C Series

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TECHNICAL TRAINING MANUAL

MODULE 3: AVIONICS

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the evolution of mobility

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ACRONYMS AND ABBREVIATIONS

A	
A/T	autothrottle
ABIT	automatic BIT
ABS	absolute
ABS	autobrake system
ACARS	aircraft communications addressing and reporting system
ACC	active clearance control
ACES	avionics cooling and extraction system
ACL	access control list
ACM	air cycle machine
ACM	aircraft condition monitoring
ACMF	aircraft condition monitoring function
ACMP	AC motor pump
ACP	audio control panel
ACU	audio conditioning unit
ADC	air data computer
ADEF	aircraft data exchange function
ADF	automatic direction finder
ADI	attitude direction indicator
ADLS	airborne data link system
ADMF	aircraft data management function
ADRF	aircraft data recording function
ADS	air data system
ADSP	air data smart probe
ADSP	air data system probe
AES	alternate extension system
AEV	avionics exhaust valve
AEMF	aft engine mount fitting
AFCS	automatic flight control system
AFCU	alternate flight control unit
AFDA	adaptive flight display application
AFDT	adaptive flight display table
AFDX	avionics full duplex switched Ethernet
AFM	Airplane Flight Manual
AFP	automated fiber placement
AGB	accessory gearbox
AGL	above ground level
AHC	attitude heading computer
AHMS	aircraft health management system
AIS	aircraft information server
AIS	audio integrating system
AIM	axle interface module
AIM	aircraft identification module
AIM	align-in-motion
AL	autoland
ALC	APU line contactor
ALI	airworthiness limitation item
Al-Li	aluminum-lithium
ALM	application license manager
ALT	altitude
ALTN FLAP	alternate flap
AM	amplitude modulation
AMCU	advanced monitor control unit
AMP	Aircraft Maintenance Publication
ANR	archive noise reduction
ANS	aircraft network switch

AOA	angle-of-attack
AOC	air/oil cooler
AOC	airport operational communications
AODV	active oil damper valve
AOHX	air/oil heat exchanger
AP	autopilot
APM	aircraft personality module
APR	automatic power reserve
APU	auxiliary power unit
AR	automatic realignment
ARTCC	air route traffic control center
ASA	autoland status annunciator
ASC	APU starting contactor
ASM	air separation module
ASRP	aircraft structure repair publication
AT	autothrottle
ATC	air traffic control
ATIS	air traffic information services
ATP	acceptance test procedure
ATS	air turbine starter
ATS	autothrottle system
ATS	air traffic services
AV-VENTS	avionics ventilated temperature sensor
B	
BALODS	bleed air leak and overheat detection system
BAP	buffer air pressure
BAS	bleed air system
BAV	bleed air valve
BACV	buffer air check valve
BAHX	buffer air heat exchanger
BAPS	buffer air pressure sensor
BAVS	buffer air valve solenoid
BAVSOV	buffer air shutoff valve
BCCC	base coat clear coat
BCS	brake control system
BCT	bus tie contactor current transformer
BDCU	brake data concentrator unit
BFO	beat frequency oscillator
BGM	boarding music
BIT	built-in test
BITE	built-in test equipment
BL	buttock line
BLC	battery line contactor
BLS	bifurcation latch system
BMPS	bleed monitoring pressure sensor
BPCU	bus power control unit
BPMS	bleed pressure monitoring sensor
BSC	battery start contactor
BTC	bus tie contactor
BTS	base transceiver station
BTMS	brake temperature monitoring system
BTS	brake temperature sensor
BTS	bleed temperature sensor
BVID	barely visible impact damage
C	
CADTS	cargo duct temperature sensor
CAI	cowl anti-ice
CAIS	cowl anti-ice system

CAIV	cowl anti-ice valve
CAM	cockpit area microphone
CAN	controller air network
CAS	calibrated airspeed
CAS	crew alerting system
CATS	cargo temperature sensor
CB	circuit breaker
CBIT	continuous built-in test
CBP	circuit breaker panel
CBV	cross-bleed valve
CC	cabin controller
CCDL	cross-channel data link
CCM	common computing module
CCMR	common computing module runtime
CCP	cursor control panel
CCU	camera control unit
CCW	counterclockwise
CDC	control and distribution cabinet
CDI	course deviation indicator
CDTS	compressor discharge temperature sensor
CEM	cover and environmental module
CF	configuration file
CFIT	controlled flight into terrain
CFRP	carbon fiber reinforced polymer
CIC	compressor intermediate case
CIC	corrosion inhibiting compound
CLAWS	control laws
CM	configuration manager
CMS	cabin management system

CMU	communication management unit
CMUI	configuration management unique identifier
CNS	communications, navigation and surveillance
COM	communication
CPCS	cabin pressure control system
CPCV	compensator pressure check valve
CPD	circuit protection device
CPDD	circuit protection device detector
CPDLC	controller-pilot data link communications
CPN	Collins part number
CPU	central processing unit
CRC	cyclical redundancy check
CRES	corrosion resistant steel
CSD	cabin service display
CSD	customer service display
CSMU	crash-survivable memory unit
CSOV	cargo shutoff valve
CT	crew terminal
CT	current transformer
CTP	control tuning panel
CVR	cockpit voice recorder
CW	clockwise
CWB	center wing box
D	
D/I	discrete input
D/O	discrete output
DBM	database manager
DCM	data concentrator module
DCMR	data concentration module runtime

DCS	data concentration system
DCU	directional control unit
DCV	directional control valve
DFSOV	dual-flow shutoff valve
DLCA	data link communications application
DMA	display manager application
DMC	data concentrator unit module cabinet
DME	distance measuring equipment
DMM	data memory module
DP	differential protection
DPCT	differential protection current transformer
DPI	differential pressure indicator
DPLY	deploy
DRA	diagnostic and reporting application
DSK	double-stack knob
DSM	digital switching module
DSU	data storage unit
DSPU	diode shunt protection unit
DTC	DC tie contactor
DTE	damage tolerance evaluation
DTI	damage tolerance inspection
DTS	duct temperature sensor
DU	display unit
E	
EBC	essential bus contactor
ECL	electronic checklist
ECS	environmental control system
ECU	electronic control unit
ECU	external compensation unit

EDCM	electronic door control module
EFAN	extraction fan
EDM	emergency descent mode
EDP	engine-driven hydraulic pump
EDP	engine-driven pump
EDU	electronic display unit
EEC	electronic engine control
EEGS	emergency electrical power generation
EEPROM	electrical erasable programmable read only memory
EESS	emergency escape slide system
EFB	electronic flight bag
EEGS	emergency electrical power generation
EFCS	electronic flight control system
eFIM	electronic fault isolation manual
EFIS	electronic flight instrument system
EGT	exhaust gas temperature
EHSV	electrohydraulic servovalve
EIC	engine inlet cowl
EICAS	engine indication and crew alerting system
ELC	external power line contactor
ELT	emergency locator transmitter
EMA	electric motor actuator
EMU	expansion module unit
EMAC	electric motor actuator controller
EMCU	electric motor control unit
EMER	emergency
EMPC	emergency power control
EOAM	emergency opening assist means
EOF	end-of-flight

EPC	electrical power center
EPC	electronic power center
EPGD	electrical power generation and distribution
EPGDS	electrical power generation and distribution system
EPGS	electrical power generation system
EPP	engine programming plug
EPSU	emergency power supply unit
EPTRU	external power transformer rectifier unit
ERAV	emergency ram air valve
ESD	electrostatic discharge
ETC	essential tie contactor
ETOPS	extended-range twin-engine operational performance standards
F	
FA	flight attendant
FAA	Federal Aviation Authority
FADEC	full authority digital engine control
FANS	future air navigation system
FAV	fan air valve
FBC	front bearing compartment
FBW	fly-by-wire
FBWPC	fly-by-wire power converter
FC	full close
FCP	flight control panel
FCS	flight control system
FCBS	fatigue critical baseline structure
FCEE	flight crew emergency exit
FCSB	fan cowling support beam
FCU	flush control unit
FCU	fuel control unit
FCV	flow control valve
FD	flight director
FDDSS	flight deck door surveillance system
FDE	flight deck effect
FDG	fan drive gearbox
FDGS	fan drive gear system
FDR	flight data recorder
FDRAS	flight deck remote access system
FDV	flow divider valve
FEGV	fan exit guide vane
FEMB	forward engine mount bulkhead
FF	fuel flow
FFDP	fuel flow differential pressure
FFSV	free fall selector valve
FG	flight guidance
FGS	flight guidance system
FIC	fan intermediate case
FIDEX	fire detection and extinguishing
FIM	fault isolation manual
FLC	flight level change
FLS	fast load-shed
FLTA	forward-looking terrain avoidance
FMA	flight mode annunciator
FMS	flight management system
FMSA	flight management system application
FMV	fuel metering valve
FO	full open
FOD	foreign object debris

FOHX	fuel/oil heat exchanger
FOHXBV	fuel/oil heat exchanger bypass valve
FPS	feedback position sensor
FPV	flight path vector
FQC	fuel quality computer
FS	fixed structure
FS	flight station
FS	fuselage station
FSA	file server application
FSV	flow sensor venturi
FSB	fasten seat belt
FSCL	flight spoiler control lever
FTIS	fuel tank inerting system
FW	failure warning
FWSOV	firewall shutoff valve
G	
GA	go-around
GCF	ground cooling fan
GCR	generator control relay
GCS	global connectivity suite
GCU	generator control unit
GFP	graphical flight planning
GFRP	glass fiber reinforced polymer
GHTS	galley heater temperature sensor
GLC	generator line contactor
GMT	Greenwich mean time
GNSS	global navigation satellite system
GPWS	ground proximity warning system
GS	glideslope

GS	ground spoiler
GSA	ground spoiler actuator
GSCM	ground spoiler control module
GSE	ground support equipment
GUI	graphical user interface
H	
HAAO	high altitude airport operation
HDG	heading
HF	high frequency
HID	high-intensity discharge
HLEIF	high load event indication function
HLSL	high lift selector lever
HMU	health management unit
HOR	hold open rod
HP	high-pressure
HPC	high-pressure compressor
HPD	hydraulic pump depressurization
HPGC	high-pressure ground connection
HPSOV	high-pressure shutoff valve
HPT	high-pressure turbine
HPV	high-pressure valve
HRD	high-rate discharge
HRTDb	high-resolution terrain database
HS	handset
HS	high solid
HSI	horizontal situation indicator
HSTA	horizontal stabilizer trim actuator
HSTS	horizontal stabilizer trim system
HUD	head-up display

HUDS	head-up display system
I	
I/O	input/output
IAMS	integrated air management system
IAS	indicated airspeed
IASC	integrated air system controller
IBIT	initiated built-in test
IBR	integral bladed rotor
ICAO	International Civil Aviation Organization
ICCP	integrated cockpit control panel
ICDU	integrated control display unit
ICU	inerting control unit
ICU	isolation control unit
ICV	isolation control valve
IFE	in-flight entertainment system
IFEC	in-flight entertainment and connectivity system
IFIS	integrated flight information system
IFPC	integrated fuel pump and control
IFS	information landing system
IFS	inner fixed structure
IGN	ignition
IGV	inlet guide vane
IGVA	inlet guide vane actuator
IIM	inceptor interface module
IIV	inlet isolation valve
ILS	instrument landing system
IMA	integrated modular avionics
IMS	information management system
INT	intermittent

IOC	input/output concentrator
IOM	input/output module
IP	information provider
IPC	integrated processing cabinet
IPCKV	intermediate pressure check valve
IPS	inches per second
IPS	integrated processing system
IRCV	inlet return check valve
IRS	inertial reference system
IRU	inertial reference unit
ISI	integrated standby instrument
ISM	input signal management
ISPS	in-seat power supply
ISPSS	in-seat power supply system
ITT	interturbine
J	
JOSV	journal oil shuttle valve
L	
L/S	lube/scavenge
LAN	local area network
LBIT	landing built-in test
LCD	life cycle data
LCT	line current transformer
LED	light-emitting diode
LLU	LED lighting unit
LGCL	landing gear control lever
LGCV	landing gear control valve
LGIS	landing gear indicating system
LGSCU	landing gear and steering control unit

LGSV	landing gear selector valve
LOC	localizer
LOP	low oil pressure
LOPA	layout of passenger area
LP	low-pressure
LPC	low-pressure compressor
LPSOV	low-pressure shutoff valve
LPT	low-pressure turbine
LRD	low-rate discharge
LRM	line replaceable module
LRU	line replaceable unit
LSK	line select key
LSOP	lubrication and scavenge oil pump
LV	lower sideband voice
LVDS	low-voltage differential signaling
LVDT	linear variable differential transformer
M	
MAX	maximum
MB	marker beacon
MCDL	motor control data link
MCE	motor control electronic
MCR	minimum control requirement
MCV	mode control valve
MDU	manual drive unit
MEL	minimum equipment list
MES	main engine start
MFK	multifunction keyboard panel
MFP	multifunction probe
MFS	multifunction spoiler
MFW	multifunction window
MIXTS	mix manifold temperature sensor
MLG	main landing gear
MLW	maximum landing weight
MMEL	Master Minimum Equipment List
MOF	main oil filter
MOT	main oil temperature
MPP	maintenance planning publication
MPSOV	minimum pressure-shutoff valve
MRW	maximum ramp weight
MSV	mode select valve
MTD	master time and date
MTO	maximum rated takeoff
MTOW	maximum takeoff weight
MWW	main wheel well
MZFW	maximum zero fuel weight
N	
NA	not activated
NACA	National Advisory Committee for Aeronautics
ND	nosedown
NCD	no computed data
NCG	network communication gap
NCU	network control unit
NDB	non-directional beacon
NDO	network data object
NEA	nitrogen-enriched air
NEADS	nitrogen-enriched air distribution system
NLG	nose landing gear
NO PED	no personal electronic device

NPRV	negative pressure-relief valve
NU	noseup
NWS	nosewheel steering
NVM	non-volatile memory
O	
OAT	outside air temperature
OBB	outboard brake
OBIGGS	onboard inlet gas generation system
OC	overcurrent
OCM	oil control module
OCM	option control module
ODI	overboard discharge indicator
ODL	onboard data loader
ODM	oil debris monitor
OEA	oxygen-enriched air
OEM	original equipment manufacturer
OF	overfrequency
OFV	outflow valve
OMS	onboard maintenance system
OMS IMA	OMS interactive maintenance application
OMSA	onboard maintenance system application
OMST	onboard maintenance system table
OPAS	outboard position asymmetry sensor
OPU	overvoltage protection unit
OSP	opposite-side pressure
OSS	overspeed/shutdown solenoid
OT	other traffic
OV	overvoltage
OWEE	overwing emergency exit

P	
P&W	Pratt and Whitney
P2	inlet pressure
PA	passenger address
PAX	passenger
PBA	pushbutton annunciator
PBE	protective breathing equipment
PBIT	power-up built-in test
PCE	precooler exhaust
PCE	precooler exit
PCU	power control unit
PDF	portable document format
PDOS	power door operating system
PDPS	pack pressure differential sensor
PDL	permitted damage limits
PDS	power distribution system
PDTS	pack discharge temperature sensor
PDU	power drive unit
PED	personal electronic device
PEM	power environment module
PEV	pressure equalization valve
PFCC	primary flight control computer
PFD	primary flight display
PFS	post flight summary
PHMU	prognostic and health monitoring unit
PIC	peripheral interface controller
PIC	processor-in-command
PIFS	pack inlet flow sensor
PIM	panel interface module

PIPS	pack inlet pressure sensor
PLD	programmable logic device
PLD	proportional lift dump
PMA	permanent magnet alternator
PMA	program manager application
PMAG	permanent magnet alternator generator
PMG	permanent magnet generator
POB	power off brake
POB	pressure off brake
POR	point of regulation
PPM	power producing module
PPT	pedal position transducer
PRAM	prerecorded announcement and message
PRSOV	pressure-regulating shutoff valve
PRV	pressure-regulating valve
PRV	pressure-relief valve
PS	passenger service
PS	pressure sensor
PSA	print server application
PSE	principal structural element
PSU	passenger service unit
PSUC	passenger service unit controller
PT	proximate traffic
PT	pressure transducer
P_t	total pressure
PTS	pack temperature sensor
PTT	push-to-talk
PTU	power transfer unit
PTY	priority

PVT	position, velocity, time
PWM	pulse width modulation
Q	
QAD	quick attach/detach
QEC	quick engine change
R	
RA	radio altimeter
RA	resolution advisory
RAM	receiver autonomous integrity monitoring
RAD	radio altitude
RARV	ram air regulating valve
RAT	ram air turbine
RDC	remote data concentrator
RDCP	refuel/defuel control panel
REL	relative altitude
REO	repair engineering order
RET	retracted
REU	remote electronic unit
RF	radio frequency
RFAN	recirculation fan
RGA	rotary geared actuator
RGC	RAT generator control
RIPS	recorder independent power supply
RIU	radio interface unit
RLC	RAT line contactor
RMA	remote maintenance access
RMS	radio management system
ROLS	remote oil lever sensor
ROV	redundant overvoltage

RPA	rudder pedal assembly
RPM	revolutions per minute
RSA	report server application
RSP	reversion switch panel
RTA	receiver-transmitter antenna
RTD	resistance temperature device
RTD	resistive thermal device
RTL	ready-to-load
RTO	rejected takeoff
RTS	return to service
RTSA	radio tuning system application
RVDT	rotary variable differential transformer
S	
SAL	specific airworthiness limitation
SAT	static air temperature
SATCOM	satellite communication
SAV	starter air valve
SB	service bulletin
SBAS	satellite-based augmentation system
SBIT	start-up BIT
SCV	surge control valve
SCV	steering control valve
SEB	seat electronics box
SELCAL	selective calling
SFCC	slat/flap control computer
SFCL	slat/flap control lever
SFCP	slat/flap control panel
SFECU	slat/flap electronic control unit
SFIS	standby flight instrument system

SFV	safety valve
SLS	slow load-shed
SMS	surface management system
SOV	solenoid operated valve
SOV	shutoff valve
SPCV	supply pressure check valve
SPDS	secondary power distribution system
SPDT	single pole double throw
SPKR	speaker
SPM	seat power module
SSC	sidestick controller
SSD OML	solid-state onboard media loader
SSI	structural significant item
SSEC	static source error connection
SSPC	solid-state power controller
SSPC-CB	solid-state power controller circuit breaker
SSRPC	solid-state remote power controller
SUA	special use airspace
SVA	stator vane actuator
SVS	synthetic vision system
T	
T/M	torque motor
T/R	thrust reverser
T2	inlet temperature
TA	traffic advisory
TACKV	trim air check valve
TAPRV	trim air pressure-regulating valve
TASOV	trim air shutoff valve
TAT	total air temperature

TAV	trim air valve
TAWS	terrain awareness and warning system
TAWSDb	terrain awareness and warning system database
TCA	turbine cooling air
TCAS	traffic alert and collision avoidance system
TCB	thermal circuit breaker
TCDS	type certificate data sheet
TCF	terrain control valve
TDR	transponder
TCV	temperature control valve
TEC	turbine exhaust case
TED	trailing edge down
TEU	trailing edge up
TFTP	trivial file transfer protocol
TIC	turbine inlet case
TIC	turbine intermediate case
TIV	temperature inlet valve
TIV	temperature isolation valve
TLA	throttle lever angle
TLC	TRU line contactor
TLD	time limited dispatch
TOGA	takeoff/go-around
TPIS	tire pressure indicating system
TPM	TAWS processing module
TPM	tire pressure module
TPMA	terrain processing module application
TPMU	tire pressure monitoring unit
TPS	tire pressure sensor
TPSA	terrain processing system application

TQA	throttle quadrant assembly
TRAS	thrust reverser actuation system
TRU	transformer rectifier unit
TSC	TRU start contactor
TSFC	thrust specific fuel consumption
TSM	trip status monitor
TSO	technical standard order
TSS	traffic surveillance system
TTG	time-to-go
TTP	time-triggered protocol
TWIP	terminal weather information for pilot
U	
UART	universal asynchronous receiver transmitter
UBMF	usage-based monitoring function
UF	underfrequency
ULB	underwater locator beacon
UPLS	ultrasonic point level sensors
USB	universal serial bus
UTC	universal time coordinated
UV	upper sideband voice
UV	ultraviolet
UV	undervoltage
V	
VAC	volts alternating current
VDC	voltage direct current
VDL	VHF data link
VDLM	VHF data link mode
VENTS	ventilated temperature sensor
VFG	variable frequency generator

VFGOOHX	variable frequency generator oil/oil heater exchanger
VGMD	vacuum generator motor drive unit
VHF-NAV	VHF navigation
VID	visible impact damage
VL	virtual link
VLAN	virtual local area network
VNAV	vertical navigation
VOC	volatile organic compounds
VOR-VHF	VHF omnidirectional radio
VORV	variable oil reduction valve
VPA	video passenger announcement
VSD	vertical situation display
VSPD	V-speed
VSWR	voltage standing-wave radio
VTU	video transmission unit
W	
WAI	wing anti-ice
WAP	wireless access point
WAIS	wing anti-ice system
WAITS	wing anti-ice temperature sensor
WAIV	wing anti-ice valve
WBV	windmill bypass valve
WIPC	windshield ice protection controller
WL	waterline
WOFFW	weight-off-wheels
WOW	weight-on-wheels
WPS	words-per-second
WS	wing situation
WSA	web server application
WST	wheel speed transducer
WTBF	wing-to-body fairing
WWHS	windshield and side window heating system
WWS	waste water system
WWSC	water and waste system controller
WXR	weather radar
Z	
ZB	zone box
ΔP	differential pressure

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MODULE 3: AVIONICS - LIST OF CHANGES

The following table details the changes applied to this revision:

ATA NAME AND NUMBER	CMUI NUMBER	CHANGES APPLIED
Front Page	CS130-21.03-05.00-042817	Version number and CMUI changed
Acronyms and Abbreviations	CS130-21.03-05.00-042817	No changes
List of Changes	CS130-21.03-05.00-042817	New list of changes added
22 Autoflight	CS130-21.03-05.00-042817	No changes
23 Communication	CS130-21.03-05.00-042817	No changes
26 Fire Protection	CS130-21.03-05.00-042817	No changes
33 Lighting System	CS130-21.03-05.00-042817	Text updated for logic details (pge 33-52)
34 Navigation	CS130-21.03-05.00-042817	Direct access keys changed to quick-access keys (pge 34-56)
		Direct access keys changed to quick-access keys in Figure 24 (pge 34-57)
44 Cabin Systems	CS130-21.03-05.00-042817	No changes

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ATA 22 - Autoflight

BD-500-1A10
BD-500-1A11

Table of Contents

22-11 Automatic Flight Control System 22-2
General Description 22-2
Automatic Flight Control System....22-2
Flight Guidance System....22-2
Autopilot....22-2
Autoland....22-2
Autothrottle....22-2
Component Location 22-4
Data Concentrator Unit Module Cabinets 22-4
Primary Flight Control Computer 22-6
Controls and Indications....22-8
Flight Control Panel 22-8
Primary Flight Display....22-10
Detailed Description 22-12
Automatic Flight Control System Interface....22-12
Primary Flight Control Computers Active/Standby Configuration....22-14
22-00 Flight Guidance System 22-16
Controls and Indications 22-16
Flight Mode Annunciator....22-16
Operation 22-18
Flight Director Display Selection....22-18
Flight Guidance Transfer 22-20
Flight Guidance Active/Standby Switching 22-22
Detailed Description 22-24
Monitoring and Tests 22-26
22-10 Autopilot....22-28
Operation 22-28
Detailed Description 22-30
Emergency Descent Mode.... 22-32
22-00 Autoland.... 22-34
Controls and Indications 22-34
Operation 22-36
Autoland - LAND2 or LAND3 Sequence 22-36
Autoland Operation During Go-Around 22-38
Detailed Description 22-40
VHF Navigation Antenna Switching 22-42
Autoland Capability 22-44
Autoland Downgrade.... 22-46
22-30 Autothrottle 22-48
General Description 22-48
Operation 22-50
Autothrottle System Engagement/Disengagement ... 22-50
Autothrottle Control Path 22-52
Autothrottle Modes 22-54
Detailed Description 22-56
Autothrottle Engage Operation.... 22-56
Monitoring and Tests 22-58

List of Figures

Figure 1: Automatic Flight Control System - General Layout (L2) 22-3
Figure 2: Data Concentrator Unit Module Cabinets (L2) 22-5
Figure 3: Primary Flight Control Computers (L2)..................22-7
Figure 4: Flight Control Panel (L2) 22-9
Figure 5: Automatic Flight Control System Indications on the Primary Flight Display (L2) 22-11
Figure 6: Automatic Flight Control System Interface (L3) 22-13
Figure 7: Primary Flight Control Computer Active/Standby Configurations (L3).....................22-15
Figure 8: Flight Mode Annunciator (L2) 22-17
Figure 9: Flight Director Selection (L2)..............................22-19
Figure 10: Flight Guidance Transfer (L2) 22-21
Figure 11: Alternate Flight Guidance Selection (L2).............22-23
Figure 12: Flight Guidance System (L3)..............................22-25
Figure 13: Flight Director Flags (L2)...................................22-27
Figure 14: Autopilot Engage/Disengage (L2) 22-29
Figure 15: Autopilot Operation (L3) 22-31
Figure 16: Emergency Descent Mode (L3)..........................22-33
Figure 17: Autoland Controls and Indications (L2) 22-35
Figure 18: Autoland Sequence (L2)....................................22-37
Figure 19: Autoland Operation Following Go-Around Selection (L2) 22-39
Figure 20: Autoland System Layout (L3).............................22-41
Figure 21: VHF Navigation Antenna Switching (L3).............22-43
Figure 22: Autoland Downgrade During Approach (L3)....... 22-47
Figure 23: Autothrottle System (L2) 22-49
Figure 24: Autothrottle Controls (L2).................................. 22-51
Figure 25: Autothrottle Control Path (L2) 22-53
Figure 26: Autothrottle Modes (L2) 22-55
Figure 27: Autothrottle Engage Operation (L3).................... 22-57

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AUTOFLIGHT - CHAPTER BREAKDOWN

Automatic Flight Control System 1

Flight Guidance System 2

Autopilot 3

Autoland 4

Autothrottle 5

22-11 AUTOMATIC FLIGHT CONTROL SYSTEM

GENERAL DESCRIPTION

AUTOMATIC FLIGHT CONTROL SYSTEM

The automatic flight control system (AFCS) is highly automated, requiring minimal crew input and featuring integrated flight guidance, autothrottle, and dual-axis autopilot functions. An optional autoland feature allows for three-axis autopilot control during approach, touchdown, and rollout.

The AFCS functions are electrically powered from the cabinets and flight control computers where installed. There are no dedicated circuit breakers for the AFCS functions.

Two circuit breakers are provided for the flight control panel (FCP), one for each FCP channel (A, B). Channel A is powered from the DC ESS BUS 3 via a thermal circuit breaker (FCP A), located on the left circuit breaker panel. Channel B is powered from the DC BUS 2 via a solid-state power controller (SSPC) (FCP B), located in the control and distribution cabinet (CDC).

FLIGHT GUIDANCE SYSTEM

The flight guidance system (FGS) uses crew selections, sensor, and navigation system inputs to compute lateral and vertical guidance. Guidance is presented on the primary flight displays (PFDs) as a magenta flight director (FD) cue. The flight guidance (FG) mode annunciations are presented on a flight mode annunciator (FMA) block, located at the top of each PFD.

During manual-controlled flight, the crew uses the flight director cue for guidance. Engaging the autopilot allows for automatic control of the aileron and elevator control systems, based on the flight guidance commands.

AUTOPILOT

The autopilot (AP) commands are routed to the fly-by-wire (FBW) system and integrated with the protective control laws.

AP engagement is made from the FCP, while disengage selections can be made from the FCP or either sidestick control.

AUTOLAND

An optional automatic landing (autoland) installation uses multiple sensors and processors to compute highly accurate, three-axis control command during an instrument landing system (ILS) approach.

Autoland includes a flare command, automatic throttle retard, and nosewheel steering control during the landing rollout. The operational capability of the autoland system is automatically calculated and annunciated to the flight crew in a dedicated status field located below the flight mode annunciator on each PFD.

AUTOTHROTTLE

The autothrottle system controls the movement of both throttle levers. The throttle levers are positioned to achieve either a thrust or airspeed target, depending on the active vertical flight guidance mode. The autothrottle system is engaged from the FCP, and can be disconnected by switches on either throttle.

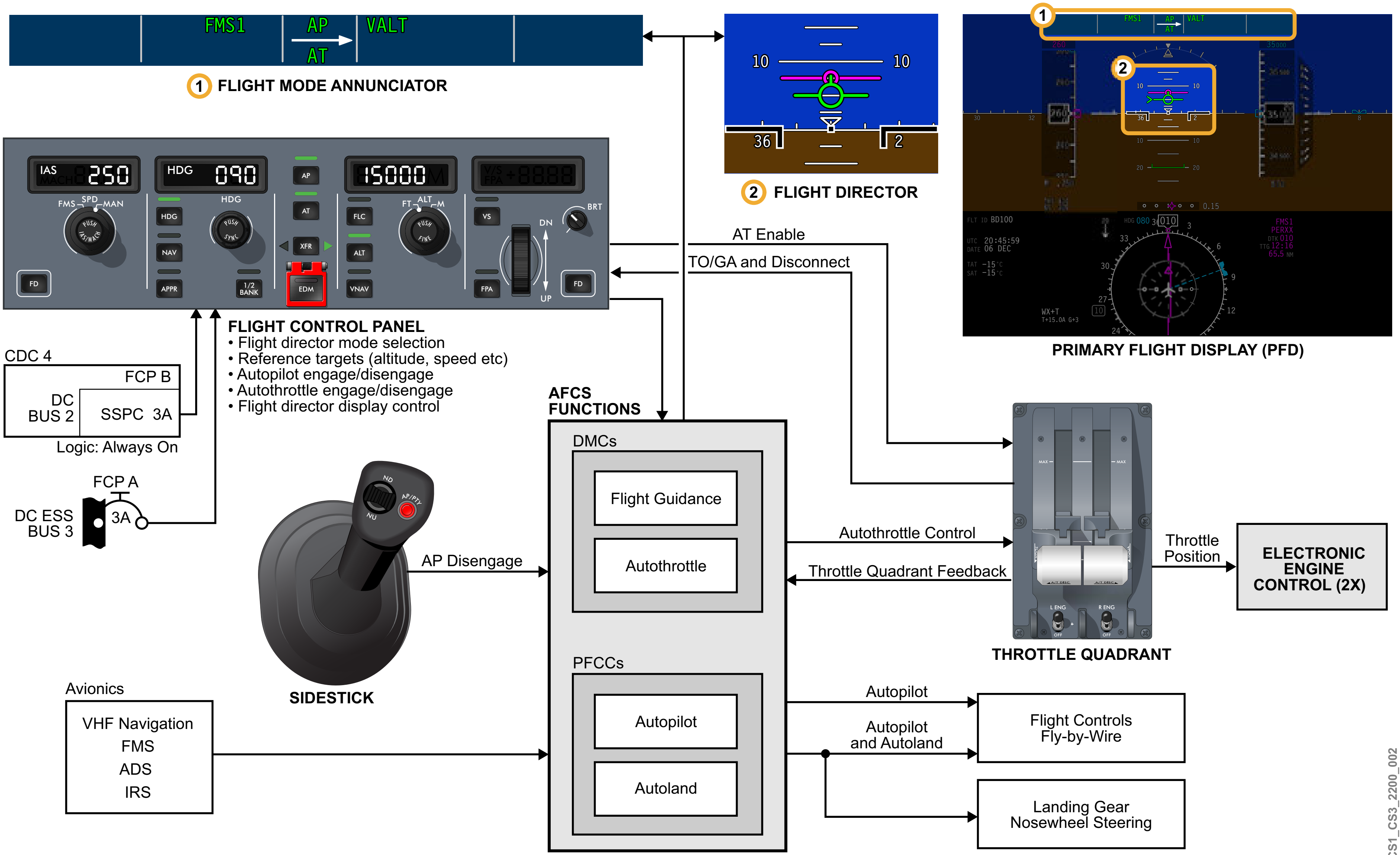


Figure 1: Automatic Flight Control System - General Layout (L2)

COMPONENT LOCATION

The AFCS is comprised of several software applications contained in the following line replaceable units (LRUs):

- Data concentrator unit module cabinets (DMCs)
- Primary flight control computers (PFCC)

DATA CONCENTRATOR UNIT MODULE CABINETS

The data concentrator unit module cabinets (DMCs) are located in the mid equipment compartment.

Each DMC includes two channels, channel A and channel B, containing line replaceable data concentrator modules (DCMs).

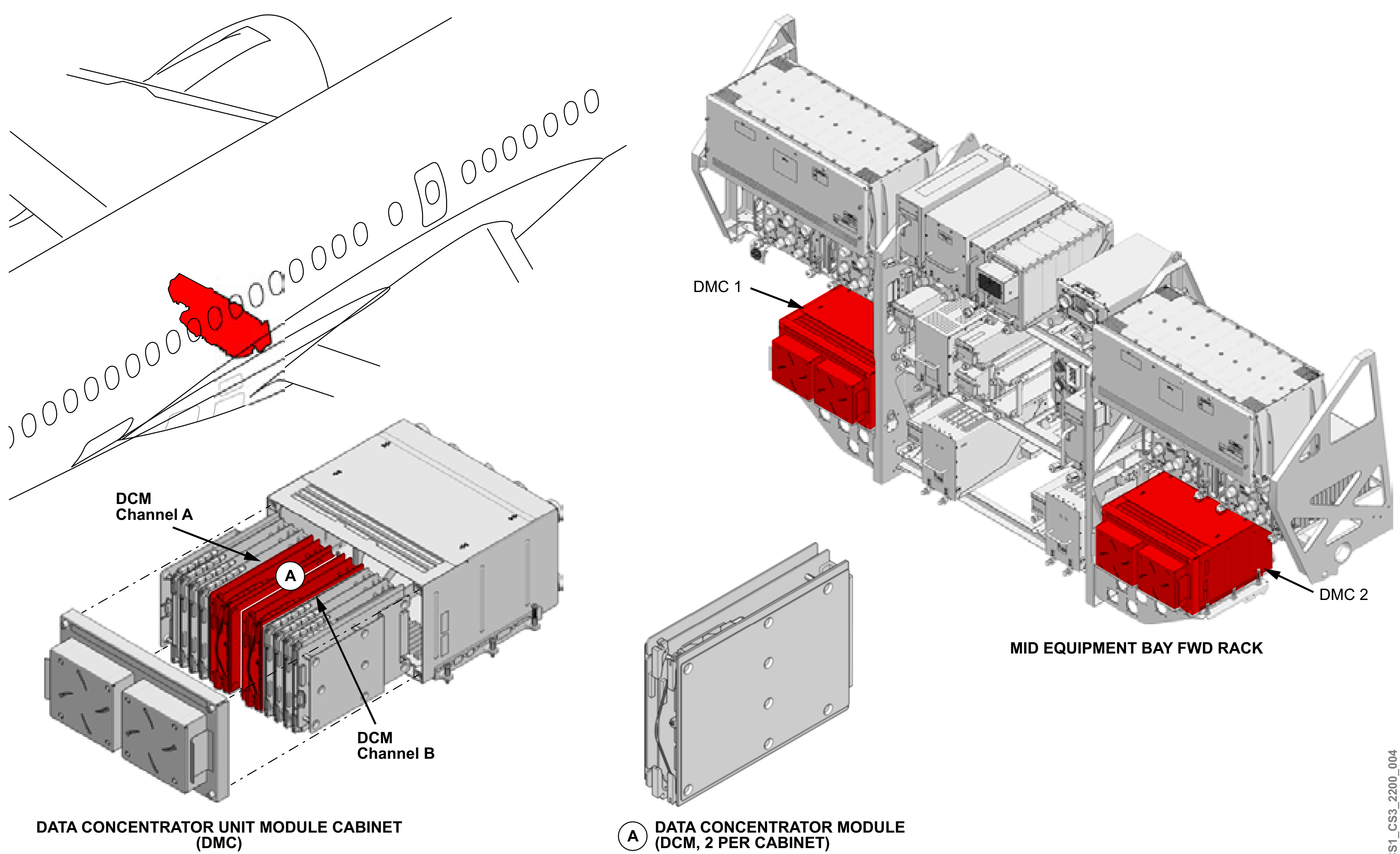


Figure 2: Data Concentrator Unit Module Cabinets (L2)

PRIMARY FLIGHT CONTROL COMPUTER

The three primary flight control computers (PFCCs) are installed in the forward and mid equipment bays.

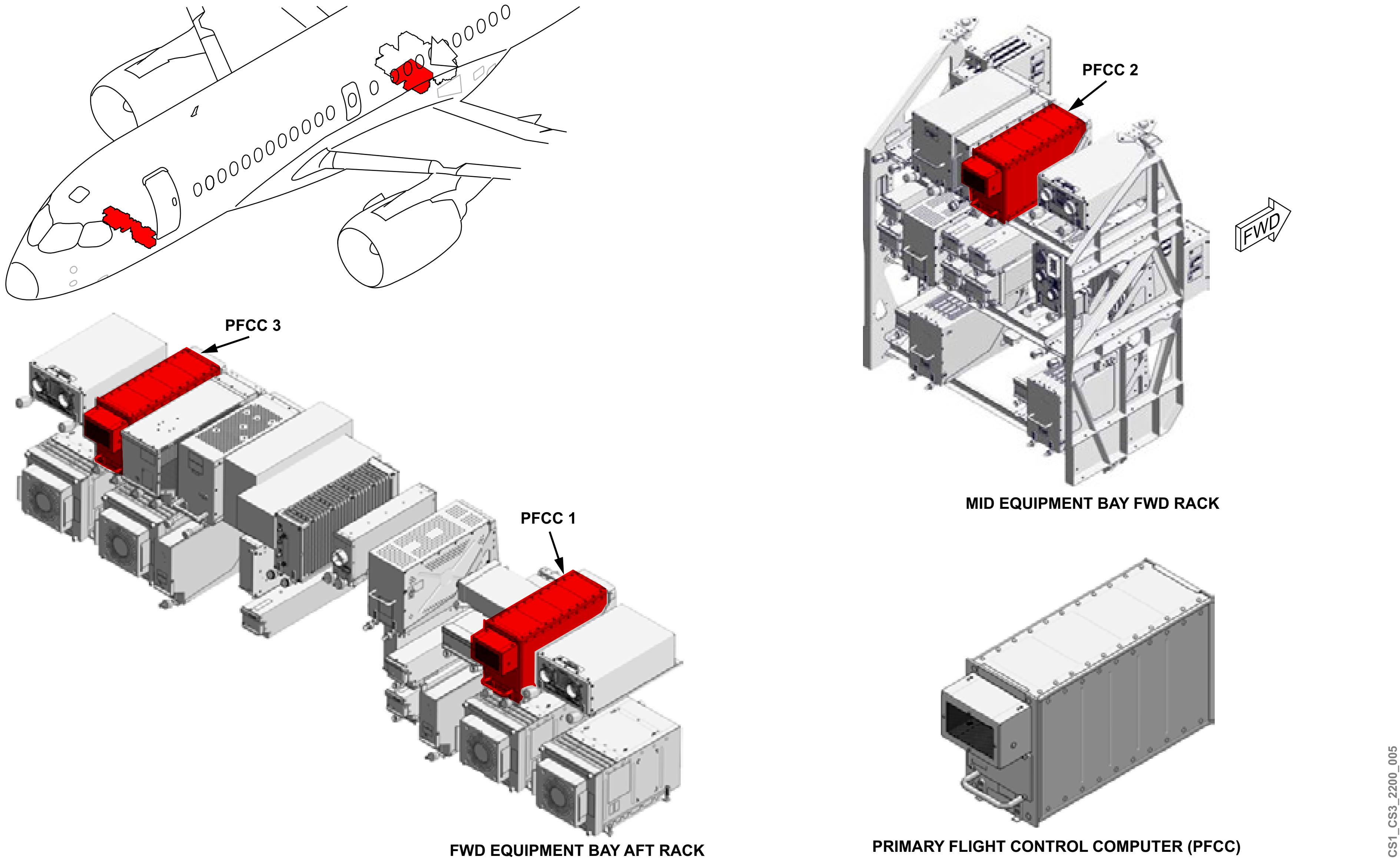


Figure 3: Primary Flight Control Computers (L2)

CONTROLS AND INDICATIONS

FLIGHT CONTROL PANEL

The automatic flight control system (AFCS) is primarily controlled using the appropriate switches and controls on the dual-channel flight control panel (FCP) as follows:

- Speed target switch
- Speed reference window
- Heading reference window
- Flight director couple select switch
- Autopilot engage switch
- Autothrottle engage switch
- Altitude reference window
- Altitude select switch
- Vertical speed reference window
- Panel windows brightness control selector
- Pilot flight director select switch
- Lateral mode switches
- Heading select knob
- Emergency descent mode switch
- Vertical mode switches
- Vertical rate control knob
- Copilot flight director select switch

The green mode indicators illuminate when the associated mode button has been manually selected, and the mode has been acknowledged by the flight guidance system. Automatically enabled modes do not cause the lamps to illuminate.

The altitude and vertical speed windows display crew selected values only. The heading window displays selected heading when heading synchronization (SYNC) is not active. The speed window displays manual speed entry only. The vertical speed, heading and speed windows remain blank if flight guidance is being managed by the flight management system (FMS).

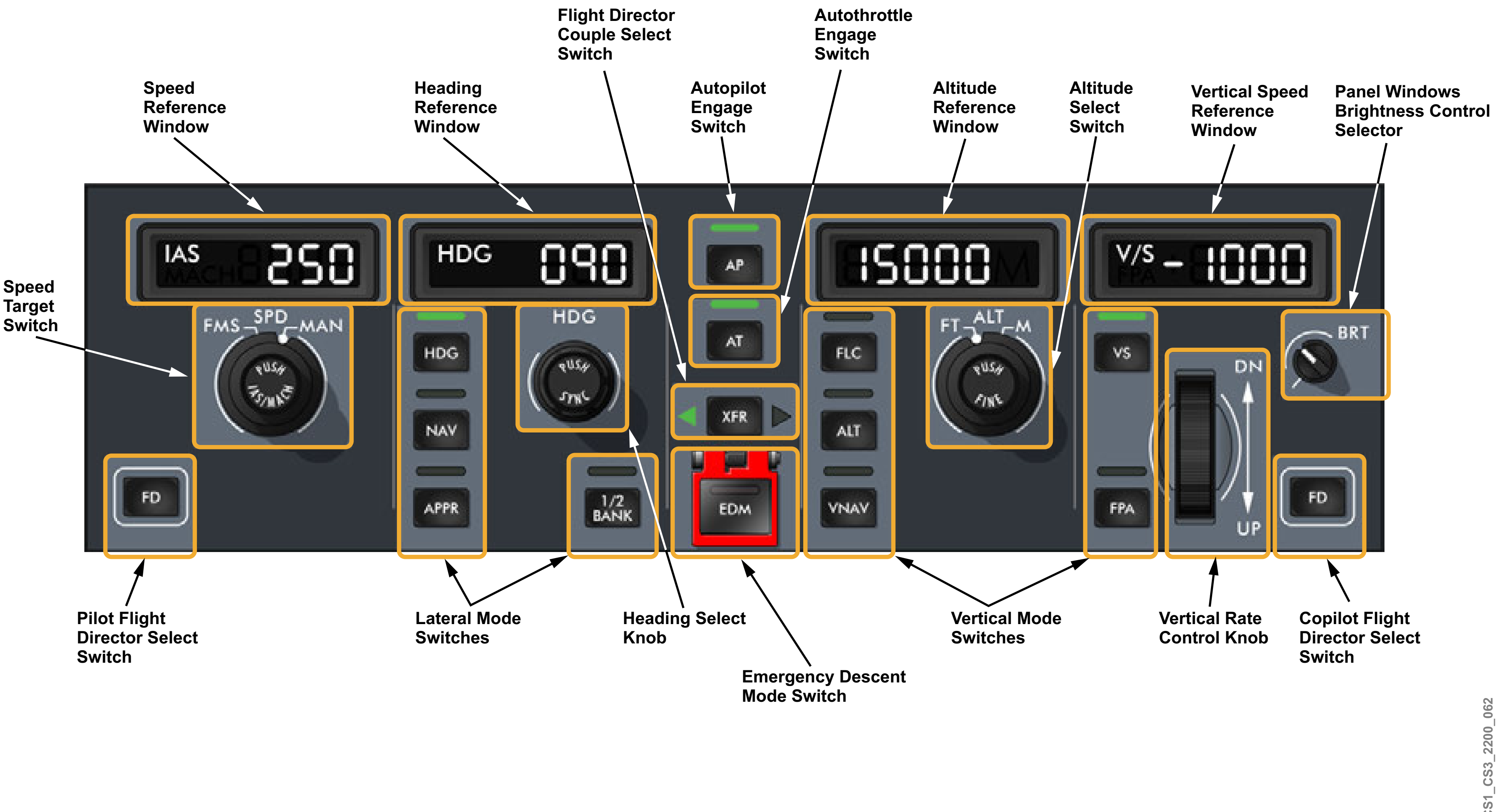
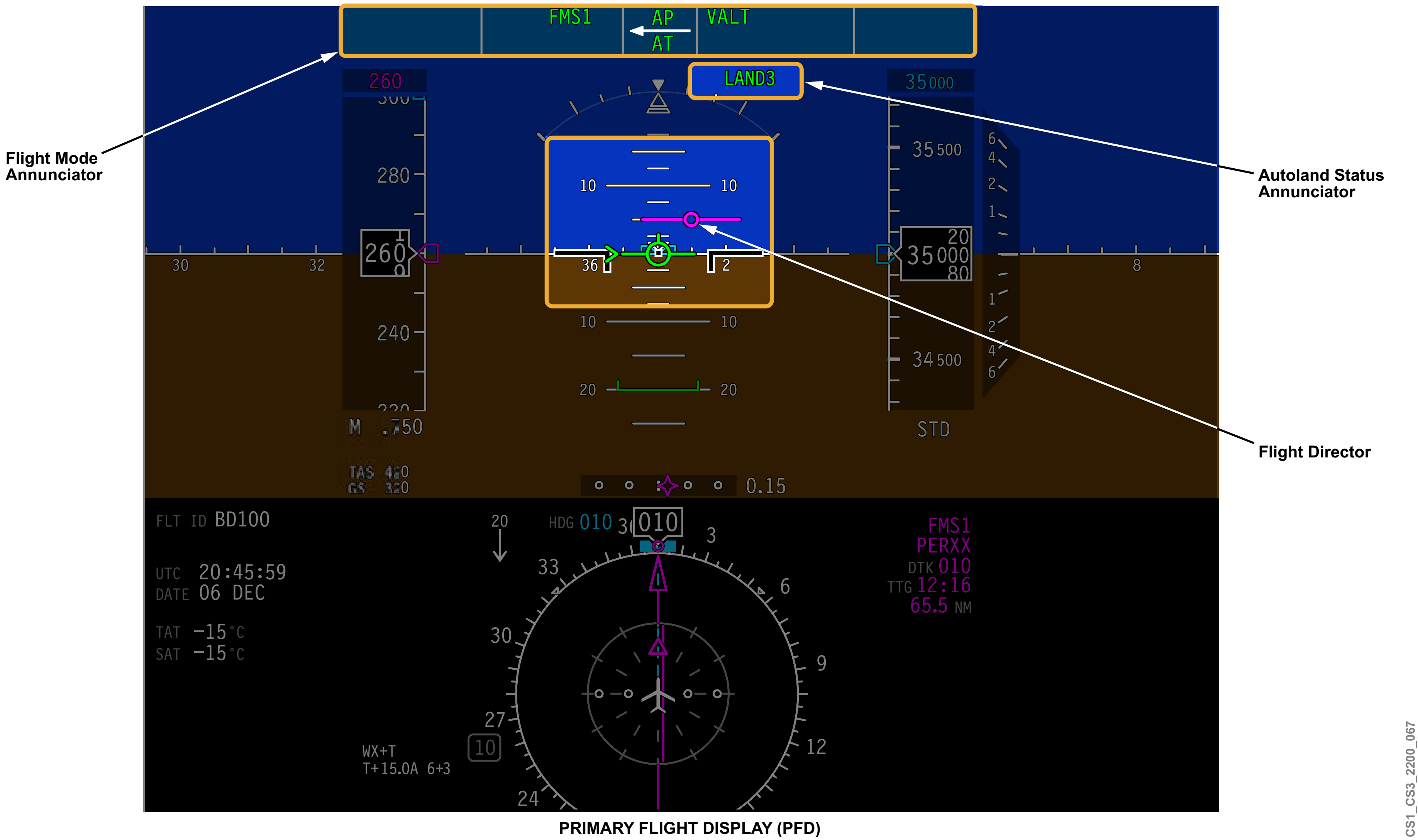


Figure 4: Flight Control Panel (L2)

PRIMARY FLIGHT DISPLAY

The automatic flight control system (AFCS) indications are presented on the left and right PFD. Indications include:

- Flight mode annunciator (FMA)
- Autoland status annunciator (ASA)
- Flight director (FD)



PRIMARY FLIGHT DISPLAY (PFD)

Figure 5: Automatic Flight Control System Indications on the Primary Flight Display (L2)

DETAILED DESCRIPTION

AUTOMATIC FLIGHT CONTROL SYSTEM INTERFACE

The AFCS interfaces with aircraft equipment and systems using ARINC 429, avionics full duplex switched Ethernet (AFDX) data communications, discrete, and analog signals.

ARINC 429 DATA BUS communications is used to route the following:

- Pilot mode and reference selections from the flight control panel (FCP)
- Speed, heading, altitude, and vertical speed reference to the FCP
- Flight guidance output from channel A and B of the data concentrator unit module cabinets (DMCs) to the primary flight control computers (PFCCs) for coupling to the autopilot
- Autothrottle rate command, from channel B of the DMCs to the throttle levers on the throttle quadrant assembly (TQA)
- Autopilot, autoland commands, status and warnings from the PFCCs to the display units and DMCs
- Navigation and sensor from the avionics systems, input to the PFCCs for operation of the autoland application
- Nosewheel steer to center command to the landing gear/steering control unit by the autoland application within the PFCCs after landing

The flight guidance commands are routed to the integrated processor cabinets over the AFDX network where it is routed to the display units. Flight plan reference data from the flight management system (FMS) application is also routed to the DMCs via the AFDX network.

Discrete signal inputs are used to provide:

- A takeoff/go-around (TOGA) selection from either throttle to the PFCCs
- An autothrottle disconnect from either throttle to the FCP
- An autothrottle servo enable command from the FCP to the TQA when conditions are satisfied for autothrottle operation
- An autopilot disconnect command from either sidestick to the PFCCs

An analog input is routed from the TQA, indicating throttle position to the electronic engine controls (EECs) for engine thrust control when the autothrottle operation is enabled.

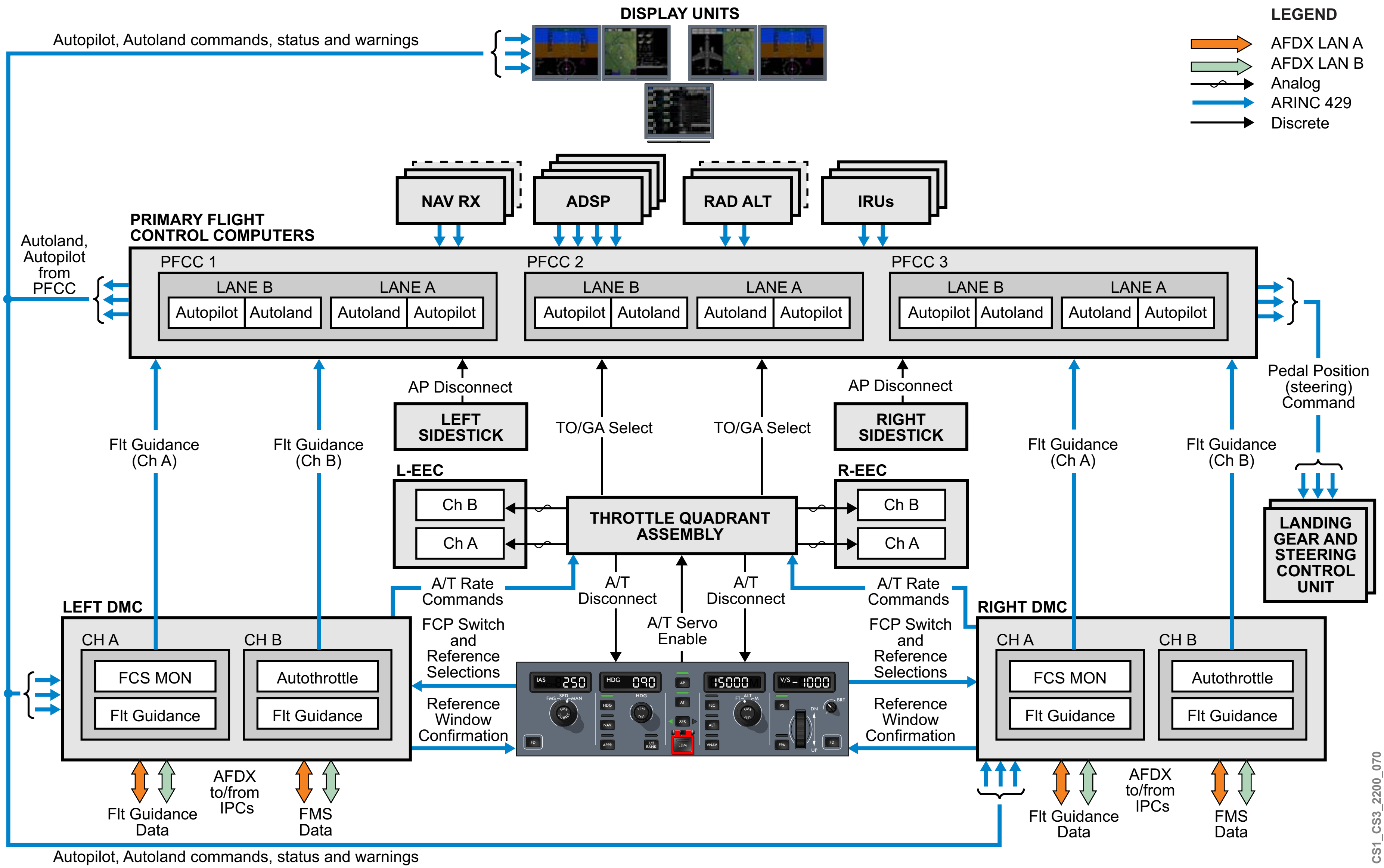


Figure 6: Automatic Flight Control System Interface (L3)

PRIMARY FLIGHT CONTROL COMPUTERS ACTIVE/STANDBY CONFIGURATION

Each of the three primary flight control computers (PFCCs) contain the autopilot and autoland functions of the AFCS.

Control laws within the PFCC provide flight envelope protection for the autopilot, autoland, and manual flight control operations.

The three computers operate in an active/standby/standby configuration. The active or PFCC in control is decided using a point system based on its highest assessed functionality.

The PFCC autoland capability is the main criteria determining the active unit. Other factors include the PFCC operational mode (normal or direct), and the status of PFCC communications. The PFCC active/standby/standby status is determined automatically with no crew action required.

There are no flight deck indications stating which PFCC is in charge.

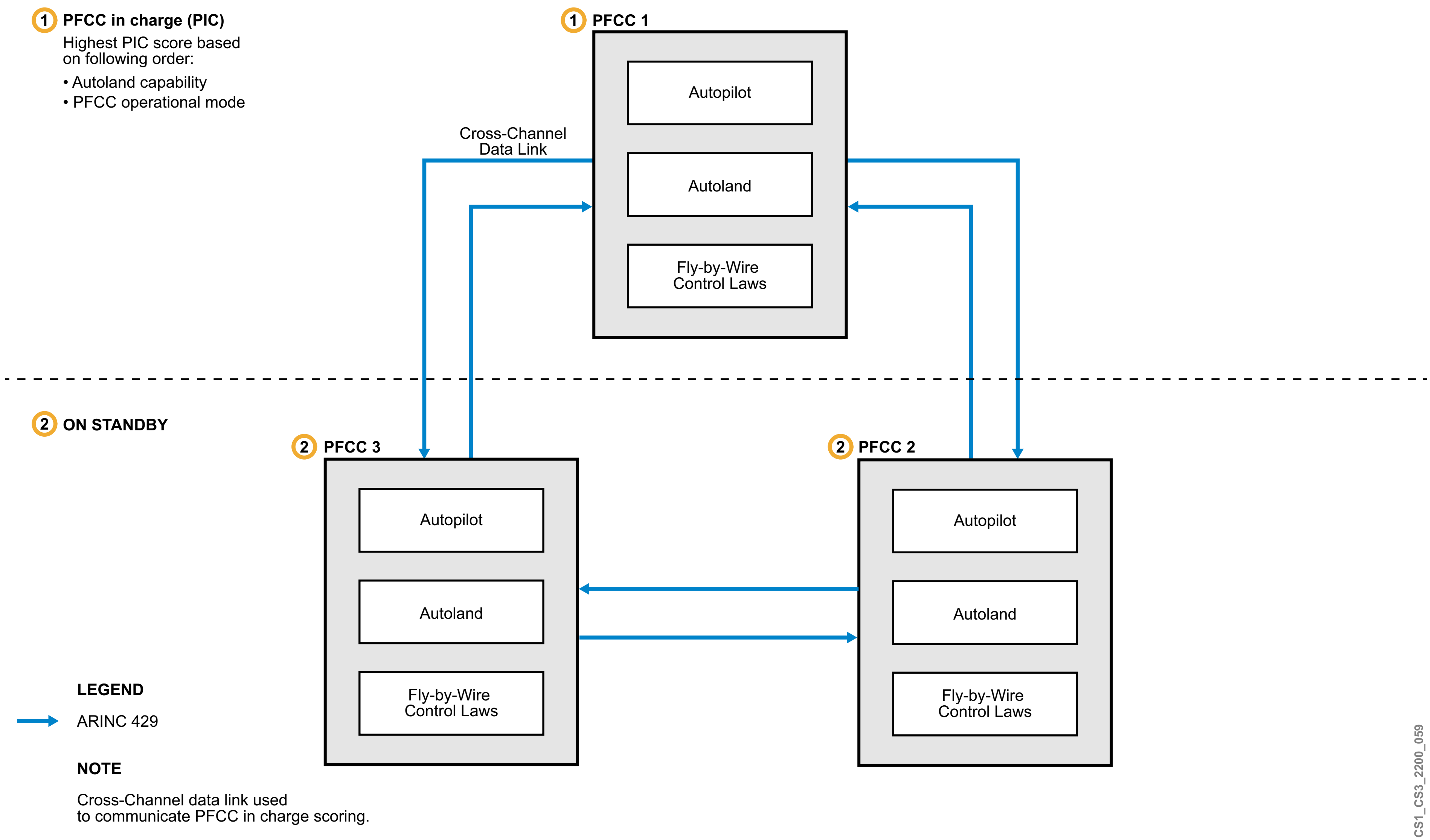


Figure 7: Primary Flight Control Computer Active/Standby Configurations (L3)

22-00 FLIGHT GUIDANCE SYSTEM

CONTROLS AND INDICATIONS

FLIGHT MODE ANNUNCIATOR

The flight mode annunciator (FMA) provides indications of flight guidance modes, autopilot, and autothrottle status.

Armed modes are shown on the lower line of the FMA in white. Captured or active modes are shown on the upper line in green. The red AP annunciation indicates that the autopilot has disconnected and immediate action is required. A yellow active mode, or armed mode is shown when the mode is unsustainable.

Autothrottle modes are located on the far left of the FMA. Lateral flight director (FD) modes are shown on to the left side, while vertical modes are shown on the right side of the FMA.

Autopilot and autothrottle engagement status are shown between the lateral and vertical modes. A left/right directional arrow indicates which side the flight director is coupled to.

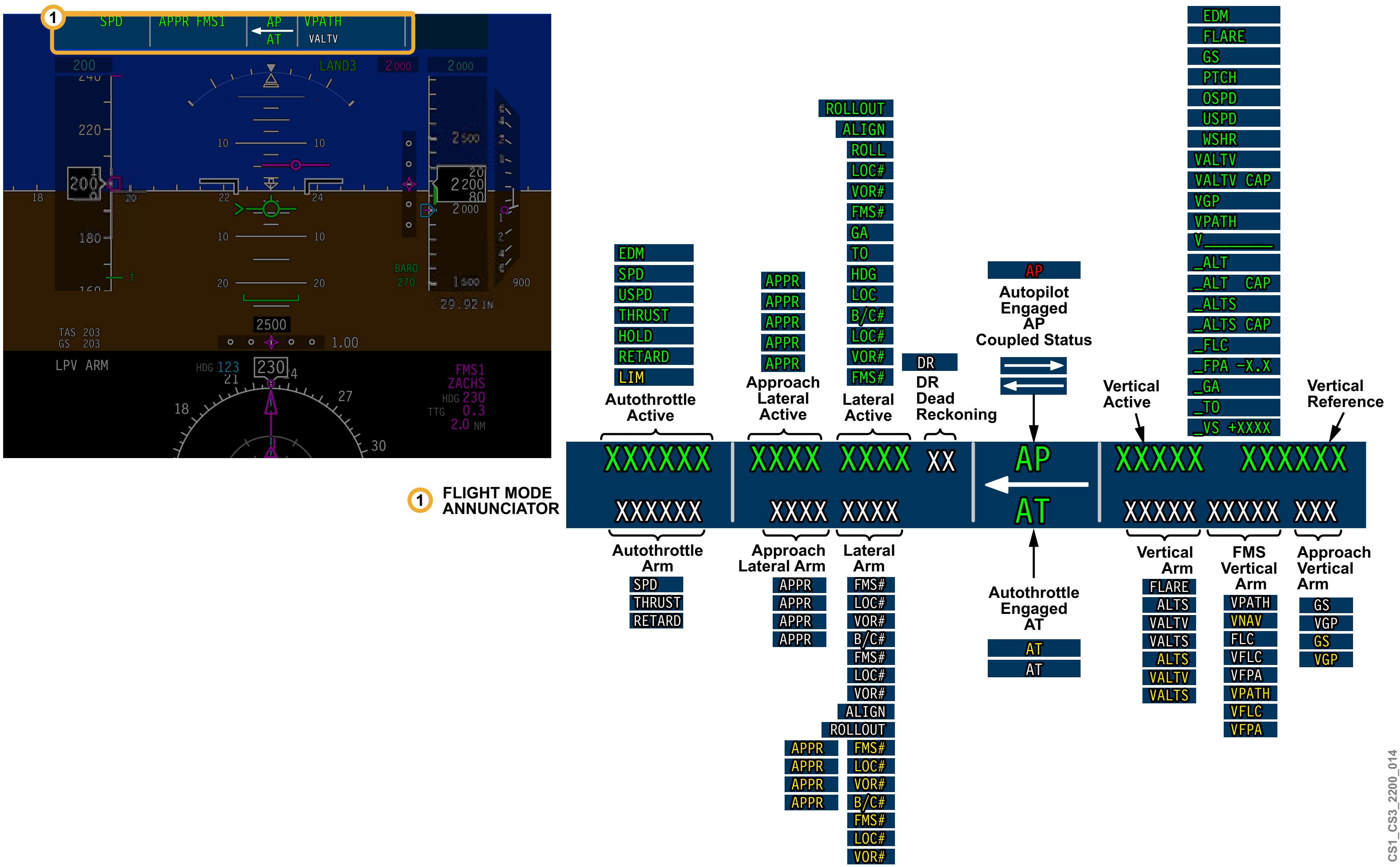


Figure 8: Flight Mode Annunciator (L2)

OPERATION

FLIGHT DIRECTOR DISPLAY SELECTION

On ground, the flight director (FD) is displayed upon selection of the takeoff/go-around (TOGA) switch on the throttle quadrant. The flight director is set to a defined takeoff pitch target.

In air, the flight director is automatically displayed as a result of any one of the following conditions:

- Flight director (FD) is selected from flight control panel
- Autopilot is engaged
- Flight director source is changed
- A takeoff/go-around (TOGA) lateral mode is engaged
- Emergency descent mode (EDM) is engaged
- Aircraft overspeed or underspeed protection is enabled

The FD cue moves up or down from the aircraft reference based on vertical flight guidance command. It moves left or right of the reference, and rotates clockwise or counterclockwise based on lateral flight guidance command.

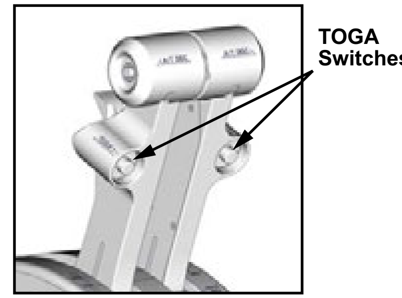
With the autopilot disengaged, pushing either FD switch toggles the corresponding FD off or on.

Once the autopilot is engaged, only the FD switch on the uncoupled side is functional. The FD may be toggled on or off for the uncoupled PFD only. Selecting the FD switch on the coupled side has no effect on either display.

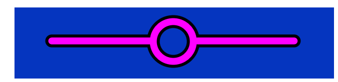
Neither FD switch will remove a flight director display when approach mode (APPR) is active.

PRIMARY FLIGHT DISPLAY

FLIGHT CONTROL PANEL



THROTTLE QUADRANT ASSEMBLY



1 **FD Director Cue**

FD Cue Display
• FD Cue shown when FD button selected or autopilot engaged

2 **Flight Director Selector**

Autopilot Disengaged:
• Pushing FD toggles onside FD Cue OFF or ON

Autopilot Engaged:
• Pushing FD on coupled side has no effect
• Pushing FD on non-coupled side toggles FD Cue OFF or ON

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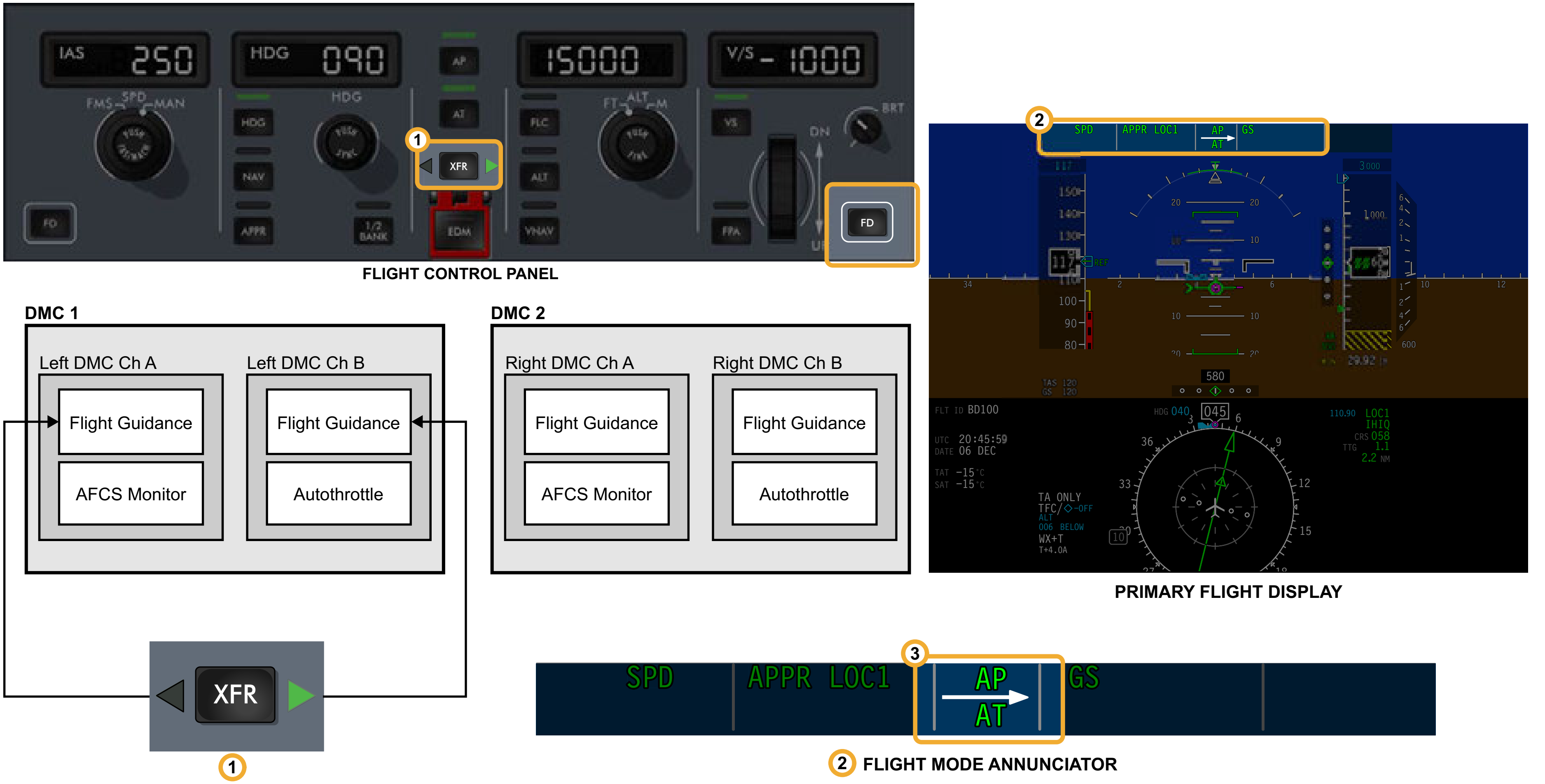
Figure 9: Flight Director Selection (L2)

FLIGHT GUIDANCE TRANSFER

The transfer (XFR) button on the flight control panel (FCP) is used to select which flight guidance channel (A or B) within the active DMC provides data to the flight guidance functions. The directional arrow on the FMA indicates which side the flight director (FD) is coupled to.



1 Selecting transfer (XFR) causes FG to source reference data from channel A or B of active DMC

3 • Directional arrow indicates which side flight director is coupled to

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Figure 10: Flight Guidance Transfer (L2)

FLIGHT GUIDANCE ACTIVE/STANDBY SWITCHING

For flight guidance (FG) and autothrottle (A/T) functions, one data concentrator unit module cabinet (DMC) serves as the active unit, while the other DMC remains on standby. Active/standby switching is based on a calendar day rotation.

In the event of a fault of the active DMC, flight guidance is automatically provided by the FG applications contained in the other DMC.

Alternatively, the flight crew can switch the active and standby DMC role by selecting the alternate (ALTN) button located on the reversion switch panel (RSP). This may be carried, for example, should a crew alerting system (CAS) caution message of FD MODE CHANGE be annunciated, indicating a possible fault with the FG application in the active DMC.

A CAS status message of FD/AT ALTN is displayed when a manual alternate selection is made. There are no other indications of active/standby DMC status during normal operation.

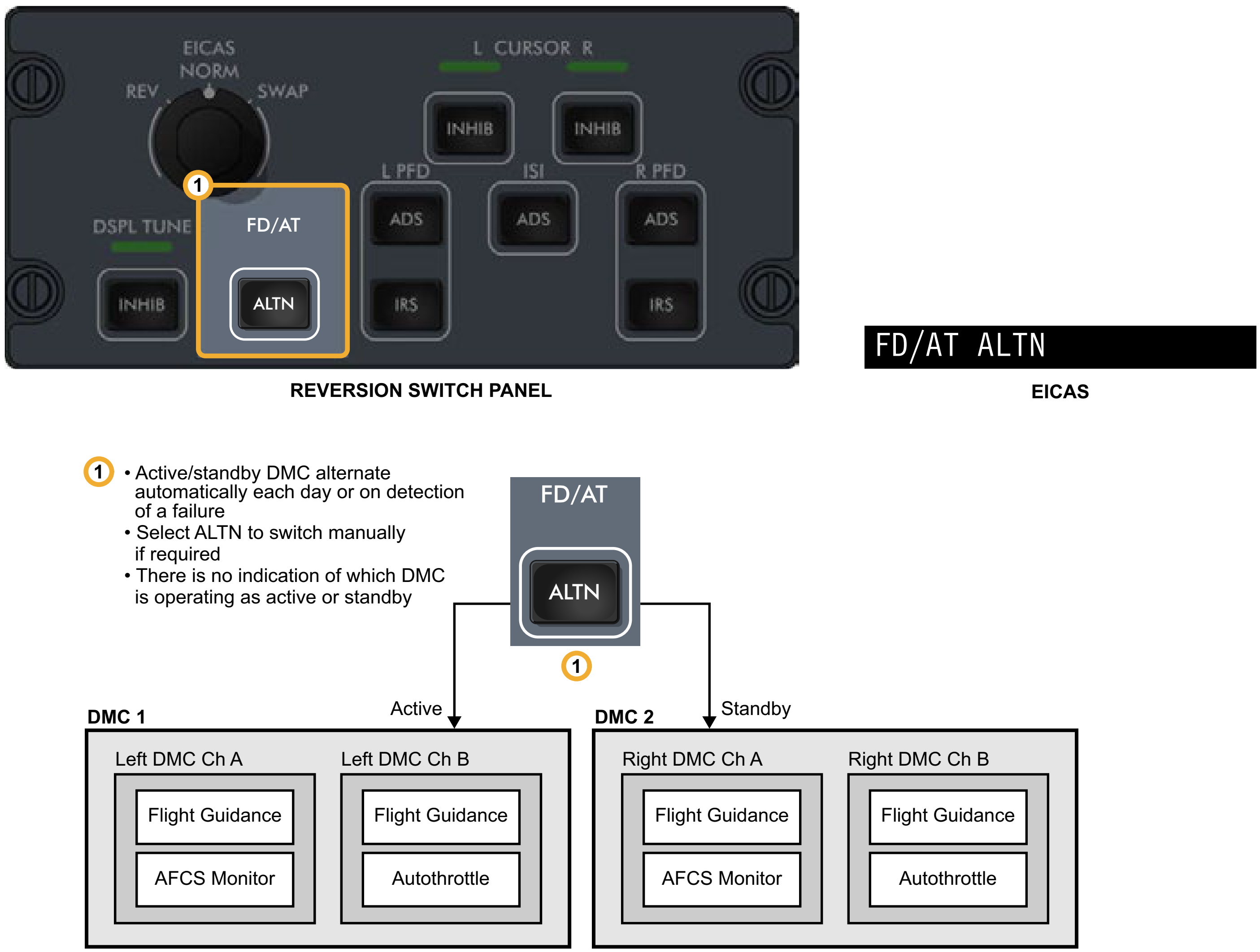


Figure 11: Alternate Flight Guidance Selection (L2)

DETAILED DESCRIPTION

The flight guidance application uses crew mode selections, flight management system (FMS), and navigation sensor inputs to compute a desired flight path.

There are a total of four independent flight guidance (FG) application installations. Two are installed in each data concentrator unit module cabinet (DMC), one per data concentrator module (DCM) channel (A, B). Each channel is capable of independently controlling the flight director presented on each primary flight display (PFD).

A flight control system monitor in channel A of each DMC checks flight guidance inputs and outputs for validity, and determines which DMC is active and which is on standby.

Channel A or channel B of the active DMC provides flight guidance commands based on which side (left or right) the flight director is coupled to.

Flight guidance is crew controlled using the flight control panel (FCP) to select modes and set reference targets. It is also managed according to the flight planning and reference data stored in the FMS.

Pitch and roll commands are based on FCP mode and target selections, in addition to input from the following systems:

- Inertial reference unit (IRU) - for attitude, rate, and related data
- Air data system (ADS) - for speed, altitude, rate, and related data
- VHF navigation (VHF-NAV) - for ILS localizer and glideslope data
- Flight management system (FMS) - for flight plan route and default settings

Flight guidance is indicated on the PFD by a magenta flight director cue.

The crew may choose to manually fly the aircraft using the flight director for guidance, or engage the autopilot and allow for automatic flight control.

A flight mode annunciator (FMA) on the PFD provides an indication of armed and captured flight guidance modes.

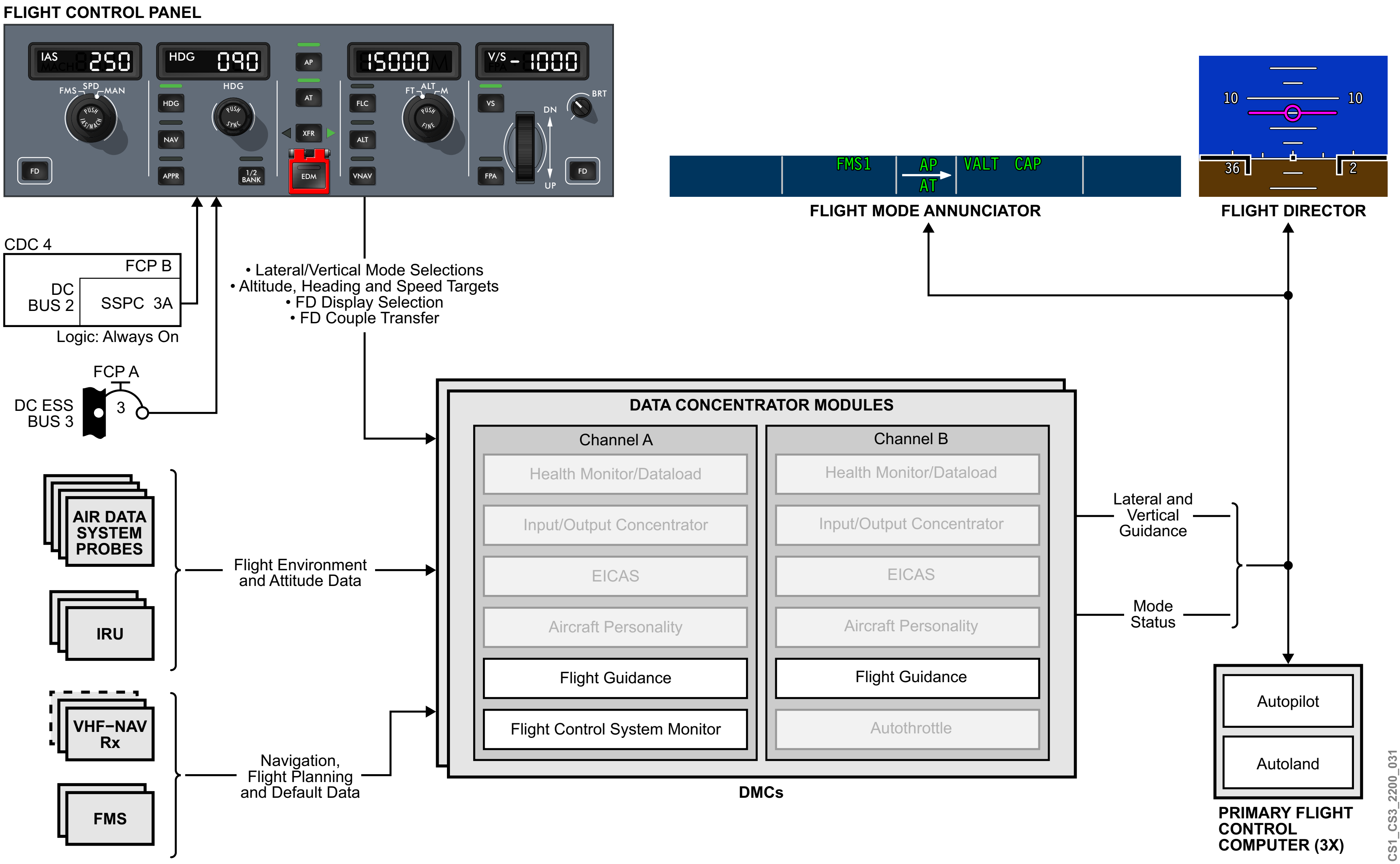


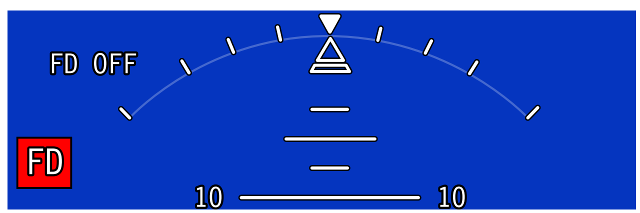
Figure 12: Flight Guidance System (L3)

MONITORING AND TESTS

A message of FD OFF is posted on the primary flight display (PFD), adjacent to the roll scale, when both flight directors (FDs) are removed from the display during flight.

A red FD flag is posted when flight guidance has been detected as invalid.

PRIMARY FLIGHT DISPLAY (PFD)



1 **FD OFF Display**
- Posted when both FD removed from display
- FD flag when guidance is invalid

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Figure 13: Flight Director Flags (L2)

22-10 AUTOPILOT

OPERATION

The autopilot is engaged by selection of the autopilot (AP) switch on the flight control panel. Manual selection of the guarded emergency descent mode (EDM) switch on the flight control panel (FCP) will also engage the autopilot. When the EDM automatically engages, the AP engages if not already engaged.

A green AP icon is shown on the flight mode annunciator when the autopilot has successfully engaged.

A manual or automatic autopilot disconnect results in an aural AUTOPILOT message, an aural alert tone, and a flashing red AP indication on the flight mode annunciator (FMA). The AP disengage warnings are removed following crew selection of the AP DISC switch on a sidestick.

Figure 14: Autopilot Engage/Disengage (L2)

DETAILED DESCRIPTION

The autopilot (AP) function is hosted in each of the primary flight control computers (PFCCs). The autopilot couples and limits flight guidance or autoland commands to the fly-by-wire (FBW) system. There are no dedicated autopilot servos installed in the flight control system.

Sensor and system inputs to the PFCCs are validated and checked for integrity before being used by the automatic flight control system (AFCS), autopilot, and autoland systems.

In the event of a loss of flight guidance (FG) information from the in-control data concentrator unit module cabinet (DMC), the PFCCs signal management function automatically switches to the opposite DMC.

Autopilot engagement occurs when the following conditions are met:

- Autopilot (AP) or emergency descent mode (EDM) switch selection on the flight control panel (FCP)
- Fly-by-wire (FBW) system is in normal mode
- Both sidesticks are in neutral position and valid
- No autopilot failures detected
- Pitch trim switch not selected
- Pitch attitude is within limits (+25° and -18°)
- Roll attitude is within limits (45°)
- Pitch rate is between +10° and -10°/s
- Roll rate is between +15° and-15°/s
- Load factor is between +1 G and -1 G
- No stall condition sensed

The autopilot commands are provided to the PFCC fly-by-wire (FBW) system during FBW normal mode operation only. An AP limiter function maintains commands below the maximum value provided by the sidesticks. This ensures that the crew can use the sidestick to override an AP command if necessary.

The AP limiter limits autopilot input to the FBW system as follows:

- Roll rate of less than 5°/s, maximum angle of 30°
- Pitch rate of less than 3°/s, maximum angle of +20°/-15°
- Maximum acceleration envelope of +/-0.3 G

The autoland function provides additional limiting and control laws to the autopilot when autoland is providing approach guidance.

The FBW system only provides the AP input to the flight control actuators if the commands are within the limitations of the PFCC control laws. Flight control feedback to the AP is provided by the FBW system. Any flight control response that does not agree with the AP command results in an immediate autopilot disengagement.

The following actions will cause the autopilot to disengage:

- Selecting the AP DISC switch on a functioning sidestick
- Pressing AP switch on the FCP
- Crew movement of either sidestick or rudder to overpower AP
- Crew manual operation of the pitch trim
- Fly-by-wire (FBW) system reverts to direct mode
- Takeoff/go-around (TOGA) selected while on ground
- Stick shaker is active (except during windshear escape operation)

Windshear escape guidance is provided whenever a windshear condition is detected by the terrain awareness and warning system (TAWS).

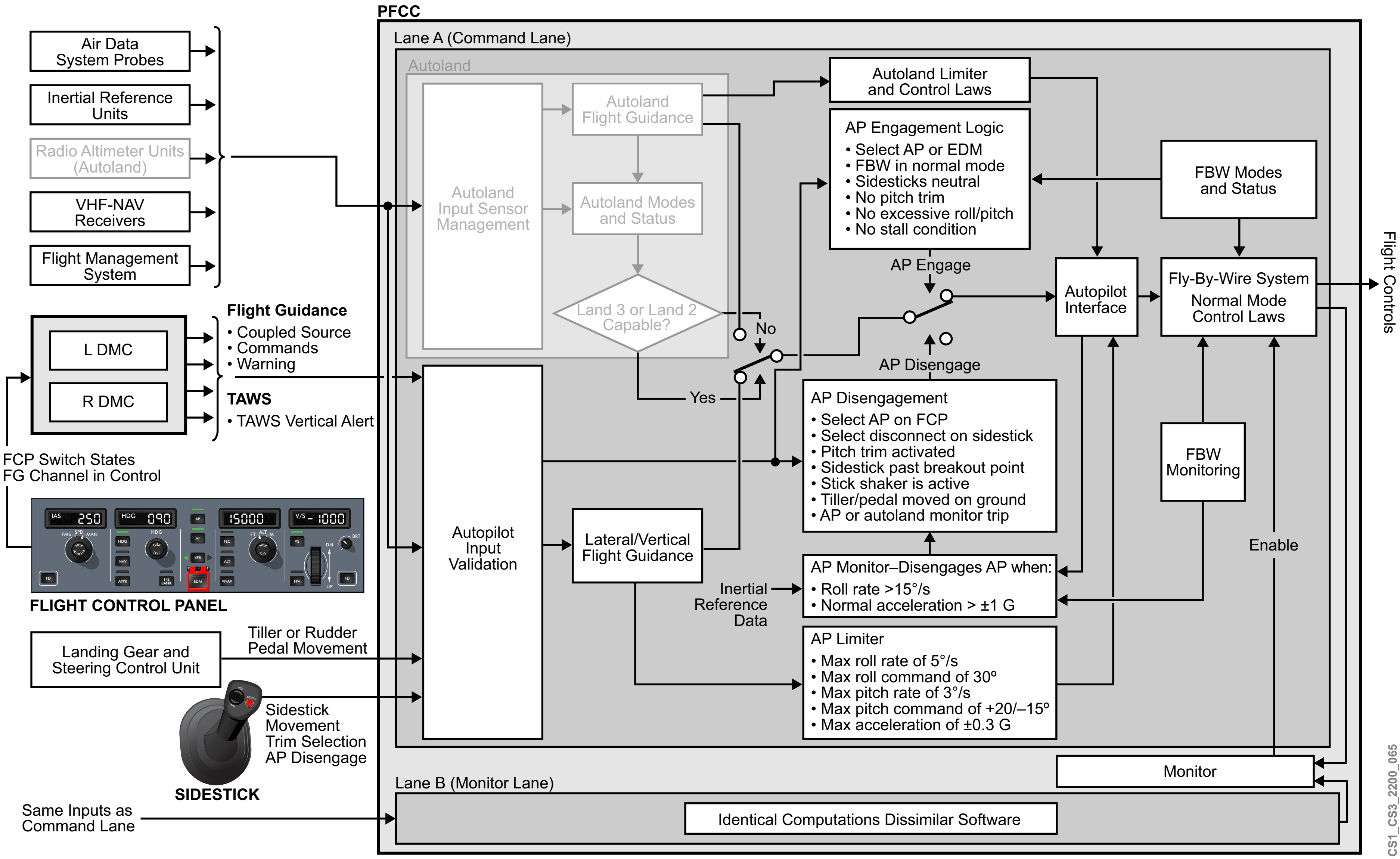


Figure 15: Autopilot Operation (L3)

EMERGENCY DESCENT MODE

When activated, the emergency descent mode (EDM) initiates a high speed autopilot-controlled descent to 15,000 ft using the flight level change (FLC), and heading (HDG) modes.

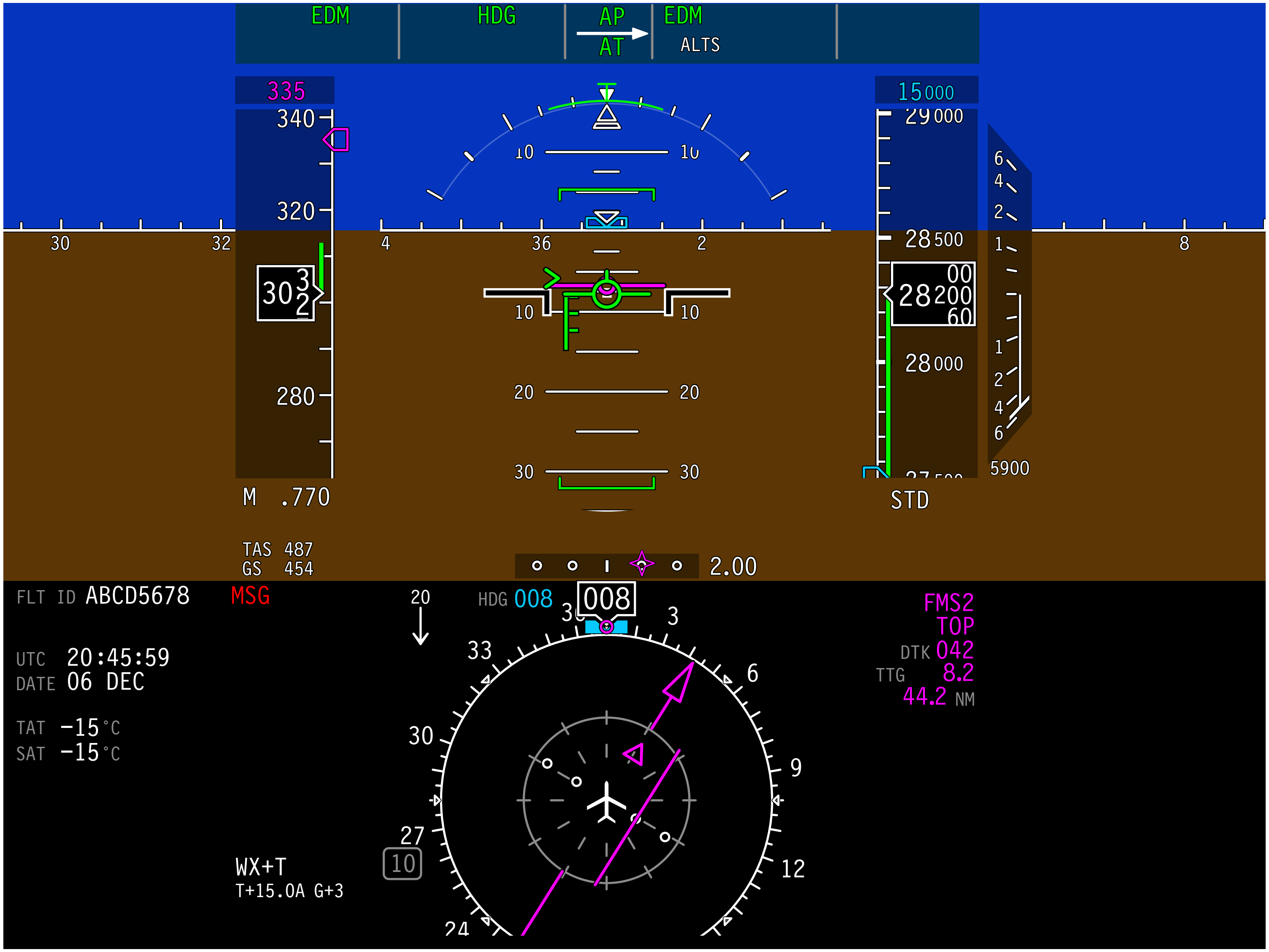
The EDM is automatically activated if the cabin altitude exceeds 14,500 ft and the aircraft is above 25,000 ft. When the aircraft altitude is above 25,000 ft, the EDM can also be manually activated by pressing the guarded EDM button on the flight control panel (FCP).

When the EDM is activated, the following actions automatically occur:

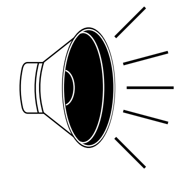
- Red bar illuminates above EDM button
- “EMERGENCY DESCENT” aural message sounds
- AP engages (if not already)
- AT engages (if not already) and thrust is reduced to flight idle
- Altitude preselect is set to 15,000 ft
- HDG is engaged and present heading is maintained
- Transponder code set to 7700 (automatic activation only)

At pressure altitude greater than 25,000 ft:

- In automatic mode, EDM sequence starts when the cabin altitude is above 14,500 ft. An EMERGENCY DESCENT engine indication and crew alerting system (EICAS) warning message is posted
- In manual mode, EDM is initiated by pressing the guarded EDM switch on the FCP. An EMERGENCY DESCENT EICAS caution message is posted



FLIGHT CONTROL PANEL



"EMERGENCY DESCENT"

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Figure 16: Emergency Descent Mode (L3)

22-00 AUTOLAND

CONTROLS AND INDICATIONS

The autoland function is enabled following selection of an instrument landing system (ILS) approach and pushing of the approach (APPR) switch on the flight control panel.

Autoland capability is automatically computed and displayed on the autoland status annunciator (ASA), located below the FMA on each PFD. Possible indications are as follows:

- LAND3
- LAND2
- NO LAND
- APPR2
- APPR1

The CAT IIIB and CAT IIIA approaches are associated with the LAND3 and LAND2 annunciations respectively. The CAT II and CAT I approaches are associated with the APPR2 and APPR1 annunciations.

Lateral and vertical modes associated with autoland operation are shown on the flight mode annunciator (FMA). These modes include:

- ALIGN (lateral mode)
- FLARE (vertical mode)
- ROLLOUT (lateral mode)

1

FG MODES SPECIFIC TO AUTOLAND	
Lateral	Vertical
ALIGN	FLARE
ROLLOUT	

2

AUTOLAND STATUS
LAND3
LAND2
NO LAND
APPR2
APPR1

CS1_CS3_2200_061

Figure 17: Autoland Controls and Indications (L2)

OPERATION

AUTOLAND - LAND2 OR LAND3 SEQUENCE

The autoland function controls and sequences the following events during the approach, at touchdown, and during the landing rollout:

- Processes ILS approach guidance for the autopilot and flight director
- Reduces any crab angle and aligning aircraft to runway
- Carries out the landing flare
- Commands autothrottle system to retard throttles
- Controls nosewheel steering to track runway centerline on landing

Between 1500 ft AGL and 800 ft AGL, autoland becomes active and takes over from the flight guidance system. Autoland capability is only shown on the autoland status annunciator (ASA) when it becomes active.

The align to runway (ALIGN) lateral mode becomes active at approximately 200 ft AGL, replacing the approach localizer (APPR LOC) indication in the flight mode annunciator (FMA). This mode is intended to reduce angles being maintained due to prelanding crosswinds.

The flare vertical mode (FLARE) becomes armed when the align mode is active. The active FLARE annunciation replaces the glideslope (GS) indication at approximately 50 ft AGL. The active FLARE mode is accompanied by arming the lateral rollout (ROLLOUT) mode.

The flare function gradually reduces the aircraft’s vertical speed for touchdown, and simultaneously commands the autothrottle system to retard the throttles. The profile is a function of the aircraft position relative to the glideslope and the sink rate.

Between 50 ft and 25 ft, the autoland system commands the autothrottle system to retard the throttles to idle. The RETARD indication is shown in the autothrottle mode block of the FMA.

The active ROLLOUT mode tracks the ILS localizer beam, and provides directional commands to the rudder and nosewheel steering to maintain the runway centerline. An extended vertical line is displayed on the primary flight displays on touchdown. This line improves pilot situational awareness by representing lateral deviation from the runway centerline during the landing rollout. It is only available during LAND3 or LAND2 operation.

The steer to centerline command is disabled below 30 kt or the pilot actuates the rudder pedals or tiller to maneuver off the centerline.

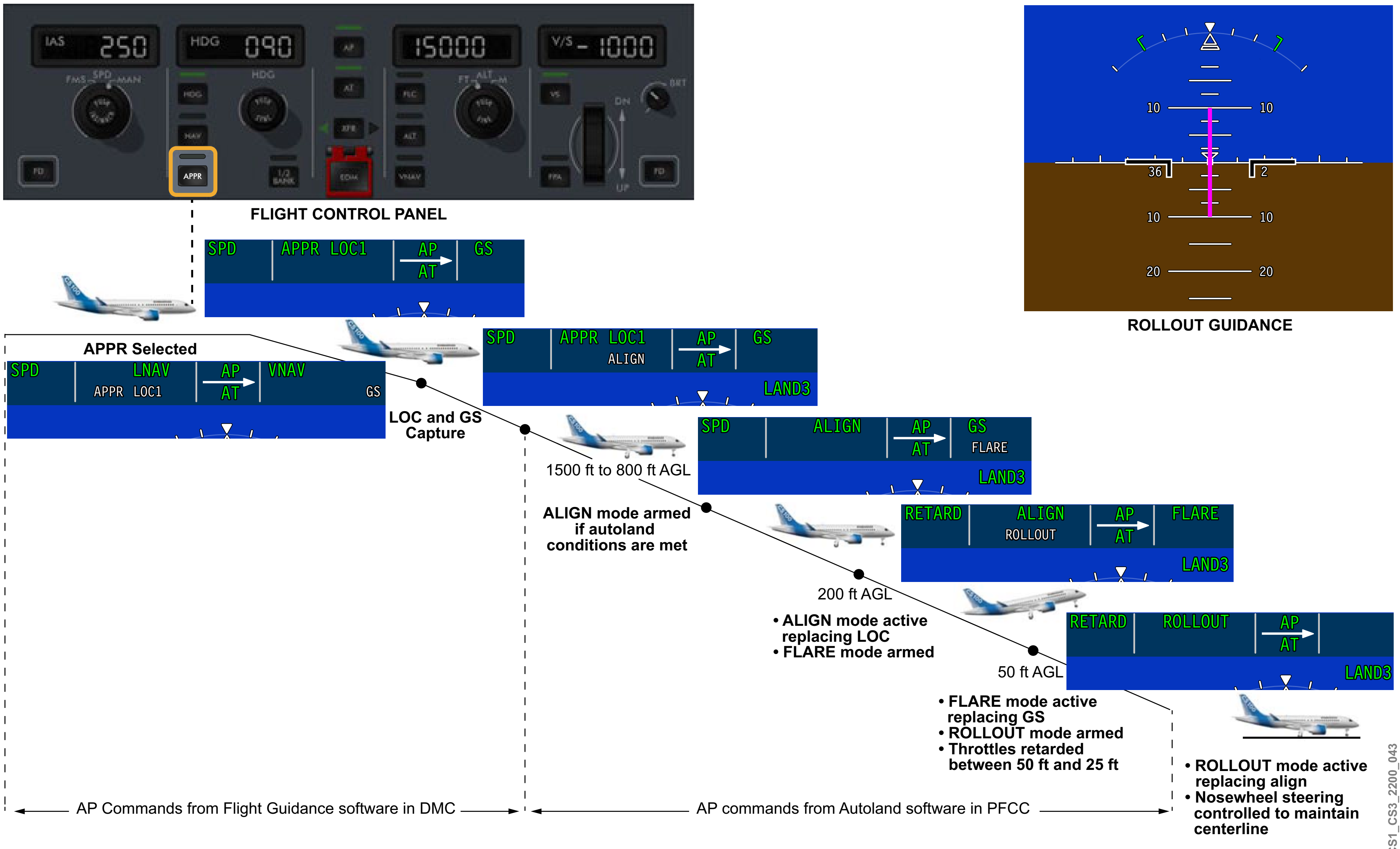

Figure 18: Autoland Sequence (L2)

AUTOLAND OPERATION DURING GO-AROUND

Selecting the takeoff/go-around (TOGA) switch on either throttle during autoland immediately removes autoland indications and initiates a go-around (GA). Autopilot operation remains enabled during GA operation. A couple GA may be executed at any altitude event, even with a momentary wheels touchdown prior to a positive climb.

A GA selection above 400 ft AGL disables autoland. Lateral and vertical go-around flight guidance is provided by the flight guidance system (FGS). Mode selection on the flight control panel (FCP) is enabled.

A GA selection between 400 ft and 200 ft AGL removes autoland indications, and disables autoland sequence. Lateral and vertical GA flight guidance continues to be provided by the instrument landing system (ILS) approach software in the PFCC. The fly-by-wire (FBW) system provides a heading hold function using rudder control, while roll commands are use to prevent a wing strike. Crew mode selections using the FCP remains disabled until the aircraft has climbed above 400 ft AGL.

A GA selection below 200 ft AGL results in continued vertical guidance from the PFCC. The wings level lateral mode is enabled, while FCP mode selections remain disabled. The autopilot holds the current heading using the rudder, while the roll command is limited to prevent a wing strike. After this transition alternate flight guidance modes can be selected by the pilot.

Above 400 ft AGL in the climb out, lateral and vertical guidance transitions from the PFCC to the flight guidance system. At this point pilot mode selections from the FCP is enabled.

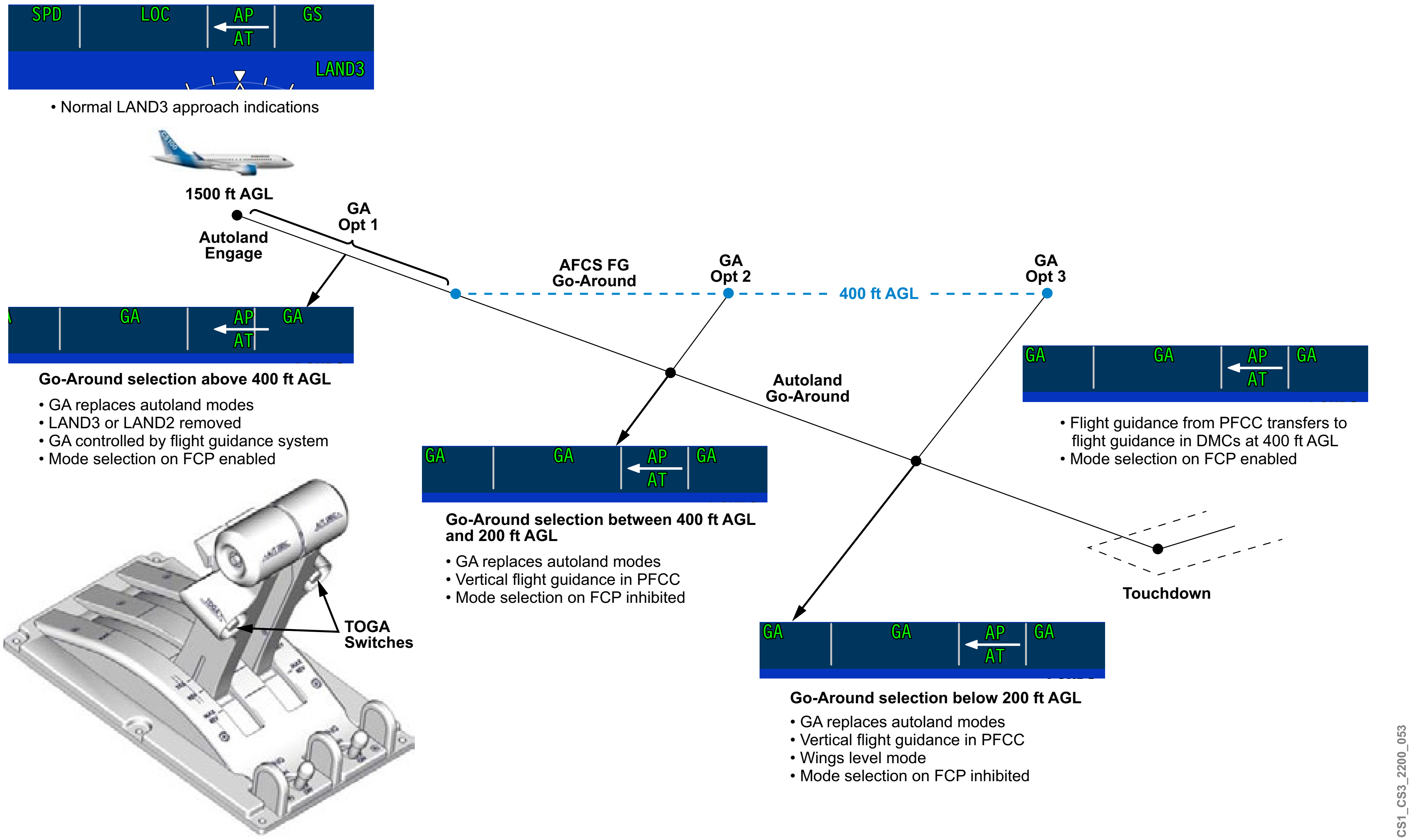

Figure 19: Autoland Operation Following Go-Around Selection (L2)

DETAILED DESCRIPTION

The autoland (AL) function is independently hosted in each of the three primary flight control computers (PFCCs). Autoland computations are provided to the autopilot and fly-by-wire (FBW) flight control systems.

The basic autoland installation provides category IIIA landing capability. An optional installation provides autoland functionality to the lowest visibility requirements, category IIIB.

The following sensor and system inputs are used by the PFCC for autoland computations:

- Inertial reference unit (IRU) - for attitude, rate and related data
- Air data system (ADS) - for speed, altitude, rate and related data
- VHF navigation (VHF-NAV) - for ILS localizer and glideslope data
- Radio altitude (RAD) - for height above terrain data, min 50 ft

The flight management system (FMS) provides selected course, glideslope angle, runway length, and elevation data in order to validate autoland computations.

The autoland system continually monitors the operational performance of sensor inputs. Based on these performance checks, the autoland system determines autoland capability.

Sensor/system input is processed by each PFCC, and cross-checked against data received by the other PFCCs.

A voter function evaluates and selects one of the dual or triple sensor inputs to be used by the autoland system. The selected or voted input is used in autoland computations, including determining the PFCC autoland capability.

The computed output from each lane is compared by an independent monitoring function within the PFCC. An enable command is provided to LANE A if computations are within comparable limits. This allows autopilot commands to be integrated into the FBW control laws and provided to the flight controls.

The basic autoland installation is fail passive. A fail passive system is identified to the crew as LAND2 in the autoland status annunciator field, and is capable of a category IIIA landing. A fail passive system does not allow a single sensor failure to cause a flight path deviation. A single fault does not allow landing to be completed using the autoland function.

The optional installation of a third VHF navigation receiver and radio altimeter transceiver makes the autoland system fail operational. A fail operational system is identified as LAND3 in the ASA field, and is capable of a category IIIB landing. A fail operational system allows full autoland operation to continue following a single sensor failure.

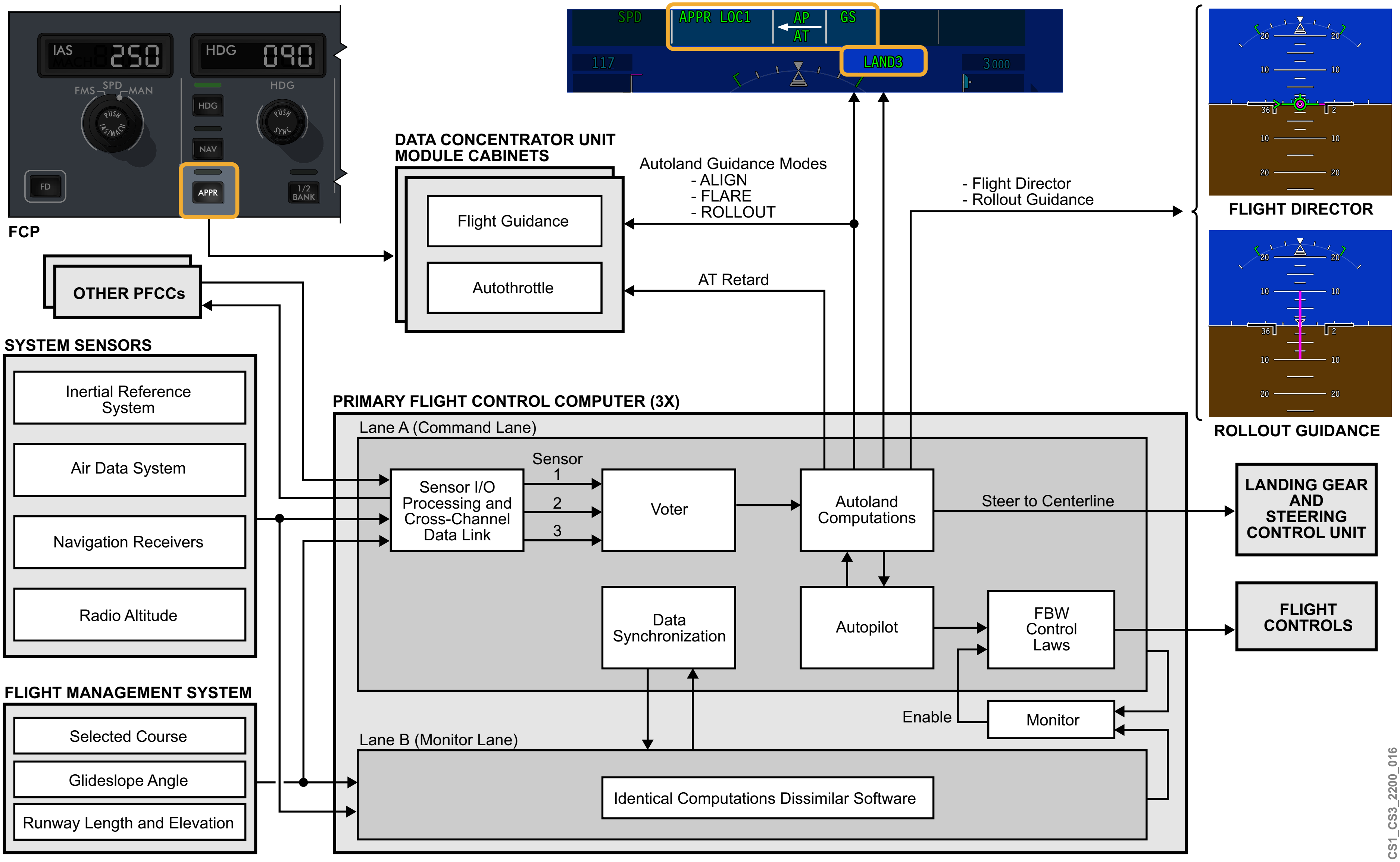

Figure 20: Autoland System Layout (L3)

VHF NAVIGATION ANTENNA SWITCHING

The VHF navigation receivers are connected to a single VOR antenna during flight.

After selection of the approach (APPR) switch on the flight control panel (FCP), a RF switching circuit disconnects the VOR antenna and connects the VHF navigation receivers to a dual-localizer (LOC) antenna. The DMCs relay the PFCCs command to control the RF switches for the VOR and LOC antenna selection.

The optional third VHF navigation system is provided with a dedicated input from a combined VOR/LOC antenna, and does not require antenna switching.

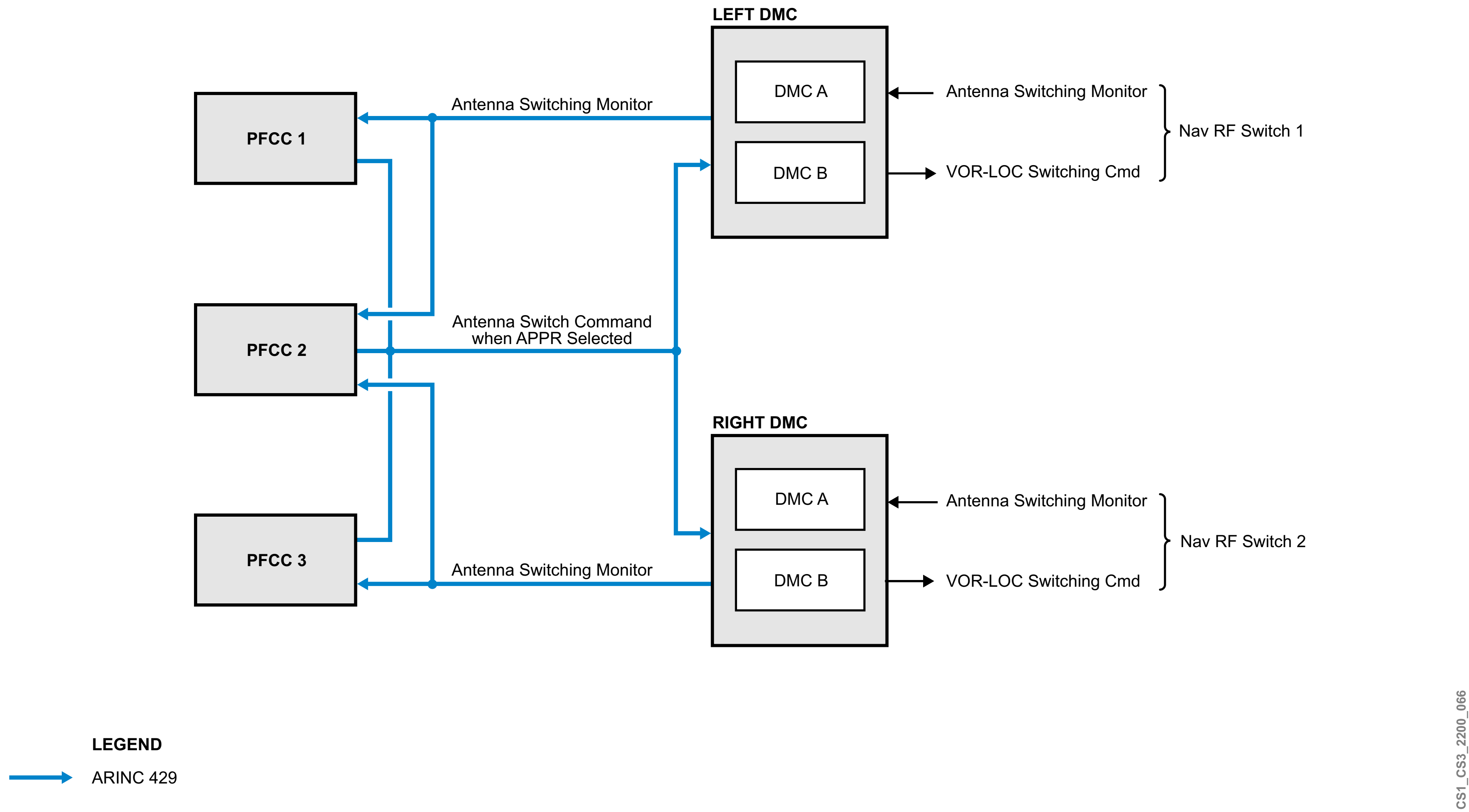

Figure 21: VHF Navigation Antenna Switching (L3)

AUTOLAND CAPABILITY

The following table identifies the equipment serviceability requirements for each landing category.

Table 1: Autoland System/Sensor Requirements

EQUIPMENT/INPUT	REQUIRED SENSOR/SYSTEM STATUS FOR:			
	CAT IIIB (LAND3)	CAT IIIA (LAND2)	CAT II (APPR2)	CAT I (APPR1)
PFCC Autoland	One PFCC is LAND3 capable, one PFCC is LAND2 capable or better.	One PFCC is LAND2 capable or better.	One PFCC is APPR2 capable or better.	One PFCC is APPR1 capable or better.
PFCC Normal/Direct	One PFCC is no more than two failures away from direct mode. One PFCC is no more than one failure away from direct mode.	One PFCC is no more than two failures away from direct mode. One PFCC is no more than one failure away from direct mode.	One PFCC is normal mode capable.	Flight director, only if FBW is in direct mode.
Inertial Reference System	Three valid and comparing outputs.	Two valid and comparing outputs.	Two valid and comparing outputs.	One valid, no comparator faults and displayed on coupled PFD.
Air Data System	Three valid and comparing outputs.	Two valid and comparing outputs.	Two valid and comparing outputs.	One valid, no comparator faults and displayed on coupled PFD.
Navigation Receiver System	Three valid and comparing outputs.	Two valid and comparing outputs.	Two valid and comparing outputs.	One valid, no comparator faults and displayed on coupled PFD.
Radio Altimeter System	Three valid comparing outputs.	Two valid and comparing outputs.	One valid, no comparator faults and displayed on both PFDs.	Not applicable.
Nosewheel Steering System	No failures.	No failures.	Not applicable.	Not applicable.
Autothrottle	Valid and engaged.			

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AUTOLAND DOWNGRADE

The autoland system continually monitors autoland functionality and, provides an assessment of the level of landing capability.

A LAND3 NOT AVAIL advisory message indicates the autoland system is unable to satisfy LAND3 operational requirements. A downgrade to LAND2 capability automatically occurs.

An AUTOLAND NOT AVAILABLE advisory message indicates the autoland system is unable to satisfy LAND2 operational requirements.

During an ILS approach, a red message of NO LAND is displayed in the ASA if LAND3 or LAND2 capability is not indicated by 800 ft AGL. This is followed by the annunciation of the next highest landing mode, APPR1 or APPR2 in the ASA. This downgrade sequence will also occur if the autopilot becomes disengaged at any time during an autoland approach.

In the event that LAND3 or LAND2 is in active mode and a nose steering system fault occurs below 200 ft, the NOSE STEER FAIL caution message is displayed. During roll out, the rudder is used to control the aircraft. At low speed, differential braking is used.

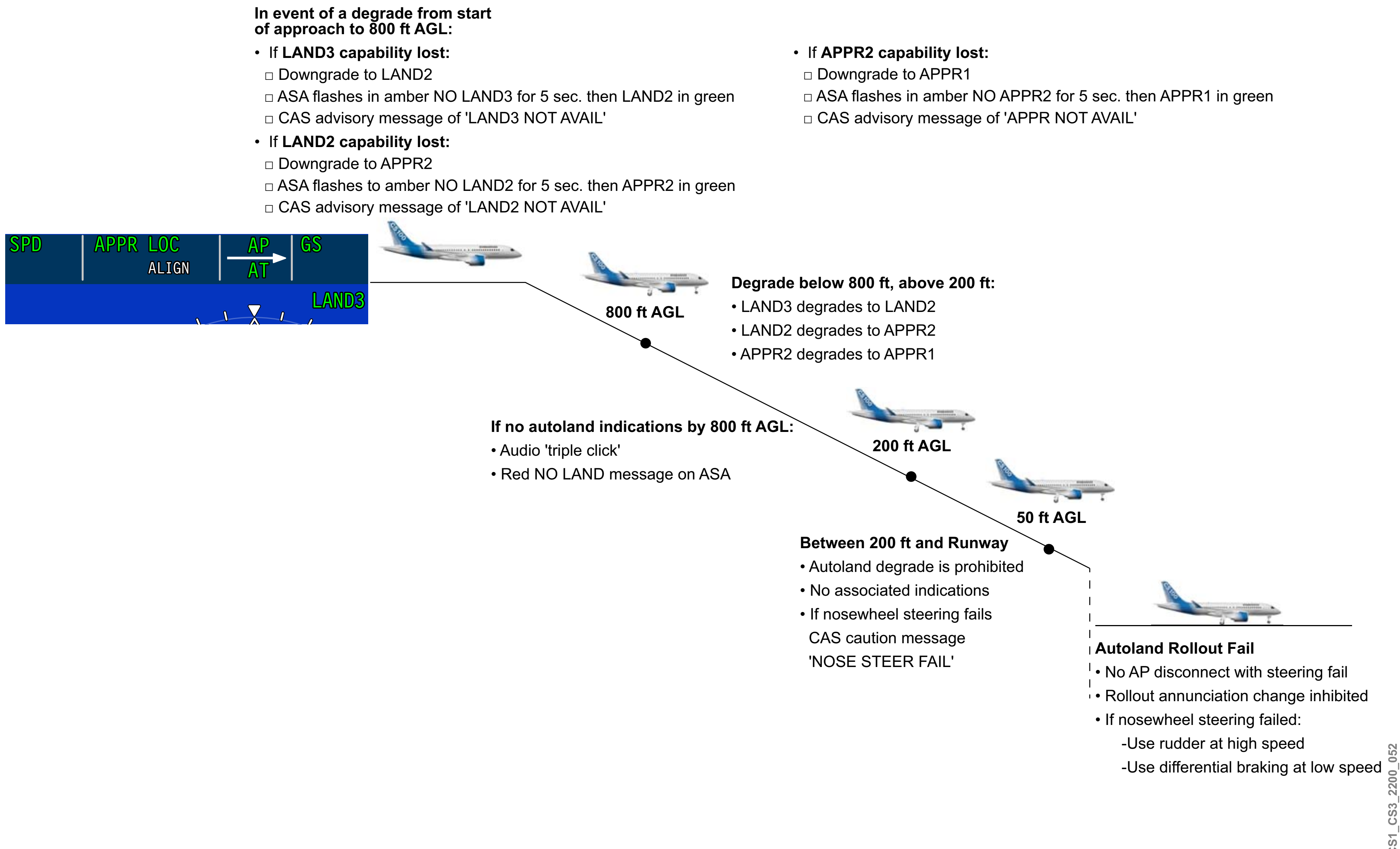


Figure 22: Autoland Downgrade During Approach (L3)

22-30 AUTOTHROTTLE

GENERAL DESCRIPTION

The dual-autothrottle systems (ATSs) automatically advance or retard the thrust levers as required to obtain a desired thrust setting, or airspeed target.

