

 DC 9/80 OPERATIONS MANUAL	Navigation System	I	
	Chapter 15 - 1/18	07/04/20	Rev 1

GENERAL

This chapter includes those units and components which provide position data to the flight crew.

For EFIS (Electronic Flight Instrument System) system description, DU's (Display Units) system description, SG's (Symbol Generators) and Dimming Panel system descriptions please refer to chap. 10 Flight Instruments.

MODE SELECT PANEL

Mode Select Panel is located in the radio panel, it is used to select a variety of visualization modes for the Navigation Display (ND). With the Mode Select Panel is possible to select the ND display MODE and RANGE, ADF, and navigation data display

- MODE knob: Four positions selector knob (ROSE, ARC, MAP, PLAN)
- ADF knob: Two positions selector knob, to display or hide ADF 1 and 2 pointers on ND.
- RANGE: Six positions selector knob that changes the ND range when in ARC, MAP or PLAN mode, corresponding range distances are: 10, 20, 40, 80, 160, 320 nm.
- N-AID, ARPT, DATA and WPT switches. Turn ON/OFF display of the corresponding navigation data

RADIO MAGNETIC INDICATOR (RMI)

The RMI is a gyro directional that indicates the position of radio aids on ground through two needles. Both indicators can be used to point to a VOR or an ADF by the corresponding selector button.

VHF NAV SYSTEM

There are two VHF/VOR systems associated to two receivers (VHF NAV1 e VHF NAV2) that give VOR and ILS information to navigation instruments like PFD's, ND's, Digital Flight Guidance System, FMS, AIDS and GPWS, but only VOR information to RMI.

DME SYSTEM

Two Distance Measure Equipment (DME) systems provide distance information in nautical miles from VOR selected navaid.

The two systems are activated in the same time while tuning VORs on VHF NAV1 and 2. The distance readings from these stations can be seen both on ND and on DME-RMI.

MARKER BEACON SYSTEM

The system generates a symbol (on PFD) and an acoustic morse warning (controlled by the marker switch on audio panel) each time the aircraft overflies an outer, middle or inner marker.

RADIO ALTIMETER SYSTEM

A precise measurement system gives the absolute height of the aircraft from the ground. This system starts working when the absolute height from the ground is 2500 feet or less. The system reads 0 feet with aircraft on ground. The radio altimeter sends height information to both the DFGS and GPWS, and to AIDS if height is 3000 feet or below. A selector knob placed on Dimming Panel allows to select a DH (Decision Height) that will be showed as a numeric value and a yellow bug in the radio altimeter scale on PFD.

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ADF SYSTEM

Two ADF receivers are installed to supply NDB information showed on RMI (selecting ADF on ADF/VOR button). ADF information can be displayed on EFIS through ADF selector on Mode Select Panel. The ADF audio morse ident can be switched on/off with the corresponding switch in the audio panel.

ENHANCED GROUND PROXIMITY WARNING SYSTEM

The EGPWS warns pilots when the aircraft is flying near the terrain in a dangerous condition.

The GPWS distinguish six different basic dangerous flight modes near terrain:

MODE 1 – EXCESSIVE SINK RATE

High descent rate below radio altimeter 2450' activates GPWS mode 1. Aural message "SINK RATE", and if the condition is not quickly normalized aural "WHOOH WHOOP PULL UP" is generated.

MODE 2– EXCESSIVE CLOSURE RATE

MODE 2A

EXCESSIVE CLOSURE RATE NOT IN LANDING CONFIGURATION

"TERRAIN-TERRAIN" aural if the present descent rate could generate a dangerous situation and if the condition persists without further action by pilots aural "WHOOH WHOOP PULL UP" is generated.

MODE 2B

EXCESSIVE CLOSURE RATE IN LANDING CONFIGURATION

To avoid false warnings during approach, mode 2A is partially inhibited at gear extension. Aural are modified as reported in the diagram below.

