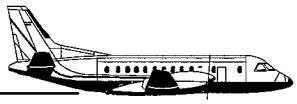
ADC	Air Data Computer
ADF	Automatic Direction Finder
ADI	Attitude Director Indicator
ADS	Air Data System
AHC	Attitude Heading Computer
AHRS	Attitude Heading Reference System
AIL	Aileron
ANG	Angular
ANT	Antenna
AP	AutoPilot
APA	Altitude Preselect/Alerter
APP	Autopilote Panel
APPR	Approach
ATC	Air Traffic Control
ATT	Attitude
B/C	Back Course
BFO	Beate Frequency Oscillator
BRG	Bearing
CDU	Control Display Unit
CHAN	Channel
CHP	Course Heading Panel
CLR	Clear
CRS	Course
CRT	Cathode Ray Tubes
CRU	Computer Receiver Unit
CVR	Cockpit Voice Recorder
CW	Continuous Wave
CWP	Central Warning Panel
D	Distance
DCP	Display Control Panel
DEV	Deviation
DFDR	Digital Flight Data Recorder
DH	Decision Height
DME	Distance Measuring Equipment
DPU	Display Processor Unit
DR	Dead Reckoning
DTA	Data
EADI	Electronic Attitude Director Indicator
EFIS	Electronic Flight Instrument System
EHSI	Electronic Horizontal Situation Indic.
EL	Elevator
EMG	Emergency
ET	Elapsed Time
FCC	Flight Control Computer
FD	Flight Director
FD/AP	Flight Director/Autopilot
FDAU	Flight Data Aquisition Unit
FDEP	Flight Data Entry Panel
FGAS	Flight Guidance & Autopilot System
FL	Flight Level
FMS	Flight Management System
FPL	Flight Plan
FRQ	Frequency
GA	Go Around
GMT	Greenwich Mean Time
GPWS	Ground Proximity Warning System
GS	GlideSlope
GSP	Ground Speed
HDG	Heading
HSI	Horizontal Situation Indicator
IAS	Indicated Airspeed
ILS	Instrument Landing System
INT	Intensity
LRN	Long Range Navigation
LOC	Localizer
M	Inner Marker
MEM	Memory
MFD	Multifunction Display
MM	Middle Marker
MPU	Multifunction Processor Unit
MSG	Message
NAV	Navigation
NORM	Normal
OBS	Omni Bearing Selector
OM	Outer Marker
PAC	Path Attenuation Correction
PGE	Page
PWR	Power
RA	Radio Altimeter
RA TST	Radio Altimeter Test
RCL	Recall
RDR	Radar
REU	Remote Electronic Unit
RMI	Radio Magnetic Indicator
RMT	Remote
RNAV	Area Nav System
RR	Radar Mode
RTU	Radio Tune Unit
RUD	Rudder



SAT	Static Air Temperature
SKP	Skip
SNS	Sensor
SPD	Speed
STB	Stabilization
STC	Sensitivity Time Control
STIM	Stimulus test mode
TAS	True Airspeed
TGT	Target
TK	Track
TTG	Time To Go
VLF	Very Low Frequency
VNAV	Vertical Navigation
VNI	Vertical Navigation Indicator
VOR	Very High Frequency Omnidirectional Radio Range
VS	Vertical Speed
WPT	Waypoint
WRN	Warning
WX	Weather Radar
WXP	Weather Radar Panel
XATT	Crosside Attitude
XDTA	Crosside Data
XFR	Transfer
XHDG	Crosside Heading
XSIDE	Crosside
XTRACK	Cross Track
YD	Yaw Damper

0. MODIFICATION STANDARD.

The system in this chapter assumes a certain modification standard of the aircraft. If a modification is not installed, the following apply as complement to what is stated in this chapter.

DESCRIPTION/OPERATION.

0.1 EFIS update.

Without Mod. 1989 embodied: Mod 1989; EFIS update.

- The Flight Director comparator caution will not come on if comparator error detected.

- The following EHSI flags will show red dashes in case of system failure instead of blanks:

  SAT
  TAS
  TTG
  GSP
  D

1. GENERAL.

The Electronic Flight Instrument System, EFIS, is as the name implies a system that uses cathode ray tubes (CRT) for displaying such flight- and navigation data normally found on the Attitude Director Indicator, ADI, and the Horizontal Situation Indicator, HSI. Consequently, the corresponding electronic display tubes are called EADI (E=Electronic) and EHSI.

Type of display information is selected via the Display Control Panel (DCP). The DCP controls a computer, the Display Processor Unit (DPU) which executes the orders by generating the necessary signals to display the required information.

There are two such systems installed and they are interconnected with a crosstalk channel in order to provide transfer of data from one side to the other in case of one side data failure (XSIDE DATA).

Each DPU can also take over the display of the opposite side if the opposite side DPU fails (DRIVE XFR).

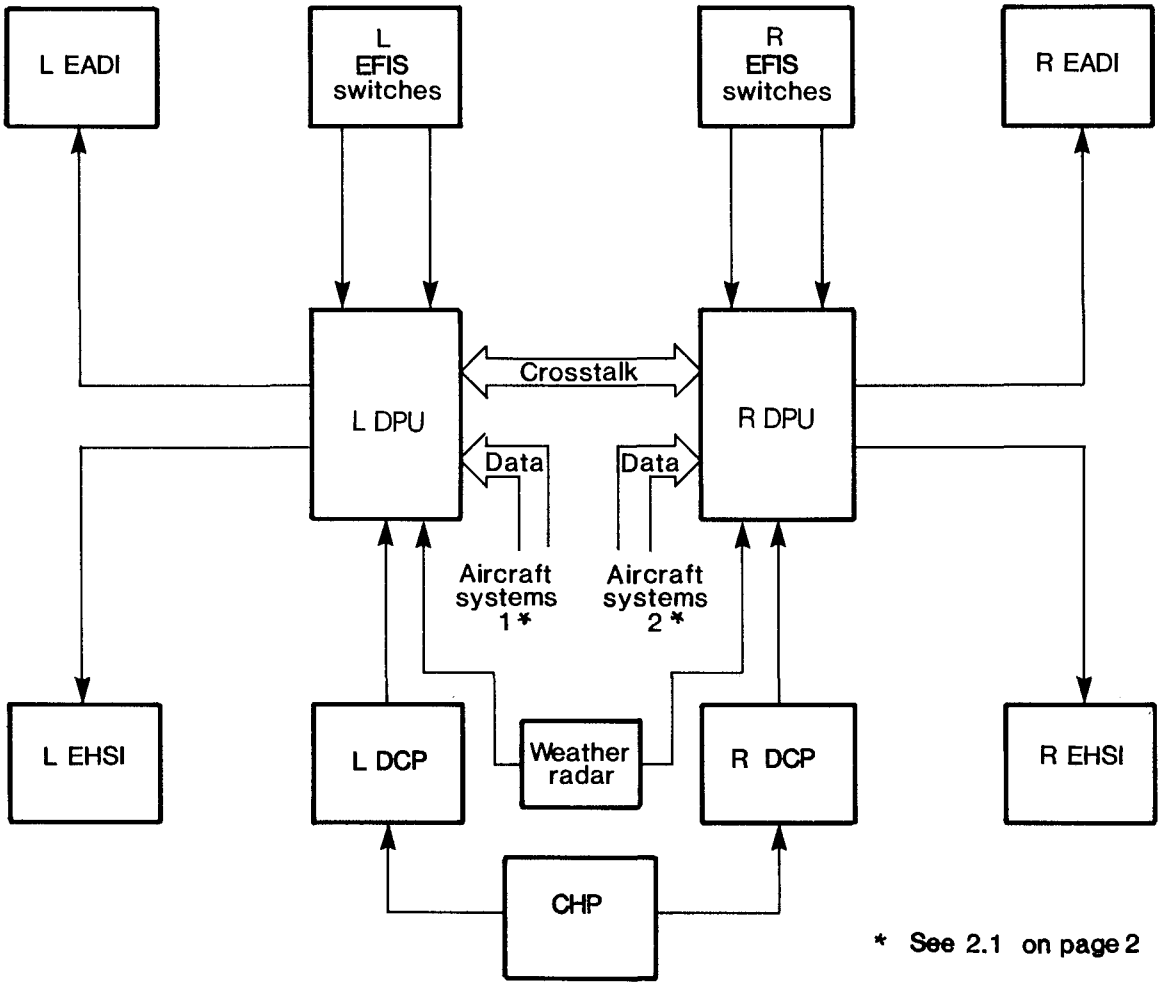


Fig. 1. EFIS - Schematic.

2. MAIN COMPONENTS AND SUBSYSTEMS.

2.1. Display Processor Unit, DPU.

The DPU receives data from the digital data busses as well as from the analogue data busses. It selects data required for the displays and transfers them to an output circuitry that generates right type of alfanumerical text, symbols and color combination needed for the display.

The following systems interface with the DPU by digital/analogue busses for display of their information.

- Radio altimeter - Radio height, DH.
- Air data computer -------- Airspeed, altitude, TAS, SAT.
- VOR/ILS/MB ------ VOR/LOC/GS deviations VOR course. Marker Beacon.
- DME ------------ Distance, Ground Speed, Time To Go.
- ADF ------------ ADF bearings.
- AHRS ----------- Pitch- and roll attitudes, magnetic heading.
- FD/AP ---------- Mode annunciation, FD command bar.
- Weather radar --- Radar display.
* - RNAV ---------- Distance, Ground Speed, Time To Go and Lateral deviation.
* - VNAV ---------- Vertical deviation.

2.2. Flight displays, EADI, EHSI.

The Flight display instruments are cathode ray tubes, CRT. They have three electronic guns, one for each basic color, red-blue-green, which, when combined, give the desired color and display symbols.

* OPTION

2.3. Display Control Panel, DCP.

The two panels, one for each side are used to select and control the information displayed on the EADI and EHSI.

2.4. Course Heading Panel, CHP.

The Course Heading Panel is used to select desired heading and also to set selected course (CRS 1 and CRS 2), displayed on EHSI.

2.5. EFIS switches.

There are two EFIS switches on each EFIS panel (Overhead panel). These switches are used in case of system failure. The displayed information on the EADI and EHSI can be switched to one of either (EADI or EHSI) as composite mode information if any EADI/EHSI should fail (ADI REV/HSI REV). They can also transfer oposite side data to onside if onside data should fail (XSIDE DATA). If the drive signals (DPU) for the EADI/EHSI fails on one side, the oposite side DPU can provide drive signals (DRIVE XFR) for the failed side. The left side switches are used to preserve displays on left side EADI/EHSI and vice versa.

NOTE: Comparator caution is inhibited when DRIVE XFR is selected. Pitch, roll and heading comparator caution is inhibited when XSIDE DATA is selected.

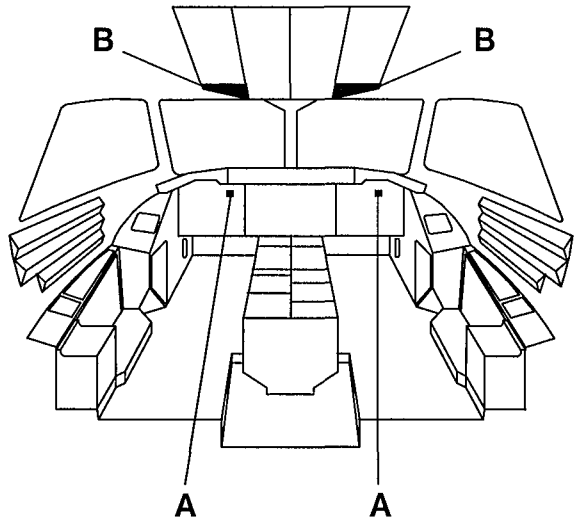
2.6. Nav source selection pushbuttons.

Two pushbuttons, NAV S L and NAV S R, are located on the glareshield panel. They are used to select left or right nav source for the FD/AP, displayed on EADI (FD command barand modes).

2.7. EFIS test panel.

Two switches (EFIS 1 and 2) located on the overhead panel (TEST 2 panel) are used to test various functions on EFIS.

3. CONTROLS AND INDICATORS.

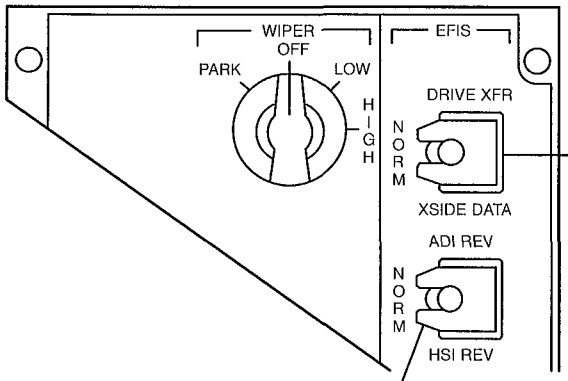


A DRIVE TRANSFER LIGHT

DRIVE XFR light (amber).

Comes on when EFIS switch on associated side is in DRIVE XFR position.

B EFIS SWITCHES



DRVE XFR/NORM/XSIDE DATA switch.

DRIVE XFR – Used if the video signals from own DPU fails (EADI and EHSI goes blank). Video signals are then provided from opposite DPU so pictures on both sides EADI and EHSI will be the same.
– DRIVE XFR light on associated side comes on.
– DCP inoperative on failed side except for brightness control.

NORM – Normal operation.

XSIDE DATA – Used if attitude and/or heading data fails.
– Data from opposite side are then displayed.
– Both sides EADI and EHSI will thus be supplied with the same attitude and heading information.
– Switched side will display XATT and XHDG in yellow on EFIS.
– DCP functions as normal.

NOTE
If switching directly from DRIVE XFR to XSIDE DATA, initialization will take 10–15 s before full information is displayed.

ADI REV/NORM/HSI REV switch.

ADI REV – Used if the EHSI has failed.
–The EHSI display is then transferred to the EADI and changed to composite format.

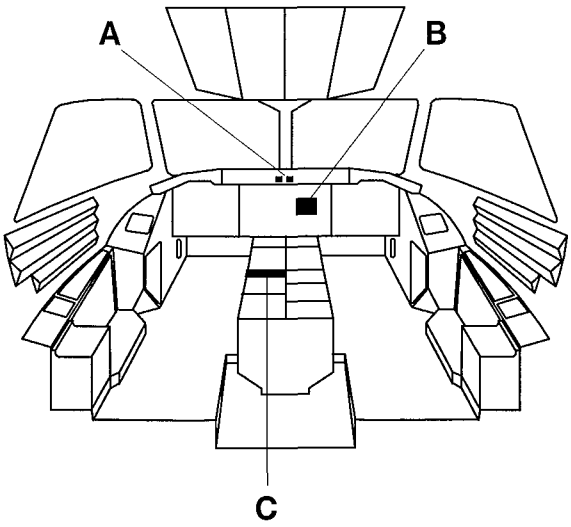
NORM –Normal operation.

HSI REV – Used if the EADI has failed.
–The EADI display is then transferred to the EHSI and changed to composite format.

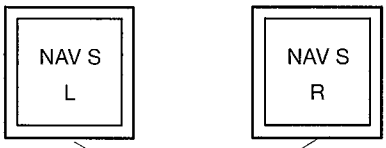
Set switch towards operating display.

A27880

Fig. 2. EFIS switches (left side shown) – controls and lights.

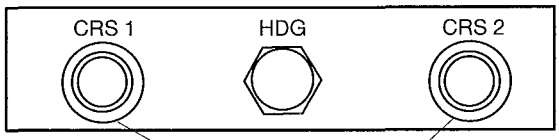


A NAV SOURC SELECTION PUSHBUTTONS



NAV SOURCE SELECTOR Pushbuttons.
–The NAV S Left respective Right pushbuttons are used to couple left or right navigation source to the FD/AP.
–Pushbutton illuminates in green when selected.

C COURSE HEADING PANEL



Course selector.
Selected course indicated on EHSI.

B CENTRAL WARNING PANEL

L FIRE DET FAIL	FUEL ↑	ELEC ↑	R FIRE DET FAIL
ICE PROT ↑	ENGINE ↑	FLAPS	AIRCOND ↑
PARK BRK ON	HYDR ↓	EMER LTS UNARMED	OXYGEN
A–SKID INOP ↓	AVIONICS	AVIONICS VENT	DOORS ↑
L STALL FAIL	GUST LOCK	PUSHER SYSTEM	R STALL FAIL

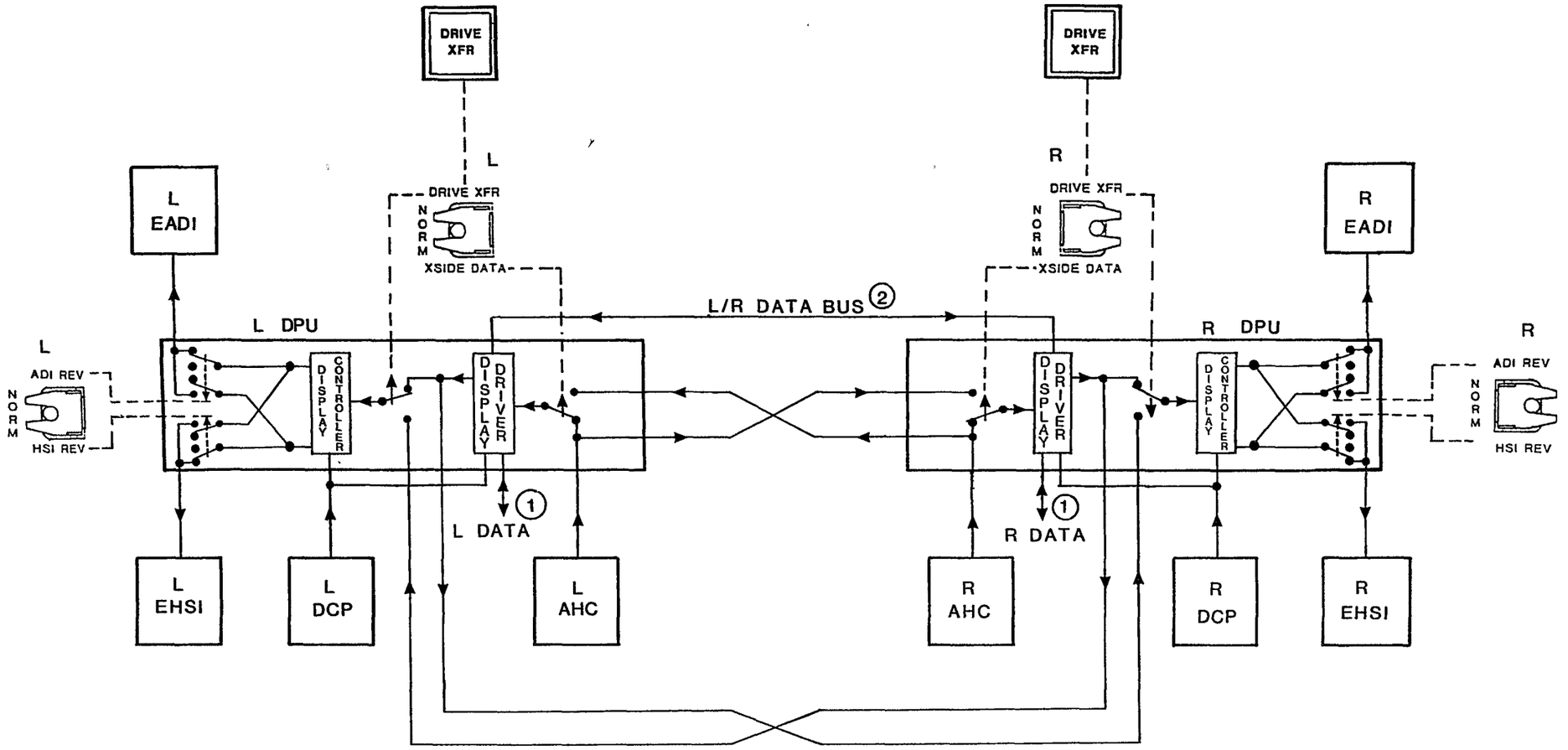
AVIONICS caution light.
Comes on flashing when EFIS comparator caution is triggered or when either EFIS test switch is actuated. Reverts to steady when MASTER CAUTION is reset.

Goes out when difference between the systems is reduced to be within limit.

NOTE: All comparator cautions are inhibited when either EFIS switch is in DRIVE XFR position. Pitch, Roll and Heading comparator caution is inhibited when either EFIS switch is in XSIDE DATA.

A27883

Fig. 3. NAV source pushbuttons, Central Warning Panel and CHP – lights and controls.



① DATA: Airspeed, FD/AP, Navigation, Radar, Radio alt.

② L/R DATA BUS: Communication between LH and RH side with FD/AP Navigation and system data.

NOTE: Switches and relays in NORM position.

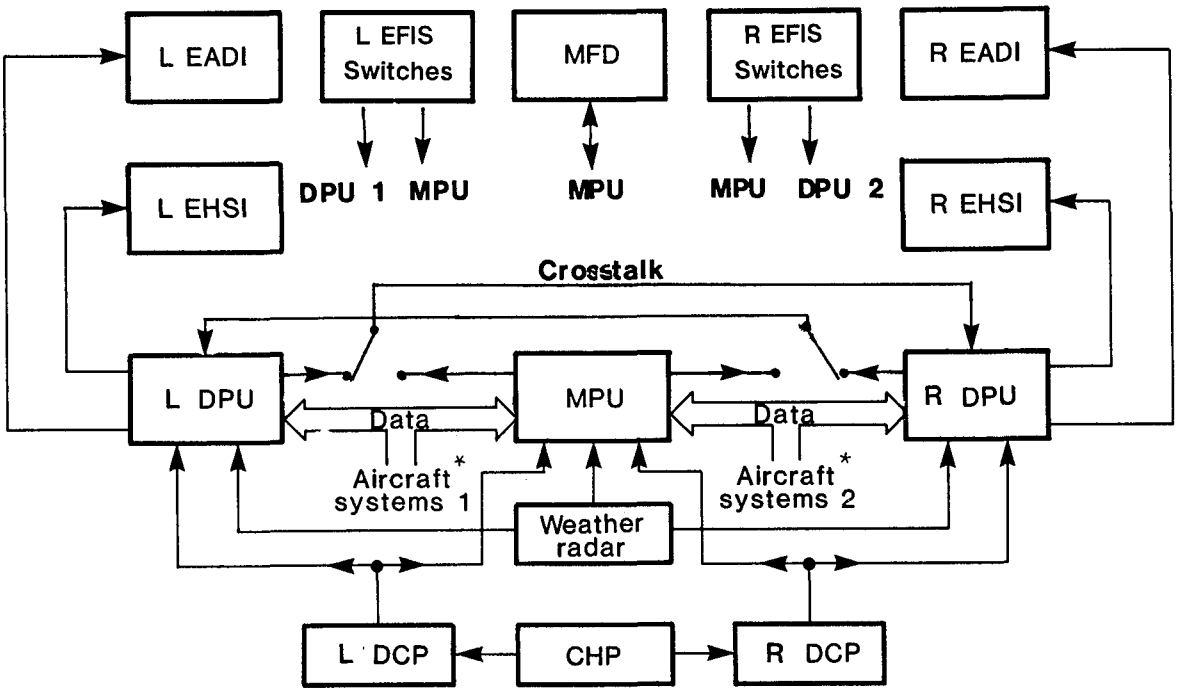
Fig. 4. EFIS switches - schematic.

1. GENERAL.

The Electronic Flight Instrument System, EFIS, is as the name implies a system that uses cathode ray tubes (CRT) for displaying such flight- and navigation data normally found on the Attitude Director Indicator (ADI) and the Horizontal Situation Indicator (HSI). Consequently, the corresponding electronic display tubes are called EADI (E=Electronic) and EHSI.

Type of display information is selected via the Display Control Panel (DCP). The DCP controls a computer, the Display Processor Unit (DPU) which executes the order by generating the necessary signals to display the required information.

There are two such systems installed and they are interconnected with a third similar system consisting of the Multifunction Display unit (MFD) with its own Multifunction Processor Unit (MPU). The MFD/MPU has crosstalk channels with both DPU and can serve as a standby for a failing DPU (DRIVE XFR). The system interconnect also provides transfer of data from one side to the other in case of one side data failure (XSIDE DATA).



* See 2.1 on page 2.

Fig. 1. EFIS with Multifunction Display, MFD - schematic.

2. MAIN COMPONENTS AND SUBSYSTEMS.

2.1. Display Processor Unit, DPU.

The DPU receives data from the digital data busses as well as from the analogue data busses. It selects data required for the displays and transfers them to an output circuitry that generates right type of alfanumerical text, symbols and color combinations needed for the selected displays.

The following systems interface with the DPU by digital/analogue busses for display of their information.

- Radio altimeter - Radio height, DH.
- Air data computer -------- Airspeed, altitude, TAS, SAT.
- VOR/ILS/MB ------ VOR/LOC/GS deviations VOR course. Marker Beacon.
- DME ------------ Distance, Ground Speed, Time To Go.
- ADF ------------ ADF bearings.
- AHRS ----------- Pitch- and roll attitudes, magnetic heading.
- FD/AP ---------- Mode annunciation, FD command bar.
- Weather radar --- Radar display.

* - RNAV ---------- Distance, Ground Speed, Time To Go and Lateral deviation.

* - VNAV ---------- Vertical deviation.

2.2. Flight displays, EADI, EHSI.

The Flight display instruments are cathode ray tubes (CRT). They have three electronic guns, one for each basic color, red-blue-green, which, when combined, give the desired color and display symbols.

* If installed.

2.3. Multifunction Processor Unit, MPU.

The MPU functions in the same way as the DPU described above and normally it furnishes only the Multifunction Display unit (MFD) with display data but can also be used as a spare for any DPU. In such a case it is switched in by the EFIS switches (DRIVE XFR).

2.4. Multifunction Display unit, MFD.

The technique to produce the picture is the same as for the EADI/EHSI. However, this display unit is provided with several switches and pushbuttons for control and selection of displayed information.

2.5. Display Control Panel, DCP.

The two panels, one for each side are used to select and control the information displayed on the EADI and EHSI.

2.6. Course Heading Panel, CHP.

The Course Heading Panel is used to select desired heading and also to set selected course (CRS 1 and CRS 2), displayed on EHSI.

2.7. EFIS switches.

There are two EFIS switches on each EFIS panel (Overhead panel). These switches are used in case of system failure. The displayed information on the EADI and EHSI can be switched to one of either (EADI or EHSI) as composite mode information if any EADI/EASI should fail (ADI REV/HSI REV). They can also transfer oposite side data to onside if onside data should fail (XSIDE DATA). If the drive signals (DPU) for the EADI/EHSI fails on any side, the MPU can provide drive signals (DRIVE XFR). The left side switches are used to preserve displays on left side EADI/EHSI and vice versa.

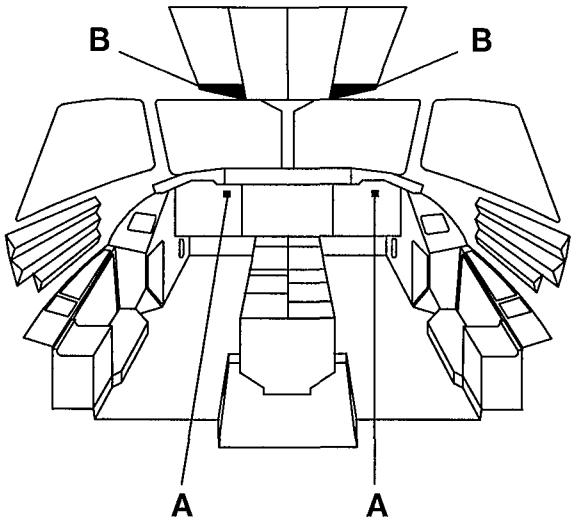
2.8. Nav source selection pushbuttons.

Two pushbuttons, NAV S L and NAV S R, are located on the glareshield panel. They are used to select left or right nav source for the FD/AP, displayed on EADI (FD command bar and modes).

2.9. EFIS test panel.

Two switches (EFIS 1 and 2) located on the overhead panel are used to test various functions on EFIS.

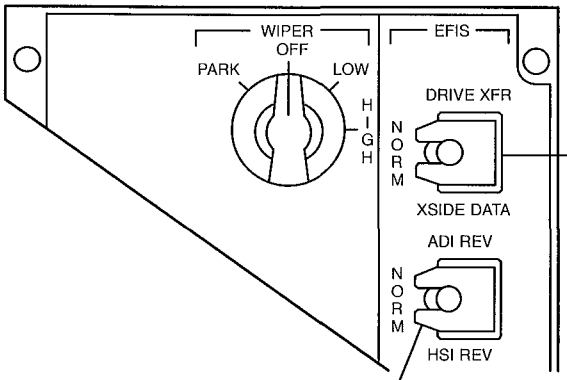
3. CONTROLS AND INDICATORS.



A DRIVE TRANSFER LIGHT

DRIVE XFR light (amber).
Comes on when EFIS switch on associated side is in DRIVE XFR position.

B EFIS SWITCHES



DRVE XFR/NORM/XSIDE DATA switch.

DRIVE XFR – Used if the video signals from own DPU fails (EADI and EHSI goes blank). Video signals are then provided from the MFD, EADI pictures on both MFD and EHSI will be the same.
– DRIVE XFR light on associated side comes on.
– DCP functions as normal

NORM – Normal operation.

XSIDE DATA – Used if attitude and/or heading data fails.
– Data from opposite side are then displayed.
– Both sides EADI, EHSI and MFD will thus be supplied with the same attitude and heading information.
– Switched side will display XATT and XHDG in yellow on the EADI/EHSI.
– DCP functions as normal.

NOTE
If switching directly from DRIVE XFR to XSIDE DATA, initialization will take10–15 s before full information is displayed.

ADI REV/NORM/HSI REV switch.

ADI REV –Used if the EHSI has failed.
–The EHSI display is then transferred to the EADI and changed to composite format.

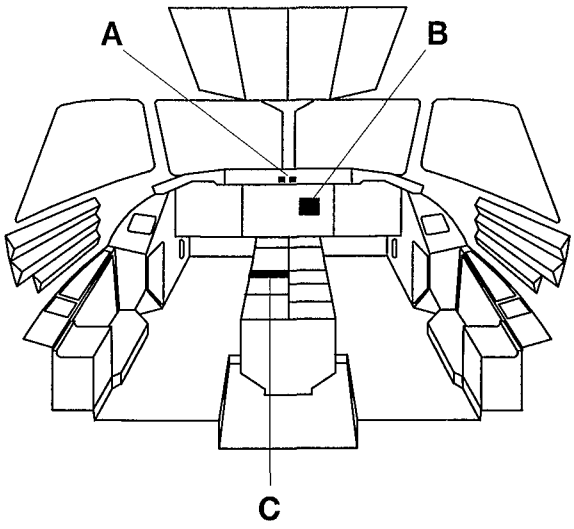
NORM –Normal operation.

HSI REV –Used if the EADI has failed.
–The EADI display is then transferred to the EHSI and changed to composite format.

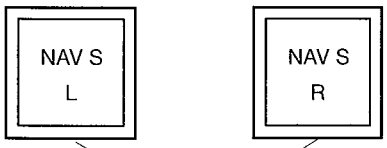
Set switch towards operating display.

A27886

Fig. 2. EFIS switches (left side shown) – controls and lights.

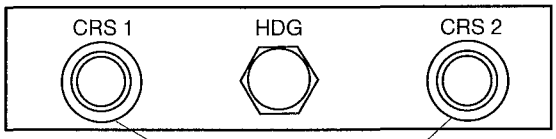


A NAV SOURC SELECTION PUSHBUTTONS



NAV SOURCE SELECTOR Pushbuttons.
–The NAV S Left respective Right pushbuttons are used to couple left or right navigation source to the FD/AP.
–Pushbutton illuminates in green when selected.

C COURSE HEADING PANEL



Course selector.
Selected course indicated on EHSI.

B CENTRAL WARNING PANEL

L FIRE DET FAIL	FUEL ↑	ELEC ↑	R FIRE DET FAIL
ICE PROT ↑	ENGINE ↑	FLAPS	AIRCOND ↑
PARK BRK ON	HYDR ↓	EMER LTS UNARMED	OXYGEN
A–SKID INOP ↓	AVIONICS	AVIONICS VENT	DOORS ↑
L STALL FAIL	GUST LOCK	PUSHER SYSTEM	R STALL FAIL

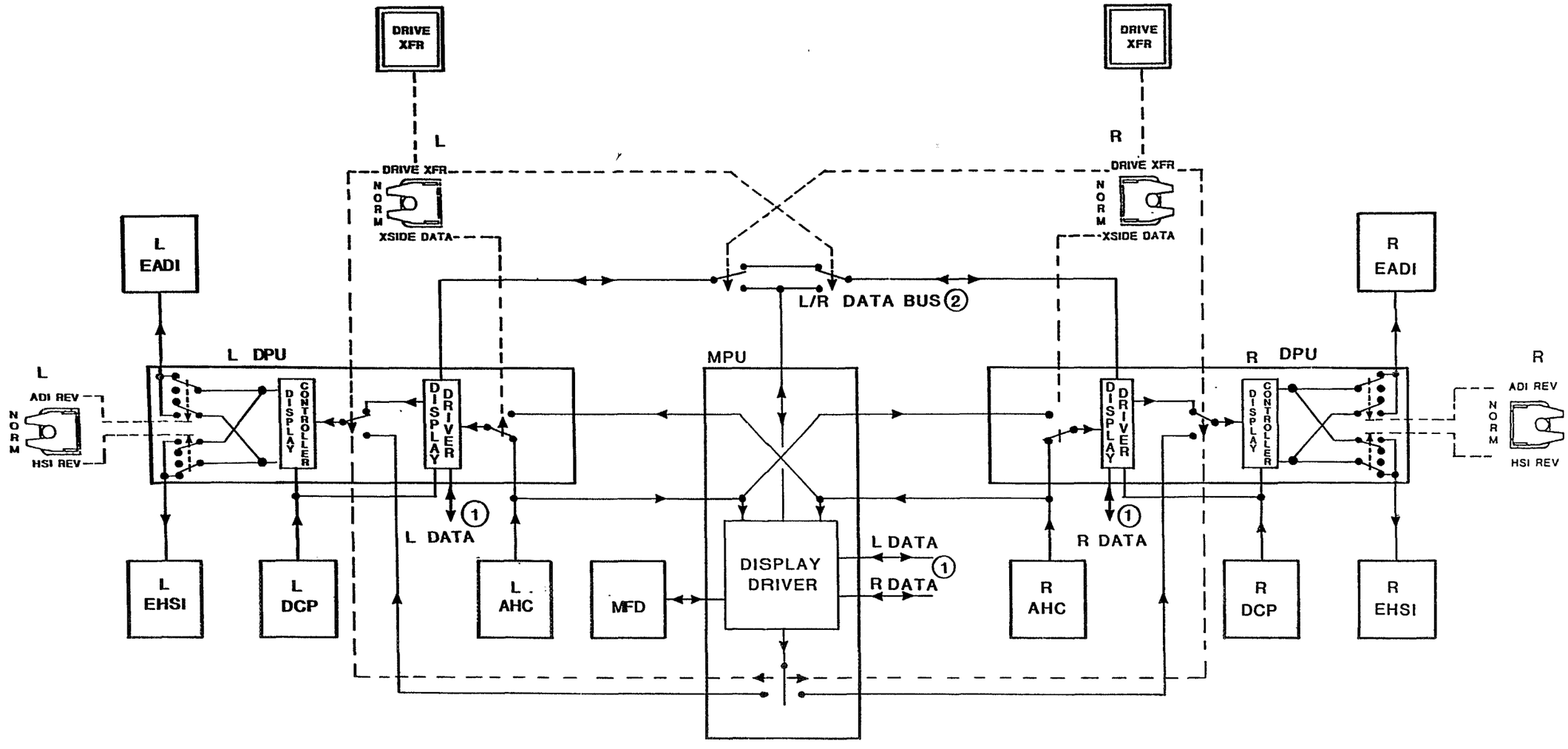
AVIONICS caution light.
Comes on flashing when EFIS comparator caution is triggered or when either EFIS test switch is actuated. Reverts to steady when MASTER CAUTION is reset.

Goes out when difference between the systems is reduced to be within limit.

NOTE: Pitch, Roll and Heading comparator caution is inhibited when either EFIS switch is in XSIDE DATA position.

A27888

FIG. 3. NAV source pushbuttons, Central Warning Panel and CHP – lights and controls.

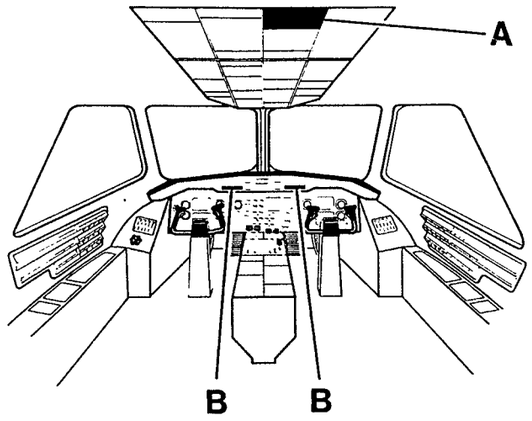


(1) DATA: Airspeed, FD/AP, Navigation, Radar, Radio alt.

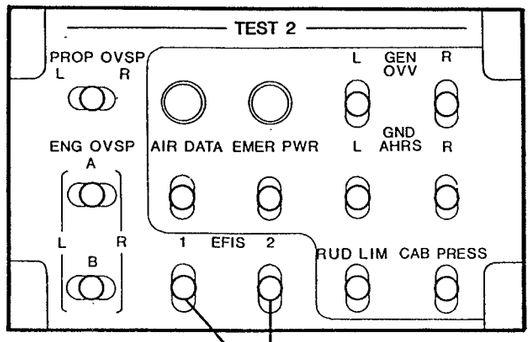
(2) LH/RH DATA BUS: Communication between LH and RH side with FD/AP, Navigation and system data.

NOTE: Switches and relays in NORM position.

Fig. 4. EFIS switches - schematic.



A EFIS TEST



EFIS test switches.
When pressed and held:
- "TEST" is displayed on the correlated EADI/EHSI.
- AVIONICS light on CWP and MASTER CAUTION comes on.
- Fixed offsets are displayed for pitch, roll and heading on EADI/EHSI.
- Comparator warnings are displayed the first 4 seconds.
- Red flags will be displayed when switch is held 4 seconds or more.

Reset is performed by releasing the test switch.

DH (Decision Height) knob.
Knob out:
- DH readout is blanked when above 2500 RALT.
- Not possible to set DH.

Knob in:
- DH readout displayed.
- DH is set by rotating the knob. Range 0-999 ft.

RA TST (Radio Altimeter Test) pushbutton.
When momentarily pressed and held:
- Radio height 50 ft on EADI.
- Flashing DH annunciation in yellow on EADI.
- DH light comes on steady.

The RA test is inhibited when:
- FD/AP engaged in NAV or APPR mode.
- EADI/EHSI in test mode.

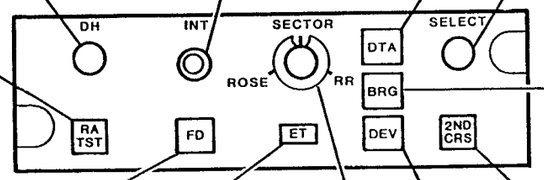
FD (Flight Director) pushbutton.
- When momentarily pushed the FD command bars are removed from the EADI.
- Next push restores the command bars.
- With FD/AP in approach mode the bars can not be removed.

Ref. AOM 3.1.

ET (Elapsed Time) pushbutton.
Controls elapsed time displayed on the EHSI.
- First push starts the chronometer.
- Second push stops the chronometer and displays elapsed time as long as the button is pushed.
- The chronometer is reset when the button is released.

B DISPLAY CONTROL PANEL

INT (Intensity) control knobs.
Small knob controls the brightness of the EADI display.
Large knob controls the brightness of the EHSI display.



Mode Selector
Selects different types of compass presentation on EHSI.
ROSE - 360° compass rose is displayed.
SECTOR - A compass sector of 80° is displayed. There are 6 sector positions corresponding to the ranges 5, 25, 100, 200, 300 and 600 NM. The range circle shows half distance of selected range.
RR - A compass sector of 80° with weather radar presentation. The range circle is controlled from the radar panel.

De-clutter pushbutton.
DTA (Data).
- When pushed GSP, TTG, TAS crosside DME and NAV data are removed from the EHSI.
- Next push restores data.

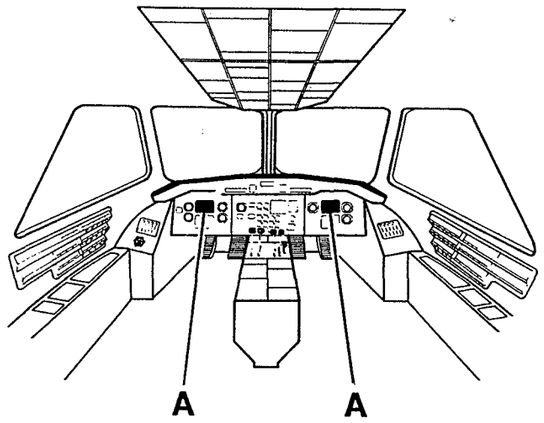
SELECT switch (RNAV selector).
The multiposition rotary switch is used to select between VOR/ILS and RNAV as navigation source, to be displayed on the EHSI:s. When turned left or right, each step gives VOR/ILS - LRN 1 - VOR/ILS - LRN 1....and on. Only the switch on the LH DCP and if RNAV is installed. Not used and no effect if operated in aircrafts without RNAV.

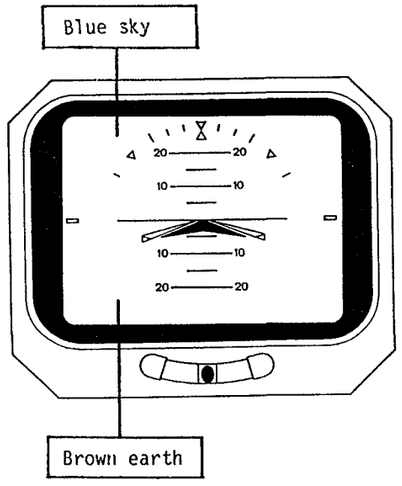
ADF pushbutton.
BRG (Bearing)
- When pushed ADF bearing pointer is removed from the EHSI.
- Next push restores the pointer.

2ND CRS (Second Course) pushbutton.
When selected, the opposite side selected course pointer comes up on own EHSI as a dashed pointer.
- 2ND CRS on LH DCP, LH EHSI displays: NAV 2 dashed course pointer in green.
- 2ND CRS on RH DCP, RH EHSI displays: NAV 1 dashed course pointer in cyan.

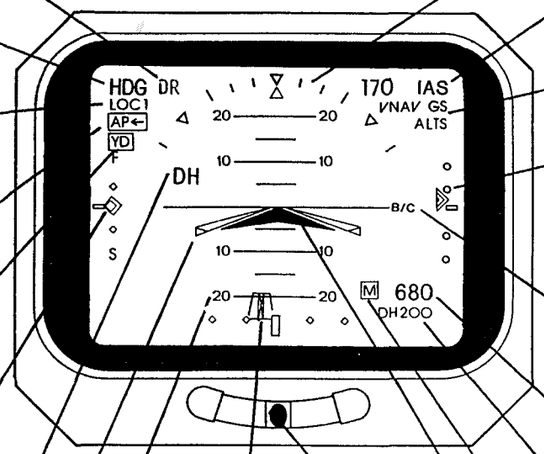
MAP mode pushbutton.
DEV, Deviation - MAP mode.
When in SECTOR or RR mode and:
- Pushed, VOR deviation indication displayed on EADI and map mode presentation displayed on EHSI comes on.
- Next push restores the standard VOR course pointer on EHSI and the VOR deviation indication on EADI goes out.

Fig. 5. Display Control Panel, DCP, and EFIS test switches - controls.





A EADI NORMAL DISPLAY



DR; Dead Reckoning in NAV mode only. When overflying a VOR-station (cone of confusion) FD/AP will hold present heading. This is annunciated with a yellow DR.

FD/AP captured lateral mode annunciator in green. At capture, flashes for 5 s then steady. AOM 3.1.

FD/AP armed lateral mode annunciator in white. AOM 3.1.

AP, AutoPilot engage/disengage annunciator in white. Green when AP engaged, red and flashing at AP disengagement. AOM 3.1.

YD, Yaw Damper annunciator in yellow. Comes on at YD disengagement. AOM 3.1.

Fast-slow speed indication. Moving diamond shaped pointer in green, index in white. 1 dot = 5 kts, Fast or Slow index = 10 kts. If speed source fails, pointer turns red, flashes for 10 s then steady. (Option). AOM 1.3 and AOM 12/1.1.

DH annunciatior in yellow. Comes on when radio height < selected Decision Height. Flashes for 10 s then steady. Goes off below 5 feet RALT. AOM 15/7.1.

FD, Flight Director command bar in magenta. FD bar disappears when FD failures occurs. AOM 3.I.

Pitch attitude scale in white. AOM 15/8.1.

Localizer deviation. Moving runway symbol in cyan for LH, green for RH. Index in white. If system fails or no LOC reception, runway symbol turns to red flag, flashes for 10 s then steady. Excessive deviation is indicated by pointer flashing between yellow and normal color. AOM 15/3.1.

Roll attitude scale in white. AOM 15/8.1.

FD/AP captured vertical mode annunciation in green. AOM 3.1.

FD/AP armed vertical mode annunciation in white. AOM 3.1.

Glideslope deviation. Moving GS pointer in cyan for LH, green for RH. Index in white. If system fails or no GS reception, pointer turns to red flag, flashes for 10 s then steady. Excessive deviation is indicated by pointer flashing between yellow and normal color. AOM 3.1.

B/C, Back Course annunciator in yellow. Comes on and replaces GS pointer and GS scale in case of ILS back course. AOM 15/3.1.

Radio altitude in green. AOM 15/7.1.

Selected Decision Height in green. AOM 15/7.1.

Marker annunciation. M in white, MM in yellow and OM in cyan. AOM 15/3.1.

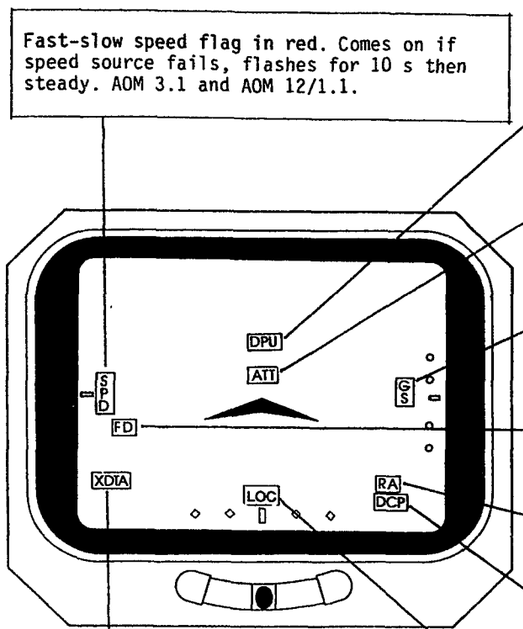
Aircraft symbol in black with white board.

Aircraft Slip/Skid indicator. Black ball with normal position index.

NOTE: LOC and GS displays are only in view when an ILS frequency selected.

Fig. 6. EADI normal display - symbols and colors.

EADI FLAGS AND WARNINGS



Fast-slow speed flag in red. Comes on if speed source fails, flashes for 10 s then steady. AOM 3.1 and AOM 12/1.1.

DPU warning in red. Comes on if Display Processor Unit fails, flashes for 10 s then steady.

Attitude warning in red. Comes on if AHRS attitude fails, flashes for 10 s then steady. AOM 15/8.1.

Glideslope flag in red. Comes on in case of glideslope failure or no station reception, flashes for 10 s then steady. AOM 15/3.1.

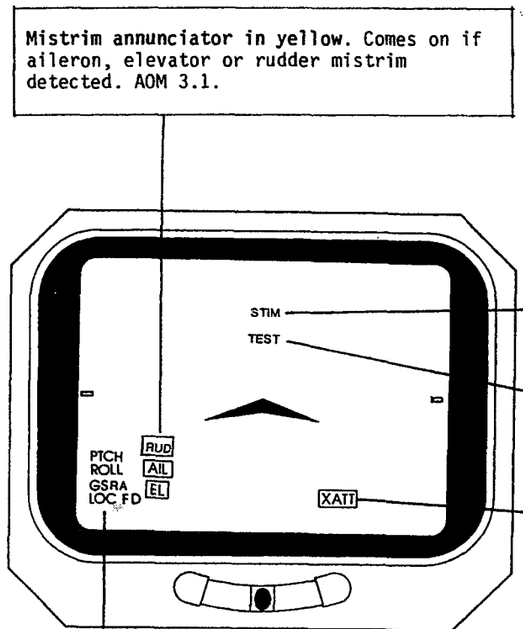
Flight Director flag in red. Comes on in case of flight director failures. Flashes for 10 s then steady. AOM 3.1.

Radio Altimeter flag in red. Comes on if radio altimeter fails, flashes for 10 s then steady. AOM 15/7.1.

DCP caution in yellow. Comes on if Display Control Panel fails, flashes for 10 s then steady.

XDATA, crosside data flag in red. Comes on if crosside data bus fails; opposite side's information not available, flashes for 10 s then steady.

Localizer flag in red. Comes on in case of localizer failure or no station reception, flashes for 10 s then steady. AOM 15/3.1.



Mistrim annunciator in yellow. Comes on if aileron, elevator or rudder mistrim detected. AOM 3.1.

STIM, AHRS in Stimulus Test, annunciator in red. On ground only AOM 15/8.1.

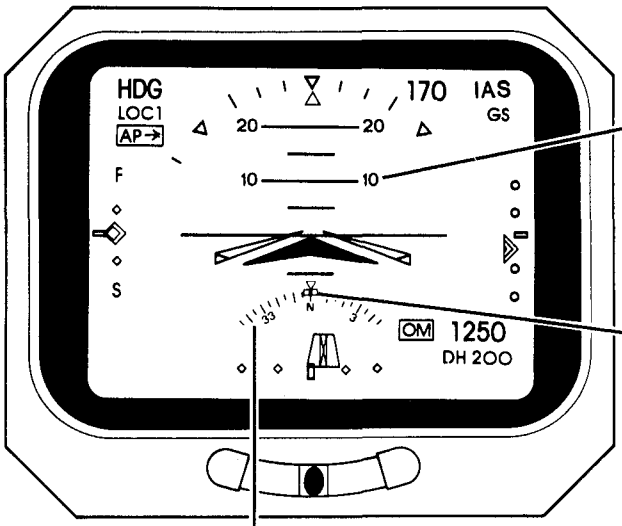
TEST annunciator in red. Comes on when corresponding EFIS test switch used.

XATT, crosside attitude annunciation in yellow, comes on when XSIDE DATA (switch) selected and data provided from opposite Attitude Heading Reference System. (AHRS).

Comparator caution in yellow. Comes on flashing if pitch, roll, glideslope, localizer, flight director or radio altimeter comparator error detected, reset by master caution detected AOM 3.1, 15/3.1, 15/7.1 and 15/8.1.

Fig. 7. EADI flags and warnings - symbols and colors.

EADI/EHSI COMPOSITE MODE



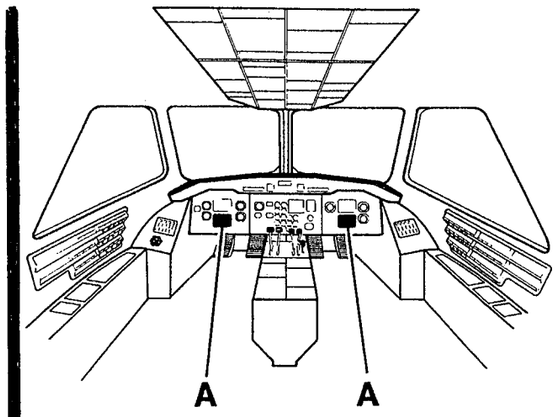
Pitch scale.
AOM 15/8.1.

Heading bug.
AOM 15/8.1.

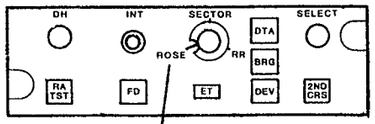
Compass sector.
± 40° of the compass rose is displayed.
AOM 15/8.1.

Fig. 8. EADI/EHSI composite format - symbols.

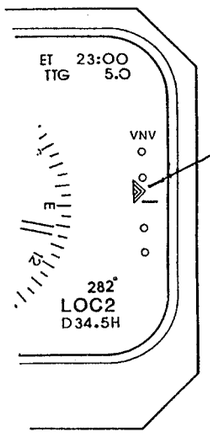
INTENTIONALLY LEFT BLANK



DCP



Mode selector in ROSE position.



Vertical NAV deviation scale. Moving vertical path pointer in cyan for LH and green for RH, scale in white. If system fails or becomes invalid, pointer turns to red flag, flashes for 10 s then steady. AOM 3.1 (Option)

Static air temperature in white. If system fails, readout disappears replaced by blanks. AOM 12/1.1.

True airspeed in white. If system fails, readout disappears replaced by blanks. AOM 12/1.1.

DME Ground Speed in cyan for LH and green for RH. Dashes in normal color if no readout displayed. If system fails, readout disappears replaced by blanks. AOM 15/4.1.

ADF relative bearing pointer in magenta. If system fails or no reception pointer parks in 3 o'clock position turns red, flashes for 10 s then steady. AOM 15/2.1.

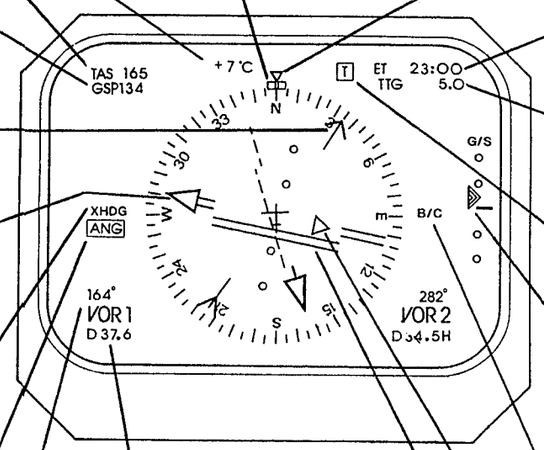
NAV, selected course pointer.
NAV1 - single pointer, NAV2 - double pointer.
LH side - NAV1 in cyan, NAV2 green and dashed pointer (2:nd course).
RH side - NAV2 in green, NAV1 cyan and dashed pointer (2:nd course).
Second course - 2ND CRS button on DCP.
AOM 15/3.1.

XHDG, crosside heading annunciation in yellow, comes on when XSIDE DATA selected and data provided from opposite Attitude Heading Computer (AHC).

ANG.
Angular means that the displayed deviation represents the angle between aircraft and selected radial for VOR/LOC.
LIN.
Linear means that the displayed deviation represents the distance (cross track) between aircraft and desired track, unaffected of distance to waypoint.
For RNAV if installed.

Navigation source flag with corresponding selected course. NAV1 in cyan, NAV2 in green. If system fails or no reception flag turns red, flashes for 10 s then steady. AOM 15/3.1.

A EHSI (R) NORMAL DISPLAY - ROSE MODE



Heading, bug in magenta. AOM 15/8.1

DME Distance (NM) in cyan for LH, green for RH. Dashes in normal color if no DME reception. If systems fails, readout disappears replaced by blanks. DME HOLD indicated by yellow D and H. AOM 1.15/4.

Magnetic heading index in white. AOM 15/8.1.

Elapsed time in white. Time in minutes and seconds, after 1 hour time in hours and minutes. Controlled by ET button on DCP. In case of failure, readout disappears replaced by blanks.

DME Time To Go in cyan for LH, green for RH. Dashes in normal color if no readout displayed. If system fails, readout disappears replaced by blanks. AOM 15/4.1.

Weather radar target alert annunciator in yellow. Comes on when Target alert selected. AOM 15/5.1.

Glideslope deviation. Moving GS pointer in cyan for LH, green for RH. Index in white. If system fails or no GS reception, pointer turns to red flag, flashes for 10 sec then steady. Excessive deviation is indicated by pointer flashing between yellow and normal color. AOM 15/3.1.

B/C, Back Course anunciator in yellow. Comes on and replaces GS pointer and GS scale in case of ILS back course. AOM 15/3.1.

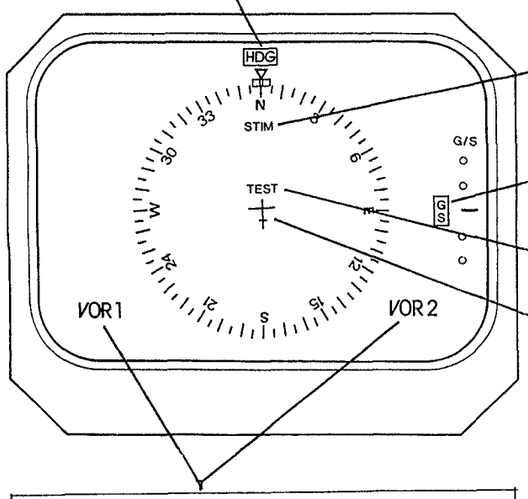
To-From indication. Disappears when NAV flagged. AOM 15/3.1. No To-From indication on second course pointer.

VOR/LOC deviation bar and scale. The bar disappears when NAV flagged. Excessive deviation is indicated by bar flashing between yellow and normal color. AOM 15/3.1.

NOTE: GS or VNAV display are only in view when selected.

Fig. 10. EHSI normal display (right side shown) - symbols and colors.

EHSI FLAGS AND WARNINGS



Heading warning and comparator caution.
Heading comparator caution in yellow, comes on flashing if heading disagreement appears between the two AHC. Steady yellow after reset by master caution button.
Heading warning in red, comes on if heading fails, flashes for 10 s then steady.
AOM 15/8.1.

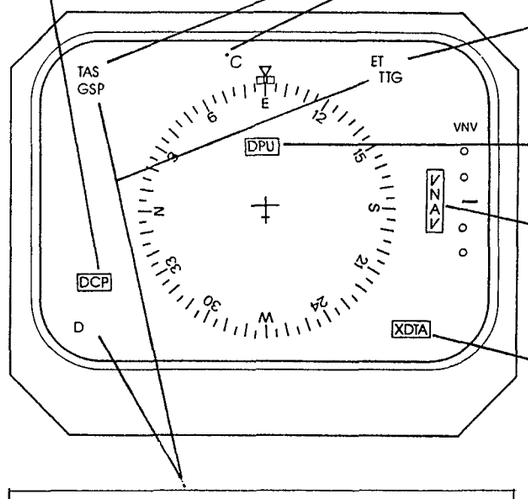
STIM, AHRS in Stimulus Test, annunciator in red. On ground only. AOM 15/8.1.

Glideslope flag in red, comes on in case of glideslope failure or no station reception, flashes for 10 s then steady. AOM 15/3.1.

TEST annunciator in red, comes on when corresponding EFIS test switch used.

Aircraft symbol in white.

Navigation source flag in red, comes on if NAV1 or NAV2 fails or no reception, flashes for 10 s then steady. AOM 15/3.1.



DCP caution in yellow.
Comes on if Display Control Panel fails, flashes for 10 s then steady.

SAT, static air temperature flag and TAS, true airspeed flag. If SAT/TAS fails, the readout disappears replaced by blanks.
AOM 12/1.1.

ET, Elapsed Time.
If timer fails, the readout disappears replaced by blanks.

DPU warning in red.
Comes on if Display Processor Unit fails, flashes for 10 s then steady.

VNAV flag in red.
Comes on if vertical NAV fails or becomes invalid, flashes for 10 s then steady.
AOM 3.1. (Option)

XDTA, crosside data flag in red.
Comes on if crosside data bus fails; opposite side's information not available, flashes for 10 s then steady.

DME flag.
If DME fails, the readouts disappear replaced by blanks. AOM 15/3.1.

NOTE: GS or VNAV display are only in view when selected.

Fig. 11. EHSI flags and warnings - symbols and colors.

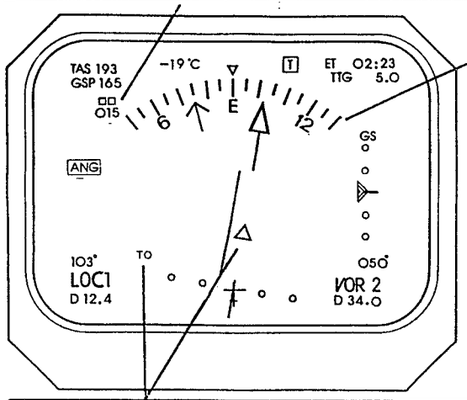
NORMAL SECTOR MODE

Heading bug, outside scale.
When selected heading is outside expanded scale the Heading bug and figures will be beside the scale.

Expanded compass rose in white. Will show ±40° from actual heading. AOM 15/8.1.

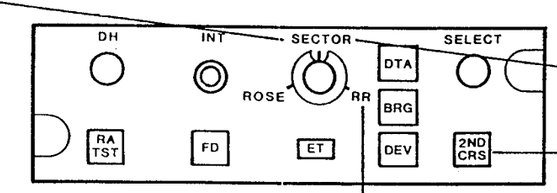
Mode selector in any of the six SECTOR positions.

In SECTOR mode with 2ND CRS selected, the range arc is a dashed white line. Distance in Nm shows half of selected range set by any of the six SECTOR positions 5, 25, 100, 200, 300 and 600 Nm.
In RADAR mode with 2ND CRS selected, the range arc is a solid cyan colored line.

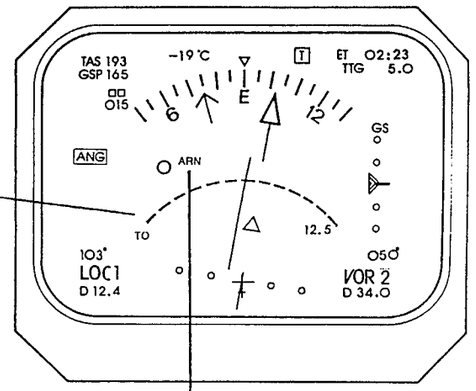


TO or FR (from) indication.
Disappears when NAV flagged. AOM 15/3.1.

DCP



SECTOR MODE WITH SECOND COURSE



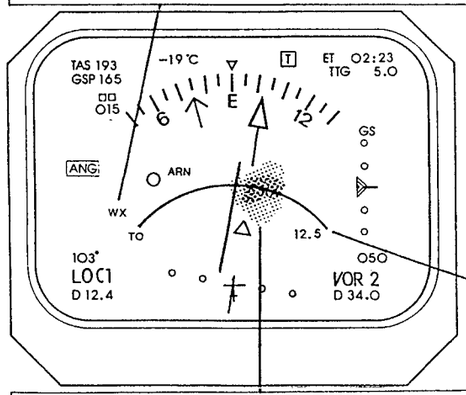
Momentarily press 2ND CRS, second course selected.

With 2ND CRS selected, the second NAV source will be displayed as an octagonal symbol together with the ident code if the NAV source is a VOR/DME and as a star symbol without ident code if the NAV source is an RNAV waypoint (if installed).
No display if the selected NAV source is only a VOR.

SECTOR MODE WITH WEATHER RADAR

Selected radar mode; MODE knob on weather radar panel. AOM 15/5.1.

Mode selector in RR position.



Radar echo display in cyan, green, yellow, red and magenta.
Colors depends on selected radar mode.
AOM 15/5.1.

Range arc in cyan when controlled by the wheather radar, RANGE knob on weather radar panel. Distance in NM indicates half of selected radar range. AOM 15/5.1.

Fig. 11. EHSI - sector mode (left side shown)

INTRODUCTION OF MAP MODE.

Compared with a standard VOR pointer with deviation bar, the MAP mode offers a visual presentation on the EHSI which can also include weather radar presentation.

The MAP mode displays the received VOR/DME stations distance and radial as an octagonal shaped symbol in RHO-THETA position (distance and radial) with respect to the aircrafts actual position.

The selected NAV/DME:s station ident code will be displayed next to the station symbol.

A courseline is drawn solid on the TO side of the VOR symbol and dashed on the FROM side.

The VOR deviation indication displayed on the EADI is similar to a standard VOR deviation bar i.e. full deviation scale equal to ± 10 degrees.

If RNAV Installed and displayed in MAP mode, the RNAV determinated waypoint will be presented as a star shaped symbol but without any ident code.

The RNAV waypoint symbol will also start to flash prior to waypoint passage.

By adding weather radar information to the MAP mode, the flight path may be planned with respect to current weather situation.

The MAP mode may also be used to visually set up a proper intercept point to next VOR.

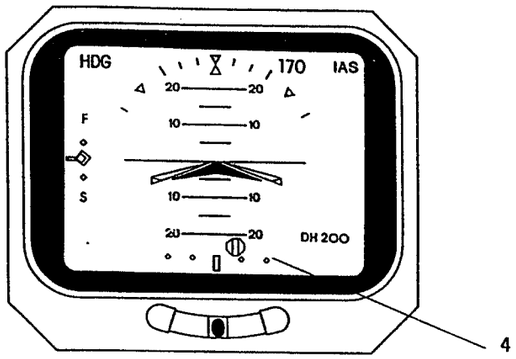
IMPORTANT. In MAP mode, the station symbol with courseline and ident code will not be displayed if:

a) Selected NAV source is only a VOR or only a DME station (both VOR and DME required).

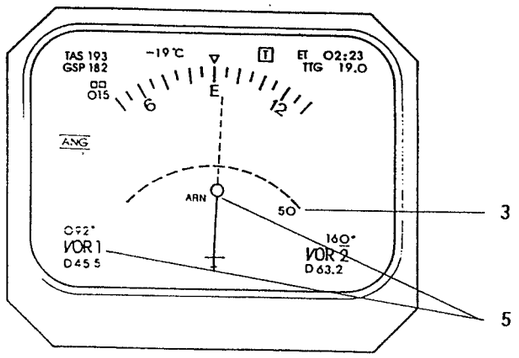
b) DME is set to DME HOLD.

