Southwest Airlines/Boeing Thrust Reverser Troubleshooting Event 2024 AMC

737-600/700/800/900
Maintenance Manual Part I

THRUST REVERSER CONTROL SYSTEM - COMPONENT LOCATIONS

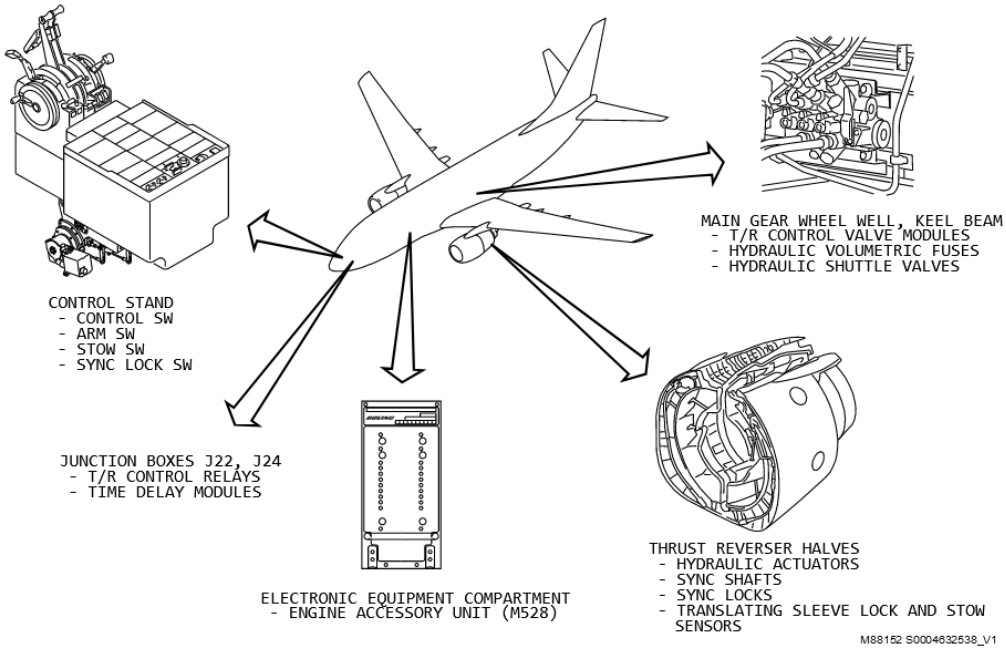
General

The thrust reverser (T/R) control components are at these areas of the airplane:

- Upper and lower control stand
- EE compartment
- T/R halves
- Main gear wheel well.

The graphic shows the general location of the control system components. Refer to the component page to see exact location.

Figure 1. THRUST REVERSER CONTROL SYSTEM - COMPONENT LOCATIONS



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THRUST REVERSER SYSTEM - GENERAL DESCRIPTION

General

The thrust reverser (T/R) system has these subsystems:

- Thrust reverser system
- Thrust reverser control system
- Thrust reverser indicating system.

Thrust Reverser System

The T/R system changes the direction of the fan air exhaust to help decrease the speed of the airplane after landing or during a rejected takeoff (RTO).

The T/R system has two thrust reversers. T/R 1 is the thrust reverser for engine 1 (left). T/R 2 is the thrust reverser for engine 2 (right).

Each T/R has a left and right half. Each half has a translating sleeve which moves aft for reverse thrust. The two sleeves on each T/R work at the same time but are independent of each other. It is permitted for one sleeve to move before the other. The two sleeves do not have to move together, but do have to deploy/stow in the time limits. The two sleeves can have a lag in movement because of the frictional differences between tolerance stack-ups in the thrust reverser assembly for the inboard and outboard sleeves. Three hydraulic actuators move each sleeve. Rotary flex shafts make sure that the hydraulic actuators extend and retract at the same rate.

T/R Control System

The T/R control system lets you deploy the T/R when the airplane is less than 10 feet (3 meters) from the ground. You give a deploy signal to the control system when you raise a reverse thrust lever.

You supply a stow signal when you return the reverse thrust lever to the stow position.

The T/R control valve module controls hydraulic power to the hydraulic actuators. The reverse thrust lever operates the switches necessary to send a deploy or stow signal to the T/ R control valve module.

The sync locks prevent the operation of the hydraulic actuators when there is no deploy signal.

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The primary purpose of the engine accessory unit (EAU) is to control the T/R stow operation. The EAU supplies front panel built-in-test equipment (BITE) to help you do troubleshooting of the control system. The EAU uses two T/R proximity sensors for each translating sleeve for control. The EAU also interfaces with the T/R indicating system to control the REVERSER light.