MODE 3 – DESCENT AFTER TAKEOFF

GPWS mode 3 warns of loss of altitude during takeoff. "DON'T SINK - DON'T SINK" message generated if the aircraft loses about 10% of barometric altitude. The aural stops with a positive climb rate.

Mode 3 begin working also on a missed approach below 200 feet and when whether the gear or the flaps are up. Mode 3 starts working from 50 feet to 700 feet radio altimeter, above 700 feet GPWS computer switches to mode 4.

MODE 4 – INADVERTENT PROXIMITY TO TERRAIN

MODE 4A – GEAR UP

A terrain proximity generates an aural "TOO LOW, TERRAIN". The aural begins if speed exceeds MACH 0.45 and barometric altitude is 1000 feet or below. With the gear retracted if flying below 500 feet and with a speed less than MACH 0.35 the aural "TOO LOW GEAR" is generated. This message starts also if flying at or below 200 feet with gear up.

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MODE 4B – LANDING FLAPS NOT SELECTED

Mode 4B is similar to 4A, aural “TOO LOW TERRAIN” is generated under the same condition. Instead of gear condition message, mode 4B advice about flap setting for approach.

MODE 5 – DESCENT BELOW GLIDE SLOPE

Mode 5 monitors the glide path deviation during an ILS approach. It begins working when an ILS frequency is tuned, and the gear is down. If the deviation from glide path is greater than 1.3 dots when the aircraft descends below 1000 feet, an aural message “GLIDESLOPE” is generated. Mode 5 can be inhibited with the corresponding button on main panel.

Button to inhibit mode 5



MODE 6 – DESCENT BELOW MINIMA.

The GPWS does not generate warning signals if the airplane is flying to a vertical obstacle. Warnings from 1 to 4B modes consist of a red illuminated “GPWS” light and in a series of acoustic messages. The acoustic system consists of nine messages of advice and warning, except for modes 3 and 6 that only have advice messages.

Mode 5 message lights an amber light “G/S” and produces an acoustic message “GLIDE SLOPE”. The frequency on which the “GLIDE SLOPE” message is repeated depends on the radio altimeter altitude and on the glide slope error. Message for mode 6 is an acoustic “MINIMUS MINIMUS”.

If a GPWS warning is active, the electronic audio message is deactivated only when there are no more dangerous flight conditions.

In the event that more than one GPWS aural are active at the same time a warning priority have been incorporated in the GPWS.

Priority list between GPWS modes:

1. “Woop-Woop Pull Up” MODES 1 & 2
2. “Terrain” MODE 2
3. “Too Low Terrain” MODES 4A & B
4. “Too Low Gear” MODE 4A
5. “Too Low Flap” MODE 4B
6. “Minimus-Minimus” MODE 6
7. “Sink Rate” MODE 1
8. “Don’t Sink” MODE 3
9. “Glide Slope” MODE 5

Enhanced functions



The EGPWS adds to the basic function the Terrain Alerting and Display (TAD) function, which uses an internal worldwide terrain database to identify possible conflict between the aircraft and the surrounding environment.

Terrain topography is displayed in the ND (when in ARC or MAP mode) and aircraft position, attitude, altitude and direction are continuously checked against nearby terrain to identify any possible conflict.

The terrain is displayed with different color as a function of relative altitude to the aircraft:

Elevation difference

-2000ft or less
from -2000ft to -1000ft'
from -1000ft to -500ft'
from -500ft to +1000ft'
from +1000ft to +2000ft'
+2000ft or more

Color

black
low intensity green
high intensity green
low intensity yellow
high intensity yellow
red

Terrain more than 2000 feet below the aircraft, or within 400 (vertical) feet of the nearest runway elevation, is not displayed (black).

When a conflict with the terrain is found two different messages are generated:

- "CAUTION TERRAIN"; the caution alert is given typically 60 seconds ahead of the terrain/obstacle conflict. Caution terrain is displayed solid yellow on the ND.
- "TERRAIN, TERRAIN, PULL UP"; the warning alert is given typically 30 seconds ahead of the terrain/obstacle conflict. Warning terrain is displayed solid red on the ND.

