



CL-350 TRAINING MANUAL

NAVIGATION SYSTEM

19

AIRCRAFT SYSTEMS
TRAINING MANUAL

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NAVIGATION SYSTEM

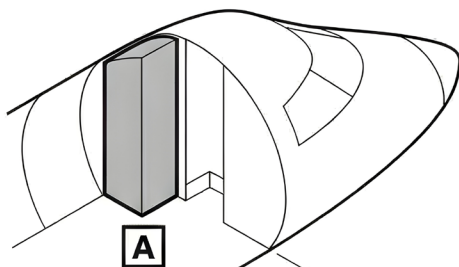
I. INTRODUCTION

The navigation system provides comprehensive positioning, guidance, and situational awareness capabilities for all phases of flight operations. The system integrates multiple navigation sensors including VHF and HF communication radios, VHF navigation receivers, GPS/GNSS, DME, ADF, inertial reference systems, and terrain awareness systems to deliver precise navigation solutions through the dual Flight Management System. Advanced features including terrain awareness, traffic collision avoidance, synthetic vision, and runway awareness enhance operational safety and efficiency throughout the flight envelope.

SYSTEM SPECIFICATIONS

Navigation System Specifications

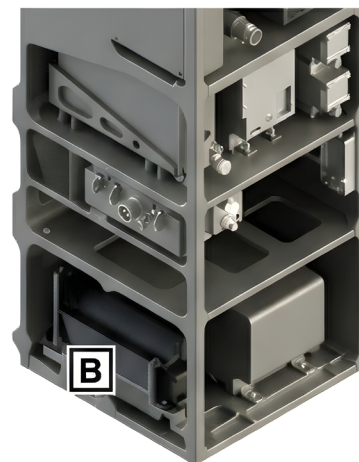
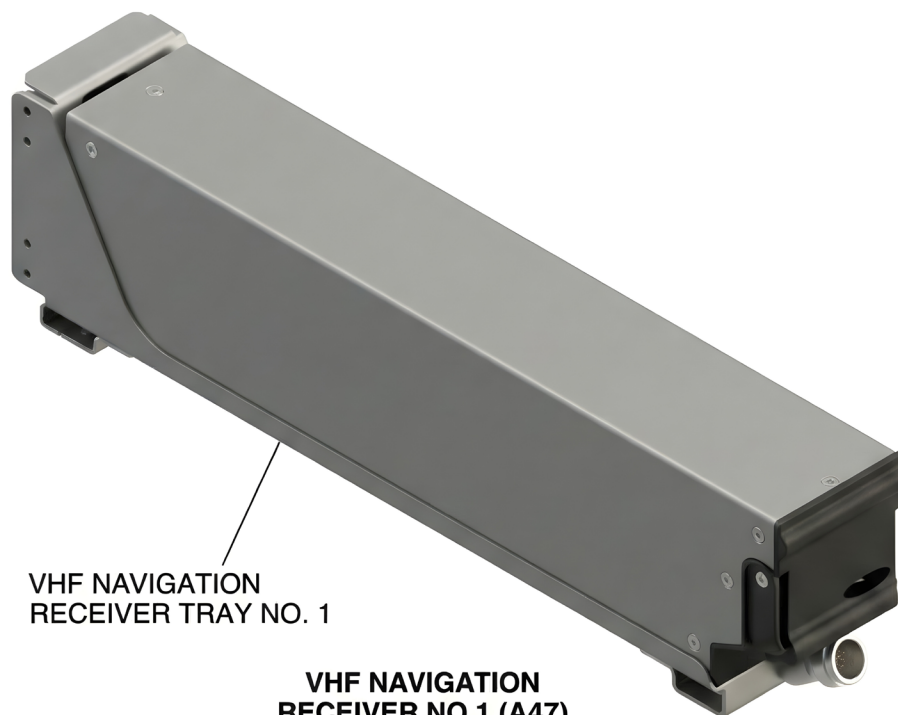
Parameter	Value/Description
Navigation Receivers	NAV-4000 and NAV-4500
VOR Frequency Range	108.00 to 117.95 MHz
VOR Channel Spacing	50 kHz (160 channels)
Localizer Frequency Range	108.10 to 111.95 MHz
Localizer Channel Spacing	50 kHz (40 channels)
Glideslope Frequency Range	329.15 to 335.00 MHz
Glideslope Channel Spacing	150 kHz (40 channels)
Marker Beacon Frequency	75.00 MHz (preset)
DME Frequency Range	962 to 1213 MHz
DME Maximum Tracking Range	300 nm
ADF Frequency Range	190 to 1799 kHz
Maritime Distress Bands (via ADF)	2088 to 2094 kHz, 2179 to 2185 kHz
GPS Sensors	2 (dual redundancy)
FMS Computers	2 x FMC-6200
Database Unit	DBU-5010E
Transponder Modes	Mode A, Mode C, Mode S, ADS-B Out
TCAS Version	TCAS II Version 7.1
Weather Radar Range	300 nm maximum
Radio Altimeter Range	-20 to 2500 feet AGL
TAWS Modes	1-7 plus sterrain awareness

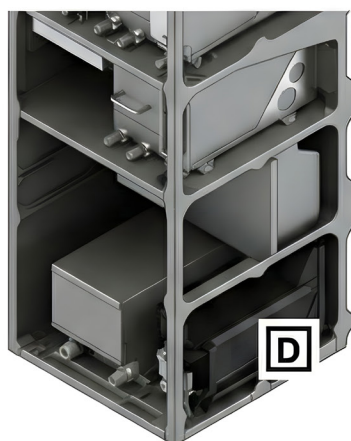
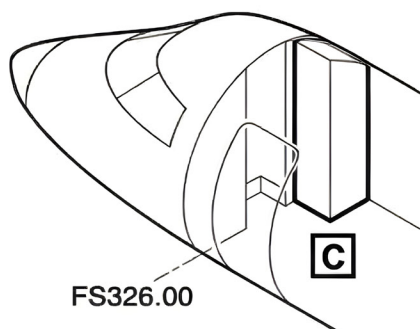


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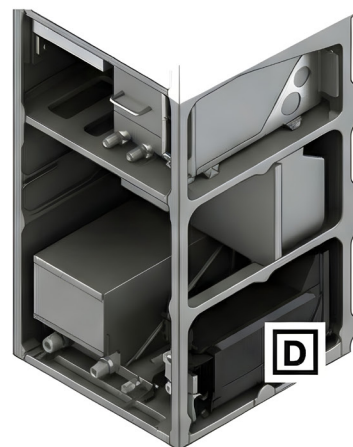
EFFECTIVITY

- ① A/C Post SB350-34-001
- ② A/C 20501 to 20874 and A/C Pre SB350-22-004
- ③ A/C 20875 to 20936 Pre SB350-22-002 and
A/C 20994 Post SB350-22-005 and A/C 20622
Post SB350-22-004 and A/C 21095 and Subs Post SB350-76-005
- ④ A/C 20622 and 20875 to 20936
Post SB350-22-002 and A/C Pre SB350-22-005 and
A/C 20937 to 21094 and A/C 21095 and Subs Pre SB350-76-005

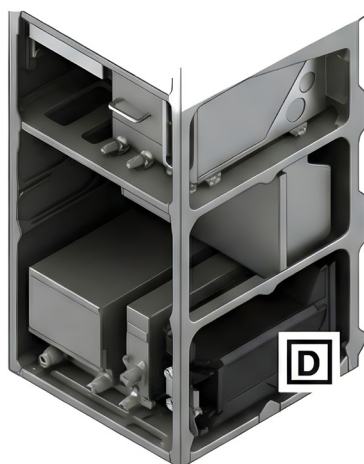
**A**VHF NAVIGATION
RECEIVER TRAY NO. 1VHF NAVIGATION
RECEIVER NO.1 (A47)**B**



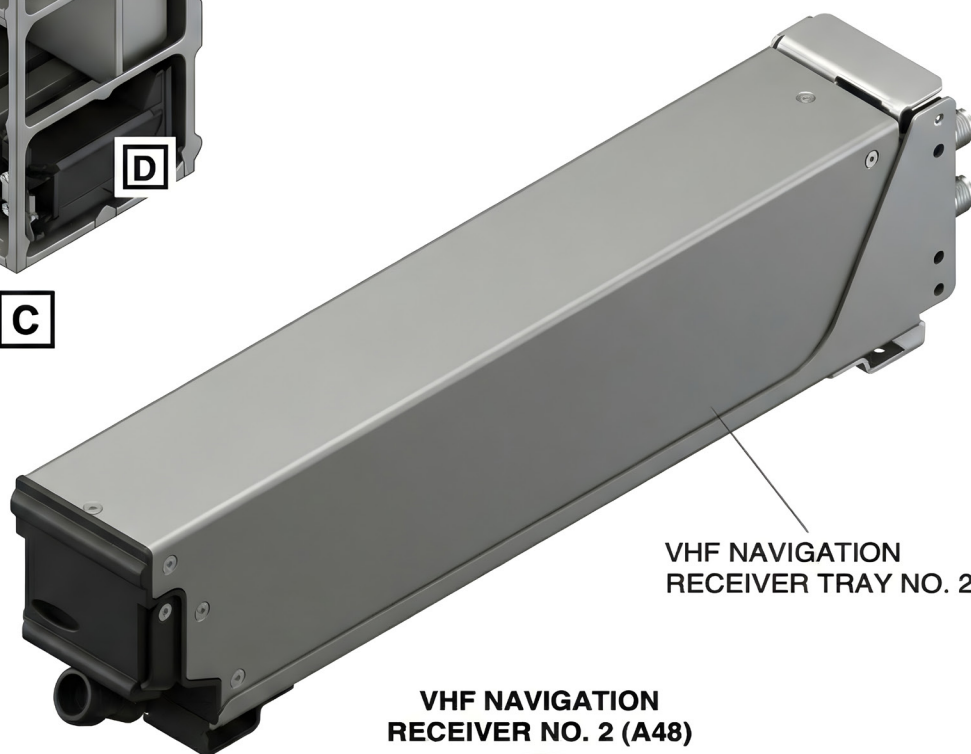
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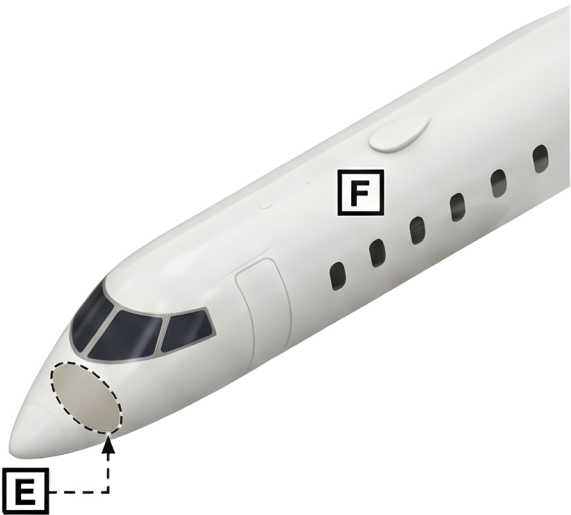
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04 C



VHF NAVIGATION
RECEIVER TRAY NO. 2



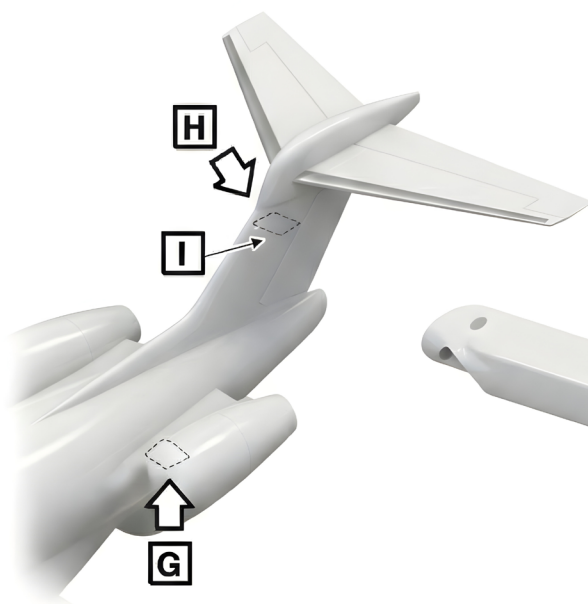
GLIDESLOPE ANTENNA (E15)

E



**DUAL AUTOMATIC DIRECTION
FINDER (ADF) ANTENNA (E22)**

01 F



**MARKER BEACON ANTENNA
(LH) (E21) (RH) (E16)**

G



**VOR/LOC ANTENNA
(LH) (E17) (RH) (E18)**

H



**VOR/LOC ANTENNA
COUPLER (CP2)**

I

II. VHF COMMUNICATION SYSTEM

A. SYSTEM CONFIGURATION

- Dual VHF COM radios installed as standard equipment
- Operating frequency range: 118.000 to 136.991 MHz
- 8.33 kHz channel spacing capability for European operations
- 25 kHz channel spacing for standard operations
- Remote-mounted transceivers with cockpit control interfaces
- FM immunity compliant with ICAO Annex 10 and ED-23B/DO-186 standards
- HF

B. COM RADIO CONTROL INTERFACES

- Primary control through Display Control Panel (DCP)
- Secondary control through Control Display Unit (CDU)
- MFD radio menu provides radio summary and control access
- Cross-side radio control capability from either pilot position
- Master tuning control selectable between MFD and CDU

C. COM RADIO TUNING - MFD METHOD

- Push RADIO button on DCP to display radio menu on MFD
- Push 1/2 button to select between side 1 and side 2 radio menus
- Turn MENU knob to move selection box to COM radio frequency display
- Turn TUNE knob to adjust desired frequency
- Push TUNE knob to acknowledge and activate new frequency
- Frequency changes immediately transmitted to radio transceivers

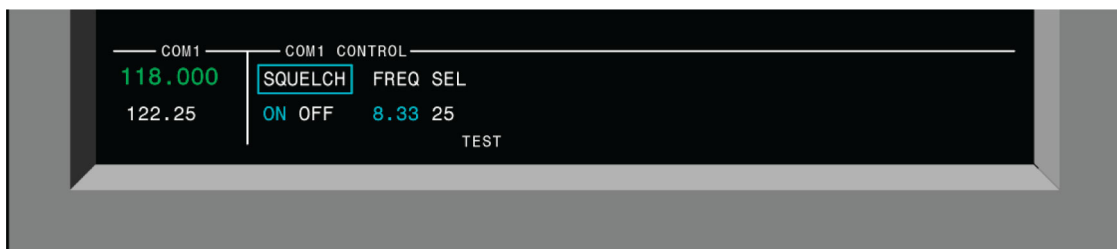


D. COM RADIO TUNING - CDU METHOD

- Push TUN key on CDU to display TUNE page
- Enter frequency directly into scratchpad
- Push line select key adjacent to appropriate COM radio
- Alternative: Enter preset channel number (1-20) in scratchpad
- Push line select key to activate preset frequency
- Empty scratchpad and push line select to access CONTROL page

E. COM RADIO CONTROL MENU FUNCTIONS

- Access CONTROL menu by pushing RADIO button with radio selected
- Squelch adjustment using DATA knob
- Voice/data mode selection via DATA knob or PUSH SELECT
- Test mode activation through TEST control selection
- Preset frequency storage and recall functions
- Exit CONTROL menu by pushing RADIO button again



F. TUNING REVERSION CAPABILITY

- Normal operation: MFD serves as master tuning control
- Reversion panel TUNE knob selects tuning source
- MFD ONLY position: MFDs control all tuning
- CDU ONLY position: CDUs control all tuning
- COM 121.50 position: Forces COM1 to emergency frequency
- CDU tuning blanked when MFD is master control



III. VHF NAVIGATION SYSTEM

A. SYSTEM OVERVIEW

- Standard configuration includes dual VOR/localizer receivers, dual glideslope receivers, dual marker beacons, single DME, and single ADF
- Optional second ADF and second DME available
- NAV-4000 receiver integrates VOR/LOC/GS/MKR/ADF in single unit
- NAV-4500 contains VOR/LOC/GS/MKR without ADF module

B. VOR/LOCALIZER RECEIVERS

- Operating frequency range: 108.00 to 117.95 MHz
- 50 kHz channel spacing (160 channels)
- Automatic tuning through FMS or manual via CDU/DCP
- VOR bearing information displayed on PFD navigation displays
- LOC deviation displayed on PFD during approach operations
- Audio identification signals routed to audio control unit

C. NAV RADIO TUNING - MFD METHOD

- Push RADIO button on DCP to display radio menu
- Turn MENU knob to move selection box to NAV radio (NAV1 or NAV2)
- Turn TUNE knob to adjust desired VOR/LOC frequency
- Push TUNE knob to acknowledge new frequency
- DME automatically pairs with selected VOR/ILS frequency
- Push RADIO button with NAV selected to access NAV CONTROL menu

D. NAV RADIO TUNING - CDU METHOD

- Push TUN key on CDU to display TUNE page
- Enter frequency directly into scratchpad
- Push line select key adjacent to appropriate NAV radio
- Alternative: Enter three-letter NAVAID identifier in scratchpad
- Push line select key for NAV 1 or NAV 2 to tune by identifier
- Enter preset channel number (1-20) for preset selection

E. NAV CONTROL MENU OPERATIONS

- DME frequency tuning independent of paired NAV frequency
- Turn MENU knob to select DME frequency when DME HOLD active
- Turn TUNE knobs to adjust DME frequency independently
- Marker sense mode selection (LO or HI) via MKR SENSE control
- Turn DATA knob or push PUSH SELECT to toggle marker sensitivity
- NAV TEST mode activation through TEST control selection



F. GLIDESLOPE RECEIVERS

- Operating frequency range: 329.15 to 335.00 MHz
- 40 channels with 150 kHz spacing
- Automatically paired with localizer frequency selection
- Vertical deviation displayed on PFD during ILS approaches
- Signal processing through IAPS computers

G. MARKER BEACON SYSTEM

- Fixed frequency operation at 75.00 MHz
- HI/LO sensitivity control selection via NAV CONTROL menu
- Visual indications on PFD during station passage
- Audio alerts through speakers and headsets when selected
- Dual marker beacon antennas on fuselage bottom
- Outer marker (400 Hz), middle marker (1300 Hz), inner marker (3000 Hz)

IV. AUTOMATIC DIRECTION FINDER (ADF)

A. SYSTEM CONFIGURATION

- Single or dual ADF configuration available
- Integrated within NAV-4000 receiver
- Frequency range: 190-1799 kHz plus maritime distress bands
- Maritime bands: 2088-2094 kHz and 2179-2185 kHz

B. OPERATIONAL FEATURES

- Beat frequency oscillator (BFO) for keyed carrier stations
- AM radio reception capability
- Bearing information displayed on PFD and MFD
- Manual tuning through CDU or DCP
- Audio identification through audio control unit

C. ADF RADIO TUNING PROCEDURES

- Push RADIO button on DCP to display radio menu
- Turn MENU knob to move selection box to ADF radio (ADF 1 or ADF 2)

- Turn TUNE knob to adjust desired frequency
- Push TUNE knob to acknowledge new frequency
- Push RADIO button to access ADF CONTROL menu

D. ADF CONTROL MENU OPERATIONS

- ADF/ANT mode selection via MODE control
- Turn DATA knob or push PUSH SELECT to toggle between ADF and ANT modes
- BFO mode control for carrier wave reception
- Turn DATA knob to select BFO ON or OFF
- ADF TEST mode activation through TEST control selection

V. DISTANCE MEASURING EQUIPMENT (DME)

A. SYSTEM ARCHITECTURE

- DME-4000 remote-mounted three-channel unit
- Single DME configuration: Channel 1 (pilot), Channel 2 (copilot), Channel 3 (FMS)
- Dual DME configuration option with six total channels
- Operating frequency: 962-1213 MHz

B. OPERATIONAL CAPABILITIES

- Line-of-sight distance measurement to ground stations
- Rate of closure and time-to-station calculations
- Maximum tracking range: 300 nm (altitude dependent)
- Paired tuning with VOR/ILS frequencies (108.00-117.95 MHz)
- Distance display format: four digits followed by NM
- No-computed-data indicated by dashes

C. DME HOLD FUNCTION

- Activated via DME H push button on DCP
- Splits paired tuning between DME and VHF navigation systems
- Enables independent VHF/DME operation
- DME frequency displayed with "H" suffix when hold active
- Turn MENU knob to select DME frequency field when hold active
- Turn TUNE knobs to adjust DME frequency independently
- Push DME H button again to cancel hold function

VI. GLOBAL POSITIONING SYSTEM (GPS/GNSS)

A. GPS RECEIVERS

- Dual GPS sensors for redundancy
- Multi-satellite simultaneous processing capability

- Minimum four satellites required for navigation solution
- Three satellites plus calibrated barometric altitude acceptable
- Position, velocity, and time computations

B. GNSS CONTROL

- GPS Control page displays position differences (POS DIFF)
- Manual enable/disable for each GPS sensor
- Position difference shown in direction and distance
- Disabled sensors remain off until manually enabled
- Automatic switchover on sensor failure

C. SBAS CAPABILITY (Satellite-Based Augmentation System)

- WAAS for North America and Hawaii
- EGNOS for Europe
- MSAS for Japan
- GAGAN for India
- Selection through SBAS Service Providers page
- Enables LPV approach capability
- Augmented GPS precision for approach operations
- RAIM prediction for destination and flight plan

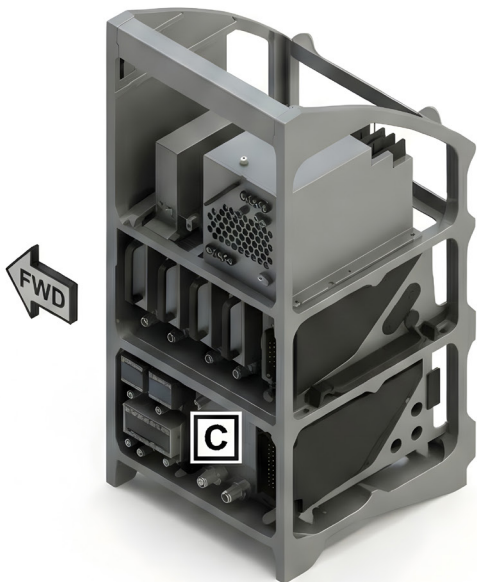
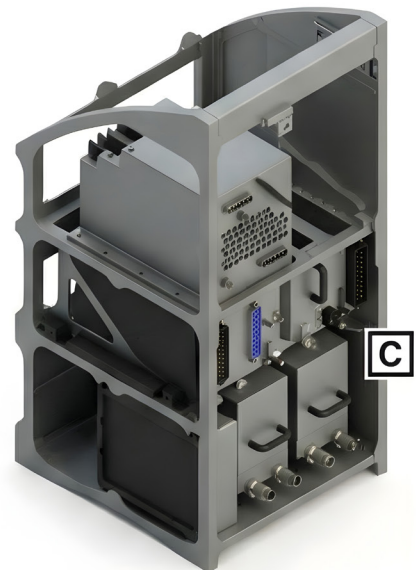
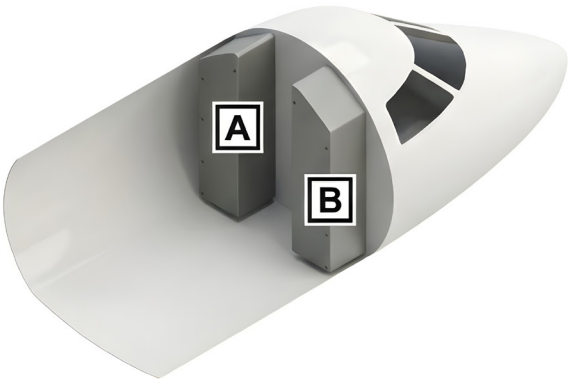
VII. INERTIAL REFERENCE SYSTEM (IRS)