T/R Indicating System

The T/R indicating system supplies these indications in the flight compartment:

- REV message on common display system (CDS)
- REVERSER light on the P5 aft overhead panel
- Linear variable differential transformer (LVDT) data on the control display unit (CDU).

The common display system (CDS) shows the REV message. This message refers to the positions of a T/R's translating sleeves. Each T/R has LVDTs which supply translating sleeve position data to the electronic engine control (EEC).

When on, the REVERSER light shows that there is a failure in one of these areas:

- T/R control system
- Mechanical failure which prevents the control system from correct operation.

The REVERSER light comes on for 10 seconds during a T/R stow operation. The light will stay on if the T/R does not stow in 10 seconds. The EAU controls this light.

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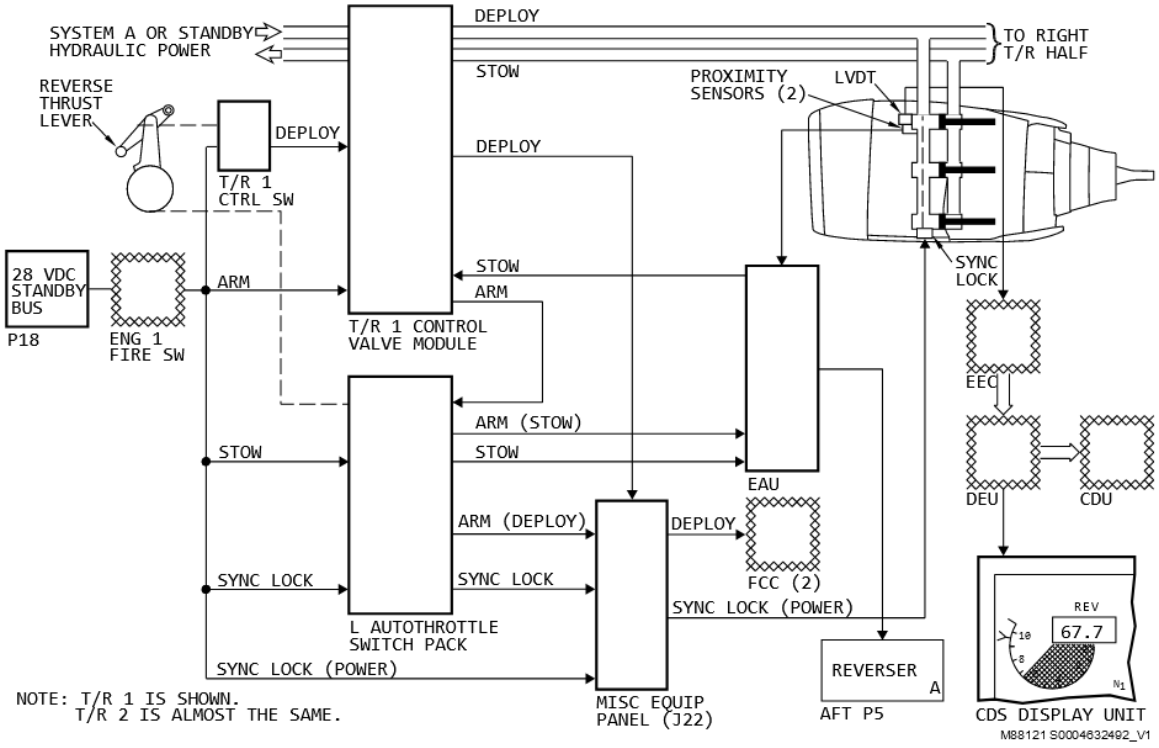
Figure 1. THRUST REVERSER SYSTEM - GENERAL DESCRIPTION



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THRUST REVERSER CONTROL SYSTEM - GENERAL DESCRIPTION

General

The thrust reverser control system controls hydraulic power and electrical power to deploy and stow the Thrust Reverser (T/R) translating sleeves. The system uses 24/28v dc electrical power and reverse thrust lever position for control.

You can deploy the thrust reversers when the airplane is less than 10 feet (3 meters) from the ground. The Flight Control Computers (FCCs) and a radio altimeter operated relay supply airplane altitude information. An air sensing relay supplies the air/ground logic. The fire handle must be down for the control system to use the electrical power.

Each T/R control valve module controls hydraulic power to deploy or stow their T/R. Each module contains the electrical and hydraulic components necessary to control the hydraulic flow to the T/R hydraulic actuators. There are two T/R control valve modules on the airplane. One for each T/R.