INTENTIONALLY LEFT BLANK

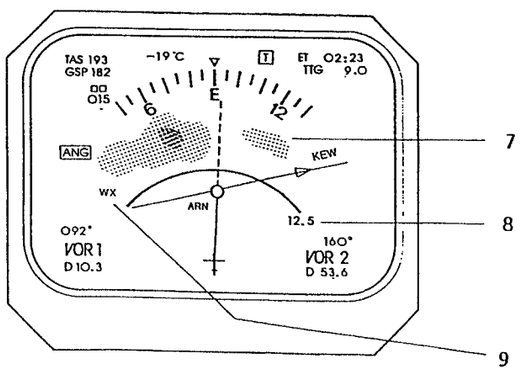
L SIDE
MAP MODE



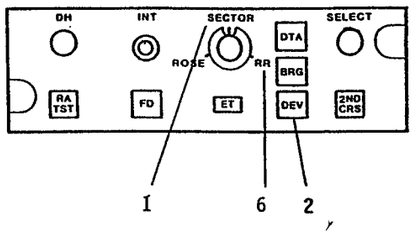
MAP MODE



MAP MODE WITH WEATHER RADAR



L DCP



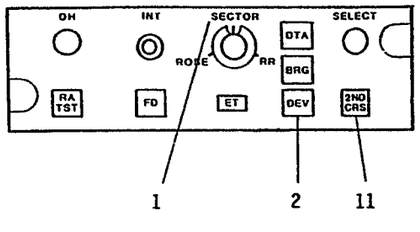
MAP MODE ENTRY
1 Set mode selector in any of the six SECTOR positions.
2 Enter MAP mode by momentarily push DEV button.
3 The range arc is controlled by the sector positions; 5, 25, 100, 200, 300, 600 Nm and indicates half of the selected distance.

MAP MODE DISPLAY
4 VOR1 deviation symbol, full scale equal to ± 10 degrees. VOR red flag if VOR/DME not valid, flashes for 10 seconds then steady.
5 VOR1/DME1 station presentation with ident code and courseline. Solid line is TO indication, dashed line is FROM indication. The VOR/DME station is displayed as an octagonal shaped symbol. If the VOR/DME station is off scale the line is drawn with an arrow pointing toward the VOR/DME station and with the station ident written on the line.
Set course with CRS knob as normal.

MAP MODE WITH WEATHER RADAR
6 Mode selector in RR position.
7 Radar echo display in cyan, green, yellow, red and magenta.
Colors depends on selected radar mode.
8 Range arc in cyan when controlled by the weather radar panel.
Distance in Nm indicates half of selected radar range.
9 Selected radar mode; MODE knob on weather radar panel.

Also see AOM 15/5.1.

R DCP



MAP MODE

10 VOR2 deviation symbol, full scale equal to ± 10 degrees. VOR red flag if VOR/DME not valid, flashes for 10 seconds then steady.

MAP MODE WITH SECOND COURSE

11 Momentarily press the 2ND CRS button.

12 Second NAV source (VOR1/DME1 on RH side) station presentation with ident code and courseline.

13 VOR2/DME2 station presentation with ident code and courseline.

IMPORTANT

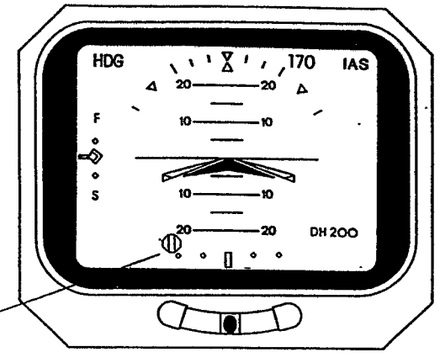
In MAP MODE, the deviation symbol and the station symbol with courseline will not be displayed if:

A Selected NAV source is only a VOR or only a DME station.

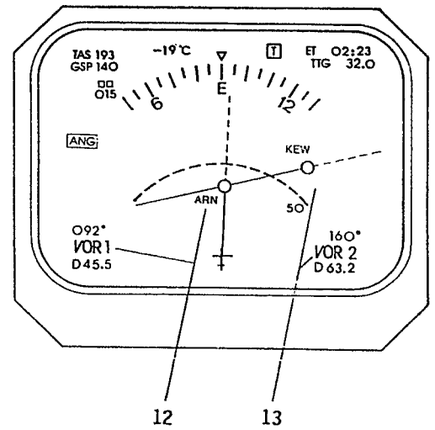
B DME is set to DME HOLD.

C No reception or if VOR/DME fails.

R SIDE
MAP MODE



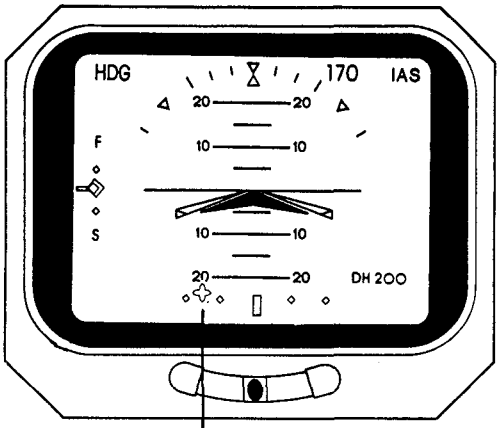
MAP MODE WITH SECOND COURSE



NOTE: When a Localizer has been selected the EHSI automatically returns to Sector Mode displaying a standard VOR course pointer. When changing back to a VOR, the EHSI will then return back to Map Mode.

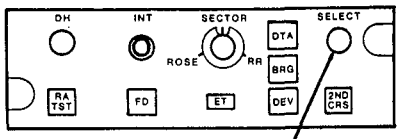
Fig. 12. EADI/EHSI - map mode.

MAP MODE - RNAV SELECTED



RNAV deviation indication in form of a star shaped symbol.
LRN flag in red when RNAV not valid.
See KNS 660 PILOT'S GUIDE regarding deviation scale sensitivity.

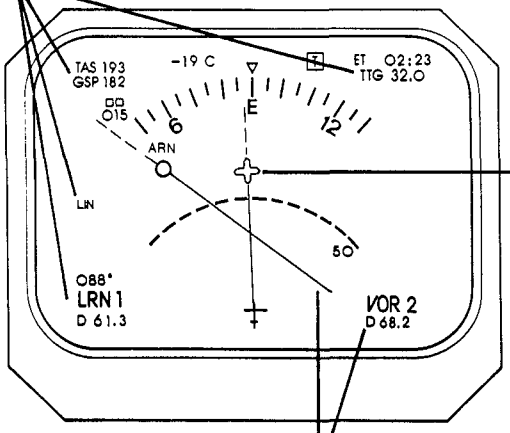
L DCP



LH DCP only.
Turn SELECT knob until LRN 1 appears in the left corner of the EHSI. The RNAV can only be displayed as L NAV source, if installed.

MAP MODE - RNAV SELECTED

RNAV flag (LRN1) and course, Distance, Ground Speed and Time To Go to next waypoint.
LIN, Linear RNAV deviation display, see page 10.



RNAV next waypoint and course presentation in cyan.
The waypoint is displayed as a star shaped symbol. Solid line indicates TO waypoint and dashed line indicates FROM waypoint.
If the waypoint is off the scale, the line is drawn with an arrow pointing towards the waypoint. The waypoint also flashes prior to waypoint passage.

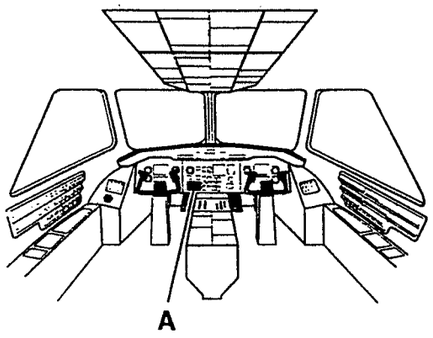
VOR2/DME2 station presentation.

ALSO SEE AOM 15/9.1 RNAV.

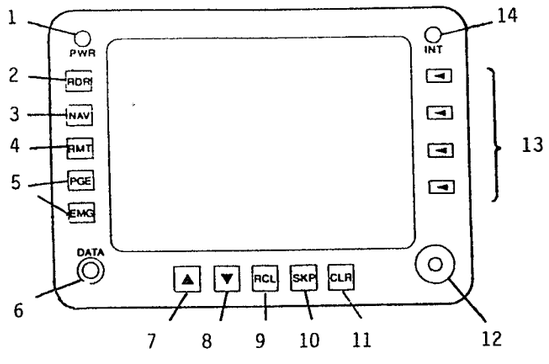
IF RNAV INSTALLED.

Fig. 13. EADI/EHSI - map mode, RNAV presentation (left side shown)

INTENTIONALLY LEFT BLANK



A MULTIFUNCTION DISPLAY, MFD



THE MFD CONTAINS 100 PAGES EACH LEAVING 12 LINES WITH 20 CHARACTERS FOR PROGRAMMING DATA. THE 100 PAGES ARE DIVIDED BETWEEN PGE AND EMG BUTTONS. ALL PROGRAMMING TO BE PERFORMED BY THE AIRCRAFT OPERATOR. FOR PROGRAMMING INSTRUCTIONS SEE COLLINS INSTRUCTION BOOK FOR MFD.

Fig. 14. MFD functions.

1 PWR, power button.

Turns MFD ON or OFF provided L AVION switch is in ON position. Normally left in ON position.

2 RDR, read pushbutton.

Enables weather radar information to be displayed. See Fig. 19.

3 NAV, navigation pushbutton.

Enables navigation information to be displayed. See Fig. 15.

4 RMT, remote pushbutton.

Enables presentation and selection of remote data information from Collins Flight Management system. Not used in SAAB 340B.

5 PGE, page and EMG, emergency pushbuttons.

Enables presentation and selection of information divided into pages and chapters containing for example A/C check lists and speed booklets etc. See Fig. 20.

6 DATA jack.

Entry jack for the Remote Data Programmer, RDP. RDP used for programming and revision of PGE and EMG information. See Collins instruction book for MFD.

7 Line reverser pushbutton.

Moves the cursor up the lines on PGE and EMG pages without confirming the lines. Lines remains yellow if not already confirmed (green).
If button pressed while cursor is on the first line of present page, the display will change over to the last line of the previous page within the selected chapter.
The button also increases NAV map range in NAV mode when weather radar deselected (when radar selected, range controlled by weather radar panel). See Fig. 19, 21.

IF MFD INSTALLED.

8 Line advance pushbutton.

Moves the cursor down the lines on PGE and EMG pages in order to confirm the information that has been given. The line currently being considered is cyan (the cursor).

Press the button to confirm and the color changes to green (confirmed information) and cursor moves to next line. Not confirmed lines are yellow.

If button pressed while cursor is on the last line of present page, the display will change over to first line on next page within selected chapter.

If the line being confirmed is the result of pressing the RCL button (recall of skipped lines), pressing the Advance button will confirm that line and advance the cursor to the next line that was skipped.

Should all lines of information within the selected chapter have been confirmed, pressing the Advance button will cause the display to scan through all of the lines in the selected chapter and return to page 1 of the selected chapter.

The button also decreases NAV map range in NAV mode when weather radar deselected (when radar selected, range controlled by weather radar panel). See Fig. 19, 21.

RCL, SKP, CLR used on PGE and EMG pages only:

9 RCL, recall pushbutton.

Recalls and displays the first page in selected chapter with a skipped line, next push recalls next skipped line. See Fig. 21.

10 SKP, SKIP pushbutton.

If a line has to be skipped for later confirmation, SKP moves the cursor down to the next line of information without confirming previous line (skipped line remains yellow).

11 CLR, clear pushbutton.

Resets all lines of the selected chapter to yellow.
See Fig. 21.

12 Joystick.

To scroll the pages within the selected chapter move Joystick DOWN for next page or UP for prior page. The Joystick will also scroll the chapter titles within the same method.

To scroll the chapters, Joystick to the RIGHT gives the first page of next chapter and Joystick to the LEFT gives the first page of prior chapter.

(The Joystick is also used to locate and defined waypoints for entry in Collins Flight Management System. Not used in SAAB 340B.)

13 Line select pushbuttons.

If PGE or EMG has been selected:

For selection of a certain chapter displayed adjacent to the pushbuttons, press the appropriate line button and the first page of the selected chapter will be displayed.

The NAVAIDS displayed in NAV mode can be selected or deselected:

When NAV mode is displayed, press the upper line button with the green boxed arrow pointing toward it. The display will then show a menu of the available NAVAIDS in green (selected) or white (deselected) color, adjacent to the line buttons.

Select/deselect the NAVAIDS by pressing the appropriate line button.
See Fig. 15, 16, 20, 21.

14 INT, intensity knob.

Controls the brightness of MFD display.

NAVIGATION MODE SELECTED

3. (**)

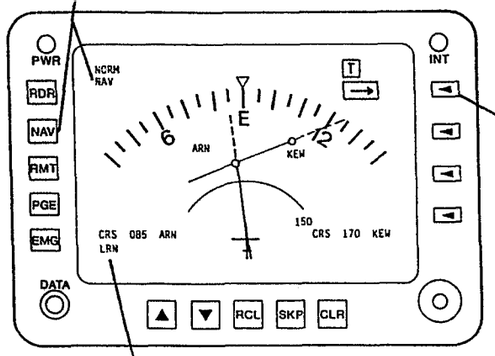


Fig. 15

VOR 1/DME 1 in cyan. VOR in red and no station presentation if flagged.

Press line select button to enter the NAVAID menu.

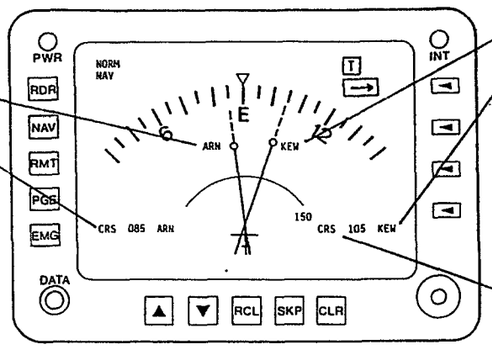


Fig. 17

VOR 2/DME 2 station presentation with ident code and courseline. Solid line is TO indication, dashed line is FROM indication. The VOR/DME station is displayed as an octagonal shaped symbol. If the VOR/DME station is off scale the line is drawn with an arrow pointing toward the VOR/DME and with the station ident written on the line. No display if selected NAV sourse is only a VOR.

Selected course (CRS) or bearing (BRG) to VOR 2/DME 2 station in green letters. The station presentation disappears and VOR in red (flagged) comes on if no reception or if system fails.

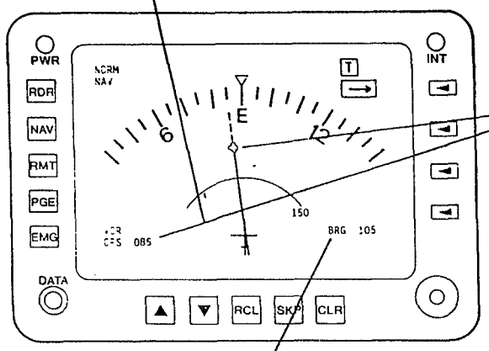


Fig. 16

RNAV next waypoint and course presentation in cyan. The waypoint is displayed as a star shaped symbol. Solid line indicates TO waypoint and dashed line indicates FROM waypoint. If the waypoint is off the scale, the line is drawn with an arrow pointing towards the waypoint. The waypoint also flashes prior to waypoint passage. LRN in red and no waypoint presentation if flagged. (*)

NOTE: The waypoint name is not displayed, next to the starshaped symbol, when using RNAV.

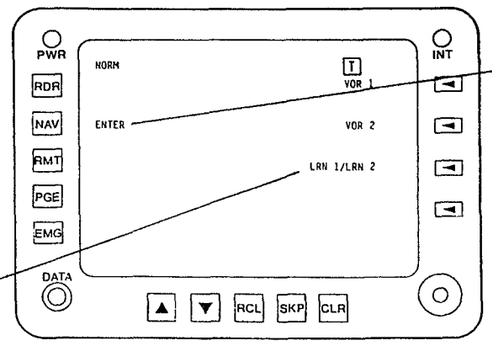


Fig. 18

Press the NAV button to ENTER selected NAVAID and return to NAV mode.

13.

Press the appropriate line button to select NAVAID:s.

Bearing (BRG) to VOR 2 station. The MFD will only display bearing to the VOR, when a VOR without DME has been selected.
When a Localizer has been selected the MFD will only display Localizer (LOC) flag.

Select LRN 1 for RNAV presentation. LRN2 not used in SAAB 340B. (*)

(*) RNAV is optional.

(**) The numbers are refering to the discription on page 19.

The colors of the symbols on the MFD are as on the EHSI's.

NOTE: If DRIVE XFR has been selected on any side, the MFD will then automatically display a copy of the EHSI picture from that side where DRIVE XFR is selected. The MFD will also inhibit the functions of the MFD pushbuttons except for PWR and INT.

Fig. 15 - 18 MFD modes - presentations and controls.

IF MFD INSTALLED.

WEATHER RADAR MODE SELECTED

2.

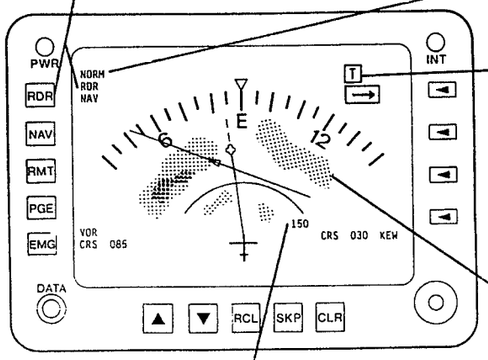


Fig. 19

Weather radar mode annunciator.

Target mode annunciator.

Radar echo presentation in cyan, green, yellow, red and magenta. Colors depends on selected mode. AOM 15/5.1.

Range arc, white in NAV and cyan in Radar mode. Distance in NM shows half of selected range. 7 - 8.

PGE OR EMG MODE SELECTED

5.

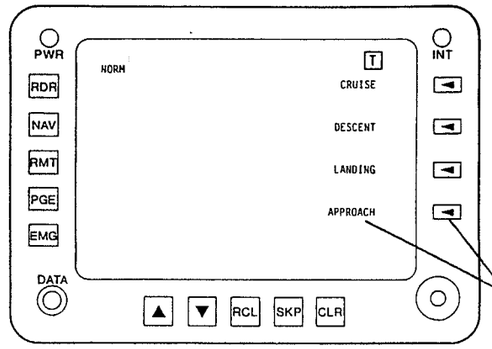


Fig. 20

13.

Press the appropriate line button to select a wanted chapter.

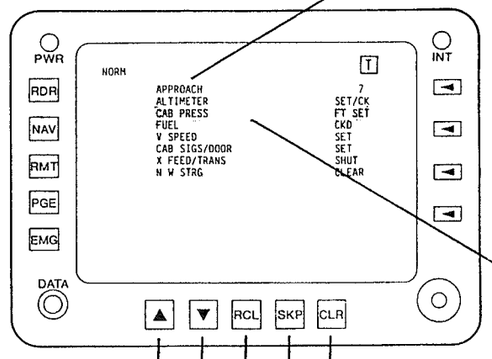


Fig. 21

Cursor, controlled by pushbuttons 7 - 11.

IF MFD INSTALLED.

Fig. 19 - 21. MFD Weather Radar and Program Modes.

4. ELECTRICAL POWER SUPPLY.

EFIS 1	L AVIONIC START BUS	G-17 EFIS DPU1	
.....	L AVIONIC START BUS	G-16 EFIS L ADI	
.....	L AVIONIC START BUS	G-15 EFIS L HSI	
.....	L AVIONIC START BUS	G-14 EFIS L DCP	
EFIS 2	R AVIONIC START BUS	N-15 EFIS DPU2	
.....	R AVIONIC START BUS	N-14 EFIS R ADI	
.....	R AVIONIC START BUS	N-13 EFIS R HSI	
.....	R AVIONIC START BUS	N-12 EFIS R DCP	
MFD/MPU.....	L AVIONIC BUS	G-18 MFD	(If MFD installed)
.....	L AVOINIC BUS	G-19 MPU L PWR	(If MFD installed)

1. LIMITATIONS.

Not applicable

2. NORMAL OPERATION.

CONDITIONS	NORMAL PROCEDURES
2.1 POWER UP	1. L and R AVION switches ..... ON – The EFIS system is switched ON/OFF by L and R AVION switches. 2. EFIS switches ..... NORM – DRIVE XFR/NORM/XSDE DATA switches and ADI REV/NORM/HSI REV switches on both side windshield wiper panel. 3. INT knobs, DCP ..... AS REQUIRED – Sets required brightness on the EADI and the EHSI. – Small knob controls the EADI and the large one the EHSI.
2.2 EFIS SYSTEM TEST.	This test to be performed on ground only. 1. EFIS test switch 1 or 2 ..... PRESS AND HOLD – 1 for left system, 2 for right system. – TEST should be displayed on EADI/EHSI. – AVIONICS light on CWP and MASTER CAUTION should come on. – Pitch, roll and heading should show fixed positions. – Comparator warning comes on the first 4 sec. – After approx 4 seconds all flags should be displayed. 2. EFIS test switch ..... RELEASE – Flags should disappear. – AVIONICS light and MASTER CAUTION should go out. – TEST should go out. – Pitch, roll and heading should go back to normal reading.

CONDITIONS	NORMAL PROCEDURES
2.3 EHSI DISPLAY FORMAT.	1. ROSE – SECTOR – RR selector, DCP ..... AS REQUIRED – ROSE gives a 360° compass rose. – SECTOR gives a compass sector of 80°. The 6 sector positions corresponds to ranges 5, 25, 100, 200, 300 and 600 NM. – RR (radar) gives the same sector as above but combined with a weather radar picture. The range is selected by the RANGE knob on the weather radar panel.
2.4 FD COMMAND BARS IN EADI.	At power on, the FD command bars are activated and thus visible on the EADI. They can, however, be removed if so desired (except in APPR, approach mode). 1. FD pushbutton ..... PRESS – FD command bars are removed. – Next push restores the FD command bars.
2.5 ELAPSED TIME.	Elapsed time can be measured and displayed on the EADI, in minutes and seconds for the first hour and thereafter in hours and minutes. 1. ET pushbutton, DCP ..... PRESS AND RELEASE – The chronometer is started. 2. ET pushbutton ..... PRESS AND HOLD – The chronometer is stopped and the elapsed time is displayed as long as the button is held. 3. ET pushbutton ..... RELEASE – The chronometer is reset to zero and can be started again.
2.6 EHSI DECLUTTER.	The information on the EHSI display can be reduced in such a way that unnecessary information is removed. 1. DTA (Data) pushbutton ..... PRESS – GSP, TAS, TTG, Crosside DME and NAV data are removed from the EHSI. – Next push restores the data.

CONDITIONS	NORMAL PROCEDURES
2.7 EHSI ADF POINTER.	1. BRG (Bearing) pushbutton ..... PRESS – The ADF bearing pointer is removed from the EHSI. – Next push restores the pointer.
2.8 MAP MODE.	1. DEV (Deviation) – MAP mode pushbutton ..... PRESS. – When mode selector in SECTOR or RR mode, pressing the DEV button allows presentation of VOR deviation indication displayed on EADI and MAP mode indication displayed on EHSI. – Next push restores the standard VOR course pointer on EHSI.
2.9 2ND COURSE.	Second NAV course (NAV 2 on LH side and NAV 1 on RH side) can be selected and displayed on the EHSI. ◆----**In ROSE position:** 1. 2ND CRS pushbutton ..... PRESS – Second course pointer comes on. – Next push, second pointer disappears. ◆----**In SECTOR position:** 1. 2ND CRS pushbutton ..... PRESS – Second NAV source comes on as an octagonal symbol together with station ident code if the NAV source is a VOR/DME. No display if the selected NAV source is only a VOR. – On R EFIS only: if RNAV installed and in use, 2ND CRS will display the RNAV waypoint as a star shaped symbol without ident code. – Next push, second NAV source disappears. ◆----**In SECTOR position with map mode selected (DEV button):** 1. 2ND CRS pushbutton ..... PRESS – Second NAV source comes on as an octagonal symbol with course line and station ident code if the NAV source is a VOR/DME. No display if the selected NAV source is only a VOR. – On R EFIS only: if RNAV installed and in use, 2ND CRS will display the RNAV waypoint as a star symbol with course line without ident code. – Next push, second NAV source disappears.

CONDITIONS	NORMAL PROCEDURES
2.10 SELECT (on L DCP and only if RNAV is installed).	The multiposition rotary switch is used to select between VOR/ILS as navigation source. 1. SELECT switch ..... TURN L or R – Each step the switch is turned gives VOR/ILS....LRN 1.... VOR/ILS....LRN 1 ..... and on. – LRN 1 is the RNAV source flag. – No effect if operated in none RNAV equipped aircraft.

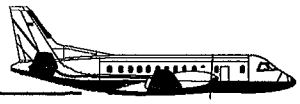
3. ABNORMAL OPERATION.

CONDITIONS	ABNORMAL PROCEDURES
3.1 POWER SUPPLY FAILURE.	**INDICATIONS.** No displays on EADI and EHSI and/or DCP inoperative. **ACTIONS.** 1. CB's ..... CHECK/RESET – System 1: G-17 / DPU 1 G-16 / L ADI G-15 / L HSI G-14 / L DCP – System 2: N-15 / DPU 2 N-14 / R ADI N-13 / R HSI N-12 / R DCP 2. End of procedure.
3.2 EADI OR EHSI FAILURE. (Cont'd)	**INDICATIONS.** Total loss of presentation (black screen), blurred or distorted picture on the L/R EADI or L/R EHSI. **ACTIONS.** Switch over to composite mode. ◆----**EADI failure.** 1. EFIS switch (failed side) ..... HSI REV ◇----**If composite mode comes on without any failure.** 2. CB for the failed EADI ..... PULL. 3. End of procedure. ◇----**If failure remains when in composite mode.** 2. EFIS switch (HSI REV) ..... BACK TO NORM 3. EFIS switch (failed side) ..... DRIVE XFR

CONDITIONS	ABNORMAL PROCEDURES
(Cont'd)	- Failed side's EADI/EHSI are now driven by the opposite DPU and controlled by the opposite DCP. - Brightness is controlled by the own DCP. - Left and right EADI/EHSI shows the same information. - Comparator caution is inhibited. - Switched side DRIVE XFR light comes on. 4. End of procedure ◆----**EHSI failure.** 1. EFIS switch (failed side) ..... ADI REV ◇----**If composite mode comes on without any failure.** 2. CB for the failed EHSI ..... PULL 3. End of procedure. ◇----**If failure remains when in composite mode.** 2. EFIS switch (ADI REV) ..... BACK TO NORM 3. EFIS switch (failed side) ..... DRIVE XFR - Failed side's EADI/EHSI are now driven by the opposite DPU and controlled by the opposite DCP. - Brightness is controlled by the own DCP. - Left and right EADI/EHSI shows the same information. - Comparator caution is inhibited. - Switched side DRIVE XFR light comes on. 4. End of procedure. **RULE BY THE THUMB** When switching ADI REV/HSI REV EFIS switch: Always set switch towards operating CRT-display. NOTE In a case where a DPU has failed and also the associated CB has popped: XDTA warning in red can or will appear on the EADI/EHSI when the applicable EFIS switch is set to DRIVE XFR.

o

CONDITIONS	ABNORMAL PROCEDURES
3.3 EADI AND EHSI FAILURE.	**INDICATIONS.** Total loss of presentation (Black screen), blurred or distorted picture on both L EADI/EHSI or R EADI/EHSI. **ACTIONS.** Use the opposite sides DPU for driving the failed sides EADI/EHSI 1. EFIS switch (failed side) ..... DRIVE XFR. – Failed side EADI/EHSI are now driven by the opposite DPU and controlled by the opposite DCP. – Brightnesss is controlled by the own DCP. – L and R EADI/EHSI shows the same information. – Comparator caution is inhibited. – Switched side DRIVE XFR light comes on. 2. End of procedure. NOTE In a case where a DPU has failed and also the associated CB has popped: XDTA warning in red can or will appear on the EADI/EHSI when the applicable EFIS switch is set to DRIVE XFR.
3.4 AHC DATA FAILURE.	**INDICATIONS.** On left or right side: Attitude (sky and earth) and FD command bars disappears and ATT red flag comes on on the EADI and/or HDG red flag comes on on the EHSI. **ACTIONS.** Use the AHRS information from the opposite side for presentation on failed side. 1. EFIS switch (failed side) ..... XSIDE DATA. – The opposite side's AHRS is now supplying the same attitude and heading information to both sides EADI and EHSI. – Pitch and Roll comparator cautions are inhibited. – Failed side EADI/EHSI displays XATT/XHDG in yellow. – Crosscheck against standby instruments during the remaining flight. – The autopilot is not possible to use. 2. End of procedure.



1. LIMITATIONS

Not applicable

2. NORMAL OPERATION

CONDITIONS	NORMAL PROCEDURES
2.1 POWER UP.	1. L and R AVION switches ..... ON – The EFIS system is switched ON/OFF by L and R AVION switches. 2. EFIS switches ..... NORM – DRIVE XFR/NORM/XSIDE DATA switches and ADI REV/NORM/HSI REV switches on both side windshield wiper panel. 3. INT knobs, DCP ..... AS REQUIRED –Sets required brightness on the EADI and the EHSI. – Small knob controls the EADI and the large one the EHSI.
2.2 EFIS SYSTEM TEST.	This test to be performed on ground only. 1. EFIS test switch 1 or 2 ..... PRESS AND HOLD – 1 for left system and MFD, 2 for right system. – TEST should be displayed on EADI/EHSI. – AVIONICS light on CWP and MASTER CAUTION should come on. – Pitch, roll and heading should show fixed positions. – Comparator warning comes on the first 4 seconds. – After approx 4 seconds all flags should be displayed. 2. EFIS test switch ..... RELEASE – Flags should disappear. – AVIONICS light and MASTER CAUTION should go out. – TEST should go out. – Pitch, roll and heading should go back to normal reading.

	CONDITIONS	NORMAL PROCEDURES
2.3	**POWER UP MFD.**	ON/OFF function is provided the MFD by the L and R AVION switches if the MFD PWR button is in ON position. 1. PWR button, MFD ..... PRESS–ON – Pressed in position is ON, button out is OFF. – The button is normally always left in ON position so that ONO/OFF is provided by the L and R AVION switches. However, the MFD can be turned ON or OFF as required. For MFD operation, see detailed MFD description in the description section of this chapter.
2.4	**EHSI DISPLAY FORMAT.**	1. Mode selector, DCP ..... AS REQUIRED – ROSE gives a 360° compass rose. – SECTOR gives a compass sector of 80°. The 6 sector positions corresponds to ranges 5, 25, 100, 200, 300 and 600 NM. – RR (radar) gives the same sector as above but combined with a weather radar picture. The range is selected by the RANGE knob on the weather radar panel.
2.5	**FD COMMAND BARS IN EADI.**	At power on, the FD command bars are activated and thus visible on the EADI. They can, however, be removed if so desired (except in APPR, approach mode). 1. FD pushbutton ..... PRESS – FD command bars are removed. – Next push restores the FD command bars.
2.6	**ELAPSED TIME.**	Elapsed time can be measured and displayed on the EADI, in minutes and seconds for the first hour and thereafter in hours and minutes. 1. ET pushbutton, DCP ..... PRESS AND RELEASE – The chronometer is started. 2. ET pushbutton ..... PRESS AND HOLD – The chronometer is stopped and the elapsed time is displayed as long as the button is held. 3. ET bushbutton ..... RELEASE – The chronometer is reset to zero and can be started again.

CONDITIONS	NORMAL PROCEDURES
2.7 EHSI DECLUTTER.	The information on the EHSI display can be reduced up in such a way that unnecessary information is removed. 1. DTA (Data) pushbutton ..... PRESS – GSP, TAS, TTG, Crosside DME and NAV data are removed from the EHSI. – Next push restores the data.
2.8 EHSI ADF POINTER.	1. BRG (Bearing) pushbutton ..... PRESS – The ADF bearing pointer is removed from the EHSI. – Next push restores the pointer.
2.9 MAP MODE.	1. DEV (Deviation) – MAP mode push button ..... PRESS – When mode selector in SECTOR or RR mode, pressing the DEV button allows presentation of VOR deviation indication displayed on EADI and MAP mode indication displayed on EHSI. – Next push restores the standard VOR course pointer on EHSI.
2.10 2ND COURSE. (Cont'd)	Second NAV source (NAV 2 on LH side and NAV 1 on RH side) can be selected and displayed on the EHSI. ◆----**In ROSE position:** 1. 2ND CRS pushbutton ..... PRESS – Second course pointer comes on. – Next push, second pointer disappears. ◆----**In SECTOR position:** 1. 2ND CRS pushbutton ..... PRESS – Second NAV source comes on as an octagonal symbol together with station ident code if the NAV source is a VOR/DME. No display if the selected NAV source is only a VOR. – On R EFIS only: if RNAV installed and in use, 2ND CRS will display the RNAV waypoint as a star symbol without ident code. – Next push, second NAV source disappears.

CONDITIONS	NORMAL PROCEDURES
(Cont'd)	◆----**IN SECTOR position with map mode selected (DEV button):** 1. 2ND CRS pushbutton ..... PRESS - Second NAV source comes on as an octagonal symbol with course line and station ident code if the NAV source is a VOR/DME. No display if the selected NAV source is only a VOR. - On R EFIS only: if RNAV installed and in use, 2ND CRS will display the RNAV waypoint as a star symbol with course line without ident code. - Next push, second NAV sourse disappears.
2.11 SELECT (on L DCP and only if RNAV is installed).	The multiposition rotary switch is used to select between VOR/ILS and RNAV as navigation source. 1. SELECT switch ..... TURN L OR R - Each step the switch is turned gives VOR/ILS....LRN 1.... VOR/ILS.... LRN 1 ..... and on. - LRN 1 is the RNAV sourse flag. - No effect if operated in none RNAV equipped aircraft.

Attached pages are reprints of COLLINS INSTRUCTION BOOK for MFD, containing MFD programming instructions.

3.13 PROGRAMMING MFD-85A PAGE (PGE) AND EMERGENCY (EMG) DATA WITH THE RDP-300 REMOTE DATA PROGRAMMER

Before beginning any programming operation, write down and lay out exactly what the chapter titles are to be and exactly what will be placed on each page within that chapter.

Note

Refer to figure 3-31 for a sample programming grid that can be duplicated on any office copier and used to write out each page of data. The grid will aid in keeping track of characters and lines available/used per page.

Keep in mind that there are 100 available pages and that each page has 12 lines of 20 characters each. Also indicate which chapters, if any, will be emergency chapters. Chapter length depends on user requirements. You may have one chapter of 100 pages or 100 chapters of one page or any combination in between It is recommended that pages be numbered consecutively within a chapter. It is also suggested that one or two blank pages be left between chapters to accommodate additional information in the future. Note also that with multiple chapters, all skips will be lost if another chapter is selected prior to completing the checklist (using the recall button) in the existing chapter. For this reason, some operators may prefer to put the entire checklist in one chapter rather than breaking the checklist out into different chapters. The information programmed into the MFD-85A will not be erased by power removal. Anything programmed during an earlier procedure will remain until reprogrammed.

Before any data can be programmed into the MFD-85A, the unit must be put into the edit mode There are two ways to enter into the edit mode, depending on the data currently in the MFD-85A. If the MFD-85A is new (never programmed before), pushing the PGE button causes the display to read:

NO PAGE
CHAPTERS FOUND. PLUG
IN RDP-300 TO EDIT.

Pushing the EMG button causes the display to read:

NO EMERGENCY
CHAPTERS FOUND. PLUG
IN RDP-300 TO EDIT.

In either case, simply plug in the RDP-300 to enter into the edit mode. If the above messages do not appear after pushing the respective PGE or EMG button, then the MFD-85A has been programmed (or at least a chapter has been defined) during an earlier procedure and the following should be used to enter into edit mode. If there are chapter titles shown next to the line select keys on the MFD-85A and a change to one of these chapters is desired, then push the line select key next to the desired chapter title, plug in the RDP-300, and make the changes. If the desired chapter title is not displayed, then move the joystick up or down until the chapter title is found for the chapter that needs to be changed. Then push the line select key next to the desired chapter title, plug in the RDP-300, and make the changes. If you do not know the chapter title of what you want to change and the 'NO PAGE CHAPTERS FOUND' or the 'NO EMERGENCY CHAPTERS FOUND' message does not appear, then push the top line select key, plug in the RDP-300, and find the page(s) you want to change (you are now in edit mode).

Whether you are in PGE edit mode (pushed the PGE button to enter) or in EMG edit mode (pushed the EMG button to enter), all 100 pages of the checklist memory can be changed. The only time you need to know which edit mode you are in is when you want to make a title page. If you want to make a PGE chapter title page, then the PGE edit mode must be entered. If you want to make an EMG chapter title page, then the EMG edit mode must be entered. Deleting chapter title pages from PGE or EMG can be done in either PGE or EMG edit mode.

A title page can be created at any time. To make a PGE title page, enter the PGE edit mode, find the page you wish to make into a title page, then position the cursor over the first character on the first of the 12 lines on the page (upper left-most character on the page). With this done, press the top line select key at the upper right of the MFD. The cursor will move one character position to the right. This signifies that a PGE title page has been created. To make an EMG title page, enter the EMG edit mode and repeat the above procedure.

A title page can also be removed at any time. To delete any title page, enter either PGE or EMG edit mode (either one will work for deleting a PGE or EMG title page). Find the title page by moving the joystick to the left or right, position the cursor over the first character of the first line of the displayed

operation 523-0775216

page, and retype the character that is under the cursor with the RDP-300. The cursor will move one character to the right and the page will no longer be a title page.

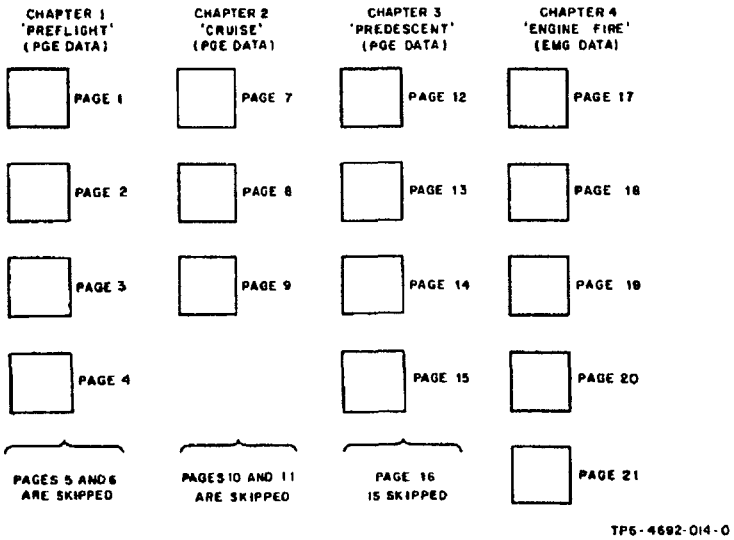
The joystick can be used in edit mode to help find pages or chapter titles more easily. If chapters have already been entered into the MFD-85A, then pushing the PGE or EMG button may give up to four titles, one next to each of the line select keys. Note that only PGE chapters will appear when the PGE button is pressed and only EMG chapters will appear when the EMG button is pressed. If the next set of four titles is desired, then pushing the joystick down will display the next set of up to four titles. Continue pushing the joystick down as needed to view successive sets of titles. If the previous set of four titles is desired, then push the joystick up to display the previous set of up to four titles. Continue pushing the joystick up as needed to view previous sets of titles.

Once in edit mode (a line select key is pressed and the RDP-300 is plugged in), the joystick can be used again. Moving the joystick down will cause the next page to be displayed even if the next page is a title page for the next PGE or EMG chapter. The cursor will be in the upper left of the display. Pushing the joystick up will cause the previous page to be displayed. The cursor will be in the lower right of the display. Pushing the joystick to the right will cause the next title page to appear, regardless of whether it is a PGE title page or an EMG title page. The cursor will be in the upper left of the display. Pushing the joystick to the left will cause the previous title page to appear, regardless of whether it is a PGE title page or an EMG title page. The cursor will be in the upper left of the display.

Because there are only 100 available pages in the MFD-85A, a title page should be part of the checklist page (ie, the entire page should be used for part of the checklist). The method for creating a title page has already been described. It should be noted that the very top line of the title page is what will show next to the line select key when either the PGE or EMG button is pressed. The line will appear exactly as it was entered (via the RDP-300) into the particular checklist (only PGE titles will appear for PGE and EMG titles for EMG mode). Therefore, the top line of the page should contain enough information to describe the chapter checklist contents. It is suggested that the top line be right justified so that it appears next to the appropriate line select key. Otherwise, fill in with periods (.) to the right of the line. This will help you select the correct title page.

The following illustration shows how a typical written layout of chapters and pages might appear.

TYPICAL CHAPTER AND PAGE LAYOUT



TP6-4692-014-0

operation 523-0775216

Note

The page numbers for all pages (1 through 100) have been visually and internally numbered at the factory for convenience. The visual page numbers will appear at the upper right of each page These page numbers can be relocated on the page, eliminated, or (not recommended) changed to a different number as desired.

Note

Those who choose to use the MFD-85A for checklist purposes must consider it an aid only and realize that it contains only the data that someone has programmed into it The aircraft flight manual contains the approved checklists.

Warning

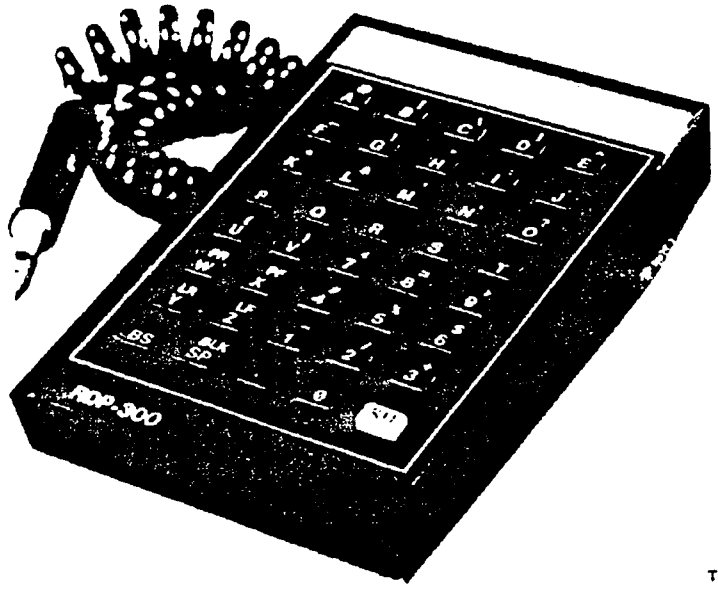
The MFD-85A EMG function displays only what has been programmed into memory as emergency data. The user must realize that this data may or may not be applicable to an actual emergency. The aircraft flight manual emergency checklist must be referred to for proper corrective actions to be taken in various emergency situations.

Caution

To prevent the loss of data, it is essential that the programming procedure is followed carefully and in the order given. Make certain that the RDP-300 is connected to or disconnected from the MFD-85A only while continuous power is applied to the system.

3.14 RDP-300 REMOTE DATA PROGRAMMER

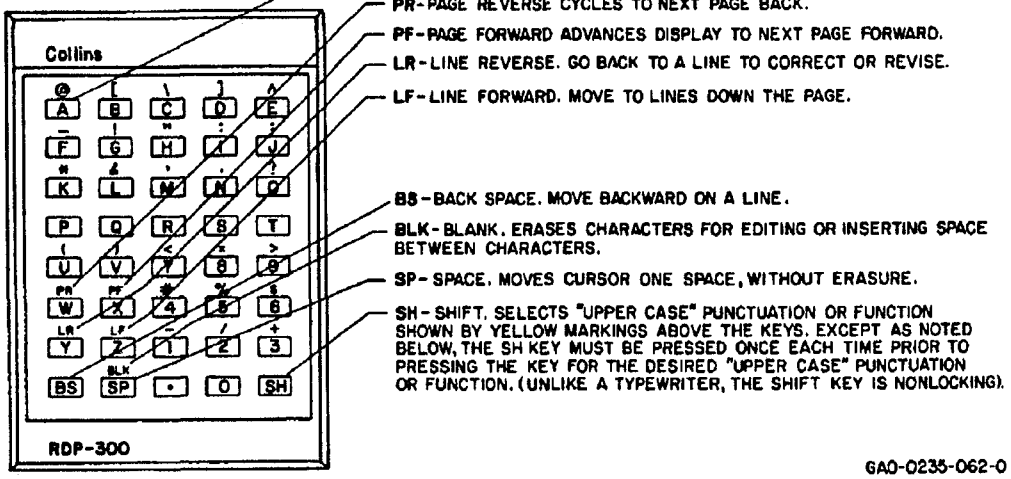
The RDP-300 (figure 3-29) is a portable, handheld unit, similar to a calculator, that is used to input data into the memory of the MFD-85A. The RDP-300 should be stored in a location that is accessible to the flight crew if on-aircraft programming is desired. The various RDP-300 keys and their functions are described in figure 3-30.



TP6-0889-017

RDP-300 Remote Data Programmer
Figure 3-29

operation 523-0775216



RDP-300 Key Descriptions
Figure 3-30

Note

There are eight keys on the RDP-300 that can be held down, causing the function assigned to that key to be continuously repeated The eight keys are PF, PR, LF, LR, - (dash, located above 1), BLK (blank), SP (space), and . (dot). The SH key does not have to be held down when holding one of the uppercase function keys down.

Note

If the SH key is pressed and then it is decided not to use the uppercase function, press the SH key a second time to cancel the shift.

3.14.1 Programming the MFD-85A Multifunction Display

The MFD-85A provides various keys to aid the user when in the edit mode. The following paragraphs describe the functions of these keys.

Line advance (inverted delta, ∇) — Similar to the SH and LF keys on the RDP-300. Pushing the ∇ key will advance the cursor one line down the display.

Line reverse (delta, Δ) — Similar to the SH and LR keys on the RDP-300. Pushing the Δ key will cause the cursor to move one line up the display.

Joystick up — Similar to the SH and PR keys on the RDP-300. Causes the MFD-85A to go back to the previous page. The cursor will be at the lower right-hand corner.

Joystick down — Similar to the SH and PF keys on the RDP-300. Causes the MFD-85A to go forward to the next page. The cursor will be at the upper left-hand corner.

Joystick right — Causes the MFD-85A to search forward and display the next chapter title page (whether it is a PGE chapter title page or an EMG chapter title page). The cursor will be in the upper left-hand corner of the display.

Joystick left — Causes the MFD-85A to search backward and display the previous chapter title page. The cursor will be in the upper left-hand corner of the display.

Top line select key — If the cursor is positioned at the upper left corner of the display, pushing this key

operation 523-0775216

will make the page shown a chapter title page. If in PGE edit mode, it will be a PGE chapter title page. If in EMG edit mode, it will be an EMG chapter title page.

3.14.2 Programming a New MFD-85A Multifunction Display

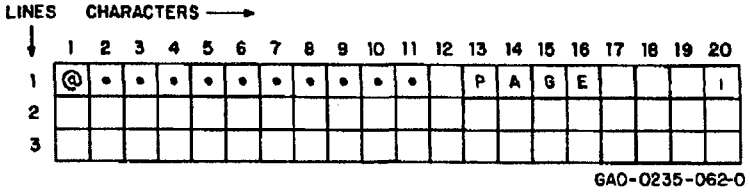
Note

The following procedures assume that the MFD-85A is new and that this is the first time it has been programmed. Procedures for changing an already programmed MFD-85A follow this section.

a. Turn on aircraft power. Ensure that the MFD-85A circuit breakers are in. Press the PWR button at the upper left of the MFD-85A. Position the WXP-85( ) MODE switch to OFF (the WXP-85( ) is not required during programming of the MFD-85A). Allow 15 seconds for the MFD-85A to warm up. Adjust the INT control at the upper right of the MFD-85A as desired.
b. Press the PGE button on the MFD-85A. The display will show:

NO PAGE
CHAPTERS FOUND. PLUG
IN RDP-300 TO EDIT.

c. Plug the RDP-300 Remote Data Programmer into the MFD-85A DATA jack. Note that the first line of page 1 is displayed adjacent to the top line select key. The characters on this first line should be a red cursor in the upper left, followed by yellow dots with PAGE 1 in the upper right.
d. If steps a through c were followed, the top line on the MFD-85A should look like the one in the following illustration.



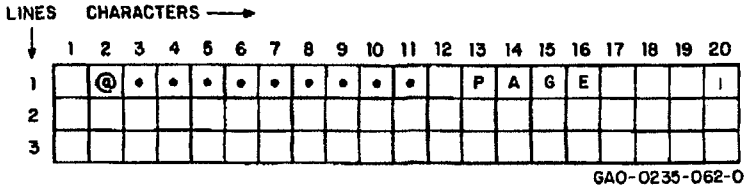
The cursor (red at (@) symbol) should be in the upper left corner. If it is not, push the SH (shift) key, then the PR (page reverse) key on the RDP-300 until the cursor is displayed in the lower right corner of the display. Note the current page number and press SH, then PF (page forward), until the cursor is at the upper left corner of page 1. After pressing the SH key, the PF or PR key can be held down for repeated function.
e. Assume that the first PGE chapter title is to be called PREFLIGHT. (You MUST have a chapter title at the top of the first page to be used even if the title is PAGE 1 as shown after performing the following steps 1 and 2.) To enter PREFLIGHT as a chapter title, perform the following.

Note

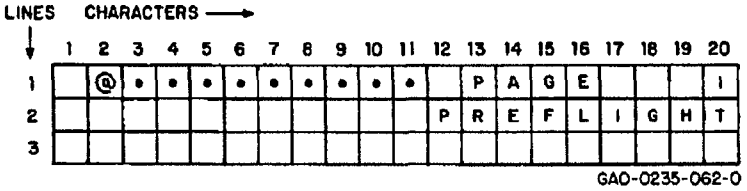
Whatever is on the top line of the title page (in this example, it will be PREFLIGHT) is what is shown beside the line select key when the chapter title is called up.

1. Press the RDP-300 BLK (blank) key once, then press the BS (back space) key once. The cursor is back in the upper left corner but the dot (period) that was in the upper left has now been erased.
2. Press the top line select key at the right side of the MFD-85A. Note that the cursor moves one character position to the right and that the space to the left of the cursor is blank. This page is now designated as a PGE chapter title page. The top line of the display should now look like the one in the following illustration.

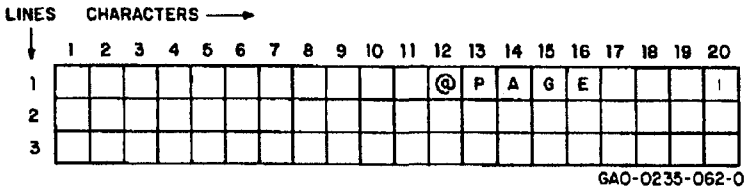
operation 523-0775216



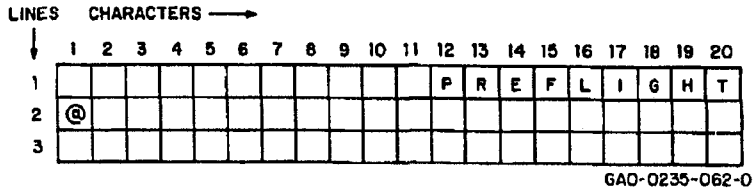
3. The following illustration is a repeat of the illustration in step 2, except that the example chapter title (PREFLIGHT) is now shown justified to the far right-hand side of the display.



The purpose of the above illustration is to show what now must be done in order to enter PREFLIGHT as a chapter title. Note that PREFLIGHT has nine letters and will fully occupy the area now taken up by PAGE 1 and the associated spaces. The only thing that must be done is to erase the yellow dots in spaces 2 (there is a dot beneath the cursor) through 11 of the first line and move the cursor to position 12. This is done by pressing the RDP-300 BLK key 10 times and then pressing the SP (space) key once. The top line should now look like the one in the following illustration.



4. Complete the chapter title entry procedure by using the RDP-300 keyboard to key-in the word PREFLIGHT. The letters will write over the data (PAGE 1) currently occupying spaces 13 through 20 and the cursor will automatically advance to the first space in line 2. The display should now look like the following illustration.



5. Continue using the RDP-300 to type in the desired preflight checklist, beginning on line 2 of the chapter title page (the chapter title page should be used as part of the checklist). Use as many pages as are needed to the complete the preflight checklist. It should be noted that all 12 lines can be used for checklist data on nontitle pages.

operation 523-0775216

Note

A blank (BLK) is considered a character. The space (SP) key is not considered a character and should be used instead of blanks to separate words, symbols, numbers, etc. A BLK should only be used to erase a character, as was done in step 1.

f. It is suggested that a couple of unprogrammed pages be left at the end of each chapter. This allows for expansion at a later date. To do this, push the joystick down twice or use the SH and PF keys on the RDP-300.
g. Repeat steps e and f to create a new PGE chapter title. Continue repeating steps e and f until all PGE chapters have been programmed.
h. To program EMG chapters, press the EMG button on the MFD-85A. The display should show the preflight checklist title page that was previously programmed into MFD-85A as a PGE chapter title page. Push the joystick down or use the RDP-300 SH and PF keys to find a page where you want to put the first EMG title page. Remember to skip all of the pages previously programmed during the PGE checklist programming procedure. Then repeat steps e through g above for the EMG chapter checklists.
i. This completes the programming of new checklists procedure. Disconnect the RDP-300 from the MFD-85A. Verify that data just programmed is accessible and correct by first pressing the PGE or EMG button on the MFD, then pressing the appropriate line select key to display the first page of the selected chapter. Use the joystick as described in paragraph 3.14.1 to view the various pages and/or select new chapter title pages.

Note

The information programmed into the MFD-85A will not be erased by power removal.

3.14.3 Changing an Already Programmed MFD-85A Multifunction Display

Note

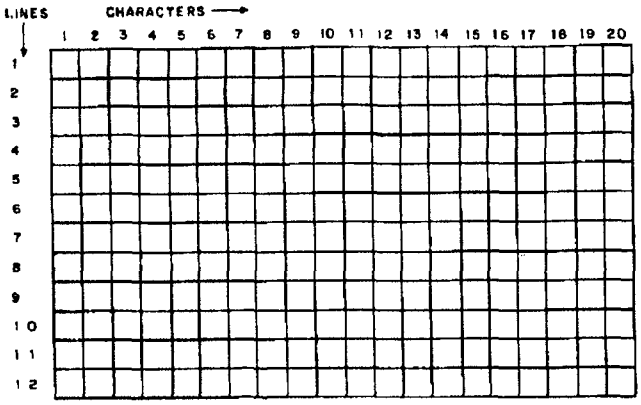
The following procedures assume that the MFD-85A has already been programmed and it is desired to change some of the text.

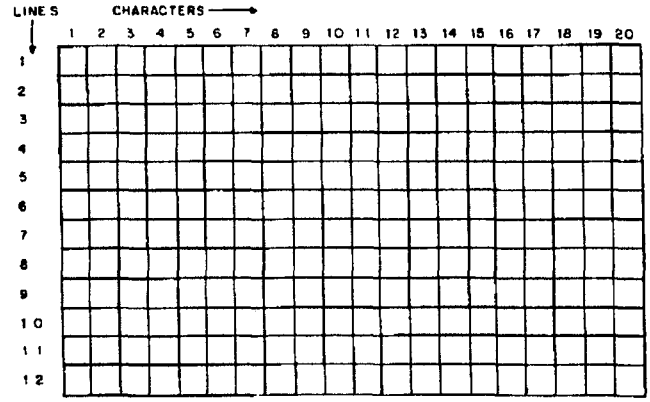
a. Turn on aircraft power. Ensure that the MFD-85A circuit breakers are in. Press the PWR button at the upper left of the MFD-85A. Position the WXP-85( ) MODE switch to OFF (the WXP-85( ) is not required during programming of the MFD-85A). Allow 15 seconds for the MFD-85A to warm up. Adjust the INT control at the upper right of the MFD-85A as desired.
b. Press the PGE or EMG button (depending on what is to be changed) on the MFD-85A.
c. When PGE or EMG is selected, up to four chapter titles will appear next to the line select keys on the right side of the MFD-85A. If data in one of these four chapters is to be changed, pressing the appropriate line select key causes the first page of the selected chapter to be displayed. If other chapter titles are required, movement of the joystick upward will cause the next set of up to four chapter titles to be displayed. Movement of the joystick downward will cause the previous four chapter titles to be displayed.
d. When the desired chapter is found and the first page has been called up, plug the RDP-300 Remote Data Programmer into the MFD-85A DATA jack and make the necessary changes. If you do not know the title name and/or nothing is displayed on the MFD-85A, push the top line select key, plug in the RDP-300, and make the necessary changes. If all of the 100 available pages have not been used, new PGE or EMG chapters can be created by searching for a group of unprogrammed pages and then making a title page and entering checklist data as required.
e. When the desired data has been entered, disconnect the RDP-300 from the MFD-85A. Verify that data just programmed is accessible and correct by first pressing the PGE or EMG button on the MFD, then pressing the appropriate line select key to display the first page of the selected chapter. Use the joystick as described in paragraph 3.14.1 to view the various pages and/or select new chapter title pages.

Note

The information programmed into the MFD-85A will not be erased by power removal. Anything programmed during an earlier procedure will remain until reprogrammed.

operation 523-0775216





TP6-4691-014-0

Programming Grids for PGE and EMG Data
Figure 3-51

operation 523-0775216

3.15 PROGRAMMING MFD-85A PAGE (PGE) AND EMERGENCY (EMG) DATA WITH THE CEU-85 CHECKLIST ENTRY UNIT

The handheld CEU-85 is used to enter 100 pages of combined checklist page and emergency page data into the MFD instead of entering it manually with the RDP-300. The CEU-85 is shown in figure 3-32.

The CEU-85 is normally used before preflight, rarely during flight. The checklist is loaded into the CEU-85 from an *Apple® II Plus/IIe/IIe enhanced computer that contains a Collins Pro Line II interface card and checklist processing disk software. Load the desired checklist data into the CEU-85, following the procedures contained in the operation section of the CEU-85 Checklist Entry Unit Instruction Book (523-0774328). Once loaded, the CEU-85 is carried to the aircraft. Proceed as follows to program the MFD-85A.

Caution

To prevent loss of data, it is essential that the CEU-85 is connected to or disconnected from the MFD-85A only while power is applied to the system.

a. Turn on aircraft power. Ensure that the MFD-85A circuit breakers are in. Press the PWR button at the upper left of the MFD-85A. Position the WXP-85C MODE switch to OFF (the WXP-85C is not required during programming of the MFD-85A). Allow 15 seconds for the MFD-85A to warm up. Adjust the INT control at the upper right of the MFD-85A as desired.
b. Press the PGE button, then press the RDR button on the MFD-85A.

Note

Steps c and d must be done within 10 seconds of each other.

c. Plug the CEU-85 into the MFD-85A DATA jack.
d. Simultaneously press the top line select key, the bottom line select key, and the line reverse key (delta Δ). (The line select keys are located along the right side of the MFD.)
e. The CEU-85 will begin to transfer checklist data into the MFD-85A 15 seconds after the CEU-85 receives power from the MFD-85A and operates without interaction. Normal checklist transfer time is approximately 11 minutes. The radar mode screen will reappear when data transfer is complete.
f. Disconnect the CEU-85 from the MFD-85A. Verify that data just loaded is accessible and correct by first pressing the PGE or EMG button on the MFD, then pressing the appropriate line select key to display the first page of the selected chapter. Use the joystick and Δ and ∇ keys to view the various pages and/or select new chapter title pages.
g. Turn off power.

Note

The information loaded into the MFD-85A will not be erased by power removal. Anything loaded during an earlier procedure will remain until reloaded.

TP6-4650-017

CEU-85 Checklist Entry Unit
Figure 3-32

Note

Those who choose to use the MFD-85A for checklist purposes must consider it an aid only and realize that it contains only the data that someone has programmed into it. The airplane flight manual contains the approved checklists.

*Apple® is the registered trademark of Apple Computer, Inc.

A9935

3. ABNORMAL OPERATION.

CONDITIONS	ABNORMAL PROCEDURES
3.1 POWER SUPPLY FAILURE.	**INDICATIONS.** No displays on EADI and EHSI and/or DCP inoperative. **ACTIONS.** 1. CB's ..... CHECK/RESET - EFIS 1: G-17 / DPU 1 G-16 / L ADI G-15 / L HSI G-14 / L DCP - EFIS 2: N-15 / DPU 2 N-14 / R ADI N-13 / R HSI N-12 / R DCP - MFD: G-18 / MFD G-19 / MPU L PWR 2. End of procedure.
3.2 EADI OR EHSI FAILURE. (Cont'd)	**INDICATIONS.** Total loss of presentation (black screen), blurred or distorted picture on the L/R EADI or L/R EHSI. **ACTIONS.** Switch over to composite mode. ◆ ---**EADI failure.** 1. EFIS switch (failured side) ..... HSI REV ◇---**If composite mode comes on without any failure.** 2. CB for the failed EADI ..... PULL 3. End of procedure. ◇---**If failure remains when in composite mode.** 2. EFIS switch (HSI REV) ..... BACK TO NORM

CONDITIONS	ABNORMAL PROCEDURES
(Cont'd)	3. EFIS switch (failed side) ..... DRIVE XFR – Failed side EADI/EHSI are now driven by the MPU. The MFD will also display the same information being presented on the failed side's EHSI. – The EADI/EHSI are still controlled from own DCP. – Switched side drive XFR light comes on. ◆ ---EHSI failure. 1. EFIS switch (failed side) ..... ADI REV ◆ ---**If composite mode comes on without any failure.** 2. CB for the failed EHSI ..... PULL 3. End of procedure. ◆ ---**If failure remains when in composite mode.** 2. EFIS switch (ADI REV) ..... BACK TO NORM 3. EFIS switch (failed side) ..... DRIVE XFR – Failed side's EADI/EHSI are now driven by the MPU. The MFD will also display the same information being presented on the failed side's EHSI. – The EADI/EHSI are still controlled from own DCP. – Switched side DRIVE XFR light comes on. 4. End of procedure. **RULE BY THE THUMB!** When switching ADI REV/HSI REV – EFIS switches: always set switch towards operating CRT-display. NOTE In a case where a DPU has failed and also the associated CB has popped: XDTA warning in red can or will appear on the EADI/EHSI when the applicable EFIS switch is set to DRIVE XFR.

CONDITIONS	ABNORMAL PROCEDURES
3.3 EADI AND EHSI FAILURE.	**INDICATIONS.** Total loss of presentation (black screen), blurred or distorted picture on both L EADI/EHSI or R EADI/EHSI. **ACTIONS.** Use the MPU for driving the failed side EADI/EHSI. 1. EFIS switch (failed side) ..... DRIVE XFR - Failed side EADI/EHSI are now driven by the MPU. The MFD will also display teh same information being presented on the failed side EHSI. - The EADI/EHSI are still controlled from own DCP. 2. End of procedure. NOTE Switching from DRIVE XFR back to NORM will cause the EADI/EHSI presentation to blank out on the switched side for a couple of seconds. NOTE In a case where a DPU has failed and also the associated CB has popped: XDTA warning in red can or will appear on the EADI/EHSI when the applicable EFIS switch is set to DRIVE XFR.
3.4 AHC DATA FAILURE. (Cont'd)	**INDICATIONS.** On left or right side: Attitude (sky and earth) and FD command bars disappears and ATT red flag comes on on the EADI and/or HDG red flag comes on on the EHSI.

CONDITIONS	ABNORMAL PROCEDURES
(Cont'd)	**ACTIONS.** Use the AHRS information from the opposite side for presentation on failed side. 1. EFIS switch (failed side) ..... XSIDE DATA - The opposite sides AHRS is now supplying the same attitude and heading information to both sides EADI and EHSI. - Pitch and Roll comparator cautions are inhibited. - Failed side EADI/EHSI displays XATT/XHDG in yellow. - Crosscheck against standby instruments during the remaining flight. - The autopilot is not possible to use. 2. End of procedure.

0. MODIFICATION STANDARD.

The system in this chapter assumes a certain modification standard of the aircraft. If a modification is not installed, the following apply as a complement to what is stated in this chapter.

DESCRIPTION/OPERATION.

0.1 Parking of the ADF pointer on EFIS, Collins ADF Pro Line II system only.

Without Collins Service Bulletin No 10 for ADF 60A and ADF 60B.

If the power supply to the ADF is interrupted (CB pulled, power failure etc.) the ADF bearing pointer displayed on EHSI will park at 45° right position and not flagged (magenta color).

1. GENERAL.

The Automatic Direction Finder, ADF, detects the relative bearing to a selected radio station (NDB). The frequency range for selection is 190 to 1749,5 kHz.

The radio bearing is combined with the magnetic compass indication on the Radio Magnetic Indicator (RMI) which thus indicates the magnetic bearing to the selected ADF station. The ADF bearing can also be indicated on the EHSI.

If two systems are installed they are completely separated. The bearing indication is displayed by RMI pointers. Single pointer indicates ADF 1 and double pointer indicates ADF 2. L EHSI ADF pointer indicates ADF 1 bearing and R EHSI ADF pointer indicates ADF 2 bearing.

With only one system installed all ADF pointers will indicate the ADF 1 bearing.

2. MAIN COMPONENTS AND SUBSYSTEMS.

2. 1. Antenna.

There is a dual antenna installed on the top of the fuselage. The antenna is of the integrated type i.e. it contains a loop and a sense antenna. A dual amplifier provides two independent outputs to the ADF receivers.

2. 2. Control Unit.

The principal part of the control unit is the microprocessor which senses switch and selector positions, transfers them into frequency and mode information and finally generates adequate control signals to the receiver.

The control unit is also provided with a gas discharge type of display for two frequencies, one active and one standby.

A programmable Memory facility is also contained in the control unit. The Memory provides four pre–programmed frequencies.To select a Memory frequency, simply step through the Memory by operating the XFR/MEM switch momentarily in MEM position.

2. 3. Receiver.

The receiver consists principally of two parts, the normal radio and audio amplifiers for the station signals and a circuitry to determine the direction to the station.

2.4. System function.

When in the normal mode (ADF), the signals from the selected station are routed to the audio integrating system and can be heard as an identification signal. The signals are also routed to a circuit that determinates the bearing to the station. In ANT mode the loop antenna output is disabled and the result is only audio without bearing indication. In TONE mode unmodulated signals (Continuous Wave, CW) are received and identified.

