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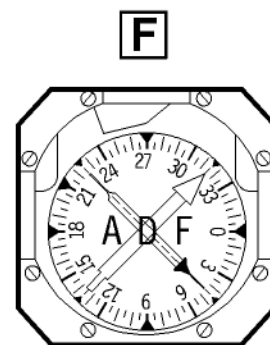
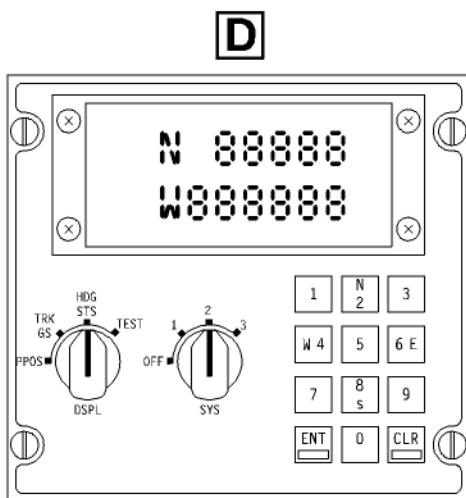
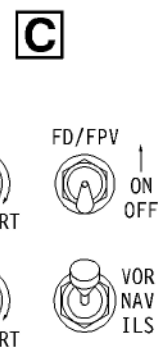
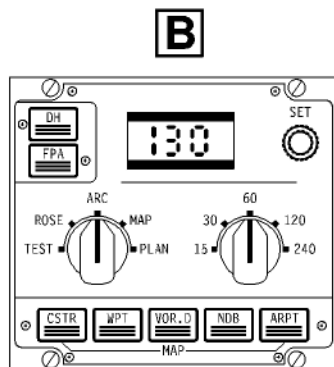
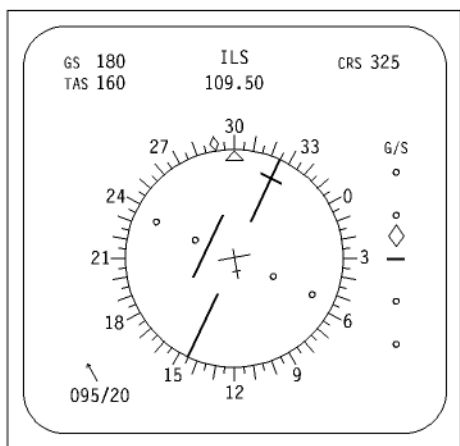
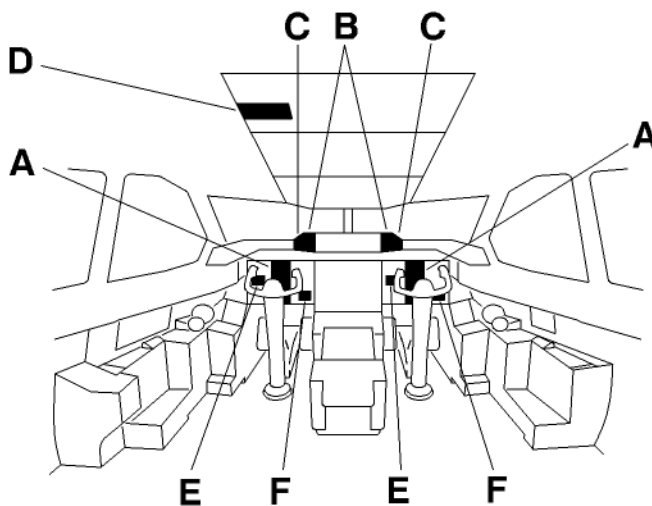
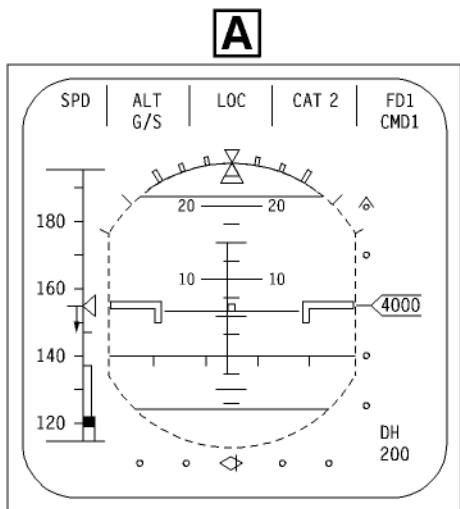
VOR/MARKERS/DME

OPERATIONAL DESCRIPTION
CONTROLS AND INDICATORS

ADF

OPERATIONAL DESCRIPTION
CONTROLS AND INDICATORS

MAIN SYSTEM CONTROLS AND DISPLAYS



Navigation Systems
**Inertial Reference System,
Operational Description**
GENERAL

- Attitude and heading information is provided by three Inertial Reference Systems (IRS) and a standby system, which includes a standby horizon and a standby compass.
- The IRS provide information to the other aircraft systems, such as attitude, heading, aircraft speed, position, track and wind.
- Each IRS consists of :
 - an IRU (Inertial Reference Unit) located in the avionics bay, and
 - a MSU (Mode Selector Unit) located on the overhead panel.
- Each IRU includes a computer and the following sensors :
 - three LASER gyros, to measure the pitch, roll and yaw angles as well as the pitch/roll/yaw rates
 and
 - three accelerometers, to measure longitudinal, vertical and lateral accelerations.
- The IRU are operated from their respective MSU.
- Additionally, a single ISDU (Inertial Sensor Display Unit) on the overhead panel can be used to enter or display information to or from any of the three IRS.
- For initialization and alignment, the IRS require parking position coordinates, usually entered from the FMS CDU, but which can be alternatively entered on the ISDU (see FMS chapter).
- If IRS 1 or 2 fail, IRS 3 can be selected to replace the lost attitude and heading information for the Captain's or F/O's flight instruments (see FLIGHT INSTRUMENTS chapter).

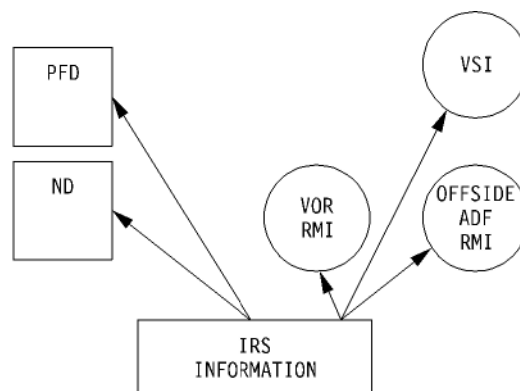
POWER SUPPLY

- During alignment, the IRS initially operate on aircraft batteries power for five seconds to ensure operation of the backup DC Power system. When this check is complete, IRS switch over to their normal source of power :
 - IRS 1 is supplied by AC EMER BUS.
 - IRS 2 is supplied by AC BUS 2.
 - IRS 3 is supplied by AC ESS BUS.
- Standby power supply (if normal AC power source is lost) :
 - IRS 1 will receive power from aircraft battery 1, until battery 1 is depleted.
 - IRS 2 and 3 will be supplied by their respective aircraft batteries (battery 2 for IRS 2, battery 3 for IRS 3) for 30 seconds.

Note : If the IRS 3 has been already selected by the Captain or if the IRS 3 is selected within 30 seconds (ATT HDG switching), it will remain supplied until its DC power source is depleted.

IRS INFORMATION DISPLAY

- IRS information is displayed on the EFIS Primary Flight Display (PFD) and Navigation Display (ND), the Vertical Speed Indicator (VSI), and the ADF and VOR/DME RMI.



Note: For detailed description of the PFD, ND and VSI, refer to the chapter FLIGHT INSTRUMENTS.

Navigation Systems**Inertial Reference System,
Operational Description****IRS inputs to the Primary Flight Displays (PFD)**

- The IRS provide the PFD with pitch, roll and heading information as well as lateral acceleration (sideslip indication).
- Additionally, the IRS provide information for the Flight Path Vector (FPV) symbol.

Note: A more detailed description of PFD is provided in the FLIGHT INSTRUMENTS chapter.

IRS inputs to the Navigation Displays (ND)

- IRS provides the ND with magnetic heading, ground track, ground speed and wind data.

IRS inputs to the VOR/DME RMI

- The CAPT's VOR/DME RMI displays heading information from IRS 1 (or 3 if ATT HDG switching pushbutton switch is selected).
- The F/O's VOR/DME RMI displays heading information from IRS 2 (or 3 if ATT HDG switching pushbutton switch is selected).

Note : For more information see VOR/DME system.

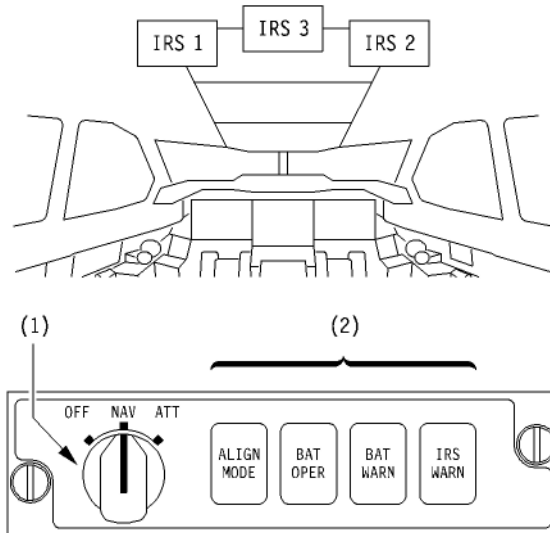
IRS inputs to the ADF RMI

- The CAPT's ADF RMI displays heading information from the F/O's primary heading source (IRS 2, or 3 if F/O ATT/HDG switching has been selected).
- The F/O's ADF RMI displays heading information from the CAPT's primary heading source (IRS 1, or 3 if CAPT ATT/ HDG switching has been selected).

Note : This enables each pilot to compare his primary heading information (ND and VOR/DME RMI) against the other pilot's heading information (ADF RMI).

Navigation Systems
**Inertial Reference System,
Controls and Indicators**
MODE SELECTOR UNIT (MSU)

- The three MSU are located on the overhead panel.


(1) Mode Selector

- **OFF**
 - The IRS is not energized.
- **NAV**
 - Normal operating mode, the IRS provides all attitude, heading, navigation and trajectory information.
- **ATT**
 - Emergency mode.
 - ATT mode only provides attitude and heading information.
 - Magnetic heading must be manually entered on the ISDU, and regularly updated by the crew.
 - Navigation information such as present position, ground speed, wind and FPV are lost.

Note: ATT is selected by the crew if a partial system failure or an electrical power loss prevent the use of the NAV mode.

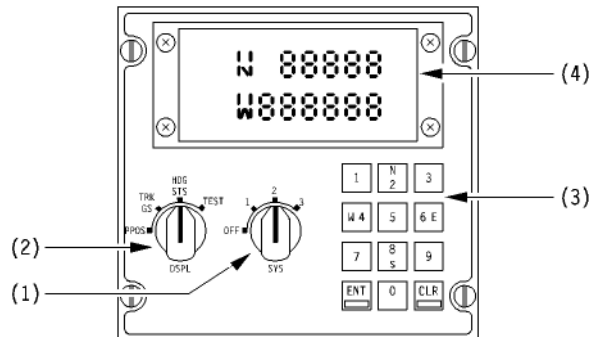
(2) Warning Annunciator Lights (amber)

- **ALIGN MODE**
 - Illuminates once DC power supply check is complete (5 seconds after system power-up) to indicate that alignment has started.
 - If present position has been entered, this light extinguishes 10 minutes later when the alignment is complete.
 - It flashes to indicate an alignment discrepancy.