Sync shafts on each translating sleeve make sure the sleeve's three actuators operate at the same speed. The actuators can operate only if the shaft is free to turn.

A sync lock connects to the bottom hydraulic actuator on each T/R half. The sync lock must unlock for the sync shafts to turn. During normal T/R operation, the sync locks energize to unlock. The sync lock is also a manual drive mechanism. You use the sync lock to manually move the T/R translating sleeves for maintenance operations.

The Engine Accessory Unit (EAU) has the electrical circuits necessary for stow operation. The EAU also uses input from sleeve proximity sensors for auto-restow logic.

The reverser thrust levers operate switches on the autothrottle switch packs. These switches control signals to these components:

- EAU
- Sync locks
- Control valve module.

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Deploy Operation

This happens when you raise the reverse thrust lever to deploy a T/R:

- Switches in the autothrottle switch pack move to energize the sync lock and an arm signal goes through the T/R control valve module
- The T/R control switch moves and a deploy signal goes through the T/R control valve module
- The T/R control valve module sends hydraulic fluid to the actuators to move the translating sleeves aft.

See the engine controls chapter for more information about the thrust lever interlock system. (CHAPTER 76)

A Flight Control Computer (FCC) or one of two relays in the nose wheel well area (J22, J24) supply an electrical ground necessary to deploy the T/Rs. Deploy hydraulic power can not go to the T/R if the air/ground or altitude conditions are not met.

Stow Operation

This happens when you lower the reverse thrust lever back to the stow position:

- The T/R control switch removes the deploy signal to the T/R control valve module
- The Engine Accessory Unit (EAU) auto-restow circuits test
- Switches in the autothrottle switch pack move to send an arm signal and a stow signal through the EAU to the T/R control valve module
- The T/R control valve module sends hydraulic fluid to the actuators to move the translating sleeves back to the stow position
- The sync locks go to the lock position after 18 seconds.

Auto-Restow

The EAU uses internal logic (auto-restow) to tell the T/R control valve module to stow the T/R anytime these conditions happen:

- The EAU receives input from a proximity sensor on a sleeve that the sleeve is not in the stow or locked position, and
- The engine's reverse thrust lever for that T/R is in the stow position.

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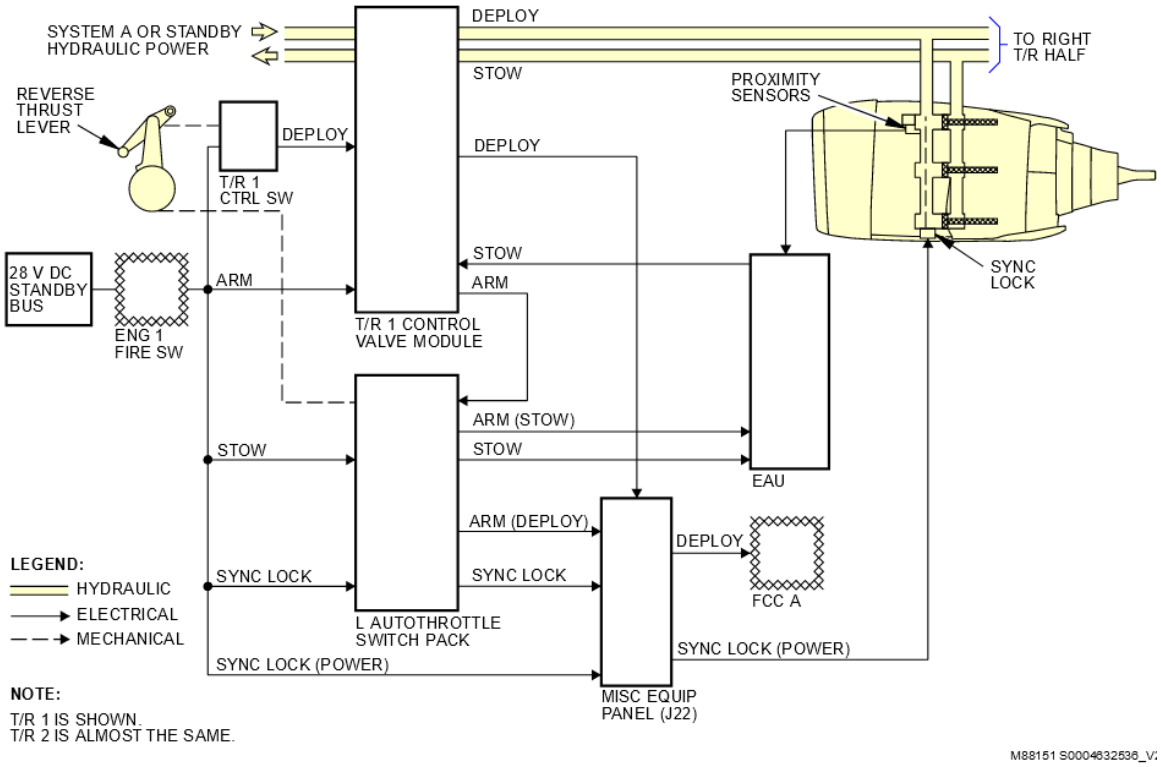
The EAU use proximity sensors for the auto-restow logic. The auto-restow circuits usually operate for 10 seconds during normal T/R stow operation.



