



NATIONAL TRANSPORTATION SAFETY BOARD

Office of Aviation Safety
Washington, D.C. 20594

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Attachment 9 –Delta Air Lines Operations Manual

MD88-90 Vol. 1 and 2 [Excerpts]

OPERATIONAL FACTORS

DCA19CA208



DAL Flight Operations

Volume 1 MD88-90

Document Reference: DAL/MD89/VOL1

Revision 1.0.0

16-Sep-2019

	VOLUME 1 MD88-90	Revision: 1.0.0 Date: 16-Sep-2019
	3 NORMAL PROCEDURES 3.4 AMPLIFIED PROCEDURES	

Pilot Flying	Pilot Monitoring
Call "APPROACH CHECKLIST."	Accomplish the Approach checklist.

Approach Checklist

- Flight & nav instruments.verified C&F
 - Ensure correct arrival and approach procedures are entered.
 - Ensure the proper frequency and course/radial are set as appropriate.
- Spoilers.RET & disarmed PM
- Cabin notification.complete C
 - Ensure that the cabin chime signal has been sounded twice.
 - If turbulence is anticipated on the arrival, consider an early cabin chime signal so that flight attendants can be seated.
- Altimeters.__, xckd C&F
 - Ensure the captain, first officer, and standby altimeters are correctly set.
 - Verbalize the altimeter setting.

	VOLUME 1 MD88-90	Revision: 0.0.0 Date: 15-Apr-2019
	5 SUPPLEMENTARY PROCEDURES 5.15 WARNING SYSTEMS	

When flying through areas of moderate to heavy rain:

System Status:

Radar range may become limited by attenuation.

Set tilt to attempt to produce ground returns beyond the weather returns.

If attenuation is confirmed:

Monitor the outer edge of the weather returns.

Turn away from shadows that dip towards the bottom of the display.

Fly towards the area of farthest returns (this is the area of lightest precipitation).

Advise ATC that your radar range is limited and request vectors away from known thunderstorm areas.

WARNING

RADAR SHADOWS ARE AREAS OF UNKNOWN WEATHER INTENSITY. NEVER PENETRATE A STORM THAT PRODUCES A RADAR SHADOW.

5.15.5.10 Turbulence Avoidance

When using radar to avoid turbulence enroute:

Deviate upwind of storms when possible.

Expect turbulence to be present in any convective activity regardless of intensity level displayed on radar.

When convective storms reach Level 3 (red):

Expect moderate to severe turbulence in all areas of the storm, including the Level 1 and 2 areas.

Note: *TURB mode can be used to detect areas of horizontal rain movement within 40 nm.*

Set tilt to ensure beam is sweeping at flight altitude.

WARNING

AN ABSENCE OF INDICATED TURBULENCE IN TURB MODE DOES NOT MEAN IT IS SAFE TO PENETRATE A WEATHER AREA THAT BY OTHER INDICATIONS IS HAZARDOUS.

	VOLUME 1 MD88-90	Revision: 1.0.0 Date: 16-Sep-2019
	5 SUPPLEMENTARY PROCEDURES 5.16 ADVERSE WEATHER	

5.16.8 Turbulence

During flight in light to moderate turbulence, the autopilot and/or autothrottle may remain engaged unless airspeed, altitude or attitude deviations require use of manual control. Avoid making large pitch, roll, thrust or trim changes.

The turbulent air penetration speed provides ample protection from stall and high speed buffet, while also providing protection from exceeding the structural limit. Refer to [Section 2.1 Operating Limitations](#) for the turbulent air penetration speed. At 10,000 feet and below, minimum recommended speed is 250 KIAS or minimum maneuvering speed (whichever is greater). Do not fly less than minimum maneuvering speed for existing configuration.

Passenger signs.ON

Advise passengers to fasten seat belts prior to entering areas of reported or anticipated turbulence.
Instruct flight attendants to check that all passengers' seat belts are fastened.