Throttle lever position is electronically provided to the two electronic engine controls (EECs), which control engine thrust accordingly. A throttle rate feedback is provided to the ATS for monitoring.

The ATS applications are located in the data concentrator unit module cabinets (DMCs). One ATS application serves as the active system, while the other installed in the opposite DMC, remains on standby. The applications alternate active/standby status each calendar day or in the event of an autothrottle system failure.

The ATS is armed by selection of the AT switch on the flight control panel (FCP). A green AT icon, in the center of the FMA is displayed when the system is enabled.

ATS indications are presented on the flight mode annunciator (FMA). Indications include an AT icon, an active/standby directional arrow, and a mode annunciation.

The ATS target is dependent on vertical flight director mode selection as well as speed references provided through the FCP and flight management systems (FMS). The ATS mode (thrust or speed) is indicated on the left side of the FMA on both primary flight displays (PFDs).

ATS operation is available over the entire flight profile and is also functional in the event of a windshear or emergency descent. The ATS also controls thrust to protect against aircraft low speed and overspeed. The ATS remains operational in the event of a single engine failure.

A separate interface between the autothrottle function and the electronic engine controls (EECs) provides fine trim control for more precise matching of throttle position and actual thrust being set.

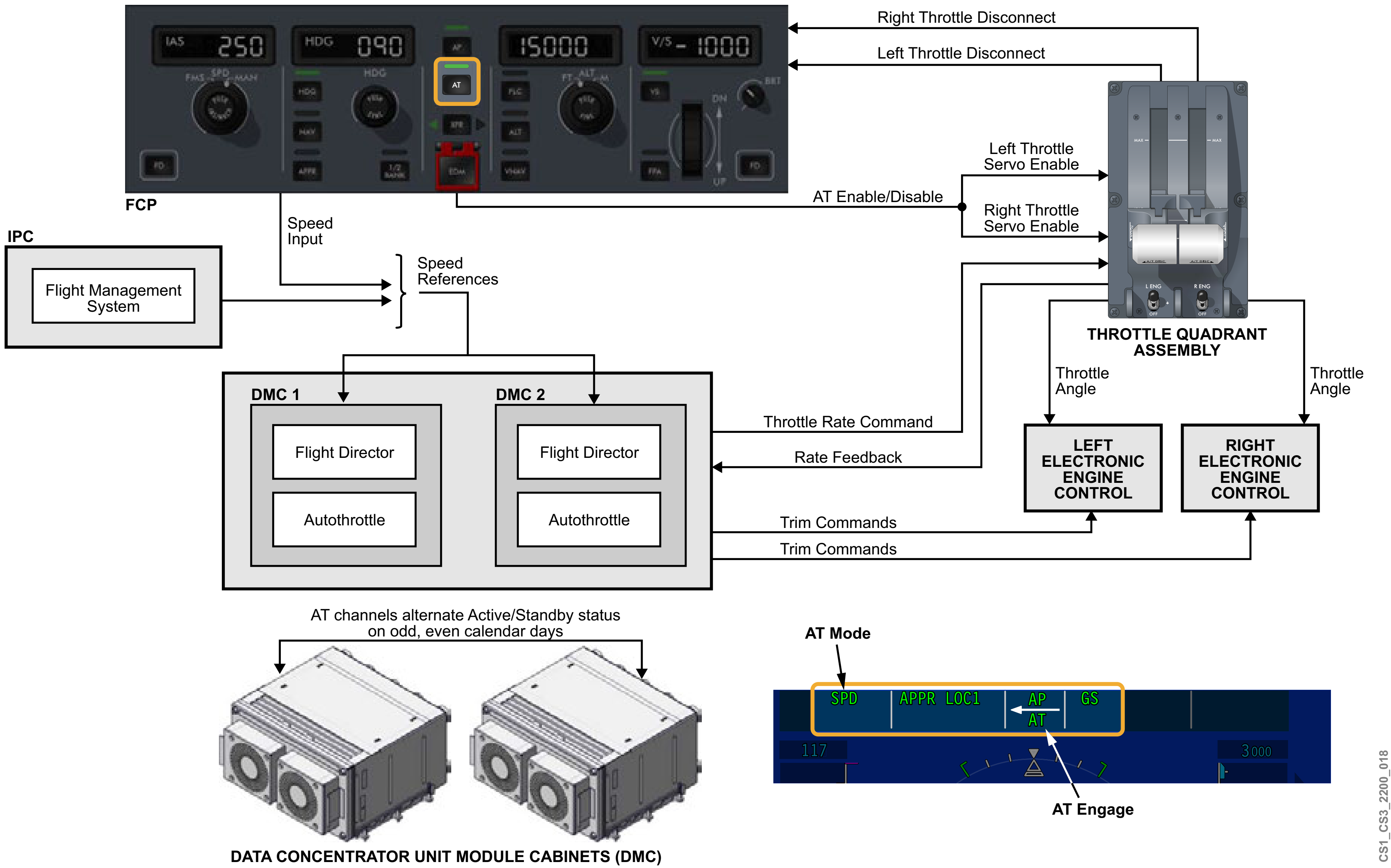


Figure 23: Autothrottle System (L2)

OPERATION

AUTOTHROTTLE SYSTEM ENGAGEMENT/DISENGAGEMENT

Prior to commencing takeoff, the ATS is armed by selection of the AT switch on the FCP. Once armed, the system becomes engaged as the throttles are manually advanced through the midrange position. Both throttle levers are physically under the control of the ATS at this point.

Throttle lever control switches provide input to the autothrottle system. This includes a takeoff/go-around (TOGA) switch and an autothrottle disconnect switch for each lever.

The TOGA commands the ATS to provide go-around (GA) thrust upon selection. While selection of the TOGA switch at takeoff sets takeoff thrust, the ATS does not engage until the throttles are manually advanced.

Selection of either autothrottle disconnect switch immediately disables the throttle servomotors, and commands the ATS software to disengage.

In addition to switch selection, crew movement of either throttle will automatically disengage the autothrottle system. The green AT icon is removed from the PFD when the ATS is disconnected by either method. The AT icon is yellow when there is an ATS malfunction.

Figure 24: Autothrottle Controls (L2)

AUTOTHROTTLE CONTROL PATH

The autothrottle system (ATS) application, located in the DMCs, carries out throttle target computations using such reference data as the flight director mode, and flight management system (FMS) data.

A controller, located within the throttle quadrant assembly (TQA), processes command signals from the ATS.

The controller provides the servomotor power to drive individual throttle levers via a slip clutch assembly. The slip clutch prevents the thrust levers from jamming, and allows the crew to move the levers in the event of a servomotor failure.

The resulting lever angle is routed by rotary variable differential transformers (RVDT), located in the TQA, to each electronic engine control (EEC).

A fine trim command is routed from the ATS to the EECs. While the throttle command to the TQA ensures the throttle positions are matched. The fine trim command ensures the N1 values are matched.

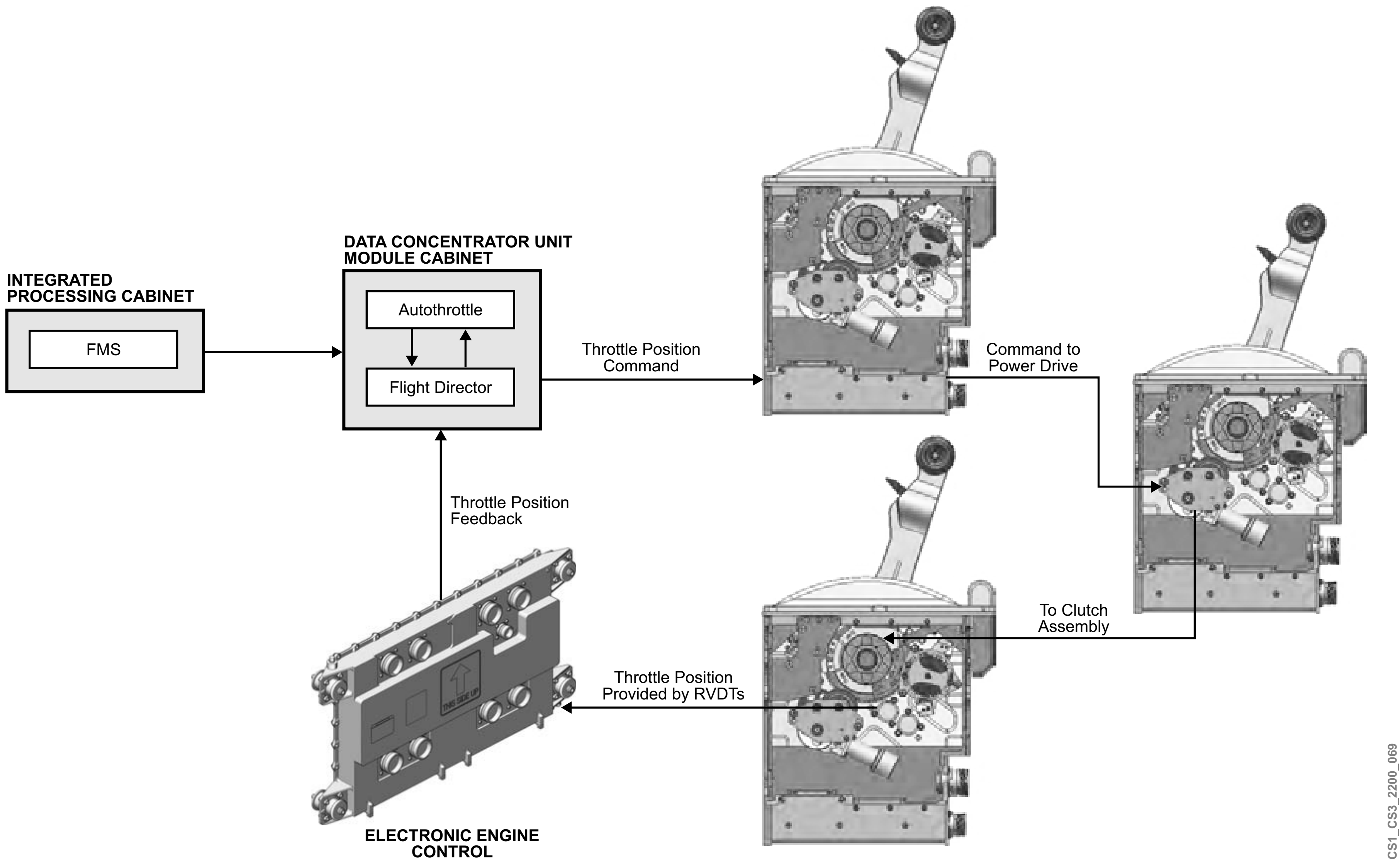


Figure 25: Autothrottle Control Path (L2)

AUTOTHROTTLE MODES

When engaged, the ATS physically advances the throttles to achieve the desired thrust target. As speed reaches 60 kt, the ATS de-clutches the throttles to hold the takeoff thrust and prevent the possibility of an uncommanded throttle rollback.

The throttles remain de-clutched until the aircraft has climbed to 400 ft AGL. Above this altitude, the ATS operates in thrust (THRUST) mode for the initial climb to altitude. This may change to a speed (SPD) mode as the flight crew makes changes to the vertical mode, and selects manual or FMS speed targets during the climb.

Autothrottle system (ATS) operation is available, up to, and including landing. During autoland operation, the autoland system sends a command to automatically retard the throttles at 30 ft AGL.

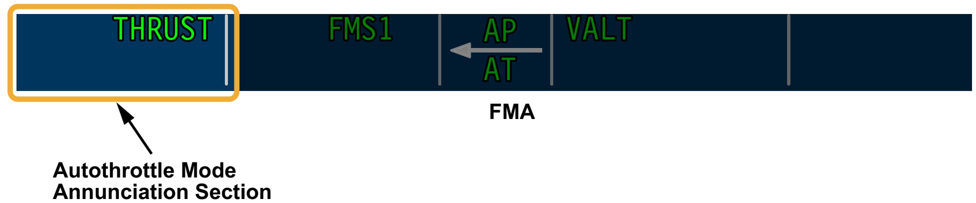
Thrust mode is also automatically enabled in the event of windshear detection or during a sensed aircraft underspeed or overspeed condition.

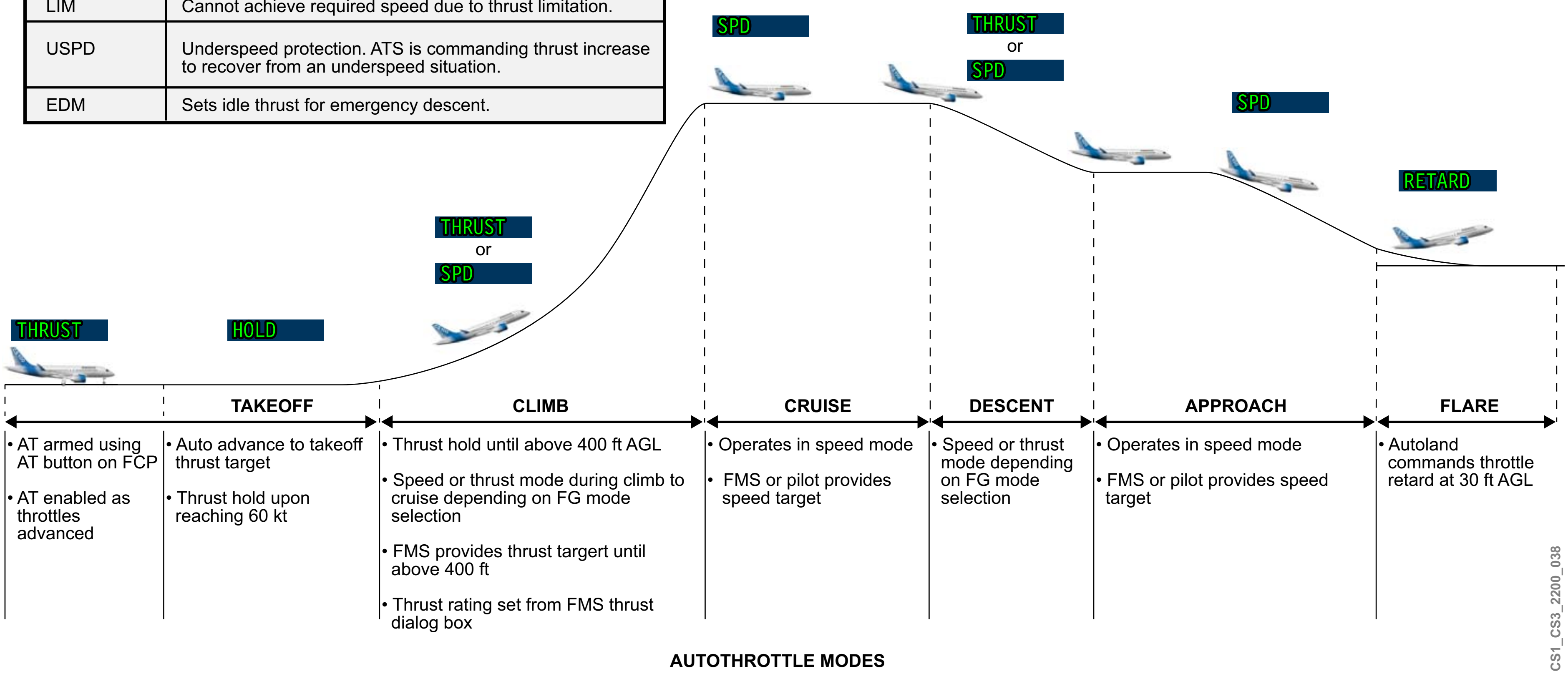
The system automatically engages following a selection of the emergency descent mode.

Following activation of the emergency descent mode (EDM), the ATS retards the throttles to the idle position.

The ATS is disengaged during the landing rollout. It is also disengaged following the selection of either ATS disconnect switch on the throttle quadrant, selection of the AT switch on the FCP, or by physical movement of either throttle.

INDICATION	DESCRIPTION
THRUST	ATS operates in thrust mode.
SPD	Throttles are adjusted to meet V minimum trim, FMS or manual speed references.
RETARD	ATS retards throttles to idle; enabled during landing flare.
HOLD	Thrust level maintained when aircraft speed reaches 60 kt. No ATS commands until 400 ft after takeoff.
LIM	Cannot achieve required speed due to thrust limitation.
USPD	Underspeed protection. ATS is commanding thrust increase to recover from an underspeed situation.
EDM	Sets idle thrust for emergency descent.





AUTOTHROTTLE MODES

Figure 26: Autothrottle Modes (L2)

DETAILED DESCRIPTION

AUTOTHROTTLE ENGAGE OPERATION

The autothrottle system (ATS) is armed on ground when the autothrottle (AT) switch on the flight control panel (FCP) is selected, and the throttles are below the midrange point on the throttle quadrant assembly (TQA).

The ATS is engaged as the throttles are manually advanced through the midrange position. From this position, the throttles are automatically advanced to the desired thrust target for takeoff.

In air, the ATS is engaged by/when:

- Pushing the AT switch on the flight control panel
- Selecting the takeoff/go-around (TOGA) switch on either throttle
- The emergency descent mode (EDM) is active

A successful engagement is indicated by a green AT icon on the flight mode annunciator (FMA).

ATS engagement logic is located in both FCP channels. The logic requires the AT engage selection, and at least one healthy autothrottle system, checked by an AFCS health monitoring function.

Once engaged, throttle commands are provided to the throttle quadrant which positions the throttles accordingly. The ATS compares commands against throttle position feedback. If required, the ATS adds a fine trim adjustment to match thrust settings, based on the sensed throttle positions. The throttles are controlled based on one of two modes, thrust or speed.

Thrust mode is used to attain a specific thrust setting identified in the flight management system (FMS). It is used during takeoff, go-around or a flight level change (climb or descent).

Speed mode is used to position the throttle levers in order to maintain a desired airspeed. The speed target is provided by the FMS or by a manual speed entry on the FCP.

The system is automatically disengaged on landing and manually disengaged by:

- Pushing the AT switch on the FCP
- Selecting AT disconnect switch on either throttle lever
- Physically overriding the position or movement of either throttle lever

Each throttle lever is provided with a takeoff/go-around switch (TOGA), and an autothrottle disconnect switch. Selection of either AT disconnect switch immediately disconnects autothrottle control from the TQA.

Selection of either TOGA switch is provided through the primary flight control computers (PFCCs), and routed to the ATS function in the data concentrator unit module cabinets (DMCs). The ATS sets a takeoff or go-around thrust accordingly.

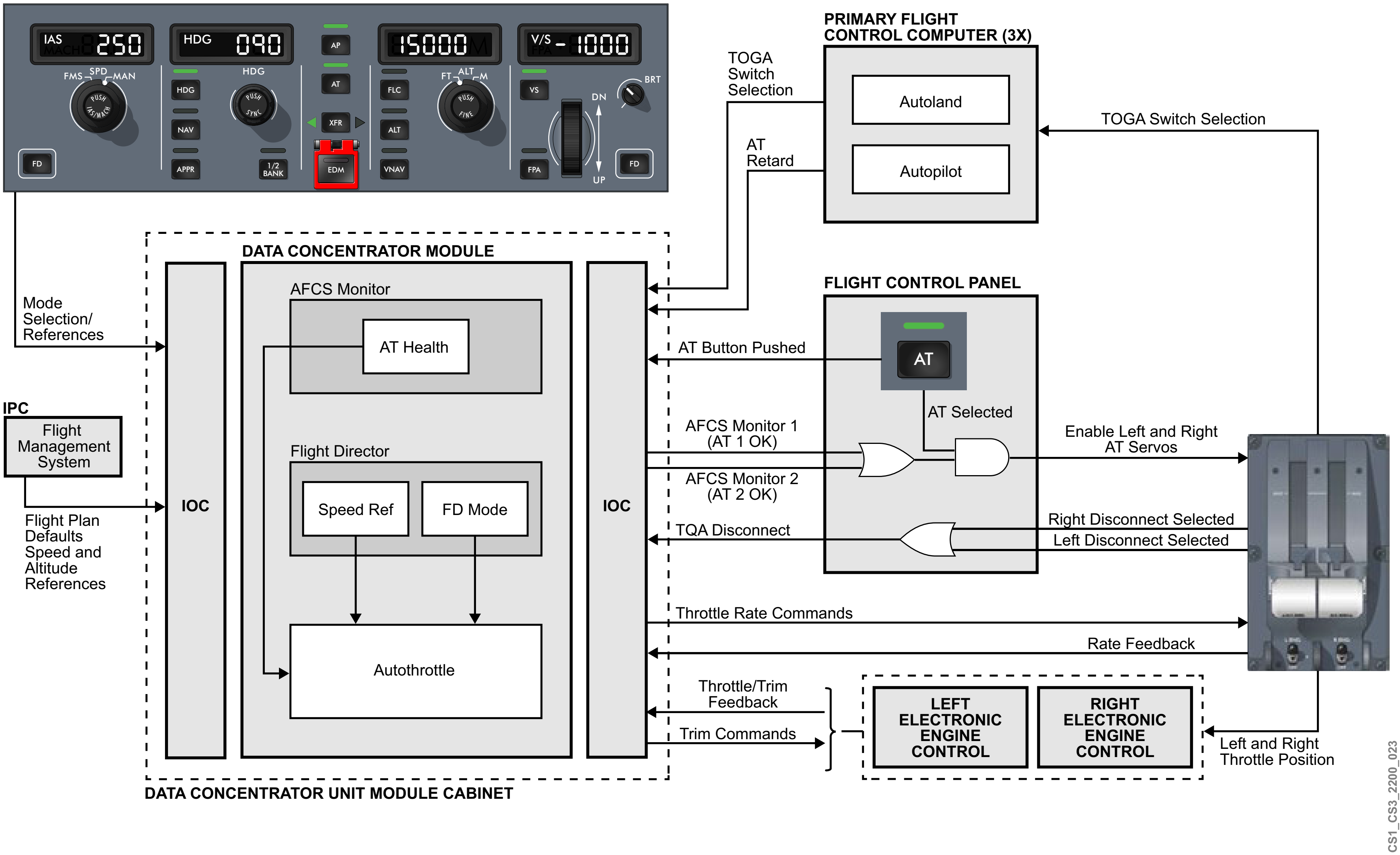


Figure 27: Autothrottle Engage Operation (L3)

MONITORING AND TESTS

The following page provides the CAS messages for the autoflight system.

Table 2: WARNING Message

MESSAGE	LOGIC
CONFIG AP	Autopilot activated and takeoff phase detected.
EMERGENCY DESCENT	Emergency descent mode is active and has been automatically engaged.

Table 3: CAUTION Messages

MESSAGE	LOGIC
AT RETARD INHIBIT	Autothrottle retard function not available due to radio altimeter data not available.
FD MODE CHANGE	Uncommanded FD mode change to a basic mode.
AP HOLDING LWD	AP is holding a mistrim command (left wing down).
AP HOLDING RWD	AP is holding a mistrim command (right wing down).
AP HOLDING NU	AP is holding a mistrim command (noseup).
AP HOLDING ND	AP is holding a mistrim command (nosedown).
EMERGENCY DESCENT	Emergency descent mode is active and has been manually engaged.
NOSE STEER FAIL	Nose wheel steering system failed OR no communication is available from both LGSCUs.

Table 4: ADVISORY Messages

MESSAGE	LOGIC
AUTO FLIGHT FAULT	Fault detected in an AFCS function.
LAND3 NOT AVAIL	LAND3 (CAT IIIB) not supported due to failure.
LAND2 NOT AVAIL	LAND2 (CAT IIIA) not supported due to failure.
APPR1 NOT AVAIL	APPR1 (CAT I) not supported due to failure.
APPR2 NOT AVAIL	APPR2 (CAT II) not supported due to failure.

Table 4: ADVISORY Messages

MESSAGE	LOGIC
L ENG A/T OFF	Left engine autothrottle command OFF.
R ENG A/T OFF	Right engine autothrottle command OFF.

Table 5: STATUS Message

MESSAGE	LOGIC
FD/AT ALTN	Alternate channel source for AT/FD selected by flight crew.

Table 6: INFO Messages

MESSAGE	LOGIC
22 AUTO FLIGHT FAULT - AP 1 INOP	AP 1 reported failed/not outputting.
22 AUTO FLIGHT FAULT - AP 2 INOP	AP 2 reported failed/not outputting.
22 AUTO FLIGHT FAULT - AP 3 INOP	AP 3 reported failed/not outputting.
22 AUTO FLIGHT FAULT - FD 1L INOP	Flight director reported failed/ not outputting, DMC channel not failed.
22 AUTO FLIGHT FAULT - FD 1R INOP	Flight director reported failed/not outputting, DMC channel not failed.
22 AUTO FLIGHT FAULT - FD 2L INOP	Flight director reported failed/not outputting, DMC channel not failed.
22 AUTO FLIGHT FAULT - FD 2R INOP	Flight director reported failed/not outputting, DMC channel not failed.
22 AUTO FLIGHT FAULT - FCP A INOP	FCP channel 1 not outputting data or invalid. DMC not reporting failure.
22 AUTO FLIGHT FAULT - FCP B INOP	FCP channel 2 not outputting or invalid. DMC not reporting failure.

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Table 6: INFO Messages

MESSAGE	LOGIC
22 AUTO FLIGHT FAULT - AT1 INOP	Indicated autothrottle failed or not outputting. DMC not reporting failure.
22 AUTO FLIGHT FAULT - AT2 INOP	Indicated autothrottle failed or not outputting. DMC not reporting failure.

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ATA 23 - Communication

BD-500-1A10
BD-500-1A11

Table of Contents

23-80 Radio Management System 23-2
General Description 23-2
Selective Calling 23-4
Component Location 23-6
Control Tuning Panel 23-6
Reversion Switch Panel 23-6
Radio Interface Unit 23-8
External Compensation Unit 23-8
Controls and Indications 23-10
SELCAL Field on CTP Main Tune Page 23-10
CTP SELCAL Control Page 23-10
Radio Tuning System Application SELCAL Display Field 23-12
SELCAL Disabled Message 23-12
SELCAL Radio Side Annunciation 23-12
CTP SELCAL Configuration Error Message 23-12
Detailed Description 23-14
Radio Management System 23-14
CAS Messages 23-16
23-51 Audio Integrating System 23-18
General Description 23-18
Power Input 23-18
Component Location 23-20
Service Interphone, Mechanic Call Panel and Flight Deck Speakers 23-22
External Service Intercom Panels 23-24
Controls and Indications 23-26
Audio Control Panel 23-26
Operation 23-30
Interphone Function 23-30
Flight Interphone 23-30
Service Interphone 23-30
MECH CALL 23-30
Detailed Description 23-32
System Interface 23-32
Monitoring and Tests 23-34
CAS Messages 23-35
23-00 Radio Tuning 23-36
General Description 23-36
Controls and Indications 23-38
Control Tuning Panel 23-38
CTP VHF-COM Radio Tuning 23-40
VHF Tuning Methods 23-42
VHF Control Pages 23-44
RTSA VHF-COM Radio Tuning 23-46
RTSA Controls 23-46
RTSA Modes of Operation 23-46
RTSA Preset Pages 23-48
CTP High Frequency Communication Radio Tuning 23-50
RTSA HF-COM Radio Tuning 23-56
RTSA Tuning Modes of Operation 23-56
RTSA HF Control and Preset Page 23-56
Graphical Tuning 23-58
23-11 Very High Frequency 23-62
General Description 23-62
Component Location 23-64
VHF-COM Transceivers 23-64
VHF-COM Antennas 23-66

Monitoring and Tests 23-68
Test...23-68
CAS Messages 23-70
23-71 Cockpit Voice Recorder..23-72
General Description 23-72
Component Location 23-74
Cockpit Voice Recorder Control Panel 23-74
Cockpit Area Microphone...23-74
Area Microphone Pre-Amplifier................................23-74
Cockpit Voice Recorder 23-76
Detailed Description 23-78
Optional Cockpit Voice Recorder Monitoring System 23-78
Monitoring and Tests..23-80
Test...23-80
CAS Messages 23-82
23-22 Airborne Data Link..23-84
General Description 23-84
Component Location 23-86
DLCA-6000 Data Link Communications Application 23-86
Controls and Indications 23-88
Data Link Control and Display 23-88
Airport Operational Communications........................23-88
Air Traffic Services...23-90
Technical Application 23-92
Detailed Description 23-94
Radio Interface Unit 23-94
External Compensation Unit 23-94
DLCA-6000 Data Link Communications Application 23-94
Cockpit Voice Recorder 23-94
Monitoring and Tests 23-96
CAS Messages 23-97

List of Figures

Figure 1: Radio Management System (L2)....23-3
Figure 2: SELCAL System (L2)....23-5
Figure 3: Control Tuning Panel and Reversion Switch Panel (L2)....23-7
Figure 4: RIU and ECU Component Location (L2)....23-9
Figure 5: SELCAL Controls and Indications (L2)....23-11
Figure 6: SELCAL Display Messages (L2)....23-13
Figure 7: Radio Management System Block Diagram (L3)....23-15
Figure 8: Audio Integrating System (L2)....23-19
Figure 9: Audio Integrating System Component Location (L2)....23-21
Figure 10: Service Interphone, Mechanic Call Panel, and Flight Deck Speakers (L2)....23-23
Figure 11: External Service Intercom Panels (L2)....23-25
Figure 12: Audio Control Panel – Transmission/Reception (L2)....23-27
Figure 13: Audio Control Panel – Controls (L2)....23-29
Figure 14: Audio Control Panel Operation (L2)....23-31
Figure 15: Audio Interface System Block Diagram (L3)....23-33
Figure 16: Radio Tuning (L2)....23-37
Figure 17: Control Tuning Panel Controls (L2)....23-39
Figure 18: CTP VHF-COM Radio Tuning (L2)....23-41
Figure 19: CTP VHF-COM Tuning Methods (L2)....23-43
Figure 20: CTP VHF-COM Annunciations (L2)....23-45
Figure 21: RTSA VHF Tuning Controls (L2)....23-47
Figure 22: RTSA VHF Tuning Control Page Annunciations (L2)....23-49
Figure 23: CTP High Frequency Communication Control Page (L2)....23-51
Figure 24: CTP High Frequency Communication Radio Preset Frequency Page (L2)....23-53
Figure 25: CTP High Frequency Communication Tuning Functions (L2)....23-55
Figure 26: RTSA High Frequency Control and Preset Page (L2)....23-57
Figure 27: Graphical Tuning Menu (L2)....23-59
Figure 28: Airport Communications and ARTCC Frequencies Dialog Boxes (L2)....23-61
Figure 29: VHF Communication System (L2)....23-63
Figure 30: VHF Component Location (L2)....23-65
Figure 31: VHF-COM Antenna Location (L2)....23-67
Figure 32: VHF Communication Test (L2)....23-69
Figure 33: CVR Block Diagram (L2)....23-73
Figure 34: CVR Component Location – Flight Deck (L2)....23-75
Figure 35: Cockpit Voice Recorder Component Location (L2)....23-77
Figure 36: Cockpit Voice Recorder – Detailed Description (L3)....23-79
Figure 37: Cockpit Voice Recorder Control Panel –Test (L2)....23-81
Figure 38: Data Link Network, ACARS/VDL, and Optional CPDLC (L2)....23-85

Figure 39: Data Link Communications Application (L2) 23-87
Figure 40: Data Link – Airport Operational Communications Menu (L2) 23-89
Figure 41: Data Link – Air Traffic Services Menu (L2)..........23-91
Figure 42: Data Link Technical Menu (L2) 23-93
Figure 43: Data Link System (L3).......................................23-95

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COMMUNICATION - CHAPTER BREAKDOWN

Communication Management 1

Voice Communication 2

Data Communication 3

Monitoring and Protecting 4

23-80 RADIO MANAGEMENT SYSTEM

GENERAL DESCRIPTION

The radio management system (RMS) provides the aircraft operator with the means to control and tune all communication and navigation radios onboard the aircraft.

The RMS consists of two dual-channel radio interface units (RIUs), two control tuning panels (CTPs), a radio tuning system application (RTSA), and graphical tuning.

Audio management for the radio management system is performed by the RIUs. Each RIU receives audio inputs from the radios, the audio control panels (ACPs), NAV receivers, and optional satellite communications (SATCOM). Digital data for tuning is sent to the integrated processing cabinets (IPC) via the data concentrator unit module cabinets (DMCs) where it is distributed to the RTSA and the flight management system (FMS) for secondary tuning.

The RIU channel B performs the aural prioritizing function. In the event of several aural alert requests received at the same time, the RIU sends the most important first to the audio integrating system (AIS). The RIU outputs the tuning commands to each radio on ARINC 429 BUSES. This is the channel B of the onside RIU communicating with the radios.

RIU 1 has a data link function and interfaces with the external compensation unit (ECU). For this reason, RIU 1 and RIU 2 are not interchangeable. The ECU stores aircraft specific configuration data, required for the data link function.

The reversion switch panel (RSP) provides a control to manually inhibit the RTSA and graphical tuning.

The RIUs are powered by the following sources:

- RIU 1 channel A; DC BUS 1
- RIU 1 channel B; DC ESS BUS 3
- RIU 2 channel A; DC ESS BUS 3
- RIU 2 channel B; DC BUS 2

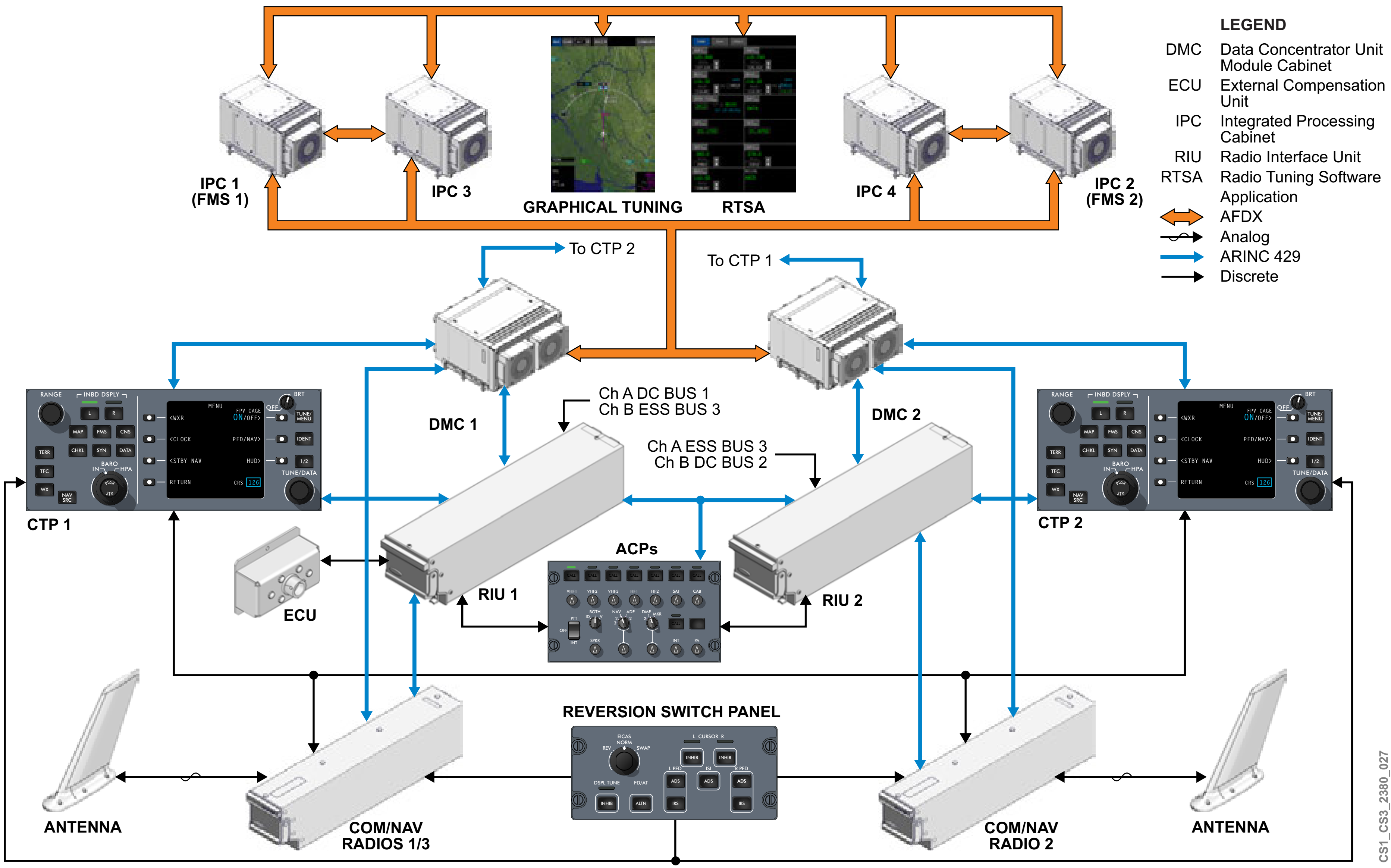


Figure 1: Radio Management System (L2)

SELECTIVE CALLING

The radio interface units (RIUs) include a selective calling (SELCAL) function. The unique SELCAL code is stored in the RIUs and the control tuning panels (CTP). The SELCAL detection ON/OFF selection is controlled from the CTPs. The SELCAL code is also displayed on the radio tuning system application (RTSA).

When a ground station transmits an aircraft-specific combination of four audio tones via VHF or HF radio, they are decoded by the RIU. If the received tones are the same code as the aircraft code:

- SELCAL advisory message is displayed
- SELCAL aural alert sounds
- VHF or HF microphone select switch CALL light on the audio control panel (ACP) illuminates

The SELCAL advisory message and CALL light are reset when the press-to-talk (PTT) switch is pressed.

The SELCAL code can be changed using the utility menu of the onboard maintenance system (OMS).

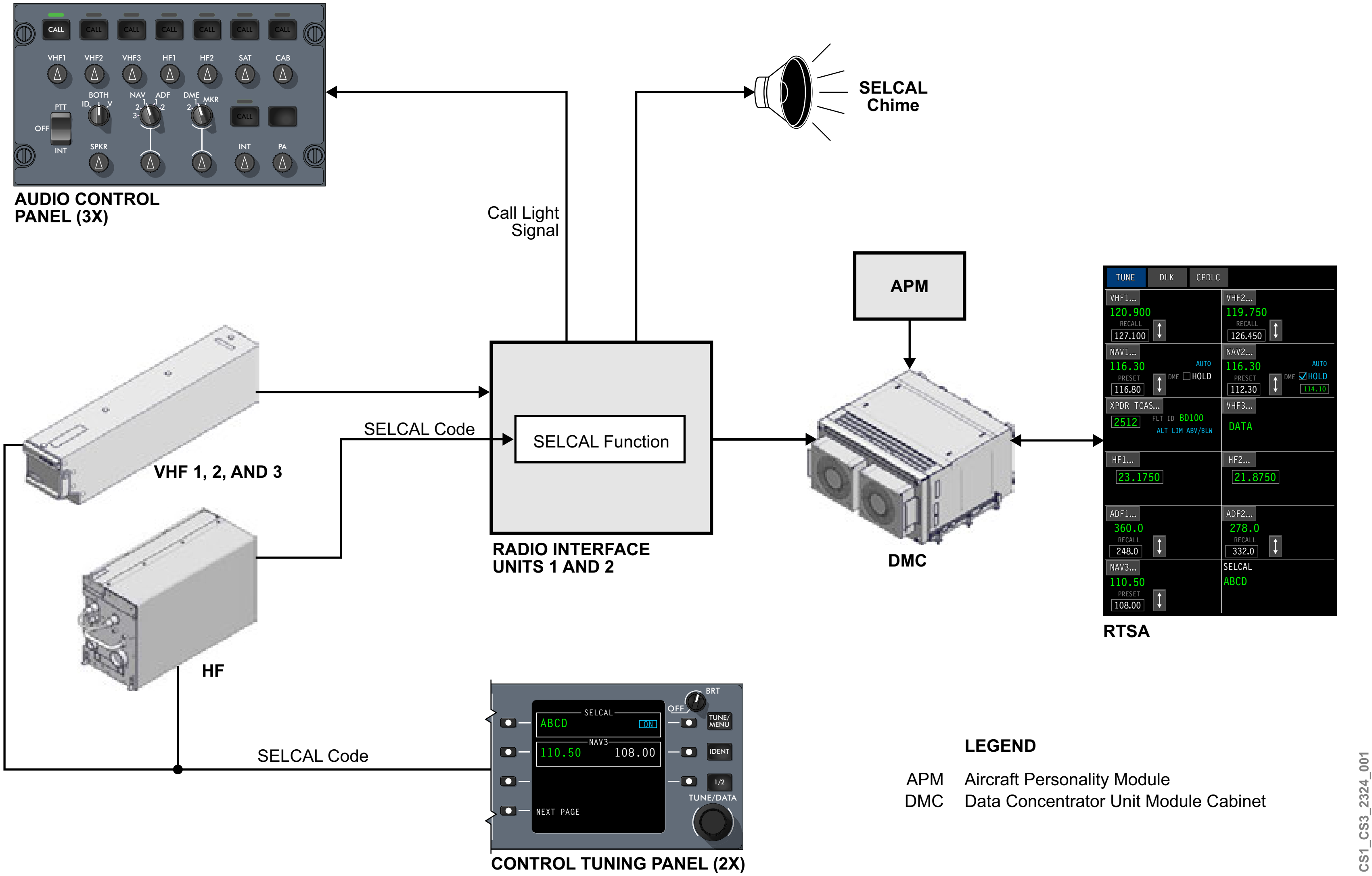


Figure 2: SELCAL System (L2)

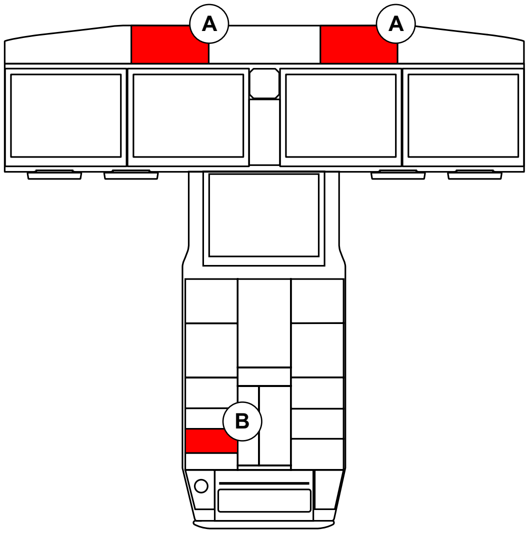
COMPONENT LOCATION

CONTROL TUNING PANEL

There are two control tuning panels (CTPs) installed on the pilot and copilot glareshield panel.

REVERSION SWITCH PANEL

The reversion switch panel (RSP), installed on the pilot side of the center pedestal.



A CONTROL TUNING PANEL (2X)

B REVERSION SWITCH PANEL

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Figure 3: Control Tuning Panel and Reversion Switch Panel (L2)

RADIO INTERFACE UNIT

The radio interface units (RIUs) are installed in the mid equipment bay forward shelf.

EXTERNAL COMPENSATION UNIT

The external compensation unit (ECU) is installed in the mid equipment bay forward shelf.

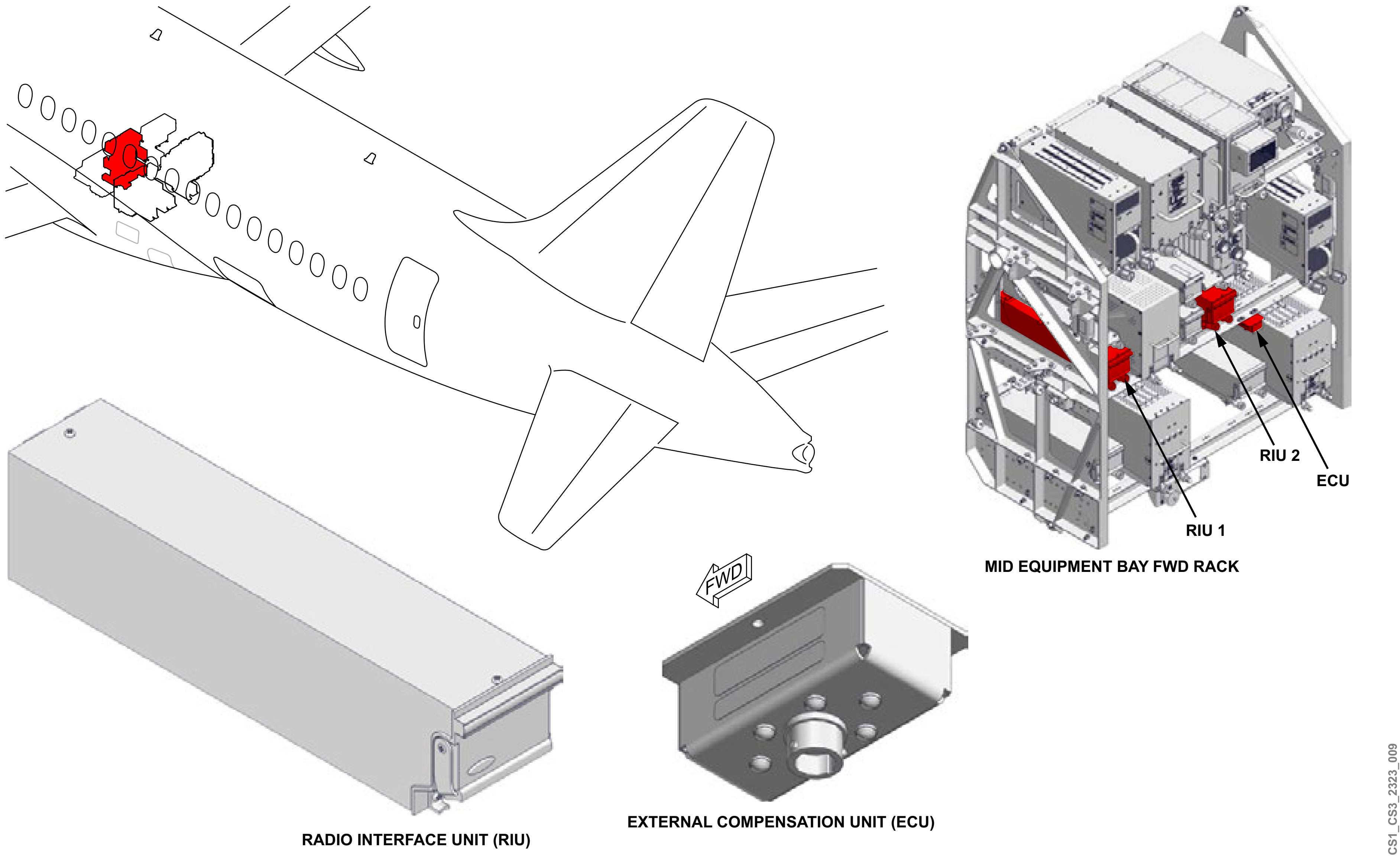


Figure 4: RIU and ECU Component Location (L2)

CONTROLS AND INDICATIONS

SELCAL FIELD ON CTP MAIN TUNE PAGE

From the top tune page, press next page twice to arrive at the SELCAL main page. The SELCAL main display contains the SELCAL code and detection ON/OFF control for the SELCAL radio. The color of the code is white if detection is turned OFF.

The SELCAL detection can be selected ON and OFF by use of the TUNE/DATA knob. The color of the active SELCAL code is green when all of the following conditions occur:

- Detection is turned ON
- The SELCAL code is valid
- All holders of the SELCAL code have the same matching code
- The RIU does not indicate a misconfiguration

The SELCAL code is synchronized among all displays, CTPs, and RIUs. An invalid SELCAL code is not synchronized with the RIUs. When data is missing for a holder code, the code is displayed as four white dashes.

CTP SELCAL CONTROL PAGE

The SELCAL control page contains the following codes for all holders in the system:

- L-CTP
- R-CTP
- L-RIU-A
- L-RIU-B
- R-RIU-A
- R-RIU-B

Entry into the SELCAL control page is inhibited except when an error is present.

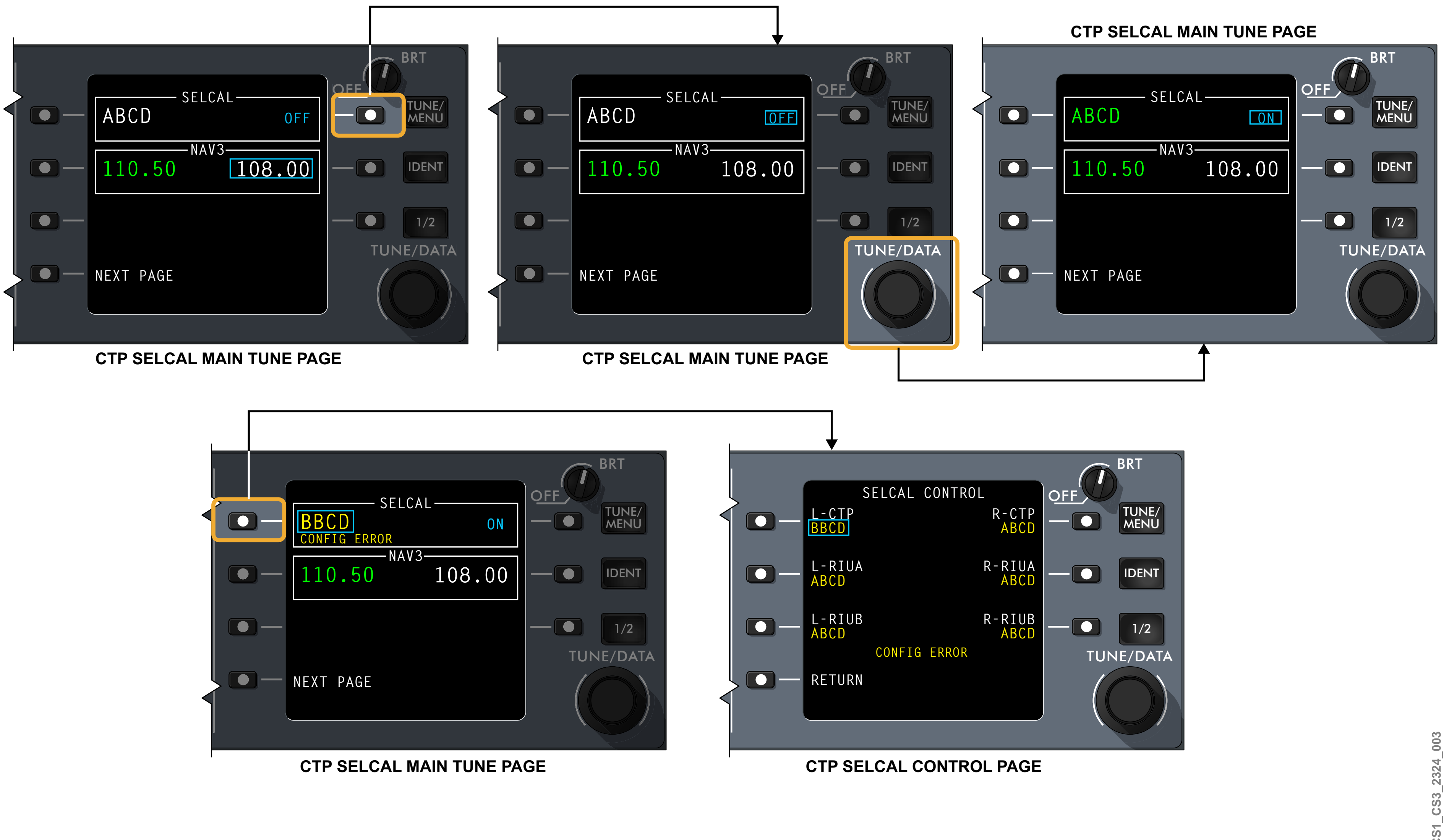


Figure 5: SELCAL Controls and Indications (L2)

RADIO TUNING SYSTEM APPLICATION SELCAL DISPLAY FIELD

The selective calling (SELCAL) display field, located on the radio tuning system application (RTSA) contains the SELCAL code.

To turn SELCAL on, rotate the cursor control panel (CCP) inner double-stack knob (DSK). The SELCAL code is green when ON.

SELCAL DISABLED MESSAGE

When both CTPs are inhibited, all data in the RTSA SELCAL display is blank and is replaced by a centered yellow SELCAL DISABLED annunciation.

SELCAL RADIO SIDE ANNUNCIATION

The RTSA displays one of the following messages if SELCAL data is not being processed:

- LEFT RADIO ONLY when right side data is not being processed
- RIGHT RADIO ONLY when left side data is not being processed

CTP SELCAL CONFIGURATION ERROR MESSAGE

If the active SELCAL code does not match the code of one or more of the other holders of the SELCAL code, the configuration error message CONFIG ERROR is displayed in yellow below the SELCAL code. It is also displayed on the RTSA.

The color of the active SELCAL code is yellow if detection is turned ON and any of the following conditions occur:

- SELCAL code is invalid
- At least one of the SELCAL code holders does not have a matching code with the other holders, including one holder is invalid (dashed) or missing (blank)
- The RIU indicates a misconfiguration

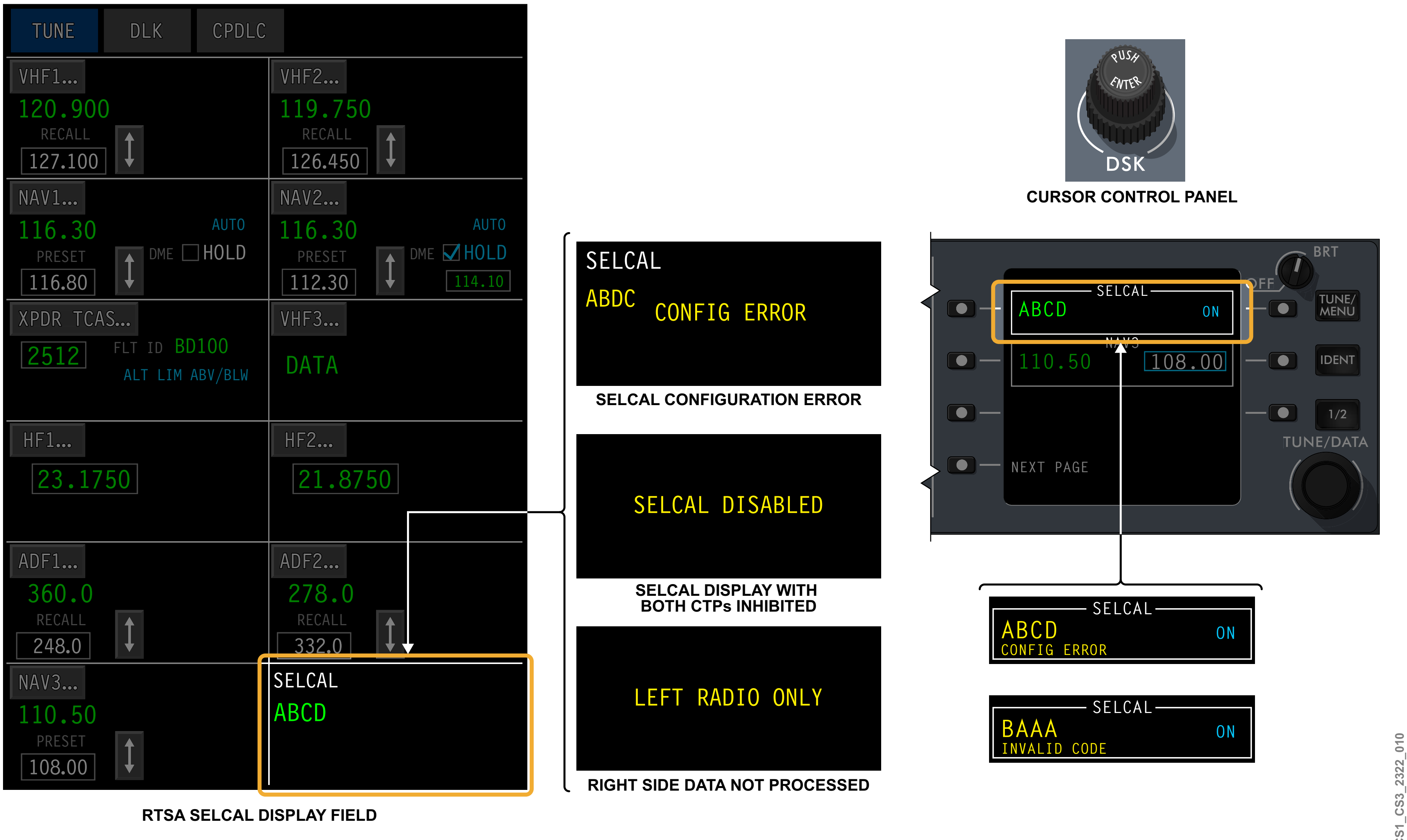


Figure 6: SELCAL Display Messages (L2)

DETAILED DESCRIPTION

RADIO MANAGEMENT SYSTEM

In normal operation, the onside control tuning panel (CTP) performs the tuning function for onside radios. The other tuners are remote tuners and send tuning requests to the onside CTP. The digital busing between these tuners is through the RIUs.

When a CTP or radio tuning system application (RTSA) sends a tune or control command to the radio, it also sends that signal to all radio tuners to synchronize them.

All radios have three tuning ports: A, B, and C. Priority for radio input ports is port B (primary), port A (secondary), and port C (tertiary).

Port B is connected to the channel B of the onside RIU and provides:

- Digital audio
- Aural warning

Port A is connected to the channel A of the onside RIU and provides:

- Digital audio
- No aural warning

Port C is connected to the display unit (DU) tuning via the data concentrator unit module cabinet (DMC) and provides:

- Backup audio
- No aural warning

If a CTP fails, the CTP must be switched off in order to force the onside radios to listen on port A.

If a RIU channel B fails, the onside CTP must be switched off in order to force the onside radios to listen on port A. This allows the cross-side CTP to tune its cross-side radios. The flight crew receives a L CTP TUNING FAIL message to switch off the CTP.

If both CTPs fail, they must both be switched off. This forces the radios to listen on port C.

When DSPL TUNE INHIB is selected on the reversion switch panel (RSP) and both CTPs are switched off, only VHF-COM 1 and VHF-COM 2 are forced to tune to the emergency frequency of 121.5 MHz.

The RIU performs power-up tests and continuous built-in test (CBIT) testing. The power-up test is completed during the first 2 seconds following power-up or reset. CBIT is initiated after the two second power-up period. The tests which run continuously during normal operation include:

- Cyclic redundancy checks (CRCs)
- Validity of ARINC 429 input bus signals
- ARINC 429 BUS activity
- Aircraft personality module (APM) interface status
- Proper execution of software
- Internal electrical erasable programmable read only memory (EEPROM) interface status
- Power supply voltage levels
- Continuous monitoring of external inputs

The radios provide audio I/O in either ARINC 429 digital format, or analog format. The RIU converts all analog signals to digital data to allow for digital mixing and volume control, and then provides the audio to the audio system.

Displays Tuning Path

All communication between the DMCs and the display units pass through the digital switching module (DSM) in the third and fourth integrated processing cabinet (IPC). Loss of both the third and fourth DSM causes display tuning to be inoperative.

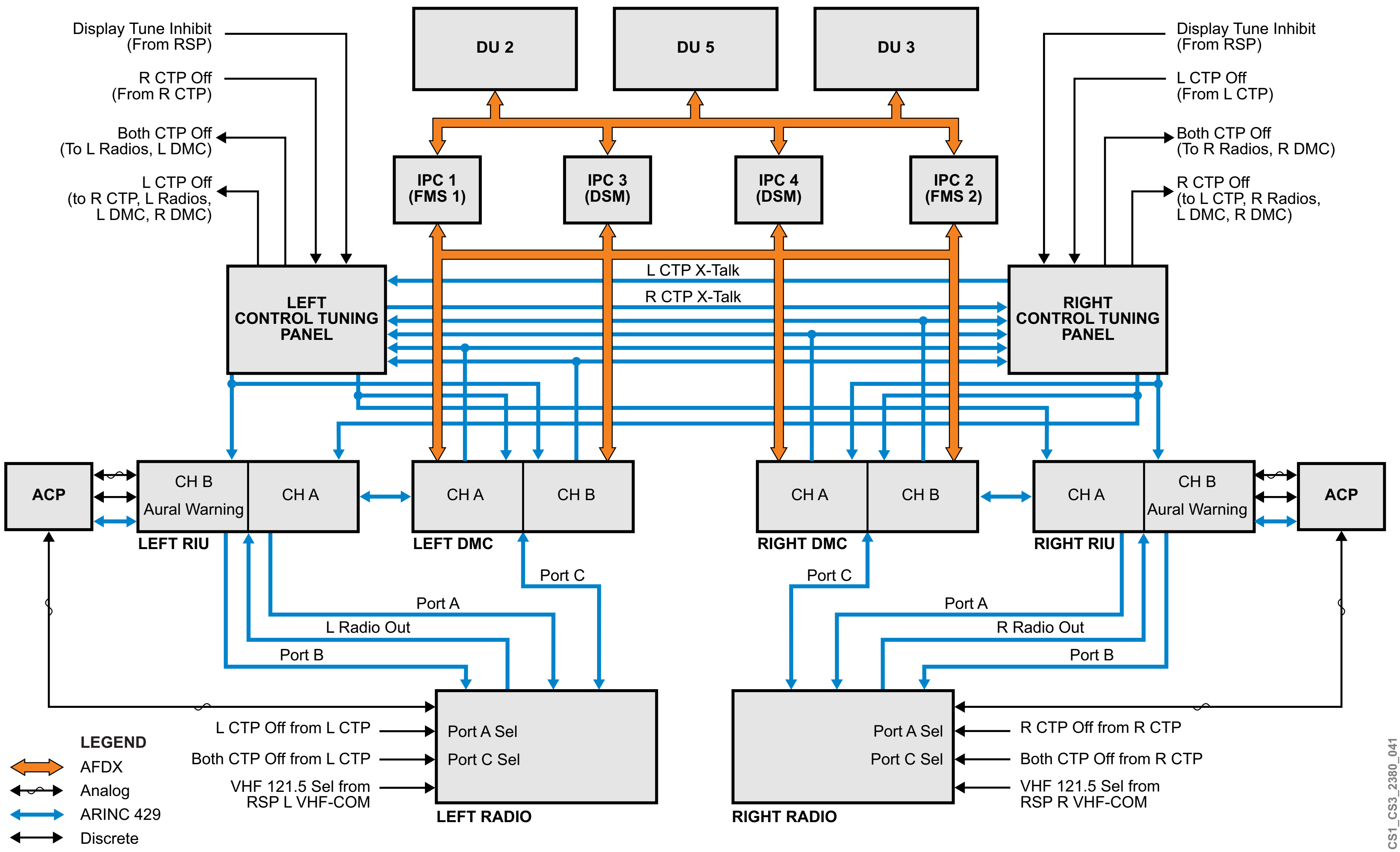


Figure 7: Radio Management System Block Diagram (L3)

CAS MESSAGES

The following page provides the crew alerting system (CAS) and INFO messages for the radio management system.

Table 1: CAUTION Messages

MESSAGE	LOGIC
L CTP TUNING FAIL	L RIU channel B failure leading to L CTP is not capable of tuning left side radio.
R CTP TUNING FAIL	R RIU channel B failure leading to R CTP is not capable of tuning right side radio.
L-R RADIO TUNING FAIL	Four channels of the RIU failed leading to emergency audio only.

Table 2: ADVISORY Messages

MESSAGE	LOGIC
SELCAL	SELCAL incoming audio request received on either VHF or HF radios.
AVIONIC FAULT	Loss of redundant or non-critical function for the avionics system.
AURAL WARN FAIL	L-RIU-B and R-RIU-B have failed.

Table 3: STATUS Messages

MESSAGE	LOGIC
DSPL TUNE INHIB	Display tuning inhibited.
VHF COM 121.5 ENABLE	VHF operating in emergency mode.

Table 4: INFO Messages

MESSAGE	LOGIC
RIU CH 1A INOP	RIU CHANNEL 1A INOP The L RIU channel A failed.
RIU CH 2A INOP	RIU CHANNEL 2A INOP The R RIU channel A failed.
RIU CH 1B INOP	RIU CHANNEL 1B INOP The L RIU channel B failed.
RIU CH 2B INOP	RIU CHANNEL 2B INOP The R RIU channel B failed.
RIU 1B AURAL INOP	RIU-1B reporting aural fail warning, or RIU-2B not receiving valid aural fail warning from RIU-1B.
RIU 2B AURL INOP	RIU-2B reporting aural fail warning, or RIU-1B not receiving valid aural fail warning from RIU-2B.

23-51 AUDIO INTEGRATING SYSTEM

GENERAL DESCRIPTION

The audio integrating system (AIS) provides full system control for the crew members.

Each crew member has access to:

- Dual jack headset/microphone connector
- Active noise reduction (ANR) connector for pilot headsets
- An oxygen mask microphone
- Push-to-talk (PTT) switches on the sidesticks and the cursor control panels (CCP)
- A hand-held microphone with a PTT switch
- A dedicated flight deck speaker

The system has interfaces to the cockpit voice recorder and aircraft aural warning system, which is part of the radio interface unit (RIU).

The audio control panel (ACP) interfaces with communication and navigation radios via the RIU, using digital buses.

The ACP provides analog interface for the flight deck intercom, the cockpit voice recorder (CVR), and the ground crew intercom through the refuel panel and electrical/towing service panel.

It also provides:

- Cabin passenger address (PA)
- Communication (COM) 1 or 2 for emergency (EMER) mode
- Analog interface for aural warning backup from the RIUs

The radios provide audio input/output in digital or analog format.

The RIU converts all analog signals to digital data which allows for digital mixing and volume control, and provides the audio to the audio system. Each RIU supports dual audio management to all ACPs.

The RIUs provide the interface between the ACPs and data concentrator unit module cabinet (DMC).

DMC 1 receives a discrete input from the ACPs Port C for backup PTT.

DMC 2 receives discrete from the ELEC/TOWING service panel and REFUEL panel for a flight deck call.

POWER INPUT

The AIS components receive 28 VDC from the following:

- ACP 1; DC ESS BUS 3 and DC ESS BUS 1
- ACP 2; DC ESS BUS 2 and DC ESS BUS 1
- ACP 3; DC ESS BUS 1

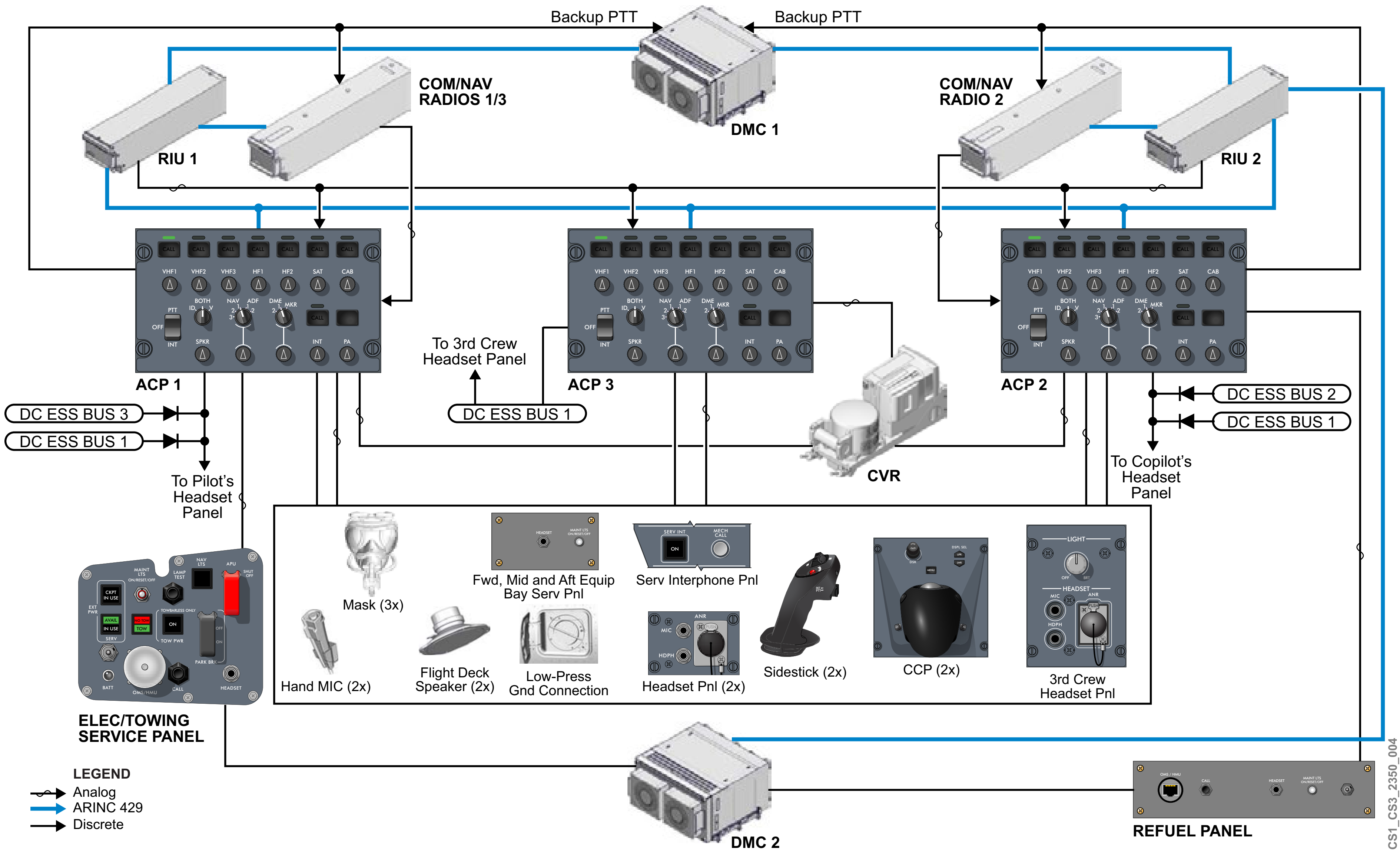


Figure 8: Audio Integrating System (L2)

COMPONENT LOCATION

The audio integrating system consists of the following components:

- Sidestick push-to-talk (PTT) switches
- Cursor control panel (CCP) PTT switches
- Hand-held microphones
- Headset panels
- Audio control panels (ACPs)
- 3rd crew headset panel

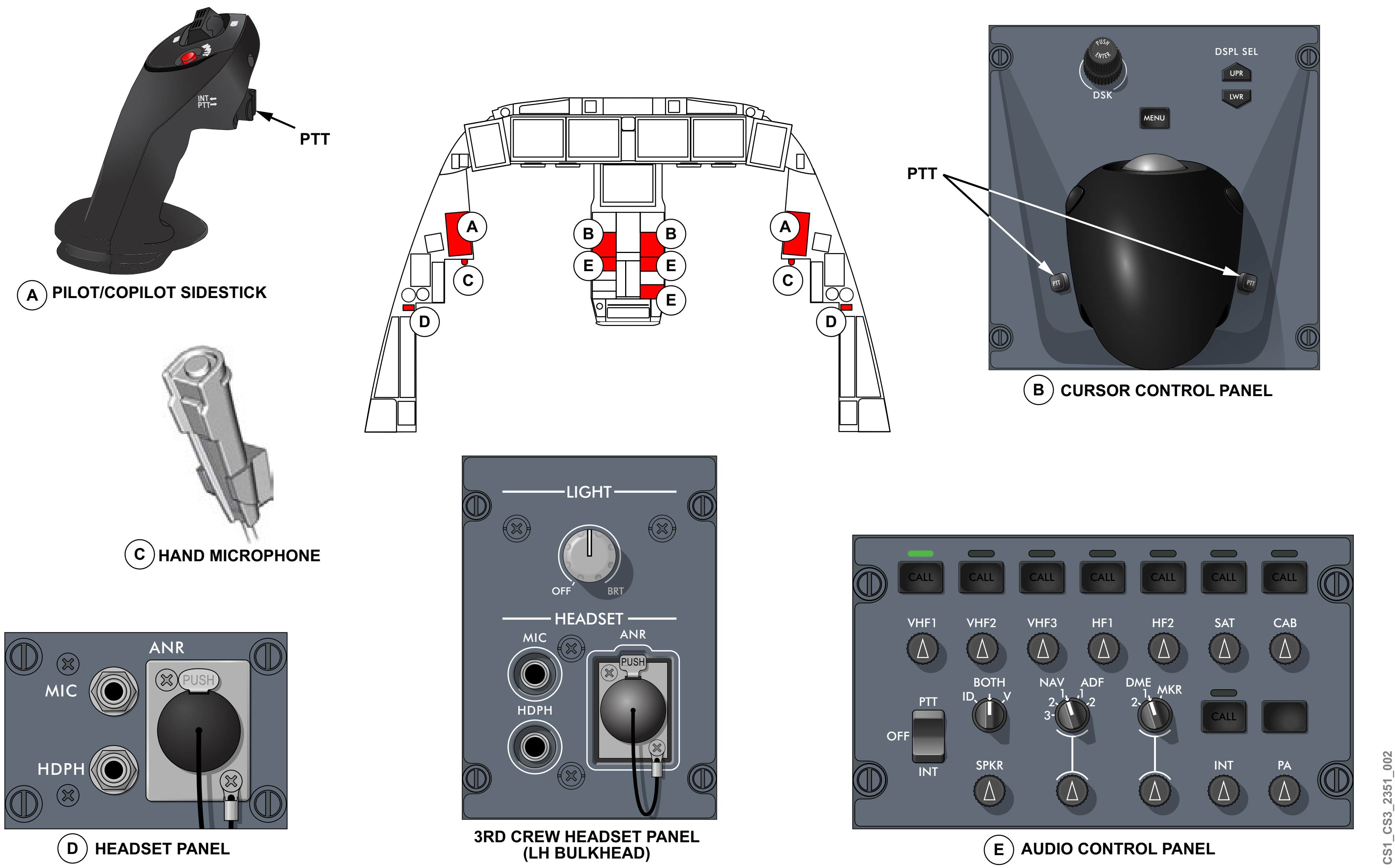


Figure 9: Audio Integrating System Component Location (L2)

SERVICE INTERPHONE, MECHANIC CALL PANEL AND FLIGHT DECK SPEAKERS

- The two flight deck speakers are located in the overhead panel area
- The SERV INT and MECH CALL panel is installed in the overhead panel

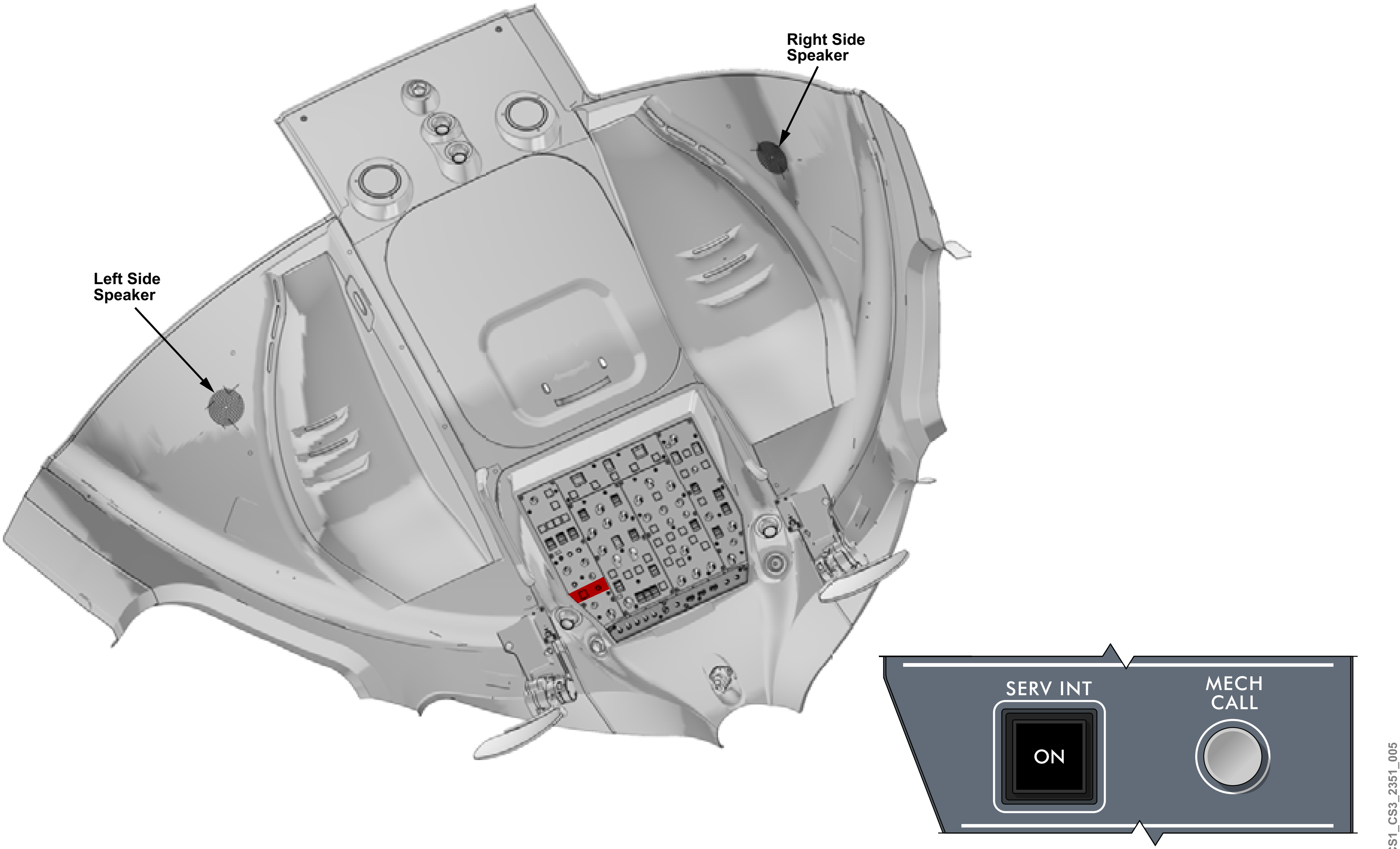


Figure 10: Service Interphone, Mechanic Call Panel, and Flight Deck Speakers (L2)

EXTERNAL SERVICE INTERCOM PANELS

- The three equipment bay service panels are installed in the forward, mid, and aft equipment bays
- The electrical towing service panel is installed in the left side nose area
- The refuel/defuel intercom panel is installed in the right wing-to-body (WTBF) fairing
- The low-pressure ground connection intercom panel is installed in the left wing-to-body (WTBF) fairing

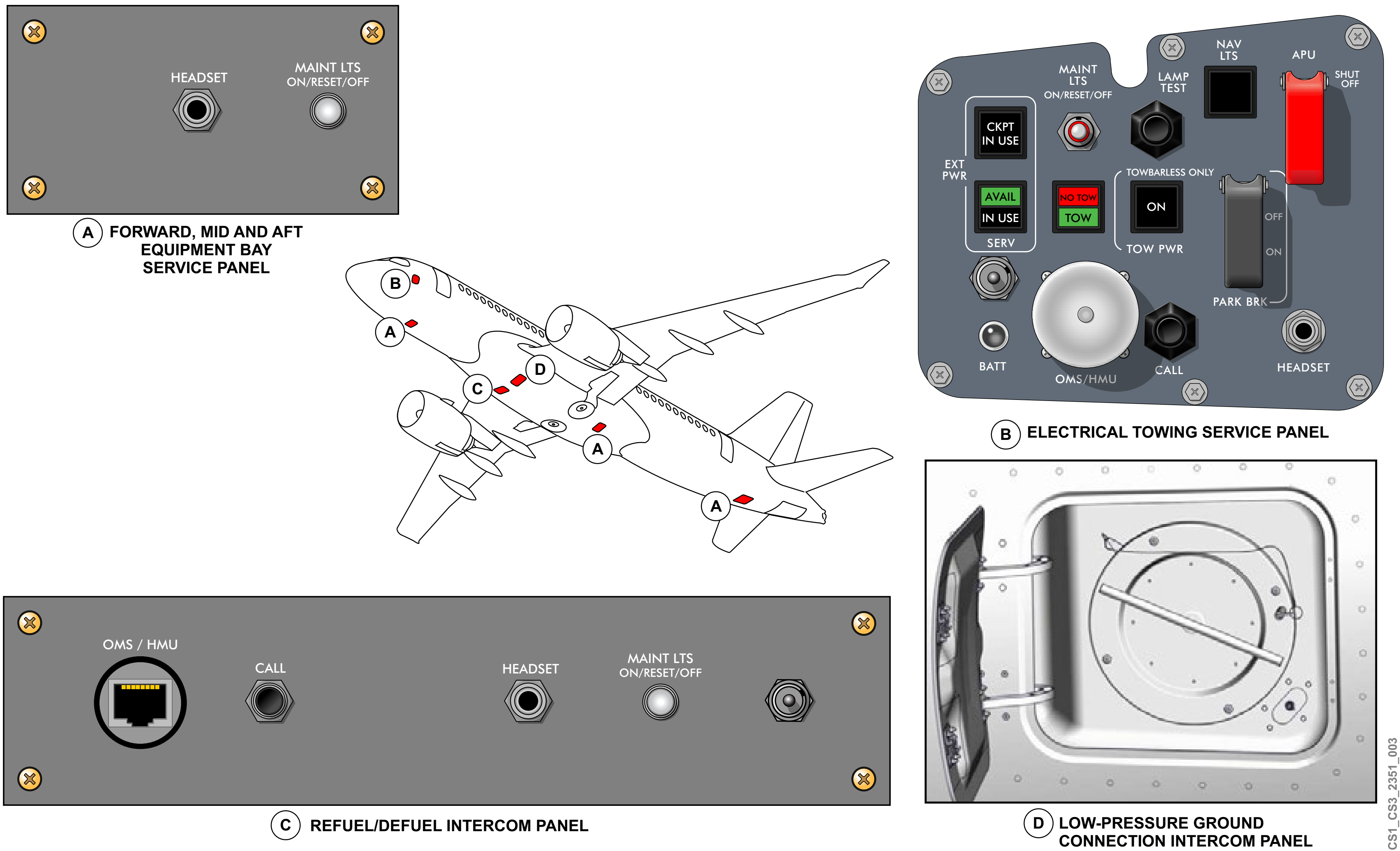


Figure 11: External Service Intercom Panels (L2)

CONTROLS AND INDICATIONS

AUDIO CONTROL PANEL

Transmission Control Pushbuttons

The VHF, HF, SAT, and CAB control pushbuttons are mutually exclusive controls that allow the flight crew to select a communication transceiver for transmission.

The CALL light on the radio transmission control button illuminates for an incoming SELCAL call, accompanied by an aural tone.

The CALL light on the cabin transmission control button illuminates for an incoming CAB call, accompanied by a caution crew alerting system (CAS) message.

Communication Volume Controls

The VHF, HF, SAT, and CAB knobs associated with the transmit controls are dual controls. Rotating the knob adjusts the associated receiver volume. The knob can also be selected in and out to turn the receive audio on and off.

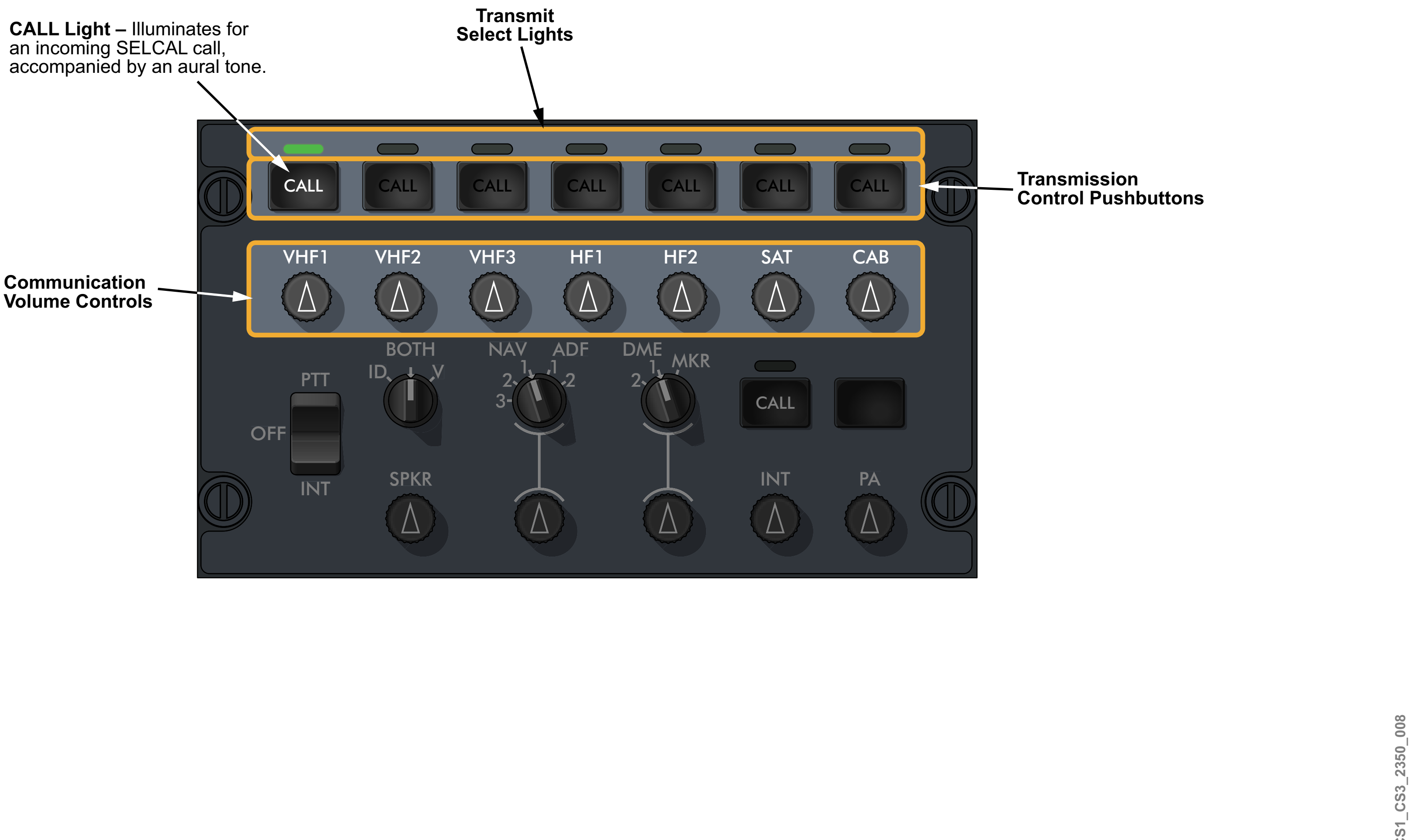


Figure 12: Audio Control Panel – Transmission/Reception (L2)

Navigation Receiver Selection and Volume Control

Two rotary switches allow the flight crew to select which navigation receivers to monitor.

Receive Filter Selection Switch

The receive filter section switch allows the flight crew to select the type of NAVAID identifier heard for the selected navigation receiver. The ID/BOTH/V filter control provides mutually exclusive selection between the Morse code (ID) identifier only, both NAVAID identifiers, or voice identifier.

Communication Rocker Switch

Pressing the PTT end of the rocker switch, performs a momentary PTT function for transmission over the selected communication transceiver. Pressing the INT end of the rocker switch, provides a latched PTT function for the interphone.

NOTE

In the event of a stuck PTT, the VHF radios time-out at 30 seconds. A message is posted, and the PTT function is disabled. In the case of the HF, SATCOM, PA and CAB, the timeout occurs after 2 minutes. To retransmit on the selected radio, select a key on the sidestick, CCP radio, PTT or hand-held microphone PTT.

Intercom Selection

Pressing the INT transmission control pushbutton connects the microphone output to the interphone and illuminates the transmit select light above the INT button. The INT volume control button is used to adjust the volume of the flight and service interphone audio.

The CALL light on the transmission control button illuminates for an incoming MECH CALL from the service panels.

Passenger Address Pushbutton

Pressing the PA transmission control pushbutton connects the microphone output to the passenger address (PA) system. To maintain an active connection push and hold the PA button.

Speaker Volume Control

The speaker volume (SPKR) control adjusts the volume of the audio from the associated flight deck speaker, except for aural warnings.

Pilot/Copilot Sidestick

The sidestick push-to-talk (PTT) switches are installed on the pilot and copilot sidestick. Each switch is a three-position sliding type switch (PTT-OFF-INT). When the switch is in the PTT momentary position, boom or mask microphones are used for transmission on the applicable radio system as selected on the audio control panel (ACP). When the switch is in the INT position (latch position), intercom mode is active, using the boom or mask microphones on the interphone system only.

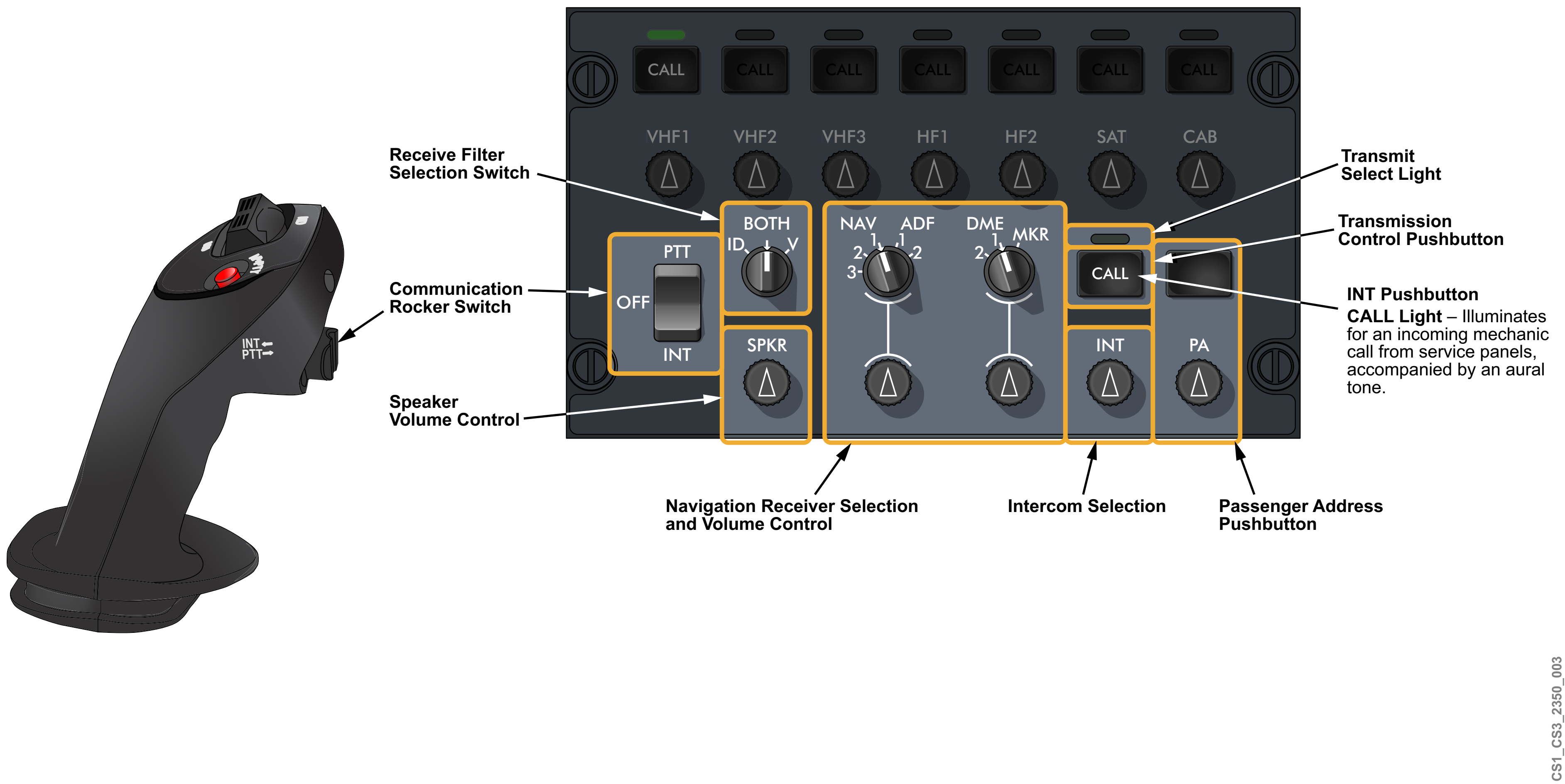


Figure 13: Audio Control Panel – Controls (L2)

OPERATION

INTERPHONE FUNCTION

The audio system provides the following interphone services:

- Flight interphone
- Service interphone

FLIGHT INTERPHONE

The flight interphone is an interphone service that interconnects the ACPs and external panels; the electrical towing service panel and the refuel/defuel intercom panel.

The two external panels have a CALL pushbutton that can be used to activate a chime (through the DMC), and a visual annunciation (ACP interphone call light) in the flight deck.

The electrical towing and fuel/defuel intercom panels are directly linked to the ACPs when the panel door is open.

SERVICE INTERPHONE

The service interphone provides interconnection between the following:

- Low-pressure ground connection intercom panel
- Fwd bay maintenance panel
- Mid bay maintenance panel
- Aft bay maintenance panel

The audio system allows both interphone services to be interconnected using the CAN BUS to the remote data concentrators (RDCs). It is connected by discrete to the data concentrator unit module cabinet (DMC) and then the radio interface units (RIUs).

A pushbutton annunciator (PBA) identified as SERV INT, located on the service intercom panel, allows this interconnection to be selected in the flight deck.

This PBA also provides the status of the interconnection between the two interphone services through its ON annunciator.

MECH CALL

The MECH CALL pushbutton is located on the service intercom panel, and is used to get the attention of ground crew. The pushbutton is a momentary switch.

When the MECH CALL pushbutton is pushed, it sounds a multifunction horn in the nosewheel well.

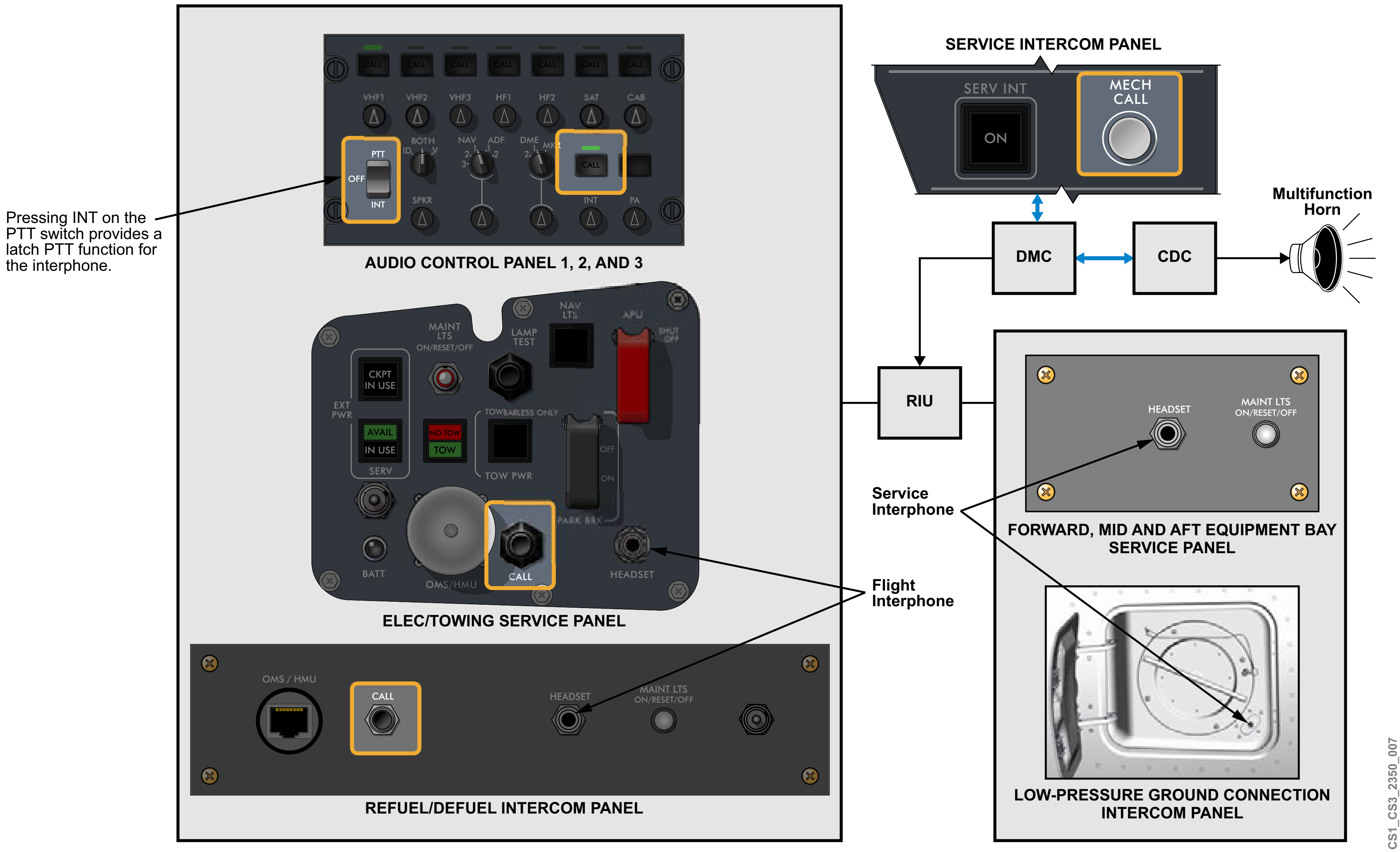


Figure 14: Audio Control Panel Operation (L2)

DETAILED DESCRIPTION

SYSTEM INTERFACE

Inputs

The ACP has the following inputs:

- PTT from cursor control panel (CCP), sidestick switches, interphone stations, and the hand-held microphone
- Audio from the boom, mask, hand-held, and interphone stations microphones
- Backup audio from the onside VHF radio
- Audio from the SATCOM (optional)
- Backup aural warning from both RIUs
- Data load enable discrete
- Audio from the HF system (optional)

Outputs

The ACP has the following outputs:

- Audio to the speakers
- Microphone audio to the PA system
- Audio to the interphone stations
- Audio to the cockpit voice recorder
- Audio to the SATCOM (optional)
- PTT to the PA system
- Backup PTT discrete to the onside VHF radio
- Backup MIC audio to the onside VHF radio
- Receiver/transmitter selections and volume control setting to the RIU
- Audio to the HF system (optional)

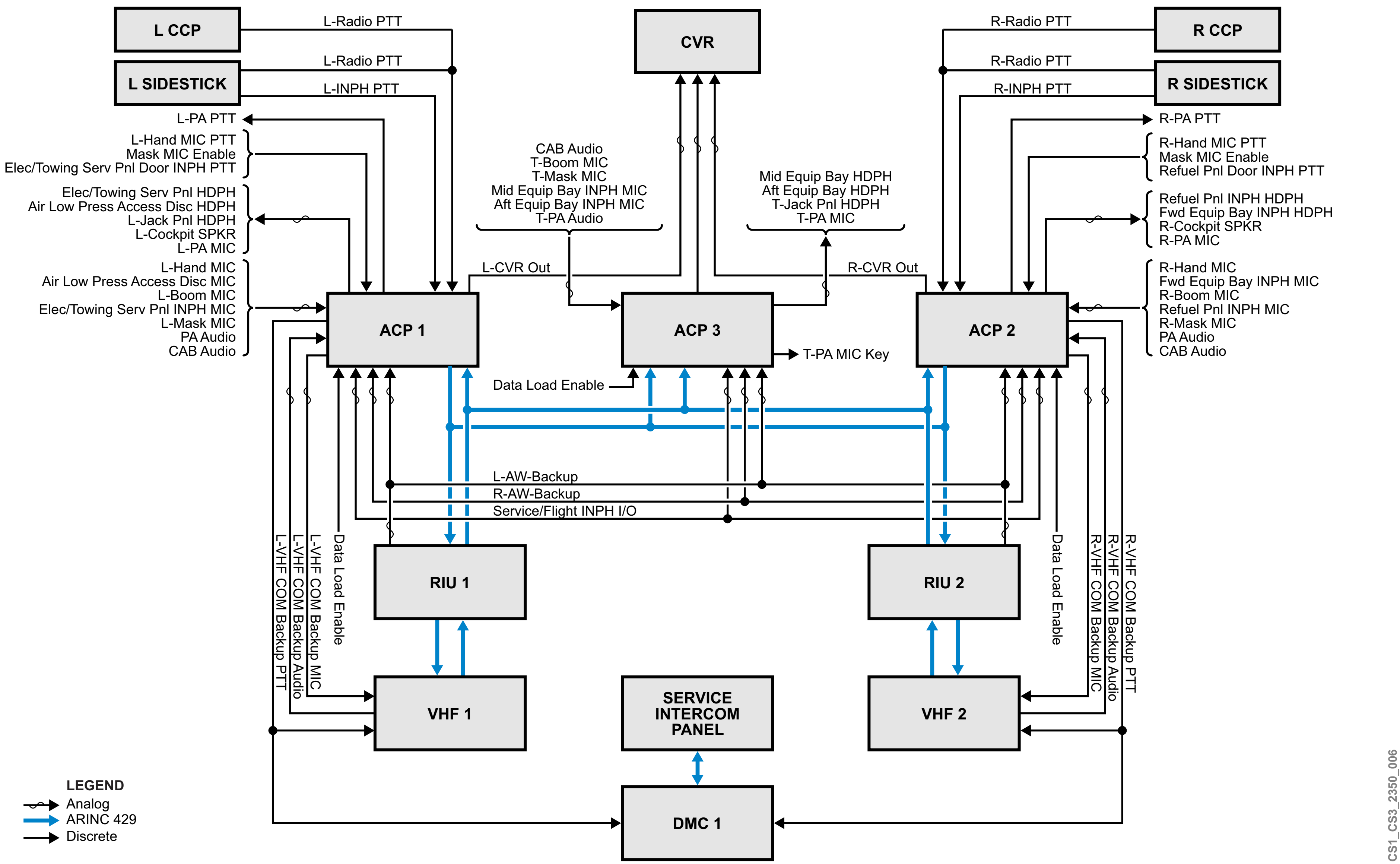


Figure 15: Audio Interface System Block Diagram (L3)

MONITORING AND TESTS

The following page provides the crew alerting system (CAS) messages for the audio integrating system.

CAS MESSAGES

Table 5: CAUTION Message

MESSAGE	LOGIC
CABIN PRIORITY	Cabin calling for a priority event.

Table 6: ADVISORY Messages

MESSAGE	LOGIC
AUDIO PNL 1 FAIL	Captain audio control panel has failed.
AUDIO PNL 2 FAIL	First officer audio control panel has failed.
AUDIO PNL 3 FAIL	Observer audio control panel has failed.
CABIN CALL	Cabin is calling for a normal situation.

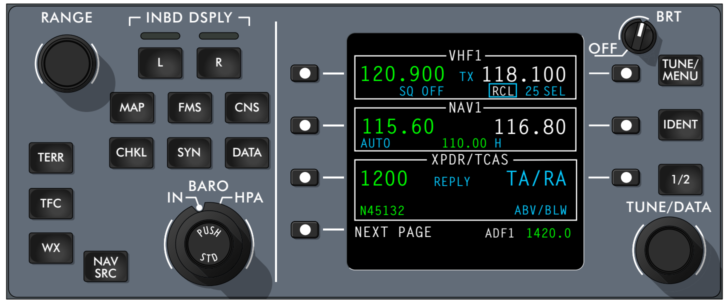
23-00 RADIO TUNING

GENERAL DESCRIPTION

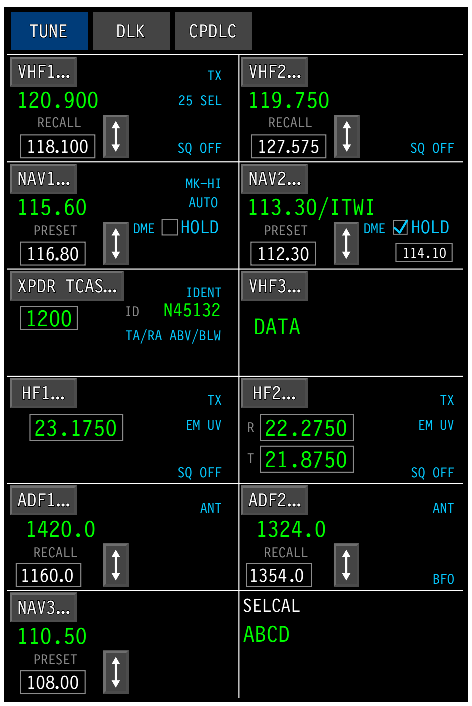
Radio tuning for all communication (COM) radios is accomplished by two control tuning panels (CTPs), the radio tuning system application (RTSA), flight management system (FMS), automatic tuning and graphical tuning.

The following are the independent means of radio tuning:

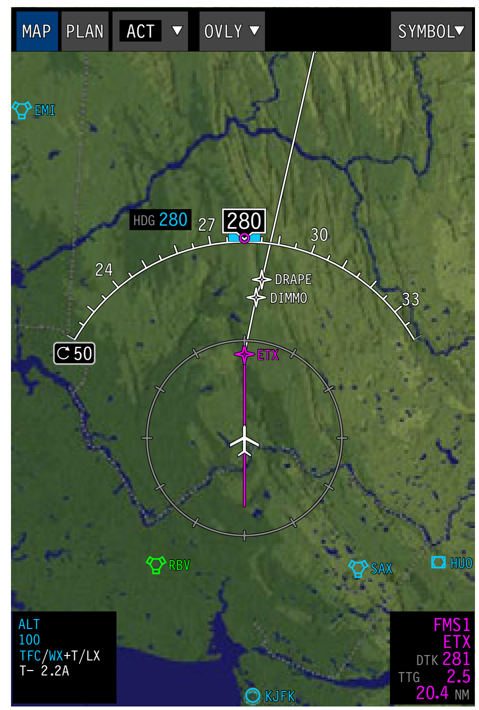
- The CTPs are the primary means to tune the radios, and provide a control to manually inhibit CTP radio tuning
- The RTSA, along with graphical tuning, provides a secondary means of tuning onscreen in the display unit (DU), and can be controlled independently by two multifunction keyboard panels (MKPs) and two cursor control panels (CCPs)
- The flight management system (FMS) provides automatic tuning control based on flight planning data



CONTROL TUNING PANEL



RADIO TUNING SYSTEM APPLICATION



GRAPHICAL TUNING

CS1_CS3_3400_031

Figure 16: Radio Tuning (L2)

CONTROLS AND INDICATIONS

CONTROL TUNING PANEL

The control tuning panel (CTP) provides control and display of the communication radio functions.

Off/Brt Knob

The OFF/BRT knob is used to turn ON and control the brightness of the CTP. Turning the control fully counterclockwise turns OFF/INHIBIT CTP operation.

Tune/Menu Pushbutton

The TUNE/MENU pushbutton alternates the CTP display between the CTP top level tuning page, and the CTP main menu page.

1/2 Pushbutton

The 1/2 pushbutton transfers CTP operation and display to the cross-side radio system.

Tune/Data Knob

The TUNE/DATA knob is used for data entry or to move the focus indicator.

Line Select Keys

The CTP has seven line select keys (LSK) adjacent to the display.

THE LSKs allow access to the system control pages of all COM radios, and are used to move the focus indicator.

CNS Key

The communications, navigation, and surveillance (CNS) key selects the radio tuning system application (RTSA) page.

Focus Indicator

The focus indicator is a cyan box that highlights the system frequency, channel, code or mode that is currently controllable using the TUNE/DATA knob or line select keys (LSKs).

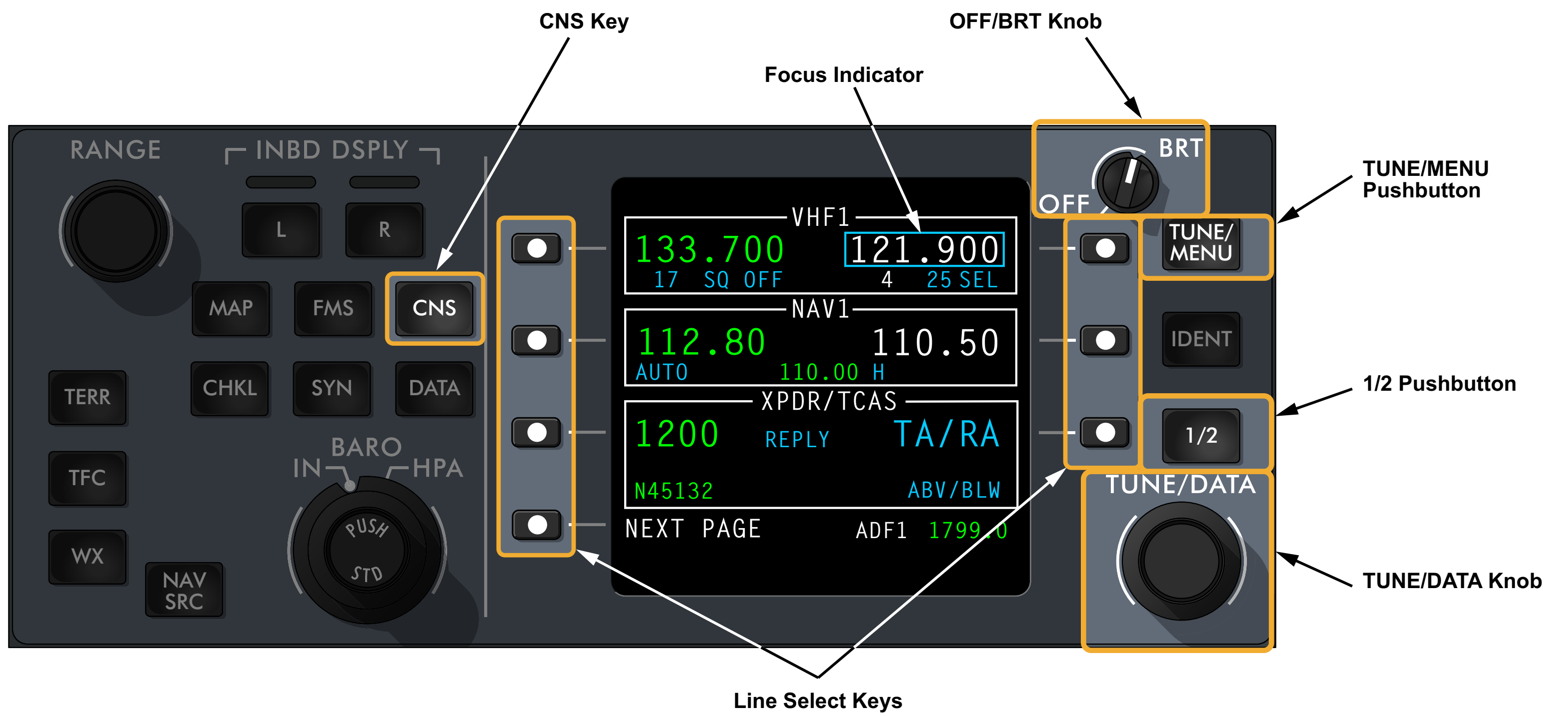


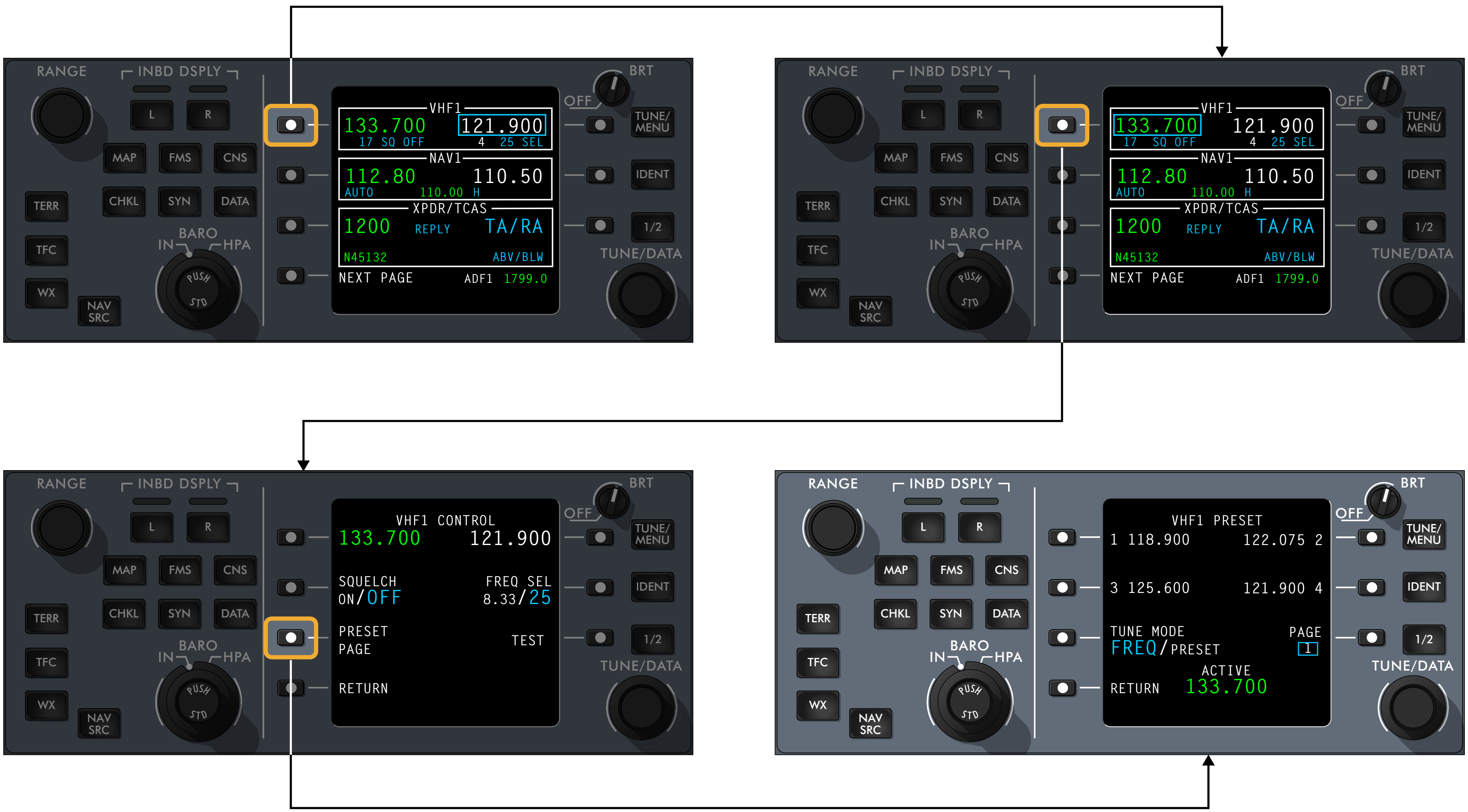
Figure 17: Control Tuning Panel Controls (L2)

CTP VHF-COM RADIO TUNING

Tuning of the VHF-COM radios is accomplished by accessing the top level tuning page, control page, and preset page.

Beginning on the control tuning panel (CTP) top level tuning page, move the focus indicator to the active frequency from the standby frequency by pressing LSK L1. The standby frequency is displayed in white, and the active frequency is displayed in green.

When the focus indicator highlights the active frequency, press LSK L1 again to access the VHF-COM control page. From this page access to the VHF-COM preset page is accomplished by selecting LSK L3.