THRUST REVERSER CONTROL SYSTEM - GENERAL DESCRIPTION
Figure 1

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THRUST REVERSER CONTROL SYSTEM - FUNCTIONAL DESCRIPTION - DEPLOY/STOW HYDRAULIC FLOW

General

The T/R control valve modules control hydraulic power to the hydraulic actuators for T/R deploy and stow operations.

Hydraulic system A supplies hydraulic power for T/R 1. System B supplies hydraulic power for T/R 2. The standby system supplies backup hydraulic power through the shuttle valves if system A or system B fails. See the shuttle valve page in this section for more information.

The graphic shows T/R 1 operation. T/R 2 operation is almost the same.

Deploy

The arm and deploy solenoids energize when you raise the reverse thrust lever. See T/R CONTROL SYSTEM - FUNCTIONAL DESCRIPTION - DEPLOY CONTROL in this section for more information about the electrical circuit.

This happens when the arm solenoid energizes and hydraulic power is available to the T/R control valve module:

- The hydraulic control valve adjacent to the arm solenoid moves against its spring and hydraulic fluid flows through the valve to the hydraulic isolation valve (HIV)
- The HIV moves to the arm position (up)
- Hydraulic power is made available at the directional control valve (DCV)
- Hydraulic fluid goes through the open manual shutoff valve to the rod side of the T/R actuators.

The deploy solenoid energizes after the sync lock receives a signal to unlock. See the deploy control functional description for more information.

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This happens when the deploy solenoid energizes and hydraulic power is available to the T/R control valve module:

- The hydraulic control valve adjacent to the deploy solenoid moves against its spring and hydraulic fluid flows through the valve to the DCV
- The DCV moves to the deploy position (up)
- Hydraulic fluid flows through the DCV to the head side and the rod side of the T/R actuator pistons
- Each locking actuator's mechanism disengages.

The hydraulic pressure on both sides of each actuator piston are equal but the surface area of the head side is larger than the rod side. The larger force on the head side causes the actuator pistons to extend.

As the actuators extend, the fluid on the rod side of the actuators goes to the manual shutoff valve and mixes with the fluid which goes to the head side.

Stow

The arm and stow solenoids temporarily energize when you return the reverse thrust lever to the stow position. The deploy solenoid de-energizes and the hydraulic control valve adjacent to it returns to its normal position. See T/R CONTROL SYSTEM - FUNCTIONAL DESCRIPTION - STOW CONTROL for more information about the electrical circuit.

These are the effects when the arm solenoid remains energized and hydraulic power is available to the T/R control valve module:

- The hydraulic control valve adjacent to the arm solenoid stays against its spring
- Hydraulic fluid keeps the HIV in the arm position
- Hydraulic power stays available at the directional control valve (DCV)
- Hydraulic system pressure stays high at the rod side of the T/R actuators.

This happens when the stow solenoid energizes:

- The hydraulic control valve adjacent to the stow solenoid moves against its spring and hydraulic fluid flows through the valve to the DCV
- The DCV moves from the deploy position to the stow position (down)
- Hydraulic pressure at the head side goes low as the fluid returns to the airplane hydraulic systems through the manual shutoff valve and the DCV
- The hydraulic pressure at the rod side cause the actuators to retract and stow the T/R.

Manual Shutoff Valve

The manual shutoff valve is normally open. You close it whenever you do maintenance on or around the T/Rs.

See CONTROL VALVE MODULE, in this section for more information about the T/R control valve module and the manual shutoff valve handle.

One Way Flow Restrictors

The one-way restrictors restrict the mass flow rate of hydraulic fluid to the T/R hydraulic actuators. They permit free hydraulic flow from the T/R hydraulic actuators. This prevents a possible hydraulic pressure build up across the head of the actuators when the T/Rs are not in operation.