5.16.8.1 Severe Turbulence

Severe turbulence should be avoided if at all possible. If severe turbulence cannot be avoided, an increased buffet margin is recommended. This can be obtained by descending approximately 4,000 feet below optimum altitude. The autothrottle should be off in severe turbulence.

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ENG IGN selector.ON

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IGNITION switch.ON

Note 1: Refer to QRH, section 3, Severe Rain/Ice/Turbulence.

Note 2: If an approach must be made into an area of severe turbulence, delay flap extension as long as possible. The airplane can withstand higher gust loads in the clean configuration. Diversion to another airfield is the best policy if severe turbulence persists in the area.



DAL Flight Operations

Volume 2 MD88-90

Document Reference: DAL/MD89/VOL2

Revision 0.0.0

26-Aug-2019

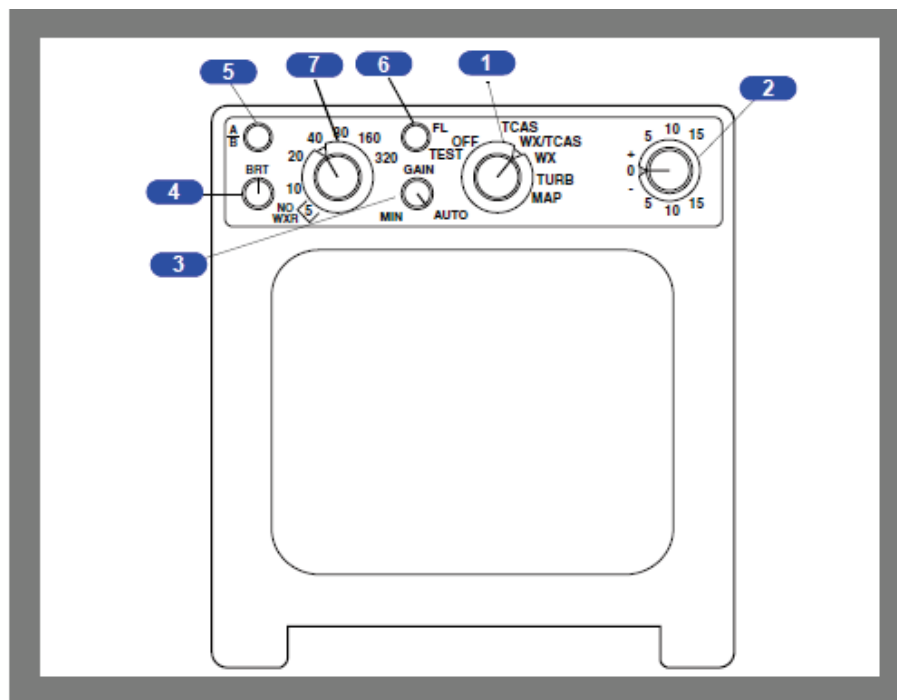
11 FLIGHT MANAGEMENT, NAVIGATION
11.1 CONTROLS AND INDICATORS

- (1) **TONE Switch**
Provides 1020Hz modulation for CW reception.
Left (L) position for ADF-1 receiver.
Right (R) position for ADF-2 receiver.
Center position for OFF.
- (2) **Frequency Knob**
Large outside knob permits selection of megahertz and 100-kHZ.
Middle knob permits selection of 10-kHZ frequency.
Inner knob permits selection of 1-kHZ and 0.5-kHZ.
- (3) **ADF/ANT/OFF Switches**
Selects ADF or ANT mode of operation.
Left (L) switch controls ADF-1 receiver.
Right (R) switch controls ADF-2 receiver.
- (4) **TEST Switches**
Starts system self-test of ADF receivers.

11.1.5 Weather Radar / TCAS Control Panel

88

9201 - 9216, 9237 - 9252



11 FLIGHT MANAGEMENT, NAVIGATION

11.1 CONTROLS AND INDICATORS

(1) **Mode Selector**

TEST - Displays test pattern. If an LRU fault exists, message(s) will be displayed on radar indicator to indicate component failure.

