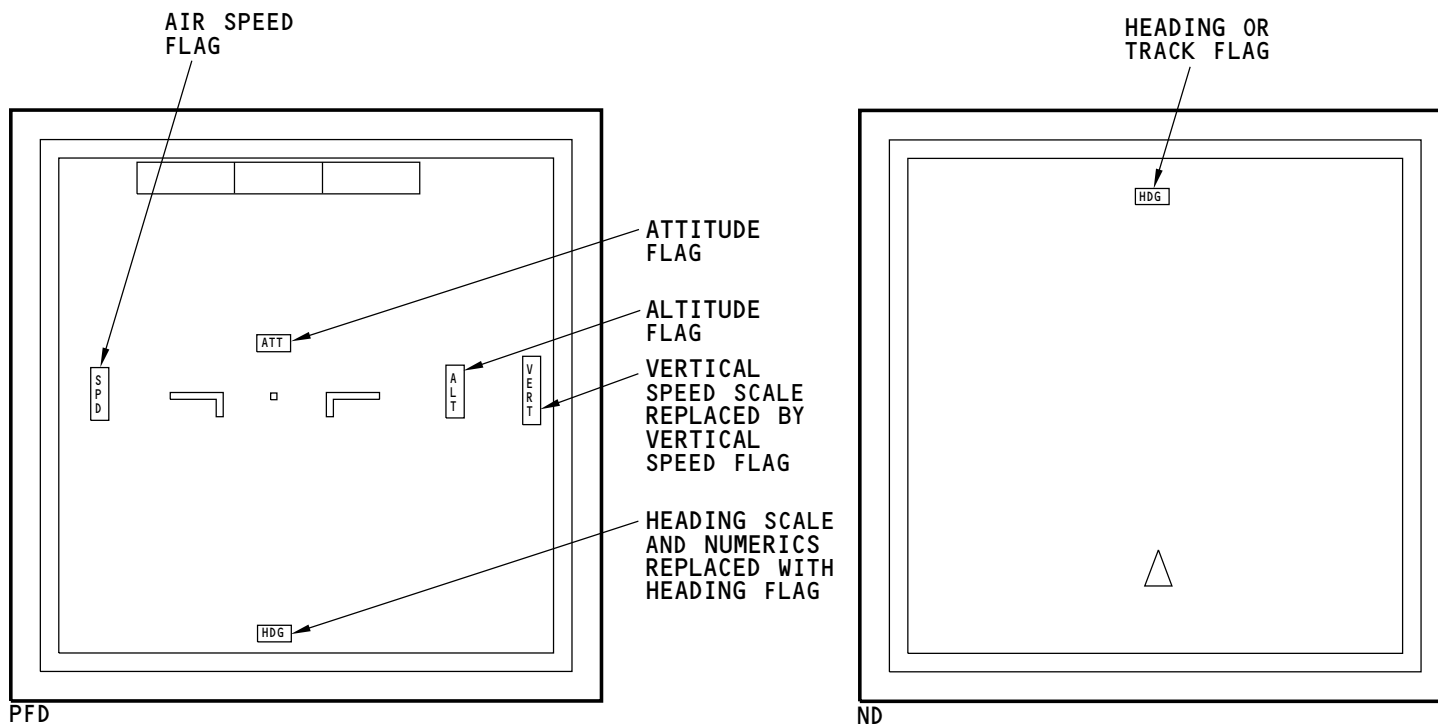
General

The PFD and ND show the invalid attitude and invalid air data indications.

The PFD shows flags for these displays:

- Airspeed
- Attitude
- Altitude
- Vertical speed
- Heading.

The ND shows a heading or track flag.



ADIRS - PFD AND ND INVALID IRS DATA

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**ADIRS - INERTIAL MONITOR PAGE****Purpose**

The inertial monitor page shows the position error rate for the ADIRU.

Page Access

To get access to the INERTIAL MONITOR page, select <INERTIAL MONITOR from the MAINTENANCE INDEX page.

Color

All text on this page is white.

Information

Line 1L is the inertial monitor drift. The drift rate is blank in the air.

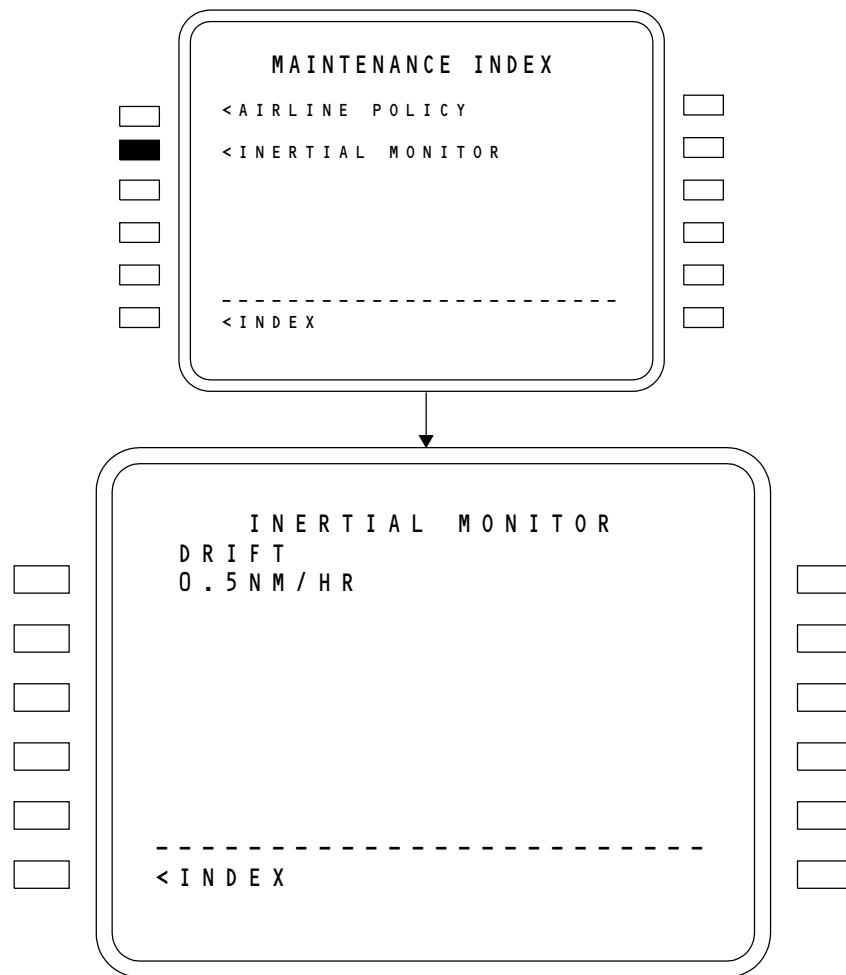
The drift rate shows for the last completed flight when these conditions occur:

- Airplane is on the ground
- Engines are shut down.

It clears at the next ground-to-air transition.

Page Selections

Select 6L, <INDEX to show the MAINTENANCE INDEX.



ADIRS - INERTIAL MONITOR PAGE

M36875 S000619129_V1

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ADIRS - FAULT REPORT AND SOFTWARE DATA LOAD

General

These components in the ADIRS report faults and system status to the central maintenance computing function (CMCF) of the AIMS:

- ADIRU
- SAARU
- ADMs.

You can not start any tests for the ADIRU or the SAARU. These components have built-in test equipment (BITE). The BITE automatically detects faults in these ADIRS components. You start a test of the ADM heat control circuit from the ground test menu on the MAT, chapter 30, ice and rain protection.

ADIRU Power-Up Test and Status

The ADIRU does a 30 second test after you put the ADIRU on/off switch in the on position. The results of the test go to the CMCF of the AIMS. The test is automatic and there are no indications for the test.

The ADIRU starts normal operation after the test ends. The air data is valid after the test. The inertial data is invalid until alignment is complete. The ADIRU continuously supplies BITE status data to the CMCF of the AIMS.

SAARU and ADM Status

The SAARU and the ADMs continuously supply BITE status data to the CMCF of the AIMS.

ADIRS Status Monitoring

If there are faults with the ADIRU, SAARU, ADMs and standby attitude display, use the maintenance access terminal (MAT) to monitor the status.

Software Data Load

Use the MAT to load software data into the ADIRU, SAARU, and the ADMs.

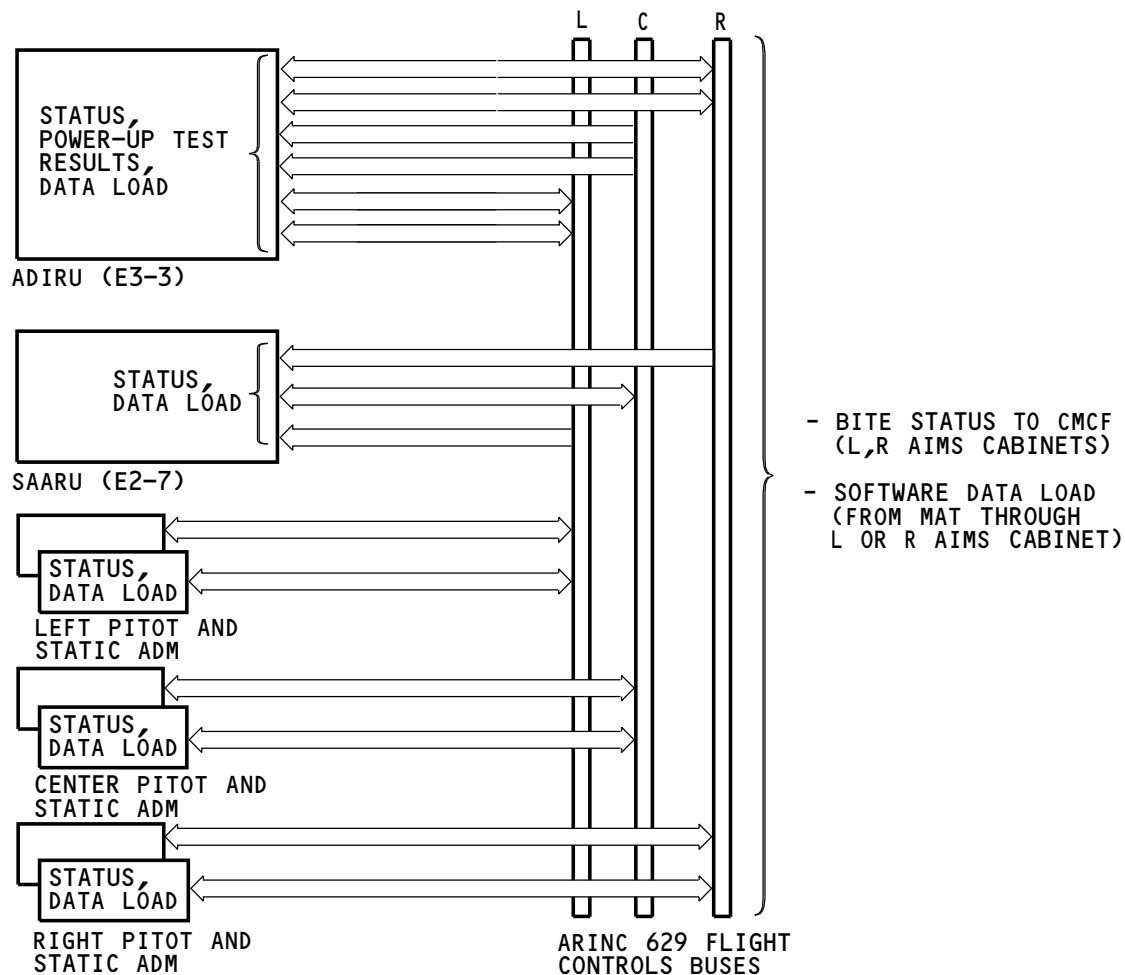
Training Information Point

The ADIRU accepts data load software from the left CMCF only.

The SAARU accepts data load software from the left or right CMCF.

The left ADMs accept data load software from the left CMCF only. The center ADMs accept data load software from the left or right CMCF. The right ADMs accept data load software from the right CMCF only.

Use the central maintenance computer switch control selection on the other functions menu from the MAT main menu to select the left or the right CMCF.



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ADIRS - FAULT REPORT AND SOFTWARE DATA LOAD

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STANDBY MAGNETIC COMPASS

Purpose

The standby magnetic compass is a backup magnetic heading reference.

Location

The standby magnetic compass is below the overhead panel (P5).

Power

The standby magnetic compass has a 5v ac light bulb. A lamp access cover permits replacement of the bulb.

Characteristics

The standby magnetic compass has a circular heading indicator card. The card floats in a case filled with liquid. The liquid does not permit the card to move quickly.

There are two magnets in the standby magnetic compass. The magnets are parallel to each other, and they are in the horizontal plane. The magnets align the compass with the magnetic flux lines of the earth.

Adjustment

The standby magnetic compass has N-S (north-south) and E-W (east-west) compensation screws. These screws change the position of the magnets.

Use the compensation screws to correct for magnetic deviations generated by electrical currents in the flight deck. Use only non-magnetic tools to turn the compensation screws.

There is a compass correction card below the compass. Use this card to write small errors that the compensation screws cannot remove.

Removal/Installation

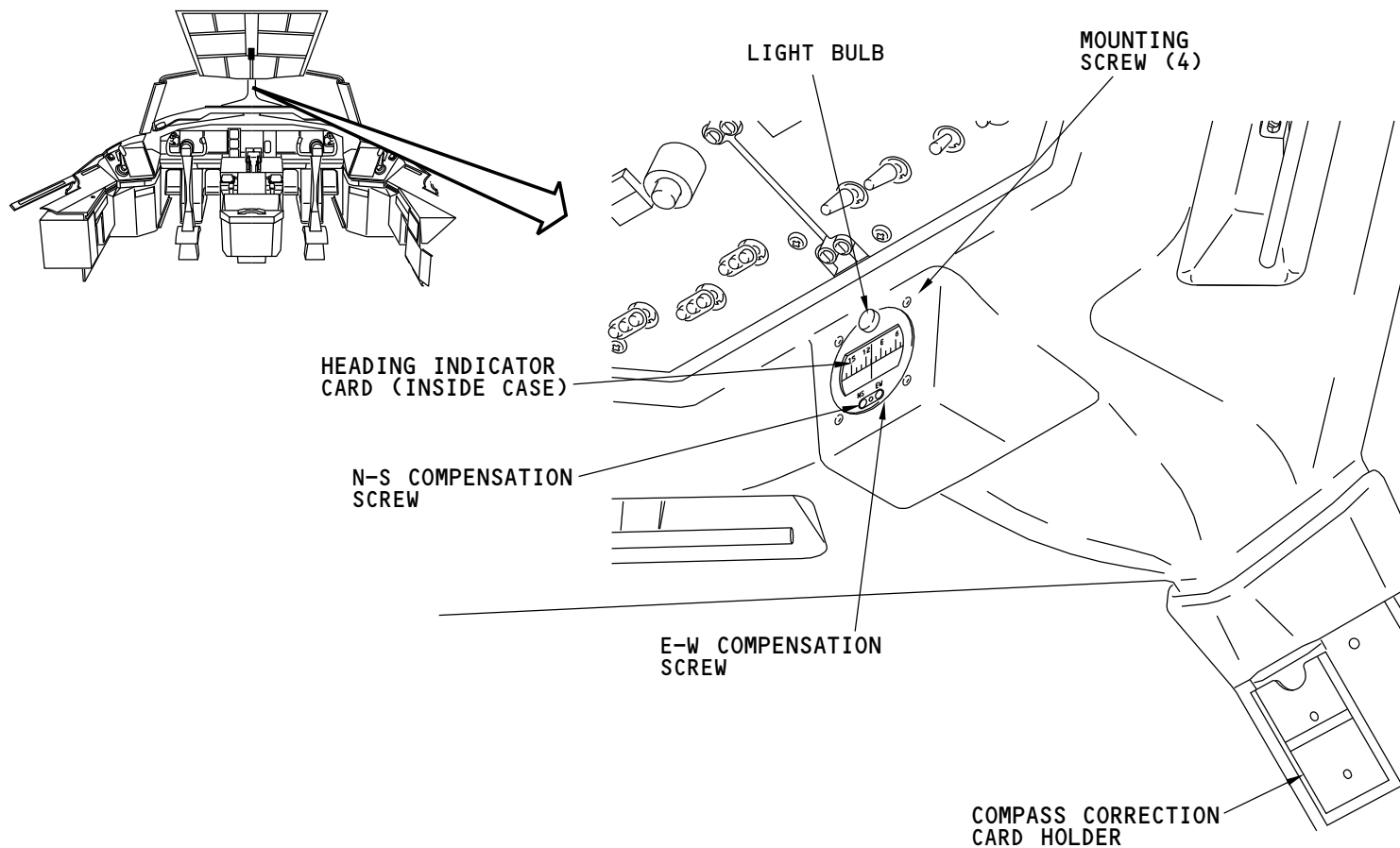
Four screws hold the standby magnetic compass in place. Use only non-magnetic tools and screws to remove and install the standby magnetic compass.

You must do a compass swing after you replace the standby magnetic compass.

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STANDBY MAGNETIC COMPASS

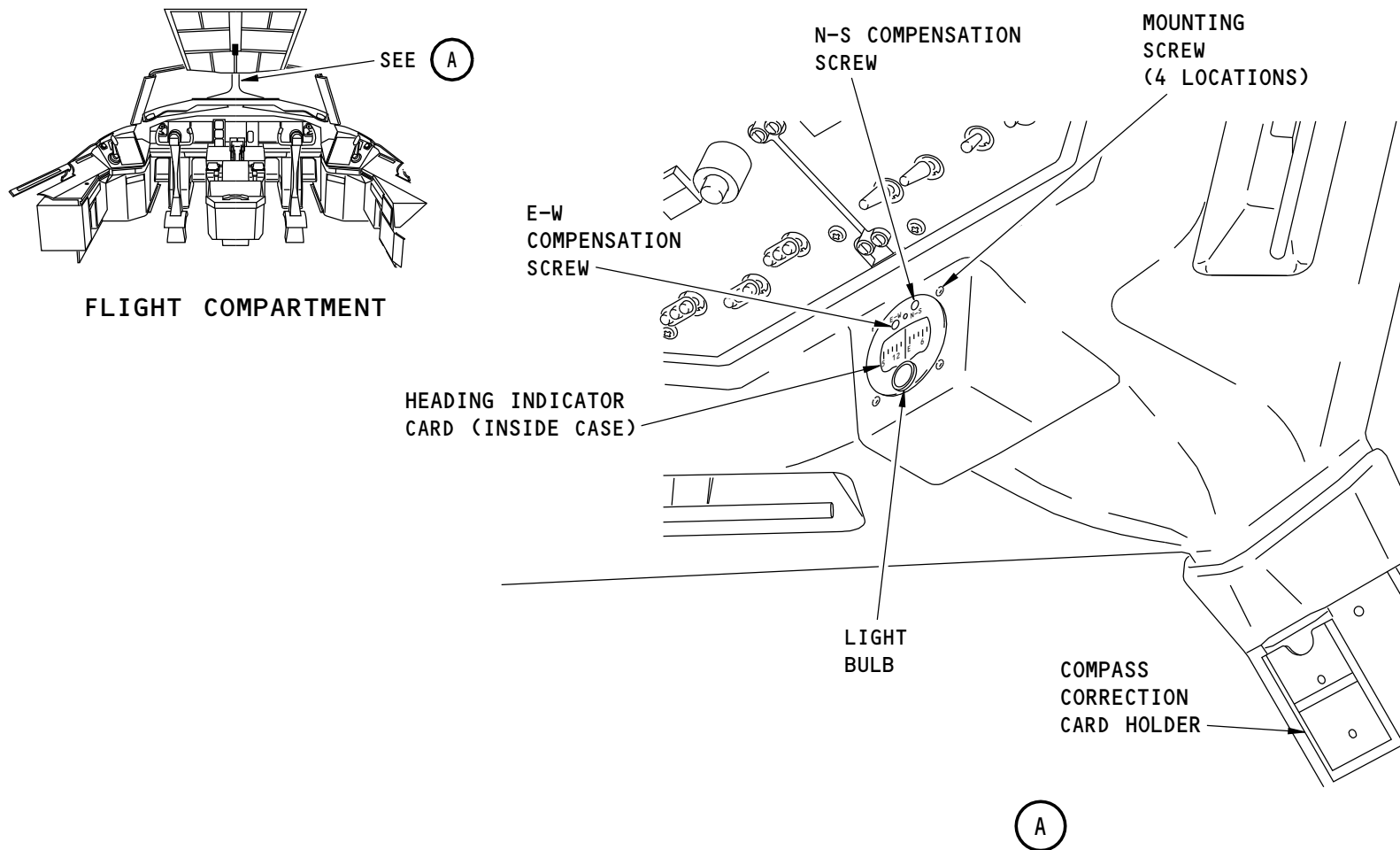
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STANDBY MAGNETIC COMPASS

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STANDBY ATTITUDE REFERENCE SYSTEM - INTRODUCTION

Purpose

The standby attitude reference system is a backup system. It shows the pilots this data:

- Pitch attitude
- Roll attitude
- Altitude
- Indicated airspeed (IAS)
- Heading
- ILS localizer and glideslope deviation.

General

The standby attitude reference system operates dependently of the air data inertial reference system.

Abbreviations and Acronyms

- AC - alternating current
- ADIRS - air data inertial reference system
- ADIRU - air data inertial reference unit
- ADM - air data module
- ARINC - Aeronautical Radio, Inc.
- alt - altitude
- amp - amperes
- app - approach
- att - attitude
- baro - barometric
- bat - battery
- BCRS - back course
- BITE - built-in test equipment
- C - degrees Celsius
- DC - direct current

- F - degrees Fahrenheit
- fail warn - failure warning
- fwd - forward
- g - grams
- g - acceleration due to gravity
- G/S - glideslope
- hdg - heading
- HP - hectopascal
- hPa - hectopascal
- IAS - indicated airspeed
- ident - identification
- ILS - instrument landing system
- IN - inches of mercury
- in Hg - inches of mercury
- init - initialization
- IR - inertial reference
- IRS - inertial reference system
- ISFD - integrated standby flight display
- kg - kilograms
- kts - knots
- LCD - liquid crystal display
- LOC - localizer
- LRU - line replaceable unit
- m - meters
- mbar - millibars
- mm - millimeters
- MMR - multi-mode receiver
- NCD - no computed data
- P/N - hardware part number
- rst - reset

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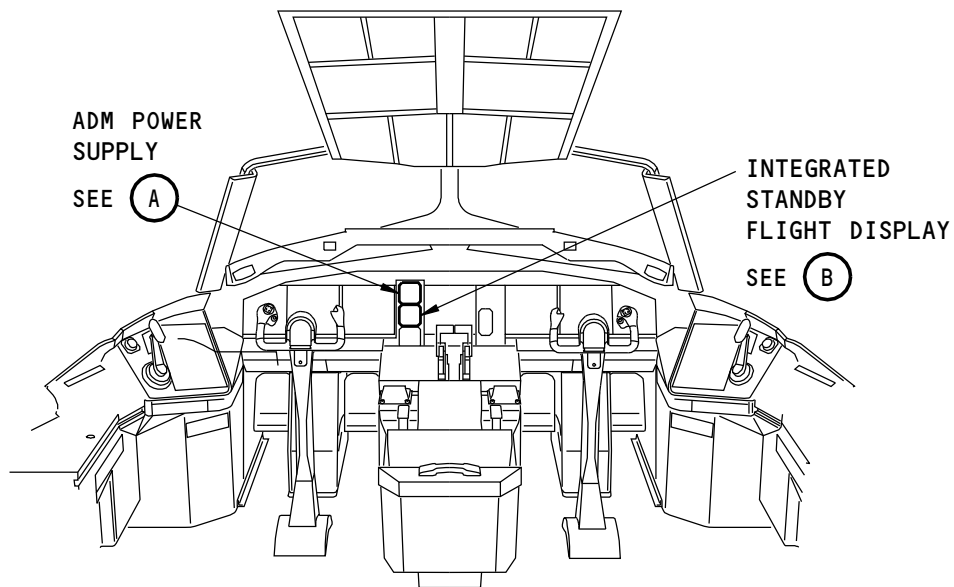
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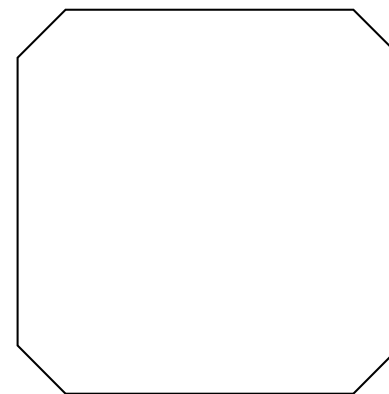


STANDBY ATTITUDE REFERENCE SYSTEM - INTRODUCTION

- s - seconds
- S/N - software part number
- spd - airspeed
- V - volts
- wrg - wiring

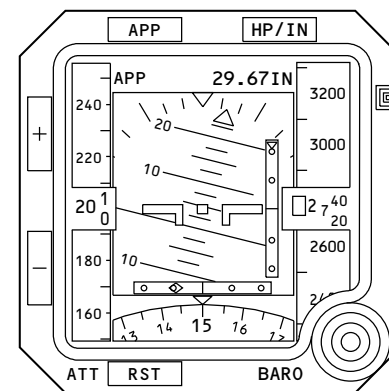


FLIGHT COMPARTMENT



ADM POWER SUPPLY

(A)



INTEGRATED STANDBY FLIGHT DISPLAY

(B)

W50430 S0000125028_V1

STANDBY ATTITUDE REFERENCE SYSTEM - INTRODUCTION

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**STANDBY ATTITUDE REFERENCE SYSTEM - GENERAL DESCRIPTION****General**

The standby attitude reference system is an alternate source of airplane pitch and roll attitude information.

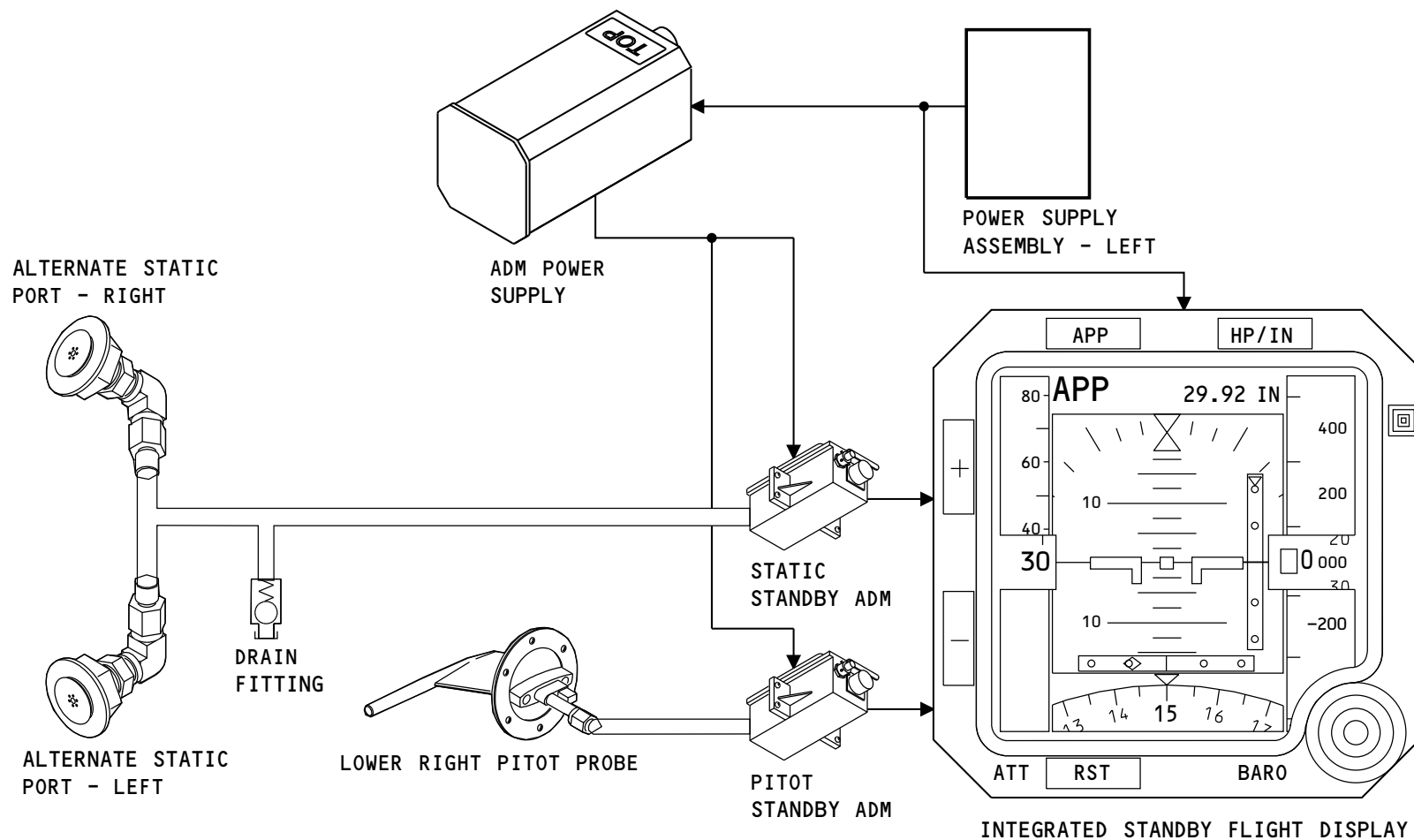
The standby attitude reference system can also show instrument landing system (ILS) localizer and glideslope deviation. ILS data is from the center multi mode receiver (MMR-C).

The failure flags on the integrated standby flight display tell the flight crew if there is an ILS or indicator failure.

Power

28v dc from the power supply assembly (left) supplies power for the standby attitude reference system.

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STANDBY ATTITUDE REFERENCE SYSTEM - GENERAL DESCRIPTION

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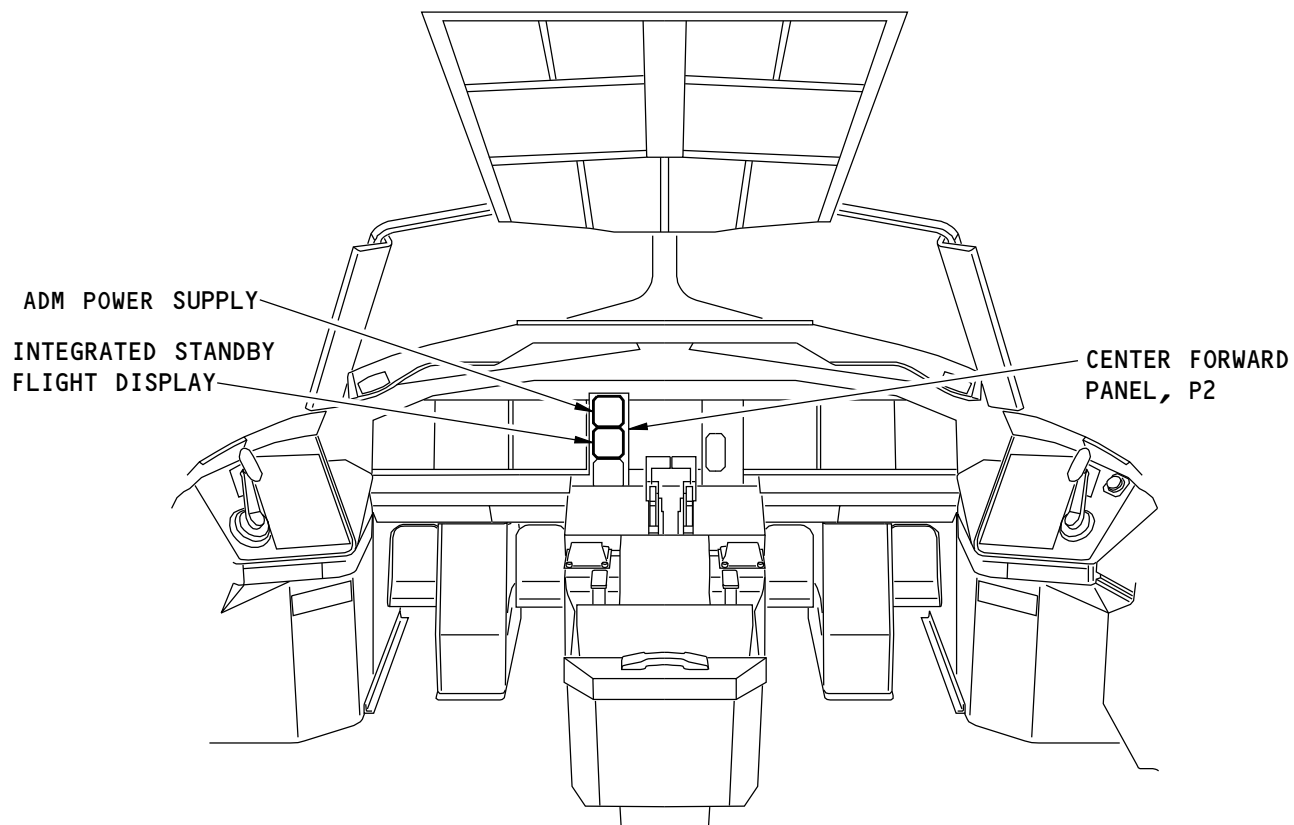
**STANDBY ATTITUDE REFERENCE SYSTEM - COMPONENT LOCATION****General**

The components for the standby attitude reference system are in the flight compartment.

Flight Compartment

The integrated standby flight display (ISFD) and the air data module (ADM) power supply are in the P2 center instrument panel.

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FLIGHT COMPARTMENT

STANDBY ATTITUDE REFERENCE SYSTEM - COMPONENT LOCATION

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**STANDBY ATTITUDE REFERENCE SYSTEM - INTERFACE****Power**

The integrated standby flight display (ISFD) gets 28v dc from the left power supply assembly.

The ISFD gets 5v ac for the front panel lights from the master dim and test circuit.

Pitot-Static Interface

The alternate (center system) pitot probe sends pitot pressure to the pitot system standby air data module (SADM). The alternate (center system) static ports send static pressure to the static system SADM. The SADMs convert the pitot and static pressures to ARINC 429 data bus signals which are transmitted to the ISFD.

The ISFD uses static pressure to show barometric altitude. The ISFD uses pitot and static air pressure to show indicated airspeed (IAS).

Instrument Landing System (ILS) Interface

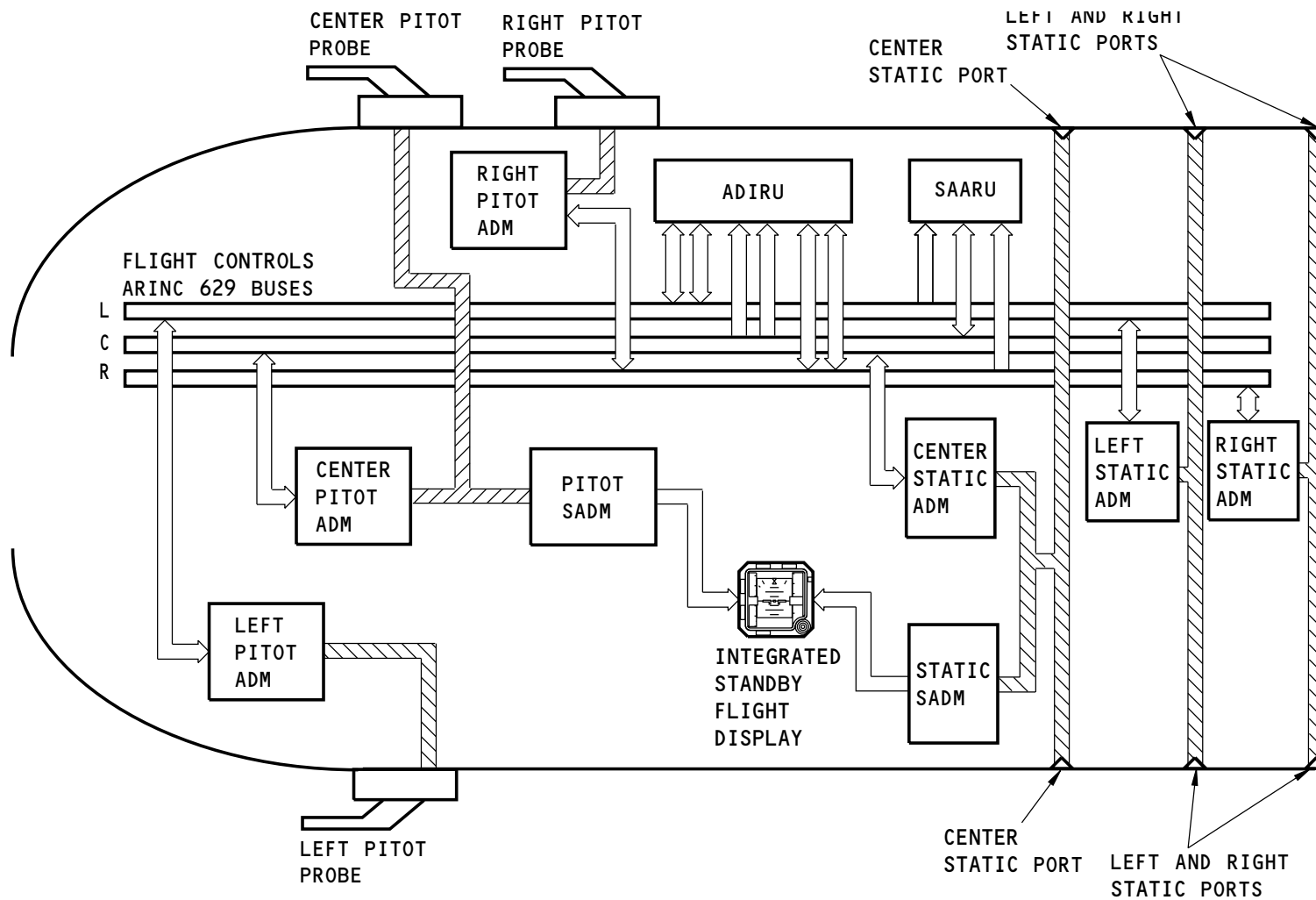
The center multi-mode receiver (MMR_C) sends localizer deviation and glideslope deviation to the ISFD on an ARINC 429 data bus.

The ISFD shows localizer and glideslope deviation on the attitude display.

Air Data Inertial Reference System (ADIRS) Interface

The air data inertial reference unit (ADIRU) sends inertial reference data to the integrated standby flight display on an ARINC 429 data bus.

The ISFD uses ground speed to sense when the airplane is on the ground.



STANDBY ATTITUDE REFERENCE SYSTEM - INTERFACE

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**STANDBY ATTITUDE REFERENCE SYSTEM - INTEGRATED STANDBY FLIGHT DISPLAY****Power**

The integrated standby flight display (ISFD) gets 28v dc from the power supply assembly (left).

The ISFD gets 5v ac for the front panel lights from the captain's instrument and panel light dimmer circuit.

Pitot-Static Interface

The center system pitot probe sends pitot pressure to the pitot standby air data module (ADM). The standby ADM converts the pitot pressure to a signal sent to the ISFD.

The pitot and static pneumatic connections on the ISFD are not used for the 777 installation.

The alternate (center) static ports send static pressure to the standby static ADM. The standby ADM converts the static pressure to a signal sent to the ISFD.

The ISFD uses static pressure to show barometric altitude. The ISFD uses pitot and static air pressure to show indicated airspeed (IAS).

Instrument Landing System (ILS) Interface

The center multi-mode receiver (MMR - C) sends localizer deviation and glideslope deviation to the ISFD on an ARINC 429 data bus.

The ISFD shows localizer and glideslope deviation on the attitude display.

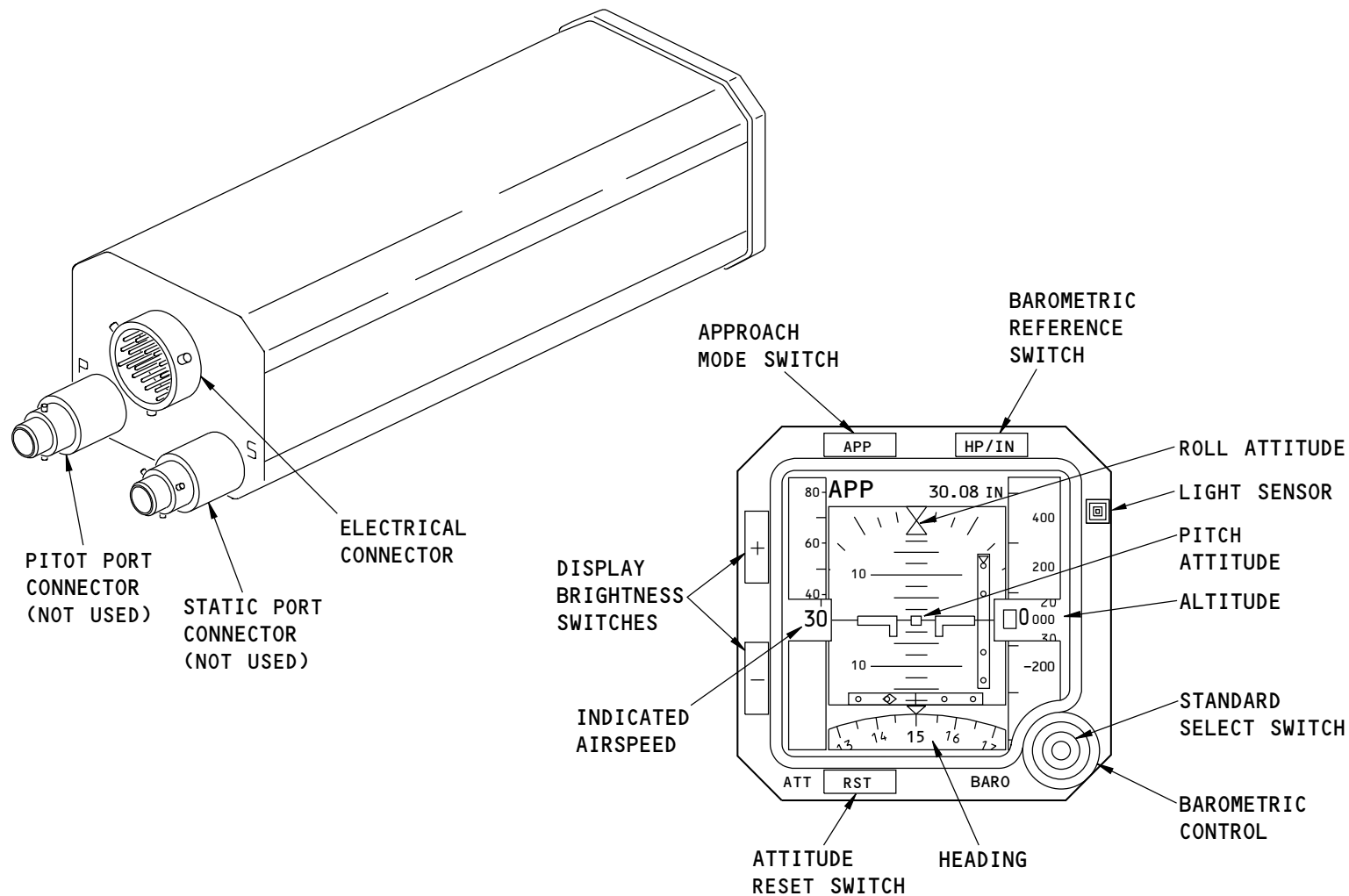
Air Data Inertial Reference System (ADIRS) Interface

The air data inertial reference unit (ADIRU) sends inertial reference data to the integrated standby flight display on an ARINC 429 data bus.

The ISFD uses magnetic heading data to show on the compass rose on the bottom of the display.

The ISFD uses ground speed to sense when the airplane is on the ground.

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STANDBY ATTITUDE REFERENCE SYSTEM - INTEGRATED STANDBY FLIGHT DISPLAY

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**STANDBY ATTITUDE REFERENCE SYSTEM - ADM POWER SUPPLY****General**

The air data module (ADM) power supply provides power to the standby air data modules. The standby ADMs provide the center pitot and center static system pressure signals to the integrated standby flight display (ISFD).

The ADM power supply is installed in the P2 panel.

Physical Properties

These are the physical properties of the ADM power supply:

- Length - 7.12 inches (180.8 mm)
- Width - 3.12 inches (80.5 mm)
- Height - 3.12 inches (80.5 mm)
- Weight - 3 pounds (1.36 kg).

The ADM power supply has one electrical connector at the rear of the unit.

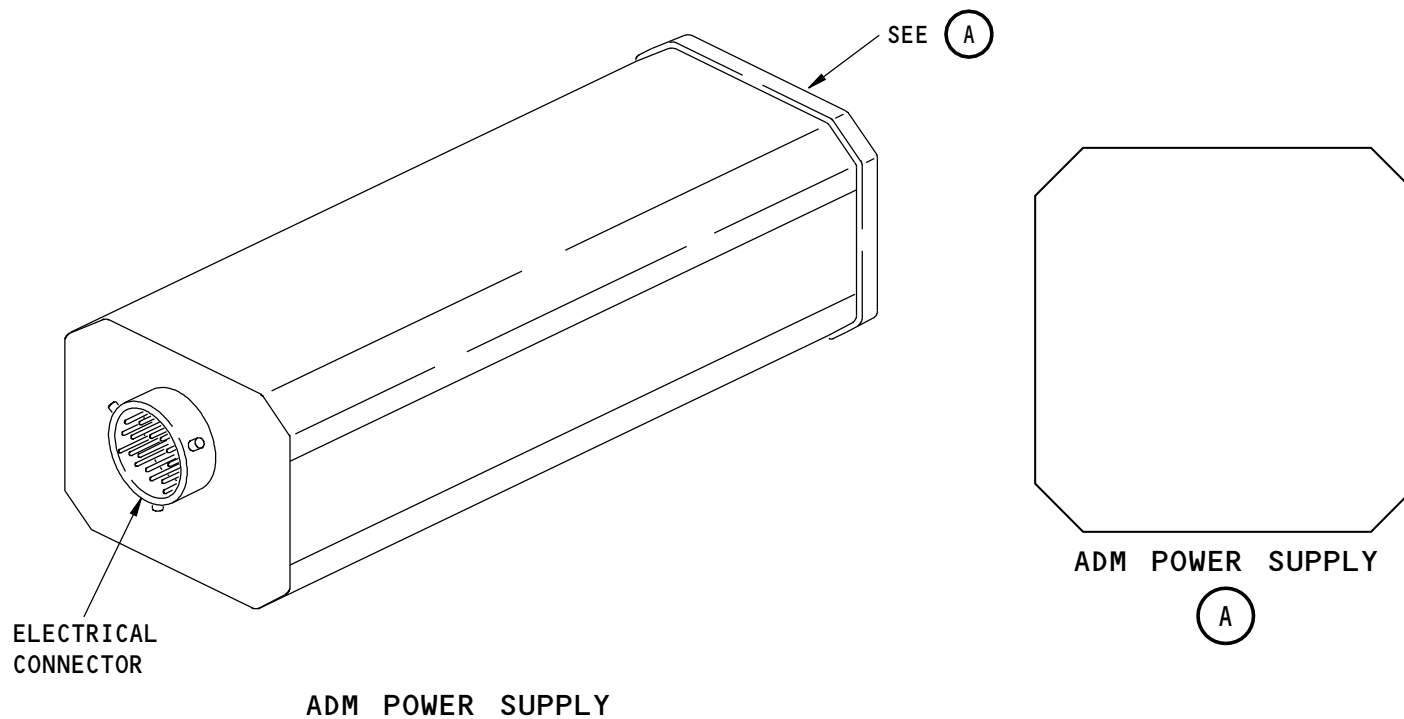
The front face of the ADM power supply has a plain cover plate design. The power supply is installed in the P2 panel with an instrument clamp.

Operation

The ADM power supply converts 28 V DC from the left power supply assembly to 13.5 V DC, for power to each of the two standby air data modules.

Controls and Indication

The ADM power supply has no controls or indication.



STANDBY ATTITUDE REFERENCE SYSTEM - ADM POWER SUPPLY

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STANDBY ATTITUDE REFERENCE SYSTEM - FUNCTIONAL DESCRIPTION

General

The components of the standby attitude reference system are the integrated standby flight display (ISFD), the air data module (ADM) power supply, and the standby pitot and static air data modules (SADM).

The ISFD shows these parameters from alternate sources:

- Attitude
- Airspeed
- Altitude.

The ISFD also shows these parameters from other sources on the airplane:

- Magnetic heading from the air data inertial reference system (ADIRS)
- Localizer deviation from the instrument landing system (ILS)
- Glideslope deviation from the ILS.

The ISFD uses airplane power from the left power supply assembly to power the ISFD. The ADM power supply converts power from the left power supply assembly to supply power to the standby pitot and static air data modules.

POWER

The left power supply assembly provides 28V DC for the ISFD and the ADM power supply. The ADM power supply converts 28V DC to 13.5V DC for the standby pitot air data module and standby static air data module.

Program Pins

The program pins tell the ISFD the airplane model and the optional parameters.

The program pins that identify the airplane model set these parameters:

- Tilt angle - To correct the attitude as a function of the angle of the main instrument panel
- Static source error correction - To correct the static pressure data as a function of the Mach number

- Air data aiding - To correct the attitude as a function of airspeed.

Other program pins identify display options.

The ISFD uses one program pin, called the parity pin, to make sure the airplane model and optional functions are correct. The sum of all the program pins and the parity pin must be an even number. If the sum is odd, there is a fault and the ISFD shows the message PROGRAM PIN ERROR.

ARINC 429 Interfaces

The ISFD receives data from these components on ARINC 429 data buses:

- Center multi-mode receiver (MMR-C) - localizer deviation and glideslope deviation
- Left AIMS cabinet - magnetic heading and ground speed.
- Pitot and Static Standby Air Data Modules

Inertial Sensors

The ISFD has inertial sensors that sense angular rate and linear acceleration. The ISFD uses the inertial sensors to calculate pitch and roll attitude.

The angular rate data comes from solid-state quartz rate sensors. Rotational movement about the sensor axis gives a DC voltage that is in proportion to the angular rate.

The linear acceleration data comes from silicon accelerometers. Each accelerometer has a single silicon crystal. Gravity and acceleration forces change the capacitance of the crystal. The accelerometer gives a DC voltage that is in proportion to the acceleration.

Bezel Controls

The front face of the ISFD has five push-buttons and one rotary knob to control the operation.

There is one light sensor on the bezel. The ISFD uses the light sensor to control the intensity of the display as the ambient light changes.

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STANDBY ATTITUDE REFERENCE SYSTEM - FUNCTIONAL DESCRIPTION

Data Control and System Processing

All inputs and controls go to the data control and system processing section of the ISFD. The processor does these functions:

- Calculates airspeed and altitude from the pressure sensor data signals
- Calculates pitch and roll attitude from the inertial sensor data signals
- Changes calculated data to graphics data for the graphics processing
- Controls brightness
- Changes the display in response to inputs from the bezel controls.

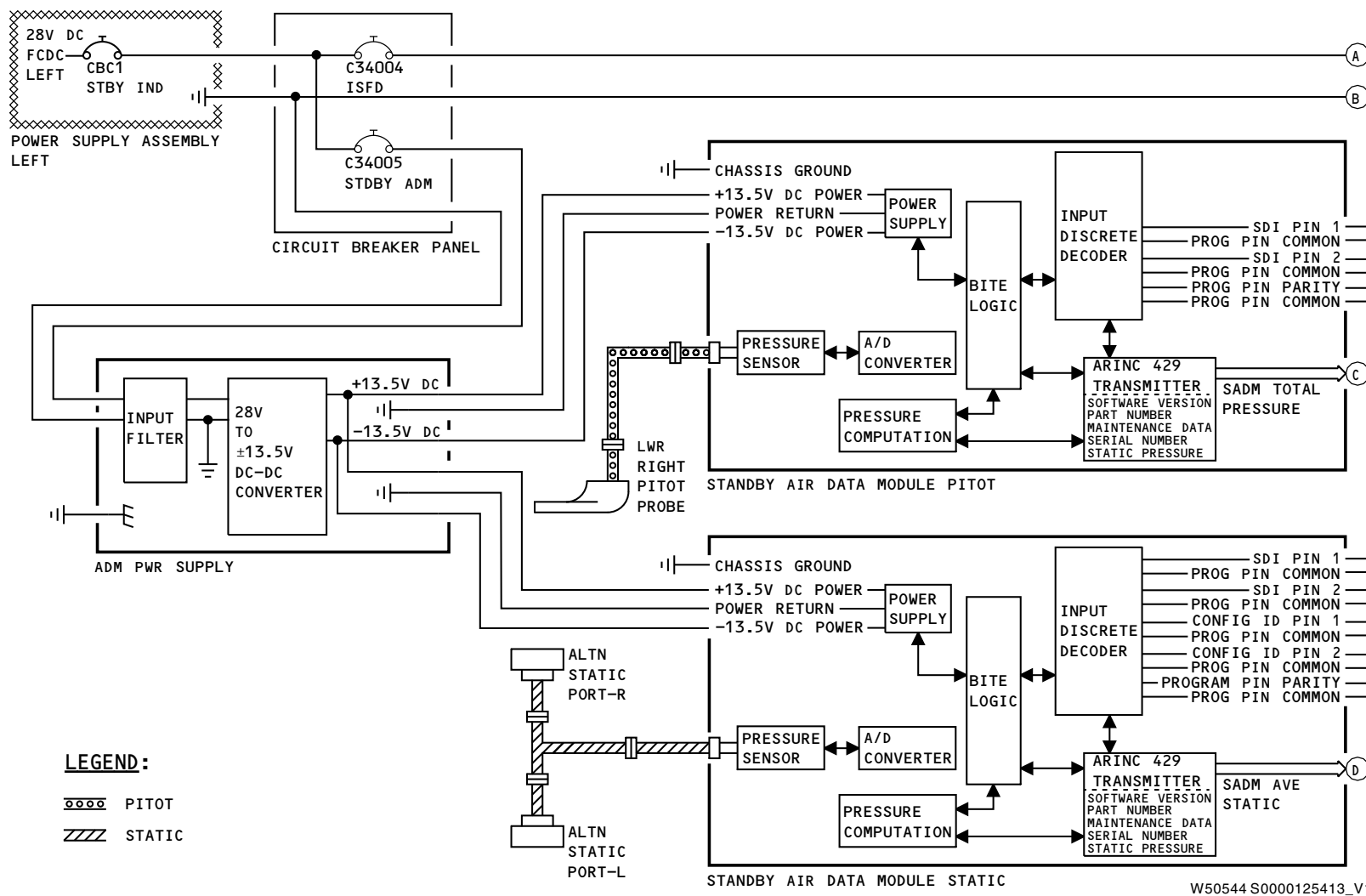
Graphics Processing and Display

The graphics processor does these functions:

- Calculates graphic data for each parameter from the system processor
- Controls the liquid crystal display (LCD) matrix drivers
- Refreshes the display.

The display has a color active matrix LCD and a back-lighting box. The back-lighting box has these components:

- Three fluorescent tubes
- Reflector
- Diffuser.



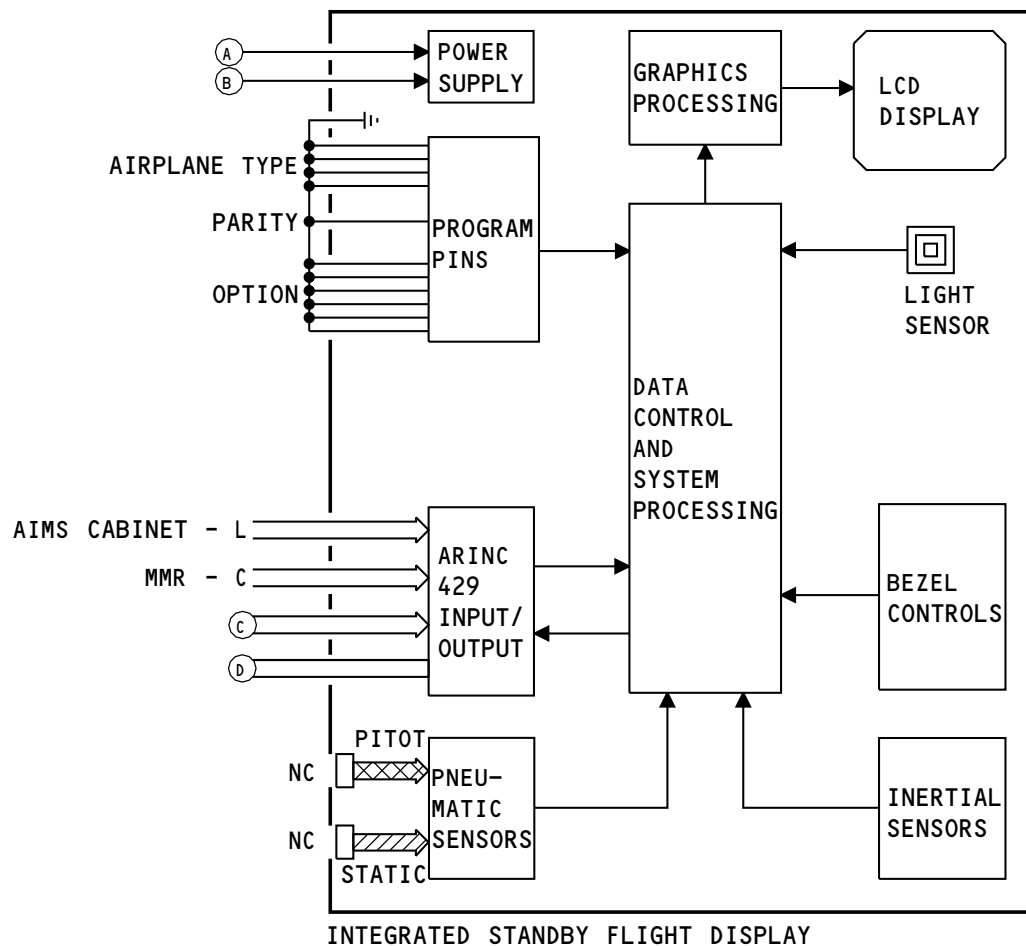
STANDBY ATTITUDE REFERENCE SYSTEM - FUNCTIONAL DESCRIPTION

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STANDBY ATTITUDE REFERENCE SYSTEM - FUNCTIONAL DESCRIPTION

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STANDBY ATTITUDE REFERENCE SYSTEM - OPERATION - POWER-UP

Power-Up Display

The ISFD shows flags when you first apply power to it.

For the first 15 seconds, the display shows these flags:

- ATT - attitude flag
- SPD - airspeed flag
- ALT - altitude flag.

The airspeed and altitude functions in the ISFD complete the initialization after 15 seconds. After 15 seconds, the display removes the SPD and ALT flags and shows the altitude and airspeed.

The attitude function in the ISFD completes the initialization after 90 seconds. After 90 seconds, the display removes the ATT flag and shows the pitch and roll attitude.

Failure Displays

If there are failures in the ISFD, the display shows failure messages when you apply power to it.

The display shows PROGRAM PIN ERROR if either one of these conditions occur:

- Parity for the program pins is odd.
- Program pins sense an airplane type or option combination that is not valid.

NOTE: The ISFD uses one program pin, called the parity pin, to make sure the airplane model and optional functions are correct. The sum of all the program pins and the parity pin must be an even number. If the sum is odd, there is a fault.

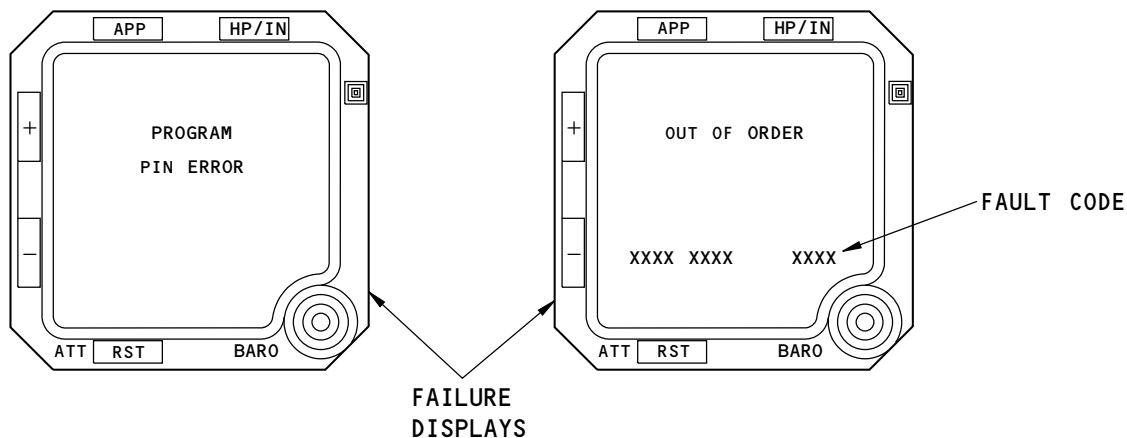
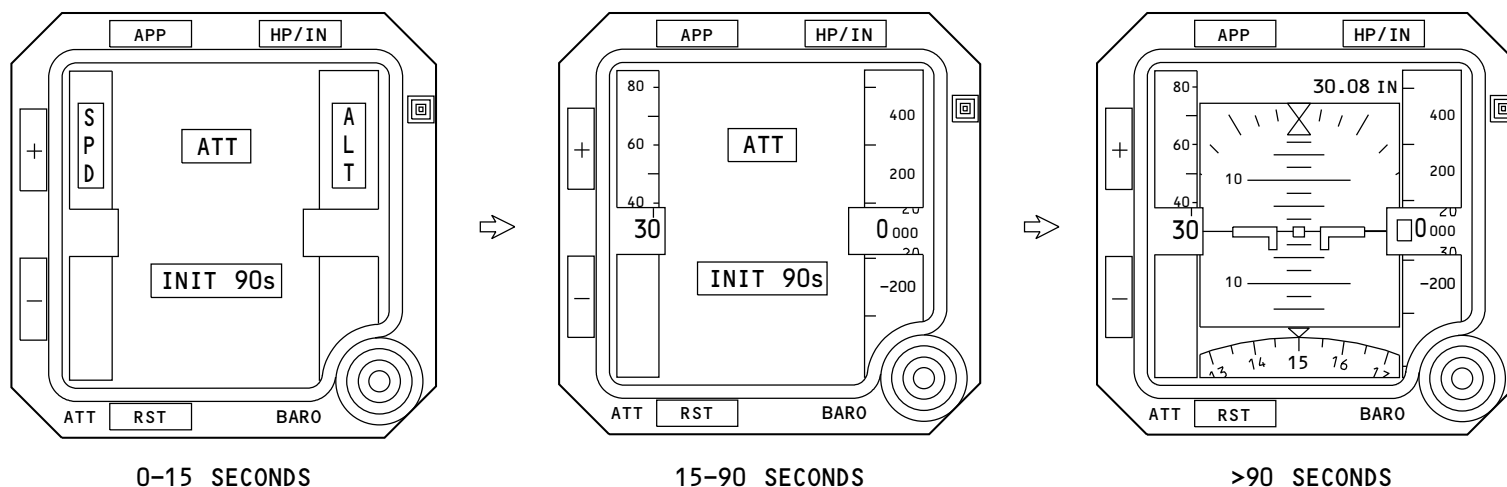
The display shows OUT OF ORDER if the ISFD has a fault. The display also shows a fault code. The bench technicians use the fault code to troubleshoot failures inside the ISFD.

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STANDBY ATTITUDE REFERENCE SYSTEM - OPERATION - POWER UP

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STANDBY ATTITUDE REFERENCE SYSTEM - OPERATION - ATTITUDE

Normal Display

The ISFD shows pitch and roll attitude.

The ISFD goes through alignment when it first receives power. 90 seconds after the ISFD receives power, the pitch and roll attitude scales and pointer show on the display.

The pitch attitude scale shows as horizontal markers from the top to the bottom of the display. There are 2.5 degrees between each marker. The airplane symbol is fixed at the center of the display. The pitch attitude scale moves up or down as the pitch angle changes.

When the pitch attitude scale shows pitch attitude more than 30 degrees, large red arrowheads show. The arrowheads point in the direction of 0 degrees pitch attitude.

The roll attitude scale is at the top of the display. The markers are at 0, 10, 20, 30, 45 and 60 degrees of bank angle.

The resolution of the display is 0.25 degree for pitch and 0.5 degree for roll.

Failure Display

If the ISFD finds a failure of the attitude function, the display shows the attitude (ATT) flag. The ISFD removes the pitch and roll scales and pointers.

Messages

The ISFD shows these messages on the attitude display:

- INIT 90s (initialize for 90 seconds)
- WAIT ATT (wait attitude)
- ATT 10s (attitude 10 seconds)
- ATT:RST (attitude reset).

The initialization 90 seconds (INIT 90s) message shows during power-up. The ISFD takes 90 seconds to align the pitch and roll attitude during power-up. When the attitude alignment is complete, the ISFD shows the pitch and roll attitude scales and pointer.

The wait attitude (WAIT ATT) message shows when the inertial sensors sense the angular rate or the acceleration is more than the maximum. The maximum angular rate is 100 degrees per second. The maximum acceleration is 3.2g.

When the angular rate and acceleration go less than the maximum, the ISFD removes the message and shows the attitude scales and pointer.

If the angular rate or acceleration is more than the maximum for more than 10 seconds, the ISFD shows the ATT:RST message.

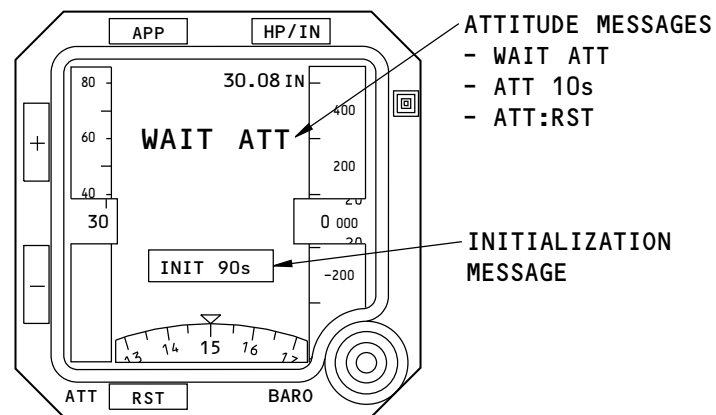
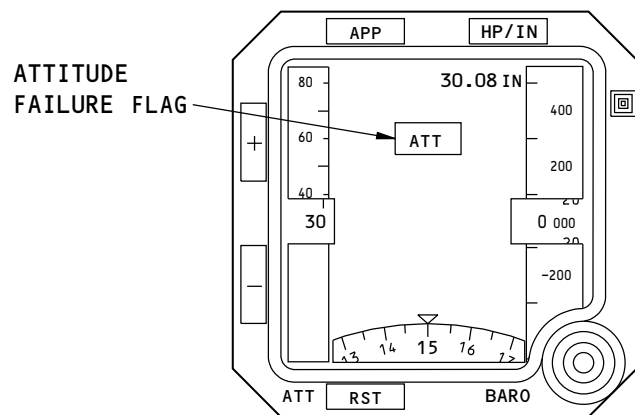
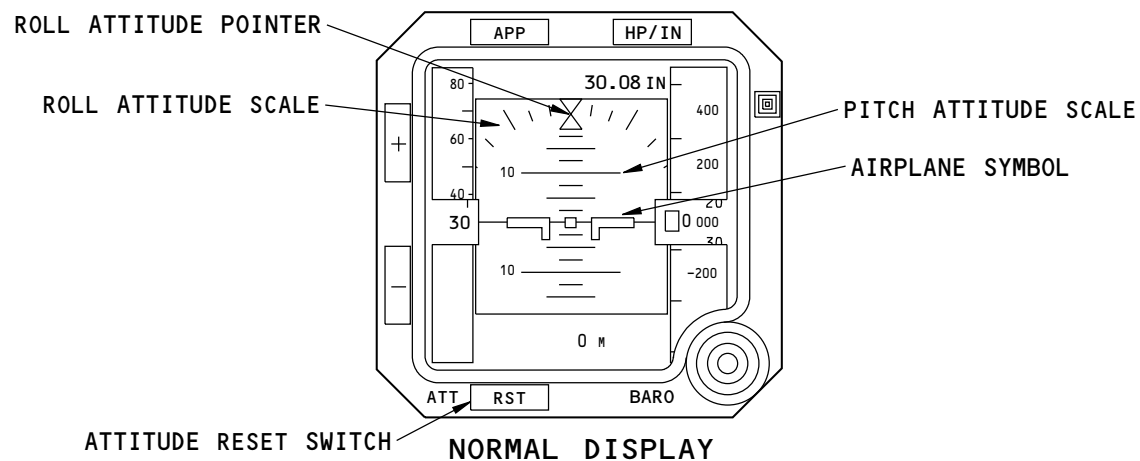
The attitude 10 seconds (ATT 10s) messages shows after you push the attitude reset switch. The ISFD aligns the attitude for 10 seconds. After 10 seconds, the ISFD shows the attitudes scales and pointer.

The attitude reset (ATT:RST) message shows if the inertial sensors sense angular rate or acceleration more than the maximum for more than 10 seconds. The maximum angular rate is 100 degrees per second. The maximum acceleration is 3.2g. Push the attitude reset switch to make the ISFD begin an attitude alignment.

Attitude Reset Switch (ATT RST)

Use the attitude reset switch to make the ISFD reset the attitude. Do this if there is an error between the ISFD attitude and the real airplane attitude, or if the ATT:RST message shows.

Push the attitude reset switch for a minimum of 2 seconds to start the attitude reset. The ISFD shows the message, ATT 10s. After 10 seconds, the message goes off and the attitude scales and pointer show.



FAILURE DISPLAY

MESSAGES

STANDBY ATTITUDE REFERENCE SYSTEM - OPERATION - ATTITUDE

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**STANDBY ATTITUDE REFERENCE SYSTEM - OPERATION - AIRSPEED AND ALTITUDE****General**

The ISFD uses electronic signals from the standby pitot and static air data modules to calculate indicated airspeed and altitude. The signals come from converted air data pressures from the lower right (center system) pitot probe and alternate (center system) static ports.

Indicated Airspeed

The airspeed tape shows on the left side of the display. Indicated airspeed shows in a digital display box with rolling digits.

The range of the indicated airspeed is 30 to 520 knots.

Altitude

The altitude tape shows on the right side of the display. Altitude shows in a digital display box with rolling digits.

The range of the altitude is -2,000 to 50,000 feet. The resolution of the altitude display is 10 feet.

Barometric Reference

The ISFD shows the barometric reference setting on the top right side of the display. Use the barometric control and the barometric reference switch to control the barometric reference setting.

Rotate the barometric control to change the barometric reference setting and set the barometric corrected altitude. The ISFD shows the barometric reference setting in units of hectopascals (hPa) or inches of mercury (in Hg). The ISFD shows HPA for hectopascals or IN for inches of mercury.

Use the barometric reference switch to change the units of the barometric reference setting. Push the switch to change the units from HPA to IN. Push the switch again to change the units to HPA.

Standard Barometric Pressure

Use the standard select switch in the center of the barometric control to set the standard barometric pressure (29.92 in Hg or 1013 hPa).

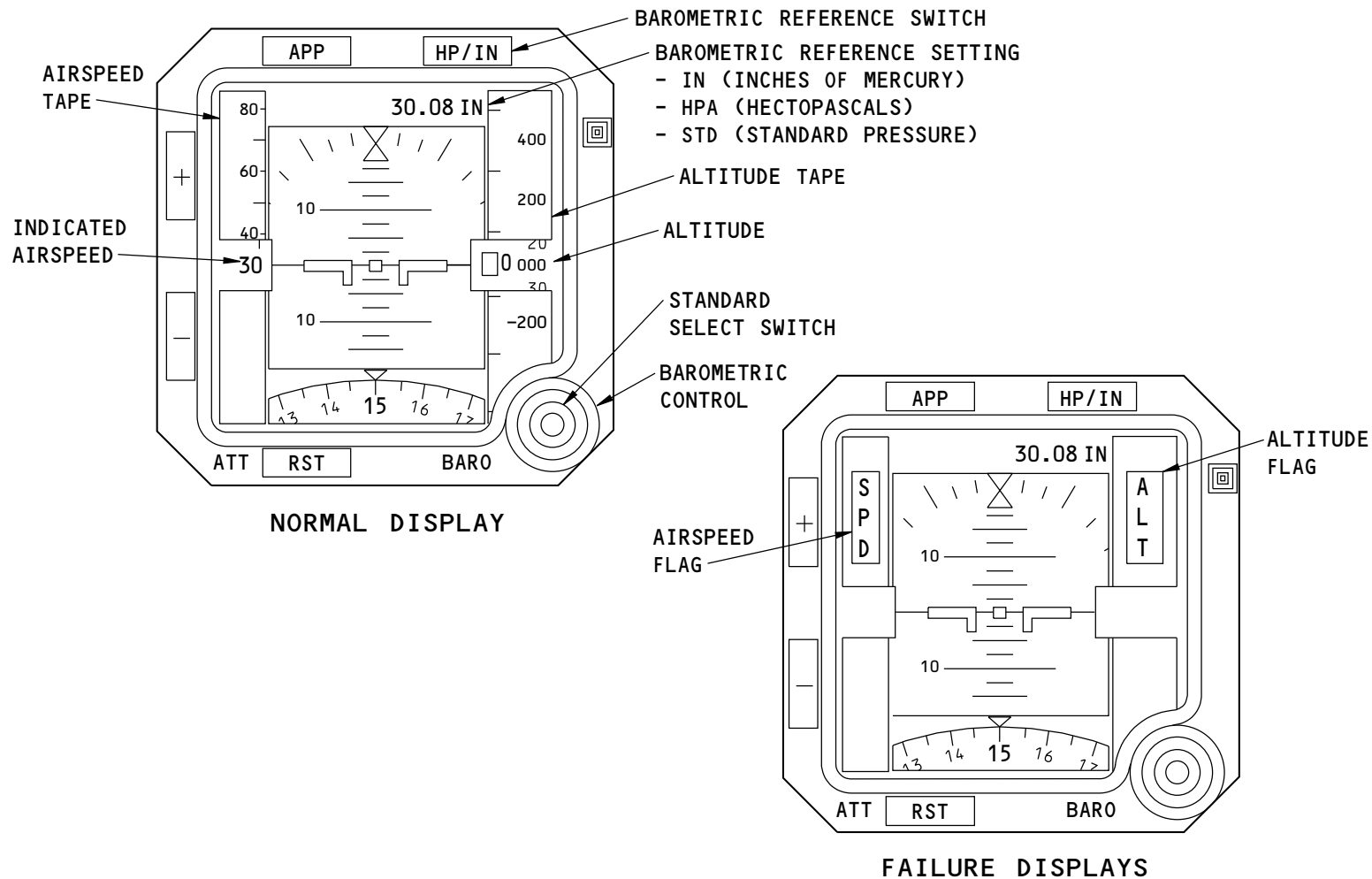
Push the standard select switch to change the barometric reference setting to the standard barometric pressure. The display shows STD for the barometric reference setting. Push the switch again to remove the standard setting. This lets you manually set the barometric reference.

Failure Displays

If the ISFD can not calculate the indicated airspeed, the airspeed tape and the indicated airspeed displays go off. The display shows the airspeed flag (SPD).

If the ISFD can not calculate the altitude, the altitude tape and the altitude displays go off. The display shows the altitude flag (ALT).

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STANDBY ATTITUDE REFERENCE SYSTEM - OPERATION - AIRSPEED AND ALTITUDE

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**STANDBY ATTITUDE REFERENCE SYSTEM - OPERATION - HEADING****General**

The integrated standby flight display (ISFD) receives magnetic heading data from the air data inertial reference system (ADIRS).

The ISFD shows the magnetic heading on a compass rose at the bottom of the display.

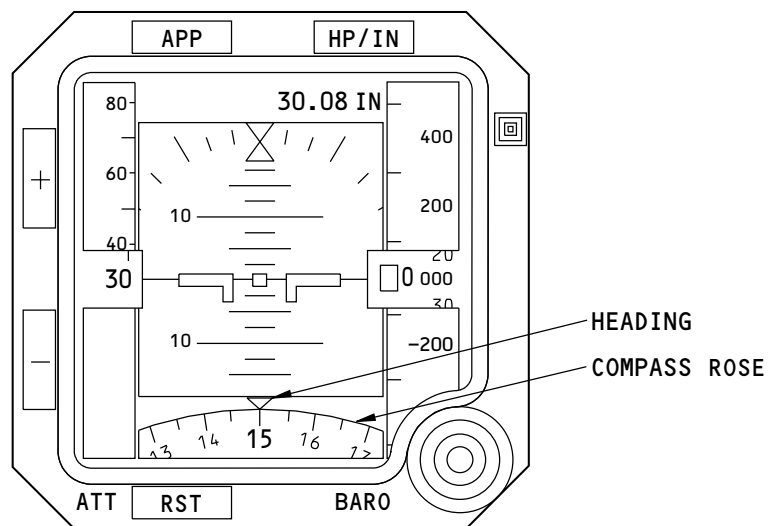
The range of the heading is from 0 to 360 degrees. The display resolution for heading is 1 degree.

Failure Display

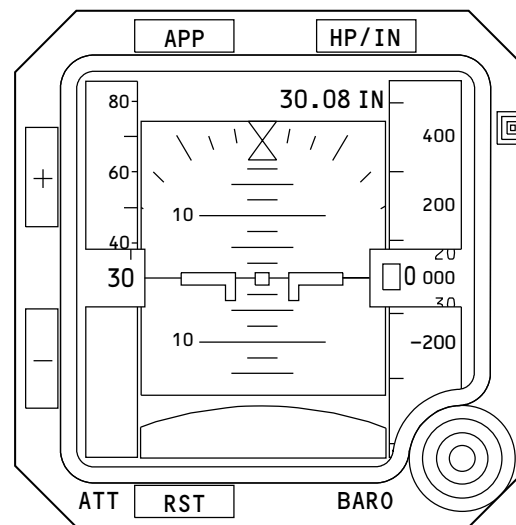
The ISFD shows the true heading and removes the compass rose if one of these conditions occurs:

- ISFD does not receive the magnetic heading data (ARINC 429 label 320) from the left AIMS cabinet
- Magnetic heading data is no computed data (NCD)
- Magnetic heading data word has a failure warning (FAIL WARN).

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NORMAL DISPLAY



FAILURE DISPLAY

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STANDBY ATTITUDE REFERENCE SYSTEM - OPERATION - HEADING

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STANDBY ATTITUDE REFERENCE SYSTEM - OPERATION - APPROACH

General

There are no special ILS tests for the integrated standby flight display (ISFD). You do a check of the approach display with a center multi-mode receiver (MMR-C) self-test.

Start the ILS self-test from the test switch on the navigation control panel. You can also start it from the test switch on MMR-C. Push the APP switch on the ISFD so that the APP annunciation shows on the display.

NOTE: The ISFD does not show ILS data at power-up. The first push of the APP switch shows normal ILS indications and the APP annunciation. The second push of the APP switch removes the glideslope scale, shows the localizer scale, and shows the BCRS annunciation. The third push of the APP switch removes all ILS indications and no ILS annunciations show.

This is the display sequence on the ISFD during the ILS self-test:

- Invalid data
- No computed data (NCD)
- Data correct - up/left
- Data correct - down/right.

The length of the self-test sequence is 14 seconds.

Invalid Data Display

Invalid data is the first display in the self-test sequence. It shows on the ISFD for three seconds. Invalid data causes these indications:

- LOC flag comes into view
- G/S flag comes into view
- Deviation scales go out of view
- Deviation pointers go out of view.

NCD Display

NCD is the second display in the self-test sequence. It shows on the ISFD for two seconds. NCD causes these indications:

- LOC flag goes out of view
- G/S flag goes out of view
- Deviation scales come into view
- Deviation pointers stay out of view.

Data Correct - Up/Left Display

Data correct - up/left is the third display in the self-test sequence. It shows for three seconds on the ISFD. Data correct - up/left causes these indications:

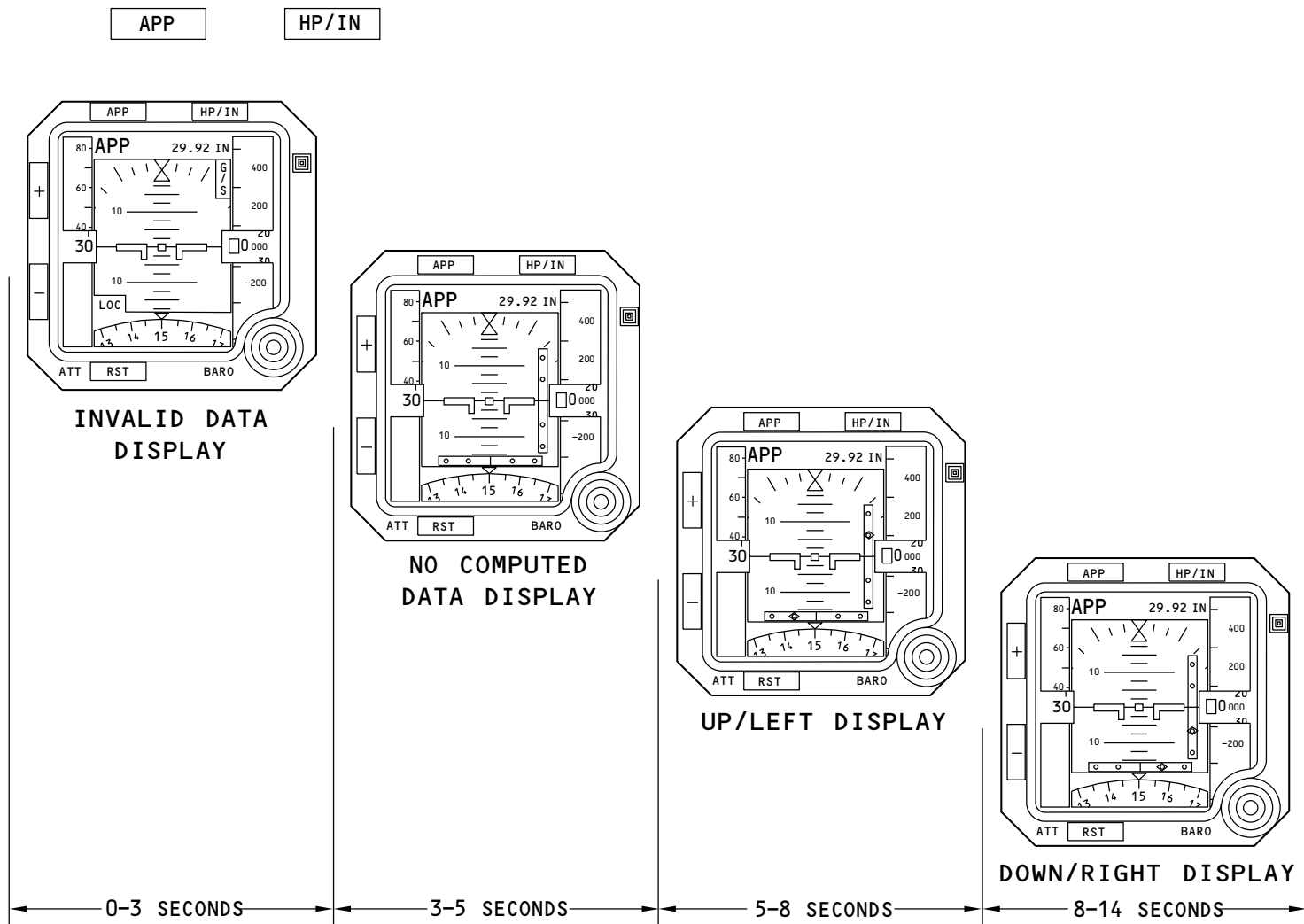
- LOC flag stays out of view
- G/S flag stays out of view
- Localizer pointer shows one dot of left deviation
- Glideslope pointer shows one dot of up deviation.

Data Correct - Down/Right Display

Data correct - down/right is the forth display in the self-test sequence. It shows for six seconds on the ISFD. Data correct - down/right causes these indications:

- LOC flag stays out of view
- G/S flag stays out of view
- Localizer pointer shows one dot of right deviation
- Glideslope pointer shows one dot of down deviation.

The approach display goes back to normal indications at the end of the self-test sequence.



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STANDBY ATTITUDE REFERENCE SYSTEM - OPERATION - APPROACH

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STANDBY ATTITUDE REFERENCE SYSTEM - TIP - BITE MENU

General

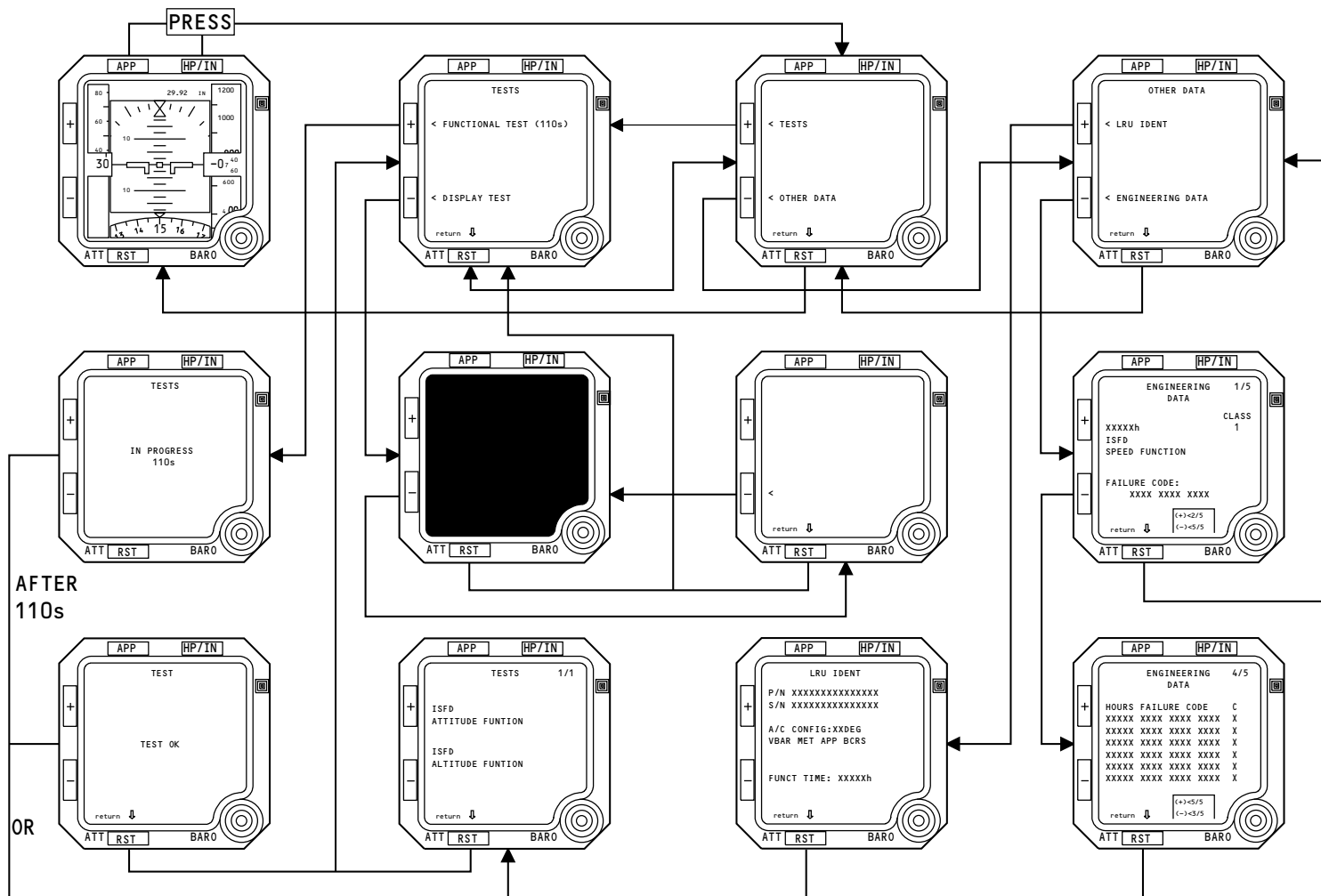
The ISFD has internal BITE that lets you monitor and do tests. To show the BITE displays, the airplane must be on the ground and the ISFD power-up complete.

NOTE: The ISFD uses internal calculations of computed air speed or, as a backup, ADIRU ground speed to determine the on ground condition. The threshold speed is 100 kts.

ISFD Tests

To start the BITE, simultaneously push and hold the APP and the HP/IN switches for at least two seconds. After two seconds, the TESTS and OTHER DATA page shows. From this BITE page you can go the other BITE pages or return to the normal display operation.

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STANDBY ATTITUDE REFERENCE SYSTEM - TIP - BITE MENU

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STANDBY ATTITUDE REFERENCE SYSTEM - TIP - BITE - FUNCTIONAL TEST

General

The functional test checks the operation of the integrated standby flight display (ISFD) and the input signals to the ISFD.

Access

Push and hold the approach mode (APP) and the barometric reference setting (HP/IN) switches for 2 seconds. The ISFD shows the menu with TESTS and OTHER DATA prompts.

Turn and push the BARO knob to select FUNCTIONAL TESTS on the maintenance page. The display shows the TEST page with the IN PROGRESS 110s message.

Functional Test

The functional test checks the internal operation of the ISFD. It also checks the input signals to the ISFD. For example, the test checks the program pins and the ARINC 429 input from the air data inertial reference unit (ADIRU).

The test lasts for about 110 seconds. When the ISFD completes the test, the display shows TEST OK or the display shows the fault messages.

When the TEST OK shows, all circuits are operating correctly. When a fault message shows, there is a failure.

Fault Messages

At the end of the functional test, the ISFD BITE shows fault messages if there are faults. The table below shows the possible fault messages and the flight deck effects.

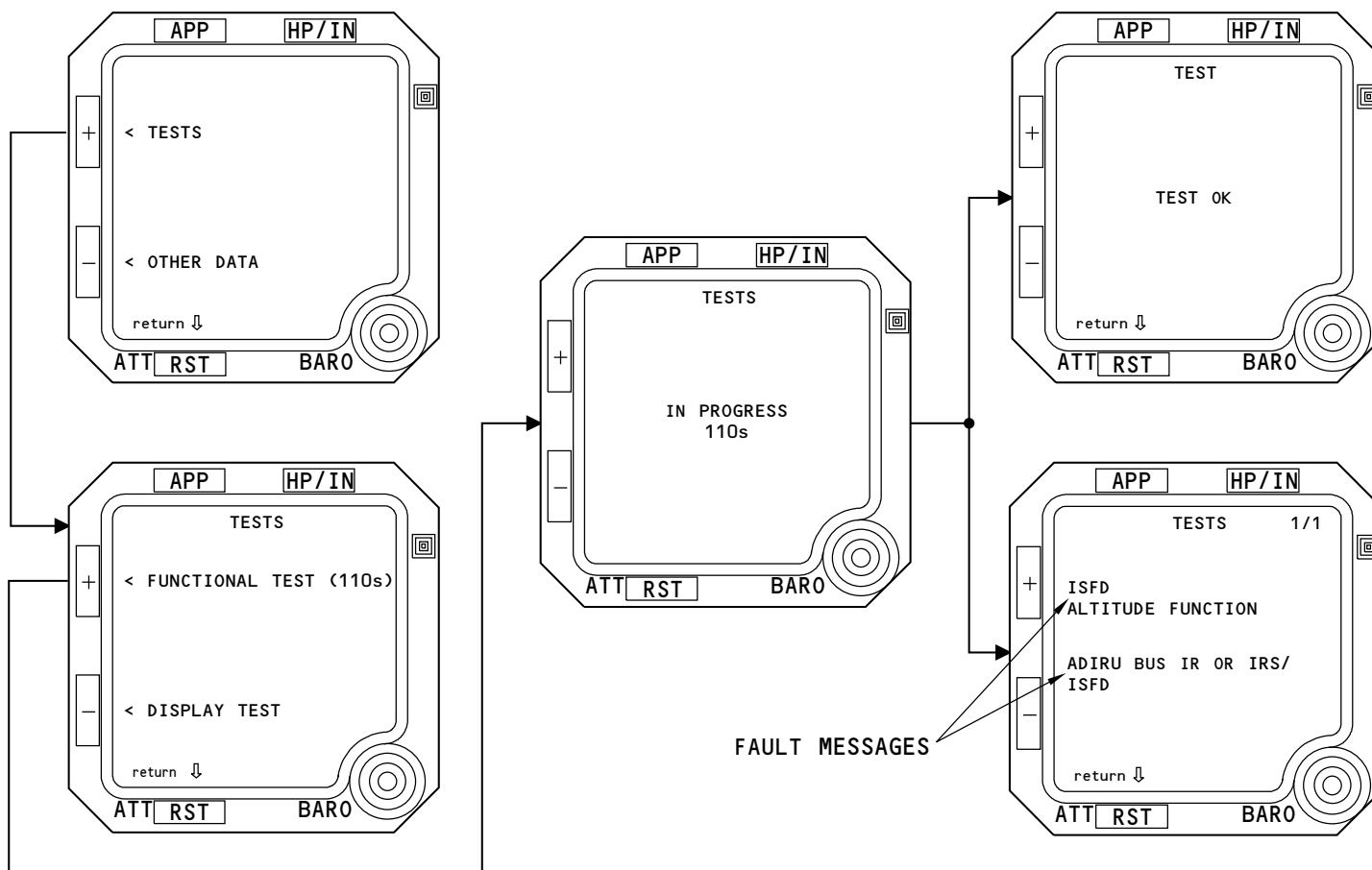
Flight Deck Effect	Fault Message	Internal or External
ATT	ISFD ATTITUDE_FUNCTION	Internal
SPD	ISFD SPEED_FUNCTION___	Internal
ALT	ISFD ALTITUDE_FUNCTION	Internal
G/S and/or LOC	ILS OR MMR/ ISFD	External
HDG	ADIRU BUS IR OR IRS/ ISFD	External
no effect	POWER SUPPLY INTERRUPT	External
no effect	WRG TEST DISCRETE/ ISFD	External

Flight Deck Effect	Fault Message	Internal or External
OUT OF ORDER	ISFD	Internal
PROGRAM PIN ERROR	WRG: MODE DISCRETE/ ISFD	External
PROGRAM PIN ERROR	WRG: PARITY PIN- PROG/ ISFD	External

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STANDBY ATTITUDE REFERENCE SYSTEM - TIP - BITE - FUNCTIONAL TEST

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**STANDBY ATTITUDE REFERENCE SYSTEM - TIP - BITE - DISPLAY TEST****General**

The display test checks the operation of the liquid crystal display (LCD) matrix in the integrated standby flight display (ISFD).

Access

Push and hold the approach mode (APP) and the barometric reference setting (HP/IN) switches for 2 seconds. The ISFD shows the menu with TESTS and OTHER DATA prompts.

Push the + switch to show the TESTS menu.

Display Test

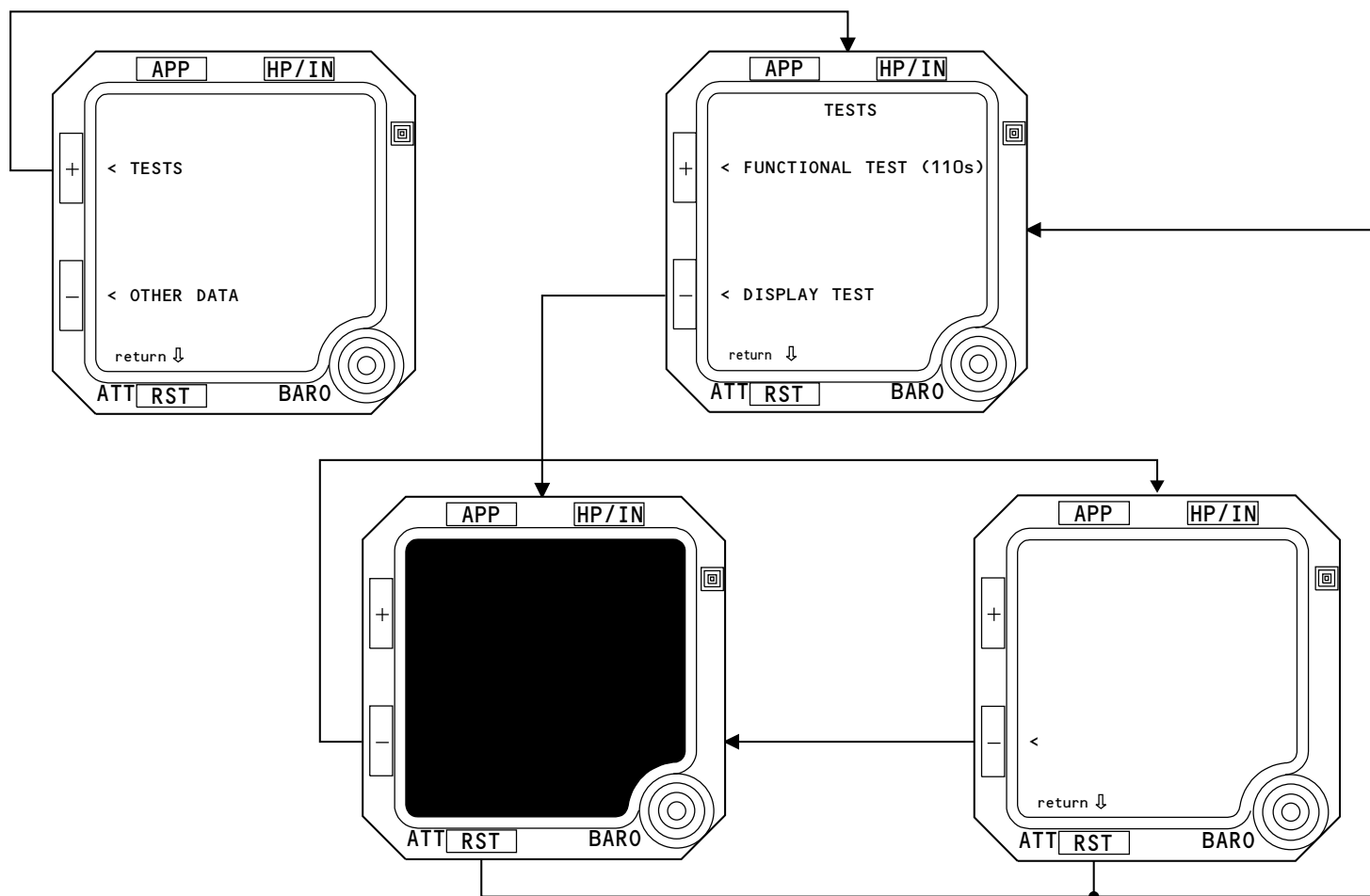
When the ISFD starts the display test, the display shows white.

Push the - switch again to make the display show black.

Continue to push the - switch to show white and black screens.

Push the attitude reset (RST) switch to return to the tests menu.

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W50596 S0000125323_V1

STANDBY ATTITUDE REFERENCE SYSTEM - TIP - BITE - DISPLAY TEST

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STANDBY ATTITUDE REFERENCE SYSTEM - TIP - BITE - LRU IDENT

General

The LRU IDENT (line-replaceable-unit identification) page lets you see identification data for the ISFD.

Access

Push and hold the approach mode (APP) and the barometric reference setting (HP/IN) switches for two seconds. The ISFD shows the menu with TESTS and OTHER DATA prompts.

Push the - switch to show the OTHER DATA menu.

Push the + switch to show the LRU IDENT page.

LRU Ident

The LRU ident page shows these parameters about the ISFD:

- Hardware part number
- Software part number
- Airplane configuration which shows the tilt angle for the airplane model
- Options set by the program pins
- Time in operation.

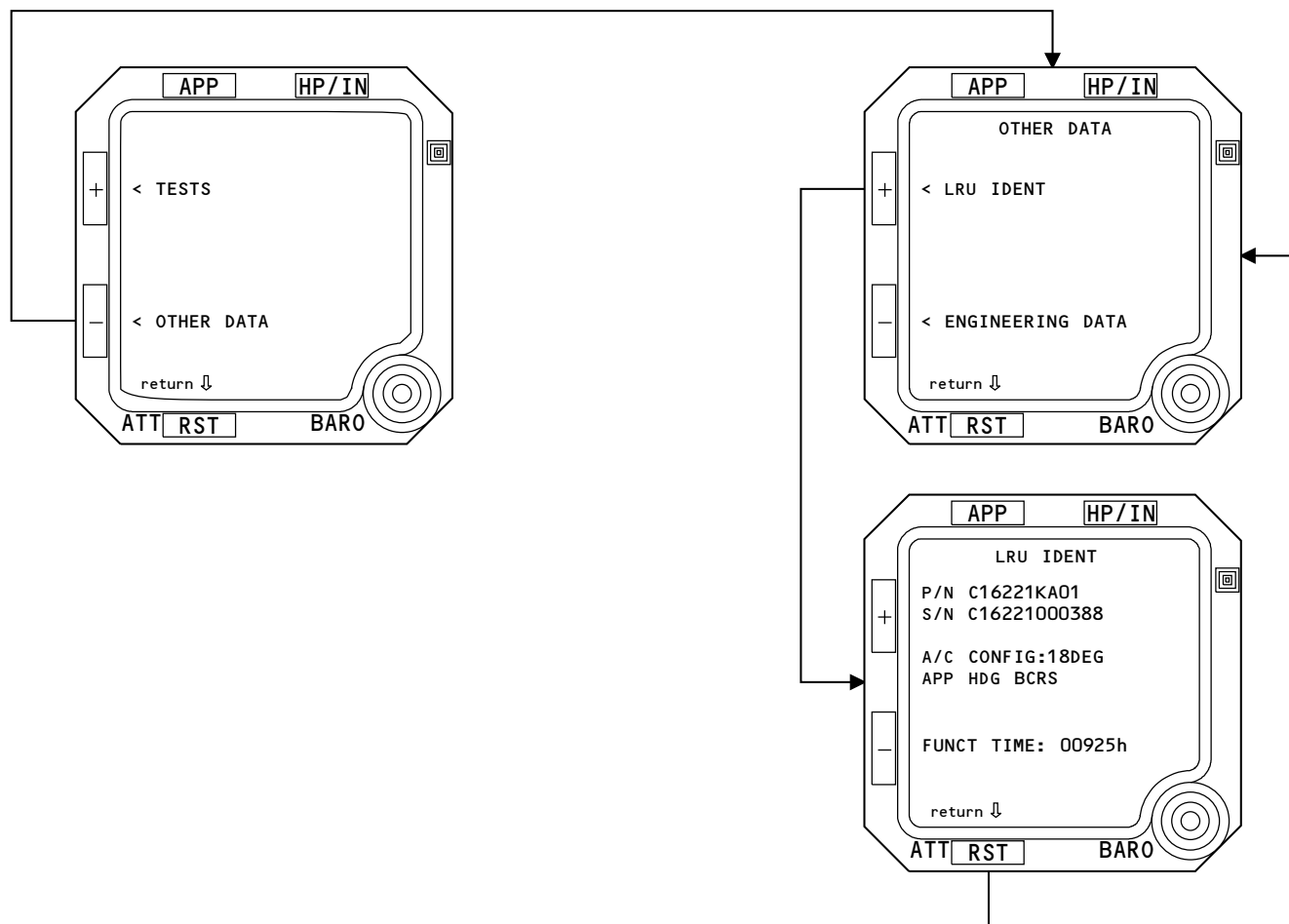
Push the attitude reset (RST) switch to return to the OTHER DATA menu.

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W50627 S0000125324_V1

STANDBY ATTITUDE REFERENCE SYSTEM - TIP - BITE - LRU IDENT

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**STANDBY ATTITUDE REFERENCE SYSTEM - TIP - BITE - ENGINEERING DATA****General**

The ENGINEERING DATA page lets you see information about faults.

Access

Push and hold the approach mode (APP) and the barometric reference setting (HP/IN) switches for two seconds. The ISFD shows the menu with TESTS and OTHER DATA prompts.

Push the - switch to show the OTHER DATA menu.

Push the - switch to show the ENGINEERING DATA page.

LRU Ident

The engineering data page shows these parameters about failures:

- Time of failure
- Class (1, 2, or 3)
- Fault message
- Failure code.

The ISFD shows 1, 2, or 3 pages of engineering data which show the fault message and failure code. These pages show one fault per page.

The ISFD shows 1 or 2 pages of engineering data which show a list of the time of failure, the failure code, and the class of the failure.

These are the classes of failures:

- Class 1 - A failure which has a flight deck effect and must be reported.
- Class 2 - A failure which is less important than a class 1 failure.
- Class 3 - A failure which has no flight deck effect and has no effect on the operation of the airplane systems.

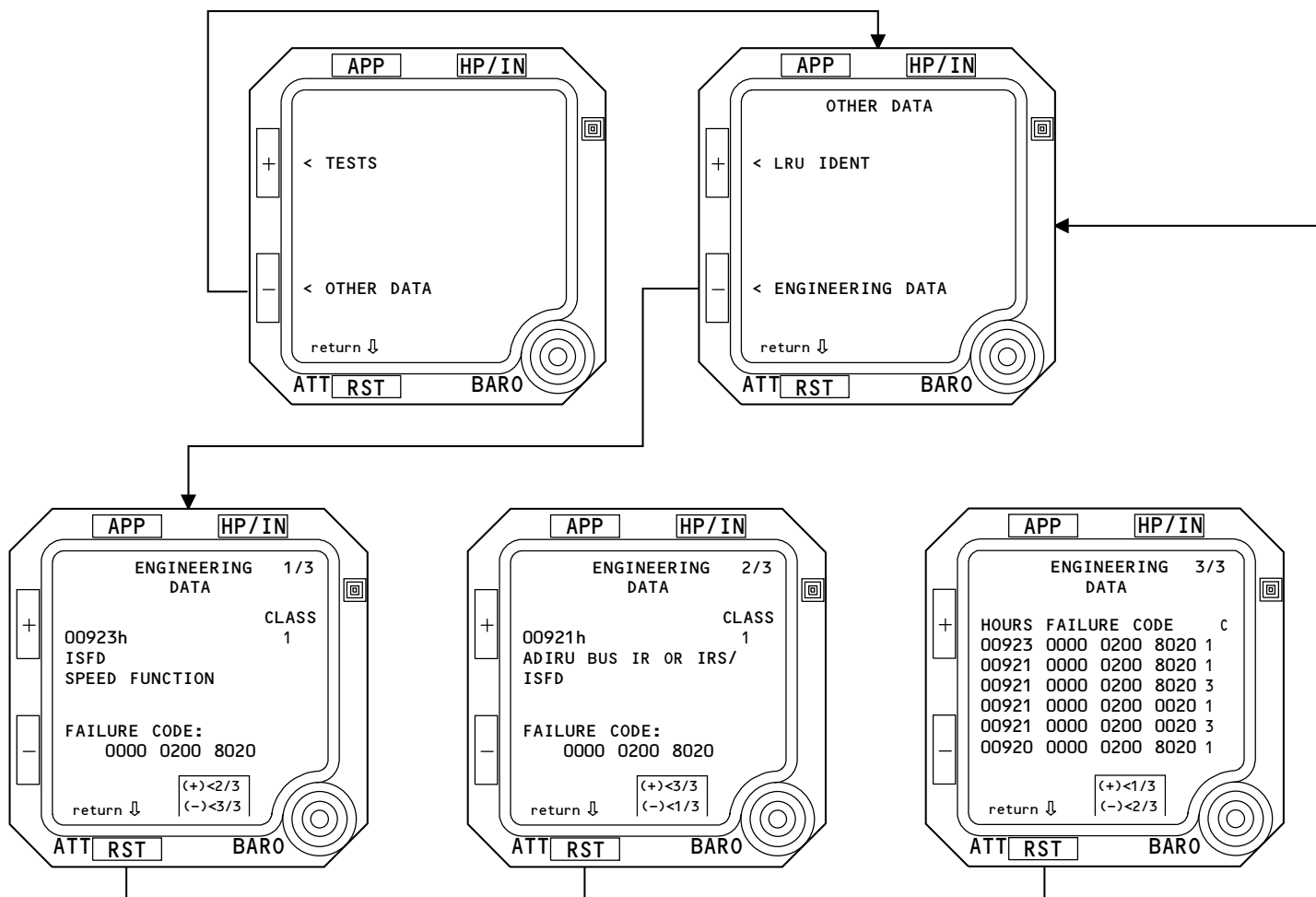
Push the attitude reset (RST) switch to return to the OTHER DATA menu.

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STANDBY ATTITUDE REFERENCE SYSTEM - TIP - BITE - ENGINEERING DATA

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ILS - INTRODUCTION

Purpose

The multi-mode receiver (MMR) has these functions:

- Instrument landing system (ILS) function
- Global positioning system (GPS) function.

The ILS function provides lateral and vertical guidance to the runway on approach. The system uses signals from a glideslope ground station and a localizer ground station.

The glideslope station transmits signals to give the airplane a descent path to the touchdown point on the runway. The localizer station transmits signals to give a lateral path to keep the airplane centered on the runway.

The ILS system provides station audio and identifier signals to the flight interphone speakers and the headsets.

Abbreviations and Acronyms

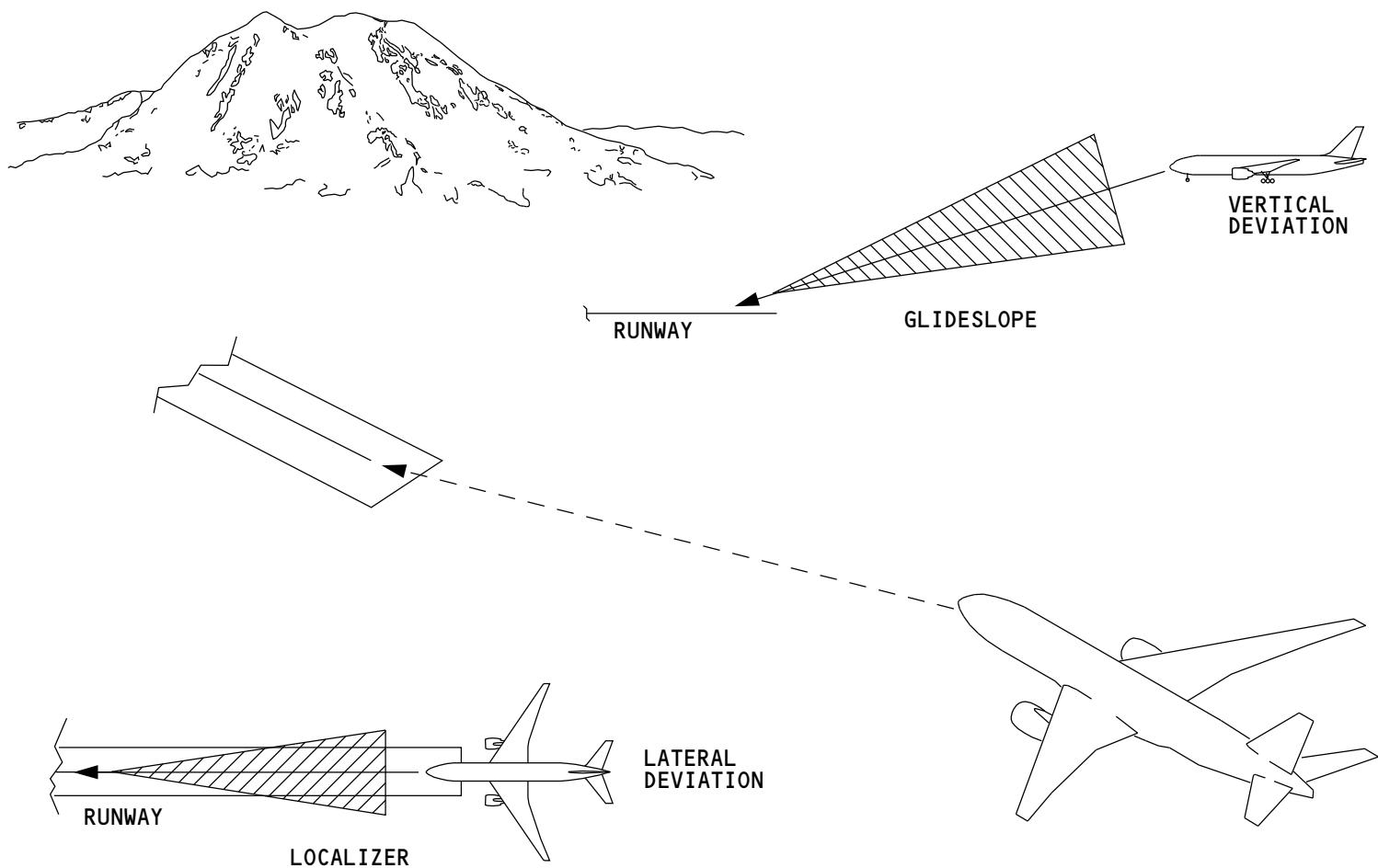
- ACP - audio control panel
- AFDS - autopilot flight director system
- AIMS - airplane information management system
- AMU - audio management unit
- CDU - control display unit
- CMCS - central maintenance computing system
- GPWC - ground proximity warning computer
- ILS - instrument landing system
- MMR - multi-mode receiver
- ND - navigation display
- PFD - primary flight display
- VOR - VHF omnidirectional ranging

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ILS - INTRODUCTION

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ILS - GENERAL DESCRIPTION

General

The instrument landing system (ILS) has three multi-mode receivers (MMRs). The ILS system uses inputs from these antennas:

- VOR antenna
- Localizer antennas
- Glideslope capture antennas
- Glideslope track antennas.

Description

The antenna inputs go through localizer and glideslope antenna switches, then to the MMRs.

The receivers get manual tune inputs from the left or right CDU, or autotune inputs from the airplane information management system (AIMS) cabinets. The receivers get tune inputs directly from the left or right CDU (alternate tune) if the tune inputs from AIMS fails.

ILS deviations go to both AIMS cabinets to show ILS data on the primary flight displays (PFDs) and navigation displays (NDs).

ILS deviations go to the autopilot flight director computers (AFDCs) for autoland calculations. The AFDCs send ILS tune inhibits during approach mode.

The left MMR sends glideslope deviation to the ground proximity warning computer (GPWC) for mode 5 alerts.

The receivers also send station audio and identifier signals to the audio management unit (AMU).

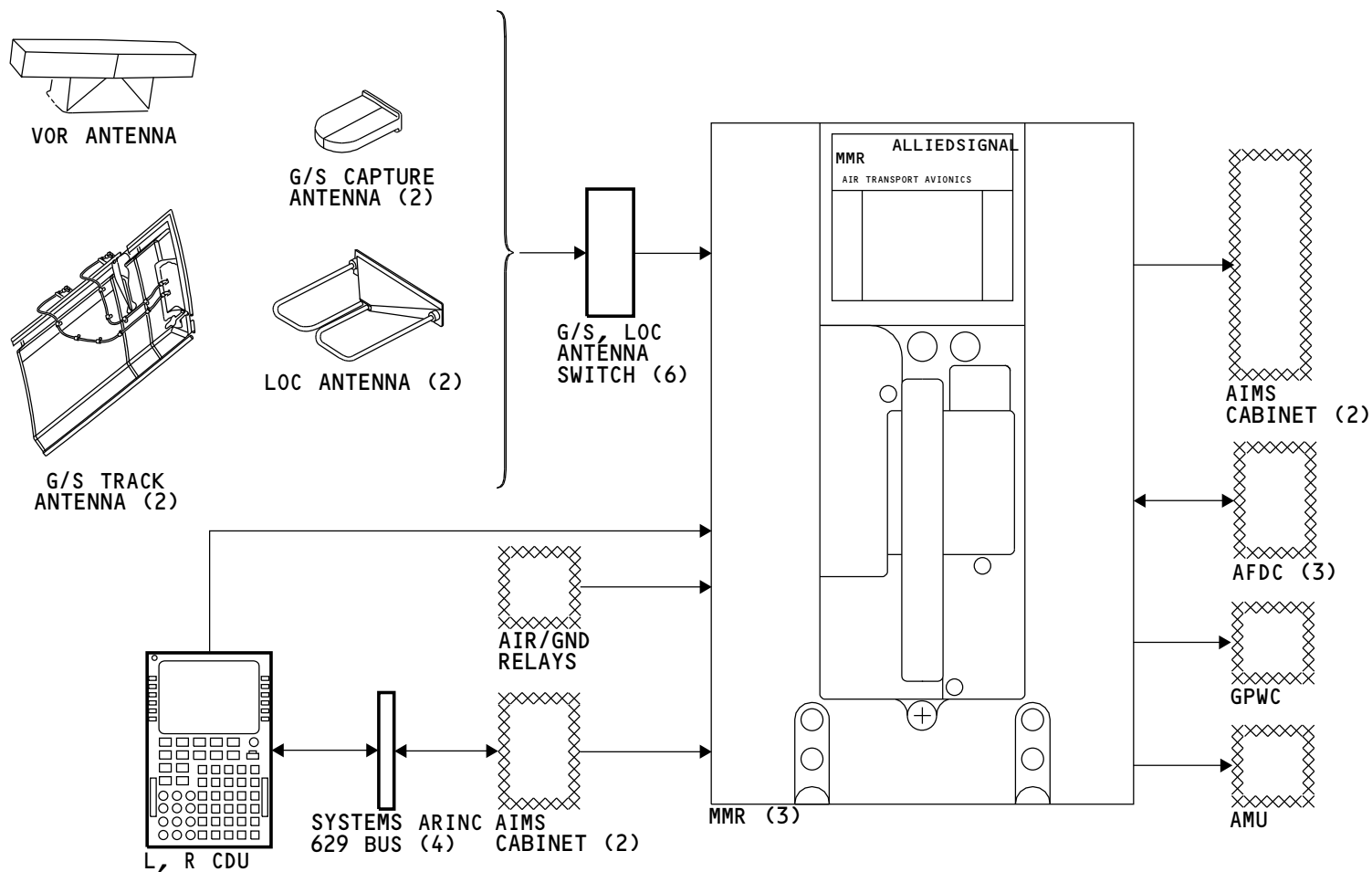
The receivers get discrete inputs from the air/ground relays.

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ILS - GENERAL DESCRIPTION

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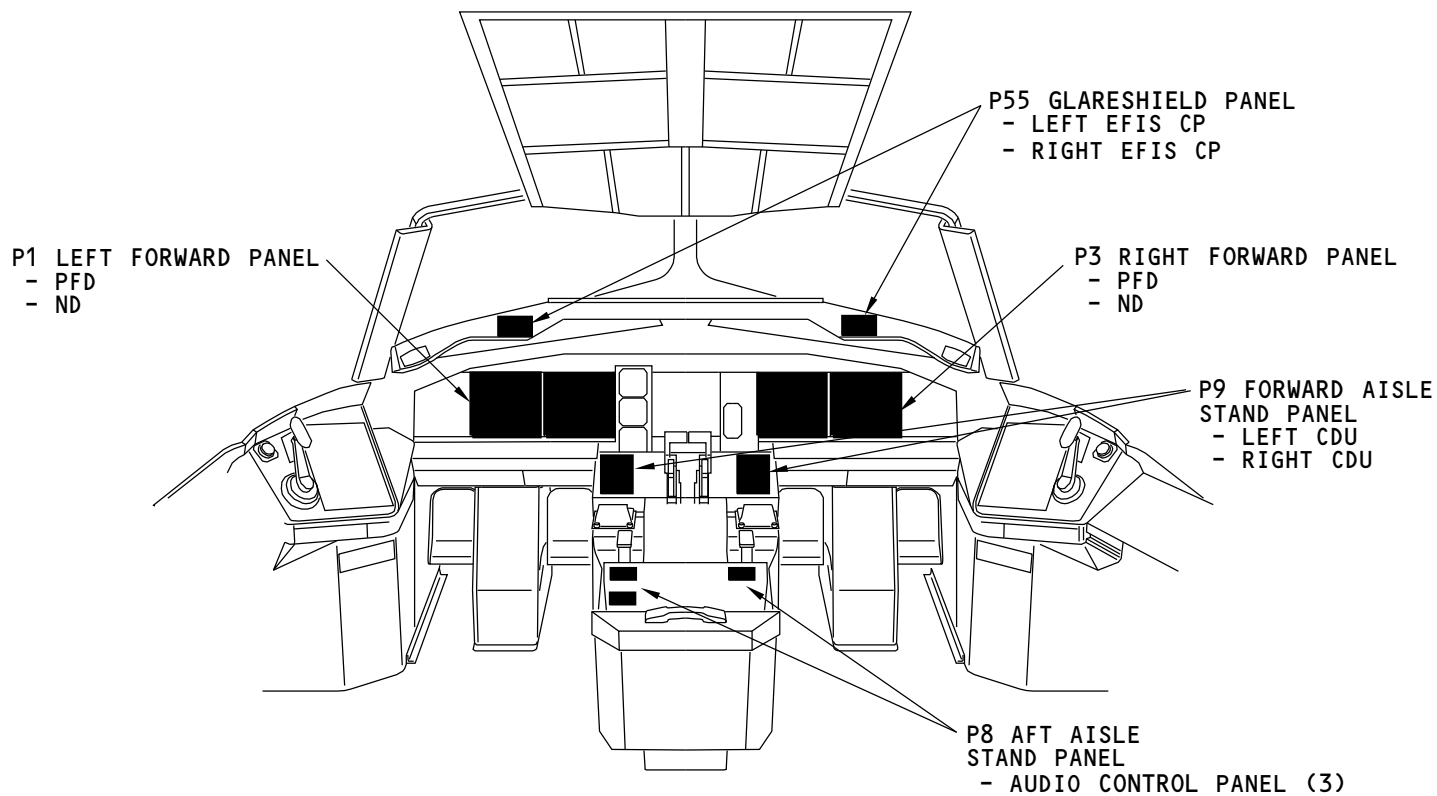


ILS - FLIGHT DECK COMPONENT LOCATION

General

The components on the flight deck that interface with the ILS system are:

- Left and right EFIS control panels
- Captain and first officer primary flight displays (PFDs) and navigation displays (NDs)
- Left and right CDUs
- Audio control panels (ACP).



ILS - FLIGHT DECK COMPONENT LOCATION

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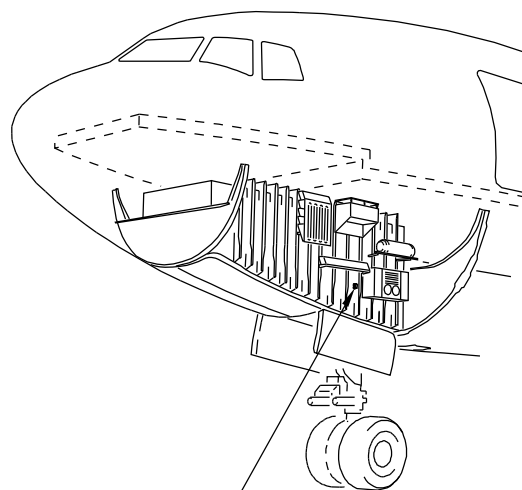


ILS - MAIN EQUIPMENT CENTER COMPONENT LOCATIONS

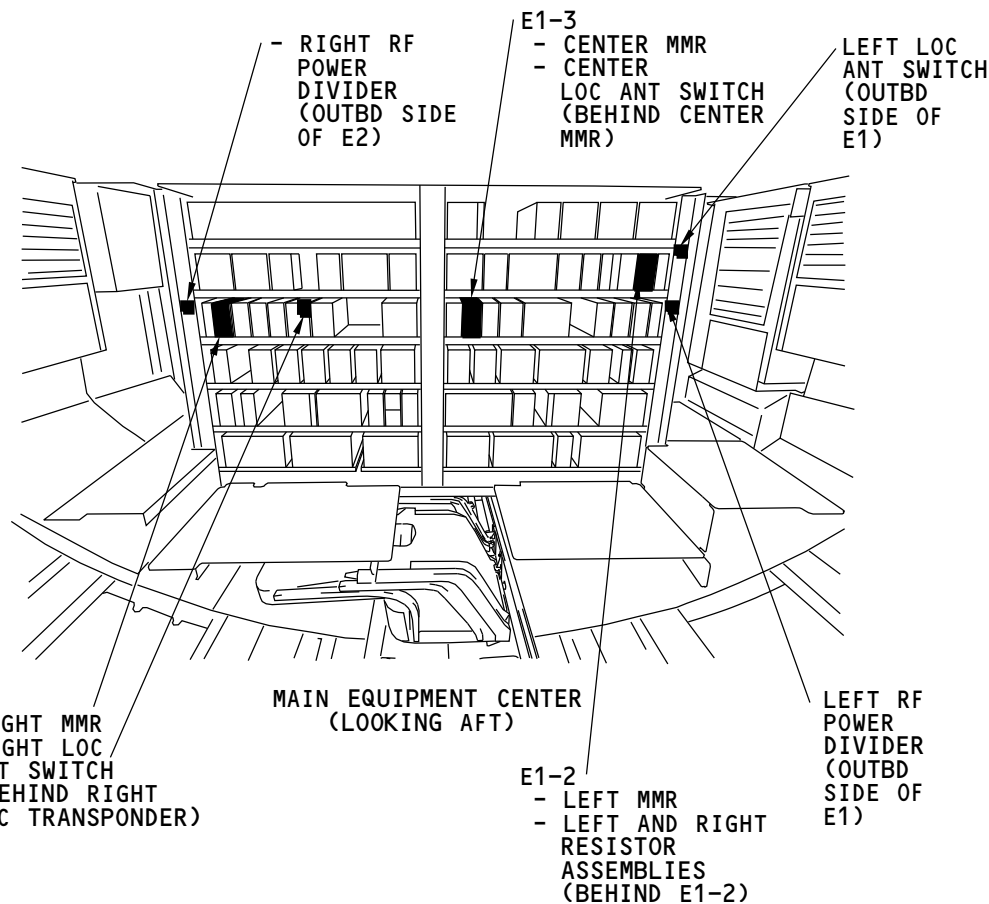
Equipment Center

These are ILS components in the main equipment center:

- Left, center, and right glideslope antenna switches
- Left, center, and right multi-mode receivers (MMRs)
- Left, center, and right localizer antenna switches
- Left and right resistor assemblies
- Left and right RF power dividers.



LEFT AND CENTER
GLIDESLOPE ANT SWITCH
(RIGHT GLIDESLOPE ANT
SWITCH SAME LOCATION
ON RIGHT SIDE)



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ILS - MAIN EQUIPMENT CENTER COMPONENT LOCATIONS

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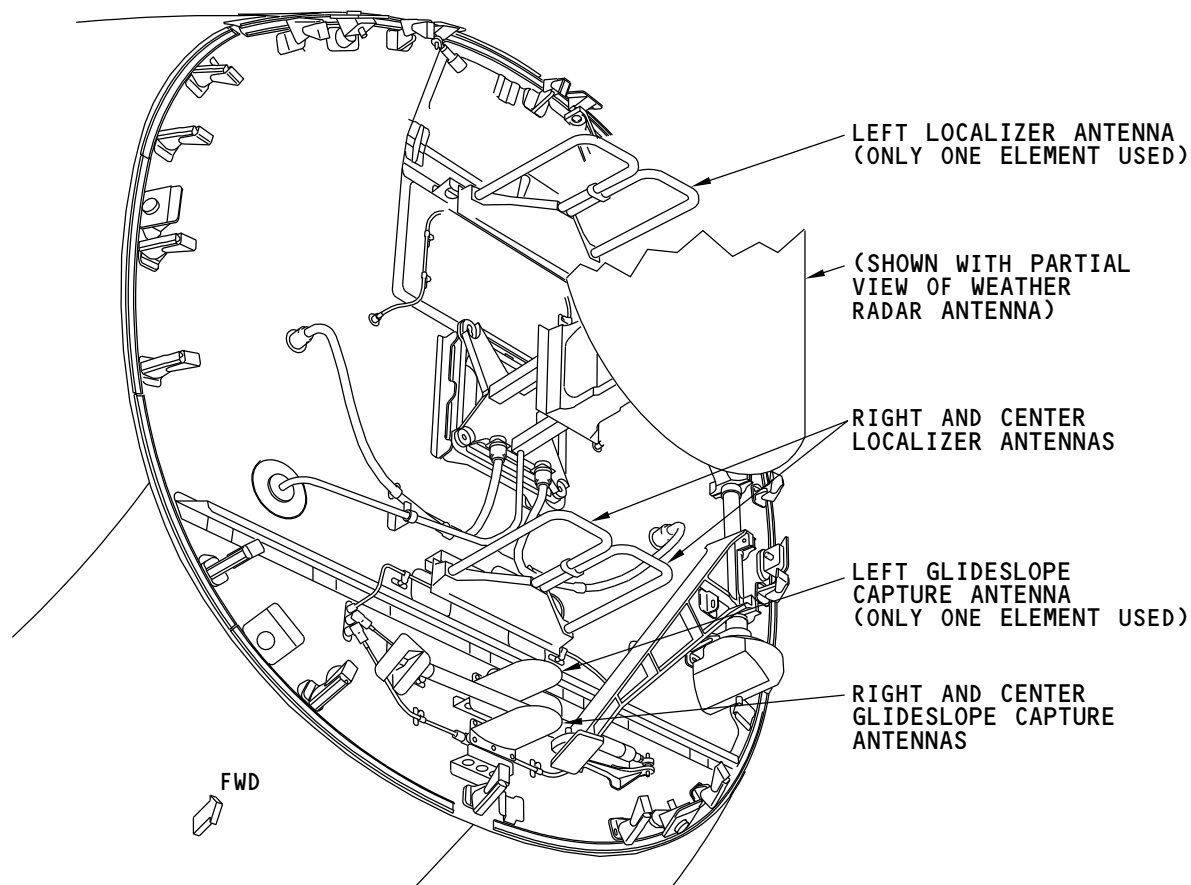
ILS - NOSE RADOME COMPONENT LOCATIONS

General

The ILS components in the nose radome are:

- Left localizer antenna
- Right and center localizer antennas
- Left glideslope capture antenna
- Right and center glideslope capture antennas.

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ILS - NOSE RADOME COMPONENT LOCATIONS

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ILS - FUSELAGE COMPONENT LOCATIONS

VOR Antenna

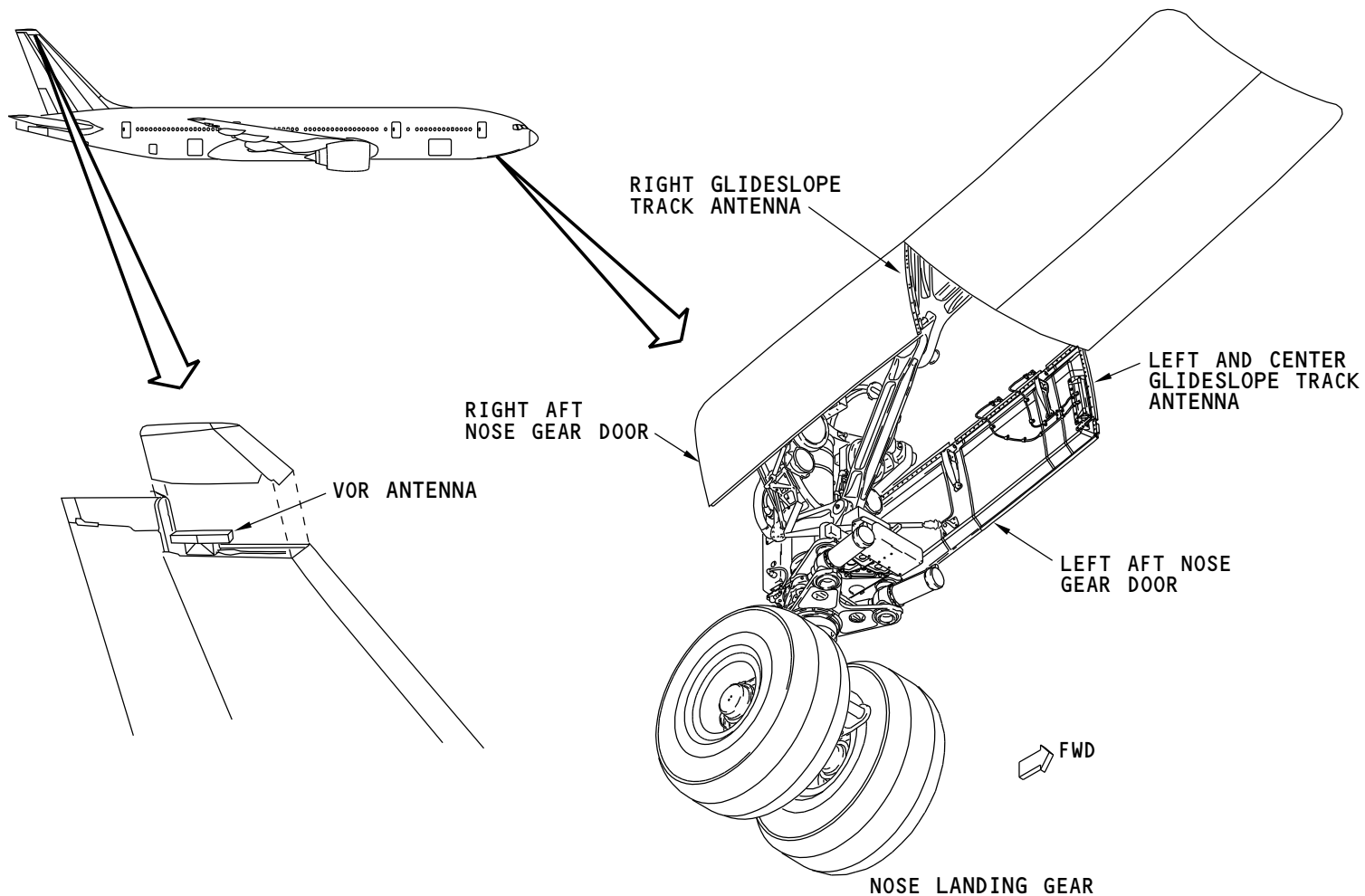
The VOR antenna is on top of the vertical stabilizer. The VOR antenna receives VOR and localizer signals.

Glideslope Track Antennas

The glideslope track antennas are on the leading edge of the left and right aft nose gear doors.

The left and center glideslope track antennas are on the left aft nose gear door and the right glideslope track antenna is on the right aft nose gear door.

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ILS - FUSELAGE COMPONENT LOCATIONS

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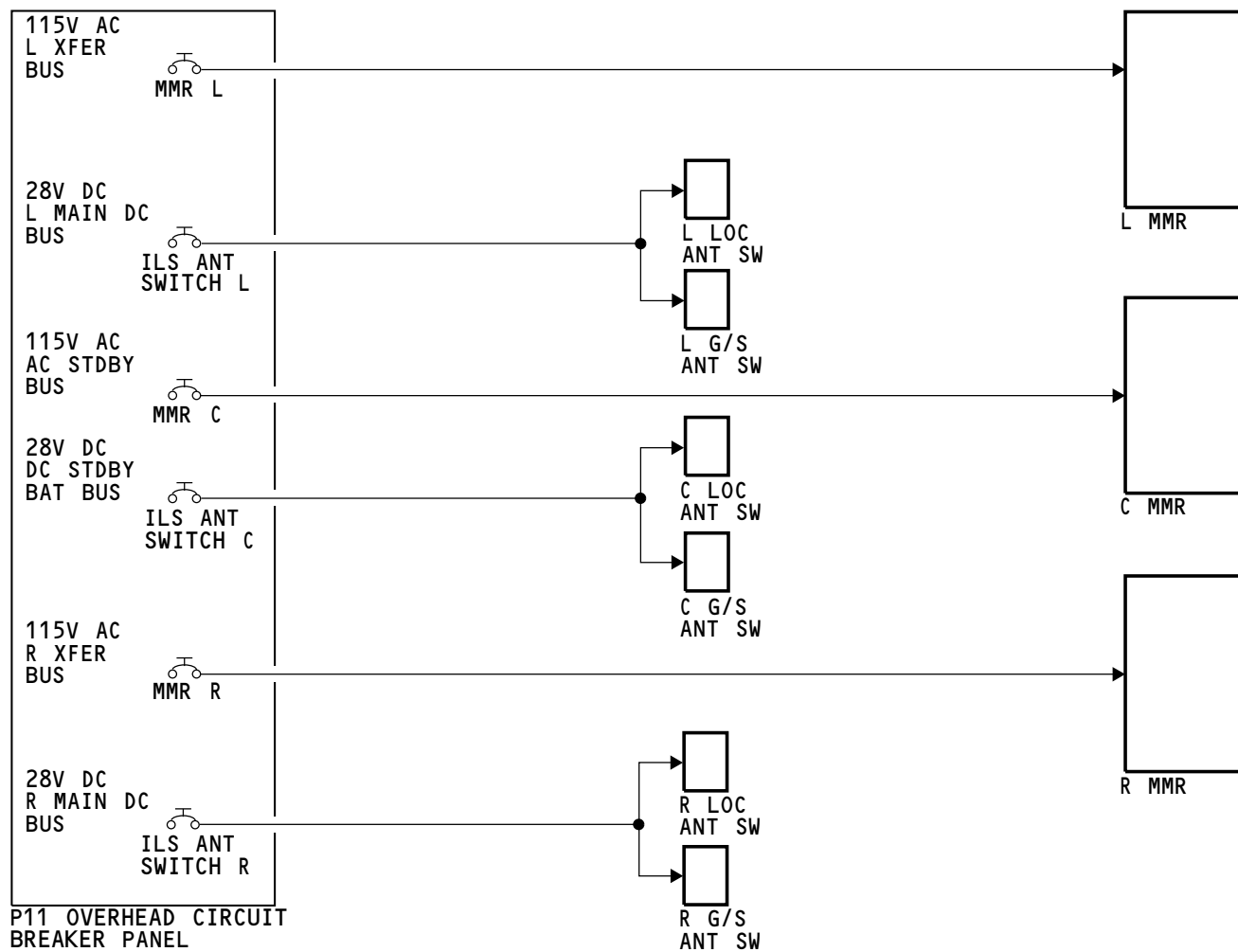


ILS - POWER INPUTS

Power Inputs

The left and right multi-mode receivers (MMRs) get 115v ac, 400 Hz power from the left and right 115v ac transfer buses. The center MMR gets 115v ac, 400 Hz power from the AC standby bus.

The left and right localizer and glideslope antenna switches get 28v dc from the left and right main DC buses. The center localizer and glideslope antenna switches get 28v dc from the DC standby battery bus.



ILS - POWER INPUTS

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ILS - ANALOG AND DISCRETE INTERFACE

General

The LRUs that interface with the multi-mode receivers (MMRs) with analog and discrete signals are:

- Left and right control display units (CDUs)
- Air/ground relays
- Left, right, and center autopilot flight director computers (AFDCs)
- Audio management unit (AMU).

Discrete Inputs

The receivers get discrete inputs from these sources:

- CDUs
- Air/ground relays
- AFDCs.

The CDUs send a frequency source select discrete to cause the receiver to select the tune input from either the CDU or the AIMS cabinets. The resistor assemblies pull up the discretes to 28v dc. The left CDU sends a ground discrete to the left and center receivers when the discrete is true. The right CDU sends a ground discrete to the right receiver when the discrete is true.

The air/ground relays send a discrete to the receivers to inhibit tests in the air. The discrete also supplies flight legs data as a backup to the AIMS cabinets flight legs data.

The AFDCs send a discrete to inhibit ILS tune inputs in approach (APP) mode when the airplane is at or below 1500 feet, and there is a localizer or glideslope signal capture. This prevents the flight crew from tuning the receivers.

Analog Outputs

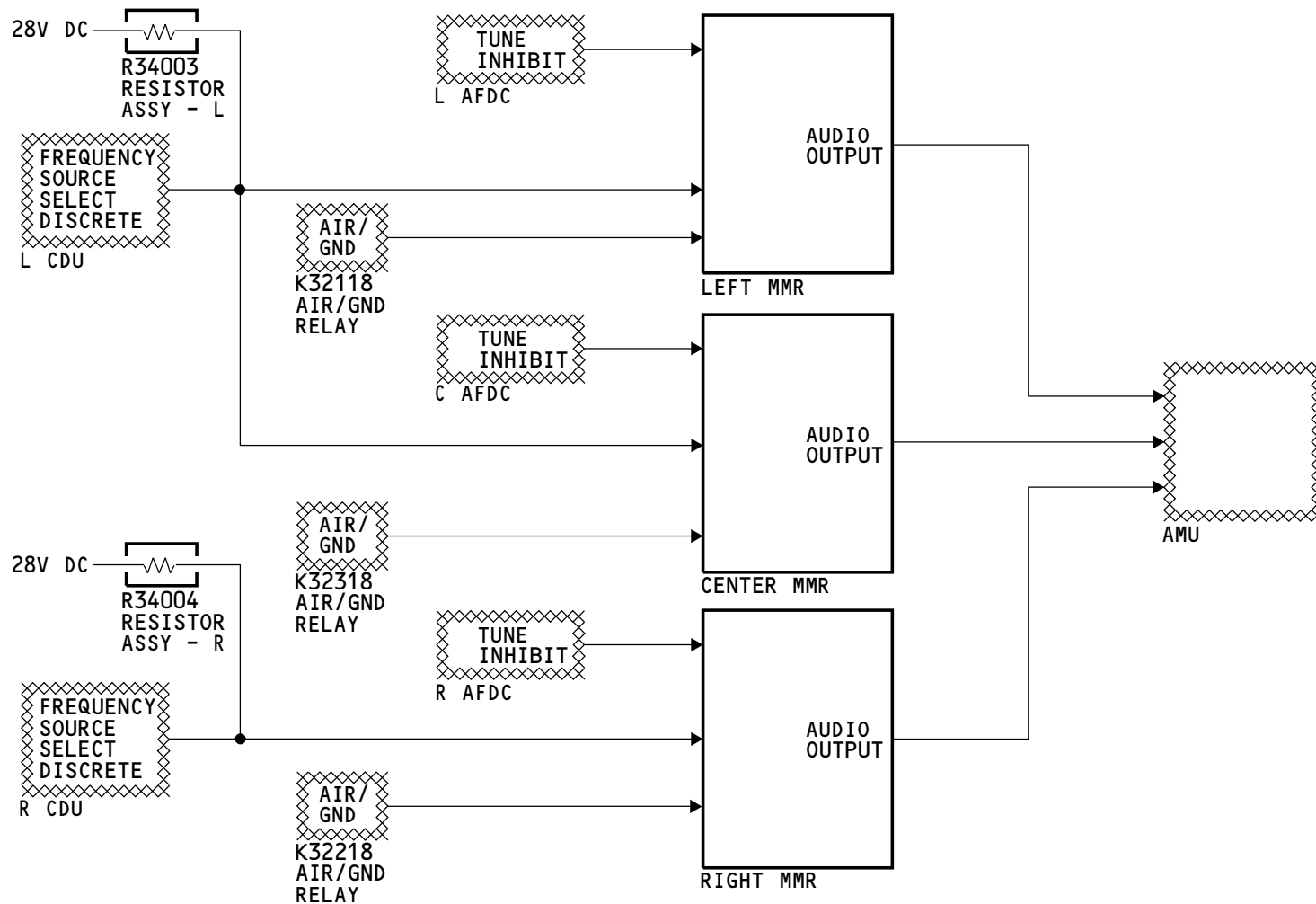
Each receiver sends an audio output to the AMU. The pilots use the audio control panels (ACP) to send ILS audio to the headsets and flight interphone speakers.

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ILS - ANALOG AND DISCRETE INTERFACE

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ILS - ARINC 429 INTERFACE

General

These are the LRUs that have interface with the multi-mode receivers (MMRs) on ARINC 429 data buses:

- Left and right control display units (CDUs)
- Left and right AIMS cabinets
- Left, center, and right autopilot flight director computers (AFDCs)
- Ground proximity warning computer (GPWC).

CDU

The left and right CDUs supply alternate tune inputs directly to the receivers if the AIMS tune inputs fail. The left CDU sends alternate tune signals to the left and center receivers. The right CDU sends alternate tune signals to the right receiver.

AIMS

The right AIMS cabinet sends manual or automatic tune inputs to the receivers on the left, center, and right tune buses.

The left AIMS cabinet sends test commands and flight legs data to the receivers on the left, center, and right CMC buses.

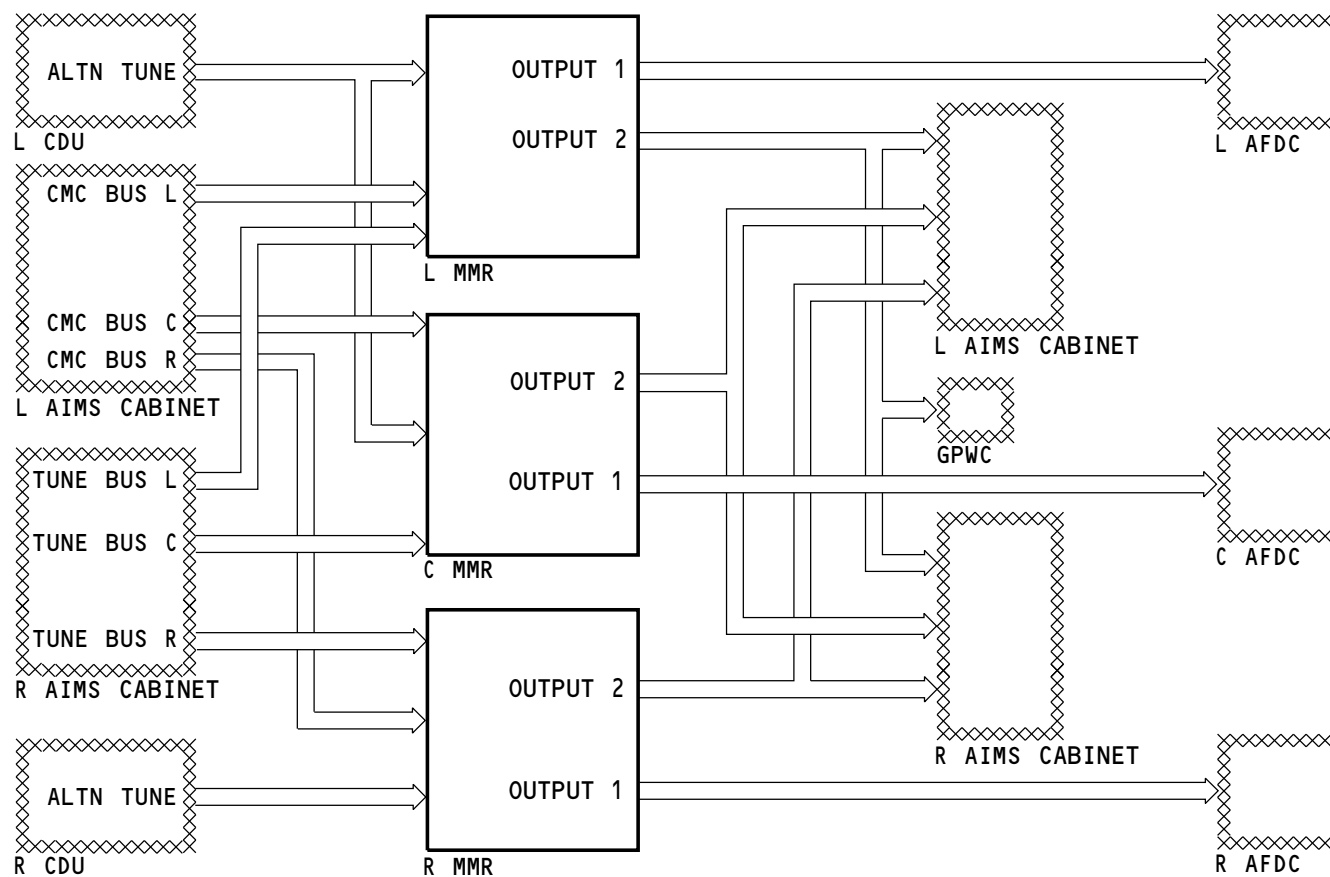
Receiver Outputs

Each receiver has two output buses. Output bus one supplies data to the onside AFDC. Output bus two supplies data to both AIMS cabinets.

Each receiver sends data to both AIMS cabinet to show ILS data on the PFDs and NDs. The receivers also send test status and fault reports.

The left receiver sends ILS data to the GPWC for mode five alerts.

Each receiver sends ILS data to the onside AFDC for autoland functions.



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ILS - ARINC 429 INTERFACE

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ILS - LOCALIZER ANTENNA INPUTS

General

The multi-mode receivers (MMRs) get localizer signal inputs from the localizer antennas in the nose radome or from the VOR antenna on the vertical stabilizer.

Antenna Inputs

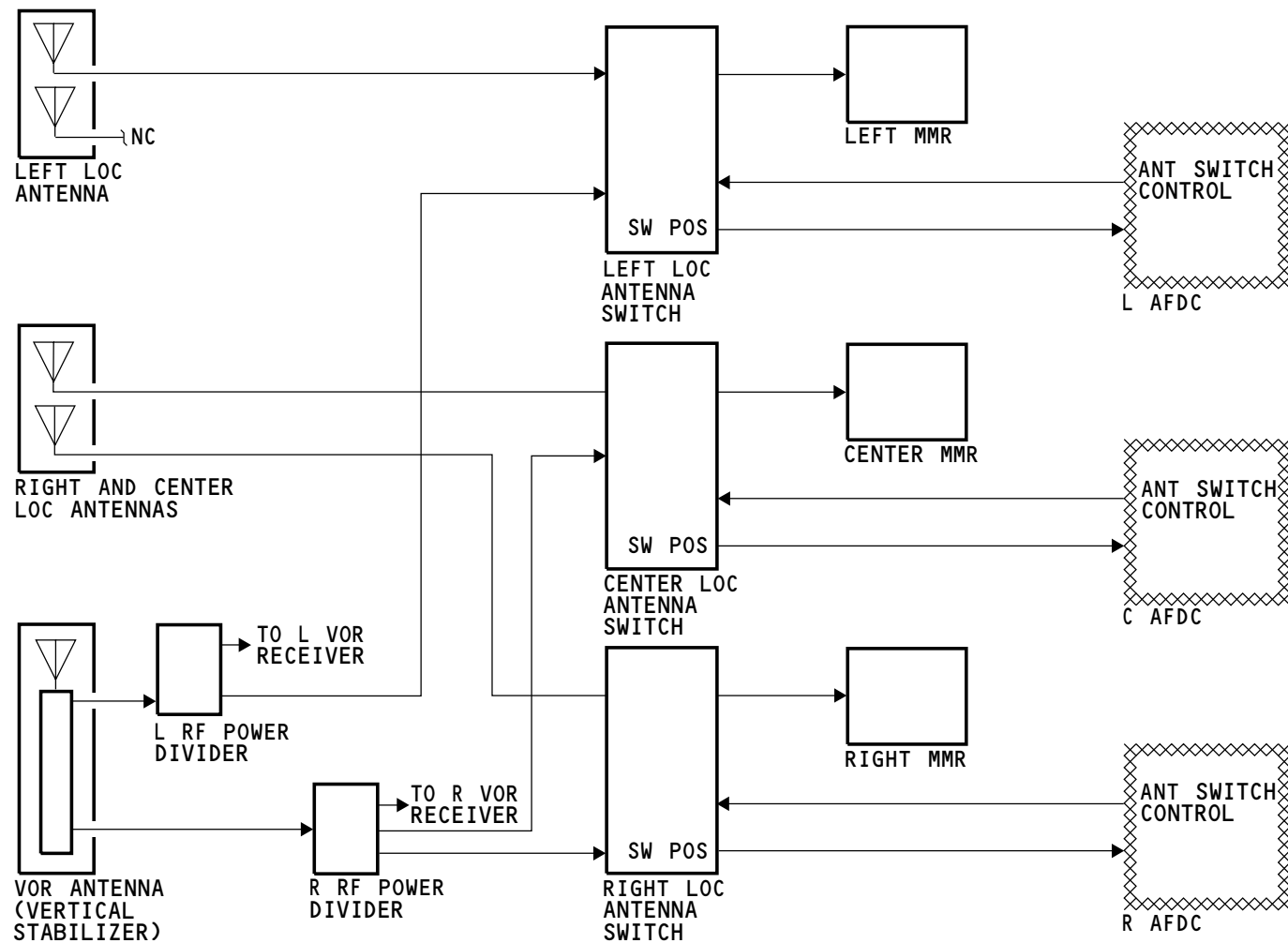
Signal inputs from the VOR antenna on the vertical stabilizer go through the RF power dividers to the localizer antenna switches.

The antenna inputs go through the localizer antenna switches then to the receivers. The switches change the input from the VOR antenna on the vertical stabilizer to the LOC track antenna in the nose radome.

Antenna Switch Control

Each autopilot flight director computer (AFDC) controls its onside localizer antenna switch. Each switch sends antenna switch position feedback to its onside AFDC.

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ILS - LOCALIZER ANTENNA INPUTS

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ILS - GLIDESLOPE ANTENNA INPUTS

General

The multi-mode receivers (MMRs) get inputs from the glideslope capture antennas in the nose radome, or from the glideslope track antennas on the aft nose gear doors. The antenna inputs go through the glideslope antenna switch, then to the MMRs.

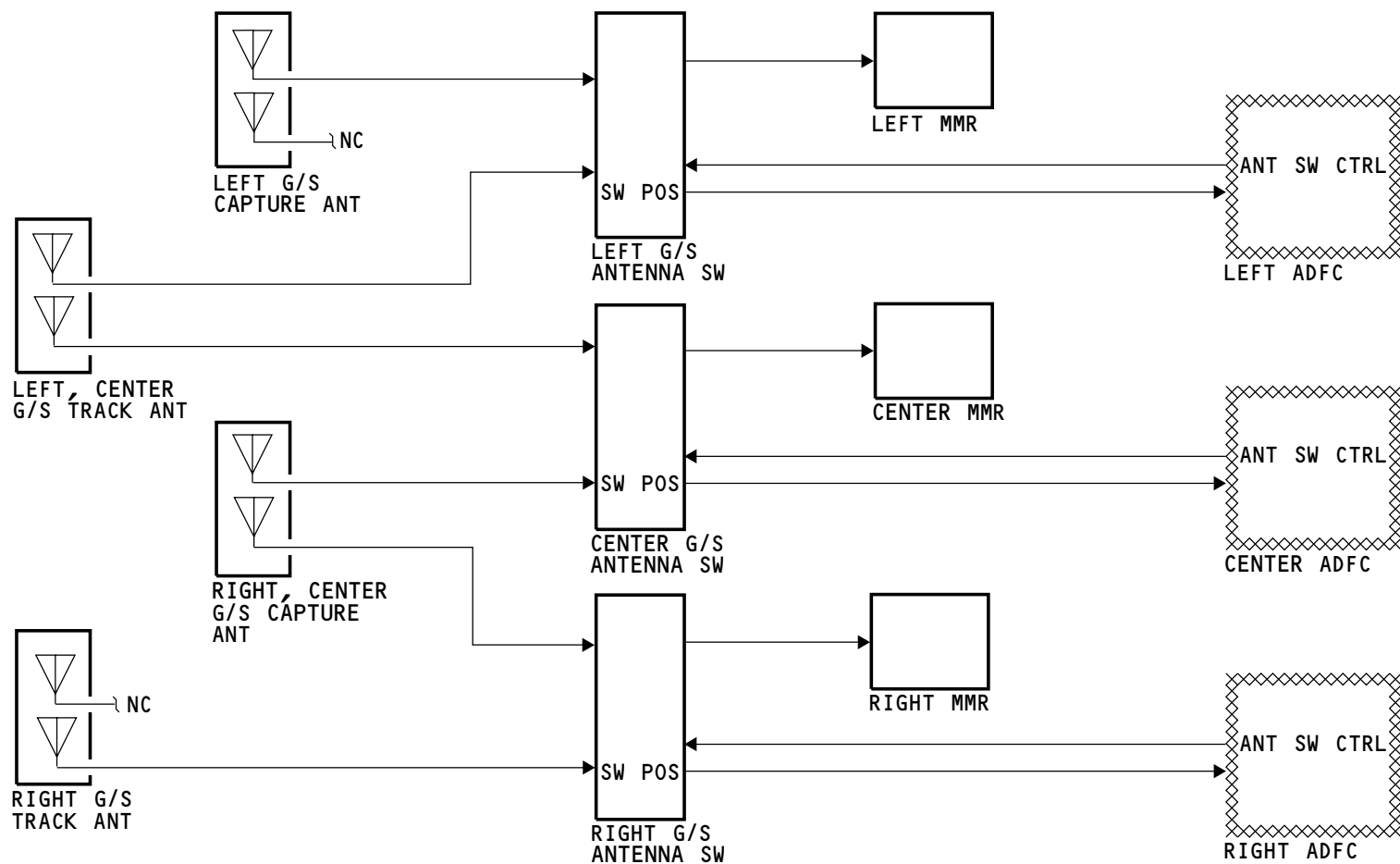
Antenna Inputs

Signal inputs from the glideslope track antenna on the left nose gear door go to the left and center receivers. Signal inputs from the glideslope track antenna on the right aft nose gear door go to the right receiver.

The left capture antenna signals go to the left receiver. The right capture antenna signals go to the center and right receivers.

Antenna Control

Each autopilot flight director computer (AFDC) controls its onside glideslope antenna switch. Each switch sends antenna switch position feedback to its onside AFDC.



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ILS - GLIDESLOPE ANTENNA INPUTS

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**ILS - RECEIVER****Purpose**

The multi-mode receiver (MMR) supplies localizer and glideslope deviation to the autopilot flight director computers (AFDCs) and to the AIMS cabinets for display.

Description

Each receiver is a standard ARINC 600 3 MCU unit. The receiver weighs ten pounds and uses 115v ac power for operation.

| ARO 001-017

The receiver has a nonvolatile flight fault memory. Only shop personnel can use this feature.

Operation

There are two switches and an LCD on the front panel of the ILS receiver. You use any of the two switches to start a test of the ILS receiver. The LCD shows the test results.

There is a memory card slot on the front of the ILS receiver. Shop personnel use this feature to insert a flash memory card which loads software into the LRU. The memory card can also store LRU status data sent by the LRU during operation. These features are not for use by line maintenance personnel.

Shop personnel use the RS-232 connector to connect shop test equipment to the LRU. This feature is not for use by line maintenance personnel.

| ARO ALL**Training Information Point**

The maintenance manual and the fault isolation manual do not have a task for the line maintenance technician to do a test from the front panel of the receiver. You must do all tests for the receiver from the MAT or a PMAT.

Many LRUs on the 777 are compatible with other model airplanes that do not have a central maintenance computing system (CMCS). For that reason those LRUs have a front panel test feature.

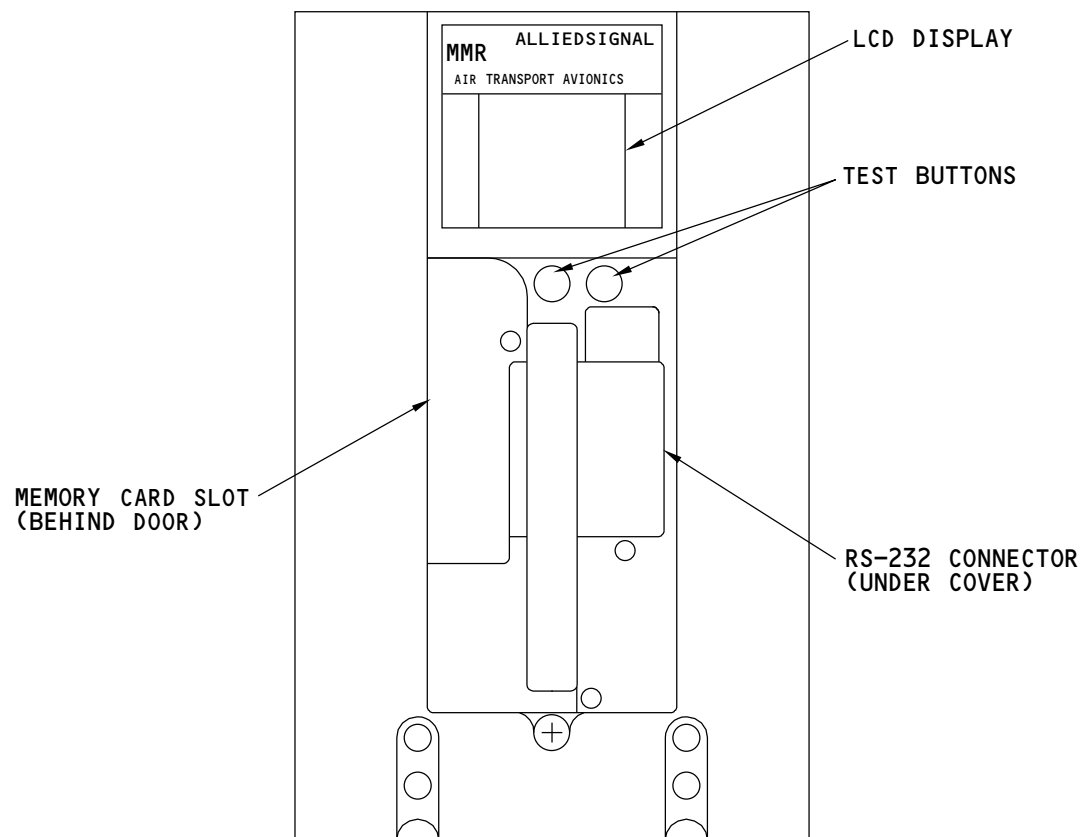
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ILS - RECEIVER

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**ILS - LOCALIZER AND GLIDESLOPE ANTENNAS****Localizer Antennas**

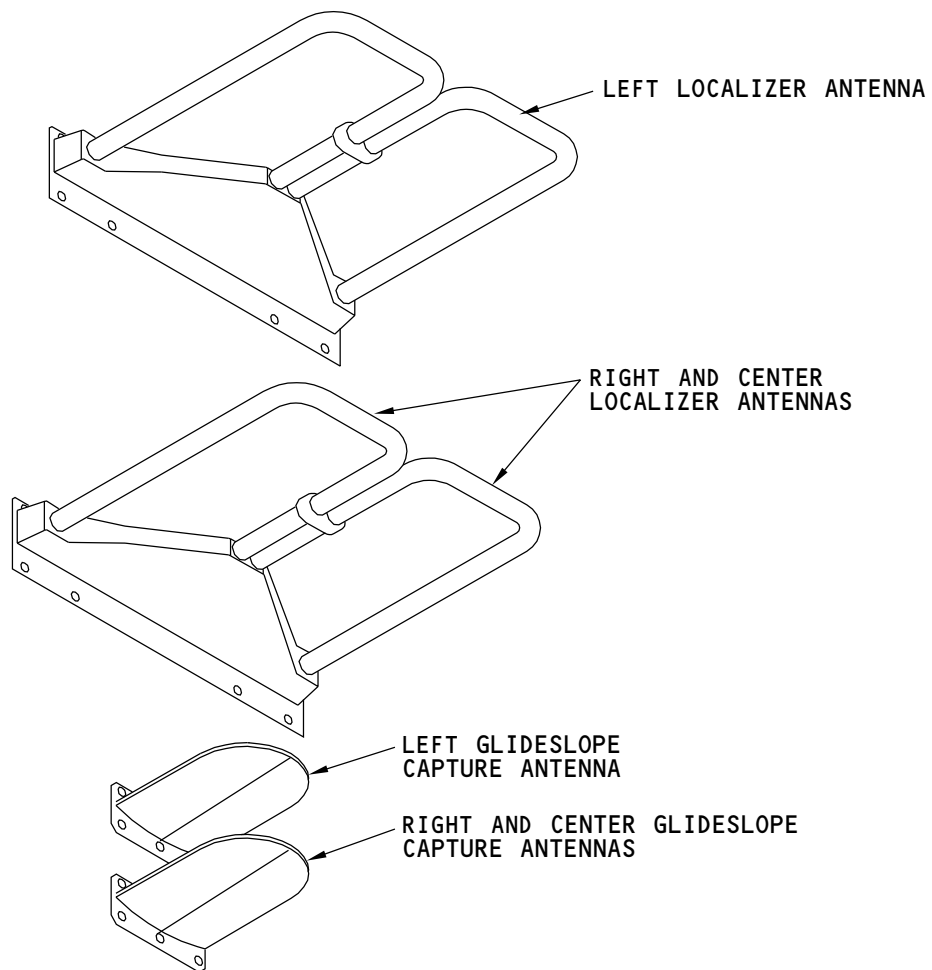
There are two localizer antennas. Each antenna has two elements. The localizer antennas receive frequencies from 108.1 MHz to 111.95 MHz at odd tenths intervals.

The antennas supply signal reception within 90 degrees to the left or right of the airplane centerline.

Glideslope Capture Antennas

There are two glideslope antennas. Each antenna has two elements. The glideslope antennas receive frequencies from 328.6 MHz to 335.4 MHz. The glideslope frequencies are paired with localizer frequencies.

The antennas supply signal reception within 90 degrees above or below the airplane centerline.



ILS - LOCALIZER AND GLIDESLOPE ANTENNAS

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ILS - GLIDESLOPE TRACK ANTENNA

General

The glideslope track antennas supply final approach and landing glideslope signals. The track antennas are in a position to minimize the vertical distance between the antenna flight path and the main landing gear.

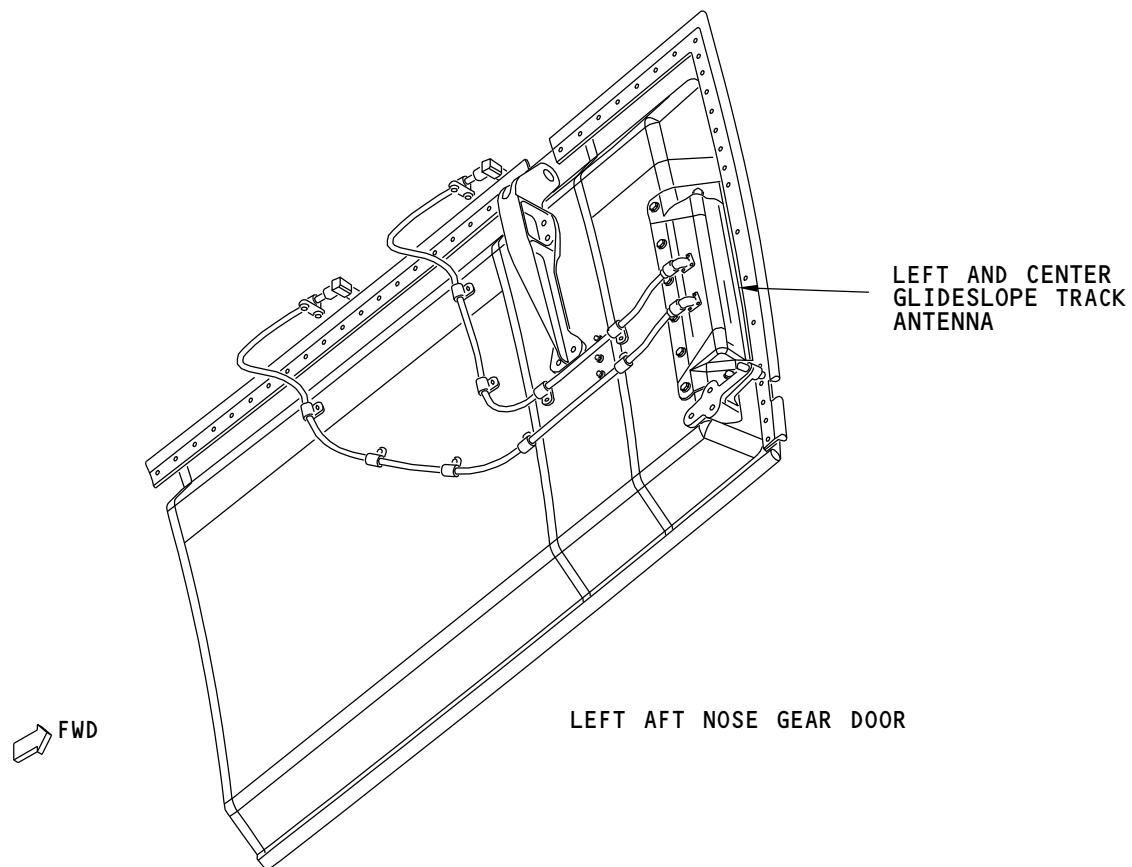
Description

The antennas receive in the frequency range of 328.6 MHz to 335.4 MHz. The glideslope track antennas are on the left and right aft nose gear doors.

Each antenna is a dual element antenna. The left glideslope track antenna on the left aft nose gear door supplies glideslope signals to the left and center ILS receiver. The right glideslope track antenna on the right aft nose gear door supplies glideslope signals to the right ILS antenna.

The graphic below shows the left and center glideslope antenna. The right glideslope antenna looks the same.

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ILS - GLIDESLOPE TRACK ANTENNA

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ILS - FUNCTIONAL DESCRIPTION

General

The multi-mode receiver (MMR) gets tune inputs to tune the localizer and glideslope receivers. These receivers inside the MMR provide localizer and glideslope deviations to other systems.

CDU and AIMS Inputs

Manual or autotune inputs from the AIMS cabinets, or alternate tune inputs from the CDUs go through the input port switch then to the processor. The processor sends them to the synthesizers to tune the glideslope and localizer receivers.

The left AIMS cabinet sends CMCF test commands and flight leg data to the receiver. When the processor receives a test command, it checks the receiver operation and control input status. Results of the test show on the MAT and display units.

Localizer and Glideslope Inputs

Inputs from the localizer and glideslope antennas go to the localizer and glideslope receiver sections. The receivers filter and detect the input RF signals.

The receivers send the signal to the analog to digital (A/D) converters. The monitors compare the outputs of the A/D converters to insure the data is the same.

ILS Outputs

The multi-mode receivers send the deviation on two ARINC 429 outputs. Both bus outputs go to an output monitor that compares the output data to the transmit data to ensure they are the same. The buses then go to the:

- AIMS cabinets
- Onside autopilot flight director computer (AFDC)
- Ground proximity warning computer (GPWC) (from the left MMR only).

The audio or Morse code station identifier goes to the audio output circuits then to the audio management unit (AMU). When the Morse code station identifier is present, the detector sends it to the processor to transmit it on the data buses.

When the navigation displays (NDs) receive the digital Morse code station identifier, it replaces the ILS frequency with the station identifier.

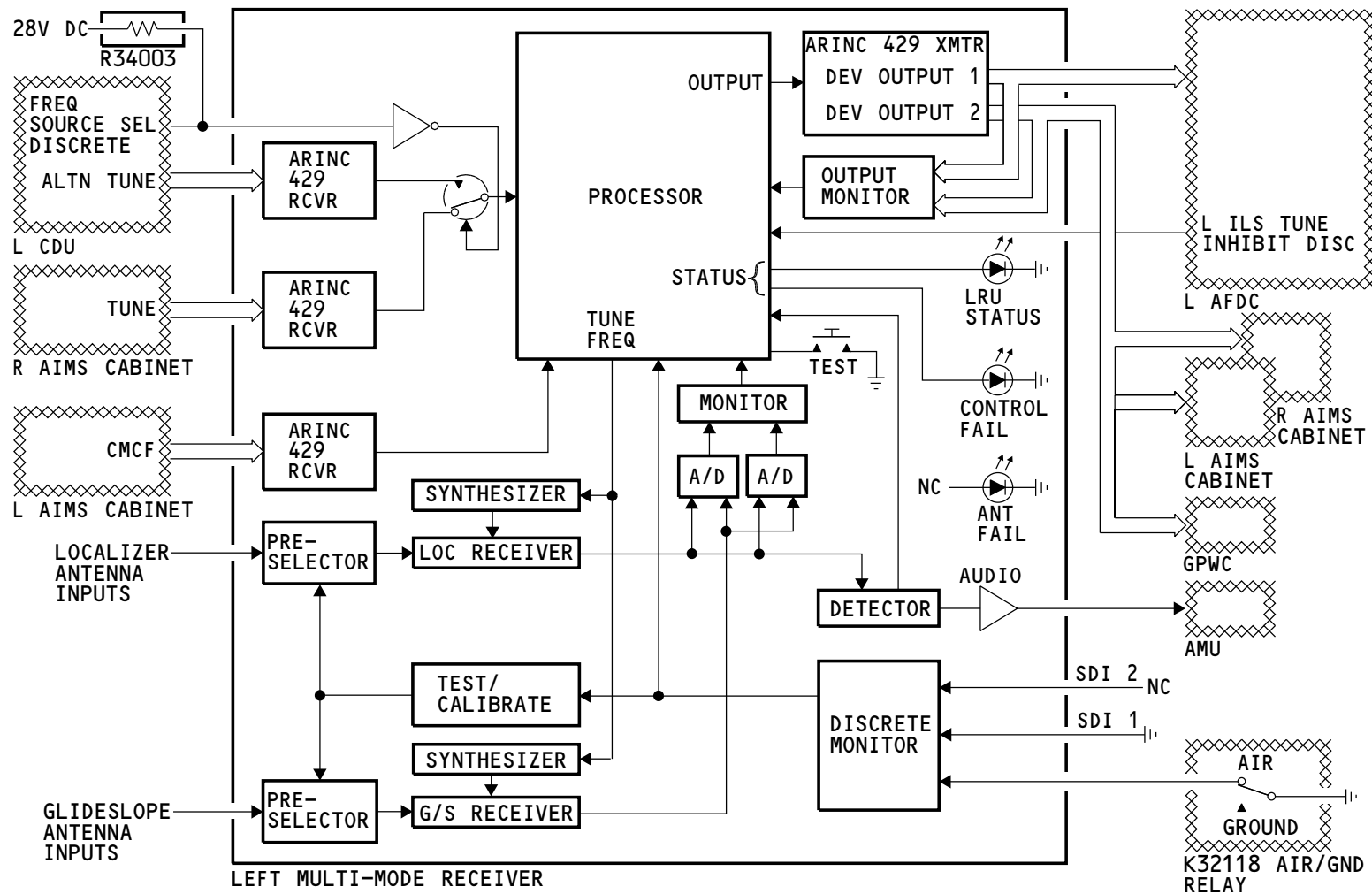
ILS Discrete Inputs

The onside AFDC sends a tune inhibit discrete to inhibit tuning of the receivers when G/S and LOC are active with the autopilot engaged. The AFDCs also supply an ILS tune inhibit when these conditions are true:

- A flight director is on
- G/S and LOC are active
- The airplane is below 500 feet of radio altitude.

The source destination identifier (SDI) program pins identify the receivers as being in the left, right, or center position.

The air/ground relay sends an air or ground discrete to the receiver to inhibit tests in the air and to supply flight leg data as a backup to the AIMS cabinet flight legs data.



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ILS - FUNCTIONAL DESCRIPTION

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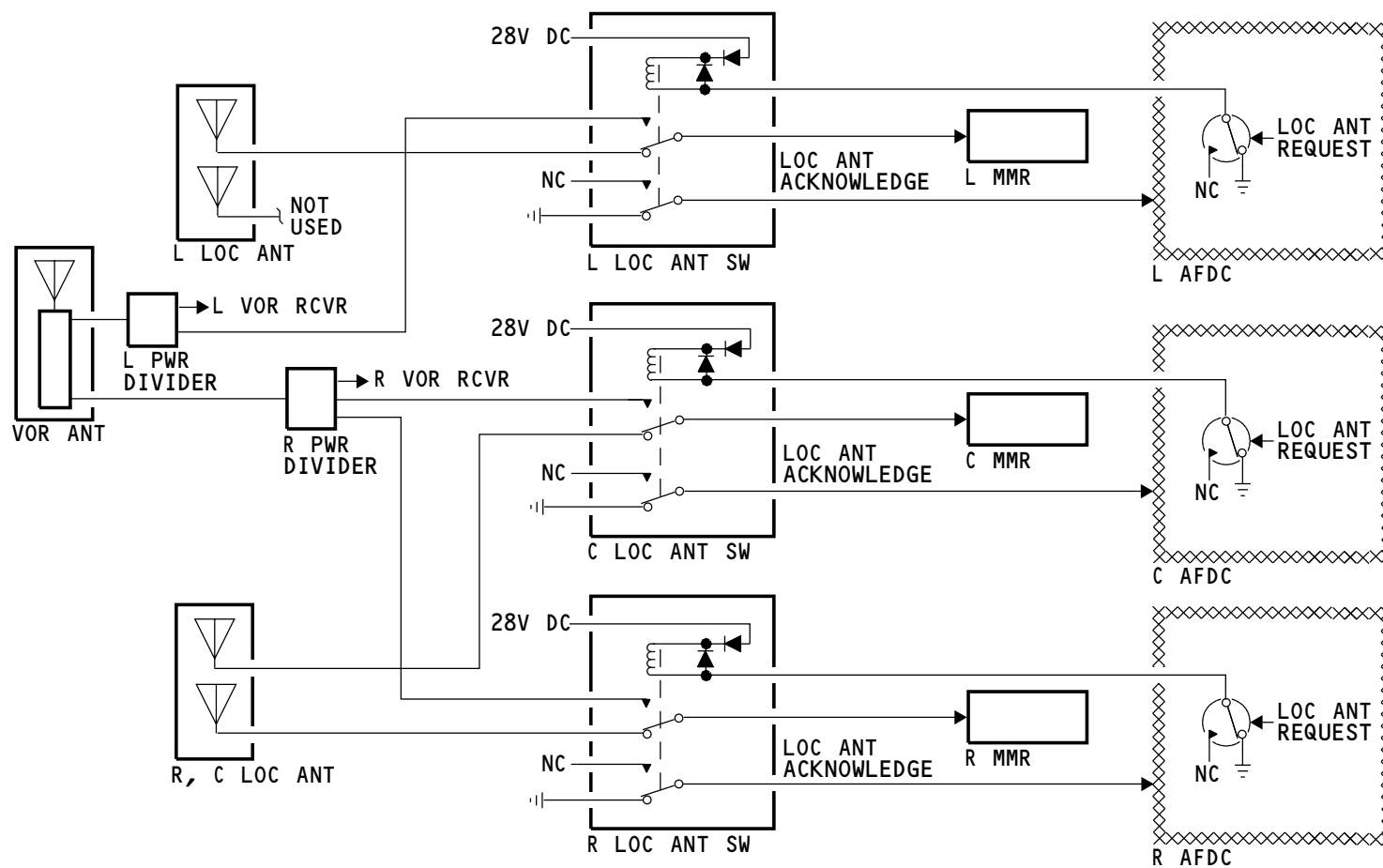
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**ILS - LOCALIZER ANTENNA SWITCHING****Operation**

The localizer antenna switch change the inputs between the VOR antenna and the localizer antennas in the nose radome.

The antenna switches get 28v dc from their respective circuit breakers. The autopilot flight director computers (AFDCs) send a localizer antenna request discrete to control the position of the antenna switches.

The localizer antenna switches send an antenna acknowledge discrete to the AFDCs to give the commanded switch position.



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ILS - LOCALIZER ANTENNA SWITCHING

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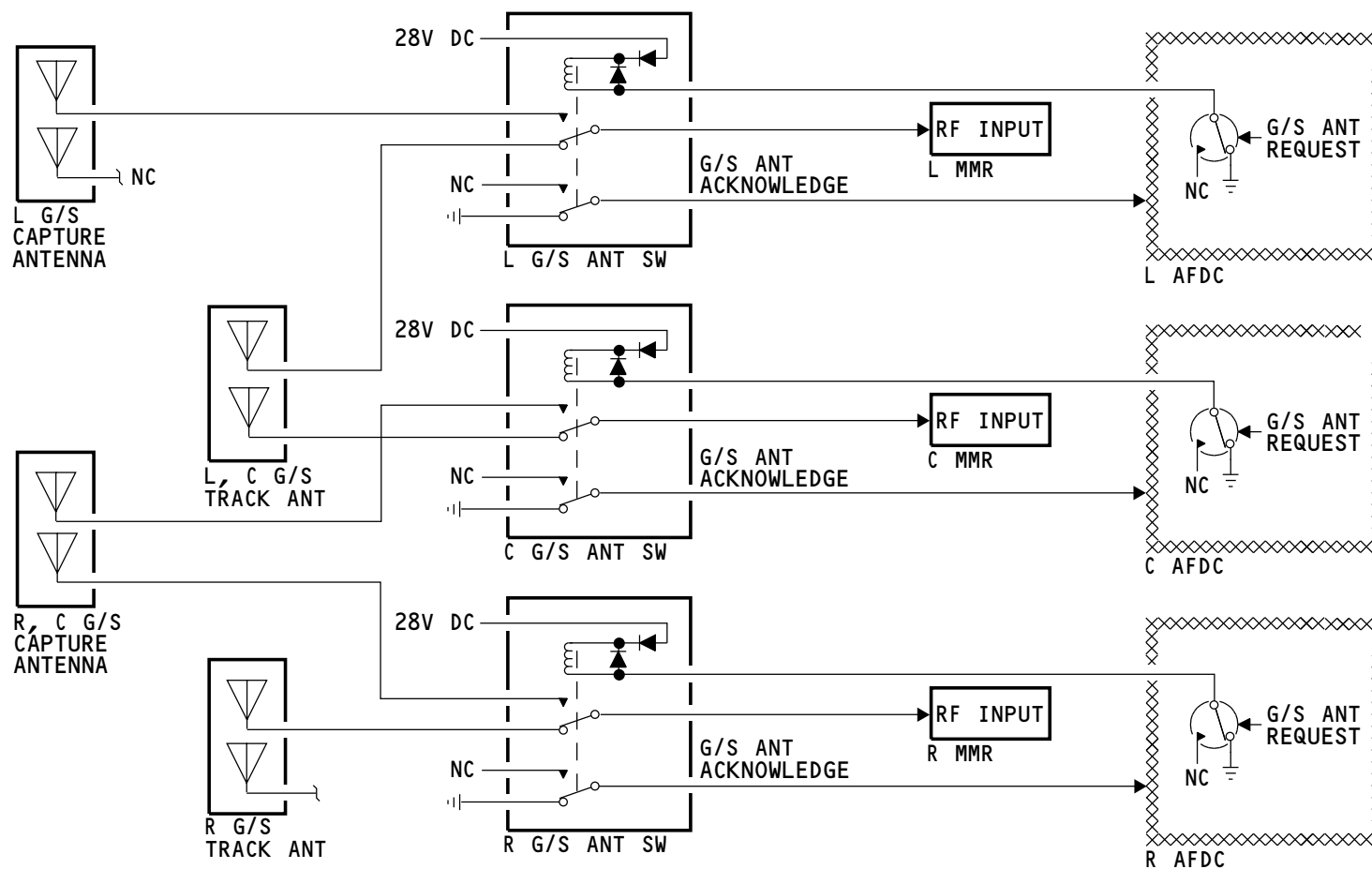
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**ILS - GLIDESLOPE ANTENNA SWITCHING****General**

The glideslope (G/S) antenna switches change the receiver glideslope antenna inputs between the G/S antenna in the nose radome and the G/S track antenna on the aft nose gear doors.

The antenna switches get 28v dc from their respective circuit breakers. The autopilot flight director computers (AFDCs) supply a glideslope antenna request discrete to control the position of the antenna switches.

The G/S antenna switches send an antenna acknowledge discrete to the AFDCs to give the commanded switch position.



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ILS - GLIDESLOPE ANTENNA SWITCHING

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ILS - TUNING

General

There are three ways to tune the multi-mode receivers (MMRs):

- Automatically by the AIMS cabinets
- Manually by the left, right, or center CDU
- By the CDUs as an alternate tuning source.

AIMS Auto Tune

The flight management computing function (FMC) of the right AIMS cabinet automatically tunes the receivers when the ILS station is part of the active flight plan. The left AIMS FMC tunes the receivers through the right AIMS cabinet, if the right FMC fails.

Manual Tuning

You use the left or right CDUs to manually tune the receivers. When you enter an ILS frequency or identifier into the CDU, the CDU frequency becomes the active frequency. It overrides the AIMS FMC auto tune input. The CDU delete function deletes the CDU frequency selection and the AIMS FMC auto tune becomes active. The center CDU tunes the receivers if the left or right CDUs fail.