CS1_CS3_2300_006

Figure 18: CTP VHF-COM Radio Tuning (L2)

VHF TUNING METHODS

The following methods are used to tune the VHF-COM radios using the control tuning panels (CTPs):

- **Direct tuning method**
  - Place the focus indicator on the standby or active frequency of the VHF radio by pushing the corresponding LSK. The TUNE/DATA tuning knob is used to input the frequency/channel
  - The outer knob tunes the most significant digits
  - The inner knob tunes the least significant digits
- **Recall method**
  - Place the focus indicator around the standby frequency of the VHF radio by pushing the LSK adjacent to the standby frequency. Press the LSK again to tune the radio to the recall frequency
- **Numbered preset method**
  - When the focus indicator highlights a numbered preset frequency:
    - Below the standby frequency on the top level tuning page
    - A preset page
  - The TUNE/DATA knob is used to cycle through the 20 preset frequencies. There are five VHF preset pages containing four preset frequencies per page. Preset frequencies 1-19 are programmable, and 20 is permanently programmed to the emergency frequency of 121.500

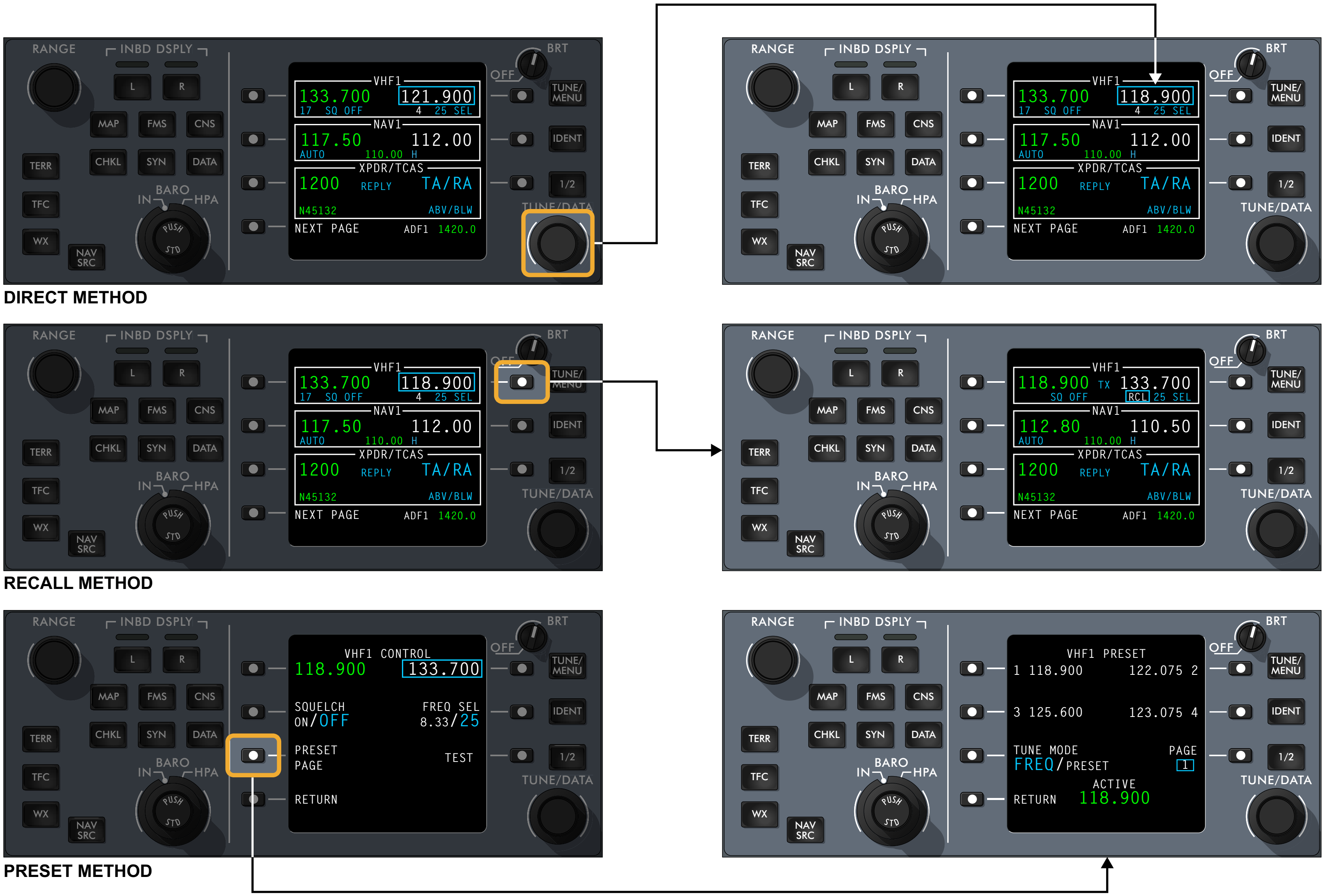
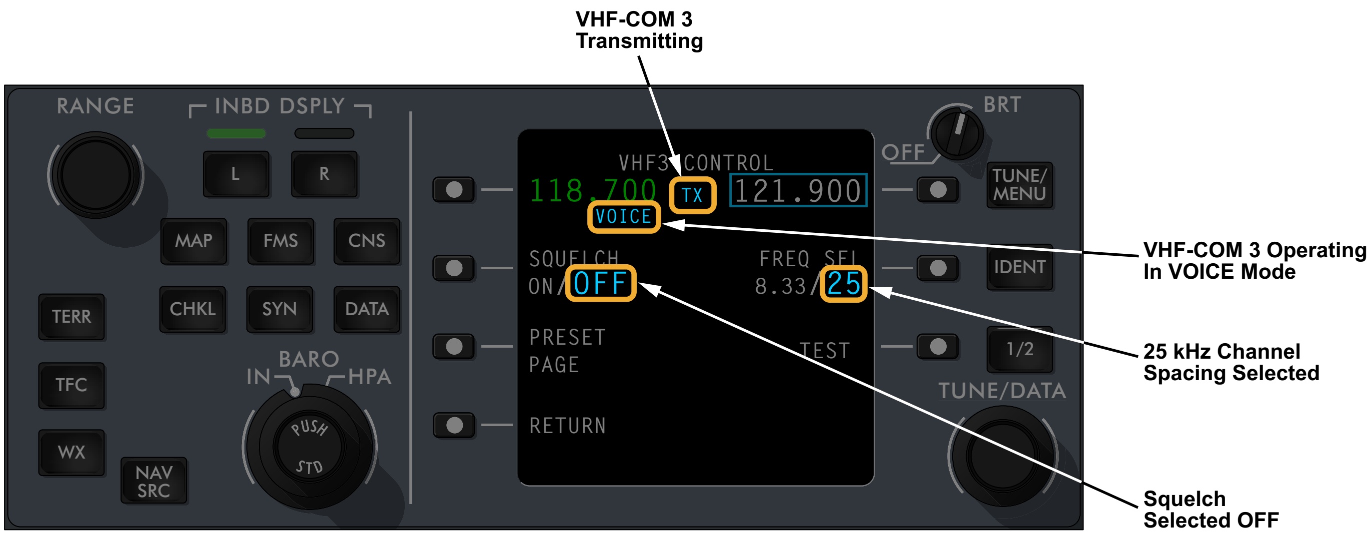


Figure 19: CTP VHF-COM Tuning Methods (L2)

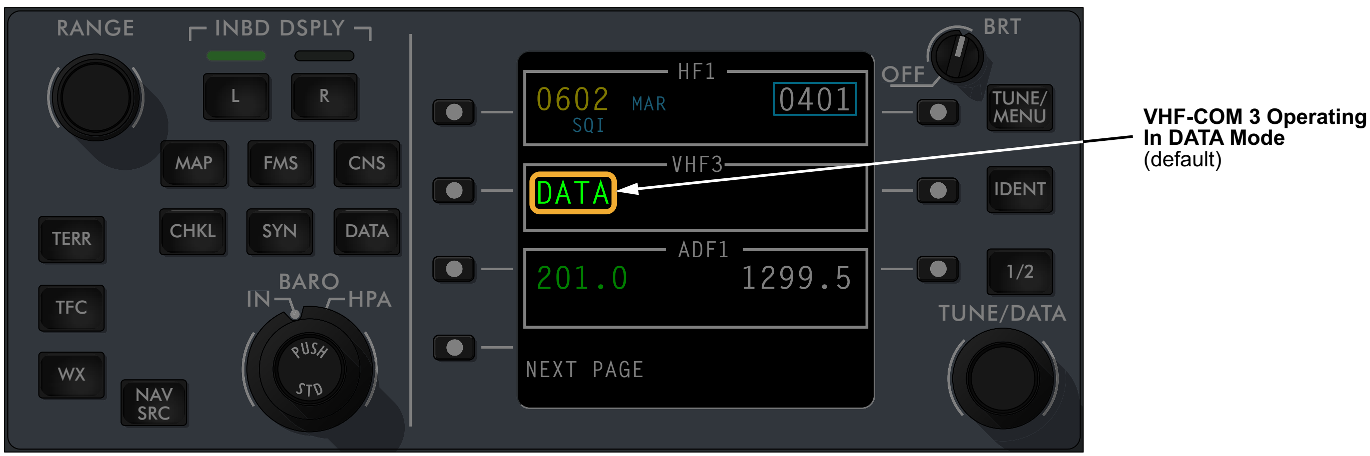
VHF CONTROL PAGES

VHF modes and options are shown as follows on the tune and control pages:

- TX is displayed in cyan when the VHF-COM is transmitting
- OFF is displayed in cyan when the squelch is selected OFF
- 25 is displayed in cyan when 25 kHz channel spacing is selected
- DATA is displayed in green on the top level tuning page when the VHF-COM 3 is in the data mode. Changing the radio to voice mode changes the DATA for a frequency display



CONTROL PAGE



TUNE PAGE

CS1_CS3_2300_005

Figure 20: CTP VHF-COM Annunciations (L2)

RTSA VHF-COM RADIO TUNING

To access the radio tuning system application (RTSA), the communication, navigation, and surveillance (CNS) button is selected by one of the following:

- Pushing the CNS quick-access key on the control tuning panel (CTP)
- Pressing the CNS quick-access key on the multifunction keyboard panel (MKP)
- Selecting the MENU button on the cursor control panel (CCP) and selecting the CNS soft key from the drop-down menu from the on screen MAIN MENU

The TUNE page is displayed and the cursor index is automatically placed over VHF 1.

Access to control pages is accomplished by selecting the soft key for VHF 1, VHF 2 or VHF 3.

When the CNS page is selected, the TUNE page is displayed automatically. From here, all COM radios can be selected.

RTSA CONTROLS

Radio Control Soft Key

The radio control soft key is gray in color. When pushed, the soft key is used to access a CONTROL PAGE for the selected radio in the expanded view.

Active Frequency Display

The active frequency font is displayed in green on the first line.

Standby Frequency

The standby frequency font is displayed in white below the RECALL text box.

Frequency Swap Soft Key

A soft key, to change the active frequency and the preset frequency, appears as a vertical line ending by two arrows. One arrow points up and the other points down.

RTSA MODES OF OPERATION

Modes of operation and annunciations are displayed on the tune page.

TX

Displayed in cyan when a VHF-COM radio is transmitting.

25 SEL

Displayed when 25 kHz channel spacing is selected.

SQ OFF

Displayed when squelch is selected OFF.

DATA

Displayed when VHF-COM 3 is selected to DATA mode.

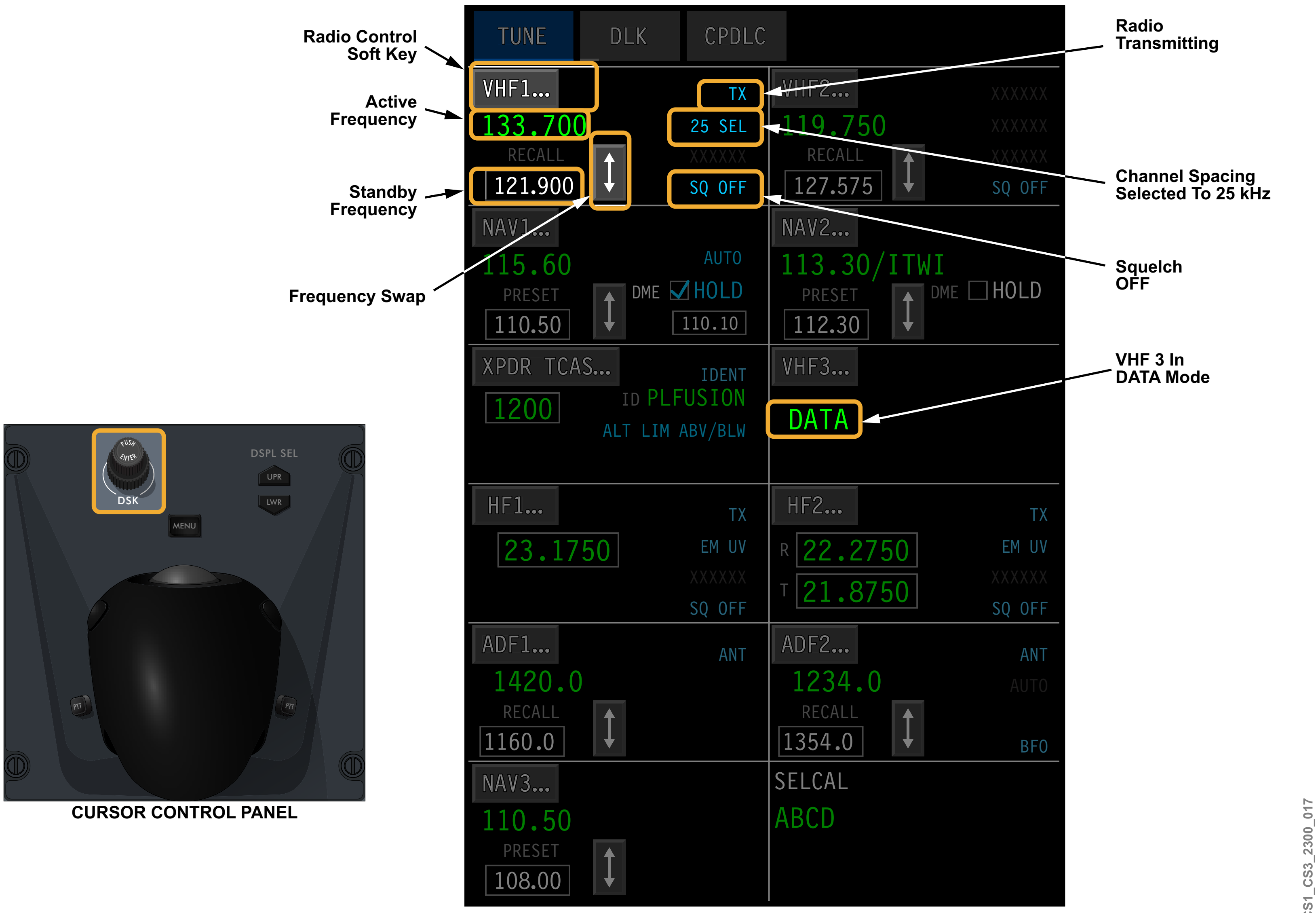


Figure 21: RTSA VHF Tuning Controls (L2)

RTSA PRESET PAGES

The control and preset pages are combined in the RTSA.

In addition to the modes that are selectable on the TUNE page, there are the following:

- Preset frequency list selection
- Preset frequency edit control soft key
- VHF test control soft key
- Preset frequency window

Presets

Up to four frequencies are listed in the preset frequency list selection, and five frequencies are listed in the preset frequency window.

VHF Preset Tuning

The VHF radios each have a total of 20 presets available. The preset frequencies are changeable by selecting a VHF radio then selecting the EDIT control soft key on the VHF preset frequency window. This enables manual selection of the preset frequencies.

The 20th preset frequency on each VHF radio is permanently programmed and cannot be changed. Preset 20 is programmed to the emergency frequency of 121.500 and is labeled EMER when selected.

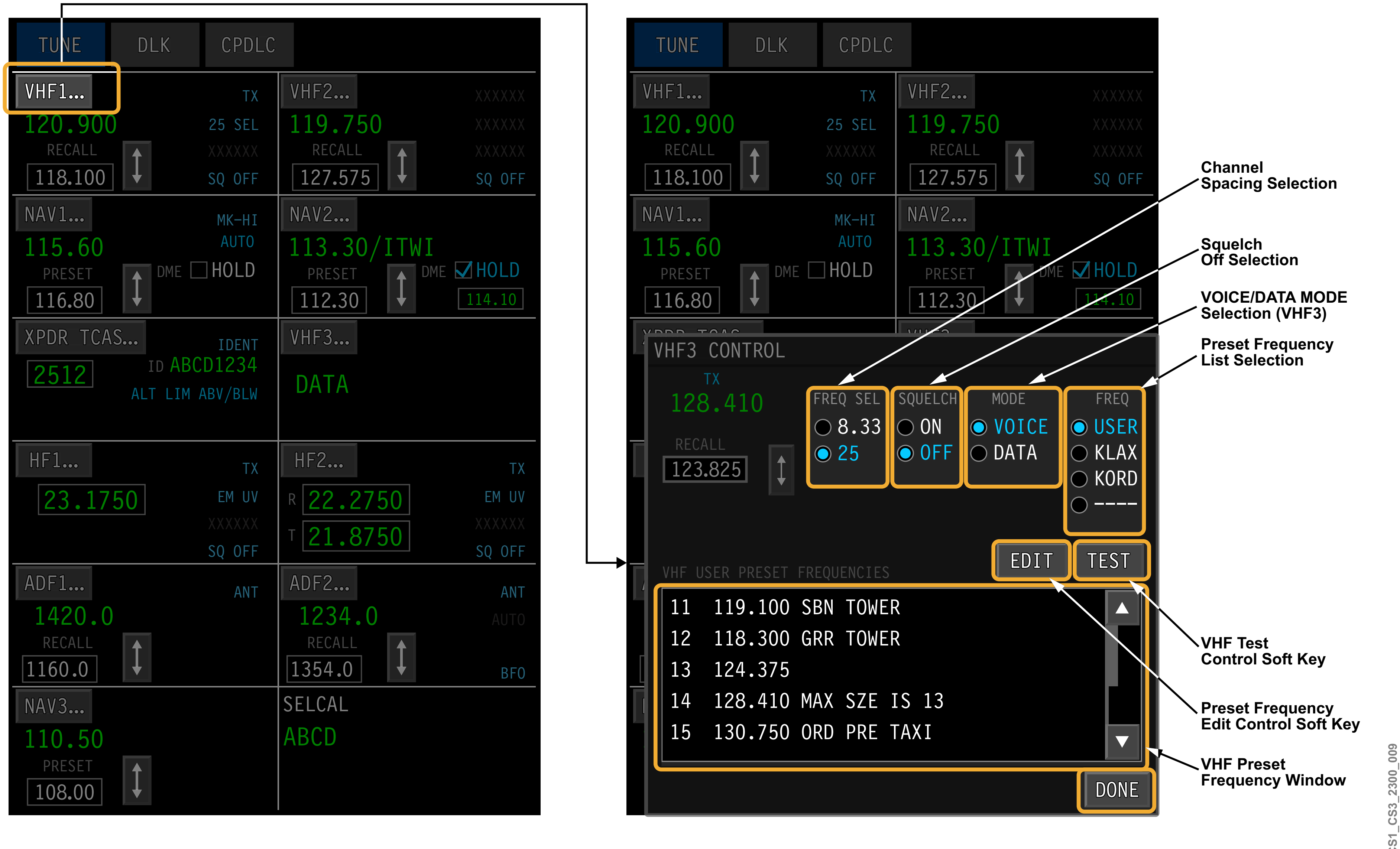


Figure 22: RTSA VHF Tuning Control Page Annunciations (L2)

CTP HIGH FREQUENCY COMMUNICATION RADIO TUNING

Radio tuning for the optional high frequency (HF) radios is accomplished by the two control tuning panels (CTPs), or the radio tuning system application (RTSA).

Tuning of the HF radios on the CTPs is similar to the VHF-COM radios:

- To access the HF tune page, push the LSK adjacent to NEXT PAGE from the top level tuning page
- The HF tune page allows direct tuning of a frequency when the focus indicator surrounds the active or standby frequency, and the TUNE/DATA knobs are used to enter a new frequency

While tuning the HF radios on the CTPs, the focus indicator does not highlight the frequencies in the same manner as with the VHF radios.

Rotating the TUNE/DATA outer knob clockwise places the focus indicator around the most significant digit(s).

Rotating the inner knob changes the digits.

Standby Frequency Tuning

Standby frequency tuning can be carried out on the high frequency (HF) tune page by moving the focus indicator around the standby frequency with the TUNE/DATA knob, and pushing the LSK R1. This swaps the standby frequency with the active frequency.

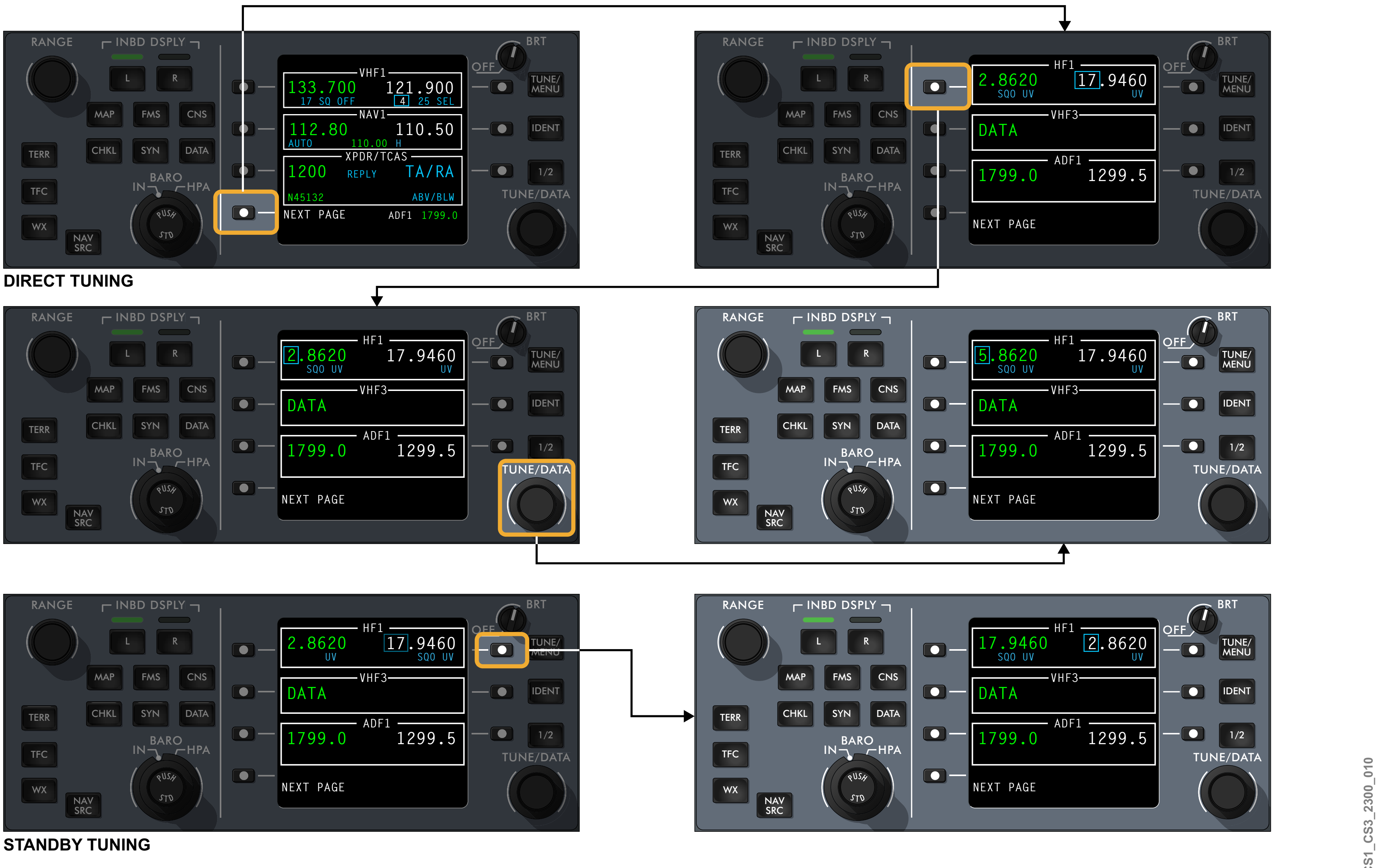


Figure 23: CTP High Frequency Communication Control Page (L2)

High Frequency Preset Frequency Page

Another method to tune the high frequency (HF) radios is by inserting a stored frequency from the preset frequency page.

Access to the HF preset page is from the HF control page by pushing the LSK adjacent to the PRESET PAGE. To select a stored frequency, push the LSK adjacent to the required frequency.

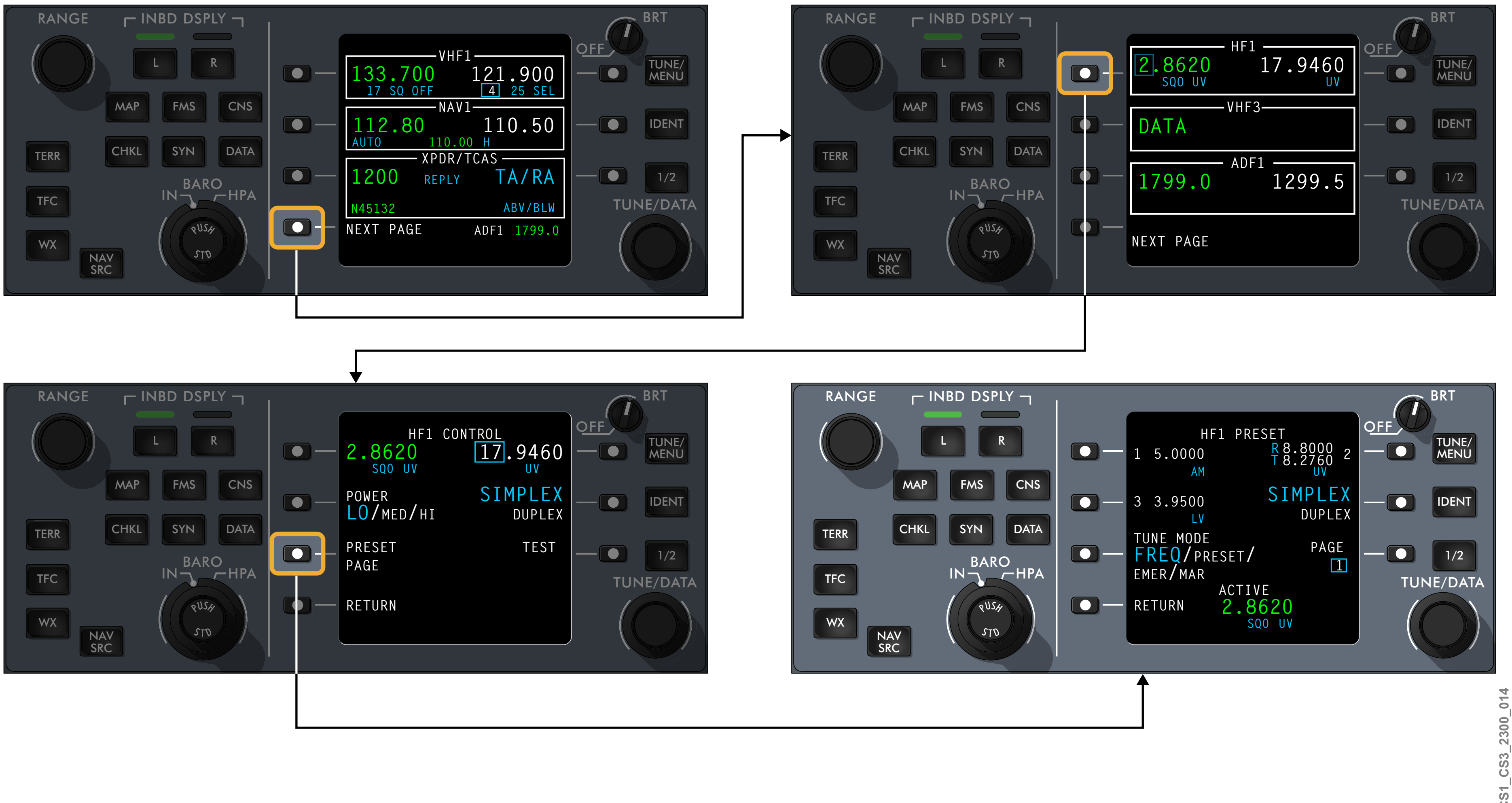


Figure 24: CTP High Frequency Communication Radio Preset Frequency Page (L2)

High Frequency Control Pages

Tuning functions and operating modes are accessible from the high frequency (HF) tune second top level page, control page or the preset page.

High Frequency Radio Functions and Operating Modes

The high frequency (HF) radio functions and operating modes can be accessed from the HF pages as follows:

- Emission mode is displayed under the active and standby frequency. Upper sideband voice (UV) is normally selected with lower sideband voice (LV) and amplitude modulation (AM)
- Power level is selectable from low (LO), medium (MED), or high (HI) for the transmit power. LO is the default setting
- Squelch is displayed under the active frequency and is normally set at 3 (maximum) and can be set at 2, 1 or 0 (squelch off)
- Tune mode is selectable from FREQ/PRESET/EMER/MAR. This allows the setting of HF preset tune modes to either frequency (default), preset emergency or maritime tune mode
- Simplex/duplex selection, is selected when a single (Simplex) or two frequencies (Duplex) is required for a specific frequency

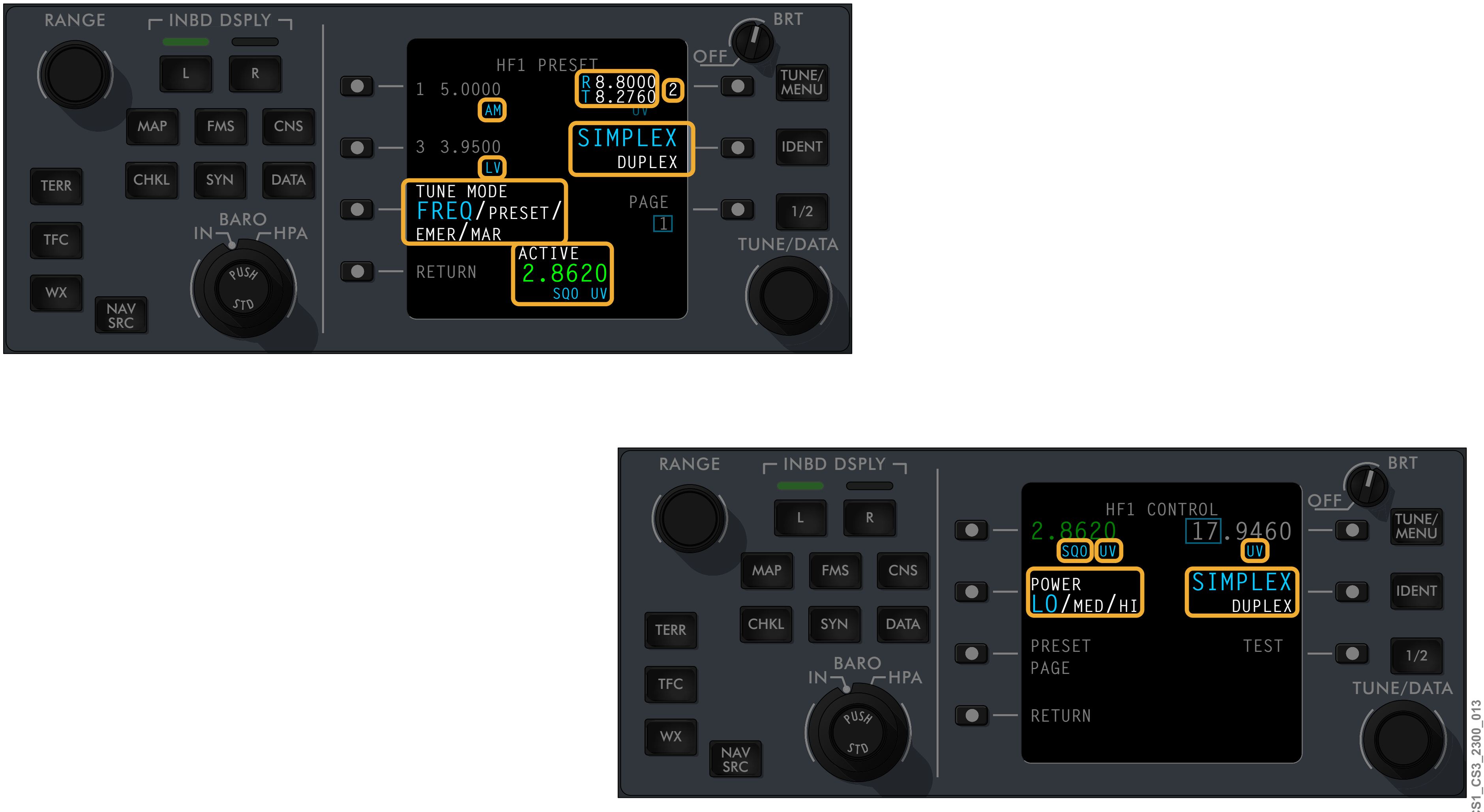


Figure 25: CTP High Frequency Communication Tuning Functions (L2)

RTSA HF-COM RADIO TUNING

When the CNS page is selected, the TUNE page is displayed automatically. From here, both HF radios can be selected.

Access to control pages is accomplished by selecting the soft key for HF 1 or HF 2.

Modes of operation and annunciations are also displayed on this page.

RTSA TUNING MODES OF OPERATION

Modes of operation and annunciations are displayed on the tune page.

TX

TX is displayed in cyan when an HF radio is transmitting.

EM

Emission mode is selectable as upper sideband voice (UV), lower sideband voice (LV) or amplitude modulation (AM).

SQ OFF

Squelch is selectable for ON or OFF.

RTSA HF CONTROL AND PRESET PAGE

The control and preset pages are combined in the RTSA.

Selections are possible for:

- Active frequency
- Transmission power level
- Transmit/receive/preset mode selection
- Squelch level
- Emission mode
- Preset edit soft key
- Test soft key
- Preset frequency window

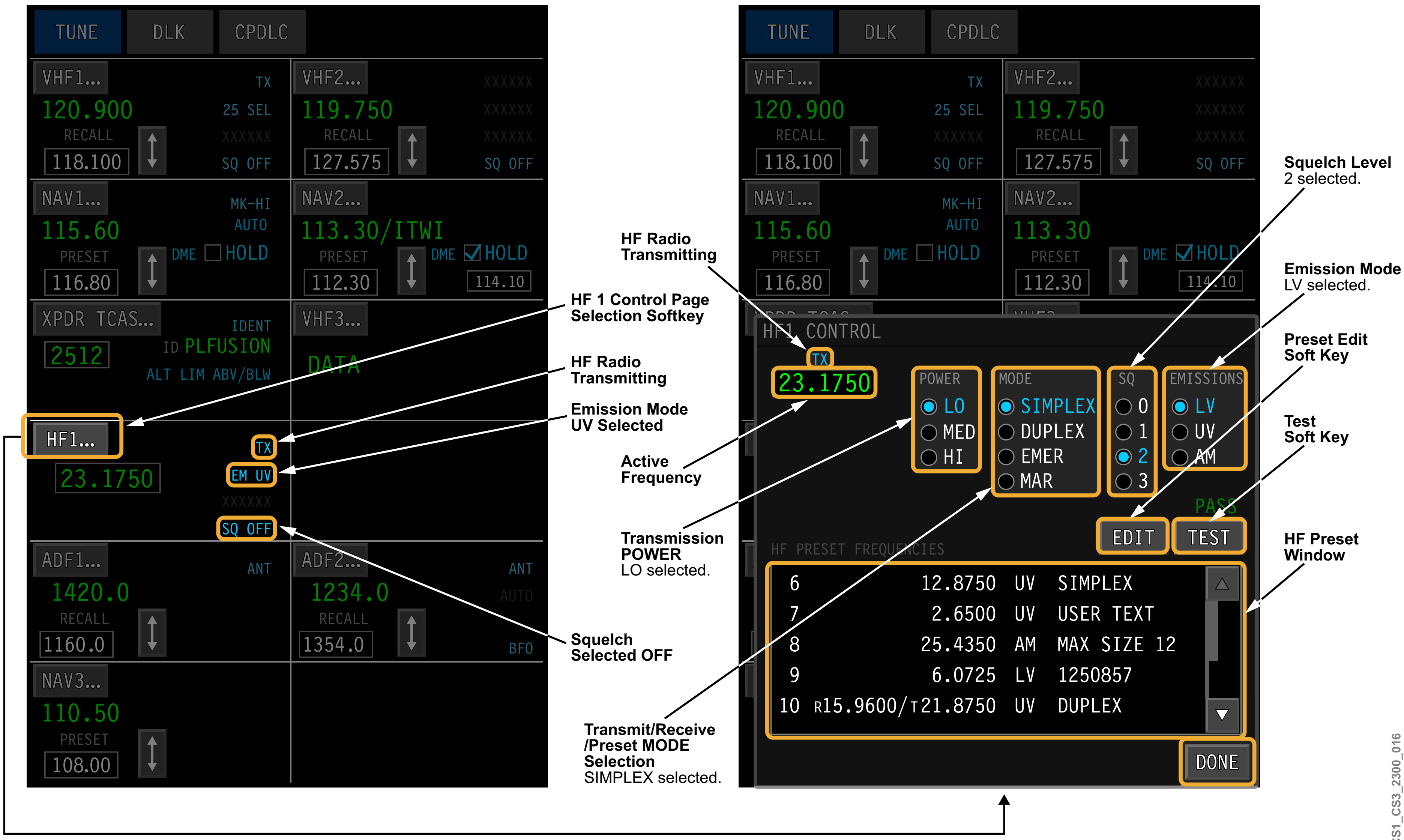


Figure 26: RTSA High Frequency Control and Preset Page (L2)

GRAPHICAL TUNING

Graphical Tuning Menus

The flight management system (FMS) graphical tuning function allows tuning of the VHF-COM radios for airport and air route traffic control center (ARTCC) COM frequencies from any multifunction window (MFW) displaying FMS MAP, PLAN page, or other FMS displays that contain selectable icons for:

- Airports
- Airports as flight plan waypoints
- Airport runways
- Latitude/longitude waypoints

Selecting these icons, using the CCP or MKP controls, displays the applicable drop-down task menu that contains the COM FREQS (airports/runways) or ARTCC (lat/long) task item. Tunable NAVAIDs and non-directional beacons (NDBs) can also be tuned from the graphical map.

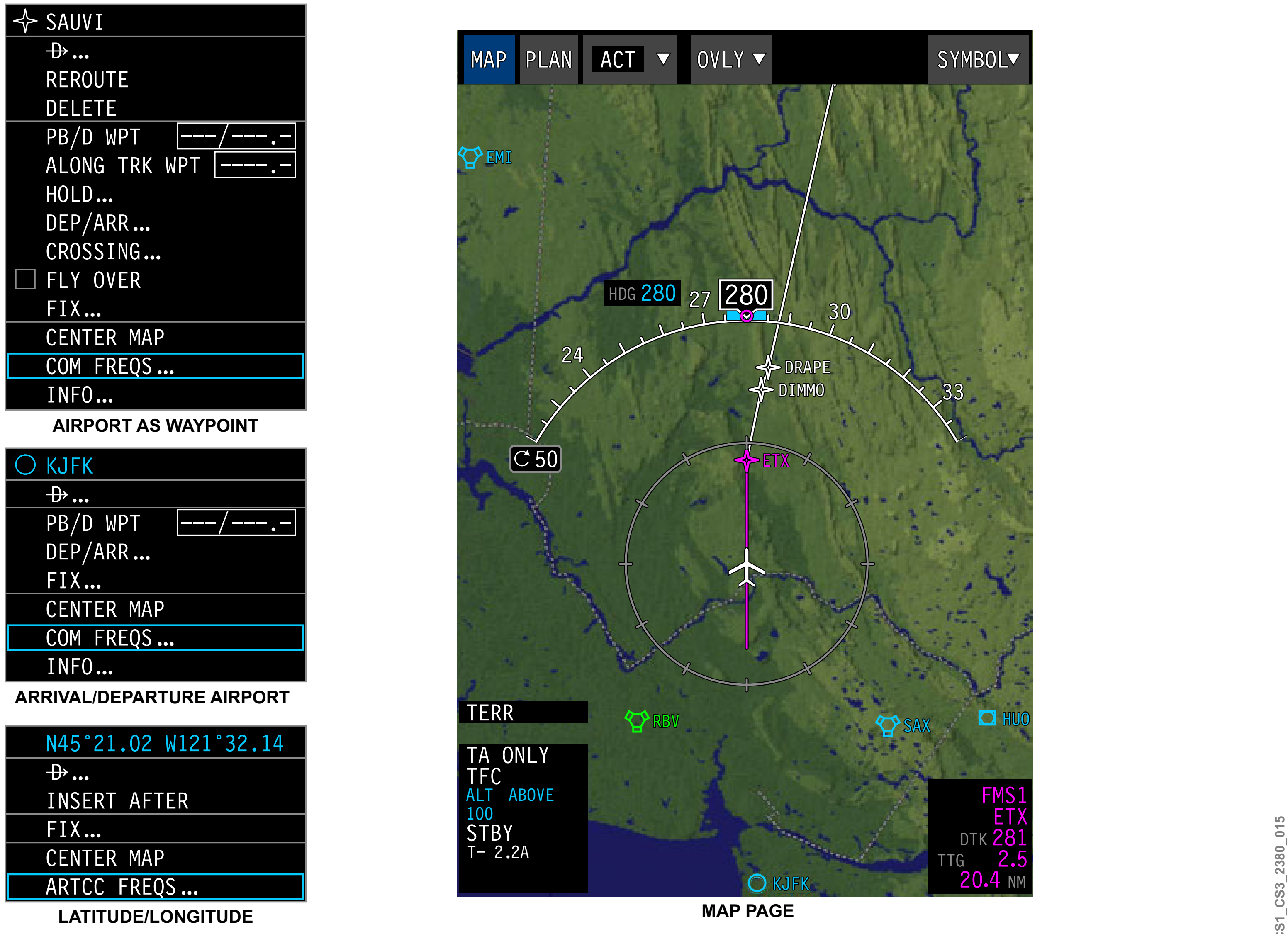


Figure 27: Graphical Tuning Menu (L2)

Airport VHF Frequencies Selection

When an airport on the graphical map is selected, COM FREQS displays in the task menu. Selecting the COM FREQS task item displays the XXX VHF (where XXXX is the ICAO airport identifier) dialog box. Airport VHF communication frequencies can be selected from a list on the VHF frequencies dialog box. These frequencies are derived from the navigation database.

TUNE VHF 1, TUNE VHF 2 and TUNE VHF 3 buttons are used to tune the selected VHF radio to the highlighted frequency. If the VHF is not available, the associated button is disabled. The newly selected frequency is synchronized between all tuners in the flight deck. A message annunciation field at the bottom of the dialog box indicates communication status with the NAV database.

ARTCC Frequencies Selection

Air route traffic control center (ARTCC) FREQS displays in the task menu. Selecting the ARTCC task item displays the ARTCC VHF dialog box. The dialog box displays up to five ARTCC frequencies within a 200 NM area from the cursor selected lat/long position on the flight management system (FMS) graphical map. These frequencies are derived from the navigation database.

The ARTCC frequencies are listed in order from nearest to farthest from the selected lat/long waypoint.

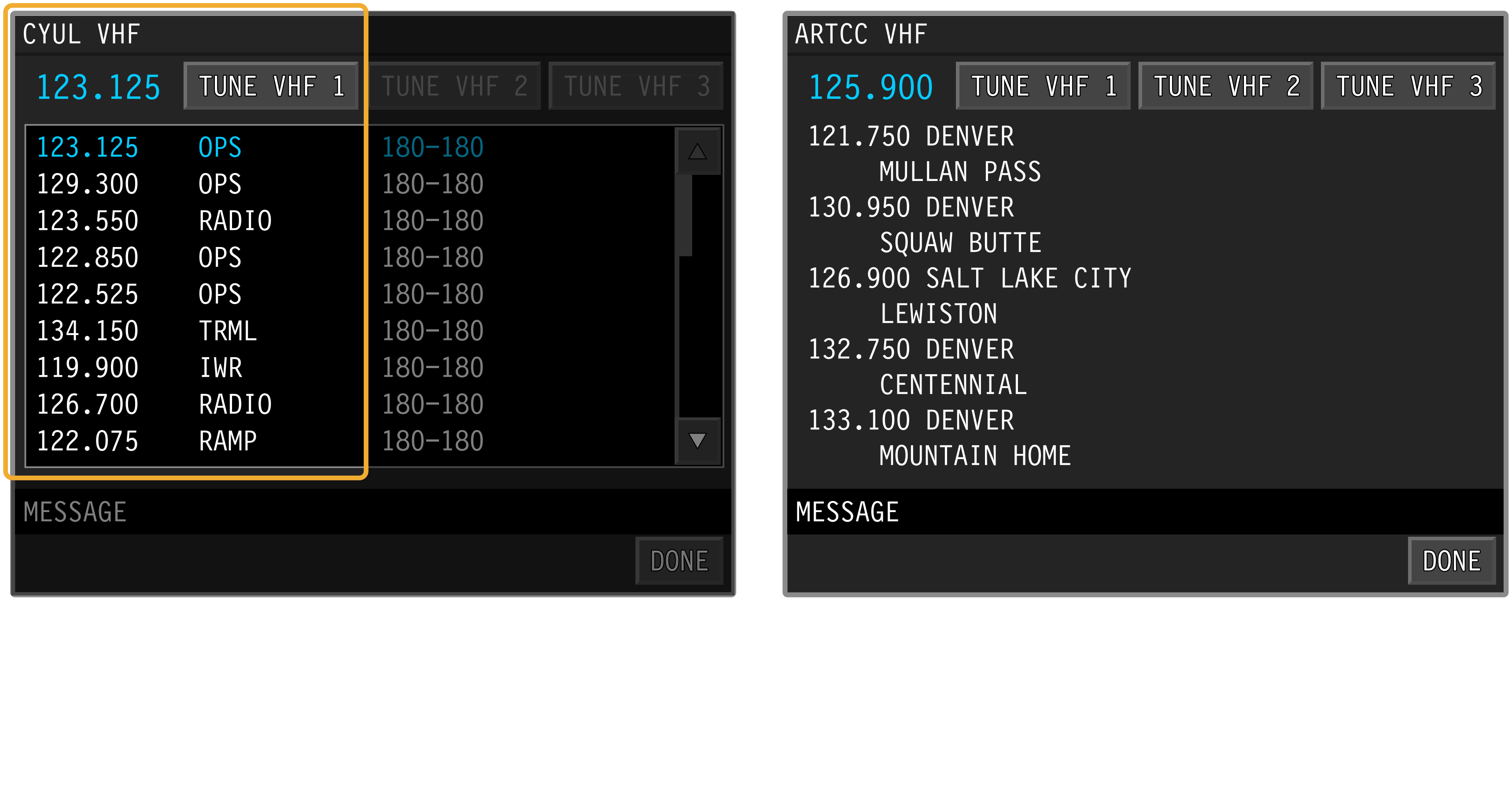


Figure 28: Airport Communications and ARTCC Frequencies Dialog Boxes (L2)

23-11 VERY HIGH FREQUENCY

GENERAL DESCRIPTION

The very high frequency (VHF) system supplies short range air-to-air and ground-to-air voice/data communication. The VHF-COM transceiver is a multichannel VHF transceiver providing AM voice communications in the frequency range from 118.00 MHz through 136.975 MHz with selectable 8.33 or 25 kHz channel spacing. The VHF-COM system consists of three VHF transceivers and antennas.

The third VHF includes:

- VHF data link (VDL)
- Mode A, aircraft communications addressing and reporting system (ACARS)
- Mode 2 data link capabilities

The VHF-COM transceivers receive 28 VDC from the following:

- VHF-COM 1; DC ESS BUS 3
- VHF-COM 2; DC BUS 2
- VHF-COM 3; DC ESS BUS 1

The VHF communication system is normally tuned by the onside CTP, but may also be tuned by the cross-side CTP or the display units (DUs). It supplies an audio output to the audio system. The data output contains the COM frequency, which is echoed back to the CTPs and the DUs. Microphone audio, keying, and receive audio are controlled by the audio control panel (ACP).

The VHF-COM system interfaces with the following via the ARINC 429, discrete and analog lines:

- Audio control panels (ACPs)
- Radio interface units (RIUs)
- Control tuning panels (CTPs)
- Data concentrator unit module cabinet (DMC)

When a push-to-talk (PTT) button is pushed, an internal timer is started on the transceiver. This timer is factory set to 30 seconds and if the transceiver is still transmitting after 30 seconds, the transmitter portion of the transceiver shuts off and switches to receive. This timing feature protects the ATC channel from long-term interference. When this occurs, there are two warning tones which signify that the PTT was automatically unkeyed. At this point, no side tone is heard in the headphones. If a transmission of more than 30 seconds is required, release the PTT to reset the factory set timer.

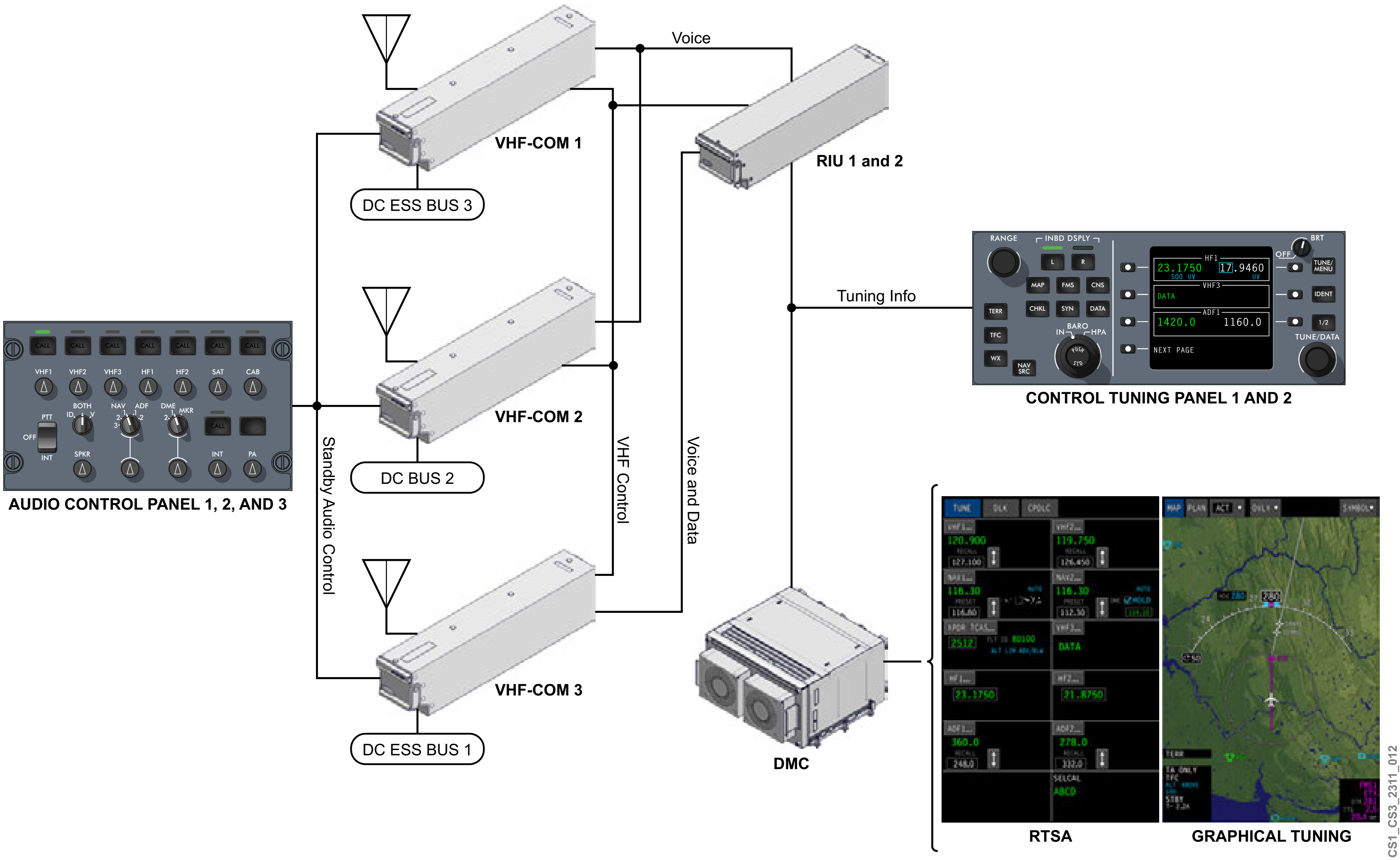


Figure 29: VHF Communication System (L2)

COMPONENT LOCATION

VHF-COM TRANSCEIVERS

The VHF-COM transceivers no. 1 and no. 2 are located in the aft shelf of the forward equipment bay.

The VHF-COM transceiver no. 3 is located in the forward shelf of the mid equipment bay.

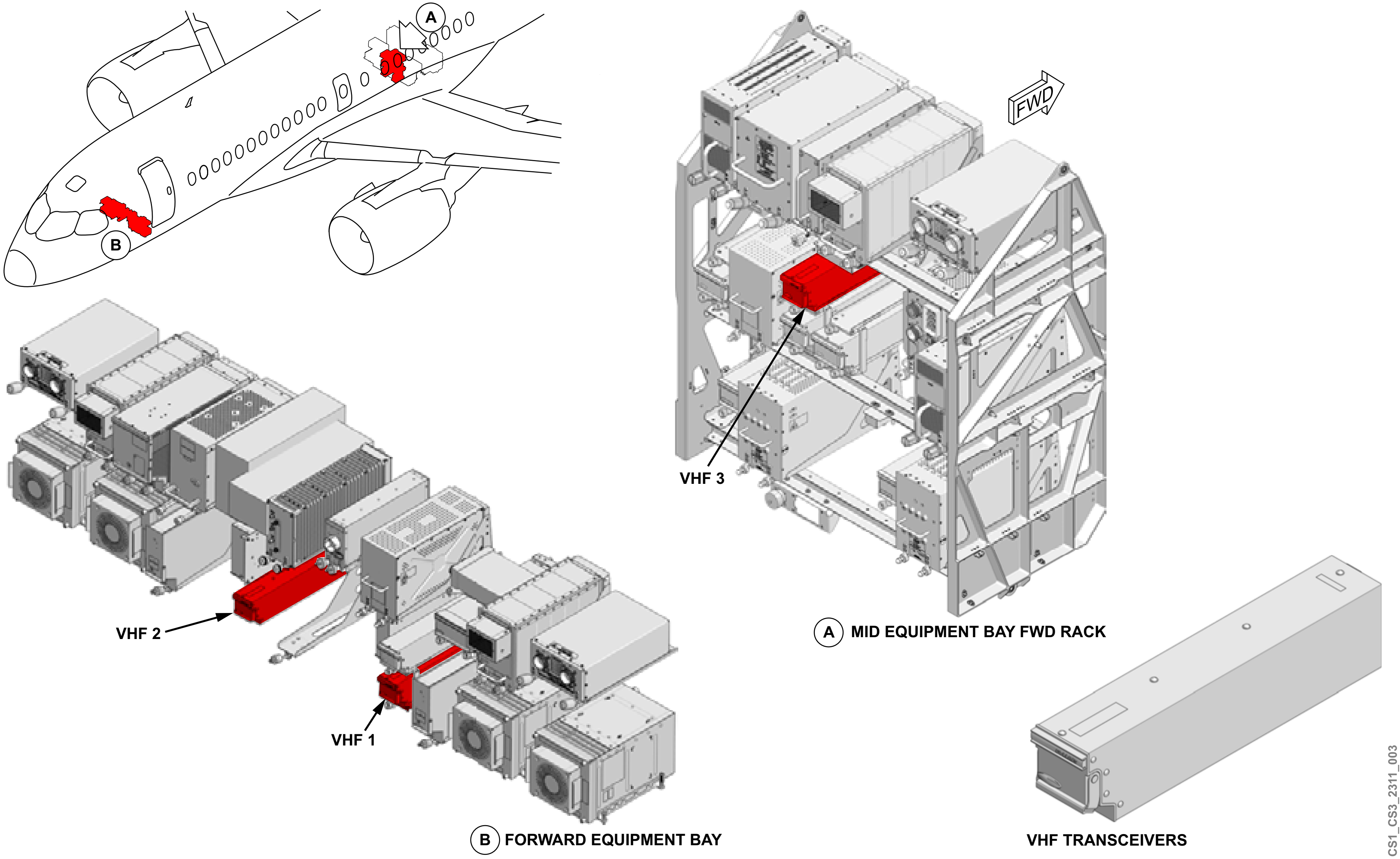


Figure 30: VHF Component Location (L2)

VHF-COM ANTENNAS

The VHF-COM antennas are located as follows:

- VHF-COM 1 in the front top of the aircraft centerline
- VHF-COM 2 in the front bottom of the aircraft centerline
- VHF-COM 3 in the aft top of the aircraft centerline

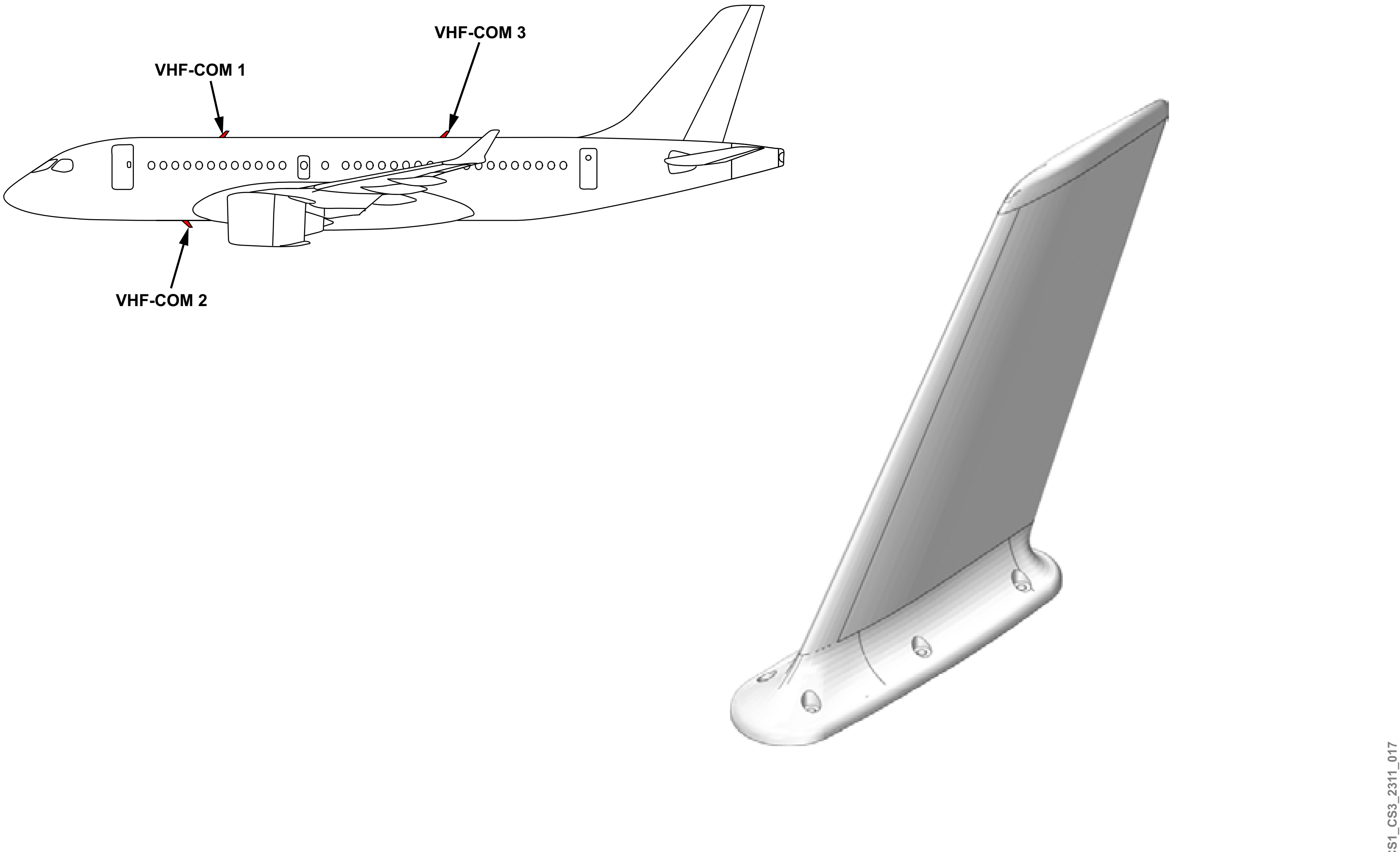


Figure 31: VHF-COM Antenna Location (L2)

MONITORING AND TESTS

TEST

The VHF transceiver is programmed to perform a power−up built−in−test (PBIT), a continuous built−in−test (CBIT), and an initiated built−in−test (IBIT). When the transceiver is first powered on, it sounds a brief tone while checking its memory. If there is a memory defect, the tone continues, indicating that the transceiver can neither receive nor transmit.

The VHF IBIT is activated by the TEST button. The test period lasts 10 seconds, and results in an aural beep.

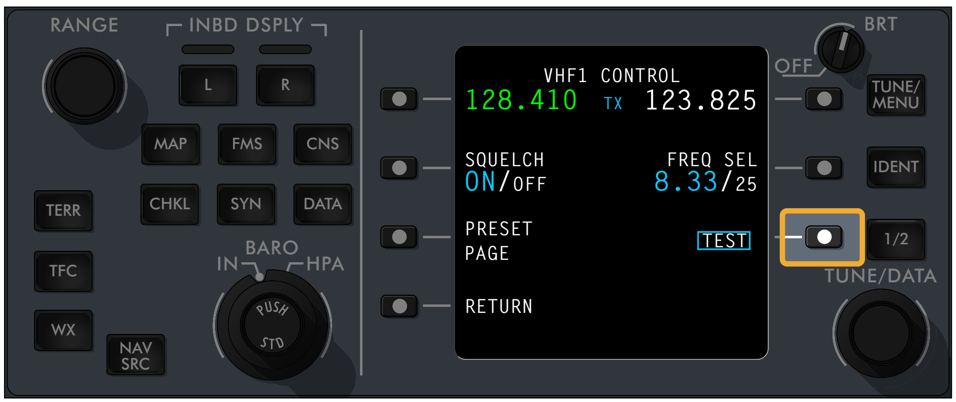
- A single beep indicates passing the test
- A double beep indicates failing the test

VHF CBIT monitoring annunciates any of the following faults within 100 ms of occurrence:

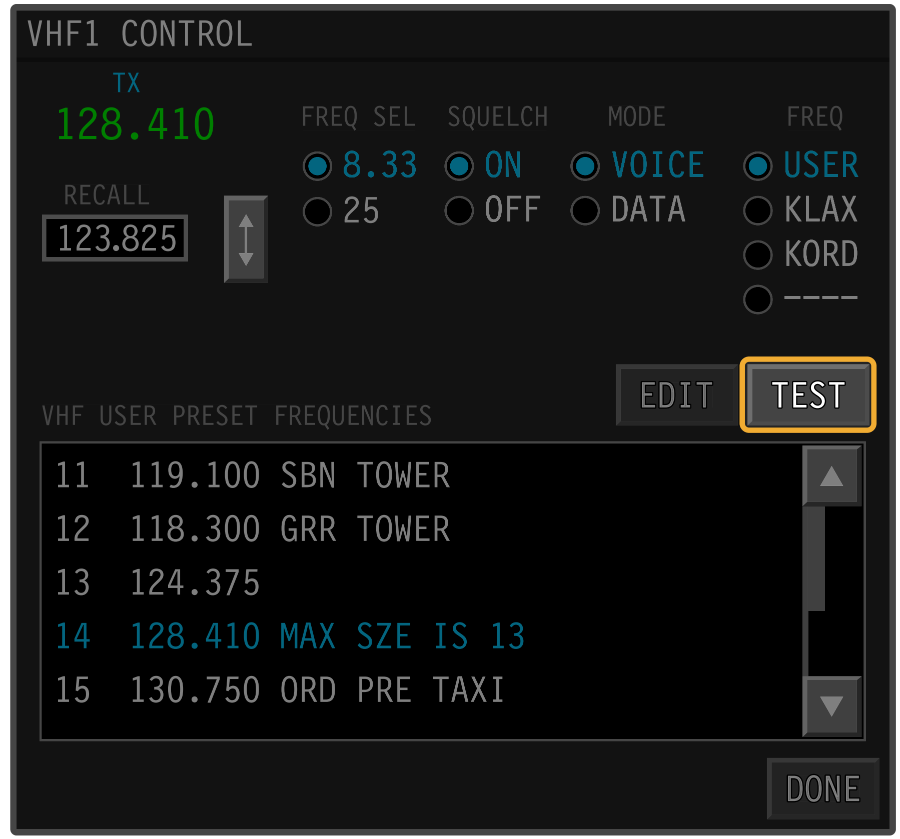
- Receiver/transmitter
- Power supply
- Tuning control
- Voltage standing-wave ratio (VSWR)
- Transmitter temperature
- Transmitter duration
- Squelch

The VHF transceivers continuously monitor their internal temperatures and cease to operate if their internal temperatures exceed +160ºC (+320ºF). When this occurs the transceivers cease to respond to a normal PTT. However, if transmission is required, this protection can be overridden by rapidly keying the PTT button twice, and holding it on the second press.

When an overheat situation occurs, a VHF COM OVERHEAT caution message is generated. System faults are reported to the onboard maintenance system (OMS).



CTP



RTSA

CS1_CS3_2311_016

Figure 32: VHF Communication Test (L2)

CAS MESSAGES

The following page provides the crew alerting system (CAS) messages for the VHF-COM system.

Table 7: CAUTION Messages

MESSAGE	LOGIC
VHF COM 1-2-3 FAIL	All three VHF radios have failed.
VHF COM 1 OVERHEAT	Detected overheat by radio.
VHF COM 2 OVERHEAT	Detected overheat by radio.
VHF COM 3 OVERHEAT	Detected overheat by radio.
VHF COM 1-2-3 OVERHEAT	All three radios are overheating.

Table 8: STATUS Message

MESSAGE	LOGIC
VHF 3 IN VOICE	VHF 3 selected to voice communication.

23-71 COCKPIT VOICE RECORDER

GENERAL DESCRIPTION

The cockpit voice recorder (CVR) is a crash survivable memory unit which contains the flash memory used as the recording medium, and retains the most recent two hours of recorded information.

The CVR records audio from the three audio control panels (ACPs). The flight deck environment is also recorded by the CVR via a cockpit area microphone (CAM) and pre-amp. Data link digital communications and clock inputs from the data concentrator unit module cabinet (DMC) 2 are also recorded.

The DC ESS BUS 2 supplies power to the CVR. The CVR starts recording when the BEACON or STROBE light switches are switched on. Recording starts regardless of the switch position when the aircraft is weight-off-wheels (WOFFW). When power is removed from the DC ESS BUS 2, the recorder independent power supply (RIPS) provides 28 VDC for 10 minutes to the CVR.

The CVR control panel has a TEST switch, an ERASE switch, a headset jack, and a TEST indicator light.

An underwater locator beacon (ULB) mounted on the front of the CVR, activates when immersed in water to assist in locating the recorder.

The optional cockpit voice recorder monitoring system provides the capability to listen to flight deck conversations from a remote location.

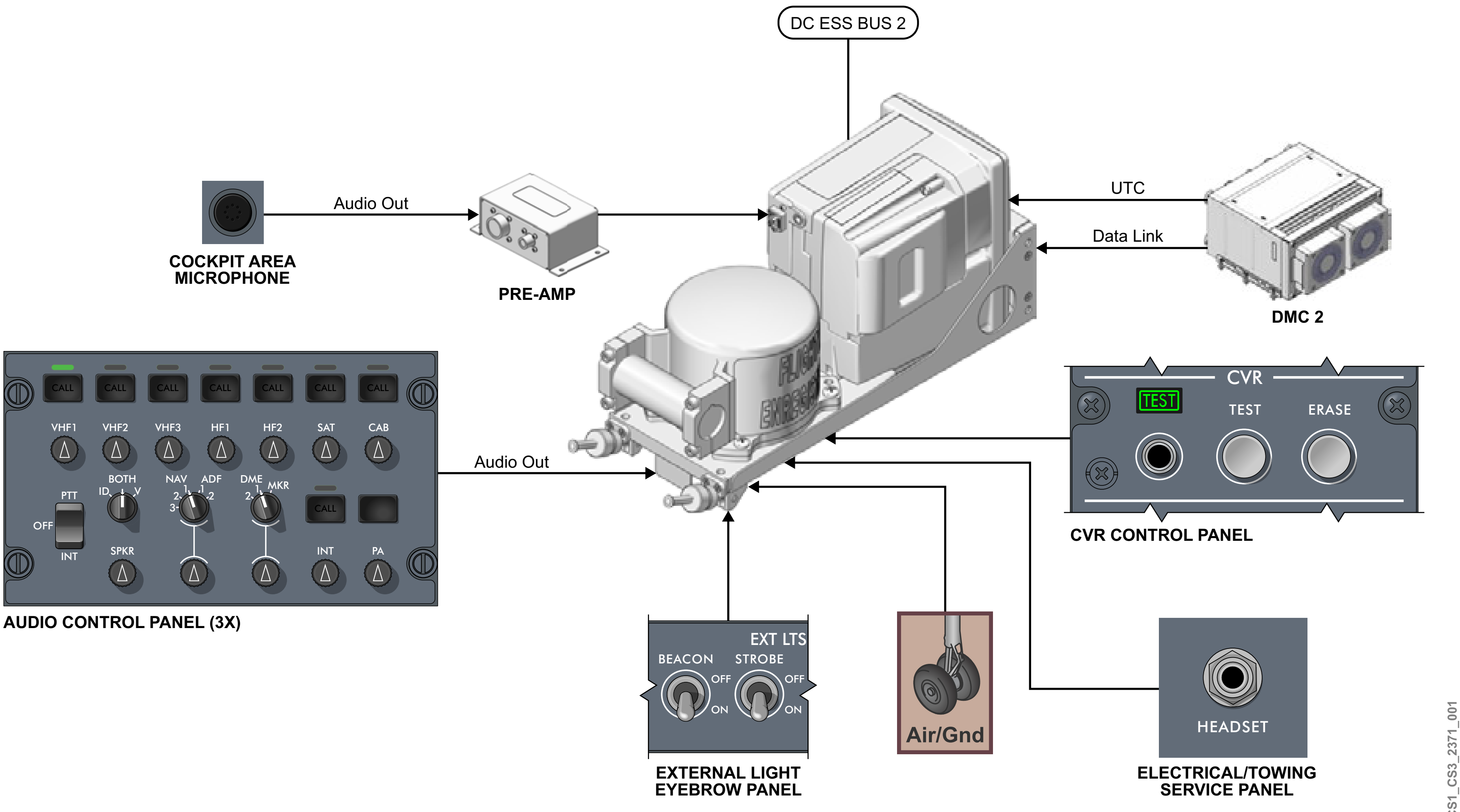


Figure 33: CVR Block Diagram (L2)

COMPONENT LOCATION

COCKPIT VOICE RECORDER CONTROL PANEL

The cockpit voice recorder (CVR) control panel is part of the overhead integrated cockpit control panel (ICCP).

COCKPIT AREA MICROPHONE

The cockpit area microphone (CAM) is mounted on the ICCP within the external light eyebrow panel.

AREA MICROPHONE PRE-AMPLIFIER

The area microphone pre-amplifier is mounted on the airframe in the flight deck ceiling.

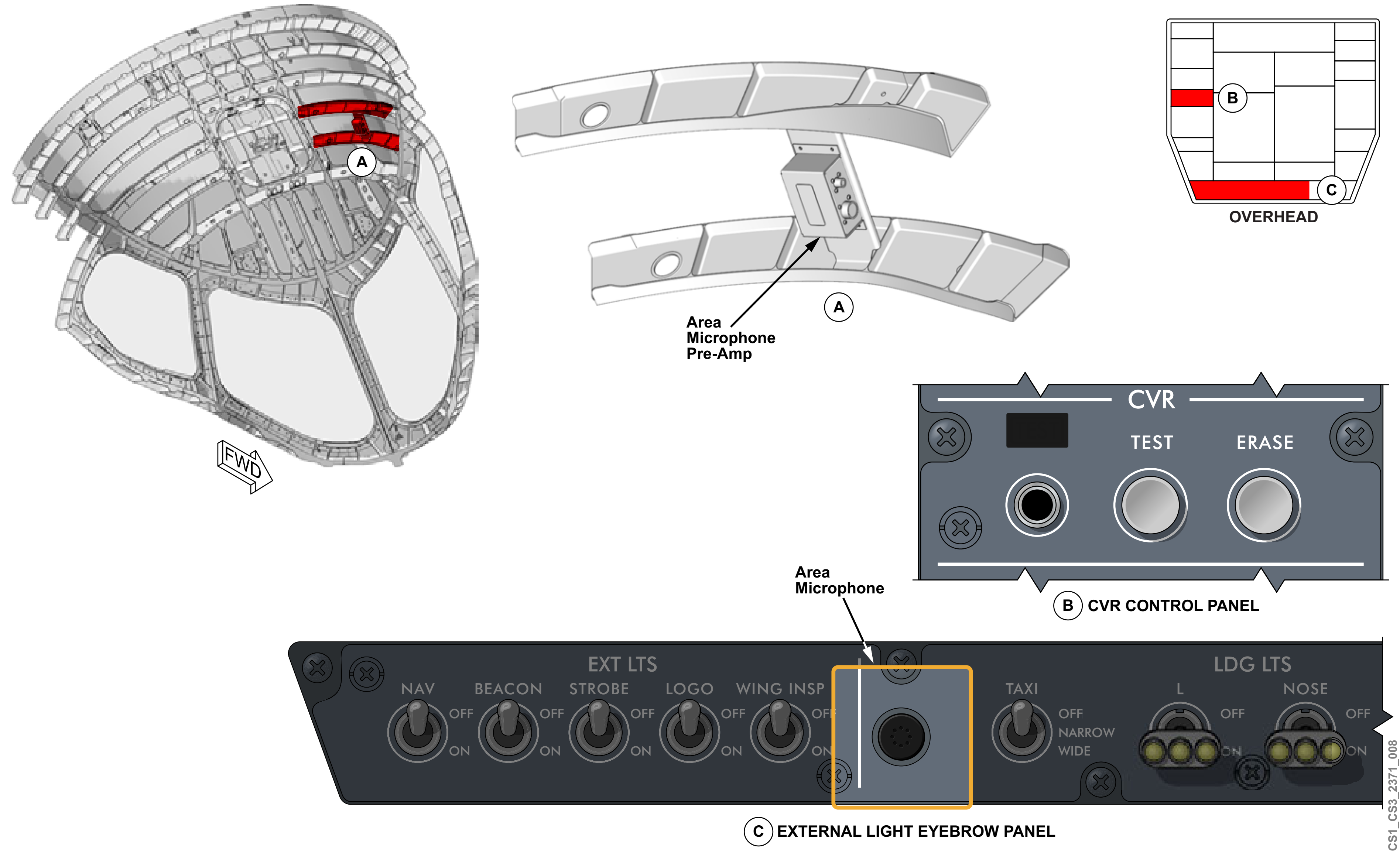


Figure 34: CVR Component Location – Flight Deck (L2)

COCKPIT VOICE RECORDER

The cockpit voice recorder (CVR) is located in the aft equipment compartment on the left side.

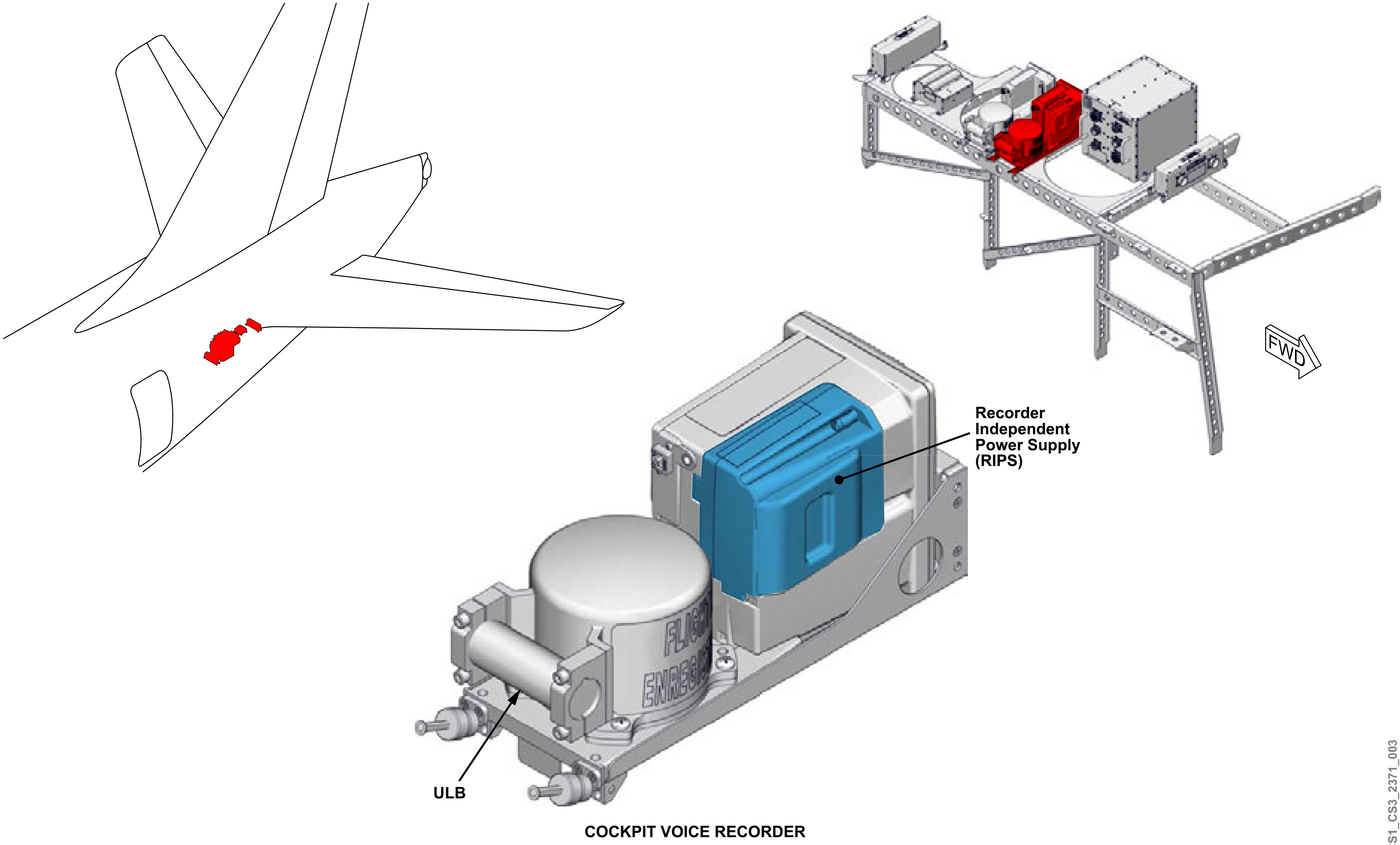


Figure 35: Cockpit Voice Recorder Component Location (L2)

DETAILED DESCRIPTION

The cockpit voice recorder (CVR) supplies 18 VDC to the cockpit area microphone (CAM) pre-amp, and 7 VDC to the recorder independent power supply (RIPS).

The recorder independent power supply (RIPS) is a line replaceable unit (LRU) attached to the CVR. Charging of the RIPS is done by the CVR.

The DC ESS BUS 2 supplies power to the CVR. The CVR starts recording when the BEACON or STROBE light switches are switched on.

When DC ESS BUS 2 is lost, the CVR transmits a RIPS active signal to the data concentrator unit module cabinet (DMC). This signal starts recording for an extra 10 minutes. The CVR inhibits recording when the signal has been present for 10 minutes.

To stop recording and prevent memory from being overwritten, the control distribution cabinet (CDC) has an AND logic that commands the solid-state power controller (SSPC) switch to open and remove the power to the CVR.

The power is removed if the following conditions are valid for more than 3 seconds:

- Both engines oil pressure < 50 psi
- Calibrated air speed < 45 kt
- Weight-off-wheels (WOFFW)

The CVR continues to record for 10 minutes.

The CVR receives clock and data link inputs from the data concentrator unit module cabinet (DMC) 2 via the ARINC 429 DATA BUS. Analog inputs are received from the ACPs and the CAM pre-amp.

An underwater locator beacon (ULB) is mounted on the front of the CVR. The ULB contains an acoustic beacon, a battery, and a water-activated switch. When water shorts the switch contacts, the ULB activates and transmits a 37.5 kHz signal. When activated, the ULB operates for 90 days. The battery has a lifetime limit and must be replaced at the expiry date stamped on it.

The ERASE pushbutton on the CVR panel is used to initiate a memory erase sequence within the CVR.

To enable the erase function:

- Press the ERASE pushbutton for 2 seconds with the aircraft on the ground
- Parking brake set, which sends a signal through the brake data concentrator unit (BDCU) and DMC

The erase function is indicated by a 400 Hz tone activated during the erase process. It can be heard using headphones plugged into the CVR control panel jack.

The erase function does not erase the data link recording.

OPTIONAL COCKPIT VOICE RECORDER MONITORING SYSTEM

The cockpit voice monitoring system consists of a headset jack and a MONITOR switch installed on the ELECTRICAL/TOWING SERVICE panel.

The MONITOR switch provides the following functions:

- Opens the CVR record inhibit discrete line, allowing the CVR to operate when the aircraft is on the ground without the BEACON or STROBE light switches turned on
- Switches the headset jack from the flight interphone system to the CVR audio output line

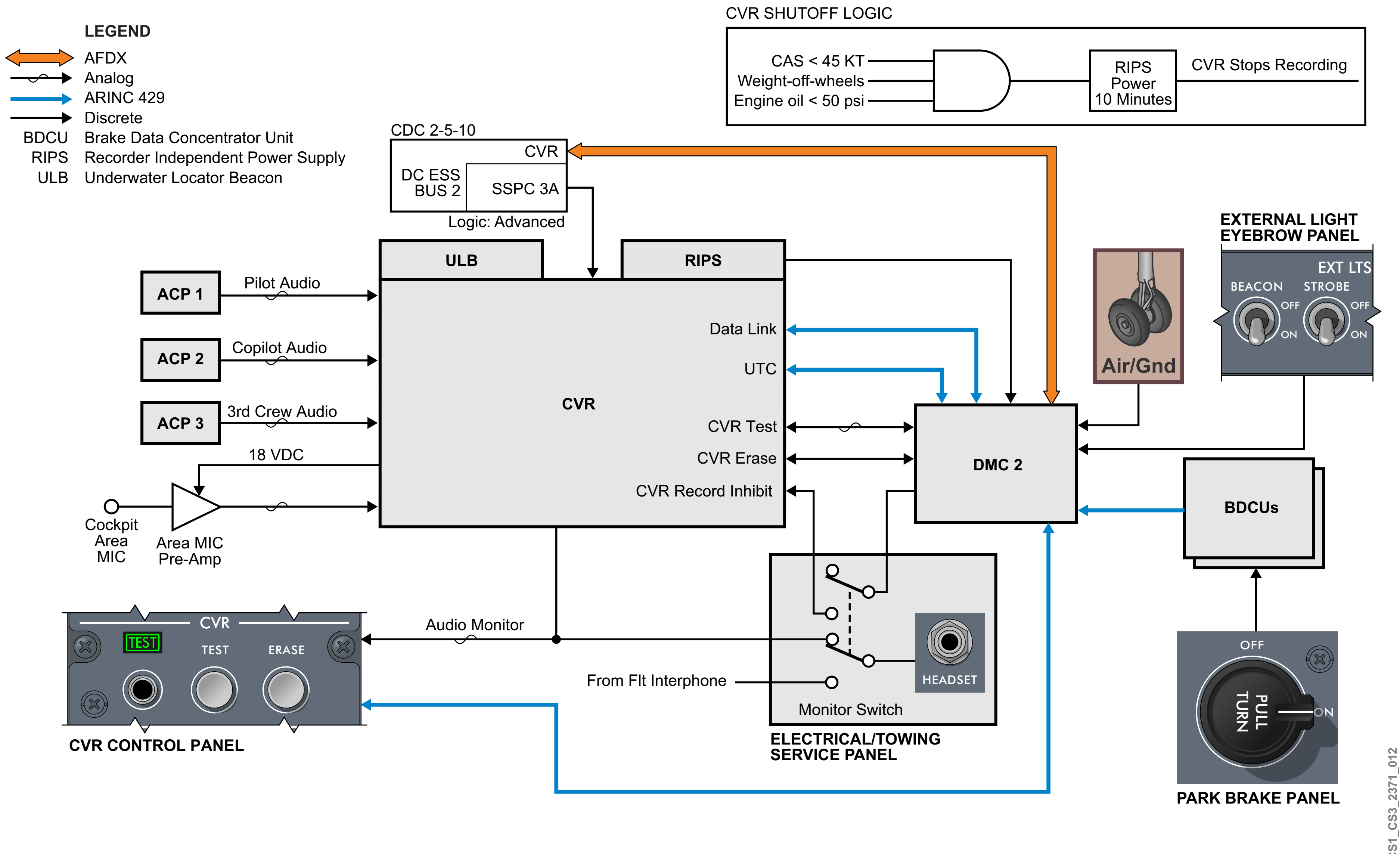


Figure 36: Cockpit Voice Recorder – Detailed Description (L3)

MONITORING AND TESTS

TEST

To initiate a self-test, the TEST button is pushed and held for 5 seconds. A 650 Hz tone is heard on the headset and test lamp illuminates indicating that the system has passed. The test lamp stays on as long as the test button is pushed.

The test is only available when the aircraft is on the ground.

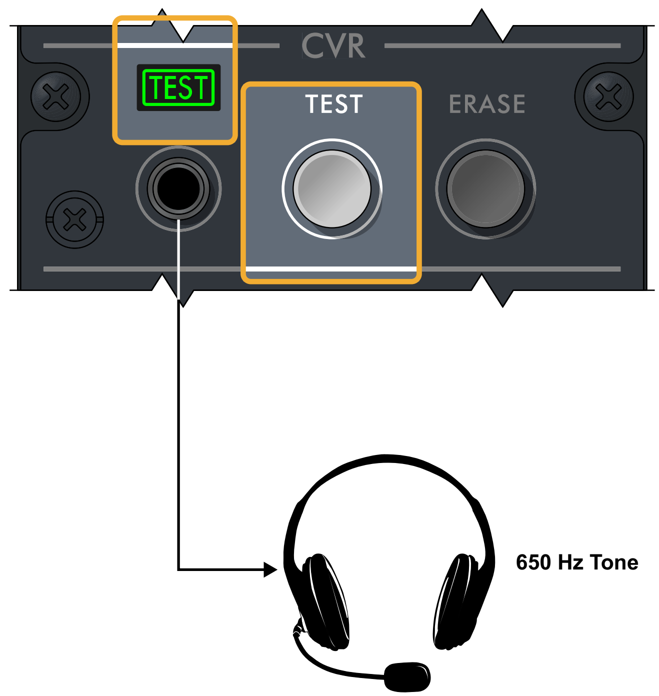


Figure 37: Cockpit Voice Recorder Control Panel –Test (L2)

CAS MESSAGES

The following page provides the crew alerting system (CAS) messages for the cockpit voice recorder (CVR).

Table 9: ADVISORY Message

MESSAGE	LOGIC
CVR FAIL	CVR is reporting itself faulty. CVR fail or CVR RIPS fail or CVR data link record fail or CVR clock fail.

23-22 AIRBORNE DATA LINK

GENERAL DESCRIPTION

The data link communication system provides digital data transmission to and from an aircraft via VHF and SATCOM subnetworks. A contract with an information provider (IP) is required. The function of the IP is to provide the data routing interface to the subscriber to provide specific messages, when requested.

These messages, referred to as uplinks and downlinks, facilitate two-way communication for applications such as:

- Weather reports
- Communications with airline dispatch and onboard maintenance system (OMS) through fixed format and free text messages
- The RIU interacts with the flight management system (FMS) to allow flight plan recall and wind aloft updates
- Air traffic control clearances

Controller-pilot data link communications (CPDLC) is an optional system that allows the aircrew to send and receive preformatted or free text messages.

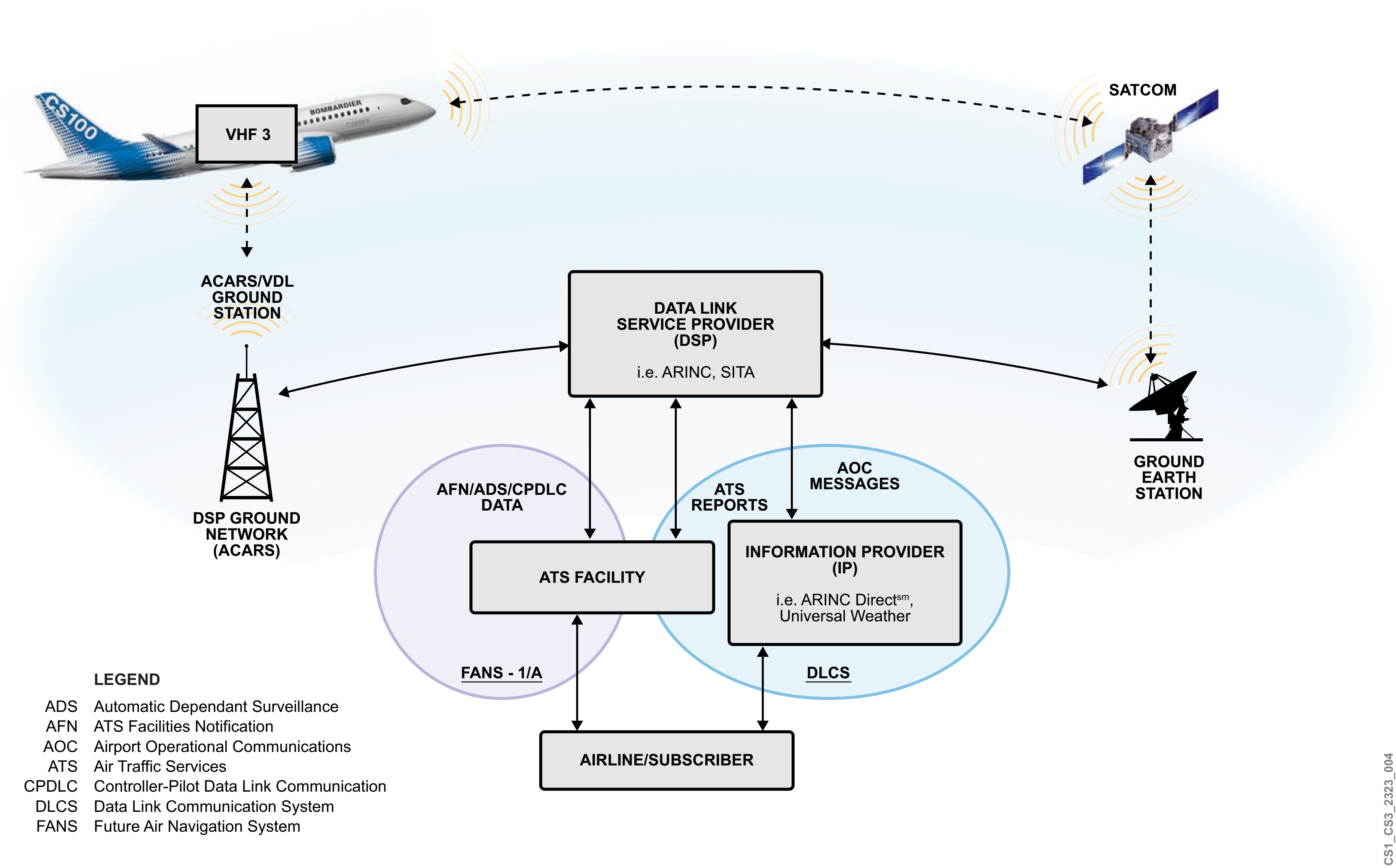


Figure 38: Data Link Network, ACARS/VDL, and Optional CPDLC (L2)

COMPONENT LOCATION

DLCA-6000 DATA LINK COMMUNICATIONS APPLICATION

The DLCA-6000 is located in the integral processing cabinet (IPC) 1 on the common computing module (CCM) 1.

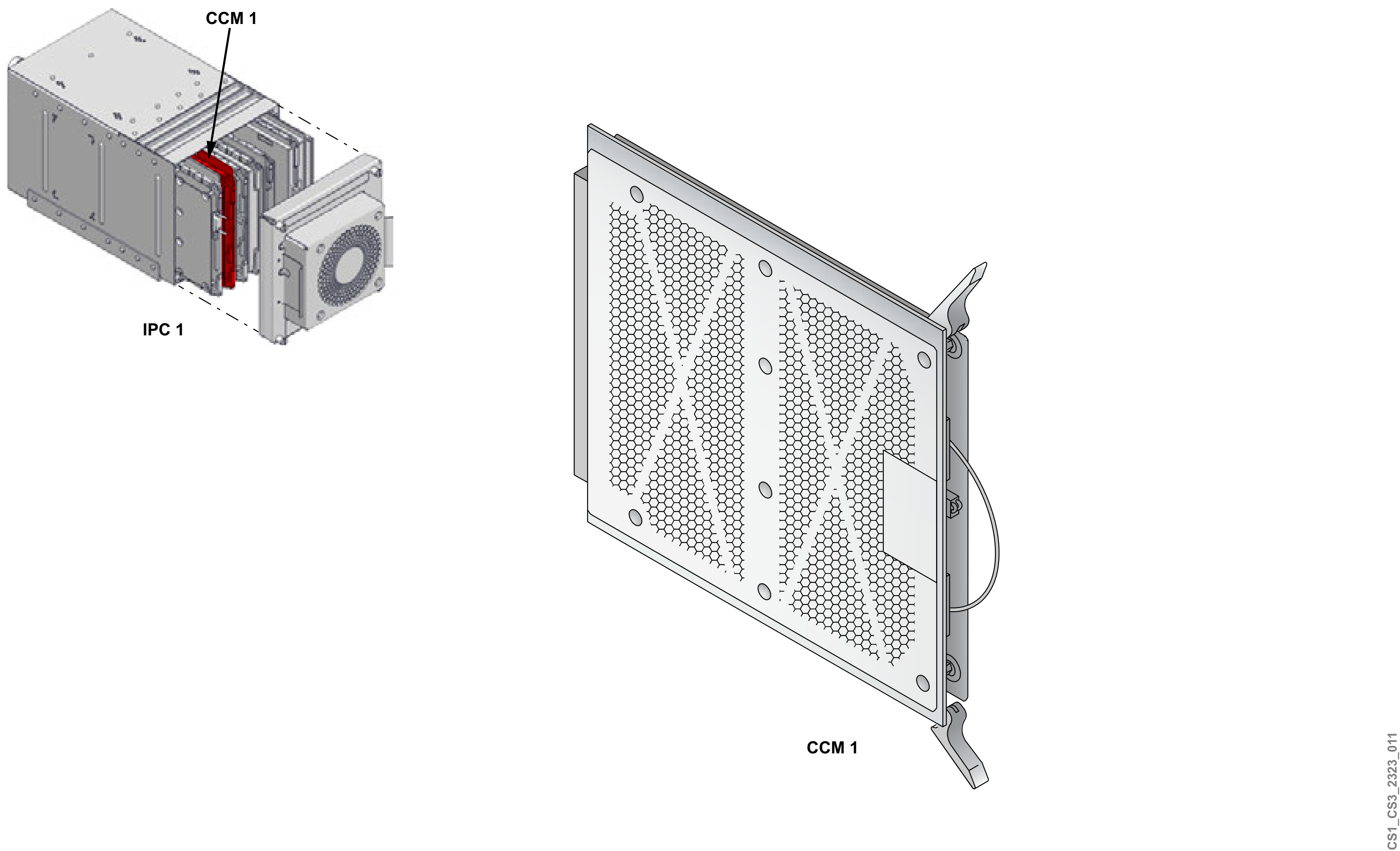


Figure 39: Data Link Communications Application (L2)

CONTROLS AND INDICATIONS

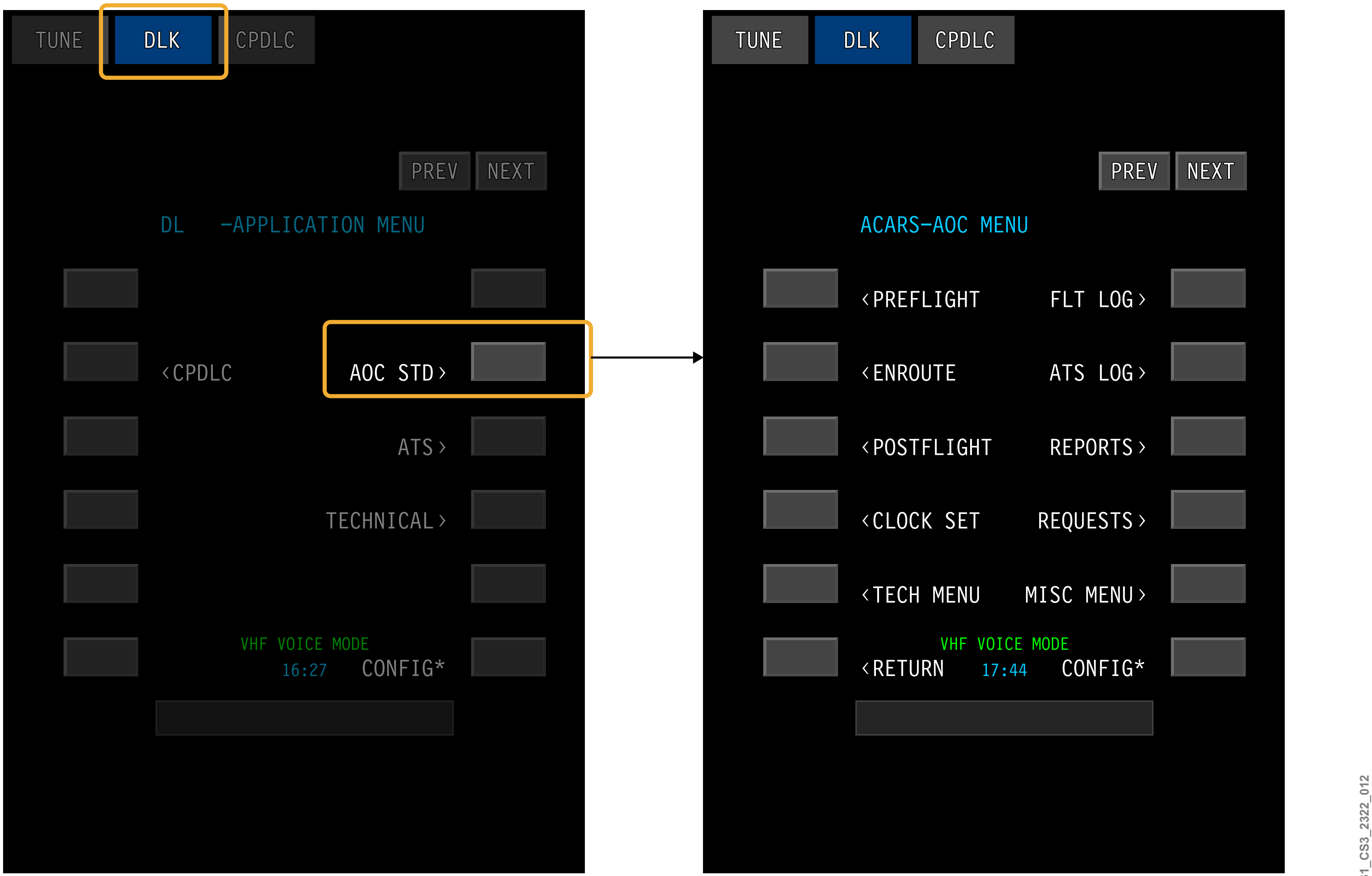
DATA LINK CONTROL AND DISPLAY

The data link applications are accessed via the communications, navigation, and surveillance (CNS) button on the CTP or the MKP and displayed on the radio tuning system application (RTSA) DLK tab. The data link main menu contains links to the following subpages:

- Airport operational communications (AOC)
- Air traffic services (ATS)
- Technical application

AIRPORT OPERATIONAL COMMUNICATIONS

The airport operational communications (AOC) function allows exchange of messages between the aircraft and the airline operation center via ACARS protocol. The AOC messages allow the airline operation control to follow the aircraft status, such as the OOOI (Out, Off, On, In) messages, which are automatically sent when the triggering condition is reached. These messages indicate that the aircraft is out-of-the gate, off-the-ground, on-the-ground (landed), and in-the-gate. A log of those reports can be accessed through the AOC interface. Other messages can be initiated by the flight crew or received from the ground, including free text messages.



RADIO TUNING SYSTEM APPLICATION

Figure 40: Data Link – Airport Operational Communications Menu (L2)

AIR TRAFFIC SERVICES

The air traffic services (ATS) allows exchange of messages related to air traffic services. The services available are:

- ATS log page
- Automatic terminal information services (ATIS)
- Departure clearance
- Oceanic clearance
- Terminal weather information for pilot (TWIP)

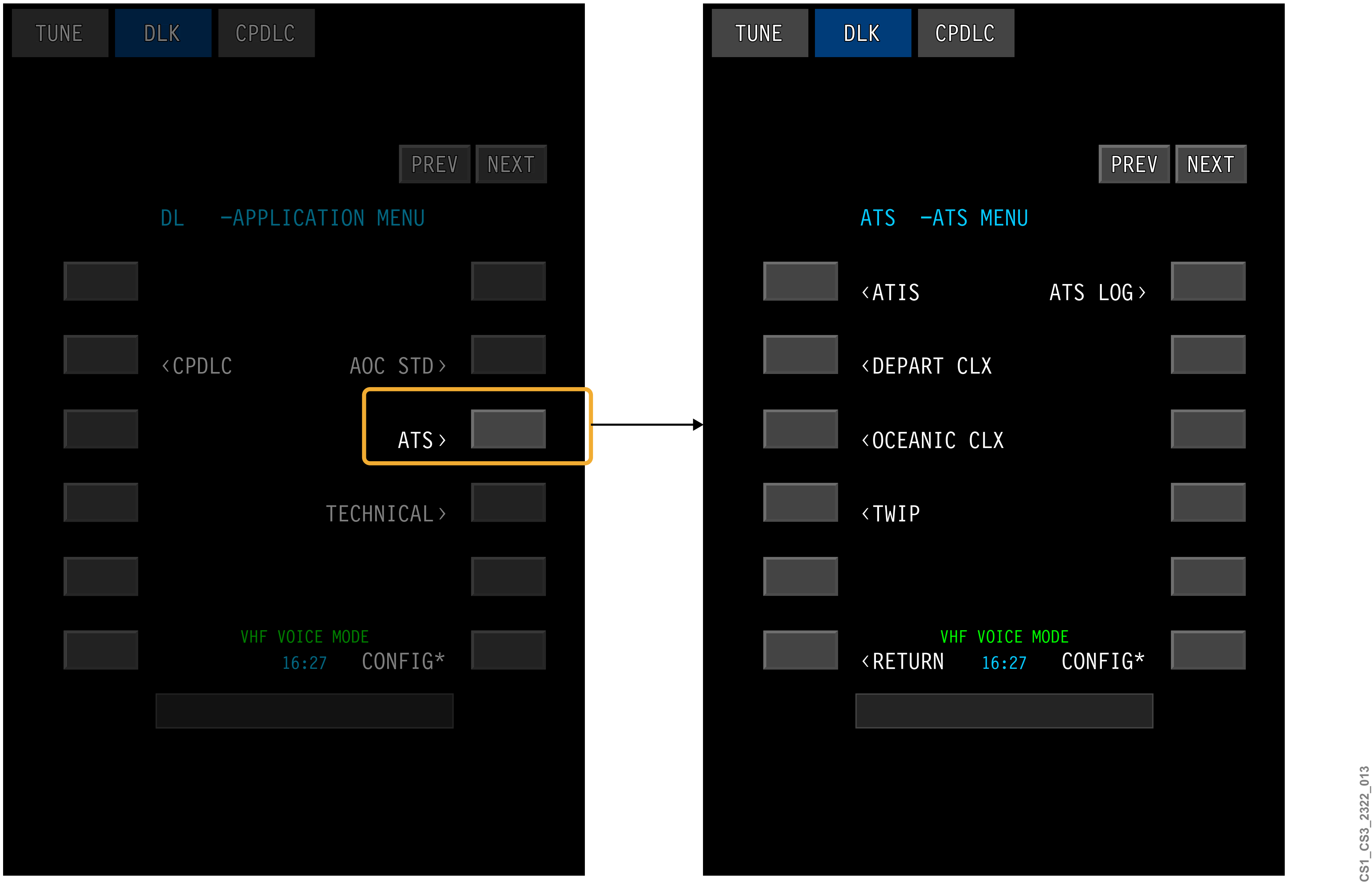


Figure 41: Data Link – Air Traffic Services Menu (L2)

TECHNICAL APPLICATION

The technical application provides the following functions:

- Various configuration part numbers
- The connection status of peripherals used by the data link
- The data link status of each available data radio
- The current state of various discrete inputs

The technical application can also query and update data contained in the RIU ECU and set a clock used by other data link applications.

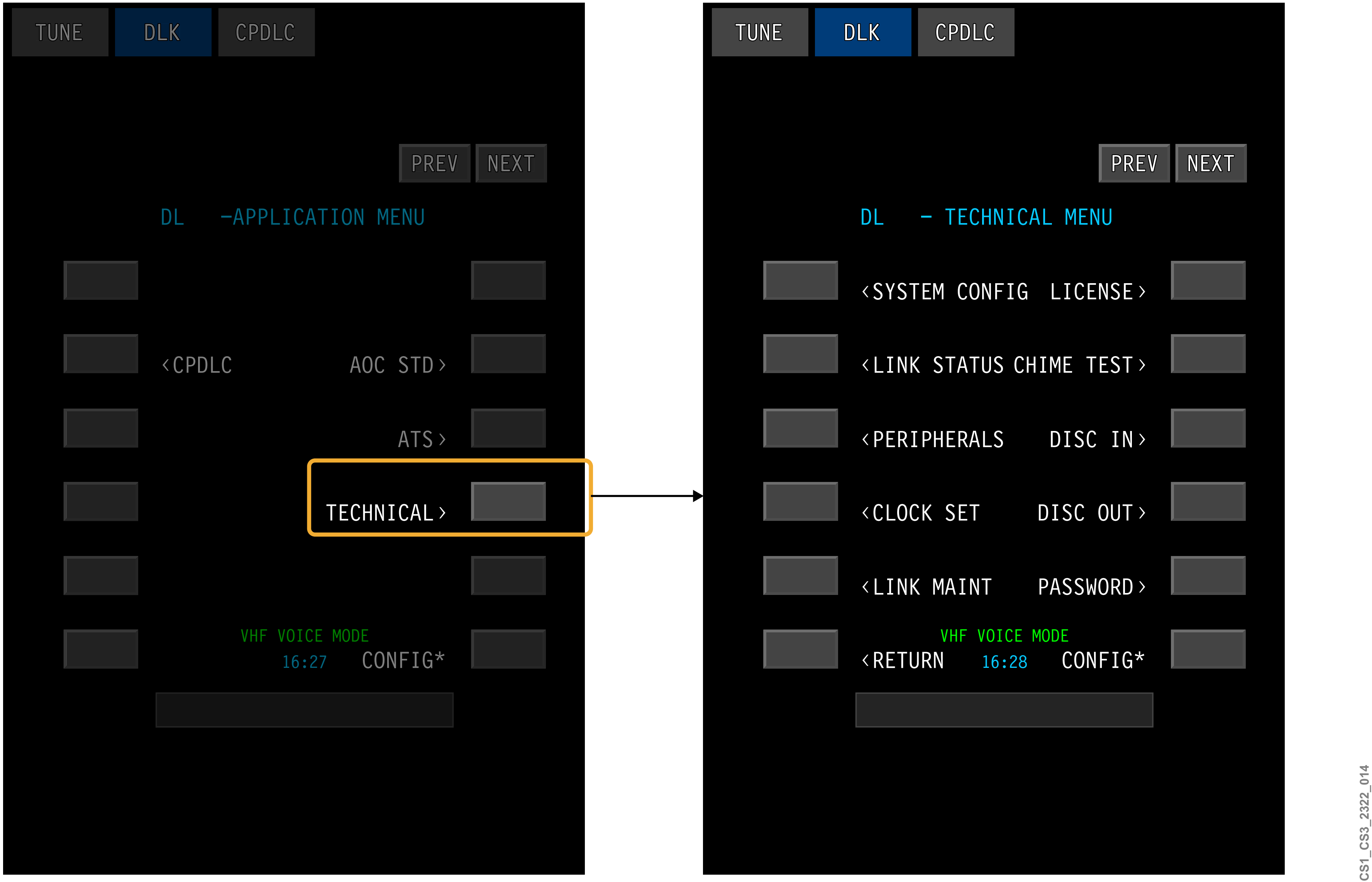


Figure 42: Data Link Technical Menu (L2)

DETAILED DESCRIPTION

RADIO INTERFACE UNIT

The data link functionality resides within a communication management unit (CMU) installed in radio interface unit (RIU) 1. The RIU contains an airborne router and data link technical applications. These applications support the aircraft communication addressing and reporting system (ACARS) to enable:

- IPC-based air traffic services (ATS) message traffic
- Airport operational communications (AOC)
- Transmission of onboard maintenance system (OMS) data

The baseline ACARS router provides the means to send and receive data messages over the third VHF-COM, which offers VDL (VHF digital link), mode A and mode 2 (VDLM2). Optional Iridium satellite communications (SATCOM) can also send and receive data messages. Data link capability requires the aircraft operator to subscribe to a data link service provider.

The RIU provides the flight management system (FMS) with flight plan recall and wind aloft updates. It also communicates with the onboard printer via ARINC 429 interfaces.

EXTERNAL COMPENSATION UNIT

The external compensation unit (ECU) is a configurable data storage device which allows aircraft specific data to be stored outside the RIU. This allows RIU replacement without the need to re-enter the aircraft specific data.

The configuration information is entered into the data link technical application menu on initial system setup. It does not need to be reconfigured until the information changes or the ECU is replaced on the aircraft.

The following information is required:

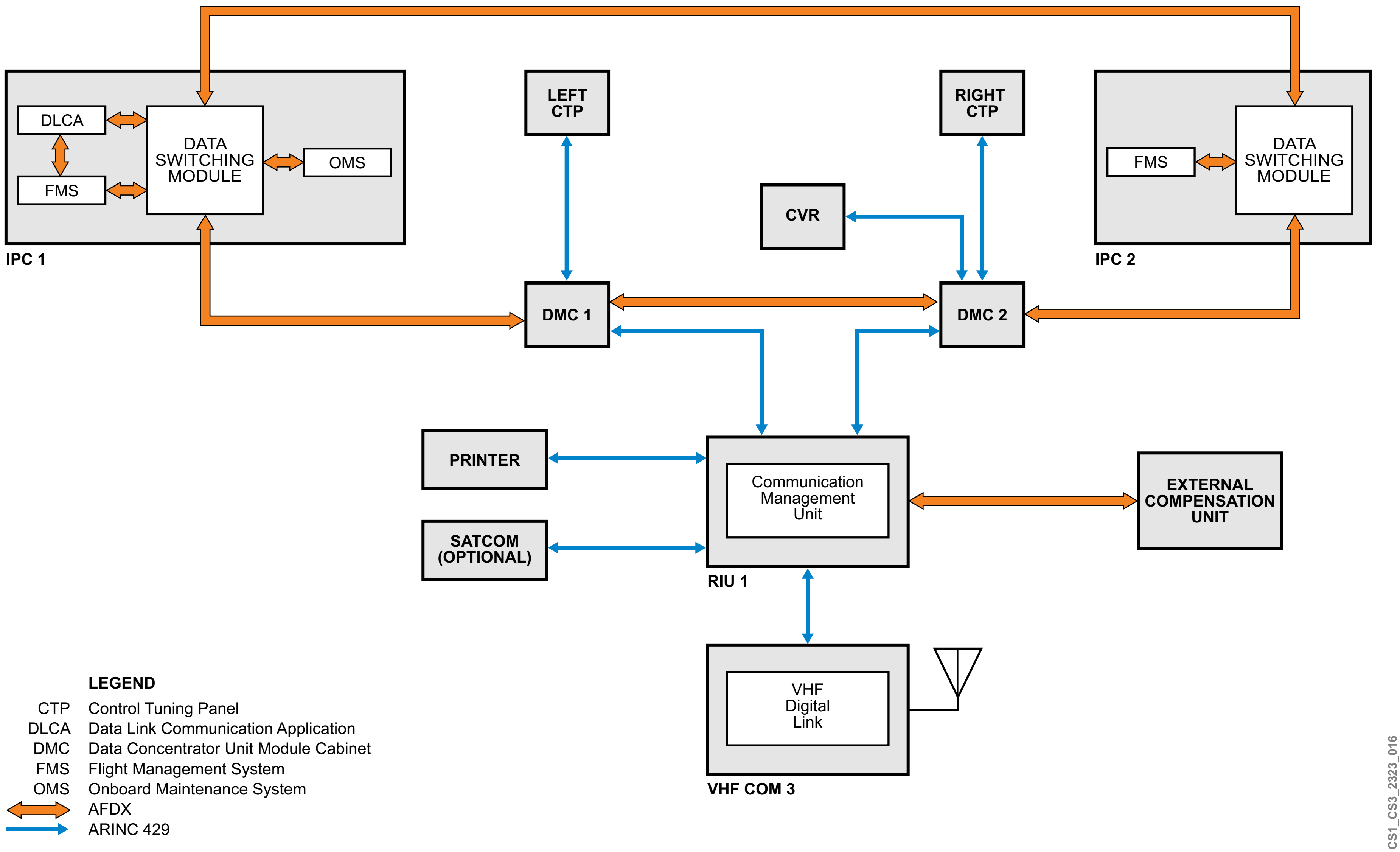
- AC TYPE: Aircraft configuration number
- REG NUM: Aircraft tail number
- AIRLINE ID: Two-letter identifier of the service provider
- ICAO ADDR: Unique address assigned by ICAO

DLCA-6000 DATA LINK COMMUNICATIONS APPLICATION

The data link communications application (DLCA) implements the future air navigation system (FANS) 1/A controller-pilot data link communications (CPDLC). FANS 1/A CPDLC provide a means of uplinking and downlinking air traffic control (ATC) messages between the pilot and controller.

COCKPIT VOICE RECORDER

The cockpit voice recorder (CVR) records the information that is sent and received by the DLCA.



LEGEND

CTP	Control Tuning Panel
DLCA	Data Link Communication Application
DMC	Data Concentrator Unit Module Cabinet
FMS	Flight Management System
OMS	Onboard Maintenance System
(orange double arrow)	AFDX
(blue arrow)	ARINC 429

Figure 43: Data Link System (L3)

MONITORING AND TESTS

The following page provides the crew alerting system (CAS) messages for the data link system.

CAS MESSAGES

Table 10: ADVISORY Messages

MESSAGE	LOGIC
DATA LINK STATUS	No communication currently available to send/receive data.
DATA LINK FAIL	Data link reports a CMU failure or data link. RIU failed/lost connection or DLCA failed and IPC/CCM powered.
DLK	ACARS message LA_RIU or ACARS message LB_RIU and EICAS in compressed mode.
CPDLC	CPDLC message exists and EICAS in compressed mode.

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ATA 26 - Fire Protection

BD-500-1A10
BD-500-1A11

Table of Contents

26-00 Fire Detection and Extinguishing System 26-2
General Description 26-2
Component Location 26-4
Detailed Description 26-6
Monitoring and Tests 26-8
CAS Messages 26-9
26-11 Engine Fire Detection 26-10
General Description 26-10
Component Location 26-12
Engine Fire Loops 26-12
Controls and Indications 26-14
Detailed Description 26-16
Monitoring and Tests 26-18
CAS Messages 26-19
Practical Aspects 26-20
26-21 Engine Fire Extinguishing 26-22
General Description 26-22
Component Location 26-24
Engine Fire Extinguishers 26-24
Component Information 26-26
Engine Fire Extinguisher 26-26
Engine Fire Extinguisher Installation 26-28
Controls and Indications 26-30
Detailed Description 26-32
Monitoring and Tests 26-34
CAS Messages 26-35
26-12 Auxiliary Power Unit Fire Detection 26-36
General Description 26-36
Component Location 26-38
APU Fire Loops 26-38
Controls and Indications 26-40
Detailed Description 26-42
Monitoring and Tests 26-44
CAS Messages 26-45
26-22 Auxiliary Power Unit Fire Extinguishing 26-46
General Description 26-46
Installation 26-48
Component Location 26-48
Auxiliary Power Unit Fire Extinguisher 26-48
Component Information 26-50
Auxiliary Power Unit Fire Extinguisher 26-50
Detailed Description 26-52
APU Fire 26-52
APU Automatic Fire Bottle Discharge 26-52
Monitoring and Tests 26-54
CAS Messages 26-55
26-14 Main Wheel Well Overheat Detection 26-56
General Description 26-56
Component Location 26-58
Sensing Elements 26-58
Detailed Description 26-60
Monitoring and Tests 26-62
CAS Messages 26-63
26-13 Avionics and Electrical Bay Smoke Detection 26-64
General Description 26-64
Component Location 26-66
Smoke Detectors 26-66

Detailed Description 26-68
Monitoring and Tests 26-70
CAS Messages 26-71
26-15 Cargo Smoke Detection 26-72
General Description 26-72
Component Location 26-74
Cargo Smoke Detectors....................26-74
Controls and Indications 26-76
Detailed Description 26-78
Monitoring and Tests 26-80
Smoke Detector Fault Monitoring 26-80
CAS Messages 26-82
26-24 Cargo Fire Extinguishing 26-84
General Description 26-84
Component Location 26-86
Component Information 26-88
High-Rate Discharge Fire Extinguisher....................26-88
Low-Rate Discharge Fire Extinguisher 26-88
Discharge Head and Cartridge 26-88
Cargo Fire Extinguisher Installation....................26-90
Controls and Indications 26-92
Detailed Description 26-94
Monitoring and Tests 26-96
CAS Messages 26-97
26-00 FIDEX System Test....................26-98
General Description 26-98
26-16 Lavatory Smoke Detection 26-100
General Description 26-100
Component Location 26-102
Lavatory Smoke Detector 26-102
Controls and Indications 26-104
Monitoring and Tests 26-106
CAS Messages 26-107
Test 26-108
26-25 Lavatory Fire Extinguishing 26-110
General Description 26-110
26-23 Portable Fire Extinguishing.................... 26-112
General Description 26-112

List of Figures

Figure 1: Fire Detection and Extinguishing System (L2) 26-3
Figure 2: FIDEX Control Unit Location (L2) 26-5
Figure 3: Fire Detection and Extinguishing System Interface (L3) 26-7
Figure 4: Engine Fire Detection System (L2) 26-11
Figure 5: Engine Fire Loop Location (L2) 26-13
Figure 6: Engine Fire Indication (L2) 26-15
Figure 7: Engine Fire Detection Logic (L3) 26-17
Figure 8: Fire Sensing Elements (L2) 26-21
Figure 9: Engine Fire Extinguishing System (L2) 26-23
Figure 10: Engine Fire Extinguishers Location (L2) 26-25
Figure 11: Engine Fire Extinguisher (L2) 26-27
Figure 12: Engine Fire Extinguisher Installation (L2)............26-29
Figure 13: Engine and APU FIRE Panel (L2) 26-31
Figure 14: Engine Fire Extinguishing Schematic (L3) 26-33
Figure 15: APU Fire Detection System (L2) 26-37
Figure 16: Auxiliary Power Unit Fire Loops Location (L2) 26-39
Figure 17: Auxiliary Power Unit Fire Detection Indication (L2) 26-41
Figure 18: APU Fire Detection Logic (L3) 26-43
Figure 19: Auxiliary Power Unit Fire Extinguisher System (L2) 26-47
Figure 20: Auxiliary Power Unit Fire Extinguisher Location (L2) 26-49
Figure 21: Auxiliary Power Unit Fire Extinguisher (L2).........26-51
Figure 22: APU Fire Extinguisher Schematic (L3) 26-53
Figure 23: Main Wheel Well Overheat System (L2)............. 26-57
Figure 24: Main Wheel Well Overheat Loops Location (L2) 26-59
Figure 25: Main Wheel Well Overheat Logic (L3) 26-61
Figure 26: Avionics and Electrical Bay Smoke Detection System (L2) 26-65
Figure 27: Avionics and Electrical Equipment Bay Smoke Detector Location (L2) 26-67
Figure 28: Avionics and Electrical Bay Smoke Detection Logic (L3)... 26-69
Figure 29: Cargo Smoke Detection System (L2) 26-73
Figure 30: Cargo Smoke Detectors (L2) 26-75
Figure 31: CARGO Panel (L2) 26-77
Figure 32: Cargo Smoke Detection Logic (L3)..................... 26-79
Figure 33: Smoke Detector (L2)... 26-81
Figure 34: Cargo Fire Extinguishing System (L2) 26-85
Figure 35: Cargo Fire Extinguisher Location (L2) 26-87
Figure 36: Cargo Fire Extinguisher (L2)............................... 26-89
Figure 37: Cargo Fire Extinguisher Installation (L2) 26-91
Figure 38: CARGO Panel (L2) 26-93
Figure 39: Cargo Fire Extinguishing Operation (L3) 26-95
Figure 40: AVIONIC Page Fire Test (L2) 26-99
Figure 41: Lavatory Smoke Detector System (L2)............. 26-101
Figure 42: Lavatory Smoke Detector Location (L2) 26-103
Figure 43: Lavatory Smoke Detector Controls and Indications (L2) 26-105

Figure 44: Lavatory Smoke Detector Test (L2) 26-109
Figure 45: Lavatory Fire Extinguishing (L2)........................26-111
Figure 46: Portable Fire Extinguishers (L2)........................26-113

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FIRE PROTECTION - CHAPTER BREAKDOWN

Fire Detection and Extinguishing System 1

Smoke Detection 2

FIDEX System Test 3

26-00 FIRE DETECTION AND EXTINGUISHING SYSTEM

GENERAL DESCRIPTION

The fire detection and extinguishing system is controlled and monitored by the fire detection and extinguishing (FIDEX) control unit. The FIDEX control unit provides:

- Detection of fire or smoke
- Monitoring of fire extinguisher pressure switches and cartridges
- Illumination of the FIRE and BTL pushbutton annunciators (PBAs)
- Automatic fire extinguishing for the APU (ground only)
- FIDEX health and status to the engine indication and crew alerting (EICAS) and onboard maintenance system (OMS)
- BIT testing

Each channel has its own independent source of power. DC ESS BUS 1 powers channel A and DC ESS BUS 2 powers channel B.