OFF - De-energizes system.

TCAS - Refer to [Chapter 15 Warning Systems](#).

WX/TCAS - TCAS information will overlay the standard weather display information.

WX - Displays areas of high density (red), lower density (amber), and light precipitation (green).

TURB - Overlays turbulence (magenta) on WX mode when turbulence exists. Available to 40 nm.

MAP - Refer to [Chapter 15 Warning Systems](#).

(2) **Antenna Tilt Selector**

Varies vertical plane of antenna scanning. Tilt limits are +/- 15 degrees of fuselage reference plane.

(3) **GAIN Selector**

MIN - Minimum receiver sensitivity.

AUTO - Automatically controls receiver sensitivity.

(4) **BRT Knob**

Adjusts intensity of display.

(5) **A/B - ABOVE/NORMAL/BELOW Pushbutton switch**

Refer to [Chapter 15 Warning Systems](#).

(6) **FL Pushbutton**

Refer to [Chapter 15 Warning Systems](#).

(7) **Range Selector**

Selects desired range and respective range marks.

9217 - 9236, 9253 - 9265



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	VOLUME 2 MD88-90	Revision: 0.0.0 Date: 26-Aug-2019
	11 FLIGHT MANAGEMENT, NAVIGATION 11.1 CONTROLS AND INDICATORS	

(1) **GAIN Knob**

AUTO - The receiver sensitivity is preset at a fixed value for optimum precipitation return. Rotating the control knob out of AUTO adjusts the receiver sensitivity to increase or decrease the threshold level of target reception on the MFD when the Mode Selector knob is in the MAP position.

Note: *With the mode selector knob in the WX position, the gain is automatic regardless of the gain knob position.*

(2) **STAB Switch (Stabilization)**

ON - One of the vertical gyros stabilizes the radar antenna in pitch and roll.

OFF - Maintains antenna alignment parallel to the aircraft's pitch and roll axes. If the WX pushbutton is depressed on the MFD, a white STAB OFF icon appears in the lower left corner of the screen.

(3) **Mode Selector Knob**

OFF - De-energizes the radar system.

TEST - Initiates automatic fault test for system checkout without radiating energy. If the WX pushbutton is depressed on the MFD, the screen displays the weather test pattern.

WX (Weather) - Transmitter energy is radiated from the antenna. If the WX pushbutton is depressed on the MFD, the screen displays areas of high precipitation (red), medium precipitation (yellow), and light precipitation (green) returns.

MAP - Used for ground mapping when the primary interest is ground returns rather than precipitation returns. If the WX pushbutton is depressed on the MFD, the screen displays ground returns.

WX/TURB - Overlays turbulence on WX mode in magenta when turbulence exists.

(4) **Antenna TILT Knob**

With the STAB in the ON position, the rotary TILT knob and fixed angle scale are referenced to the horizon.

With the STAB in the OFF position, the TILT knob and scale are referenced to the centerline of the airframe.

11.1.6 TCAS/Transponder Control Panel

(Pre ADS-B Out Modification)

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9201-9219, 9237-9265

	VOLUME 2 MD88-90	Revision: 0.0.0 Date: 26-Aug-2019
	11 FLIGHT MANAGEMENT, NAVIGATION 11.2 NAVIGATION SYSTEMS DESCRIPTION	

The ADF system drives the pointer on the Captain's and First Officer's ND and RDMI. Audio for ADF-1 is selected on the audio control panel.

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Two automatic direction finding (ADF) systems, each consisting of a receiver and ADF sensing/loop antenna are installed. The systems are operated by a dual control panel. ADF bearing data is displayed on the pilot's ND and RDMI. ADF-1 bearing is displayed by a single pointer and ADF-2 bearing by a double pointer.

11.2.5 Marker Beacon

The marker beacon system consists of outer marker lights (blue), middle marker lights (amber), and inner marker lights (white) with corresponding low, mid and high frequency tones that indicate passage over airways and ILS markers.