By using the ADF switch on the RMI, the ADF bearing indication can be displayed on the RMI. With the BRG button on the display control panel (DCP) the ADF bearing indication can be displayed on the EHSI or deselected from the EHSI.

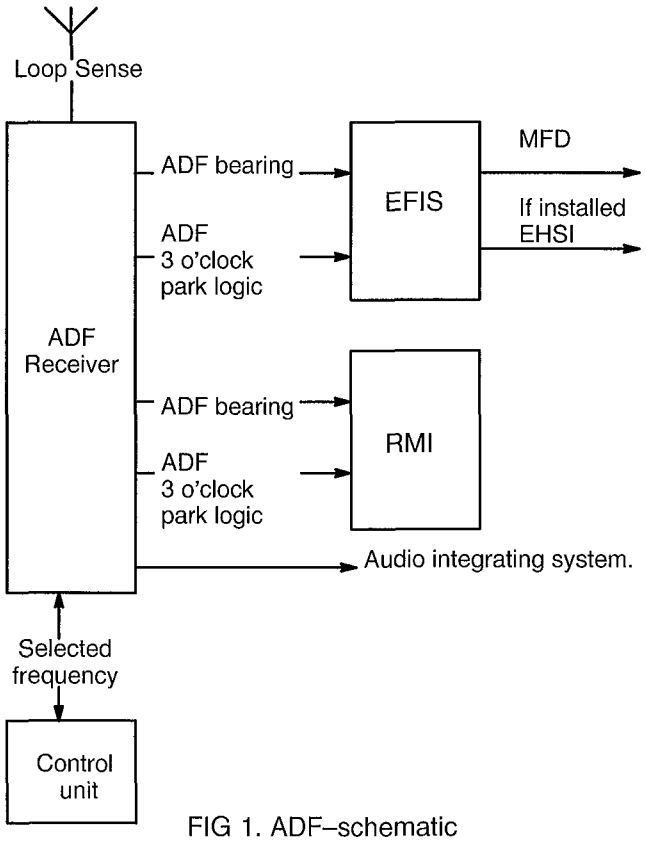
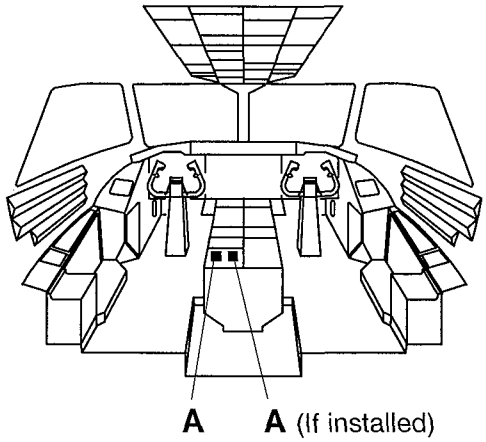


FIG 1. ADF–schematic

3. CONTROLS AND INDICATORS.



XFR/MEM switch.
When momentarily switched to:

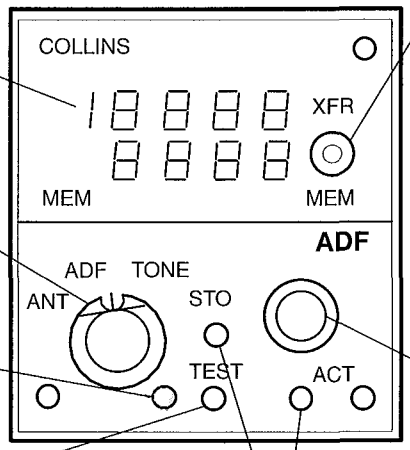
XFR – Standby frequency moves to upper display and becomes active.

– Former active frequency moves to lower display and becomes standby.

MEM – Steps through the four pre–programmed frequencies

– After having chosen a frequency, XFR/MEM switch to XFR position to make memory frequency active.

A ADF CONTROL UNIT WITH MEMORY



Frequency display.
Upper display–Active frequency.

Lower display–Standby frequency.

Function selector.
ANT – Audio only

ADF – Bearing indication and audio ident.

TONE – Provides a 1000 Hz tone for audio ident (CW).

Photocell.
Controls display brightness.

TEST button.
When pressed and held:
- ADF pointers in EHSI and RMI rotate to a 90° position counterclockwise of previous indication.
- 1000 Hz tone should be heard.
- Control unit will enter and display Diagnostic Fail Code mode (maintenance).

STO button.
Select memorycell to program (CH.–) with XFR/MEM switch then momentarily press STO button:

- Control unit enters Program mode. Set up frequency with frequency selector. Press STO button to store frequency.
- XFR/MEM switch for next memorycell (CH –).
- No activity for 3 seconds, returns display to normal.

ACT button.
When depressed for more than 2 seconds:

- Standby frequency display goes off. Frequency selector controls active frequency display.

For return to normal:

- Depress for more than 2 seconds

Frequency selector.
Large knob – Controls the two left digits (1000 and 100 kHz)

Small knob – Controls the three right digits (tens, units and tenths of kHz).

A10065

FIG.2 ADF – controls

1. GENERAL.

The Automatic Direction Finder, ADF, detects the relative bearing to a selected radio station (NDB). The frequency range for selection is 190 to 1749,5 kHz.

The radio bearing is combined with the magnetic compass indication on the Radio Magnetic Indicator (RMI) which thus indicates the magnetic bearing to the selected ADF station. The ADF bearing can also be indicated on the EHSI.

If two systems are installed they are completely separated. The bearing indication is displayed by RMI pointers. Single pointer indicates ADF 1 and double pointer indicates ADF 2. L EHSI ADF pointer indicates ADF 1 bearing and R EHSI ADF pointer indicates ADF 2 bearing.

With only one system installed all ADF pointers will indicate the ADF 1 bearing.

2. MAIN COMPONENTS AND SUBSYSTEMS.

2. 1. Antenna.

There is one antenna installed for each system; ADF 1 in the bottom of the fuselage and ADF 2 (if installed) on the top of the fuselage.

The antennas are of the integrated type i.e. it contains a loop and a sense antenna. An amplifier provides outputs to the ADF receivers.

2. 2. Control Unit.

The principal part of the control unit is the microprocessor which senses switch and selector positions, transfers them into frequency and mode information and finally generates adequate control signals to the receiver.

The control unit is also provided with a gas discharge type of display for two frequencies, one active and one for standby.

2. 3. Receiver.

The receiver consists principally of two parts, the normal radio and audio amplifiers for the station signals and a circuitry to determine the direction to the station.

2.4. System function.

When in the normal mode (ADF), the signals from the selected station are routed to the audio integrating system and can be heard as an identification signal. The signals are also routed to a circuit that determinates the bearing to the station. In ANT mode the loop antenna output is disabled and the result is only audio without bearing indication. In TONE mode unmodulated signals (Continuous Wave, CW) are received and identified.

By using the ADF switch on the RMI, the ADF bearing indication can be displayed on the RMI. With the BRG button on the display control panel (DCP) the ADF bearing indication can be displayed on the EHSI or deselected from the EHSI.

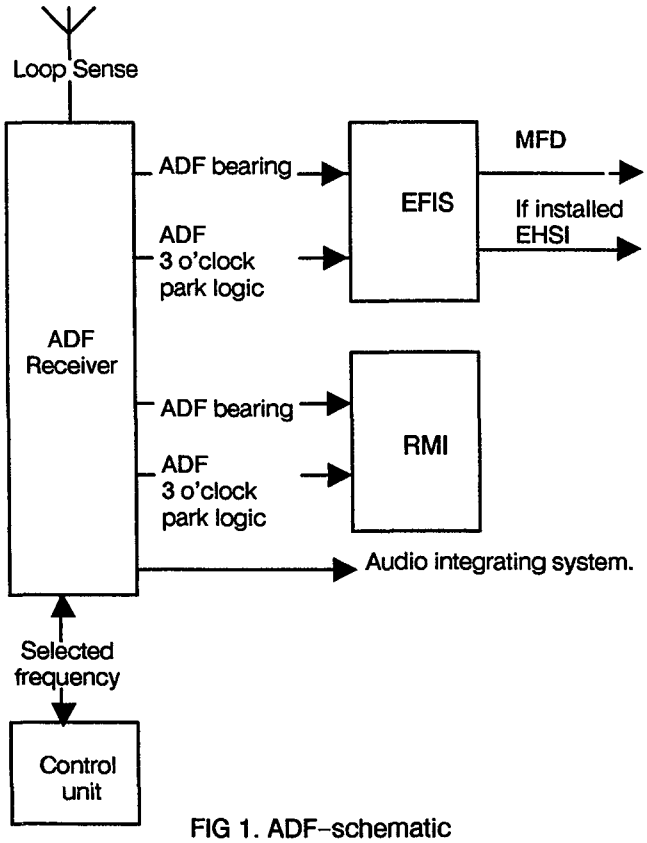
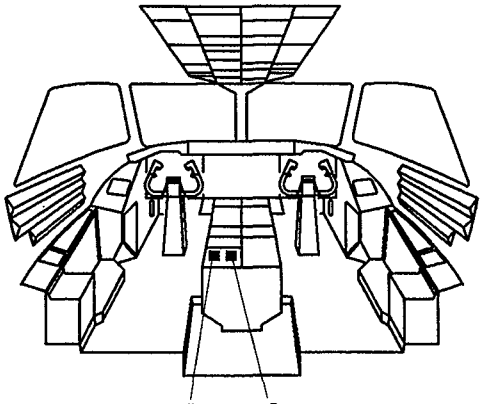


FIG 1. ADF–schematic

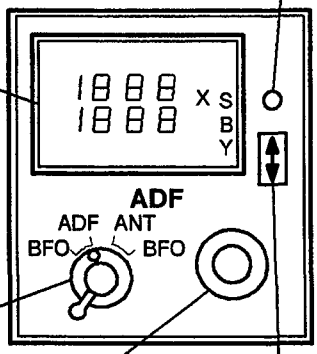
3. CONTROLS AND INDICATORS.



A ADF CONTROL UNIT

Photocell.
Controls display brightness.

Frequency display.
Upper display – active frequency.
Lower display – standby frequency.
Display flashed if selected frequency less than 190 kHz. X right of active frequency is displayed in ANT mode and when detector circuit not locked on a bearing.



Function selector.
ADF– Bearing indication and audio ident.
BFO– Adds a 1000 Hz signal for audio ident (CW).
ANT– Audio only.
BFO– Adds a 1000 Hz signal for audio ident (CW).

Frequency selector.
Large knob– Controls the two left digits (1000 and 100 kHz).
Small knob– Controls tens of kHz when pushed in and units fo kHz pulled out.
The selected frequency will appear in lower (standby) display.
See also "Transfer button".

Transfer button.
When momentarily pressed:
– Standby frequency moves to upper display and becomes active. Former active frequency moves to lower display and becomes standby.
When depressed for more than 2 seconds:
– Standby frequency display goes off. Frequency selectors control active frequency display.
When pressed again momentarily:
– Standby frequency displayed again and function back to normal.

A10064

FIG. 2 ADF– controls

1. GENERAL.

The Automatic Direction Finder, ADF, detects the relative bearing to a selected radio station (NDB). The frequency range for selection is 190 to 1749,5 kHz.

The radio bearing is combined with the magnetic compass indication in the Radio Magnetic Indicator (RMI) which thus indicates the magnetic bearing to the selected ADF station. The ADF bearing can also be indicated on the EHSI.

If two systems are installed they are completely separated. The bearing indication is displayed by RMI pointers. Single pointer indicates ADF 1 and double pointer indicates ADF 2. L EHSI ADF indicates ADF 1 bearing and R EHSI ADF pointer indicates ADF 2 bearing.

With only one system installed all ADF pointers will indicate the ADF 1 bearing.

2. MAIN COMPONENTS AND SUBSYSTEMS.

2. 1. Antenna.

There is one antenna installed for each system. ADF 1 in the bottom of the fuselage and ADF 2 (if installed) on the top of the fuselage. The antenna is of the integrated type i.e. it contains a loop and a sense antenna. An amplifier provides outputs to the ADF receivers.

2. 2. Controls unit.

The principal part of the control unit is the microprocessor which senses switch and selector positions, transfers them into frequency and mode information and finally generates adequate control signals to the receiver.

The control unit is also provided with a gas discharge type of display for two frequencies, one active and one standby.

A programmable Memory facility is also contained in the control unit. The Memory provides nine pre-programmed frequencies by momentarily pressing the CHAN button and thereafter, choosing frequency by means of the Frequency selector.

2. 3. Receiver

The receiver consists principally of two parts, the normal radio and audio amplifiers for the station signals and a circuitry to determine the direction to the station.

2. 4. System function.

When in the normal mode (ADF), the signals from the selected station are routed to the audio integrating system and can be heard as an identification signals. The signals are also routed to a circuit that determinates the bearing to the station. In ANT mode the loop antenna output is disabled and the result is only audio without bearing indication. In TONE mode unmodulated signals (Continuous Wave, CW) are received and identified.

By using the ADF switch on the RMI, the ADF bearing indication can be displayed on the RMI. With the BRG button on the display control panel (DCP) the ADF bearing indication can be displayed on the EHSI or deselected from the EHSI.

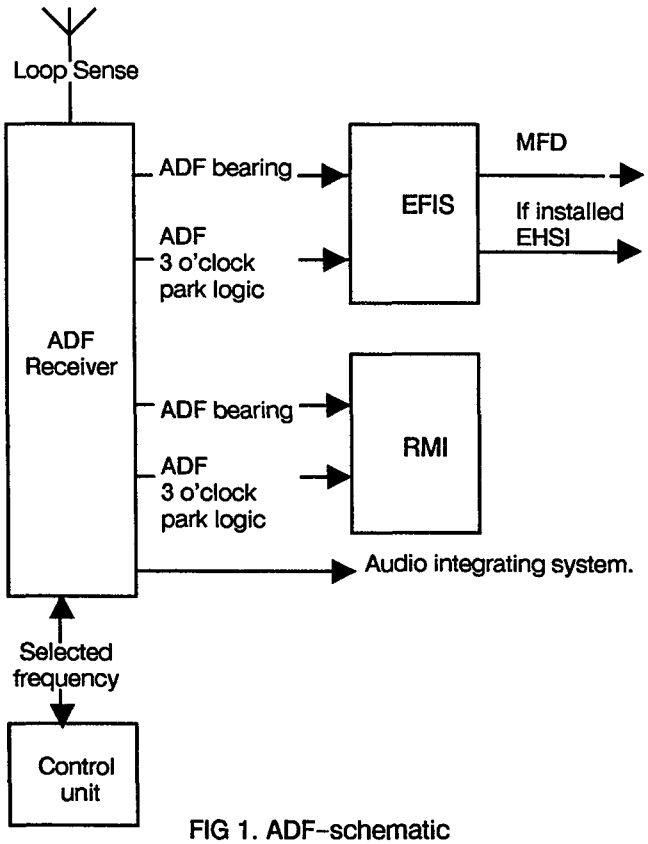
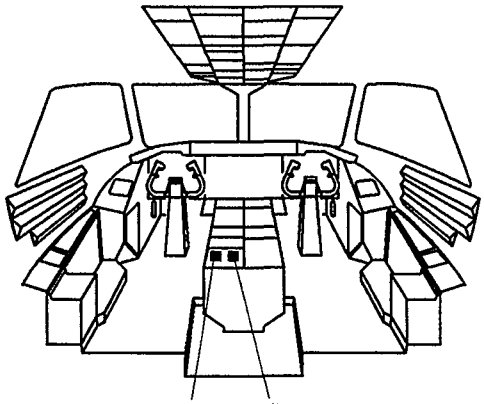


FIG 1. ADF-schematic

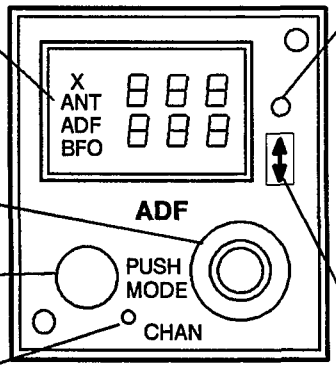
3. CONTROLS AND INDICATORS.



A ADF CONTROL UNIT WITH MEMORY

Frequency display.
Upper display - active frequency.
Lower display - standby frequency.
Display flashed if selected frequency less than 190 kHz. X Left of active frequency is displayed in ANT mode and when detector circuit not locked on a bearing.

Photocell.
Controls display brightness.



Frequency selector.
Large knob - Controls the two left digits (1000 and 100 kHz)
Small knob - Controls tens of kHz when pushed in and units of kHz pulled out.
- The selected frequency will appear in lower (standby) display.

Also see "Transfer button".
In memory mode, any of the two knobs will control the memory cells.

Function button.
When momentarily pressed:
ADF - Bearing indication and audio ident.
BFO - Adds a 1000 Hz signal for audio ident (CW).
ANT - Audio only.
BFO -Adds a 1000 Hz signals for audio ident (CW).

CHAN button.
When momentarily pressed:
- Unit enters 9 frequencies memory.
- Select memory frequency with Frequency selector then press CHAN or wait for 5 sec. (also see Transfer button).
- Selected frequency becomes standby.

When pressed and held for more than 2 seconds:
- Unit enters PROGRAM mode for 9 frequencies.
- Select memory cell to be programmed with Frequency selector, then momentarily press Transfer button.
- Select frequency to be stored. (Flashing display indicates which display is controlled by the frequency selector).
- For return to Normal, press CHAN or wait for 20 seconds.

Transfer button:
When momentarily pressed:
- Standby frequency moves to upper display and becomes active.
- Former active frequency moves to lower display and becomes standby.

When depressed for more than 2 seconds:
- Standby frequency display goes off.
- Frequency selectors control active frequency display.

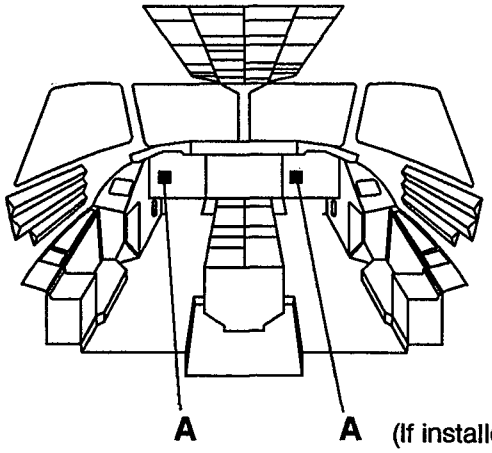
When momentarily pressed again:
- Standby frequency displayed again and function back to normal.

When pressed in CHANNEL mode:
- Selected frequency becomes active and former active frequency becomes standby.

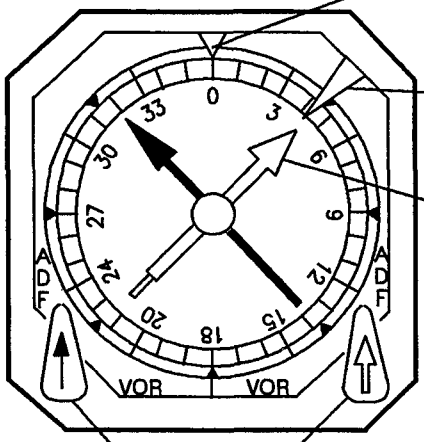
When pressed in PROGRAM mode:
- Frequency selector has control over either upper or Lower display for set-up of Memory.
- Flashing display indicates which display is controlled by the frequency selector.

A10063

FIG. 2 ADF - controls



A RADIO MAGNETIC INDICATOR



Magnetic Heading Index

Warning flag (red).

Comes into view for heading or power supply failures.

ADF pointer (if ADF selected).

Indicates magnetic bearing to the ADF station.

ADF1 – single pointer.

ADF2 – double pointer.

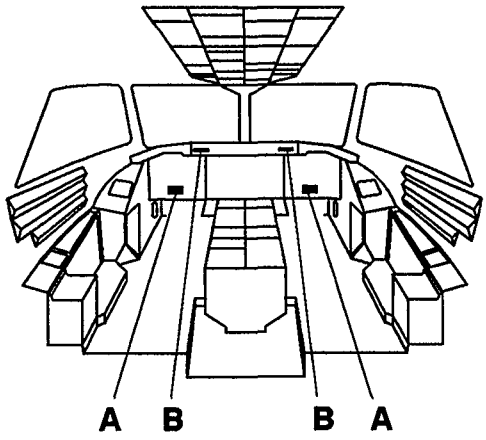
With only one ADF installed both ADF pointers will display "ADF1" bearing. ADF, power supply failures or no reception of selected station is indicated by pointer in parked position (3 o'clock).

ADF – VOR switch.

Selects ADF or VOR display for respective pointer.

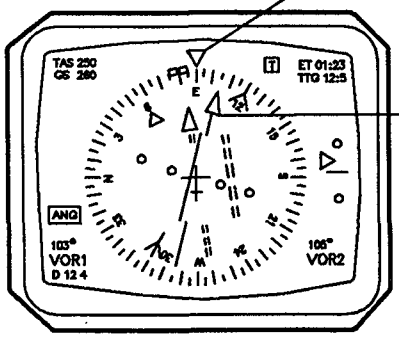
A10066

FIG. 3 RMI, ADF functions – controls and indicators.



Magnetic Heading Index

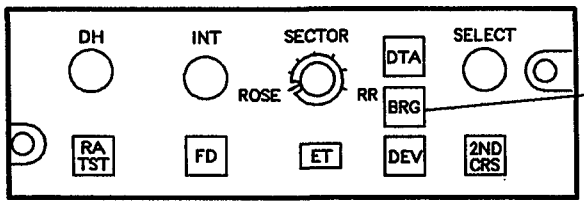
A EHSI ADF DISPLAY



ADF pointer (magenta).

Indicates magnetic bearing to the ADF station. ADF 1 on left EHSI, and ADF 2 on right EHSI. With only one ADF installed left and right EHSI will both display ADF 1. ADF, power supply failure or no reception of selected station is indicated by pointer in parking position at 3 o'clock and turning red.

B DISPLAY CONTROL BUTTON



BRG - button.

First push removes the ADF bearing pointer on the EHSI. Next push makes it reappear.

A10067

FIG. 4 EHSI, ADF functions and Display Control Panel - controls and indicators.

4. ELECTRICAL POWER SUPPLY.

ADF1	L AVIONIC BUS	E-18	ADF1
ADF2	R AVIONIC BUS	L-17	ADF2

1. LIMITATIONS.

Not applicable.

2. NORMAL OPERATION.

CONDITIONS	NORMAL PROCEDURES
2. 1. POWER UP.	1. ESS, L and R AVION switches ..... ON – The ADF systems are switched ON/OFF by ESS, L and R AVION switches.
2. 2. ADF SYSTEM TEST.	1. TEST button (ADF control unit) ..... PRESS AND HOLD – ADF pointer on EHSI and RMI rotate to a position 90° counterclockwise of previous indication. – 1000 Hz tone should be heard. – Control unit displays Diagnostics Fail Code mode. (Maintenance). 2. TEST button ..... RELEASE. – ADF pointer on EHSI and RMI returns to actual reading again.
2. 3. PROGRAMMING OF THE FREQUENCY MEMORY.	The Control unit contains four programmable memorycells. 1. XFR/MEM switch ..... MEM PRESS – Momentarily press switch to select memorycell to be programmed. 2. STO button ..... PRESS – Momentarily press STO to enter program mode. 3. Frequency selector ..... SET FREQUENCY – Set frequency in memorycell. 4. STO button ..... PRESS – Momentarily press STO to store frequency. – Control unit will also return to normal. 5. To set up next memory frequency, proceed with item 1 above. No activity for 3 seconds will return Control unit to normal display.

CONDITIONS	NORMAL PROCEDURES
2. 4. OPERATION.	**- Frequency set up.** 1. Frequency selector ..... SET FREQUENCY – Proceed with item 3 below. **- Frequency set–up from the memory.** 1. XFR/MEM switch ..... MEM PRESS – Momentarily press switch to MEM, will step through the memory for choice of frequency. 2. XFR/MEM switch ..... XFR PRESS – Momentarily press switch to XFR will make chosen memory frequency active. 3. Function selector ..... AS REQUIRED – ADF for bearing indications and audio. – ANT for audio only. – TONE provides a 1000 Hz tone for audio signal ident (CW). 4. VOICE/IDENT switch ..... IDENT 5. ADF volume lever ..... AS REQUIRED 6. Identify station. – If call signal is not heard, station frequency may be slightly above or below the published one. Try tuning 0.5 kHz above. If no result try 0.5 kHz below. 7. EHSI ..... CHECK – Check for correct indication. – ADF indication can be switched on/off by BRG button on the DCP. 8. RMI switches ..... ADF – Check for correct indication.

3. ABNORMAL OPERATION.

CONDITIONS	ABNORMAL PROCEDURES
3. 1. NO AUDIO SIGNAL.	**ACTIONS.** 1. Frequency selection ..... CHECK 2. Headsets/audio and circuits ..... CHECK 3. End of procedure.
3. 2. NO BEARING INDICATION WHEN WITHIN THE RANGE OF SELECTED STATION.	**ACTIONS.** **- Both RMI and EHSI affected.** 1. Function selector (ADF control unit) ..... CHECK ADF 2. CB's E-18 (ADF 1), L-17 (ADF 2) ..... CHECK/RESET 3. End of procedure. **- Only RMI affected.** 1. 26V inverter switch ..... STBY INV If dual Main Inverters installed: 1. INVERTER switch ..... 1 or 2 – Select the other Inverter. 2. End of procedure. **- Only EHSI affected.** 1. BRG button, DCP ..... CHECK/RESET 2. End of procedure.
3. 3. ADF CONTROL UNIT FAILURE.	**INDICATIONS.** The control unit frequency display goes out. **ACTIONS.** 1. CB's, E-18 (ADF 1), L-17 (ADF 2) ..... CHECK/RESET 2. End of procedure.

1. LIMITATIONS.

Not applicable.

2. NORMAL OPERATION.

CONDITIONS	NORMAL PROCEDURES
2. 1. POWER UP.	1. ESS, L and R AVION switches ..... ON – The ADF systems are switched ON/OFF by ESS, L and R AVION switches.
2. 2. OPERATION.	**Frequency set up.** 1. Frequency selector ..... SET FREQUENCY 2. Function selector ..... AS REQUIRED – ADF for bearing indications and audio ident. – BFO adds a 1000 Hz tone for audio ident (CW). – ANT for audio only. – BFO adds a 1000 Hz tone for audio ident (CW). 3. VOICE/IDENT switch ..... IDENT 4. ADF volume lever ..... AS REQUIRED 5. Identify station. – If call signal is not heard, station frequency may be slightly above or below the published one. Try tuning 1000 Hz above. If no result try 1000 Hz below. 6. EHSI ..... CHECK – Check for correct indication. – ADF indication can be switched on/off by BRG button on the DCP. 7. RMI switches ..... ADF – Check for correct indication.

3. ABNORMAL OPERATION.

CONDITIONS	ABNORMAL PROCEDURES
3. 1. NO AUDIO SIGNAL.	**ACTIONS.** 1. Frequency selection ..... CHECK 2. Headsets/audio and circuits ..... CHECK 3. End of procedure.
3. 2. NO BEARING INDICATION WHEN WITHIN THE RANGE OF SELECTED STATION.	**ACTIONS.** ◆ - **Both RMI and EHSI affected.** 1. Function selector (ADF control unit) ..... CHECK ADF 2. CB's E–18 (ADF 1), L–17 (ADF 2) ..... CHECK/RESET 3. End of procedure. ◆ - **Only RMI affected.** 1. 26V inverter switch ..... STBY INV If dual Main Inverters installed: 1. INVERTER switch ..... 1 or 2 – Select the other Inverter. 2. End of procedure. ◆ - **Only EHSI affected.** 1. BRG button, DCP ..... CHECK 2. End of procedure.
3. 3. ADF CONTROL UNIT FAILURE.	**INDICATIONS.** The control unit frequency display goes out. **ACTIONS.** 1. CB's, E–18 (ADF 1), L–17 (ADF 2) ..... CHECK/RESET 2. End of procedure.

1. LIMITATIONS.

Not applicable.

2. NORMAL OPERATION.

CONDITIONS	NORMAL PROCEDURES
2. 1. POWER UP.	1. ESS, L and R AVION switches ..... ON – The ADF systems are switched ON/OFF by ESS, L and R AVION switches.
2. 2. PROGRAMMING OF THE FREQUENCY MEMORY.	The Control unit contains nine programmable memorycells. 1. CHAN button ..... PRESS 2 SEC – Momentarily press CHAN button for more than 2 seconds to enter program mode. 2. Frequency selector ..... SELECT MEMORYCELL – Any one of the two knobs will control the memorycells. 3. Transfer button ..... PRESS – When momentarily pressed gives frequency selector control over either upper or lower display. – Controlled display is flashing. 4. Frequency selector ..... SET ◆ – **To program next frequency:** 5. Transfer button ..... PRESS – Proceed with item 2 above. ◆ – **For return of Control unit to normal display:** 5. CHAN button ..... PRESS No activity for 20 seconds will also return Control unit to normal display.

CONDITIONS	NORMAL PROCEDURES
2. 3. OPERATION.	◆ - **Frequency set up.** 1. Frequency selector ..... SET FREQUENCY - Proceed with item 4 below. ◆ - **Frequency set-up from the memory.** 1. CHAN button ..... PRESS - Momentarily press CHAN to enter the frequency memory. 2. Frequency selector ..... CHOSE MEMORY FREQUENCY - Any one of the two knobs will control the memorycells. 3 Transfer button ..... PRESS - Momentarily prress Transfer button to make chosen memory frequency active. - Or, no activity for 5 seconds will make chosen memory frequency standby (SBY). 4. Function selector ..... AS REQUIRED - ADF for bearing indication and audio ident. - BFO adds a 1000 Hz tone for audio ident (CW). - ANT for audio only. - BFO adds a 1000 Hz tone for audio ident (CW). 5. VOICE/IDENT switch ..... IDENT 6. ADF volume lever ..... AS REQUIRED 7. Identify station. - If call signal is not heard, station frequency may be slightly above or below the published one. Try tuning 1000 Hz above. If no result try 1000 kHz below. 8. EHSI ..... CHECK - Check for correct indication. - ADF indication can be switched on/off by BRG button on the DCP. 9. RMI switches ..... ADF - Check for correct indication.

3. ABNORMAL OPERATION.

CONDITIONS	ABNORMAL PROCEDURES
3. 1. NO AUDIO SIGNAL.	**ACTIONS.** 1. Frequency selection ..... CHECK 2. Headsets/audio and circuits ..... CHECK 3. End of procedure.
3. 2. NO BEARING INDICATION WHEN WITHIN THE RANGE OF SELECTED STATION.	**ACTIONS.** ◆ - **Both RMI and EHSI affected.** 1. Function selector (ADF control unit) ..... CHECK ADF 2. CB's E–18 (ADF 1), L–17 (ADF 2) ..... CHECK/RESET 3. End of procedure. ◆ - **Only RMI affected.** 1. 26V inverter switch ..... STBY INV If dual Main Inverters installed: 1. INVERTER switch ..... 1 or 2 – Select the other Inverter. 2. End of procedure. ◆ - **Only EHSI affected.** 1. BRG button, DCP ..... CHECK 2. End of procedure.
3. 3. ADF CONTROL UNIT FAILURE.	**INDICATIONS.** The control unit frequency display goes out. **ACTIONS.** 1. CB's, E–18 (ADF 1), L–17 (ADF 2) ..... CHECK/RESET 2. End of procedure.

1. GENERAL.

The VOR/ILS Marker system receives signals from the selected station (VOR or ILS) and presents them as navigation information on EFIS, RMI and a VOR/ILS indicator.This information is also sent to the FD/AP as guidance for navigation and approach. The station identification signal as well as the Marker signals can be heard over the audio integrating system. This function, reception and generation of indicator and guidance data, is performed by the navigation receiver. There are two such systems installed (only one marker system, part of NAV 1 is used). The distribution of data is shown in Figure 1.

The VOR or ILS frequencies are selected on the two control units, located on the glarshield panel. When a VOR or ILS frequency is selected, the DME frequency, if paired to that station, is also automatically selected.

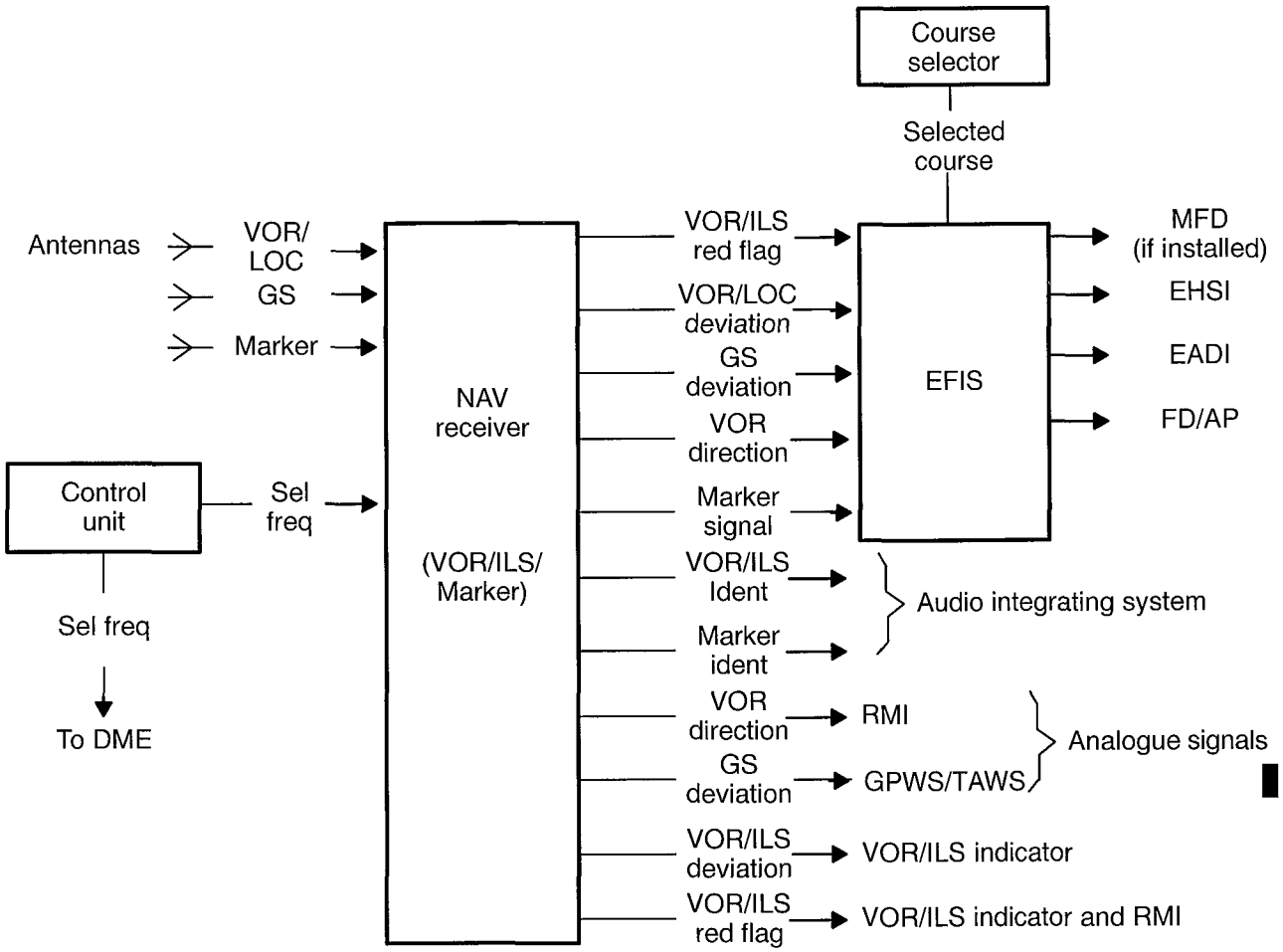


Fig. 1. VOR/ILS/Marker system – schematic.

2. MAIN COMPONENTS AND SUBSYTEMS.

2.1. Control unit.

The control unit can display two frequencies, one active that tunes the receiver and one as standby which easily can be made active. The unit is provided with the necessary controls for frequency –and transfer selection. A selected DME station can be retained by a HOLD mode and a new VOR/ILS or DME frequency can be tuned without affecting DME function.

A programmable Memory facility is also contained in the control unit. The Memory provides four preprogrammed frequencies. To select a Memory frequency, simply step through the Memory by, operating the XFR/MEM switch momentarily in MEM position.

2.2. Navigation receiver.

The navigation receiver contains circuitry for the VOR, ILS (Localizer and glideslope) and marker functions.

VOR.

Both a frequency and the course (CRS) to a station has to be selected. The receiver then compares the received radial with the selected course and calculates the deviation. The selected course and deviation is displayed on the EHSI and on the VOR/ILS indicator. The deviation is Angular presented, as announced on the EHSI by the letters ANG. The RMI will display magnetic bearing to the received VOR station.

– Angular means that the displayed deviation represents the angle between aircraft and selected radial and is thus unaffected of distance.

TO and FROM indication is determinated by the system from the selected course with respect to the received radial.

The magnetic information for the presentation of the course is received from the Attitude Heading Reference System (AHRS). See AOM 15/8.1. The VOR receiver also generates a flag signal which, in case of failure or no reception of selected station, displays VOR in red on EFIS and a red NAV flag on the VOR/ILS indicator. The flag also drives the RMI VOR pointers to a 3 o'clock parking position.

ILS.

When an ILS frequency is selected, both the localizer and the glideslope receivers are tuned to that frequency. The receivers determinate the aircraft movements with respect to received localizer and gliseslope signals and with selected localizer inbound course (CRS 1/CRS 2 knobs). The aircraft movements are then converted into direct proportional localizer and glideslope deviations. The localizer and glideslope deviations and displayed on the EADI and EHSI by LOC and GS symbols and on the VOR/ILS indicator, by localizer and glideslope bars.

Marker.

The marker system receives the signals from the marker beacon stations and determines which type of marker is present. The station signals are then modulates and presented on the EADI as follows:

– 400 Hz for outer marker (CYAN).

– 1300 Hz for middle marker (AMBER).

– 3000 Hz for inner (airway) marker (WHITE).

The marker audio signals are filtered out and made audible via the audio integrating system.

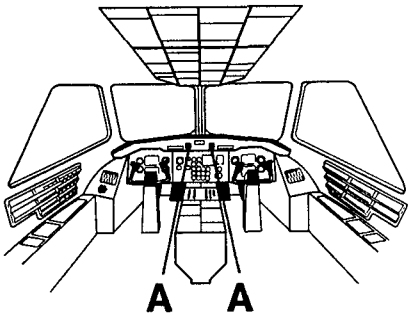
2.3. Antennas.

– A dual antenna is used for the VOR/LOC signals. It is located on top of the fin.

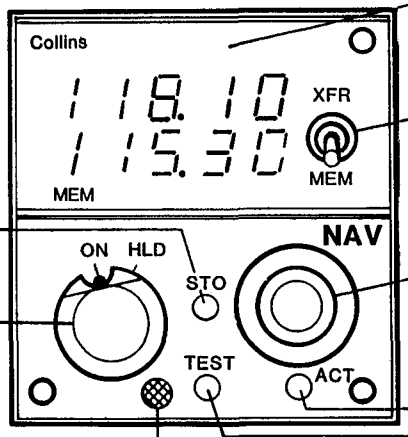
– A dual antenna is also used for the glideslope signals. This antenna is installed inside the nose radome.

– The marker signals are received by an antenna mounted on the bottom of the fuselage just forward of the wing.

3. CONTROLS AND INDICATORS.



A NAV CONTROL UNIT WITH MEMORY



Frequency display.
Upper display - Active frequency.
Lower display - Standby frequency.

XFR/MEM switch.
When switched momentarily to:
XFR - Standby frequency moves to upper display and becomes active.
- Former active frequency moves to lower display and becomes standby.
MEM - Steps through the four preprogrammed frequency's.
- After chosen a frequency, XFR/MEM switch to XFR position, to make memory frequency active.

Frequency selector.
Normaly controls standby frequency display:
- Larger knob - Controls the three left digits (MHz).
- Smaller knob - Controls the two right digits (kHz).

ACT button.
When depressed for more than 2 seconds:
- Standby frequency display goes off. Frequency selector controls active frequency display.

For return to normal:
- Depress for more than 2 seconds.

Photocell.
Controls display brightness.

Function selector.
NORM - DME station paired to active frequency in upper display.
HOLD - System holds DME station. A new frequency can be tuned without affecting DME function.
- Standby display will show held DME stations frequency.
- Frequency selector controls active display.

TEST button.
When pressed and held:
- Control unit enters and displays Diagnostics Fail Code mode (maintenance).

And if an ILS frequency selected (for approx. 12 s):
- And CRS 1 or CRS 2 set at present aircraft heading, LOC goes to the right and GS goes down on EFIS and GS bar goes down on the VOR/ILS Indicator.
- A 30 Hz marker tone is heard and marker is indicated by alternatley display of M, MM and OM.
- DME D, GSP, TTG readouts: turnes to dashes.

And if a VOR frequency selected (for approx. 12 s):
- Deviation bar on EHSI centered and TO indication, if course selected 360° (CRS 1 or CRS 2). (VOR/ILS Indicator not affected)
- A 30 Hz marker tone is heard and marker is indicated by alternately display of M, MM and OM.
- DME D, GSP, TTG readouts: turns to dashes.
- RMI pointer to 360° (VOR).

NOTE:
The test is inhibited when AP engaged in NAV or APPR mode.

STO button.
Select memorycell to program (CH.-) with XFR/MEM switch then momentarily press STO button:
- Control unit enters Program mode. Setup frequency with frequency selector. Press STO button to store frequency.
- XFR/MEM switch for next memorycell (CH.-)...
- No activity for 3 seconds, returns display to normal.

Fig. 2. NAV - controls.

INTENTIONALLY LEFT BLANK

1. GENERAL.

The VOR/ILS Marker system receives signals from the selected station (VOR or ILS) and presents them as navigation information on EFIS, RMI and a VOR/ILS indicator.This information is also sent to the FD/AP as guidance for navigation and approach. The station identification signal as well as the Marker signals can be heard over the audio integrating system. This function, reception and generation of indicator and guidance data, is performed by the navigation receiver. There are two such systems installed (only one marker system, part of NAV 1 is used). The distribution of data is shown in Figure 1.

The VOR or ILS frequencies are selected on the two control units, located on the glarshield panel. When a VOR or ILS frequency is selected, the DME frequency, if paired to that station, is also automatically selected.

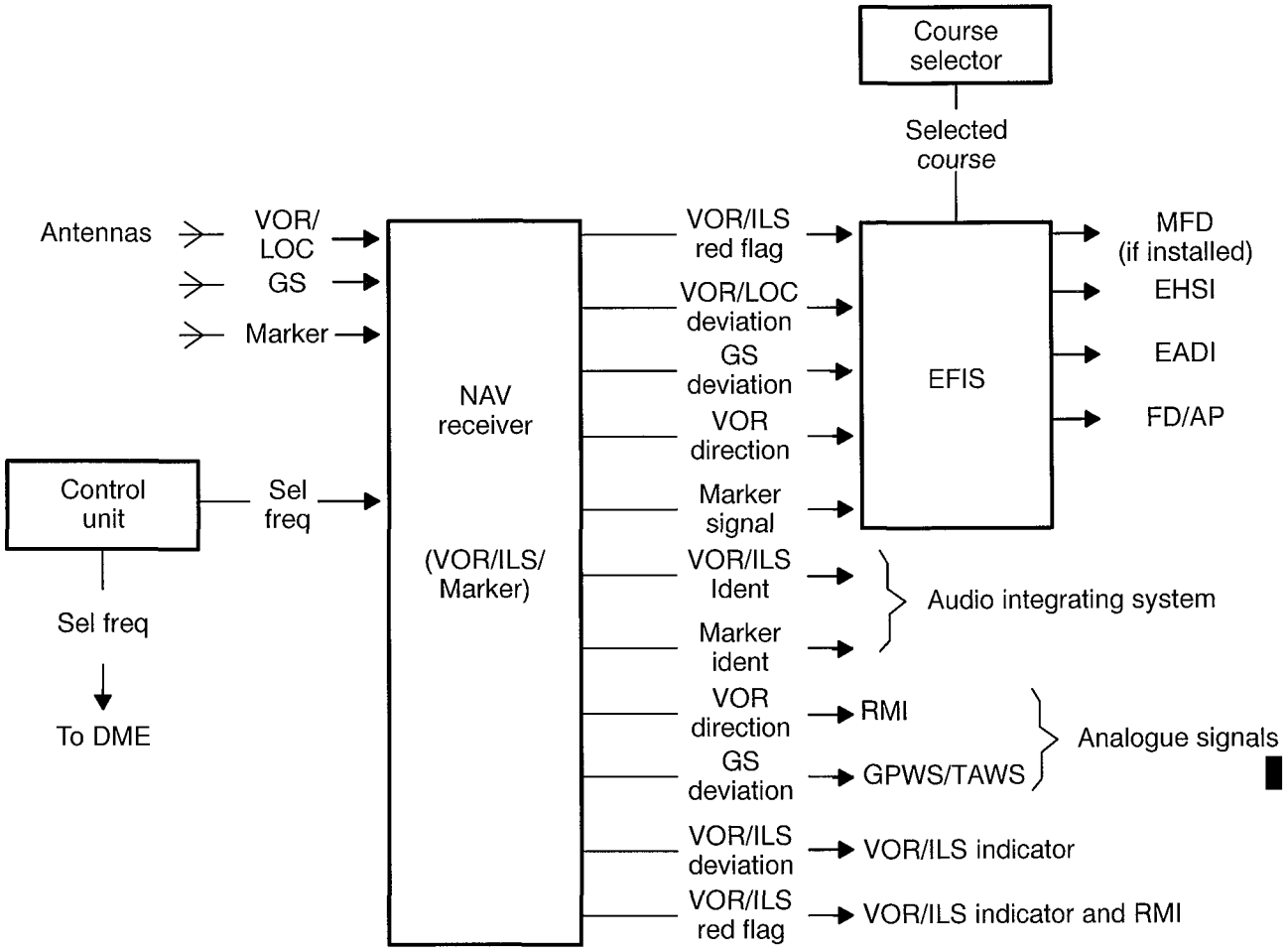


Fig. 1. VOR/ILS/Marker system – schematic.

2. MAIN COMPONENTS AND SUBSYTEMS.

2.1. Control unit.

The control unit can display two frequencies, one active that tunes the receiver and one as standby which easily can be made active. The unit is provided with the necessary controls for frequency –and transfer selection. A selected DME station can be retained by a HOLD mode and a new VOR/ILS or DME frequency can be tuned without affecting DME function.

2.2. Navigation receiver.

The navigation receiver contains circuitry for the VOR, ILS (Localizer and glideslope) and marker functions.

VOR.

Both a frequency and the course (CRS) to a station has to be selected. The receiver then compares the received radial with the selected course and calculates the deviation. The selected course and deviation is displayed on the EHSI and on the VOR/ILS indicator. The deviation is Angular presented, as announced on the EHSI by the letters ANG. The RMI will display magnetic bearing to the received VOR station.

– Angular means that the displayed deviation represents the angle between aircraft and selected radial and is thus unaffected of distance.

TO and FROM indication is determinated by the system from the selected course with respect to the received radial.

The magnetic information for the presentation of the course is received from the Attitude Heading Reference System (AHRS). See AOM 15/8.1. The VOR receiver also generates a flag signal which, in case of failure or no reception of selected station, displays VOR in red on EFIS and a red NAV flag on the VOR/ILS indicator. The flag also drives the RMI VOR pointers to a 3 o'clock parking position.

ILS.

When an ILS frequency is selected, both the localizer and the glideslope receivers are tuned to that frequency. The receivers determinate the aircraft movements with respect to received localizer and gliseslope signals and with selected localizer inbound course (CRS 1/CRS 2 knobs). The aircraft movements are then converted into direct proportional localizer and glideslope deviations. The localizer and glideslope deviations and displayed on the EADI and EHSI by LOC and GS symbols and on the VOR/ILS indicator, by localizer and glideslope bars.

Marker.

The marker system receives the signals from the marker beacon stations and determines which type of marker is present. The station signals are then modulates and presented on the EADI as follows:

– 400 Hz for outer marker (CYAN).

– 1300 Hz for middle marker (AMBER).

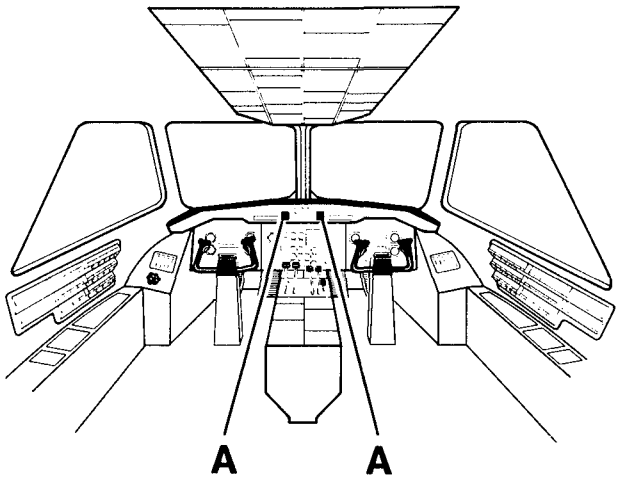
– 3000 Hz for inner (airway) marker (WHITE).

The marker audio signals are filtered out and made audible via the audio integrating system.

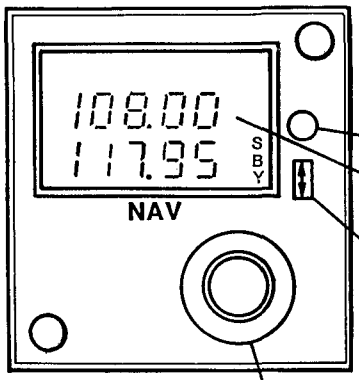
2.3. Antennas.

– A dual antenna is used for the VOR/LOC signals. It is located on top of the fin.
– A dual antenna is also used for the glideslope signals. This antenna is installed inside the nose radome.
– The marker signals are received by an antenna mounted on the bottom of the fuselage just forward of the wing.

3. CONTROLS AND INDICATORS.



A NAV CONTROL UNIT



Photocell.
Controls display brightness.

Frequency display.
Upper display - Active frequency.
Lower display - Standby frequency.

Transfer switch.
When pressed, standby frequency moves to upper display and becomes active.
Former active frequency moves to lower display and becomes standby.

Frequency selector.
Small knob - Controls the two right digits (kHz).
Large knob - Controls the three left digits (MHz).
When the small knob is pulled out, standby display goes off and the selector controls the active display.
When the small knob is pushed in standby display is returned and controlled by the selector.

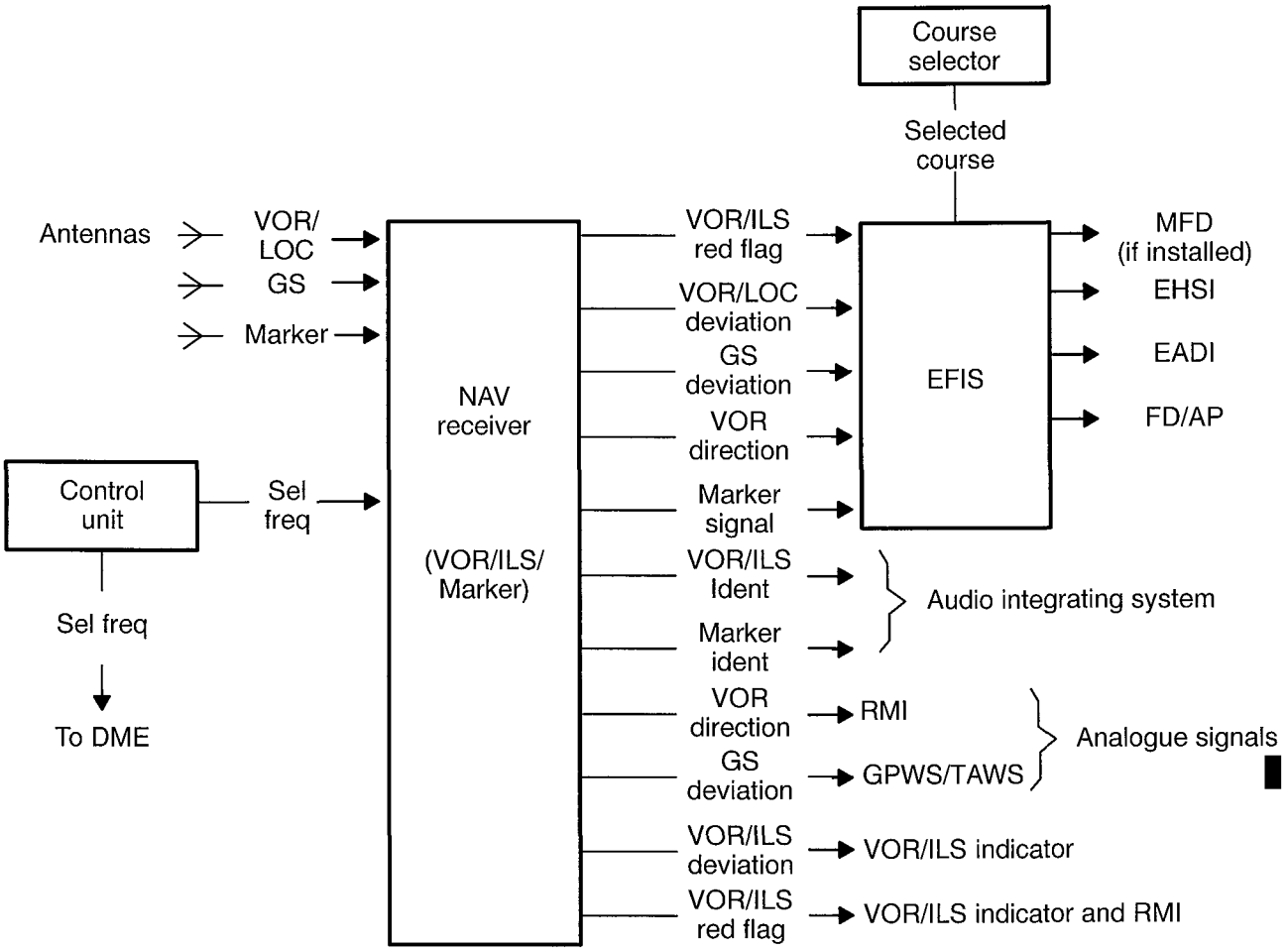
Fig. 2. NAV - controls.

INTENTIONALLY LEFT BLANK

1. GENERAL.

The VOR/ILS Marker system receives signals from the selected station (VOR or ILS) and presents them as navigation information on EFIS, RMI and a VOR/ILS indicator.This information is also sent to the FD/AP as guidance for navigation and approach. The station identification signal as well as the Marker signals can be heard over the audio integrating system. This function, reception and generation of indicator and guidance data, is performed by the navigation receiver. There are two such systems installed (only one marker system, part of NAV 1 is used). The distribution of data is shown in Figure 1.

The VOR or ILS frequencies are selected on the two control units, located on the glareshield panel. When a VOR or ILS frequency is selected, the DME frequency, if paired to that station, is also automatically selected.



A27945

Fig. 1. VOR/ILS/Marker system – schematic.

2. MAIN COMPONENTS AND SUBSYTEMS.

2.1. Control unit.

The control unit can display two frequencies, one active that tunes the receiver and one as standby which easily can be made active. The unit is provided with the necessary controls for frequency –and transfer selection. A selected DME station can be retained by a HOLD mode and a new VOR/ILS or DME frequency can be tuned without affecting DME function.

A programmable Memory facility is also contained in the control unit. The Memory provides nine pre–programmed frequencies, by momentarily pressing the CHAN button and thereafter, choose frequency by means of the Frequency selector.

2.2. Navigation receiver.

The navigation receiver contains circuitry for the VOR, ILS (Localizer and glideslope) and marker functions.

VOR.

Both a frequency and the course (CRS) to a station has to be selected. The receiver then compares the received radial with the selected course and calculates the deviation. The selected course and deviation is displayed on the EHSI and on the VOR/ILS indicator. The deviation is Angular presented, as announced on the EHSI by the letters ANG. The RMI will display magnetic bearing to the received VOR station.

– Angular means that the displayed deviation represents the angle between aircraft and selected radial and is thus unaffected of distance.

TO and FROM indication is determinated by the system from the selected course with respect to the received radial.

The magnetic information for the presentation of the course is received from the Attitude Heading Reference System (AHRS). See AOM 15/8.1. The VOR receiver also generates a flag signal which, in case of failure or no reception of selected station, displays VOR in red on EFIS and a red NAV flag on the VOR/ILS indicator. The flag also drives the RMI VOR pointers to a 3 o'clock parking position.

ILS.

When an ILS frequency is selected, both the localizer and the glideslope receivers are tuned to that frequency. The receivers determinate the aircraft movements with respect to received localizer and glideslope signals and with selected localizer inbound course (CRS 1/CRS 2 knobs). The aircraft movements are then converted into direct proportional localizer and glideslope deviations. The localizer and glideslope deviations and displayed on the EADI and EHSI by LOC and GS symbols and on the VOR/ILS indicator, by localizer and glideslope bars.

Marker.

The marker system receives the signals from the marker beacon stations and determines which type of marker is present. The station signals are then modulates and presented on the EADI as follows:

– 400 Hz for outer marker (CYAN).

– 1300 Hz for middle marker (AMBER).

– 3000 Hz for inner (airway) marker (WHITE).

The marker audio signals are filtered out and made audible via the audio integrating system.

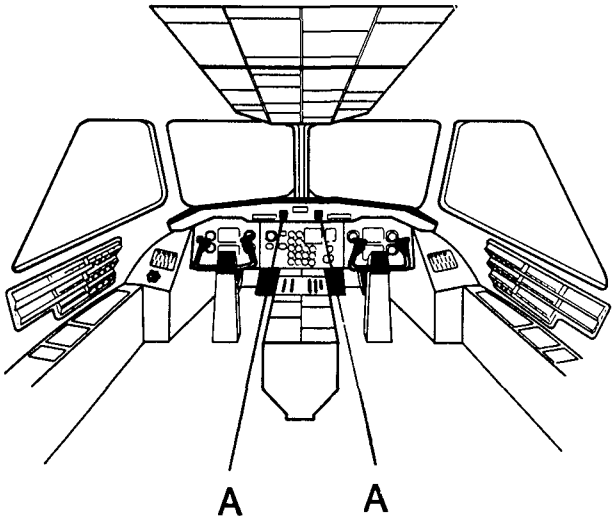
2.3. Antennas.

– A dual antenna is used for the VOR/LOC signals. It is located on top of the fin.

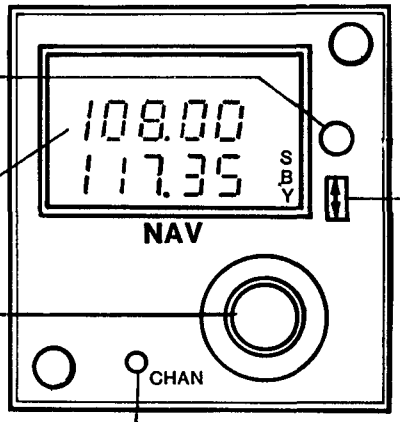
– A dual antenna is also used for the glideslope signals. This antenna is installed inside the nose radome.

– The marker signals are received by an antenna mounted on the bottom of the fuselage just forward of the wing.

3. CONTROLS AND INDICATORS.



A NAV CONTROL UNIT WITH MEMORY



Photocell.
Controls display brightness.

Frequency display.
Upper display - Active frequency.
Lower display - Standby frequency.

Frequency selector.
Large knob - Controls the three left digits (MHz).
Small knob - Controls the two right digits (kHz).
The selected frequency will appear in lower (standby) display.
See also "Transfer button".

CHAN button.
When momentarily pressed:
- Unit enters 9 frequency's CHANNEL mode.
- Select frequency with frequency selector then, press CHAN or wait for 5 seconds (also see Transfer button).
- Selected frequency becomes standby.

When pressed and hold for more than 2 seconds:
- Unit enters PROGRAM mode for 9 frequency's.
- Select CHANNEL to be programmed, then momentarily press Transfer button.
- Select frequency to be stored. (Flashing display indicates which display is controled by the frequency selector.)
- For return to Normal, press CHAN or wait for 20 seconds.

Transfer button.
When momentarily pressed:
- Standby frequency moves to upper display and becomes active.
- Former active frequency moves to lower display and becomes standby.

When depressed for more than 2 seconds:
- Standby frequency display goes off.
- Frequency selectors control active frequency display.

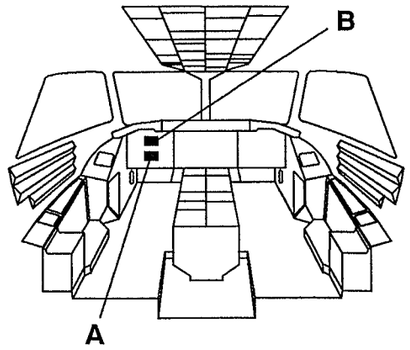
When pressed again momentarily:
- Standby frequency displayed again and function back to normal.

When pressed in CHANNEL mode:
- Selected frequency becomes active and former active frequency becomes standby.

When pressed in PROGRAM mode:
- Frequency selector controls either one of Upper/Lower display for setup of Memory.

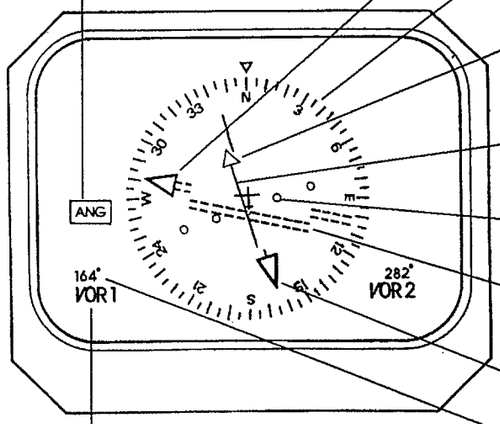
Fig. 2. NAV - controls.

INTENTIONALLY LEFT BLANK



ANG display (blue).
Angular presentation of VOR deviation AOM 15/1.1 EFIS.

A L EHSI VOR/LOC DISPLAYS



NAV source flag.
NAV 1 source in left corner (cyan). NAV 2 source in right corner (green). If no reception or if system fails, indication turnes red and flashes for 10 s then steady.

NAV selected course.
VOR 1/LOC 1 in left corner (cyan).
VOR 2/LOC 2 in right corner (green).

NAV 1 selected course pointer (cyan).

NAV 2 VOR/LOC course deviation bar (green).
Disappears when NAV 2 source red flag comes on.

Deviation scale (cyan).

NAV 1 VOR/LOC course deviation bar (cyan).
Disappears when NAV1 source red flag comes on.

NAV 1 To–From indication.
Disappears when NAV 1 source red flag comes on. No To–From indication on second course pointer.

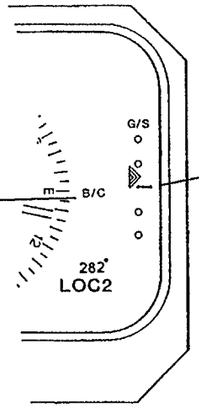
Compass rose (white).

NAV 2 selected course pointer (green).
NAV 2 is second course on left EHSI wich is indicated by the dashed pointer.

Localizer back course indication.
- The back course is automatically corrected for by EFIS and annunciated by a yellow B/C replacing the GS indication on the EADI/EHSI. With the CRS selector set for the normal localizer inbound course, the LOC symbol on the EADI is not reversed when flying:
- Inbound on the back course.
- Outbound on the localizer inbound course.

A12112

B L EADI ILS/MARKER DISPLAYS

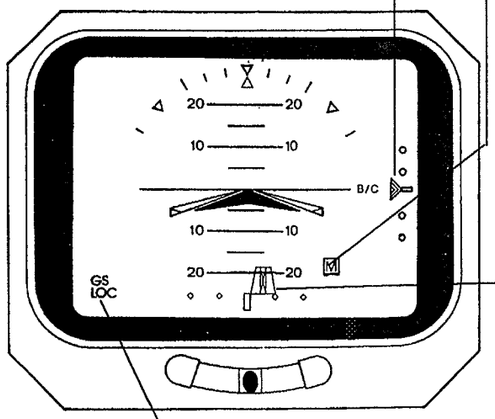


Glideslope deviation display.
- Scale in white dots, moving Glide Path symbol in blue.
- In case of GS failure or no reception, GS within red box will appear, flash for 10s then become steady.
- In case of excessive GS deviation when between 90 and 600 ft radioheight the pointer colour will change to yellow – back to normal – yellow etc. until deviation within limit again. Limit = 0,85 dot.

Marker display.
OM in cyan – Outer Marker.
MM in yellow – Middle Marker.
M in white – Inner Marker.

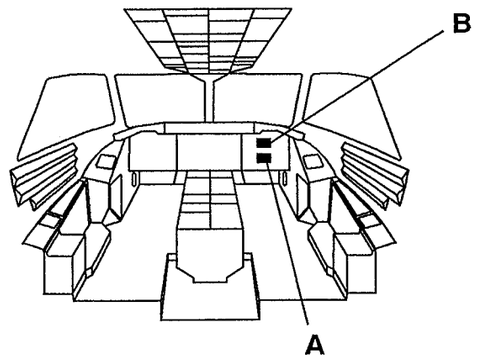
Localizer deviation display.
- Scale in white dots, moving runway symbol in green.
- In case of localizer failure or no reception LOC within red box will appear, flash for 10s then steady.
- In case of excessive LOC deviation when between 90 and 600 ft radioheight the pointer colour will change to yellow – back to normal – yellow etc. until deviation within limit again. Limit = 0,25 dot.

Back course indication:
- The back course is automatically corrected for by EFIS and annunciated by a yellow B/C replacing the GS indication on the EADI/EHSI. With the CRS selector set for the normal localizer inbound course, the LOC symbol on the EADI is not reversed when flying:
- Inbound on the back course.
- Outbound on the localizer inbound course.