Alternate Tuning

If the AIMS FMC tuning functions fail, the CDU sends a frequency source selection discrete to the receiver to select the tuning source. This ground signal from the CDU changes the tuning input from AIMS to the CDU. You use the right CDU to tune the right receiver. You use the left CDU to tune the left and center receivers. There is no alternate tune function from the center CDU.

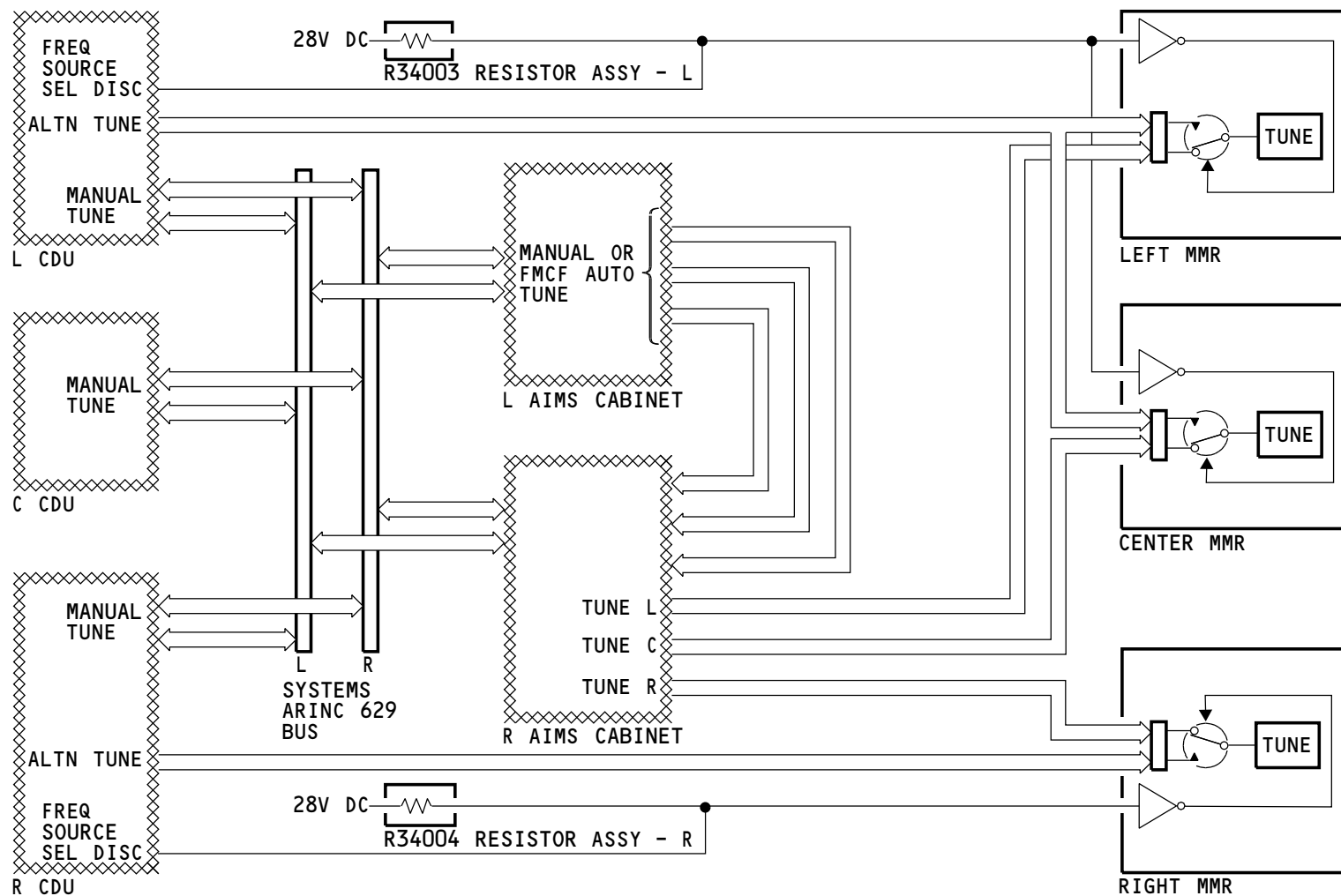
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ILS - TUNING

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ILS - AUDIO CONTROL PANEL ILS AUDIO CONTROLS

General

The audio control panels (ACPs) supply control inputs to the audio management unit. This lets the crew hear audio signals on the speakers and headsets in the flight deck.

Description

These are the controls on the audio control panel that let you hear ILS audio:

- NAV filter selector
- Approach receiver volume control
- Approach receiver selector.

NAV Filter Selector

The NAV filter selector lets you select one of these:

- Voice (V) audio
- Both (B) voice and range audio.
- Range (R) audio

Approach Receiver Volume Control

The approach receiver volume control turns on the audio and controls the volume.

Approach Receiver Selector

The approach receiver selector lets you select ILS or marker beacon as the source of audio.

Operation

To hear ILS audio, do this:

- Set the approach receiver selector to the left (L), center (C) or right (R) APP position

- Push the approach receiver volume control to turn on the ILS audio (turn the control to adjust the volume)
- Set the NAV filter selector to the voice (V) position.

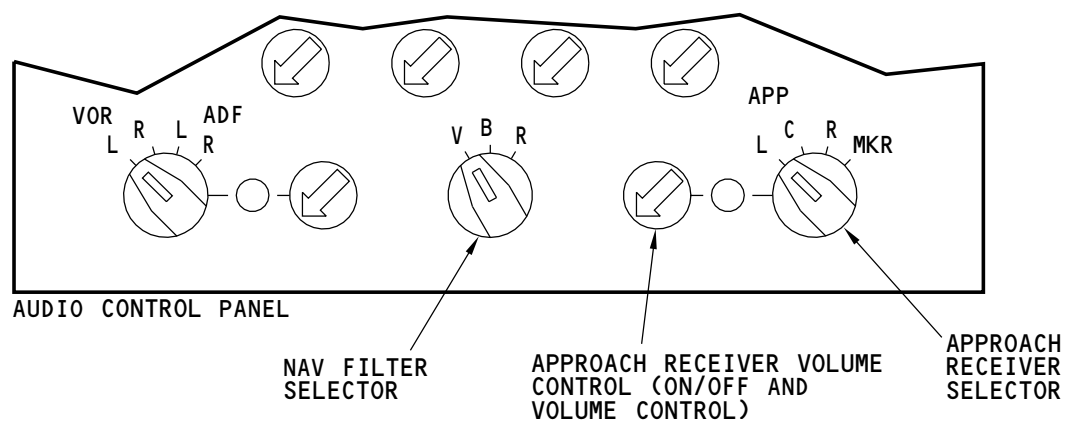
To hear the station identifier, set the NAV filter selector to either the both (B) or the range (R) position.

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ILS - AUDIO CONTROL PANEL ILS AUDIO CONTROLS

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ILS - CDU ILS TUNING

General

The CDUs supply manual tune inputs during normal operation and alternate tune inputs when the AIMS tune functions fail.

Operation

To see ILS tune frequencies, push the NAV RAD key on the CDU. The NAV RADIO page shows data for the ILS systems.

To manually tune the multi-mode receiver (MMR), enter a valid ILS frequency or identifier and course into the CDU scratch pad and push line select key 4L.

You can enter the frequency and course together or separately. When you enter the course separately, a diagonal slash must be entered first followed by the course.

The PARK display can show on the CDU when the FMCF of AIMS autotunes the receivers. PARK shows for these conditions:

- PARK shows when the ILS is part of the active flight plan and not tuned, and the airplane is more than 200 nm from top of descent, or less than halfway to the destination.
- The frequency and PARK shows when the ILS is part of the active flight plan and not tuned, and the airplane is less than 200 nm from top of descent, or greater than halfway to the destination.

When the FMCF tunes the frequency, only the frequency shows. The PARK display goes out of view when less than 50 nm from top of descent, greater than 150 nm from the runway threshold, or the FMC is in the descent mode.

To delete the frequency and course, push the delete (DEL) key on the CDU. The delete function shows in the CDU scratchpad. Next, push the line select key next to the ILS data line to delete the frequency and course.

Alternate Tune

The ALTN NAV RADIO page is available only when the tune inputs from the AIMS cabinets fail.

To get to the ALTN NAV RADIO page, push the NAV RAD key on the CDU.

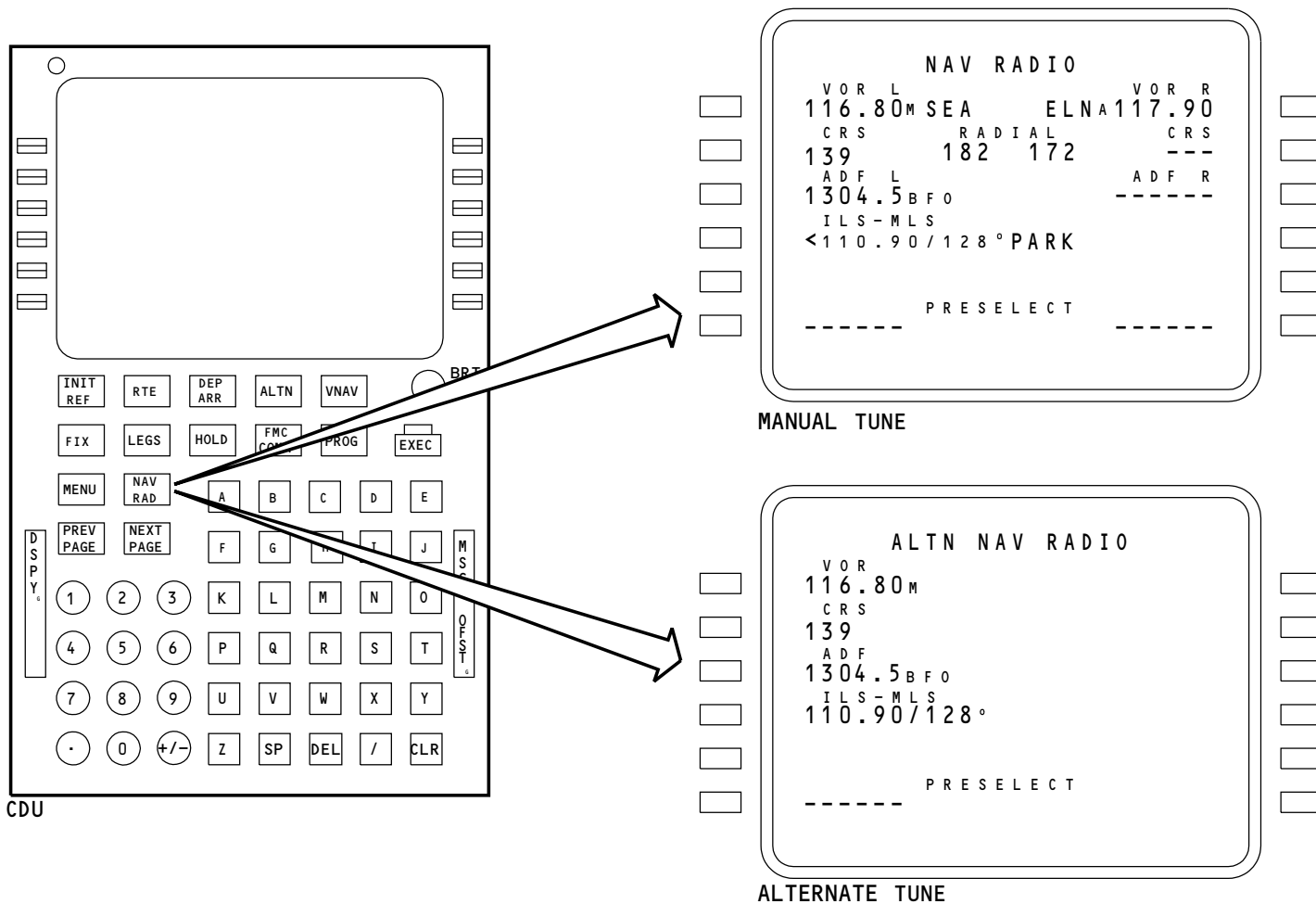
The ALTN NAV RADIO page is different than the NAV RADIO page. The ALTN NAV RADIO page shows data for the left NAV radio systems. Normally, the left CDU ALTN NAV RADIO page controls the left NAV receivers. The right CDU NAV RADIO page controls the right NAV radio receivers. However, for ILS in alternate tune, the left CDU tunes the left and center MMRs. The right CDU tunes the right MMR.

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ILS - CDU ILS TUNING

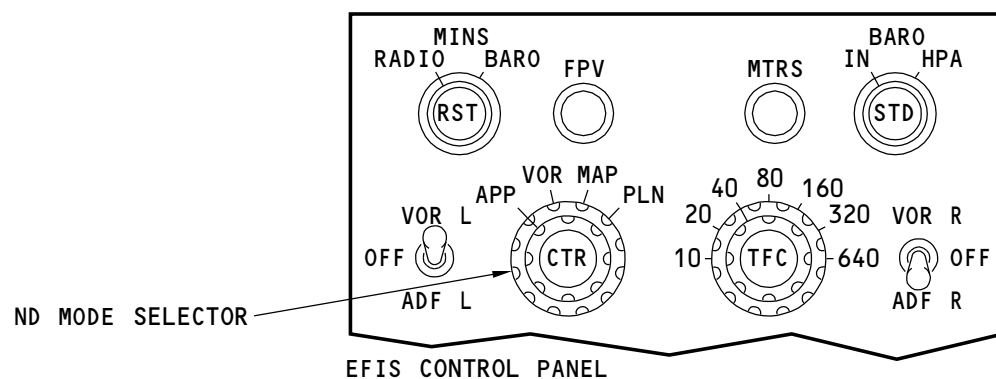
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ILS - EFIS ILS CONTROLS

General

To show ILS data on the ND, turn the mode selector to the APP position. The switch has a CTR push on, push off switch in the center. This switch changes the display format from the expanded format to the centered format.



ILS - EFIS ILS CONTROLS

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ILS - PFD DISPLAYS

ILS Indications

These are the ILS indications on the PFD:

- Localizer frequency or identifier
- ILS course
- Localizer deviation scale and pointer
- Glideslope deviation scale and pointer
- ILS deviation warnings.

Display Source Priority

The flight crew cannot manually select a multi-mode receiver (MMR) for the PFD. When a MMR fails, the AIMS selects another receiver to show on the PFD. LOC and G/S flags show on the PFDs when all MMRs fail.

This is the AIMS priority selection of ILS display data on the PFD:

Captain PFD	L, C, R
First Officer PFD	R, C, L

Localizer Frequency and Identifier

The localizer frequency or four letter identifier shows at the top left corner of the PFD in white. The frequency shows until the MMR detects the ILS station Morse code identifier. When the station identifier is present, it replaces the frequency.

ILS Course

The ILS course shows to the right of the localizer frequency or identifier in white. It is a three digit display with a range of 1 to 360 degrees.

Localizer and Glideslope Deviation

The localizer deviation scale and pointer show at the bottom of the attitude display. The scale is a standard four dot scale where one dot equals 1 degree of deviation.

The scale can show in the standard display or the expanded scale where a 2 dot scale replaces the four dot scale. In the expanded scale, each dot equals 0.5 degrees of deviation.

The expanded scale shows when these conditions occur:

- LOC deviation is less than 5/8 dot
- The autopilot or flight director is engaged in the LOC or ROLLOUT mode
- ILS course and airplane track are within 5 degrees of each other
- RA is less than 200 feet.

The glideslope deviation scale and pointer show to the right of the attitude display. The scale is a standard four dot scale where one dot equals 0.35 degrees of deviation. There is no expanded scale for glideslope deviation.

Rising Runway

The rising runway shows when there is a LOC and G/S signal capture and the radio altitude is below 2500 feet. The symbol goes out of view above 2500 feet. The rising runway symbol is green with a magenta stem.

The rising runway symbol represents the airplanes radio altitude above the runway and moves laterally with the localizer pointer to show localizer deviation. The symbol starts to move when the airplane is 200 feet above the runway and it touches the airplane symbol on the PFD at zero altitude or touchdown.

ILS Deviation Warning

These are the two types of ILS deviation warnings:

- Localizer deviation warnings
- Glideslope deviation warnings.

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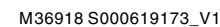


ILS - PFD DISPLAYS

Localizer deviation warnings occur between 0 and 500 feet RA with localizer captured. Glideslope deviation warnings occur between 100 feet and 500 feet RA with glideslope captured. Localizer deviation warnings occur when deviation is more than 1/4 dot or there is a localizer capture fail. Glideslope deviation warnings occur when the deviation is more than 7/8 dot. The deviation warnings cause the scales and the pointers to turn yellow and blink at a 5Hz rate.

Backcourse Deviation Indications

For backcourse indications, the glideslope pointer goes out of view and the localizer pointer moves in reverse operation. AIMS shows backcourse indications when the ILS course and airplane track is more than 90 degrees apart.



ILS - PFD DISPLAYS



ILS - PFD NCD AND INVALID ILS DISPLAYS

Frequency or Identifier

The ILS frequency or identifier does not show when the ILS input frequency goes invalid or if the selected frequency is not a valid localizer frequency.

ILS course

Dashes replace the ILS course display when the input goes NCD. The course display goes out of view when the course input goes invalid.

Localizer Pointer and Scale

The localizer scale remains in view and the localizer pointer goes out of view if:

- The localizer deviation is NCD
- The ILS course is invalid or NCD
- The airplane track is NCD or invalid.

The amber LOC flag replaces the localizer scale and pointer when the localizer deviation goes invalid.

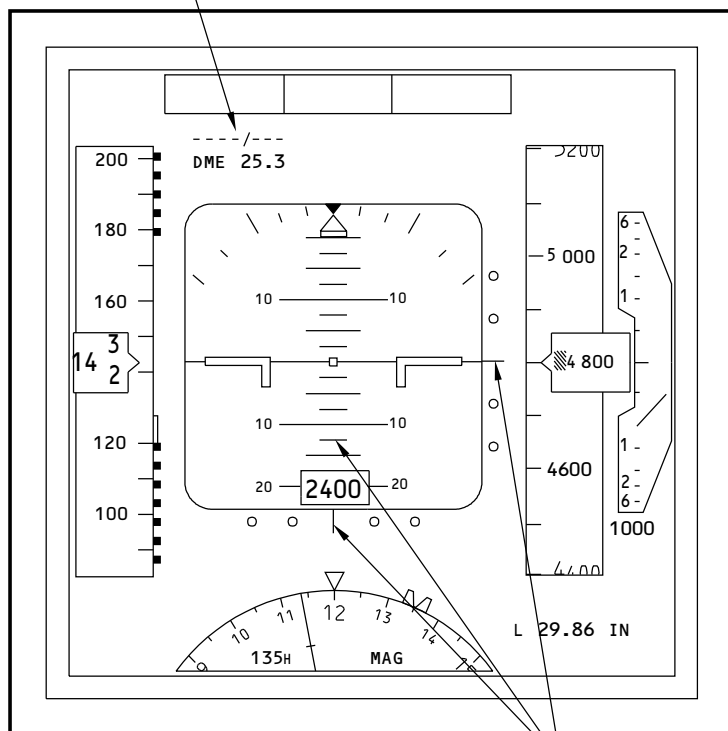
Glideslope Pointer and Scale

The glideslope scale stays in view and the glideslope pointer goes out of view when the deviation goes NCD or when the airplane is in a backcourse configuration. The amber G/S flag replaces the glideslope scale and pointer when the glideslope deviation goes invalid.

Rising Runway

The rising runway symbol goes out of view whenever the localizer pointer or radio altitude display goes out of view. There is no flag for the rising runway

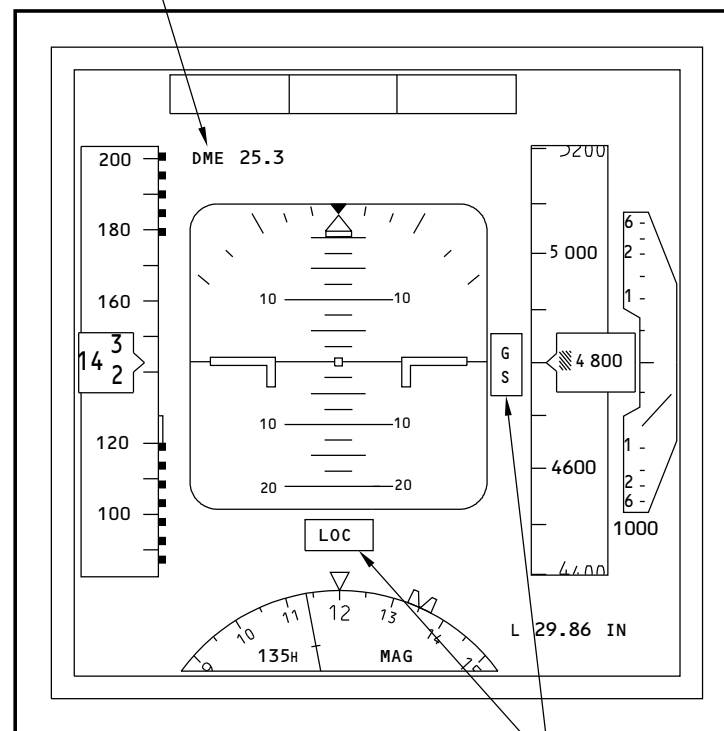
REPLACE LOCALIZER
FREQUENCY OR IDENTIFIER
AND RUNWAY HEADING WITH DASHES



NO COMPUTED DATA DISPLAY

REMOVE GLIDESLOPE
AND LOCALIZER
POINTERS AND
RISING RUNWAY

REMOVE LOCALIZER
FREQUENCY OR IDENTIFIER
AND RUNWAY HEADING



INVALID DISPLAY

REMOVE GLIDESLOPE
AND LOCALIZER
POINTERS AND SCALES
AND SHOW THE
GS AND LOC FLAGS

ILS - PFD NCD AND INVALID ILS DISPLAYS

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ILS - ND ILS DISPLAYS

General

Select approach (APP) on the EFIS control panel to show ILS displays on the navigation display (ND). The data shows in both the expanded or center mode formats. Use the mode selector on the EFIS control panel to choose which format shows on the ND.

ILS Displays

These are the ILS displays on the ND:

- Reference receiver for ILS deviation
- ILS frequency or identifier
- ILS course
- Localizer deviation indication
- Localizer deviation scale
- Glideslope deviation pointer
- Glideslope deviation scale.

Display Source Priority

The flight crew cannot manually select a multi-mode receiver (MMR) for the ND. When a MMR fails, the AIMS selects another MMR to show on the ND. LOC and G/S flags show on the NDs when all MMRs fail.

This is the AIMS priority selection of ILS display data on the ND:

Captain ND	L, C, R
First Officer ND	R, C, L

Reference Receiver for ILS Deviation

The reference receiver for ILS deviation shows to the left of the frequency display. It identifies the left, right, or center receiver as the source for the ILS deviation displays.

ILS frequency or Identifier

The ILS frequency or identifier show at the top right corner of the ND. The frequency shows until the receiver decodes the station identifier. When the receiver decodes the station identifier, the four letter code replaces the frequency.

ILS Course

The ILS course shows below the ILS frequency display at the upper right corner of the ND. The three digit display corresponds to the position of the course arrow. The display range is 1 degree to 360 degrees.

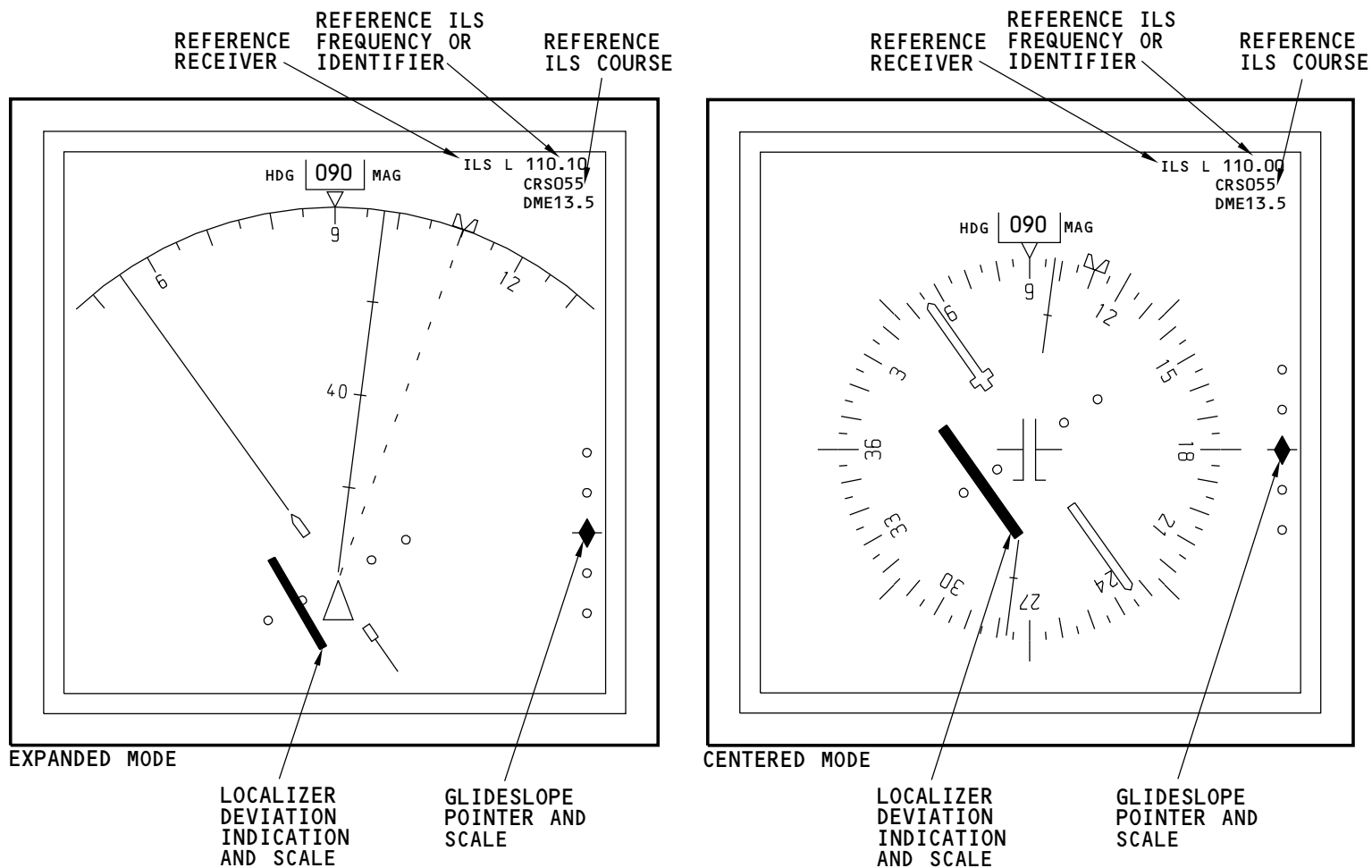
Localizer and Glideslope Deviation

The localizer deviation indication and scale show in the center of the ND. In the expanded ND format, the deviation scale shows at the bottom of the ND. The deviation scale is the standard four dot scale where one dot is equal to 1 degree of deviation. The deviation indication shows deviation to the left or right of the runway centerline.

The glideslope deviation scale and pointer show at the right side of the ND. The fixed scale is the standard four dot scale where each dot equals 0.35 degrees of deviation. The pointer gives fly to commands to intercept the glideslope beam.

Backcourse

Backcourse happens when the airplane track and runway heading are more than 90 degrees apart. In a backcourse configuration, the glideslope pointer goes out of view.



ILS - ND ILS DISPLAYS

M36930 S000619185_V1

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ILS - ND ILS NCD INDICATIONS

ILS Course

When the ILS course input is NCD, dashes replace the three digit course. These are the displays that go out of view:

- Course pointer
- Localizer deviation indication
- Localizer deviation scale
- Glideslope deviation pointer
- Glideslope deviation scale.

ILS Frequency

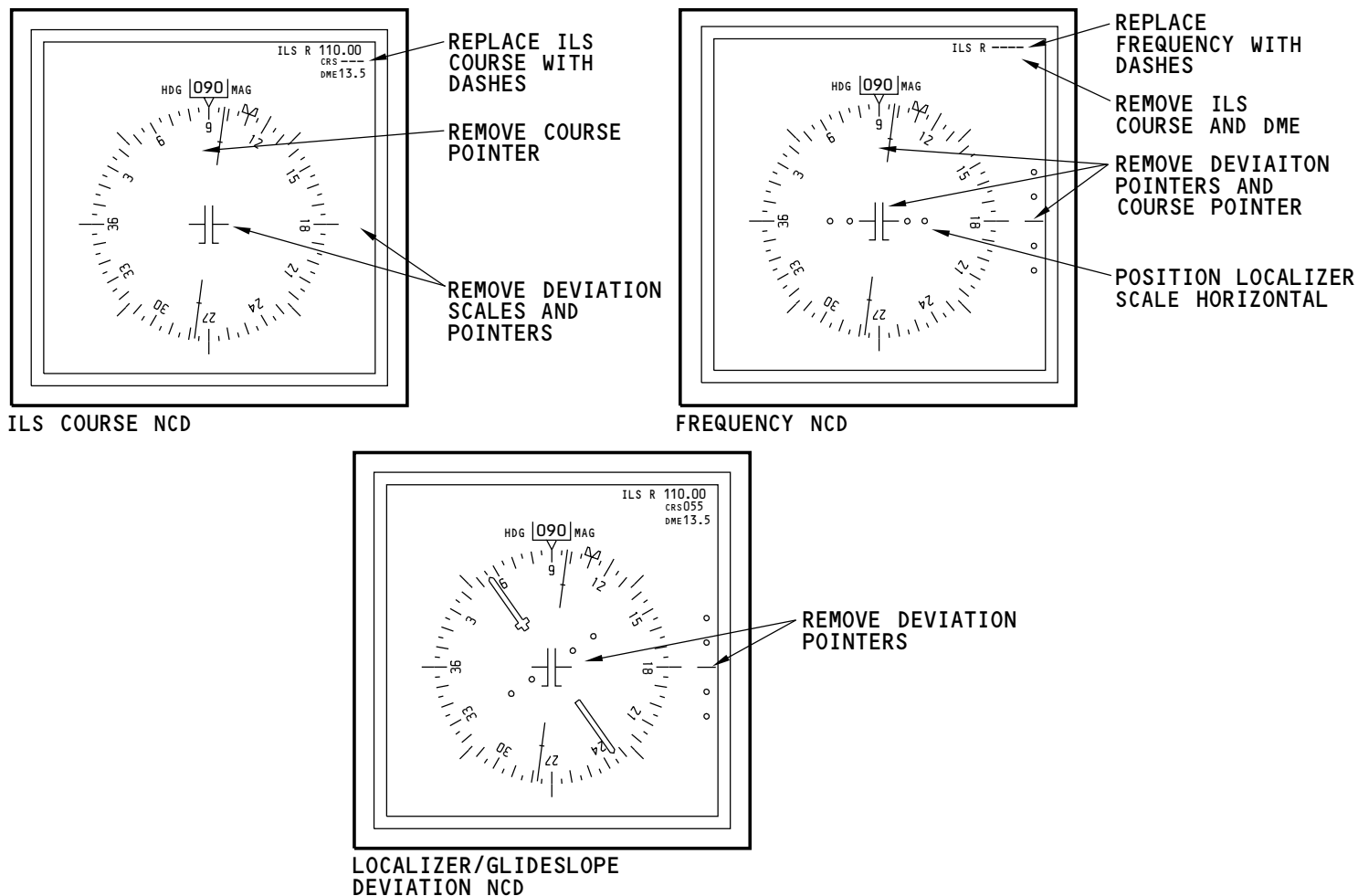
When the ILS frequency is NCD, dashes replace the frequency. These are the displays that go out of view:

- ILS course
- DME
- Localizer deviation indication
- Glideslope deviation pointer.

The localizer scale goes to the horizontal position.

ILS Deviation

The localizer deviation indication goes out of view when the localizer deviation is NCD. The glideslope deviation pointer goes out of view when the glideslope deviation is NCD.



ILS - ND ILS NCD INDICATIONS

M36931 S000619186_V1

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**ILS - ND ILS INVALID DISPLAY****Localizer Frequency**

When the localizer frequency goes invalid, the frequency/identifier line goes out of view. The localizer and glideslope pointers and scales go out of view.

ILS Course

When the ILS course input goes invalid, these are the displays that go out of view:

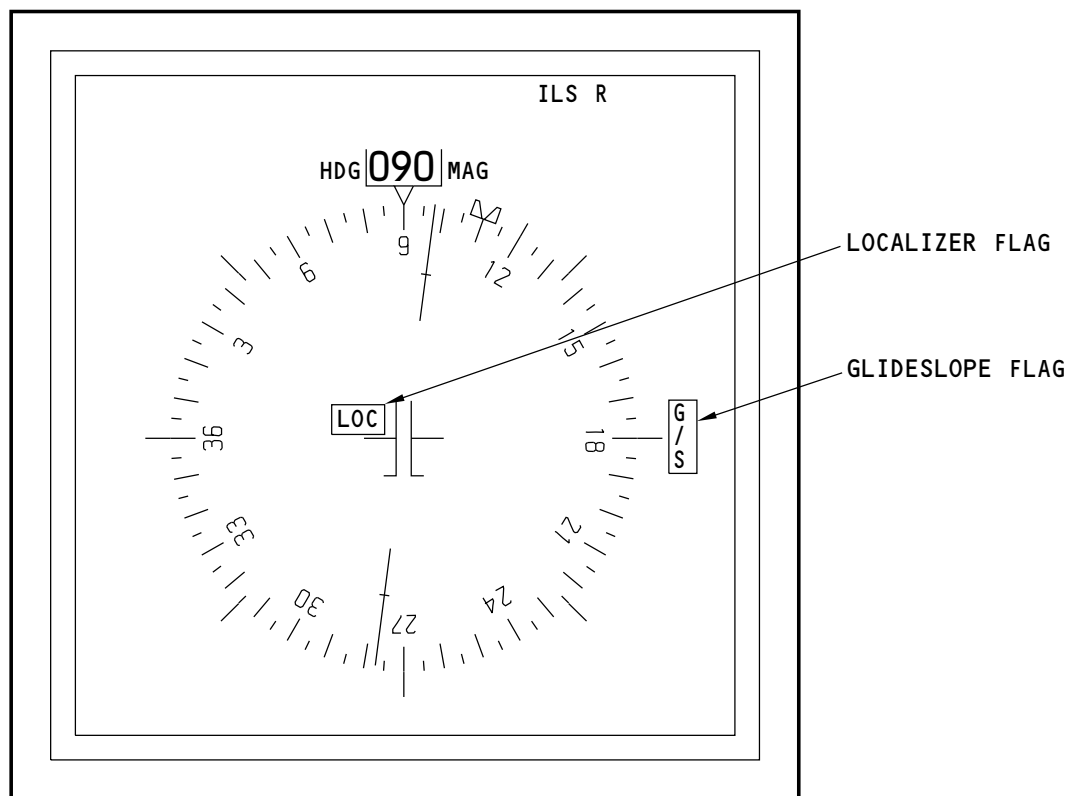
- CRS display and ILS course
- Localizer deviation indication and scale
- Glideslope deviation pointer and scale
- Course pointer.

Localizer Deviation

When the localizer deviation is invalid, the localizer deviation bar and scale go out of view. The LOC flag shows when all ILS receivers fail.

Glideslope Deviation

When the glideslope deviation is invalid, the glideslope deviation pointer and scale go out of view. The G/S flag shows when all ILS receivers fail.



ILS - ND ILS INVALID DISPLAY

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ILS - PFD AND ND ILS TEST DISPLAYS

General

Use the maintenance access terminal (MAT) to do a test of the multi-mode receivers (MMRs). The MAT sends the test command to the left AIMS cabinet. The central maintenance computer function of the left AIMS cabinet sends the command to the MMR.

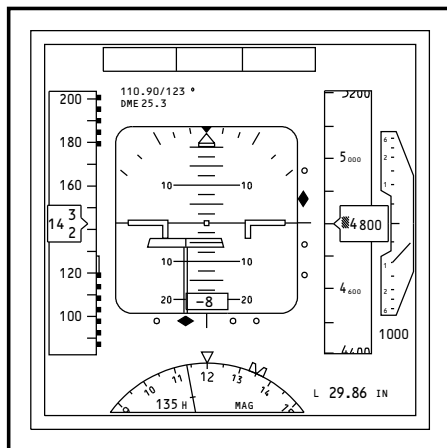
Test Sequence

The receivers start their test sequence when the test command comes from the AIMS cabinet. This is the sequence:

- Invalid data for the first three seconds
- NCD data for approximately two seconds
- Valid data - glideslope pointer up one dot, localizer pointer left one dot for 3 seconds
- Valid data - glideslope pointer down one dot, localizer pointer right one dot for 3 seconds
- Back to pretest displays.

The AIMS cabinets change the ILS display source when a receiver goes invalid. For this reason, the LOC and G/S flags do not show while the receiver test sequence goes invalid. To see the flags in the test sequence, the receivers that are not in test must be in a failed condition or power removed.

When the test sequence goes NCD, the localizer pointers and glideslope pointers go out of view.

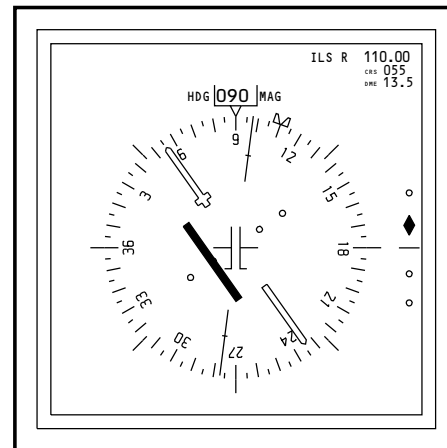


PFD

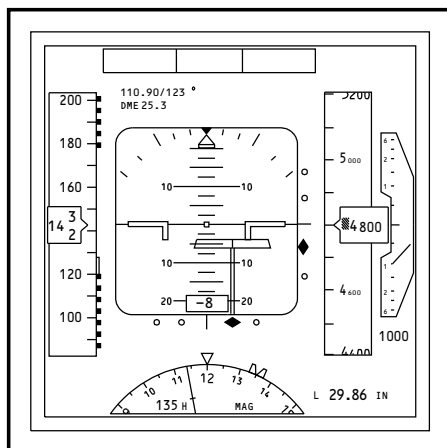
FIRST 3 SECONDS
OF TEST DISPLAY

LOCALIZER = ONE DOT
LEFT

GLIDESLOPE = ONE DOT
UP



ND

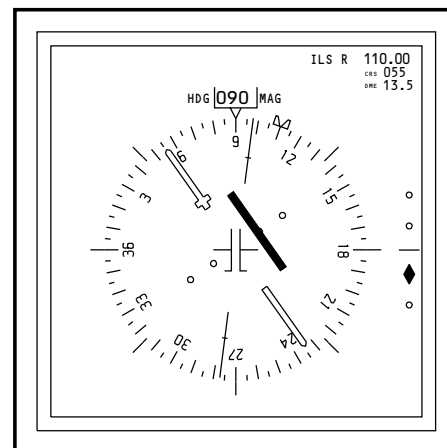


PFD

NEXT 3 SECONDS
OF TEST DISPLAY

LOCALIZER = ONE DOT
RIGHT

GLIDESLOPE = ONE DOT
DOWN



ND

ILS - PFD AND ND ILS TEST DISPLAYS

M36937 S000619192_V1

ILS - FRONT PANEL TEST

| ARO 001-017

Description

Push any test switch on the front of the receiver to start a test of the ILS receiver.

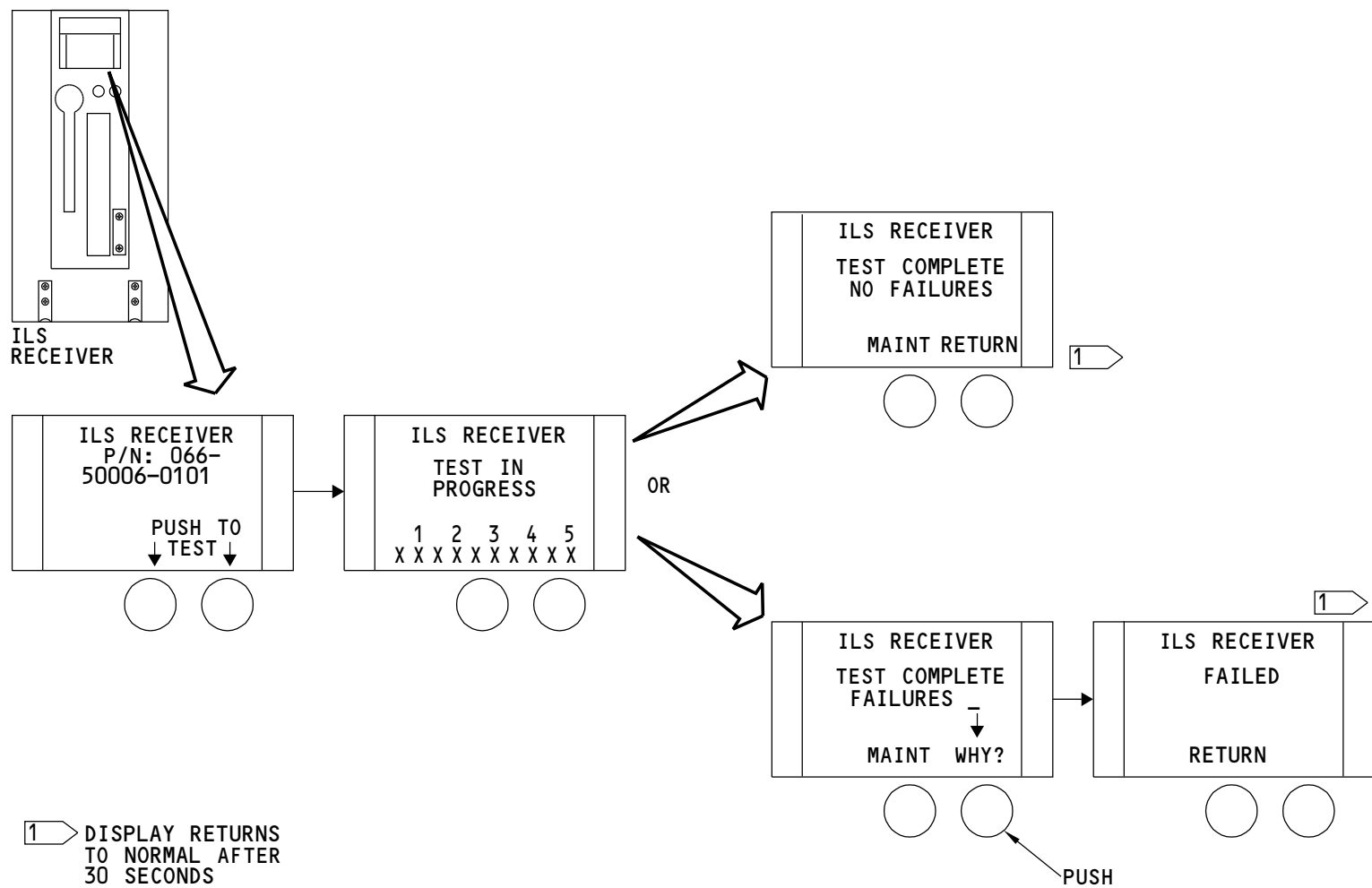
The receiver then does a check of the internal receiver operation and of its interfaces. The test results show on the LCD.

| ARO ALL

Training Information Point

The maintenance manual and the fault isolation manual do not have a task for the line maintenance technician to do a test from the front panel of the multi-mode receiver (MMR). You must do all tests for the MMR from the MAT or a PMAT.

Many LRUs on the 777 are compatible with other model airplanes that do not have a central maintenance computing system (CMCS). For that reason, these LRUs have a front panel test feature.



M36943 S000619199_V1

ILS - FRONT PANEL TEST

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**ILS - GROUND TEST****General**

You can do a test of the ILS system from the MAT. These are the tests that are available from the operational test selection on the MAT:

- Center instrument landing system
- Left instrument landing system
- Right instrument landing system.

Operational Test

The operational test make sure that the instrument landing system is serviceable.

GROUND TESTS

SELECT ATA SYSTEM

(55)

32 PROXIMITY SENSOR SYSTEM (PSS)

32 LEFT MAIN LANDING GEAR

32 NOSE LANDING GEAR

32 RIGHT MAIN LANDING GEAR

34 INSTRUMENT LANDING SYSTEM

34 RADIO ALTIMETER SYSTEM

34 PARAVISUAL DISPLAY SYSTEM

34 WEATHER RADAR SYSTEM

34 TRAFFIC ALERT AND COLLISION AVOIDANCE SYSTEM

SELECT TEST TYPE

SYSTEM TEST

OPERATIONAL TEST

REPLACEMENT TEST

SELECT OPERATIONAL TEST

(3)

CENTER INSTRUMENT LANDING SYSTEM

LEFT INSTRUMENT LANDING SYSTEM

RIGHT INSTRUMENT LANDING SYSTEM

CONTINUE

HELP

GO BACK

SELECT OPERATIONAL TEST

(3)

CENTER INSTRUMENT LANDING SYSTEM
LEFT INSTRUMENT LANDING SYSTEM
RIGHT INSTRUMENT LANDING SYSTEM

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ILS - GROUND TEST

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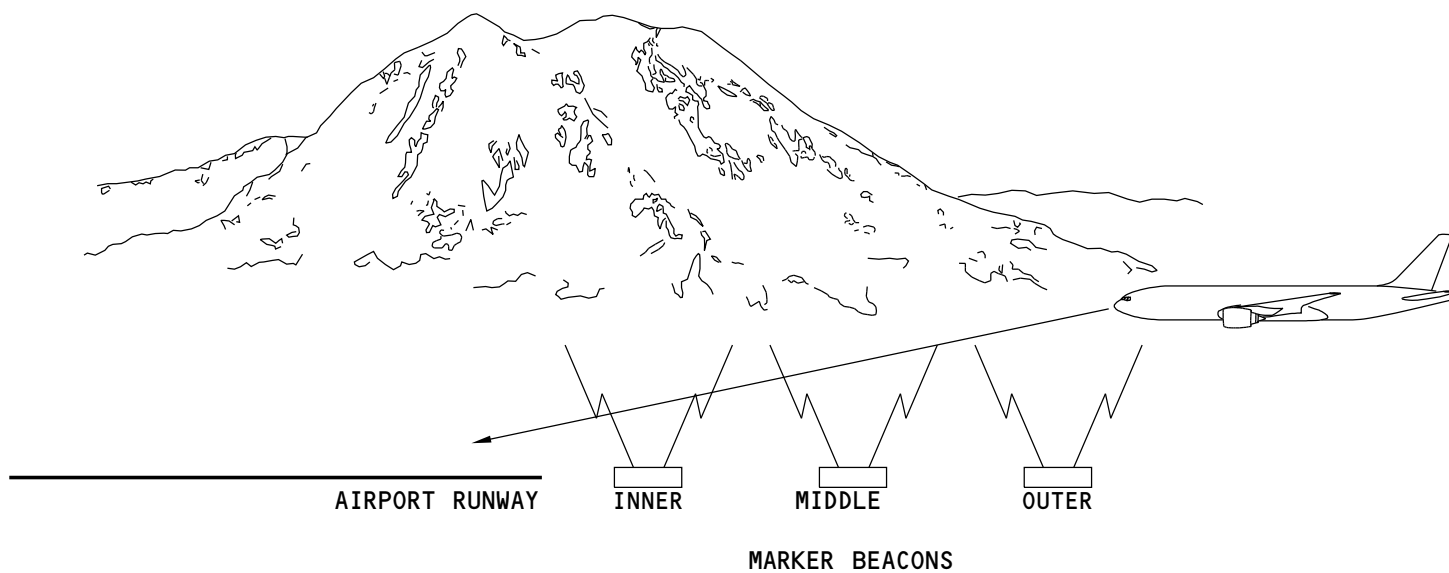
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**MARKER BEACON SYSTEM - INTRODUCTION****Purpose**

The marker beacon system supplies visual and aural indications when the airplane flies over marker beacon transmitters.

Abbreviations and Acronyms

- ACP - audio control panel
- AIMS - airplane information management system
- AMU - audio management unit
- BITE - built-in test equipment
- CMCF - central maintenance computing function
- CMCS - central maintenance computing system
- FT - functional test
- IM - inner marker
- I/O - input/output
- LED - light emitting diode
- MAT - maintenance access terminal
- MB - marker beacon
- MM - middle marker
- NVM - non-volatile memory
- OM - outer marker
- PDSF - primary display system function
- PFD - primary flight display
- RF - radio frequency
- SDI - source/destination indicator
- VOR - VHF omnidirectional ranging



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MARKER BEACON SYSTEM - INTRODUCTION

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**MARKER BEACON SYSTEM - GENERAL DESCRIPTION****General**

The marker beacon system has an antenna and a VOR/marker beacon (VOR/MB) receiver. The marker beacon function only operates in the left VOR/MB receiver.

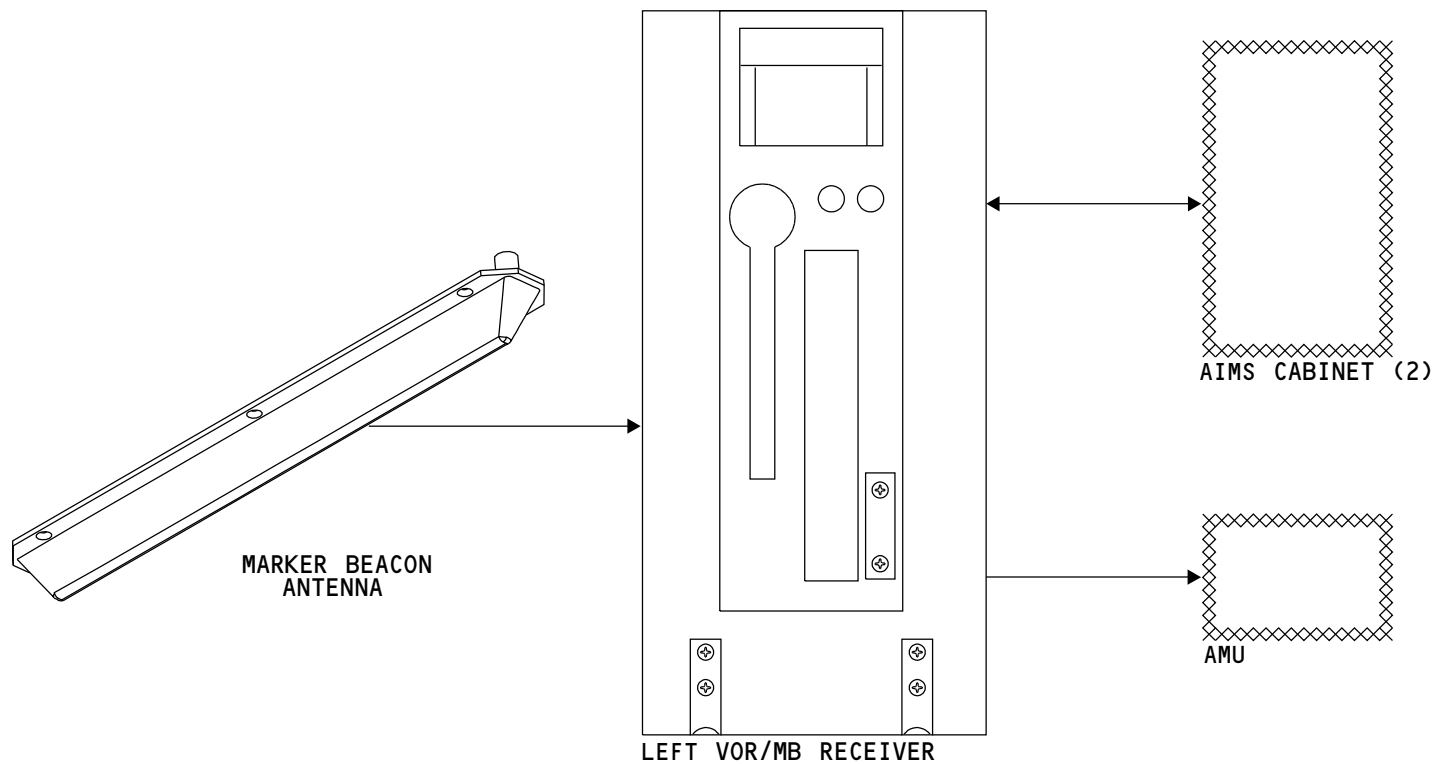
Description

The marker beacon antenna receives the marker beacon signals. The signals go to the left VOR/MB receiver.

The receiver sends marker beacon data to the airplane information management system (AIMS) cabinets to show on the the primary flight displays (PFDs).

The receiver sends marker beacon audio to the audio management unit (AMU).

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MARKER BEACON SYSTEM - GENERAL DESCRIPTION

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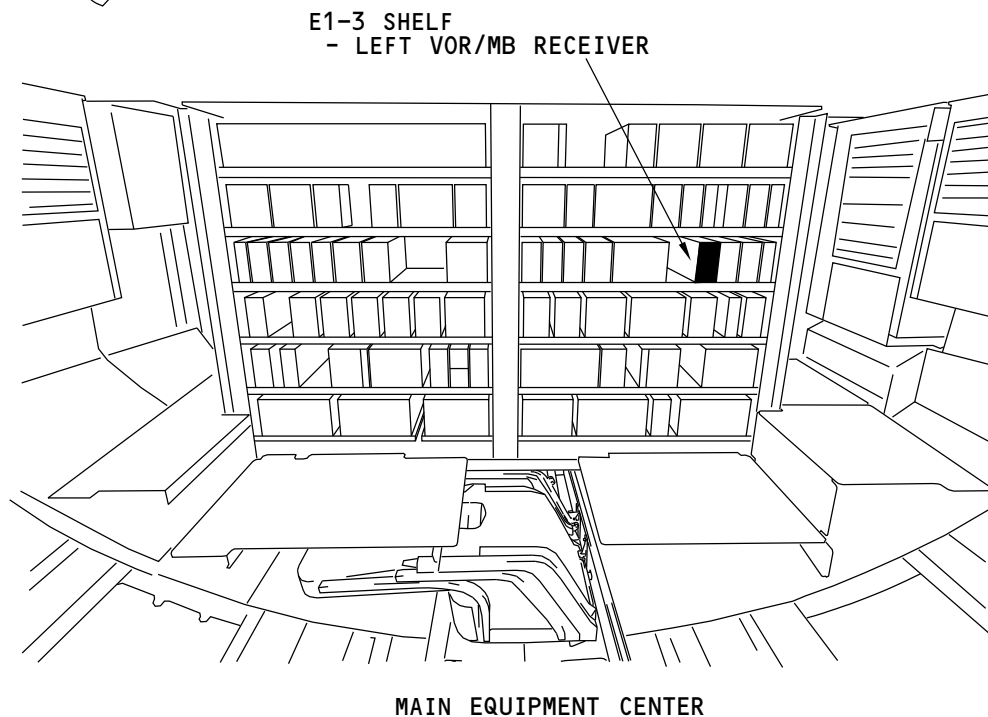
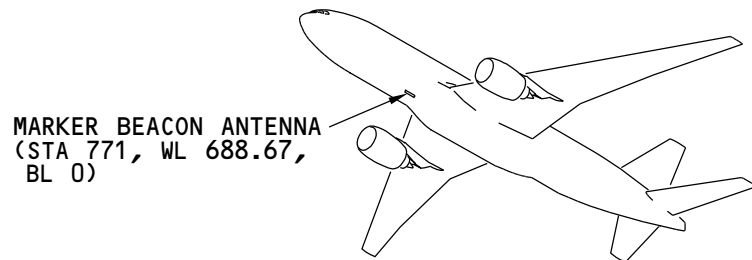
MARKER BEACON SYSTEM - COMPONENT LOCATIONS

General

The marker beacon antenna is on the bottom of the fuselage.

The left VOR/MB receiver is in the main equipment center.

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MARKER BEACON SYSTEM - COMPONENT LOCATIONS

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**MARKER BEACON SYSTEM - INTERFACES****Power**

The left VOR/marker beacon (VOR/MB) receiver uses 115v ac for power.

Antenna Interface

The marker beacon antenna sends radio frequency (RF) signals to the left VOR/marker beacon (VOR/MB) receiver.

Air/Ground Relay

The air/ground relay supplies an air/ground discrete signal to the left VOR/marker beacon (VOR/MB) receiver. The VOR/MB receiver uses this signal:

- To prevent a test in the air
- To count flight legs for an internal nonvolatile fault memory.

Audio Interface

The VOR/MB receiver sends marker beacon audio to the audio management unit (AMU). The AMU supplies marker beacon audio to the flight deck.

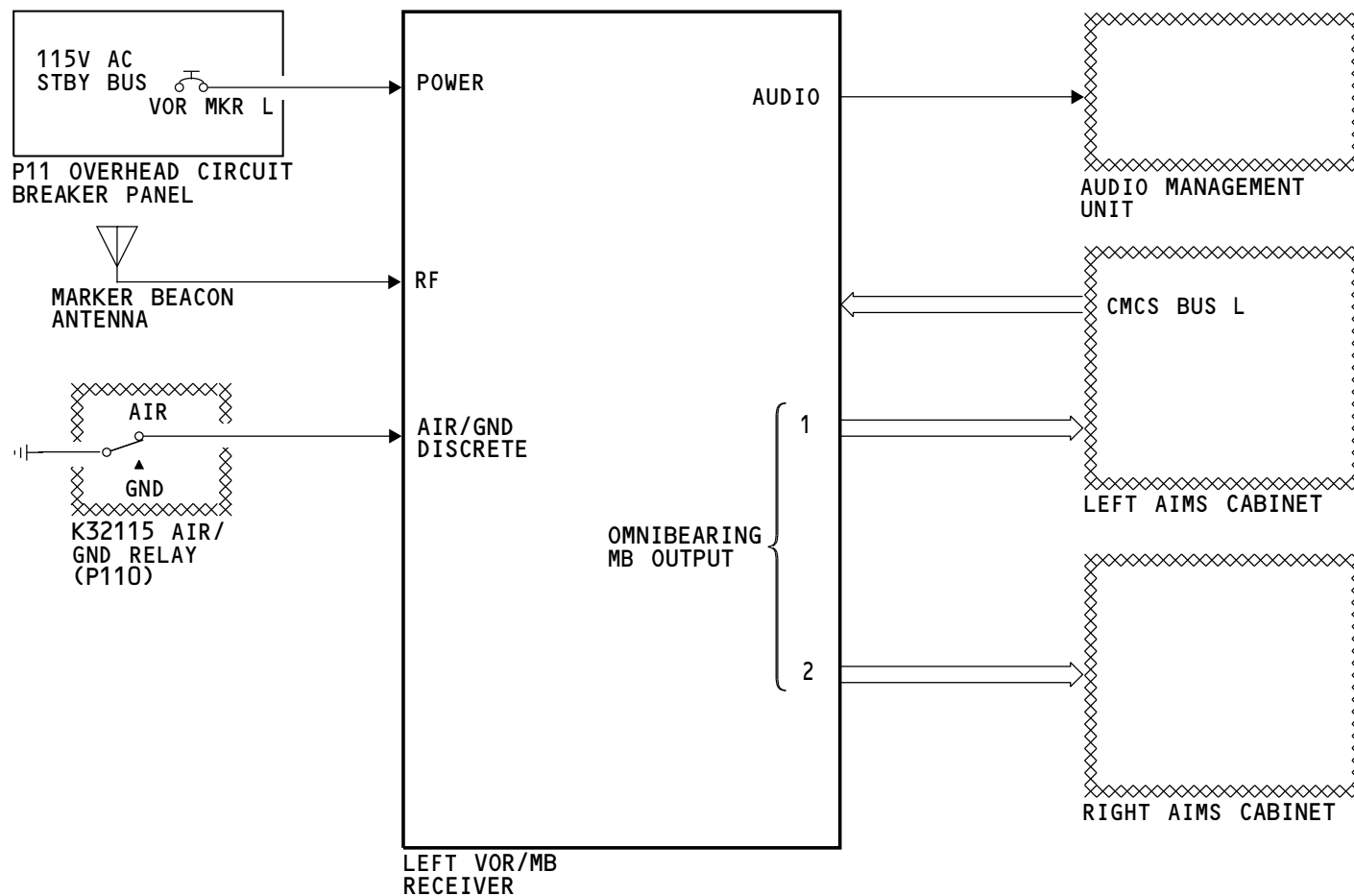
CMCS Interface

The left AIMS cabinet sends central maintenance computing system (CMCS) data to the left VOR/MB receiver. The receiver uses this data to start a test.

Marker Beacon Output

The left VOR/MB receiver supplies marker beacon data to the left and right AIMS cabinets. The AIMS cabinets:

- Supply marker beacon display data to the PFDs
- Receive marker beacon fault and status data.



MARKER BEACON SYSTEM - INTERFACES

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**MARKER BEACON SYSTEM - VOR/MARKER BEACON RECEIVER****General**

The VOR/marker beacon (VOR/MB) receiver has two parts:

- VOR receiver
- Marker beacon receiver

The marker beacon system uses only the left VOR/MB receiver. The marker beacon receiver receives only 75 MHz signals.

Test and Indications

When you do a test of the left VOR/MB receiver, you do a test of the VOR function and the marker beacon function in the VOR/MB receiver at the same time.

There are two switches and an LCD on the front panel of the VOR/MB receiver. You use any of the two switches to start a test of the VOR/MB receiver. The LCD shows the test results.

You can also do a test from the maintenance access terminal (MAT).

There is a memory card slot on the front of the VOR/MB receiver. Shop personnel use this feature to insert a flash memory card which loads software into the LRU. The memory card can also store LRU status data sent by the LRU during operation. These features are not for use by line maintenance personnel.

Shop personnel use the RS 232 connector to connect shop test equipment to the LRU. This feature is not for use by line maintenance personnel.

Flight Fault Memory

The VOR/MB receiver has a nonvolatile flight fault memory. Only shop personnel can read the memory.

Training Information Point

The maintenance manual and the fault isolation manual do not have a task for the line maintenance technician to do a test from the front panel of the VOR/MB receiver. You must do all tests for the VOR/MB receiver from the MAT or a PMAT.

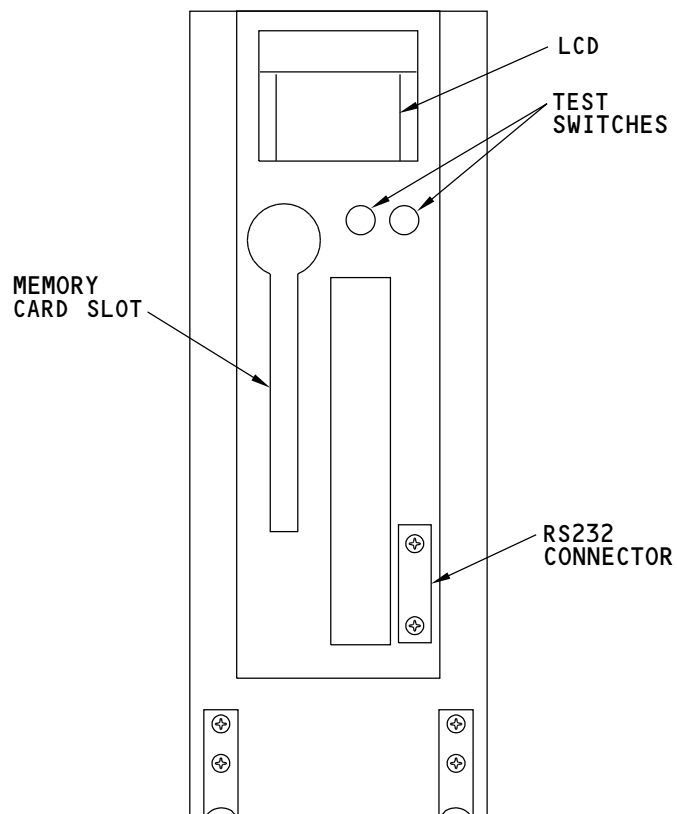
Many LRUs on the 777 are compatible with other model airplanes that do not have a central maintenance computing system (CMCS). For that reason these LRUs have a front panel test feature.

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MARKER BEACON SYSTEM - VOR/MARKER BEACON RECEIVER

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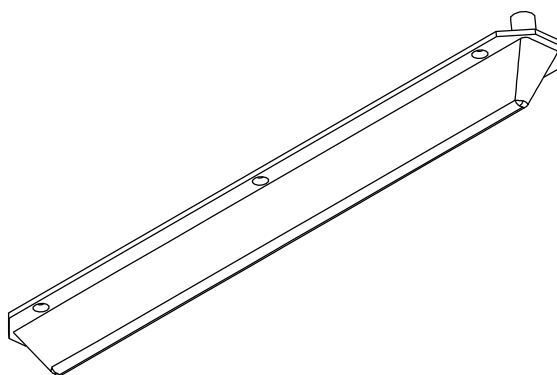
MARKER BEACON SYSTEM - MARKER BEACON ANTENNA

General

The marker beacon antenna receives signals from marker beacon ground stations.

Six screws hold the antenna to the fuselage.

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MARKER BEACON SYSTEM - MARKER BEACON ANTENNA

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MARKER BEACON SYSTEM - DISPLAYS AUDIO OUTPUTS

General

When the airplane passes over a marker beacon transmitter, marker beacon data shows on the primary flight display (PFD).

If you want to listen to marker beacon audio, select the marker beacon audio on the audio control panel (ACP).

Display Types

OM shows when the airplane passes over the outer marker. The OM letters and the circle around them are cyan.

MM shows when the airplane passes over the middle marker. The MM letters and the circle around them are amber.

IM shows when the airplane passes over the inner marker, backcourse marker, or an airways marker. The letters IM and the circle around them are white.

Audio General

The audio control panel (ACP) supplies control signals to the audio management unit (AMU). The AMU uses the control signals to select the audio that goes to the flight interphone speakers and headsets.

Use the ACP to listen to marker beacon audio.

Audio Operation

To listen to marker beacon audio signals:

- Select marker beacon audio with the approach receiver selector
- Push the approach receiver volume control to make the marker beacon audio come on
- Turn the approach receiver volume control to change the volume level.

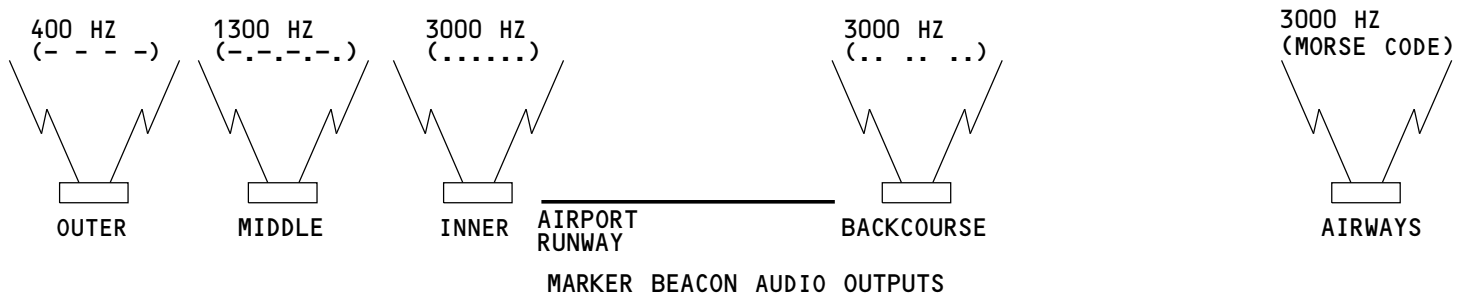
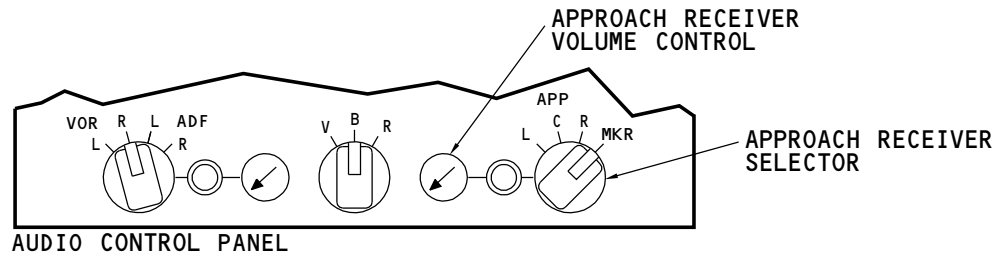
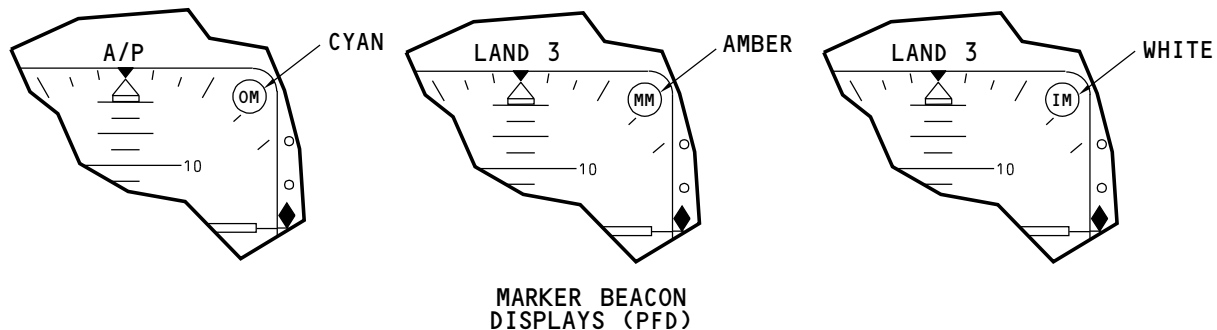
Audio Outputs

These are the marker beacon audio outputs:

- Outer marker (OM) is 400 Hz, continuous dashes (- - - -)

- Middle marker (MM) is 1300 Hz, alternate dots and dashes (-.-.-.-)
- Inner marker (IM) is 3000 Hz, continuous dots (.....)
- Backcourse marker is 3000 Hz, continuous paired dots (.. ..)
- Airways marker is 3000 Hz with the Morse code identifier for that station.

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MARKER BEACON SYSTEM - DISPLAYS AUDIO OUTPUTS

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MARKER BEACON SYSTEM - FUNCTIONAL DESCRIPTION

Marker Beacon Signal

The marker beacon antenna receives the 75 MHz signal and sends it to a 75 MHz filter in the left VOR/marker beacon (VOR/MB) receiver. This filter tunes and rejects unwanted signals. The output goes to a radio frequency (RF) amplifier. A detector receives the amplifier output and sends the demodulated signal to three bandpass filters.

The bandpass filters are at 400 Hz, 1300 Hz, and 3000 Hz. The filters send the signals to an audio amplifier and to an input/output (I/O) card. The audio amplifier sends audio tones to the audio management unit (AMU). The I/O card sends data to the primary display system function (PDSF) and central maintenance computing function (CMCF) in the AIMS cabinets.

The AIMS PDSF shows marker beacon displays on the PFDs.

Program Pins

A marker beacon (MB) program pin enables the marker beacon functions in the left VOR/MB receiver. A discrete monitor enables the marker beacon function when an open is present on the program pin.

A source/destination indicator (SDI) program pin identifies the VOR/MB receiver as left or right. The VOR/MB receiver sends this information to the AIMS cabinets.

Monitor and Test

The test switches start a test of the VOR/MB receiver. The built-in test equipment (BITE) circuits do a test of the VOR/MB receiver. The results of the test show on the LCD, the primary flight display (PFD), and through the flight interphone speakers and headsets.

During the test, a self-test frequency generator gives a 75 MHz RF signal that has 400 Hz, 1300 Hz, and 3000 Hz audio signals. The bandpass filters detect the audio signals and send them to the audio amplifier. The audio amplifier sends the audio signals to the AMU. The AMU sends the audio signals to the flight interphone speakers and headsets in the flight deck.

The maintenance access terminal sends a test request signal to the left AIMS CMCF. The left AIMS CMCF sends the test request signal to the BITE circuits in the VOR/MB receiver. The results of the test go to the CMCF. The marker beacon audio tones come on in the flight deck. The LCD does not show the test results during the test.

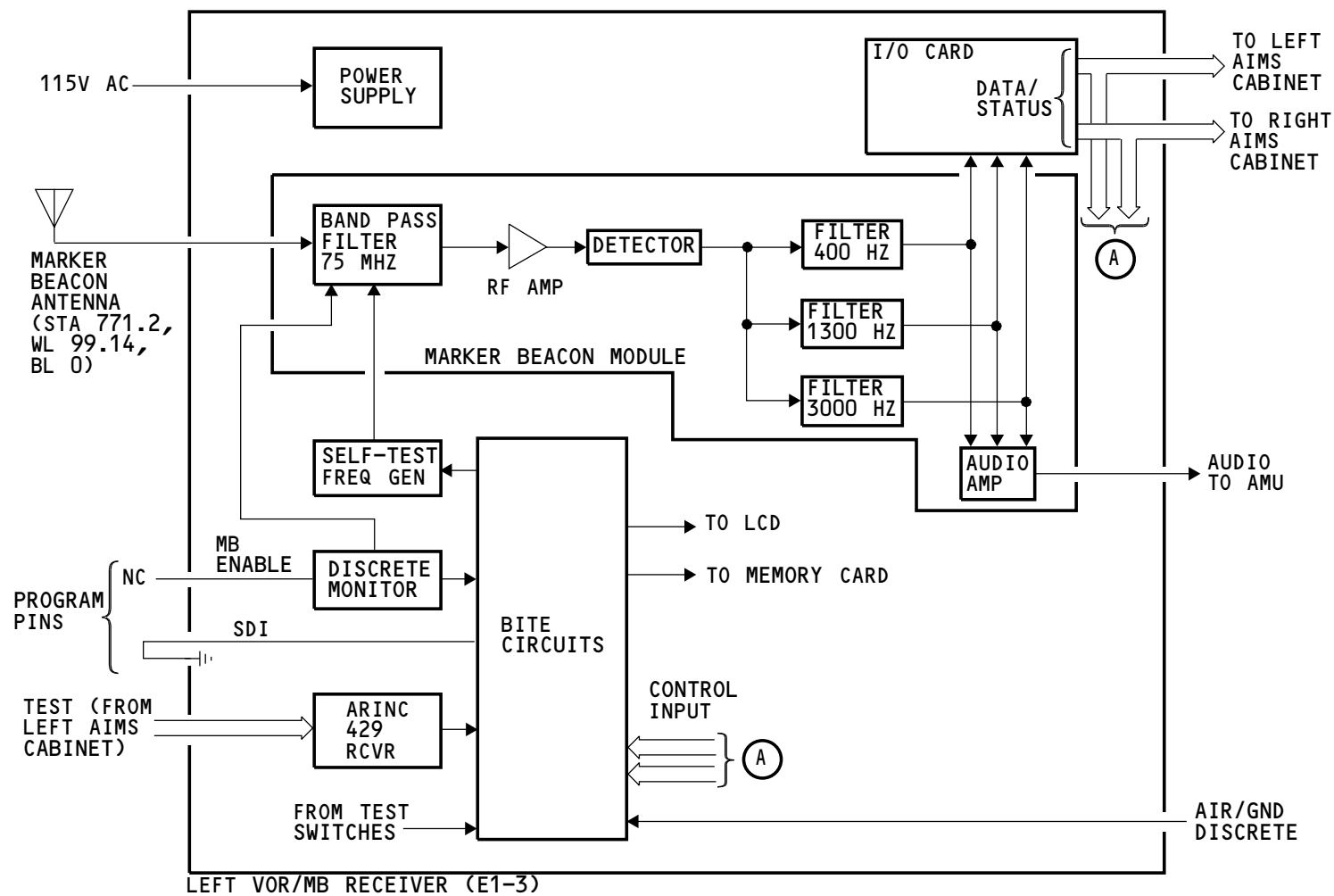
The BITE circuits monitor the status of the output data of the VOR/MB receiver.

Air/Ground Discrete

The VOR/MB receiver gets an air/ground discrete signal from the air/ground relay. The VOR/MB receiver uses this signal to prevent a test in the air.

An internal nonvolatile fault memory (NVM) in the BITE circuits uses the air/ground discrete signal. The NVM uses this signal as an alternate method to define flight legs if the AIMS CMCF fails.

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MARKER BEACON SYSTEM - FUNCTIONAL DESCRIPTION

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**MARKER BEACON SYSTEM - TEST****General**

When you do a test of the marker beacon system, you do a test of the left VOR receiver at the same time.

Operation

Push any test switch on the front of the receiver to start a test of the left VOR/MB receiver. The receiver then does a check of the internal receiver operation and of its interfaces. The test results show on the LCD.

The primary flight display (PFD) shows FT (functional test) during a marker beacon test.

You must select marker beacon audio on at least one of the audio control panels (ACPs) to hear the audio tones. All the marker beacon audio tones come on in the flight deck during the test. The audio tones come on continuously and all at the same time.

Maintenance Access Terminal

You can also use the maintenance access terminal (MAT) to do a test of the marker beacon system. The LEDs on the VOR/MB receiver do not come on when you do a marker beacon test from the MAT. Other test indications are the same.

Training Information Point

The maintenance manual and the fault isolation manual do not have a task for the line maintenance technician to do a test from the front panel of the VOR/MB receiver. You must do all tests for the VOR/MB receiver from the MAT or a PMAT.

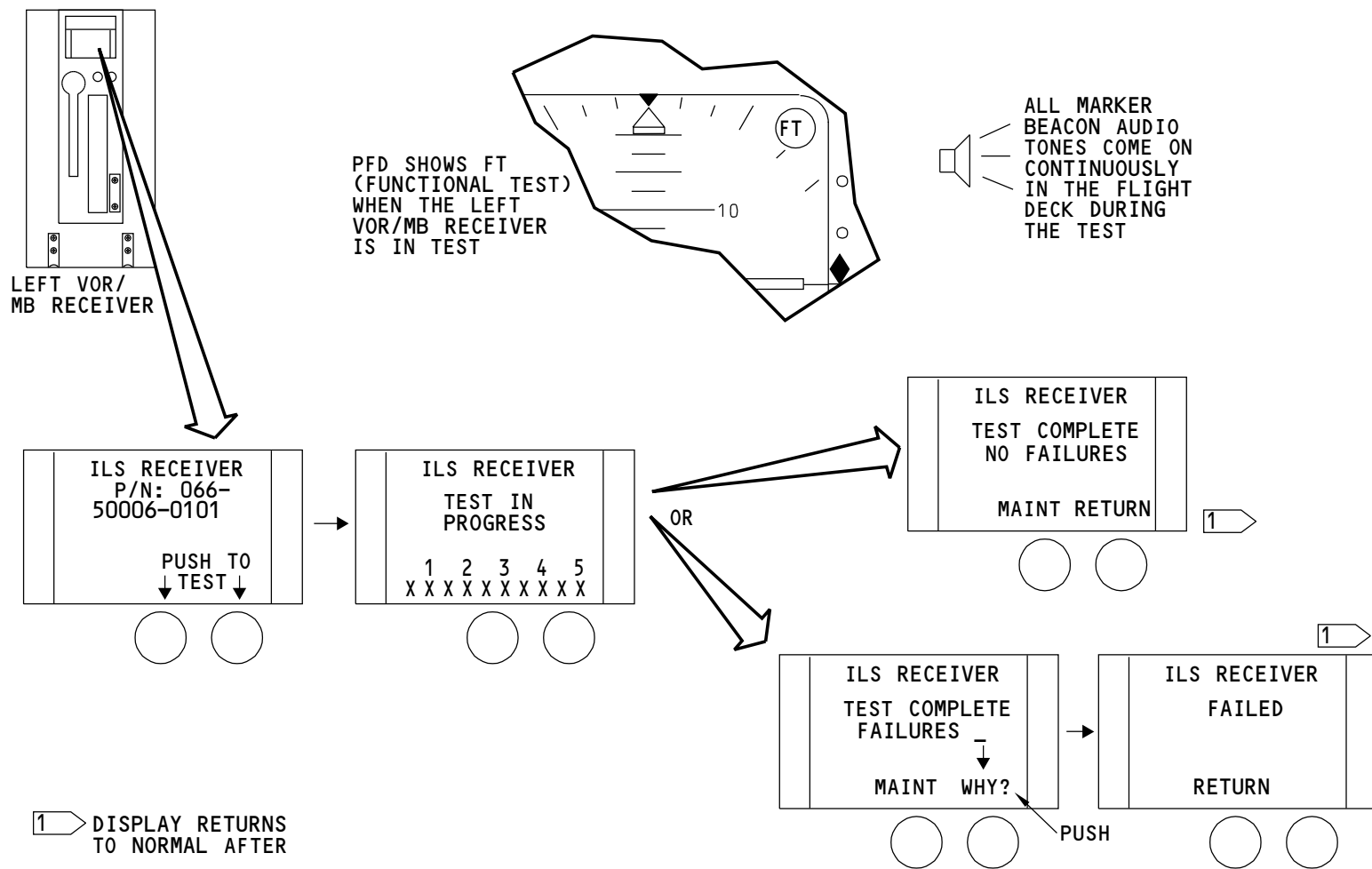
Many LRUs on the 777 are compatible with other model airplanes that do not have a central maintenance computing system (CMCS). For that reason these LRUs have a front panel test feature.

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MARKER BEACON SYSTEM - TEST

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**MARKER BEACON SYSTEM - GROUND TEST****General**

You can do a left VOR/MB system test from the MAT.

Left VOR M/B System Test

When you do a test of the left VOR system, you also do a test of the marker beacon system.

This test verifies the operation of the marker beacon system. You will see the letters FT on the PFD during the test. The front panel LEDs on the left VOR/MB receiver will not come on during this test.

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GROUND TESTS

SELECT ATA SYSTEM

- 34 RADIO ALTIMETER SYSTEM
- 34 PARAVISUAL DISPLAY SYSTEM
- 34 WEATHER RADAR SYSTEM
- 34 TRAFFIC ALERT AND COLLISION AVOIDANCE SYSTEM
- 34 GROUND PROXIMITY WARNING SYSTEM
- 34 VOR / MARKER BEACON SYSTEM
- 34 AIR TRAFFIC CONTROL (ATC) MODE S SYSTEM
- 34 DISTANCE MEASURING EQUIPMENT SYSTEM
- 34 AUTOMATIC DIRECTION FINDER (ADF) SYSTEM

(55)

SELECT TEST TYPE

☐ TEST

☒ OPERATIONAL TEST

☐ REPLACEMENT TEST

SELECT OPERATIONAL TEST

LEFT VOR M/B SYSTEM

RIGHT VOR SYSTEM

(2)

CONTINUE

HELP

GO BACK

SELECT OPERATIONAL TEST

(2)

LEFT VOR M/B SYSTEM
RIGHT VOR SYSTEM

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MARKER BEACON SYSTEM - GROUND TEST

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**RADIO ALTIMETER SYSTEM - INTRODUCTION****General**

The radio altimeter (RA) system measures the distance from the airplane to the ground. The radio altitude shows in the flight deck.

The system has a range of -20 to 2500 feet. The flight crew and other airplane systems use radio altitude during approach and landing.

Abbreviations and Acronyms

- AFDC - autopilot flight director computer
- AIMS - airplane information management system
- CMCF - central maintenance computing function
- GPWC - ground proximity warning computer
- PFC - primary flight computer

ARO 001-013, 017-999

- PWS - predictive windshear

ARO ALL

- RA - radio altitude
- TCAS - traffic alert and collision avoidance system

ARO 001-013, 017-999

- WXR - weather radar

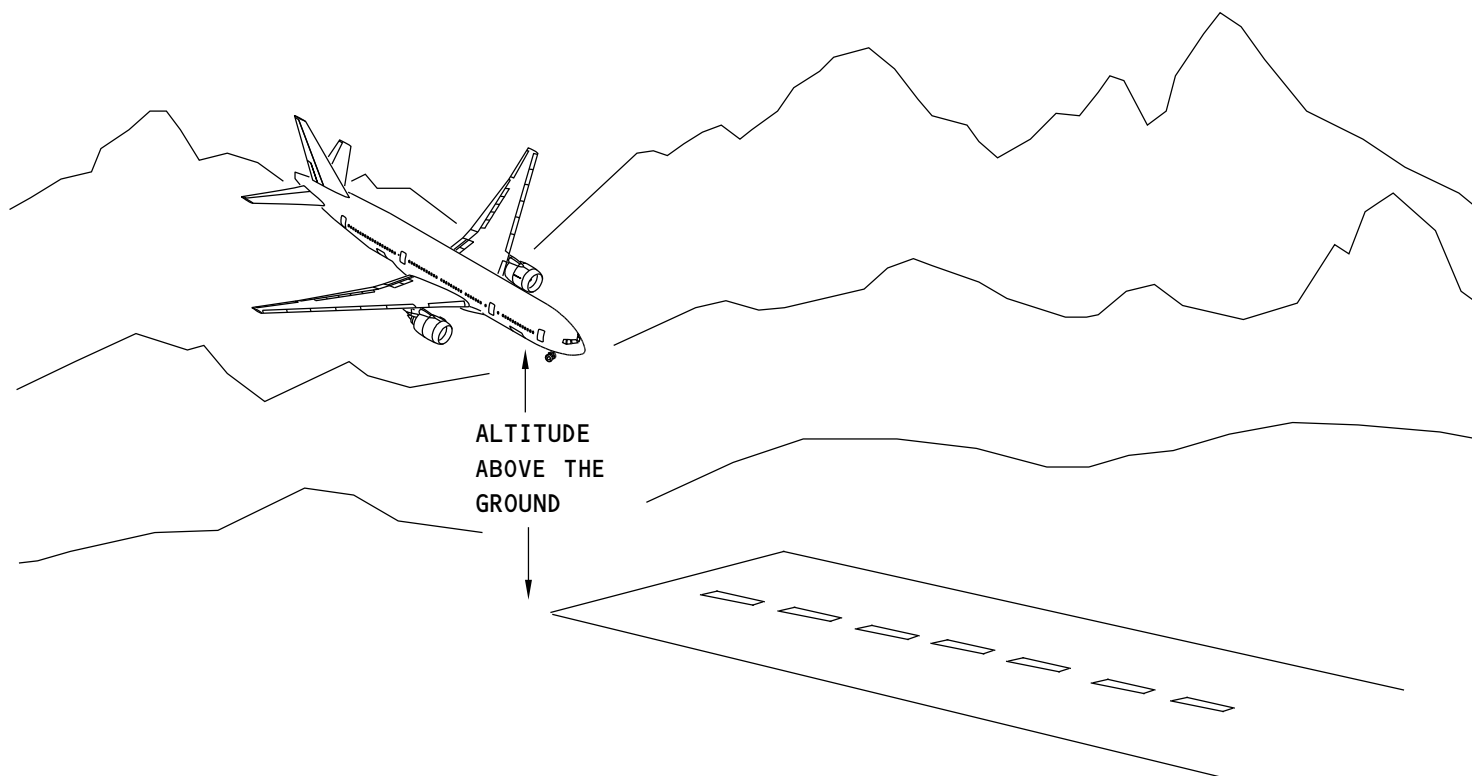
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- xcvr - transceiver

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RADIO ALTIMETER SYSTEM - INTRODUCTION

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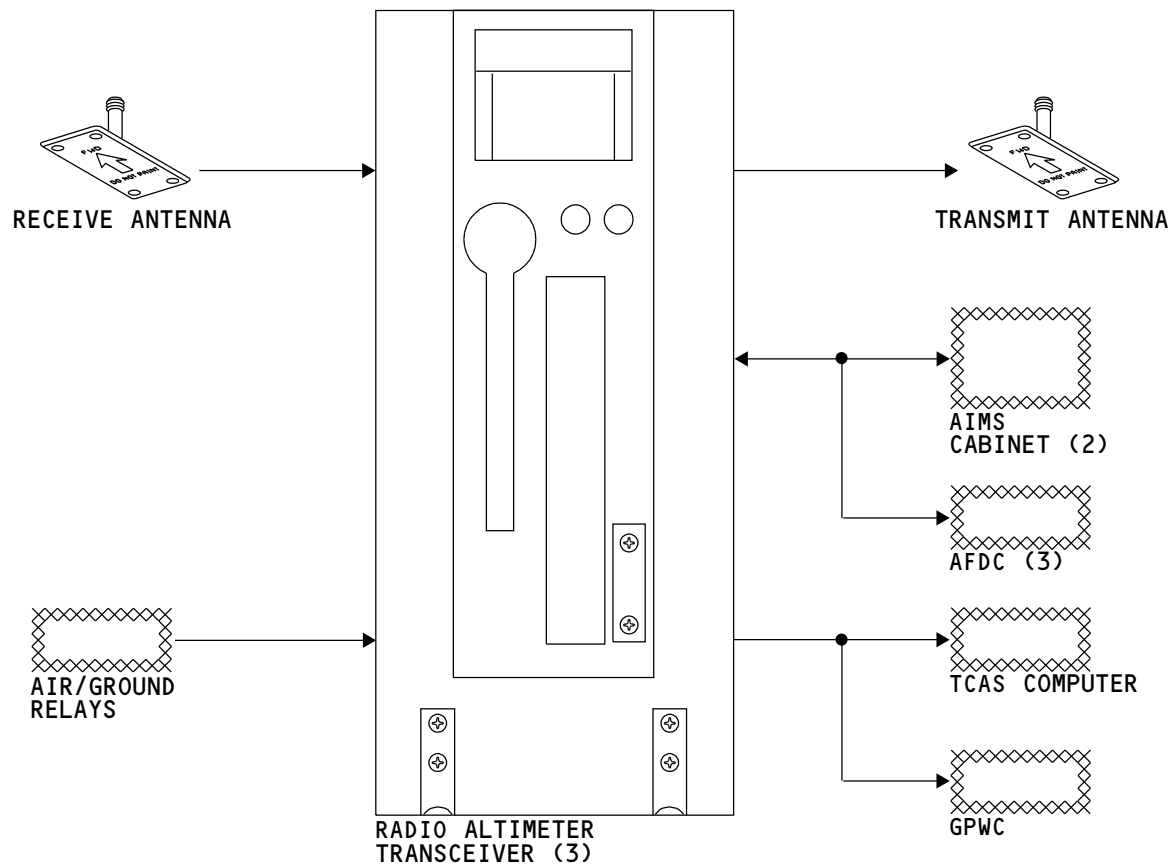
**RA SYSTEM - GENERAL DESCRIPTION****General**

The system has three transceivers (xcvr). Each xcvr has a transmit and a receive antenna.

The transceivers get discrete inputs from the air ground relays and from the AIMS cabinets.

Radio altitude data goes on ARINC 429 data buses to the these components:

- Airplane information management system (AIMS) cabinets
- Autopilot flight director computers (AFDCs)
- Traffic alert and collision avoidance system (TCAS) computer
- Ground proximity warning computer (GPWC).



RA SYSTEM - GENERAL DESCRIPTION

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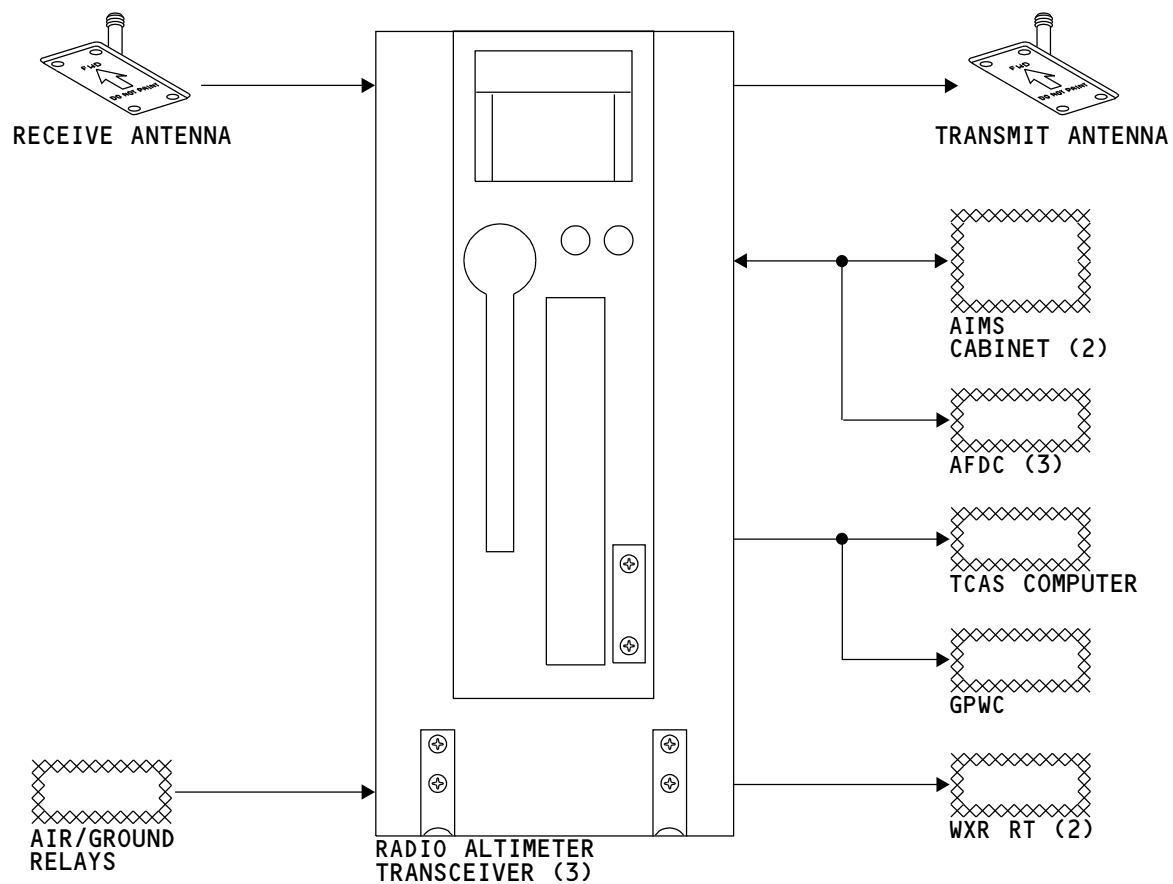
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RA SYSTEM - GENERAL DESCRIPTION

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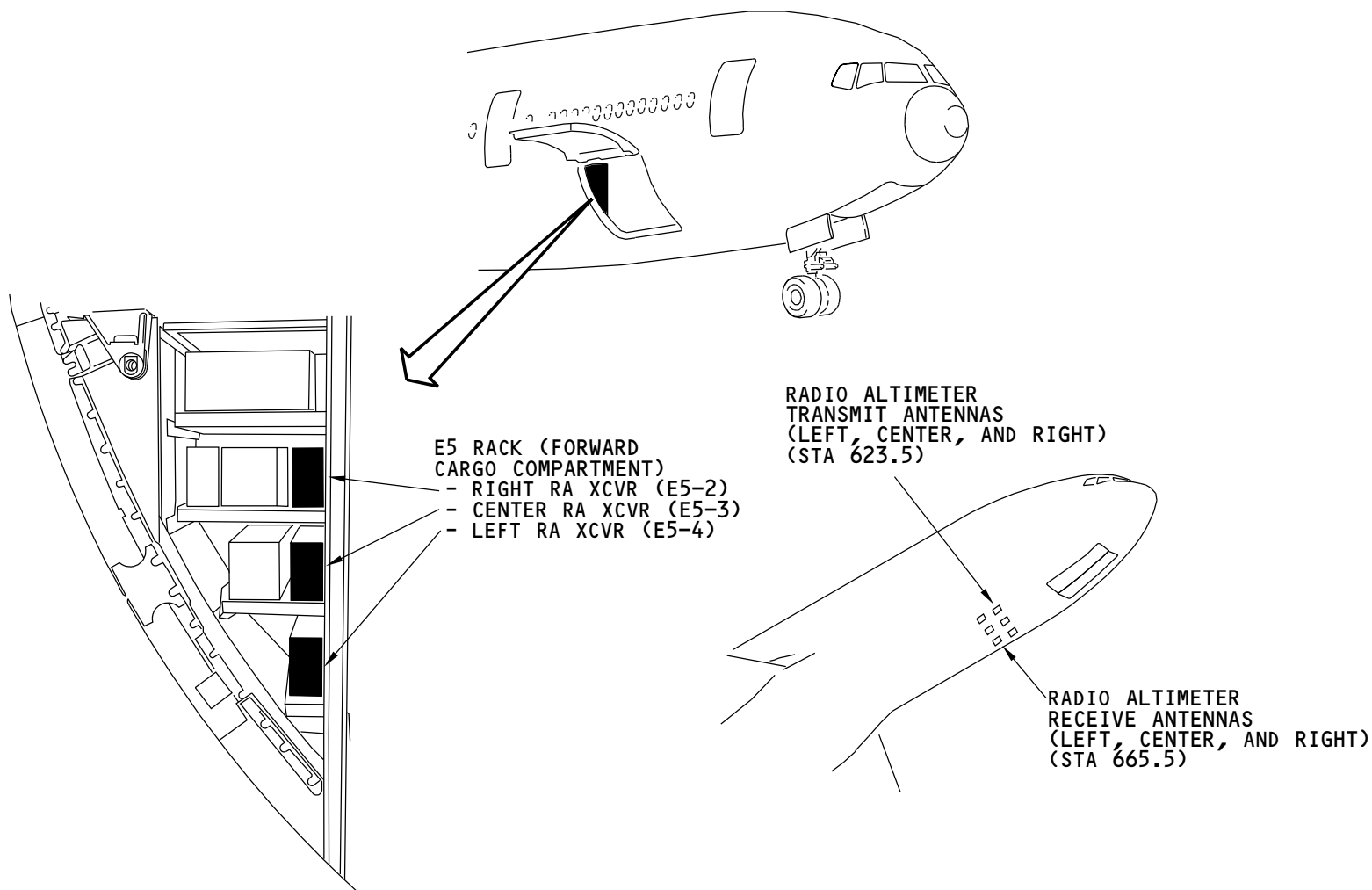
**RA SYSTEM - COMPONENT LOCATION - 1****General**

These are the RA system components in the E5 rack in the forward cargo compartment:

- Right RA transceiver (xcvr)
- Center RA xcvr
- Left RA xcvr.

These are the RA system components on the bottom of the fuselage:

- Left RA receive antenna
- Center RA receive antenna
- Right RA receive antenna
- Left RA transmit antenna
- Center RA transmit antenna
- Right RA transmit antenna.



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RA SYSTEM - COMPONENT LOCATION - 1

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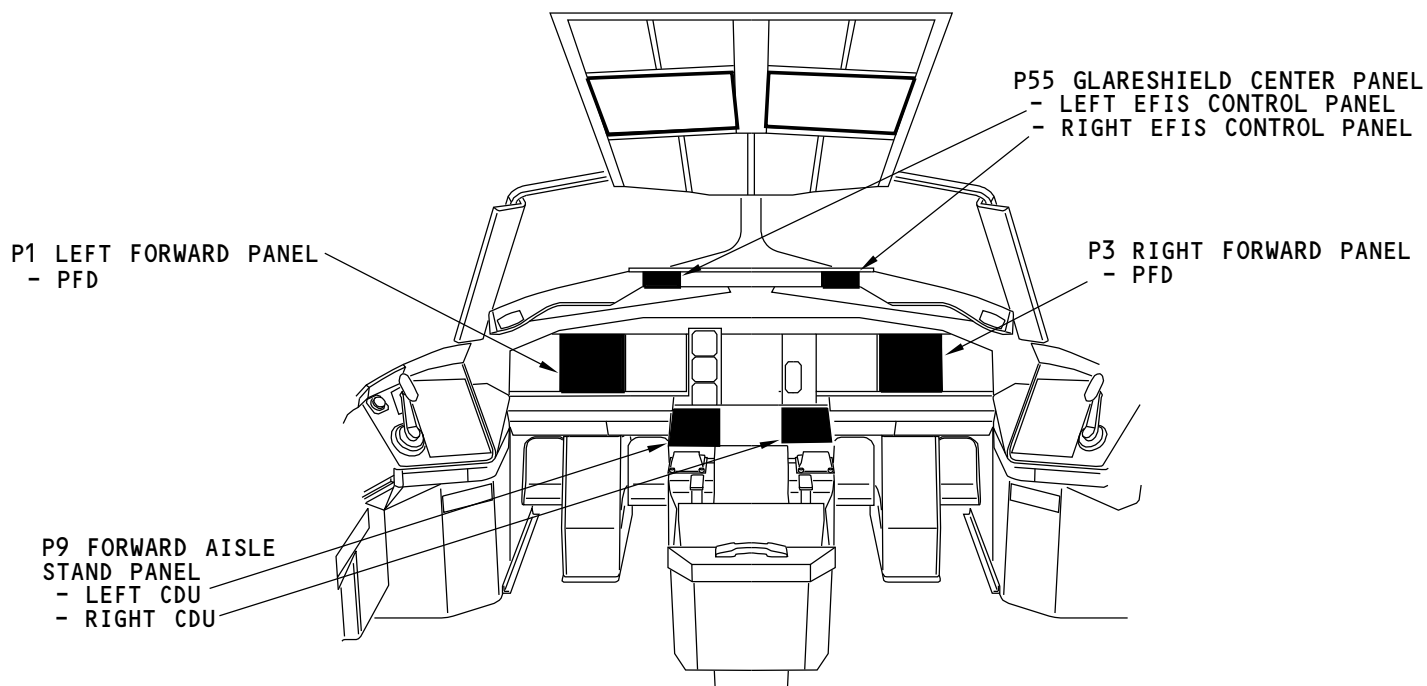
RA SYSTEM - COMPONENT LOCATION - 2

General

These are the RA system components and components that interface with the RA system in the flight deck:

- Primary flight displays (PFD)
- Left and right EFIS control panels
- Left and right control display units (CDU).

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RA SYSTEM - COMPONENT LOCATION - 2

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RA SYSTEM - POWER, ANTENNA, AND DISCRETE INPUTS**Power**

Power for the RA xcvs is 115v ac from:

- 115v ac left transfer bus (left RA)
- 115v ac standby bus (center RA)
- 115v ac right transfer bus (right RA).

Antenna Interfaces

The transmit antennas send radio frequency (RF) signals to the ground. The receive antennas send reflected RF signals to the receiver circuits of the RA xcvr.

AIMS Discrete

The primary flight control computers (PFCs) supply a test inhibit signal to the RA xcvr through the airplane information management system (AIMS) cabinets. This signal prevents a RA test when the primary flight computers detect a ground speed more than 40 knots, or the airplane is in the air.

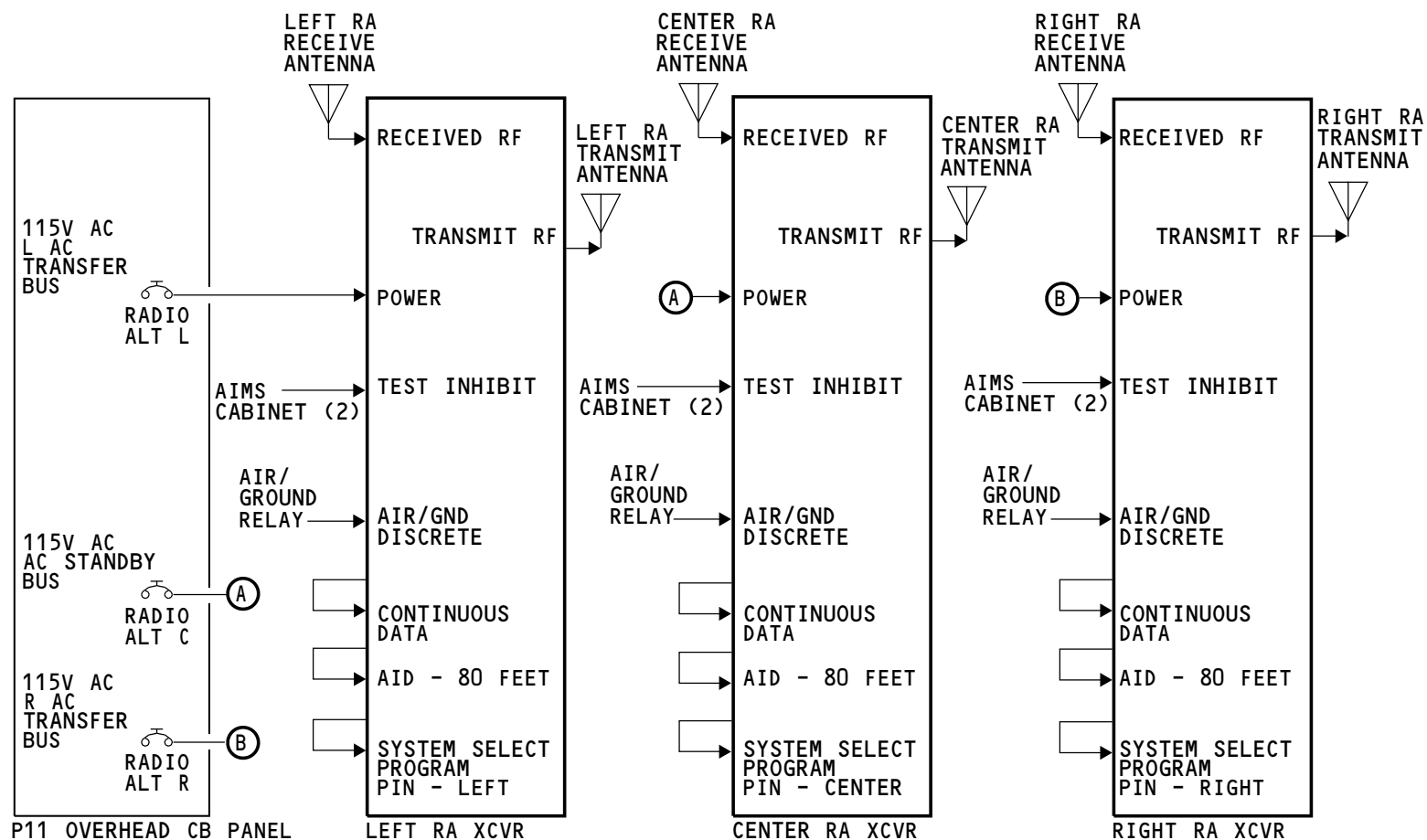
Air/Ground Discrete

The RA xcvr stores internal faults in a nonvolatile fault memory. The RA xcvr stores these faults by flight segments. The central maintenance computing function (CMCF) of the AIMS supplies the primary flight leg start times. The air/ground relay is an alternate way to detect the air/ground condition.

Input Program Pins

The RA xcvr program pins are:

- Continuous data
- Aircraft installation delay (AID) of 80 feet
- System select.



RA SYSTEM - POWER, ANTENNA, AND DISCRETE INPUTS

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**RA SYSTEM - DATA BUS OUTPUTS, RADIO MINIMUMS INTERFACE****General**

The RA system supplies data to the:

- Left, center, and right AFDCs
- TCAS computer
- GPWC
- Left and right AIMS cabinets
- Left, right, and center PFCs (through the AIMS cabinets).

Altitude Data

Radio altitude goes to the AIMS for PFD displays and status messages.

Each AFDC gets radio altitude from its onside RA transceiver. The AFDCs use radio altitude in their approach control calculations.

The GPWC uses radio altitude in its ground proximity alert and warning logic calculations.

The TCAS computer uses radio altitude to set the sensitivity levels and for intruder advisory calculations.

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Weather radar (WXR) uses radio altitude data for the following:

- Automatic on/off logic
- Alert and display logic.

ARO ALL**Fault Summary Data**

Fault data from each radio altimeter goes to the AIMS cabinets. The AIMS cabinets send data to the status page. The status page shows RA status messages.

The CMCF of the AIMS cabinets receives and stores RA fault information. Maintenance personnel use the MAT to get fault information.

Radio Minimums GPWC Interface

Radio minimums and radio altitude go to the GPWC for various modes of warning.

Radio Minimums Interface

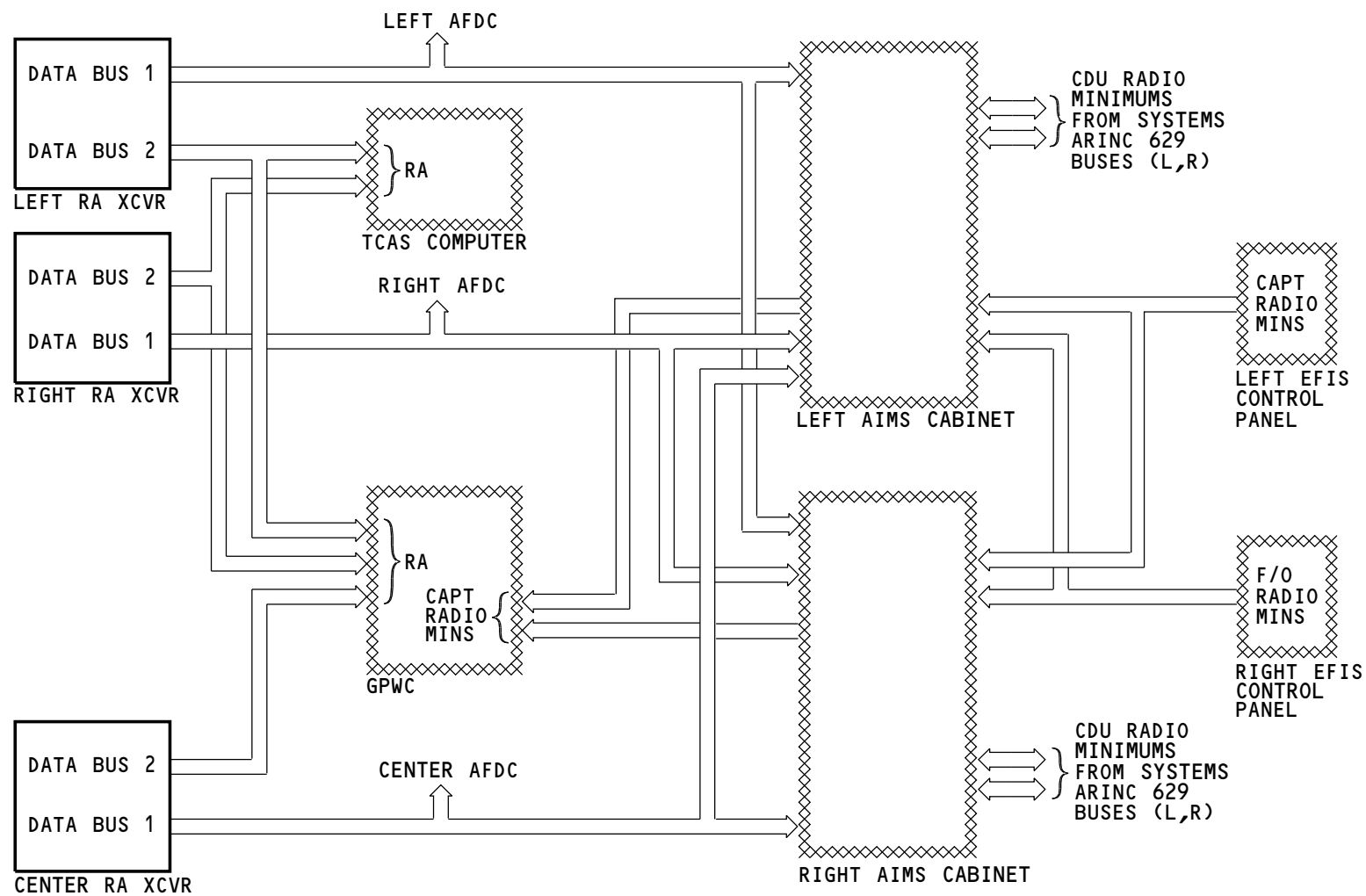
The EFIS control panels supply radio minimums values to the AIMS. The control display units (CDUs) supply backup radio minimums values to the AIMS.

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RA SYSTEM - DATA BUS OUTPUTS, RADIO MINIMUMS INTERFACE

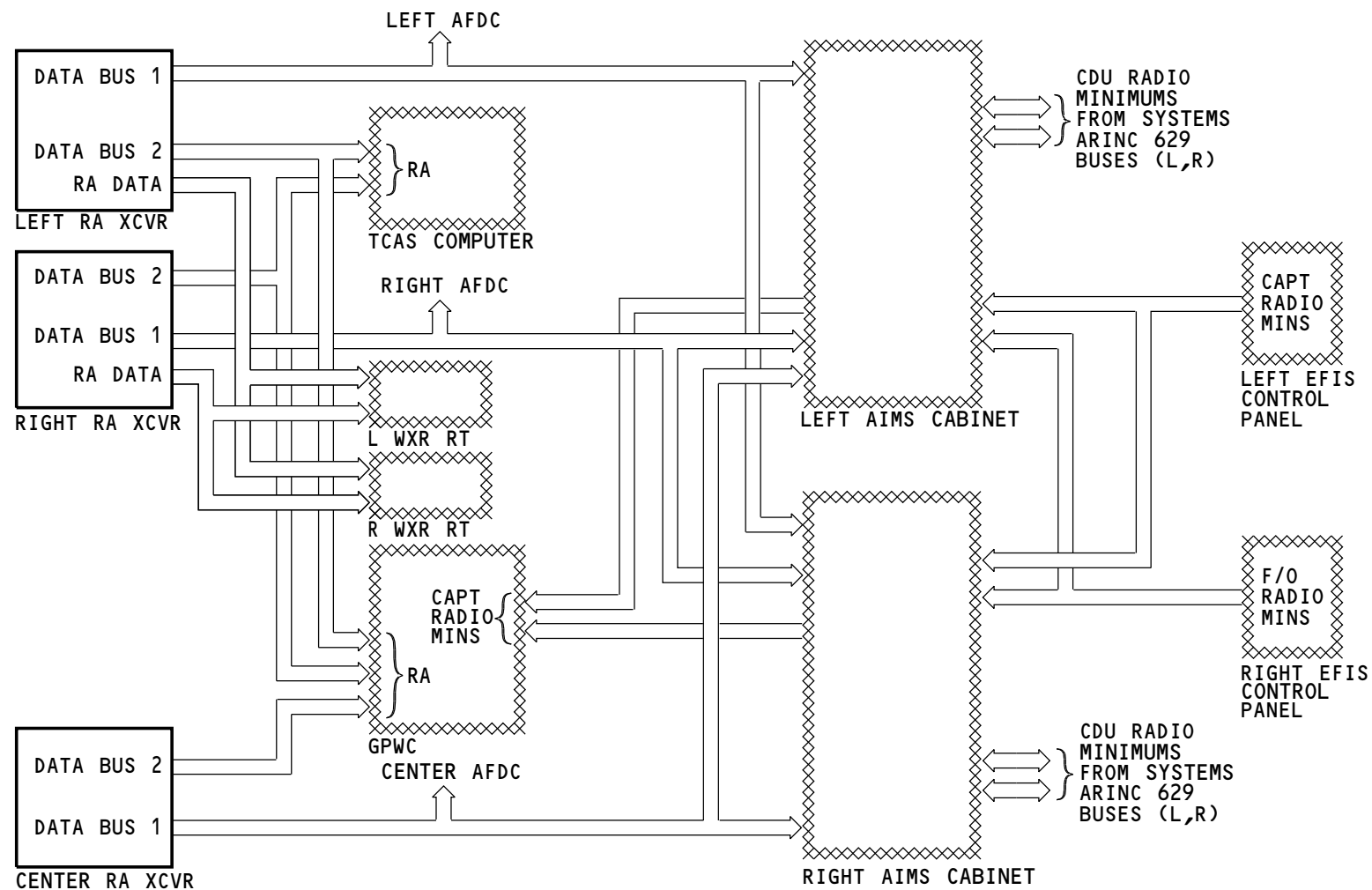
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RA SYSTEM - DATA BUS OUTPUTS, RADIO MINIMUMS INTERFACE

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**RA SYSTEM - CMCF INTERFACE****CMCF Interface**

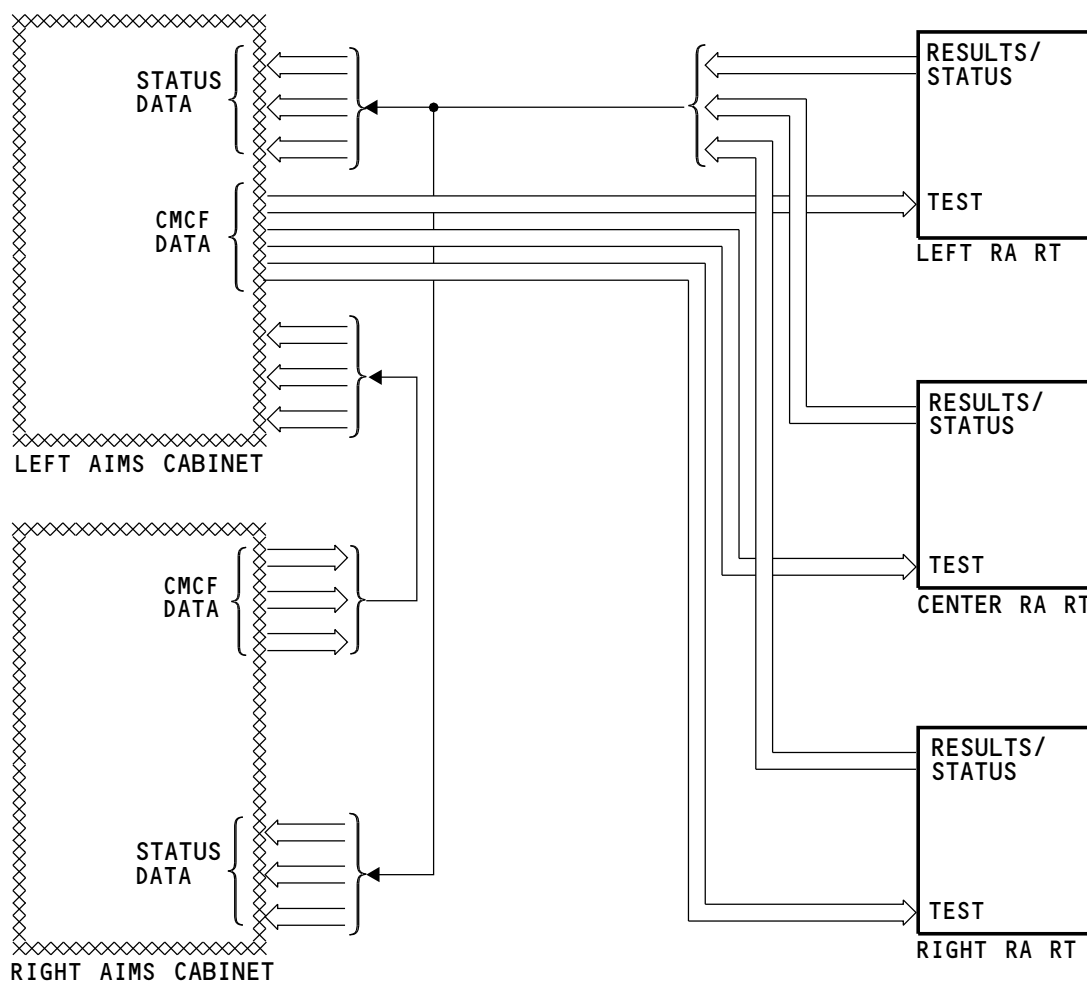
The central maintenance computing function (CMCF) of the airplane information management system (AIMS) does tests and monitors the status of the RA system. Maintenance technicians use the maintenance access terminal (MAT) to interface with the CMCF.

The MAT data goes to the AIMS cabinets. The left AIMS cabinet sends the data to the RA system to start a test. If the left AIMS cabinet fails, data goes from the right AIMS cabinet to the RA system through the left AIMS cabinet.

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RA SYSTEM - CMCF INTERFACE

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RA SYSTEM - RA TRANSCEIVER

Purpose

The RA transceiver calculates radio altitude.

The RA transceiver has a non-volatile memory which stores fault information. Only shop personnel read the non-volatile memory information.

Operational Characteristics

These are the operational characteristics of the transceiver:

- Frequency = 4235 MHz to 4365 MHz
- Transmit power = 500 mw nominal
- Operating range = -20 to 2500 feet.

Operation

There are two switches and an LCD on the front panel of the RA transceiver. You use any of the two switches to start a test of the RA transceiver. The LCD shows the test results.

There is a memory card slot on the front of the RA transceiver. Shop personnel use this feature to insert a flash memory card which loads software into the LRU. The memory card can also store LRU status data sent by the LRU during operation. These features are not for use by line maintenance personnel.

Shop personnel use the RS 232 connector to connect shop test equipment to the LRU. This feature is not for use by line maintenance personnel.

Training Information Point

The maintenance manual and the fault isolation manual do not have a task for the line maintenance technician to do a test from the front panel of the RA transceiver. You must do all tests for the RA transceiver from the MAT or a PMAT.

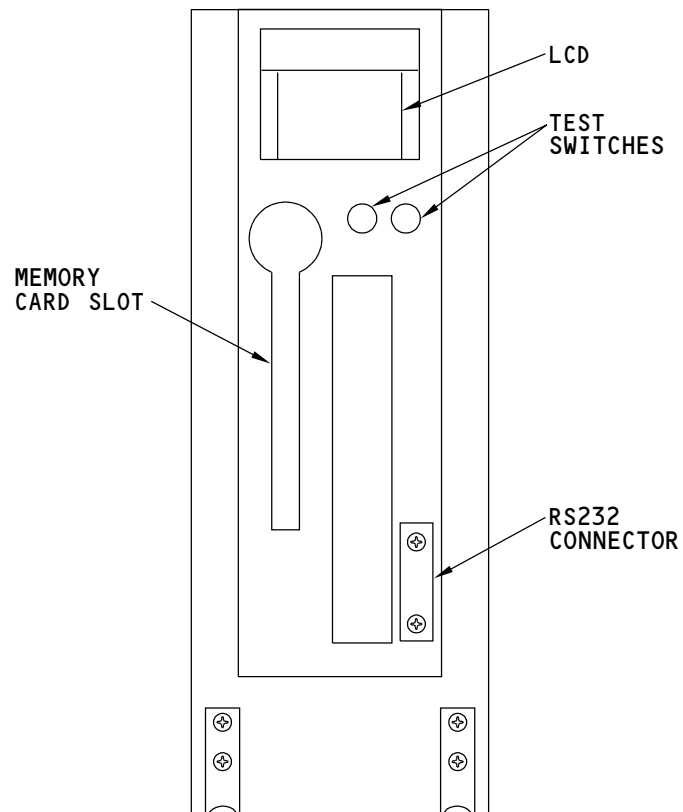
Many LRUs on the 777 are compatible with other model airplanes that do not have a central maintenance computing system (CMCS). For that reason these LRUs have a front panel test feature.

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RA SYSTEM - RA TRANSCEIVER

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**RA SYSTEM - RA ANTENNA****Purpose**

The RA system uses six antennas that transmit and receive RF signals. Each RA xcvr has a transmit and receive antenna. The transmit and receive antenna are the same and interchangeable.

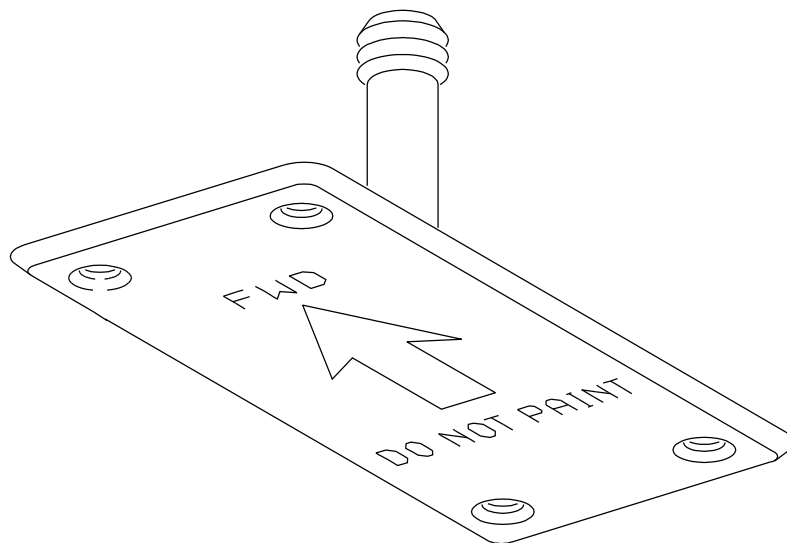
Physical Description

Four screws attach each antenna to the bottom of the fuselage. There is an O-ring seal in a groove around the electrical connector. The O-ring seal supplies moisture protection. The radiation side of the antenna has red markings "FWD" and "DO NOT PAINT".

Training Information Point

Do not paint the radiation surface or the back plate of the antenna. Paint does not permit the antenna to radiate or receive RF signals.

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RA SYSTEM - RA ANTENNA

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RA SYSTEM - OPERATION - 1

EFIS Control Panel

The EFIS control panel controls the radio minimums and resets the radio minimums alert. The radio minimums show on the captain and first officer PFDs. The left EFIS control panel controls the captain PFD. The right EFIS control panel controls the first officer PFD.

The RADIO/BARO MINS control has these three concentric controls:

- Two-position rotary switch (minimums reference selector)
- Three-position rotary switch which is spring loaded to center (minimums selector)
- Radio minimums reset switch.

The flight crew uses the minimums reference selector to select either radio minimums or barometric minimums. Radio minimums is the same as decision height (DH). Barometric minimums is the same as minimum descent altitude (MDA).

When the flight crew selects a radio minimums value, the three-position rotary switch, which is spring loaded to center, adjusts the radio minimums between -1 foot and +999 feet.

The flight crew pushes the reset switch to reset the radio minimums alert.

The barometric minimums function does not relate to the radio altimeter operation.

PFD

The PFD shows radio altitude and radio minimums values. The flight crew uses this data during approach and landing.

Radio altitude shows digitally for altitudes between -20 and 2500 feet. The display updates in:

- Two foot increments from -20 to 100 feet
- Ten foot increments from 100 to 500 feet
- Twenty foot increments from 500 to 2500 feet.

The display goes out of view above 2500 feet.

Radio minimums show on the PFD. The radio minimums display has the letters RADIO (radio minimums) and the radio minimums value. If the radio minimums value is less than zero feet or more than 999 feet, the display goes out of view.

Radio Minimums Alert

This happens as the airplane descends through the radio minimums value:

- Radio altitude display changes from white to yellow
- Green letters RADIO and the radio minimums value below it change from green to yellow.
- Radio altitude, the letters RADIO, and the radio minimums value blinks three times at a 4Hz rate.

Each of these resets the radio minimums alert:

- Push the radio minimums reset (RST) switch on the EFIS control panel
- Airplane climbs to 75 feet above the radio minimums value
- Radio minimums alert resets automatically at touchdown.

Reset causes the radio minimums value to go back to green and the radio altitude to go back to white.

RA Data Invalid

Invalid RA data causes a yellow RA flag to show in place of the radio altitude. The invalid occurs when the RA transceiver detects a failure in the RA system.

RA Data NCD

RA NCD causes the RA display to go out of view. The NCD occurs when the return RA signals are too weak or the radio altitude is more than 2500 feet.

RA Data NCD

RA NCD causes the RA display and rising runway symbol to go out of view. The NCD occurs when the return RA signals are too weak or the radio altitude is more than 2500 feet.

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RA SYSTEM - OPERATION - 1

Radio Minimums Data Invalid or NCD

Invalid or NCD EFIS control panel data causes the letters RADIO and the radio minimums value to go out of view. The invalid occurs when the EFIS control panel, the onside CDU, and the center CDU fail.

RA Display Priority

The flight crew cannot manually select a radio altimeter for the PFD. When an RA transceiver fails, the AIMS selects another transceiver to show on the PFD. The selection priority shows below. A RA yellow flag shows on the PFDs only when all radio altimeters fail.

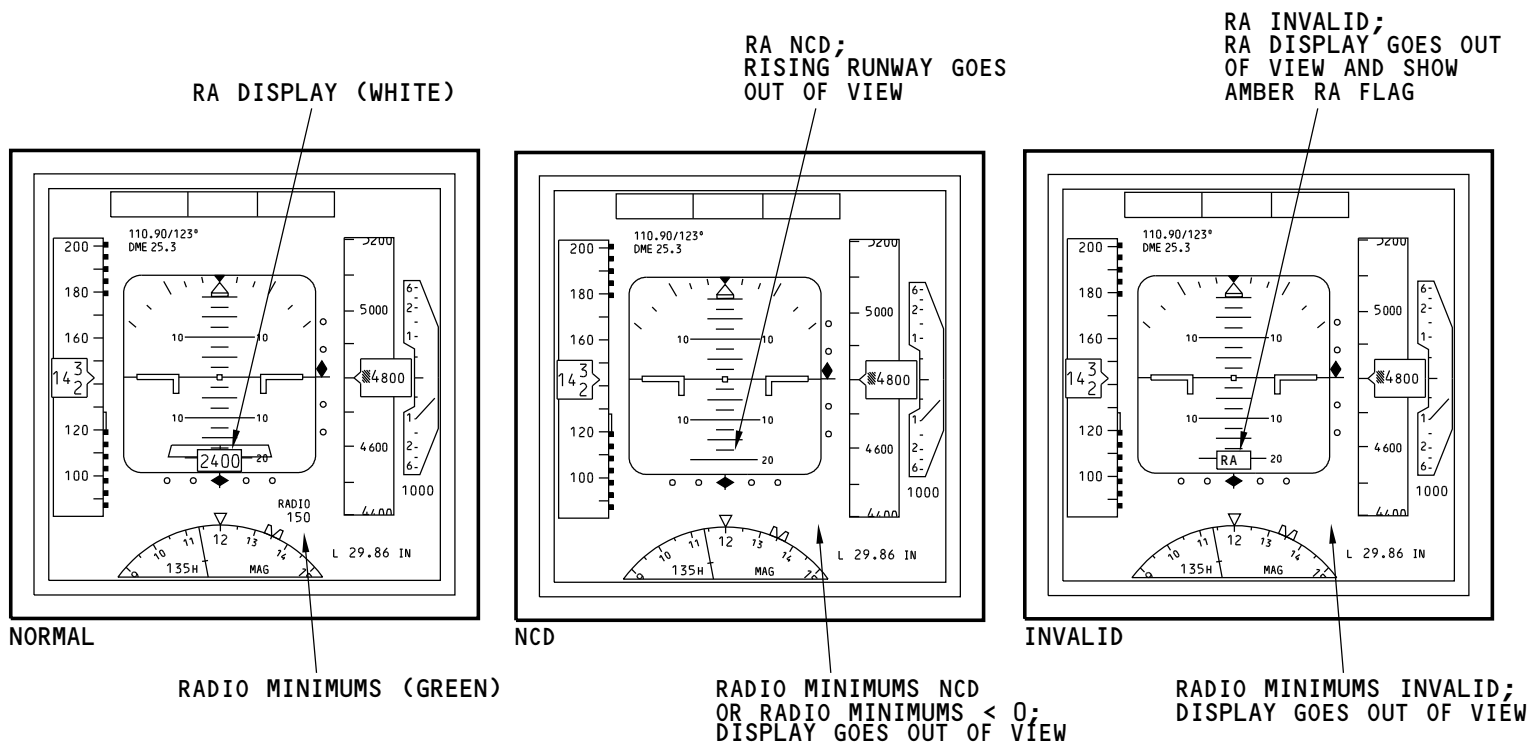
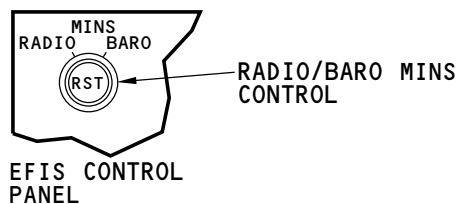
AIMS priority selection of PFD RA display:

Captain PFD	L, C, R
First Officer PFD	R, C, L

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RA SYSTEM - OPERATION - 1

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RA SYSTEM - OPERATION - 2

Purpose

In addition to the EFIS control panels, the flight crew can use the CDUs to select a radio minimums value and to reset a radio minimums alert. When the flight crew uses the CDU, the onside EFIS control panel does not operate.

Operation

The captain selects a radio minimums value on the left CDU. The captain's radio minimums show on the captain's PFD. The first officer selects a radio minimums value on the right CDU. The first officer's radio minimums show on the first officer's PFD.

When the flight crew selects the EFIS control page on the CDU, the page shows the last radio minimums or barometric minimums of the onside EFIS control panel.

Push the line select key next to <RAD> BARO to make the letters RAD show in green large letters and the letters BARO show in white small letters. This action selects radio minimums in place of barometric minimums.

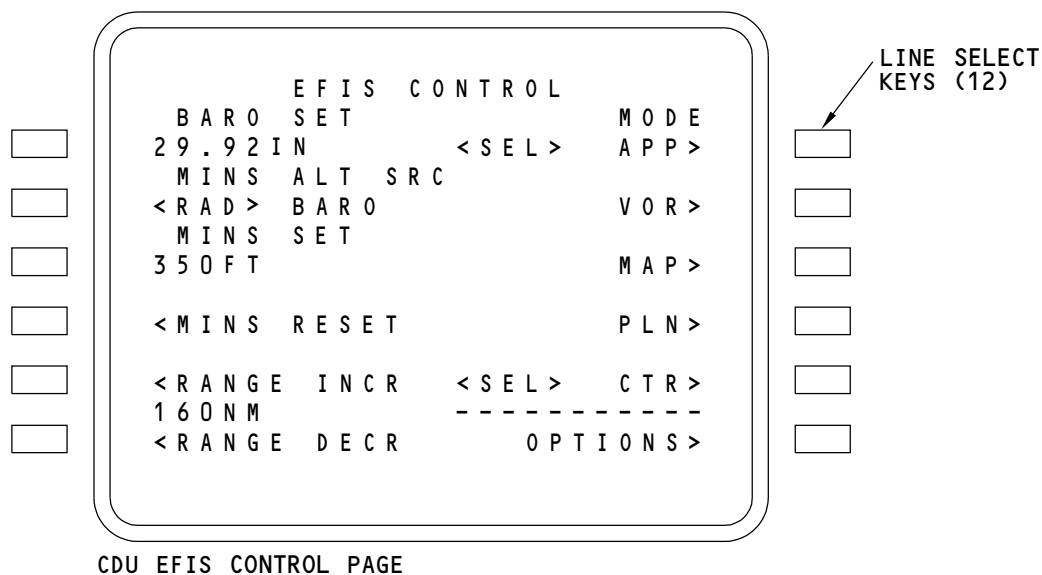
Type a new radio minimums value into the CDU scratch pad and push the line select key below MINS SET. Valid entries are 0 to 999 feet.

Push the line select key next to MINS RESET to clear a radio minimums alert.

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RA SYSTEM - OPERATION - 2

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**RA SYSTEM - RF PROCESSING****General**

The RA transceiver (xcvr) transmits a frequency modulated/continuous wave (FM/CW) signal through the transmit antenna. This signal is a CW carrier that sweeps linearly from 4235 MHz to 4365 MHz 145 times a second.

Transmit and Receive

The transmit signal reflects from the ground and the receive antenna receives the reflected signal. The receiver mixes the transmit and receive signals to make a difference frequency. The difference frequency is proportional to the signal travel time to the ground and back. The altitude processor converts the difference frequency to radio altitude. The radio altitude goes out on two ARINC 429 data buses. These buses supply radio altitude and status information to these:

- Left AFDC
- AIMS cabinets

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- Weather radar.

ARO ALL

- TCAS computer
- GPWC.

Input Program Pins

The system select program pin input sets the system modulation rate and system identification. The modulation rate for the left RA system is 145 Hz, the center at 150 Hz, the right at 155 Hz.

The aircraft installation delay (AID) program pin is grounded to 80 feet selection. This calibrates the system so that the radio altitude is zero feet at touchdown. It compensates for the:

- Length of the antenna cables
- Fuselage to ground distance

- Flare angle.

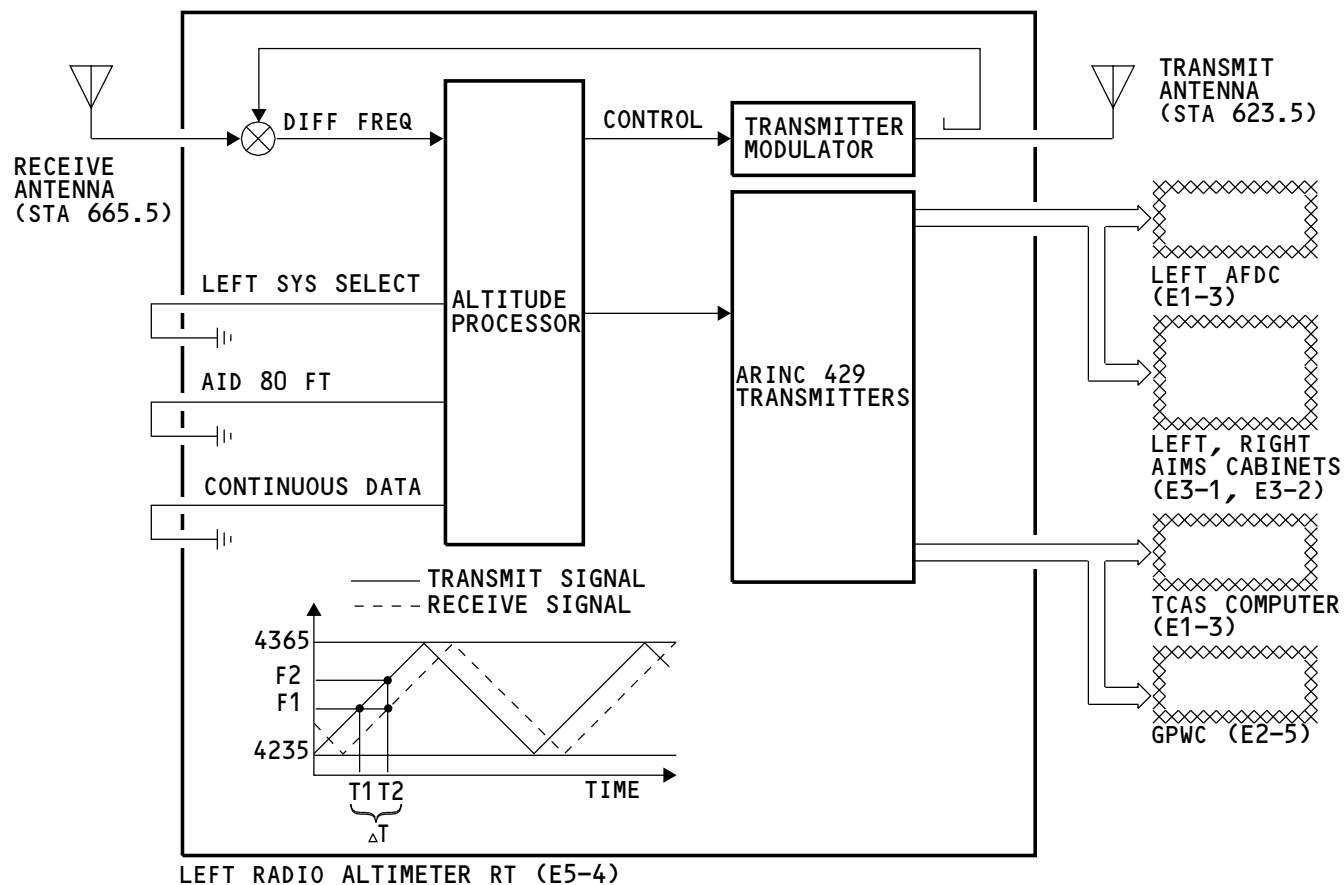
When grounded, the continuous data program pin selects non-interrupted RA data output at all times.

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RA SYSTEM - RF PROCESSING

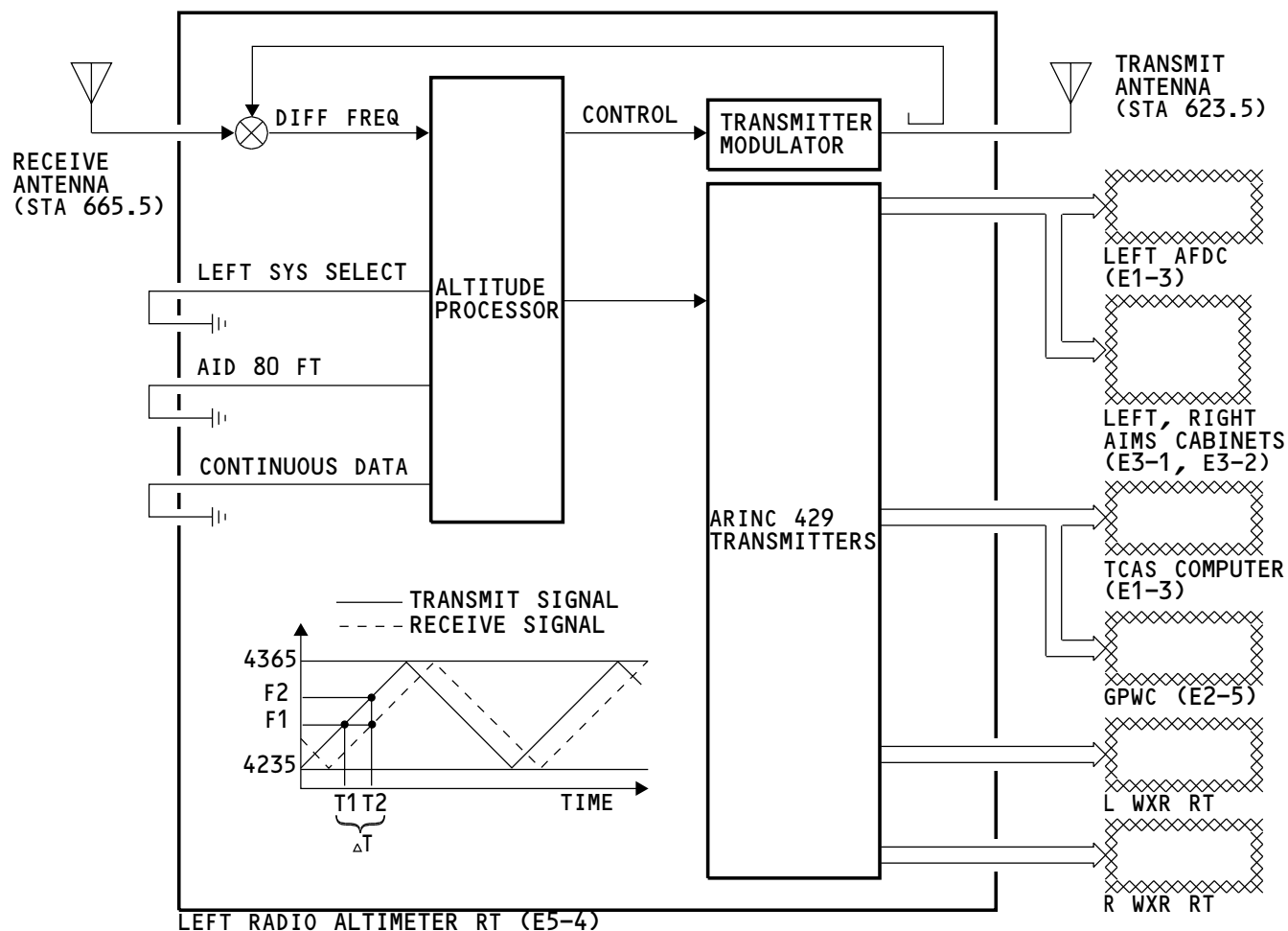
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RA SYSTEM - RF PROCESSING

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**RA SYSTEM - MONITOR/TEST****BITE Logic**

The built-in test equipment (BITE) logic monitors the circuits in the RA transceiver (xcvr) for faults. The BITE logic stores faults in a non-volatile fault memory. Only shop personnel can read the fault memory contents.

Test

The test switches on the front of the RA xcvr start a RA self-test. The LCD shows the results of the self-test.

Maintenance personnel start a ground test from the maintenance access terminal (MAT). When the ground test starts, a test command goes from the left AIMS cabinet to the RA xcvr. The test command starts the test. When the left AIMS cabinet fails, the right AIMS cabinet supplies the test command.

The xcvr ground test and self-tests do a check of these:

- Transceiver internal status
- ARINC 429 output transmitters status
- Antennas and coaxial cables.

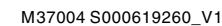
The results of the ground test go to the left and right AIMS cabinets.

System status information goes to the AIMS cabinets continuously. This is for fault monitoring of the RA system.

The primary flight computers (PFCs) supply a test inhibit signal to the xcvr through the AIMS. This prevents a RT test when the ground speed is more than 40 knots or the airplane is in the air.

The air/ground relay supplies a discrete signal to the RA RT altitude processor and control section of the RA xcvr. This discrete prevents an RA test in flight. This discrete is also an alternate way to define flight legs for the nonvolatile fault memory in the RA xcvr.

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**RA SYSTEM - SELF TEST****Operation**

Push any test switch on the front of the receiver to start a test of the RA xcvr. The xcvr then does a check of the internal xcvr operation and of its interfaces. The test results show on the LCD.

Test Inhibit

The primary flight control computers supply a test inhibit signal through the AIMS. This signal prevents a self test of the RA xcvr when the airplane is in the air or the ground speed is greater than 40 knots.

A discrete signal from the ground mode relay prevents a self test of the RA xcvr in flight.

Training Information Point

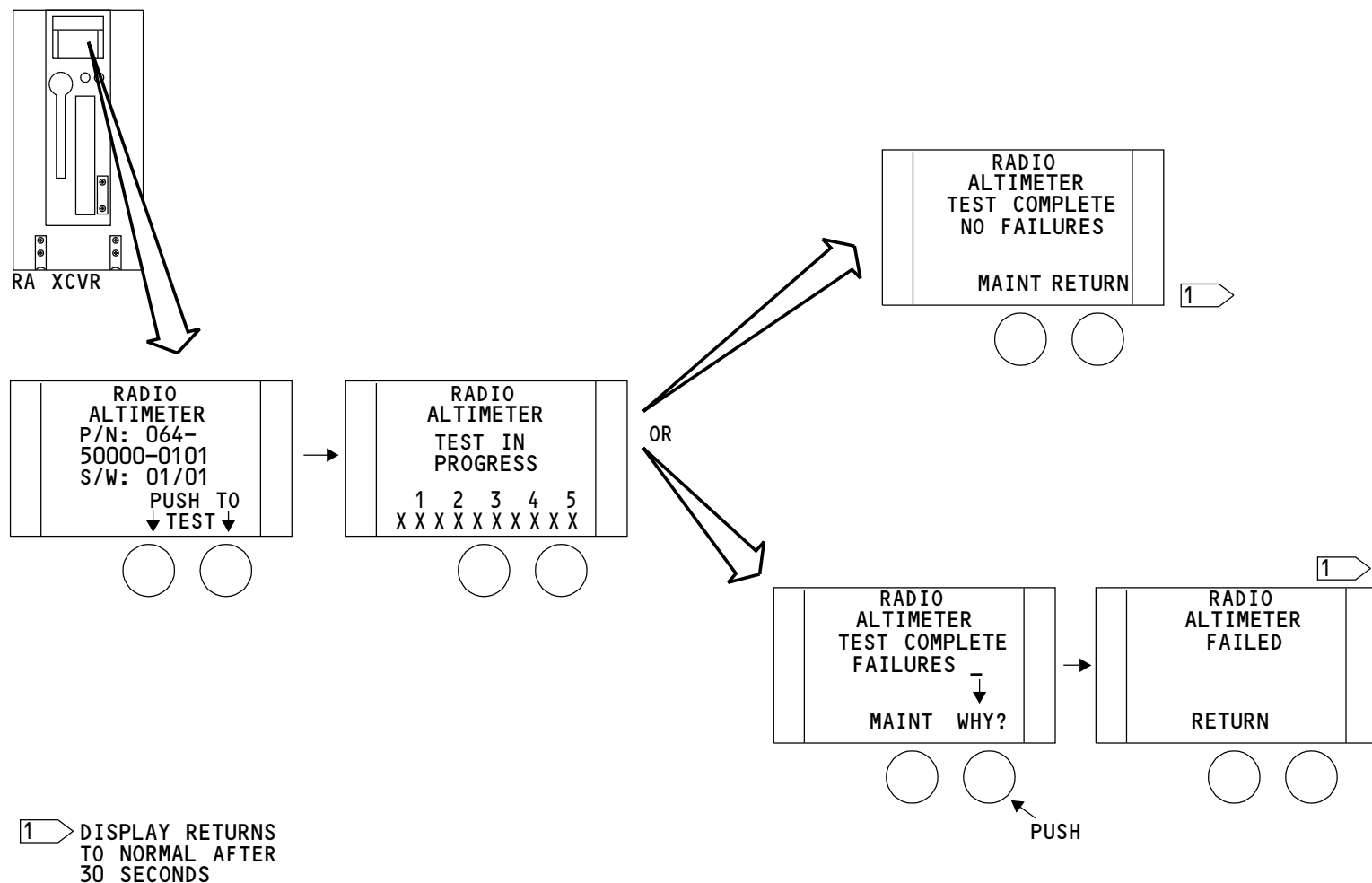
The maintenance manual and the fault isolation manual do not have a task for the line maintenance technician to do a test from the front panel of the RA xcvr. You must do all tests for the RA xcvr from the MAT or a PMAT.

Many LRUs on the 777 are compatible with other model airplanes that do not have a central maintenance computing system (CMCS). For that reason these LRUs have a front panel test feature.

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RA SYSTEM - SELF TEST

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**RA SYSTEM - GROUND TEST****General**

There are only operational tests available for the radio altimeter system. These are the operational tests available:

- Center radio altimeter system
- Left radio altimeter system
- Right radio altimeter system.

Operational Test

The purpose of this test is to verify the operation and function of the radio altimeter transceivers.

This test does a check of the radio altimeter transceiver operation. The test also does a check of the transmission and receive antennas and their coaxial cables.

GROUND TESTS

SELECT ATA SYSTEM (55)

- 32 NOSE LANDING GEAR
- 32 RIGHT MAIN LANDING GEAR
- 34 INSTRUMENT LANDING SYSTEM
- 34 RADIO ALTIMETER SYSTEM**
- 34 PARAVISUAL DISPLAY SYSTEM
- 34 WEATHER RADAR SYSTEM
- 34 TRAFFIC ALERT AND COLLISION AVOIDANCE SYSTEM
- 34 GROUND PROXIMITY WARNING SYSTEM
- 34 VOR / MARKER BEACON SYSTEM

SELECT TEST TYPE

- ☐ SYSTEM TEST
- ☒ OPERATIONAL TEST
- ☐ REPLACEMENT TEST

SELECT OPERATIONAL TEST (3)

- CENTER RADIO ALTIMETER SYSTEM
- LEFT RADIO ALTIMETER SYSTEM
- RIGHT RADIO ALTIMETER SYSTEM

CONTINUE

HELP

GO BACK

SELECT OPERATIONAL TEST

(3)

CENTER RADIO ALTIMETER SYSTEM
LEFT RADIO ALTIMETER SYSTEM
RIGHT RADIO ALTIMETER SYSTEM

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RA SYSTEM - GROUND TEST

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WEATHER RADAR SYSTEM - INTRODUCTION

Purpose

The weather radar (WXR) system supplies these visual indications:

- Weather conditions
- Land contours.
- TCAS - traffic and collision avoidance system
- WES - warning electronics system
- WEU - warning electronics unit
- WX - weather
- WXR - weather radar

Description

The WXR system transmits radio frequency (RF) pulses in a 180 degree sector forward of the airplane path. Precipitation or terrain contours reflect the pulses back to the airplane.

Display

The WXR returns show in four different colors on the navigation displays (ND). The colors of the indications depend on the intensity of the returns.

Abbreviations and Acronyms

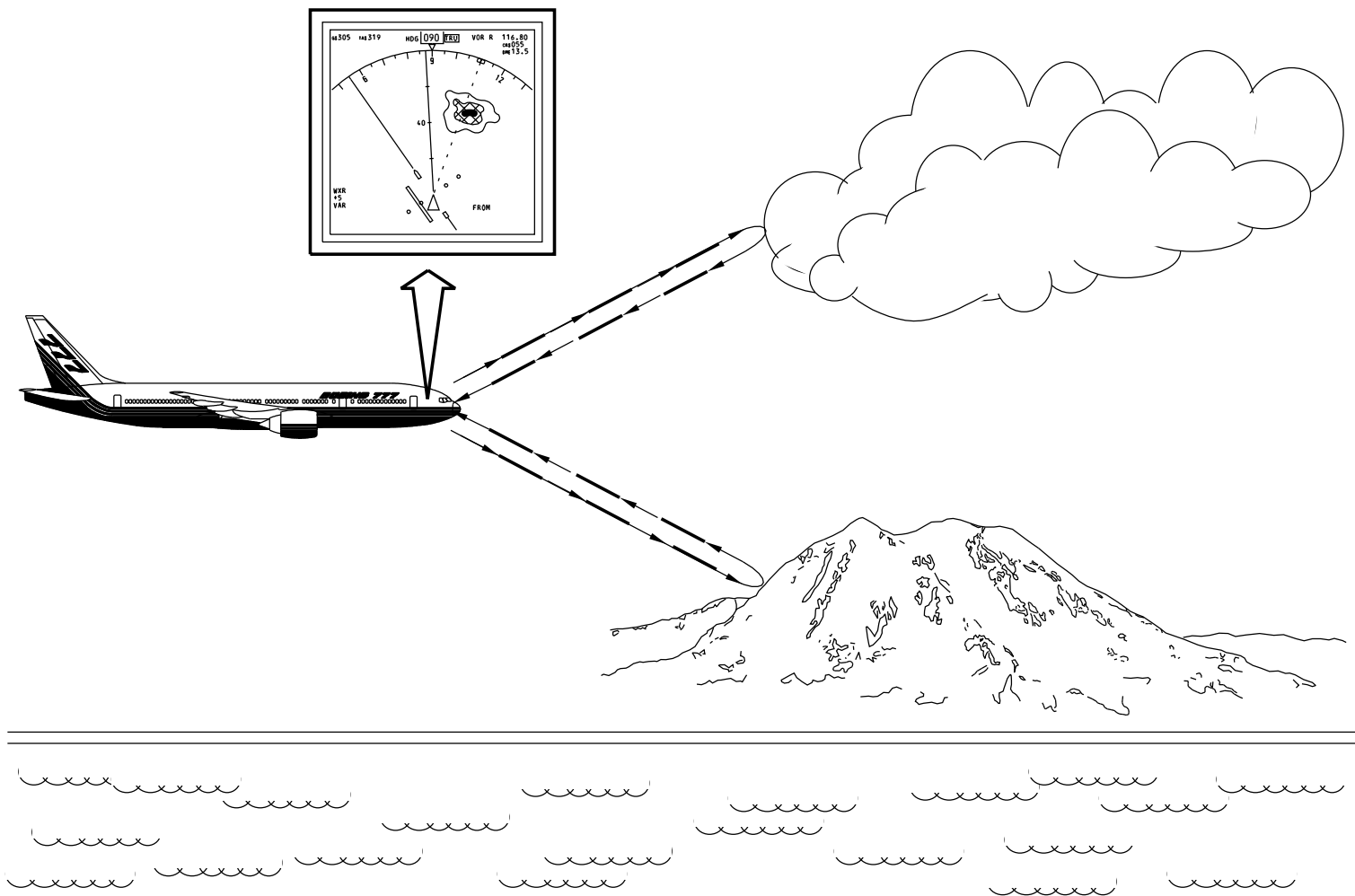
- AIMS - airplane information management system
- CMCF - central maintenance computing function
- CDU - control display unit
- CP - control panel
- GPWC - ground proximity warning computer
- MWL - master warning light
- ND - navigation display
- OPAS - overhead panel ARINC 629 system
- PFD - primary flight display
- PRF - pulse repetition frequency
- PWS - predictive windshear
- RA - radio altimeter
- RF - radio frequency
- RP - radar processor
- RT - receiver-transmitter

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WEATHER RADAR SYSTEM - INTRODUCTION

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WXR SYSTEM - GENERAL DESCRIPTION

Control

These components supply weather radar (WXR) system control:

- Left, center, and right control display units (CDUs)
- Left and right EFIS CPs
- WXR panel

Display

WXR data shows on the navigation displays (NDs). The weather data from the WXR RP goes through the AIMS cabinets then to the NDs.

Antenna

The WXR antenna transmits the RF pulses and receives the RF returns. The RP gets air data inertial reference system (ADIRS) pitch and roll data from the airplane information management system (AIMS) cabinets for antenna stabilization.

The WXR system automatically controls the antenna scan to collect weather and terrain information. This information is stored in a three-dimensional (3D) volumetric memory that is continuously updated and compensated for aircraft movement.

Receiver-Transmitter (RT) and Radar Processor (RP)

The central components of the WXR system are the weather radar receiver-transmitter (RT) and the radar processor (RP). The system has dual RTs and RPs. Only one RT and one RP operate at a time. The WXR RT does these functions:

- Produces RF pulses
- Transmits RF pulses
- Receives RF pulses

The WXR RP does these functions:

- Processes the RF returns
- Supplies the WXR display data.

- Contains an internal worldwide terrain database.

ARO 001-013, 017-999

Interfaces

The WXR system interfaces with these systems:

- Warning electronic system (WES)
- Ground proximity warning system (GPWS)
- Traffic alert and collision avoidance system (TCAS)
- Radio altimeter (RA) system
- Overhead panel ARINC 629 system (OPAS).

The WXR system interfaces with these system components:

- Air/ground relay
- Landing gear control lever module.

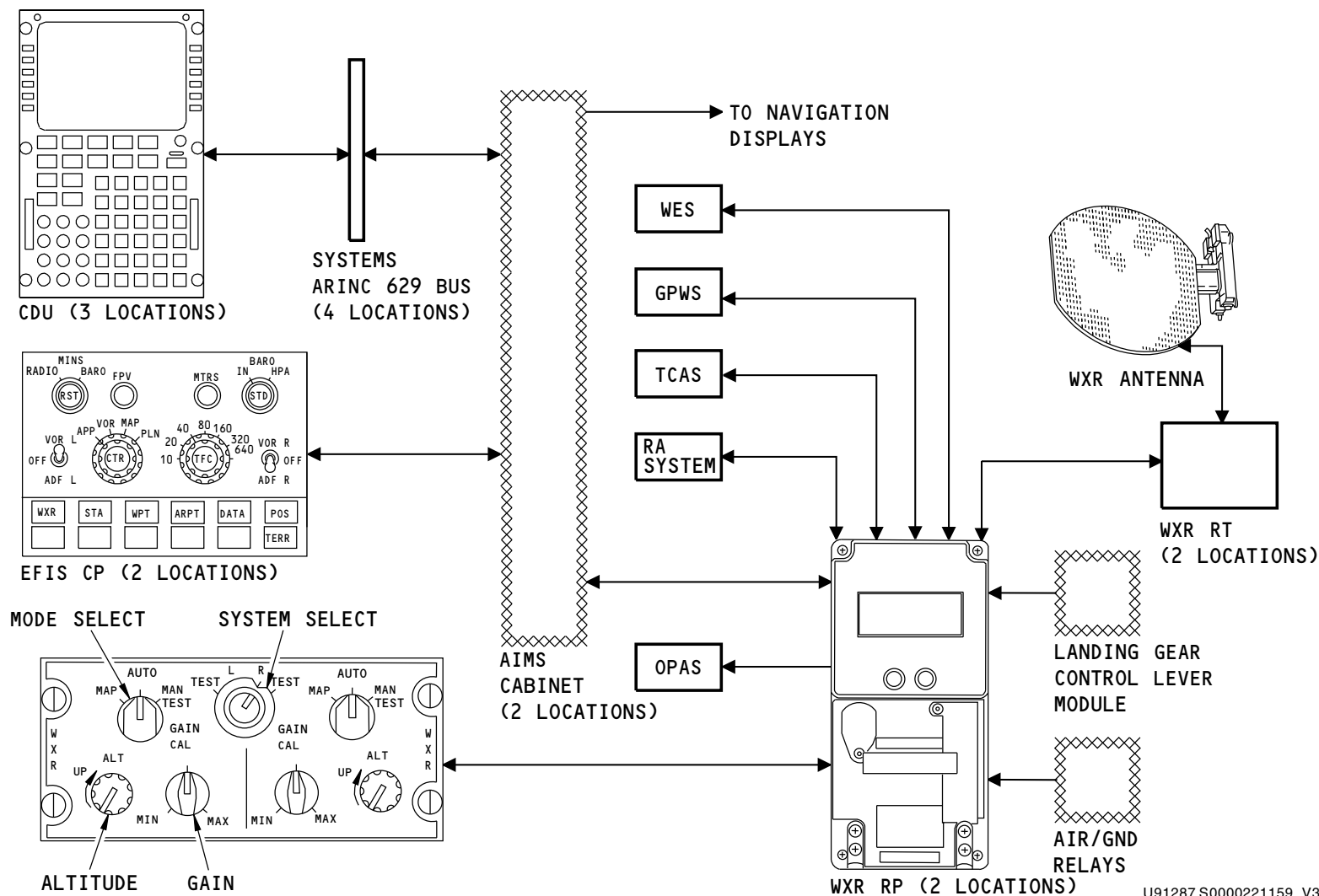
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WXR SYSTEM - GENERAL DESCRIPTION

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**WXR SYSTEM - COMPONENT LOCATIONS - FLIGHT DECK****WXR System Components**

The WXR system component on the flight deck is the weather radar panel.

- Landing gear control lever module

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ARO 014-016

WXR System Interface Components

The components that interface with the WXR system are:

- Left EFIS control panel
- Right EFIS control panel
- Left navigation display (ND)
- Right ND
- Left control display unit (CDU)
- Center CDU
- Right CDU.

ARO 001-013, 017-999

WXR System Interface Components

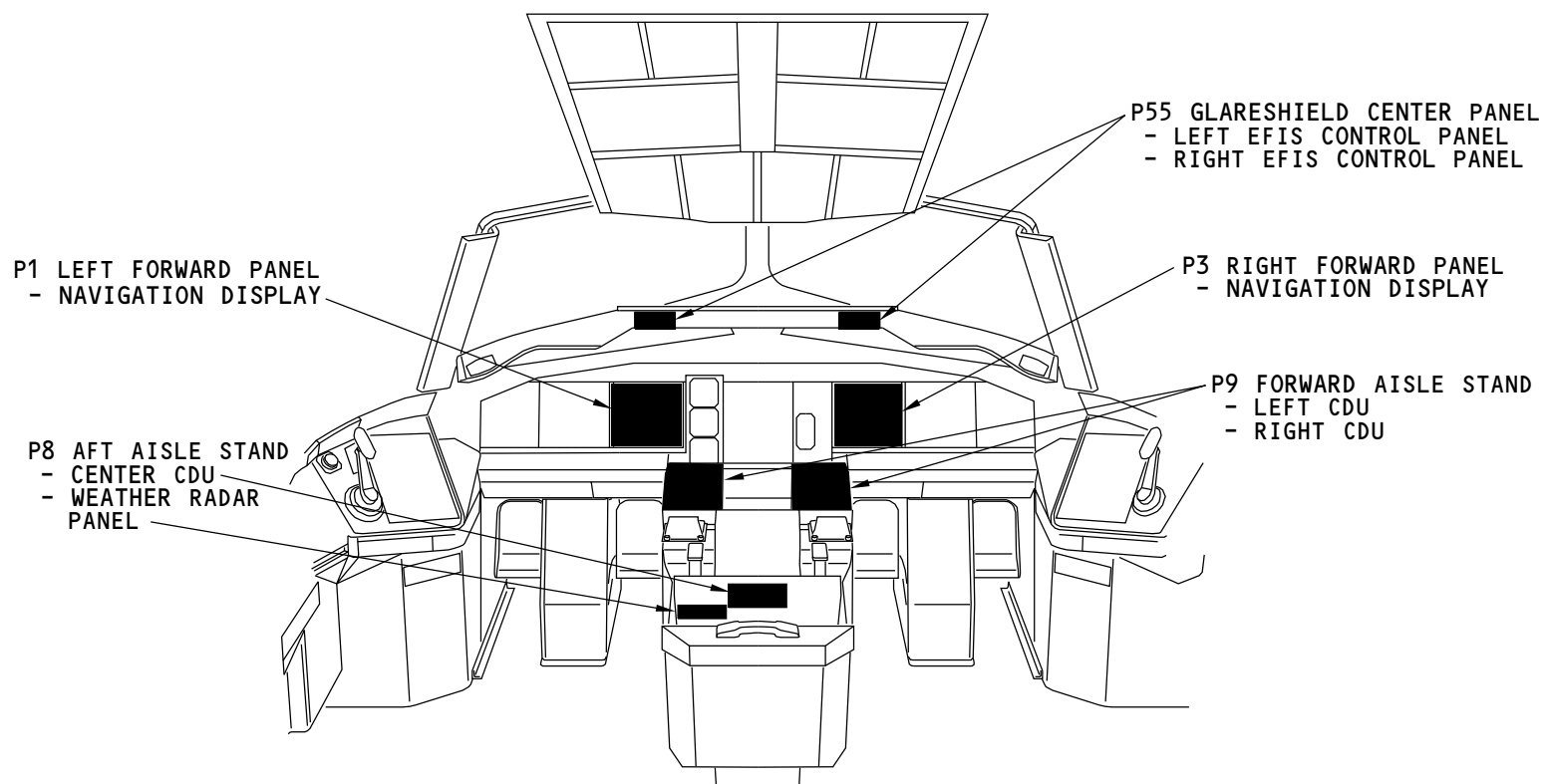
The components that interface with the WXR system are:

- Left EFIS control panel
- Right EFIS control panel
- Left control display unit (CDU)
- Center CDU
- Right CDU
- Left navigation display (ND)
- Right ND
- Left primary flight display (PFD)
- Right PFD
- Master warning lights
- Aural warning speakers

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WXR SYSTEM - COMPONENT LOCATIONS - FLIGHT DECK

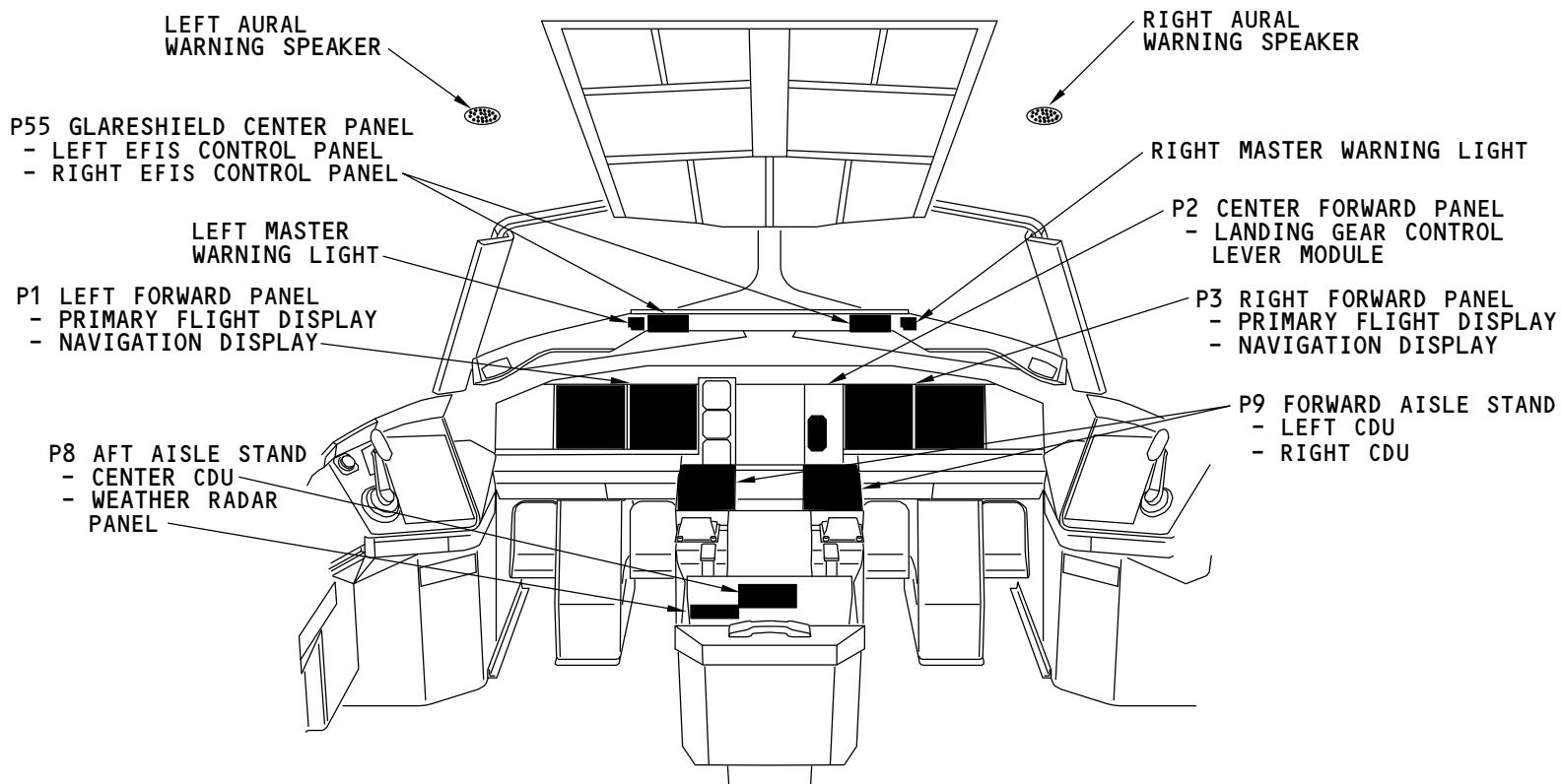
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WXR SYSTEM - COMPONENT LOCATIONS - FLIGHT DECK

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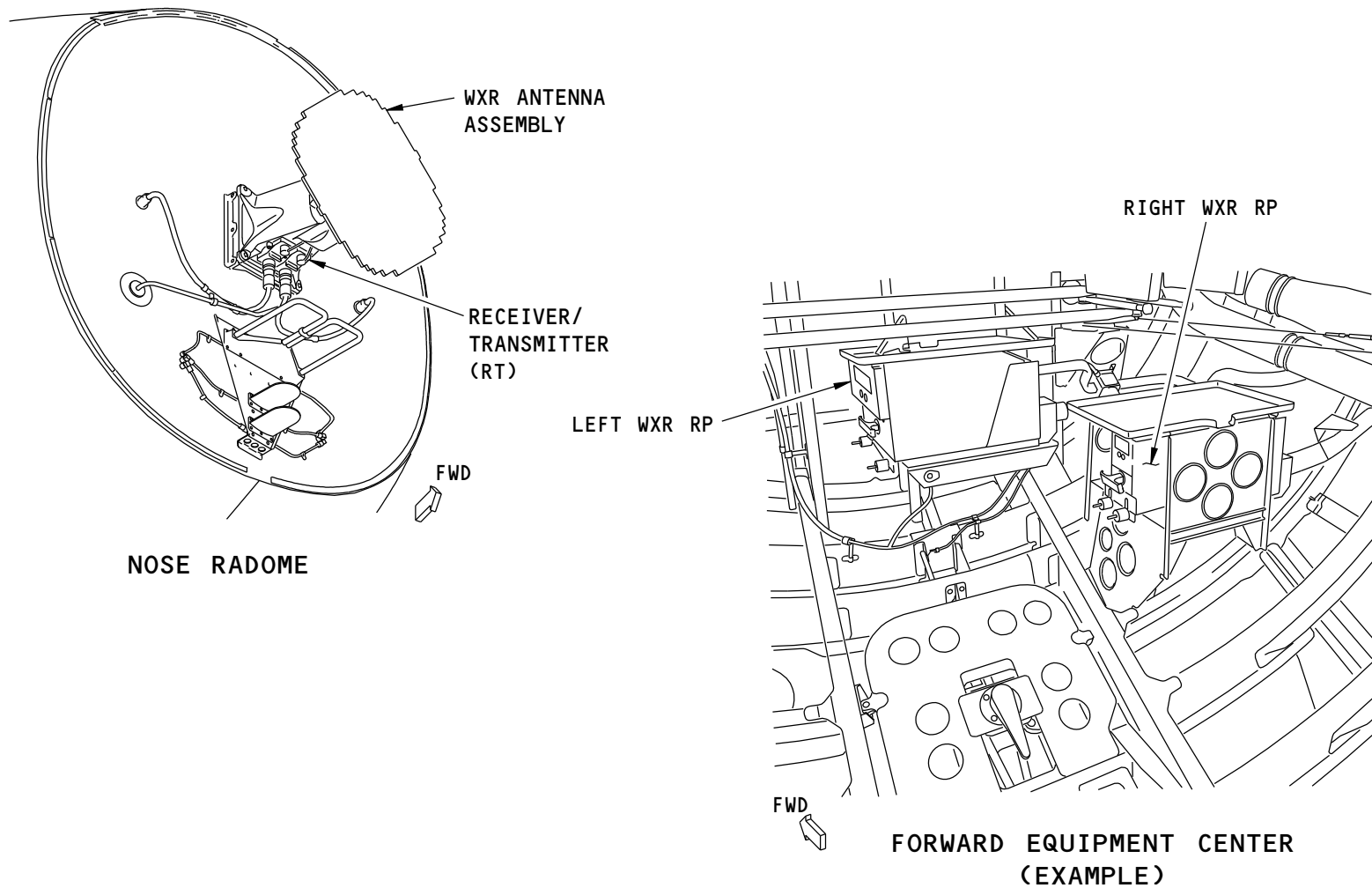
WXR SYSTEM - COMPONENT LOCATIONS - FORWARD EQUIPMENT CENTER AND NOSE RADOME

General

The WXR antenna assembly and transceivers (RT) are in the nose radome.

The WXR RP's are in the forward equipment center.

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WXR SYSTEM - COMPONENT LOCATIONS - FORWARD EQUIPMENT CENTER AND NOSE RADOME

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WXR SYSTEM - INTERFACE - POWER, INTERLOCKS, ENABLES AND RF TRANSMISSION**System Power**

The left WXR RP gets 115v ac through the left WXR circuit breaker from the left ac transfer bus (L AC XFR).

The right WXR RP gets 115v ac through the right WXR circuit breaker from the right ac secondary 2 bus (R AC SEC 2).

**WARNING**

MAKE SURE YOU OPEN THESE CIRCUIT BREAKERS FOR THE WEATHER RADAR SYSTEM BEFORE YOU RUN THE ENGINE. IF YOU DO NOT, YOU CAN CAUSE INJURY OR DEATH TO PERSONS AND DAMAGE TO EQUIPMENT.

The left and right WXR RPs send 28v dc to the onside power supply in the WXR panel.

Interlocks, Enables and RF Transmission

The left and right AIMS cabinets receives WXR on/off discrete inputs from the left and right EFIS CP or left, right or center CDUs and sends it to the WXR panel.

WXR panel sends the ON/OFF discrete to the selected RP. This discrete permits the selected RP and RT to operate.

WXR RP sends 28v dc to the WXR panel for the power interlock (INTRLK). The WXR panel RP ENABLE goes to the WXR RP to enable operation.

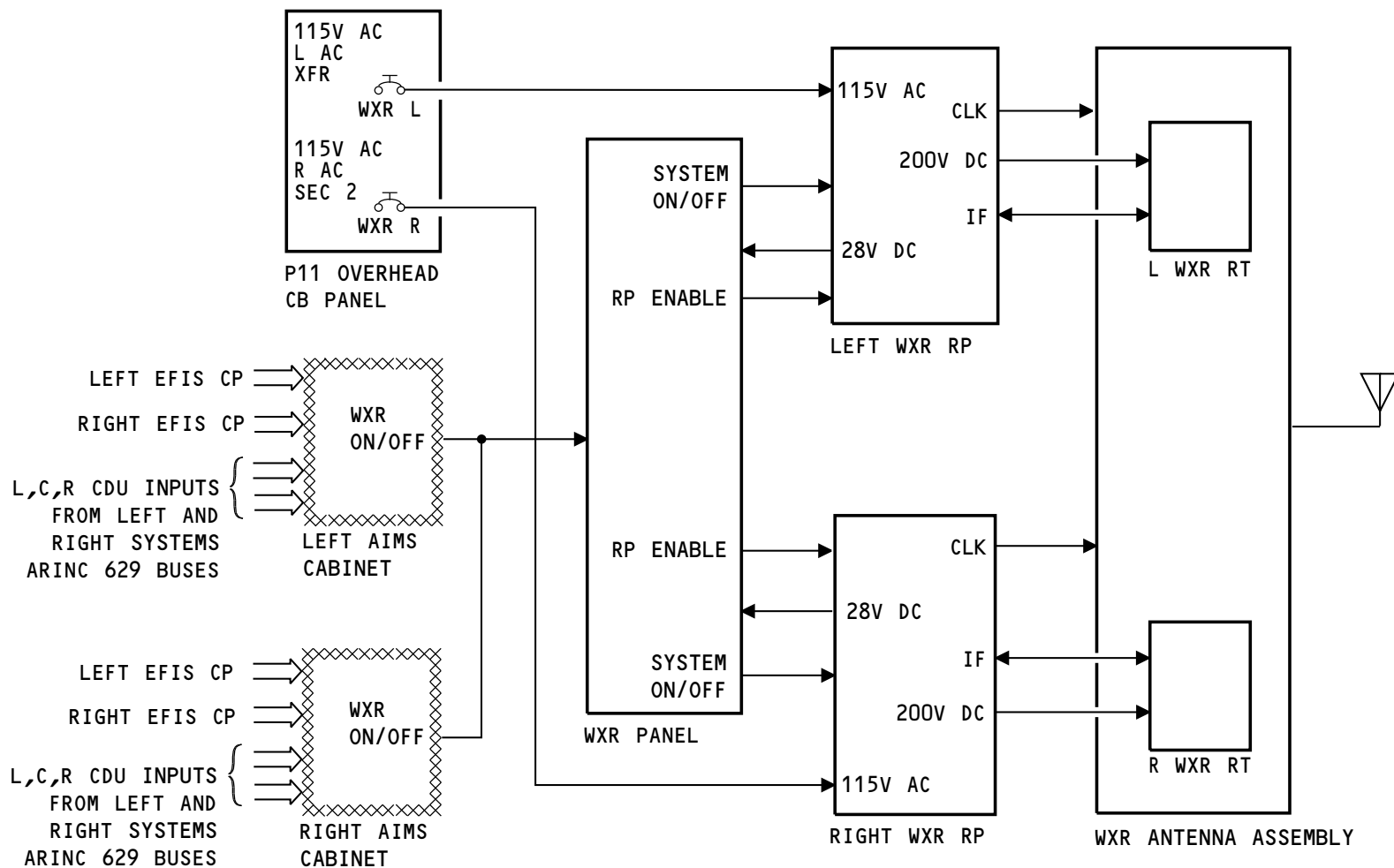
The RP ENABLE also causes the waveguide to connect to the selected RT. When the selected RT operates, it sends 28v dc to the WXR antenna assembly.

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WXR SYSTEM - INTERFACE - POWER, INTERLOCKS, ENABLES AND RF TRANSMISSION

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**WXR SYSTEM - PREDICTIVE WINDSHEAR INTERFACES****General Description**

The predictive windshear (PWS) part of the weather radar (WXR) system interfaces with other airplane systems and components.

Radio Altimeter

The radio altimeter (RA) provides radio altitude data to PWS. PWS uses this data to do these functions:

- Turn PWS on and off
- Enable/disable display and alert functions.

Ground Proximity Warning Computer

PWS sends windshear alert data to the ground proximity warning computer (GPWC) on the ARINC 429 systems bus. The GPWC prioritizes alerts. If a higher priority alert exists, the GPWC sends an inhibit discrete to WXR. This discrete inhibits the PWS alert output.

Warning Electronic System

PWS sends these signals to the WES:

- PWS alert audio output
- PWS warning discrete.

WES uses the PWS warning discrete to turn on the master warning lights.

WES sends a takeoff configuration arm discrete to PWS. PWS uses this discrete to turn on PWS when the engines get to takeoff thrust.

Traffic Alert and Collision Avoidance System

WXR sends an inhibit discrete to the traffic alert and collision avoidance system (TCAS) computer when there is a PWS alert. This discrete does these functions:

- Changes resolution advisories (RAs) to traffic advisories (TAs)
- Inhibits all TCAS audio alerts.

AIMS Cabinets

PWS receives this data from AIMS:

- Attitude data
- Air data
- System test commands.

PWS sends windshear display data to AIMS.

Overhead Panel ARINC 629 System

PWS sends these discretes to the overhead panel ARINC 629 system (OPAS):

- Windshear caution alert
- Windshear warning alert
- PWS fail.

OPAS changes these discretes to ARINC 629 data and sends the data to AIMS. AIMS makes the visual alert annunciations on the ND and PFD.

Landing Gear Control Lever Module

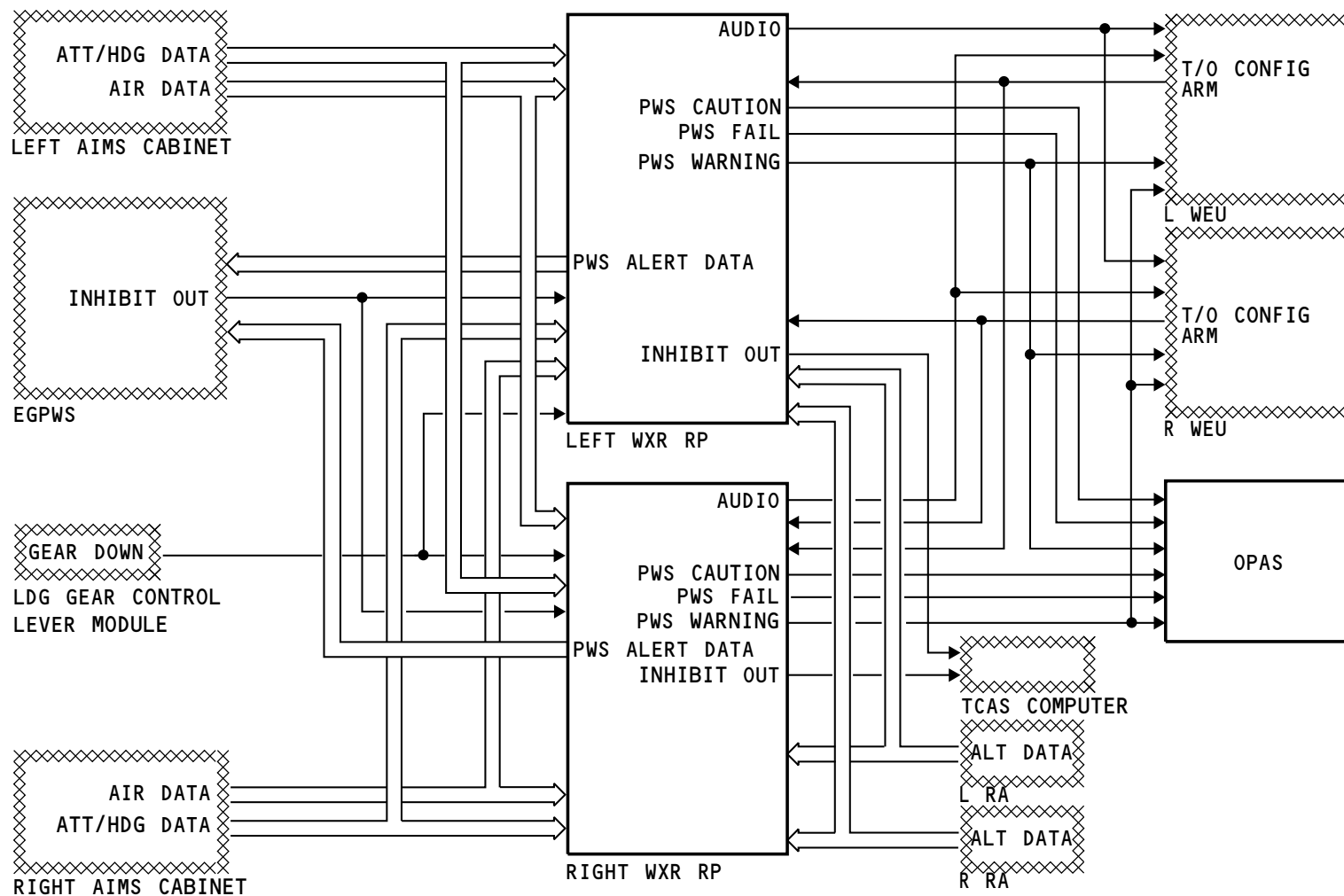
The landing gear control lever module sends an analog discrete to PWS. PWS uses this discrete in its takeoff/approach alert logic.