Marker beacons are displayed on the captain's and first officer's PFD displays. Audio reception is controlled through the Audio Control Panels (ACPs).

11.2.6 Weather Radar System

The weather radar system displays weather and mapping targets on the ND and pedestal radar indicator. The system consists of a receiver/transmitter, antenna and radar control panel.

Weather and mapping targets are displayed in magenta, red, amber, and green colors. Magenta areas indicate possible turbulence. Red areas represent areas of high density precipitation or ground targets with high level reflectivity. Amber areas represent areas of lower density precipitation or ground targets with moderate level reflectivity. Green areas represent areas of light density precipitation or ground targets with low level reflectivity. Displays of the selected mode, range, and antenna tilt angle are also presented.

The radar antenna is normally stabilized in pitch and roll by IRS. The antenna tilt is controllable from 15 degrees up to 15 degrees down.

11.2.6.1 Navigation Display Weather Radar

9217-9236, 9253-9265

Weather radar data is displayed on the ND in both ARC and MAP modes. The brightness is adjusted by the WXR contrast control on the EFIS dimming panel.

Each Symbol Generator checks for valid range information and overheat condition. If the check detects a range fault, the "WXR RANGE" message is displayed. If the check detects an overheat condition, the "NO WX" message is displayed.

11.2.6.2 Pedestal Weather Radar

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9201-9216, 9237-9252

A color weather radar displays weather and TCAS traffic on the radar indicator with selective ranges of 10, 20, 40, 80, 160 and 320 nautical miles. All controls are provided on the indicator, and a test mode is included. TCAS traffic can be displayed on the radar indicator up to 40 nm.

A monitor automatically checks for faults and compares certain functions of the radar. If the checks or comparisons detect a fault or abnormality, one or more fault messages will be displayed on the indicator. When the mode selector is in TEST, Line Replaceable Unit (LRU) fault messages are displayed.

15 WARNING SYSTEMS
15.1 CONTROLS AND INDICATORS
(4) LRU Fault Messages

TR FAULT - Transmitter/Receiver fault.

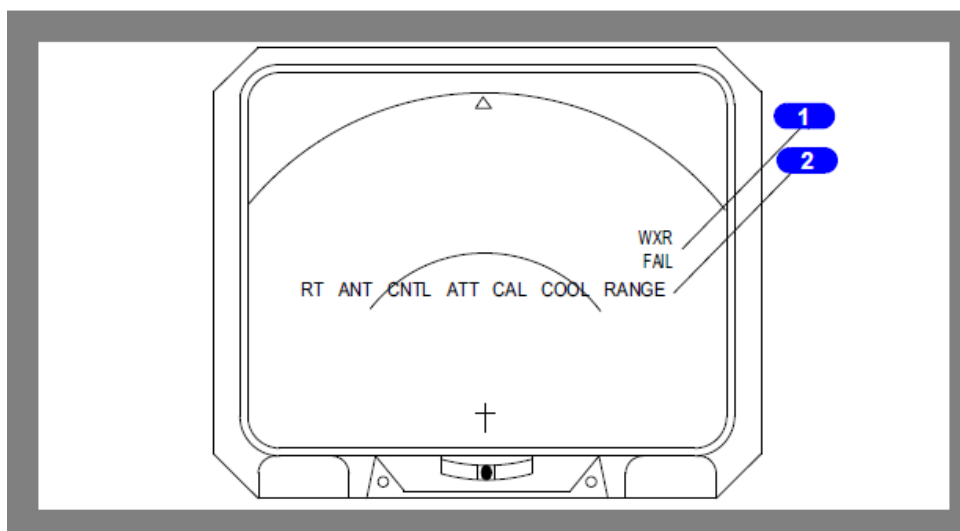
ANT FAULT - Antenna fault.

CON FAULT - Control fault.

ATT FAULT - Radar antenna attitude fault.

IND FAULT - Radar indicator fault.

COOL FAULT - T/R cooling fault.

