CHAPTER

76

Engine Control GE 115

(GE90-100 SERIES ENGINES)

CHAPTER 76
ENGINE CONTROL GE 115

Subject/Page	Date	COC
76-EFFECTIVE PAGES		
1	Sep 05/2018	
2	BLANK	
76-CONTENTS		
1	Sep 05/2016	
2	BLANK	
76-00-00		
1	May 05/2015	
2	May 05/2015	
3	May 05/2015	
4	May 05/2015	
5	May 05/2015	
6	May 05/2015	
7	May 05/2015	
8	May 05/2015	
9	May 05/2015	
10	Sep 05/2016	
11	Sep 05/2016	
12	Sep 05/2016	
13	Sep 05/2016	
14	Sep 05/2016	
15	Sep 05/2016	
16	Sep 05/2016	
17	Sep 05/2016	
18	Sep 05/2016	

Subject/Page	Date	COC
76-00-00 (cont.)		
19	Sep 05/2016	
20	BLANK	

A = Added, R = Revised, D = Deleted, O = Overflow, C = Customer Originated Change

76-EFFECTIVE PAGES

CHAPTER 76
ENGINE CONTROL GE 115

76-CONTENTS

THIS PAGE IS INTENTIONALLY LEFT BLANK

ENGINE CONTROLS - INTRODUCTION

General

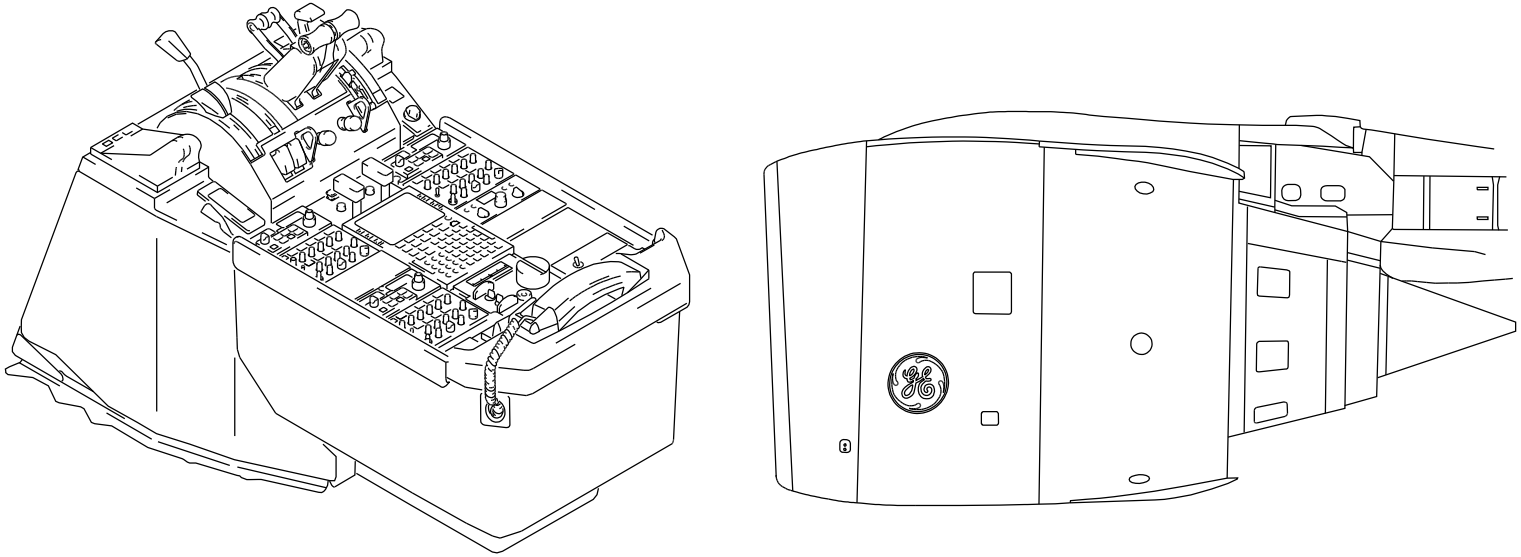
The engine controls system supplies most of the control signals the engine needs to operate. It also controls inputs to other airplane systems that require engine control status.

The engine controls system includes these components:

- Thrust levers
- Fuel control switches
- Autothrottle servo motors
- Thrust lever switches
- Switch pack
- Thrust lever angle (TLA) resolvers.

Abbreviations and Acronyms

- AIMS - airplane information management system
- ASM - autothrottle servo motor
- ATA - air transport association
- A/T - autothrottle
- EDIU - engine data interface unit
- EEC - electronic engine control
- ELMS - electrical load management system
- EPCS - electronic propulsion control system
- GSE - ground support equipment
- HMU - hydromechanical unit
- IDG - integrated drive generator
- MFD - multi-function display
- TLA - thrust lever angle
- TO/GA - takeoff/go-around
- TRA - thrust resolver angle
- T/R - thrust reverser



ENGINE CONTROLS

- THRUST LEVERS
- FUEL CONTROL SWITCHES
- AUTOTHROTTLE SERVO MOTORS
- THRUST LEVER SWITCHES
- SWITCH PACK
- TLA RESOLVERS

M43892 S000621516_V1

ENGINE CONTROLS - INTRODUCTION

ENGINE CONTROLS - GENERAL DESCRIPTION

General

The engine controls system supplies manual and automatic control inputs to operate the engine. You use the thrust levers and fuel control switches to supply the manual inputs. The AIMS supplies the automatic inputs.

Thrust Control

The thrust levers supply thrust command signals to the electronic engine controls (EEC) through the TLA resolvers. Each thrust lever mechanically connects to a TLA resolver. When the thrust lever moves, it turns the TLA resolver. The EEC supplies power to excite the TLA resolver and reads the position of the resolver.

The thrust management function of the AIMS supplies automatic thrust command signals to the EEC with the TLA resolver. To do this, it turns the TLA resolver (and thrust lever) with the autothrottle servo motor (ASM). The ASM turns a brake that connects to the thrust lever and TLA resolver.