Note: "IRS IN ALIGN" message is displayed on the ECAM MEMO page when any IRS is in the ALIGN mode.

- **BAT OPER**
 - Indicates that the IRS is being supplied by its respective aircraft battery.
- Note:** This light illuminates for 5 seconds at the start of the alignment, when the backup DC power supply is being tested.

- **BAT WARN**
 - Indicates that the voltage of the associated aircraft battery is below 18 V.
- **IRS WARN**
 - Indicates a complete IRS failure, or that ATT mode must be selected (STATUS code must be checked to determine which failure case has occurred).

Navigation Systems
**Inertial Reference System,
Controls and Indicators**
INERTIAL SENSOR DISPLAY UNIT (ISDU)


- The ISDU is connected to all three Inertial Reference Unit (IRU). The ISDU provides an alternate means of displaying the IRS main navigation data, or entering the present position coordinates for IRS alignment.

Note: These operations are normally performed using the Flight Management System.

(1) SYS Selector

- **OFF**
 - The ISDU is not energized.
- **1, 2 or 3**
 - IRS 1, 2 or 3 is selected for data display on the ISDU, or for present position (alignment) or magnetic heading entry (ATT mode) using the ISDU keyboard.

(2) DSPL (Display) Selector

- **PROS**
 - The present position (latitude and longitude) of selected the IRS is displayed.

Note: This position is also selected to enter the present position coordinates for alignment.

- **TK/GS**
 - True Track (TK) and Ground Speed (GS) information, from the selected IRS is displayed.
- **HDG/STS**
 - True Heading (HDG) and any STATUS code (as applicable) are displayed.

Note 1: During alignment, the display indicates the applicable STS code and the number of minutes remaining until the alignment is complete. If several STS codes are applicable, codes are displayed in turn for two seconds.

Note 2: When ATT mode has been selected on any MSU, HDG/STS and the affected IRS (1, 2 or 3) must be selected to enter the magnetic heading, using the keyboard.

- **TEST**

- Illuminates all digits on the ISDU display, and the ENT and CLR key lights for test.

(3) ISDU Keyboard

- Present position (and the magnetic heading, if ATT mode has been selected) are entered using this keypad.

(4) ISDU Display

- Depending on the position of the DSPL selector, the ISDU display indicates:
 - True Track and Ground Speed, or
 - Present position, or
 - True Heading and status codes.
- The following codes can be displayed when the DSPL selector is in the HDG/STS position:
 - 01 REMOVE IRU (for maintenance),
 - 02 DELAYED MAINTenance,
 - 03 ENTER POSition,
 - 04 SELECT ATT mode (IRS NAV failure),
 - 05 EXCESSIVE MOTION (during alignment),
 - 06 SWITCH ADC (switch to other ADC),
 - 07 CHECK C/B (check circuit breaker),
 - 08 REMOVE ISDU (for maintenance),
 - 09 SYSTEM BELOW -15 (if the ambient temperature is below -15° C, the alignment time is increased),
 - 10 RE-ENTER PPOS.

(4) ISDU Display

- Depending on the position of the DSPL selector, the ISDU display indicates :
 - True Track and Ground Speed, or
 - Present position, or
 - True Heading and status codes.

- The following codes can be displayed when the DSPL selector is in the HDG/STS position :
 - 01 REMOVE IRU (for maintenance),
 - 02 DELAYED MAINTenance,
 - 03 ENTER POSition,
 - 04 SELECT ATT mode (IRS NAV failure),
 - 05 EXCESSIVE MOTION (during alignment),
 - 06 SWITCH ADC (switch to other ADC),
 - 07 CHECK C/B (check circuit breaker),
 - 08 REMOVE ISDU (for maintenance),
 - 09 ENTER MAGNETIC HEADING

Navigation Systems
**Inertial Reference System,
Use of the IRS**
ALIGNMENT

- The IRS operation begins when the alignment is complete. If the present position coordinates have been entered, this takes place at least 10 minutes after the system was powered by placing the MSU selector from OFF to NAV.

Note: The IRS can not be able to align in NAV mode at latitudes above 70° N. Therefore, the IRS should be kept operating during stops above 70° N.

- If excessive motion is detected during alignment, the system restarts the entire 10 minutes alignment cycle automatically once the motion stops.
- During the alignment, the IRS compares the crew-entered latitude to its own internally calculated latitude. If the difference between the two latitudes exceeds 0.5 (30 minutes of arc), the MSU ALIGN MODE light flashes to indicate latitude entry error.

A new latitude must be entered before alignment can continue.

- During a stopover, when IRS is already operating in NAV mode, a rapid IRS re-alignment can be performed in 30 seconds by placing each MSU mode selector in OFF position (for a minimum of 2 seconds and a maximum of 7 seconds), and then back to NAV position.

The present position must then be entered through the FMS or ISDU to complete the rapid re-alignment.

INITIALIZATION

- When the MSU selector is placed in NAV position, the MSU BAT OPER warning light illuminates for the first 5 seconds as the system performs tests.
- After this test period, the MSU ALIGN MODE annunciator light illuminates. The crew can now initialize the IRS by entering the aircraft's present position in one of two ways:
 - Standard method: entry from the FMS CDU (see FMS chapter).
 - Alternate method: manual insertion from the ISDU.

- To manually enter the Present Position on the ISDU:
 - Select any IRS on the ISDU SYS selector (e.g.: IRS 1 - all other IRS will receive the coordinates simultaneously).
 - Select PPOS on the ISDU DSPL selector.
 - Enter latitude and longitude (it does not matter which data is entered first).
 - Latitude is entered by first pressing N or S. The ENT and CLR keys now illuminate green.

Note: If any other key than N, S, E or W is pressed first, the CLR key illuminates to indicate that an entry error has been made.

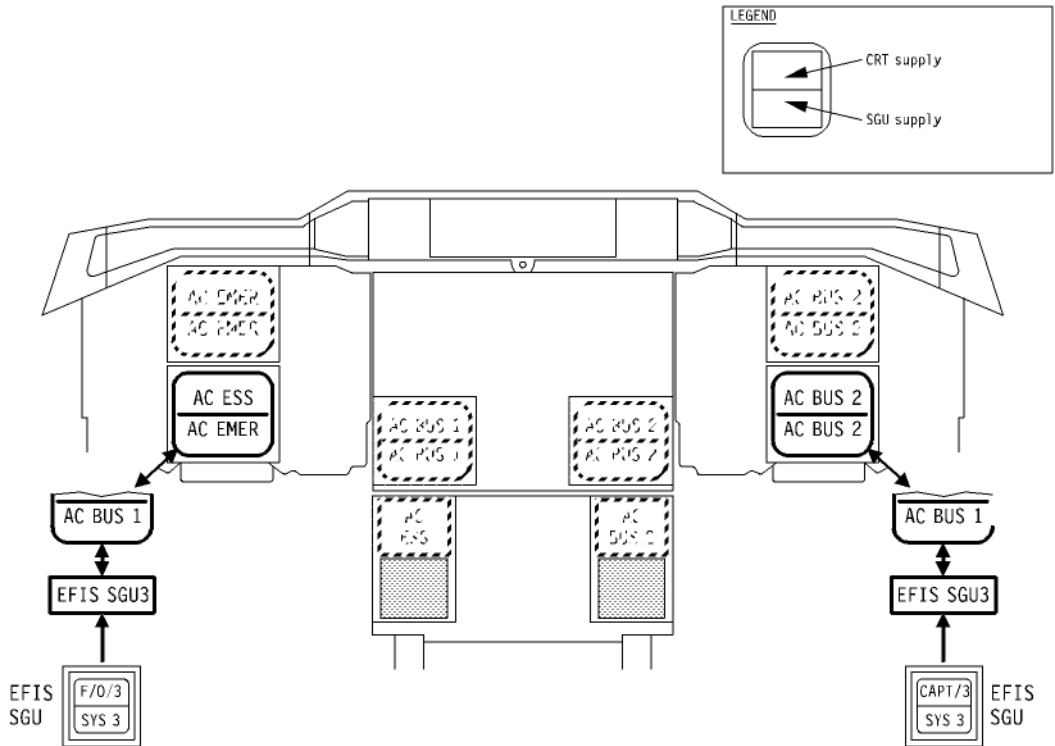
- Then enter the five digits corresponding to the latitude in degrees, minutes and tenths of minute (e.g.: 41° 37.6' would be entered as 41376). The latitude value is displayed on the upper line of the display.
- Press ENT to load the data.
- Longitude is entered similarly. First press E or W, and then the 6 digits (e.g.: 1° 22.9' would be entered as 001229). The longitude value will appear on the lower line of the display.
- Press ENT to load the data.
- In ATT mode, a magnetic heading can be entered. With the DSPL selector in HDG/STS position, enter the four digits of the magnetic heading in degrees and tenths of a degree (e.g.: 032° would be entered on the ISDU keyboard as then 0320).

Note: - Both AC and DC power must be available to fully align the IRS in NAV mode (DC for standby power check, then AC for normal operation).

- **IRS 1, IRS 2, IRS 3 pushbutton switches located on the maintenance panel allow to test the three IRS.**

Navigation Systems
**Navigation Display,
Operational Description**
GENERAL

- The Navigation Display (ND), normally presented on the lower EFIS Cathode Ray Tube (CRT), provides information related to both the lateral and vertical navigation.
- Several types of ND displays can be selected on the EFIS control panel: ROSE, ARC, MAP or PLAN.
- If a system failure affects an information provided on the ND, this information is cleared from the display.
- In some cases, a red warning message is displayed on the ND to indicate the information being affected.
 - Note:** - When changing the ND mode, the message "MODE CHANGE" is displayed until the new mode is available.
 - When changing ND range, the message "RANGE CHANGE" is displayed until the new range is available.
- The CAPT and F/O ND CRT's and SGU's are electrically supplied as illustrated hereafter :



Navigation Systems
**Navigation Display,
Operational Description**
DATA SOURCES AND INPUTS TO EFIS SGU's

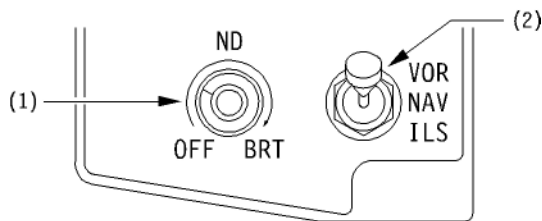
- The following table recalls the data sources and inputs received by the EFIS SGU's for display on the PFD and ND.

SOURCE	PFD	ND
IRS	- Pitch- Roll- Magnetic heading - Side-slip - Flight path vector	- Magnetic heading - Wind - Magnetic track - Ground speed
ADC	- Baro altitude - Mach - Computed airspeed	- TAS
FCC	- AP modes - Landing capability - FD bard	
TCC	- ATS modes	
FAC	- Vss- VLS - F- S- Green dot speed — Vmax - Speed trend	
FCU	- Selected speed - Selected altitude - Selected heading	- Selected heading
VOR	- Selected course (for flight path reference)	- Selected course - VOR deviation - TO/FROM
ILS	- G/S and LOC deviations - Runway heading (for flight path	- G/S and LOC deviations - Runway heading
RA	- Radio height - H < DH warning	
ADF		- ADF 1 and 2
FWC	- CHECK ATT	- CHECK HDG
EFIS CTL PNL	- Flight path reference slope (FPA)	- WR range
WR		- WR image
FMC	- DME ILS - V1 - FMS target speed	- Flight plan

Navigation Systems

Navigation Display, Controls and Indicators

EFIS SECONDARY CONTROL PANEL



(1) ND Brightness

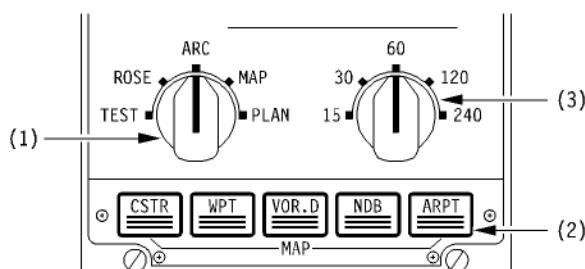
- The inner knob controls the brightness of the ND (lower CRT).
- The ND is turned off when this knob is set to OFF.
- The outer knob controls the brightness of the radar image on the ND (in MAP and ARC modes only).