When the aircraft is 500 ft or more above the highest terrain in view the display will revert to Peak Mode. When in Peak Mode the terrain is displayed with different green patterns, and no alert are generated by the system.

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EGPWS is controlled by two switches located near the navigation display.



TERR switch.

ON: The terrain data is displayed on the ND.

OFF: Terrain data is not displayed on ND.

TERR OVRD switch.

OVRD: inhibit terrain database functions and keeps the basic GPWS modes operative.

INOP: The GPWS terrain function has failed, only basic GPWS modes are operative.

Terrain is not displayed if either of these annunciators are illuminated.

NOTE: OVRD button is present only at Captain's side.

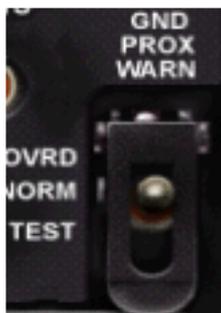
Auto popup

When EGPWS issues a caution or warning alert ND will automatically revert to terrain display.

EGPWS overhead switch

There is a GPWS switch placed on overhead panel; the TEST position it is used to execute the system test. During the test some of the aural message will be played and the ND will show a colour pattern (if in ARC or MAP mode).

The OVRD protected position simulates the landing flaps position despite of flaps lever position, inhibiting modes 2A and 4B.



GPWS DIAGRAM AND PRIORITY SCHEME

MODE	INDICATION		
	VISUAL	AUDIO	
		ADVISORY	WARNING
1. Excessive Sink Rate	GPWS	SINK RATE	WHOOOP-WHOOOP, PULL UP
2. Excessive Terrain Closure	GPWS	TERRAIN TERRAIN	WHOOOP-WHOOOP, PULL UP
3. Descent after Takeoff (or missed approach from below 200ft)	GPWS	DON'T SINK	
4. Inadvertent Proximity to Terrain: - 4A Gear Up - 4B Landing flaps not selected	GPWS	TOO LOW, TERRAIN	TOO LOW, GEAR
	GPWS	TOO LOW, TERRAIN	TOO LOW, FLAP
5. Descent Below Glideslope	BELOW G/S	GLIDESLOPE (SOFT)	GLIDESLOPE (HARD)

TCAS SYSTEM

The Traffic Alert and Collision Avoidance System (TCAS) works interrogating near airplanes transponders and warning the pilots in case of intrusions in a range of 15 nm. Traffic are visualized as symbols on the VSI display and visual and sound warnings are activated when there is a threat of collision. There are two types of messages:

- Traffic Advisory (TA)
- Resolution Advisory (RA)

RAs are displayed in the VSI vertical speed scale with red and green arcs. A Resolution Advisory indicates to pilot what is the climb or descent rate to maintain to avoid the collision. The pilot must climb or descent within the indicated rate as soon as possible.

TAs indicates nearby traffic which can cause a threat of collision.



Dimming knob:

Rotates to change the intensity of the display from maximum to OFF.

This picture shows a Resolution Advisory generated by TCAS.

Symbols used to identify nearby traffics are:

EMPTY DIAMOND: distant traffic.

FILLED DIAMOND: Traffic near aircraft.

FILLED YELLOW CIRCLE: Traffic Advisory. The traffic can be a potential danger of collision. Aural warning "TRAFFIC, TRAFFIC" is generated.

FILLED RED SQUARE: Resolution Advisory. The traffic is on a collision trajectory with the aircraft. The VSI display shows the vertical rate to maintain to avoid collision. Aural warning is generated accordingly (i.e. "DESCENT, DESCENT" or "CLIMB, CLIMB").

When the RA condition is finished a "CLEAR OF CONFLICT" message is generated.

The number associated to the traffic symbol is the relative altitude between the traffic and airplane in hundred of feet. An arrow displays if the traffic is climbing or descending with a rate greater than 500 feet/minute.