See the autoflight chapter for more information on the ASM control (CHAPTER 22).

Fuel Control Switches

The fuel control switches control relays in the electrical load management system (ELMS). The relays control the start and stop functions of the engine.

Thrust Lever Switches

These are the thrust lever switches:

- Takeoff/Go-around (TO/GA)
- Autothrottle (A/T) disconnect
- Thrust reverser (T/R) sync lock control valve.

See the autoflight chapter for more information on the TO/GA and A/T disconnect switches (CHAPTER 22).

See the engine exhaust chapter for more information on the T/R sync lock control valve switch (CHAPTER 78).

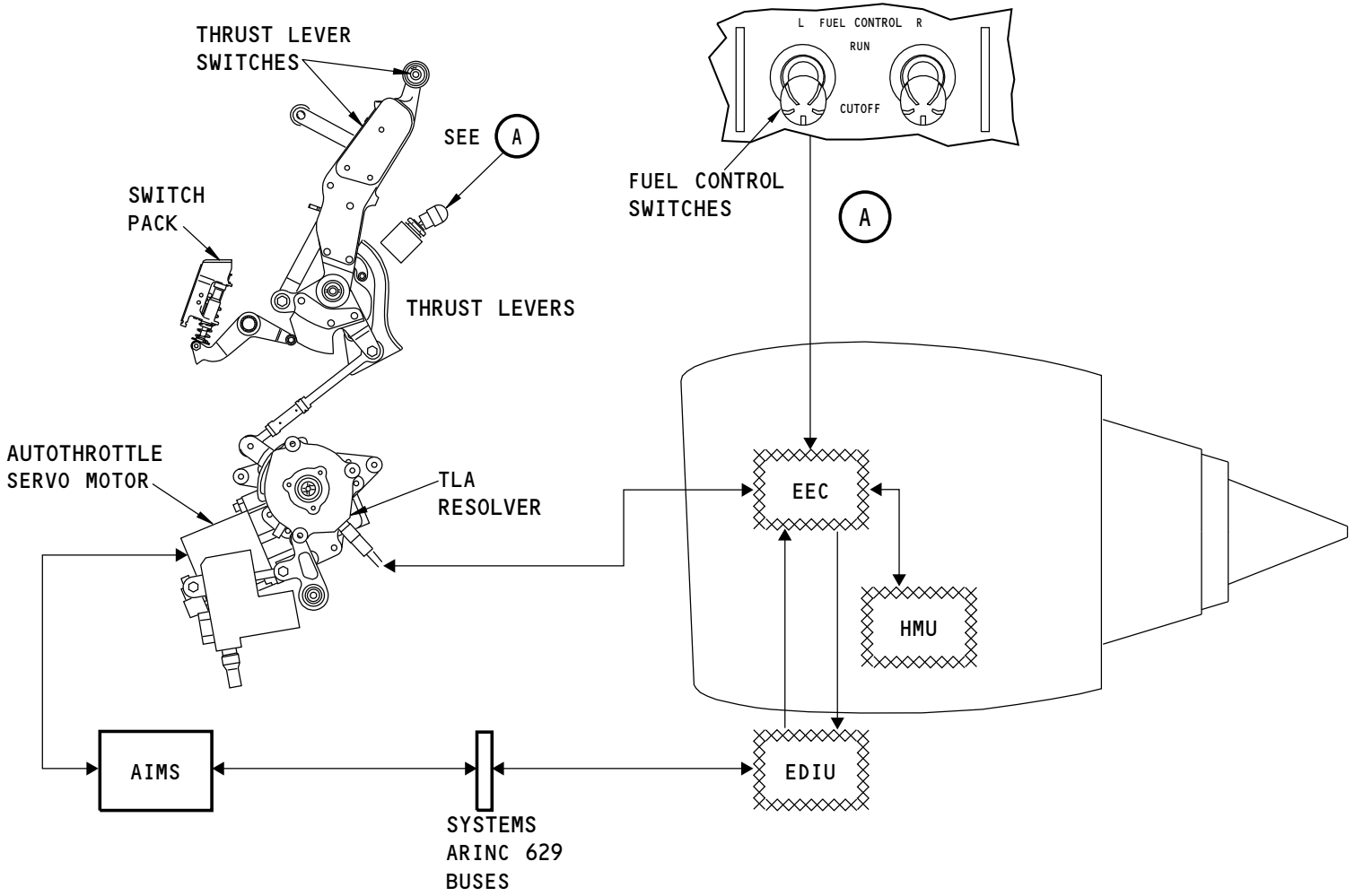
Switch Pack Switches

These are the switch pack switches:

- T/R directional control valve
- Autobrake inhibit.

See the engine exhaust chapter for more information on the T/R directional control valve pack switch (CHAPTER 78).

See the landing gear chapter for more information on the autobrake inhibit pack switch (CHAPTER 32).