(2) VOR/NAV/ILS Switch

- If the ND is in ROSE or ARC modes, the switch selects whether the VOR or ILS course and deviation are displayed.
- In NAV or ILS position, the VOR is autotuned by the FMS for VOR/DME position updating.

Note: NAV should only be selected when MAP or PLAN modes are displayed. In ROSE or ARC modes, VOR or ILS should be selected.

EFIS PRIMARY CONTROL PANEL



(1) Mode Selector

- The selector is used to set the ND display to TEST, ROSE, ARC, MAP or PLAN mode.

Note: Placing the EFIS mode selector in TEST simulates an attitude difference greater than 4°, resulting in the activation and display of a "CHK ATT" message on the PFD.

(2) Display Options (in MAP or PLAN mode only)

- When in ND MAP or PLAN display modes, the following FMS information can be viewed on the ND by pressing one of the five pushbutton switches:
 - CSTR (Constraints),
 - WPT (Waypoints),
 - VOR.D (VOR/DME),
 - NDB (Non Directional Beacons),
 - ARPT (Airports).

- Pressing any of these pushbutton switches displays the indicated navigational information on the ND, illuminates the associated pushbutton switch light and cancels any of the other four options which may have been previously selected.

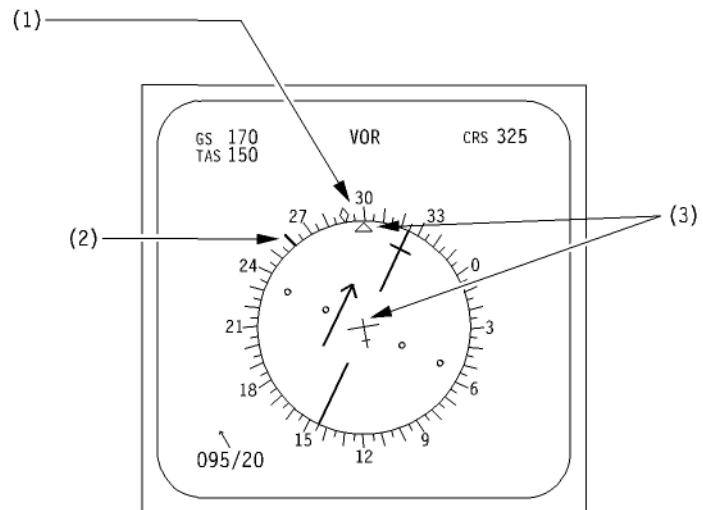
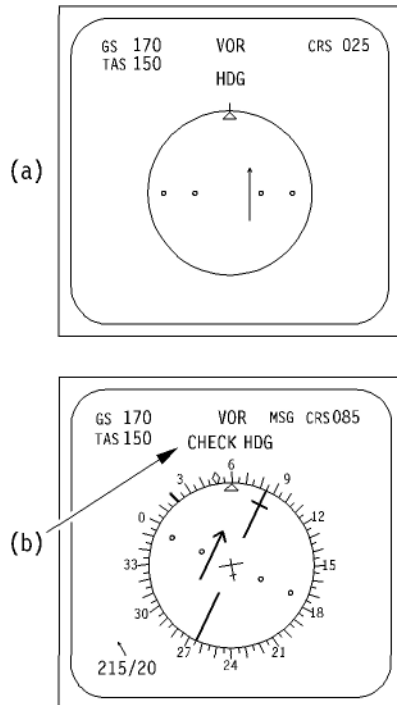
A second push cancels the option and extinguishes the pushbutton switch light.

- If any of the five options is being displayed in MAP or PLAN, and then ROSE or ARC mode is selected, the option remains selected, but will not be displayed until MAP or PLAN mode is selected again.

(3) Range Selector

- In ARC, MAP or PLAN mode the crew can select any of five ND viewing ranges: 15, 30, 60, 120 or 240 nm.

ROSE MODE



- ROSE mode presents an HSI-like display on the ND, that is to say a magnetic heading compass rose with a selected VOR or ILS course line and a Course Deviation Indicator (CDI).
- ROSE mode is used to display VOR, ILS and NDB information (raw navaid data).
- Additional information such as magnetic track, True Airspeed (TAS), Ground Speed (GS) and wind information is also presented.

(1) Aircraft Heading

- The aircraft's magnetic heading is indicated by reading the position of the yellow triangular lubber line against the white compass rose (graduated in 5° increments).
- If IRS heading information is lost, the compass rose is cleared from display and a red "HDG" message is displayed at the top of the ND – item (a).

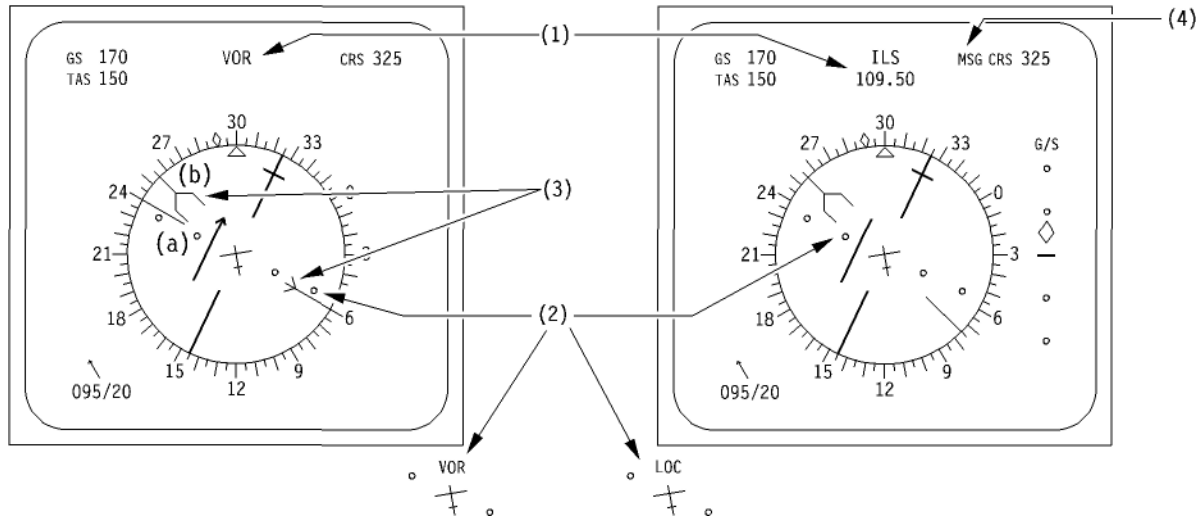
- If a difference greater than 4° is detected between the Captain and F/O's heading sources, a red "CHECK HDG" message is displayed on both ND item (b).

(2) Selected Heading

- The heading selected on the Flight Control Unit HDG SEL window is indicated on the heading scale with a blue index line.

(3) Magnetic Track

- The orientation of the yellow aircraft symbol indicates the magnetic track computed by the IRS.
- If IRS track information is not available, the yellow aircraft symbol is replaced by a yellow circle.
- The magnetic track is also indicated by a green diamond-shaped symbol on the compass rose (only with EFIS SGU standard E13 or subsequent).

Navigation Systems
**Navigation Display,
Rose Mode**
ROSE MODE (continued)

(1) ILS or VOR mode

- If the VOR/NAV/ILS selector is in the VOR position, "VOR" is displayed in blue.
If ILS is selected, "ILS" is displayed in blue.
The ILS frequency is also displayed in blue (only with EFIS SGU standard E13 or subsequent).
- When NAV is selected, no information is displayed.

(2) Lateral Deviation Scale and CDI

- This white scale is marked with **two dots** on each side of the selected course centerline.
- The deviation from the selected course is indicated by the displacement of the CDI. CDI display depends on the position of the VOR/NAV/ILS switch :
 - **VOR:** the CDI is blue and features an arrow-head (TO-FROM indication). Each dot represents a 5° deviation from selected course.
 - **ILS:** the CDI is magenta. In case of excessive deviation from the localizer (**two dots**), both the CDI and the scale flash.
 - **NAV:** the selected course and CDI are not displayed.

- The maximum displacement of the CDI is two dots. Beyond this point the CDI remains against the second dot.
- The CDI is not displayed until a VOR or ILS signal is received.
- If the LOC or VOR receiver fails, the CDI is cleared from the display and a red "LOC" (or "VOR") message is displayed in the center of the compass rose.

(3) ADF Bearing Information

- When receiving ADF bearing information, this information is presented on the ND as follows:
 - A thin magenta pointer indicates the bearing to ADF 1 - item (a).
 - A wide green pointer indicates the bearing to ADF 2 - item (b).
- If ADF 1 or 2 receivers fail, or if ADF information is lost, the corresponding pointer is cleared.

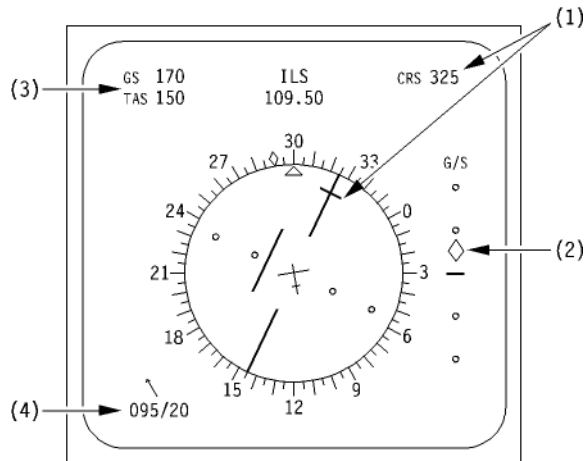
(4) FMS Messages

- Whenever a message is displayed in the FMS CDU scratchpad, an amber MSG attention - getter is displayed.

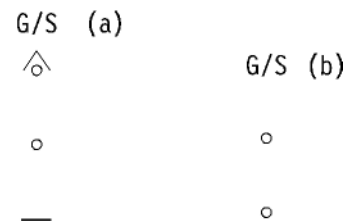
Navigation Systems

Navigation Display, Rose Mode

ROSE MODE (continued)



- In case of excessive deviation from the glide slope (one dot), both the diamond index and the scale flash.
- The diamond index is not displayed until an ILS signal is received.



(1) Selected VOR or ILS Course

- The course information displayed on the ND depends on the position of the VOR/NAV/ILS switch :
 - VOR :
 - the course set on the VOR control panel and the CDI, are both displayed in blue,
 - the TO/FROM indication is provided by the arrow at the end of the CDI.
 - ILS :
 - the localizer course set on the ILS control panel is displayed in blue,
 - the CDI is displayed in magenta (pink),
 - the frequency set on the ILS control panel is displayed above the compass rose.
 - NAV :
 - the selected course line, the CDI and the digital selected course information are cleared from the ND.

(2) G/S Vertical Deviation Scale and Index

- The vertical deviation scale and index diamond are displayed only in ILS mode.
- This scale indicates glide slope deviation.