TCAS control panel is coupled with the transponder in the pedestal panel.

XPNDR1: system number 1 in use.
XPNDR2: system number 2 in use.
IDENT: Pushing this button will send an IDENT signal.
ATC LIGHT: the ATC indicator is illuminated when in XPNDR mode.
FID LIGHT: the FID indicator is illuminated when in FLIGHT ID mode. It flashes while a new FLIGHT ID code is being entered.
XPNDR FAIL LIGHT ON: System fault, the other system must be selected.

MODE SELECTOR KNOB.

STBY: Transponder and TCAS are OFF.
ALT OFF: Transponder is active, but the system will not send altitude information.
TA: Transponder is active, and the system will also send altitude information and generates Traffic Advisories only.
TA/RA: Transponder is active, and the system will also send altitude information and generates Traffic Advisories and Resolution Advisories.
TEST (push button): tests TCAS and transponder systems.



SCRATCHPAD: In ATC mode use these keys to set the 4 digits Transponder code, as required by ATC.
SCRATCHPAD: In FID mode use these keys to set the Aircraft ID number that the system will broadcast to ATC when under S mode coverage.
RNG+/RNG-: increases or decreases the displayed range of the integrated TCAS in VSI (3/5/10/15 nm).
ATC/FID: switches between ATC/FID mode for scratchpad input.
FL: the display will show absolute flight level of intruder traffic. It will revert to normal after a few seconds.
A/N/B: cycles between above/normal/below modes for displaying intruders.
CLR: clears last selected digit.
ENT: enters selected values in the system.

VHF NAV SYSTEM

Frequency Readout:
NAV frequency selected



CRS Readout:
Selected course.

Frequency Select Knob:
External selector knob changes integer digits. Internal selector knob changes decimal digits.

CRS Select Knob:
Rotate to select course.

DME 1 Readout:
Distance in nm from selected NAV1 VOR/ILS.



DME 2 Readout:
Distance in nm from selected NAV2 VOR/ILS.

VOR/ADF 1 Pointer:
Points VHF NAV1 VOR or ADF1 NDB.

VOR/ADF 2 Pointer:
Points VHF NAV2 VOR or ADF2 NDB.

VOR/ADF 1 Button:
Selects whether to point VOR1 or ADF1 navaid.

VOR/ADF 2 button:
Selects whether to point VOR2 or ADF2 navaid.



RADIO NAV Transfer Selector:

BOTH ON 2: C/M-1's and C/M-2's HSI, ADI and GPWS receive input from VHF NAV 2.

NORM: C/M-1's HSI, ADI and GPWS receive input from VHF NAV 1. C/M-2's HSI, ADI and GPWS receive input from VHF NAV 2.

BOTH ON 1: C/M-1's and C/M-2's HSI, ADI and GPWS receive input from VHF NAV 1.

EFIS DIMMING PANEL

TEST button:

Push and hold to initiate a self test on the VOR/ILS, marker beacon, decision height and PFD/ND.

PFD knob:

Turns ON/OFF the PFD display.

ND knob: turns ON/OFF the ND display.

NOTE: If the ND is off and the PFD is on the display will automatically switch to COMPACT mode.



DH Selection:

Rotate clockwise to increment DH, or counter clockwise to decrease DH. If DH value is 0 and the DH selector knob is rotated counter clockwise DH information are deleted from PFD.

MODE SELECT PANEL

EFIS ADF Selector:

OFF: No ADF indication on ND.

ADF: The external selector displays ADF 1 and the internal one displays ADF 2 on ND.

NOTE: To show/hide ADF1 needle left click on the selector, and to show/hide the ADF2 needle right click on the selector.

EFIS RANGE Selector:

Selects the display range of ARC MAP and PLAN modes.



MODE SELECTOR:

Select four modes on ND: ROSE, ARC, MAP e PLAN.

In MAP and PLAN modes is possible to show or hide nav aids, airports, route fix data and waypoints database from the map using the corresponding switches.