A. SYSTEM CONFIGURATION

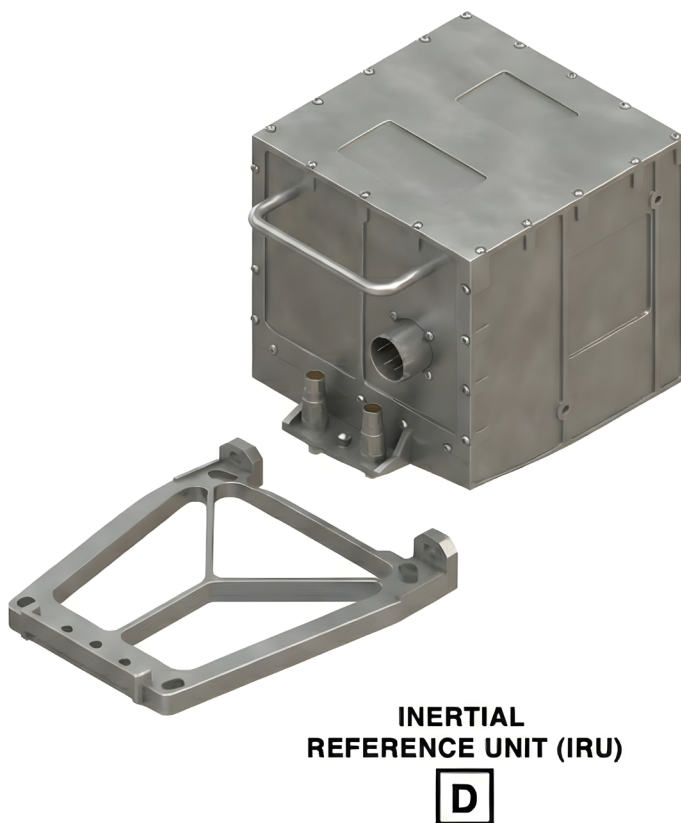
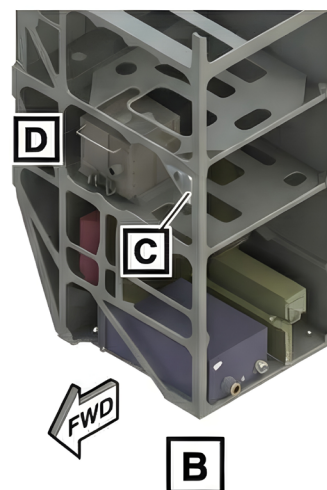
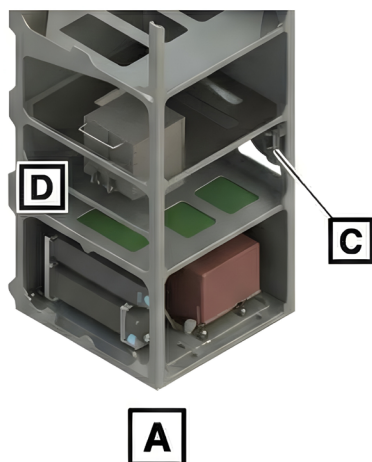
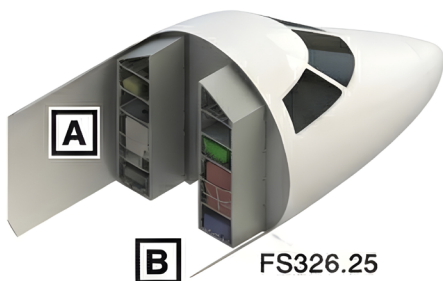
- Dual IRS units for redundancy
- Laser ring gyro technology
- Independent operation capability

B. FUNCTIONAL CAPABILITIES

- Attitude and heading reference
- Position and velocity computation
- Integration with FMS for navigation
- IRS Control page for sensor management
- Automatic cross-side switching on failure
- Attitude mode operation capability
- SET POS command for position update

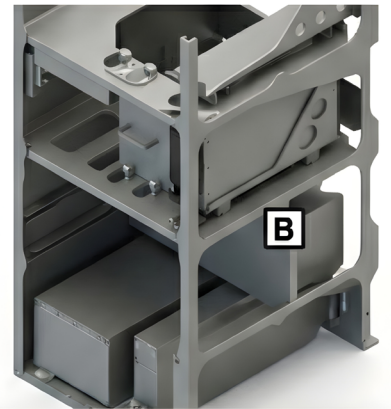
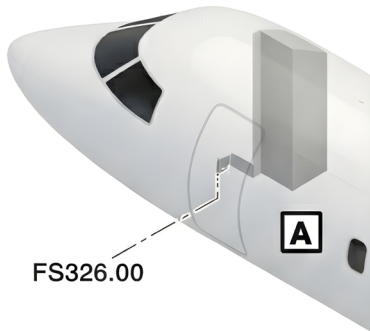
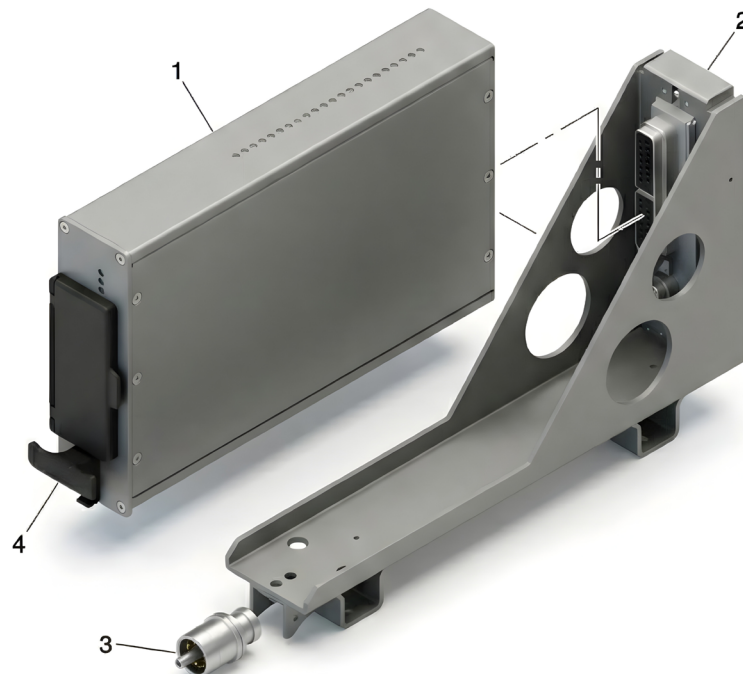


GPS RECEIVER PANEL



Inertial Reference Unit (IRU) – Component Location

VIII. TERRAIN AWARENESS WARNING SYSTEM (TAWS)

**A****B**

Terrain-Avoidance Warning System (TAWS) Computer – Removal/Installation



MFD Control Panel (MCP)



TAWS Control Panel



Display Control Panel (DCP)

GPWS / EGPWS MODES & WARNINGS

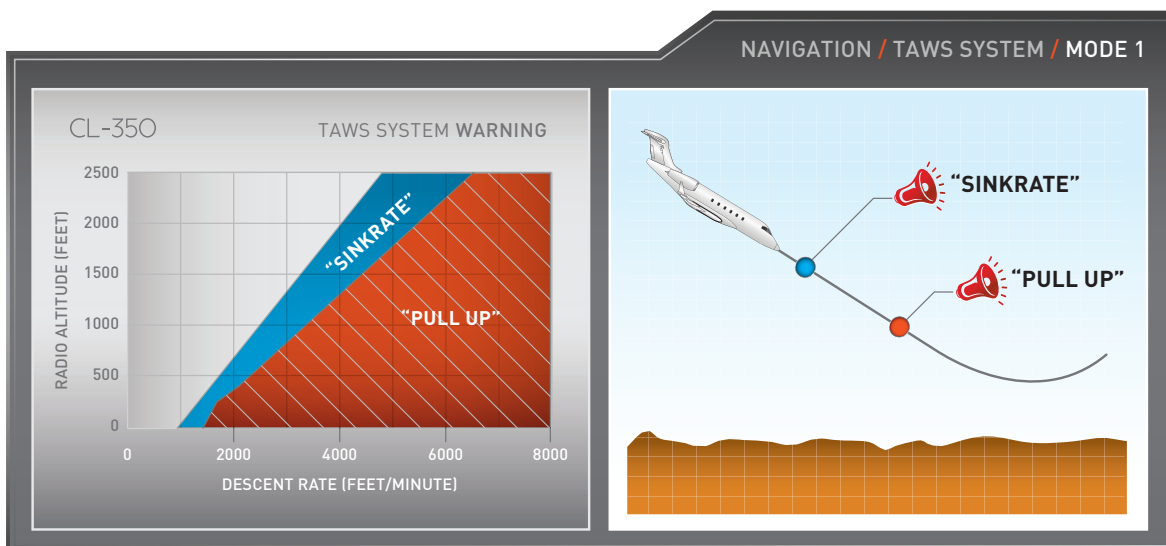
MODE 1:  EXCESSIVE DESCENT RATE WARNINGS: • SINKRATE • PULL UP!	MODE 2:  EXCESSIVE TERRAIN CLOSURE RATE WARNINGS: • TERRAIN..TERRAIN • PULL UP!	MODE 3:  SINK AFTER TAKEOFF WARNING: • DON'T SINK!	MODE 4:  TOO CLOSE TO TERRAIN WARNINGS: • TOO LOW-TERRAIN • TOO LOW-GEAR • TOO LOW-FLAPS
MODE 5:  EXCESSIVE DEVIATION BELOW GLIDESLOPE WARNING: • GLIDESLOPE	MODE 6:  EXCESSIVE BANK ANGLE WARNING: • BANK ANGLE! • ALTITUDE CALL-OUTS "...FIVE HUNDRED..."	MODE 7:  WINDSHEAR CAUTION/WARNING WARNINGS: • WINDSHEAR, WINDSHEAR • WINDSHEAR	

A. SYSTEM ARCHITECTURE

- Three systems integrated in one line replaceable unit
- Ground Proximity Warning System (GPWS) - Modes 1-6
- Terrain/obstacle awareness system
- Windshear detection system (Mode 7)
- Enhanced Ground Proximity Warning Computer (EGPWC) processes all inputs
- Provides aural alerts and visual annunciations for CFIT avoidance
- PULL UP and GND PROX annunciations displayed on PFD
- Worldwide terrain database with obstacles
- Smart Runway/Smart Landing capability (if equipped with SB 350-34-008)

B. MODE 1 - EXCESSIVE DESCENT RATE

- Active when airplane is less than 2,500 feet AGL
- Requires radio altitude and rate-of-descent data
- Alert area penetration:
- GND PROX amber CAS alert on PFD
- Aural "SINKRATE, SINKRATE"
- Aural alert annunciated once
- Repeated if condition degrades by more than 20% based on computed time to impact
- Visual alert remains until condition rectified
- Warning area penetration:
- PULL UP red CAS alert on PFD
- Aural "PULL UP" warning
- Aural warning annunciated continuously until condition rectified

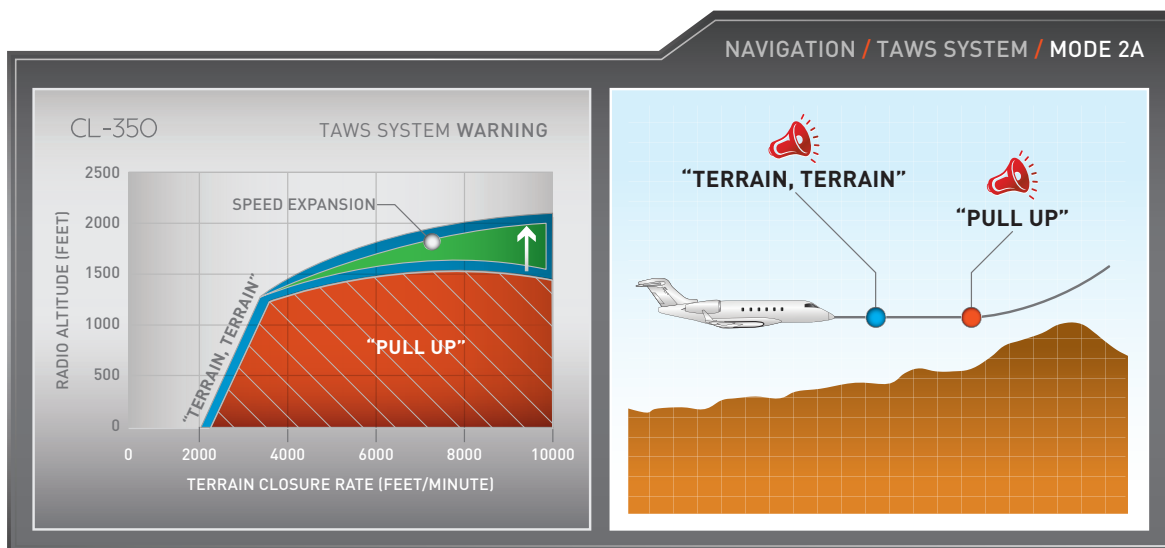


C. MODE 2 - EXCESSIVE TERRAIN CLOSURE RATE

- Detects excessive closure rate between airplane and terrain
- Active in descent, level flight, or climb with rising terrain
- Uses radio altitude and vertical speed inputs
- Two sub-modes: Mode 2A and Mode 2B

Mode 2A - Flaps Not in Landing Position

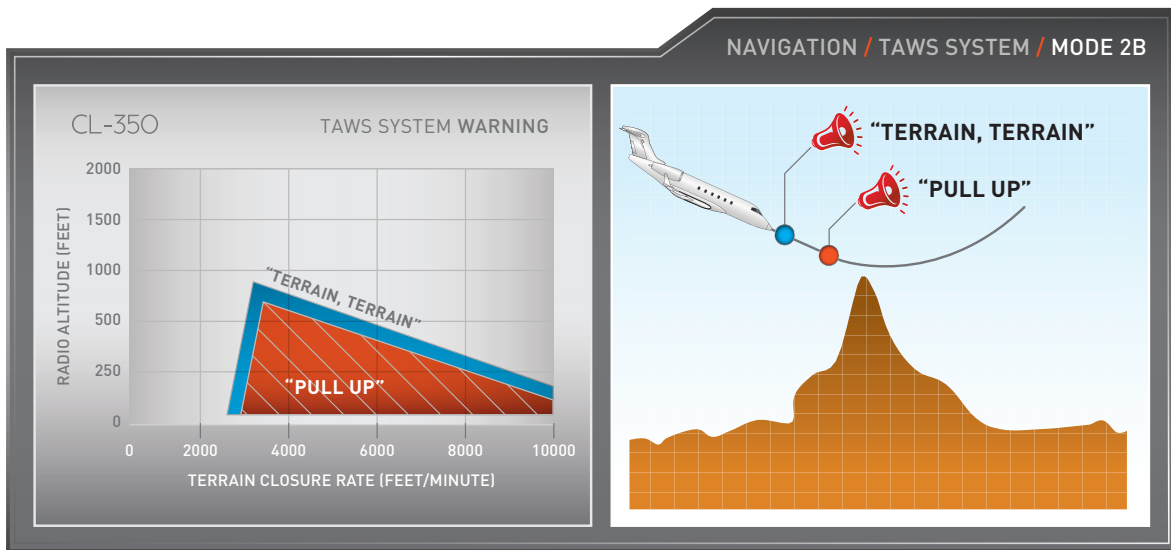
- Activated when flaps are not in landing configuration
- Alert area penetration:
- GND PROX amber CAS on PFD
- Aural "TERRAIN, TERRAIN" warning
- Aural warning annunciated once
- Visual alert remains until condition rectified
- Warning area penetration:
- PULL UP red CAS alert on PFD
- Aural "PULL UP" warning
- Aural and visual warnings continuous until rectified



Mode 2B - Flaps in Landing Configuration

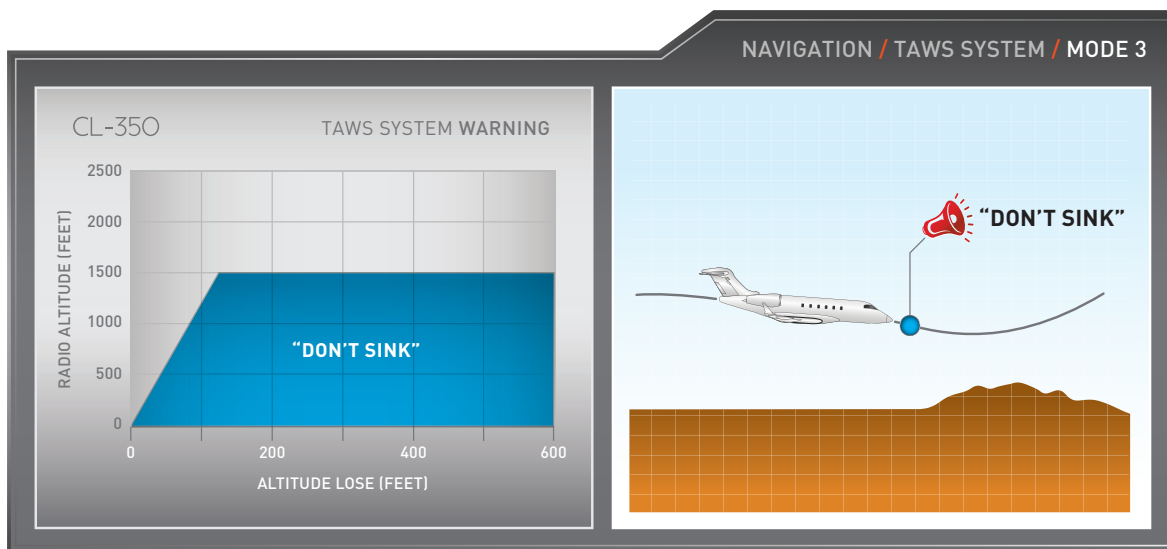
- Activated when:
- Flaps are in landing configuration, OR
- Flaps up with airplane on ILS approach (GS/LOC deviations $\leq \pm 2$ dots), OR
- Within 60 seconds after takeoff
- Alert area penetration:

- GND PROX amber CAS on PFD
- Aural “TERRAIN, TERRAIN” warning
- Aural and visual alerts continuous until rectified
- Warning area penetration:
- PULL UP red CAS warning on PFD
- Aural “PULL UP” warning
- Aural and visual warnings continuous until rectified
- Warning envelope inhibited below 30 feet AGL



D. MODE 3 - ALTITUDE LOSS AFTER TAKEOFF

- Provides warnings for significant altitude loss after takeoff or go-around
- Uses radio altitude, barometric altitude, and altitude rate
- Enabled after takeoff or go-around when gear/flaps not in landing configuration
- Remains enabled until sufficient altitude gained (no longer in takeoff phase)
- Stores altitude value at descent initiation and compares to successive data
- Alert area penetration:
- GND PROX alert on PFD
- Aural “DON’T SINK, DON’T SINK” warning
- Aural warning annunciated once
- Repeated at 20% degradation intervals from initially stored value
- Condition remains until airplane regains initial altitude
- Mode 3 inhibited for radio altitude values exceeding 1,500 feet

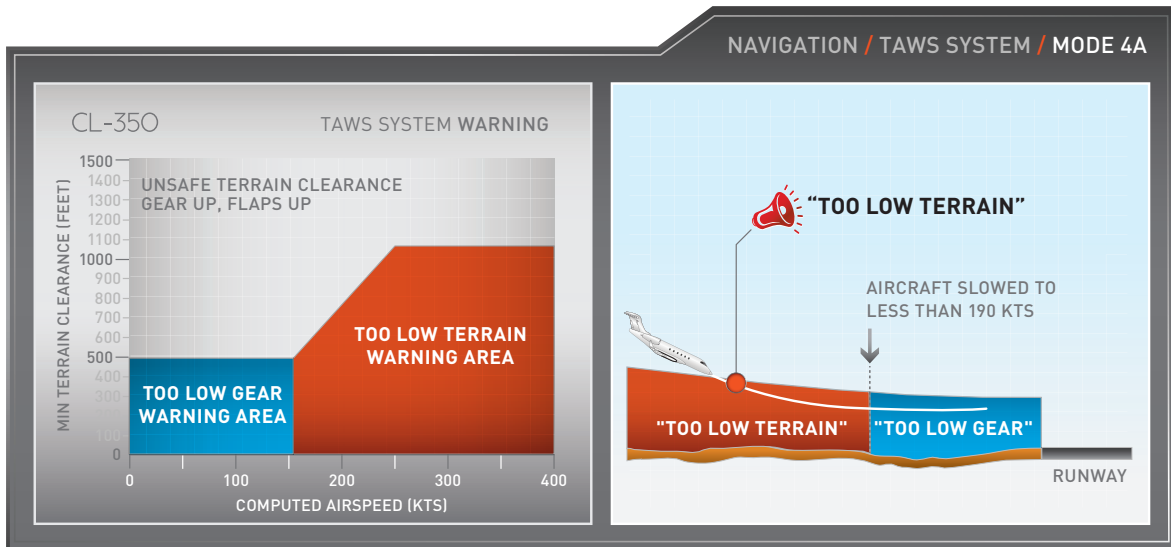


E. MODE 4 - UNSAFE TERRAIN CLEARANCE

- Provides alerts for insufficient terrain clearance based on phase of flight and speed
- Requires radio altitude, computed airspeed, gear position, and flap position
- Three sub-modes: Mode 4A, Mode 4B, and Mode 4C

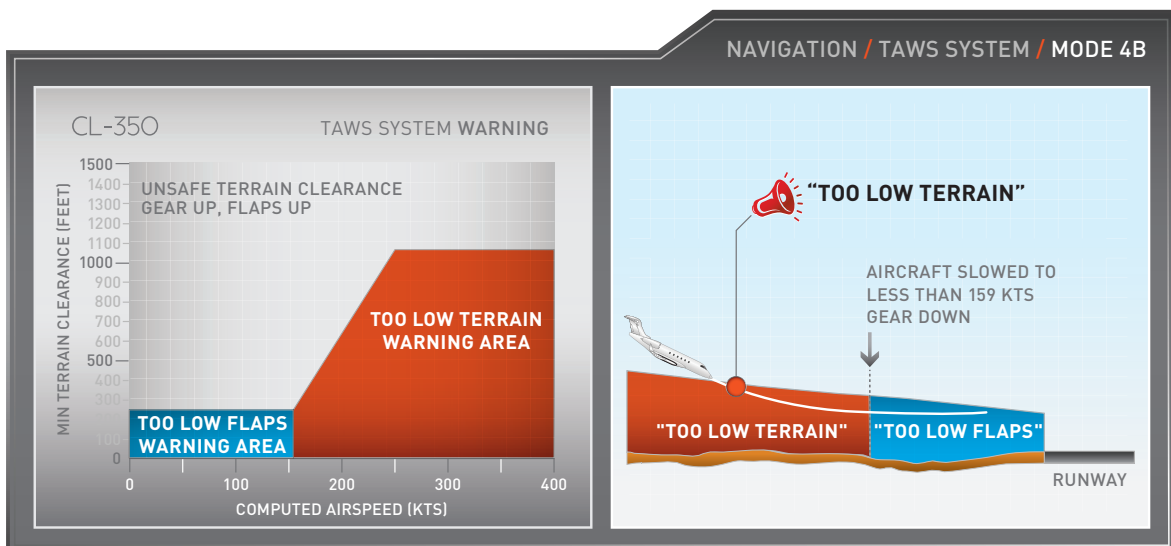
Mode 4A - Gear Up, Flaps Not in Landing Position

- Active in cruise or approach with landing gear not down
- Alert envelope: 30 feet AGL to 500 feet AGL
- Upper boundary increases with airspeed (1,000 feet at 250+ knots)
- Above 190 knots penetration:
 - Amber GND PROX display on PFD
 - Continuous aural "TOO LOW TERRAIN" warning
- Below 190 knots penetration:
 - Amber GND PROX alert on PFD
 - Aural "TOO LOW GEAR" warning
- Warnings remain until airplane exits envelope