M43893 S000621517_V3

ENGINE CONTROLS - GENERAL DESCRIPTION

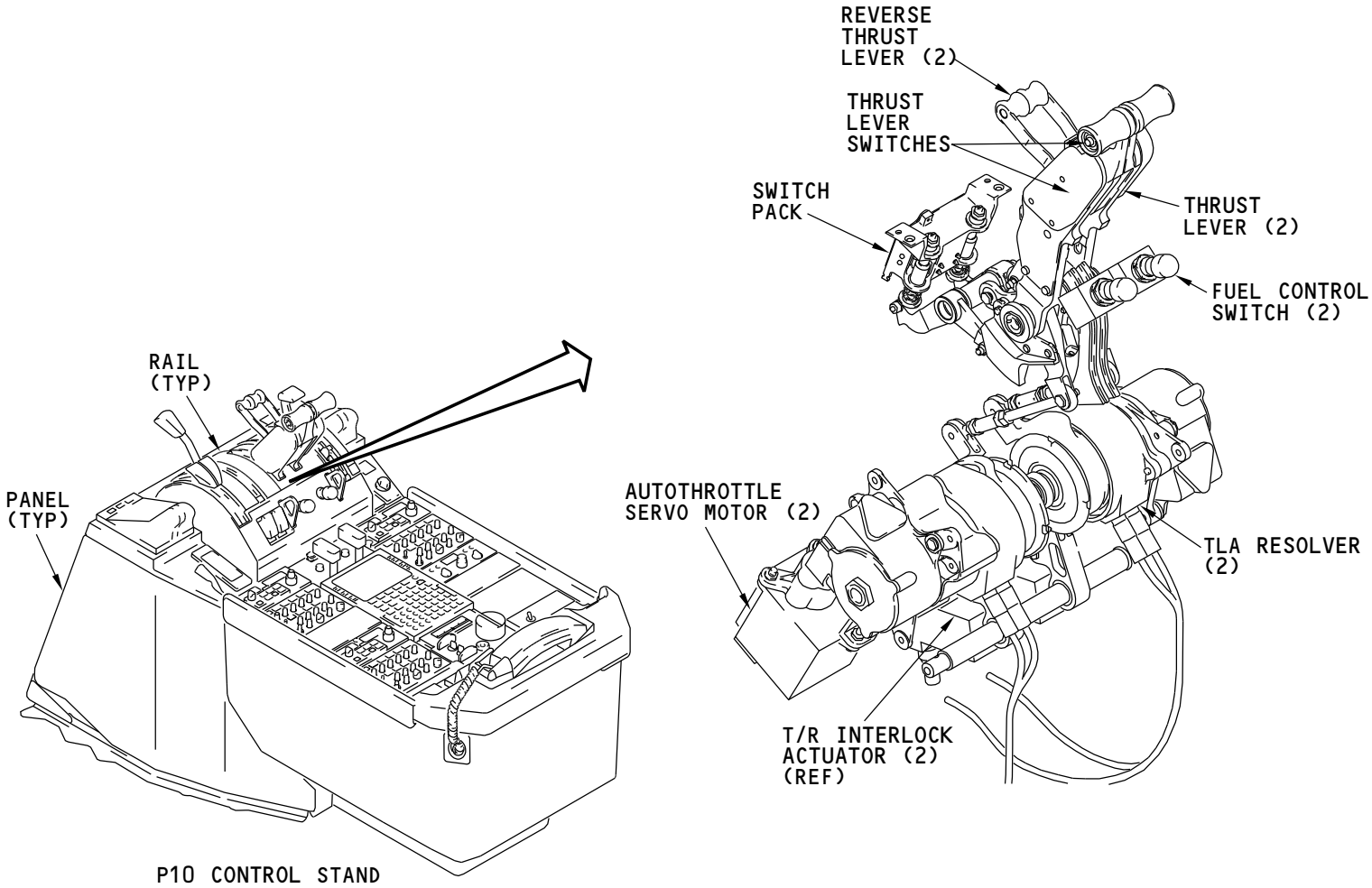
ENGINE CONTROLS - COMPONENT LOCATIONS

General

All of the engine controls components are at the P10 control stand in the flight deck. You get access to the components by removing panels, rails, or covers. These are the components:

- Switch pack
- Thrust lever switches
- Thrust levers
- Fuel control switches
- TLA resolvers
- Autothrottle servo motors.

See the autoflight chapter for more information on the autothrottle servo motors (CHAPTER 22).



M43894 S000621518_V1

ENGINE CONTROLS - COMPONENT LOCATIONS

ENGINE CONTROLS - SWITCHES - COMPONENT LOCATIONS

General

The thrust levers contain removable control switches. You remove covers to get access to the switches.

Thrust Lever Switches

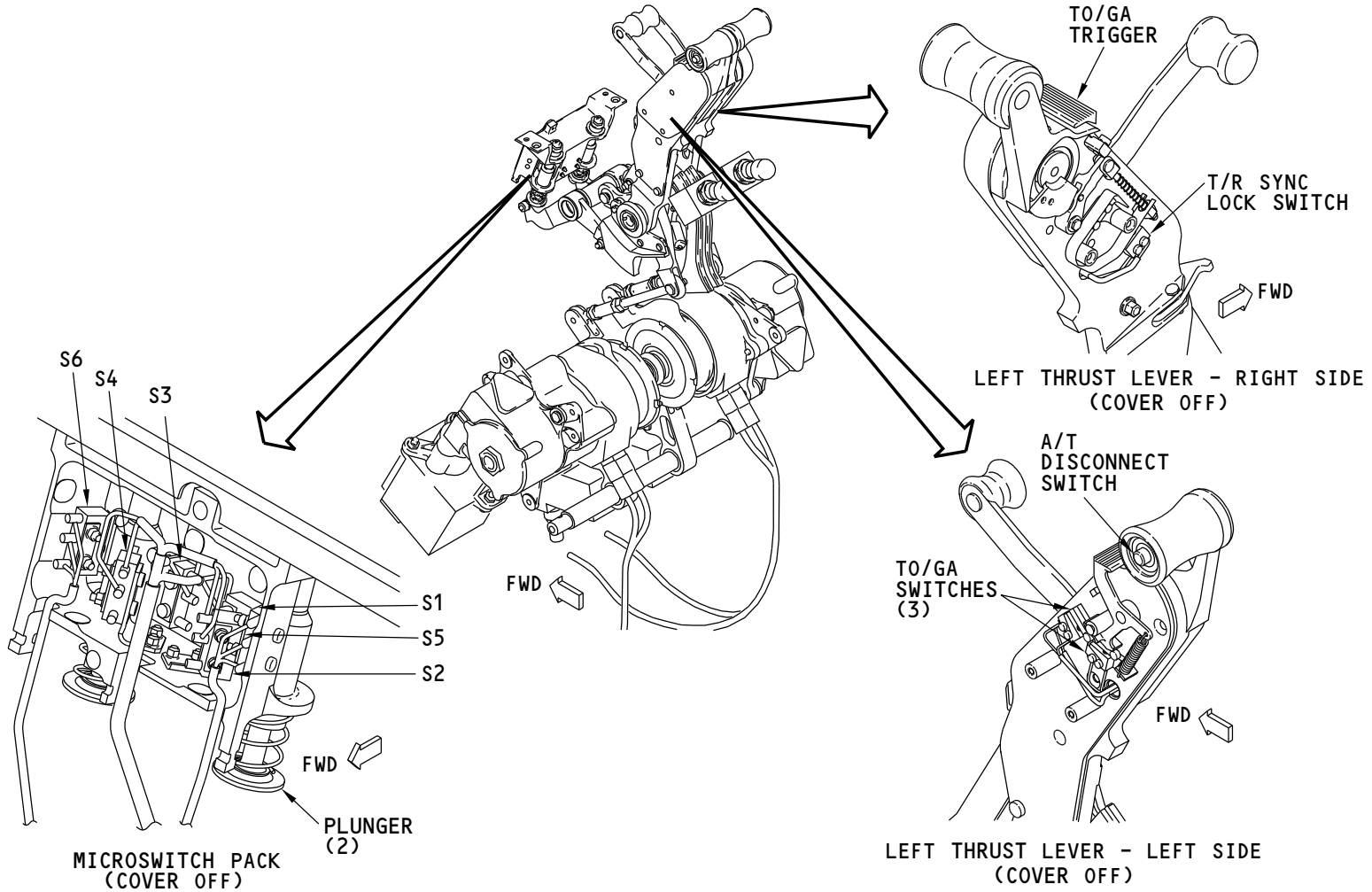
Four switches attach to the sides of each thrust lever. The TO/GA switches are on the outboard side. The T/R sync lock switch is on the inboard side. The TO/GA trigger moves the TO/GA switches. The reverse thrust lever moves the T/R sync lock switch.