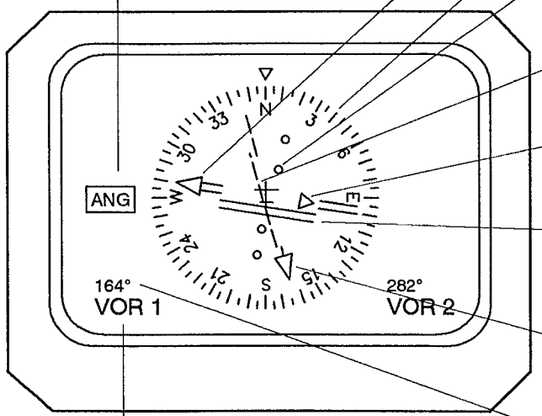
Glideslope–Localizer comparator caution.
- The comparator caution is enabled below 1000 ft radio height.
- Comes on for a discrepancy of approx 1/2 dot for GS and approx 1/3 dot for LOC. CWP.
- AVIONICS light will come on flashing together with master cautions. The AVIONICS light will revert to steady when caution is reset. The caution indication will disappear when the error no longer exists.

FIG. 3. L EHSI – VOR display and L EADI – ILS/Marker display – indicators.



ANG display (green).
Angular presentation of VOR deviation AOM 15/1.1 EFIS.

A R EHSI VOR/LOC DISPLAYS



NAV source flag.
NAV 1 source in left corner (cyan). NAV 2 source in right corner (green). If no reception or if system fails, indication turnes red and flashes for 10 s then steady.

NAV 2 selected course pointer (green).

Compass rose (white).

Deviation scale (green).

NAV 1 VOR/LOC course deviation bar (cyan).
Disappears when NAV source red flag comes on.

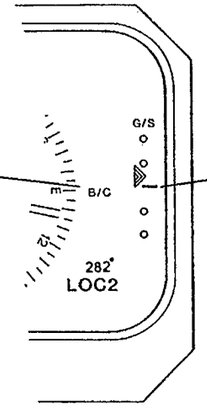
NAV 2 To–From indication.
Disappears when NAV 2 source red flag comes on. No To–From indication on second course pointer.

NAV 2 VOR/LOC course deviation bar (green).
Disappears when NAV 2 source red flag comes on.

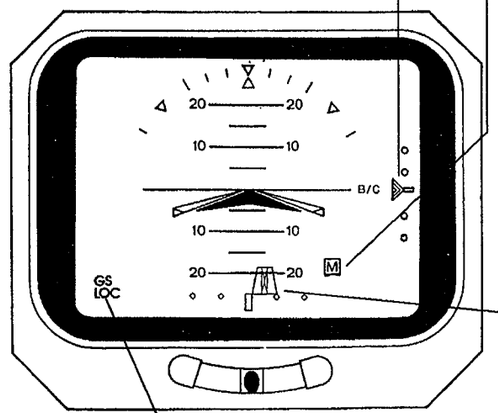
NAV 1 selected course pointer (cyan).
NAV 1 is second course on right EHSI wich is indicated by the dashed pointer.

NAV selected course.
VOR 1/LOC 1 in left corner (cyan).
VOR 2/LOC 2 in right corner (green).

Localizer back course indication.
- The back course is automatically corrected for by EFIS and annunciated by a yellow B/C replacing the GS indication on the EADI/EHSI. With the CRS selector set for the normal localizer inbound course, the LOC symbol on the EADI is not reversed when flying:
- Inbound on the back course.
- Outbound on the localizer inbound course.



B R EADI ILS/MARKER DISPLAYS



Glideslope deviation display.
- Scale in white dots, moving Glide Path symbol in blue.
- In case of GS failure or no reception, GS within red box will appear, flash for 10s then become steady.
- In case of excessive GS deviation when between 90 and 600 ft radioheight the pointer colour will change to yellow – back to normal – yellow etc. until deviation within limit again. Limit = 0,85 dot.

Marker display.
OM in cyan – Outer Marker.
MM in yellow – Middle Marker.
M in white – Inner Marker.

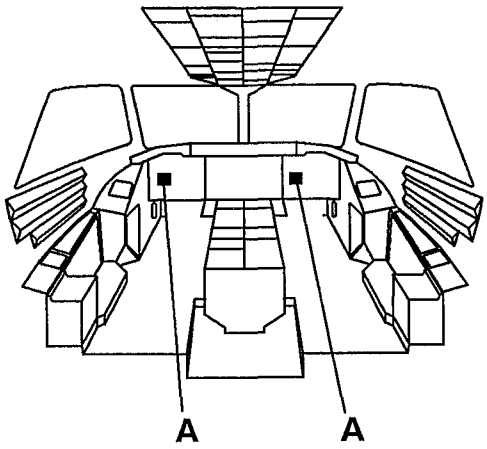
Localizer deviation display.
- Scale in white dots, moving runway symbol in blue.
- In case of localizer failure or no reception LOC within red box will appear, flash for 10s then steady.
- In case of excessive LOC deviation when between 90 and 600 ft radioheight the pointer colour will change to yellow – back to normal – yellow etc. until deviation within limit again. Limit = 0,25 dot.

Back course indication:
- The back course is automatically corrected for by EFIS and annunciated by a yellow B/C replacing the GS indication on the EADI/EHSI. With the CRS selector set for the normal localizer inbound course, the LOC symbol on the EADI is not reversed when flying:
- Inbound on the back course.
- Outbound on the localizer inbound course.

Glideslope–Localizer comparator caution.
- The comparator caution is enabled below 1000 ft radio height.
- Comes on for a discrepancy of approx 1/2 dot for GS and approx 1/3 dot for LOC. CWP.
- AVIONICS light will come on flashing together with master cautions. The AVIONICS light will revert to steady when caution is reset. The caution indication will disappear when the error no longer exists.

A12698

FIG. 4. R EHSI – VOR display and R EADI – ILS/Marker display – indicators.



NOTE

When a VOR station selected:

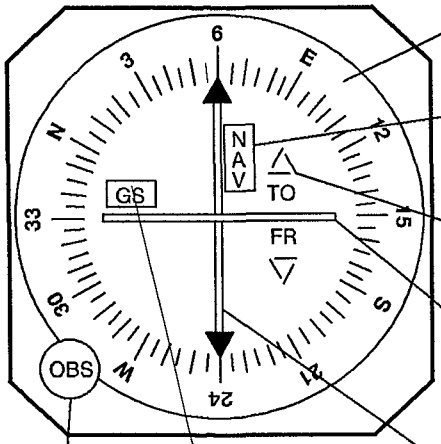
- Glideslope deviation bar parks at "Fly Up" position without the glideslope warning flag visible.

CAUTION

When flying back course approach:

- The standby VOR/ILS indicator will reverse the Localizer indication.
- Do not use the Glideslope indication.

A STANDBY VOR/ILS INDICATOR



Azimuth card.

VOR/LOC warning flag (red).

TO – FROM indication (white).

Glideslope deviation bar (white).

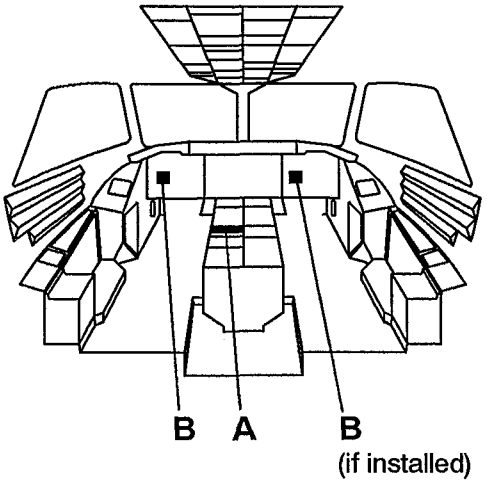
VOR/LOC deviation bar (white).

Omni Bearing Selector.

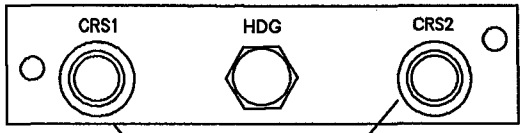
Glideslope warning flag (red).

A10136

Fig. 4. VOR/ILS indicator – controls and indicators.

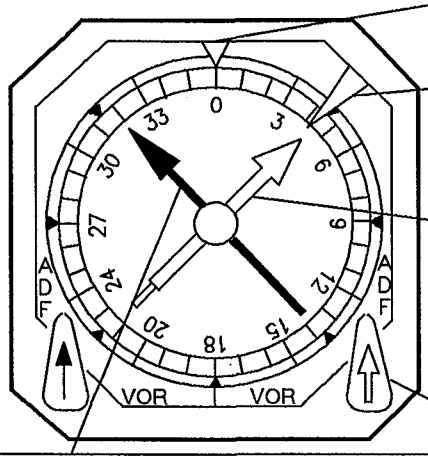


A COURSE HEADING PANEL



Course selector.
Selected course indicated on EHSI.
- CRS 1: NAV 1 course pointer.
- CRS 2: NAV 2 course pointer.

B RADIO MAGNETIC INDICATOR



Magnetic heading index.

Warning flag (red).
Comes into view for heading or power supply failures.

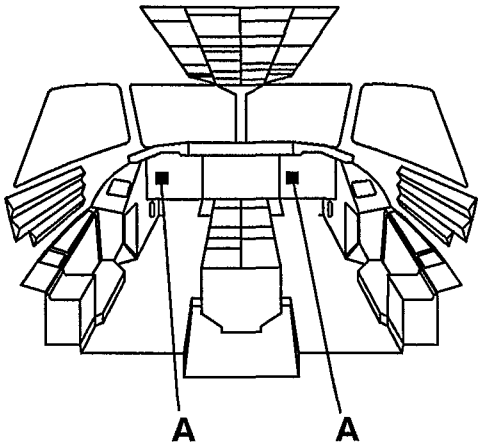
VOR 2 pointer (if VOR selected).
No station reception, VOR or power supply failure is indicated by pointer in parked position (3 o'clock).

ADF-VOR switch.
Selects information to the pointers.
Left switch – single pointer.
Right switch – double pointer

VOR 1 pointer (if VOR selected).
No station reception,VOR or power supply failure is indicat ed by pointer in parked position (3 o'clock).

A10776

Fig. 5. RMI and Course Heading Panel – controls and indicators

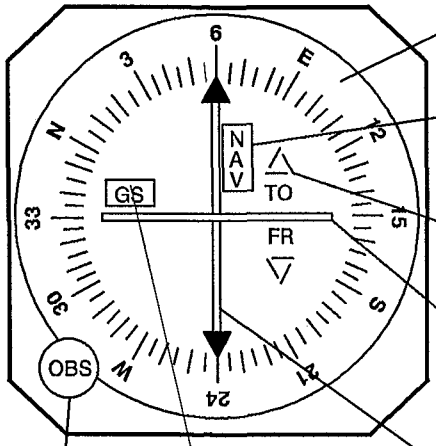


CAUTION

When flying back course approach:

- The standby VOR/ILS indicator will reverse the Localizer indication.
- Do not use the Glideslope indication.

A STANDBY VOR/ILS INDICATOR



Azimuth card.

VOR/LOC warning flag (red).

TO – FROM indication (white).

Glideslope deviation bar (white).

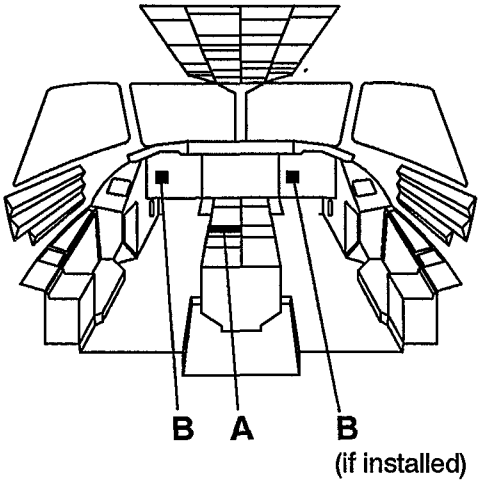
VOR/LOC deviation bar (white).

Omni Bearing Selector.

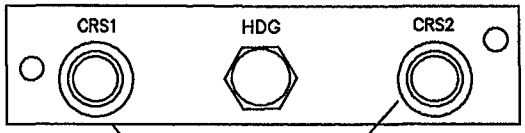
Glideslope warning flag (red).

A10136

Fig. 4. VOR/ILS indicator – controls and indicators.

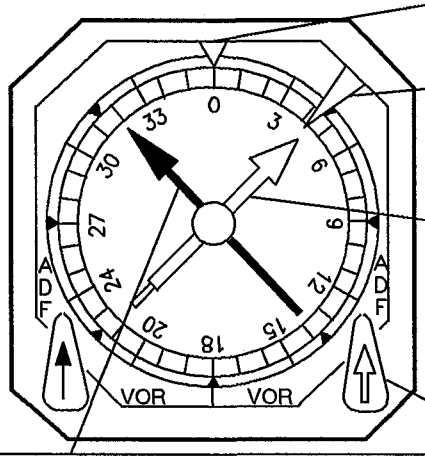


A COURSE HEADING PANEL



Course selector.
Selected course indicated on EHSI.
- CRS 1: NAV 1 course pointer.
- CRS 2: NAV 2 course pointer.

B RADIO MAGNETIC INDICATOR



Magnetic heading index.

Warning flag (red).
Comes into view for heading or power supply failures.

VOR 2 pointer (if VOR selected).
No station reception, VOR or power supply failure is indicated by pointer in parked position (3 o'clock).

ADF-VOR switch.
Selects information to the pointers.
Left switch – single pointer.
Right switch – double pointer

VOR 1 pointer (if VOR selected).
No station reception,VOR or power supply failure is indicat ed by pointer in parked position (3 o'clock).

A10776

Fig. 5. RMI and Course Heading Panel – controls and indicators

4. ELECTRICAL POWER SUPPLY.

VOR/ILS/Marker 1 ..... ESS AVIONIC BUS E-16 NAV 1
VOR/ILS/Marker 2 ..... R AVIONIC BUS L-15 NAV 2

1. LIMITATIONS.

Not applicable.

2. NORMAL OPERATION.

CONDITIONS	NORMAL PROCEDURES
2.1 POWER UP.	1. ESS, L and R AVION switch ..... ON - The NAV systems are switched ON/OFF by ESS, L and R AVION switches.
2.2 NAV SYSTEM TEST.	1. Frequency selector ..... SELECT AN ILS FREQUENCY 2. CRS knob ..... SELECT PRESENT AIRCRAFT HEADING 3. TEST button (NAV control unit) ..... PRESS AND HOLD - LOC goes to the right and GS goes down on EFIS and GS bar goes down on VOR/ILS indicator. - A 30 Hz marker tone is heard and marker indicated by flashing display. (NAV 1 only.) - DME 0, GSP, TTG readouts turns to dashes. - Control unit enters and displays Diagnostics Fail Code mode (maintenance). 4. TEST button ..... RELEASE 5. Frequency Selector ..... SELECT A VOR FREQUENCY 6. CRS knob ..... SELECT 360° 7. Test button (NAV control unit) ..... PRESS AND HOLD - Deviation bar on EHSI centered and TO indication, if course selected 360° (CRS 1 or CRS 2).(VOR/ILS Indicator not affected.) - A 30 Hz marker tone is heard and marker indicated by flashing display. (NAV 1 only.) - DME 0, GSP, TTG readouts turns to dashes.
(Cont'd)	

CONDITIONS	NORMAL PROCEDURES
(Cont'd)	- RMI pointer to 360° (VOR). - Control unit enters and displays Diagnostics Fail Code mode (maintenance). 8. TEST button ..... RELEASE
2.3 **PROGRAMMING OF THE FREQUENCY MEMORY.**	The Control unit contains four programmable memorycells. 1. XFR/MEM switch ..... MEM PRESS - Momentarily press switch to select memorycell to be programmed. 2. STO button ..... PRESS - Momentarily press STO to enter program mode. 3. Frequency selector ..... SET FREQUENCY - Set frequency in memorycell. 4. STO button ..... PRESS - Momentarily press STO to store frequency. - Control unit will also return to normal. 5. To set up next memory frequency, proceed with item 1 above. No activity for 3 seconds will return Control unit to normal display.
2.4 **VOR OPERATION.** (Cont'd)	◆----**If RNAV installed.** 1. SELECT knob, L DCP ..... SET - Rotate until VOR 1 is displayed in the lower left corner of both EHSI. - Proceed with frequency set up. ◆----**If RNAV not installed.**

CONDITIONS	NORMAL PROCEDURES
(Cont'd)	◆-**Frequency set up.** 1. Frequency selector ..... SET FREQUENCY - Proceed with item 3 below. ◆-**Frequency set up from the memory.** 1. XFR/MEM switch ..... MEM PRESS - Momentarily press switch to MEM will step through the memory for choice of frequency. 2. XFR/MEM switch ..... XFR PRESS - Momentarily press switch to XFR will make chosen memory frequency active. 3. VOICE/IDENT switch ..... IDENT 4. NAV volume lever ..... AS REQUIRED 5. Identify station. - When identifying a VOR or ILS, observe that a DME associated with a VOR or ILS localizer transmits its identification signal at 30 seconds intervals in synchronization with the identification signal of the VOR or ILS localizer. Since the DME and the VOR or ILS localizer have the same identity code letters,the DME signal is recognized by a slight increase in strength during transmission of the identity signal. In a 30 second period, the DME identification signal is thus transmitted once and the VOR or ILS localizer signal 3 times. 6. Mode selector, DCP ..... AS REQUIRED 7. CRS knob, CHP ..... AS REQUIRED 8. EHSI ..... CHECK - Check for correct indication. 9. RMI switch ..... VOR - Check RMI for correct indication.
(Cont'd)	

CONDITIONS	NORMAL PROCEDURES
(Cont'd)	N O T E - The possibility of a wrong EHSI/RMI indication with correct call sign and NAV source flag exist if the receiver is tuned 50 kHz off the ground station frequency. Always make sure the VOR receiver is correctly tuned by checking the frequency display. C A U T I O N Always assure proper ADF/VOR selection on the RMI before using the bearing pointer information.
2.5 ILS OPERATION. (Cont'd)	◆----**If RNAV installed.** 7. SELECT knob, L DCP ..... SET - Rotate until LOC 1 is displayed in the lower left corner of both EHSI. - Proceed with frequency set up. ◆----**If RNAV not installed.** ◆----**Frequency set up.** 1. Frequency selector ..... SET FREQUENCY - Proceed with item 3 below. ◆----**Frequency set up from the memory.** 1. XFR/MEM switch ..... MEM PRESS - Momentarily press switch to MEM will step through the memory. 2. XFR/MEM switch ..... XFR PRESS - Momentarily press switch to XFR will make chosen memory frequency active. 3. VOICE/IDENT switch ..... IDENT 4. NAV volume lever ..... AS REQUIRED

CONDITIONS	NORMAL PROCEDURES
(Cont'd)	5. Identify station. – When identifying a VOR or ILS, observe that a DME associated with a VOR or ILS localizer transmits its identification signal at 30 seconds intervals in synchronization with the identification signal of the VOR or ILS localizer. Since the DME and the VOR or ILS localizer have the same identity code letters, the DME signal is recognized by a slight increase in strength during transmission of the identity signal. In a 30 second period, the DME identification signal is thus transmitted once and the VOR or ILS localizer signal 3 times. 6. Mode selector, DCP ..... AS REQUIRED. 7. CRS knob, CHP ..... SET LOC INBOUND COURSE. 8. EADI ..... CHECK AND CROSSCHECK. – Check for correct indication, glideslope and localizer. NOTE – If localizer indications differ on the two ILS, a go around shall be made unless a crosscheck with other facilities definitely reveals the system giving the wrong indication. – If glideslope indications differ, always follow the one indicating more flyup until overhead a fix (e.g. marker) where an altitude check can be made. CAUTION The back course is automatically corrected for by EFIS and annunciated by a yellow B/C replacing the GS indication on the EADI/EHSI. With the CRS selector set for the normal Localizer inbound course the LOC symbols on the EADI/EHSI are not reversed when flying: – Inbound on the back course. – Outbound on the Localizer inbound course.
(Cont'd)	

CONDITIONS	NORMAL PROCEDURES
(Cont'd)	CAUTION When flying back course approach: – The standby VOR/ILS indicator will reverse the Localizer indication. – Do not use the Glideslope indication.
2.6 MARKER OPERATION	1. MKR volume lever ..... AS REQUIRED 2. EADI ..... CHECK – Check to give indication when marker passage. – 4–8 seconds after start of OM flashing gives the most accurate positioning overhead the outer marker.

3. ABNORMAL OPERATION.

CONDITIONS	NORMAL PROCEDURES
3.1 NO AUDIO SIGNAL.	**ACTIONS.** 1. Frequency selection ..... CHECK 2. Headset audio and circuits ..... CHECK 3. End of procedure.
3.2 NO INDICATION WHEN WITHIN THE RANGE OF SELECTED STATION.	**INDICATIONS.** No VOR indication and VOR flag is displayed in red. No Localizer/Glideslope indication and LOC/GS flags are displayed in red. No Marker Beacon indication at marker passage. **ACTIONS.** 1. NAV1 NAV2 ..... CROSSCHECK 2. 26 V inverter switch ..... STBY INV If dual Main Inverters installed: 2. INVERTER switch ..... 1 or 2 – Select the other Inverter. 3. CB's E–16 (NAV1), L–15 (NAV2) ..... CHECK/RESET 4. End of procedure.
3.3 RMI FAILURE.	**INDICATIONS.** The RMI warning flag comes in view. **ACTIONS.** 1. 26 V inverter switch ..... STBY INV If dual Main Inverters installed: 1. INVERTER switch ..... 1 or 2 – Select the other Inverter. 2. End of procedure.

CONDITIONS	NORMAL PROCEDURES
3.4 NAV CONTROL UNIT FAILURE.	**INDICATIONS.** The control unit frequency display goes out. **ACTIONS.** 1. CB's, E–16 (NAV1), L–15 (NAV2) ..... CHECK/RESET

1. LIMITATIONS.

Not applicable.

2. NORMAL OPERATION.

CONDITIONS	NORMAL PROCEDURES
2.1 **POWER UP.**	1. ESS, L and R AVION switches ..... ON - The NAV systems are switched ON/OFF by ESS, L and R AVION switches.
2.2 **VOR OPERATION.**	1. Frequency selector ..... SET FREQUENCY 2. VOICE/IDENT switch ..... IDENT 3. NAV volume lever ..... AS REQUIRED 4. Identify station. - When identifying a VOR or ILS, observe that a DME associated with a VOR or ILS localizer transmits its identification signal at 30 seconds intervals in synchronization with the identification signal of the VOR or ILS localizer. Since the DME and the VOR or ILS localizer have the same identity code letters, the DME signal is recognized by a slight increase in strength during transmission of the identity signal. In a 30 second period, the DME identification signal is thus transmitted once and the VOR or ILS localizer signal 3 times. 5. Mode selector, DCP ..... AS REQUIRED 6. CRS knob, CHP ..... AS REQUIRED 7. EHSI ..... CHECK - Check for correct indication. 8. RMI switches ..... VOR
(Cont'd)	

CONDITIONS	NORMAL PROCEDURES
(Cont'd)	N O T E - The possibility of a wrong EHSI/RMI indication with correct call sign and NAV source flag exists if the receiver is tuned 50 kHz off the ground station frequency. Always make sure the VOR receiver is correctly tuned by checking the frequency display. C A U T I O N Always assure proper ADF/VOR selection on the RMI before using the bearing pointer information.
2.3 ILS OPERATION.	1. Frequency selector ..... SET FREQUENCY 2. VOICE/IDENT switch ..... IDENT 3. NAV volume lever ..... AS REQUIRED 4. Identify station. - When identifying a VOR or ILS, observe that a DME associated with a VOR or ILS localizer transmits its identification signal at 30 seconds intervals in synchronization with the identification signal of the VOR or ILS localizer. Since the DME and the VOR or ILS localizer have the same identity code letters, the DME signal is recognized by a slight increase in strength during transmission of the identity signal. In a 30 second period, the DME identification signal is thus transmitted once and the VOR or ILS localizer signal 3 times. 5. Mode selector, DCP ..... AS REQUIRED 6. CRS knob, CHP ..... SET LOC INBOUND COURSE 7. EADI ..... CHECK AND CROSSCHECK - Check for correct indication, glideslope and localizer.
(Cont'd)	

CONDITIONS	NORMAL PROCEDURES
(Cont'd)	NOTE – If localizer indications differ on the two ILS, a go around shall be made unless a crosscheck with other facilities definitely reveals the system giving the wrong indication. – If glideslope indications differ, always follow the one indicating more flyup until overhead a fix (e.g. marker) where an altitude check can be made. CAUTION The back course is automatically corrected for by EFIS and annunciated by a yellow B/C replacing the GS indication on the EADI/EHSI. With the CRS selector set for the normal Localizer inbound course the LOC symbols on the EADI/EHSI are not reversed when flying: – Inbound on the back course. – Outbound on the Localizer inbound course. CAUTION When flying back course approach: – The standby VOR/ILS indicator will reverse the Localizer indication. – Do not use the Glideslope indication.
2.4 MARKER OPERATION.	1. MKR volume lever ..... AS REQUIRED. 2. EADI ..... CHECK. – Check to give indication when marker passage. – 4–8 seconds after start of OM flashing gives the most accurate positioning overhead the outer marker.

3. ABNORMAL OPERATION.

CONDITIONS	NORMAL PROCEDURES
3.1 NO AUDIO SIGNAL.	**ACTIONS.** 1. Frequency selection ..... CHECK 2. Headset audio and circuits ..... CHECK 3. End of procedure.
3.2 NO INDICATION WHEN WITHIN THE RANGE OF SELECTED STATION.	**INDICATIONS.** No VOR indication and VOR flag is displayed in red. No Localizer/Glideslope indication and LOC/GS flags are displayed in red. No Marker Beacon indication at marker passage. **ACTIONS.** 1. NAV1 NAV2 ..... CROSSCHECK 2. 26 V inverter switch ..... STBY INV If dual Main Inverters installed: 2. INVERTER switch ..... 1 or 2 – Select the other Inverter. 3. CB's E–16 (NAV1), L–15 (NAV2) ..... CHECK/RESET 4. End of procedure.
3.3 RMI FAILURE.	**INDICATIONS.** The RMI warning flag comes in view. **ACTIONS.** 1. 26 V inverter switch ..... STBY INV If dual Main Inverters installed: 1. INVERTER switch ..... 1 or 2 – Select the other Inverter. 2. End of procedure.

CONDITIONS	NORMAL PROCEDURES
3.4 NAV CONTROL UNIT FAILURE.	**INDICATIONS.** The control unit frequency display goes out. **ACTIONS.** 1. CB's, E–16 (NAV1), L–15 (NAV2) ..... CHECK/RESET

1. **LIMITATIONS.**

Not applicable.

2. **NORMAL OPERATION.**

CONDITIONS	NORMAL PROCEDURES
2.1 **POWER UP.**	1. ESS, L and R AVION switch ..... ON - The NAV systems are switched ON/OFF by ESS, L and R AVION switches.
2.2 **PROGRAMMING OF THE FREQUENCY**	The Control unit contains nine programmable memorycells. 1. CHAN button ..... PRESS 2 SEC - Momentarily press CHAN button for more than 2 seconds to enter program mode. 2. Frequency selector ..... SELECT MEMORYCELL - Any one of the two knobs will control the memorycells. 3. Transfer button ..... PRESS - When momentarily pressed gives frequency selector control over either upper or lower display. - Controlled display is flashing. 4. Frequency selector ..... SET FREQUENCY ◆----**To program next frequency:** 5. Transfer button ..... PRESS - Proceed with item 2 abowe. ◆----**For return of Control unit to normal display:** 5. CHAN button ..... PRESS No activity for 20 seconds will also return Control unit to normal display.

CONDITIONS	NORMAL PROCEDURES
2.3 **VOR OPERATING.**	◆----**If RNAV installed.** 1. SELECT knob, L DCP ..... SET - Rotate until VOR 1 is displayed in the lower left corner of both EHSI. - Proceed with frequency set up. ◆----**If RNAV not installed.** ◆----**Frequency set up.** 1. Frequency selector ..... SET FREQUENCY - Proceed with item 4 below. ◆----**Frequency set up from the memory.** 1. CHAN button ..... PRESS - Momentarily press CHAN to enter the frequency memory. 2. Frequency selector ..... CHOSE MEMORY FREQUENCY - Any one of the two knobs will control the memorycells. 3. Transfer button ..... PRESS - Momentarily press Transfer button to make chosen memory frequency active. - Or, no activity for 5 seconds will make chosen memory frequency standby (STBY). 4. VOICE/IDENT switch ..... IDENT 5. NAV volume lever ..... AS REQUIRED 6. Identify station. - When identifying a VOR or ILS, observe that a DME associated with a VOR or ILS localizer transmits its identification signal at 30 seconds intervals in synchronization with the identification signal of the VOR or ILS localizer. Since the DME and the VOR or ILS localizer have the same identity code letters, the DME signal is recognized by a slight increase in strength during transmission of the identity signal. In a 30 second period, the DME identification signal is thus transmitted once and the VOR or ILS localizer signal 3 times.
(Cont'd)	

CONDITIONS	NORMAL PROCEDURES
(Cont'd)	7. Mode selector, DCP ..... AS REQUIRED 8. CRS knob, CHP ..... AS REQUIRED 9. EHSI ..... CHECK 10. RMI switches ..... VOR - Check RMI for correct indication. N O T E - The possibility of a wrong EHSI/RMI indication with correct call sign and NAV source flag exists if the receiver is tuned 50 kHz off the ground station frequency. Always make sure the VOR receiver is correctly tuned by checking the frequency display. C A U T I O N Always assure proper ADF/VOR selection on the RMI before using the bearing pointer information.
2.4 ILS OPERATION. (Cont'd)	◆----**If RNAV installed.** 1. SELECT knob, DCP ..... SET - Rotate until LOC 1 is displayed in the lower left corner of both EHSI. - Proceed with frequency set up. ◆----**If RNAV not installed.** ◆----**Frequency set up.** 1. Frequency selector ..... SET FREQUENCY - Proceed with item 4 below. ◆----**Frequency set up from the memory.** 1. CHAN button ..... PRESS - Momentarily press CHAN to enter the frequency memory.

CONDITIONS	NORMAL PROCEDURES
(Cont'd)	2. Frequency selector ..... CHOSE MEMORY FREQUENCY - Any one of the two knobs will control the memorycells. 3. Transfer button ..... PRESS - Momentarily press Transfer button to make chosen memory frequency active. - Or, no activity for 5 seconds will make chosen memory frequency standby (STBY). 4. VOICE/IDENT switch ..... IDENT 5. NAV volume lever ..... AS REQUIRED 6. Identify station. - When identifying a VOR or ILS, observe that a DME associated with a VOR or ILS localizer transmits its identification signal at 30 seconds intervals in synchronization with the identification signal of the VOR or ILS localizer. Since the DME and the VOR or ILS localizer have the same identity code letters, the DME signal is recognized by a slight increase in strength during transmission of the identity signal. In a 30 second period, the DME identification signal is thus transmitted once and the VOR or ILS localizer signal 3 times. 7. Mode selector, DCP ..... AS REQUIRED 8. CRS knob, CHP ..... SET LOC INBOUND COURSE 9. EADI ..... CHECK AND CROSSCHECK - Check for correct indication, glideslope and localizer. N O T E - If localizer indications differ on the two ILS, a go around shall be made unless a crosscheck with other facilities definitely reveals the system giving the wrong indication. - If glideslope indications differ, always follow the one indicating more flyup until overhead a fix (e.g. marker) where an altitude check can be made.
(cont'd)	

CONDITIONS	NORMAL PROCEDURES
(Cont'd)	CAUTION The back course is automatically corrected for by EFIS and annunciated by a yellow B/C replacing the GS indication on the EADI/EHSI. With the CRS selector set for the normal Localizer inbound course the LOC symbols on the EADI/EHSI are not reversed when flying: – Inbound on the back course. – Outbound on the Localizer inbound course. CAUTION When flying back course approach: – The standby VOR/ILS indicator will reverse the Localizer indication. – Do not use the Glideslope indication.
2.4 MARKER OPERATION.	1. MKR volume lever ..... AS REQUIRED. 2. EADI ..... CHECK. – Check to give indication when marker passage. – 4–8 seconds after start of OM flashing gives the most accurate positioning overhead the outer marker.

3. ABNORMAL OPERATION.

CONDITIONS	NORMAL PROCEDURES
3.1 NO AUDIO SIGNAL.	**ACTIONS.** 1. Frequency selection ..... CHECK 2. Headset audio and circuits ..... CHECK 3. End of procedure.
3.2 NO INDICATION WHEN WITHIN THE RANGE OF SELECTED STATION.	**INDICATIONS.** No VOR indication and VOR flag is displayed in red. No Localizer/Glideslope indication and LOC/GS flags are displayed in red. No Marker Beacon indication at marker passage. **ACTIONS.** 1. NAV1 NAV2 ..... CROSSCHECK 2. 26 V inverter switch ..... STBY iNV If dual Main Inverters installed: 2. INVERTER switch ..... 1 or 2 – Select the other Inverter. 3. CB's E–16 (NAV1), L–15 (NAV2) ..... CHECK/RESET 4. End of procedure.
3.3 RMI FAILURE.	**INDICATIONS.** The RMI warning flag comes in view. **ACTIONS.** 1. 26 V inverter switch ..... STBY INV If dual Main Inverters installed: 1. INVERTER switch ..... 1 or 2 – Select the other Inverter. 2. End of procedure.

CONDITIONS	NORMAL PROCEDURES
3.4 NAV CONTROL UNIT FAILURE.	**INDICATIONS.** The control unit frequency display goes out. **ACTIONS.** 1. CB's, E–16 (NAV1), L–15 (NAV2)

1. GENERAL.

The Distance Measuring Equipment, DME, provides slant distance to a ground station. The DME station does not have to be specially selected if it is paired with a selected ILS or VOR station. The Distance is displayed on the EHSI together with Groundspeed and Time To Go, both calculated from the DME information.

Distance, Groundspeed and Time To Go is also displayed on a DME indicator (if installed).

2. MAIN COMPONENTS AND SUBSYSTEMS.

2.1. Transceiver.

The frequency information is received from the VOR/ILS/Marker control unit as a serial data stream which is transferred into a frequency control circuitry that tunes both the transmitter and the receiver.

The airborne system interrogates a ground station by transmitting squitter pulses which are returned as reply puls pairs by the ground station after a fixed delay time equal for all stations. The airborne system can distinguish the replay as its own signals from other aircraft replays and measure the time difference between transmitted and received signal and thus determine the distance. This distance, the straight line between the aircraft and the ground station, is the slant range. Time To Go and Groundspeed are both calculated and based upon the rate of change of DME distance.

If no reply is received, the DME readout is replaced by cyan (DME 1) or green (DME 2) dashes.

If DME system fails, the system generates a warning - the DME display is replaced by red dashes. The DME 2 display will indicate red dashes if only DME 1 installed.

The DME ground station also sends an identification signal which can be heard over the audio integrating system.

The inhibit circuits of the ATC transponder and DME systems are interconnected in order to avoid interference between the DME and the transponder. The DME is inhibited when the transponder transmits and vice versa.

2.2. Control unit.

DME controls is provided by the NAV control unit. When a VOR/ILS frequency is selected the DME frequency, if paired to that station, is also selected. The DME frequency can also be Held in order to select a new VOR/ILS or DME freqyency without affecting the previous selected DME station.

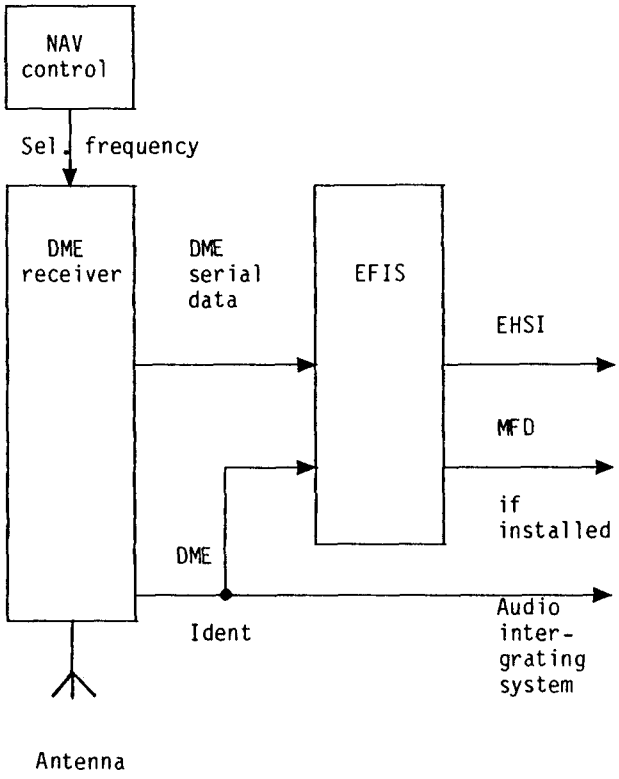
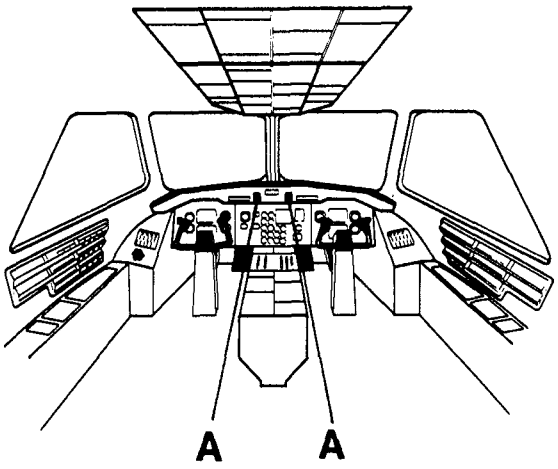
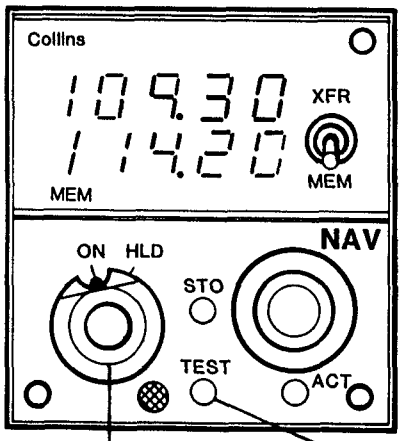


Fig. 1. DME System - schematic.

3. CONTROLS AND INDICATORS.



A NAV CONTROL UNIT WITH MEMORY



ALSO SEE AOM 15/3.1 CII.

Function selector.
NORM - DME station or DME paired to active VOR/ILS frequency in upper display.
HOLD - System holds DME station.
A new VOR/ILS or DME frequency can be tuned without affecting DME function.
- Standby display will show the frequency of the held DME station.
- Frequency selector controls active display.

TEST button.
When pressed and held:
- DME Distance, GSP, and TTG readouts turns to dashes.
- DME audio gives ident AOK if no faults have been detected.

Fig. 2. DME - controls.

1. GENERAL.

The Distance Measuring Equipment, DME, provides slant distance to a ground station. The DME station does not have to be specially selected if it is paired with a selected ILS or VOR station. The Distance is displayed on the EHSI together with Groundspeed and Time To Go, both calculated from the DME information.

2. MAIN COMPONENTS AND SUBSYSTEMS.

2.1. Transceiver.

The frequency information is received from the VOR/ILS/Marker control unit as a serial data stream which is transferred into a frequency control circuitry that tunes both the transmitter and the receiver.

The airborne system interrogates a ground station by transmitting squitter pulses which are returned as reply puls pairs by the ground station after a fixed delay time equal for all stations. The airborne system can distinguish the replay as its own signals from other aircraft replays and measure the time difference between transmitted and received signal and thus determine the Distance. This Distance, the straight line between the aircraft and the ground station, is the slant range. Time To Go and Groundspeed are both calculated and based upon the rate of change of DME distance.

If no reply is received, the DME readout is replaced by cyan (DME 1) or green (DME 2) dashes.

If DME system fails, the system generates a warning; the DME readouts are replaced by red dashes. The DME 2 display will indicate red dashes if only DME 1 installed.

The DME ground station also sends an identification signal which can be heard over the audio integrating system.

The inhibit circuits of the ATC transponder and DME systems are interconnected in order to avoid interference between the DME and the transponder. The DME is inhibited when the transponder transmits and vice versa.

2.2. Control unit.

DME control is provided by the NAV control unit. When a VOR/ILS frequency is selected the DME frequency, if paired to that station, is also selected. The DME frequency can also be Held in order to select a new VOR/ILS or DME freqyency without affecting the previous selected DME station.

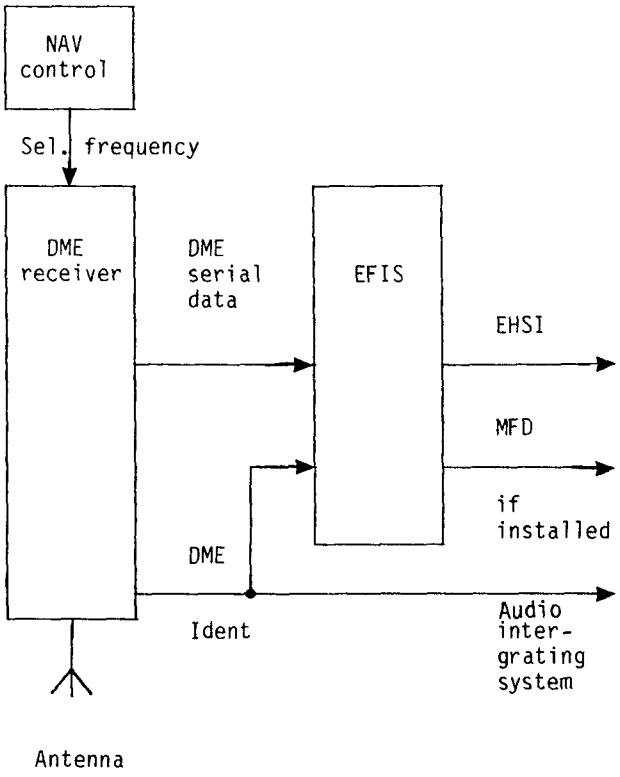
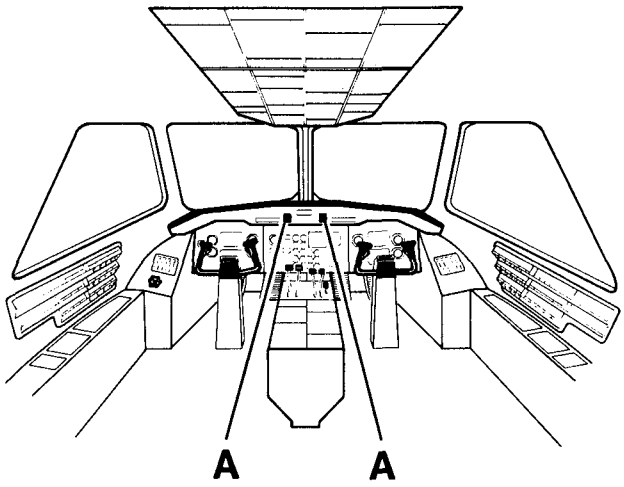


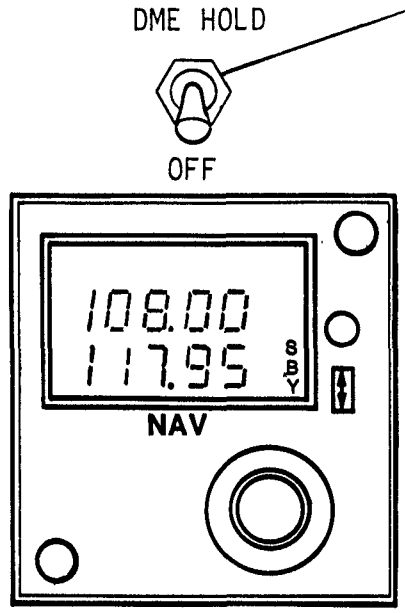
Fig. 1. DME System - schematic.

3. CONTROLS AND INDICATORS.



A NAV CONTROL UNIT

DME HOLD switch.
OFF - DME station or DME paired to active VOR/ILS frequency in upper display.
DME HOLD - System holds DME station. A new VOR/ILS or DME frequency can be tuned without affecting DME function.



ALSO SEE AOM 15/3.1 K.

Fig. 2. DME - controls.

1. GENERAL.

The Distance Measuring Equipment, DME, provides slant distance to a ground station. The DME station does not have to be specially selected if it is paired with a selected ILS or VOR station. The Distance is displayed on the EHSI together with Groundspeed and Time To Go, both calculated from the DME information.

2. MAIN COMPONENTS AND SUBSYSTEMS.

2.1. Transceiver.

The frequency information is received from the VOR/ILS/Marker control unit as a serial data stream which is transferred into a frequency control circuitry that tunes both the transmitter and the receiver.

The airborne system interrogates a ground station by transmitting squitter pulses which are returned as reply puls pairs by the ground station after a fixed delay time equal for all stations. The airborne system can distinguish the replay as its own signals from other aircraft replays and measure the time difference between transmitted and received signal and thus determine the Distance. This Distance, the straight line between the aircraft and the ground station, is the slant range. Time To Go and Groundspeed are both calculated and based upon the rate of change of DME distance.

If no reply is received, the DME readout is replaced by cyan (DME 1) or green (DME 2) dashes.

If DME system fails, the system generates a warning; the DME readouts are replaced by red dashes. The DME 2 display will indicate red dashes if only DME 1 installed.

The DME ground station also sends an identification signal which can be heard over the audio integrating system.

The inhibit circuits of the ATC transponder and DME systems are interconnected in order to avoid interference between the DME and the transponder. The DME is inhibited when the transponder transmits and vice versa.

2.2. Control unit.

DME control is provided by the NAV control unit. When a VOR/ILS frequency is selected, the DME frequency, if paired to that station, is also selected. The DME frequency can also be Held in order to select a new VOR/ILS or DME freqyency without affecting the previous selected DME station.

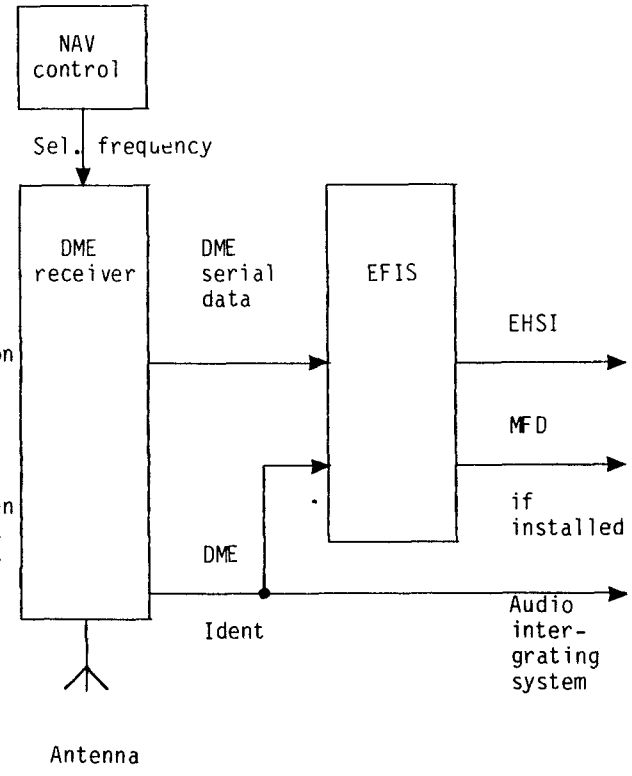
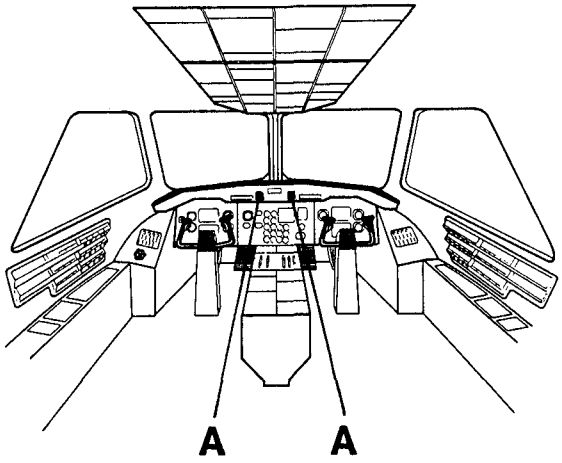


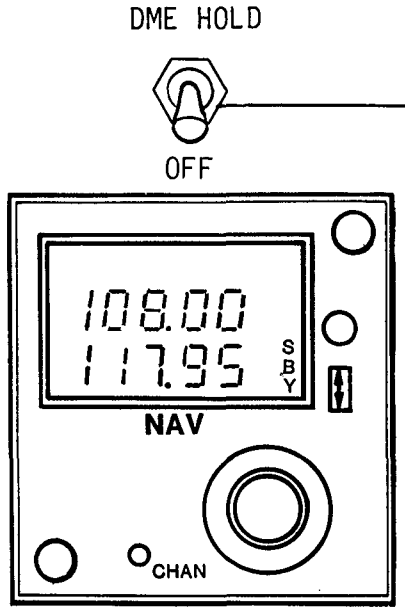
Fig. 1. DME System - schematic.

3. CONTROLS AND INDICATORS.



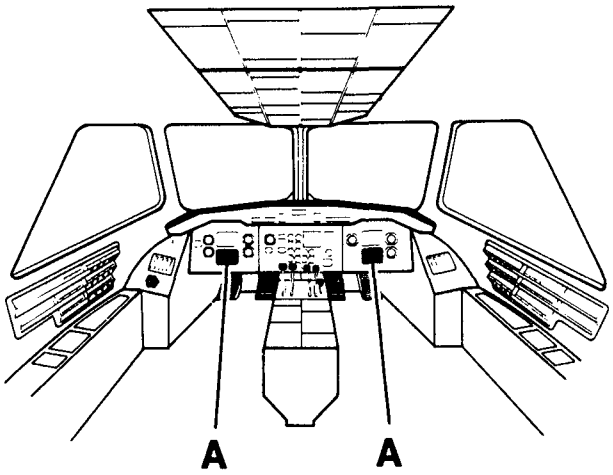
ALSO SEE AOM 15/3.1 KO.

A NAV CONTROL UNIT WITH MEMORY

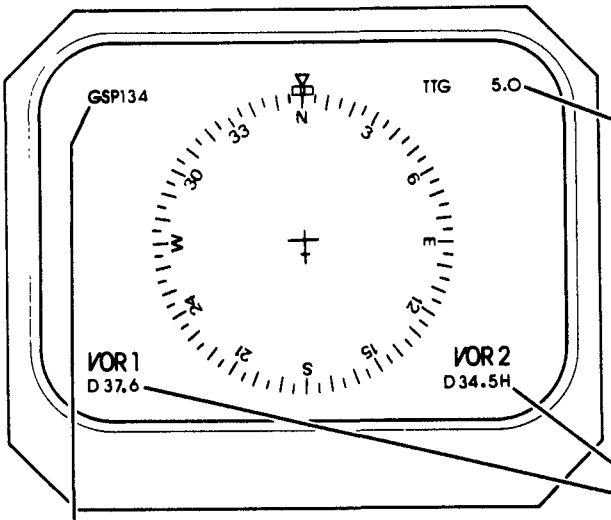


DME HOLD switch.
OFF - DME station or DME paired to active VOR/ILS frequency in upper display.
DME HOLD - System holds DME station. A new VOR/ILS or DME frequency can be tuned without affecting DME function.

Fig. 2. DME - controls.



A EHSI DME DISPLAYS



NOTE: If DME 2 not installed right side DME displayed will show red dashes.

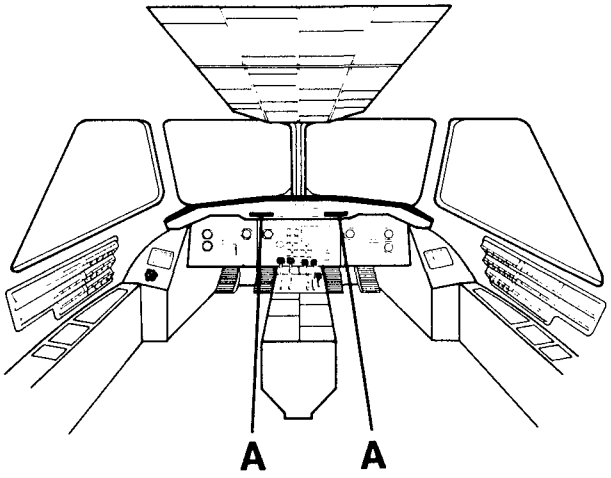
ALSO SEE AOM 15/1.1 FOR DME PRESENTATION IN MAP MODE.

Time To Go display.
- Time To Go display is cyan for left side and green for right side.
- The time is in minutes.
- If no computed data, the display will be dashes in normal colour.
- If system fails, the display will be red dashes, flashing for 10s, then steady.

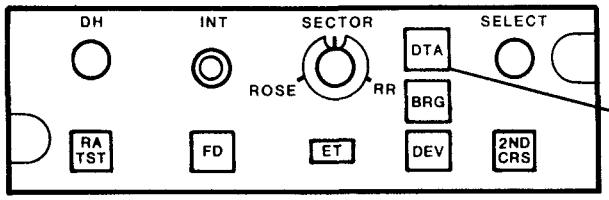
Distance display.
- Distance display is cyan for left and green for right side.
- Indicates distance in NM to selected DME station.
- If in DME HOLD mode a yellow H will appear after the readout and the letter D turns to yellow.
- If no computed data, the display will be dashes in normal colour.
- If system fails, the display will be red dashes, flashing for 10s, then steady.

Groundspeed display.
- Groundspeed display is cyan for left and green for right side.
- The speed in knots is only accurate when the aircraft is flying directly to or from the selected DME station.
- If no computed data is available, the display will be dashes in normal color.
- If system fails, the display will be red dashes, flashing for 10s, then steady.

Fig. 3. EHSI, DME display - indicators.

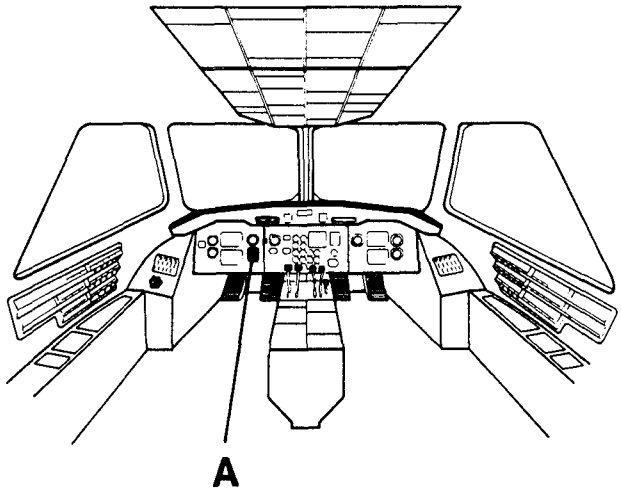


A DISPLAY CONTROL PANEL

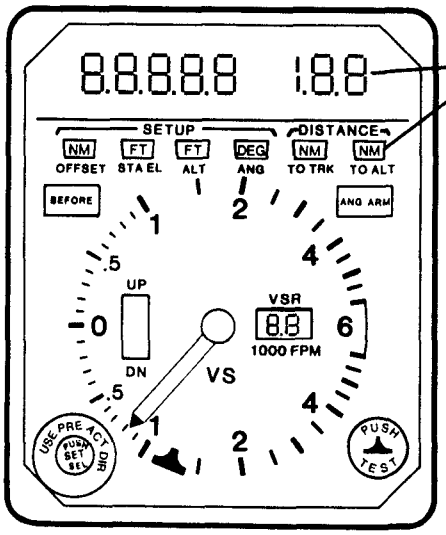


DTA, data button.
- When pushed, GSP, TTG, TAS, crosside DME and NAV data are removed from the EHSI.
- Next push restores the data.

Fig. 4. Display Control Panel - controls.



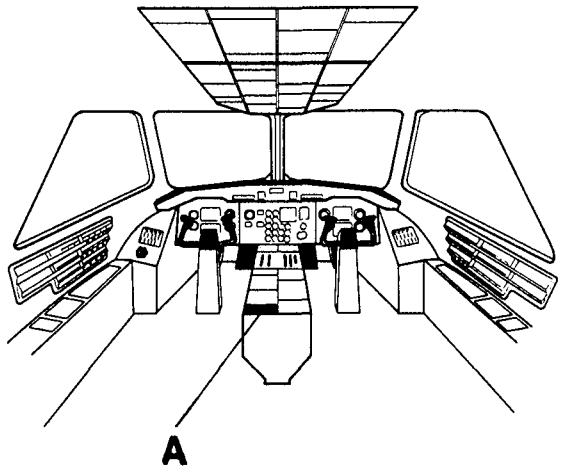
A VERTICAL NAVIGATION INDICATOR



DISTANCE display and annunciators.
Indicates distance in NM from aircraft to path capture when TO TRK annunciates NM and to aimpoint when TO ALT annunciates NM.
Also see AOM 3.1 AUTOFLIGHT.

Fig. 5. VNI Indicator - distance indication.

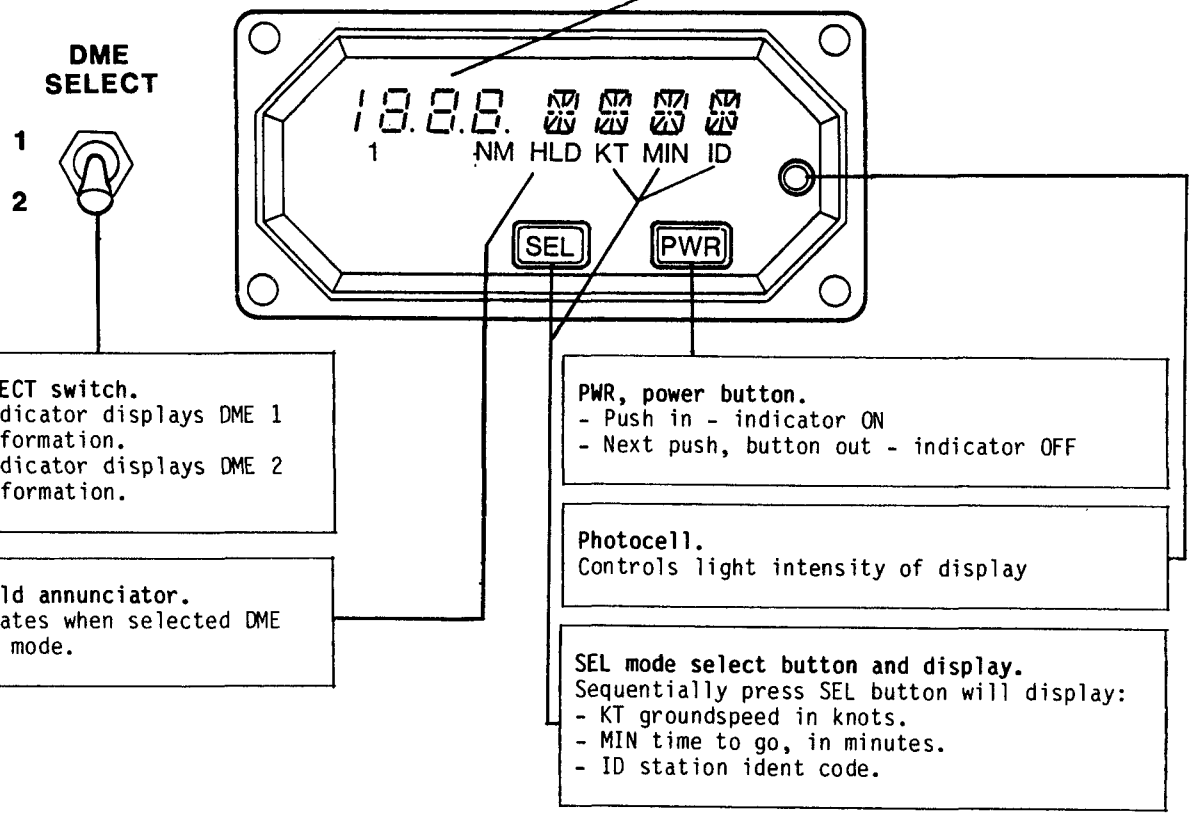
IF VNI INSTALLED.



DME TEST.
When NAV test button is pressed and held, the DME INDICATOR will enter and display the self-test diagnostic mode (for maintenance use).

DME distance display in NM.
1 - DME system wired to channel 1 of the indicator (maintenance).

A DME INDICATOR



DME SELECT switch.
- 1. Indicator displays DME 1 information.
- 2. Indicator displays DME 2 information.

HLD, hold annunciator.
Illuminates when selected DME in HOLD mode.

PWR, power button.
- Push in - indicator ON
- Next push, button out - indicator OFF

Photocell.
Controls light intensity of display

SEL mode select button and display.
Sequentially press SEL button will display:
- KT groundspeed in knots.
- MIN time to go, in minutes.
- ID station ident code.

IF DME IND. INSTALLED.

Fig. 6. DME indicator - controls and indicators.

4. ELECTRICAL POWER SUPPLY.

DME1	L AVIONIC BUS	E-17	DME1
DME2	R AVIONIC BUS	L-16	DME2

1. LIMITATIONS.

Not applicable.

2. NORMAL OPERATION.

CONDITIONS	NORMAL PROCEDURES
2.1 POWER UP.	1. L and R AVION switches ..... ON - The DME systems are switched ON/OFF by L and R AVION switches.
2.2 DME SYSTEM TEST.	1. Function selector ..... NORM 2. TEST button (NAV control unit) ..... PRESS AND HOLD - DME Distance, GSP and TTG readouts turns to dashes. 3. TEST button ..... RELEASE - Distance, GSP and TTG readouts turns back to normal. - DME audio gives ident AOK if no faults have been detected.
2.3 PROGRAMMING OF THE FREQUENCY MEMORY.	The Control unit contains four programmable memorycells. 1. XFR/MEM switch ..... MEM PRESS - Momentarily press switch to select memorycell to be programmed. 2. STO button ..... PRESS - Momentarily press STO to enter program mode. 3. Freqyency selector ..... SET FREQUENCY - Set frequency in memorycell. 4. STO button ..... PRESS - Momentarily press STO to store frequency. - Control unit will also return to normal. 5. To set up next memory frequency, proceed with item 1 above. No activity for 3 seconds will return Control unit to normal display.

CONDITIONS	NORMAL PROCEDURES
2.4 OPERATION.	◆----If RNAV installed. 1. SELECT knob, L DCP ..... SET - Rotate until VOR1 or LOC1 is displayed in the lower left corner of both EHSI's. - Proceed with item 1 below. ◆----If RNAV not installed. 1. Function selector ..... NORM ◆----Frequency set up. 2. Frequency selector ..... SET FREQUENCY - Proceed with item 3 below. ◆----Frequency set up from the memory. 2. XFR/MEM switch ..... MEM PRESS - Momentarily press switch to MEM will step through the memory for choice of frequency. 3. XFR/MEM switch ..... XFR PRESS - Momentarily press switch to XFR will make chosen memory frequency active. 4. VOICE/IDENT switch ..... IDENT 5. NAV volume lever..... AS REQUIRED 6. Identify station. - An independent DME transmits its identification signal once every 30 seconds. - A DME associated with a VOR or ILS localizer transmits its identification signal at 30 sec intervals in synchronization with the identification signal of the VOR or ILS localizer. Since the DME and the VOR or ILS localizer have the same identity code letters, the DME signal is recognized by a slight increase in strength during transmission of the identity signal. In a 30 second period the DME identification signal is thus transmitted once and the VOR or ILS localizer signal 3 times.
(Cont'd)	

CONDITIONS	NORMAL PROCEDURES
(Cont'd)	7. Mode selector, DCP ..... AS REQUIRED 8. DME readout ..... CHECK N O T E Due to uncoordinated military (TACAN) and civil DME frequency allocations, erroneous indications may result even if the proper NAV frequency has been selected. Make sure that the DME station is positively identified before relying on the DME readouts.
2.5 OPERATION IN DME HOLD.	The selected DME station can be held, if the pilot decides to keep the selected DME station tuned and select a different NAV frequency. 1. Function selector ..... HOLD - A yellow H will appear after the Distane readout and the letter D turns to yellow. - A new NAV frequency can be selected without affecting the DME. - Standby display will show the frequency of the held DME station. - Frequency selector controls active display.

3. ABNORMAL OPERATION.

CONDITIONS	ABNORMAL PROCEDURES
3.1 NO AUDIO SIGNAL.	ACTIONS. 1. Frequency selection ..... CHECK 2. Headsets and audio circuits ..... CHECK 3. End of procedure.
3.2 NO DME INDICATION.	INDICATIONS. DME Distance, GSP and TTG readouts displays red dashes. ACTIONS. 1. CB's E-17 (DME 1), L-16 (DME 2) ..... CHECK/RESET 2. End of procedure.

1. LIMITATIONS.

Not applicable.

2. NORMAL OPERATION.

CONDITIONS	NORMAL PROCEDURES
2.1 POWER UP.	1. L and R AVION switches ..... ON - The DME systems are switched ON/OFF by L and R AVION switches.
2.2 OPERATION.	1. DME HOLD switch (above NAV control unit) ..... OFF 2. Frequency selector ..... SET FREQUENCY 3. VOICE/IDENT switch ..... IDENT 4. NAV volume lever ..... AS REQUIRED 5. Identify station. - An independent DME transmits its identification signal once every 30 seconds. - A DME associated with a VOR or ILS localizer transmits its identification signal at 30 sec intervals in synchronization with the identification signal of the VOR or ILS localizer. Since the DME and the VOR or ILS localizer have the same identity code letters, the DME signal is recognized by a slight increase in strength during transmission of the identity signal. In a 30 second period, the DME identification signal is thus transmitted once and the VOR or ILS localizer signal 3 times. 6. Mode selector, DCP ..... AS REQUIRED 7. DME readout ..... CHECK N O T E Due to uncoordinated military (TACAN) and civil DME frequency allocations, erroneous indications may result even if the proper NAV frequency has been selected. Make sure that the DME station is positively identified before relying on the DME readouts.