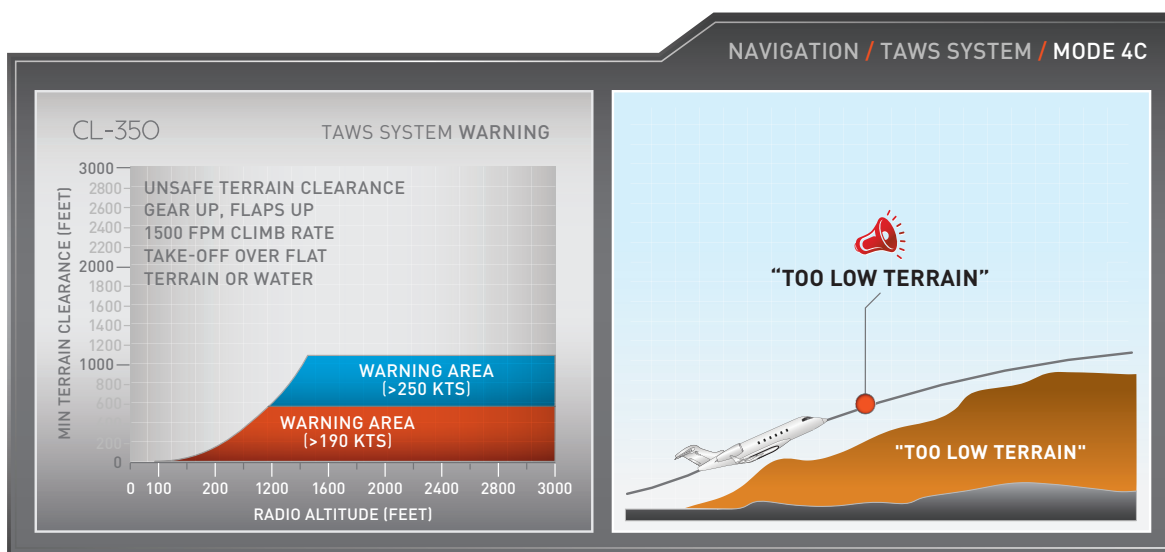
Mode 4B - Gear Down, Flaps Not in Landing Position

- Active in cruise or approach with landing gear down
- Alert envelope: 30 feet AGL to 245 feet AGL
- Above 159 knots penetration:
 - Amber GND PROX display on PFD
 - Continuous aural "TOO LOW TERRAIN" warning
- Below 159 knots penetration:
 - Amber GND PROX display on PFD
 - Aural "TOO LOW FLAPS" warning
 - "TOO LOW FLAPS" can be silenced with FLAPS switch OFF on TAWS panel



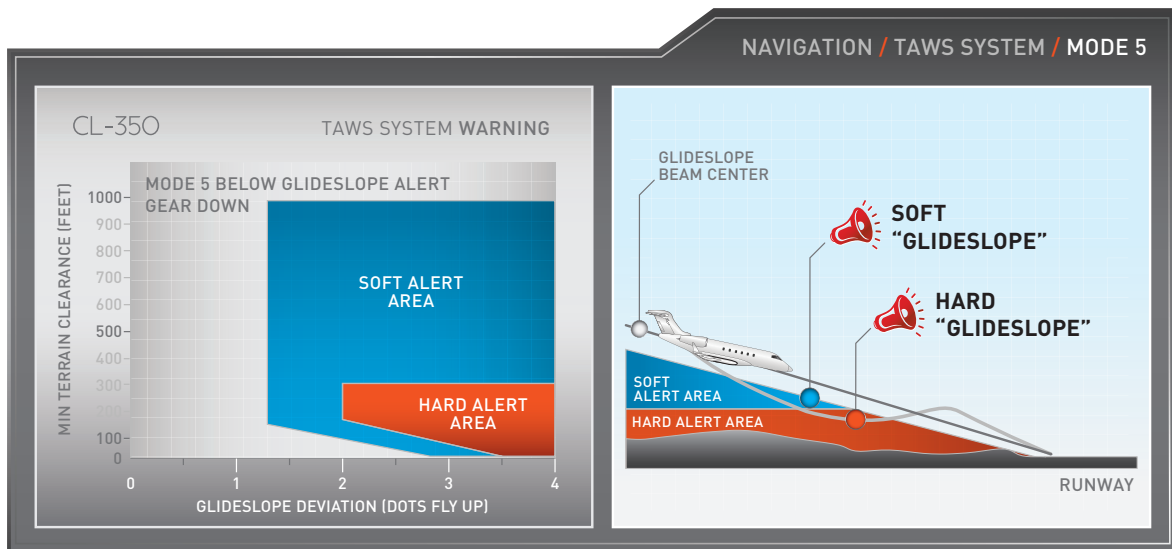
Mode 4C - Takeoff Configuration

- Based on minimum terrain clearance floor that increases with radio altitude
- Active during takeoff over flat terrain or water
- Assumes 1,500 FPM climb rate
- Warning areas vary by speed (<190 kts vs >250 kts)
- Any altitude decrease below minimum terrain clearance:
- Amber GND PROX display on PFD
- Aural "TOO LOW TERRAIN" warning



F. MODE 5 - DESCENT BELOW GLIDESLOPE

- Provides alerts when airplane descends below ILS glideslope
- Applicable to ILS and GPS/SBAS LPV approaches
- Two-tone warning system based on glideslope position
- Soft alert (1.3-2.0 dots below glideslope):
- Quiet (6 dB) aural "GLIDESLOPE"
- Hard alert (>2.0 dots below glideslope):
- Full volume aural "GLIDESLOPE" warning
- Amber GND PROX displayed on PFD
- Alerts continuous until airplane exits alert envelope
- "GLIDESLOPE" aural can be muted with GS switch OFF on TAWS panel



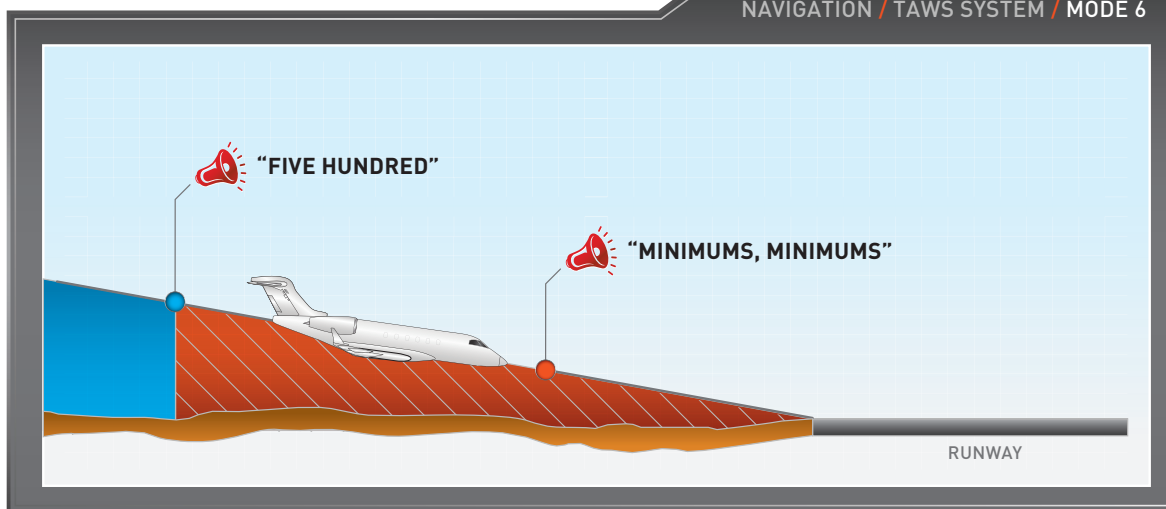
G. MODE 6 - ALTITUDE CALLOUTS AND EXCESSIVE BANK ANGLE

Approach Minimums Transition

- Activates for APPROACHING DECISION HEIGHT or APPROACHING MINIMUMS
- Generates aural "MINIMUMS, MINIMUMS" warning
- Enabled between 1,000 feet and 10 feet radio altitude or DH minimums
- Requires corrected altitude exceeding MDA value by 200 feet
- Landing gear must be down for activation

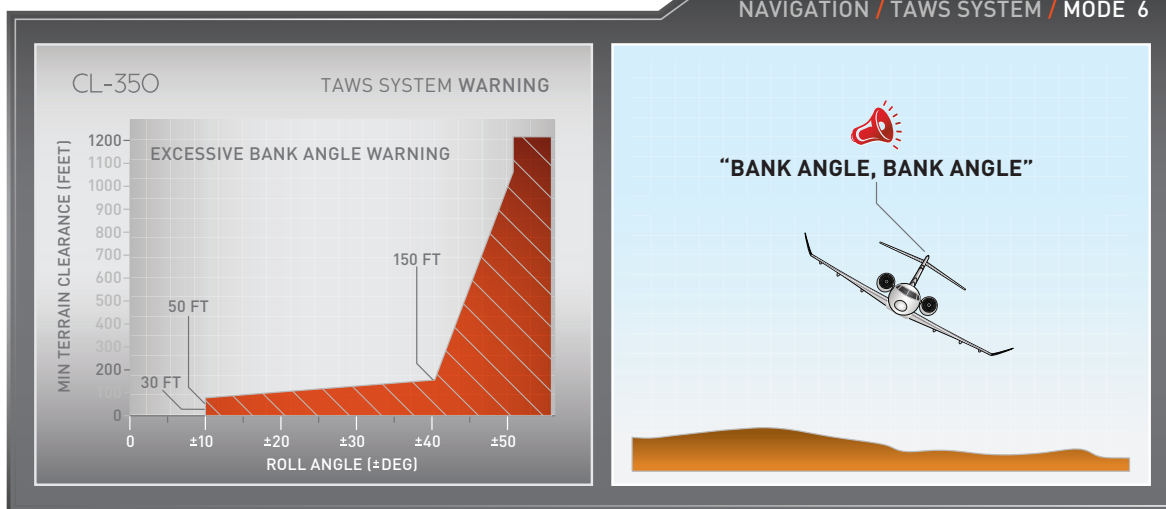
Altitude Callouts

- Standard callouts: "ONE HUNDRED", "FIFTY", "THIRTY" feet AGL
- Last annunciated altitude memorized to prevent repeat annunciation
- Memory cleared when climbing above 1,000 feet or transitioning to takeoff mode
- Smart altitude callout "FIVE HUNDRED":
- Generated at 500 feet radio altitude during non-precision approach
- Generated during precision approach if $>\pm 2$ dots deviation from GS or LOC
- Also generated during backcourse approach
- Additional callouts available: "FORTY", "TWENTY", "TEN" feet AGL



Excessive Bank Angle

- Alert envelope varies with altitude AGL:
- 10° bank at 30 feet AGL
- 40° bank at 150 feet AGL
- 55° bank at 2,450 feet AGL
- Generates aural "BANK ANGLE, BANK ANGLE"
- Alert annunciated once, repeats if bank angle increases by 20%
- Continuous annunciation if bank angle increased to 55°
- Alert continues until bank angle decreased below threshold



H. MODE 7 - WINDSHEAR WARNING

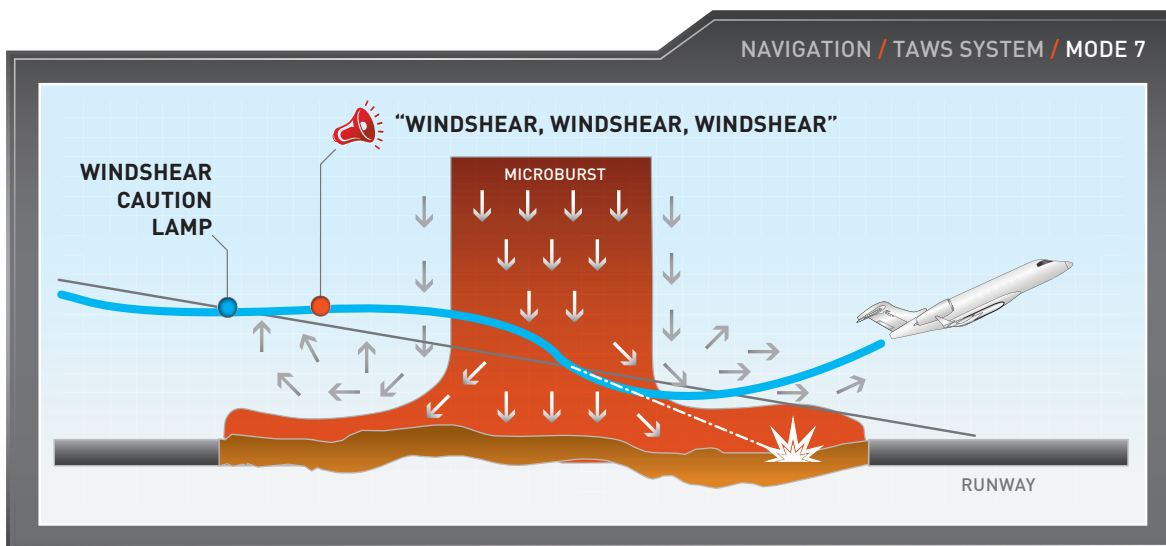
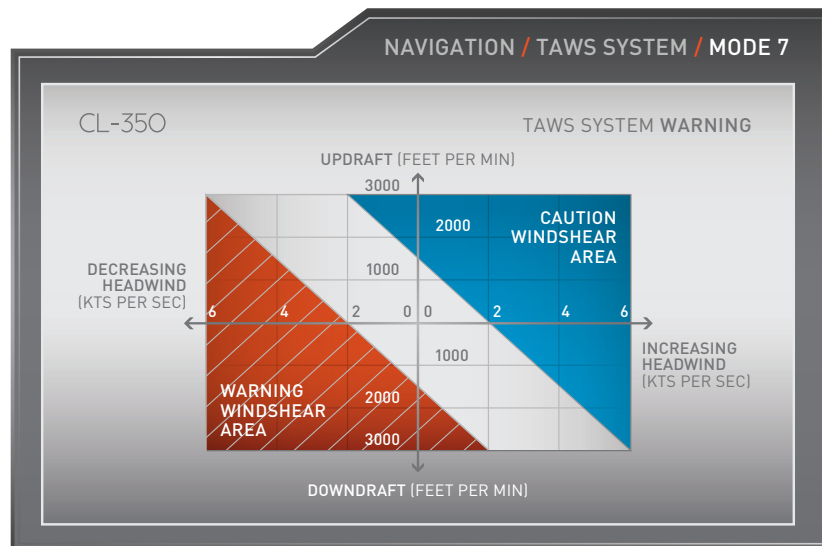
- Active during takeoff and landing phases between 10 and 1,500 feet AGL
- Two types of windshear detection:

Increasing Performance Shear (Updraft/Headwind)

- Flight director display removed
- WINDSHEAR © flashes for 5 seconds then steady
- Aural tone “CAUTION WINDSHEAR” warning

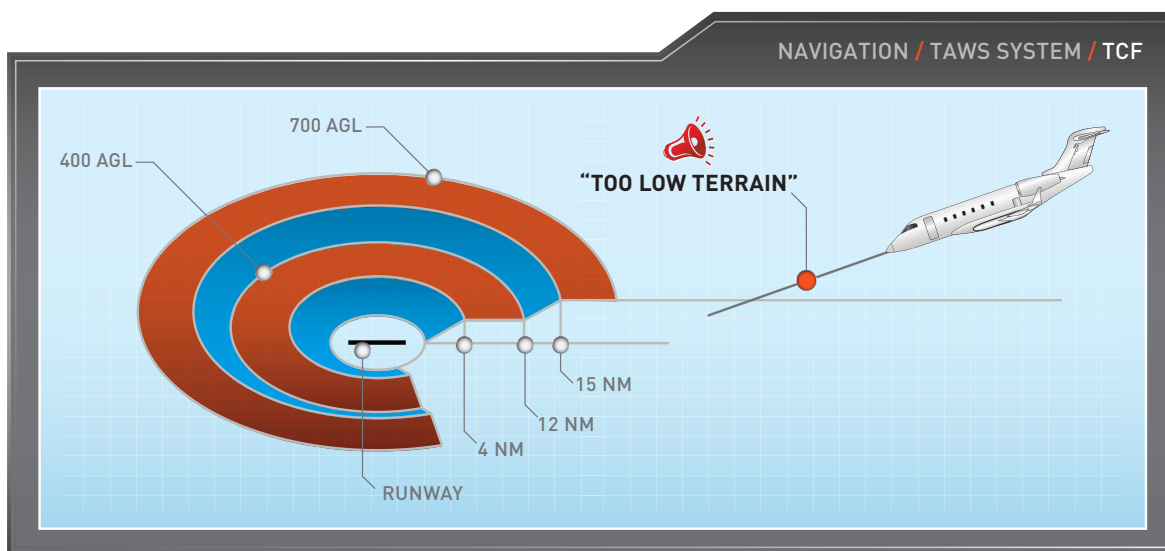
Decreasing Performance Shear (Downdraft/Tailwind)

- Flight director display removed
- WINDSHEAR (W) flashes for 5 seconds then steady
- Aural tone “WINDSHEAR WINDSHEAR” warning



I. TERRAIN CLEARANCE FLOOR (TCF)

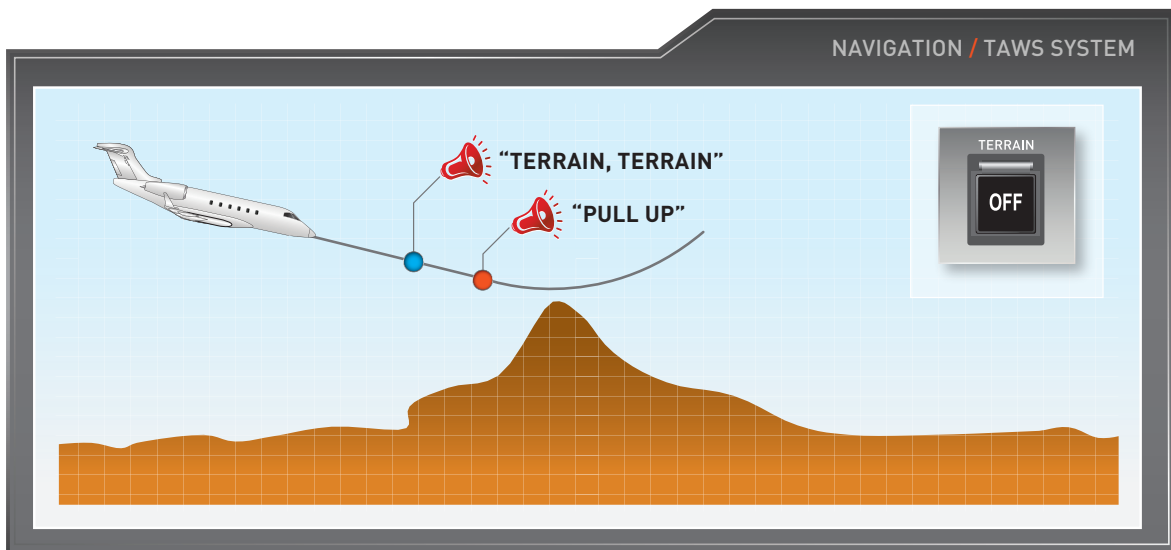
- Supplements GPWS with additional terrain clearance envelope around airports
- Based on current airplane location and nearest runway center point
- Internal database includes worldwide hard-surface runways >3,500 feet
- Creates increasing terrain clearance envelope related to distance from runway
- Alert envelope penetration:
- Aural "TOO LOW TERRAIN"
- Amber GND PROX displayed on PFD
- Aural alert repeated twice
- Repeated again if radio altitude decreases >20% from initial warning altitude
- Amber GND PROX remains until airplane exits envelope



J. TERRAIN AWARENESS ALERTING

- Computes minimum terrain clearance envelopes along flight path
- Uses airspeed and flight path angle with worldwide terrain database
- Terrain display available by pressing TR/WX button on DCP
- Displays terrain within 2,000 feet of airplane altitude
- Automatic terrain display at 10 nm range when caution at 60 seconds from impact
- Terrain threat detection:
- Aural "CAUTION TERRAIN, CAUTION TERRAIN"
- Amber GND PROX on PFD
- Amber areas on MFD display
- Terrain collision prediction:

- Aural “TERRAIN PULL UP, PULL UP”
- Amber PULL UP on PFD
- Red areas on MFD display
- Automatic display at 10 nm range when warning at 30 seconds from impact
- Can be inhibited by selecting the TERRAIN switch OFF (TAWS WARN PANEL)



K. TERRAIN DISPLAY COLOR CODING

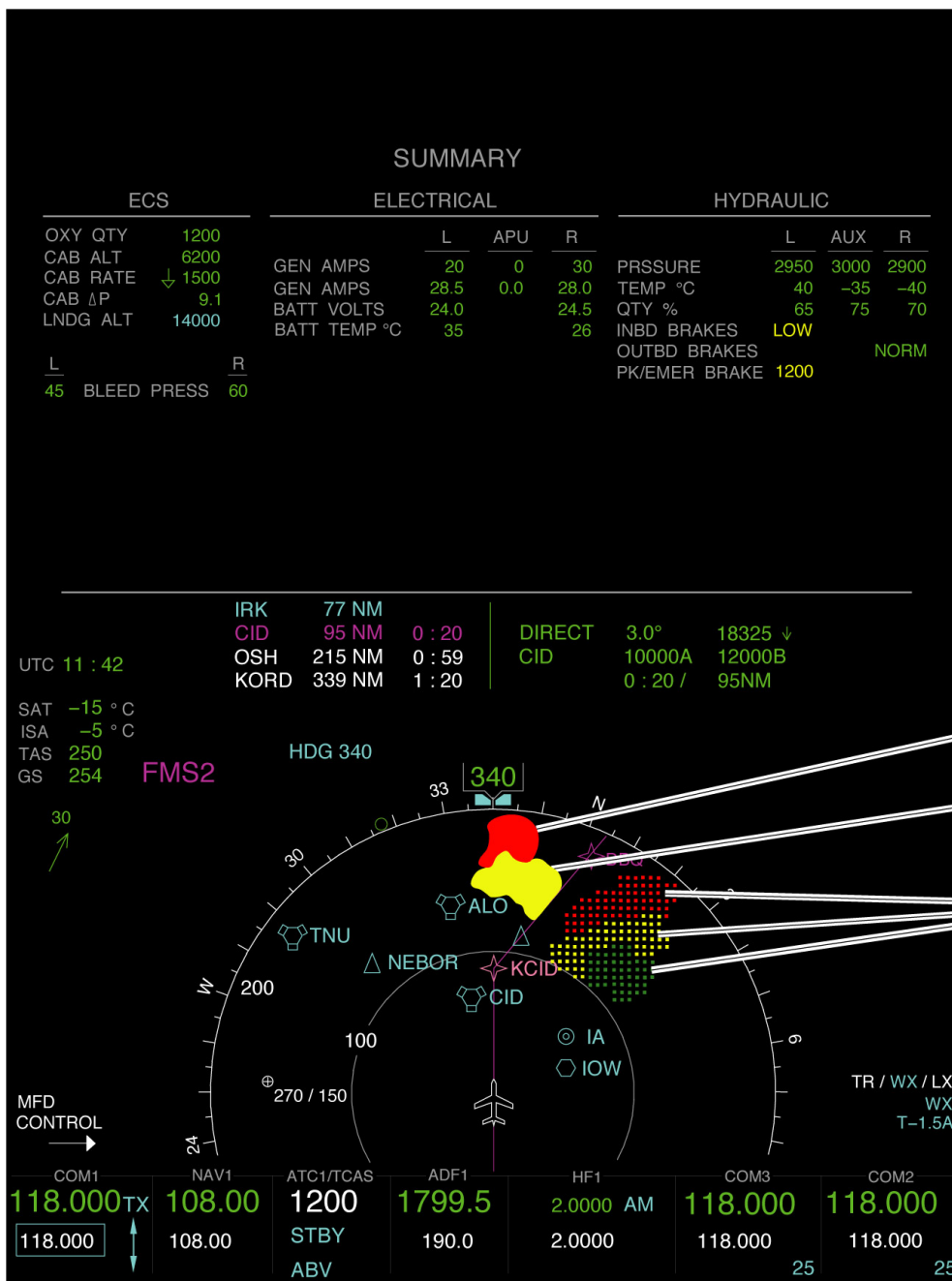
- SOLID RED: Areas satisfying terrain warning alert criteria
- SOLID AMBER: Areas satisfying terrain caution alert criteria
- GREEN, AMBER, RED DOT PATTERN: Areas significantly close but not satisfying alert criteria
- Terrain automatically displays in MAP mode during alerts