15.1.5.2 ND Weather Radar Messages (Typical)

(1) WXR Status Messages

WXR OFF - Weather radar is off.

NO WX - Weather radar imagery has been removed due to overheat condition.

WXR FAIL - Receiver/transmitter fault, antenna fault, or control fault which results in removal of weather radar imagery.

WXR RANGE - Computed range is not equal to selected range which results in removal of weather radar imagery.

The following messages indicate operating modes of R/T unit:

WX - Weather radar displayed without turbulence.

MAP - Ground mapping displayed.

TURB - Turbulence displayed only.

REAC - Indicates R/T units inability to look behind intervening rainfall.

STBY - Weather radar in standby mode.

The following messages have the prefix XXXX. This represents any one of the operating modes that may appear directly above the message:

XXXX VAR - Weather radar input sensitivity is not calibrated to any precipitation rate.

XXXX CAL - Loss of calibration.

XXXX ATT - Attitude input fault.

XXXX STAB - Stabilization is off.

	VOLUME 2 MD88-90	Revision: 0.0.0 Date: 26-Aug-2019
	15 WARNING SYSTEMS 15.1 CONTROLS AND INDICATORS	

(2) **LRU Fault Messages**

If a failure exists in test mode, TEST will be replaced by FAIL and one or more fault messages.

RT - Receiver/Transmitter fault.

ANT - Antenna fault.

CNTL - Control fault.

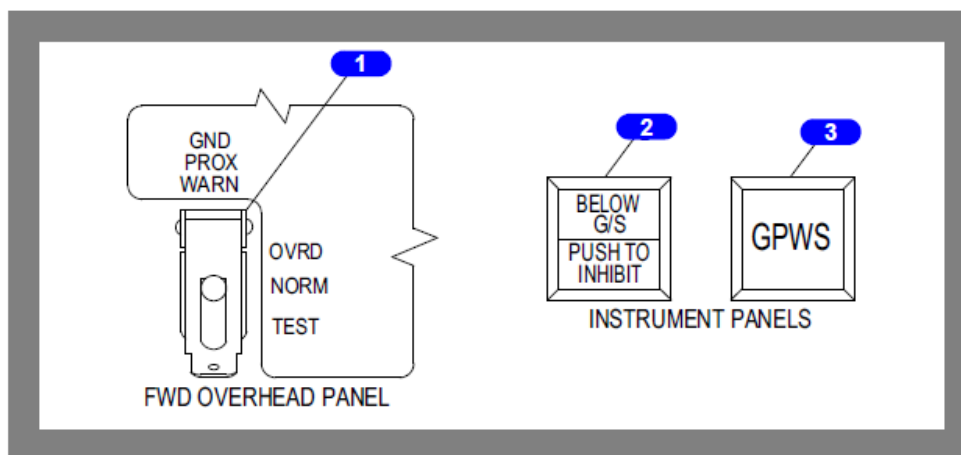
ATT - Attitude fault.

CAL - Calibration fault.

RANGE - Range fault (MSP fault).

COOL - R/T unit cooling fault.

15.1.6 Ground Proximity Warning System (GPWS)



(1) **GND PROX WARN Switch**

OVRD - Inhibits "TOO LOW FLAPS" warning when landing is made with less than normal landing flap configuration.

NORM - System annunciates dangerous situations while remaining silent during normal flight operations.

TEST - (Momentary) Initiates system test.

(2) **BELOW G/S Switch-Light (amber)**

Illuminated - Indicates excessive deviation below glide slope. Light is accompanied by voice warning "GLIDE SLOPE".

Pushing switch-light, when the airplane is below 1000 feet radio altitude, will inhibit or cancel the warning.

(3) **GPWS Warning Light (red)**

Illuminated - Indicates corrective action is required due to airplane proximity to the ground or not in proper configuration for descent. Light is accompanied by appropriate aural/voice warning. Light has a push-to-test feature and is connected to the instrument panel light dimming circuit.

15.1.7 Enhanced Ground Proximity Warning System (EGPWS)

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