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WXR SYSTEM - PREDICTIVE WINDSHEAR INTERFACES

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**WXR SYSTEM - CONTROL AND DISPLAY INTERFACE****Control Inputs**

The WXR panel supplies this data to the WXR RPs:

- Transmit mode
- Altitude (MAN mode)
- Gain control.

Range data and the on/off discretes go from the EFIS control panel or CDU through the AIMS cabinets to the WXR RPs.

WXR Output Data and Display

The selected WXR RP sends WXR display data to the left and right AIMS cabinets. The data is shown on the navigational displays (NDs).

Display Relays

The weather radar (WXR) processor (RPs) and the ground proximity warning computer (GPWC) send data to the four terrain select relays. These relays control which data shows on each ND.

ARO 001-008 PRE SB 777-34-0232

Relay Power

The terrain select relays gets 28v dc from the TERRAIN DISPLAY circuit breaker on the P11 overhead circuit breaker panel.

ARO ALL

Relay Interfaces

The WXR RPs connect to the terrain select relays with weather display data buses. The GPWC connects to the terrain select relays with terrain display data buses.

The terrain select relays connect to the AIMS cabinets with data buses. The AIMS cabinets show the data on the NDs.

ARO 009-999; ARO 001-008 POST SB 777-34-0232

Relay Interfaces

The WXR RTs connect to the terrain select relays with weather display data buses.

The terrain select relays connect to the AIMS cabinets with data buses. The AIMS cabinets show the data on the NDs.

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Relay Control

With weather radar selected, the normal relay position lets weather radar data show on the NDs. When you select TERR on either EFIS control panel (CP), a terrain select ground signal energizes the two on-side terrain select relays. This allows the terrain data to show on the on-side display. Push the TERR switch again and the on-side relays deenergize. The display then shows weather radar data.

Relay Monitor

The GPWC monitors the terrain select relay positions for faults.

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Cross Cabinet Bus

The left AIMS cabinet supplies WXR display data to the right AIMS cabinet and the NDs.

The right AIMS cabinet supplies WXR display data to the left AIMS cabinet and the NDs.

Status Display

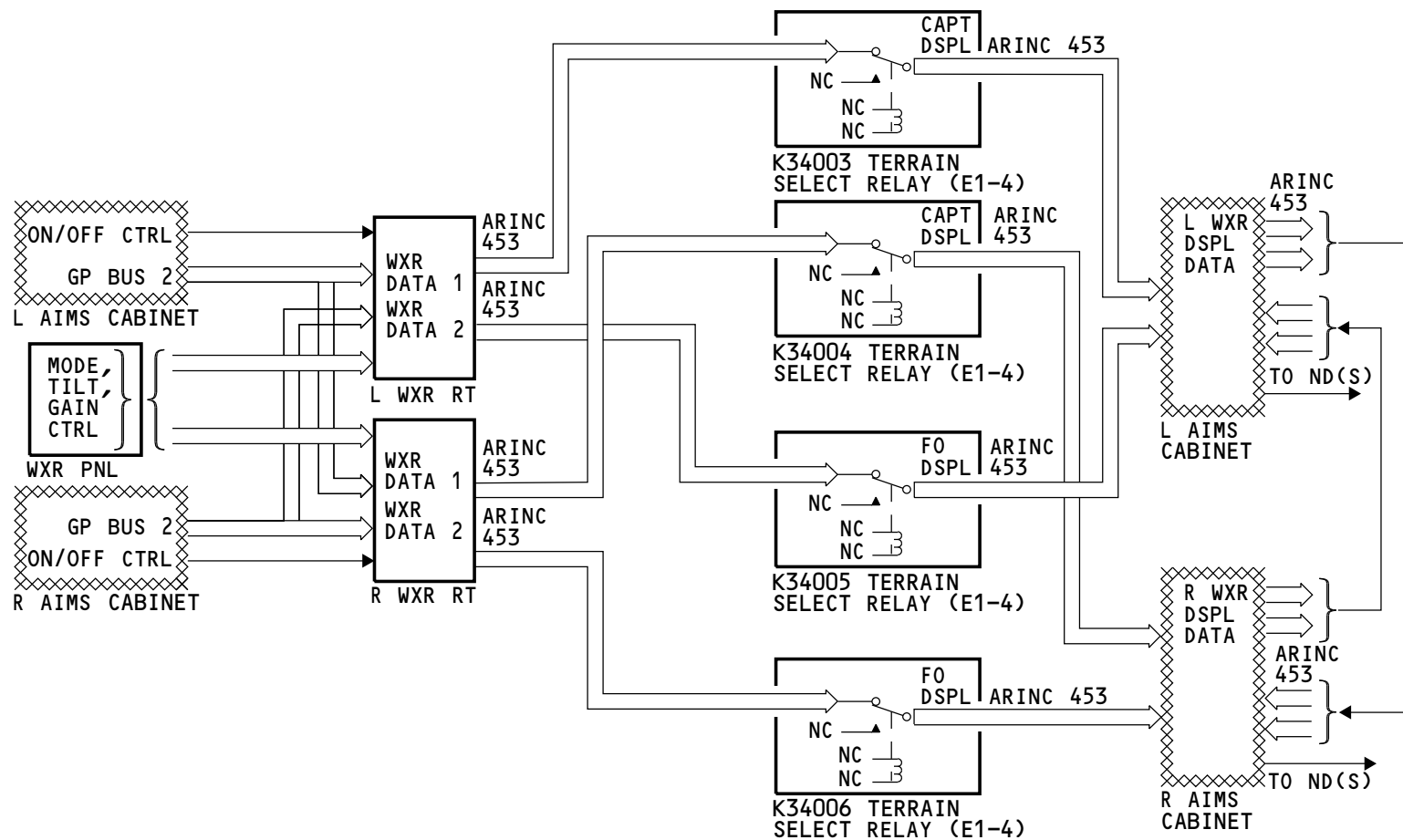
The AIMS cabinets get WXR system mode and status data so the NDs can show WXR system mode of operation and system status.

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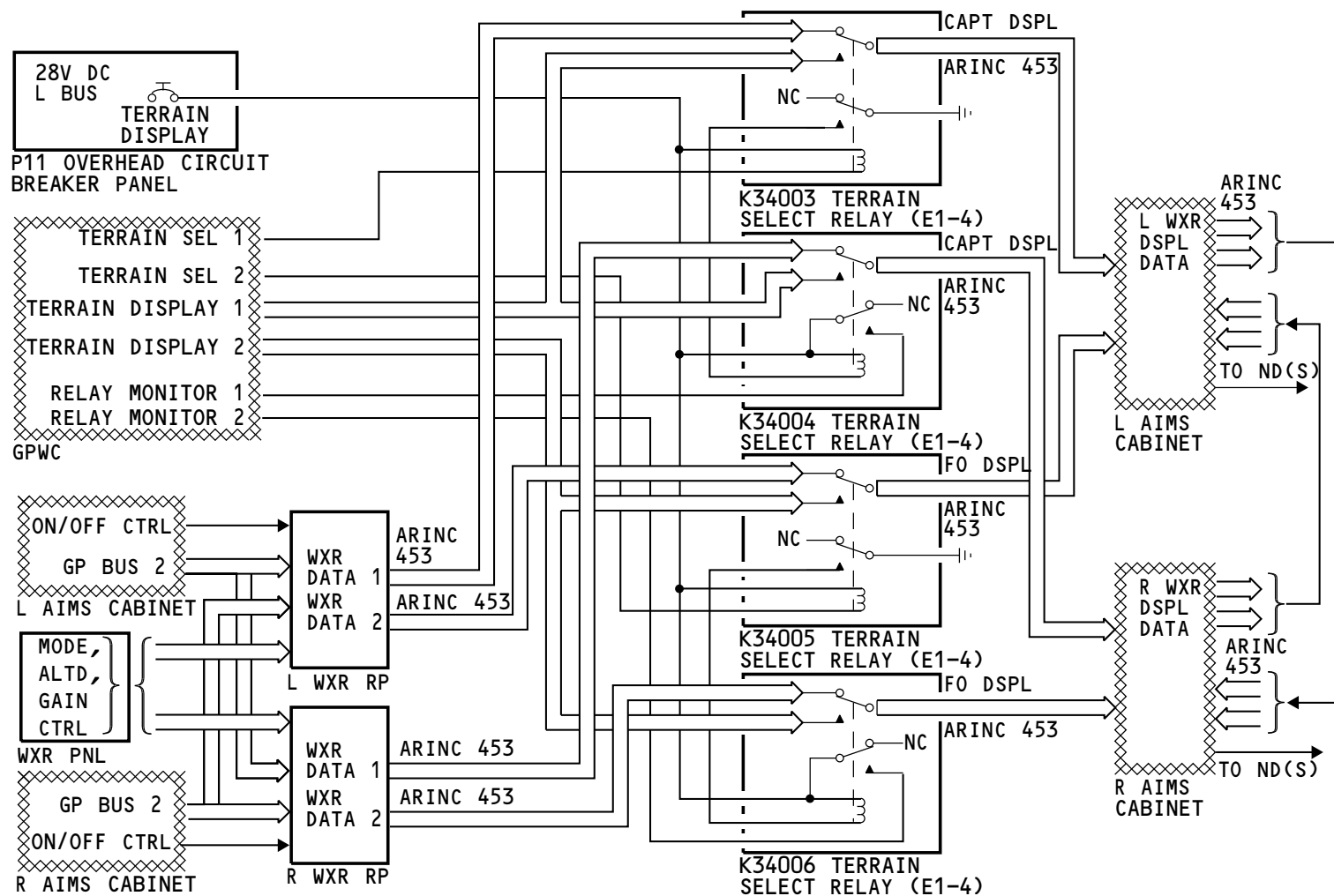
WXR SYSTEM - CONTROL AND DISPLAY INTERFACE

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WXR SYSTEM - CONTROL AND DISPLAY INTERFACE

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WXR SYSTEM - ANTENNA CONTROL INTERFACE**Antenna Altitude**

The WXR panel supplies antenna altitude control signals to the WXR RT.

Attitude Sources

The WXR RP uses ADIRS attitude data from AIMS for antenna stabilization.

The left ADIRS signals from left AIMS cabinet connect to the onside attitude input of the left WXR RP and to the offside attitude input of the right WXR RP. The right ADIRS signals from right AIMS cabinet connect to the onside attitude input of the right WXR RP and to the offside attitude input of the left WXR RP.

Attitude On/Off Discrete

A failed AIMS cabinet supplies an ADIRS invalid discrete to the WXR RP. This permits the RP to use the offside attitude inputs.

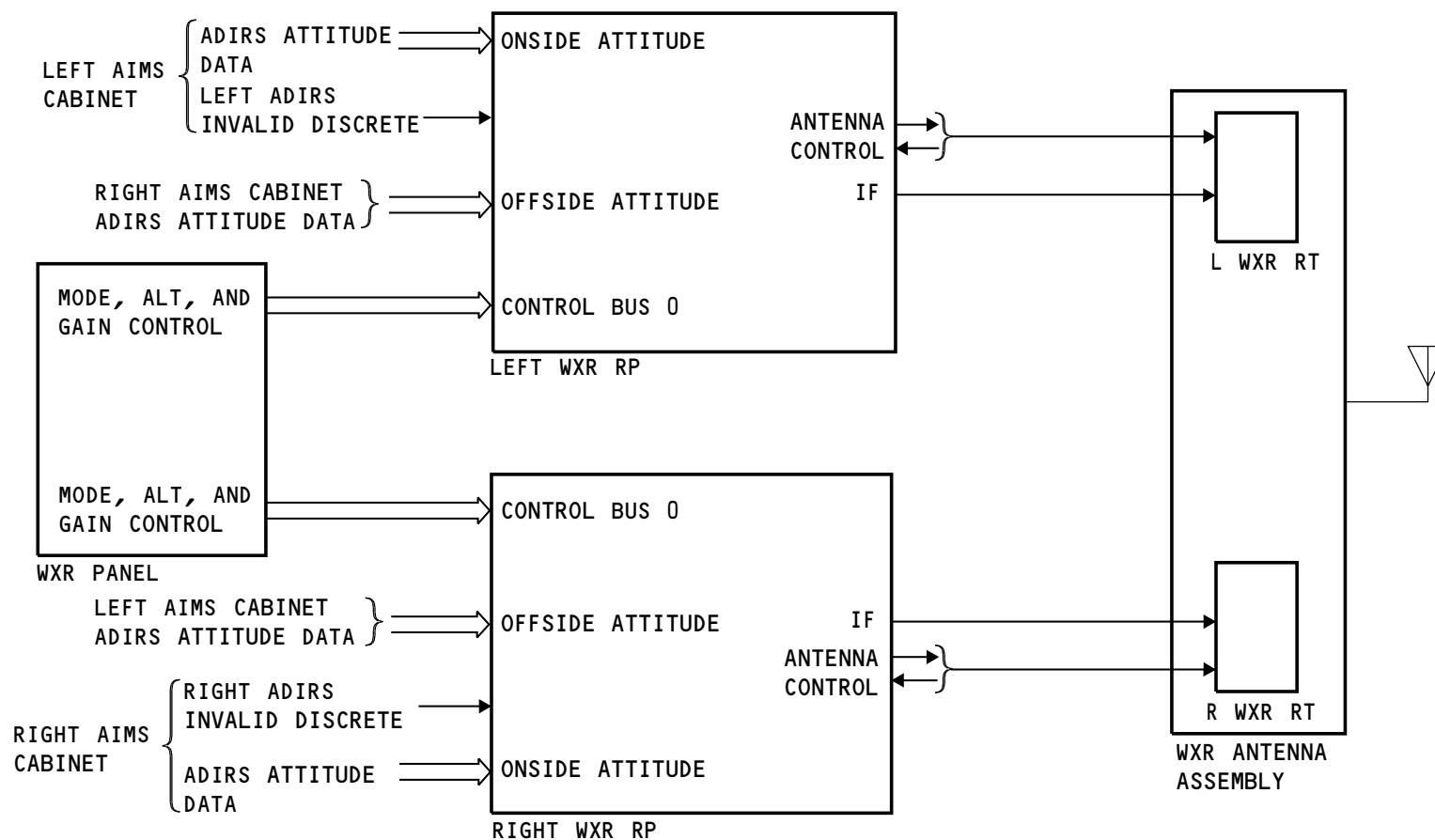
WXR RT Antenna Control

The WXR RP sends antenna control and stabilization signals to the RT. WXR RT uses this signal to align antenna drive to a desired position.

Antenna Position Monitoring

The WXR antenna sends antenna position feedback to the WXR RP for scan and elevation position monitoring.

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WXR SYSTEM - ANTENNA CONTROL INTERFACE

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WXR SYSTEM - MAINTENANCE INTERFACES**RP Central Maintenance Computer System Interface**

The central maintenance computer system (CMCS) of the left AIMS cabinets sends this data to the left and right WXR RPs:

- Flight legs for the RP nonvolatile memory (NVM)
- Ground test commands to start a WXR system test.

WXR System Maintenance Data

The WXR RPs send WXR system maintenance data to the CMCS in the left and right AIMS cabinets.

Air/Ground**ARO 014-016**

The air/ground relay defines flight legs if the flight legs data from the CMCS fails.

ARO 001-013, 017-999

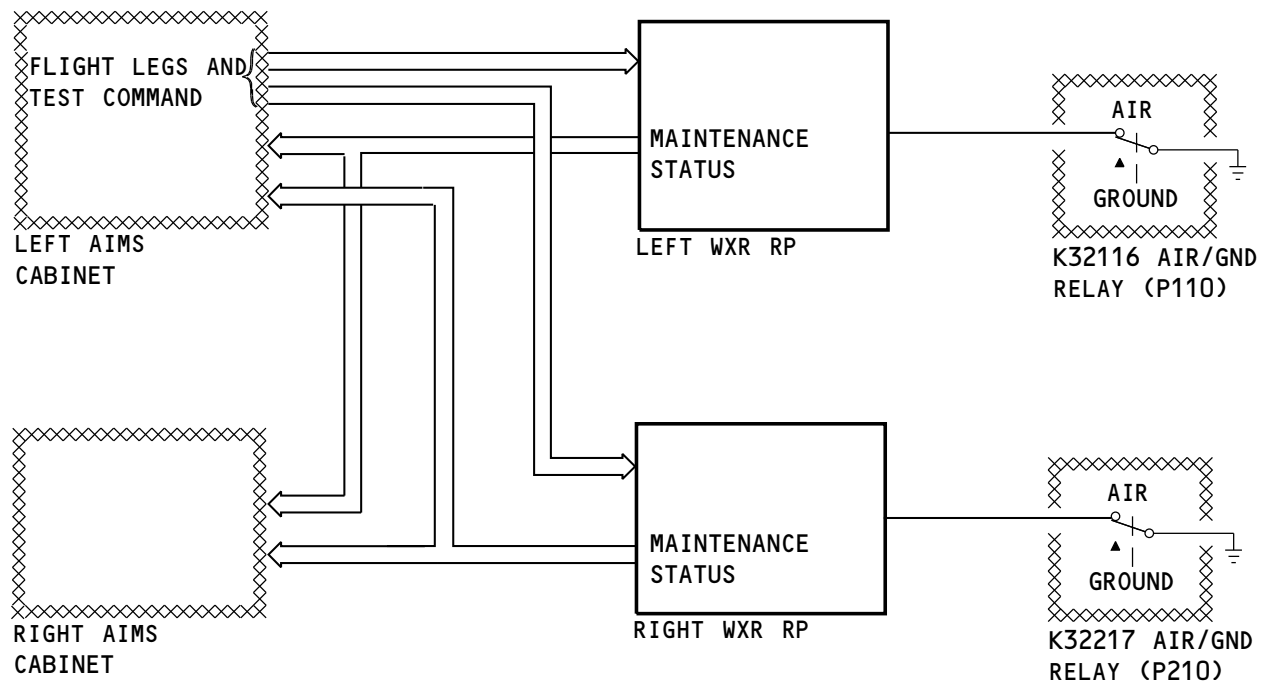
The air/ground relay input does these functions:

- Inhibits PWS test alerts in the air
- Defines flight legs if the flight legs data from the CMCS fails.

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WXR SYSTEM - MAINTENANCE INTERFACES

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**WXR SYSTEM - WEATHER RADAR PANEL****Purpose**

The weather radar (WXR) panel has controls for WXR system operation.

Mode Selector

The mode selector has these positions:

- AUTO - sets the multiscan (automatic) mode.
- MAN - sets the multiscan (manual) mode.
- MAP - selects the ground map mode.

System Select Switch

The system select switch has four positions that let you select the left (L) or right (R) WXR RP and left (L) or right (R) WXR RP TEST for operation.

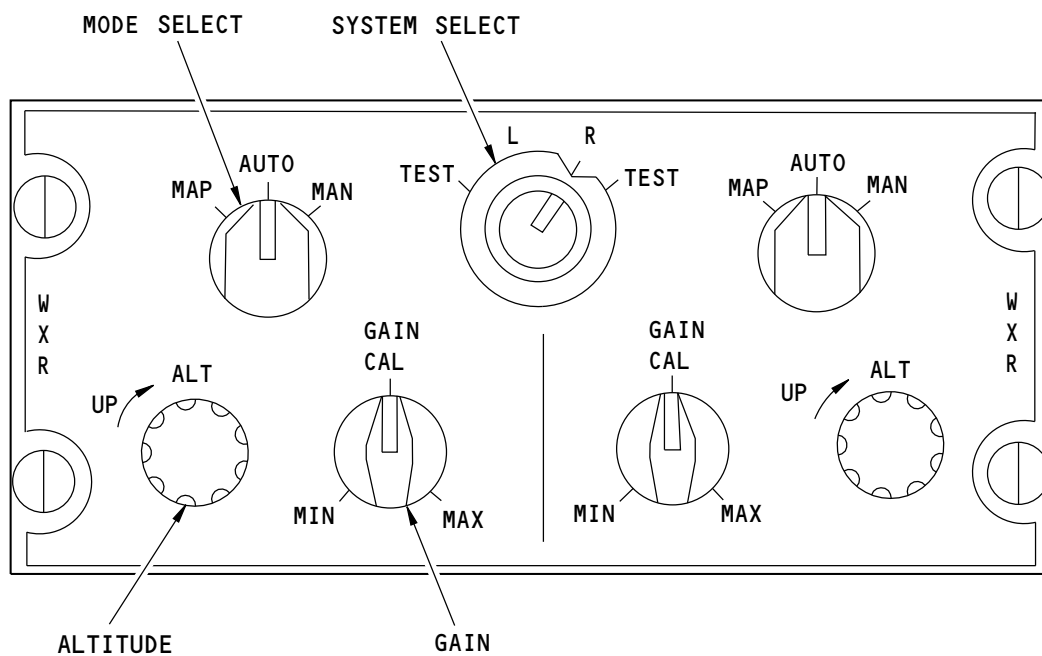
TEST - lets the flight crew do a self-test on the selected RP and shows the test results on the NDs. Line maintenance personnel should use the MAT to do a test of the WXR system.

Altitude Control

The altitude control lets you adjust the altitude slice (in 1,000 feet increments) from 0 to 60,000 feet AGL.

Gain Control

The gain control adjusts the gain for the WXR RT signal returns. In the CAL position, the gain is set to a calibrated level by the RP. You can rotate the gain control out of the CAL position to manually adjust the gain.



WXR SYSTEM - WEATHER RADAR PANEL

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**WXR SYSTEM - RADAR PROCESSOR****Purpose**

This is the purpose of the WXR radar processor (RP):

- Process RF return signals
- Make display data
- Send display data to the AIMS
- Supply antenna stabilization
- Monitor and test system operation
- Send and record fault status and test results
- Make WXR display test patterns to show on the display units.

Physical Description

The WXR RP weighs 12lb (5.45 kg). Forced air cools the WXR RP.

Test Equipment Connectors

There is a shop test connector on the front panel of the RP.

Front Panel

There is a LCD maintenance display on the front panel of the RP. The maintenance display shows WXR system test and fault information. After 5 minutes of inactivity, LCD display will return to the main menu.

There are two display select buttons on the front of the RP for displaying fault history, software and hardware configuration.

Training Information Point

The maintenance manual and the fault isolation manual do not have a task for the maintenance technician to do a test from the front panel of the WXR RP. You must do all tests for the WXR RP from the MAT, PMAT, or from the WXR panel.

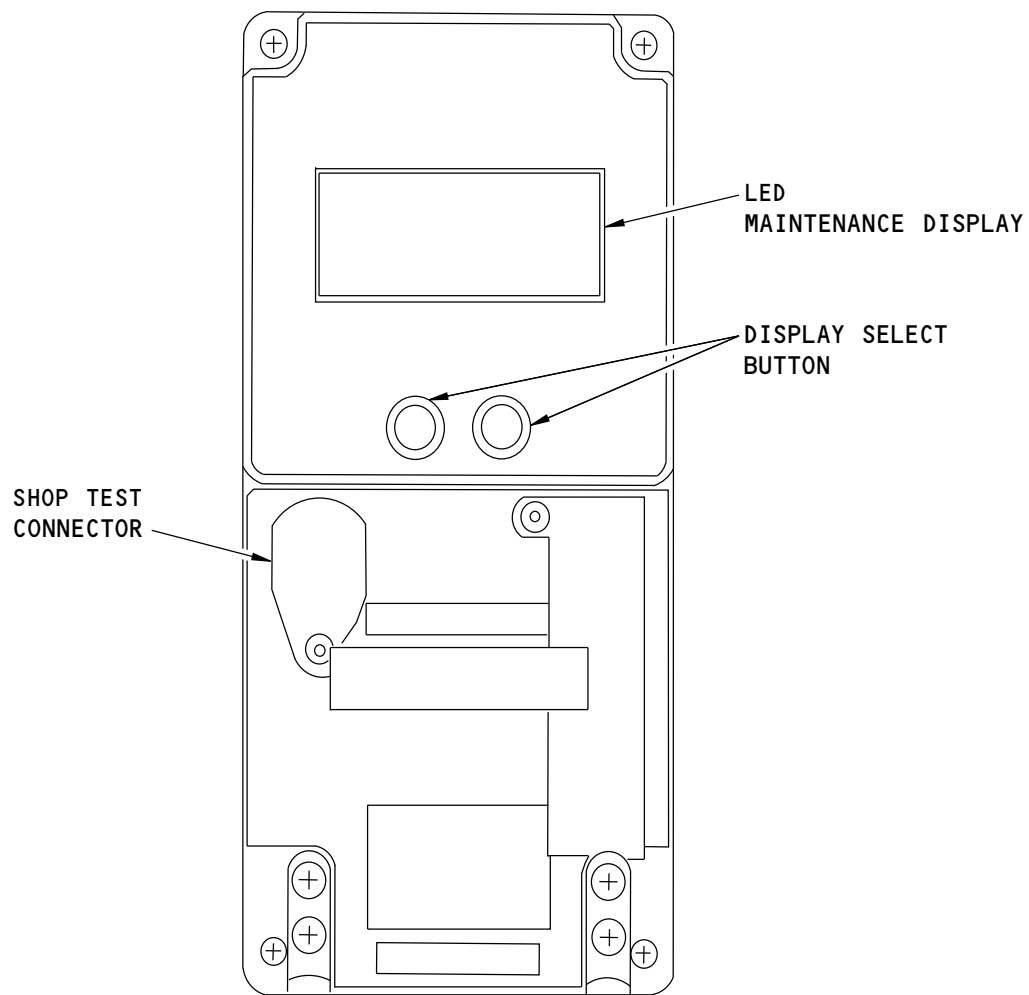
Many LRUs on the 777 are compatible with other model airplanes that do not have a central maintenance computing system (CMCS). For that reason, these LRUs have a front panel test feature.

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WXR SYSTEM - RADAR PROCESSOR

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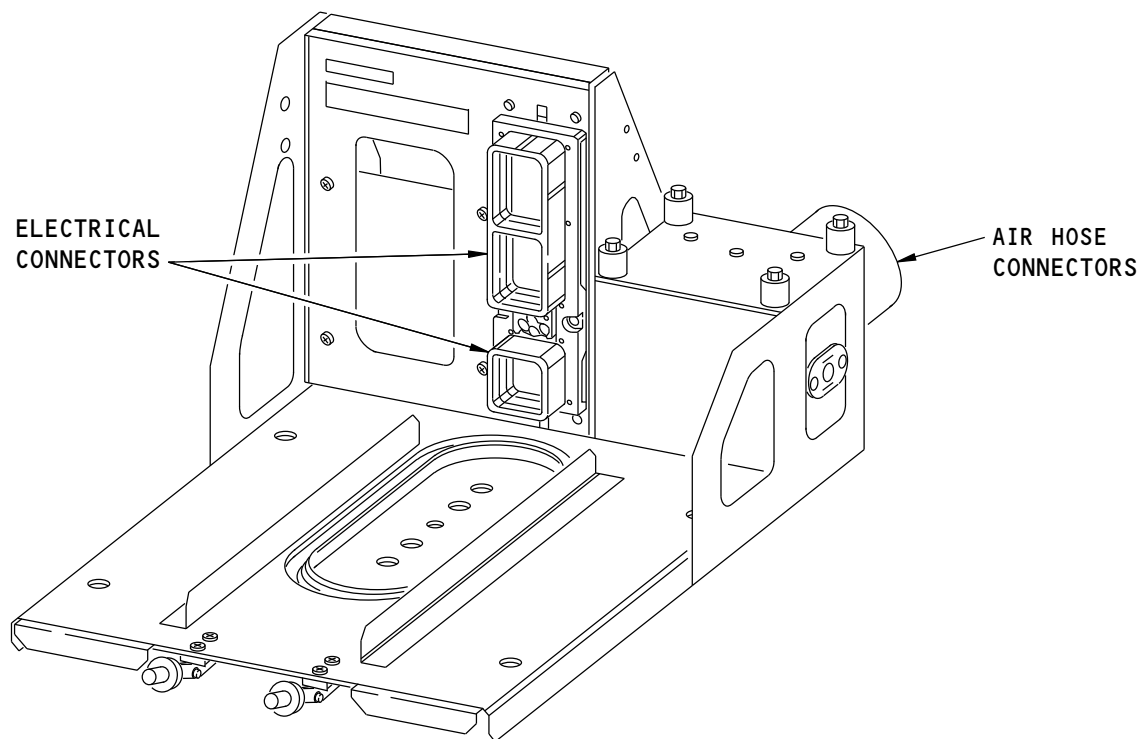
WXR SYSTEM - RP MOUNT

Purpose

The purpose of the WXR RP mount is to:

- Hold the RP
- Connect the RP to the airplane wiring
- Supply airplane cooling air to the RP

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WXR SYSTEM - RP MOUNT

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WXR SYSTEM - ANTENNA ASSEMBLY 1**Antenna Assembly**

The antenna assembly includes:

- Receiver-Transmitter(s)
- The flat plate WXR antenna
- The antenna pedestal

Flat Plate Antenna

The flat plate antenna transmits RF pulses from the WXR RT, and receives the pulses as they reflect off precipitation formations.

The flat plate antenna is an array of radiation slots. The RF pulses radiate from each of the slots and combine to make a pencil beam 3.0 degrees high and 3.0 degrees wide. The antenna weighs 30 lb (13.61 kg) and is 30 inches wide.

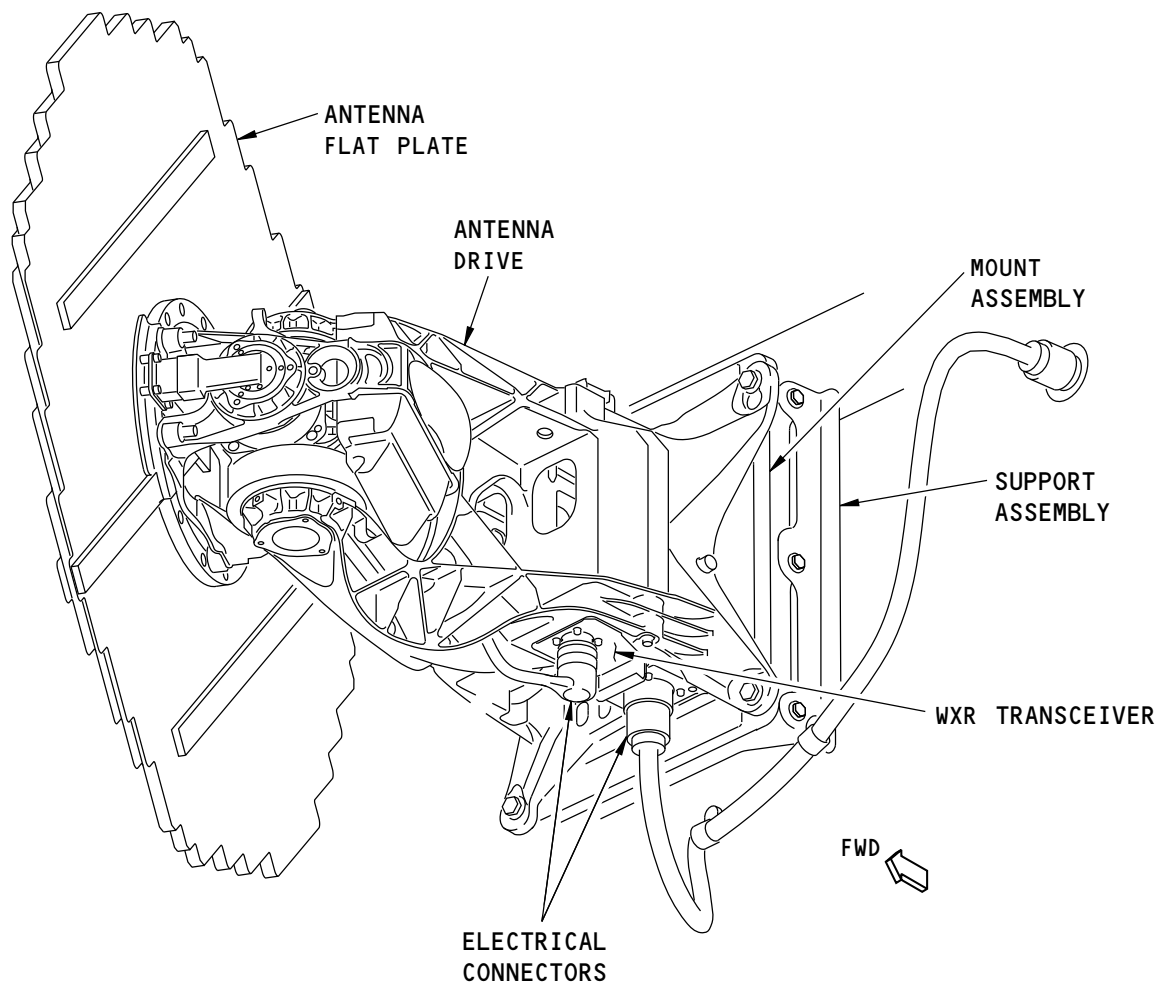
Antenna Pedestal

The antenna pedestal contains these items:

- RTs
- Electrical connectors
- Stepper motors to drive the horizontal scan and vertical elevation scan
- Antenna position monitors

The antenna pedestal receives power from the WXR RT. The antenna pedestal has two sets of power supplies and electronics. One set drives the antenna with the left RT selected. The other set drives the antenna with the right RT selected.

There is a horizontal scan stepper motor to drive the antenna +/- 80 degrees of the airplane centerline. There is also a vertical elevation scan stepper motor to drive the antenna +/- 35 degrees up or down. Horizontal and vertical stepper motors get 28v dc from WXR RT to operate.



WXR SYSTEM - ANTENNA ASSEMBLY 1

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**WXR SYSTEM - ANTENNA MOUNT ASSEMBLY****General**

The antenna drive unit attaches to the antenna mount assembly with four antenna drive assembly bolts.

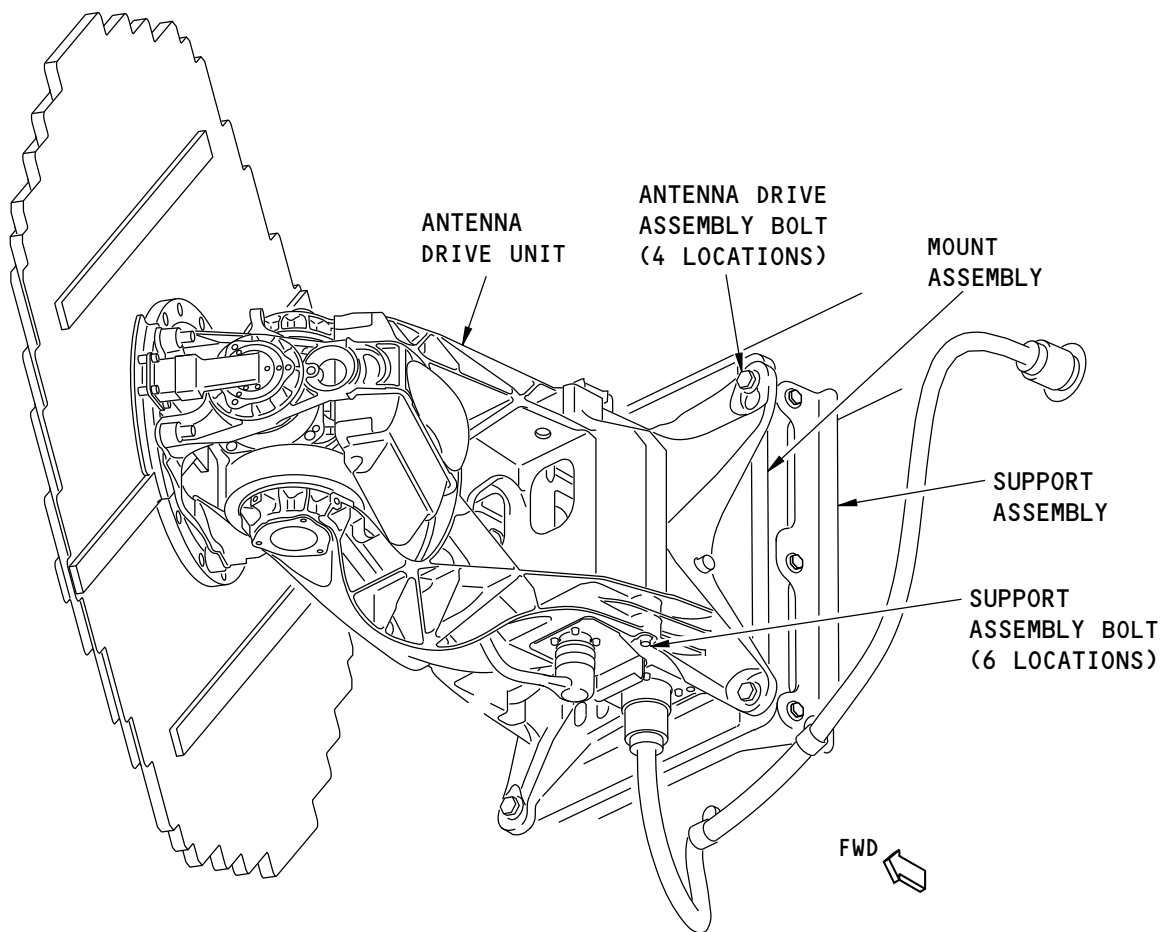
The mount assembly attaches to a support assembly with five mount assembly bolts.

The support assembly attaches to the forward pressure bulkhead with six support assembly bolts.

Training Information Point

The support assembly and mount assembly are aligned at the factory.

NOTE: Do not loosen the mount assembly bolts or the support assembly bolts. The support assembly and mount assembly are aligned at the factory. If the bolts are accidentally loosened or if the base is loose or not aligned, special alignment procedures must be done by a Boeing specialty team. Contact Boeing Seattle A.O.G. Office, Technical Assistance Team.



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WXR SYSTEM - ANTENNA MOUNT ASSEMBLY

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WXR SYSTEM - CONTROL - EFIS CONTROL PANEL**EFIS Control Panel**

These are the functions of the EFIS control panel for WXR control:

- Supplies the on and off control of the WXR RPs
- Enables the NDs to show WXR data
- Supplies the selection of different ND modes
- Supplies the selection of different ranges for WXR data to show on the NDs.

WXR Map Switch

When you push the WXR map switch on the EFIS control panel:

- The WXR RP/RT selected on the WXR panel starts to operate
- The WXR data shows on the outside ND.

To stop the operation of the WXR RP/RT, the WXR switches on both EFIS control panels and the WXR selections on the CDUs must be off.

ND Mode Selector

Use the mode selector switch to select an ND mode. The ND modes that show a WXR display are:

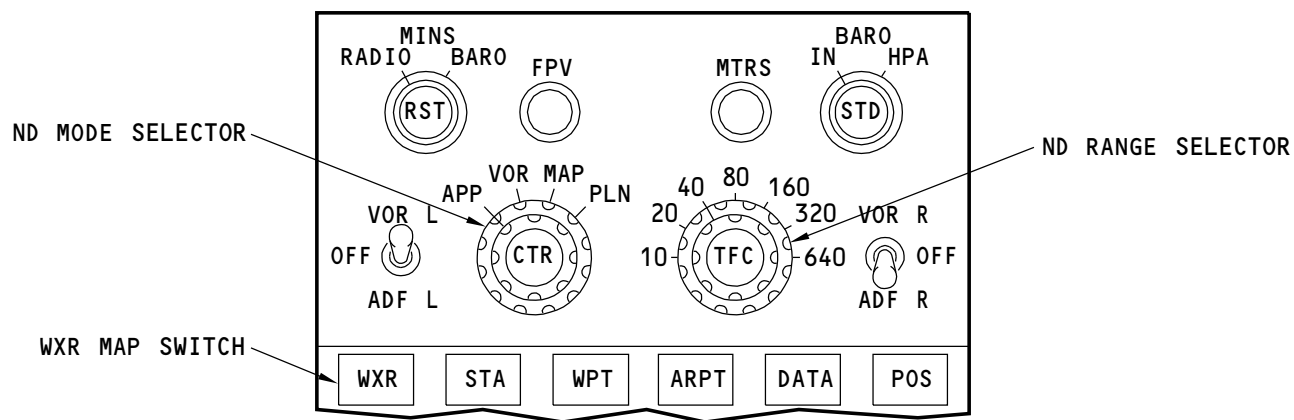
- Expanded APP (approach) mode
- Expanded VOR mode
- Expanded MAP mode
- Centered MAP mode.

If the mode selector is not in a correct mode when you push the WXR map switch, the weather display arms. When armed, the weather display shows as soon as you change the ND selector to a correct mode. The weather display stays armed even if you push the WXR map switch again.

ND Range Selector

The EFIS control panel has a six position range selector. The range selections are 10, 20, 40, 80, 160, 320 and 640 NM. With the 640 NM range selection, the 640 NM range shows on the ND, but the WXR RT only shows weather displays out to its maximum range of 320 NM.

The MAP mode shows the range at all times. The APP and VOR modes show the range only when the WXR is on.



WXR SYSTEM - CONTROL - EFIS CONTROL PANEL

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WXR SYSTEM - CDU SELECTIONS**Alternate or Backup EFIS Control Panel**

The EFIS control page on the control display unit (CDU) permits alternate or backup controls for the WXR system.

If the EFIS CP fails or for alternate operation, use the EFIS control CDU pages on the onside CDU for:

- On/off power control of the WXR system
- On/off control of the onside WXR display
- WXR range selection
- ND mode selection.

When you select EFIS control to ON from the CDU page, the onside EFIS CP does not operate.

Access

To get the EFIS control CDU pages on the CDU:

- Push the MENU line select key (LSK) on the CDU to make the MENU page come on
- Push the EFIS CTL LSK on the MENU page and the EFIS prompt comes on
- Push the LSK next to EFIS and the EFIS control page comes on
- Select the ND modes and range From the EFIS CONTROL page
- Push the OPTIONS LSK on the EFIS CONTROL page to go to the EFIS OPTIONS page
- Push the WXR LSK on the EFIS OPTIONS page for ON/OFF control of the WXR system and to enable the WXR display for the onside ND.
- Push the CONTROL LSK on the EFIS OPTIONS page to return to the EFIS CONTROL page.

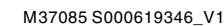
You can use the EFIS CP CDU pages on the CDU at anytime, but normally the EFIS CP supplies the control for the WXR system.

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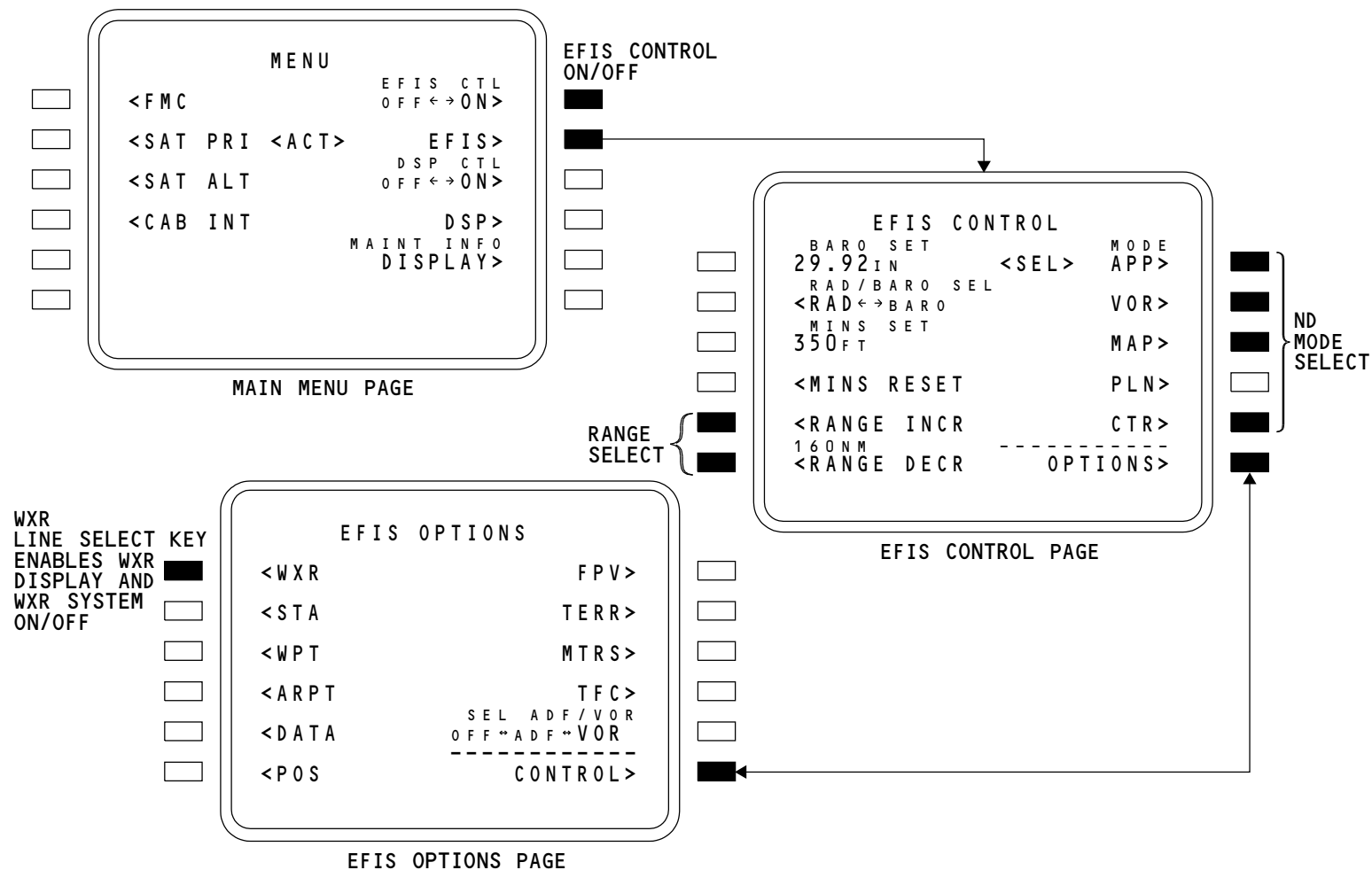
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WXR SYSTEM - CDU SELECTIONS

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WXR SYSTEM - NORMAL DISPLAYS

Display Modes

The ND shows WXR system data in these modes:

- Expanded approach mode
- Expanded VOR mode
- Centered MAP mode
- Expanded MAP mode.

Each ND mode has a range selection for 10, 20, 40, 80, 160, 320, or 640 NM. Use the EFIS CP to select the mode and range for the ND.

WXR System Display Data

For the WXR system, the ND shows this information:

- WXR displays
- WXR system messages
- WXR alert messages.

WXR Displays

The WXR displays on the ND show the weather in front of the airplane or the terrain below. The WXR display shows in four colors. These colors represent the strength of the RF return signals from the weather or the terrain. These are the four colors for the WXR displays:

- Green shows light weather
- Yellow shows medium weather
- Red shows heavy weather
- Magenta shows turbulence.

The WXR system detects and shows turbulence only to 40 NM.

WXR System Messages

The ND shows WXR system messages on three lines. Line 1 shows WXR mode messages. These are the messages that show on line 1:

- WXR (weather precipitation mode)
- MAP (manual gain)
- TEST (test mode).

Line 2 shows the altitudet value set on the WXR panel during MAN mode. The tilt value is 00o feet to 60o feet AGL.

Line 3 shows the manual gain selection made on the WXR panel. The message for manual gain selection, as applicable, is VAR or CAL.

When the flight crew does not make a manual gain selection, the WXR RP uses preset calibrated gain and no gain message shows.

All WXR system messages show in the color cyan.

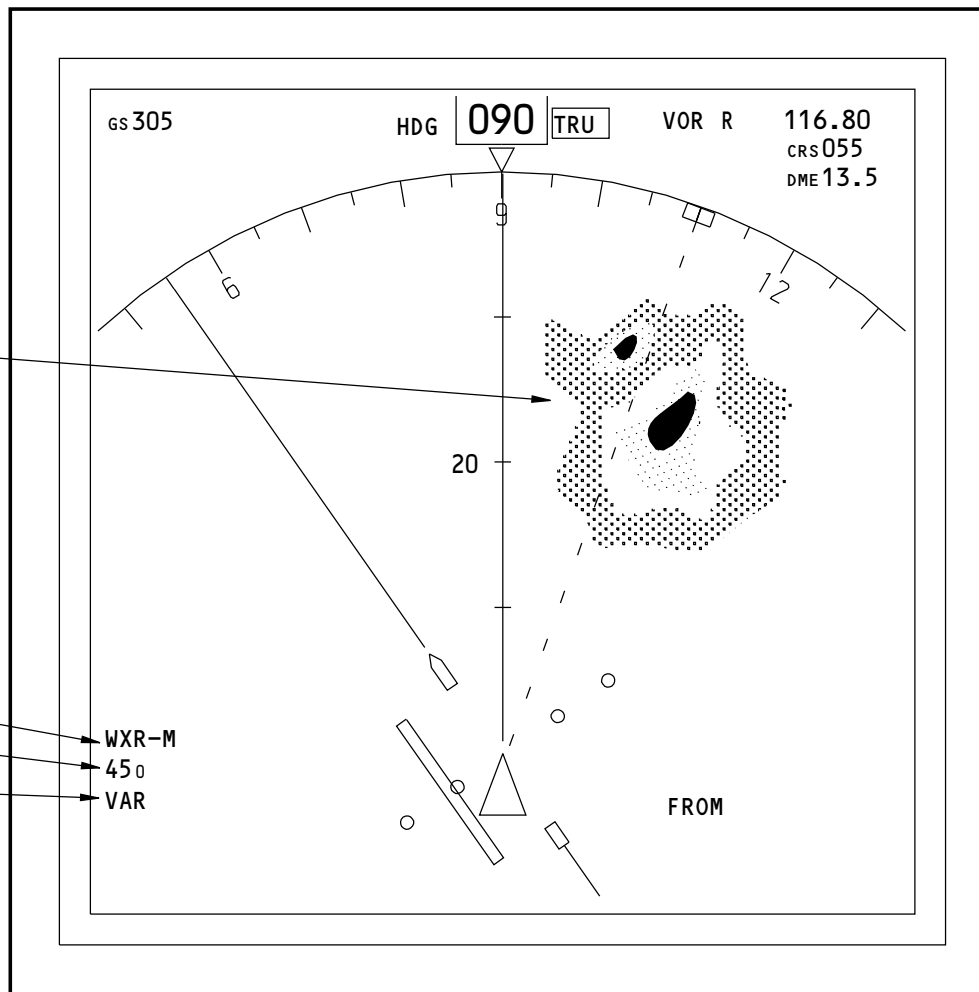
WEATHER DISPLAY:

- GREEN = LIGHT WEATHER
- YELLOW = MEDIUM WEATHER
- RED = HEAVY WEATHER
- MAGENTA = TURBULENCE

WEATHER SYSTEM MESSAGES:

- WEATHER MODE → WXR-M
- ANTENNA ALTITUDE → 450
- GAIN VALUE → VAR

EXPANDED VOR MODE



WXR SYSTEM - NORMAL DISPLAYS

U90398 S0000221253_V2

WXR SYSTEM - PREDICTIVE WINDSHEAR

General Description

Weather radar with predictive windshear (PWS) detects windshear ahead of the airplane. PWS uses doppler radar returns, inertial data and air data to detect windshear. If PWS detects a windshear condition, it alerts the flight crew with visual and aural annunciations.

System On/Off - Takeoff

PWS turns on automatically when the airplane is on the ground and one of these conditions exists:

- An engine gets to takeoff thrust
- The flight crews pushes the WXR button on an EFIS control panel or control display unit (CDU).

The WXR button on the EFIS CP does not turn off the PWS if the engines are at takeoff thrust. PWS turns off automatically when the airplane climbs above 1800 feet radio altitude.

System On/Off - Approach

PWS turns on automatically when the airplane descends below 1800 feet radio altitude. PWS turns off automatically when one of these conditions exists:

- Airspeed is less than 60 knots
- The airplane climbs above 1800 feet radio altitude.

If PWS is on and WXR is not selected on the EFIS CP or the CDU, all antenna sweeps search for windshear. If WXR is selected, the antenna uses one sweep to search for windshear and the other sweep to search for normal weather returns. PWS operation does not affect the WXR mode or range selected by the flight crew.

PWS Display

If PWS detects windshear, it makes a windshear symbol on the ND. The symbol is red and black bars. Yellow bars go from the edges of the symbol to the compass rose. The yellow bars help the crew to see the PWS symbol.

The ND mode selector must be in a correct mode for the windshear data to show. These are the ND modes that show windshear data:

- Expanded APP
- Expanded VOR
- Expanded MAP
- Centered MAP.

Windshear data does not show above 1200 feet radio altitude.

PWS Automatic Display Function

If PWS detects a windshear threat, weather data automatically shows on both NDs. Weather data automatically shows if these conditions exist:

- PWS detects a windshear threat
- Airplane altitude is less than 1200 feet
- WXR is not selected on either EFIS CP or CDU
- The ND mode selector is in a correct mode.

PWS Fail

These EICAS messages show for a PWS failure:

- Status message - WINDSHEAR PRED
- Advisory message - WINDSHEAR SYS.

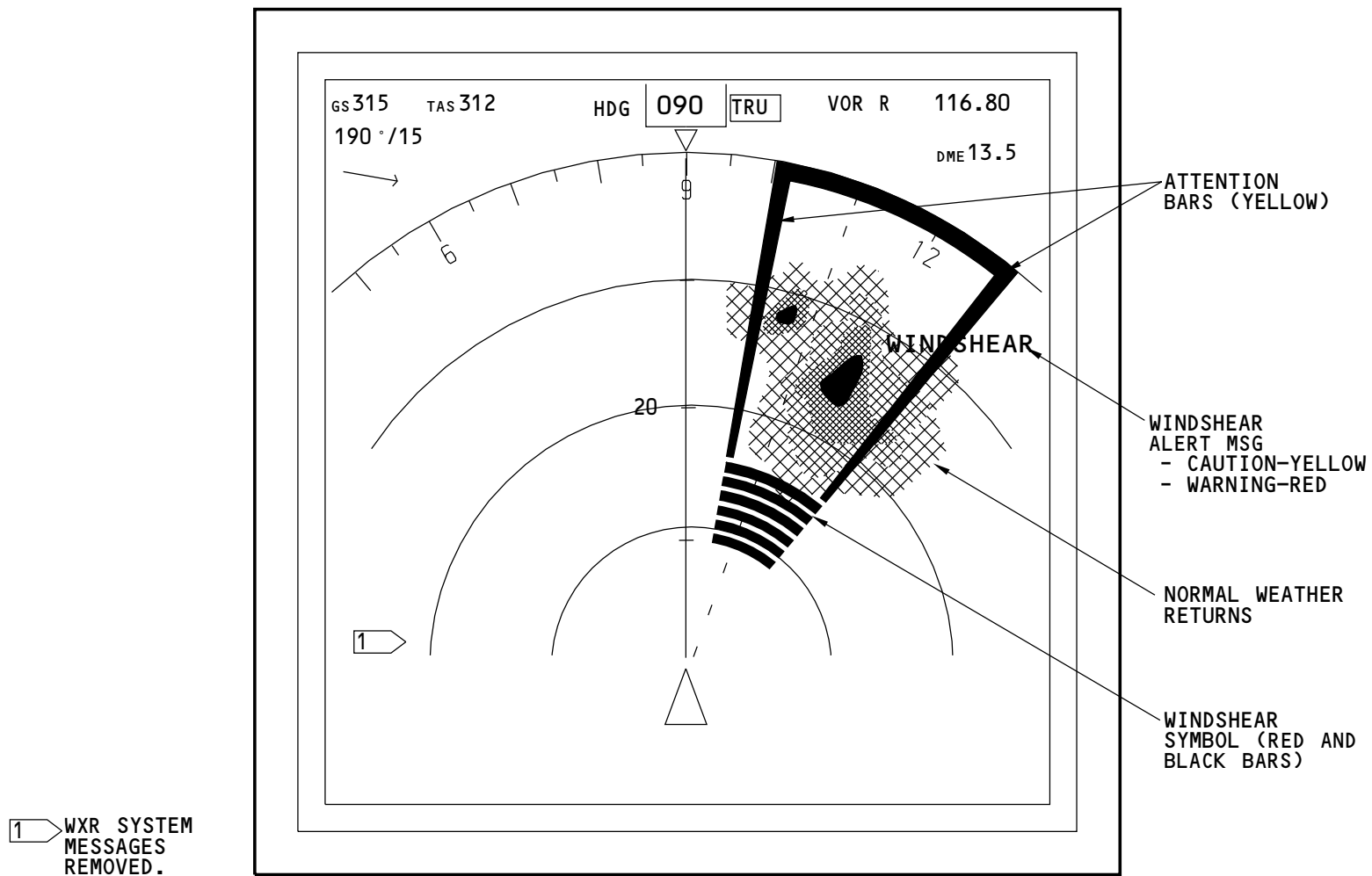
There are no ND messages for a PWS failure.

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WXR SYSTEM - PREDICTIVE WINDSHEAR

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WXR SYSTEM - PREDICTIVE WINDSHEAR ALERTS**General Description**

If PWS detects a windshear threat, it makes an alert. The alert may be a warning or a caution. The alert the crew receives depends upon these conditions:

- Position of the windshear relative to airplane heading
- Distance to the windshear
- Airplane flight phase - takeoff or approach.

PWS Warning Area

During takeoff, PWS gives a warning if it detects a windshear threat in this area:

- Less than 0.25 nm on either side of the airplane projected magnetic heading
- More than 0.5 nm but less than 3 nm ahead of the airplane.

During approach, PWS gives a warning if it detects a windshear threat in this area:

- Less than 0.25 nm on either side of the airplane projected magnetic heading
- More than 0.5 nm but less than 1.5 nm ahead of the airplane.

PWS inhibits new windshear warnings during takeoff and approach if these conditions exist:

- Airspeed more than 100 knots
- Less than 50 feet radio altitude.

PWS Caution Area

PWS gives a caution if it detects a windshear threat in this area:

- Within 25 degrees on either side of the airplane projected magnetic heading
- More than 0.5 nm but less than 3 nm ahead of the airplane

- Not in the PWS warning area.

PWS inhibits new windshear cautions during takeoff and approach if both these conditions exist:

- Airspeed more than 80 knots
- Less than 400 feet radio altitude.

All PWS alerts are inhibited above 1200 feet radio altitude.

PWS Warning - Flight Deck Effects

A PWS warning has these visual and aural annunciations:

- A red WINDSHEAR message on the PFD
- A red WINDSHEAR message on the ND
- A windshear symbol on the ND
- Master warning lights on
- Aural annunciation - WINDSHEAR AHEAD, WINDSHEAR AHEAD (takeoff)
- Aural annunciation - GO AROUND, WINDSHEAR AHEAD (approach).

PWS Caution - Flight Deck Effects

A PWS caution has these visual and aural annunciations:

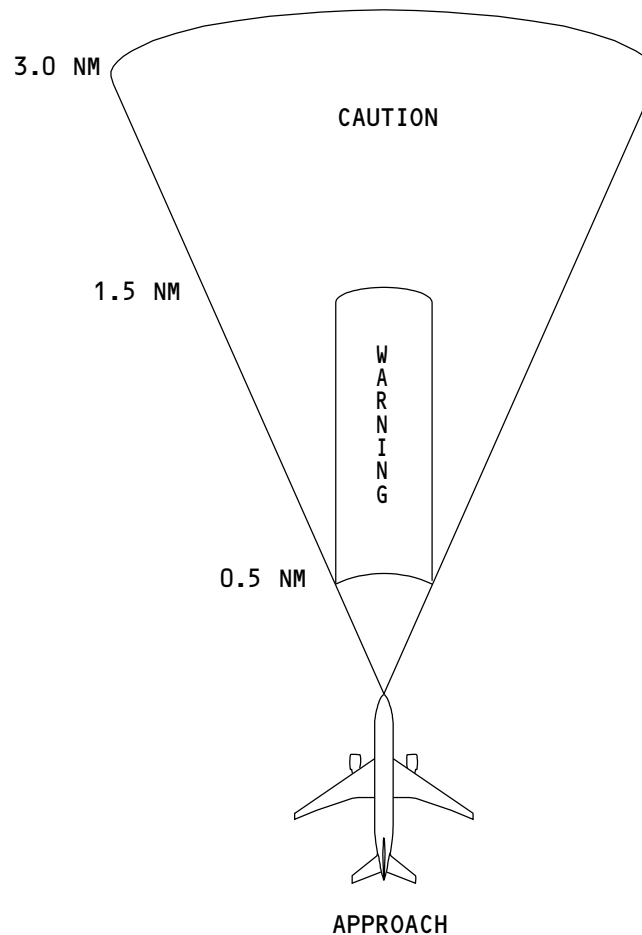
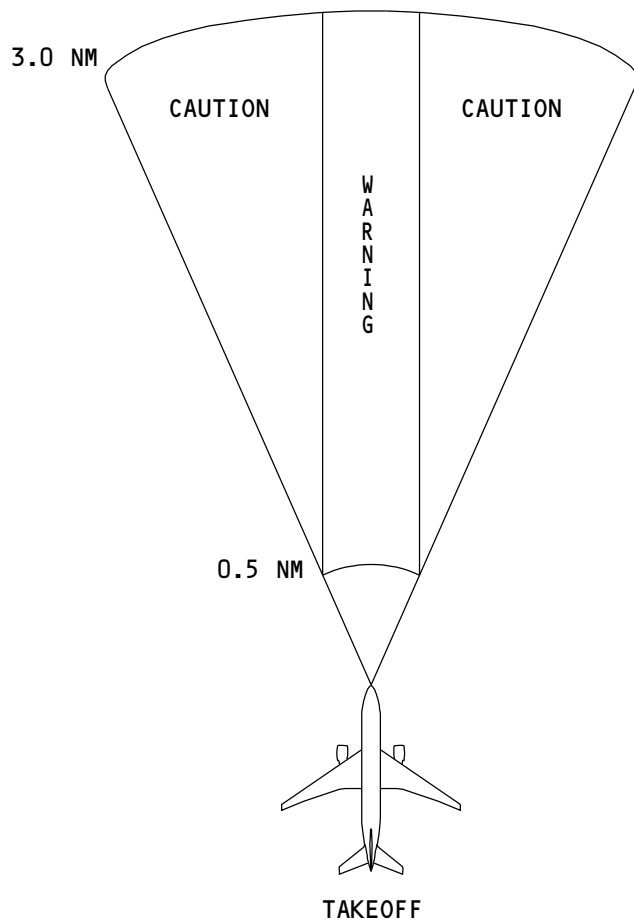
- An amber WINDSHEAR message on the ND
- A windshear symbol on the ND
- Aural annunciation - MONITOR RADAR DISPLAY.

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WXR SYSTEM - PREDICTIVE WINDSHEAR ALERTS

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WXR SYSTEM - FAIL MESSAGES AND DISPLAYS

ARO 014-016

WXR System Alert Messages and Display

When a WXR RT processes data that is not satisfactory, alert messages show on the ND and the WXR display continues to show. These are the alert messages:

- WXR WEAK - receiver gain calibration fail
- WXR ATT - both attitude inputs fail
- WXR STAB - airplane attitude exceeds stabilization limits.

The alert messages show on these alert lines:

- Line 1 shows WXR in amber
- line 2 shows WEAK or ATT in amber, WEAK has the highest priority
- Line 3 shows STAB in cyan.

ARO 001-013, 017-999

WXR System Alert Messages and Display

When a WXR RP processes data that is not satisfactory, alert messages show on the ND and the WXR display continues to show. These are the alert messages:

- WXR CAL - receiver gain calibration failure
- WXR STAB - both attitude inputs fail
- WXR STB OFF - airplane attitude exceeds the stabilization limits.

The alert messages show on these alert lines:

- Line 1 shows WXR in amber
- Line 2 shows CAL or STAB in amber, CAL has the highest priority

- Line 3 shows STB OFF in cyan.

ARO ALL

WXR System Fail Messages and Display

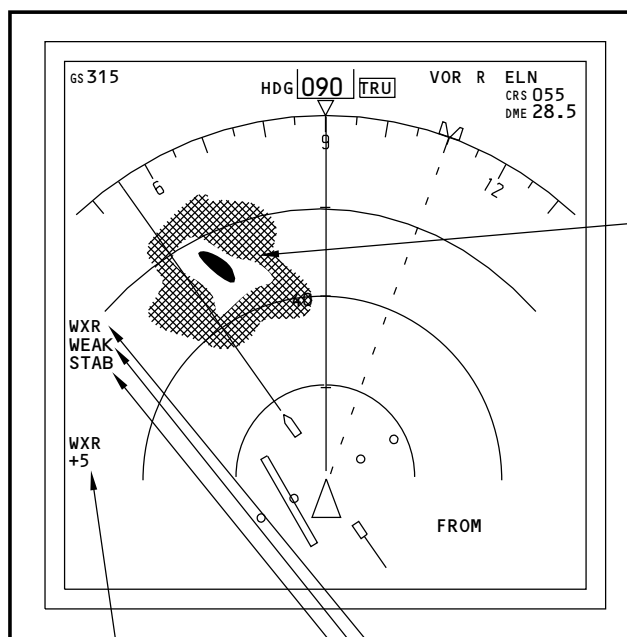
When a failure occurs, a WXR fail message shows and the WXR display does not show.

The fail messages show on these alert-lines:

- Line 1 shows WXR in amber
- Line 2 shows FAIL in amber.

These WXR system fail messages show on alert-line 3:

- RT - receiver-transmitter failure
- ANT - antenna failure
- CONT - WXR CP failure.



WEATHER SYSTEM
MESSAGES STAY IN
VIEW

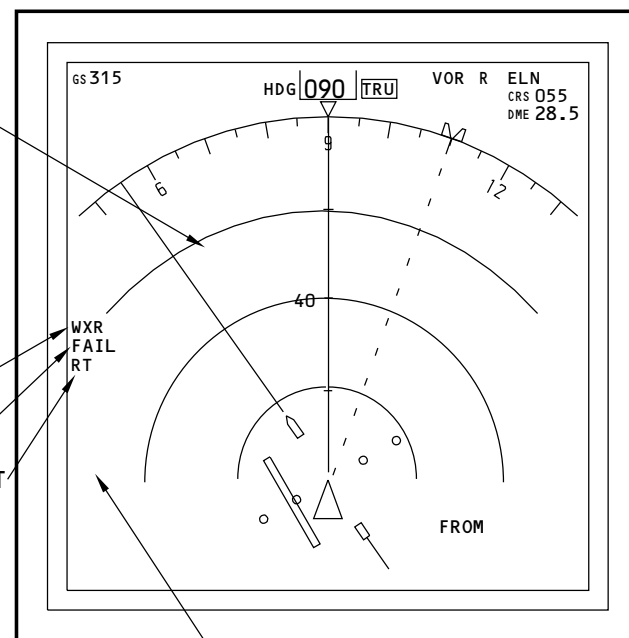
ALERT MESSAGES:
- WXR SHOWS IN AMBER
- WEAK OR ATT SHOWS IN AMBER
- STAB SHOWS IN CYAN

WXR SYSTEM ALERT MESSAGES AND DISPLAY

WEATHER DISPLAY
IS REMOVED

WEATHER DISPLAY
STAYS IN VIEW

FAIL MESSAGES:
- WXR SHOWS IN
AMBER
- FAIL SHOWS IN
AMBER
- RT, ANT OR CONT
SHOWS IN AMBER



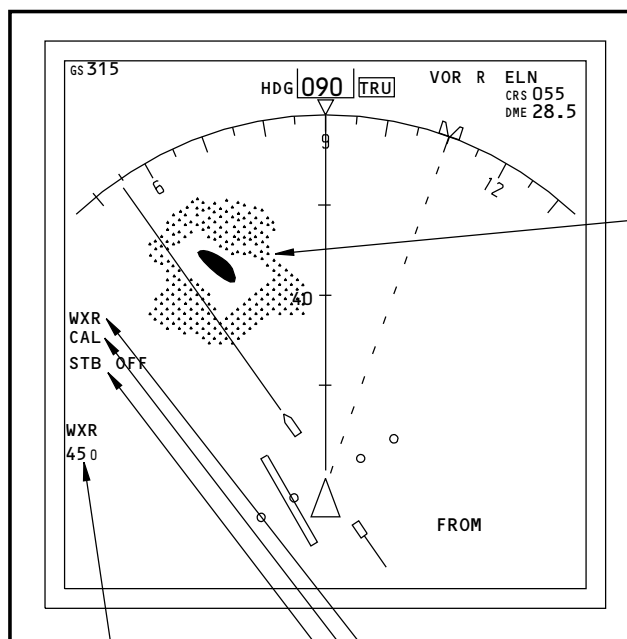
WEATHER SYSTEM
MESSAGES REMOVED

WXR SYSTEM FAIL MESSAGES AND DISPLAY

WXR SYSTEM - FAIL MESSAGES AND DISPLAYS

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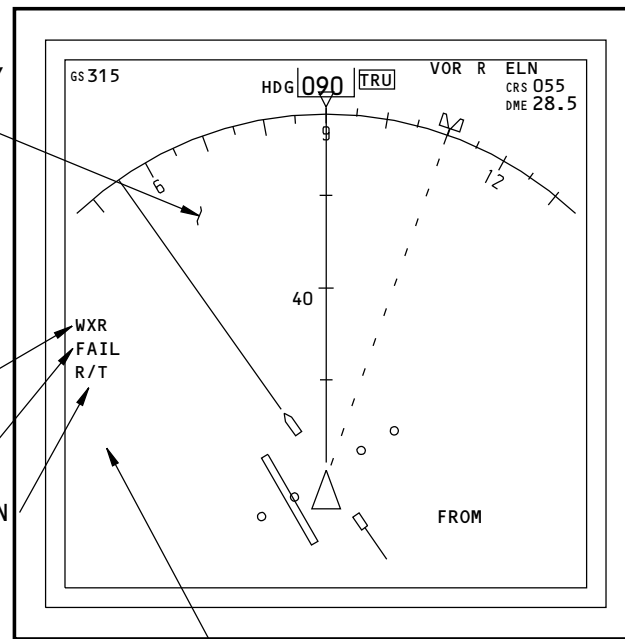
WXR SYSTEM ALERT MESSAGES AND DISPLAY

WEATHER DISPLAY IS REMOVED

WEATHER DISPLAY STAYS IN VIEW

FAIL MESSAGES:

- WXR SHOWS IN AMBER
- FAIL SHOWS IN AMBER
- R/T, ANT OR CON SHOWS IN AMBER



WXR SYSTEM FAIL MESSAGES AND DISPLAY

WXR SYSTEM - FAIL MESSAGES AND DISPLAYS

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WXR SYSTEM - ND RANGE DISAGREEMENT**General**

The graphics generators (GGs) in the left and right AIMS cabinets do a comparison of the ranges from these places:

- EFIS CP
- WXR RP
- Flight management computer function (FMC).

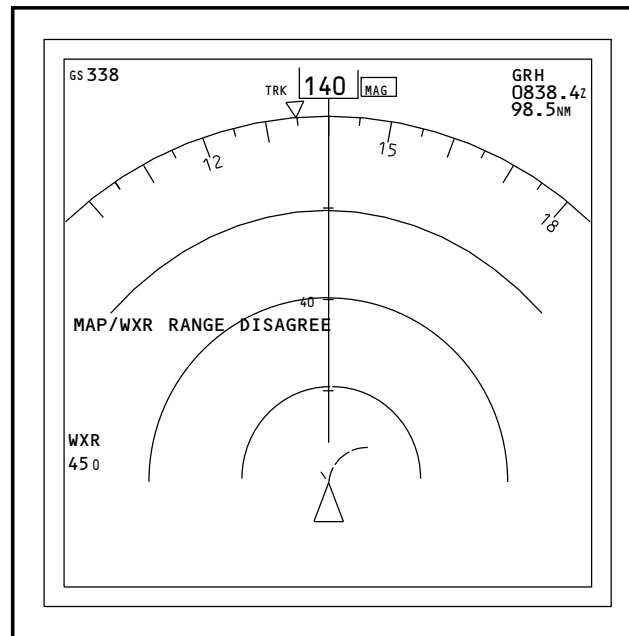
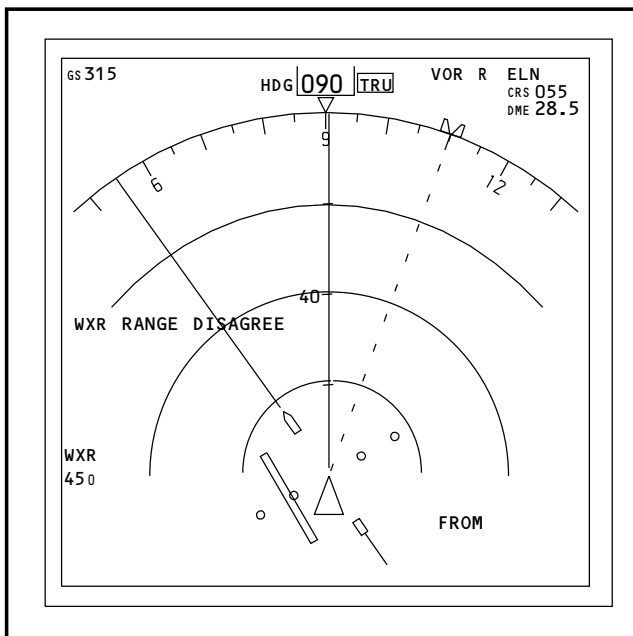
A difference between any of these ranges causes an amber range disagreement message.

These two range disagreement messages are possible:

- WXR RANGE DISAGREE shows when there is a difference between the EFIS CP range and the WXR RP range
- MAP/WXR RANGE DISAGREE shows when there is a difference between the EFIS CP range, the WXR RP range, and the FMC range.

This happens during a range disagreement:

- The WXR display does not show
- The mode, altitude, and gain messages show
- The FMC range shows.



EXPANDED APPROACH
EXPANDED VOR
EXPANDED MAP
CENTERED MAP

} MODES

EXPANDED MAP
CENTERED MAP

} MODES

WXR SYSTEM - ND RANGE DISAGREEMENT

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WXR SYSTEM - SYSTEM SELECT AND SYSTEM ON/OFF**System Select**

When you select the left or right WXR system on the WXR panel, it sends system on discrete signal to the WXR RP. When RP gets the on signal, it sends 28v dc to the WXR panel for the power INTRLK (interlock). This enables the selected RP and RT operations.

System On

To make the WXR system operate, do either of these:

- Push the WXR switch on an EFIS control panel
- Push the LSK for WXR on the EFIS OPTIONS page on the CDU.

When you do this, the left and right AIMS cabinets supply a ground level discrete through the WXR panel to the RP and RT. WXR RP gets 115v ac power from circuit breaker and supplies 200v dc to RT. WXR RP also supplies 64 Mhz clock (CLK) data and 48 Mhz intermediate frequency (IF) to RT to operate.

Right and left AIMS cabinet supplies altitude information to WXR RP and that causes PWS function to turn on and off automatically. When this happens, the ground signal comes from the PWS card in the selected RP, instead of the AIMS cabinets.

System Off

To make the WXR system go OFF, do either of these:

- Push the WXR switch again
- Push the WXR LSK on the EFIS OPTIONS page again.

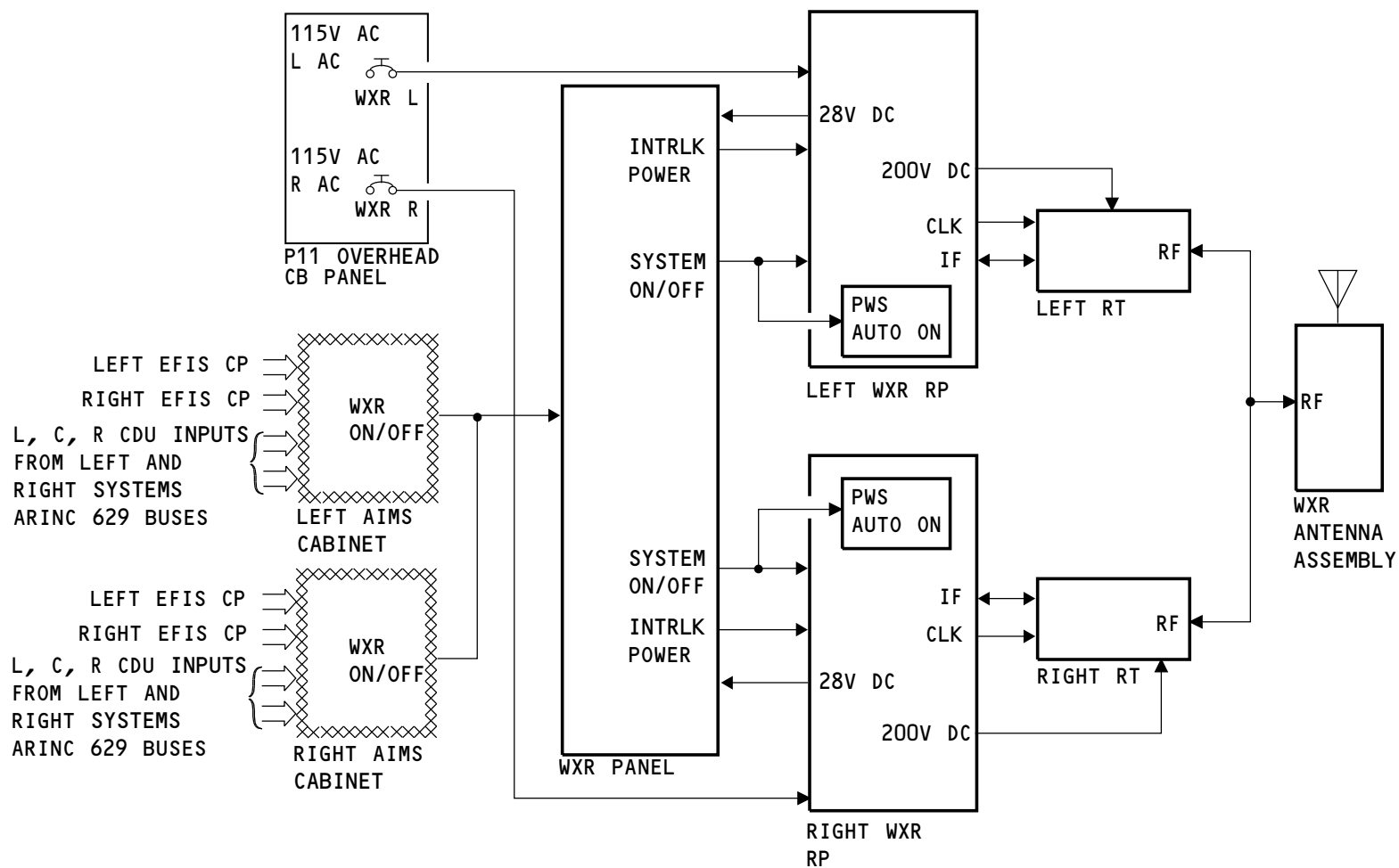
This removes the ground level discrete from the AIMS cabinet. If more than one WXR switch is on, push all of the switches again.

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WXR SYSTEM - SYSTEM SELECT AND SYSTEM ON/OFF

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WXR SYSTEM - WXR RT FUNCTIONAL DESCRIPTION

General

The selected left or right WXR RT makes RF pulses and sends them over a waveguide to the antenna. The antenna transmits pulses and receives the return signals and sends them to the selected RT. The RP processes the return signals to make display data that shows on the NDs. The WXR display on the NDs shows the weather patterns in front of the airplane.

Control Inputs

The EFIS CP or CDU sends the WXR system ON/OFF and the WXR range selection data to the onside AIMS cabinet.

The AIMS cabinet sends this control data on its ARINC 429 general purpose data bus #2 to:

- The CONTROL BUS 1 input of the onside WXR RP
- The CONTROL BUS 2 input to the off-side WXR RP.

The WXR panel sends control data on CONTROL BUS 0 to the WXR RP. The WXR panel sends this data:

- Gain, altitude, and mode of operation

Antenna Control

Each AIMS cabinet gets attitude data for antenna stabilization from the air data inertial reference system (ADIRS). An AIMS cabinet sends this attitude data to:

- The onside attitude input of the onside RP
- The offside attitude input of the offside RP.

If the attitude data from the AIMS cabinet fails, an ADIRS invalid analog discrete goes to the onside WXR RP. The RP then uses the offside attitude data.

Maintenance Interface

Test start commands from the CMCF in the AIMS cabinet go into the RP on a ARINC 429 maintenance (MAINT) DATA IN data bus. The WXR RP sends WXR system status and maintenance data to both AIMS cabinets on the MAINT DATA OUT data bus.

Central Processor Unit

The RP has a central processor unit (CPU) that uses the control data to control the operation of the RP, RT and the antenna drive. The CPU sends some of these control signals such as range, gain, and operational mode to the transmitter circuits. Also, the CPU makes the scan and elevation signals from the ADIRS attitude data. It sends these scan and elevation signals to the antenna assembly for antenna stabilization. The CPU also gets antenna position monitor signals from the antenna assembly.

Oscillator/Transmitter Circuits

The oscillator/transmitter circuit make RF pulse patterns and sends them out through the WXR antenna. When the radar is active, it continuously scan and update 3D memory so that the current radar data is immediately available whenever WXR is selected to display. This radar can generate two different views simultaneously without impacting the system performance. The Captain's control panel controls the left side display and first Officer's side controls the right side display.

RF Transmit

The RF pulses go from the transmitter circuits through the duplexer. The duplexer connects the antenna to the transmitter during RF transmission. It also connects the antenna to the receiver circuits to get the return RF pulses. From the duplexer, the RF goes to the WXR antenna assembly.

RF Receive

The antenna receives the RF return signals. Then the RF goes through the duplexer and to the receiver circuits. The receiver circuits process the return signals and send them to the CPU. The CPU uses the strength of the RF return signals to calculate the rate of rainfall and to make the WXR display data.

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WXR SYSTEM - WXR RT FUNCTIONAL DESCRIPTION

WXR Display Data

The CPU puts the WXR display data, system mode, and status data into the ARINC 453 format and sends it to the ARINC 453 transmitters. The 453 transmitters put the data on the high speed ARINC 453 DATA BUS 1 and DATA BUS 2. Each data bus sends the data for both the captain's and first officer's ND. Certain bits on the data word are set to define if the display data is to go on the captain's or first officer's ND.

System Status Data

The BITE module continuously gets system status data. The BITE module sends the system status data through the ARINC 429 input/output (I/O) and out on the MAINT DATA OUT data bus to the CMCF of both AIMS cabinets. The BITE module gets test start command from the CMCF of AIMS or the WXR CP.

ARO 001-013, 017-999

Predictive Windshear

The predictive windshear (PWS) function is a separate circuit card in each RP. The PWS card turns on the selected RP/RT when certain conditions exist. PWS detection circuitry uses Doppler radar returns with inertial reference and attitude data to calculate if a windshear alert exists. If an alert exists, the PWS card makes a symbol and sends it to WXR core processor. The core processor adds the windshear symbol to the WXR display.

The PWS card makes a hazard bus output that contains windshear alert data. This data goes to the ground proximity warning computer (GPWC) priority alert logic. The GPWC sends a discrete inhibit back to the PWS card if a higher alert exists. The PWS card also makes an inhibit discrete that changes TCAS resolution advisories to traffic advisories during a windshear alert.

The PWS card uses takeoff configuration arm signals from the warning electronic system (WES) to turn on the PWS function at takeoff. It also makes these outputs that go to WES:

- Audio alert output
- Windshear warning discrete.

The PWS card makes these discretes that go to OPAS:

- PWS caution
- PWS fail
- PWS warning.

The PWS card uses an input from the landing gear lever module in its alert logic circuit.

The PWS card uses an input from the air/ground relay for these logics:

- Alert logic
- PWS auto on/off logic.

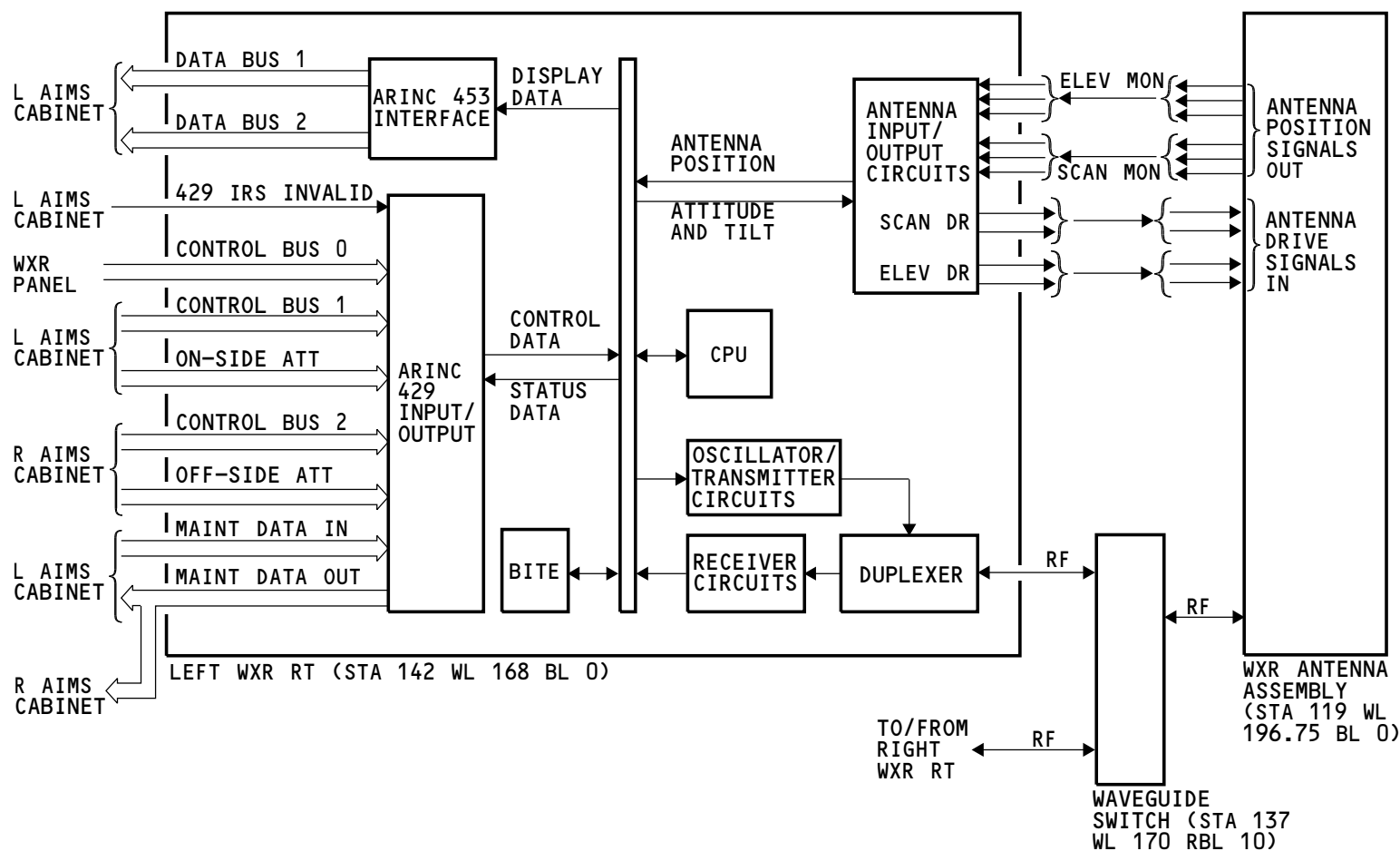
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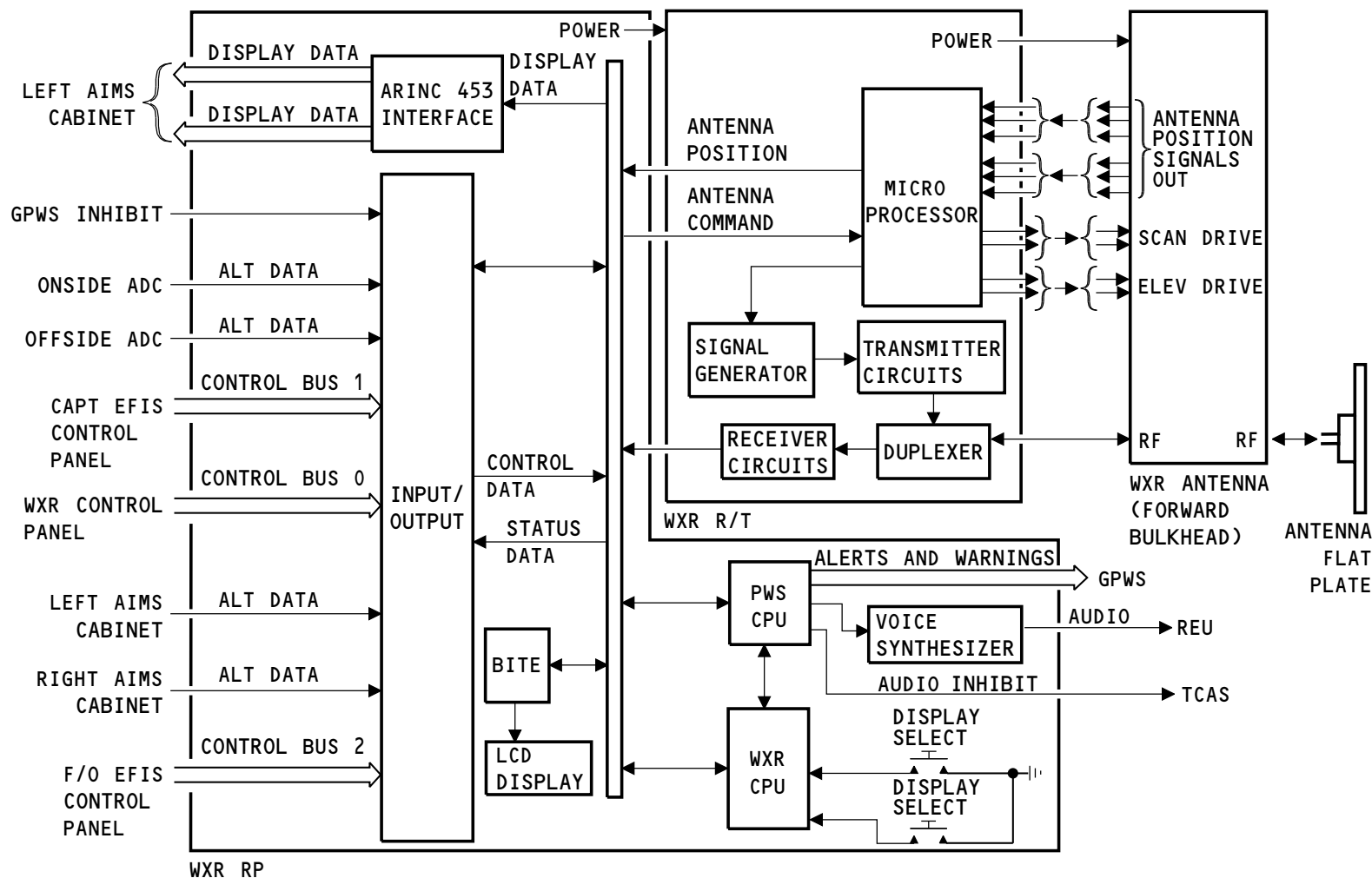
WXR SYSTEM - WXR RT FUNCTIONAL DESCRIPTION

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WXR SYSTEM - WXR RT FUNCTIONAL DESCRIPTION

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**WXR SYSTEM - ANTENNA ASSEMBLY FUNCTIONAL DESCRIPTION****Antenna Control**

The central processing unit (CPU) in the WXR RP controls and monitors the antenna operation.

Antenna Stabilization

The WXR RP uses attitude inputs from the ADIRS for antenna stabilization. The CPU uses the attitude inputs to calculate and command scan and elevation movements and sends them to the antenna for stabilization.

Left/Right System Operation

The antenna assembly has two sets of electronics and two power supplies. When you select the left WXR RT/RP, the left power supply in the antenna assembly gets 28v dc from the left WXR RT. When you select the right WXR RP, the right power supply in the antenna assembly gets 28v dc from the right WXR RT. This 28v dc power supply goes to the scan and elevator motor drives for antenna operations.

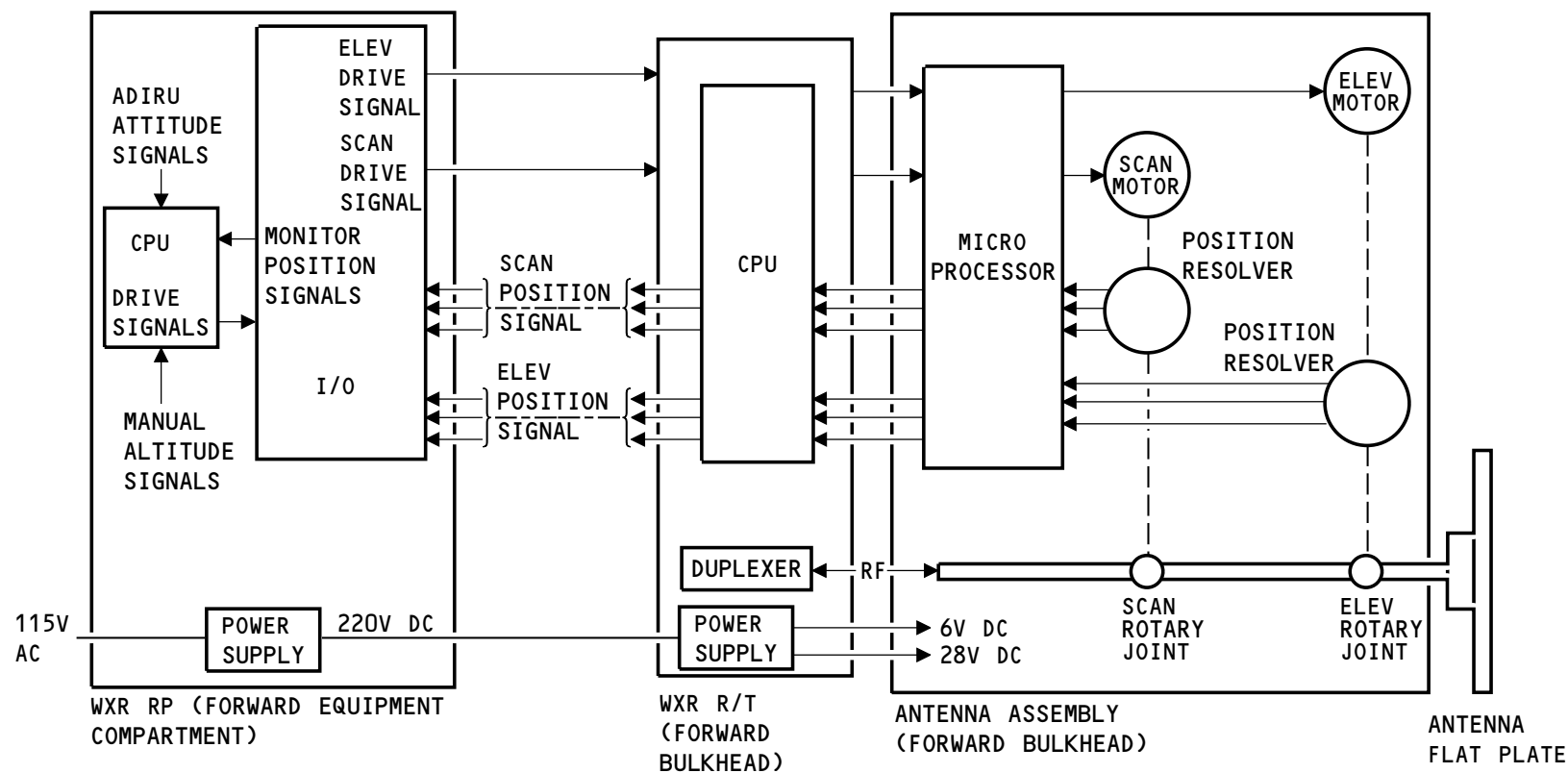
Antenna Drive

The antenna has one scan motor and one elevation motor. The scan motor drives the antenna horizontally. It moves the antenna 80 degrees left and right of the centerline of the airplane. The elevation motor drives the antenna vertically. It moves the antenna up and down 35 degrees.

Antenna Position Feedback

Resolvers send position data back to RT and RT sends it back to RP. In the WXR RP, this information is compared to correct any faults in desired antenna position. The radar system built-in-test (BIT) monitors the two positions for faults.

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WXR SYSTEM - ANTENNA ASSEMBLY FUNCTIONAL DESCRIPTION

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WXR SYSTEM - WXR RT BITE-FUNCTIONAL DESCRIPTION**General**

The CPU in the WXR RP controls the operation of the BITE module. These are the functions of the BITE module:

- Gets status information from the interface components
- Gets internally monitored data
- Does a self-test when it gets a command from the WXR CP or the maintenance access terminal (MAT)
- Sends a test pattern to the inside AIMS cabinet so it shows on the ND
- Sends system status data to both AIMS cabinets so the system status data can show on the ND
- Stores faults in nonvolatile fault memory
- Sends data to both AIMS cabinets so the CMCF can store it in memory.

Internal Input Monitoring

The BITE monitors these things:

- Over temperature from the power supply
- Control and range from the WXR panel on control bus 0
- Range inputs from the AIMS cabinets on control bus 1 and 2
- Antenna scan and elevation position from the CPU.

AIMS/CMCS Interface

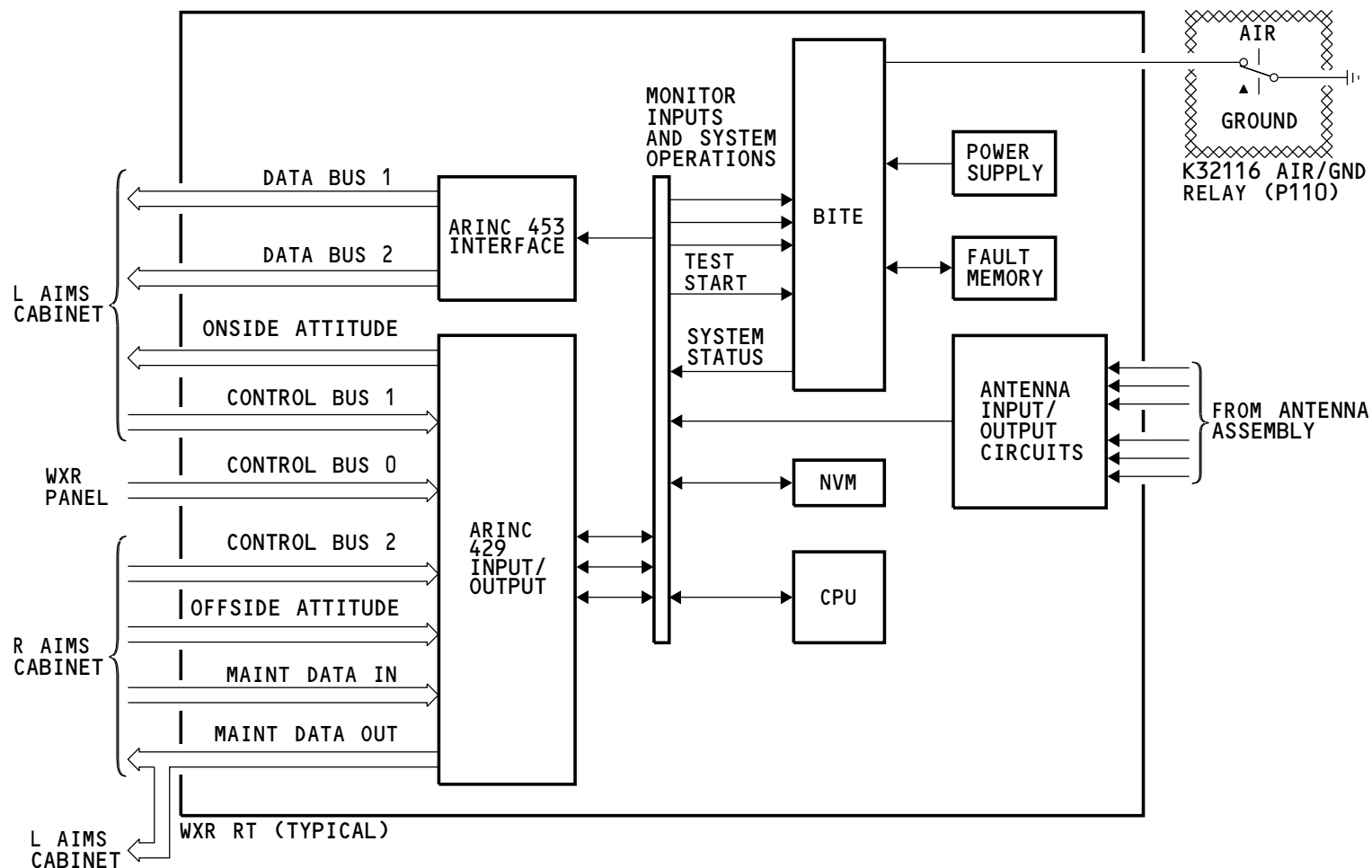
The BITE continuously sends system status data to the CMCF of AIMS. The CMCF stores this data. Use the maintenance access terminal (MAT) to view the system status data stored in the CMCF.

A WXR system ground test request starts from the MAT. The WXR RP gets the test start command from the left AIMS cabinet. After the RP does the test, it sends the results to both AIMS cabinets. The CMCFs store the results in memory and send them to the MAT. The MAT shows the results.

The air/ground relay defines flight legs if flight legs data from the CMC fails.

Fault Memory

The WXR RP has a nonvolatile fault memory to store faults per flight leg. An input from the CMCF of AIMS defines the start and the end of a flight leg. If the CMCF of AIMS fails, an input from the air/ground relay defines the start and the end of the flight leg.



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WXR SYSTEM - WXR RT BITE-FUNCTIONAL DESCRIPTION

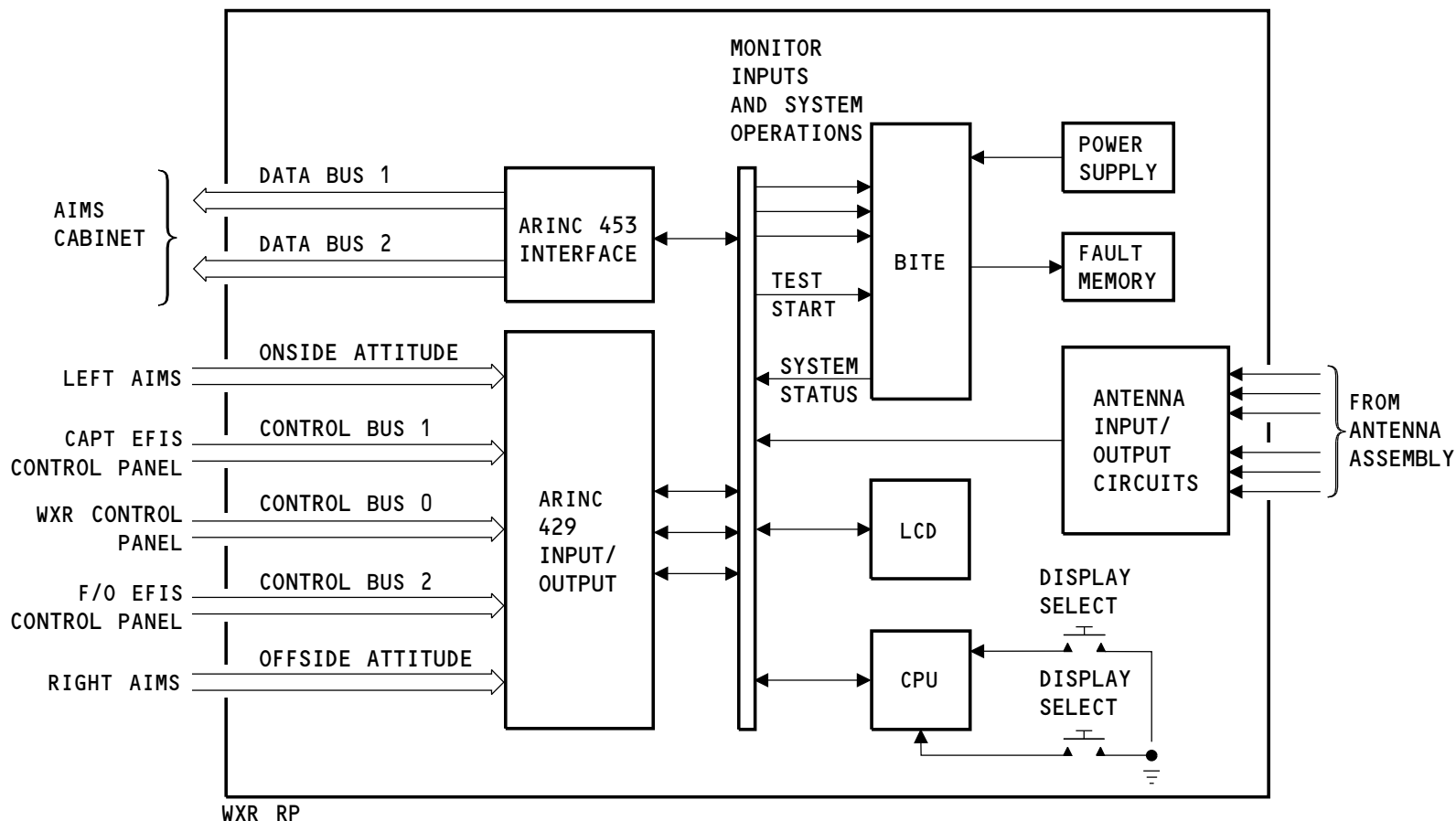
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WXR SYSTEM - WXR RT BITE-FUNCTIONAL DESCRIPTION

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WXR SYSTEM - SELF-TEST

General

The WXR self-test function does a test of the WXR system. This test gives the flight crew a way to do a check of the WXR system.

Training Information Point

The weather radar (WXR) system transmits some pulses to let BITE monitor for correct operation.

Test Start

Use an EFIS control panel or a CDU to do these steps:

- Select an ND mode that can show the WXR display
- Push the WXR button to apply power to the selected RT/RP.

Select TEST on the WXR control panel to start self-test.

ARO 014-016

Test Operation

During the test, these things happen:

- The RT makes a test pattern and sends it to the AIMS cabinet to show on the NDs
- The ND shows TEST.

ARO 001-013, 017-999

Test Operation

These visual and aural annunciations show for a normal test:

- Amber WINDSHEAR message on ND
- Aural message - MONITOR RADAR DISPLAY
- Aural message - GO AROUND, WINDSHEAR AHEAD, (pause) WINDSHEAR AHEAD, WINDSHEAR AHEAD
- Red WINDSHEAR message on ND and PFD

- Master warning lights on
- WXR test pattern shows on the ND
- EICAS advisory message WINDSHEAR SYS.

The WXR TEST pattern shows until you select another mode on the WXR panel or EFIS control panel. The TEST pattern shows without any alert annunciations if these conditions exist:

- PWS is on
- Airplane is in the air.

The PWS symbol never shows in the TEST pattern. If PWS detects a real windshear threat while in TEST mode, the test stops. PWS then shows the actual display data and alert annunciations.

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Training Information Point

The maintenance manual and the fault isolation manual do not have tasks for the WXR FAIL messages on the ND.

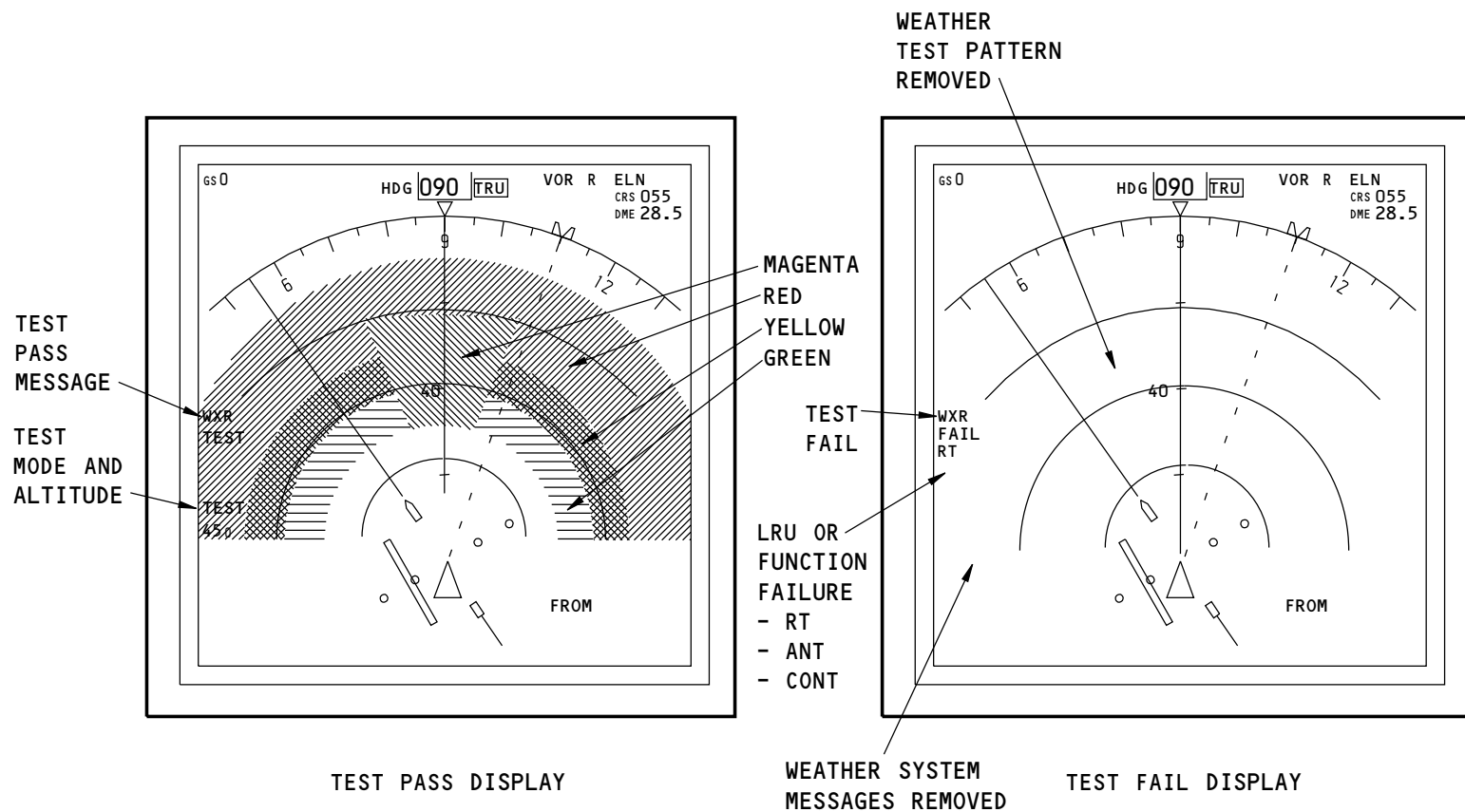
Many LRUs on the 777 are compatible with other model airplanes that do not have a central maintenance computing system (CMCS). For this reason, the WXR system shows fail messages on the ND. Maintenance personnel should use the MAT to do a test of the WXR system.

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WXR SYSTEM - SELF-TEST

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**WXR SYSTEM - RP MAINTENANCE DISPLAY****General**

The RP front panel has a Liquid Crystal Display (LCD) and two select buttons. The LCD will show current faults and faults that are recorded in the RPs non-volatile memory (NVM). This data can be used to identify a defective Line Replaceable Unit (LRU). The NVM has the capacity to record a minimum of 256 faults in 64 flight legs. The two select buttons are used to move through the different screens.

LCD and Select Buttons

The RP uses a 4 row by 16 character LCD and two select buttons. The buttons are momentary-contact push buttons. When facing the front of the unit, the left button is referred to as Button 1, and the right button as Button 2. Lines 1 through 3 of the LCD show user information. Line 4 of the LCD shows the softkey names of the two push buttons. The display will return to the main menu after five minutes if not used.

Display Menu

The main menu screen initially shows on the LCD. These are the menu screens that are available from the main menu:

FAULT RECORD; shows Flight Faults and Current Faults

CONFIGURATION; shows the list of LRUs and the LRU Software and Hardware configurations.

CLR FAULT HIST; provides a way to delete all of the System Fault History data from the RP.

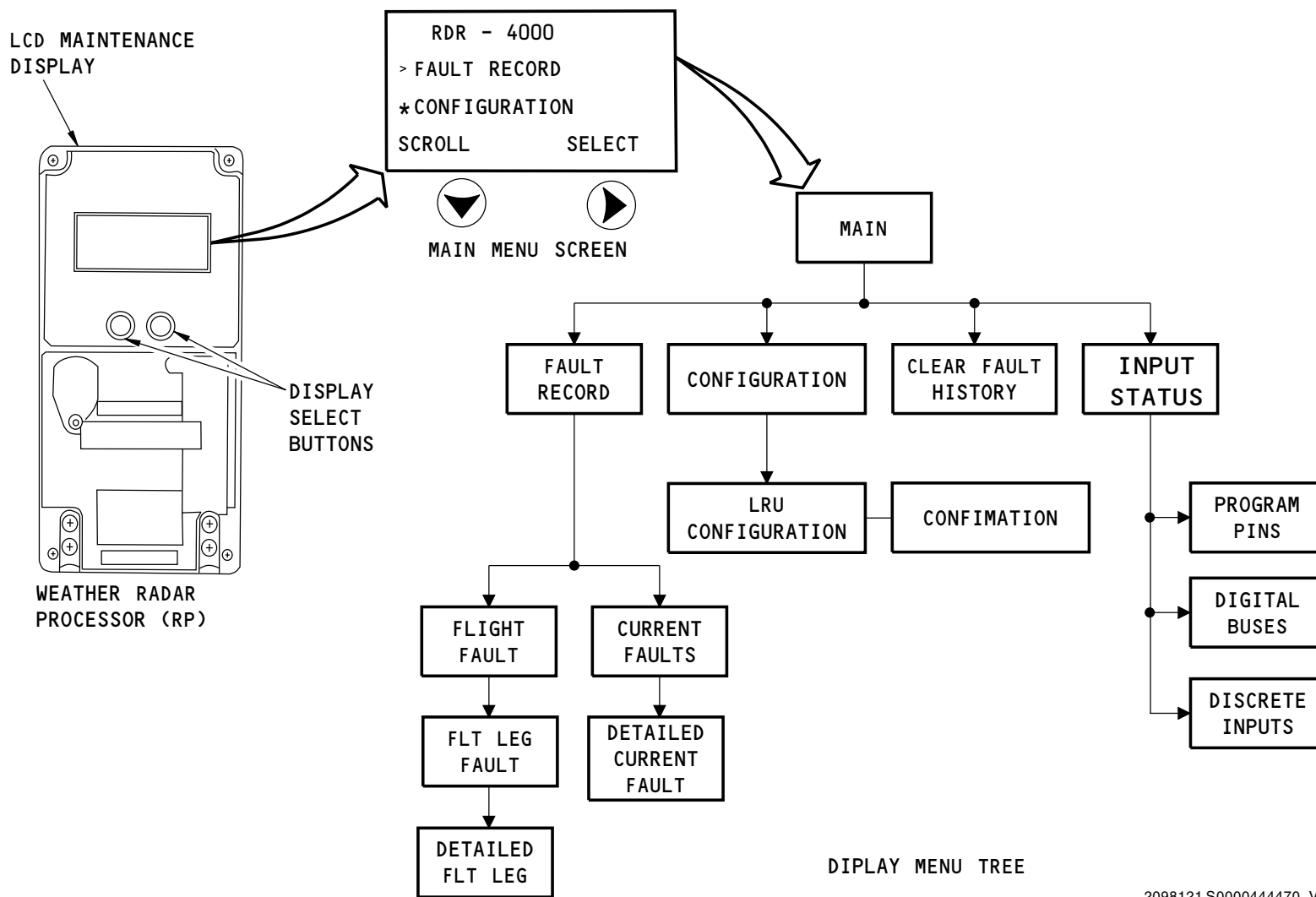
INPUT STATUS; shows the status of the Program Pins, Digital Buses, or Discrete Inputs.

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WXR SYSTEM - RP MAINTENANCE DISPLAY

DIPLAY MENU TREE

2098121 S0000444470_V1

**WXR SYSTEM - LRU REPLACEMENT TEST****General**

The WXR system LRU replacement test does an internal check of WXR RP operations. This test also makes sure the WXR RP connections are good. This test does not do a detailed check of the WXR RP data inputs.

These are the LRU replacement tests for the weather radar system:

- Left WXR system
- Right WXR system.

Training Information Point

Make sure the nose of the airplane points away from buildings, other aircraft or large metal objects.

Test Start

Follow the instructions on the MAT to start a WXR LRU replacement test.

Test Operation

There are no WXR test display patterns or other flight deck effects (FDEs) for a WXR LRU replacement test.

Test Results

For a valid WXR LRU replacement test, PASSED must show adjacent to TEST CONDITION on the MAT. For a WXR LRU replacement test that fails, FAILED shows adjacent to TEST CONDITION on the MAT.

GROUND TESTS

SELECT ATA SYSTEM (55)

- 34 WEATHER RADAR SYSTEM
- 34 TRAFFIC ALERT AND COLLISION AVOIDANCE SYSTEM
- 34 GROUND PROXIMITY WARNING SYSTEM
- 34 VOR/MARKER BEACON SYSTEM
- 34 AIR TRAFFIC CONTROL (ATC) MODE S SYSTEM
- 34 DISTANCE MEASURING EQUIPMENT
- 34 AUTOMATIC DIRECTION FINDER (ADF) SYSTEM
- 34 GLOBAL POSITIONING SYSTEM
- 34 AIMS - FLIGHT MANAGEMENT COMPUTING SYSTEM

SELECT TEST TYPE

- ☐ SYSTEM TEST
- ☒ OPERATIONAL TEST
- ☒ LRU REPLACEMENT TEST

SELECT LRU REPLACEMENT TEST (2)

LEFT WXR SYSTEM

RIGHT WXR SYSTEM

CONTINUE

HELP

GO BACK

SELECT LRU REPLACEMENT TEST

(2)

LEFT WXR SYSTEM
RIGHT WXR SYSTEM

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WXR SYSTEM - LRU REPLACEMENT TEST

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**WXR SYSTEM - SYSTEM TEST****Training Information Point**

The weather radar (WXR) system transmits some pulses to let BITE monitor for correct operation. Make sure the nose of the airplane points away from buildings and other aircraft or large metal objects.

Test Start

Follow the instructions on the MAT to start a WXR system test.

ARO 014-016**Test Operation**

During the test, these things happen:

- The RT makes a test pattern and sends it to the AIMS cabinet to show on the NDs
- The ND shows TEST.

ARO 001-013, 017-999**Test Operation**

These visual and aural annunciations show for a normal test:

- Amber WINDSHEAR message on ND
- Aural message - MONITOR RADAR DISPLAY
- Aural message - GO AROUND, WINDSHEAR AHEAD, (pause) WINDSHEAR AHEAD, WINDSHEAR AHEAD
- Red WINDSHEAR message on ND and PFD
- Master warning lights on
- WXR test pattern shows on the ND
- EICAS advisory message WINDSHEAR SYS

The WXR TEST pattern shows until you select another mode on the WXR panel or EFIS control panel. The TEST pattern shows without any alert annunciations if these conditions exist:

- PWS is on
- Airplane is in the air.

The PWS symbol never shows in the TEST pattern. If PWS detects a real windshear threat while in TEST mode, the test stops. PWS then shows the actual display data and alert annunciations.

ARO ALL**Test Pass**

For a valid self-test, PASSED must show adjacent to TEST CONDITION on the MAT. You must also see and hear all visual and aural annunciations.

Test Fail

For a self-test that fails, FAILED shows next to TEST CONDITION on the MAT. The test also fails if you do not see and hear all visual and aural annunciations.

Training Information Point

The maintenance manual and the fault isolation manual do not have tasks for the WXR FAIL messages on the ND.

Many LRUs on the 777 are compatible with other model airplanes that do not have a central maintenance computing system (CMCS). For this reason, the WXR system shows fail messages on the ND. Use the MAT to do a test of the WXR system.

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GROUND TESTS

SELECT ATA SYSTEM (55)

- 34 WEATHER RADAR SYSTEM
- 34 TRAFFIC ALERT AND COLLISION AVOIDANCE SYSTEM
- 34 GROUND PROXIMITY WARNING SYSTEM
- 34 VOR/MARKER BEACON SYSTEM
- 34 AIR TRAFFIC CONTROL (ATC) MODE S SYSTEM
- 34 DISTANCE MEASURING EQUIPMENT
- 34 AUTOMATIC DIRECTION FINDER (ADF) SYSTEM
- 34 GLOBAL POSITIONING SYSTEM
- 34 AIMS - FLIGHT MANAGEMENT COMPUTING SYSTEM

SELECT TEST TYPE

- ☒ SYSTEM TEST
- ☐ OPERATIONAL TEST
- ☐ LRU REPLACEMENT TEST

SELECT SYSTEM TEST (2)

LEFT WXR SYSTEM

RIGHT WXR SYSTEM

CONTINUE

HELP

GO BACK

SELECT SYSTEM TEST

(2)

LEFT WXR SYSTEM
RIGHT WXR SYSTEM

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WXR SYSTEM - SYSTEM TEST

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TRAFFIC ALERT AND COLLISION AVOIDANCE SYSTEM - INTRODUCTION

General

The traffic alert and collision avoidance system (TCAS) helps the flight crew and air traffic control maintain safe air traffic separation. TCAS is an airborne system. TCAS uses an air traffic control radar beacon system (ATCRBS) transponder or an ATC/Mode S transponder to track other airplanes. TCAS also coordinates maneuvers with other airplanes that have TCAS.

TCAS supplies a traffic display and visual and aural vertical commands to the flight crew. All commercial airlines and some general aviation airplanes have TCAS.

Abbreviations and Acronyms

- ABS - absolute
- ABV - above
- AIMS - airplane information management system
- ATC - air traffic control
- ATCRBS - air traffic control radar beacon system
- BITE - built-in-test equipment
- BLW - below
- CMCS - central maintenance computer system
- CPA - closest point of approach
- GPWC - ground proximity warning computer
- PSEU - proximity switch electronics unit

ARO 001-013, 017-999

- PWS - predictive windshear

ARO ALL

- TCAS - traffic alert and collision avoidance system
- RA - resolution advisory
- REL - relative
- TCAS - traffic alert and collision avoidance system
- WEU - warning electronic unit

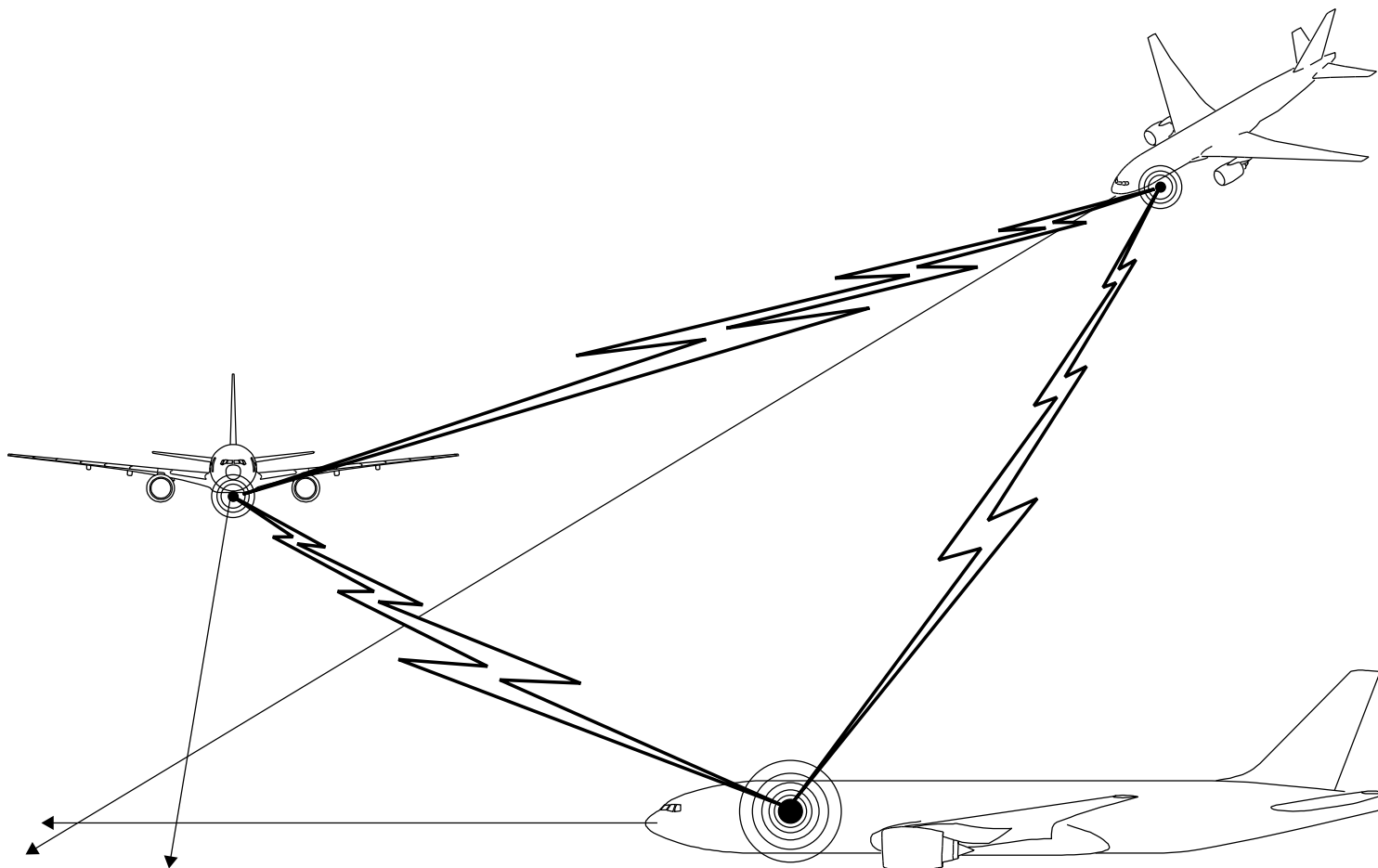
ARO 001-013, 017-999

- WXR - weather radar

ARO ALL**34-45-00****ARO ALL EFFECTIVITY**

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TRAFFIC ALERT AND COLLISION AVOIDANCE SYSTEM - INTRODUCTION

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TCAS - GENERAL DESCRIPTION

General

The traffic alert and collision avoidance system (TCAS) interrogates other airplanes to get altitude, range, and bearing data. TCAS uses the replies and inputs from other onboard airplanes systems to calculate traffic avoidance data.

General Description

These are the TCAS components:

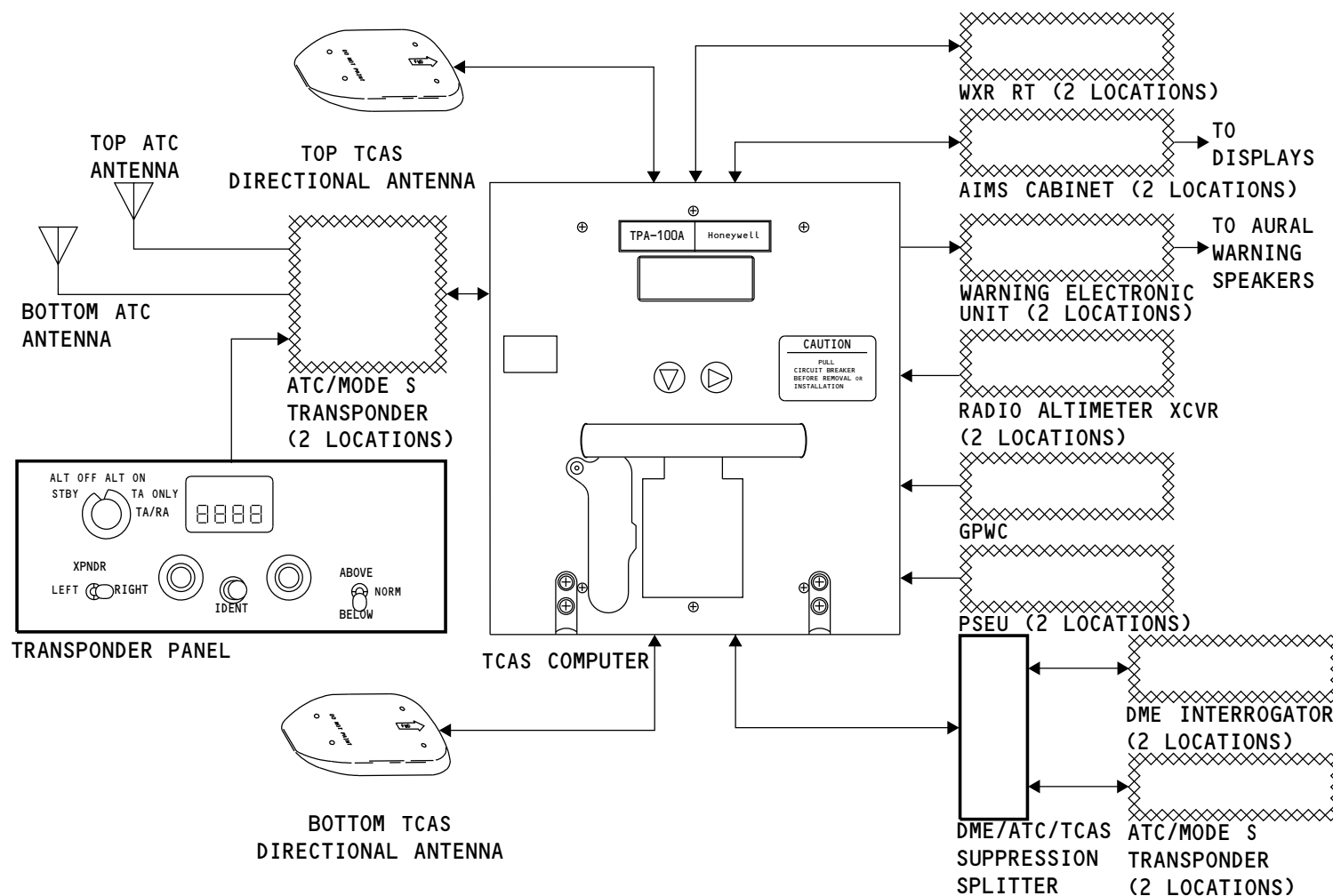
- ATC antennas
- Transponder panel
- TCAS directional antennas
- TCAS computer.

TCAS interfaces with these other system components:

- Left and right airplane information management system (AIMS) cabinets
- Left and right ATC/Mode S transponders
- Left and right warning electronic units (WEUs)
- Left and right radio altimeters
- Left and right proximity switch electronics units (PSEUs)
- Ground proximity warning computer (GPWC).

Suppression

The TCAS computer connects to the DME interrogators and the ATC transponders through a suppression splitter.



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TCAS - GENERAL DESCRIPTION

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**TCAS - COMPONENT LOCATIONS****Main Equipment Center**

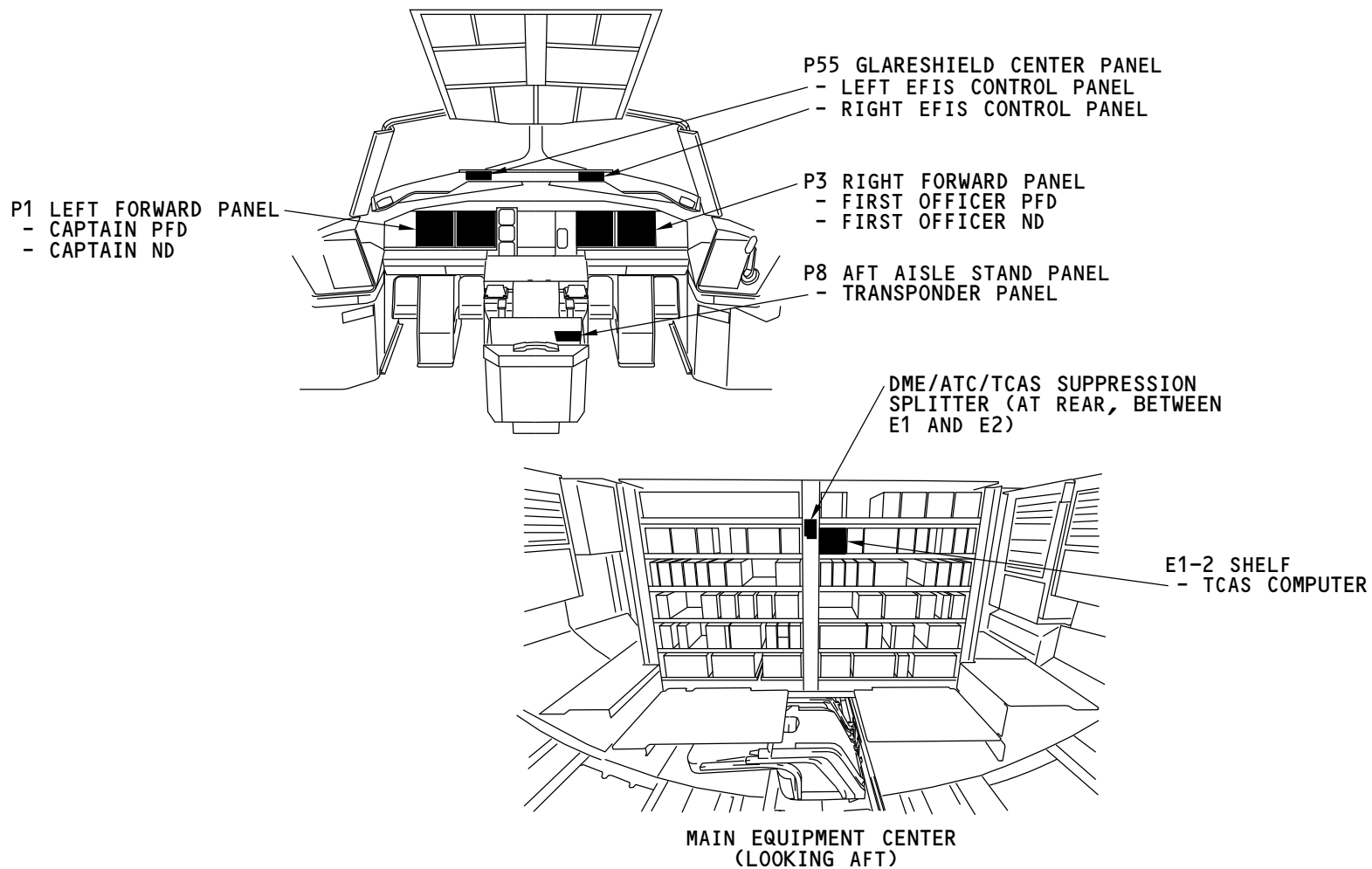
The TCAS computer and the DME/ATC/TCAS suppression splitter are in the main equipment center.

Flight Deck

These are the components in the flight deck that interface with TCAS:

- Left EFIS control panel
- Captain primary flight display (PFD)
- Captain navigation display (ND)
- Right EFIS control panel
- First officer PFD
- First officer ND.

The transponder panel is on the P8 aft aisle stand panel.



TCAS - COMPONENT LOCATIONS

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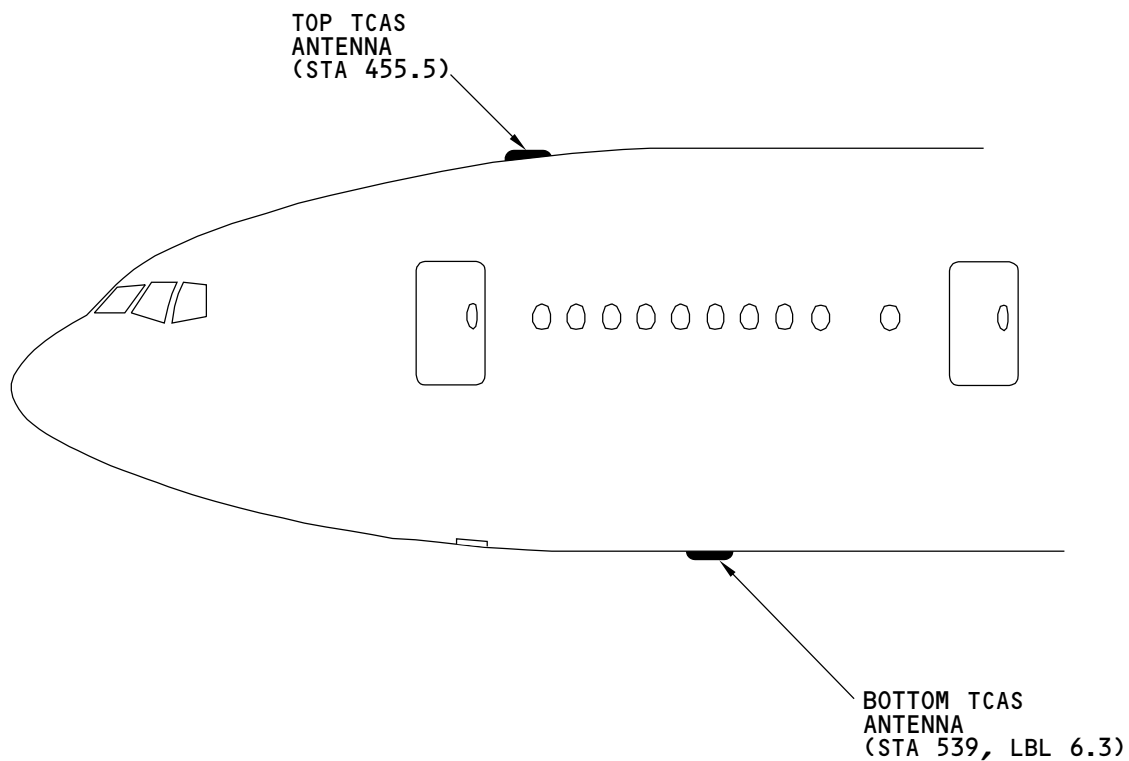


TCAS - ANTENNA LOCATION

General

The top TCAS antenna is on top of the fuselage. The bottom TCAS antenna is on bottom of the fuselage.

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TCAS - ANTENNA LOCATION

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May 05/2015



TCAS - POWER, ANTENNAS, ANALOG DISCRETE INTERFACES AND PROGRAM PINS

General

The TCAS computer has interfaces with these components:

- Overhead circuit breaker panel
- Top and bottom TCAS directional antennas
- Left AIMS cabinet
- Right AIMS cabinet
- Air/ground relay
- Ground proximity warning computer (GPWC)
- Proximity sensor electronics unit (PSEU) 1
- PSEU 2
- DME/ATC/TCAS suppression splitter
- Left warning electronic unit (WEU)

ARO 001-013, 017-999

- Left WXR RT

ARO ALL

- Right WEU.

There are program pins to supply control of the TCAS computer.

Power

The TCAS computer gets 115v ac from the left ac secondary 2 bus, through the overhead circuit breaker panel.

Antennas

There are two TCAS directional antennas, one on the top and one on the bottom of the airplane. The TCAS directional antennas receive traffic airplane reply signals. They also transmit the TCAS interrogation signals.

AIMS - Display Status

An analog discrete from either AIMS cabinet goes to the TCAS computer when the display function of AIMS fails. When the TCAS computer gets this discrete, the TCAS computer does not do these functions:

- Send TCAS display outputs to the AIMS
- Send TCAS aural to the warning electronic system (WES)
- Transmit coordination data to traffic airplanes with TCAS.

Air/Ground Relay

This discrete from the air/ground relay supplies in-air or on-ground status to the TCAS computer. The air/ground discrete inhibits resolution advisories (RAs) when the airplane is on the ground and inhibits tests when in the air. Also, the air/ground discrete increments flight legs in the TCAS nonvolatile memory when the central maintenance computing system (CMCS) fails.

ARO 009-999; ARO 001-008 POST SB 777-34-0232**GPWC - Advisory Delay Discretes**

The GPWC sends three analog discretes to the TCAS computer. These discretes inhibit advisories during some ground proximity warning and alert conditions.

ARO 001-008 PRE SB 777-34-0232**GPWC - Advisory Delay Discretes**

The GPWC sends a discrete to the TCAS computer to inhibit TCAS advisories during some ground proximity warning conditions.

ARO ALL**PSEU - Landing Gear Position**

This analog discrete from the PSEUs supply the TCAS computer with the position of the landing gear. When the TCAS computer gets this discrete, the TCAS computer makes the bottom directional antenna become an omnidirectional antenna.

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**TCAS - POWER, ANTENNAS, ANALOG DISCRETE INTERFACES AND PROGRAM PINS****Suppression Input/Output**

The TCAS computer gets a suppression pulse when an ATC transponder or DME interrogator transmits. When the TCAS computer transmits, it sends a suppression pulse to the ATC transponders and the DME interrogators.

WEU - TCAS Aural - Voice Outputs

The TCAS computer sends RA and TA aural signals to the warning electronic units (WEUs). The WEUs amplify the RA and TA aural signals and send them to the aural warning speakers to alert the flight crew.

ARO 001-013, 017-999**WXR - TCAS Alert Inhibit**

The TCAS computer gets an inhibit discrete from the predictive windshear (PWS) function of WXR. When there is a PWS alert, this discrete does these functions:

- Changes TCAS resolution advisories (RAs) to traffic advisories (TAs)
- Inhibits TCAS aural alerts.

ARO ALL**Program Pins**

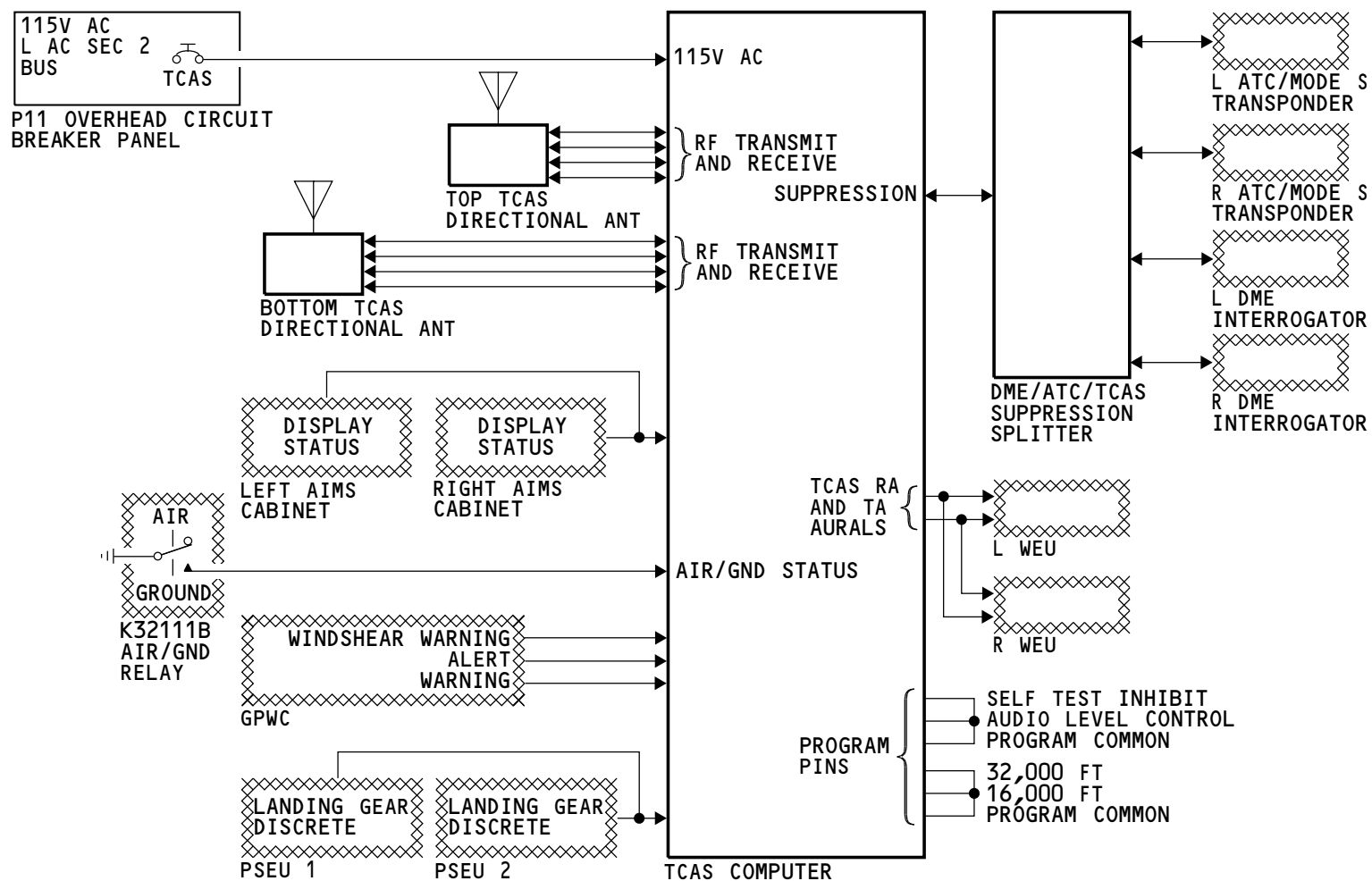
These are the functions that the program pins on the TCAS computer enable:

- A self-test inhibit to prevent self-test in the air
- The audio level of the voice outputs
- TCAS advisories. The 16,000 FT and the 32,000 FT program pins enable climb advisories up to an altitude of 48,000 feet.

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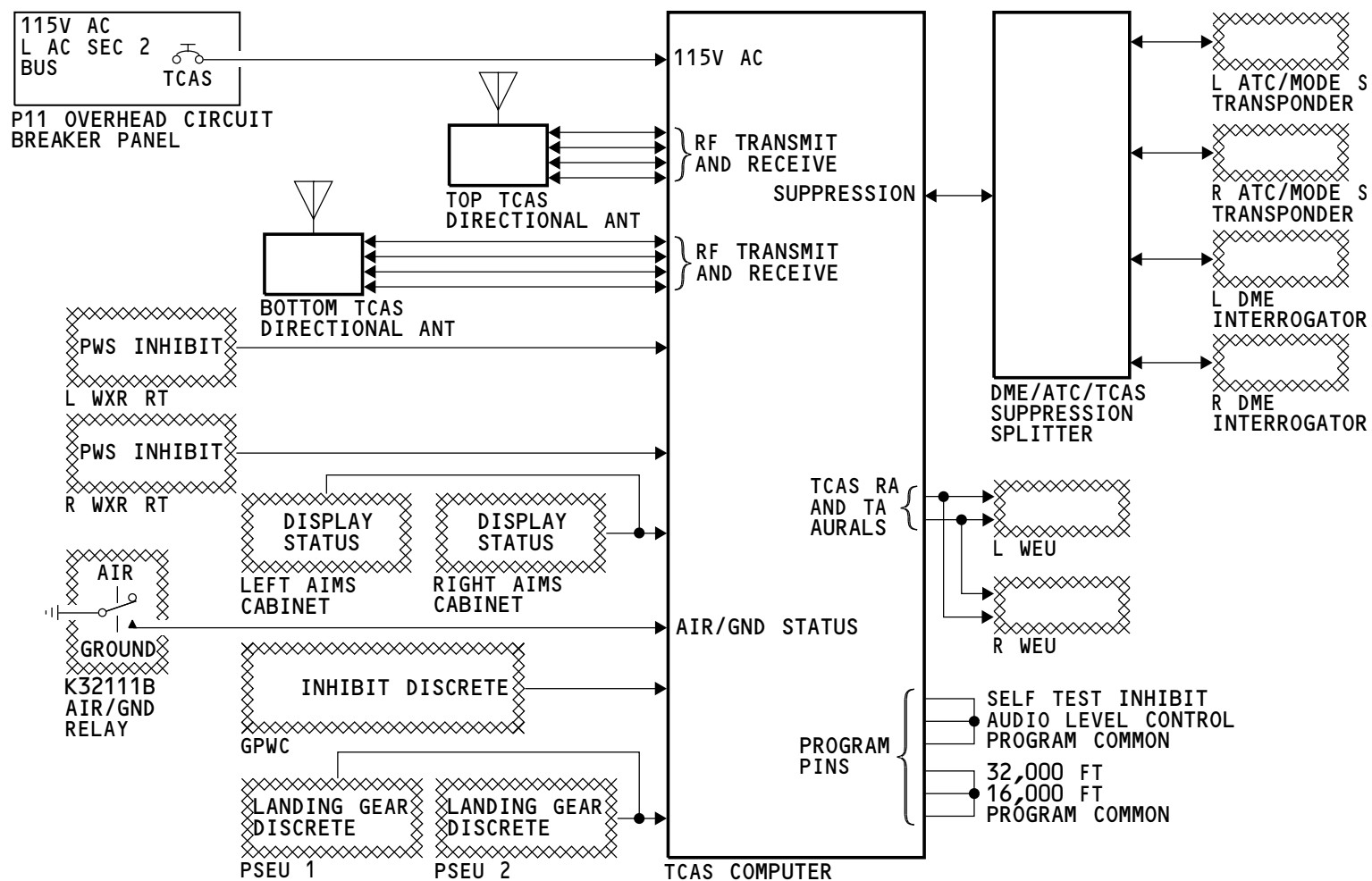
TCAS - POWER, ANTENNAS, ANALOG DISCRETE INTERFACES AND PROGRAM PINS

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TCAS - POWER, ANTENNAS, ANALOG DISCRETE INTERFACES AND PROGRAM PINS

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TCAS - DIGITAL INTERFACES

General

The TCAS computer has digital interfaces with these units:

- Left ATC/Mode S transponder
- Right ATC/Mode S transponder
- Left radio altimeter transceiver
- Right radio altimeter transceiver
- Left AIMS cabinet
- Right AIMS cabinet.

ATC/Mode S Transponder - Control and Coordination Data

The dual transponder panel sends this control data through the selected ATC/Mode S transponder to the TCAS computer:

- TCAS mode selection (TA only or TA/RA)
- Control of the altitude limits for the TCAS display that shows on the ND.

For the TCAS computer to calculate coordination data, ATC transponder sends this data to the TCAS computer:

- 24-bit airplane address
- Barometric altitude
- Maximum true airspeed.

The TCAS computer sends this data to the transponder:

- General TCAS operational status
- Mode S coordination data.

Radio Altimeter Inputs

The TCAS computer gets radio altitude from the left and right radio altimeter transceivers.

TCAS Inputs from AIMS

The left AIMS cabinet supplies these inputs to the TCAS computer:

- Inertial reference unit (IRU) data from the air data inertial reference system (ADIRS).
- Data loader data
- Data loader enable analog discrete
- Central maintenance computing system (CMCS) data.

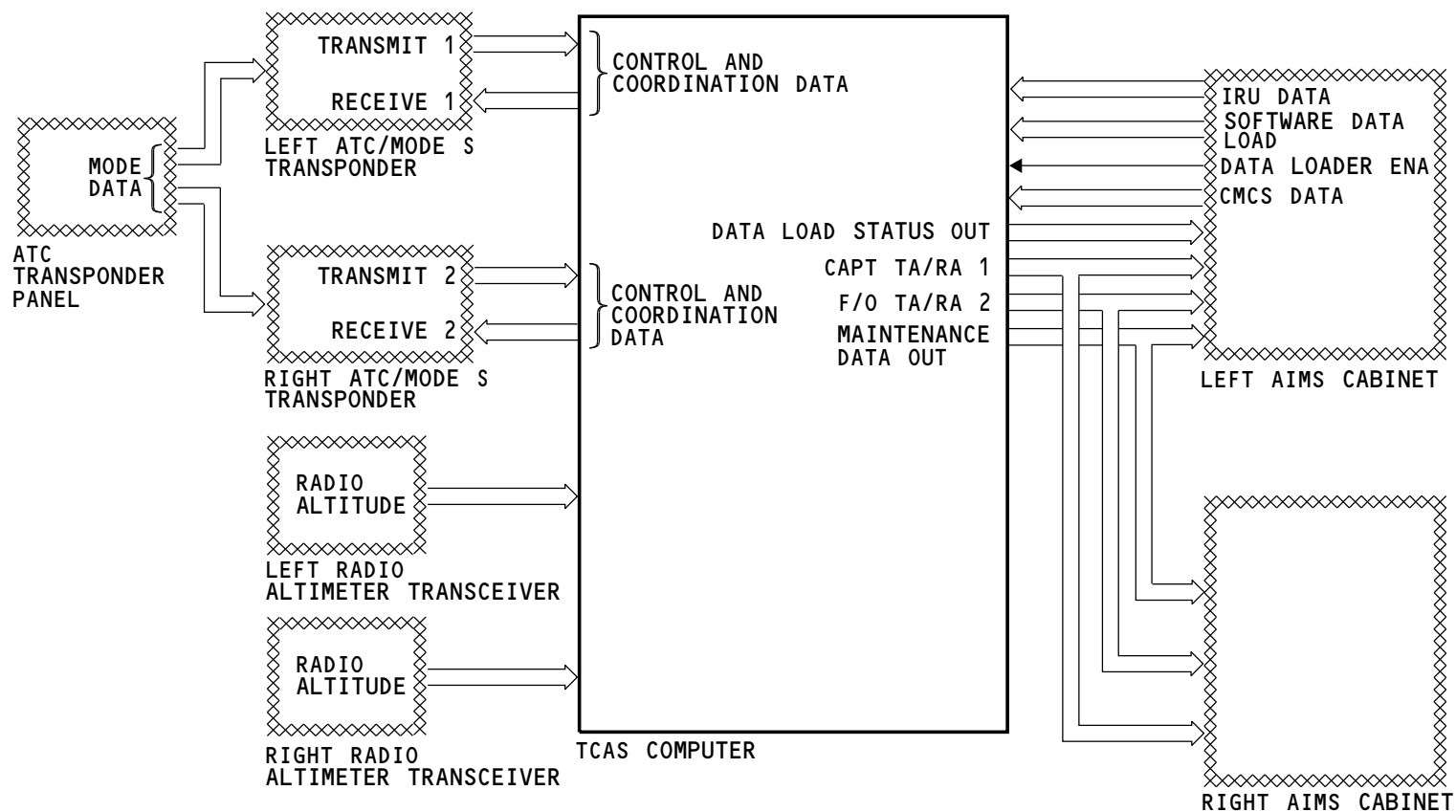
The right AIMS cabinet does not supply any inputs to the TCAS computer.

TCAS Outputs to AIMS

The TCAS computer sends TCAS data load status to the left AIMS cabinet.

The TCAS computer supplies these outputs to both AIMS cabinets:

- Traffic advisory (TA) and resolution advisory (RA) data, which includes all traffic data for TCAS displays
- TCAS maintenance data.



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TCAS - DIGITAL INTERFACES

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TCAS - TCAS COMPUTER

Purpose

The TCAS computer is the main component of the TCAS. It controls these functions:

- Surveillance
- Tracking
- Advisory
- Air-to-air maneuver coordination.

The TCAS computer sends signals alert the flight crew to:

- Maintain the current flight plan
- Make flight maneuvers to avoid a possible collision with other airplanes in the area.

Physical Description

The TCAS computer is a 6 MCU size unit that weighs 14.0 lb (6.35 kg).

Functional Description

The TCAS computer transmits 1030 MHz pulse-coded interrogation signals. It receives 1090 MHz pulse-coded reply signals from intruder airplanes with a transponder.

Front Panel Module

The front panel module has these:

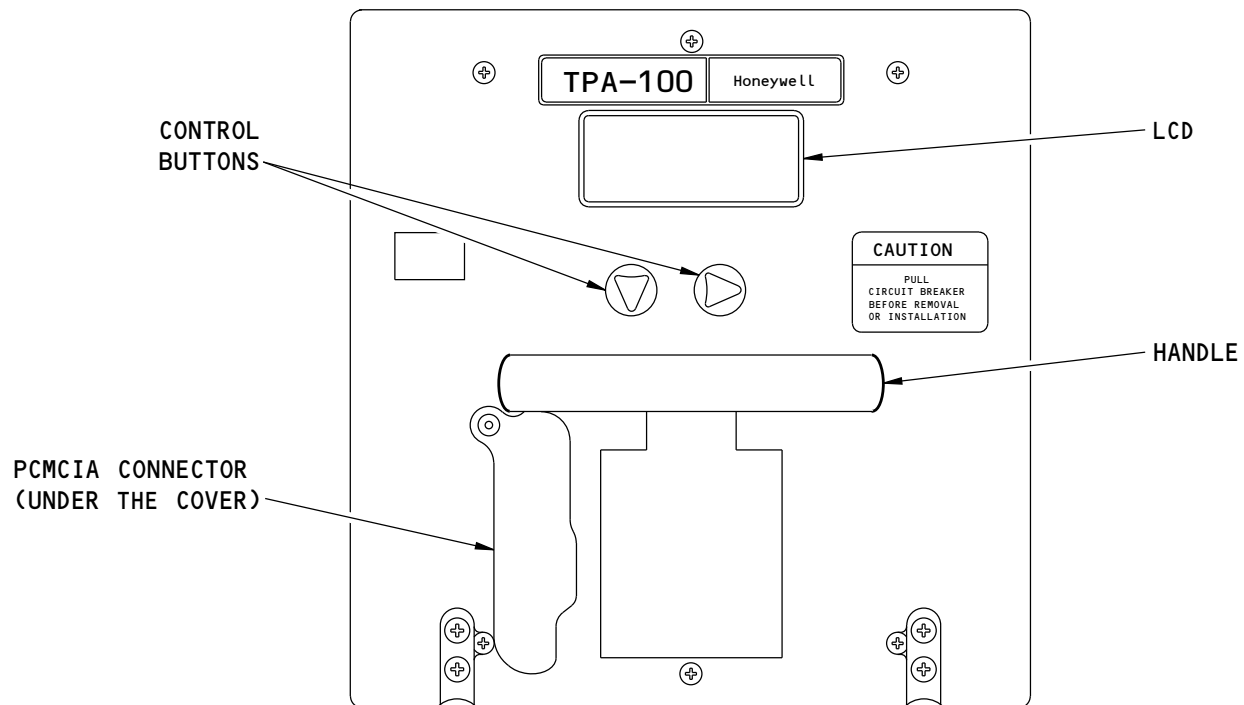
- An LCD which is used for maintenance, data loads and to display the computer configuration and state data
- Control buttons to allow the user to select functions from the LCD menu
- A PCMCIA connector which is used to load software and data into the computer and to record software program data back from the computer
- A board interconnect which provides the interface between the receiver, transmitter, power supply, and digital modules.

Front Panel Self-Test

Use the control buttons and LCD on the front panel module to start a test of the TCAS computer and to view the test results.

Software Loading

The TCAS computer is software loadable. Use a PCMCIA card or an ARINC 615 data loader to install the operational software into the TCAS computer.



TCAS - TCAS COMPUTER

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TCAS - TRANSPONDER PANEL

General

The transponder panel controls the TCAS computer to send the selected display data to the AIMS.

Transponder Mode Selector

The transponder mode selector lets the flight crew select one of these two TCAS modes:

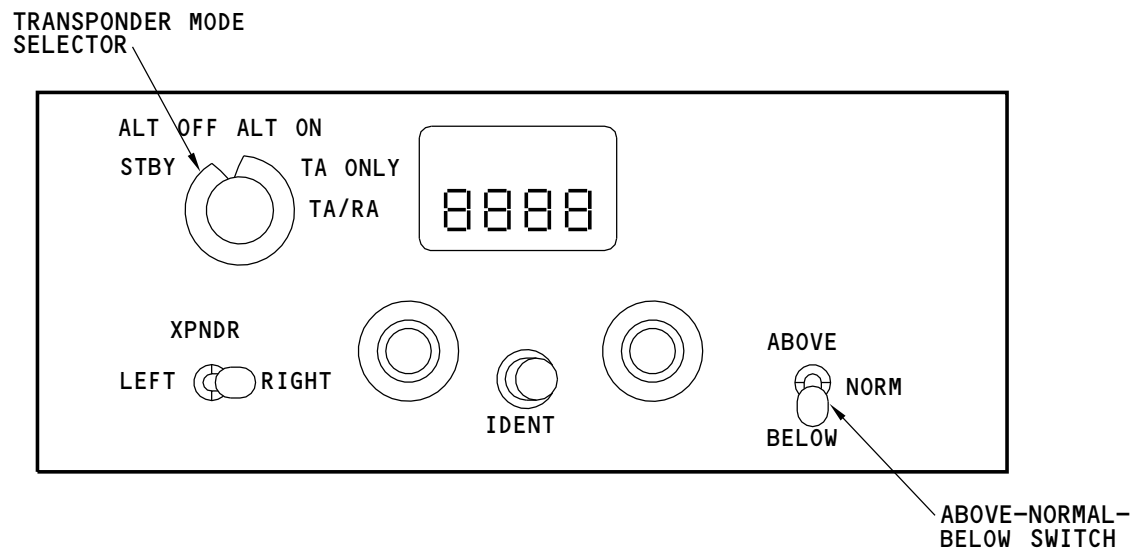
- TA ONLY mode. In this mode, all intruder traffic except RAs show
- TA/RA mode. In this mode, all intruder traffic shows. This is the normal mode of operation for TCAS.

Above-Normal-Below Switch

The above-normal-below (ABOVE-NORM-BELOW) switch controls the amount of altitude that shows for the TCAS display on the captain's and first officer's ND.

The switch has these three positions:

- ABOVE; this makes the ND show intruder airplanes that are from 2700 feet below to 9000 feet above present airplane altitude
- NORMAL; this makes the ND show intruder airplanes that are within 2700 feet below or above present airplane altitude
- BELOW; this makes the ND show intruder airplanes that are from 9000 feet below to 2700 feet above present airplane altitude.



TCAS - TRANSPONDER PANEL

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TCAS - TCAS DIRECTIONAL ANTENNA

General

The TCAS uses a top and bottom directional antenna. The antennas are the same and interchangeable.

Physical Description

The directional antenna is a phased array antenna. Four array elements on the antenna make up the array. Each element has a color coded connector. The TCAS computer sends the array elements transmit interrogation signals with different phases. This makes the interrogation signal directional.

To attach the antenna, match the color of the coaxial cable with the color coded band on the array element connector.

Four screws fasten each antenna to the airplane. The radiation side of the antenna shows "FWD" and "DO NOT PAINT".



DO NOT PAINT THE RADIATION SURFACE OR THE BACKPLATE OF THE ANTENNA. PAINT DOES NOT PERMIT THE ANTENNA TO RADIATE OR RECEIVE RF SIGNALS.



TO PREVENT DAMAGE TO THE ANTENNA CABLES, DO NOT PULL ON THEM.

Training Information Point

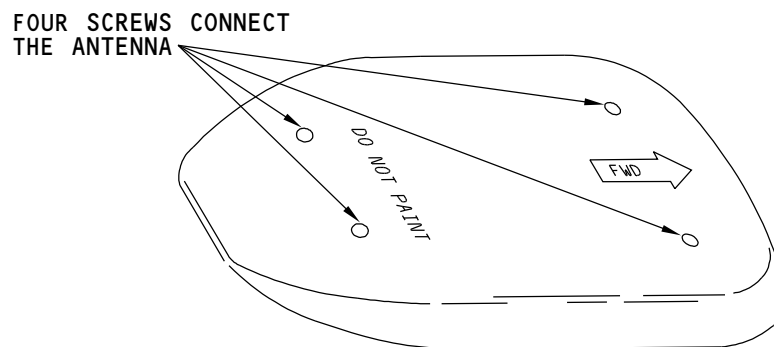
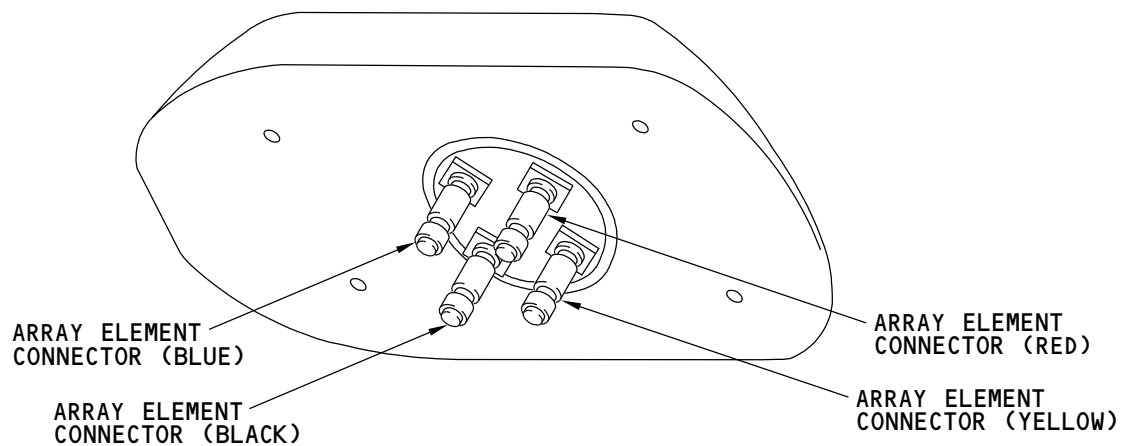
An antenna connection includes the coax cable and an antenna element. The TCAS computer checks the resistance of each antenna connection at power-up. The TCAS computer reports an antenna fault when it detects that the resistance of the connection is out of range. If you do not match the coax cable to the correct element, the TCAS computer reports an antenna fault.

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TCAS - TCAS DIRECTIONAL ANTENNA

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**TCAS - OPERATION - SURVEILLANCE AREA****General**

The TCAS tracks and evaluates the possible threat of up to 30 airplanes that are within the surveillance area.

These four types of traffic airplanes show on the NDs:

- Other traffic are airplanes that have an altitude separation of +/- 2700 feet and the time until the closest point of approach (CPA) is more than 40 seconds
- Proximate traffic are airplanes that have an altitude separation of +/- 1200 feet and the time until the CPA is more than 40 seconds
- Intruder traffic which causes a traffic advisory (TA), are airplanes that have an altitude separation of +/- 1200 feet and the time until the CPA is between 25 and 40 seconds
- Threat traffic which causes a resolution advisory (RA), are airplanes that have an altitude separation of +/- 900 feet and the time until the CPA is less than 25 seconds.

Surveillance Area

TCAS has a surveillance area that is 10,000 feet above and below the airplane and 30 nm range in front of the airplane. The surveillance range behind and on the sides of the airplane is not as large as in the front of the airplane.

Within the surveillance area, there are two other areas called traffic advisory (TA) and resolution advisory (RA). To calculate RA and TA, the TCAS computer uses the time until the CPA and the relative altitude of the traffic airplane.

To calculate the CPA and the relative altitude, the TCAS computer uses:

- The TCAS airplane airspeed and altitude
- Range, altitude, and airspeed of the traffic airplane.

The RA and TA times change between 20 and 45 seconds with the TCAS airplane altitude. The RA and TA times also change with the airspeed and altitude of the TCAS airplane, and the closure rate of each traffic airplane.

Traffic Advisory

When a traffic airplane is an intruder, the TCAS computer makes a traffic advisory (TA) that shows on the NDs.

Resolution Advisory

When a traffic airplane is a threat, the TCAS computer makes these resolution advisories (RAs):

- Indications show on the NDs
- Maneuver indications on the PFDs guide the flight crew to avoid a possible collision
- Aural come from the aural warning speakers.

System Inhibits

TAs or RAs may not occur if the airplane radio altitude is too low or if a higher priority alert exists.

This table shows the inhibits and the parameters that cause the inhibits.

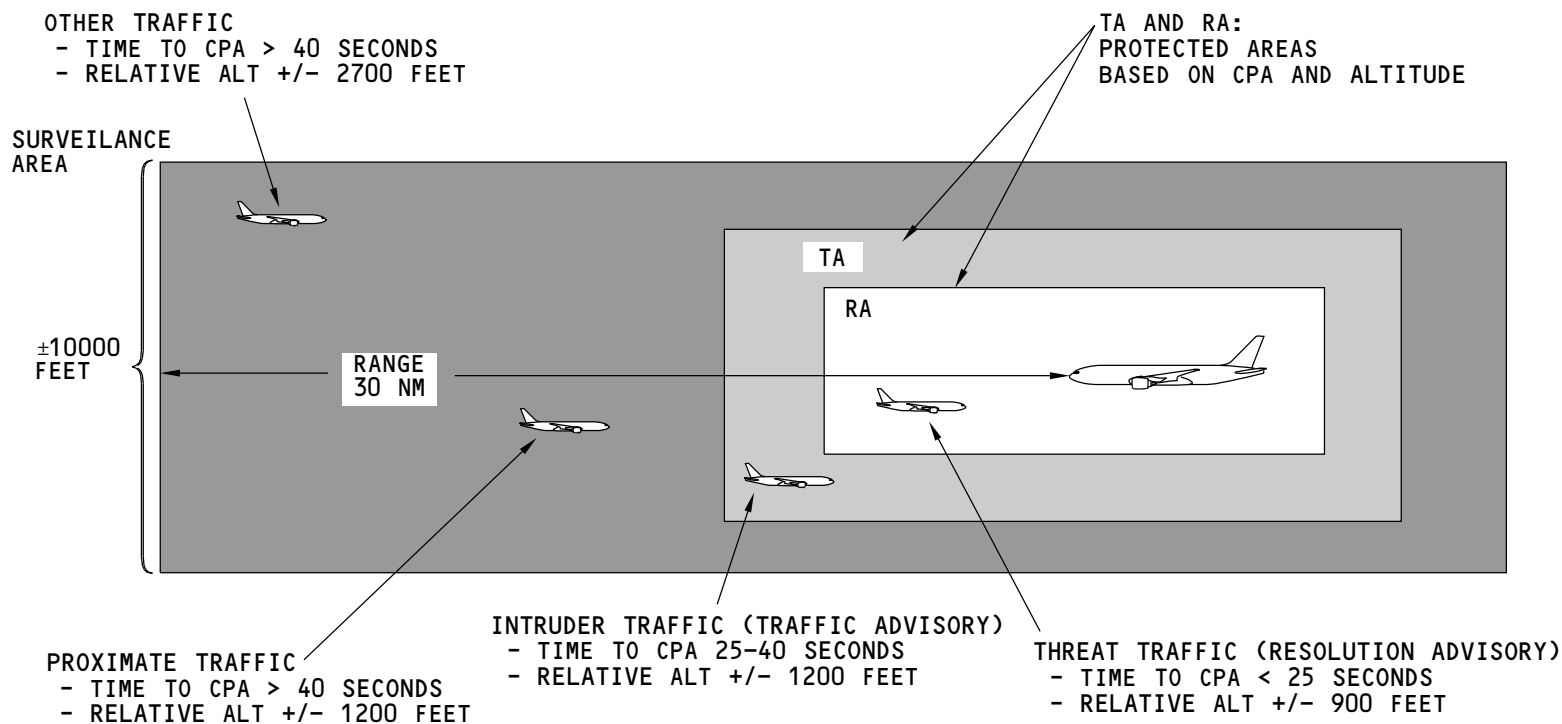
CONDITION	PARAMETERS
Increased descent RA	Inhibited below 1450 ft AGL
Descend RA	Inhibited below 1000 ft AGL in descent and 1200 ft AGL in climb
Resolution Advisories	Inhibited below 900 ft AGL in descent and below 1100 ft AGL in climb. (TCAS automatically goes into TA ONLY)
TA voice message	Inhibited below 400 ft AGL in descent and below 600 ft AGL in climb
Advisory priority	TA/RA goes to TA ONLY when there are higher priority advisories from GPWS

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TCAS - OPERATION - SURVEILLANCE AREA

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TCAS - BASIC OPERATION

General

TCAS transmits these two types of interrogation signals:

- Whisper-shout for ATCRBS (air traffic control radar beacon system) transponders
- Mode S (squitter).

The TCAS detects, tracks, and monitors all of the airplanes that have ATCRBS or mode S transponders. The TCAS operates with the ATC/Mode S transponders to interrogate traffic airplanes and calculate if it is a threat.

All airplanes with TCAS can calculate coordinated commands to avoid possible collisions with traffic airplanes.

The TCAS does not track airplanes that do not have a transponder.

Whisper-Shout Interrogation

The TCAS uses an ATCRBS all-call whisper-shout interrogation to search for airplanes that have an ATCRBS transponder without TCAS. The whisper-shout technique changes the strength of the interrogation pulse to interrogate intruders at different ranges. The airplanes that are near detect the lower power (whisper) interrogations. The airplanes that are farther away detect the higher power (shout) interrogations.

Mode S Interrogation

The TCAS listens for mode S signal transmissions from airplanes that have mode S transponders. The signals contain a 24-bit airplane identification code. When the TCAS receives a valid airplane identification signal, the identification of that airplane goes on a roll-call list in the TCAS computer. The TCAS then interrogates the mode S transponder of the traffic airplane with the discrete 24-bit airplane address on the roll-call list.

TCAS Data Calculation

When the TCAS interrogates a traffic airplane with TCAS, the reply signal from the airplane contains the airplane identification and altitude.

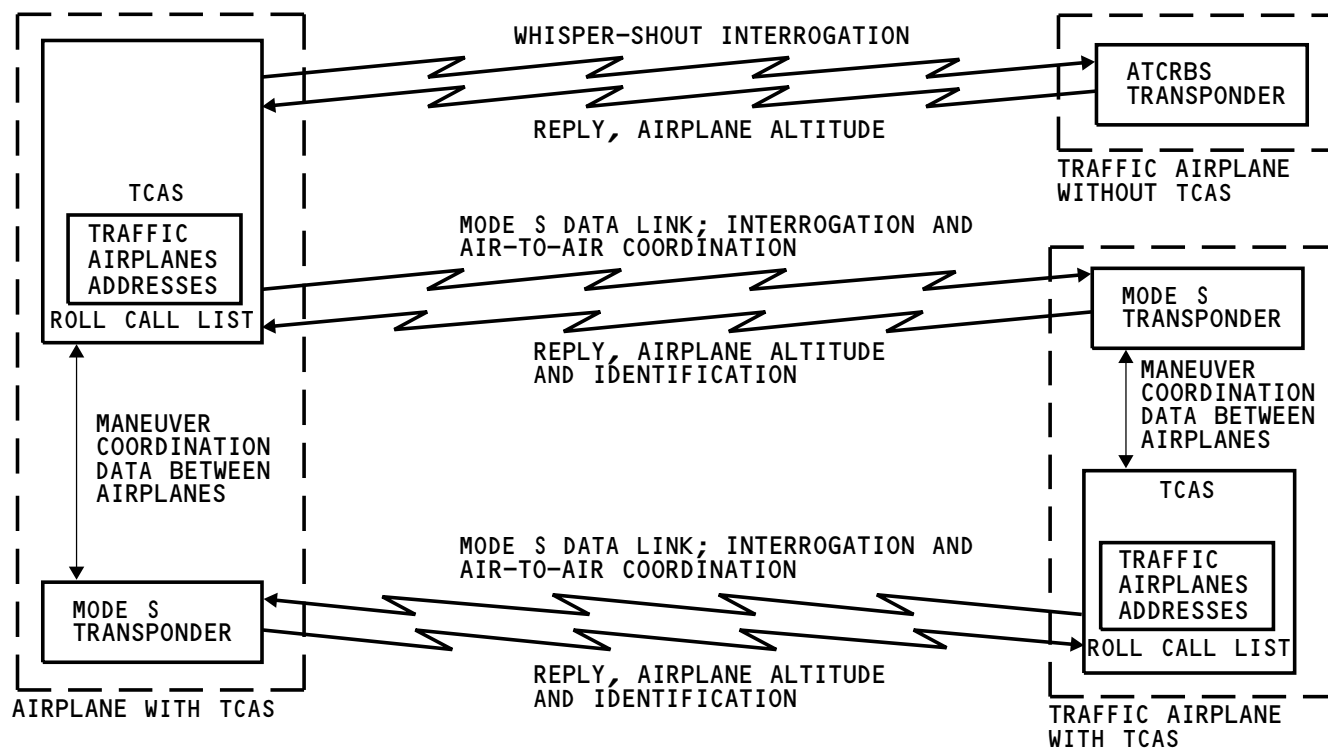
The TCAS computer uses the round-trip time of the reply signal to calculate the range and range rate of the traffic airplane. It also uses direction of the reply to calculate bearing of the intruder airplane.

The TCAS computer uses the traffic airplane data to calculate if the traffic airplane is on a possible collision course with the flight path. If it is, the TCAS computer calculates traffic coordination maneuver data. AIMS uses this data to make the TCAS displays.

Mode S Data Link

After the TCAS computer calculates the traffic coordination maneuver data, it transmits this data in the mode S format to the mode S transponder of the traffic airplane. The ATC/Mode S transponder receives coordination data from the traffic airplane. This sets up the air-to-air mode S data link between two or more airplanes.

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TCAS - BASIC OPERATION

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TCAS - CONTROL AND DISPLAY

General

The EFIS control panel and the transponder panel control the TCAS data that shows on the PFD and ND.

EFIS Control Panel

To show the TCAS data on the ND, first put the mode control switch on the EFIS control panel in one of these modes:

- Expanded approach
- Expanded VOR
- Expanded map
- Centered map.

Then push the TFC (traffic) switch on the range selector to enable the ND to show the TCAS data. When you do this, the TFC message and all of the TCAS symbols shows on the ND.

To remove all of the TCAS messages and symbols from the ND, push the TFC switch again. To do this, the ND must be in one of these modes:

- Expanded approach
- Expanded VOR
- Expanded map
- Centered map.

Transponder Panel

The transponder panel sends control data through the selected ATC/Mode S transponder to the TCAS computer.

The TCAS computer sends the selected data to the AIMS for display on the NDs and PFDs.

Push the TFC switch to show TCAS data. If the function selector is not in the TA ONLY or TA/RA position, the ND has these changes:

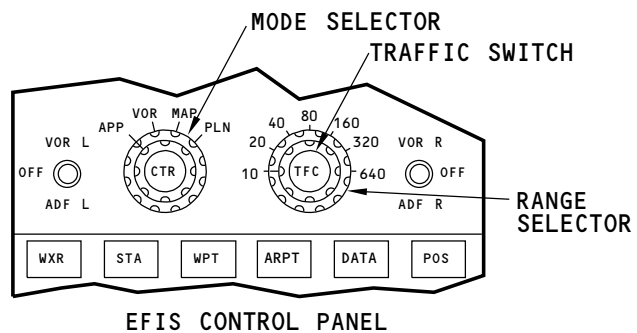
- Shows an amber message, TCAS OFF.
- Does not show TCAS data.

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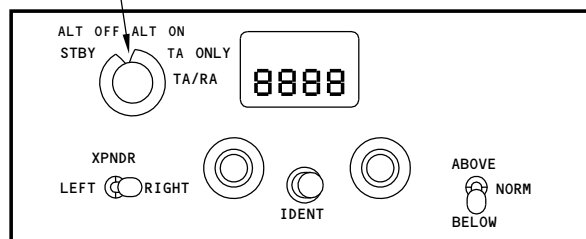
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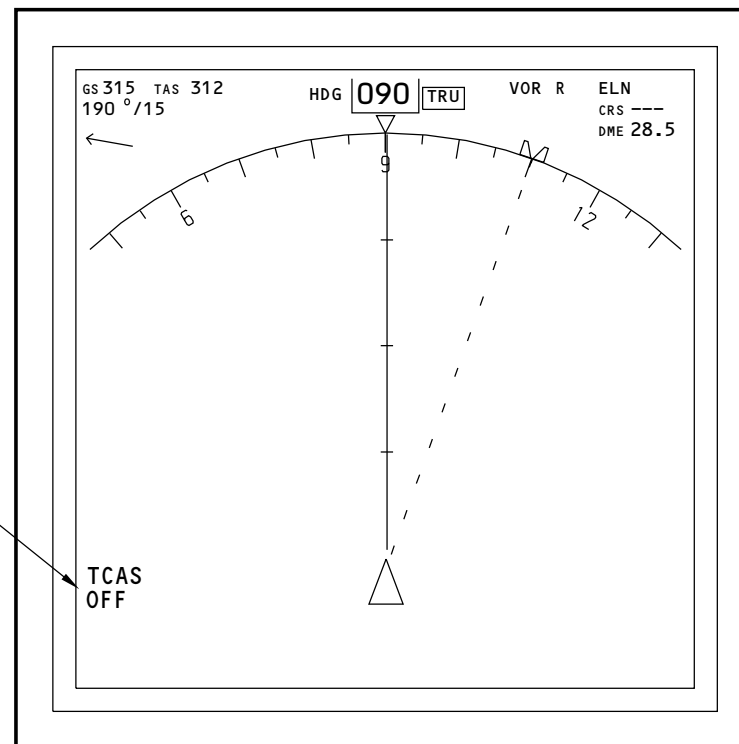


FUNCTION SELECTOR NOT IN
TA ONLY OR TA/RA



TRANSPONDER PANEL

TCAS OFF (AMBER)



ND - EXPANDED VOR

TCAS - CONTROL AND DISPLAY

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TCAS - NAVIGATION DISPLAY

General

The TCAS computer puts traffic into these four different groups with different symbols to show different types of traffic:

- Other traffic shows as a white open diamond, and the altitude readout is small white text
- Proximate traffic shows as a solid white diamond, and the altitude readout is small white text
- Traffic advisory (TA) shows as a solid amber circle, and the altitude readout is amber text
- Resolution advisory (RA) shows as a solid red square and the altitude readout is red text.

Each traffic symbol has an altitude readout and a vertical motion arrow. The traffic symbols show in one of these modes only:

- Center (CTR) MAP
- Expanded (EXP) MAP
- Expanded (EXP) VOR
- Expanded (EXP) APP.

Range Data

When you push the TFC switch on the EFIS control panel to show TCAS data, the range selected on the EFIS control panel shows on the ND.

Also, when you push the TFC switch, range arcs show.

TCAS Messages

The ND can show these messages for TCAS:

- TFC shows in cyan in and all modes
- TA ONLY shows in cyan and in all modes
- TCAS TEST shows in cyan and in all modes
- TCAS FAIL shows on two lines in amber, and in the CTR MAP and EXP MAP,VOR and APP modes

- TCAS OFF shows on two lines in amber, and in the CTR MAP and EXP MAP,VOR and APP modes.

Altitude Separation

The TCAS computer uses the absolute altitude of the TCAS airplane and the traffic airplane to calculate the altitude separation. The altitude separation shows on the ND in hundreds of feet. If the traffic is above, the digits show above the traffic symbol with a plus (+) sign. If the traffic is below, the digits show below the traffic symbol with a minus (-) sign.

If the altitude separation is less than 100 feet, 00 feet shows.

If the altitude separation is NCD, the altitude readout does not show.

Vertical Motion Arrow

A vertical motion arrow shows on the right side of the traffic symbol. It is the same color as the traffic symbol. If the traffic airplane is in a descent, the arrow points down. If the traffic airplane is in a climb, the arrow points up.