DIGITAL ADF SYSTEM

ADF L Freq. Readout:
ADF1 frequency
(inoperative)

ADF TEST Switch:
Executes ADF test.

ADF R Freq. Readout:
ADF2 frequency



ADF 1 Freq. Selector:
Rotate to select ADF 1 frequency.

ADF Function Switch (L, R):
Selects ADF operating mode. On ADF to display NDB pointers on RMI.
ANT: Excludes the antenna loop; no pointer indication but is still possible to hear morse code.
OFF: ADF system Off

ADF 2 Freq. Selector:
Rotate to select ADF 2 frequency.

EFIS PFD

Bank Indicator and Horizon Bar:

Bank angle is indicated by the Bank Angle Index.

Bank Angle Index:

Scale: 5°, 10°, 20°, 30°, 45°.

G/S Deviation and Scale pointer:

If ILS tuned on NAV the magenta indicator and the white scale display the G/S deviation.



Radar altimeter strip e DH indicator:

Displays the height from terrain (in feet) measured from radio altimeter, and DH.

Marker Beacon Symbol:

Displayed when over flying a marker: I (inner), M (middle) and O (outer).

FD Bars:

Gives a guide on the attitude to follow the DFGC selection.

Airplane Reference Symbol:

Shows the aircraft position related to horizon bar.

Expander Localizer:

With an ILS frequency tuned, a magenta indicator shows deviation related to localizer on a white horizontal bar.

Rising Runway:

Appears at 200 feet (radio altimeter) and represents the landing runway. The symbol moves horizontally to indicate localizer deviation.

EFIS ROSE MODE

Heading Readout

DME 1 Readout

Course point,
deviation bar
and scale.

ADF 1 Pointer



DME 2 Readout

ILS glide slope
pointer and
scale.

VOR: Indicates NAV1 tuned on VOR. If NAV1 is tuned on ILS frequency an "ILS" text will be displayed as well with the glide slope deviation bar.

HDG FAIL MESSAGE



EFIS ARC MODE

DME 1 Readout

Course pointer,
deviation bar
and scale.



DME 2 Readout

Heading Select
Cursor

ADF 1 Pointer

HDG FAIL MESSAGE



EFIS MAP MODE

Distance to waypoint:

Distance to next waypoint.

Heading Select Cursor



Estimated Time of Arrival:

Estimated time of arrival, Zulu time.

EFIS PLAN MODE



WEATHER RADAR SYSTEM

The display is controlled separately for ND 1 and ND 2. The left knob and upper button row will control the left (C/M-1's) display, while the right knob and lower button row will control the right (C/M-2's) display.

POWER BUTTON:
Applies or removes power to the indicator only.

TEST BUTTON: When test button is pushed (momentarily) initiates a self-test of system. During self test, a pattern bands with green, yellow and red will be displayed. Push again the button to exit self test and resume normal operation.

CAL/GAIN Control:
System gain is manually controlled in the MAP mode or in the weather detection mode.



TILT Control:
Controls antenna tilt up or down for desired radar scanning. Antenna tilt will be displayed on ND.



WX display on ND

MODE SELECTOR

TFR: Depressing the right(left) TFR push button cause the right (left) ND to display the same mode, tilt ground clutter suppression (GCS) and gain as the left (right) ND.