The A/T disconnect switch is in the handle of the forward thrust lever.

Microswitch Pack

The microswitch pack is in the forward part of the control stand. It contains six switches. Each thrust lever moves a plunger in the switchpack to operate three of the switches. You can remove and install the pack as an assembly or replace an individual switch. You must use a soldering iron to replace an individual switch. These are the switches:

- S1 - autobrake inhibit left 1
- S2 - autobrake inhibit left 2
- S3 - autobrake inhibit right 1
- S4 - autobrake inhibit right 2
- S5 - T/R directional control solenoid valve left
- S6 - T/R directional control solenoid valve right.



M43895 S000621519_V1

ENGINE CONTROLS - SWITCHES - COMPONENT LOCATIONS

ENGINE CONTROLS - THRUST LEVER & AUTOTHROTTLE ASSEMBLY - FUNCTIONAL DESCRIPTION

General

The thrust lever and autothrottle assembly work together to supply thrust commands to the EEC. You use the thrust levers to make manual inputs. The autothrottle servo motor (ASM) makes automatic inputs.

Thrust Lever

The thrust lever is one assembly with many pieces. These pieces mechanically transmit the thrust lever commands to the autothrottle assembly:

- Reverse thrust lever
- Forward thrust lever
- Thrust lever crank
- Lever latch
- Control rod.

When you move the forward thrust lever, the force goes through the reverse thrust lever down to the thrust lever crank. The forward thrust lever and crank turn on the same shaft, but only connect together with the reverse thrust lever. The crank connects to the ASM brake with the control rod. The ASM brake turns the rotor of the TLA resolver. The resolver sends a thrust resolver angle (TRA) signal to the EEC.

When the forward thrust lever is not at idle, the lever latch holds the reverse thrust lever down. When the forward thrust lever is at idle, you can raise the reverse thrust lever. When the reverse thrust lever is up, the latch holds the forward thrust lever at idle.

Autothrottle Assembly

These are the four components of the autothrottle (A/T) assembly:

- ASM
- ASM gearbox
- TLA resolver
- ASM brake.

The ASM turns a shaft in the A/T assembly through the ASM gearbox. When the shaft turns, it turns the ASM brake. The ASM brake turns the rotor of the TLA resolver and, at the same time moves the thrust lever.

ASM Brake

The ASM brake is a spring-loaded clutch assembly. These are its functions:

- Mechanical connection to the thrust lever
- Friction source for the thrust lever
- Mechanical connection to the TLA resolver
- Mechanical connection to the A/T assembly shaft
- T/R control interface.

The ASM brake connects to the A/T assembly shaft with a clutch. This permits you to manually override ASM inputs.