L. TAWS CONTROL PANEL

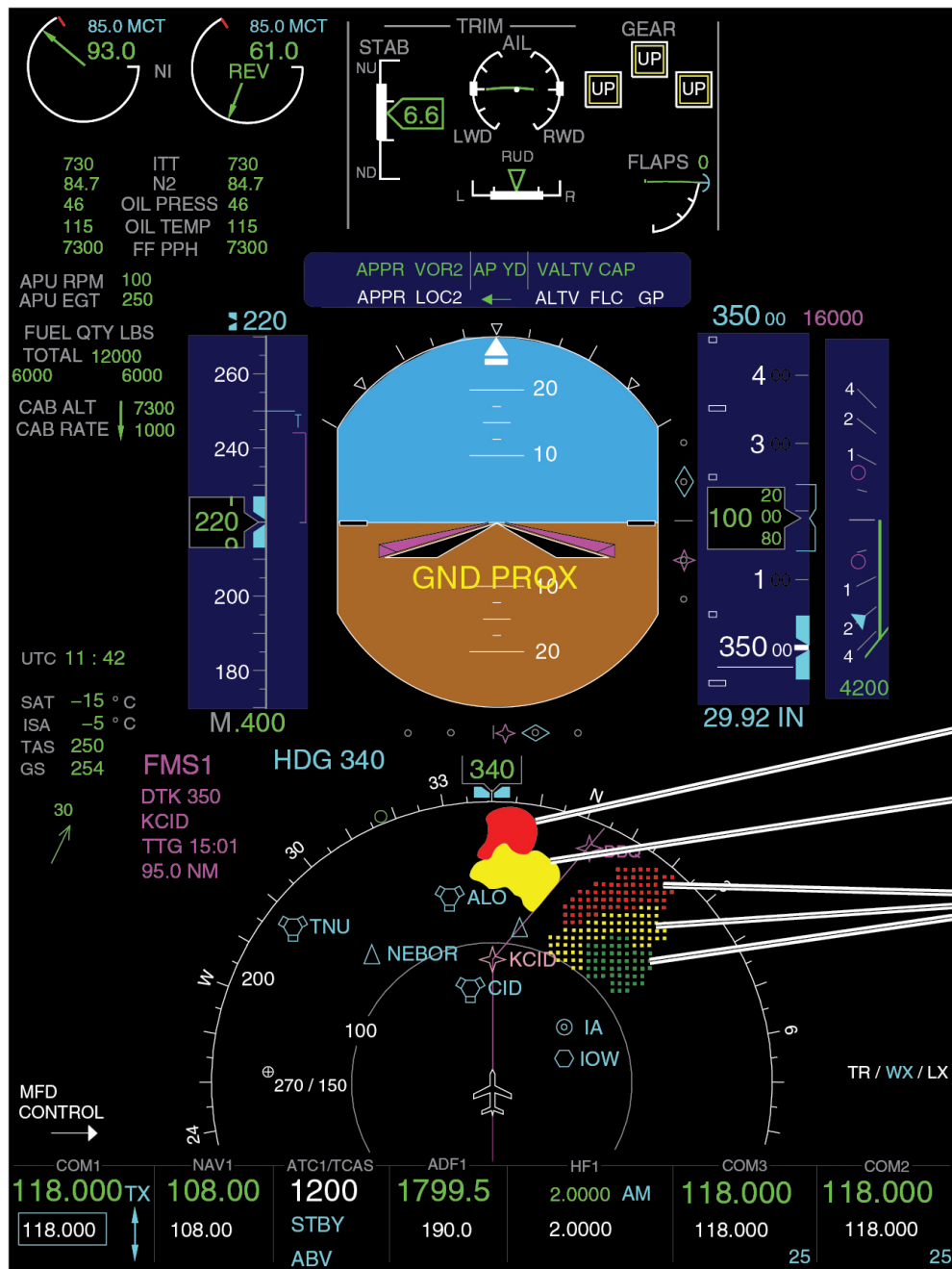
- Located on center instrument panel
- GS switch: Mutes “glideslope” warnings (normally OFF for backcourse approaches)
- FLAPS switch: Mutes related GPWS warnings when landing with flaps not at 30 degrees
- TERRAIN switch: Deselects terrain function of TAWS
- RAAS switch (if equipped): Inhibits SR/SL advisories except altitude monitor
- Status messages displayed when switches selected OFF



TAWS Control Panel

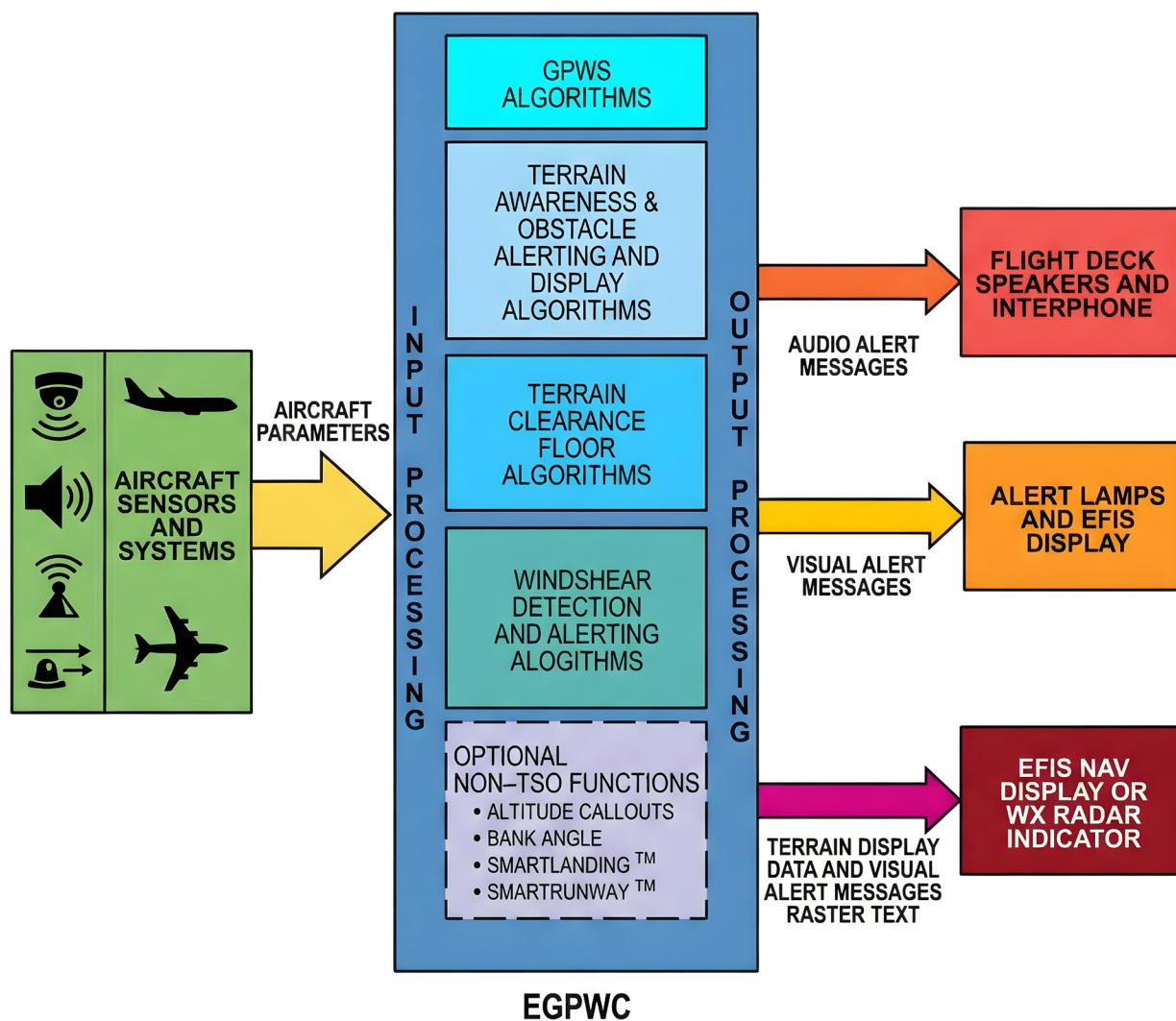


1. SOLID RED – Areas of terrain that satisfy the terrain warning alert criteria.
2. SOLID AMBER – Areas of terrain that satisfy the terrain caution alert criteria.
3. GREEN, AMBER, RED DOT PATTERN – Areas of terrain that are significantly close to the aircraft but do not satisfy warning alert or caution alert criteria.



PFD Display Indicating Terrain Data

1. SOLID RED – Areas of terrain that satisfy the terrain warning alert criteria.
2. SOLID AMBER – Areas of terrain that satisfy the terrain caution alert criteria.
3. GREEN, AMBER, RED DOT PATTERN – Areas of terrain that are significantly close to the aircraft but do not satisfy warning alert or caution alert criteria.



M. SMART RUNWAY/SMART LANDING (SR/SL) / (RAAS) - If Equipped

- Available with EGPWC MK V computer (SB 350-34-008)
- Provides runway awareness and alert system (RAAS)
- Supplements pilot awareness of aircraft position and configuration
- Aural and visual advisories during ground and flight operations
- RAAS inhibit switch on TAWS WARN panel
- Configurable options: Voice gender, units (feet/meters), altimeter setting callout

SR/SL Advisory Functions

- Approaching Runway - In Air/On Ground:
- Aural "Approaching XX" or "Approaching Runways"
- Visual APP XX (green) or APP RWYS (green)
- On Runway:
- Aural "On Runway XX" or "On Runways"
- Visual ON XX (green) or ON RWYS (green)
- Distance Remaining (Landing & Rollout):
- Maximum 2000 feet callout
- Aural "ZZ Remaining"
- Runway End (<100 feet):
- Aural "One Hundred Remaining" (feet) or "Thirty Remaining" (meters)
- Insufficient Runway Length (In Air):
- 5000 feet threshold
- Aural "Approaching Runway XX, ZZ available"
- Visual APP XX ZZ (amber)
- Insufficient Runway Length (On Ground):
- 6000 feet threshold
- Aural "On Runway XX, ZZ remaining"
- Visual ON XX ZZ (amber)
- Extended Hold On Runway:
- Initial/Repeats: 180 sec/180 sec
- Aural "On Runway XX - On Runway XX"
- Visual ON XX (amber)
- Taxiway Takeoff:
- Aural "Caution, On Taxiway"
- Visual advisory





RAAS Advisory Settings

Advisory Group	Advisory/Alert	Enabled	Settings	Audio	Visual
RAAS	GPS Antenna Location	–	15 feet	–	–
	Advisory Suppress Window	YES	450–550 ft	–	–
RAAS	Approaching Runway – In Air/On Ground	YES	–	"Approaching XX" "Approaching Runways" (if more than one runway meets the qualifying condition)	APP XX (in green) APP RWYS (in green)(if more than one runway meets the qualifying condition)
	On Runway	YES	–	"On Runway XX" "On Runways" (if more than one runway meets the qualifying condition)	ON XX (in green) ON RWYS (in green)(if more than one runway meets the qualifying condition)
	Distance Remaining (Landing & Rollout)	YES	2000 feet max	"ZZ Remaining"	NONE
	Runway End (< 100 feet)	YES	–	"One Hundred Remaining" (in feet) "Thirty Remaining" (in meters)	NONE
	Insufficient Runway Length (In Air)	YES	5000 feet	"Approaching Runway XX, ZZ available"	APP XX ZZ (in amber)
	Short Runway Landing	NO	–	–	–
	Insufficient Runway Length (On Ground)	YES	6000 feet	"On Runway XX, ZZ remaining"	ON XX ZZ (in amber)
	Short Runway Takeoff	NO	–	–	–
	Extended Hold On Runway Initial/Repeats	YES	180 sec/ 180 sec	"On Runway XX – On Runway XX"	ON XX (in amber)
	Taxiway Takeoff	YES	–	"Caution, On Taxiway! On Taxiway"	ON TAXIWAY (in amber) GND PROX alert on PFD also illuminated
	Distance Remaining (Rejected Takeoff)	YES	50% of Runway	"ZZ Remaining"	NONE
	Taxiway Landing	YES	–	"Caution, Taxiway! Caution, Taxiway!"	TAXIWAY (in amber) GND PROX alert on PFD also illuminated
	Takeoff Flaps	YES	Min: 6°; Max: 24°	"On Runway XX, Flaps– Flaps"	FLAPS (in amber) GND PROX alert on PFD also illuminated

Stability Approach Monitor Settings

Advisory Group	Advisory/Alert	Enabled	Settings	Audio	Visual
Stability Approach Monitor	Landing Flaps (Not Aligned With Runway)	NO	–	–	–
	Landing Flaps (Aligned With Runway)	YES	800 feet	"Flaps–Flaps"	FLAPS (in amber)
	Too High (During Approach)	YES	–	"Too High–Too High"	TOO HIGH (in amber)
	Too Fast (During Approach)	YES	–	"Too Fast–Too Fast"	TOO FAST (in amber)
	Unstable (During Approach)	YES	–	"Unstable–Unstable"	UNSTABLE (in amber) GND PROX alert on PFD also illuminated

Long Landing Monitor Settings

Advisory Group	Advisory/Alert	Enabled	Settings	Audio	Visual
Long Landing	Long Landing Distance	YES	2000 ft past approach end	"Long Landing – Long Landing"	LONG LANDING (in amber) GND PROX alert on PFD also illuminated
	Long Landing Percentage		67% remaining	"Long Landing – Long Landing"	LONG LANDING (in amber) GND PROX alert on PFD also illuminated
	Long Landing Distance Remaining		3000 ft past approach end	"ZZ Remaining"	LONG LANDING (in amber) GND PROX alert on PFD also illuminated
	Long Landing Distance Remaining Percentage		60% remaining	"ZZ Remaining"	LONG LANDING (in amber) GND PROX alert on PFD also illuminated

Corrected Altitude Monitor Settings

Advisory Group	Advisory/Alert	Enabled	Settings	Audio	Visual
Corrected Altitude Monitor	Altimeter Setting (Below Transition Altitude)	YES	–	"Altimeter Setting"	ALTM SETTING (in amber)
	Altimeter Setting (Above Transition Altitude)	YES	–	"Altimeter Setting"	ALTM SETTING (in amber)



N. ALERT PRIORITIES

- TAWS/GPWS warnings (highest)
- ROAAS warnings
- TAWS/GPWS cautions
- ROAAS cautions
- RAAS cautions (lowest)

PFD ALERT	DESCRIPTION	PRIORITY
WINDSHEAR PULL UP	GPWS Warning GPWS/TAWS Warning	1
RWY LENGTH DECELERATE	ROAAS IN-AIR Warning ROAAS ON-GROUND Warning	2
GND PROX WINDSHEAR	GPWS/TAWS Caution GPWS Caution	3
RWY LENGTH DECELERATE	ROAAS IN-AIR Caution ROAAS ON-GROUND Caution	4
GND PROX	RAAS (if installed) Cautions	5

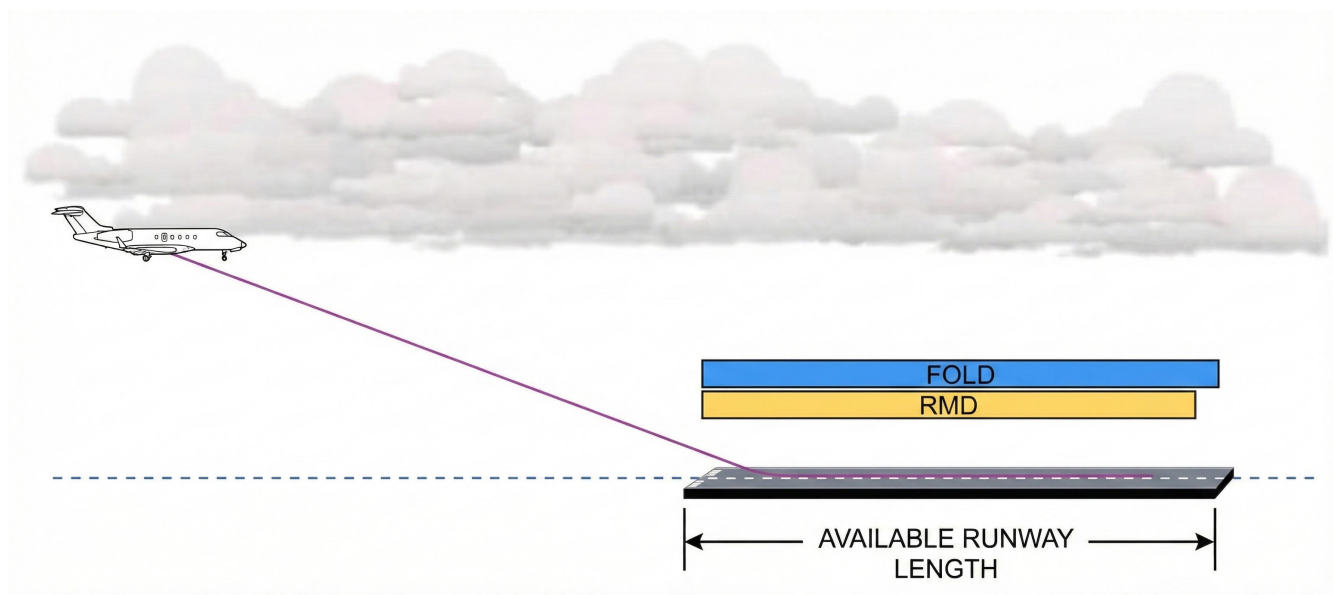
IX. RUNWAY OVERRUN AWARENESS AND ALERTING SYSTEM (ROAAS)

A. SYSTEM FUNCTIONS

- Landing distance assessment
- Runway condition monitoring
- Approach stabilization alerts
- Distance remaining annunciations

B. COMPONENTS AND OPERATION

- ROAAS is hosted on the TAWS computer
- Uses TAWS database for available runway length computations
- Utilizes Factored Operational Landing Distance (FOLD) as it's basis
- Uses RCC condition code 6 and 5 only
- ROAAS Model Distance calculations (RMD) approximated by FOLD
- See FCOM1 Chapter 6 for FOLD Information (or QRH 1, P-43)
- Automatically armed during approach within 4.5 NM and 1,000 ft above landing runway
- Two modes: In-Air and On-Ground



Receives data from the following systems:

- FMS – Gross weight & true track angle
- GPS – Position, speed, true track angle, GNSS height and vertical and horizontal position errors
- IRS – Inertial vertical speed, ground speed
- ADS – Pressure altitude, true airspeed, static air temperature
- Landing Gear – Main gear Weight on Wheels (WOW)
- Flaps – Flap lever in landing configuration
- Engine – Thrust Level Angles (TLA), Thrust Reversers status
- Brakes – Brake pressure
- Radio Altimeter – Radio height
- Flight Guidance System – FG coupled side, vertical go-around

ROAAS PBA Switch:

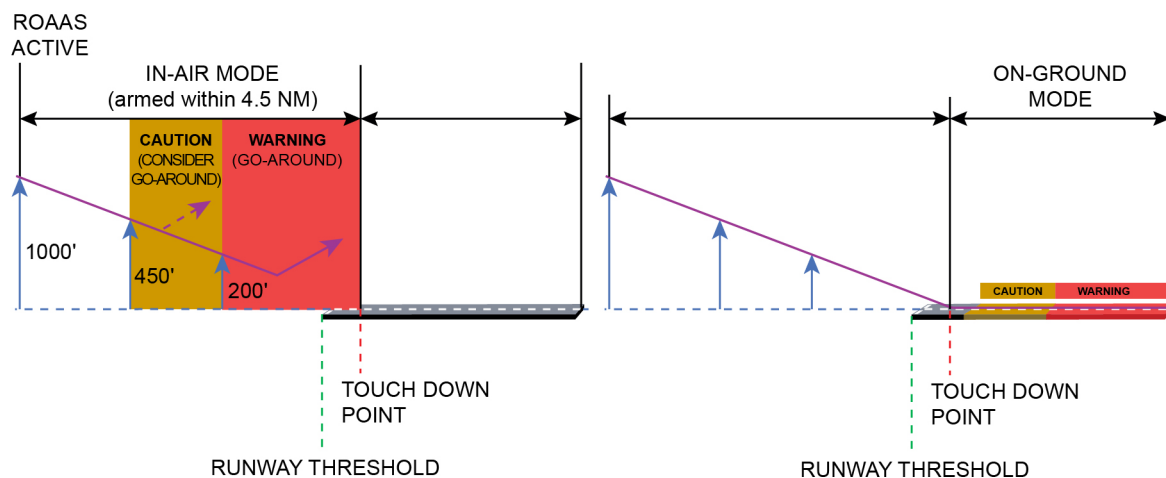
- Located on TAWS WARN Panel
- Inhibits ROAAS functions
- White OFF light is illuminates when pushed in

ROAAS RCC 5 PBA Switch:

- Located on TAWS WARN Panel
- Inhibits ROAAS functions
- White OFF light is illuminates when pushed in

Runway Selection Criteria:

- ROAAS uses aircraft position and actual track to select the intended runway
- Aircraft track must be within 20° of the runway extended centerline
- Runway selection is automatic and independent of FMS inputs
- Runway parameters are retrieved from TAWS database
- For ROAAS runway selection, must be ROAAS-enabled airport and runway over 3,000'