CONDITIONS	NORMAL PROCEDURES
2.3 OPERATION IN DME HOLD.	The selected DME station can be held, if the pilot decides to keep the selected DME station tuned and select a different NAV frequency. 1. DME HOLD switch (above NAV control unit) ..... DME HOLD - A yellow H will appear after the Distance readout and the letter D turns to yellow. - A new NAV frequency can be selected without affecting the DME. - The held DME stations frequency is no longer related to the frequency displayed on the NAV control unit.

3. ABNORMAL OPERATION.

CONDITIONS	ABNORMAL PROCEDURES
3.1 NO AUDIO SIGNAL.	ACTIONS. 1. Frequency selection ..... CHECK 2. Headsets and audio circuits ..... CHECK 3. End of procedure.
3.2 NO DME INDICATION.	INDICATIONS. DME Distance, GSP and TTG readouts displays red dashes. ACTIONS. 1. CB's E-17 (DME 1), L-16 (DME 2) ..... CHECK/RESET 2. End of procedure.

1. LIMITATIONS.

Not applicable.

2. NORMAL OPERATION.

CONDITIONS	NORMAL PROCEDURES
2.1 POWER UP.	1. L and R AVION switches ..... ON - The DME systems are switched ON/OFF by L and R AVION switches.
2.2 PROGRAMMING OF THE FREQUENCY MEMORY.	The Control unit contains nine programmable memorycells. 1. CHAN button ..... PRESS 2 SEC - Momentarily press CHAN button for more than 2 seconds to enter program mode. 2. Frequency selector ..... SELECT MEMORYCELL - Any one of the two knobs will control the memorycells. 3. Transfer button ..... PRESS - When momentarily pressed gives frequency selector control over either upper or lower display. - Controlled display is flashing. 4. Frequency selector ..... SET FREQUENCY ◆----**To program next frequency:** 5. Transfer button ..... PRESS - Proceed with item 2 abowe. ◆----**5. For return of Control unit to normal display:** CHAN button ..... PRESS No activity for 20 seconds will also return Control unit to normal display.

CONDITIONS	NORMAL PROCEDURES
2.3 OPERATION.	◆----If RNAV installed. 1. SELECT knob, L DCP ..... SET - Rotate unit VOR1 or LOC1 is displayed in the lower left corner of both EHSI. - Proceed with item 1 below. ◆----If RNAV not installed. 1. DME HOLD switch (above NAV control unit) ..... OFF ◆----Frequency set up. 2. Frequency selector ..... SET FREQUENCY - Proceed with item 4 below. ◆----Frequency set up from the memory. 2. CHAN button ..... PRESS - Momentarily press CHAN to enter the frequency memory. 3. Frequency selector ..... CHOSE MEMORY FREQUENCY - Any one of the two knobs will control the memorycells for choice of frequency. 4. Transfer button ..... PRESS - Momentarily press Transfer button to make chosen memory frequency active. - Or, no activity for 5 seconds will make chosen memory frequency standby (STBY). 5. VOICE/IDENT switch ..... IDENT 6. NAV volume lever ..... AS REQUIRED 7. Identify station. - An independent DME transmits its identification signal once every 30 seconds.
(Cont'd)	

CONDITIONS	NORMAL PROCEDURES
(Cont'd)	- A DME associated with a VOR or ILS localizer transmits its identification signal at 30 sec intervals in synchronization with the identification signal of the VOR or ILS localizer. Since the DME and the VOR or ILS localizer have the same identity code letters, the DME signal is recognized by a slight increase in strength during transmission of the identity signal. In a 30 second period, the DME identification identification signal is thus transmitted once and the VOR or ILS localizer signal 3 times. 8. Mode selector, DCP ..... AS REQUIRED 9. DME readout ..... CHECK N O T E Due to uncoordinated military (TACAN) and civil DME frequency allocations, erroneous indications may result even if the proper NAV frequency has been selected. Make sure that the DME station is positively identified before relying on the DME readouts.
2.4 OPERATION IN DME HOLD.	The selected DME station can be held, if the pilot decides to keep the selected DME station tuned and select a different NAV frequency. 1. DME HOLD switch (above NAV control) ..... DME HOLD - A yellow H will appear after the Distance readout and the letter D turns to yellow. - A new NAV frequency can be selected without affecting the DME. - The held DME stations frequency is no longer related to the frequency displayed on the NAV control unit.

3. ABNORMAL OPERATION.

CONDITIONS	ABNORMAL PROCEDURES
3.1 NO AUDIO SIGNAL.	ACTIONS. 1. Frequency selection ..... CHECK 2. Headsets and audio circuits ..... CHECK 3. End of procedure.
3.2 NO DME INDICATION.	INDICATIONS. DME Distance, GSP and TTG readouts displays red dashes. ACTIONS. 1. CB's E-17 (DME1), L-16 (DME2) ..... CHECK/RESET 2. End of procedure.

1. GENERAL.

The aircraft is provided with an airborne radar system which is used mainly for avoidance of severe weather but can also be used for ground mapping. The system will detect and present weather conditions in an angle of 90 degrees and to the range of 300 NM in front of the aircraft. Flight hazards due to weather conditions are primarily the result of turbulence and hail. Wet hail can be detected by radar, but turbulent air by itself will not provide a radar echo. (Examples are clear-air turbulence and aircraft vortices.) Areas having high rainfall rates are ordinarily associated with turbulence, and it is from this rainfall that radar echoes are reflected and the accompanying turbulence associated with the rainfall is implied. Small areas with extremely heavy rainfall rate or large areas of moderate rainfall rate can reduce the ability of the radar waves to penetrate and present a full picture of the weather area. This may mask or cause strong targets at a farther range to appear much less intense than they actually are. Always assume that all weather behind another is at least one level higher than whats being presented on the radar picture. Proper use of the GAIN and TILT controls will aid the user in interpreting the displayed targets.

The receiver transmitter unit generates microwave energy in the form of pulses. These pulses are then transferred to the antenna where they are focused into a beam by the antenna. The radar beam is much like the beam of a flashlight. The energy is focused and radiated by the antenna in such a way that it is most intense in the center of the beam with decreasing intensity near the edge. The same antenna is used for both transmitting and receiving. When a pulse intercepts a target, the moisture (rain drops and ice) present in clouds in front of the aircraft, reflects some of this energy to the antenna. The reflected energy provides a measure of moisture intensity which is converted into a color code. The radar color picture will therefore represent a cross section of the cloud situation in front of the aircraft.

Even though the color code corresponds to a certain amount of moisture, rain and ice, bear in mind that the radar beam will also be reflected by the ground surface, mountains etc. Therefore the pilot must know his position before relying on the radar picture being just weather.

The Weather Radar is a three color display system and the picture can be presented on the EHSI and the MFD (if installed).

The weather radar is not a go/no go signal, it is a weather analysis instrument and must be used in conjunction with a knowledge of the atmospheric conditions. It should never be used to make a decision to fly through a convective weather system, but as a guide of how far to circumnavigate it.

1.1. Operational Modes.

Normal weather detection (NORM-position).

The signals representing echos from targets on different ranges are treated with a Sensitivity Time Control, STC, which means that the target intensity remains relatively constant for close-in ranges. The radar beam power is higher but with lower resolution than for ground mapping.

Detectable weather is color coded with the black screen representing no detectable moisture, while detectable weather appears as one of three colors: green, yellow, or red (least reflective to most reflective).

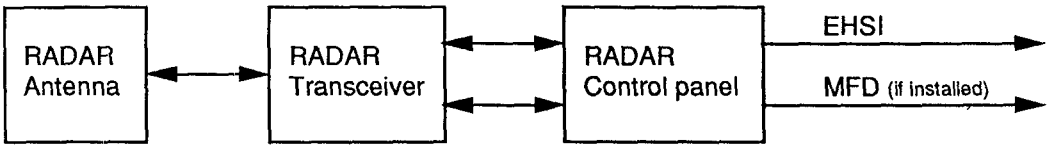


Fig. 1. WEATHER RADAR - schematic.

The color code for the weather picture is:

WXR 200 COLOR	dbz	VIP-LEVEL	VIP-DEFINITIONS
BLACK	< 20	--	--
GREEN	> 20	1	Minimum detectable moisture level (weak). - Weak rainfall rate. - Light to moderate turbulence is possible with lightning.
YELLOW	> 30	2	Moderate moisture level. - Moderate rainfall rate. - Light to moderate turbulence is possible with lightning
RED	> 40	3	Strong moisture level. - Strong rainfall rate. - Severe turbulence is possible with lightning.
		4	Very strong moisture level. - Very strong rainfall rate. - Severe turbulence is likely with lightning.
	> 50	5	Intense moisture level. - Intensive rainfall rate. - Severe turbulence is very likely with lightning, organized wind gusts and hail.
	> 60	6	Extreme moisture level. - Extreme rainfall rate. - Severe turbulence is certain with large hail, lightning, and extensive wind gusts.

VIP = Video Integrated Processor (U.S National Weather Service).

Weather detection with contour (WX-position).

Normal weather detection with cycling cloud contour (WX-position). Same weather detection as for NORM mode and with the contouring areas of the storm cell alternating between red and black at a one-cycle-per-second rate. This is the core of the storm cell. The contouring is to highlight the most hazardous storm cells.

Ground mapping (MAP-position).

The signals representing ground echos are treated with the Sensitivity Time Controller, STC, in order to keep constant echo intensity for close-in ranges. The shape of the radar beam is more narrow and with lower beam power than for weather detection in order to provide better resolution of the ground echo returnes.

CAUTION

Do not rely on MAP mode only for navigation.

The colors for the ground picture are somewhat changed:

WXR 200 COLOR	DEFINITIONS
CYAN	Ground targets with low reflectivity.
YELLOW	Ground targets with moderate reflectivity.
MAGENTA	Ground targets with most reflectivity.

Target alert.

Activated Target alert is indicated by a steady yellow boxed T on EHSI and MFD. When selected, T is visible also with EHSI in ROSE mode and on the MFD even if RDR mode is not selected. The T will start to flash and alert the pilot if the signal strength of the echo increases up to storm cell level and the target is detected in a sector within 50 to 150 NM and ± 15° of dead ahead regardless of selected range.

2. MAIN COMPONENTS AND SUBSYSTEMS.

2.1. Antenna.

The ANT-212 antenna is 12 inch and is installed inside the nose kevlar radome. It has a scan sector of 90°. The antenna is also stabilized up to 30° in the pitch axis to compensate for aircraft movement in order to have a stable scanning. The antenna is not stabilized in roll, which causes parts of the radar picture to disappear with roll movements of the aircraft. The antenna can be manually tilted between ±15° from horizontal.

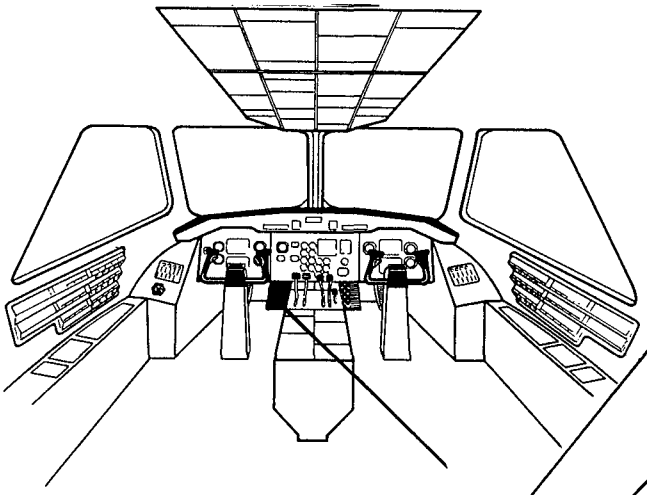
2.2. Transceiver.

The transceiver operates in the X-band at a frequency of 9,345 GHz. It transmits and receives the radar beam and transforms the result into digital information fed to the radar control panel.

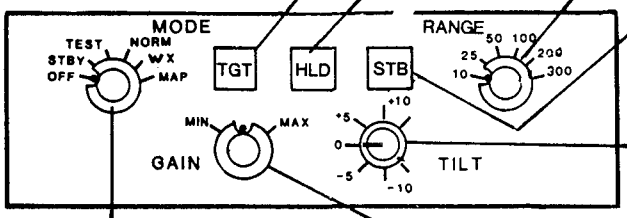
2.3. Weather radar control panel - WXP.

The control panel is provided with the necessary controls to select the various modes and functions. The control panel also contains a microprocessor that creates and controls the radar picture presented on EHSI and MFD from the digital information sent by the transceiver.

3. CONTROLS AND INDICATORS.



A WEATHER RADAR CONTROL PANEL



TGT (target) button.
TGT selected, enables Target alert and is indicated by a yellow steady T on the EHSI/MFD. The T will start to flash and alert the pilot if the signal strength of the echo increases up to Red (VIP-Level 3) and the target is detected in a sector within 50 to 150 NM and ± 15° of dead ahead regardless of selected range.

HLD (Hold) button.
The picture is held without any update when selected (push on/push off button). Hold is indicated by HOLD flashing alternately with the radar mode annunciator on EHSI/MFD.

RANGE selector.
Selects operating range in NM.

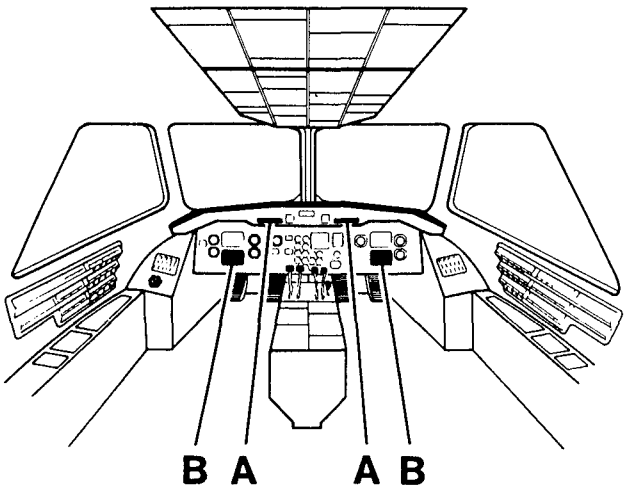
STB (Stabilization) button.
Stabilization of the antenna is provided when the button is pushed in. No stabilization when the button is pushed a second time (out).

TILT control.
Adjusts the antenna tilt angle.
Range ±15°.

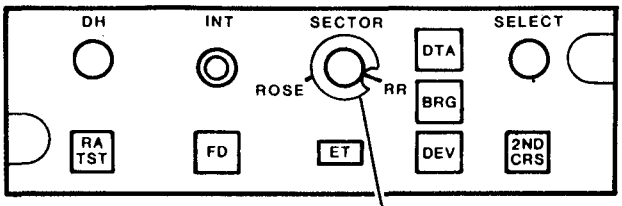
GAIN control (5-position switch).
The gain is highest in MAX position, with each of the other four positions reducing receiver sensitivity by 6 dbz. By reducing the gain, it is possible to evaluate the relative severity of the weather system because the weather echos will gradually disappear from the radar picture, leaving only the stronger echos. Reduced gain is indicated by GAIN flashing alternately with the radar mode annunciator on EHSI/MFD. Do not leave the GAIN control reduced after use, always return to MAX position.

MODE selector.
STBY - Powered (warm up) but no energy transmitted.
TEST - Internal test performed without any energy transmission.
NORM - Normal weather detection.
WX - Normal weather detection with cycling cloud contour.
MAP - Ground mapping.

Fig. 2. Weather radar - controls.

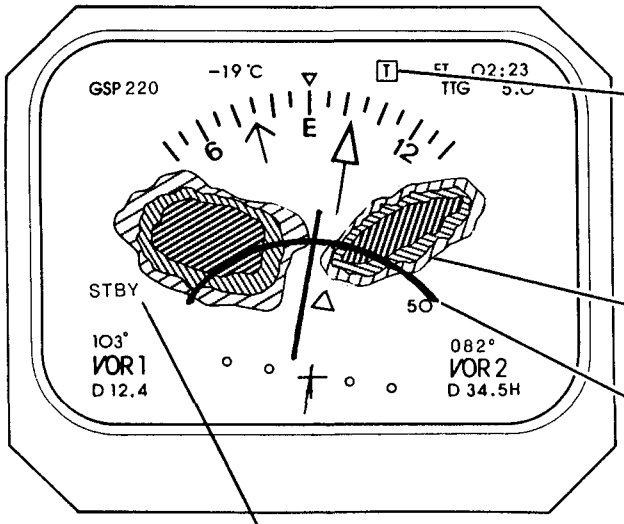


A DISPLAY CONTROL PANEL



MODE selector.
Weather radar display is added to the EHSI sector picture when RR position is selected (and with radar switched on).

B EHSI SECTOR MODE/WEATHER RADAR DISPLAY



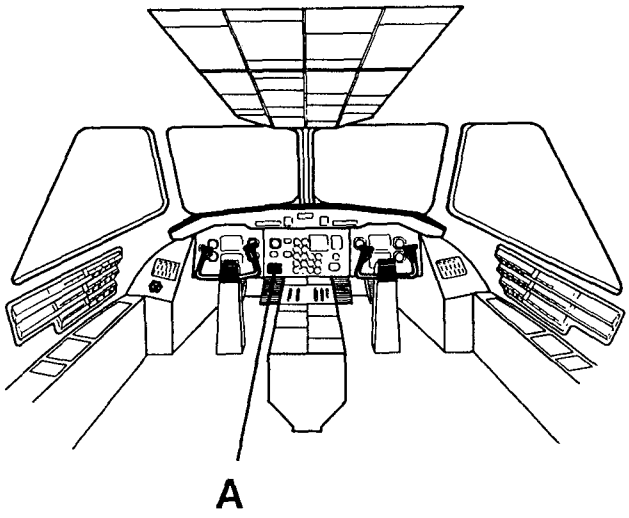
Target mode.
A yellow steady T is displayed when TGT button is selected. The T will start to flash and alert the pilot if the signal strength of the echo increases up to Red (VIP-level 3) and the target is detected in a sector within 50 to 150 NM and ± 15° of dead ahead regardless of selected range. If selected, the T is visible also when ROSE mode is selected.

Radar echo display.
Colors depend on selected radar mode and echo level.

Range arc and range in NM.
Cyan in NORM and WX mode, green in MAP mode. The arc indicates half of selected range.

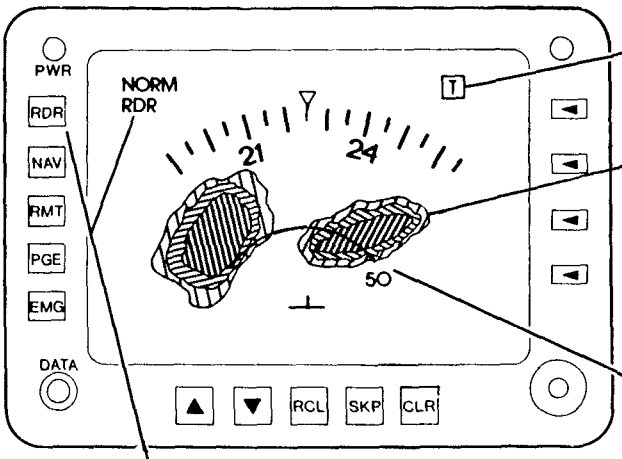
Mode annunciator.
OFF, STBY, TEST, NORM, WX or MAP in white. GAIN or HOLD can also be displayed alternately with the Mode annunciator.

Fig. 3. Display control panel and EHSI - controls and indicators.



A

A MFD – RDR MODE



Target mode.
A yellow steady T is displayed when TGT button is selected. The T will start to flash and alert the pilot if the signal strength of the echo increases up to Red (VIP-level 3) in a sector within 50 to 150 NM and ± 15° of dead ahead regardless of selected range. If selected, the T is visible also when RDR mode is not selected on the MFD.

Radar echo display.
Colors depend on selected radar mode and echo level.

Range arc and range in NM.
Cyan in NORM and WX mode, green in MAP mode. The arc indicates half of selected range. If in RDR or combined RDR-NAV mode, range will be controlled from the radar control panel. In NAV mode, range is controlled by the Line buttons, ▲ ▼ see AOM 15/1.1.

RDR button.
Enables radar display on MFD. Radar display can be mixed with NAV display if both RDR and NAV selected.
RDR annunciated in green when button depressed. Mode annunciator OFF, STBY, TEST, NORM, WX or MAP in cyan. GAIN or HOLD can also be displayed alternately with the Mode annunciator.

Fig. 4. Multifunction display, MFD, in radar mode - controls and radar picture.

4. ELECTRICAL POWER SUPPLY.

Radar power	R AVIONIC BUS	M-14	WX RADAR PWR
Radar stabilization	R INV BUS 115VAC	M-13	WX RADAR STAB

1. GENERAL.

The aircraft is provided with an airborne radar system which is used mainly for avoidance of severe weather but can also be used for ground mapping. The system will detect and present weather conditions in an angle of 120 degrees and to the range of 300 NM in front of the aircraft. Flight hazards due to weather conditions are primarily the result of turbulence and hail. Wet hail can be detected by radar, but turbulent air by itself will not provide a radar echo. (Examples are clear-air turbulence and aircraft vortices.) Areas having high rainfall rates are ordinarily associated with turbulence, and it is from this rainfall that radar echoes are reflected and the accompanying turbulence associated with the rainfall is implied. Small areas with extremely heavy rainfall rate or large areas of moderate rainfall rate can reduce the ability of the radar waves to penetrate and present a full picture of the weather area. This may mask or cause strong targets at a farther range to appear much less intense than they actually are. Always assume that all weather behind another is at least one level higher than whats being presented on the radar picture. Proper use of the RANGE, GAIN and TILT controls will aid the user in interpreting the displayed targets.

The receiver transmitter unit generates microwave energy in the form of pulses. These pulses are then transferred to the antenna where they are focused into a beam by the antenna. The radar beam is much like the beam of a flashlight. The energy is focused and radiated by the antenna in such a way that it is most intense in the center of the beam with decreasing intensity near the edge. The same antenna is used for both transmitting and receiving. When a pulse intercepts a target, the moisture (rain drops and ice) present in clouds in front of the aircraft, reflects some of this energy back to the antenna. The reflected energy provides a measure of moisture intensity which is converted to a color code. The radar color picture will therefore represent a cross section of the cloud situation in front of the aircraft.

Even though the color code corresponds to a certain amount of moisture, rain and ice, bear in mind that the radar beam will also be reflected by the ground surface, mountains etc. therefore the pilot must know his position before relying on the radar picture being just weather.

The Weather Radar is a four color display system and the picture can be presented on both EHSI's and the MFD (if installed).

The weather radar is not a go/no go signal, it is a weather analysis instrument and must be used in conjunction with a knowledge of the atmospheric conditions. It should not be used to make a decision to fly through a convective weather system, but as a guide of how far to circumnavigate it.

1.1. Operational Modes.

Normal weather detection (NORM-position).

The signals representing echos from targets on different ranges are treated with a Sensitivity Time Control, STC, which means that the target intensity remains relatively constant for close-in ranges. The radar beam power is higher but with lower resolution than for ground mapping.

Detectable weather is color coded with the black screen representing no detectable moisture, while detectable weather appears as one of four colors: green, yellow, red, or magenta (least reflective to most reflective).

In some weather conditions echoes at a certain distance and density could absorb enough beam energy to cause a very low level, if any, return signal to the radar (leaving a shadow area beyond the echo). This will cause the PAC alert (Path Attenuation Correction) bar to appear on the radar picture extending beyond the absorbing echo which alerts the pilot about possible hidden severe weather beyond the displayed echo. However, the pilot is still the master and should be monitoring the radar picture as the PAC alert has levels which have to be exceeded before PAC alert bar comes on.

Observe that the PAC function is intended for weather detection modes only. Using a weather detection mode and downward tilt to produce a ground map will probably produce a display which makes correct interpretation more difficult. The PAC circuits interprets the return signals from ground targets as intense storm targets and tries to compensate for attenuated signal, resulting in the PAC alert bar to appear. In MAP mode, the PAC alert is disabled.

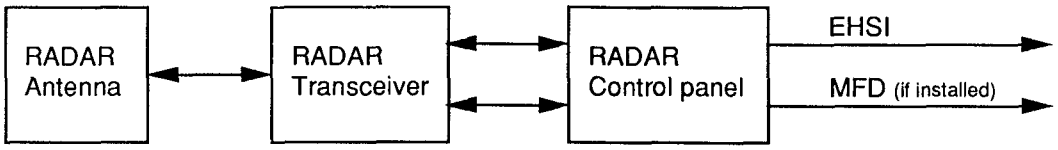


Fig. 1. WEATHER RADAR - schematic.

COLLINS WXR 350

The color code for the weather picture is:

WXR 350 COLOR	dbz	VIP-LEVEL	VIP-DEFINITIONS
BLACK	< 20	--	--
GREEN	> 20	1	Minimum detectable moisture level (weak). - Weak rainfall rate. - Light to moderate turbulence is possible with lightning.
YELLOW	> 30	2	Moderate moisture level. - Moderate rainfall rate. - Light to moderate turbulence is possible with lightning.
RED	> 40	3	Strong moisture level. - Strong rainfall rate. - Severe turbulence is possible with lightning.
		4	Very strong moisture level. - Very strong rainfall rate. - Severe turbulence is likely with lightning.
MAGENTA	> 50	5	Intense moisture level. - Intensive rainfall rate. - Severe turbulence is very likely with lightning, organized wind gusts and hail.
	> 60	6	Extreme moisture level. - Extreme rainfall rate. - Severe turbulence is certain with large hail, lightning, and extensive wind gusts

VIP = Video Integrated Processor (U.S National Weather Service).

Weather detection with contour (WX-position).

Normal weather detection with cycling cloud contour (WX-position). Same weather detection as for NORM mode and with the contouring areas of the storm cell alternating between red and black at a one-cycle-per-second rate. This is the core of the storm cell. The contouring is to highlight the most hazardous storm cells.

Ground mapping (MAP-position).

The signals representing ground echos are treated with the Sensitivity Time Controller, STC, in order to keep constant echo intensity for close-in ranges. The shape of the radar beam is more narrow and with lower beam power than for weather detection in order to provide better resolution of the ground echo returnes.

CAUTION

Do not rely on MAP mode only for navigation.

The colors for the ground picture are somewhat changed:

WXR 350 COLOR	DEFINITIONS
CYAN	Ground targets with low reflectivity.
YELLOW	Ground targets with moderate reflectivity.
MAGENTA	Ground targets with most reflectivity.

Target alert.

Activated Target alert is indicated by a steady yellow boxed T on EHSI and MFD. When selected the, T is visible also with EHSI in ROSE mode and on the MFD even if RDR mode is not selected. The T will start to flash and alert the pilot if the signal strength of the echo increases up to storm cell level and the target is detected in a sector within 50 to 150 NM and ± 15° of dead ahead regardless of selected range.

2. MAIN COMPONENTS AND SUBSYSTEMS.

2.1. Antenna.

The ANT-312 or ANT-318 antenna is installed in the nose of the aircraft and covered with a kevlar radome. It has a scan sector of 120°. The antenna is also stabilized up to 30° in roll and pitch to compensate for aircraft movement in order to have a stable scanning. The antenna can be manually tilted between ±15° from the aircraft's x-axis or from horizontal with stabilization selected.

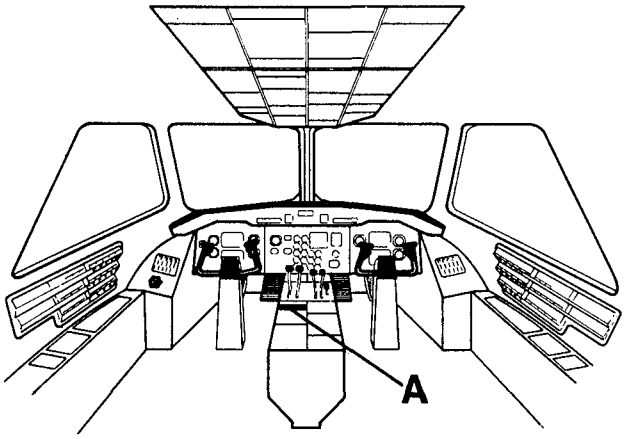
2.2. Transceiver.

The transceiver works in the X-band at a frequency of 9,345 GHz. It transmits and receives the radar beam and transforms the result into digital information fed to the radar control panel.

2.3. Weather radar control panel - WXP.

The control panel is provided with the necessary controls to select the various modes and functions. The control panel also contains the microprocessor that creates and controls the radar picture presented on EHSI and MFD from the digital information sent by the transceiver.

3. CONTROLS AND INDICATORS.



A WEATHER RADAR CONTROL PANEL

TGT (target) button.
TGT selected, enables Target alert and is indicated by a yellow steady "T" on the EHSI/MFD. The "T" will start to flash and alert the pilot if the signal strength of the echo increases up to Red (VIP-level 3) and the target is detected in a sector within 50 to 150 NM and ± 15° of dead ahead regardless of selected range.

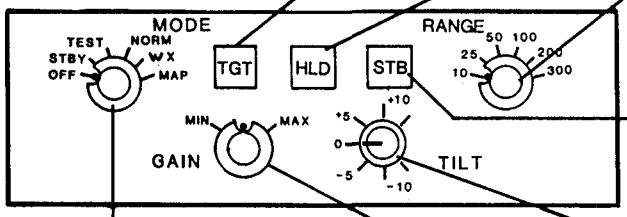
HLD (Hold) button.
The picture is held without any update when selected (push on/push off button). Hold is indicated by HOLD flashing alternately with the radar mode annunciator on EHSI/MFD.

RANGE selector.
Selects operating range in NM.

STB (Stabilization) button.
Stabilization of the antenna is provided when the button is pushed in. No stabilization when the button is pushed a second time (out).

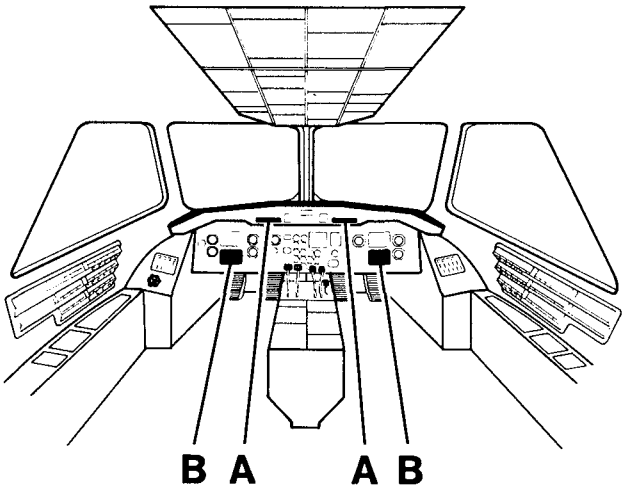
TILT control.
Adjusts the antenna tilt angle.
Range ±15°.

GAIN control (5-position switch).
The gain is highest in MAX position, with each of the other four positions reducing receiver sensitivity by 6 dbz. By reducing the gain, it is possible to evaluate the relative severity of the weather system because the weather echos will gradually disappear from the radar picture, leaving only the stronger echos. Reduced gain is indicated by GAIN flashing alternately with the radar mode annunciator on EHSI/MFD. Do not leave the GAIN control reduced after use, always return to MAX position.

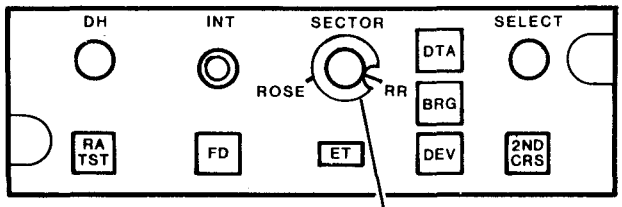


MODE selector.
STBY - Powered (warm up) but no energy transmitted.
TEST - Internal test performed without any energy transmission.
NORM - Normal weather detection with PAC alert.
WX - Normal weather detection with PAC alert and cycling cloud contour.
MAP - Ground mapping.

Fig. 2. Weather radar - controls.

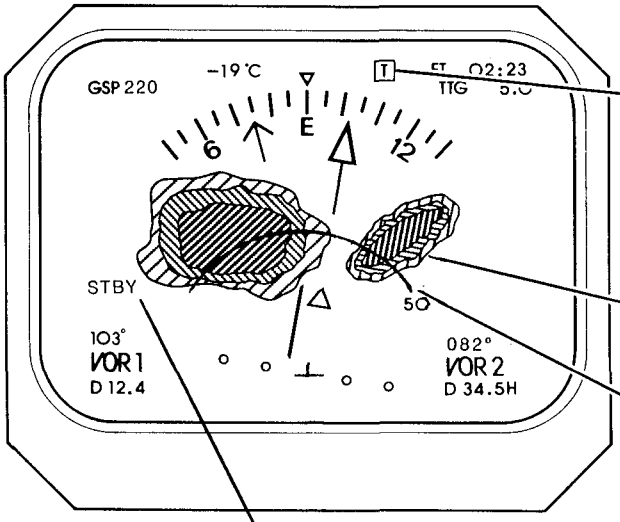


A DISPLAY CONTROL PANEL



MODE selector.
Weather radar display is added to the EHSI sector picture when RR position is selected (and with radar switched on).

B EHSI SECTOR MODE/WEATHER RADAR DISPLAY



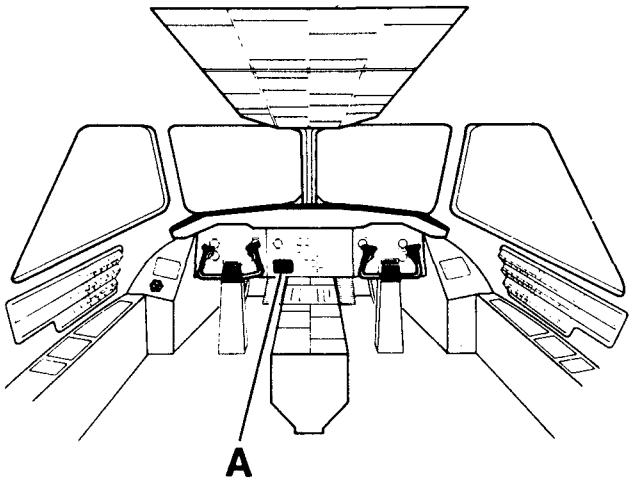
Target mode.
A yellow steady T is displayed when TGT button is selected. The T will start to flash and alert the pilot if the signal strength of the echo increases up to Red (VIP-level 3) and the target is detected in a sector within 50 to 150 NM and ± 15° of dead ahead regardless of selected range. If selected, the T is visible also when ROSE mode is selected.

Radar echo display.
Colors depend on selected radar mode and echo level.

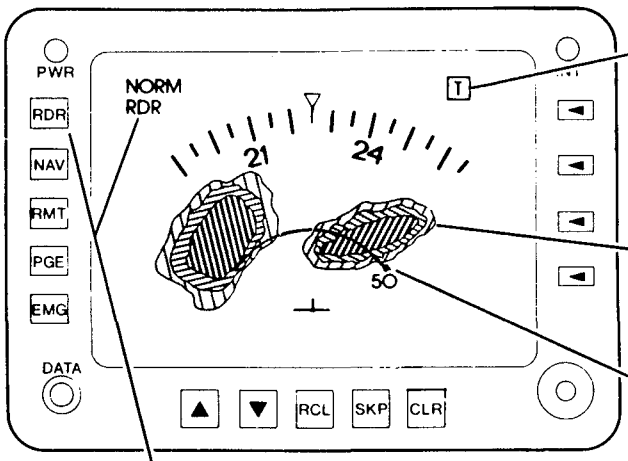
Range arc and range in NM.
Cyan in NORM and WX mode, green in MAP mode. The arc indicates half of selected range.

Mode annunciator.
OFF, STBY, TEST, NORM, WX or MAP in white. GAIN or HOLD can also be displayed alternately with the Mode annunciator.

Fig. 3. Display control panel and EHSI - controls and indicators.



A MFD RDR — MODE



Target mode.
A yellow steady T is displayed when TGT button is selected. The T will start to flash and alert the pilot if the signal strength of the echo increases up to Red (VIP-level 3) in a sector within 50 to 150 NM and ± 15° of dead ahead regardless of selected range. If selected, the T is visible also when RDR mode is not selected on the MFD.

Radar echo display.
Colors depend on selected radar mode and echo level.

Range arc and range in NM.
Cyan in NORM and WX mode, green in MAP mode. The arc indicates half of selected range.
If in RDR or combined RDR-NAV mode, range will be controlled from the radar control panel. In NAV mode, range is controlled by the Line buttons, ▲ ▼, see AOM 15/1.1.

RDR button.
Enables radar display on MFD. Radar display can be mixed with NAV display, if both RDR and NAV selected.
RDR annunciated in green when button depressed. Mode annunciator OFF, STBY, TEST, NORM, WX or MAP in cyan. GAIN or HOLD can also be displayed alternatley with the Mode annunciator.

Fig. 4. Multifunction display, MFD, in radar mode - controls and radar picture.

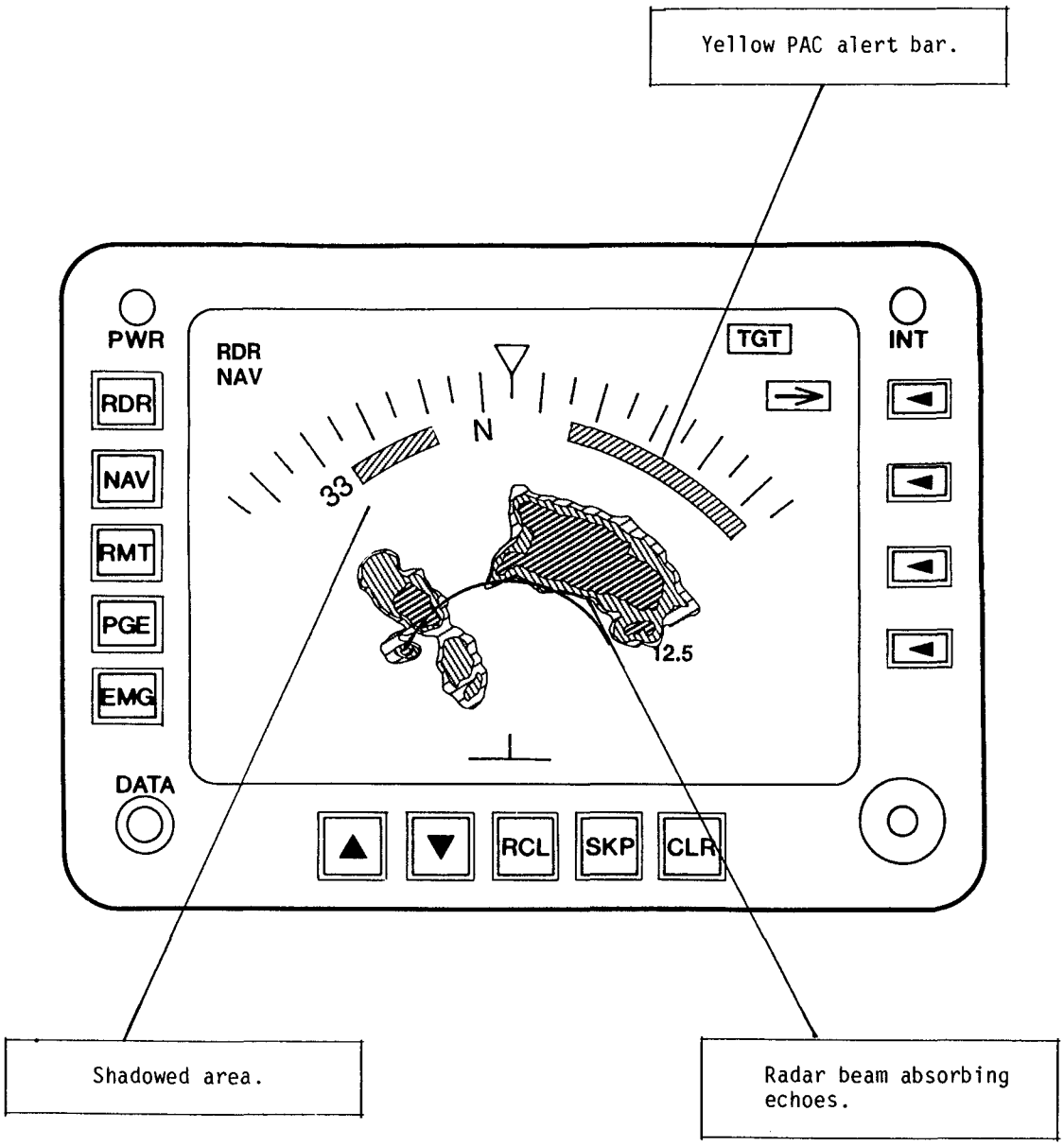


Fig. 5. EHSI/MFD radar picture with PAC alert (MFD shown).

COLLINS WXR 350

4. ELECTRICAL POWER SUPPLY.

Radar power	R AVIONIC BUS	M-14	WX RADAR PWR
Radar stabilization	R INV BUS 115VAC	M-13	WX RADAR STAB

1. GENERAL.

The aircraft is provided with an airborne radar system which is used mainly for avoidance of severe weather but can also be used for ground mapping. The system will detect and present weather conditions in an angle of 120 degrees and to the range of 300 NM in front of the aircraft. Flight hazards due to weather conditions are primarily the result of turbulence and hail. Wet hail can be detected by radar, but turbulent air by itself will not provide a radar echo. (Examples are clear-air turbulence and aircraft vortices.) Areas having high rainfall rates are ordinarily associated with turbulence, and it is from this rainfall that radar echoes are reflected and the accompanying turbulence associated with the rainfall is implied. Small areas with extremely heavy rainfall rate or large areas of moderate rainfall rate can reduce the ability of the radar waves to penetrate and present a full picture of the weather area. This may mask or cause strong targets at a farther range to appear much less intense than they actually are. Always assume that all weather behind another is at least one level higher than whats being presented on the radar picture. Proper use of the RANGE, GAIN and TILT controls will aid the user in interpreting the displayed targets.

The receiver transmitter unit generates microwave energy in the form of pulses. These pulses are then transferred to the antenna where they are focused into a beam by the antenna. The radar beam is much like the beam of a flashlight. The energy is focused and radiated by the antenna in such a way that it is most intense in the center of the beam with decreasing intensity near the edge. The same antenna is used for both transmitting and receiving. When a pulse intercepts a target, the moisture (rain drops and ice) present in clouds in front of the aircraft, reflects some of this energy back to the antenna. The reflected energy provides a measure of moisture intensity which is converted to a color code. The radar color picture will therefore represent a cross section of the cloud situation in front of the aircraft.

The radar also provides turbulence detection in which the system uses the Doppler principle of frequency shift to detect and display precipitation related turbulence. The radar cannot detect clear air turbulence or turbulence not precipitation related.

Even though the color code corresponds to a certain amount of moisture, rain and ice, bear in mind that the radar beam will also be reflected by the ground surface, mountains etc. therefore the pilot must know his position before relying on the radar picture being just weather.

The Weather Radar is a four color display system and the picture can be presented on both EHSI's and the MFD (if installed).

The weather radar is not a go/no go signal, it is a weather analysis instrument and must be used in conjunction with a knowledge of the atmospheric conditions. It should not be used to make a decision to fly through a convective weather system, but as a guide of how far to circumnavigate it.

1.1. Operational Modes.

Normal weather detection (WX-position).

The signals representing echos from targets on different ranges are treated with a Sensitivity Time Control, STC, which means that the target intensity remains relatively constant for close-in ranges. The radar beam power is higher but with lower resolution than for ground mapping.

Detectable weather is color coded with the black screen representing no detectable moisture, while detectable weather appears as one of four colors: green, yellow, red, or magenta (least reflective to most reflective).

In some weather conditions echoes at a certain distance and density could absorb enough beam energy to cause a very low level, if any, return signal to the radar (leaving a shadow area beyond the echo). This will cause the PAC alert (Path Attenuation Correction) bar to appear on the

radar picture extending beyond the absorbing echo which alerts the pilot about possible hidden severe weather beyond the displayed echo. However, the pilot is still the master and should be monitoring the radar picture as the PAC alert has levels which have to be exceeded before PAC alert bar comes on.

Observe that the PAC function is intended for weather detection modes only. Using a weather detection mode and downward tilt to produce a ground map will probably produce a display which makes correct interpretation more difficult. The PAC circuit interprets the return signals from ground targets as intense storm targets and tries to compensate for the attenuated signal, resulting in the PAC alert bar to appear. In MAP mode, the PAC alert is disabled.

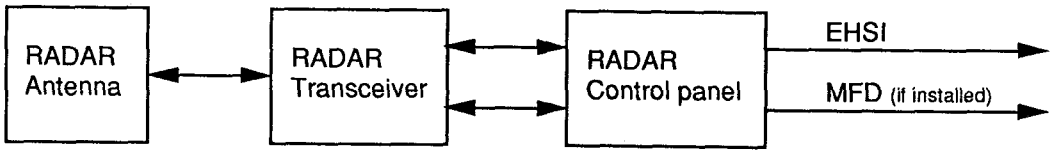


Fig. 1. WEATHER RADAR - schematic.

The color code for the weather picture is:

TWR 850 COLOR	dbz	VIP-LEVEL	VIP-DEFINITIONS
BLACK	< 20	--	--
GREEN	> 20	1	Minimum detectable moisture level (weak). - Weak rainfall rate. - Light to moderate turbulence is possible with lightning.
YELLOW	> 30	2	Moderate moisture level. - Moderate rainfall rate. - Light to moderate turbulence is possible with lightning.
RED	> 40	3	Strong moisture level. - Strong rainfall rate. - Severe turbulence is possible with lightning.
		4	Very strong moisture level. - Very strong rainfall rate. - Severe turbulence is likely with lightning.
MAGENTA	> 50	5	Intense moisture level. - Intensive rainfall rate - Severe turbulence is very likely with lightning, organized wind gusts and hail.
	> 60	6	Extreme moisture level. - Extreme rainfall rate. - Severe turbulence is certain with large hail, lightning, and extensive wind gusts.
MAGENTA	--	--	Turbulence related to precipitation. - In WX+T or TURB mode only and for turbulence greater than16.4 ft/s (5m/s)(moderate turbulence)

VIP = Video Integrated Processor (U.S National Weather Service).

Weather with turbulence (WX+T-position).

Same weather detection as for WX mode but also allows precipitation related turbulence to be detected on the 5, 10, 25 and 50 NM ranges. (Turbulence cannot be detected at ranges greater than 50 NM). Same color code as for normal weather detection except that magenta indicates both most reflective precipitation and precipitation related turbulence where the wind velocity exceeds 16.4 ft/s (5 m/s).

Turbulence detection only (TURB-position).

TURB mode instantly removes all weather echoes from the display except for areas of detectable precipitation related turbulence, which appears in magenta. The TURB position of the MODE selector is spring loaded, meaning the selector must be held in the TURB position. Releasing the selector returns it to the WX+T position and restores the full weather radar display. By removing the green, yellow, red and magenta precipitation echoes from the display, the areas of turbulence can be observed alone. As in the WX+T mode, the turbulence can only be detected in the 5, 10, 25, and 50 NM ranges.

Ground mapping (MAP-position).

The signals representing ground echos are treated with the Sensitivity Time Controller, STC, in order to keep constant echo intensity for close-in ranges. The shape of the radar beam is more narrow and with lower beam power than for weather detection in order to provide better resolution of the ground echo returnes. The PAC alert and ground clutter suppression (GCS) functions are disabled in MAP mode.

C A U T I O N

Do not rely on MAP mode only for navigation.

The colors for the ground picture are somewhat changed:

TWR 850 COLOR	DEFINITIONS
CYAN	Ground targets with low reflectivity.
GREEN	Ground targets with moderate reflectivity.
YELLOW	Ground targets with strong reflectivity.
MAGENTA	Ground targets with most reflectivity.

Target alert (TGT-position).

Activated Target alert mode is annunced on the EHSI and MFD by a yellow box with the letters TGT inscribed. When selected, the annunciator is visible also with EHSI in ROSE mode and on the MFD even if RDR mode is not selected. The target mode provides an alert sector from 7 to 200 NM and + 15 degree of dead ahead regard-less the selected range. The TGT annunciator will start to flash and alert the pilot if an echo inside the sector increases up to Red (VIP-3 level). If the wind velocity also exceeds 16.4 ft/s (5 m/s) the flashing annunciation will alternate between TGT and TRB (turbulence).

2. MAIN COMPONENTS AND SUBSYSTEMS.

2.1. Physical description.

The system consists of two separate units, the Receiver-Transmitter-Antenna and the weather radar panel. The mechanical feature of the TWR 850 radar is its compact construction, combining the receiver, transmitter and antenna into a single unit. The forward part of this unit is the flat-plate antenna. Directly behind the antenna is the RF assembly, consisting of the transmitter and receiver. Mating the antenna and receiver-transmitter eliminates the need for waveguide.

2.2. Antenna.

The RTA-854 antenna plate is 14 inch and installed in the nose of the aircraft and covered with a kevlar radome. It has a scan sector of 120°. The antenna is also stabilized up to 30° in roll and pitch to compensate for aircraft movement in order to have a stable scanning. The antenna can be manually tilted between ±15° from the aircraft's x-axis or from horizontal with stabilization selected.

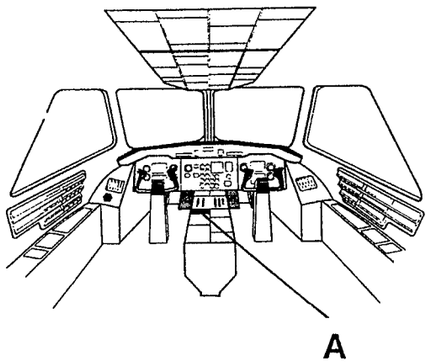
2.3. Transceiver.

The transceiver works in the X-band at a frequency of 9,345 GHz. It transmits and receives the radar beam and transforms the result into digital information fed to the radar control panel.

2.4. Weather radar control panel - WXP.

The control panel is provided with the necessary controls to select the various modes and functions. The control panel also contains the microprocessor that creates and controls the radar picture presented on EHSI and MFD from the digital information sent by the transceiver.

3. CONTROLS AND INDICATORS.



A

MODE selector
Rotate this knob to select system operating modes.
STBY - Turns on the system but does not allow it to transmit.
TEST - Causes the radar self-test display to appear.
TGT - Allows targets to be detected but not displayed.
MAP - Use this mode for ground mapping.
WX - Basic weather detection mode. Targets may appear in green, yellow, red or magenta.

WX+T - Same as WX but also allows precipitation related turbulence to be detected on the 5, 10, 25, and 50 mile ranges.

TURB - Removes all targets except detected areas of precipitation related turbulence which appear in magenta.

GCS (Ground Clutter Suppression) button
Press and release the GCS button to reduce the intensity of ground returns.

This makes the precipitation returns easier to see. The pilot should note that the GCS feature may also reduce the intensity of, or completely eliminate weaker precipitation returns. For this reason, the GCS feature times out after approximately 10 seconds. When selected, GCS is annunciated on EHSI/MFD.

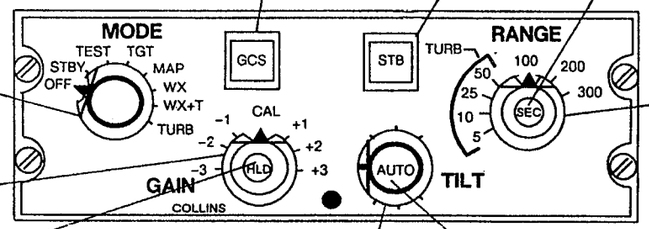
STB (Stabilization) button
Press the STB button to turn on the radar antenna stabilization circuits.

The STB button is latching and is normally left in the on (or pushed in) position. Antenna stabilization is turned off in the event of an attitude input signal failure. When STB is off, USTB is annunciated on EHSI/MFD.

SEC (Sector Scan) button
Press the SEC button to reduce the normal 120 degree scan (60 degrees either side of center) to a 60 degree scan (30 degrees either side of center).

Reducing the sector scan effectively increases the radar update rate. Press the SEC button again to return to the full 120 degree scan. Annunciation is via the reduced size of the range arcs.

A WEATHER RADAR CONTROL PANEL



RANGE selector
Rotate this knob to select the maximum display range.

Note that turbulence can only be detected on the 5, 10, 25, or 50 mile range. Half scale range is annunciated on EHSI/MFD.

GAIN control
Rotate this knob to change the gain of the radar receiver above or below the CAL (calibrated) setting.

Normal system operation is with the knob in the CAL position. Settings other than CAL are annunciated on EHSI/MFD (e.g. G+2, G-3).

Each step reduces or increases the receiver sensitivity by 6dbz for a total of 18 dbz. By reducing the gain, it is possible to evaluate the relative severity of the weather system because the weather echos will gradually disappear from the radar picture leaving only the stronger echos. Do not leave the GAIN control reduced or increased after use, always return to CAL position.

HLD (Hold) button
Press the HLD button to "freeze" the display for detailed analysis of targets.

The display remains in the hold mode until the HLD button is pressed again, or until a change in mode, range, gain GCS or SEC occurs, or until the MODE switch is turned OFF. Target updating does not occur when HLD is selected. Annunciation is on EHSI/MFD and consists of HOLD alternating with the selected mode (HOLD-WX-HOLD-WX).

TILT Control
Rotate this knob to change the tilt angle of the stabilized radar antenna.

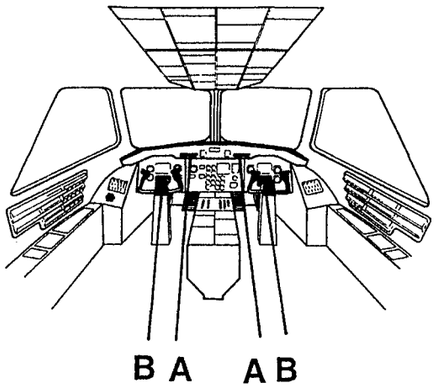
All tilt settings are annunciated on EHSI/MFD to the nearest quarter of a degree (e.g. +10.5, -5.2).

AUTO (Autotilt) switch
Pull out on the AUTO knob to select the autotilt feature.

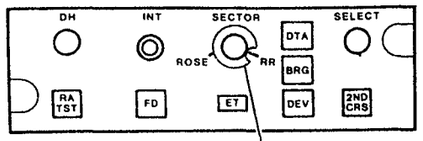
Autotilt is designed to reduce pilot workload. First the pilot uses the TILT control to adjust the antenna to the optimum tilt angle for the present range and flight altitude. After this is done, select autotilt by pulling out on the AUTO knob. With autotilt selected, changing ranges or altitudes causes the antenna to automatically tilt up or down to maintain the same ratio of tilt angle to range that were present prior to selecting autotilt. Annunciation is on EHSI/MFD with an "A" placed before the tilt angle (e.g. A +5,6, etc.)

Fig. 2. Weather Radar - controls

COLLINS TWR 850



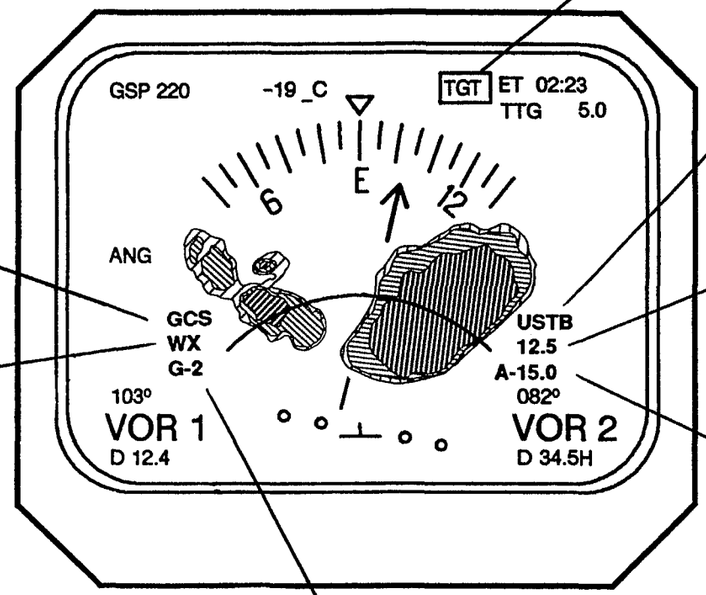
A DISPLAY CONTROL PANEL



MODE selector.
Weather radar display is added to the EHSI sector picture when RR position is selected (and with radar switched on).

Mode annunciator in white.
OFF
STBY
TEST
TGT
MAP
WX
WX+T
TURB
If hold selected, HOLD will alternate with the selected radar mode.

B EHSI SECTOR MODE/WEATHER RADAR DISPLAY



Radar echo display.
Colors depend on selected radar mode and echo level.

GCS (Ground Clutter Suppression) in white.
Indicates that ground clutter suppression is selected.

Gain annunciator in white.
Selected gain setting out of CAL position is annunced by G-1, G-2 or G-3 for reduced gain and G+1, G+2 or G+3 for increased.

TGT target and TRB turbulence annunciator in yellow.
The target mode provides an alert sector from 7 to 200 NM and ± 15 degree of dead ahead regardless of the selected range. The TGT annunciator will start to flash and alert the pilot if an echo inside the sector increases up to Red (VIP-level 3). If the wind velocity also exceess 16.4 ft/s (5 m/s) the flashing annunciation will alternate between TGT and TRB (turbulence).

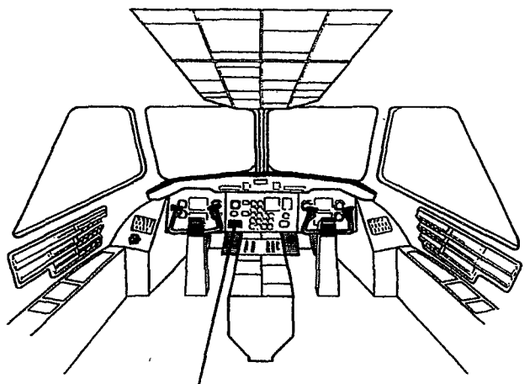
USTB unstabilized in white.
Indicates that antenna stabilization is turned off.

Range arc and range in NM.
The arc indicates half of selected range. The color is cyan in modes STBY, TEST, WX, WX+T and TURB, dashed white lines in TGT and a white solid line in MAP.

Tilt setting annunciator in white.
The tilt settings are annunced to the nearest quarter of a degree (+10.5, -5.2). If auto-tilt is selected, an A is placed before the tilt angle (A+8.5).

Fig. 3. Display control panel and EHSI - controls and indicators.

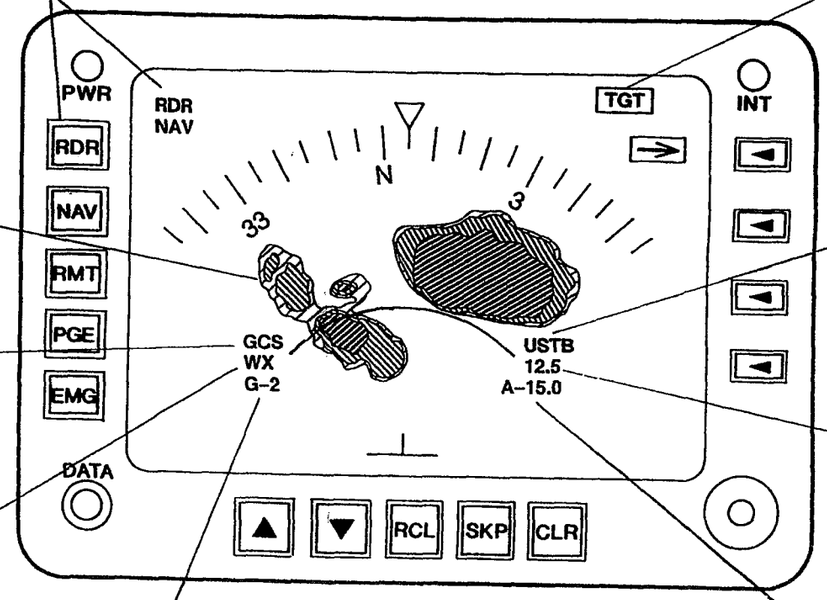
COLLINS TWR 850



A

RDR button.
Enables radar display on MFD. Radar display can be mixed with NAV dislay, if both RDR and NAV selected.
RDR annunciated in green when button depressed.

A MFD – RDR MODE



Radar echo display.
Colors depend on selected radar mode and echo level.

GCS (Ground Clutter Suppression) in white.
Indicates that ground clutter suppression is selected.

Mode annunciator in white.
OFF
STBY
TEST
TGT
MAP
WX
WX+T
TURB
If hold selected, HOLD will alternate with the selected radar mode.

Gain annunciator in white.
Selected gain setting out of CAL position is annunced by G-1, G-2 or G-3 for reduced gain and G+1, G+2 or G+3 for increased.

TGT target and TRB turbulence annunciator in yellow.
The target mode provides an alert sector from 7 to 200 NM and + 15 degree of dead ahead regardless of the selected range. The TGT annunciator will start to flash and alert the pilot if an echo inside the sector increases up to Red (VIP-Level 3). If the wind velocity also exceeds 16.4 ft/s (5 m/s) the flashing annunciator will alternate between TGT and TRB (turbulence).

USTB unstabilized in white.
Indicates that antenna stabilization is turned off.

Range arc and range in NM.
The arc indicates half of selected range. If in RDR or combined RDR-NAV mode, range will be controlled from the radar control Panel. In NAV mode, range is controlled by the Line buttons, ▲ ▼ see AOM 15/1.1.
The color is cyan in modes STBY, TEST, WX, WX+T and TURB, dashed white Lines in TGT and a white solid Line in MAP.

Tilt setting annunciator in white.
The tilt settings are annunced to the nearest quarter of a degree (+10.5, -5.2). If auto-tilt is selected, an A is placed before the tilt angle (A+8.5).

Fig. 4. Multifunction display, MFD, in radar mode - controls and radar picture.

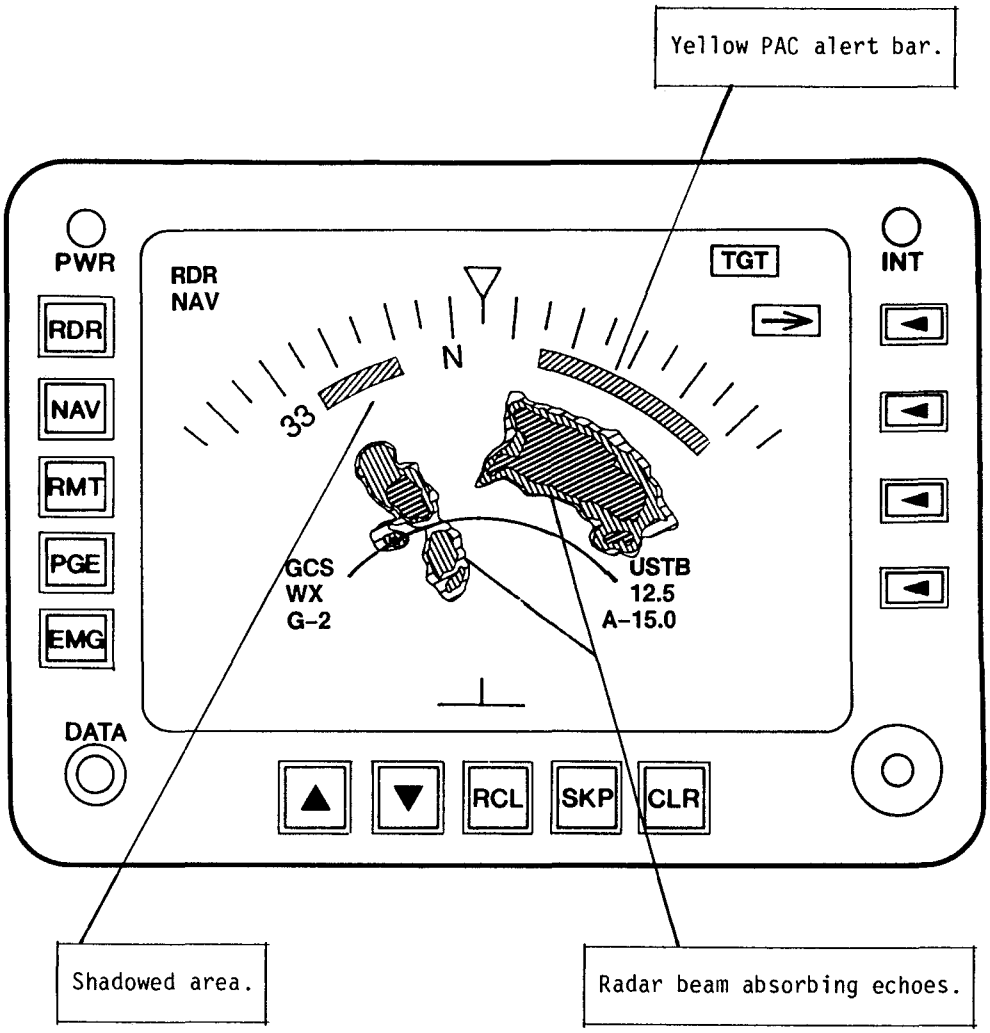


Fig. 5. EHSI/MFD radar picture with PAC alert (MFD shown).

COLLINS TWR 850

4. ELECTRICAL POWER SUPPLY.

Radar power	R AVIONIC BUS	M-14	WX RADAR PWR
Radar stabilization	R INV BUS 115VAC	M-13	WX RADAR STAB

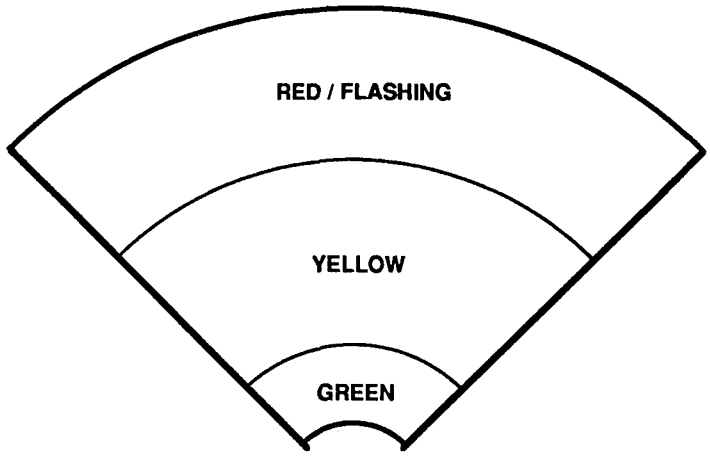
1. LIMITATIONS.