OFFSCALE

The OFFSCALE message shows on the ND when a RA or TA is outside the ND range. If a RA is outside the ND range, the OFFSCALE message shows in red. If a TA is outside the ND range, the OFFSCALE message shows in amber. If both a TA and RA are outside the ND range, the OFFSCALE message shows in red.

TRAFFIC

The red TRAFFIC message shows any time there is a RA. The amber TRAFFIC message shows any time there is a TA. The TRAFFIC message shows in all ND formats.

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TCAS - NAVIGATION DISPLAY

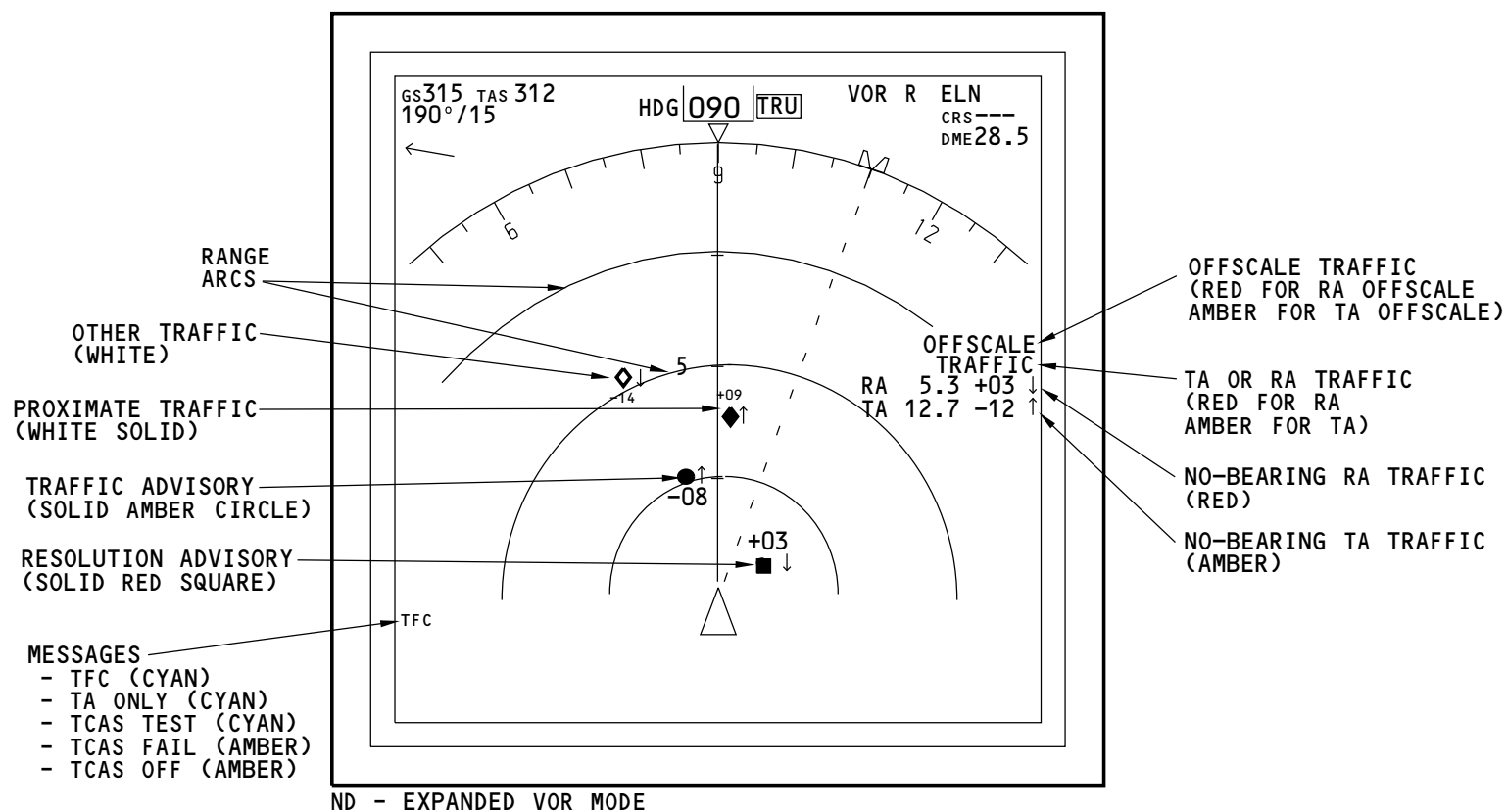
RA and TA No-Bearing Traffic

The no-bearing RA and TA messages show on the ND when TCAS loses the bearing of the RA or TA traffic. When the landing gear is down, the bottom directional antenna becomes an omnidirectional antenna. When this happens, the bottom antenna cannot track the bearing of the intruder traffic, thus the bearing is NCD. Because of this, the no-bearing messages show on the ND. If a TA becomes no-bearing traffic, an amber TA with the range, altitude, and vertical motion arrow shows on the ND. If a RA becomes no-bearing traffic, a red RA with the range, altitude, and vertical motion arrow shows on the ND.

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NOTE: TCAS FAIL AND TCAS OFF SHOW ON TWO LINES

TCAS - NAVIGATION DISPLAY

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**TCAS - PRIMARY FLIGHT DISPLAY****General**

These are the two types of TCAS advisories that can show on the PFD:

- TCAS preventative down advisory
- TCAS preventative up advisory.

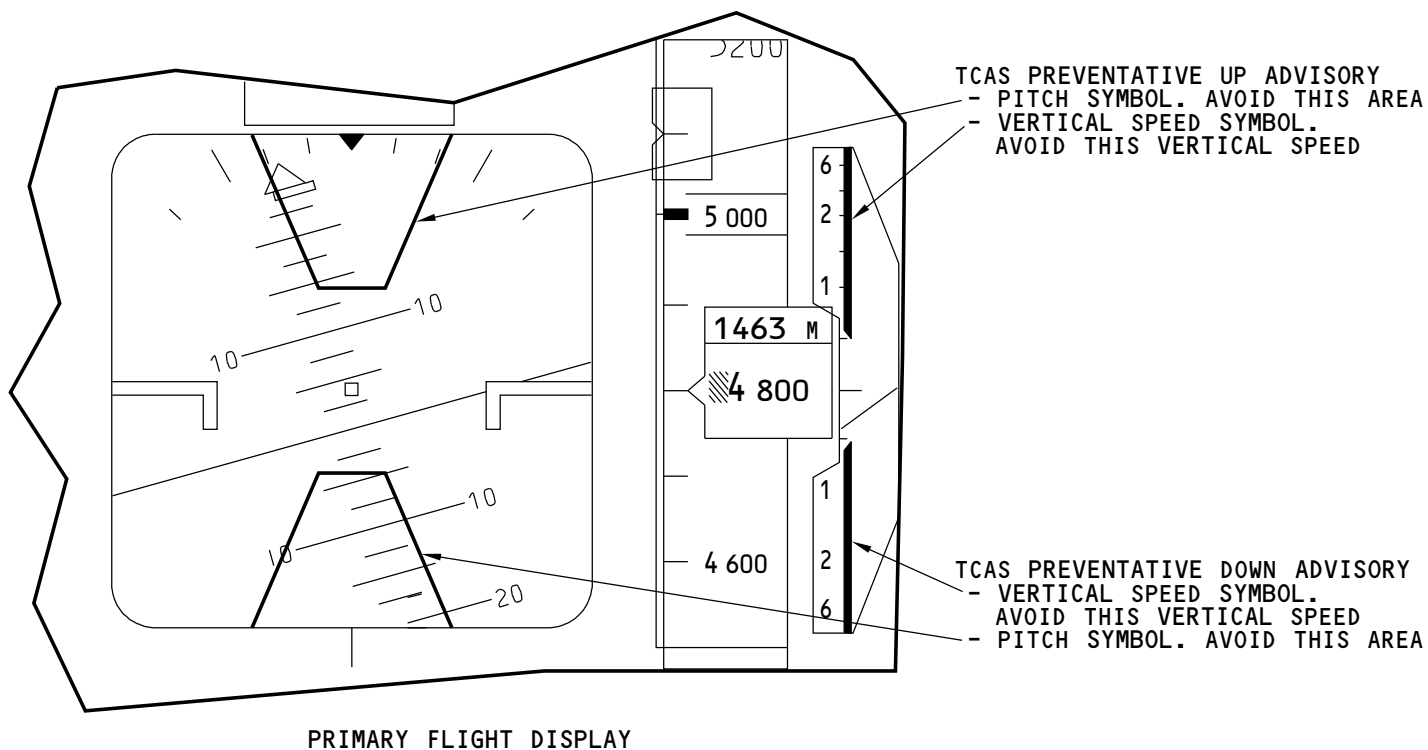
These symbols only show for an RA when the function selector on the transponder panel is in the TA/RA position and TCAS communicates with threat airplanes that have TCAS.

Description

The red advisories that show on the attitude display tells the flight crew to avoid this area.

The red advisories that show on the vertical speed tape tells the flight crew to avoid this area.

The flight crew uses the advisories to avoid a possible collision with threat airplanes.



TCAS - PRIMARY FLIGHT DISPLAY

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TCAS - AURAL MESSAGES

General

Aural advisory messages come on during traffic advisories (TA), resolution advisories (RA) and a TCAS system test.

Traffic Advisory Aural

When a traffic advisory occurs, the aural message TRAFFIC TRAFFIC comes on. This message tells the flight crew to monitor the ND for intruder traffic.

Resolution Advisory

These are the two types of aural messages that can come on during a resolution advisory (RA):

- Preventative action RA
- Corrective action RA.

Preventative Action RA

This type of RA occurs when at the closest point of approach (CPA) the vertical speed results in a safe altitude separation from the threat airplane. When this happens the aural advisory is MONITOR VERTICAL SPEED - MONITOR VERTICAL SPEED. This message tells the flight crew to:

- Maintain the flight path
- Do not fly into the area of RA pitch symbol on the PFD
- Maintain the vertical speed rate.

Corrective Action RA

This type of RA occurs when the altitude separation at the CPA is not safe. These RA aural advisories tell the flight crew to take corrective action to avoid a possible collision:

- CLIMB - CLIMB. The flight crew must climb at a rate to avoid the preventative down advisories.

- CLIMB CROSSING CLIMB - CLIMB CROSSING CLIMB. The flight crew must climb at a rate to avoid the preventative down advisories. The flight path crosses through the flight path of the threat.
- REDUCE CLIMB - REDUCE CLIMB. The flight crew must reduce the rate of climb to avoid the preventative up advisories.
- DESCEND - DESCEND. The flight crew must descend at a rate to avoid the preventative up advisories.
- DESCEND CROSSING DESCEND - DESCEND CROSSING DESCEND. The flight crew must descend at a rate to avoid the preventative up advisories. The flight path crosses through the flight path of the threat.
- REDUCE DESCENT - REDUCE DESCENT. The flight crew must reduce the rate of descent to avoid the preventative up advisories.
- LEVEL OFF - LEVEL OFF. The flight crew must reduce the rate of descend or climb to avoid the preventative up or down advisories.
- MAINTAIN VERTICAL SPEED - MAINTAIN. The flight crew must remain at their current vertical speed to avoid the preventative up or down advisories.

Increase Corrective Action RA

This type of RA tells the flight crew to increase the corrective maneuvers because the changes in the threat airplane maneuvers:

- INCREASE CLIMB - INCREASE CLIMB. This follows the CLIMB advisory when the threat airplane maneuver changes to tell the flight crew to increase the rate of climb.
- INCREASE DESCENT - INCREASE DESCENT. This follows the DESCEND advisory when the threat airplane maneuver changes to tell the flight crew to increase the rate of descent.
- CLIMB, CLIMB NOW - CLIMB, CLIMB NOW. This follows the DESCEND advisory when a climb is necessary to give safe vertical separation at CPA.
- DESCEND, DESCEND NOW - DESCEND, DESCEND NOW. This follows the CLIMB advisory when a descent is necessary to give safe vertical separation at CPA.

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TCAS - AURAL MESSAGES

Clear of Conflict

When the range of the threat airplane that causes an RA increases, the aural message CLEAR OF CONFLICT comes on.

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AURAL MESSAGE	MESSAGE TYPE
TRAFFIC, TRAFFIC	TRAFFIC ADVISORY
MONITOR VERTICAL SPEED	RESOLUTION ADVISORY (PREVENTATIVE ACTION)
CLIMB, CLIMB	RESOLUTION ADVISORY (CORRECTIVE ACTION)
DESCEND, DESCEND	
CLIMB, CROSSING CLIMB	
CLIMB, CROSSING CLIMB	
DESCEND, CROSSING DESCEND	
DESCEND, CROSSING DESCEND	
LEVEL OFF, LEVEL OFF	
MAINTAIN VERTICAL SPEED, MAINTAIN	RESOLUTION ADVISORY (INCREASED CORRECTIVE ACTION) 1
CLIMB, CLIMB NOW	
CLIMB, CLIMB NOW	
DESCEND, DESCEND NOW	
DESCEND, DESCEND NOW	
INCREASE CLIMB, INCREASE CLIMB	CLEAR OF CONFLICT 2
INCREASE DESCENT, INCREASE DESCENT	
CLEAR OF CONFLICT 2	CLEARED RESOLUTION ADVISORY
TCAS SYSTEM TEST OK	SYSTEM TEST RESULTS
TCAS SYSTEM TEST FAIL	

1 INCREASED CORRECTIVE ACTION RA
FOLLOWS A CORRECTIVE ACTION RA

2 OCCURS WHEN THE RANGE OF THE THREAT
INCREASES

TCAS - AURAL MESSAGES

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**TCAS - TCAS COMPUTER - FUNCTIONAL DESCRIPTION****General**

The TCAS computer receives replies from other airplanes and gets many analog and digital inputs. The TCAS computer uses these reply inputs to calculate if an airplane is a collision threat. The TCAS computer sends display data to the AIMS cabinets. Also, the TCAS transmits data to other airplane that have TCAS. The other TCAS airplane uses the transmitted data to coordinate maneuvers between the airplanes to avoid a collision.

The TCAS computer has these circuits:

- Input/output (I/O)
- Voice output
- Central processing unit (CPU) and memory
- BITE
- Suppression
- Signal Processor
- Receiver
- Intermediate frequency (IF) video processor
- Transmitter
- Directional antenna
- Beam steering.

I/O

The I/O circuit gets other on-board airplane systems data, such as these:

- Magnetic heading, pitch and roll IRU data from the AIMS cabinets
- Altitude from the radio altimeters
- Coordination and control data from the ATC/Mode S transponder system
- Landing gear down discrete from the PSEUs
- Aural inhibit discretes from the GPWC.

Use the MAT to load the operational software files into the TCAS computers.

Program pins enable altitude limits and audio volume control functions in the TCAS computer.

The I/O circuits send this data to the CPU.

CPU

The CPU gets the data from the inputs of the I/O and puts it into memory. The CPU combines the input data and the data received from the signal processor, the CPU makes calculations necessary for the TCAS displays and traffic advisories (TA) and resolution advisories (RA) aural.

The CPU sends the AIMS cabinets TCAS display data to show on the NDs and PFDs. It also sends signals to the voice output circuits to make TCAS aural.

BITE

The TCAS computer has BITE that continuously checks TCAS for system faults and interface faults during normal operation. Also, when you start a self-test, the BITE makes signals and sends them to the signal processor and receiver/transmitter circuits. The BITE checks for system faults and interface faults during the self-test.

When the BITE detects a fault through the continuous fault monitor, the fault goes into the fault memory and also to the I/O circuits for output CMCS through the left AIMS cabinet.

When the BITE detects a fault during a self-test, the fault data goes to the I/O and to the CMCS and also to the status LEDs on the front panel.

Voice Output

When there is a TA, RA, or during a self-test, the TCAS computer sends signals to the voice output circuits. The voice output circuits send TA, RA, and test voice signals to the WEUs. The WEUs makes the TA, RA, and test aural messages and sends them to the aural warning speakers. During windshear, ground proximity warning, and ground proximity alert conditions, the GPWC sends analog discretes to the TCAS computer to inhibit TCAS advisories.

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TCAS - TCAS COMPUTER - FUNCTIONAL DESCRIPTION

Suppression

The suppression circuits send a suppression pulse each time the TCAS computer transmits. The TCAS computer receives a suppression pulse when an onboard ATC/Mode S transponder or DME interrogator system transmits. This suppression pulse inhibits the TCAS computer receiver circuits.

Signal Processor

The signal processor gets bearing information from the IF/video processor and converts it into digital signals. The signal processor:

- Uses bearing measurement logic and the bearing information to calculate the intruder airplane range and bearing
- Detects the mode C or mode S pulses
- Makes all signals necessary to receive and transmit mode S and ATCRBS interrogations through the receiver/transmitter circuits.

Receiver and IF Video Processor

The receiver has four individual sections, one for each element of the directional antenna. The receiver and the IF video processor combine the 1090 MHz received signals. The signal processor uses the four received signals from the receiver sections to calculate the bearing information and detect the mode C and mode S data pulses.

Transmitter

The transmitter has a 1030 MHz output. The transmitter gets signals from the signal processor. It makes and sends four output signals to the beam steering circuits.

Directional Antenna

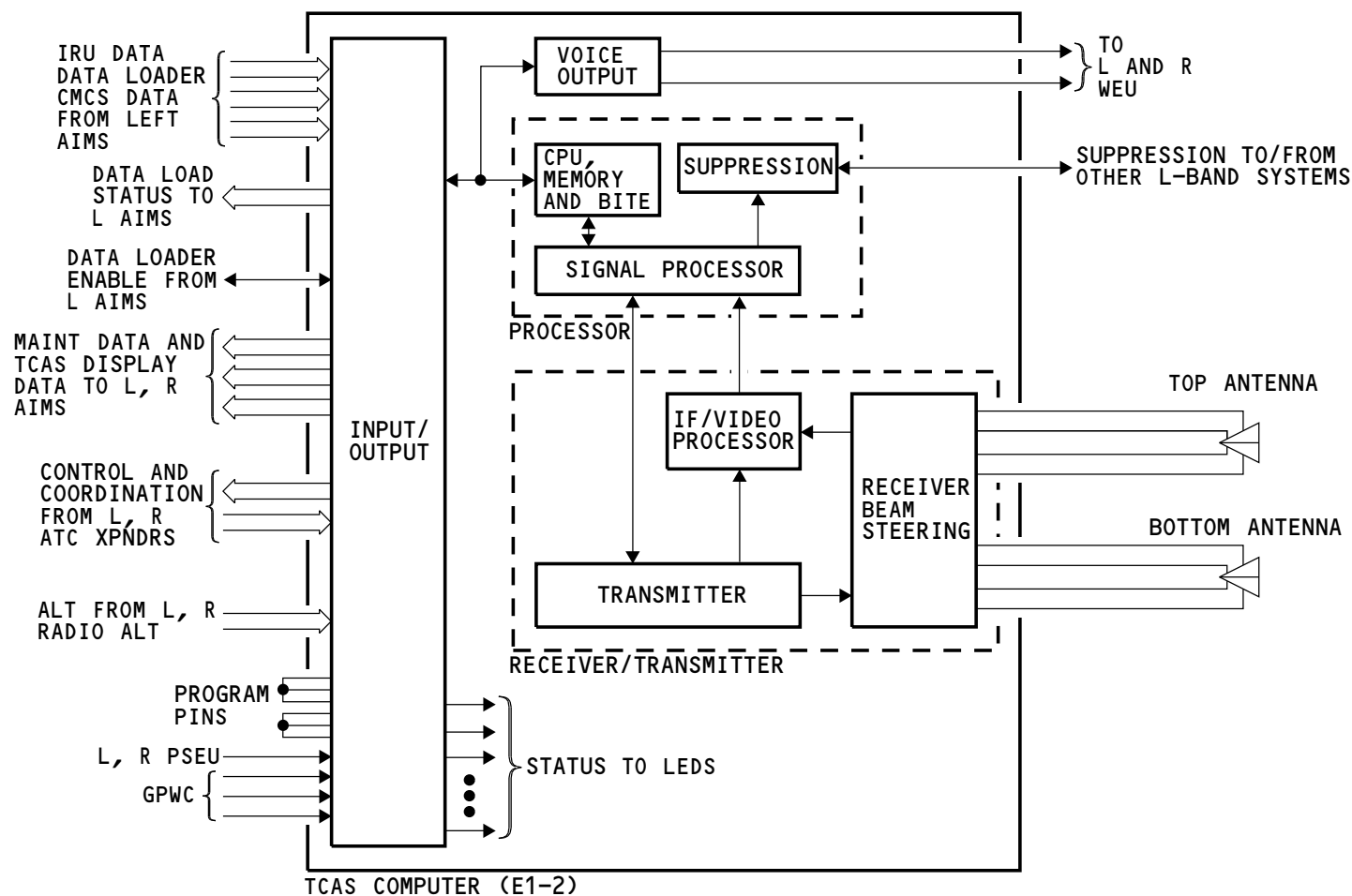
The directional antenna has four elements spaced 90 degrees apart. Each element is independent of the others and has its own coaxial connector.

Beam Steering Circuit

The beam steering circuits direct the antenna sensitivity during receive or transmit. During transmit, the beam steering circuit controls the phase relationships of four RF outputs for each antenna element. The different phases of the four transmit signals direct the RF beam.

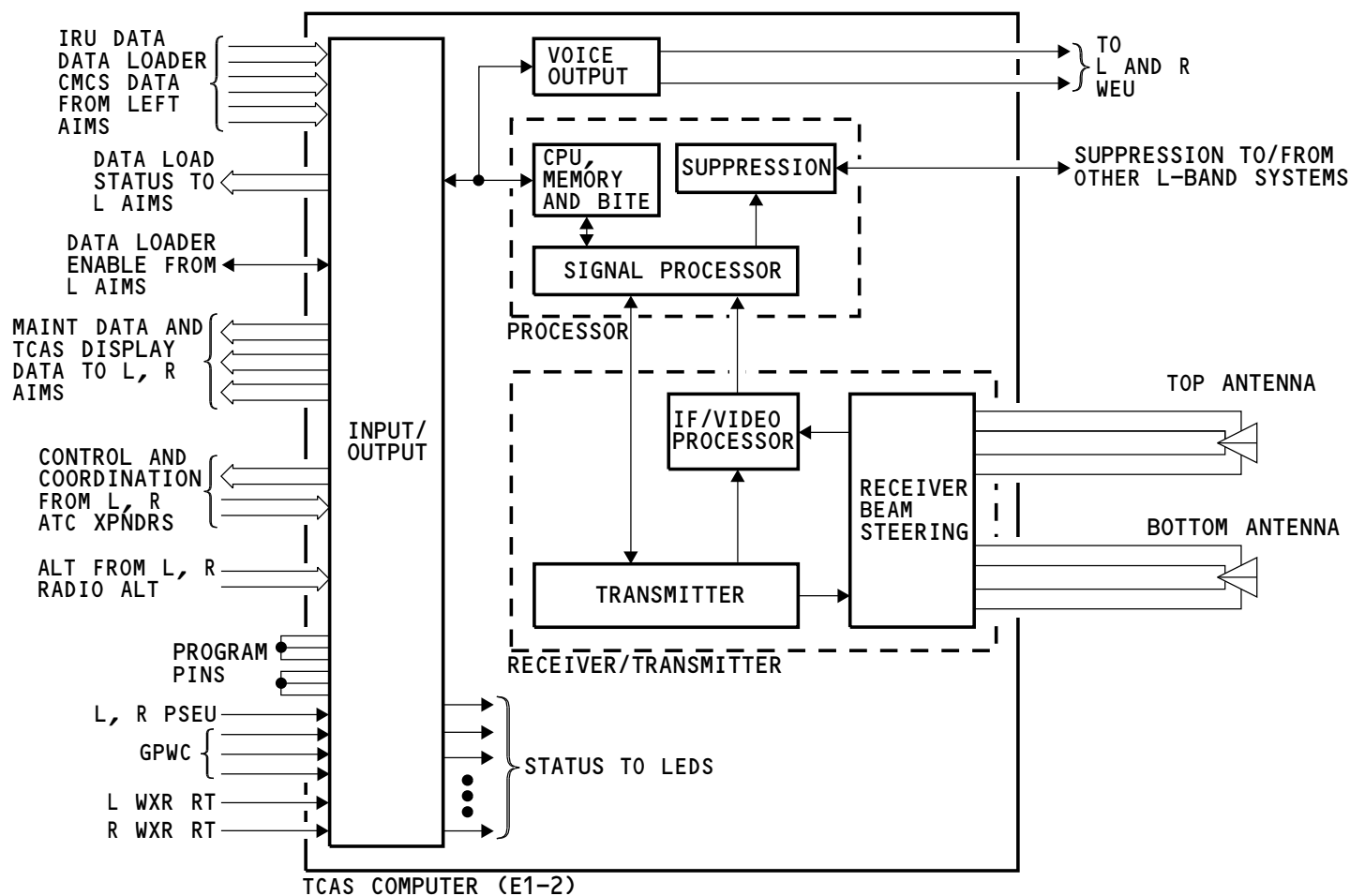
During receive, the phase of the received signals are different in each element.

When the landing gear is down, the TCAS computer receives an analog discrete input from the PSEUs. The analog discrete makes the TCAS computer use only one beam steering output for the bottom antenna. The bottom antenna operates as an omnidirectional antenna.



TCAS - TCAS COMPUTER - FUNCTIONAL DESCRIPTION

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TCAS - TCAS COMPUTER - FUNCTIONAL DESCRIPTION

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TCAS - TEST DISPLAYS

General

When a self-test starts, TCAS test indications go to the PFDs, NDs, and the front panel of the TCAS computer. At the end of the test, a TCAS test aural comes on at the aural warning speakers.

There are two ways to start a self-test:

- From the maintenance access terminal (MAT)
- From the front panel test switch.

TCAS Self-Test Indications - ND

During a self-test, the ND shows this data:

- A cyan message, TCAS TEST
- Amber TA traffic symbol at the 9:00 position, -200 feet relative altitude with an up vertical motion arrow and 2 nm distance from the airplane center
- White other traffic symbol at the 11:00 position, +1000 feet relative altitude with no vertical motion arrow and 3.6 nm distance from the airplane center
- White proximate traffic symbol at the 1:00 position, -1000 feet relative altitude with a down vertical motion arrow and 3.6 nm distance from the airplane center
- Red RA traffic symbol at the 3:00 position, +200 feet relative altitude with no vertical motion arrow and 2 nm distance from the airplane center.

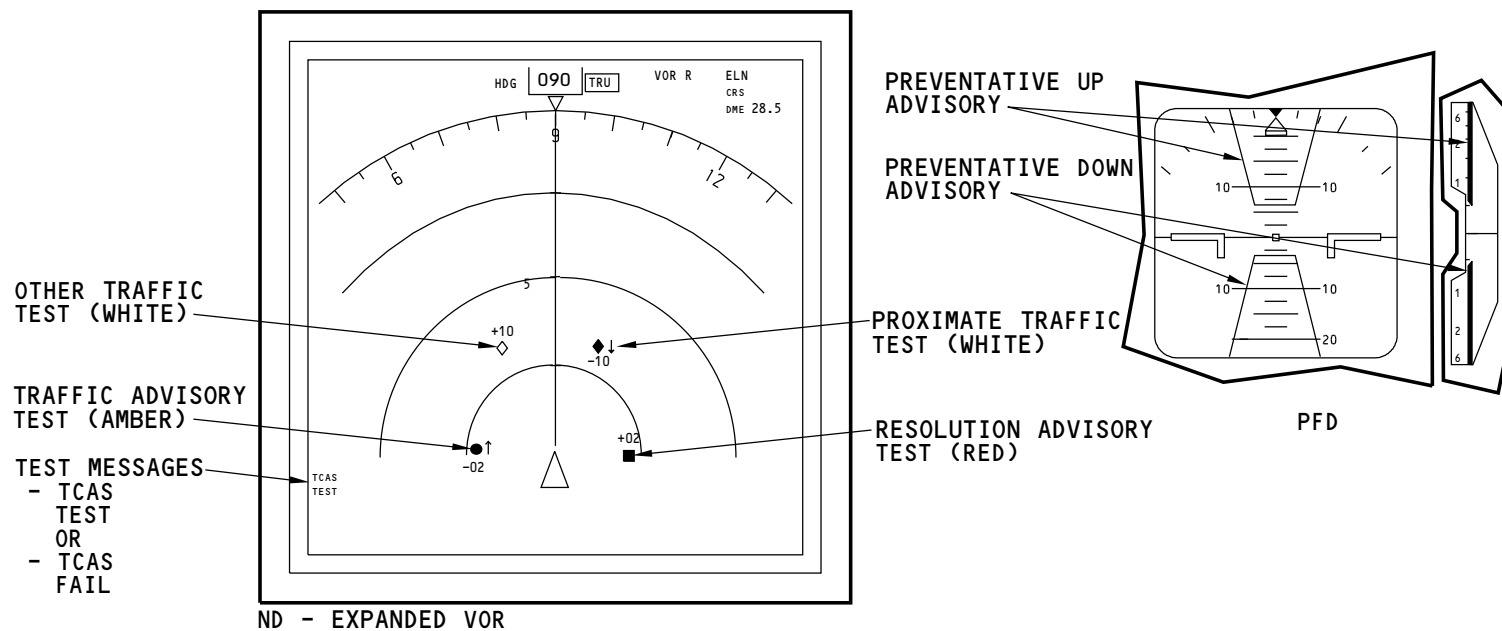
If the test fails, the message TCAS FAIL replaces the TCAS TEST message.

TCAS Self-Test Indications - PFD

During a self-test, the PFD shows the red RA preventative down advisory and red RA preventative up advisory cues on the attitude display.

TCAS Self-Test Aural

When the test completes with no faults, the aural message TCAS SYSTEM TEST OK comes on. If the BITE detects a fault during the self-test, the aural message is TCAS SYSTEM TEST FAIL.z



TCAS - TEST DISPLAYS

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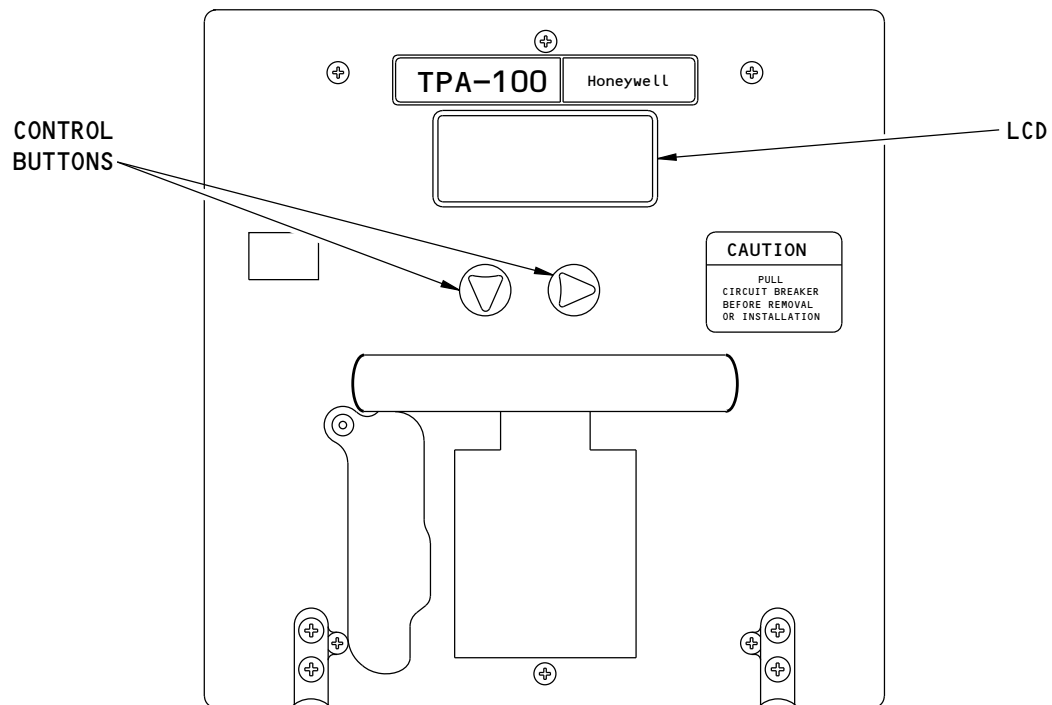
**TCAS - SELF-TEST****Front Panel Self-Test**

Use the LCD and control buttons to start a unit self-test and to view the test results. Follow the prompts on the screen to perform the test.

Training Information Point

The maintenance manual and the fault isolation manual do not have a task for the line maintenance technician to do a test from the front panel of the TCAS computer. You must do all tests for the TCAS computer from the MAT or a PMAT.

Many LRUs on the 777 are compatible with other model airplanes that do not have a central maintenance computing system (CMCS). For that reason, these LRUs have a front panel test feature.



TCAS - SELF-TEST

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**TCAS - GROUND TESTS****General**

You can do a TCAS system test from the MAT.

TCAS System Test

The TCAS system test makes sure the TCAS computer and its interfaces operate properly.

You get these indications when you do a system test:

- Traffic symbols on the NDs
- Up and down preventative advisories on the PFDs
- TCAS TEST PASS or FAIL aural at the end of the test.

GROUND TESTS

SELECT ATA SYSTEM (55)

34 WEATHER RADAR SYSTEM
34 TRAFFIC ALERT AND COLLISION AVOIDANCE SYSTEM
34 GROUND PROXIMITY WARNING SYSTEM
34 VOR/MARKER BEACON SYSTEM
34 AIR TRAFFIC CONTROL (ATC) MODE S SYSTEM
34 DISTANCE MEASURING EQUIPMENT SYSTEM
34 AUTOMATIC DIRECTION FINDER
34 GLOBAL POSITIONING SYSTEM
34 AIMS - FLIGHT MANAGEMENT COMPUTING SYSTEM

SELECT TEST TYPE

SYSTEM TEST
OPERATIONAL TEST
END
REPLACEMENT TEST

SELECT SYSTEM TEST (1)

CONTINUE

HELP

GO BACK

SELECT SYSTEM TEST

(1)

TCAS - GROUND TESTS

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GPWS - INTRODUCTION

Purpose

The purpose of the ground proximity warning system (GPWS) is to alert the flight crew of an unsafe condition when near the terrain. It also supplies a warning for windshear conditions.

Description

The GPWS uses aural messages, lights, and displays to give alerts and warnings in the flight deck.

GPWS Modes

These are the GPWS modes:

- Mode 1 - Large descent rate
- Mode 2 - Too much of a closure rate when approaching terrain that is rising
- Mode 3 - Too much altitude loss during climbout (at takeoff or in go-around) when not in landing configuration
- Mode 4 - Not enough terrain clearance when the airplane is not in landing configuration
- Mode 5 - Too much deviation below the glideslope centerline
- Mode 6 - Aural callouts when descending through selected radio altitudes
- Mode 7 - Warning for windshear conditions.

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The GPWS also alerts the flight crew to early descent on approach, or to terrain threats ahead of the airplane.

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Abbreviations and Acronyms

- AOA - angle of attack
- BITE - built-in test equipment
- EFIS - electronic flight instrument system

- FMC - flight management computer
- GPS - global positioning system
- GPWC - ground proximity warning computer
- GPWS - ground proximity warning system
- IVS - inertial vertical speed
- LED - light emitting diode
- MAT - maintenance access terminal
- MMR - multi-mode receiver
- MWL - master warning light
- ND - navigation display
- ovrd - override

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- PCMCIA - personal Computer Memory Card International Association

ARO ALL

- PFD - primary flight display

ARO 001-013, 017-999

- PWS - predictive windshear

ARO ALL

- RA - radio altitude
- RT - receiver-transmitter
- TCAS - traffic alert and collision avoidance system
- USB - universal serial bus
- TCF - terrain clearance floor
- WEU - warning electronic unit
- WES - warning electronic system
- WXR - weather radar

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GPWS - INTRODUCTION

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**GPWS - GENERAL DESCRIPTION****General Description**

The main component of the ground proximity warning system (GPWS) is the ground proximity warning computer (GPWC). It uses inputs from other systems to determine if an unsafe condition is present and then gives the proper annunciations.

The GPWS displays terrain forward of the airplane, and also alerts the flight crew of early descent when landing.

Visual annunciations show on these places:

- Primary flight displays (PFDs)
- Navigation displays (NDs)
- GND PROX light
- Master warning lights.

Aural annunciations come from the aural warning speakers.

The GPWC sends terrain data to the airplane information management system (AIMS) cabinets to show on the NDs.

Alert and warning discretes go to the traffic alert and collision avoidance system (TCAS).

These components control GPWS:

- Electronic flight instrument system (EFIS) control panels (CPs)
- Control display units (CDUs)
- Glideslope inhibit switch
- Override switches.

ARO 001-008 PRE SB 777-34-0232

The program pins select options available for the GPWC.

ARO 009-999; ARO 001-008 POST SB 777-34-0232

The enhanced GPWC is loaded with software that activates optional features.

ARO 014-016

The GPWC sends discretes to the traffic alert and collision avoidance system (TCAS).

ARO 001-013, 017-999

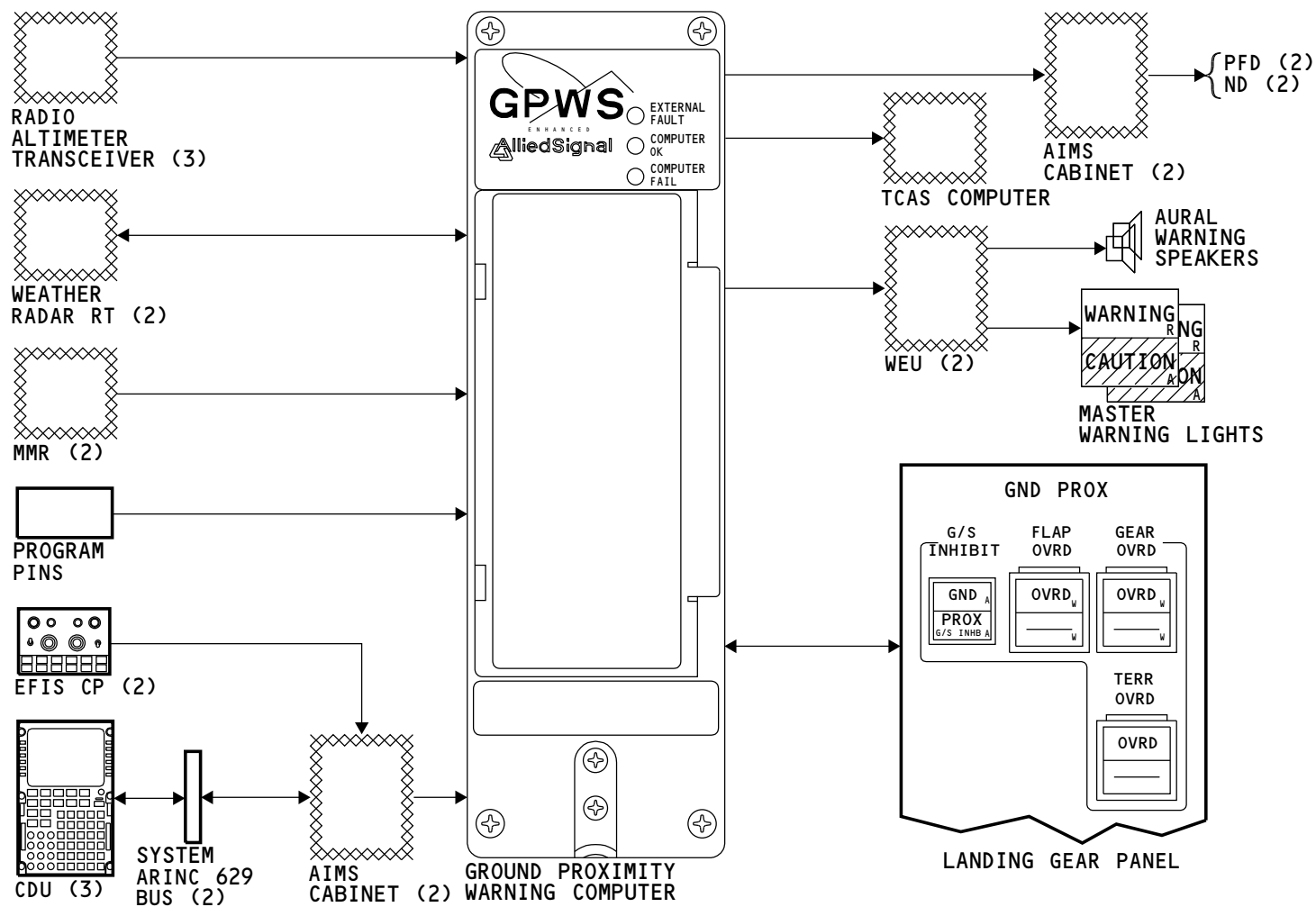
The GPWC sends discretes to the weather radar (WXR) system and to the traffic alert and collision avoidance system (TCAS).

ARO ALL**34-46-00**

EFFECTIVITY
ARO ALL

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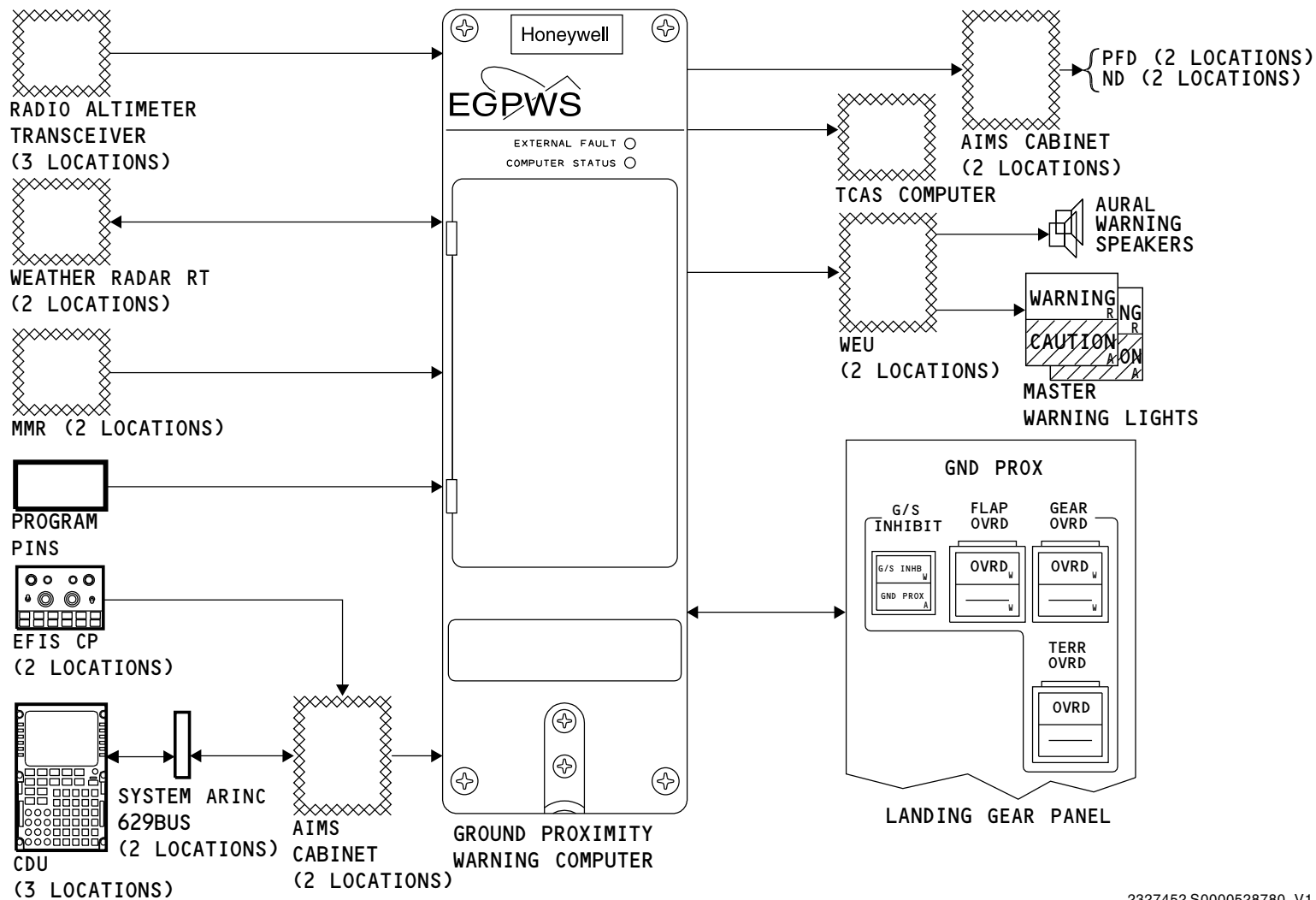
GPWS - GENERAL DESCRIPTION

34-46-00

EFFECTIVITY
ARO 001-008 PRE SB 777-34-0232

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GPWS - GENERAL DESCRIPTION

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**GPWS - FLIGHT DECK COMPONENT LOCATIONS****GPWS Component Locations**

These are the GPWS components in the flight deck:

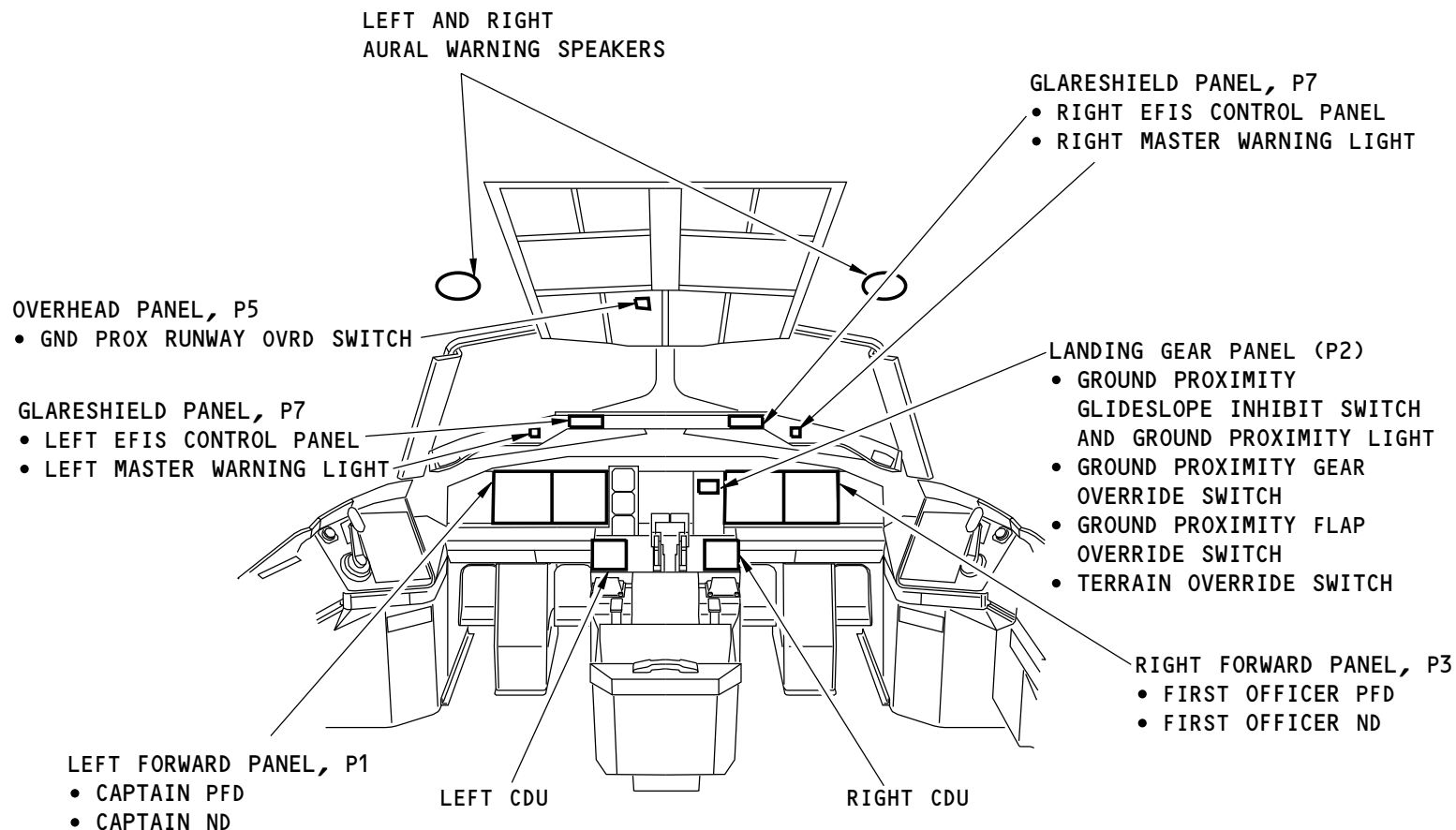
- Ground proximity glideslope inhibit switch and ground proximity light
- Ground proximity gear override switch
- Terrain override switch
- Ground proximity flap override switch.
- GND PROX Runway override switch

Other Systems Component Locations

These are the components in the flight deck that have an interface with the GPWS:

- Left and right aural warning speakers
- Left and right master warning lights
- Captain and first officer navigation displays (NDs)
- Left and right electronic flight instrument system (EFIS) control panel (CP)
- Left and right control display units (CDUs)
- Captain and first officer primary flight displays (PFDs).

ARO ALL	EFFECTIVITY



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GPWS - GND PROX RUNWAY OVERRIDE SWITCH

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GPWS - MAIN EQUIPMENT CENTER COMPONENT LOCATIONS

GPWS Component Locations

These components are in the main equipment center:

- Terrain select relays
- Ground proximity warning computer (GPWC).

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GPWS - MAIN EQUIPMENT CENTER COMPONENT LOCATIONS

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ARO ALL	EFFECTIVITY

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GPWS - INTERFACE

Power

The GPWC gets 115v ac power from the GND PROX circuit breaker on the P11 overhead circuit breaker panel.

General Interface

The ground proximity warning computer (GPWC) has an interface with these:

ARO 001-016

- Left, right, and center radio altimeter transceivers

ARO ALL

- Left and right AIMS cabinets
- Multi-mode receivers (MMRs)
- Warning electronic units (WEUs)
- Landing gear panel

ARO 001-008 PRE SB 777-34-0232

- Program pins

ARO ALL

- TCAS computer.

Radio Altimeter System

ARO 001-016

The GPWC uses radio altitude from the three radio altimeter transceivers. If the three radio altimeter transceivers are valid, the GPWC selects the left radio altimeter transceiver if the left radio altitude is within 500 feet of the center or right radio altitudes.

If the three radio altimeter transceivers are valid and the left radio altitude is not within 500 feet of the center or right radio altitudes, the GPWC uses the center radio altimeter transceiver if its altitude is within 500 feet of the right radio altitude.

If the three radio altimeter transceivers are valid and the left, right, and center radio altitudes are different by more than 500 feet between each other, the GPWC uses the left radio altimeter transceiver.

If there are less than three valid radio altimeter transceivers, the GPWC selects one of the radio altimeter transceivers in this order:

- Left
- Center
- Right.

ARO ALL

Airplane Information Management System (AIMS)

The GPWC receives data from the left and right AIMS cabinets. The primary input is from the left AIMS cabinet. Both cabinets supply data to the GPWS on three ARINC 429 data buses. A fourth data bus from the left AIMS cabinet supplies CMCF test requests to the GPWC.

IRS data buses supply this data:

- Latitude and longitude (from the ADIRU)
- Magnetic track
- Ground speed
- True heading
- Vertical speed
- True track
- Inertial vertical speed and altitude
- Pitch and roll angle
- Pitch rate
- Normal acceleration
- Longitudinal acceleration
- Vertical acceleration.

The general purpose (GP) data buses supply this data:

- Computed airspeed

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GPWS - INTERFACE

- True airspeed
- Barometric altitude
- Baro-corrected altitude
- Barometric altitude rate
- Latitude and longitude (from the FMCF)
- Magnetic track
- Decision height
- Electronic flight instrument system (EFIS) control panel (CP) control data
- Control display unit (CDU) control data (alternate EFIS CP)
- Flap and gear position
- Indicated and corrected AOA
- Stick shaker AOA
- Minimum operating speed
- Air/ground status.

The central maintenance computing (CMC) data bus supplies test commands.

The GPWC sends digital data to the AIMS cabinets on an ARINC 429 data bus. This is the data:

- Windshear warning discrete
- Pull up warning discrete
- Master warning light enable
- Test command reply.

Global Positioning System (GPS)

The GPWC receives this data from the multi-mode receivers (MMRs):

- Latitude
- Longitude
- Altitude
- Vertical speed

- Date
- Time (UTC)
- Ground speed
- True track
- Integrity of data
- Sensor status.

Instrument Landing System (ILS)

The GPWC receives this data from the left multi-mode receiver (MMR):

- Glideslope deviation
- Localizer deviation
- Selected runway heading.

Warning Electronic System (WES)

Audio signals from the GPWC go to the warning electronic units (WEUs). The WEUs send the audio to the aural warning speakers.

Landing Gear Panel

The landing gear panel has these functions:

- Terrain override switch
- Ground proximity gear override switch
- Ground proximity flap override switch
- Ground proximity glideslope inhibit switch
- Ground proximity light.

The GPWC sends an alert discrete signal to the GPWS landing gear panel to turn on the GND PROX light.

Traffic Alert and Collision Avoidance System (TCAS)

The GPWC sends a discrete to the TCAS computer to inhibit TCAS advisories that may conflict with GPWS aural messages.

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**GPWS - INTERFACE****ARO 001-008 PRE SB 777-34-0232****Program Pins**

Seventeen program pins connect to six GPWS lamp drivers. The connections are at terminal blocks on the E1-4 shelf in the main equipment center (MEC). When the airplane powers up, the lamp drivers turn on and off one at a time to read the program pin connections. These connections make up the GPWS configuration. The non-volatile memory (NVM) stores this configuration. The configuration determines such parameters as:

- Airplane type
- Mode 6 callouts
- High or low audio volume.

ARO 009-999; ARO 001-008 POST SB 777-34-0232**Program Pins**

Three aircraft type program pins connect to the GPWS lamp drivers. The connections are at terminal blocks on the E1-4 shelf in the main equipment center (MEC). When the airplane powers up, the lamp drivers turn on and off one at a time to read the program pin connections. The non-volatile memory (NVM) stores this configuration.

GPWC Software Options

The options for the EGPWS are contained in the Operational Program Configuration (OPC) software which is loaded into the GPWC through a front panel connector.

ARO 001-013, 017-999**Weather Radar (WXR) System**

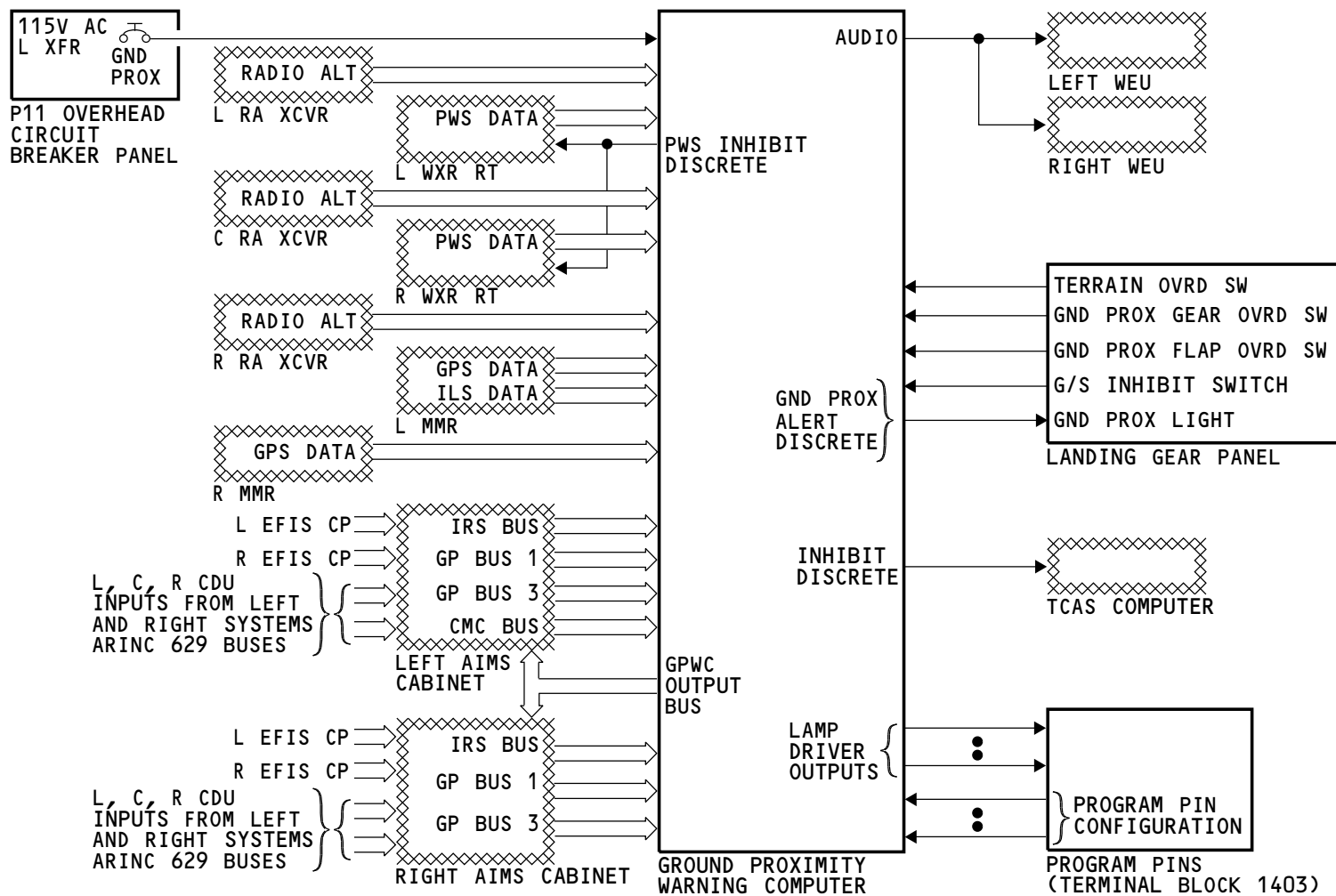
The WXR receiver-transmitters (RTs) sends predictive windshear (PWS) data to the GPWC to inhibit lower priority GPWS alerts.

The GPWC sends a discrete to the WXR RTs to inhibit lower priority PWS alerts.

ARO ALL**34-46-00****ARO ALL EFFECTIVITY**

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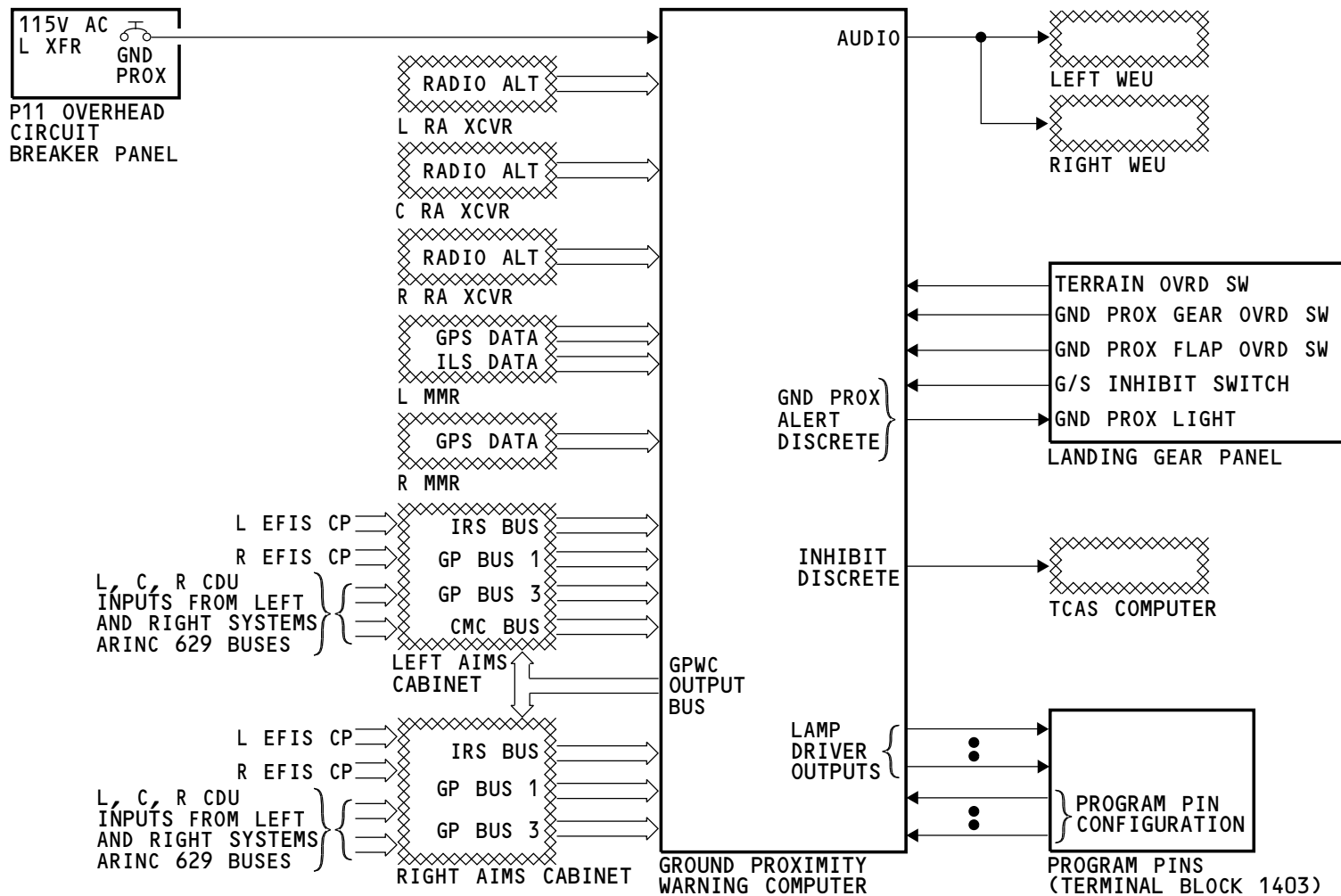
GPWS - INTERFACE

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ARO 001-013

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GPWS - INTERFACE

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GPWS - DISPLAY RELAY INTERFACE

Purpose

The ground proximity warning computer (GPWC) and the weather radar (WXR) receiver-transmitters (RTs) send display data that shows on the navigational displays (NDs). Four terrain select relays control which data shows on each ND.

Relay Power

The terrain select relays gets 28v dc from the TERRAIN DISPLAY circuit breaker on the P11 overhead circuit breaker panel.

Relay Interfaces

The GPWC connects to all terrain select relays with terrain display data buses. The WXR RTs connect to all terrain select relays with weather display data buses.

The terrain select relays connect to the AIMS cabinets with data buses. The AIMS cabinets show the data on the NDs.

Relay Control

With weather radar selected, the normal relay position lets weather radar data show on the NDs. When you select TERR on either EFIS control panel (CP), a terrain select ground signal energizes the two on-side terrain select relays. This allows the terrain data to show on the on-side display. Push the TERR switch again and the on-side relays deenergize. The display then shows weather radar data, if selected.

Relay Monitor

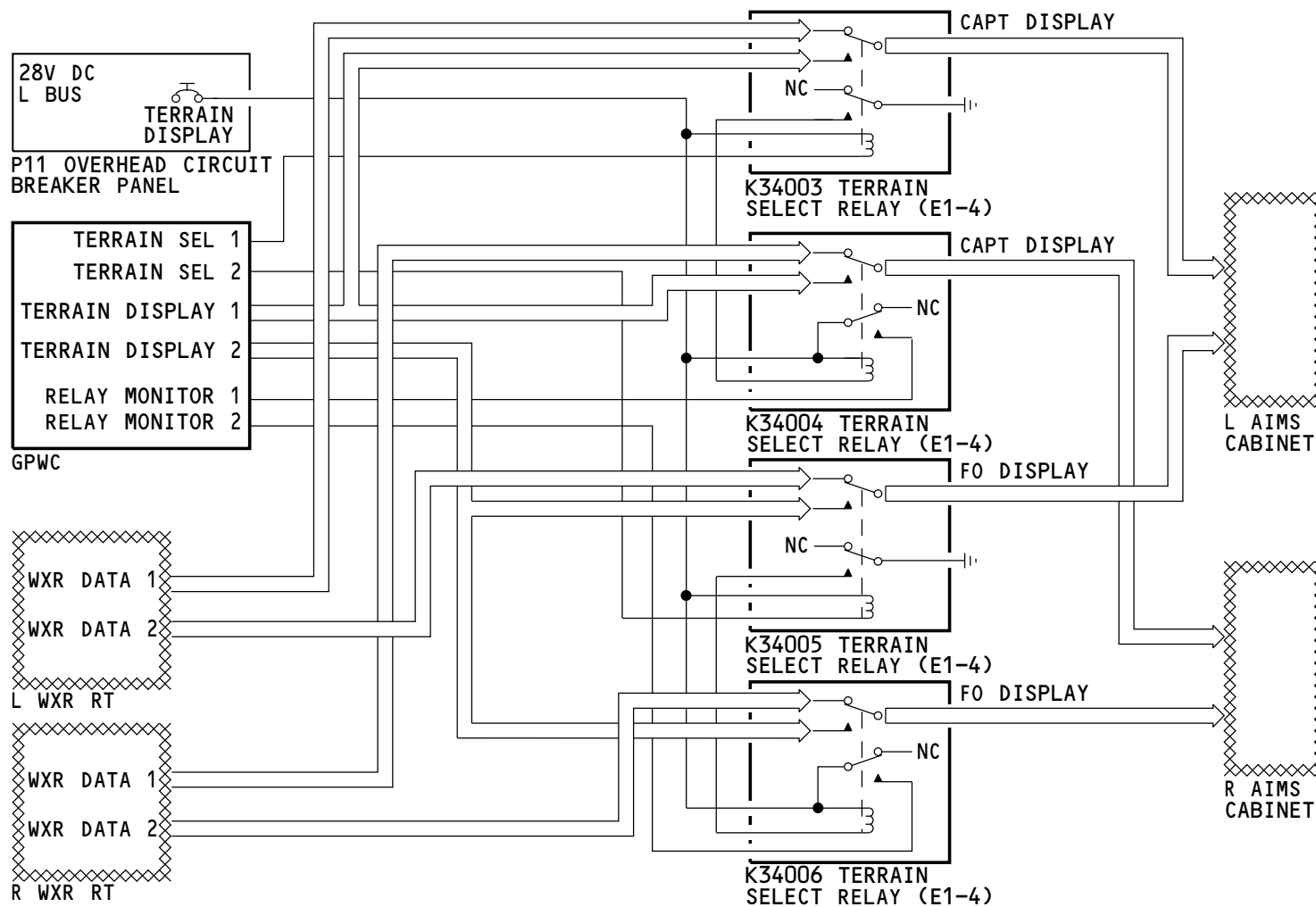
The GPWC monitors the terrain select relay positions for faults.

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GPWS - DISPLAY RELAY INTERFACE

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GPWS - GROUND PROXIMITY WARNING COMPUTER

Purpose

The ground proximity warning computer (GPWC) compares the airplanes flight profile, flap and gear position, and terrain clearance to determine if an alert condition exists.

ARO 001-008 PRE SB 777-34-0232

Description

The enhanced GPWS function contains a worldwide terrain database. It compares airplane position, track, and speed with this database to find if there is an alert condition. Terrain data shows on the navigation displays (NDs).

The enhanced GPWS function also contains an airport database. This database contains terrain information for all hard surface runways 3500 feet or longer. GPWS compares airplane position and runway location to find if there is an alert condition.

The Enhanced GPWC with a Runway Awareness and Advisory System (RAAS) installed will provide flight crew an increased situational and advisories related to aircraft operations in and around runway areas. RAAS is a software enhancement that is hosted on EGPWS. RAAS is intended to provide aural and visual annunciations that supplement flight crew awareness of position during ground operations and on approach to landing. It also provides alerts for non-normal conditions that require crew awareness and action. EGPWS protection and operation are unaltered by the addition of RAAS. RAAS operates automatically, without any action required from the flight crew.

ARO 009-999; ARO 001-008 POST SB 777-34-0232

Description

The enhanced GPWC is the main component of the GPWS. The computer front panel contains two LEDs that show the computer is OK, or internal and external failures. The front panel also contains a self-test switch. The switch provides access to six self-test modes. The faults are annunciated through the flight deck speakers or through headphones connected to the jack below the switch.

You can load the Operational Program Configuration (OPC) software to configure optional features with the data loader control panel and a data loader. The front panel also contains USB and Ethernet data load connectors and a status indicator.

The computer has front panel D-SUB type and ethernet test connectors.

The Enhanced GPWC with Runway Awareness and Advisory System (RAAS) installed will provide flight crew with an increased situational and advisory feature related to aircraft operations in and around runway areas. RAAS provides aural callouts that supplement flight crew awareness of position during ground operations and on approach to landing. It also provides alerts for non-normal conditions that require crew awareness and action. EGPWS protection and operation are not altered by the addition of RAAS. RAAS operates automatically, without any action required from the flight crew.

ARO ALL

Physical Description

The ground proximity warning computer (GPWC) is a two MCU chassis and weighs seven pounds. Forced cooling air is not necessary.

ARO 001-008 PRE SB 777-34-0232

Front Panel

The GPWC front panel has three status LEDs and a door.

These are the three status LEDs on the front panel:

- EXTERNAL FAULT - amber LED turns on for a failure external to the GPWC.
- COMPUTER OK - green LED stays on when GPWC has power and operates normally
- COMPUTER FAIL - red LED turns on when the GPWC has an internal failure.

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**GPWS - GROUND PROXIMITY WARNING COMPUTER****ARO 001-008 PRE SB 777-34-0232 (Continued)**

- D-sub test connector - for vendor use only.

ARO ALL

The front panel door allows access to these:

- PRESS TO SELF TEST switch - starts a GPWS test
- Headphone jack - lets you hear self test audio
- Memory card slot - lets you upload software from a Personal Computer Memory Card International Association (PCMCIA) memory card or download fault and warning history data
- Upload/download status indicators - shows conditions of upload or download operation
- RS-232 connector - used for shop test or for the upload/download of data.

ARO 009-999; ARO 001-008 POST SB 777-34-0232**Front Panel**

The GPWC front panel has two status LEDs and a door.

These are the two status LEDs on the front panel:

- EXTERNAL FAULT - amber LED turns on for a failure external to the GPWC.
- COMPUTER STATUS - green LED indicates the GPWC is okay or a red LED indicates an internal computer fault is detected.

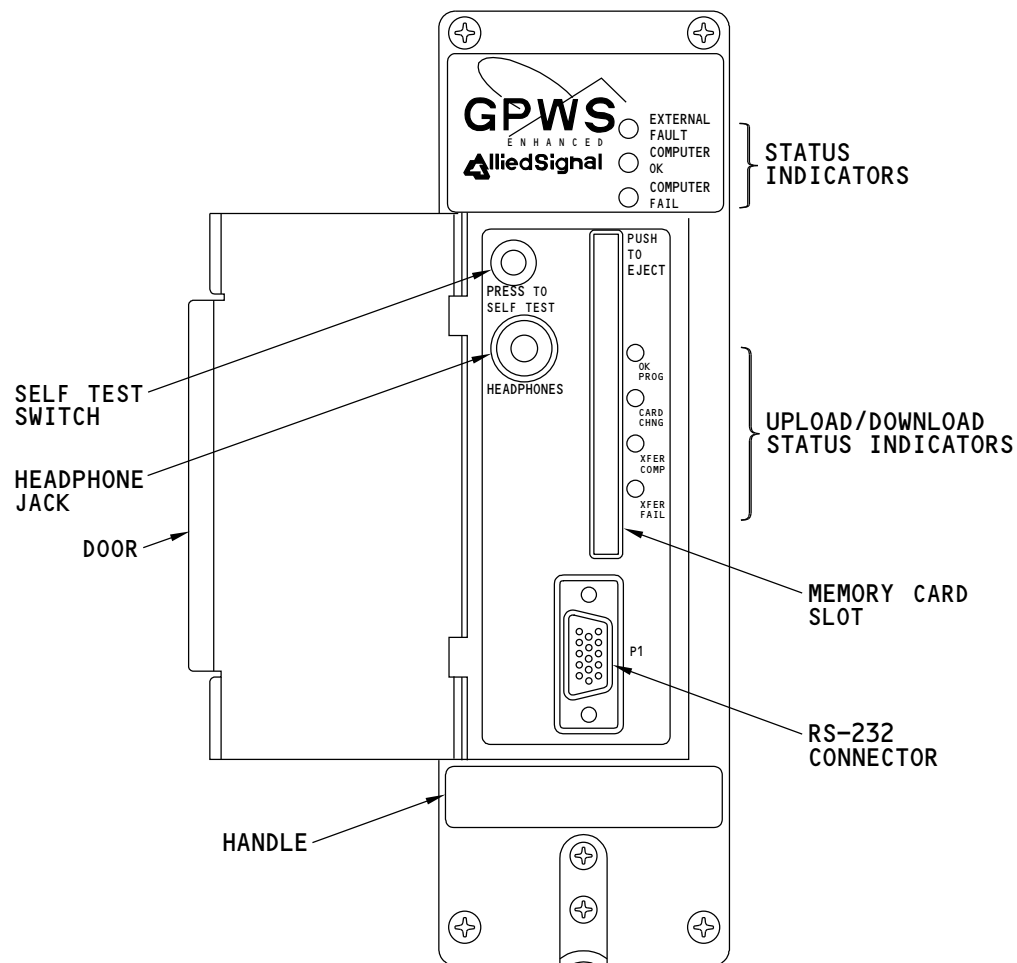
The front panel door gives access to these:

- SELF-TEST switch - starts a test of the GPWS
- Headphone jack - lets you hear self-test audio
- USB dataload connector
- Dataload Status LED
- RJ45 Ethernet dataload connector
- RJ45 Ethernet test connector

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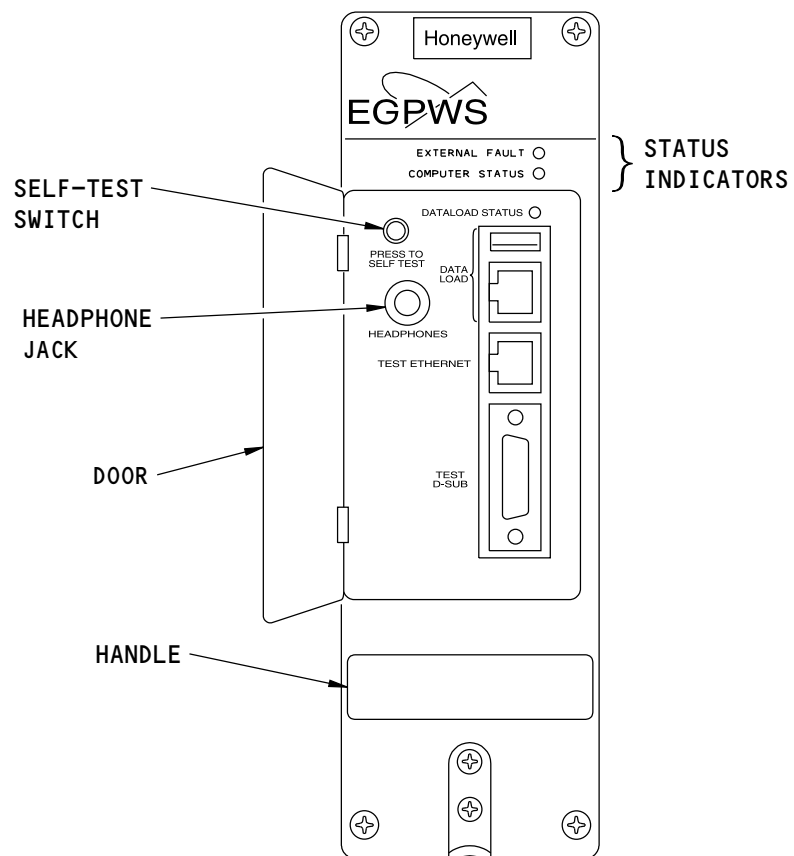
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GPWS - GROUND PROXIMITY WARNING COMPUTER

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GPWS - GROUND PROXIMITY WARNING COMPUTER

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EFFECTIVITY
ARO 009-999; ARO 001-008 POST SB 777-34-0232

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GPWS - CONTROL - EFIS CONTROL PANEL

Description

The EFIS control panel provides these functions:

- Enables the navigation displays (NDs) to show terrain data
- Supplies the selection of different ND modes
- Supplies the selection of different ranges for terrain data to show on the NDs.

TERR Map Switch

When you push the TERR map switch on the EFIS control panel, terrain data shows on the on-side ND. Push the TERR map switch again to remove the display.

ND Mode Selector

Use the ND mode selector to select an ND mode. The ND modes that show terrain data are:

- Expanded APP (approach) mode
- Expanded VOR mode
- Expanded MAP mode
- Centered MAP mode.

If the mode selector is not in a correct mode when you push the TERR map switch, the terrain display arms. When armed, the terrain display shows as soon as you change the ND selector to a correct mode. The terrain display stays armed even if you push the TERR map switch again. Push the WXR map switch to disarm the terrain display and arm the weather display.

ND Range Selector

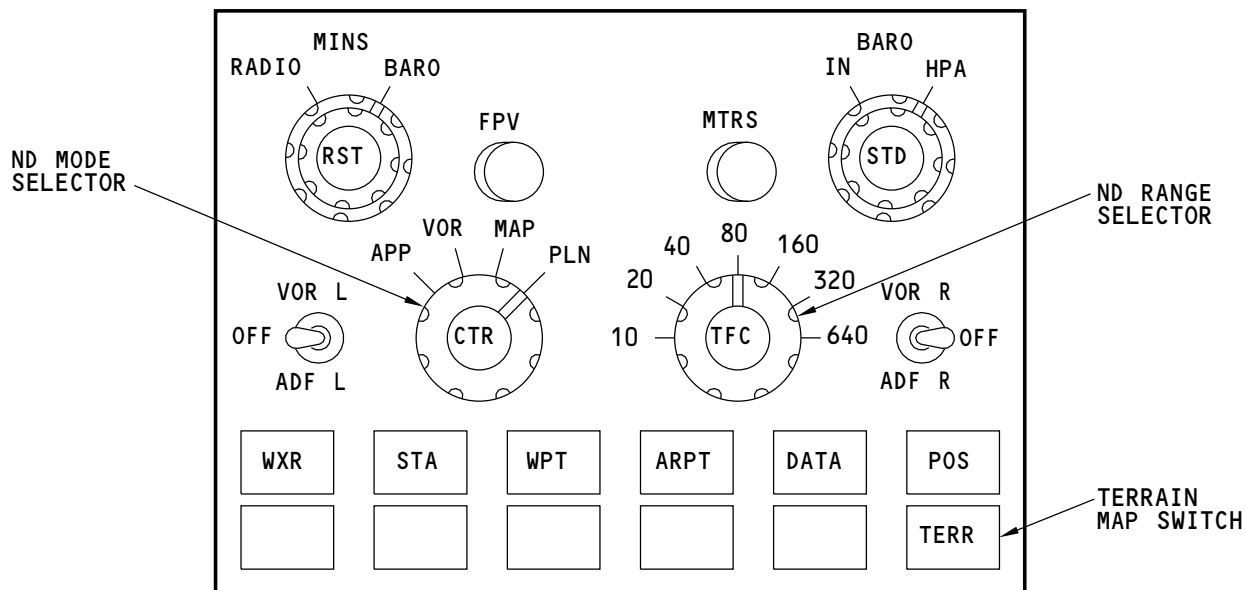
The EFIS control panel has a six position range selector. The range selections are 10, 20, 40, 80, 320 and 640 NM. The map mode displays the range at all times. APP and VOR modes display the range only when TERR or WXR data show.

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GPWS - CONTROL - EFIS CONTROL PANEL

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GPWS - CDU SELECTIONS

Alternate or Backup EFIS Control Panel

The EFIS control page on the control display unit (CDU) permits alternate or backup controls for the ground proximity warning system.

If the EFIS control panel (CP) fails or for alternate operation, use the EFIS control CDU pages on the on-side CDU for:

- On/off control of the on-side terrain display
- Terrain display range selection
- ND mode selection.

When you select EFIS control to ON from the CDU page, the on-side EFIS CP does not operate.

Access

To get the EFIS control CDU pages on the CDU:

- Push the MENU line select key (LSK) on the CDU to make the MENU page come on
- Push the EFIS CTL LSK on the MENU page and the EFIS prompt comes on
- Push the LSK next to EFIS and the EFIS control page comes on
- Select the ND modes and range From the EFIS CONTROL page
- Push the OPTIONS LSK on the EFIS CONTROL page to go to the EFIS OPTIONS page
- Push the TERR LSK on the EFIS OPTIONS page for ON/OFF control of the GPWS and to enable the terrain display for the on-side ND.
- Push the CONTROL LSK on the EFIS OPTIONS page to return to the EFIS CONTROL page.

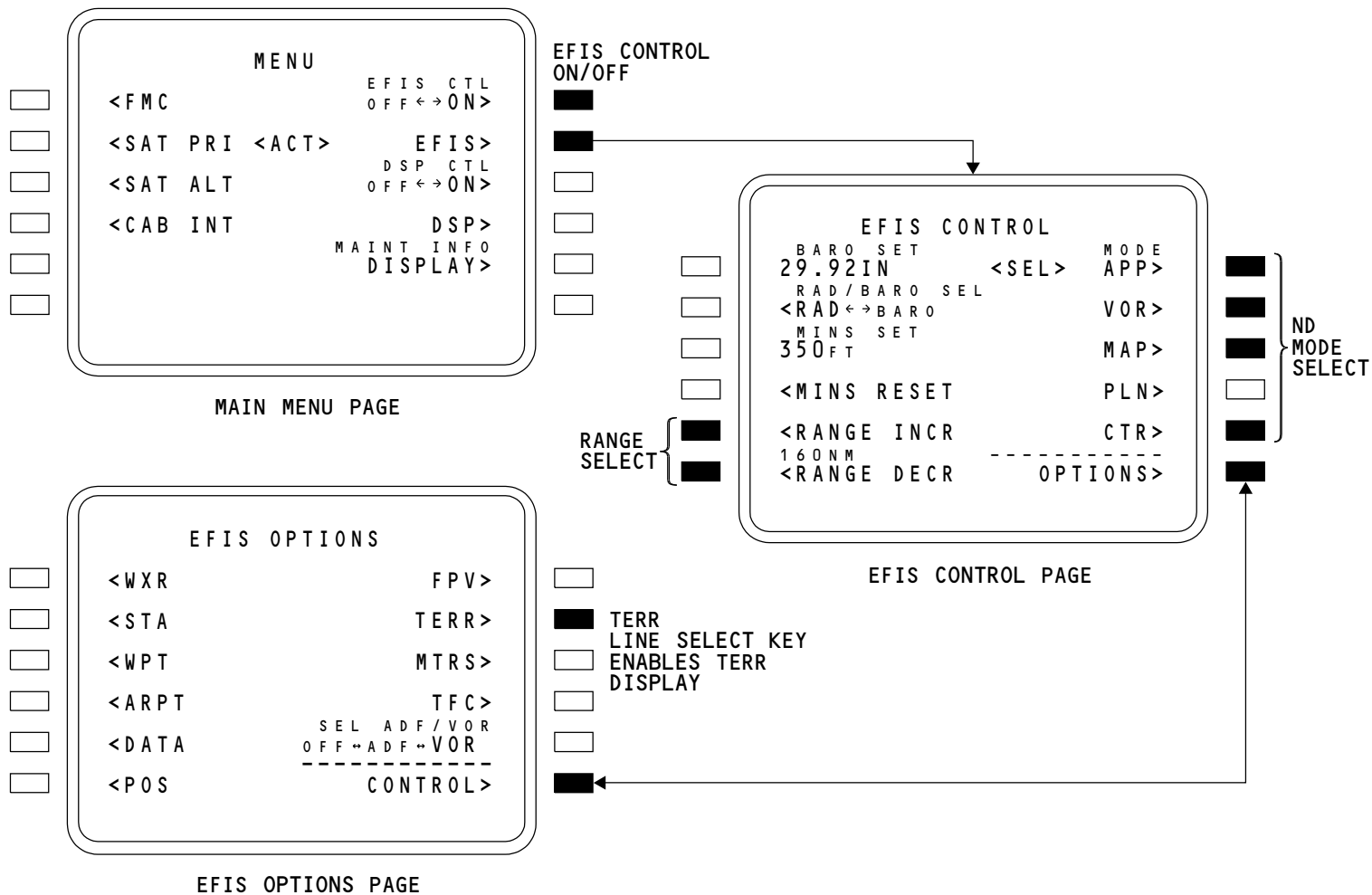
You can use the EFIS CP CDU pages on the CDU at any time.

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GPWS - CONTROL COMPONENTS**Description**

These are the controls on the landing gear panel:

- Ground proximity light
- Ground proximity glideslope inhibit switch
- Flap override switch
- Terrain override switch
- Gear override switch.

Ground Proximity Light/Ground Proximity Glideslope Inhibit Switch

This combination light/switch has two functions. The amber ground proximity light shows ground proximity alerts for modes 1 through 5.

Push the switch to prevent mode 5 (below glideslope) alerts.

Override Switches

The flap override and the gear override switches simulate a flaps down condition and a gear down condition. The use of these switches prevent alerts when the flight crew makes flaps up or gear up approaches intentionally. The flight crew uses the terrain override switch for any of the following conditions:

- The crew determines position data is not valid
- Terrain awareness alerts show when it is obvious no terrain threats exist.

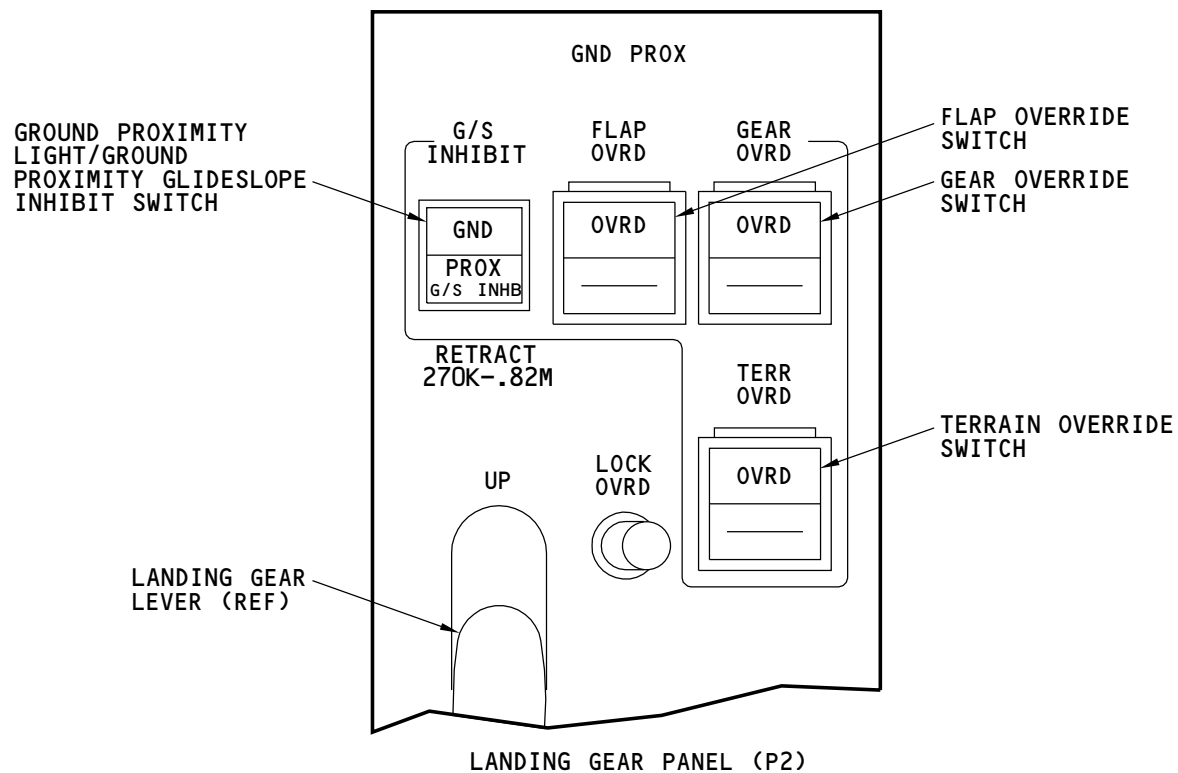
The switches have guards to keep them in the normal position.

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GPWS - CONTROL COMPONENTS

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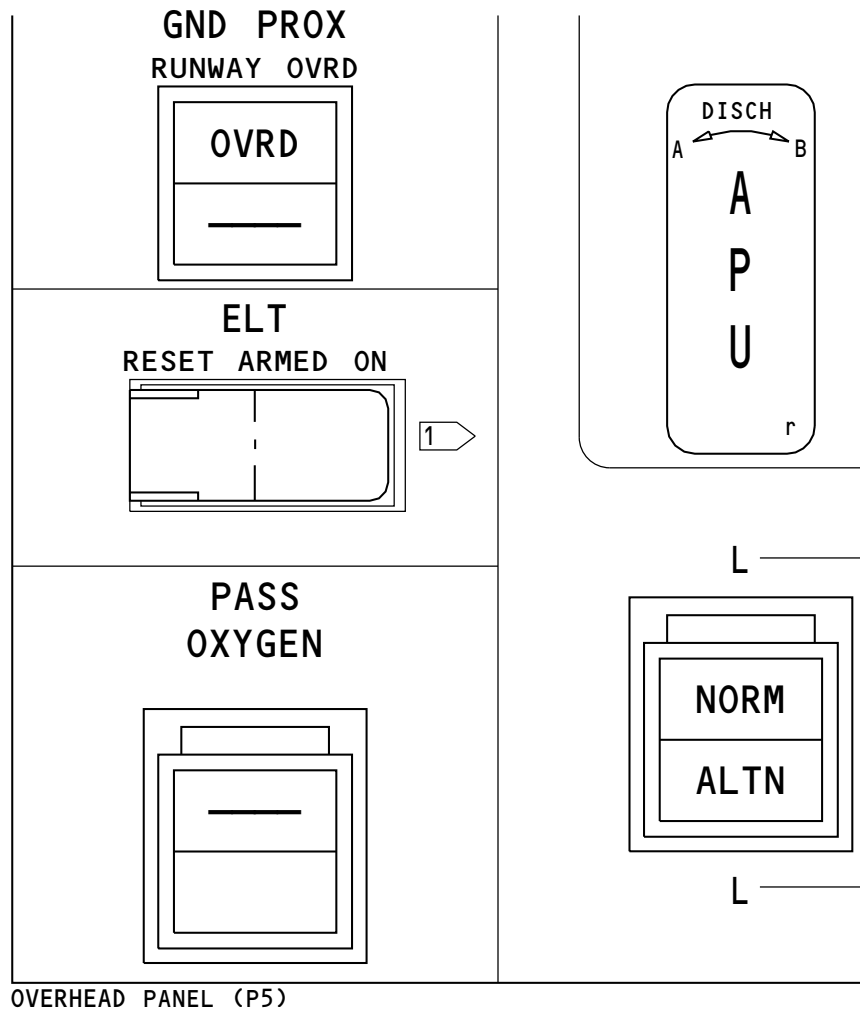
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**GND PROX RUNWAY OVERRIDE SWITCH****Description**

The GND PROX Runway Override Switch is on the P5 panel in the upper left panel directly above the PASS OXYGEN switch. The GND PROX Runway Override Switch is a lighted pushbutton switch with a switch guard. The white OVRD light will come on when the switch is pushed. The OVRD light will go off when the switch is pushed again.

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1 IF INSTALLED

GPWS - GND PROX RUNWAY OVERRIDE SWITCH

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**GPWS - MODE 1 DESCRIPTION****Purpose**

Mode 1 supplies alerts and warnings for large descent rates when the airplane is near the terrain. This mode is independent of flap or gear positions.

Description

Mode 1 alerts or warnings occur between 2450 feet and 30 feet. The rate of descent sets the point at which mode 1 alerts occur.

The alert consists of these annunciations:

- Aural message SINK RATE
- Ground proximity light on the landing gear panel.

If the descent rate does not decrease, the alert changes to a warning. These are the warning annunciations:

- A red PULL-UP message on the PFD
- Red master warning lights
- The aural message PULL-UP.

ARO ALL	EFFECTIVITY



THE LOWER LIMIT FOR MODE 1 ALERTS AND WARNINGS IS 30 FEET RADIO ALTITUDE

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GPWS - MODE 1 DESCRIPTION

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GPWS - MODE 1 OPERATION**General****ARO 001-016**

Mode 1 alerts and warnings occur between 30 feet and 2450 feet radio altitude. The LRUs that supply inputs for mode 1 operation are the left, right, and center radio altimeter transceivers and the AIMS cabinets.

ARO ALL

The GPWC uses this data to detect mode 1 alerts and warnings:

- Radio altitude
- Inertial vertical speed
- Barometric altitude.

The mode detector in the GPWC calculates the descent rate from the inertial vertical speed input. If it is not available, the mode detector uses barometric altitude rate.

The type of annunciation depends on the rate of descent and the radio altitude.

The first annunciation is an alert. If the rate of descent does not decrease, the annunciation changes to a warning.

Operation

The mode detector uses the inputs to see if there is an alert or warning condition.

If there is an alert condition, the GPWC sends a discrete to the ground proximity light. The alert discrete goes to the speech prom to make the alert aural. The alert aural goes to the warning electronic units (WEUs) which amplify and send it to the aural warning speakers.

The alert discrete also goes to the TCAS computer to inhibit any TCAS advisory messages.

If there is a warning condition, the GPWC sends a PULL-UP warning discrete to the AIMS cabinets to show the message PULL UP on the PFDs. The warning discrete goes to the speech prom to make the warning aural. The warning aural goes to the warning electronic units (WEUs) which amplify and send it to the aural warning speakers.

The warning discrete also goes to the TCAS computer to inhibit any TCAS advisory messages.

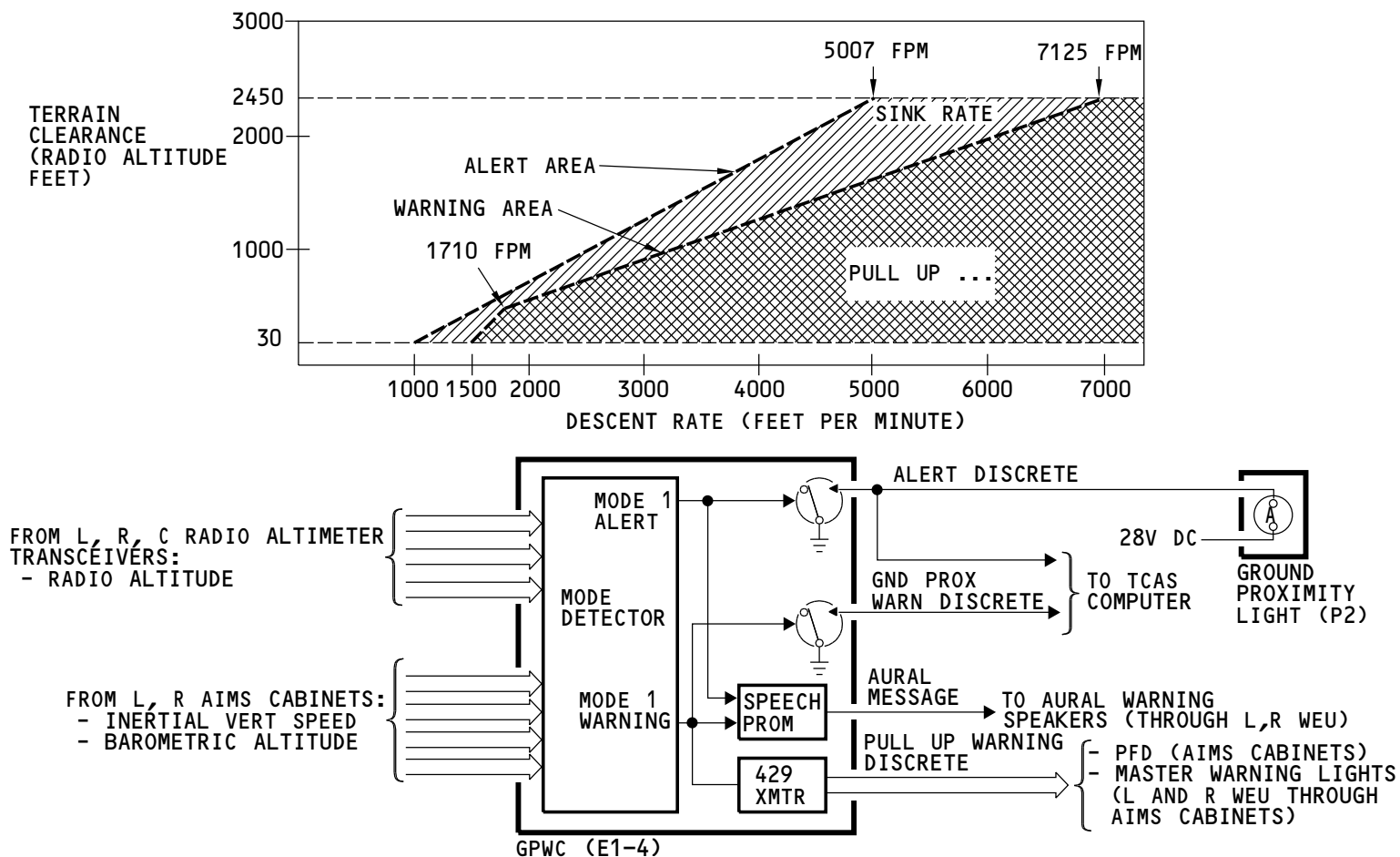
The AIMS cabinets send the warning discretes to the warning electronic units (WEUs) to make the master warning lights come on.

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GPWS - MODE 1 OPERATION

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GPWS - MODE 2A DESCRIPTION

Purpose

Mode 2 supplies alerts and warnings if the closure rate to the terrain is too large. Mode 2 has two submodes (mode 2A and 2B).

The position of the flaps determine if it is a mode 2A or a mode 2B alert.

Description

Mode 2A gives annunciations for a large closure rate with the flaps up (less than 15 units). Mode 2A gives an alert and a warning. This is the alert:

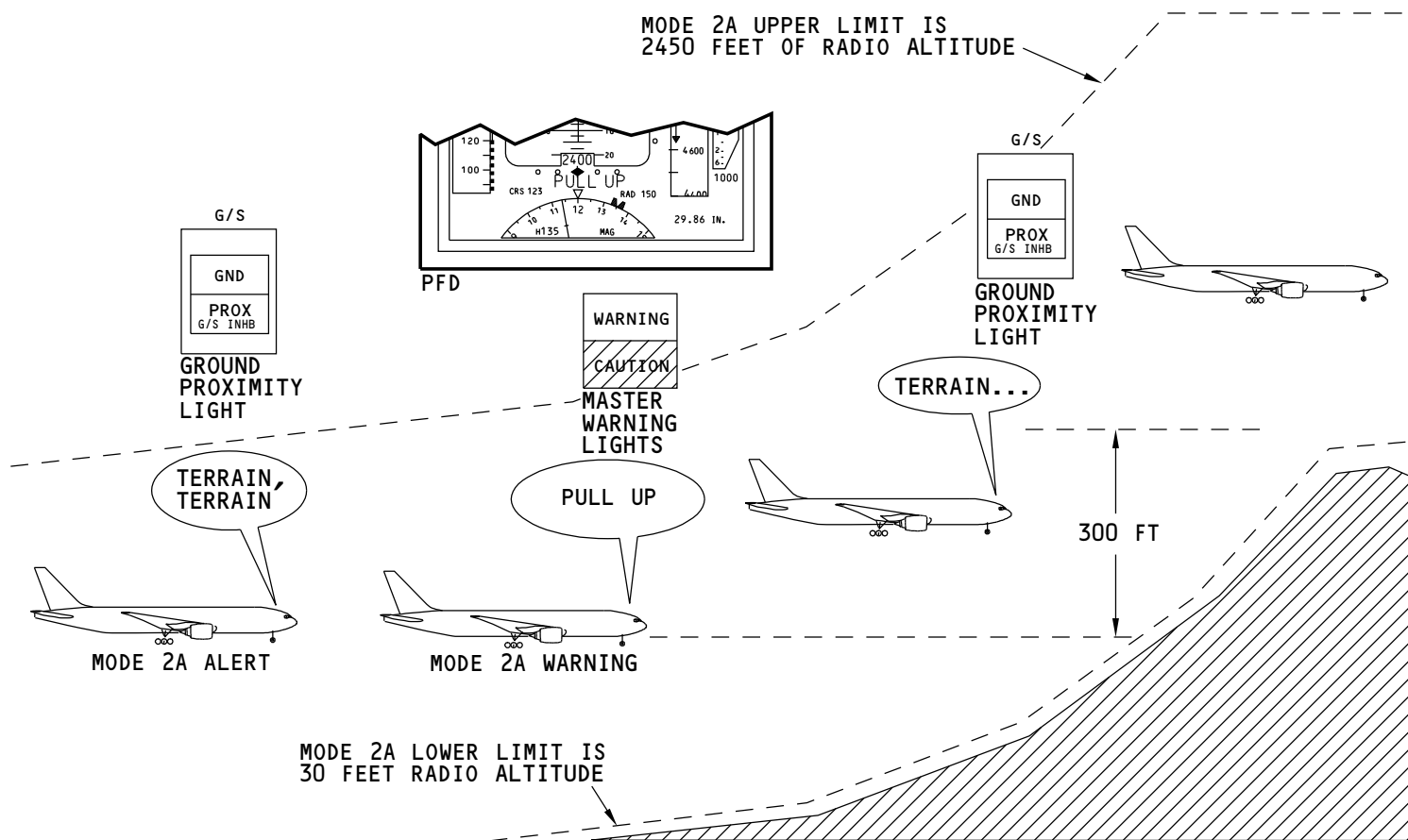
- An aural message TERRAIN, TERRAIN
- The ground proximity light.

This is the warning:

- A red PULL-UP message on the PFDs
- The master warning lights come on
- An aural message PULL-UP.

The warning changes back to the alert annunciation TERRAIN and the ground proximity light on if the closure rate decreases or if the pilot does a pull up maneuver.

The alert annunciation continues until there is an increase of 300 feet inertial altitude or the gear comes down.



M37279 S000619584_V1

GPWS - MODE 2A DESCRIPTION

34-46-00

34-46-00-010

ARO ALL	EFFECTIVITY

D633W101-ARO

**GPWS - MODE 2B DESCRIPTION****General**

Mode 2B gives annunciations for a large closure rate when the flaps are down (more than 15 units).

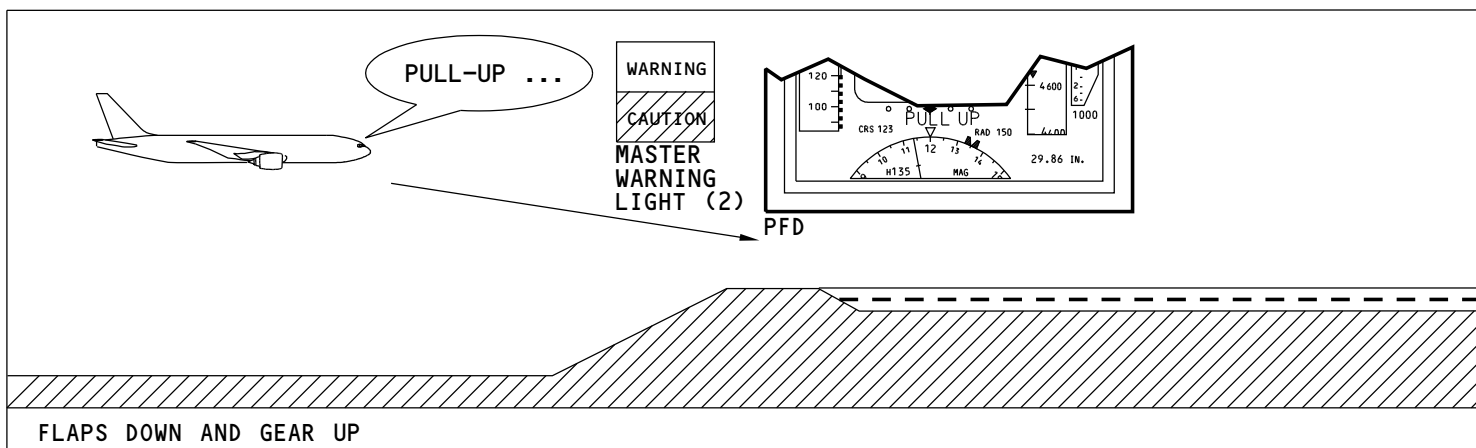
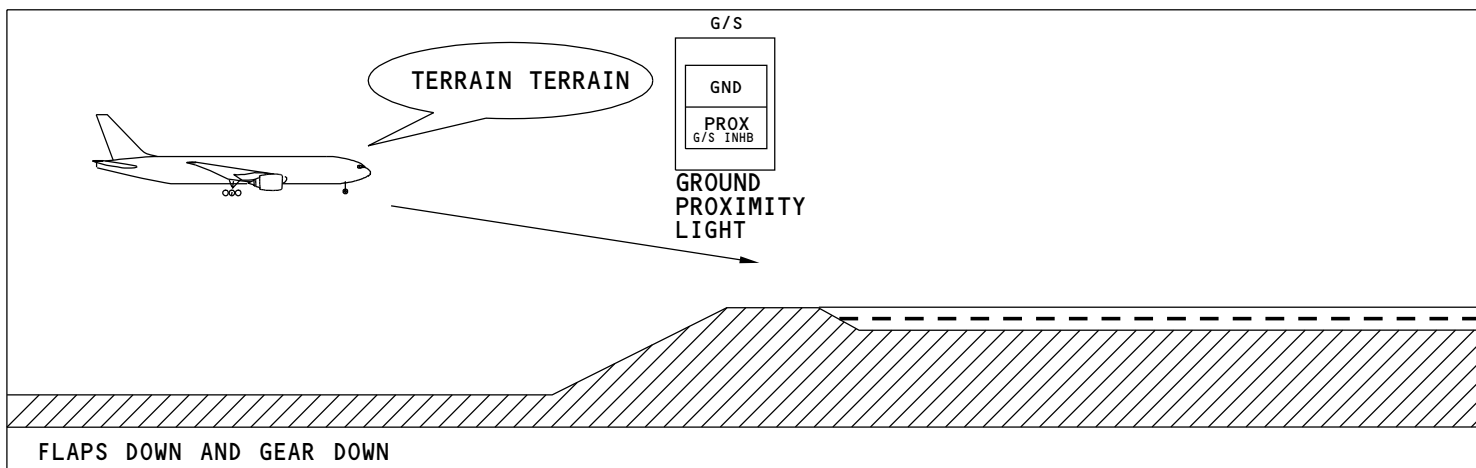
Mode 2B gives two types of annunciations that depend on the position of the landing gear.

When the landing gear is down, the GPWC gives an alert. These are the annunciations:

- The aural message TERRAIN TERRAIN
- The ground proximity light comes on.

When the gear is up, the alert is a warning and these are the annunciations:

- The aural message PULL-UP
- Master warning lights come on
- A red PULL-UP message on the PFDs.



M37284 S000619589_V1

GPWS - MODE 2B DESCRIPTION

34-46-00

ARO ALL EFFECTIVITY

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GPWS - MODE 2 OPERATION

General

Mode 2A annunciations occur between 30 feet and 1650 feet. The upper limit goes up to 2450 feet for airspeeds more than 310 kts.

Mode 2B annunciations occur between 200 feet and 789 feet. The lower limit is variable between 200 - 600 feet and depends on the inertial vertical speed closure rate. At 400 feet/min the lower limit is 200 feet and increases as the vertical speed closure rate increases.

ARO 001-016

The LRUs that supply inputs for mode 2 operation are the left, right, and center radio altimeter transceivers and the AIMS cabinets.

ARO ALL

This is the data the GPWC uses to detect mode 2 alerts and warnings:

- Radio altitude
- Inertial vertical speed (IVS)
- Barometric altitude rate
- Barometric altitude
- Computed airspeed
- Flap and gear position.

Operation

The mode detector uses the inputs to find if there is an alert or warning condition.

If there is an alert condition, the detector sends a discrete to the ground proximity light. The discrete goes to the speech prom to enable the alert aural. The alert aural goes to the WES which sends it to the aural warning speakers in the flight deck.

The alert discrete also goes to the TCAS computer to inhibit any TCAS advisory messages.

If there is a warning condition, the mode detector sends a PULL-UP discrete to the AIMS cabinet to show the message on the PFDs. The AIMS cabinets send the discrete to the WES to turn on the master warning lights. The warning discrete goes to the speech prom to enable the warning aural. The warning aural goes to the WES which sends it to the aural warning speakers in the flight deck.

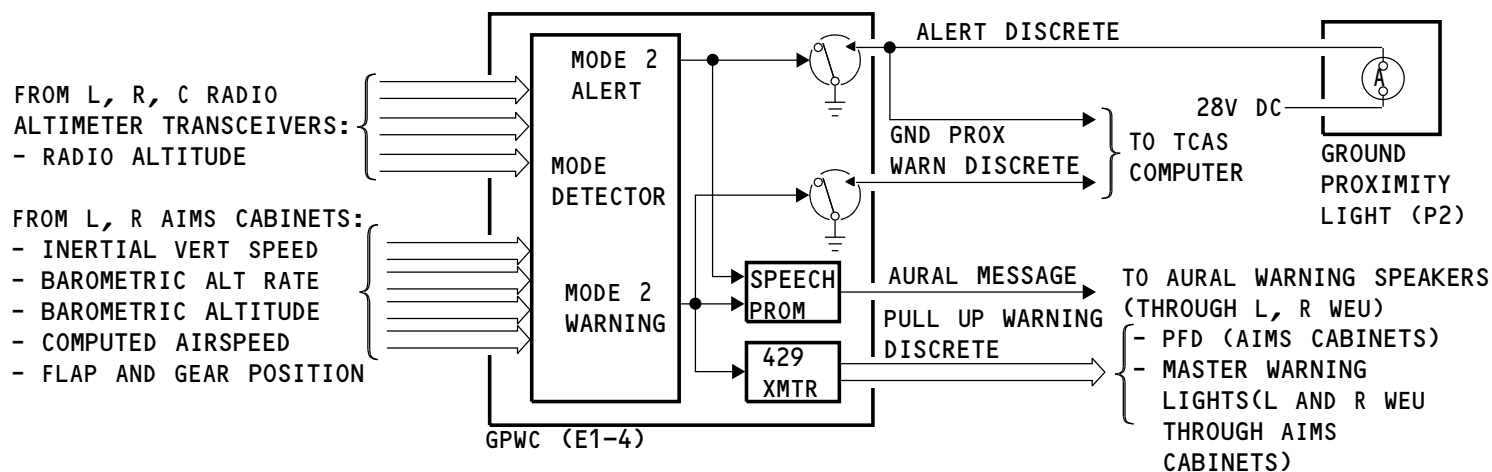
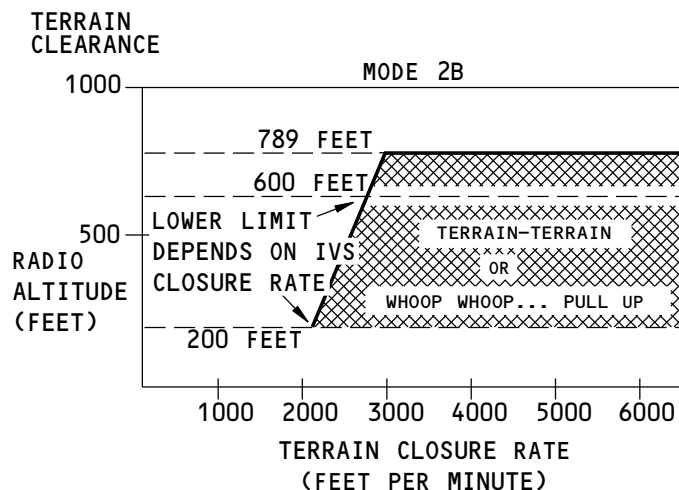
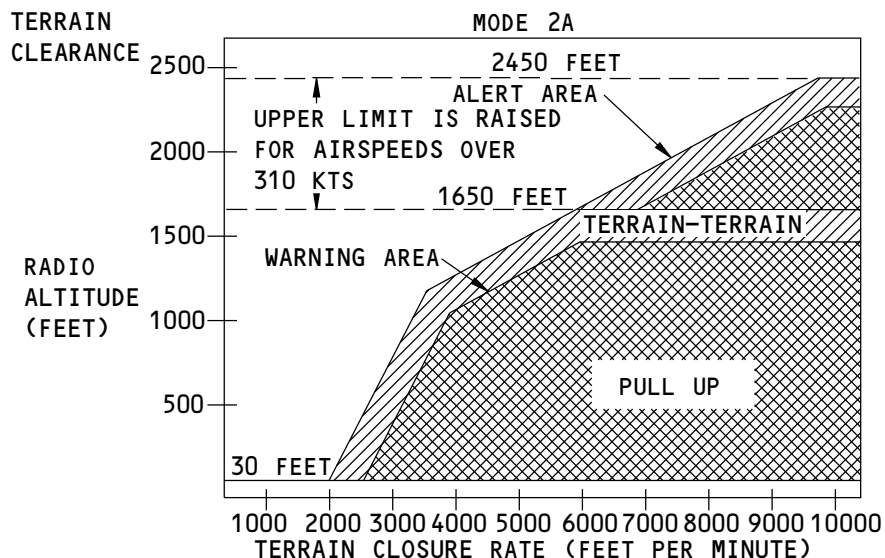
The ground proximity warning discrete goes to the TCAS computer to inhibit any TCAS advisory messages.

34-46-00

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M37291 S000619596_V2

GPWS - MODE 2 OPERATION

34-46-00

EFFECTIVITY
ARO 001-016

D633W101-ARO

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GPWS - MODE 3 DESCRIPTION

Purpose

Mode 3 supplies alerts for a large altitude loss during:

- Takeoff
- A missed approach when the gear is up and flaps are less than 25 units.

Mode 3 consists of these two submodes:

- Submode 3A
- Submode 3B.

Submode 3A

Submode 3A gives an alert when the airplane loses too much inertial altitude after takeoff. The amount of altitude loss depends on the climb rate and radio altitude of the airplane.

This is the alert:

- Ground proximity light
- Aural message DON'T SINK.

Submode 3B

Submode 3B gives an alert if the radio altitude terrain clearance goes below the amount stored in a filter in the GPWC, when the gear is up and the flaps are up (less than 15 units).

This is the alert:

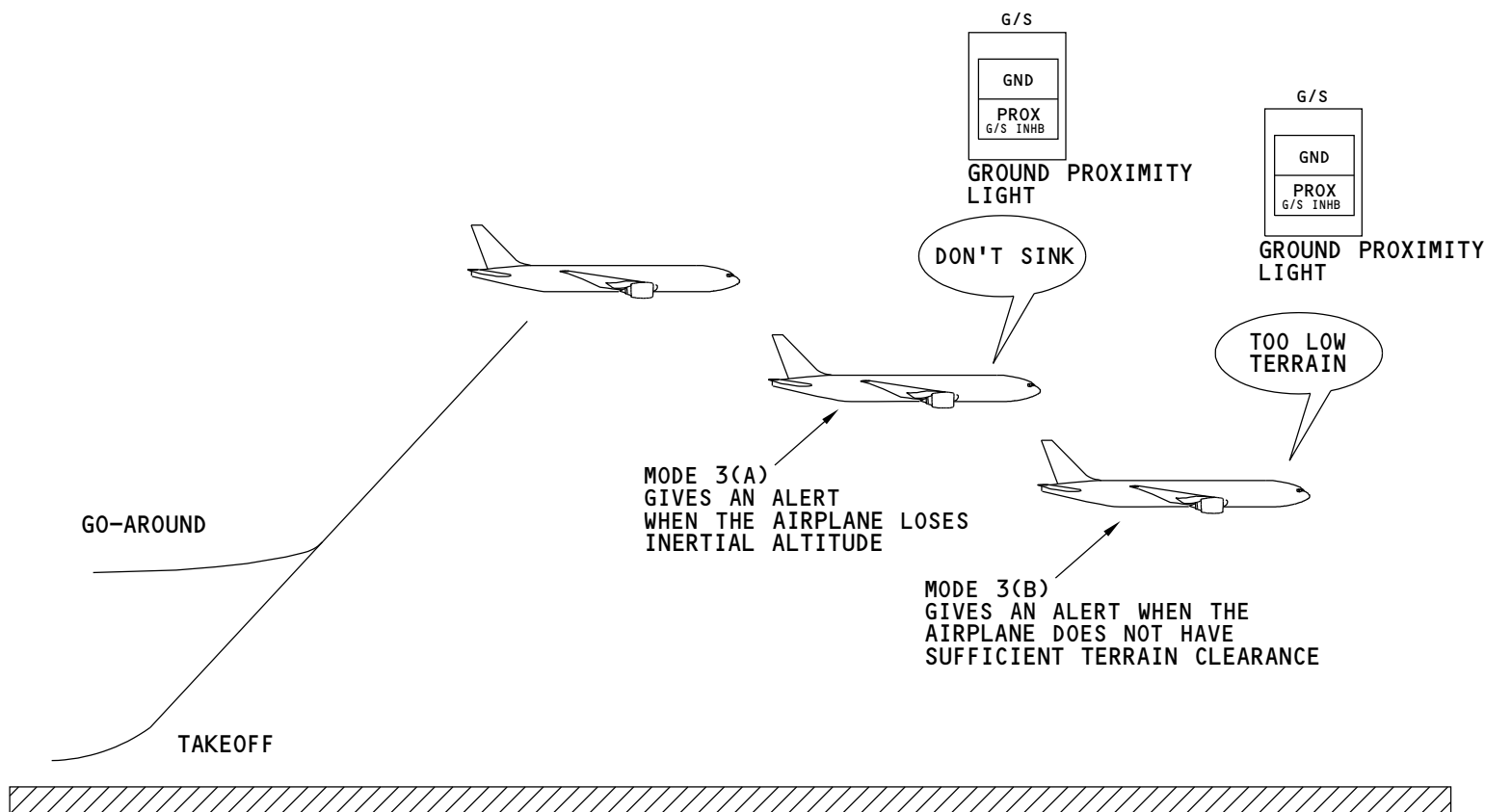
- Ground proximity light
- Aural message TOO LOW TERRAIN.

34-46-00

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M37292 S000619597_V1

GPWS - MODE 3 DESCRIPTION

34-46-00

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GPWS - MODE 3 OPERATION**General**

Mode 3 alerts occur between 30 feet and 1333 feet. Mode 3 arms when any of these conditions are true:

- Airplane goes below 245 feet and not in landing configuration.
- Airplane goes below 30 feet regardless of flap position.

ARO 001-016

The LRUs that supply inputs for mode 3 operation are the left, right, and center radio altimeter transceivers and the AIMS cabinets.

ARO ALL

The GPWC uses this data to detect mode 3 alerts:

- Radio altitude
- Inertial altitude
- Inertial vertical speed
- Barometric altitude
- Barometric altitude rate
- Flap and gear position.

Mode 3B alerts occur when the altitude is lower than the value stored in a filter in the GPWC. The filter activates at 150 feet and stores approximately 75% of the actual altitude.

The filter stores up to 500 feet altitude for airspeeds below 190 knots (500 feet in the filter represents an altitude of 667 feet).

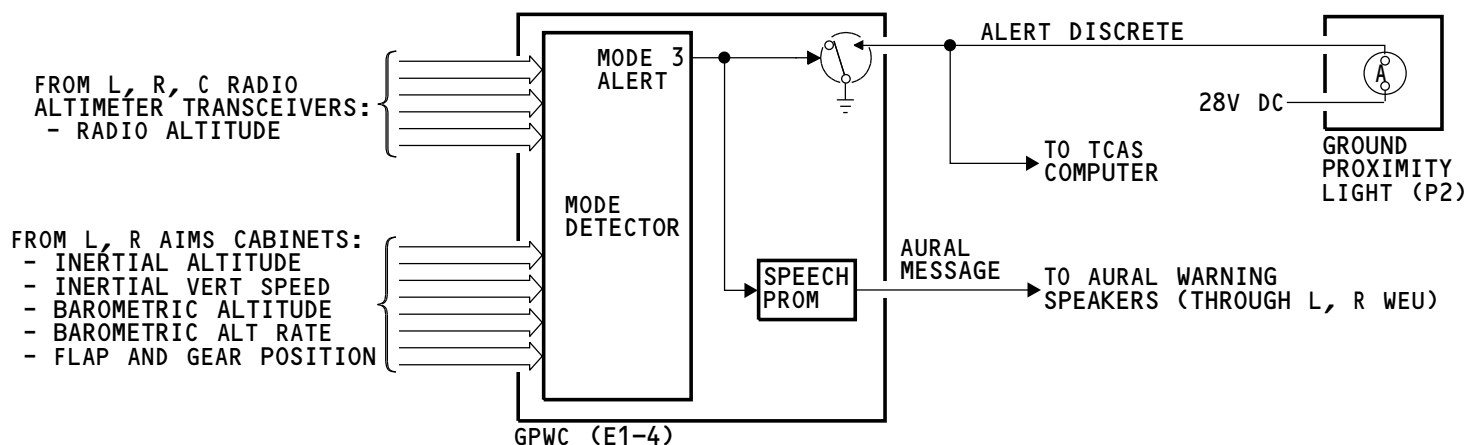
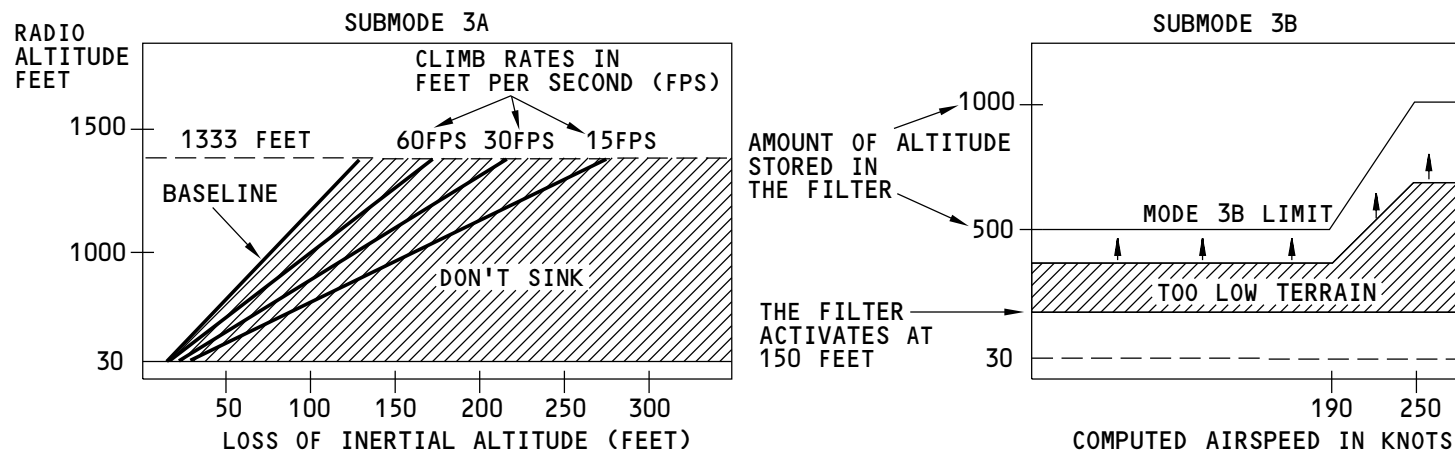
When the airspeed goes above 250 knots, the upper limit goes to 1000 feet (this represents an altitude of 1333 feet).

Mode 3 changes to mode 4 when the altitude gain filter gets to the upper limits.

Operation

The mode detector uses the inputs to find if there is an alert condition. If there is an alert condition, the mode detector sends a discrete to the ground proximity light. The discrete goes to the speech prom to make the alert aural which goes to the WES. The WES sends the aural to the aural warning speakers.

A discrete also goes to the TCAS computer to inhibit any TCAS advisory messages.



GPWS - MODE 3 OPERATION

M37296 S000619601_V1

34-46-00

EFFECTIVITY
ARO 001-016

D633W101-ARO

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GPWS - MODE 4 DESCRIPTION

General

Mode 4 supplies alerts when the airplane is too close to the terrain and the airplane is not in the landing configuration.

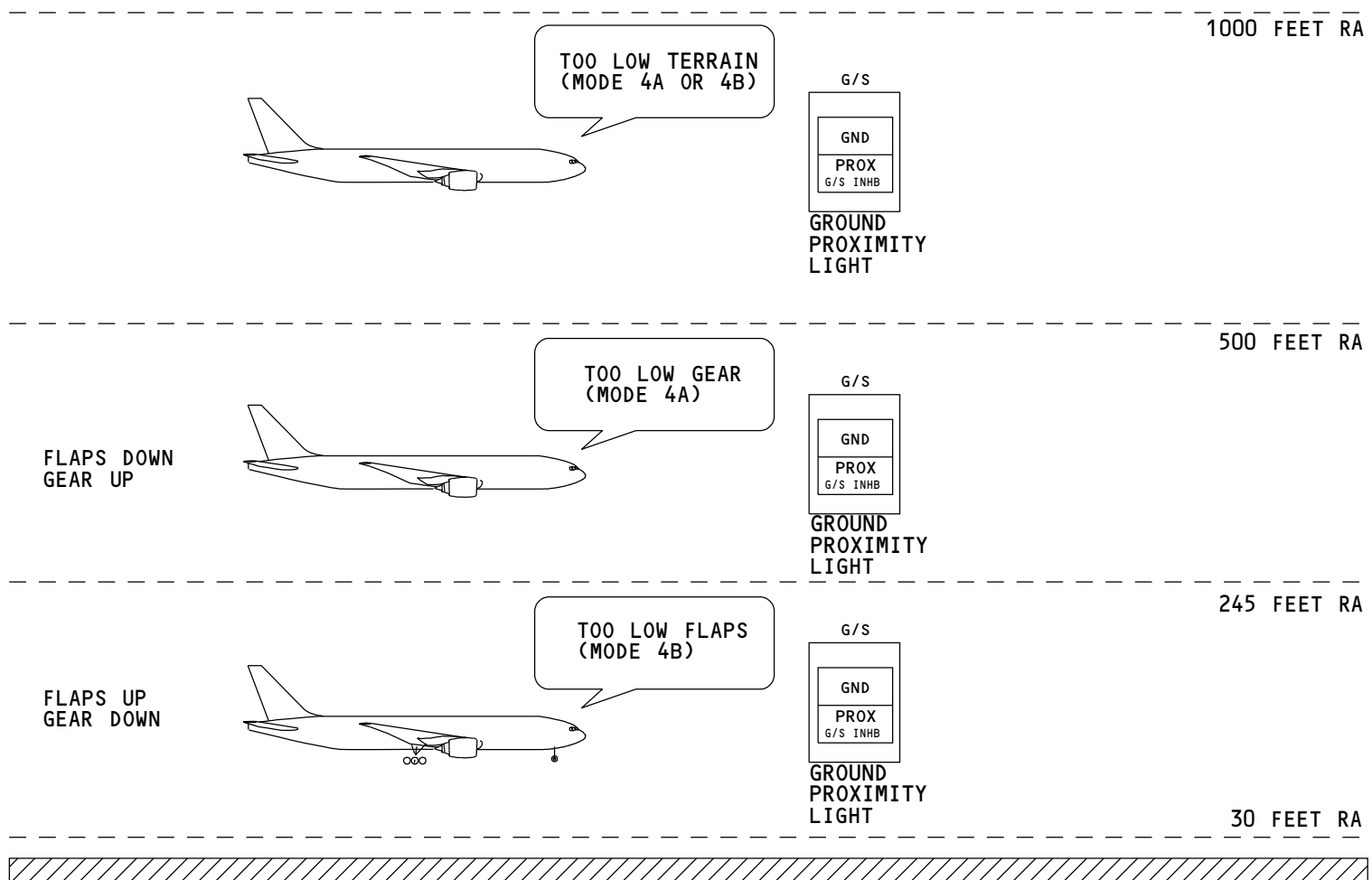
Mode 4 has these two submodes:

- 4A
- 4B.

Description

The Ground Proximity Warning Computer (GPWC) gives a mode 4A alert when the landing gear is up. Mode 4A gives different types of aural messages. The aural messages are TOO LOW GEAR, and TOO LOW TERRAIN. The ground proximity light will come on for either of these aural messages.

The GPWC gives a mode 4B alert when the gear is down and the flaps are less than or equal to 20 units. Mode 4B can have two aural messages depending on airspeed. The aural messages are TOO LOW FLAPS, and TOO LOW TERRAIN. The ground proximity light comes on for either of the aural messages.



M37297 S000619602_V1

GPWS - MODE 4 DESCRIPTION

34-46-00

ARO ALL EFFECTIVITY

D633W101-ARO

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GPWS - MODE 4 OPERATION

General

ARO 001-016

Mode 4 alerts occur between 30 feet and 1000 feet. The LRUs that supply inputs for mode 4 operation are the left, right, and center radio altimeter transceiver and the AIMS cabinets.

ARO ALL

The GPWC uses this data to detect mode 4 alerts:

- Radio altitude
- Computed airspeed
- Flap and gear position.

The mode 4A aural message TOO LOW-GEAR... changes to the aural TOO LOW-TERRAIN... when the airspeed goes more than 190 knots when the flaps are less than 15 units.

ARO 001-008 PRE SB 777-34-0232

If the flaps are more than 15 units, the aural messages change at 159 knots.

ARO 009-999; ARO 001-008 POST SB 777-34-0232

If the flaps are more than 15 units, the aural messages change at 185 knots.

ARO 001-008 PRE SB 777-34-0232

Mode 4B aural message TOO LOW-FLAPS... changes to TOO LOW-TERRAIN when the airspeed goes more than 159 knots.

ARO 009-999; ARO 001-008 POST SB 777-34-0232

Mode 4B aural message TOO LOW-FLAPS... changes to TOO LOW-TERRAIN when the airspeed goes more than 185 knots.

ARO ALL

Mode 4 changes to mode 3 if the airplane goes below 245 feet in landing configuration (flaps and gear down).

Operation

The mode detector uses the inputs to find if there is an alert condition.

If there is an alert condition, the mode detector sends a discrete to turn on the ground proximity light. The alert discrete goes to the speech prom to make the alert aural.

The alert aural goes to the WES which sends it to the aural warning speakers.

The alert discrete also goes to the TCAS computer to inhibit any TCAS advisory messages.

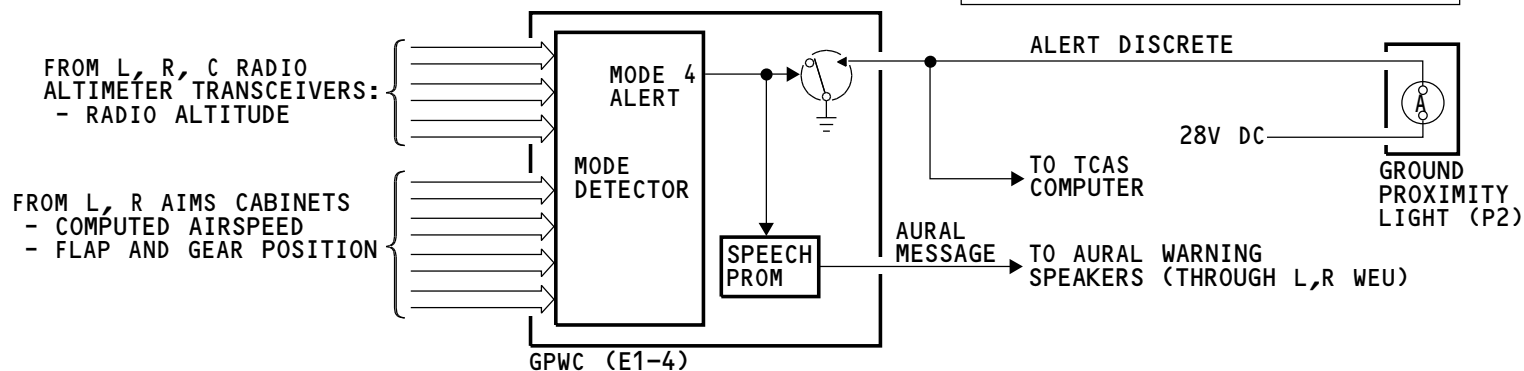
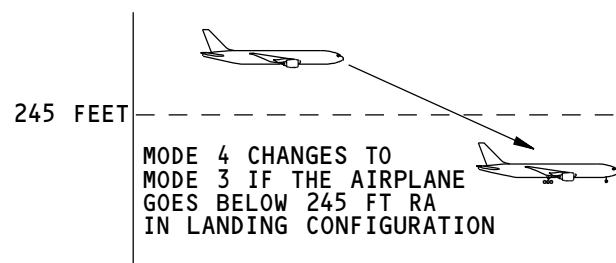
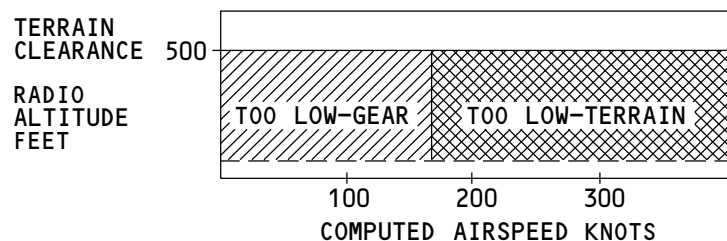
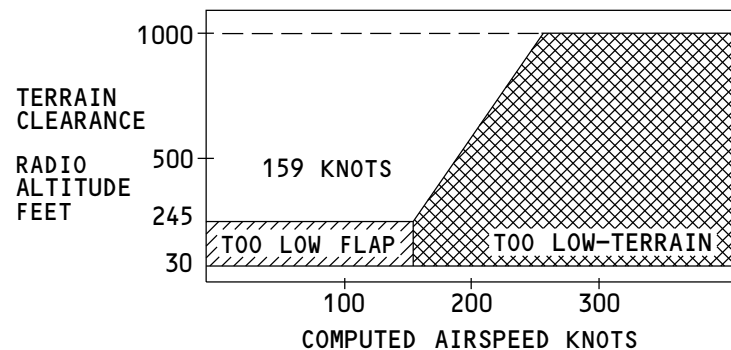
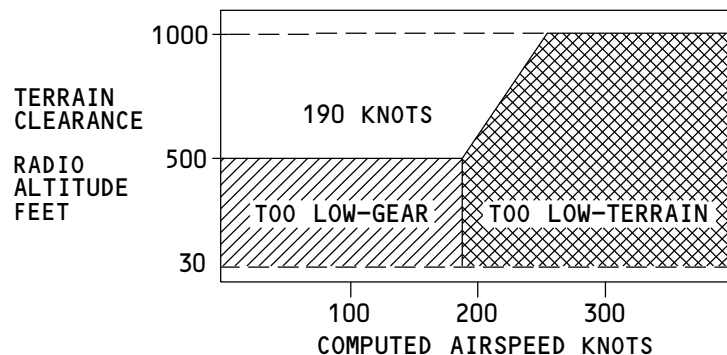
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GPWS - MODE 4 OPERATION

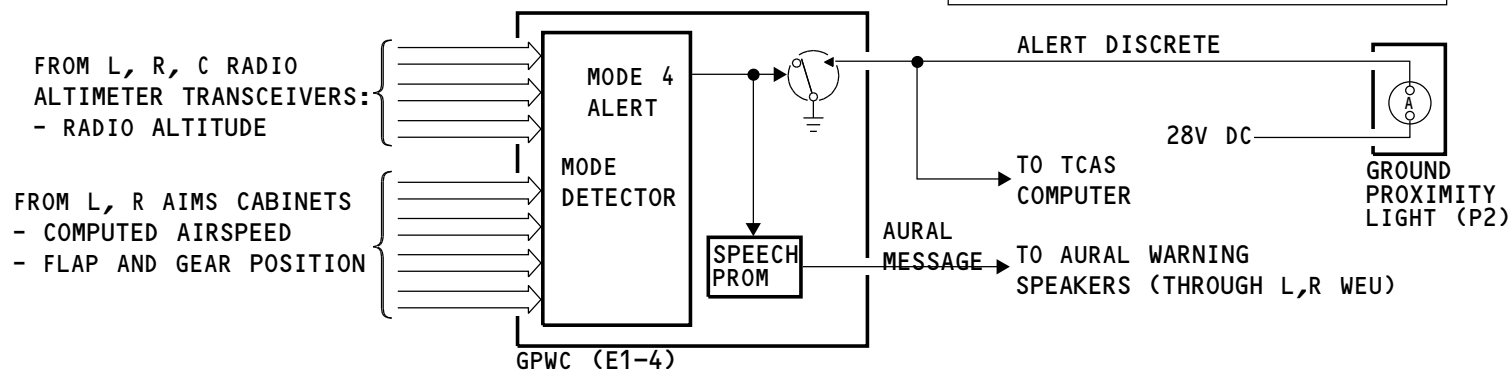
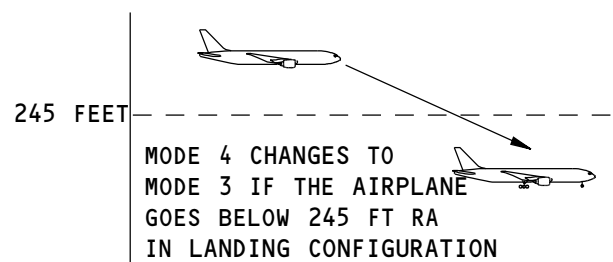
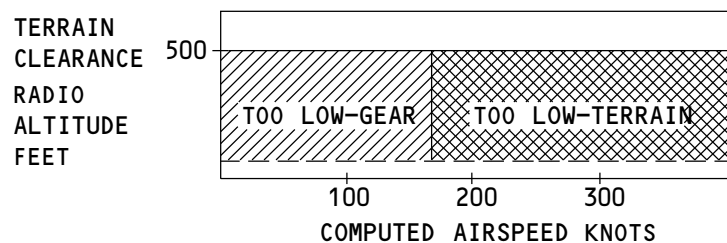
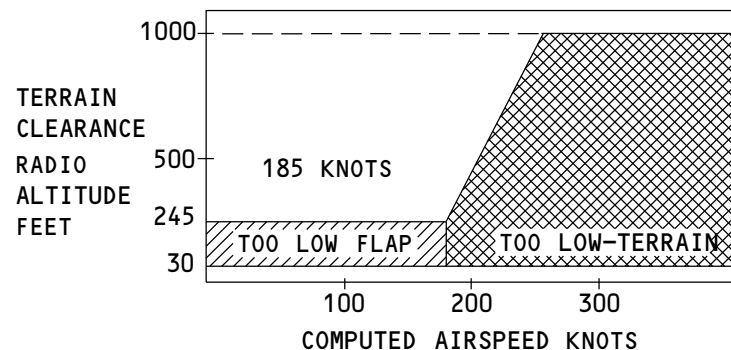
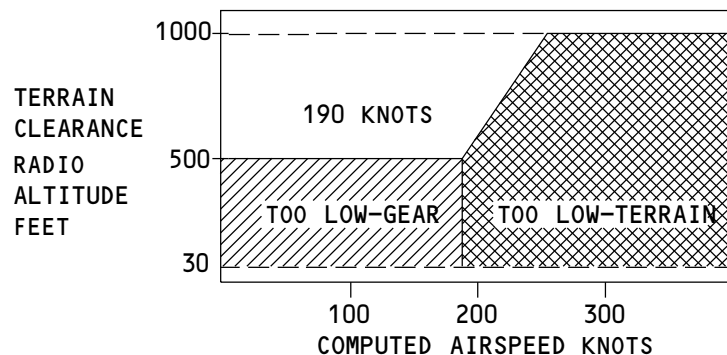
M37300 S000619605_V1

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EFFECTIVITY
ARO 001-008 PRE SB 777-34-0232

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GPWS - MODE 4 OPERATION

2327470 S0000528790_V1

34-46-00

EFFECTIVITY
ARO 009-016; ARO 001-008 POST SB 777-34-0232

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**GPWS - MODE 5 DESCRIPTION****General**

The GPWC gives a mode 5 alert when the airplane is too far below the glideslope during a front course approach when the landing gear is down. Mode 5 does not operate during back course approaches.

Description

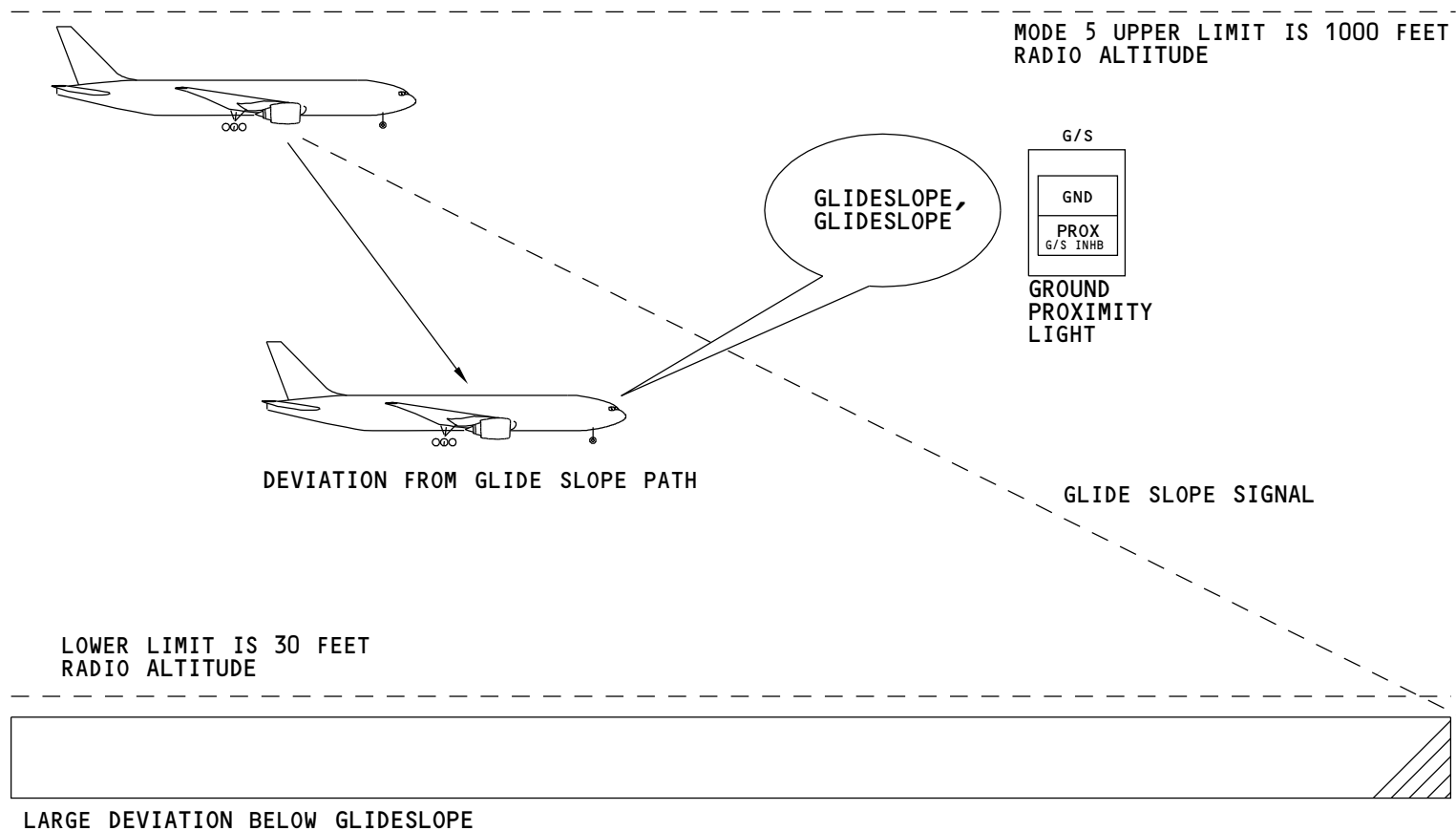
Mode 5 alerts can occur between 30 and 1000 feet. The aural alert message is GLIDESLOPE GLIDESLOPE and the ground proximity light comes on.

The ground proximity glideslope inhibit switch inhibits or cancels mode 5 alerts.

If the deviation below the glideslope increases, the volume of the aural message increases.

The message repeats faster as the terrain gets closer, or if the glideslope deviation increases.

ARO ALL	EFFECTIVITY



GPWS - MODE 5 DESCRIPTION

M37302 S000619607_V1

34-46-00

34-46-00-017

ARO ALL	EFFECTIVITY

D633W101-ARO

GPWS - MODE 5 OPERATION

General

Mode 5 alerts can occur between 30 and 1000 feet radio altitude. Mode 5 arms during these conditions:

- The airplane terrain clearance is less than 1000 feet
- The gear is down
- The glideslope signal is captured.

These LRUs supply inputs for mode 5 operation:

ARO 001-016

- Left, right, and center radio altimeter transceivers

ARO ALL

- Left ILS receiver
- AIMS cabinets.

The GPWC uses this data to detect mode 5 alerts:

- Glideslope deviation
- Selected runway heading
- Magnetic track
- Gear position.

Low level audio occurs below 1000 feet down to 30 feet when the deviation is more than 1.3 dots.

Normal level audio occurs below 300 feet when the deviation is more than 2 dots.

The interval between messages is normally 5.15 seconds. At 300 feet, the message repeats at a faster rate for a larger glideslope deviation.

Operation

Push the ground proximity glideslope inhibit switch to inhibit or cancel mode 5 aural and visual alerts.

If you push the switch before mode 5 alerts begin, you inhibit the aural and visual annunciations.

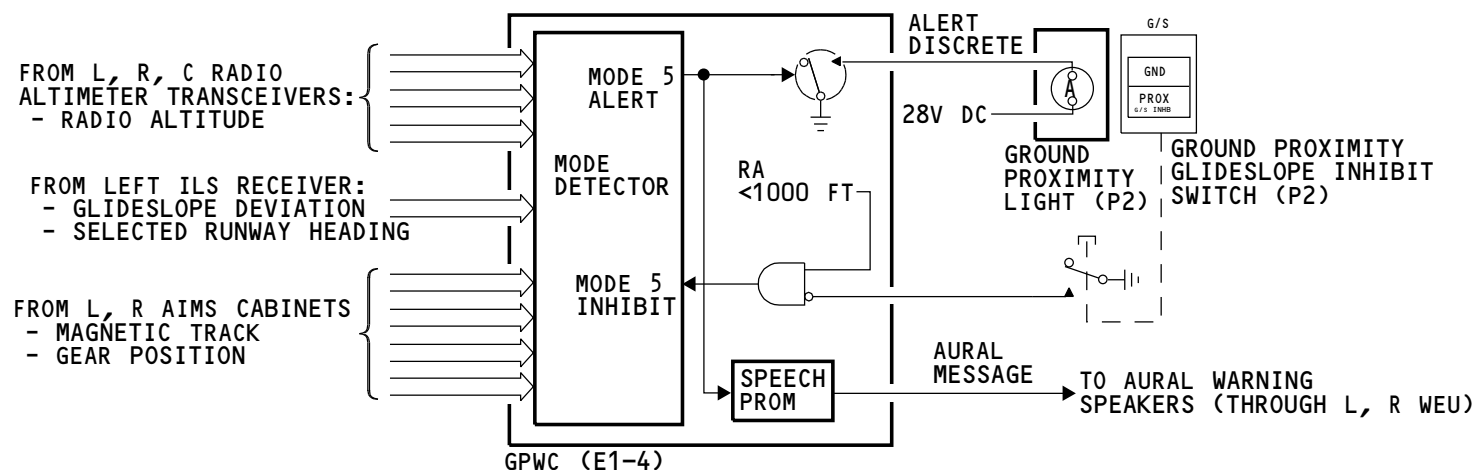
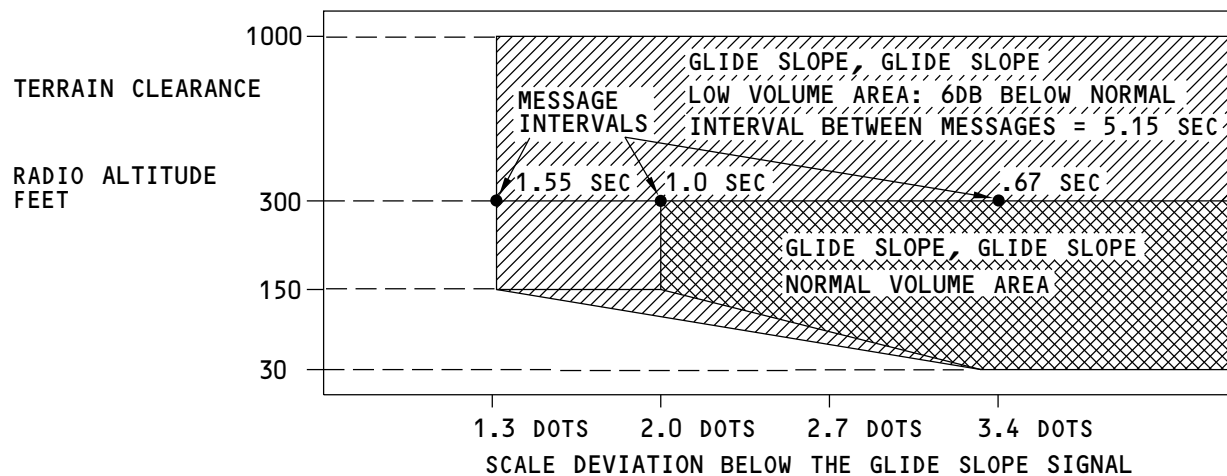
If you push the ground proximity glideslope inhibit switch during a mode 5 alert, you cancel the aural and visual annunciations.

When you inhibit or cancel the alert, you cannot activate it again unless the airplane leaves the mode 5 alert area or you operate the landing gear.

The mode detector uses the inputs to look for an alert condition. If there is an alert condition, the mode detector sends a discrete to turn on the ground proximity light. The discrete goes to the speech prom to make the alert aural.

The alert aural also goes to the WES which sends it to the aural warning speakers.

ARO ALL	EFFECTIVITY



GPWS - MODE 5 OPERATION

M37306 S000619611_V1

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EFFECTIVITY
ARO 001-016

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GPWS - MODE 6 DESCRIPTION**General**

The GPWC gives mode 6 aural callouts when the airplane descends through selected altitudes with the gear down. A program pin selection determines the callout configuration. Mode 6 supplies only callouts. There are no visual indications.

Description

The GPWC receives inputs from:

ARO 001-016

- Left, right, or center radio altimeter transceivers

ARO ALL

- AIMS cabinets

The GPWC uses this data to determine mode 6 alerts:

- Radio altitude
- Gear position
- Program pin selection.

The program program pins do these functions:

- Enable the callouts
- Select the callout configuration
- Select low volume or normal volume for the callouts.

Mode 6 callouts come on only once. These are the two ways to reset mode 6 callouts:

- The airplane climbs through 1,000 feet of radio altitude while on approach.
- The airplane goes from takeoff to approach and the radio altitude is higher than an altitude callout. In this case, only those altitude callouts that are lower than the current radio altitude come on as the airplane descends.

Bank Angle

If the airplane roll angle goes more than 35 degrees, the GPWC makes the callout BANK ANGLE.

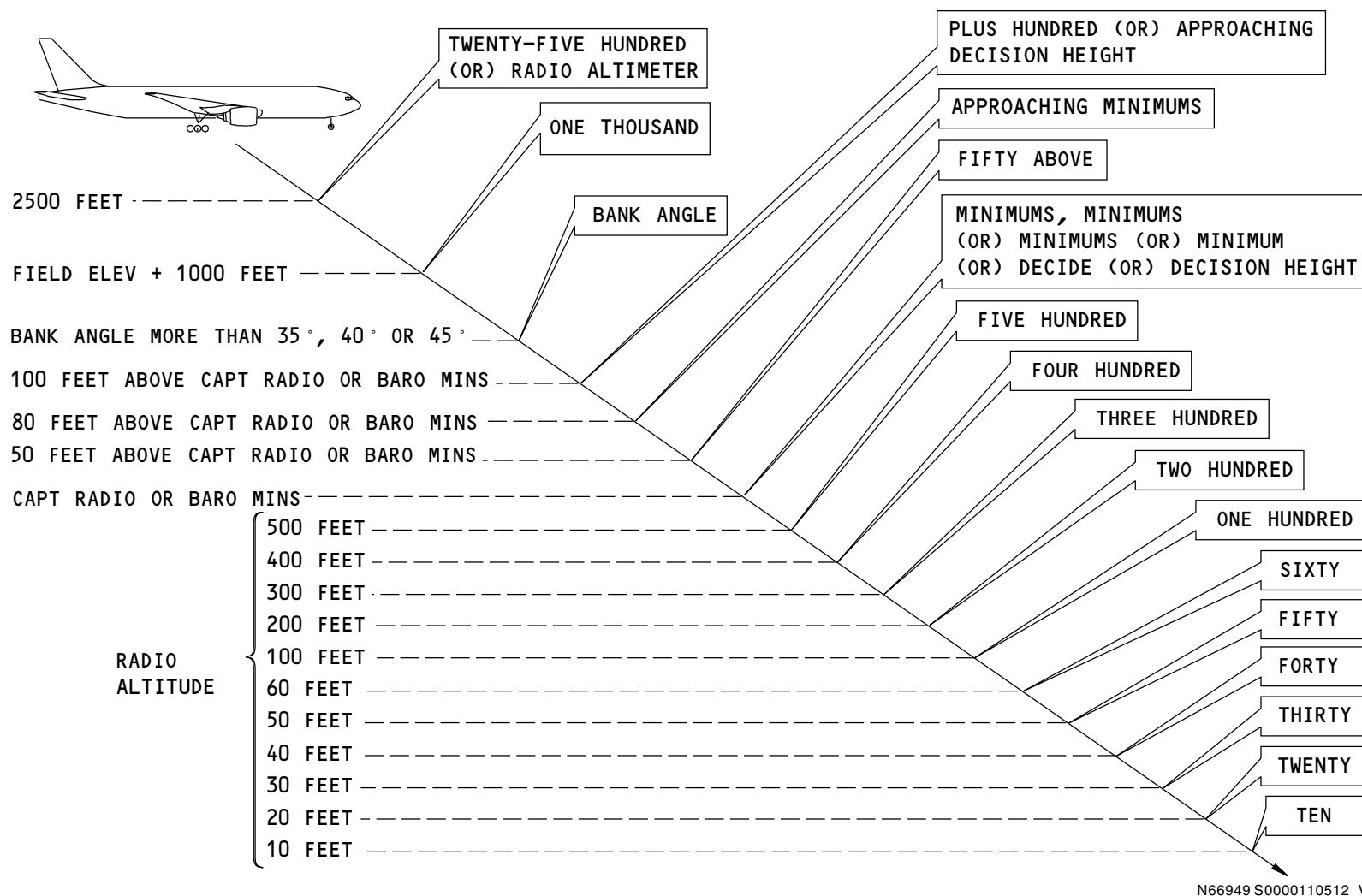
If the roll angle increases to more than 40 degrees, the GPWC makes the callout BANK ANGLE again.

If the roll angle increases again and goes to more than 45 degrees, the GPWC makes the callout BANK ANGLE again.

34-46-00**ARO ALL EFFECTIVITY**

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GPWS - MODE 6 DESCRIPTION

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GPWS - MODE 7 DESCRIPTION

General

The GPWC gives mode 7 warnings when windshear conditions are present in takeoff or approach. The thresholds depend on flap position.

Description

Windshear is the effect of large volumes of air that change direction quickly. The most dangerous type of windshear for airplanes is the microburst. When the airplane is near the terrain, a downward microburst gives a pilot little time to respond to the effects.

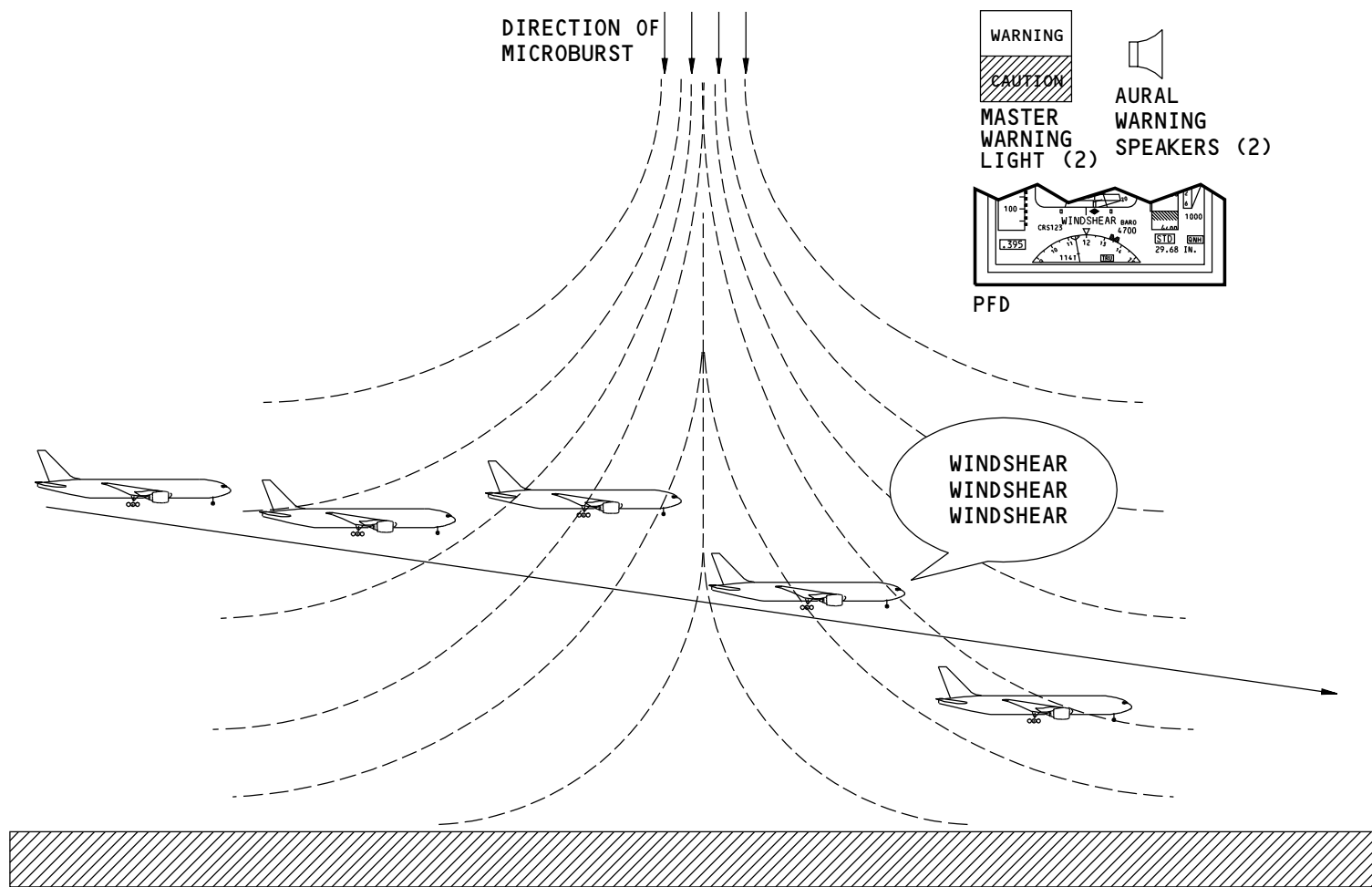
The initial effects on an airplane when it is in a microburst are an increase in airspeed and lift. Because of the increase in lift, the airplane altitude increases.

As the airplane continues through the microburst, the effects quickly change to a loss in airspeed and lift. Because of the decrease in lift, the airplane altitude decreases.

The GPWC uses inputs from airplane systems to detect the changes caused by windshear conditions.

Mode 7 warnings are:

- Master warning lights come on.
- Siren then the aural message WINDSHEAR WINDSHEAR WINDSHEAR from the aural warning speakers
- Red WINDSHEAR message on the PFDs.



M37336 S000619642_V1

GPWS - MODE 7 DESCRIPTION

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34-46-00-020

ARO ALL	EFFECTIVITY

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GPWS - MODE 7 OPERATION

General**ARO 001-008 PRE SB 777-34-0232**

Program pins enable mode 7.

ARO 009-999; ARO 001-008 POST SB 777-34-0232

The OPC enables mode 7 operation.

ARO ALL

These LRUs supply data for mode 7 operation:

ARO 001-016

- Left, right, and center radio altimeter transceivers

ARO ALL

- AIMS cabinets

ARO 001-008 PRE SB 777-34-0232

- Program pins.

ARO ALL

The GPWC uses this data to detect windshear:

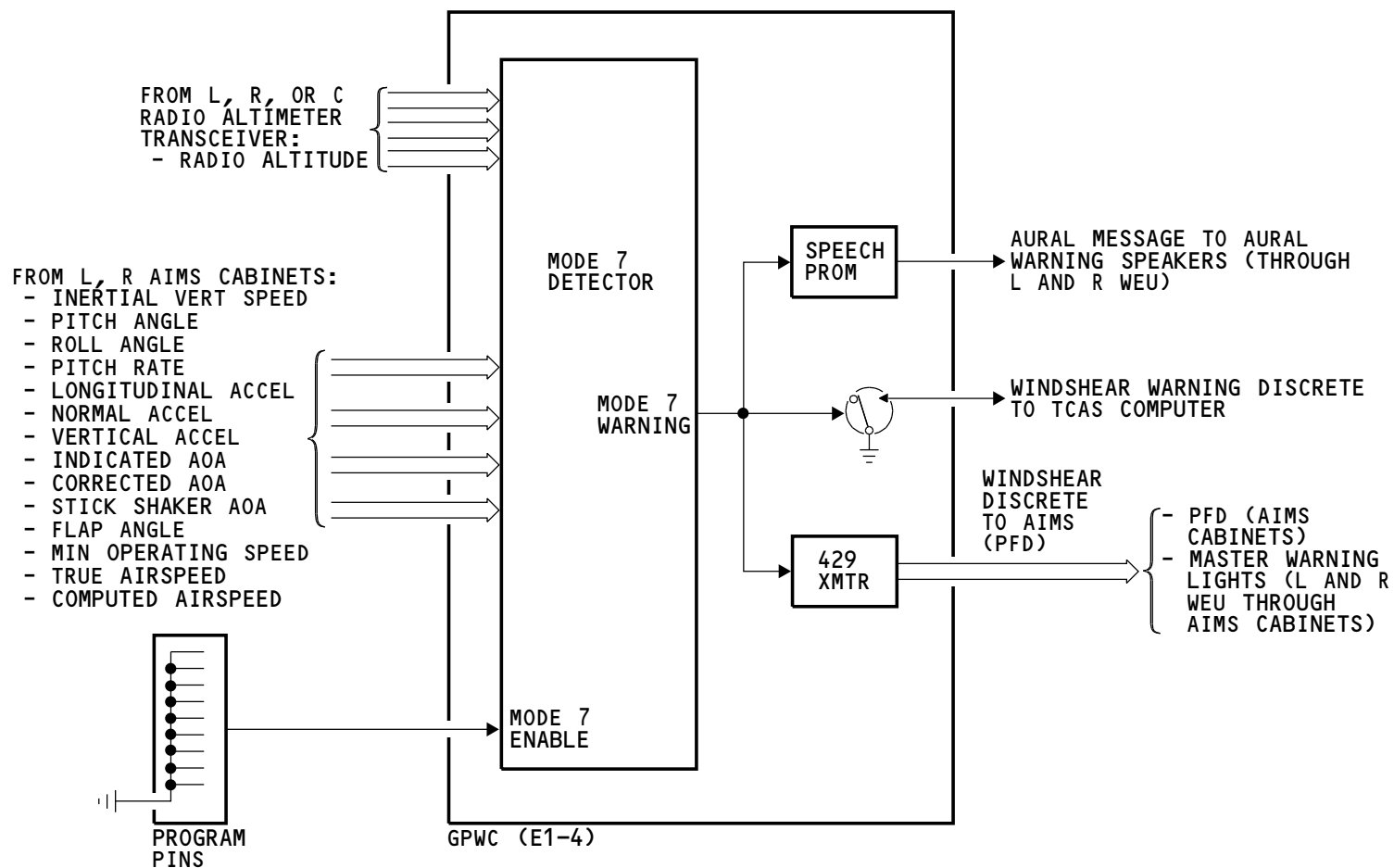
- Radio altitude
- Inertial vertical speed
- Pitch and roll angle
- Pitch rate
- Longitudinal acceleration
- Normal acceleration
- Vertical acceleration
- Indicated angle of attack (AOA)
- Corrected AOA
- Stick shaker AOA
- Flap angle

- Minimum operating speed
- True airspeed
- Computed airspeed.

34-46-00**ARO ALL EFFECTIVITY**

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GPWS - MODE 7 OPERATION

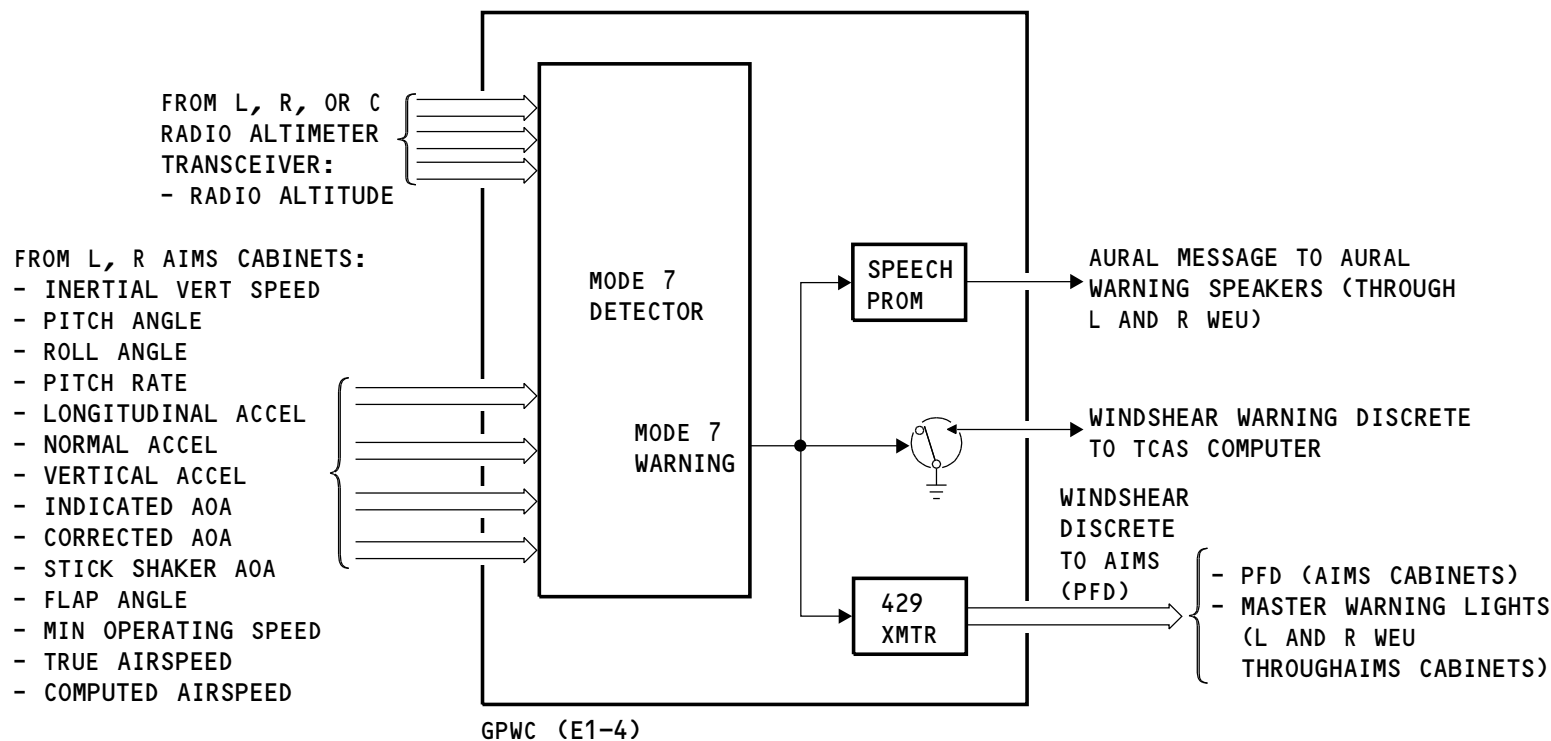
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EFFECTIVITY
ARO 001-008 PRE SB 777-34-0232

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GPWS - MODE 7 OPERATION

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ARO 009-999; ARO 001-008 POST SB 777-34-0232

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May 05/2016

GPWS - TERRAIN AWARENESS

Purpose

The ground proximity warning computer (GPWC) compares the airplane flight profile, flap and gear position, and terrain clearance to determine if an alert or warning condition exists.

Terrain Awareness Inputs

The GPWC receives airplane data from the air data inertial reference system (ADIRS) and the global positioning system (GPS). The terrain awareness function uses this data:

- Latitude
- Longitude
- Barometric altitude
- Ground track
- Ground speed
- Heading
- Roll attitude
- Flight path angle (calculated by GPWC).

Terrain Awareness Calculation

The terrain awareness function uses GPS for latitude and longitude. It uses air data inertial reference system (ADIRS) data if the GPS data is invalid or not available. If the GPWC finds the ADIRS data is not accurate enough for the current flight phase, the terrain awareness function fails.

The GPWC stores a world-wide terrain database in memory. The GPWC looks at airplane position and track, and compares this data to the terrain database. If the GPWC finds there is a terrain threat, it makes an alert.

Terrain Display Output

The GPWC makes a digital map of the terrain forward of the airplane. It sends this digital map to AIMS to show on the navigational displays (NDs). The display uses different colored dots to show terrain altitude relative to airplane altitude.

Terrain Alert Outputs

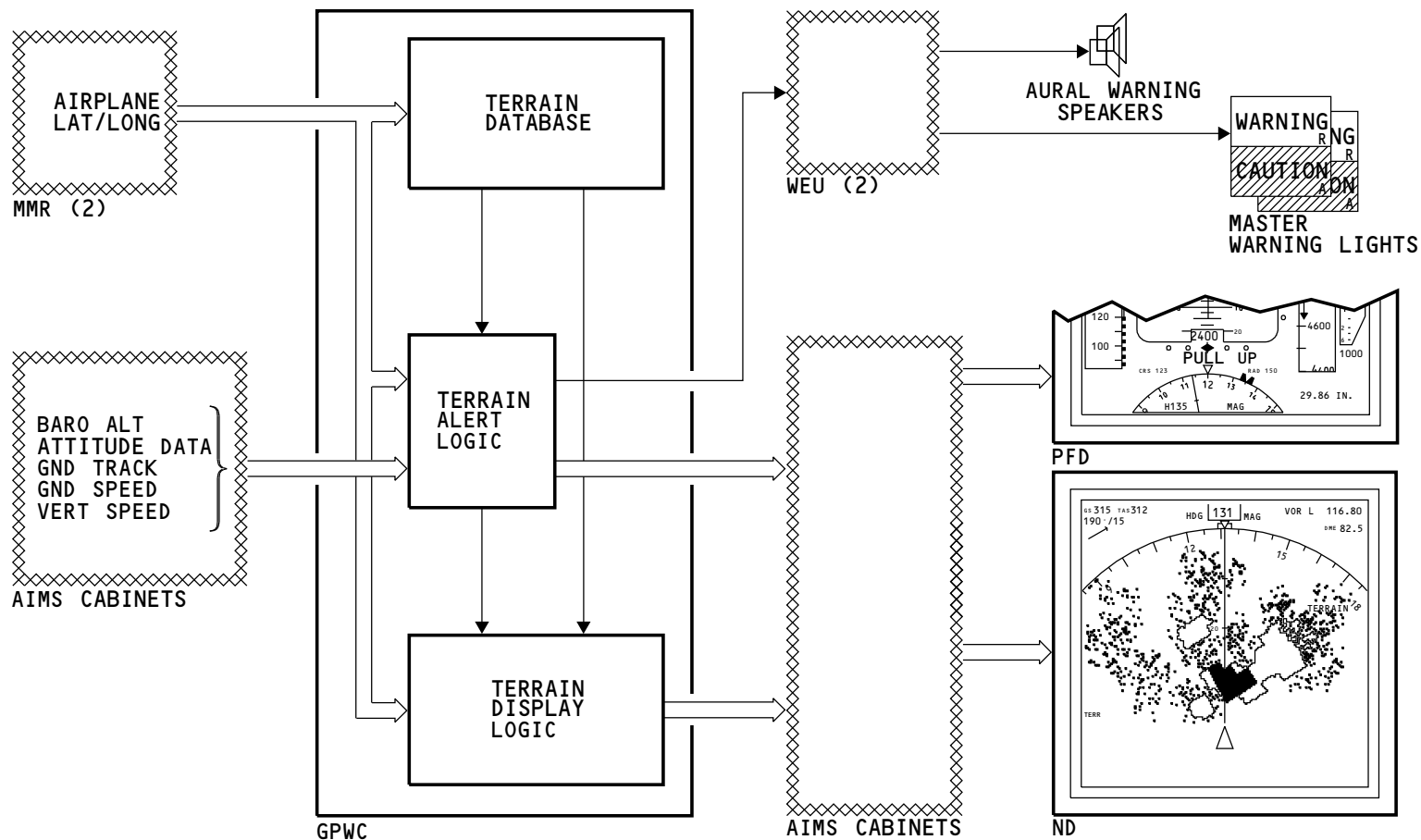
If the GPWC finds the airplane is 60 seconds from a terrain conflict, it makes a terrain caution alert. These are the caution alert indications:

- Alert aural message CAUTION TERRAIN
- Amber message TERRAIN shows on the ND
- The terrain display shows on both NDs if not selected on either one
- The threat terrain on the ND changes from dots to a solid yellow color
- The ground proximity warning light comes on.

If the GPWC finds the airplane is 30 seconds from a terrain conflict, it makes a terrain warning alert. These are the warning alert indications:

- Aural message TERRAIN, TERRAIN PULL UP
- A red PULL UP message shows on the primary flight display (PFD)
- A red TERRAIN message shows on the ND
- The terrain display shows on both NDs if not selected on either one
- The terrain threat on the ND changes from dots to a solid red color
- The master warning lights come on.

ARO ALL	EFFECTIVITY



M37371 S000619678_V1

GPWS - TERRAIN AWARENESS

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34-46-00-035

ARO ALL	EFFECTIVITY
	D633W101-ARO

GPWS - TERRAIN CLEARANCE FLOOR

Description

Terrain clearance floor (TCF) alerts the flight crew when the airplane descends too low on approach. TCF uses airplane position and a runway database to determine if an alert condition exists.

Terrain Clearance Floor Inputs

The ground proximity warning system (GPWS) receives airplane data from these systems:

- Global positioning system (GPS)
- Air data inertial reference system (ADIRS)
- Radio altitude (RA) system.

TCF uses this data:

- Latitude
- Longitude
- Radio altitude.

TCF uses GPS for latitude and longitude. It uses flight management computing function (FMCF) data if GPS data is not valid.

Terrain Clearance Floor Logic

The GPWC stores a runway database in memory. This database contains the location of all hard surface runways in the world that are 3,500 feet or more in length. TCF makes a terrain clearance envelope around the runway. The altitude of the envelope increases as the distance from the airport increases. GPWC compares airplane latitude, longitude, and radio altitude with TCF envelope data. If the airplane descends through the floor of the envelope, GPWC makes an alert.

TCF makes an alert even if the airplane is in landing configuration.

Terrain Clearance Floor Caution Alert

If the GPWC determines the airplane is below the TCF, it makes this caution alert:

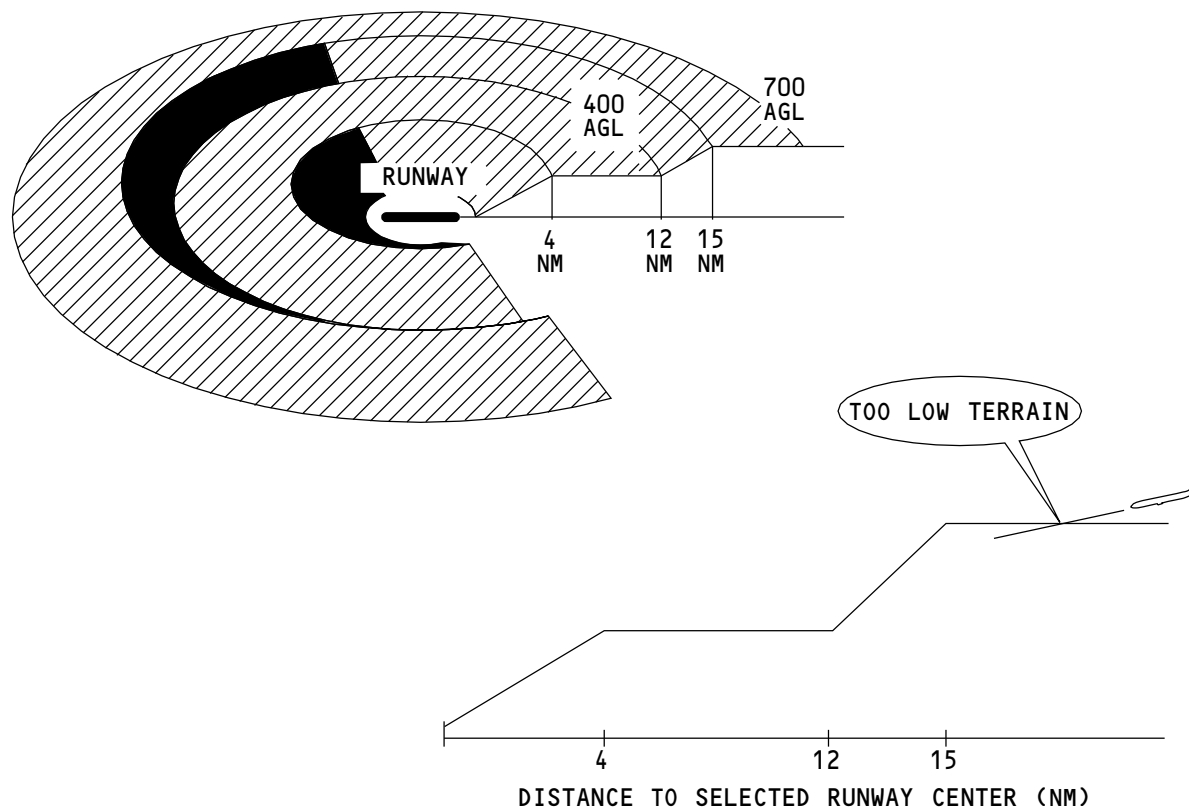
- Aural message TOO LOW TERRAIN. This message repeats for each 20 percent loss of altitude.
- The ground proximity warning light comes on and stays on until the airplane climbs above the TCF.

There is no TCF warning alert.

The GPWC inhibits TCF alerts for any of these conditions:

- Airplane is on the ground
- Less than 20 seconds after takeoff
- Less than 30 feet radio altitude.

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GPWS - TERRAIN CLEARANCE FLOOR

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GPWS - NORMAL DISPLAYS

Terrain Awareness Display Data

The navigational displays (NDs) show this GPWS data:

- Terrain awareness display
- Peak awareness display
- Obstacle awareness display
- GPWS system messages
- GPWS alert messages.

Terrain and Obstacle Awareness Display

The peaks feature shows the highest and lowest elevations for the terrain being displayed. The graphical terrain map is displayed at all altitudes. (Without peaks, the display is blank for elevations greater than 2000 feet above terrain.)

The obstacle feature utilizes a database for obstacle conflict alerting and display that is not yet worldwide. This function provides caution and warning visual and audio alerts when an obstacle conflict is detected.

The terrain awareness display on the NDs uses dots to show terrain ahead of the airplane. Dot color and dot pattern density compare terrain altitude with airplane altitude. These are the dot colors and patterns the terrain display uses:

- High density red - Terrain more than 2,000 feet above airplane altitude.
- High density yellow - Terrain 1,000 feet to 2,000 feet above airplane altitude.
- Low density yellow - Terrain 500 feet below to 1,000 feet above airplane altitude. Gear down changes the 500 feet to 250 feet.
- Solid green - Shows highest terrain not within 500 feet (250 feet with gear down) of airplane altitude. Shows only when no red or yellow terrain areas are within range of the display.
- High density green - Terrain 500 feet below to 1,000 feet below airplane altitude. Gear down changes the 500 feet to 250 feet.
- Low density green - Terrain 1,000 feet below to 2,000 feet below airplane altitude.

- Black - No significant terrain.

When the GPWS detects a terrain caution alert, the threat terrain changes from dots to a solid yellow color. When the GPWS detects a terrain warning alert, the threat terrain changes from dots to a solid red color.

When the GPWS detects an obstacle caution alert, the obstacle shows as a solid yellow color. When the GPWS detects an obstacle warning alert, the obstacle shows as a solid red color.

On final approach, terrain near the runway does not show.

GPWS System Messages

These GPWS system messages show on the left side of the ND:

- TERR (cyan) shows when terrain data displays
- TERR TEST (cyan) shows when the GPWS is in self test mode.
- Terrain altitude display - (red, amber or green) Upper number is the highest elevation that shows on the ND. Lower number is the lowest elevation that shows on the ND. When the terrain is flat, only one number shows. Altitude display is in hundreds of feet above mean sea level.