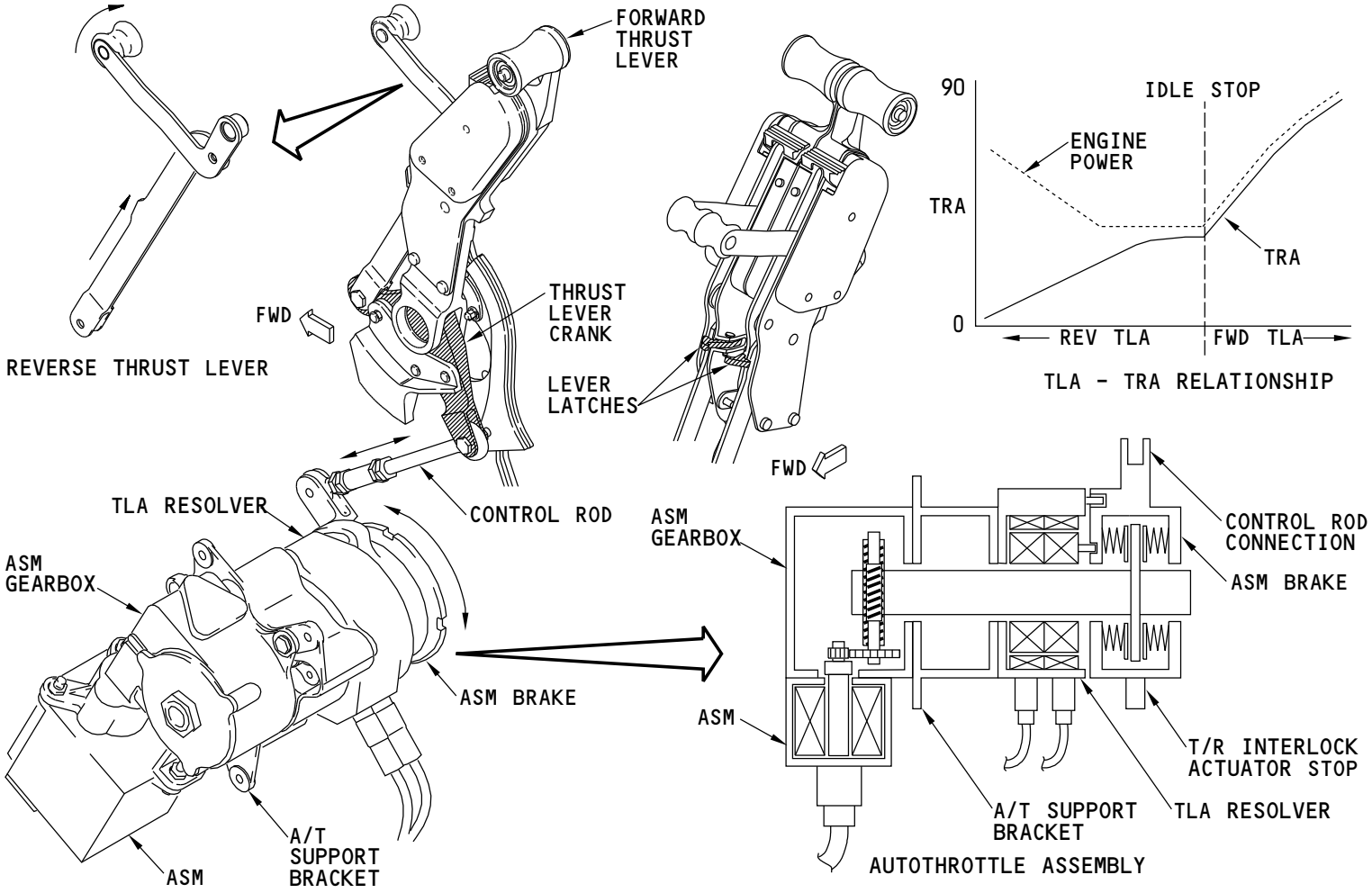
The T/R interlock actuator (not shown) keeps the ASM brake from turning beyond reverse idle until the thrust reverser deploys.

TLA-TRA Relationship

When the thrust lever is at idle, the TRA is approximately 34 degrees. As you move the thrust lever forward, the forward TLA increases. At full forward TLA, the TRA is approximately 85 degrees.

When you raise the reverse thrust lever, the reverse TLA increases. At full reverse TLA, the TRA is approximately 5 degrees. The flat spot in the reverse TRA curve is where the reverse thrust lever closes reverser control switches without increasing engine power.

Engine power increases between approximately 34 and 85 degrees TRA in forward thrust. Engine power increases between approximately 24 and 5 degrees TRA in reverse thrust.