The FIDEX control unit monitors for fire and smoke detection using:

- Dual-loop AND logic for the engine and APU fire detection
- Dual-loop AND logic for main wheel well overheat detection
- Dual-loop AND logic for cargo compartment, avionics, and electrical bay smoke detection
- Single channel lavatory smoke detection

When a fire is detected, the appropriate FIRE PBA illuminates. The engine and APU fire extinguishers are discharged using the FIRE and BTL PBAs on the ENGINE and APU FIRE panel. The fire extinguishers are powered by BATT DIR BUS 1 and BATT DIR BUS 2 . The APU fire extinguisher can also be discharged by the FIDEX control unit if the aircraft is on the ground. The FIDEX control unit provides an indication of an extinguisher discharge on the BTL PBA.

When smoke is detected in a cargo compartment, the FIDEX control unit illuminates the appropriate CARGO FIRE PBA.

The cargo fire extinguishers are discharged using the CARGO FIRE and BTL PBAs on the CARGO FIRE panel.

The system can be manually tested at anytime from the AVIONIC synoptic page. The FIDEX control unit also runs startup and continuous BIT tests. The system automatically reconfigures to single-loop operation if a fault is detected. All faults are reported to the EICAS, as well as the OMS for fault indication.

The FIDEX control unit has field loadable software.

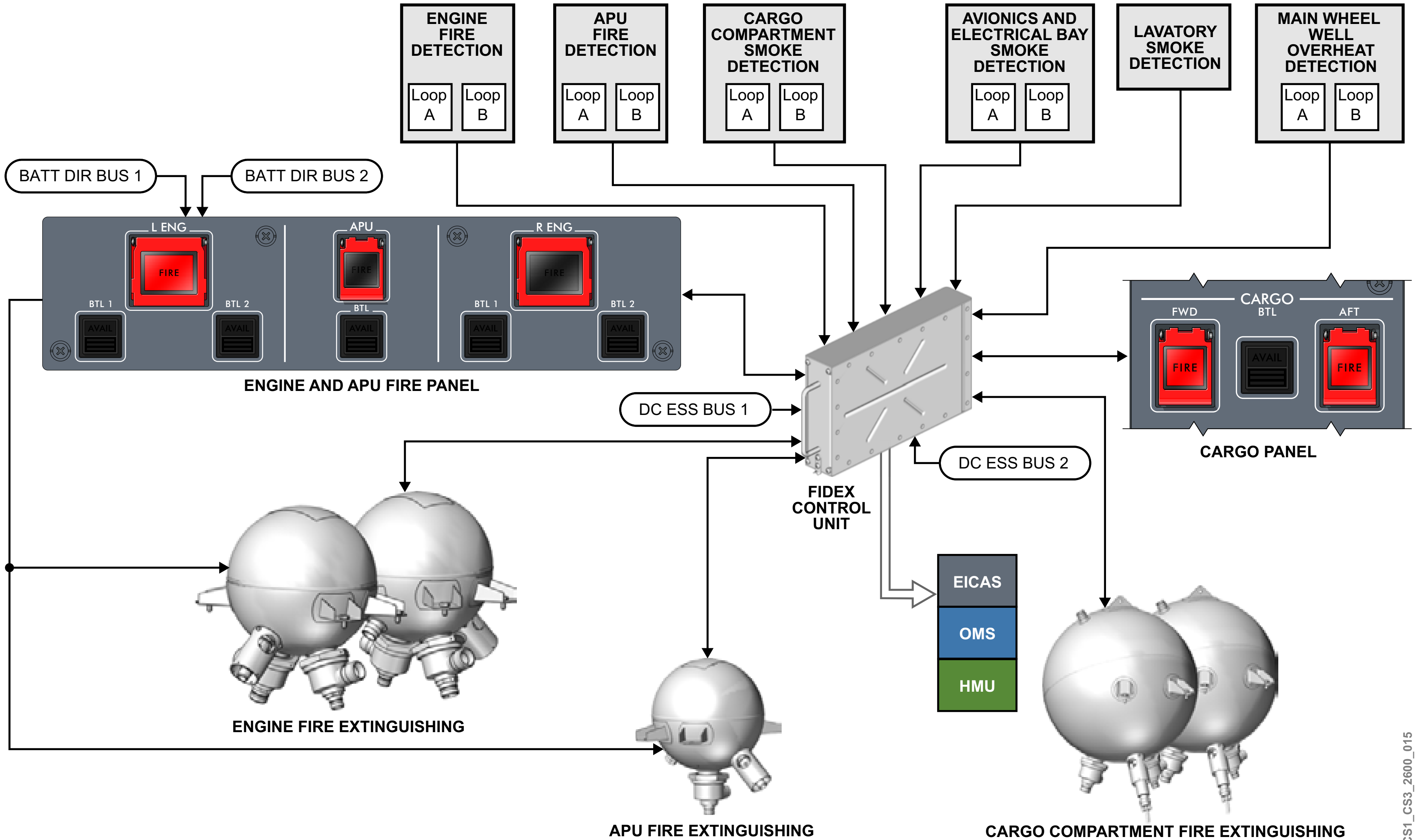


Figure 1: Fire Detection and Extinguishing System (L2)

COMPONENT LOCATION

The FIDEX control unit is located in the mid equipment bay.

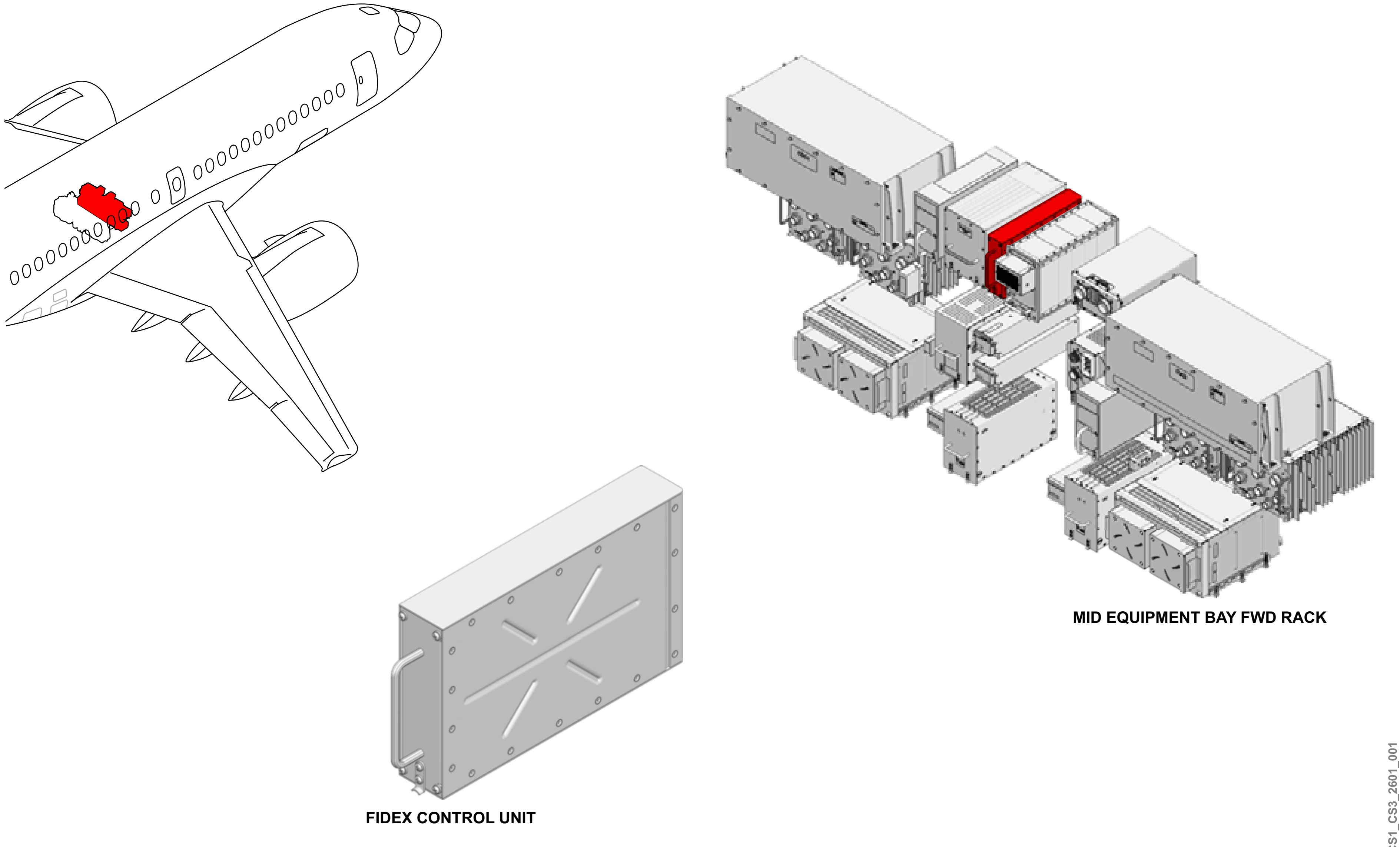


Figure 2: FIDEX Control Unit Location (L2)

DETAILED DESCRIPTION

The fire detection and extinguishing (FIDEX) control unit has two control cards. The control cards communicate with the data concentrator unit module cabinet (DMC) via an ARINC 429 BUS. Each card receives aircraft information, such as initiated BIT commands, weight-on-wheels (WOW) signal, flight leg, and time.

Data transmitted from the control cards to the DMC include fire detection alarms, extinguisher pressure, cartridge status, smoke detector alarms, status and health, control card faults, and maintenance messages.

In case of an engine, auxiliary power unit (APU), or main wheel well loop failure, the FIDEX control unit does not report a fire, but reverts to OR logic using the remaining good loop to monitor the zone for fire.

The FIDEX control unit transmits the failure data to the OMS. A FIRE SYS FAULT advisory message is displayed. Loss of ARINC 429 communication or certain pilot-initiated test failures produce a FIRE SYSTEM FAIL caution message.

If an APU fire is detected when the aircraft is on the ground, the FIDEX control unit enters an unattended mode of operation. A signal shuts down the APU and activates the APU horn. If the APU FIRE PBA is not pressed within 10 seconds, the FIDEX control unit discharges the APU fire extinguisher.

The cargo compartment, avionics, and electrical bay smoke detectors are divided into two channels for AND logic. Each channel communicates with one FIDEX control card using a CAN BUS. The smoke detector locations are identified by pin programming.

The forward lavatory detector communicates on CAN BUS A, while the aft lavatory detector communicates on CAN BUS B.

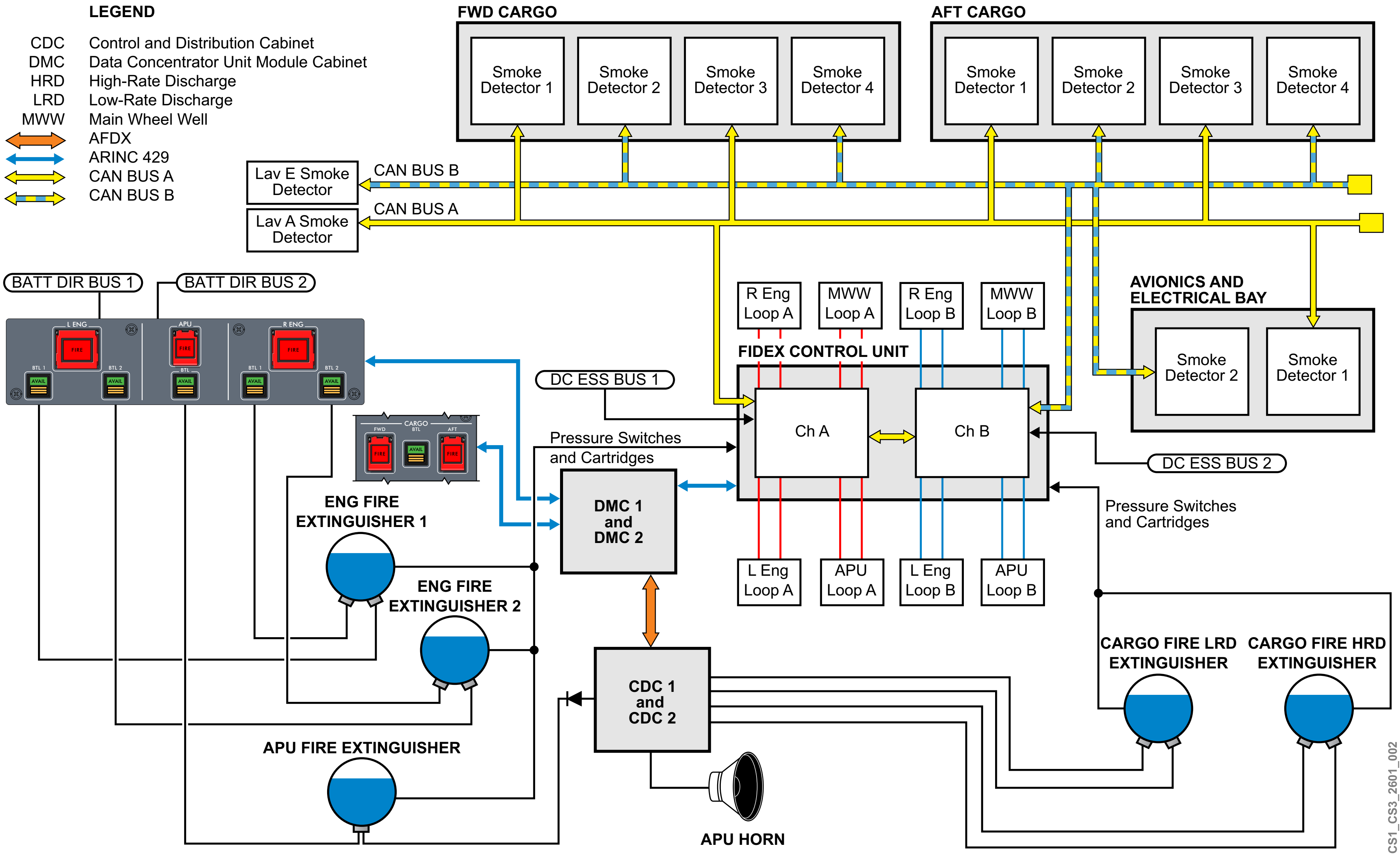


Figure 3: Fire Detection and Extinguishing System Interface (L3)

MONITORING AND TESTS

The following page provides the crew alerting system (CAS) and INFO messages for the FIDEX control unit.

CAS MESSAGES

Table 1: CAUTION Message

MESSAGE	LOGIC
FIRE SYSTEM FAIL	FIRE SYS FAIL is the loss of valid FIDEX A and FIDEX B communication for at least 10 seconds.

Table 2: ADVISORY Message

MESSAGE	LOGIC
FIRE SYSTEM FAULT	Loss of redundancy in the FIDEX system.

Table 3: INFO Messages

MESSAGE	LOGIC
26 FIRE SYSTEM FAULT - CTRL UNIT CONFIG INOP	Invalid control unit configuration.
26 FIRE SYSTEM FAULT - CTRL UNIT CHAN A DEGRADED	FIDEX control unit channel A degraded.
26 FIRE SYSTEM FAULT - CTRL UNIT CHAN B DEGRADED	FIDEX control unit channel B degraded.
26 FIRE SYSTEM FAULT - CTRL UNIT A INOP	FIDEX control unit channel A inoperative.
26 FIRE SYSTEM FAULT - CTRL UNIT B INOP	FIDEX control unit channel B inoperative.
26 FIRE SYSTEM FAULT - CTRL UNIT CHAN A A429 INPUT LOSS	Loss of any ARINC 429 input to FIDEX control unit channel A
26 FIRE SYSTEM FAULT - CTRL UNIT CHAN B A429 INPUT LOSS	Loss of any ARINC 429 input to FIDEX control unit channel B.

26-11 ENGINE FIRE DETECTION

GENERAL DESCRIPTION

The fire detection system provides fire and overheat detection for the engines. It uses dual-loop sensors with five elements per loop. The fire detection and extinguishing (FIDEX) control unit interfaces with the engine indication and crew alerting system (EICAS) to alert the crew if a fire or overheat condition is present or a critical failure occurs.

The FIDEX continuously monitors the condition of the left and right engines. Under normal conditions, two loops must detect a fire to produce a fire alarm in the cockpit. Under failure conditions where one loop or FIDEX channel has failed, the remaining channel will provide detection and indication.

Under fire conditions a L or R ENG FIRE warning message is displayed on EICAS. The system automatically clears the fire warning indication if the temperature returns to normal.

When an engine fire is detected, the FIDEX control unit signals the data concentrator unit module cabinet (DMC). The DMC provides the following indications:

- “LEFT ENGINE FIRE” aural warning
- FIRE indication above the N1 display on EICAS
- L or R ENG FIRE warning message on EICAS
- L or R ENG FIRE PBA illuminates red on the ENGINE and APU FIRE panel
- L or R FIRE light on the ENGINE START CONTROL panel

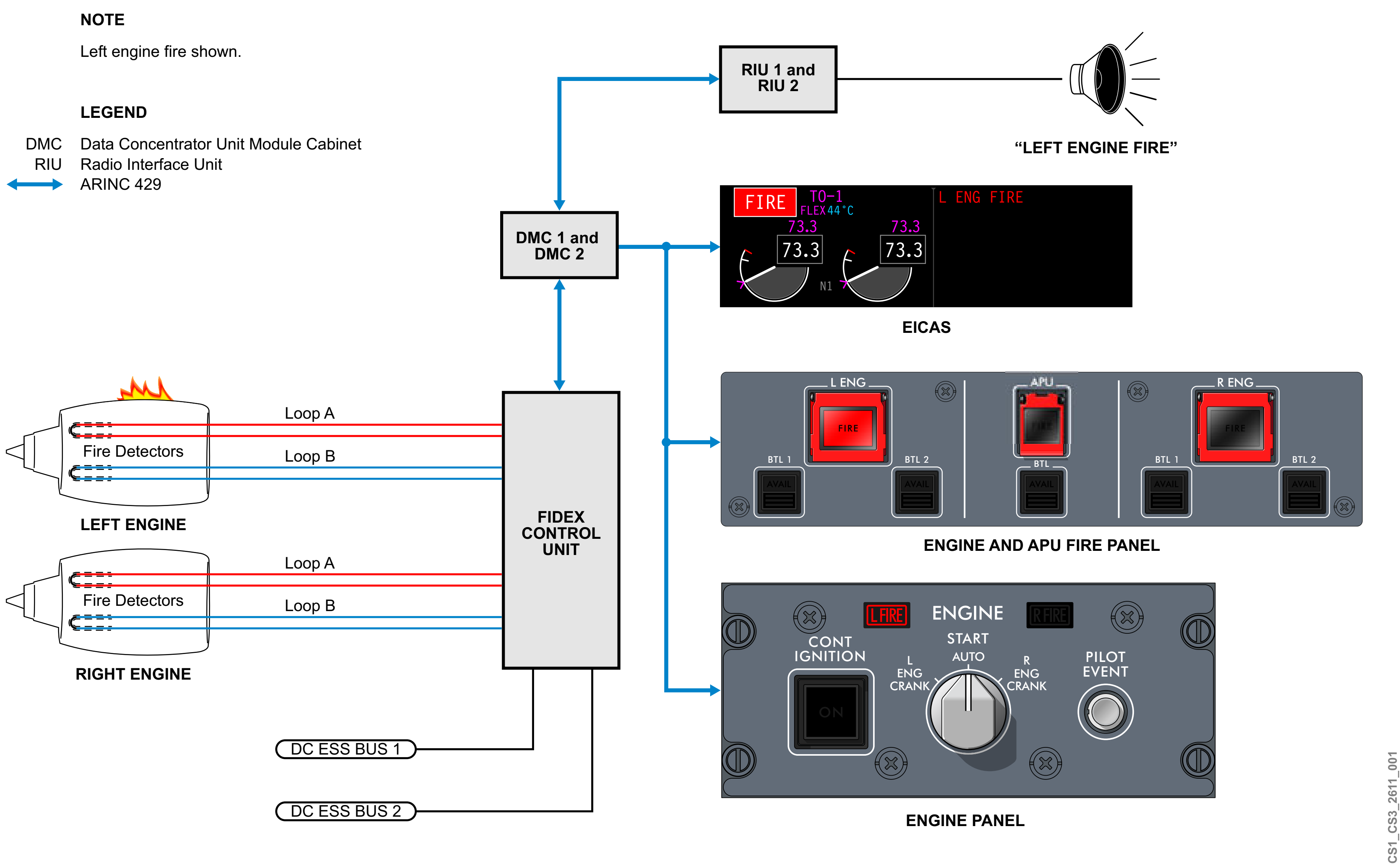


Figure 4: Engine Fire Detection System (L2)

COMPONENT LOCATION

The following components are installed in the engine fire detection system:

- Engine fire loops

ENGINE FIRE LOOPS

Engine core fire loops are surface-mounted on the L and R inner fixed structure of the core cowlings.

The pylon floor fire loop is rail-mounted on the forward pylon floor in the region of the fuel and hydraulic connections.

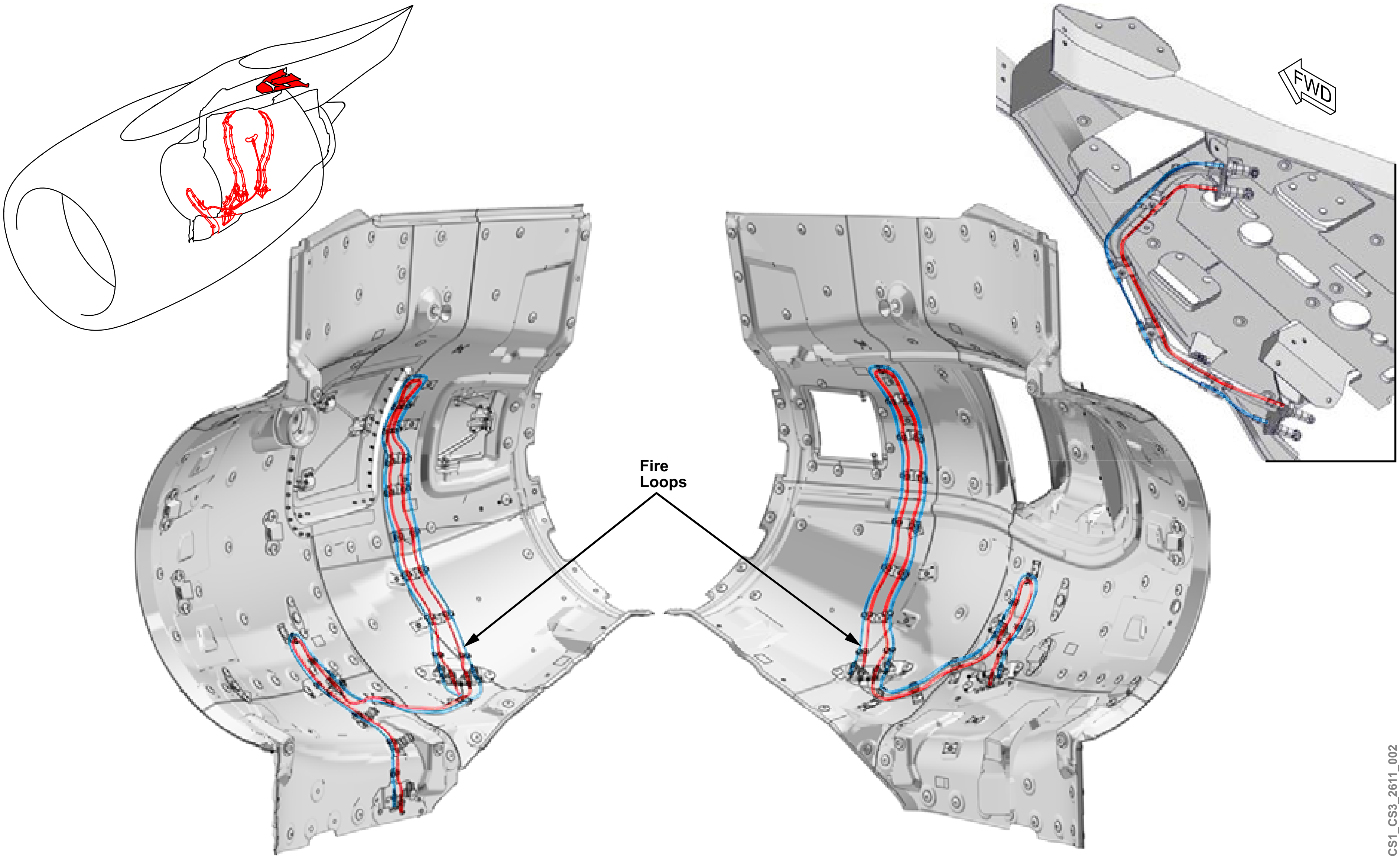


Figure 5: Engine Fire Loop Location (L2)

CONTROLS AND INDICATIONS

The ENGINE and APU FIRE panel FIRE pushbutton annunciators (PBAs) illuminate red when a fire is detected. A switch guard prevents inadvertent operation of the PBA.

The engine FIRE lights on the ENGINE START panel indicate which engine is on fire.

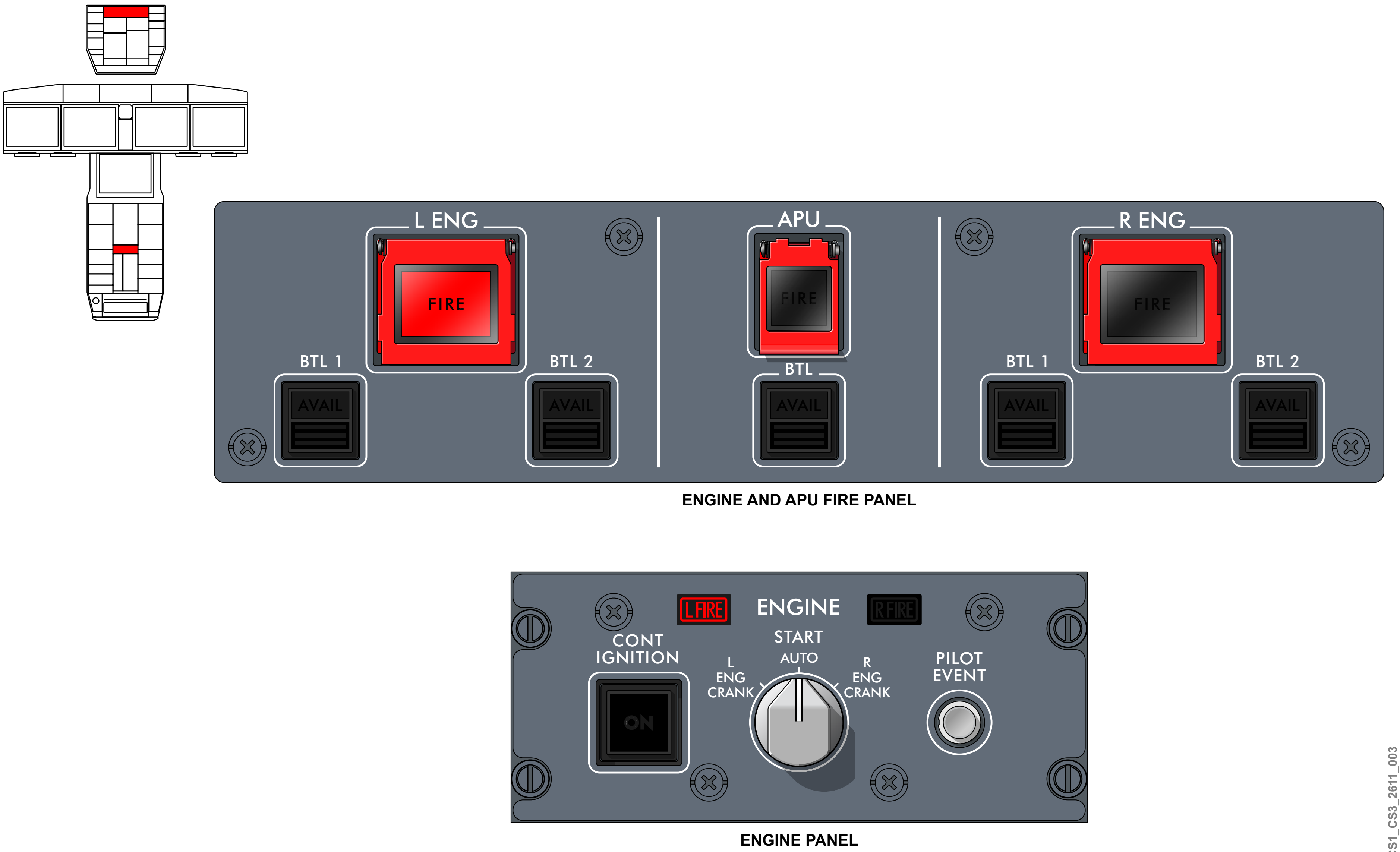


Figure 6: Engine Fire Indication (L2)

DETAILED DESCRIPTION

Under normal conditions, the continuous and periodic BIT checks individual fire or overheat detector loop functions, monitoring circuits, and decision logic.

The loops provide a continuous resistance change as a function of temperature variation. In addition to monitoring the sensing elements for fire information, the resistance characteristics of the sensing elements allow for detection of open or short conditions, which could prevent proper detection. A short versus fire discriminator circuit operates on a rate of resistance change principle. It discriminates between a loop resistance lowered at a finite rate when caused by heating of a sensing element, and the nearly instantaneously lowered resistance caused by a short to ground.

If an element in a loop fails in a shorted condition, the loop cannot detect a fire. A single open element in a loop does not cause complete failure and is still capable of detecting a fire or overheat. When an open loop is sensed, it is not removed until after cold start BIT or fire test occurs.

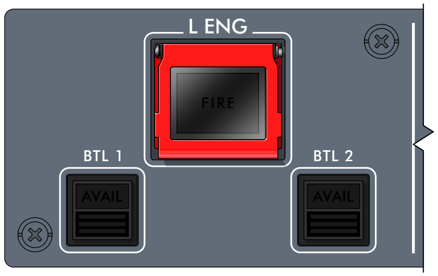
In normal operation, the FIDEX control unit monitors the engine fire loop elements using AND logic. Under fire conditions, detection loop A and B elements heat simultaneously, and each FIDEX channel produces an alarm output. Both channels must report an alarm condition to trigger the flight deck warnings. An engine fire is indicated by a red ENG FIRE warning message on EICAS and the ENG FIRE PBA illuminating.

In dual-loop AND logic, the FIDEX control unit does not allow a single-loop fire condition to remain for longer than 20 seconds without declaring a fire or a loop fault. If one element is hot and the other loop is cold, the FIDEX control unit fire alarm logic checks system parameters and determines if the hot loop represents either a fire condition or a loop failure (false alarm).

The decision is based on a BIT test of the non-reporting loop. If this loop passes the BIT test, then the alarm reporting loop is faulted and the system reverts to OR logic. If the BIT test of the non-reporting loop fails, then the reporting loop is considered good and an alarm is declared. If a loop has failed a FIRE SYS FAULT advisory EICAS message is displayed along with an INFO message.

When the system is operating in OR logic, a single-loop reporting an alarm condition triggers the flight deck warnings.

If both fire detection loops on the same engine fail, an L or R ENG FIRE DET FAIL caution message is displayed on EICAS.



LOOP	STATE
A	Normal
B	Normal

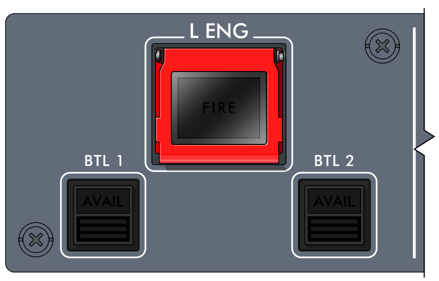
NORMAL STATE “AND” LOGIC

FIRE SYSTEM FAULT

EICAS

26 FIRE SYSTEM FAULT – L ENG FIRE DET REDUND LOSS

SYNOPTIC PAGE - INFO

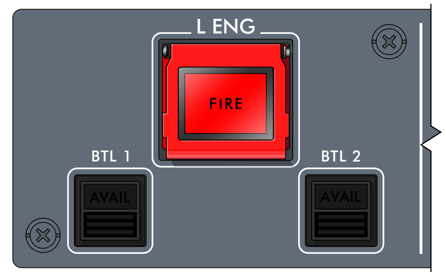


LOOP	STATE	BIT + 20S	STATE
A	Normal	Alarm	Fail
B	Normal	Normal	Normal

ONE LOOP FAILED “OR” LOGIC

L ENG FIRE

EICAS

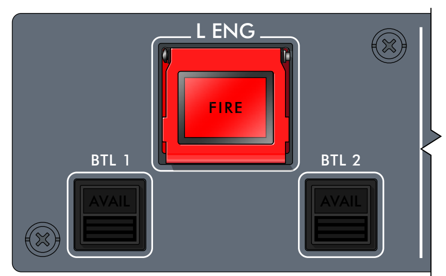


LOOP	STATE
A	Alarm
B	Alarm

ALARM STATE “AND” LOGIC

L ENG FIRE

EICAS



LOOP	STATE
A	Fail
B	Alarm

“OR” LOGIC ALARM STATE

CS1_CS3_2611_004

Figure 7: Engine Fire Detection Logic (L3)

MONITORING AND TESTS

The following page provides the crew alerting system (CAS) and INFO messages for the engine fire detection system.

CAS MESSAGES

Table 4: WARNING Messages

MESSAGE	LOGIC
L ENG FIRE	Left engine fire detected.
R ENG FIRE	Right engine fire detected.

Table 5: CAUTION Messages

MESSAGE	LOGIC
L ENG FIRE DET FAIL	L ENG FIRE DET_FAIL is failure of A and B left engine fire detection, or failure of either detection when other channel is inoperative.
R ENG FIRE DET FAIL	R ENG FIRE DET_FAIL is failure of A and B right engine fire detection, or failure of either detection when other channel is inoperative.

Table 6: ADVISORY Message

MESSAGE	LOGIC
FIRE SYSTEM FAULT	Loss of redundancy in the FIDEX system.

Table 7: INFO Messages

MESSAGE	LOGIC
26 FIRE SYSTEM FAULT - L ENG FIRE DET REDUND LOSS	Loss of channel A or B detection loop.
26 FIRE SYSTEM FAULT - R ENG FIRE DET REDUND LOSS	Loss of channel A or B detection loop.

PRACTICAL ASPECTS

The sensing element has an Inconel™ sheath with two conductors embedded in a thermistor material. One wire is the center conductor wire while the other wire is grounded to the sheath. The element is constructed with a number 8 terminal lug on one end, and a number 10 terminal lug on the other to minimize the chance of crossed wiring. The elements are grounded at each end, as the loss of a ground results in a loss of detection.

One or more elements are connected in series to form a loop. The loops are installed to provide coverage of fire hazard areas. Each loop is monitored by the FIDEX control unit for alarm, open, and shorted conditions. If a loop goes open circuit during normal operation, it still provides fire detection capability, however, on the next power-up BIT or fire test, the element is considered inoperative. A dual-loop configuration is used to provide redundancy.

The loops can be mounted on a rail assembly for installation or directly mounted to the surface of a structure.

NOTE

When installing engine, APU, or main landing gear bay fire detection elements, do not exceed the bend radius of the element.

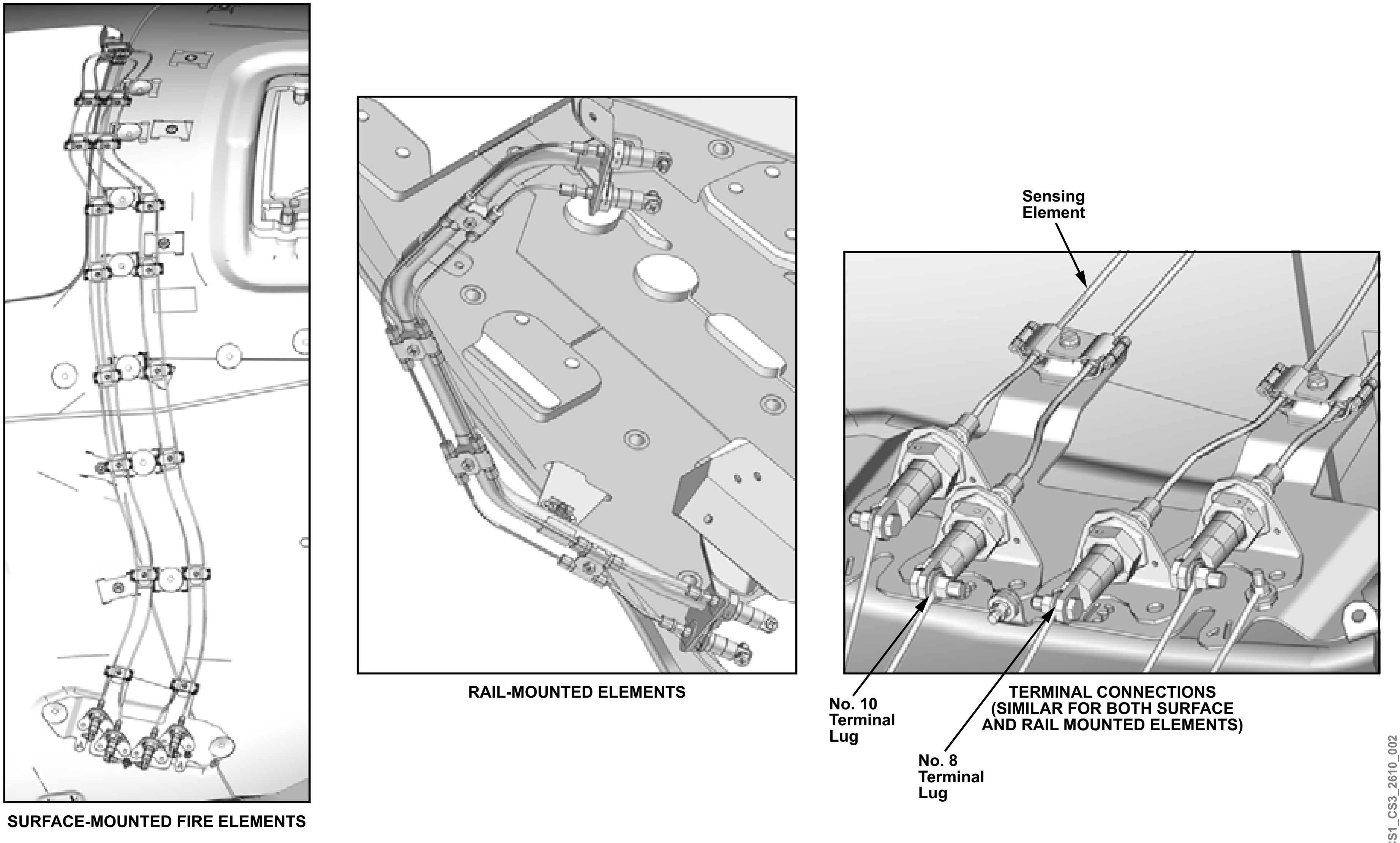


Figure 8: Fire Sensing Elements (L2)

26-21 ENGINE FIRE EXTINGUISHING

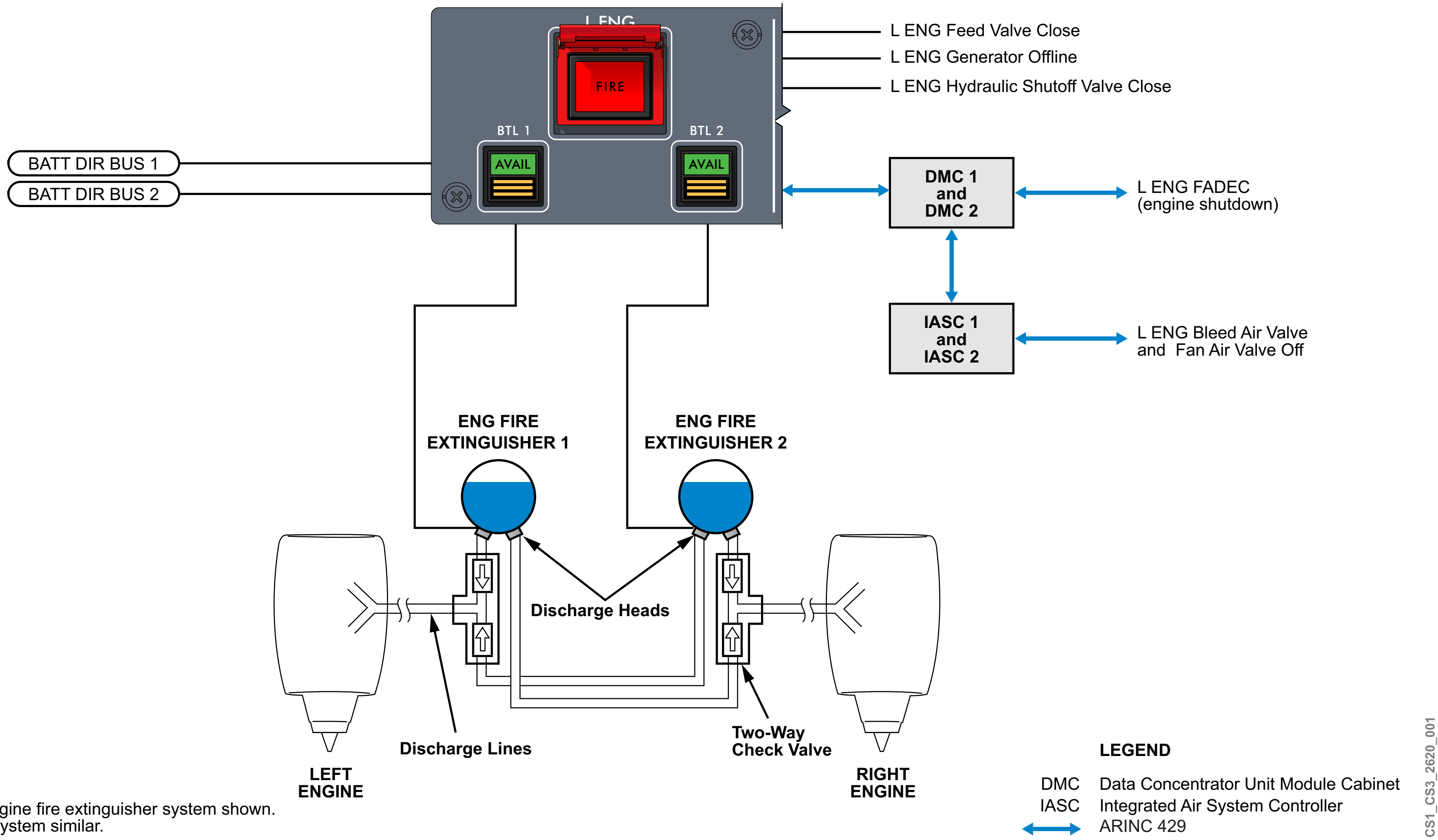
GENERAL DESCRIPTION

The fire extinguishing system provides fire extinguishing for the left and right engine zones. The fire extinguishers and distribution lines are arranged so that one fire extinguisher discharges into each engine, or both fire extinguishers discharge into one engine.

Each fire extinguisher has two discharge heads. The contents of the fire extinguisher discharge through the selected discharge head to the two-way check valve. The two-way check valve contains two inlet fittings and one outlet fitting. The two-way check valve connects one of the fire extinguisher discharge heads to each engine using distribution lines that run along the aft spar and down the pylon to the discharge nozzles in the engine core compartment.

When a fire is detected, the ENG FIRE PBA illuminates. Pressing the FIRE PBA isolates the engine from the airframe by closing the fuel, hydraulic, and bleed and fan air shutoff valves, tripping the generator, and signalling the FADEC to shut down the engine. It also arms the engine fire extinguishers for discharge.

The fire extinguisher discharges when the BTL PBA is pressed. A cartridge, located on each discharge head fires to discharge the contents of the extinguisher. The cartridges receive power from BATTERY DIRECT BUS 1 and BATTERY DIRECT BUS 2. If required, the contents of the second bottle can be selected for discharge into the same engine by pressing the other BTL switch.



NOTE

Left engine fire extinguisher system shown.
Right system similar.

LEGEND

DMC	Data Concentrator Unit Module Cabinet
IASC	Integrated Air System Controller
⟷	ARINC 429

Figure 9: Engine Fire Extinguishing System (L2)

COMPONENT LOCATION

The following components are installed in the engine fire extinguishing system:

- Engine fire extinguishers

ENGINE FIRE EXTINGUISHERS

The engine fire extinguishers are located on a bracket attached to the aft spar in the wing-to-body fairing (WTBF).

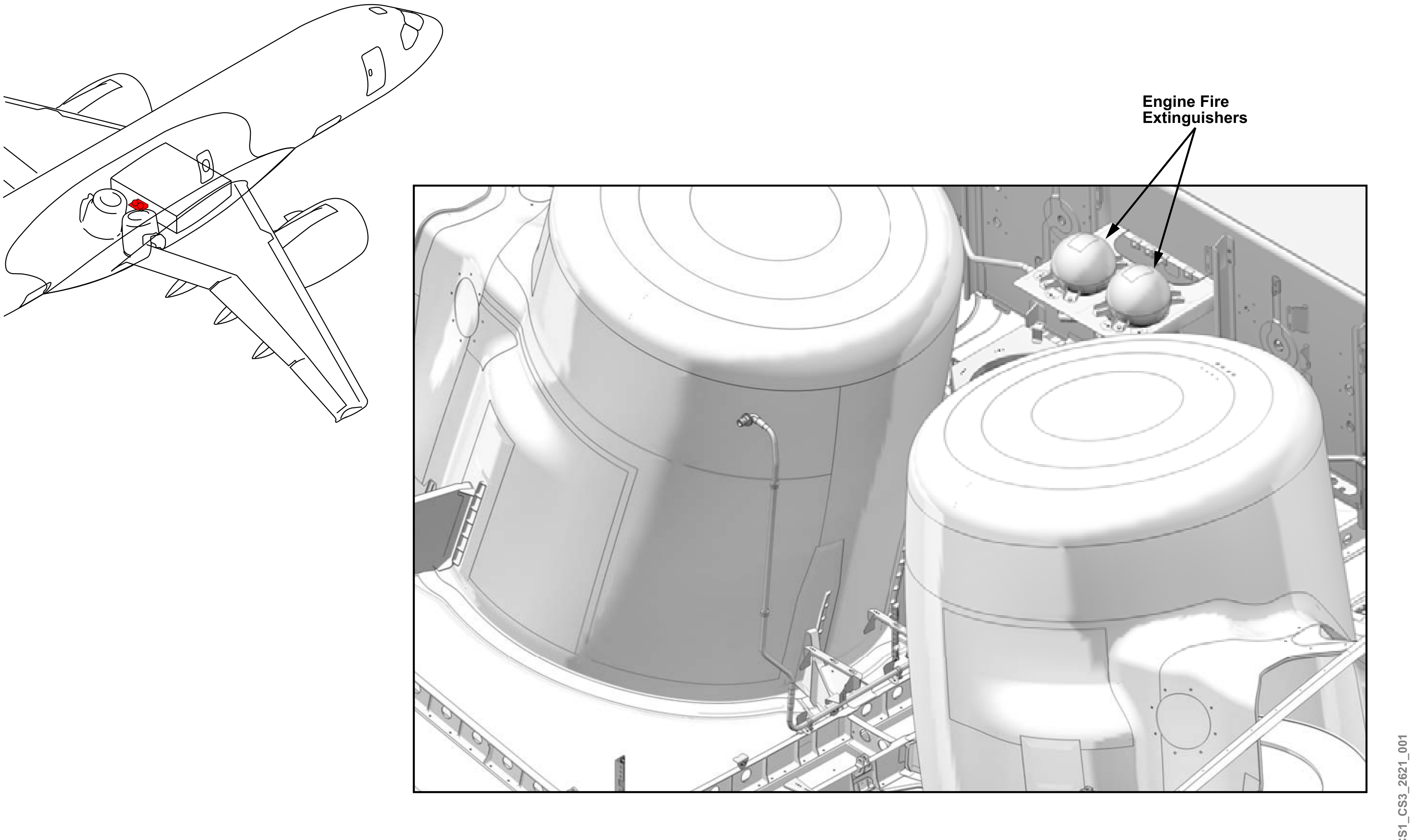


Figure 10: Engine Fire Extinguishers Location (L2)

COMPONENT INFORMATION

ENGINE FIRE EXTINGUISHER

The fire extinguisher is a dual-outlet bottle filled with Halon 1301 fire extinguishing agent and pressurized with nitrogen gas. Each outlet on the bottle has a discharge head equipped with a cartridge. Each cartridge has two bridge wire circuits that ignite an explosive mixture when the BTL switch is pressed.

Mounting lugs support the bottle in the bracket mounted on the aft spar.

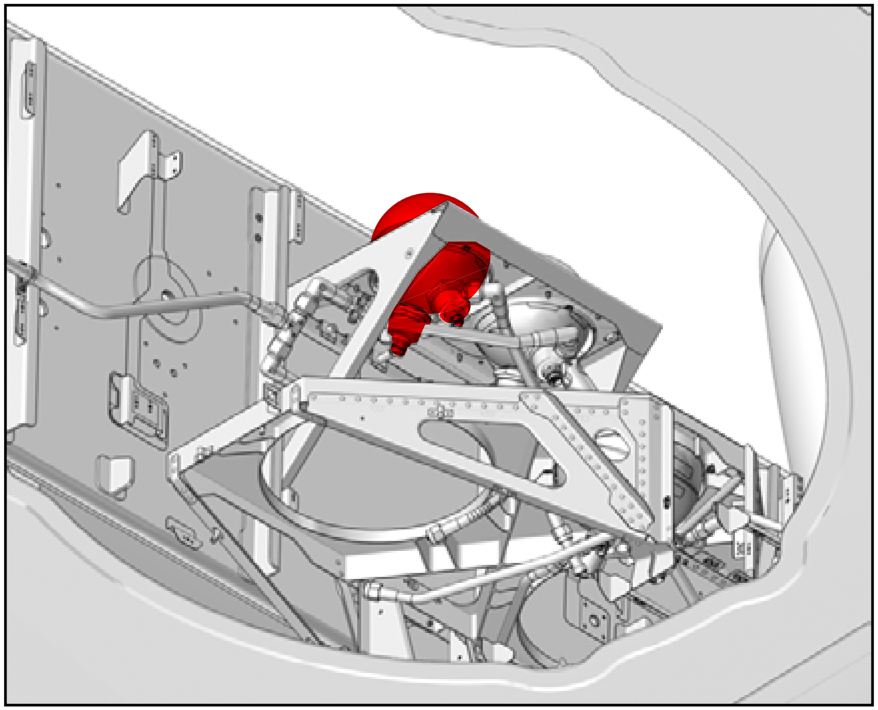
A pressure switch on the bottle is continually monitored by the FIDEX control unit. The bottle pressure switch has a ground check feature that can be checked using a 3/32 in. allen key. Rotating the allen key simulates a low-bottle pressure. The appropriate BTL PBA amber bar located on the ENGINE and APU FIRE panel illuminates and an EICAS ENG BTL 1(2) LO advisory message is displayed.

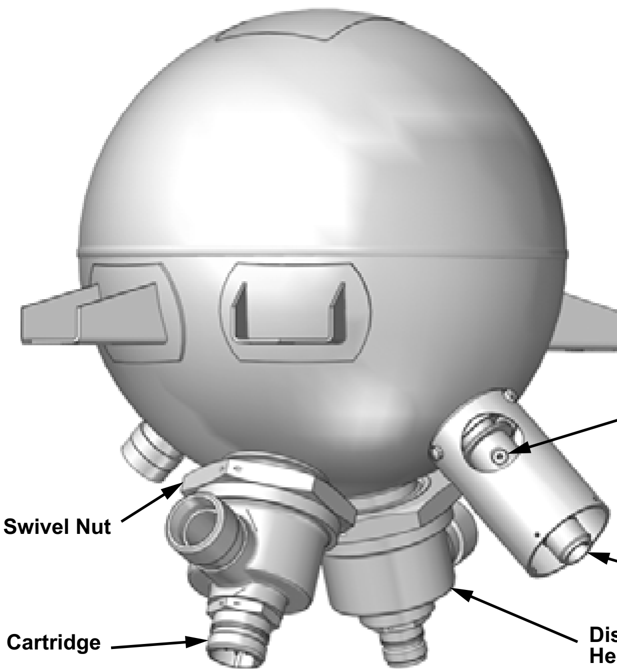
CAUTION

1. **Do not use more than 0.28 Nm (2.5 lb·in) of torque when turning the test point socket. Doing so can cause damage to the pressure switch and the fire extinguisher will not operate correctly.**
2. **Loosen the swivel nut before aligning the discharge head with the discharge line. If the discharge head is aligned before the swivel nut is loosened, the discharge head may be damaged.**

WARNING

1. **IN CASE OF BOTTLE DISCHARGE, DO NOT TOUCH OR BREATHE THE HALON GASES. THE HALON GASES MAY BE HARMFUL TO EYES, SKIN, NOSE, AND LUNGS. MAKE SURE ALL PERSONNEL GO TO A WELL VENTILATED AREA.**
2. **MAKE SURE THAT THE CONTACT PINS OF THE DISCHARGE-CARTRIDGE ELECTRICAL CONNECTOR HAVE AN EQUAL ELECTRICAL POTENTIAL. WHEN DISCONNECTING THE ELECTRICAL CONNECTOR, IMMEDIATELY INSTALL A SHUNT PLUG IN THE DISCHARGE-CARTRIDGE ELECTRICAL CONNECTOR. THE DISCHARGE CARTRIDGE IS AN ELECTRICALLY-FIRED EXPLOSIVE DEVICE AND CAN CAUSE INJURY TO PERSONS IF IT IS ACCIDENTALLY ENERGIZED.**
3. **BE CAREFUL WHILE HANDLING THE FIRE EXTINGUISHER BOTTLE. MAKE SURE ALL OPEN PORTS ARE PROTECTED AND DO NOT LET THE BOTTLE TOUCH OTHER AIRCRAFT PARTS. ACCIDENTAL FIRE EXTINGUISHER ACTIVATION CAN CAUSE INJURY TO PERSONNEL OR DAMAGE THE EQUIPMENT.**





NOTE

Left hand wheel bin removed for clarity.

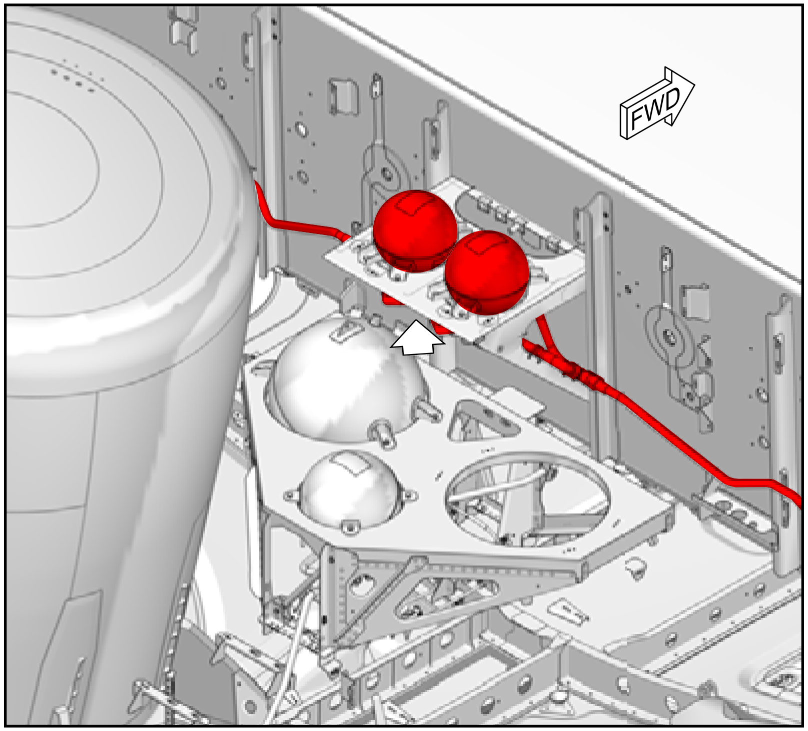
Figure 11: Engine Fire Extinguisher (L2)

ENGINE FIRE EXTINGUISHER INSTALLATION

The engine fire extinguishing system uses two dual-outlet fire extinguishers. To prevent cross connection of the fire extinguishing system, the discharge heads on each fire extinguisher are threaded differently. One head has a left-hand thread, while the other is a standard right-hand thread.

The cartridges on each fire extinguisher are threaded differently and have different electrical connectors.

One mounting lug hole is offset on each fire extinguisher providing orientation clocking.



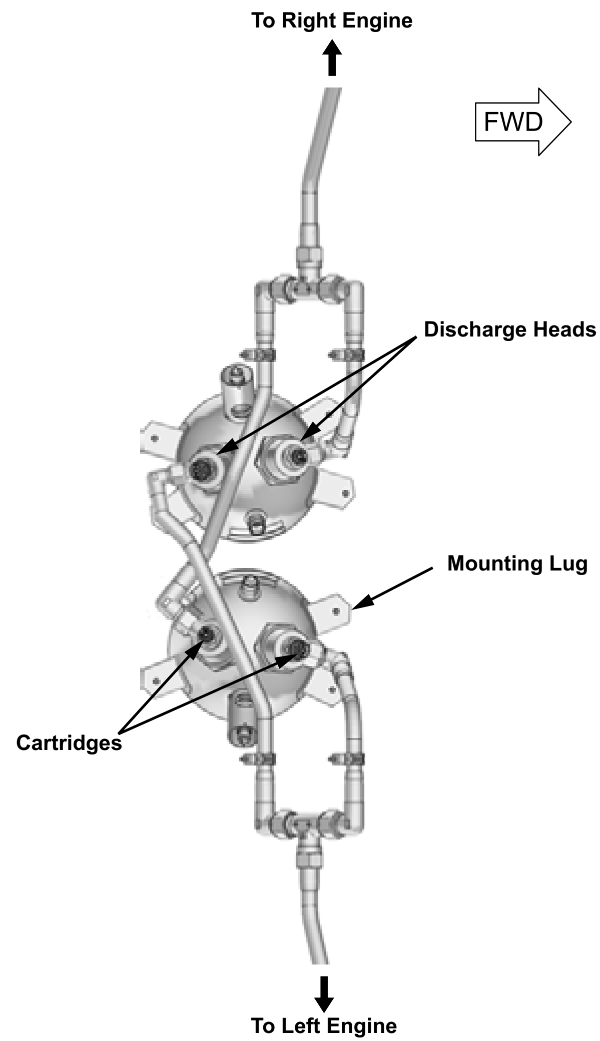


Figure 12: Engine Fire Extinguisher Installation (L2)

CONTROLS AND INDICATIONS

The ENGINE and APU FIRE panel is located on the overhead panel. Each engine has a guarded FIRE PBA and two BTL PBAs labeled BTL 1 and BTL 2.

Pressing the FIRE PBA arms the bottle circuits. The BTL 1 and BTL 2 PBAs have a green AVAIL light to indicate the fire extinguishers are ready for discharge. Each BTL PBA has an amber bar to indicate a cartridge fault or a low-bottle pressure.

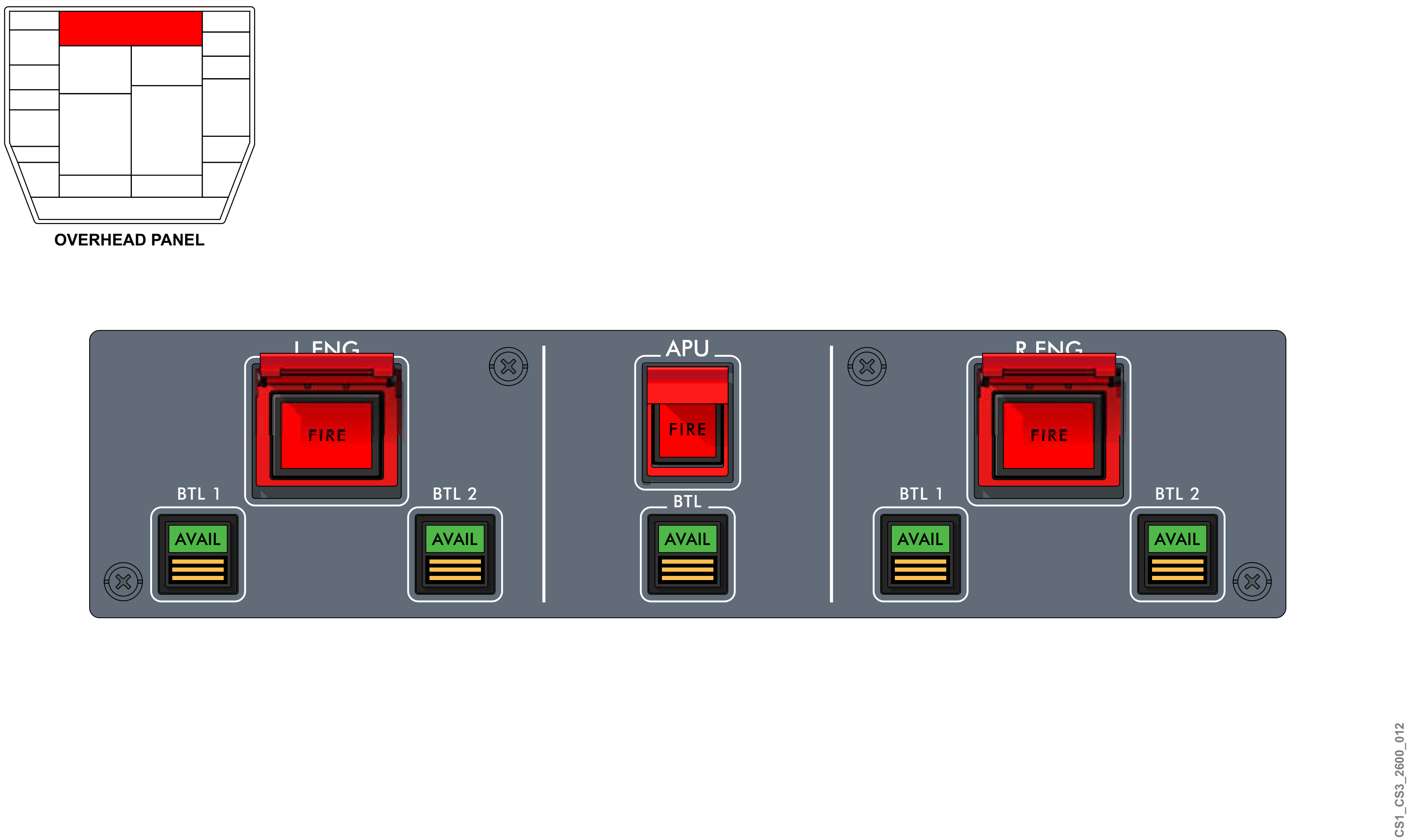


Figure 13: Engine and APU FIRE Panel (L2)

DETAILED DESCRIPTION

When an engine fire is detected, the red L or R FIRE light illuminates. Pressing the FIRE PBA initiates the following:

- Engine feed shutoff valve closes
- Pressure-regulating shutoff valve (PRSOV) closes
- Fan air valve closes
- Hydraulic shutoff valve closes
- Generator trips offline
- FADEC commands engine shutdown
- Both engine fire extinguisher bottles are armed

Both BTL 1 and BTL 2 green AVAIL lights illuminate when the bottles are armed for discharge. When the BTL 1 PBA is pressed, the cartridge in the associated fire extinguisher fires and the contents are directed to the engine. Each cartridge has two bridge wires powered by a separate power source (BATTERY DIRECT BUS 1 and BATTERY DIRECT BUS 2) to ensure the cartridge fires. After the fire extinguisher discharges, the AVAIL light on the BTL 1 PBA extinguishes and the amber bar illuminates. An L (R) ENG BTL 1 LO advisory message appears on EICAS. The amber light and L (R) ENG BTL 1 LO advisory message also indicates abnormal low-pressure. If an engine fire extinguisher cartridge fails, an L (R) ENG BTL FAULT advisory message is displayed.

BTL 2 PBA operation is similar but fires the cartridge on fire extinguisher 2 and discharges into the same engine. The amber light on the BTL 2 PBA and the L (R) ENG BTL 2 LO advisory message appears on EICAS when the fire extinguisher bottle discharges.

The red FIRE light remains illuminated until the fire is extinguished.

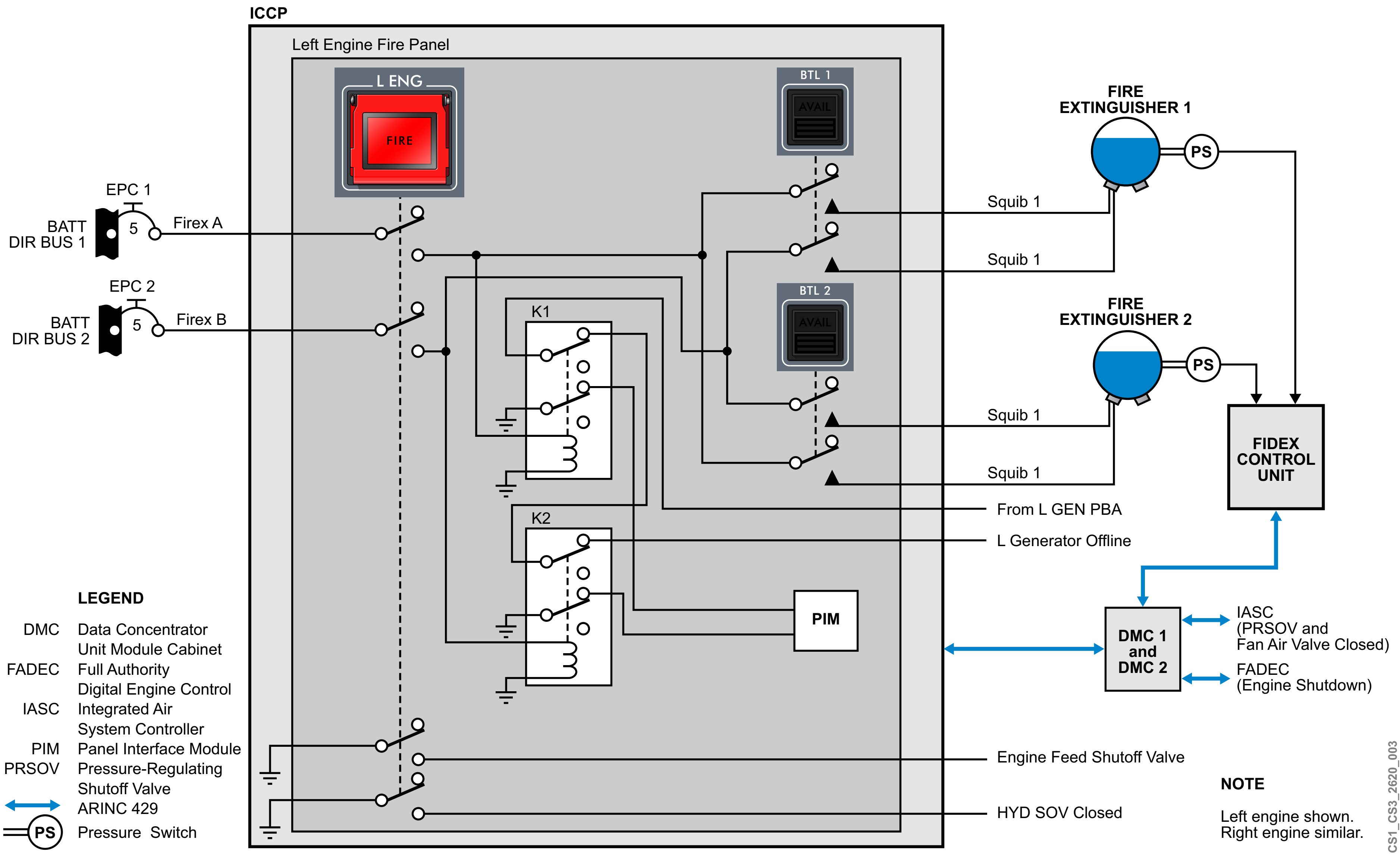


Figure 14: Engine Fire Extinguishing Schematic (L3)

MONITORING AND TESTS

The following page provides the crew alerting system (CAS) and INFO messages for the engine fire extinguishing system.

CAS MESSAGES

Table 8: CAUTION Messages

MESSAGE	LOGIC
L ENG BTL FAIL	Loss of both port squibs for L engine and PBA not armed.
R ENG BTL FAIL	Loss of both port squibs for R engine and PBA not armed.
L-R ENG BTL FAIL	Loss of all extinguishing ability to either engine and extinguishing PBA not armed.

Table 9: ADVISORY Messages

MESSAGE	LOGIC
L ENG BTL FAULT	Loss of L port squib on BTL 1 or BTL 2 and PBA not armed.
R ENG BTL FAULT	Loss of R port squib on BTL 1 or BTL 2 and PBA not armed.
ENG BTL 1 LO	Low pressure condition found on Engine Bottle 1 (normal or abnormal).
ENG BTL 2 LO	Low pressure condition found on Engine Bottle 2 (normal or abnormal).
FIRE SYSTEM FAULT	Loss of redundancy in the FIDEX system.

Table 10: INFO Messages

MESSAGE	LOGIC
26 FIRE SYSTEM FAULT - L ENG BTL SQUIB REDUND LOSS	Loss of any L engine bridge wire on BTL 1 or 2.
26 FIRE SYSTEM FAULT - R ENG BTL SQUIB REDUND LOSS	Loss of any R engine bridge wire on BTL 1 or 2.

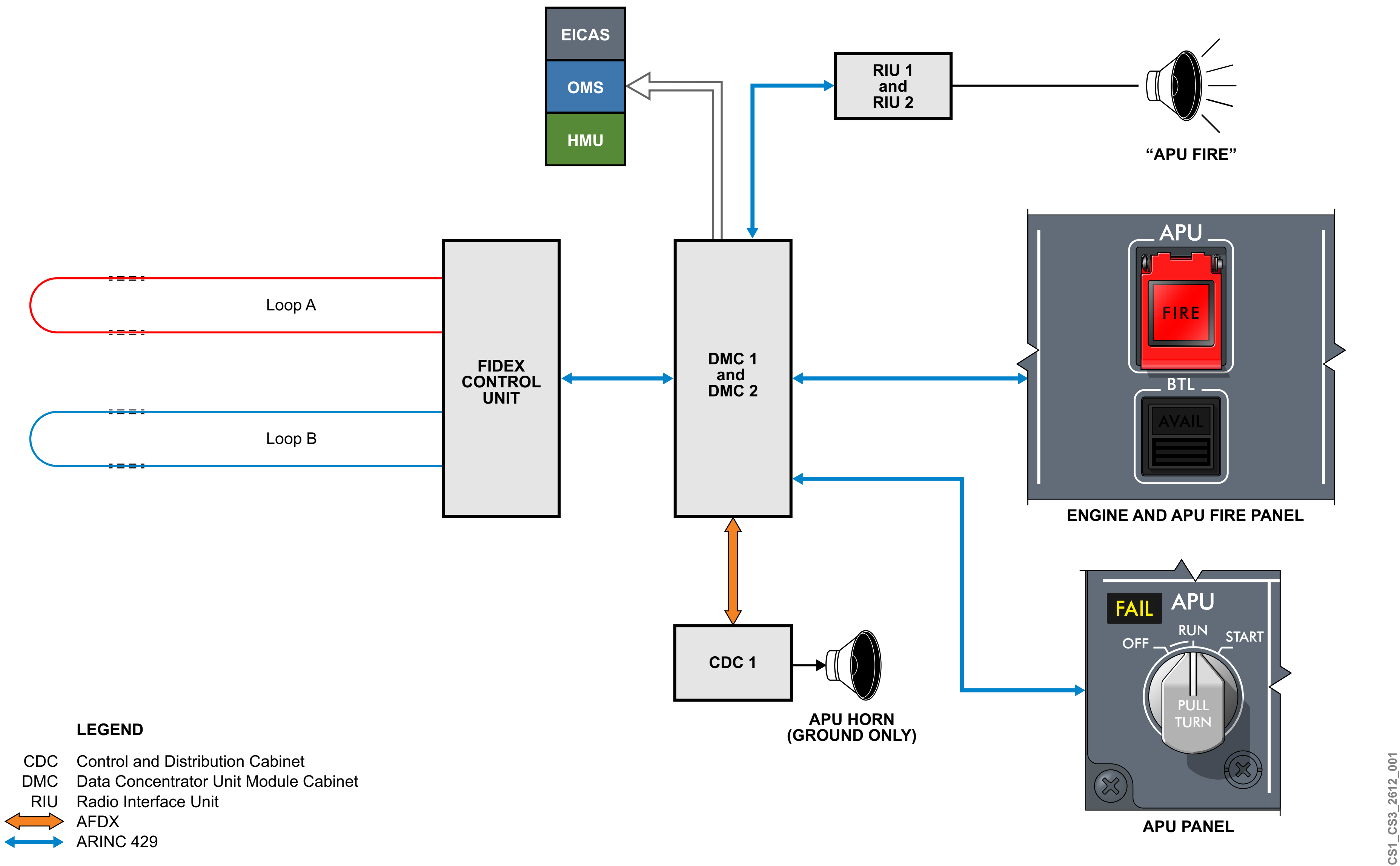
26-12 AUXILIARY POWER UNIT FIRE DETECTION

GENERAL DESCRIPTION

The auxiliary power unit (APU) fire detection system consists of two identical loops (loop A and B) that are routed in parallel within the APU compartment. The loops are mounted on the APU firewalls. Each loop has two elements connected in series to the FIDEX control unit. The loops are configured in AND logic.

When an APU fire is detected, the APU FIRE PBA on the APU FIRE panel illuminates. An aural APU FIRE message is generated through the radio interface units (RIUs). If the aircraft is on the ground, the APU horn sounds.

The FIDEX control unit provides warning and failure messages to the engine indication and crew alerting system (EICAS) and the onboard maintenance system (OMS). If the APU fire detection system fails completely, the FAIL light illuminates on the APU panel.



LEGEND

CDC	Control and Distribution Cabinet
DMC	Data Concentrator Unit Module Cabinet
RIU	Radio Interface Unit
(orange arrow)	AFDX
(blue arrow)	ARINC 429

Figure 15: APU Fire Detection System (L2)

COMPONENT LOCATION

The following components are installed in the APU fire detection system:

- APU fire loops

APU FIRE LOOPS

The loops are located in the APU compartment on the top and forward firewalls.

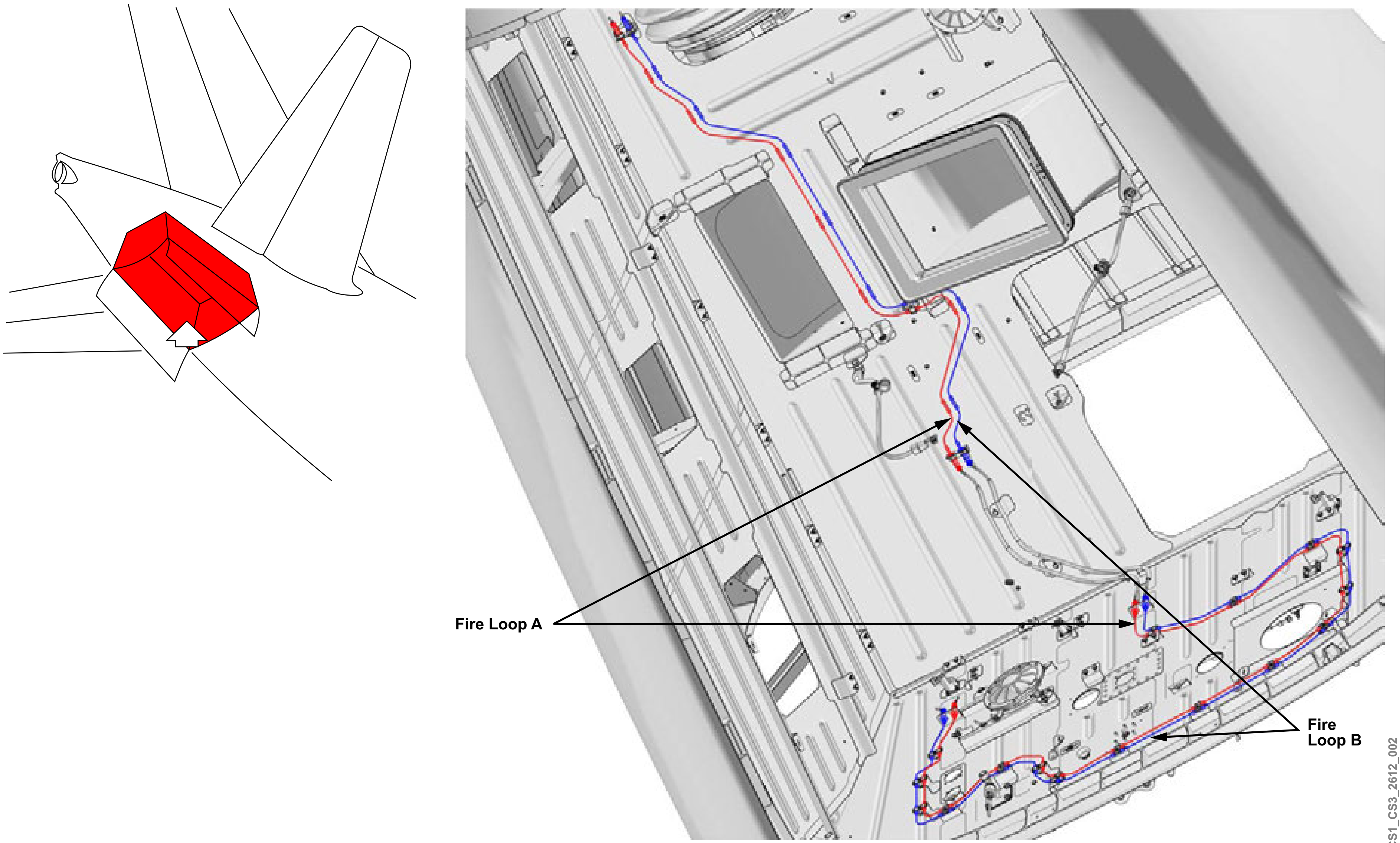
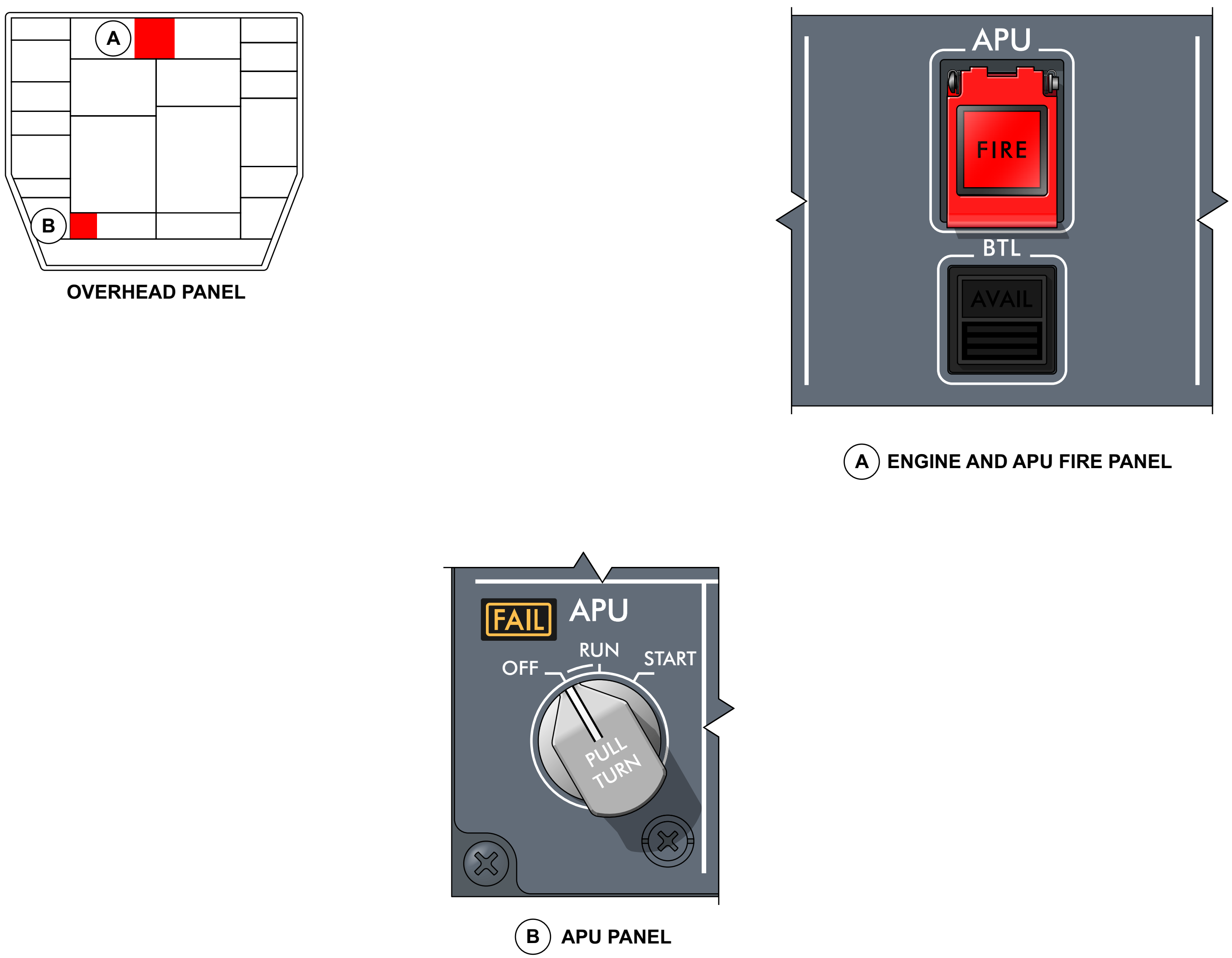


Figure 16: Auxiliary Power Unit Fire Loops Location (L2)

CONTROLS AND INDICATIONS

The APU FIRE panel has a red FIRE PBA that illuminates when an APU fire is detected.

The APU panel FAIL light illuminates when the aircraft is on the ground and the fire detection system has failed.



CS1_CS3_2612_004

Figure 17: Auxiliary Power Unit Fire Detection Indication (L2)

DETAILED DESCRIPTION

Under normal conditions, the continuous and periodic BIT checks individual fire or overheat detector loop functions, monitoring circuits, and decision logic.

The loops provide a continuous resistance change as a function of temperature variation. In addition to monitoring the sensing elements for fire information, the resistance characteristics of the sensing elements allow for detection of open or short conditions, which could prevent proper detection. A short versus fire discriminator circuit operates on a rate of resistance change principle. It discriminates between a loop resistance lowered at a finite rate when caused by heating of a sensing element, and the nearly instantaneously lowered resistance caused by a short to ground.

If an element in a loop fails in a shorted condition, the loop cannot detect a fire. A single open element in a loop does not cause complete failure and is still capable of detecting a fire or overheat. When an open loop is sensed, it is not removed until after cold start BIT or fire test occurs.

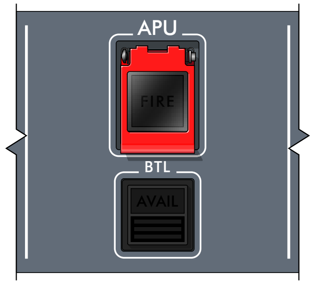
In normal operation, the FIDEX control unit monitors the APU fire loop elements using AND logic. Under fire conditions, detection loop A and B elements heat simultaneously, and each FIDEX channel produces an alarm output. Both channels must report an alarm condition to trigger the flight deck warnings. An APU fire is indicated by a red APU FIRE CAS message and the APU FIRE PBA illuminating.

In dual-loop AND logic, the FIDEX control unit does not allow a single-loop fire condition to remain for longer than 20 seconds without declaring a fire or a loop fault. If one element is hot and the other loop is cold, the FIDEX control unit fire alarm logic checks system parameters and determines if the hot loop represents a fire condition or a loop failure (false alarm).

The decision is based on a BIT test of the non-reporting loop. If this loop passes the BIT test, then the alarm reporting loop is faulted and the system reverts to OR logic. If the BIT test of the non-reporting loop fails, then the reporting loop is considered good and an alarm is declared. A FIRE SYS FAULT advisory EICAS message is displayed along with an INFO message if a loop has failed.

When the system is operating in OR logic, a single-loop reporting an alarm condition triggers the flight deck warnings.

If both fire detection loops on the same engine fail, an APU FIRE DET FAIL caution message is displayed on EICAS.

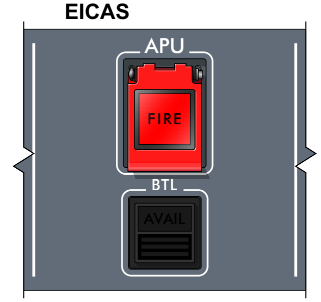


LOOP	STATE
A	Normal
B	Normal

NORMAL STATE "AND" LOGIC

APU FIRE

EICAS



LOOP	STATE
A	Alarm
B	Alarm

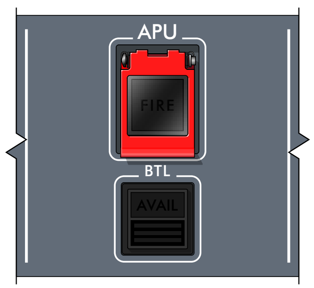
ALARM STATE "AND" LOGIC

FIRE SYSTEM FAULT

EICAS

26 FIRE SYSTEM FAULT - APU FIRE DET REDUND LOSS

SYNOPTIC PAGE - INFO

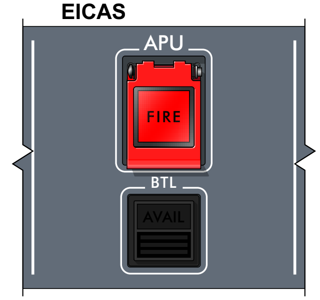


LOOP	STATE	BIT + 20S	STATE
A	Normal	Alarm	Fail
B	Normal	Normal	Normal

ONE LOOP FAILED "OR" LOGIC

APU FIRE

EICAS



LOOP	STATE
A	Fail
B	Alarm

"OR" LOGIC ALARM STATE

CS1_CS3_2612_005

Figure 18: APU Fire Detection Logic (L3)

MONITORING AND TESTS

The following page provides the crew alerting system (CAS) and INFO messages for the APU fire detection system.

CAS MESSAGES

Table 11: WARNING Message

MESSAGE	LOGIC
APU FIRE	APU fire detected.

Table 12: CAUTION Message

MESSAGE	LOGIC
APU FIRE DET FAIL	APU FIRE DET FAIL is failure of A and B APU fire detection, or failure of either detection when other channel is inoperative.

Table 13: ADVISORY Message

MESSAGE	LOGIC
FIRE SYSTEM FAULT	Loss of redundancy in the FIDEX system.

Table 14: INFO Message

MESSAGE	LOGIC
26 FIRE SYSTEM FAULT - APU FIRE DET REDUND LOSS	Loss of channel A or B detection loop.

26-22 AUXILIARY POWER UNIT FIRE EXTINGUISHING

GENERAL DESCRIPTION

The auxiliary power unit (APU) fire extinguishing system provides fire protection for the APU compartment using a single fire extinguisher bottle. When an APU fire is detected, the red FIRE PBA light illuminates on the ENGINE and APU FIRE panel. On the ground, the APU horn sounds.

The system operates when the APU FIRE and BTL pushbutton annunciators (PBAs) are pressed on the ENGINE and APU FIRE panel in the flight deck. On the ground, the fire detection and extinguishing (FIDEX) control unit provides a signal to the control and distribution cabinets (CDCs) to automatically discharge the fire extinguisher when a fire condition is detected.

When pressed, the APU FIRE PBA:

- Signals the APU ECU to shut down the APU
- Closes the APU feed valve
- Trips the generator
- Arms the APU fire extinguisher
- Cancels the APU horn

A green BTL PBA AVAIL light indicates the fire extinguisher is armed. Pressing the BTL PBA discharges the bottle. A pressure switch monitors the fire extinguisher pressure. When the extinguisher discharges, the amber bar on the BTL PBA illuminates.

On the ground, when the FIDEX control unit detects an APU fire:

- Signals the APU ECU to shut down the APU
- Closes the APU feed valve
- Sounds the APU horn
- Discharges the APU fire extinguisher after 10 seconds

If the APU FIRE PBA is pressed within 10 seconds, the APU horn is silenced and the automatic discharge of the bottle is canceled. The APU fire extinguisher must be discharged by pressing the APU BTL PBA.

The FIRE PBA light turns off when the fire is extinguished.

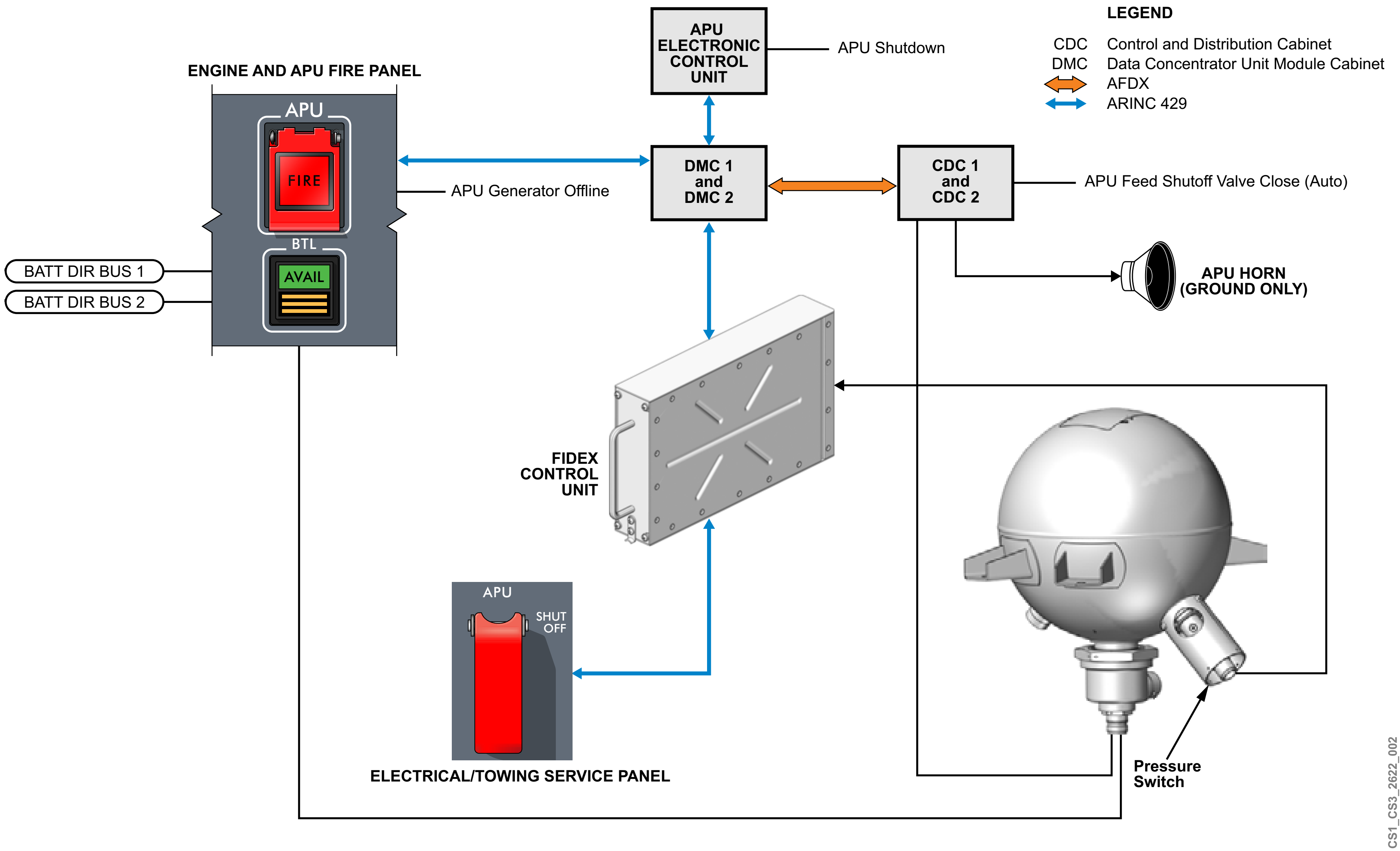


Figure 19: Auxiliary Power Unit Fire Extinguisher System (L2)

INSTALLATION

The APU fire extinguishing system has one fire extinguisher. A discharge head connects to a discharge line that directs the fire extinguisher contents to two ports on the APU forward firewall.

COMPONENT LOCATION

The following component is installed in the APU fire extinguishing system:

- APU fire extinguisher

AUXILIARY POWER UNIT FIRE EXTINGUISHER

The APU fire bottle is located outside of the APU compartment forward of the firewall.

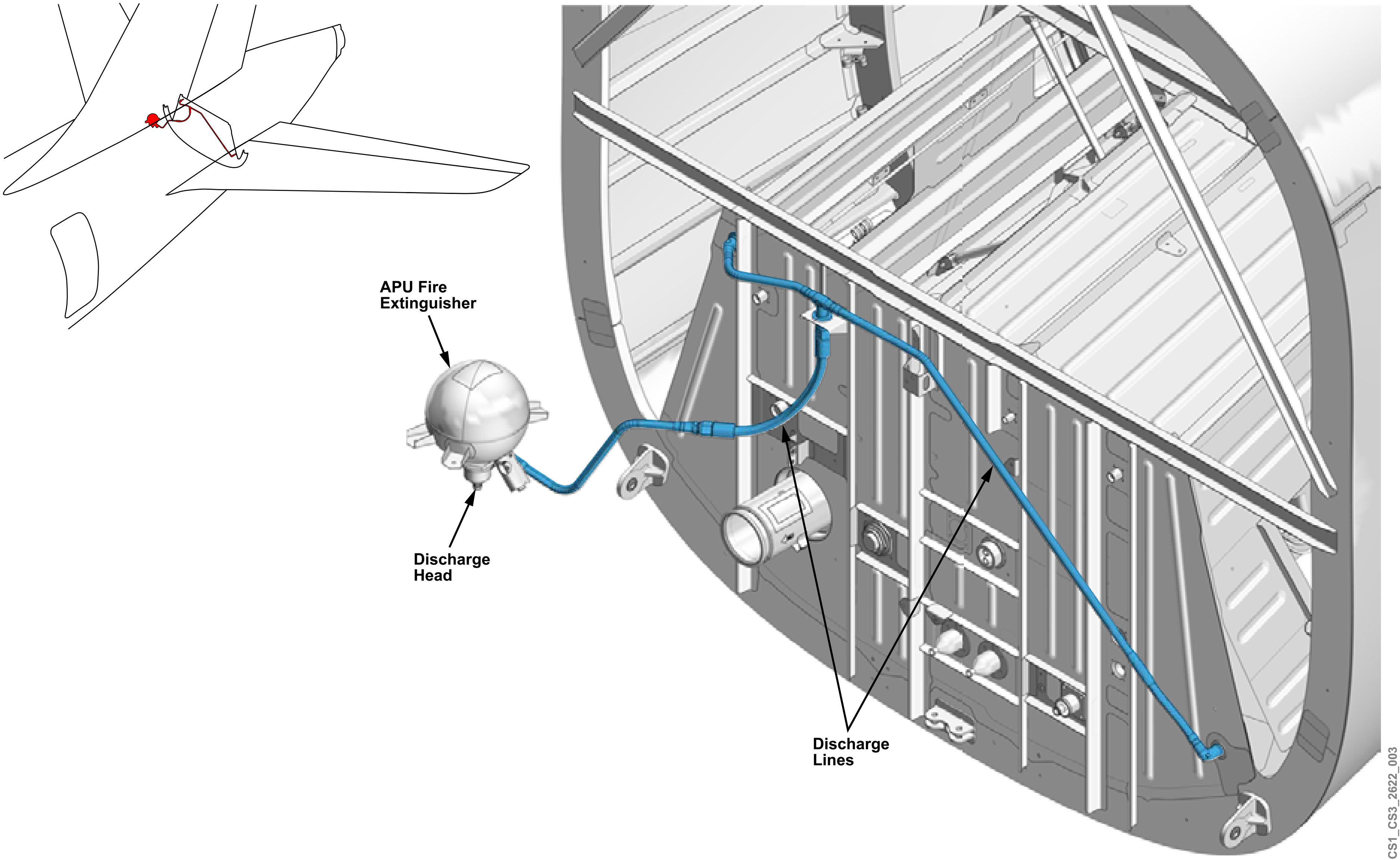


Figure 20: Auxiliary Power Unit Fire Extinguisher Location (L2)

COMPONENT INFORMATION

AUXILIARY POWER UNIT FIRE EXTINGUISHER

The APU and engine fire extinguishers are similar. The fire extinguisher is a single-outlet bottle filled with Halon 1301 fire extinguishing agent and pressurized with nitrogen gas. The outlet on the bottle has a discharge head equipped with a cartridge. The cartridge has two bridge wire circuits that ignite an explosive mixture when the BTL switch is pressed.

Mounting lugs support the bottle in the bracket mounted on the aft spar.

A pressure switch on the bottle is continually monitored by the FIDEX control unit. The bottle pressure switch has a ground check feature that can be checked using a 3/32 in. allen key. Rotating the allen key simulates a low bottle-pressure. The appropriate BTL PBA amber bar located on the ENGINE and APU FIRE panel illuminates and an EICAS APU BTL LO advisory message is displayed.

CAUTION

1. **Do not use more than 0.28 Nm (2.5 lb·in) of torque when turning the test point socket. Doing so can cause damage to the pressure switch and the fire extinguisher will not operate correctly.**
2. **Loosen the swivel nut before aligning the discharge head with the discharge line. If the discharge head is aligned before the swivel nut is loosened, the discharge head may be damaged.**

WARNING

1. **IN CASE OF BOTTLE DISCHARGE, DO NOT TOUCH OR BREATHE THE HALON GASES. THE HALON GASES MAY BE HARMFUL TO EYES, SKIN, NOSE, AND LUNGS. MAKE SURE ALL PERSONNEL GO TO A WELL VENTILATED AREA.**
2. **MAKE SURE THAT THE CONTACT PINS OF THE DISCHARGE-CARTRIDGE ELECTRICAL CONNECTOR HAVE AN EQUAL ELECTRICAL POTENTIAL. WHEN DISCONNECTING THE ELECTRICAL CONNECTOR, IMMEDIATELY INSTALL A SHUNT PLUG IN THE DISCHARGE-CARTRIDGE ELECTRICAL CONNECTOR. THE DISCHARGE CARTRIDGE IS AN ELECTRICALLY-FIRED EXPLOSIVE DEVICE AND CAN CAUSE INJURY TO PERSONS IF IT IS ACCIDENTALLY ENERGIZED.**
3. **BE CAREFUL WHILE HANDLING THE FIRE EXTINGUISHER BOTTLE. MAKE SURE ALL OPEN PORTS ARE PROTECTED AND DO NOT LET THE BOTTLE TOUCH OTHER AIRCRAFT PARTS. ACCIDENTAL FIRE EXTINGUISHER ACTIVATION CAN CAUSE INJURY TO PERSONNEL OR DAMAGE THE EQUIPMENT.**

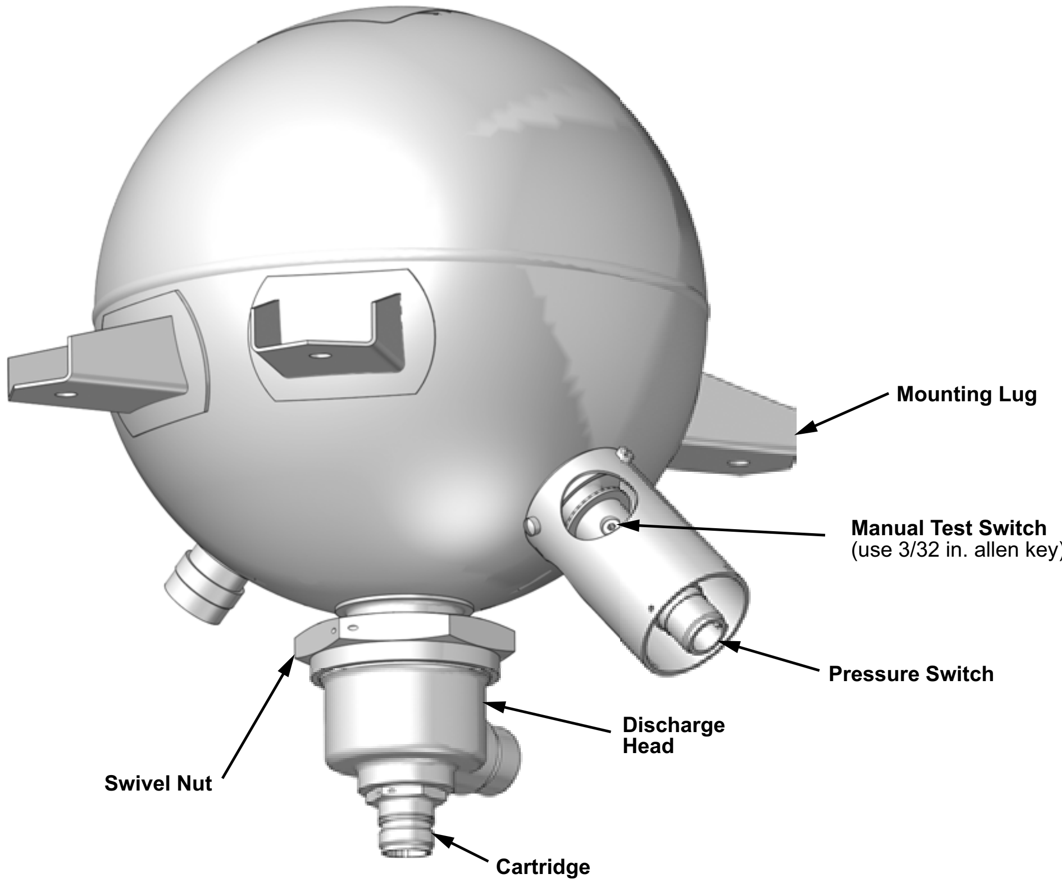


Figure 21: Auxiliary Power Unit Fire Extinguisher (L2)

DETAILED DESCRIPTION

APU FIRE

If the aircraft is in flight and an APU fire is detected by the FIDEX control unit, a signal is transmitted to the data concentrator unit module cabinet (DMC) to illuminate the APU FIRE PBA red.

When the APU FIRE PBA is pushed, the BTL PBA AVAIL light illuminates green indicating the APU bottle is armed. A signal is sent to the APU electronic control unit (ECU) to shut down the APU and close the APU feed SOV.

When the BTL PBA is pushed, 28 VDC from BATTERY DIRECT BUS 1 and BATTERY DIRECT BUS 2 is sent to the extinguisher bottle cartridge, discharging the agent into the APU compartment. Upon detection of low-bottle pressure, the AVAIL light goes out, and the amber bar illuminates.

NOTE

If an APU bottle is unavailable for discharge, the APU BTL PBA AVAIL light does not turn on and the amber bar illuminates. An APU BTL FAIL caution message is displayed on EICAS.

APU AUTOMATIC FIRE BOTTLE DISCHARGE

If an APU fire is detected while the aircraft is on the ground, the FIDEX control unit initiates an APU shutdown and automatically discharges the fire bottle to prevent further damage to the aircraft if it is unattended.

When an APU fire is detected by the FIDEX control unit, a signal is transmitted to the DMC to illuminate the APU FIRE PBA red and sound the APU fire horn.

The FIDEX control unit starts an internal 10 second timer for the auto-discharge function. When the auto-discharge timer reaches 10 seconds, the FIDEX control unit signals control and distribution cabinet (CDC) 1 and CDC 2 to supply 28 VDC from the DC ESSENTIAL BUSES to the APU fire extinguisher cartridge.

The APU feed shutoff valve (SOV) is closed through the APU SOV auto solid-state power controller (SSPC) in CDC 1 and the APU shuts down.

If the APU FIRE PBA is pushed before 10 seconds, the timer stops, and the APU horn is deactivated. The APU fire extinguisher bottle must be discharged manually, using the APU BTL PBA.

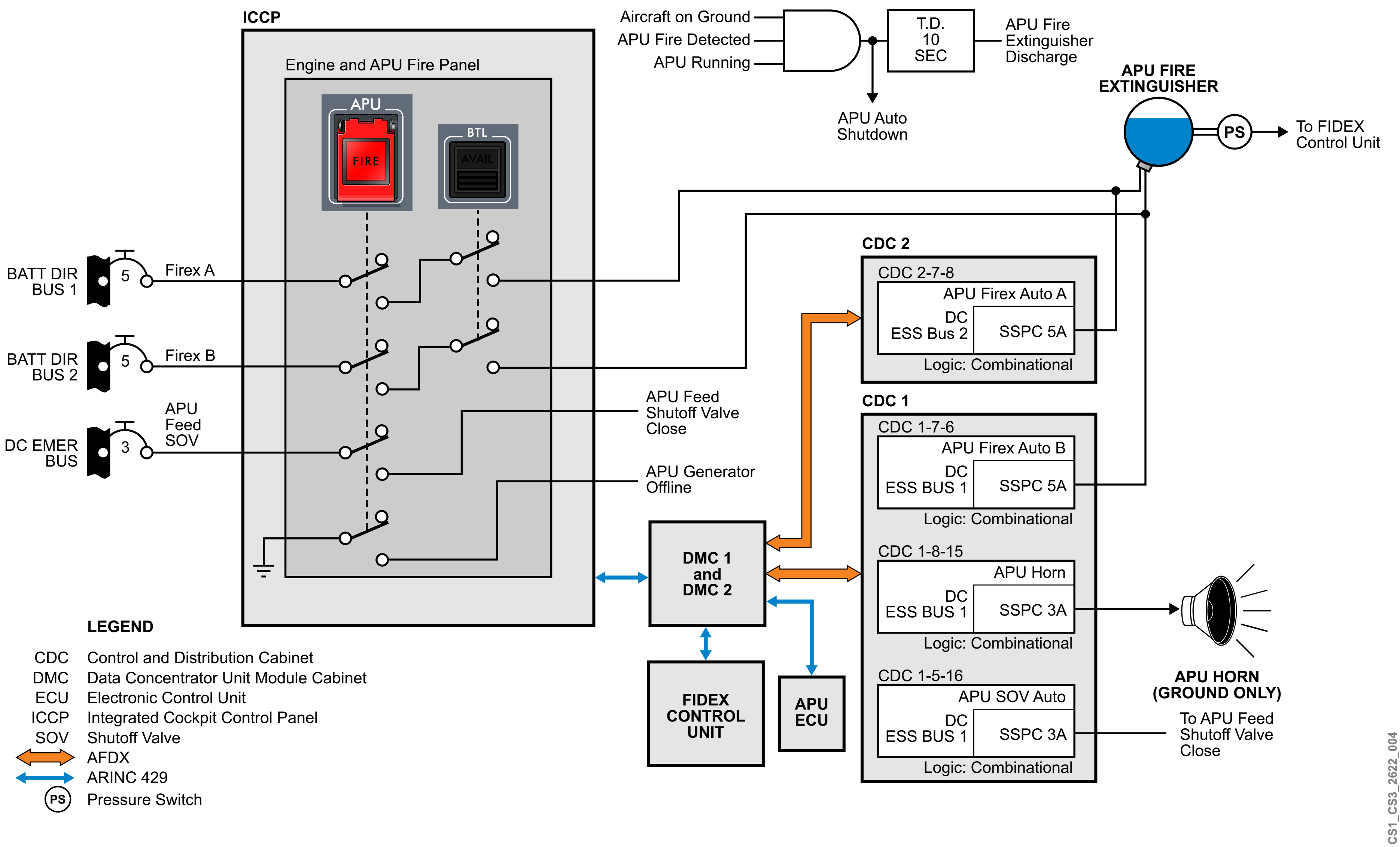


Figure 22: APU Fire Extinguisher Schematic (L3)

MONITORING AND TESTS

The following page provides the crew alerting system (CAS) and INFO messages for the APU fire extinguishing system.

CAS MESSAGES

Table 15: CAUTION Message

MESSAGE	LOGIC
APU BTL FAIL	Loss of squib on APU bottle or APU bottle low-pressure switch activation as detected by either FIDEX A or B while discharge switch has not been activated.

Table 16: ADVISORY Messages

MESSAGE	LOGIC
APU BTL LO	APU fire bottle low and extinguisher PBA was activated.
FIRE SYSTEM FAULT	Loss of redundancy in the FIDEX system.

Table 17: INFO Message

MESSAGE	LOGIC
26 FIRE SYSTEM FAULT - APU BTL SQUIB REDUND LOSS	Loss of one bridge wire on APU BTL.

26-14 MAIN WHEEL WELL OVERHEAT DETECTION

GENERAL DESCRIPTION

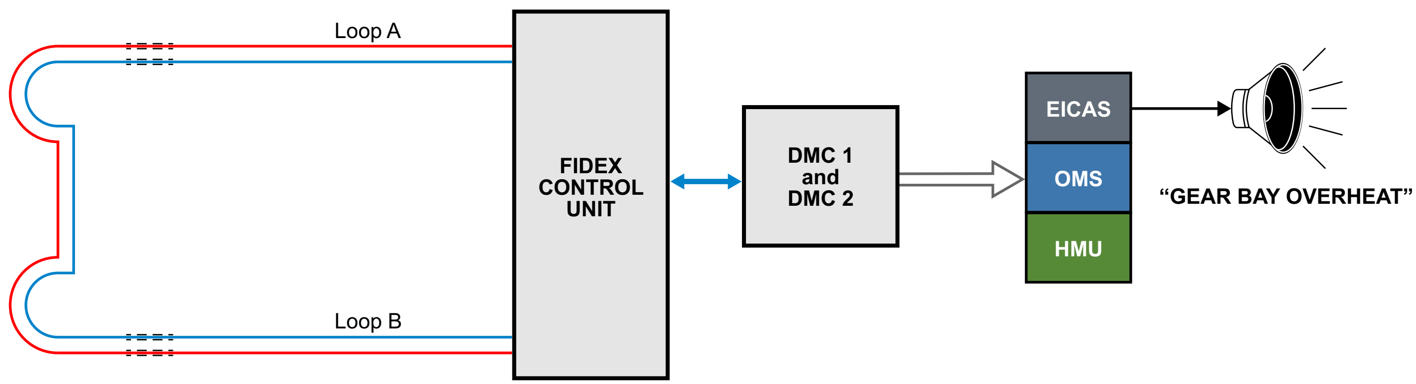
The main wheel well (MWW) overheat detection system monitors the main landing gear wheel well for overheat and fire conditions.

The MWW detection system consists of two identical loops (loop A and loop B) that are routed in parallel within the MWW compartment. Each loop has two sensing elements mounted inside the top of the wheel bin enclosing each main landing gear wheel.

The fire detection and extinguishing (FIDEX) control unit continuously monitors each of the detection loops for overheat and short circuit conditions in dual-loop logic mode. In dual-loop AND logic mode, overheat conditions must be reached on both loops before an EICAS MWW OVHT warning message is displayed and a “GEAR BAY OVERHEAT” message is heard.

If a failure in one of the loops is detected, the system switches to OR logic and reports overheat warnings based on the remaining operational loop.

The FIDEX control unit transmits all fault information to the engine indication and crew alerting system (EICAS) and the onboard maintenance system (OMS).



LEGEND

DMC Data Concentrator Unit Module Cabinet
ARINC 429

CS1_CS3_2614_002

Figure 23: Main Wheel Well Overheat System (L2)

COMPONENT LOCATION

The following components are installed in the wheel well overheat detection system:

- Sensing elements

SENSING ELEMENTS

The sensing elements are mounted to the top inner surface of each wheel bin.

NOTE

Each element feeds through the wheel bin and is attached to a bracket on top of each wheel bin. The aircraft wiring attaches to the elements at the brackets. The aircraft wiring must be disconnected before removing the wheel bins. A removable panel is installed on each wheel bin to provide access for disconnecting the wiring.

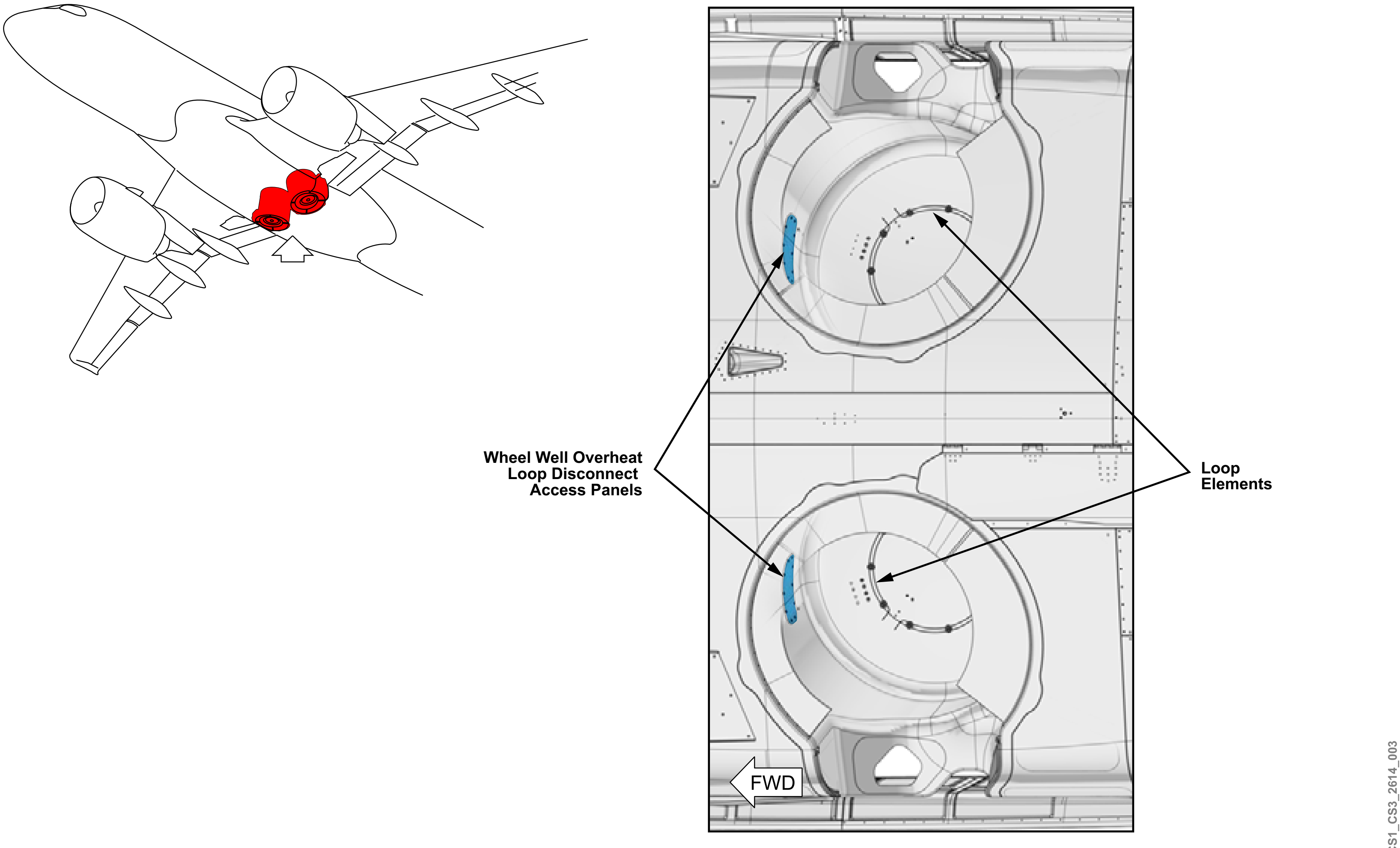


Figure 24: Main Wheel Well Overheat Loops Location (L2)

DETAILED DESCRIPTION

Under normal conditions, the continuous and periodic BIT checks individual fire or overheat detector loop functions, monitoring circuits, and decision logic.

The loops provide a continuous resistance change as a function of temperature variation. In addition to monitoring the sensing elements for fire information, the resistance characteristics of the sensing elements allow for detection of open or short conditions, which could prevent proper detection. A short versus fire discriminator circuit operates on a rate of resistance change principle. It discriminates between a loop resistance lowered at a finite rate when caused by heating of a sensing element, and the nearly instantaneously lowered resistance caused by a short to ground.

If an element in a loop fails in a shorted condition, the loop cannot detect a fire. A single open element in a loop does not cause complete failure and is still capable of detecting a fire or overheat. When an open loop is sensed, it is not removed until after cold start BIT or fire test occurs.

In normal operation, the FIDEX control unit monitors the main wheel well overheat loop elements using AND logic. Under overheat conditions, detection loop A and B elements heat simultaneously, and each FIDEX channel produces an alarm output. Both channels must report an alarm condition to trigger the flight deck warnings. A main wheel well overheat is indicated by a red CAS MLG BAY OVHT warning message.

In dual-loop AND logic, the FIDEX control unit does not allow a single-loop overheat condition to remain for longer than 20 seconds without declaring an overheat or a loop fault. If one element is hot and the other loop is cold, the FIDEX control unit fire alarm logic checks system parameters and determines if the hot loop represents an overheat condition or a loop failure (false alarm).

The decision is based on a BIT test of the non-reporting loop. If this loop passes the BIT test, then the alarm reporting loop is faulted and the system reverts to OR logic. If the BIT test of the non-reporting loop fails, then the reporting loop is considered good and an alarm is declared. A FIRE SYS FAULT advisory EICAS message is displayed along with an INFO message if a loop has failed.

When the system is operating in OR logic, a single-loop reporting an alarm condition triggers the flight deck warnings.

If the system fails completely, a MLG BAY OVHT DET FAIL caution message is displayed on EICAS.

MLG BAY OVHT
EICAS

LOOP	STATE
A	Normal
B	Normal

NORMAL STATE “AND” LOGIC

LOOP	STATE
A	Alarm
B	Alarm

ALARM STATE “AND” LOGIC

FIRE SYSTEM FAULT
EICAS

26 FIRE SYSTEM – MLG OVHT DET REDUND LOSS
SYNOPTIC PAGE - INFO

LOOP	STATE	BIT + 20S	STATE
A	Normal	Alarm	Fail
B	Normal	Normal	Normal

ONE LOOP FAILED “OR” LOGIC

MLG BAY OVHT
EICAS

LOOP	STATE
A	Fail
B	Alarm

“OR” LOGIC ALARM STATE

CS1_CS3_2614_004

Figure 25: Main Wheel Well Overheat Logic (L3)

MONITORING AND TESTS

The following page provides the crew alerting system (CAS) and INFO messages for the main wheel well overheat system.