W A R N I N G

Do not operate radar within 60 m/180 feet of other aircraft being refueled or within 30 m/90 feet of personnel in the beam area.

2. NORMAL OPERATION.

CONDITIONS	NORMAL PROCEDURES
2.1 POWER UP.	1. L and R AVION switches ..... ON - Power is supplied to the radar by L and R AVION switches. 2. MAIN INV switch ..... ON * - 115 V AC and 26 V AC via left AHRS (provided the 26 V switch is in MAIN INV position) are applied for radar antenna stabilization. 3. MODE selector, weather radar panel ..... STBY - Radar powerized (warm up) but no energy transmitted. * If dual main 115 V AC and 26 V AC inverters installed: 2. INVERTER switch ..... 1 or 2
2.2 POWER DOWN.	1. TILT control ..... SET MAX UP - Tilt max up is for ground safety reasons. 2. MODE selector, weather radar panel ..... STBY - Radar can also be switched off with MODE selector in OFF position.
2.3 TESTING. (Cont'd)	1. Mode selector, DCP ..... RR 2. RANGE selector (weather radar panel) ..... 10 3. MODE selector (weather radar panel) ..... TEST - After approx 30-60 s a test picture will be displayed. 4. Test picture ..... CHECK - Check to comply with fig. 1.

CONDITIONS	NORMAL PROCEDURES
(Cont'd)	5. Test picture for WXR 200 system.  Fig. 1.
2.4 OPERATION. (Cont'd)	<>----If radar picture to be displayed on MFD (if installed). 1. RDR pushbutton ..... PRESS - Proceed with item 2 below. <>----If radar picture to be displayed on EHSI. 1. Mode selector, DCP ..... RR 2. MODE selector (weather radar panel) ..... AS REQUIRED - NORM - WX - MAP 3. Mode indication on EHSI/MFD ..... CHECK 4. RANGE selector ..... AS REQUIRED 5. GAIN control ..... MAX - Each click reduces the receiver sensitivity by 6 dbz. - By reducing GAIN, weather echos will gradually disappear from the radar picture, leaving only the stronger echos. - Do not leave the GAIN control reduced after use, always return to MAX position.

COLLINS WXR 200

CONDITIONS	NORMAL PROCEDURES
(Cont'd)	6. TILT control ..... CHECK - +10 to -5 is useful for weather detection (with STB selected). - 0 to -10 is useful for ground mapping (with STB selected). 7. TGT button ..... SELECT OR AS REQUIRED - Gives flashing target alert on EFIS (yellow boxed T), when a storm cell is detected within 50 to 150 NM and ± 15 degrees ahead of the aircraft regardless of range selected. - Helpful if other modes than weather radar has been selected on EFIS (i.e. compass rose mode). 8. HLD button ..... AS REQUIRED - Radar picture is held without any update, if selected (push-on/push-off button). 9. STB button ..... SELECT - Enables stabilization of radar antenna. 10. Radar picture ..... CHECK - Adjust picture with RANGE, GAIN, TILT and display intensity for best results.

INTENTIONALLY LEFT BLANK

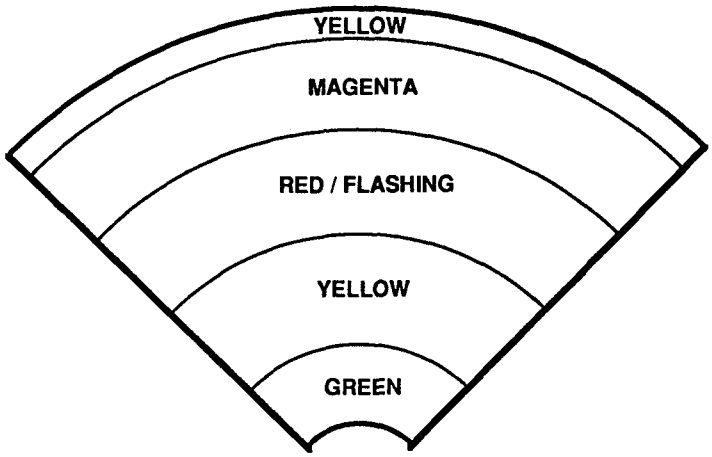
1. LIMITATIONS.

W A R N I N G

Do not operate radar within 60 m/180 feet of other aircraft being refueled or within 30 m/90 feet of personnel in the beam area.

2. NORMAL OPERATION.

CONDITIONS	NORMAL PROCEDURES
2.1 POWER UP.	1. L and R AVION switches ..... ON - Power is supplied to the radar by L and R AVION switches. 2. MAIN INV switch ..... ON * - 115 V AC and 26 V AC via left AHRS (provided the 26 V switch is in MAIN INV position) are applied for radar antenna stabilization. 3. MODE selector, weather radar panel ..... STBY - Radar powerized (warm up) but no energy transmitted. * If dual main 115 V AC and 26 V AC inverters installed: 2. INVERTER switch ..... 1 or 2
2.2 POWER DOWN.	1. TILT control ..... SET MAX UP - Tilt max up is for ground safety reasons. 2. MODE selector, weather radar panel ..... STBY - Radar can also be switched off with MODE selector in OFF position.
2.3 TESTING. (Cont'd)	1. Mode selector, DCP ..... RR 2. RANGE selector (weather radar panel) ..... 10 3. MODE selector (weather radar panel) ..... TEST - After approx 30-60 s a test picture will be displayed. 4. Test picture ..... CHECK - Check to comply with fig. 1.

CONDITIONS	NORMAL PROCEDURES
(Cont'd)	5. Test picture for WXR 350 system.  Fig. 1.
2.4 OPERATION.	<>----If radar picture to be displayed on MFD (if installed). 1. RDR pushbutton ..... PRESS - Proceed with item 2 below. <>----If radar picture to be displayed on EHSI. 1. Mode selector, DCP ..... RR 2. MODE selector (weather radar panel) ..... AS REQUIRED - NORM - WX - MAP 3. Mode indication on EHSI/MFD ..... CHECK 4. RANGE selector ..... AS REQUIRED 5. GAIN control ..... MAX - Each click reduces the receiver sensitivity by 6 dbz. - By reducing GAIN, weather echos will gradually disappear from the radar picture, leaving only the stronger echos. - Do not leave the GAIN control reduced after use, always return to MAX position.

CONDITIONS	NORMAL PROCEDURES
(Cont'd)	6. TILT control ..... CHECK - +10 to -5 is useful for weather detection (with STB selected). - 0 to -10 is useful for ground mapping (with STB selected). 7. TGT button ..... SELECT OR AS REQUIRED - Gives flashing target alert on EFIS (yellow boxed T), when a storm cell is detected within 50 to 150 NM and ± 15 degrees ahead of the aircraft regardless of range selected. - Helpful if other modes than weather radar has been selected on EFIS (i.e. compass rose mode). 8. HLD button ..... AS REQUIRED - Radar picture is held without any update, if selected (push-on/push-off button). 9. STB button ..... SELECT - Enables stabilization of radar antenna. 10. Radar picture ..... CHECK - Adjust picture with RANGE, GAIN, TILT and display intensity for best results.

INTENTIONALLY LEFT BLANK

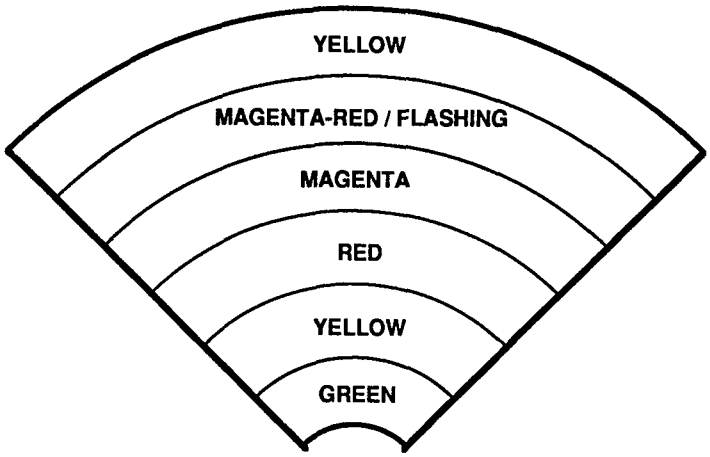
1. LIMITATIONS.

W A R N I N G

Do not operate radar within 60 m/180 feet of other aircraft being refueled or within 30 m/90 feet of personnel in the beam area.

2. NORMAL OPERATION.

CONDITIONS	NORMAL PROCEDURES
2.1 POWER UP.	1. L and R AVION switches ..... ON - Power is supplied to the radar by L and R AVION switches. 2. MAIN INV switch ..... ON * - 115 V AC and 26 V AC via left AHRS (provided the 26 V switch is in MAIN INV position) are applied for radar antenna stabilization. 3. MODE selector, weather radar panel ..... STBY - Radar powerized (warm up) but no energy transmitted. * If dual main 115 V AC and 26 V AC inverters installed: 2. INVERTER switch ..... 1 or 2
2.2 POWER DOWN.	1. TILT control ..... SET MAX UP - Tilt max up is for ground safety reasons. 2. MODE selector, weather radar panel ..... STBY - Radar can also be switched off with MODE selector in OFF position.
2.3 TESTING. (Cont'd)	1. Mode selector, DCP ..... RR 2. RANGE selector (weather radar panel) ..... ANY POSITION 3. MODE selector (weather radar panel) ..... TEST - After approx 30-60 s a test picture will be displayed. 4. Test picture ..... CHECK - Check to comply with fig. 1.

CONDITIONS	NORMAL PROCEDURES
	5. Test picture for TWR 850 system.  Fig. 1.
2.4 OPERATION. (Cont'd)	<>----If radar picture to be displayed on MFD (if installed). 1. RDR pushbutton ..... PRESS - Proceed with item 2 below. <>----If radar picture to be displayed on EHSI. 1. Mode selector, DCP ..... RR 2. MODE selector (weather radar panel) ..... AS REQUIRED - TGT - MAP - WX - WX+T - TURB 3. Mode indication on EHSI/MFD ..... CHECK 4. RANGE selector ..... AS REQUIRED

COLLINS TWR 850

CONDITIONS	NORMAL PROCEDURES
(Cont'd)	5. SEC button ..... AS REQUIRED - 120 degree scan - 60 degree scan 6. GAIN control ..... CAL - Each click out of CAL position reduces (-1, -2, -4) or increases (+1, +2, +3) the receiver sensitivity by 6 dbz. - By reducing GAIN, weather echos will gradually disappear from the radar picture, leaving only the stronger echos. - Do not leave the GAIN control reduced or increased after use, always return to CAL position. 7. TILT control ..... CHECK - +10 to -5 is useful for weather detection (with STB selected). - 0 to -10 is useful for ground mapping (with STB selected). 8. AUTO switch ..... AS REQUIRED - Autotilt is selecten when switch is pulled out. 9. HLD button ..... AS REQUIRED - Radar picture is held without any update, if selected (push-on/push-off button). 10. STB button ..... SELECT - Enables stabilization of radar antenna. 11. GCS button ..... AS REQUIRED - Ground clutter suppression reduced the intensity of ground returns, if selected (push-on/push-off button). 12. Radar picture ..... CHECK - Adjust picture with RANGE, GAIN, TILT and display intensity for best results.

INTENTIONALLY LEFT BLANK

CONDITIONS	NORMAL PROCEDURES
2.5 GAIN CONTROL.	Operators must recognize that reducing the gain of the system reduces the effective range and the sensitivity of the system. The variable GAIN control should only be used to reduce the receiver's sensitivity to aid in determining the relative intensity of multiple thunderstorms and locating embedded cells in a rain front at low altitude and in terminal areas - not to locate a path to penetrate the storm area. As the gain is reduced the red areas of the target will eventually be displayed as yellow and the yellow areas will turn into green. The red area that is the last to change to the next lower level is the strongest part of the target. If there is a large area of red displayed and the pilot desires to know which way to deviate to avoid the strongest part of the cell, he may reduce the gain slowly and note which part of the target remains red longest. That is the strongest part of the red return and the area to avoid by the greatest distance. Reducing the gain when ground mapping through light rainfall will clear up the ground picture. GAIN is flashed on the display whenever a reduced gain mode is selected. Do not leve the GAIN control reduced after use, always return to MAX (CAL for TWR 850) position. WXR 200 How to see the difference between a strong cell and a severe thunderstorm. Example: - Red color comes on at a reflectivity over 40 dbz. - Strong and very strong cells have reflectivities in excess of 40 dbz. - Severe thunderstorms have reflectivities in excess of 50 dbz. - Each click on the GAIN control reduces the receiver sensitivity with 6 dbz. All cells in a weather system that still indicates red after the GAIN has been reduced two clicks, must be treated as severe thunderstorms. WXR 350/TWR 850 The WXR 350 weather radar has a fifth color, magenta, which comes on at a reflectivity exceeding 50 dbz.
2.6 HOLD BUTTON.	The (weather) hold function allows the pilot to evaluate storm direction and rate of movement relative to the aircraft's present heading. The hold function will provide the greatest assistance when used on the longer ranges. On the shorter ranges, the weather situation can change too rapidly to justify using the hold function.

CONDITIONS	NORMAL PROCEDURES
2.7 TILT SETTINGS (with STB selected.)	The radar beam is a narrow cone with a beam width of 6° for 18 inch antenna, 7° for 14 inch antenna and 8° for 12 inch antenna and it sweeps in a plane relative to the earth. The tilt control is used to vary the sweep of the beam up or down with respect to the plane of the earth. The key to best weather radar effectivity is precision antenna tilt management of detection, analyzing and avoiding hazardous convective weather handling of the TILT control allows the pilot to measure precipitation densities, the height of a storm, rain core shapes, rain gradients or even distinguish between weather and ground exhoes. Described further on are some technics to manipulate the TILT control for best weather detections. 1. Finding the calibrated 0° tilt. With STB selected the 0° index on the TILT control should normally position the radar beam in parallel to the surface of the earth. (We can ignore the earth curvature up to 60 NM distances.) This will be true only if the radar antenna has been properly aligned with precision instruments like by the aircraft manufacture. However, experience has shown that the alignment will sometimes deviate after workshop visits and overhauls of the radar system. Therefore the tilt index must be checked and calibrated before the pilot can rely on the tilt effectivity. If we bear in mind that everything connected with tilt management is angular, we will find that when tilt is changed in degrees, the beam is displaced up or down a certain numbers of feet dependent on the distance from the aircraft. The numbers of feet at a particular distance can easily be calculated by this formula: distance x 100 = feet per degree. One degree of tilt change moves the beam up or down 100 feet at one NM from the antenna. At 5 NM the movement is 5 x 100 = 500 feet. At 12,5 NM; 12,5 x 100 = 1250 feet etc. This formula can now easily be applied to determine the time zero tilt. On a clear day, start with level off the aircraft and set a normal cruise speed, over flat terrain, With STB selected, turn the tilt down until the ground echo is displayed from the range arc and out. Then identify the altitude AGL and the arc range in the following table. By adjusting the tilt with the value taken from the table, the radar beam will be leveled in parallel with the surface of the earth. Now, any difference between this tilt setting and the 0° TILT index is a result of misalignment.
(Cont'd)	

CONDITIONS	NORMAL PROCEDURES
(Cont'd)	

12 INCH ANTENNA (WXR 200)

ALTITUDE AGL	Arc range			
	5nm	12,5nm	25nm	50nm
2000	0°	- 2.5°	- 3°	- 3.5°
4000	+ 4°	- 1°	- 2.5°	- 3°
6000	+ 8°	+ 1°	- 1.5°	- 2.5°
8000	+12°	+ 2.5°	- 1°	- 2.5°
10000	+16°	+ 4°	0°	- 2°
12000	-	+ 5.5°	+1°	- 1.5°
14000	-	+ 7°	+1.5°	- 1°
16000	-	+ 9°	+2.5°	- 1°
18000	-	+10.5°	+3°	- 0.5°
20000	-	+12°	+4°	0°
22000	-	+13.5°	+5°	+0.5°
25000	-	+16°	+6°	+1°
27000	-	-	+7°	+1.5°
29000	-	-	+7.5°	+2°
31000	-	-	+8.5°	+2.5°

14 INCH ANTENNA (TWR 850)

ALTITUDE AGL	Arc range			
	5nm	12,5nm	25nm	50nm
2000	+ 0.5°	- 2°	- 2.5°	- 3°
4000	+ 4.5°	- 0.5°	- 2°	- 2.5°
6000	+ 8.5°	+ 1.5°	- 1°	- 2°
8000	+12.5°	+ 3°	- 0.5°	- 2°
10000	+16.5°	+ 4.5°	+0.5°	- 1.5°
12000	-	+ 6°	+1.5°	- 1°
14000	-	+ 7.5°	+2°	- 0.5°
16000	-	+ 9.5°	+3°	- 0.5°
18000	-	+11°	+3.5°	0°
20000	-	+12.5°	+4.5°	+0.5°
22000	-	+14°	+5.5°	+1°
25000	-	+16.5°	+6.5°	+1.5°
27000	-	-	+7.5°	+2°
29000	-	-	+8°	+2.5°
31000	-	-	+9°	+3°

(Cont'd)

CONDITIONS	NORMAL PROCEDURES
(Cont'd)	

18 INCH ANTENNA (WXR 350)

ALTITUDE AGL	Arc range			
	5nm	12,5nm	25nm	50nm
2000	+ 1°	- 1.5°	- 2°	- 2.5°
4000	+ 5°	0°	- 1.5°	- 2°
6000	+ 9°	+ 2°	- 0.5°	- 1.5°
8000	+13°	+ 3.5°	0°	- 1.5°
10000	+17°	+ 5°	+1°	- 1°
12000	-	+ 6.5°	+2°	- 0.5°
14000	-	+ 8°	+2.5°	0°
16000	-	+10°	+3.5°	0°
18000	-	+11.5°	+4°	+0.5°
20000	-	+13°	+5°	+1°
22000	-	+14.5°	+6°	+1.5°
25000	-	+17°	+7°	+2°
27000	-	-	+8°	+2.5°
29000	-	-	+8.5°	+3°
31000	-	-	+9.5°	+3.5°

2. The parked position.

Any time when not operating the radar RANGE and TILT controls the radar should be set to the parked position. The idea is to set up the radar so that the radar beam slightly tilted down to provide ground returns from a certain distance and outwards relative the selected range. With this setting on the radar the pilot is given a fast and certain mean to insure the radar is functioning and most important, a possibility to recognize radar shadows.

With ground returns displayed on the indicator;

- any prominent echo that works back inside the ground returns is probable weather.
- any echo that can not be identified as a city, hill, mountain peak or geological structure is a weather system.
- if black areas start to grow from the outer edge of the ground return on the indicator and inwards, the aircraft is approaching a radar shadow.
- any echoes that changes rapidly in size, shape or intensity is a dynamic weather system.
- if the indicator goes totally black, the radar has failed.

(Cont'd)

CONDITIONS	NORMAL PROCEDURES
(Cont'd)	With the parked position selected, the pilot can also easily measure the clearance to an object. Suppose that an echo working back toward the aircraft, is fading out at the 30 NM range. The echo has faded because it has worked back under the radar beam. Fading out at 30 NM means that the echo - whatever it is - will be cleared by about 1200-1500 feet (depending on which antenna). If the echo fades out at 2 NM it will be cleared by less than 800-1000 feet, if at all. The formula is: half the beam width + 1 x range x 100. Beam width is 6° for 18 inch antenna, 7° for 14 inch and 8° for 12 inch. To find the parked position, set the tilt down one degree. Then adjust the Range control so that ground is being painted on the outer one-third to one-half of the indicator. The following table shows range setting versus altitude and distance from where the ground return is painted.

12 INCH ANTENNA (WXR 200)

ALTITUDE AGL	Distance from where ground return is painted in nm.	Radar range setting
2000	4	10
4000	8	
6000	12	25
8000	16	
10000	20	
12000	24	50
14000	28	
16000	32	
18000	36	
20000	40	
22000	44	100
25000	50	
27000	54	
29000	58	
31000	62	

(Cont'd)

CONDITIONS	NORMAL PROCEDURES
(Cont'd)	

14 INCH ANTENNA (TWR 850)

ALTITUDE AGL	Distance from where ground return is painted in nm.	Radar range setting
2000	4.5	10
4000	9	25
6000	13.5	
8000	18	
10000	22.5	50
12000	27	
14000	31	
16000	35.5	
18000	40	
20000	44.5	100
22000	49	
25000	55.5	
27000	60	
29000	64.5	
31000	69	

18 INCH ANTENNA (WXR 350)

ALTITUDE AGL	Distance from where ground return is painted in nm.	Radar range setting
2000	5	10
4000	10	25
6000	15	
8000	20	
10000	25	50
12000	30	
14000	35	
16000	40	
18000	45	100
20000	50	
22000	55	
25000	63	
27000	68	
29000	73	
31000	76	

(Cont'd)

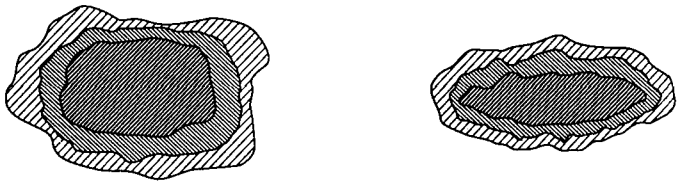
CONDITIONS	NORMAL PROCEDURES
(Cont'd)	**3. Tilt up position.** If the tilt is precisely positioned so the bottom of the beam sweeps on a plane parallel to the earth's surface, the radar will detect and display only objects that intrude through the flight level of the aircraft. This tilt position can be set by using a simple technique. Set the tilt so that ground returns are being displayed for example from the 50 NM arc outward. Then drop the thousands from the aircraft height (AGL), divide by 5, and move the tilt up that number of degrees. Example: Flying at Flight Level 210, assume that the present ground elevation is 1000 feet, the height AGL will be about 20000 feet, and 20 divided by 5 equals 4. Then note the tilt setting with the bottom of the beam sweeping on the 50 NM arc, then increase tilt by the number of degrees equal to the calculation (4 degrees). The calculation can also be made with other range settings. NM arc / Divide by 5 / 0.5 12.5 / 1.25 25 / 2.5 50 / 5 100 / 10 150 / 15 If finding the calibrated 0° tilt technique has been conducted. The Tilt up position can also be performed by moving the tilt up one-half beam width from the calibrated 0° tilt position. One-half beam width is: 3° for 18 inch antenna, 3,5° for 14 inch antenna and 4° for 12 inch antenna. **4. Measure the height of a radar target.** The tilt can also be used to determine the height of a radar target. Slowly increase the tilt in 1° increments from the setting calculated above until the echo becomes so weak that it almost disappears from the display. The bottom of the beam is now barely overscanning the top of the target. Now calculate the height of the target relative to the aircrafts altitude with this formula: Distance to the target multiplied by 100 multiplied by the number of degrees the tilt was increased equals targets radar height.
(Cont'd)	

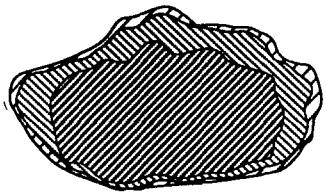
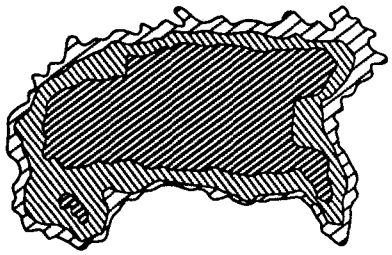
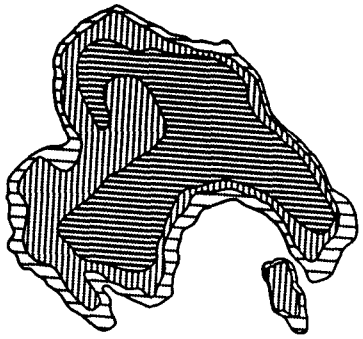
CONDITIONS	ABNORMAL PROCEDURES
(Cont'd)	Example: A target is displayed at 50 NM with the bottom of the beam leveled at the aircraft altitude. After increasing tilt, the echo disappeard at 4°. Now calculate the height of the target like this: 50 x 100 x 4 = 20000 feet. The radar top of the target is 20000 feet above the aircraft. Observe that this method measures the radar top of the target, it does not measure total storm height, hazards may excist several thousands feet above the radar top. The method can also be used to measure radar tops below the aircraft altitude in the same manner by adjust the tilt downward. The method will work with airborne radars out to a distance of 60 NM. Beyond that, the curvature of the earth and some other factors render it unreliable. A repetition of the height determinating method is recommended in 2 to 3 minute intervals when approaching a weather system to monitor whether the storm is growing in height or dissipating. Rapid growth in radar height of the weather above 20000 to 30000 feet, indicates a very hazardous weather system. Experience has proven that the hazards associated with a weather system are directly proportional to its radar height. In terminal areas, any storm with a radar top exceeding 20000 feet AGL is a potential killer. 5. + 10° tilt. Sometimes there is just no time for much knob tweaking and calculating during a busy approach. In those cases the + 10° on the tilt method is to prefer. Execute the method every 2 minutes for best efficiency. With + 10° on the tilt, echoes displayed at distances of 25 NM or more have radar tops of at least 25000 feet above the present altitude and echoes at 15 NM or more have radar tops of more than 15000 feet above present aircraft altitude. Never leave the tilt at + 10° for more than a 5-10 sweeps at most. Always return to the Parked position.
2.8 PREFLIGHT AND CLIMB-OUT TIPS. (Cont'd)	Make it a part of the preflight to check the radar prior to leaving the ramp. Set the Mode selector to TEST. While taxiing or when the aircraft is clear of the terminal area and other aircraft, select the shortest range on the radar panel, set the Mode selector to WX, and then adjust the antenna tilt downward until ground echoes appear at the bottom of the display. This is a confidence check to ensure the radar is operational. Tilt the antenna upward and use the radar to determine the weather situation around the airport while taxiing and lined-up, especially in darkness (make sure to be clear of other aircraft).

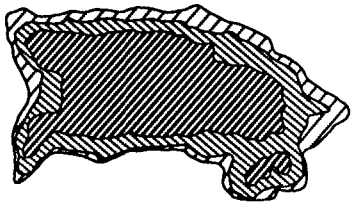
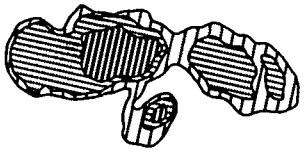
CONDITIONS	NORMAL PROCEDURES
(Cont'd)	The best radar performance and confidence check is while airborne. The check is quite simple, if the radar can not display ground returns to a distance of at least 100 NM it can not be trusted. It is convenient to perform the check at 10000 feet because at 10000 feet the line of sight is just 100 NM. Perform the check as the aircraft is climbing through 10000 feet AGL. With STB selected, set RANGE at 200 NM and the TILT control at -1°. Now check radar picture when passing through 10000 feet. There should be ground returns displayed out to a distance of at least 100 NM.
2.9 AVOIDANCE PATH PLANNING.	Along squall lines, individual cells are in different stages of development. Areas between closely spaced, intense echoes may contain developing clouds not having enough moisture to produce an echo. The lightest level (green) may or may not be displayed, which would indicate light rainfall rates or no rainfall; yet, these areas could have strong updrafts or downdrafts. In penetrating a squall line, fly as far from building cells as possible. Avoid contoured areas of the display (areas of intense turbulence) by at least 10 miles or more, whenever possible. Targets showing wide areas of green are generally precipitation without severe turbulence. Avoid all cells containing magenta and red areas by at least 20 miles, if possible. Avoid to deviate downwind unless absolutely necessary. The changes of encountering severe turbulence and damaging hail are greatly reduced by selecting the upwind side of a storm.
2.10 TERMINAL AREAS.	There are three Life-and-death rules for terminal areas: - With + 10° tilt, any echo that appears on the display at 20 NM or greater must be avoided regardless if it is contouring or not. - With + 10° tilt, any echo giving contours regardless of distance must be avoided no matter how high it is. - With + 10° tilt and aircraft in landing configuration, if any countouring echo is detected within 5 NM and can not be avoided, perform immediate go-around. If lined up for takeoff, do not go. Also on an approach, do not hesitate to ask the controller how the weather lookes like from the tower side. Ask questions like the following: - What does the weather look like from your position? - How long time ago did the weather develop? - Does the weather seem to be dissipating or growing? - Is the weather moving? - At what speed and direction is it moving? - Is the weather in a line?

CONDITIONS	NORMAL PROCEDURES
2.11 RADAR SHADOW.	Extremely heavy rainfall can reduce the ability of the radar waves to penetrate and present a full picture of the weather area. This condition is referred to as "radar attenuation". It is a case where ground returns can be helpful in analyzing the weather situation. Tilt the antenna down and observe the ground returns around the radar echo. With very heavy intervening rain, the ground returns behind the echo will not be present but rather will appear as a shadow. This may indicate a larger area of precipitation than appears on the indicator. Shadowing storms will also contain microbursts, downbursts, large hail, extreme turbulence and very possibly, tornadoes. Never fly toward a radar shadow, always avoid penetrating a shadowed area. Standing on the ground and scanning a storm with + 5° till + 15° tilt. If the storm echo appears bowed or cresent shaped, arcing away from the radar, opposite to the range arc on the display, it is a shadow producing severe thunderstorm. Another indication is also a dip on the backside of the echo pointing toward the radar. THE ULTIMATE RADAR RULE IS: NEVER EVER CONTINUE FLIGHT TOWARD A RADAR SHADOW.
2.12 THUNDERSTORMS.	The most intense echoes are severe thunderstorms with a reflectivity in excess of 50 dbz. Remember that hail may fall several miles from the cloud. It is also important to bear in mind that radar detects the presence of precipitation. Storm associated turbulence without precipitation can extend several thousand feet above a storm and outward more than 20 miles. The pilot should avoid the most intense echoes by at least 20 miles, if possible. Thunderstorm development is rapid. A course that appears clear may contain cells a short time later. When viewing the shorter ranges, periodically select one of the longer ranges to observe distant conditions. This permits early planning of necessary avoidance maneuvers. Do not be fooled by the size of an echo. Even an echo as small as 1500 feet in diameter may produce extreme danger. Studies have shown that thunderstorms tend to travel in the direction of the winds around the 10000-foot level. New cells generally form on the side of a cloud in the direction toward which it is moving, usually an easterly direction. Newly developing cells often do not contain sufficient water to reflect an echo, yet, they can cause severe turbulence. In general, detour to the diminishing side of thunderstorms, especially if passing at close range. See 2.5 GAIN CONTROL for how to identify severe thunderstorms.

CONDITIONS	NORMAL PROCEDURES
2.13 TORNADOES.	The extreme case of severe turbulence is a tornado. Cumulonimbus-mamatus clouds producing tornadoes have, in a few instances, been related to a characteristic target display. The display is not usually different from that of a regular thunderstorm. Radar displays of clouds, from which tornadoes were confirmed, have, on occasion, shown the formation of a hook pattern in connection with the tornado. A narrow, fingerlike portion extends from the cloud display and, in a short time, curls into a hook and closes on itself. Other echoes associated with tornadoes are V-shaped notches and doughnut shapes. These shapes do not always indicate tornadoes, nor are tornado echoes limited to these characteristic patterns. Of the confirmed radar observation of tornadoes from target thunderstorms, most displays have not shown shapes different from those of a normal thunderstorm display. Conditions conductive to tornado formation produce severe updrafts and downdrafts that carry large amounts of water to great heights. Contouring areas (WX mode) with steep rainfall gradients that produce echoes at high altitudes (TILT control up more than usual) are indicative of tornado-forming conditions. In no case should these areas be penetrated. Avoid them by a margin of at least 20 miles, since turbulence extends outward from the echoproducing area for large distances.
2.14 HAIL. (Cont'd)	Hail results from updrafts carrying water high enough to freeze. Consequently, the greater the height of a thunderstorm echo, the greater the probability that it contains hail. An estimate of the height can be made by the amount of antenna uptilt required to view the upper part of the target echo. In the upper regions of a cloud where ice particles are "dry" (no liquid coating on the particle), echoes will be less intense. Liquid water reflects about 5 times more radar energy than solid ice particles of the same mass. Since hailstones are considerably larger than water drops and are usually coated with a thin layer of liquid water, the echo intensity from "wet" hail is greater than that from rainfall. Thunderstorm targets having an intensity greater than that associated with maximum rainfall will most likely contain hail. It is not always possible to determine from the display, whether the echo is from hail or from rain. Instances have been reported of hail targets producing fingerlike protrusions up to 5 miles long and blunt protuberances up to 3 miles from the edge of thunderstorm echoes. In parts of the world where hail occurs often, contouring extensions (WX mode) from thunderstorms generally indicate the presence of hail. This same type of display is also associated with new convective cells that may not yet contain hail.

CONDITIONS	NORMAL PROCEDURES
(Cont'd)	As with tornadoes, there are no uniquely distinctive displays that are, in all cases, associated with hail. Protruding fingers, hooks, scalloped edges and U-shapes are display shapes that have been associated with hail, yet hail echoes are not limited to these shapes. These displays, however, do indicate areas of severe turbulence and must be avoided by a wide margin. Echoes from hail can appear quickly and along any edge of a storm cell. These echoes can also change in shape and intensity in a very short period of time. For this reason, close and careful monitoring of the display is required.
2.15 ORDER OF REFLECTANCE.	Most reflective - WET HAIL - RAIN - ICE CRYSTALS - WET SNOW - DRY HAIL Least reflective - DRY SNOW
2.16 RADAR ECHO. (Cont'd)	ROUND OR OVAL. Convective rain shower and general storm cells tend to produce a round or oval radar echo. They should never be penetrated, but either one can be approached to within a couple of miles. The circumnavigation distances should be greater the more the shape deviates from round to oval. 

CONDITIONS	NORMAL PROCEDURES
(Cont'd)	**STEEP GRADIENT.** Gradient is the distance from the outer edge of the echo to the red color which is the core of the cell. The rain gradient depicted in an echo is directe proportional to vertical shear potential. The steeper the gradient, the greater the potential for severe vertical shears and also horizontal shears near the ground.  **SCALLOPED EDGES.** Echoes with a wavy scalloped edge is quite typical for a hail producing storm. Presence of extreme hail shafts exists if the echo also shows protrusions, protuberances, U-shapes, hooks and fingers.  **HOOKS, FINGERS AND NOTCHES.** V-shaped or U-shaped notches indicate extreme vertical shear. A finger that appears to curl into a hook or closes into a loop is an indication of suspected tornadoes. Be aware of large hooks protruding from the echo. 
(Cont'd)	

CONDITIONS	NORMAL PROCEDURES
(Cont'd)	**PENDANT.** An echo shaped like a pendant is a sign of a tornado producing storm. Most major tornadoproducing storms have had this shape. A notch in the large end indicates a strong wind aloft blowing towards the large end from the small end. Variations of the pendant shape can also be echoes looking like a frying pan, a heart or a spearpoint. The echo normally moves towards the notched end.  **HOURGLASS.** A two cell connected together relationship should be carefully avoided. In such a complex combination, one cell will frequently become dominant and suching the energy and moisture from the weaker cell. This kind of development can result in an weather explosion producing extreme microbursts with surface gusts above 70 knots. Also expect extreme rain. This entire event is very rapid and may occur as fast as five minutes.  **BUILDING AND DISSIPATING ECHOES.** A storm which has passed through mature stage and has begun to dissipate shows an echo with an indistinct and fuzzy appearance along the outer periphery. It will still be dangerous but with some patients, it will dissipate into a nondangerous area of heavy rain. Small echoes with a hard crisp look is a characteristic shape of a growing storm. Be very carefully about over flying any growing storms, seems the development is very rapid and well in excess of 6000 feet per minute.

NORMAL PROCEDURES.
APPENDICES.

U.S. Department of Transportation
Federal Aviation Administration

Advisory Circular

Subject: THUNDERSTORMS | Date: 1/20/83 | Initiated by: AFO-260 | AC No: 00-24B | Change:

1. PURPOSE. This advisory circular describes the hazards of thunderstorms to aviation and offers guidance to help prevent accidents caused by thunderstorms.

2. CANCELLATION. Advisory Circular 00-24A, dated June 23, 1978, is canceled.

3. RELATED READING MATERIAL. Advisory Circulars 00-6A, Aviation Weather, 00-45B, Aviation Weather Services, 00-50A, Low Level Wind Shear.

4. GENERAL. We all know what a thunderstorm looks like. Much has been written about the mechanics and life cycles of thunderstorms. They have been studied for many years; and while much has been learned, the studies continue because much is not known. Knowledge and weather radar have modified our attitudes toward thunderstorms, but one rule continues to be true--any storm recognizable as a thunderstorm should be considered hazardous until measurements have shown it to be safe. That means safe for you and your aircraft. Almost any thunderstorm can spell disaster for the wrong combination of aircraft and pilot.

5. HAZARDS. A thunderstorm packs just about every weather hazard known to aviation into one vicious bundle. Although the hazards occur in numerous combinations, let us look at the most hazardous combination of thunderstorms, the squall line, then we will examine the hazards individually.

a. Squall Lines. A squall line is a narrow band of active thunderstorms. Often it develops on or ahead of a cold front in moist, unstable air, but it may develop in unstable air far removed from any front. The line may be too long to detour easily and too wide and severe to penetrate. It often contains steady-state thunderstorms and presents the single most intense weather hazard to aircraft. It usually forms rapidly, generally reaching maximum intensity during the late afternoon and the first few hours of darkness.

b. Tornadoes.

(1) The most violent thunderstorms draw air into their cloud bases with great vigor. If the incoming air has any initial rotating motion, it often forms an extremely concentrated vortex from the surface well into the cloud. Meteorologists have estimated that wind in such a vortex can exceed 200 knots; pressure inside the vortex is quite low. The strong winds gather dust and debris and the low pressure generates a funnel-shaped cloud extending downward from the cumulonimbus base. If the cloud does not reach the surface, it is a "funnel cloud"; if it touches a land surface, it is a "tornado."

(2) Tornadoes occur with both isolated and squall line thunderstorms. Reports for forecasts of tornadoes indicate that atmospheric conditions are favorable for violent turbulence. An aircraft entering a tornado vortex is almost certain to suffer structural damage. Since the vortex extends well into the cloud, any pilot inadvertently caught on instruments in a severe thunderstorm could encounter a hidden vortex.

(3) Families of tornadoes have been observed as appendages of the main cloud extending several miles outward from the area of lightning and precipitation. Thus, any cloud connected to a severe thunderstorm carries a threat of violence.

c. Turbulence.

(1) Potentially hazardous turbulence is present in all thunderstorms, and a severe thunderstorm can destroy an aircraft. Strongest turbulence within the cloud occurs with shear between updrafts and downdrafts. Outside the cloud, shear turbulence has been encountered several thousand feet above and 20 miles laterally from a severe storm. A low level turbulent area is the shear zone associated with the gust front. Often, a "roll cloud" on the leading edge of a storm marks the top of the eddies in this shear and it signifies an extremely turbulent zone. Gust fronts often move far ahead (up to 15 miles) of associated precipitation. The gust front causes a rapid and sometimes drastic change in surface wind ahead of an approaching storm. Advisory Circular 00-50A, "Low Level Wind Shear," explains in greater detail the hazards associated with gust fronts. Figure 1 shows a schematic cross section of a thunderstorm with areas outside the cloud where turbulence may be encountered.

(2) It is almost impossible to hold a constant altitude in a thunderstorm, and maneuvering in an attempt to do so produces greatly increased stress on the aircraft. It is understandable that the speed of the aircraft determines the rate of turbulence encounters. Stresses are least if the aircraft is held in a constant attitude and allowed to "ride the waves." To date, we have no sure way to pick "soft spots" in a thunderstorm.

d. Icing.

(1) Updrafts in a thunderstorm support abundant liquid water with relatively large droplet sizes; and when carried above the freezing level, the water becomes supercooled. When temperature in the upward current cools to about -15°C, much of the remaining water vapor sublimates as ice crystals; and above this level, at lower temperatures, the amount of supercooled water decreases.

(2) Supercooled water freezes on impact with an aircraft. Clear icing can occur at any altitude above the freezing level; but at high levels, icing from smaller droplets may be rime or mixed rime and clear. The abundance of large, supercooled water droplets makes clear icing very rapid between 0°C and -15°C and encounters can be frequent in a cluster of cells. Thunderstorm icing can be extremely hazardous.

1/20/83 AC 00-24B

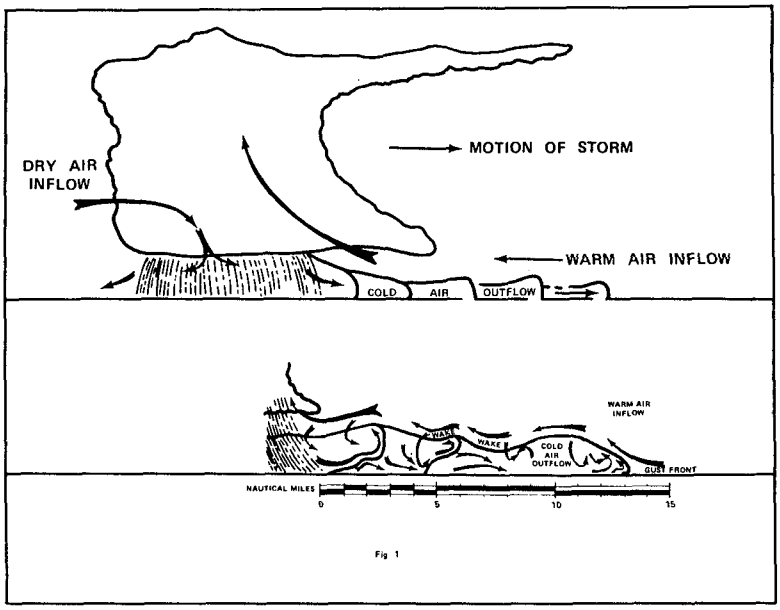


Fig 1

e. Hail.

(1) Hail competes with turbulence as the greatest thunderstorm hazard to aircraft. Supercooled drops above the freezing level begin to freeze. Once a drop has frozen, other drops latch on and freeze to it, so the hailstone grows--sometimes into a huge iceball. Large hail occurs with severe thunderstorms with strong updrafts that have built to great heights. Eventually, the hailstones fall, possibly some distance from the storm core. Hail may be encountered in clear air several miles from dark thunderstorm clouds.

(2) As hailstones fall through air whose temperature is above 0°C, they begin to melt and precipitation may reach the ground as either hail or rain. Rain at the surface does not mean the absence of hail aloft. You should anticipate possible hail with any thunderstorm, especially beneath the anvil of a large cumulonimbus. Hailstones larger than one-half inch in diameter can significantly damage an aircraft in a few seconds.

f. Low Ceiling and Visibility. Generally, visibility is near zero within a thunderstorm cloud. Ceiling and visibility also may be restricted in precipitation and dust between the cloud base and the ground. The restrictions create the same problem as all ceiling and visibility restrictions; but the hazards are increased many fold when associated with the other thunderstorm hazards of turbulence, hail, and lightning which make precision instrument flying virtually impossible.

Par 5 3

AC 00-24B 1/20/83

g. Effect on Altimeters. Pressure usually falls rapidly with the approach of a thunderstorm, then rises sharply with the onset of the first gust and arrival of the cold downdraft and heavy rain showers, falling back to normal as the storm moves on. This cycle of pressure change may occur in 15 minutes. If the pilot does not receive a corrected altimeter setting, the altimeter may be more than 100 feet in error.

h. Lightning. A lightning strike can puncture the skin of an aircraft and can damage communications and electronic navigational equipment. Lightning has been suspected of igniting fuel vapors causing explosion; however, serious accidents due to lightning strikes are extremely rare. Nearby lightning can blind the pilot rendering him momentarily unable to navigate either by instrument or by visual reference. Nearby lightning can also induce permanent errors in the magnetic compass. Lightning discharges, even distant ones, can disrupt radio communications on low and medium frequencies. Though lightning intensity and frequency have no simple relationship to other storm parameters, severe storms, as a rule, have a high frequency of lightning.

i. Engine Water Ingestion.

(1) Turbine engines have a limit on the amount of water they can ingest. Updrafts are present in many thunderstorms, particularly those in the developing stages. If the updraft velocity in the thunderstorm approaches or exceeds the terminal velocity of the falling raindrops, very high concentrations of water may occur. It is possible that these concentrations can be in excess of the quantity of water turbine engines are designed to ingest. Therefore, severe thunderstorms may contain areas of high water concentration which could result in flameout and/or structural failure of one or more engines.

(2) At the present time, there is no known operational procedure that can completely eliminate the possibility of engine damage/flameout during massive water ingestion. Although the exact mechanism of these water-induced engine stalls has not been determined, it is felt that thrust changes may have an adverse effect on engine stall margins in the presence of massive water ingestion.

(3) Avoidance of severe storm systems is the only measure assured to be effective in preventing exposure to this type of multiple engine damage/flameout. During an unavoidable encounter with severe storms with extreme precipitation, the best known recommendation is to follow the severe turbulence penetration procedure contained in the approved airplane flight manual with special emphasis on avoiding thrust changes unless excessive airspeed variations occur.

1/20/83 AC 00-24B

6. WEATHER RADAR.

a. Weather radar detects droplets of precipitation size. Strength of the radar return (echo) depends on drop size and number. The greater the number of drops, the stronger is the echo; and the larger the drops, the stronger is the echo. Drop size determines echo intensity to a much greater extent than does drop number. Hailstones usually are covered with a film of water and, therefore, act as huge water droplets giving the strongest of all echoes.

b. Numerous methods have been used in an attempt to categorize the intensity of a thunderstorm. To standardize thunderstorm language between weather radar operators and pilots, the use of Video Integrator Processor (VIP) levels is being promoted.

c. The National Weather Service (NWS) radar observer is able to objectively determine storm intensity levels with VIP equipment. These radar echo intensity levels are on a scale of one to six. If the maximum VIP Levels are 1 "weak" and 2 "moderate," then light to moderate turbulence is possible with lightning. VIP Level 3 is "strong" and severe turbulence is possible with lightning. VIP Level 4 is "very strong" and severe turbulence is likely with lightning. VIP Level 5 is "intense" with severe turbulence, lightning, hail likely, and organized surface wind gusts. VIP Level 6 is "extreme" with severe turbulence, lightning, large hail, extensive surface wind gusts, and turbulence.

d. Thunderstorms build and dissipate rapidly. Therefore, do not attempt to plan a course between echoes. The best use of ground radar information is to isolate general areas and coverage of echoes. You must avoid individual storms from in-flight observations either by visual sighting or by airborne radar. It is better to avoid the whole thunderstorm area than to detour around individual storms unless they are scattered.

e. Airborne weather avoidance radar is, as its name implies, for avoiding severe weather--not for penetrating it. Whether to fly into an area of radar echoes depends on echo intensity, spacing between the echoes, and the capabilities of you and your aircraft. Remember that weather radar detects only precipitation drops; it does not detect turbulence. Therefore, the radar scope provides no assurance of avoiding turbulence. The radar scope also does not provide assurance of avoiding instrument weather from clouds and fog. Your scope may be clear between intense echoes; this clear area does not necessarily mean you can fly between the storms and maintain visual sighting of them.

f. Remember that while hail always gives a radar echo, it may fall several miles from the nearest visible cloud and hazardous turbulence may extend to as much as 20 miles from the echo edge. Avoid intense or extreme level echoes by at least 20 miles; that is, such echoes should be separated by at least 40 miles before you fly between them. With weaker echos you can reduce the distance by which you avoid them.

AC 00-24B 1/20/83

7. DO'S AND DON'TS OF THUNDERSTORM FLYING.

a. Above all, remember this: never regard any thunderstorm lightly even when radar observers report the echoes are of light intensity. Avoiding thunderstorms is the best policy. Following are some do's and don'ts of thunderstorm avoidance:

(1) Don't land or takeoff in the face of an approaching thunderstorm. A sudden gust front of low level turbulence could cause loss of control.

(2) Don't attempt to fly under a thunderstorm even if you can see through to the other side. Turbulence and wind shear under the storm could be disastrous.

(3) Don't fly without airborne radar into a cloud mass containing scattered embedded thunderstorms. Scattered thunderstorms not embedded usually can be visually circumnavigated.

(4) Don't trust the visual appearance to be a reliable indicator of the turbulence inside a thunderstorm.

(5) Do avoid by at least 20 miles any thunderstorm identified as severe or giving an intense radar echo. This is especially true under the anvil of a large cumulonimbus.

(6) Do circumnavigate the entire area if the area has 6/10 thunderstorm coverage.

(7) Do remember that vivid and frequent lightning indicates the probability of a severe thunderstorm.

(8) Do regard as extremely hazardous any thunderstorm with tops 35,000 feet or higher whether the top is visually sighted or determined by radar.

b. If you cannot avoid penetrating a thunderstorm, following are some do's BEFORE entering the storm:

(1) Tighten your safety belt, put on your shoulder harness if you have one, and secure all loose objects.

(2) Plan and hold your course to take you through the storm in a minimum time.

(3) To avoid the most critical icing, establish a penetration altitude below the freezing level or above the level of $-15^{o}C$.

(4) Verify that pitot heat is on and turn on carburetor heat or jet engine anti-ice. Icing can be rapid at any altitude and cause almost instantaneous power failure and/or loss of airspeed indication.

6 Par 7

1/20/83 AC 00-24B

(5) Establish power settings for turbulence penetration airspeed recommended in your aircraft manual.

(6) Turn up cockpit lights to highest intensity to lessen temporary blindness from lightning.

(7) If using automatic pilot, disengage altitude hold mode and speed hold mode. The automatic altitude and speed controls will increase maneuvers of the aircraft thus increasing structural stress.

(8) If using airborne radar, tilt the antenna up and down occasionally. This will permit you to detect other thunderstorm activity at altitudes other than the one being flown.

c. Following are some do's and don'ts during the thunderstorm penetration:

(1) Do keep your eyes on your instruments. Looking outside the cockpit can increase danger of temporary blindness from lightning.

(2) Don't change power settings; maintain settings for the recommended turbulence penetration airspeed.

(3) Do maintain constant attitude; let the aircraft "ride the waves." Maneuvers in trying to maintain constant altitude increase stress on the aircraft.

(4) Don't turn back once you are in the thunderstorm. A straight course through the storm most likely will get you out of the hazards most quickly. In addition, turning maneuvers increase stress on the aircraft.

William T. Brennan

WILLIAM T. BRENNAN
Acting Director of Flight Operations

Par 7 7

3. ABNORMAL OPERATION.

CONDITIONS	ABNORMAL PROCEDURES
3.1 POWER SUPPLY FAILURE.	INDICATIONS. No radar picture and the weather radar mode annunciator on EHSI/MFD indicates OFF, regardless of the radar MODE selector setting. ACTIONS. 1. CB, M-14 (WX RADAR PWR) ..... CHECK/RESET 2. End of procedure.
3.2 NO RADAR PICTURE.	ACTIONS. 1. GAIN control ..... CHECK 2. CB, M-14 (WX RADAR PWR) ..... CHECK/RESET 3. Try the other EHSI or MFD. 4. End of procedure.
3.3 ANTENNA STABILIZATION FAILURE.	INDICATIONS. Parts of the radar picture disappears with roll or pitch movements of the aircraft. ACTIONS. 1. STB button ..... CHECK IF SELECTED 2. MAIN INV ..... CHECK * 3. 26 V switch ..... CHECK * - Check to be in MAIN INV position. 4. CB, M-13 (WX RADAR STAB) ..... CHECK/RESET 5. If still stabilization failure, use the radar when flying wing level and make correction for aircraft pitch attitude, with the manual TILT control. 6. End of procedure. N O T E WXR 200 is only stabilized in pitch causing parts of the radar picture to disappear with roll movements of the aircraft. * If dual main 115 V AC and 26 V AC inverters installed: 2. INVERTER switch ..... CHECK 3. INVERTER switch ..... 1 or 2 - Select second inverter.

CONDITIONS	ABNORMAL PROCEDURES
3.4 ANTENNA TILT FAILURE.	INDICATIONS. No response from TILT control setting. ACTIONS. 1. MAIN INV ..... CHECK * 2. 26 V switch ..... CHECK * - Check to be in MAIN INV position. 3. CB, M-13 (WX RADAR STAB) ..... CHECK/RESET 4. GAIN control ..... CHECK 5. End of procedure. * If dual main 115 V AC and 26 V AC inverters installed: 2. INVERTER switch ..... CHECK 3. INVERTER switch ..... 1 or 2 - Select second inverter.

1. GENERAL.

The Air Traffic Control (ATC) transponder is used to receive and reply to interrogations from ground stations by transmitting information consisting of aircraft identifier (code number) and if selected, the operating altitude of the aircraft.

2. MAIN COMPONENTS AND SUBSYSTEMS.

2. 1. Control unit.

The control unit is common to both system 1 and 2 (if two systems installed). It is provided with a switch (dual system only), permitting only one system at the time to be active.

2. 2. Transmitter.

The interrogation and reply modes:

– Selector in ON position:
Transponder replies to Mode A interrogations with Ident code.

– Selector in ALT position:
Transponder replies to Mode A and Mode C interrogations with ident code and flight altitude.

If Mode S transponder installed:

– Selector in ALT position:
Transponder replies to Mode A and Mode C interrogations with ident code and flight altitude. The transponder is also capable of discrete addressing and sending/receiving data link messages. In Mode S each transponder acquires a unique identity and responds when interrogated according to that identity. Mode S transponder is used in combination with TCAS.

The identification code is set by the pilot and stored in the transponder. The altitude information is received as a code from an encoder in the altimeter. A reply is recognized by illumination of the light in the IDENT button on the control unit. The transponder can also produce a special identification pulse which is used on request by the ATC ("Squawk IDENT"). The pulse which is repeated during approx 20 seconds is triggered by the IDENT–button on the control unit.

The inhibit circuits of the transponder and DME systems are interconnected in order to avoid interference between the transponder and the DME. The transponder is inhibited when the DME transmits and vice versa.

2. 3. Antenna.

The antennas are located on the bottom of the fuselage just forward of the wing.

If Mode S transponder installed:

Two antennas per transponder are installed, one on the top and the other on the bottom of the fuselage. This provides for more reliable air–to–air surveillance and communications.

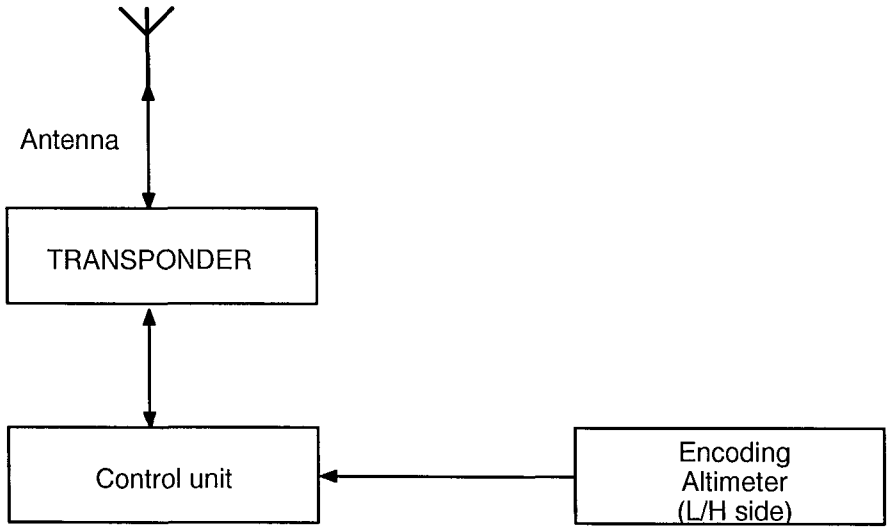
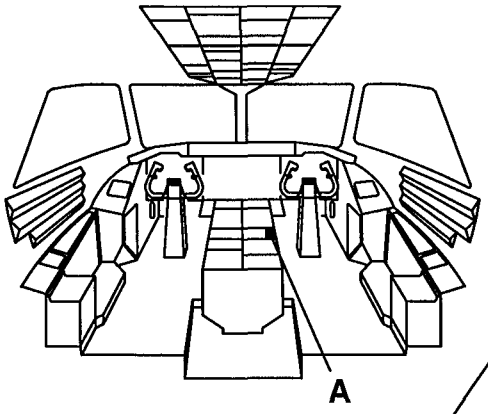
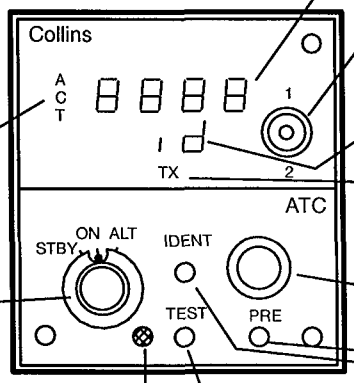


FIG. 1 ATC Transponder – schematic.

3. CONTROLS.



A CONTROL UNIT



Ident code display.
Displays selected code.

Transponder selector.
1 – Transponder 1 active.
2 – Transponder 2 active (if installed).

Altitude/Ident display.
Normally blank except when:
– TEST button pressed:
Aircraft altitude in 100 feet increments.
– IDENT button pressed:
ID comes on for approx 15s.

Reply indication.
Comes on each time an interrogation is replied.

Code selector.
Range 0000–7777
The larger knob controls the two left digits, and the smaller knob the two right digits.

PRE button.
To store a code in the nonvolatile memory:
– Press and hold PRE button while selecting a code for storage, then release button.
To recall preset code:
– Momentarily press PRE button.

Ident button.
When momentarily pressed, the system will transmit an ident pulse for appr. 15 s. ("Squawk")

TEST button.
Control unit enters Diagnostic Fail Code mode (maintenance).

Photocell.
Controls display brightness.

Function selector.
STBY– Power applied but prevented from transmitting replies.
ON– Mode A. Transponder replies with selected code.
ALT – Mode C. Transponder replies with both selected code and altitude information.

ACT Light.
ACT flashes continuously if the reply code is not the same as the code shown in the display.

A11227

FIG. 2 ATC Transponder – controls.

1. GENERAL.

The Air Traffic Control (ATC) transponder is used to receive and reply to interrogations from ground stations and other ACAS/TCAS equipped aircraft by transmitting information consisting of aircraft identifier (code number) and if selected, the operating altitude of the aircraft. If selected, the transponder also transmitts a flight ID code.

2. MAIN COMPONENTS AND SUBSYSTEMS.

2.1. Control unit.

The control unit is common to both system 1 and system 2. It is provided with a switch, permitting only one system at a time to be active.

2.2. Transmitter.

The interrogation and reply modes:

- Selector in ON position:
  Transponder replies to Mode A and Mode S interrogations with Ident code and flight ID.
- Selector in ALT position:
  Transponder replies to Mode A, Mode C and Mode S interrogations with ident code, flight altitude and flight ID. The transponder is also capable of discrete addressing and sending/receiving data link messages.
  In Mode S each transponder acquires a unique identity and responds when interrogated according to that identity. Mode S transponder is used in combination with ACAS/TCAS.
- Selector in FID position:
  A flight identification code (FID) can be selected. Once the code is entered the transponder will automatically transmit the the flight ID.

The identification code is set by the pilot and stored in the transponder. The altitude information is received as a code from an encoder in the altimeter. A reply is recognized by illumination of the light in the IDENT button on the control unit. The transponder can also produce a special identification pulse which is used on request by the ATC ("Squawk IDENT"). The pulse which is repeated during approx 20 seconds is triggered by the IDENT–button on the control unit.

The inhibit circuits of the transponder and DME systems are interconnected in order to avoid interference between the transponder and the DME. The transponder is inhibited when the DME transmits and vice versa.

2.3. Antenna.

Two antennas per transponder are installed, one on the top and the other on the bottom of the fuselage. This provides for more reliable air–to–air surveillance and communications. The antenna is connected to the selected Transponder in use by a coax relay.

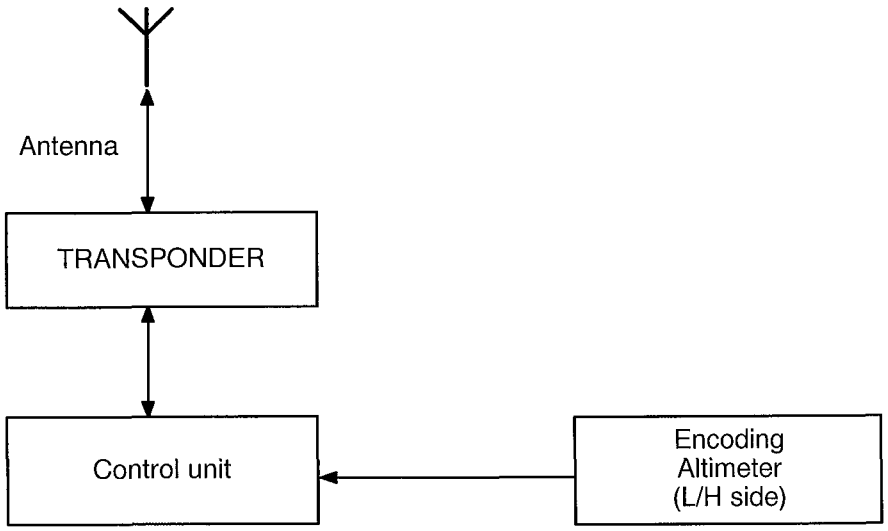
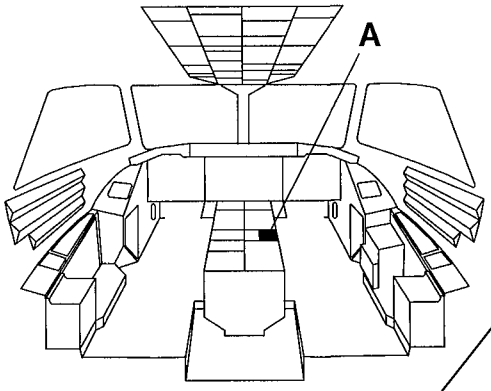


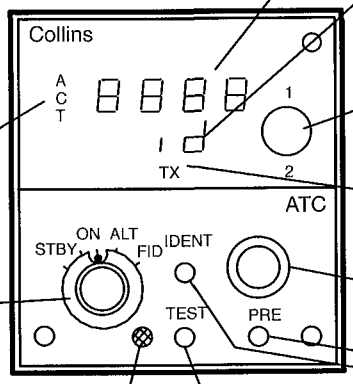
FIG. 1 ATC Transponder – schematic.

Applicable to aircraft with Mod. No. 3134 installed (Elementary surveillance).

3. CONTROLS.



A CONTROL UNIT



Ident code display.
Displays selected code.

Altitude/Ident display.
Normally blank except when:
- TEST button pressed: Aircraft altitude in 100 feet increments.
- IDENT button pressed: ID comes on for approx 15s.
- Flight ID is entered.

Transponder selector.
Pushbutton toggles between transponder 1 active ("1" illuminated) and transponder 2 active ("2" illuminated).

Reply indication.
Comes on each time an interrogation is replied.

Code selector.
Range 0000–7777
The larger knob controls the two left digits, and the smaller knob the two right digits.

PRE button.
To store a code in the nonvolatile memory:
- Press and hold PRE button while selecting a code for storage, then release button.

To recall preset code:
- Momentarily press PRE button.

Ident button.
When momentarily pressed, the system will transmit an ident pulse for appr. 15 s. ("Squawk")

TEST button.
Control unit enters Diagnostic Fail Code mode (maintenance).

Photocell.
Controls display brightness.

Function selector.
- STBY– Power applied but prevented from transmitting replies.
- ON– Mode A and S. Transponder replies with selected code and flight ID.
- ALT – Mode A, C and S. Transponder replies with selected code, altitude information and flight ID.
- FID – With the selector in FID, a flight ID can be entered using the selector knobs.

ACT Light.
ACT flashes continuously if the reply code is not equal to the code shown in the display.
– If the Transponder selector is in position 1, select position 2 or conversely.

C1835

C1835

FIG. 2 ATC Transponder with elementary surveillance – controls.

1. GENERAL.

The Air Traffic Control (ATC) transponder is used to receive and reply to interrogations from ground stations by transmitting information consisting of aircraft identifier (code number) and if selected, the operating altitude of the aircraft.

2. MAIN COMPONENTS AND SUBSYSTEMS.

2.1. Control unit.

The control unit is common to both system 1 and 2 (if two systems installed). It is provided with a switch (dual system only) permitting only one system at the time to be active.

2.2. Transmitter.

The interrogation and reply modes:

- Selector in ON position:
  Transponder replies to Mode A interrogations with Ident code.

- Selector in ALT position:
  Transponder replies to Mode A and Mode C interrogations with ident code and flight altitude.

The identification code is set by the pilot and stored in the transponder. The altitude information is received as a code from an encoder in the altimeter. A reply is recognized by illumination of the light in the IDENT button on the control unit. The transponder can also produce a special identification pulse which is used on request by the ATC ("Squawk IDENT"). The pulse which is repeated during approx 20 seconds is triggered by the IDENT-button on the control unit.

The inhibit circuits of the transponder and DME systems are interconnected in order to avoid interference between the transponder and the DME. The transponder is inhibited when the DME transmits and vice versa.

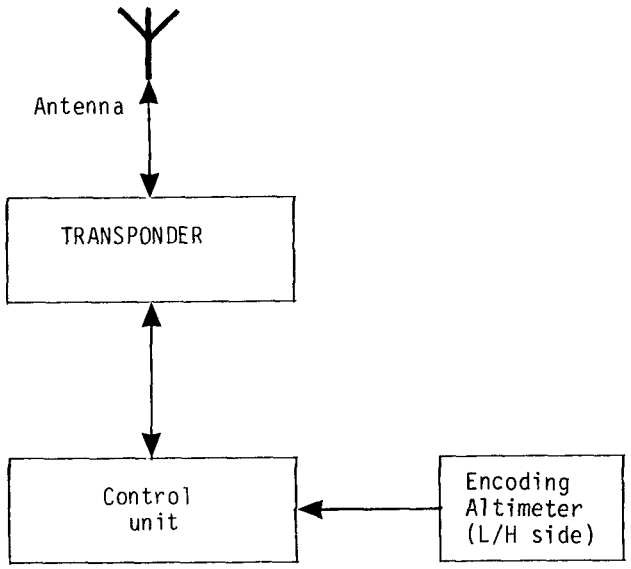
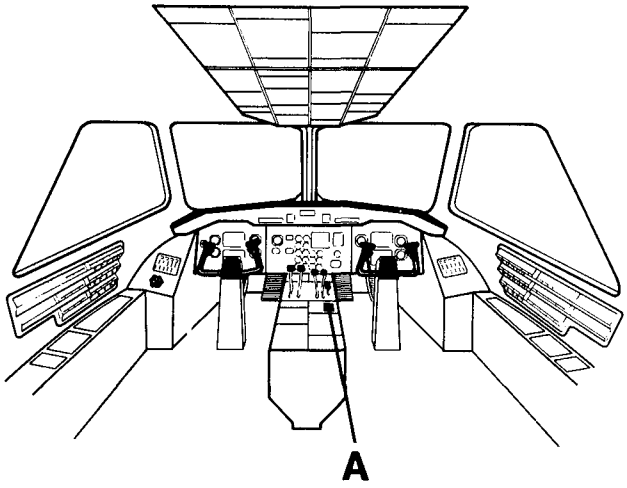


Fig. 1. ATC Transponder - schematic.