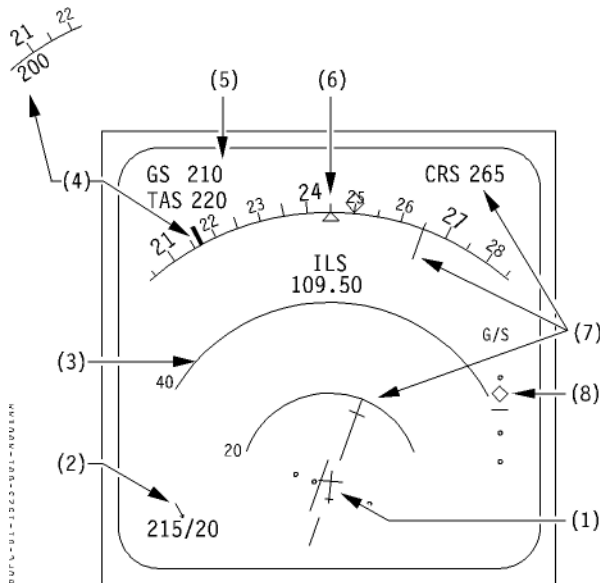
- Item (a)-When more than two dots from the glide slope, the diamond index remains against the second dot (and only an half of the diamond shaped index is displayed).
- Item (b) - If the glide slope receiver fails, the diamond index is cleared and a red "G/S" flag is displayed in the center of the scale.

(3) Ground Speed and True Airspeed

- Ground Speed (GS) and True Airspeed (TAS) are displayed in green in the upper left hand corner.
- If this data is not available, the digital value is replaced by dashed lines.

(4) Wind

- The IRS-computed wind direction and velocity is displayed in green in the lower left corner.
- The digits indicate the true wind direction and speed.
- The pointer indicates the magnetic wind direction.
- In case of IRS failure the digits and pointer are cleared from the display.

ARC MODE


- ARC mode displays selected VOR or ILS course information (raw navaid data) with a heading scale ($\pm 40^\circ$ from the present aircraft heading).
- Weather radar information is available in ARC mode.
- Additional information such as magnetic track, TAS, GS and wind information is also presented.

Note: ADF information cannot be displayed in ARC mode.

(1) Magnetic Track

- Same as ROSE mode.

(2) Wind

- Same as ROSE mode.

(3) Range Arcs

- Using the range selector on the EFIS primary control panel, the crew can select any of five maximum viewing ranges : 15, 30, 60, 120 or 240 nm.
- The three arcs display 1/3 of, 2/3 of and the full maximum range selected (for example, if the EFIS range selector is set at 60 nm range, the first arc is 20 nm from the aircraft, the second arc is at 40 nm, and the third arc-heading scale-indicates 60 nm).

(4) Selected Heading Index

- Same as ROSE mode, except that when the selected heading is off the scale (more than 40° from the aircraft heading) the selected heading is displayed as a digital number on the corresponding side of the scale.

(5) Ground Speed and True Airspeed

- Same as ROSE mode.

(6) Heading Scale

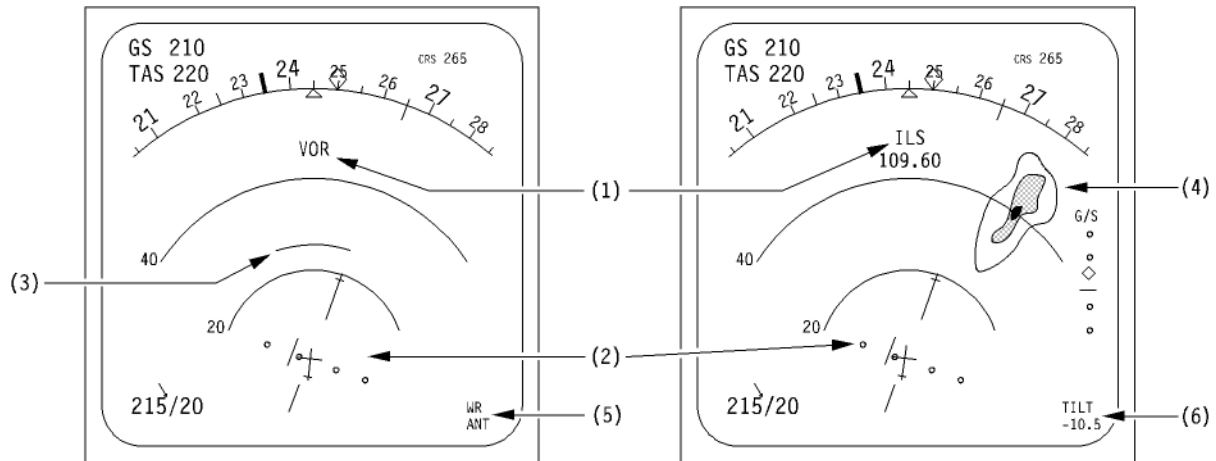
- Same as ROSE mode, except that the digital heading values are enlarged every 30° .

(7) Selected Course / Course Line / CDI

- Same as ROSE mode.

(8) G/S Vertical Deviation Scale and Index

- Same as ROSE mode.

ARC MODE (continued)

(1) ILS or VOR Mode

- Same as ROSE mode.

(2) Lateral Deviation Scale and CDI

- Same as ROSE mode.

(3) Altitude Intercept Arc

- This small yellow arc indicates the point where the aircraft will reach the altitude selected on the Flight Control Unit if the present flight path is maintained.

Note: This arc is cleared when the aircraft is within 500 ft of the selected altitude.

(4) Weather Radar Returns

- If the radar is operating, and the ND radar brightness knob on the EFIS secondary control panel is correctly adjusted, radar returns are displayed on the ND.

The radar image is displayed in accordance with the range selected for the arcs display.

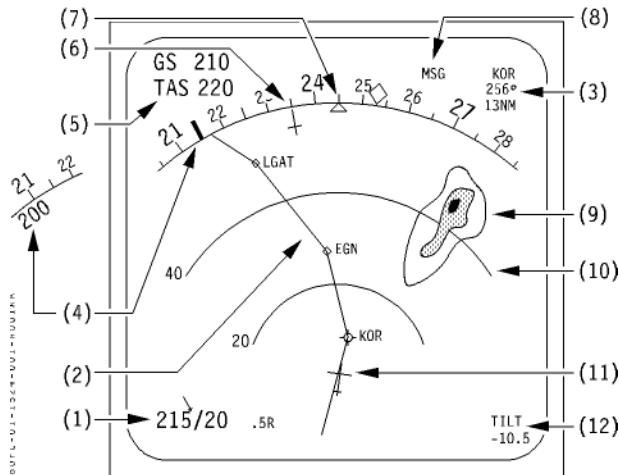
- The radar echoes are displayed in different colors depending on the intensity of the precipitation.

(5) Radar Failure Messages

- Weather Radar failure messages are displayed in the lower right corner of the ND.
- Radar failures that cause the loss of the radar image are displayed in red.
- Radar failures that do not cause loss of the radar image are displayed in amber.
- When TEST is selected on the radar control panel, a test pattern is displayed and the amber message "WR TEST" is displayed.

(6) TILT Value

- The tilt value set on the radar control panel is displayed in blue in the lower right part of the ND (+ is up, - is down, displayed in 0.5° intervals).
- If a radar failure is detected, the TILT information display is replaced by the applicable failure message.

Navigation Systems
**Navigation Display,
MAP Mode**
MAP MODE


- MAP mode is similar to the ARC mode but illustrates the aircraft position relative to the FMS flight plan.
- Weather radar information is available in MAP mode.
- Additional information such as magnetic track, TAS, GS, and wind information is also presented.

Note: Raw VOR, ADF, and ILS navaid data information can not be displayed in MAP mode.

(1) Wind

- Same as ROSE and ARC modes.

(2) Flight Plan

- The FMS flight plan route ahead of the aircraft is displayed on the ND, and moves as the aircraft progresses along.
- The flight plan is displayed in accordance with the range selected for the arcs display.

(3) Next Waypoint

- The name of the next waypoint, and its bearing and distance are displayed in green in the upper right corner of the ND.

(4) Selected Heading

- Same as ARC mode.

(5) Ground Speed and True Airspeed

- Same as ROSE and ARC modes.

(6) ILS Course

- When the VOR/NAV/ILS switch is in ILS position, a blue index line is displayed on the heading scale, to recall the selected ILS course.
- When the ILS course is beyond the displayed heading range, this index line is not displayed.

(7) Heading Scale and Selected Heading Index Line

- Same as ARC mode.

(8) FMS Messages

- Same as ROSE mode.

(9) Weather Radar Returns

- Same as ARC mode.

NOT IMPLEMENTED

(10) Range Arcs

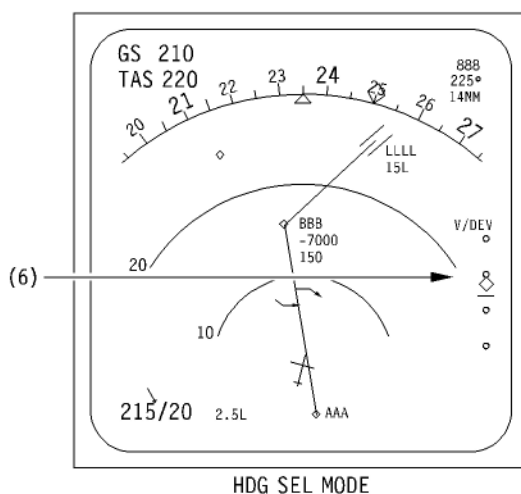
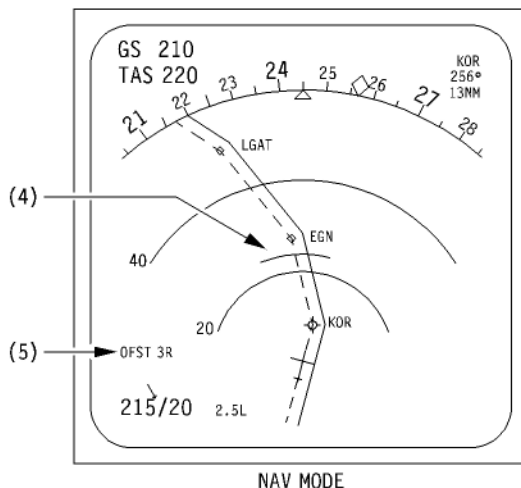
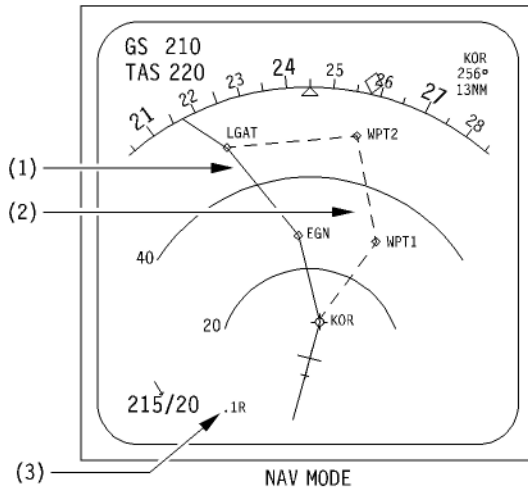
- Same as ARC mode.

(11) Magnetic Track and Aircraft Symbol

- Same as ROSE and ARC modes.

(12) Tilt or Radar Failure Messages

- Same as ARC mode.

MAP MODE (continued)

(1) Active Flight Plan

- The active route being flown by the aircraft is displayed as a solid white line.