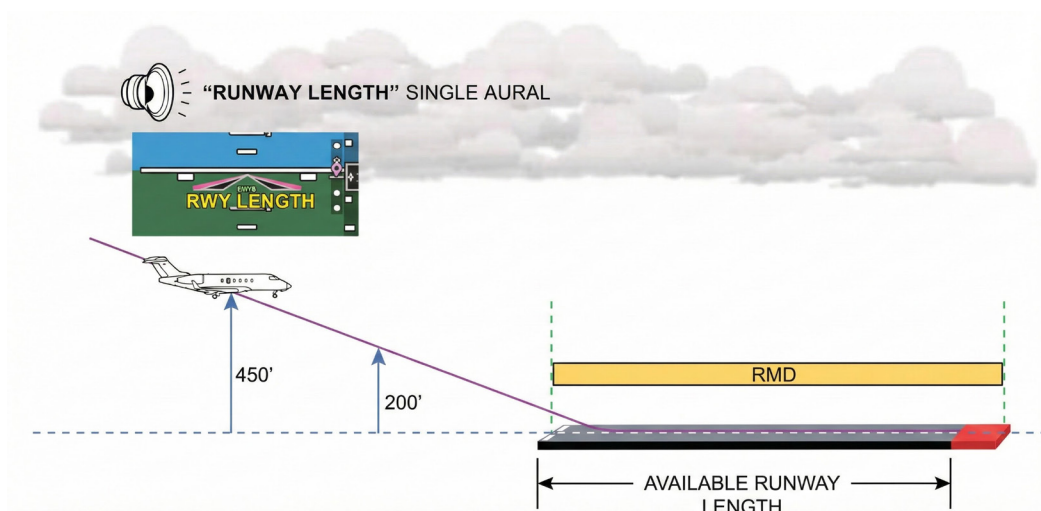


C. IN-AIR MODE

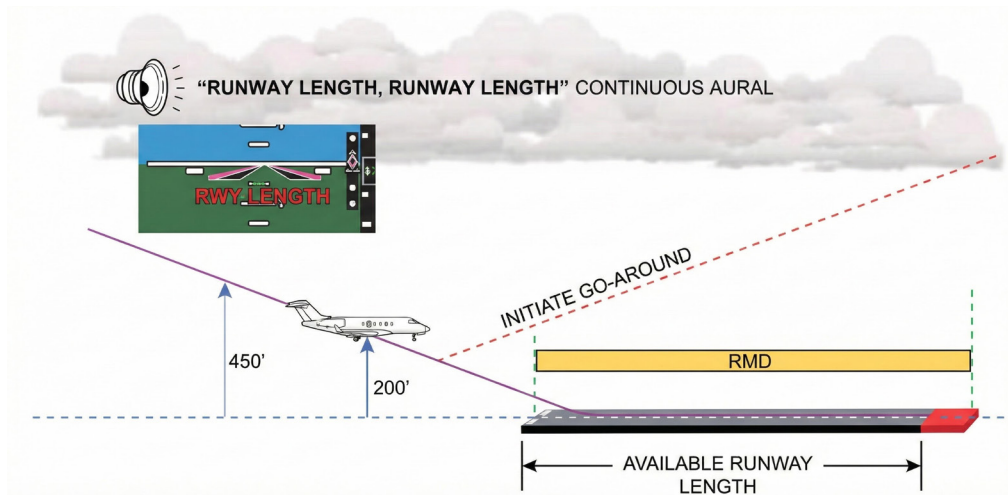
- Monitors aircraft state through air data, IRS, FMS, GNSS data
- Uses selected Runway Condition Code (RCC 5 or 6)
- Continuously calculates predicted distance required for landing and stopping (RMD)
- Compares to ROAAS Model Distance (RMD)
- Constantly compares RMD (ROAAS Model Distance) to available runway length
- When RMD is within available runway length, no ROAAS Alerts are triggered
- Should RMD be longer than the remaining available runway length, ROAAS generates an alert

Two Levels of In-Air Alerts:

- CAUTION **RWY LENGTH** Alert displayed when RMD is longer than available landing distance
- Active during caution threshold zone – 450' to 200' above runway elevation
- Single aural "RUNWAY LENGTH"



- WARNING **RWY LENGTH** Alert displayed when RMD is longer than the available landing distance
- Active below 200' above runway elevation to touch down
- Continuous aural "RUNWAY LENGTH, RUNWAY LENGTH"

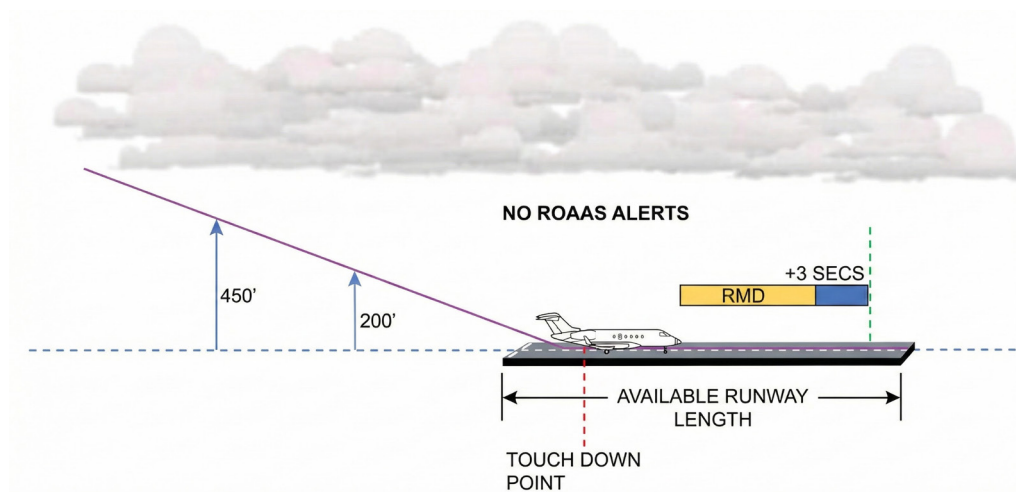


D. ON-GROUND MODE

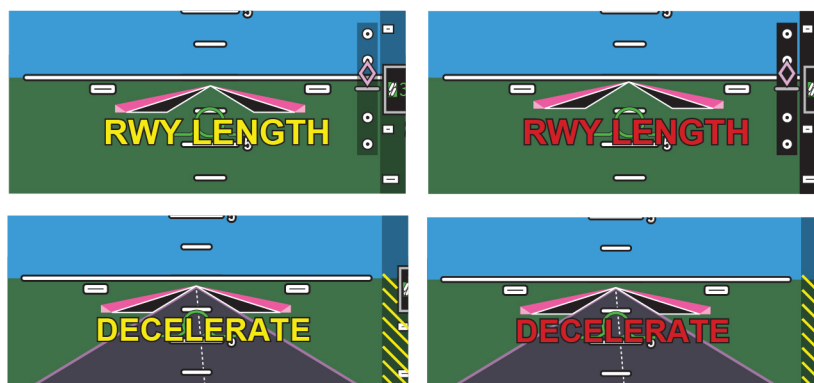
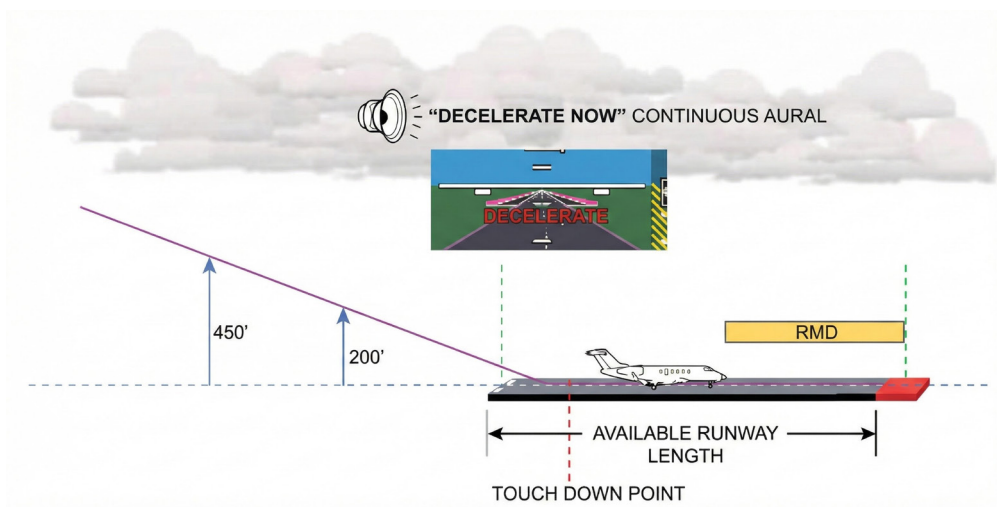
- Roll out phase of landing
- Active between touchdown and 40 knots ground speed
- Continuously monitors its RMD and deceleration and compares to remaining runway length
- Should RMD exceed the remaining available runway length, ROAAS generates an alert

Two Levels of On-Ground Alerts:

- CAUTION **DECELERATE** Alert displayed when:
 - 3 Seconds prior to when RMD is longer than the available landing distance
 - Predicted stopping point (based on deceleration) is at or beyond the end of the runway
- Active between touchdown and 40 knots ground speed
- Single aural "DECELERATE"



- WARNING **DECELERATE** Alert displayed when RMD is longer than the available landing distance
- Active between touchdown and 40 knots ground speed
- Continuous aural “DECELERATE NOW”



ROAAS visual alerts are displayed on the center of the PFD. The visual alerts with flash for five seconds when first displayed, then remain steady. When a ROAAS visual alert is displayed, it will also be accompanied by a corresponding aural.

E. CAS MESSAGES

- ROAAS alerts are unaffected by the CAS inhibit logic
- Provides aural/visual alerts if RMD exceeds remaining available runway length

ADVISORY ROAAS/RAAS Advisory Messages

Crew awareness and potential action

Message	Meaning	Inhibits
ROAAS FAIL	ROAAS failed (Internal software failure, input signal failure)	TO/LAND
ROAAS NOT AVAIL	ROAAS is not available. ROAAS NOT AVAIL will be displayed and ROAAS alerts will not occur for the following scenarios: • Landing above MLW • Not aligned with runway below 500 feet above runway elevation • Landing at a non-ROAAS airport • Steep Approach Landing on a runway below the minimum length (3000 feet)	TO/LAND
ROAAS/RAAS FAIL	ROAAS and RAAS failed (if RAAS installed)	TO/LAND
ROAAS/RAAS NOT AVAIL	ROAAS and RAAS are not available (if RAAS installed)	TO/LAND

STATUS ROAAS/RAAS Status Messages

Information only - no crew action required

Message	Meaning
ROAAS OFF	ROAAS PBA (switch) is set to OFF (ROAAS is inhibited)
ROAAS RCC 5 ON	ROAAS RCC 5 PBA (switch) is set to ON (RCC 5 has been selected)
ROAAS/RAAS OFF	ROAAS and RAAS PBAs (switches) are set to OFF (ROAAS and RAAS are inhibited)

X. TRANSPONDER SYSTEM

A. SYSTEM CONFIGURATION

- Dual TSS-4100 Mode S transponders installed
- Mode A, Mode C, and Mode S capability
- Enhanced surveillance capabilities
- ADS-B Out compliant per 14 CFR 91.227
- Automatic transponder selection

B. TRANSPONDER OPERATION

- Beacon code entry through MFD or CDU
- Active tuning control for codes 0000-7777
- IDENT function via control wheel switches
- 18-second IDENT transmission duration
- Automatic altitude reporting in Mode C/S

C. TRANSPONDER/TCAS CONTROL MENU

- Push RADIO button to access radio menu
- Turn MENU knob to TRANSPONDER/TCAS display
- Push RADIO button to display control menu
- Active transponder selection (ATC 1 or ATC 2)
- Flight ID entry using TUNE knobs
- Test mode activation via TEST control



D. MODE SELECTION

- STBY: Transponder in standby mode
- ALT ON: Altitude reporting enabled
- ALT OFF: Altitude reporting disabled
- 2-second delay prevents transient mode changes
- XPDR FAIL annunciation on transponder failure

XI. TRAFFIC COLLISION AVOIDANCE SYSTEM (TCAS)**A. TCAS II VERSION 7.1**

- Resolution advisories (RA) for vertical guidance
- Traffic advisories (TA) for awareness
- Coordinated RAs with other TCAS aircraft
- 40 aircraft simultaneous tracking capability
- RA inhibited below 1000 feet AGL

B. TCAS DISPLAY MODES

- Traffic displayed on PFD and MFD
- Relative altitude or absolute altitude display
- ABV/NORM/BLW altitude filter selections
- Intruder symbology based on threat level
- Range rings for distance reference

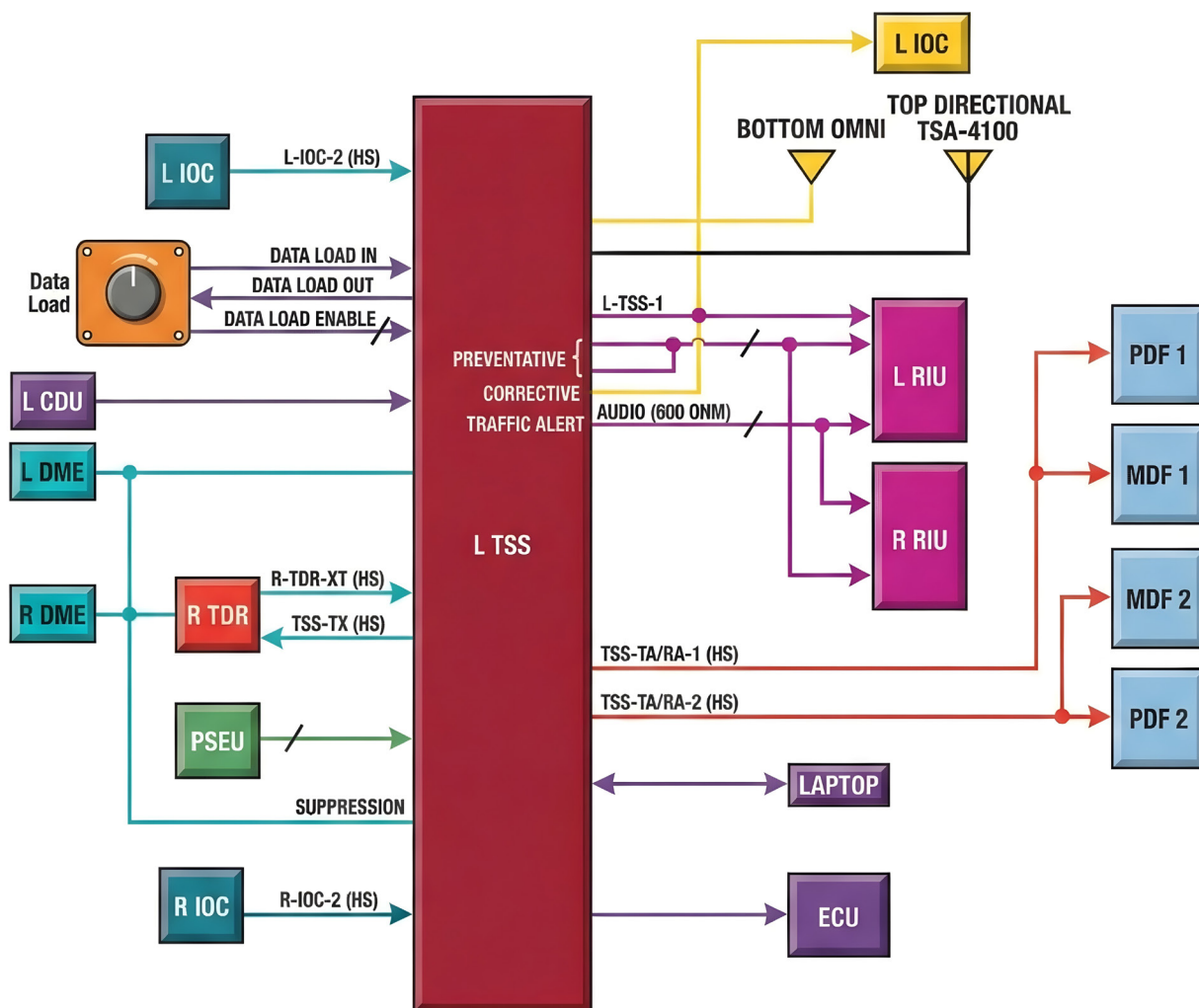
C. TCAS OPERATIONAL MODES

- TA/RA: Full TCAS protection active
- TA ONLY: Traffic advisories without RAs
- Traffic altitude mode selection (REL or ABS)
- Non-threat traffic display ON/OFF selection
- Altitude limits customization

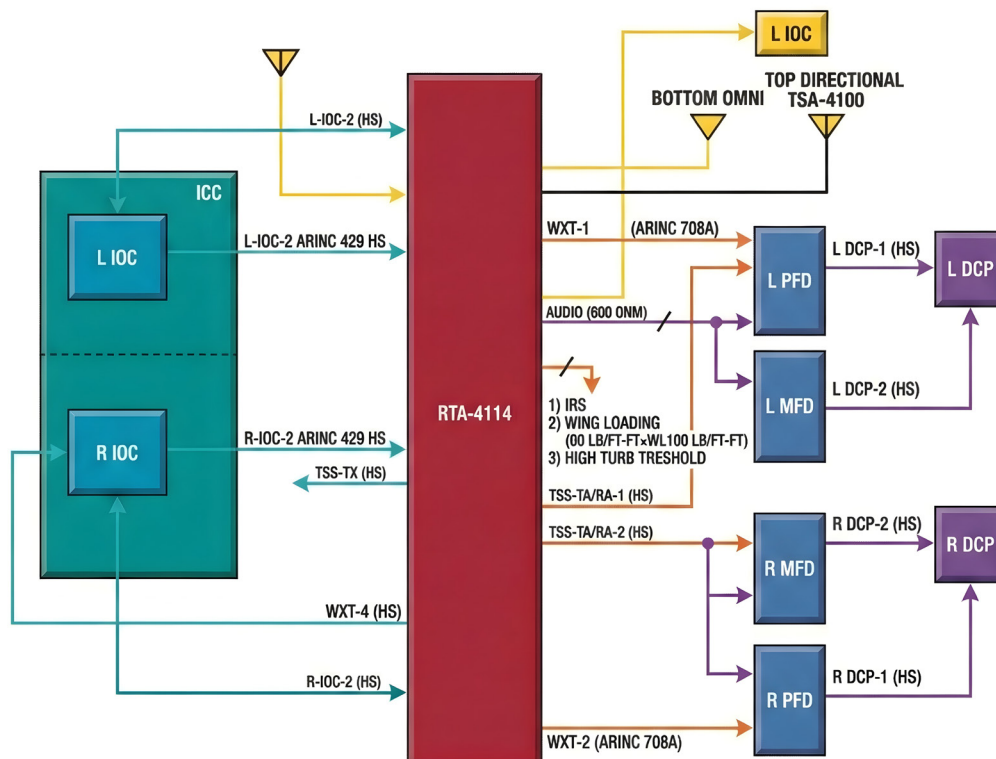
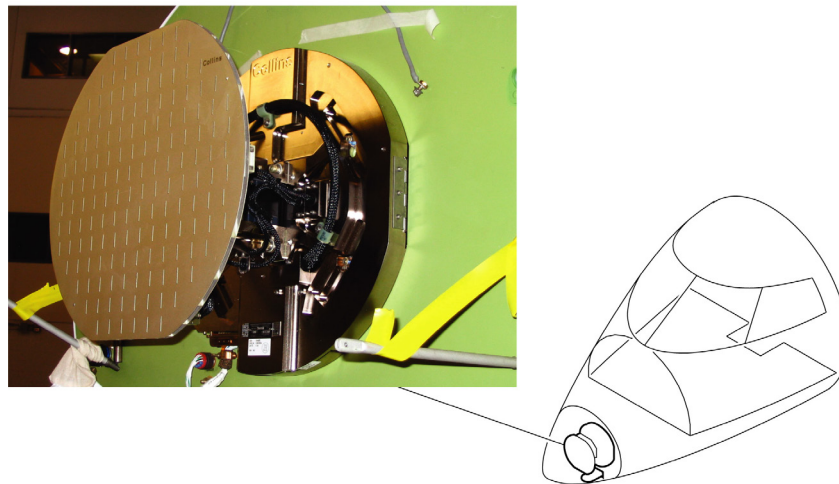
D. TCAS ALERTS

- Aural announcements through speakers
- Visual RA guidance on PFD VSI
- Red and amber threat symbology
- "TRAFFIC TRAFFIC" for TAs
- Vertical speed commands for Ras





The Multiscan WXR features advanced automated functions including path attenuation compensation, ground clutter suppression, and overflight protection that work together to present an optimized weather picture on the cockpit displays, enabling crews to make informed decisions about weather avoidance and route selection.





A. SYSTEM DESCRIPTION

- X-band color weather radar for atmospheric moisture detection and ground mapping
- Single radar installation type: RTA-4114 (multiscan weather radar)
- Provides radar-detectable precipitation and precipitation-based turbulence displays $\pm 60^\circ$ of aircraft heading
- Maximum detection range of up to 300 nautical miles
- Ground mapping capability for navigation reference
- System features include autotilt, ground clutter suppression, range compensation, and path attenuation correction

B. SYSTEM COMPONENTS

- Receiver/Transmitter/Antenna (RTA) assembly - RTA-4114
- Radar cockpit controls via Display Control Panel (DCP) and Cursor Control Panel (CCP)
- Dual controller configuration for pilot and copilot operation
- IRS Laseref VI provides attitude information for stabilization function
- Internal worldwide terrain database for weather formation intensity detection

C. RADAR ANTENNA SPECIFICATIONS

- Antenna scan: 60° left and right of airplane heading (total 120° scan arc)
- Manual tilt adjustment range: -15° (down) to $+15^\circ$ (up)
- Auto tilt adjustment range: -30° (down) to $+30^\circ$ (up)
- Stabilization function maintains consistent scan angles relative to earth's horizon
- IRS provides attitude information for stabilization

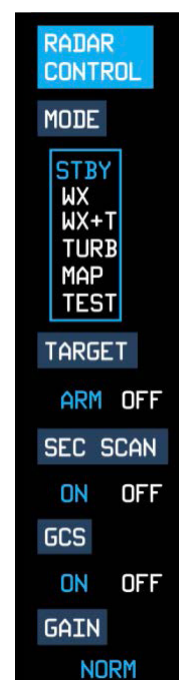
D. POWER SUPPLY

- Weather radar RTA powered by Left Main DC Bus
- Circuit breaker: 5-A at CB1-A8
- Circuit breaker nomenclature: WX

E. WEATHER DISPLAY COLOR CODING

Precipitation Intensity (Weather Detection Mode)

- BLACK (Background): Little or no rainfall
- GREEN: Moderate rainfall
- AMBER: Less severe rainfall
- RED: Heavy rainfall
- MAGENTA: Very heavy rainfall
- MAGENTA: Areas of detected turbulence



Ground Map Mode (MAP)

- GREEN: Least reflective ground surfaces
- YELLOW: Moderately reflective ground surfaces
- RED: Highly reflective ground surfaces
- MAGENTA: Most reflective ground surfaces

F. RADAR CONTROL MENU ACCESS

- Radar menu displayed on PFD by pressing RADAR button on DCP
- Radar display selection via TR/WX button on DCP
- Range control via inside knob of TILT-RANGE control on DCP
- Manual tilt control via outside knob of TILT-RANGE control on DCP
- TARGET and SEC SCAN functions covered by AUTO control in menu



Weather Radar Operational Modes

Mode	Description
STBY (Standby)	Default mode; antenna parked, no transmission
AUTO Control	Recommended mode; automatic tilt, gain, PAC, GCS, Smart Scan
MAN (Manual)	Backup mode; manual tilt and gain control
WX	Four-color weather display; detects rain, snow, wet hail
WX+T	Weather plus turbulence detection (up to 40 NM)
TURB	Turbulence-only mode; 30-second timeout to WX+T
MAP	Ground mapping for navigation reference
TEST	Rainbow pattern display for system verification

G. OPERATIONAL MODES

STBY (Standby) Mode

- Default selection in RADAR CONTROL menu
- Antenna does not transmit in this mode
- Flat plate antenna parked at bore sight position
- Automatically set after 65 seconds from Air to Ground transition
- Selecting either side to STBY causes both sides to go STBY
- **NOTE:** While on ground, if radar control is other than STBY or TEST, white “RADAR ON” annunciation displays on PFD

AUTO Control Mode

- Normal control mode for WXR system
- System sends multiple scans at different elevation tilt angles
- Provides best possible weather picture with ground clutter suppression from lower scan
- Radar can act like two independent radars - pilot and copilot can select desired mode
- If AUTO selected on either side, both sides configured to automatic function
- Gain adjustable while in AUTO to examine weather cells
- Tilt function automatically adjusted; “A” displayed after tilt readout
- **NOTE:** Manual tilt is not available in AUTO control mode
- AUTO mode with GAIN set to NORM is the default and recommended radar operation

AUTO Mode Automatic Features

- Conventional increase/decrease of receiver sensitivity with variable temperature-based gain
- Path attenuation compensation (PAC) – Yellow arc at display perimeter indicates uncertainty sectors
- Smart scan – Improves weather detection during aircraft turns
- Overflight protection – Stores and displays weather data until you are past the storm
- Ground Clutter Suppression (GCS) – Eliminates 98% of ground returns; auto-resets after 30 seconds
- Target Alert (TGT) – Auto search 7-50 NM; cyan/yellow TGT annunciation