M43896 S000621520_V1

ENGINE CONTROLS - THRUST LEVER & AUTOTHROTTLE ASSEMBLY - FUNCTIONAL DESCRIPTION

ENGINE CONTROLS - TLA RESOLVER

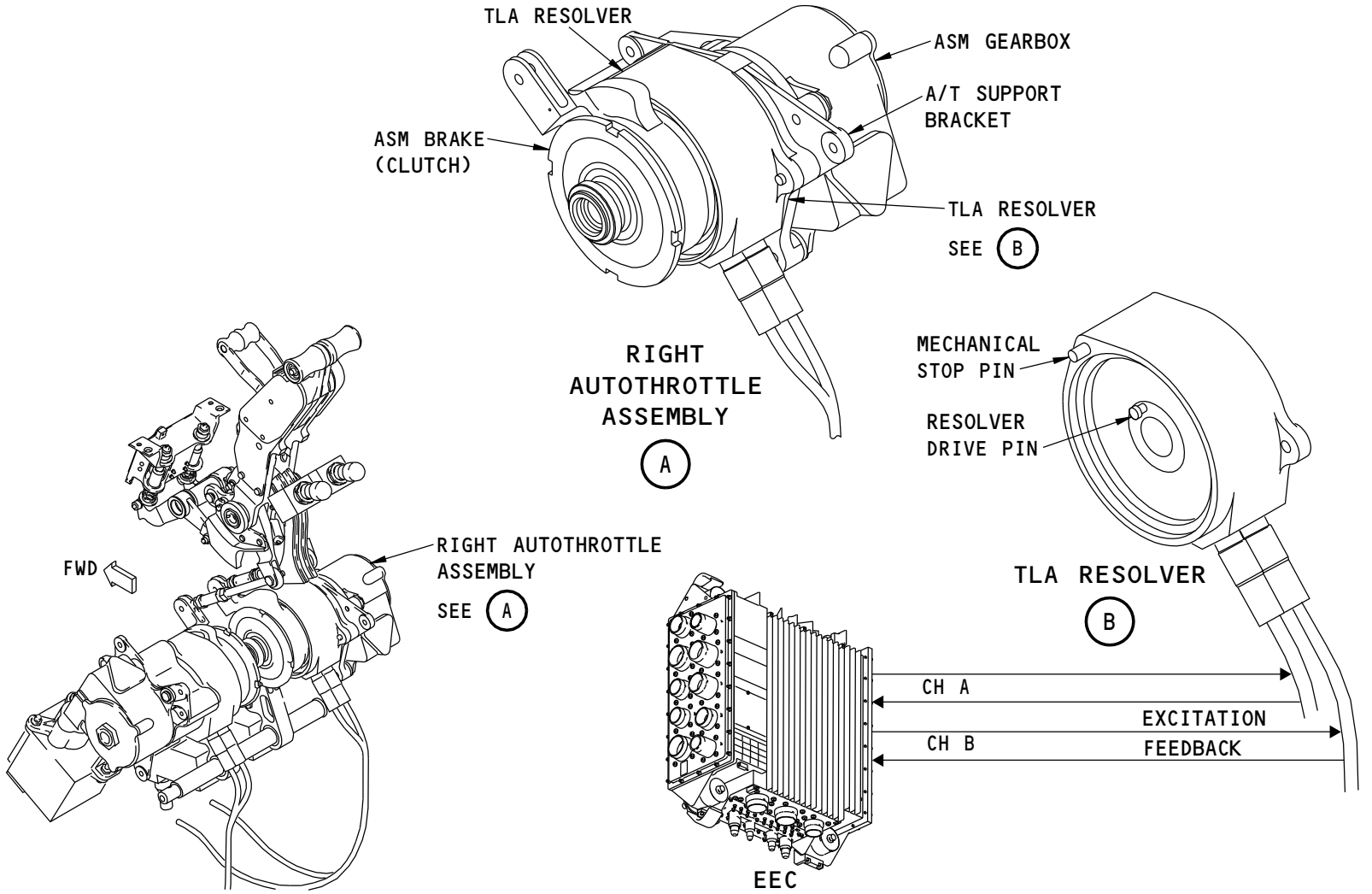
General

There is one TLA resolver for each engine. The resolver sends an electrical signal to the EEC in proportion to the thrust lever angular position.

Functional Description

The TLA resolver has two elements. Each channel of the EEC supplies a low-voltage, ac excitation signal to one element of the resolver. The feedback signal from the resolver to the EEC is in proportion to the thrust lever angular position.

The ASM brake turns the resolver with the resolver drive pin. The mechanical stop pin prevents too much ASM brake movement that can damage the resolver.



ENGINE CONTROLS - TLA RESOLVER

ENGINE CONTROLS - FUEL CONTROL SWITCHES - FUNCTIONAL DESCRIPTION

General

Each fuel control switch controls a set of four relays in the ELMS. The relays control many functions. These are the relays:

- Reset/fuel spar
- Ignition/fire detection
- Generator control/ignition
- EEC reset/IDG disconnect.

One electrical source supplies power to both coils of each relay. Each position of the fuel control switch supplies a ground for one coil of each relay.

Reset/Fuel Spar Relay

The reset/fuel spar relay controls these functions:

- Fuel control switch position signal to the AIMS
- EEC channel A reset signal
- Fuel control switch position signal to the ELMS
- Fuel spar valve control.

Ignition/Fire Detection Relay

The ignition/fire detection relay controls these functions:

- EEC power control
- Fuel control switch position signal to the engine data interface unit (EDIU)
- Ignition 1 power
- Fire switch lockout control.

Generator Control/Ignition Relay

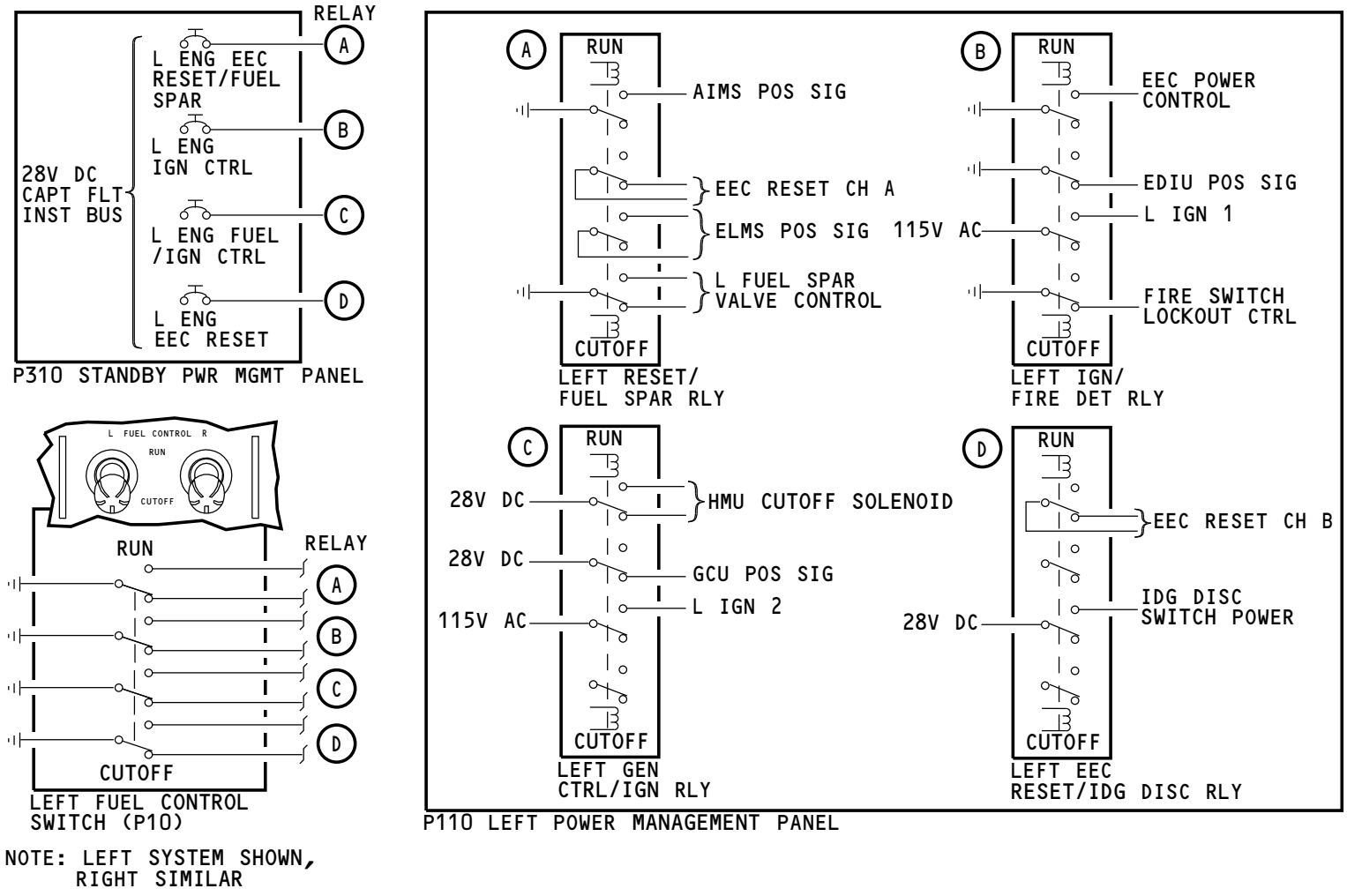
The generator control/ignition relay controls these functions:

- Hydromechanical unit (HMU) cutoff solenoid power
- Fuel control switch position signal to the generator control unit (GCU)
- Ignition 2 power.

EEC Reset/IDG Disconnect Relay

The EEC reset/IDG disconnect relay controls these functions:

- EEC channel B reset signal
- IDG disconnect switch power.



M43898 S000621522_V1

ENGINE CONTROLS - FUEL CONTROL SWITCHES - FUNCTIONAL DESCRIPTION

ENGINE CONTROLS - OPERATION

Controls

You use many flight deck controls and displays with the engine controls system to operate the engine. These are the controls and displays and the ATA chapters where you find the details on them:

- Thrust levers (76)
- Fuel control switches (76)
- EEC maintenance switches (73)
- EEC mode switches (73)
- Start/Ignition switches (74,80)
- Autostart switch (80)
- Fire switches (26)
- EICAS display (77)
- Multi-function display (MFD) (73,75,76,77,78,79,80).

Thrust Lever (76)

Each thrust lever mechanically moves its TLA resolver. The resolver sends the EEC a signal in proportion to the angular position of the thrust lever. This permits the EEC to set the proper thrust.

Fuel Control Switch (76)

Each fuel control switch has two positions; RUN and CUTOFF. In RUN, the switch controls the HMU to open the engine fuel shutoff valve. In CUTOFF, the switch controls the HMU to close the valve.

In addition, when you move the fuel control switch from RUN to CUTOFF, the EEC resets. This stops the software programs in the EEC and sets them to run from the start.

EEC Maintenance Switch (73)

Each EEC maintenance switch has two positions; NORM and TEST. In NORM, the switch lets EEC power come from normal operating power sources. In TEST, the switch connects airplane ac power to the EEC without starting any EEC control logic.

EEC Mode Switch (73)

Each EEC mode switch lets the pilots set the EEC control mode: normal or alternate. You should always operate both engines in the same control mode.

Start/Ignition Switches (74,80)

You use the start/ignition switch to begin the start of the engine. It also lets you select continuous ignition on the engine.

Autostart Switch (80)

The autostart switch permits the EEC to automatically control engine starts.

Fire Switch (26)

The fire switch permits fuel control power to go to the hydromechanical unit (HMU) when the switch is in its normal position (in). If the switch is pulled out, power connects directly to the HMU cutoff solenoid to stop fuel flow to the engine.

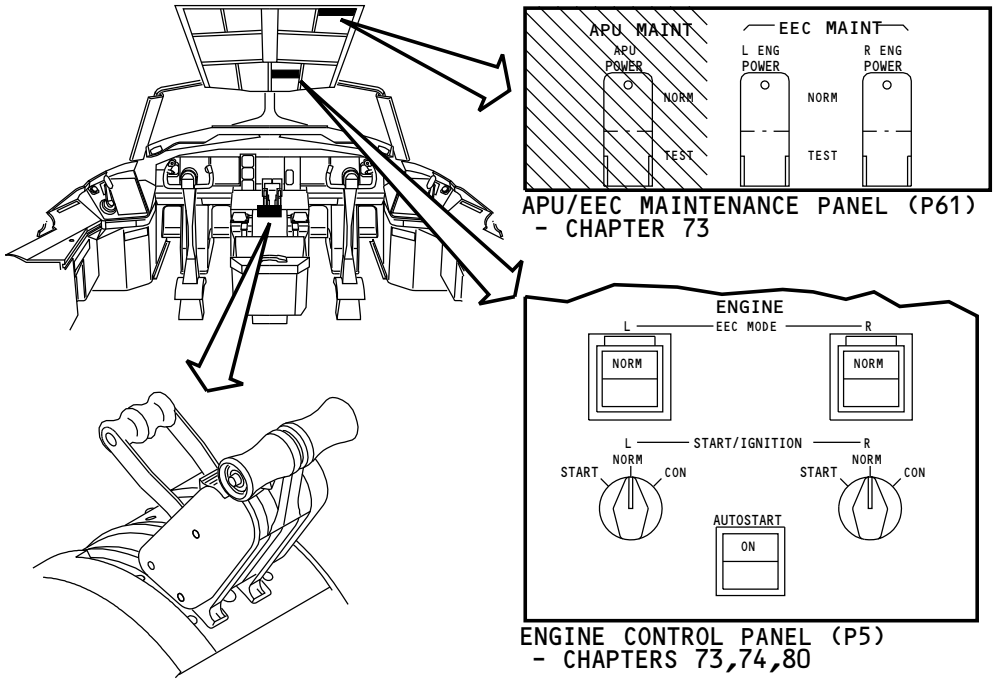
EICAS Display (77)

The EICAS display shows the primary engine indications. These are N1 and EGT.

Multi-Function Display (MFD) (73,75,76,77,78,79,80)

Many different MFDs show data that relates to engine controls. These are those MFDs:

- Secondary engine display
- Performance maintenance page
- EPCS maintenance page
- Propulsion data limits maintenance page
- Engine exceedance maintenance page.