CAS MESSAGES

Table 18: WARNING Message

MESSAGE	LOGIC
MLG BAY OVHT	MLG bay overheat detected.

Table 19: CAUTION Message

MESSAGE	LOGIC
MLG BAY OVHT DET FAIL	MLG BAY OVHT FAIL is the failure of A and B overheat detection loops, or the failure of either detection loop when the other channel is inoperative.

Table 20: ADVISORY Message

MESSAGE	LOGIC
FIRE SYSTEM FAULT	Loss of redundancy in the FIDEX system.

Table 21: INFO Message

MESSAGE	LOGIC
26 FIRE SYSTEM FAULT - MLG OVHT DET REDUND LOSS	Loss of channel A or B detection loop.

26-13 AVIONICS AND ELECTRICAL BAY SMOKE DETECTION

GENERAL DESCRIPTION

The avionics and electrical bay cooling air exhaust ducts are monitored by two ducted smoke detectors that operate using AND logic. Both detectors must detect smoke to produce a smoke warning. If one detector fails, the remaining functional detector monitors the duct for smoke. The fire detection and extinguishing (FIDEX) control unit provides an output if smoke is detected. A SMOKE warning crew alerting system (CAS) message is displayed and an aural SMOKE alert is generated. Smoke detector 1 is powered from DC ESSENTIAL BUS 1 and smoke detector 2 is powered from DC ESSENTIAL BUS 2.

The smoke detectors are mounted in housings with connections for sampling tubes that supply the avionics and electrical bay cooling exhaust air for monitoring.

Air flowing through the avionics and electrical bay cooling air exhaust ducts enters a tube attached to each smoke detector inlet port. The air flows through the smoke detector and is exhausted into the equipment bay. The ducted smoke detectors require an air flow input between 1 to 6 cfm for proper operation.

The exhaust cooling air extracted from equipment bays is exhausted near the recirculation fan filters. To prevent smoke from being mixed with cabin return air, the recirculation fan is shut down.

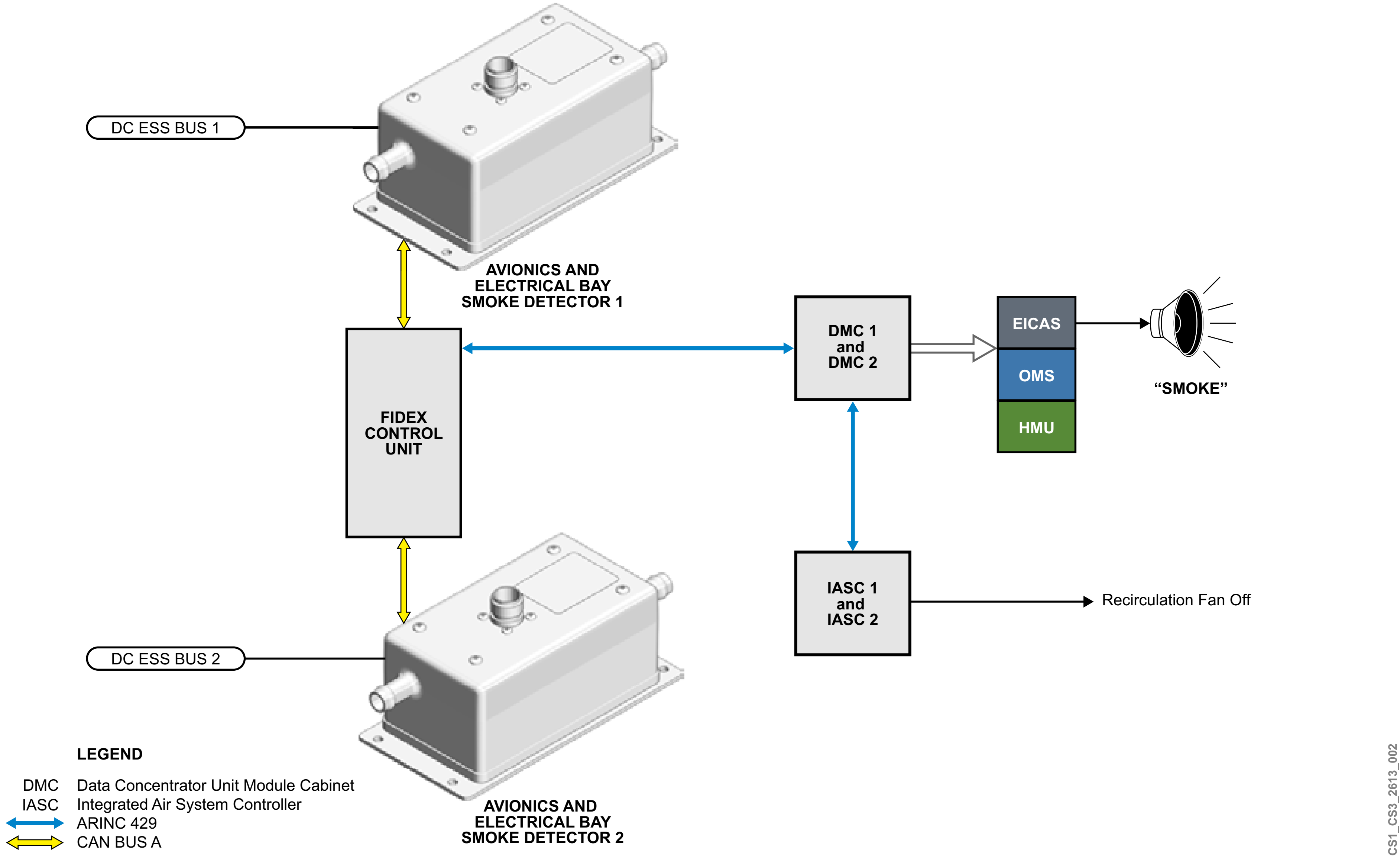


Figure 26: Avionics and Electrical Bay Smoke Detection System (L2)

COMPONENT LOCATION

The following components are installed in the avionics and electrical bay smoke detection system:

- Smoke detectors

SMOKE DETECTORS

The smoke detectors are mounted on the right side of the environmental control distribution bay.

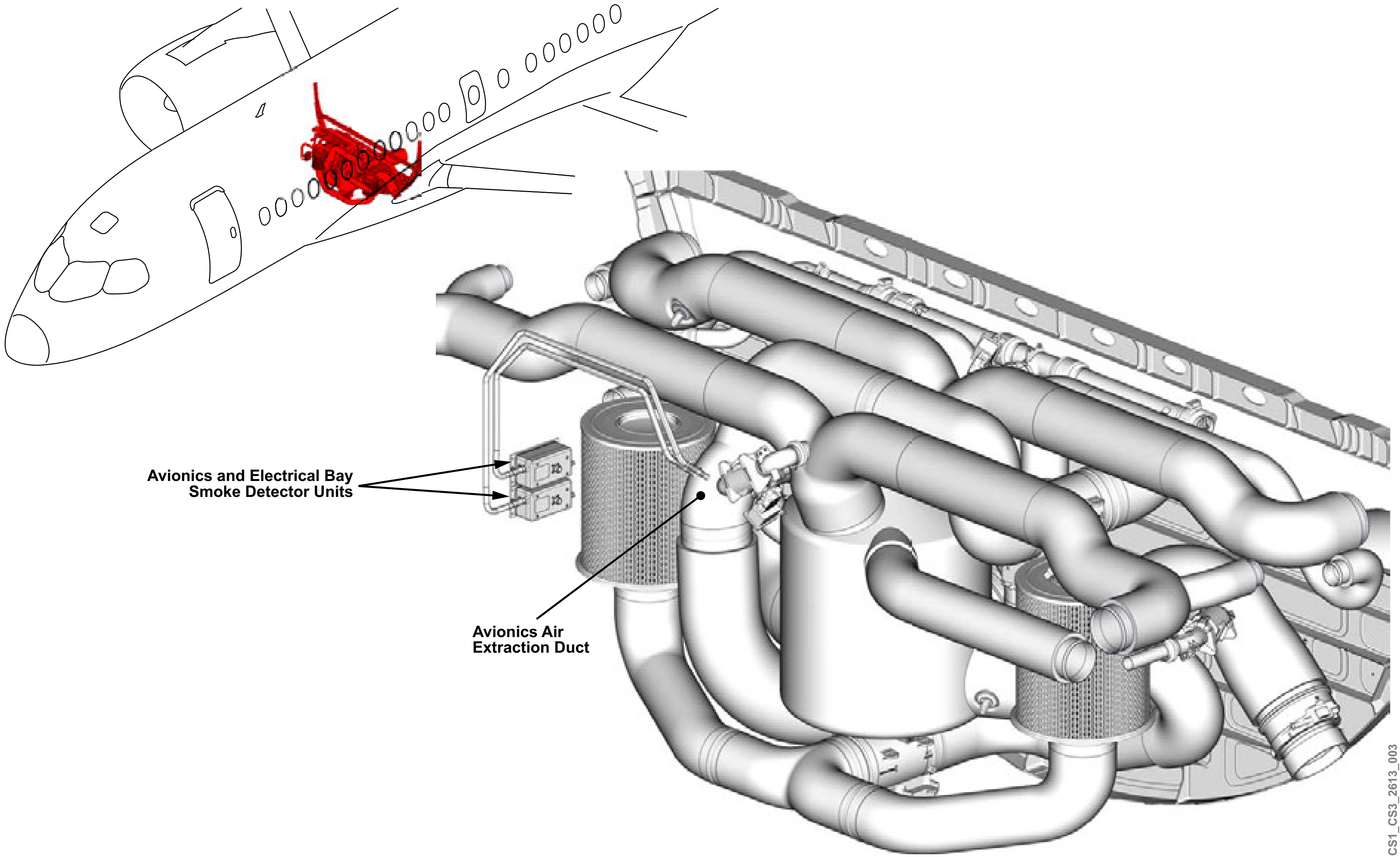


Figure 27: Avionics and Electrical Equipment Bay Smoke Detector Location (L2)

DETAILED DESCRIPTION

In normal operation, the FIDEX control unit monitors the avionics and equipment bay smoke detectors using AND logic. A red SMOKE CAS warning message is displayed when avionics and electrical bay smoke is detected.

While in AND logic mode, an alarm from a single smoke detector starts a 45-second timer internal to the FIDEX control unit. During the 45 seconds, an alarm from the other detector completes the AND logic and the FIDEX control unit provides a warning to EICAS. If, at the end of the 45 seconds, the other detector has not produced an alarm, the FIDEX control unit will perform a smoke detector BIT test. If the other detector responds properly to the BIT, the FIDEX control unit remains in AND logic mode and starts a 75-second internal timer.

If, at the end of the 75 seconds (2 minutes from the initial unit going into alarm), the other detector has not issued an alarm, the unit in alarm is considered failed. Failure of this unit automatically switches the FIDEX control unit to OR logic mode and a FIRE SYSTEM FAULT advisory is displayed on EICAS along with an INFO message identifying the failed detector.

In OR logic, a single smoke detector reporting an alarm condition triggers the flight deck warnings.

An EQUIP BAY SMOKE FAIL caution message is displayed on EICAS if both smoke detectors fail.

SMOKE DETECTOR	STATE
1	Normal
2	Normal

NORMAL STATE “AND” LOGIC

SMOKE
EICAS

SMOKE DETECTOR	STATE
1	Alarm
2	Alarm

ALARM STATE “AND” LOGIC

SMOKE
EICAS

SMOKE DETECTOR	STATE
1	FAIL
2	Alarm

NORMAL STATE “OR” LOGIC

FIRE SYSTEM FAULT
EICAS

26 FIRE SYSTEM FAULT – EQUIPMENT BAY SMOKE DET REDUND LOSS
SYNOPTIC PAGE - INFO

SMOKE DETECTOR	STATE	≤ 45S	BIT + 75S	STATE
1	Alarm	Alarm	Alarm	Fail
2	Normal	Normal	Normal	Normal

ONE DETECTOR FAILED “OR” LOGIC

CS1_CS3_2622_005

Figure 28: Avionics and Electrical Bay Smoke Detection Logic (L3)

MONITORING AND TESTS

The following page provides the crew alerting system (CAS) and INFO messages for the avionics and electrical bay smoke detection system.

CAS MESSAGES

Table 22: WARNING Message

MESSAGE	LOGIC
EQUIP BAY SMOKE	Equipment bay smoke detected.

Table 23: CAUTION Message

MESSAGE	LOGIC
EQUIP BAY SMOKE FAIL	EQUIP BAY SMOKE FAIL is the failure of both A and B EE Bay detectors, or the failure of either one when the other channel is inoperative.

Table 24: ADVISORY Message

MESSAGE	LOGIC
FIRE SYSTEM FAULT	Loss of redundancy in the FIDEX system.

Table 25: INFO Message

MESSAGE	LOGIC
26 FIRE SYSTEM FAULT - EQUIP BAY SMOKE DET REDUND LOSS	Loss of one detector in equipment bay exhaust.

26-15 CARGO SMOKE DETECTION

GENERAL DESCRIPTION

The smoke detectors are connected to the fire detection and extinguishing (FIDEX) control unit through CAN BUSES. In each cargo compartment, the number 1 and 3 smoke detectors report to channel A, and smoke detectors 2 and 4 report to channel B.

The smoke detectors connected to CAN BUS A receive power from DC ESS BUS 1 and smoke detectors connected to CAN BUS B receive power from DC ESS BUS 2.

The smoke detectors in each cargo compartment are configured in a dual-loop configuration using AND logic. At least two detectors from a cargo compartment must report an alarm before it is reported to the flight deck. If any smoke detector fails, the system switches to OR logic.

When a cargo fire or smoke is detected by the FIDEX, a signal is transmitted by channel A and channel B FIDEX control unit to the data concentrator unit module cabinet (DMC). The DMC commands either the FWD or AFT CARGO FIRE PBA to illuminate in red on the CARGO panel and an aural CARGO FIRE alert is generated.

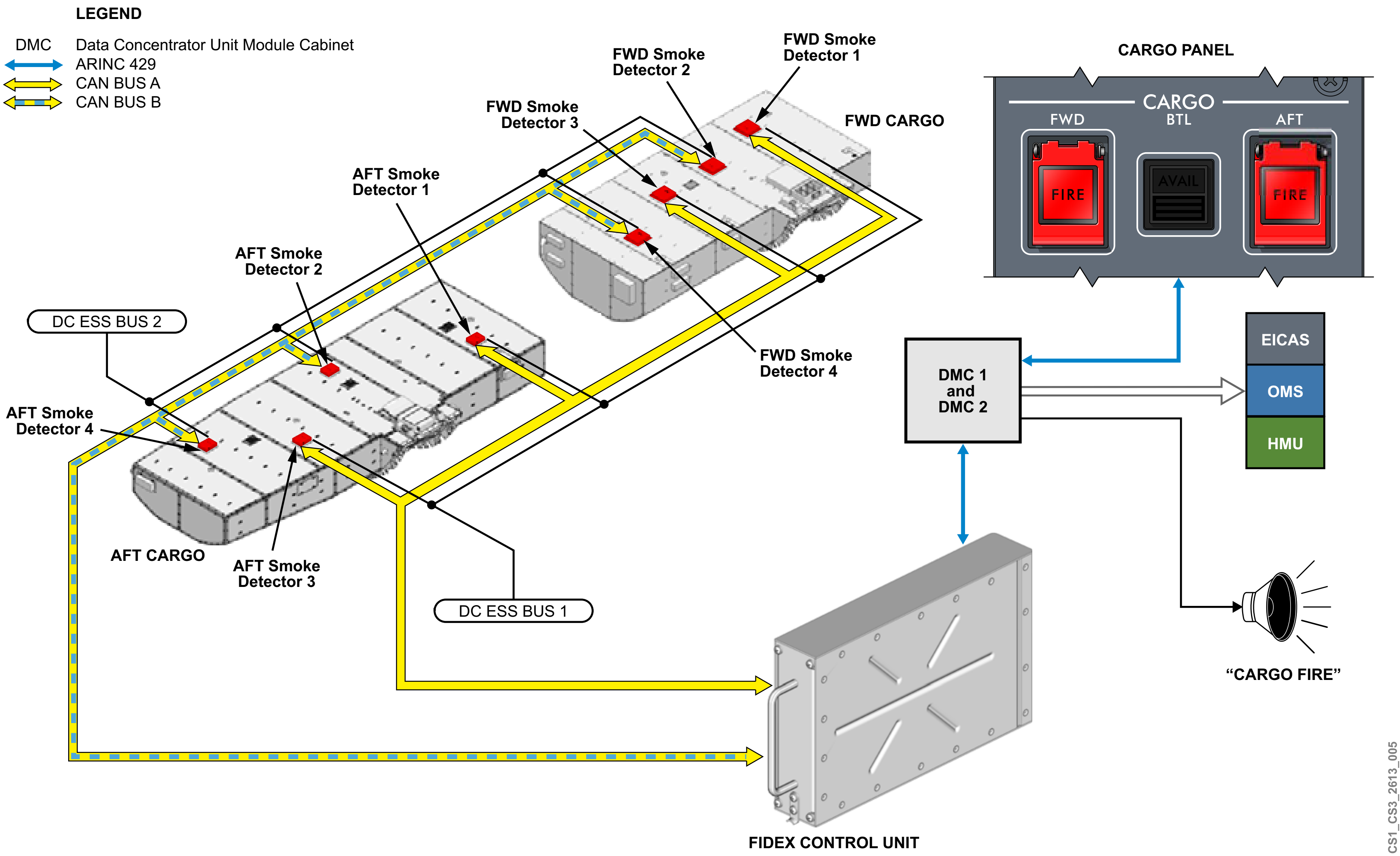


Figure 29: Cargo Smoke Detection System (L2)

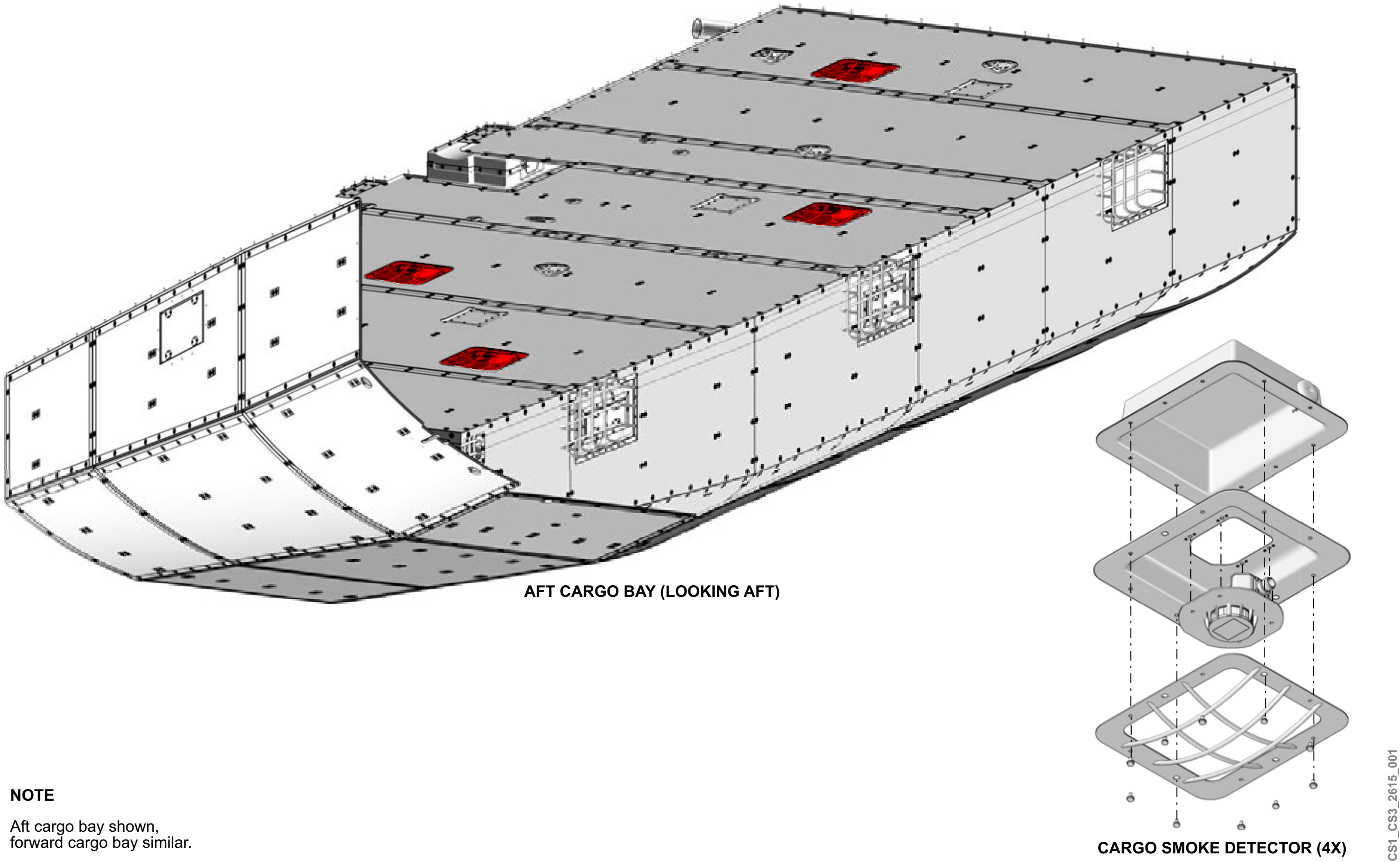
COMPONENT LOCATION

The following components of the lower cargo smoke detection system are installed in the ceiling of the cargo compartments:

- Cargo smoke detectors

CARGO SMOKE DETECTORS

The smoke detectors are mounted in a recessed fire resistant tray so that they are flush with the ceiling. A protective wire cage is installed around each smoke detector so that baggage cannot contact the detector.



NOTE

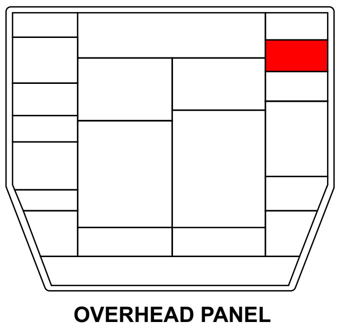
Aft cargo bay shown,
forward cargo bay similar.

Figure 30: Cargo Smoke Detectors (L2)

CONTROLS AND INDICATIONS

The CARGO panel is located on the RH outboard integrated cockpit control panel (ICCP). There are two red guarded pushbutton annunciators (PBAs) labeled FWD and AFT, and one momentary BTL PBA.

The FWD or AFT PBA illuminates red when fire or smoke is detected in the cargo compartment.



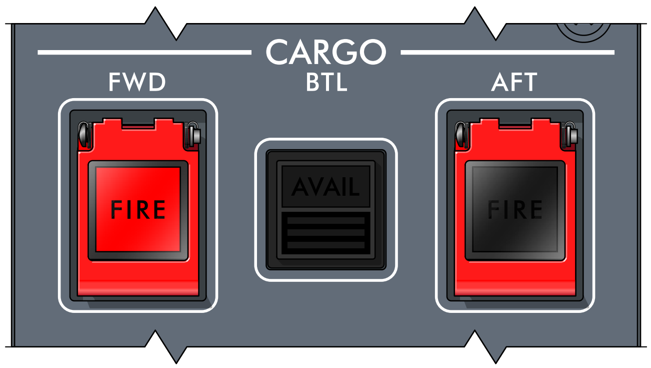


Figure 31: CARGO Panel (L2)

DETAILED DESCRIPTION

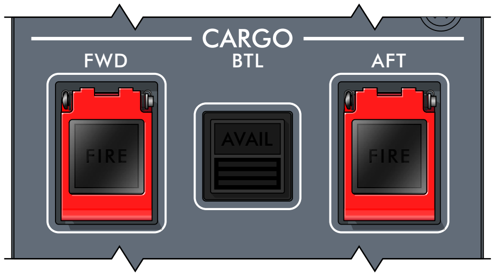
In normal operation, the FIDEX control unit monitors the cargo compartment smoke detectors using AND logic. A cargo fire is indicated by a CARGO FIRE PBA and a red CARGO FIRE CAS message illuminating.

While in AND logic mode, an alarm from a single smoke detector starts a 45-second timer internal to the FIDEX control unit. During the 45 seconds, an alarm from any other detector within the same bay completes the AND logic and the FIDEX control unit issues the warning to the EICAS. If, at the end of the 45 seconds, no other detector within the same bay has produced an alarm, the FIDEX control unit performs a smoke detector BIT test. If all other detectors respond properly to the BIT, the FIDEX control unit remains in AND logic mode and starts a 75-second internal timer.

If, at the end of the 75 seconds (2 minutes from the initial unit going into alarm), the other detector has not issued an alarm, the unit in alarm is considered failed. Failure of this unit automatically switches the FIDEX control unit to OR logic mode and a FIRE SYSTEM FAULT advisory is displayed on EICAS along with an INFO message identifying the failed detector.

In OR logic, a single smoke detector reporting an alarm condition triggers the flight deck warnings.

If the entire smoke detection system in a cargo compartment fails, a FWD or AFT CARGO SMOKE FAIL caution message is displayed on EICAS.

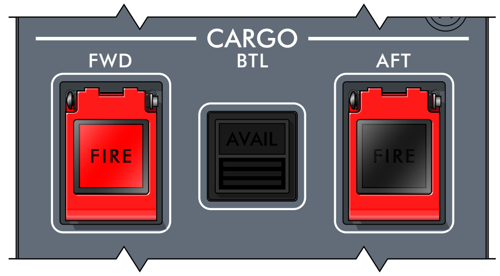


SMOKE DETECTOR	STATE
1	Normal
2	Normal
3	Normal
4	Normal

NORMAL STATE “AND” LOGIC

FWD CARGO FIRE

EICAS

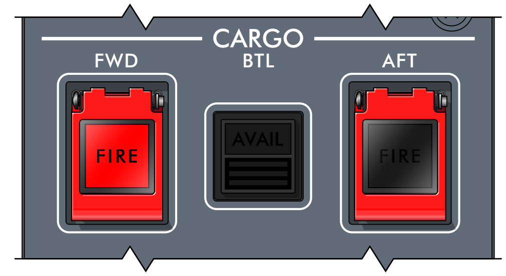


SMOKE DETECTOR	<45 S
1	Alarm
2	Normal
3	Normal
4	Alarm

ALARM STATE “AND” LOGIC

FWD CARGO FIRE

EICAS



SMOKE DETECTOR	STATE
1	Fail
2	Normal
3	Alarm
4	Normal

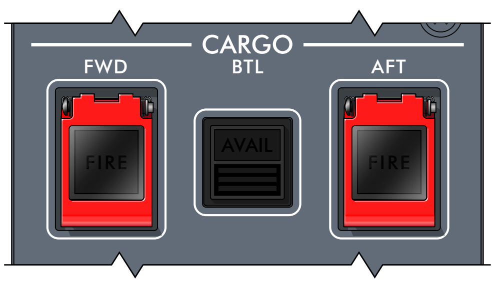
“OR” LOGIC ALARM STATE

FIRE SYSTEM FAULT

EICAS

26 FIRE SYSTEM FAULT – FWD CARGO SMOKE DET REDUND LOSS

SYNOPTIC PAGE - INFO



SMOKE DETECTOR	STATE	≤ 45S	BIT + 75S	STATE
1	Alarm	Alarm	Alarm	Fail
2	Normal	Normal	Normal	Normal
3	Normal	Normal	Normal	Normal
4	Normal	Normal	Normal	Normal

ONE DETECTOR FAILED “OR” LOGIC

CS1_CS3_2615_003

Figure 32: Cargo Smoke Detection Logic (L3)

MONITORING AND TESTS

SMOKE DETECTOR FAULT MONITORING

The smoke detectors use optical dual-wavelength detection technology. Red and blue light-emitting diodes (LEDs) provide light sources with different wavelengths. The longer wavelength red light is scattered by larger dust particles and the shorter wavelength blue light is scattered by smaller smoke particles. This allows the smoke detector to distinguish between dust and smoke in order to reduce the chance of a false alarm.

As air flows through the smoke chamber, smoke or dust particles cause the light beams to scatter. The scattered light is reflected by a mirror to a photodiode. The smoke detector processes the information received by the photodiode to determine if an alarm condition exists.

The detector has an internal thermal sensor that goes to alarm state when the ambient temperature reaches 100ºC. The alarm annunciation operates the same as for smoke alarm.

The detector has a self-calibration function that maintains the sensitivity of the detector within original design tolerances. Self-calibration is automatic and occurs at frequent intervals. The function does not interfere with normal detector operation.

The smoke detector health management function operates on a continuous basis. The health management function detects fault states in the detector. Faults may be classified into two categories, type 1 and type 2 faults.

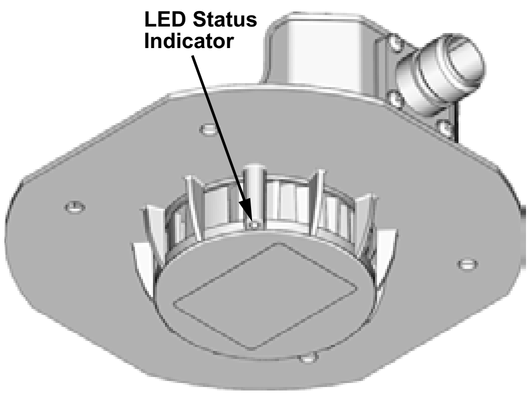
Type 1 faults include faults that indicate the detector requires maintenance. This is typically caused by sensor values close to the edge of the tolerance range. The smoke detector will continue to function and annunciate alarms within its ability to do so.

Type 2 faults are major failures that cause the smoke detector to be inoperative or unreliable.

A LED indicates the status of the unit:

- Normal operation: solid green LED
- Type 1 fault: blinking green LED
- Type 2 fault: blinking red LED
- Alarm state or major failure: solid red LED

A periodic BIT monitors the health of the smoke detector every 5 minutes when power is applied.



COLOR	INDICATION	STATUS
Green	Solid	Normal Operation
Green	Blinking	Type 1 Fault
Red	Blinking	Type 2 Fault
Red	Solid	Alarm State or Major Failure

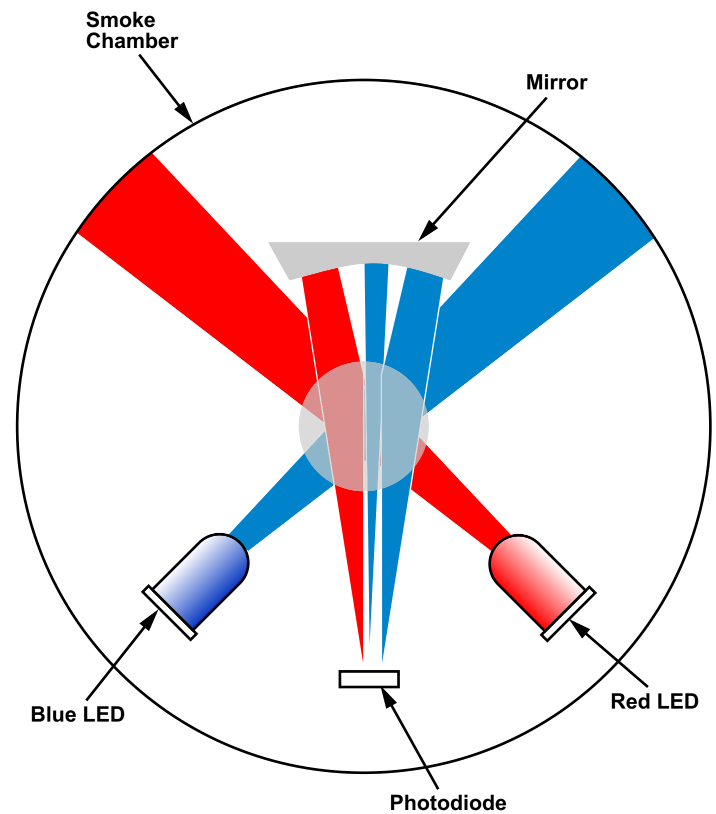


Figure 33: Smoke Detector (L2)

CAS MESSAGES

The following CAS and INFO messages apply to the cargo smoke detection system.

Table 26: WARNING Messages

MESSAGE	LOGIC
FWD CARGO FIRE	Forward cargo smoke detected.
AFT CARGO FIRE	Aft cargo smoke detected.

Table 27: CAUTION Messages

MESSAGE	LOGIC
FWD CARGO SMOKE FAIL	FWD CARGO SMOKE FAIL is failure of channel A and channel B FWD smoke detection, or failure of the critical number of detectors required to assure timely detection.
AFT CARGO SMOKE FAIL	AFT CARGO SMOKE FAIL is failure of channel A and channel B AFT smoke detection, or failure of the critical number of detectors required to assure timely detection.

Table 28: ADVISORY Message

MESSAGE	LOGIC
FIRE SYSTEM FAULT	Loss of redundancy in the FIDEX system.

Table 29: INFO Messages

MESSAGE	LOGIC
26 FIRE SYSTEM FAULT - FWD CARGO SMOKE DET REDUND LOSS	Loss of one or more detectors in the FWD bay.
26 FIRE SYSTEM FAULT - AFT CARGO SMOKE DET REDUND LOSS	Loss of one or more detectors in the AFT bay.

26-24 CARGO FIRE EXTINGUISHING

GENERAL DESCRIPTION

The cargo compartment fire extinguishing system suppresses fires and overheat conditions in the forward and the aft cargo compartments. The system is operated through the CARGO panel in the flight deck.

The system includes one dual-outlet, high-rate discharge (HRD) extinguisher bottle and one dual-outlet, low-rate discharge (LRD) extinguisher bottle. The extended-range, twin-engine operational performance standards (ETOPS) (option) includes a second LRD. The HRD extinguisher provides the initial suppression of fire and the LRD prevents re-ignition.

The cargo compartment discharge lines have nozzles that discharge the extinguishing agent into the cargo compartments. The discharge lines are installed in the wing-to-body fairing (WTBF) and run to the forward and aft cargo compartments. The lines are arranged so that both bottles can be discharged into either the forward or aft cargo compartments, but not both at the same time.

The HRD has a metering orifice that is sized to meter discharge agent into the cargo bay at a rate that rapidly establishes an initial 5% concentration in the cargo compartment.

The LRD metering orifice is sized to provide longer discharge time than the HRD. The longer discharge time is needed to maintain a 3% extinguishing agent concentration in the cargo compartment for 60 minutes.

To contain the fire extinguishing agent in the cargo compartment, the cargo ventilation system is shut down. The FIDEX control unit signals the integrated air system controller (IASC) to close the respective cargo compartment cargo shutoff valves (ATA 21).

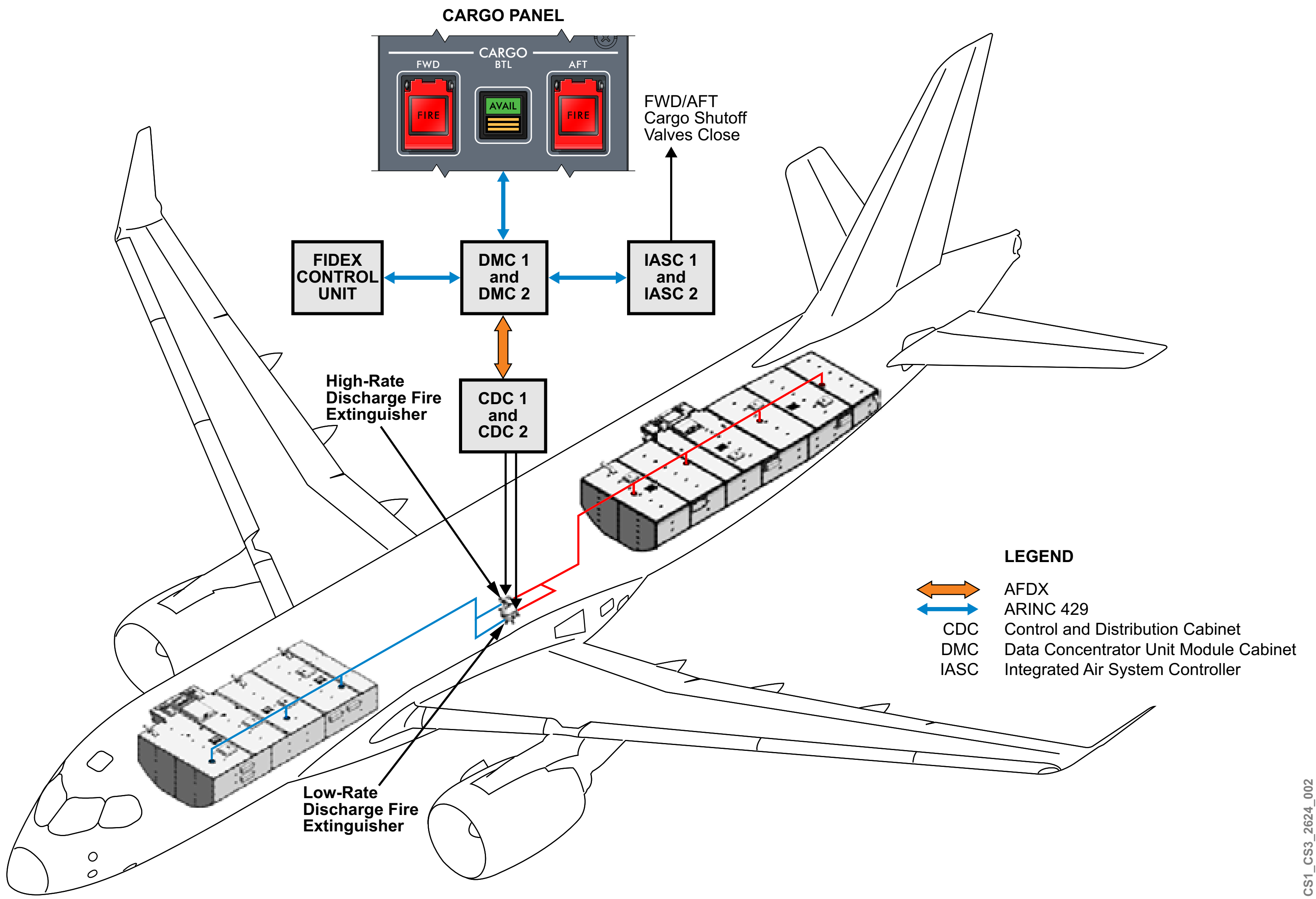


Figure 34: Cargo Fire Extinguishing System (L2)

COMPONENT LOCATION

The following components are located in the wing-to-body fairing (WTBF) on a bracket attached to the aft spar:

- High-rate discharge fire extinguisher
- Low-rate discharge fire extinguisher

The bracket has provisions for a second low-rate fire extinguisher to be installed if required.

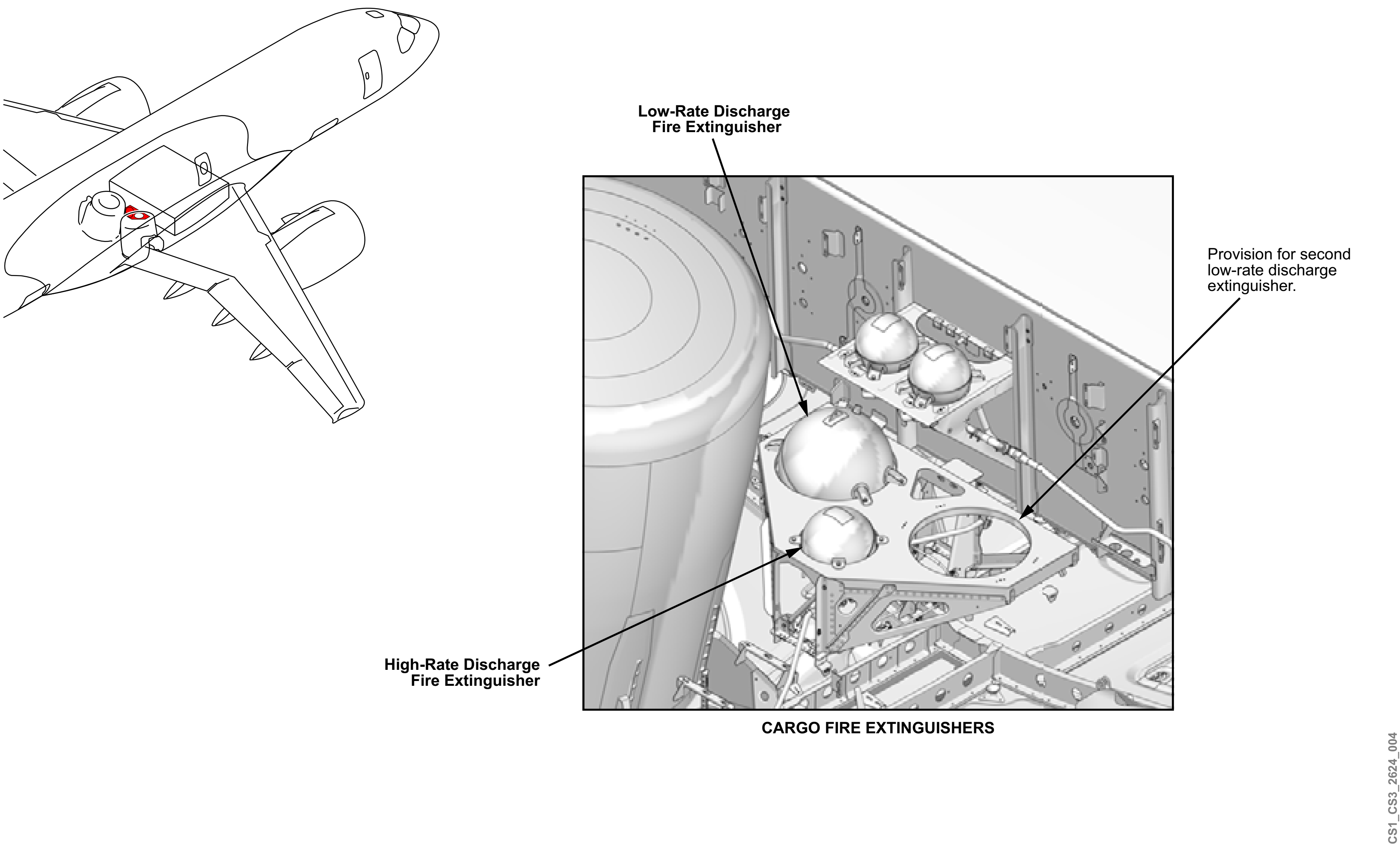


Figure 35: Cargo Fire Extinguisher Location (L2)

COMPONENT INFORMATION

HIGH-RATE DISCHARGE FIRE EXTINGUISHER

The HRD extinguisher is a 6194 cm^3 (378 in^3.) steel pressure vessel charged to 360 ± 25 psi at 21°C (70°F).

The bottle has two threaded discharge ports hermetically sealed by a rupture disc welded to each port, a fill port, and a pressure switch that incorporates a manual test switch activated using a 3/32 in. allen key. Four lugs welded to pads on the vessel wall provide a mount.

LOW-RATE DISCHARGE FIRE EXTINGUISHER

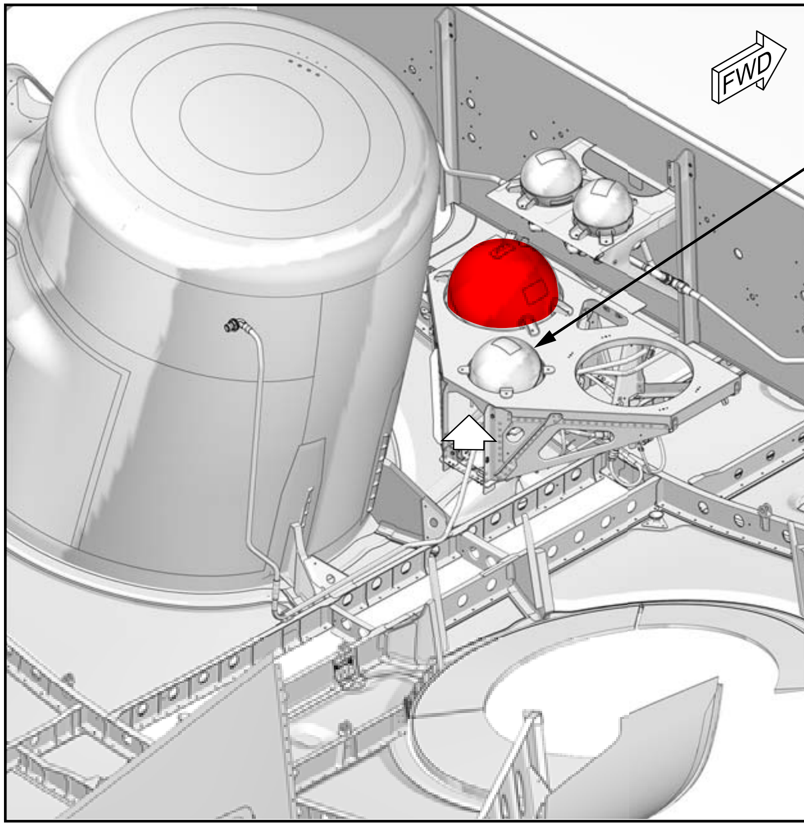
The LRD extinguisher is a 22,942 cm^3 (1400 in^3.) steel pressure vessel charged to 360 +- 25 psi at 21°C (70°F).

The bottle has two threaded discharge ports hermetically sealed by a rupture disc welded to each port, a fill port, and a pressure switch that incorporates a manual test switch activated using a 3/32 in. allen key.

DISCHARGE HEAD AND CARTRIDGE

The discharge heads mounted on the fire extinguisher connect to the aircraft extinguishing distribution lines. A cartridge is installed in each discharge head. The cartridge fires to burst the frangible disc and release the fire extinguisher contents through the discharge lines. A screen inside the discharge head traps cartridge debris and burst disc fragments.

The discharge head of each fire extinguisher has a swivel nut that can be loosened so that the head can be rotated to mate with the distribution plumbing.



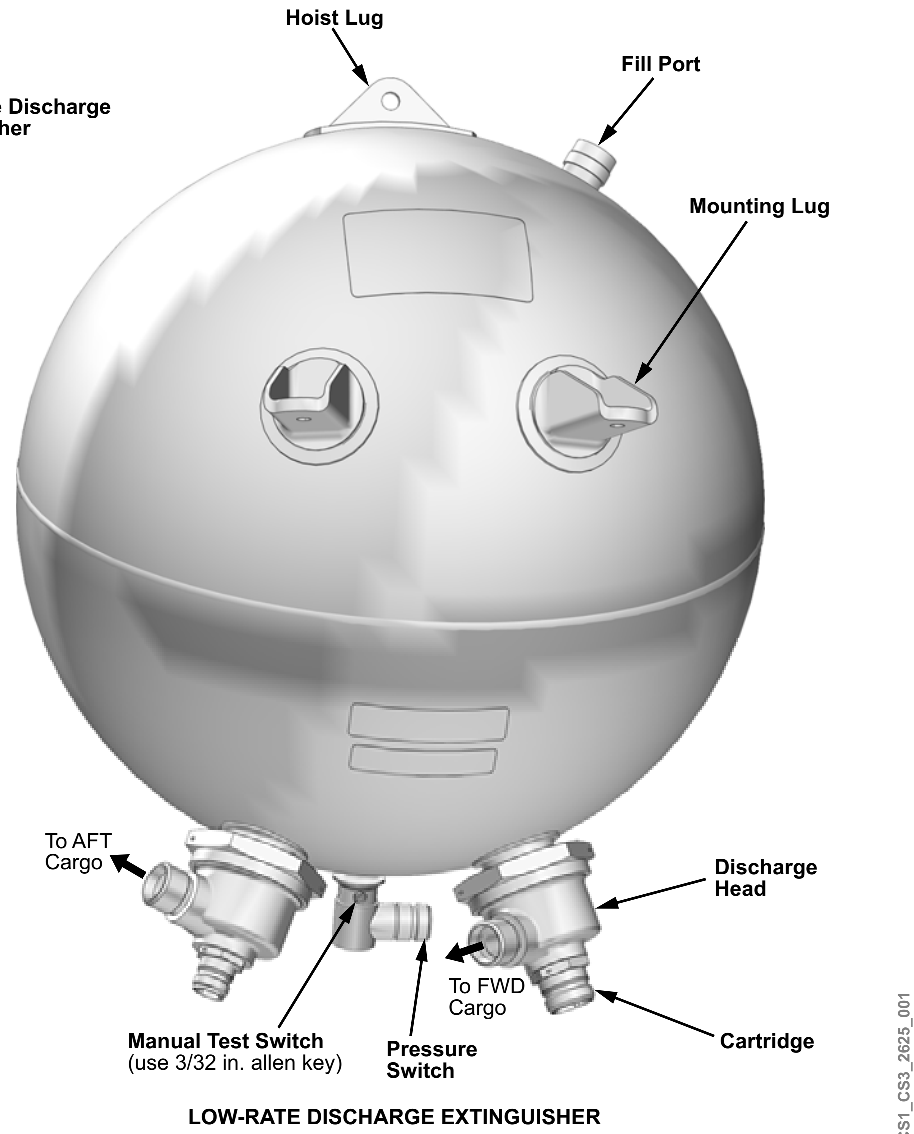


Figure 36: Cargo Fire Extinguisher (L2)

CARGO FIRE EXTINGUISHER INSTALLATION

The installation of the cargo fire extinguishers and engine fire extinguishers are similar. The cargo fire extinguishing system uses two dual-outlet fire extinguishers. To prevent cross-connection of the fire extinguishing system, the discharge heads on each fire extinguisher are threaded differently. One head has a left-hand thread, while the other is a standard right-hand thread.

The cartridges on each fire extinguisher are threaded differently and have different electrical connectors.

One mounting lug hole is offset on each fire extinguisher providing orientation clocking.

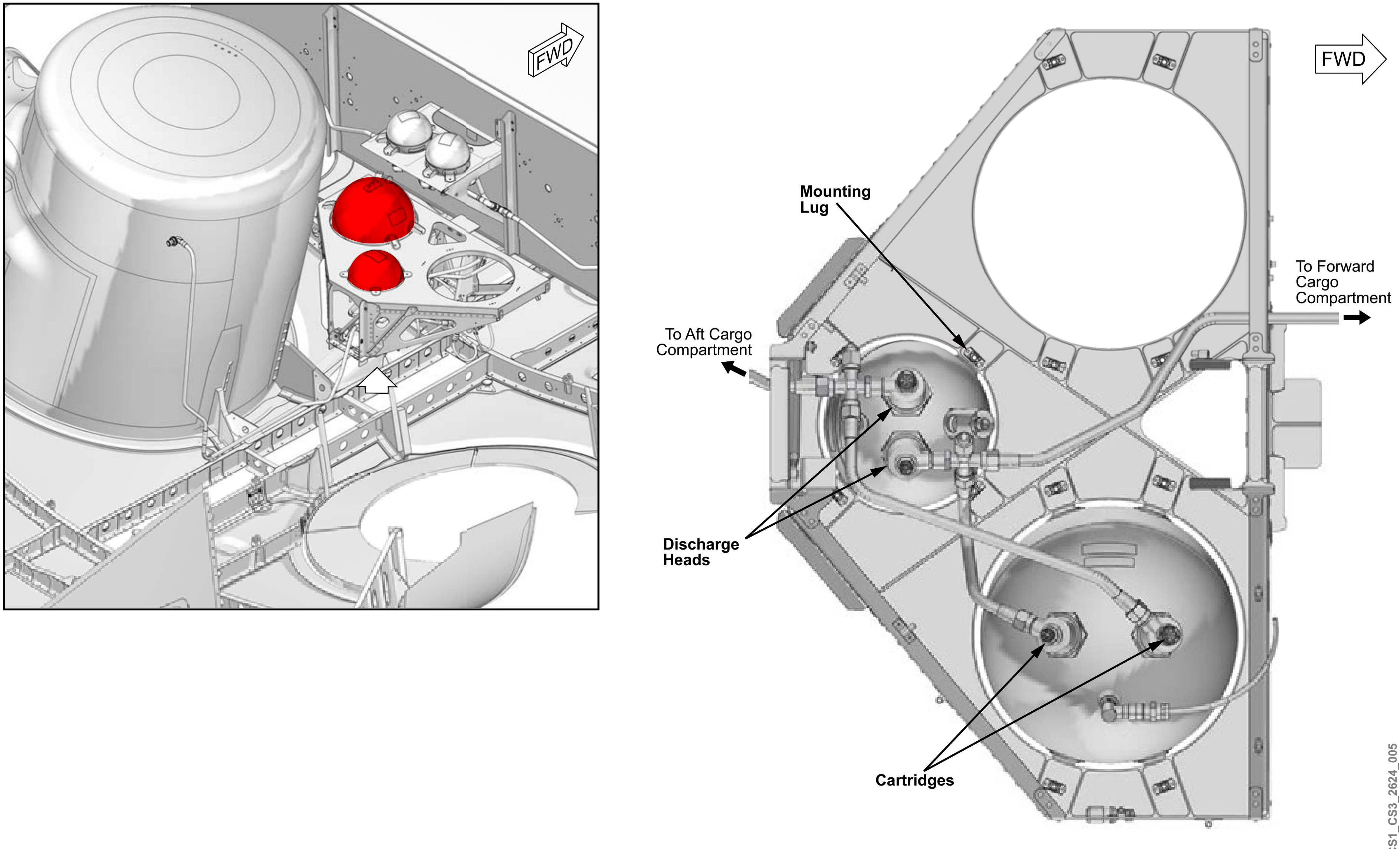


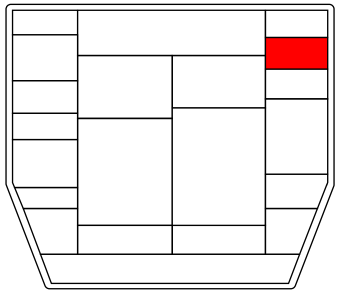
Figure 37: Cargo Fire Extinguisher Installation (L2)

CONTROLS AND INDICATIONS

The CARGO panel includes two red guarded FIRE PBAs and one BTL PBA. The cargo fire extinguishers are armed by lifting the guard and pressing the FWD FIRE or AFT FIRE PBA.

The BTL PBA discharges the fire extinguishers into the selected cargo compartment. The BTL PBA AVAIL light illuminates green when the FWD or AFT FIRE PBA is pressed and the high-rate discharge (HRD) and low-rate discharge (LRD) extinguishers are ready for discharge.

The amber bar on the PBA illuminates when there is low-pressure in the fire extinguishers or a cartridge failure.



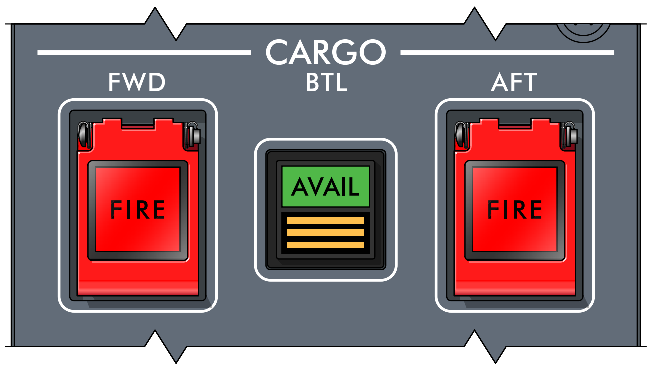


Figure 38: CARGO Panel (L2)

DETAILED DESCRIPTION

The high-rate discharge (HRD) and low-rate discharge (LRD) bottles are discharged simultaneously. The cargo fire extinguishers are available for either forward or aft extinguishing, but not both.

The cargo compartment fire extinguishing system is controlled from the CARGO panel on the overhead ICCP located in the flight deck. When a cargo compartment fire occurs, either the FWD or AFT FIRE PBA illuminates red.

Pressing the FWD or AFT FIRE PBA:

- Illuminates the AVAIL light on the CARGO BTL PBA
- Signals the integrated air system controllers (IASCs) to close the respective cargo shutoff valves

Pressing the CARGO BTL PBA signals the control and distribution cabinets to send 28 VDC to the FWD or AFT fire extinguisher cartridges, discharging the extinguishing agent into the selected cargo compartment.

When the FIDEX control unit detects a high-rate discharge (HRD) extinguisher low pressure, along with open cartridge circuits on the low-rate discharge (LRD) extinguisher, the green AVAIL light goes out and the CARGO BTL PBA amber bar illuminates.

NOTE

1. If the aircraft is configured for ETOPS operation, a second LRD bottle will be discharged simultaneously, with squib monitoring for confirmation.
2. If a cargo bottle is not available when either the FWD or AFT CARGO FIRE PBA is pressed, the CARGO BTL PBA yellow bar illuminates.

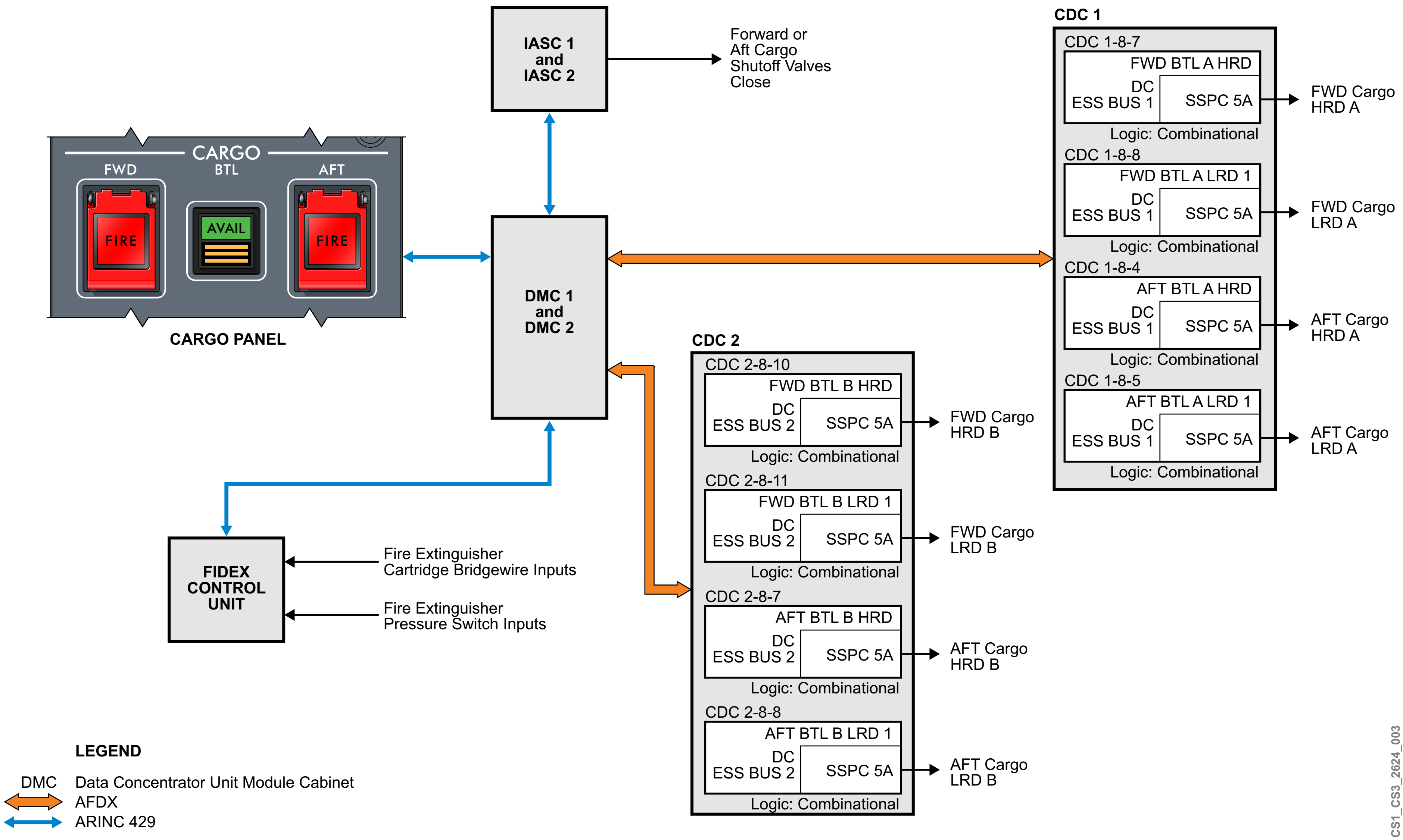


Figure 39: Cargo Fire Extinguishing Operation (L3)

MONITORING AND TESTS

The following page provides the crew alerting system (CAS) and INFO messages for the cargo fire extinguishing system.

CAS MESSAGES

Table 30: CAUTION Messages

MESSAGE	LOGIC
CARGO BTL FAIL	Failure or severe reduction of ability to extinguish any cargo fires, and PBA not armed.
FWD CARGO BTL FAIL	Loss of FWD port squib on either HRD or LRD cargo bottle and PBA not armed
AFT CARGO BTL FAIL	Loss of AFT port squib on either HRD or LRD cargo bottle and PBA not armed.

Table 31: ADVISORY Messages

MESSAGE	LOGIC
CARGO BTL LO	Cargo HRD bottle low, LRD squibs open, and extinguisher PBA active (armed).
FIRE SYSTEM FAULT	Loss of redundancy in the FIDEX system.

Table 32: INFO Messages

MESSAGE	LOGIC
26 FIRE SYSTEM FAULT - FWD CARGO BTL SQUIB REDUND LOSS	Loss of any FWD cargo bridge wire on BTL, HRD, or LRD.
26 FIRE SYSTEM FAULT - AFT CARGO BTL SQUIB REDUND LOSS	Loss of any AFT cargo bridge wire on BTL, HRD, or LRD.

26-00 FIDEX SYSTEM TEST

GENERAL DESCRIPTION

The fire detection and extinguishing (FIDEX) pilot-initiated test is done from the AVIONIC synoptic page.

When the FIRE virtual button is selected, an IN PROG message appears beside it. The following components are tested:

- FIDEX control unit
- Cargo compartment, avionics, and electrical bay smoke detectors
- All fire and overheat detection loops

The following PBAs on the ENGINE and APU, and CARGO panels illuminate for 4 seconds:

- L ENG, R ENG, APU, FWD CARGO, and AFT CARGO
- L FIRE and R FIRE on the engine start panel
- All BTL green AVAIL lights
- All BTL amber bars

NOTE

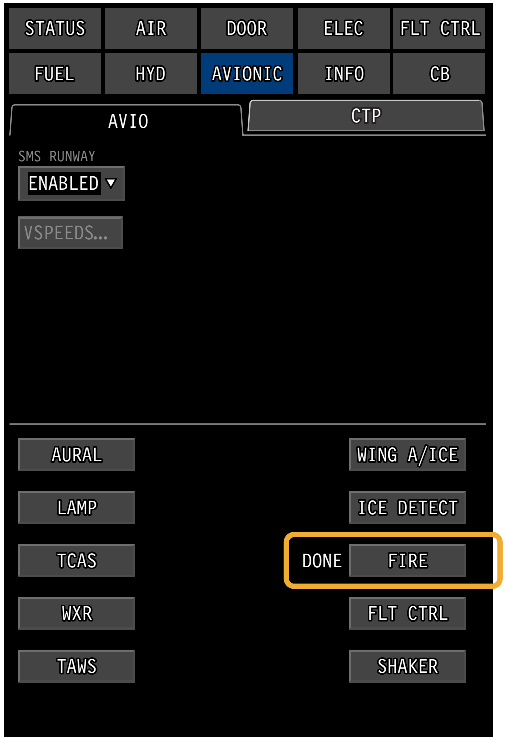
1. The ENGINE and APU, and CARGO panel lights are not monitored by the FIDEX control unit. Illumination must be confirmed visually during the test.
2. The light operation can be tested using the LAMP test on the AVIONIC page.

When the test is complete, DONE appears beside the FIRE virtual button, if all FIDEX components pass.

If a fault or failure is detected, the message FAULT or FAIL appears beside the FIRE virtual button along with a FIRE SYSTEM FAULT advisory message. The specific fault or failure can be found on the INFO page.

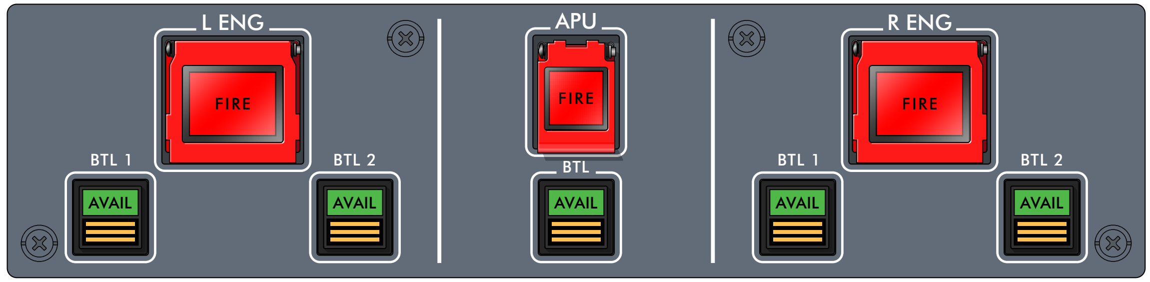
NOTE

During a FIRE test, the auxiliary power unit (APU) horn does not sound.

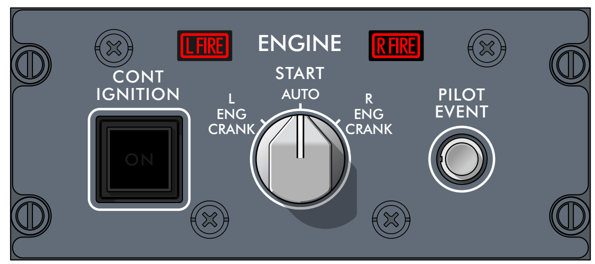


SYNOPTIC PAGE - AVIONIC
(FIRE TEST COMPLETED)

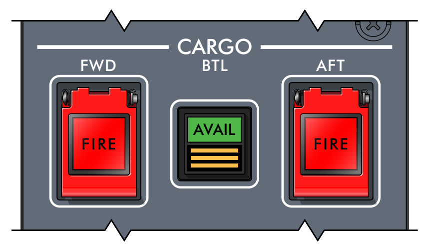
PILOT INITIATED TEST INDICATIONS	
Symbol	**Condition**
FAIL	Associated fire system fail message on CAS
FAULT	Associated fire system fault message on CAS
IN PROG	Test in progress
DONE	Test done



ENGINE AND APU FIRE PANEL



ENGINE PANEL



CARGO PANEL

CS1_CS3_2626_001

Figure 40: AVIONIC Page Fire Test (L2)

26-16 LAVATORY SMOKE DETECTION

GENERAL DESCRIPTION

A smoke detector is installed in each lavatory on the aircraft. The smoke detector goes into alarm mode when smoke is present or the temperature exceeds 100°C (212°F).

The forward lavatory smoke detector is connected to the FIDEX control unit channel A via CAN BUS A. The aft lavatory E smoke detector is connected to the FIDEX control unit channel B via CAN BUS B. The forward lavatory smoke detector is powered by DC ESS BUS 1. The aft lavatory is powered by DC ESS BUS 2.

The lavatory smoke detector produces audible and visual warnings on the unit itself, on the cabin management system, and provides a corresponding LAV SMOKE warning message on the EICAS. Each lavatory smoke detector can be tested individually.

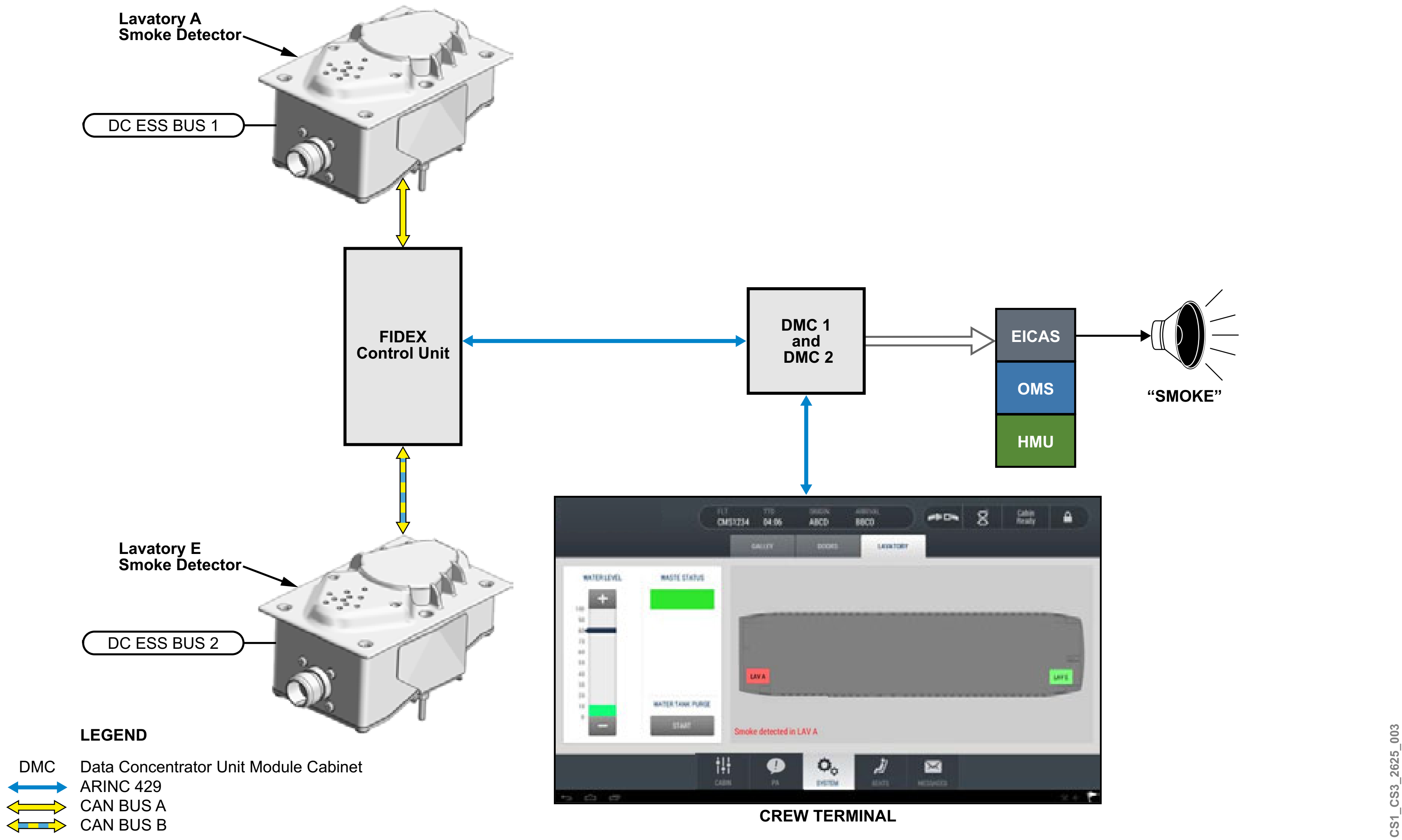


Figure 41: Lavatory Smoke Detector System (L2)

COMPONENT LOCATION

The lavatory smoke detection system has the following component:

- Lavatory smoke detector

LAVATORY SMOKE DETECTOR

One lavatory smoke detector is installed in each lavatory ceiling.

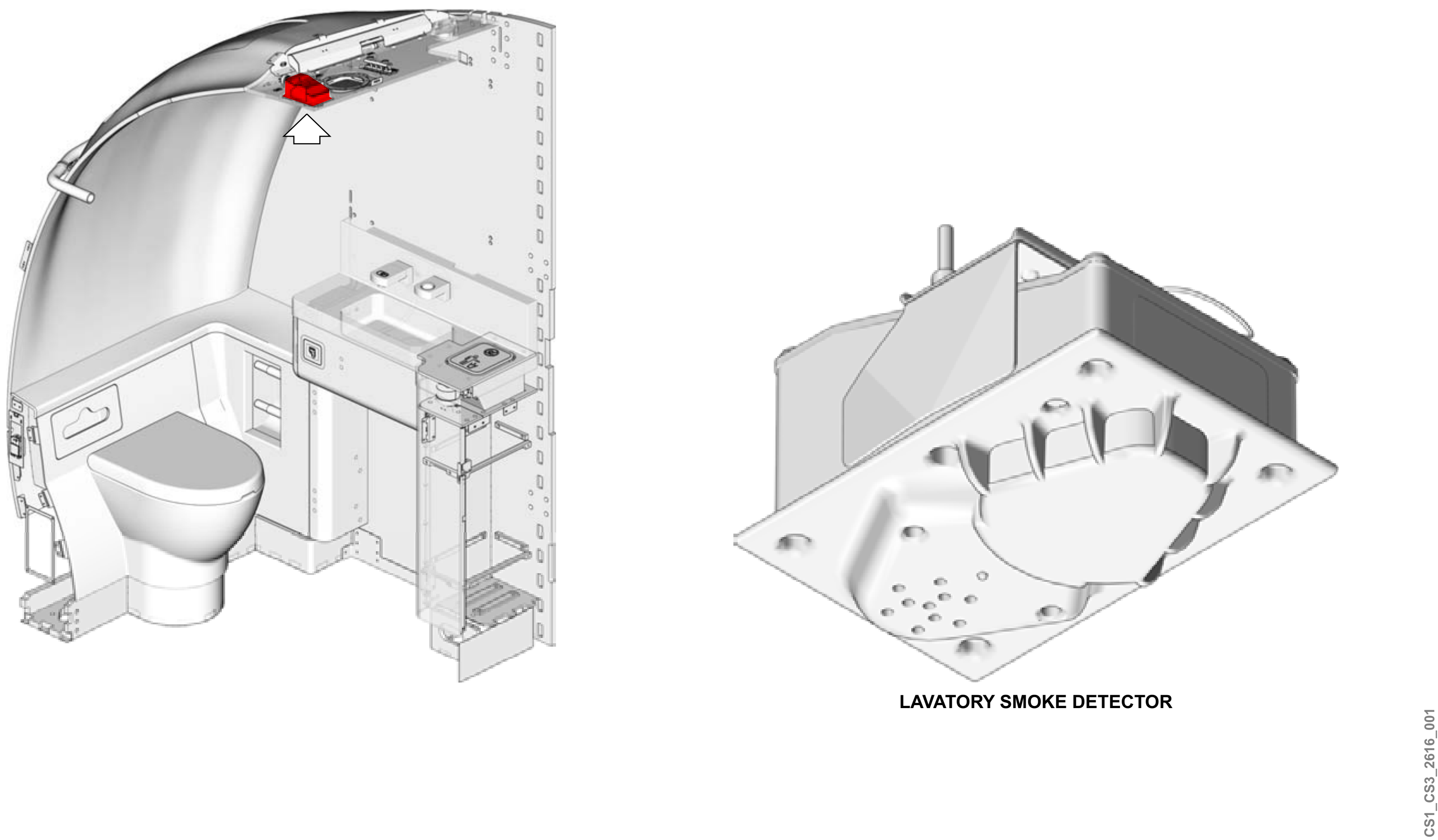


Figure 42: Lavatory Smoke Detector Location (L2)

CONTROLS AND INDICATIONS

An alarm from the smoke detector sounds via a built-in horn in the smoke detector. A status indicator lamp located on the smoke detector shows the status of the unit. A horn cancel switch is used to silence the horn.

The lavatory smoke detector status is also indicated on the water and waste page of the cabin management system crew terminal.

When a lavatory smoke detector goes into alarm, an orange light illuminates on the area call panels in the cabin (ATA 44).

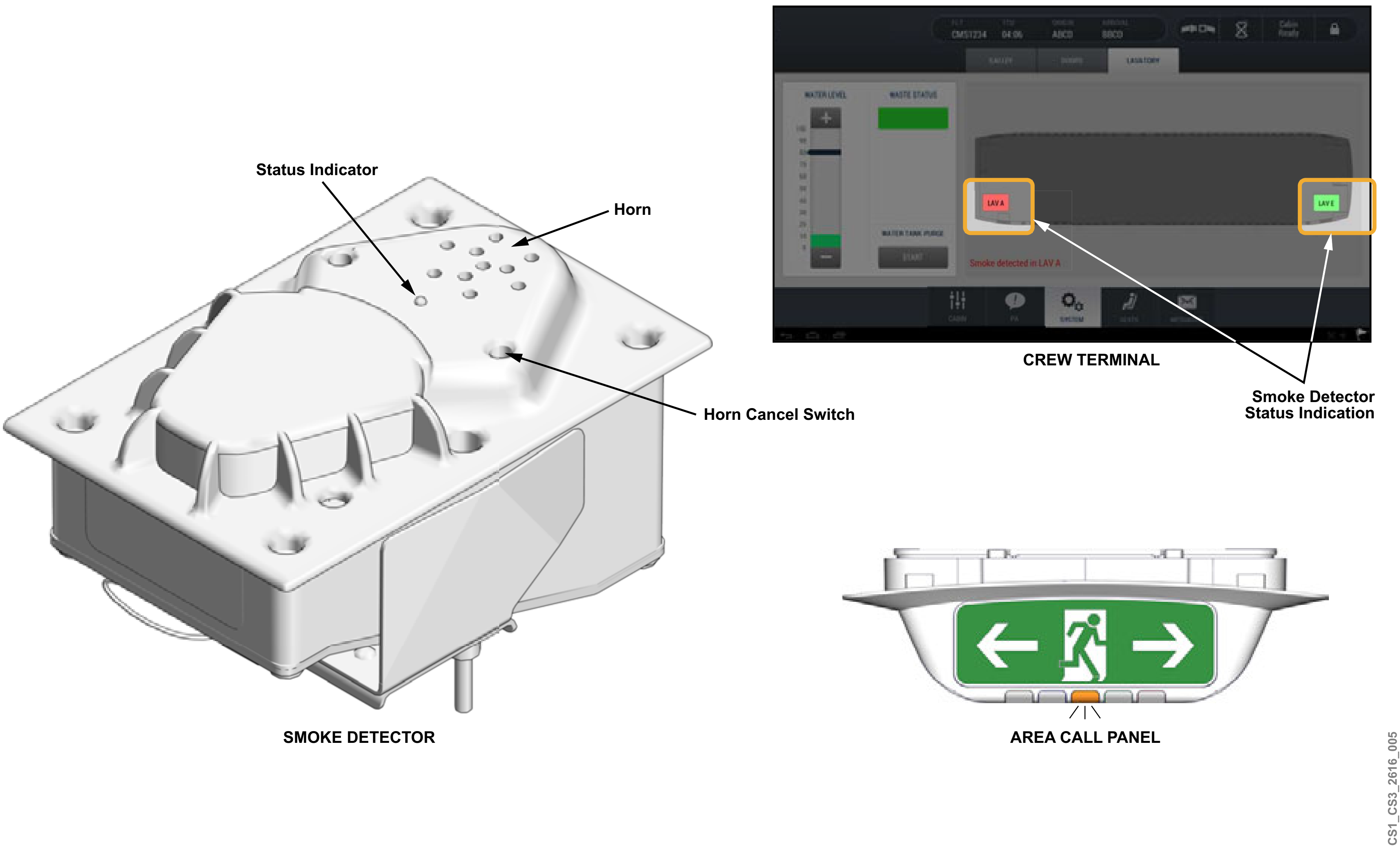


Figure 43: Lavatory Smoke Detector Controls and Indications (L2)

MONITORING AND TESTS

The following page provides the crew alerting system (CAS) and INFO messages for the lavatory smoke detection system.

CAS MESSAGES

Table 33: WARNING Message

MESSAGE	LOGIC
LAV SMOKE	Lavatory smoke detected.

Table 34: CAUTION Message

MESSAGE	LOGIC
LAV SMOKE FAIL	Failure of the FWD or AFT lavatory smoke detector.

Table 35: INFO Messages

MESSAGE	LOGIC
26 LAV SMOKE FAIL - FWD LAV A SMOKE DET INOP	Forward lavatory smoke detector failure.
26 LAV SMOKE FAIL - AFT LAV E SMOKE DET INOP	Aft lavatory E smoke detector failure.

TEST

The lavatory smoke detectors can be tested by pressing the self-test switch on the smoke detector. The switch is actuated using a small rod to press the switch.

The state of the individual lavatory smoke detector is reported to the DMC via the FIDEX control unit.

Press the lavatory smoke detector test switch and check:

- Smoke detector horn sounds
- Red alarm light comes on
- LAV SMOKE warning message on EICAS
- LAV SMOKE warning on CMS crew terminal

All associated indications go out after self-test is completed.

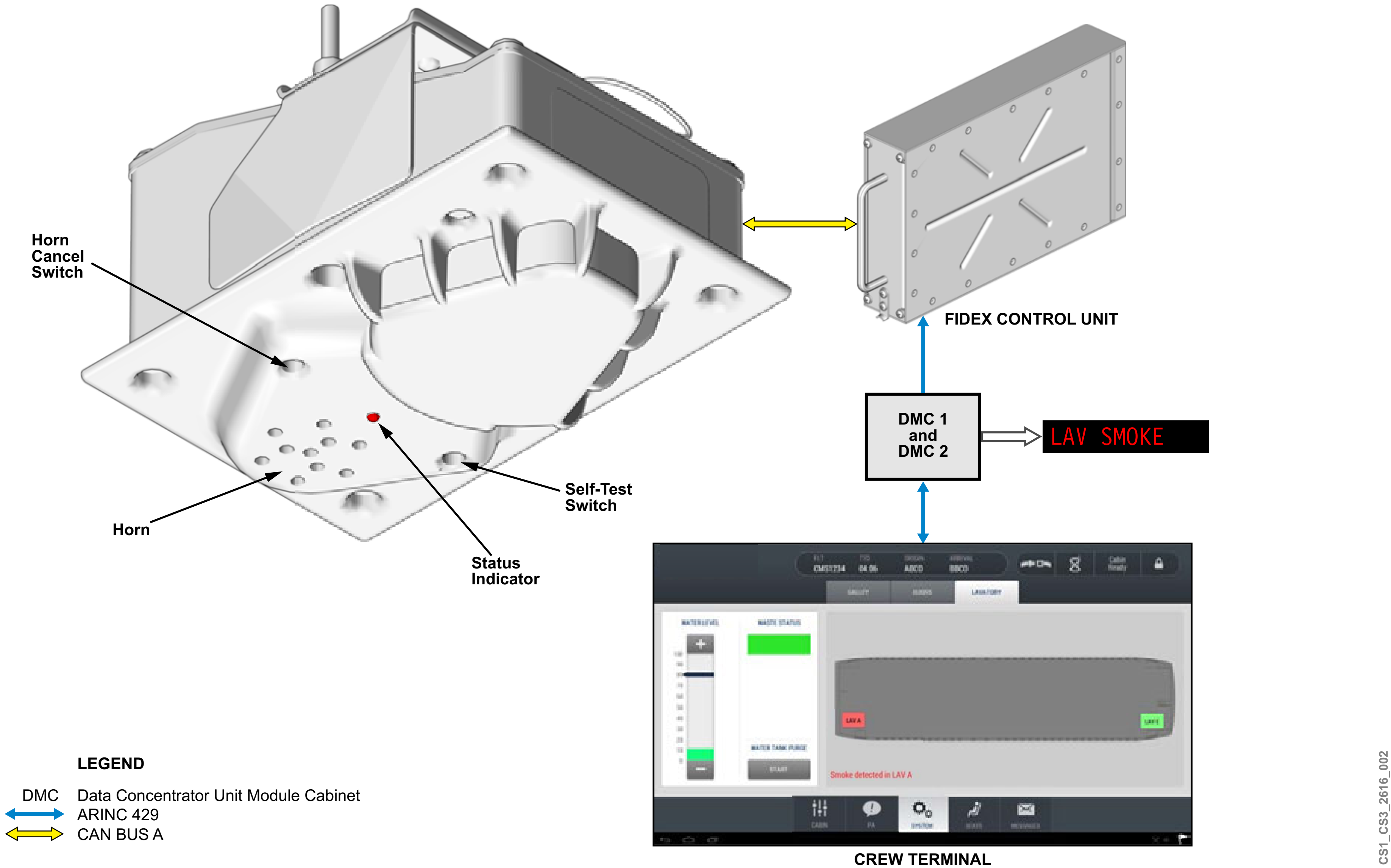


Figure 44: Lavatory Smoke Detector Test (L2)

26-25 LAVATORY FIRE EXTINGUISHING

GENERAL DESCRIPTION

The lavatory fire extinguisher is a sealed pressurized container filled with heptaflouropropane and charged to 200 psi with nitrogen.

The lavatory fire extinguisher automatically discharges extinguishing agent when the fusible alloy that seals the end caps melts and releases the end caps from the discharge tubes. The discharge tubes direct the extinguishing agent into the waste bin. The container discharges its contents in 3 to 15 seconds.

The lavatory fire extinguisher is installed under the sink area, with the discharge tubes pointing toward the trash bin.

Figure 45: Lavatory Fire Extinguishing (L2)

26-23 PORTABLE FIRE EXTINGUISHING

GENERAL DESCRIPTION

The portable Halon fire extinguisher has an aluminum cylinder, a pressure gauge, and a valve assembly. The valve assembly has a nozzle to discharge the extinguishing agent. The valve assembly, pressure gauge, and nozzle are installed on the top of the cylinder. A pull-out pin and seal prevent the fire extinguisher from being operated accidentally.

The fire extinguisher cylinder is filled with Halon 1211 and pressurized with nitrogen. The extinguishers are rated A (paper, wood, cloth, etc.), B (volatile liquids, gas, oils, paints), and C (electrical equipment).

To operate the fire extinguisher, remove the pin. Point the nozzle at the fire and squeeze the lever. The extinguisher discharges within 8 to 10 seconds.

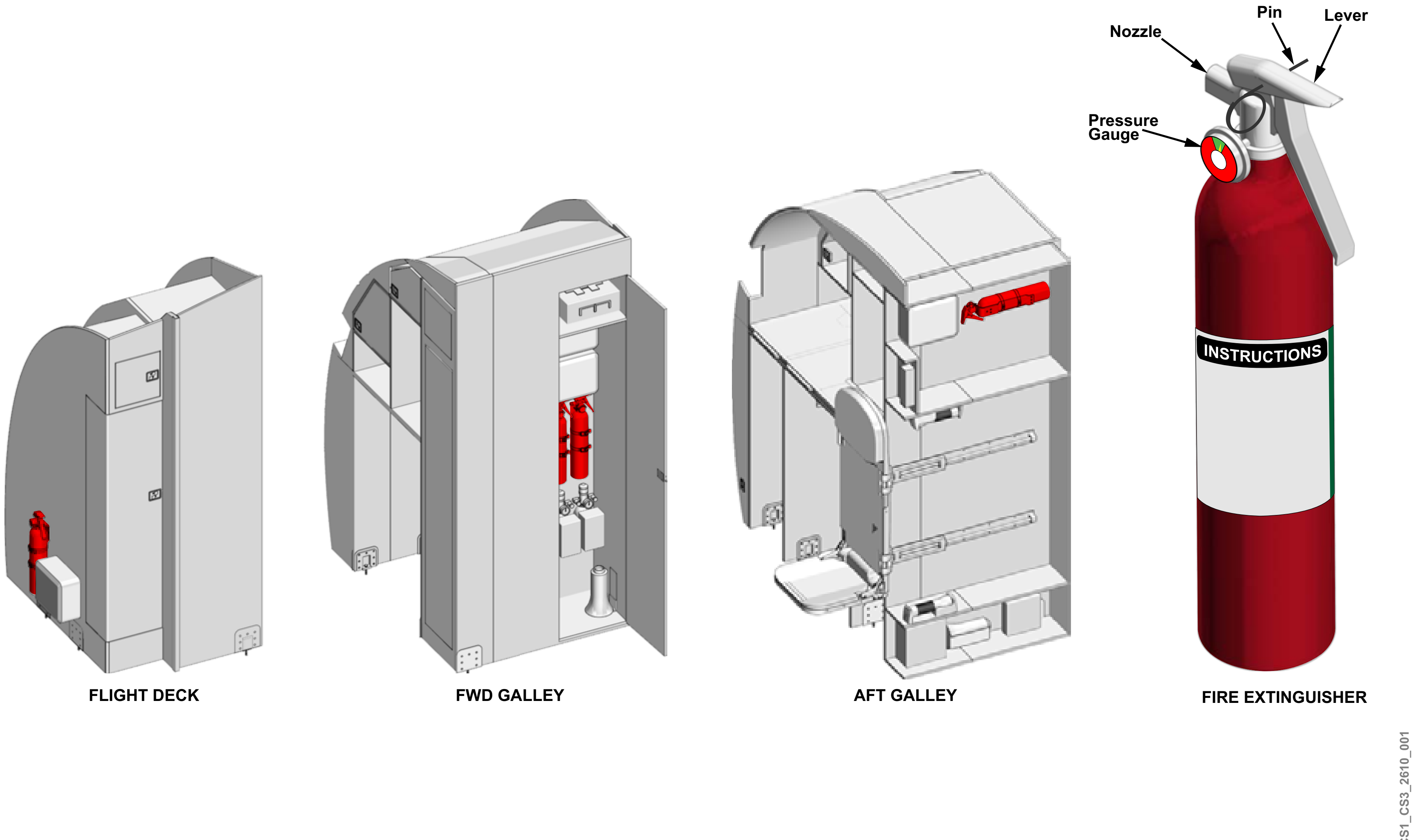


Figure 46: Portable Fire Extinguishers (L2)

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ATA 33 - Lighting System

BD-500-1A10
BD-500-1A11

Table of Contents

33-10 Flight Deck Lighting 33-2
General Description 33-2
Floodlighting 33-2
Miscellaneous Lights 33-2
Component Location 33-4
Current Dimmer Box 33-4
Voltage Dimmer Box 33-4
Controls and Indications 33-6
Dome and Entrance Light Panel 33-6
Miscellaneous Light Panel 33-6
Left and Right Reading Light Panels 33-6
Left and Right Side Light Panels 33-6
Lighting and Cockpit Door Panel 33-6
Third Crew Light Switch Panel 33-6
Detailed Description 33-8
Floodlighting 33-8
Miscellaneous Lights 33-10
33-20 Passenger Cabin Lighting 33-16
Main Cabin Lighting 33-16
General Description 33-16
Controls and Indications 33-18
Cabin Management System Crew Terminal 33-18
Forward Flight Attendant Panel 33-18
Detailed Description 33-20
Entry and Galley Lights 33-22
General Description 33-22
Entry Lights 33-22
Galley Lights 33-22
Controls and Indications 33-24
Crew Terminal 33-24
Forward Flight Attendant Panel 33-24
Forward Galley Panel 33-24
Aft Flight Attendant Panel 33-24
Aft Galley Panel 33-24
Detailed Description 33-26
Entry Lights 33-26
Dome Light 33-28
Galley Lights 33-30
Flight Deck Door Light 33-32
General Description 33-32
Flight Deck Door Light 33-32
Detailed Description 33-34
Ordinance Lights 33-36
General Description 33-36
Detailed Description 33-38
Lavatory Lights 33-40
General Description 33-40
Detailed Description 33-42
33-50 Emergency Lights 33-44
General Description 33-44
Component Location 33-46
Emergency Power Supply Unit 33-46
Exterior Emergency Lights 33-46
Exit Marker Signs 33-48
Exit Locator Signs 33-48
Exit Identifier Signs 33-48
Overhead Emergency Lights 33-48

Aisle Emergency Lights 33-48
Flight Deck Emergency Light Switch 33-50
Passenger Cabin Emergency Light Switch 33-50
Detailed Description 33-52
Emergency Lights Operation 33-52
Emergency Light Power Distribution....................33-54
Monitoring and Test 33-56
CAS Messages 33-57
33-40 Exterior Lights....................33-58
General Description 33-58
Landing and Taxi Lights 33-60
General Description 33-60
Component Location 33-62
Light Assembly....................33-62
Landing/Taxi Power Supply 33-62
Detailed Description 33-64
Navigation Lights 33-66
General Description 33-66
Component Location 33-68
Wing Navigation Lights 33-68
Tail Navigation Lights....................33-68
Detailed Description 33-70
Tow PWR PBA....................33-70
NAV LTS PBA....................33-70
NAV Switch....................33-70
Wing Inspection Lights 33-72
General Description 33-72
Component Location 33-74
Wing Inspection Lights 33-74
Detailed Description 33-76
Beacon Lights 33-78
General Description 33-78
Optional Beacon Light Operation from the TOW POWER PBA 33-78
Component Location 33-80
LED Beacon Light 33-80
Beacon Light Power Supply 33-80
Beacon Light Inverter 33-82
Detailed Description 33-84
Optional Beacon Light Operation from the TOW POWER PBA 33-84
Anticollision Strobe Lights 33-86
General Description 33-86
Component Location 33-88
Strobe Light Assembly 33-88
Strobe Light Power Supply....................33-88
Detailed Description 33-90
Logo Lights 33-92
General Description 33-92
Components 33-94
Logo Lights....................33-94
Detailed Description 33-96
33-30 Cargo Lights 33-98
General Description 33-98
Component Location 33-100
Cargo Light Assembly 33-100
Loading Area Light Assembly 33-100
Detailed Description 33-102
33-30 Service and Maintenance Lights....................33-104
General Description 33-104

Detailed Description 33-106

List of Figures

Figure 1: Flight Deck Lighting (L2) 33-3
Figure 2: Current and Voltage Dimmer Boxes (L2) 33-5
Figure 3: Flight Deck Lighting (L2) 33-7
Figure 4: Main Instrument Floodlight Panel and Side Console Lights Detailed Description (L3)......33-9
Figure 5: Cockpit Dome Light (L3)....................................33-11
Figure 6: Reading, Map, and Compass Lights (L3)............33-13
Figure 7: Entrance, Floor, Foot, and Bag Lights (L3) 33-15
Figure 8: Main Cabin Lighting (L2) 33-17
Figure 9: Main Cabin Light Control (L2) 33-19
Figure 10: Passenger Cabin Lighting Detailed Description (L3) 33-21
Figure 11: Entry and Galley Lights (L2)...............................33-23
Figure 12: Entry and Galley Lights Control (L2) 33-25
Figure 13: Entry Lights Detailed Description (L3)................33-27
Figure 14: Dome Light Detailed Description (L3) 33-29
Figure 15: Galley Lights Detailed Description (L3)...............33-31
Figure 16: Flight Deck Door Lighting and Control (L2) 33-33
Figure 17: Flight Deck Door Light Detailed Description (L3) 33-35
Figure 18: Ordinance Lights Component Location (L2)........33-37
Figure 19: Ordinance Lights Detailed Description (L3).........33-39
Figure 20: Lavatory Lights (L2)...33-41
Figure 21: Lavatory Lights Detailed Description (L3) 33-43
Figure 22: Emergency Lights General Description (L2) 33-45
Figure 23: Emergency Lights Power Supply Unit and Exterior Emergency Light (L2)........................... 33-47
Figure 24: Emergency Exit Signs and Overhead and Aisle Emergency Lights (L2).............................. 33-49
Figure 25: Flight Deck and Passenger Cabin Emergency Light Switches (L2) 33-51
Figure 26: Emergency Lights Detailed Description (L3) 33-53
Figure 27: Emergency Light Power Distribution (L3) 33-55
Figure 28: Exterior Lights General Description (L2)............ 33-59
Figure 29: Landing and Taxi Lights General Description (L2) 33-61
Figure 30: Landing and Taxi Lights (L2) 33-63
Figure 31: Landing and Taxi Lights Detailed Description (L3) 33-65
Figure 32: Navigation Lights General Description (L2) 33-67
Figure 33: Navigation Lights (L2).. 33-69
Figure 34: Navigation Lights Detailed Description (L3)........ 33-71
Figure 35: Wing Inspection Lights General Description (L2) 33-73
Figure 36: Wing Inspection Lights (L2) 33-75
Figure 37: Wing Inspection Lights Detailed Description (L3) 33-77
Figure 38: Beacon Light General Description (L2).............. 33-79
Figure 39: LED Beacon Light and Beacon Light Power Supply (L2) 33-81

Figure 40: Beacon Light Inverter (L2) 33-83
Figure 41: Beacon Lights Detailed Description (L3) 33-85
Figure 42: Anticollision Strobe Lights General Description (L2) 33-87
Figure 43: Anticollision Strobe Lights (L2) 33-89
Figure 44: Strobe Lights Detailed Description (L3) 33-91
Figure 45: Logo Lights General Description (L2) 33-93
Figure 46: Logo Lights (L2) 33-95
Figure 47: Logo Lights Detailed Description (L3) 33-97
Figure 48: Cargo and Loading Area Lights (L2) 33-99
Figure 49: Cargo and Loading Area Lights (L2) 33-101
Figure 50: Cargo Lights Detailed Description (L3) 33-103
Figure 51: Service and Maintenance Lights (L2) 33-105
Figure 52: Service and Maintenance Lights Detailed Description (L3) 33-107

LIGHTING SYSTEM - CHAPTER BREAKDOWN

Flight Deck Lighting 1

Passenger Cabin Lighting 2

Emergency Lighting 3

Exterior Lighting 4

Cargo Lights 5

Service and Maintenance Lighting 6

33-10 FLIGHT DECK LIGHTING

GENERAL DESCRIPTION

Flight deck lighting consists of:

- Floodlighting
- Miscellaneous lighting
- Integral lighting (refer to ATA 31)

FLOODLIGHTING

Main Instrument Floodlights

The main instrument floodlights are located under the glareshield. The lights illuminate the pilot and copilot displays. The lights are controlled by the FLOOD potentiometer on the LIGHTING AND COCKPIT DOOR PANEL.

Side Console Panel Lights

The side console panel lights provide illumination for the pilot and copilot side console panels. The lights are controlled by the SIDE potentiometer on the SIDE CONSOLE panel.

MISCELLANEOUS LIGHTS

Dome Lights

The dome lights provide illumination of the flight deck area. The lights are turned on by the DOME switch on the overhead panel.

Reading Lights

There are reading lights in the flight deck for pilots and the observer. Each reading light is individually controlled by LIGHT potentiometers located on the overhead panel and the observer panel.

Map Lights

The pilot and copilot map reading lights are located on the windshield side post. Each light has an ON/OFF switch, dimmer control, and a red or white color selection.

Compass Light

The compass light is selected on by a pushbutton located in the overhead panel.

Entrance Ceiling and Floor Lights

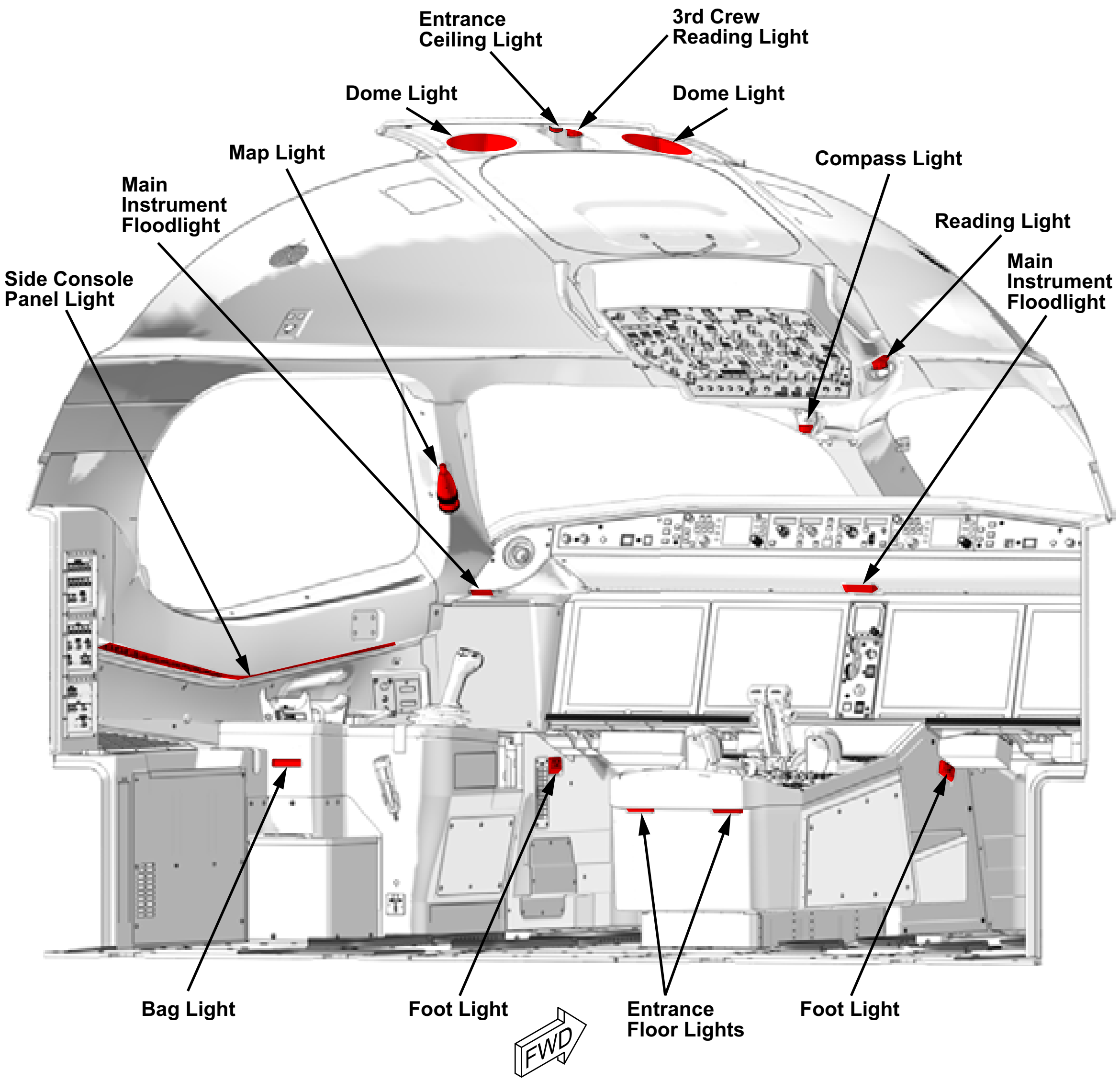
The entrance ceiling light is located on the overhead trim panel. The entrance floor lights are located on the back of the center pedestal.

Foot Lights

The flight deck foot lights, located within the pilot and copilot rudder pedal well, provides illumination for the floor area between the rudder pedals and around the pilot seats. The foot lights are controlled by a switch on the SIDE CONSOLE panel.

Bag Lights

The bag lights, located on the aft face of the pilot and copilot side consoles, provide illumination for the flight crew bag storage. The bag lights are controlled by a switch on the SIDE CONSOLE panel.



LIGHT		POWER
Main Instrument Panel Floodlights		DC ESS BUS 1
Left Side Console Panel Light		DC BUS 1
Right Side Console Panel Light		DC BUS 2
Dome Lights	Battery Only	DC EMER BUS
	Ground Service	DC BUS 1
	Normal Power	DC ESS BUS 3
Reading Lights		DC BUS 1
Left Map Light		DC BUS 1
Right Map Light		DC BUS 2
Compass Light		RDC 3
Entrance Light	Ceiling	DC BUS 1
	Floor	DC BUS 2
Left Foot Lights		DC BUS 1
Right Foot Lights		DC BUS 2
Left Bag Light		DC BUS 1
Right Bag Light		DC BUS 2

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Figure 1: Flight Deck Lighting (L2)

COMPONENT LOCATION

The main instrument and side console lights have the following major components:

- Current dimmer box
- Voltage dimmer boxes

CURRENT DIMMER BOX

The current dimmer box 1 is located behind the LH overhead trim panel.

VOLTAGE DIMMER BOX

One voltage dimmer box is located in each of the side consoles. Voltage dimmer box 3 is located behind the right side console and voltage dimmer box 2 is located behind the left side console.

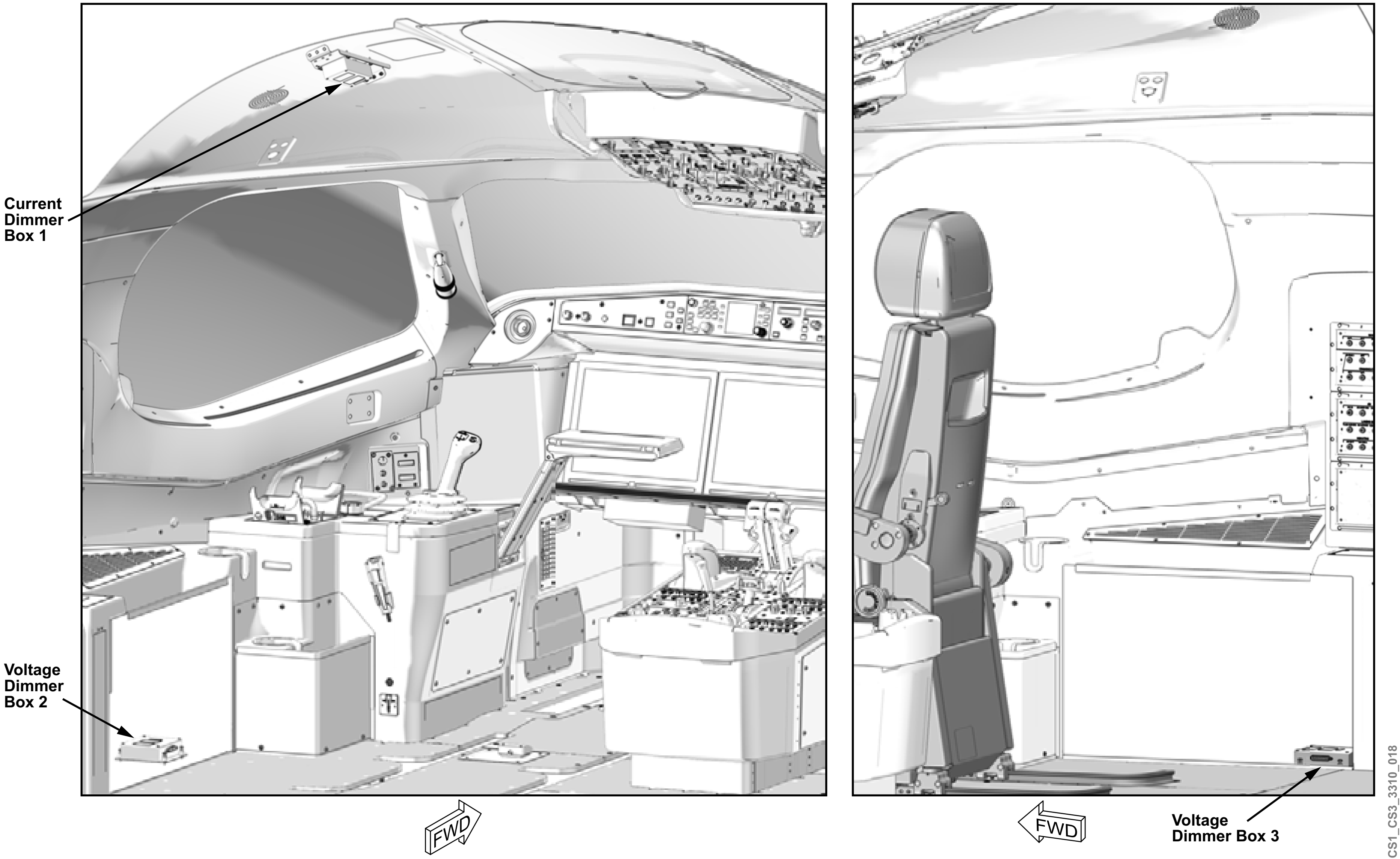


Figure 2: Current and Voltage Dimmer Boxes (L2)

CONTROLS AND INDICATIONS

DOME AND ENTRANCE LIGHT PANEL

The DOME and ENTRANCE LIGHT panel has a pushbutton annunciator (PBA) for the DOME light and a potentiometer that controls the overhead entrance light and console mounted FLOOR lights.

MISCELLANEOUS LIGHT PANEL

The MISCELLANEOUS LIGHT panel has controls for the CIRCUIT BREAKER AND OVERHEAD panel integral lights.

The STORM position of the ANNUN switch turns all of the integral lights on to full intensity. The STORM position also turns on the flight deck DOME lights.

The compass light is turned on by the COMPASS switch.

LEFT AND RIGHT READING LIGHT PANELS

The left and right reading light potentiometers, located on the outboard overhead panels, have ON/OFF and brightness control.

LEFT AND RIGHT SIDE LIGHT PANELS

The left and right SIDE light panels have controls for the side console lights, as well as BAG, and FOOT lights.

LIGHTING AND COCKPIT DOOR PANEL

The LIGHTING and COCKPIT DOOR panel has controls for the main instrument panel floodlighting and the main instruments panel and glareshield integral lights.

THIRD CREW LIGHT SWITCH PANEL

The third crew light switch panel has a READING light potentiometer with ON/OFF and BRT (brightness) control.

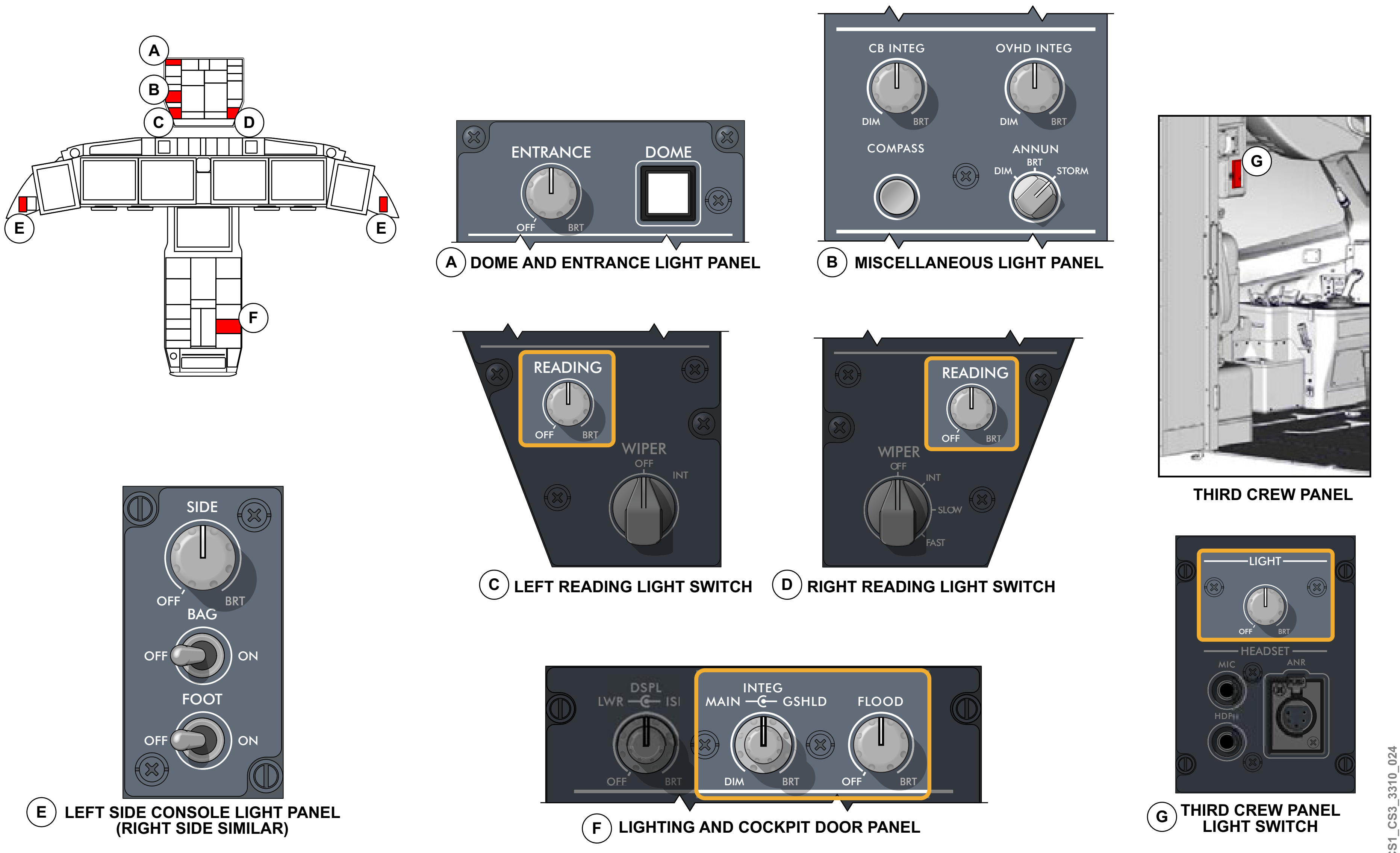


Figure 3: Flight Deck Lighting (L2)

DETAILED DESCRIPTION

FLOODLIGHTING

Main Instrument Floodlights

Voltage dimmer box 2, channel 1, is powered by DC BUS 1, and channel 2 is powered by DC ESS BUS 1.

Each dimmer box supplies three 28 VDC outputs and one 6 VDC output.

The main instrument floodlights are powered by DC ESS BUS 1 through dimmer box 2. The FLOOD potentiometer, located on the center pedestal, adjusts the brightness and provides ON/OFF control.

Side Console Panel Lights

The left side console panel light is powered by DC BUS 1 through voltage dimmer box 2. The right side console panel light is powered by DC BUS 2 through voltage dimmer box 3. The SIDE potentiometer, located on the left and right side panel consoles below the glareshield, adjusts the brightness and provides ON/OFF control.

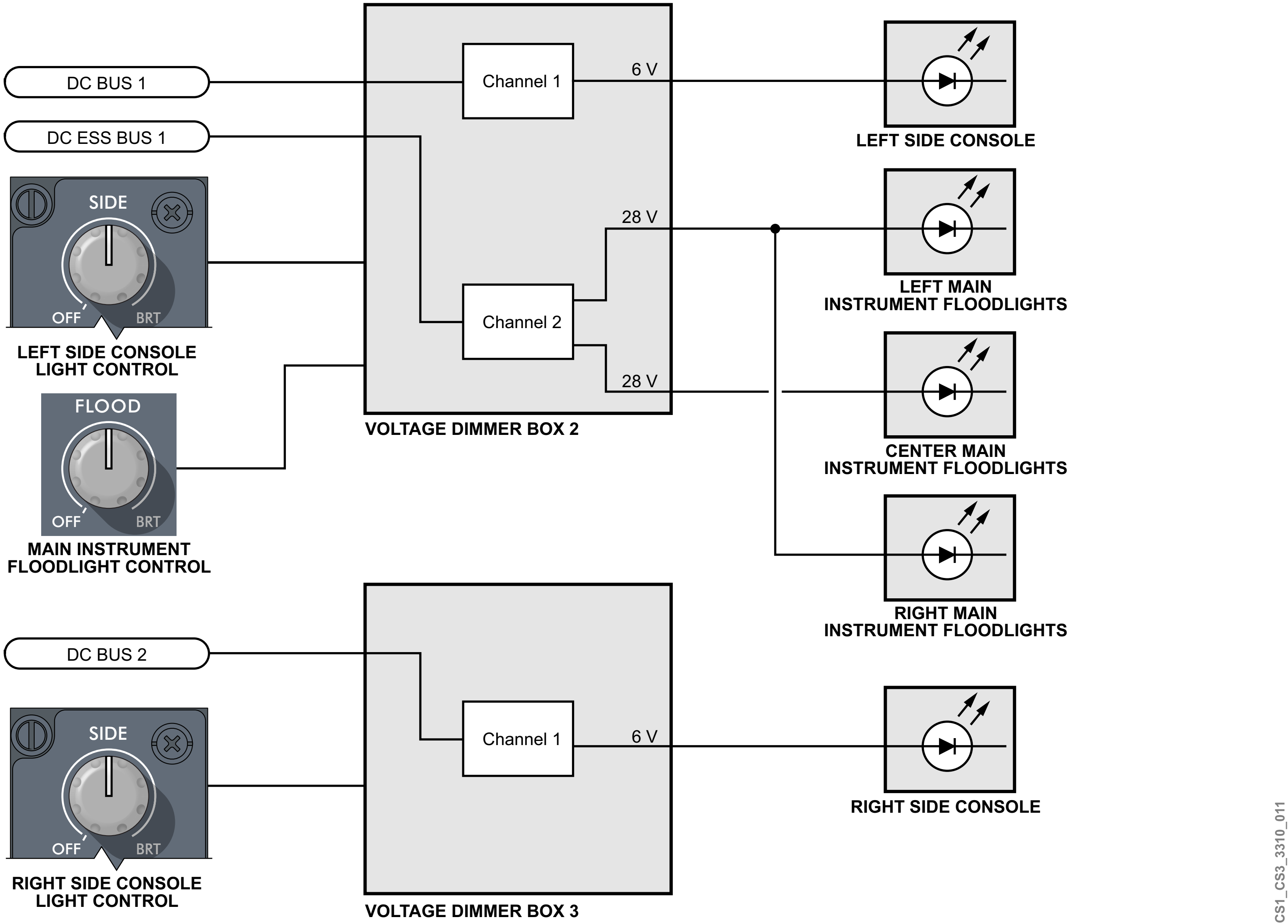


Figure 4: Main Instrument Floodlight Panel and Side Console Lights Detailed Description (L3)

MISCELLANEOUS LIGHTS

Cockpit Dome Light

The lights are turned on by the DOME PBA on the overhead panel. The two dome lights in the cockpit are connected in parallel.

Battery Power Only

Power for the dome lights is provided by the DC EMER BUS when the aircraft is on battery power only. A timer function turns off the lights automatically after 20 minutes.

Ground Service Mode

If the aircraft is in ground service mode, the lights are powered by DC BUS 1 through the SSPC. The lights remain powered as long as the DOME PBA is selected.

Normal Power

When the aircraft is fully powered, the lights are powered from DC ESS BUS 3. The lights remain powered as long as the DOME PBA is selected.

Storm Lights

If the DOME PBA is selected off and the ANNUN switch is selected to STORM, the dome lights are powered on via the SSPC.

DOME PBA Light

The DOME PBA annunciator is turned on by the ENTRY switch at the forward passenger door when the aircraft is not powered.