MAN (Manual) Control Mode

- Crew can adjust tilt and gain from DCP
- Intended as secondary/backup mode when AUTO mode has failed
- GCS, PAC, and Overflight Protection features NOT available in manual mode
- **NOTE:** Manual mode is encouraged only when AUTO mode is not available

WX Mode

- Four-color weather display representing four different precipitation rates
- PAC and STC features automatically enabled
- GCS available
- Detects rain, snow, and wet hail

WX+T Mode

- Four-color weather display plus turbulence mode
- Detects turbulence up to 40 NM range
- Turbulence detection always active even if range set greater than 50 NM

TURB Mode

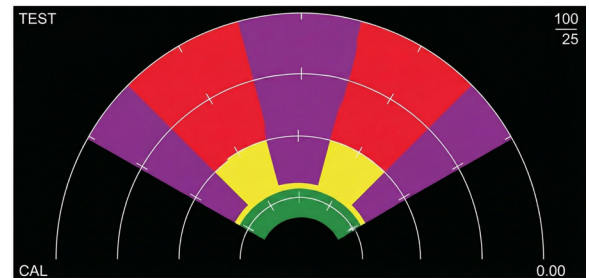
- Turbulence-only mode
- Allows turbulence to be separated from heavy rainfall
- GCS available
- Turbulence detection limited to 40 NM
- After 30 seconds of operational time-out, WX+T mode automatically selected

MAP Mode

- Used for detection and display of prominent ground features as navigation aid
- PAC, GCS, and turbulence detection features automatically disabled
- STC derived from different algorithm than weather modes

TEST Mode

- Simulated target return creates rainbow-like pattern on display
- Verifies system ability to display weather target information
- Transmitter turned OFF during test
- Scan rotation not allowed
- Test pattern output to displays
- **NOTE:** Inconsistent color pattern or blanking indicates system malfunction

**H. RANGE CONTROL**

- Available in all mode operations
- Controlled by inside DCP range knob (inside knob of TILT-RANGE control)
- Controls display range on MFD and PFD
- Available range settings: 5, 10, 25, 50, 100, 200, and 300 NM

I. TILT CONTROL

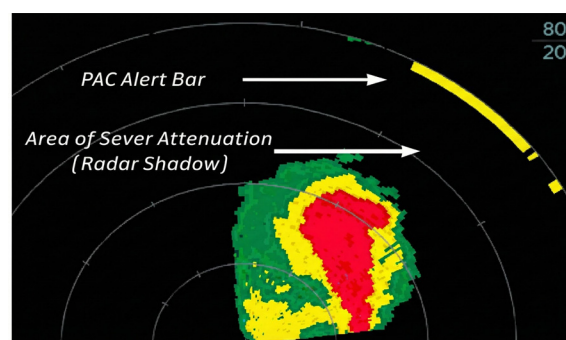
- Only available in Manual (MAN) control mode
- Controlled by outside knob of TILT-RANGE control on DCP
- Used to analyze weather/ground targets by adjusting antenna elevation
- Compensates radar beam angle when aircraft changes altitude
- Tilt angle range: +15° to -15°
- Tilt angle preceded by "T" on radar status line
- "A" displayed after tilt readout if autotilt active
- **NOTE:** In AUTO mode, tilt is automatically adjusted and manual tilt is not available

J. GAIN CONTROL

- Function can be varied from -3 to +3
- Default and recommended setting: NORM
- Lower gain setting used to analyze intense weather activity
- Higher gain used to detect light precipitation
- Available in AUTO and MAN modes; NOT available in STBY or TEST mode
- Gain value selected by DATA knob, activated by pressing MENU SELECT button on DCP
- Each dB of gain increase causes equal change in total STC compensation
- Receiver gain shows letter "G" and value in radar status field if other than NORM
- **NOTE:** Weather radar false returns can display at higher than NORM gain settings
- **NOTE:** If gain set too low, weather targets ahead may not appear on display
- **IMPORTANT:** In AUTO control mode, always reset GAIN to NORM after analyzing

K. PATH ATTENUATION COMPENSATION (PAC)

- Compensates for radar beam absorption as it penetrates precipitation cells
- Yellow PAC alert arc appears at perimeter of radar display
- Highlights sectors of uncertainty for pilot to avoid
- Automatically enabled in AUTO mode
- Not available in MAN (manual) mode



L. SENSITIVITY TIME CONTROL (STC)

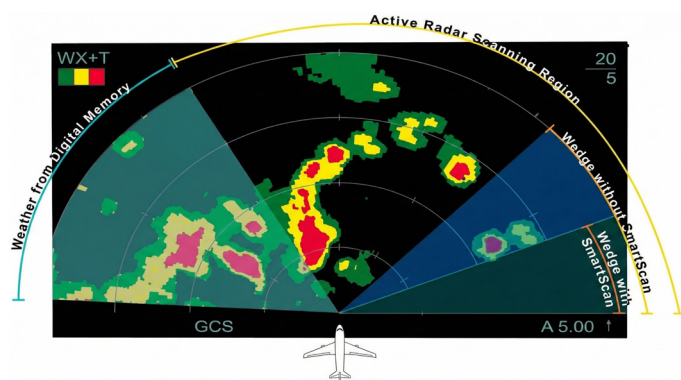
- Compensates for stronger radar returns at closer range
- Allows true intensity of precipitation cells to be displayed
- Automatically enabled in WX and WX+T modes

M. GROUND CLUTTER SUPPRESSION (GCS)

- Eliminates 98% of ground returns from display
- Allows radar to scan at lower tilt angle where most reflective portion of storm is located
- In AUTO mode, GCS always ON by default
- Can be turned OFF from RADAR menu
- Automatically switches back to ON after 30 seconds
- GCS is OFF in MAN (manual) mode

N. SMART SCAN

- Improves weather detection when aircraft is turning
- Automatically enabled in AUTO mode
- Not available in MAN mode



O. OVERFLIGHT PROTECTION

- Multiscan WXR stores weather data and displays it until aircraft has flown past the storm
- Automatically enabled in AUTO mode
- Not available in MAN mode

P. TARGET ALERT (TGT)

- In AUTO mode with no on-side weather radar overlay display selected:
 - WXR automatically searches for weather targets and turbulent areas
 - Search range: 7 nm to 50 nm
 - Cyan TGT message displays in radar status field on PFD and MFD (target mode active)
 - TGT message changes from cyan to yellow to indicate target alert
 - If turbulence detected, TRB shows in yellow to left of TGT message
- Target alert issued if either channel (pilot or copilot side) reports a target
- TGT message flashes for 5 seconds, then remains steady while target detected
- **NOTE:** If both on-side PFD and MFD selected to terrain, no TGT/TRB alert will occur
- **NOTE:** TGT message displays in white to show target mode is inactive

Q. SECTOR SCAN (SEC SCAN)

- Reduced antenna azimuth scan mode
- Restricts mechanical scan angle used and processed by RTA
- Can be used with any other scanning mode of operation
- Used to increase radar update rate
- **NOTE:** Antenna scan range limited to maximum $\pm 30^\circ$ from aircraft heading line in this mode
- **NOTE:** If either command channel is in target mode, sector scan is disabled

R. TERRAIN DATABASE

- Multiscan WXR has internal worldwide terrain database
- Used in conjunction with aircraft geographic position from FMC
- Determines factor for intensity of detecting weather formation
- Terrain Database Fault message displays if database error occurs

S. DUAL INDEPENDENT OPERATION

- Radar can act like two independent radars
- Pilot and copilot can select desired mode independently
- If AUTO selected on either side, both sides configured to automatic function
- Each dB of gain increase causes equal change in total STC compensation for current display Range

T. STABILIZATION

- Allows radar to scan with appropriate angles consistently relative to earth's horizon
- Compensates for change of aircraft attitude



- IRS Laseref VI provides attitude information for stabilization function
- Loss of IRS input to RTA results in WX FAULT message in yellow on radar status line

U. LIGHTNING DETECTION SYSTEM (OPTIONAL)

- Maps location of thunderstorm activity 360° around airplane
- Detection range: up to 200 nautical miles
- Displays lightning bolt icons on MFD
- Color coding by intensity:
 - **YELLOW**: Light level cells (1-4 strikes)
 - **RED**: Medium level cells (5-9 strikes)
 - **MAGENTA**: Heavy level cells (over 9 strikes)

V. WEATHER RADAR FAULT INDICATIONS

- No EICAS messages for weather radar system
- Fault messages displayed on radar status line in PFD/MFD
- Fault indication flashes for 5 seconds then becomes steady
- Fault annunciations removed by deselecting radar overlay

WX FAIL

- Displayed on map when loss of operation of weather radar video bus
- All weather data and radar modes removed
- WX FAIL flashes for 5 seconds when first displayed, then becomes steady

WX FAULT

- Displayed when ability to detect precipitation, turbulence, or perform ground mapping is degraded or inoperative
- Caused by: failed internal bit, parity strap failure, or loss of aircraft pitch and roll data
- Radar continues to attempt to display weather data

TURB FAULT

- Displayed when turbulence function is not available
- Radar's ability to detect turbulence degraded or inoperative
- Radar continues to attempt to provide turbulence information

AUTO FAULT

- Displayed when automatic mode is not available
- Radar's ability to automatically control tilt degraded or inoperative
- Usually indicates loss of ARINC input data
- Switch to manual operation when AUTO FAULT is displayed

CTRL FAULT

- Displayed when control fault is detected
- Indicates loss of control bus data on pilot side, copilot side, or both

- If displayed on one side only, that side slaves to other side
- If both sides display CTRL FAULT:
 - Radar continues to function in last range/mode selected until power turned off
 - If power cycled and control bus still not present on both sides, radar defaults to STBY mode

W. MODE TRANSITION NOTES

- MANUAL to AUTO mode transition (or vice versa): minimum 2-minute wait required for accurate weather data results
- After 30 seconds of TURB mode operation, WX+T mode automatically selected
- GCS automatically resets to ON after 30 seconds if turned OFF in AUTO mode

X. WEATHER RADAR SPECIFICATIONS TABLE

Weather Radar System Specifications

Parameter	Specification
Radar Type	RTA-4114 Multiscan Weather Radar
Frequency Band	X-band
Maximum Range	300 NM
Antenna Scan	$\pm 60^\circ$ of aircraft heading
Manual Tilt Range	-15° to $+15^\circ$
Auto Tilt Range	-30° to $+30^\circ$
Range Settings	5, 10, 25, 50, 100, 200, 300 NM
Gain Range	-3 to +3
Default Gain Setting	NORM
Turbulence Detection Range	Up to 40 NM
Target Alert Range	7 to 50 NM
Sector Scan Range	$\pm 30^\circ$ maximum
Ground Clutter Suppression	98% ground return elimination
Data Bus	ARINC 708A
Stabilization Source	IRS Laseref VI

Y. OPERATIONAL NOTES

- AUTO mode with GAIN set to NORM is the default and recommended radar operation
- Manual mode intended as secondary/backup mode when AUTO mode has failed
- Always reset GAIN to NORM after analyzing weather cells in AUTO mode
- Weather radar false returns can occur when gain is higher than NORM



- Weather targets may not appear if gain is set too low
- Minimum 2-minute wait required when transitioning between MANUAL and AUTO modes for accurate data
- Use lower gain settings to analyze intense weather activity
- Use higher gain settings to detect light precipitation
- Turbulence detection limited to 40 NM regardless of display range setting
- PAC, GCS, and Overflight Protection features are NOT available in manual control mode

XIII. FLIGHT MANAGEMENT SYSTEM (FMS)

The Rockwell Collins dual Flight Management System represents the core navigation and flight management capability of the Challenger 350 aircraft. This fully integrated system provides comprehensive lateral and vertical navigation, flight plan management, multi-sensor navigation solutions, and performance calculation throughout all phases of flight.

The FMS integrates position data from GPS/GNSS receivers, inertial reference systems, DME, and VOR to deliver precise navigation solutions that support en-route, terminal, and approach operations including advanced RNP and LPV approach capabilities.

A. DUAL FMC-6200 CONFIGURATION

- Dual FMC-6200 flight management computers installed
- PowerPC 460EX processor architecture
- Independent operation capability for redundancy
- Cross-channel data comparison for integrity monitoring
- Automatic reversion capability on single FMS failure
- +5V and +/-12V power supplies from respective IAPS card cage
- IAPS 1 powers left FMC, IAPS 2 powers right FMC

B. SOFTWARE ARCHITECTURE

- FMS Application (FMSA) - Provides flight planning and guidance functions, FMS maps, and pilot interfaces via CDU pages
- Radio Tuning System Application (RTSA) - Controls radio tuning including auto tune VOR/DME, tune-by-ident, and airport frequency lookup
- Data Link Communication Application (DLCA) - Implements FANS 1/A applications including AFN, ADS-C, and CPDLC

C. FMC-6200 TECH INSERTION FEATURES

- Increased number of fix points from 5 to 10
- Flight planning enhancement from 9 to 10 characters in route names
- Increased pilot defined waypoints from 50 to 100
- Sensor selection words changed to ENABLED/DISABLED instead of YES/NO
- Abbreviation changes: GNSS for GPS, TKE for TAE, XTK for XTD, TTG for ETE, EPU for POS Accuracy



D. NEW CAPABILITIES

- Localizer Precision with Vertical Guidance (LPV)
- Airway to airway transitions
- Radius to Fix (RF) legs
- Step down fixes
- Inertial Reference System (IRS) support
- IRS CTL page
- Magnetic heading display
- FMS latitude limits

E. CONTROL DISPLAY UNIT (CDU)

- Dual CDUs for pilot and copilot operation
- Full alphanumeric keyboard for data entry
- Line select keys for menu navigation
- Dedicated function keys: DIR, FPLN, LEGS, DEP ARR, PERF, DSPL MENU, MFD ADV, MFD DATA, PREV, NEXT
- MSG key for message access
- EXEC key for flight plan execution
- IDX key for index page access
- TUN key for radio tuning functions

F. MODIFIED CDU PAGES

- GNSS Control (formerly GPS Control)
- Frequency Data
- Fix Info
- VOR/DME Control (formerly VOR Control)
- Pos Init
- Hold List
- Progress
- Defaults
- Arrival Data
- Fuel Management
- Nearest Airports
- Index
- LRN Status (to GNSS Status and IRS Status)
- Depart/Arrival
- Data Base



G. NEW CDU PAGES

- SBAS Service Providers
- RNP RAIM
- FPLN PRAIM
- IRS Control

H. MULTI-SENSOR NAVIGATION

Navigation Sensor Inputs:

- DME - Distance measuring equipment
- VOR - VHF omnidirectional range
- GPS (GNSS) - Global Navigation Satellite System
- IRS - Inertial Reference System
- DR - Dead reckoning (when no position data available)

Sensor Data Processing:

- FMS provides navigation data in en-route, terminal, and approach phases
- Primary navigation mode uses all selected sensors
- FMC smooths transients caused by changes in available sensor data
- Automatic switchover to cross-side system if on-side data is invalid (ADS, IRS)
- IRS Control page used for IRS select/deselect for FMC usage
- IRS Control page accessed from IRS CTL option on INDEX page

GPS/GNSS Integration:

- Dual GPS sensors process transmissions from multiple satellites simultaneously
- Minimum four satellites with acceptable geometry required for navigation solution
- Three satellites plus calibrated barometric altitude acceptable as alternative
- Computed GPS position, velocity, and time are inputs to FMS
- GPS data integrated into flight plan based navigation solution
- IRS, ADC, DME, and VOR systems supply supplementary data

GNSS Control Page:

- Displays position differences (POS DIFF) between each GPS sensor and FMS calculated position
- Shows direction and distance of position differences
- Line select key enables or disables each GPS sensor
- Disabled GPS sensor remains disabled until manually enabled
- Manual enable/disable capability for each sensor

I. DEAD RECKONING (DR) MODE

DR Mode Operation:

- Activated when no navigation sensor data is available
- Estimates position based on last known position, heading, and airspeed

- FMS DR annunciated on MFD when active
- FMS DR annunciated on PFD if NAV SOURCE is FMS
- DR status shows on CDU message line and MESSAGES page

DR Mode Limitations:

- Prohibited to use FMS as primary navigation source during dead reckoning
- FMS DR message indicates DR mode is active
- RNAV operations prohibited when FMS DR is annunciated
- Navigation by other means must be utilized

J. FLIGHT PLAN MANAGEMENT**Flight Plan Initialization:**

- FMS can be initialized by various means
- Waypoints set and destinations selected through CDU
- AUTO position initialization uses on-side GNSS sensor position
- MAN selection posts INITIALIZE POSITION crew awareness message if position not initialized
- IRS position can be set via SET POS command (latitude/longitude) when not in Navigation mode

Route Capabilities:

- SID, STAR, and airways accommodated
- Great circle route calculated between waypoints for en-route LNAV
- Company route database capability
- Pilot-stored waypoint capacity: 100 waypoints
- Route names up to 10 characters
- Runway database with threshold coordinates

Flight Plan Features:

- Flight plan management through FPLN pages
- Legs page displays waypoint sequence
- Departure and arrival procedure selection
- Direct-to navigation capability
- Flight plan modifications with EXEC key confirmation
- Secondary flight plan function (use prohibited per AFM)

Flight Plan Limitations:

- Prohibited to load pilot routes from PILOT ROUTE LIST during flight
- Prohibited to upload flight plans from ROUTE MENU (FPLN RECALL) during flight
- Prohibited to select FPLN WIND UPDATE from ROUTE MENU
- IFR navigation prohibited unless pilot verifies database currency or waypoint accuracy

K. LATERAL NAVIGATION (LNAV)

LNAV Features:

- Great circle route computations between waypoints
- Roll steering provided to flight control system (FCS)
- Fly-by and fly-over waypoint logic
- Radius to Fix (RF) path terminators
- Offset flight path capability
- Parallel track offset operations
- Airway to airway transitions

LNAV Guidance:

- LNAV can be advisory only if FMS not coupled
- Coupled LNAV provides automatic roll steering
- Cross track distance (XTK) displayed
- Track angle error (TKE) displayed
- Course deviation indicator (CDI) shows lateral deviation

L. VERTICAL NAVIGATION (VNAV)

VNAV Capabilities:

- Climb, cruise, and descent profiles
- Speed and altitude constraints
- Sophisticated interface with FCS for vertical mode selection
- Coupled VNAV interface allows FMS to select FCS vertical modes
- VNAV and LNAV capability can be advisory only if FMS not coupled
- FMS provides vertical steering when required by FCS

VNAV Modes:

- VNAV PATH mode
- VNAV SPD mode
- Economic cruise speed calculations
- Step climb recommendations
- Altitude intervention capability

VNAV Limitations:

- Vertical guidance is aid to assist pilots with altitude restrictions
- Primary barometric altimeter must be used for altitude compliance
- Use of VNAV prohibited when barometric altitude corrected to QFE
- Use of VFLC prohibited during climb when airspeed reference displayed as Mach
- Prohibited to select MCRZ from FMS VNAV CRUISE page
- Prohibited to select VNAV following go-around during missed approach
- Baro-VNAV prohibited on airplanes 20501-20663 not incorporating SB 350-34-012

VNAV Cautions:

- Errors to VNAV paths may occur due to database coding errors or altimetry errors
- Actual VNAV path may deviate below intended path in very cold temperatures
- Temperature compensation function corrects for non-standard temperatures
- Database coding may result in VNAV paths below MDA, DA, or DH
- VNAV paths (pseudo glide paths) are not equivalent to ILS glideslope
- Position must be verified prior to VNAV descent
- Required visual reference must be obtained before descent below published minimums

M. PERFORMANCE COMPUTATIONS

Performance Functions:

- Optimum altitude calculations
- Step climb recommendations
- Fuel predictions and reserves
- Time predictions and ETAs
- Wind calculations and corrections
- Economic cruise speed calculations

Performance Data:

- FMS performance data is advisory only
- ETE/ETA and Fuel Remaining information is advisory only
- Airplane operation must not be predicated upon FMS performance data
- Measured mode or manual entry fuel predictions not updated while flight plan modification is open

Performance Database:

- Performance database part number must be verified: 096-5327-001 (airplanes 20578 and subsequent)
- V-speed database part number: 096-5016-001 (airplanes 20501-20663) or 096-5016-002 (20664 and subsequent)
- Contaminated runway data enabled on V-speed database 096-5016-002

N. FMS CALCULATED VSPEEDS

VSPEED Function:

- Allows pilot to set or adjust takeoff and approach speeds on PFD
- Reference speeds shown on airspeed tape
- VSPEEDS grouped into takeoff speeds and approach speeds
- FMS calculated VSPEEDS are optional feature

VSPEED Display:

- Reference speed shown as digital readout on speed reference table



- Reference bug set for each VSPEED on airspeed scale
- Manually set values displayed in cyan characters
- FMS calculated values displayed in magenta characters
- Combination of FMS calculated and manually set values permitted

VSPEED Verification:

- FMS does not compare actual aircraft data against manually input data
- Pilot must verify aircraft configuration matches FMS inputs
- Pilot must validate environmental conditions match FMS inputs
- Verification required before posting FMS computed VSPEEDS on PFD
- Takeoff performance summary on MFD TAKEOFF REFERENCE page
- Approach performance summary on MFD APPROACH REFERENCE page

REFS Menu Operation:

- Access via REFS button on DCP
- Menu automatically removed 20 seconds after last activity
- Push another menu button on DCP to manually exit
- MENU, DATA, or PUSH SELECT knob activity resets timeout

O. REQUIRED NAVIGATION PERFORMANCE (RNP)**RNP Capabilities:**

- RNP 4 - Oceanic/Remote operations
- RNP 2 - En Route operations
- RNP 1 - Terminal operations
- RNP APCH - GNSS Non-Precision Approach
- RNP AR APCH - Authorization Required approaches

RNP Function:

- RNP is statement of navigation performance accuracy for defined airspace
- RNP value may be specified by pilot on FMS PROGRESS page
- FMS computes expected position accuracy based on sensors in use
- POS ACCURACY (now EPU) displayed on PROGRESS page
- FMS position error should be less than RNP value 95% of time
- LOW POS ACCURACY message displayed when EPU exceeds RNP value

RNP AR Approaches:

- RNP AR approaches to RNP of 0.30 available
- Applicable to airplanes incorporating SB 350-34-009

CDI Scale Requirements:

- RNP APCH: CDI Scale 0.3 nm
- BASIC RNP-1: CDI Scale 1.0 nm
- RNP-2: CDI Scale 2.0 nm



- RNP-4: CDI Scale 4.0 nm (pilot selected)
- RNP-10: CDI Scale 4.0 nm (pilot selected)

RNP Leg Length Limitations:

- BASIC RNP-1: Maximum 200 nm per leg
- RNP-2: Maximum 400 nm per leg
- RNP-4 and RNP-10: Maximum 500 nm per leg
- Pilot defined waypoints must not create legs shorter than limiting length

P. RAIM AND INTEGRITY MONITORING**RAIM Prediction:**

- RNP RAIM page performs RAIM prediction on destination only
- FPLN PRAIM page performs RAIM prediction over entire flight plan
- Five satellites required to detect satellite error
- Six satellites required to isolate error to individual satellite

RAIM Accuracy Criteria:

- 4 nm for oceanic/remote operations
- 2 nm for en-route operations
- 1 nm for terminal operations
- 0.3 nm for approach operations

Satellite Deselect:

- Individual satellites can be deselected by entering identifier
- Used when satellite is NOTAM'd under test
- FMS ignores data from deselected satellite

Loss of Integrity Messages:

- Two types: Advisory (white) and Caution (yellow)
- LOI message displayed on PFD when caution level reached
- Messages pertain to GNSS HPL/HIL (horizontal protection/integrity limits)
- LOI not displayed during Approach phase