2.3. Antenna.

The antennas are located on the bottom of the fuselage just forward of the wing.

3. CONTROLS.



Ident button.
When momentarily pressed, the system transmit an ident pulse and the IDT display comes on for appr 20 s.

Photocell.
Controls display brightness.

Ident code display.
Displays selected code.

Reply indication.
Comes on each time an interrogation is replied and when selector in TEST.

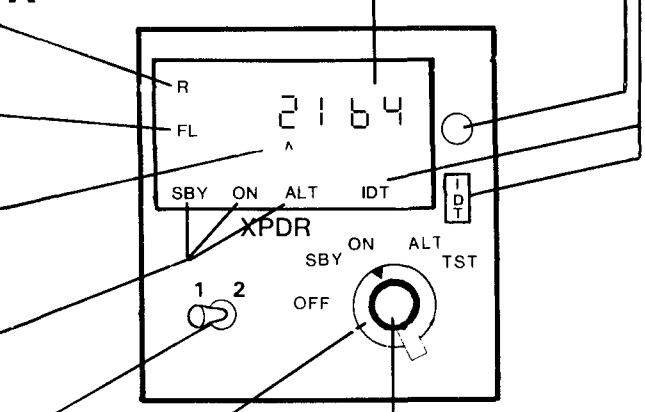
Flight level indication.
Comes on together with flight level indication in hundreds of feet, when selector TEST.

Cursor.
Used to select code.

Mode indication.
Comes on when respective mode is selected.

Transponder selector.
1 - Transponder 1 active.
2 - Transponder 2 active (if installed).

Function selector.
SBY - Power applied but the transceiver is inhibited.
ON - Mode A. Transponder replies with selected code.
ALT - Mode C. Transponder replies with both selected code and altitude information.
TST - Internal test. The reply indication R and flight level indication FL comes on together with present flight level in hundreds of feet.



Code selector.
Range 0000-7777
- Momentarily press the smaller knob until cursor is under the digit to be changed.
- Set numerical value by rotating the code knob.
- Storage of a new code in the nonvolatile memory is made by simultaneously pressing the IDT button and Code selector.
- To recall the preset code, depress code knob for more than 3 s.

Fig. 2. ATC transponder - controls.

1. GENERAL.

The Air Traffic Control (ATC) transponder is used to receive and reply to interrogations from ground stations by transmitting information consisting of aircraft identifier (code number) and if selected, the operating altitude of the aircraft.

2. MAIN COMPONENTS AND SUBSYSTEMS.

2.1. Control unit.

The control unit is common to both system 1 and 2 (if two systems installed). It is provided with a switch (dual system only) permitting only one system at the time to be active.

2.2. Transmitter.

The interrogation and reply modes:

- Selector in ON position:
  Transponder replies to Mode A interrogations with Ident code.

- Selector in ALT position:
  Transponder replies to Mode A and Mode C interrogations with ident code and flight altitude.

The identification code is set by the pilot and stored in the transponder. The altitude information is received as a code from an encoder in the altimeter. A reply is recognized by illumination of the light in the IDENT button on the control unit. The transponder can also produce a special identification pulse which is used on request by the ATC ("Squawk IDENT"). The pulse which is repeated during approx 20 seconds is triggered by the IDENT-button on the control unit.

The inhibit circuits of the transponder and DME systems are interconnected in order to avoid interference between the transponder and the DME. The transponder is inhibited when the DME transmits and vice versa.

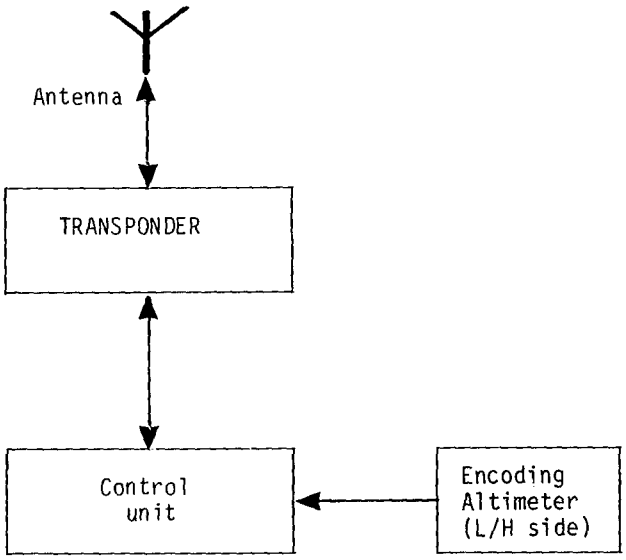
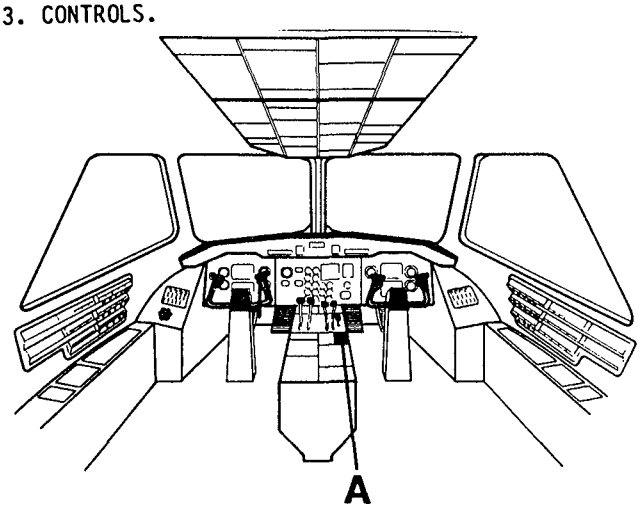


Fig. 1. ATC Transponder - schematic.

2.3. Antenna.

The antennas are located on the bottom of the fuselage just forward of the wing.

3. CONTROLS.



Ident button.
When momentarily pressed, the system transmit an ident puls and the IDT display comes on, for approx. 20 s.

Photocell.
Controls display brightness.

Ident code display.
Displays selected code.

Reply indication.
Comes on each time an interrogation is replied.

Flight level indication.
Comes on together with flight level indication in hundreds of feet, when selector in TEST.

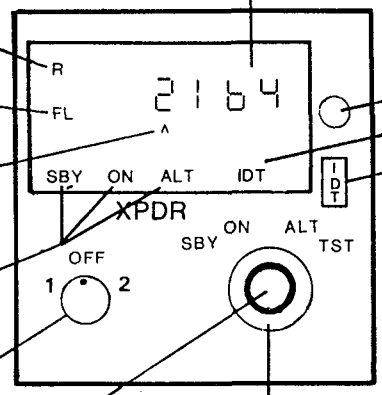
Cursor.
Used to select code.

Mode indication.
Comes on when respective mode is selected.

Transponder selector.
1 - Transponder 1 active.
OFF - Both systems off.
2 - Transponder 2 active.

Code selector.
Range 0000 - 7777
- Momentarily press the smaller knob until cursor is under the digit to be changed. Set numerical value by rotating the code knob.
- Storage of a new code in the nonvolatile memory, is made by simultaneously press IDT and Code Selector.
- To recall the preset code, depress code knob for more than 3 s.

A CONTROL UNIT



Function selector.
The function selector is of a rotary type without endstop. However, the modes will not roll over, they will stop at SBY or TST positions.
SBY - SBY mode, transceiver inhibited, will always come on when power is applyed.
ON - Mode A. Transponder replies with selected code.
ALT - Mode C. Transponder replies with both selected code and altitude informaition.
TST - Internal test. The reply indication R and flight level indication FL comes on together with present flight level in hundreds of feet.

Fig. 2. ATC Transponder - controls.

4. ELECTRICAL POWER SUPPLY.

ATC Transponder 1	L AVIONIC BUS	E-19	XPDR1
ATC Transponder 2	R AVIONIC BUS	L-18	XPDR2

1. LIMITATIONS.

Not applicable.

2. NORMAL OPERATION.

CONDITIONS	NORMAL PROCEDURES
2.1 POWER UP.	1. L and R AVION switches ..... ON - The Transponder systems are switched ON/OFF by L and R AVION switches. 2. Function selector ..... STBY CHECK
2.2 STORAGE OF CODE.	◆----Code storage. 1. PRE button ..... PRESS/HOLD - Press and hold PRE button while selecting a code for storage. 2. Code selector ..... SET - The large knob controls the two left digits and the smaller one the two right digits. 3. PRE button ..... RELEASE ◆----Code recall. 1. PRE button ..... PRESS
2.3 OPERATION.	1. Transponder selector ..... AS REQUIRED - If two systems installed. 2. Code selector ..... SET ACC TO ATC INSTRUCTION - The large knob controls the two left digits and the smaller one the two right digits. 3. Function selector ..... ALT - Unless otherwise instructed by ATC. 4. IDENT button ..... PRESS WHEN REQUESTED BY ATC - Check "id" to be displayed.

3. ABNORMAL OPERATION.

CONDITIONS	ABNORMAL PROCEDURES
3.1 TEST U/S OR CODE/ALTITUDE NOT RECEIVED BY ATC.	INDICATIONS. Code and altitude are not received by the ATC. ACTIONS. 1. Transponder selector ..... SECOND SYSTEM - If two systems installed. 2. CB's, E-19 (XPDR 1), L-18 (XPDR 2) ..... CHECK/RESET 3. End of procedure.
3.2 ALTITUDE REPORT FAILS.	INDICATIONS. Altitude reading reported to be inaccurate by ATC. ACTIONS. 1. Transponder selector ..... SECOND SYSTEM - If two systems installed. 2. Function selector ..... ON - Altitude report not available. 3. End of procedure.
3.3 TRANSPONDER CONTROL UNIT FAILURE.	INDICATIONS. The control unit frequency display goes out. ACTIONS. 1. Transponder selector ..... SECOND SYSTEM - If two systems installed. 2. CB's, E-19 (XPDR 1), L-18 (XPDR 2) ..... CHECK/RESET

1. LIMITATIONS.

Not applicable.

2. NORMAL OPERATION.

CONDITIONS	NORMAL PROCEDURES
2.1. POWER UP.	1. L and R AVION switches ..... ON. – The Transponder systems are switched ON/OFF by L and R AVION switches. 2. Function selector ..... STBY CHECK.
2.2. STORAGE OF CODE.	**Code storage.** 1. PRE button ..... PRESS/HOLD. – Press and hold PRE button while selecting a code for storage. 2. Code selector ..... SET. – The large knob controls the two left digits and the smaller one the two right digits. 3. PRE button ..... RELEASE. **Code recall.** 1. PRE button ..... PRESS.
2.3. OPERATION.	1. Transponder selector ..... AS REQUIRED. – If two systems installed. 2. Code selector ..... SET ACC TO ATC IN–STRUCTION. – The large knob controls the two left digits and the smaller one the two right digits. 3. Function selector ..... ALT. – Unless otherwise instructed by ATC. 4. . IDENT button ..... PRESS WHEN REQUESTED BY ATC. – Check "id" to be displayed.

Applicable to aircraft with Mod. No. 3134 installed (Elementary surveillance).

CONDITIONS	NORMAL PROCEDURES
2.4. FLIGHT ID.	1. *Transponder selector* ..... SET TO FID 2. Code selector ..... SET FLIGHT ID – Rotate the large knob to select which of the 8 positions should be used and the smaller one to enter the flight ID code. 3. Function selector ..... ALT – Unless otherwise instructed by ATC. 4. IDENT button ..... PRESS WHEN REQUESTED BY ATC – Check "ID" to be displayed.

Applicable to aircraft with Mod. No. 3134 installed (Elementary surveillance).

3. ABNORMAL OPERATION.

CONDITIONS	ABNORMAL PROCEDURES
3.1. TEST U/S OR CODE/ALTITUDE NOT RECEIVED BY ATC.	**INDICATIONS.** Code and altitude are not received by the ATC. **ACTIONS.** 1. Transponder selector ..... SECOND SYSTEM. – If two systems installed. 2. CB's, E–19 (XPDR 1), L–18 (XPDR 2) ..... CHECK/RESET. 3. End of procedure.
3.2. ALTITUDE REPORT FAILS.	**INDICATIONS.** Altitude reading reported to be inaccurate by ATC. **ACTIONS.** 1. Transponder selector ..... SECOND SYSTEM. – If two systems installed. 2. Function selector ..... ON. – Altitude report not available. 3. End of procedure.
3.3. TRANSPONDER CONTROL UNIT FAILURE.	**INDICATIONS.** The control unit frequency display goes out. **ACTIONS.** 1. Transponder selector ..... SECOND SYSTEM. – If two systems installed. 2. CB's, E–19 (XPDR 1), L–18 (XPDR 2) ..... CHECK/RESET.

Applicable to aircraft with Mod. No. 3134 installed (Elementary surveillance).

1. LIMITATIONS.

Not applicable.

2. NORMAL OPERATION.

CONDITIONS	NORMAL PROCEDURES
2.1 POWER UP.	1. L and R AVION switches ..... ON - Power is applyed to the Transponder systems by L and R AVION switches. 2. Function selector..... SBY - The Transponders are switched on/off by the Functions switch OFF/SBY positions. However, the Function switch can be left in SBY and on/off will be provided by L and R AVION switches. 3. Mode indication ..... SBY CHECK
2.2 TRANSPONDER SYSTEM TEST.	1. Function selector..... TST - The reply indicator R and the flight level indicator FL shall come on together with present flight level in hundreds of feet. - If two systems are installed, check both by selecting 1 and 2, one at a time. 2. Function selector..... SBY 3. Mode indicator ..... SBY CHECK
2.3 STORAGE OF CODE.	◆----Code storage. 1. Code selector ..... SET - Momentarily press smaller knob until cursor is under digit to be changed. - Change digit by rotating selector knob. - Proceed in the same way with all digits to be changed. 2. IDT button - Code selector ..... PRESS/RELEASE - Simultaneously press and release IDT and Code selector. ◆----Code recall. 1. Code selector ..... PRESS 3 SEC

CONDITIONS	NORMAL PROCEDURES
2.4 OPERATION.	1. Transponder selector ..... AS REQUIRED - If two system installed. 2. Code selector ..... SET ACC TO ATC INSTRUCTION - Momentarily press smaller knob until cursor is under digit to be changed. - Change digit by rotating selector knob. - Proceed in the same way with all digits to be changed. 3. Function selector ..... ALT - Unless otherwise instructed by ATC. - Check ALT to be displayed. 4. IDENT button ..... PRESS WHEN REQUESTED BY ATC - Check IDT to be displayed. N O T E After the new code has been set, 5 seconds has to go before changing over to the other Transponder, if considered to do so. If not, the new code will disappear and the old code remain.

3. ABNORMAL OPERATION.

CONDITIONS	ABNORMAL PROCEDURES
3.1 TEST U/S OR CODE/ALTITUDE NOT RECEIVED BY ATC.	INDICATIONS. The test does not function properly or the code and altitude are not received by the ATC. ACTIONS. 1. Transponder selector ..... SECOND SYSTEM - If two systems installed. 2. CB's, E-19 (XPDR 1), L-18 (XPDR 2) ..... CHECK/RESET 3. End of procedure.
3.2 ALTITUDE REPORT FAILS.	INDICATIONS. Altitude reading reported to be inaccurate by ATC. ACTIONS. 1. Transponder selector ..... SECOND SYSTEM - If two systems installed. 2. Function selector ..... ON - Altitude report not available. 3. End of procedure.
3.3 TRANSPONDER CONTROL UNIT FAILURE.	INDICATIONS. The control unit frequency display goes out. ACTIONS. 1. Transponder selector ..... SECOND SYSTEM - If two systems installed. 2. CB's, E-19 (XPDR 1), L-18 (XPDR 2) ..... CHECK/RESET

1. LIMITATIONS.

Not applicable.

2. NORMAL OPERATION.

CONDITIONS	NORMAL PROCEDURES
2.1 POWER UP.	1. L and R AVION switches ..... ON - Power is applyed to the Transponder systems by L and R AVION switches. 2. Transponder selector ..... SET 1/2 - If two systems installed. - The Transponders are switched on/off by the Transponder selector 1-OFF-2 positions. However, the Transponder selector can be left in 1 or 2, and on/off will be provided by L and R AVION switches. 3. Mode indication ..... SBY CHECK - SBY mode will always come on when power is applyed.
2.2 TRANSPONDER SYSTEM TEST.	1. Function selector ..... TST - The reply indicator R and the flight level indicator FL shall come on together with present flight level in hundreds of feet. - If two systems installed, check both by selecting 1 and 2, one at a time. 2. Function selector ..... SBY 3. Mode indicator ..... SBY CHECK

CONDITIONS	NORMAL PROCEDURES
2.3 STORAGE OF CODE.	◆----Code storage. 1. Code selector ..... SET - Momentarily press smaller knob until cursor is under digit to be changed. - Changed digit by rotating selector knob. - Proceed in the same way with all digits to be changed. 2. IDT button - Code selector ..... PRESS/ RELEASE - Simultaneously press and release IDT and Code selector. ◆----Code recall. 1. Code selector ..... PRESS 3 SEC
2.4 OPERATION.	1. Code selector ..... SET ACC TO ATC IN-STRUCTIONS - Momentarily press smaller knob until cursor is under digit to be changed. - Change digit by rotating selector knob. - Proceed in the same way with all digits to be changed. 2. Function selector ..... ALT - Unless otherwise instructed by ATC. - Check ALT to be displayed. 3. IDT button ..... PRESS WHEN REQUESTED BY ATC - Check IDT to be displayed. N O T E After the new code has been set, 5 seconds has to go before changing over to the other Transponder, if considered to do so. If not, the new code will disappear and the old code remain.

3. ABNORMAL OPERATION.

CONDITIONS	ABNORMAL PROCEDURES
3.1 TEST U/S OR CODE/ALTITUDE NOT RECEIVED BY ATC.	INDICATIONS. The test does not function properly or the code and altitude are not received by the ATC. ACTIONS. 1. Transponder selector..... SECOND SYSTEM - If two systems installed. 2. CB's, E-19 (XPDR 1), L-18 (XPDR 2) ..... CHECK/RESET 3. End of procedure.
3.2 ALTITUDE REPORT FAILS.	INDICATIONS. Altitude reading reported to be inaccurate by ATC. ACTIONS. 1. Transponder selector ..... SECOND SYSTEM - If two systems installed. 2. Function selector ..... ON - Altitude report not available. 3. End of procedure.
3.3 TRANSPONDER CONTROL UNIT FAILURE.	INDICATIONS. The control unit frequency display goes out. ACTIONS. 1. Transponder selector ..... SECOND SYSTEM - If two systems installed. 2. CB's, E-19 (XPDR 1), L-18 (XPDR 2) ..... CHECK/RESET

0. MODIFICATION STANDARDS.

The system described in this chapter assumes a certain modification standard of the aircraft. If a modification is not installed, the following apply as a complement to what is stated in this chapter.

DESCRIPTION/OPERATION

0.1 DH annunciation and DH Light.

Without Mod. 1989 embodied: Mod. 1989; EFIS update.

- The DH annunciation and DH Light is not inhibited on ground and during takeoff.

- Note.
  Nuisance DH annunciation and DH Light may come on when standing or taxiing on a wet tarmac or runway.

  DH annunciation and DH Light will come on after takeoff and extinguishes first when the aircraft has reached 50 ft above set decision height.

1. GENERAL.

The radio altimeter system provides a signal corresponding to the height above ground. This information is displayed on the EADI and used for GPWS (Closure rate) and the AP/FD (CAT II window).

2. MAIN COMPONENTS AND SUBSYSTEMS.

2.1. Transceiver.

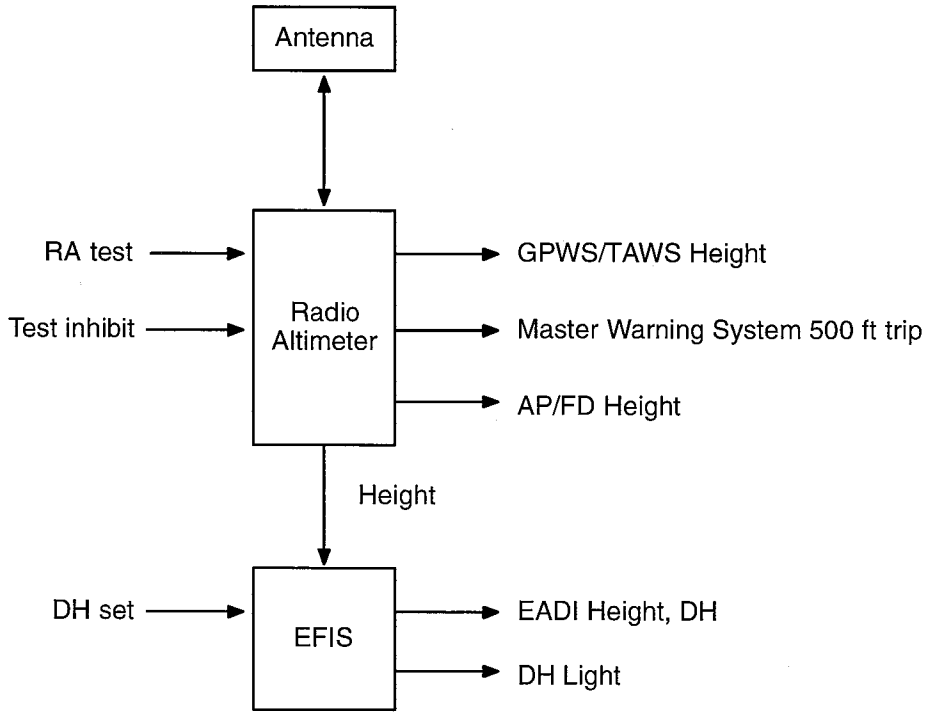
The transceiver measures the time between generated and reflected signal and transforms this time into an analog signal representing the height. The range is 0 to 2500 feet. The system has 4 setable trip–switches of which so far only one is used. This trip–switch is set to 500 feet and is used in the master warning system (AOM 19.1) to enable the configuration warning. The radio altimeter is also provided with a self–test function.

2.2. Antenna.

The two antennas are located on the forward part of the bottom of the aircraft.

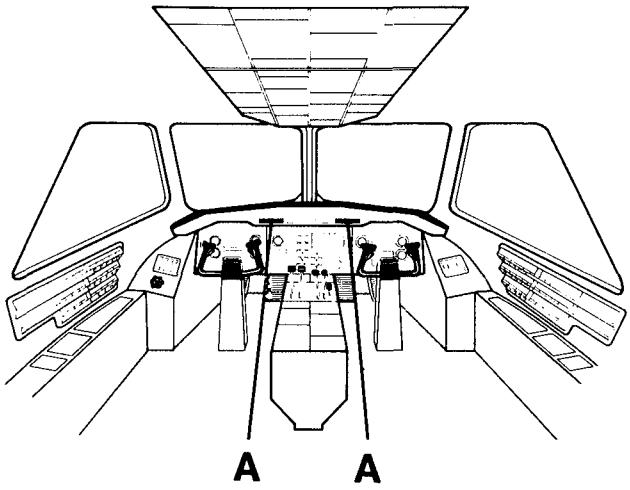
2.3. Indication.

The radio height is displayed on the EADI together with the DH, Decision Height announcement. The DH comes on and alerts the pilot when aircraft radio height is less or equal with the selected Decision Height. In CAT II equipped aircraft, an additional DH light is located at the upper right corner of both EADI's. The DH annunciation and Light is inhibited on ground and becomes enabled after takeoff when aircraft reaches selected DH plus 100 ft.



A28002

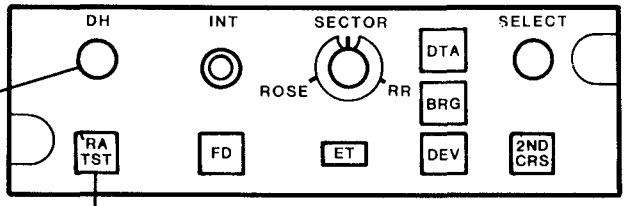
3.CONTROLS AND INDICATORS.



A DISPLAY CONTROL PANEL

DH knob.
Knob out:
- DH readout is blanked when above 2500 RALT.
- Not possible to set DH.

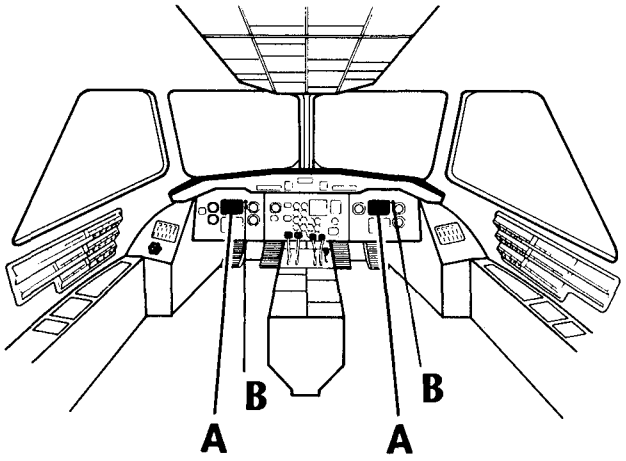
Knob in:
- DH readout displayed.
- DH is set by rotating the knob.
  Range 0-999 ft.



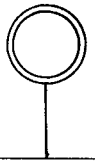
RA TST (Test) button.
When momentarily pressed and held:
- Radio height 50 ft on EADI.
- Flashing DH annunciation on EADI.
- DH light comes on steady.

The RA test is inhibited when:
- FD/AP engaged in NAV or APPR mode.
- EADI/EHSI in test mode.

Fig. 2. Display Control Panel, DCP, - Radioaltimeter controls.

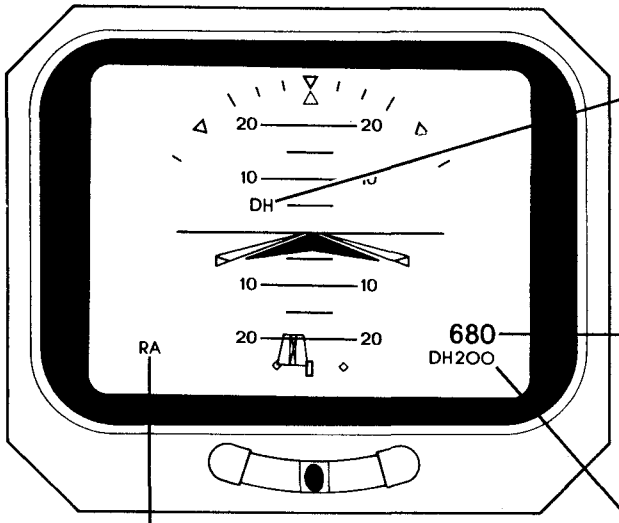


B DH LIGHT



DH Light (yellow).
Comes on steady when set DH is reached.
Disappears at 5 ft.

A EADI RADIO ALTIMETER DISPLAY



DH annunciation (yellow).
Comes on when set DH is reached.
Flashes for 10 s then steady.
Disappears at 5 ft.

Radio height display (green).
- Height display in ft when below 2500 ft. Increments 50 ft when above 1000 ft, otherwise 10 ft.
- Display blanked when out of range (above 2500 ft).
- Display replaced by RA in red when radio altimeter fails. Flashes for 10 s then steady.

DH display (green).
- Displays DH set on DCP.
- Blanked when above 2500 ft if DH-knob is in out position.

Radio height comparator caution (yellow).
The inputs to the two DPU:s are compared.
Triggering level varies linearly with height from 30 to 170 ft.
Master caution light and AVIONICS light on the CWP will also come on and flash until Master caution has been reset, then steady.
The display is deleted when the error no longer exists.

Fig. 3. EADI, radio height - display and colors.

4. ELECTRICAL POWER SUPPLY.

Radio altimeter	L AVIONIC BUS	F-10	RADIO ALTIM.

1. LIMITATIONS.

Radio height indication	Max 2500 feet.
Selectable DH	Max 999 feet.

2. NORMAL OPERATION.

CONDITIONS	NORMAL PROCEDURES
2.1 **POWER UP.**	1. L AVION switch ..... ON. - The RALT system is switched ON/OFF by L AVION switch.
2.2 **RALT SYSTEM TEST.**	1. EADI ..... CHECK. - Radio height should be 0 on both EADI's. 2. RA TEST button, DCP ..... PRESS AND HOLD. - Radio height should be 50 ft. - Flashing DH annunciation on EADI. - DH light comes on (if installed). 3. RA TEST button ..... RELEASE. - Height should be 0 on both EADI's. N O T E The RA test is inhibited when: - FD/AP engaged in NAV or APPR mode. - EADI/EHSI in test mode.
2.3 **DH SETTING.**	1. DH knob, DCP ..... SET. - Set DH according to airline practice.

3. ABNORMAL OPERATION.

CONDITIONS	ABNORMAL PROCEDURES
3.1. RALT FAILURE.	INDICATIONS. RA red flag warning on EADI. ACTIONS. 1. CB F-10 (RADIO ALTIM) ..... CHECK/RESET. 2. End of procedure.

1. GENERAL.

The attitude and heading information comes from the two Attitude Heading Computers (AHC) and their subsystems which together are called Attitude Heading Referens System, AHRS.

As a back-up, there is a standby horizon and a standby compass.

The AHRS replaces vertical- and directional gyros and instead has sensors that gives angular rates and accelerations which after processing in a microcomputer result in the normal attitude and heading outputs to the FD/AP and EFIS.

An important difference from a normal gyro is that the unit is not space oriented but oriented to the aircraft axes. This is called a "strap down" system. The AHRS is also provided with an internal monitoring circuit.

2. MAIN COMPONENTS AND SUBSYSTEMS.

2.1. Inertial sensors.

The sensing elements in this system are piezo-electric crystals. These crystals have a sensitive axis which will generate a voltage when exposed to stresses such as accelerations. The accelerations that are sensed are Coriolis accelerations which are proportional to the angular rate of the unit i.e. the angular rate of the aircraft.

The elements are combined into two sensor units which thus measure the angular rate and the acceleration in two axis. By combining two such units the necessary three axis pitch, roll and yaw can be covered. The fourth channel is redundant and used for monitoring purposes.

The strap down principle means that the sensor can not be levelled and aligned as a normal gyro or platform. The space orientation is determined by the computer which calculates corrections based upon the measured accelerations. In order to remove vehicle acceleration errors in the gravity measurements used for levelling, TAS and vertical speed from ADC and IAS from a separate sensor are also entered into the computer.

2.2 Flux detector unit.

Each system has one detector located in the wing to avoid magnetic distrubances. The detector unit consists of two coils oriented 90° apart which sense the horizontal components (Cos and Sin) of the magnetic field. The coil system is kept horizontal by a fluid damped pendulum.

The output representing the direction of the magnetic field is transferred to the computer where it is compensated for magnetic errors of the detector. The compensated signal slaves the heading information with 1° per minute and the result is thus magnetic heading. Each computer has a compensator card for adjustment of the magnetic error, which is normaly set at the aircraft compass swing (maintenance).

The system also contains a quick heading slave function, which by means of a push button, slaves the magnetic heading related to present flux detector readout. There are two HDG SLAVE buttons, one on each side, located underneath the EHSI:s.

2.3. Computer.

The computer has several functions:
- To determine levelling, alignment and slaving corrections. This is automatically initiated at power up of the comupter and is completed after approximately 70 seconds within which time the aircraft must not be moved.

- To determine attitude angles from the sensor values and to distribute these signals to various instruments.

- To determine the magnetic heading and to distribute this value both as analogue and digital signals.

2.4. Standby horizon.

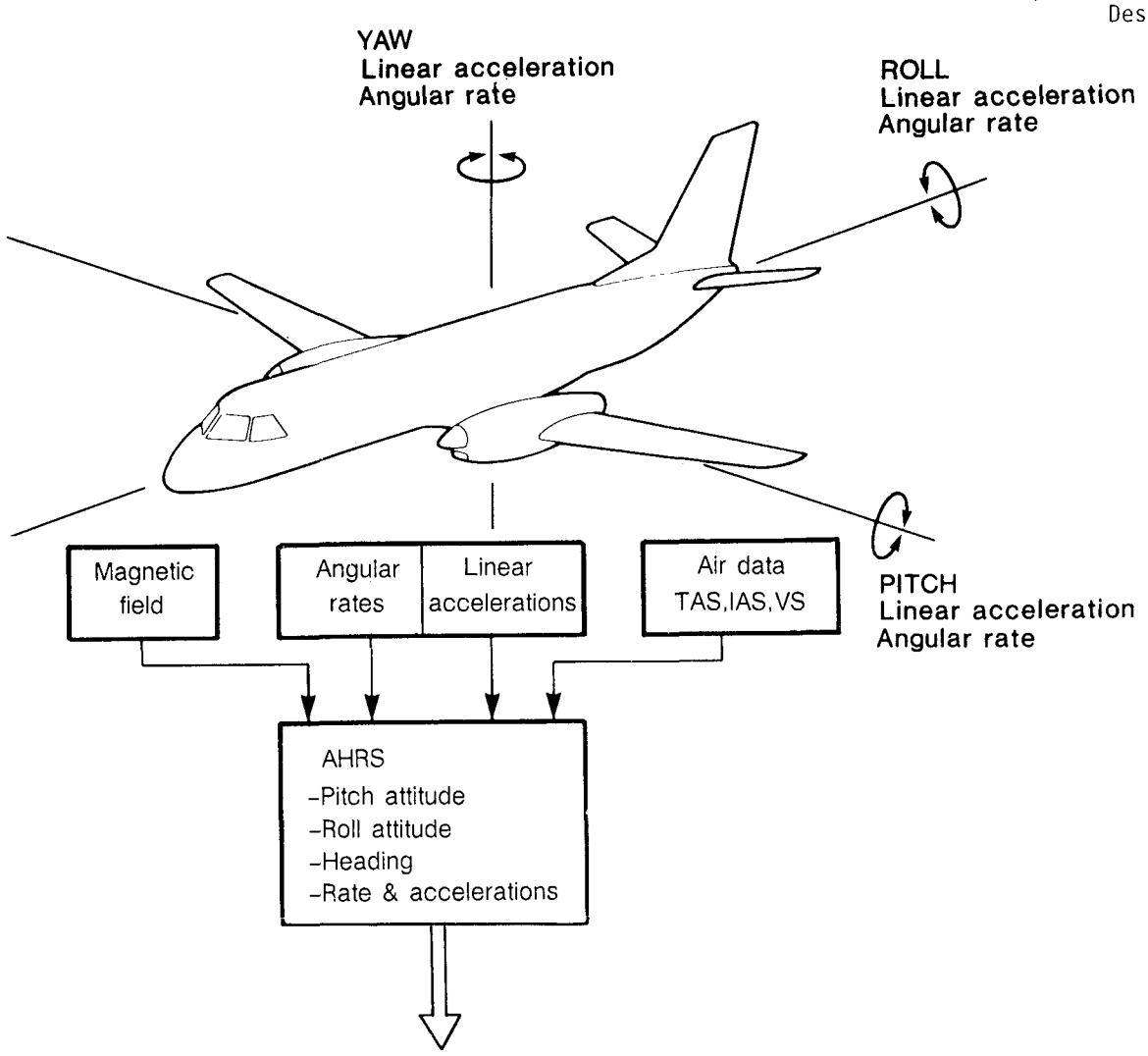
The aircraft is provided with a standby horizon which is a self-contained instrument with an internal vertical gyro. The gyro is erected manually by a caging knob on the instrument.

2.5. Standby compass.

The aircraft is also provided with a standby compass. It is a self-contained magnetic compass which is compensated for magnetic disturbance including the average failure from standby pitot heating on and off.

2.6. Deviation cards.

The aircraft is provided with a deviation card for the standby compass, located underneath the forward part of the overhead panel.



AHRS 1 gives:		AHRS 2 gives:	
Digital data to	- AP/FD - DPU 1 (DFDR) - MPU (MFD) - FDAU (DFDR) - RNAV	Digital data to	- AP/FD - DPU 2 - MPU (MFD)
Analogue heading to	- RMI 2	Analogue heading to	- RMI 1
Analogue pitch/roll to	- Weather radar		

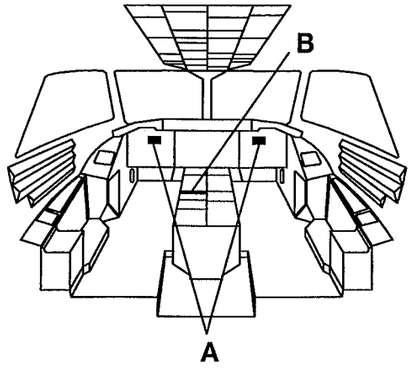
Digital data means: Roll/Pitch attitude and rates.
Yaw rate.
Longitudinal/lateral/vertical acceleration.
Heading.
Valid flags.

Type of data is selected according to the need of each system connected to the AHRS.

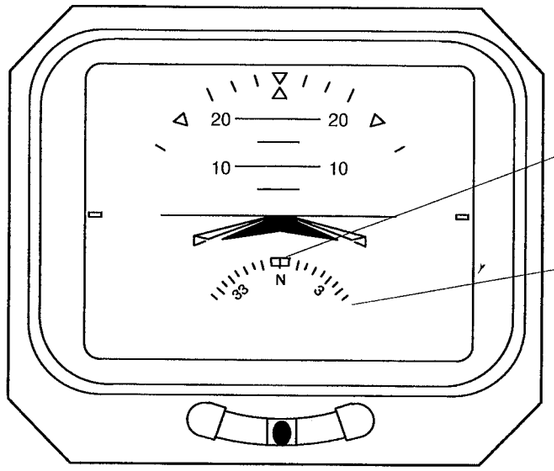
Fig. 1. AHRS - schematic and outputs.

INTENTIONALLY LEFT BLANK

3. CONTROLS AND INDICATORS.



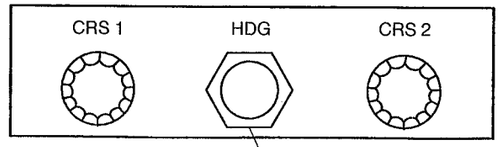
A EADI COMPOSITE MODE



Heading bug (magenta).

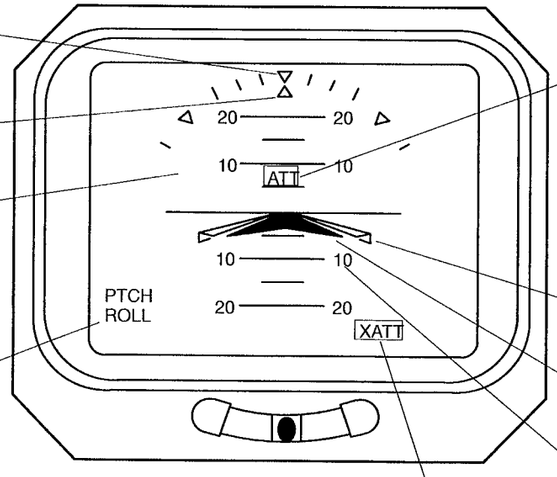
Compass rose ±40° (white).

B COURSE HEADING PANEL



HDG knob.
Controls the Heading bug, displays on both EHSI's.

A EADI ATTITUDE DISPLAYS



Bank angle scale (white).
Scaled with 10°, 20°, 30°, 45° and 60° markings.

Roll index (white).

Attitude background.
Blue sky and brown ground.

Comparator caution (yellow).
Will come on if the sources of attitude differ more than 4° (3° when FD/AP in APPR mode) in pitch or roll. AVIONICS light on central warning panel, also comes on and flashes until master caution has been reset. The caution goes off when the error no longer exists.

ATT warning (red).
In case of a failure in the attitude system the warning will come on flashing for 10 s and then become steady. Background, pitch scale and roll index will also be removed. If extreme attitudes are obtained i.e. pitch more than 30° UP or 20° DN, roll more than 65°; all information is removed except attitude warning and attitude presentation.

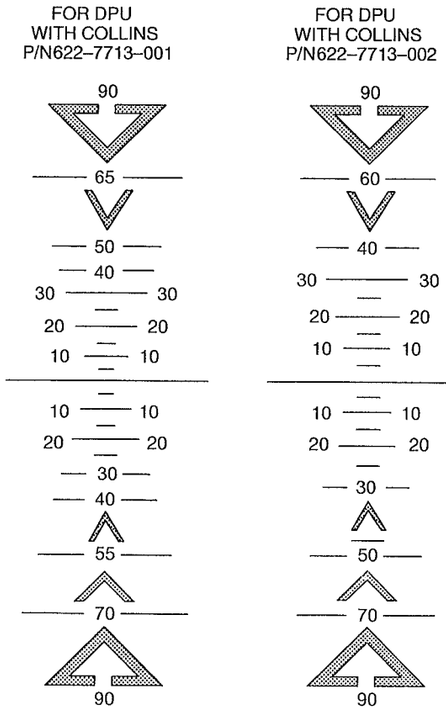
Flight Director command bar (magenta).

Aircraft symbol (black/white).

Pitch scale (white).
See separate illustration.

XATT caution (yellow).
Will come on when own sides EFIS switch is set to XSIDE DATA position and the attitude information comes from opposite sides AHCI (also see AOM 15/1.1).

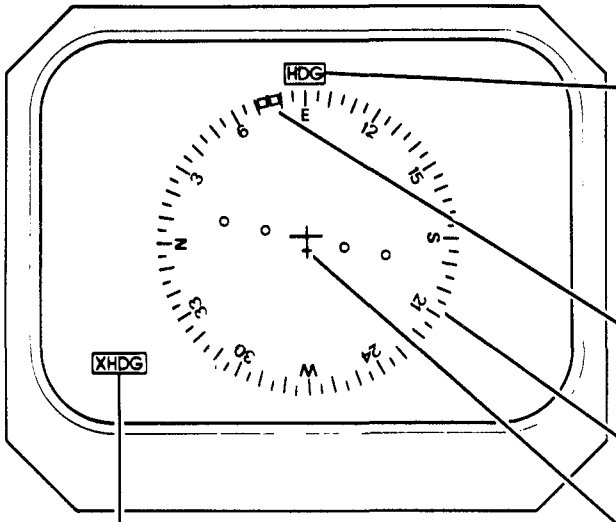
PITCH SCALE



A24050

Fig. 2 Course Heading Panel and EADI – controls and attitude presentation

EHSI ROSE MODE



Comparator caution in yellow or Heading warning in red.
HDG in yellow will come on flashing if heading differs more than 6° between the two AHRS's, HDG turn steady when master caution has been reset.
If heading fails, HDG in red comes on, flashes for 10 s then steady.

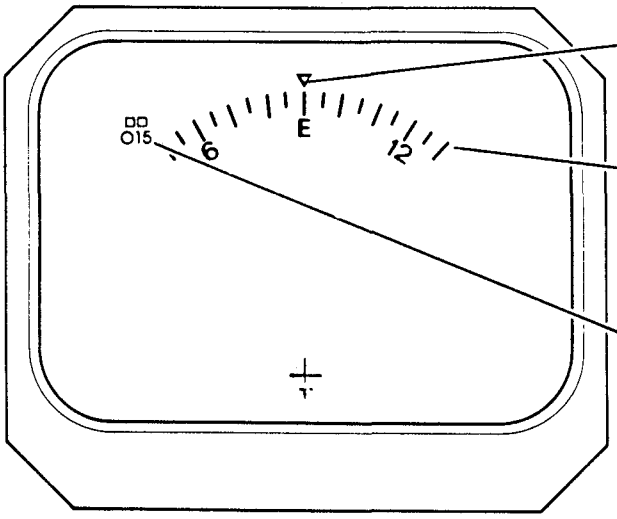
Heading bug (magenta).

Compass rose (white).

Aircraft symbol (white).

XHDG caution (yellow).
Will come on when own sides EFIS switch is set to XSIDE DATA position and the heading informaiton comes from opposite sides AHC, also see AOM 15/1.1.

EHSI SECTOR MODE

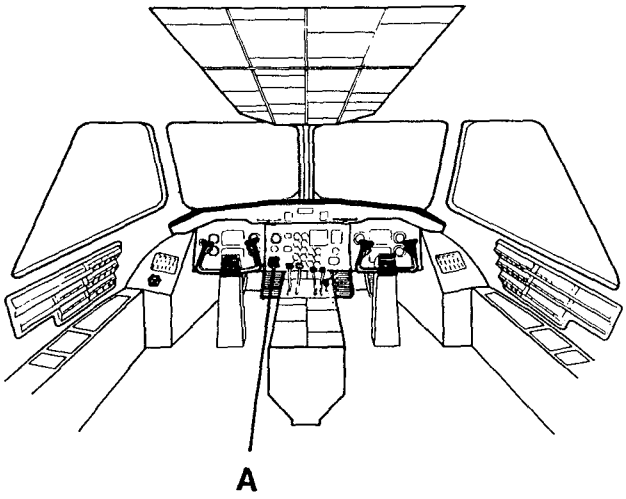


Magnetic heading index. (White)
In all EHSI modes.

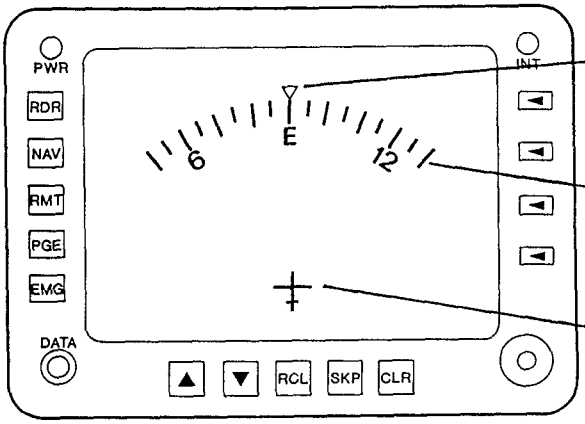
80° sector compass (white).
Will show ± 40° from actual heading.

Heading bug outside scale (magenta).
When selected heading is outside expanded scale the heading and symbol will be displayed beside the scale on either left or right side of the scale.

Fig. 3. EHSI - Heading presentation.



A MULTIFUNCTION DISPLAY, MFD



Magnetic heading index (white).

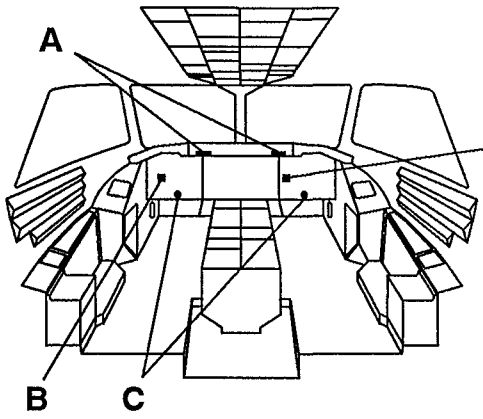
80° sector compass (white).
Will show ± 40° from actual heading.

Aircraft symbol (white).

The Magnetic Heading displayed on the MFD comes from LH AHC if both sides EFIS's switches are in NORM or if LH sides EFIS switch is in DRIVE XFR.
The Magnetic Heading comes from RH AHC if LH side EFIS switch is in XSIDE DATA.

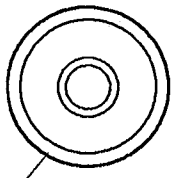
Fig. 4. MFD - Heading presentation.

IF MFD INSTALLED



B (If installed.)

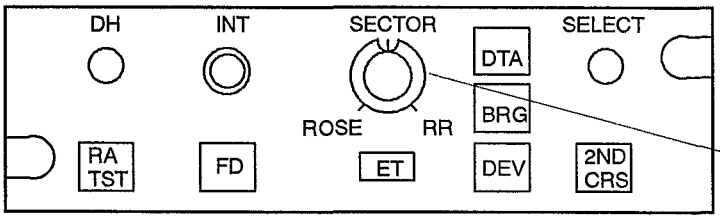
C HDG SLAVE BUTTON



HDG SLAVE button.
When momentarily pressed and released:
- The AHRS magnetic heading will be fast slaved to the present flux detector readout.
- HDG slave is inhibited with autopilot engaged.

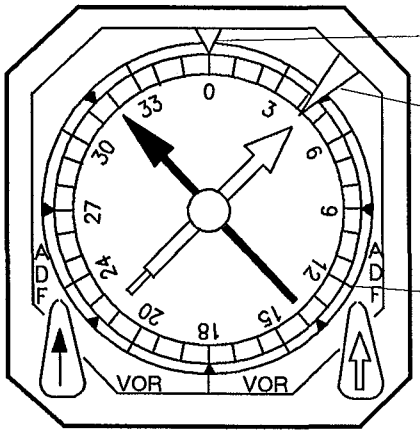
CAUTION.
Avoid to slave heading when standing on runways/taxiways with magnetic disturbance or when flying in turbulent air.

A DISPLAY CONTROL PANEL



Mode Selector.
ROSE– 360° compass rose.
SECTOR – 80° compass sector.
RR– 80° compass sector with weather radar presentation.
Also see AOM 15/1.1.

B RADIO MAGNETIC INDICATOR



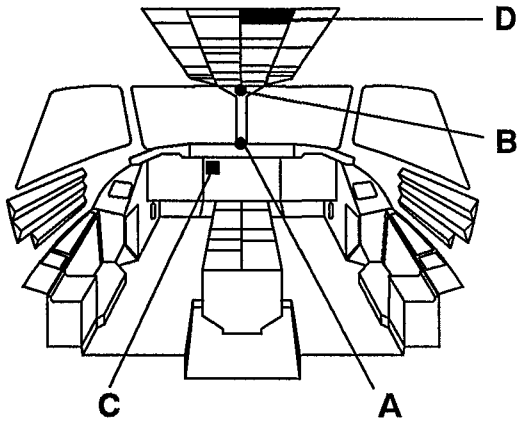
Magnetic aircraft heading.

Warning flag.
Comes on in case of heading failure.

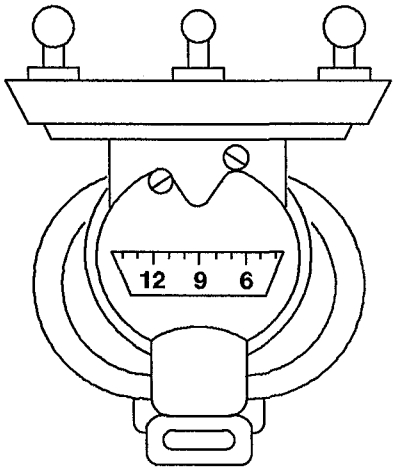
Compass rose.

A12679

FIG. 5. Display control panel, RMI and HDG slave button – controls and indicators.



A STANDBY COMPASS



B COMPASS DEVIATION CARD

K^{O}_{M}	K^{O}_{K}	$^{O}_{S}$
0		
30		
60		
90		
120		
150		
180		
210		
240		
270		
300		
330		
DATE	SIGN	

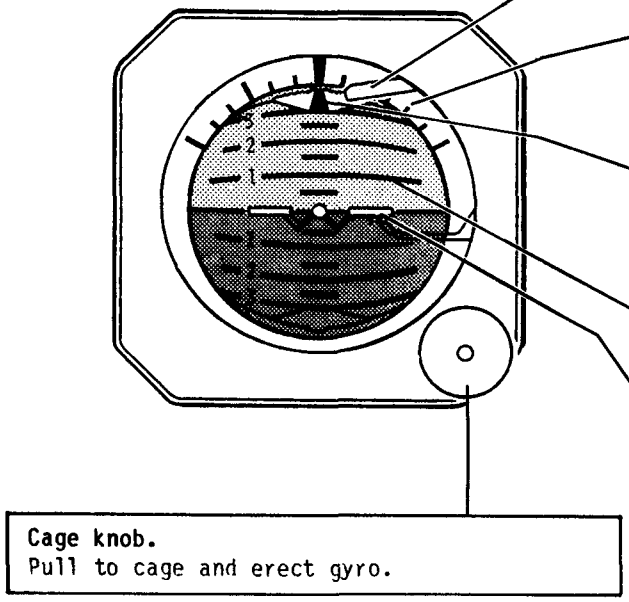
NOTE

Lighting strikes on the a/c may cause the standby compass reading not to be reliable due to residual magnetizing.

A12367

FIG.6. Standby compass and deviation card.

C STANDBY HORIZON



Warning flag (red).

Bank angle scale.
Scaled with 10°, 20°, 30°, 40°, 50° and 60°.

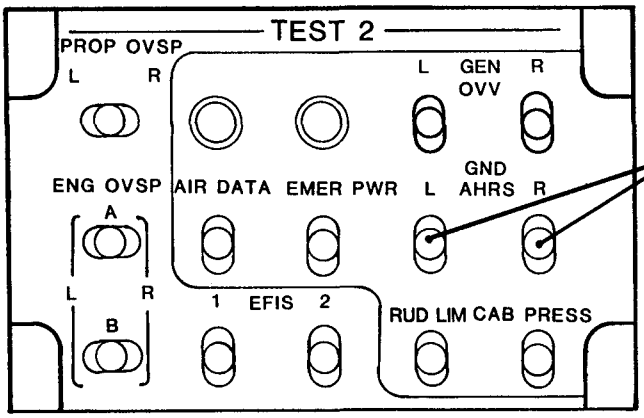
Roll index.

Pitch angle scale.

Aircraft symbol.

Cage knob.
Pull to cage and erect gyro.

D TEST 2 PANEL



AHRS L and R STIM mode switches. (4 MODES)
Used when AHRS orientation memory information is lost (on ground only); see section 23, ABNORMAL PROCEDURES.
Also used for maintenance AHRS STIM mode operations.

Fig. 7. Standby horizon and TEST 2 panel.

4. ELECTRICAL POWER SUPPLY.

AHRS 1	L AVIONIC BUS	F-12	AHC 1 AVION
.....	L HOT BAT BUS	F-11	AHC 1 BAT
.....	L INV BUS 26VAC	Fuse	(305 VU Electrical center)
AHRS 2	R AVIONIC BUS	M-10	AHC 2 AVION
.....	R HOT BAT BUS	M-11	AHC 2 BAT
.....	R INV BUS 26VAC	Fuse	(306 VU Electrical center)
Standby horizon	EMER AVIONIC BUS	G-9	STBY HORIZON

1. LIMITATIONS.

1.1 OPERATIONAL ACCURACIES.

AHRS.

- Pitch ..... 0.5° Steady flight
  1.0° Maneuvering
- Roll ..... 0.5° Steady flight
  1.0° Maneuvering
- Heading ..... 1.0° Steady flight
  2.0° Holding patterns

Standby Horizon.

- Pitch ..... < 0.5° Steady flight

Standby compass.

- After compensation ..... 10° Steady flight

2. NORMAL OPERATION.

CONDITIONS	NORMAL PROCEDURES
2.1 GENERAL.	Special considerations must be taken to correctly initialize inertially based attitude heading reference systems in order to establish correct attitude and heading references with respect to earth references. During the alignment or initialization period, an inertial system is susceptible to aircraft movement and to some extent bus voltage transients. The method traditionally used to initialize an inertial system is to apply power to the system and to keep the aircraft stationary until all errors in the system are biased to zero. Aircraft movement due to taxiing will cause inertial errors that are excessive. To avoid voltage transients, operation of hydraulic pump operation shall not be performed during initialization. AHRS initialization requires approximately 70 seconds to be completed after that electrical power was switched on. To reduce time with passenger aboard until commence taxiing, the recommendation is to perform AHRS initialization before engine start when using external power for start up, and after first engine start when using aircraft batteries for start up.

CONDITIONS	NORMAL PROCEDURES
2.2 POWER SUPPLY.	The two AHRS's are switched ON/OFF by L and R AVION switches and the Standby Horizon by ESS AVION switch. AHRS 1 and 2 main power supply is from L/R AVIONIC BUS respectively, however if AHRS main power is switched off (L/R AVION switched OFF) or during engine start, a timer circuit is activated supplying back up power from L/R HOT BAT BUS. The back up power timer circuit will keep AHRS on line for 11 minutes and 12 seconds.
2.3 AHRS INITIALIZATION. (Cont'd)	◆-EXTERNAL POWER ENGINE START. AHRS initialization is recommended to be performed before engine start. **External Power Connected:** 1. L/R AVION switches ..... ON - After approximately 70 seconds check AHRS initialization to be completed as indicated by presentation of attitude on both EADI and removal of red flags ATT on EADI and HDG on EHSI. - AHRS initialization is indicated by the slow compass rose rotation from North one revolution clockwise to North and then rapidly to present aircraft heading. **Before Engine start:** 2. L/R AVION switches ..... OFF - AHRS stays on line supplied by back up power via the timer circuit from HOT BAT BUS'es. **After Engine start:** 3. L/R AVION switches ..... ON - Check for no ATT or HDG flag on EADI and EHSI respectively. - In case of any flags allow 70 seconds for reinitialization. **Line up:** - Minimum 2 minutes after initialization was completed.

CONDITIONS	NORMAL PROCEDURES
(Cont'd)	4. Flight instrument ..... CHECK - Check that attitude difference between attitude displayed on both EADI's and standby ADI is 3° or less (Roll and Pitch) and that heading is not slewing away from aircraft heading. In theory AVION switches could be ON during engine start but practical experience shows that Flight Director warning may come on after engine start depending on electrical transients during engine startup. In most cases the warning goes out after about 30 seconds but it may remain on, and can then only be cleared by switching L/R AVION switches OFF/ON. ◆-**BATTERY POWER ENGINE START.** AHRS initialization is recommended to be performed after first engine start. **First Engine Running (GEN on line):** 1. L/R AVION switches ..... ON - After approximately 70 seconds check AHRS initialization to be completed as indicated by presentation of attitude on both EADI and removal of red flags ATT on EADI and HDG on EHSI. - AHRS initialization is indicated by the slow compass rose rotation form North one revolution clockwise to North and then rapidly to present aircraft heading. **Before Second Engine Start (generator cross start):** 2. L/R AVION switches ..... OFF - AHRS stays on line supplied by back up power via the timer circuit from HOT BAT BUS'es. **After Second Engine Start:** 3. L/R AVION switches ..... ON - Check for no ATT or HDG flag on EADI and EHSI respectively. - In case of any flags allow 70 seconds for reinitialization.
(Cont'd)	

CONDITIONS	NORMAL PROCEDURES
(Cont'd)	**Line up:** - Minimum 2 minutes after initialization was completed. 4. Flight instrument ..... CHECK - Check that attitude difference between attitude displayed on both EADI's and standby ADI is 3° or less (Roll and Pitch) and that heading is not slewing away from aircraft heading. Before first engine start AHRS initialization is not possible without external power, AVION BUS'es are not supplyed by Batteries only. During second engine start (generator cross start) the voltage will drop but normally not to a level making AHRS to go off line however in some cases e.g. in extreme cold conditions, it may drop to a level causing an AHRS reinitialization after second engine start.
2.4 OPERATION.	For attitude there is only one type of presentation on the EADI but the heading information can be presented either as a complete compass rose (360°) or as a sector of ±40° around the present aircraft heading on the EHSI. 1. Mode selector ..... AS REQUIRED - ROSE, 360° compass rose. - SECTOR, 80° compass sector. - RR, 80° compass sector with weather radar presentation. 2. HDG SLAVE button ..... IF REQUIRED - Fast slaving of aircraft heading. C A U T I O N Avoid to slave heading when standing on runways/taxiways with magnetic disturbance or when flying in turbulent air.
2.5 STANDBY HORIZON OPERATION.	**After Standby Horizon red flag is out of view:** 1. Cage knob ..... PULL - Pull knob to erect gyro.

3. ABNORMAL OPERATION

For Abnormal Operation, also see section 23, ABNORMAL PROCEDURES.

CONDITIONS	ABNORMAL PROCEDURES
3.1 AHRS FAILURE.	**INDICATIONS.** Attitude (sky and earth) and FD command bars disappears and ATT red flag comes on, on the EADI and/or HDG red flag comes on, on the EHSI. **ACTIONS.** 1. See AOM 15/1.2. ABNORMAL PROCEDURES: AHC DATA FAILURE.
3.2 COMPARATOR CAUTIONS.	C A U T I O N The AHRS design is such that HDG Comparator caution (caused by external magnetic disturbance to the flux detectors) is considerably more frequent than PTCH and ROLL comparator cautions. Experience has shown the possibility of inadvertently overlooking a ROLL or PTCH comparator caution when resetting a believed caution for HDG comparator. Therefore, the recommendation is to treat all avionic cautions as a PTCH and/or ROLL comparator caution until it is positively established that this is not the case. A Comparator Caution does normally show the same on both sides, but there is a possibility, due to design tolerances, to get a caution on one side only. This should be treated as if there were a caution on both sides. A Comparator Caution tells us that the two systems differ and must be checked with a third reference. It should also be observed that the Avionic Master Caution and Chime are inhibited when T/O INH button is illuminating.
3.3 STANDBY HORIZON FAILURE. Cont'd)	**INDICATIONS.** The Standby Horizon red flag comes in view.

CONDITIONS	ABNORMAL PROCEDURES
(cont')	**ACTIONS.** 1. CB G-9 (STANDBY HORIZON) ..... CHECK/RESET 2. End of procedure.

1. GENERAL.

The KNS 660 is an intergrated multisensor Flight Management System, FMS, which enables the pilot to navigate point–to–point on an great circle route (Area Navigation, RNAV) using VOR/DME stations.

It is assumed that the pilot is familiar with the KNS 660 and this description is not intended to be a comprehensive guide on the system. Such detailed information is contained in the KNS 660 Pilot's Guide and should be consulted when any ambiguity occurs.

Contained in this discription is a general outline of the system with regards to the 340 B installation.

2. MAIN COMPONENTS AND SUBSYSTEMS.

The FMS consists of a Navigation Computer, a cockpit mounted Control Display Unit (CDU), four Remote Indicators and a Frequency Management Control facility.

2.1. Navigation Computer.

The NAV Computer is located in the avionics rack. The Nav Computer is the computational center of the FMS. It includes a Data Base and interfaces with other systems such as EFIS, AIR DATA, AHRS and NAV systems.

The Data Base memory must be updated every 28 days, using a diskette and data loader. The world has been broken into 10 geographical regions, with the chosen region being programmed into the FMS. Information contained on each region includes navaids, airports, waypoints – but is dependant on the region.

2.2. Control Display Unit (CDU).

The CDU (mounted in the aft section of the center pedestal) contains separate alpha and numerical keys, control keys and a CRT screen.

2.3. Remote Indicators.

The Remote Indicators are mounted on the glareshield panel.

– WPT (Blue) — Illuminates prior to a waypoint passage.

i) 90 seconds prior to reaching a waypoint when, operating in OBS; approaching the last non–ILS waypoint in the flight plan or going to a DIRECT TO waypoint which is not part of the active flight plan.

ii) 15 seconds before turning onto the transition course change when operating in AUTO/LEG.

– MSG (Amber) — Flashes when the FMS has a message to relate.

- Press the MSG button on the CDU to enable viewing the message on the RNAV.
- Repress the MSG button on the CDU to return the display to the previously displayed page.

– DR (Amber) — Illuminates when the FMS is in DEAD REKONING mode, after a certain amount of time dependent upon which mode is selected LRN 1 red flag on EHSI will occur.

– XTK (Green) — Illuminates when flying parallel to the flight plan track. (Parallel offset.)

2.4. COM/NAV/PULS Control heads.

Together with KING control heads installed the FMS has a Frequency Management Control facility (KING avionics only).

2.5. FMS Software.

In addition to the Data Base the FMS also contains a self genrated user Data Base, independent of the monthly updated Data Base, which can store 175 locations able to accomodate any combination of ground stations and airports.

The FMS will support 100 flight plans, each consisting of maximum 25 Alpha/Numeric designated waypoints. However the total number of waypoints is limited to 800. These flight plans may be composed of waypoints taken directly from the Data Base or from the 175 user generated non–volatile waypoints.

3. OPERATION.

System operation may be manual to selected waypoints or automatic providing uninterrupted navigation throughout a complete flight plan. Nav sensors may be selected separately or blended within the computer. The FMS becomes integrated and takes control over NAV 1/DME 1 systems when LRN 1 has been selected by means of the SELECT knob on L DCP. The system also interfaces with the EFIS to provide presentation on the EFIS displays, such as next waypoints of the flight plans, selected course and reference ground stations. Autoflight controlled by the FMS is made through L NAV SOURCE SELECT and NAV mode on the autopilot MODE SELECT PANEL.

3.1. Operational Status Selection.

	Enroute:		Approach:		
	Airways, Flight Plans or Direct TO	Intersecting a specified VOR Radial TO or FROM	VOR	RNAV	LOC
Method of Operation	AUTO/ LEG	OBS	OBS	OBS	OBS
Sensor	BLEND	VOR	VOR	VOR	ILS
Mode	RNV ENR	NAV	NAV	RNAV APR	ILS

CAUTION

When using the FMS for navigation, the No. 1 pointer on both RMIs will automatically be parked in 3 o'clock position with No. 1 pointer VOR/ADF switch in VOR position. However, if using the No. 1 pointer, for ADF, the RMI indications will be normal.
The VOR Indicator is also inoperative when operating the FMS.

3.2. FMS Selection.

Activations of the FMS is controlled from the DISPLAY CONTROL PANEL (DCP) on the glareshield. The NAV information is shown on both pilots EHSI. Active tuning of VOR 1 and DME 1 sensors is now controlled from the FMS. When selecting RNAV, the upper frequency display NAV 1 control heads will go out.