GPWS Alert Messages

These GPWS alert messages show on the right side of the ND:

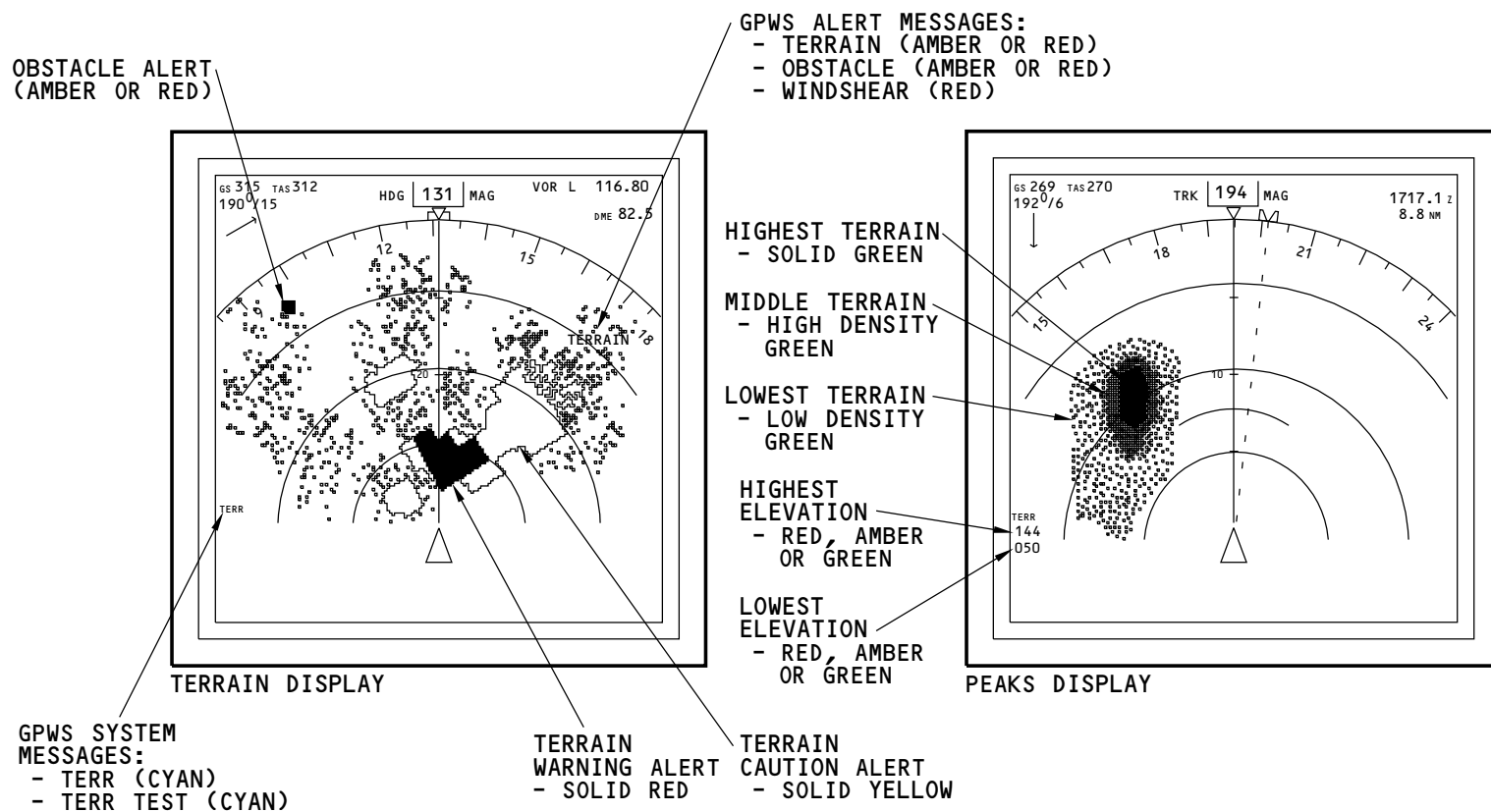
- TERRAIN (amber) shows when a terrain awareness caution occurs
- TERRAIN (red) shows when a terrain awareness warning occurs
- OBSTACLE (amber) shows when an obstacle caution alert occurs
- OBSTACLE (red) shows when an obstacle warning alert occurs
- WINDSHEAR (red) shows when a predictive windshear warning occurs.

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GPWS - NORMAL DISPLAYS

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GPWS - MODE DESCRIPTION SUMMARY

General

This summary shows this information:

- GPWS modes
- Mode conditions
- Aural messages for each mode
- Lights or displays that come on.

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Modes	CONDITION		AURAL MESSAGE	PFD-RED MESSAGE	ND MESSAGE	GND PROX-G/S INHIBIT LIGHT	MWL
1	INITIAL ANNUNCIATION		"SINK RATE..."			X	
	WARNING		"PULL UP..."	PULL UP			X
2A	FLAPS ≤20 AND G/S DEV >2 DOTS	INITIAL ANNUNCIATION	"TERRAIN TERRAIN"			X	
		WARNING	"PULL UP..."	PULL UP			X
		ALTITUDE GAIN FUNCTION: - STARTS WHEN MODE 2 CONDITION STOPS - STOPS WHEN 300 FT OF INERTIAL ALT IS GAINED OR GEAR GOES DOWN	"TERRAIN.."			X	
2B	FLAPS ≥25 OR G/S DEV <2 DOTS	FLAPS AND GEAR DOWN	"TERRAIN.."			X	
		FLAPS AND/OR GEAR UP INITIAL ANNUNCIATION	"TERRAIN TERRAIN.."			X	
		WARNING	"PULL UP..."	PULL UP			X
3A	FLAPS ≤20 AND/OR GEAR UP (FOR ALTITUDE LOSS OF APPROXIMATELY 10% TO 20%)		"DON'T SINK..."			X	
3B	FLAPS ≤20 AND/OR GEAR UP. RA LESS THAN THRESHOLD VALUE.		"TOO LOW TERRAIN..."			X	
4A	GEAR UP	AIRSPEED <190 KNOTS AND RA <500 FT	"TOO LOW GEAR..."			X	
		AIRSPEED >190 KNOTS AND RA CHANGES BUT EQUAL TO OR LESS THAN 1000 FT	"TOO LOW TERRAIN..."			X	
4B	GEAR DOWN FLAPS ≤20	AIRSPEED <159 KNOTS AND RA <245 FT	"TOO LOW FLAPS..."			X	
		AIRSPEED >159 KNOTS AND RA CHANGES BUT EQUAL TO OR LESS THAN 1000 FT	"TOO LOW TERRAIN..."			X	
5	ILS FRONT COURSE APPROACH AND GEAR DOWN	RA <1000 FT AND G/S DEVIATION >1.3 DOTS	"GLIDE SLOPE..." AT 1/2 VOLUME, FREQ PROPORTIONAL TO DEVIATION AND GROUND PROXIMITY.			X	
		RA <300 FT AND G/S DEVIATION >2.0 DOTS	"GLIDE SLOPE..." AT FULL VOLUME, FREQ PROPORTIONAL TO G/S DEVIATION AND GROUND PROXIMITY.			X	
6	GEAR DOWN		RADIO ALTITUDE CALLOUTS AS SELECTED BY PROGRAM PINS				
7	WINDSHEAR CONDITION		SIREN, THEN "WINDSHEAR, WINDSHEAR, WINDSHEAR..."	WINDSHEAR			X
TERR	60 SEC TO THREAT TERRAIN		"CAUTION, TERRAIN..."		TERRAIN	X	
	30 SEC TO THREAT TERRAIN		"TERRAIN, TERRAIN, PULL UP..."	PULL UP	TERRAIN		X
TCF	AIRPLANE BELOW TERRAIN CLEARANCE FLOOR		"TOO LOW TERRAIN..."			X	

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GPWS - MODE DESCRIPTION SUMMARY

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Modes	CONDITION		AURAL MESSAGE	PFD-RED MESSAGE	ND MESSAGE	GND PROX-G/S INHIBIT LIGHT	MWL
1	INITIAL ANNUNCIATION		"SINK RATE..."			X	
	WARNING		"PULL UP..."	PULL UP			X
2A	FLAPS ≤20 AND G/S DEV >2 DOTS	INITIAL ANNUNCIATION	"TERRAIN TERRAIN"			X	
		WARNING	"PULL UP..."	PULL UP			X
		ALTITUDE GAIN FUNCTION: - STARTS WHEN MODE 2 - CONDITION STOPS - STOPS WHEN 300 FT OF INERTIAL ALT IS GAINED OR GEAR GOES DOWN	"TERRAIN..."			X	
2B	FLAPS ≥25 OR G/S DEV <2 DOTS	FLAPS AND GEAR DOWN	"TERRAIN..."			X	
		FLAPS AND/OR GEAR UP	"TERRAIN TERRAIN..."			X	
		WARNING	"PULL UP..."	PULL UP			X
3A	FLAPS ≤20 AND/OR GEAR UP (FOR ALTITUDE LOSS OF APPROXIMATELY 10% TO 20%)		"DON'T SINK..."			X	
3B	FLAPS ≤20 AND/OR GEAR UP. RA LESS THAN THRESHOLD VALUE.		"TOO LOW TERRAIN..."			X	
4A	GEAR UP	AIRSPEED <190 KNOTS AND RA <500 FT	"TOO LOW GEAR..."			X	
		AIRSPEED >190 KNOTS AND RA CHANGES BUT EQUAL TO OR LESS THAN 1000 FT	"TOO LOW TERRAIN..."			X	
4B	GEAR DOWN FLAPS ≤20	AIRSPEED <185 KNOTS AND RA <245 FT	"TOO LOW FLAPS..."			X	
		AIRSPEED >185 KNOTS AND RA CHANGES BUT EQUAL TO OR LESS THAN 1000 FT	"TOO LOW TERRAIN..."			X	
5	ILS FRONT COURSE APPROACH AND GEAR DOWN	RA <1000 FT AND G/S DEVIATION >1.3 DOTS	"GLIDE SLOPE..." AT 1/2 VOLUME, FREQ PROPORTIONAL TO DEVIATION AND GROUND PROXIMITY.			X	
		RA <300 FT AND G/S DEVIATION >2.0 DOTS	"GLIDE SLOPE..." AT FULL VOLUME, FREQ PROPORTIONAL TO G/S DEVIATION AND GROUND PROXIMITY.			X	
6	GEAR DOWN		RADIO ALTITUDE CALLOUTS AS SELECTED BY PROGRAM PINS				
7	WINDSHEAR CONDITION		SIREN, THEN "WINDSHEAR, WINDSHEAR, WINDSHEAR..."	WINDSHEAR			X
TERR	60 SEC TO THREAT TERRAIN		"TERRAIN AHEAD..."		TERRAIN	X	
	30 SEC TO THREAT TERRAIN		"TERRAIN AHEAD, PULL UP..."	PULL UP	TERRAIN		X
TCF	AIRPLANE BELOW TERRAIN CLEARANCE FLOOR		"TOO LOW TERRAIN..."			X	

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GPWS - MODE DESCRIPTION SUMMARY

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GPWS - SPEECH PROM**General**

The speech PROM supplies aural messages when the mode detector detects an alert or warning condition.

The speech PROM also gives altitude callouts for selected radio altitudes.

Description

The speech PROM gives only one message at a time. If more than one message discrete comes from the mode detector, the speech PROM sends the message that has the highest priority.

The glideslope repetition rate circuit controls the repetition rate of the glideslope message.

ARO 001-008 PRE SB 777-34-0232

The program pins select the radio altitude callout configuration.

ARO 009-999; ARO 001-008 POST SB 777-34-0232

The OPC selects the radio altitude callout configuration.

ARO ALL**Training Information Point**

The GPWC stores these two aural which are not related to the GPWC alert modes:

- ENGINE FAIL
- V1.

The GPWC makes these aural come on when the GPWC receives a request from the AIMS.

The AIMS makes the ENGINE FAIL aural request when an engine fails, the airplane is on the ground, and the airplane CAS is more than 65 knots, but less than 3 knots below V1. V1 is the takeoff decision speed.

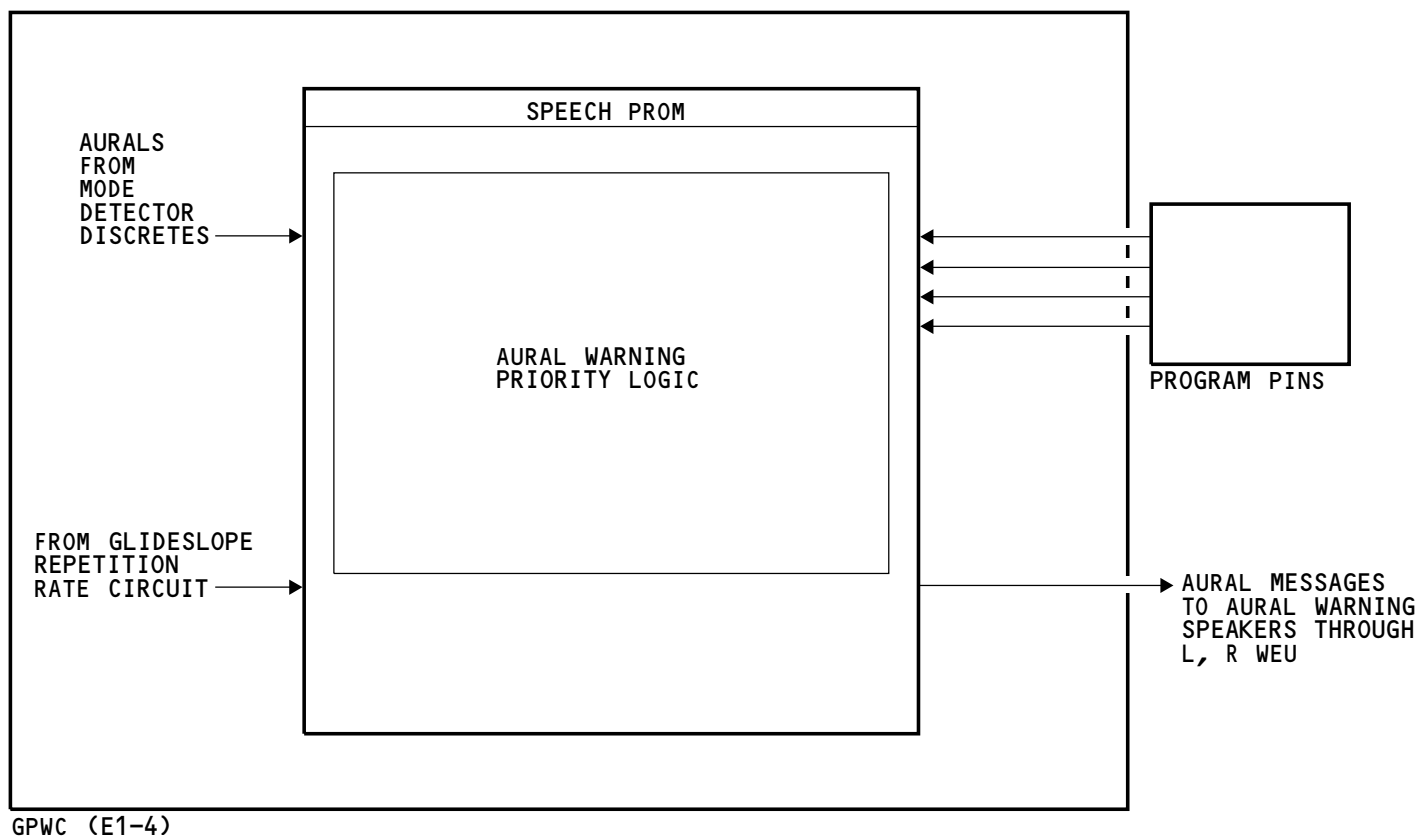
The ENGINE FAIL and V1 aural do not come on during a GPWC test.

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GPWS - SPEECH PROM

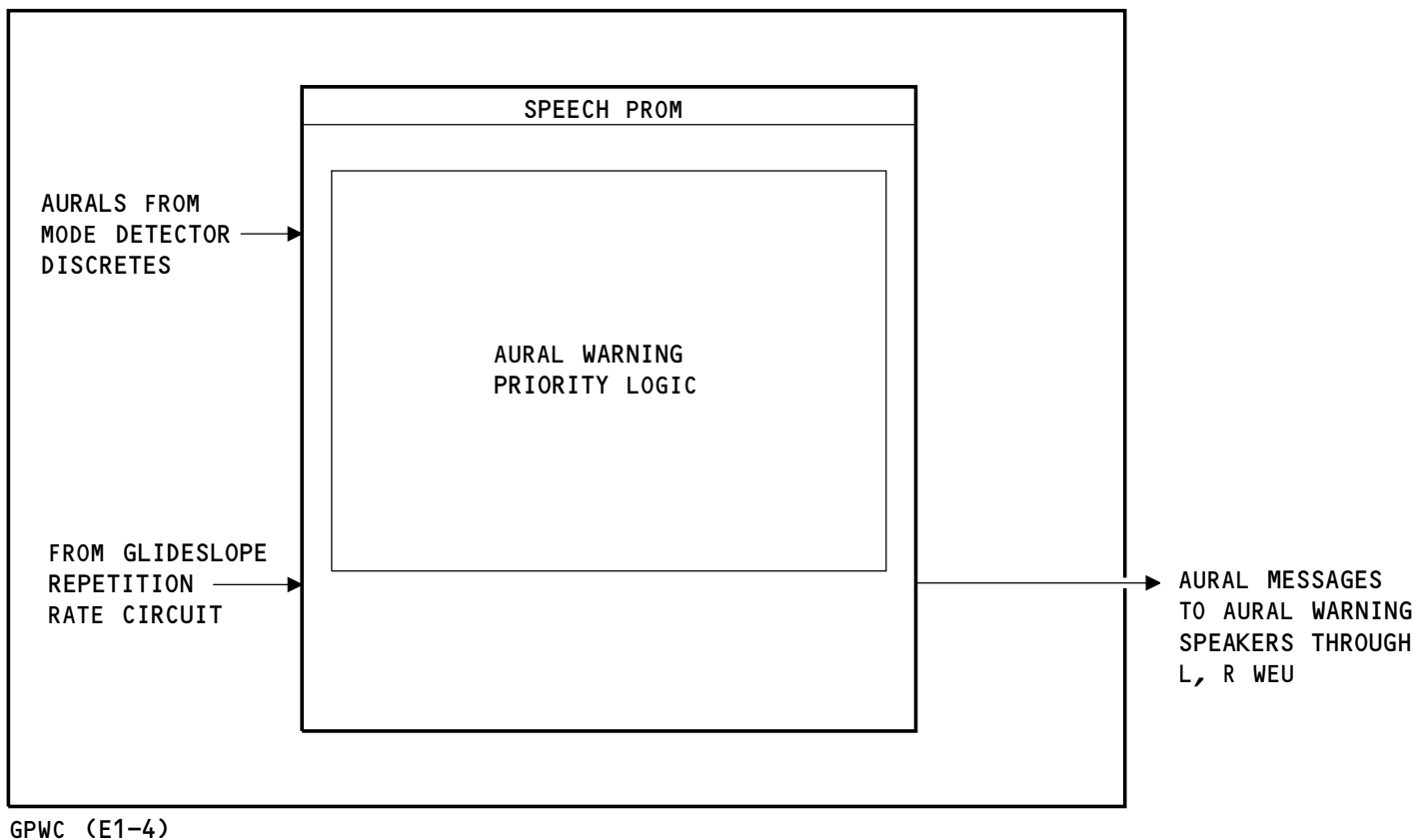
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GPWS - SPEECH PROM

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**GPWS - ENVELOPE MODULATION****General**

Some airports have unusual terrain clearances near their runways that cause false messages by the GPWS. Envelope modulation modifies specific alert and warning areas to prevent false messages.

Functional Description

The airports that need envelope modulation are in the GPWC memory and identified by their latitude and longitude. As the airplane approaches one of these airports, the GPWC looks at other airplane parameters to verify if an envelope modulation condition exists. The additional parameters are:

- Radio altitude
- Magnetic track
- Glide slope deviation
- Localizer deviation
- Selected runway heading
- Barometric corrected altitude.

MODE	TYPE OF MODULATION	PURPOSE OF MODULATION
1	RAISES THE DESCENT RATE LIMIT	TO PERMIT GREATER BAROMETRIC DESCENT RATES WITHOUT FALSE ALERTS/WARNINGS
2	LOWERS RADIO ALTITUDE LIMITS	TO PERMIT THE AIRPLANE TO FLY CLOSER TO THE TERRAIN WITHOUT FALSE ALERTS/WARNINGS
4	LOWERS RADIO ALTITUDE LIMITS	TO LOWER THE MINIMUM TERRAIN CLEARANCE DURING HIGH AIRSPEEDS TO PREVENT FALSE ALERTS
5	- RAISES RADIO ALTITUDE LIMITS - REMOVES GEAR DOWN REQUIREMENTS	TO PERMIT MODE 5 ANNUNCIATIONS AT HIGHER ALTITUDES WITHOUT THE GEAR DOWN
6	REMOVES GEAR DOWN REQUIREMENTS	TO PERMIT MODE 6 ANNUNCIATIONS WITHOUT THE GEAR DOWN

GPWS - ENVELOPE MODULATION

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**GPWS - OVERRIDE CAPABILITIES****General**

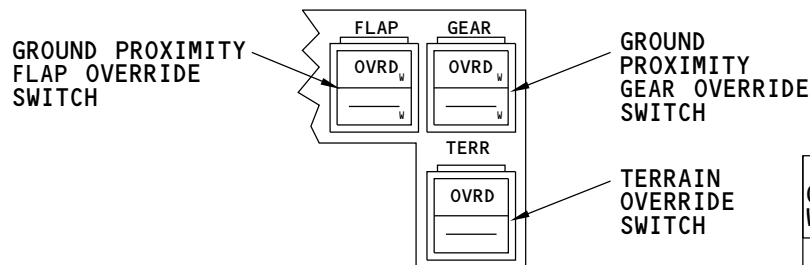
These override switches modify or cancel certain GPWS modes:

- Ground proximity flap override switch
- Ground proximity gear override switch
- Terrain override switch.

The graphic shows these conditions:

- Modes
- Configuration of the flaps and gear
- Effects of each override switch for the mode.

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GROUND PROXIMITY WARNING SYSTEM MODE	FLAP AND GEAR POSITION	OVERRIDE SWITCH ACTIVE	EFFECT OF OVERRIDE SWITCH
MODE 2A LARGE CLOSURE RATE WHEN NOT IN LANDING (FLAPS UP AND G/S DEVIATION > 2 DOTS)	FLAPS UP, GEAR UP OR DOWN.	FLAP	MODE 2A CHANGES TO MODE 2B
		GEAR	INHIBIT ALTITUDE GAIN FUNCTION
MODE 2B LARGE CLOSURE RATE WHEN IN LANDING (FLAPS DOWN AND G/S DEVIATION < 2 DOTS)	FLAPS DOWN AND GEAR UP	GEAR	"PULL UP" CHANGES TO "TERRAIN". RED MWL CHANGES TO AMBER GND PROX LIGHT
	FLAPS UP AND GEAR DOWN	FLAP	
MODE 3A LARGE ALTITUDE LOSS IN CLIMB-OUT OR GO-AROUND WITH FLAPS AND/OR GEAR UP	FLAPS UP AND GEAR DOWN	FLAP	INHIBIT MODE 3
	FLAPS DOWN AND GEAR UP	GEAR	INHIBIT MODE 3

GROUND PROXIMITY WARNING SYSTEM MODE	FLAP AND GEAR POSITION	OVERRIDE SWITCH ACTIVE	EFFECT OF OVERRIDE SWITCH
MODE 4A TERRAIN CLEARANCE NOT SAFE WITH GEAR UP	FLAPS UP	FLAP	AT HIGH SPEED, THRESHOLD CHANGES FROM 1000' TO 500'
		GEAR	MODE 4A CHANGES TO MODE 4B
	FLAPS DOWN	GEAR	INHIBIT MODE 4
MODE 4B TERRAIN CLEARANCE NOT SAFE WITH GEAR DOWN AND FLAPS UP		FLAP	INHIBIT MODE 4
MODE 5 BELOW GLIDESLOPE WITH GEAR UP		GEAR	ENABLE MODE 5
MODE 6 RADIO ALTITUDE CALLOUTS WITH GEAR DOWN		GEAR	ENABLE MODE 6
TERRAIN TERRAIN THREAT		TERRAIN	INHIBIT TERRAIN ALERTS

NOTE: THE OVERRIDE SWITCHES HAVE NO EFFECT ON MODES 1 AND 7

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GPWS - OVERRIDE CAPABILITIES

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**GPWS - PFD AND MASTER WARNING LIGHT ANNUNCIATIONS****Master Warning Lights**

The captain and first officer red master warning lights come on with a PULL UP or WINDSHEAR warning. The AIMS cabinets send a discrete to the warning electronic system (WES) to enable the lights.

PFD Warning Annunciations

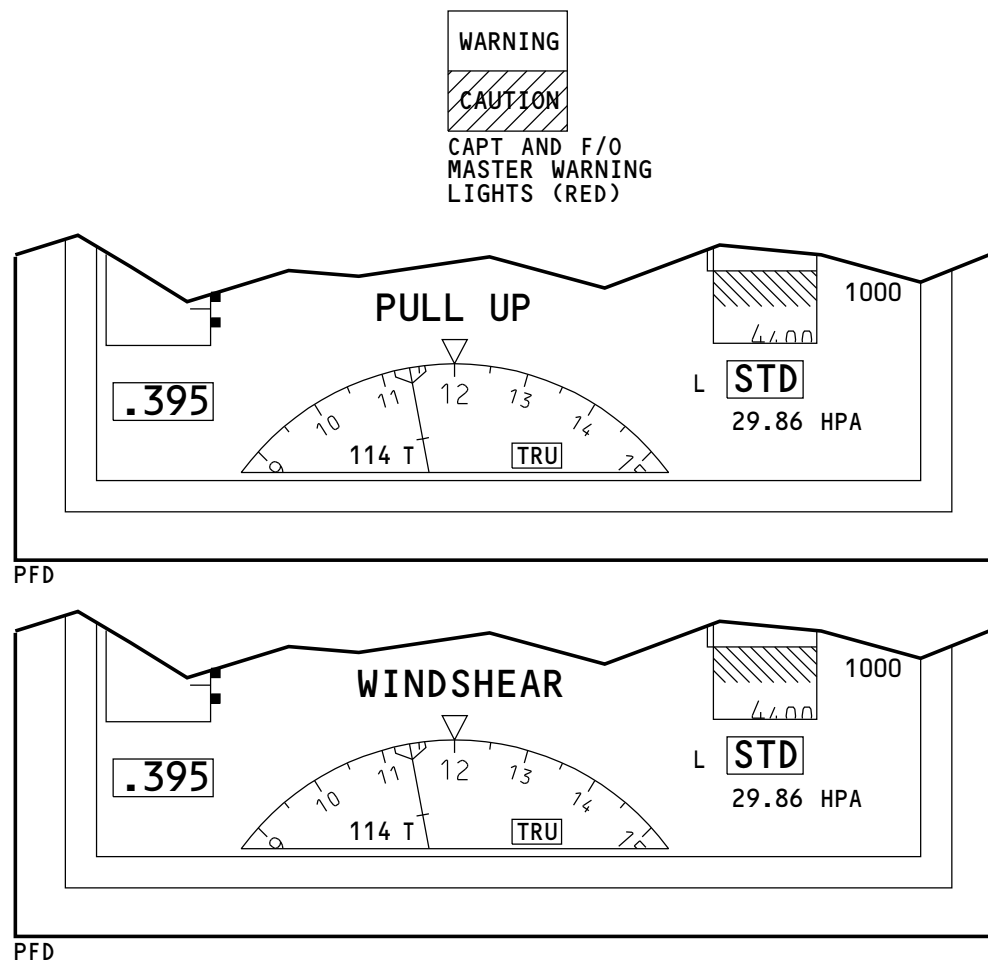
The primary flight displays (PFDs) show these two GPWS messages:

- Red PULL UP
- Red WINDSHEAR.

The red PULL UP message shows for these conditions:

- Mode 1 warnings
- Mode 2 warnings
- Terrain awareness warnings.

The red WINDSHEAR message shows a mode 7 warning.



GPWS - PFD AND MASTER WARNING LIGHT ANNUNCIATIONS

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GPWS - NON-NORMAL DISPLAYS

GPWS Non-Normal Messages

These messages show on the navigational display (ND) to alert the flight crew of GPWS non-normal conditions:

- System alert messages
- Range disagree messages.

GPWS System Alert Messages

These messages show in amber on the left side of the ND:

- TERR POS shows when the GPWS determines airplane position data is not valid
- TERR OVRD shows when you push the terrain override switch on the landing gear panel
- TERR FAIL shows when a fault occurs in the GPWS.

Terrain data does not show on either ND if there is a system alert message.

Range Disagree Messages

These alert messages show in amber on the ND when there is a range disagree fault:

- TERR RANGE DISAGREE shows when the GPWS range disagrees with the range selected on the on-side EFIS control panel
- MAP/TERR RANGE DISAGREE shows when the GPWS range, the on-side EFIS range, and the FMC range disagree.

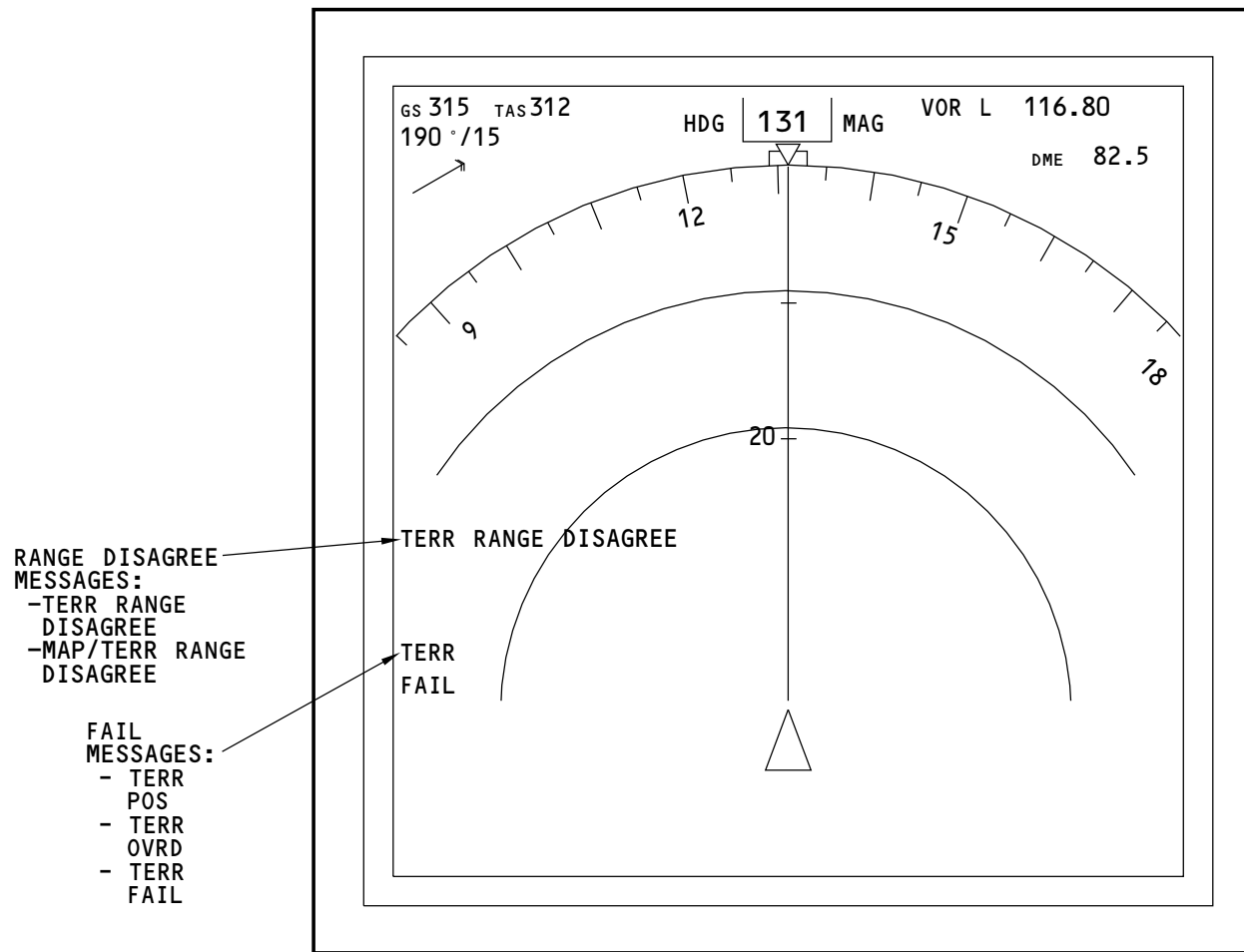
Terrain data does not show on the ND if there is a range disagree message.

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GPWS SYSTEM ALERT MESSAGES AND DISPLAY

GPWS - NON-NORMAL DISPLAYS

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GPWS - SELF TEST - LEVEL 1

General

The ground proximity warning system (GPWS) has six levels of self-test. Each level provides different information about the GPWS. These are the six levels of self-test:

- GO/NO-GO operational test
- Current faults
- System configuration
- Fault history
- Alert/warning history
- Discrete input test.

Level one is a GO/NO-GO operational test. A level one test provides visual and aural annunciations on the flight deck.

Level One Test Preparation

These conditions must be true to do a level one self-test of the GPWS:

- Airplane on ground
- GPWS power on
- EFIS ND mode selector in correct mode (expanded VOR, APP, or MAP or centered MAP)
- TERR switch on EFIS control panel (CP) selected.

Level One Test Procedure

Select operational test from the maintenance access terminal (MAT) to begin a level one test. A level one test first does a test of these configuration conditions:

- Program pin parity
- Airplane configuration database validity
- Airplane type.

If the test finds a configuration fault, the self-test annunciates the fault and the self-test ends. If the GPWS passes the configuration test, the level one test continues.

Training Information Point

You can start a level one self-test from the front panel of the GPWC, but you cannot see the flight deck annunciations. Use the MAT to start an operational test of the GPWS.

Level One Test - Normal Indications

These messages will show at some time for a normal Level one self-test:

- EICAS Advisory - GROUND PROX SYS
- EICAS Advisory - WINDSHEAR SYS
- EICAS Advisory - ALTITUDE CALLOUTS
- EICAS Advisory - TERR POS
- EICAS Status - GROUND PROX SYS
- EICAS Status - WINDSHEAR REAC
- EICAS Status - TERR SYS
- Amber ND alert message - TERR TEST
- Amber ND alert message - TERR FAIL.

These visual and aural annunciations are for a normal level one test:

- ND system message TERR TEST shows in cyan
- Ground proximity warning light on and aural message GLIDESLOPE
- Master warning lights on, PFD message PULL UP (red), and aural message PULL UP
- Master warning lights on, PFD message WINDSHEAR (red), and aural message WINDSHEAR, WINDSHEAR, WINDSHEAR
- Terrain test pattern shows on ND for 12 seconds

GPWS - SELF TEST - LEVEL 1

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- Operational Program Configuration software part number and terrain database version number in the center of the terrain test pattern on the ND.

ARO ALL

- Master warning lights on, PFD message PULL UP (red), TERRAIN alert message (red) on NDs, and aural message TERRAIN, TERRAIN, PULL UP.
- Ground proximity light on and TERRAIN alert message (amber) on NDs
- Aural message SINKRATE
- Aural message PULL UP
- Aural message TERRAIN
- Aural message PULL UP
- Aural message DONT SINK
- Aural message DONT SINK
- Aural message TOO LOW TERRAIN
- Aural message TOO LOW GEAR
- Aural message TOO LOW FLAPS
- Aural message TOO LOW TERRAIN
- Aural message GLIDESLOPE
- Aural message BANK ANGLE, BANK ANGLE
- Mode 6 altitude callouts
- Aural message WINDSHEAR, WINDSHEAR, WINDSHEAR
- Aural message TOO LOW TERRAIN
- Aural message CAUTION TERRAIN, CAUTION TERRAIN
- Aural message TERRAIN, TERRAIN, PULL UP.
- Master warning lights on, PFD message PULL UP (red), OBSTACLE alert message (red) on NDs, and aural message OBSTACLE, OBSTACLE, PULL UP
- Ground proximity light on and OBSTACLE alert message (amber) on NDs
- Aural message CAUTION OBSTACLE, CAUTION OBSTACLE

Level One Self-Test - Non-Normal Indications

The GPWS level one test fails for any of these conditions:

- The terrain test pattern does not show
- The TERR FAIL message on the ND stays on
- You do not see and hear all annunciations.

Training Information Point

Some GPWS modes have the same annunciations. If you do not see and hear all annunciations, the test fails.

GPWS Mode Failures

These aural messages that show for GPWS modes that do not function:

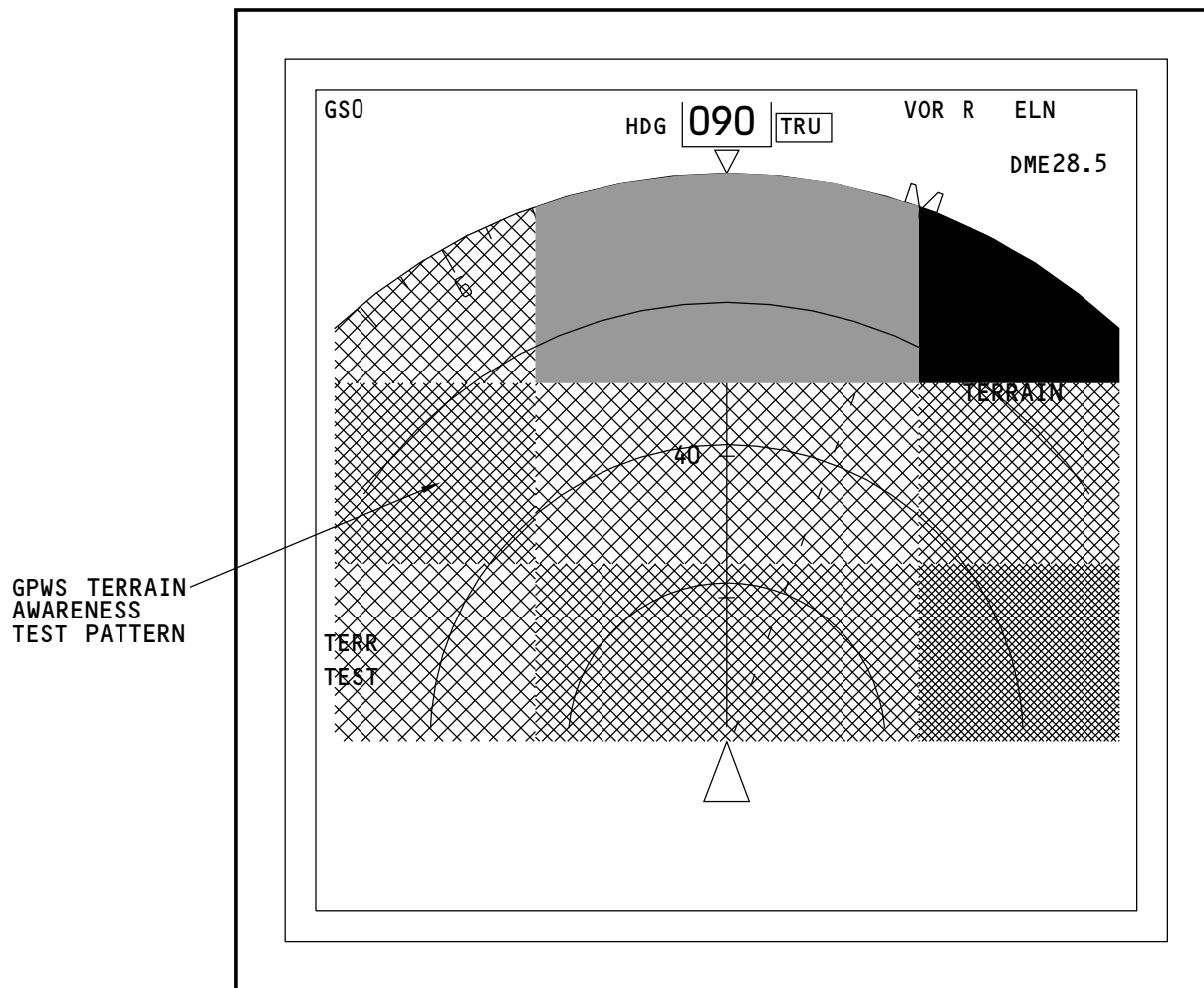
- GLIDESLOPE INOP
- GPWS INOP
- BANK ANGLE INOP
- CALLOUTS INOP
- WINDSHEAR INOP
- TERRAIN INOP.

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GPWS - SELF TEST - LEVEL 1

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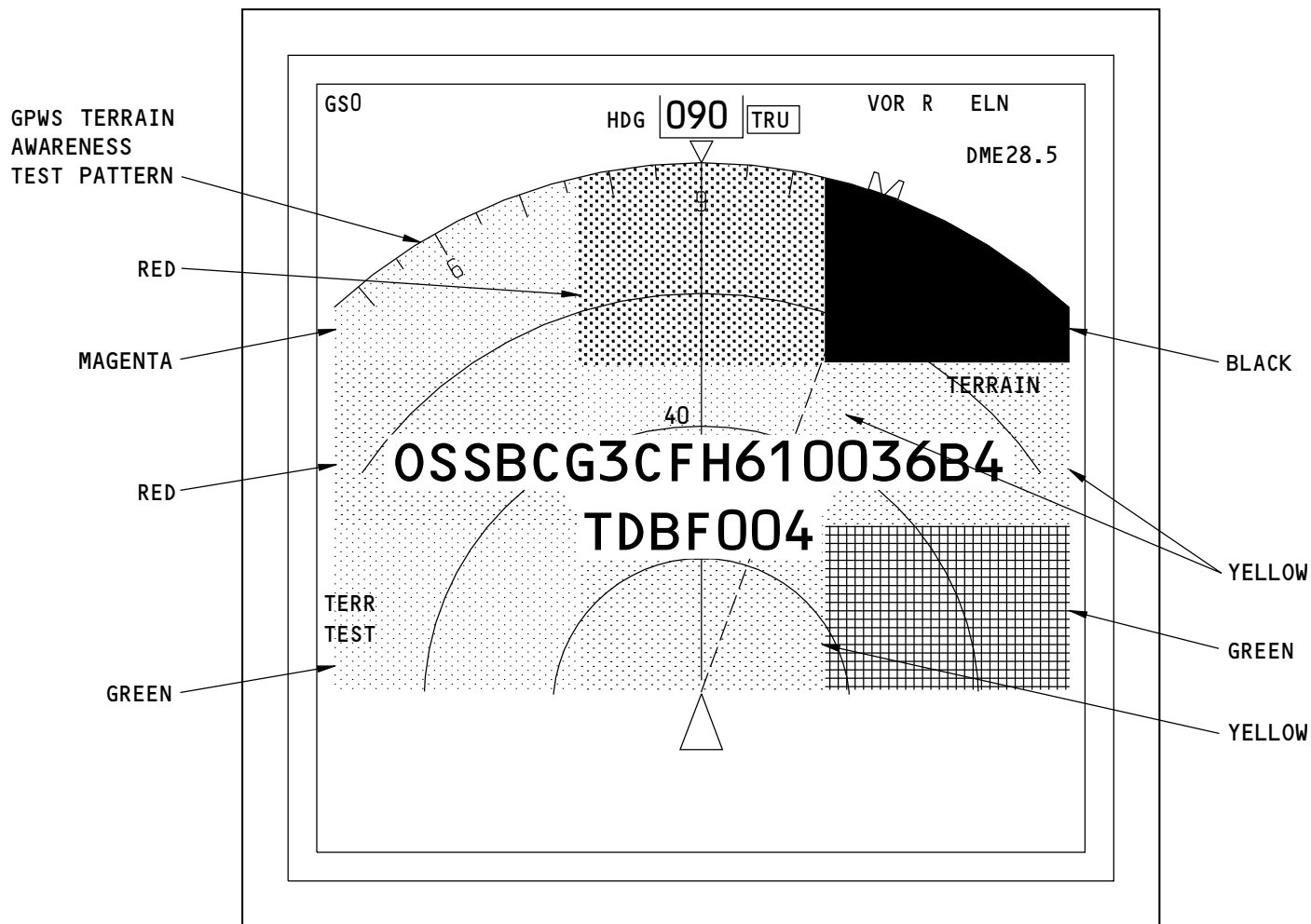
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GPWS - SELF TEST - LEVEL 1

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GPWS - SELF TEST - LEVELS 2-5

General Description

The ground proximity warning computer (GPWC) has six levels of self test:

- 1 - GO/NO-GO operational test
- 2 - Current faults
- 3 - System configuration
- 4 - Fault history
- 5 - Alert/warning history
- 6 - Discrete input test.

Self test levels 2-6 access self test information not available through the maintenance access terminal (MAT). Use a 600 ohm headphone to listen to the test information. Plug the headphone into the jack on the front panel of the GPWC.

Use the self test button on the front panel of the GPWC to access levels 2-6. The self test button has these two modes:

- Short cancel - push the button for less than two seconds
- Long cancel - push the button for more than two seconds.

Use the self test button for these functions:

- Start self test level one
- Go to the next item or flight leg within a test
- Go to the next self test level
- End the self test.

When a test level ends, the aural message PRESS TO CONTINUE annunciates. Push the self test button to go to the next test level. If you do not push the self test button within three seconds, self test ends.

Level Two Self Test - Current Faults

A level two test begins with the aural message CURRENT FAULTS. If there are no current faults, you hear the aural message NO FAULTS. If faults exist, the GPWC annunciates the faults one at a time. A short or long cancel ends the level two test.

Level Three Self Test - System Configuration

A level three test annunciates the GPWS configuration. A level three test begins with the aural message SYSTEM CONFIGURATION. A short cancel causes the test to go immediately to the next configuration item. A long cancel ends the level three test. A level three test provides this information:

- GPWC part number
- GPWC modification status
- GPWC serial number
- Application software version
- Configuration software version
- Terrain database version
- Envelope modulation database version
- Boot code version
- Aircraft type
- Audio menu
- Altitude callout menu number
- Selected options.

Level Four Self Test - Fault History

Level four self test annunciates the GPWS fault history over the last ten flights.

A level four test begins with the aural message FAULT HISTORY. If there are no faults in the flight history memory, you hear the aural message NO FAULTS. If there are faults in the flight history memory, you hear the most recent faults annunciate first. You hear the faults in this order:

- FLIGHT X (X is the most recent flight leg number)
- Internal faults for flight X
- External faults for flight X
- Go to next oldest flight leg and repeat.

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**GPWS - SELF TEST - LEVELS 2-5**

A short cancel causes the test to go immediately to the next flight leg. A long cancel ends self test level four.

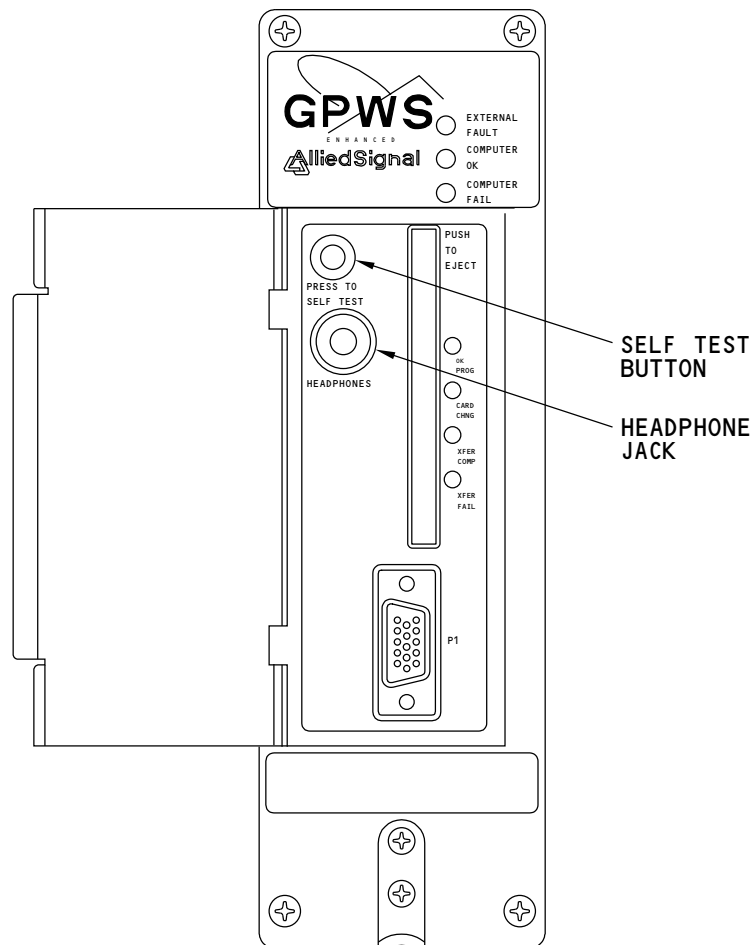
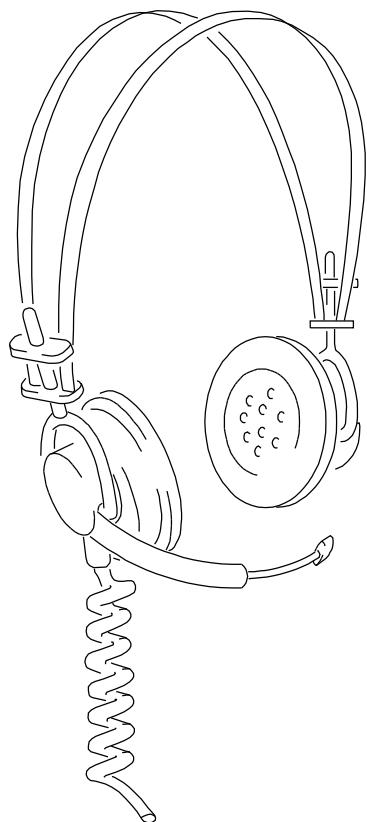
Level Five Self Test - Warning History

Level five self test annunciates GPWS alerts over the last ten flights.

A level five test begins with the aural message WARNING HISTORY. If there are no alerts in the flight history memory, you hear the aural message NO WARNINGS. If there are alerts in the flight history memory, you hear the most recent alerts first. You hear the alerts in this order:

- FLIGHT X (X is the most recent flight leg number)
- GPWS alerts for flight X
- Go to next oldest flight leg and repeat.

A short cancel cause the test to go immediately to the next flight leg. A long cancel ends self test level four.



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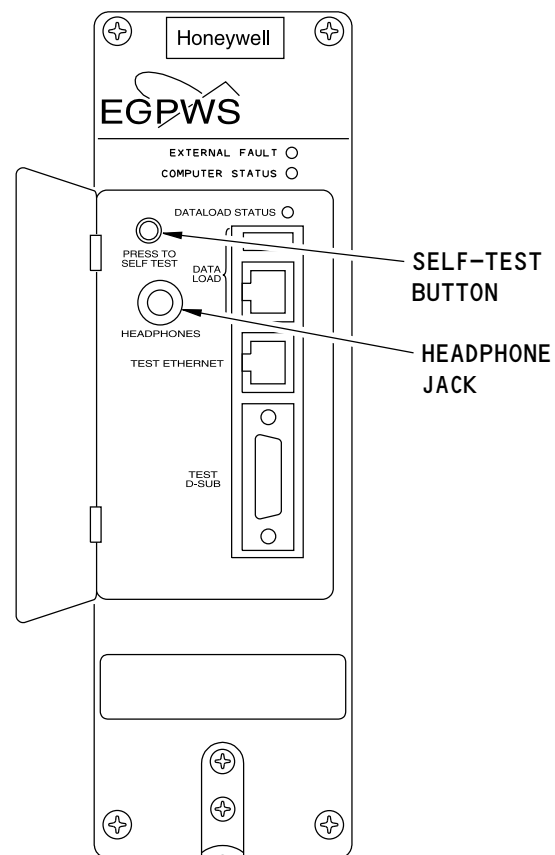
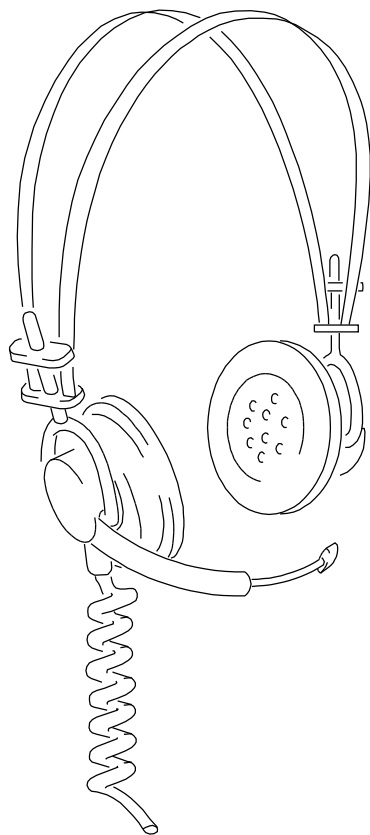
GPWS - SELF TEST - LEVELS 2-5

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GPWS - SELF TEST - LEVELS 2-5

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GPWS - SELF TEST - LEVEL 6**General Description**

The ground proximity warning computer (GPWC) has a level six discrete input test.

This test accesses test information not available from the maintenance access terminal (MAT). Use a 600 ohm headphone to listen to the test information. Plug the headphone into the jack on the front panel of the GPWC.

Use the self test button on the front panel of the GPWC to access level six. The self test button has these two modes:

- Short cancel - push the button for less than two seconds
- Long cancel - push the button for more than two seconds.

Use the self test button for these functions:

- Start self test level one
- Go to the next item or flight leg within a test
- Go to the next self test level
- End the self test.

When a test level ends, the aural message PRESS TO CONTINUE annunciates. Push the self test button to go to the next test level. If you do not push the self test button within three seconds, self test ends.

Level Six Self Test - Discrete Input Test

A level six test checks changes in discrete inputs.

The test starts with the aural message DISCRETE TEST. If the state of a discrete input changes, you hear the new state of the discrete.

You hear the aural message DISCRETE INPUT TEST - PRESS TO CANCEL every 60 seconds. Push a short or long cancel to end the self test.

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DISCRETE INPUT	INPUT SOURCE	ANNUNCIATIONS
- GEAR OVERRIDE SWITCH	P2-2 PANEL	LANDING GEAR DOWN LANDING GEAR UP
- FLAP OVERRIDE SWITCH	P2-2 PANEL	LANDING FLAPS NOT LANDING FLAPS
- GLIDESLOPE OVERRIDE SWITCH	P2-2 PANEL	GLIDESLOPE CANCELLED GLIDESLOPE ENABLED
- TERRAIN OVERRIDE SWITCH	P2-2 PANEL	TERRAIN OFF TERRAIN ON
- TERRAIN RELAY 1	LEFT EFIS TERR SWITCH	TERRAIN RELAY 1 ON TERRAIN RELAY 1 OFF
- TERRAIN RELAY 2	RIGHT EFIS TERR SWITCH	TERRAIN RELAY 2 ON TERRAIN RELAY 2 OFF

LEVEL 6 DISCRETE INPUT TEST

GPWS - SELF TEST - LEVEL 6

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**GPWS - STATUS LEDS****ARO 001-008 PRE SB 777-34-0232****Purpose**

There are three status LEDs on the front panel of the ground proximity warning computer (GPWC). The LEDs come on when there is power to the GPWC. These LEDs are:

- External fault - amber
- Computer OK - green
- Computer fail - red.

ARO 009-999; ARO 001-008 POST SB 777-34-0232**Purpose**

There are two status LEDs on the front panel of the ground proximity warning computer (GPWC). The LED indicators show the status of the GPWC when power is supplied. The LEDs turn on for these conditions:

- External fault - yellow
- Computer status - green/red.

The yellow external fault LED shows that the GPWC has detected an external interface fault. The green computer status LED shows the GPWC operation is normal and a red computer status LED shows an internal GPWC fault.

ARO ALL**Training Information Point**

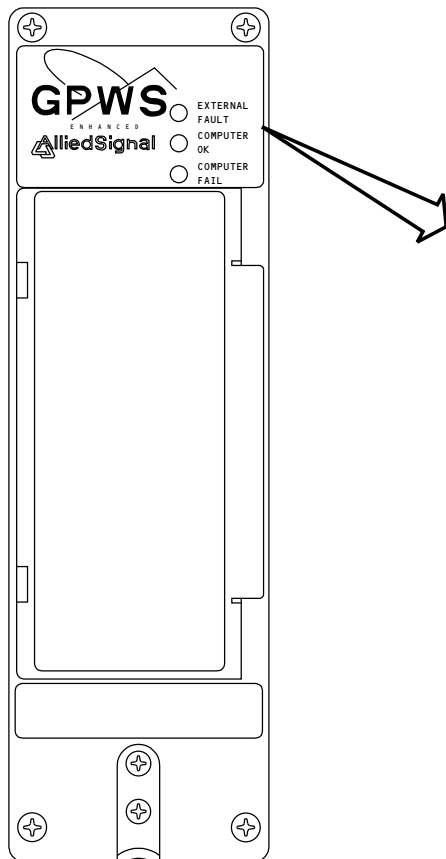
The maintenance manual and the fault isolation manual do not have a task for the line maintenance technician to use the status LEDs to do a test of the GPWC. Use the maintenance access terminal for a level one test of the ground proximity warning system. Use the self test switch and headphones to do tests of levels two through six.

Many LRUs on the 777 are compatible with other model airplanes that do not have a central maintenance computing system (CMCS). For that reason, these LRUs have front panel test features.

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EXTERNAL FAULT	COMPUTER OK	COMPUTER FAIL	CONDITION
OFF	OFF	OFF	GPWC POWER OFF
OFF	OFF	RED	GPWC INTERNAL FAULT
OFF	GREEN	OFF	NORMAL OPERATION
OFF	GREEN	RED	GPWC INTERNAL FAULT
YELLOW	OFF	OFF	GPWS EXTERNAL FAULT
YELLOW	OFF	RED	BOTH GPWC INTERNAL AND GPWS EXTERNAL FAULTS
YELLOW	GREEN	OFF	GPWS EXTERNAL FAULT
YELLOW	GREEN	RED	GPWC INTERNAL FAULT

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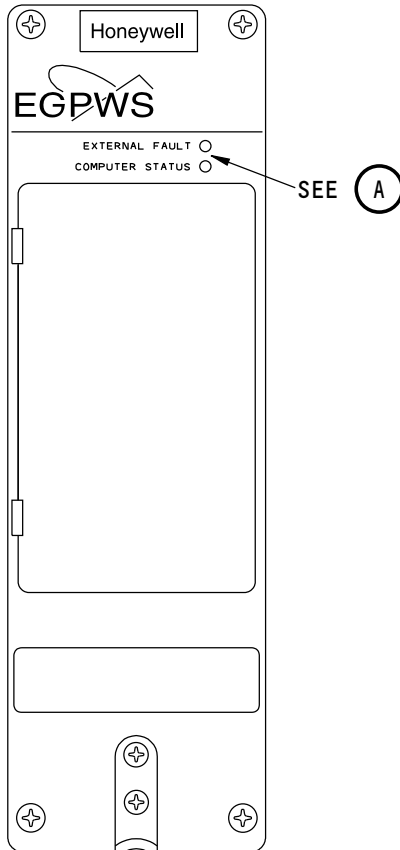
GPWS - STATUS LEDS

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EXTERNAL FAULT	COMPUTER STATUS	CONDITION
OFF	OFF	EGPWC POWER OFF
OFF	RED	EGPWC INTERNAL FAULT EXISTS
OFF	GREEN	NORMAL OPERATION
AMBER	OFF	INVALID CONDITION
AMBER	RED	BOTH EGPWC INTERNAL AND GPWS EXTERNAL FAULTS EXIST
AMBER	GREEN	EGPWC EXTERNAL FAULT EXISTS

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GPWS - STATUS LEDS

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**GPWS - GROUND TESTS****General**

You do an operational test of the GPWS from the MAT.

Operational Test

The operational test makes sure the ground proximity warning system operates correctly.

You get these indications when you do an operational test:

- All the GPWS aural
- The master warning lights come on
- PULL UP and WINDSHEAR messages show on the PFDs
- The ground proximity light comes on.

Training Information Point

If you do not hear all the GPWS aural and see the master warning lights come on, PFD messages show, and the ground proximity light come on, the operational test failed.

During the test, these aural do not come on:

- ENGINE FAIL
- V1.

This test is the same as the self test-level 1.

GROUND TESTS

SELECT ATA SYSTEM (55)

- 34 WEATHER RADAR SYSTEM
- 34 TRAFFIC ALERT AND COLLISION AVOIDANCE SYSTEM
- 34 GROUND PROXIMITY WARNING SYSTEM
- 34 VOR/MARKER BEACON SYSTEM
- 34 AIR TRAFFIC CONTROL (ATC) MODE S SYSTEM
- 34 DISTANCE MEASURING EQUIPMENT SYSTEM
- 34 AUTOMATIC DIRECTION FINDER
- 34 GLOBAL POSITIONING SYSTEM
- 34 AIMS - FLIGHT MANAGEMENT COMPUTING SYSTEM

SELECT TEST TYPE

- ☐ SYSTEM TEST
- ☒ OPERATIONAL TEST
- ☐ DEPLOYMENT TEST

SELECT OPERATIONAL TEST (1)

GROUND PROXIMITY WARNING SYSTEM

CONTINUE

HELP

GO BACK

SELECT OPERATIONAL TEST (1)

GROUND PROXIMITY WARNING SYSTEM

GPWS - GROUND TESTS

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VHF OMNIDIRECTIONAL RANGING (VOR) SYSTEM

Purpose

The VHF omnidirectional ranging (VOR) system is a navigation aid that gives magnetic bearing data from a VOR ground station to the airplane.

- VHF - very high frequency
- VOR - VHF omnidirectional ranging

Description

The VOR ground stations transmit an omnidirectional signal and directional signal. Together the signals give magnetic radial information from 000 degrees to 359 degrees. All VOR stations reference the 000 degree to magnetic north.

The VOR system receives the ground station signals and calculates bearing data. The data goes to various systems for display and navigation use.

The VOR system supplies station audio and identifier signals to the flight deck speakers and headsets.

Abbreviations and Acronyms

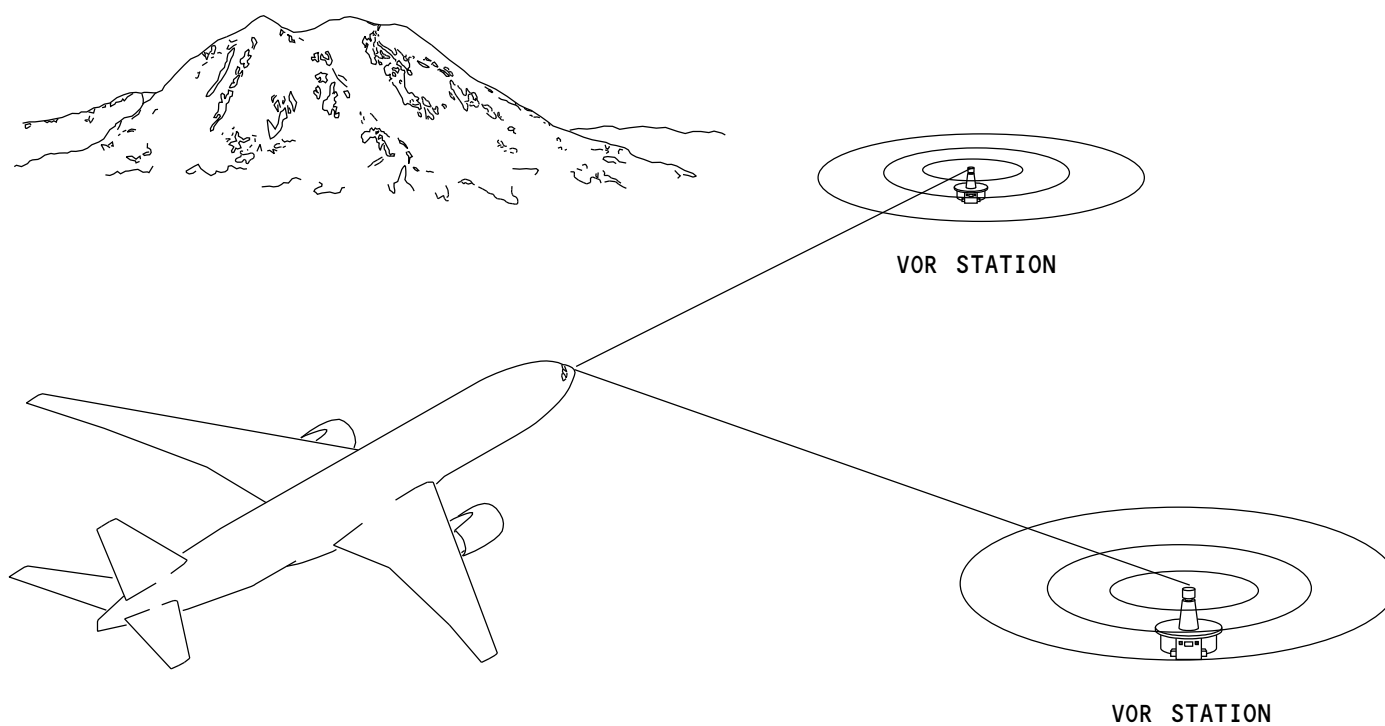
- ACP - audio control panel
- AIMS - airplane information management system
- ALTN - alternate
- ARINC - aeronautical radio, inc.
- ATE - automatic test equipment
- auto - automatic
- BITE - built-in test equipment
- CDU - control display unit
- CMCF - central maintenance computing function
- CMCS - central maintenance computing system
- EFIS - electronic flight instrument system
- FMCF - flight management computing function
- LED - light emitting diode
- MHz - megahertz
- NCD - no computed data
- RF - radio frequency

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VHF OMNIDIRECTIONAL RANGING (VOR) SYSTEM

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VOR - GENERAL DESCRIPTION

General

The VOR system has two VOR/marker beacon (MB) receivers. The receivers have both VOR and marker beacon functions. This section covers only the VOR operation of the VOR/MB receiver. The VOR receivers get RF inputs from one VOR antenna on the vertical stabilizer.

Description

The receivers get manual tune inputs from the left or right CDU or autotune inputs from the airplane information management system (AIMS) cabinets. Manual or autotune inputs both go through the AIMS cabinets, then to the VOR receivers.

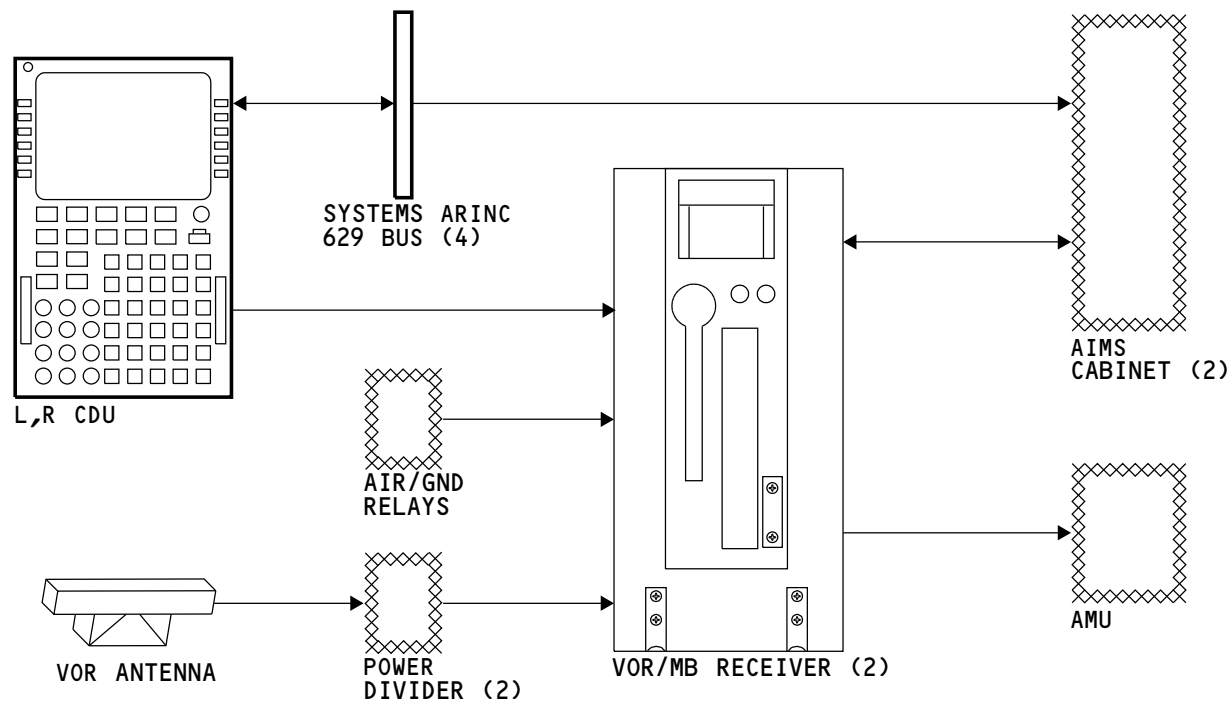
The VOR receivers can get tune inputs directly from the left or right CDU (alternate tune) if the tune inputs from the AIMS cabinets fail.

RF signals from the VOR antenna go through power dividers, then to the VOR receivers. The VOR receivers use the RF signals to calculate station bearing and to decode the Morse code station identifier signal.

The receivers get discretes from the air/ground relays.

The receivers send VOR bearing data to the AIMS cabinets to show on the navigation displays (NDs).

The VOR/MB receivers send station audio and identifier signals to the audio management unit (AMU).



VOR - GENERAL DESCRIPTION

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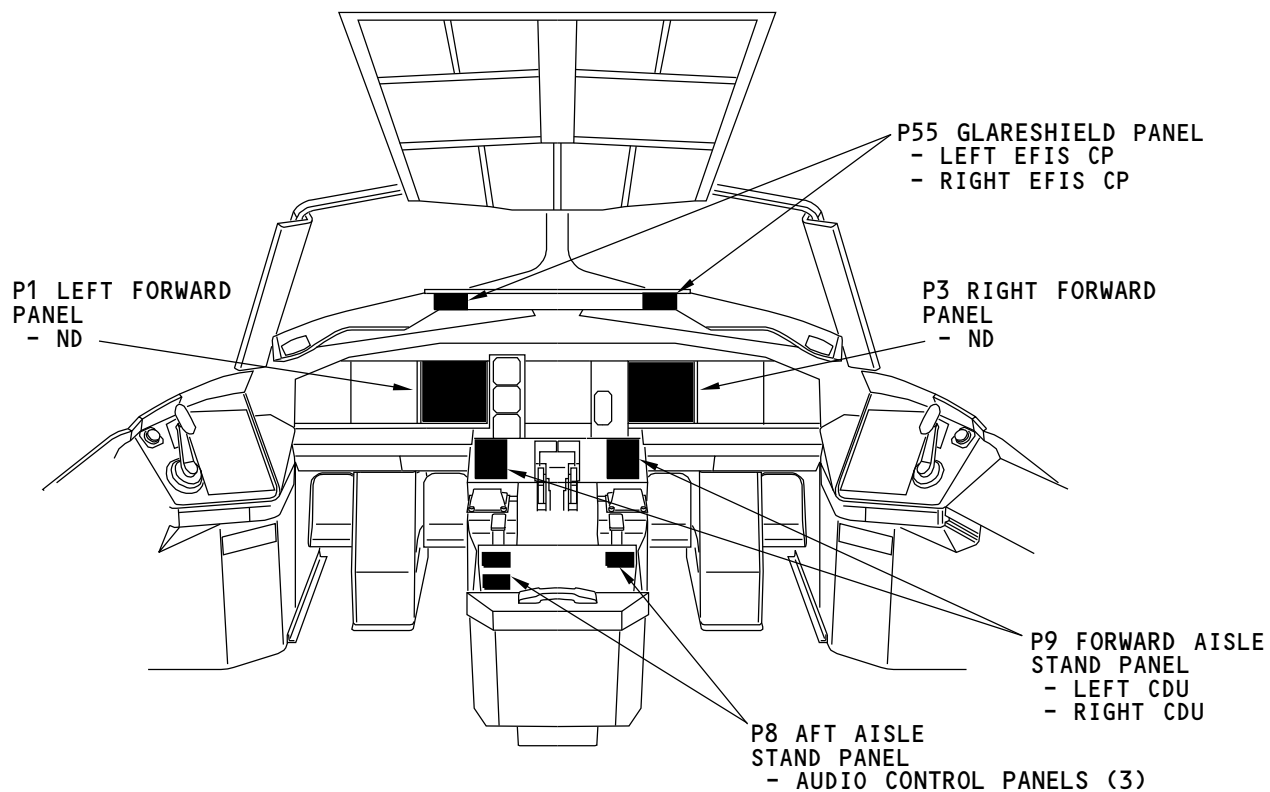
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**VOR - FLIGHT DECK COMPONENT LOCATION****General**

The components on the flight deck that interface with the VOR system are:

- Captain and first officer navigation displays (NDs)
- Left and right EFIS control panels (CPs)
- Left and right CDUs
- Audio control panels (ACPs).



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VOR - FLIGHT DECK COMPONENT LOCATION

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VOR - ANTENNA AND MAIN EQUIPMENT CENTER COMPONENT LOCATION

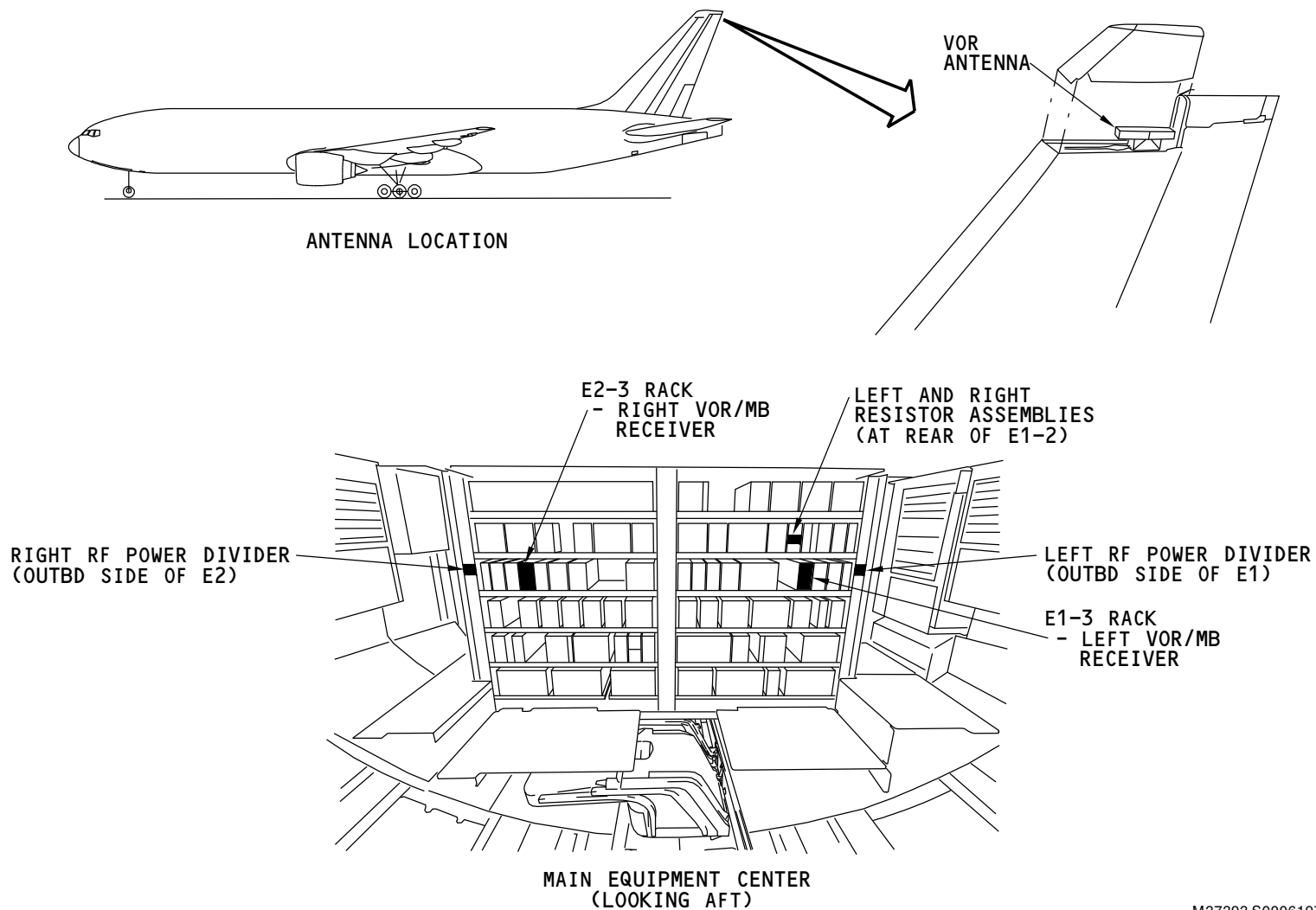
General

The VOR antenna is at the top of the vertical stabilizer.

These components are in the main equipment center on the E1 and E2 racks:

- Left and right VOR/MB receivers
- Left and right RF power dividers
- Left and right resistor assemblies.

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VOR - ANTENNA AND MAIN EQUIPMENT CENTER COMPONENT LOCATION

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**VOR - POWER, ANALOG, AND DISCRETE INTERFACE****General**

These are the components that have interface with the VOR system:

- Circuit breakers
- VOR antenna
- Control display units (CDUs)
- AFDCs
- Air/ground relays
- Audio management unit (AMU).

Circuit Breakers

The VOR circuit breakers supply 115v ac power for operation. The left VOR/MB receiver gets power from the ac standby bus and the right VOR/MB receiver gets power from the right ac transfer bus.

CDUs

The CDUs send a frequency source select discrete to cause the VOR receivers to select the tune input from either the CDU or the AIMS cabinets. The resistor assemblies pull up the discretes to 28v dc. The left CDU sends a ground discrete to the left VOR receiver to change the source. The right CDU sends a ground discrete to the right VOR receiver to change the source.

Air/Ground Relay

The air/ground relays supply discrete inputs to the VOR/MB receivers to do these functions:

- Set flight legs (as alternate source, primary is from the CMCF of AIMS)
- Inhibit test commands in the air.

VOR Antenna

The VOR antenna sends RF signals through the left and right power dividers to the VOR/MB receivers.

Audio Management Unit

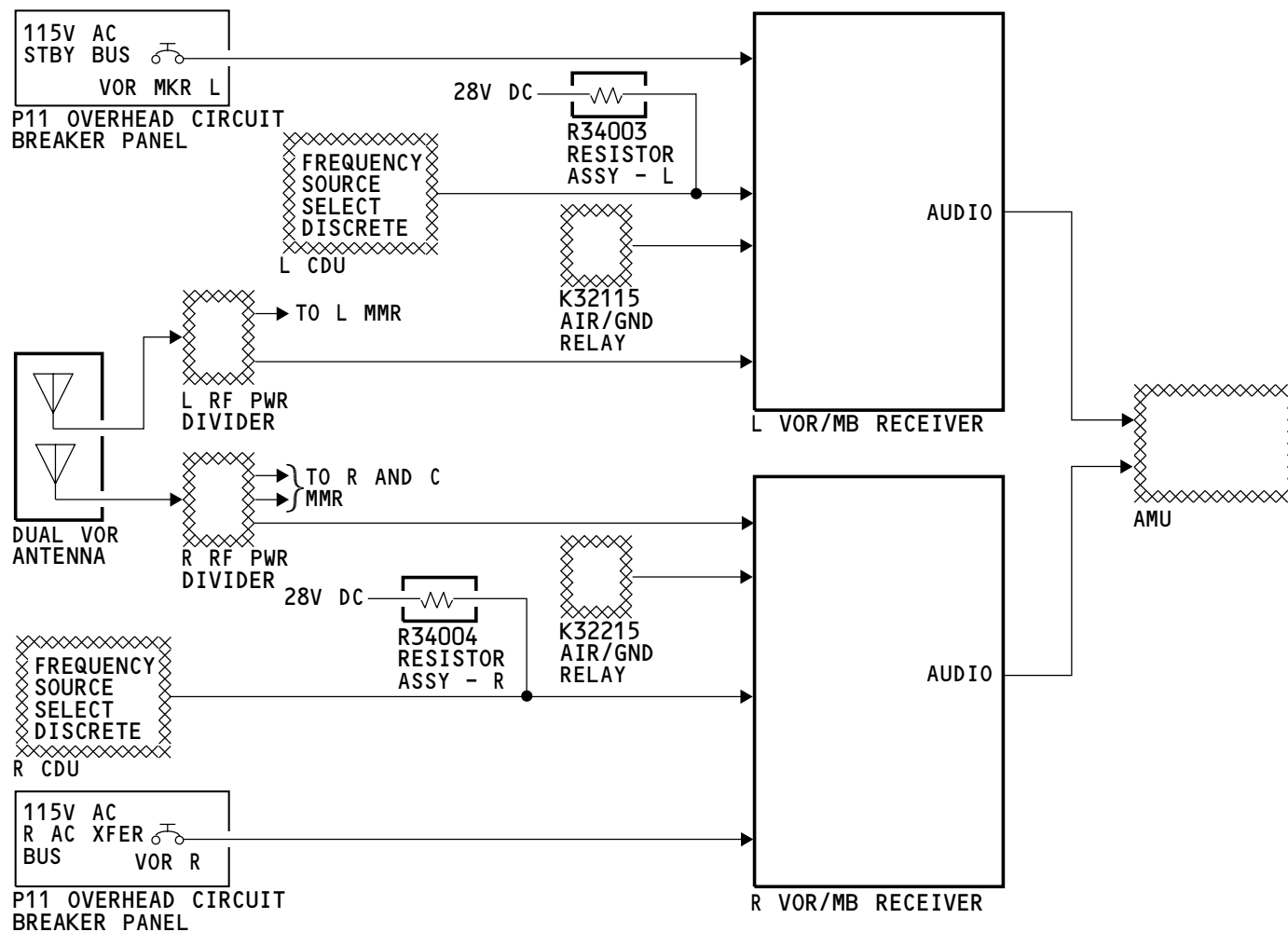
The audio management unit receives Morse code station identifier signals and station audio from the VOR receivers and supplies them to the flight interphone speakers and headsets.

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VOR - POWER, ANALOG, AND DISCRETE INTERFACE

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VOR - SYSTEM INTERFACE

General

These are the components that interface with the VOR receivers:

- Left and right control display units (CDUs)
- Left and right airplane information management system (AIMS) cabinets.

All digital interfaces are on ARINC 429 data buses.

CDU

The left and right CDUs supply alternate tune inputs directly to the VOR receivers if the AIMS tune inputs fail. The left CDU alternate tunes the left VOR receiver and the right CDU alternate tunes the right VOR receiver.

AIMS

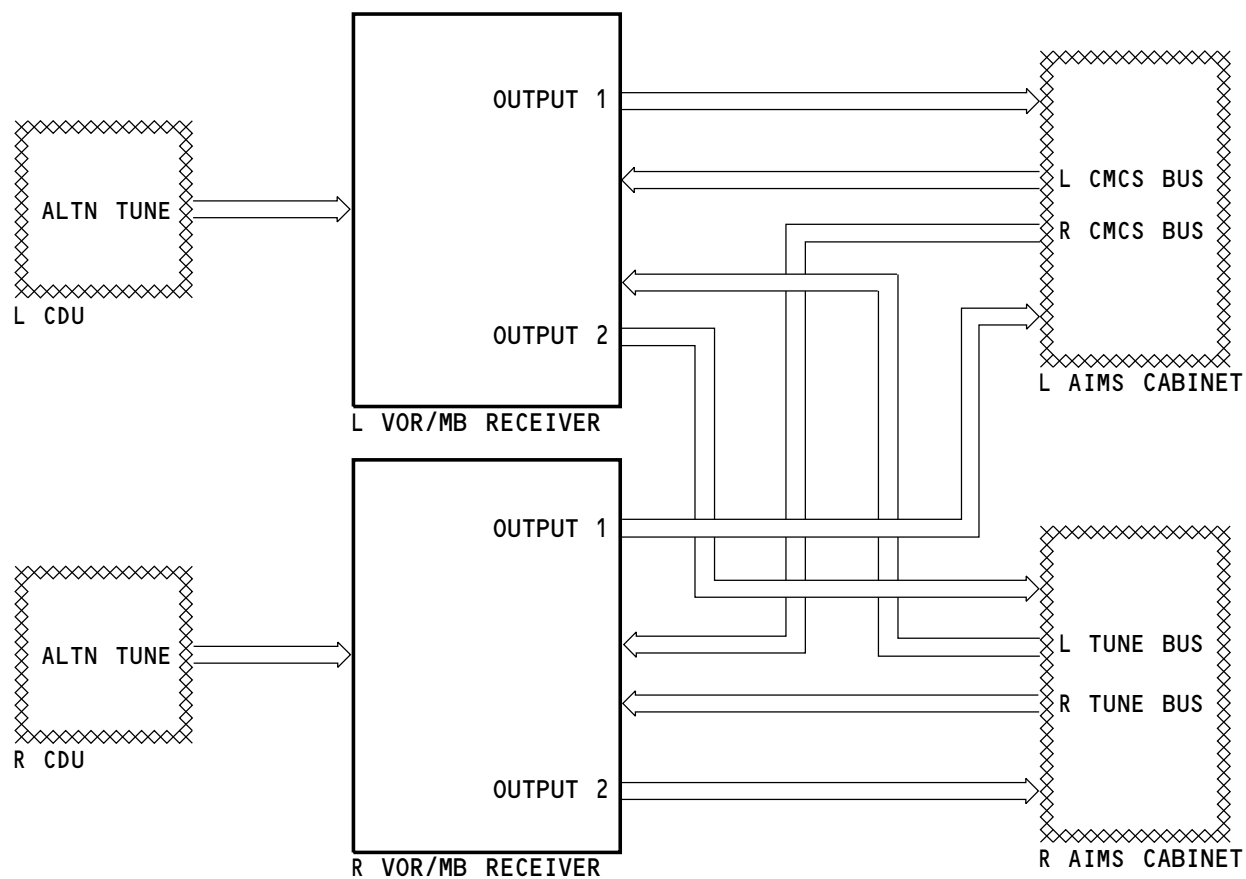
The left AIMS cabinet sends test commands and primary flight leg information to the left and right receivers on the Left CMC bus and right CMC bus.

The right AIMS cabinet sends manual tune and autotune inputs to the left and right VOR receivers on the left tune bus and right tune bus.

VOR Outputs

Each VOR receiver has two output buses. One output bus to the left AIMS cabinet and one output bus to the right AIMS cabinet. Output bus one and two from each receiver sends VOR data, test results, and fault information to the left and right AIMS cabinets.

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VOR - SYSTEM INTERFACE

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VOR - VOR/MB RECEIVER

General

The VOR/marker beacon (VOR/MB) receiver has two receivers:

- VOR receiver
- Marker beacon receiver

Test and Indications

There are two switches and an LCD on the front panel of the VOR/MB receiver. You use any of the two switches to start a test of the VOR/MB receiver. The LCD shows the test results. When you do a test of the left VOR/MB receiver, you do a test of the VOR function and the marker beacon function in the VOR/MB receiver at the same time.

There is a memory card slot on the front of the VOR/MB receiver. Shop personnel use this feature to insert a flash memory card which loads software into the LRU. The memory card can also store LRU status data sent by the LRU during operation. These features are not for use by line maintenance personnel.

Shop personnel use the RS 232 connector to connect shop test equipment to the LRU. This feature is not for use by line maintenance personnel.

Flight Fault Memory

The VOR/MB receiver has a non-volatile flight fault memory. Only shop personnel can read the memory on the test bench.

Training Information Point

The maintenance manual and the fault isolation manual do not have a task for the line maintenance technician to do a test from the front panel of the VOR/MB receiver. You must do all tests for the VOR/MB receiver from the MAT or a PMAT.

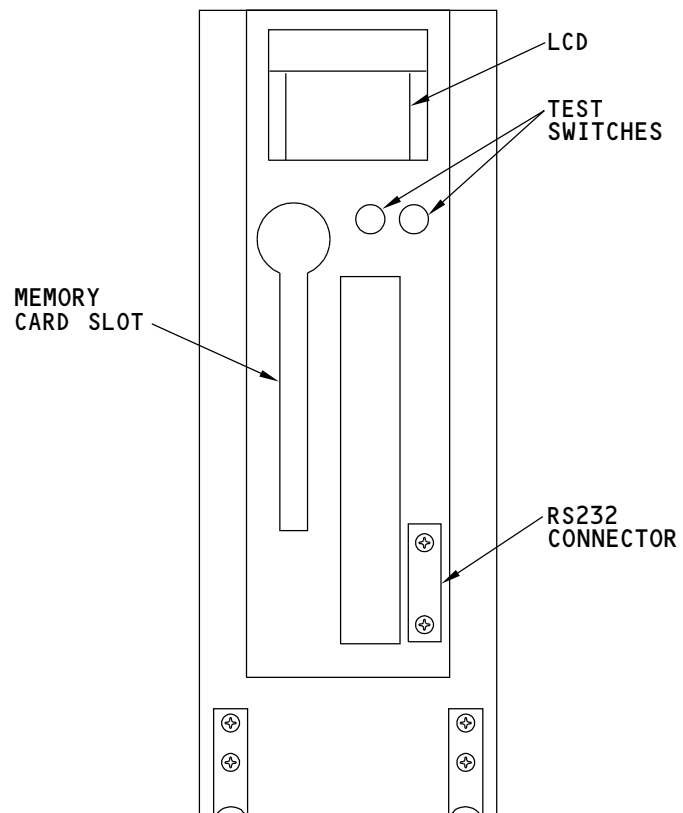
Many LRUs on the 777 are compatible with other model airplanes that do not have a central maintenance computing system (CMCS). For that reason these LRUs have a front panel test feature.

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VOR - VOR/MB RECEIVER

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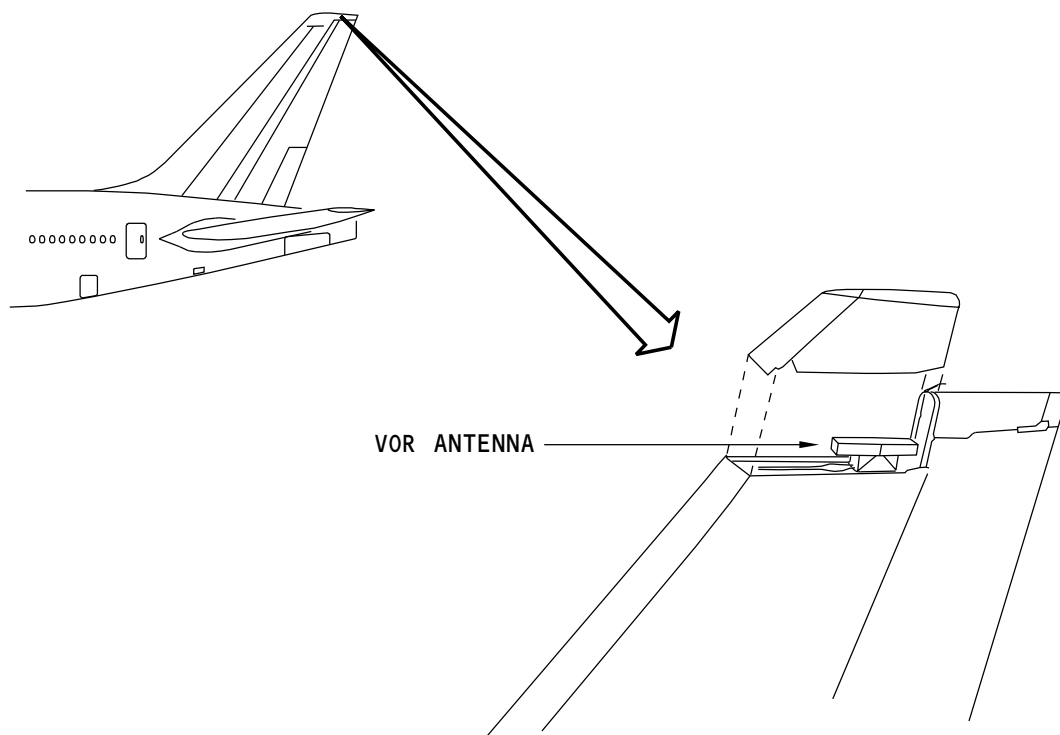
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**VOR - ANTENNA****General**

The VOR antenna is on the top of the vertical stabilizer. The VOR antenna receives RF signals in the frequency range of 108 MHz to 117.95 MHz. The antenna receives VOR and ILS frequencies. The VOR antenna sends VOR signals to both VOR/MB receivers.

The VOR antenna has two outputs, one to each VOR receiver.



VOR ANTENNA

VOR - ANTENNA

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**VOR - VOR/MB RECEIVER FUNCTIONAL DESCRIPTION****General**

The receiver has both VOR and marker beacon functions. This section only covers the VOR functions.

Operation

Manual or autotune inputs from the AIMS cabinets, or alternate tune inputs from the CDUs go through the input port switch then to the processor. The processor sends them to the frequency synthesizer to tune the receiver circuits.

The left AIMS cabinet sends test/status commands and flight legs discrete to the VOR receiver. When the processor receives a test command, it does a check of the VOR/MB receiver operation and control input status. Test results show on the LCD when you do a test from the front panel of the VOR/MB receiver.

The memory card stores faults. Only shop personnel can read the memory card contents.

The air/ground relay discrete input inhibits a VOR test when the airplane is in the air. The receiver also uses the air ground discrete for flight legs if the AIMS flight leg discrete input fails.

The processor receives a source destination identifier (SDI) program pin discrete to designate the receiver as the left or right system receiver.

VOR Antenna Input

Input signals from the VOR antenna go through the power divider then to the receiver circuits in the VOR/MB receiver. The receiver circuit sends any audio or Morse code station identifier signals from the ground station to the audio processor. The audio or Morse code station identifier goes to the audio output circuits then to the audio management unit.

The receiver circuit sends the antenna input signals to the bearing computer which calculates the VOR station bearing. Bearing data from the bearing computer goes to an ARINC 429 transmitter. The VOR/MB receiver transmits VOR bearing data on two output buses. The output buses go to the left and right AIMS cabinets.

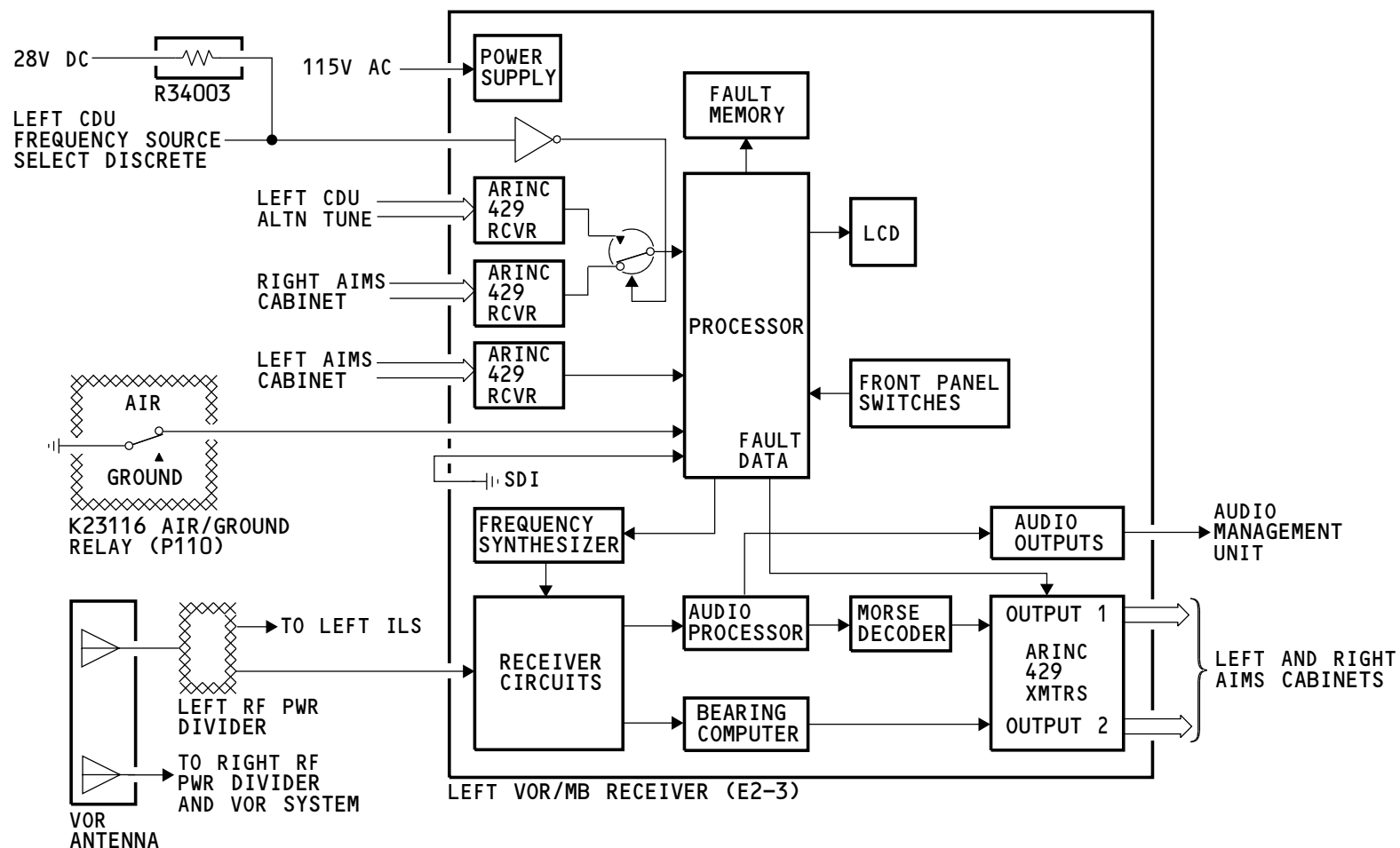
The audio processor also sends Morse code station identifier signals to a Morse decoder circuit. This circuit decodes the station identifier and puts it in a digital format then sends it to the ARINC 429 transmitter. When the ND receives the digital Morse code station identifier, it replaces the VOR station frequency with the identifier.

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VOR - VOR/MB RECEIVER FUNCTIONAL DESCRIPTION

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VOR - TUNE INPUTS

General

These are the three ways to tune the VOR receivers:

- Manually by the left, center, or right CDU
- Automatically by the AIMS cabinets
- By the CDUs as an alternate tune source.

Manual Tune

You manually tune the VOR receivers from the left or right control display unit (CDU). The center CDU can tune the receivers if the left or right CDU fails. Manual tune inputs from the CDUs go through the left and right systems ARINC 629 buses, then to the left and right AIMS cabinets.

The left AIMS cabinet sends manual and autotune data through the AIMS intercabinet ARINC 629 buses to the right AIMS cabinet.

Manual tune inputs from the left or right AIMS cabinet goes through the right AIMS cabinet to the VOR receivers.

AIMS Autotune

The flight management computing function (FMCF) of the left or right AIMS cabinet can automatically tune (autotune) the VOR receivers. Autotune inputs from the left or right AIMS cabinet go through the right AIMS cabinet, then to the VOR receivers.

Alternate Tune

The CDUs monitor the AIMS cabinets tune functions. If the AIMS tune function fails, the CDUs send a frequency source select discrete to the VOR receivers. This ground signal changes the tune input from the right AIMS cabinet to the tune input from the left or right CDU.

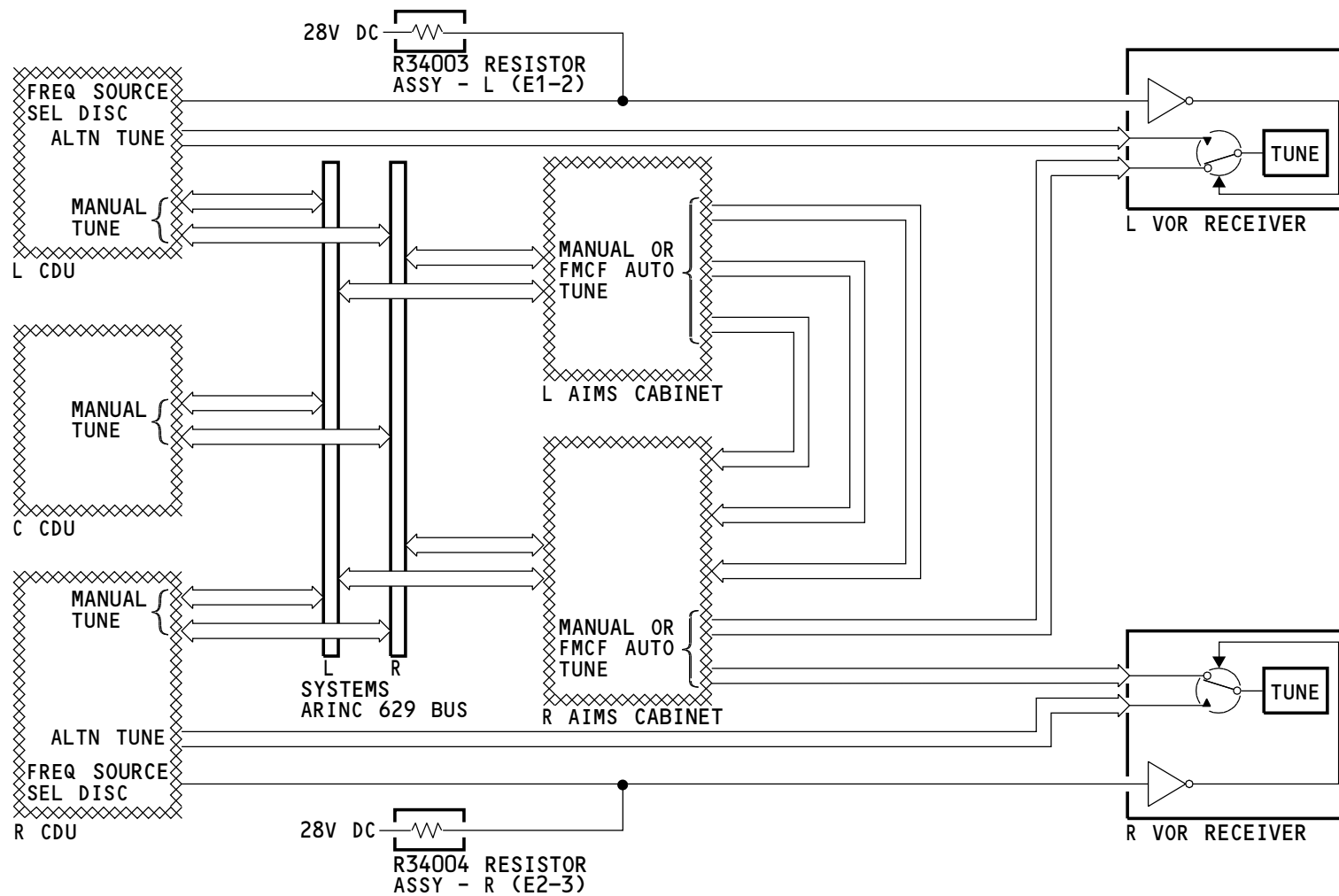
In the alternate tune mode, the left CDU tunes the left VOR receiver and the right CDU tunes the right VOR receiver. The center CDU has no alternate tune function.

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VOR - TUNE INPUTS

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VOR - AUDIO CONTROLS

General

The audio control panels supply control inputs to the audio management unit. This lets the crew hear audio on the speakers and headsets in the flight deck.

Description

These are the controls on the audio control panel that let you hear VOR audio:

- VOR/ADF receiver selector
- VOR/ADF receiver volume control
- NAV filter selector.

VOR/ADF Receiver Selector

The VOR/ADF receiver selector lets you select ADF or VOR as the source of audio.

VOR/ADF Receiver Volume Control

The VOR/ADF receiver volume control turns on the audio and controls the volume.

NAV Filter Selector

The NAV filter selector lets you select one of these:

- Voice (V) audio
- Both (B) voice and range audio.
- Range (R) audio

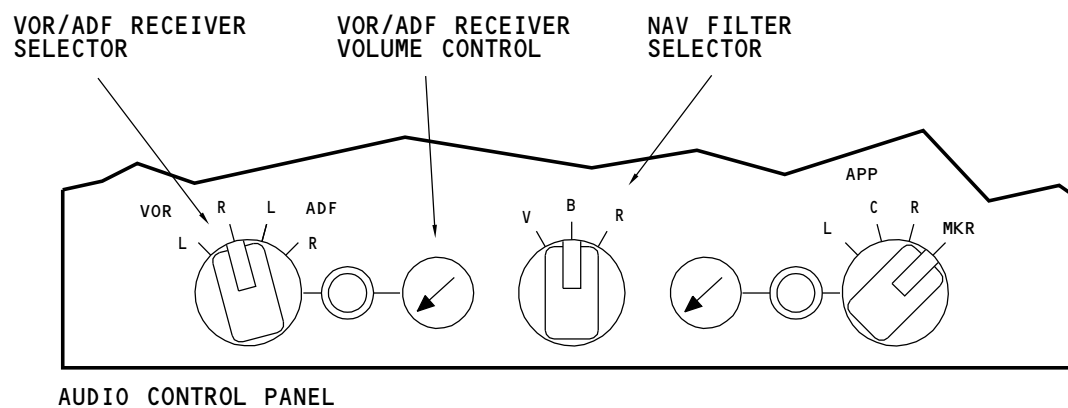
Operation

To hear VOR audio, do this:

- Set the VOR/ADF receiver selector to the left (L) or right (R) VOR position

- Push the VOR/ADF receiver volume control to turn on the ADF audio (turn the control to adjust the volume)
- Set the NAV filter selector to the voice (V) position.

To hear the station identifier, set the NAV filter selector to either the both (B) or the range (R) position.



AUDIO CONTROL PANEL

VOR - AUDIO CONTROLS

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VOR - CDU TUNING

General

The CDUs supply manual tune inputs during normal operation and alternate tune inputs when the AIMS tune functions fail.

Operation

To see VOR tune frequencies, push the NAV RAD key on the CDU. The NAV RADIO page shows data for the left and right VOR systems.

To manually tune a VOR receiver, enter a valid VOR frequency or identifier into the CDU scratch pad. Push line select key 1L or 1R to enter the frequency for the left or right VOR receiver.

When you manually enter a VOR frequency, the letter M shows after the frequency.

The letter A shows after the frequency when the FMCF of AIMS autotunes the receivers.

To enter the selected course, enter the course into the CDU scratchpad. Push line select key 2L or 2R to enter the course for the left or right VOR receiver.

To delete the frequency or course, push the delete (DEL) key on the CDU. The delete function shows in the CDU scratchpad. Next, push the line select key (LSK) next to the applicable VOR data line.

Alternate Tune

The ALTN NAV RADIO page is available only when the tune inputs from the AIMS cabinets fail.

To access the ALTN NAV RADIO page, push the NAV RAD key on the CDU.

The ALTN NAV RADIO page is different than the NAV RADIO page. The ALTN NAV RADIO page shows data for only the onside NAV radio systems. The left CDU ALTN NAV RADIO page controls the left VOR receiver. The right CDU ALTN NAV RADIO page controls the right VOR receiver.

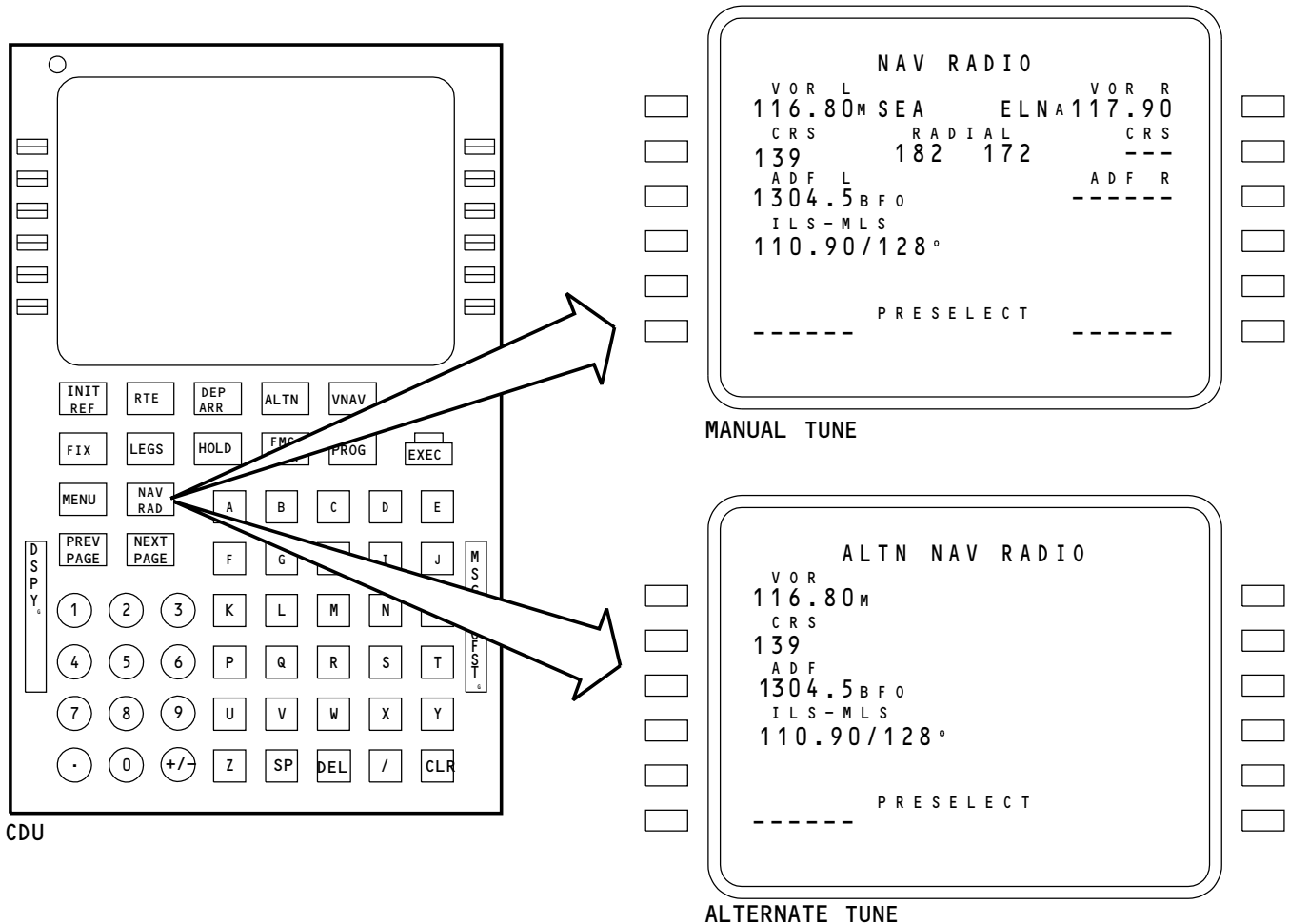
You enter a VOR frequency and selected course the same as you do for normal manual tuning.

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VOR - CDU TUNING

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VOR - EFIS CONTROLS

General

The EFIS control panel has controls to select the display mode of the ND. These are the EFIS controls that cause VOR displays to show:

- Navigation display mode selector
- Left and right VOR/ADF switches.

Navigation Display Mode Selector

Use the mode selector to select the display mode. To see VOR data, set the mode selector to the VOR position.

VOR/ADF Switch

The VOR/ADF switches select the VOR or ADF receivers as the source of data for the left and right bearing pointers on the ND. There are two switches for the left and right bearing pointers. When the VOR/ADF switches are in the VOR position, VOR data shows in the approach (APP), VOR, and map modes. When the switches are set to the off position, the VOR data goes out of view.

Alternate or Backup EFIS Control Panel

You access the EFIS control page from the MENU page on the control display unit (CDU). The EFIS control page on the CDU permits alternate or backup controls for the VOR system displays.

The left CDU is the alternate or backup control for the left EFIS control panel and the right CDU is the alternate or backup for the right EFIS control panel.

When you select EFIS control from the CDUs, the onside EFIS control panel does not operate.

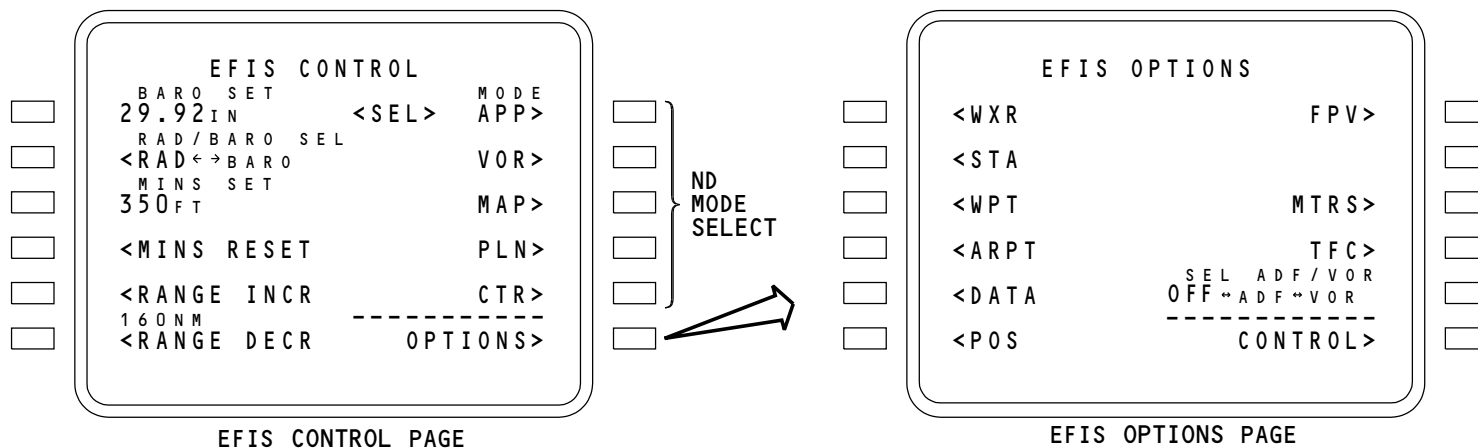
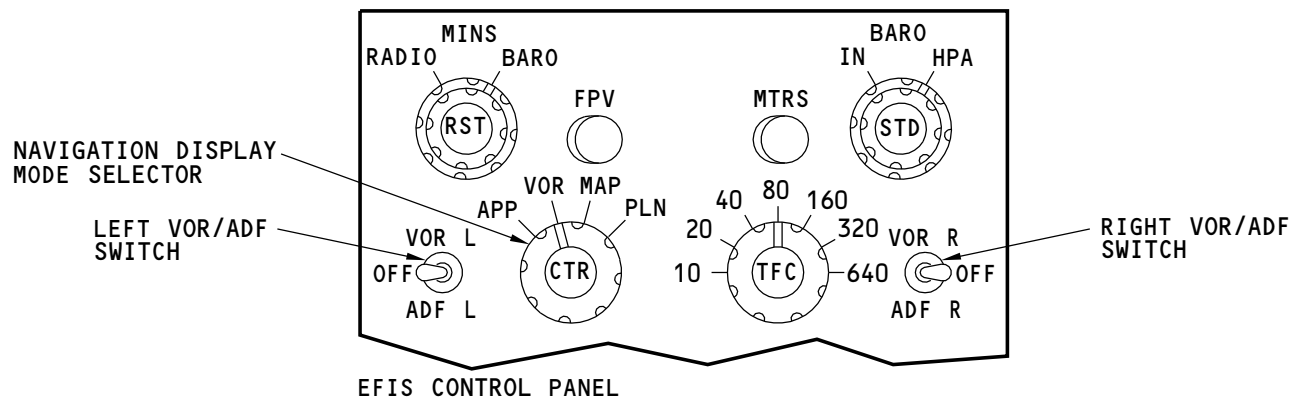
On the EFIS control page you can select the ND mode display for:

- APP
- VOR
- MAP.

There is no VOR display for PLAN mode. To select VOR data for the bearing pointers, you must push the OPTIONS line select key on the EFIS control page. This brings up the EFIS OPTIONS page.

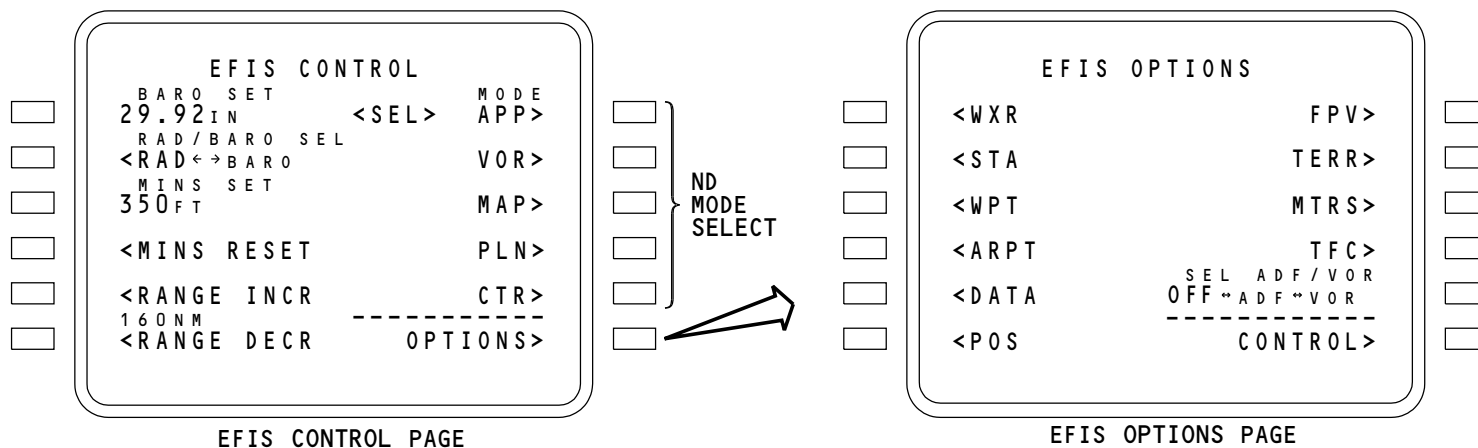
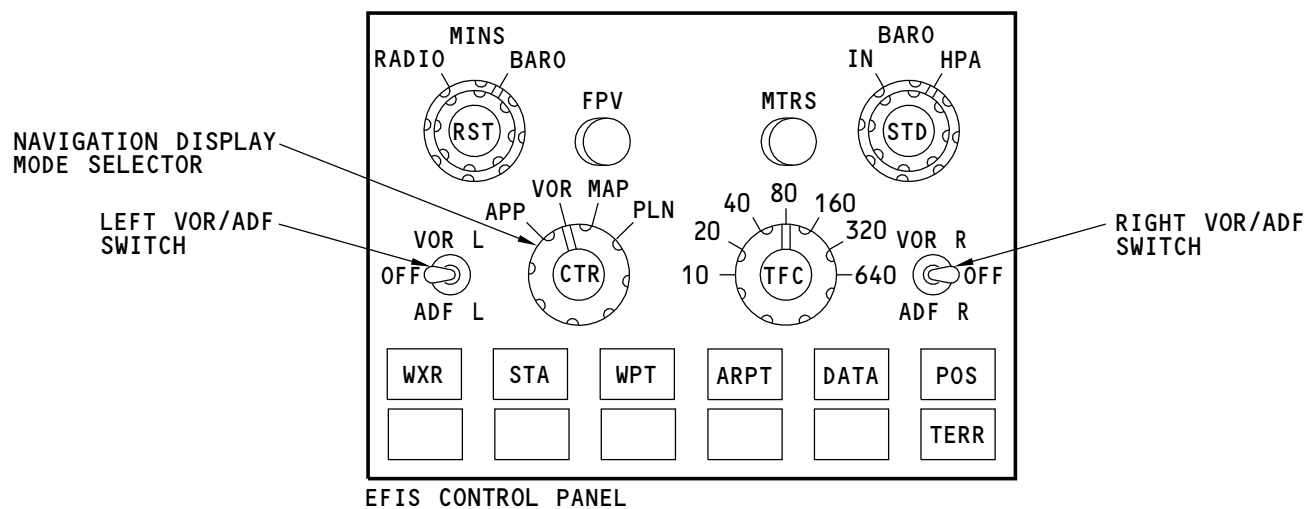
The line select key next to the OFF-ADF-VOR data line on the EFIS OPTIONS page permits you to toggle between ADF or VOR data as the source of data for the bearing pointers.

OFF selection removes the bearing pointer and data.



VOR - EFIS CONTROLS

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VOR - EFIS CONTROLS

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VOR - ND VOR DISPLAYS

General

When the navigation display mode selector on the EFIS control panel is in the VOR position and the VOR/ADF switch is set to VOR, these displays show:

- VOR deviation bar and scale
- NAV data source
- VOR frequency or identifier
- Selected course
- Bearing pointers
- To/from pointer and indicator
- VOR data.

VOR displays show in the centered mode or expanded mode.

VOR Display Source

The VOR display source for the VOR mode is the inside VOR receiver only. If the left VOR receiver fails, the captain's VOR mode will not show VOR deviation. If the right VOR receiver fails, the first officer's VOR mode will not show VOR deviation.

VOR Deviation Bar and Scale

The deviation bar and scale shows deviation from the selected course.

NAV Data Source

The NAV data source display shows at the top right corner of the ND. The NAV data source shows which VOR system supplies the navigation data on the ND.

VOR Frequency or Identifier

The frequency or identifier shows at the top right of the ND next to the NAV data source. If the receiver gets a valid VOR ground station signal and the station identifier is present, then the station identifier replaces the frequency.

VOR Selected Course

The VOR selected course shows below the frequency or identifier. Selected course shows when there is a manual selection of the VOR station on the CDUs. The selected course becomes dashes when the AIMS cabinets autotunes the VOR stations.

Bearing Pointers

The left and right pointers show when the VOR/ADF switches are in the VOR or ADF position. The pointers show in APP, VOR, and MAP display modes. The pointers go out of view when the switches are in the off position. The pointers show around the compass arc. In the expanded mode, the pointers show if the bearing of the station is within the range of the compass arc.

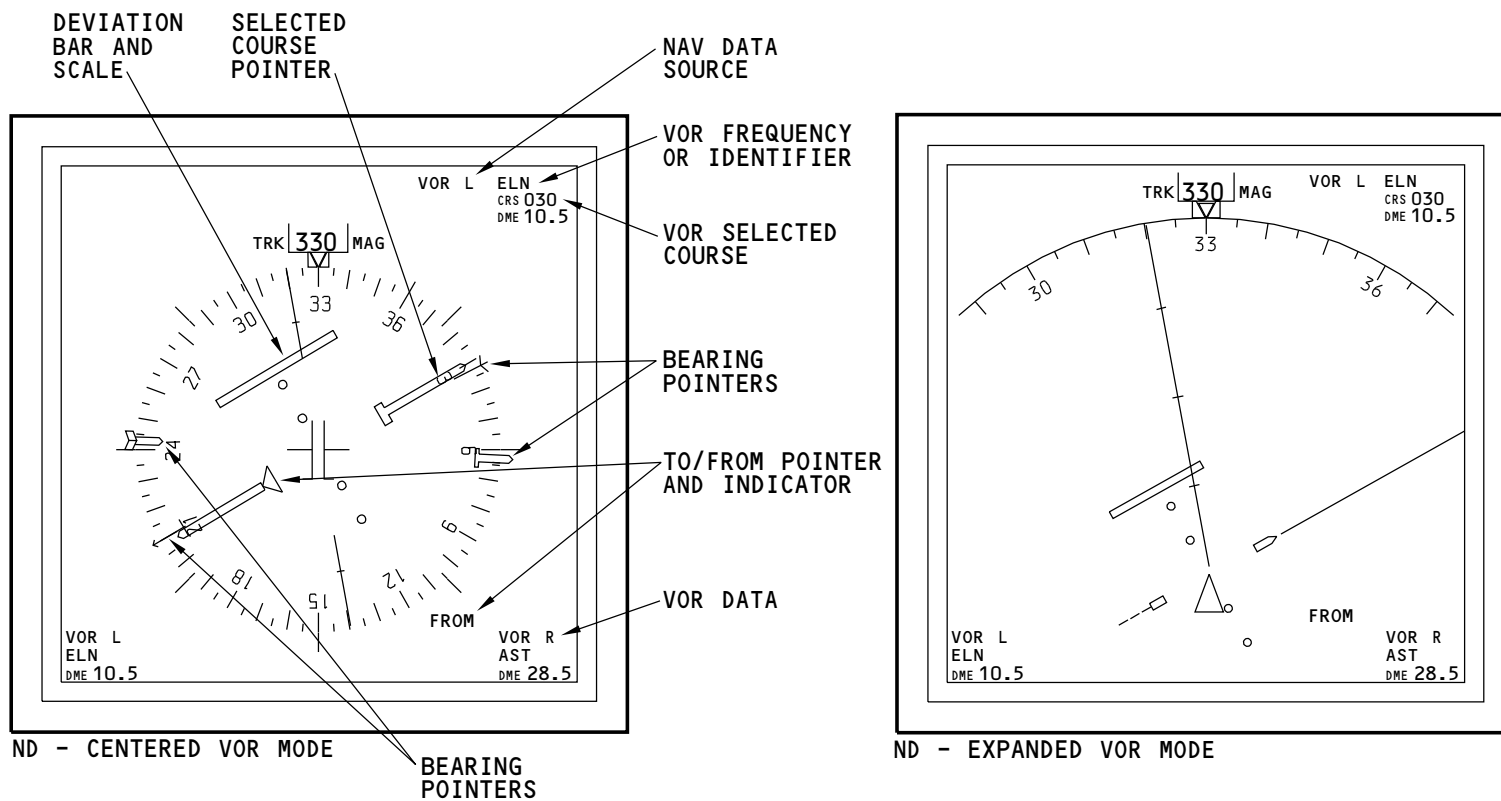
To/From Pointer and Indicator

The to/from indications show if the selected course will take the airplane to or from the VOR station.

VOR/ADF Switch Data

The VOR/ADF data shows the data source for the left and right bearing pointers and their frequencies. The data shows at the lower corners of the ND in the APP, VOR, and MAP display modes.

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VOR - ND VOR DISPLAYS

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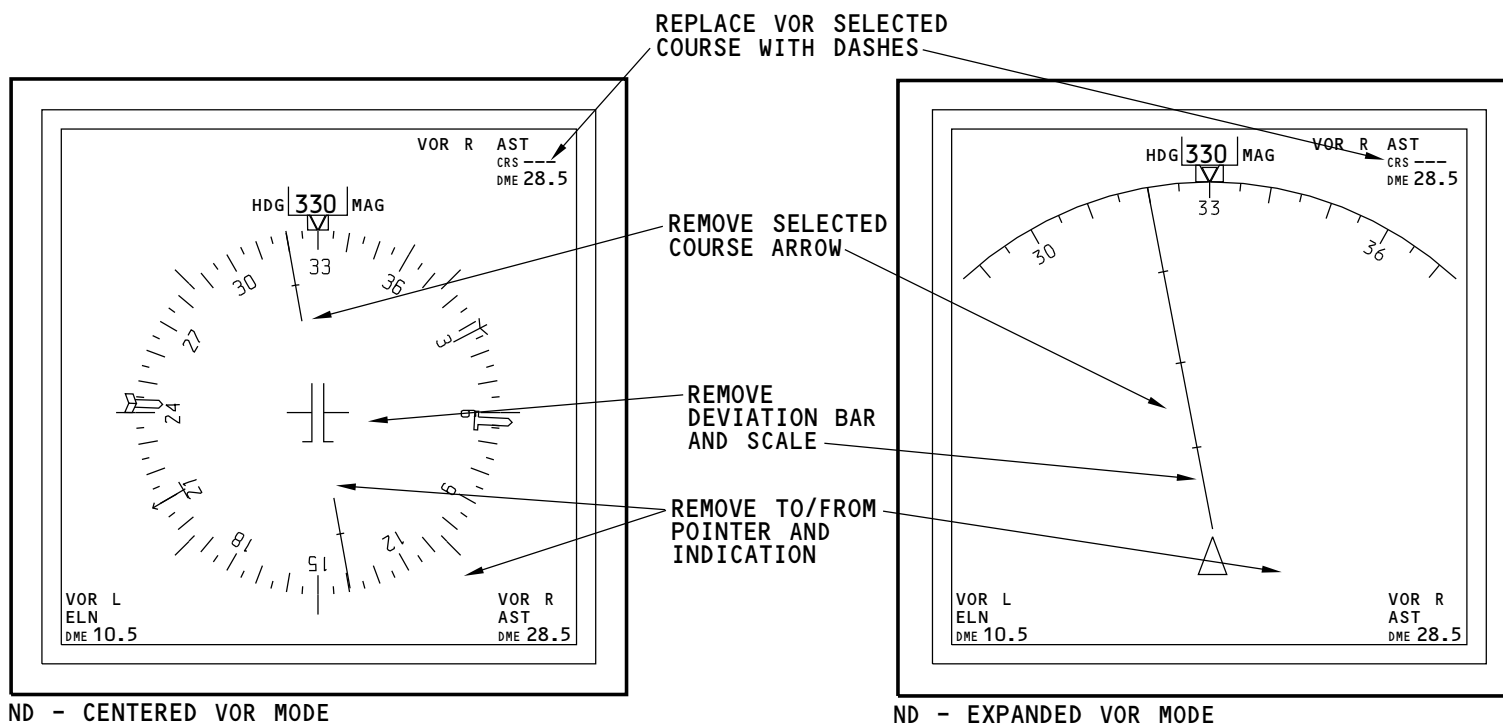
**VOR - ND VOR AUTOTUNE DISPLAY****General**

In autotune, the flight management computing function (FMCF) of AIMS supplies the VOR frequencies to the VOR/MB receivers.

Autotune Displays

When the FMCF of AIMS autotunes the receivers, these displays change:

- Replace VOR selected course numbers with dashes
- Remove selected course arrow
- Remove deviation bar and scale
- Remove to/from pointer and indication.



VOR - ND VOR AUTOTUNE DISPLAY

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**VOR - ND VOR MAP MODE DISPLAYS****General**

VOR data shows in the ND map mode when the VOR/ADF switches on the EFIS control panels are in the VOR position.

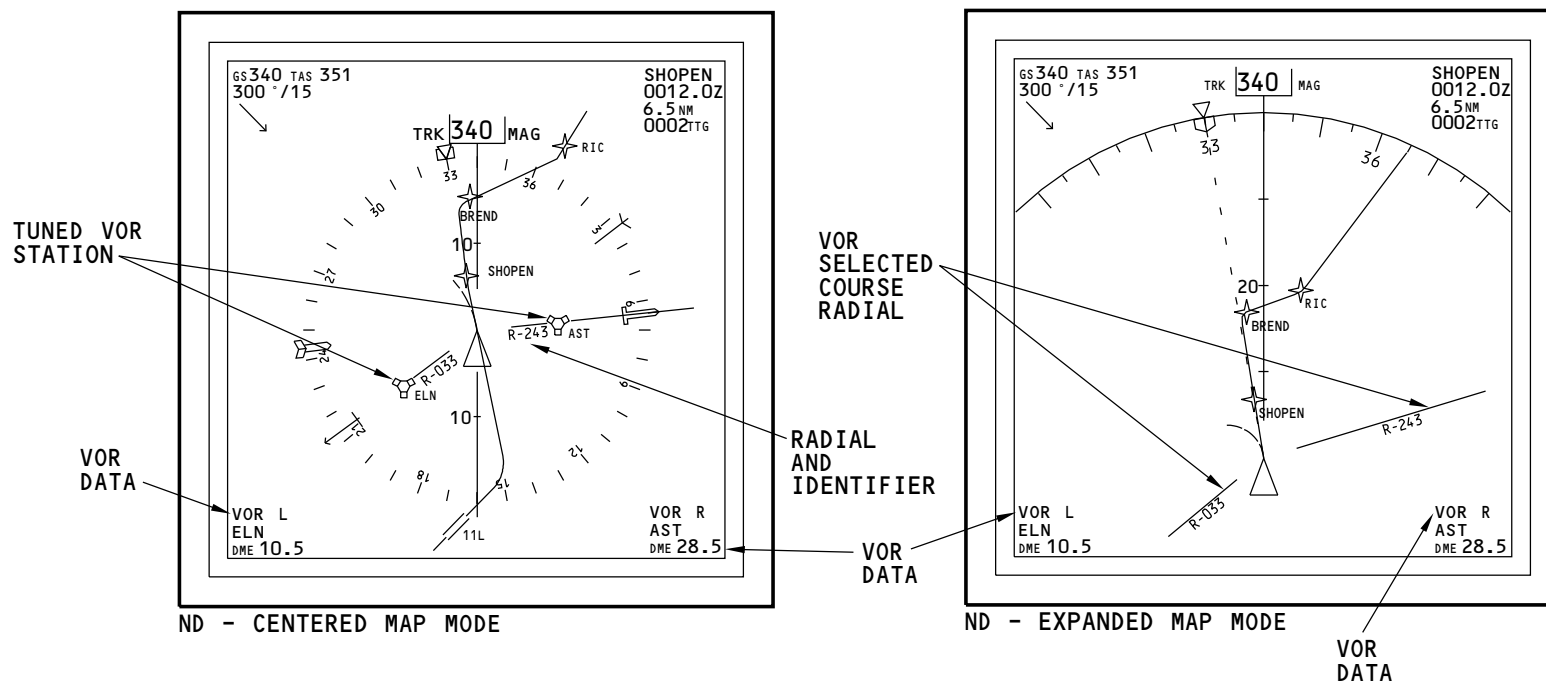
Description

The ND map mode shows in the centered or expanded mode. The map mode shows the tuned VOR stations if they are inside the selected range. When you set the EFIS control panel VOR/ADF switches to the VOR position, the bearing pointers show on the compass scale and the VOR data show at the lower corners of the NDs.

When the VOR/ADF switches are set to the off position, the pointers and VOR data go out of view.

Push the POS button on the EFIS control panel to show VOR radial data. The radial shows as a green line from the tuned VOR station to the airplane symbol. The radial identifier shows as the letter R followed by a three digit number.

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VOR - ND VOR MAP MODE DISPLAYS

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VOR - ND VOR NCD DISPLAYS**General**

The inputs that are necessary for VOR displays are:

- Bearing from the VOR/MB receivers
- Frequencies from the CDUs or the AIMS cabinets
- Selected course from the CDUs or the AIMS cabinets.

When one of these inputs change to a no computed data (NCD) condition, some of the displays go out of view.

Bearing NCD

When the VOR bearing output from the VOR/MB receiver goes to an NCD condition, these VOR displays change:

- Remove the deviation bar
- Remove to/from pointer and indication.

Frequency NCD

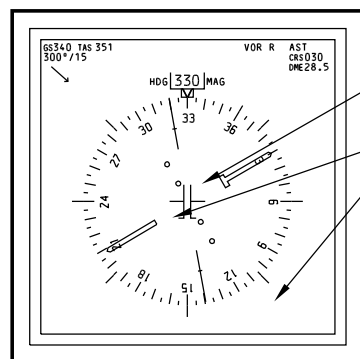
When the frequency input to the VOR/MB receiver goes to an NCD condition, these VOR displays change:

- Replace frequency or identifier with dashes
- Remove the deviation bar
- Remove the to/from pointer and indication.

Selected Course NCD

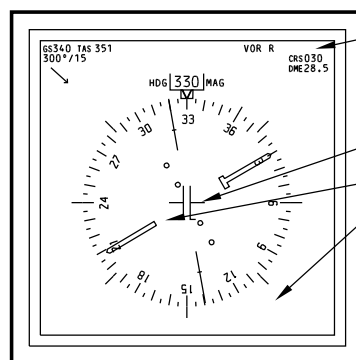
When the selected course input goes to an NCD condition, these displays change:

- Replace the selected course numbers with dashes
- Remove the selected course arrow
- Remove the deviation bar and scale
- Remove the to/from pointer and indication.



VOR - BEARING NCD

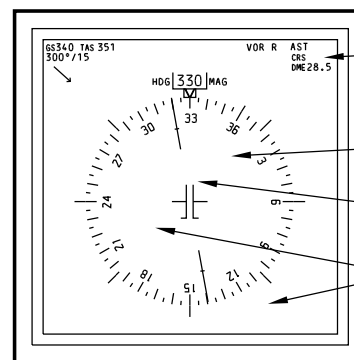
REMOVE DEVIATION BAR

REMOVE TO/FROM POINTER
AND INDICATION


VOR - FREQUENCY NCD

REPLACE FREQUENCY OR
IDENTIFIER WITH DASHES

REMOVE DEVIATION BAR

REMOVE TO/FROM POINTER
AND INDICATION


VOR - SELECTED COURSE NCD

REPLACE SELECTED
COURSE NUMBERS
WITH DASHES

REMOVE SELECTED
COURSE ARROW

REMOVE DEVIATION
BAR AND SCALE

REMOVE TO/FROM
POINTER AND
INDICATION

VOR - ND VOR NCD DISPLAYS

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VOR - ND VOR INVALID DISPLAYS**General**

The inputs that are necessary for VOR displays are:

- Bearing from the VOR/MB receivers
- Frequencies from the CDU or the AIMS cabinets
- Selected course from the CDUs or the AIMS cabinets.

When one of these inputs change to an invalid condition, some of the VOR displays change.

Bearing Invalid

When the VOR/MB receiver bearing goes invalid, these changes occur for the VOR displays:

- Show amber VOR flag
- Remove to/from pointer and indication.
- Remove VOR deviation bar and scale

Frequency Invalid

When the frequency input goes invalid, these changes occur for the VOR displays:

- Remove the VOR frequency or identifier
- Remove the to/from pointer and indication
- Remove the VOR deviation bar.

Selected Course Invalid

When the selected course input goes invalid, these changes occur for the VOR display:

- Remove the VOR frequency or identifier
- Remove the selected course number
- Remove the selected course arrow
- Remove the VOR deviation bar and scale

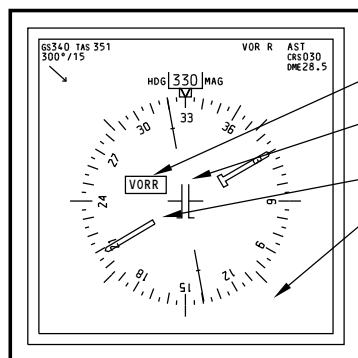
- Remove the to/from pointer and indication.

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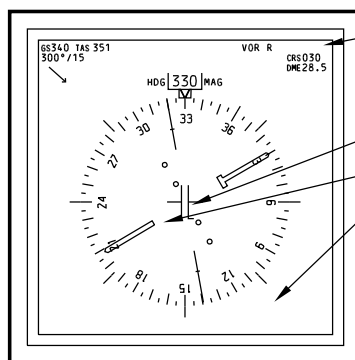
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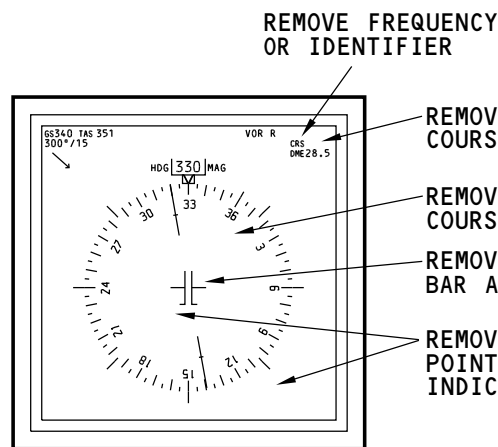
VOR - BEARING INVALID

- SHOW AMBER VOR FLAG
- REMOVE DEVIATION BAR AND SCALE
- REMOVE TO/FROM POINTER AND INDICATION



VOR - FREQUENCY INVALID

- REMOVE FREQUENCY OR IDENTIFIER
- REMOVE DEVIATION BAR
- REMOVE TO/FROM POINTER AND INDICATION



VOR - SELECTED COURSE INVALID

- REMOVE FREQUENCY OR IDENTIFIER
- REMOVE SELECTED COURSE NUMBERS
- REMOVE SELECTED COURSE ARROW
- REMOVE DEVIATION BAR AND SCALE
- REMOVE TO/FROM POINTER AND INDICATION

VOR - ND VOR INVALID DISPLAYS

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VOR - ND VOR TEST DISPLAYS

General

When you do a test of the VOR/MB receiver, the receiver starts a test sequence that lasts approximately 15 to 20 seconds. During the test sequence, the receiver output changes to these conditions:

- Invalid data for the first three seconds
- NCD for two seconds
- Test display for approximately ten seconds.

- The to/from pointer and indication show a FROM indication.

Invalid Data Test Display

For the first three seconds of the test, the receiver output goes invalid. These are the ND display changes:

- Remove the selected course arrow
- Remove the deviation bar and scale
- Remove the to/from pointer and indication
- Show the amber VOR flag.

NCD Data Test Display

After the first three seconds of invalid data, the receiver output goes to an NCD condition for two seconds. These are the ND display changes:

- Remove the deviation bar
- Remove the to/from pointer and indication
- Show the selected course arrow
- Show the deviation scale.

VOR Test Display

After the NCD condition, the receiver shows a valid test display for approximately ten seconds. These are the VOR test displays:

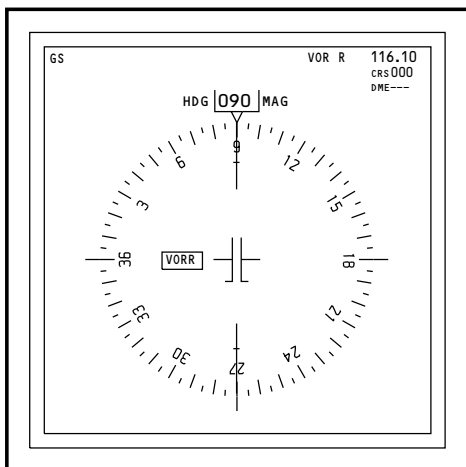
- Selected course arrow points to 0 degrees on the compass
- The deviation bar is centered if 000 is the selected course during the test

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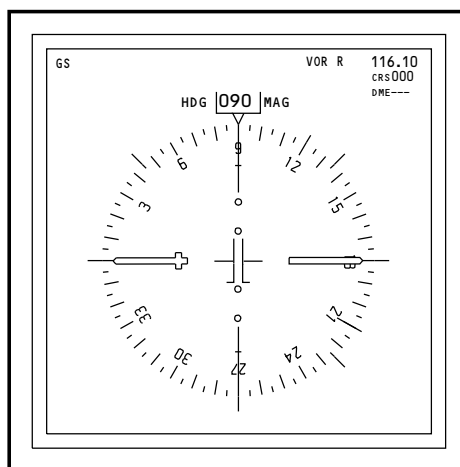
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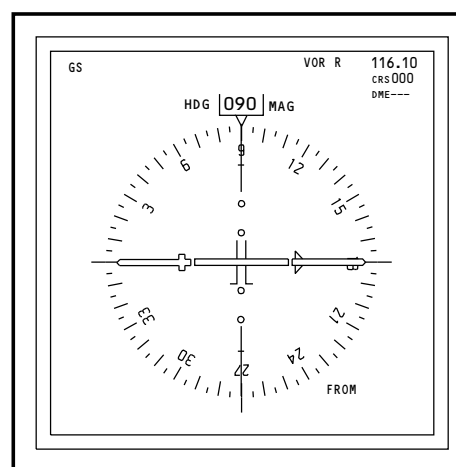
INVALID DATA FIRST 3 SECONDS:

- REMOVE SELECTED COURSE ARROW
- REMOVE DEVIATION BAR AND SCALE
- REMOVE TO/FROM POINTER AND INDICATION
- SHOW AMBER VOR FLAG



NCD DATA FOR 2 SECONDS:

- REMOVE DEVIATION BAR
- REMOVE TO/FROM POINTER AND INDICATION
- SHOW SELECTED COURSE ARROW
- SHOW DEVIATION SCALE



TEST DISPLAY FOR APPROX. 10 SECONDS:

- SELECTED COURSE POINTER AT 0 DEGREES (YOU MUST SELECT A COURSE OF 000)
- DEVIATION BAR CENTERED
- TO/FROM POINTER AND INDICATION SHOWS - FROM

VOR - ND VOR TEST DISPLAYS

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**VOR - VOR/MB RECEIVER FRONT PANEL TEST DISPLAYS****General**

When you do a test of the VOR/MB receiver, you can monitor the receiver test sequence on the NDs and on the VOR/MB receiver front panel LED status lights.

Test Sequence

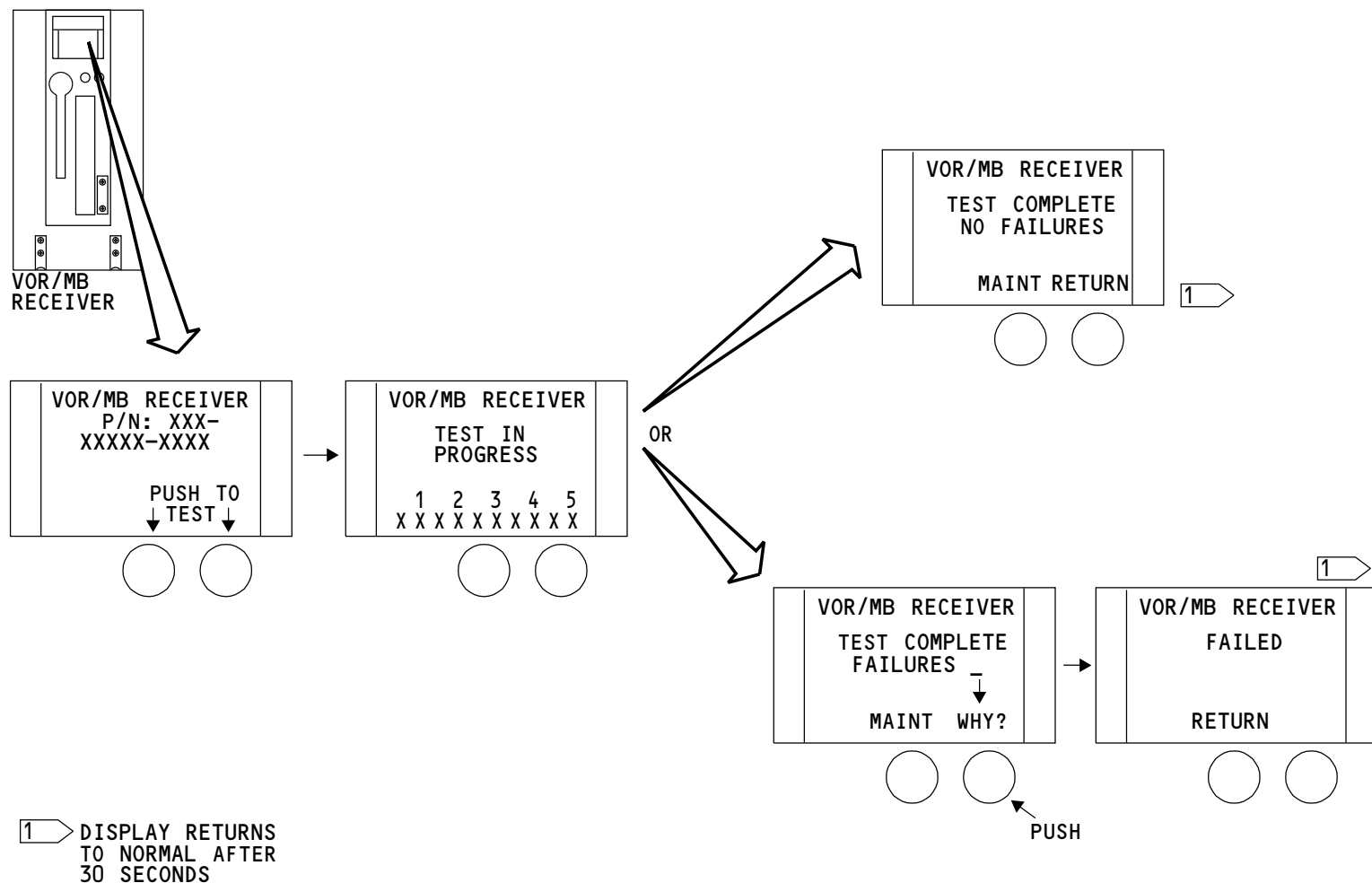
Push any test switch on the front of the receiver to start a test of the VOR/MB receiver. The receiver then does a check of the internal receiver operation and of its interfaces. The test results show on the LCD.

Training Information Point

The maintenance manual and the fault isolation manual do not have a task for the line maintenance technician to do a test from the front panel of the VOR/MB receiver. You must do all tests for the VOR/MB receiver from the MAT or a PMAT.

Many LRUs on the 777 are compatible with other model airplanes that do not have a central maintenance computing system (CMCS). For that reason these LRUs have a front panel test feature.

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VOR - VOR/MB RECEIVER FRONT PANEL TEST DISPLAYS

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**VOR - GROUND TEST****General**

You can test the VOR/MB system from the MAT. These are the tests that are available from the operational test selection on the MAT:

- Left VOR M/B System
- Right VOR System.

Operational Test

The operational test for the left VOR M/B system does a test of:

- Normal operation of the VOR receiver
- Normal operation of the marker beacon receiver.

The operational test for the right VOR system does a test for normal operation of the right VOR receiver.

The test is the same from the MAT or the receiver front panel test switch. The only difference is that the test from the MAT does not do a lamp test of the receiver front panel LEDs.

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GROUND TESTS

SELECT ATA SYSTEM

(55)

34 PARAVISUAL DISPLAY SYSTEM

34 WEATHER RADAR SYSTEM

34 TRAFFIC ALERT AND COLLISION AVOIDANCE SYSTEM

34 GROUND PROXIMITY WARNING SYSTEM

34 VOR / MARKER BEACON SYSTEM

34 AIR TRAFFIC CONTROL (ATC) MODE S SYSTEM

34 DISTANCE MEASURING EQUIPMENT SYSTEM

34 AUTOMATIC DIRECTION FINDER SYSTEM

34 GLOBAL POSITIONING SYSTEM

SELECT TEST TYPE

SYSTEM TEST

OPERATIONAL TEST

CRUISE MEASUREMENT TEST

SELECT OPERATIONAL TEST

(2)

LEFT VOR M/B SYSTEM

RIGHT VOR SYSTEM

CONTINUE

HELP

GO BACK

SELECT OPERATIONAL TEST

(2)

LEFT VOR M/B SYSTEM

RIGHT VOR SYSTEM

VOR - GROUND TEST

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AIR TRAFFIC CONTROL/MODE S TRANSPONDER SYSTEM

General

The air traffic control (ATC) ground stations interrogate the airborne ATC/Mode S transponder system. The ATC/Mode S transponder replies to the interrogations in the form of coded information that the ground station uses.

The ground station uses a primary surveillance radar (PSR) to get radar returns from airplanes within the radar range. To make a communication link with the airplanes in the radar range, the ground station uses a secondary surveillance radar (SSR) to interrogate the ATC/Mode S transponder. The ground station transmits a side lobe suppression signal to inhibit close ATC replies that come from a SSR side lobe transmission.

On the ground radar display, the ATC operator sees the radar returns, altitude, and a four digit airplane identifier.

The ATC operator also sees airplane derived Enhanced Surveillance downlink data on the ground station radar display, such as Magnetic Heading, Air Speed (indicated air speed and mach number), Ground Speed, Roll Angle, Selected Altitude, True Track Angle, and Vertical Rate.

The ATC/Mode S transponder also replies to mode S interrogations from the traffic alert and collision avoidance systems (TCAS) of other airplanes.

ATC/Mode S transponders with Extended Squitter function provide broadcast of Global Position System (GPS) position and velocity data.

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ADS-B is a surveillance system that uses a global navigation satellite system, aircraft avionics, and ground infrastructure to accurately and quickly transmit flight information, such as speed, heading, current position, aircraft identification, altitude and velocity. This information is then broadcast to the air traffic control centers in real time.

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Abbreviations and Acronyms

- ABS - absolute
- ABV - above

- ADIRS - air data inertial reference system
- AIMS - airplane information management system
- ALT - altitude
- ant - antenna
- ATC - air traffic control
- ATCRBS - air traffic control radio beacon system
- BITE - built-in test equipment
- BLW - below
- CMCF - central maintenance computing function
- CMCS - central maintenance computing system
- coax - coaxial
- CPU - central processing unit
- EHS - enhanced surveillance
- gnd - ground
- GPS - global position system
- I/O - input/output
- ident - identification
- INS - instrument
- LED - light emitting diode
- MAT - maintenance access terminal
- MAX - maximum
- MCP - mode control panel
- PSR - primary surveillance radar
- RA - resolution advisory
- REL - relative
- RF - radio frequency
- RPTG - reporting
- SDI - source destination identifier
- SLS - side lobe suppression
- SSR - secondary surveillance radar

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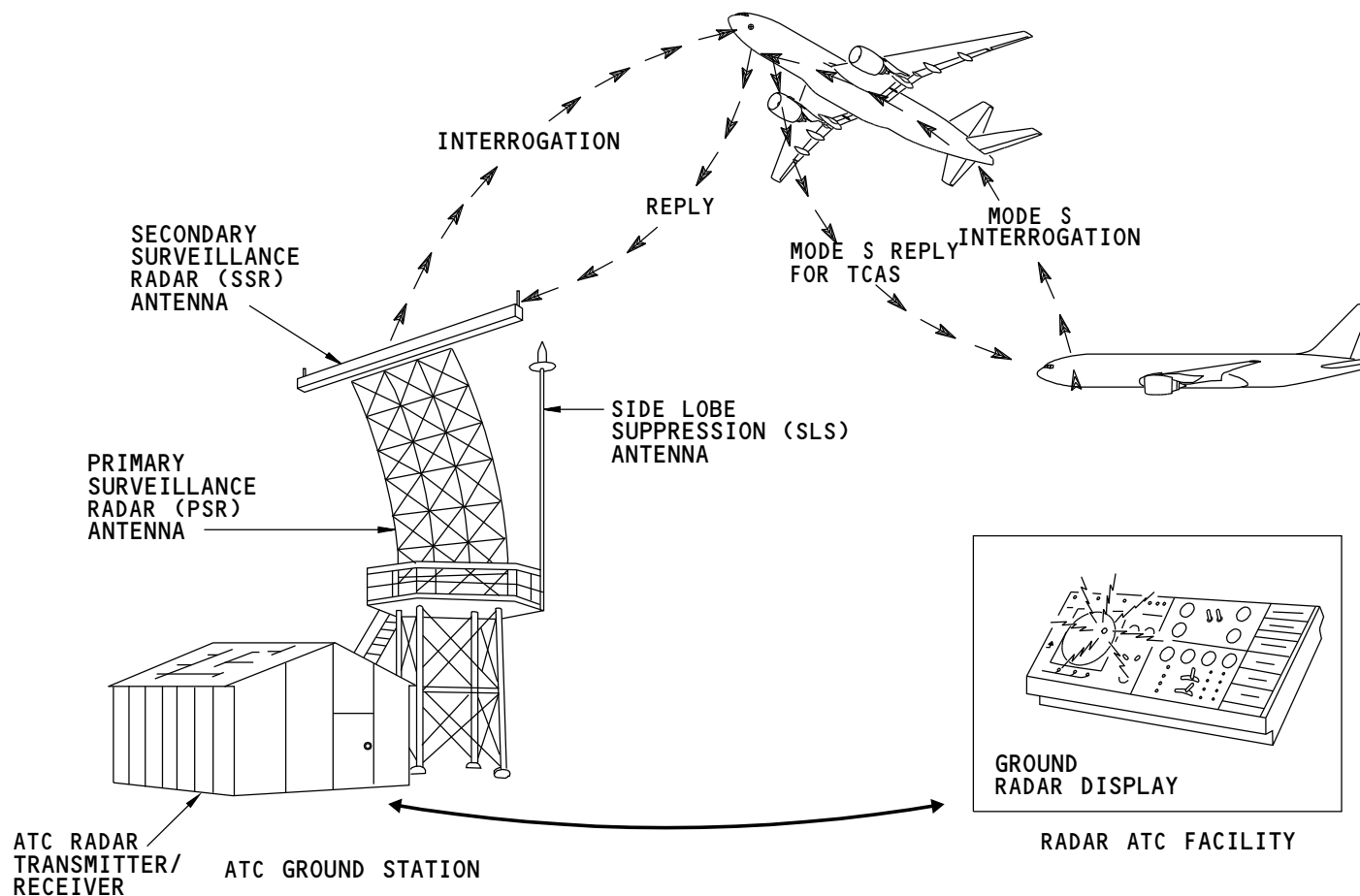
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AIR TRAFFIC CONTROL/MODE S TRANSPONDER SYSTEM

- SPI - special purpose identification
- STBY - standby
- sw - switch
- TA - traffic advisory
- TAS - true air speed
- TCAS - traffic alert and collision avoidance system
- tpr - transponder
- XFR - transfer
- xpdr - transponder
- xpndr - transponder



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AIR TRAFFIC CONTROL/MODE S TRANSPONDER SYSTEM

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**ATC/MODE S TRANSPONDER SYSTEM - GENERAL DESCRIPTION****General**

When a ground station or a TCAS computer from another airplane interrogates the ATC/Mode S transponder system, the transponder transmits a pulse-coded reply signal. The reply signal identifies, and shows the altitude of the airplane.

ATC/Mode S transponder Enhanced Surveillance (EHS) capability reply signals identify and show additional airplane state and intent parameters such as Magnetic Heading, Air Speed (Indicated Airspeed and Mach Number), Selected Altitude, Vertical Rate, Roll Angle, Ground Speed, and True Track Angle.

General Description

The components of the ATC system are:

- Top antenna
- Bottom antenna
- ATC coaxial relay top
- ATC coaxial relay bottom
- Transponder panel
- Two ATC/Mode S transponders
- Two program switch modules.

The two antennas supply transmit and receive signals to the ATC/Mode S transponder through the ATC coax relays.

The transponder panel sends identification and control data to the transponders and control to the ATC coax relays.

The AIMS cabinets supply altitude and central maintenance computing function (CMCF) data to the ATC/Mode S transponders.

The ATC/Mode S transponders have interface with the TCAS computer.

The AIMS cabinets also provide Enhanced Surveillance transmission of downlink aircraft parameters to the ATC Mode S transponders, such as Magnetic Heading, Air Speed, Vertical Rate, Roll Angle, Ground Speed, and True Track Angle.

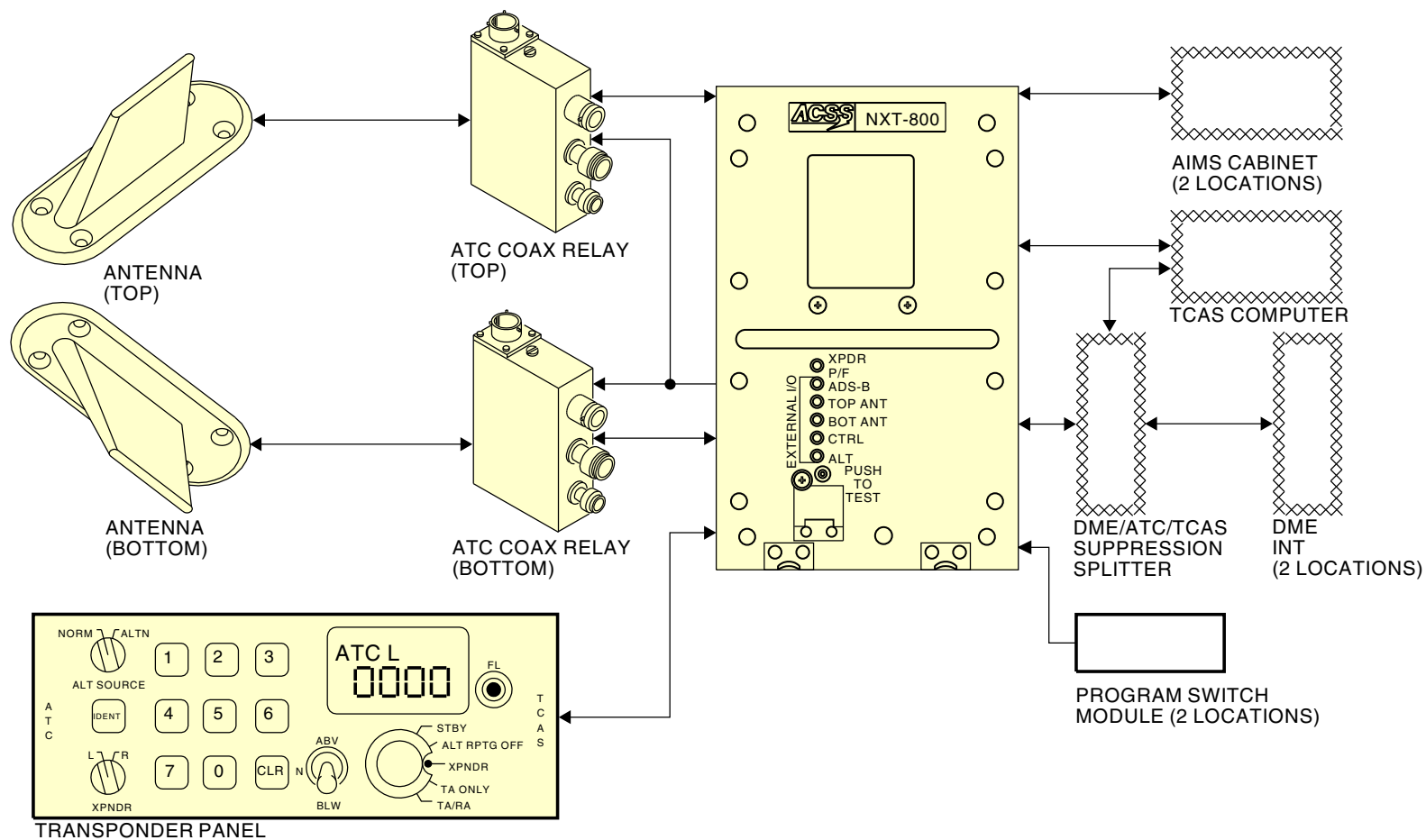
The Mode Control Panel (MCP) provides Enhanced Surveillance downlink aircraft parameters to the ATC Mode S transponders, such as Selected Altitude.

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ATC/MODE S TRANSPONDER SYSTEM - GENERAL DESCRIPTION

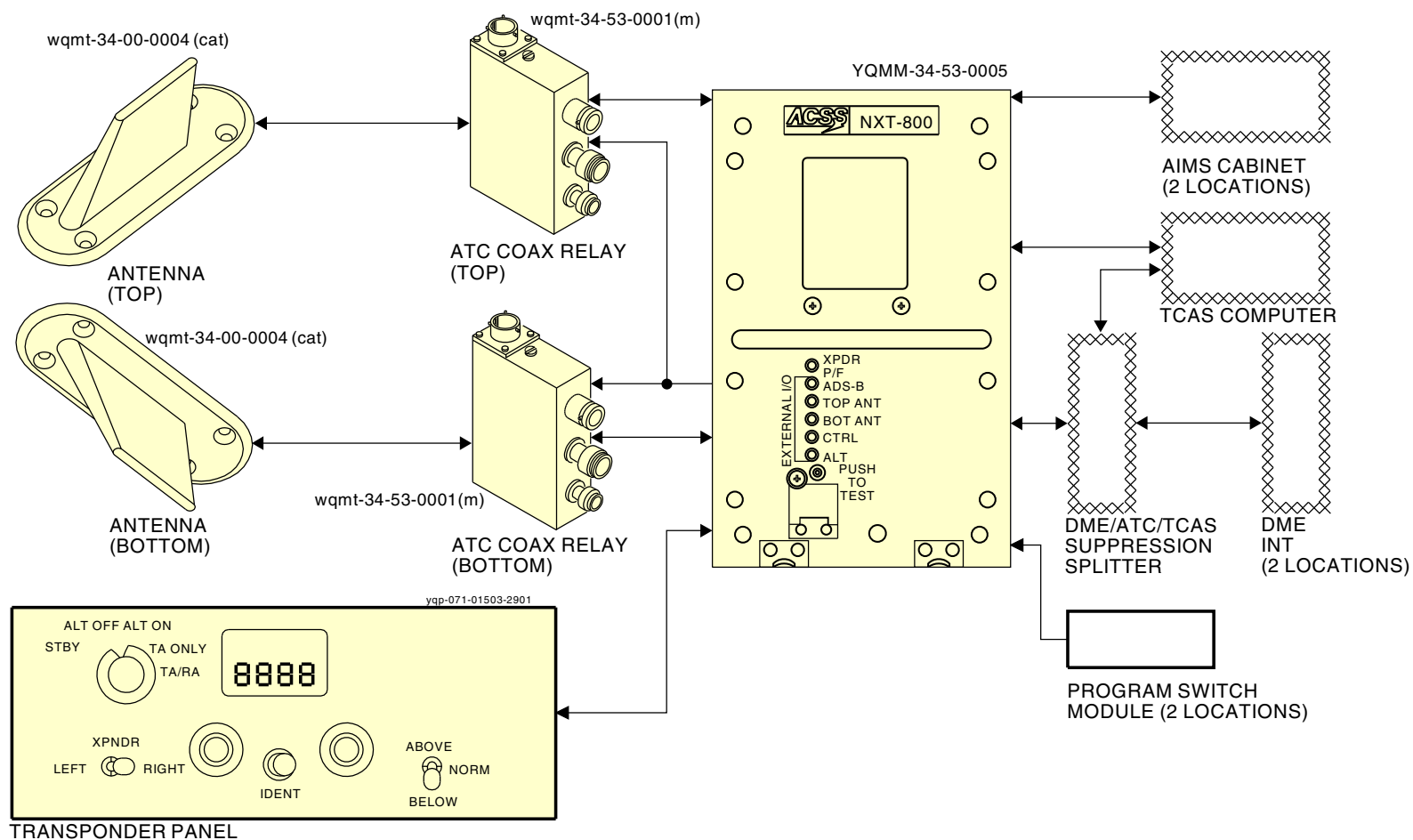
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ATC/MODE S TRANSPONDER SYSTEM - GENERAL DESCRIPTION

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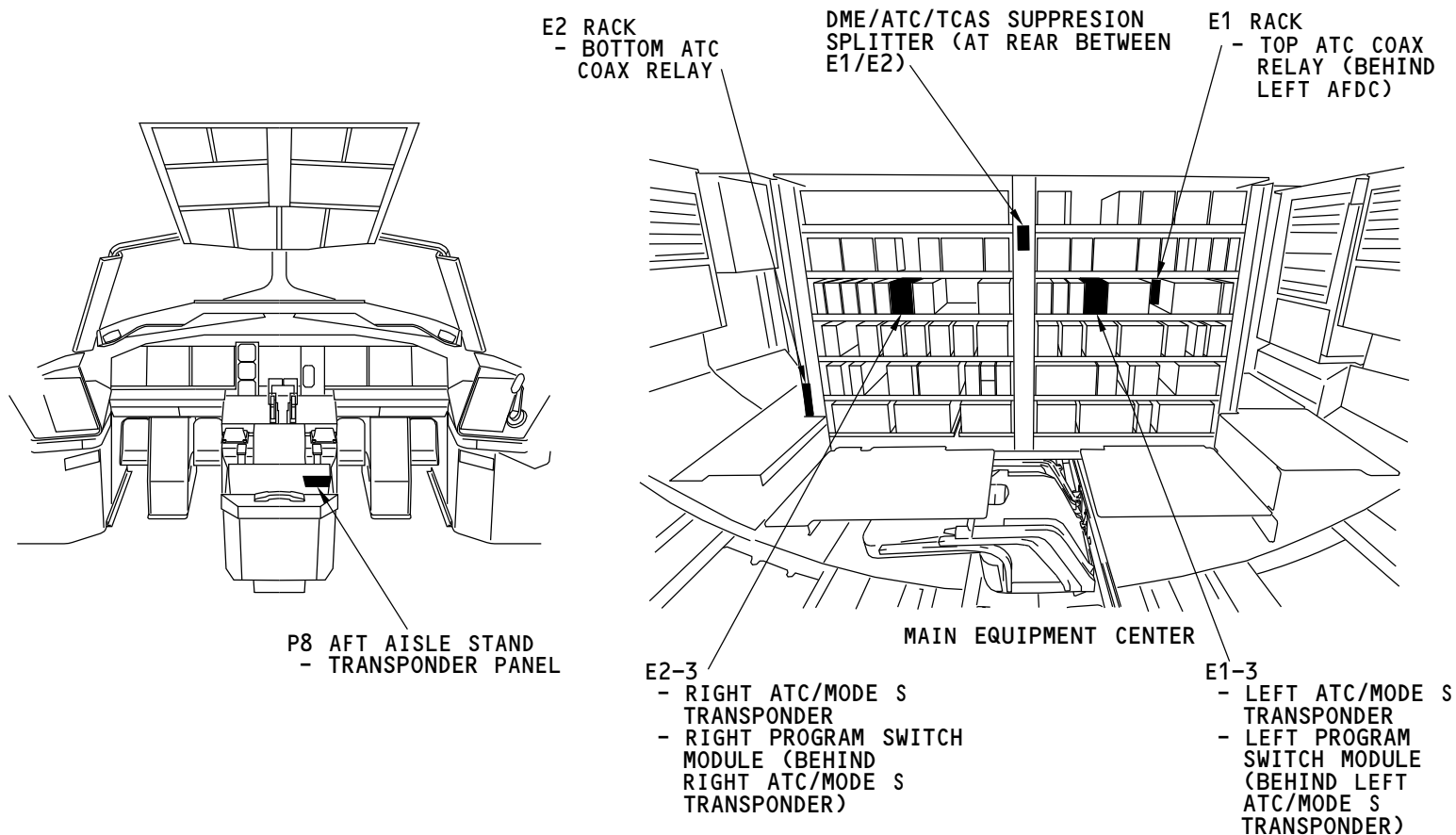
**ATC/MODE S TRANSPONDER SYSTEM - COMPONENT LOCATIONS****Flight Deck**

The transponder panel is on the P8 aft aisle stand.

Main Equipment Center

These are the ATC/Mode S transponder system components in the main equipment center:

- Left ATC/Mode S transponder
- Right ATC/Mode S transponder
- DME/ATC/TCAS suppression splitter
- Left program switch module
- Right program switch module
- Top ATC coax relay
- Bottom ATC coax relay.



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ATC/MODE S TRANSPONDER SYSTEM - COMPONENT LOCATIONS

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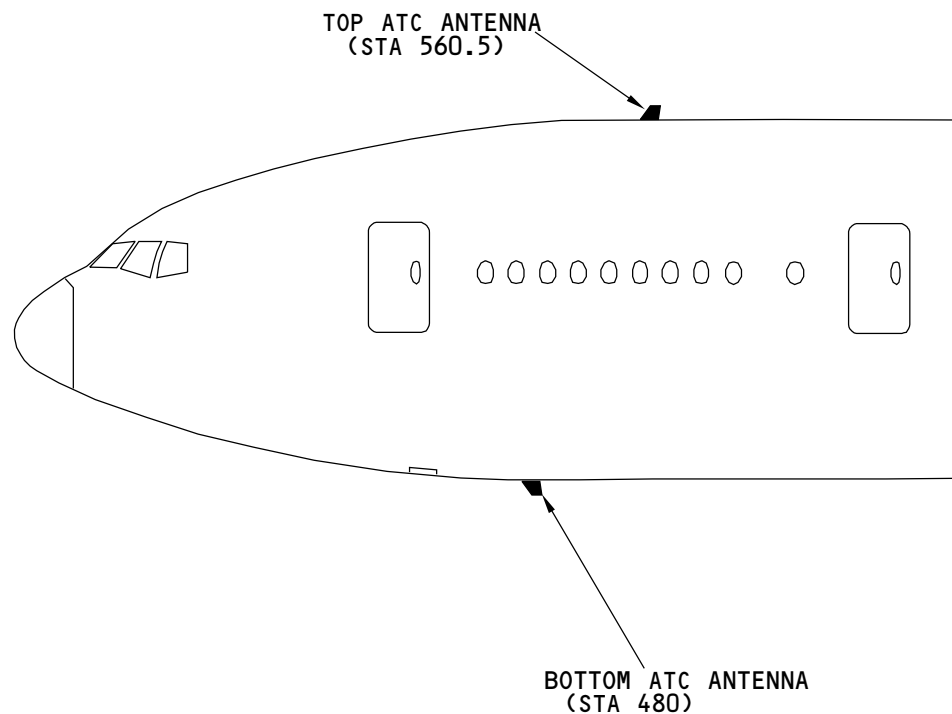


ATC/MODE S TRANSPONDER SYSTEM - ANTENNA LOCATION

General

The top antenna is on top of the fuselage and the bottom antenna is bottom of the fuselage.

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ATC/MODE S TRANSPONDER SYSTEM - ANTENNA LOCATION

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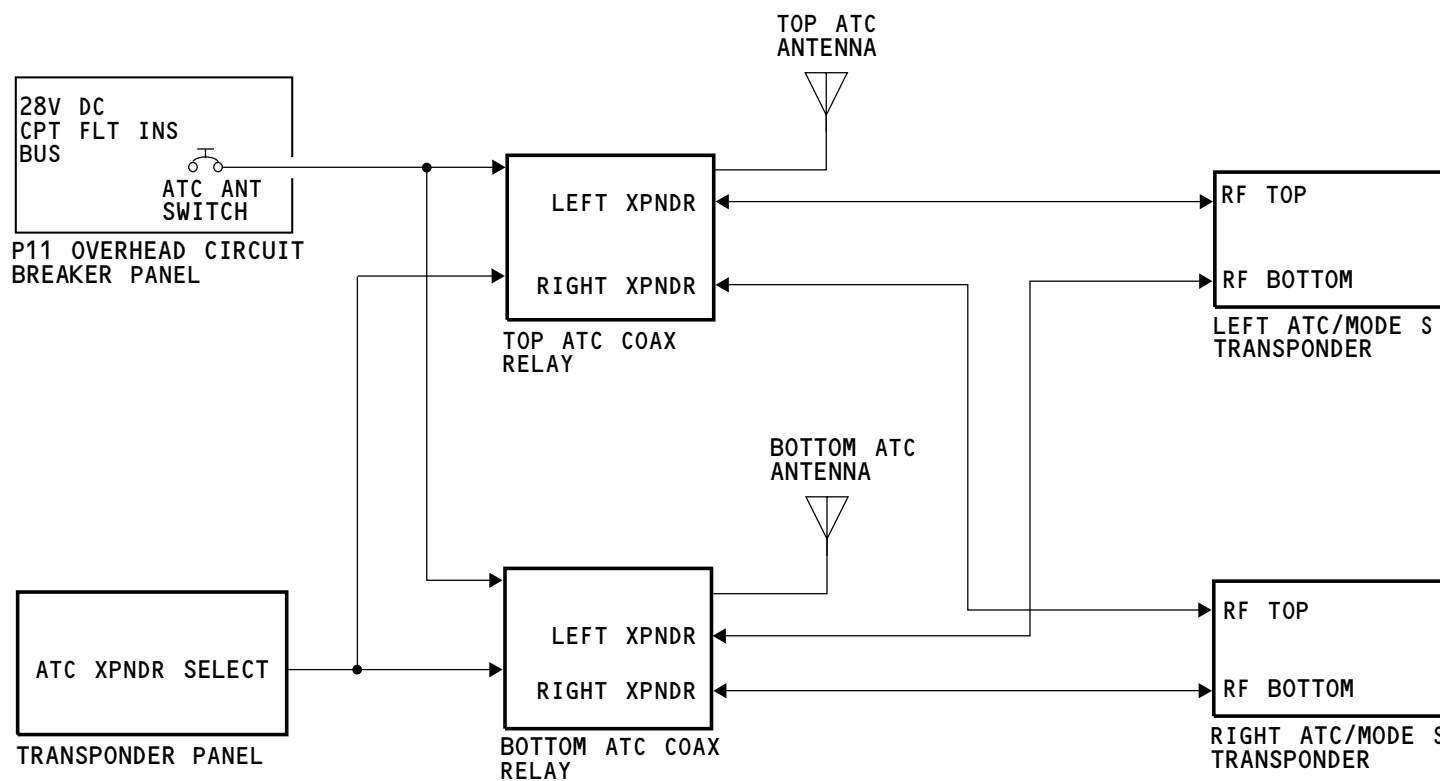


ATC/MODE S TRANSPONDER SYSTEM - ANTENNA INTERFACE

General

When you select the left ATC/mode S transponder system, the ATC coax relays do not energize and the antennas connect to the left transponder. When you select the right ATC/mode S transponder system, the transponder panel sends a discrete to the ATC coax relays. This makes the top and bottom antennas connect to the right transponder.

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ATC/MODE S TRANSPONDER SYSTEM - ANTENNA INTERFACE

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**ATC/MODE S TRANSPONDER SYSTEM - POWER, IDENTITY, CONTROL, AND AIR DATA INTERFACES****Power**

The left ATC/Mode S transponder gets 115v ac power from the ac standby bus. The right ATC/Mode S transponder gets 115v ac power from the right ac transfer bus. The dual transponder panel gets 115v ac power from the ac standby bus.

Standby/On Discrete

The transponder panel sends a (ground) standby discrete to the transponder that is not in use.

Identity Code

The flight crew sets the four digit identity code and it shows on the transponder panel. Both transponders get the identity code from the transponder panel.

Control Data

The transponder panel also sends control data to the transponders. This control data does these functions:

- Permit mode C altitude reporting
- Permit the transponder to send the special position identification (SPI) pulse or airplane identification code.

Air Data

The air data inertial reference unit (ADIRU) and the secondary attitude air data reference unit (SAARU) send air data to the AIMS cabinets. ATC/Mode S transponders receive the air data from both AIMS cabinets.

The left transponder gets air data at ADC input 1 from the ADIRU general purpose (GP) bus 3 from left AIMS cabinet. Air data at ADC input 2 comes from the SAARU GP bus 3 from the right AIMS cabinet.

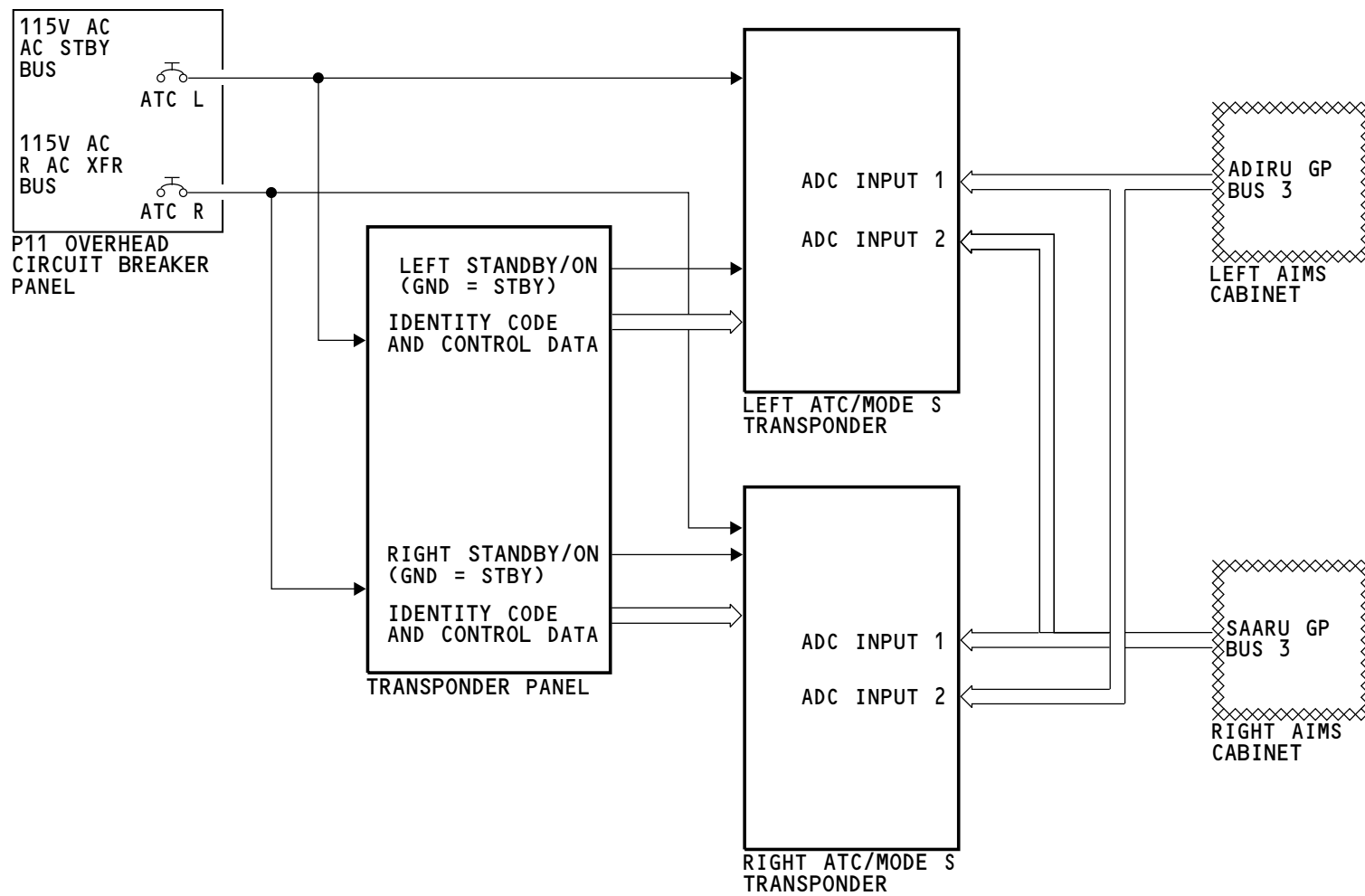
The right transponder gets air data at ADC input 1 from the SAARU GP bus 3 of the right AIMS cabinet. Air data at ADC input 2 comes from the ADIRU GP bus 3 from the left AIMS cabinet.

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ATC/MODE S TRANSPONDER SYSTEM - POWER, IDENTITY, CONTROL, AND AIR DATA INTERFACES

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**ATC/MODE S TRANSPONDER SYSTEM - MAINTENANCE INTERFACE****Air/Ground**

The air/ground discretes go through the transponder panel to the transponders.

The purpose of the air ground relay is to:

- Prevent ground tests of the ATC system in the air
- Define flight legs in the non-volatile memory if the CMCFs fail.

Transponder - Central Maintenance Computing Function Interface

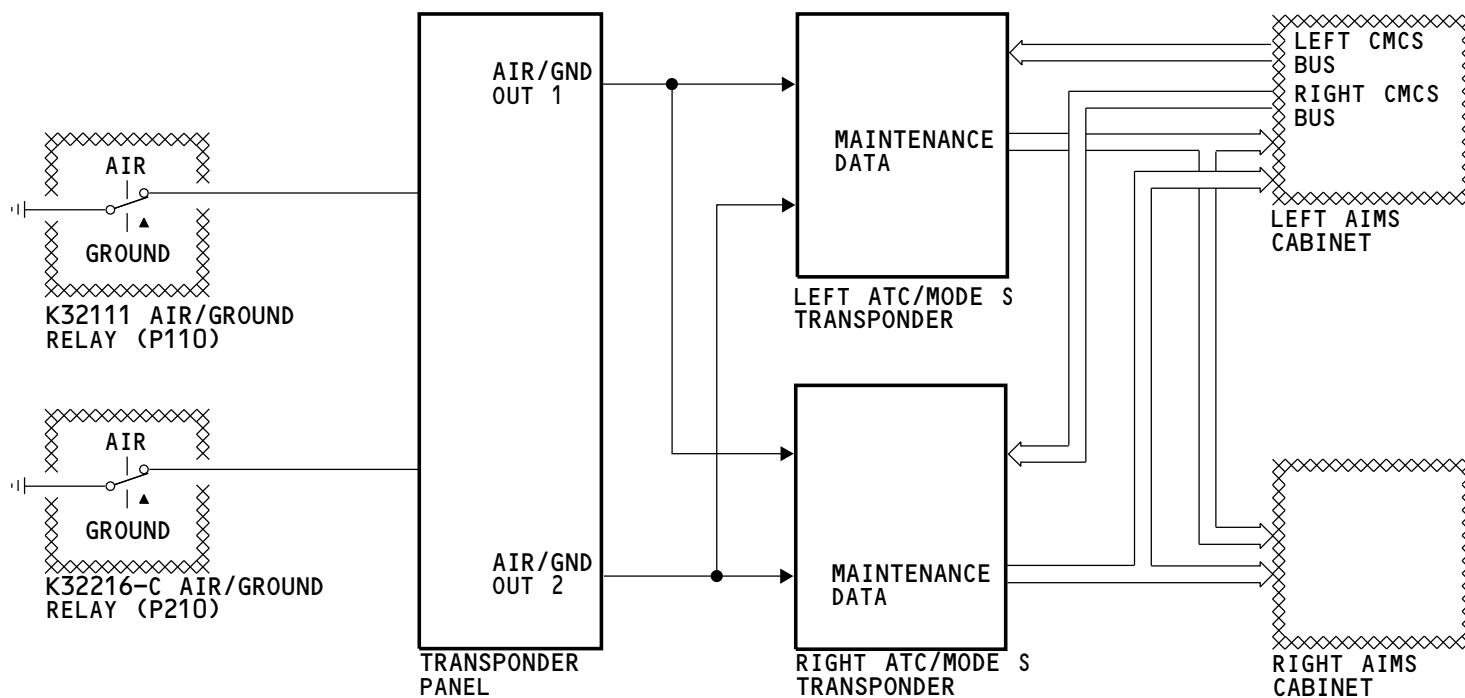
Each transponder has a maintenance interface to the central maintenance computing function (CMCF) of the AIMS cabinets.