Internal Valve Position Sensors

The EAU uses the position sensors on the DCV and The HIV for fault detection. See the EAU page in this section for more information.

Training Information Point

There is no hydraulic return to the standby system for T/R 1. There is a transfer of hydraulic fluid from the standby system to system A during stow if the standby system deploys the T/R.

There is no similar transfer of hydraulic fluid for T/R 2 operation.

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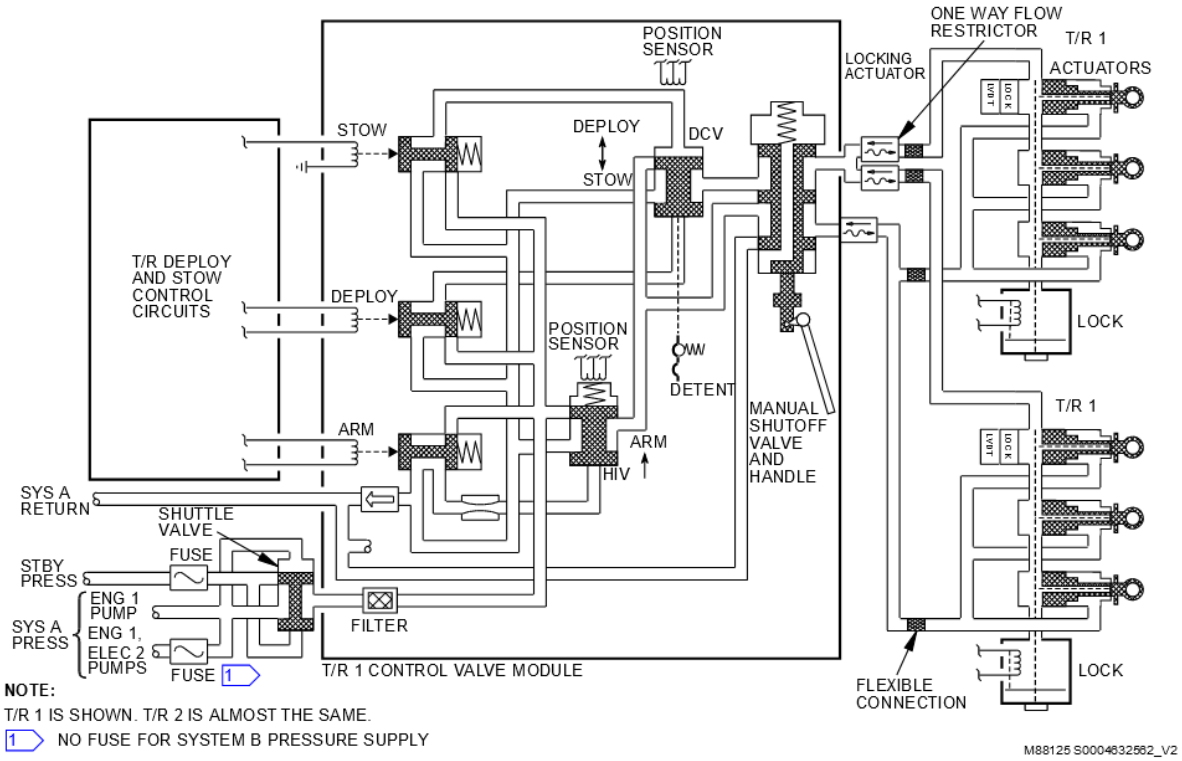
Figure 1. THRUST REVERSER CONTROL SYSTEM - FUNCTIONAL DESCRIPTION - DEPLOY/STOW HYDRAULIC FLOW



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THRUST REVERSER CONTROL SYSTEM - CONTROL SWITCH

Purpose

The control switch supplies electrical power to the deploy solenoid in the T/R control valve module during a T/R deploy operation. There are two control switches, one for each T/R.

See the functional description part of this section for more information about how the T/R control system uses the control switches.

Location

The control switches are in the thrust levers. Each thrust lever has one switch. You must remove the cover on the side of the thrust lever to get access to the switch.

Functional Description

The thrust lever camshaft turns when you move the reverse thrust lever. The camshaft causes the roller assembly and rod to move down when you raise the reverse thrust lever. The control switch spring relaxes and operates the control switch.

The spring around the rod keeps the rod and the roller assembly against the cam. The rod and the roller move back to their normal position when you lower the reverse thrust lever. The control switch spring compresses and the switch moves back to the stow position.

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Figure 1. THRUST REVERSER CONTROL SYSTEM - CONTROL SWITCH