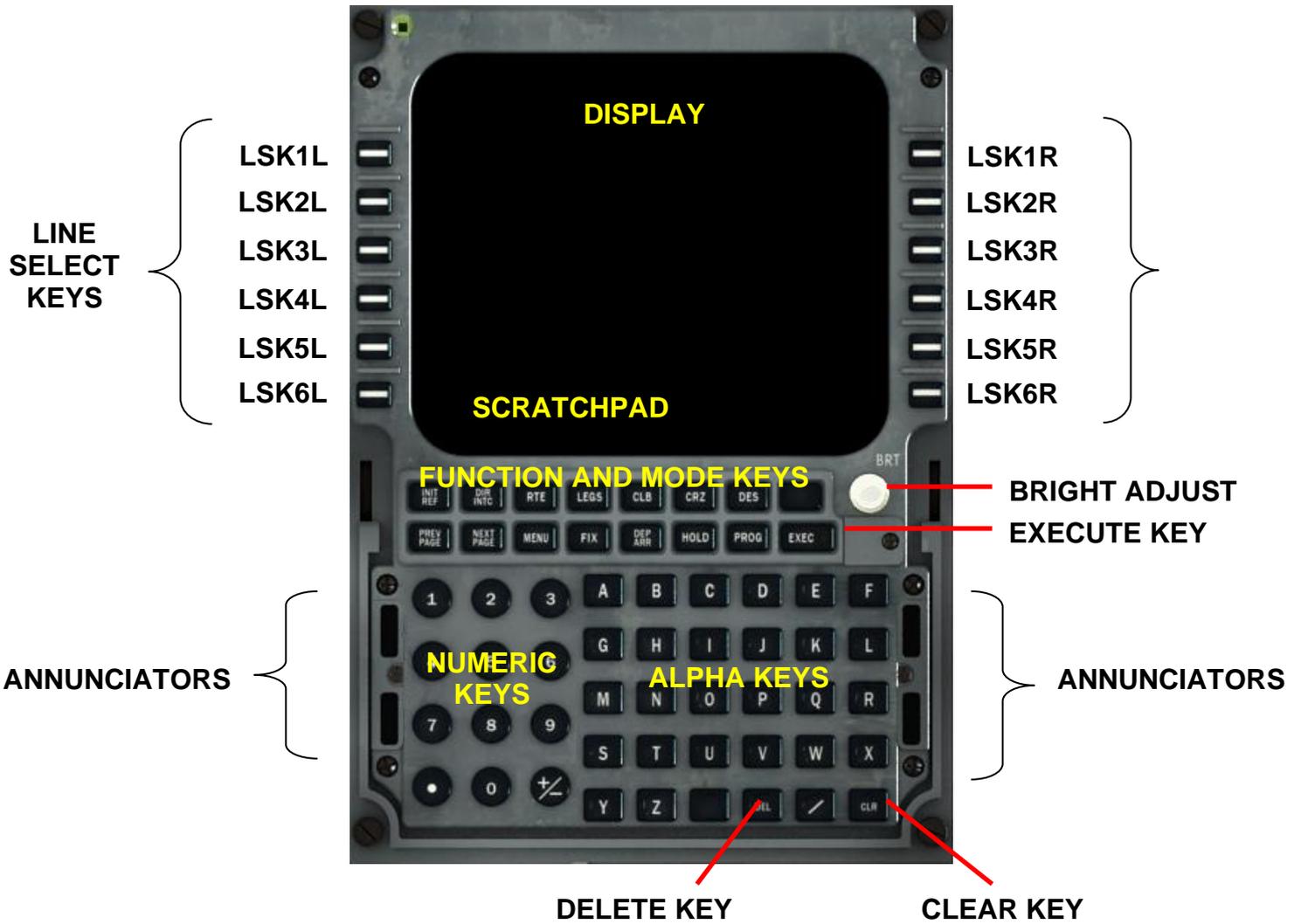
WX/T: radar will be set to weather + turbulence mode (range is limited to 50 nm).

WX: radar will be set to weather mode.

MAP: radar will be set to MAP mode.

GCS: Enables Ground Clutter Suppression.

HONEYWELL FLIGHT MANAGEMENT SYSTEM



For more information on the FMS see Chapter 6, Volume 2.



OVERHEAD PANEL

FMS Transfer Selector:
BOTH ON 2: DFGC 1 and DFGC 2 receive input from FMS 2.
NORM: DFGC 1 receive input from FMS 1. DFGC 2 receive input from FMS 2
BOTH ON 1: DFGC 1 and DFGC 2 receive input from FMS 1.

CANADIAN MARCONI CMA-900 FLIGHT MANAGEMENT SYSTEM