(2) Secondary Flight Plan

- The secondary flight plan is displayed in yellow dashes only if one of the pages associated to the SEC F-PLN function is displayed on the onside FMS CDU.

(3) Lateral Course Deviation

- The number of nm right (R) or left (L) of the flight plan course is displayed.

(4) Yellow Altitude Intercept Arc

- Same as ARC mode, but it is not displayed when PROFILE mode is engaged.

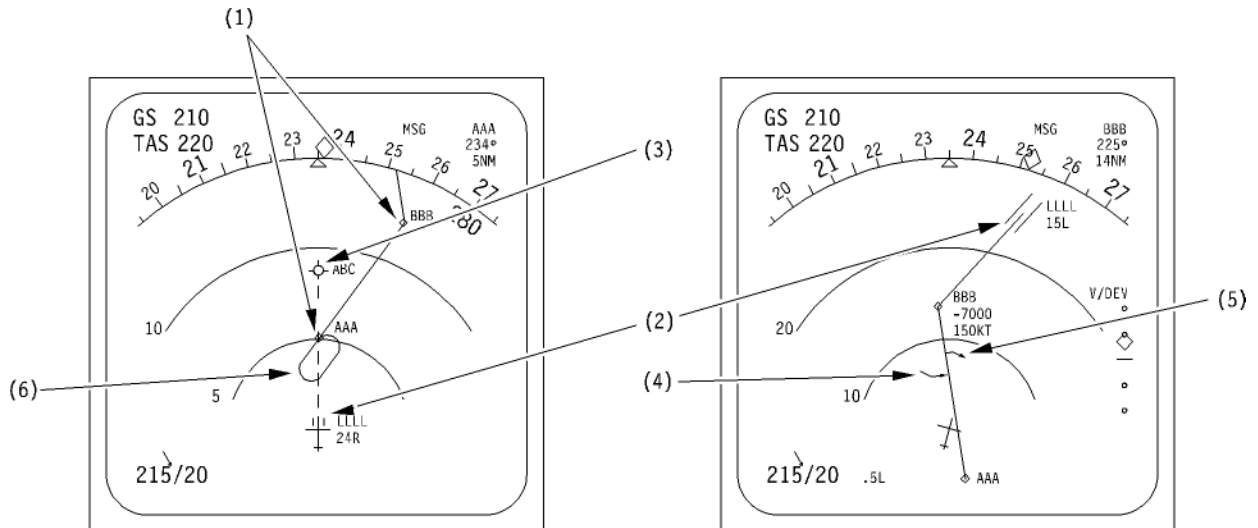
(5) Offset Course

- When a parallel offset course is selected on the FMS CDU, the offset course becomes the active flight plan (solid white line). The original flight plan is displayed as a white dashed line.
- The offset value is displayed as "OFST XX R" (or L) where XX is the offset distance in nm, and L or R indicates whether the offset is left or right of the original flight plan course.

(6) Vertical Deviation (V/DEV)

- Indicates deviation from the FMS-computed glide path (only for non-precision approaches when a MDA has been set in the FMS).
- Each dot represents 200 ft deviation.

MAP MODE (continued)



(1) FMS Flight Plan Waypoints

- Waypoints on the FMS flight plan route are displayed as diamond-shaped symbols together with the waypoint identifiers.
- The next waypoint is green, all others are white.

(2) Departure and Destination Airports

- Departure and destination airports are automatically displayed when within the display range.
- The display depends on the range selected and on the runway indication (refer to page 6).
- When the runway is indicated, the four letter ICAO airport identifier and the two digit runway identifier are displayed.

Note: With a scale of 15 or 30 nm, if an FMS flight plan discontinuity exists between the flight plan and the runway, a 74 nm extended on-track line is displayed as a white dashed line to assist manual interception of the final approach course.

(3) Tuned Navaid

- VOR/DME stations auto-tuned by the FMS, and displayed on the VOR RMI, are displayed in blue.

(4) Altitude Intercept Point

- In PROFILE mode, the point on the flight plan where the altitude (or FL) selected on the Flight Control Unit will be reached is indicated as a blue arrow symbol.

Note: This symbol is cleared when the aircraft is within 100 ft of the selected altitude.

(5) Top of Descent (T/D)

- The point where idle power descent from cruise altitude should be started is displayed as a white arrow shaped symbol.
- If an intermediate step down altitude (or FL) has been selected, the point at which the step down altitude (or FL) must be left to continue an idle descent is displayed with the same symbol, but in blue.

(6) Holding Patterns and Procedure Turns Symbols

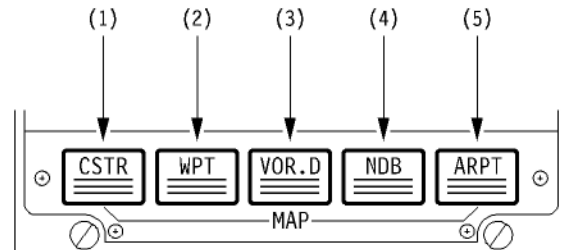
- Holding patterns and procedure turns symbols are displayed only if they are on the active flight plan.
- The display depends on the range selected .

Navigation Systems

Navigation Display, MAP Mode

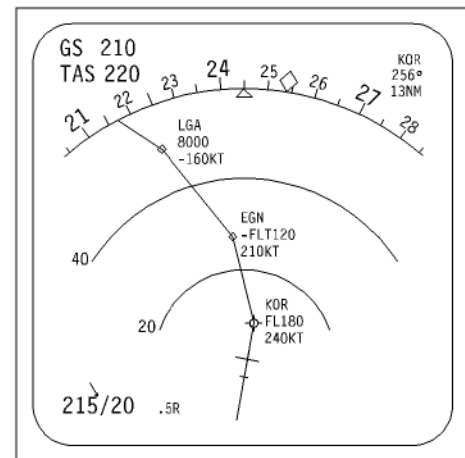
Optional Map Symbols

- The flight crew can display additional information on the MAP display with the five pushbutton switches on the bottom of the primary EFIS control panel (CSTR, WPT, VOR.D, NDB, ARPT).
- Only one of the five pushbutton switches can be selected at a time.
- The selected information is displayed in magenta on the ND.



(1) CSTR (Constraints) Pushbutton Switch

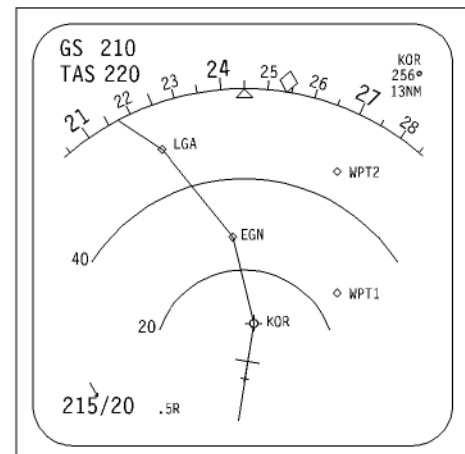
- Any altitude, speed or time constraints stored in the FMS database for active flight plan waypoints are displayed next to the concerned waypoints.
- Examples :
 - KOR waypoint : the aircraft must be at FL 180 and at 240 kt.
 - EGN waypoint : the aircraft must be at FL 120 or below and at 210 kt.
 - LGA waypoint : the aircraft must be at 8000 ft and at 160 kt or less.



CSTR SELECTED

(2) WPT (Waypoints) Pushbutton Switch

- Displays all waypoints within the selected ND range which are not in the active flight plan.

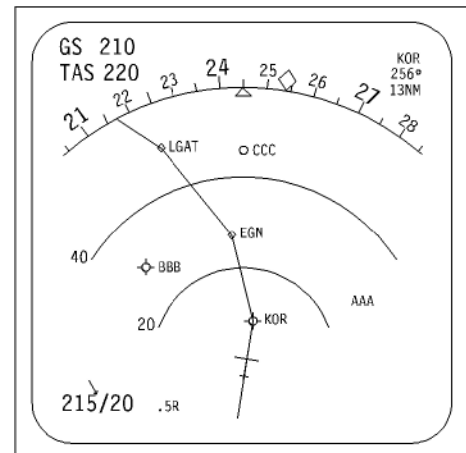


WPT SELECTED

Optional Map Symbols (continued)

(3) VOR.D Pushbutton Switch

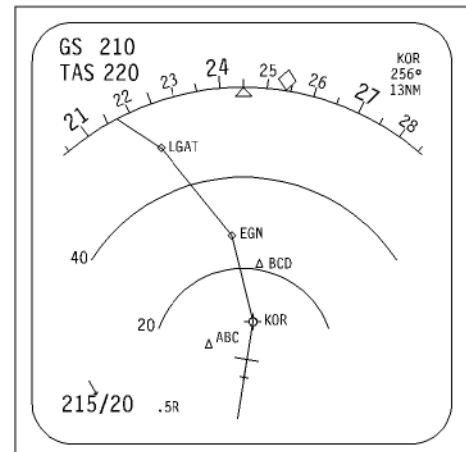
- VOR, DME or VOR/DME which are within the selected range (but not presented on the RMI) are displayed.



VOR.D SELECTED

(4) NDB Pushbutton Switch

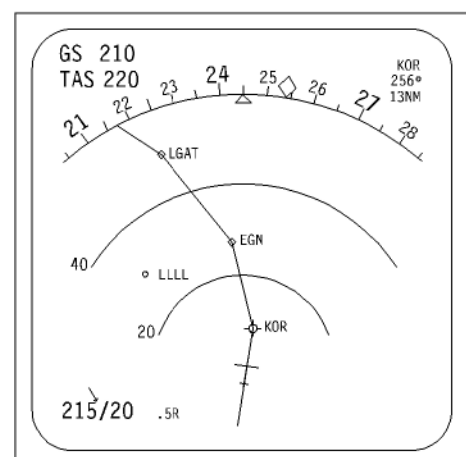
- NDB which are within the selected range are displayed.



NDB SELECTED

















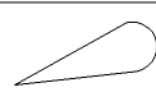
(5) ARPT Pushbutton Switch

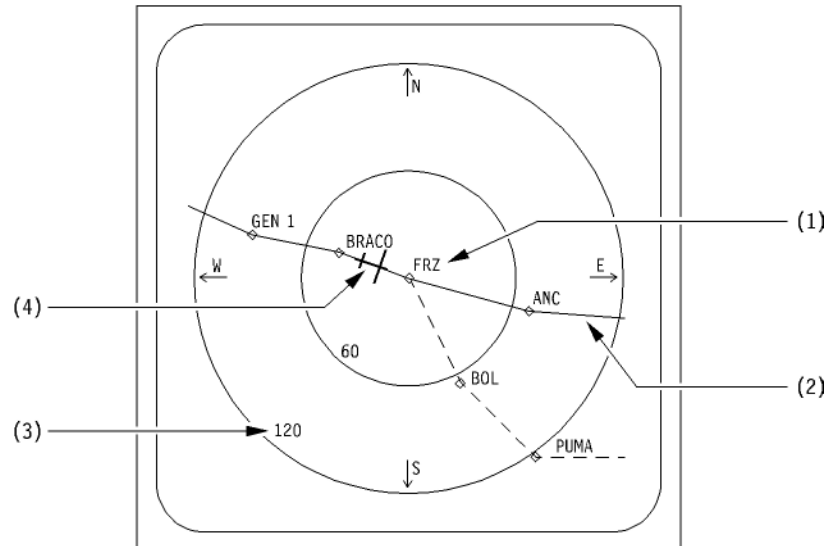
- Airports which are not in the active flight plan, but are within the selected range, are displayed.