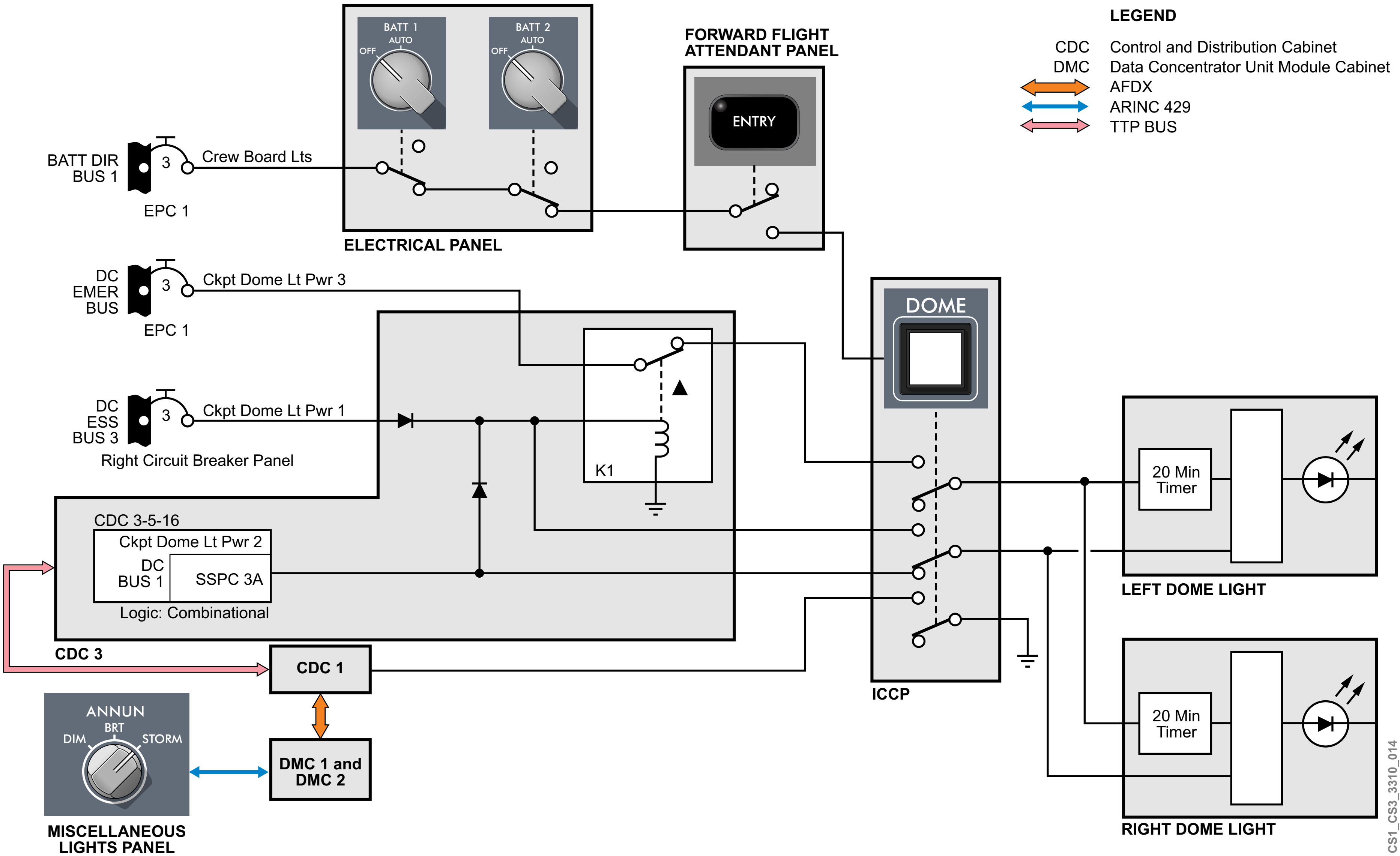


Figure 5: Cockpit Dome Light (L3)

Reading Lights

Each reading light is individually controlled by READING LIGHT potentiometers located on the overhead panel and the observer panel. The reading lights are powered by DC BUS 1 through current dimmer box 1.

Map Lights

Each light has an ON/OFF switch, dimmer control, and red or white selection. The pilot map light is powered by DC BUS 1 and copilot map light is powered by DC BUS 2.

Compass Light

The compass light is controlled by the COMPASS pushbutton located on the overhead panel. The compass light receives power from remote data concentrator (RDC) 3.

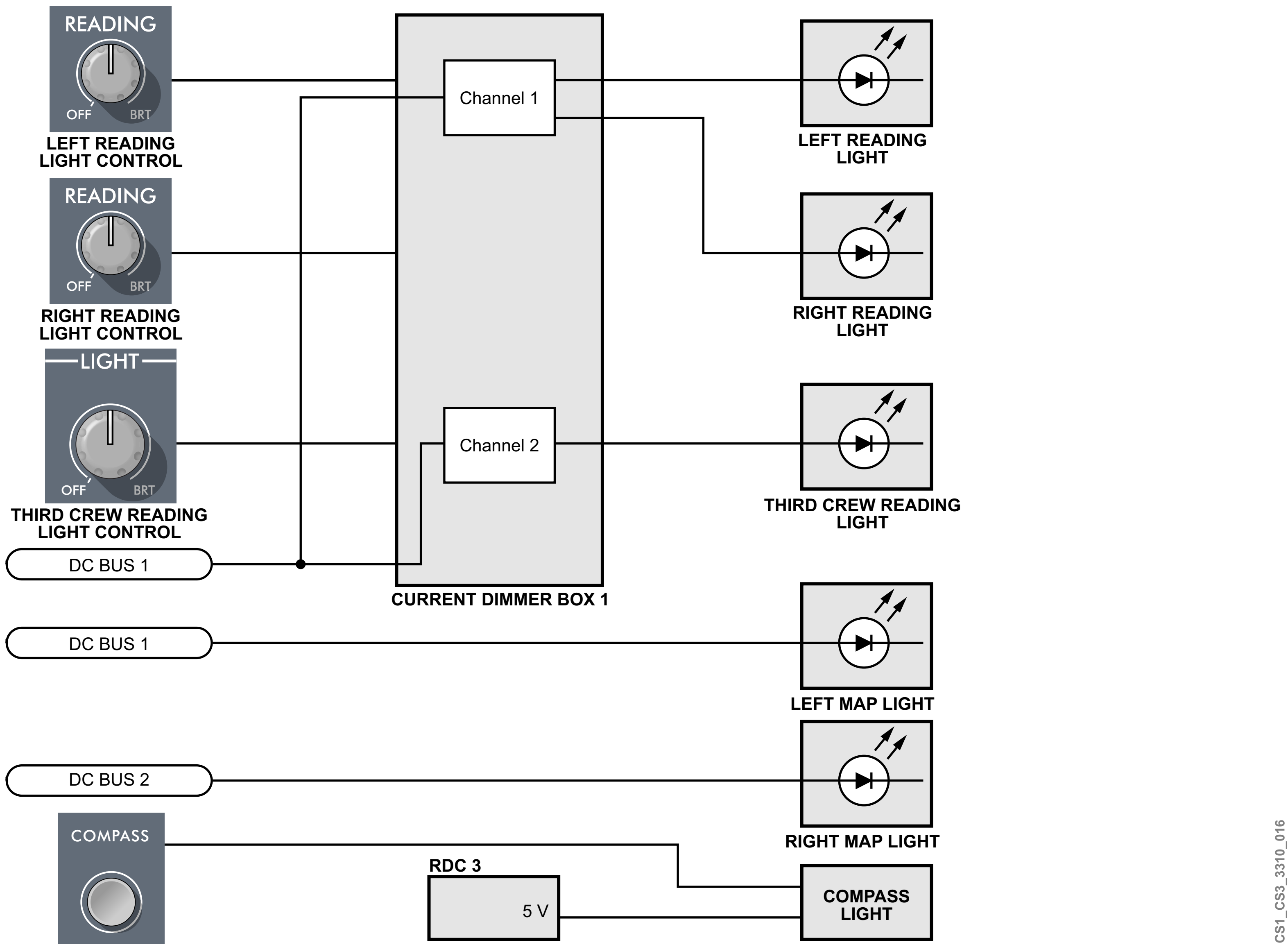


Figure 6: Reading, Map, and Compass Lights (L3)

Entrance Ceiling and Floor Lights

The entrance ceiling light is powered by DC BUS 1 through current dimmer box 1. The dual ganged ENTRANCE potentiometer adjusts the brightness and provides ON/OFF control. The initial 50% rotation of the potentiometer turns on the entrance lights. Further rotation past 50% turns on the floor lights.

The entrance floor lights are controlled through voltage dimmer box 3. The input power is supplied by DC BUS 2.

Foot Lights

The pilot foot lights are powered by DC BUS 1. The copilot foot lights are powered by DC BUS 2. They are controlled by ON/OFF switches on the pilot and copilot left and right SIDE control panels.

Bag Lights

The bag lights, located on the aft face of the pilot and copilot side consoles, provide illumination for the flight crew bag storage.

The pilot crew bag light is powered by DC BUS 1. The copilot bag light is powered by DC BUS 2. They are controlled by ON/OFF switches on the pilot and copilot left and right SIDE control panels.

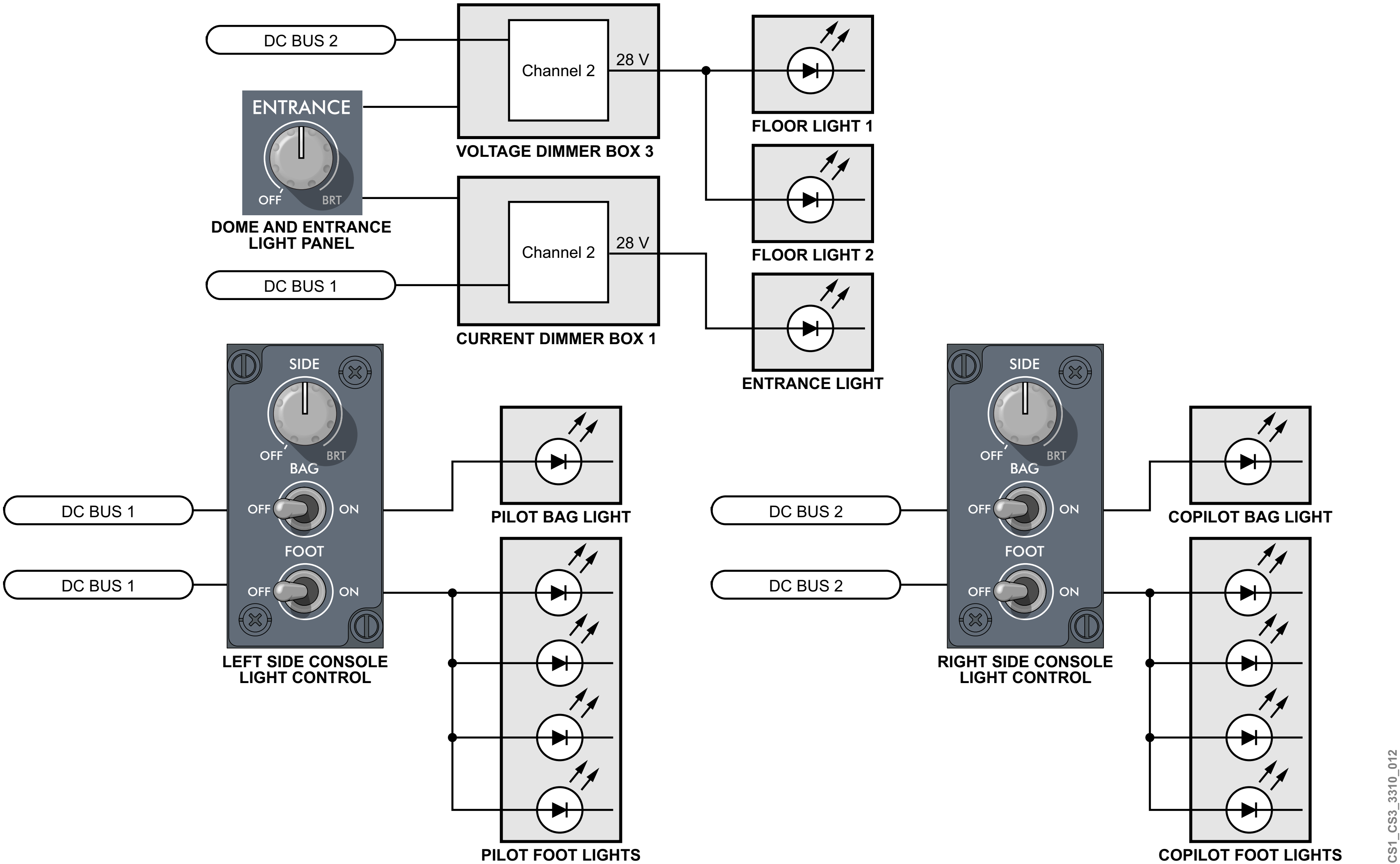


Figure 7: Entrance, Floor, Foot, and Bag Lights (L3)

33-20 PASSENGER CABIN LIGHTING

MAIN CABIN LIGHTING

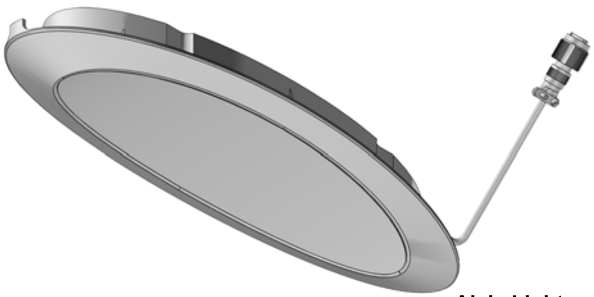
GENERAL DESCRIPTION

The main cabin lighting consists of wash lighting on the ceiling and sidewalls that is provided by light-emitting diode (LED) lighting units. The light units are powered by DC BUS 1. The light units are supplied in several different lengths, and can be linked together to form a continuous strip along the full length of the cabin.

The main cabin lighting is controlled by preprogrammed scenarios from the cabin management system (CMS) crew terminal. The settings for brightness and color are transmitted from the CMS to the lighting units via a data bus.

If the data bus communication fails, the light units can be switched off by the SIDEWALL and CEILING switches on the forward flight attendant light panel. These switches turn off the lights even if the CMS data bus is active.

The aisle lights are installed on the centerline of the ceiling to provide accent lighting along the aisle. The aisle lights are powered by DC ESS BUS 1 and controlled as part of the preprogrammed scenarios from the CMS crew terminal. The aisle lights are also separately powered by the emergency light system to provide illumination when essential power is lost.



POWER SOURCE	
Light	**Power**
Ceiling	DC BUS 1
Side Wall	DC BUS 1
Aisle	DC ESS BUS 1

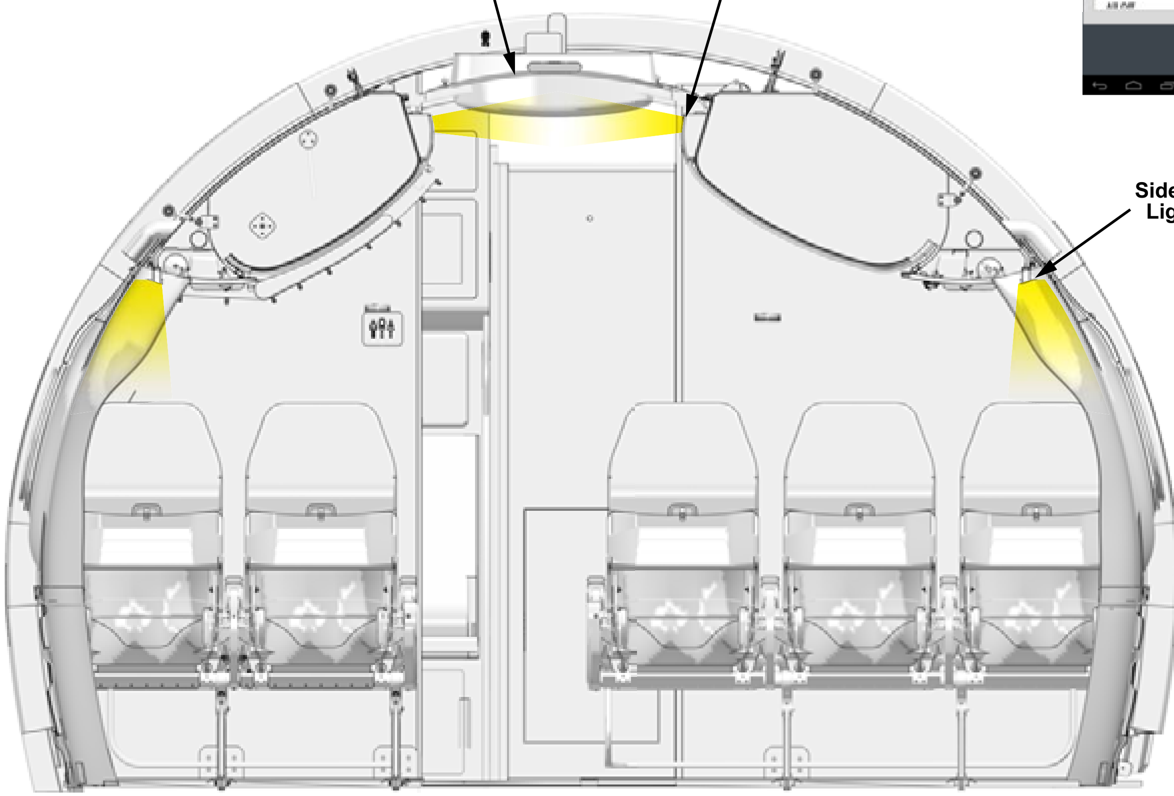


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Figure 8: Main Cabin Lighting (L2)

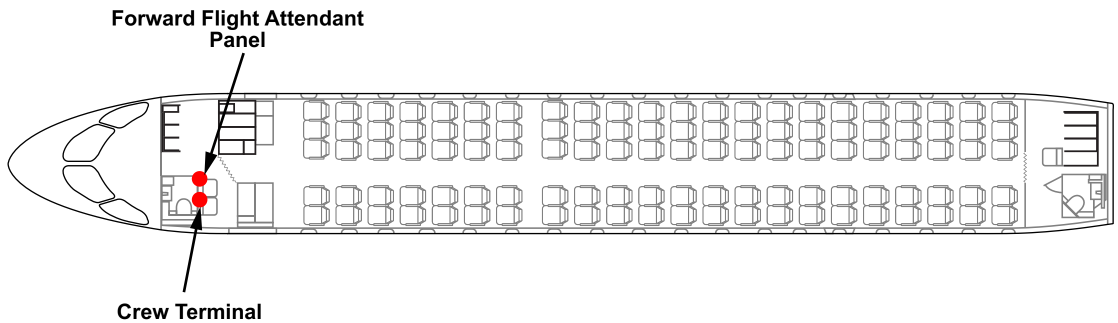
CONTROLS AND INDICATIONS

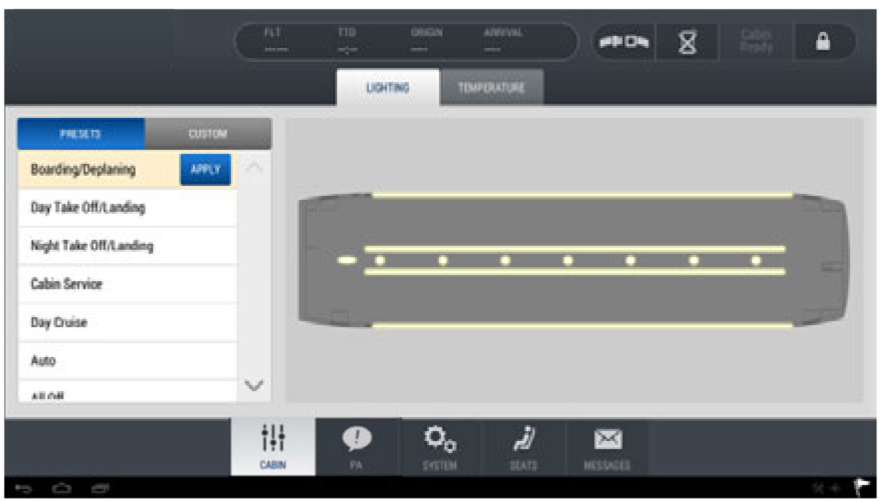
CABIN MANAGEMENT SYSTEM CREW TERMINAL

The ceiling and sidewall lights are controlled from the cabin management system (CMS) crew terminal. The CMS lighting page has several preprogrammed scenarios selectable from a menu. The CMS shows a preview of the selected lighting scenario on the lighting page.

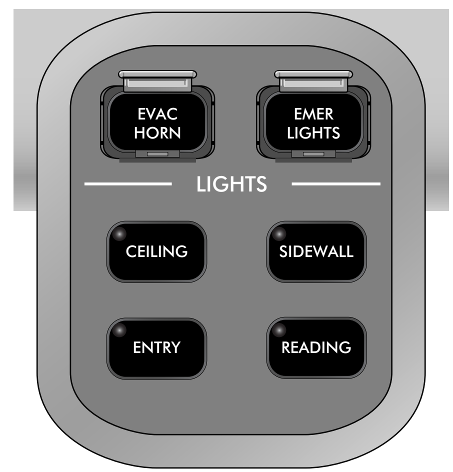
FORWARD FLIGHT ATTENDANT PANEL

The cabin and sidewall lights can be turned off from the forward FLIGHT ATTENDANT panel if the CMS crew terminal fails.





CREW TERMINAL



FORWARD FLIGHT ATTENDANT PANEL

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Figure 9: Main Cabin Light Control (L2)

DETAILED DESCRIPTION

The cabin lighting is a networked system controlled by the cabin management system (CMS) (ATA 44) to provide a wide range of brightness settings and color variations. The CMS crew terminal controls the cabin controller through zone box 1.

The ceiling and sidewall LED lighting units (LLUs) are connected to the CMS zone box 1 and zone box 2 via an RS-485 BUS. The light units can be addressed individually or grouped into zones.

The LLUs are powered by DC BUS 1. Normally the zone box will control the lighting units with programmed scenarios. The scenarios can be selected from the CMS crew terminal.

If a fault occurs, the lighting units can be switched off by the CEILING and SIDEWALL switches located at the forward flight attendant seats. The CEILING and SIDEWALL light switches provide inputs to the control and distribution cabinets (CDCs) through CDC 3 to turn off the ceiling and sidewall solid-state power controllers (SSPCs).

The LLUs provide fault status (load or internal fault, and overtemperature) to the onboard maintenance system (OMS) via the CMS and data concentrator unit module cabinets (DMCs). The CMS does not provide failure messages to the OMS when the RS-485 BUS has failed and the CEILING and SIDEWALL switches have been selected.

The aisle lights are powered from DC ESS BUS 1. Operation is controlled by the CMS and is synchronized to the preprogrammed scenarios for the main cabin lighting. If a CMS failure occurs, the lights will turn off.

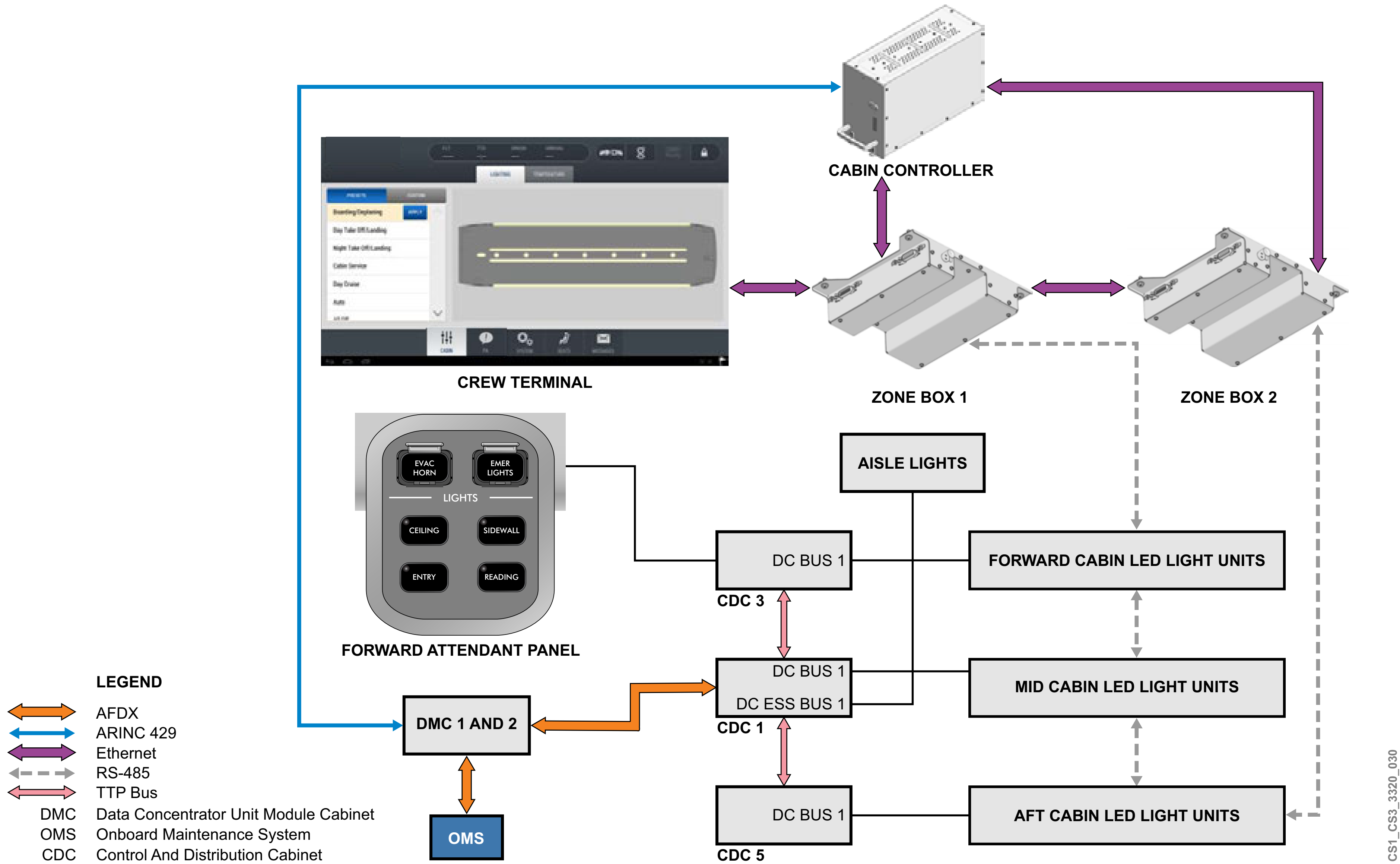


Figure 10: Passenger Cabin Lighting Detailed Description (L3)

ENTRY AND GALLEY LIGHTS

GENERAL DESCRIPTION

ENTRY LIGHTS

Entry spotlights are fitted in the aircraft forward and aft entrance areas to provide illumination for the entryways. All entry lights are powered by DC BUS 1. They are controlled from the CMS using the same scenarios as the main cabin lights. The entry lights are also controlled by the ENTRY lights switch on the flight attendant control panel.

One entry spotlight, located over the flight attendant seats, is also controlled by the READING light switch on the flight attendant panel.

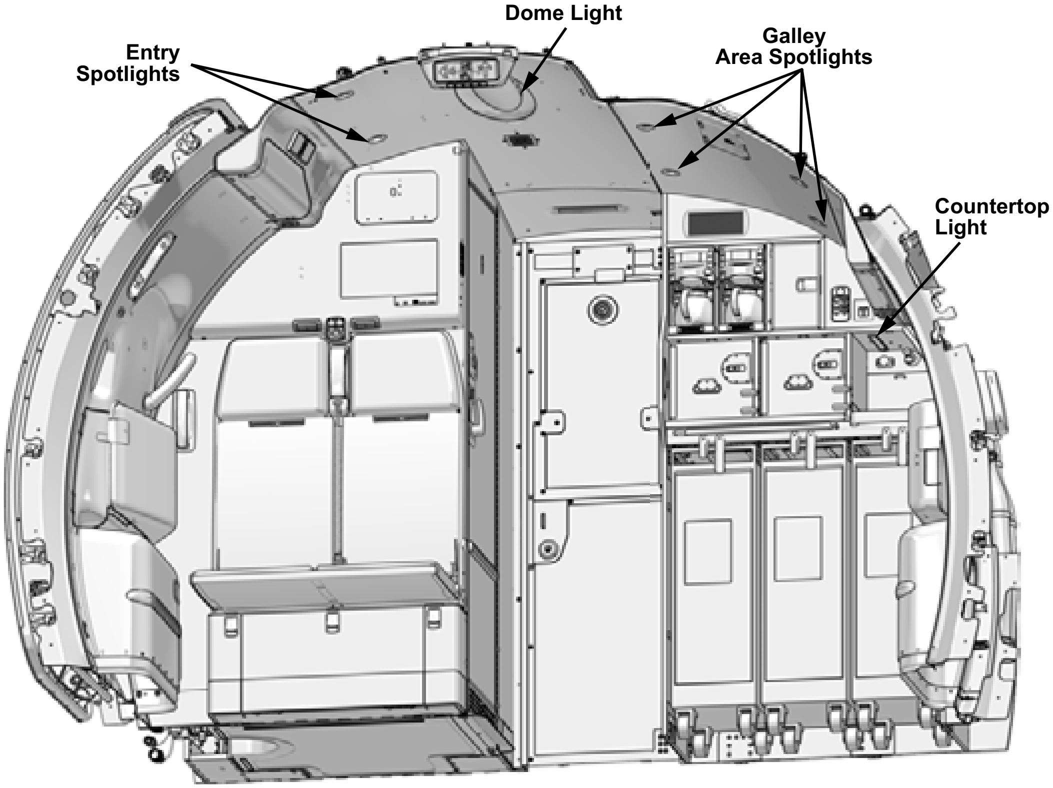
The dome light is located in the ceiling above the forward entry area. The dome light gives general illumination to the entry area. There is also a colored feature light around the periphery of the dome light. It is controlled from the CMS using the same scenarios as the main cabin lights. In addition, the dome light provides the crew entry function if the aircraft is not powered. When the ENTRY light switch is turned on, the dome light will illuminate on battery power for 20 minutes.

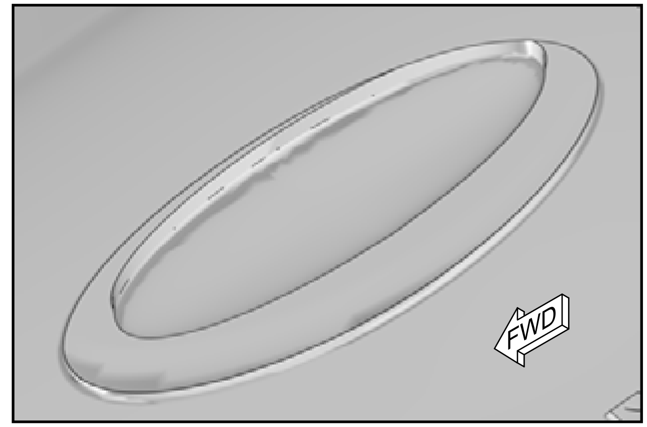
GALLEY LIGHTS

The galley lighting illuminates the forward and aft galley area zone and aft service door. Each galley area has four ceiling-mounted entry spotlights. The galley spotlights are powered from DC BUS 1. The galley area spotlights are normally controlled by the CMS, but can be overridden by the switches on the galley panel, which control the ON/OFF and BRT/DIM functions.

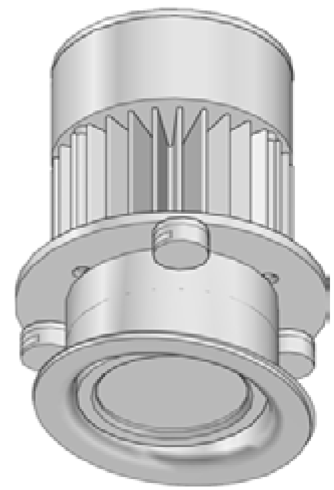
A countertop light illuminates the galley work space. The light is controlled directly from the galley control panel.

POWER SOURCE	
Light	**Power**
Entry Spotlight	DC BUS 1
Galley Area Spotlight	DC BUS 1
Countertop Light	DC BUS 1
Dome Light (Crew Entry)	BATT DIR BUS 1
Dome Light (Normal)	DC BUS 1





DOME LIGHT



SPOTLIGHT

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Figure 11: Entry and Galley Lights (L2)

CONTROLS AND INDICATIONS

CREW TERMINAL

The crew terminal controls the entry lighting through the same selectable preprogrammed scenarios as the main cabin lighting.

FORWARD FLIGHT ATTENDANT PANEL

The FWD flight attendant panel controls the dome light through the ENTRY switch when no power is on the aircraft. The panel also controls one entry spotlight over the flight attendant seat through the READING switch.

FORWARD GALLEY PANEL

The FWD galley panel controls the galley area and countertop lights.

AFT FLIGHT ATTENDANT PANEL

The AFT flight attendant panel has a READING switch to control one entry spotlight above the flight attendant seat. The ENTRY and BRT/DIM switches control the area lights.

AFT GALLEY PANEL

The AFT galley panel controls the aft galley area and countertop lights.

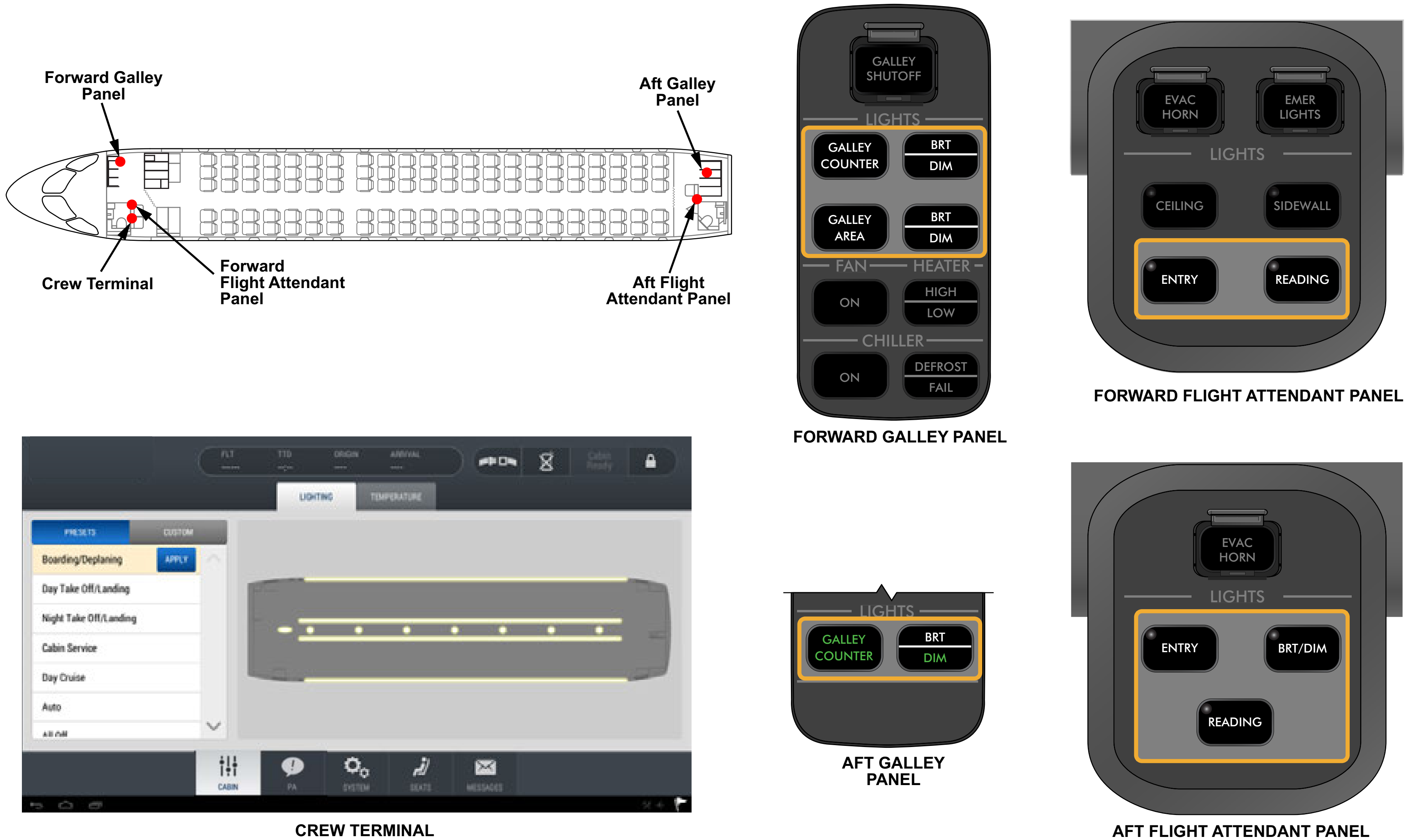

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Figure 12: Entry and Galley Lights Control (L2)

DETAILED DESCRIPTION

ENTRY LIGHTS

Entry spotlights are controlled from the cabin management system (ATA 44) using the same scenarios as the main cabin lights. If the RS-485 BUS fails, then the entry spotlight turns on at 50% brightness.

One entry spotlight over the flight attendant seat operates as a reading light and can be controlled using the READING switch on the FORWARD FLIGHT ATTENDANT panel. If the RS-485 BUS fails, the READING switch has no control over the light.

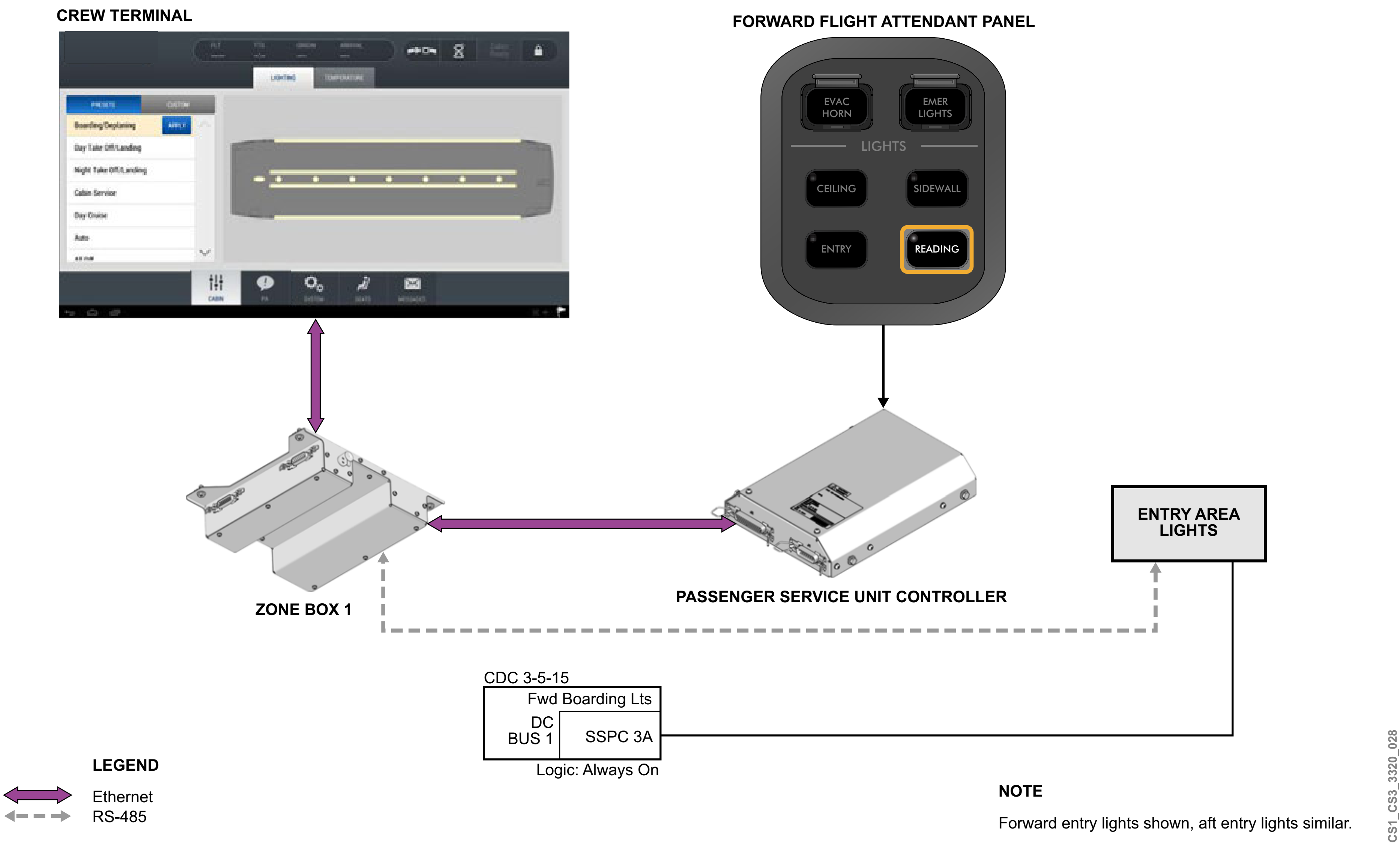


Figure 13: Entry Lights Detailed Description (L3)

DOME LIGHT

Normal Operation

The dome light is controlled via a RS-485 BUS and uses the same lighting scenarios from the CMS as the main cabin lighting. The dome light receives power from DC BUS 1. In the event of a CMS failure, the unit goes to 50% brightness.

Crew Entry

The crew entry function provides lighting when the aircraft is not powered. Pressing the ENTRY switch energizes a relay in CDC 3. Once this relay is latched on, the dome light is powered by BATT DIR BUS 1 and provides light for the forward entry area and the DOME PBA in the flight deck. A timer in the dome light assembly turns the light off after 20 minutes to prevent the aircraft batteries from depleting.

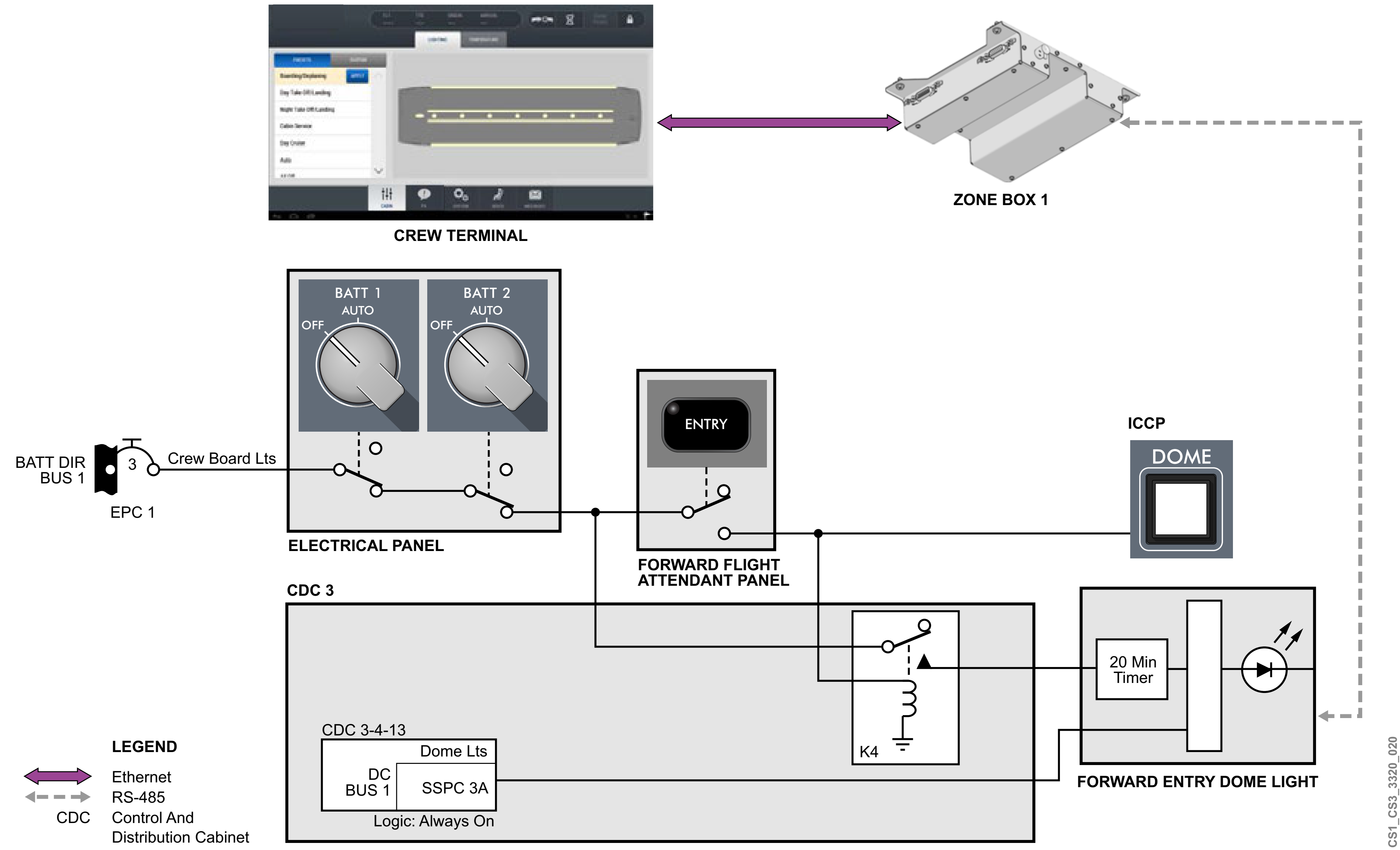


Figure 14: Dome Light Detailed Description (L3)

GALLEY LIGHTS

The galley countertop light is directly connected to the CDC and is controlled by the GALLEY COUNTER and BRT/DIM switches from the GALLEY panel.

The galley area lighting is controlled from the CMS crew terminal using preprogrammed lighting scenarios. The GALLEY AREA switch on the GALLEY panel turns the lights on or off through zone box 1 (ATA 44). The BRT/DIM switch controls the light intensity.

If the cabin management system fails, the lights are powered by the CDC and turn on dim level only. The lights cannot be controlled from the GALLEY panel.

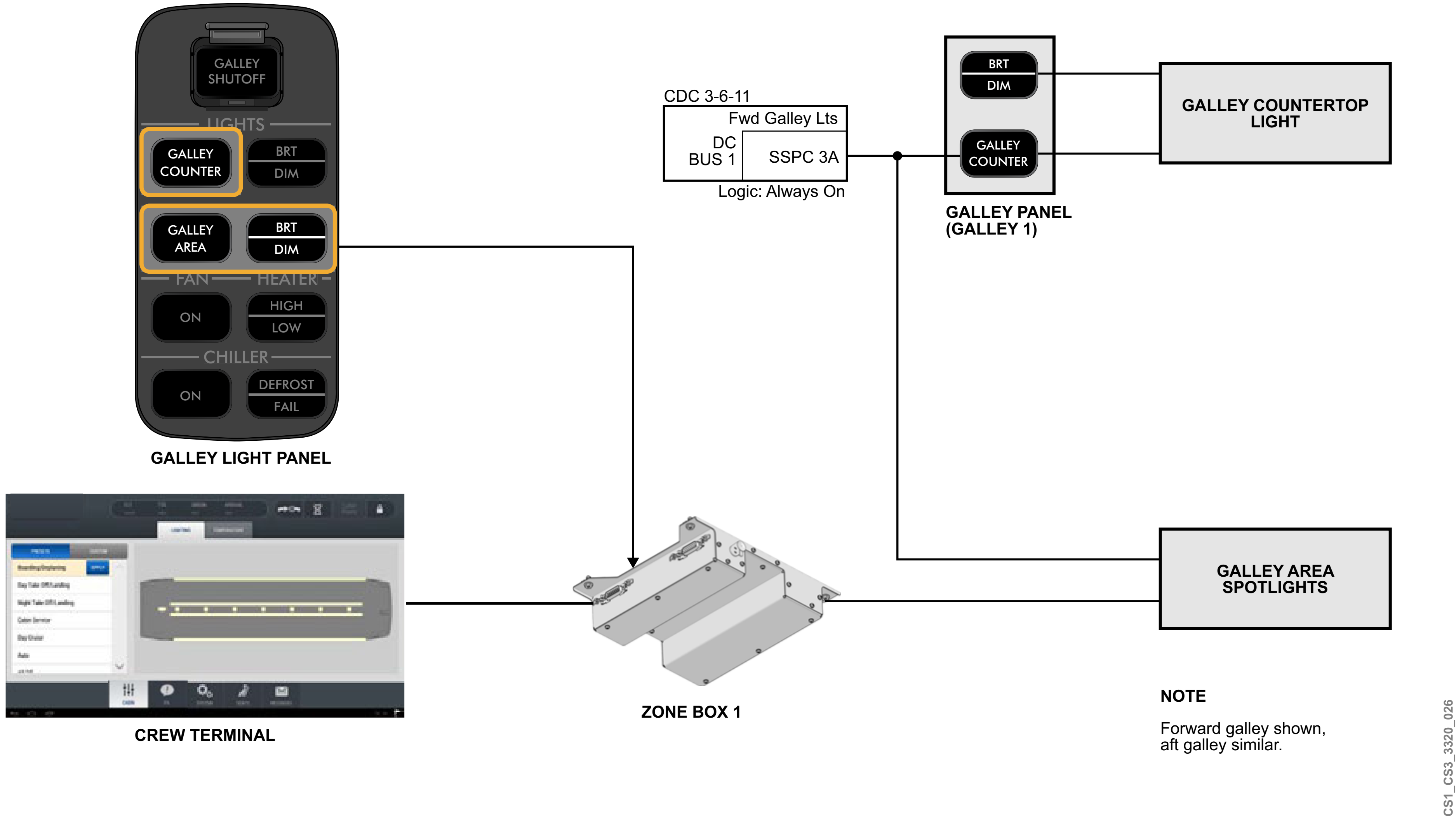


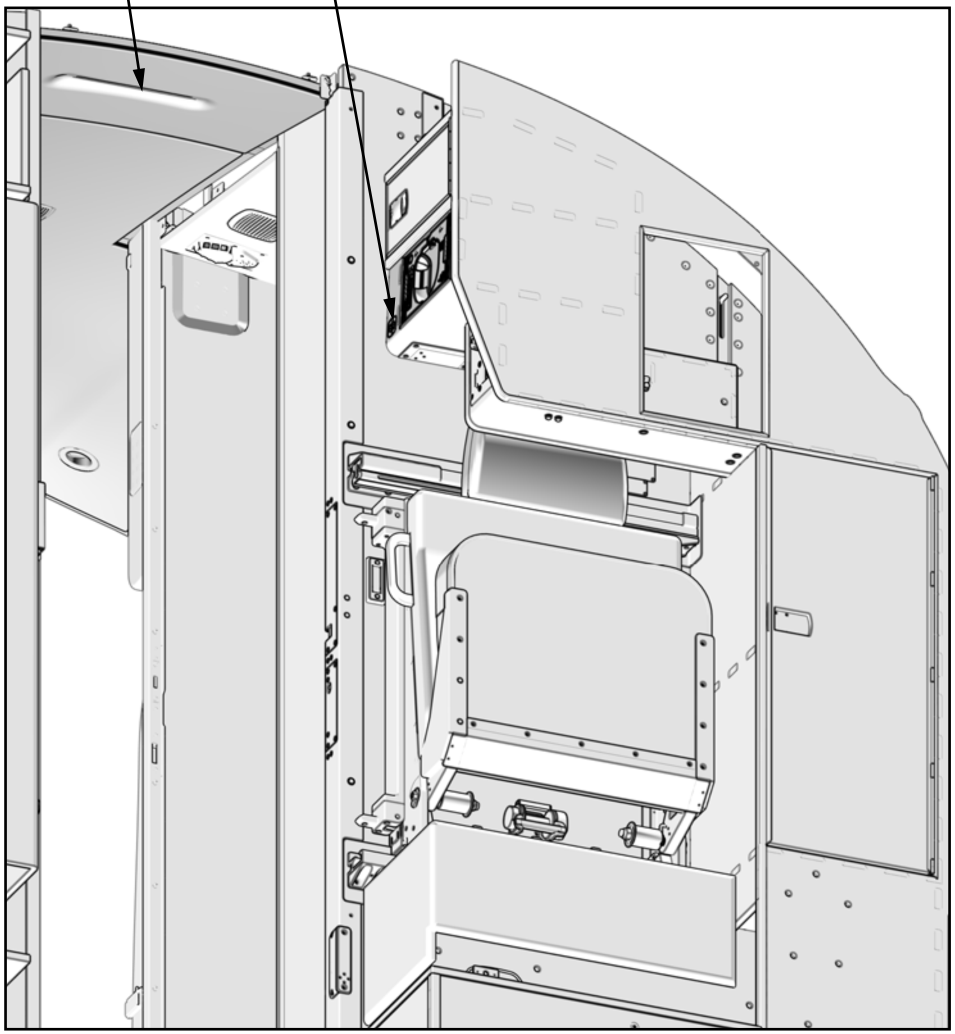
Figure 15: Galley Lights Detailed Description (L3)

FLIGHT DECK DOOR LIGHT

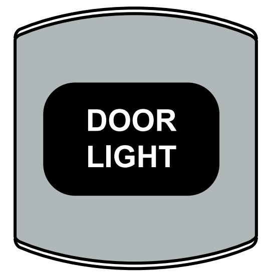
GENERAL DESCRIPTION

FLIGHT DECK DOOR LIGHT

The flight deck door light is mounted outside the flight deck door. The light is operated by a momentary switch located near the observer seat. The light illuminates the door area to improve visibility when looking through the viewport.



POWER SOURCE	
Light	**Power**
Flight Deck Door Light	DC BUS 1



FLIGHT DECK DOOR LIGHT SWITCH

CS1_CS3_3320_018

Figure 16: Flight Deck Door Lighting and Control (L2)

DETAILED DESCRIPTION

The flight deck door light operates using the momentary switch next to the flight deck door. The light is supplied with 28 VDC from CDC 3 through the momentary switch.

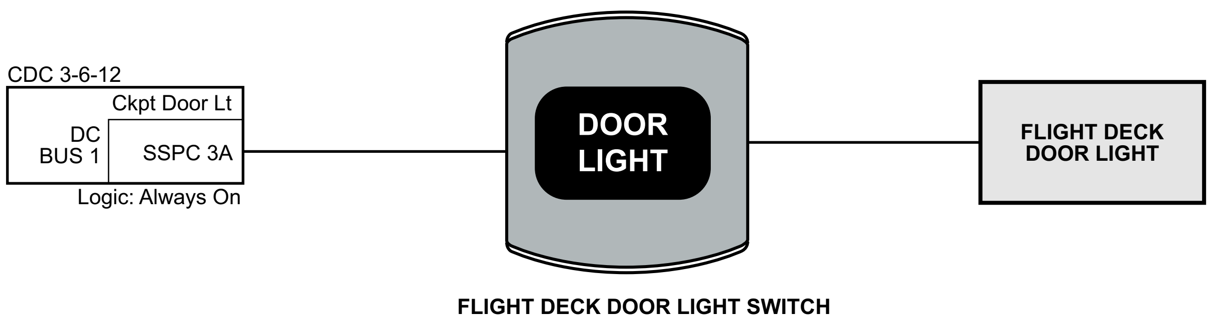


Figure 17: Flight Deck Door Light Detailed Description (L3)

ORDINANCE LIGHTS

GENERAL DESCRIPTION

The ordinance lights consist of the no personal electronic device (NO PED) and fasten seatbelt (FSB) signs located throughout the cabin and the return to seat signs in the lavatory. Each ordinance sign has a no smoking sign symbol that does not illuminate.

There is one NO PED/FSB sign installed on each passenger service unit (PSU) located above each seat row. The return to seat sign on the lavatory PSU is turned on when fasten seatbelt sign is on.

Each galley has a NO PED/FSB sign on the aft face of the area call panels in the forward and aft galleys.

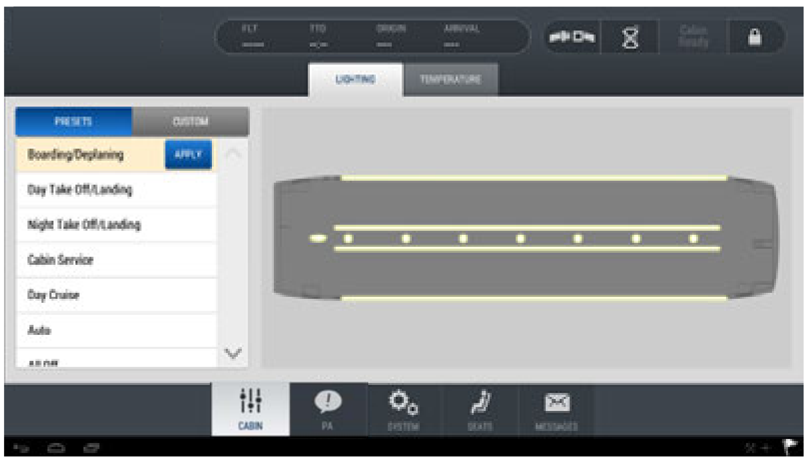
The flight deck ordinance switches, located on the eyebrow panel, normally control the ordinance signs.

The CMS crew terminal can control the ordinance lights depending on the position of the flight deck ordinance light switches.

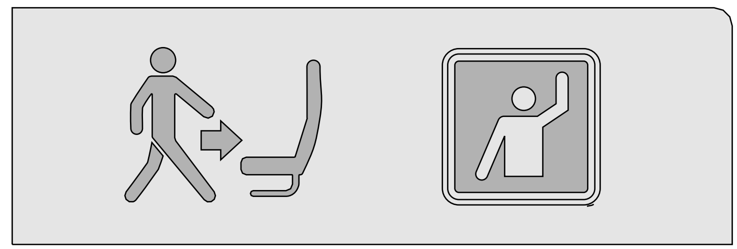
The ordinance signs receive power from the passenger service unit controller (PSUC). Each lavatory has a dedicated PSUC mounted in the ceiling. There is one PSUC for every two seat rows in the cabin. The PSUCs are located above the passenger service units. The lavatory PSUCs and left PSUCs receives power from DC BUS 1. The right PSUCs receive power from DC BUS 2.

EYEBROW PANEL

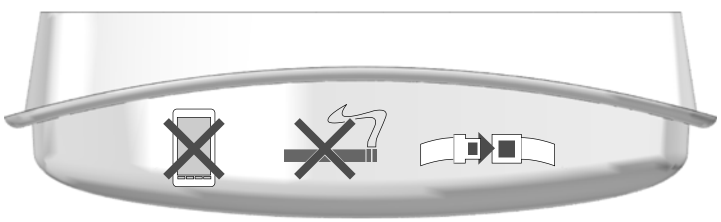
POWER SOURCE	
Ordinance Sign	**Power**
Lav A	DC BUS 1
Lav E	DC BUS 1
LH PSUC	DC BUS 1
RH PSUC	DC BUS 2



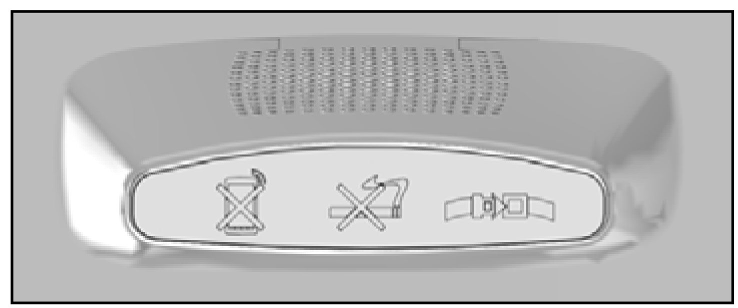
CREW TERMINAL



LAVATORY PASSENGER SERVICE UNIT



AREA CALL PANEL



PASSENGER SERVICE UNIT

CS1_CS3_3320_019

Figure 18: Ordinance Lights Component Location (L2)

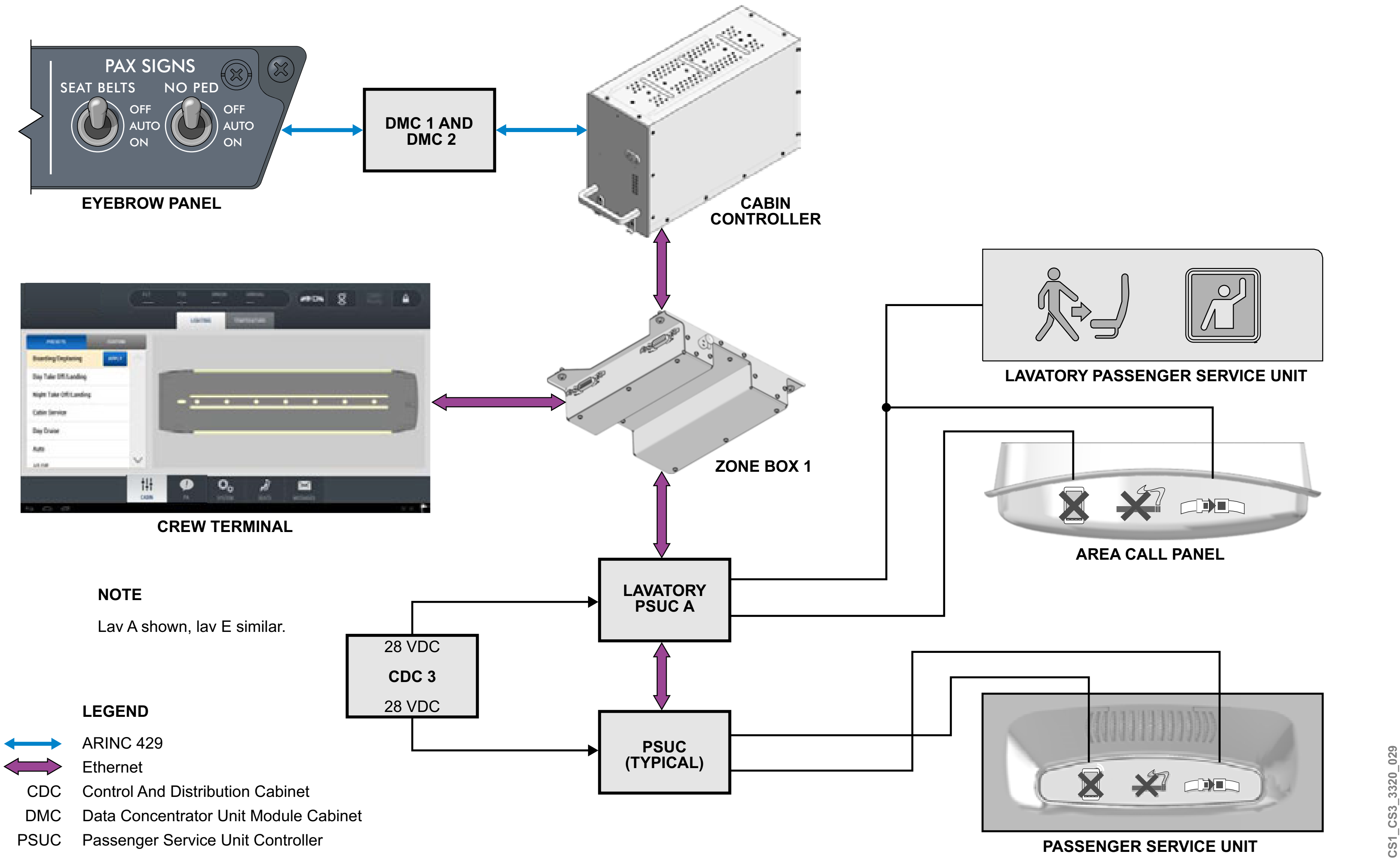
DETAILED DESCRIPTION

The ordinance signs receive 28 VDC power from their respective PSUC.

The NO PED/FSB and lavatory return to seat signs are controlled by the ordinance sign switches in the flight deck. The switches have OFF, AUTO, and ON positions. In the AUTO position, the signs turn on, based on the flight phase.

The signs can also be controlled from the CMS crew terminal when:

- Flight deck ordinance light switches are OFF
- Flight deck ordinance switches are in AUTO during cruise and descent flight phases



NOTE

Lav A shown, lav E similar.

LEGEND

- ARINC 429
- Ethernet
- CDC Control And Distribution Cabinet
- DMC Data Concentrator Unit Module Cabinet
- PSUC Passenger Service Unit Controller

Figure 19: Ordinance Lights Detailed Description (L3)

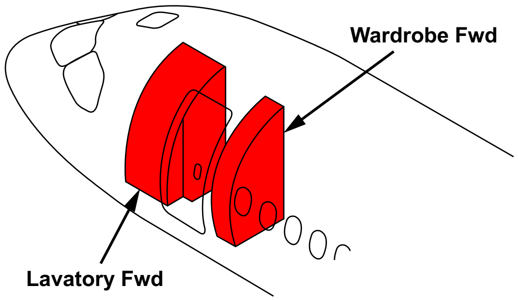
LAVATORY LIGHTS

GENERAL DESCRIPTION

Each lavatory has an LED light unit mounted in the ceiling. The LED light unit is controlled by the cabin management system (CMS) crew terminal. Lavatory A has an additional entry spotlight in the ceiling. The lavatory lights receive power from DC BUS 1.

LED light strips illuminate the mirror, countertop, and paper dispenser. When the lavatory door is unlocked, the lavatory light strips are in dimmed mode, the LED lighting unit is dim and the lavatory occupied sign is off.

The lavatory lights are turned on bright for cleaning purposes from the MAINTENANCE screen of the CMS crew terminal.



CREW TERMINAL

POWER SOURCE	
Light	**Power**
Lavatory Lights	DC BUS 1

NOTE

LAV A shown, aft similar.

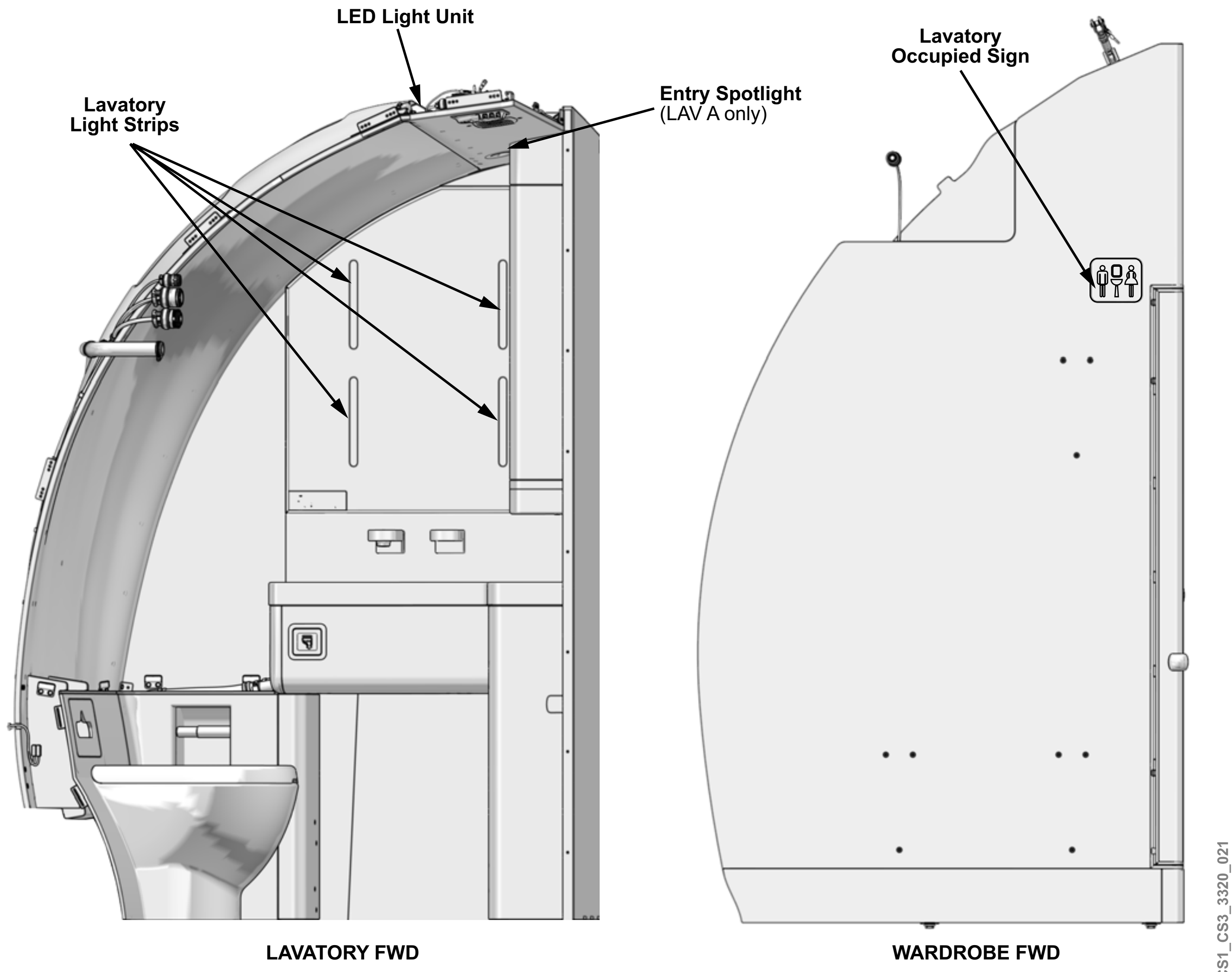


Figure 20: Lavatory Lights (L2)

DETAILED DESCRIPTION

The units in the lavatory are controlled by the CMS via a lavatory PSUC, with the exception of the lavatory ceiling LED lighting unit and entry spotlight, which are controlled by the CMS via the RS-485 BUS.

The lavatory door microswitch provides a door locked signal to the PSUC. When the lavatory door is locked, the LED light strips switch to bright mode and the lavatory occupied sign illuminates.

The lavatory lights are controlled from the CMS crew terminal MAINTENANCE screen. When CLEANING mode is selected on the CMS crew terminal MAINTENANCE screen, the LED light strips are in bright mode even if the lavatory door is unlocked.

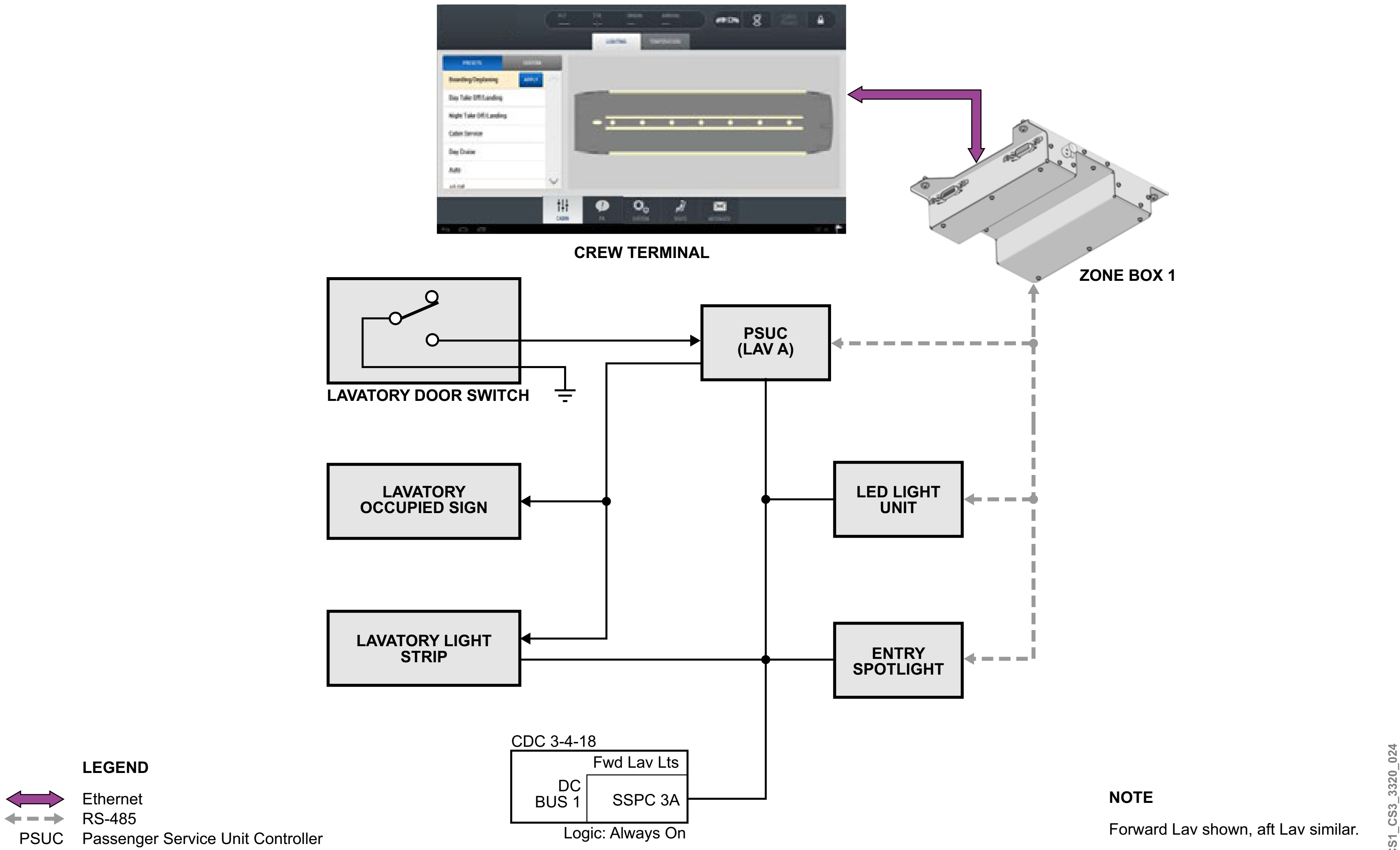


Figure 21: Lavatory Lights Detailed Description (L3)

33-50 EMERGENCY LIGHTS

GENERAL DESCRIPTION

The emergency lighting system provides illumination when the DC essential buses are not powered.

The emergency lights and signs operate on 5.6 VDC power supplied by six emergency power supply units (EPSUs) located throughout the cabin. Each EPSU is powered from a DC ESSENTIAL BUS.

The flight deck and passenger cabin emergency light switches manually control the lights and provide mode control inputs to turn the EPSU on automatically.

The EPSU monitors the DC ESSENTIAL BUS as part of its turn on logic. When DC essential power is lost, the EPSUs provide 10 minutes of power for the lights. If power is lost in flight and the ram air turbine (RAT) is deployed, the DC essential buses are repowered and the emergency lights turn off.

The EPSU reports its status, battery status, and when it is discharging to the DMC.

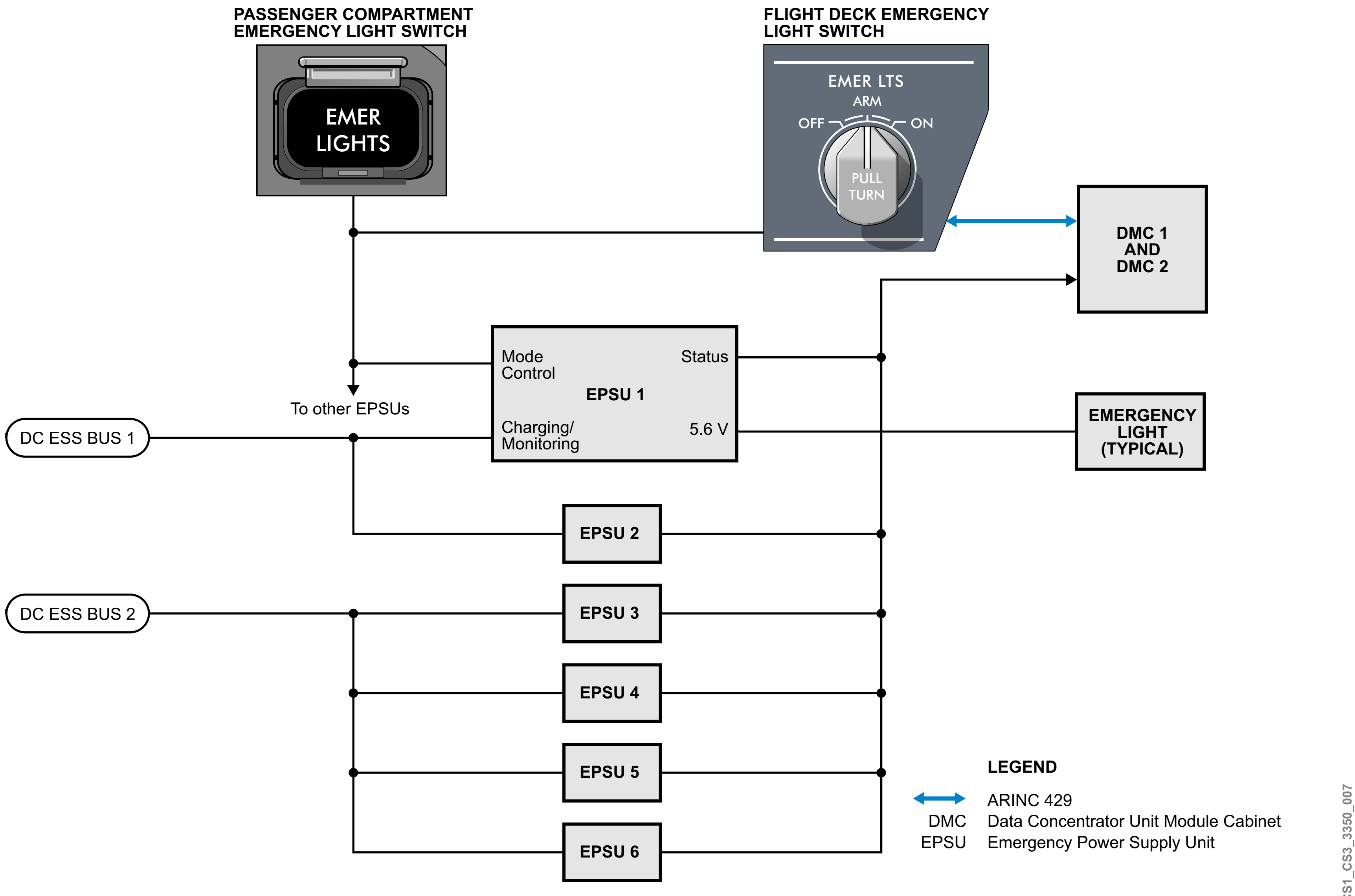


Figure 22: Emergency Lights General Description (L2)

COMPONENT LOCATION

The emergency lights system has the following components:

- Emergency power supply unit (EPSU)
- Exterior emergency lights
- Exit marking sign marker
- Exit location sign locator
- Exit identifier sign
- Overhead emergency lights
- Aisle emergency lights
- Flight deck emergency light switch
- Passenger cabin emergency light switch

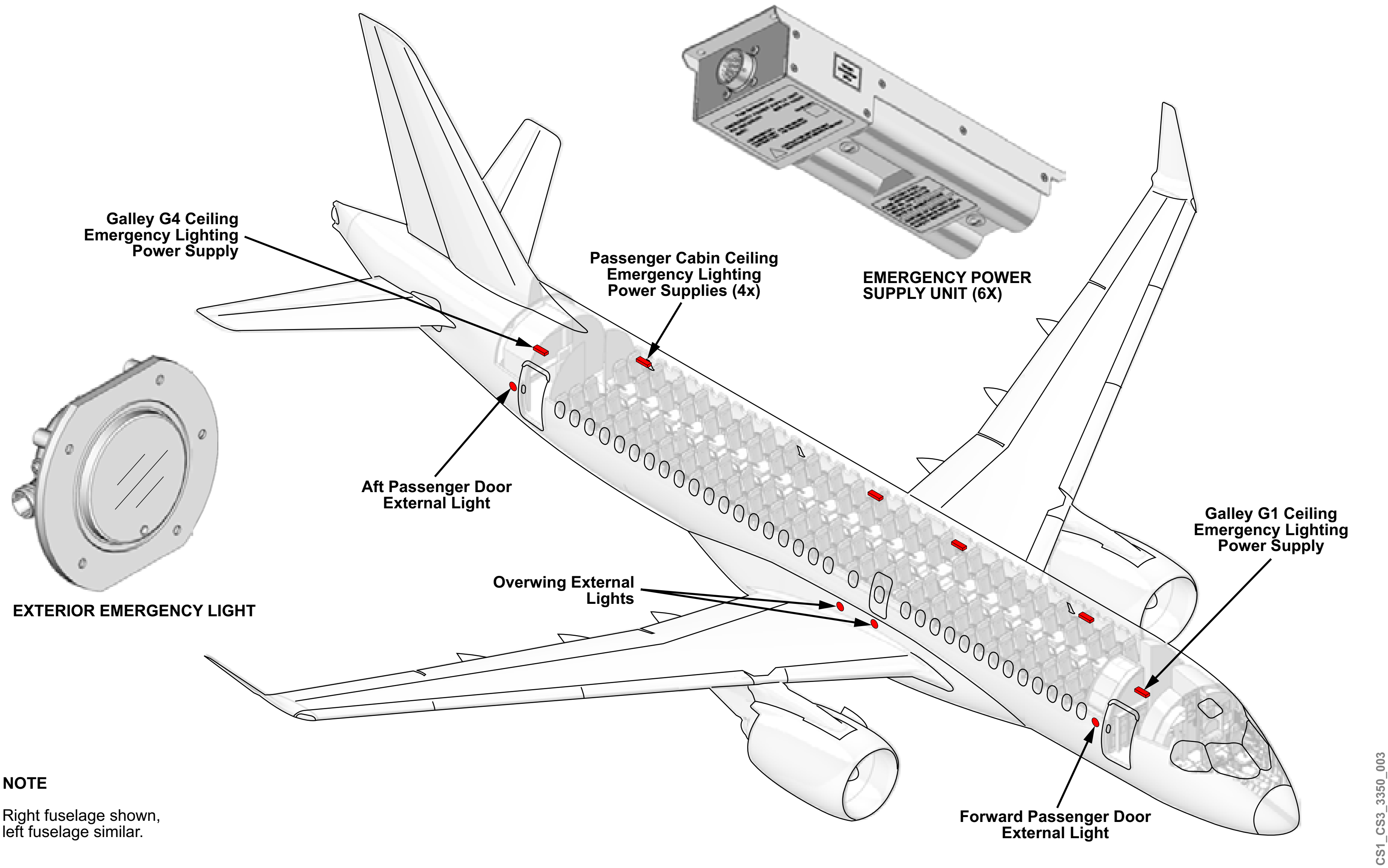
EMERGENCY POWER SUPPLY UNIT

Each EPSU consists of a charger and control assembly, and a replaceable battery pack containing NiMH batteries. The EPSUs are mounted in the main cabin and galley ceilings, and are accessed by removing the ceiling panels.

EXTERIOR EMERGENCY LIGHTS

There are lights installed at each of the entrance and service doors.

There are two lights installed on each side of the wing-to-body fairing (WTBF) over the wings, to mark the slide path over the wing.



NOTE

Right fuselage shown, left fuselage similar.

Figure 23: Emergency Lights Power Supply Unit and Exterior Emergency Light (L2)

EXIT MARKER SIGNS

An exit marker sign is located above each door and overwing emergency exit (OWEE).

EXIT LOCATOR SIGNS

The exit locator signs are installed on the galley area ceiling panels to indicate the position of the emergency exits. One exit locator sign is installed in the main cabin to locate the overwing exits.

EXIT IDENTIFIER SIGNS

Each door has one exit identifier located on door surround, near the floor.

OVERHEAD EMERGENCY LIGHTS

The overhead emergency lights are located in the entryways and overwing exit areas to provide illumination from the main aisle to each emergency exit.

AISLE EMERGENCY LIGHTS

The aisle emergency lights are installed on the passenger ceiling panel in the cabin.

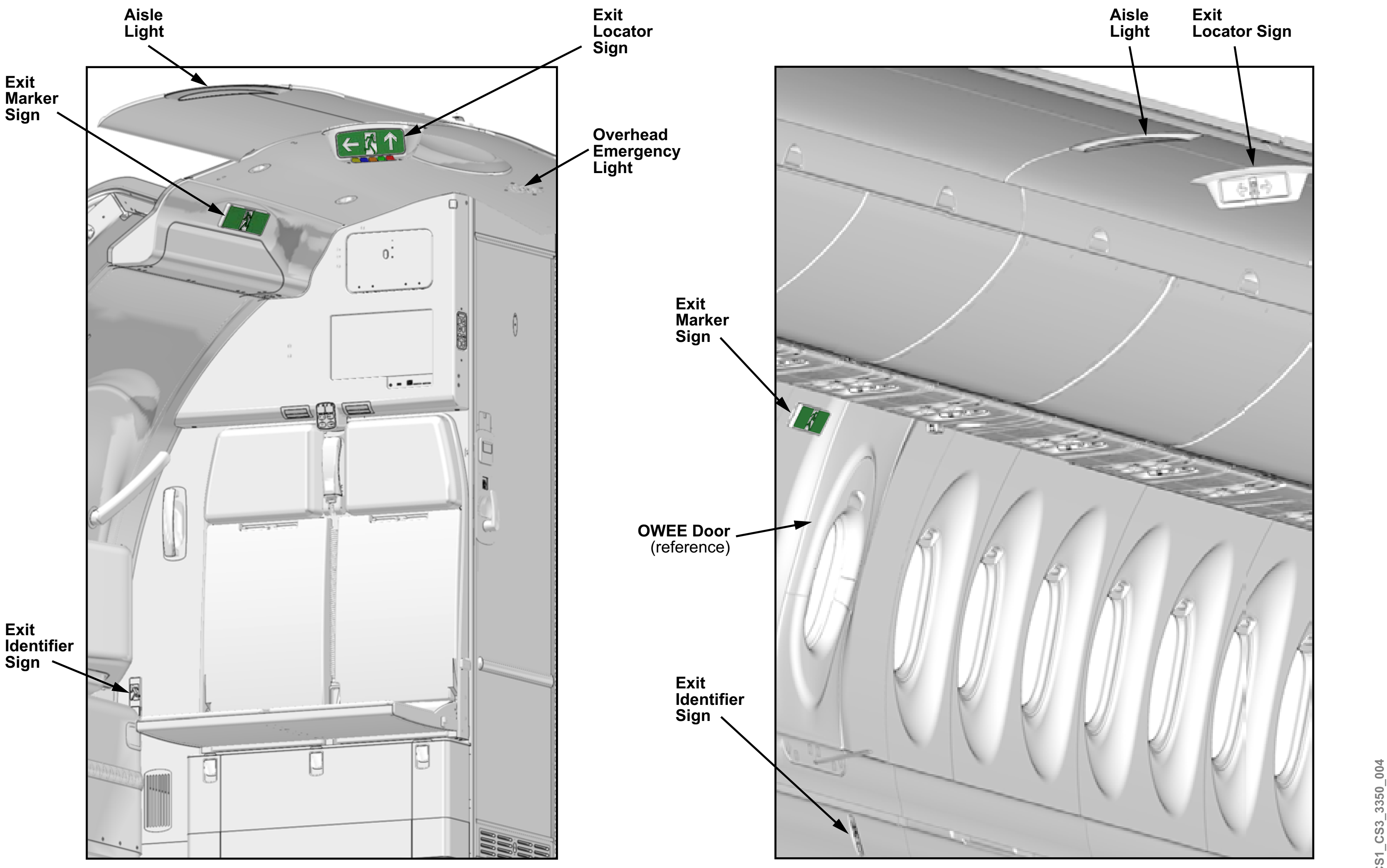


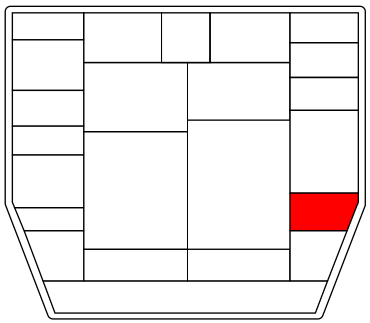
Figure 24: Emergency Exit Signs and Overhead and Aisle Emergency Lights (L2)

FLIGHT DECK EMERGENCY LIGHT SWITCH

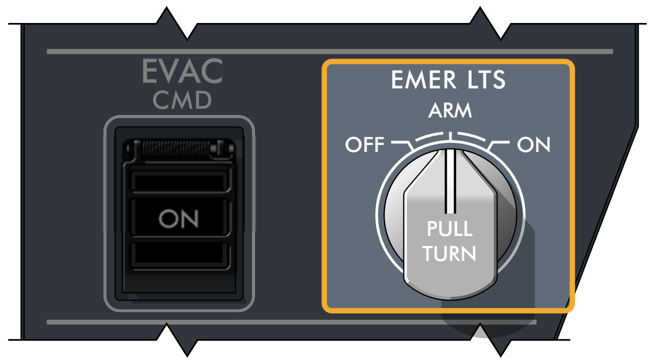
The flight deck emergency light switch is located in the flight deck on the right outboard overhead panel.

PASSENGER CABIN EMERGENCY LIGHT SWITCH

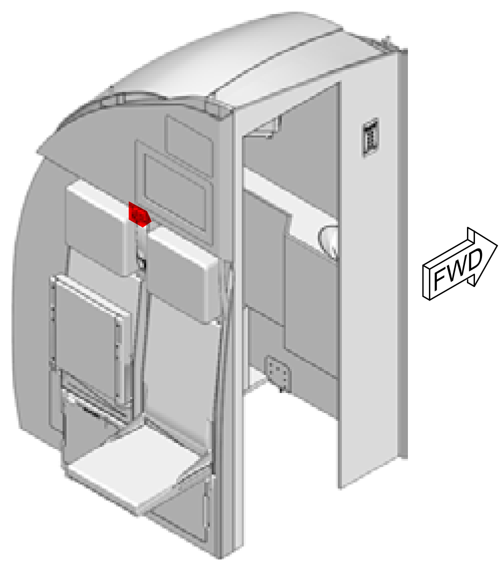
The passenger cabin emergency light switch is located on the light control panel near the forward attendant seats. The switch is guarded to prevent inadvertent operation.



OVERHEAD



EMERGENCY LIGHTS SWITCH



FORWARD FLIGHT ATTENDANT STATION

FORWARD FLIGHT ATTENDANT PANEL

CS1_CS3_3350_005

Figure 25: Flight Deck and Passenger Cabin Emergency Light Switches (L2)

DETAILED DESCRIPTION

EMERGENCY LIGHTS OPERATION

The emergency lights are controlled by the EMER LTS switch on the flight deck overhead panel. Three mode control wires monitor the flight deck and passenger cabin emergency light switches, and provide the logic to turn the emergency lights on or off. The EMER LTS switch is monitored by the DMC and an EICAS caution message EMERG LTS OFF is displayed when the switch is in the OFF position.

The switch has three positions that are used to control the EPSUs. In normal operation, the switch is in the ARM position and if the essential power input to the EPSU is lost, the emergency lights turn on.

The OFF position is used to ensure the emergency lights do not turn on when the aircraft power is switched off. The OFF position is detented to prevent inadvertent turn off in flight. DC ESS BUS 2 is monitored when the flight deck EMER LTS switch is in the OFF position. If voltage is present at mode control 1, and mode control 2 and 3 are open, the logic inhibits the EPSU output.

The ON position forces the emergency lights to turn on even if the DC essential buses are powered.

The flight attendant EMER LIGHTS switch can be used to turn the lights on or off if the flight deck EMER LTS switch is in the ARM or OFF position. The flight attendant switch has no effect if the flight deck switch is set to ON. The flight attendant EMERG LIGHTS switch is guarded to prevent accidental turn on.

NOTE

The flight deck EMER LTS switch and the flight attendant EMER LIGHTS switch must be turned to the OFF position before power is removed from the aircraft, or the emergency lights will turn on.

EPSU 1 and EPSU 2 are charged when DC ESS BUS 1 is powered. EPSUs 3, 4, 5, and 6 are charged by DC ESS BUS 2. A fully discharged EPSU can be charged in 60 minutes.

Each EPSU provides its status and the status of its battery pack to the DMCs. The ESPU OK signal indicates the ESPU has no internal or mode control wiring faults and the battery is capable of supplying power for 10 minutes. The ESPU BATT OK signal indicates the battery is installed and has no internal faults. When the EPSU battery is discharging, a signal is sent to the DMCs and a EMER LTS ON status message is displayed.

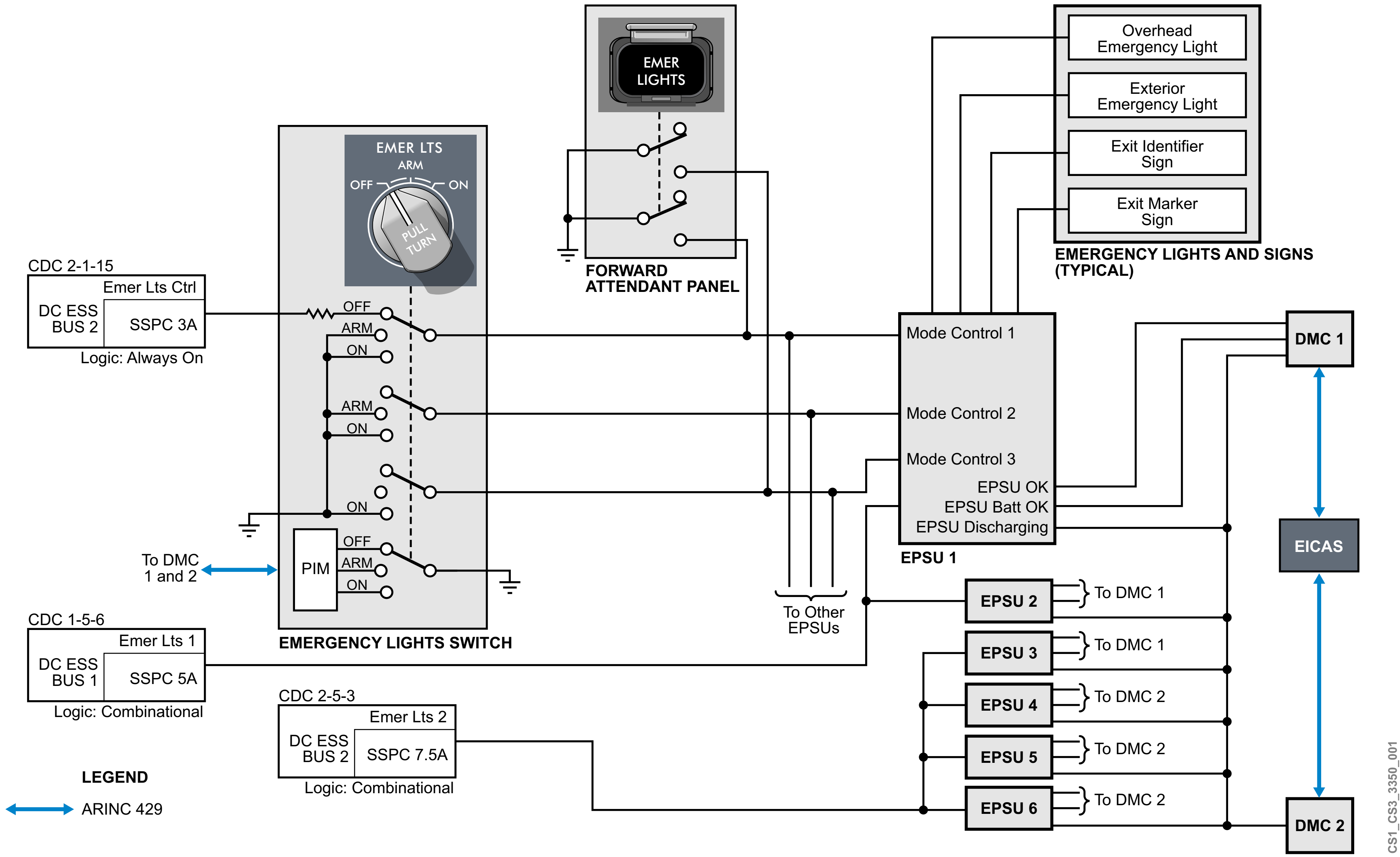


Figure 26: Emergency Lights Detailed Description (L3)

EMERGENCY LIGHT POWER DISTRIBUTION

Each EPSU supplies power to emergency lights and signs in its vicinity. The lights are directly connected to the EPSU.

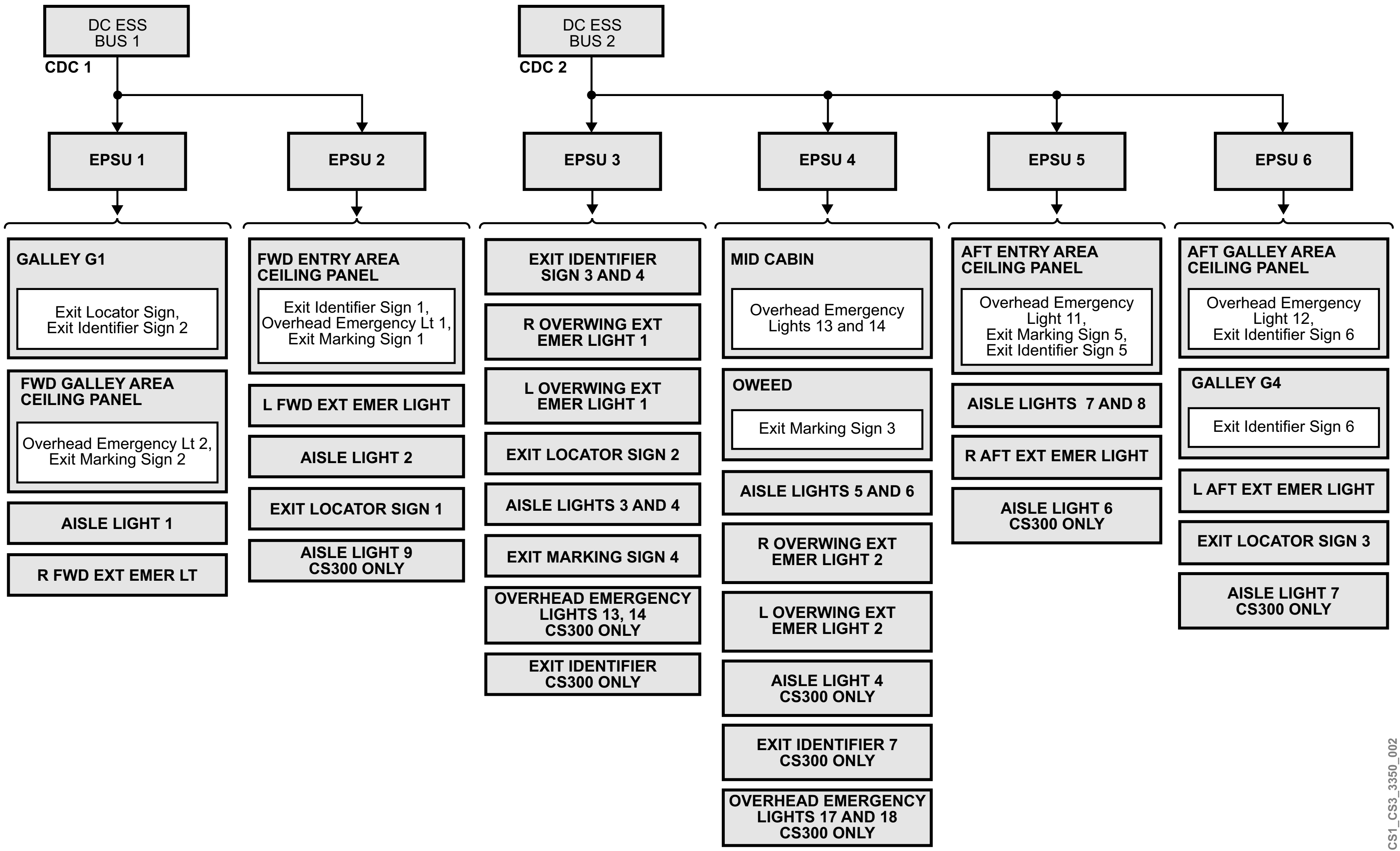


Figure 27: Emergency Light Power Distribution (L3)

MONITORING AND TEST

The following page provides the crew alerting system (CAS) messages for the emergency lights.

CAS MESSAGES

Table 1: CAUTION Message

MESSAGE	LOGIC
EMERG LTS OFF	EMER LTS switch set to the off position.

Table 2: STATUS Message

MESSAGE	LOGIC
EMER LTS ON	The EPSUs are discharging due to ESS power loss or the emergency lights have been turned on.

33-40 EXTERIOR LIGHTS

GENERAL DESCRIPTION

The exterior lights are controlled by switches located on the eyebrow panel. The switch position is digitally monitored and reported to the data concentrator unit module cabinets (DMCs) via an ARINC 429 BUS.

The DMCs signal the control and distribution cabinets (CDCs) over an AFDX BUS to provide power to the exterior lights power supply units or directly to the lights.

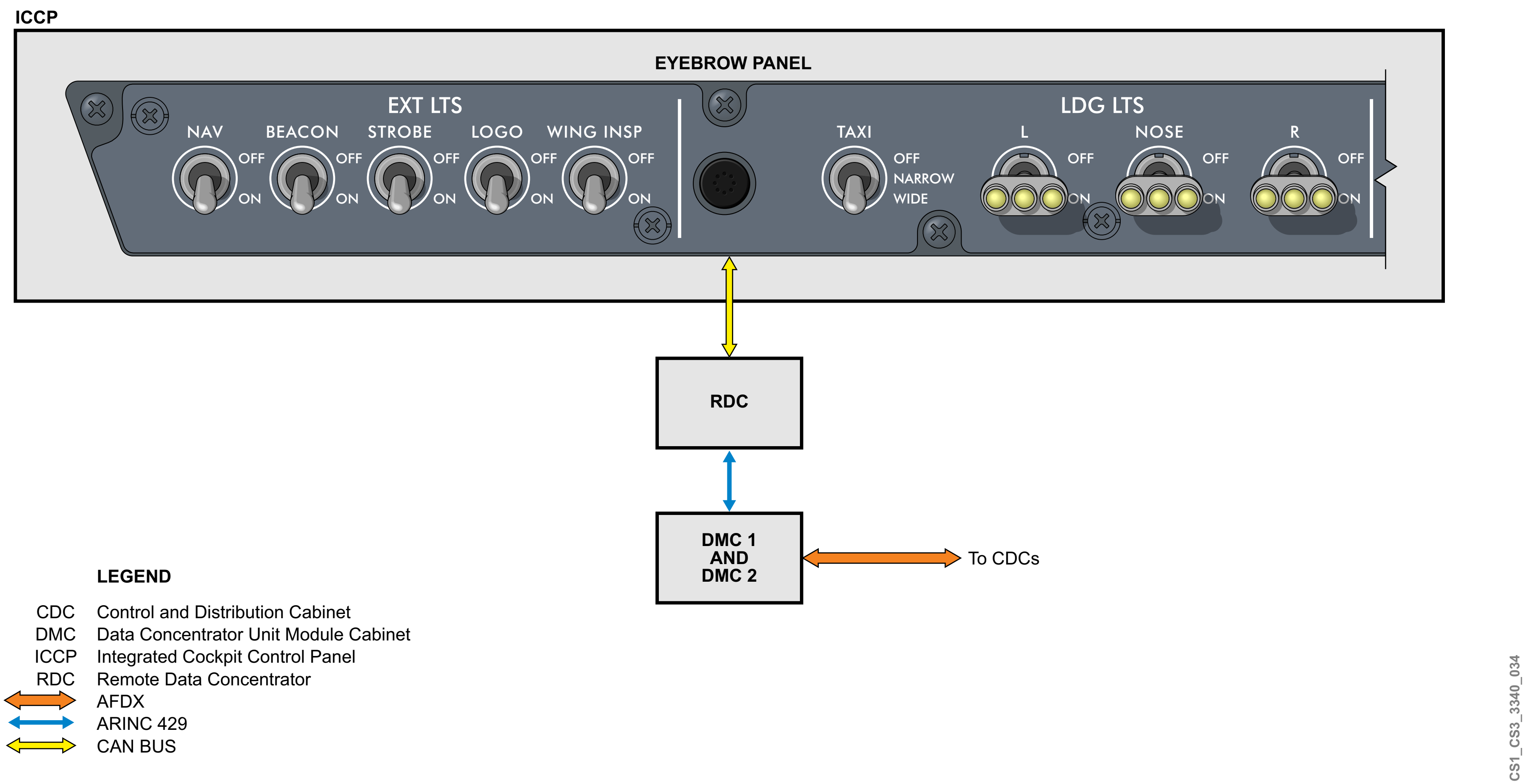


Figure 28: Exterior Lights General Description (L2)

LANDING AND TAXI LIGHTS

GENERAL DESCRIPTION

There is one landing light and one taxi light installed on the nose landing gear and in each side of the wing-to-body fairing (WTBF). The landing and taxi lights are powered by landing and taxi light power supplies.

The landing lights are individually controlled by three LDG LTS switches located in the LDG LTS panel.

The taxi lights are controlled by the three position TAXI switch on the LDG LTS panel.

POWER SOURCE	
Light	**Power**
L Landing	AC BUS 1
R Landing	AC BUS 2
Nose Landing	AC BUS 1
L Taxi	AC BUS 1
R Taxi	AC BUS 2
Nose Taxi	AC BUS 2

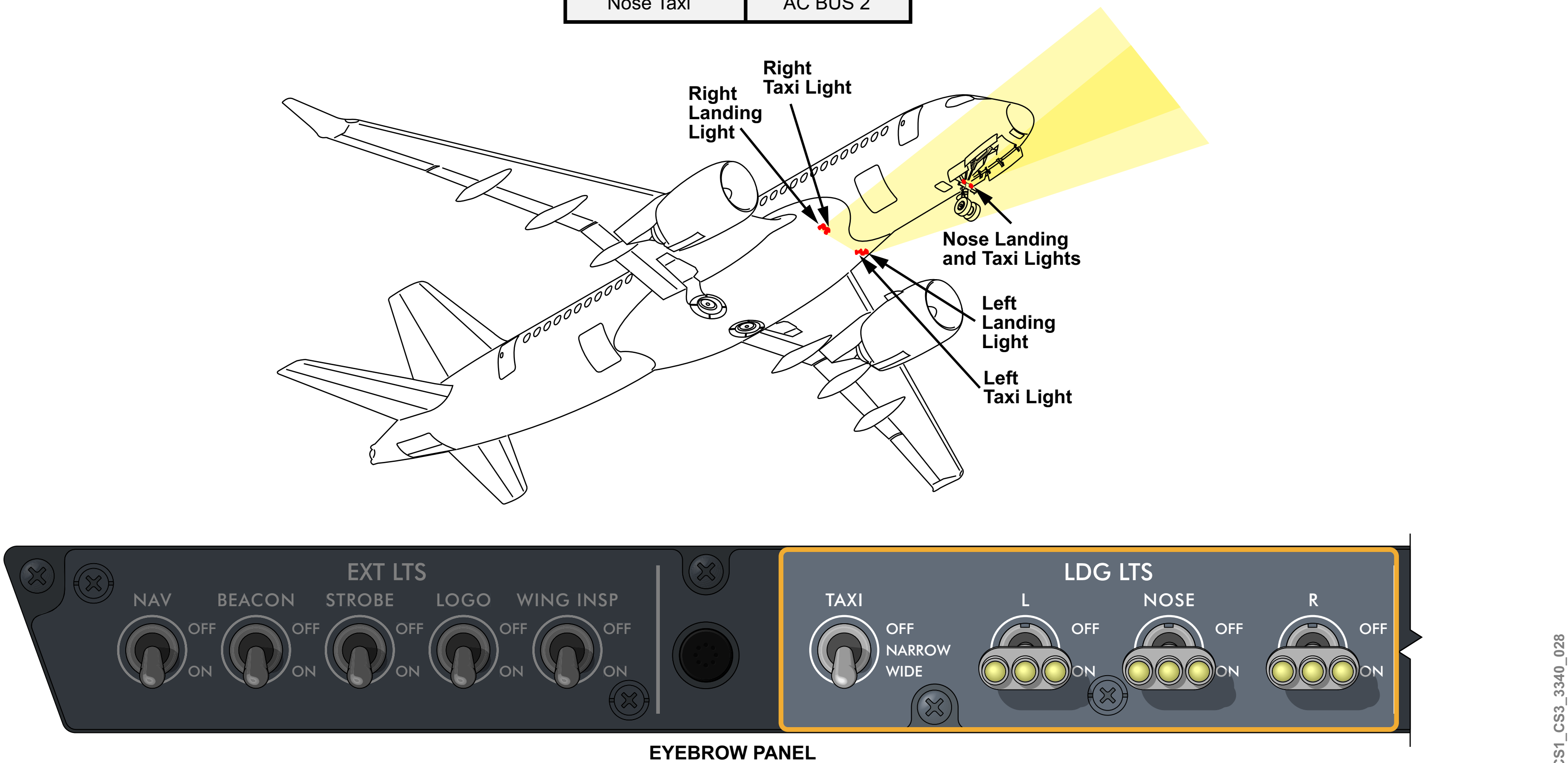


Figure 29: Landing and Taxi Lights General Description (L2)

COMPONENT LOCATION

The landing and taxi lights consist of:

- Light assemblies
- Landing/taxi power supply

LIGHT ASSEMBLY

The HID landing light assembly has a 50 W HID lamp with a rear mounted ignition unit supplied by an HID power supply.

LANDING/TAXI POWER SUPPLY

Each landing/taxi power supply provides power for two HID lights. There are three landing/taxi power supplies installed on the aircraft. Two located in the belly fairing area, one in the left side supplying power for the LH taxi and landing lights, and the other supplying power for the RH taxi and landing lights. The landing/taxi power supply for the nose landing gear taxi and landing lights is located in the forward equipment bay.

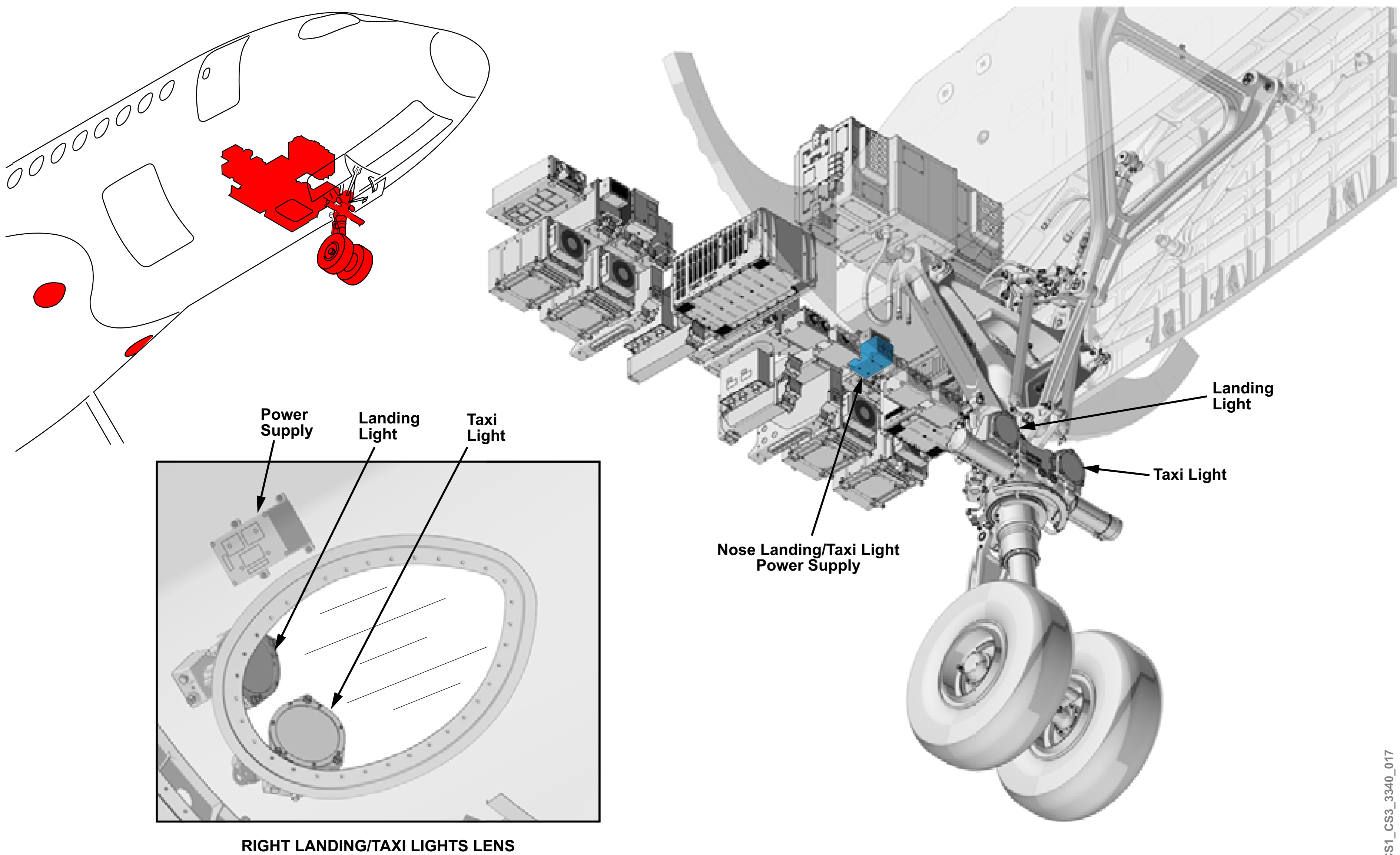


Figure 30: Landing and Taxi Lights (L2)

DETAILED DESCRIPTION

The landing and taxi lights receive power from AC BUS 1 and 2. The power for both nose landing gear landing and taxi lights on the nose gear will only be available when the nose landing gear is down and locked, as confirmed by the landing gear and steering control units (LGSCUs).

When NARROW is selected, only the nose taxi light operates. When WIDE is selected on the TAXI switch, all three taxi lights operate.

The power supply feeds an ignition unit on the lamp assembly. The ignition unit controls the startup conditions for the gas discharge lamp. The transformer circuit of the ignition unit provides a high ignition voltage. The initial startup power to the lamp is higher than the steady state output. The lamp reaches 75% light output in 5 seconds and 100% light output in 10 seconds.

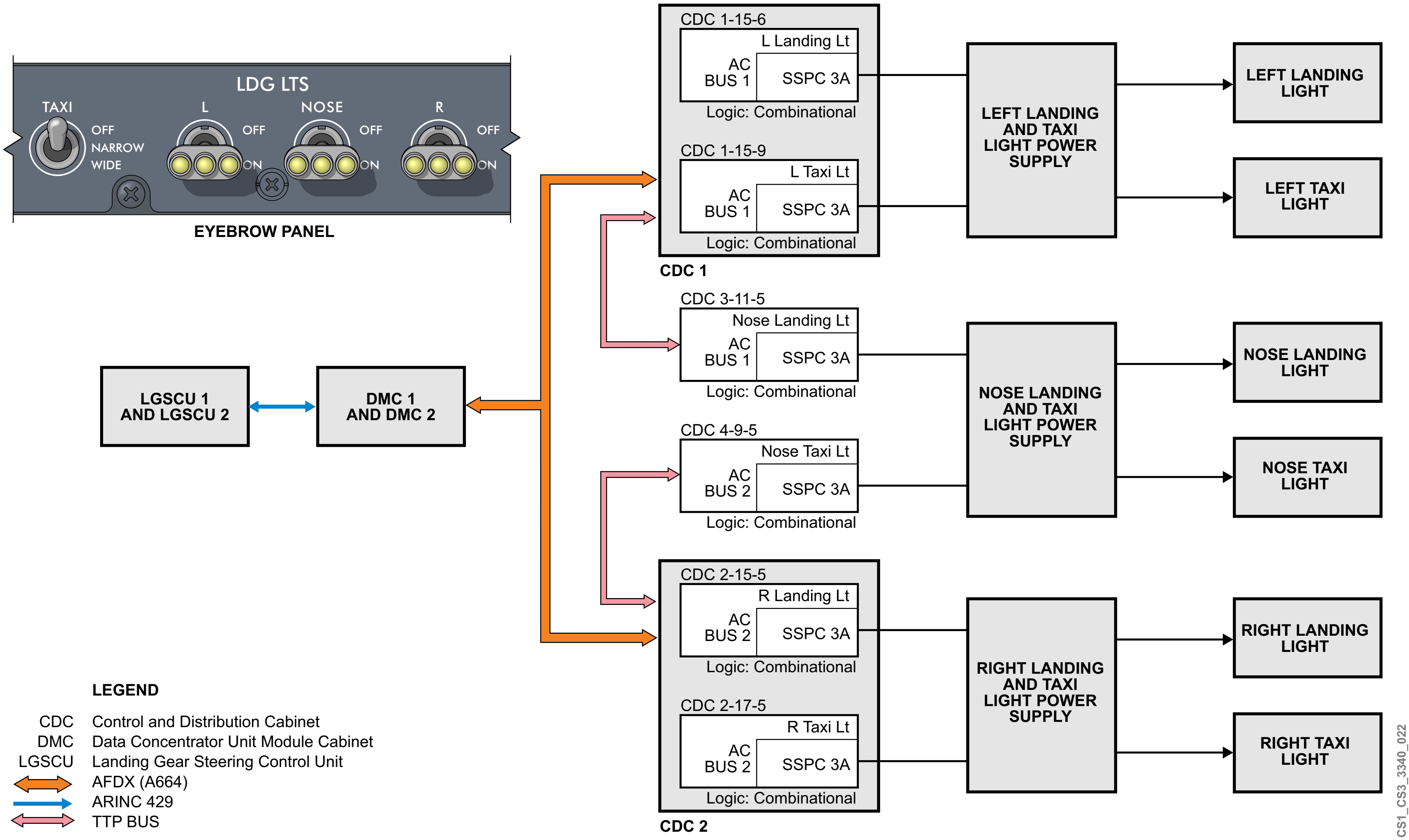


Figure 31: Landing and Taxi Lights Detailed Description (L3)

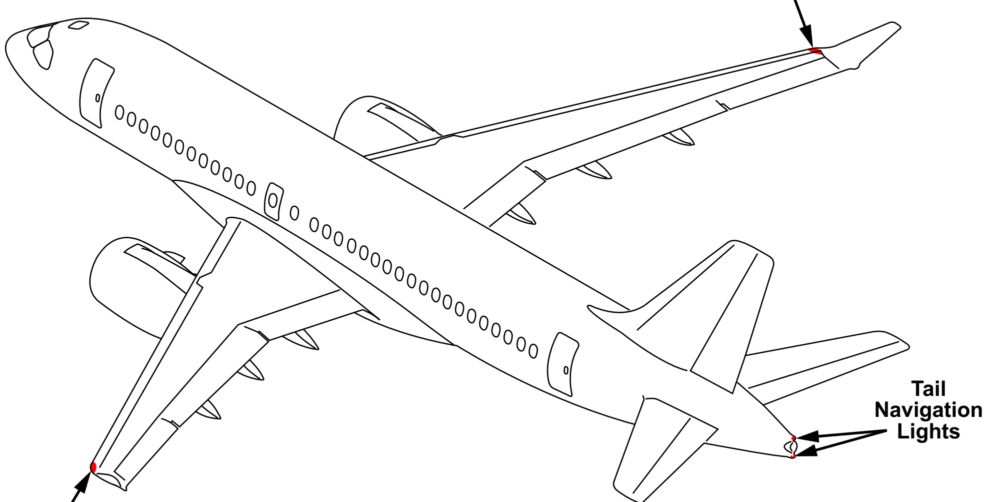
NAVIGATION LIGHTS

GENERAL DESCRIPTION

There are six LED type navigation lights installed on the aircraft. The wing navigation lights are covered by an acrylic lens used as an aerodynamic fairing. A thermal switch on each wing navigation light assembly reduces the power output of the navigation lights to prevent damage to the wingtip lens.

The lights are controlled by a NAV lights switch on the EXT LTS panel in the flight deck or the NAV LTS switch on the ELECTRICAL/TOWING SERVICE panel.

POWER SOURCE	
Light	**Power**
Nav Lights Normal Mode	DC BUS 1
Ground Service Mode	DC BUS 1
Towing Mode	DC EMER BUS



ELECTRICAL/TOWING SERVICE PANEL

EYEBROW PANEL

CS1_CS3_3340_029

Figure 32: Navigation Lights General Description (L2)

COMPONENT LOCATION

The navigation lights consist of:

- Wing navigation lights
- Tail navigation lights

WING NAVIGATION LIGHTS

The wing navigation lights are mounted on the forward wingtip under an acrylic lens.

TAIL NAVIGATION LIGHTS

The tail navigation lights are mounted below the APU exhaust on the tailcone.