The transponders continuously send ATC system maintenance data to the CMCFs in the AIMS cabinets.

The central maintenance computing function (CMCF) in the left AIMS cabinet sends data to both transponders to do these functions:

- Define flight legs for the non-volatile memory (NVM) in the transponder
- Command the ATC/Mode S transponder to start an ATC/Mode S transponder system test.

Use the maintenance access terminal (MAT) to start the ATC system test through the CMCFs.



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ATC/MODE S TRANSPONDER SYSTEM - MAINTENANCE INTERFACE

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ATC/MODE S TRANSPONDER SYSTEM - TCAS INTERFACE AND PROGRAM PINS**Program Pins**

Each ATC/Mode S transponder has these types of program pins:

- Airplane mode S address program pins
- Source destination indicator (SDI) program pins
- Maximum true airspeed program pin.

There are 24 airplane address program pins on each transponder. A program switch module connects to the program pins. The program switch module supplies the open and ground connections necessary to make the 24 bit unique airplane identification.

The SDI defines the transponder as a left or right ATC/Mode S transponder.

The maximum true airspeed pins define the maximum true airspeed for the airframe. The transponder formats and sends the maximum true airspeed to the TCAS computer.

Digital Data to TCAS

The active ATC/Mode S transponder sends this data to the traffic alert and collision avoidance system (TCAS) computer:

- The 24-bit mode S airplane identification. TCAS needs the airplane mode S identification for maneuver coordination
- Barometric altitude
- Maximum true airspeed
- TCAS coordination message data
- ATC/Mode S transponder system failure data.

TCAS to Active Transponder

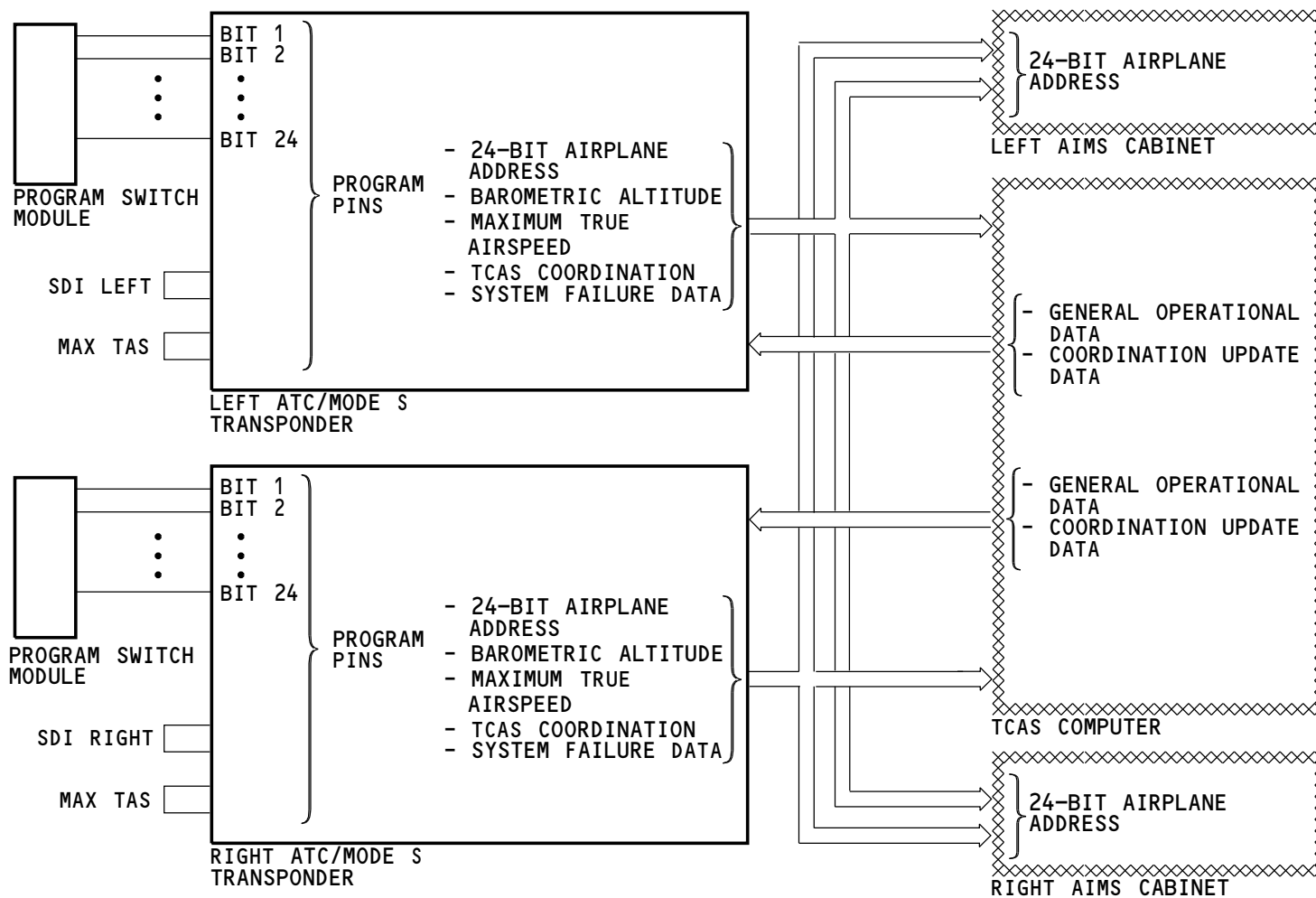
The TCAS computer sends this data to the active transponder:

- General TCAS operational data
- Coordination update data.

Digital Data to the AIMS Cabinets

The ATC/Mode S transponders send the airplane unique 24-bit mode S airplane identification to the AIMS cabinets for use in other systems.

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ATC/MODE S TRANSPONDER SYSTEM - TCAS INTERFACE AND PROGRAM PINS

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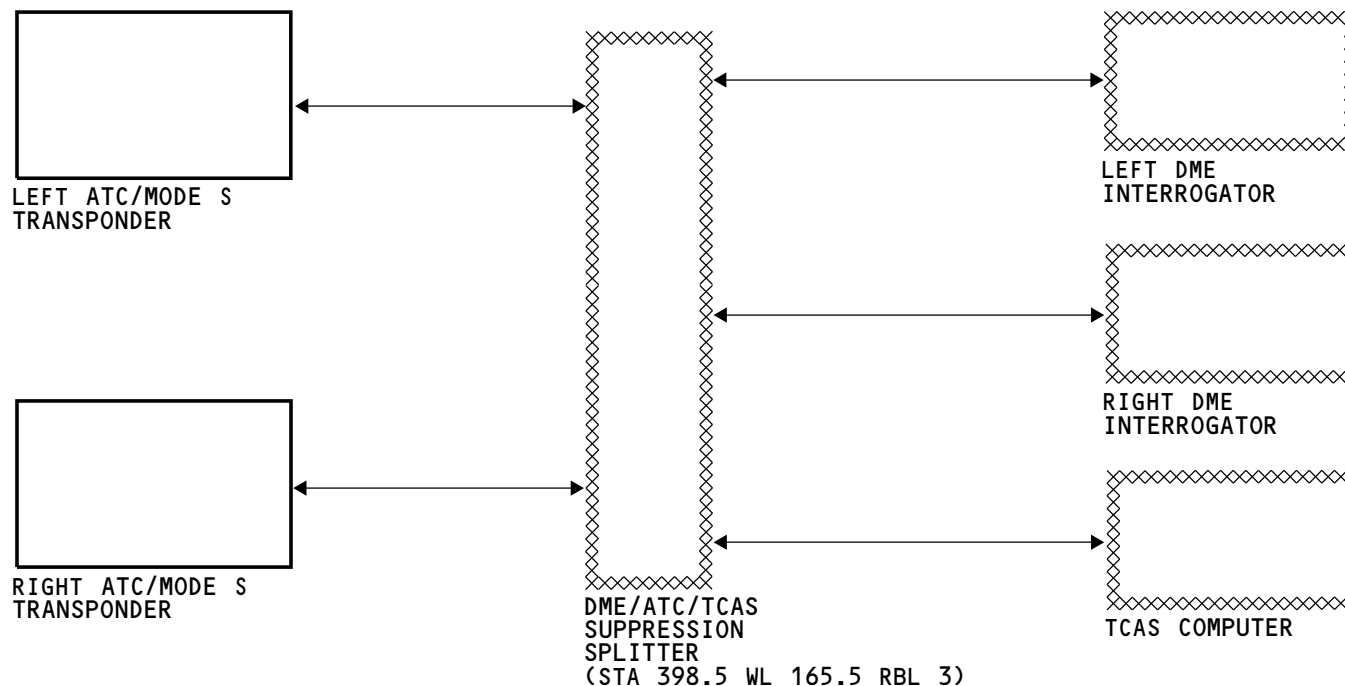
ATC/MODE S TRANSPONDER SYSTEM - SUPPRESSION INTERFACE

General

The ATC/Mode S transponders, TCAS, and the DME interrogators operate in the same frequency band. There is a suppression interface between these units. This prevents damage to the receiver circuits during a signal transmission.

The first unit to transmit sends a suppression pulse through the suppression splitter to the other units. This suppression pulse prevents the operation of the receiver circuits in the other units.

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ATC/MODE S TRANSPONDER SYSTEM - SUPPRESSION INTERFACE

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**ATC/MODE S TRANSPONDER SYSTEM - ATC/MODE S TRANSPONDER****General**

The ATC ground station interrogates the ATC/Mode S transponder with a pulse-coded signal at a frequency of 1030 MHz.

The transponder responds with pulse-coded signals at a frequency of 1090 MHz.

Characteristics

The transponder responds to air traffic control radar beacon system (ATCRBS) mode A and mode C interrogations. The transponder also responds to the TCAS computer with the mode select (mode S) format.

The ATC/Mode S transponder has a non-volatile flight-fault memory.

A computer with the ACSS WebEDDIT software application can connect to the RJ-45 connector to load software into the ATC/Mode S transponder.

Front Panel Indications

The light emitting diode (LED) status indicators on the front panel show:

- Green XPDR P/F, if there are no LRU failures
- Red XPDR P/F, if there is an LRU failure
- Red ADS-B, if GPS position input fails
- Red TOP ANT, if the top antenna fails
- Red BOT ANT, if the bottom antenna fails
- Red CNTL, for a control panel input failure
- Red ALT, if the digital altitude sources are failing.

The test switch starts a self-test.

Training Information Point

The maintenance manual and the fault isolation manual do not have a task for the line maintenance technician to do a test from the front panel of the ATC/mode S transponder. You must do all tests for the ATC/mode S transponder from the MAT or a PMAT.

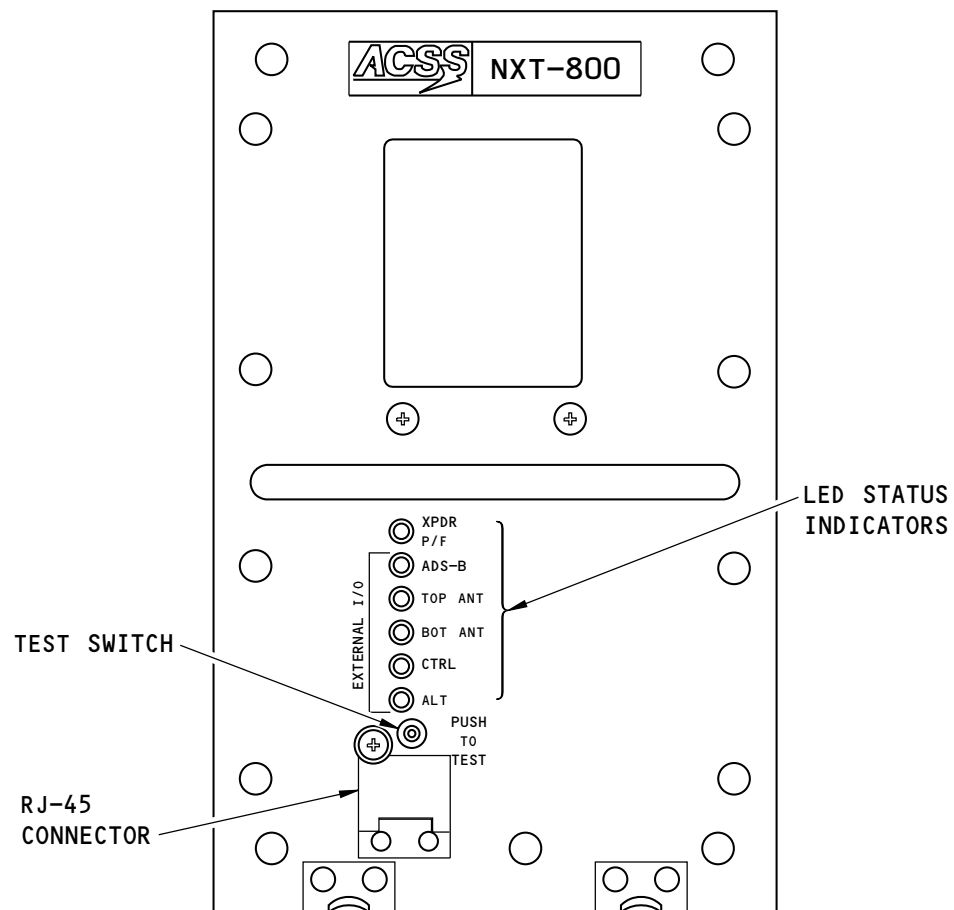
Many LRUs on the 777 are compatible with other model airplanes that do not have a central maintenance computing system (CMCS). For that reason these LRUs have a front panel test feature.

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ATC/MODE S TRANSPONDER SYSTEM - ATC/MODE S TRANSPONDER

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ATC/MODE S TRANSPONDER SYSTEM - TRANSPONDER PANEL

General

The dual transponder panel controls the ATC/Mode S transponder and the TCAS computer.

The ATC controls and displays on the transponder panel are:

- IDENT switch
- Four digit identification code
- Active system display
- Transponder mode selector
- Transponder code selectors
- Transponder selector.

Transponder Selector and Active System Display

The transponder selector has a left and a right transponder (XPNDR) position. With the left position selected, the control panel sends a ground standby/on discrete to the right transponder only. Then the right transponder is in standby. The left transponder is active.

With the right position selected, the control panel sends an open standby/on discrete to the right transponder to make it active. A ground standby/on discrete goes to the left transponder and an antenna transfer discrete goes to the ATC coax relays. This puts the left transponder in standby, and makes the relays connect the ATC antennas to the right transponder.

The selected ATC system shows on the LCD active system display.

Identification Code Display and Selection

The flight crew uses the code selectors to set the four digits of the identification code. The four digits show on the liquid crystal display (LCD). Codes are from 0000 to 7777, with 4096 different selections.



CAUTION

DO NOT SELECT CODES 7500, 7600 OR 7700. THESE CODES ARE USED ONLY FOR EMERGENCIES.

Transponder Mode Selector

The transponder mode selector has several positions. These are the functions that the ATC system uses:

- STBY (standby) - a ground discrete goes to both transponders. This ground discrete prevents operation of the transponder, but does not prevent built-in-test-equipment (BITE) functions.
- ALT OFF (altitude reporting off) - the active transponder responds to ATC interrogations with mode A and mode S replies only.
- ALT ON - the active transponder responds to ATC interrogations with mode A and mode C (altitude reporting) and mode S replies.

These are the functions that the traffic alert and collision avoidance system (TCAS) uses:

- TA ONLY - all intruder traffic advisories (TAs), except resolution advisories (RAs), show for the alert and collision avoidance system (TCAS).
- TA/RA - all intruder traffic shows. This is the normal mode of operation for TCAS.

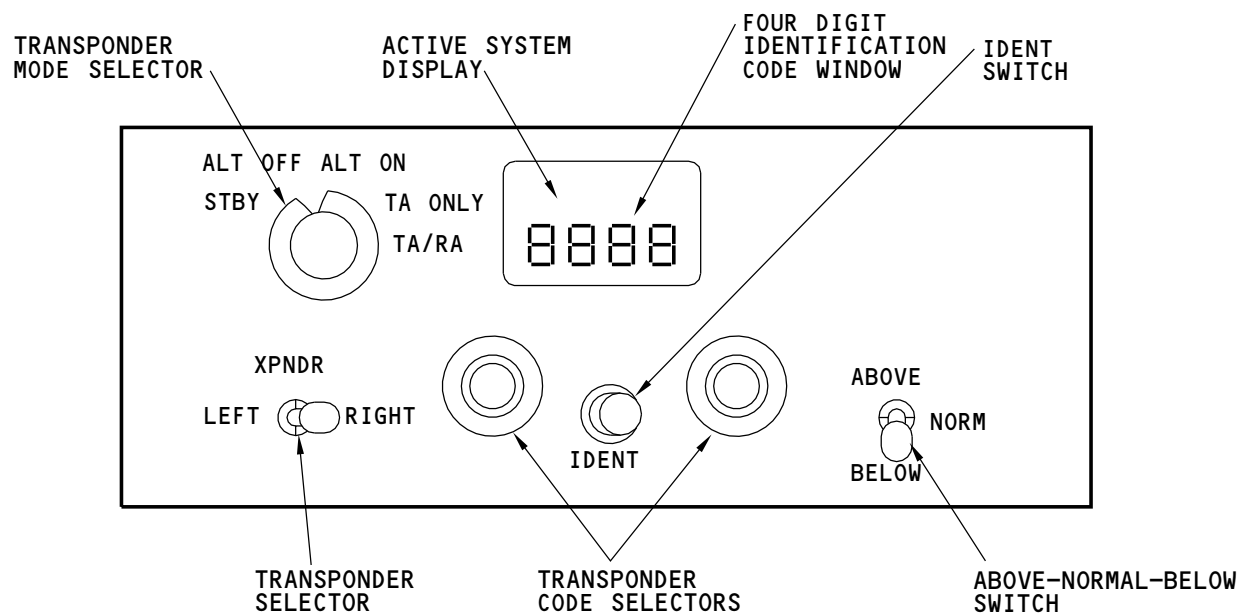
IDENT Switch

When the ATC controller requests the airplane identifier, the pilot pushes the momentary IDENT switch. The transponder adds a special position identification (SPI) pulse to the interrogation reply for the next 18 seconds.

Above-Normal-Below Switch

The above-normal-below switch changes the altitude envelope that shows the TCAS intruders on the NDs.

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ATC/MODE S TRANSPONDER SYSTEM - TRANSPONDER PANEL

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ATC/MODE S TRANSPONDER SYSTEM - ATC ANTENNA**Purpose**

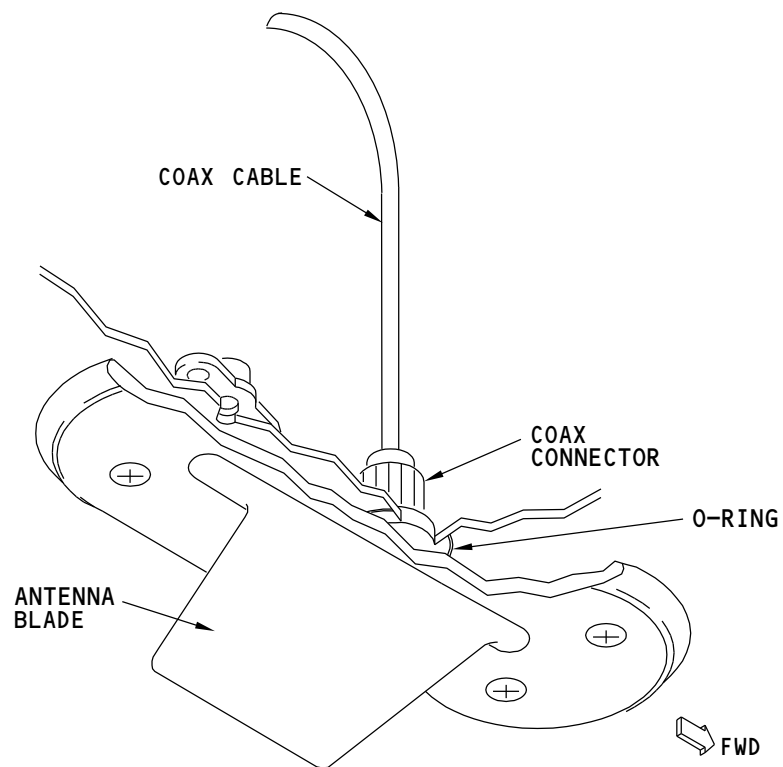
The ATC L-band blade antenna receives 1030 MHZ interrogations from ATC ground stations and other airplanes that have TCAS. The ATC/Mode S transponder transmits the reply signals through the L-band antenna.

Physical Description

Connect the coaxial cable connector to the antenna. The antenna has an O-ring moisture seal and attaches to the airplane by four screws. The ATC and DME antennas are the same and are interchangeable.



EXTRA FORCE ON THE ANTENNA BASE MAY BE REQUIRED TO BREAK WEATHERPROOFING SEAL. TO PREVENT DAMAGE TO AIRPLANE SKIN OR ELECTRICAL CABLE AT THE ANTENNA BASE, CAREFULLY PRY AROUND THE ANTENNA WITH A SEALANT REMOVAL TOOL.



ATC/MODE S TRANSPONDER SYSTEM - ATC ANTENNA

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**ATC/MODE S TRANSPONDER SYSTEM - ATC COAX RELAY****General**

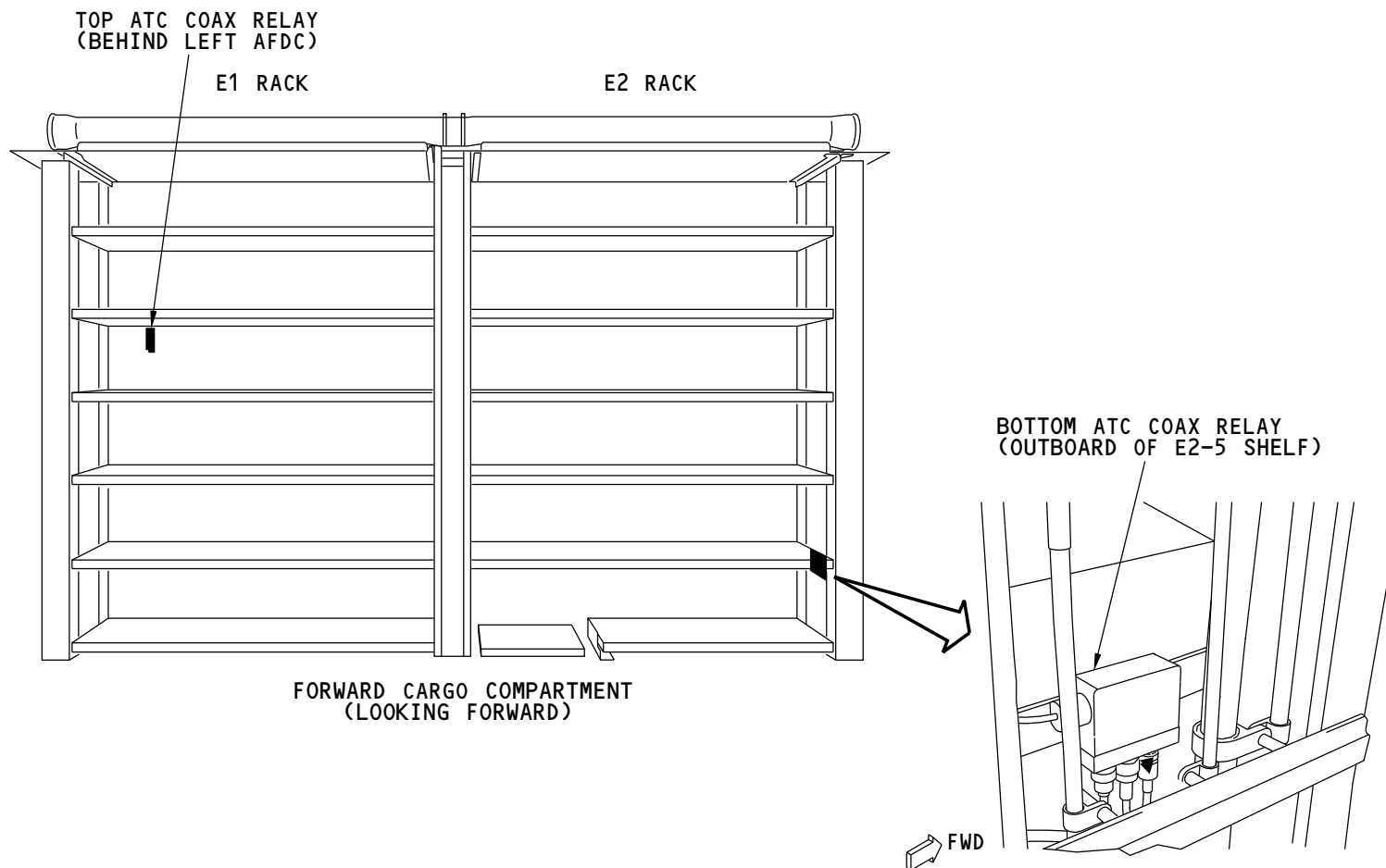
The ATC coax relays connect the active ATC/mode S transponder to the top and bottom ATC antennas.

The electrical connector has an input from these components:

- ATC antenna switch circuit breaker
- ATC control panel.

The ATC coax relays supply an RF interface for the ATC system interrogation and reply signals. These are the connectors:

- Right ATC/mode S transponder connector
- ATC antenna connector
- Left ATC/mode S transponder connector.



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ATC/MODE S TRANSPONDER SYSTEM - ATC COAX RELAY

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ATC/MODE S TRANSPONDER SYSTEM - INPUTS AND CONTROL

Transponder Panel

The transponder panel controls the operation of the ATC/Mode S transponders.

The microprocessor in the control panel gets inputs from these:

- Code selectors
- IDENT switch
- Mode selector.

The microprocessor changes these inputs into ARINC 429 digital data. The transponder panel sends this data on an ARINC 429 data bus to the selected transponder.

The digital data contains:

- The identity code the flight crew selects to reply to mode A interrogations
- Digital discretes for the position of the IDENT switch
- Digital discretes for ALT RPTG OFF or ON.

The standby analog discrete selects one transponder for operation. The selected transponder receives an open discrete from the control panel. A ground discrete goes from the panel to the other transponder to put it in the standby mode. This discrete also goes to the ATC antenna coax relay to connect the two ATC antennas to the selected ATC/Mode S transponder.

Air/Ground Input

The transponder receives an air/ground discrete from an air/ground relay. The CPU uses the air/ground discrete to count flight segment in the fault history non-volatile memory. This discrete also prevents mode A and mode C replies when the airplane is on the ground.

ATC/Mode S Transponder Inputs

The transponder has an input/output (I/O) that has an interface with the ARINC 429 data and analog discretes from the panel.

Control Inputs

The digital data bus from the panel contains two digital discretes. One shows if the function selector on the panel is in the ALT RPTG OFF (altitude reporting off) position. If it is, the CPU does not let the transponder make a mode C reply.

The other digital discrete from the control panel shows the position of the IDENT switch on the control panel. The pilot momentarily pushes the IDENT switch at the request of the ground station. When this happens, the transponder sends a special position identification (SPI) pulse at the end of every normal mode A reply. It continues for 18 seconds. The SPI causes the airplane identification to show on the air traffic controller radar screen.

Altitude Inputs

The AIMS cabinets send barometric altitude to each transponder. Each transponder has two sources of altitude data. The altitude source selector on the panel sends an analog discrete to select the normal or the alternate altitude source.

Altitude input number one is the normal source for the left transponder. Input number two is the normal source for the right transponder.



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ATC/MODE S TRANSPONDER SYSTEM - INPUTS AND CONTROL

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**ATC/MODE S TRANSPONDER SYSTEM - TRANSPONDER RECEIVE FUNCTION****General**

The antennas send the interrogation signals to the transponder. The signals go through the duplexer circuits to two individual receivers. The 1030 MHz interrogation signal mixes with a 1090 MHz signal supplied by the 1090 MHz oscillator. This makes an intermediate frequency signal that the signal processor uses.

Suppression

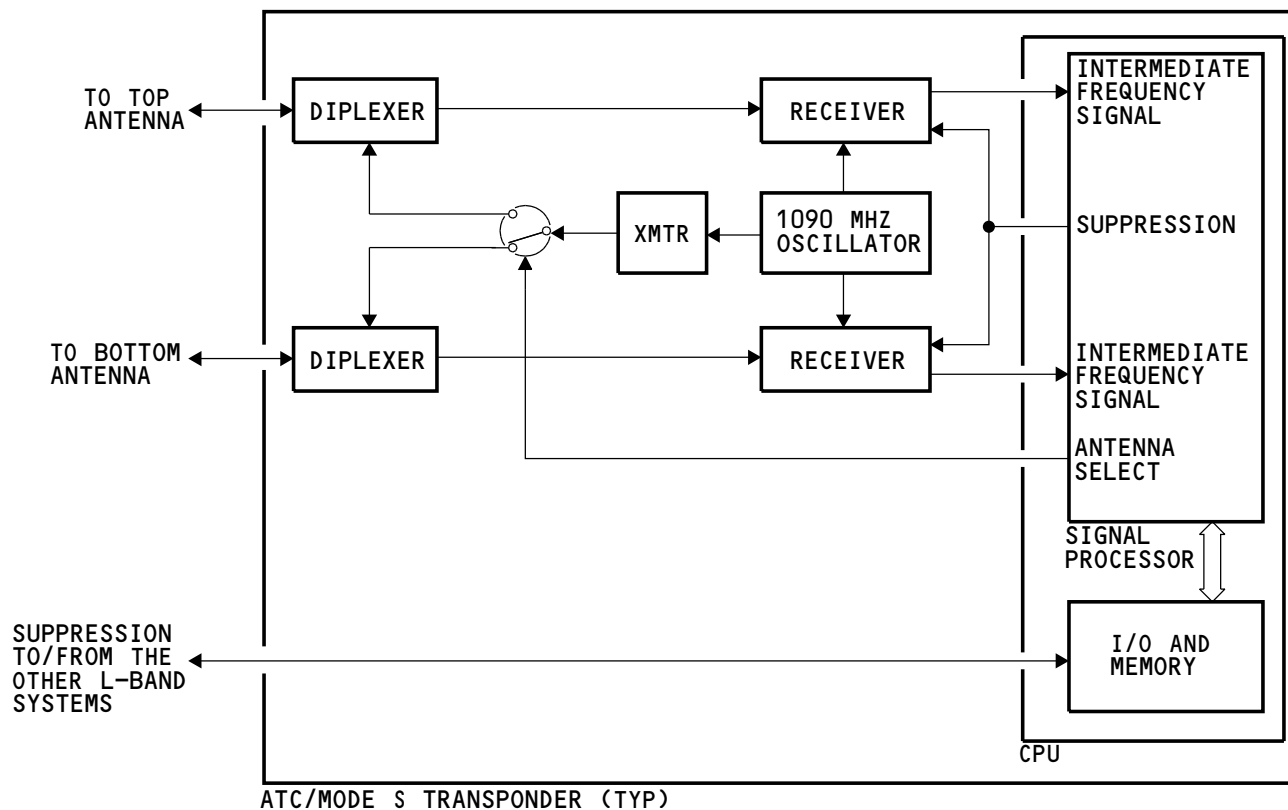
When the transponder gets a suppression pulse from another system, the signal processor circuits do not permit the receiver circuits to operate.

Antenna Select

The antenna select circuit chooses the duplexer and antenna that supplies the strongest receiver signal. The transmission of the reply signal goes through the selected duplexer and antenna.

Signal Processor

The signal processor determines if the transponder receives a valid interrogation signal. It also determines the correct reply mode; mode A, mode C or mode S.



ATC/MODE S TRANSPONDER SYSTEM - TRANSPONDER RECEIVE FUNCTION

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ATC/MODE S TRANSPONDER SYSTEM - TRANSPONDER TRANSMIT AND CMCF FUNCTION

Transmit

The central processor unit (CPU) controls the transponder to reply to a mode A, mode C or mode S interrogation. The mode format circuits use the identity code, airplane altitude and the unique 24-bit airplane address from the memory to format the data for the reply signals.

A mode A reply contains only the airplane identity code.

A mode C reply contains both the airplane identity code and the airplane altitude.

Mode S interrogations come from the TCAS equipment of other airplanes. The mode S replies contain a unique 24-bit airplane address.

After the signal processor chooses the correct mode for the reply data, the modulator makes a reply signal from that format. The modulated signal goes to the power amplifier. The signal mixes with a 1090 MHz frequency to make the transmission reply signal. The transmission reply signal goes to the diplexer and to the ATC antenna.

The antenna select circuit makes the transmission signal go to the antenna that receives the strongest interrogation signal.

Test

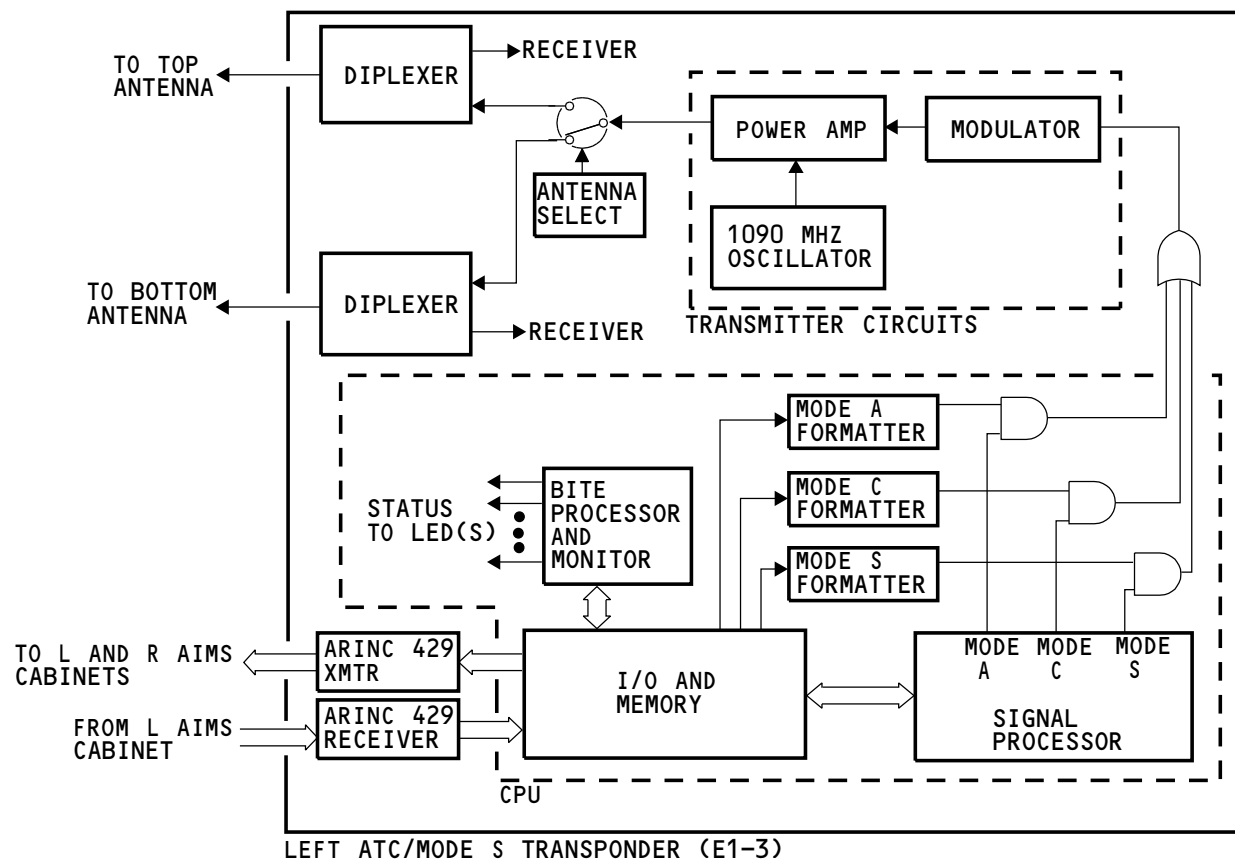
When you apply power or do a test of the ATC/Mode S transponder system, the built-in test equipment (BITE) does a check of the operational status of all the internal circuits and for the correct antenna impedance. The BITE circuits identify any failures and put them into the non-volatile memory.

The LEDs on the front panel of the transponder show:

- Transponder status
- Antenna status
- Transponder control and altitude interfaces.

AIMS CMCF Function

The ATC/Mode S transponder transmits fault summary data on an ARINC 429 bus to the CMCF of both AIMS cabinets. To do a test of the ATC/Mode S transponder system, a test command comes from the maintenance access terminal (MAT) through the CMCF of the left AIMS cabinet.



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ATC/MODE S TRANSPONDER SYSTEM - TRANSPONDER TRANSMIT AND CMCF FUNCTION

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**ATC/MODE S TRANSPONDER SYSTEM - ANTENNA COAX RELAY CONTROL****General**

Use the transponder panel to select the active ATC system. When you do this, the transponder panel sends a discrete open or ground to the top and bottom ATC coax relays. This connects the right transponder or left transponder to the top and bottom ATC antennas.

Left System Select or Standby

When the airplane power is on and when the transponder panel has the left transponder or standby selected, the S1 switches open. Relays R1 and R2 do not energize. The top and bottom antennas connect to the left ATC/Mode S transponder.

Right System Select

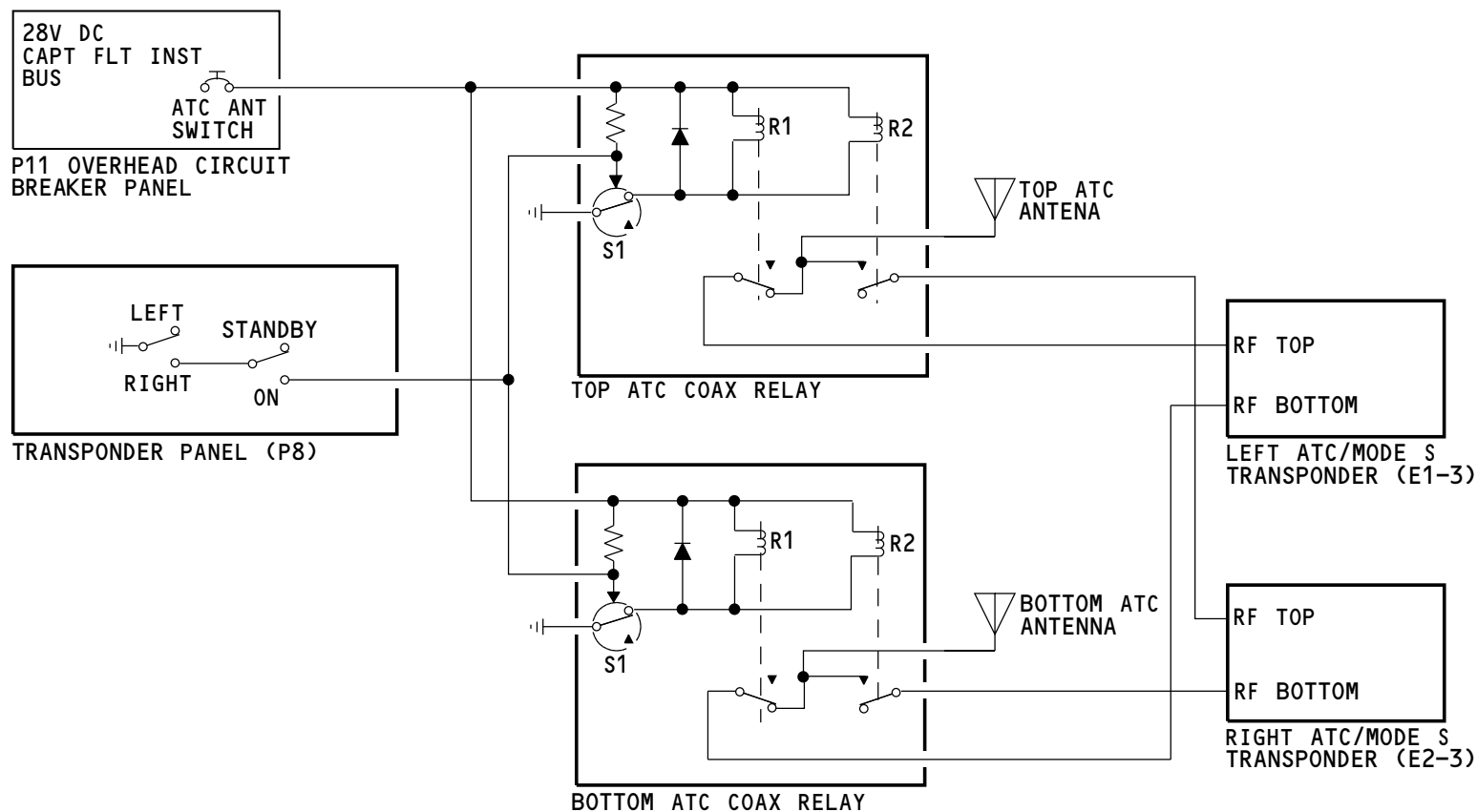
With the right transponder selected, switch S1 closes to supply a ground to energize relays R1 and R2. The top and bottom antennas connect to the right ATC/Mode S transponder.

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ATC/MODE S TRANSPONDER SYSTEM - ANTENNA COAX RELAY CONTROL

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ATC/MODE S TRANSPONDER SYSTEM - SELF-TEST**General**

The TEST switch on the front panel of the transponder starts a test of the ATC system. During test, the transponder BITE circuits do this:

- A test for normal operation
- Memory tests
- A simulated interrogation test of the receiver circuits
- A test of the antenna impedance
- A check for valid control and altitude inputs.

Test from the Front Panel

Push and release the test switch on the front panel, you will see the present status of the ATC/mode S transponder. During the test the front panel shows these things:

- All LEDs come on for approximately 3 seconds. This is an LED test
- The applicable LEDs come on to show the present status of the TCAS computer or the TCAS computer interfaces. The LEDs stay on for approximately 10 seconds.

Training Information Point

The maintenance manual and the fault isolation manual do not have a task for the line maintenance technician to do a test from the front panel of the ATC/mode S transponder. You must do all tests for the ATC/mode S transponder from the MAT or a PMAT.

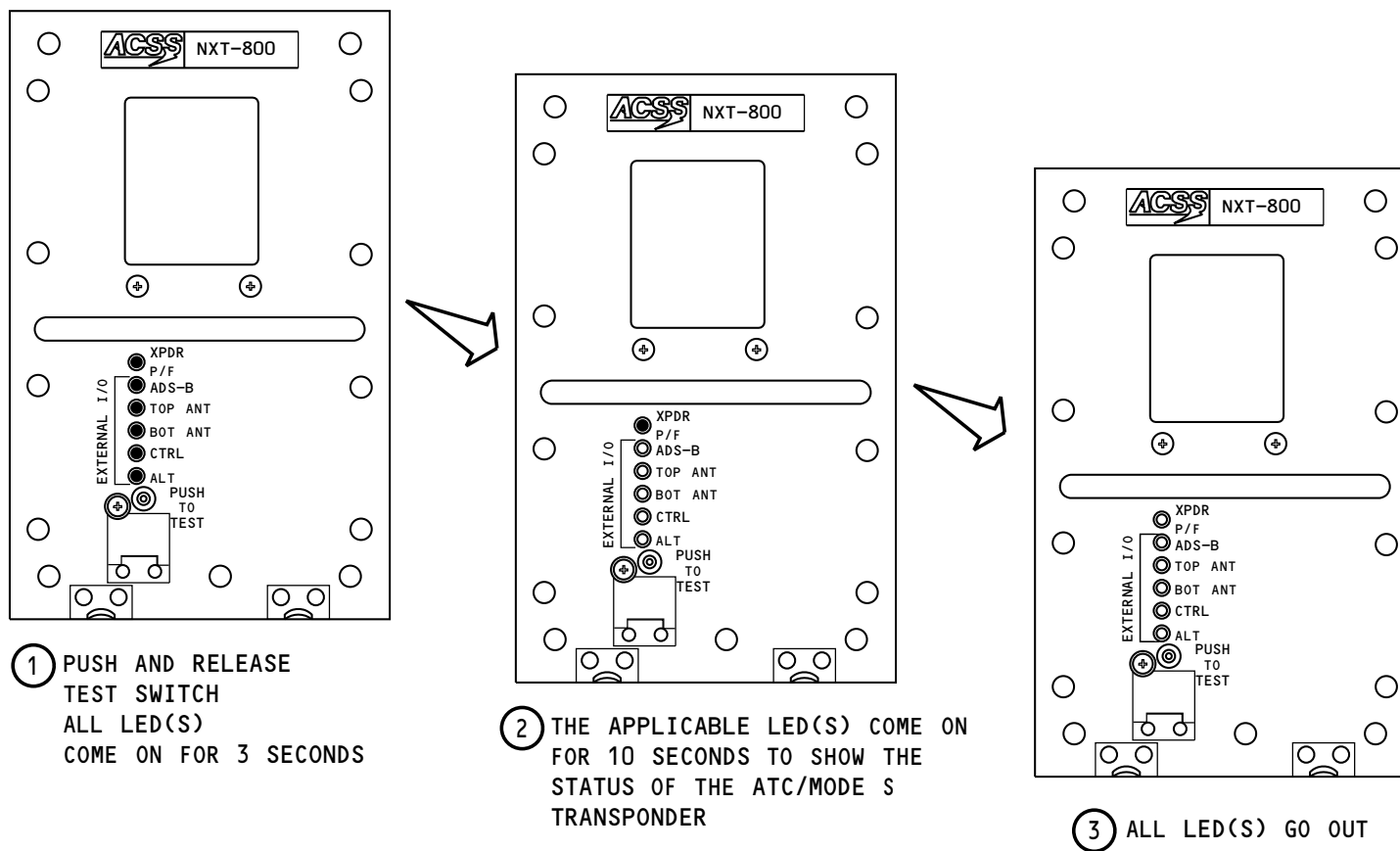
Many LRUs on the 777 are compatible with other model airplanes that do not have a central maintenance computing system (CMCS). For that reason these LRUs have a front panel test feature.

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NOTE: PUSH AND HOLD THE TEST SWITCH
TO SEE THE STATUS OF THE ATC/
MODE S TRANSPONDER FOR UP TO
THE LAST 10 FLIGHT LEGS.

ATC/MODE S TRANSPONDER SYSTEM - SELF-TEST

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**ATC/MODE S TRANSPONDER SYSTEM - GROUND TESTS****General**

You can do a system test of the ATC/Mode S transponder system from the MAT.

System Test

There is a system test for the left ATC/Mode S transponder system and the right ATC/Mode S transponder system.

The system test for the ATC/Mode S transponder system does a check of these functions:

- Transponder for correct operation
- Transponder panel for correct control data
- Antennas for correct impedance
- Altitude input for correct altitude data.

GROUND TESTS

SELECT ATA SYSTEM

(55)

34 WEATHER RADAR SYSTEM

34 TRAFFIC ALERT AND COLLISION AVOIDANCE SYSTEM

34 GROUND PROXIMITY WARNING SYSTEM

34 VOR/MARKER BEACON SYSTEM

34 AIR TRAFFIC CONTROL (ATC) MODE S SYSTEM

34 DISTANCE MEASURING EQUIPMENT SYSTEM

34 AUTOMATIC DIRECTION FINDER

34 GLOBAL POSITIONING SYSTEM

34 AIMS - FLIGHT MANAGEMENT COMPUTING SYSTEM

SELECT TEST TYPE

SYSTEM TEST

OPERATION TEST

PRO REPLACEMENT TEST

SELECT SYSTEM TEST

(0) (0)

LEFT ATC SYSTEM

RIGHT ATC SYSTEM

CONTINUE

HELP

GO BACK

SELECT SYSTEM TEST (2)

LEFT ATC SYSTEM

RIGHT ATC SYSTEM

ATC/MODE S TRANSPONDER SYSTEM - GROUND TESTS

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DISTANCE MEASUREMENT EQUIPMENT SYSTEM - INTRODUCTION

Purpose

The distance measuring equipment (DME) system supplies slant range (line of sight) distance between the airplane and the ground station.

The DME system supplies station audio and identifier signals to the flight interphone speakers and headsets.

Abbreviations and Acronyms

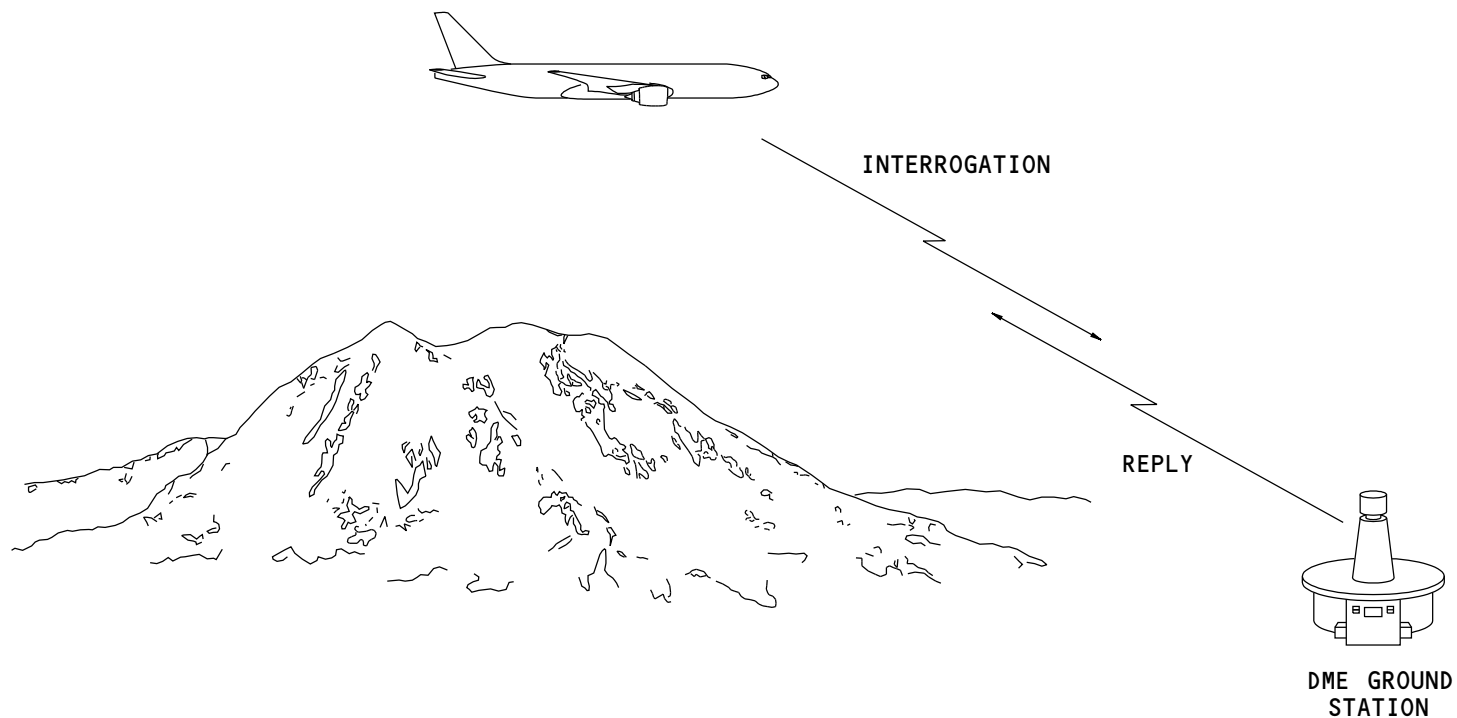
- ACP - audio control panel
- AIMS - airplane information management system
- ALTN - alternate
- ARINC - Aeronautical Radio, Incorporated
- ATE - automatic test equipment
- auto - automatic
- BITE - built-in test equipment
- CDU - control display unit
- CMCF - central maintenance computing function
- CMCS - central maintenance computing system
- DME - distance measurement equipment
- EFIS - electronic flight instrument system
- FMCF - flight management computing function
- LED - light emitting diode
- MHz - megahertz
- NCD - no computed data
- RF - radio frequency

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DISTANCE MEASUREMENT EQUIPMENT SYSTEM - INTRODUCTION

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**DME SYSTEM - GENERAL DESCRIPTION****General**

The DME system has two interrogators and two antennas.

The DME interrogator transmits a signal to DME ground stations. The ground stations send a reply signal back to the interrogator. The interrogator measures the time between the transmit signal and the reply signal and calculates distance to the station.

Description

The interrogators get manual tune inputs from the left or right CDU or autotune inputs from the airplane information management system (AIMS) cabinets. The interrogators can get tune inputs directly from the left or right CDU (alternate tune) when the tune inputs from AIMS cabinet fails.

The air/ground relays send discretes to the DME interrogators.

The DME interrogators send slant range data to the AIMS cabinets to show on the primary flight displays (PFDs) and navigation displays (NDs).

The DME system, air traffic control (ATC) system, and traffic alert and collision avoidance system (TCAS) operate on the same frequency band. When either DME interrogator, or either ATC transponder, or the TCAS computer transmits, that unit sends out a suppression pulse. This pulse goes through a suppression splitter to the other units to inhibit reception in the other units to prevent interference in them.

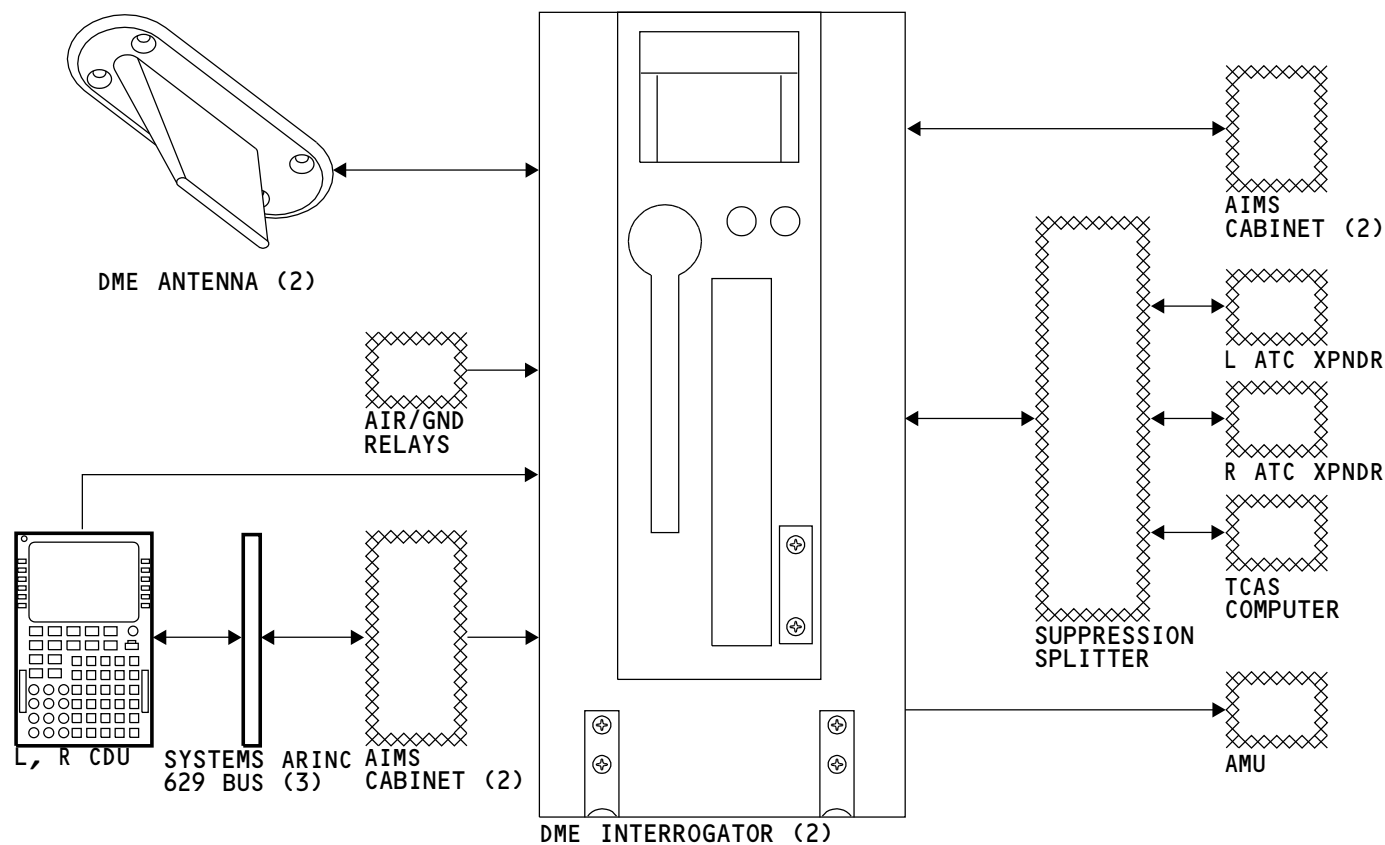
The DME interrogator receives the station audio identifiers and sends them to the audio management unit (AMU).

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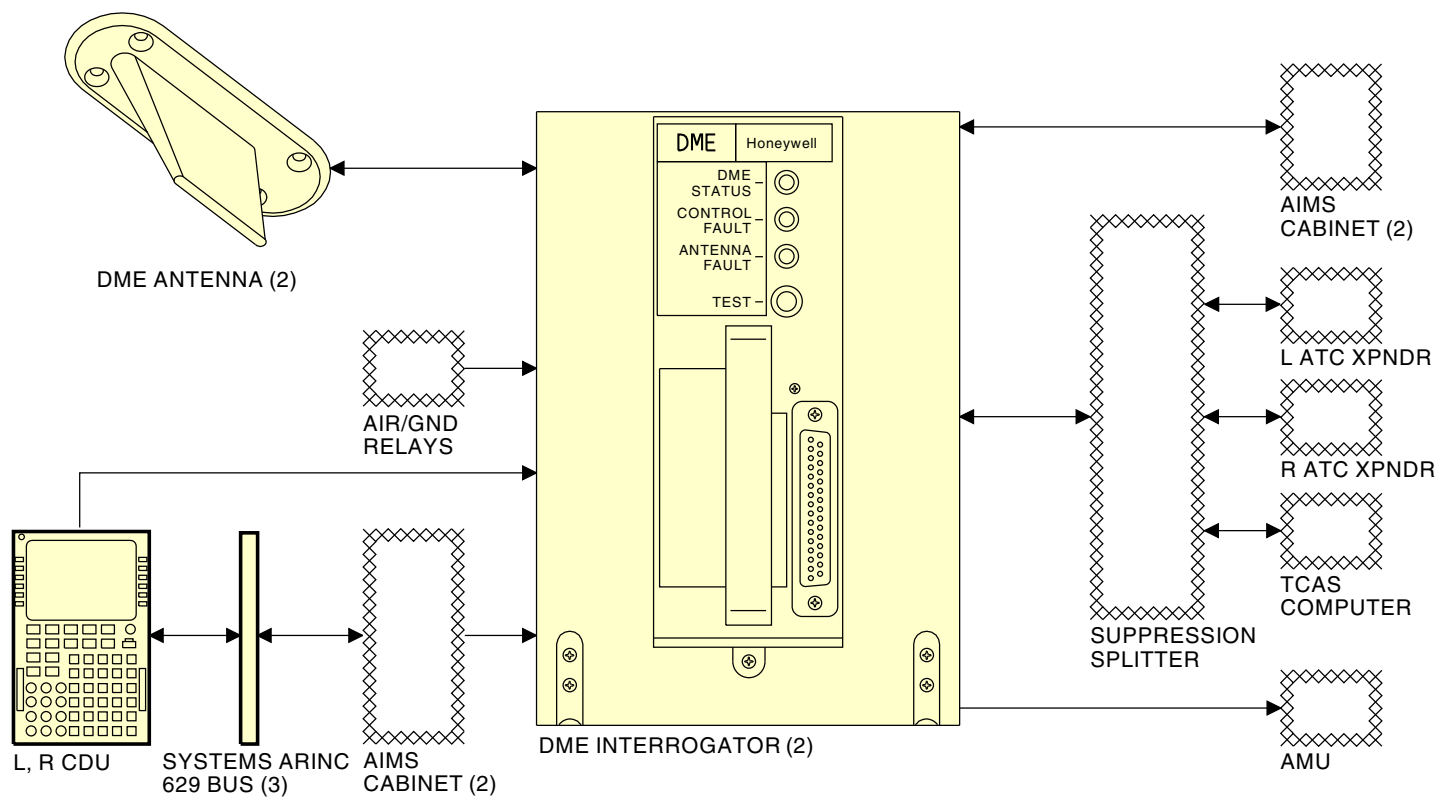
DME SYSTEM - GENERAL DESCRIPTION

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DME SYSTEM - GENERAL DESCRIPTION

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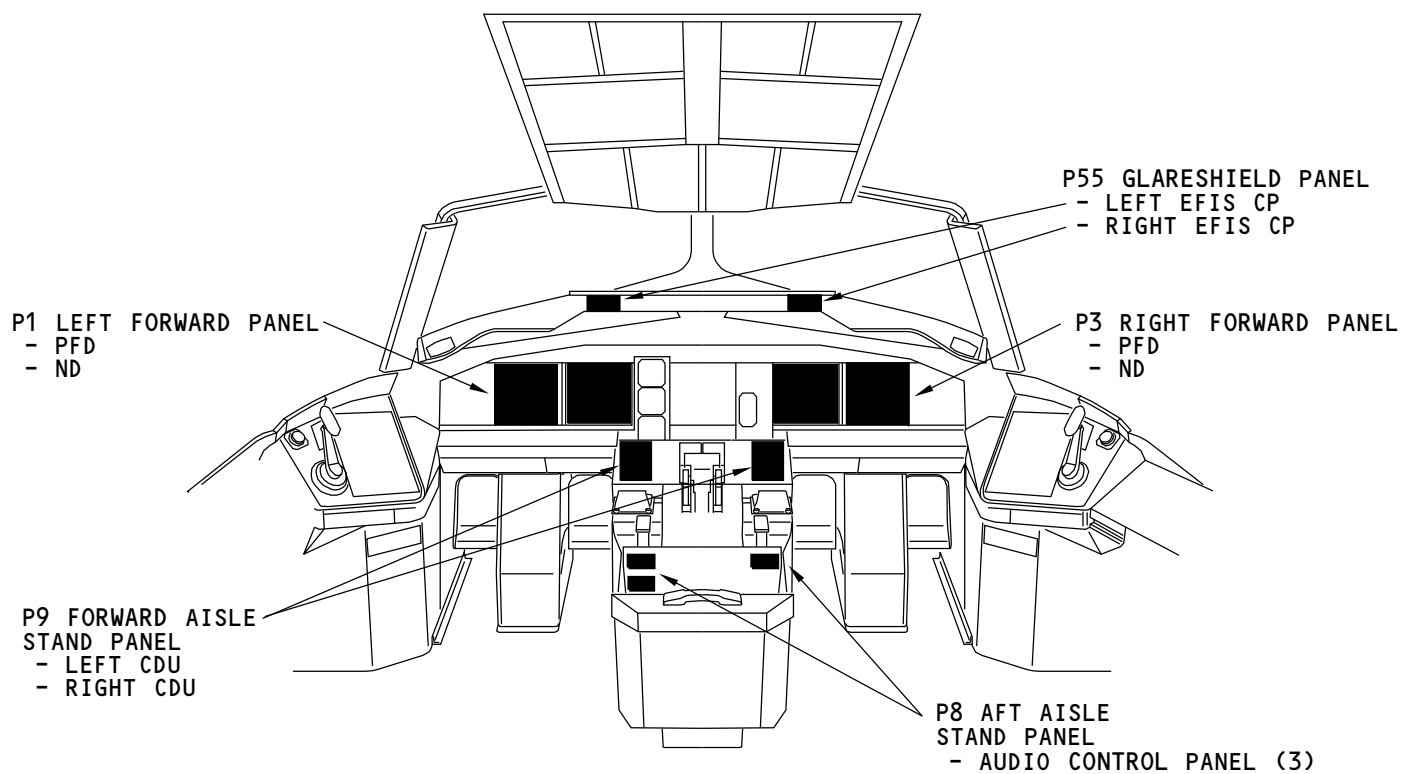
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**DME SYSTEM - COMPONENT LOCATIONS - FLIGHT DECK****DME Component locations - Flight Deck**

These are the components on the flight deck that interface with DME:

- Left and right EFIS Control Panel (CP)
- Captain and first officer primary flight displays (PFDs) and navigation displays (NDs)
- Left and right control display units (CDUs)
- Audio control panels (ACPs).

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DME SYSTEM - COMPONENT LOCATIONS - FLIGHT DECK

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**DME SYSTEM - COMPONENT LOCATION - MAIN EQUIPMENT CENTER AND ANTENNAS****DME Component Locations**

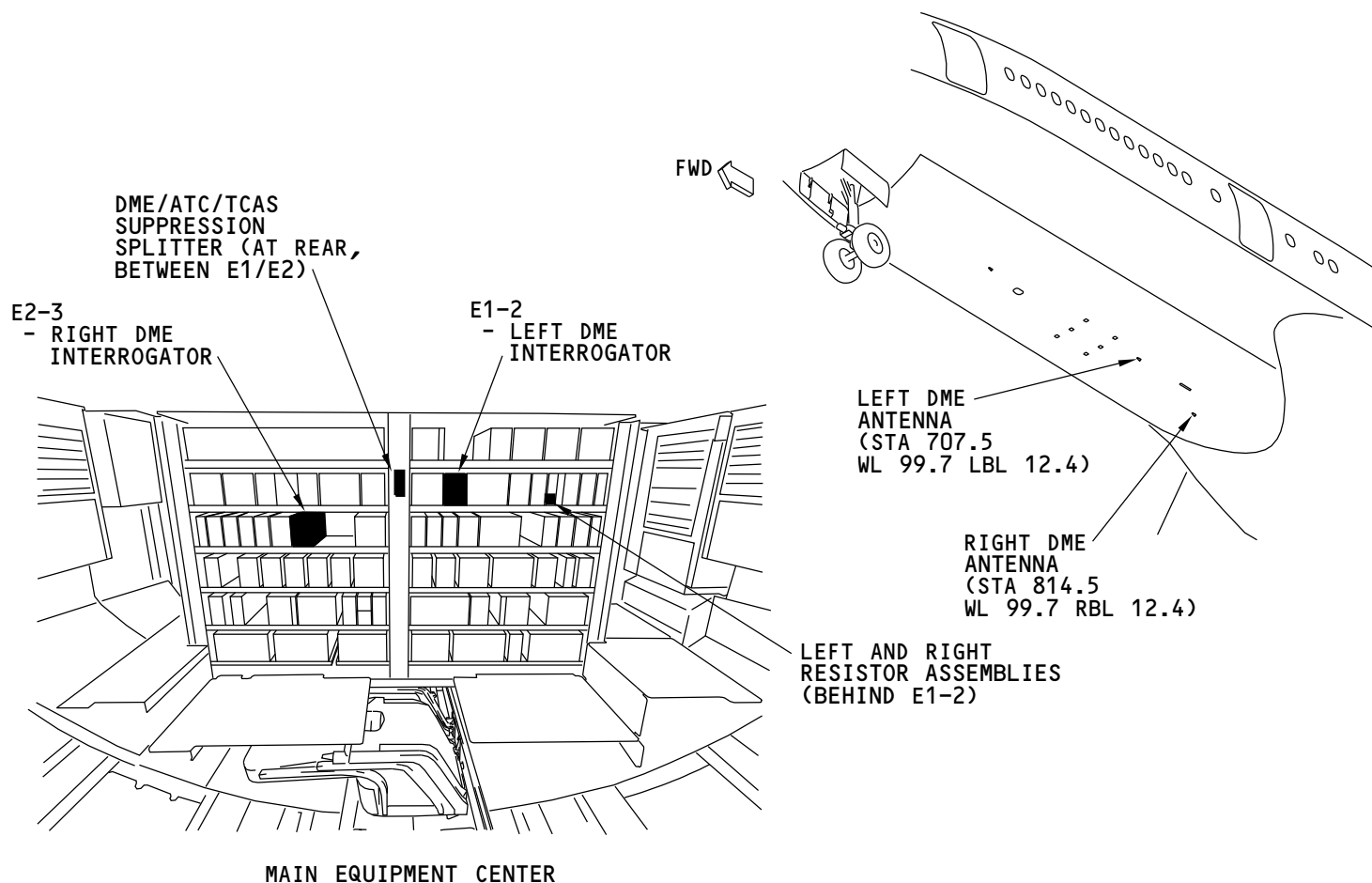
These components are in the main equipment center:

- Left DME interrogator
- Right DME interrogator
- DME/ATC/TCAS suppression splitter
- left and right resistor assemblies.

These components are on the exterior of the airplane:

- Left DME antenna
- Right DME antenna.

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DME SYSTEM - COMPONENT LOCATION - MAIN EQUIPMENT CENTER AND ANTENNAS

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DME SYSTEM - POWER, ANALOG, AND DISCRETE INTERFACE

Power and Antenna Interface

Each DME interrogator receives 115v ac from its circuit breaker.

Air/Ground Relay

The air/ground relays supply discrete inputs to the DME interrogators for these functions:

- Set flight legs (as alternate source, primary is from the CMCF of AIMS)
- Inhibit test commands in the air.

CDU

The CDUs send a frequency source select discrete to cause the interrogator to select the tune input from either the CDU or the AIMS cabinets. The resistor assemblies pull up the discretes to 28v dc. The left CDU sends a ground discrete to the left interrogator when the discrete is true. The right CDU sends a ground discrete to the right interrogator when the discrete is true.

DME Antenna

The DME antennas transmit and receive DME signals. The antenna transmits signal pulse pairs to the ground stations then receive the reply signal pulse pairs from the DME ground station and sends them to the interrogator.

DME/ATC/TCAS Suppression

The DME system, the air traffic control (ATC) system, and the traffic alert and collision avoidance system (TCAS) operate in the same frequency band. When a DME interrogator, an ATC transponder or a TCAS computer transmits, it sends a suppression pulse through the suppression splitter. This pulse inhibits reception of the other four units. This prevents damage to the receiver circuits of the other LRUs.

DME Audio

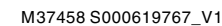
The DME interrogator sends the DME station audio identifier to the audio management unit (AMU). The AMU combines the DME audio with VOR or ILS audio. The audio goes to the headsets and the flight interphone speakers.

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DME SYSTEM - POWER, ANALOG, AND DISCRETE INTERFACE

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**DME SYSTEM - ARINC 429 INTERFACES****CDU**

The left and right CDUs supply alternate tune inputs directly to the DME interrogators if the AIMS tune inputs fail. The left CDU alternate tunes the left interrogator and the right CDU alternate tunes the right interrogator.

DME Outputs

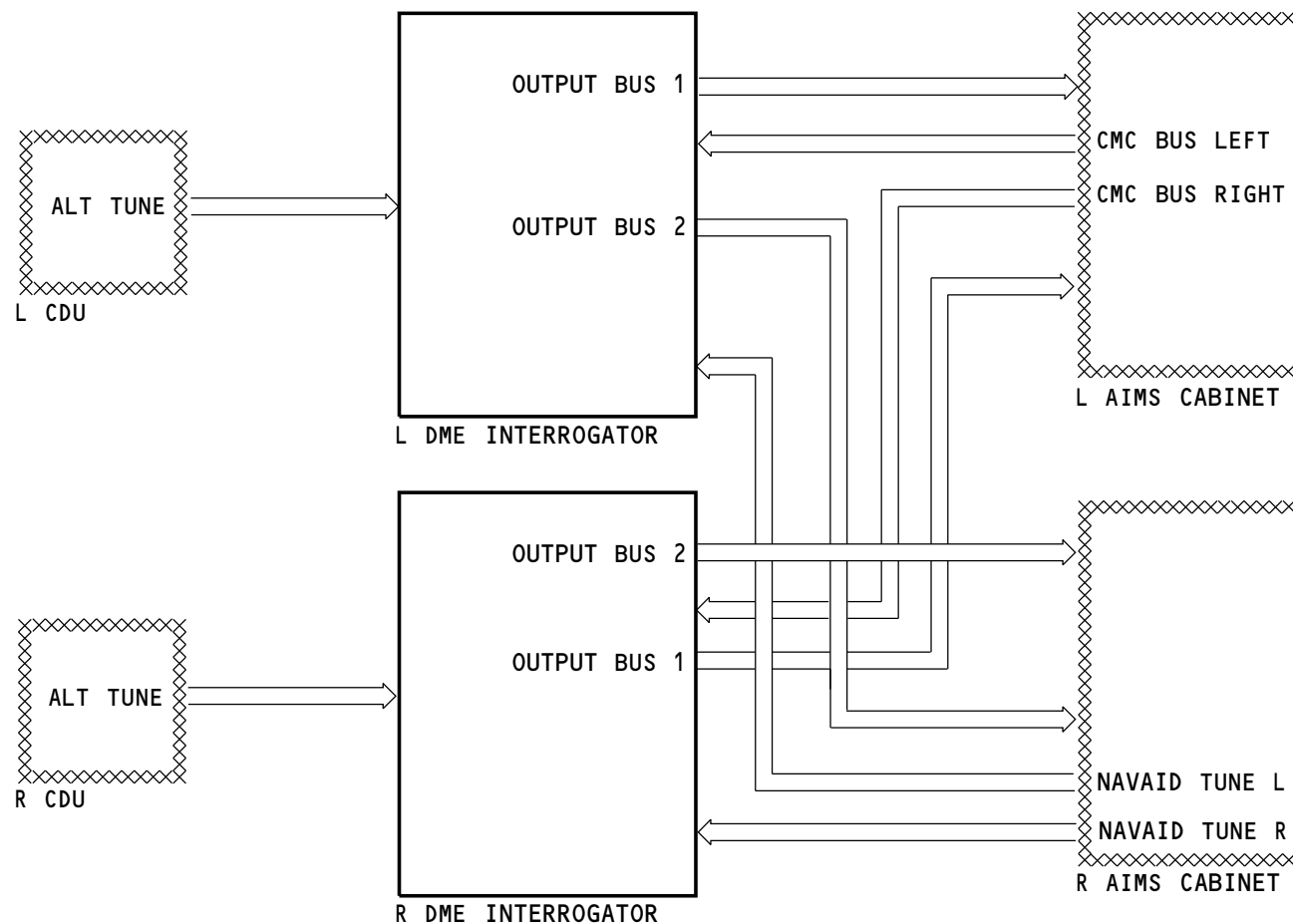
Each DME interrogator has two output buses. The output buses supply data to both AIMS cabinets.

Each DME interrogator sends data to both AIMS cabinet to display DME data on the PFDs and NDs. The interrogators also send test status and fault reports.

AIMS

The left AIMS cabinet sends test commands and flight legs data to the DME interrogators on the left and right CMC buses.

The right AIMS cabinet sends manual or automatic tune inputs to the DME interrogators on the left and right tune buses.



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DME SYSTEM - ARINC 429 INTERFACES

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**DME SYSTEM - INTERROGATOR****General**

The DME interrogator scans 252 channels and calculates distance information for all channels in the DME range. There are 200 DME channels paired with the VHF NAV frequencies. The other 52 channels are for military TACAN facilities. The DME receive frequency is 63 MHz above or below the transmit frequency.

Purpose

The purpose of the DME interrogator is to:

- Interrogate DME stations
- Receive the station replies
- Receive audio identifiers
- Calculate slant range distances.

Frequencies

The DME interrogator uses these L-Band frequencies:

- 1025 MHz to 1150 MHz (transmit)
- 962 MHz to 1215 MHz (receive).

These DME tuning frequencies are in the VHF band:

- 108.00 to 117.95 MHz paired VOR or ILS
- 133.30 to 135.95 MHz unpaired.

Front Panel**ARO 001-016**

There are two switches and an LCD on the front panel of the DME interrogator. You use any of the two switches to start a test of the DME interrogator. The LCD shows the test results.

ARO 017-999

There is a pushbutton switch on the front of the DME and 3 LEDs. The pushbutton switch is used to start a test of the DME interrogator. The LEDs show the test results.

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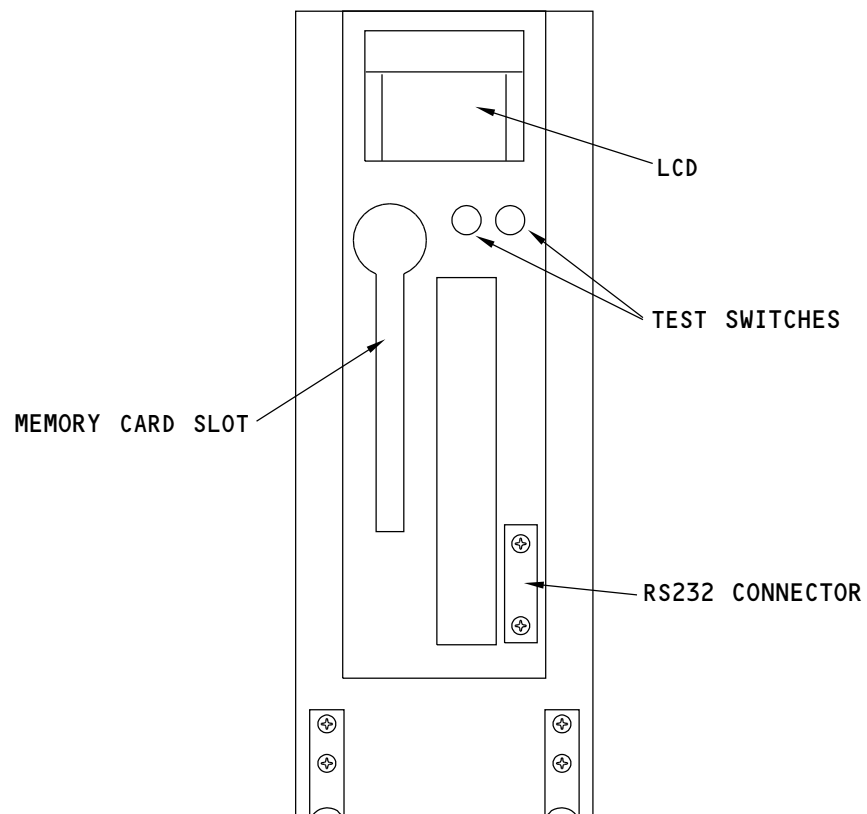
There is a memory card slot on the front of the DME interrogator. Shop personnel use this feature to insert a flash memory card which loads software into the LRU. The memory card can also store LRU status data sent by the LRU during operation. These features are not for use by line maintenance personnel.

Shop personnel use the RS-232 connector to connect shop test equipment to the LRU. This feature is not for use by line maintenance personnel.

ARO ALL**Training Information Point**

The maintenance manual and the fault isolation manual do not have a task for the line maintenance technician to do a test from the front panel of the DME interrogator. You must do all tests for the DME interrogator from the MAT or a PMAT.

Many LRUs on the 777 are compatible with other model airplanes that do not have a central maintenance computing system (CMCS). For that reason these LRUs have a front panel test feature.



DME SYSTEM - INTERROGATOR

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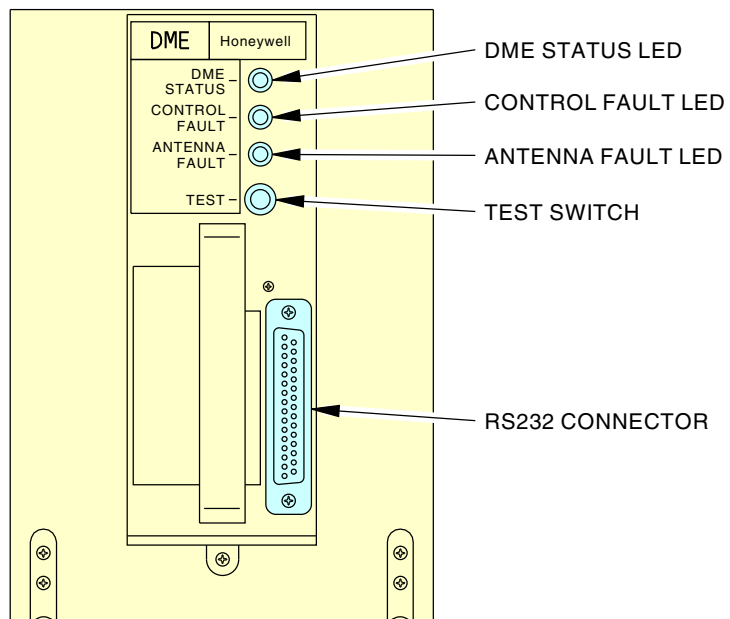
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DME SYSTEM - INTERROGATOR

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DME SYSTEM - ANTENNA**General**

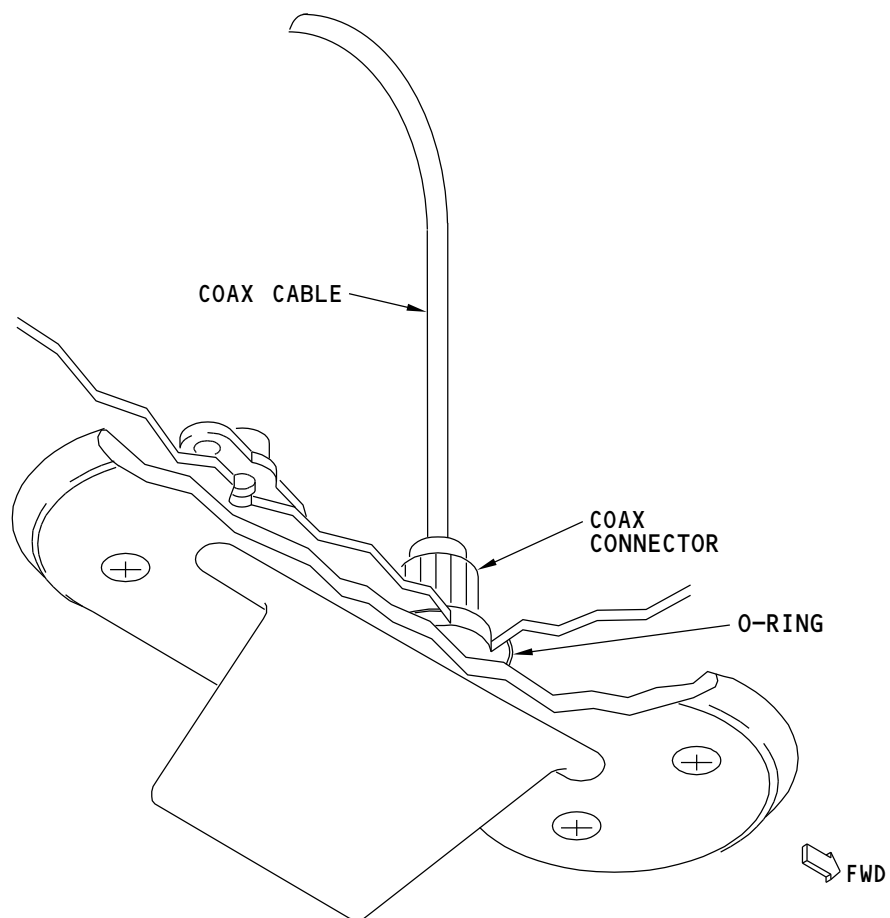
The DME I- band antenna transmits the interrogator output signal and receives the ground station reply signals.

Physical Description

The antenna has an O-ring moisture seal and attaches to the airplane by four screws. The DME and ATC antennas are the same and are interchangeable.

Training Information Point

EXTRA FORCE ON THE ANTENNA BASE MAY BE REQUIRED TO BREAK THE WEATHERPROOFING SEAL. TO PREVENT DAMAGE TO AIRPLANE SKIN OR ELECTRICAL CABLE AT THE ANTENNA BASE, CAREFULLY PRY AROUND THE ANTENNA WITH A SEALANT REMOVAL TOOL.



DME SYSTEM - ANTENNA

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DME SYSTEM - TUNING

General

These are the three ways to tune the DME interrogators:

- Manually by the left, right, or center CDU
- Automatically by the FMCF in the AIMS cabinets
- By the CDUs as an alternate tune source.

Manual Tune

You manually tune the DME interrogators from the left or right control display units (CDUs). The center CDU can tune the interrogators if the left or right CDU fails. Manual tune inputs from the CDUs go through the left and right systems ARINC 629 buses, then to the left and right AIMS cabinets. Manual tune inputs from the left or right AIMS cabinet comes from the right AIMS cabinet and goes to the DME interrogators.

AIMS Autotune

The flight management computing function (FMCF) of the left or right AIMS cabinet can automatically tune (autotune) the DME interrogators. Autotune inputs from the left or right AIMS cabinets go through the right AIMS cabinet, then to the DME interrogators.

Alternate Tune

The CDUs monitor the AIMS cabinets tune functions. If the AIMS tune function fails, the CDUs send a frequency source select discrete to the DME interrogators. This ground signal from the CDU changes the inputs from the right AIMS cabinet to the input from the left or right CDU.

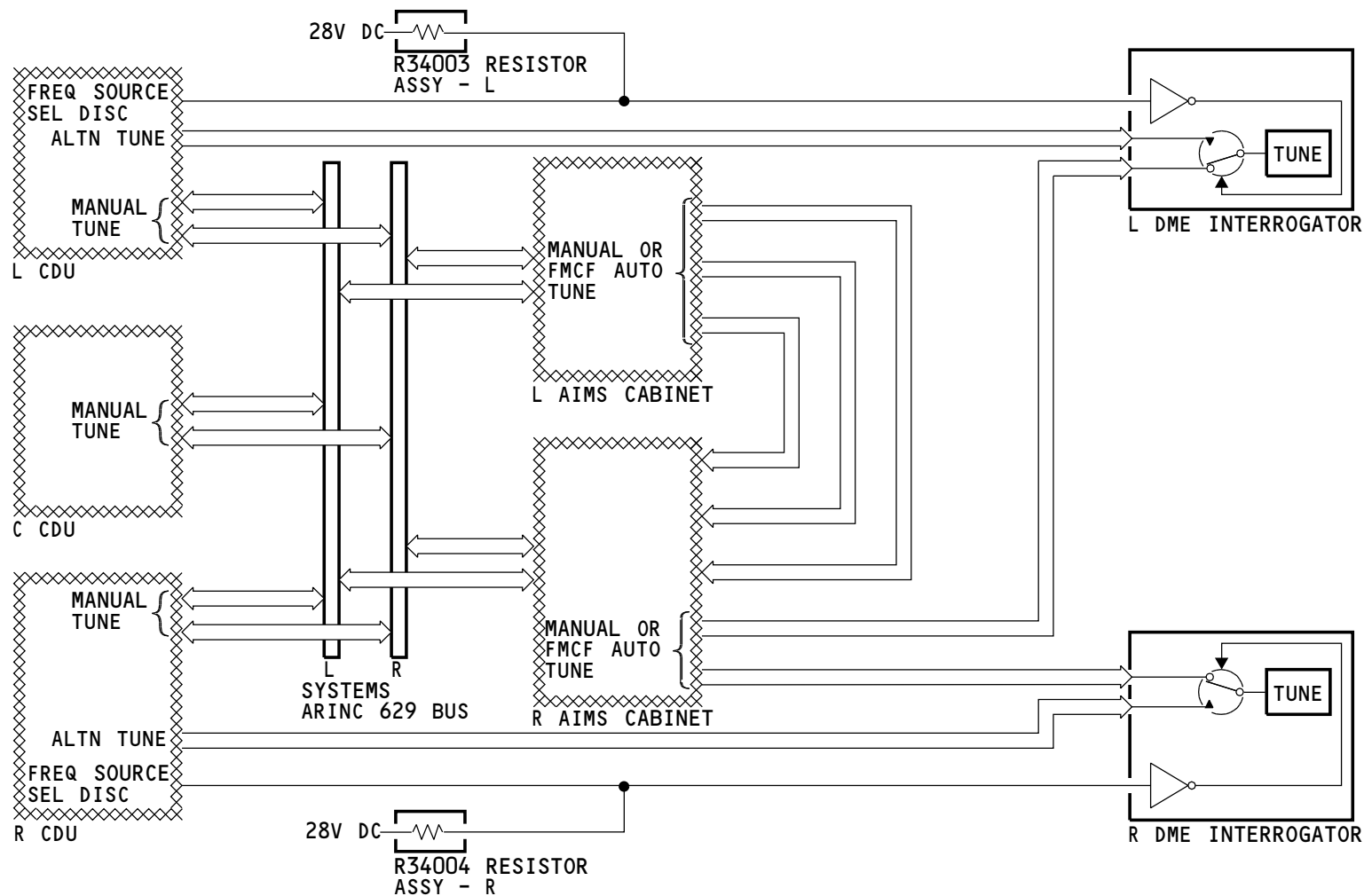
In the alternate tune mode, the left CDU alternate tunes the left DME interrogator and the right CDU alternate tunes the right DME interrogator. The center CDU has no alternate tune function.

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DME SYSTEM - TUNING

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DME SYSTEM - AUDIO CONTROL PANEL

General

The audio control panels supply control inputs to the audio management unit. This lets the crew hear audio signals on the speakers and headsets in the flight deck.

DME Audio Pairing

The flight management computing function (FMC) of AIMS can pair the DME station identifier audio with VOR station identifier audio, or with ILS station identifier audio.

The flight crew uses the EFIS control panels or the EFIS CONTROL page on the CDU to determine how to pair the DME audio. The flight crew selections go to the FMC. The FMC sends the DME pairing signal to the audio management unit (AMU). The AMU uses the pairing signal to pair the DME audio with ILS or VOR audio.

When the captain selects the approach (APP) ND mode on the left EFIS control panel or on the left CDU EFIS CONTROL page, the AMU pairs the left DME interrogator audio with the left multi-mode receiver (MMR) audio. When the captain selects the VOR, MAP, or PLAN mode, the AMU pairs the left DME interrogator audio with the left VOR receiver audio.

When the first officer selects the approach (APP) ND mode on the right EFIS control panel or on the right CDU EFIS CONTROL page, the AMU pairs the right DME interrogator audio with the right MMR audio. When the first officer selects the VOR, MAP, or PLAN mode, the AMU pairs the right DME interrogator audio with the right VOR receiver audio.

Description

These are the controls on the audio control panel that let you hear DME audio:

- VOR/ADF receiver selector
- VOR/ADF receiver volume control
- NAV filter selector.
- Approach receiver volume control
- Approach receiver selector.

VOR/ADF Receiver Selector

The VOR/ADF receiver selector lets you select VOR or ADF as the source of audio. When the selector is in the VOR positions, you hear DME station identifier audio and VOR station audio.

VOR/ADF Receiver Volume Control

The VOR/ADF receiver volume control turns on the audio and controls the volume.

NAV Filter Selector

The NAV filter selector lets you select one of these:

- Voice (V) audio
- Both (B) voice and range audio.
- Range (R) audio.

Approach Receiver Volume Control

The approach volume control makes the audio come on and controls the volume for the approach (APP) selector.

Approach Receiver Selector

The approach receiver selector lets you select ILS or marker beacon as the source of audio.

When the selector is in the left (L) position, you hear audio from the left DME interrogator. The DME audio you hear is the DME station identifier audio that is paired with the multi-mode receiver (MMR) audio.

When the selector is in the right (R) position, you hear audio from the right DME interrogator. The DME audio you hear is the DME station identifier audio that is paired with the right MMR audio.

When the selector is in the center (C) position, you do not hear any DME audio. You only hear ILS station identifier audio from the center MMR.

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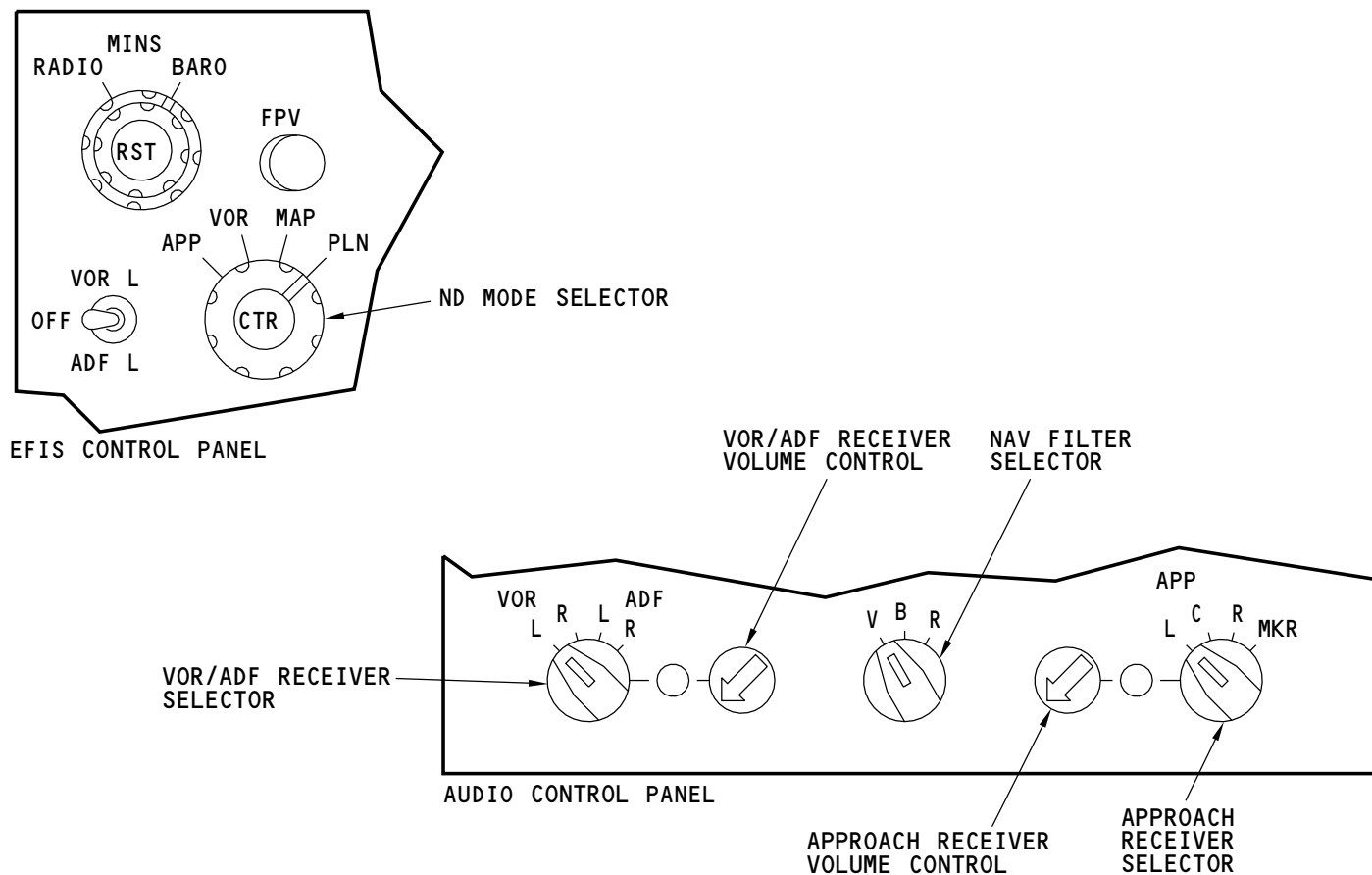
**DME SYSTEM - AUDIO CONTROL PANEL****Operation**

Do this to hear DME or VOR/DME audio:

- Set the VOR/ADF receiver selector to the left (L) or right (R) VOR position
- Push the VOR/ADF receiver volume control to make the VOR audio come on (turn the control to adjust the volume)
- Set the NAV filter selector to the both (B) or range (R) position.

Do this to hear ILS/DME audio:

- Set the approach receiver selector to the left (L) or right (R) position
- Push the approach receiver volume control to make the ILS audio come on (turn the control to adjust the volume).



DME SYSTEM - AUDIO CONTROL PANEL

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**DME SYSTEM - MANUAL AND ALTERNATE TUNING****General**

The CDUs supply manual tune inputs during normal operation and alternate tune inputs when the AIMS tune inputs fail.

Since DME stations are normally paired with VOR or ILS stations, to tune the DME interrogators, you enter a VOR or ILS frequency. You can also tune DME stations that are not paired with VOR or ILS stations.

Operation

To see DME frequencies and DME/VOR or DME/ILS paired frequencies, push the NAV RAD key on the CDU. The NAV RADIO page shows data for the NAV radios.

To manually tune a DME interrogator, enter a valid VOR or ILS frequency or identifier into the scratch pad. Push the line select key to enter the frequency for the applicable data line. To tune an unpaired DME frequency, enter the VOR frequency into the VOR data line for the left or right VOR system.

When you manually enter a VOR frequency, the letter M shows after the frequency.

The letter A shows after the VOR frequency when the FMCF of AIMS autotunes the frequency.

To delete the frequency, push the delete (DEL) key on the CDU. The delete function shows in the CDU scratchpad. Next, line select the delete function to the applicable VOR data line.

Alternate Tuning

The ALTN NAV RADIO page is available only when the tune inputs from the AIMS cabinets fail.

To get access to the ALTN NAV RADIO page, push the NAV RAD key on the CDU.

The ALTN NAV RADIO page is different from the NAV RADIO page. The ALTN NAV RADIO page shows data for only the left or right NAV radios. The left CDU ALTN NAV RADIO page controls the left NAV receivers and the right CDU ALTN NAV RADIO page controls the right NAV receivers.

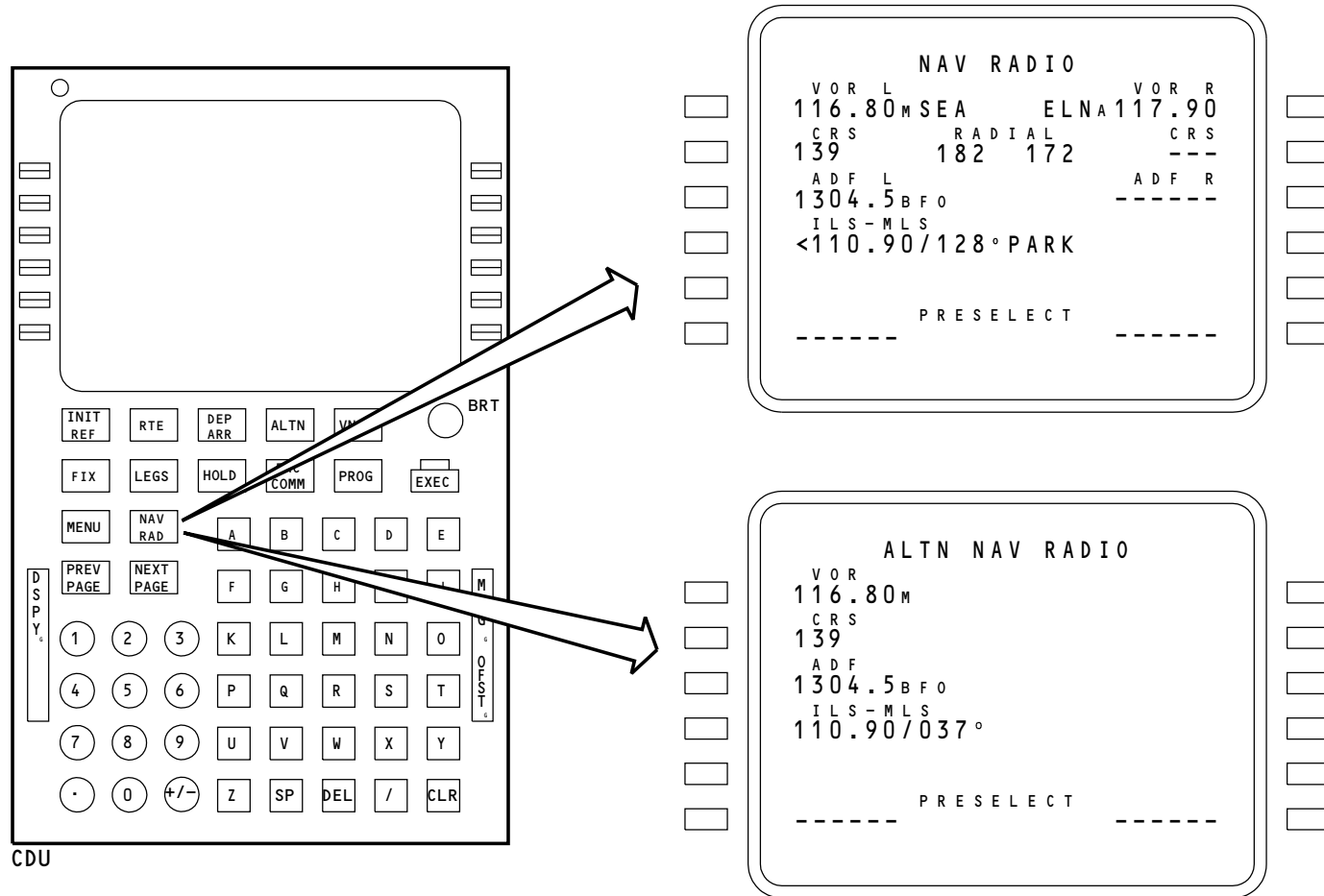
You enter a VOR or ILS frequency the same as you do for normal manual tuning.

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DME SYSTEM - MANUAL AND ALTERNATE TUNING

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**DME SYSTEM - EFIS CONTROLS****General**

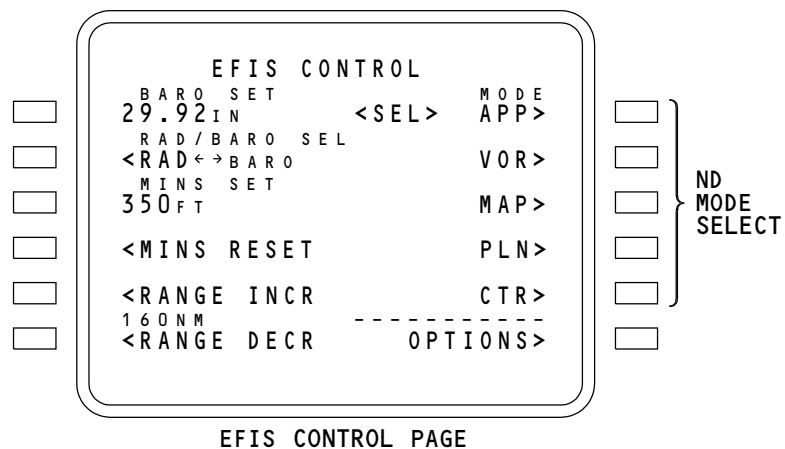
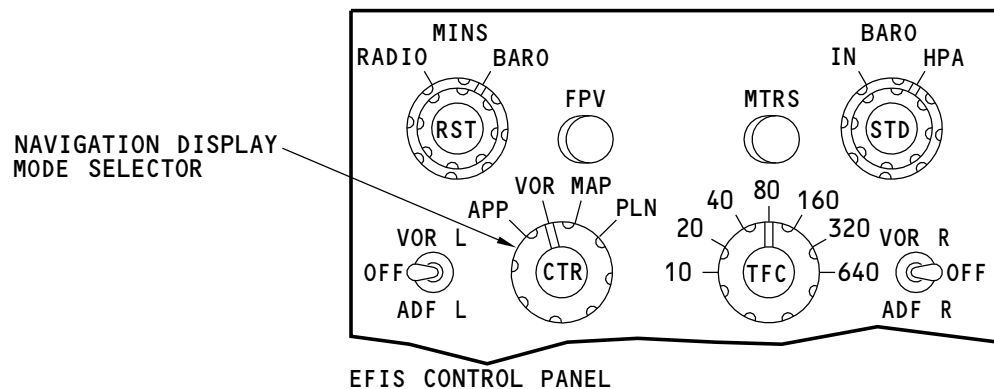
The EFIS control panel has controls to select DME data to show on the navigation displays (NDs).

Navigation Display Mode Selector

You use the navigation display mode selector to select the display mode on the NDs. DME data shows in all modes except plan (PLN) mode.

Alternate or Backup EFIS Control Panel

The EFIS control page on the CDU supplies backup controls for the EFIS control panel. You can use the EFIS control page to select the display mode for the NDs.



DME SYSTEM - EFIS CONTROLS

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**DME SYSTEM - PRIMARY FLIGHT DISPLAY****Normal Display**

The primary flight display (PFD) format shows the ILS/DME distance when you tune the onside DME to a paired ILS frequency and when the onside DME distance is valid.

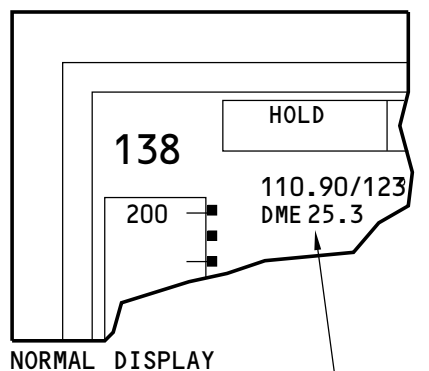
The left PFD shows left DME data. The right PFD shows right DME data. The DME distance display shows in white letters and numbers.

DME NCD and Fail Displays

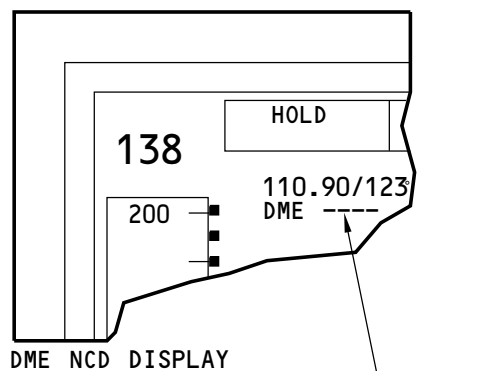
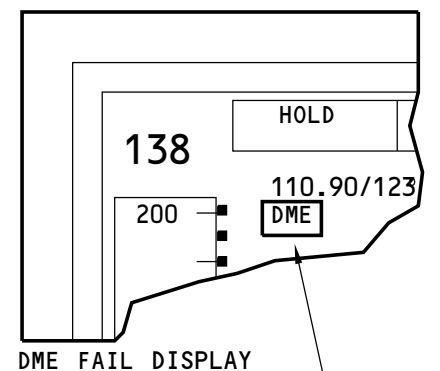
Dashes replace the DME distance when the DME distance data is no computed data (NCD). If the DME fails, the DME flag replaces the DME distance. Both the NCD and fail flag show in amber.

Only the onside DME distance shows on the PFDs. The left DME distance shows only on the captain's PFD. The right DME distance shows only on the first officer's PFD. If the left DME distance is NCD, dashes shows on the captain's PFD. If the left DME fails, a DME flag shows on the captain's PFD. The same occurs for the first officer's PFD if the right DME is NCD or fails.

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DME DISTANCE


NO COMPUTED
DME DATA

DME FAIL
FLAG (AMBER)

DME SYSTEM - PRIMARY FLIGHT DISPLAY

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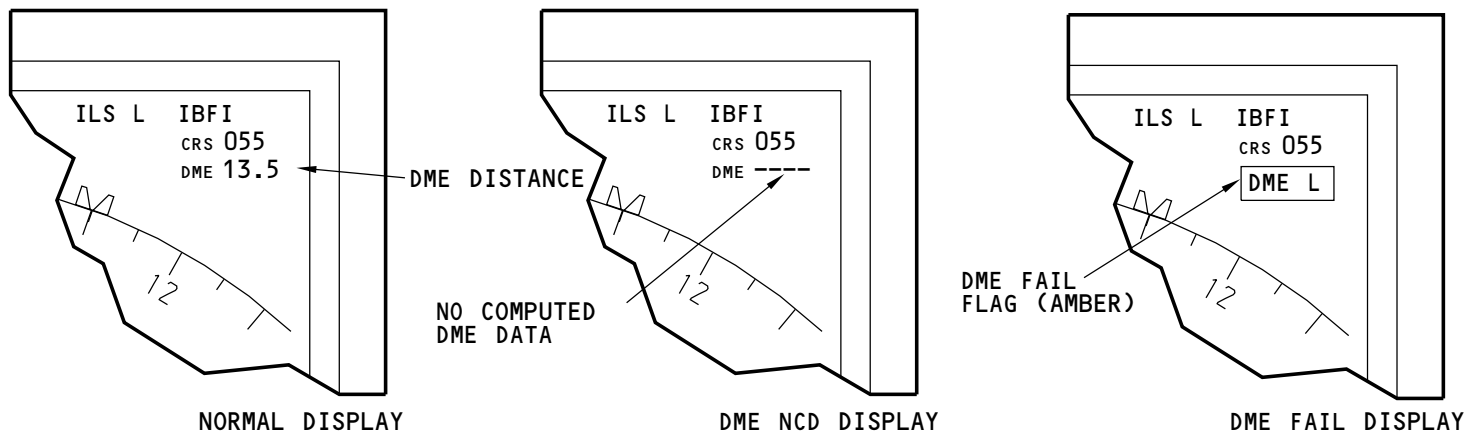
**DME SYSTEM - ND APPROACH MODE DISPLAY****DME Normal Displays**

The ILS/DME data shows on the ND in the centered and expanded approach (APP) modes. DME distance shows in the upper right corner of the ILS display when the onside DME is tuned to a paired ILS frequency, and the onside DME distance is valid.

DME NCD or Failed Displays.

Dashes replace digits when the DME distance is NCD. If the DME fails, an amber DME flag replaces the DME distance.

Only onside DME distance shows on the upper right corner of the approach mode. The left DME distance shows only on the captain's approach mode. The right DME distance shows only on the first officer's approach mode. If the left DME distance is NCD, dashes shows on the upper right corner of the captain's approach mode. If the left DME fails, a DME flag shows on the upper right corner of the captain's approach mode. The same occurs for the first officer's approach mode if the right DME is NCD or fails.



DME SYSTEM - ND APPROACH MODE DISPLAY

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**DME SYSTEM - MAP MODE DISPLAY****General**

The DME distance shows in all ND modes except PLAN. With the EFIS control panel mode selector set to the MAP mode and the VOR/ADF switches in the VOR position, the ND shows slant range distance of the paired DME stations.

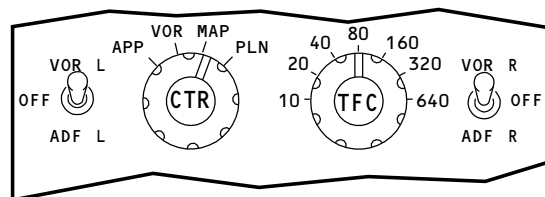
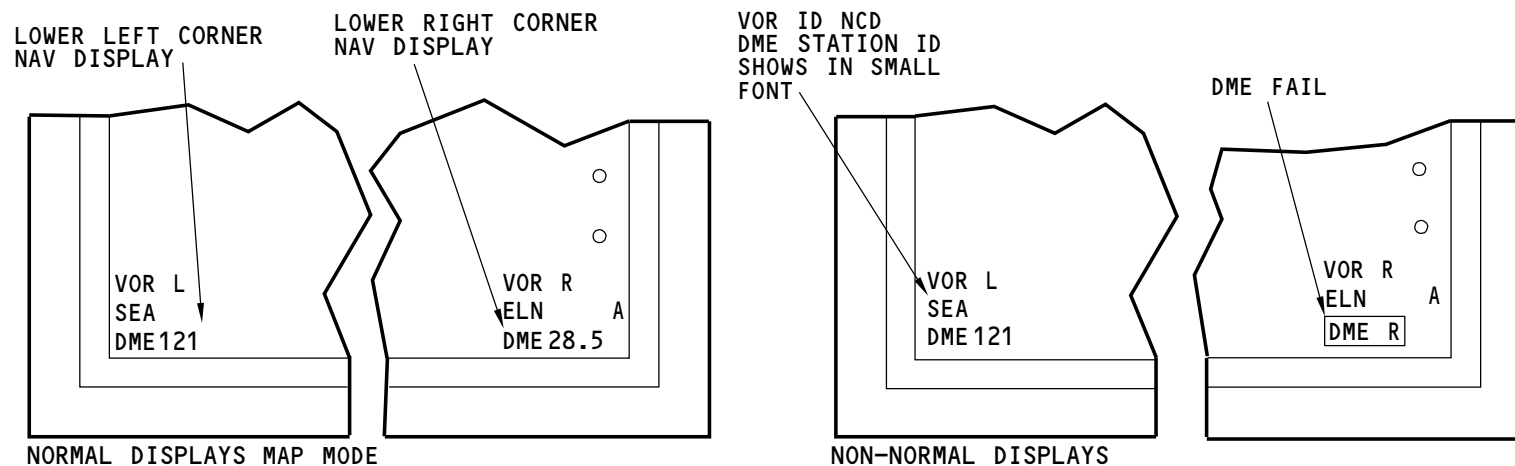
Distance Display

For DME distance less than 99.5 nm, the distance shows in tenths of an nm. For DME distances of 99.5 nautical miles (nm) or greater, the distance shows to the nearest 1 nm.

NCD or Invalid Displays.

Dashes replace digits when the DME distance data is NCD. A DME flag replaces the DME distance when DME fails.

ARO ALL	EFFECTIVITY



EFIS CONTROL PANEL (P55)

DME SYSTEM - MAP MODE DISPLAY

M37466 S000619775_V1

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ARO ALL EFFECTIVITY

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DME SYSTEM - VOR MODE DISPLAY**DME Normal Displays**

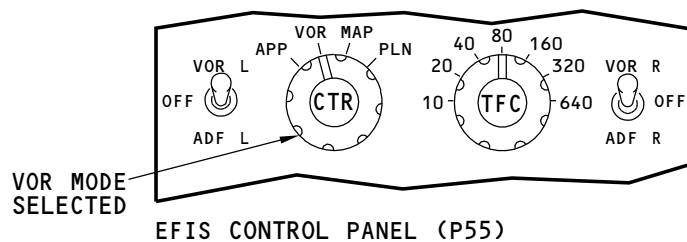
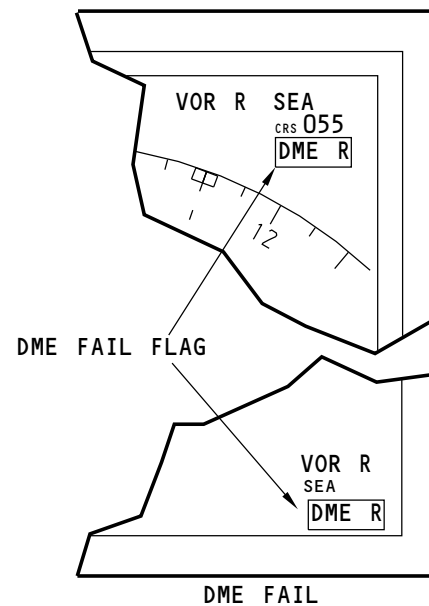
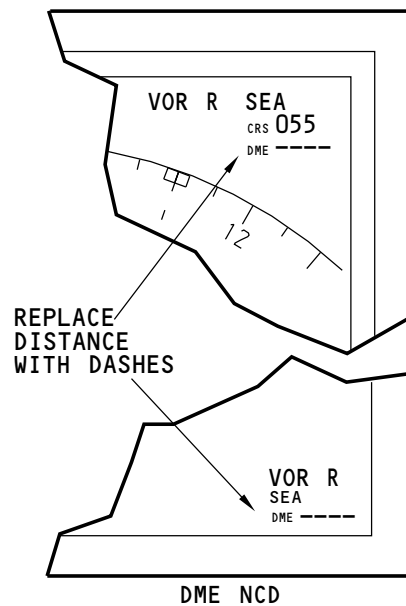
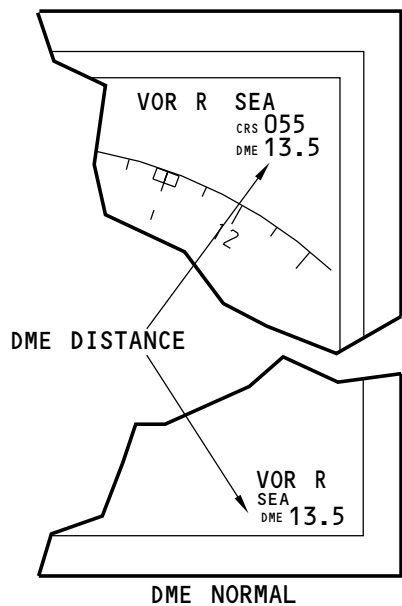
The VOR/DME data shows on the ND in center or expanded VOR modes. DME distance shows in the upper right corner of the VOR display when the onside DME is tuned to a paired VOR frequency, and the onside DME distance is valid.

When the VOR/ADF switches are in the VOR position the DME distance for a paired VOR station shows in the lower corners.

DME NCD or Failed Displays.

Dashes replace digits when the DME distance is NCD. If the DME fails, a DME flag replaces the DME distance.

DME distance shows only on the upper right corner of the onside VOR mode display. The left DME distance shows only on the captain VOR mode. The right DME distance shows only on the first officer VOR mode. If the left DME distance is NCD, dashes shows on the upper right corner captain VOR mode. If the left DME fails, a DME flag shows on the upper right corner of the captain VOR mode. The same occurs for the first officer VOR mode if the right DME is NCD or fails.



DME SYSTEM - VOR MODE DISPLAY

M37467 S000619776_V1

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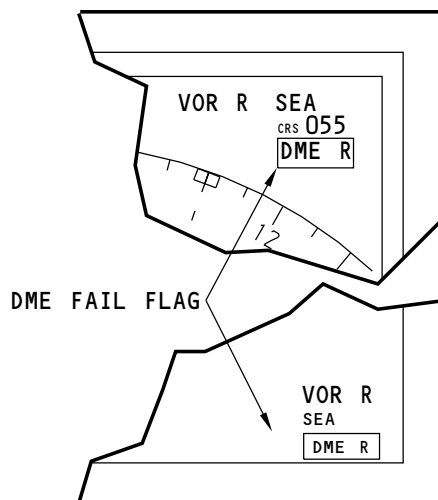
**DME SYSTEM - TEST DISPLAYS****General**

During a ground test or a self test, the onside PFD and ND show:

- The DME fail condition for two seconds
- The DME NCD condition for the next two seconds
- The DME normal condition to end the test.

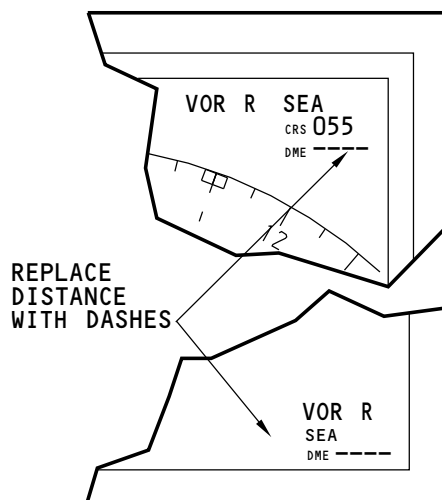
The DME normal condition is the distance that shows before the test starts.

ARO ALL	EFFECTIVITY



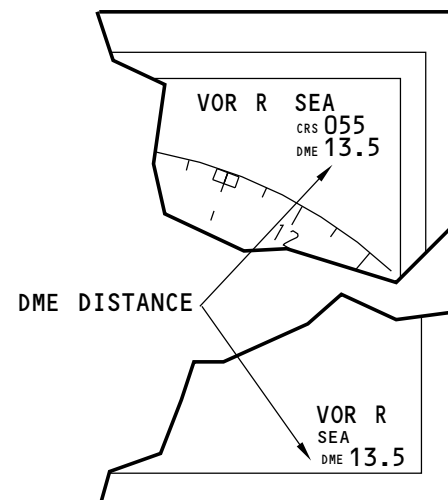
ND - VOR MODE

① DISPLAYS SHOW A DME FAIL CONDITION FOR TWO SECONDS



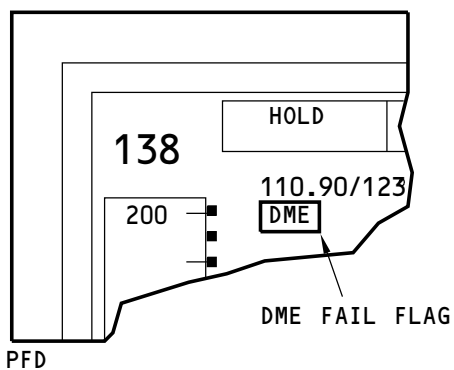
ND - VOR MODE

② DISPLAYS SHOW A DME NCD CONDITION FOR TWO SECONDS

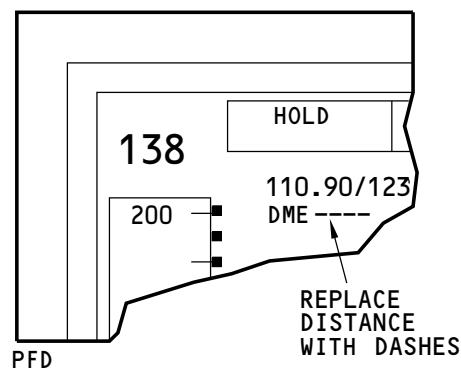


ND - VOR MODE

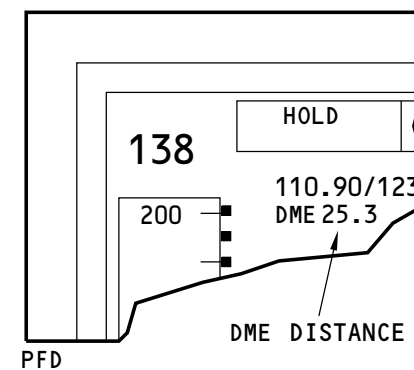
③ DISPLAYS SHOW A NORMAL DME CONDITION



PFD



PFD



PFD

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DME SYSTEM - TEST DISPLAYS

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ARO ALL EFFECTIVITY

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DME SYSTEM - SIGNAL PROCESSING

CDU and AIMS Inputs

The right AIMS cabinet is the normal source for tune inputs. It supplies both manual tune inputs from the CDUs and autotune inputs from the FMCF.

The CDU sends a frequency source select discrete to the CPU when the CDU detects an AIMS tune output fail condition. When the CPU receives the discrete, it changes the input from the right AIMS cabinet to the CDU.

The CDU sends direct tune inputs when the CDU is in alternate tune mode.

The left AIMS cabinet sends data on the left CMCF bus. The CMCF data is for:

- Test commands
- Flight legs data.

Discrete Inputs

The source destination identifier (SDI) program pin inputs identify if the interrogator is in the left or right DME system.

The air/ground relay supplies a discrete to inhibit a DME test in the air. The discrete also supplies flight leg data if the left AIMS cabinet flight leg data fails.

Operation

The CPU uses tune inputs to tune the frequency synthesizer. The CPU commands the transmitter to send interrogation pulses. The transmit pulses go through a circulator then to the DME antenna.

The transmitter sends a signal to the suppression circuits. During a transmission, the suppression circuit in the left DME interrogator sends a suppression pulse to the:

- Right DME interrogator
- Left and right ATC transponder (XPNDR)
- TCAS computer.

The suppression pulse inhibits receiver operation in the other LRUs to prevent receiver interference.

Receive

The circulator sends the received RF pulse pairs from the antenna to the receiver. The receiver sends the pulse pair to the CPU. The CPU calculates the slant range distance with the time it takes to transmit pulse pairs and get a reply from the ground station. When another L-band system transmits, a suppression pulse inhibits the receiver operation.

Interrogator Output

After the CPU calculates slant range distance, the CPU sends it to the ARINC 429 transmitter. The ARINC 429 transmitter sends the slant range data to the AIMS cabinets for the flight deck displays. The CPU sends the pulse pairs to the pulse pair decoder. The decoder sends the DME audio to the AMU.

Test

ARO 017-999

The CPU does a test of the interrogator when it receives a test command from the left AIMS cabinet or when the test switch on the front panel of the interrogator is pushed.

ARO 001-016

The CPU does a test of the interrogator when it receives a test command from the left AIMS cabinet or when you push a test switch on the front panel of the interrogator.

ARO 017-999

The CPU sends the test results to the LEDs.

ARO 001-016

The CPU sends the test results to the LCD.

ARO ALL

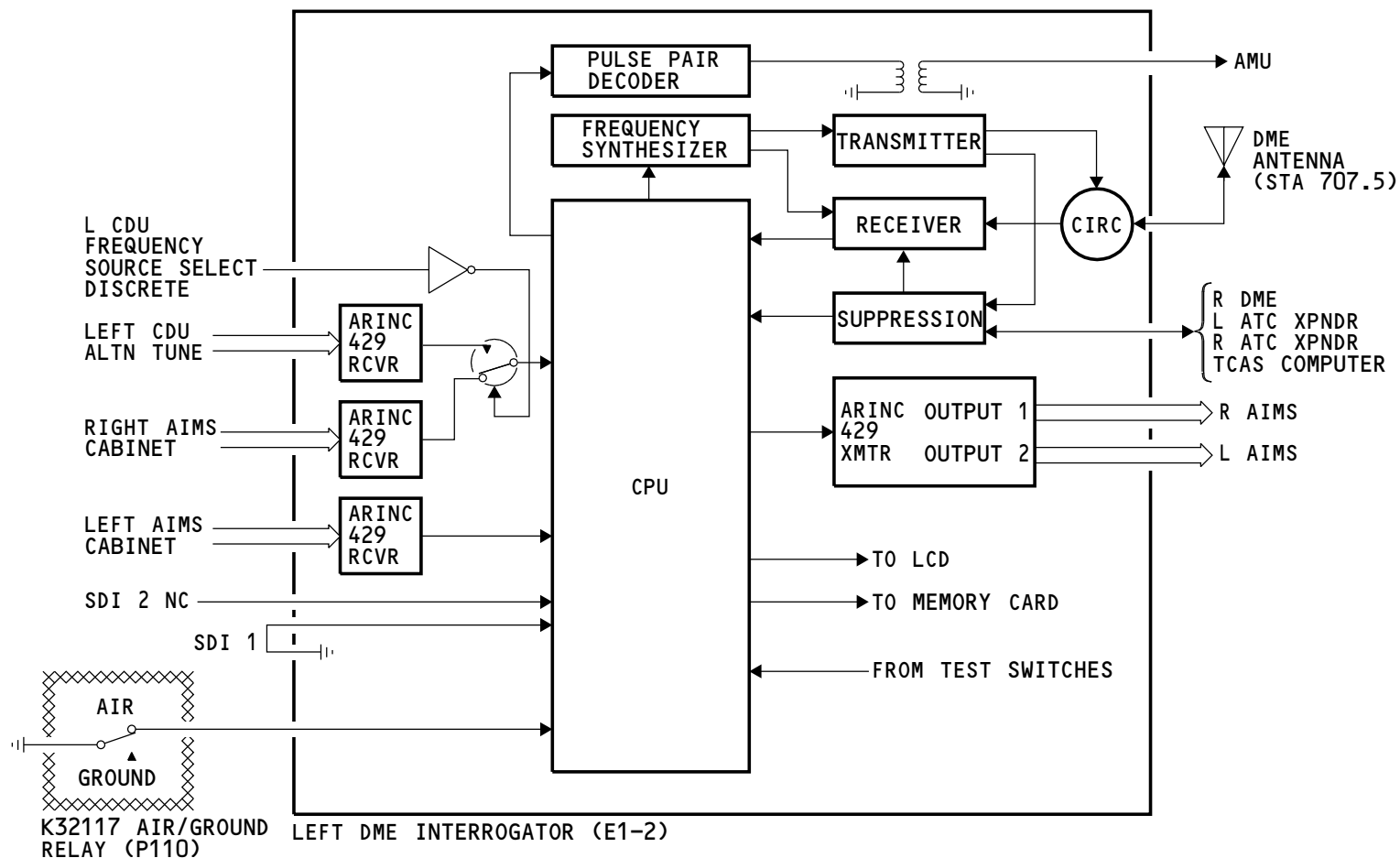
The CPU also sends tests results to the AIMS cabinets.

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ARO ALL

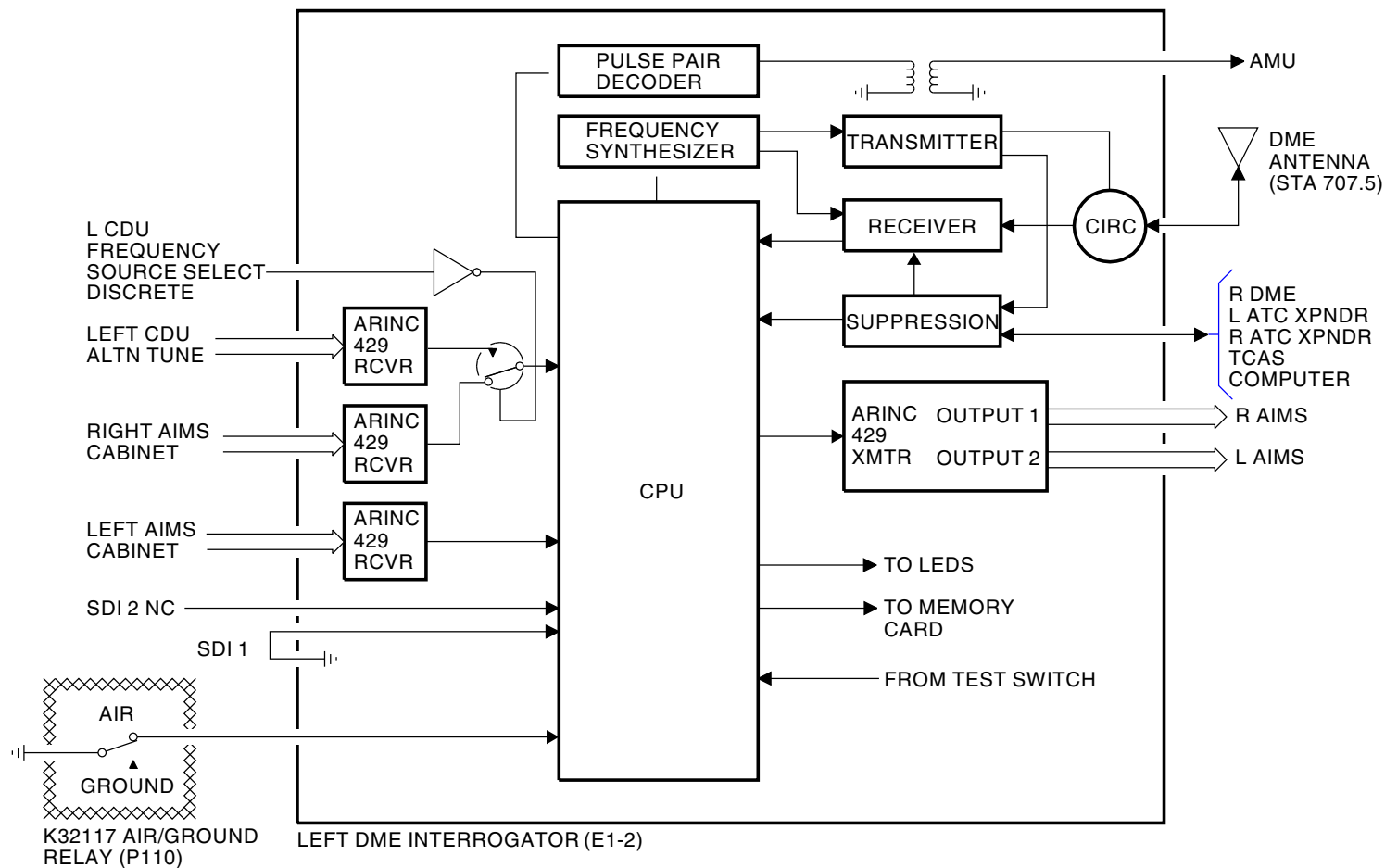
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DME SYSTEM - SIGNAL PROCESSING

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DME SYSTEM - SIGNAL PROCESSING

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**DME SYSTEM - SELF-TEST****Self Test****ARO 001-016**

Push any test switch on the front of the receiver to start a test of the DME interrogator. The interrogator then does a check of its internal operation and interfaces. The test results show on the LCD.

ARO 017-999

Push the test switch on the front of the receiver to start the test of the DME. During the test operation the 3 LEDs will be amber. The interrogator then does a check of its internal operation and interfaces. The test results are shown on the 3 LEDs. The LEDs are green for correct operation or red when a fault occurs. The LEDs are:

- DME STATUS
- CONTROL FAULT
- ANTENNA FAULT.

ARO ALL**Training Information Point**

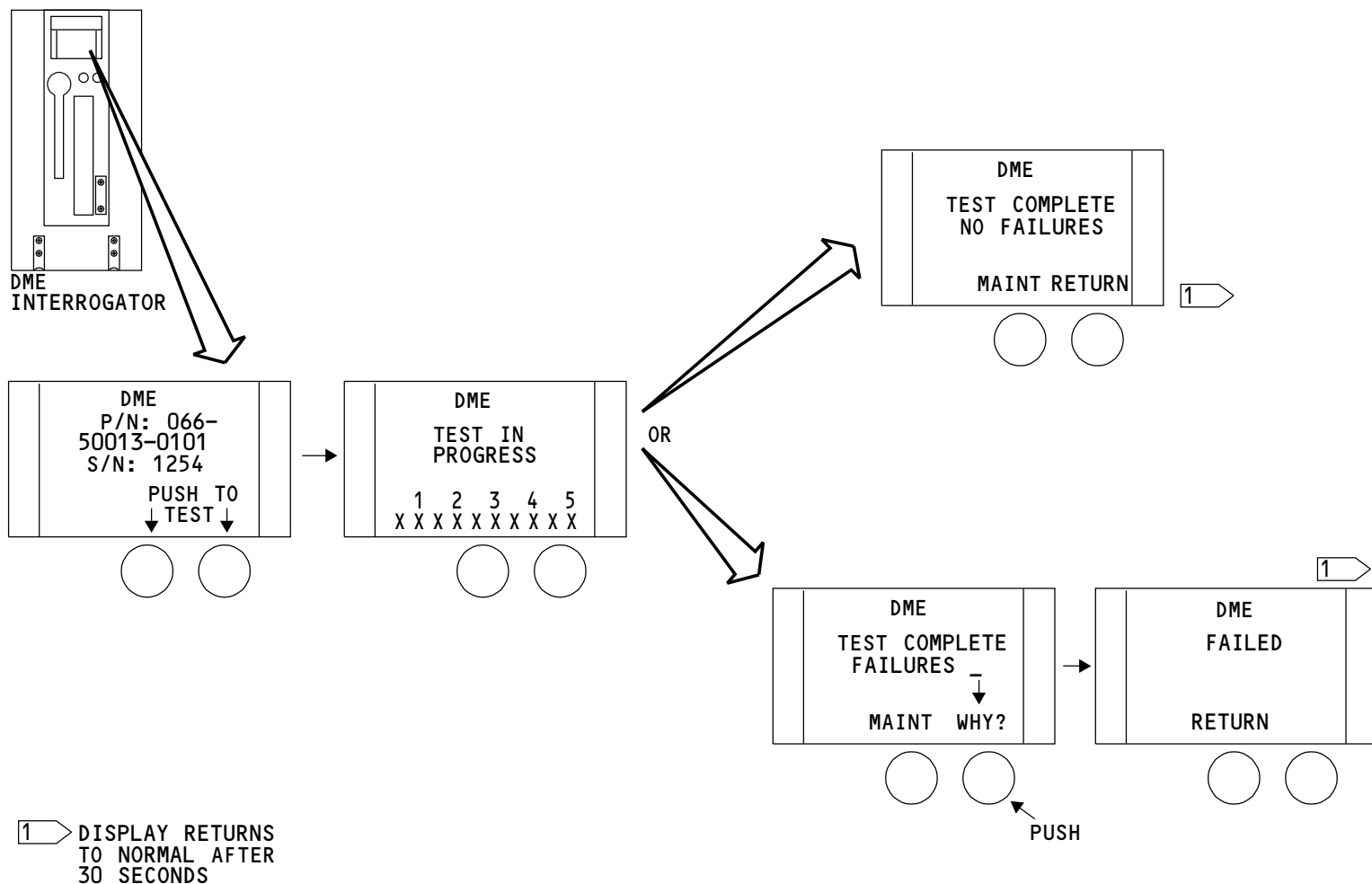
The maintenance manual and the fault isolation manual do not have a task for the line maintenance technician to do a test from the front panel of the DME interrogator. You must do all tests for the DME interrogator from the MAT or a PMAT.

Many LRUs on the 777 are compatible with other model airplanes that do not have a central maintenance computing system (CMCS). For that reason these LRUs have a front panel test feature.

34-55-00**ARO ALL** **EFFECTIVITY**

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DME SYSTEM - SELF-TEST

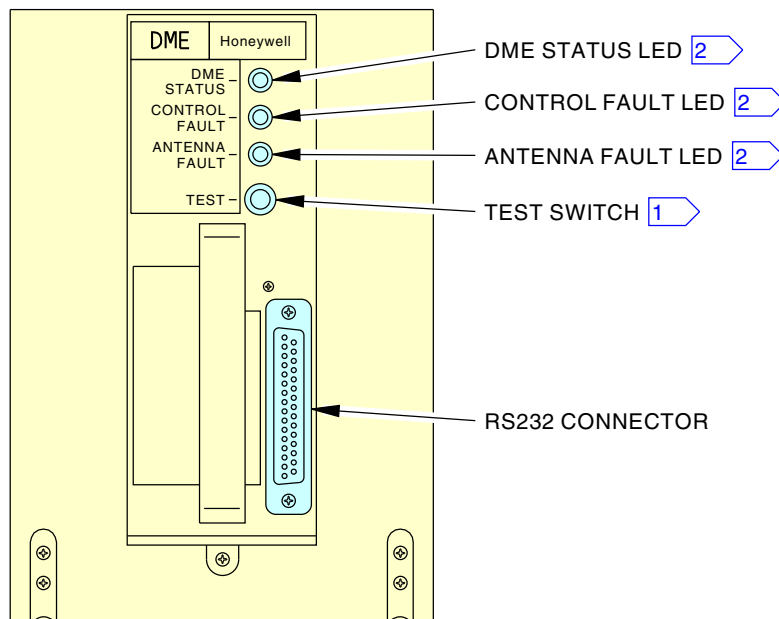
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EFFECTIVITY
ARO 001-016

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- 1 PUSH TEST SWITCH AND ALL LEDS SHOW AMBER.
- 2 ALL LEDS SHOW GREEN NO FAULTS, LED SHOWS RED FOR FAULT.

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DME SYSTEM - SELF TEST

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ARO 017-999

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**DME SYSTEM - GROUND TEST****General**

You can do a test of the DME system from the MAT. These tests are available from the operational test selection on the MAT:

- Left DME System
- Right DME System.

Operational Test

The operational test for the left and right DME systems does a check for normal operation of the DME interrogators and the control inputs to both interrogators.

GROUND TESTS

SELECT ATA SYSTEM

34 PARAVISUAL DISPLAY SYSTEM
34 WEATHER RADAR SYSTEM
34 TRAFFIC ALERT AND COLLISION AVOIDANCE SYSTEM
34 GROUND PROXIMITY WARNING SYSTEM
34 VOR / MARKER BEACON SYSTEM
34 AIR TRAFFIC CONTROL (ATC) MODE S SYSTEM
34 DISTANCE MEASURING EQUIPMENT SYSTEM
34 AUTOMATIC DIRECTION FINDER (ADF) SYSTEM
34 GLOBAL POSITIONING SYSTEM

SELECT TEST TYPE

☐ SYSTEM TEST
☒ OPERATIONAL TEST
☐ CRUISE MEASUREMENT TEST

SELECT OPERATIONAL TEST

LEFT DME SYSTEM

RIGHT DME SYSTEM

CONTINUE

HELP

GO BACK

SELECT OPERATIONAL TEST

(2)

LEFT DME SYSTEM
RIGHT DME SYSTEM

DME SYSTEM - GROUND TEST

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**AUTOMATIC DIRECTION FINDER SYSTEM - INTRODUCTION****Purpose**

The automatic direction finder (ADF) system is a navigation aid. The ADF receiver uses AM signals from ground stations to calculate the bearing to the station from the airplane longitudinal axis, and to receive standard AM radio broadcasts.

Abbreviations and Acronyms

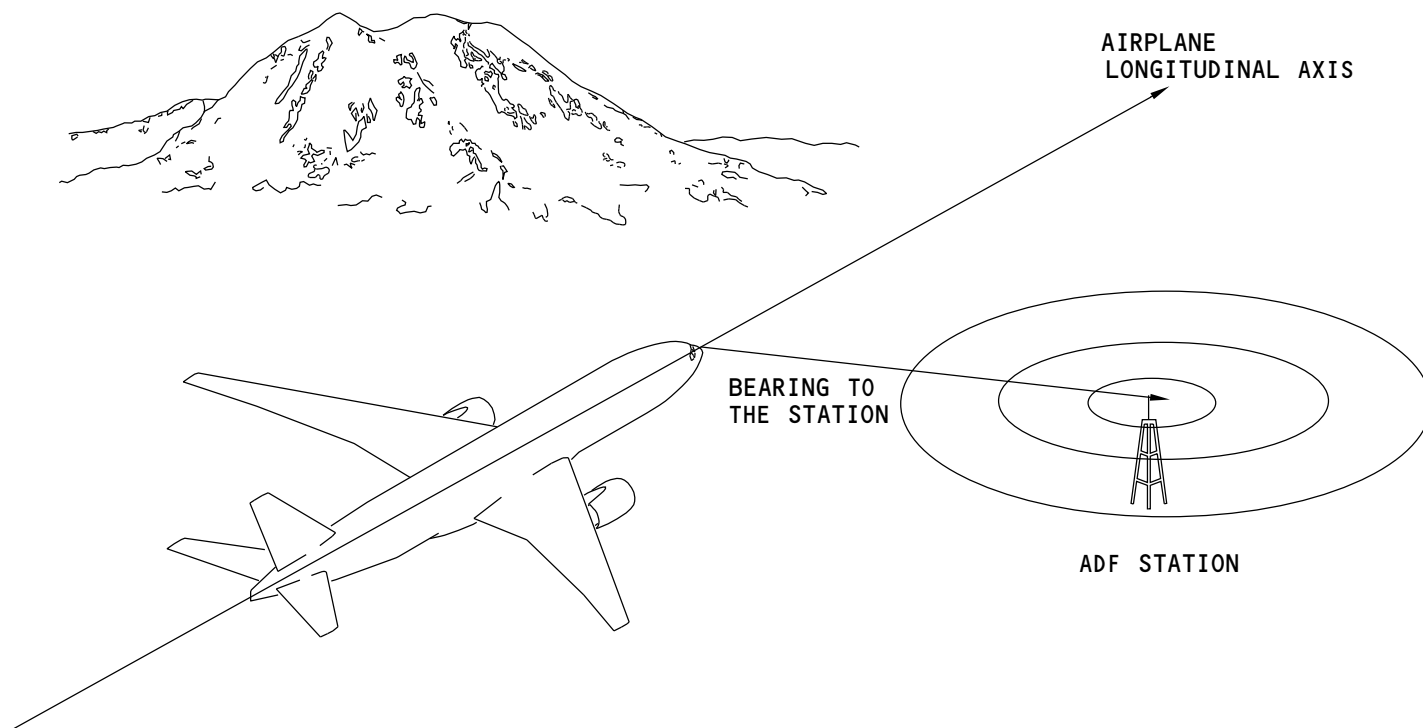
- ACP - audio control panel
- ADF - automatic direction finder
- AIMS - airplane information management system
- air/gnd - air ground
- altn - alternate
- AM - amplitude modulation
- AMU - audio management unit
- ant - antenna
- ARINC - Aeronautical Radio, Inc.
- BFO - beat frequency oscillator
- CDU - control display unit
- CMCF - central maintenance computing function
- kHz - kilohertz
- MAT - maintenance access terminal
- NCD - no computed data
- ND - navigation display
- QEC - quadrantal error correction
- RF - radio frequency
- SDI - source destination indicator
- sta - station

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AUTOMATIC DIRECTION FINDER SYSTEM - INTRODUCTION

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**ADF SYSTEM - GENERAL DESCRIPTION****General**

The ADF system has two receivers and two antennas.

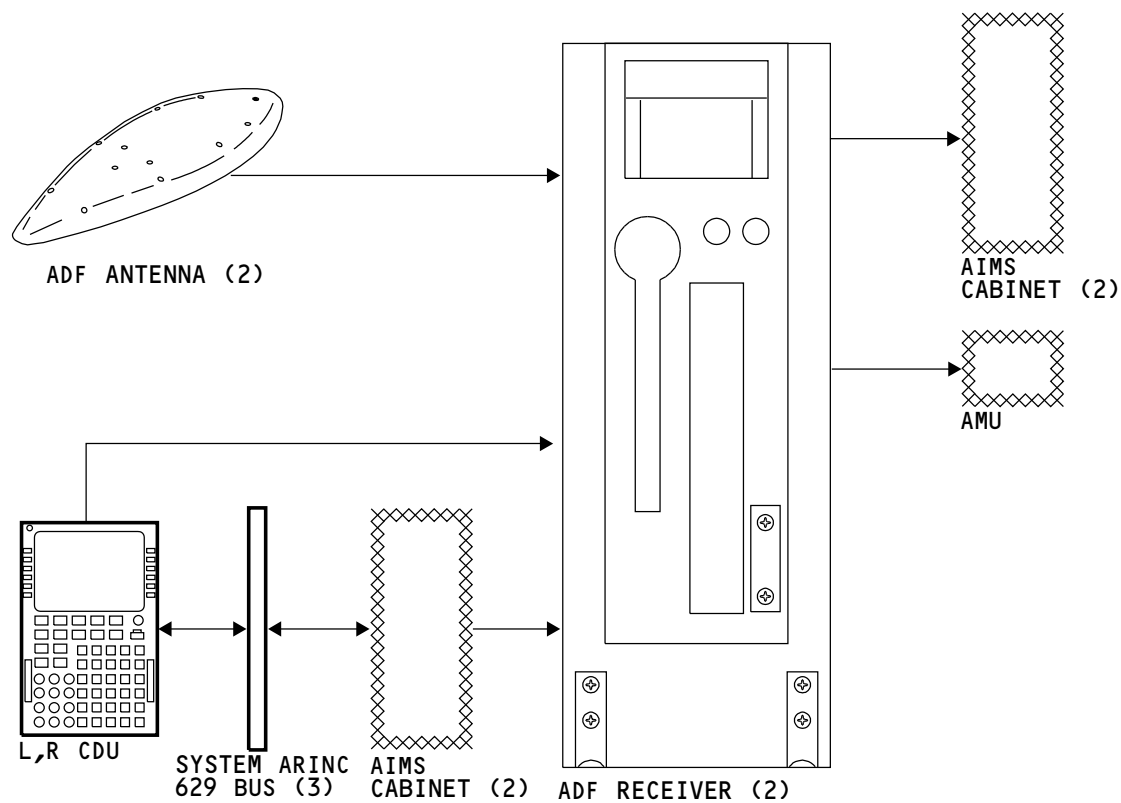
Description

The ADF antenna assembly has both the loop and sense antennas. The antenna receives signals from the ground stations and sends them to the ADF receiver.

The ADF receiver calculates the bearing to the station and sends it to the AIMS cabinets to show on the navigation displays (ND).

You can tune the ADF receivers manually from the left or right CDU. The airplane information management system does not autotune the ADF receivers. The receivers can get tune inputs directly from the left or right CDU (alternate tune) if the tune inputs through the AIMS cabinets fail.

The ADF receiver processes the station audio and sends it to the audio management unit (AMU).



ADF SYSTEM - GENERAL DESCRIPTION

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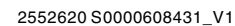
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ADF SYSTEM - GENERAL DESCRIPTION

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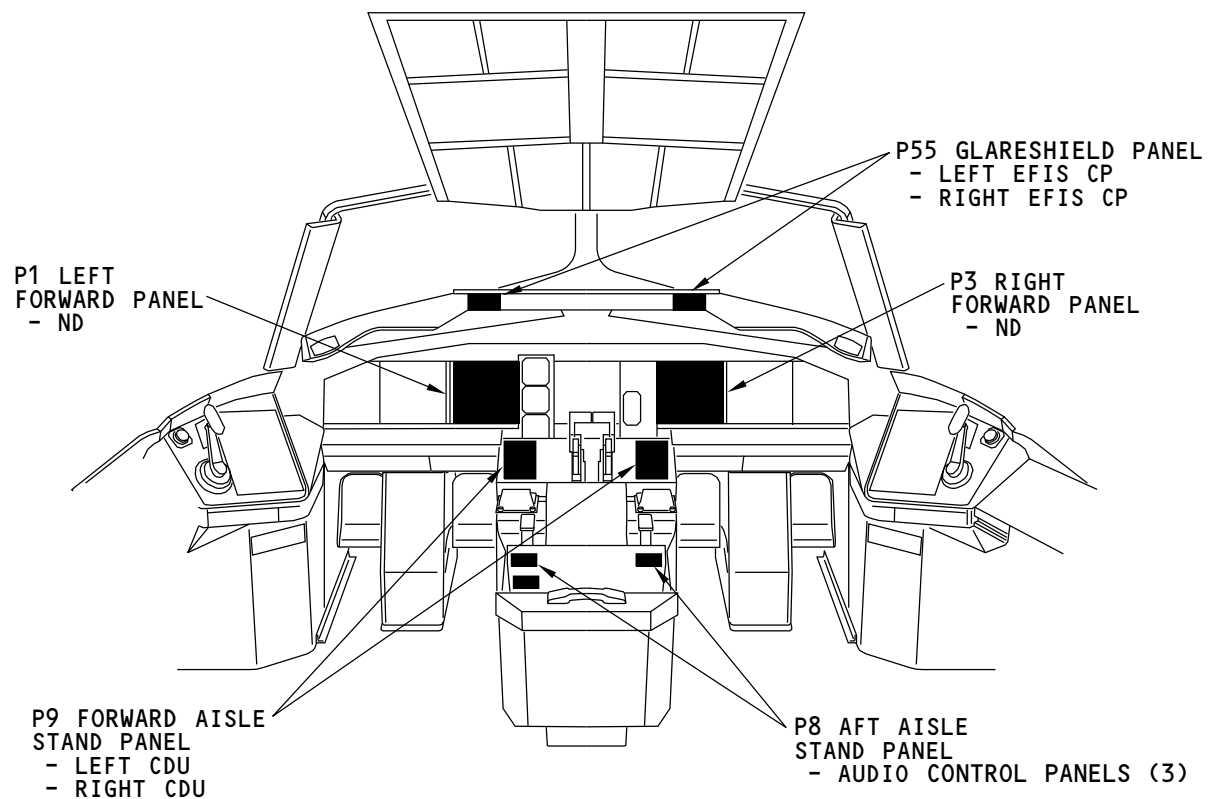
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**ADF SYSTEM - FLIGHT DECK COMPONENT LOCATION****General**

These are the components on the flight deck that interface with the ADF system:

- Left and right EFIS control panel (CP)
- Captain and first officer navigation display (ND)
- Left and right control display units (CDUs)
- Audio control panels (ACPs).

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ADF SYSTEM - FLIGHT DECK COMPONENT LOCATION

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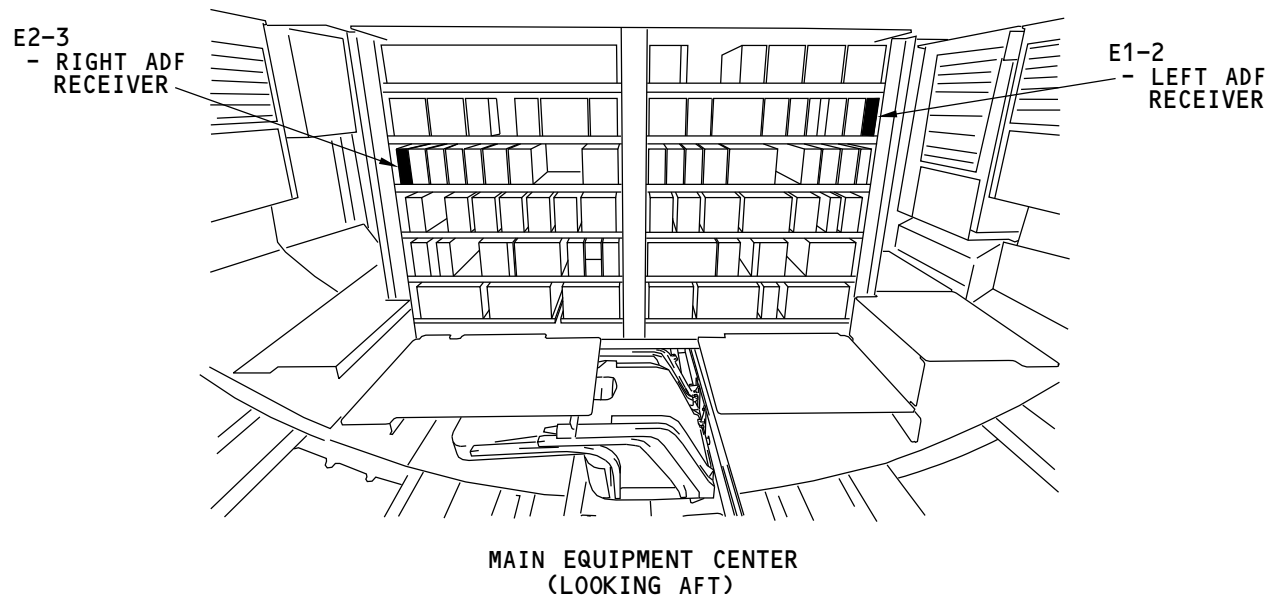
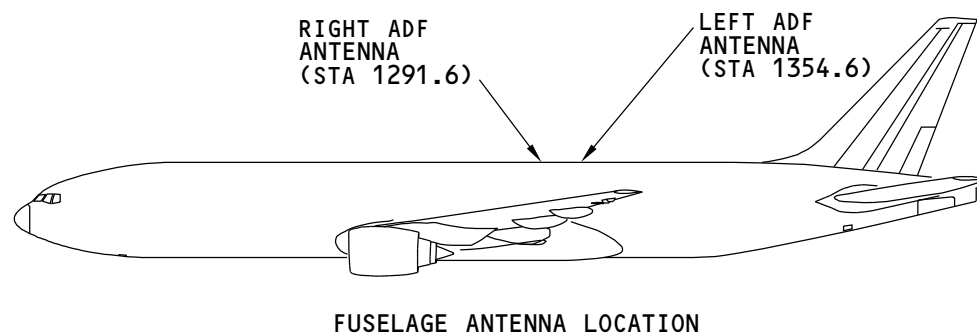


ADF SYSTEM - MAIN EQUIPMENT CENTER AND FUSELAGE COMPONENT LOCATION

General

The ADF antennas are on the top of the fuselage. The left and right ADF receivers are in the main equipment center on the E1 and E2 racks.

ARO ALL	EFFECTIVITY



ADF SYSTEM - MAIN EQUIPMENT CENTER AND FUSELAGE COMPONENT LOCATION

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**ADF SYSTEM - POWER, ANALOG, AND DISCRETE INTERFACES****Power**

The left and right ADF receivers get 115v ac from the left and right 115v ac transfer buses.

The ADF receivers send 12v dc to their ADF antennas.

ADF Antennas

The ADF antennas send AM ground station signals to the ADF receivers.

CDUs

The CDUs supply frequency source select discretes to the ADF receivers when the tune inputs from the AIMS fails. The resistor assemblies pull up the discretes to 28v dc. The left CDU sends a ground discrete to the left receiver when the discrete is true. The right CDU sends a ground discrete to the right receiver when the discrete is true.

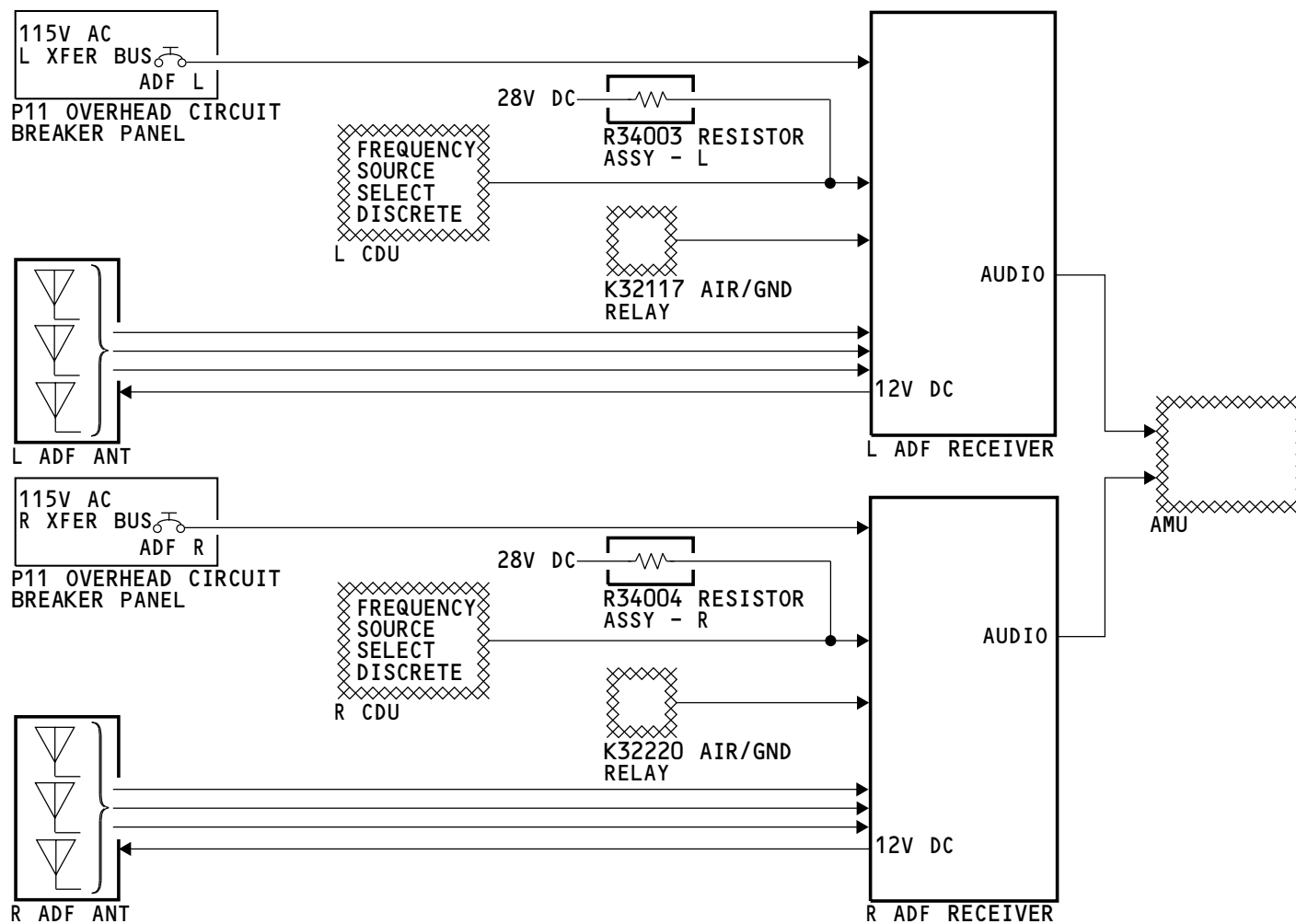
Air/Ground Relay

The air/ground relay supply discrete inputs to the ADF receivers to:

- Set flight legs (as alternate source, primary is from the CMCF of AIMS)
- Inhibit test commands in the air.

AMU

The audio management unit (AMU) receives Morse code station identifier signals and audio from the receivers and sends them to the flight interphone speakers and headsets.



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ADF SYSTEM - POWER, ANALOG, AND DISCRETE INTERFACES

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**ADF SYSTEM - DIGITAL INTERFACE****General**

The components that interface with the ADF receivers on ARINC 429 data buses are the left and right CDUs and the left and right AIMS cabinets.

CDU Interfaces

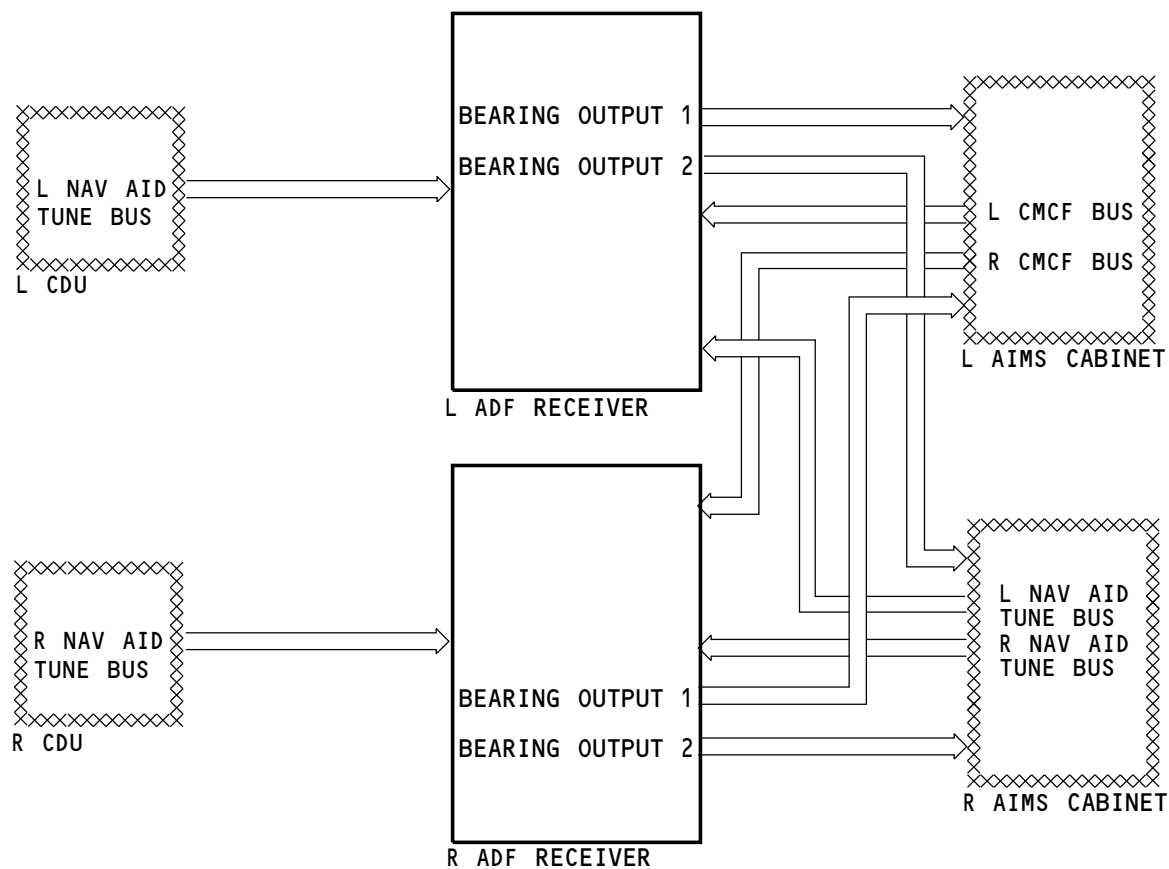
The CDUs supply tune inputs directly to the ADF receivers on the NAV aid tune buses when the tune inputs from the AIMS cabinets fail.

AIMS Cabinet Interfaces

The ADF receivers get tune inputs from the flight management computer function (FMCF) in the right AIMS cabinet. The left and right ADF receivers get tune inputs on the left and right NAV aid tune buses from the right AIMS cabinet.

Test commands come from the central maintenance computer function (CMCF) in the left AIMS cabinet. The left and right ADF receivers get test commands on the left and right CMCF buses from the left AIMS cabinet. The AIMS cabinets also give flight leg data to the ADF receivers.

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ADF SYSTEM - DIGITAL INTERFACE

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ADF SYSTEM - ADF RECEIVER

Purpose

The ADF receiver calculates bearing to a station that transmits in the frequency range of 190 KHz to 1750 KHz. The receiver also receives station identifiers and AM broadcasts.

Description

The ADF receiver operates on 115v ac power. The receiver has built-in test equipment (BITE) that monitors receiver operation and data inputs.

Use the maintenance access terminal (MAT) to do a test of the ADF receiver.

Operation**ARO 001-015**

There are two switches and an LCD on the front panel of the ADF receiver. You use any of the two switches to start a test of the ADF receiver. The LCD shows the test results.

ARO 016-999

There is one switch and three LEDs on the front panel of the ADF receiver. You use any of the switch to start a test of the ADF receiver. The LEDs display the unit's operating status. A separate front panel adapter can be used to show the indications and functionality of an LCD display.

ARO 001-015

There is a memory card slot on the front of the ADF receiver. Shop personnel use this feature to insert a flash memory card which loads software into the LRU. The memory card can also store LRU status data sent by the LRU during operation. These features are not for use by line maintenance personnel.

ARO ALL

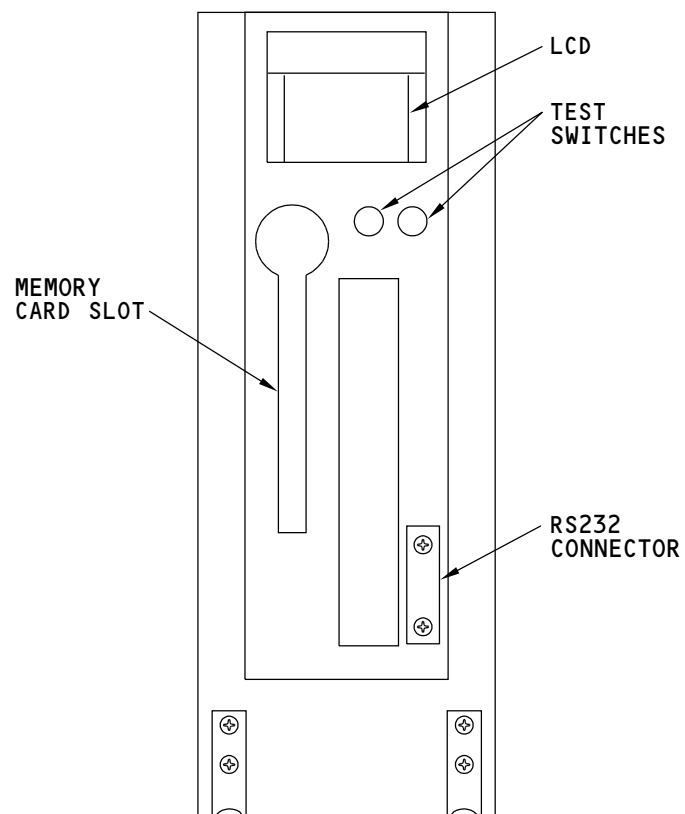
Shop personnel use the RS 232 connector to connect shop test equipment to the LRU. This feature is not for use by line maintenance personnel.

Training Information Point

The maintenance manual and the fault isolation manual do not have a task for the line maintenance technician to do a test from the front panel of the ADF receiver. You must do all tests for the ADF receiver from the MAT or a PMAT.

Many LRUs on the 777 are compatible with other model airplanes that do not have a central maintenance computing system (CMCS). For that reason these LRUs have a front panel test feature.

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ADF SYSTEM - ADF RECEIVER

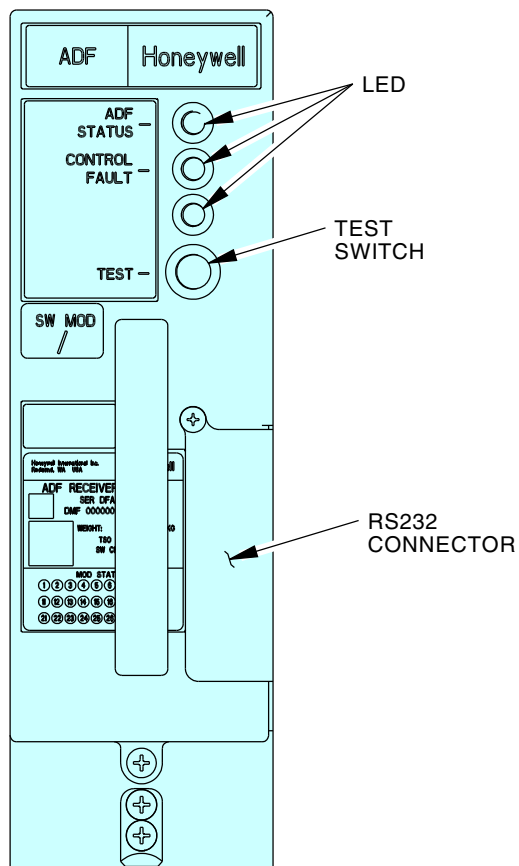
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ADF SYSTEM - ADF RECEIVER

ADF SYSTEM - ADF RECEIVER

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**ADF SYSTEM - ADF ANTENNA****Purpose**

The ADF antenna receives electromagnetic signals from ground stations. The loop antenna receives the magnetic part of the ground station signal, and the sense antenna receives the electrical part of the signal.

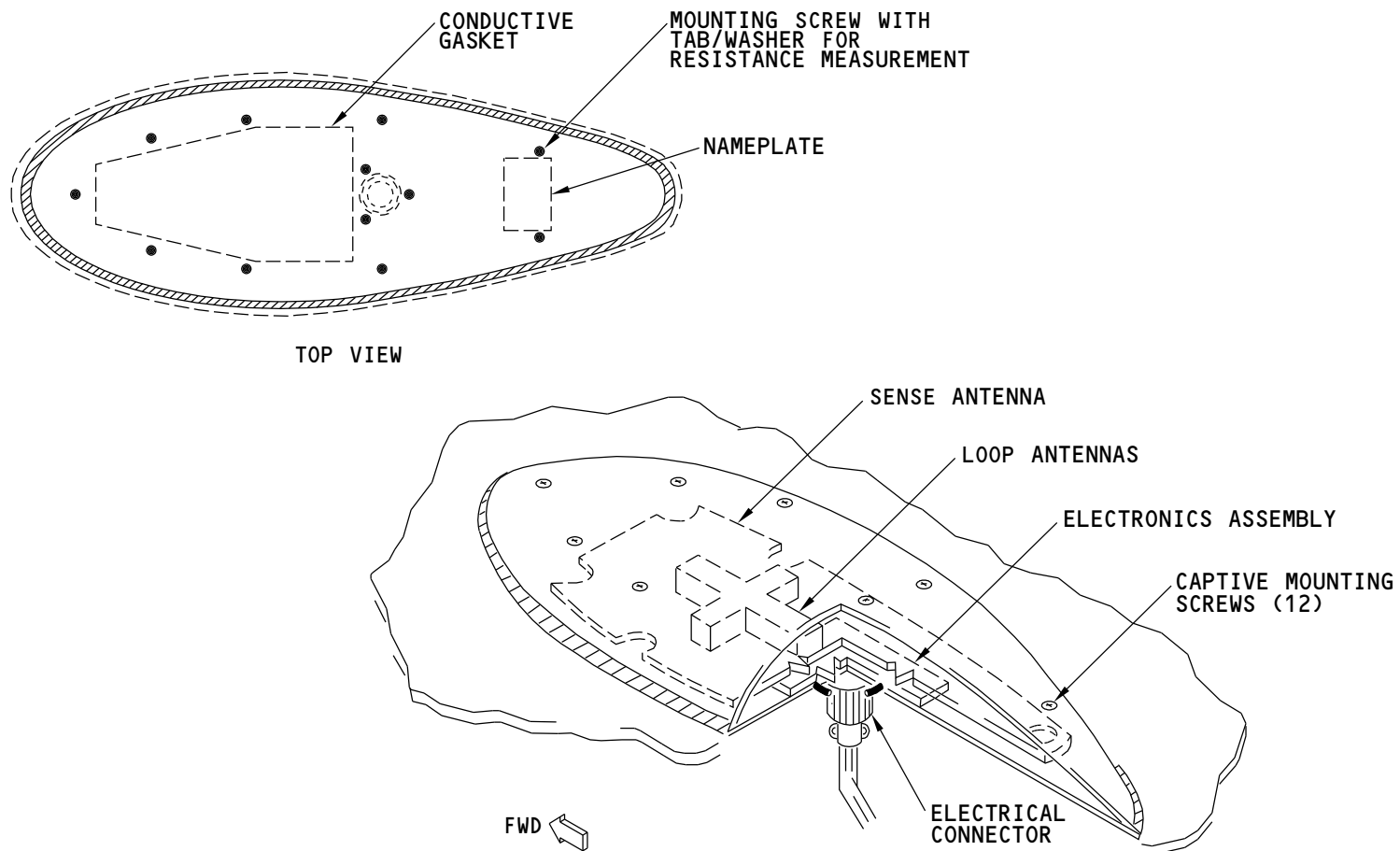
Description

The antenna assembly is a one piece molded shell. The antenna assembly has:

- Loop antenna elements (2)
- Sense antenna (1)
- Amplifiers (3), one for each antenna element
- Transformers (3), one for each antenna element.

The ADF antenna elements each have an amplifier and output transformer. The amplifiers receive 12v dc power from the ADF receiver. The left ADF receiver sends power to the left antenna and the right ADF receiver sends power to the right antenna.

The antenna has captive screws.



ADF SYSTEM - ADF ANTENNA

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ADF SYSTEM - FUNCTIONAL DESCRIPTION

Power

The ADF receiver power supply receives 115v ac and supplies all the voltages for the internal circuits.

Antenna Inputs

The receiver circuits get radio frequency (RF) signals from the antenna. The antenna amplifiers receive 12v dc from the antenna control circuits in the ADF receiver. The RF signals from the antenna elements go through amplifiers and transformers then to the receiver circuits.

Tuning Inputs

The ADF receiver input/output data processor receives manual tune inputs from the right AIMS cabinet and alternate tune inputs from the CDUs. If the right AIMS cabinet tune input fails, alternate tune inputs come directly from the onside CDU.

When the AIMS cabinet fails, the CDU sets the frequency source select discrete to ground. This changes the tune input port to the CDU.

Receiver Operation

The data processor sends the tune frequencies to the receiver circuits.

For normal operation, the receiver circuit removes the audio signal from the RF signal and sends it to the audio processor. The audio goes through an audio amplifier then to the AMU.

The audio processor sends the Morse code station identifier to the Morse decoder circuits. When there is an identifier, the Morse decoder sends it to the ARINC 429 transmitter. The identifier replaces the frequency on the NDs.

The receiver circuits send the bearing part of the RF signal to the bearing computer circuit. The bearing circuit compares the inputs of the loop and sense antenna elements to calculate bearing to the ADF station.

Bearing data goes to an ARINC 429 transmitter that has two outputs. For the left ADF receiver, output 1 goes to the left AIMS cabinet and output 2 goes to the right AIMS cabinet. For the right ADF receiver, output 1 goes to the right AIMS cabinet and output 2 goes to the left AIMS cabinet.

If you select the antenna (ANT) mode, the processor sends a signal to the receiver circuit that removes the inputs from the loop antenna elements. In the ANT mode, the receiver circuits use inputs only from the sense antenna.

If you select the beat frequency oscillator (BFO) mode, the processor sends a BFO mode signal to the audio processor to enable a 1020 Hz oscillator. The oscillator permits the audio processor to identify the keyed morse code identifier.

Built-in-Test Equipment

The ADF receiver contains BITE that monitors ADF receiver operation and signal inputs. A fault memory keeps failures that occur by flight legs. A discrete from the AIMS cabinets sets the flight legs. If the input discrete from the AIMS cabinet fails, the ADF receiver uses the air/ground discrete from the air/ground relay to set the flight legs.

The central maintenance computer function (CMCF) in the left AIMS cabinet sends test signals to the ADF receivers. The processor sends test signals to the antenna control circuit and to a function test RF coupler.

Test

During a test, the antenna control removes power to the antenna amplifiers of the ADF antenna so that no RF signals go to the receiver circuits. A test RF frequency replaces the antenna RF input and the receiver sends the signal through its internal circuits. Test results show on the navigation displays.

Program Pin Inputs

The ADF receivers get discretes from program pin selections.

The bearing computer circuit uses quadrantal error correction (QEC) program pin inputs to adjust for signal distortion caused by airplane structures.

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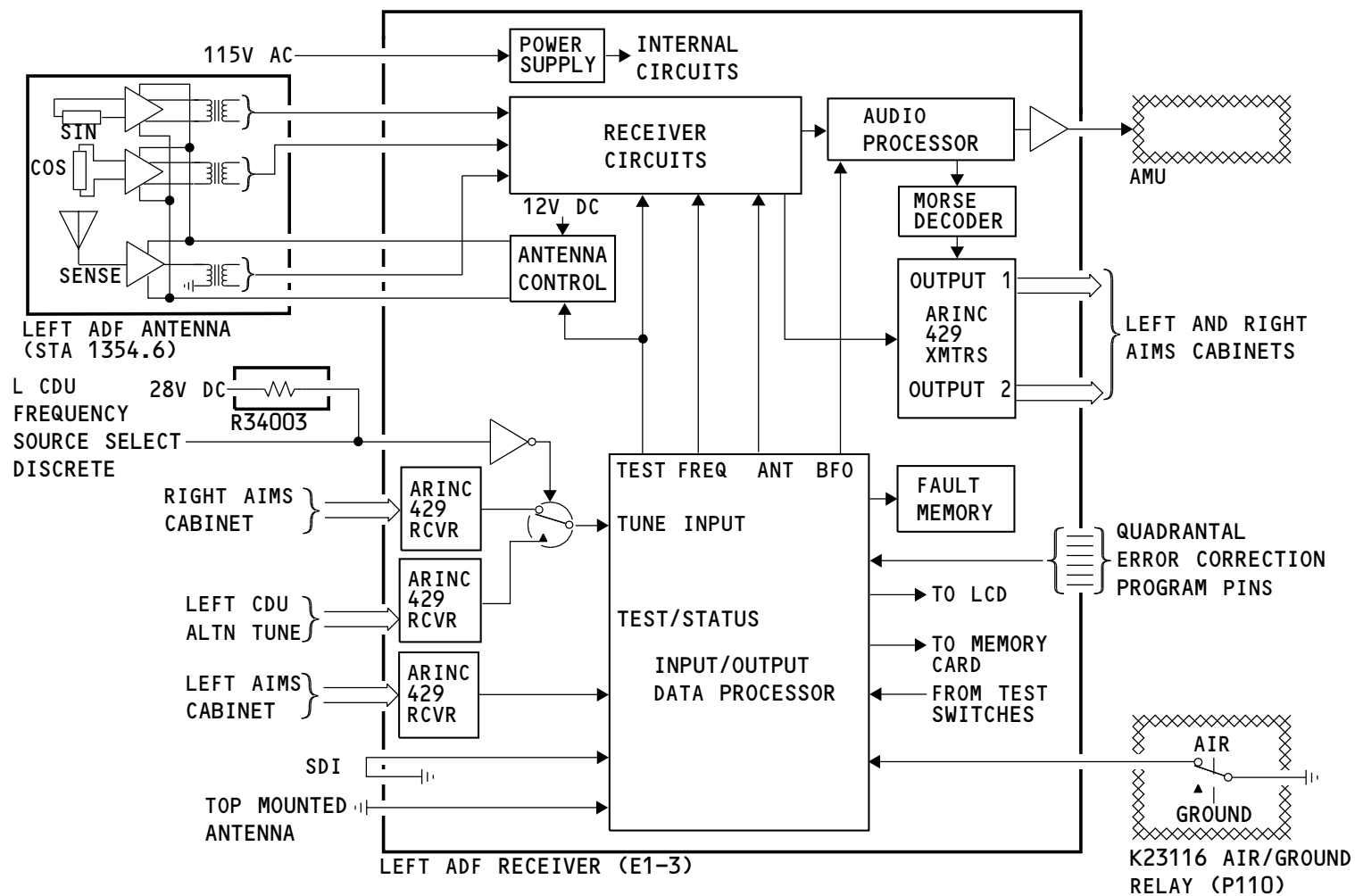


ADF SYSTEM - FUNCTIONAL DESCRIPTION

The source destination indicator (SDI) discrete identifies the ADF receiver as the left or right receiver.

A discrete identifies the antenna location as a top mounted antenna.

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ADF SYSTEM - FUNCTIONAL DESCRIPTION

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ADF SYSTEM - TUNING INPUTS

General

These are the two ways to tune the ADF receivers:

- Manually by the left, center, or right CDU
- By the CDUs as an alternate tune source.

Manual Tuning

You manually tune the ADF receivers from the left or right control display units (CDUs). The center CDU can tune the receivers if the left or right CDU fails. Manual tune inputs from the CDUs go through the left and right systems ARINC 629 buses, then to the left and right AIMS cabinets. Manual tune inputs from the left or right AIMS cabinet goes from the right AIMS cabinet to the ADF receivers.

Alternate Tune

The CDUs monitor the AIMS cabinets tune functions. If the AIMS tune function fails, the CDUs send a frequency source select discrete to the ADF receivers that changes the inputs from the right AIMS cabinet, to the input that comes directly from the left or right CDU. The CDUs use 28v dc from a pull-up resistor to set the discrete.

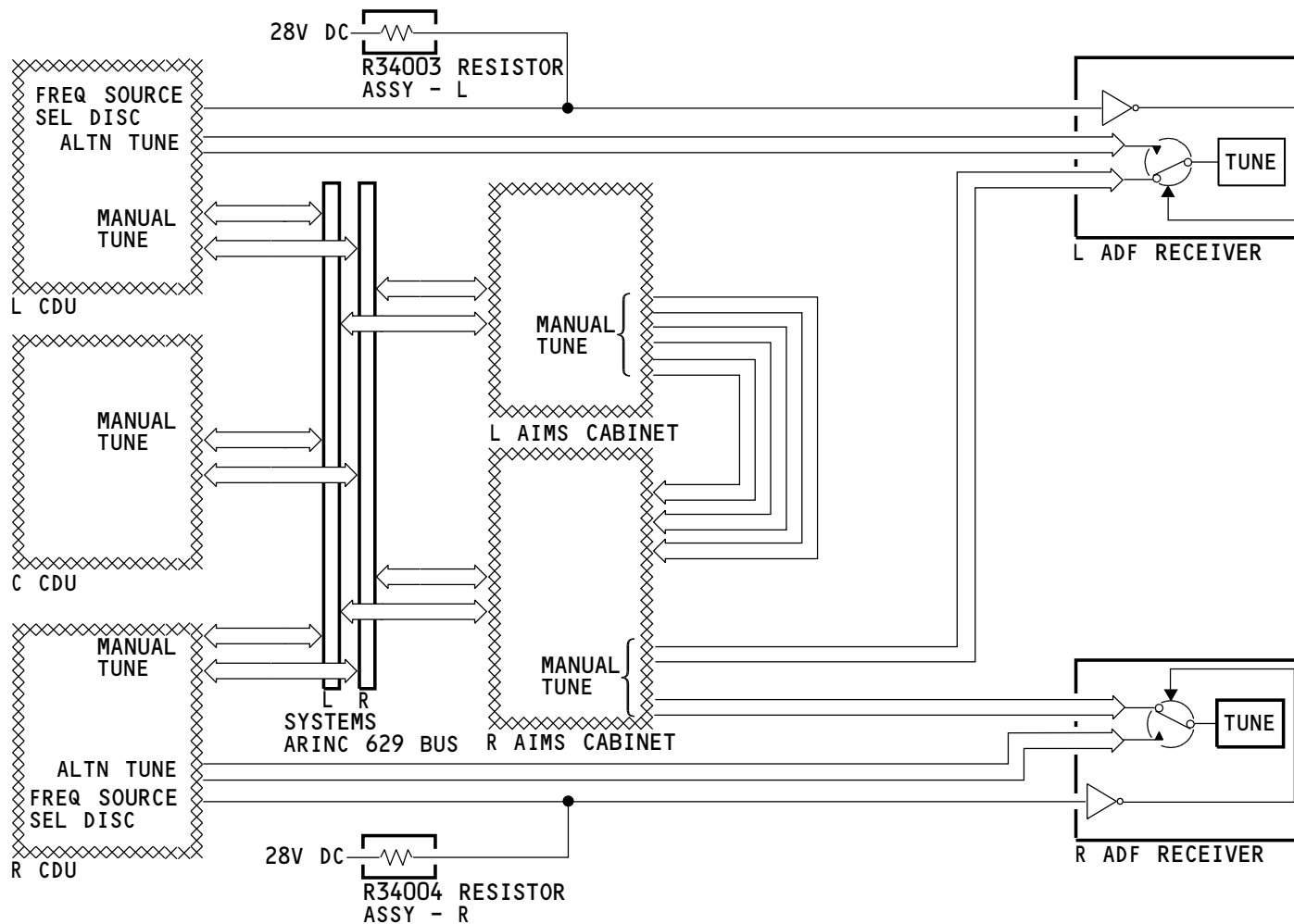
In alternate tune mode, the left CDU alternate tunes the left ADF receivers and the right CDU alternate tunes the right ADF receiver. The center CDU has no alternate tune function.