THRUST LEVERS (P10)
- CHAPTER 76

APU/EEC MAINTENANCE PANEL (P61)
- CHAPTER 73

ENGINE CONTROL PANEL (P5)
- CHAPTERS 73,74,80

EICAS DISPLAY
- CHAPTER 77

FUEL CONTROL SWITCHES (P10)
- CHAPTER 76

ENGINE FIRE PANEL (P8)
- CHAPTER 26

MFD
- CHAPTERS 73,75,76,77,78,79,80

M43909 S000621523_V1

ENGINE CONTROLS - OPERATION

ENGINE CONTROLS - TRAINING INFORMATION POINTS

Thrust Lever Check

You measure the force to move the thrust levers to make sure they are within limits. To move the reverse thrust lever, you must disconnect the T/R interlock actuator rod end from the thrust lever assembly.

TLA Resolver Adjustment

Each thrust lever connects to an ASM brake with an adjustable control rod. The ASM brake turns the TLA resolver. You adjust the length of the control rod to change the relationship between the thrust lever position and the resolver position. You make the adjustment with either portable ground support equipment (GSE) or with onboard equipment.

Adjustment - GSE

The most accurate method of adjustment for the TLA resolver is to use special GSE to:

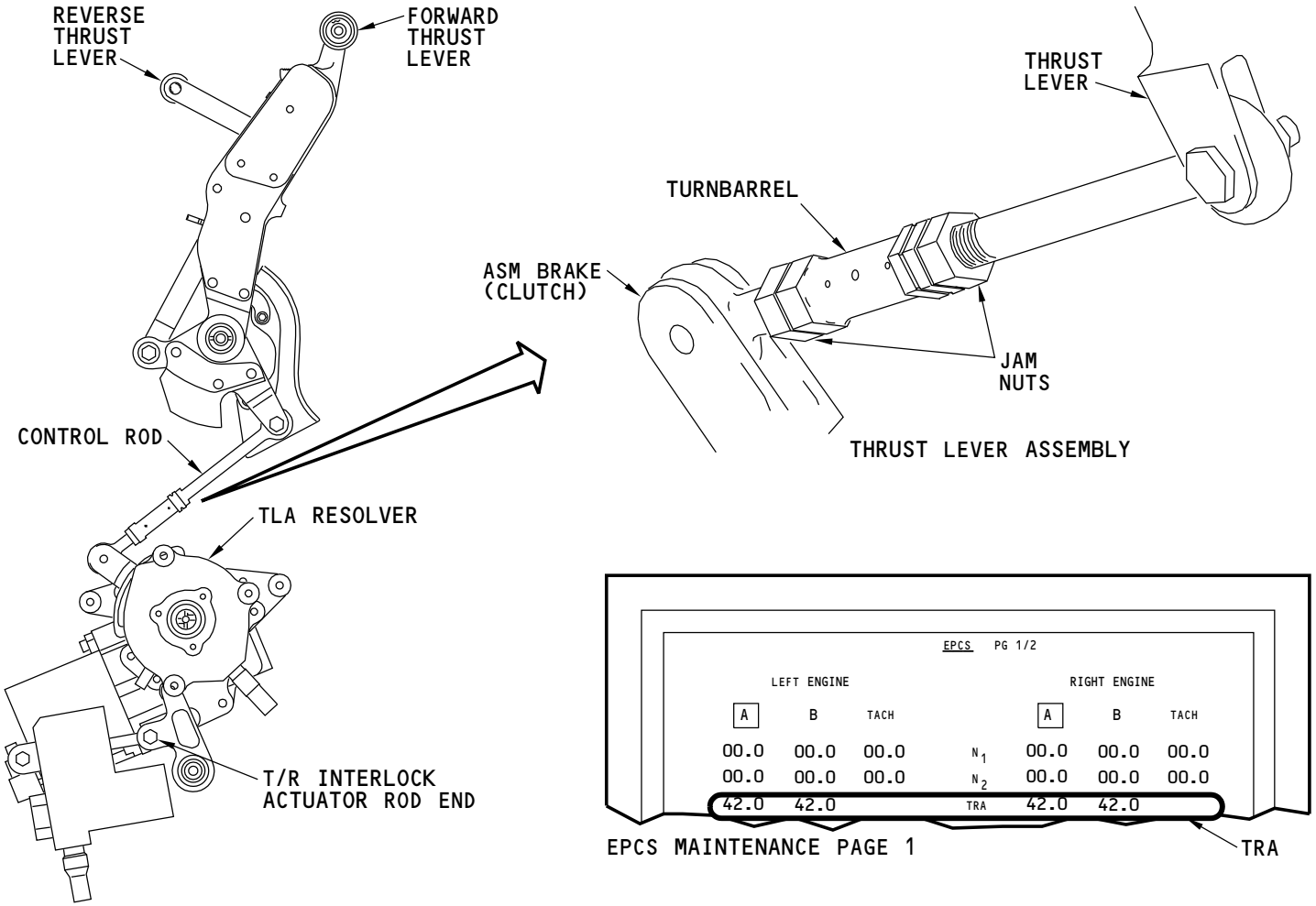
- Measure the thrust lever position
- Excite the resolver
- Read the resolver angle.

With the thrust lever at idle, you turn the turnbarrel to change the length of the control rod to get the correct resolver angle. Jam nuts and safety wire hold the turnbarrel in position.

To make sure the adjustment is correct, you move the thrust lever to its full-forward position and back to idle. Read the resolver angle again. It should agree with the first number. You also check the resolver angle at the thrust lever positions of full-forward and full-reverse.

Adjustment - Onboard

You can adjust the resolver using airplane equipment. You supply the EEC with airplane power and read the TLA resolver angle (thrust resolver angle - TRA) on the electronic propulsion control system (EPCS) maintenance page 1.



M43899 S000621524_V1

ENGINE CONTROLS - TRAINING INFORMATION POINTS