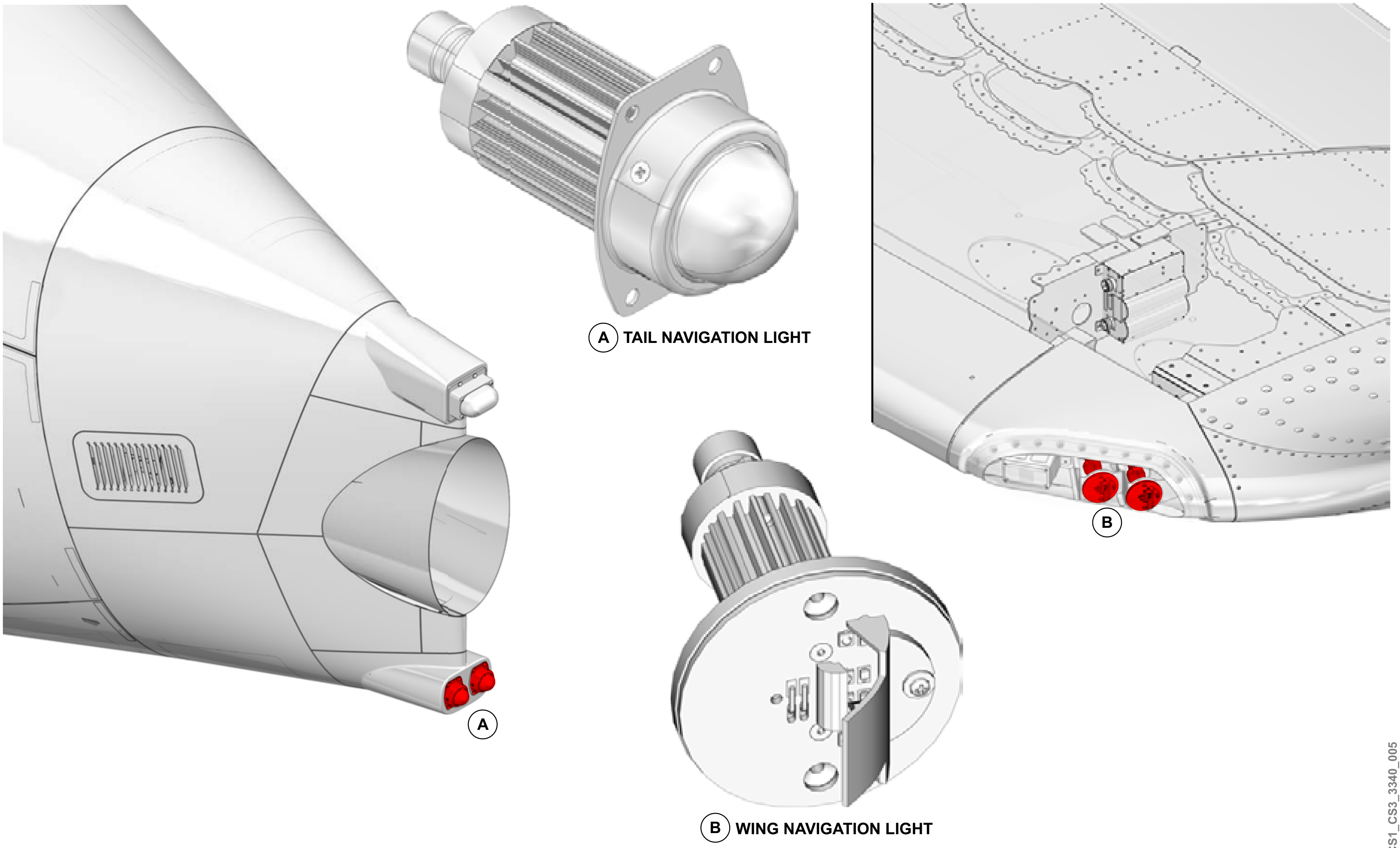


Figure 33: Navigation Lights (L2)

DETAILED DESCRIPTION

The navigation lights can be turned on using:

- TOW PWR PBA
- NAV LTS PBA
- NAV switch

TOW PWR PBA

The navigation lights are commanded on by the TOW PWR PBA. The TOW PWR PBA is used when towing an unpowered aircraft. The flight deck BATT 1 and BATT 2 switches must be in the OFF position. The DC EMER BUS is routed via a relay located in CDC 1 to the navigation lights and the beacon lights.

NAV LTS PBA

The NAV LTS PBA is used when the aircraft is in electrical ground service mode. When the NAV LTS PBA is pressed, CDC 3 signals to CDC 1 to turn on the navigation lights. Pressing the NAV LTS PBA a second time turns the navigation lights off.

NAV SWITCH

The NAV switch, located on the eyebrow panel, is used when the aircraft is fully powered. The navigation lights are powered from DC BUS 1.

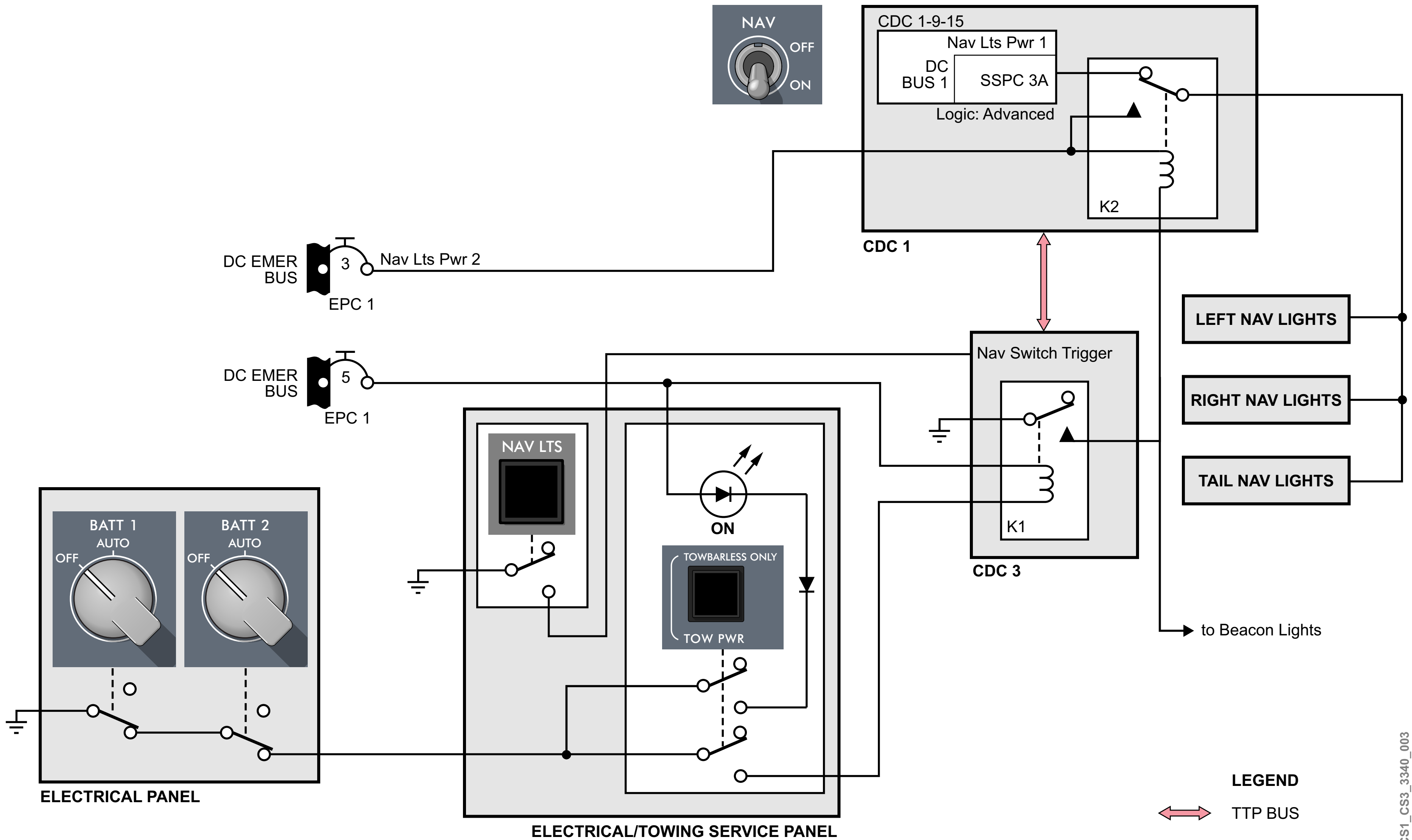


Figure 34: Navigation Lights Detailed Description (L3)

WING INSPECTION LIGHTS

GENERAL DESCRIPTION

The wing inspection lights illuminate the wing leading edge and engine inlet. The wing inspection light assembly has a power and control circuit card and an LED assembly.

The lights are controlled by a WING INSP switch on the EXT LTS panel.

POWER SOURCE	
Light	**Power**
L Wing Inspection Light	AC BUS 1
R Wing Inspection Light	AC BUS 2

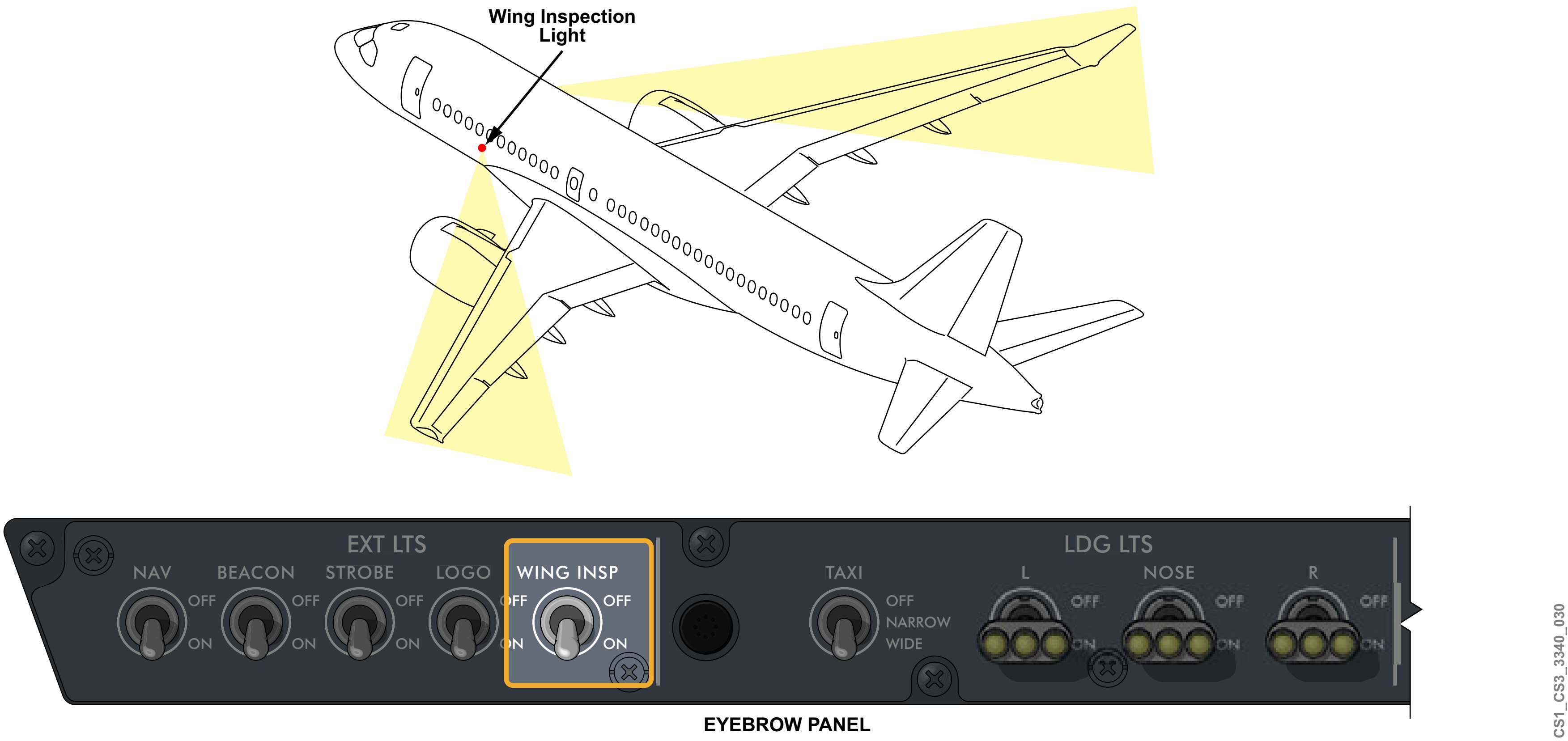


Figure 35: Wing Inspection Lights General Description (L2)

COMPONENT LOCATION

The wing inspection lights consist of:

- Wing inspection lights

WING INSPECTION LIGHTS

The lights are installed on each side of the fuselage, just forward of the wings.

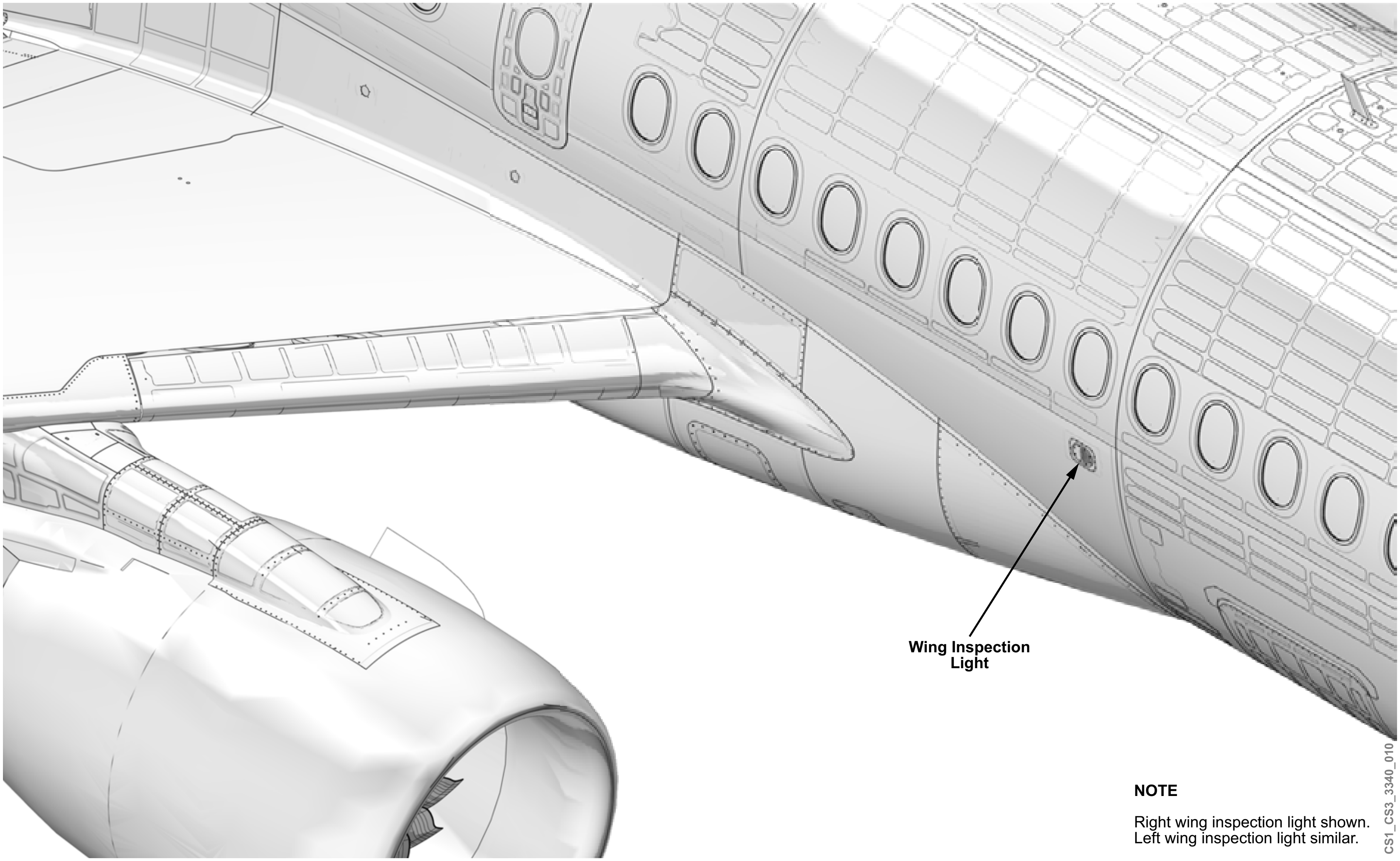


Figure 36: Wing Inspection Lights (L2)

DETAILED DESCRIPTION

The left wing inspection light is powered from AC BUS 1 and the right is powered from AC BUS 2.

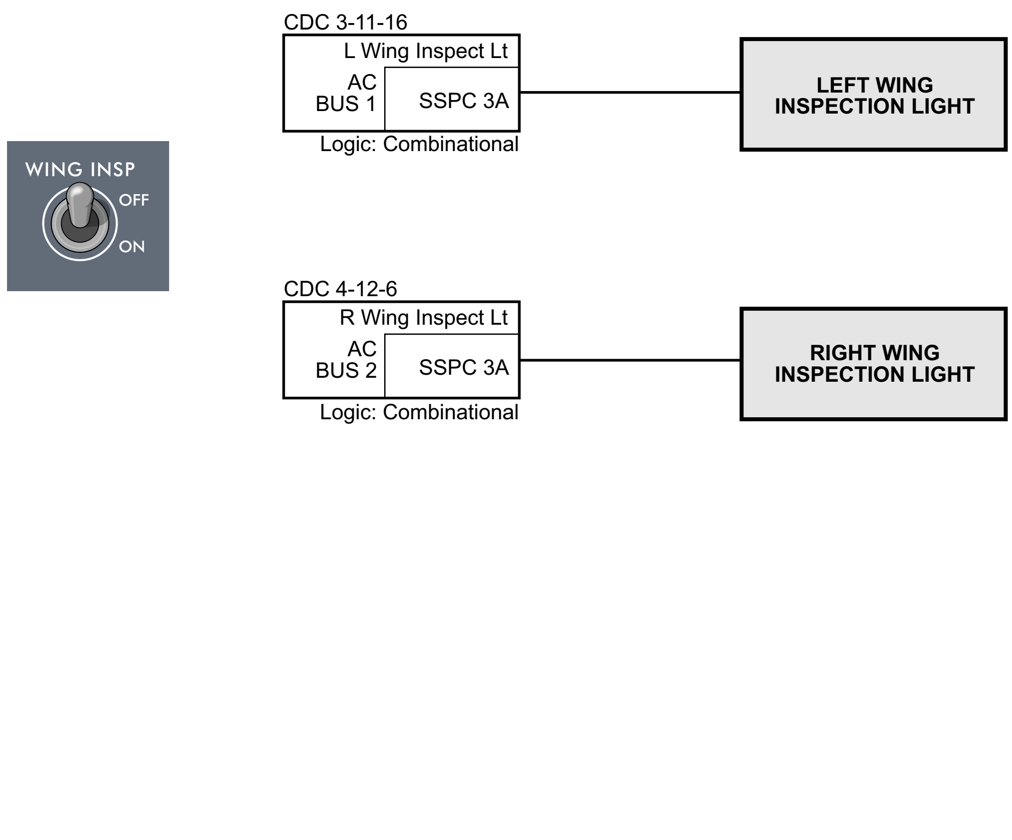


Figure 37: Wing Inspection Lights Detailed Description (L3)

BEACON LIGHTS

GENERAL DESCRIPTION

The beacon lights have a power and control circuit card and an LED assembly. Each beacon light is powered by an individual power supply installed near the beacon lights.

The lights are controlled by a BEACON lights switch on the EXT LTS panel and are synchronized with the strobe lights. AC BUS 2 powers the beacon lights in normal operation.

OPTIONAL BEACON LIGHT OPERATION FROM THE TOW POWER PBA

The beacon lights can also be turned on during towing using the TOW PWR PBA on the ELECTRICAL/TOWING SERVICE PANEL. When the TOW PWR PBA is used the beacon light inverter is powered from the BATT DIR BUS 2. The beacon light inverter then provides AC power to the beacon lights.

POWER SOURCE	
Operation	**Power**
Normal	AC BUS 2
Towing	BATT DIR BUS 2 to Beacon Light Inverter

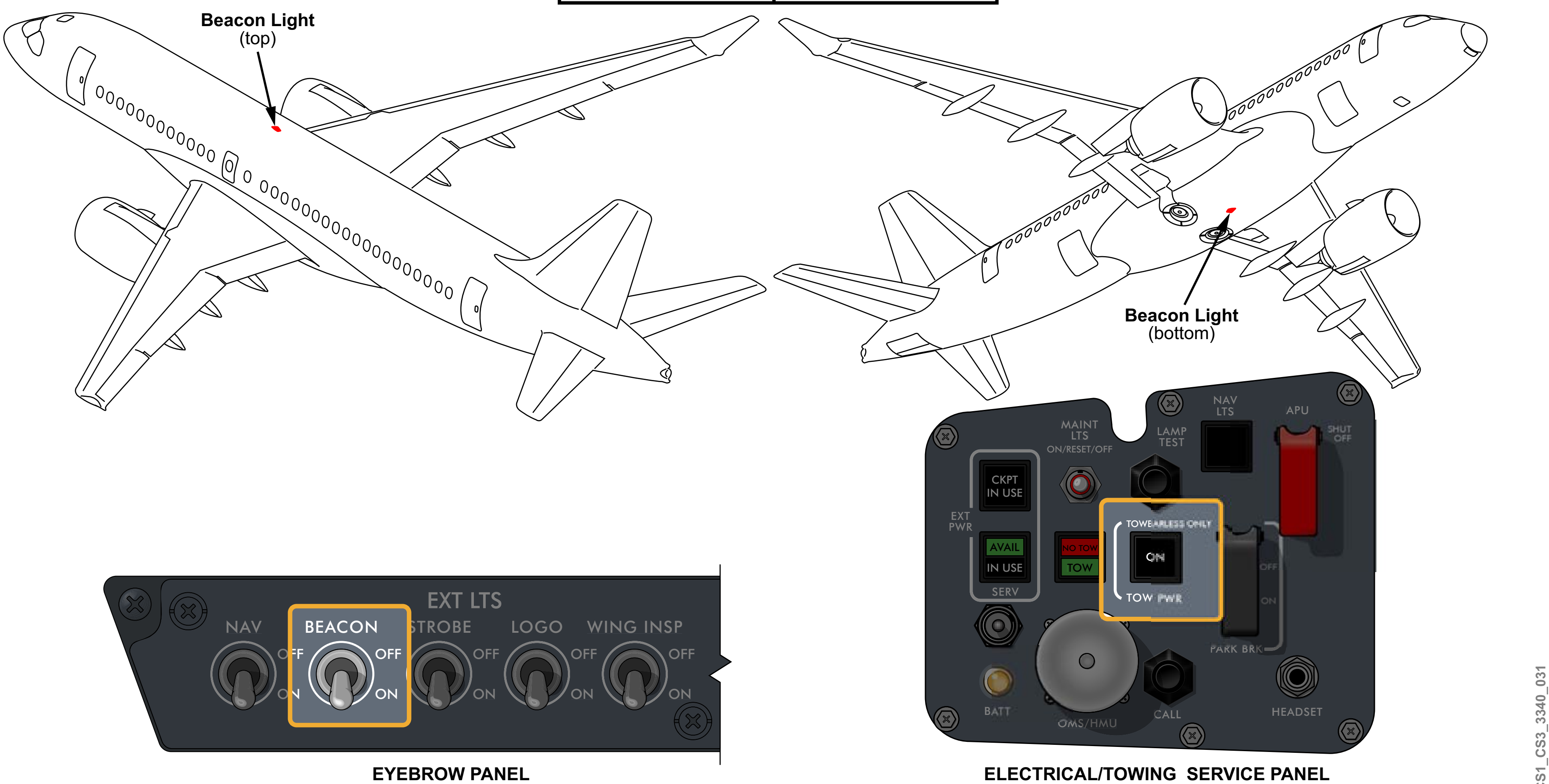


Figure 38: Beacon Light General Description (L2)

COMPONENT LOCATION

The beacon lights consist of:

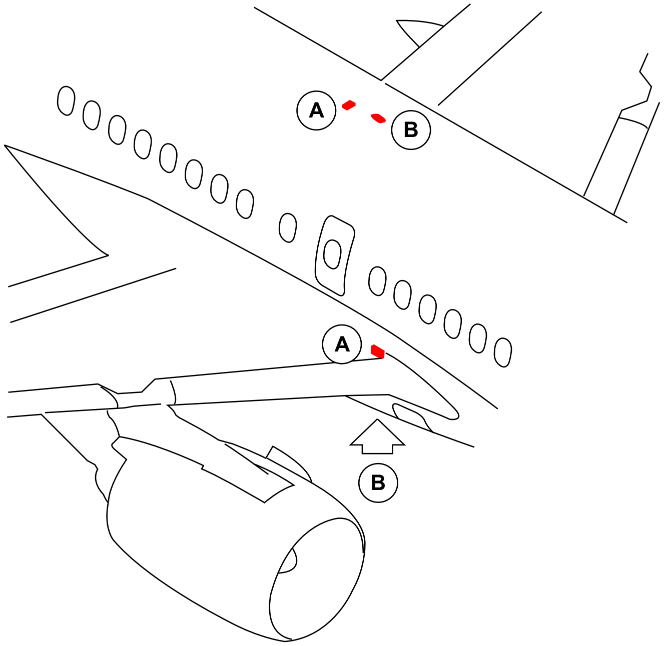
- LED Beacon light assembly (Refer to figure 39)
- Beacon light power supply (Refer to figure 39)
- Beacon light inverter (Refer to figure 40)

LED BEACON LIGHT

One LED beacon light is installed on the upper mid fuselage and one is installed on the bottom of the wing-to-body fairing (WTBF).

BEACON LIGHT POWER SUPPLY

There are two power supply units installed in the aircraft, located next to their associated beacon light. The lower power supply is installed in the WTBF fairing forward of the main landing gear bay. The upper beacon power supply is installed above the cabin headliner between FRAME 47 and 48.



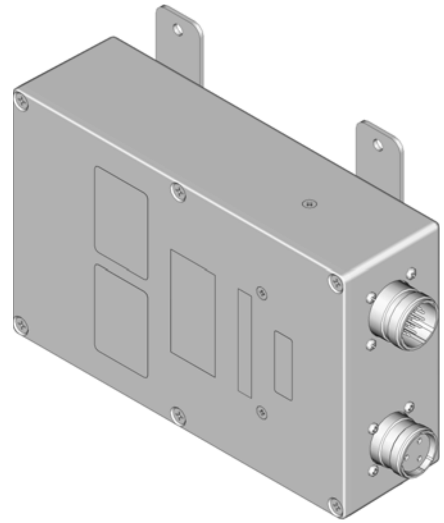


Figure 39: LED Beacon Light and Beacon Light Power Supply (L2)

BEACON LIGHT INVERTER

The beacon light inverter is located on the aft rack of the mid equipment bay.

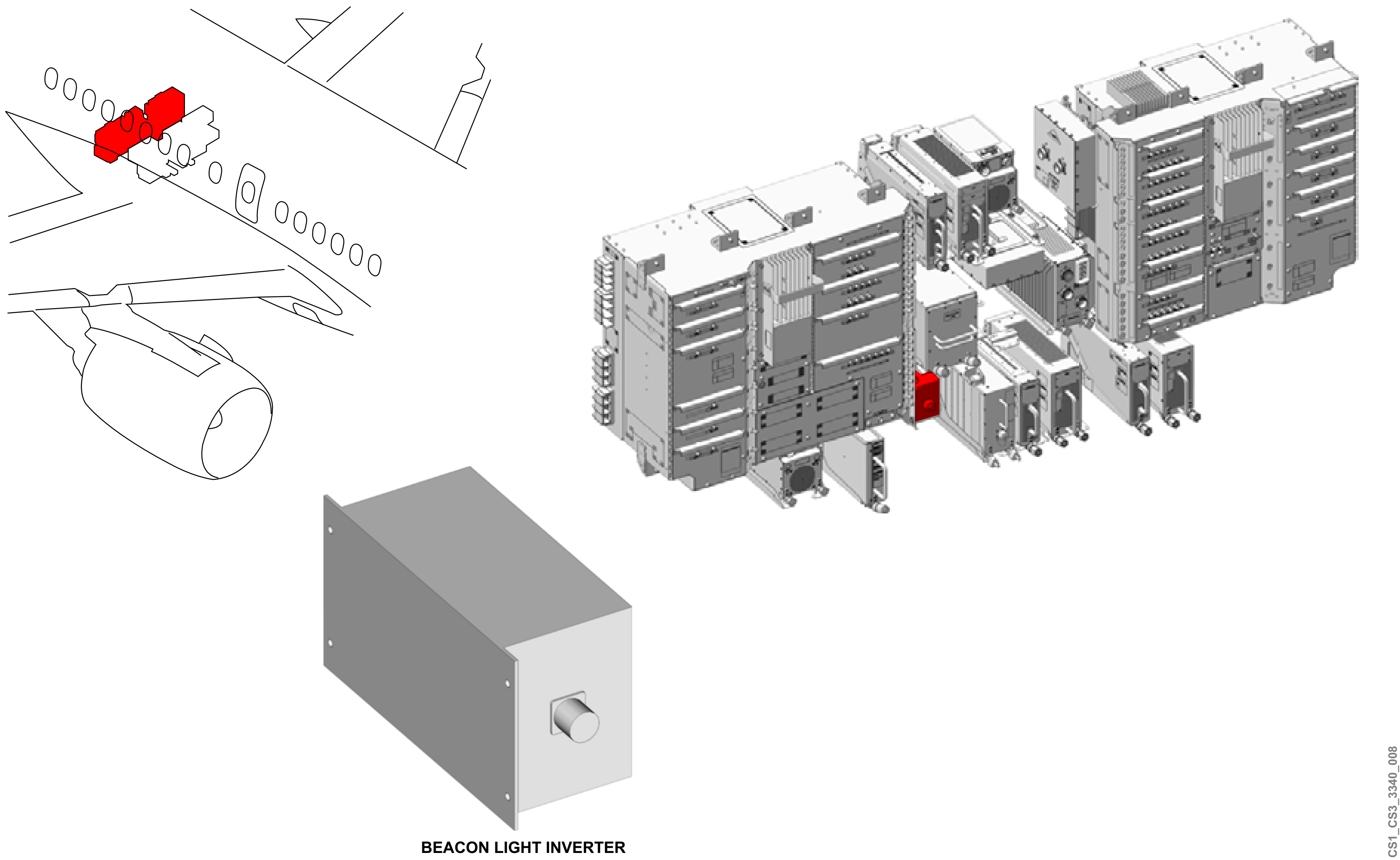


Figure 40: Beacon Light Inverter (L2)

DETAILED DESCRIPTION

The beacon lights and anticollision strobe lights are synchronized to flash simultaneously. The upper beacon light power supply provides a synchronization signal to the lower beacon light and left wing strobe power supplies.

Whenever CDC 2 receives a weight-on-wheels (WOW) signal, both beacon light power supplies reduce the intensity of the beacon light.

OPTIONAL BEACON LIGHT OPERATION FROM THE TOW POWER PBA

The beacon lights can be turned on using the TOW PWR PBA on the ELECTRICAL/TOWING SERVICE PANEL. Pushing the TOW PWR PBA supplies a ground to energize relays K2, K3, and K4 in CDC 2. BATT DIR BUS 2 powers the beacon light inverter through relay K4. The beacon light inverter provides AC power to both beacon light power supplies through the energized relays K2 and K3, allowing the beacon lights to operate when towing the aircraft.

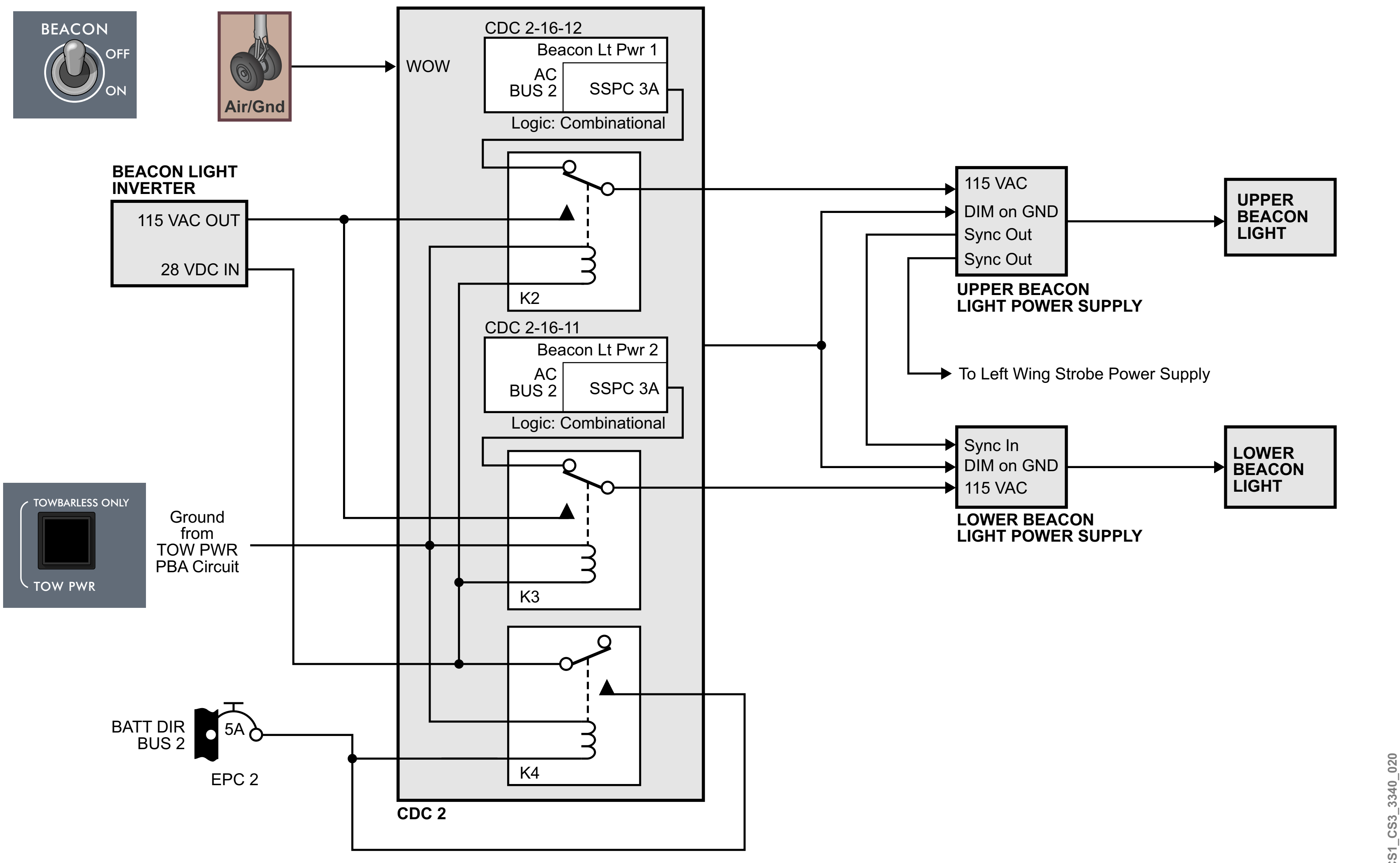


Figure 41: Beacon Lights Detailed Description (L3)

ANTICOLLISION STROBE LIGHTS

GENERAL DESCRIPTION

The wing and tail anticollision strobe lights have a Xenon flash tube, reflector, and transformer. The transformer boosts the input voltage to approximately 10,000 V. Each strobe light is powered by an individual power supply. The power supplies provide 400 VAC to the strobe light assemblies.

All three lights are controlled simultaneously by the STROBE switch located on the flight deck EXT LTS panel and are synchronized with the upper beacon power supply.

POWER SOURCE	
Light	**Power**
L Wing Strobe	AC BUS 1
R Wing Strobe	AC BUS 2
Tail Strobe	AC BUS 1

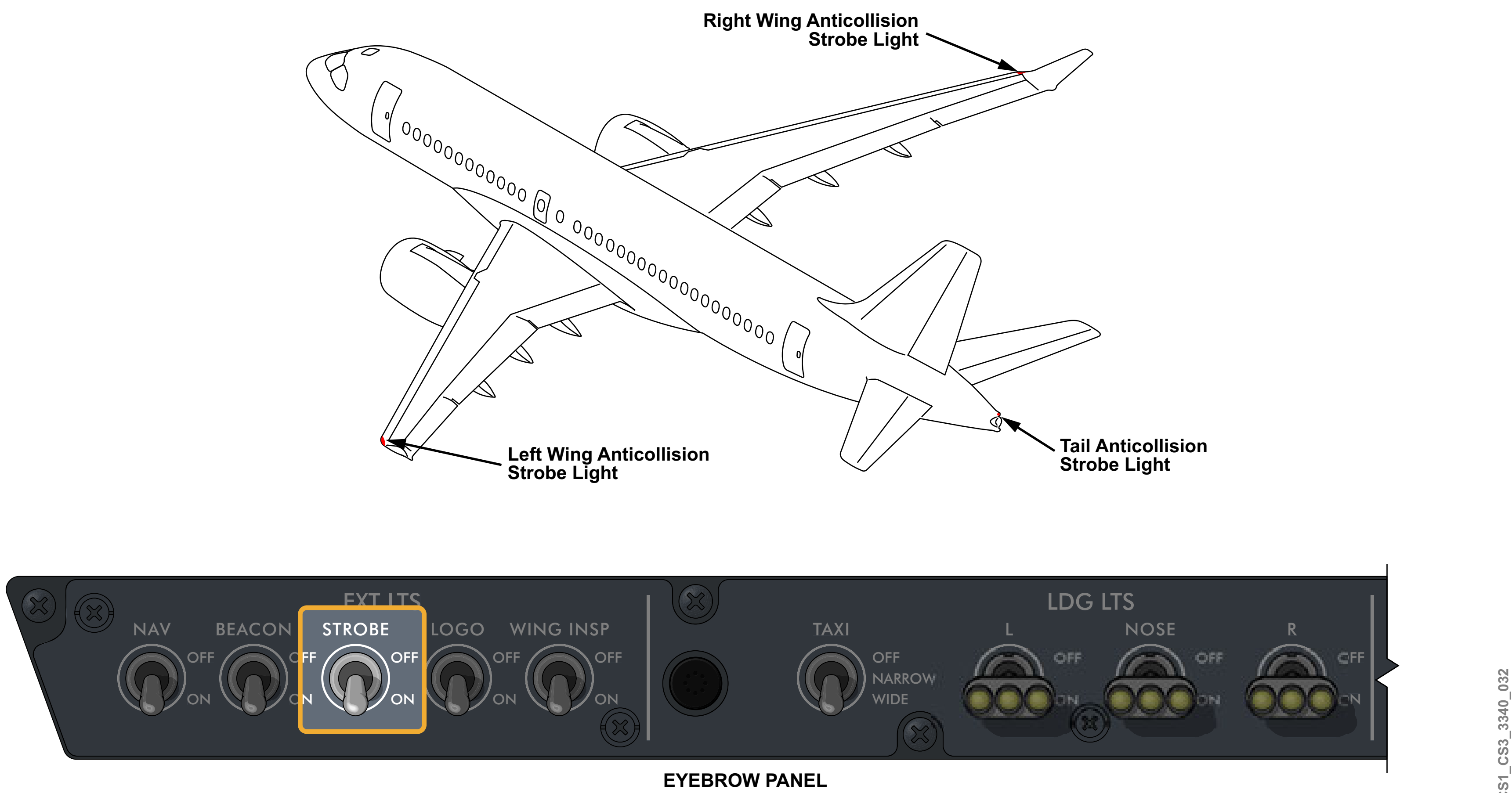


Figure 42: Anticollision Strobe Lights General Description (L2)

COMPONENT LOCATION

The anticollision lights consist of:

- Strobe light assembly
- Strobe light power supply

STROBE LIGHT ASSEMBLY

The white anticollision lights are located on each wingtip next to the navigation lights and on the tail of the aircraft above the APU exhaust.

STROBE LIGHT POWER SUPPLY

The power supplies are mounted on RIB 26 in the wingtips and near FRAME 83 in the aft equipment bay.

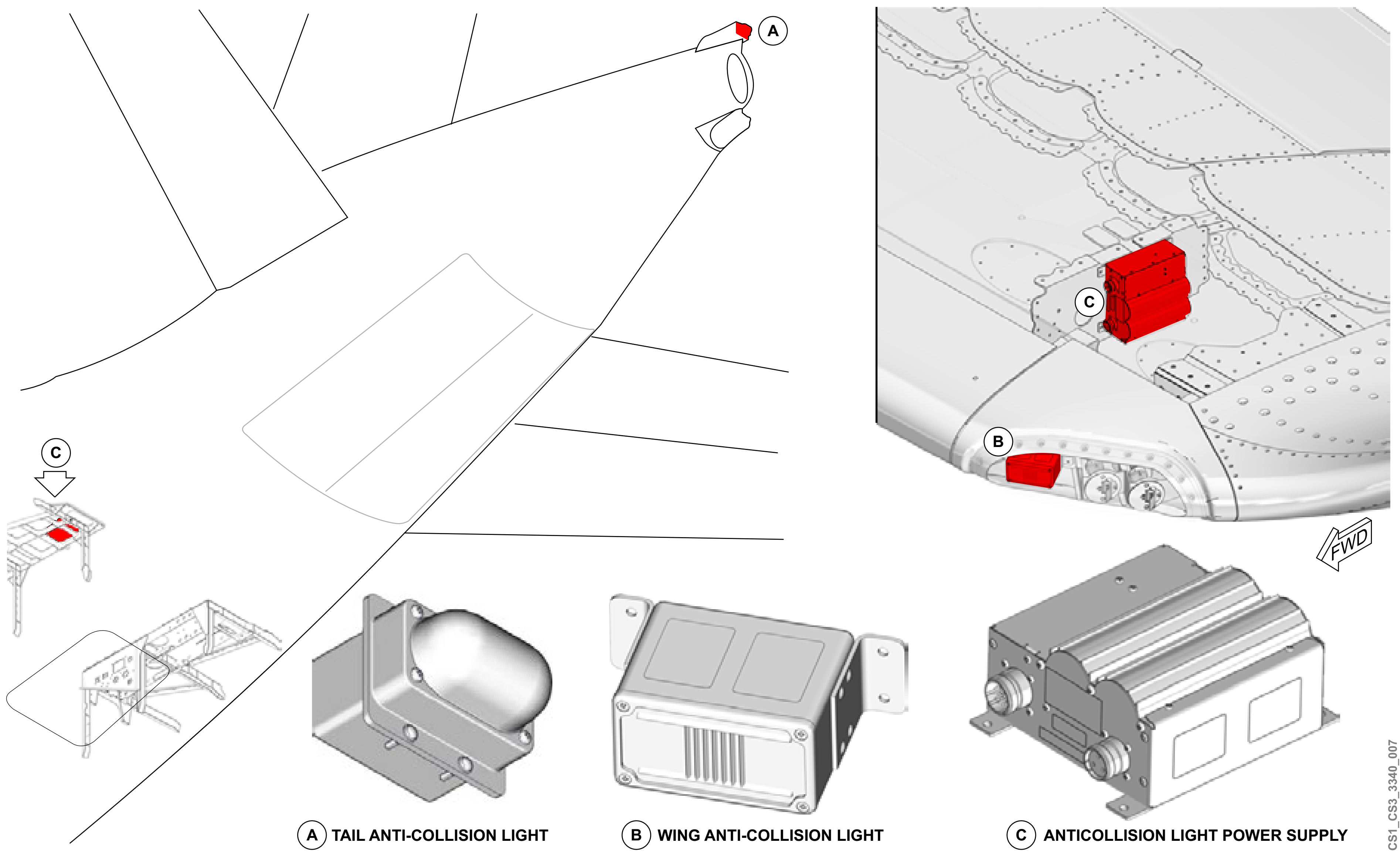


Figure 43: Anticollision Strobe Lights (L2)

DETAILED DESCRIPTION

The three white strobe lights are synchronized to flash simultaneously. The upper beacon light power supply supplies the strobe light synchronization signal. The left and tail anticollision lights are powered by AC BUS 1 and the right anticollision light is powered by AC BUS 2.

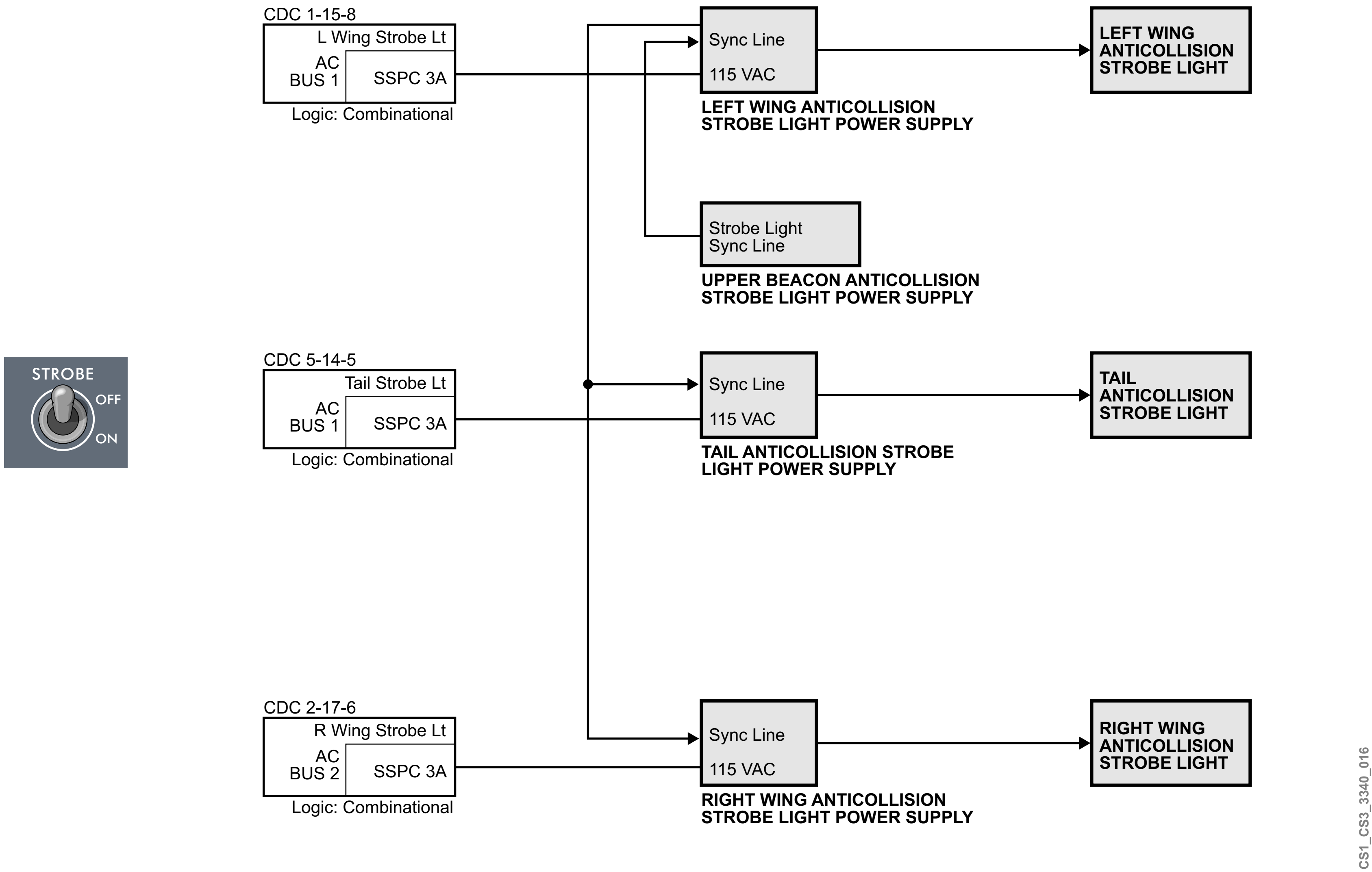


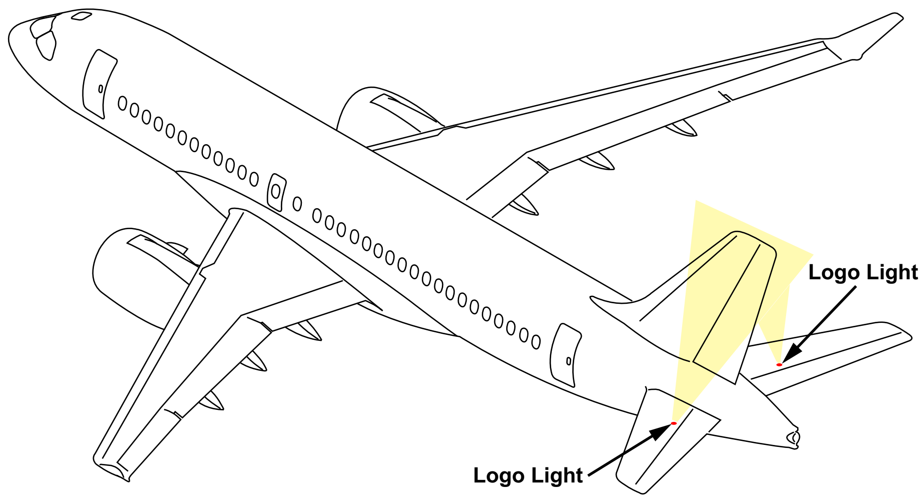
Figure 44: Strobe Lights Detailed Description (L3)

LOGO LIGHTS

GENERAL DESCRIPTION

The LED type logo lights illuminate the vertical stabilizer. The logo lights have a power and control circuit card and an LED assembly. The lights are controlled by a LOGO switch on the EXT LTS panel.

POWER SOURCE	
Light	**Power**
L Logo Light	AC BUS 1
R Logo Light	AC BUS 1



EYEBROW PANEL

CS1_CS3_3340_033

Figure 45: Logo Lights General Description (L2)

COMPONENTS

The logo lights consist of:

- Logo light assembly

LOGO LIGHTS

There is one logo light installed on each horizontal stabilizer.

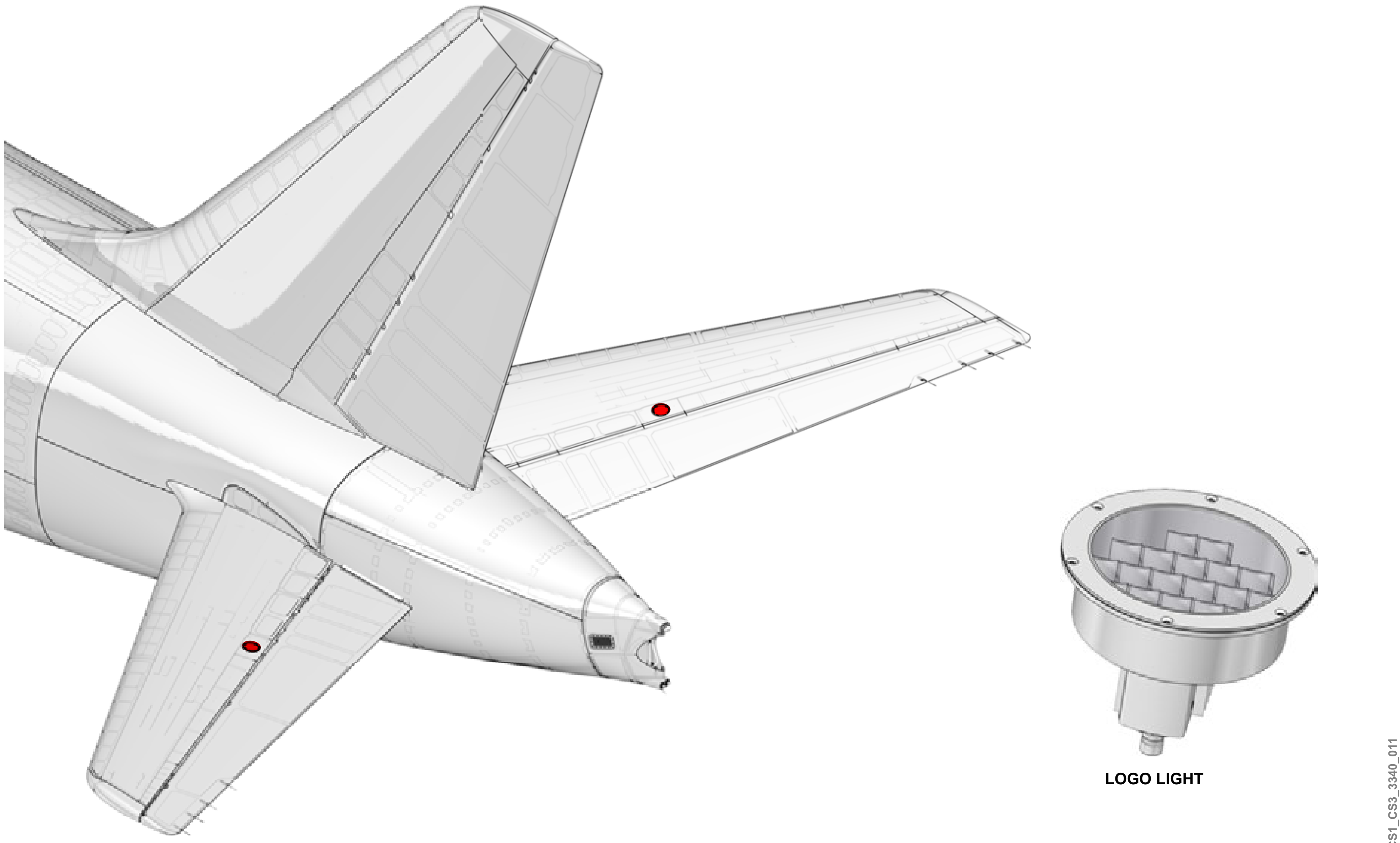


Figure 46: Logo Lights (L2)

DETAILED DESCRIPTION

The logo lights receive power from AC BUS 1.

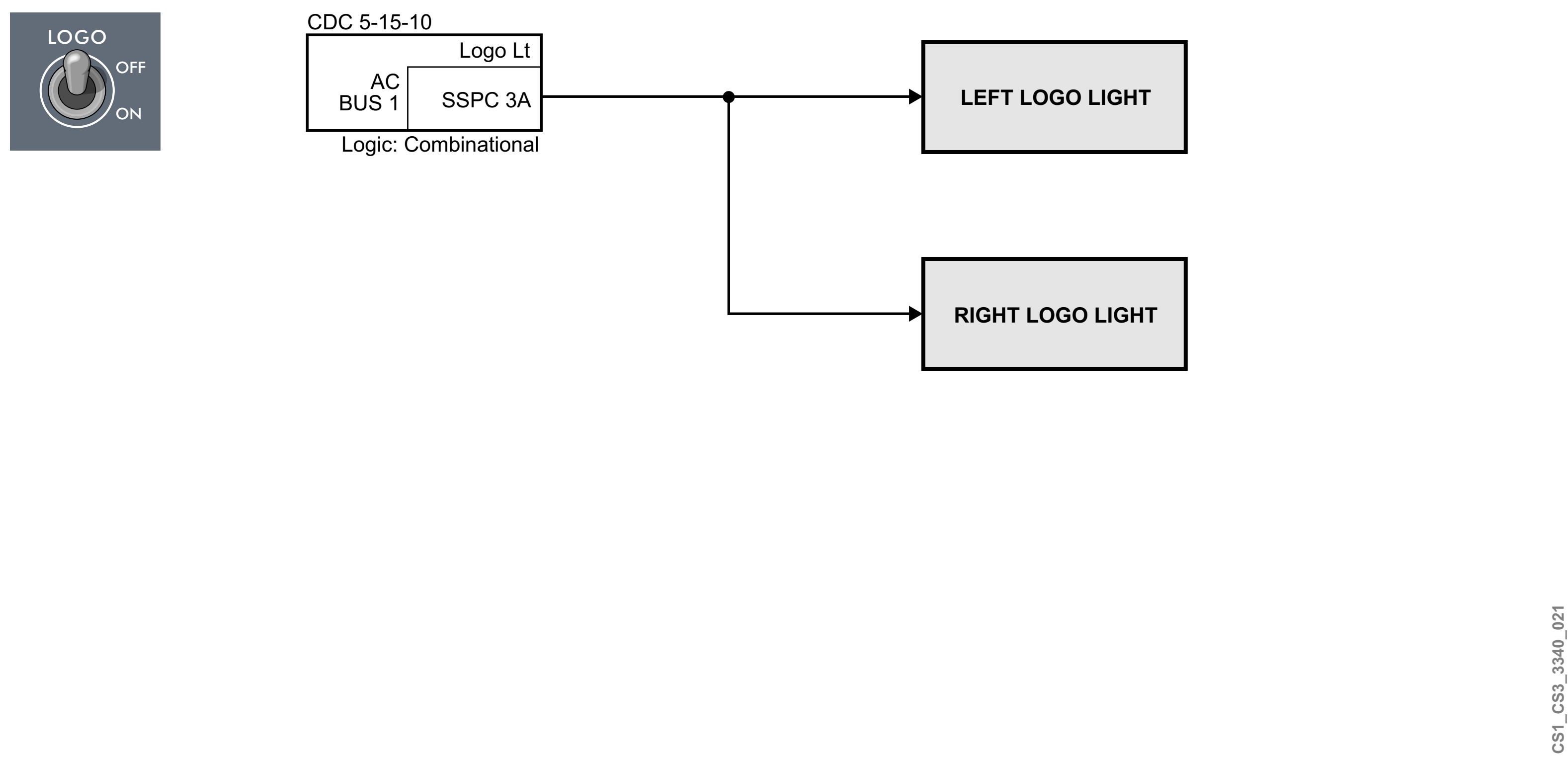


Figure 47: Logo Lights Detailed Description (L3)

33-30 CARGO LIGHTS

GENERAL DESCRIPTION

The cargo compartment lights and loading area lights can be switched on when the cargo door handle is lifted and the door is open. The cargo lights are turned on by a switch inside the door frame. There are four cargo lights in each compartment. Each light assembly has a control circuit and a LED assembly.

A loading area light is mounted on the cargo door to provide ground illumination when the cargo door is open. The loading light switch is located in the cargo door control panel. Each light assembly has a control circuit and an LED assembly.

The cargo and loading area lights have a timer that turns the lights off after 30 minutes.

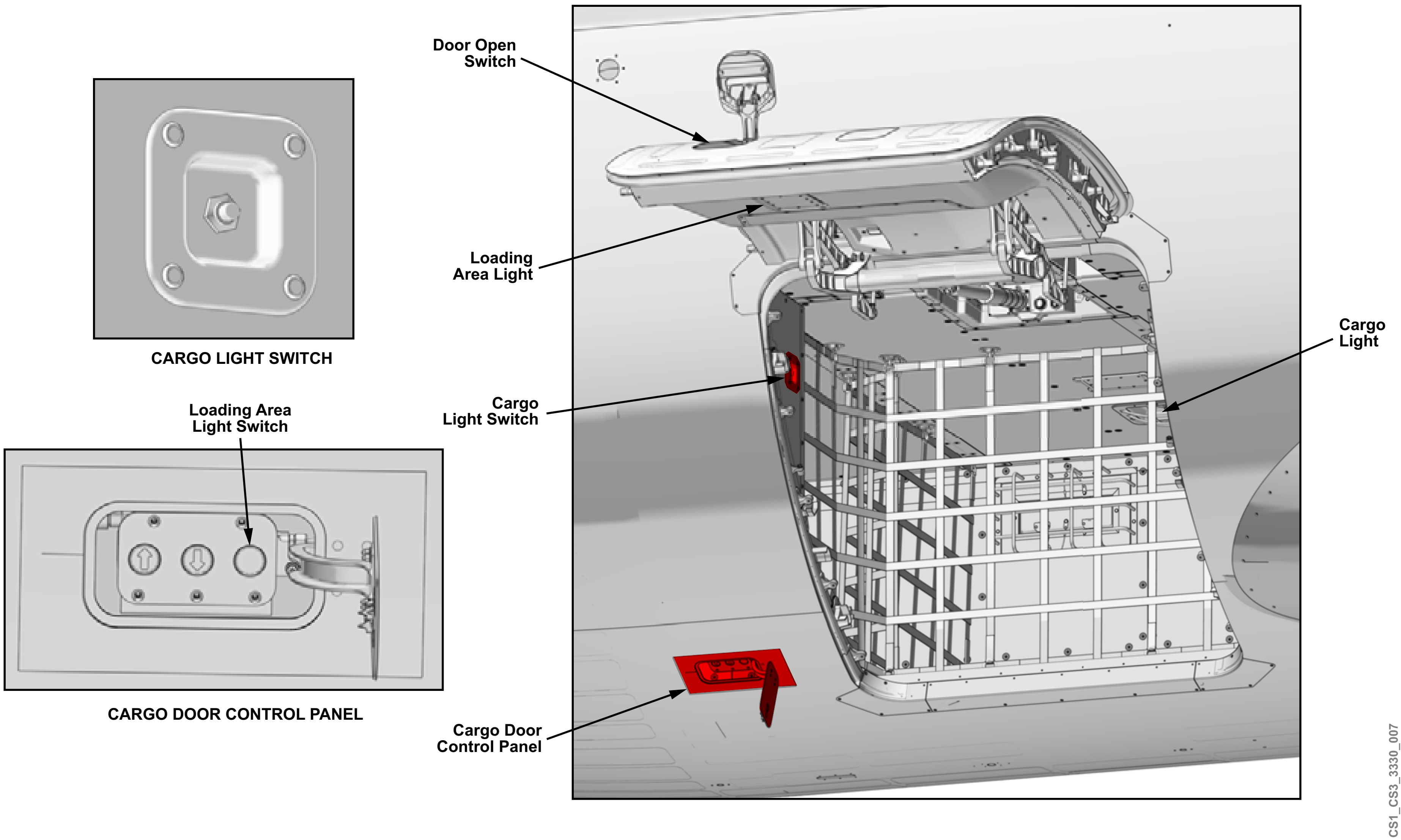


Figure 48: Cargo and Loading Area Lights (L2)

COMPONENT LOCATION

The cargo lights include the following components:

- Cargo light assembly
- Loading area light assembly

CARGO LIGHT ASSEMBLY

The cargo compartment lights units are installed on the cargo ceiling.

LOADING AREA LIGHT ASSEMBLY

A loading area light unit is installed on the cargo door.

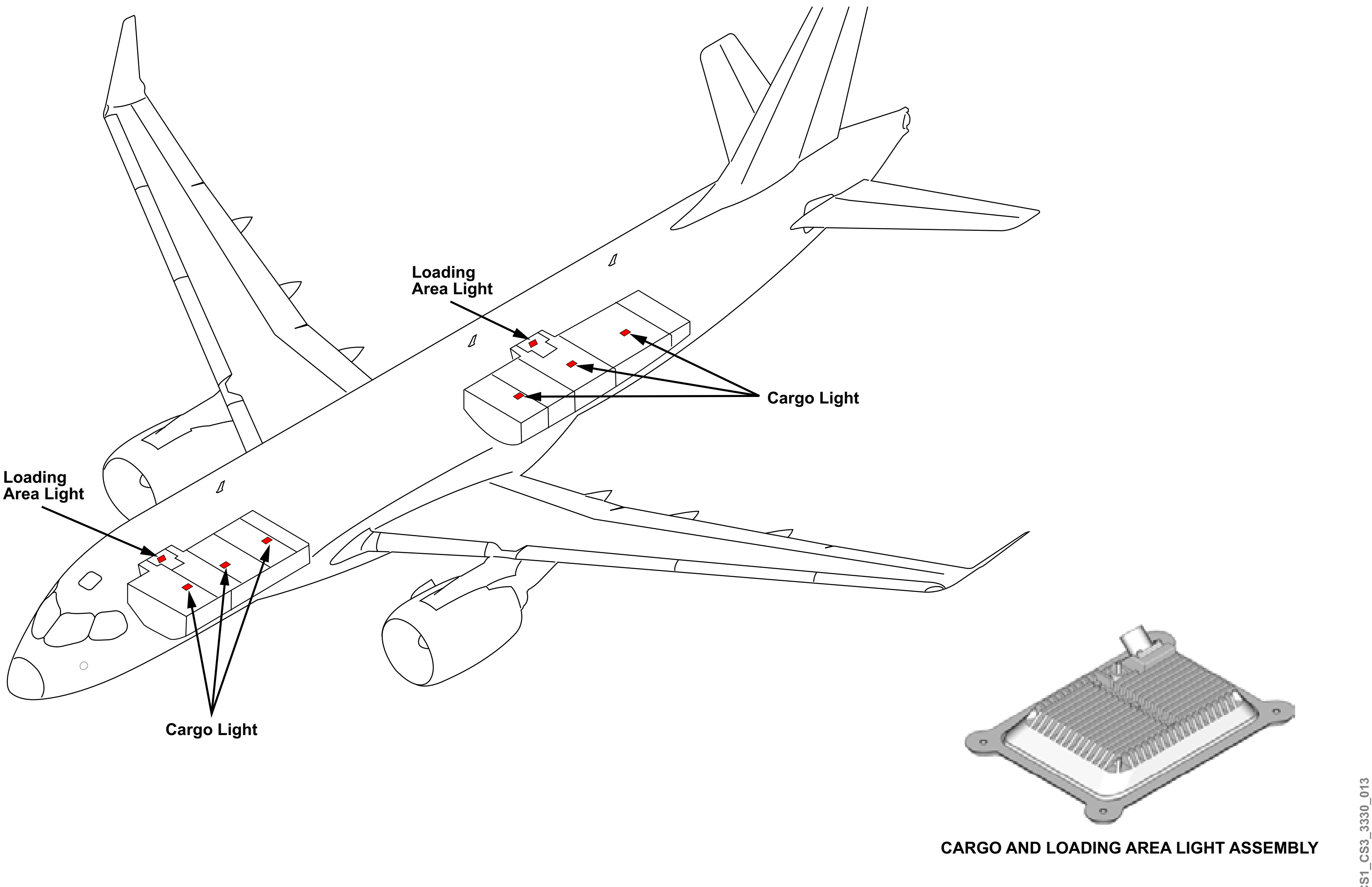


Figure 49: Cargo and Loading Area Lights (L2)

DETAILED DESCRIPTION

The forward and aft cargo compartment light operation is similar.

The cargo DOOR OPEN microswitch, located on the door handle mechanism, provides a ground path for all cargo light assemblies.

The lights are powered by the BATTERY DIRECT BUS 2. A built-in timer turns the lights off after 30 minutes. If the lights are left on, the lights go off when the cargo door is fully closed.

The loading area units are turned on by a switch on the exterior cargo door control panel and the cargo lights are turned on by a switch inside the cargo compartment. A built-in timer turns the lights off after 30 minutes.

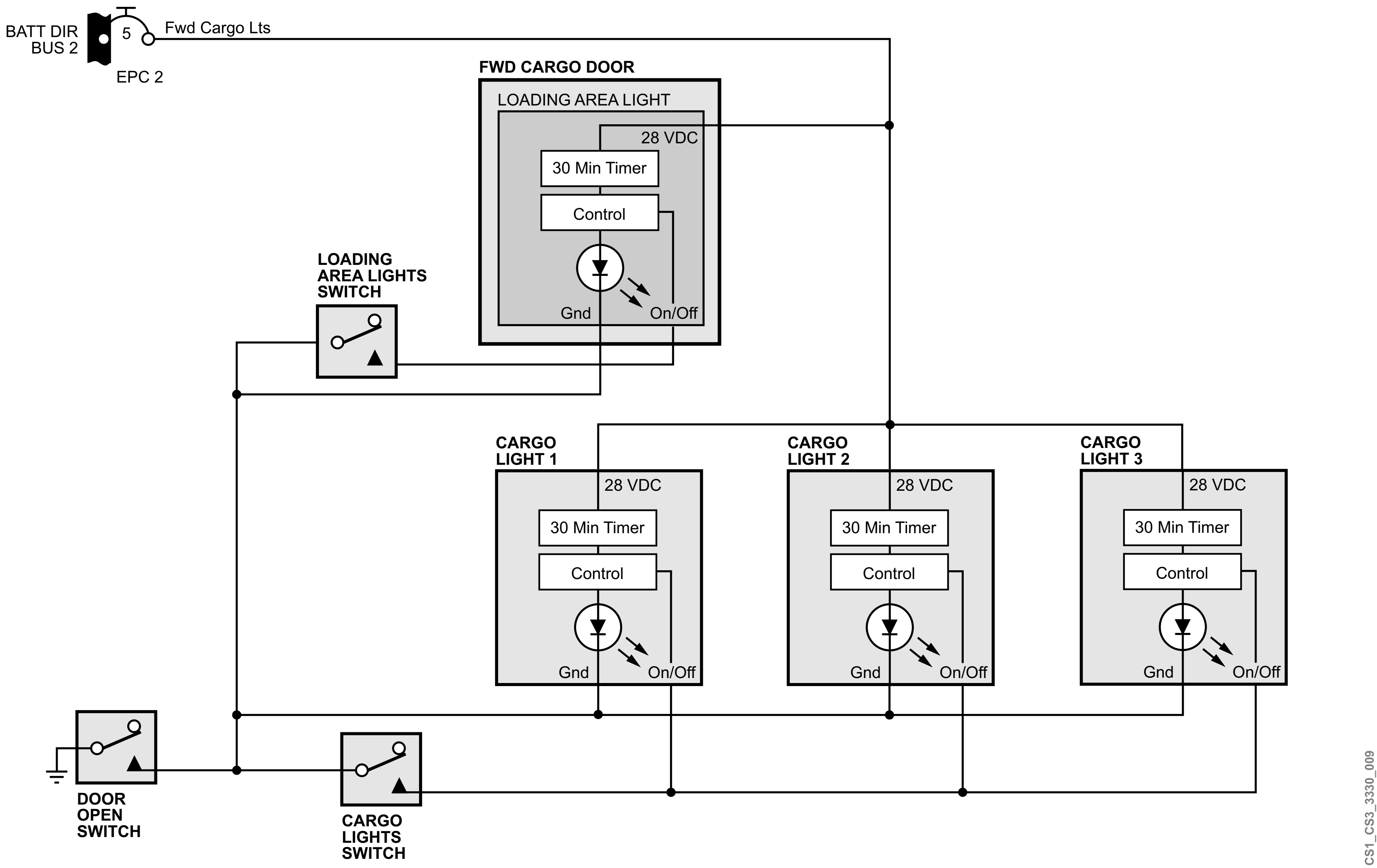


Figure 50: Cargo Lights Detailed Description (L3)

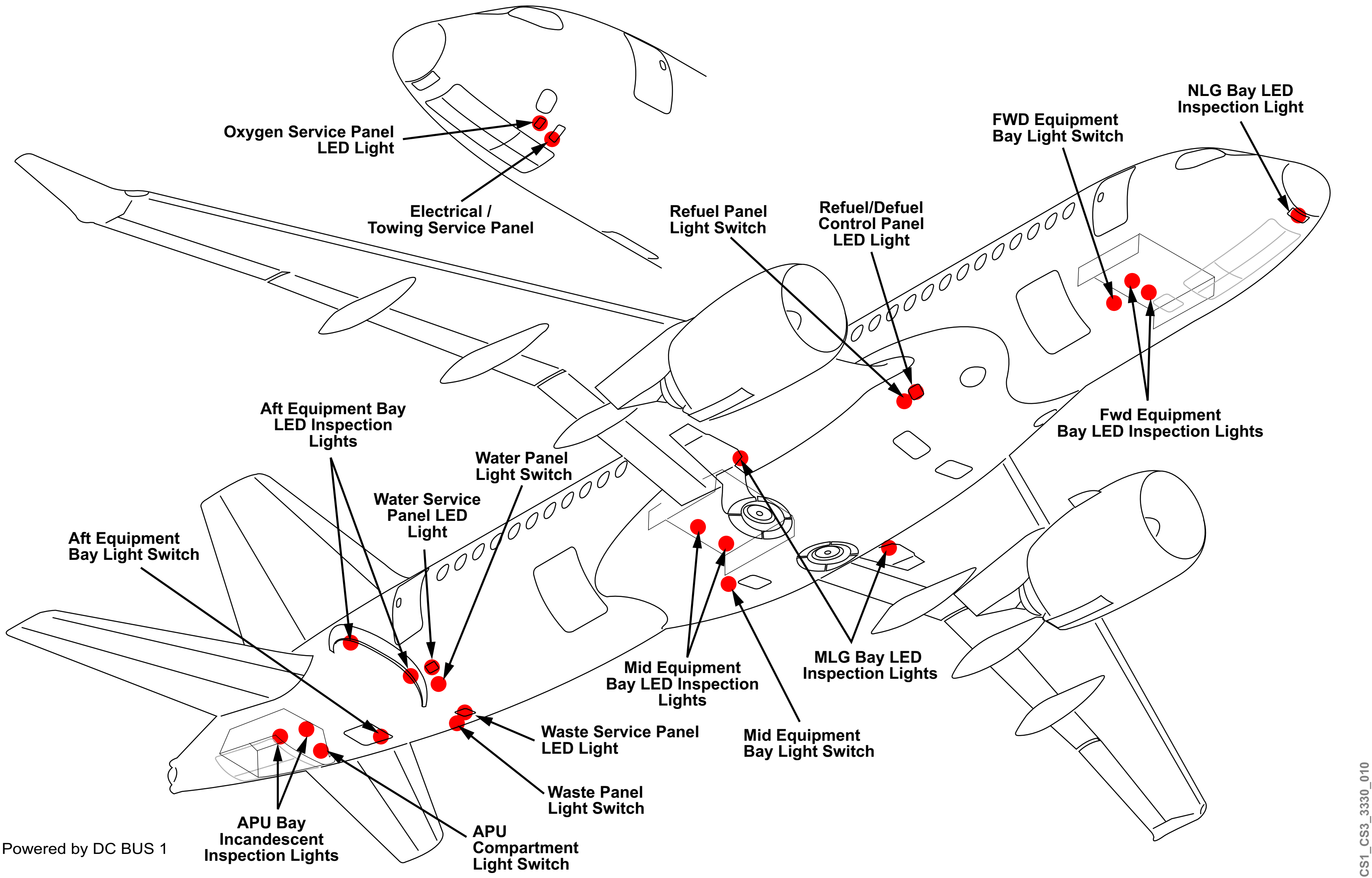
33-30 SERVICE AND MAINTENANCE LIGHTS

GENERAL DESCRIPTION

Service and maintenance lighting provides illumination to the external service panels, landing gear wheel wells, equipment bays, and the auxiliary power unit (APU) compartment.

The switches are located at most service panels and equipment bays. Pressing any switch turns on all of the service and maintenance lights.

The lights are powered from DC BUS 1.



NOTE

Lights Powered by DC BUS 1

Figure 51: Service and Maintenance Lights (L2)

DETAILED DESCRIPTION

The service and maintenance light switches are wired in parallel. The switches provide inputs to control and distribution cabinet (CDC) 1. Any switch turns on all of the lights.

All switch inputs are fed into CDC 1 and distributed to CDC 3 and CDC 5 via TTP BUS to control the light operation. The first press of the switch turns on all of the service and maintenance lights at the same time. A second press of the switch turns the lights off.

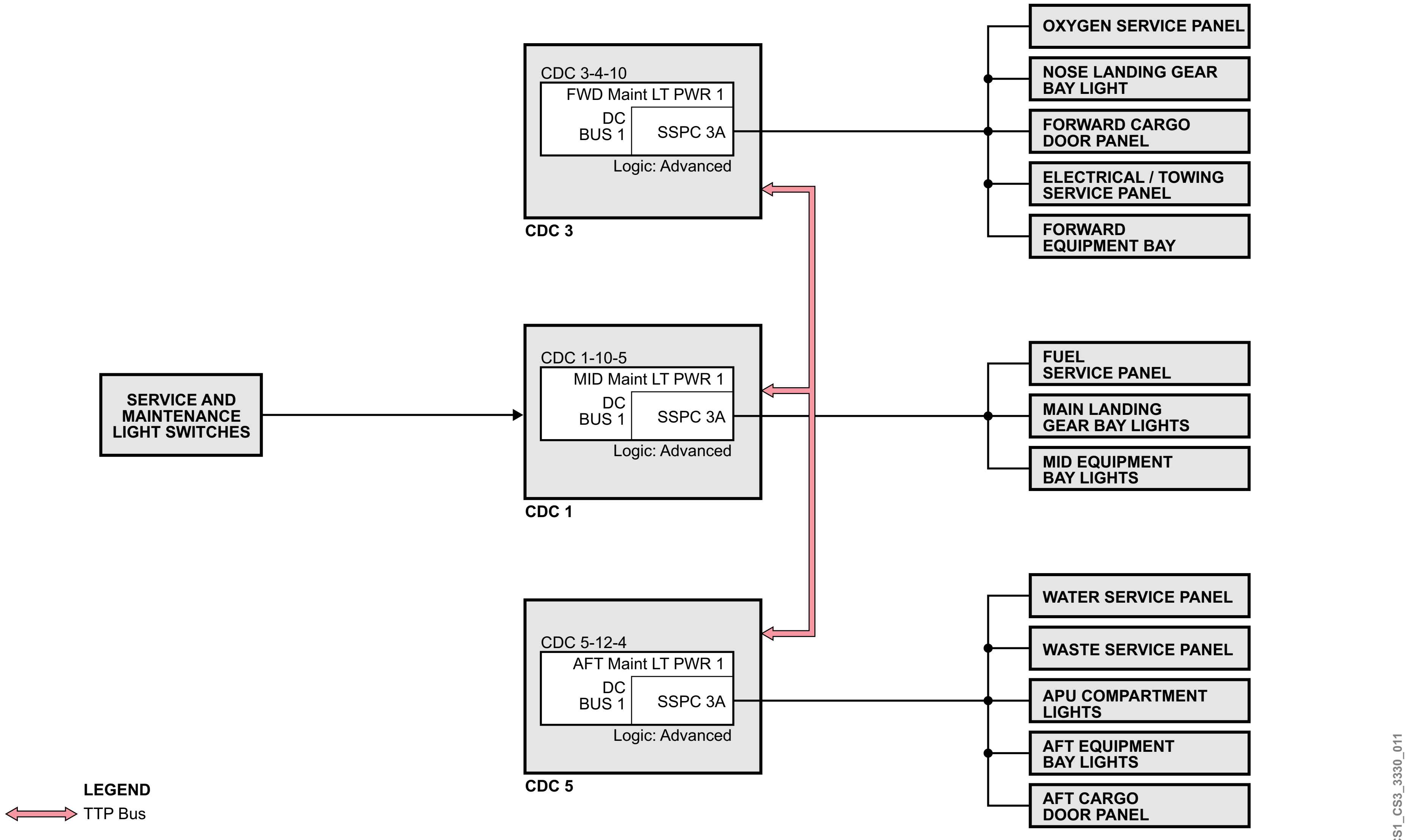


Figure 52: Service and Maintenance Lights Detailed Description (L3)

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ATA 34 - Navigation

BD-500-1A10
BD-500-1A11

Table of Contents

34-11 Air Data System....34-2
General Description....34-2
Component Location....34-4
Air Data Smart Probe....34-4
Total Air Temperature Probe....34-4
Angle-of-Attack Vane....34-4
Controls and Indications....34-6
Detailed Description....34-8
System Theory....34-8
System Interface....34-10
System Redundancy....34-12
Power Sources....34-14
Monitoring and Tests....34-16
CAS Messages....34-18
34-45 Inertial Reference System....34-24
General Description....34-24
Component Location....34-26
Inertial Reference Unit....34-26
Aircraft Personality Module....34-26
Controls and Indications....34-28
Primary Flight Display....34-28
FMS Format Page....34-28
Operation....34-30
Position Initialization....34-30
Detailed Description....34-32
Operation Modes....34-32
Attitude Mode....34-32
Stationary Alignment Mode....34-32
Align-in-Motion Mode....34-32
Automatic Realignment....34-32
Reversionary Attitude Mode....34-32
System Interface....34-34
Monitoring and Tests....34-36
CAS Messages....34-37
System Monitoring....34-38
Practical Aspects....34-40
34-13 Standby Flight Instrument System....34-42
General Description....34-42
Component Location....34-44
Standby Flight Instrument....34-44
Options Control Module....34-44
Controls and Indications....34-46
Setup Menu....34-48
Detailed Description....34-50
System Interface....34-50
Monitoring and Tests....34-52
System Monitoring....34-52
Alignment Annunciations....34-52
Red Flags....34-52
34-00 Tuning and Controls....34-54
General Description....34-54
Controls and Indications....34-56
Control Tuning Panel....34-56
VHF-NAV Radio Tuning....34-58
XPDR/TCAS Controls....34-60
Automatic Direction Finder Tuning Page....34-62
Weather Radar Menu....34-64
PFD/NAV Menu....34-64
Display Tuning Inhibit....34-66

Radio Tuning System Application 34-68
XPDR/TCAS Controls via Radio Tuning System Application 34-70
Graphical Navigation Tuning....................................34-72
34-51 VHF Navigation System 34-74
General Description 34-74
Component Location 34-76
VOR Antenna..34-76
ADF Antenna 34-76
LOC Antenna 34-76
Glideslope Antenna...34-76
Marker Beacon Antenna 34-76
VHF-NAV Receivers 34-78
Marker Beacon Antenna Diplexer.............................34-78
Radio Frequency Switches 34-78
Controls and Indications 34-80
Primary Flight Display...34-80
Bearing Source Selection 34-82
Standby NAV Display..34-84
Standby Flight Instrument System............................34-84
Detailed Description 34-86
System Interface...34-86
Monitoring and Tests 34-88
System Monitoring 34-88
System Test..34-90
34-53 Distance Measurement System...............................34-92
General Description 34-92
Component Location 34-94
Antennas..34-94
DME Transceivers 34-96
Controls and Indications 34-98
Primary Flight Display...34-98
Standby NAV Display... 34-98
Detailed Description 34-100
System Interface 34-100
Monitoring and Tests 34-102
System Monitoring 34-102
System Test 34-104
34-55 Global Navigation Satellite System........................ 34-106
General Description 34-106
Component Location 34-108
GNSS Receivers 34-108
GNSS Antennas.. 34-108
Controls and Indications 34-110
Detailed Description 34-112
System Interface 34-112
Monitoring and Tests... 34-114
CAS Messages 34-115
System Test 34-116
34-44 Radio Altimeter 34-118
General Description 34-118
Component Location 34-120
Radio Altimeter Transceivers 34-120
Radio Altimeter Antennas 34-122
Controls and Indications 34-124
Detailed Description 34-126
System Interface 34-126
Monitoring and Tests 34-128
Radio Altimeter Monitoring.................................... 34-128
System Monitoring 34-130
34-41 Weather Radar 34-132
General Description 34-132
Component Location 34-134

Receiver-Transmitter Antenna 34-134
Controls and Indications 34-136
Windshear Indications...34-136
Predictive Wndshear Operation 34-138
Detailed Description 34-140
System Interface 34-140
Monitoring and Tests 34-142
Weather Radar Monitoring...34-142
System Monitoring 34-144
System Test 34-146
34-42 Terrain Awareness and Warning System 34-148
General Description 34-148
Component Location 34-150
TAWS Common Computing Module 34-150
TAWS Processing Module 34-150
TAWS Control Panel..34-150
Controls and Indications 34-152
TAWS Alert Annunciations..34-152
Terrain Overlays 34-154
Detailed Description 34-156
System Description 34-156
System Interface 34-158
Monitoring and Tests 34-160
System Monitoring 34-160
System Test 34-164
Practical Aspects 34-166
Installation Considerations..34-166
Data Loading...34-166
34-43 Traffic Surveillance System 34-168
General Description 34-168
Air Traffic Control Transponder...............................34-170
Component Location 34-172
Traffic Surveillance System Processing Unit 34-172
Air Traffic Control Transponder.............................. 34-172
Strapping Module 34-172
External Compensation Unit 34-172
Antennas 34-174
Controls and Indications 34-176
Traffic Surveillance System Controls 34-176
Traffic Surveillance System Indications 34-178
Detailed Description 34-180
System Interface 34-180
Monitoring and Tests 34-182
System Test 34-182
Test Indications 34-184
System Monitoring 34-186
34-61 Flight Management System 34-190
General Description 34-190
Component Location 34-192
Controls and Indications 34-194
Multifunction Keyboard Panel 34-194
Control Tuning Panel 34-194
FMS Format Windows... 34-194
Graphical Flight Planning 34-194
Operation 34-196
Synchronized Mode 34-196
Single Mode 34-196
Split Mode 34-196
Detailed Description 34-198
System Interface 34-198
Monitoring and Tests 34-200
Dialog Box... 34-200
Horizontal Situation Indicator Message
Fields and Lines 34-200

Flags 34-200
Aural 34-200
CAS Messages 34-202
Practical Aspects 34-204
Data Loading 34-204
Shunt Configuration 34-206

List of Figures

Figure 1: Air Data System (L2) 34-3
Figure 2: Component Location (L2) 34-5
Figure 3: Controls and Indications (L2) 34-7
Figure 4: System Theory (L3) 34-9
Figure 5: System Interface (L3) 34-11
Figure 6: System Redundancy (L3) 34-13
Figure 7: Power Sources (L3) 34-15
Figure 8: Monitoring and Tests (L2) 34-17
Figure 9: Inertial Reference System (L2) 34-25
Figure 10: Inertial Reference System Components (L2) 34-27
Figure 11: Controls and Indications (L2) 34-29
Figure 12: Position Initialization (L2) 34-31
Figure 13: Operation Modes (L3) 34-33
Figure 14: System Interface (L3) 34-35
Figure 15: System Monitoring (L2) 34-39
Figure 16: Practical Aspects (L2) 34-41
Figure 17: Standby Flight Instrument System (L2) 34-43
Figure 18: Component Location (L2) 34-45
Figure 19: Controls and Indications (L2) 34-47
Figure 20: Setup Menu (L2) 34-49
Figure 21: System Interface (L3) 34-51
Figure 22: System Monitoring (L2) 34-53
Figure 23: Tuning and Controls (L2) 34-55
Figure 24: Control Tuning Panel (L2) 34-57
Figure 25: VHF-NAV Radio Tuning (L2) 34-59
Figure 26: XPDR/TCAS Controls (L2) 34-61
Figure 27: Automatic Direction Finder Tuning Page (Optional) (L2) 34-63
Figure 28: Weather Radar and Radio Altimeter Selections (L2) 34-65
Figure 29: Display Tuning Inhibit (L2) 34-67
Figure 30: Radio Tuning System Application (L2) 34-69
Figure 31: XPDR/TCAS Controls via Radio Tuning System Application (L2) 34-71
Figure 32: Graphical Navigation Tuning (L2) 34-73
Figure 33: VHF Navigation System (L2) 34-75
Figure 34: VHF-NAV Component Location (L2) 34-77
Figure 35: VHF-NAV Receivers, Marker Beacon Antenna Diplexer, and Radio Frequency Switches (L2) 34-79
Figure 36: Primary Flight Display (L2) 34-81
Figure 37: Bearing Source Selection (L2) 34-83
Figure 38: Standby Displays (L2) 34-85
Figure 39: System Interface (L3) 34-87
Figure 40: System Monitoring (L2) 34-89
Figure 41: System Test (L2) 34-91
Figure 42: Distance Measurement System (L2) 34-93
Figure 43: Distance Measuring Equipment Antennas (L2) 34-95
Figure 44: Distance Measuring Equipment Transceivers (L2) 34-97

Figure 45: Primary and Standby Flight Displays (L2) 34-99
Figure 46: System Interface (L3) 34-101
Figure 47: System Monitoring (L2) 34-103
Figure 48: System Test (L2) 34-105
Figure 49: Global Navigation Satellite System (L2)...........34-107
Figure 50: Global Navigation Satellite System Component Location (L2)................................34-109
Figure 51: Global Navigation Satellite System Indications (L2)..34-111
Figure 52: System Interface (L3) 34-113
Figure 53: Global Navigation Satellite System Test (L2) 34-117
Figure 54: Radio Altimeter (L2) 34-119
Figure 55: Radio Altimeter Transceivers (L2)....................34-121
Figure 56: Radio Altimeter Antennas (L2) 34-123
Figure 57: Controls and Indications (L2) 34-125
Figure 58: System Interface (L3) 34-127
Figure 59: Radio Altimeter Monitoring (L2).......................34-129
Figure 60: Weather Radar (L2)..34-133
Figure 61: Receiver-Transmitter Antenna Component Location (L2)................................34-135
Figure 62: Controls and Indications (L2) 34-137
Figure 63: Predictive Windshear Operation (L2) 34-139
Figure 64: System Interface (L3) 34-141
Figure 65: System Monitoring (L2) 34-143
Figure 66: System Test (L2) 34-147
Figure 67: Terrain Awareness and Warning System (L2) 34-149
Figure 68: Component Location (L2) 34-151
Figure 69: TAWS Alert Annunciations (L2)....................... 34-153
Figure 70: Terrain Overlays (L2)...................................... 34-155
Figure 71: System Description (L3) 34-157
Figure 72: System Interface (L3) 34-159
Figure 73: System Monitoring (L2).................................. 34-161
Figure 74: System Test (L2) 34-165
Figure 75: Practical Aspects (L2)..................................... 34-167
Figure 76: Traffic Surveillance System (L2)...................... 34-169
Figure 77: Air Traffic Control Transponder (L2)................ 34-171
Figure 78: Component Location (L2) 34-173
Figure 79: Antennas (L2) 34-175
Figure 80: Traffic Surveillance System Controls (L2) 34-177
Figure 81: Traffic Surveillance System Indications (L2)..... 34-179
Figure 82: System Interface (L3) 34-181
Figure 83: System Test (L2) 34-183
Figure 84: Test Indications (L2) 34-185
Figure 85: Traffic Surveillance System Monitoring (L2) 34-187
Figure 86: Flight Management System (L2)...................... 34-191
Figure 87: Component Location (L2) 34-193
Figure 88: Controls and Indications (L2).......................... 34-195
Figure 89: Operation (L2)... 34-197
Figure 90: System Interface (L3) 34-199
Figure 91: Monitoring and Tests (L2)............................... 34-201
Figure 92: Data Loading (L2).. 34-205
Figure 93: Shunt Configuration (L2)................................. 34-207

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NAVIGATION - CHAPTER BREAKDOWN

Flight Environment Data 1

Attitude and Direction 2

Independent Position Determining 3

Dependent Position Determining 4

Landing and Taxi Aids 5

Flight Management Computing 6

34-11 AIR DATA SYSTEM

GENERAL DESCRIPTION

The air data system (ADS) consists of four independent, cross-coupled air data smart probes (ADSPs), two angle-of-attack (AOA) vanes, and two total air temperature (TAT) probes. The system provides pressure altitude, altitude rate, AOA, CAS, TAS, Mach, TAT, SAT, and V_{MAX}.

Each ADSP consists of two subassemblies; a multifunction probe (MFP), and an integrated dual-channel air data computer (ADC), which eliminates the need for a separate air data computer. The two subassemblies are not independently line replaceable.

For static source error correction (SSEC), the ADSP receives inputs from its opposite probe.

The ADSPs provide primary air data directly to the display units (DUs), the primary flight control computers (PFCCs), and the data concentrator unit module cabinets (DMCs), which distributes this data to various other systems.

In normal operation, ADSP 1 provides air data to DU 1 (left outboard), ADSP 2 to DU 4 (right outboard), and ADSP 3 to the standby flight instrument system.

The AOA vanes act as secondary sources of AOA data and send their data to the ADSPs.

The TATs send the external air temperature data to the ADSPs for computation.

The ADSPs receive data coming from:

- Full authority digital engine controller (FADEC)
- Landing gear and steering control unit (LGSCU)
- Integrated cockpit control panel (ICCP)
- Slat flap electronic control unit (SFECU)

The control tuning panel (CTP) sends the baro settings to the DUs for pressure altitude correction.

The ADSPs are powered by the following sources:

- ADSP 1, DC BUS 1
- ADSP 2, DC BUS 2
- ADSP 3, DC ESS BUS 3
- ADSP 4, DC ESS BUS 2

The AOA vane 1 receives power from DC ESS BUS 1, and AOA vane 2 from DC BUS 2.

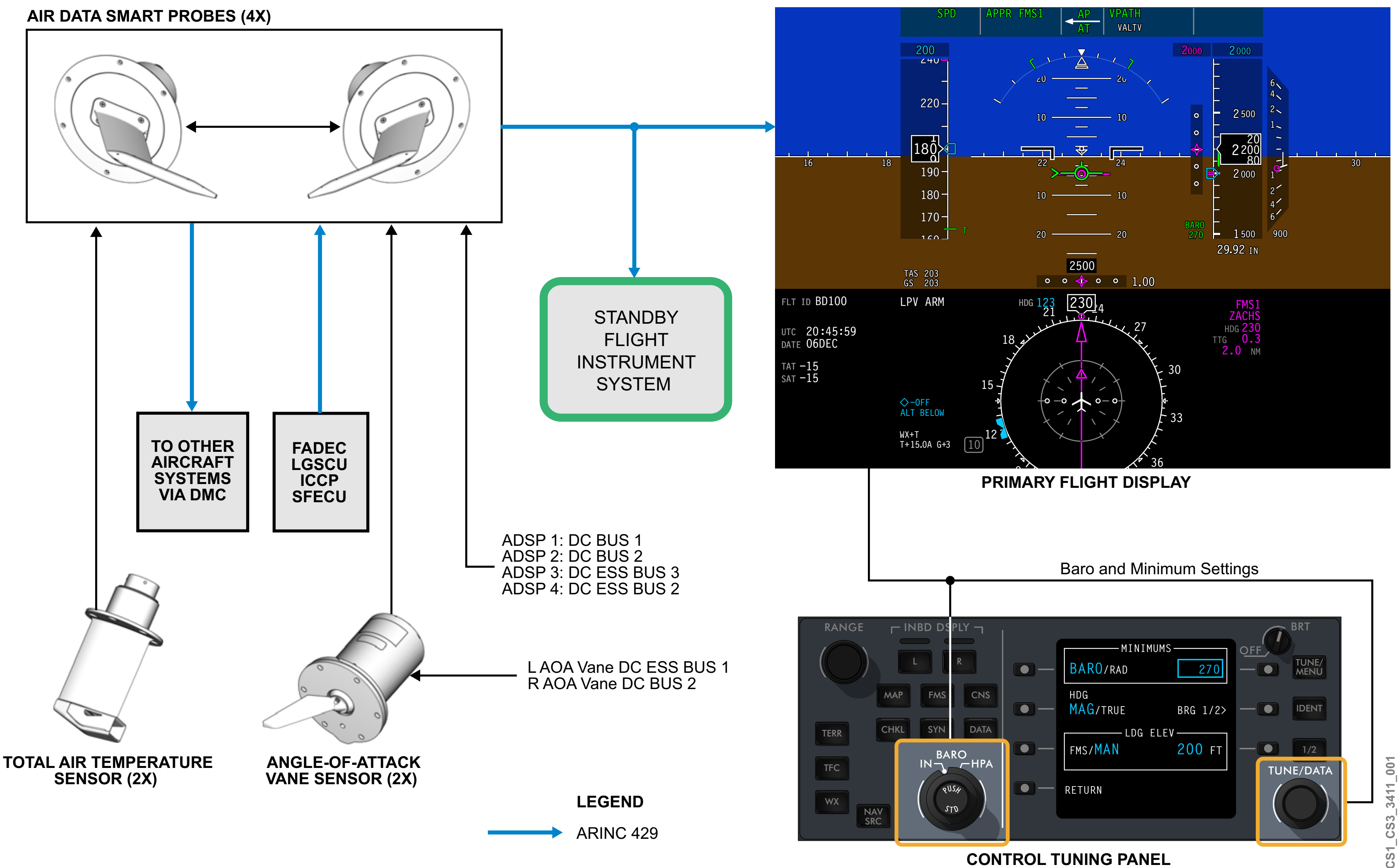


Figure 1: Air Data System (L2)

COMPONENT LOCATION

AIR DATA SMART PROBE

There are four ADSPs located on both sides of the nose fuselage.

TOTAL AIR TEMPERATURE PROBE

There are two identical TATs mounted on the nose fuselage.

ANGLE-OF-ATTACK VANE

The two angle-of-attack (AOA) vanes are located on the nose fuselage of the aircraft.

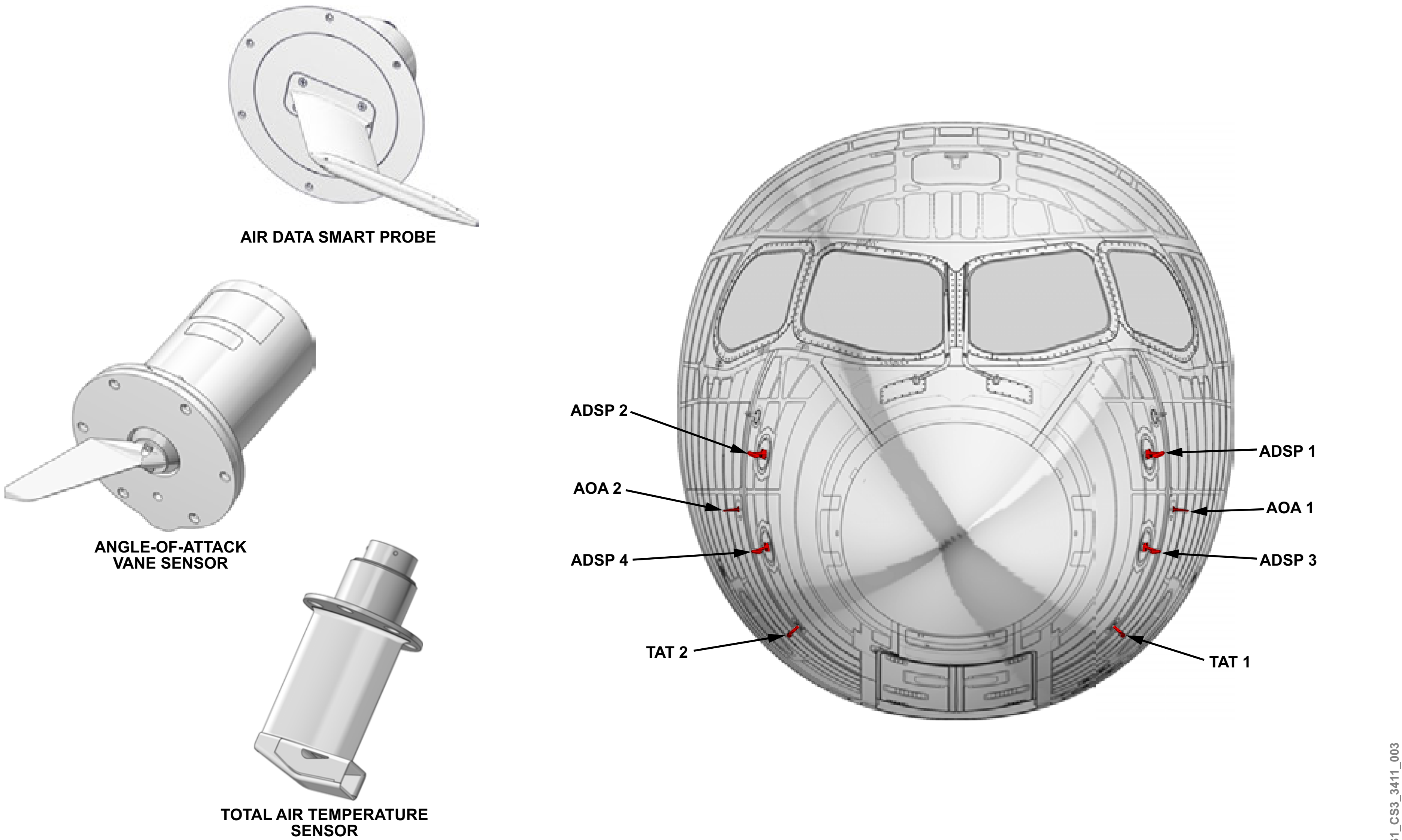


Figure 2: Component Location (L2)

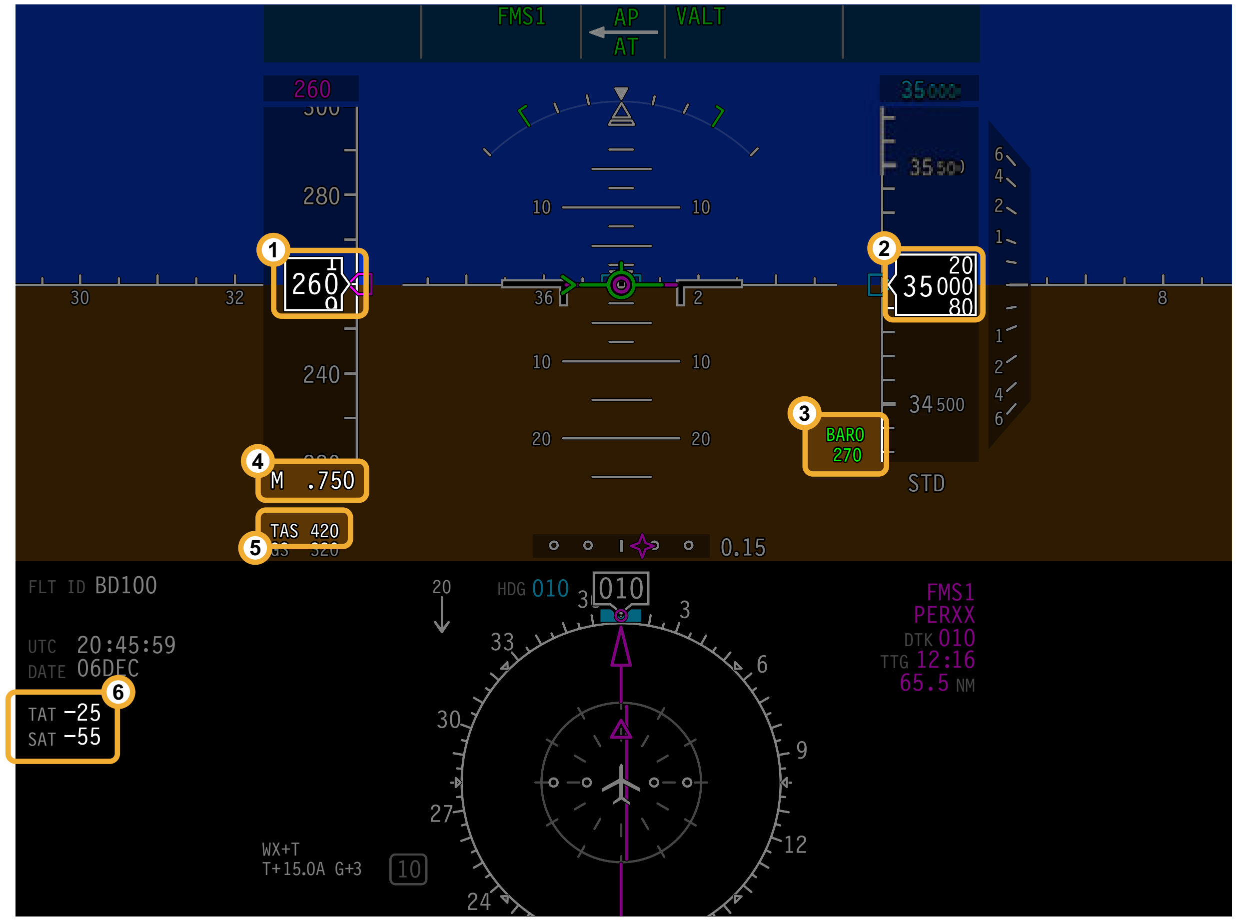
CONTROLS AND INDICATIONS

The ADS provides pressure altitude, indicated airspeed (IAS), Mach, TAT, static air temperature (SAT), and Vmax parameters to the DUs.

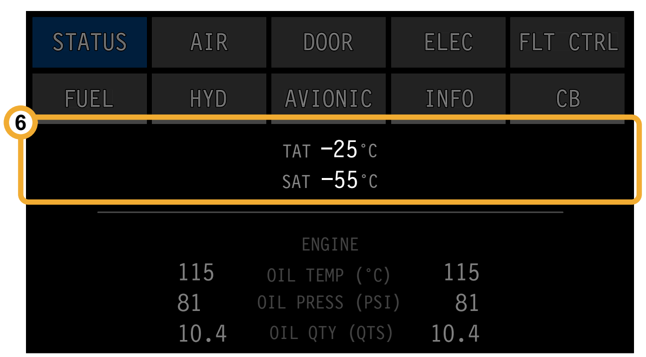
The system also provides pressure altitude, indicated airspeed, and V_{mo} /M_{mo} parameters to the standby flight instrument system (SFIS).

The SAT and TAT information is accessible on the synoptic status page.

1. Indicated airspeed
2. Pressure altitude
3. Barometer minimum
4. Mach
5. True airspeed
6. Total and static air temperature



PRIMARY FLIGHT DISPLAY



SYNOPTIC PAGE – STATUS

CS1_CS3_3411_004

Figure 3: Controls and Indications (L2)

DETAILED DESCRIPTION

SYSTEM THEORY

The ADSP is a line replaceable unit (LRU) consisting of a multifunction probe (MFP) and an ADC.

The MFP contains the pneumatic ports necessary to deliver total, static and AOA pressures to the ADC. Any moisture is expelled by the drain holes.

The ADC has two channels:

- Main channel
- Opposite-side pressure (OSP) channel

The main channel has the following functions:

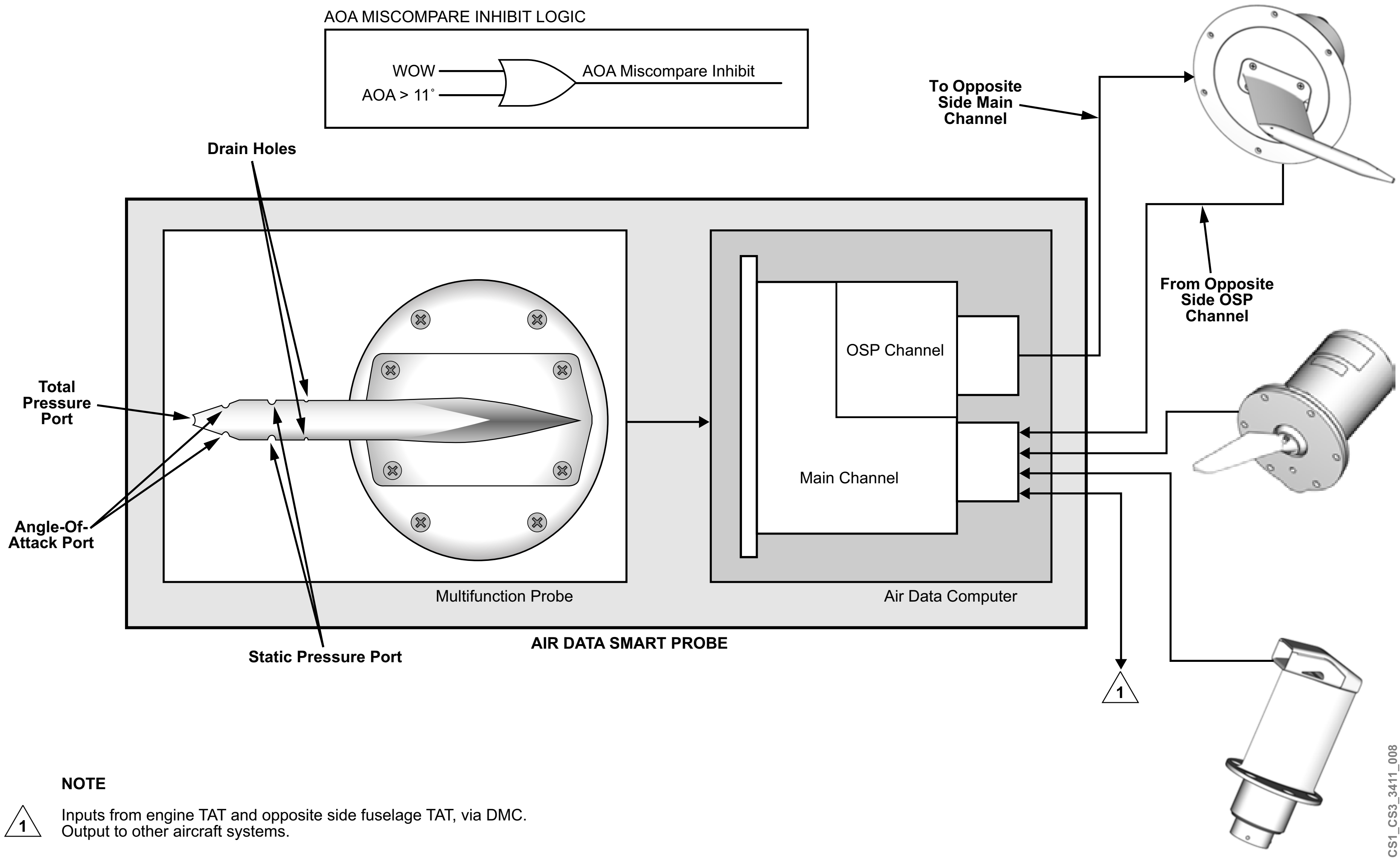
- Measure pressures from its own MFP
- Receive pressure from the OSP channel from the opposite ADSP
- Calculate and transmit air data parameters to the appropriate aircraft systems
- Receive aircraft configuration and status via ARINC 429
- Receive data from TAT and AOA vane sensors
- Control and monitor MFP heater power

The OSP channel measures static pressure from its own MFP and provides the opposite-side ADSP main channel with static pressure data to correct for side-slip effects. It also monitors MFP heater function.

The ADC main channel also uses its same side AOA vane data to calculate a separate aircraft AOA. The two calculated AOAs are then compared inside the ADC main channel. An ADS FAULT advisory message is displayed and an INFO message becomes available when the ADC detects the following:

- A difference greater than 2.5° between both same side ADSPs and the same side AOA vane
- A fault is detected in either the ADSPs or AOA vane
- The heater for one of the ADSPs or AOA vanes is not functional

The AOA miscompare messages are inhibited when the aircraft is on the ground to prevent nuisance messages. The messages are also inhibited when the aircraft AOA is above 11° because of airflow disruptions due to the position of the lower ADSPs with respect to the AOA vanes.



NOTE

1 Inputs from engine TAT and opposite side fuselage TAT, via DMC. Output to other aircraft systems.

Figure 4: System Theory (L3)

SYSTEM INTERFACE

The four ADSPs sense and process air data used by the aircraft systems.

The ADSPs generate four independent sources of air data information to provide sideslip compensated air data with a direct ARINC 429 link to the DMCs, the PFCCs, and DUs.

The two lower probes (ADSP 3 and 4), known as essential probes, also send air data directly to the SFIS. ADSP 3 is the primary source for the SFIS, and ADSP 4 is the secondary.

The main channel of each ADSP is the distributor of the final calculated air data that is sent to the systems. The OSP channel provides the opposite main ADSP channel with the data required for sideslip compensation, via CAN BUS.

Each ADSP receives temperature signals directly from the same side fuselage TAT sensors.

The ADS outputs air data information to aircraft systems through the DMC.

The following are air data inputs via DMCs:

- FBW - Status. To determine fly-by-wire (FBW) mode status (normal or direct)
- SFECU - Slat/flap position. For maximum airspeed calculation
- EEC - Engine TAT. For backup TAT
- LGSCU - WOW. For probes heating logic
- ICCP - Probe heat switch. For probe heating override
- FGC - Estimated beta signal used for backup sideslip compensation calculation
- IRS - Inertial lateral acceleration data. For AOA vane sensor correction

ADSP 1 is the primary source for the left primary flight display (PFD), and ADSP 2 is the primary source for the right PFD.

The reversion sourcing sequence is as follows:

- L PFD: ADS 1 (default), ADS 4 (spare), ADS 2 (cross-side), ADS 3 (same as SFIS)
- R PFD: ADS 2 (default), ADS 4 (spare), ADS 1 (cross-side), ADS 3 (same as SFIS)
- SFIS: ADS 3 (default), ADS 4 (spare)

When the aircraft is on the ground, the probe heat switch turns on the MFP heater for 2 minutes for ice protection.

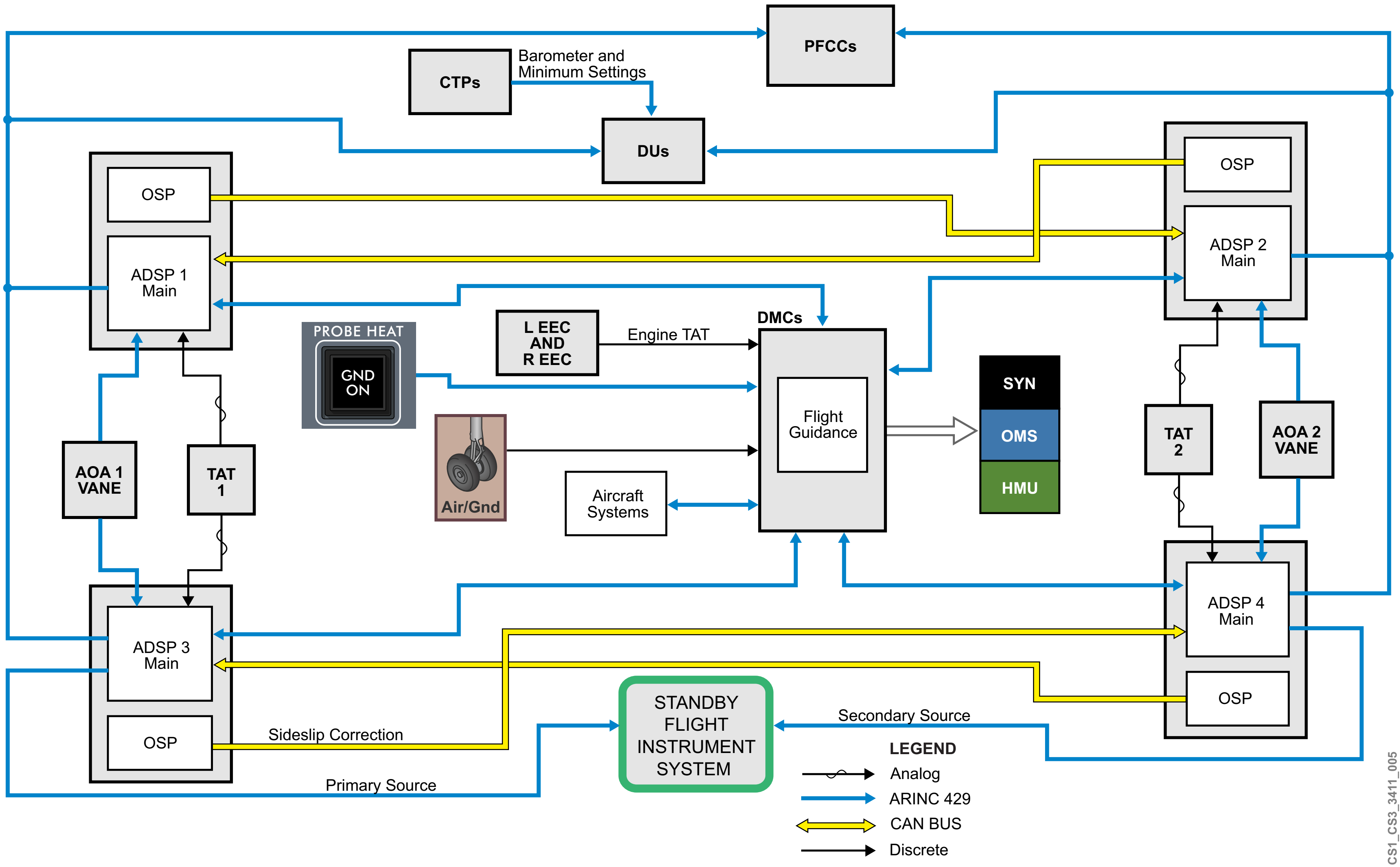


Figure 5: System Interface (L3)

SYSTEM REDUNDANCY

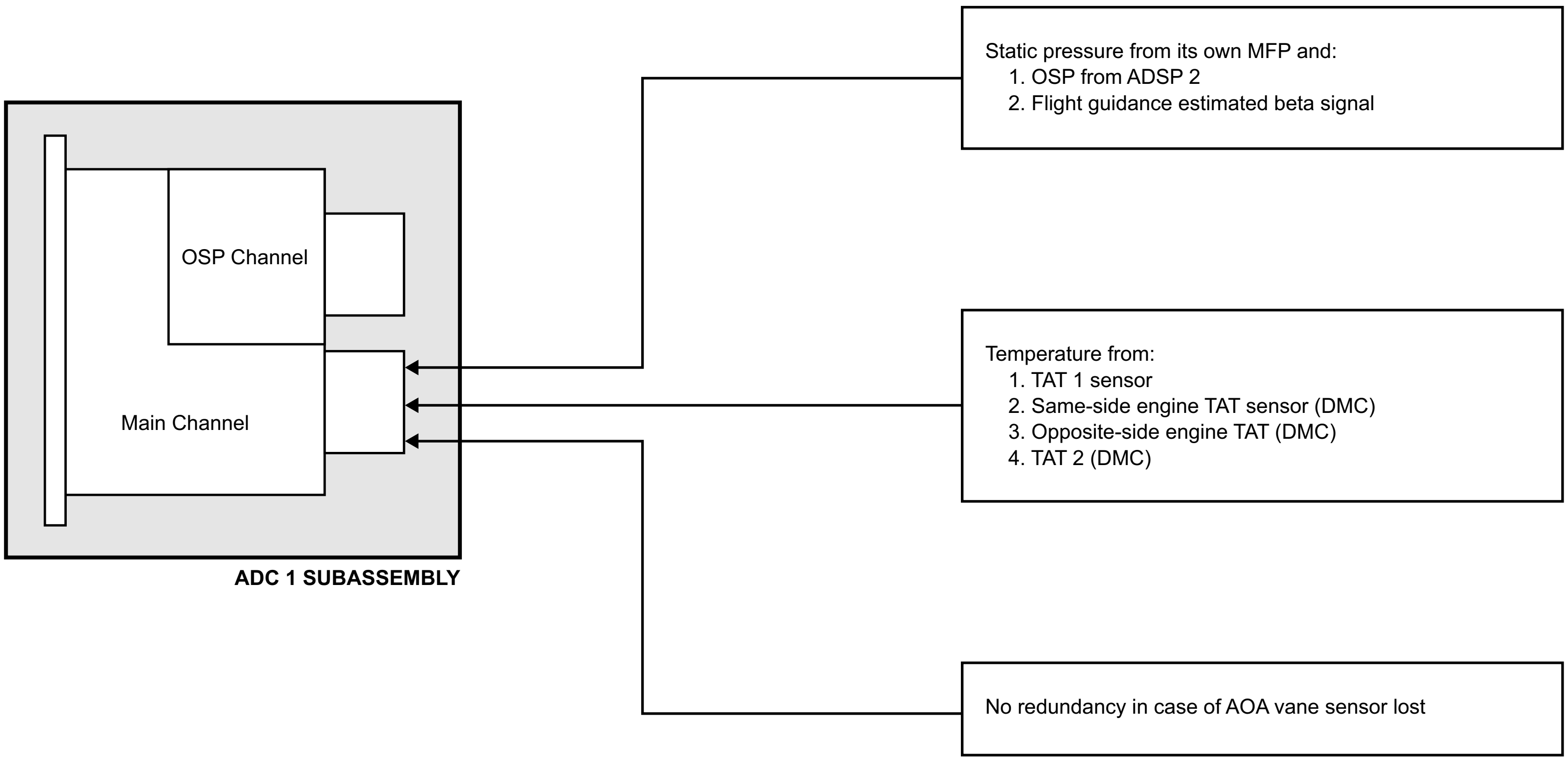
If the opposite-side static pressure via CAN BUS is lost, the ADSP uses an estimated beta signal from the flight guidance (FG). For example, if ADSP 1 main channels input from ADSP 2 OSP is lost; ADSP 1 uses the aircraft beta signal to correct for side-slip effect. If both sources are not available, ADSP continues to provide local information without side-slip correction.