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ADF SYSTEM - TUNING INPUTS

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**ADF SYSTEM - AUDIO CONTROLS****General**

The audio control panels supply control inputs to the audio management unit. This permits the crew to hear audio signals on the speakers and headsets in the flight deck.

Description

These are the controls on the audio control panel that let you to hear ADF audio:

- VOR/ADF receiver selector
- VOR/ADF receiver volume control
- NAV filter selector.

VOR/ADF Selector

The VOR/ADF receiver selector lets you select VOR or ADF as the source of audio.

VOR/ADF Receiver Volume Control

The VOR/ADF receiver volume control makes the audio come on and controls the volume.

NAV Filter Selector

The NAV filter selector lets you select one of these:

- Voice (V) audio
- Both (B) voice and range audio
- Range (R) audio.

Operation

Do this to hear ADF audio:

- Set the VOR/ADF selector to the left (L) or right (R) ADF position
- Push the VOR/ADF receiver volume control to make the ADF audio come on (turn the control to adjust the volume)

- Set the NAV filter selector to the voice (V) position.

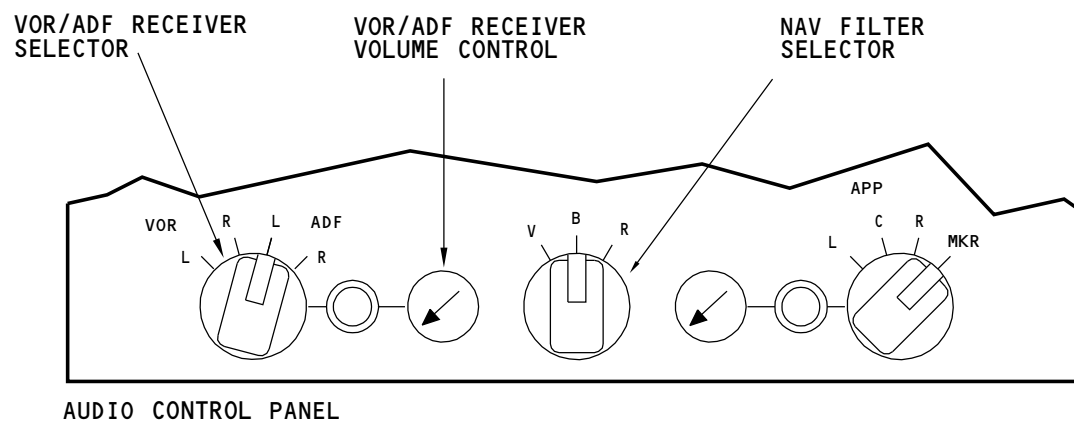
To hear the station identifier, set the NAV filter selector to either the both (B) or the range (R) position.

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ADF SYSTEM - AUDIO CONTROLS

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**ADF SYSTEM - CDU ADF TUNING****General**

The CDUs supply manual tune inputs during normal operation and alternate tune inputs when the AIMS tune function fails.

Operation

To see ADF tune frequencies, push the NAV RAD key on the CDU. The NAV RADIO page shows data for the left and right ADF systems.

To manually tune an ADF receiver, enter a valid ADF frequency into the scratchpad. Push line select key 3L or 3R to enter the frequency for left or right ADF receiver.

You cannot use the delete key to delete an ADF frequency.

Alternate Tune

The ALTN NAV RADIO page is available only when the tune inputs from the AIMS cabinets fail.

To get to the ALTN NAV RADIO page, push the NAV RAD key on the CDU.

The ALTN NAV RADIO page is different from the NAV RADIO page. The ALTN NAV RADIO page shows data for only the onside NAV radio systems. The left CDU ALTN NAV RADIO page controls the left ADF receiver and the right CDU ALTN NAV RADIO page controls the right ADF receiver.

Antenna (ANT) Mode

In the antenna (ANT) mode, the ADF receiver uses only the sense antenna to receive station audio broadcasts. To select the ANT mode, enter the letter A after the frequency, then line select the data to the ADF data line. When you enter the frequency, ANT shows after the frequency.

To delete the ANT mode, push the delete key on the CDU. The delete function shows in the CDU. Next, push the line select key next to the ADF line to delete the ANT.

Beat Frequency Oscillator (BFO) Mode

The ADF receivers can detect the station Morse code identifier if the 1020 Hz signal is amplitude modulated with the station audio signal. The ADF receiver can not detect the station Morse code identifier if the signal is a keyed Morse code signal. To hear the station morse code identifier, you must select the BFO mode. To select the BFO mode, type the letter B after the frequency and line select the data to the ADF data line. When you enter the frequency, BFO shows after the frequency.

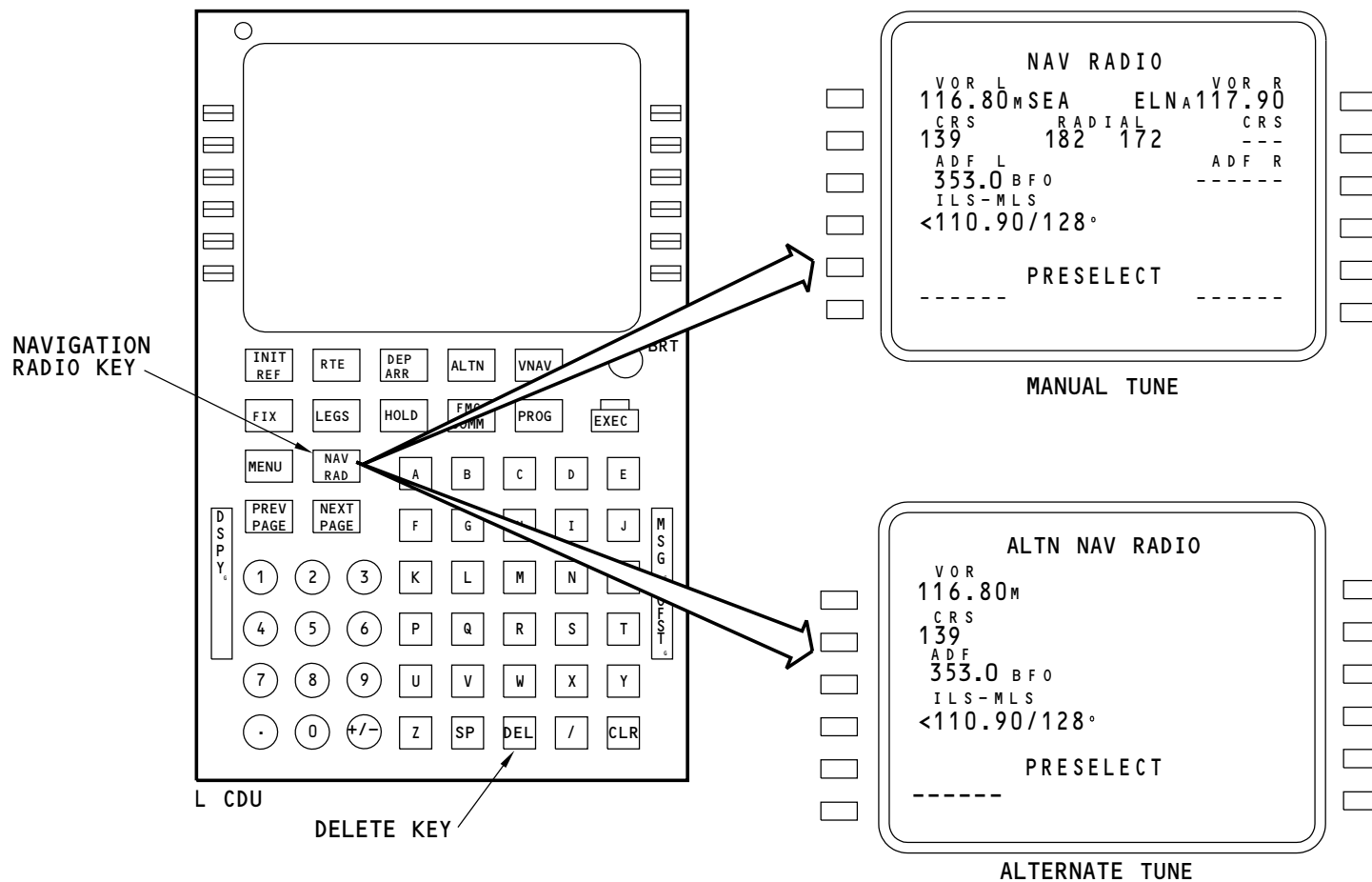
To delete the BFO mode, push the delete key on the CDU. The delete function shows in the CDU. Next, push the line select key next to the ADF line to delete the BFO.

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ADF SYSTEM - CDU ADF TUNING

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**ADF SYSTEM - EFIS CONTROLS****General**

The EFIS control panel has controls to select ADF data to show on the navigation displays (NDs).

VOR/ADF Switch

The VOR/ADF switches select the VOR or ADF receivers as the source of data for the left and right bearing pointers on the ND. There are two switches, one for the left bearing pointer and one for the right bearing pointer. When the switches are set to the off position, the bearing pointers and ADF data goes out of view.

Alternate or Backup EFIS Control Panel

The EFIS control page on the CDU supplies backup controls for the EFIS control panel. To select ADF data for the bearing pointers, push the OPTIONS line select key on the EFIS control page. This brings up the EFIS OPTIONS page.

Push the line select key next to the OFF-ADF-VOR data line on the EFIS OPTIONS page to toggle between ADF or VOR data.

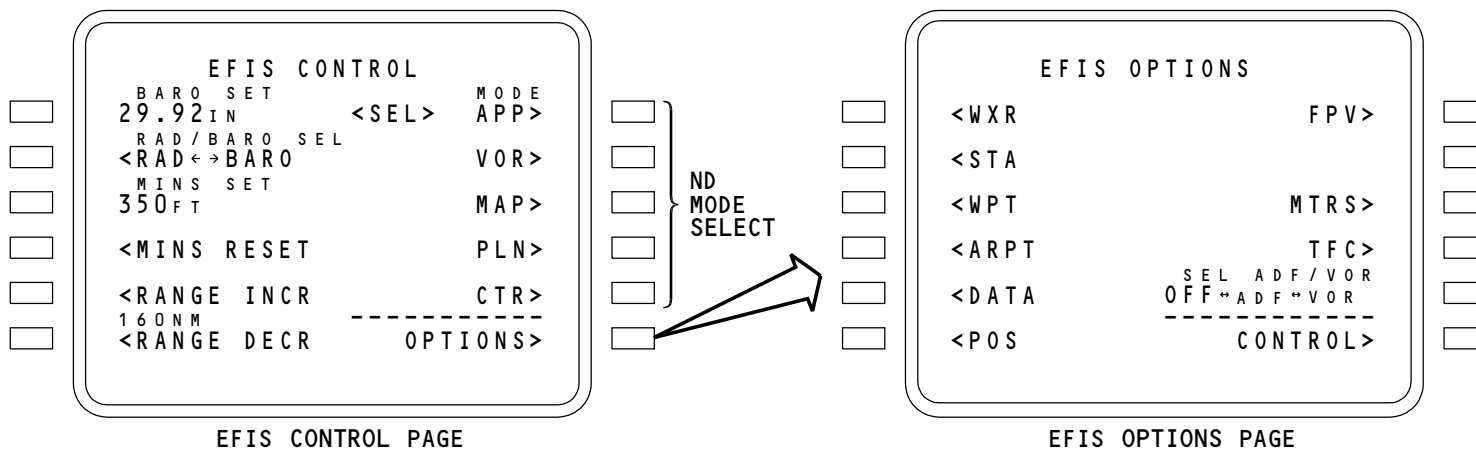
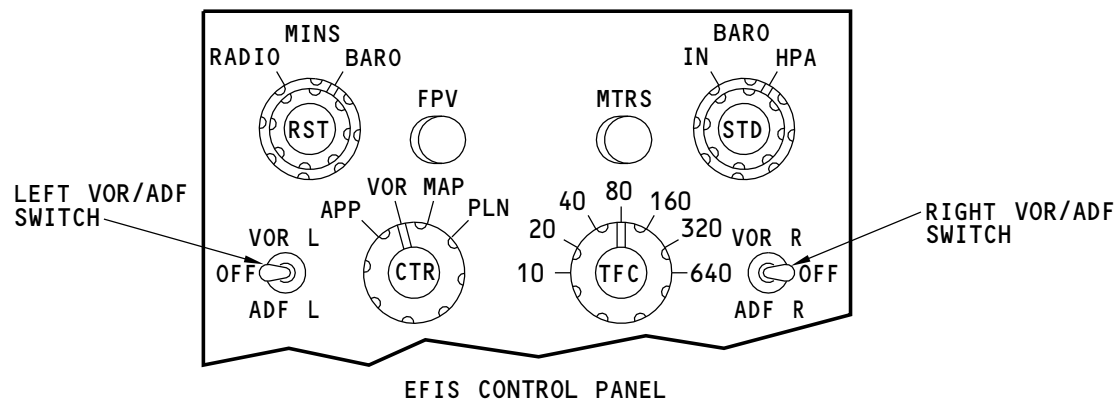
The active mode shows in large letters.

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ADF SYSTEM - EFIS CONTROLS

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ADF SYSTEM - DISPLAYS

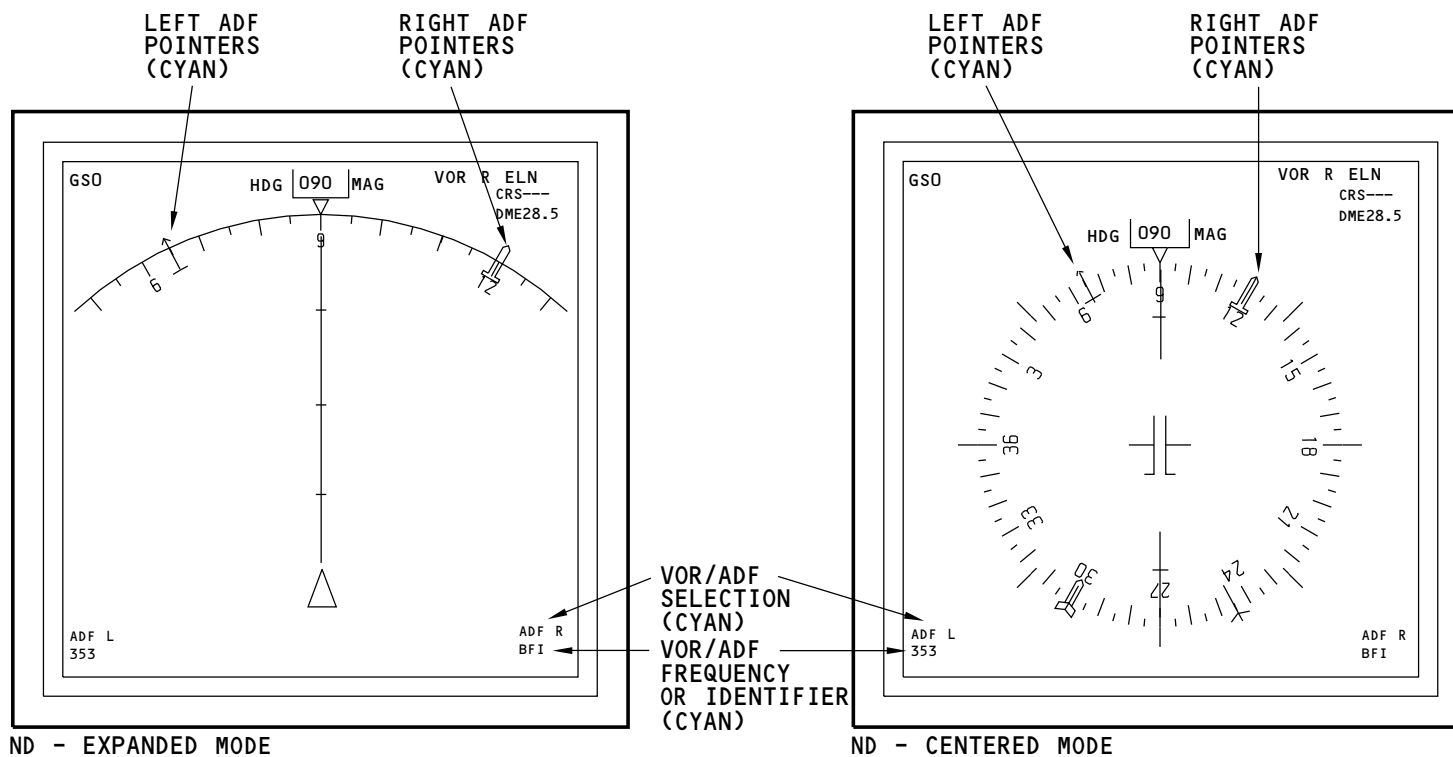
General

ADF pointers show in all EFIS modes but PLN (plan). The pointers are cyan in color. To display the ADF pointers, set the ND mode selector to APP, VOR, or MAP. Set the VOR/ADF switch on the EFIS control panel to the ADF position.

The ADF pointers move around the compass scale. The wide pointer shows the bearing from the right ADF receiver, and the thin pointer shows the bearing from the left ADF receiver.

The ADF source annunciation and frequency or identifier show in cyan at the lower corners of the NDs. The station identifier replaces the frequency when the data is valid from the ADF receiver.

NOTE: The graphic shows the displays for the VOR mode, the displays are the same for the other ND modes except PLN.



ADF SYSTEM - DISPLAYS

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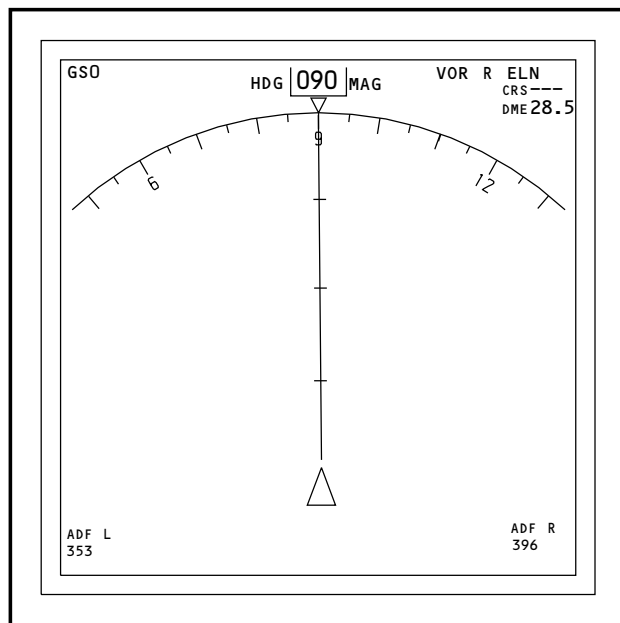
**ADF SYSTEM - ND NCD AND INVALID DISPLAYS****General**

When the receiver output is no computed data (NCD), the ADF pointers go out of view. The source annunciation and frequency remain in view.

When the receiver output is invalid, all ADF data goes out of view and the amber ADF flags show.

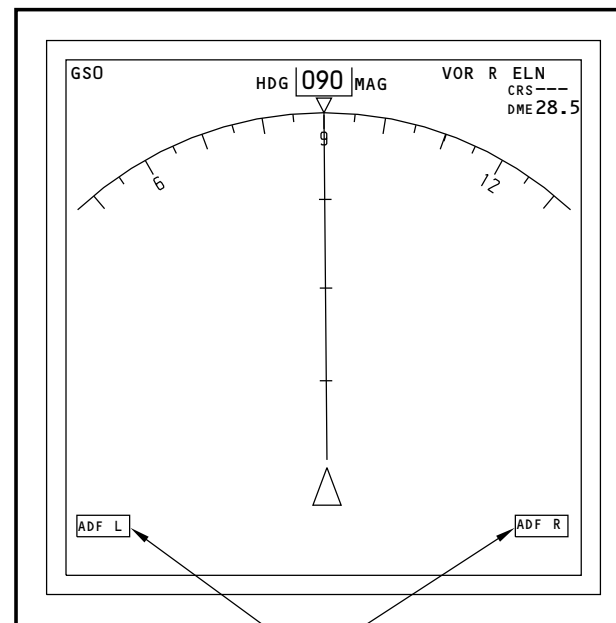
When you move the VOR/ADF switch on the EFIS control panel from the ADF position, these displays go out of view:

- ADF flags
- Source annunciation
- Frequency
- ADF pointers.



NCD:

REMOVE POINTERS AND SHOW SOURCE
ANNUNCIATION AND FREQUENCY.



INVALID:

REMOVE POINTERS, SOURCE ANNUNCIATION,
AND FREQUENCY OR IDENTIFIER AND SHOW
AMBER ADF FLAGS.

ADF FAIL
FLAGS

ADF SYSTEM - ND NCD AND INVALID DISPLAYS

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ADF SYSTEM - TEST DISPLAYS

Test

Use the maintenance access terminal (MAT) to do a test of the ADF receivers. To see the test displays, select APP, VOR, or MAP on the ND mode selector of the EFIS control panel. Set the VOR/ADF switch to ADF.

When you select test on the MAT, the receiver starts a test sequence. The test displays show on the ND.

From one to three seconds, these invalid displays show on the ND:

- Remove the ADF source annunciation
- Remove ADF frequency
- Remove ADF pointers
- Show the amber ADF flag.

From three to six seconds, these NCD displays show on the ND:

- Show source annunciation
- Show frequency.
- Remove ADF pointers
- Remove the amber flag.

From six seconds to the end of test, the ND shows the test display with the ADF pointer at 135 degrees in relation to the face of the ND until the end of test.

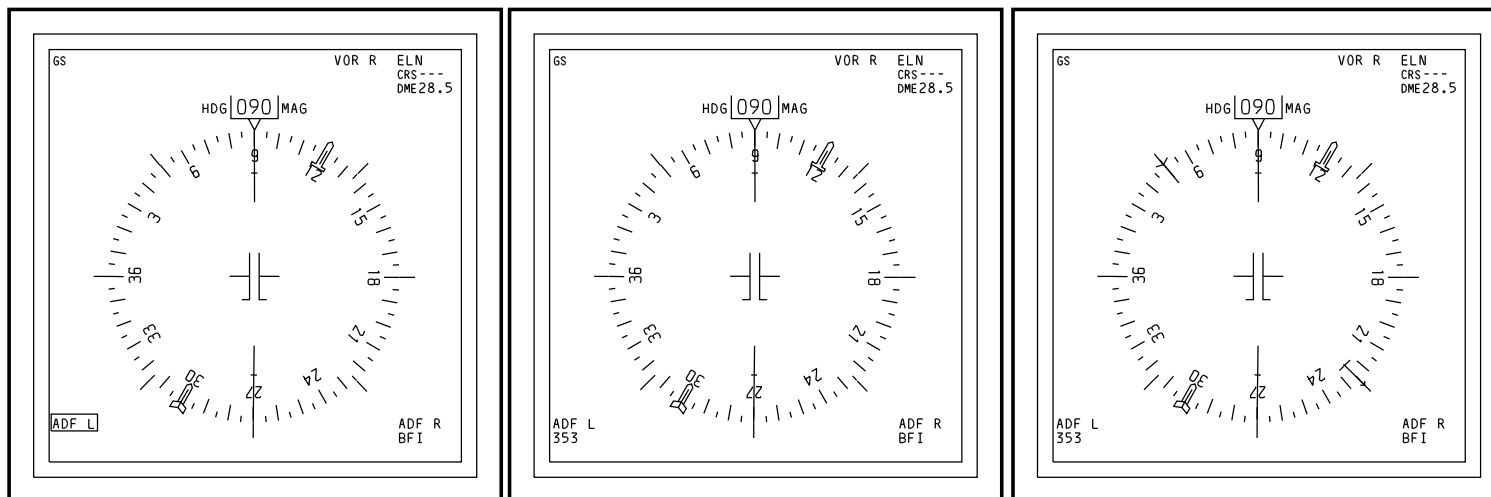
NOTE: The graphic shows a test of the left ADF receiver. The test is the same for the right ADF system.

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1 TO 3 SECONDS:

THE RECEIVER OUTPUT GOES INVALID, ALL ADF DATA GOES OUT OF VIEW, AND THE AMBER ADF FLAG SHOWS.

3 TO 6 SECONDS:

THE RECEIVER OUTPUT GOES TO NO COMPUTED DATA (NCD). THE FLAG GOES OUT OF VIEW, THE SOURCE ANNUNCIATION AND FREQUENCY SHOW AND THE ADF POINTERS STAY OUT OF VIEW.

FROM 6 SECONDS TO END OF TEST:

THE RECEIVER OUTPUT GOES VALID AND THE POINTERS GO TO THE TEST POSITION (APPROX. 135 DEGREES FROM THE CENTER LINE).

NOTE: THESE DISPLAYS ARE FOR THE LEFT ADF TEST.
THE RIGHT ADF TEST IS SIMILAR.

ADF SYSTEM - TEST DISPLAYS

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ADF SYSTEM - SELF TEST**General**

The TEST switch on the front panel of the ADF receiver starts a test of the ADF system. During the test, the receiver BITE circuits:

- Do a test for normal operation
- Do a check of the control input data status.

Operation**ARO 001-015**

Push any test switch on the front of the receiver to start a test of the ADF receiver. The receiver then does a check of the internal receiver operation and of its interfaces. The test results show on the LCD.

ARO 016-999

Push the test switch on the front of the receiver to start a test of the ADF receiver. The receiver then does a check of the internal receiver operation and of its interfaces. The test results show on the LEDs. The LEDs will show green if the status is good and red if an internal fault is detected.

ARO ALL**Training Information Point**

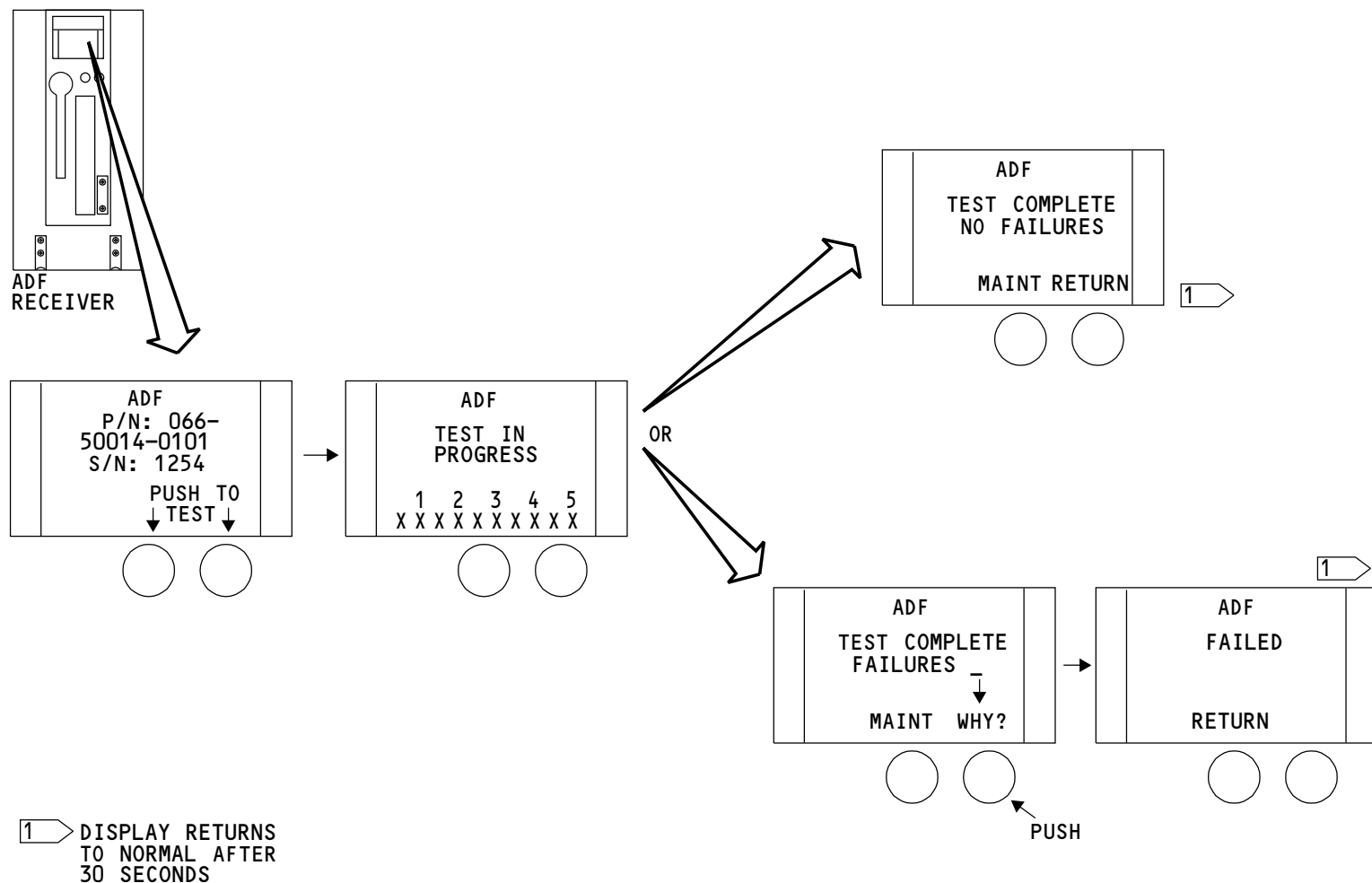
The maintenance manual and the fault isolation manual do not have a task for the line maintenance technician to do a test from the front panel of the ADF receiver. You must do all tests for the ADF receiver from the MAT or a PMAT.

Many LRUs on the 777 are compatible with other model airplanes that do not have a central maintenance computing system (CMCS). For that reason these LRUs have a front panel test feature.

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ADF SYSTEM - SELF TEST

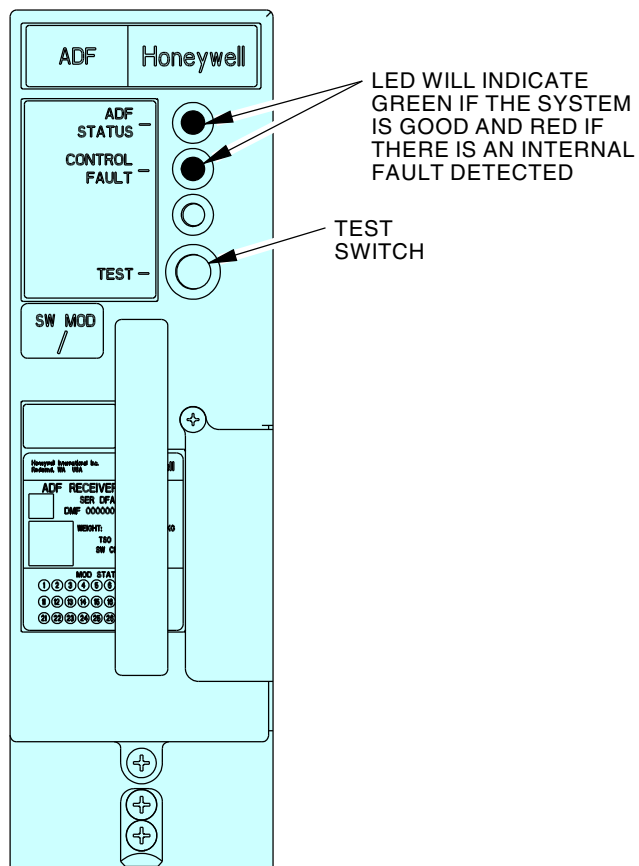
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ADF SYSTEM - ADF RECEIVER

ADF SYSTEM - SELF TEST

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**ADF SYSTEM - GROUND TEST****General**

You can do a test of the ADF system from the MAT. These are the tests that are available from the operational test selection on the MAT:

- Left ADF System
- Right ADF System.

Operational Test

The operational test for the ADF system makes sure the ADF receiver operates normally.

GROUND TESTS

SELECT ATA SYSTEM (55)

- 34 PARAVISUAL DISPLAY SYSTEM
- 34 WEATHER RADAR SYSTEM
- 34 TRAFFIC ALERT AND COLLISION WARNING SYSTEM
- 34 GROUND PROXIMITY WARNING SYSTEM
- 34 VOR / MARKER BEACON SYSTEM
- 34 AIR TRAFFIC CONTROL (ATC) MODE S SYSTEM
- 34 DISTANCE MEASURING EQUIPMENT SYSTEM
- 34 AUTOMATIC DIRECTION FINDER (ADF) SYSTEM
- 34 GLOBAL POSITIONING SYSTEM

SELECT TEST TYPE

SYSTEM TEST

OPERATIONAL TEST

DRY REPLENISHMENT TEST

SELECT OPERATIONAL TEST (2)

LEFT ADF SYSTEM

RIGHT ADF SYSTEM

CONTINUE

HELP

GO BACK

SELECT OPERATIONAL TEST

(2)

LEFT ADF SYSTEM
RIGHT ADF SYSTEM

ADF SYSTEM - GROUND TEST

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GLOBAL POSITIONING SYSTEM - INTRODUCTION

General

The global positioning system (GPS) uses navigation satellites to supply accurate airplane position to airplane systems and to the flight crew.

Abbreviations and Acronyms

- ADIRU - air data inertial reference unit
- AIMS - airplane information management system
- BITE - built-in-test equipment
- CDU - control display unit
- CMCS - central maintenance computing system
- D/A - digital-to-analog
- FMCF - flight management computing function
- GP - general purpose
- GPS - global positioning system

ARO 001-008 PRE SB 777-34-0232

- GPWC - ground proximity warning computer

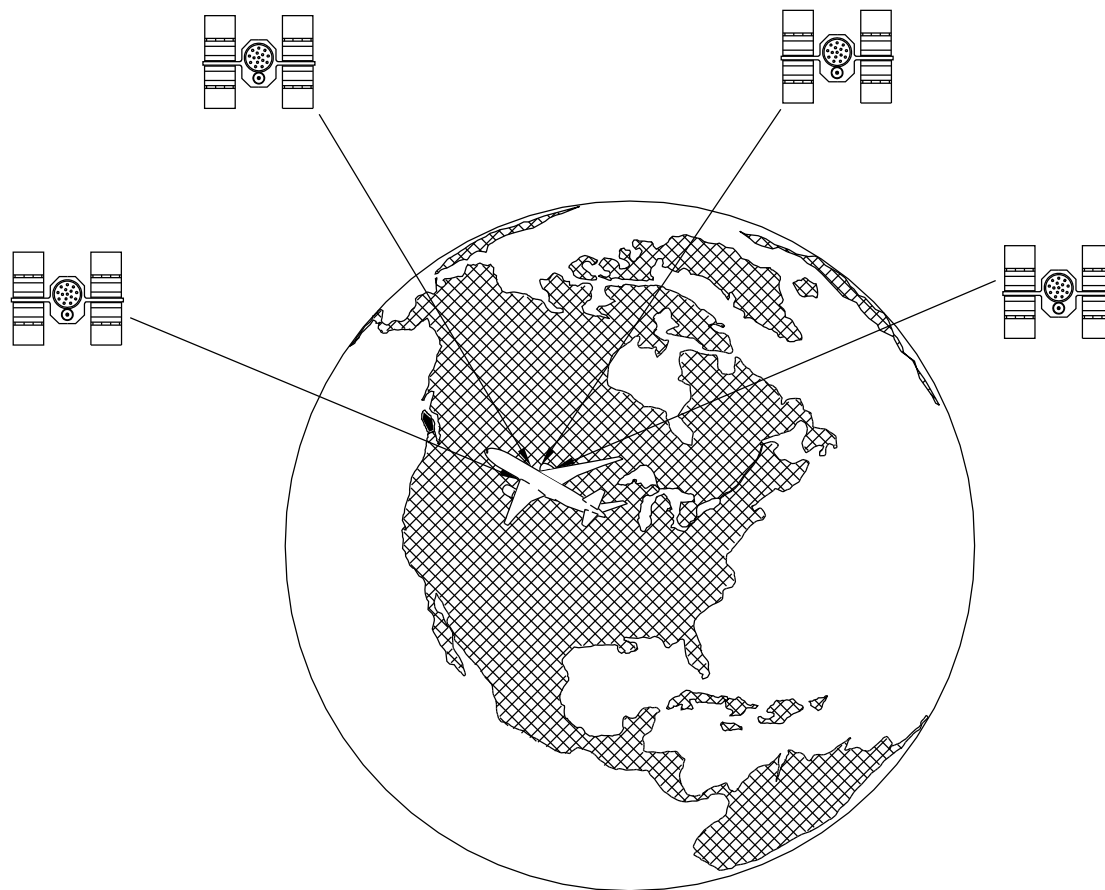
ARO ALL

- MAT - maintenance access terminal
- MMR - multi-mode receiver
- NCD - no computed data
- PPS - precision positioning service
- RAIM - receiver autonomous integrity monitor
- SPS - standard positioning service
- UTC - universal time (coordinated)

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GLOBAL POSITIONING SYSTEM - INTRODUCTION

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GPS - GENERAL DESCRIPTION

General

The global positioning system (GPS) calculates:

- Latitude
- Longitude
- Altitude
- Accurate time
- Ground speed.

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There are two GPS antennas. The MMRs send power to the antenna amplifier circuits. The left antenna receives satellite signals and sends them to the left multi-mode receiver (MMR). The right GPS antenna connects to the right MMR. The MMRs calculate the airplane position and accurate time. This data goes to the AIMS cabinets. The flight management computing function (FMC) in the AIMS uses GPS data to calculate the airplane position.

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There are two GPS antennas. The MMRs send power to the antenna amplifier circuits. The left antenna receives satellite signals and sends them to the left multi-mode receiver (MMR). The right GPS antenna connects to the right MMR. The MMRs calculate the airplane position and accurate time. This data goes to the AIMS cabinets and the ground proximity warning computer (GPWC). The flight management computing function (FMC) in the AIMS uses GPS data to calculate the airplane position.

ARO ALL

The AIMS cabinets send GPS data to the air data inertial reference unit (ADIRU). The ADIRU uses GPS data to calibrate its internal sensors. This decreases inertial reference drift.

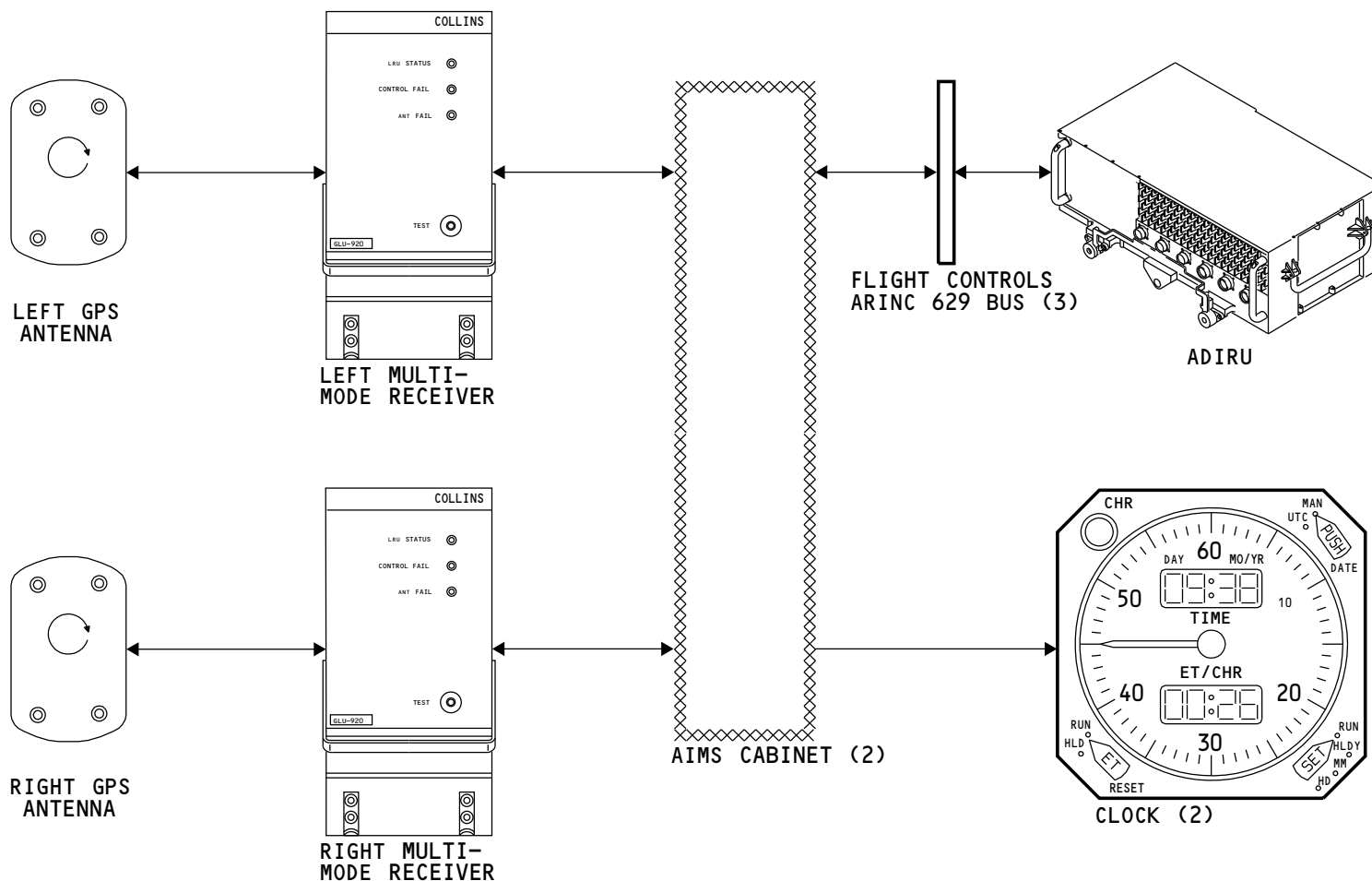
GPS time goes to the universal time coordinated function (UTC) in AIMS. GPS time goes to the clocks in the flight deck through the AIMS cabinets. The clocks can show GPS time.

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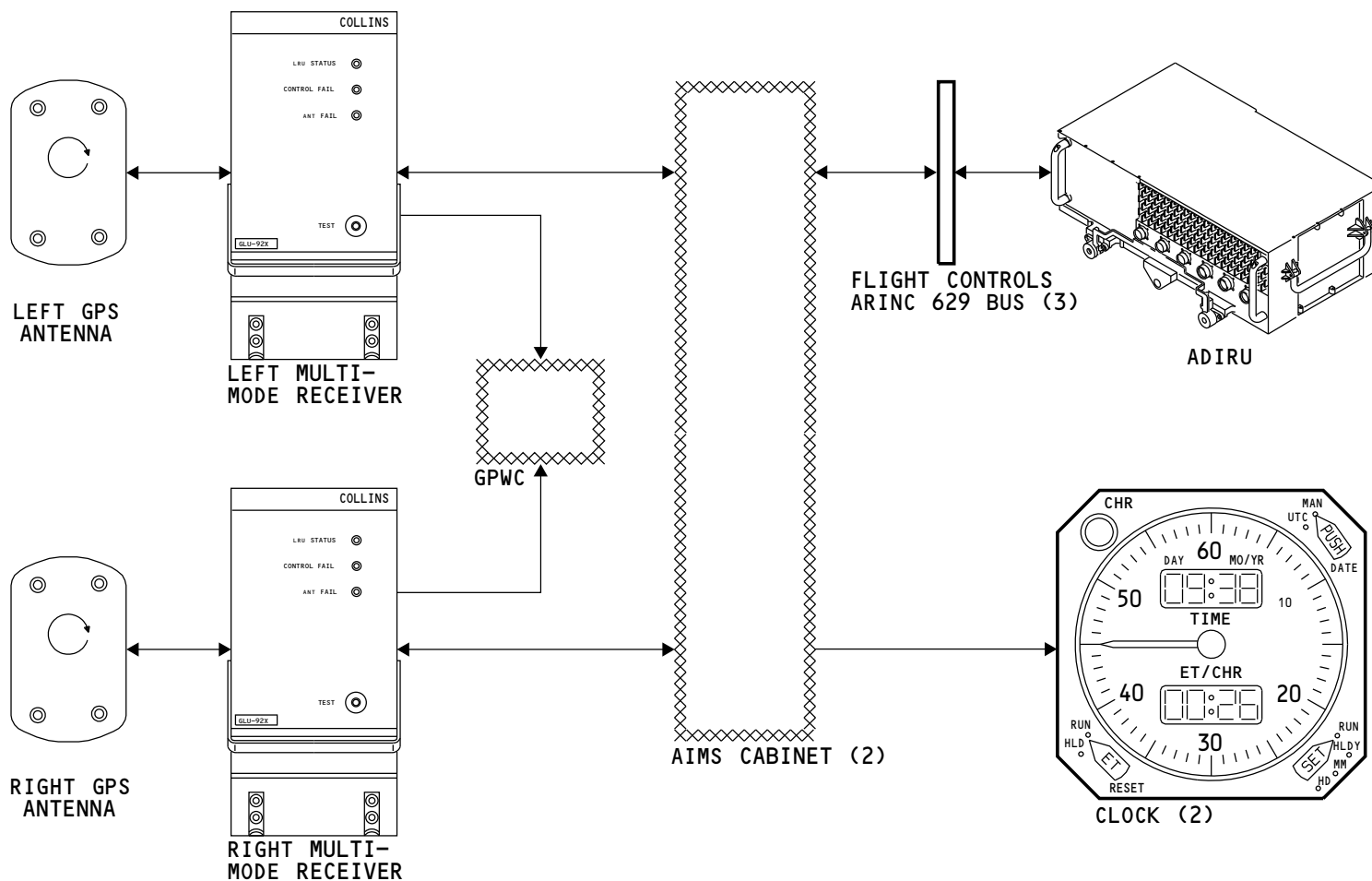
GPS - GENERAL DESCRIPTION

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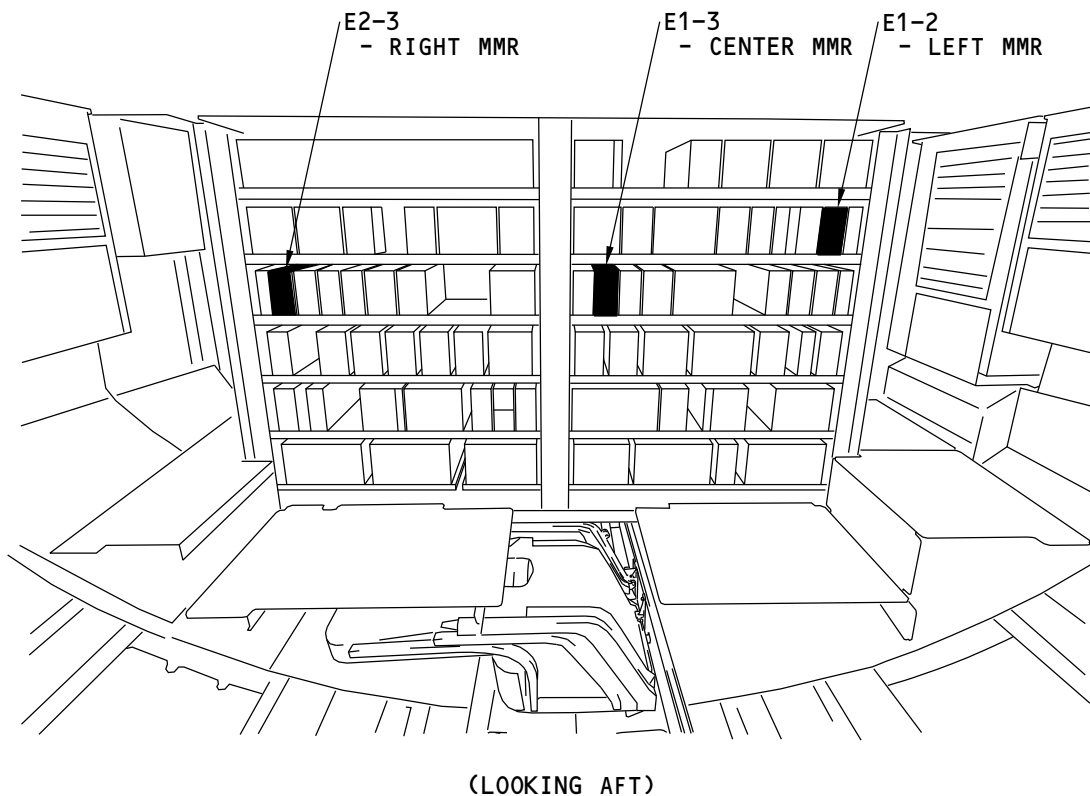


GPS - MAIN EQUIPMENT CENTER COMPONENT LOCATIONS

Equipment Center

The left MMR is on the E1-2 shelf. The center MMR is on the E1-3 shelf.
The right MMR is on the E2-3 shelf.

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GPS - MAIN EQUIPMENT CENTER COMPONENT LOCATIONS

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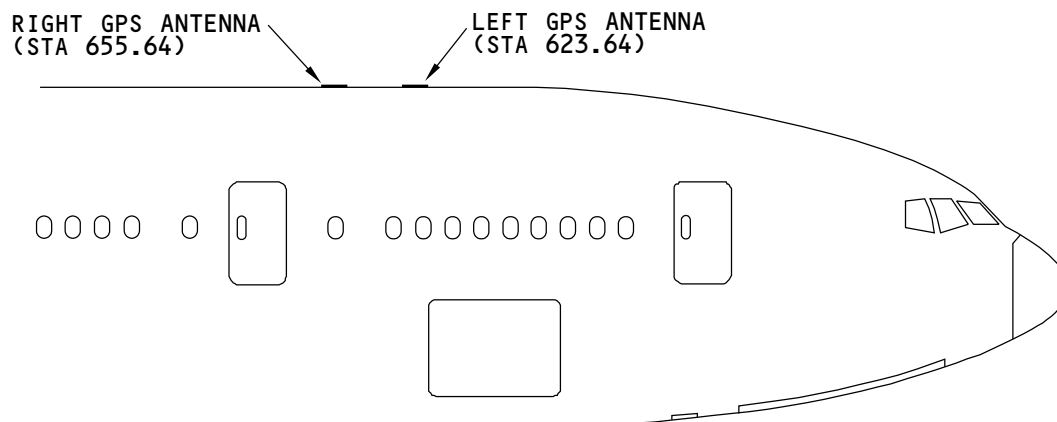


GPS - ANTENNA LOCATIONS

General

The GPS antennas are on the top of the fuselage.

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GPS - ANTENNA LOCATIONS

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GPS - INTERFACES

Power and Antenna Interface

Each multi-mode receiver (MMR) has a circuit breaker. The 115v ac standby and transfer buses supply power to the MMRs.

Each MMR sends 12v dc to its GPS antenna. The power goes through the center conductor of the coaxial cable to each antenna. Amplifiers in the antennas use the power to increase the strength of the received RF signals from the satellites.

Each MMR receives a radio frequency (RF) signal from its GPS antenna.

IRS Data Bus

The MMRs get inertial reference from the flight management computing function (FMCF) in each AIMS cabinet. The MMRs use this data for system initialization and to help system operation during periods of low satellite coverage.

Central Maintenance Data

The left and right MMRs receive central maintenance computing system (CMCS) data from the left AIMS cabinet. The CMCS data supplies airplane ID and flight leg information.

GPS Data Output Bus

The left and right MMRs send GPS data to both AIMS cabinets. The data is for:

- GPS position reports
- General GPS data reports
- Fault information reports.

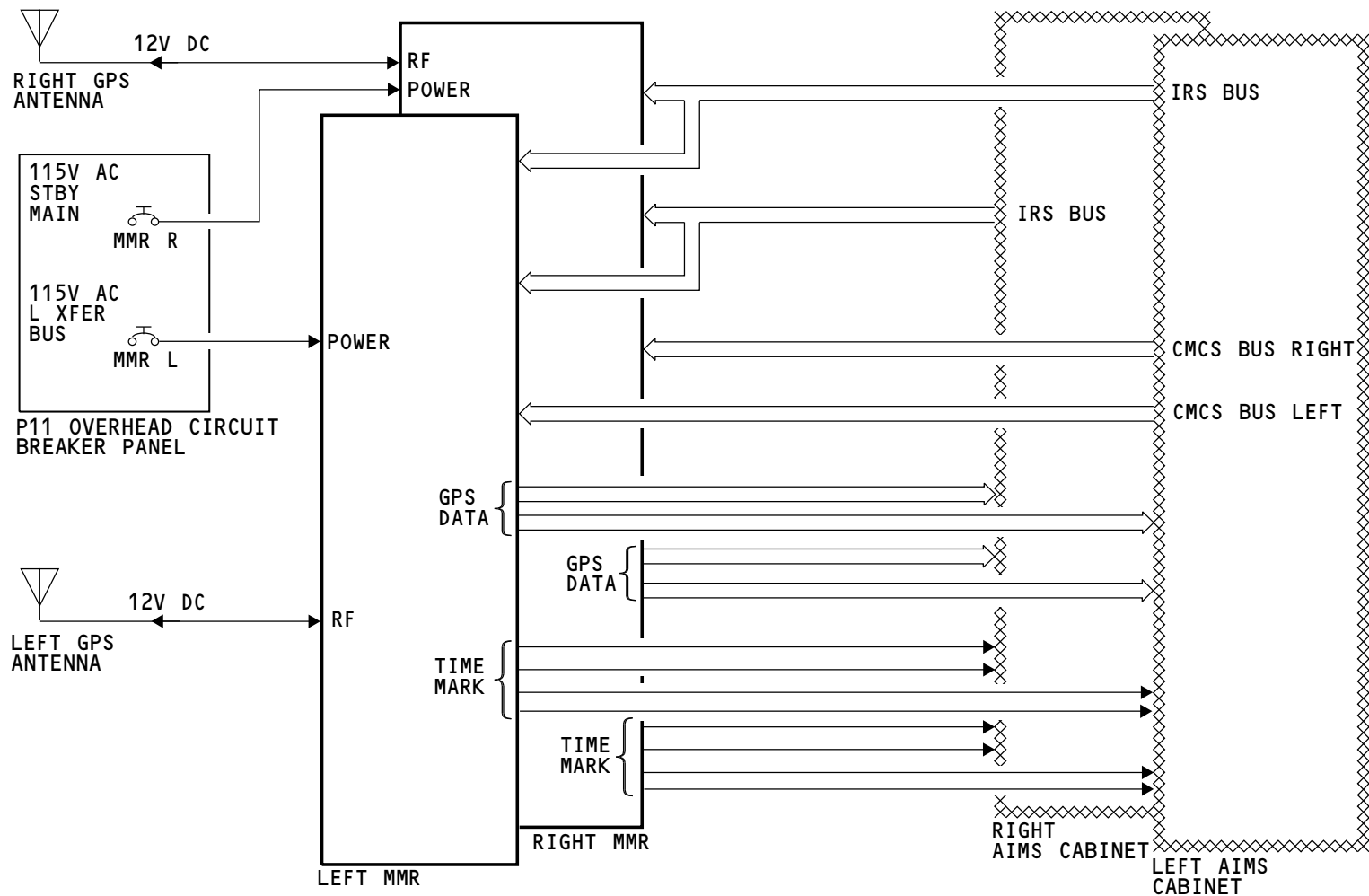
ARO 001-008 PRE SB 777-34-0232

The left and right MMRs also send position data to the ground proximity warning computer (GPWC). The GPWC uses this data in its terrain awareness and terrain clearance floor functions.

ARO ALL

Time Mark

The left and right MMRs supply time mark pulses to each AIMS cabinet. The pulses occur once per second and have an amplitude of approximately four volts. These pulses are the same as accurate universal time (coordinated) (UTC).



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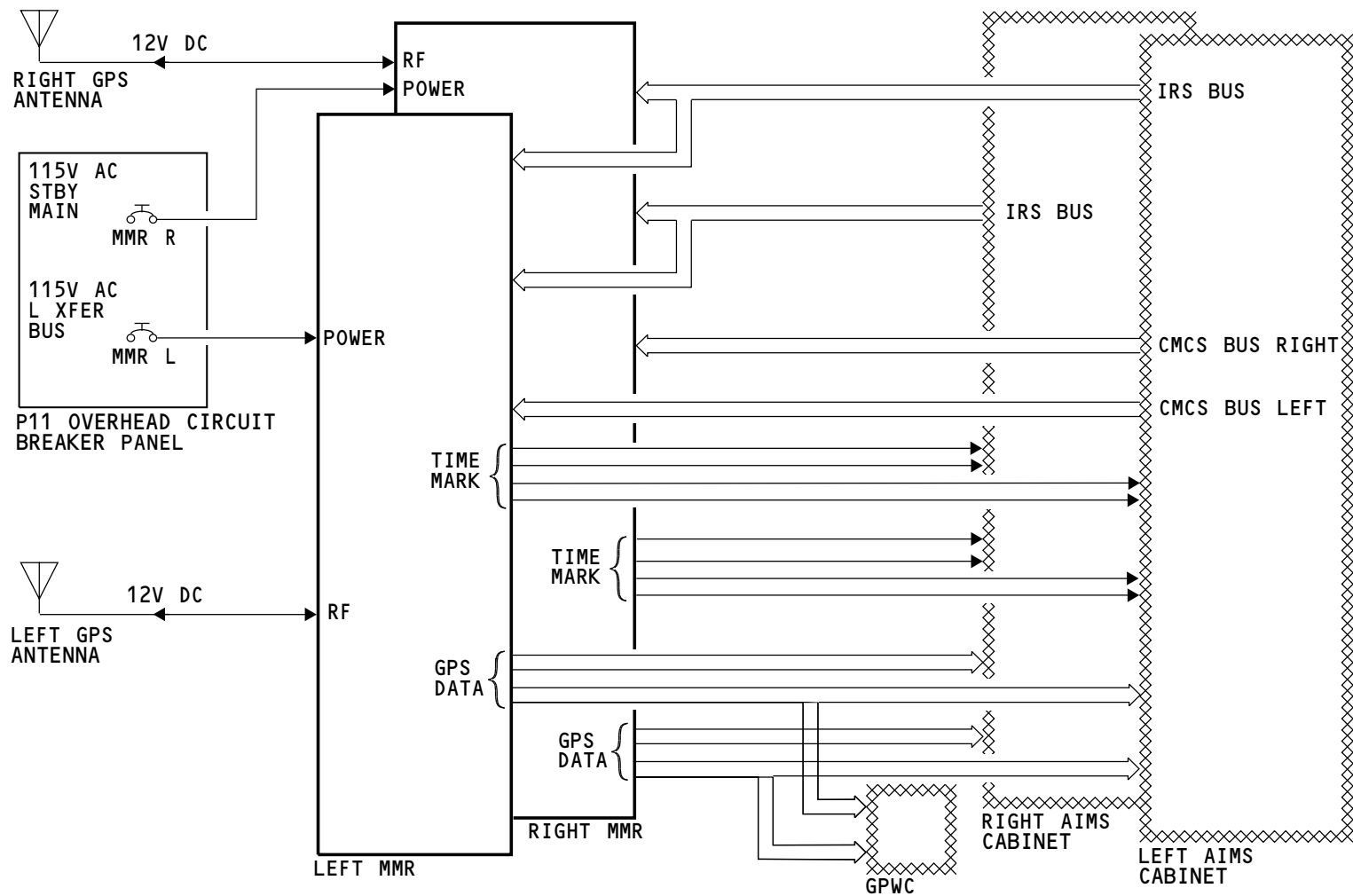
GPS - INTERFACES

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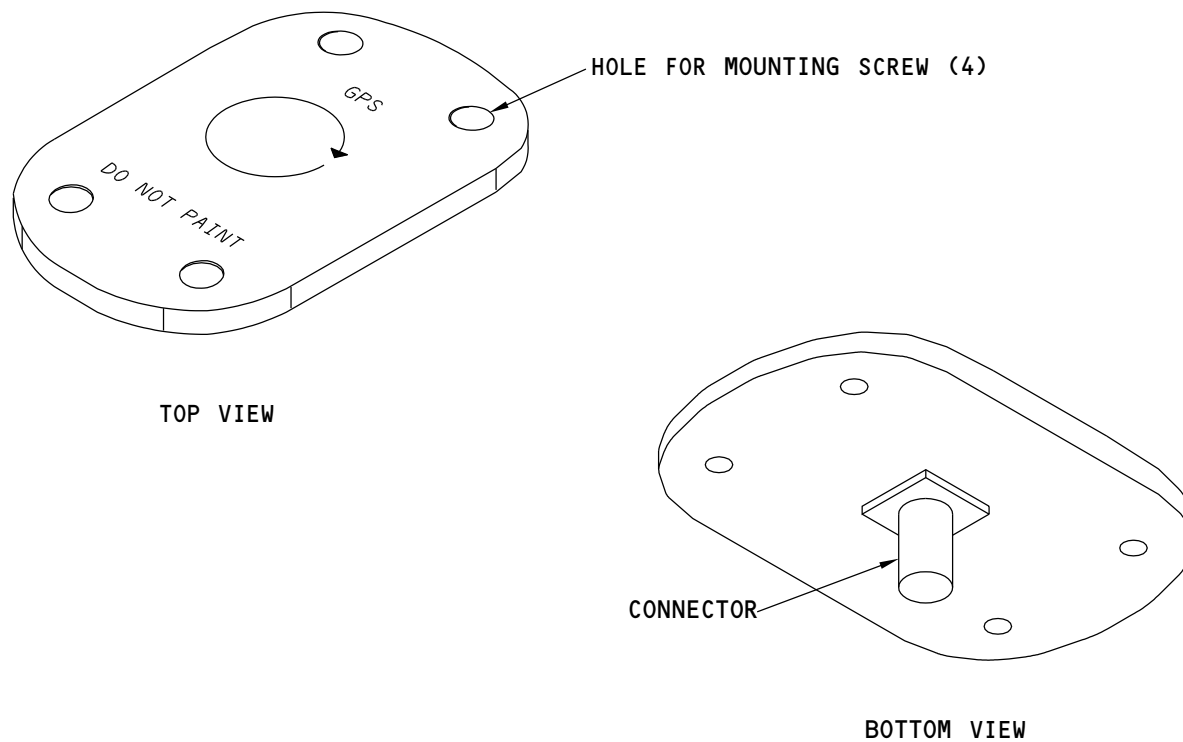
GPS - GPS ANTENNA

General

The GPS antennas receive L-band frequency signals and send them to the multi-mode receivers (MMRs).

The GPS antenna impedance is 50 ohms.

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GPS - GPS ANTENNA

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GPS - THEORY OF OPERATION - 1

GPS Segments

The GPS has three segments:

- Satellite
- User
- Control.

Satellite Segment

The satellite segment is a group of satellites that orbit approximately 10,900 nautical miles above the earth. Each satellite completes an orbit approximately once every 12 hours. There are 21 operational satellites and 3 spares.

The satellites continuously transmit radio signals with navigation data, range code, and the exact time.

User Segment

The user segment is the multi-mode receiver (MMR) on the airplane. It receives the satellite signals. The MMR uses the satellite data to calculate the airplane position.

Control Segment

The control segment has control and monitor stations on earth that continuously monitor and track the satellites. The purpose of the control segment is to:

- Monitor and correct satellite orbits and clocks
- Calculate and format a satellite navigation message. This message has up-to-date descriptions of the satellites future positions, and a collection of the latest data on all GPS satellites
- Update the satellite navigation message regularly.

The control segment has one master control station and five monitor stations. Three of the monitor stations are also upload stations.

The master control station is in Colorado Springs, Colorado USA. The master control station is the operational center of the GPS. The master control station controls all operations in the control segment. The master control station has an atomic clock. This clock is the reference for the GPS.

The monitor stations track the satellites 24 hours a day. The master control station remotely controls the monitor stations through on-line connections. The monitor stations are in these locations:

- Ascension island
- Colorado Springs, Colorado USA
- Diego Garcia island
- Hawaii
- Kawajalein island.

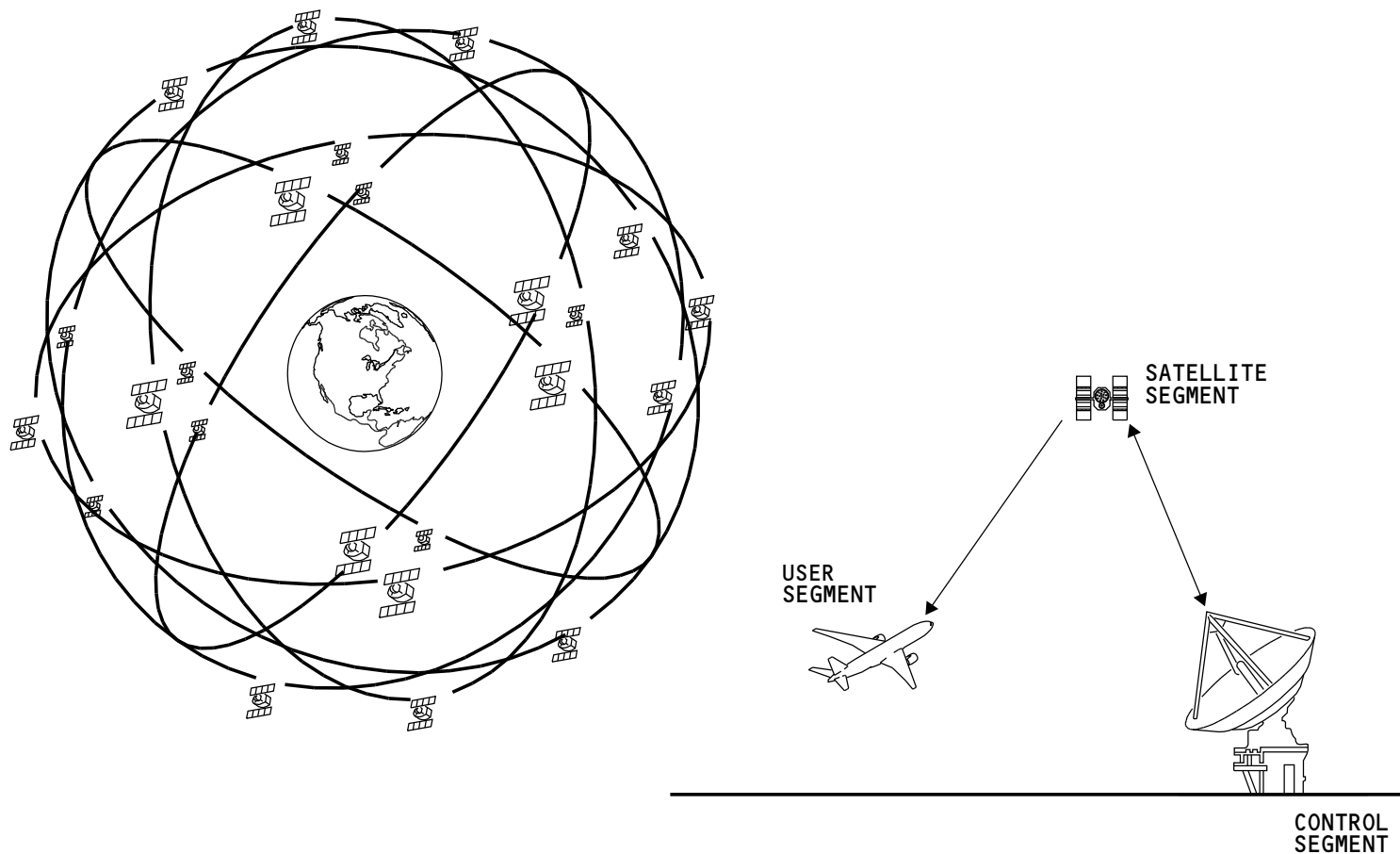
The monitor stations receive the same information from the satellites that the MMRs in the airplane receive. The monitor stations:

- Record the accuracy of the satellite clocks
- Collect and relay to the control station meteorologic data such as barometric pressure, temperature, and dew point. The master control station uses this data to calculate the tropospheric signal delay
- Continuously measure the ranges to all visible satellites. The master control station uses this data to calculate and predict the satellites orbits.

The master control station uses the upload stations to send:

- Orbit correction commands to the satellites. The satellites use control rockets to correct their orbits
- The navigation message to the satellites.

The upload stations are in Ascension island, Diego Garcia island, and Kawajalein island.



GPS - THEORY OF OPERATION - 1

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GPS - THEORY OF OPERATION - 2

Ranging

The multi-mode receivers (MMRs) use the principle of ranging to measure the distance between the MMR on the airplane and the satellites. The MMR has in memory the location of the satellites in their orbits at any time. It is possible for the MMR to know the position of each satellite because they follow a known orbit.

The MMR measures the time it takes for a radio signal to go from a satellite to the airplane. Since the MMR knows the location of the satellite and that the radio signal travels at the speed of light, it can calculate the distance to the satellite.

However, since this is a one-way range measurement, the MMR must know exactly at what time the satellite sent the radio signal. The MMR compares the satellite signal to a signal that the MMR makes at the same time as the satellite. The difference between the two signals (time bias) is the time the satellite signal took to get to the MMR.

Each satellite has atomic clocks to keep accurate time. All the satellites have precisely the same time. The MMR in the airplane has an internal clock but it is not atomic, so it is not as accurate. Thus, it is not possible for the MMR to have precisely the same time as the satellite.

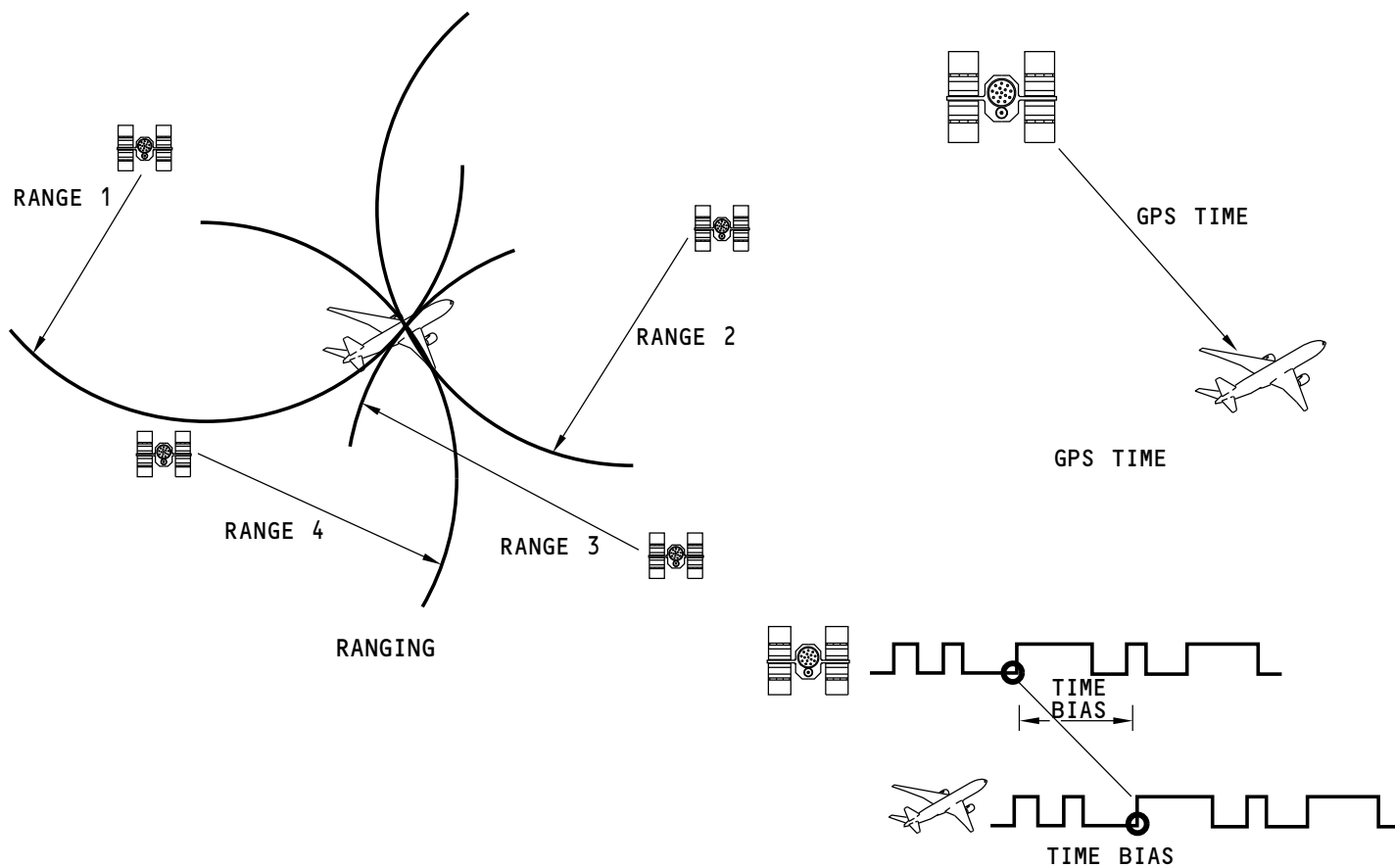
The MMR assumes that its internal clock is off by some clock bias. This clock bias is an unknown that the MMR must calculate. The clock bias is the difference between the MMR time and GPS time.

To calculate the airplane position (latitude, longitude, and altitude) and the clock bias, the MMR must know the position of at least four satellites. The MMR then measures the distances to all the satellites at the same time, and solves for these four unknowns with four range equations:

- Latitude
- Longitude
- Altitude
- Clock bias.

GPS Time

All the satellites synchronize to universal time (coordinated) (UTC). The satellites transmit this time to the MMR. The accuracy of the satellite UTC is approximately 100 nanoseconds. The MMR transmits UTC on an ARINC 429 format. The MMR also transmits a very accurate time mark once per second.



GPS - THEORY OF OPERATION - 2

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GPS - THEORY OF OPERATION - 3

GPS Modes of Operation

The multi-mode receiver (MMR) operates in these modes:

- Acquisition mode
- Navigation mode
- Altitude aided mode
- Aided mode.

Acquisition Mode

The MMR looks for and locks on to the satellite signals. The MMR must find at least 4 satellites before it starts to calculate GPS data. The MMR accepts this data from the flight management computing function (FMC) in the AIMS when the MMR is in the acquisition mode:

- Position
- Velocity
- Time
- Date.

The MMR uses the FMC data to calculate which satellites are available at the present airplane position. This helps the MMR get the signals from those satellites available.

If the AIMS data is not available, the MMR can still acquire satellites signals. However, the MMR takes longer to acquire the satellite signals because it has to look for all the satellites. When the MMR finds the satellites, it calculates which it can use.

The MMR takes approximately 75 seconds to acquire the satellite signals when the AIMS data is available. The MMR takes approximately 4 minutes (maximum of 10 minutes) to acquire the satellites when the AIMS data is not available.

Navigation Mode

The MMR enters the navigation mode after it acquires and locks on to at least 4 satellites. When the MMR is in the navigation mode, it computes GPS data. The MMR output goes NCD (no computed data) when the accuracy is not within 16 nautical miles of the actual position.

Altitude Aided Mode

With four satellites available, the MMR stores the difference between the ADIRU inertial altitude and the GPS altitude.

The MMR stores the difference between inertial and GPS altitude so that it can estimate the GPS altitude when only three satellites are available.

In the altitude aided mode, the MMR uses the airplane altitude from the ADIRU and the length of the earth radius as the fourth range.

The MMR enters the altitude aided mode only after these three conditions are true:

- The MMR was in the navigation mode
- There are only 3 satellites available with good geometry for position fixes
- The MMR stored the difference between inertial and GPS altitude in memory.

The MMR starts normal operation again when a fourth satellite comes into view.

Aided Mode

The MMR enters the aided mode during short periods (less than 30 seconds) of bad satellite coverage. An example of bad satellite coverage is poor satellite geometry, where at least four satellites are available but they are not spread out far enough so the MMR can make an accurate position fix.



GPS - THEORY OF OPERATION - 3

In the aided mode, the MMR receives altitude, heading, and speed from the flight management computing function (FMC) of the AIMS. The MMR uses the FMC data to go back quickly to the navigation mode when there is good satellite coverage again. The MMR output is NCD in this mode.

- MMR status.

GPS Frequencies

The satellites transmit to the MMR in the airplane on the L1 (1575.42 MHz) and L2 (1227.6 MHz) frequencies. The satellites downlink satellite status data to the monitor stations on 1783.74 MHz.

The upload stations send information to the satellites on 2227.5 MHz.

Autonomous Integrity Limit

The MMR has a receiver autonomous integrity monitor (RAIM) function. The RAIM monitors the status of the satellites that the MMR uses for calculations. The output of the RAIM function is an estimate of the GPS position error. The autonomous integrity monitor value goes to the flight management computing function (FMC) of the AIMS. The FMC uses the autonomous integrity monitor to determine if it can use GPS data for navigation.

Values Calculated by the MMR

These are some of the values that the MMR calculates:

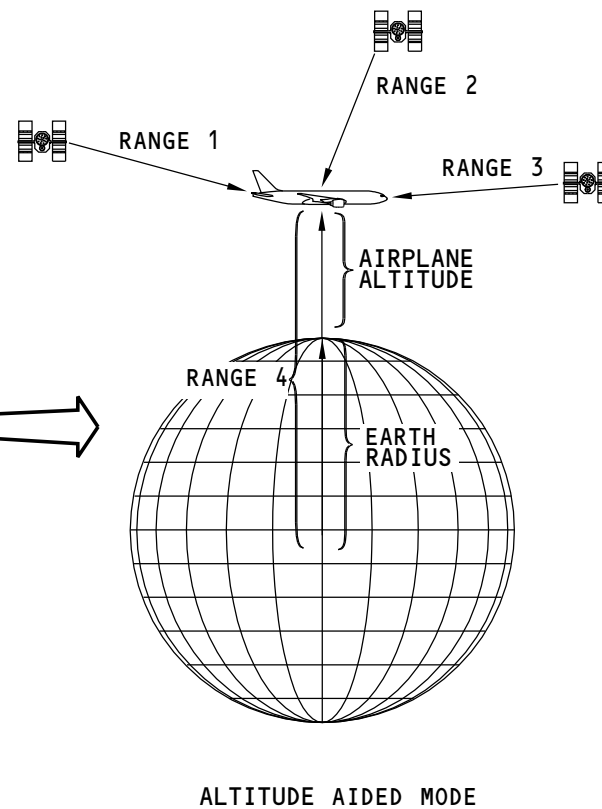
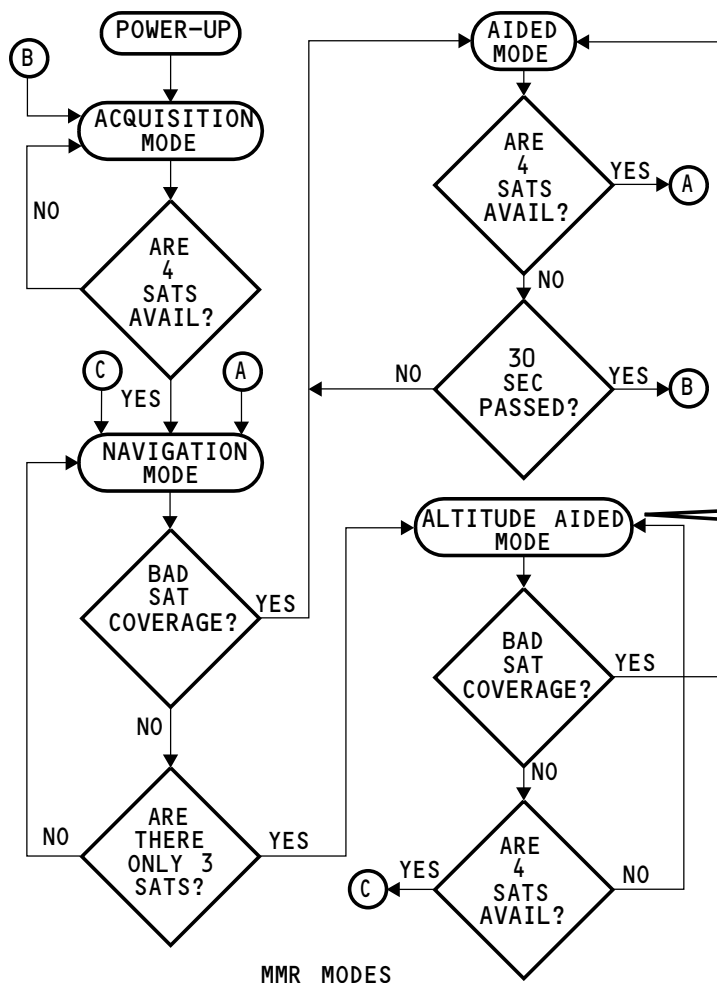
- Latitude
- Longitude
- Altitude
- Universal time (coordinated) (UTC)
- Date
- North/south velocity
- East/west velocity
- Vertical velocity
- Track angle
- Autonomous integrity limit
- Satellite position

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GPS - THEORY OF OPERATION - 3

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GPS - FUNCTIONAL DESCRIPTION

Power

The power supply makes various AC voltages from the 115V AC input to the multi-mode receiver (MMR). The MMR sends 12v dc on the center conductor of the antenna coax to the amplifier in the GPS antenna.

Satellite Signal Processing

The low noise amplifier (LNA) receives and amplifies the satellite signals from the GPS antenna. The receiver detects the satellite signal and sends it to a digital-to-analog converter (D/A). The D/A sends the digitized signal to the microprocessor. The microprocessor calculates the airplane position and other GPS data. The GPS data goes to the flight management computing function (FMCF) in the left and right AIMS cabinets.

The MMR makes time mark pulses once per second. The time mark pulses goes to the AIMS cabinets.

Inputs

The AIMS cabinets use inertial reference data from the FMCF in the left and right AIMS cabinets during initialization. The MMR also uses this data in the aided and altitude aided modes.

The left MMR receives test and fault report requests on the central maintenance computing system (CMCS) bus from the left AIMS cabinet. Built-in-test equipment (BITE) circuits test and report faults to the AIMS cabinets.

Outputs

The left and right MMRs send position and time mark data to the left and right AIMS cabinets.

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The GPSSUs also send position data to the ground proximity warning computer (GPWC). The GPWC uses this data in its terrain awareness and terrain clearance floor functions.

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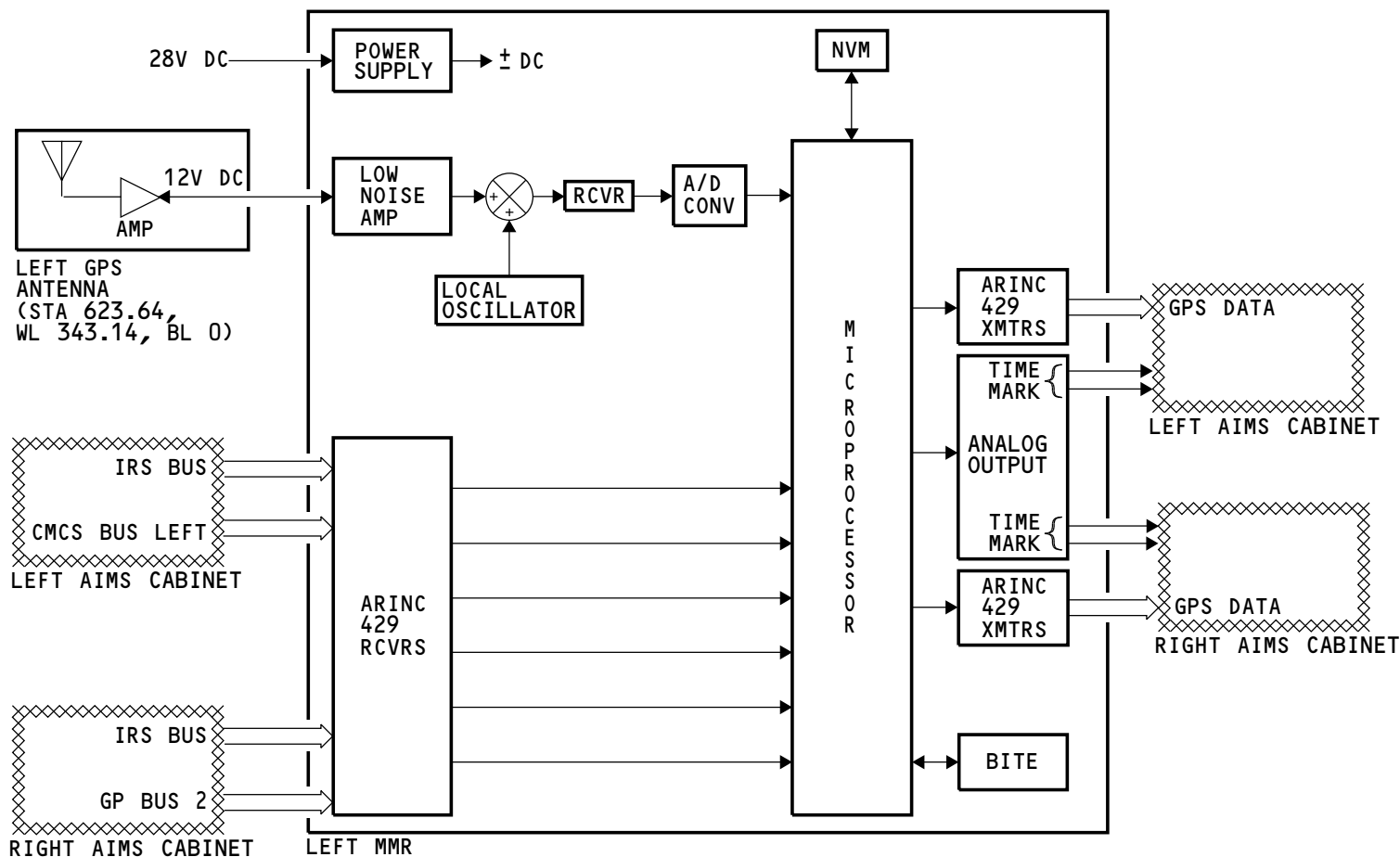
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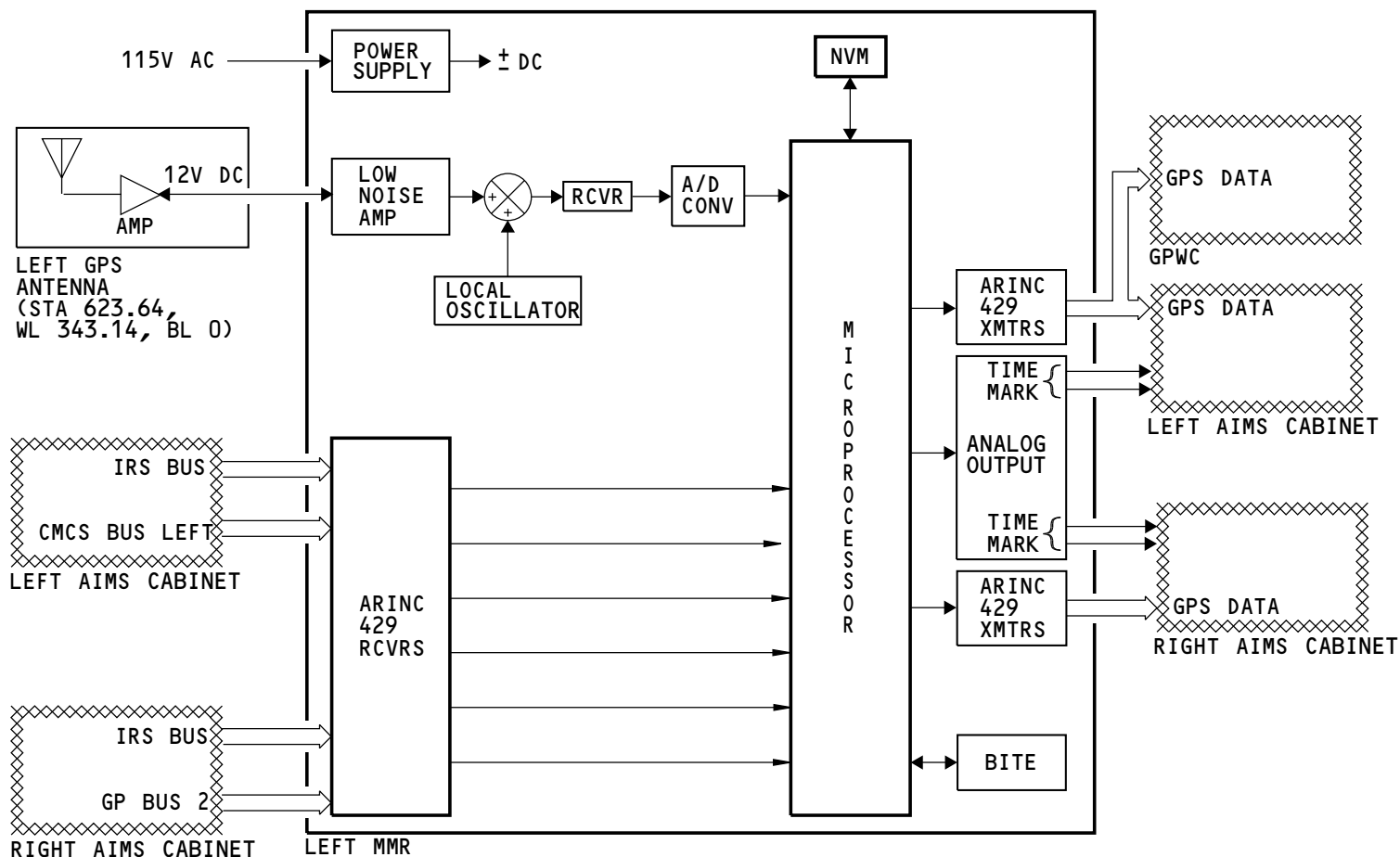
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NOTE: LEFT MMR IS SHOWN. RIGHT MMR IS SIMILAR.

GPS - FUNCTIONAL DESCRIPTION

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NOTE: LEFT MMR IS SHOWN. RIGHT MMR IS SIMILAR.

GPS - FUNCTIONAL DESCRIPTION

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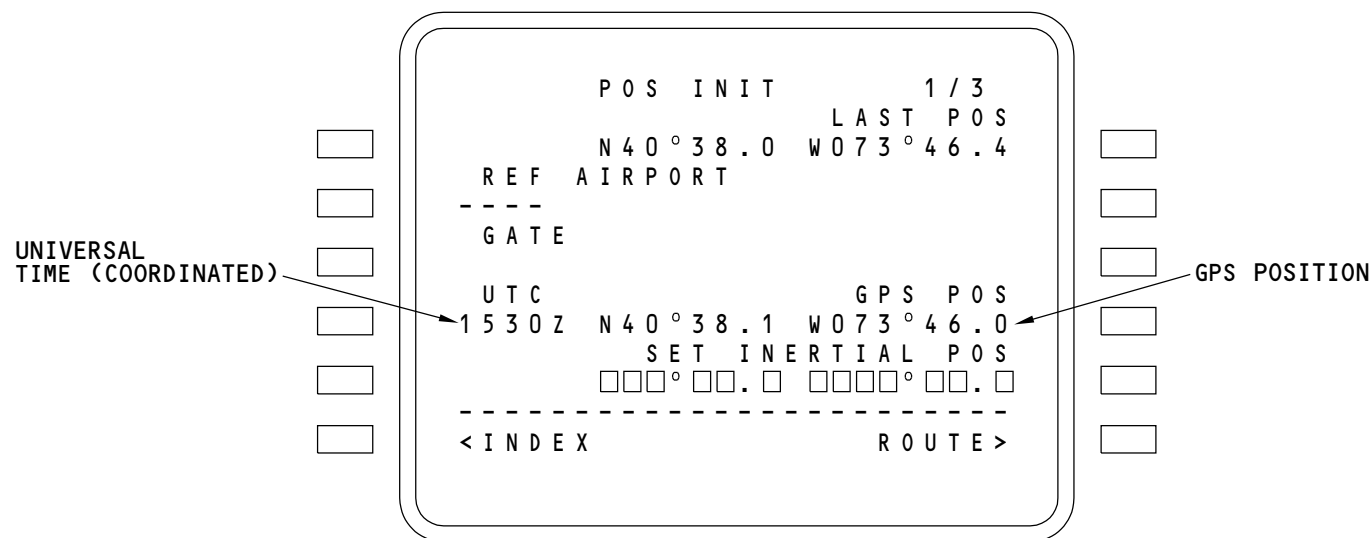
**GPS - DISPLAYS - 1****General**

The flight management computing function (FMCF) of the AIMS shows position initialization and position reference pages on the control display unit (CDU).

The multi-mode receivers (MMRs) send GPS data to the AIMS cabinets. GPS data shows on the CDU. The position initialization page shows the GPS position and GPS time.

The flight crew can use the GPS position to initialize the air data inertial reference unit (ADIRU) position.

The GPS universal time (coordinated) (UTC) shows on the CDU when the GPS time is valid.



POSITION INITIALIZATION PAGE

GPS - DISPLAYS - 1

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GPS - DISPLAYS - 2

General

Position reference page two shows the active flight management computing function (FMCF) airplane position.

The FMCF can use GPS position data to calculate the airplane position. The FMCF also uses these other navigation aids to calculate the airplane position:

- Air data inertial reference unit (ADIRU)
- Distance measuring equipment (DME)
- Very high frequency omnidirectional ranging (VOR)
- Localizer (LOC).

The FMCF calculates the accuracy of the data from each navigation aid. These calculations show as ACTUAL next to each navigation aid on POS REF page 2 of 3. Accuracy shows in nautical miles.

Use line select keys (LSK) 2R-4R to make the active FMCF use the selected data to update the FMCF position.

The left FMCF uses the left multi-mode receiver (MMR), and the right FMCF uses the right MMR. If the onside MMR fails, the FMCFs use the offside MMR.

Use line select key 6R to see the position reference in bearing/distance format or in latitude/longitude format.

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ACTIVE FMC
POSITION

POS REF		2 / 3
FMC (GPS)	UPDATE	
N40°38.0 W073°46.4	ARMED	
INERTIAL	ACTUAL 0.46NM	
N40°38.0 W073°46.1	NOW>	
GPS	ACTUAL 0.01NM	
N40°38.1 W073°46.4	NOW>	
RADIO	ACTUAL 0.25NM	
N40°38.8 W073°45.5	NOW>	
RNP / ACTUAL	DME DME	
1.00 / 0.46NM	IPDX SEA	

<INDEX	BRG / DIST>	

GPS
POSITION

POS REF		2 / 3
FMC (GPS)	UPDATE	
N40°38.0 W073°46.0	ARMED	
INERTIAL		
000° / 0.0NM		
GPS		
000° / 0.0NM		
RADIO		
000° / 0.2NM		
RNP / ACTUAL	GPS NAV	
1.00 / 0.46NM	OFF<->ON>	

<INDEX	LAT / LON>	

POSITION REFERENCE PAGE 2

GPS - DISPLAYS - 2

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**GPS - DISPLAYS - 3****General**

Position reference page three shows this information:

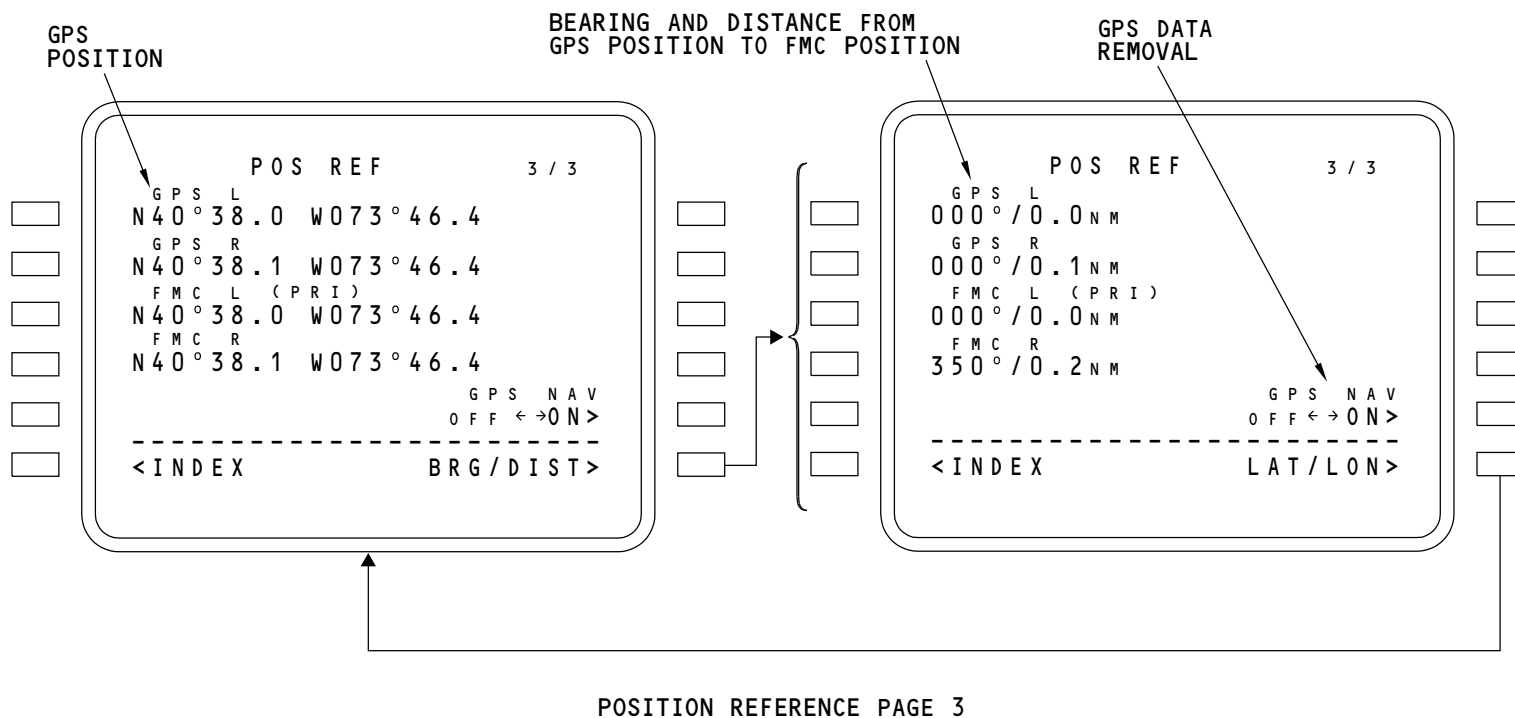
- GPS position
- Bearing and distance to the FMCF airplane position from the GPS position.

GPS Data Elimination

You can remove GPS data from the FMCF position calculation:

- Select line select key (LSK) 5R when ON shows in larger letters to remove GPS data from the FMCF calculation
- Select LSK 5R when OFF shows in larger letters to let the FMCF use GPS data.

Push LSK 6R to see the FMCF airplane position as bearing/distance or latitude/longitude.



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GPS - DISPLAYS - 3

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GPS - GROUND TEST

General

There are only system tests available for the GPS. These are the system tests available:

- Left global positioning system
- Right global positioning system.

System Test

This test lets you verify the operation of the GPS function of the multi-mode receivers (MMRs).

Training Information Point

The MMRs report their operational status to the central maintenance computing system (CMCS) at all times during operation after power-up. The MMRs do not do any additional test when you do a test from the maintenance access terminal (MAT).

During power-up, the MMRs do a test of the antennas. At that time, the MMRs verify continuity on the antenna connections. The MMRs do not do a test of the antennas during operation after power-up.

GROUND TESTS

SELECT ATA SYSTEM

34 GROUND PROXIMITY WARNING SYSTEM
34 VOR / MARKER BEACON SYSTEM
34 AIR TRAFFIC CONTROL (ATC) MODE S SYSTEM
34 DISTANCE MEASURING EQUIPMENT
34 AUTOMATIC DIRECTION FINDER (ADF) SYSTEM
34 GLOBAL POSITIONING SYSTEM
34 AIMS - FLIGHT MANAGEMENT COMPUTING SYSTEM
34 AIR SUPPLY CONTROL SYSTEM
34 AIMS - CENTRAL MAINTENANCE COMPUTING SYSTEM

SELECT TEST TYPE

(55)

SYSTEM
TEST

SELECT SYSTEM TEST

(2)

LEFT GLOBAL POSITIONING SYSTEM

RIGHT GLOBAL POSITIONING SYSTEM

CONTINUE

HELP

GO BACK

SELECT SYSTEM TEST

(2)

LEFT GLOBAL POSITIONING SYSTEM
RIGHT GLOBAL POSITIONING SYSTEM

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GPS - GROUND TEST

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FLIGHT MANAGEMENT COMPUTING SYSTEM - INTRODUCTION

General

The purpose of the FMCS is to supply these functions:

- Flight plan control data
- Navigation calculations
- Display information.

The flight crew can use the FMCS data to manually or automatically fly the airplane.

Abbreviations and Acronyms

- A - at or above an altitude
- A - antenna (mode for ADF)
- A - automatic (radio tuning mode)
- ABM - abeam
- ACIPS - airfoil and cowl ice protection system
- ACMF - airplane condition monitoring function
- act - active
- A/T - autothrottle
- ADIRS - air data inertial reference system
- AFDC - autopilot flight director computer
- AFDS - autopilot flight director system
- AIMS - airplane information management system
- alt - altitude
- ALTN - alternate
- ALTN NAV - alternate navigation
- AMI - airline modifiable information
- AMU - audio management unit
- appr - approach
- ARINC - Aeronautical Radio, Incorporated
- arr - arrival

- ASCPC - air supply cabin pressure controller
- ASG - ARINC signal gateway
- ATA - actual time of arrival
- ATN - aeronautical telecommunication network
- avail - available
- B - at or below an altitude
- B/A - bank angle
- B/C - back course
- BFO - beat frequency oscillator
- BPCU - bus power control unit
- brg - bearing
- C - center
- C - celsius
- CAM - crew alertness monitor
- CAS - computed airspeed
- CDU - control display unit
- clb - climb
- clr - clear
- CMCF - central maintenance computing function
- cmd - command
- co - company
- con - continuous
- CPM - core processor module
- crs - course
- crz - cruise
- CTC - cabin temperature controller
- ctr - center
- D - derated
- DCMF - data communication management function
- DCGF - data conversion gateway function

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FLIGHT MANAGEMENT COMPUTING SYSTEM - INTRODUCTION

- DD - drift down
- DFDAF - digital flight data acquisition function
- del - delete
- dep - departure
- des - descent
- dest - destination
- dev - deviation
- dist - distance
- dspl - display
- DTG - distance to go
- DME - distance measuring equipment
- DSP - display select panel
- DSP - display switching panel
- E - east
- E/O - engine out
- econ - economy
- E/D - end of descent
- EDIU - engine data interface unit
- EEC - electronic engine control
- EFC - expect further clearance
- ELMS - electrical load management system
- eng - engine
- ETA - estimated time of arrival
- ETE - estimated time enroute
- exec - execute
- F - Fahrenheit
- FDCF - flight deck communication function
- FF - fuel flow
- FL - flight level
- FLCH - flight level change
- flt - flight
- FMA - flight mode annunciation
- FMCF - flight management computing function
- FMCS - flight management computing system
- FMF - flight management function
- FPA - flight path angle
- FQPU - fuel quantity processor unit
- FSEU - flap slat electronics unit
- FW - failure warning
- fwd - forward
- G/A - go around
- GBST - ground based software tool
- GPSSU - global positioning system sensor unit
- GPS - global positioning system
- GPWC - ground proximity warning computer
- GRWT - gross weight
- H - hot
- hdg - heading
- ht - heat
- HFOM - horizontal figure of merit
- ICAO - International Civil Aviation Organization
- ICB - intercabin bus
- ident - identification
- IEI - imbedded element identifier
- IMI - imbedded message identifier
- inbd - inboard
- info - information
- INIT/REF - initialization reference
- intcp - intercept
- ISA - international standard atmosphere

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FLIGHT MANAGEMENT COMPUTING SYSTEM - INTRODUCTION

- ISSP - instrument source select panel
- KTS - nautical miles per hour (knots)
- L - left
- lat - latitude
- LED - light emitting diode
- LF - left front
- lim - limit
- LNAV - lateral navigation
- lo - low
- long - longitude
- LRC - long range cruise
- max - maximum
- MCP - mode control panel
- MFD - multi-function display
- MLS - microwave landing system
- MMR - multi-mode receiver
- mod - modification
- msg - message
- m - meters
- N - north
- N1 - low pressure rotor speed
- N2 - high pressure rotor speed
- nav - navigation
- NAV RAD - navigation radio
- NCD - no computed data
- NDB - navigation database
- NM - nautical miles
- OAT - outside air temperature
- OFST - offset
- OPAS - overhead panel ARINC 629 system
- OPBC - overhead panel bus controller
- OPC - operational program configuration
- opt - optimum
- PA/CI - passenger address/cabin interphone
- PBD - place bearing distance
- PDB - performance data base
- PDF - primary display function
- PDS - primary display system
- perf - performance
- PFC - primary flight computer
- PFCS - primary flight control system
- pl - place
- pln - plan
- pos - position
- PPOS - present position
- pred - predicted
- preflt - preflight
- proc - procedure
- prof - profile
- PSD - port select discrete
- PSEU - proximity sensor electronics unit
- PTC - push to center
- QAD - quick attach/detach
- QARF - quick access recorder function
- QFE - altimeter setting to indicate height above reference airfield
- QNH - altimeter setting to indicate altitude above mean sea level
- QRH - quick reference handbook
- QUAD - quadrant
- qty - quantity
- R - right

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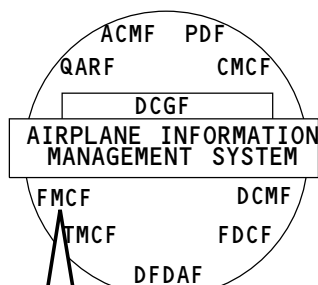
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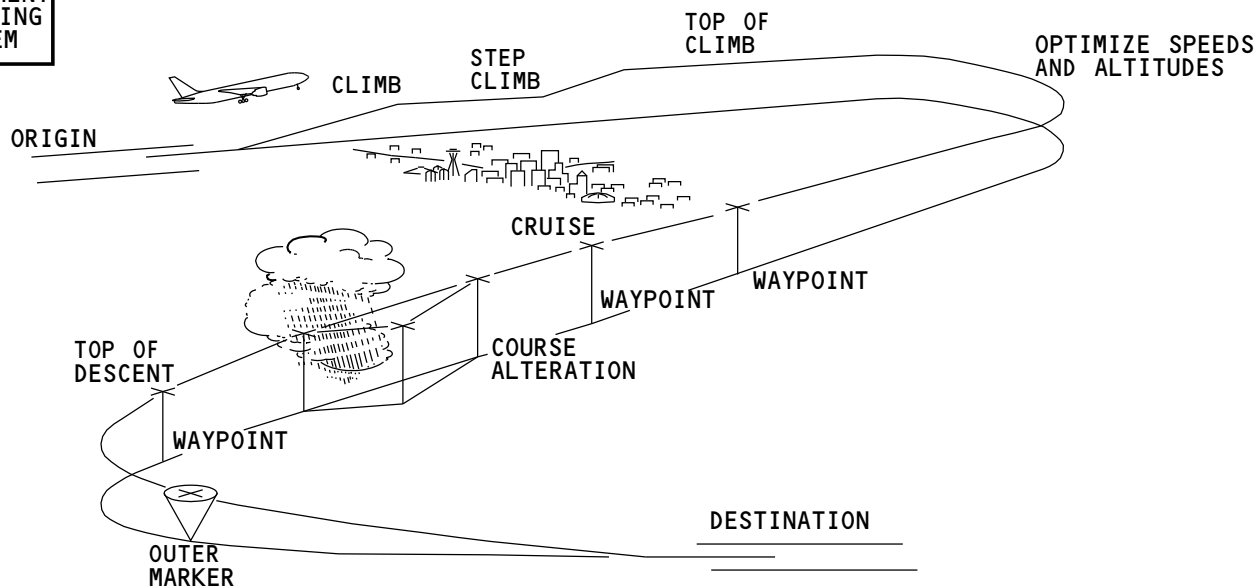
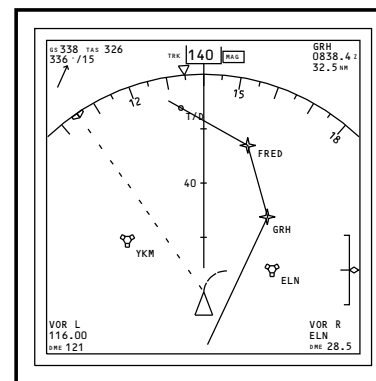
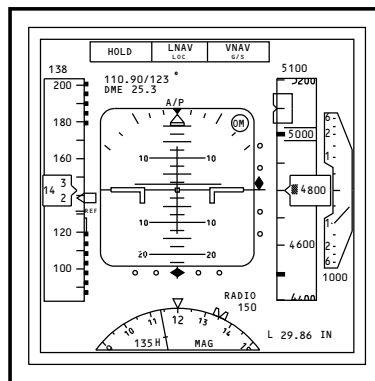
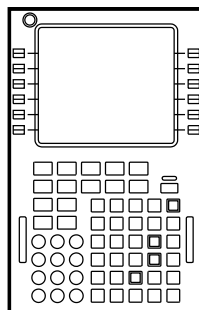


FLIGHT MANAGEMENT COMPUTING SYSTEM - INTRODUCTION

- rad - radio
- ref - reference
- rev - revise
- rte - route
- rwy - runway
- S - south
- S/C - step climb
- SAARU - secondary attitude air data reference unit
- SAT - static air temperature
- SATCOM - satellite communications
- SDU - satellite data unit
- sel - selector
- SID - standard instrument departure
- SPD - speed
- STAR - standard terminal arrival route
- TACAN - tactical air navigation
- TAS - true airspeed
- TAT - total air temperature
- T/C - top of climb
- T/D - top of descent
- tgt - target
- thr - thrust
- thr ref - thrust reference
- TMCF - thrust management computing function
- TMCS - thrust management computing system
- TO/GA - takeoff/go-around
- TRA - throttle resolver angle
- trans - transition
- trk - track
- TTG - time to go (CDU)
- UTC - universal time (coordinated)
- V1 - takeoff decision speed
- V2 - takeoff safety speed
- v - volt
- VNAV - vertical navigation
- VR - rotation speed
- VREF - landing reference speed
- V/S - vertical speed
- VTK - vertical track
- W - west
- WES - warning electronic system
- WEU - warning electronic unit
- wpt - waypoint
- wt - weight
- XTK - cross track
- ZFW - zero fuel weight



**FLIGHT
MANAGEMENT
COMPUTING
SYSTEM**



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FLIGHT MANAGEMENT COMPUTING SYSTEM - INTRODUCTION

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FMCS - GENERAL DESCRIPTION

General

The flight management computing system shares data with the these systems or components:

- Air data inertial reference system
- Global positioning system
- Navigation radios
- Engine sensors
- Fuel sensors
- FMCF internal databases
- Key entries into the control display units (CDUs).

The FMCS uses the data from the airplane systems to do these functions:

- Navigation
- Flight planning
- Performance management
- Guidance and control
- Thrust management
- Display and system control
- Datalink interface.

FMCS Components

The FMCS has these components:

- Flight management computing function (FMCF) (2) one in each AIMS cabinet
- CDUs (3)
- FMC selector
- Instrument source select panel (ISSP) navigation source switches (2).

Also, the mode control panel (MCP) has an interface with the FMCS, but is not an FMCS component.

Flight Management Computing Function

Each FMCF has these two software partitions:

- Flight management function (FMF) partition
- Navigation function partition.

The FMF partition supplies these functions:

- Flight planning
- Lateral navigation (LNAV) guidance commands
- Vertical navigation (VNAV) guidance commands
- Thrust guidance commands
- Performance data
- Display control
- ND MAP display
- Manual, route, and procedure selection of navigation radios
- Required time of arrival (RTA) calculation
- Automatic dependent surveillance function (ADSF)
- BITE and fault monitoring.

The navigation function partition supplies these functions:

- Position calculation
- Navaid selection for radio position calculation
- Navigation radio tuning command outputs.

The FMCFs use performance and navigation data bases and sensor inputs to calculate guidance commands. When the flight crew uses the MCP to select the LNAV and VNAV modes, the FMCF sends this data:

- LNAV and VNAV guidance commands to the autopilot flight director computers (AFDCs)
- Thrust guidance commands and thrust limit data to the thrust management computing function (TMCF)

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FMCS - GENERAL DESCRIPTION

- Display and fault data to the primary display and central maintenance computing functions in the AIMS cabinets.

Automatic Dependent Surveillance Function

The automatic dependent surveillance function (ADSF) is a sub-function of the FMCF. The purpose of the ADSF is to let air traffic control (ATC) monitor the airplane in the air.

ATC sends automatic dependent surveillance (ADS) requests from the ground to the airplane. The ADSF in the airplane sends airplane position, heading, airspeed, and other data to the ground. ATC uses this data to manage air traffic. The ADSF is automatic and does not require flight crew action.

CDU - General

There are three CDUs in the flight deck. The CDUs are the primary control and display interface unit for the FMCF. The flight crew uses the left and right CDUs to enter flight plan data and interface with the FMCF and other systems. If the left or right CDU fails, the center CDU is the backup.

All CDUs can select a maintenance page format on a multifunction display (MFD) in the primary display system (PDS).

All CDUs can control the satellite communication (SATCOM) system.

The center CDU is the interface for the passenger address/cabin interphone (PA/CI) controller.

The CDU supplies these functions when the FMCFs fail:

- Backup navigation radio tuning
- Calculates LNAV guidance commands
- Backup map data.

ARO 014-999; ARO 001-013 WITH CDU CONFIGURATION PAGE

CDUs can display its hardware and software configuration on the CDU screen.

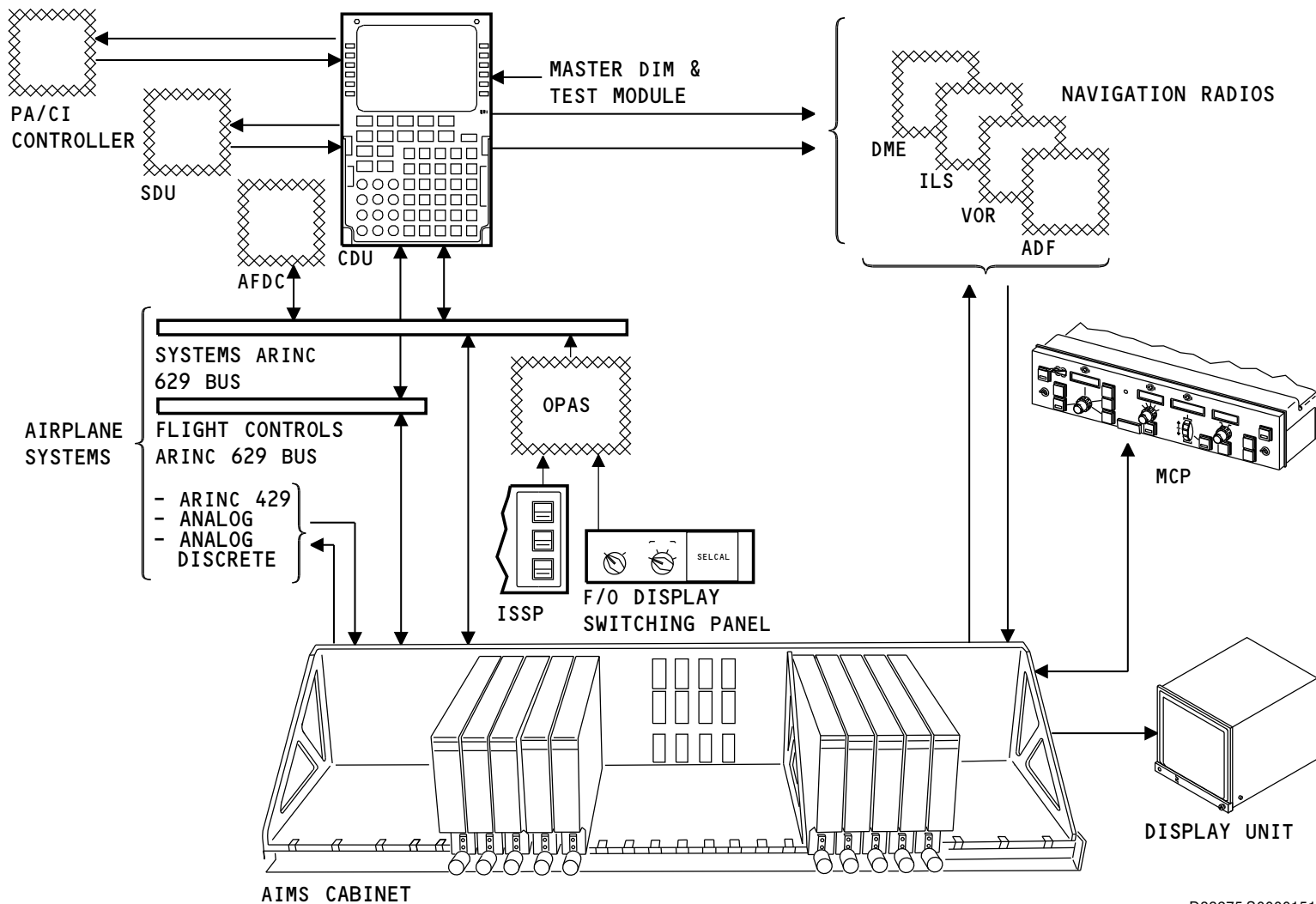
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FMC Selector and Instrument Source Select Panel

The FMC selector is on the first officer display switching panel. It determines the active FMCF.

The FMC selector and ISSP switches supply analog inputs to the overhead panel ARINC 629 system (OPAS). The OPAS changes these inputs and sends them to the AIMS cabinet on the systems ARINC 629 buses.

The NAV ISSP switch determines the source of navigation display data.



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FMCS - GENERAL DESCRIPTION

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**FMCS - FLIGHT DECK COMPONENT LOCATIONS****FMCS Component Locations - P8 and P9 Panels**

The FMCS components on the P9 forward aisle stand and P8 aft aisle stand panels are:

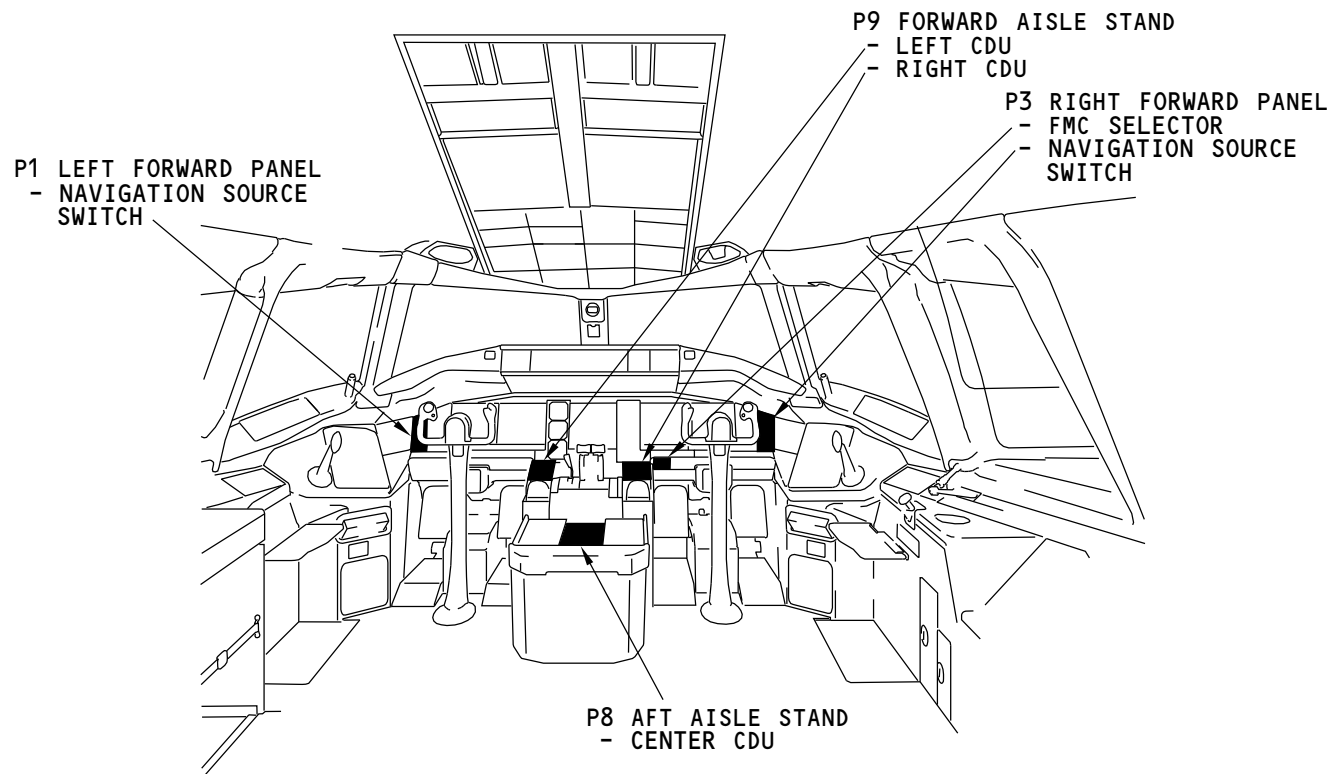
- Left control display unit (CDU)
- Right CDU
- Center CDU.

FMCS Component Locations - P1 and P3 Panels

The FMCS components on the P1 left forward panel and P3 right forward panel are:

- Left and right navigation source switch (P1/P3)
- FMC selector (P3).

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FMCS - FLIGHT DECK COMPONENT LOCATIONS

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FMCS - MAIN EQUIPMENT CENTER COMPONENT LOCATIONS

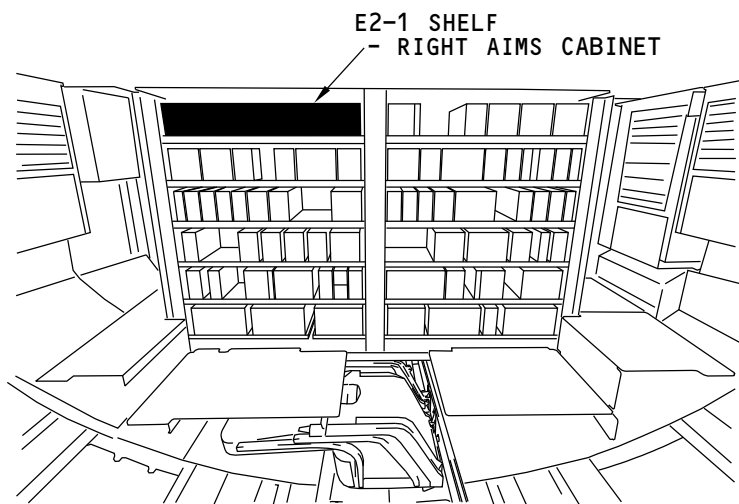
General

Each AIMS cabinet has an FMCF. The AIMS cabinets have the FMCF in the core processor module/standard (CPM/STD).

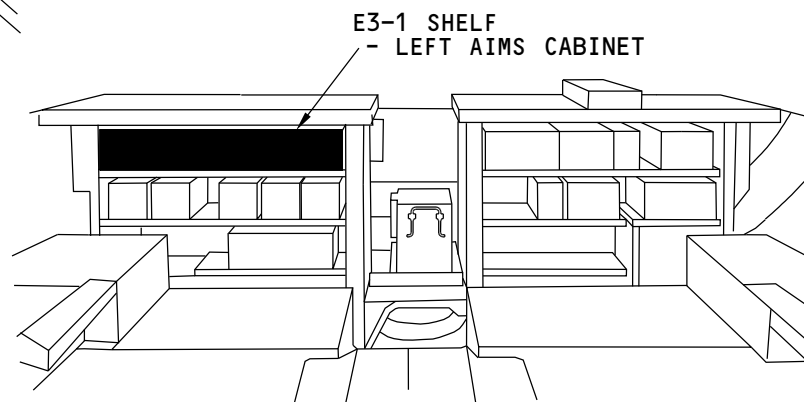
Main Equipment Center Component Location

The left AIMS cabinet is on the E3-1 shelf. The right AIMS cabinet is on the E2-1 shelf.

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MAIN EQUIPMENT CENTER
(LOOKING AFT)



MAIN EQUIPMENT CENTER
(LOOKING FORWARD)

FMCS - MAIN EQUIPMENT CENTER COMPONENT LOCATIONS

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**FMCS - CDU POWER INTERFACE****General**

These power buses supply 28v dc power to a CDU through an insertion switch:

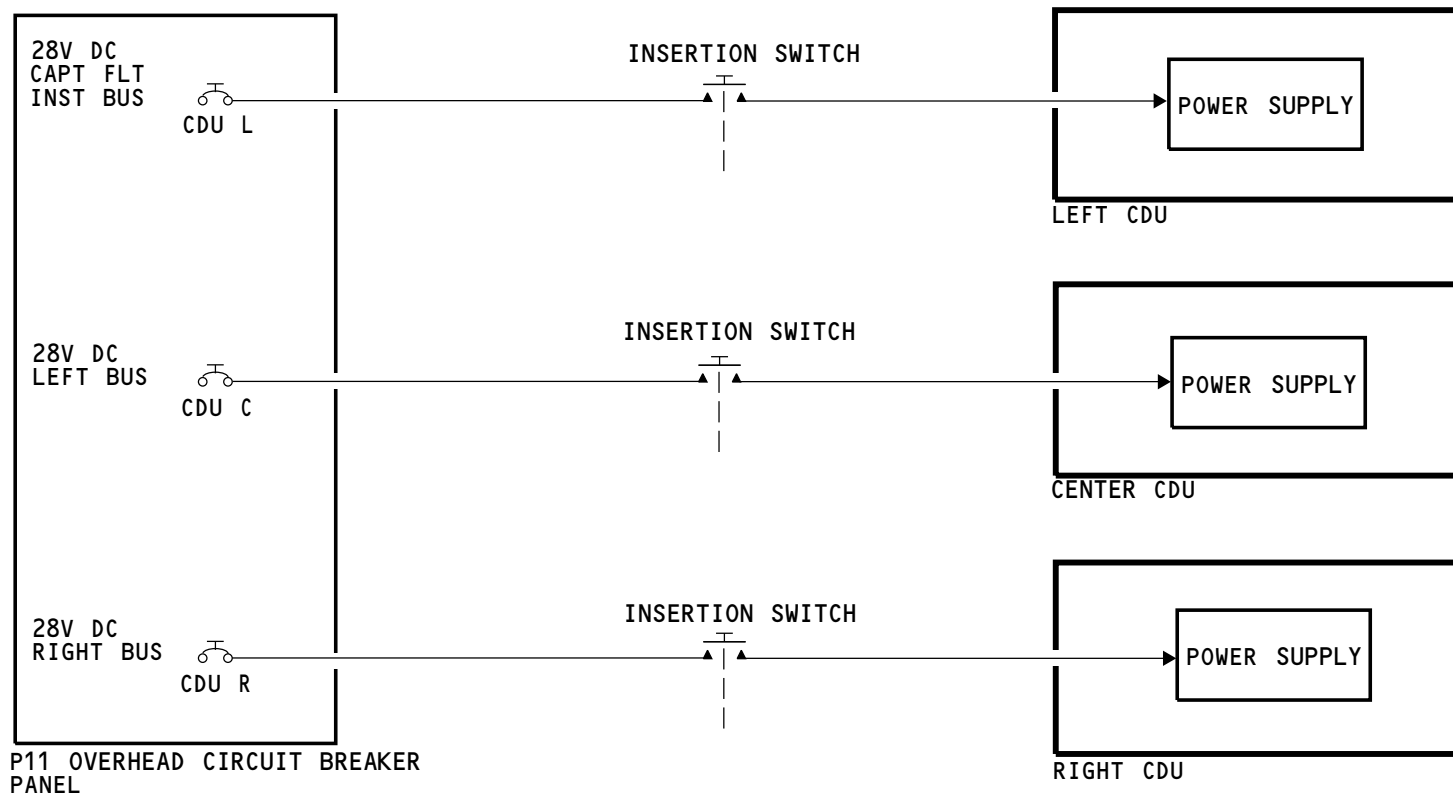
- Captain's flight instrument bus (L CDU)
- Left bus (C CDU)
- Right bus (R CDU).

Insertion Switch

When you remove the CDU from the CDU mount, the insertion switch opens and removes power from the CDU.

When you put the CDU into the CDU mount, the insertion switch closes and supplies power to the CDU.

The insertion switch is a spring loaded switch near the connector on the CDU mount.



FMCS - CDU POWER INTERFACE

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FMCS - FMCF INTERFACES - 1

General

The FMCF in the AIMS cabinets receives digital and analog discrete inputs from components, sensors, and switches on these buses:

- Flight controls ARINC 629 buses
- Systems ARINC 629 buses
- ARINC 429 buses
- AIMS intercabinet ethernet buses
- Analog discretes.

The FMCF in the AIMS cabinets sends digital data on these buses:

- Flight controls ARINC 629 buses
- Systems ARINC 629 buses
- ARINC 429 buses
- AIMS intercabinet ethernet buses.

Input Overview

These are the components that have an interface on the flight controls ARINC 629 buses:

- Primary flight computer (PFC) (3)
- Air data inertial reference unit (ADIRU)
- Secondary attitude air data reference unit (SAARU).

These are the components that have an interface on the systems ARINC 629 buses:

- Autopilot flight director computers (AFDCs) (3)
- Warning electronic unit (WEU) (2)
- Air supply cabin pressure controller (ASCPC) (2)
- Cabin temperature controller (CTC) (2)
- Engine data interface units (EDIU) (2)
- Flap slat electronics unit (FSEU) (2)

- Proximity switch electronic units (PSEU) (2)
- Electrical load management system (ELMS) (3)
- Fuel quantity processing unit (FQPU) (2)
- Overhead panel ARINC 629 system (OPAS)
- Audio management unit (AMU)
- Card files (2)
- ARINC signal gateway (ASG).

These are the components that have an interface on the AIMS intercabinet ARINC 629 bus 2:

- L AIMS cabinet
- R AIMS cabinet.

These are the components that have an interface on the ARINC 429 buses:

- Multi-mode receiver (MMR) (2)
- Ground proximity warning computer (GPWC)
- EFIS control panel (2).

The FMCFs receive analog discretes from these:

- VHF communication transceiver (3)
- HF communication transceiver (2)
- TO/GA switches (3).

Input Details

The FMCFs get data from these interfaces:

- Flight control ARINC 629 buses
- Systems ARINC 629 buses
- AIMS inter-cabinet bus 2
- ARINC 429 buses
- Analog discretes.

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FMCS - FMCF INTERFACES - 1

PFC Inputs - Flight Control ARINC 629 Bus (L, R, & C)

The PFCs send bank angle protection data to the FMCs. The FMCs use this data to calculate the lateral guidance command.

ADIRU Inputs - Flight Control ARINC 629 Bus (L & R)

The ADIRU sends air data and inertial data to the FMCs. The FMCs use this data to calculate guidance and display commands.

SAARU Inputs - Flight Control ARINC 629 Bus (C)

The SAARU sends back-up air data and inertial data when the ADIRU fails.

AFDS Inputs - Systems Bus ARINC 629 (L, R, & C1)

The AFDCs send the ILS tune inhibit discrete and the arm/operational mode discretes to the FMCs. The FMCs use the ILS discrete to inhibit all ILS tune requests when the AFDS is in the approach mode. The arm/operational mode discretes tell the FMCF when to send its LNAV/VNAV guidance commands to the AFDS.

WEU Inputs - Systems ARINC 629 Bus (L, R, & C1)

The WEUs send this data to the FMCs:

- Maximum operating speed
- Minimum operating speed
- Maximum placard speed.

The FMCs use this data to compare with its maximum and minimum speed calculations. The active FMCF sends the safe maximum and minimum speeds to the WEUs for aural annunciations.

ASCPC and CTC Inputs - Systems ARINC 629 Bus (L & R)

The ASCPCs and CTCs send bleed air data to the FMCs. The FMCs use this data to calculate thrust and display commands when VNAV engages.

EDIU Inputs - Systems ARINC 629 Bus (L, R, C1, & C2)

The data the EDIUs send to the FMCs includes this:

- Low speed compressor RPM (N1)
- Fuel flow for each engine.

The FMCs use this data to calculate thrust commands and thrust limits.

FSEU Inputs - Systems ARINC 629 Bus (L, R, & C1)

The FSEUs send flap position and flap lever position to the FMCs. The FMCF uses this data in its maximum speed and minimum speed calculations.

PSEU Inputs - Systems Bus ARINC 629 (L & R)

The PSEUs send landing gear position to the FMCs. The FMCs use this data to calculate speed limits.

FQPU Inputs - Systems Bus ARINC 629 (L & R)

The FQPUs send total fuel to the FMCs. The FMCs use this data to calculate performance data.

OPAS Inputs - Systems ARINC 629 Bus (L & R)

The OPAS send this data to the FMCs:

- FMC selector position (Left, right or AUTO)
- Navigation source switch position
- Display select panel (DSP) switch position.

Card Files Inputs - Systems ARINC 629 Bus (L & R)

The FMCs receive air/ground discretes and airfoil and cowl ice protection system (ACIPS) bleed air data from the card files. The FMCs use the air/ground data to start and stop radio position calculation. The FMCs use ACIPS data to help calculate performance commands.

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FMCS - FMCF INTERFACES - 1**FMCF Inputs - AIMS Intercabinet ARINC 629 Bus 2**

The active FMCF receives intercabinet data, such as flight plan and map data, from the other FMCF. It does a comparison check with the other data. The active FMCF starts a resync to the other FMCF when the comparison check does not agree.

GPS Inputs - ARINC 429 Bus

The GPS sends this data to the FMCFs:

- Altitude
- Latitude
- Longitude
- East/north/vertical velocities
- Horizontal figure of merit (HFOM).

The FMCFs use GPS altitude, position (LAT and LON), and velocity data with ADIRU and radio data to calculate present position and ground speed. The FMCFs use the HFOM to reject the GPS data when the data is not within the necessary limits.

EFIS Control Panel Inputs - ARINC 429 Bus

The EFIS CPs send map data requests to the active FMCF to process. The active FMCF sends this map data to the PDF for display:

- Map mode
- Map range
- Navaid and waypoint data.

Analog Discrete Inputs - HF (2) and VHF (3) Communication Transceivers and TO/GA Switches (3)

When the flight crew pushes the microphone switch on the HF or VHF communication transceivers or pushes the TO/GA switches, an analog discrete signal goes to the FMCFs. The FMCFs use the analog discretes with other entry inputs from these components to monitor crew work:

- MCP
- EFIS CP (2)
- DSP (2)
- CDU (3).

If the flight crew does not do any work over a period of time, the FMCF makes these alerts occur in cruise and descent:

- Warning
- Caution
- Advisory.

Output Overview

The active FMCF sends digital data to these components on the flight controls ARINC 629 buses:

- ADIRU
- SAARU.

The active FMCF sends digital data to these components on the system ARINC 629 buses:

- AFDS (3)
- ELMS (3)
- AMU
- ASG (2).

The active FMCF sends digital data to the other AIMS cabinet on the ICB ARINC 629 buses.

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FMCS - FMCF INTERFACES - 1

The active FMCF sends digital data to these components on the ARINC 429 buses:

- GPWC.

Output Details

The FMCFs send data to these interfaces:

- Flight controls ARINC 629 buses
- Systems ARINC 629 buses
- AIMS intercabinet ARINC 629 bus 2
- ARINC 429 buses.

SAARU/ADIRU Outputs - Flight Controls ARINC 629 Bus (3)

The active FMCF sends CDU heading requests to the SAARU when the SAARU is the active navigation source.

The active FMCF sends CDU LAT and LON entries to the ADIRU for initialization.

AFDS Outputs - Systems ARINC 629 Bus (L, R, & C1)

The active FMCF sends the AFDS lateral and vertical steering guidance commands after the FMCFs receive an arm/operational mode discrete from the AFDS.

ELMS Outputs - Systems ARINC 629 Bus (L & R)

The active FMCF sends zero fuel weight to the ELMS.

AMU Outputs - Systems ARINC 629 Bus (L)

The FMCF sends a VOR/DME or ILS/DME pair discrete to the AMU. This pair discrete lets you hear the DME audio identifier with the co-located VOR or ILS audio identifier. Selections on the EFIS control panel and the audio control panel defines the audio pair.

ASG Outputs - Systems ARINC 629 Bus (L & R)

The active FMCF sends this data to the ASG:

- Airframe configuration
- Engine configuration
- Wing configuration.

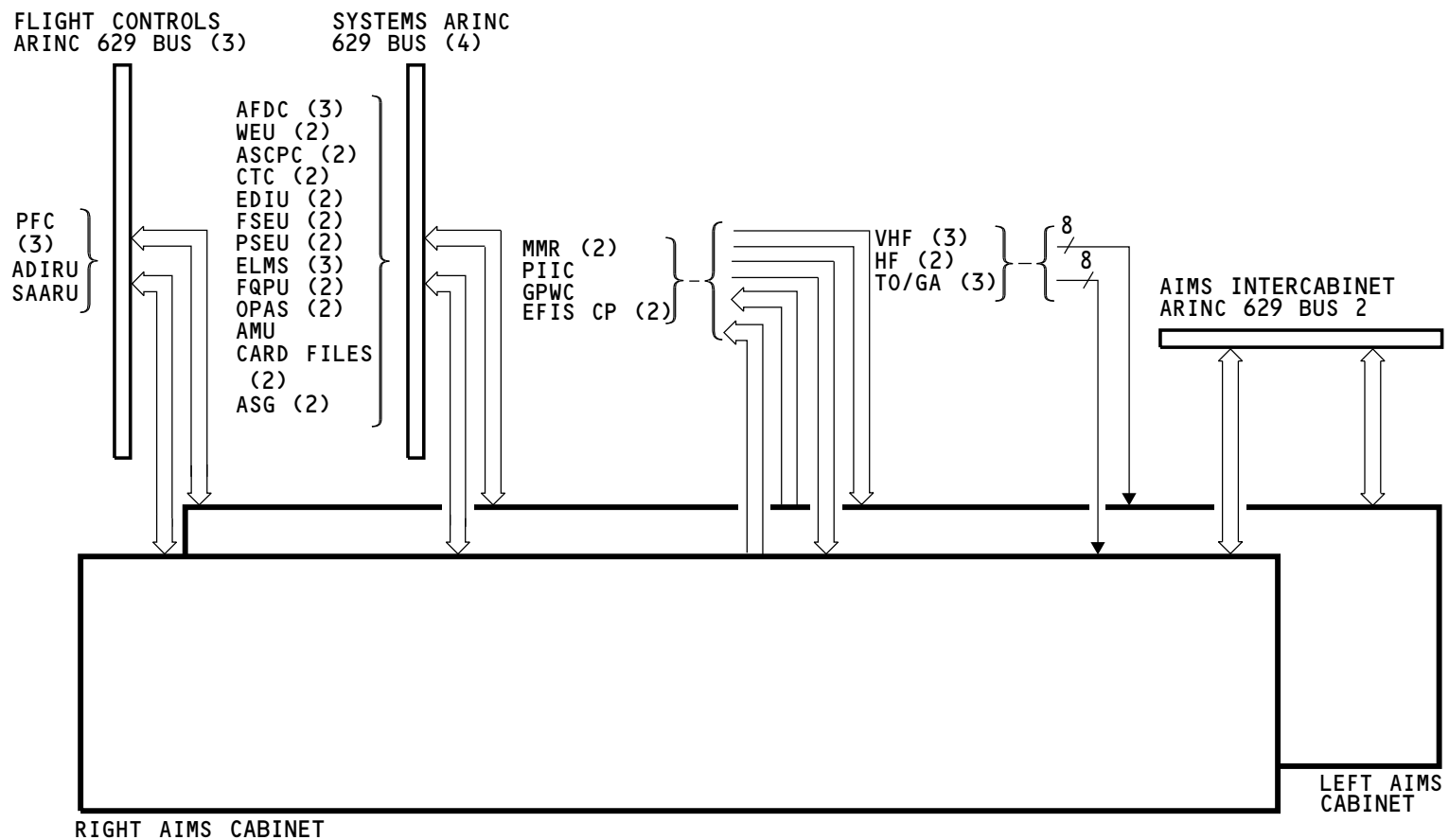
FMCF Outputs - AIMS Intercabinet ARINC 629 Bus 2

The active FMCF sends resync data, such as flight plan and map data, to the other FMCF. This happens when a comparison check of the data between the two FMCFs fails.

GPWC Outputs - ARINC 429 Bus

The active FMCF sends this data to the GPWC on a low speed ARINC 429 data bus:

- Air data and inertial data
- Magnetic track angle
- Position (latitude and longitude).



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FMCS - FMCF INTERFACES - 1

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FMCS - FMCF INTERFACES - 2**General**

The FMCFs receive mode and status data from the mode control panel (MCP).

The FMCFs receive inputs from these navigation radios:

- MMR
- VOR
- DME
- ADF.

The navigation radio inputs go to the input/output modules (IOMs) in the left and right AIMS cabinets.

The FMCFs use DME distance, ILS deviation and VOR bearing for position update.

MCP Inputs - ARINC 429 Bus

The MCP sends this data to the FMCFs on two 429 buses:

- Altitude and altitude intervention
- Speed and speed intervention
- Mach and mach intervention
- LNAV and VNAV mode requests.

Navigation Radio Inputs - ARINC 429 Buses

The multi-mode receivers (MMRs) send runway heading and ILS deviation data to the FMCF navigation partition. The FMCF uses this data to calculate a position. The MMRs also send frequency data to the FMCF navigation partition. The FMCF uses this data to verify valid ILS tuning.

The VOR receivers send bearing, frequency, and course data.

The DME interrogators send distance and frequency data.

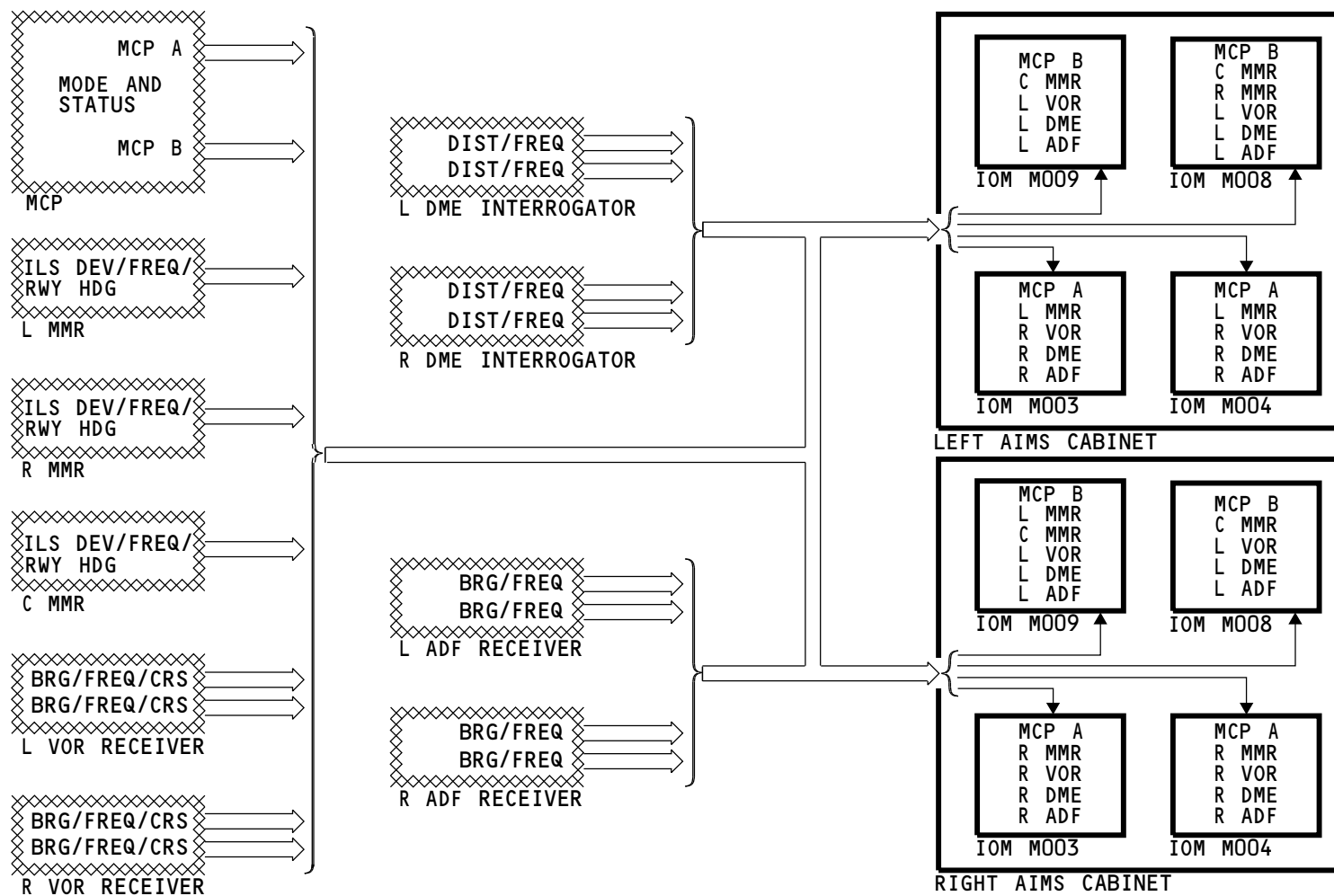
The ADF receivers send bearing and frequency data.

The navigation radios send the tuned frequencies back to the FMCFs. The FMCFs use these frequencies as a wrap around tests. The FMCFs use status data to blank or show dashes instead of the normal display.

The FMCFs use the navigation radios for position update in this order:

- ILS/DME in approach and ILS active
- DME/DME
- DME/VOR.

The FMCFs do not use ADF bearing in their position calculations.



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FMCS - FMCF INTERFACES - 2

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FMCS - FMCF INTERFACES - 3

General

These are the three types of procedures to tune navigation radio:

- Automatic
- Manual
- Alternate.

For the automatic procedure, the FMCFs send tune data to the ILS, VOR and DME navigation radios automatically. The ADF navigation radios are not tuned automatically.

For the manual tune procedure, you use the left or right CDU to manually tune all of the navigation radios through the FMCFs. You use the center CDU to manually tune the navigation radios only when the left or right CDU fails.

When both FMCFs fail, you use the CDUs and the alternate procedure to tune all of the navigation radios. The tune data goes from the on-side CDU directly to the on-side navigation radio. The center multi-mode receiver (MMR) gets the alternate tune data from the left CDU.

FMCF Radio Tune Outputs

Both FMCFs in the AIMS cabinets generate radio tune data. The left AIMS cabinet sends radio tune data to the right AIMS cabinet on ARINC 429 data buses.

The right AIMS FMCF radio tune sub-function normally tunes the navigation radios. The right AIMS cabinet has the radio tune relays. The radio tune relays energize when the right navigation radio tune sub-function and the input/output modules (IOMs) are valid.

Both AIMS FMCF radio tune sub-functions process radio input data and make radio tune output data. When the right radio tune sub-function fails, the right radio tune relays de-energize. This allows the left AIMS radio tune sub-function to tune the radios through the relaxed position of the relays in the right AIMS cabinet.

The right AIMS cabinet IOM M004 sends radio tune data to input port B in these radios:

- Right MMR receiver
- Right VOR receiver
- Right DME interrogator
- Right ADF receiver, manual tune only.

The right AIMS cabinet IOM M009 sends radio tune data to input port B in these radios:

- Left MMR
- Left VOR receiver
- Left DME interrogator
- Left ADF receiver, manual tune only.

The right AIMS cabinet IOM M008 sends radio tune data to input port B in the center ILS receiver.

CDU Navigation Radio Outputs - ARINC 429 Bus

When the FMCFs fail, the CDUs send a frequency source select discrete to the navigation radios. This discrete causes the navigation radios to select the input port A. Input port A receives the tune frequency directly from the ARINC 429 bus of the on-side CDU.

The FMCF or the on-side CDU for the alterenate tune procedure send this data to the NAV radios:

- ILS frequency and runway heading
- DME frequency
- VOR frequency and course
- ADF frequency, tune mode.

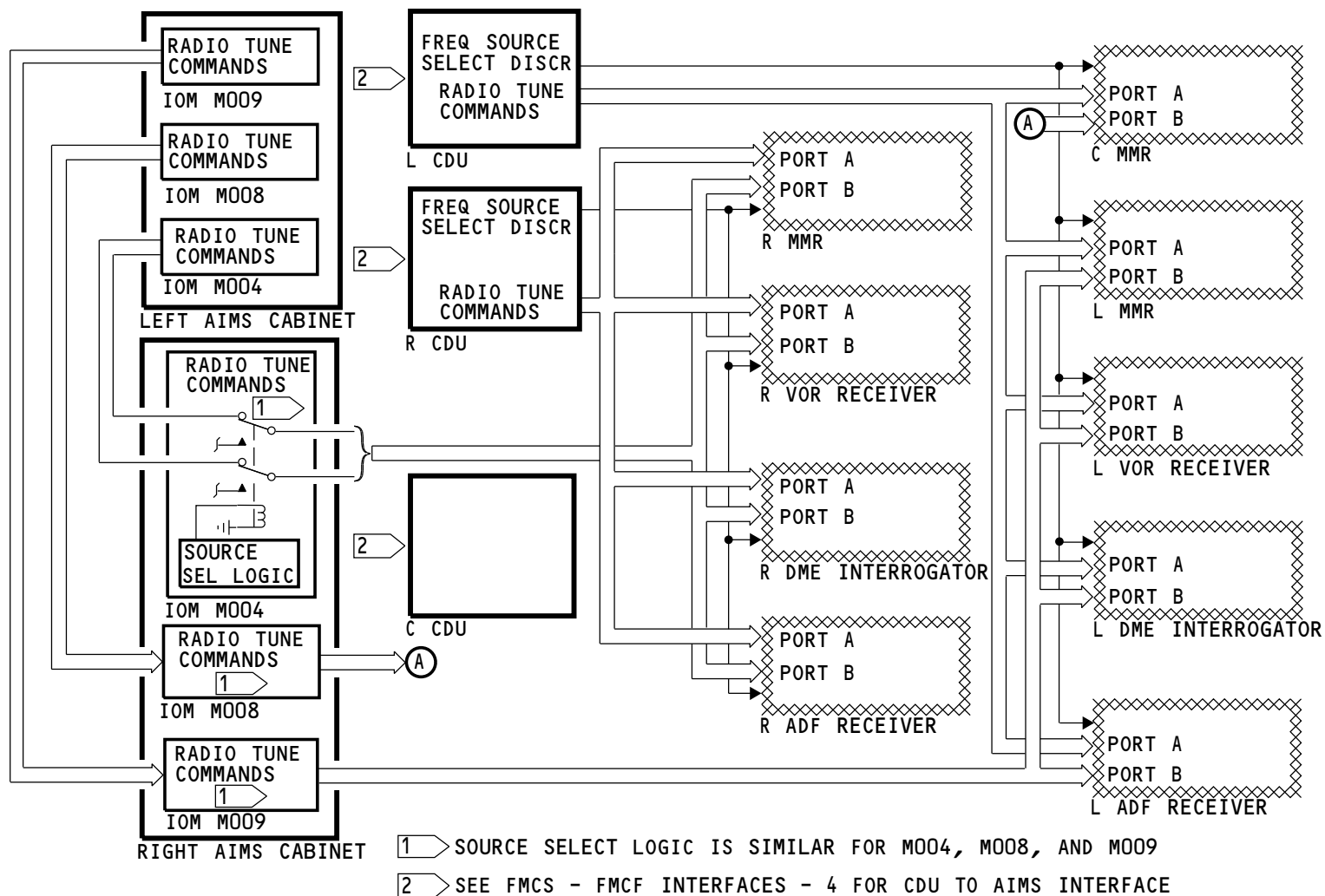
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FMCS - FMCF INTERFACES - 3

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FMCS - FMCF INTERFACES - 4

General

The CDU is the primary interface for the FMCF and other systems. The CDU also processes inputs from external sensors to supply alternate commands when the active FMCF fails. The CDUs receive some of the same inputs as the FMCFs.

The CDU also supplies:

- Alternate lateral navigation steering commands and map display data (LNAV)
- The interface with SATCOM
- The interface with the passenger address/cabin interphone (PA/CI) controller on the center CDU
- Alternate radio tuning (L and R)
- Alternate electronic flight instrument system control panel (EFIS CP)
- Alternate display select panel (DSP) control
- Alternate map display and control
- BITE and fault monitoring
- Maintenance page access.

CDU - Inputs Overview

The CDUs receive air data inertial reference unit (ADIRU) data on the flight controls ARINC 629 buses.

The CDUs receive digital data on the systems ARINC 629 buses from these components:

- Audio management unit (AMU)
- CDU (2)
- ARINC signal gateway (ASG) (2)
- Bus power control unit (BPCU)
- Overhead panel ARINC system (OPAS) (2)
- Autopilot flight director computer (AFDC) (3)
- AIMS FMCF data.

The CDUs receive digital data on the ARINC 429 bus from the satellite communication data unit (SDU).

The center CDU also gets data from the passenger address/cabin interphone (PA/CI) controller.

The CDUs receive analog discretes from the master dim and test module.

The CDUs receive digital flight plan data on the AIMS intercabin bus (ICB) 2 from the active FMCF.

ADIRU Inputs - Flight Controls ARINC 629 Bus (L and R)

The ADIRU sends inertial data to the CDUs. The CDUs use this data to calculate LNAV commands when the active FMCF fails. The CDUs receive this data from the ADIRU:

- ADIRU mode (alignment, navigation or auto nav realign)
- Position, latitude and longitude (lat/long)
- North and east velocities
- Heading (hdg)
- Roll angle
- Altitude data
- Ground speed data for air/ground logic.

CDU Inputs - Systems ARINC 629 Buses (L & R)

Each CDU receives flight plan synchronization data and brightness control data from the other CDUs. If both FMCFs failed, the flight plan synchronization data prevents flight plan map shifts when a CDU fails and the next CDU takes over. The brightness control input is from the local light sensors from each of the other CDUs and the PDS light sensors.

ASG Inputs - Systems ARINC 629 Bus (L and R)

The ASG function sends weight-on-wheels data to the CDUs. The CDUs use this data for the air/ground logic.

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FMCS - FMCF INTERFACES - 4

BPCU Inputs - Systems ARINC 629 Bus (L and R)

The BPCU sends primary and secondary power available data to the CDUs. The CDUs use this data for the air/ground logic.

OPAS Inputs - Systems ARINC 629 Bus (L and R)

The OPAS sends this data to the CDUs:

- Captain navigation source select position (AUTO or CDU)
- First officer navigation source select position (AUTO or CDU)
- Heading reference switch position (NORM or TRUE).

AFDC Inputs - Systems ARINC 629 Buses (L and R)

The AFDS sends LNAV arm/operate data to the CDUs during the alternate LNAV guidance mode. The AFDS also sends an ILS tune inhibit to the left and right CDUs to stop manual tune requests to the ILS radios in approach.

AIMS Cabinet Inputs - Systems ARINC 629 Bus (L and R)

These functions in AIMS send data to the CDUs on the left and right systems ARINC 629 buses:

- Central maintenance computing function (CMCF)
- Primary display function (PDF)
- Flight deck communication function (FDCF)
- Flight management computing function (FMCF).

The CMCF sends this data to the CDUs:

- Airplane identification
- Flight leg
- Flight phase
- Date and time
- Directed message commands
- Operational software
- Load commands

The PDF sends this data to the CDUs:

- Brightness command
- Display select panel (DSP) data
- EFIS CP data.

The FDCF sends a command to clear the scratchpad for the multi-functional display (MFD) text entry to the CDUs.

The FMCF sends this data to the left and right CDUs on the left and right system ARINC 629 buses:

- Flight plan download
- Radio tune download
- Page displays.

The FMCF sends the same data on the left and right system buses to the center CDU when the left or right CDU fails.

AIMS also sends fuel switch position to the CDUs for use in air/ground logic.

SDU Inputs - ARINC 429 Bus

The SDU sends communications data to the CDUs on a high speed ARINC 429 data bus.

PA/CI Controller Inputs - ARINC 429 Bus

The PA/CI controller sends passenger address and cabin interphone data to the center CDU for flight deck and cabin interface.

Analog Inputs

The CDUs receive lamp test and bright/dim inputs from the master/dim and test module.

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FMCS - FMCF INTERFACES - 4

CDU Outputs Overview

The CDU sends digital and analog data to components and systems on these buses:

- Systems ARINC 629 buses
- ARINC 429 buses

AMU Outputs - Systems ARINC 629 Bus (L)

This signal pairs the DME identifier audio with either VOR audio in the EFIS VOR mode or ILS audio in the EFIS approach mode.

AFDS Outputs - Systems ARINC 629 Bus (L and R)

When both FMCFs fail, the left CDU sends LNAV guidance commands to the AFDS. If the left CDU fails, the center CDU supplies the LNAV guidance commands. If the center CDU fails, the right CDU supplies the LNAV guidance data.

AIMS Outputs - Systems ARINC 629 Bus (L and R)

The CDUs send data to these AIMS functions on the left and right system buses:

- CMCF
- Primary display function (PDF)
- FDCF
- FMCF.

The CDUs send fault reports and directed messages to the CMCF in the AIMS cabinets on the L and R systems ARINC 629 buses.

The CMCF in AIMS receives operational program load status data from the CDUs during data load operation.

The PDF in AIMS receives this data from the CDUs on the L and R systems ARINC 629 buses:

- Map background data

- Dynamic map data
- EFIS CP data
- DSP data
- Maintenance display enable signal.

The CDUs supply on-side map display. The center CDU acts as a back-up CDU for the left or right CDU if a CDU failure occurs.

The FMCFs receives scratchpad contents from the CDUs on the L and R system ARINC 629 buses.

The FMCFs get button push and protocol data from the CDUs through the left and right system ARINC 629 buses.

SDU Outputs - ARINC 429 Bus

Each CDU sends communication data to the SDU on a high speed ARINC 429 data bus.

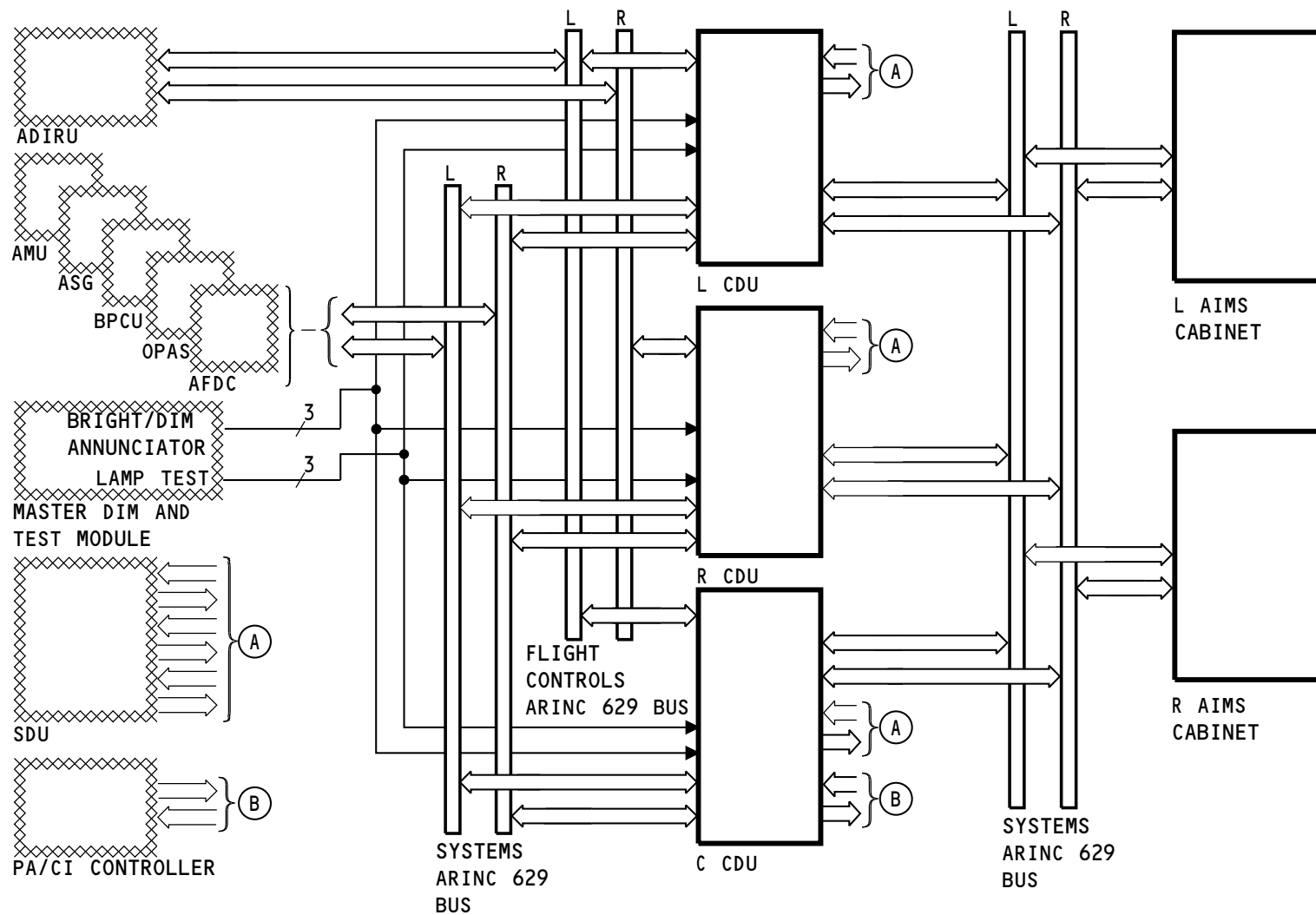
PA/CI Controller Outputs - ARINC 429 Bus

The center CDU sends passenger address and cabin interphone data to the PA/CI controller on a high speed ARINC 429 bus.

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FMCS - FMCF INTERFACES - 4

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FMCS - CONTROL DISPLAY UNIT

Purpose

The CDU is the primary control and display interface for the FMCF. You use the CDU to enter flight plan data and performance data. Also, you use the CDU to manually tune the navigation radios and access maintenance pages. In the event of a EFIS control panel failure or display select panel (DSP) failure, you use the on-side CDU as a back-up EFIS control panel and any CDU as a back-up DSP.

Physical Features

The CDU weighs approximately 16 pounds. It is 9 inches tall, 10.5 inches deep and 5.75 inches wide. The LCD of the CDU shows the flight modes and data in color. The CDU needs 28v dc input power for normal operation. The CDUs use forced air through inlet and exhaust ports for cooling. The CDU shuts down at temperatures above 77C. It restarts when the temperature is below 77C. The CDU has these physical features:

- LCD
- CDU controls
- Annunciators
- Light sensor
- Manual brightness control.

LCD Display Format

The LCD shows 14 lines of data in various colors. Each line is 24 characters long. The top line is the page title field. The title field shows the function of the page and the current page number and the total number of pages for the page display. Lines 1L to 6L and 1R to 6R have title fields and data fields. The scratchpad area is below line 6L and 6R.

To enter or transfer data use the scratchpad. Alert and advisory messages also show in the scratchpad.

Some data fields can show box prompts or dashes. When the box prompts show, you must enter data into that data field. When the dashes show, data entry into that data field is optional.

Color

The LCD uses different colors to show flight activity and modes. Information shows in these colors:

- Black - background
- White - default color for text
- Magenta - next active waypoint in the flight plan
- Green - multiple state data fields with large font (ON) and VOR tuned navigational aids
- Cyan - ADF tuned navigational aids
- Shaded white - data that modifies the flight plan.

The CDU shows this data in white:

- Text
- Alert and advisory messages
- Multiple state data fields with small font (off)
- Tuned ILS navigational aids
- Line titles
- Dashes, except when the dash is an integral part of the data field
- Slashes, except when the slash has data on both sides.

CDU Controls

These are the primary controls for the CDU:

- Line select keys
- Function keys
- Mode keys
- Alpha-numeric keys
- Special keys.

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FMCS - CONTROL DISPLAY UNIT

Line Select Keys

Line select keys 1L to 6L and 1R to 6R, permit the operator to do these things:

- Transfer data from the scratchpad to a data field
- Copy data from a data field to the scratchpad
- Delete data from a data field
- Select an operation. (This occurs when the CDU operates as a control panel in the alternate mode, EFIS or DSP control panel. In this case, the line select key acts as a toggle switch to select between two states (OFF or ON))
- Select another page. This occurs when a caret (prompt) and a page title show next to a line select key.

Not all keys permit all actions. Keys can have different functions on other pages.

Function Keys

These are the three function keys:

- Execute (EXEC)
- NEXT PAGE
- Previous page (PREV PAGE).
- Use the EXEC key to execute (make active) or to modify a page with data entry when the EXEC light comes on.
- Use the NEXT PAGE key to go to the next page when the page count shows more than one page (1/X, 2/X ...).
- Use the PREV PAGE key to go back one page when the page count shows more than one page (1/X, 2/X ...).

Mode Keys

The mode keys select the page for the current airplane condition. These are the mode keys:

- Initialization/reference (INIT/REF)

- Route (RTE) page
- Departure/arrival (DEP/ARR) page
- Alternate (ALTN) page
- Vertical navigation (VNAV) pages
- FIX page
- LEGS page
- HOLD page
- FMC COMM page
- Progress (PROG) pages
- MENU page
- Navigation radio page (NAV/RAD).

Alpha-numeric Keys

The alpha-numeric keys permit the operator to type alpha-numeric data into the scratchpad. The operator can use the line select key to enter scratchpad data into a data field. Some data fields do not let the operator enter data.

Special keys

The keyboard has some special keys in addition to the alpha-numeric keys. These are the special keys:

- Change sign (+/-)
- Space (SP)
- Slash (/)
- Clear (CLR)
- Delete (DEL).

The change sign (+/-), SP keys and slash (/) keys are standard keys on a keyboard.

Use the CLR key to remove a single alpha-numeric character in the scratchpad or an alert or advisory message from the scratchpad with one push. Hold the CLR key down for one second to remove all scratchpad data.

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FMCS - CONTROL DISPLAY UNIT

A push of the DEL key puts the word DELETE in the CDU scratchpad and this permits the operator to delete a data field with the line select key next to the data field. The DEL key does not work when the scratchpad contains data. Some data fields do not permit the DEL key function. In this case, the INVALID DELETE message shows in the CDU scratchpad.

Annunciators

The annunciators come on to show status. These are the annunciators:

- Display (DSPY)
- Message (MSG)
- Offset (OFST).

DSPY shows when the current page does not relate to the active flight plan or present active mode or function. The DSPY comes on, as an example, when the route page 2 of 3 (2/3) shows on the LCD and the airplane is at the departure gate.

The MSG annunciator comes on whenever an alert or an advisory message shows in the scratchpad. The CDU or the FMCF can cause this to occur.

The OFST annunciator comes on when the airplane is in the air and an offset route is active. An offset route is a route parallel (left or right) to the active route.

Light Sensor

The light sensor on the CDU is one of four light sensor inputs the CDU uses to set the LCD brightness level. The others are the light sensors from the other CDUs and the PDS light sensors.

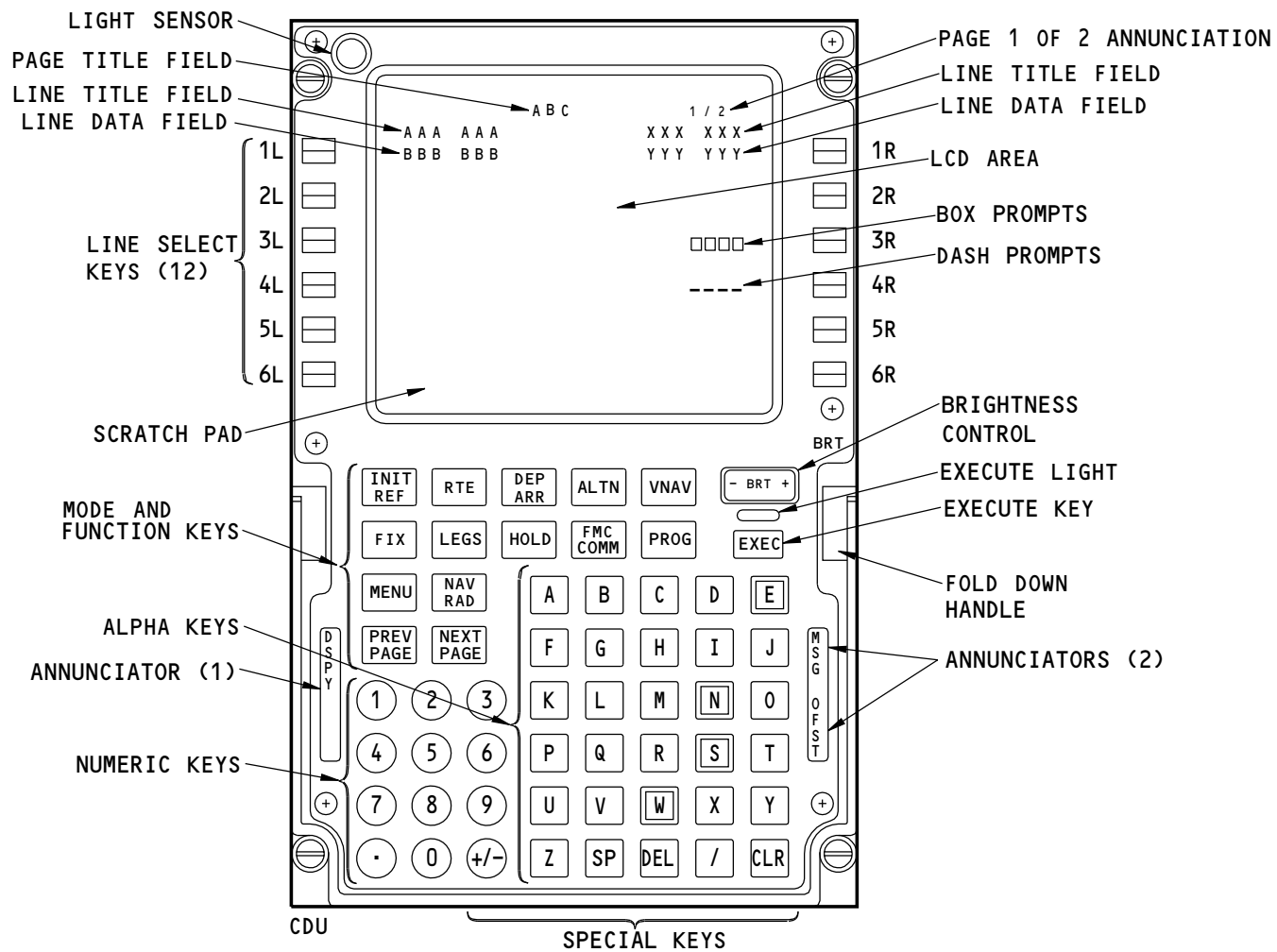
Manual Brightness Control

The manual brightness control adjusts the brightness level above or below the automatic brightness level set by the CDU. To do this, push the plus or minus on the brightness control toggle switch.

Training Information Point

The CDU has no line replaceable parts. The CDU is a line replaceable unit (LRU).

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FMCS - CONTROL DISPLAY UNIT

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FMCS - INSTRUMENT SOURCE SELECT PANELS AND F/O DISPLAY SWITCHING PANEL

General

The FMCS has an interface with these controls:

- Captain's NAV source switch on the instrument source select panel (ISSP)
- First officer's NAV source switch on the ISSP
- FMC selector on the first officer's display switching panel
- LNAV and VNAV mode switches on the mode control panel (MCP)

Operation - NAV Source Switch

The NAV source switch selects the source of NAV data that shows on the on-side ND and PFD. In the AUTO position, the active FMCF is the source of NAV data for the PFDs and NDs. The on-side CDU supplies map data to the on-side ND when both FMCFs fail and the FMC selector is in the AUTO position. The on-side CDU also supplies map data when the FMC selector is in the left or right FMCF position and the related FMCF fails.

The NAV source switches in the CDU position causes the on-side CDU to supply NAV data to the on-side ND. This position permits the flight and maintenance crews to do a check of the CDU alternate navigation capability. The CDU uses the active FMCF flight plan/map data, reformats it, and sends it to the on-side ND.

Operation - FMC Selector

The FMC selector has these three positions:

- Left (L)
- AUTO
- Right (R).

In the left position, the left FMCF and TMCf are active. If the left FMCF fails, there is no active FMCF.

In the AUTO position, a random selection of the active FMCF and TMCf occurs after power is supplied. If the active FMCF fails, the other FMCF becomes active.

In the right position, the right FMCF and TMCf are active. If the right FMCF fails, there is no active FMCF.

Mode Switches (LNAV and VNAV)

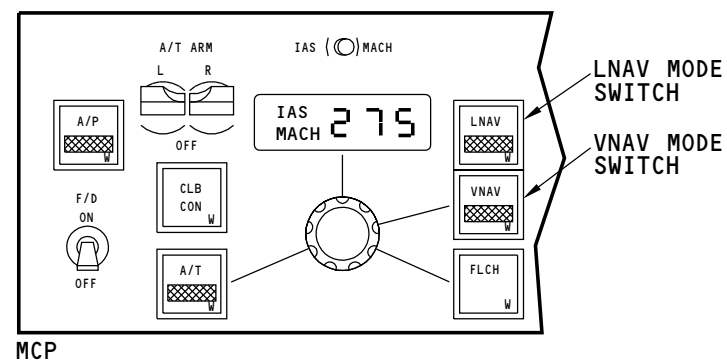
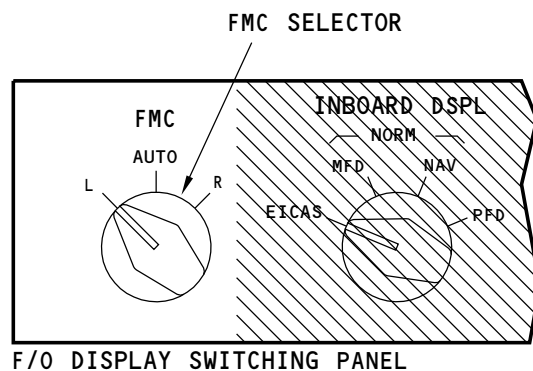
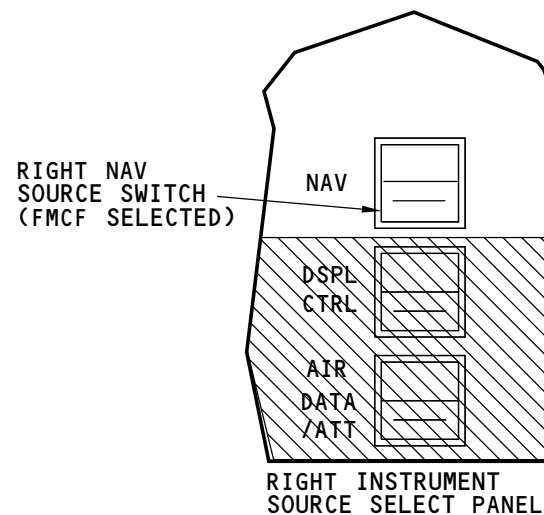
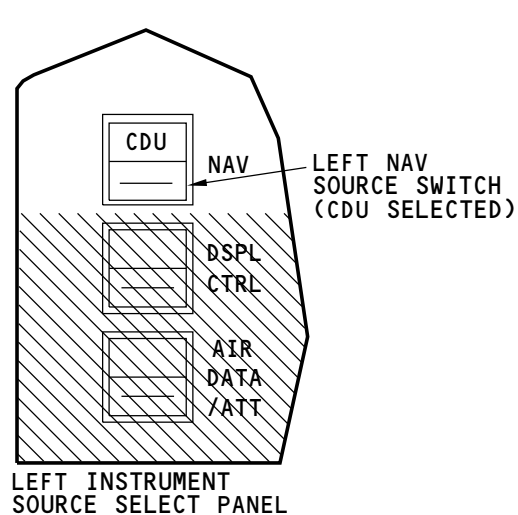
The LNAV mode switch on the MCP sends mode requests to the FMCFs and the CDUs. Normally, the active FMCF uses the mode request to send lateral steering commands to the autopilot flight director system (AFDS) when the airplane is in the air. The CDU sends lateral steering commands to the AFDS when both FMCFs fail.

The VNAV mode switch on the MCP sends mode requests to the FMCFs. Normally, the active FMCF uses the mode request to send vertical steering commands to the AFDS when the airplane is in the air. The CDU does not calculate VNAV steering commands.

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FMCS - INSTRUMENT SOURCE SELECT PANELS AND F/O DISPLAY SWITCHING PANEL

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**FMCS - PRIMARY FLIGHT DISPLAY (PFD)****General**

The flight management computing function (FMCf) sends speed and compass data to the primary display system to show on the primary flight display (PFD).

Speed Data

When the flight crew completes the FMCf pre-flight, the active FMCf sends this speed data to the primary display system to show on the PFDs:

- Selected target speed/mach and target cursor
- High SPD buffet
- Takeoff safety speed (V2)
- Rotation speed (VR)
- Takeoff decision speed (V1)
- Landing reference speed (VREF)
- Flap maneuver speed (extend or retract)
- Minimum speed limit (VMIN).

As part of the pre-flight, the flight crew can enter target speed/mach into the FMCf. When the vertical navigation (VNAV) mode is active, the FMCf selected target speed/mach shows above the speed tape on the PFD. Also, the selected target speed cursor points to the same target speed on the speed tape. If VNAV is not active, the MCP selected speed/mach shows.

High speed buffet is the maximum maneuver speed. The high speed buffet shows as a hollow yellow bar. The bar extends from the bottom of the maximum operating speed symbol. The maximum operating speed symbol is the red and black barber pole symbol which comes from the warning electronic system (WES).

V2 is the takeoff safety speed. V2 shows in green next to the climb out speed tick on the airspeed tape. V2 goes away when the flaps begin to retract.

VR is the takeoff rotation speed. VR shows in green next to the rotation speed tick on the airspeed tape. VR goes away after takeoff.

V1 is the takeoff decision speed. V1 shows in green next to the decision speed tick on the airspeed tape. V1 goes away after takeoff.

VREF is the landing approach speed when the flaps are extended. A green REF and a bar shows next to the airspeed tape.

Flap maneuver speeds show the flight crew the necessary flap selection for the current takeoff or cruise/approach speed. The retract or extend speed shows as a tick mark on the airspeed tape with labels for the flap selections.

The landing flaps setting and VREF also shows in a digital format at the bottom of the airspeed tape.

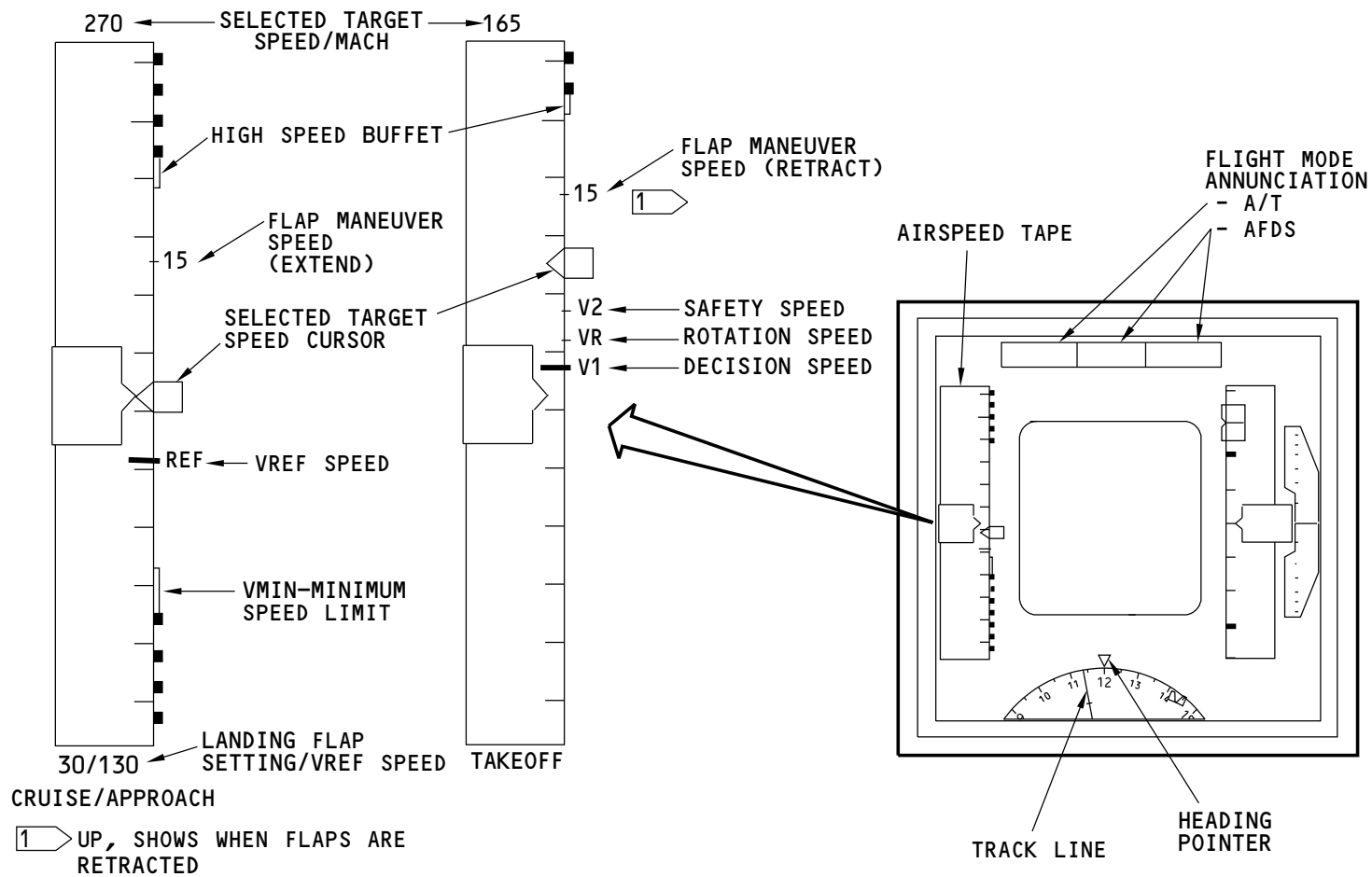
VMIN is the minimum speed limit of the airplane when the flaps/slats extend. VMIN shows as a hollow yellow bar that extends up from the top of the stick shaker symbol. The stick shaker symbol is a red and black barber pole symbol. The stick shaker symbol comes from the WES.

Compass Data

The active FMCf sends this compass data to the primary display system to show on the PFD:

- Heading
- Track.

The air data inertial reference unit (ADIRU) sends heading and track data to the PFDs when the active FMCf fails.