Q. SBAS AND LPV APPROACHES**SBAS Service Providers:**

- WAAS - North America and Hawaii
- EGNOS - Europe
- MSAS - Japan
- GAGAN - India
- Selection through SBAS Service Providers page
- Enables LPV approach capability

LPV Approach Capabilities:

- Localizer Performance with Vertical guidance
- SBAS-VNAV used for vertical guidance
- Similar to ILS approach capability
- FMS provides steering commands along flight plan route

LPV Approach Requirements:

- Dual PFD required
- Two GNSS/SBAS sensors required to commence approach
- One GNSS/SBAS sensor required to continue approach
- Dual FMS required
- LPV APPR annunciation must be displayed on PFD

LPV Approach Limitations:

- LP approaches cannot be performed
- Prohibited to conduct LPV with FMS2 as pilot nav source and FMS1 as copilot nav source
- RNP operations to LPV minimum prohibited with VNV flag, NO APPR, EFIS MISCOMPARE,
- LPV NOT AVAIL

R. FMS APPROACH OPERATIONS**FMS Approach Guidance:**

- Lateral and vertical guidance available throughout FMS-based approaches
- FMS lateral guidance uses GNSS position data unless sensor fails or disabled
- FMS vertical guidance based on Baro-VNAV
- SBAS-VNAV used for SBAS LPV or SBAS LNAV/VNAV
- FMS provides steering commands to fly flight plan route
- Captures FMS-generated lateral and vertical flight path for approach

Approach Requirements:

- Instrument approaches must use procedures in FMS database
- RNP APPR or LPV APPR annunciation required on PFD
- Vectored ILS approaches exempt (do not rely on FMS guidance)
- ILS back course approaches exempt if vectored

Coordinate Reference Requirements:

- FMS with GNSS may only be used if approach referenced to WGS84 or NAD83
- GNSS sensors must be deselected when approach not referenced to WGS84 or NAD83
- SVS shall be deselected when conducting approach in non-WGS84/NAD83 airspace

Approach Limitations:

- FMS as primary nav source beyond FAF prohibited for ILS, LOC, LOCBC approaches
- FMS as supplementary nav source permitted when APPR or REF APPR annunciated



- Nav aid referenced in procedure must be displayed and monitored during approach
- Prohibited to tune localizer on TUNE page using identifier only

S. FMS NAVIGATION SOURCE REQUIREMENTS

Navigation Source Minimum Requirements (Airplanes 20664 and subsequent):

- One GNSS; or
- Two DMEs; or
- One VOR/DME; or
- One IRS

Navigation Source Minimum Requirements (Airplanes 20501-20663):

- Two GNSSs required

Latitude Limitations:

- FMS navigation and magnetic heading display prohibited:
 - All latitudes greater than N82°
 - Latitudes greater than N73° if between W080° and W170°
 - Latitudes greater than S82°
 - Latitudes greater than S60° if between E120° and E160°
 - Canadian Northern Domestic Airspace
- Prohibited to load FMS procedures referenced to True Heading

T. FMS ANNUNCIATIONS

Annunciation Locations:

- PFD annunciation lines FMS A1 and A2 below NAV source data
- A1 line allows up to 11 characters
- A2 line allows 8 characters only
- PFD message shows below and right of aircraft symbol on HSI
- MFD message shows right and lower than aircraft symbol
- CDU message line shows crew awareness and CDU annunciations
- Messages stay on while condition exists, minimum 5 seconds

Repeater Display:

- Amber FMS messages on PFD A1 line repeated on ADI (airplanes with SB 350-34-009)
- Display located below and left of FMS indication

EPU Display (Estimated Position Uncertainty):

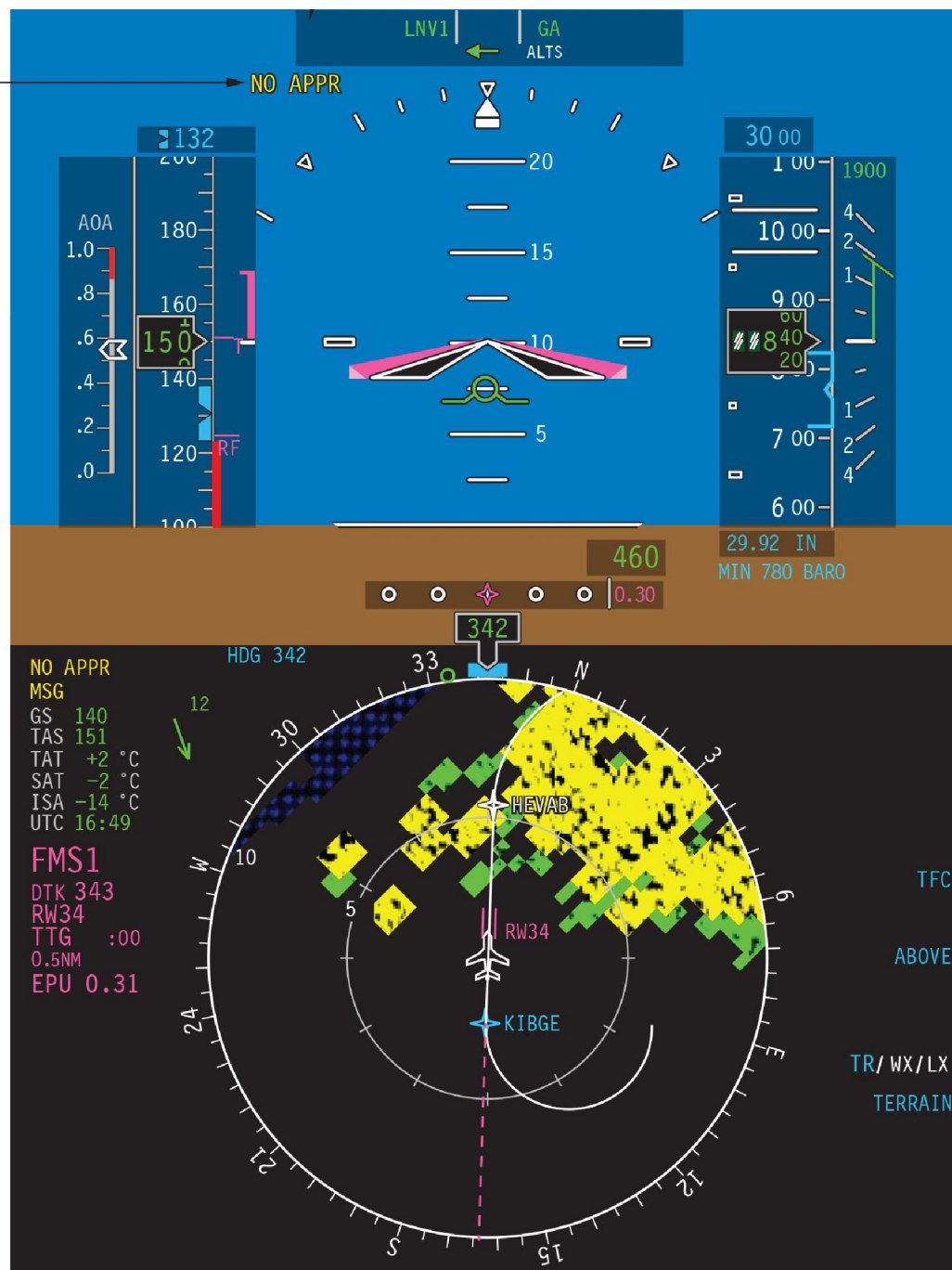
- EPU value continuously displayed on PFD below distance to go readout
- Applicable to airplanes incorporating SB 350-34-009

FMS A1 and A2 Message Lines:

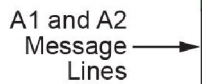
- Message lines moved to top of data block (airplanes with SB 350-34-009)

REPEATER DISPLAY

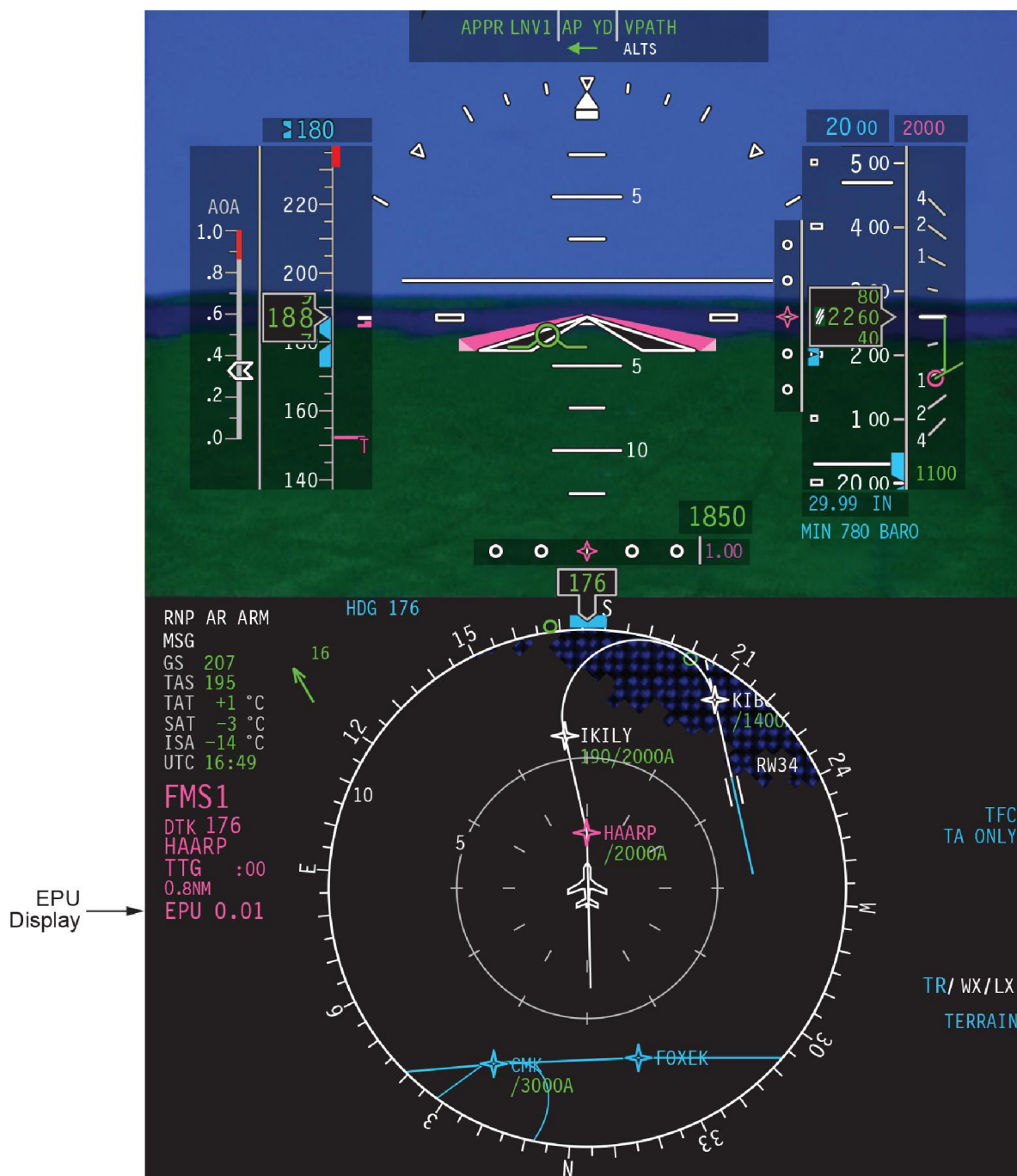
Amber
FMS A1 Line
Messages
Repeated
Here



A1 AND A2 MESSAGE LINES



EPU (ESTIMATED POSITION UNCERTAINTY) DISPLAY

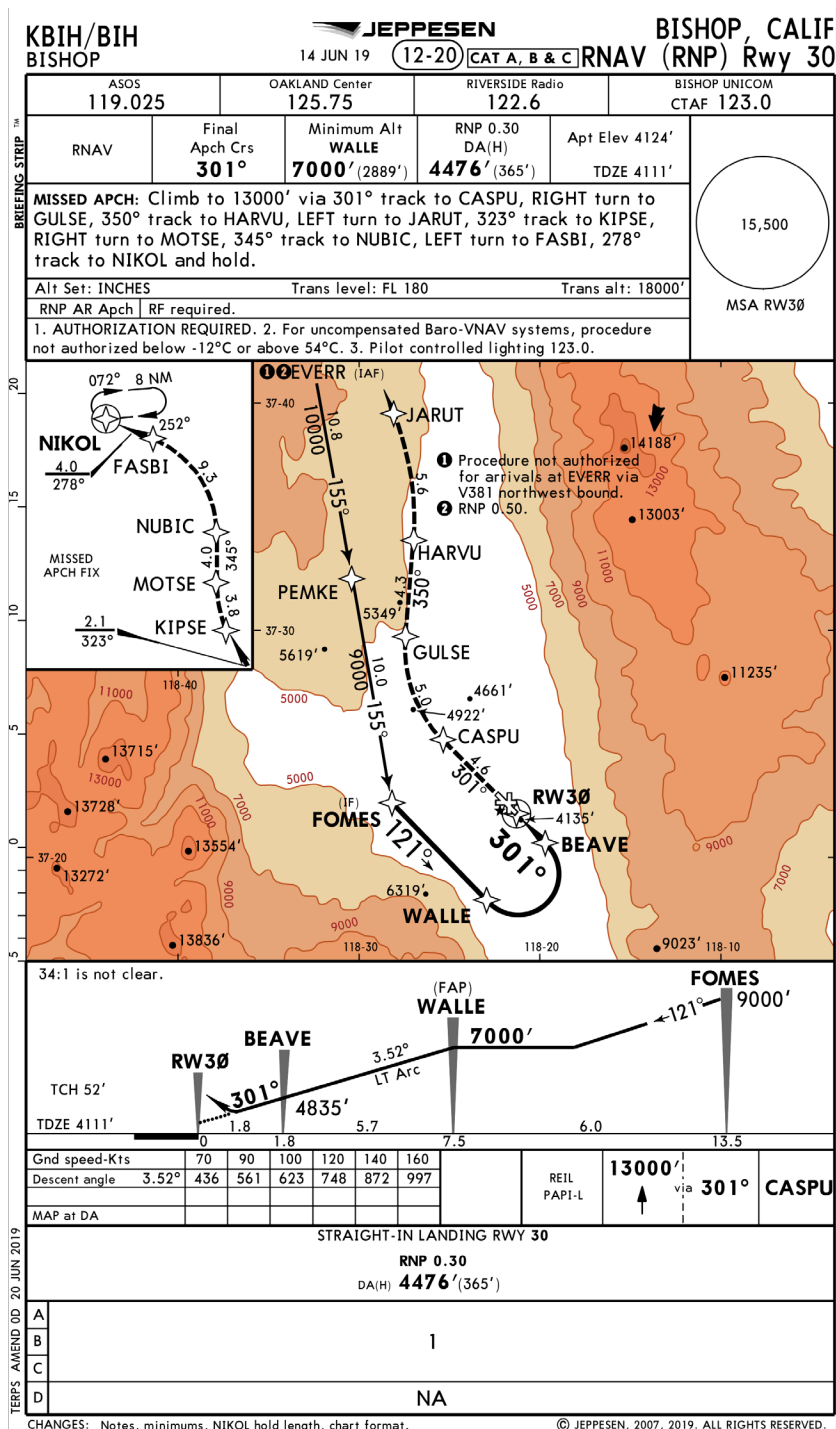




REQUIRED NAVIGATION PERFORMANCE – AUTHORIZATION REQUIRED (RNP AR)

Applicable to airplanes incorporating SB 350-34-009

RNP AR Approaches to an RNP of 0.03 is now available.



U. DATABASE MANAGEMENT

Data Base Unit (DBU-5010E):

- Performs data file transfer between USB drive and aircraft LRUs
- Installed in left equipment rack facing forward
- Provides enhanced data loading functionality over DBU-5000

DBU Capabilities:

- Upload FMS navigation and Vspeed databases
- Upload/download pilot waypoints and routes
- Upload/download MDC data: MDT and fault reports
- Load IFIS files and databases (e-charts, GWX, enhanced maps)
- Upload/download multiple LRUs simultaneously

V. FMS LIMITATIONS SUMMARY

Operational Limitations:

- FMS must be operated per AFM and Rockwell Collins Operators Guide
- AFM takes precedence over Operators Guide if differences exist
- Operators Guide must be immediately available when FMS navigation used
- Approved software versions: HSCD CPN 946-2720-101 (or later) / 946-2720-130 (20664 and subsequent)

Prohibited Operations:

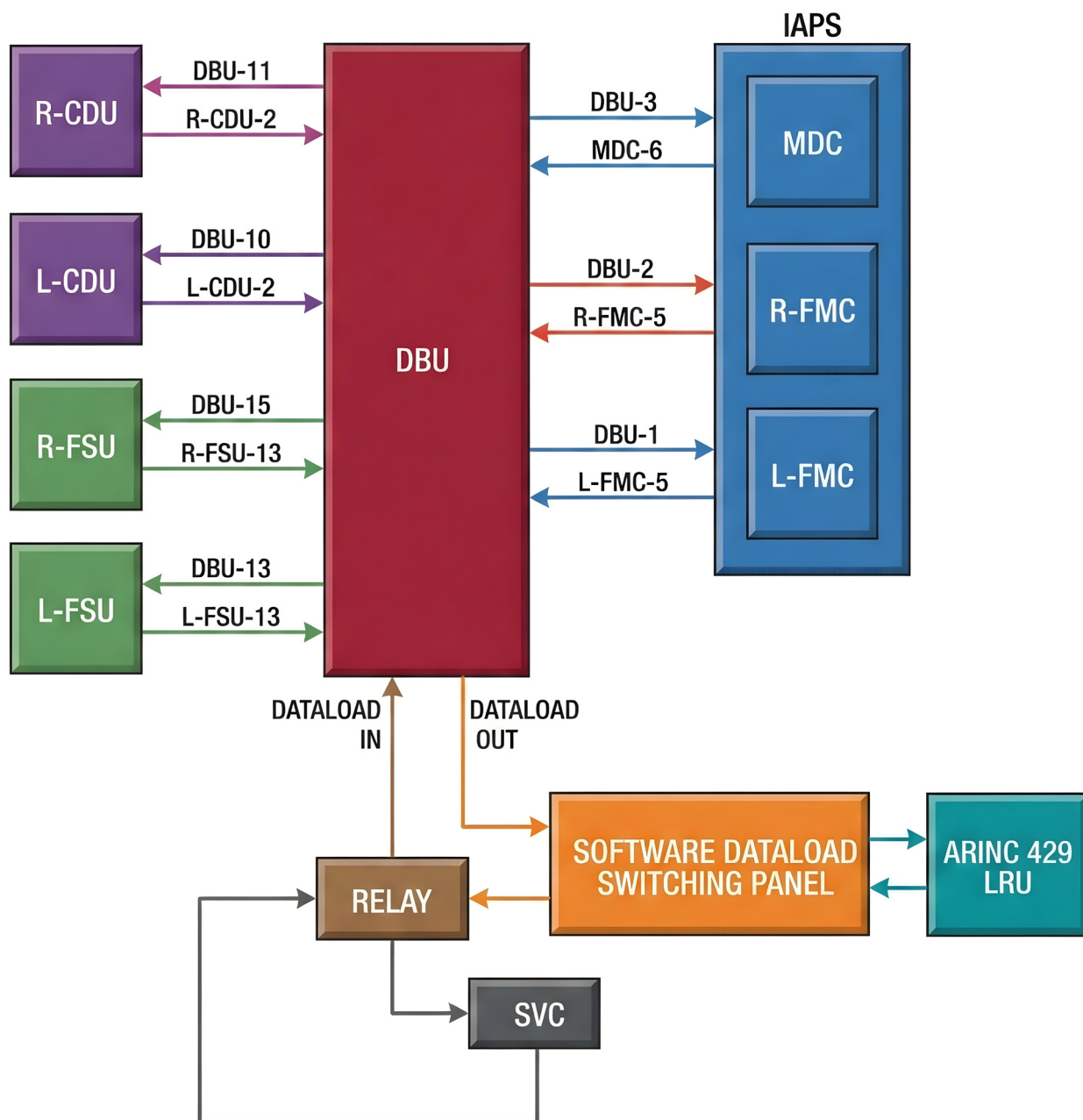
- RF leg procedures prohibited on airplanes 20501-20663 without SB 350-34-012
- FMS DR navigation as primary source
- RNAV operations with FMS DR, IRS ONLY, VOR/DME ONLY, VOR/DME DIST > 40.0 NM, or CHK POS
- RNP operations with NO APPR or UNABLE RNP messages
- NAV RADIO SELF TEST during flight

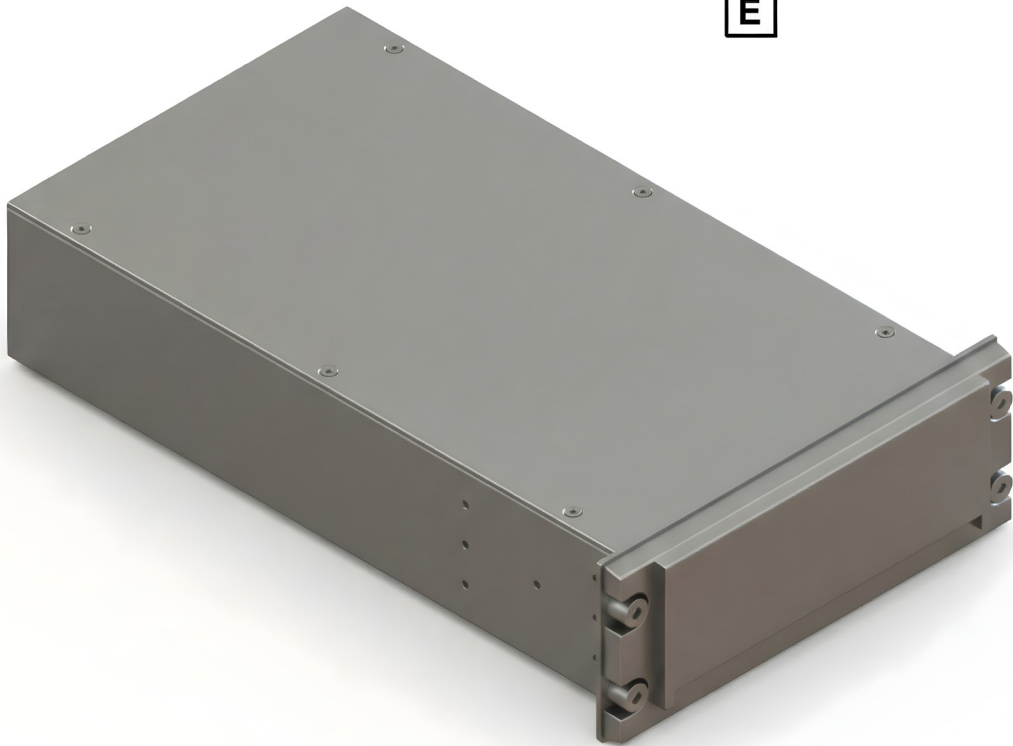
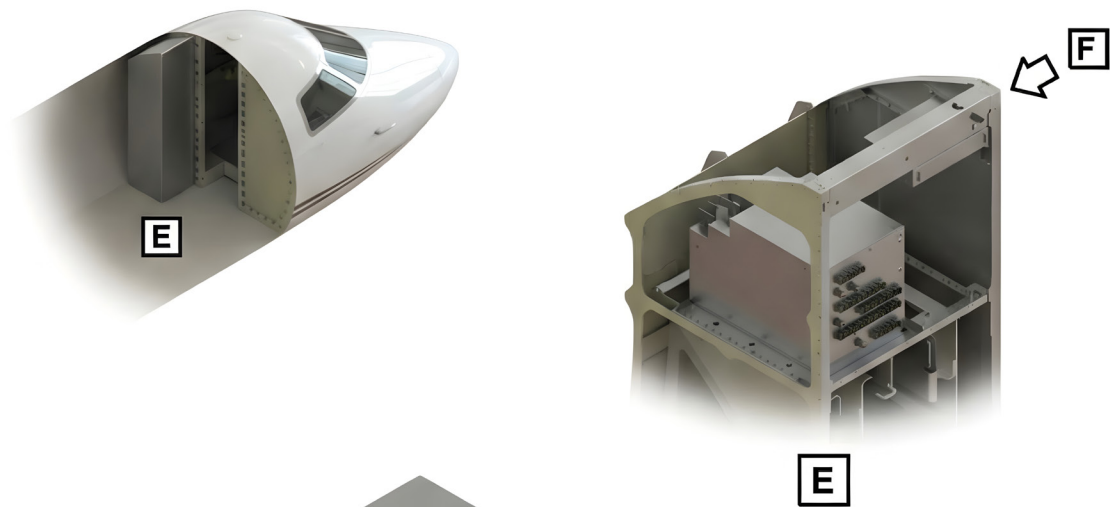
Database Requirements:

- IFR navigation requires verified current database or waypoint verification
- FMS automatically displays displaced thresholds if identified in database
- Manual runway length entry disables headwind/crosswind computation



DBU Interface





DATA LOADER (A191)

F



XIV. ADS-B

A. ADS FUNCTIONS

- ADS-B Out certified operation
- ADS-C for oceanic operations
- Automatic position reporting
- Intent broadcasting capability
- Enhanced surveillance support

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XV. EICAS MESSAGES

A. CAUTION MESSAGES

CAUTION MESSAGES

Timely crew awareness/action needed

Message	Meaning	Inhibits
XPDR 1 & 2 FAIL	For TSS equipped aircraft: Transponders 1 and 2 have failed	—
XPDR 1 (2) FAIL	For TSS equipped aircraft: Transponders 1 or 2 have failed	—

B. ADVISORY MESSAGES

ADVISORY MESSAGES

Crew awareness - no immediate action required

Message	Meaning	Inhibits
TAWS BASIC FAIL	Some or all of the basic modes (Mode 1 thru 6) of the terrain awareness warning system have failed. The terrain awareness warning system has failed	TO/LAND
TAWS SYSTEM FAIL	The terrain awareness warning system has failed	TO/LAND
TAWS TERR FAIL	The terrain function of the terrain awareness system has failed	TO/LAND
TAWS TERR NOT AVAIL	The TAWS terrain database has no data for the current location	TO/LAND
TAWS WINDSHEAR FAIL	The windshear function of the terrain awareness warning system has failed	TO/LAND
TSS FAN FAIL	For aircraft with TSS installation: The cooling fan on the TSS mounting tray is not operating properly	—
XPDR 1 (2) FAIL	For TSS equipped aircraft: The indicator transponder has failed	—

C. STATUS MESSAGES

STATUS MESSAGES	
Information only - no crew action required	
Message	Meaning
TAWS FLAPS OFF	The flap warning function of the terrain awareness warning system has been selected OFF by the crew
TAWS GS WARN OFF	The glideslope warning function of the terrain awareness warning system has been selected OFF
TAWS TERR OFF	The terrain warning function of the terrain awareness warning system has been selected OFF
XPDRS IN STBY	For aircraft with TSS installation: Both transponders 1 and 2 are in standby mode. (If one of the transponders has failed, this message will not display.)