ARPT SELECTED

Navigation Systems
**Navigation Display,
MAP Mode**
Map Display Symbols

ITEM	SYMBOLS	RANGE SELECTED	COLOR
WAYPOINT	 ABC	ALL	WHITE OR GREEN IF TO WAYPOINT
VOR	 BCD	ALL	MAGENTA OR BLUE WHEN TUNED
DME	 CDE		MAGENTA OR BLUE WHEN TUNED
VOR/DME	 DEF		MAGENTA OR BLUE WHEN TUNED
NDB	 EFG	ALL	MAGENTA
AIRPORTS	 LSGG	ALL	MAGENTA OR WHITE FOR ORIGIN AND DESTINATION
	 LSGG 33R	60, 120 OR 240 NM	MAGENTA OR WHITE FOR ORIGIN AND DESTINATION
	 LSGG 33R	15 OR 30 NM	MAGENTA OR WHITE FOR ORIGIN AND DESTINATION
ALTITUDE INTERCEPT POINT	 OR 	ALL	BLUE
TOP OF DESCENT			WHITE
HOLDING PATTERN	RIGHT  OR  LEFT	60, 120 OR 240 NM	WHITE
		15 OR 30 NM	WHITE OR BLUE OR AMBER
PROCEDURE TURN	RIGHT  OR  LEFT	60, 120 OR 240 NM	WHITE
		15 OR 30 NM	WHITE OR BLUE OR AMBER

PLAN MODE


- PLAN mode is primarily used to review the FMS flight plan, and to view changes being made to the flight plan.
- PLAN mode is not intended for use as a primary inflight navigation reference.
- PLAN mode displays the aircraft position on the FMS flight plan course on a display which is always oriented so that North is up.
- The following information is not available in PLAN mode :
 - Weather radar, magnetic track, TAS, GS, wind information and BRG/DIST to next WPT.
 - VOR, ADF, and ILS navaid data information.
- In case of failure of the associated FMS, the message "PLAN NOT AVAIL" is displayed and the flight plan is erased.

(1) Reference Waypoint

- When scrolling the FMS F-PLN for review, the point in the center of the PLAN display is always the second waypoint indicated on the FMS F-PLN page (TO WPT).

(2) Flight Plan

- Same as in MAP mode, except that the flight plan is presented in a "North up" orientation.
- Symbols are the same as in MAP mode.

(3) Range Scale and Rings

- Same as ARC or MAP mode except that the range selected is the diameter of the PLAN circle.

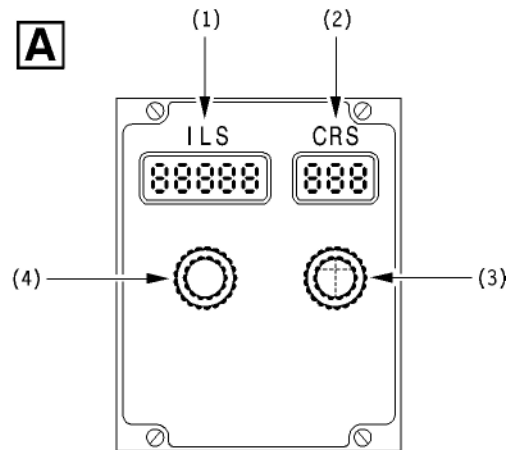
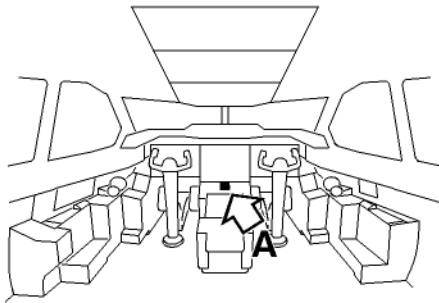
For example, if 240 nm range is selected, the distance from the center of the display to the outer ring is 120 nm, and the inner ring range is 60 nm (total diameter of the PLAN circle is 240 nm).

(4) True Track and Aircraft Position

- The yellow aircraft symbol points at the aircraft's true track, and indicates the position of the aircraft relative to the FMS flight plan course.
- If the IRS track information is lost, the yellow aircraft symbol is replaced by a yellow circle.

Navigation Systems**Instrument Landing System,
Operational Description****GENERAL**

- The Instrument Landing System (ILS) provides guidance for the capture and tracking of the ILS glide slope (G/S) and localizer (LOC) beams.
 - Two ILS receivers are installed. Both receivers are controlled by a single ILS control panel on the center pedestal.
 - Both receivers use one localizer antenna in the radome and one glide slope antenna under the flight compartment .
 - The ILS is tuned by setting the LOC frequency and CRS on the ILS control panel.
Setting the LOC frequency automatically tune the paired G/S frequency.
 - Glide slope and localizer deviations are displayed on the PFD and ND :
 - With the captain's VOR/NAV/ILS switch in ILS position, the captain's PFD displays information from ILS 1 receiver and captain's ND displays information from ILS 2 receiver.
 - Similarly, with the first officer's VOR/NAV/ILS switch in ILS position, the first officer's PFD displays information from ILS 2 receiver and first officer's ND displays information from ILS 1 receiver.
 - ILS failure indications are displayed on the PFD and ND :
 - If the localizer and/or glide slope receiver(s) fail, a red "LOC" and/or "G/S" warning is displayed on the localizer and/or glide slope deviation scale when the associated VOR/NAV/ILS switch is in ILS position.
- If both ILS receivers fail when LAND mode is armed or engaged, the AP/FD reverts to basic V/S and HDG modes.
 - ILS audio signals can be monitored by selecting the ILS reception knob on the audio selector panels.
 - ILS 1 is supplied by the AC EMER BUS, and ILS 2 is supplied by the AC BUS 2.
 - The ILS receivers can be tested with the ILS 1 and 2 TEST pushbutton switches on the lateral maintenance panel.

ILS CONTROL PANEL

(1) ILS Frequency Display

- Displays the selected ILS frequency (from 108.10 to 111.95 MHz).

(2) Localizer Course Display

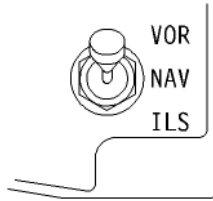
- Displays selected runway course (from 0° to 359°).

(3) Localizer Course Selector Knob

- This knob is used to set the desired ILS localizer course.
- The selected course is displayed on the ND in ROSE, ARC, or MAP modes, when the VOR/NAV/ILS switch is in ILS position.

(4) ILS Frequency Selector Knob

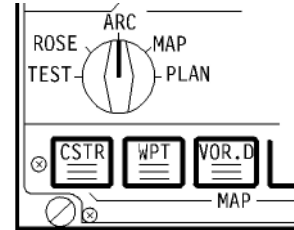
- This knob is used to set the desired ILS frequency (localizer frequency).
- The outer knob sets the whole units of MHz, and the inner knob is used to set the hundredths of MHz in 0.05 MHz increments.
- Below 700 ft with at least one AP engaged, tuning of the ILS receiver is inhibited, even if the control panel setting is changed.

Navigation Systems
**Instrument Landing System,
Controls and Indicators**
VOR/NAV/ILS SWITCH


- The VOR/NAV/ILS switches are located on each pilot's secondary EFIS control panel.
- ILS position must be selected to display ILS information on the PFD and ND.

G/S and LOC scales and deviation index are displayed as follows:

	ND ROSE or ARC modes	PFD
G/S scale	Displayed if switch in ILS position	Always displayed (vertical deviation scale)
LOC scale	Displayed if switch in ILS position	Displayed if switch in ILS position
G/S deviation index	Displayed if switch in ILS position and ILS signal received	Displayed if switch in ILS position and ILS signal received
LOC deviation index	CDI displayed if switch in ILS position and ILS signal received	Displayed if switch in ILS position and ILS signal received

ND MODE SELECTOR


- These selectors are located on each pilot's EFIS control panel.
- To display ILS information on the associated ND:
 - ROSE or ARC must be selected, and
 - the associated VOR/NAV/ILS switch must be in ILS position.
- In MAP mode, the localizer course is displayed on the ND heading scale.

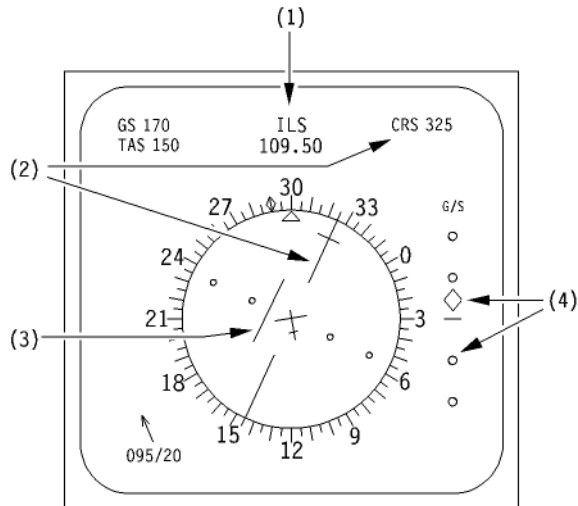
Note: See ROSE, ARC and MAP mode descriptions in this chapter for more information.

Navigation Systems

Instrument Landing System, Controls and Indicators

ND ILS INDICATIONS

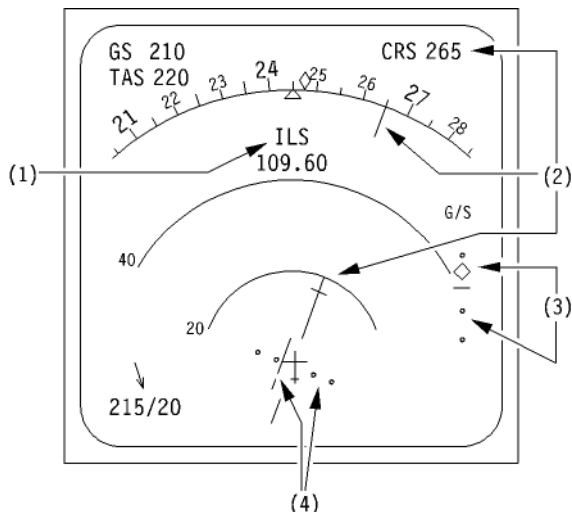
ROSE MODE



- (1) ILS Mode
- (2) Selected ILS Course
- (3) LOC CDI and Scale
- (4) G/S Deviation Index and Scale

Note: For detailed description, refer to section - ROSE MODE.

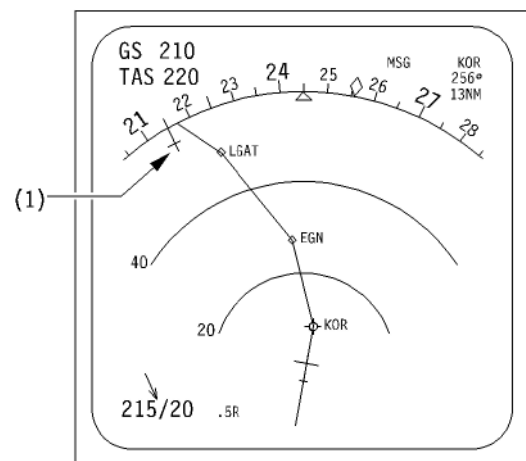
ARC MODE



- (1) ILS Mode
- (2) Selected ILS Course
- (3) G/S Deviation Index Scale
- (4) LOC CDI and Scale

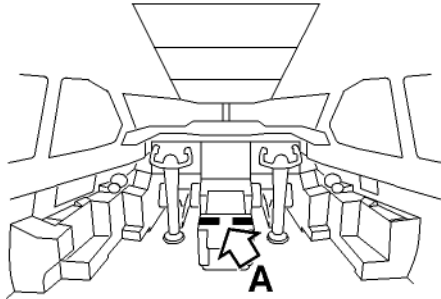
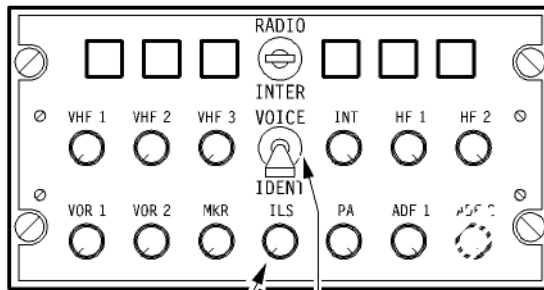
Note: For detailed description, refer to section - ARC MODE.