FMCS - PRIMARY FLIGHT DISPLAY (PFD)

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FMCS - NAVIGATION DISPLAY (ND)

General

The flight management computing function (FMC) sends navigation display data to the primary display system (PDS) to show on the navigation display (ND).

Display Data

The active FMC sends navigation data to the NDs for all display modes. If both FMCs fail, the on-side CDU sends the navigation data.

There are two types of navigation data: dynamic data and background data. Dynamic data changes as a function of time. Background data is stationary data that does not move as a function of time.

Dynamic Data

The active FMC sends this dynamic data to show on the NDs via the PDF:

- Track (TRK)
- Heading (HDG)
- Ground speed (GS)
- Wind data - direction, speed, and angle. This shows when true airspeed is greater than 100 knots and wind speed is greater than 5 knots
- Active waypoint (magenta). This is the fly to waypoint. When the airplane crosses it, the waypoint color goes to white and the next fly to waypoint becomes magenta
- Altitude range arc. This shows the range to the mode control panel (MCP) altitude
- VNAV path deviation. This shows as a vertical scale and magenta pointer when the airplane goes through the top of descent profile point. The scale range is +/- 420 feet in 50 foot increments to a maximum of 9999 feet
- Estimated time of arrival (ETA) - FMC or time to go (TTG) - CDU
- Distance to go (DTG). DTG to the active waypoint shows in nautical miles (nm) when greater than 100 nm and in tenths at less than 100 nm

- Altitude profile points. These are along the flight plan to show flight mode or vertical flight path changes, top of climb (T/C), top of descent (T/D), step climb (S/C), end of descent (E/D)
- Route. The route shows magenta when active, cyan when inactive, and white dash lines for modifications
- Airplane position
- FMC position update mode. This shows the data the FMCs use for position update (GPS, IOC, DME/DME, VOR-DME, INERTIAL)
- Tuning mode. This shows as an A (auto tune) or M (manual tune).

The active FMC sends this dynamic data to the NDs:

- Track
- Heading
- Ground speed
- Wind data.

When the active FMC fails, the air data inertial reference unit (ADIRU) sends wind data, ground speed, track, and heading data to the ND.

If both FMCs fail, the on-side CDU sends this dynamic data to the ND:

- Active waypoint
- Time to go (TTG)
- Distance to go (DTG)
- Route
- CDU position
- CDU (L, C or R) source for display.

Background Data

The active FMC sends this background data to the NDs in the map and plan mode only:

- Runways
- Airports
- Waypoints, flight plan and off route waypoints

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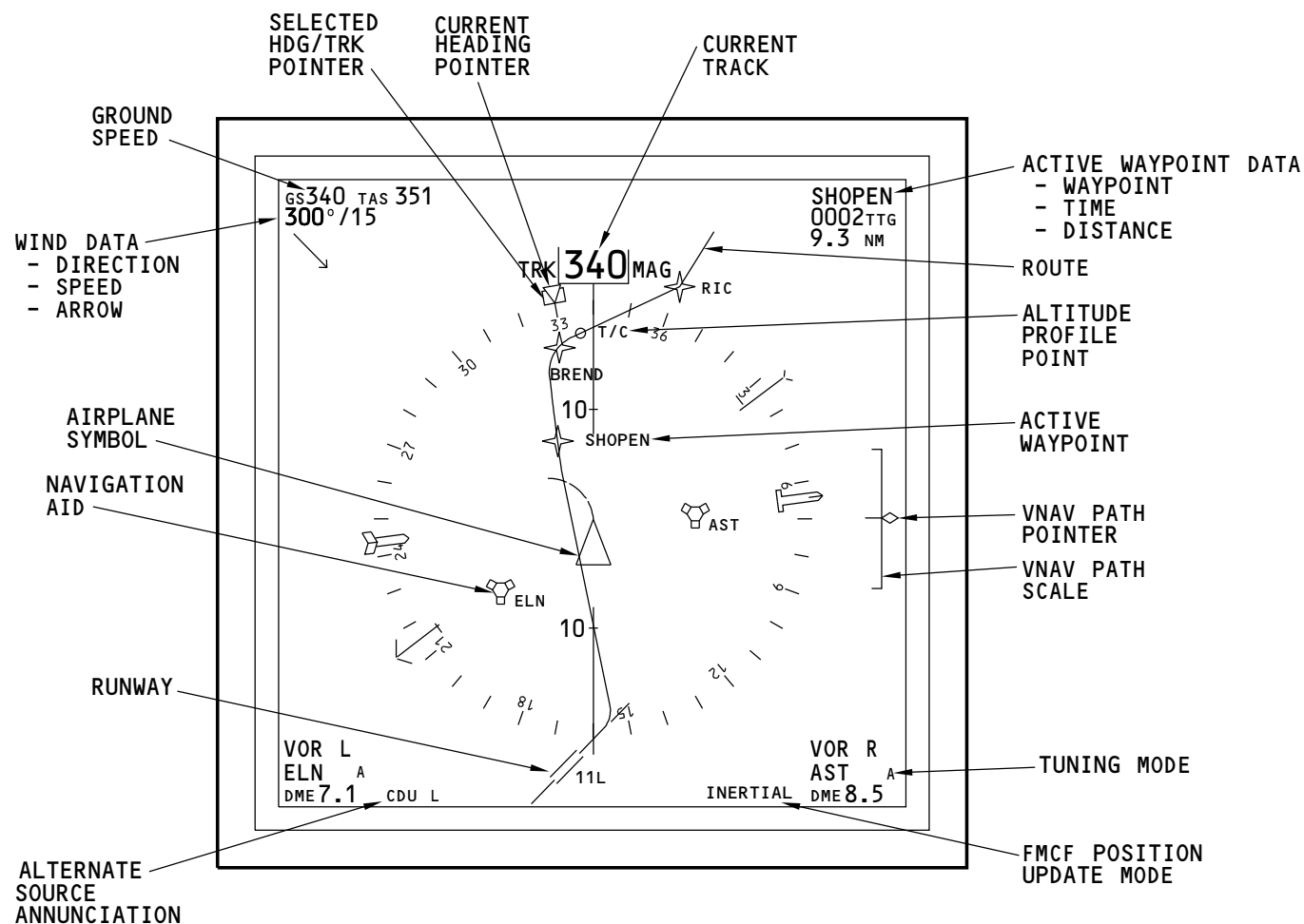


FMCS - NAVIGATION DISPLAY (ND)

- Nav aids (VOR, DME, etc.)
- Beacons, marker and non-directional
- Procedure turns
- Holding patterns
- Energy management circles.

If both FMCFs fail, the on-side CDU goes into the back-up navigation mode. In this mode, the on-side CDU sends this background data to the on-side ND through the PDF:

- Waypoints of current flight plan
- Other waypoints (LAT/LON only).



FMCS - NAVIGATION DISPLAY (ND)

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FMCS - FMCF/CDU MESSAGES

General

The FMCS sends messages to the CDUs and the primary display system. The FMCS messages alert and advise the flight crew with:

- Information that relates to airplane system level of operation
- Airplane flight phase of operation
- Entry errors.

The CDUs show the FMCS message content in the scratchpad and the CDU MSG annunciator comes on. The FMCF sends an alert discrete that causes the advisory message (FMC MESSAGE) to show on the EICAS display. The alert message content shows in the CDU scratchpad.

The CDUs show messages when they operate as the alternate navigation source.

Message, Priority, and Reset

The CDUs show these three message types in this priority:

- Entry error advisory
- Alert
- Advisory.

The CDUs store messages in stacks with a maximum of ten in each stack. The entry error advisory message has priority over the alert and advisory message that show in the CDU scratchpad. Alert messages have priority over advisory messages.

When a CDU scratchpad message occurs, it goes to the top of the related stack. A new message pushes down any other messages in the stack. A maximum of ten messages may enter a stack. If the stack is full and another message occurs, the message at the bottom of the stack exits the stack.

The CDU scratchpad message clears out of the scratchpad in one of these ways:

- A push of the CLR key - one push removes one message
- A new message occurs at the same level or higher

- The condition that causes the message resets.

All CDU scratchpad messages are white.

Entry Error Advisory Messages

Entry error advisory messages relate to any crew entries on a CDU. Each CDU responds to entries from its keyboard. These are examples of entry error advisory messages:

- NOT IN DATA BASE
- INVALID ENTRY
- STANDBY ONE
- BUSY.

The CDU that is in use for entry shows the entry error advisory message in its scratchpad. The MSG annunciator comes on for all CDUs. The CDUs can supply the entry error advisory messages when the FMCFs fail.

Alert Messages

Alert messages tell the flight crew a flight phase or flight mode limitation. These are examples of alert messages:

- END OF ROUTE
- NO ACTIVE ROUTE
- UNABLE NEXT ALTITUDE
- INSUFFICIENT FUEL.

Alert messages set the CDU output discrete to show the advisory FMC MESSAGE on the EICAS display. The left and right CDU scratchpad shows the alert message.

The CDU annunciator MSG comes on for all CDUs.

Scratchpad display priority does not override the alert message indication on the EICAS display and MSG annunciator on the CDUs.

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**FMCS - FMCF/CDU MESSAGES**

The approach flight phase and below 500 feet above ground level (AGL) inhibits the display of the alert messages when the arrival runway is part of the active route. The alert messages that occur in this flight phase show at flight completion or after the airplane climbs through 1000 feet AGL.

Advisory Messages

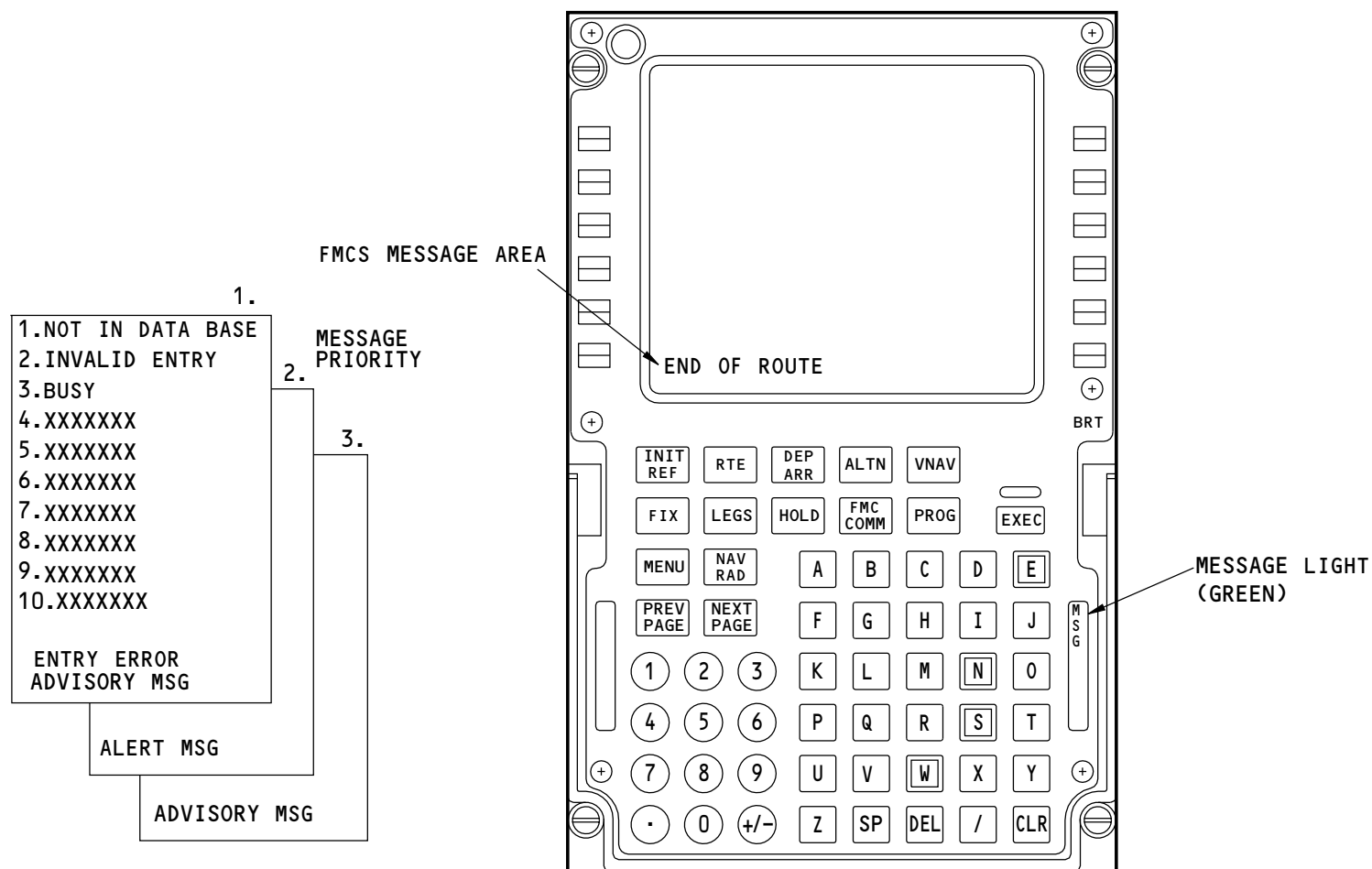
Advisory messages tell the crew flight activity they should perform to make their flight go smoothly. These are examples of advisory messages:

- NOT ON INTERCEPT HEADING
- RWY/ILS COURSE ERROR
- TIMEOUT - RESELECT.

The left and right CDU scratchpad shows the advisory message. The CDU annunciator MSG comes on for all CDUs.

The CDUs can supply the advisory messages when the FMCFs fail.

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FMCS - FMC/CDU MESSAGES

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FMCS - MENU PAGE

General

The MENU page gives a list of selections for systems that use the CDU. These are the systems that use the CDU:

- Flight management computing system (FMCS)
- Satellite communication (SATCOM) system
- Cabin services system (CSS)
- Primary display system (PDS).

The CDUs can operate as alternate control panels for the EFIS control panels and the display select panel (DSP).

The CDU has a selection that lets you get access to maintenance pages on an MFD.

Page Access

The MENU page shows at CDU power-up or push the MENU mode key to show the menu page.

Color

All text on the MENU page is white except for the OFF/ON indications for the alternate EFIS CP and DSP functions. OFF is green when an EFIS CP or DSP has failed and should be selected. ON is green when the EFIS CP or DSP function on the CDU is in use.

Operation

The left line select keys select which system communicates with the CDU. Only one of these systems can control the CDU at a time. <ACT> shows on the MENU page for the system that is active. If a system requests control of the CDU, there is a <REQ> after the system name.

Push 1L <FMC for the FMCF to communicate with the CDU. The INIT/REF INDEX page shows.

Push 2L <SAT for the satellite data unit (SDU) to communicate with the CDU. The associated CDU page shows.

Push 4L <CAB INT for the passenger address/cabin interphone controller to communicate with the CDU. The associated CDU pages show. The <CAB INT prompt is only available on the center CDU.

Push 5R MAINT INFO DISPLAY> to show the PDS maintenance pages CDU on the MFD.

The left and right CDUs normally show the prompts for the alternate on-side EFIS CP function. If the left or right CDU fails, the EFIS CP function shows on the center CDU.

Do this to operate the alternate EFIS controls:

- Push 1R EFIS CTL OFF on> and EFIS> shows on line 2R
- Push 2R to go to the EFIS control selections page.

All three CDUs show the alternate DSP prompt.

Do this to operate the alternate display select panel (DSP) controls:

- Push 3R DSP CTL OFF on> and DSP> shows on line 4R
- Push 4R, DSP> to go to the DSP control selections page.

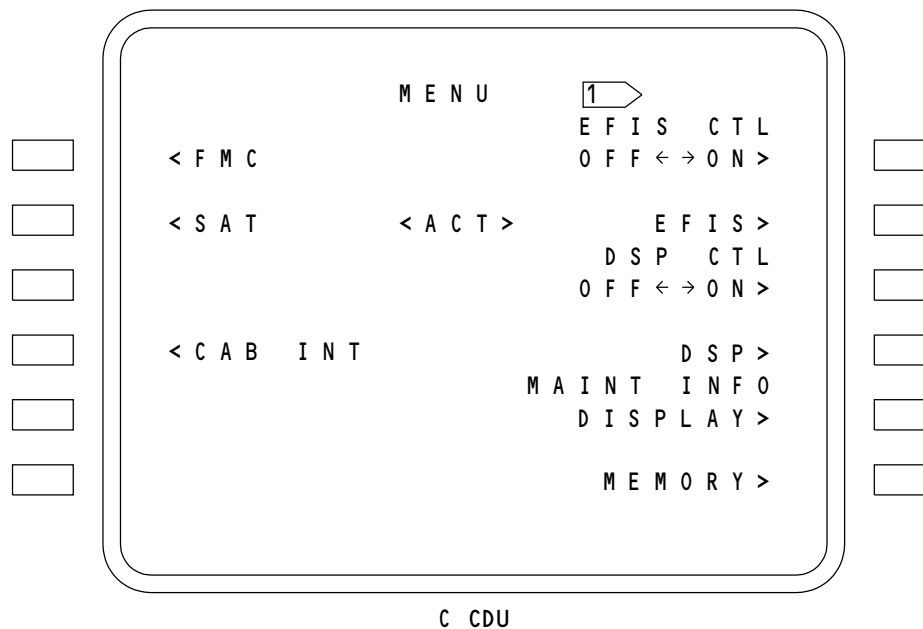
You must cancel the alternate DSP function from the same CDU you used to enable the alternate DSP function.

The MEMORY selection at 6R is for shop use only.

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1 THE EFIS CTL FUNCTION IS AVAILABLE ON THE C CDU WHEN IT IS ALTERNATE FOR A LEFT OR RIGHT CDU.

FMCS - MENU PAGE

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**FMCS - INIT/REF INDEX PAGE****General**

The initialization reference (INIT/REF) INDEX page is a menu of the pre-flight pages. You select these pages to initialize the FMCS and the ADIRU and enter other kinds of reference data.

The INIT/REF INDEX page also shows some inflight pages and the maintenance page prompt.

Push 5R MAINT> to show the maintenance index page. The MAINT> prompt only shows when the airplane is on the ground.

Page Access

To get access to the INIT REF INDEX page, do one of these steps:

- Push the INIT REF mode key to show a preflight page
- Push 6L <INDEX on a preflight page.

Color

All text on this page is white.

Page Selections

Use the active line select keys on the INIT/REF INDEX page to select additional pages.

Push 1L <IDENT to show the identification page.

Push 2L <POS to show the position initialization page.

Push 3L <PERF to show the performance initialization page.

Push 4L <THRUST LIM to show the thrust limits page.

Push 5L <TAKEOFF to show the takeoff reference page.

Push 6L <APPROACH to show the approach reference page.

Push 1R NAV DATA> to show the navigation data reference page.

Push 2R ALTN> and the alternate page shows. The alternate page shows alternate route structures. Fuel and ETA also shows for the alternates route structures.

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INIT / REF INDEX	
☐	< IDENT NAV DATA >
☐	< POS ALTN >
☐	< PERF
☐	< THRUST LIM
☐	< TAKE OFF
☐	< APPROACH MAINT >

FMCS - INIT/REF INDEX PAGE

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**FMCS - IDENT PAGE****Purpose**

The identification (IDENT) page shows this information:

- Airplane model number
- Navigation database configuration
- Operational program
- Engine identification
- Drag factors
- Fuel flow factors.

Page Access

To get access to the IDENT page, select IDENT from the INIT/REF index page.

This page also shows when the self test is not satisfactory at power-up.

Color

All text on this page is white.

Information

Line 1L shows the model number. This number is the aircraft model from the airframe/engine program pins. Blanks show if the program pins do not match the performance database.

Line 2L shows the navigation data base number. Blanks show if there is a bad database load.

Line 4L shows the operational program part number.

Line 1R shows the engine identification. This line shows the engine identification number from the EECs and the airframe/engine program pin. Blanks show if the program pins do not match the performance database.

Line 2R shows the active navigational database.

Line 3R shows the navigational database that is not active.

Line 5R shows the drag factor followed by a fuel flow factor.

Operations

To change the navigation database:

- Push 3R, the inactive navigational database to copy the dates into the scratchpad
- Push 2R to transfer the navigational database that is not active to the active position.

Page Selections

Push 6L <INDEX to show the INIT REF INDEX page.

Push 6R POS INIT> to show the POS INIT page.

Training Information Point

Refer to the Flight Operations Manual for more information related to the IDENT page.

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	I D E N T		
	M O D E L	E N G I N E S	
	7 7 7 - X X X	G E 9 0 - X X	
	N A V D A T A	A C T I V E	
	X X 4 9 5 0 6 0 0 1	J U N 0 1 J U N 2 9 / 9 5	
		J U N 2 9 J U L 2 7 / 9 5	
	O P P R O G R A M		
	P S 4 0 7 3 5 4 0 - X X X		
		(A R M) D R A G / F F	
		+ 1 . 1 / - 3 . 5	

	< I N D E X	P O S I N I T >	

FMCS - IDENT PAGE

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FMCS - POS INIT 1/3 PAGE
Purpose

The position initialization (POS INIT) 1/3 page lets the user enter a reference position for the air data inertial reference unit (ADIRU) alignment. The page also shows the FMCS time reference.

Page Access

To get access to the POS INIT 1/3 page, do one of these steps:

- Push POS INIT from the INIT/REF 1/3 page
- Push POS INIT from the IDENT page
- Push POS INIT from the TAKEOFF REF page
- On the ground with the ADIRU position not initialized, push the INIT/REF mode key.

Color

All text on this page is white.

Information

Line 4L shows the UTC time.

Line 1R shows the FMCF last calculated position. If the FMCF position is not valid, the last valid FMCF position shows.

Line 2R shows the reference airport position. This position shows when an airport identification is in line 2L.

Line 3R shows the reference gate position. This position shows with a gate entry in line 3L.

Line 4R shows the global positioning system (GPS) position.

Entries

This page permits entries of airports and gate identifiers in order to get the latitude and longitude from the navigation database. These latitudes and longitudes are available to initialize the ADIRU.

Do this to get the latitude and longitude of an airport:

- Type a valid airport identifier into the scratchpad
- Enter into 2L
- The latitude and longitude of the airport shows in 2R.

Do this to get the latitude and longitude of a gate at an airport:

- Type a valid gate identifier into the scratchpad
- Enter into 3L
- The latitude and longitude of the gate shows in 3R.

To initialize the ADIRU, there are two steps. First, enter a latitude and longitude into the scratchpad with one of these steps:

- Manually type the data with the keypad
- Push 1R, the last position
- Push 2R, the reference airport position
- Push 3R, the reference airport gate position
- Push 4R, the GPS position.

Then line select this data into 5R.

This page also permits the entry of a manual heading.

When the ADIRU has failed and the SAARU navigation parameters are valid, SET HDG shows above line 5L.

Page Selections

Push 6L <INDEX to show the INIT/REF INDEX.

Push 6R <ROUTE to show the appropriate RTE page.

Push the NEXT PAGE or PREV PAGE mode keys to go to the other POS INIT pages.

Training Information Point

Refer to the Flight Operations Manual for more information related to the this page.

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	POS INIT	1 / 3	
		LAST POS	
	N 40 ° 38 . 0	W 073 ° 46 . 4	
	REF AIRPORT		

	GATE		
	UTC	GPS POS	
	1530Z N 40 ° 38 . 1	W 073 ° 46 . 0	
	SET HDG SET INERTIAL POS		
	--- ° □□□° □□. □	□□□□° □□. □	

	< INDEX	ROUTE >	

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FMCS - POS INIT 1/3 PAGE

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FMCS - POS REF 2/3 AND 3/3 PAGES

Purpose - POS REF Page 2/3 and 3/3

There are two additional POS REF pages. The POS REF page 2/3 shows this position information:

- FMCF position calculation
- Inertial position
- Global positioning system (GPS) position
- Radio position.

You can use these pages to update the FMCF position calculation so it to matches either the inertial, GPS, or radio position.

The POS REF page 3/3 shows the left and right GPS positions and the left and right FMCF positions.

This page lets the operator remove the GPS position update from the FMCFs at 5R.

The POS REF pages also permits the flight crew to show the relative bearing and distance from the FMCF position at 6R.

Page 2/3 access

To get access to the POS REF 2/3 page, do one of these steps:

- Push the NEXT PAGE function key while on the POS INIT page
- Push POS REF on the PROGRESS page.

Color - POS REF Page 2/3

All text on this page is white.

Information - POS REF 2/3 Page

Line 1L shows the FMCF position. The header shows if the inertial, GPS or radio is the primary source for update of the current FMCF position. The header shows one of these:

- GPS
- RADIO

- INERTIAL
- LOC-GPS
- LOC-RADIO
- LOC.

Line 2L shows the inertial position from the ADIRU.

Line 3L shows the GPS position.

Line 4L shows the radio position.

Line 5L shows the FMCF required navigation precision (RNP) and the FMCF actual position accuracy in nautical miles (NM). The RNP or actual position accuracy shows to the nearest 1/10NM if the accuracy is more than or equal to 10NM. The RNP or actual position accuracy shows to the nearest 1/100NM if the inaccuracy is less than 10NM. The active FMCF automatically sets the RNP for each flight phase. You can also manually update the RNP.

Line 5R shows the three or four letter identifiers of the navigation stations that the FMCF uses in the radio navigation solution. The header shows the active radio update mode as one of these:

- DME/DME
- LOC/LOC
- VOR/DME.

Operations - POS REF Page 2/3

To update the computed FMCF position so it matches the inertial, GPS or radio position, first push 1R, ARM>. This arms the FMCF position update function and the line changes to ARMED. Then do one of these:

- Push either 2R, NOW> to update the FMCF position to match the inertial position
- Push 3R, NOW> to update the FMCF position to match the GPS position
- Push 4R, NOW> to update the FMCF position to match the radio position.

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**FMCS - POS REF 2/3 AND 3/3 PAGES****Page Selections**

Push 6L <INDEX> to show the INIT/REF INDEX page.

Page 3/3 Access

To get access to the POS REF 3/3 page, do one of these steps:

- Push 6R BRG/DIST> while on the POS REF page 2/3
- Push NEXT PAGE function key while on the POS REF page 2/3
- Push PREV PAGE function key while on the POS INIT page.

Color - POS REF 3/3 Page

All text on this page is white except the GPS NAV ON/OFF indication. The active condition is green and the not active condition is white.

Information - POS REF 3/3 Page

Line 1L shows the left GPS sensor unit position.

Line 2L shows the right GPS sensor unit position.

Line 3L shows the position from the left FMCF.

Line 4L shows the position from the right FMCF.

Operations - POS REF 3/3 Page

To toggle the GPS position update of the FMCF ON/OFF, do one of these:

- Push 5R when ON shows and the GPS data is inhibited from the FMCF navigation solution
- Push 5R when OFF shows and the GPS data is included in the FMCF navigation solution.

To toggle the display of the GPS and FMCF positions between latitude and longitude format and bearing distance format, do one of these:

- Push 6R, LAT/LON>, to show positions latitude and longitude
- Push 6R, BRG/DIST>, to show positions bearing and distance.

Training Information Point

Refer to the Flight Operations Manual for more information related to this page.

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P O S R E F		2 / 3
F M C (G P S)	U P D A T E	
N 4 0 ° 3 8 . 0 W 0 7 3 ° 4 6 . 0	A R M	
I N E R T I A L A C T U A L	2 . 2 8 N M	
N 4 0 ° 3 8 . 0 W 0 7 3 ° 4 6 . 1		
G P S A C T U A L	0 . 0 4 N M	
N 4 0 ° 3 8 . 1 W 0 7 3 ° 4 6 . 0		
R A D I O A C T U A L	0 . 5 0 N M	
N 4 0 ° 3 8 . 8 W 0 7 3 ° 4 5 . 5		
R N P / A C T U A L	D M E D M E	
1 . 0 0 / 0 . 0 4 N M	P D X S E A	

< I N D E X	B R G / D I S T >	

P O S R E F		3 / 3
G P S L	2 7 0 ° / 0 . 0 N M	
G P S R	2 6 3 ° / 0 . 1 N M	
F M C L (P R I)	0 0 0 ° / 0 . 0 N M	
F M C R	3 5 0 ° / 0 . 2 N M	
		G P S N A V
		O F F < - > O N >

< I N D E X	L A T / L O N >	

FMCS - POS REF 2/3 AND 3/3 PAGES

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FMCS - RTE 1 1/3, 2/3, AND 3/3 PAGES

Purpose - RTE 1 1/3 Page

The purpose of the route (RTE) 1 1/3 page is to let the flight crew enter a lateral flight plan. This page shows:

- Origin station
- Runway
- Route data uplink request
- Route data downlink report
- Destination airport
- Flight number
- Company route.

The flight crew can:

- Select data to the scratchpad
- Enter data
- Delete data fields
- Select another page.

Page Access - RTE 1 1/3 Page

To get access to the RTE 1 1/3 page, do one of these steps:

- Push the RTE mode key
- Push 6R ROUTE> or 6L <ROUTE line key from another pre-flight page.

Color

All text on this page is white.

Entries - RTE 1 1/3 Page

Do this to enter an origin airport:

- Type a four character alphanumeric identifier into the scratchpad. The navigation data base must contain the identifier
- Enter into 1L.

Do this to enter a runway:

- Type a five character alphanumeric identifier into the scratchpad. The runway data may consist of an optional prefix of RW with one or two digits between one and 36 with a L, C, or R suffix.
- Enter into 2L.

Push 3L <REQUEST to send the company a data uplink request for a flight plan.

Push 4L <REPORT to send the company a data downlink of the active flight plan.

Do this to enter a destination (DEST) airport:

- Type a four character alphanumeric identifier into the scratchpad. The navigation data base must contain the identifier.
- Enter into 1R.

Do this to enter a flight number (FLT NO):

- Type up to ten alphanumeric characters into the scratchpad
- Enter into 2R.

The operator may enter a company route at 3R. This causes the relative runway to show at 2L.

Do this to enter a company route (CO ROUTE):

- Type up to ten alphanumeric characters into the scratchpad
- Enter into 3R.

A company route entry causes this page and other route pages to fill with the applicable data. The CO ROUTE can include:

- Origin
- Departure procedures
- Waypoints
- Arrival procedures
- Destination airport.

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**FMCS - RTE 1 1/3, 2/3, AND 3/3 PAGES**

To enter a ROUTE COPY, select 4R ROUTE COPY>. This causes COMPLETE to show in the data field and copies the active route into the alternate route.

Page Selections - RTE 1 1/3 Page

Push 6L <RTE 2 to show the route 2 page.

Push 6L <ERASE (shows during route modifications) to delete the lateral and vertical modifications.

Push 5R ALTN> to show the alternate page.

Push 6R ACTIVATE> to activate the flight plan. This causes the EXEC light to come on.

Push 6R PERF INIT> to show the PERF INIT (VNAV) page.

Push 6R TAKEOFF> to show the TAKEOFF REFERENCE page.

Purpose - RTE 1 2/3 Page

The purpose of the RTE 1 2/3 page is to permit the flight crew to access the VIA and TO fields for the RTE 1 flight plan. Also, it lets the flight crew enter a route offset.

Page Access - RTE 1 2/3 Page

To get access to the RTE 1 2/3 page, push the NEXT PAGE function key while on the RTE 1 1/X page.

Color

All text on this page is white.

Entries

Do this to enter a VIA departure identifier:

- Type a five character alphanumeric departure identifier that is in the navigation data base.
- Enter into 1L-5L

- Type DIRECT into the scratchpad
- Enter into 1L-5L
- Select an identifier from the DEP/ARR page
- Enter into 1L-5L.

Do this to enter a TO navaid or waypoint identifier:

- Type a valid navaid or waypoint identifier into the scratchpad
- Enter into 1R-5R.

When the airplane is not on a SID, STAR, or transition, the OFFSET prompt shows at 6R.

Do this to enter an OFFSET:

- Type an L or R into the scratchpad
- Type a one or two digit value up to 99 (nautical miles) into the scratchpad
- Enter into 6R
- Push the EXEC function key to make the OFFSET entry active.

A delete entry cancels the OFFSET.

Page Selections - RTE 1 2/3 Page

Line <6L has the same selections as <6L on the RTE 1 1/3 page.

Line 6R> has the same selections as 6R> on the RTE 1 1/3 page.

Purpose - RTE 1 3/3 Page

RTE 1 3/3 page shows continuation data from the RTE 1 2/3 page. This page also shows the missed approach procedures.

Page Access - RTE 1 3/3 Page

To get access to the RTE 1 3/3 page, push the NEXT PAGE function key from the RTE 1 2/X page.

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**FMCS - RTE 1 1/3, 2/3, AND 3/3 PAGES****Color**

All text on this page is white.

Entries - RTE 1 3/3 Page

The RTE 1 3/3 has the same entries as the RTE 1 2/3 page.

Page Selections - RTE 1 3/3 Page

Line <6L has the same selections as <6L on the RTE 1 2/3 page.

Line 6R> has the same selections as 6R> on the RTE 1 2/3 page.

Training Information Point

Refer to the Flight Operations Manual for more information related to the this page.

	RTE 1	1 / 3	
	ORIGIN	DEST	
	KJFK	KATL	
	RUNWAY	FLT NO	
	-----	ABC777	
	ROUTE	CO ROUTE	
	<REQUEST	BO 012	
	ROUTE		
	<REPORT	RTE COPY>	
	-----	ALTN>	
	<RTE 2	ACTIVATE>	

	RTE 1	2 / 3	
	VIA	TO	
	DIRECT	PSK	
	PSK.MACEY5	ATL	
	THEN		
	-----	□□□□	
	-- ROUTE DISCONTINUITY --		
	-----	TANGO	
	ILS26L	RW26L	
	<RTE 2	ACTIVATE>	

	RTE 1	3 / 3	
	VIA	TO	
	MISSED APPR	TROYS	
	-----	-----	
	<RTE 2	ACTIVATE>	

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FMCS - RTE 1 1/3, 2/3, AND 3/3 PAGES

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**FMCS - DEP/ARR INDEX PAGE****Purpose**

The departure/arrival (DEP/ARR) INDEX page gives access to the departure and arrival data lists for the origin and destination airports.

Training Information Point

Refer to the Flight Operations Manual for more information related to the this page.

Page Access

To get access to the DEP/ARR INDEX page, push the DEP/ARR mode key.

Color

All text on this page is white.

Entries

Do this to get departure and arrival information on any airport:

- Type a four letter ICAO airport identifier into the scratchpad
- Enter into 6L or 6R.

Departure and arrival selections are available after the airport entry.

Page Selections

Do this to select route 1:

- Push 1L, <DEP to show the DEPARTURE page for the origin
- Push 1R, ARR> to show the ARRIVAL page for the origin
- Push 2R, ARR> to show the ARRIVAL page for the destination.

Do this to select route 2:

- Push 3L, <DEP to show the DEPARTURE page for the origin
- Push 3R, ARR> to show the ARRIVAL page for the origin
- Push 4R, ARR> to show the ARRIVAL page for the destination.

Do this for other airport entries:

- Push 6L, <DEP to show the DEPARTURES page
- Push 1R, ARR> to show the ARRIVALS page.

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DEP / ARR INDEX		
RTE 1		
< DEP	K J F K	ARR >
	K A T L	ARR >
----- RTE 2 (ACT) -----		
< DEP	K S F O	ARR >
	K S E A	ARR >

DEP	O T H E R	ARR
< -----		----- >

FMCS - DEP/ARR INDEX PAGE

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**FMCS - DEPARTURES PAGE****Purpose**

The DEPARTURES page gives a list of runways and departure procedures that relate to the airport selection.

Page Access

To get access to the DEPARTURES page, do one of these steps:

- Push <DEP from the DEP/ARR INDEX page
- Push the DEP/ARR mode key when the airplane is on the ground and there is an active route.

Color

All text on this page is white.

Page Selections

Push 6L, <INDEX to show the DEP/ARR INDEX page.

Push 6R, ROUTE> to show the RTE page applicable with the current departures page.

Use the NEXT PAGE or PREV PAGE function keys to go to additional departure pages.

Training Information Point

Refer to the Flight Operations Manual for more information related to the this page.

K J F K		D E P A R T U R E S		1 / 2
S I D S	R T E	1	R U N W A Y S	
B E L L E 1	< S E L >	< S E L >	0 4 L	
C Y N 9			0 4 R	
F R E H 8			1 3 L	
O K W D 7			1 3 R	
P L U M E 3			2 2 L	

< I N D E X			R O U T E >	

FMCS - DEPARTURES PAGE

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**FMCS - ARRIVALS PAGE****Purpose**

The ARRIVALS page gives a list of arrival procedures related to airport selections.

Page Access

To get access to the ARRIVALS page, do one of these steps:

- Push <ARR from the DEP/ARR INDEX page
- Push the DEP/ARR mode key when an active route exists and the airplane is in flight.

Color

All text on this page is white.

Page selections

Push 6L, <INDEX to show the DEP/ARR INDEX page.

Push 6R, ROUTE> to show the RTE page related with the current ARRIVALS page.

Use the NEXT PAGE/PREV PAGE mode keys to go to more arrival pages.

Training Information Point

Refer to the Flight Operations Manual for more information related to the this page.

	KATL	ARRIVALS	1 / X	
	STARS	RTE 1	APPROACHES	
☐	LGC2	<SEL>	ILS08	☐
☐	MACEY1		ILS09	☐
☐	RMG8		ILS26	☐
☐	SINCA1		ILS27L	☐
☐	CANUK		ILS27R	☐
☐	-----			☐
	<INDEX		ROUTE>	

FMCS - ARRIVALS PAGE

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**FMCS - PERF INIT PAGE****Purpose**

The performance initialization (PERF INIT) page lets the user initialize the FMCS for performance calculations.

Page Access

To get access to the PERF INIT page do one of these steps:

- When the airplane is on the ground with the ADIRU position initialized, push the INIT/REF mode key
- Push PERF from the INIT/REF INDEX page
- Push PERF INIT from the ACT RTE page or the TAKEOFF REF page.

Color

All text on this page is white.

Data Fields

These data fields show the box prompts if the flight crew does not enter the data for the pre-flight. After the flight crew enters data, numbers show in the data fields.

This is the data that can show:

- Line 1L shows the gross weight
- Line 2L shows the total fuel
- Line 3L shows the zero fuel weight
- Line 4L shows the fuel reserves
- Line 5L shows the request prompt for performance data uplink request
- Line 6L shows the index page prompt
- Line 1R shows the cruise altitude
- Line 2R shows the cost index
- Line 3R shows the fuel freeze temperature
- Line 4R shows the cruise center of gravity
- Line 5R shows the step size

- Line 6R shows the thrust limit page prompt.

Page Selections

Push the 6L <INDEX to show the INIT/REF INDEX page.

Push the 6R THRUST LIM> to show the THRUST LIM page.

Training Information Point

Refer to the Flight Operations Manual for more information related to the this page.

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	PERF INIT										
	GR WT					CRZ ALT					
	□□□.□					□□□□					
	FUEL					COST INDEX					
	115.0LB CALC					□□□□					
	ZFW					FUEL FRZ TEMP					
	□□□.□					-37°C					
	RESERVES					CRZ CG					
	□□□.□					20.0%					
	PERF INIT					STEP SIZE					
	<REQUEST					ICAO					

	<INDEX					THRUST LIM>					

FMCS - PERF INIT PAGE

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**FMCS - THRUST LIM PAGE****Purpose**

The thrust limit (THRUST LIM) page permits these operations:

- Takeoff thrust selection
- Climb thrust selection
- Temperature entries for the assumed temperature derate function.
- APU to Pack Takeoff selection

The thrust limit page also shows the thrust limit for the selected mode.

Page Access

To get access to the THRUST LIM page, push the INIT/REF mode key when the airplane is in the air and in the climb mode. You can also push key 6R from any of these CDU pages to get access to the THRUST LIM page:

- INIT/REF INDEX page
- PERF INIT page
- TAKEOFF REF page
- APPROACH REF page

Color

All text on this page is white.

Information

Line 1C is the outside air temperature (OAT) from the ADIRU or the SAARU.

Line 1R is the current N1 limit value from the FMCF/TMCF. The header show the selected thrust limit mode followed by a space and N1. If an assumed temperature derate is active, the thrust limit mode has a D before it.

Entries

To enter a selected temperature:

- Make sure the airplane is on the ground and autothrottle is not engaged

- Type a valid Celsius temperature between 0 and 99 or a valid Fahrenheit temperature between 32 and 210
- Enter into 1L.

Operations

To select APU to Pack Takeoff:

- Type APU and enter into 1L
- APU is displayed in small font
- After bleed valves successfully configure for APU to Pack Takeoff, TMF augments N1 based on Bleed Monitor and APU is displayed in large font

To make a takeoff thrust selection, do one of these:

- Push 2L, <TO on the ground or <GA in the air
- Push 3L, TO 1
- Push 4L, TO 2.

<SEL> shows next to the selected takeoff thrust derate.

To make a climb thrust selection, do one of these:

- Push 2R, CLB>
- Push 3R, CLB 1>
- Push 4R, CLB 2>.

<ARM> shows next to the selected climb thrust derate.

Page Selections

Push 6L, <INDEX to show the INIT/REF INDEX page.

Push 6R, TAKEOFF>, to show the TAKEOFF REF page.

Training Information Point

Refer to the flight operations manual for more information about this page.

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	T H R U S T L I M				
	A P U / S E L	O A T	T O	N 1	
	A P U	1 2 ° C		9 9 . 6 %	
	< T O				C L B >
	T O 1				
	< - 8 %	< S E L >	< A R M >	C L B 1 >	
	T O 2				
	< - 2 0 %				C L B 2 >

	< I N D E X		T A K E O F F >		

FMCS-THRUST LIM PAGE

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**FMCS - TAKEOFF REF PAGE****Purpose**

The takeoff reference (TAKEOFF REF) page shows preflight FMCF initialization status. This page permits manual entries and shows FMCF takeoff calculation data.

Page Access

To get access to the TAKEOFF REF page, push the INIT/REF mode key when preflight status is complete. Also, to get access to the TAKEOFF REF page, push the TAKEOFF line select key from one of these CDU pages:

- INIT/REF INDEX page
- PERF INIT page
- THRUST LIM page
- RTE page.

Color

All text on this page is white.

Data Fields

These data fields show for the TAKEOFF REF page 1/2:

- 1L - takeoff flaps selection
- 2L - assumed temperature for the takeoff thrust derate calculations
- 3L - center of gravity (CG) and stabilizer trim takeoff setting
- 4L - takeoff runway and takeoff distance from the runway threshold
- 5L - prompt to request for a takeoff data uplink
- 1R - decision speed (V1)
- 2R - rotate speed (VR)
- 3R - engine out climb speed (V2)
- 4R - takeoff gross weight
- 5R - status of the reference speeds display. When OFF shows in green, the reference speeds do not show. When ON shows in green, the reference speeds show in the center column next to the V speeds.

These data fields show for the TAKEOFF REF page 2/2:

- 3L - wind direction and wind speed
- 4L - FMC calculated headwind/tailwind and crosswind components for the takeoff runway and surface wind
- 5L - runway slope
- 1R - engine out acceleration height
- 2R - acceleration height
- 3R - thrust reduction altitude or flaps setting
- 4R - uplinked takeoff gross weight
- 5R - outside air temperature.

Page Selections

Push 6L, <INDEX to show the INIT/REF INDEX page.

Push 6R on page 1/2 to show one of these pages:

- POS INIT> - This shows when on the ground and ADIRU initialization is not complete.
- ROUTE> - This shows when the ADIRU POS INIT page is complete and the RTE page is not complete.
- PERF INIT> - This shows when the route page is complete and the PERF INIT page is not complete.
- THRUST LIM> - This shows if none of the other conditions exist.

Training Information Point

Refer to the flight operations manual for more information about the TAKEOFF REF page.

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FMCS-TAKEOFF REF PAGE

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**FMCS - APPROACH REF PAGE****Purpose**

The approach reference (APPROACH REF) page shows approach data.

Page Access

To get access to the APPROACH REF page, do one of these steps:

- Select APPROACH from the INIT/REF INDEX page
- Push the INIT/REF mode key during flight when the climb mode is not active.

Color

All text is white or green.

Data Fields

The APPROACH REF page shows these data fields:

- 1L - gross weight
- 3L - landing reference as QFE or QNH. QFE is active when it shows in large green font. QNH is active when it shows in large green font. Only one reference can be active at one time
- 4L - runway length in feet and meters
- 1R, 2R, and 3R - calculated landing flaps setting a related landing speed
- 4R - entered landing flaps setting and related landing speed.

Page Selections

Push 6L - <INDEX, to show the INIT/REF page.

Push 6R - THRUST LIM>, to show the THRUST LIM page.

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A P P R O A C H R E F			
G R O S S W T	F L A P S	V R E F	
1 5 0 . 0	2 0 °	1 3 0 K T	
		2 5 °	1 2 7 K T
L A N D I N G R E F			
Q F E ← → Q N H	3 0 °	1 2 4 K T	
K A T L 2 6 R	F L A P / S P E E D		
1 0 0 0 0 F T 3 0 4 8 M	2 5 / 1 3 5		

< I N D E X		T H R U S T L I M >	

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FMCS - APPROACH REF PAGE

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FMCS - REF NAV DATA PAGE

Purpose

The reference navigation (REF NAV) data page shows additional data for any entered waypoint, navaid, airport, or destination runway in the data base or the flight plan route. The page also lets the user inhibit use of specific navaids for position update and inhibit the VOR/DME position update.

Page Access

To get access to this page, select NAV DATA from the INIT/REF INDEX page.

Color

All text on this page is white except for the selected VOR/DME option at 6R. The selected state (OFF or ON) is green.

Information

Line 1L shows one of these:

- Navaid
- Waypoint
- Airport
- Runway.

Line 1R, 2L, 2R, 3L, and 3R shows data that relates to the item in 1L.

Line 1R shows the frequency of the item in 1L if it is a navaid.

Line 2L and 2R shows the latitude and longitude of the item in 1L.

Line 3L shows magnetic variation of the item in 1L if it is a navaid with an associated VOR. Line 3L shows the runway length in feet or meters of the item in 1L if it is a runway. Line 3L is blank if for all other entries in 1L.

Line 3R shows this data:

- Elevation of the item in 1L if it is valid navaid that is not a VOR
- Valid navaid that is not a LOC only, an airport, or a runway.

Entries

To get additional information on a waypoint, navaid, airport or destination runway:

- Type an identifier for a waypoint, navaid, airport or destination runway into the scratchpad
- Enter this into 1L.

This data shows in 1R, 2L, 2R, 3L and 3R:

- Frequency
- Latitude and longitude
- Magnetic variation
- Runway length
- Elevation.

To inhibit a nav aid for use in navigation position updating:

- Type an identifier for a navaid into the scratchpad
- Enter this into 4L or 4R.

You can replace or delete data from Line 4L and 4R.

To inhibit a VOR for use in navigation position updating:

- Type an identifier for a VOR into the scratchpad
- Enter this into 5L or 5R.

You can replace or delete data from Line 5L and 5R.

Operation

To toggle the VOR/DME NAV radio position update:

- Select 6R when OFF is in large font to change the radio position update to ON
- Select 6R when ON is in large font to change the radio position to OFF.

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**FMCS - REF NAV DATA PAGE**

When the radio position update is OFF, the VOR/DME radio position update is inhibited. Any navigation aids previously selected for VOR inhibit are cleared and ALL shows in 5L and 5R.

When radio position update is ON, the VOR/DME radio position update is enabled. Dashes show in 5L and 5R and individual navigation aids can be inhibited.

Page Selections

Select 6L <INDEX to show the INIT/REF INDEX page.

REF NAV DATA			
IDENT			FREQ
ABC			113.30
LATITUDE	LONGITUDE		
N50°36.4	W082°16.4		
MAG VAR	ELEVATION		
E15			1600FT
NAVAID INHIBIT			
----			----
VOR ONLY INHIBIT			
----			----
-----VOR/DME NAV			
<INDEX			OFF<->ON>

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FMCS - REF NAV DATA PAGE

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FMCS - NAV RADIO PAGE

Purpose

You use the NAV RADIO page on the left and right CDUs to manually tune the VOR/DME, ADF, and ILS radios.

Page Access

To get access to the NAV RADIO page, push the NAV RAD mode key. This causes the NAV RADIO page to show for that CDU when the FMCF is the tuning source. The ALTN NAV RADIO page shows when the FMCFs fail.

Color

All text on this page is white, except for these conditions:

- The VOR frequency and the identifier is green at 1L and 1R
- Course is green at 2L and 2R
- The ADF frequency is cyan at 3L and 3R.

VOR Tuning

These are the four ways the FMC tunes a VOR radio:

- Auto-tune (A)
- Procedure (P) tune
- Route (R) tune
- Manual (M) tune.

The letter A shows between the frequency and the identifier for the auto-tune mode. The FMC automatically tunes to the best available VOR station.

The letter P shows between the frequency and the identifier for the procedure auto-tune mode. The FMC automatically tunes to a navaid necessary for approach or departure procedures. The approach or departure procedure is part of the FMC flight plan.

The letter R shows between the frequency and the identifier for the route auto-tune mode. The FMC automatically tunes to a navaid that is a waypoint on the FMC flight plan.

The letter M shows between the frequency and the identifier for the manual-tune mode. You can manually tune the VOR radios at any time. The manual tune procedure overrides the A, P or R auto-tune modes.

To manually tune a VOR radio, you must enter a valid VOR frequency or station identifier into the scratch pad. Then line select the frequency or the identifier into 1L to tune the left VOR, or 1R to tune the right VOR.

The VOR frequency range is 108.0 to 117.95 MHz. Frequencies in odd tenths between 108.0 to 111.95 are not valid VOR frequencies. All frequencies from 112 to 117.95 MHz are valid VOR frequencies.

After manual tuning, dashes show at 2L and 2R to let you enter a VOR course.

To enter a VOR course at 2L or 2R, do this:

- Type a three digit number between 000 and 360 into the scratchpad
- Enter into 2L or 2R.

To delete the VOR course at 2L or 2R do this:

- Push the DEL key, DELETE shows in the scratchpad
- Enter into 2L or 2R.

After you delete the VOR course, the dashes show again.

To return to the auto-tune mode, do this:

- Push the DEL key, DELETE shows in the scratchpad
- Enter into 1L or 1R.

The letter A, P or R shows between the frequency and the identifier at 1L or 1R.

ADF Tuning

To enter or change an ADF frequency at 3L or 3R, do this:

- Type a three or four digit number between 190 and 1750 into the scratchpad
- Enter into 3L or 3R.

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FMCS - NAV RADIO PAGE

To enter an A (ANT) or B (BFO) ADF tune mode at 3L or 3R, do this:

- Type the letter A (ANT) or B (BFO) into the scratchpad
- Enter into 3L or 3R.

To delete an A (ANT) or B (BFO), do this:

- Push the delete key. DELETE shows in the scratchpad
- Enter into line 3L or 3R.

The deletion causes the mode to return to ADF and no A or B shows.

You cannot use the DELETE key to delete an existing ADF frequency.

ILS Tuning

The multi-mode receivers (MMRs) are automatically tuned by the FMCFs when the destination runway is part of the active flight plan. You can also manually tune all MMRs and enter an ILS course.

If there is a destination runway entered as part of the FMC flight plan, 4L on the NAV RAD page shows this information:

- PARK in large font if the airplane is more than 200 nm from the top of descent or less than halfway to the destination. The multi-mode receivers (MMRs) are not tuned at this time.
- A prompt, ILS frequency, ILS course, and PARK in medium font when the airplane is less than 200 nm from the top of descent or more than halfway to the destination. The MMRs are not tuned at this time. Selection of the prompt manually tunes the MMRs to the ILS frequency that shows.
- The ILS frequency, ILS course, and the letter A to show the auto-tune mode. This occurs when the airplane is less than 50 nm from the top of descent or less than 150 nm from the runway threshold.

Manual tuning overrides the auto-tune mode. The letter M replaces the letter A to show that the MMRs are manually tuned.

To manually tune the MMRs, do this:

- Type an ILS frequency between 108.10 to 111.95 (odd tenths)

- Type a course between 000 to 360 with a leading slash
- Enter into 4L.

To return to the auto-tune mode, do this:

- Push the DEL key, DELETE shows in the scratchpad
- Enter into 4L.

Preselect line

The preselect line can store additional tuning data in 6L and 6R for later use. Enter in the additional tuning data into the scratchpad then line select it to the preselect line. To use this data on the preselect line, do this:

- Push 6L or 6R to make the data go into the scratch pad
- Push the related key 1L, 2L, 3L, 4L, 1R, 2R, 3R, or 4R to enter the data in that line.

Training Information Point

Refer to the flight operations manual for more information about this CDU page.

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NAV RADIO			
VOR L		VOR R	
116.80	ASEA	ELNM	117.90
CRS		CRS	
	RADIAL		
	182	172	
ADF L		ADF R	
1304.5	BFO		
ILS-MLS			
<110.90 / 128° PARK			
PRESELECT			
-----		-----	

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FMCS - NAV RADIO PAGE

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**FMCS - MAINTENANCE INDEX PAGE****Purpose**

Use the MAINTENANCE INDEX page to access several pages of data. These pages let maintenance personnel examine and change FMCF policy data and monitor ADIRU inertial position data.

Page Access

To get access to the MAINTENANCE INDEX page the airplane must be on the ground. Select MAINT> from the INIT/REF INDEX page.

Color

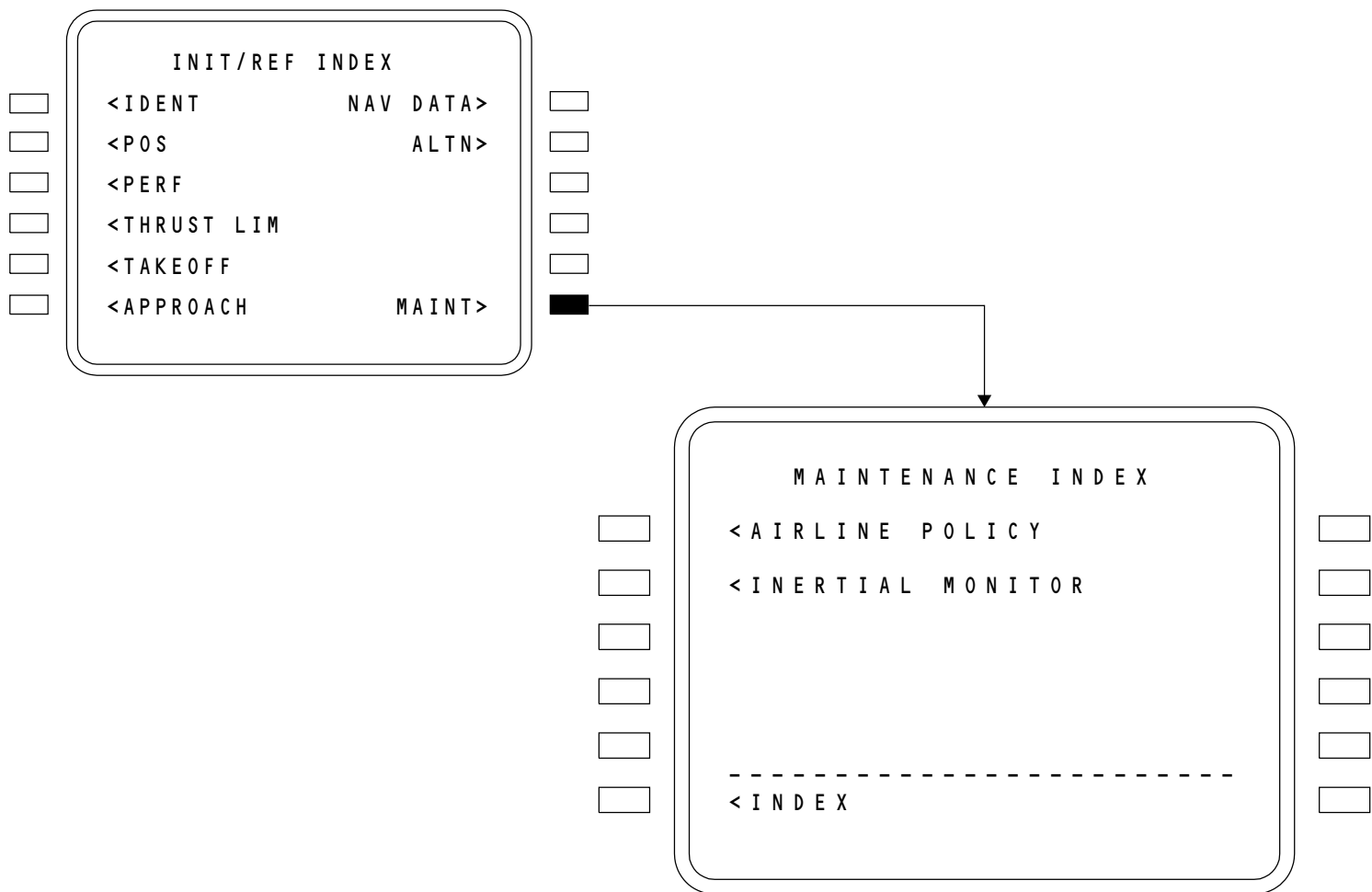
All text on this page is white.

Page Selections

Select 1L, <AIRLINE POLICY, to show the AIRLINE POLICY pages.

Select 2L, <INERTIAL MONITOR, to show the INERTIAL MONITOR page.

Select 6L, <INDEX, to show the INIT/REF INDEX page.



FMCS - MAINTENANCE INDEX PAGE

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FMCS - AIRLINE POLICY 1/2 PAGE

Purpose

Use the AIRLINE POLICY 1/2 page to see some values from the airline modifiable information (AMI) file and the operational program configuration (OPC) file.

Page Access

To get access to the AIRLINE POLICY 1/2 page, select <AIRLINE POLICY from the MAINTENANCE INDEX page.

Color

All text on this page is white.

Information

Line 3L is the maneuver margin. This number is from the AMI. If the AMI is invalid or not loaded, the FMCF default value shows.

Line 4L is the minimum cruise time. This number is from the AMI. If the AMI is invalid or not loaded, the FMCF default value shows.

Line 5L is the fuel freeze temperature. This number is from the AMI. If the AMI is invalid or not loaded, the FMCF default value shows.

Line 1R is the option code. This option code is from the OPC.

Line 2R is the minimum rate of climb margin in climb. This number is from the AMI. If the AMI is invalid or not loaded, the FMCF default value shows.

Line 3R is the default thrust rating in cruise and minimum rate of climb margin in cruise. This number is from the AMI. If the AMI is invalid or not loaded, the FMCF default value shows.

Line 4R is the default thrust reduction height or the thrust reduction flap setting. Thrust reduction values show in feet for the altitude or show as FLAPS1 and FLAPS5. This number is from the AMI. If the AMI is invalid or not loaded, the FMCF default value shows.

Line 5R is the default all engine acceleration height and the default engine out acceleration height. This number is from the AMI. If the AMI is invalid or not loaded, the FMCF default value shows.

Line 6R is the AMI software part number. If no AMI is loaded, the field is blank.

Entries

To enter a takeoff derate percentage:

- Type a number between 0 and 30% and, if you enter two percentages separate them by a /, into the scratchpad
- Enter this into 2L.

You can also delete this value. When you delete an entered value, the takeoff derate percentage that shows returns to the FMCF default value.

Page Selections

Select 6L, <INDEX, to show the MAINTENANCE INDEX page.

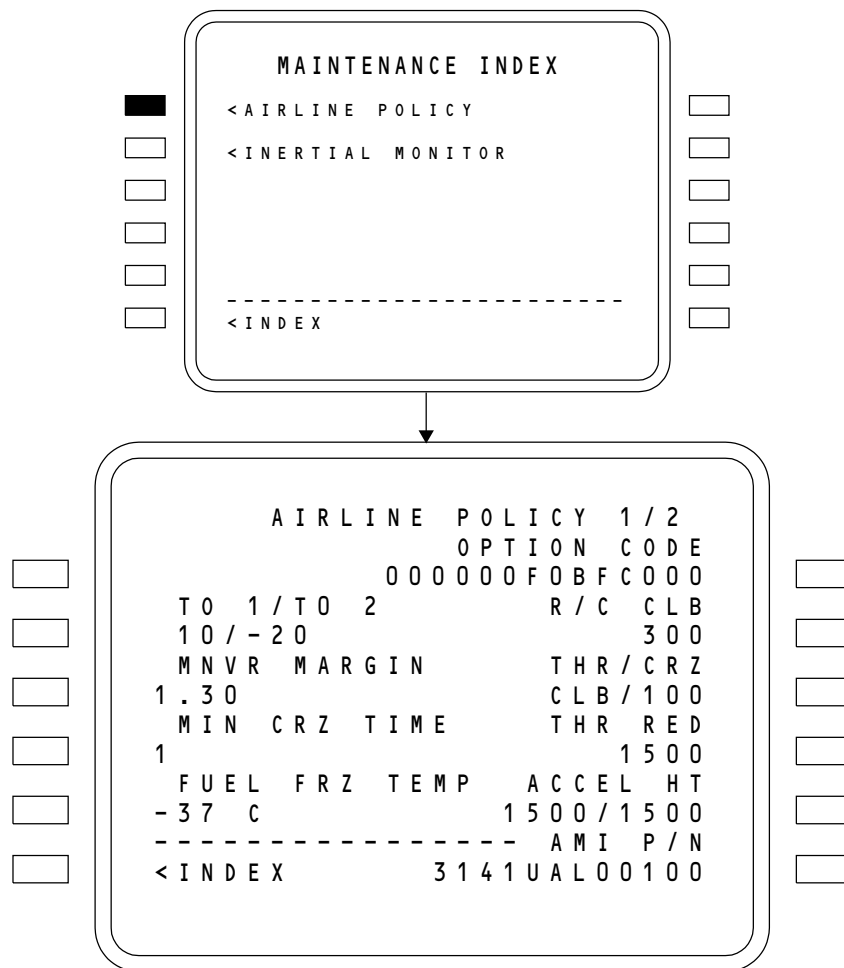
Select the NEXT PAGE / PREV PAGE mode key to see AIRLINE POLICY page 2/2.

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FMCS - AIRLINE POLICY 1/2 PAGE

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FMCS - AIRLINE POLICY 2/2 PAGE

Purpose

Use the AIRLINE POLICY 2/2 page to see values from the airline modifiable information (AMI) file.

Page Access

To get access to the AIRLINE POLICY 2/2 page, do these steps:

- Select <AIRLINE POLICY from the MAINTENANCE INDEX page
- Push the NEXT PAGE function key.

Color

All text on this page is white.

Information

Line 1L is the default speed transition computed airspeed and the default speed transition altitude. The data is from the AMI. If the AMI is invalid or not loaded, the FMCF default value shows. The default value is the customer's baseline or delivered configuration without the AMI.

Line 2L is the alternate minimum runway length. The data is from the AMI. If the AMI is invalid or not loaded, the FMCF default value shows.

Line 3L is the alternate default speed mode. The data is from the AMI. If the AMI is invalid or not loaded, the FMCF default value shows.

Line 4L is the company speed thrust rating. The data is from the AMI. If the AMI is invalid or not loaded, the FMCF default value shows.

Line 5L is the company speed. The data is from the AMI. If the AMI is invalid or not loaded, the FMCF default value shows.

Line 1R is the default speed restriction computed airspeed and default speed restriction altitude. The data is from the AMI. If there is no AMI loaded, this field is blank.

Line 2R is the alternate altitude. The data is from the AMI. If there is no AMI loaded, this field is blank.

Line 3R is the data link option code. The data is from the AMI. If the AMI is invalid or not loaded, the FMCF default value shows.

Line 4R is the engine out drag factor. The data is from the Boeing navigation database. If a non-Boeing database is loaded, it is blank.

Line 5R is the minimum idle thrust descent factor and approach idle thrust descent factor. The data is from the Boeing navigation database. If a non-Boeing database is loaded, it is blank.

Page Selections

Select 6L, <INDEX to show the MAINTENANCE INDEX page.

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	AIRLINE POLICY 2 / 2				
	SPD	TRANS	SPD	RESTR	
	250	/10000	270	/12000	
	ALTN	RWY LGTH	ALTN	ALT	
	8000	FT	FL	240	
	ALTN	SPD	DATA	LINK	
	EOLRC		003	FFC00	
	CO	SPD THR	EO	DRAG	
	CRZ			+5.0	
	CO	SPD	IDLE	MIN / APP	
	263	/ .82	+2.0	/ -2.0	

	< INDEX				

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FMCS - AIRLINE POLICY 2/2 PAGE

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**FMCS - INERTIAL MONITOR PAGE****Purpose**

The inertial monitor page shows the position error rate for the ADIRU.

Page Access

To get access to the INERTIAL MONITOR page, select <INERTIAL MONITOR from the MAINTENANCE INDEX page.

Color

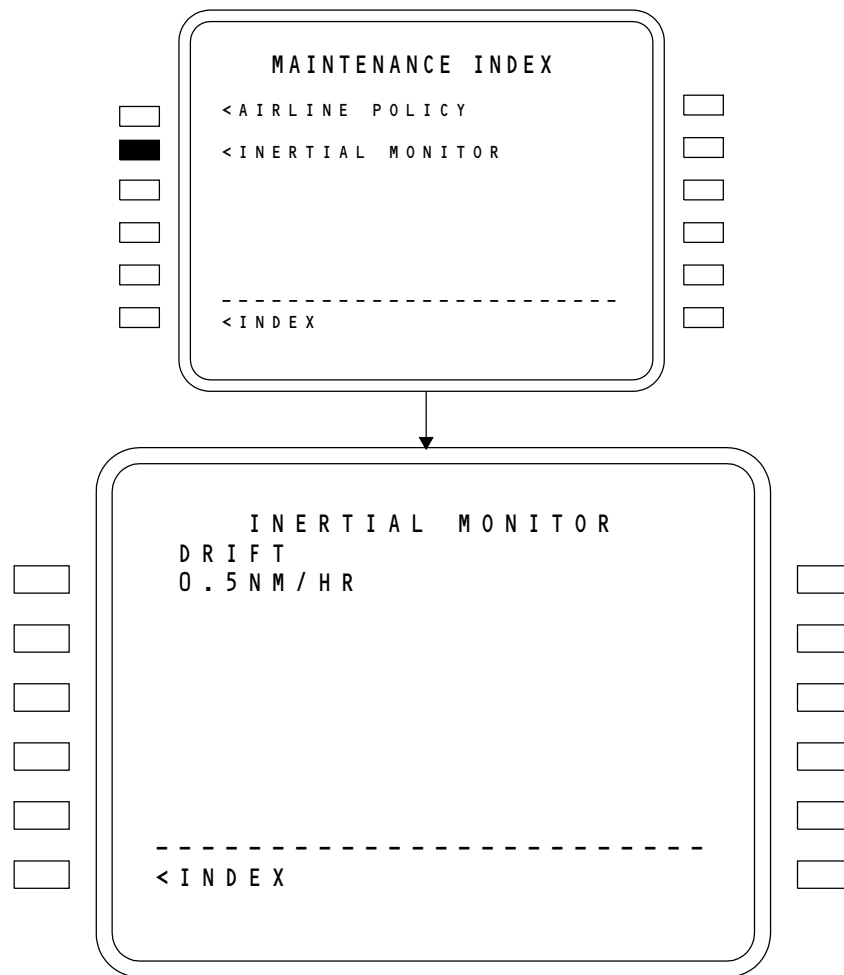
All text on this page is white.

Information

Line 1L is the inertial monitor drift. The drift rate shows for the last completed flight. It clears at the ground-to-air transition.

Page Selections

Select 6L, <INDEX to show the MAINTENANCE INDEX.



FMCS - INERTIAL MONITOR PAGE

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FMCS - ACT ECON CLB PAGE**Purpose**

The active economy climb (ACT ECON CLB) page lets the flight crew change the current climb or next climb segment during the VNAV mode of operation.

Page Access

To get access to the CLB page, do one of these steps when the VNAV mode is active:

- Push the VNAV mode key
- Push the PREV PAGE function key when the CRZ page shows
- Push the NEXT PAGE function key when the DES page shows.

The CLB page also shows automatically when the airplane sequences to a missed approach.

Color

All text on this page is white except the SEL SPD or MACH. They are magenta when VNAV is active in climb.

Information

The ACT ECON CLB page shows this data in flight:

- ECON SPD
- SEL SPD. The last climb speed mode is a pilot entry or default speed transition speed
- EO SPD. The last segment speed mode is an engine-out minimum drag
- The speed and altitude at the waypoint in the lateral flight plan
- Vertical error for the waypoint, fix, or navaid identifier
- Along track error in nautical miles (NM)
- Undershoot error in feet
- Transition speed and speed transition altitude.

		ACT	ECON	CLB	1 / 3	
	CRZ	ALT		AT	RUBEL	
	FL 350			230 /	5000	
	ECON	SPD			ERROR	
	280			350 LO	2 LONG	
	SPD	TRANS		TRANS	ALT	
	250 / 10000				18000	
	SPD	RESTR		MAX	ANGLE	
	--- / ---			215 /	.640	

				ENG	OUT >	
				CLB	DIR >	

FMCS - ACT ECON CLB PAGE

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FMCS - ACT ECON CRZ PAGE**Purpose**

The active economy cruise (ACT ECON CRZ) page lets the flight crew review the fuel burn and time to destination for these flight conditions:

- Optimum step climbs that occur in cruise
- Step climbs that occur at preset points in the flight plan
- A flight plan that has no steps in the cruise flight phase.

- ETA at destination airport or fix identifier
- Fuel that remains at destination airport or fix identifier
- Optimum altitude
- Maximum altitude.

Page Access

To get access to the CRZ page, do one of these steps:

- Push the VNAV mode key
- push the NEXT PAGE function key when the CLB page shows
- Push the PREV PAGE function key when the DES page shows
- The CRZ page shows automatically when the airplane captures the mode control panel (MCP) cruise altitude.

Color

All text on this page is white except for these conditions:

- The FMC target altitude is magenta when the route is active or is modified active
- The FMCF target speed/mach (ECON, EO, LRC, CO SPD, or SEL SPD) is magenta when the route is active or modified active.

Information

The ACT ECON CRZ page shows this data in flight:

- Engine thrust target
- Lo speed compressor RPM (N1)
- Distance to go (DTG) to a waypoint in the flight plan
- Estimated time of arrival (ETA) to a waypoint in the flight plan
- Destination airport identifier or fix identifier

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	ACT	ECON	CRZ	2 / 3	
	CRZ	ALT		STEP	TO
	FL 350			FL 370	
	SEL	SPD		AT	
	.810		1004Z / 1200NM		
	N1		KATL	ETA / FUEL	
	95.31		2003Z / 100.6		
	STEP	SIZE	OPT	MAX	
	ICAO		FL 358	FL 376	

			ENG	OUT >	
			LRC >		

FMCS - ACT ECON CRZ PAGE

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**FMCS - ACT ECON DES PAGE****Purpose**

The active economy descent (ACT ECON DES) page lets the flight crew review and change the current DES and next DES flight segments.

The flight crew can:

- Select data
- Enter data
- Delete data fields
- Select another page.

Page Access

To get access to the DES page, do one of these steps:

- Push the VNAV mode key when VNAV is active and descent is the active flight phase
- Push the PREV PAGE function key when the climb page shows
- Push the NEXT PAGE function key when the CRZ page shows
- This page shows automatically when the airplane transitions from the CRZ flight phase to the DES flight phase and VNAV is active
- Select 6L (DES) on the OFFPATH DES page
- Select 6R (DES) on the DES FORECASTS page.

Color

All text on this page is white except for these conditions:

- The FMCF target altitude and waypoint is magenta when a lateral route is active or modified active
- The FMCF target speed (ECON or SEL) is magenta when a lateral route is active or modified active
- The FMCF target computed airspeed (CAS) and mach is magenta when a lateral route is active or a modified active, the mach value shows magenta when both values appear

- The FMCF target speed (SEL SPD) is magenta when the lateral route is active or modified active.

Information

The ACT ECON DES page shows this data in flight:

- End of descent (E/D) constraint altitude and at (AT) constraint waypoint identifier
- Speed/mach and transition altitude in descent
- The next waypoint constraint (AT) or HOLD AT and its intercept (INTC) target altitude (AT, A = above, or B = below).

	ACT	ECON	DES	3 / 3
E / D	AT		AT	(INTC)
2200		RW13R		2200A
ECON	SPD			
250				
SPD	TRANS			
240	10000			
SPD	RESTR			
---	/	----		

			FORECAST	>
<OFFPATH	DES		DES	DIR>

FMCS - ACT ECON DES PAGE

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FMCS - DESCENT FORECAST PAGE

Purpose

The descent forecast page lets the flight crew enter forecast values of parameters to more accurately define the computed descent profile. These parameters can also be sent on datalink.

Page Access

To get access to the DESCENT FORECAST page, select FORECAST> from the descent page.

Color

All text on this page is white.

Entries

Do this to enter a transition level:

- Type a valid altitude into the scratchpad
- Enter this into 1L.

For the descent phase, the default value for the transition level is FL180. If an arrival procedure has a transition level, it shows.

Do this to enter an altitude for expected thermal anti-ice:

- Type a valid altitude into the scratchpad
- Enter into 1R.

Do this to enter descent wind altitudes with wind direction and speed:

- Type a valid altitude into the scratchpad
- Enter this into 2L-5L
- Type a wind direction followed by a / and wind speed into the scratchpad
- Enter into 2R-5R.

Operations

Use 6L to control uplink function defined by the airline through the airline modifiable information (AMI).

Page Selections

Select 6R, DES> to show the descent page.

DESCENT FORECAST			
TRANS	LVL	TAI/ON	ALT
FL 180			-----
ALT		WIND DIR/SPD	
FL 290		090 ° / 105 KT	
FL 210		078 ° / 69 KT	
5000		130 ° / 29 KT	
-----		--- ° / --- KT	
FORECAST		-----	
< REQUEST		DES >	

FMCS - DESCENT FORECAST PAGE

M37600 S000619913_V1

34-61-00

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FMCS - OFFPATH DES PAGE**Purpose**

The OFFPATH descent (DES) page lets the flight crew review data that relates to a clean or speed brake descent to a specific point. The flight crew can select, enter, or delete data fields or go to another page.

Page Access

To get access to the OFFPATH DES page, do one of these steps:

- Select OFFPATH DES from the ACT ECON DES page
- Select OFFPATH DES from the DESCENT FORECASTS page.

Entry to this page does not require an active route or an end of descent point.

Color

All text on this page is white except for these conditions:

- The FMCF target speed (ECON or SEL) is magenta when a lateral route is active or modified active state
- The FMCF target computed airspeed (CAS) and mach is magenta when a lateral route is active or a modified active, the mach value is magenta when both values appear
- The FMCF target speed (SEL SPD) is magenta when the lateral route is active or modified active
- The display font ON is green when it is large font.

Information

The OFFPATH DES page shows this data in the descent flight phase:

- Speed and transition altitude in descent
- Distance from the airplane to the clean descent path at the current altitude for a clean idle descent
- Distance from the airplane to the drag descent path at the current altitude for a full speed brake idle descent.

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		OFFPATH DES		
	DES TO	DTG	SPD / ALT	
	NOLLA	150	170 / 2200	
	ECON SPD		TO CLEAN	
	.805 / 270		-25NM	
	SPD TRANS		TO DRAG	
	240 / 10000		89NM	
	SPD RESTR			
	--- / -----			

			DISPLAY	
	<DES	OFF < -> ON>		

FMCS - OFFPATH DES PAGE

M37601 S000619914_V1

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**FMCS - ACT RTE 1 DATA PAGE****Purpose**

The active route (ACT RTE) 1 DATA page shows additional route data for the flight crew.

Page Access

To get access to the ACT RTE 1 DATA page, do one of these steps:

- Select the <RTE DATA prompt on a ACT RTE 1 LEGS page
- Push the NEXT PAGE or PREV PAGE function key while on the RTE DATA page
- Select the <RTE DATA prompt on an ACT WIND page.

Color

All text on this page is white except the identifier at 1C. It is magenta when the route is active or modified active.

Information

The ACT RTE 1 DATA page shows this data in flight:

- Estimated time of arrival (ETA)
- Waypoint name
- Fuel that remains on arrival
- Wind data options.

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☐	ACT RTE 1 DATA 15/20	☐
☐	ETA WPT FUEL WIND	☐
☐	0122Z EAT 131.7 W>	☐
☐	0130Z DUVAL 128.5 >	☐
☐	-- ROUTE DISCONTINUITY -	☐
☐	0213Z N47W101 105.3 >	☐
☐	1320Z NOLLA 99.7 W>	☐
☐	----- WIND DATA	☐
	<LEGS REQUEST>	

FMCS - ACT RTE 1 DATA PAGE

M37602 S000619915_V1

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**FMCS - WINDS PAGE****Purpose**

The WINDS page shows wind forecast and outside air temperature (OAT) at specific altitude entries for up to 120 waypoints.

Page Access

To get access to the WINDS page, select the W> prompt on a RTE DATA page next to the waypoint. Push the NEXT PAGE or PREV PAGE function key while on the WIND page to go to another WINDS page.

Color

All text on this page is white.

Information

This data shows on the WINDS page:

- WINDS waypoint in the page title field
- Wind direction in degrees for the altitude and speed
- A single OAT and altitude entry at 5R that modifies all OATs on lines 1L through 4L.

	N 4 0 W 1 2 2	W I N D S	3 0 / 1 0 0	
	A L T	O A T	D I R / S P D	
	- - - - -			
	- - - - -			
	F L 3 3 0	- 5 3 ° C	3 1 5 ° / 1 0 0 K T	
	F L 2 7 0	- 4 1 ° C	3 1 7 ° / 9 3 K T	
	A L T / O A T			
	- - - - - / - - - ° C			
	- - - - -			
	R T E D A T A >			

FMCS - WINDS PAGE

M37603 S000619916_V1

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**FMCS - MOD RTE 1 LEGS PAGE****Purpose**

The modified route (MOD RTE) 1 LEGS page shows the same data as ACT RTE 1 LEGS page. This page lets the flight crew review the waypoints and their speed/altitude in the flight plan.

Page Access

To get access to the MOD RTE 1 LEGS page, do one of these steps:

- Enter a valid waypoint over an active waypoint on the ACT RTE 1 LEGS page
- Push the PREV PAGE or NEXT PAGE function key while on the DIR/INTC RTE LEGS page 2/XX.

Color

All text on this page is white.

Entries

The MOD RTE 1 LEGS page shows this data during a flight plan change:

- XYZXXX where XYZ is the waypoint identifier
- Waypoint identifier
- Navaid identifier
- Airport
- Runway for destination airport
- Along track offset
- lat/lon
- Speed
- Altitude
- Intercept course.

	MOD	RTE	1	LEGS	1 / X	
	286°					
	XYZ			260 /	6000	
	THEN					
	□□□□					
	--	ROUTE		DISCONTINUITY	--	
	CYN			250 /	6000	
	320°		27NM	-----		
	ENO			ABEAM	PTS>	
	249°		60NM			
	ENO			RTE	COPY>	
	-----			INTC	CRS	
	<ERASE				□□□	

FMCS - MOD RTE 1 LEGS PAGE

M37604 S000619917_V1

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**FMCS - MOD RTE 1 HOLD PAGE****Purpose**

The modified route (MOD RTE) 1 HOLD page lets the flight crew review and change HOLD information that relates to a fix.

Page Access

To get access to the HOLD page, do one of these steps:

- Push the HOLD mode key when a HOLD pattern is part of the active flight plan
- Push the NEXT PAGE or PREV PAGE function key when on a RTE HOLD page.

This page shows automatically when a valid HOLD fix is in the active flight plan and the HOLD waypoint is the next waypoint in the flight plan

Color

All text on this page is white except for these FMCF target values that are magenta when the route is active or modified active:

- INBD CRS/DIR
- LEG DIST
- SPD/TGT ALT
- BEST SPEED
- The fix identifier.

RTE X HOLD shows cyan when the route is not active.

Information

The MOD RTE 1 HOLD page shows this data:

- The hold fix
- Quadrant/radial
- Inbound course/turn
- Leg time in minutes
- Leg distance in nautical miles

- Speed/target altitude at the hold fix
- Estimated time of arrival (ETA) to the hold fix
- Estimated further clearance (EFC) time
- The hold time available in hours and minutes at the current fuel burn rate
- Best speed for the hold.

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☐	MOD RTE 1 HOLD 1 / X	☐
☐	FIX SPD / TGT ALT	☐
☐	LOGEN 210 / FL 230	☐
☐	QUAD / RADIAL FIX ETA	☐
☐	NE / 030 ° 1424.5 Z	☐
☐	INBD CRS / DIR EFC TIME	☐
☐	210 ° / R TURN - - - - Z	☐
☐	LEG TIME HOLD AVAIL	☐
☐	1.5 MIN 0+48	☐
☐	LEG DIST BEST SPEED	☐
☐	- - . - NM 220KT	☐
☐	- - - - -	☐
☐	< E R A S E	☐

FMCS - MOD RTE 1 HOLD PAGE

M37605 S000619918_V1

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**FMCS - PROGRESS PAGE 1/2****Purpose**

The PROGRESS 1/2 page shows dynamic data that relates to the flight progress.

Page Access

To get access to the PROGRESS 1/2 page, do one of these steps:

- Push the PROG mode key
- Push the NEXT PAGE or PREV PAGE function key when on PROGRESS 2/2 page
- Select the <PROGRESS prompt when on the POS REPORT page.

Color

All text on this page is white except the FMCF target speed (SEL SPD) or mach is magenta when it is the active speed.

Information

The PROGRESS 1/2 page shows this data when the PERF INIT (VNAV) page is complete:

- The waypoint the airplane is flying to
- Distance to go (DTG)
- Estimated time of arrival (ETA)
- Fuel at the waypoint
- Next waypoint
- Predicted fuel on arrival
- FMCF target speed/mach (SEL SPD)
- ETA to top of descent (T/D) or another flight phase
- DTG to T/D or another flight phase.

	T B C 7 7 7 P R O G R E S S 1 / 2				
	T O	DTG	ETA	FUEL	
	EN O	6 1	1 3 5 5 Z	4 3 . 8	
	N E X T				
	G V E	1 9 2	1 4 1 1 Z	4 0 . 0	
	D E S T				
	K A T L	6 0 6	1 5 1 8 Z	1 2 . 7	
	S E L S P			T O T / D	
	. 7 8 0		1 4 0 2 Z /	8 2 N M	

	< P O S R E P O R T		P O S R E F >		

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FMCS - PROGRESS PAGE 1/2

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FMCS - PROGRESS PAGE 2/2

Purpose

The PROGRESS 2/2 page shows dynamic data that relates to the flight progress.

Page Access

To get access to the PROGRESS 2/2 page, do one of these steps:

- Push the PROG mode key and then the NEXT PAGE or PREV PAGE function key
- Select the <PROGRESS prompt when on the POS REPORT page and then the NEXT PAGE or PREV PAGE function key.

Color

All text on this page is white.

Information

The PROGRESS 2/2 page shows this data when in flight:

- Head or tail wind in knots (KTs)
- Wind direction in degrees and speed in KT
- Cross wind (X) direction (left-L or right-R) in KT
- Cross track error (XTK) L/R in nautical miles (NMs)
- Vertical track error (VTK) +/- in feet (ft)
- True airspeed (TAS)
- Static air temperature (SAT) in +/- centigrade (C)
- Left fuel used
- Total (TOT) fuel used
- Right fuel used
- Fuel quantity from the totalizer (fuel quantity system) and the FMCF fuel calculation.

	TBC 777 PROGRESS 2 / 2				
	H / WIND	WIND	X / WIND		
	32 KT	080° / 57	L 23 KT		
	XTK ERROR	VTK ERROR			
	L 0.1 NM		+10 FT		
	TAS		SAT		
	470 KT		-25°C		
	LEFT	FUEL USED	RIGHT		
	28.7	TOT 56.6	27.9		
	<USE FUEL QTY USE>				
	TOTALIZER		CALCULATED		
	155.1		158.3		

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FMCS - PROGRESS PAGE 2/2

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FMCS - RTA PROGRESS PAGE 3/3

Purpose

The required time of arrival (RTA) progress page 3/3 permits the flight crew to enter a time constraint for an existing flight plan fix. This makes the FMCF calculate the necessary airplane changes to arrive at the fix at the specified time.

Page Access

To see the RTA progress page 3/3, select:

- NEXT PAGE mode key from progress page 2/3
- PREV PAGE mode key from progress page 1/3
- RTA progress prompt for the CRZ page. The RTA progress prompt shows on the CRZ page only when certain conditions are true. See the flight operations manual for more information.

Color

All text on this page is white.

Entries and Information

Line 1L shows the RTA waypoint fix entered by the flight crew. The RTA waypoint fix can also be uplinked automatically by the automatic dependent surveillance (ADS) function of the FMCF.

If there is an RTA fix on line 1L and an RTA time on line 1R, line 2I shows the FMCF calculated RTA speed necessary for the airplane to arrive at the RTA waypoint fix on time.

Line 5L shows the maximum speed the FMC can use for RTA calculations. The flight crew can change the maximum speed to any speed between .100 and .990. The default maximum speed value is .850.

The flight crew uses line 1R to enter the desired time they want the airplane to arrive at the RTA waypoint fix. The flight crew enters the hour, minutes, and a suffix of A, B, or blank. A shows the RTA time is at or after time. B shows the RTA time is at or before time. A blank (no suffix) shows the RTA time is at time. The RTA time can also be uplinked automatically by the automatic dependent surveillance (ADS) function of the FMCF.

Line 2R shows the predicted altitude and estimated time of arrival (ETA) at the RTA fix.

If the airplane is on the ground before a flight, the flight crew can enter a takeoff time. The FMCF uses this value to calculate RTA data.

Training Information Point

Refer to the flight operations manual for more information related to this page.

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FMCS - RTA PROGRESS PAGE 3/3

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**FMCS - POSITION REPORT PAGE****Purpose**

The position report page provides position parameters and fuel at the reporting waypoint.

Page Access

To get access to the POSITION REPORT page, do one of these steps:

- Select POS REPORT from the PROGRESS page
- Select POS REPORT from the FMC COMM page.

Color

All text on this page is white.

Information

The title line shows the company flight number if applicable.

Line 4L is the current static air temperature.

Line 4C is the current FMCF wind direction and wind speed.

Line 5R is the fuel remaining in thousands of pounds or kilograms at the 1L waypoint.

Operations

To datalink a position report, select 6R, REPORT>.

Page Selections

Select 6L, <PROGRESS to show the PROGRESS page.

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☐
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☐
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☐

T B C 7 7 7 P O S R E P O R T

P O S	ATA	ALT
4 7 3 0 N 1 1 0 W	1 3 3 6 Z	F L 3 7 0
EST	ETA	
G R F	1 3 3 5 Z	
NEXT		
4 6 N 1 2 0 W		
TEMP	WIND	
- 5 2 C	2 1 5 / 5 7 K T	
	P O S	F U E L
		5 2 . 3

< P R O G R E S S
R E P O R T >

☐
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FMCS - POSITION REPORT PAGE

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**FMCS - FIX INFO PAGE****Purpose**

The FIX information (INFO) page lets the flight crew create waypoints and waypoint fixes. A fix can be, a point between the present flight plan and specific radial or a distance from a known waypoint. The CDU and navigation display (ND) show the fix information.

Page Access

To get access to this page, push the FIX mode key.

Use the NEXT PAGE or PREV PAGE function key to go to other FIX pages.

Color

All text on this page is white.

Information

This data shows on the FIX INFO page and ND:

- The fix name
- Bearing/distance from fix
- Brg/dis, estimated time of arrival (ETA), distance to go, and altitude for a bearing or distance entry
- ABEAM point ETA, distance to go and altitude.

FIX INFO					1 / 2
FIX	BRG / DIS	FR			
ABC	111 / 29				
BRG / DIS	ETA	DTG	ALT		
138 / 24	2004Z	10	12000		
180 / 28	2008Z	32	FL190		
--- / --					
ABEAM					
150 / 23	2006Z	18	15500		
		PRED	ETA-ALT		
<ERASE FIX		112 NM	2108Z		
ABC180.0 / 026.4					

FMCS - FIX INFO PAGE

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**FMCS - ACT ALTN NAV LEGS PAGE****Purpose**

The active alternate navigation (ACT ALTN NAV) LEGS page lets the flight crew enter a flight plan, modify and show details of each leg of the flight plan when the active FMCF fails.

Page Access

To get access to the ALTN NAV LEGS page, do one of these:

- Push the LEGS mode key on the CDU keyboard when the active FMCF fails. This occurs when the FMC selector is in the left or right position. This also occurs when the FMC selector is in the auto position and both FMCFs fail
- Push the NEXT PAGE or PREV PAGE function key to see a different ALTN NAV LEGS page.

Color

All text on this page is white except the active waypoint is magenta when the route is active or modified active.

Information

This data shows on the ACT ALTN NAV LEGS page:

- Magnetic (mag) bearing (brg) to the last waypoint
- MAG track (TK) to each additional waypoint
- Position (latitude-lat and longitude-lon) of each fix
- Distance to the next waypoint in nautical miles.

ACT	ALTN	NAV	LEGS	1 / X
250° M				
ENO	N 39° 03 9		W 075° 01 0	
248° T	131 NM			
GVE	N 38° 00 0		W 078° 09 2	
282° T	118 NM			
PSK	N 37° 05 3		W 080° 02 8	
222° T	280 NM			
N 42 W 115	N 42° 21 9		W 115° 26 4	
265° T	250 NM			
MACEY	N 44° 21 3		W 130° 26 4	

FMCS - ACT ALTN NAV LEGS PAGE

M37612 S000619924_V1

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D633W101-ARO	

**FMCS - ALTN NAV PROGRESS PAGE****Purpose**

The alternate navigation (ALTN NAV) PROGRESS page shows current flight plan information about the progress of the flight when the active FMCF fails. The flight crew can also change the destination airport or waypoint.

Page Access

To get access to this page, push the PROG mode key when the active FMCF fails. This occurs when the FMC selector is in the left or right position. This also occurs when the FMC selector is in the auto position and both FMCFs fail.

Color

All text on this page is white except for the active waypoint which is magenta when the route is active or modified active.

Information

This information shows on the ALTN NAV PROGRESS page:

- The last, to, next, and destination (DEST) waypoint
- Altitude (ALT) of the last waypoint
- Distance to go (DTG) to the waypoint
- Time to go (TTG) to the waypoint
- Inertial position
- Ground speed (GS)
- Cross track (XTK) error
- Desired track (DTK)
- Current track.

ALTN NAV PROGRESS			
LAST	ALT		
CYN	FL 240		
TO	DTG	TTG	
ENO	81 NM	00:16	
NEXT			
GVE	131 NM	00:25	
DEST			
KATL	680 NM	02:06	
INERTIAL POS		GS	
N 45° 37' 2"	W 119° 18' 5"	310 KT	
XTK ERROR	DTK	TK	
L 0.1 NM	250° M	220° M	

FMCS - ALTN NAV PROGRESS PAGE

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FMCS - ALTN NAV RADIO PAGE

Purpose

The alternate (back-up) navigation (ALTN NAV) RADIO page gives an alternate means to tune the navigation radios. The left CDU does the alternate tune for the left navigation radios and the center ILS radio. The right CDU does the alternate tune for the right navigation radios.

Page Access

To get access to the ALTN NAV RADIO page, push the NAV RAD mode key when both FMCFs fail.

Color

All text on this page is white except for these indications:

- VOR frequency and course (CRS) entries are green and in large font
- ADF frequency entry is cyan in large font.

Information

Line 1L shows the last FMCF VOR frequency or manual frequency entry for the onside radio. The M shows for both cases.

Line 2L shows the manual CRS entry or dashes with no previous CRS entry. The CRS entry or dashes show when there is a valid frequency in 1L.

Line 3L shows the ADF frequency and tune mode. The tune mode shows next to the ADF frequency, ANT (A) or BFO (B). No show of A or B means that ADF is the active tune mode.

Line 4L shows the ILS title field with L & C for the left CDU and R for the right CDU along with the frequency and course.

Entries and Deletes

Do this to enter a VOR frequency at 1L:

- Type a valid VOR frequency between 108.0 to 117.95 into the scratchpad
- Enter into 1L.

The VOR frequency range does not include the frequencies between 108.0 to 111.95 MHz and frequencies that contain odd tenths. All frequencies from 112 to 117.95 MHz are included.

Line 1L shows dashes with a delete entry.

Line 2L shows dashes with a delete entry.

To enter a VOR course at 2L or 2R when dashes show, do this:

- Type a number between 000 to 360 into the scratchpad
- Enter into 2L.

Dashes show in the VOR course data field and M shows next to the VOR frequency. An entry of 360 shows as 000.

A delete at line 2L with a course present blanks the course data field and dashes show.

Do this to enter an ADF frequency at 3L:

- Type a frequency between 190.0 and 1750 kHz into the scratchpad
- Enter into 3L.

Do this to enter an A (ANT) or B (BFO) ADF tune mode at 3L:

- Type the letter A or B into the scratchpad
- Enter into 3L.

Do this to delete the A or B from an ADF entry at line 3L:

- Push the DEL key. DELETE shows in the scratchpad
- Enter into line 3L.

You can not use the DELETE key to delete an ADF frequency.

Do this to enter an ILS frequency or course at 4L:

- Type an ILS frequency between 108.10 to 111.95 (odd tenths)
- Type a course between 000 to 360 with a leading slash
- Enter into 4L.

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FMCS - ALTN NAV RADIO PAGE

A course entry of 360 shows as 000 in the ILS course field at 4L.

Do this to delete an ILS entry at 4L:

- Push the DEL key
- Enter into 4L.

Line 4L shows dashes with a delete entry.

Line 6L or 6R entries are valid 1L, 2L, 3L, and 4L frequency or course formats.

Line 6L or 6R shows dashes with a delete entry.

	ALTN NAV RADIO		
	VOR		
	116.80M		
	CRS		

	ADF		
	1304.5BFO		
	ILS-MLS L&C		
	110.80/037°		
	PRESELECT		
	110.90/128°	-----	

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FMCS - ALTN NAV RADIO PAGE

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**FMCS - COMM PAGE****Purpose**

The FMC communication (COMM) page does these functions:

- Supplies access to FMC CDU pages that have data link information
- Shows which FMC CDU pages have pending uplink information
- Shows the data link status.

Page Access

To see the FMC COMM page, select the FMC COMM mode key.

Color

All text on this page is white.

Information

Line 6R shows the data link status, the possible indications are:

- READY
- NO COMM
- VOICE
- FAIL.

Selections

Push line 1L to access RTE 1 page. If RTE 2 shows on line 1L then you will access the RTE 2 page. The word UPLINK shows in small font above line 1L when there is an uplink pending.

Push line 2L to access the ALTN page. The word UPLINK shows in small font above line 2L when there is an uplink pending.

Push line 3L to access the PERF INIT page. The word UPLINK shows in small font above line 3L when there is an uplink pending.

Push line 4L to access the TAKEOFF REF page 1/2. The word UPLINK shows in small font above line 4L when there is an uplink pending.

Push line 5L to access the ACT RTE X DATA or MOD RTE X DATA. The word UPLINK shows in small font above line 5L when there is an uplink pending.

Push line 6L to access the DESCENT FORECAST page. The word UPLINK shows in small font above line 6L when there is an uplink pending.

Push line 1R to access the POS REPORT page.

Push line 3R to access the automatic surveillance/air traffic control (ADS/ATC) status page.

Training Information Point

Refer to the flight operations manual for more information related to this page.

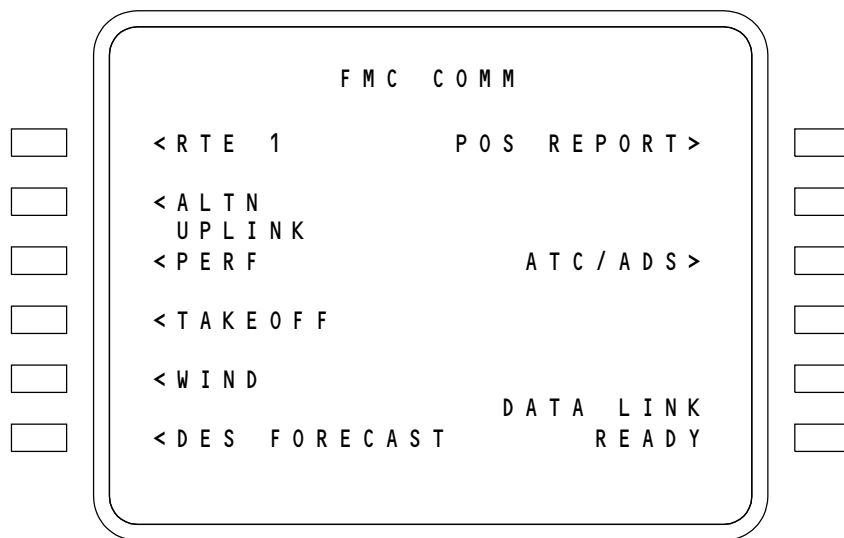
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FMCS - COMM PAGE

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**FMCS - CDU CONFIGURATION PAGE****Purpose**

The CDU configuration page shows hardware and software configuration of the CDU.

Page Access

To get access to the CONFIGURATION page, do these steps:

- On the CDU MENU page, select 6R MEMORY.
- On the memory page (no title in header), select 6R BITE HISTORY.
- On the BITE HISTORY page, select 6L MAINT BITE.
- On the CDU MAINT BITE INDEX page, select 5L CONFIG.

Color

Text on this page is white and green (left side of the screen - white, right side - green).

Information

The CDU configuration page shows this data:

- HARDWARE PART NUMBER
- SOFTWARE PART NUMBER
- PPRM SOFTWARE PART NUMBER
- SERIAL NUMBER

Page Selection

Select 6L <INDEX to show the CDU MAINT BITE INDEX page.

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CDU CONFIGURATION			
HW P/N	B50A000-00-100		
S/N	B1003038		
SW P/N	341ELCVFPV00		
OF P CRC	B119DBD1		
PP P/N	3411LCVPRM00		
PFPGA	2.04	HFPGA	2.43
RCPLD	1.03	629	2.00
PFPGA CRC	099D3D0B		
CPU ETI	0021.530		
LVPS ETI	0019.274		
CDU LOC	LEFT		
<INDEX			

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FMCS - CDU CONFIGURATION PAGE

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FMCS - FMCF FUNCTIONAL DESCRIPTION - INTRODUCTION

General

There are two FMCFs, one in the CPM/STD in the left AIMS cabinet and one in the CPM/STD in the right AIMS cabinet.

The FMCFs use digital and analog inputs from external sensors and components, flight deck controls, internal AIMS cabinet interfaces, and cross cabinet AIMS interfaces.

Each FMCF has two software partitions. These are:

- Navigation (NAV) partition
- Flight management function (FMF) partition.

The flight management computing function (FMCF) does these sub-functions:

- Lateral navigation (LNAV) - NAV partition
- Nav radio tune - NAV partition
- Vertical nav (VNAV) - FMF partition
- Guidance - FMF partition
- BITE/fault monitoring - FMF partition
- Display control - FMF partition.

The active FMCF sub-function sends this data to these user systems:

- Guidance sub-function sends LNAV and VNAV commands and mode data to the AFDS
- Guidance sub-function sends VNAV thrust commands mode and data to the TMCF
- Radio tune sub-function sends radio tune commands and mode data to the navigation radios
- BITE sub-function sends fault and display data to the PDF and CMCF of AIMS
- Display control sub-function sends page and display data to the CDUs, PDF, and CMCF of AIMS.

NAV - Lateral Navigation Position Calculation

The LNAV sub-function uses these inputs to calculate the current airplane position:

- Air data inertial reference unit (ADIRU) inertial data
- Global position system (GPS) position data
- Navigation data base (NDB)
- Nav radio data.

The LNAV sub-function sends these outputs to the VNAV and guidance sub-function for the autopilot flight director system (AFDS):

- Position and velocity data
- Flight path data
- Heading and track data.

NAV - Nav Radio Tune

The nav radio tune sub-function allows autotune and manual tuning of the navigation radios. The FMCF uses the autotuned radios for position update. The flight crew uses the data to verify their position.

The FMCF does not auto tune the ADF radios.

The nav radio tune sub-function receives these inputs to do its calculations:

- Nav radio data
- LNAV data
- NDB
- CDU requests.

The nav radio tune sub-function sends these outputs to the nav radios:

- Tune mode
- Tune frequency
- Identifier
- Course

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FMCS - FMCF FUNCTIONAL DESCRIPTION - INTRODUCTION

- ILS course.

FMF - Vertical Navigation

The VNAV sub-function uses these inputs to calculate VNAV (pitch) commands and other display data:

- Airframe and engine performance data from the performance data base (PDB)
- Inertial data from the ADIRU
- Air/ground data
- LNAV data from the NAV partition
- Engine data from the engine controllers
- Fuel data from the fuel quantity system
- Crew entries from the CDU performance initialization and the takeoff reference page.

The VNAV sub-function sends these outputs to the guidance sub-function for the AFDS and the thrust management computing function (TMCF):

- Altitude
- Vertical track (VTK)
- Cross track (XTK)
- Fuel used
- Thrust limits
- Gross weight
- Takeoff speeds
- Approach speeds.

FMF - Guidance

The guidance sub-function calculates steering and thrust commands. To do this, it looks at inputs from external sensors, components, and internal FMCF interfaces. The guidance sub-function compares the actual position from the LNAV sub-function with the flight plan from the display control sub-function. It compares the VNAV sub-function targets (pitch and thrust) with actual airplane pitch and actual thrust. The guidance sub-function sends roll and pitch steering commands to the AFDS.

The guidance sub-function also supplies these outputs to the AFDS:

- LNAV operate mode
- VNAV operate mode.

It sends this data to the TMCF:

- Thrust commands
- Speed commands
- Thrust limit mode
- Autothrottle mode.

The guidance sub-function also supplies these outputs to the display control sub-function:

- Roll flight path data
- Pitch flight path data.

FMF - BITE/Fault Monitoring

The BITE/fault monitoring sub-function contains hardware monitors, software monitors and fault detection circuits. The BITE/fault monitoring sub-function stores BITE and fault detection information and status for the last ten flight legs in non-volatile memory (NVM). It also records the status of the input source in BITE history. The BITE/fault monitoring sub-function supplies FMCF faults to the display control sub-function.

The BITE/fault monitoring sub-function responds to CMCF test requests when the airplane is on the ground.

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**FMCS - FMCF FUNCTIONAL DESCRIPTION - INTRODUCTION****FMF - Display Control**

The display control sub-function formats, updates and sends data to the CDU. It sends button push and other flight deck data to the sub-functions. The display control sub-function uses data from the LNAV, VNAV, guidance, and BITE/fault monitoring sub-functions to update and reformat the CDU pages.

The display control sub-function also sends background and dynamic data to the PDF.

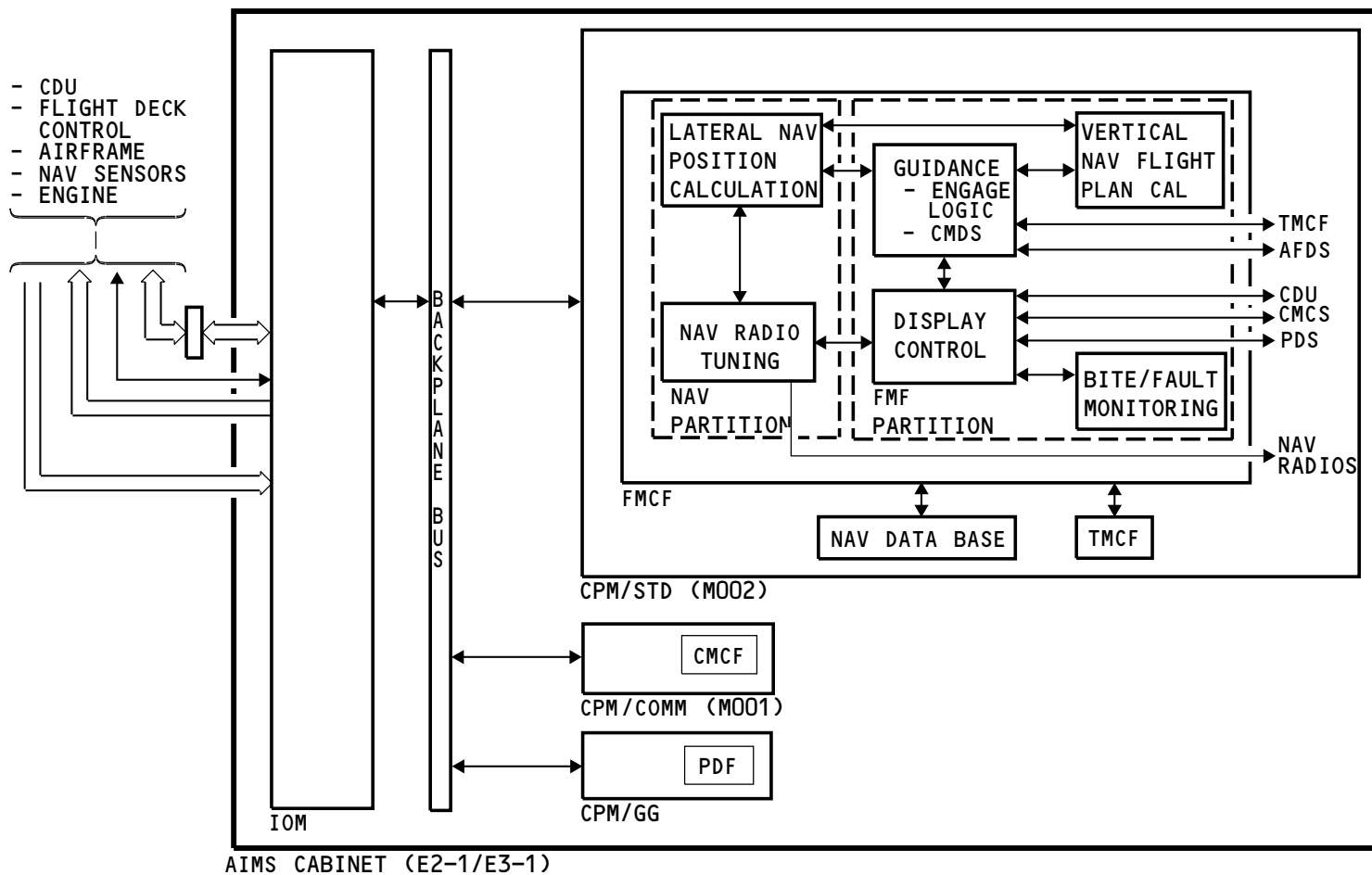
The display control sub-function sends alert and advisory messages to the CDU. It also sends the alert message to the PDF for a flight deck annunciation.

The display control sub-function sends fault and display data to the CMCF for display. This occurs during normal FMCF operation and for CMCF test requests.

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FMCS - FMCF FUNCTIONAL DESCRIPTION - INTRODUCTION

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FMCS - FMCF FUNCTIONAL DESCRIPTION - NAVIGATION FUNCTION

General

The FMCF navigation function uses data from external systems and internal data from AIMS to calculate navigation data for the performance, guidance, and display control sub-function of the FMCF.

The navigation function supplies this data:

- Navigation update mode
- Position uncertainty
- Velocity vectors
- Wind data.

The active FMCF display control sub-function sends display data to the CDUs and the primary display function (PDF).

Navigation Update Mode

The FMCF has ten navigation update modes. The navigation update mode determines which sensors the FMCF uses to calculate the airplane position and velocity. These are the ten navigation update modes (not in order of priority):

- No nav - There are no valid FMCF sensors (GPS, radios, or ADIRU) necessary
- GPS only - The FMCF uses global positioning system (GPS) data
- ADIRU only - The FMCF uses ADIRU data
- VOR/DME/ADIRU - The FMCF filters VOR, DME, and ADIRU data
- DME/DME/ADIRU - The FMCF filters DME and ADIRU data
- GPS/ADIRU - The FMCF filters ADIRU data with GPS position data
- LOC/ADIRU - The FMCF filters localizer deviation with ADIRU data
- LOC/VOR/DME/ADIRU - The FMCF filters localizer deviation, collocated VOR/DME, and ADIRU data
- LOC/DME/DME/ADIRU - The FMCF filters localizer deviation, DME/DME, and ADIRU data
- LOC/GPS/ADIRU - The FMCF filters localizer deviation, GPS, and ADIRU data.

Position Uncertainty

The FMCF uses mathematical algorithms to calculate a position uncertainty value for each one of the navigation sensors (GPS, radios, ADIRU).

The FMCF selects only one navigation update mode at a time. The FMCF selects the navigation update mode with the least amount of position uncertainty.

Velocity Vector Calculation

The navigation function uses north, east, and vertical velocity components from the ADIRU and GPS position bias or radio position bias to calculate the velocity vectors. These are the outputs from the total velocity vector calculations:

- Ground speed
- Distance-to-go to next waypoint
- Cross-track error
- True heading
- Magnetic track
- True track
- Flight path angle
- Magnetic heading
- Altitude.

Wind Data Calculation

The navigation function uses these inputs to calculate wind data:

- Flight path angle
- North and east velocity
- True heading
- ADIRU true airspeed (TAS).

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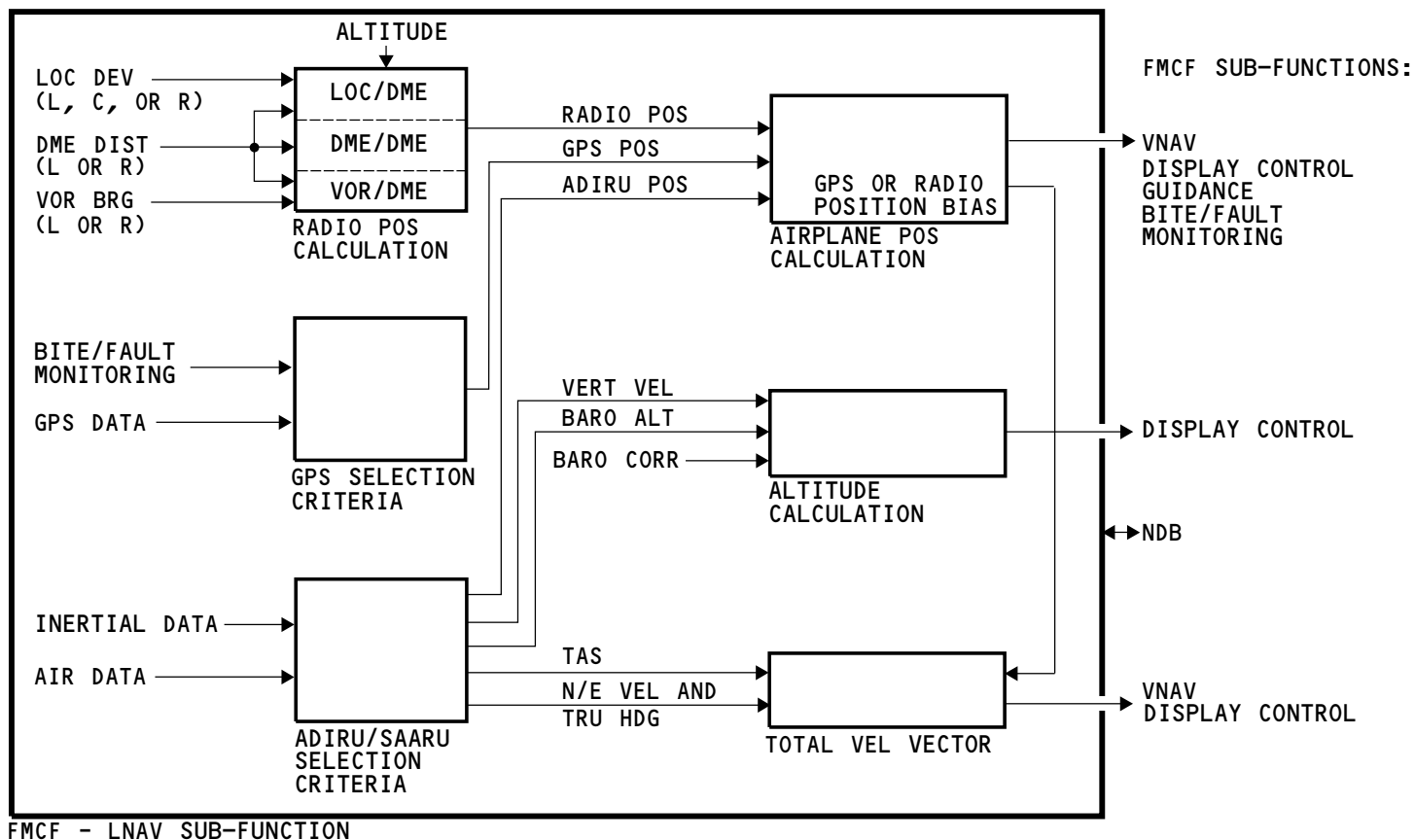
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**FMCS - FMCF FUNCTIONAL DESCRIPTION - NAVIGATION FUNCTION**

The navigation function gives wind speed and wind direction. The resultant of the true airspeed vector and the ground speed vector provides the wind direction when referenced to North (true or magnetic) and its magnitude determines the wind speed.



FMCS - FMCF FUNCTIONAL DESCRIPTION - NAVIGATION FUNCTION

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FMCS - FMCF FUNCTIONAL DESCRIPTION - RADIO TUNE SUB-FUNCTION

General

Normally, the radio tune commands come from the right FMCF for automatic or manual tune of the navigation radios. If the radio tune sub-function in the right AIMS cabinet fails, the tune commands from the left FMCF are used.

After the FMC autotunes the navigation radios, the radio data goes to the FMCF. If global positioning system (GPS) data is not available, the FMCFs use nav radio data to update the inertial position from the air data inertial reference unit (ADIRU).

Navaid Autotuning

The FMCFs autotune to the best nav aids for position updates. The FMCFs autotune to VOR/DME nav aids in three different ways. These are the three types and the indications that show on the NAV RADIO page on the CDU:

- The letter P shows for procedure tuning when the FMCF automatically tunes to a nav aid that is part of the active departure or arrival procedure.
- The letter R shows for route tuning when the FMCF automatically tunes to a nav aid that is a waypoint in the active route.
- Autotune (A) occurs when no procedure (P) or route (R) tune is active. The FMCFs automatically tune to the best nav aids.

During autotune (A), the FMCFs use a selection criteria to find the best DME/DME pair to autotune as the nav aids. This is the selection criteria:

- Range; the range of nav aid station must not be farther than the line-of-sight or closer than 9 nm
- Geometry; the angle between the two stations is between 30 and 150 degrees, with the airplane as the center point
- Raw data availability; when the station is tuned it returns valid data.

The FMCFs make a list of the 20 nav aid stations closest to the current FMCF position. The FMCFs update the list every three minutes. The nav aid stations are from the navigation data base.

The FMCFs select five nav aid stations from the list of 20 to autotune. The FMCFs select the best five nav aids that meet the selection criteria. Each DME tunes to those five nav aid stations. The FMCFs use two of the five nav aid stations for position updates. The FMCFs use two more nav aid stations for DME distance display updates in the navigation display. The FMCFs use the last nav aid station for co-located ILS/DME distance.

If a DME/DME pair is not available, the FMCFs use the VOR bearing and DME distance from a co-located VOR/DME station.

If the destination runway is a part of the flight plan, the FMCFs autotune to the co-located ILS/DME station for the destination runway. The FMCFs use the ILS localizer deviation and DME slant range distance for FMCF position updates during a landing.

Navaid Manual Tuning

Use the CDU to manually tune the nav radios. To tune to a nav aid station, enter a tuning frequency for ILS, VOR, DME or ADF nav aids or station identifier for VOR or DME. When you do this, the tuning frequency or identifier goes to the FMCFs. The FMCFs do a check of the validity of the tuning frequency or identifier, and make sure that it is in the navigation data base. If the tuning frequency is valid, the FMCFs send it to the related radio. Then the radio tunes to that station. If you enter a station identifier for VOR or DME, the FMCFs change the station identifier to the related tuning frequency. The FMCFs send the related tuning frequency to the VOR receiver and DME interrogators.

A manual tune entry overrides a P, R, or an A-autotune mode for VOR/DME tuning and an A autotune mode for ILS. This causes the letter M to show between the frequency and identifier on the NAV RADIO page of the CDU. A delete of the manual tune mode causes a P, R or an A to show between the frequency and identifier on the NAV RADIO page.

Navigation Radios Tune Modes

These are the tune modes for the VOR/DME, ILS, and ADF navigation radios:

- VOR/DME - M, P, R, or A

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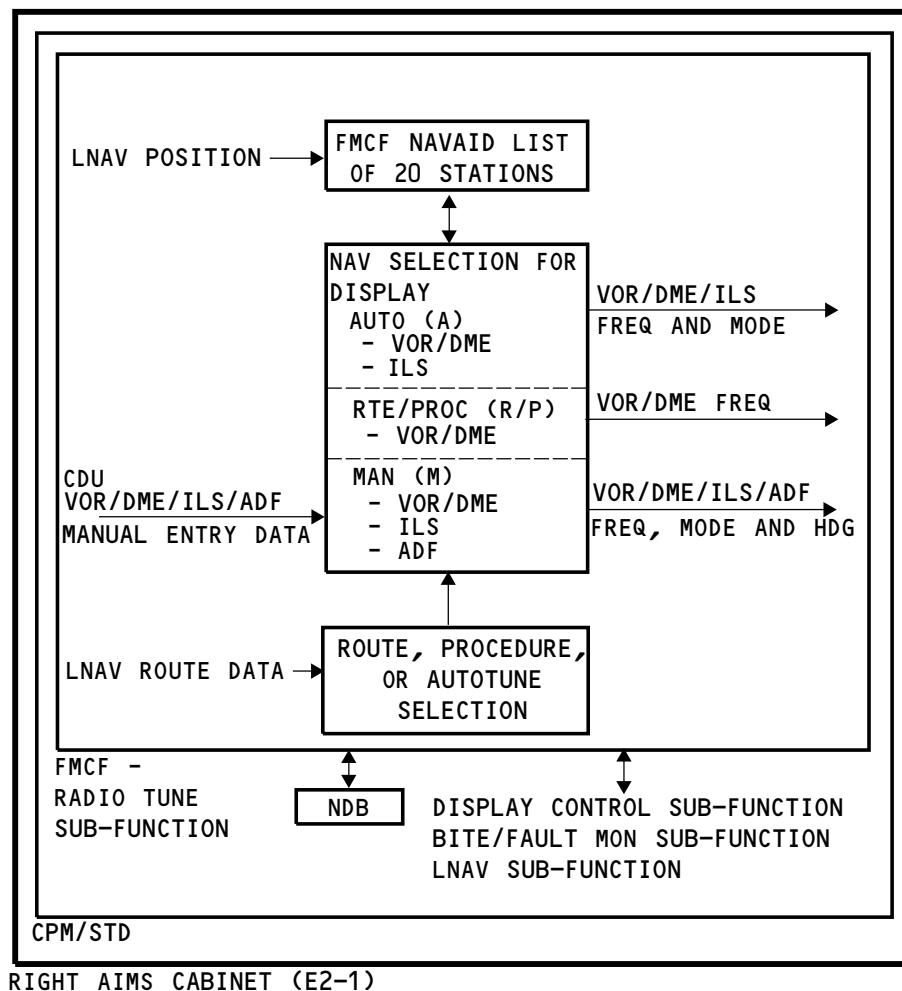
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FMCS - FMCF FUNCTIONAL DESCRIPTION - RADIO TUNE SUB-FUNCTION

- ILS - M or A, the FMCF auto-tunes the ILS when the airplane is within range of the destination airport and the ILS runway is part of the active flight plan
- ADF - M (manual) tune only.

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FMCS - FMCF FUNCTIONAL DESCRIPTION - RADIO TUNE SUB-FUNCTION

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**FMCS - FMC FUNCTIONAL DESCRIPTION - VNAV SUB-FUNCTION****General**

The FMC VNAV sub-function uses aerodynamic and engine models along with optimization algorithms to supply a vertical flight profile. This occurs for all selectable vertical modes.

The VNAV sub-function supplies this data:

- VNAV speed (SPD)/mach targets
- VNAV path
- Thrust (thr) targets
- Thrust and speed limit commands to fly and guide the airplane along the vertical flight profile trajectory predictions
- Fuel weight calculations
- Quick reference handbook (QRH) calculations.

The FMC VNAV sub-function also uses this data to calculate VNAV outputs:

- Airframe sensors and components
- Engine sensors and components
- Flight deck control panels
- Flight deck switches.

The VNAV sub-function responds to BITE requests and supplies display data to the display control sub-function.

Speed/Mach, Path, and Thrust Targets

The VNAV sub-function calculates the optimum speed/mach, path and thrust targets. These calculations occur during climb, cruise, and the descent flight phases with an active lateral route and vertical flight plan.

The speed/mach targets go to the guidance sub-function. The guidance sub-function supplies steering commands to the autopilot flight director system (AFDS). SPD on elevators use SPD/MACH targets in climb. Path on elevators use altitude (path) targets in cruise and descent to control the pitch axis of the airplane.

The thrust management computing function uses target speed on throttles or target thrust on throttles. It uses speed/MACH targets or thrust targets to control the thrust of the airplane. The TMCS uses thrust targets in climb and descent and speed/MACH targets in cruise to control the thrust of the airplane.

Trajectory Predictions

The trajectory section uses these to simulate the airplane trajectory over a flight plan:

- Equations of motion
- Models of the airplane
- Engine characteristics.

The trajectory calculation optimizes the time the airplane is in an idle engine thrust configuration. The calculations do not violate speed and altitude restrictions.

The flight plan prediction section calculates the flight trajectory from takeoff to landing. To do this, it uses internal data and these inputs:

- VNAV performance page data (GW, cost index, ALT, fuel quantity, reserve fuel)
- Active route with end of descent point
- Present position
- Wind at altitude
- Icing conditions forecasts
- Performance factors (Fuel flow, climb thrust derate, and drag).

These outputs go to the display control sub-function to show on the CDU and the primary display system. The cabin pressure system receives this data to calculate the cabin pressurization schedule in climb, cruise and the descent flight phase.

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**FMCS - FMC FUNCTIONAL DESCRIPTION - VNAV SUB-FUNCTION****Thrust/Speed Limit Protection**

The target thrust section of the VNAV sub-function calculates a maximum and a minimum thrust limit and speed limit for climb, cruise, and the descent flight phases. To do this, the VNAV sub-function uses this data:

- Engine and airframe database
- Models of the airplane
- ADIRU data (altitude, temperature and barometric pressure)
- Gross weight
- Airplane configuration.

The AFDS (speed) outputs do not exceed the VNAV sub-function speed limits in automatic flight control when the VNAV mode is active. The autothrottle speed or thrust outputs do not exceed the VNAV sub-function speed or thrust limits when VNAV is active.

Fuel/Weight Calculation

The fuel/weight section calculates fuel burn-off, fuel remaining, and airplane gross weight. It also sends a fuel quantity alert message when the fuel quantity system and fuel calculation differs by 9,000 pounds.

Quick Reference Handbook Calculations (QRH)

The QRH section calculates these advisory takeoff speeds:

- V1
- VR
- VREF
- V2
- CG
- Takeoff stabilizer position equal to those found in a QRH.

The data for this section comes from the performance data base (PDB).

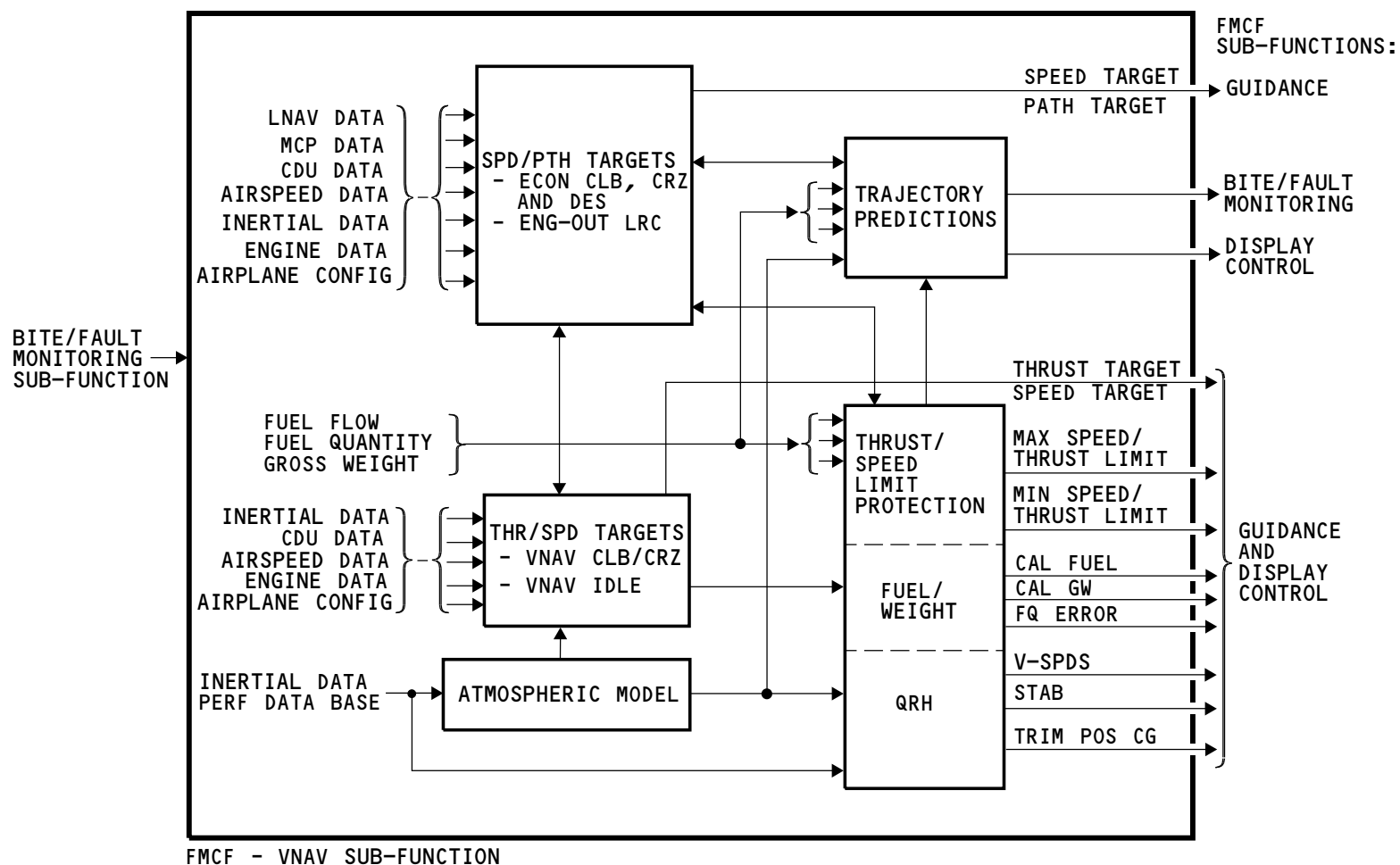
The advisory stabilizer position calculation needs a gross weight and CG entry.

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FMCS - FMCF FUNCTIONAL DESCRIPTION - VNAV SUB-FUNCTION

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**FMCS - FMCF FUNCTIONAL DESCRIPTION - GUIDANCE SUB-FUNCTION****General**

The FMCF guidance sub-function calculates lateral and vertical guidance steering commands. This occurs when the guidance sub-function receives an active route (lateral flight plan) and active vertical flight plan.

There are two guidance sub-functions, one for AFDS and one for TMCF. They receive these inputs to calculate the guidance commands:

- LNAV sub-function (desired)
- Mode control panel (MCP)
- VNAV sub-function (desired)
- CDU
- Lateral position (actual)
- Vertical position (actual)
- Airspeed (actual)
- TMCF thrust (actual)
- LNAV Engage
- VNAV engage.

Guidance Sub-function - AFDS

The AFDS guidance sub-function uses desired lateral (route) and desired vertical flight plan data from the LNAV and VNAV sub-functions. It also uses actual airplane position data from the sensors. The guidance steering commands are the difference between the desired and actual.

The active FMCF sends the LNAV and VNAV steering commands to the AFDS for automatic roll and pitch control of the airplane during the climb, cruise, and the descent flight phases.

The active FMCF sends speed commands to the AFDS in the climb flight phase to control it to the VNAV sub-function target speed. It sends VNAV path commands to the AFDS in the cruise and the descent flight phases.

The CDU and mode control panel (MCP) is the main interface for preflight and enroute changes of the LNAV and VNAV flight plans. The LNAV and VNAV modes can arm on the ground and become active in the air.

Guidance Sub-function - TMCF (Thrust/Speed)

The TMCF guidance sub-function uses thrust or speed targets from the VNAV sub-function and compares them with the actual airplane thrust or speed. The difference between the target and the actual thrust or speed is the guidance command.

The active FMCF sends thrust steering commands to the TMCS to control the engine thrust in climb and descent. The FMCF sends speed commands to the TMCS to control the airplane speed in cruise.

VNAV Mode Summary

The AFDS and TMCS guidance sub-functions supply five basic VNAV modes to fly the airplane along the vertical flight profile. The AFDS controls the pitch axis and the TMCS controls the thrust. These are the five basic VNAV modes:

- VNAV speed/thrust
- VNAV path/speed
- VNAV path/idle
- VNAV altitude/speed
- VNAV speed/hold.

VNAV speed/thrust causes the AFDS to control to the FMCF speed. The TMCF controls the throttles to a thrust target.

VNAV path/speed causes the AFDS to control to a path (cruise altitude). The TMCF controls the throttles to a target airspeed in cruise and shallow path descents.

VNAV path/idle causes the AFDS to control to a set descent path from the top of descent to the end of descent. The TMCF moves the throttles to the idle position.

VNAV altitude/speed causes the AFDS to control to an altitude hold request from the MCP or an altitude override in climb or descent. The TMCF controls the throttles to a speed target.

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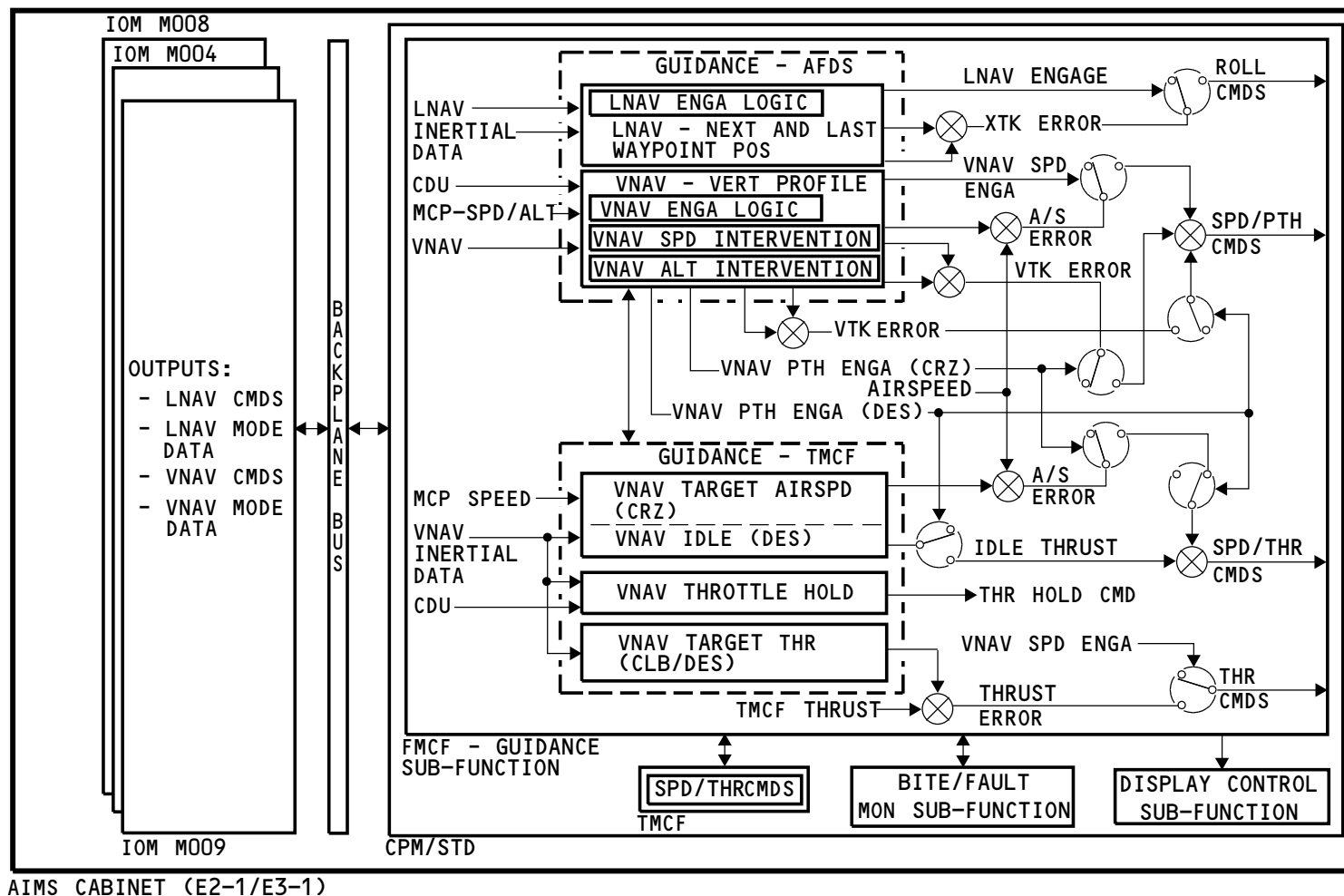
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**FMCS - FMCF FUNCTIONAL DESCRIPTION - GUIDANCE SUB-FUNCTION**

VNAV speed/hold causes the AFDS to control to a speed target and the TMCF to remove servo power from the servomotors. This occurs in steep descents. Power loss to the servomotors allows manual throttle control with no resistance.

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FMCS - FMCF FUNCTIONAL DESCRIPTION - GUIDANCE SUB-FUNCTION

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**FMCS - FMCF FUNCTIONAL DESCRIPTION - LNAV AND VNAV ENGAGE LOGIC****General**

LNAV and VNAV engage logic uses inputs from several sources to engage the LNAV and VNAV modes.

The guidance sub-function needs the engage logic input to complete its steering command output path to the AFDS and the TMCS. The engage/operate logic also goes to the display control sub-function in the AIMS cabinets to cause the arm and engage modes to show on the primary display system.

LNAV/VNAV Engage Initiation

LNAV/VNAV engage starts with a push of the LNAV or VNAV switch on the mode control panel (MCP). The MCP sends these requests by way of the AFDCs to the guidance sub-function.

LNAV Engage Logic

These are the other inputs for LNAV engage logic:

- Software monitors valid
- Hardware monitors valid
- ADIRU data valid
- Other FMCF not active
- LNAV captive criteria
- Active FMCF
- Active route
- 50 feet above ground level (AGL)
- LNAV arm/operate input set
- Not localizer mode active
- Not go-around mode active.

This is the LNAV capture criteria:

- A crosstrack distance of 2.5 nautical miles or less or a crosstrack distance from which the guidance sub-function can initiate path capture when on an intercept heading. Path capture is a function of ground speed intercept angle and bank angle (25 degree maximum)
- Intercept heading - the current aircraft heading intercepts/crosses the active leg.

The active FMCF sends the LNAV engage status to the guidance sub-function and display sub-function. LNAV engages for these flight phases:

- Climb
- Cruise
- Descent
- LNAV approach.

Localizer capture cancels or inhibits LNAV operation. Go-around start also cancels LNAV operation.

The LNAV guidance sub-function receives navigation partition data from the inactive FMCF when its navigation partition fails.

VNAV Engage Logic

These are the other inputs for VNAV engage logic:

- Software monitors valid
- Hardware monitors valid
- ADIRU data valid
- Other FMCF not active
- Active FMCF selected
- Active route
- VNAV arm/operate input set
- Performance data valid
- 400 feet above ground level (AGL)

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**FMCS - FMCF FUNCTIONAL DESCRIPTION - LNAV AND VNAV ENGAGE LOGIC**

- Not glideslope mode active
- Not go-around mode active.

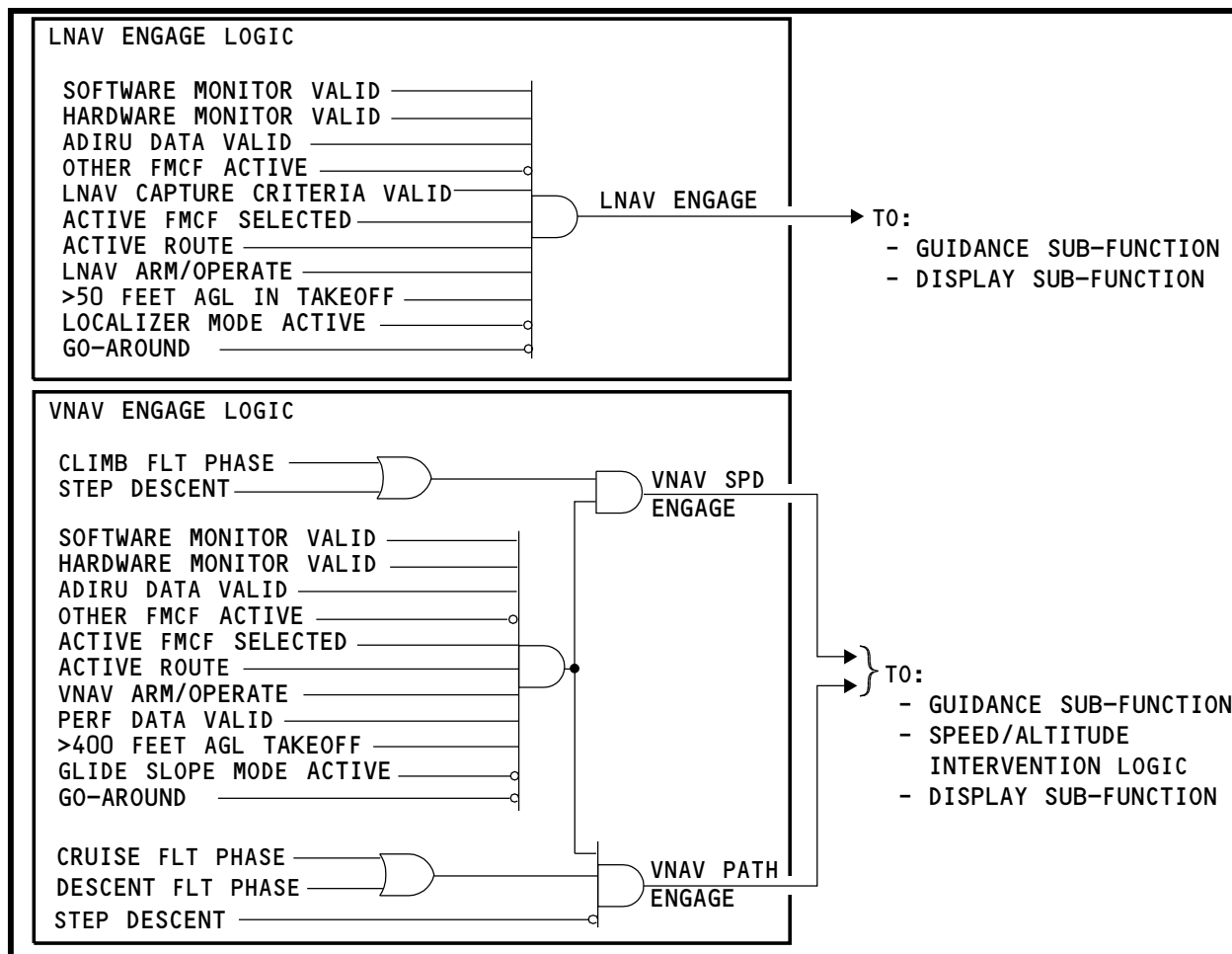
The VNAV engage logic also gets inputs about the climb, cruise and descent flight phases. The VNAV engage logic uses this data to engage into the VNAV SPD or VNAV PATH mode.

The active FMCF sends the VNAV engage status to the guidance sub-function, speed and altitude intervention logic, and the display sub-function. VNAV engages for these flight phases:

- Climb
- Cruise
- Descent
- VNAV approach to glideslope capture.

Glideslope capture cancels or inhibits VNAV operation. Go-around initiation also cancels VNAV operation.

The VNAV guidance sub-function does not receive VNAV sub-function data from the inactive FMCF when its VNAV sub-function fails. In this case, the FMCF fails.



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FMCS - FCMF FUNCTIONAL DESCRIPTION - LNAV AND VNAV ENGAGE LOGIC

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**FMCS - FCMF FUNCTIONAL DESCRIPTION - VNAV SPEED AND ALTITUDE INTERVENTION ENGAGE LOGIC****General**

The active FCMF sends speed and altitude targets to the autopilot flight director system (AFDS). The FCMF sends speed targets to the thrust management computing system (TMCS) in cruise. The flight crew can change the speed (speed intervention) and altitude (altitude intervention) targets with a switch selection and a manual entry.

Speed Intervention

The guidance sub-function sends speed commands to the AFDS to control speed. The mode control panel (MCP) IAS/mach window blanks the display when VNAV SPD engages.

VNAV speed intervention lets the operator override the active FCMF speed target. To do this, push the IAS/mach selector on the MCP. The window then shows the FCMF target airspeed. Turn the selector knob to change the target airspeed.

Push the selector again to make the window go blank. The active FCMF then uses the FCMF target airspeed.

Altitude Intervention

The active FCMF sends altitude commands to the AFDS. The active FCMF uses the altitude window and altitude selector to do these functions:

- Remove altitude constraints
- Change the FCMFs cruise altitude
- Capture the MCP altitude.

Altitude constraint removal occurs when the MCP altitude is higher than the constraint altitude in climb or lower than the constraint altitude in descent. To do this, push the altitude selector. Each push of the altitude selector removes one constraint between the airplane and the MCP altitude.

Set a new cruise altitude above or below the current airplane altitude. Altitude intervention in cruise occurs with a push of the altitude selector on the MCP. This causes the airplane to go in the direction of the altitude change. This also causes the present cruise altitude to change to the MCP altitude.

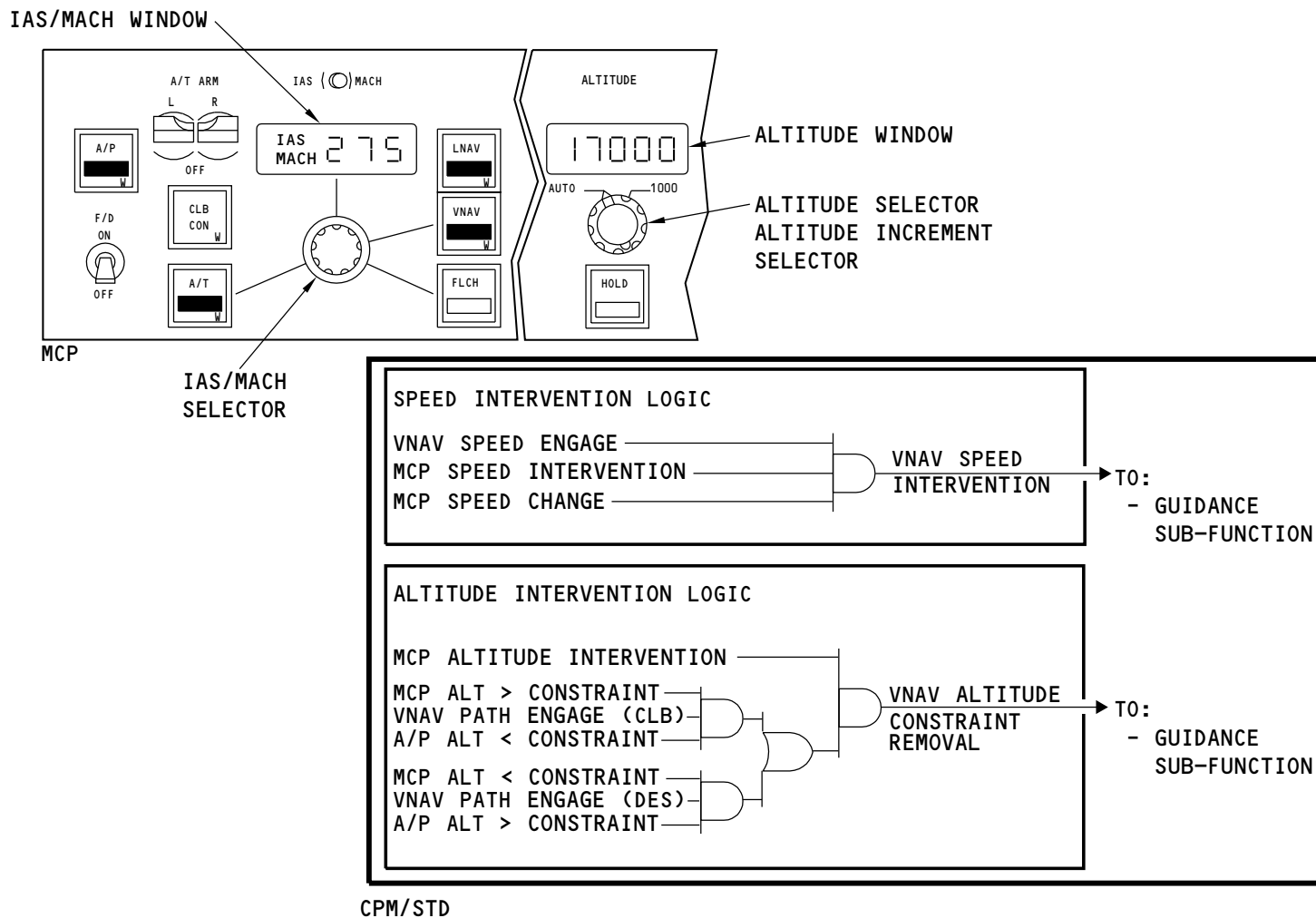
MCP altitude capture occurs when the airplane attempts to fly through the MCP altitude in climb and descent or away from the MCP altitude in cruise. In these conditions, the active FCMF gives a VNAV altitude hold command. This causes the airplane to fly to and capture the MCP altitude. This occurs when the AFDS VNAV mode is active. Annunciation of the VNAV ALT mode shows on the primary display system.

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FMCS - FMCF FUNCTIONAL DESCRIPTION - VNAV SPEED AND ALTITUDE INTERVENT

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FMCS - FMCF FUNCTIONAL DESCRIPTION - DISPLAY CONTROL SUB-FUNCTION**General**

The display control sub-function receives inputs from the CDUs and from the flight deck control panels. The display control sub-function, with these inputs, interfaces with the other sub-functions of the FMCF to supply:

- Map data to the primary display function (PDF)
- Flight path mode data to the PDF
- Page display data to the CDUs
- Messages to the CDUs
- Fault messages to the PDF
- Fault, data load, test display data to the CMCF.

Map Data

The display control sub-function formats and updates dynamic data and background data for the navigation display (ND) map mode. The display control sub-function uses inputs from the:

- EFIS control panel
- CDU push buttons
- Mode control panel (MCP).

Dynamic data is symbology or active alphanumeric data readouts. This shows as airplane position, velocity and airplane orientation on the NDs. This data has a refresh rate from one to 20 times per second.

Background data shows as stationary ground points and alphanumeric text data on the NDs. Background data has a refresh rate once every five seconds to ten seconds. New background data with a mode change occurs within one to two seconds.

Flight Path Mode Data

The display control sub-function sends dual flight mode data to the PDF when LNAV and VNAV sub-functions are active.

CDU Page and Message Display Data

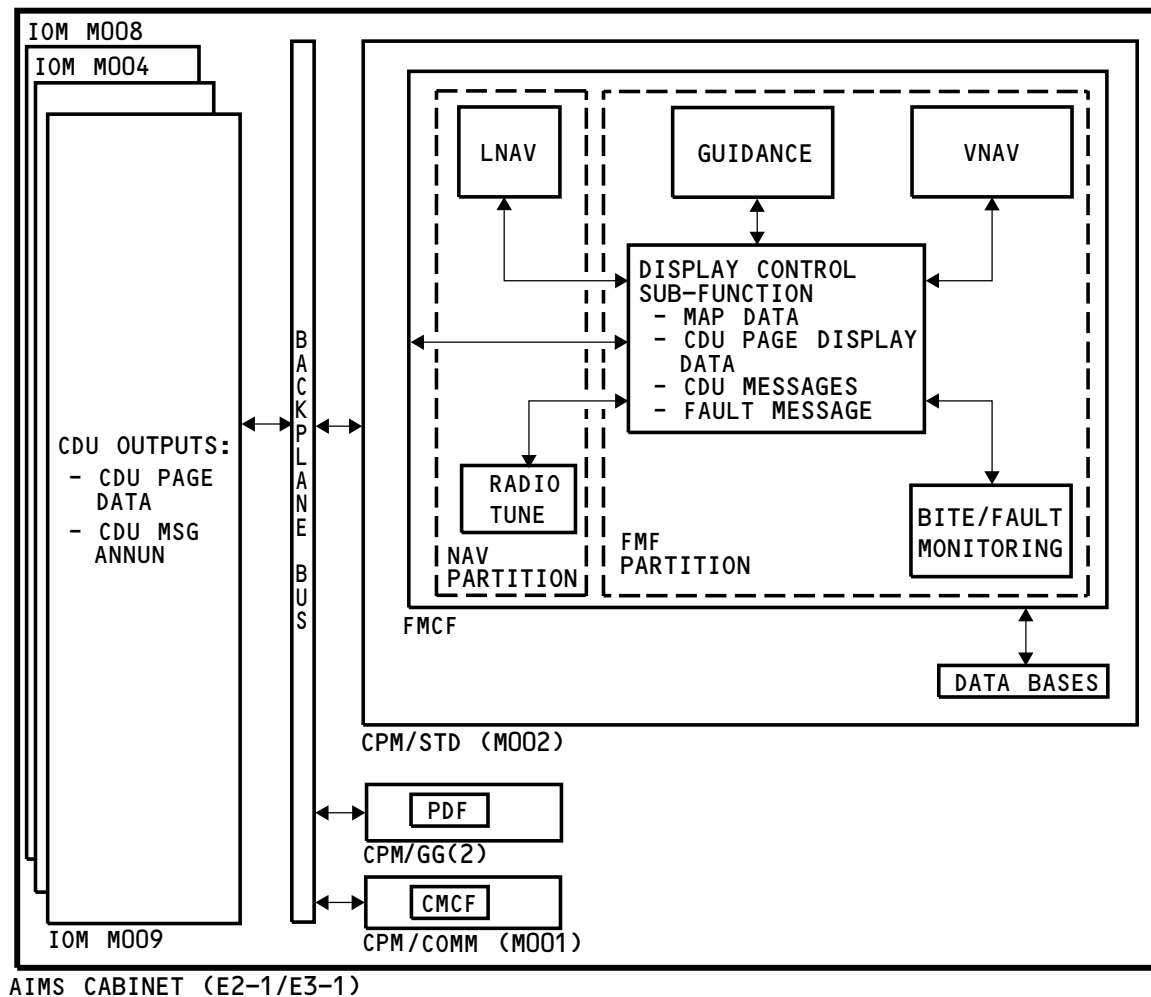
The display control sub-function receives line select key, mode, function, and alphanumeric keyboard data from the CDUs to update and change display data and format. It also monitors CDU inputs for invalid entries and shows applicable advisory messages in the CDU scratchpad. It monitors the other functions to advise or alert the crew with an applicable message in the scratchpad.

Fault Messages

The display control sub-function listens to the BITE and fault monitoring sub-function and CDU keyboard inputs to cause fault messages to show on the EICAS display.

CMCF Data

Fault and test display data goes to the CMCF to show on the MAT. Data load information and progress for the CDU operational program and NAV data base goes to the MAT for display.



FMCS - FMCF FUNCTIONAL DESCRIPTION - DISPLAY CONTROL SUB-FUNCTION

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**FMCS - AUTOMATIC DEPENDENT SURVEILLANCE FUNCTION FUNCTIONAL DESCRIPTION****General**

ATC sends automatic dependent surveillance (ADS) requests from the ground to the airplane. The ADSF in the airplane sends airplane data to the ground. ATC uses this data to manage air traffic. The ADSF is automatic and does not require flight crew action.

Functional Description

ATC sends ADS requests from the ground to the airplane. The link between the ground and the airplane is through the ACARS sub-function of the DCMF.

The DCMF sends the request to the ADSF. The ADSF receives inputs from these units and functions:

- Air data inertial reference unit (ADIRU)
- Flight management computing function (FMCf)
- Flight deck communication function (FDCF)
- Data communication management function (DCMF)
- Primary display function (PDF).

The ADSF uses these inputs to manage and format the transmission of ADS reports to the ground. The ADSF sends the report to the DCMF. The ACARS sub-function of the DCMF down links the report to the ground.

The reports contain data ATC uses to track the airplane in the air. These are examples of data transmitted to ATC:

- Airplane position
- Flight plan waypoints
- True heading
- True track
- Ground speed
- Wind speed
- Wind direction
- Position uncertainty

- Validity status of the airplane TCAS system
- Aircraft tail identification
- Operational status of the ADSF
- Uncorrected barometric altitude
- Mach number
- Total air temperature (TAT)
- Vertical rate.

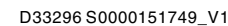
The ADS reports occur without any flight crew action.

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FMCS - FMCF FUNCTIONAL DESCRIPTION - BITE/FAULT MONITORING SUB-FUNCTION**General**

The FMCF BITE and fault monitoring sub-function does software and hardware comparisons, input monitoring, and fault recording. The BITE and fault monitoring sub-function uses both external and internal inputs to do:

- Input monitoring
- Power-up checks
- Cross cabinets checks
- Synchronization monitoring
- Software reset.

The BITE and fault monitoring sub-function sends fault display data to the display control sub-function. It also sends fault data to the central maintenance computing function (CMCF) for fault recording.

Input Monitoring

The FMCFs monitor inputs from the CDUs and all the applicable line replaceable units (LRUs). The FMCFs monitor the input buses to find if the input signals are active, not active, valid or invalid.

Power-Up Checks

The FMCF does compatibility and comparison checks during power-up and internal monitoring during normal operation. Power-up checks are done at power-up and at BITE restarts. These are the checks and comparisons that occur:

- Operational program configuration (OPC) check. The FMCF compares the OPC and the FMCF operational software. If they do not agree, the FMCF fails and a maintenance message occurs on the MAT.
- Performance database (PDB) check. The FMCF monitors the airframe/engine identification program pin input and OPS. If they do not agree, the FMCF fails and a maintenance message occurs on the MAT.
- PDB/electronic engine controller (EEC) comparison. The FMCF compares the engine type and thrust rating in the PDB and the engine type and thrust rating from the EEC. If they do not agree, the FMCF stores the EEC data in non-volatile memory then restarts.

- Airline modifiable information (AMI) comparison. The FMCF compares the AMI file with the OPS and the OPC. If they do not agree, the FMCF uses the AMI default values.

Cross Cabinet Checks

The active FMCF compares its OPS, PDB, and navigation data base (NDB) to the inactive FMCF to make sure they agree. If they do not agree, the inactive FMCF fails. A maintenance message goes to the CMCF for display and storage.

Synchronization Monitoring

FMCF synchronization monitoring occurs at power-up and during normal operation. The active FMCF sends flight plan data to the inactive FMCF. This occurs so the inactive FMCF can take over if the active FMCF fails. The active FMCF sends its flight plan data to the inactive FMCF for these conditions:

- Long term power-ups
- BITE induced restart
- Flight plan entries and performance data changes.

When the active FMCF fails, a resynchronization (resync) occurs. Resyncs take about 1 second for an entire flight plan update. The active FMCF always resyncs the inactive FMCF. The active FMCF selection is a function of the FMC selector position and FMF partition health.

Software Reset

An AIMS software reset from the MAT does a test of the FMCFs and clears memory buffers, flight plans, and user entered data. Fault data stays in memory over the reset.

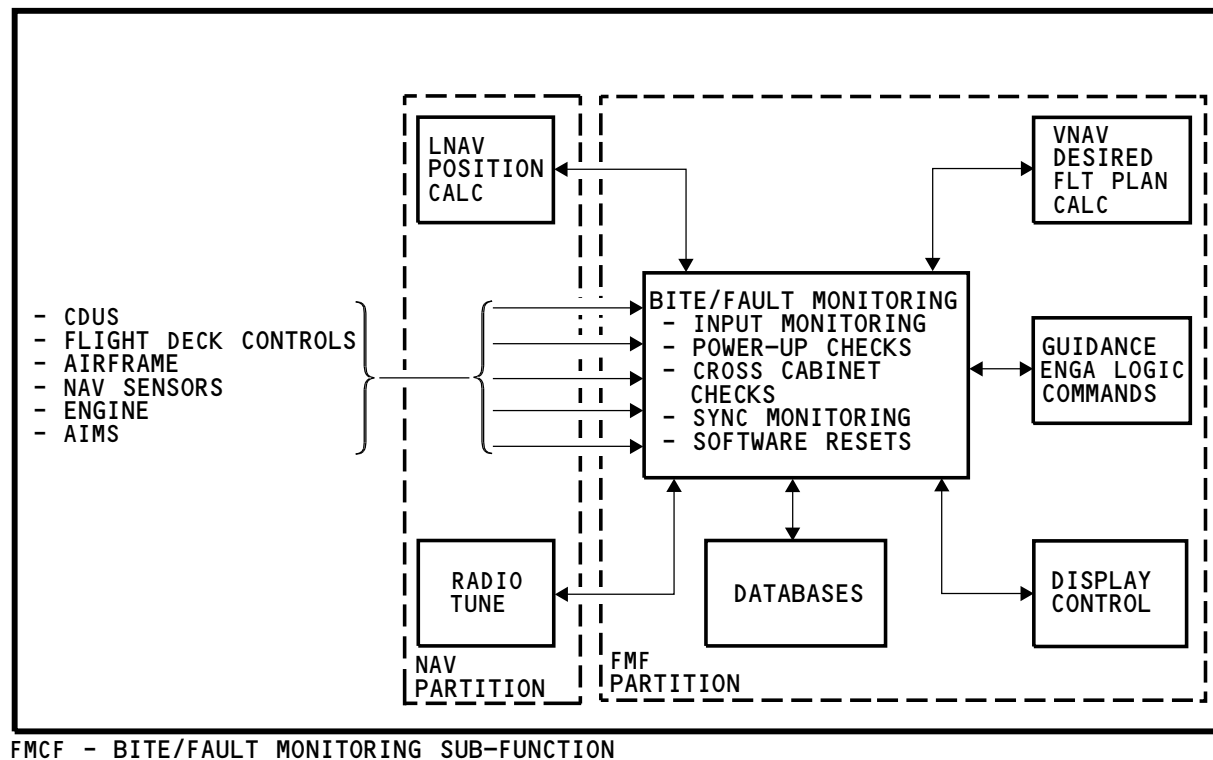
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FMCS - FMCF FUNCTIONAL DESCRIPTION - BITE/FAULT MONITORING SUB-FUNCTION

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FMCS - AIRLINE MODIFIABLE INFORMATION

General

The 777 airplane lets the airlines customize certain default values in the flight management computing system. You customize these functions through airline modifiable information (AMI). You use the ground based software tool (GBST) to make the modifications.

These functions have default values:

- Performance, guidance, and takeoff data
- Alternate function parameters
- Crew alertness monitor
- Request uplink imbedded message identifier (IMI) table
- Datalink option codes
- Downlink trigger parameters.

You can modify any of the default values for these functions. In addition, you can create tables or values for these functions:

- Downlink address table
- Airline ground address table.

There are no default values for these tables.

Performance, Guidance and Takeoff Data

The table shows the default values and the valid range for the performance, guidance and takeoff data.

Parameter	Default Value	Valid Range
All Eng Accel ht	1000 feet	400-9999 feet
Eng out accel ht	1000 feet	400-9999 feet
Speed restriction	none	100-400 kts
Speed transition	250 kts/10000 ft	Spd 100-400 kts Alt 0-40000 ft
Maneuver margin	1.2 FAA 1.3 CAA/JAR	1.2-1.3 FAA 1.3-CAA/JAR

Parameter	Default Value	Valid Range
Rate of climb margin for climb	100 ft/min	0-500 ft/min
Rate of climb margin for cruise	100 ft/min	0-500 ft/min
Default thrust rating in cruise	Max cruise thrust	Max climb or max cruise thrust
Minimum cruise time	1 minute	1-20 minutes
Thrust reduction height/ flap setting	1000 feet	400-9999 feet
Fuel freeze/min operating temp	-37C	-99C to -1C
Takeoff Derate 1	10%	0-30%
Takeoff Derate 2	20%	0-30%
Company speed	Defined in NDB	1-400 kts CAS (.1 to .99 MACH)
Company speed thrust rating	Max climb thrust	Max climb, Max cruise, Max con

Alternate Function Parameters

The table shows the default values and the valid range for the alternate function parameters.

Parameter	Default Value	Valid Range
Altitude	FMCF computed	1500-40000 ft
Min runway length	0 feet	0-15000 ft
Speed mode	ECON	ECON, CAS/MACH, LRC, EOLRC, COSPD
Speed value	None	1-400 kts CAS .1 - .99 MACH

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FMCS - AIRLINE MODIFIABLE INFORMATION

Crew Alertness Monitor Parameters

The table shows the default values and the valid range for the crew alertness monitor parameters.

Parameter	Default Value	Valid Range
Cruise advisory timer	15 min	15-60 min
Cruise caution timer	20 min	15-75 min
Cruise warning timer	25 min	15-75 min
Descent advisory timer	5 min	5-60 min
Descent caution timer	6 min	5-75 min
Descent warning timer	7 min	5-75 min

Also, the default settings for the crew alertness warning, caution, and advisory annunciations are disabled. You can enable any or all of these annunciations.

Request Uplink IMI Table

The table shows the default IMI values and the associated imbedded element identifier (IEI) values for uplink requests.

IMI Description	IMI	Associated IEI
Flight Plan	FPN	RP, FN
Load information	LDI	RR
Performance initialization	PER	PR
Position	POS	POS
Progress (ETA) report	PRG	DT

Datalink Option Codes

You set a bit in a data word to a logic 1 or a logic 0 to control the datalink option codes. Bits 1-10 are for functions that show on a CDU display. The default value for these functions is set to a logic 0 which causes the function to show on the appropriate display. A logic 1 blanks the function. These are the functions:

- Bit 1 - Flight plan data request inhibit
- Bit 2 - Performance Initialize data request inhibit
- Bit 3 - Takeoff data request inhibit
- Bit 4 - Enroute wind data request inhibit
- Bit 5 - Descent forecast data request inhibit
- Bit 6 - Company preferred alternate request inhibit
- Bit 7 - Alternate flight list data request inhibit
- Bit 8 - Alternate weather data request inhibit
- Bit 9 - Flight plan data report inhibit
- Bit 10 - Position report inhibit.

Bits 11 through 23 control data that may be added to message content or functions that will be added. These items have a default value of logic 0 which excludes the functionality:

- Bit 11 - Time stamp IEI enable
- Bit 12 - Ground address IEI enable
- Bit 13 - Company distribution IEI enable
- Bit 14 - Scratchpad IEI enable
- Bit 15 - Flight number IEI enable
- Bit 16 - Flight plan response enable
- Bit 17 - Performance initialize response message enable
- Bit 18 - Takeoff response message enable
- Bit 19 - Wind response message enable
- Bit 20 - Pos report trigger response message enable
- Bit 21 - ALTN response message enable

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FMCS - AIRLINE MODIFIABLE INFORMATION

- Bit 22 - Change in destination airport trigger enable
- Bit 23 - Change in arrival runway trigger enable.

Downlink Trigger Parameters

The table shows the default values and the valid range for the downlink trigger parameters.

Parameter	Default Value	Valid Range
Head wind discrepancy	Disable	0-99 kts
Change in destination ETA	Disable	0-999 min
Time to top of descent 1	Disable	0-999 min
Time to top of descent 2	Disable	0-999 min
Time to top of descent 3	Disable	0-999 min
Time to top of descent 4	Disable	0-999 min
Time to top of descent 5	Disable	0-999 min
Time to destination 1	Disable	0-999 min
Time to destination 2	Disable	0-999 min
Time to destination 3	Disable	0-999 min
Time to destination 4	Disable	0-999 min
Time to destination 5	Disable	0-999 min

Downlink Address Table

The downlink address table has the ground addresses and the company distribution for IMIs. There are no default entries for this table. You may enter a maximum of 20 IMIs in the table.

Airline Ground Address Table

The airline ground address table has the ground addresses with the identification of ADS uplinks that originate with the airline. There are no default entries for this table. You may enter a maximum of 5 ground addresses or 5 groups of addresses in the table.

Default Values Summary

Default values are non-modifiable values found in the operational software of the CPM/STD. To cause the function to operate with new values, you must develop a customized AMI and load that software into the CPMs. These new values do not override the default values but are used instead of the default values. If the AMI fails, FMCFs use the default values.

With the FMCF, you can also use the airline policy page to modify the AMI values on a short term basis. You can do this between flights.

FUNCTIONS WITH DEFAULT VALUES

PERFORMANCE, GUIDANCE AND TAKEOFF DATA
ALTERNATE FUNCTION PARAMETERS
CREW ALERTNESS MONITOR
REQUEST UPLINK IMI TABLE
DATALINK OPTION CODES
DOWNLINK TRIGGER PARAMETERS

MODIFIABLE FUNCTIONS

PERFORMANCE, GUIDANCE AND TAKEOFF DATA
ALTERNATE FUNCTION PARAMETERS
CREW ALERTNESS MONITOR
REQUEST UPLINK IMI TABLE
DATALINK OPTION CODES
DOWNLINK TRIGGER PARAMETERS
DOWNLINK ADDRESS TABLE
AIRLINE GROUND ADDRESS TABLE

FMCS - AIRLINE MODIFIABLE INFORMATION

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FMCS - CDU FUNCTIONAL DESCRIPTION

General

The left and right CDUs operate independently to supply different pages of data with CDU keyboard entries. The CDU main interface is with the active FMCF for flight control. The CDUs interface with other systems. The CDUs also do back-up functions and alternate functions for some systems.

The CDUs receive inputs from these:

- External systems
- Flight deck panels
- AIMS cabinets
- Other CDUs.

The CDUs use the inputs to do these functions:

- Menu control and access of systems
- Alternate control panel functions
- Alternate LNAV function
- Alternate LNAV guidance
- Alternate LNAV engage and disengage logic
- Alternate navigation radio tuning
- Bite and fault monitoring
- Display and control
- Liquid crystal display (LCD).

The CDUs supply data to these functions and components:

- AIMS (CMCF, FMCF, and PDF)
- LCD function
- Navigation radios
- Autopilot flight director system (AFDS)
- Satellite data unit (SDU)
- Passenger address/cabin interphone (PA/CI) controller.

Systems Access

Push the MENU key to access the MENU page. This MENU page shows the FMC and other systems the operator may access. The left and right CDUs are the main crew interface for preflight and inflight control. The crews use the CDUs and the mode control panel (MCP) to initialize the FMCFs during preflight. The flight crews use the CDUs to change the lateral and vertical flight profile inflight.

The flight and maintenance crews also use the CDUs to interface with these subsystems:

- Satellite data unit (SDU) allows voice and data communication
- Passenger address/cabin interphone (PA/CI) controller allows menu control to communicate to the cabin
- Airplane maintenance menu access on the multi-functional displays (MFD)
- Text entry for the flight deck communication function (FDCF) formats.

Alternate Control Panel Functions

The left and right CDUs give an alternate control panel function for the onside electronic flight instrument system (EFIS) control panel. The center CDU acts as a left or right CDU when either CDU fails. The CDUs have controls for the display select panel (DSP). The EFIS control panel and the DSP lose their functionality when a CDU acts as a backup for that position.

Alternate LNAV Function

Each CDU can be an alternate navigation source. The active FMCF supplies map and flight plan data to the CDUs. The left and right CDUs can display the active FMCF map and flight plan data in two ways.

The left and right CDUs can retransmit the active map data and send it to the onside navigation display (ND) through the PDF when the NAV source switch is in the CDU position. The CDUs also show FMCF pages.

FMCS - CDU FUNCTIONAL DESCRIPTION

The CDUs can reformat and transmit the map and flight plan data to the outside ND via the PDF when the NAV source switch is in the normal position. This occurs if the FMCFs fail. If this happens, no FMCF pages are available.

All CDUs can show the ALTN LEGS, ALTN NAV PROGRESS, and ALTN NAV RADIO pages for display when the active FMCF or both FMCFs fail. This lets the crew review and change the lateral flight plan through CDU line select keys and keyboard entries. The center CDU can replace the left or right CDU for map display on the ND when the left or right CDU fails.

The CDUs supply great circle distance calculations and other data the same way as the FMCF. The CDUs use this data from the air data inertial reference unit (ADIRU) to supply navigation outputs:

- Altitude
- Ground speed
- Latitude and longitude
- Mag heading
- Roll angle
- True heading
- North and east velocities.

The CDUs do not calculate radio position or receive global positioning system (GPS) inputs to help in navigation calculations. The CDUs do not calculate performance data.

Alternate LNAV Guidance

The CDU receives flight plan data from the active FMCF partition and uses actual airplane position from the ADIRU to calculate lateral steering commands. The CDUs send lateral steering commands to the AFDS when:

- The alternate navigation mode is active
- A flight plan exists
- LNAV request from the MCP.

The AFDS selects the left, center, or right CDU (priority with all CDUs valid) lateral guidance command for roll control. The CDU that sends commands to the AFDS also sends map data to the captain ND.

The CDUs do not give guidance for holding patterns and lateral path offsets. They also do not give runways or airports for display.

Alternate LNAV Engage and Disengage Logic

The CDU LNAV engage logic starts with these conditions:

- LNAV mode request from the AFDS
- The current FMCF flight plan or a manual flight plan entry
- The airplane position satisfies the LNAV capture criteria (capture criteria is a crosstrack distance of 2.5 nautical miles or less, or a crosstrack distance that the CDU LNAV function can initiate a path capture when on an intercept heading)
- Active FMCF not valid
- ADIRU roll data is valid
- ADIRU position data is valid.

The LNAV disengage logic is set when the AFDS inputs are invalid or the AFDS disengages.

Alternate (Back-up) Navigation Radio Tuning

The left and right CDUs can do alternate navigation radio tuning. The center CDU is not a backup for the left or right CDU for alternate navigation radio tuning.

The CDUs (left and right) send a tuning source discrete and frequency to the outside radios when the active FMCF fails. The left CDU sends a tuning source discrete and frequency to the left and center navigation radios. The right CDU sends a tuning source discrete to the right radios.

The navigation radios transfer tuning control to the CDUs when they receive the tuning source discrete. The CDUs transmit the last tuning data to their outside navigation radios from the active FMCF.

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FMCS - CDU FUNCTIONAL DESCRIPTION

The ALTN NAV RADIO page permits manual entries to tune the onside navigation radios. The frequencies go to the navigation radio on an ARINC 429 bus.

Bite and Fault Monitoring

The CDU BITE and fault monitoring function consists of:

- Software and hardware comparisons
- Input monitoring
- Fault recording.

These are the sub-functions that the BITE and fault monitoring circuits do:

- Input monitoring
- Self checks during power-up and normal operation
- Manual tests done by the ground crew.

The BITE and fault monitoring function sends fault data to the central maintenance computing function (CMCF) for display and fault recording.

For input monitoring, the CDU monitors inputs from all its line replaceable units (LRUs). The CDU monitors the integrity of input buses and does checks of the input signals to determine their status. Signal status includes inactivity and validity fail for ARINC 629 LRU data.

The ARINC 429 LRU transmitters use no computed data (NCD) and failure warning (FW) status conditions. The CDU does certain reasonableness checks for key data to guard against failures that it cannot detect.

For self checks the CDU does compatibility checks during power-up and internal monitoring during normal operation. Power-up checks are done at power-up and at BITE restarts.

Display and Control Function

The display control function receives these inputs:

- CDU line select keys
- Keyboard entries

- Flight deck control panel inputs
- AIMS FMF partition inputs
- BITE/fault monitoring requests
- CMCF requests.

The display control function use the inputs to supply these outputs:

- Map data to the PDF
- Flight path mode data to the PDF
- Button push information
- Data load to the CMCF for operational program load
- CDU page display data to the CDU
- CDU messages that show in the CDU scratchpad
- Fault and test data that goes to the CMCF.

The display control function of the CDU makes CDU page and message displays. The display control function also sends data to the PDF for map and flight path mode data. The CDU map and flight path mode data format is almost the same as the FMCF display function.

Liquid Crystal Display (LCD) Function

The LCD function has both color and gray scale capability.

The backlight driver assembly has:

- Temperature sensors
- Heaters
- Power supplies
- Filament monitoring circuits.

The character generator has these functions:

- Interface control
- Character generation control logic
- Voltage references.

The LCD driver sends image data to the LCD for display.

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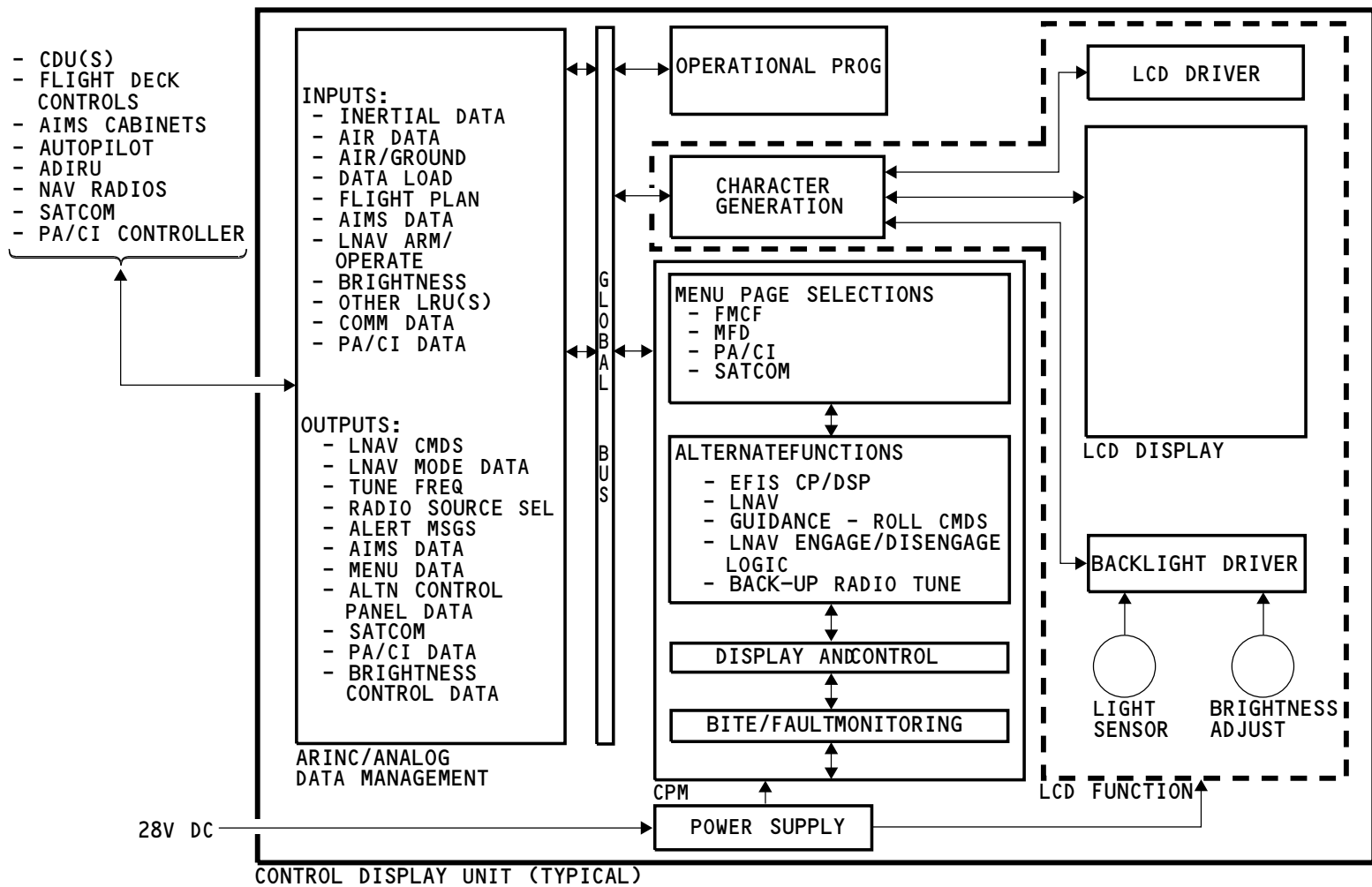
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**FMCS - CDU FUNCTIONAL DESCRIPTION**

The LCD shows color and gray scale text data. The LCD circuit also sends voltage reference data to the character generator and LCD driver for image compensation.

A manual control and a sensor on the front of the CDU permit brightness control.



FMCS - CDU FUNCTIONAL DESCRIPTION

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**FMCS - SYSTEM TESTS****General**

These are the system tests for the flight management computing system:

- Control display unit (CDU), center
- Control display unit, left
- Control display unit, right.

CDU System Test

This test makes sure that the center, left, or right CDU operates correctly. The CDU display (screen) goes blank during the test. After you start the test, you can not stop it. This test takes less than one minute.

GROUND TESTS

SELECT ATA SYSTEM (55)

- 32 LEFT MAIN LANDING SYSTEM
- 32 NOSE LANDING GEAR
- 32 PROXIMITY SENSOR SYSTEM
- 32 RIGHT MAIN LANDING SYSTEM
- 34 AIMS FLIGHT MANAGEMENT COMPUTING SYSTEM
- 34 INSTRUMENT LANDING SYSTEM
- 34 RADIO ALTIMETER SYSTEM
- 34 TRAFFIC ALERT AND COLLISION AVOIDANCE SYSTEM
- 34 WEATHER RADAR SYSTEM

SELECT TEST TYPE

- ☒ SYSTEM TEST
- ☐ FUNCTION TEST
- ☐ PERFORMANCE TEST

SELECT SYSTEM TEST (3)

- CONTROL DISPLAY UNIT (CENTER)
- CONTROL DISPLAY UNIT (LEFT)
- CONTROL DISPLAY UNIT (RIGHT)

CONTINUE

HELP

GO BACK

SELECT SYSTEM TEST (3)

- CONTROL DISPLAY UNIT (CENTER)
- CONTROL DISPLAY UNIT (LEFT)
- CONTROL DISPLAY UNIT (RIGHT)

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FMCS - SYSTEM TESTS

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FMCS - CDU SPECIAL FUNCTIONS

General

The FMCS control display unit (CDU) special function makes sure the internal hardware and software operates correctly. During a special function, the CDU uses built-in test equipment (BITE) to do a power-up test. The special function also makes a CDU test patterns show on the CDU for operator inspection.

The MAT shows these CDU special function screens/dialogue boxes:

- Select ATA system
- Select function (left, center, or right CDU)
- CDU center, left, or right special function
- Description (same for all CDUs)
- Special function condition - ready, inhibited, or completed
- Special function instructions - what to look for on the CDU display
- CDU center, left, or right white test pattern
- CDU center, left, or right black test pattern
- CDU center, left, or right checkerboard test pattern.

CDU Display - Special Function Description

The CDU special function permits the operator to look for faults in the CDU LCD glass or drive circuits. Normal operating formats are not on the CDU during this special function.

The approximate time to run a CDU special function is two to five minutes.

There are no limitations or special requirements to run a CDU special function.

To do a CDU special function, select a CDU from the MAT select function screen/dialogue box. Next, read and follow the instructions on the MAT screens/dialogue boxes that show.

CDU LCD Test Pattern - White

This special function causes the CDU display to show a white test pattern. Look for defects on the display.

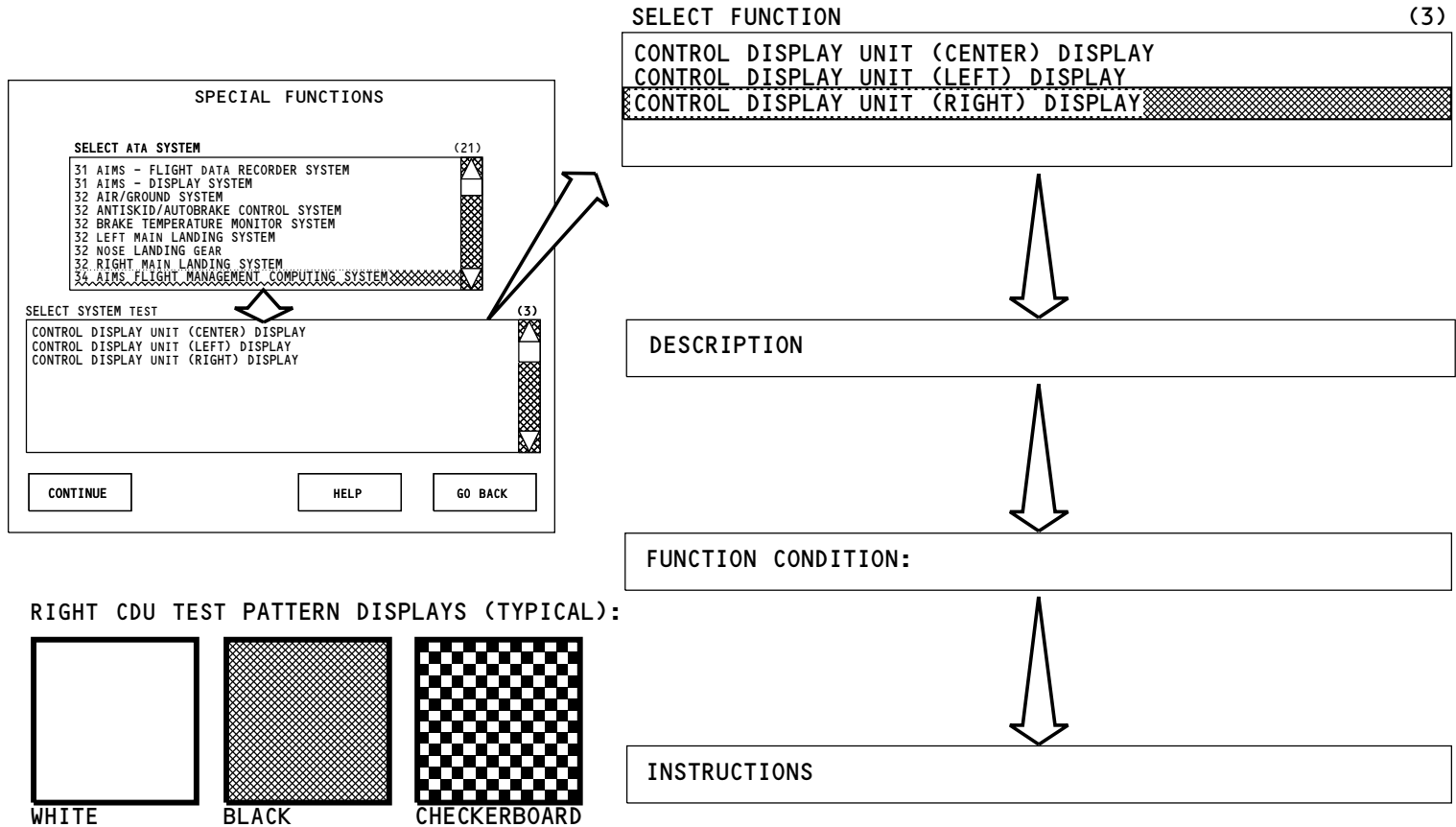
CDU LCD Test Pattern - Black

This special function causes the CDU display to show a black test pattern. Look for defects on the display.

CDU LCD Test Pattern - Checkerboard

This special function causes the CDU display to show a checkerboard test pattern. Look for defects on the display.

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FMCS - CDU SPECIAL FUNCTIONS

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