3.3. FMS presentation on EFIS.

BOTH PILOTS EHSI

i) Will display LRN 1 at the bottom left of the display (when RNAV is selected).

ii) When operating in map mode:
waypoint is shown by ✣ with a line TO/FROM it, indicating the track.
A TO/FROM arrow ➚ will shown on the trackline when the WPT is off the screen.

LEFT PILOTS EHSI

i) The KNS 660 provides automatic No. 1 course needle drive while using the AUTO/LEG method of operation.

ii) In the OBS method of operation the No. 1 course needle must be set manually, from the COURSE HEADING PANEL (CHP) or from the CDU.

iii) The deviation bar on the EHSI provides LEFT/RIGHT steering information from the FMS.

iv) The DME1 display provides distance to next waypoint (WPT) in nautical miles, time and ground speed.

RIGHT PILOTS EHSI

When second course is selected:

i) The FMS provides automatic No. 2 course needle drive while using the AUTO/LEG method of operation.

ii) In the OBS method of operation the No. 2 course needle must be set manually from the CHP or from the CDU.

iii) The deviation bar provides LEFT/RIGHT steering information from the FMS.

iv) The DME 1 display provides distance to next WPT in nautical miles.

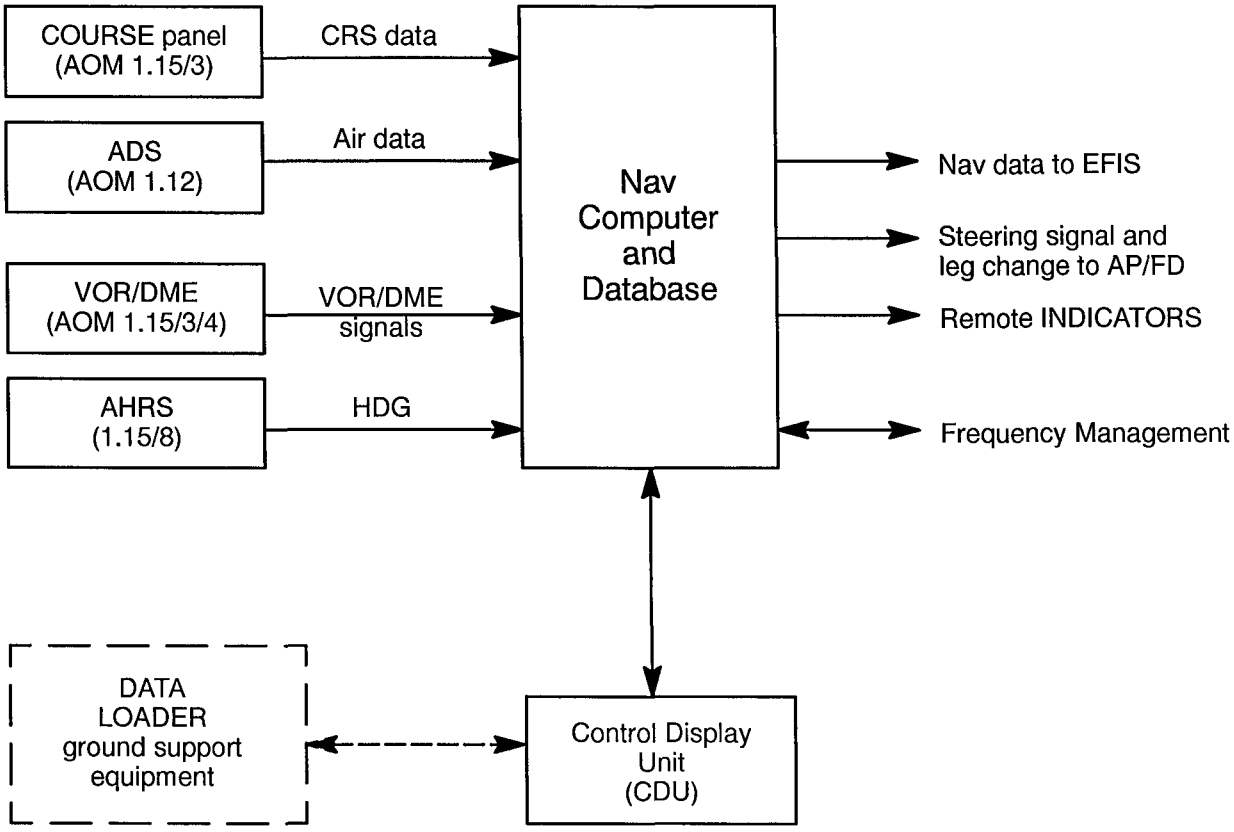
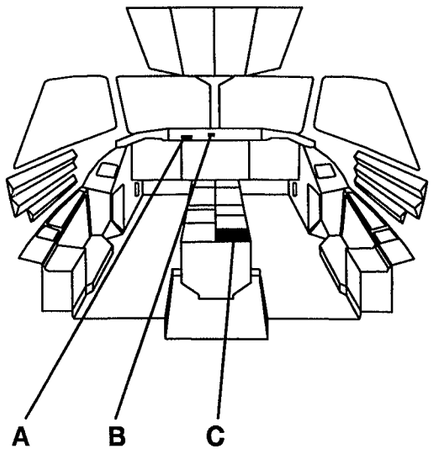


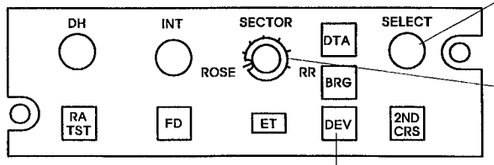
FIG. 1. RNAV System schematic.

THIS PAGE INTENTIONALLY LEFT BLANK !

4. CONTROLS AND INDICATORS



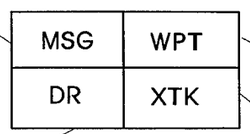
A LH DISPLAY CONTROL PANEL (DCP)



DEVIATION (DEV) Push button.
The Map Mode display is entered by selecting a sector compass display and pressing the DEV push button.

MESSAGE (MSG).
Flashes when there is a new message on the message page in the CDU.

B REMOTE INDICATORS



DEAD RECKONING (DR).
The DR annunciator comes on when the FMS is dead reckoning.

A20548

MESSAGE key (MSG).
Selects the message page. Used be the pilot to acknowledge a MSG light, above the KEY and on the remote indicator.

FLIGHT PLAN key (FPL).
Selects the active flight plan (FPLO) or the flight plan menu pages.

DIRECT TO key (D).
Selects the DIRECT TO operation.

SELECT KNOB.
The multiposition rotary switch is used to select the navigation sensor, NAV 1 or LRN 1, to be displayed on EHSI (left DCP only).

ROSE – SECTOR – RR selector.
Selects different types of display in EHSI.
ROSE – Compass rose is displayed.
SECTOR – A compass sector of ± 40° is displayed. There are 6 sector positions corresponding to the ranges 5, 25, 100, 200, 300 and 600 NM to be used in Map Mode.
RR – Adds weather radar to the sector display.

WAYPOINT key (WPT).
Cycles through the way point pages associated with the active flight plan and allows the display of any waypoint page.

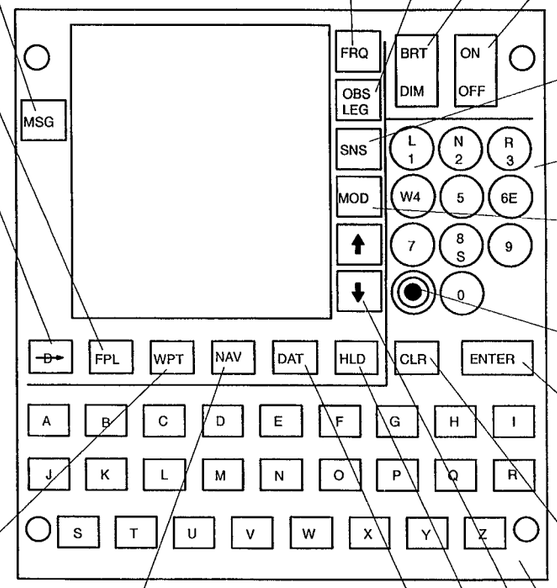
WAYPOINT (WPT) ALERT.
Comes on 90 sec. prior to each WPT passage and DIRECT TO command which is not part of the active flight plan, in OBS MODE. 15 sec. prior to course change in AUTO/LEG mode.

X–TRACK.
Comes on whenever a left or right Cross Track Parallel is activated.

FUNCTION key (OBS/LEG).
Selects the method of operation OBS or AUTO/LEG.

FREQUENCY key (FRQ).
Selects the frequency pages allowing frequency managment.
(For FMS interfaced with KING avionics only).

C CONTROL DISPLAY UNIT (CDU)



NAVIGATION key (NAV).
Selects the two NAV pages.
Alternate pushes selects pages 1 or 2.
NAV 1 or NAV 2.

DATA key (DAT).
Selects the two Data Menu pages.
Alternate pushes selects page 1 or 2.
(DATA 1 or DATA 2).

BRIGHTNESS CONTROL switch (BRT/DIM).
A rocker type switch which, increases or decreases the picture brightness of the CRT when pressed at the top or the bottom. 80 % of maximum level when the unit is turned on.

ON/OFF switch.
A rocker type switch which, when pushed at the top, provides power and self test initialization. When turning off, a caution message is generated.

SENSOR key (SNS).
Selects the active sensor to be used for navigation. Alternate key strokes will select VOR or BLEND.

Numeric keyboard.

Mode key (MOD).
Allows selection of NAV, RNV ENR or RNV APR operation.

Data loading plug in socket.

ENTER key.
Enters data, presented under the cursor or a complete page of info into the system. Also used to select various memeo items and to approved specific cursor statment.

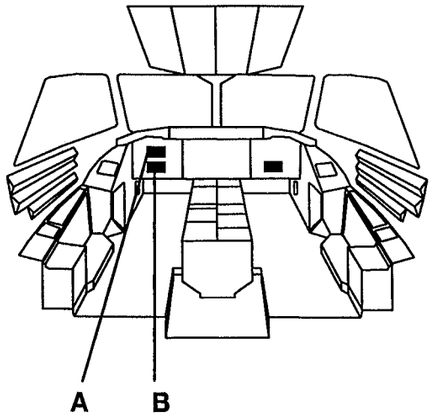
CLEAR key.
Clears data under the cursor or allows entry to non–enterable fields preceded by a right caret ">".

Alpha keyboard.

CURSOR key.
The two buttons are used to position the cursor over the changeable information in that line.

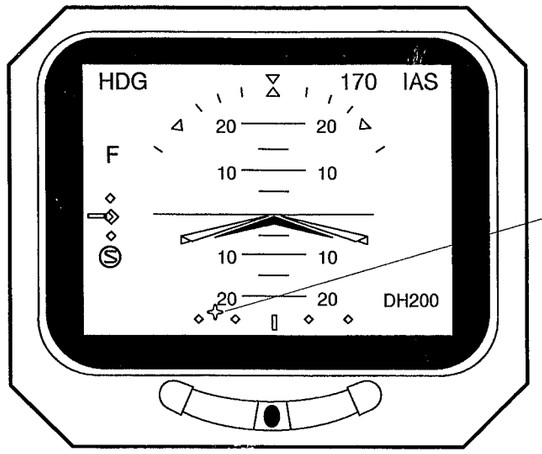
HOLD key (HLD).
Selects the two HOLD pages.
Alternate pushes selects page 1 or 2.
(HOLD 1 or HOLD 2).

Fig. 2. FMS Overview – controls and indicators.



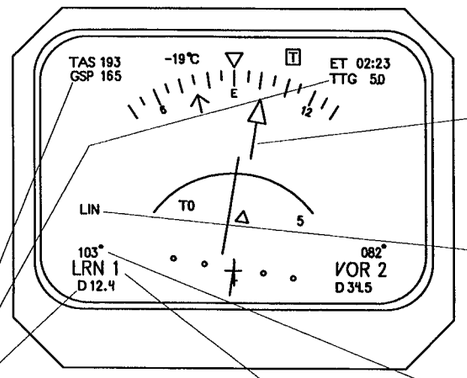
NOTE: Either one of NAV 1 or FMS can be displayed, not both at the same time.

A EADI (LH) MAP MODE
FMS SELECTED



FMS deviation indication in form of a star shaped symbol.
Also see AOM 1.15/1 EFIS.
See KNS 660 Pilots Guide regarding deviation scale sensitivity.

B EHSI (LH) SECTOR MODE
FMS SELECTED



Course and deviation to next way-point.
Second course pointer on RH EHSI.
Also see AOM 1.15/1 EFIS.
See KNS 660 pilots guide regarding deviation scale sensitivity.

LIN display.
Linear RNAV deviation display.
See AOM 1.15/1 EFIS.

D, GSP, TTG
distance, ground speed and time to next waypoint.
Only distance is displayed on RH EHSI.

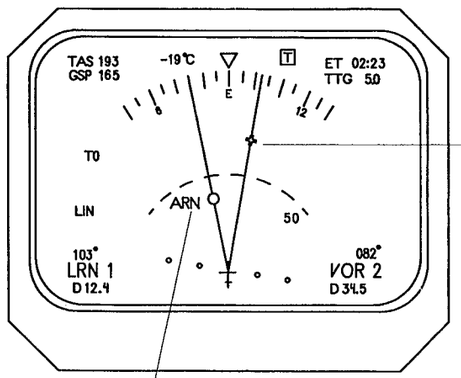
FMS valid flag.

Selected course to next waypoint.

A20547

Fig. 3. EHSI – FMS presentation in SECTOR MODE.

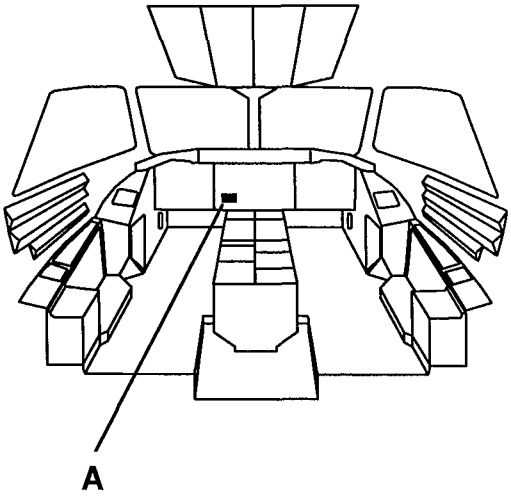
B EHSI (LH) MAP MODE
RNAV SELECTED



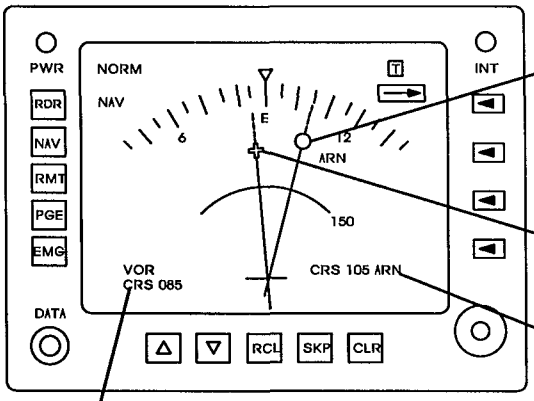
FMS next waypoint and course pre-sentaion. The waypoint is displayed as a star symbol.
Solid courseline indicates TO waypoint and dashed courseline indicates FROM waypoint. Waypoint flashes prior to waypoint passage (cyan).

VOR 2/DME 2 station presentation with ident code and courseline (green).

Fig. 4. LH EADI/EHSI – FMS presentation i MAP MODE.



A MULTIFUNCTION DISPLAY,
MFD FMS SELECTED



VOR 2/DME 2 station presentation with ident code and courseline (green).

Waypoint determined by the FMS. Flashes prior to waypoint passage (cyan).

NOTE: The waypoint name is not displayed, next to the starshaped symbol, when using FMS.

Selected course (CRS) and ident to the VOR 2/DME 2 station.

Course to next waypoint (cyan).

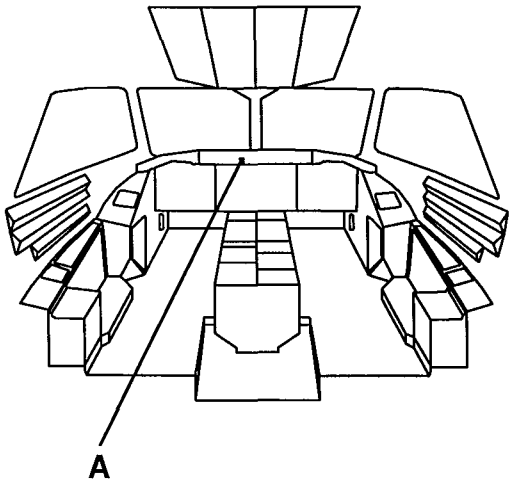
NOTE: Either one of NAV 1 or FMS can be displayed, not both at the same time.

A20566

FIG. 5. MFD – FMS presentation

IF MFD INSTALLED

THIS PAGE INTENTIONALLY LEFT BLANK !



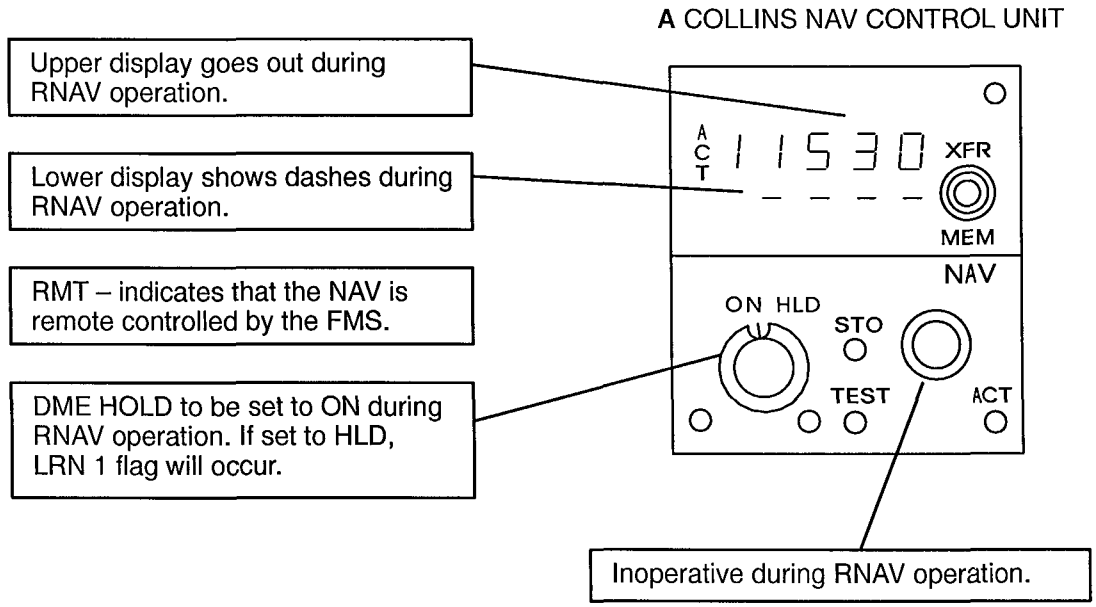
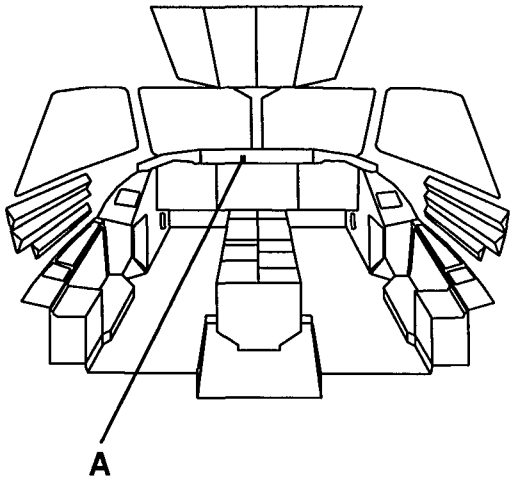


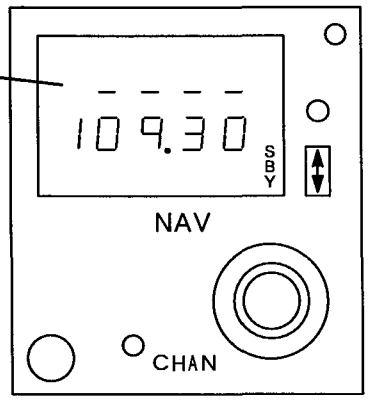
FIG. 6. NAV control unit – RNAV operation.

THIS PAGE INTENTIONALLY LEFT BLANK !



A KING CONTROL UNIT

Upper display goes out during RNAV operation.
The lower display can still be controlled by the freqency knob.



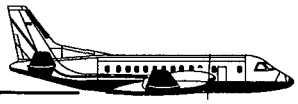
A20562

FIG. 6. NAV control unit – RNAV operation.

THIS PAGE INTENTIONALLY LEFT BLANK !

5. ELECTRICAL POWER SUPPLY.

FMS	R AVIONIC BUS	N–17	AREA NAV



1. GENERAL.

This FMS description gives a general outline of the system with regards to the SAAB 340B installation. Detailed information for operation is contained in the UNIVERSAL UNS–1Msp OPERATOR'S MANUAL. In the Saab 340B the system is referred to as FMS but in the UNIVERSAL MANUAL the system is referred to as Navigation Management System, NMS.

The Flight Management System, FMS, offers capabilities such as flight planning, steering guidance and fuel management. The navigation data is received from the internal GPS receiver and from the interfaced navigation sensors i.e. the Air Data Computer, the VOR/DME and the Attitude Heading Reference System, AHRS. Based on the available information a"best position" is calculated (as a Kalman filtered solution). When the best position is obtained, navigational information such as course to waypoint, Estimated Time Enroute, ETE, distance to waypoint, wind and ground speed are computed and displayed. The information will be available on the FMS alphanumeric display as well as on the EFIS display, and MFD display (if installed).

The fuel flow management receives fuel flow input from the aircraft fuel flow sensors and along with data supplied by the pilot, continuously updates and displays fuel management information during the flight. The fuel flow management is only an advisory for planning.

Three Remote Annunciators (WPT/XTK, MSG/HDG and APPR/GPS) driven by the FMS are also installed on the glareshield panel.

NOTE

The FMS offers vertical navigation, VNAV, and non–precision approach, NPA. These functions have not been implemented in the SAAB 340B installation.

2. MAIN COMPONENTS AND SUBSYSTEMS.

2.1. Flight Management System.

The Flight Management System, FMS, consists of the following units:

1 Navigation Computer Unit, NCU
1 Control Display Unit, CDU
1 Configuration Module, CM
1 GPS Antenna
3 Remote Annunciators

Navigation Computer Unit, NCU

The Navigation Computer Unit is located in the avionics rack. The NCU is the computational center of the Flight Management System. The GPS receiver is physically located in the NCU.

Control Display Unit

The Control Display Unit, located in the center pedestal, is the interface between the Flight Management System and the pilot. Data and commands are entered to the FMS through the keyboard and information is presented on a Flat Panel Liquid Crystal Display. Dimming of the CDU is provided by the CTR PNLS knob located on the INT LIGHT panel.

Configuration Module

The FMS is configured to its specific aircraft installation by the use of a configuration module, which is programmed via the FMS keypad inputs to completely define the sensors inputs, fuel flow, air data etc. The configuration module is mounted on the FMS wire harness connector.

GPS antenna

The GPS antenna is a single frequency antenna with an internal preamplifier.

Remote annunciators

The FMS provides outputs to the following remote annunciators: WPT/XTK, MSG/HDG and APPR/GPS.

WPT Illuminates approximately 15 seconds prior to a leg change. When the light comes on, the appropriate message will be available on the CDU. The light will automatically go out when the leg change occurs.

XTK Illuminates when a parallel course has been selected for the current navigation leg. The XTK will remain on until the parallel course is cancelled manually or automatically at the next leg change.

MSG Flashes when a message is given on the CDU message page.

HDG Illuminates whenever the heading mode has been selected. When the annunciator is on, the FMS flight director and autopilot outputs are referenced to a pilot selected heading rather than to the active FR–TO nav leg. The FMS heading will remain on until the heading mode is either automatically or manually cancelled.

APPR FMS approach function, not used in the SAAB 340B.

GPS Is a GPS integrity uncertain annunciator and it will come on when the GPS sensor is in NONE or ALARM states.

2.2. FMS Software.

Navigation Data Base

The navigation data base contains waypoint information on VORs, DMEs, enroute intersections, non–directional beacons and airports including airport reference points, airport runway thresholds and airport terminal waypoints. The region of data base coverage is tailored to meet the needs of the user. The data base has a twentyeight day period of effectivity and is stored on a PCMCIA card and shall be installed in the NCU during operation.

Company Routes

The FMS allows up to 200 company routes be to stored in the FMS. Each route may contain up to 98 waypoints. In addition to the pre–defined waypoints, 200 operator defined waypoints can be defined and stored in the FMS. Up to 2000 company routes may be stored via the off–line flight plan program.

2.3. Operation.

Initialization

After power up, the first page presented is the Initialization page. This page displays the date, UTC time, present position, the data base start and expiration date. When GPS transitions to NAV mode, then <GPS> will be displayed in the present position ID field and GPS lat/long will be displayed below. If the current date is later than the expiration date, the message DATA BASE OLD will appear under the MSG page. The system can still be used for navigation, but the pilot must verify each waypoint prior to use for IFR operation. Present Position Identifier (<PP> ID) may be corrected by entering an identifier into this field. Initial position coordinates will be automatically updated.

Flight Planning

The pilot selects from waypoints, routes, airways, arrivals and departures, approaches and runways to create the desired flight plan. The flightplan will be presented in terms of direct leg, bearing to waypoint, distance to go and estimated time en route. The flight plans will consist of waypoints from the nav data base and/or pilot defined waypoints. The flight plan waypoints are deleted from the presentation as they are passed.

Navigation

The FMS accepts data from multiple navigation sensors and (using a Kalman filter) computes a position estimate. The FMS smooths the transients caused by changes in the available sensor data. When the best position is obtained navigational information such as course to waypoint, estimated time en–route, distance to waypoint, wind and ground speed are computed. A sensor "watchdog" automatically protects against a large error being input from a navigation sensor which could cause an error in the best computed position. This is accomplished by continuously monitoring the difference between the computed position and the FMS best computed position. If the difference exceeds a pre–set value, the "watchdog" will activate the appropriate message to alert the pilot. Additionally, a sensor monitor will detect any sensor that is rapidly diverging from the FMS position, and will deselect that sensor before it can affect the FMS position.

FMS DME control

The FMS will allocate a DME (using DME 1) channel in order to calculate a DME–DME position by searching the nav data base to determine which DME stations are within range (approximately 300 NM) and sequentially tune each station. By interrogating multiple DME stations at a four second rate, knowing the geographic co–ordinates for each station, and correcting the distance computation for slant range using station elevation and aircraft altitude, the FMS is able to compute the position of the aircraft.

Steering

When a flight plan has been activated, the FMS will output roll command to the FCC. The roll rate is limited to 3° per second.

Fuel Flow Management

The FMS receives fuel flow information from the fuel flow sensors. The initial fuel onboard has to be inserted, and thereafter the fuel used can be presented. The Fuel Flow Management is only an advisory for planning.

2.4. FMS presentation on EFIS.

Activations of the FMS is controlled from the DISPLAY CONTROL PANEL (DCP) on the glareshield. The FMS information is shown on both pilots EHSI. Active tuning of DME1 is now controlled from the FMS system.

BOTH PILOTS EHSI

– Will display LRN1 at the bottom left of the display.

When operating EHSI in map mode:

– Waypoint is shown by a star shaped symbol and with a line TO/FROM it, indicating the track. A TO/FROM arrow will show on the trackline if the WPT is off the screen.

LEFT PILOTS EHSI

– The FMS provides automatic No 1 course needle drive.

– The deviation bar on the EHSI provides LEFT/RIGHT steering information from the FMS.

– The DME1 display provides distance to next waypoint (WPT) in nautical miles, time and ground speed.

RIGHT PILOTS EHSI

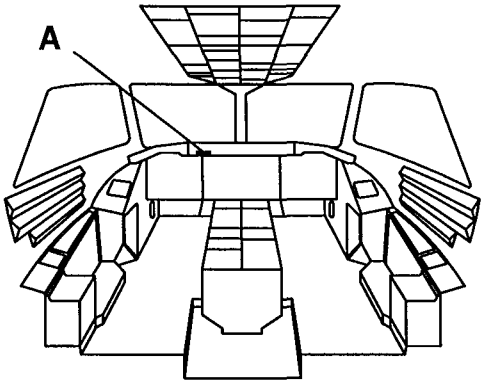
When second course is selected:

– The FMS provides automatic No 2 course needle drive.

– The deviation bar provides LEFT/RIGHT steering information from the FMS.

– The DME1 display provides distance to next waypoint (WPT) in nautical miles.

3. CONTROLS AND INDICATORS.



A LH DISPLAY CONTROL PANEL (DCP) and REMOTE ANNUNCIATORS

REMOTE ANNUNCIATORS

WPT – Illuminates approximately 15 seconds prior to a leg change. When the light comes on, the appropriate message will be available on the CDU. The light will automatically go out when the leg change occurs.

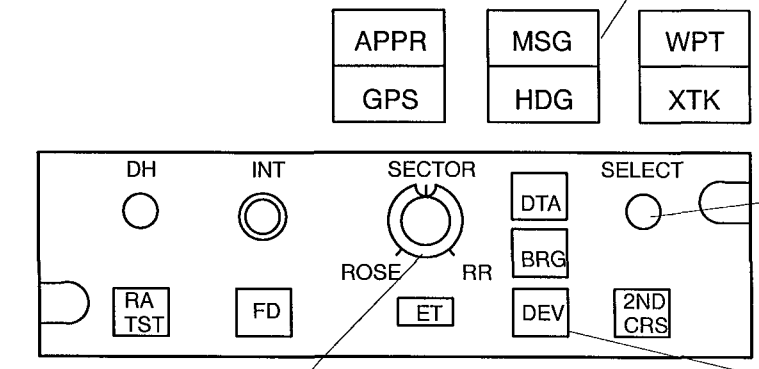
XTK – Illuminates when a parallel course has been selected for the current navigation leg. The XTK will remain on until the parallel course is cancelled manually or automatically at the next leg change.

MSG – Flashes when a message is given on the message page.

HDG – Illuminates whenever the heading mode has been selected. When the annunciator is on, the FMS flight director and autopilot outputs are referenced to a pilot selected heading rather than to the active FR–TO nav leg. The FMS heading will remain on until the heading mode is either automatically or manually cancelled.

APPR – FMS approach functional, not used in the Saab 340B.

GPS – Is an integrity uncertain annunciator and it will come on when the GPS sensor is in NONE or ALARM states.



SELECT knob

The muiltiposition rotary switch is used to select the navigation sensor, NAV 1 or LRN 1 (for FMS), to be displayed on EHSI (left DCP only).

ROSE – SECTOR – RR – selector

Selects different types of display in EHSI.

ROSE – Compass rose is displayed in EHSI.

SECTOR – A compass sector of ± 40° is displayed corresponding to the ranges 5, 25, 100, 200, 300 and 600 NM to be used in Map Mode.

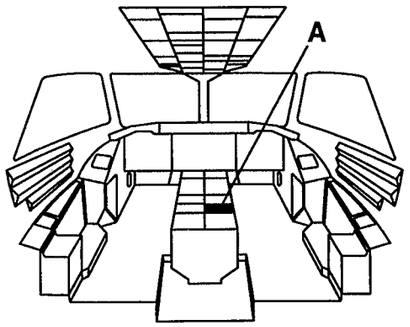
RR – Adds weather radar to the sector display.

DEVIATION (DEV) push button

The Map Mode display is entered by selecting a sector compass display and pressing the DEV push button.

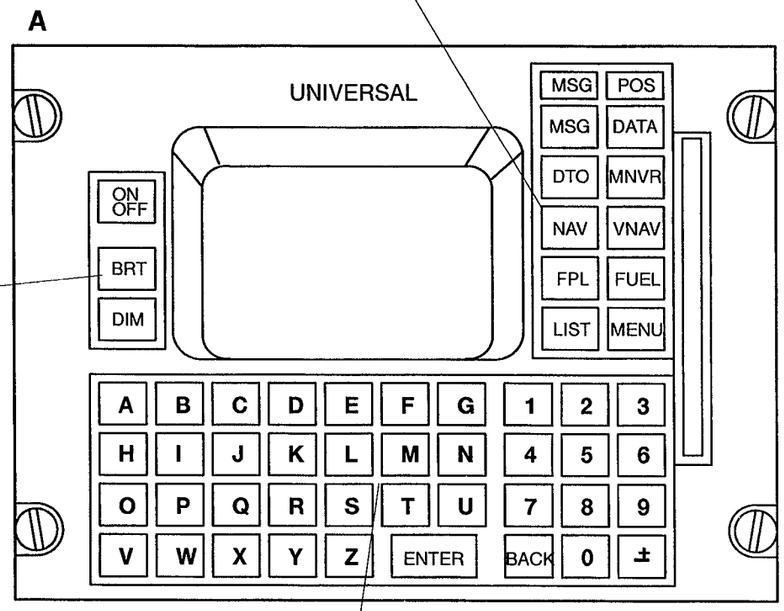
A15885

Fig. 1. FMS activation on DCP and Remote Annunciators.



Function Keys
The function keys are used to directly access certain functions or the FMS: DATA, FPL, NAV, VNAV, DTO, FUEL, LIST, MENU and MNVR.

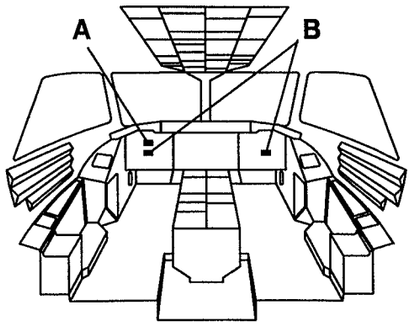
Miscellaneously Keys
ON–OFF, BRT, DIM, MSG, ENTER, ±, BACK.



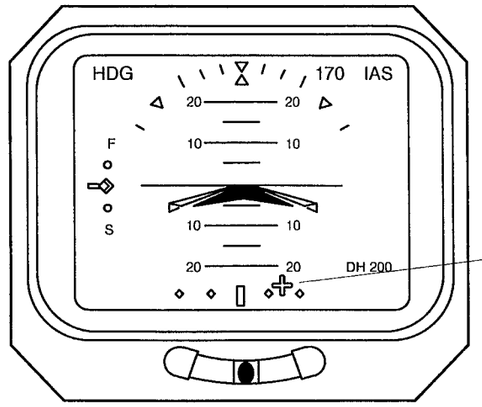
Data Entry Keys
The data entry keys are numeric 0–9 and the alphabetic A–Z keys.

A15904

Fig. 2. FMS control display unit.



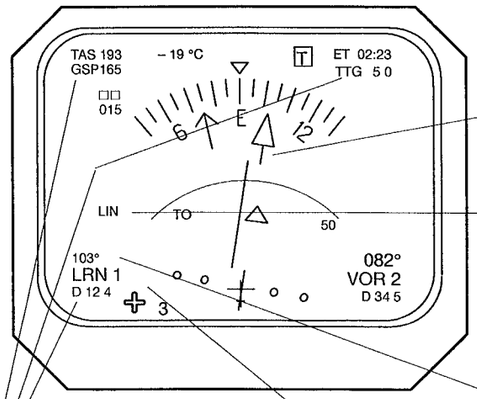
A EADI (LH) MAP MODE SELECTED



FMS deviation indication in form of a star shaped symbol.
See UNS–1 Msp OPERATOR'S MANAGUAL regarding deviation scale sensitivity.

NOTE
Either one of NAV 1 or FMS can be displayed, not both at the same time.

B EHSI (LH) SECTOR MODE SELECTED



Course and deviation to next wayoint.
Second course pointer on RH EHSI.
See UNS–1 Msp OPERATOR'S MANUAL regarding deviation scale sensitivity.

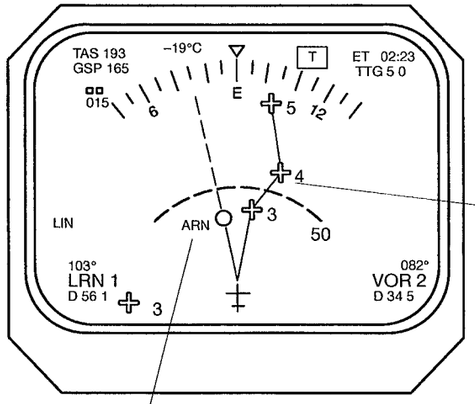
LIN display
Linear RNAV deviation display.

D GSP TTG
Distance, ground speed and time to next waypoint.
Only distance is displayed on RH EHSI.

FMS valid flag

Selected course to next waypoint.

B EHSI (LH) MAP MODE SELECTED

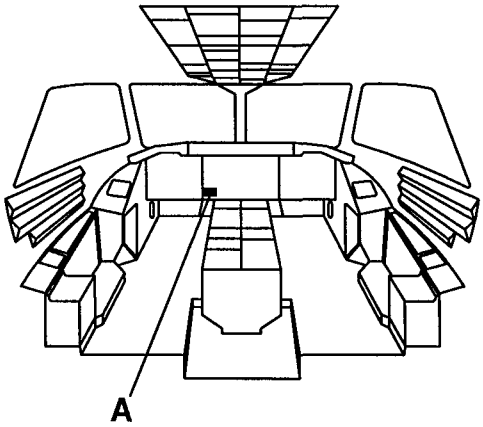


FMS Active flight plan with the next three waypoints presented (cyan). The waypoints are displayed as star symbols. The next (to be overflown) waypoint flashes prior to waypoint passage to the new leg.

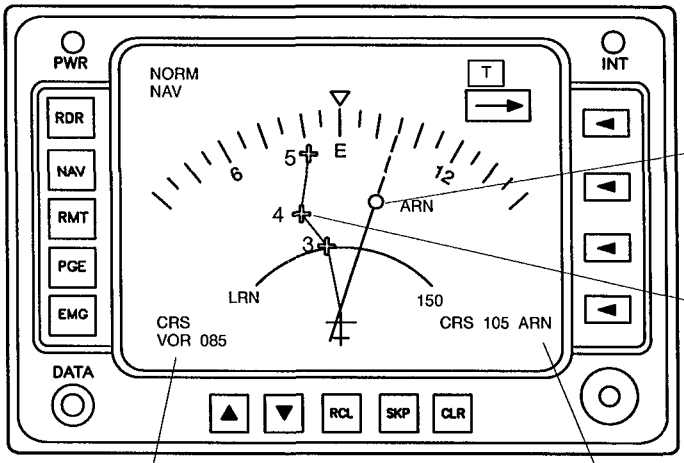
VOR 2/DME 2 station presentation with ident code and courseline (green).

A15910

Fig. 3 and 4. LH EHSI – FMS presentation in SECTOR MODE and LH EADI/EHSI – FMS presentation in MAP MODE.



A MULTIFUNCTION DISPLAY, MFD – FMS SELECTED



VOR 2/DME 2 station presentation with ident code and courseline (green).

Waypoint determined by the FMS. Flashes prior to waypoint passage (cyan).

Course to next waypoint (cyan).

Selected course (CRS) and ident to the VOR 2/ DME 2 station.

NOTE

Either one of NAV 1 or FMS can be displayed, not both at the same time.

A15884

IF MFD INSTALLED.

Fig. 5. FMD – FMS presentation.

4. ELECTRICAL POWER SUPPLY.

FMS	R AVIONIC BUS	N–17	AREA NAV

1. GENERAL.

This FMS description gives a general outline of the system with regards to the SAAB 340B installation. Detailed information for operation is contained in the UNIVERSAL UNS–1K OPERATOR'S MANUAL (SCN 602). In the Saab 340B the system is referred to as FMS but in the UNIVERSAL MANUAL the system is referred to as Navigation Management System, NMS.

The Flight Management System, FMS, offers capabilities such as flight planning, steering guidance and fuel management. The navigation data is received from the internal GPS receiver and from the interfaced navigation sensors i.e. the Air Data Computer, the VOR/DME and the Attitude Heading Reference System, AHRS. Based on the available information a "best position" is calculated (as a Kalman filtered solution). When the bes t position is obtained, navigational information such as course to waypoint, Estimated Time Enroute, ETE, distance to waypoint, wind and ground speed are computed and displayed. The information will be available on the FMS alphanumeric display as well as on the EFIS display, and MFD display (if installed).

The fuel flow management receives fuel flow input from the aircraft fuel flow sensors and along with data supplied by the pilot, continuously updates and displays fuel management information during the flight. The fuel flow management is only an advisory for planning.

Three Remote Annunciators (WPT/XTK, MSG/HDG and APPR/GPS without Mod. No. 2966 or DR/GPS with Mod. No. 2966 installed) driven by the FMS are also installed on the glareshield panel.

NOTE

The FMS offers vertical navigation, VNAV, and non–precision approach, NPA. VNAV has not been implemented in the SAAB 340B installation and GPS based NPA is only available when Mod. No. 3034 is installed.

2. MAIN COMPONENTS AND SUBSYSTEMS.

2.1. Flight Management System.

The Flight Management System, FMS, consists of the following units:

1 Navigation Computer Unit, NCU
1 Control Display Unit, CDU
1 Configuration Module, CM
1 GPS Antenna
3 Remote Annunciators
1 Data Transfer Unit, DTU

Navigation Computer Unit, NCU

The Navigation Computer Unit is located in the avionics rack. The NCU is the computational center of the Flight Management System. The GPS receiver is physically located in the NCU.

Control Display Unit

The Control Display Unit, located in the center pedestal, is the interface between the Flight Management System and the pilot. Data and commands are entered to the FMS through the keyboard and information is presented on a Flat Panel Liquid Crystal Display. Dimming of the CDU is provided by the CTR PNLS knob located on the INT LIGHT panel.

Configuration Module

The FMS is configured to its specific aircraft installation by the use of a configuration module, which is programmed via the FMS keypad inputs to completely define the sensors inputs, fuel flow, air data etc. The configuration module is mounted on the NCU mounting tray.

GPS antenna

The GPS antenna is a single frequency antenna with an internal preamplifier.

Data Transfer Unit

The Data Transfer Unit (DTU) is a 3.5" floppy disc drive housed in a protective case. It is mounted in the center pedestal and powered from the NCU. It communicates with the NCU through a digital bus. The DTU is used to:

- Update the standard and expanded navigation databases
- Load aircraft specific performance data
- Load pilot defined flightplans and checklists

Remote annunciators

The FMS provides outputs to the following remote annunciators: WPT/XTK, MSG/HDG and APPR/GPS or DR/GPS.

WPT — Illuminates approximately 15 seconds prior to a leg change. When the light comes on, the appropriate message will be available on the CDU. The light will automatically go out when the leg change occurs.

XTK — Illuminates when a parallel course has been selected for the current navigation leg. The XTK will remain on until the parallel course is cancelled manually or automatically at the next leg change.

MSG — Flashes when a message is given on the CDU message page.

HDG — Illuminates whenever the heading mode has been selected. When the annunciator is on, the FMS flight director and autopilot outputs are referenced to a pilot selected heading rather than to the active FR–TO nav leg. The FMS heading will remain on until the heading mode is either automatically or manually cancelled.

APPR — FMS approach function, not used in the SAAB 340B unless Mod. No. 3034 is installed (without Mod. No. 2966 installed).

DR — Dead Reckoning annunciator illuminates when the position signals from the used navaids are lost (with Mod. No. 2966 installed). The computation and display of the FMS navigation information is then extrapolated from the last known position which makes the information less reliable.

GPS — Is a GPS integrity uncertain annunciator and it will come on when the GPS sensor is in NONE or ALARM states.

2.2. FMS Software.

Navigation Data Base

The navigation data base contains waypoint information on VORs, DMEs, enroute intersections, non–directional beacons and airports including airport reference points, airport runway thresholds and airport terminal waypoints. The region of data base coverage is tailored to meet the needs of the user. The data base has a twentyeight day period of effectivity and is stored on a 3.5" floppy disc which is loaded into the FMS via the DTU.

Company Routes

The FMS allows up to 200 company routes be to stored in the FMS. Each route may contain up to 98 waypoints. In addition to the pre–defined waypoints, 200 operator defined waypoints can be defined and stored in the FMS. Up to 2500 company routes may be stored via the off–line flight plan program.

2.3. Operation.

Initialization

After power up, the first page presented is the Initialization page. This page displays the date, UTC time, present position, the data base start and expiration date. When GPS transitions to NAV mode, then <GPS> will be displayed in the present position ID field and GPS lat/long will be displayed below. If the current date is later than the expiration date, the message DATA BASE OLD will appear under the MSG page. The system can still be used for navigation, but the pilot must verify each waypoint prior to use for IFR operation. Present Position Identifier (ID) may be corrected by entering an identifier into this field. Initial position coordinates will be automatically updated.

Flight Planning

The pilot selects from waypoints, routes, airways, arrivals and departures, approaches and runways to create the desired flight plan. The flightplan will be presented in terms of direct leg, bearing to waypoint, distance to go and estimated time en route. The flight plans will consist of waypoints from the nav data base and/or pilot defined waypoints. The flight plan waypoints are deleted from the presentation as they are passed.

Navigation

The FMS accepts data from multiple navigation sensors and (using a Kalman filter) computes a position estimate. The FMS smooths the transients caused by changes in the available sensor data. When the best position is obtained navigational information such as course to waypoint, estimated time en–route, distance to waypoint, wind and ground speed are computed. A sensor "watchdog" automatically protects against a large error being input from a navigation

sensor which could cause an error in the best computed position. This is accomplished by continuously-monitoring the difference between the computed position and the FMS best computed position. If the difference exceeds a pre–set value, the "watchdog" will activate the appropriate message to alert the pilot. Additionally, a sensor monitor will detect any sensor that is rapidly diverging from the FMS position, and will deselect that sensor before it can affect the FMS position.

FMS DME control

The FMS will allocate a DME (using DME 1) channel in order to calculate a DME–DME position by searching the nav data base to determine which DME stations are within range (approximately 300 NM) and sequentially tune each station. By interrogating multiple DME stations at a four second rate, knowing the geographic co–ordinates for each station, and correcting the distance computation for slant range using station elevation and aircraft altitude, the FMS is able to compute the position of the aircraft.

Steering

When a flight plan has been activated, the FMS will output roll command to the FCC. The roll rate is limited to 3° per second.

Fuel Flow Management

The FMS receives fuel flow information from the fuel flow sensors. The initial fuel onboard has to be inserted, and thereafter the fuel used can be presented. The Fuel Flow Management is only an advisory for planning.

2.4. FMS presentation on EFIS.

Activations of the FMS is controlled from the DISPLAY CONTROL PANEL (DCP) on the glareshield. The FMS information is shown on both pilots EHSI. Active tuning of DME1 is now controlled from the FMS system.

BOTH PILOTS EHSI

– Will display LRN1 at the bottom left of the display.

When operating EHSI in map mode:

– Waypoint is shown by a star shaped symbol and with a line TO/FROM it, indicating the track. A TO/FROM arrow will show on the trackline if the WPT is off the screen.

LEFT PILOTS EHSI

– The FMS provides automatic No 1 course needle drive.

– The deviation bar on the EHSI provides LEFT/RIGHT steering information from the FMS.

– The DME1 display provides distance to next waypoint (WPT) in nautical miles, time and ground speed.

RIGHT PILOTS EHSI

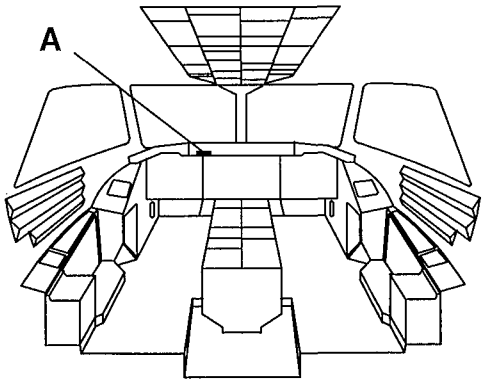
When second course is selected:

– The FMS provides automatic No 2 course needle drive.

– The deviation bar provides LEFT/RIGHT steering information from the FMS.

– The DME1 display provides distance to next waypoint (WPT) in nautical miles.

3. CONTROLS AND INDICATORS.



REMOTE ANNUNCIATORS

WPT – Illuminates approximately 15 seconds prior to a leg change. When the light comes on, the appropriate message will be available on the CDU. The light will automatically go out when the leg change occurs.

XTK – Illuminates when a parallel course has been selected for the current navigation leg. The XTK will remain on until the parallel course is cancelled manually or automatically at the next leg change.

MSG – Flashes when a message is given on the message page.

HDG – Illuminates whenever the heading mode has been selected. When the annunciator is on, the FMS flight director and autopilot outputs are referenced to a pilot selected heading rather than to the active FR–TO nav leg. The FMS heading will remain on until the heading mode is either automatically or manually cancelled.

GPS – Is an integrity uncertain annunciator and it will come on when the GPS sensor is in NONE or ALARM states.

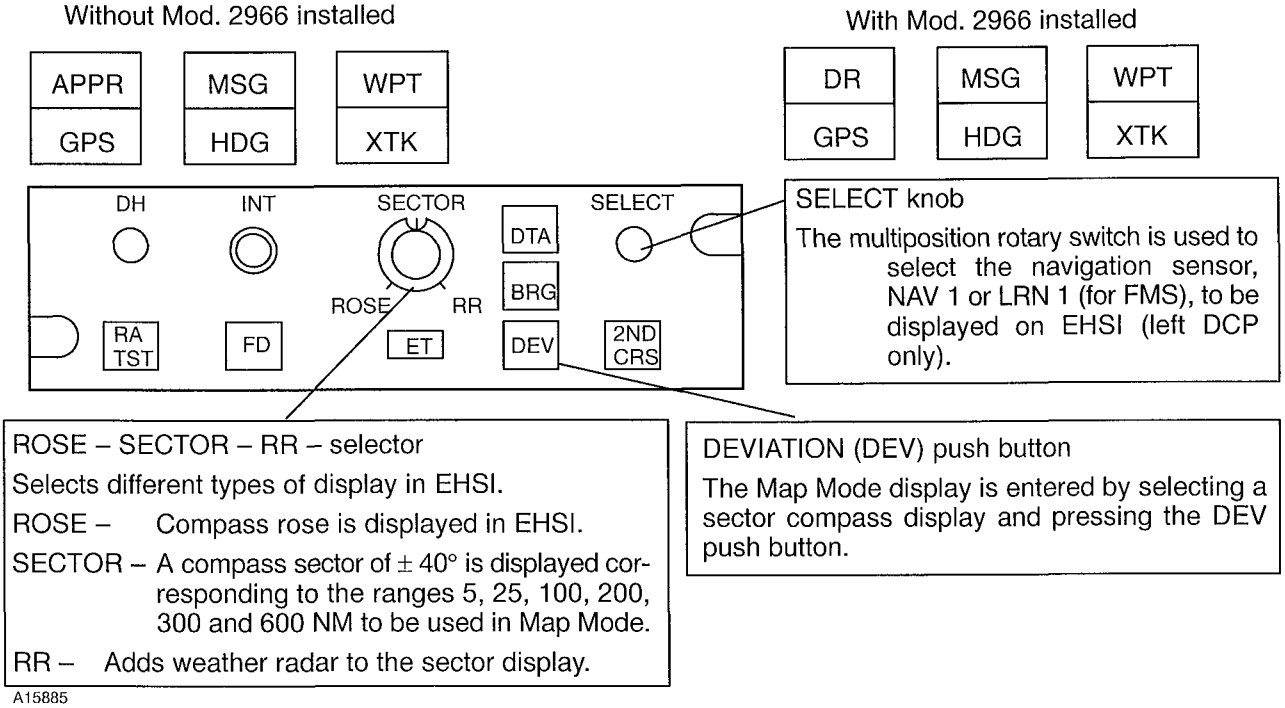
without Mod. No. 2966 installed:

APPR –FMS approach functional, not used in the Saab 340B unless Mod. No. 3034 is installed.

with Mod. No. 2966 installed:

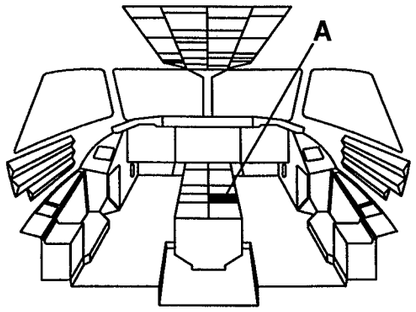
DR – Dead Reckoning annunciator illuminates when the position signals from the used navaids are lost. The computation and display of the FMS navigation information is then extrapolated from the last known position which makes the information less reliable.

A LH DISPLAY CONTROL PANEL (DCP) and REMOTE ANNUNCIATORS



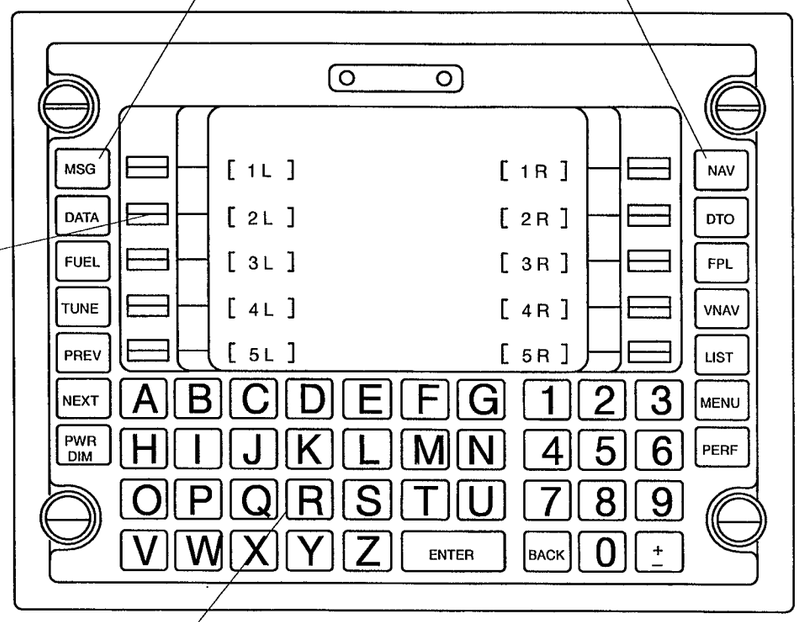
A15885

Fig. 1. FMS activation on DCP and Remote Annunciators.



Function Keys
The function keys are used to directly access certain functions of the FMS: DATA, FPL, NAV, VNAV, DTO, FUEL, LIST, MENU, TUNE and PERF.

Line Select Keys
The line select keys provides the option to position the cursor and input the desired data

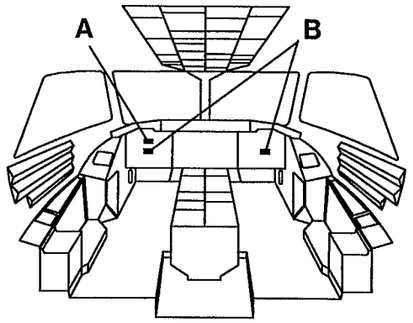


Data Entry Keys
The data entry keys are numeric 0–9 and the alphabetic A–Z keys.

A18004

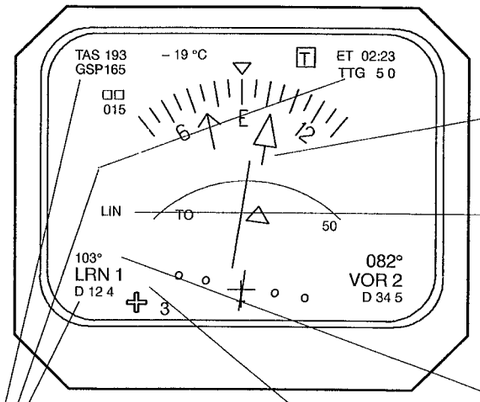
A15904

Fig. 2. FMS control display unit.



NOTE
Either one of NAV 1 or FMS can be displayed, not both at the same time.

B EHSI (LH) SECTOR MODE SELECTED



Course and deviation to next wayoint. Second course pointer on RH EHSI. See UNS–1K OPERATOR'S MANUAL regarding deviation scale sensitivity.

LIN display
Linear RNAV deviation display.

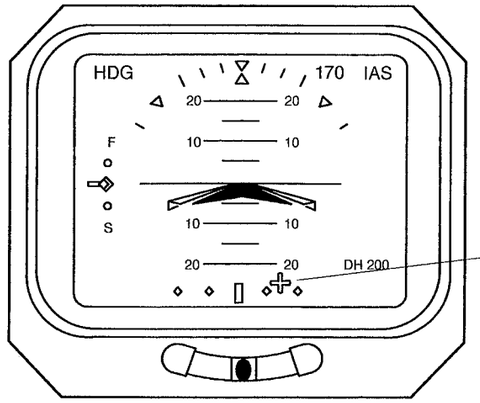
D GSP TTG
Distance, ground speed and time to next waypoint.
Only distance is displayed on RH EHSI.

FMS valid flag

Selected course to next waypoint.

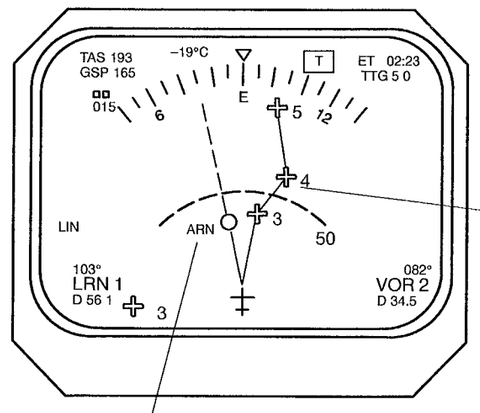
A15910

A EADI (LH) MAP MODE SELECTED



FMS deviation indication in form of a star shaped symbol. See UNS–1K OPERATOR'S MANUAL regarding deviation scale sensitivity.

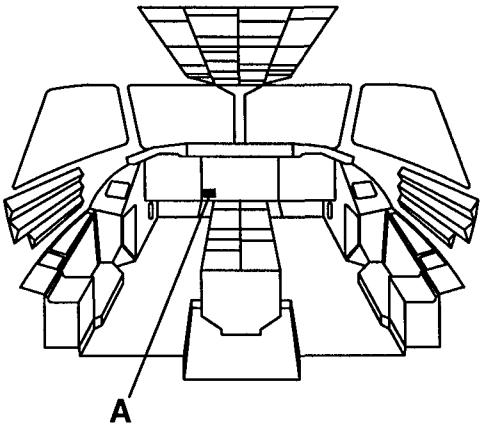
B EHSI (LH) MAP MODE SELECTED



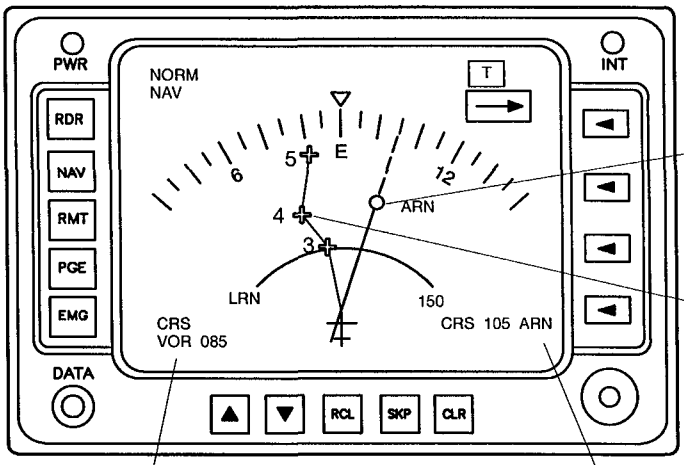
FMS Active flight plan with the next three waypoints presented (cyan). The waypoints are displayed as star symbols. The next (to be overflown) waypoint flashes prior to waypoint passage to the new leg.

VOR 2/DME 2 station presentation with ident code and courseline (green).

Fig. 3 and 4. LH EHSI – FMS presentation in SECTOR MODE and LH EADI/EHSI – FMS presentation in MAP MODE.



A MULTIFUNCTION DISPLAY, MFD – FMS SELECTED



VOR 2/DME 2 station presentation with ident code and courseline (green).

Waypoint determined by the FMS. Flashes prior to waypoint passage (cyan).

Course to next waypoint (cyan).

Selected course (CRS) and ident to the VOR 2/ DME 2 station.

NOTE

Either one of NAV 1 or FMS can be displayed, not both at the same time.

A15884

IF MFD INSTALLED.

Fig. 5. FMD – FMS presentation.

4. ELECTRICAL POWER SUPPLY.

FMS	R AVIONIC BUS	N–17	AREA NAV

1. LIMITATIONS.

The AFM LIMITATIONS must be adhered to.

2. NORMAL OPERATION.

CONDITIONS	NORMAL PROCEDURES
2.1 FMS SELECTION/ DESELECTION.	1. SELECT knob ..... TURN – On the L DCP only. – Turn switch until LRN 1 is displayed in left corner of the EHSI. 2. Mode Selector (DCP) ..... AS REQUIRED 3. The FMS information is displayed by NAV 1 course pointer and NAV 1 source flag and waypoint data by the cyan colored D, GSP and TTG. 4. Monitor the FMS navigation with the primary navigation equipment. – The GPS mode may not be used as the primary source of navigation. – Operation in GPS mode requires continuous monitoring of primary navigation source. 5. When deselecting LRN, by turning the select knob, VOR or LOC is displayed in the left corner of the EHSI. Simultaneously the heading bug is synchronized to actual aircraft heading. The active FD mode is HDG. VOR or LOC modes are armed. NOTE MSP APPR button is selectable but function is disabled while FMS selection is valid.
2.2 FMS NAVIGATION WITH FD/AP.	1. NAV S L button ..... SELECT – FMS serves as left navigation system for FD/AP. 2. MSP NAV button ..... SELECT 3. CRS 1 knob is controlled by the FMS and can not be set manually. 4. Monitor the FMS navigation with the primary navigation equipment.

CONDITIONS	NORMAL PROCEDURES
2.3 RNAV OPERATION	For FMS operation instructions see KING KNS 660 PILOT'S GUIDE.

3. ABNORMAL OPERATION.

CONDITIONS	ABNORMAL PROCEDURES		
3.1 FMS FAILURE MODES.	Failure mode	Indication	Action
	Loss of FMS navigation	Obvious when FMS used	Use basic nav info
	Misleading info from FMSwithout warning	Possible deviation from cleared route	Use basic nav info for alternative route

1. LIMITATIONS.

The AFM LIMITATIONS must be adhered to.

2. NORMAL OPERATION.

CONDITIONS	NORMAL PROCEDURES
2.1 FMS SELECTION/ DESELECTION.	1. SELECT knob ..... TURN – On the L DCP only. – Turn switch until LRN 1 is displayed in left corner of the EHSI. 2. Mode Selector (DCP) ..... AS REQUIRED 3. The FMS information is displayed by NAV 1 course pointer and NAV 1 source flag and waypoint data by the cyan colored D, GSP and TTG. 4. Monitor the FMS navigation with the primary navigation equipment. 5. When deselecting LRN, by turning the select knob, VOR or LOC is displayed in the left corner of the EHSI. Simultaneously the heading bug is synchronized to actual aircraft heading. The active FD mode is HDG. VOR or LOC modes are armed. NOTE MSP APPR button is selectable but function is disabled while FMS selection is valid.
2.2 FMS NAVIGATION WITH FD/AP.	1. NAV S L button ..... SELECT – FMS serves as left navigation system for FD/AP. 2. MSP NAV button ..... SELECT 3. CRS 1 knob is controlled by the FMS and can not be set manually. 4. Monitor the FMS navigation with the primary navigation equipment.
2.3 RNAV OPERATION	For FMS operation instructions see UNIVERSAL UNS–1 Msp OPERATOR'S MANUAL.

3. ABNORMAL OPERATION.

CONDITIONS	ABNORMAL PROCEDURES		
3.1 FMS FAILURE MODES.	Failure mode	Indication	Action
	Loss of FMS/GPS navigation	Obvious when FMS/GPS used	Use basic nav info
	Misleading info from FMS/GPS without warning	Possible deviation from cleared route	Use basic nav info for alternative route
	Loss of Fuel Flow Management	Obvious when FMS/GPS used	Use basic Fuel Flow information
	Misleading info from Fuel Flow Management without warning	By monitoring of basic Fuel Flow information	Use basic Fuel Flow information

1. LIMITATIONS.

The AFM LIMITATIONS must be adhered to.

2. NORMAL OPERATION.

CONDITIONS	NORMAL PROCEDURES
2.1 FMS SELECTION/ DESELECTION.	1. SELECT knob ..... TURN – On the L DCP only. – Turn switch until LRN 1 is displayed in left corner of the EHSI. 2. Mode Selector (DCP) ..... AS REQUIRED 3. The FMS information is displayed by NAV 1 course pointer and NAV 1 source flag and waypoint data by the cyan colored D, GSP and TTG. 4. Monitor the FMS navigation with the primary navigation equipment. 5. When deselecting LRN, by turning the select knob, VOR or LOC is displayed in the left corner of the EHSI. Simultaneously the heading bug is synchronized to actual aircraft heading. The active FD mode is HDG. VOR or LOC modes are armed. NOTE MSP APPR button is selectable but function is disabled while FMS selection is valid, unless Mod No. 3034 is installed.
2.2 FMS NAVIGATION WITH FD/AP.	1. NAV S L button ..... SELECT – FMS serves as left navigation system for FD/AP. 2. MSP NAV button ..... SELECT 3. CRS 1 knob is controlled by the FMS and can not be set manually. 4. Monitor the FMS navigation with the primary navigation equipment.
2.3 RNAV OPERATION	For FMS operation instructions see UNIVERSAL UNS–1K OPERATOR'S MANUAL (SCN 602).

3. ABNORMAL OPERATION.

CONDITIONS	ABNORMAL PROCEDURES		
3.1 FMS FAILURE MODES.	Failure mode	Indication	Action
	Loss of FMS/GPS navigation	Obvious when FMS/GPS used	Use basic nav info
	Misleading info from FMS/GPS without warning	Possible deviation from cleared route	Use basic nav info for alternative route
	Loss of Fuel Flow Management	Obvious when FMS/GPS used	Use basic Fuel Flow information
	Misleading info from Fuel Flow Management without warning	By monitoring of basic Fuel Flow information	Use basic Fuel Flow information