MAP MODE



- (1) Selected Course

Note: For detailed description, refer to section - MAP MODE.

Navigation Systems
**Instrument Landing System,
Controls and Indicators**
ILS AUDIO

A


(1) (2)

(2) VOICE/IDENT Switch

- **VOICE**
 - Only voice is received and Morse code is filtered out.
- **IDENT**
 - Only Morse code is audible and voice is filtered out.

SELECTION
(1) ILS Ident Reception Knob

- On each audio selector panel, an ILS pushbutton switch is provided for reception of audio signals through the ILS receivers.
- **Pressed then released**
 - The pushbutton switch illuminates white.
- **Rotate**
 - The rotation of the pushbutton switch adjusts the audio volume.
- **Pressed again**
 - The pushbutton switch remains in. The light extinguishes.

Navigation Systems

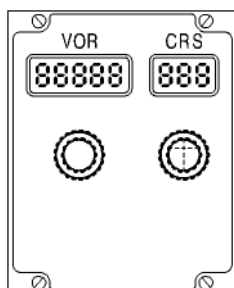
VOR/Marker/DME Systems, Operational Description

GENERAL

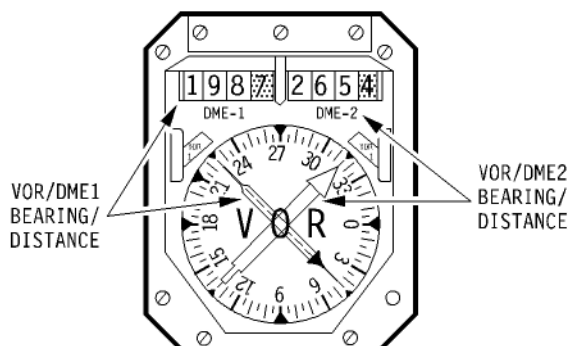
- Two VOR/DME systems and one Marker Beacon system are installed on the aircraft.
- The two VOR share one common antenna, located at the top of the fin.
- Each DME and MARKER beacon receivers have their own individual antennas, located aft of the nose landing gear.
- The VOR/DME are automatically powered when their supplying electrical buses are powered.
- Audio signals for identification of a VOR or DME station, or marker beacon, can be heard by selecting the VOR/DME or MKR pushbutton switches on the audio selector panels.

VOR

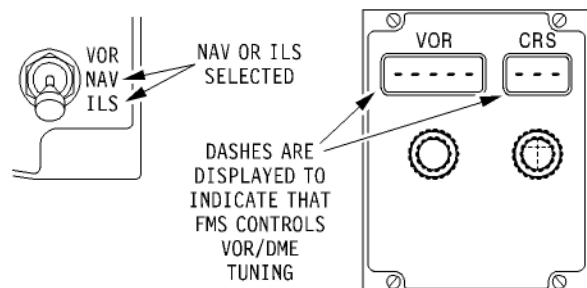
- Each VOR receiver has a VOR/DME control panel located at the front of the center pedestal.



- VOR 1 and 2 raw data are displayed on both the Captain and first officer's VOR/DME RMI.



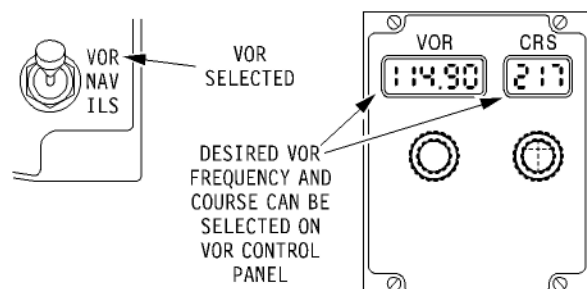
- VOR information can also be displayed on the ND in ROSE or ARC modes.
 - Normally VOR 1 supplies the Captain's ND and VOR 2 supplies the first officer's ND.
- If the VOR/NAV/ILS switch on the secondary EFIS control panel is in the NAV or ILS position, the associated VOR/DME can be :
 - Autotuned by the associated FMS. Dashes are displayed on the related VOR control panel. The VOR control panel cannot be used to make VOR/DME frequency selections.



- Manually tuned by selecting the VOR/DME frequency on the FMS PROGRESS page.

Note: When a VOR/DME is manually tuned on the FMS PROG page or if the VOR/NAV/ILS switch is left in the VOR position, the FMS uses the manually tuned VOR-DME for position update as long as possible. If auto-tuning is not reselected on the PROG page or if the VOR/NAV/ILS switch is not repositioned to NAV, downgrading of the FMS navigation accuracy will occur.

- If the VOR/NAV/ILS switch is in VOR position, the associated VOR/DME receiver is remotely tuned by setting the desired frequency on the associated VOR control panel.



Navigation Systems**VOR/Marker/DME Systems,
Operational Description****VOR (continued)**

- VOR frequencies can be selected from 108.00 to 117.95 MHz (0.05 MHz spacing).
- VOR failure is indicated by red warning flags on the VOR/DME RMI and ND.

Note : VOR/DME information is also supplied to the associated FMC and FCC.

- VOR 1 is supplied by the AC EMER BUS, and VOR 2 is supplied by the AC BUS 2.
- Both VOR/DME systems and the Marker system can be tested by the VOR/MKR 1 and 2 TEST pushbutton switches on the AVIONICS SYS TEST section of the maintenance panel.

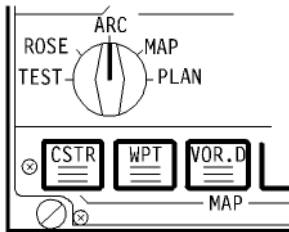
DME

- The DME frequency associated with a VOR/DME station is automatically set by selecting the VOR frequency.
- If the selected VOR station is DME-equipped, the slant range distance to the station is displayed on both VOR/DME RMI.
- During approach, the ILS/DME is autotuned by the FMS and the ILS/DME distance is displayed in the lower left corner of both PFD.
- DME failure is indicated by flags covering the DME windows on the VOR/DME RMI.
- DME 1 is supplied by the AC ESS BUS, and DME 2 is supplied by the AC BUS 2.

- Both DME receivers can be tested with the DME 1 and DME 2 TEST pushbutton switches on the AVIONICS SYS TEST section of the maintenance panel.

MARKER BEACONS

- Outer, middle and inner or airway marker beacon signals are received and processed by a marker beacon receiver for visual and audio annunciation of beacon overfly.
- Beacon overfly is indicated by two MKR lights on the Captain and first officer's instrument panels and by an audio signal in the loudspeakers.
- Marker beacon receiver is supplied by the AC EMER BUS, and indicator lights are supplied by the DC NORM BUS.
- The Marker system is automatically tested when the VOR 1 is tested.

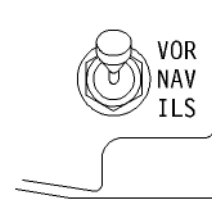
Navigation Systems
**VOR/Marker/DME Systems,
Controls and Indicators**
ND MODE SELECTOR


Note : The following description of the EFIS mode selectors only covers how they affect the VOR system. For more information refer to the FLIGHT INSTRUMENTS chapter.

- These selectors located on the primary EFIS control panels, are used to select the associated ND's display mode.
- In ROSE or ARC, the related ND displays VOR information, if available.

IMPORTANT

In ROSE or ARC, the associated VOR/NAV/ILS switch must be placed in the VOR or ILS positions, as applicable. If ROSE or ARC is selected, but the VOR/NAV/ILS switch is left in NAV position, no specific navaid information is displayed on the ND.

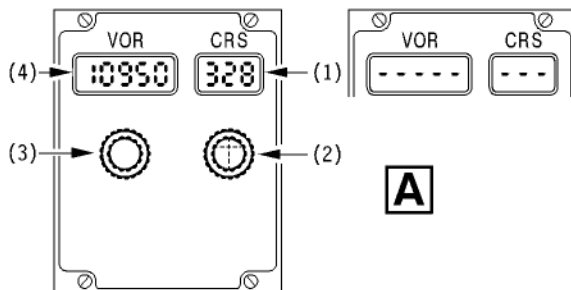
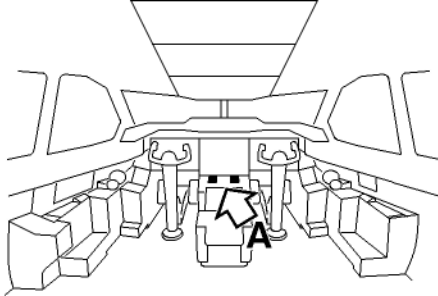
VOR/NAV/ILS SWITCH


- The VOR/NAV/ILS switches are located on the Captain and F/O's secondary EFIS control panels.
- Each switch position controls :
 - VOR or ILS information displayed on the PFD/ND.
 - Autotuning/manual tuning or remote tuning of the associated VOR control panel.
- **VOR**
 - The associated VOR control panel can be manually tuned.
 - In ROSE or ARC modes, VOR data is displayed on the associated ND and VOR RMI.
- **NAV**
 - The associated VOR is autotuned by the onside FMS (dashes are displayed in the windows of the VOR control panel).

IMPORTANT

With the VOR/NAV/ILS switch in NAV position, the ND mode selector must be placed in the MAP position. If ROSE or ARC mode is selected, no specific navaid information is displayed on the ND.

- **ILS**
 - The associated VOR is autotuned by the onside FMS (dashes are displayed in windows of the VOR control panel).
 - In ROSE or ARC mode, ILS raw data is displayed on the associated PFD and ND.
 - In MAP or PLAN mode, ILS raw data is displayed on the associated PFD. The associated ND displays only the selected ILS localizer course with no deviation data.

VOR/DME CONTROL

PANEL

- The following VOR controls and indicators are operative only if the VOR/NAV/ILS switch is in the VOR position.

(1) CRS Window

- The selected VOR course (from 0 to 359) is displayed.

Note : With the VOR/NAV/ILS switch in NAV or ILS, dashes are displayed to indicate that the VOR/DME receiver is being autotuned by the associated FMS.

(2) CRS Selector Knob

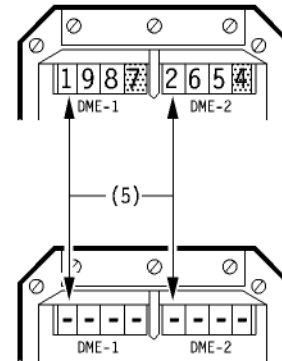
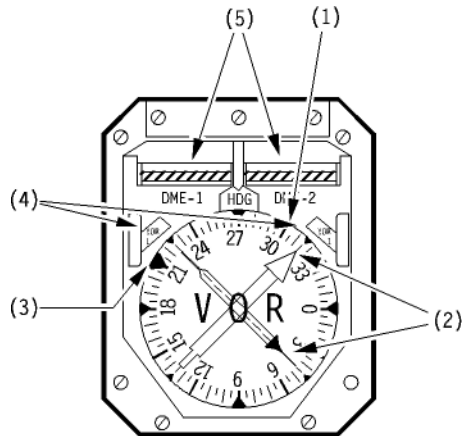
- The desired VOR course can be selected by turning the knob. The selected course is displayed in the CRS window.
- Pressing this knob automatically changes the displayed VOR course to its reciprocal course.