XVI. LIMITATIONS

A. FMS LIMITATIONS

Flight Management System (FMS) Limitations

General FMS Prohibitions (All Aircraft)

The following limitations apply to ALL aircraft:

- It is **Prohibited** to load pilot routes from the PILOT ROUTE LIST during flight.
- It is **Prohibited** to upload flight plans from ROUTE MENU (FPLN RECALL) during flight.
- It is **Prohibited** to select FPLN WIND UPDATE from the ROUTE MENU.
- It is **Prohibited** to tune a localizer on the TUNE page using the identifier only.
- It is **Prohibited** to initiate a NAV RADIO SELF TEST from either the NAV radio tuning page on the FMS CDU or the MFD nav radio menu during flight.
- It is **Prohibited** to use the FMS as the primary source of navigation during periods of dead reckoning (indicated by the FMS DR message).
- It is **Prohibited** to load FMS procedures that are referenced to True Heading into the flightplan.
- IFR navigation is **Prohibited** unless the pilot verifies the currency of the database or verifies the waypoints for accuracy by reference to current publications.
- TAWS TERRAIN OFF **must be selected** when QFE operations, and GPS is not available.

FMS Navigation Source Requirements

Effectivity: On airplanes 20664 and subsequent, and airplanes incorporating SB 350-34-012:

- It is **Prohibited** to use the FMS as a navigation source when it is not receiving suitable navigation information from the following: One GNSS; or Two DMEs; or One VOR/DME; or One IRS.

Effectivity: On airplanes 20501-20663 not incorporating SB 350-34-012:

- It is **Prohibited** to use the FMS as a navigation source when it is not receiving suitable navigation information from Two GNSSs.
- Use of the FMS Secondary Flight Plan function is **Prohibited**.

FMS Geographic Prohibitions (All Aircraft)

The following limitations apply to ALL aircraft:

- FMS navigation (FMS selected as NAV Source) and display of magnetic heading is **Prohibited** in Canadian Northern Domestic Airspace and at the following locations:

Location	Restriction
Northern Latitudes	All latitudes greater than N82°
Canadian Arctic	Latitudes greater than N73° if between W080° and W170° longitude
Southern Latitudes	Latitude greater than S82°
Antarctic Region	Latitude greater than S60° if between E120° and E160° longitude

B. VNAV LIMITATIONS

Vertical Navigation (VNAV) Limitations

General VNAV Prohibitions (All Aircraft)

The following limitations apply to ALL aircraft:

- Use of VNAV vertical guidance is **Prohibited** when the barometric altitude is corrected to the landing field elevation (QFE).
- Use of VFLC (FLC with VNAV) is **Prohibited** during climb when the airspeed reference is displayed as Mach.
- It is **Prohibited** to select MCRZ from the FMS VNAV CRUISE page.
- It is **Prohibited** to select VNAV following a go-around during the missed approach procedure.
- Use of VNAV vertical guidance for VMDA type approach between the final approach fix and the missed approach fix is **Prohibited**.
- The flight crew must verify any altitude/speed constraints on the last waypoint of any entered STAR procedure and/or the first waypoint of any entered approach procedure.

Barometric VNAV Prohibition

Effectivity: On airplanes 20501-20663 not incorporating SB 350-34-012:

- Use of barometric VNAV vertical guidance is **Prohibited**.

C. NAV RECEIVER LIMITATIONS

Navigation Receiver Limitations

The following limitations apply to ALL aircraft:

- It is **Prohibited** to conduct ILS Approach operations with LOC2 as pilot navigation source and LOC1 as copilot navigation source.
- It is **Prohibited** to navigate using VOR or LOC as Nav source when displaying true heading mode.



D. SYNTHETIC VISION SYSTM (SVS) LIMITATIONS

Synthetic Vision System (SVS) Limitations

The following limitations apply to ALL aircraft:

- TAWS alerts must take priority over the image depicted on SVS.
- Use of the SVS for airplane navigation is **Prohibited**.
- Use of the SVS is **Prohibited** when the barometric altitude is corrected to the landing field elevation (QFE).
- When conducting an approach in airspace not referenced to WGS-84 or NAD-83, the SVS shall be deselected prior to passing the FAF.
- When conducting an approach to a runway not entered in the FMS flight plan, the SVS shall be deselected.
- The SVS Airport/Runway database must incorporate the current update cycle. If not, the SVS shall be deselected prior takeoff and prior to passing the FAF.
- The SVS does not render a video image above latitude 85°N and below latitude 85°S. The SVS shall be deselected prior reaching these latitudes.

SVS Shall Not Be Sole Source For:

Prohibited Use

Continuation of an approach, landing or takeoff below published minima
Execution of an approach, landing or takeoff in low visibility conditions
Replacement for natural vision where specific visual requirements exist
Replacement for basic attitude, flight guidance or navigation displays
Performance of any specific flight related task
Flight crew judgment, decision or action solely based on SVS display
Application of any operational credit

E. TERRAIN AWARENESS WARNING SYSTEM (TAWS) LIMITATIONS

Terrain Awareness Warning System (TAWS) Limitations

The following limitations apply to ALL aircraft:

- Navigation must not be predicated upon the use of the terrain awareness display.
- TAWS TERRAIN OFF must be selected when using QFE operations, and GPS is not available.

TAWS Mode Operating Parameters

Mode	Active Altitude	Function
Mode 1	Below 2,500 ft AGL	Excessive Descent Rate
Mode 4A	Below 190 kts: "TOO LOW GEAR" Above 190 kts: "TOO LOW TERRAIN"	Unsafe Terrain Clearance
Terrain Display	Maximum 300 nm range	Terrain Awareness

F. WEATHER RADAR LIMITATIONS

Weather Radar Limitations

The following limitations apply to ALL aircraft:

- Weather Radar information must be displayed continuously on at least one (1) PFD or MFD during the entire flight.
- Following a TAWS terrain caution or terrain warning, the Weather Radar information must be reinstated on at least one (1) PFD or MFD, after the encounter has been resolved.

Weather Radar Operating Parameters

Parameter	Value
Maximum Range	300 nm
Turbulence Mode Scan	±15°
Tilt Range	-15° to +15°
Predictive Windshear	Available below 1,200 feet AGL

G. RUNWAY AWARENESS and ADVISORY SYSTEM (RAAS) LIMITATIONS

Runway Awareness and Advisory System (RAAS) Limitations

The following limitations apply to ALL aircraft with RAAS installed:

- RAAS advisories are not intended for navigation purposes.
- Pilots should not deviate from ATC clearances or otherwise correct aircraft position based solely on RAAS advisories.
- Pilots may not use RAAS advisories as a replacement for NOTAM or ATIS information.
- RAAS Short and Insufficient Runway functions do not take into account aircraft performance factors such as aircraft weight, wind, runway conditions, slope, air temperature and altitude of airport.
- Data on newly constructed runways, changes to length of existing runways, or the rare change of runway identifier may not necessarily be included in the RAAS runway database.
- RAAS does not have knowledge of where painted hold lines are located at airports.
- The RAAS system is a situational awareness tool and should not be used as the primary source of determining field position, runway length, field performance, etc.
- Altimeter Monitor-Below Transition Altitude function is not available at airports defined as QFE in the EGPWS database.

H. RUNWAY OVERRUN AWARENESS and ALERTING SYSTEM (ROAAS) LIMITATIONS

Runway Overrun Awareness and Alerting System (ROAAS) Limitations

The following limitations apply to ALL aircraft with ROAAS installed:

- The use of ROAAS for approach and landings to runways with the departure end of runway (far end) temporarily displaced is **Prohibited**.
- With ROAAS on, to avoid ROAAS alerts, the landing distance available must be equal to or greater than FOLD (Factored Operational Landing Distance).

ROAAS Operating Parameters

Parameter	Value
Minimum Runway Length	3,000 feet
Arm Distance	Within 4.5 nm of runway
Arm Altitude	Less than 1,000 feet above runway
Track Alignment	Within 20° of runway centerline
In-Air Caution Zone	450 to 200 feet above runway
In-Air Warning Zone	200 feet to touchdown
On-Ground Active Range	Touchdown to 40 kts groundspeed
Alert Clearing Speed	Below 25 kts groundspeed

I. TRAFFIC ALERT and COLLISION AVOIDANCE SYSTEM (TCAS) LIMITATIONS

Traffic Alert and Collision Avoidance System (TCAS) Limitations

The following limitations apply to ALL aircraft:

- Maneuvers must not be based solely on information presented on the traffic map overlay.
- TCAS Resolution Advisories (RA) are inhibited below 1,000 feet AGL.

TCAS Operating Parameters

Parameter	Value
Maximum Range	40 nm
Maximum Intruders Displayed	32 aircraft
RA Inhibit Altitude	Below 1,000 feet AGL
TA Time to CPA	Approximately 35 seconds
RA Time to CPA	Approximately 25 seconds

TCAS Regional Limitations

Effectivity: For airplanes on the Russian Federation (RF) and Commonwealth of Independent States (CIS) countries' registry:

- Flight is not permitted along routes where ATC service provided is not in RBS mode.
- TCAS II TA/RA mode is not recommended on routes where ATC modes not limited to RBS are provided. On these routes, while in TA mode, the pilot action shall be coordinated with ATC.



J. INTEGRATED FLIGHT INFORMATION SYSTEM (IFIS) LIMITATIONS

Integrated Flight Information System (IFIS) Limitations

The following limitations apply to ALL aircraft:

- Incorporation of Dual IFIS does not constitute operational approval to dispatch without adequate backup documentation.
- The IFIS related databases utilized (charts, airspace, airways, geographic, political, graphical weather) must incorporate the current update cycle.
- The IFIS does not include enroute charts.
- The airplane symbol on the electronic charts is advisory and is presented for increased situational awareness. It is not to be used for navigation.
- The display of geo-political boundaries, airspace and airways on the MFD (Enhanced Map overlays) is for enhanced situational awareness only, and use for navigation is **Prohibited**.
- All weather products data linked to the airplane are advisory.
- For a single IFIS, adequate backup documentation must be immediately available to the flight crew.
- The airplane symbol displayed on airport diagram charts during ground operations is advisory and is presented for increased situational awareness. It is not to be used for precision maneuvering on the ground.
- It is not possible to display landscape formatted approach charts in split view.

K. RADIO ALTIMETER LIMITATIONS

Radio Altimeter Limitations

The following limitations apply to ALL aircraft:

Parameter	Value
Operating Range	-20 to 2,500 feet AGL
Display Range	Below 2,500 feet AGL

L. STANDBY INSTRUMENT (ISI) and COMPASS LIMITATIONS

Standby Instrument Limitations

The following limitations apply to ALL aircraft:

- Use of the standby instrument localizer deviation guidance is **Prohibited** during localizer backcourse approaches.
- L and R WSHLD/WINDOW switches must be temporarily selected OFF while the standby compass is being read.

M. DISTANCE MEASUREMENT EQUIPMENT (DMA) LIMITATIONS**Distance Measuring Equipment (DME) Limitations**

The following limitations apply to ALL aircraft:

Parameter	Value
Maximum Tracking Range	300 nm
Operating Frequency	962 to 1213 MHz
Limitation	Line-of-sight operations only

N. AUTOMATIC DIRECTION FINDER (ADF) LIMITATIONS**Automatic Direction Finder (ADF) Limitations**

The following limitations apply to ALL aircraft:

Parameter	Value
Frequency Range	190-1799 kHz
Maritime Distress Bands	2088-2094 kHz and 2179-2185 kHz
Limitation	Subject to thunderstorm interference



0. APPROACH LIMITATIONS

Approach Limitations

General Approach Requirements (All Aircraft)

The following limitations apply to ALL aircraft:

- Instrument approaches must be accomplished only in accordance with instrument approach procedures that are contained in the FMS database.
- It is **Prohibited** to conduct LPV Approach operations with FMS2 as pilot navigation source and FMS1 as copilot navigation source.
- Use of FMS instrument approaches is **Prohibited** unless RNP APPR or LPV APPR is annunciated on the PFD.
- FMS as a primary navigation source beyond the FAF is **Prohibited** for ILS, LOC and LOCBC approaches.
- When conducting an instrument approach with a T-Transition and utilizing VNAV for descent guidance, indicated airspeed at the initial approach fix must be 210 KIAS or less.
- Other than automatic FMS temperature compensation, changes to altitudes in the final approach segment (including FAF and step-down fixes) for any FMS approach procedures are **Prohibited**.
- The FMS with inputs from GNSS may only be used for approach guidance if the reference coordinate data system for the instrument approach is WGS84 or NAD83.
- GNSS sensors must be deselected when on approach in airspace not referenced to WGS84 or NAD83.

LPV Approach Prohibitions (All Aircraft)

The following limitations apply to ALL aircraft:

- RNP operations down to LPV minimum when any of the following messages are present, are **Prohibited**:

Message/Condition	Location
Red boxed "VNV" flag	Vertical deviation scale on PFD
NO APPR	PFD
EFIS MISCOMPARE	CAS message
EFIS COMPARATOR INOP	CAS message
LPV NOT AVAIL	CDU

LPV Equipment Requirements (All Aircraft)

The following limitations apply to ALL aircraft:

Equipment	Requirement
PFD	Dual PFD required
GNSS/SBAS Sensors	Two required to commence; one required to continue
FMS	Dual FMS required

LPV Geographic Prohibition

Effectivity: For airplanes NOT incorporating Service Bulletins SB350-34-025 or SB350-34-033:

- LPV approach operations are **Prohibited** in the area defined by the following coordinates:

Point	Latitude	Longitude
A	N75°	W175°
B	N75°	W130°
C	N50°	W175°
D	N50°	W155°

P. RNP OPERATIONS LIMITATIONS

RNP Operations Limitations

CDI Scale Requirements (All Aircraft)

The following limitations apply to ALL aircraft:

- When conducting RNP operations the pilot must verify the PFD CDI scale annunciation is appropriate for the RNP leg:

RNP Type	Required CDI Scale
RNP APCH	0.3 nm
BASIC RNP-1	1.0 nm
RNP-2	2.0 nm
RNP-4	4.0 nm (selected by pilot)
RNP-10	4.0 nm (selected by pilot)

Flight Plan Leg Length Limitations (All Aircraft)

The following limitations apply to ALL aircraft:

RNP Operation	Maximum Leg Length
BASIC RNP-1	200 nm
RNP-2	400 nm
RNP-4 or RNP-10	500 nm

- Pilot defined waypoints (e.g. along track offset) must not be used to create individual legs shorter than the limiting length.
- When conducting non-AR RNP operations, pilots should maintain CDI lateral deviation less than +/-1 dot deviation except brief deviation in excess of +/-1 dot deviation during waypoint sequencing is permitted.



P. RNP OPERATIONS LIMITATIONS (continued)

Radius-to-Fix (RF) Leg Prohibition

Effectivity: On airplanes 20501-20663 not incorporating SB 350-34-012:

- Performing any departure, arrival, approach or missed approach procedure that contains any radius-to-fix (RF) leg(s) is **Prohibited**.

RNAV Prohibited Operations (All Aircraft)

The following limitations apply to ALL aircraft:

- RNAV operations per AC 90-100A or AC 90-96A in RNAV 1, RNAV 2 or RNAV 5 are **Prohibited** with any of the following FMS messages annunciated:

Message	Location
FMS DR	PFD, MFD or CDU
IRS ONLY	PFD, MFD or CDU
VOR/DME ONLY or V/D ONLY	CDU or PFD
VOR/DME DIST > 40.0 NM	CDU
CHK POS	PFD or CDU

- RNP operations with any of the following FMS messages annunciated are **Prohibited**:

Message	Location
NO APPR	PFD
UNABLE RNP	PFD

XVII. CIRCUIT BREAKERS

Navigation System Circuit Breakers

CB Name	Bus	Location
CB Name	Bus	Location
NAV 1	LEFT ESS	CB1-A1
NAV 2	RIGHT MAIN	CB2-A1
DME 1	LEFT MAIN	CB1-A2
DME 2	RIGHT MAIN	CB2-A2
GPS 1	LEFT ESS	CB1-A3
GPS 2	RIGHT MAIN	CB2-A3
CDU 1	LEFT ESS	CB1-A4
CDU 2	RIGHT MAIN	CB2-A4
TCAS/XPDR1	LEFT ESS	CB1-A5
XPDR 2	RIGHT MAIN	CB2-A5
TAWS	RIGHT MAIN	CB2-A6
WX	LEFT MAIN	CB1-A8
ATT HDG 1	LEFT ESS	CB1-C2
ATT HDG 2	RIGHT MAIN	CB2-C2
ELT/NAV	LEFT ESS	CB3-D4



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XVIII. NAVIGATION SYSTEM QUIZ

1. What is the VHF COM radio frequency range?
 - A) 108.00 to 117.95 MHz
 - B) 118.000 to 136.991 MHz
 - C) 121.50 to 135.975 MHz
 - D) 108.00 to 136.991 MHz
2. How many VHF COM radios are standard on the Challenger 350?
 - A) 1
 - B) 2
 - C) 3
 - D) 4
3. What is the maximum tracking range of the DME system?
 - A) 200 nm
 - B) 250 nm
 - C) 300 nm
 - D) 350 nm
4. How many GPS satellites are required minimum for a navigation solution?
 - A) Three satellites
 - B) Four satellites
 - C) Five satellites
 - D) Six satellites
5. What is the fixed operating frequency of the marker beacon receiver?
 - A) 75.00 MHz
 - B) 108.00 MHz
 - C) 110.00 MHz
 - D) 121.50 MHz
6. Which SBAS service provider is used for North American LPV approaches?
 - A) EGNOS
 - B) MSAS
 - C) GAGAN
 - D) WAAS
7. At what altitude is Mode 1 TAWS active?
 - A) Below 2000 feet AGL
 - B) Below 2500 feet AGL
 - C) Below 3000 feet AGL
 - D) Below 3500 feet AGL

8. At what altitude is TCAS resolution advisory inhibited?
- A) Below 500 feet AGL
 - B) Below 1000 feet AGL
 - C) Below 1500 feet AGL
 - D) Below 2000 feet AGL
9. What is the operating range of the radio altimeter system?
- A) -10 to 2000 feet
 - B) -20 to 2500 feet
 - C) 0 to 3000 feet
 - D) -50 to 5000 feet
10. How many channels does the DME-4000 unit provide?
- A) Two channels
 - B) Three channels
 - C) Four channels
 - D) Five channels
11. What processor powers the FMC-6200 flight management computer?
- A) Intel Core i7
 - B) ARM Cortex
 - C) PowerPC 460EX
 - D) MIPS R3000
12. What is the maximum range of the weather radar system?
- A) 160 nm
 - B) 240 nm
 - C) 300 nm
 - D) 400 nm
13. Which navigation receiver integrates VOR/LOC/GS/MKR/ADF functions?
- A) NAV-4000
 - B) NAV-4500
 - C) NAV-5000
 - D) NAV-6000
14. What annunciation is required on the PFD for FMS instrument approaches?
- A) NAV ARM
 - B) RNP APPR or LPV APPR
 - C) FMS ACTIVE
 - D) APPR MODE
15. What is the ADF frequency range for maritime distress band monitoring?
- A) 2088-2094 kHz and 2179-2185 kHz
 - B) 1900-2000 kHz and 2100-2200 kHz
 - C) 2050-2100 kHz and 2150-2200 kHz
 - D) 2000-2050 kHz and 2200-2250 kHz



16. At what speed does Mode 4A change from “TOO LOW GEAR” to “TOO LOW TERRAIN”?

- A) 159 knots
- B) 190 knots
- C) 250 knots
- D) 300 knots

17. What is the glideslope receiver operating frequency range?

- A) 108.00 to 117.95 MHz
- B) 329.15 to 335.00 MHz
- C) 960 to 1215 MHz
- D) 108.10 to 111.95 MHz

18. Which Mode S transponder model is installed in the Challenger 350?

- A) TSS-3000
- B) TSS-3500
- C) TSS-4100
- D) TSS-4500

19. At what latitude limits does the SVS system stop rendering terrain?

- A) 80°N and 80°S
- B) 85°N and 85°S
- C) 90°N and 90°S
- D) 75°N and 75°S

20. What happens when a GPS sensor is manually DISABLED?

- A) It automatically re-enables after 5 minutes
- B) It remains disabled until manually enabled
- C) It re-enables on the next flight
- D) It re-enables when crossing 10,000 feet

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