(3) VOR/DME Frequency Selector Knob

- The desired VOR/DME frequency can be set.
 - The outer knob sets whole MHz,
 - The inner knob sets decimal MHz fractions.

(4) VOR/DME Frequency Window

- The selected VOR/DME frequency is displayed.
- When the VOR/NAV/ILS switch is in the NAV or ILS position, dashes are displayed in the window.

VOR/DME RMI

(1) Compass Rose

- The rotating compass rose, graduated in 5° increments, indicates the aircraft magnetic heading.
- Heading information is provided :
 - for the Captain's RMI, by the IRS 1 (IRS 3 if Captain has pressed ATT/HDG pushbutton switch).
 - for the F/O's RMI, by the IRS 2 (IRS 3 if F/O has pressed ATT/HDG pushbutton switch).

(2) VOR 1 and 2 Pointers

- The thin dashed red pointer indicates magnetic bearing to VOR 1.
- The wide green pointer indicates magnetic bearing to VOR 2.
- When the VOR signal is not received, the associated pointer is set to the 3 o'clock position.
- If electrical supply is lost, or if the RMI fails internally, the pointer is frozen in the last position and the associated VOR flag appears - see (4).

(3) Selected Heading Index

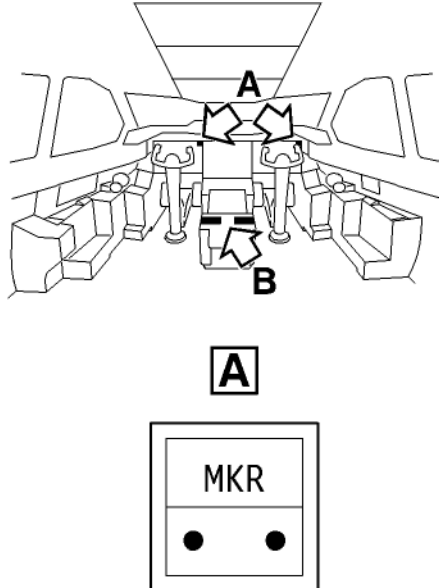
- This orange bug indicates the heading selected on the FCU HDG SEL window.
- In case of failure, the orange index is set to the 6 o'clock position.

(4) VOR 1 and 2 Flags

- An amber VOR 1 or VOR 2 flag appears in case of failure of the respective VOR.
- Both VOR flags also appear whenever the HDG flag appears (heading information lost).

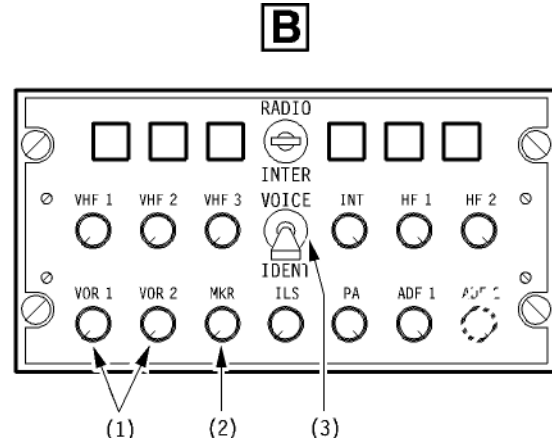
(5) DME 1 and DME 2 Counters

- The distance to the VOR/DME station tuned on VOR 1 or VOR 2 is displayed in the associated DME-1 or DME-2 window.
- If DME data is not available, white dashes appear in the window.
- In case of failure of the DME indication, an amber and white striped flag covers the affected window.

Navigation Systems
**VOR/Marker/DME Systems,
Controls and Indicators**
A. MARKER BEACON LIGHTS


- MRK lights on the Captain and F/O's instrument panels illuminate when signal reception indicates the overfly of an outer, middle or inner (or airway) marker beacon.
- Illumination of this light is accompanied by an audio signal :
 - Outer marker : a 400 Hz audio tone sounds,
 - Middle marker : a 1 300 Hz audio tone sounds,
 - Inner or Airway marker : a 3 000 Hz audio tone sounds.
- The MRK lights can be tested by pressing the light pushbutton.

Note: The MRK lights also illuminate when VOR 1 is tested from the maintenance panel.

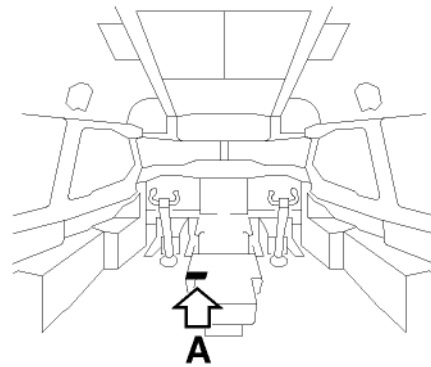
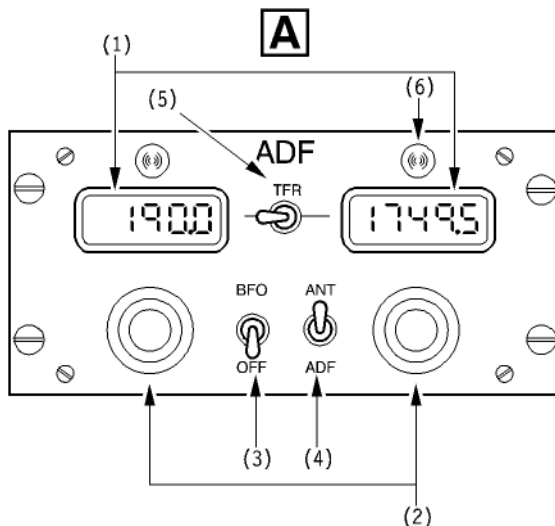
B. VOR/DME/MARKER AUDIO SELECTION


- (1) VOR/DME 1 and 2 Audio Reception Knob**
- (2) MARKER Audio Reception Knob**
- (3) VOICE/IDENT Switch**

Note: For more information regarding operation and use of the audio selector panel controls, refer to the chapter - COMMUNICATIONS.

ADF CONTROL PANELS

- NDB frequencies can be set on the ADF control panel.


(1) Frequency Windows

- The selected NDB frequencies are displayed in two windows.

(2) Frequency Selectors Knobs

- The frequency selector knobs consist of three parts:
 - The inner knob sets the decimals and units of kHz.
 - The middle knob sets the tens of KHz.
 - The outer knob sets the hundreds of KHz.

(3) BFO/OFF Switch

- **BFO**
 - Used to receive the audio signal for beacon identification.
- **OFF**
 - The BFO is de-activated.

(4) ANT/ADF Switch

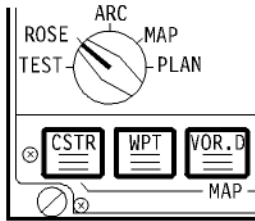
- **ANT**
 - Used if only reception of audio without direction finding.
- **ADF**
 - Normal operation.

(5) TRF Switch

- Allows to switch-over from the selected NDB 1 (2) to the selected NDB 2 (1).

(6) Transfer Lights

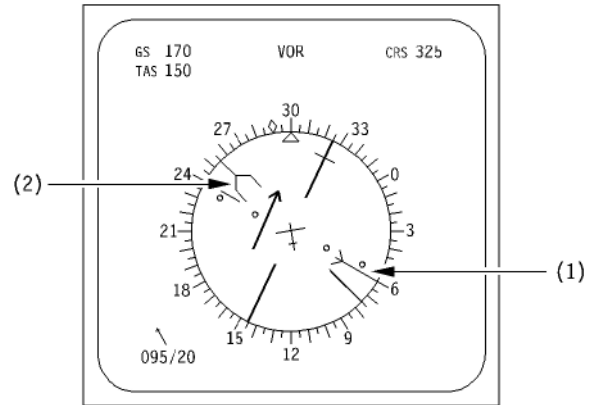
- Illuminates to indicate the selected frequency used to tune the ADF receiver.

ND MODE SELECTOR


- To display ADF information on the ND, the selector must be in the ROSE position.
- This selector is located on the primary EFIS control panel.

ADF INDICATIONS ON ND

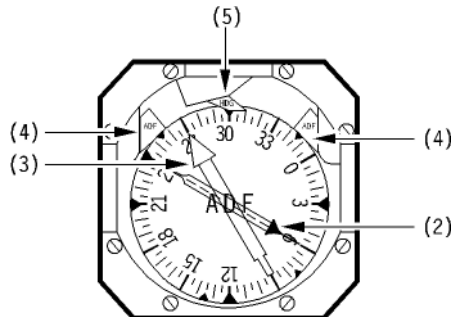
- In ROSE mode, the following ADF information is displayed on the associated ND:



(1) ADF 1 Bearing

(2) ADF 2 Bearing

Note: For more information on the display of the ADF bearing on the ND in ROSE mode, refer to section - NAVIGATION DISPLAY - ROSE MODE.

Navigation Systems
**ADF System,
Controls and Indicators**
ADF RMI


- The Captain and first officer's RMI are identical.

(1) Compass Rose

- The rotating compass rose, graduated in 5° increments, indicates the aircraft magnetic heading.
- Heading information is provided:
 - For the Captain's ADF RMI, by the IRS that is supplying the first officer's ND and VOR RMI (usually IRS 2).
 - For the first officer's ADF RMI, by the IRS that is supplying the Captain's ND and VOR RMI (usually IRS 1).

(2, 3) ADF Pointers

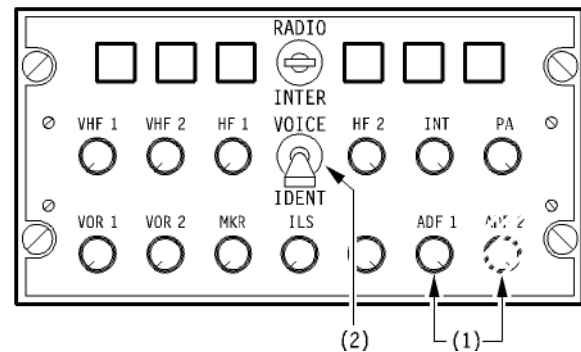
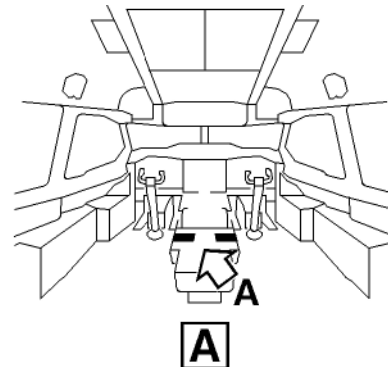
- The thin dashed pointer (2) is active when the TRF switch is on the left hand position.
- The wide pointer (3) is active when the TRF switch is on the right hand position.
- The unused pointer is set to the 3 o'clock position.

(4) ADF 1 Flag

- A red ADF 1 flag appears in case of failure of the ADF.

(5) HDG Flag

- The red HDG flag is displayed when :
 - IRS heading information is lost, or
 - RMI power supply is lost, or
 - RMI heading indication fails.

ADF AUDIO SELECTION

(1) ADF 1 and ADF 2 Audio Reception Knobs
(2) VOICE/IDENT Switch

Note: For more information regarding the operation and use of the audio selector panel controls, refer to the chapter COMMUNICATIONS.