If ADSP 1 uses the aircraft avionics beta signal or the comparator function fails an ADS 1 SLIPCOMP FAIL caution CAS message is displayed. The same scenario applies for all ADSPs.

In the event that both ADSP 3 and ADSP 4 comparator functions have failed or they are both using the aircraft avionics beta signal, an ADS ISI SLIPCOMP FAIL caution CAS message is displayed.

If the fuselage TAT signal is lost or invalid, the ADSP uses the same-side engine TAT data via the DMC. If this is also invalid, the ADSP uses the opposite side engine TAT data via the DMC. If that is also unavailable, then the system uses the opposite side fuselage TAT.

An ADS FAULT advisory CAS message is displayed whenever the TAT signal is changed from its primary source.



NOTE

The logic shown in this example applies to all four systems.

CS1_CS3_3411_009

Figure 6: System Redundancy (L3)

POWER SOURCES

Power for the air data system is supplied as follows:

- DC BUS 1 for ADSP 1
- DC BUS 2 for ADSP 2 and AOA 2
- DC ESS BUS 1 for AOA 1
- DC ESS BUS 2 for ADSP 4
- DC ESS BUS 3 for ADSP 3

Each ADSP main channel outputs 9 VDC to power the OSP channel.

Additional information on the power sources for the heating elements are contained in ATA 30, Ice and Rain Protection.

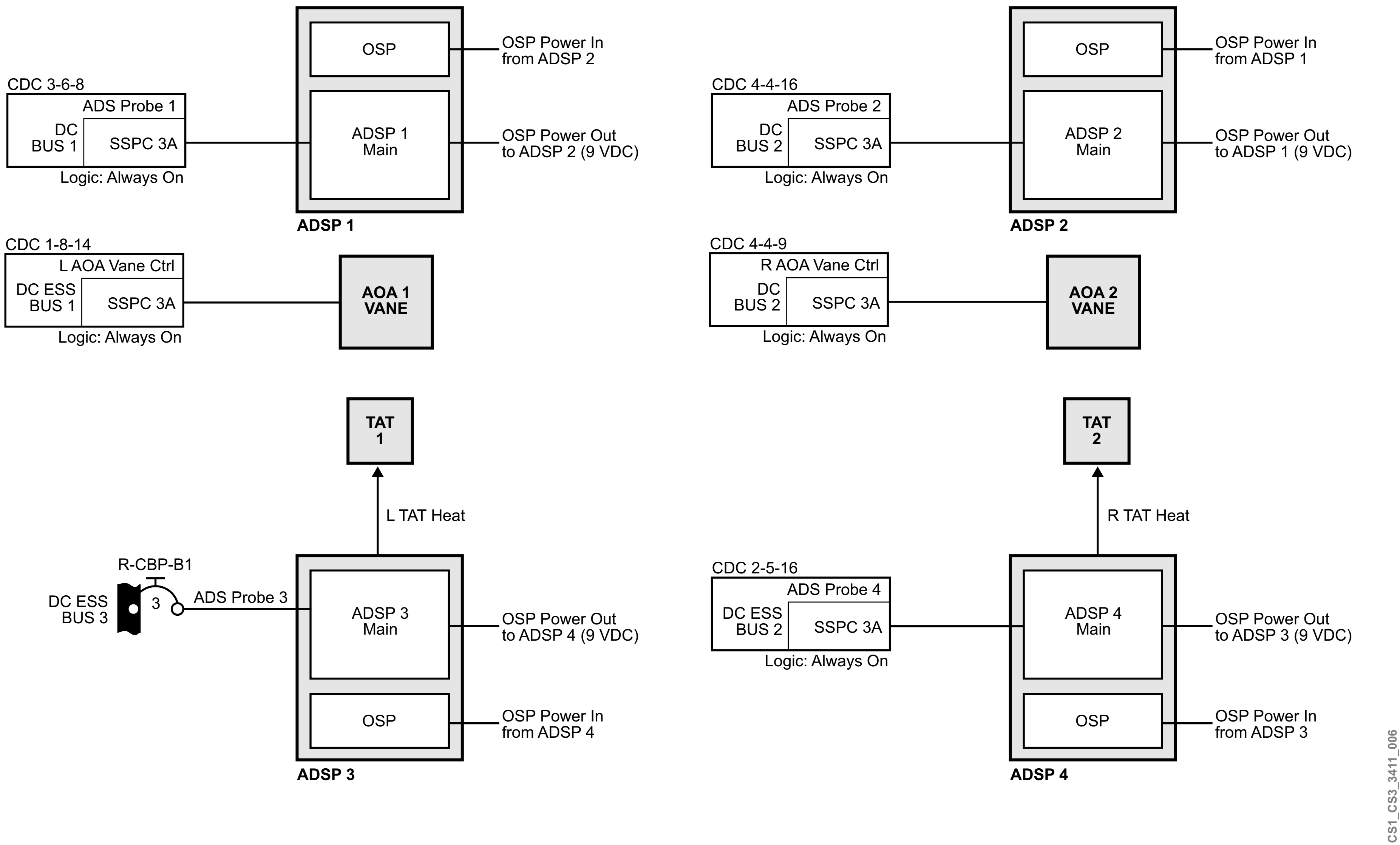


Figure 7: Power Sources (L3)

MONITORING AND TESTS

The ADSP continually monitors critical internal functions to verify and flag any failures, both in the status word to the onboard maintenance system (OMS), health monitoring unit (HMU) and display units, and in internal non-volatile memory for retrieval and analysis.

A red IAS or ALT box on the PFD indicates airspeed or altitude is lost or invalid.

The air data source can be manually reverted by the crew by toggling the ADS button on the reversion switch panel (RSP). The selection sequence is indicated on the flight mode annunciator (FMA) as follows:

- If the DU is using normal air data source, there is no indication
- If the DU is using another source, then a source indicator appears
- If two DUs are using the same source, then the source indicator becomes amber (common source)

In case of heater failure, ADS PROBE HEAT FAIL CAS message is displayed. The system does not autorevert. When flying in icing conditions, the crew can manually revert to an alternate source.

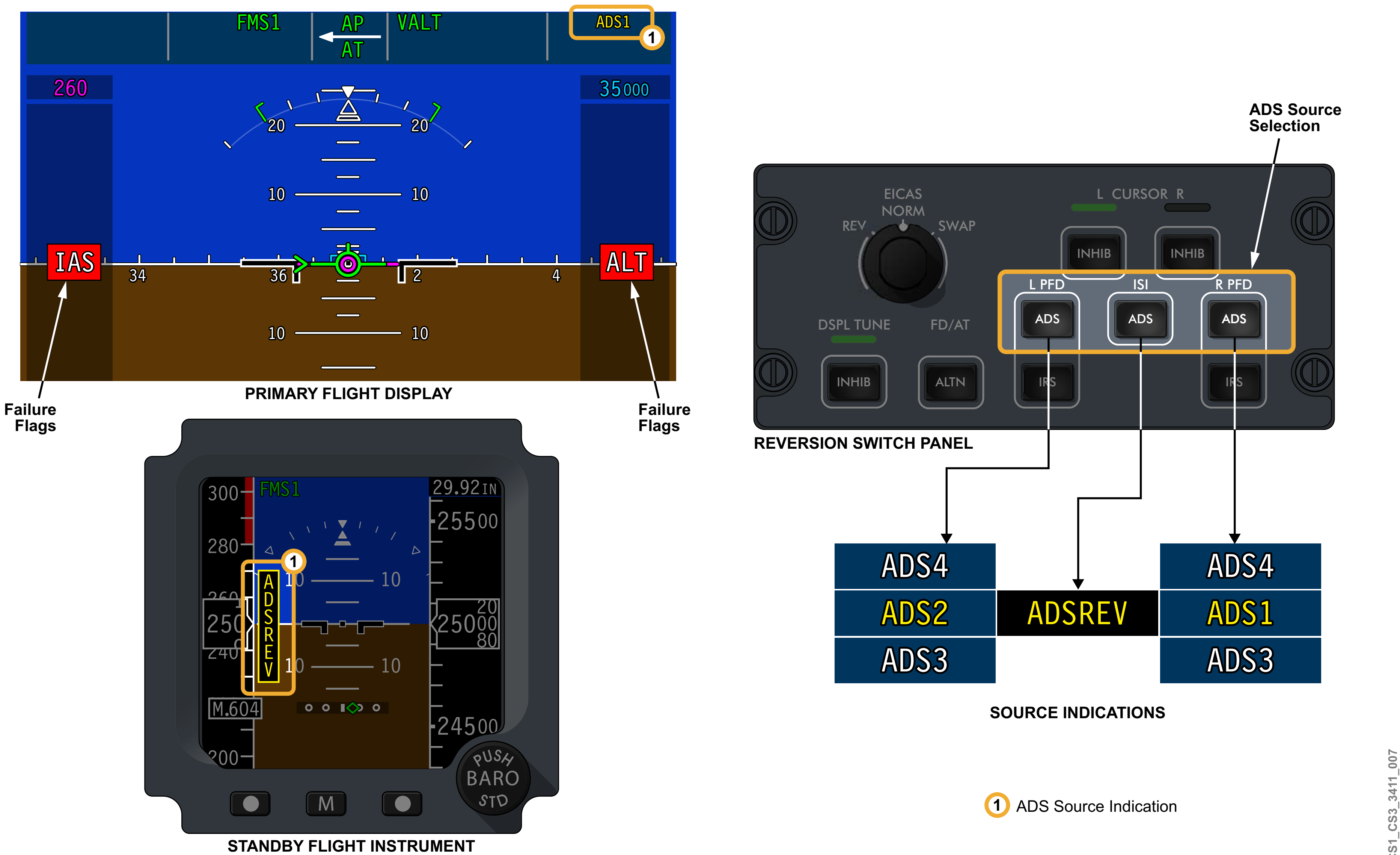


Figure 8: Monitoring and Tests (L2)

CAS MESSAGES

The following pages provides the CAS and INFO messages for the air data system.

Table 1: CAUTION Messages

MESSAGE	LOGIC
ADS 3 FAIL	ADS_3_FAIL if ADSP_3 reports FAILED, excludes OSP and heater fails.
ADS ISI FAIL	ADS_ISI_FAIL if both ADS 3 and ADS 4 have failed.
ADS SAME SOURCE	ADS_SAME_SOURCE_CAS if two ADS sources have failed, but should not appear when ADS 3 and ADS 4 fails because this failure case is covered in ADS ISI FAIL CAS message logic.
ADS 1 PROBE HEAT FAIL	ADS_1_Probe_Heat_Fail if either: ADSP 1 heater is not being heated per expectation, or BIT has detected a failure of the heater system.
ADS 2 PROBE HEAT FAIL	ADS_2_Probe_Heat_Fail if either: ADSP 2 heater is not being heated per expectation, or BIT has detected a failure of the heater system.
ADS 3 PROBE HEAT FAIL	ADS_3_Probe_Heat_Fail if either: ADSP 3 heater is not being heated per expectation, or BIT has detected a failure of the heater system.
ADS 4 PROBE HEAT FAIL	ADS_4_Probe_Heat_Fail if either: ADSP 4 heater is not being heated per expectation, or BIT has detected a failure of the heater system.
ADS ISI PROBE HEAT	ADS_3_Probe_Heat_Fail and ADS_4_Probe_Heat_Fail.
ADS 1 SLIPCOMP FAIL	Loss of all sideslip compensation capability, (cross and estimated beta) in ADS 1 OR sideslip source is aircraft estimated beta.
ADS 2 SLIPCOMP FAIL	Loss of all sideslip compensation capability, (cross and estimated beta) in ADS 2 OR sideslip source is aircraft estimated beta.
ADS 3 SLIPCOMP FAIL	Loss of all sideslip compensation capability, (cross and estimated beta) in ADS 3 OR sideslip source is aircraft estimated beta.

Table 1: CAUTION Messages

MESSAGE	LOGIC
ADS 4 SLIPCOMP FAIL	Loss of all sideslip compensation capability, (cross and estimated beta) in ADS 4 OR sideslip source is aircraft estimated beta.
ADS ISI SLIPCOMP FAIL	Loss of all sideslip compensation capability, (cross and estimated beta) in ADS 3 and ADS 4 OR sideslip source is aircraft estimated beta for ADS 3 and ADS 4.

Table 2: ADVISORY Messages

MESSAGE	LOGIC
ADS 1 FAIL	ADS_1_FAIL if ADSP_1 reports FAILED, excludes OSP and heater fails.
ADS 2 FAIL	ADS_2_FAIL if ADSP_2 reports FAILED, excludes OSP and heater fails.
ADS 4 FAIL	ADS_4_FAIL if ADSP_4 reports FAILED, excludes OSP and heater fails.
ADS FAULT	Loss of redundant or non-critical function for the air data system.
ADS 1 DEGRADED	SSEC Correction lost and based on default input value(s) for ADS 1 - includes loss of AOA offset.
ADS 2 DEGRADED	SSEC Correction lost and based on default input value(s) for ADS 2 - includes loss of AOA offset.
ADS 3 DEGRADED	SSEC Correction lost and based on default input value(s) for ADS 3- includes loss of AOA offset.
ADS 4 DEGRADED	SSEC Correction lost and based on default input value(s) for ADS 4- includes loss of AOA offset.

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Table 3: STATUS Message

MESSAGE	LOGIC
ADS PROBE HEAT GND ON	No fail condition. Status message to indicate ADSP(s) responding to override switch activated.

Table 4: INFO Messages

MESSAGE	LOGIC
34 ADS FAULT - ADS SENSE LINE HEATER 1 INOP	Loss of sense line heater capability. Potential for long-term moisture buildup.
34 ADS FAULT - ADS SENSE LINE HEATER 2 INOP	Loss of sense line heater capability. Potential for long-term moisture buildup.
34 ADS FAULT - ADS SENSE LINE HEATER 3 INOP	Loss of sense line heater capability. Potential for long-term moisture buildup.
34 ADS FAULT - ADS SENSE LINE HEATER 4 INOP	Loss of sense line heater capability. Potential for long-term moisture buildup.
34 ADS FAULT - ADS HEATER 1 REDUND LOSS	Loss of heater control redundancy due to either loss of power input controller circuit, or loss of one heater power input.
34 ADS FAULT - ADS HEATER 2 REDUND LOSS	Loss of heater control redundancy due to either loss of power input controller circuit, or loss of one heater power input.
34 ADS FAULT - ADS HEATER 3 REDUND LOSS	Loss of heater control redundancy due to either loss of power input controller circuit, or loss of one heater power input.
34 ADS FAULT - ADS HEATER 4 REDUND LOSS	Loss of heater control redundancy due to either loss of power input controller circuit, or loss of one heater power input.

Table 4: INFO Messages

MESSAGE	LOGIC
34 ADS FAULT - ADS 1 PRIMARY SIDESLIP COMP INOP	Failure/loss of ADSP 2 OSP electronics.
34 ADS FAULT - ADS 2 PRIMARY SIDESLIP COMP INOP	Failure/loss of ADSP 1 OSP electronics.
34 ADS FAULT - ADS 3 PRIMARY SIDESLIP COMP INOP	Failure/loss of ADSP 4 OSP electronics.
34 ADS FAULT - ADS 4 PRIMARY SIDESLIP COMP INOP	Failure/loss of ADSP 3 OSP electronics.
34 ADS FAULT - L TAT HEATER INOP	Fuselage TAT not able to be heated on left side. ADS 1 and ADS 3 revert to onside engine TAT (loss of redundancy only).
34 ADS FAULT - R TAT HEATER INOP	Fuselage TAT not able to be heated on right side. ADS 2 and ADS 4 revert to onside engine TAT (loss of redundancy only).
34 ADS FAULT - ADS 1 TAT ELEMENT INOP	ADS 1 loss of onside fuselage TAT measurement (automatic reversion to the onside engine TAT - loss of redundancy only).
34 ADS FAULT - ADS 2 TAT ELEMENT INOP	ADS 2 loss of onside fuselage TAT measurement (automatic reversion to the onside engine TAT - loss of redundancy only).
34 ADS FAULT - ADS 3 TAT ELEMENT INOP	ADS 3 loss of onside fuselage TAT measurement (automatic reversion to the onside engine TAT - loss of redundancy only).

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Table 4: INFO Messages

MESSAGE	LOGIC
34 ADS FAULT - ADS 4 TAT ELEMENT INOP	ADS 4 loss of onside fuselage TAT measurement (automatic reversion to the onside engine TAT - loss of redundancy only).
34 ADS FAULT - L AOA VANE INOP	ADS 1 or ADS 3 is reporting a loss or internal failure (HW, SW, strapping changed since power-up) of the LEFT AOA VANE by setting SSM to failure warning or NCD.
34 ADS FAULT - R AOA VANE INOP	ADS 2 or ADS 4 is reporting a loss or internal failure (HW, SW, strapping changed since power-up) of the RIGHT AOA VANE by setting SSM to failure warning or NCD.
34 ADS FAULT - L AOA VANE HEATER INOP	ADS 1 or ADS 3 is reporting a heating failure of the LEFT AOA VANE, This INFO message will be inhibited in case the AOA vane heater should not be heated per exception.
34 ADS FAULT - R AOA VANE HEATER INOP	ADS 2 or ADS 4 is reporting a heating failure of the RIGHT AOA VANE, This INFO message will be inhibited in case the AOA vane heater should not be heated per exception.
34 ADS FAULT - L AOA VANE DEGRADED	L AOA VANE local AOA miscompares with ADSP 1 and ADSP 3 local AOA.
34 ADS FAULT - R AOA VANE DEGRADED	R AOA VANE local AOA miscompares with ADSP 2 and ADSP 4 AOA.
34 ADS FAULT - L AOA CASE HEATER INOP	ADS 1 or ADS 3 is reporting that the left AOA case heater current is lower than the minimum for operational condition in flight. This INFO message will be inhibited in case the AOA case heater should not be heated per exception.
34 ADS FAULT - R AOA CASE HEATER INOP	ADS 2 or ADS 4 is reporting that the right AOA case heater current is lower than minimum for operational condition in flight. This INFO message will be inhibited in case the AOA case heater should not be heated per exception.

34-45 INERTIAL REFERENCE SYSTEM

GENERAL DESCRIPTION

The inertial reference unit (IRU) is the main component of the system. When coupled with air data and global navigation satellite system (GNSS) input, the IRU provides a hybrid and inertial data to various navigation systems in the aircraft.

Each IRU receives initialization data either from the flight management system (FMS), or through the GNSS receivers. In return, the IRUs provide data to the FMS, traffic surveillance system (TSS), terrain awareness and warning system (TAWS), weather radar (WXR), and global navigation satellite system (GNSS). The IRUs also provide data directly to the display units (DUs).

An align-in-motion (AIM) feature provides full navigational recovery capabilities during movement on ground or following interruption of power during flight. Valid GPS data must be available for AIM to operate.

The aircraft personality module (APM), is a non-volatile memory device that allows the IRU to be removed and replaced without any alignment or programming requirements.

The IRU also stores internal APM data, which is used when replacing a failed APM.

The power sources for the inertial reference system are as follows:

- IRU 1 - L FBW PC (primary) and DC ESS BUS 2 (secondary)
- IRU 2 - DC BUS 2 (primary) and DC BUS 1 (secondary)
- IRU 3 - DC ESS BUS 3 (primary) and DC BUS 1 (secondary)

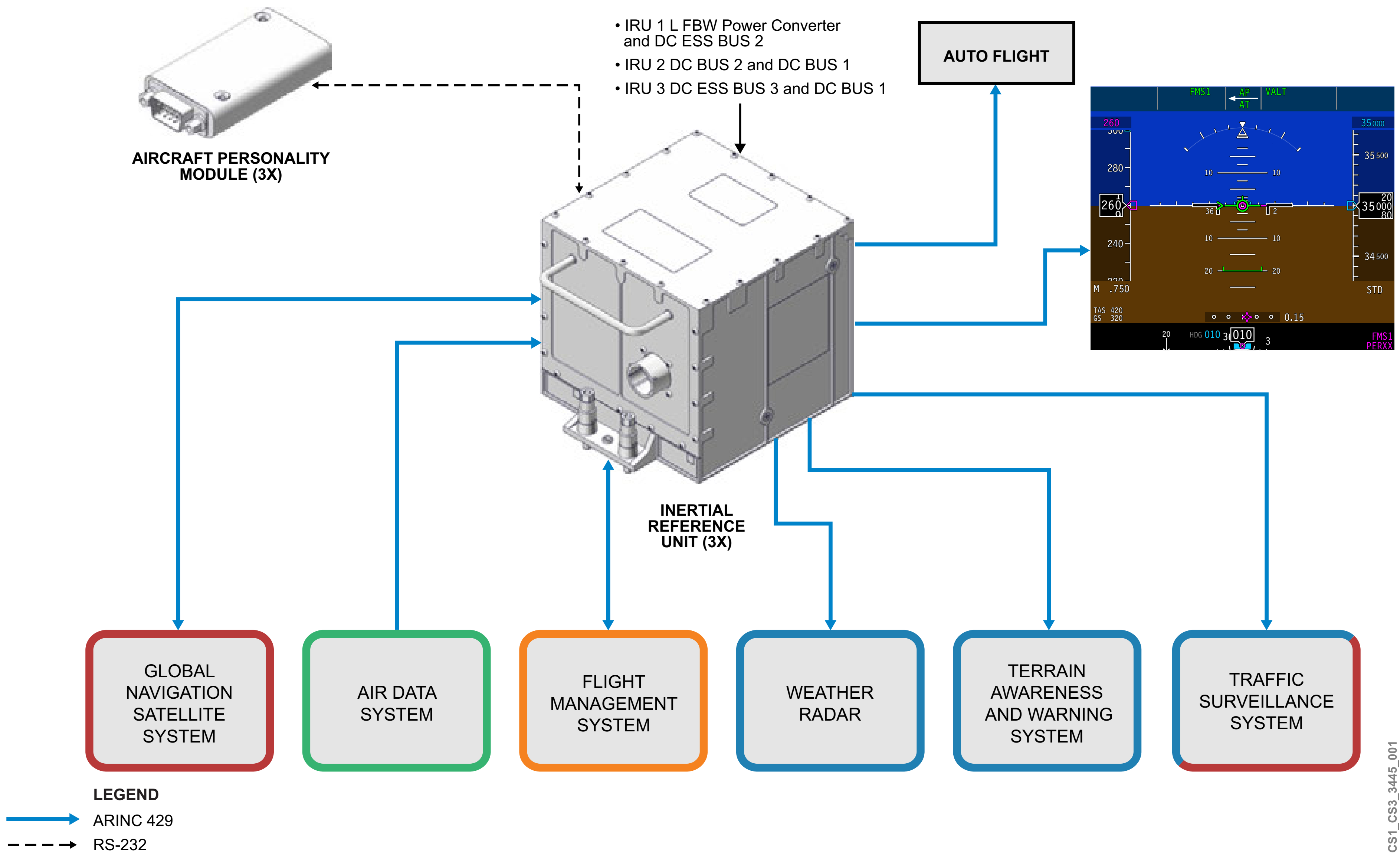


Figure 9: Inertial Reference System (L2)

COMPONENT LOCATION

The inertial reference system contains the following components:

- Inertial reference unit
- Aircraft personality module

INERTIAL REFERENCE UNIT

There are three inertial reference units (IRUs) installed in the flight deck.

The left side console contains IRU 1 and IRU 3. The right side console contains IRU 2.

AIRCRAFT PERSONALITY MODULE

There are three aircraft personality modules (APMs) installed in the flight deck.

APM 1, 2 and 3 are located beside their respective IRUs.

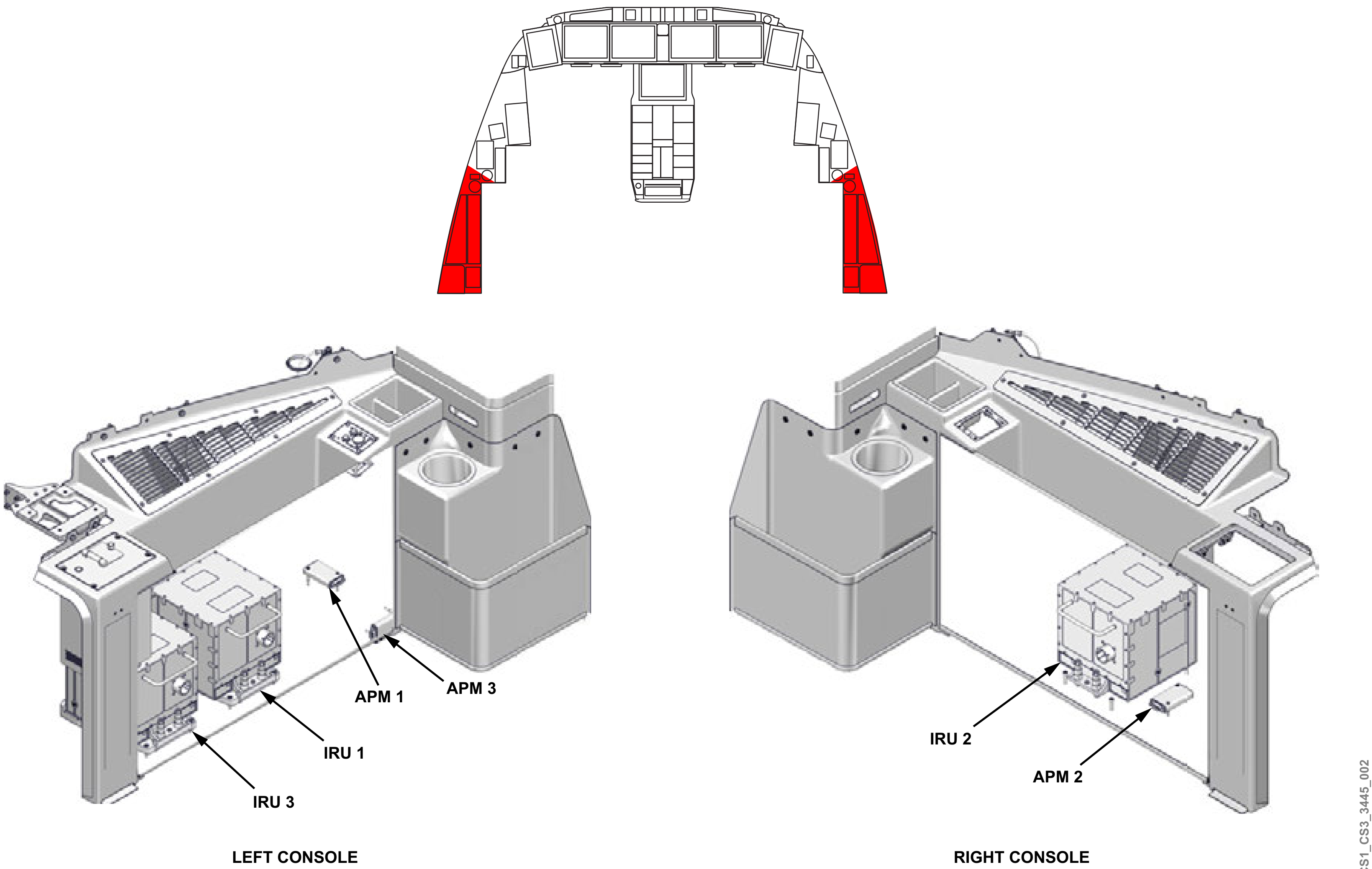


Figure 10: Inertial Reference System Components (L2)

CONTROLS AND INDICATIONS

The IRS sends data to the DUs to be used by the primary flight display and the FMS page on any multifunction window.

The default display allocation is as follows:

- Left PFD uses data from IRS 1
- Right PFD uses data from IRS 2
- IRS 3 is the spare source in case of failure.

In case of failure of any of the IRSs, the display reversion is automatic. Manual reversion is possible through reversion switches located on the reversion switch panel (RSP).

PRIMARY FLIGHT DISPLAY

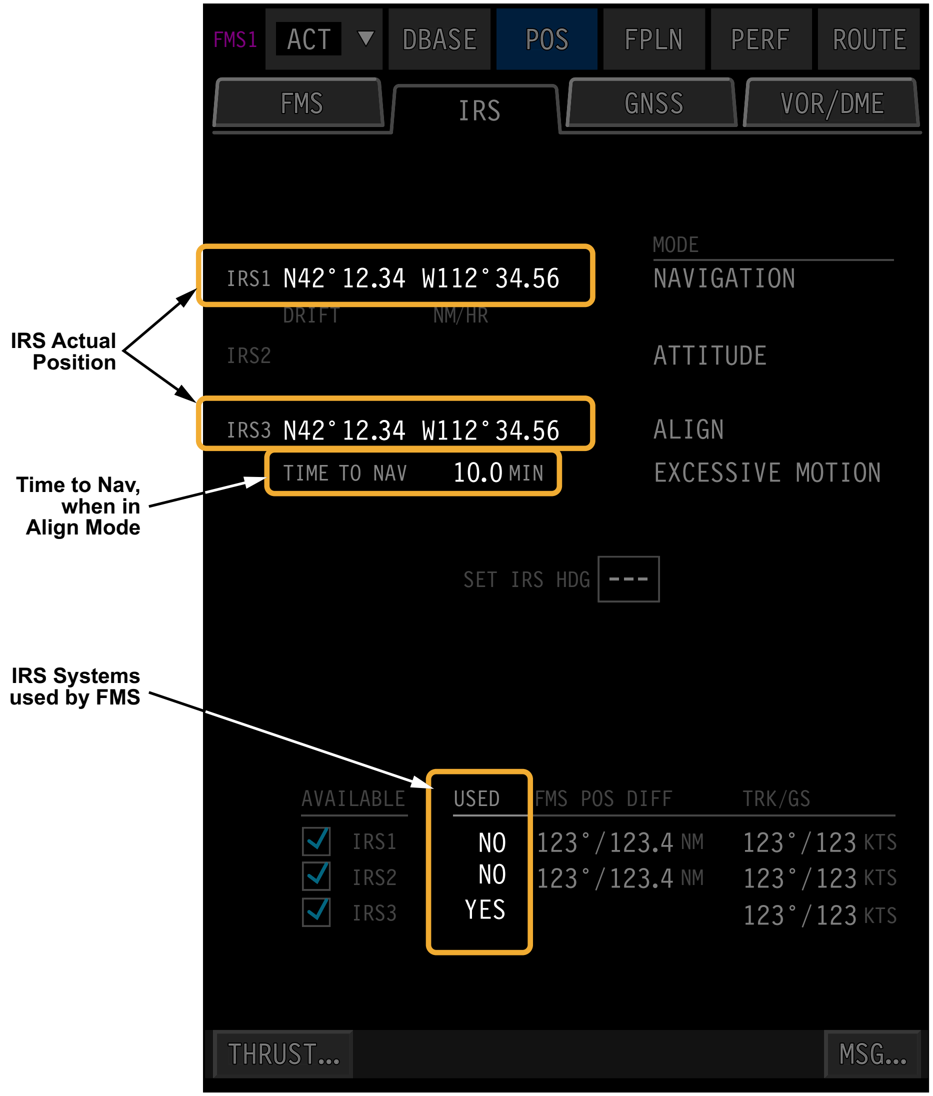
The primary flight display (PFD) uses data from the IRS to indicate the following:

- Roll and pitch attitude
- Slip/skid indication
- Flight path vector (FPV)
- Heading information (on HSI)
- Wind speed and direction (on HSI)

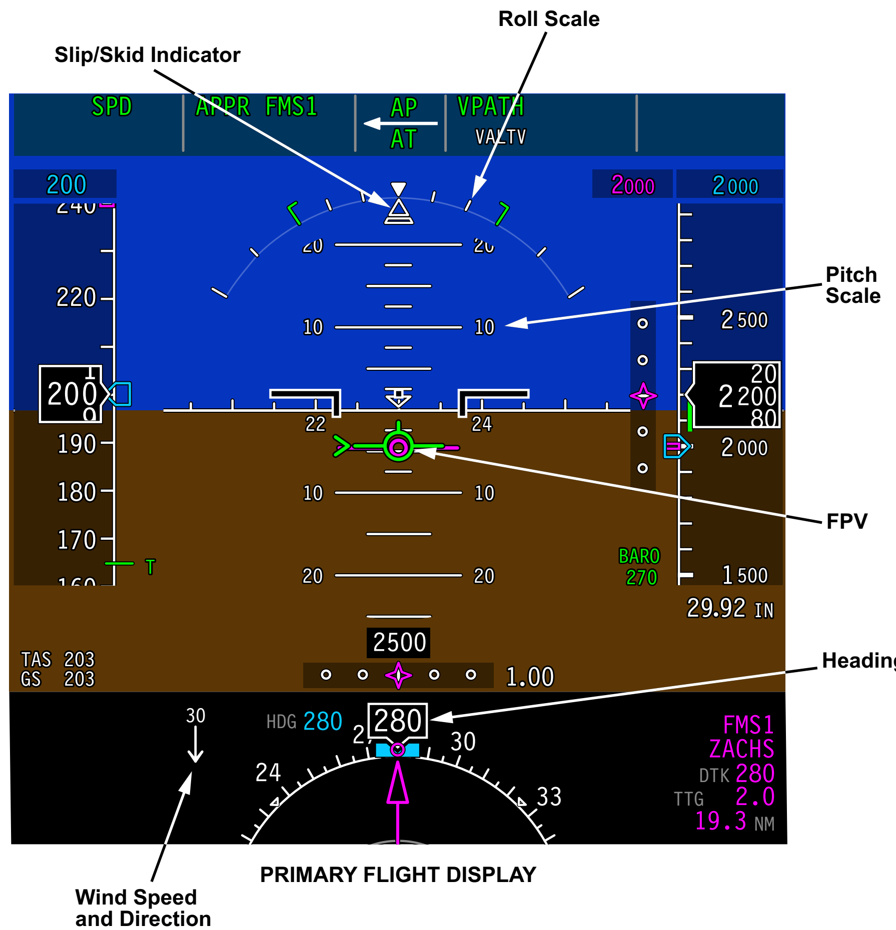
FMS FORMAT PAGE

The IRS tab in the FMS format page contains the following information:

- IRS actual position
- Time to NAV (when in align mode)
- IRS systems used by FMS



FMS PAGE - IRS TAB



PRIMARY FLIGHT DISPLAY

CS1_CS3_3445_003

Figure 11: Controls and Indications (L2)

OPERATION

Following power-up on ground, the inertial reference unit (IRU) begins an automatic attitude and reference axis alignment.

Stationary alignment and align-in-motion modes are performed prior to entry into navigation mode.

No crew input is required during alignment operation. A PFD message of ATT/ HDG ALIGNING - DO NOT TAXI is displayed while the onside IRU is aligning. If an alignment is required during flight, the displayed message is ATT/ HDG ALIGNING.

POSITION INITIALIZATION

The IRU uses GNSS source for position initialization. If there is no GNSS position available, the unit remains in align mode until the position is manually entered through the FMS tab, on the POS synoptic page.

There are three possibilities for manually entering the aircraft position:

- Based on airport position data - Four letter airport code
- Based on gate position data
- Based on a reference point

After entering this information, the LOAD button must be selected for the system to accept the data.

The GNSS position is the normal position source for the inertial reference system.

IRS Manual Position Initialization

Figure 12: Position Initialization (L2)

DETAILED DESCRIPTION

OPERATION MODES

Stationary alignment and align-in-motion modes are performed when the system is in attitude mode, prior to entry into navigation mode. This ensures that valid attitude outputs are available immediately after power-up. Auto realign mode is performed in conjunction with the navigation mode. The IRU changes to the navigation mode following completion of either alignment mode. Once navigation mode is attained, the IRU remains in this mode indefinitely while valid power is applied to the device. While motionless in the navigation mode, the IRU automatically realigns itself using the auto realign function.

ATTITUDE MODE

After power-up alignment, the IRU transitions to attitude mode. The primary purpose of the attitude mode is to provide pitch and roll attitudes, body rotational rates, and linear accelerations, prior to reaching navigation mode.

STATIONARY ALIGNMENT MODE

After completion of the power-up and attitude modes, the IRU enters the stationary alignment mode if the aircraft is on ground (WOW) and has a ground speed of less or equal to 30 kt.

The stationary alignment mode is the primary means of aligning the inertial reference system when on the ground. If the aircraft begins to move before stationary alignment is complete (more than 30 kt), then stationary alignment is aborted and the system goes in align-in-motion (AIM) mode.

The duration for the stationary alignment mode varies from 3 minutes to 17 minutes, depending on the latitude position.

ALIGN-IN-MOTION MODE

The AIM system is capable of regaining full inertial navigational functions if a full power interruption occurs during flight, or while the aircraft is in motion (> 30 kt). Valid GNSS data must be available in order for AIM to operate. The IRU also enters AIM when excessive horizontal motion exceeds 0.011 ft/s for more than one second. The system uses GNSS series of measurements observed over time to produce a statistically optimal estimate of the pitch, roll, and true heading. This method is known as the Kalman filter. The precision of these calculations increases as ground speed increases, which reduces the time to complete AIM. The time to complete AIM is between 10 and 20 minutes.

AUTOMATIC REALIGNMENT

The purpose of the automatic realignment (AR) function is to automatically determine when the IRU is motionless, and then perform a realignment and navigation reset to fine tune the system.

The IRU enters the AR mode when the IRU is in the NAV mode and the aircraft is stationary for an extended period of time.This time varies from 7.5 to 15 minutes, depending of the aircraft position latitude.

REVERSIONARY ATTITUDE MODE

In addition to these alignments and navigation modes, the IRS provides a reversionary attitude mode which allows quick recovery of attitudes, body rates, and body accelerations in the event of an interruption of power during flight.

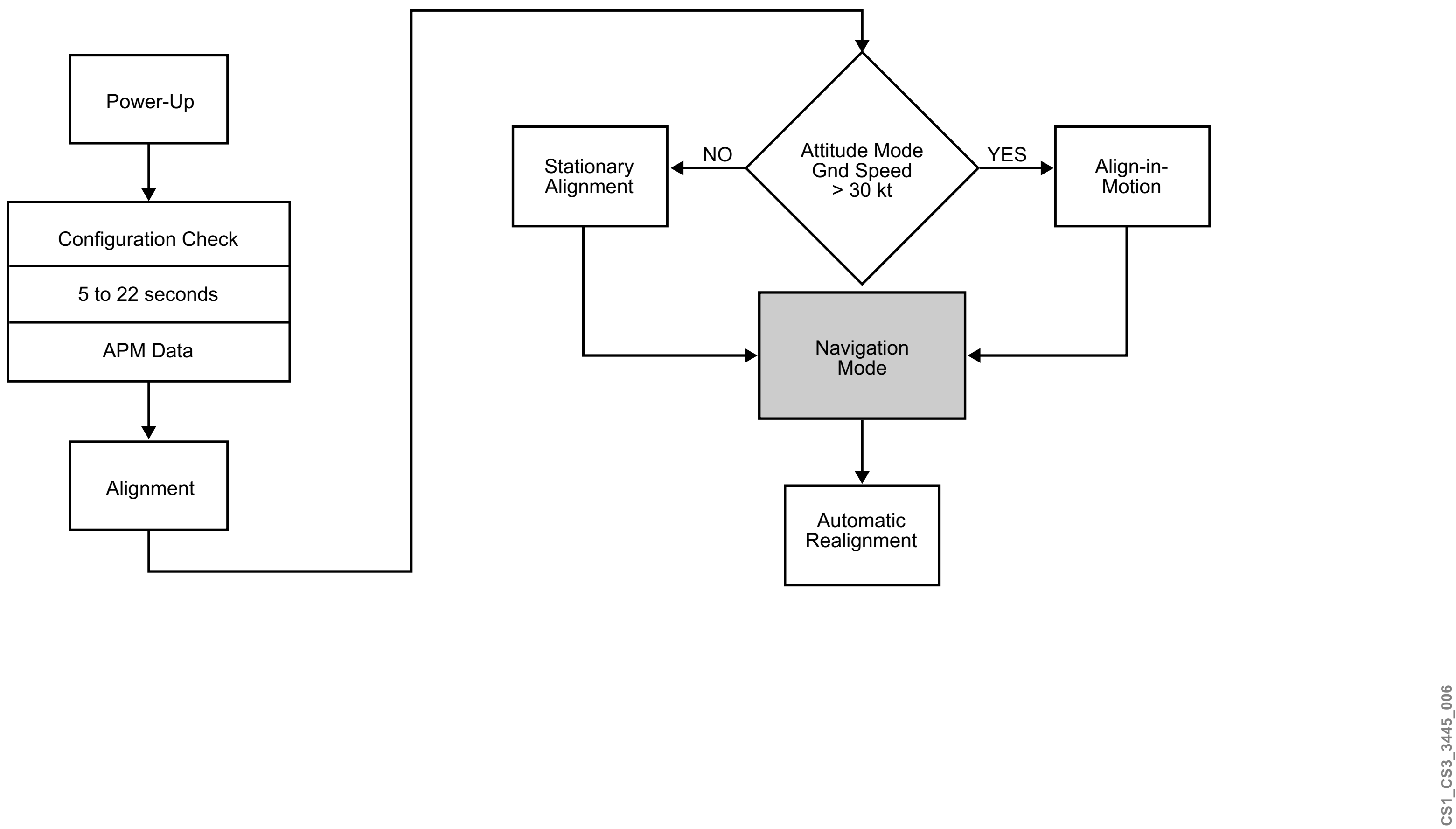


Figure 13: Operation Modes (L3)

SYSTEM INTERFACE

Each inertial reference unit (IRU) interfaces with various aircraft systems and produces inertial navigation data using body acceleration and body angular rate.

To achieve optimal position, velocity, and attitude performance, the IRUs produce hybrid navigation data. This is a blend of GNSS data from one or two external GNSS receivers (directly) and altitude data from the air data system (ADS) through data concentrator unit module cabinets (DMCs).

The IRS includes an aircraft personality module (APM). The APM is a non-volatile memory device, mounted externally from the IRU. The APM stores IRU installing information such as:

- Program pin discrete data
- Mount misalignment
- Euler angles
- Aircraft type and serial number

The IRUs receive initialization data either from the FMS through the DMC or directly from the GNSS receivers.

Each IRU sends information directly to all DUs and primary flight control computers via ARINC 429.

Other navigation systems consume data from the IRSs as follow:

- Terrain awareness and warning system (TAWS) uses position and angle information
- Air traffic control transponder system (ATC) and traffic surveillance system (TSS) use magnetic heading and vertical speed information
- Weather radar system (WXR) uses pitch and roll information

The IRUs are connected to two independent sources of power. The IRU 1 primary input is powered by the L FBW PC, the secondary input power is from DC ESS BUS 2.

Primary power input for IRU 2 is from DC BUS 2, the secondary power input is from DC BUS 1

Primary power input for IRU 3 is from DC ESS BUS 3, the secondary power input is from DC BUS 1

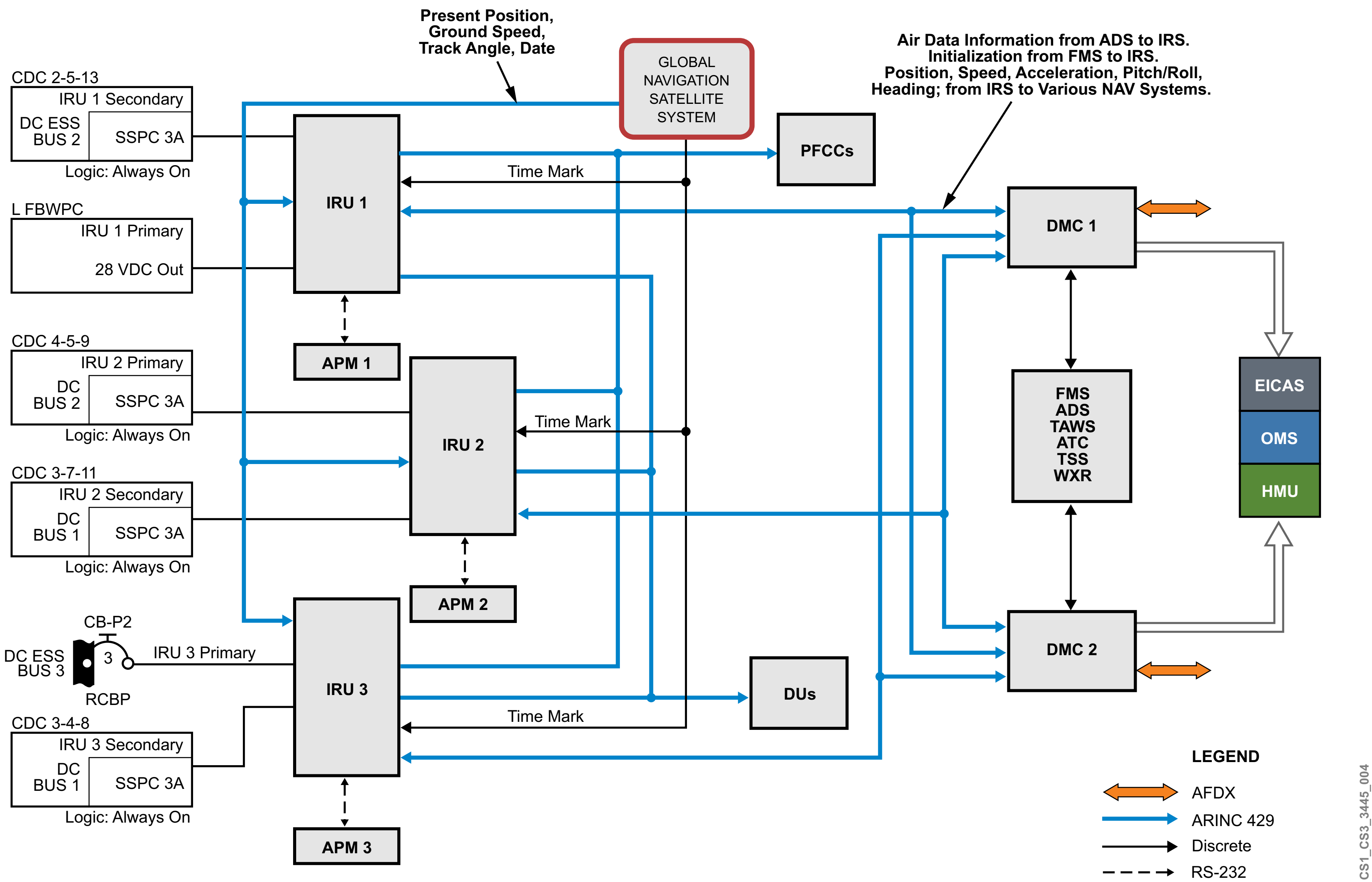


Figure 14: System Interface (L3)

MONITORING AND TESTS

The following page provides the CAS and INFO messages for the inertial reference system.

CAS MESSAGES

Table 5: CAUTION Messages

MESSAGE	LOGIC
IRS SAME SOURCE	2 of 3 IRS failed.
IRS SET HEADING	Alignment in motion occurs but not in AIM attitude mode or excessive motion in rev attitude mode.

Table 6: ADVISORY Messages

MESSAGE	LOGIC
IRS 1 FAIL	IRS 1 failure reported.
IRS 2 FAIL	IRS 2 failure reported.
IRS 3 FAIL	IRS 3 failure reported.
IRS 1 PWR FAULT	The IRS 1 is operating on secondary power or if secondary power is not available to the IRS.

SYSTEM MONITORING

The inertial reference system (IRS) data is continuously monitored for validation. Any failed information is shown in red on the primary flight display as follow:

- HDG: heading failure flag
- ATT: attitude failure flag
- FPV: flight path vector failure flag
- ROL: roll failure flag

The IRS source is indicated on the right side of the flight mode annunciator (FMA) on the PFD as follows:

- No indication if normal source is used
- White when spare source is used (IRS 3)
- Yellow if same source is used

The IRS source can be manually reverted by the crew by toggling the IRS buttons on the reversion switch panel (RSP).

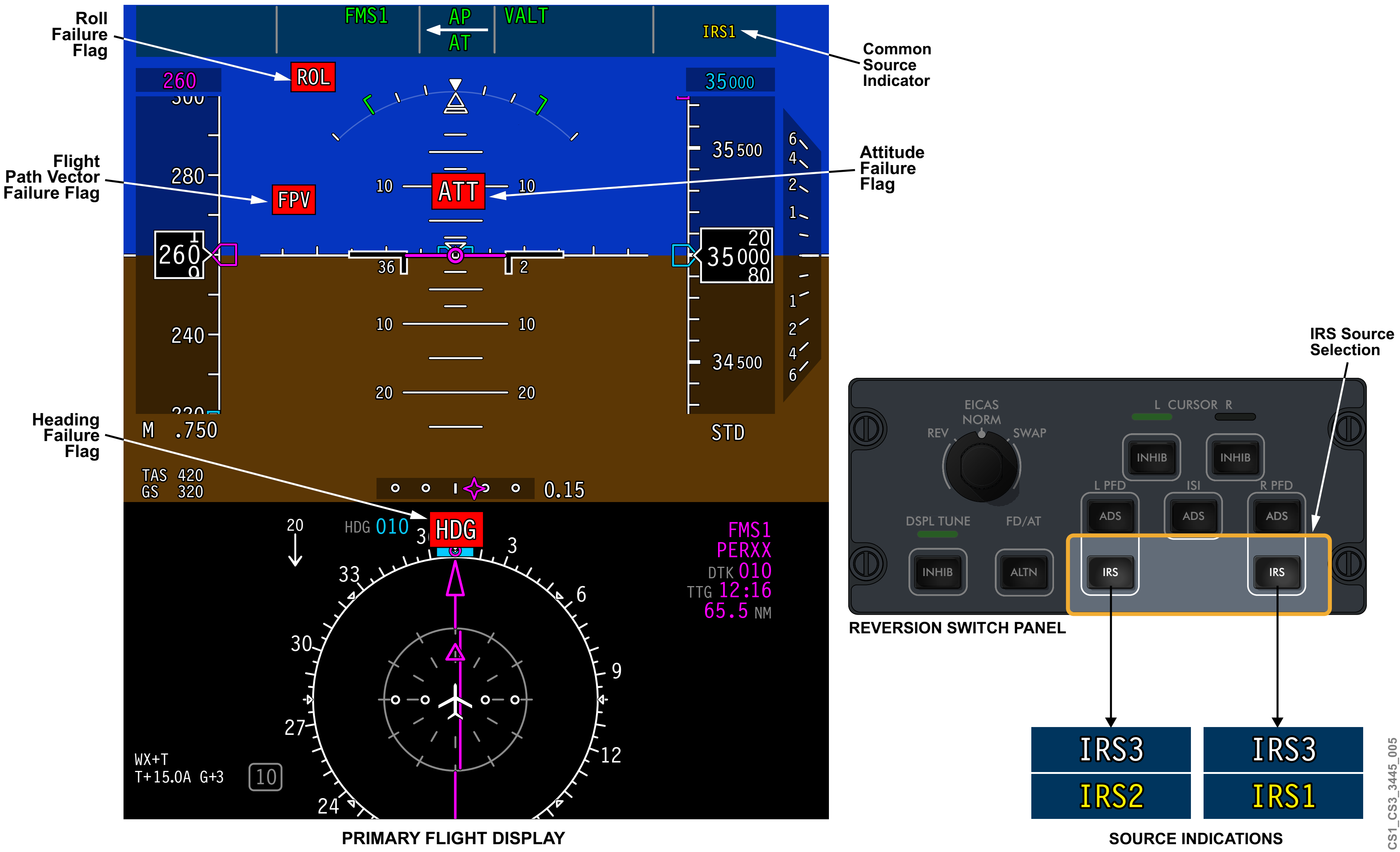


Figure 15: System Monitoring (L2)

PRACTICAL ASPECTS

A calibrated aircraft personality mode (APM) should not be moved from one tray location to another, or swapped for fault isolation. If this occurs, the IRS sets a critical fault and the integrity of the installation may be compromised.

Removal of the mounting tray voids the Euler angle and alignment data stored in the APM. When a mounting tray is replaced, the APM should be erased and a transfer alignment done.

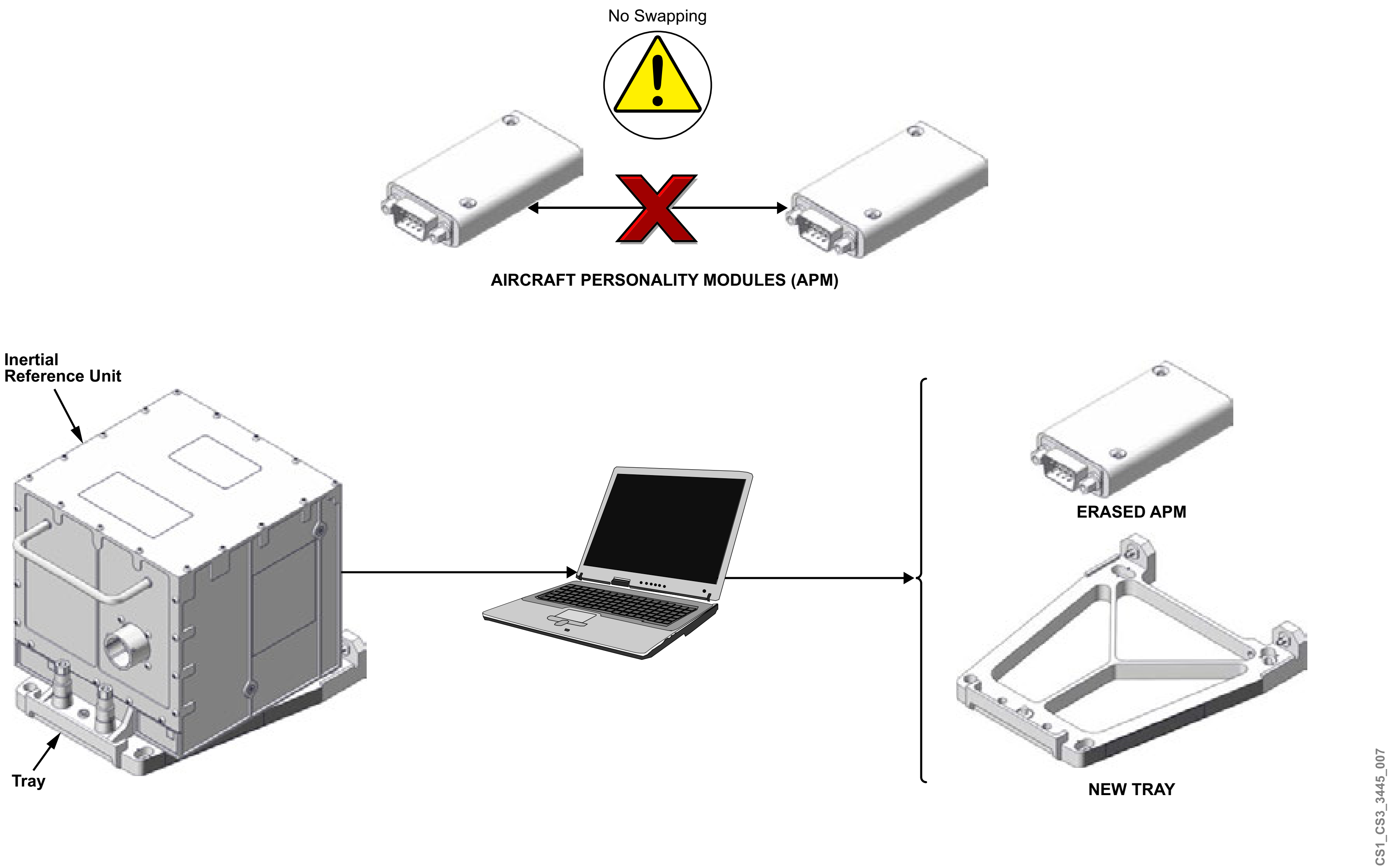


Figure 16: Practical Aspects (L2)

34-13 STANDBY FLIGHT INSTRUMENT SYSTEM

GENERAL DESCRIPTION

The standby flight instrument system (SFIS), also known as the integrated standby instrument (ISI), provides a reliable source of navigation information, in case of a complete failure of all the display units (DUs). The SFIS interfaces with the air data smart probe (ADSP 3 and ADSP 4) for display of altitude and airspeed parameters, and the VHF-NAV 1 system for localizer and glideslope guidance. The control tuning panel (CTP) provides a means to set the course and baro units.

The option control module (OCM) is a memory device that stores information for configuration. The device remains permanently attached to the harness to allow for removal and replacement of the standby flight instrument unit, and automatic configuration of the replacement unit.

The SFIS has an analog input for backlight dimming via the lighting and cockpit door panel.

The unit contains software which can be updated on the aircraft using the information management system (IMS). This requires the SFIS to be in ground mode, which is enabled by a weight-on-wheels (WOW) discrete signal.

The SFIS contains pitch, roll, and yaw sensors that provide inertial information. This information is sent to the primary flight control computers (PFCCs).

The unit provides maintenance information for monitored data as well as the loaded software configuration and reports to the health management monitoring unit (HMU) and the onboard maintenance system (OMS).

The system uses power from the DC ESS BUS 3 as the primary power source and DC BUS 2 as a secondary power source.

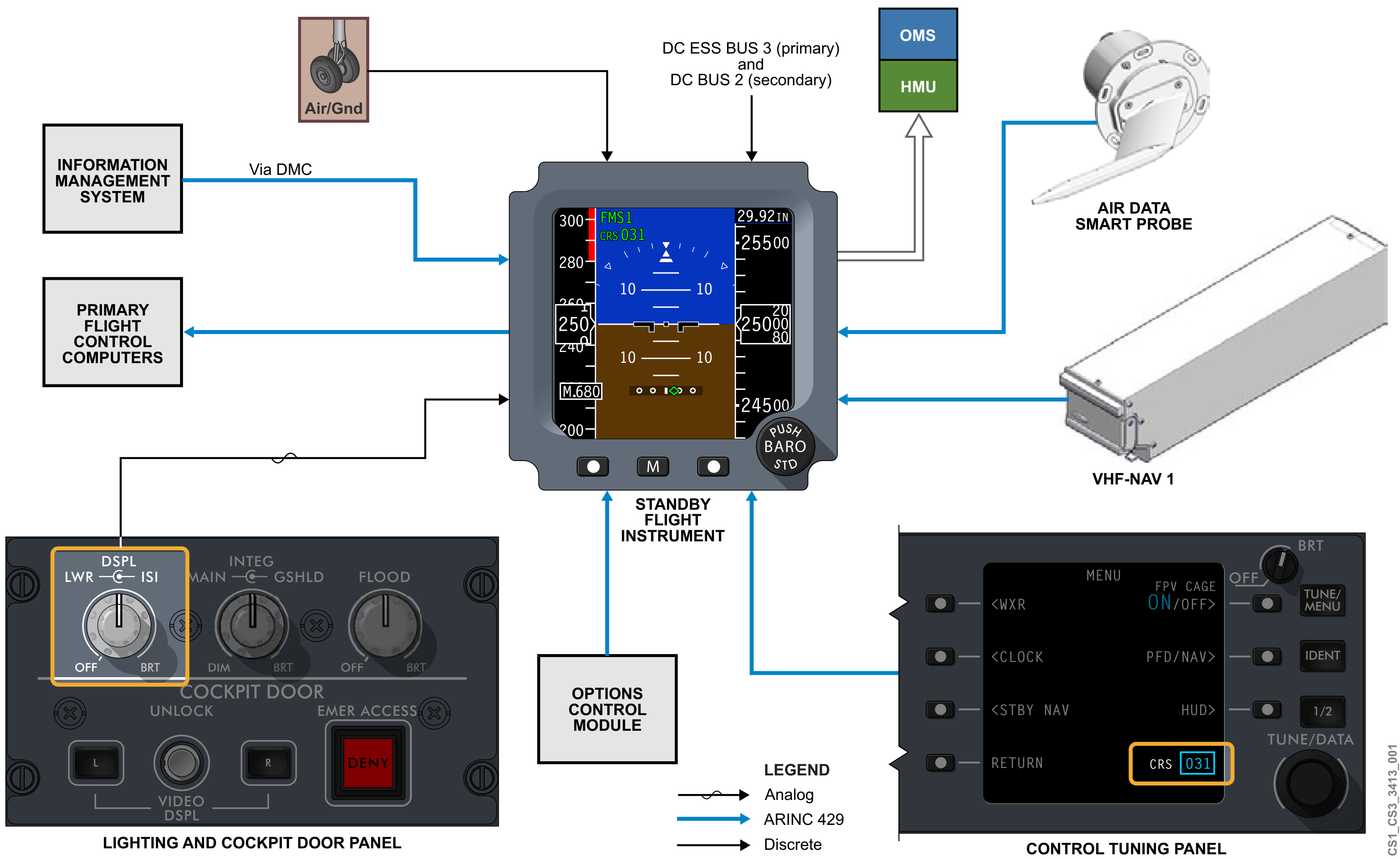


Figure 17: Standby Flight Instrument System (L2)

COMPONENT LOCATION

The standby flight instrument system contains the following components:

- Standby flight instrument
- Options control module

STANDBY FLIGHT INSTRUMENT

The standby flight instrument unit is installed in the cockpit between the left and right inboard DUs.

OPTIONS CONTROL MODULE

The options control module is permanently attached to the aircraft inside the wiring harness and communicates with the SFIS.

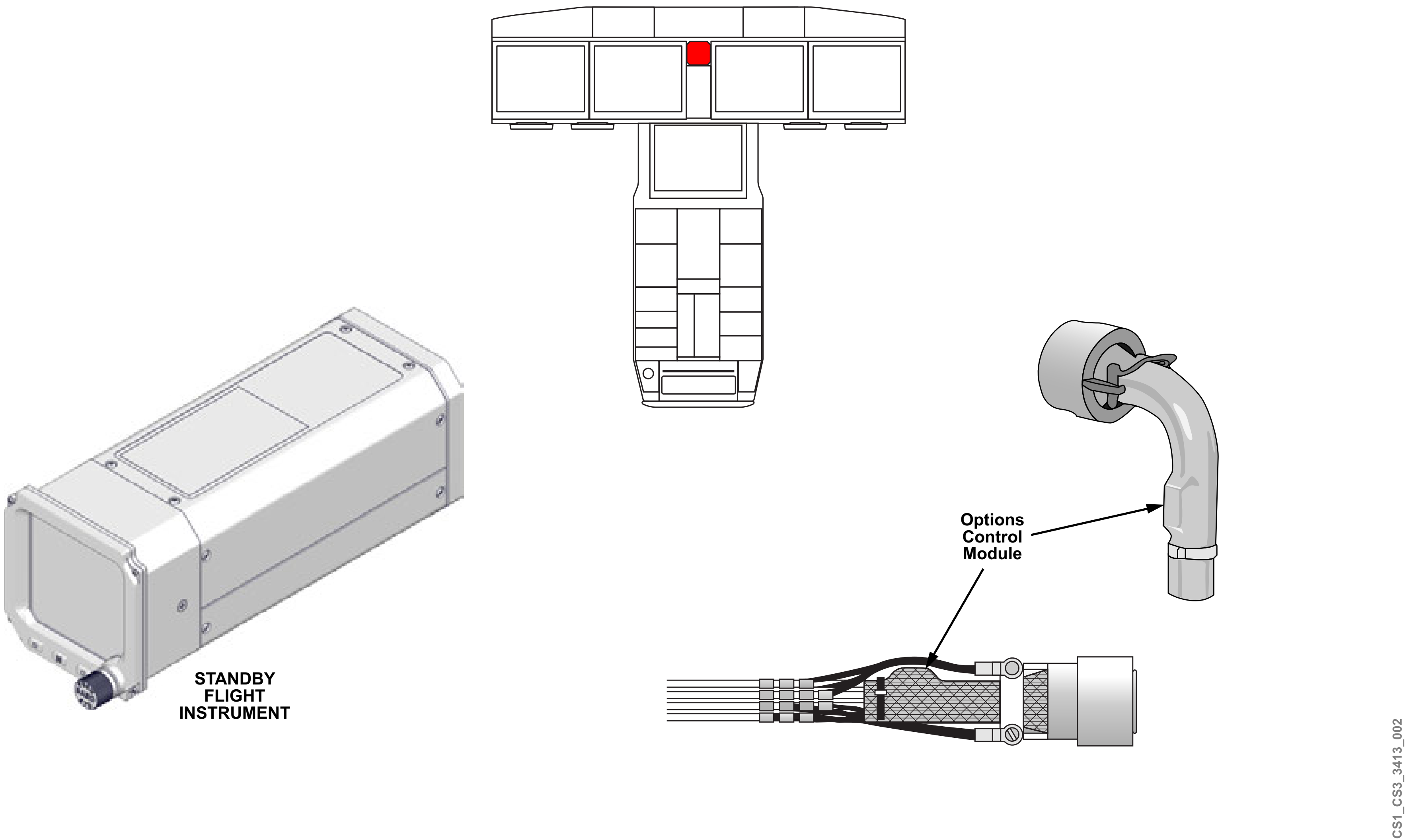


Figure 18: Component Location (L2)

CONTROLS AND INDICATIONS

The menu display can be accessed anytime by pressing the center M button.

The information displayed on the unit, in the menu page, depends on the state of the aircraft. When on ground, the unit displays two maintenance menu functions:

- ALIGN MODE
- SYS STATUS

The UP and DOWN buttons are used to select a menu item.

If the aircraft is in the air, the menu shares the screen with the navigation graphical display. Pushing the M button accesses the ALIGN mode. Once in ALIGN mode, CONFIRM START ALIGNMENT is displayed. The left and right buttons CANCEL or CONFIRM alignment.

In either case, select EXIT to exit the menu display. If no selection has been made after 8 seconds, the diplay reverts to the navigation screen.

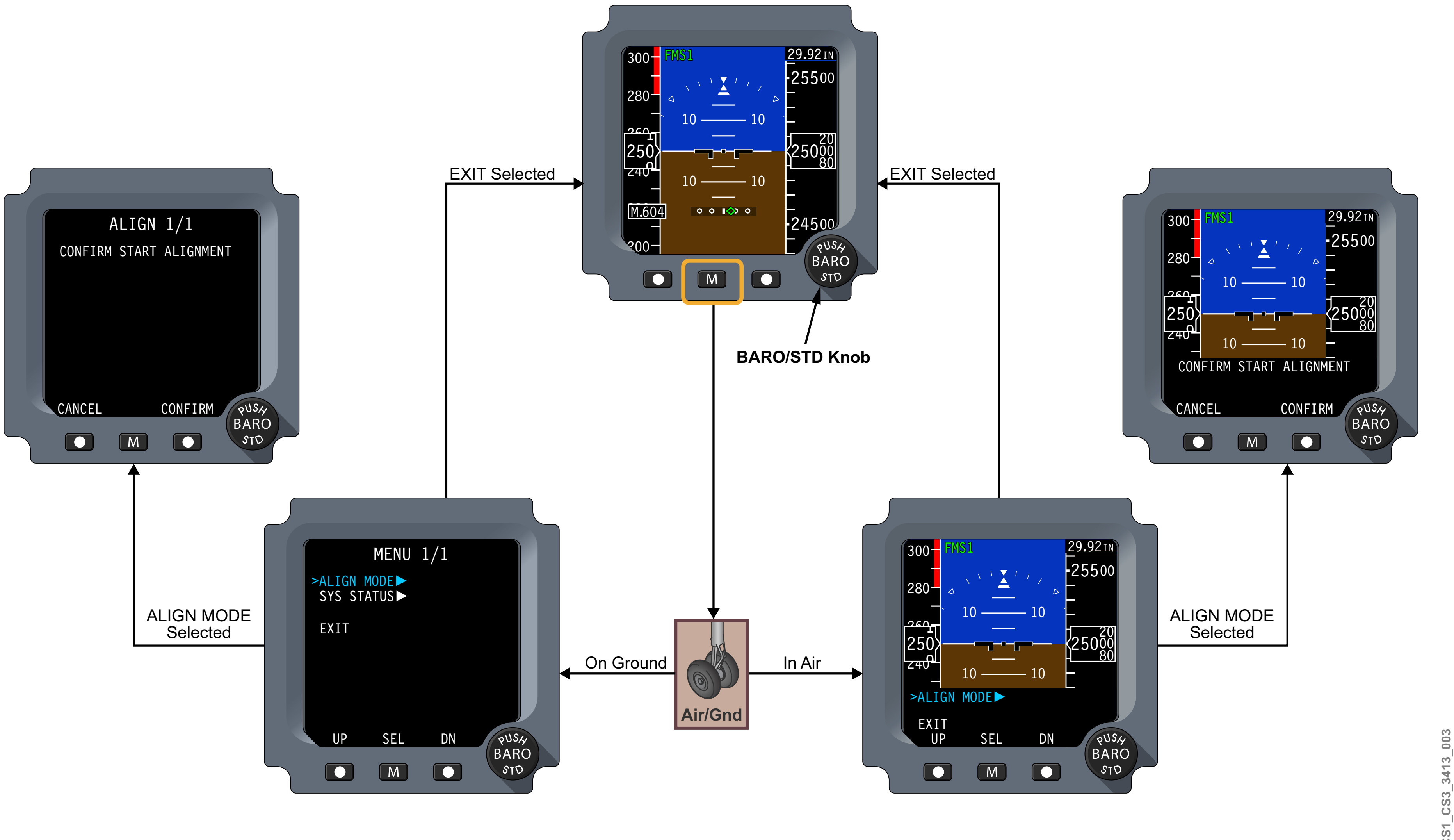


Figure 19: Controls and Indications (L2)

SETUP MENU

There are three pushbutton keys at the bottom of the display and an adjustment knob to allow navigation through the setup menu as follows:

- BARO adjustment knob to scroll through menu items
- Left and right buttons to modify data contained in the menu, and for saving any changes
- The M button to exit the page

The setup menu is activated by cycling power to the unit and holding down all three buttons when the aircraft is on ground.

From this menu it is possible to copy installation data from the option control module (OCM). Since the OCM stays with the aircraft, copy data can be used to quickly restore the previous settings to a new unit.

This operation can only copy data in one direction, from the OCM to the SFIS and cannot be performed as part of a new OCM installation.

Selected menu items have a blue background. It is necessary to cycle power to exit setup mode.

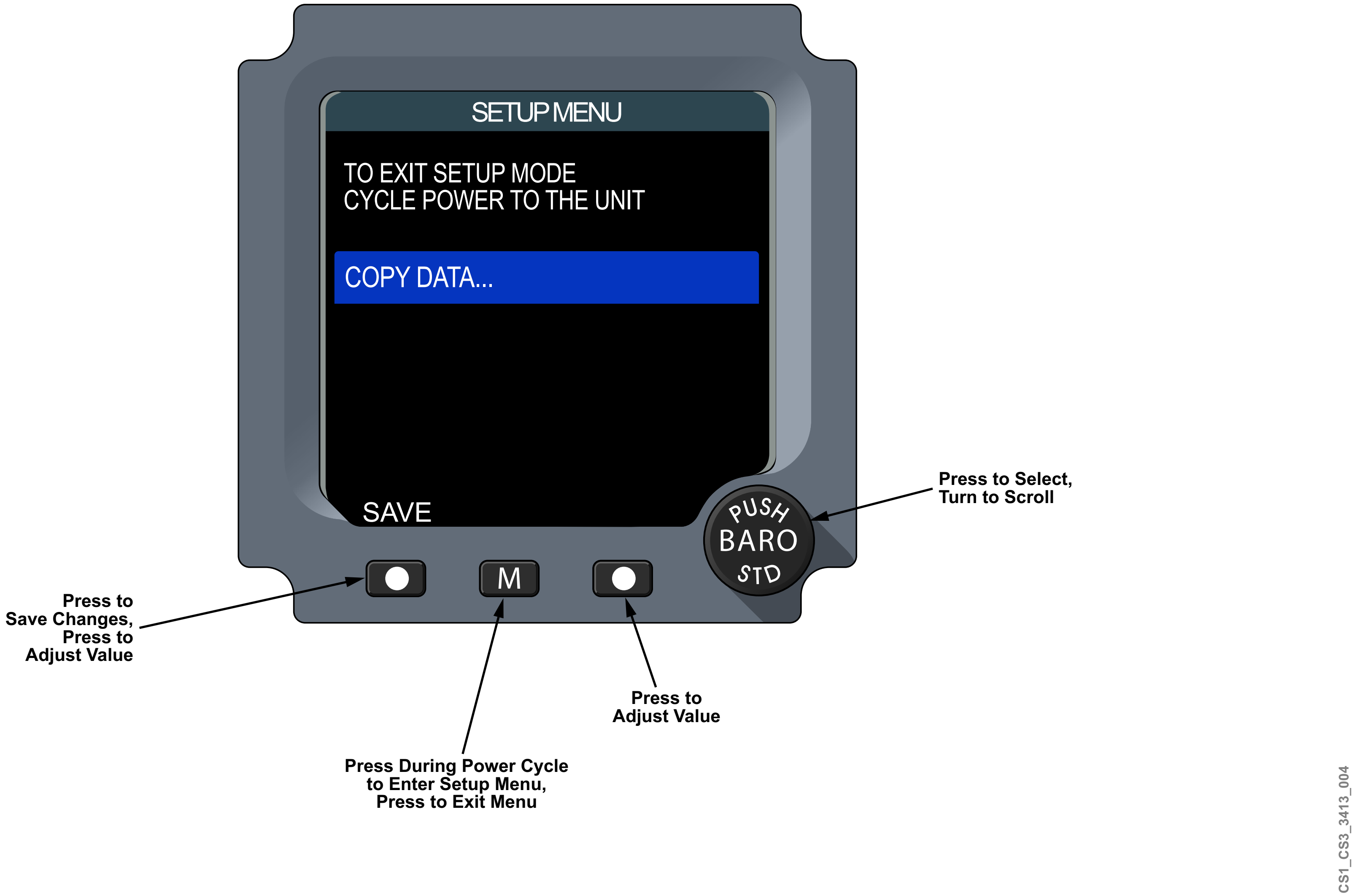


Figure 20: Setup Menu (L2)

DETAILED DESCRIPTION

SYSTEM INTERFACE

The SFIS interfaces via ARINC 429 with the following systems:

- Alternate flight control unit (AFCU) to send pitch, roll, and yaw data
- Primary flight control computer (PFCC) to send angles and acceleration data
- Control tuning panel (CTP) via the DMC to receive selected course value and BARO units selection
- VHF navigation receiver (VHF-NAV 1) to receive ILS information
- Air data smart probe (ADSP) to receive environment data from ADSP 3; ADSP 4 being the backup source

The SFIS has three discrete inputs:

- Weight-on-wheels (WOW)
- Information management system (IMS) data load enable
- Reversion selection panel (RSP) for manual reversion of the ADSP source from ADSP 3 to ADSP 4

The system uses the OCM to retrieve display parameters such as color and symbology; and physical interface parameters such as bus speeds, bus input assignments and discrete input type. The OCM uses I^2C protocol to communicate with the SFIS.

The DSPL knob on the lighting and cockpit door panel provides analog light dimming control.

Primary power is from DC ESS BUS 3 through a thermal circuit breaker, located on the right circuit breaker panel.

Secondary power is provided from DC BUS 2 through a solid-state power controller (SSPC), located in the control and distribution cabinet (CDC) 4.

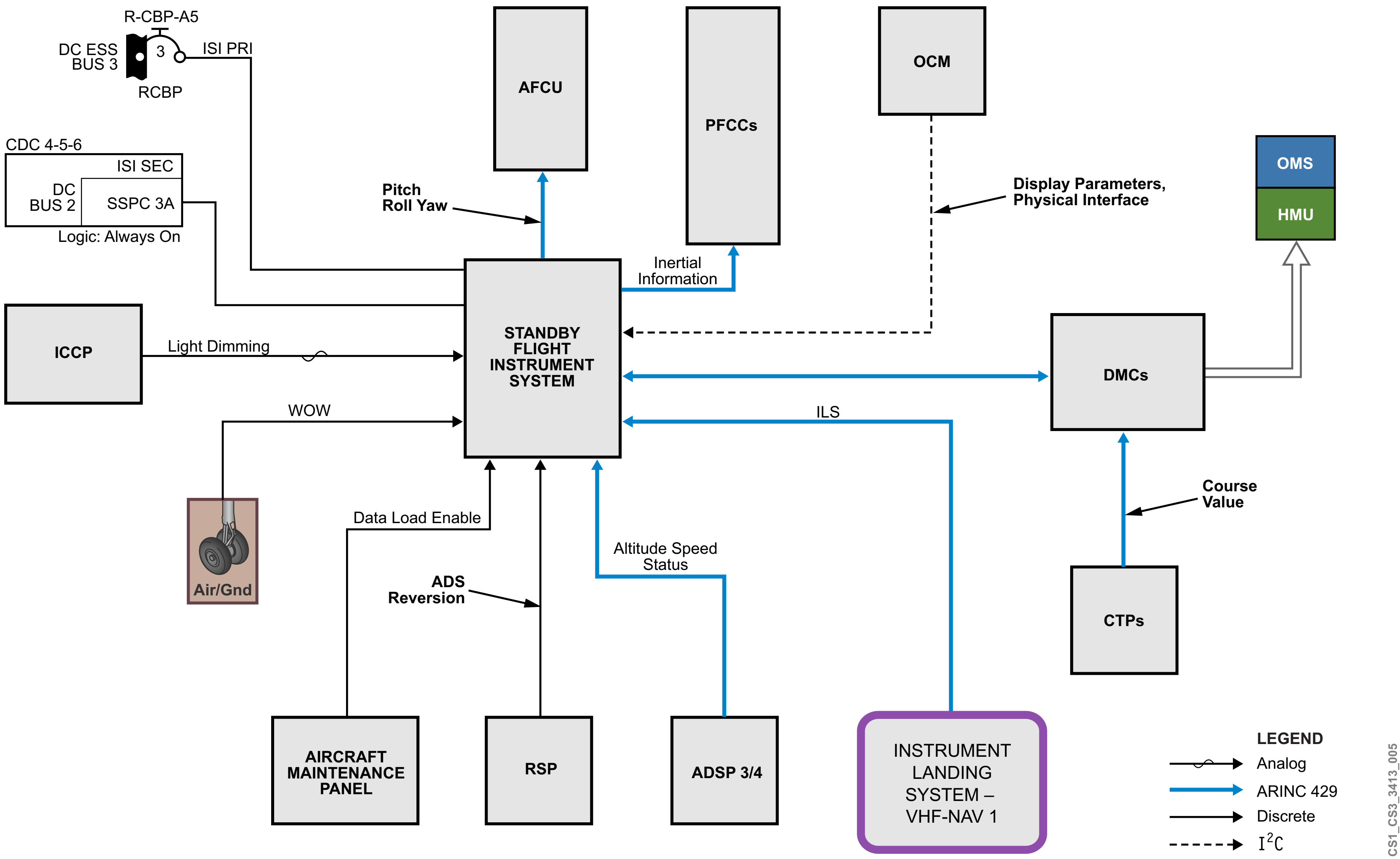


Figure 21: System Interface (L3)

MONITORING AND TESTS

SYSTEM MONITORING

The unit performs continuous monitoring to detect internal failures and invalid inputs. Any red flag indicates invalid or missing information as follows:

ALIGNMENT ANNUNCIATIONS

"ATT ALIGNING", "DO NOT TAXI" indicates that the internal sensors are aligning.

RED FLAGS

- LOC 1 - Radio navigation source failure
- IAS - Loss of airspeed data
- ATT - Attitude heading reference failure
- ALT - Loss of altitude data
- LOC - Localizer failure
- GS - Glideslope failure

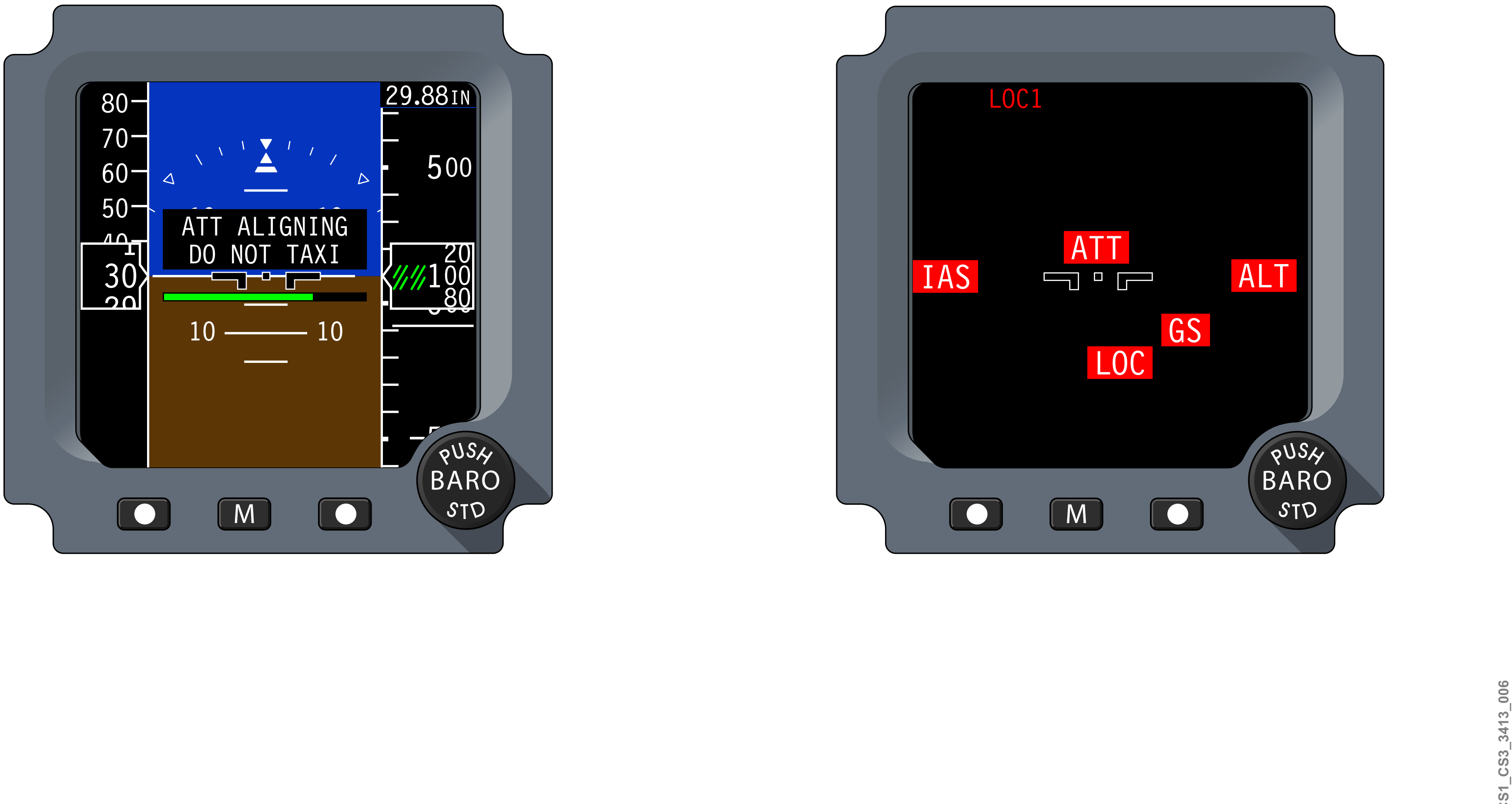


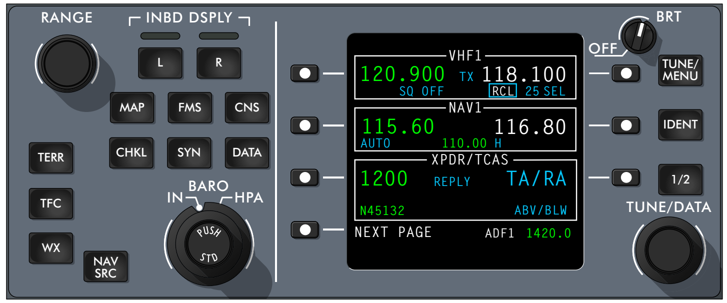
Figure 22: System Monitoring (L2)

34-00 TUNING AND CONTROLS

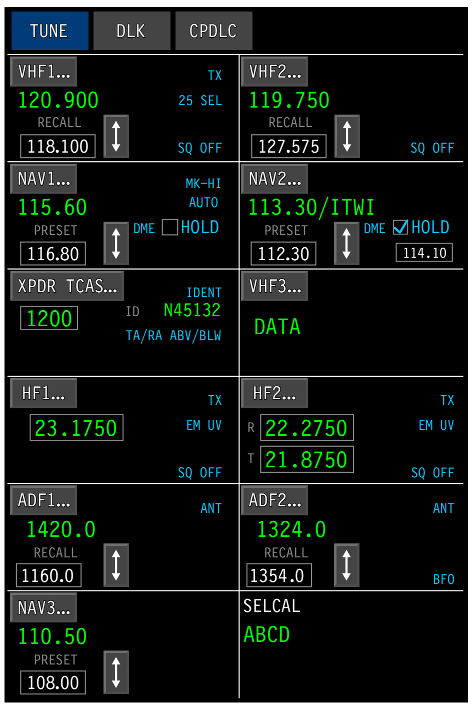
GENERAL DESCRIPTION

Controls for the navigation system are located on:

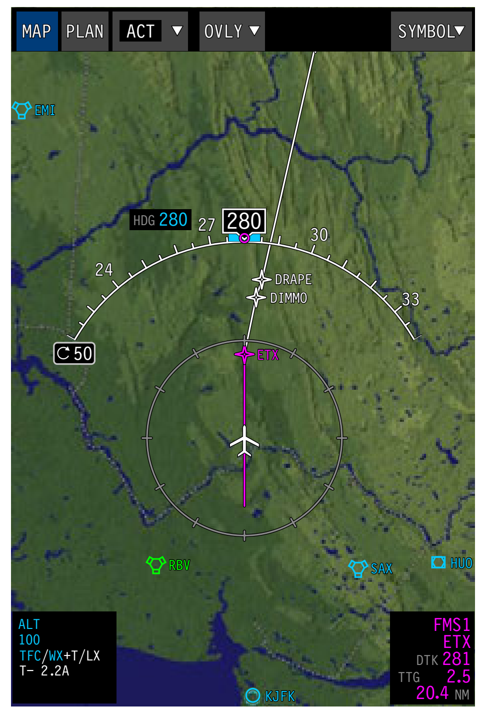
- Control tuning panel (CTP)
- Radio tuning system application (RTSA)
- Graphical navigation tuning



CONTROL TUNING PANEL



RADIO TUNING SYSTEM APPLICATION



GRAPHICAL TUNING

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Figure 23: Tuning and Controls (L2)

CONTROLS AND INDICATIONS

CONTROL TUNING PANEL

The control tuning panel (CTP) is the main interface for NAV tuning.

Data entry on the CTP is made via line select keys (LSKs), and the TUNE/DATA knob. The following sections describe the CTP controls and displays that are relevant to the NAV system.

Quick-Access Keys

These keys select the page format on the onside multifunction window. The tuning page is selected by pressing the CNS key.

Line Select Keys

The CTP has seven LSKs adjacent to the display. The LSK function depends on the page format present on the display.

Overlay Control Keys

The following buttons control overlays on the onside HSI:

- TERR - controls the terrain overlay
- TFC - controls the traffic overlay
- WX - controls the WXR overlay

NAV SRC Selection Key

The NAV source pushbutton allows selection of onside, and cross-side navigation sources.

Pressing the left CTP NAV SRC pushbutton cycles through the navigation sources in the following order: FMS 1 - NAV 1 - FMS 2 - NAV 2 - LOC 3.

Pressing the right CTP NAV SRC pushbutton cycles through the navigation sources in the following order: FMS 2 - NAV 2 - FMS 1 - NAV 1 - LOC 3.

LOC 3 is only available with the third receiver option and if the LOC is tuned.

ON/OFF and Brightness Switch

This allows the CTP to be switched ON or OFF, and also controls the brightness of the screen.

TUNE/MENU

The TUNE/MENU key toggles between the CTP main menu page and the NAV tuning top level page.

IDENT

Ident reply key.

1/2 Selection Key

The 1/2 selection key tunes the cross-side NAV system. When selected, the cross-side NAV legends are displayed in yellow on the tuning pages.

TUNE/DATA Knob

The TUNE/DATA knob changes data in the selected fields. Rotating the outer TUNE/DATA knob changes the digits to the left of the decimal, and rotating the inner TUNE/DATA knob changes the digits to the right of the decimal.

BARO Knob

This control sets the atmospheric pressure at sea level (QNH). The barometric units are selected by turning the outer ring.

WXR Range Knob

This provides range control for the weather radar image by turning the knob. The WXR range knob also has an inner WXR STBY/ON button that selects the WXR to STBY or ON.

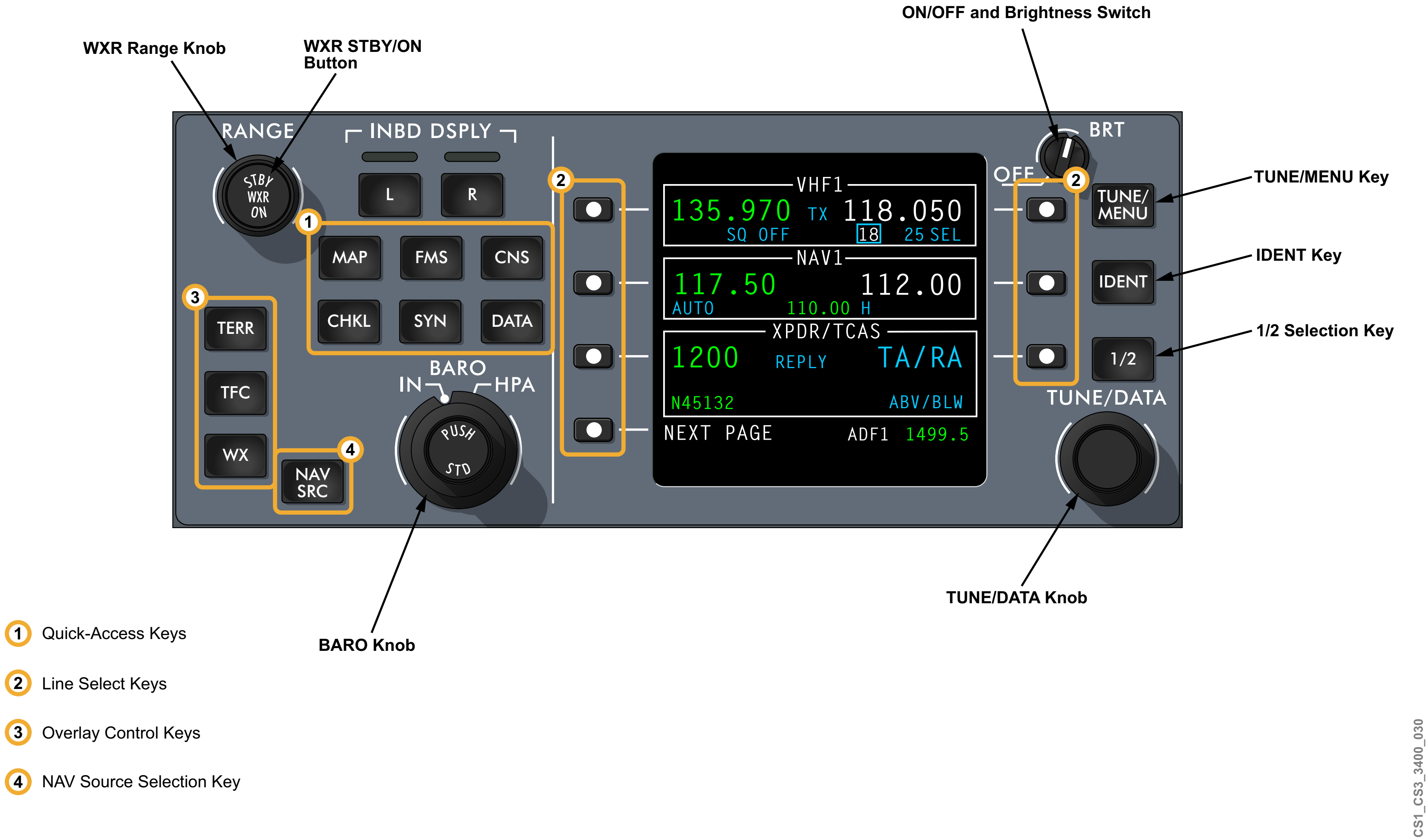

Figure 24: Control Tuning Panel (L2)

VHF-NAV RADIO TUNING

Pressing the LSK next to the active NAV frequency brings up the NAV control menu. This shows the active and preset NAV frequency and allows selection of either the AUTO NAV tuning, or the MAN NAV tuning.

Rotating the TUNE/DATA knob and pressing the PAGE key in the NAV CONTROL menu brings up the second page, which gives the ability to toggle the marker beacon (MB) sensitivity to HI or LO. In case MKR SENS HI is selected, MK-HI is displayed in the CTP main page between the active NAV frequency and the preset NAV frequency.

The active NAV frequencies are displayed in green for approximately 3 seconds. They remain green if they match the echo frequency, and they change to yellow if they do not match.

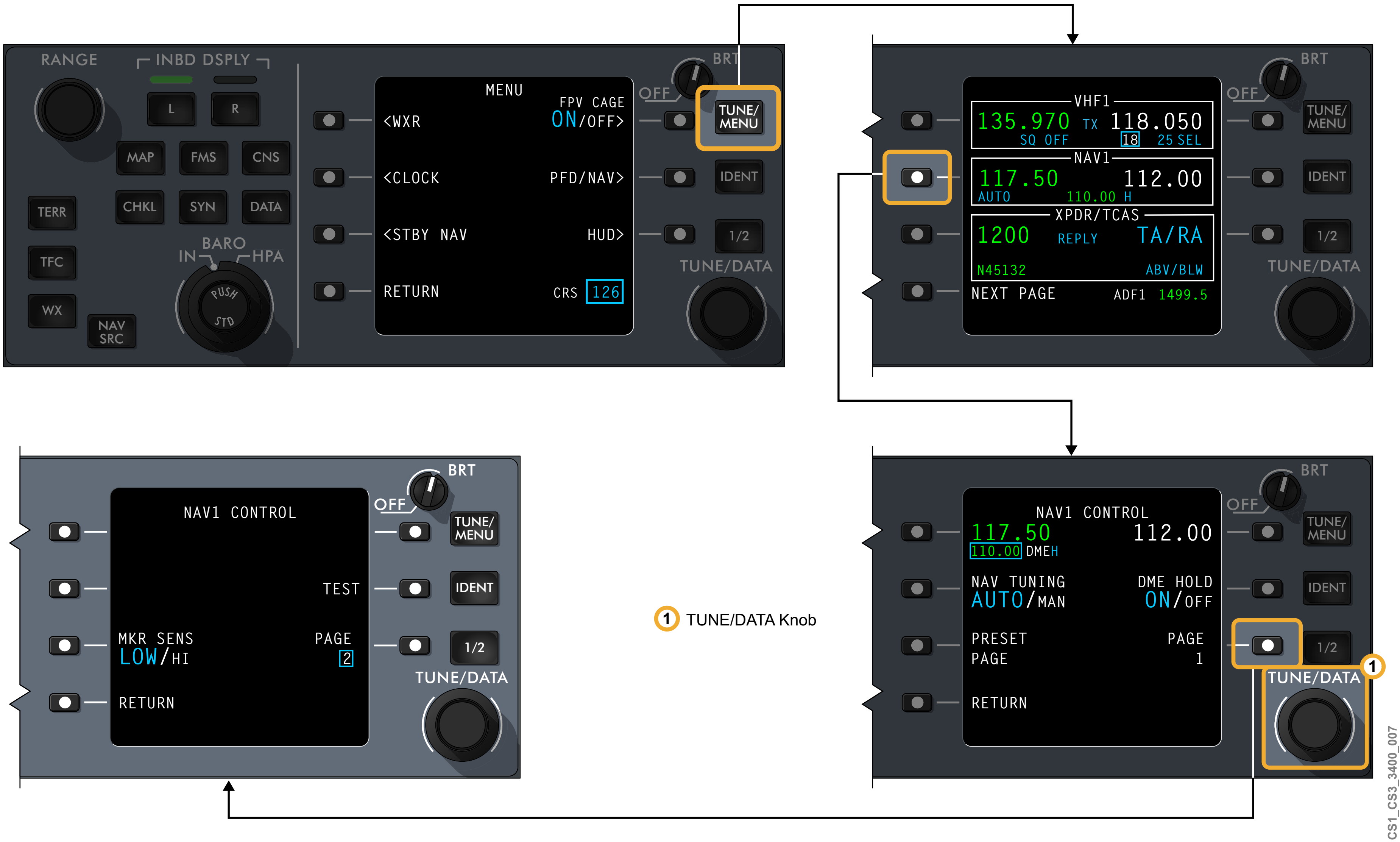

Figure 25: VHF-NAV Radio Tuning (L2)

XPDR/TCAS CONTROLS

Changes to the four digit XPDR code can be done by pressing the left third line select key (L-LSK3), and using the TUNE/DATA knob.

Pressing the L-LSK3 twice permits access to the XPDR/TCAS control page. These controls are covered in the traffic surveillance system (TSS) section.

The XPDR/TCAS mode is displayed next to the R-LSK3. Pressing the key once then rotating the TUNE/DATA inner knob cycles through all the possible XPDR/TCAS modes as follows:

- AUTO
- STBY
- TA/RA
- TA ONLY
- ALT ON
- ALT OFF

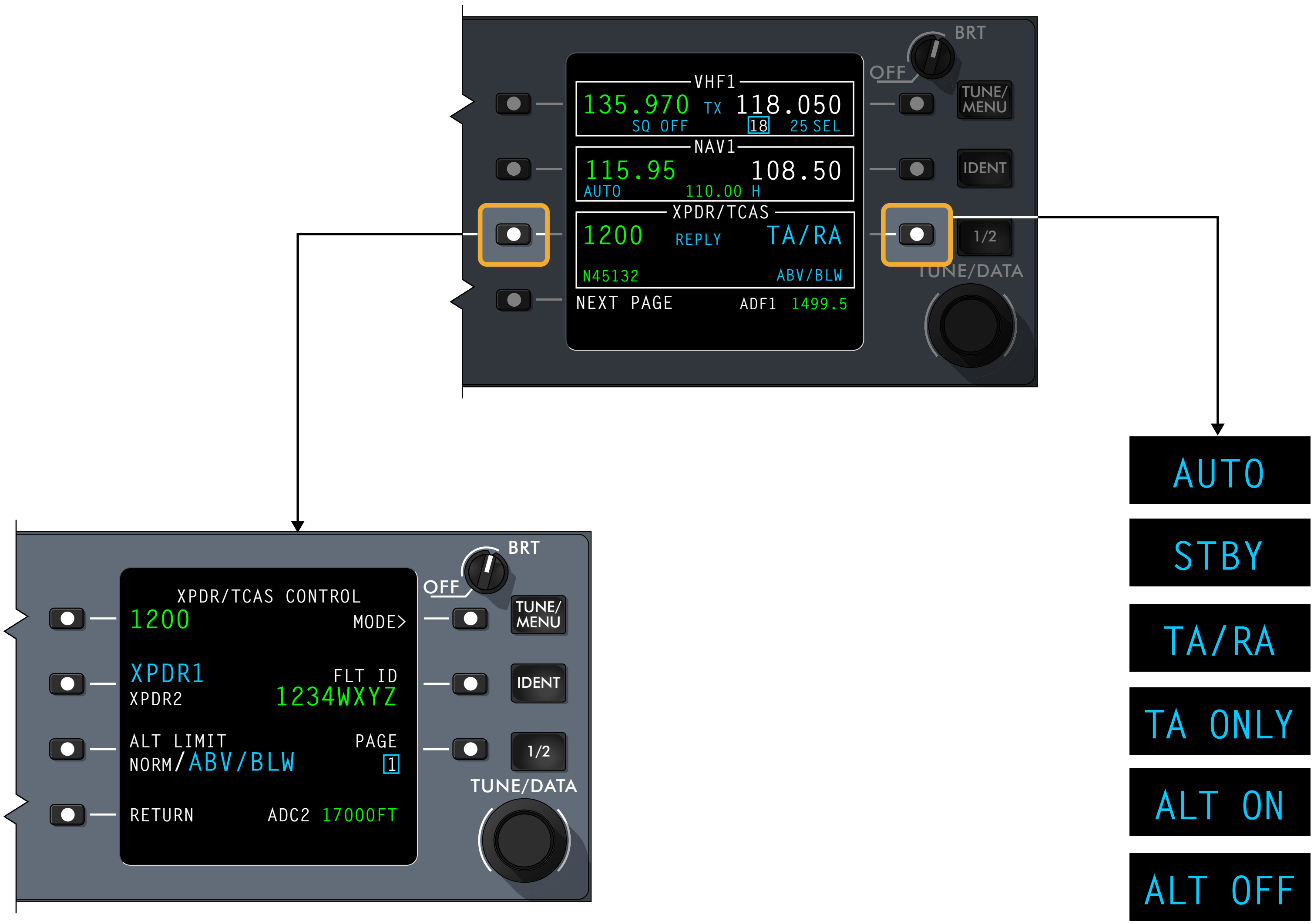

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Figure 26: XPDR/TCAS Controls (L2)

AUTOMATIC DIRECTION FINDER TUNING PAGE

From the top level tuning menu, selecting the next page key displays the second tuning page, making it possible to select the optional automatic direction finder (ADF) control menu.

From the ADF control menu, it is possible to either tune the ADF receiver or select the ADF preset page.

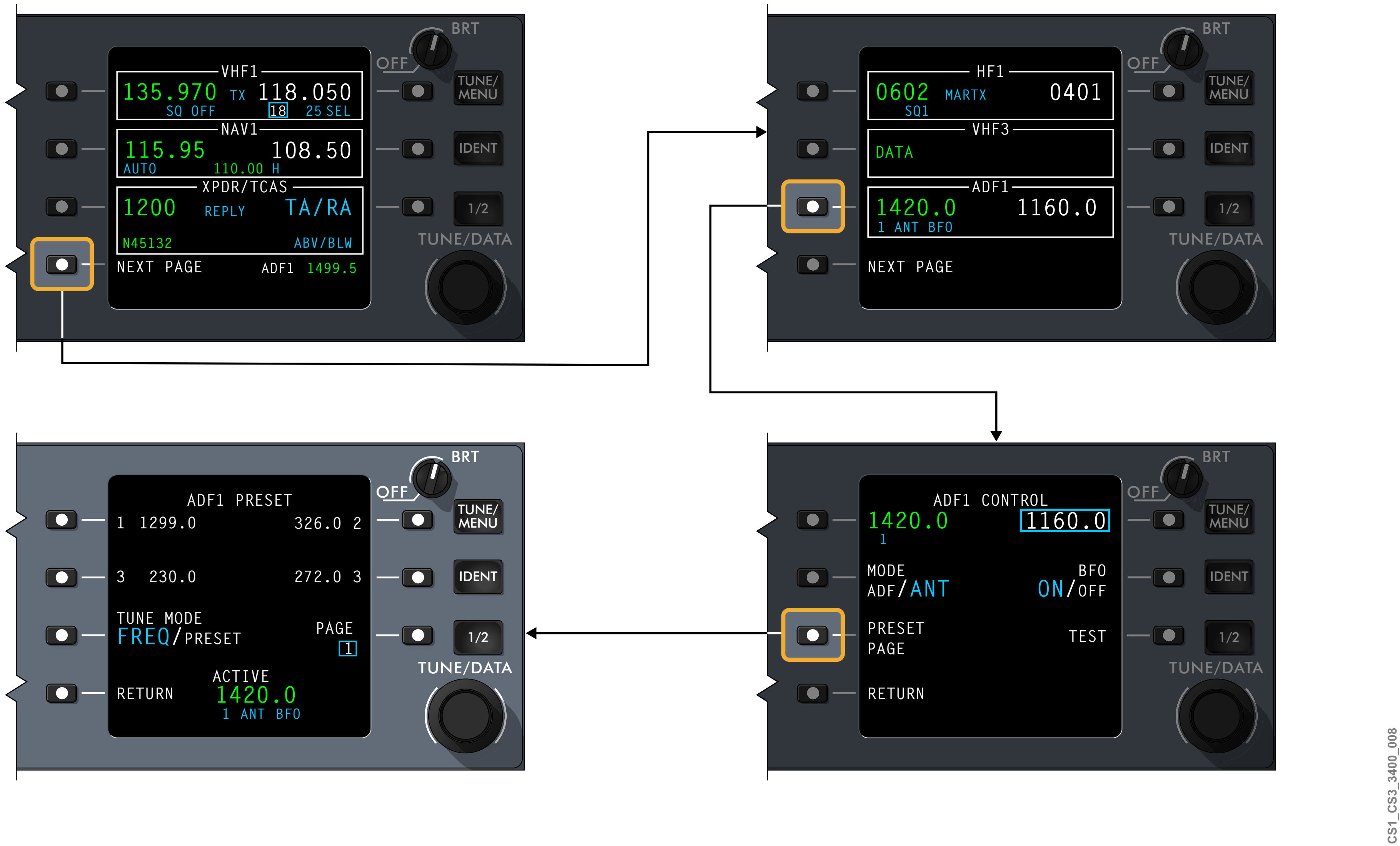

Figure 27: Automatic Direction Finder Tuning Page (Optional) (L2)

WEATHER RADAR MENU

By pressing LSK next to the WXR title, various parameters of the weather radar (WXR) can be controlled.

After a power cycle, the system goes by default to the following values:

- STBY
- AUTO
- WX
- GAIN: NORM
- GCS: ON
- TILT - none

PFD/NAV MENU

Selecting the PFD/NAV page of the CTP, allows to change the following parameters:

- Radio and baro minimum altitude alert
- Selection of magnetic or true heading
- Bearing pointers (BRG) needles
- Landing elevation

The values for the MINIMUMS and the LDG ELEV remain the same after a power cycle.

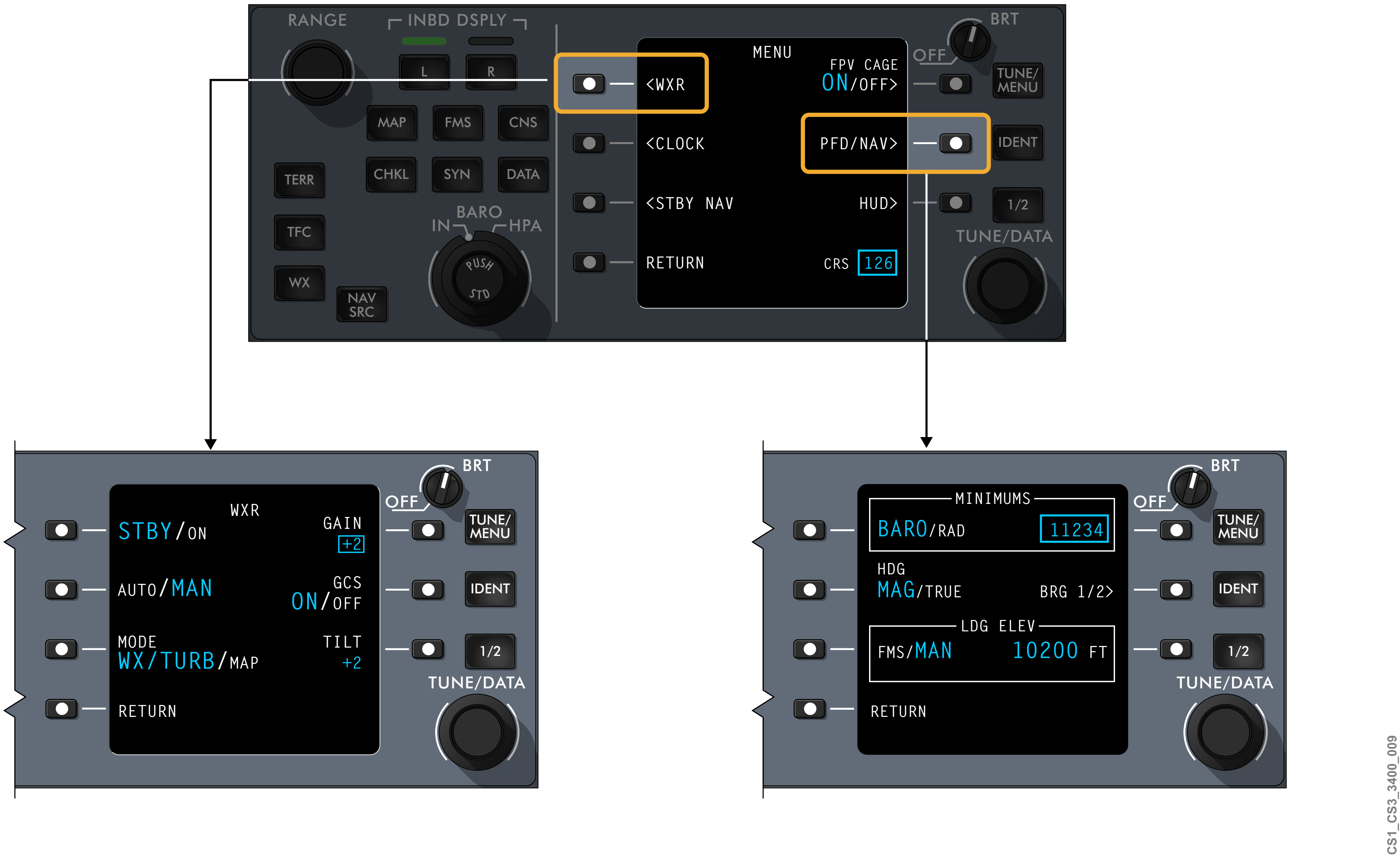

Figure 28: Weather Radar and Radio Altimeter Selections (L2)

DISPLAY TUNING INHIBIT

This switch is located on the reversion switch panel. It inhibits the tuning from the display units. When selected, the associated green light illuminates.

Pressing the switch a second time, the display tuning is restored.

REVERSION SWITCH PANEL

Figure 29: Display Tuning Inhibit (L2)

RADIO TUNING SYSTEM APPLICATION

The radio tuning system application (RTSA) is the secondary means of tuning the VHF-NAV system. The RTSA page appears on any MFW by selecting the communications, navigation, and surveillance (CNS) key on the CTP, or on the MKP.

The NAV main display is accessible from the tune tab in the RTSA menu, and contains frequency control, display, and annunciations for the NAV radios. Each section opens up submenus.

Selecting NAV 1 brings up the NAV 1 control page, where NAV 1 frequencies, tuning mode, and MB sensitivity can be changed.

The EDIT soft key provides access to the EDIT NAV PRESET FREQUENCIES dialog box, and enters frequencies into the preset memory.

The EDIT NAV PRESET FREQUENCIES dialog box contains a scrollable list of twenty user-defined NAV preset frequencies.

Selecting ADF 1 brings up the ADF 1 control page for tuning ADF frequencies. Also available on the page are operation mode, and the beat frequency oscillator (BFO), with switch selection to either ON or OFF.

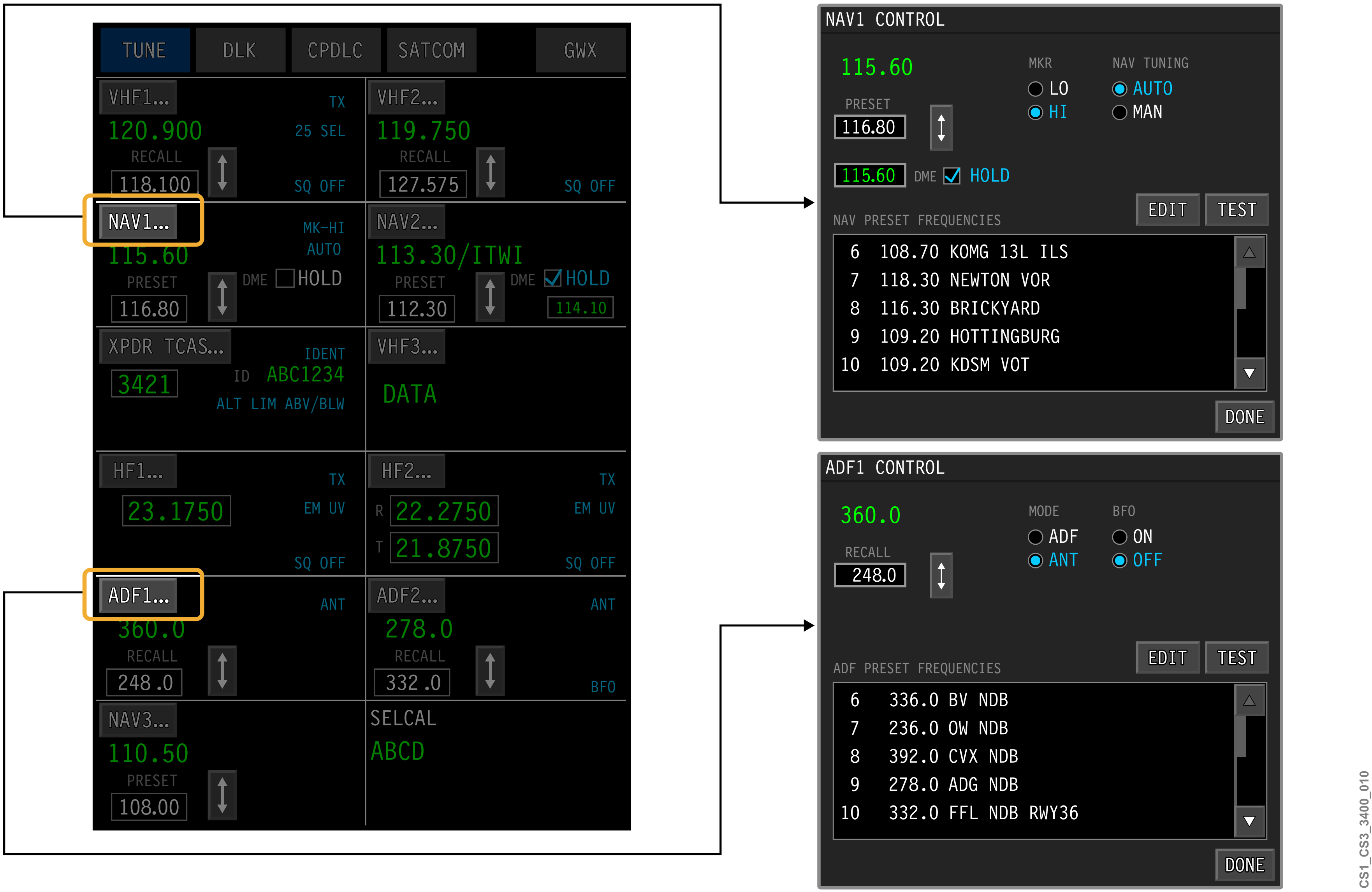

Figure 30: Radio Tuning System Application (L2)

XPDR/TCAS CONTROLS VIA RADIO TUNING SYSTEM APPLICATION

Selecting the XPDR/TCAS button from the RTSA on any multifunction window (MFW) permits access to TSS controls.

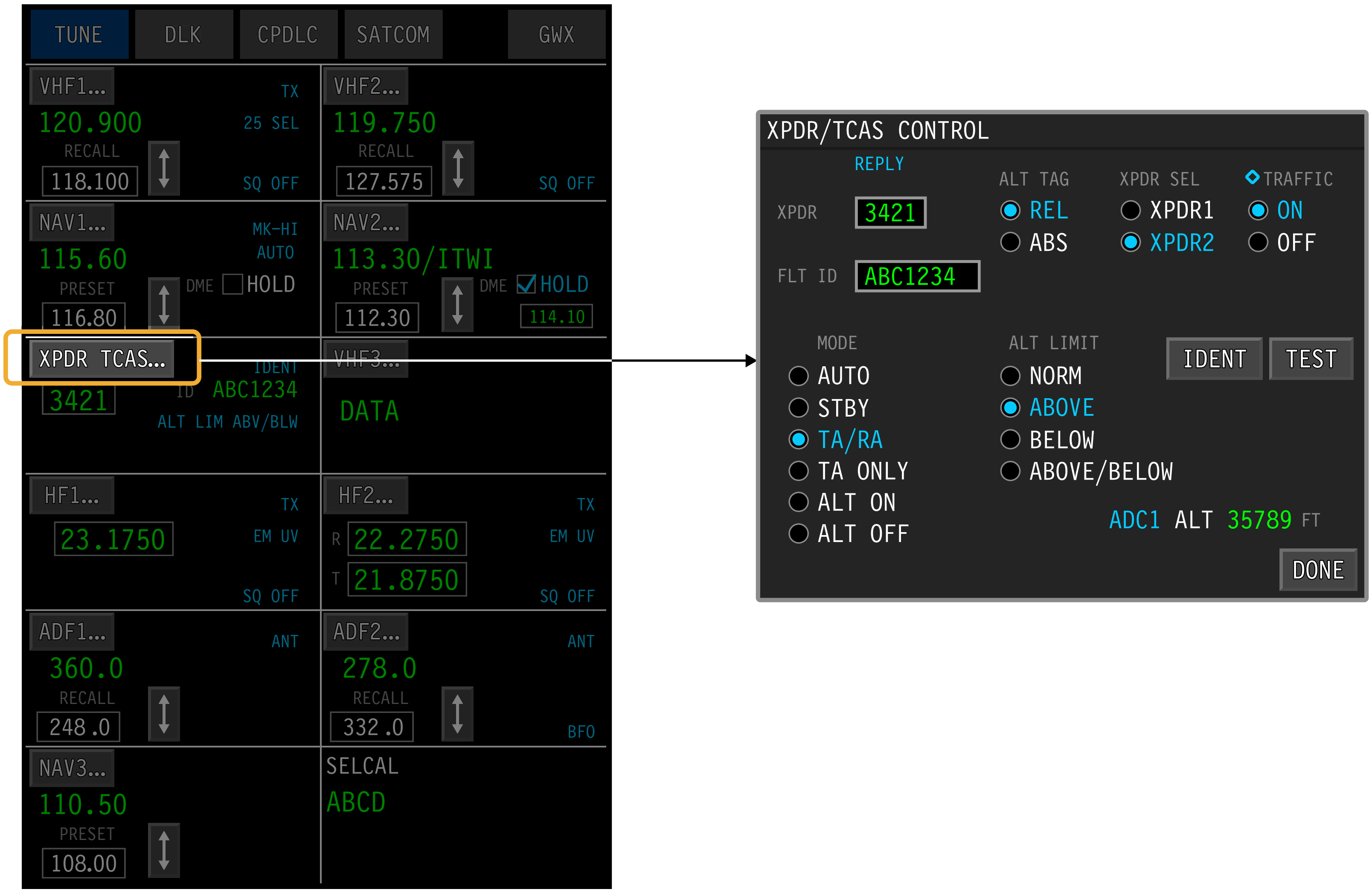

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Figure 31: XPDR/TCAS Controls via Radio Tuning System Application (L2)

GRAPHICAL NAVIGATION TUNING

The crew may tune a VHF-NAV or ADF receiver using both the cursor control and the graphic map display on the MFW.

All navaids included in the flight plan are displayed on the MFW, and are selectable using the cursor.

Cursor selection of any navaid results in the display of a drop-down task menu. The task menu contains a tuning option for the VHF-NAV receiver, or ADF receiver, depending on the navaid selected.

When selecting a TUNE task item, the frequency corresponding to the selected VHF-NAV radio, or ADF receiver is automatically set and displayed as the active frequency on the associated CTP.

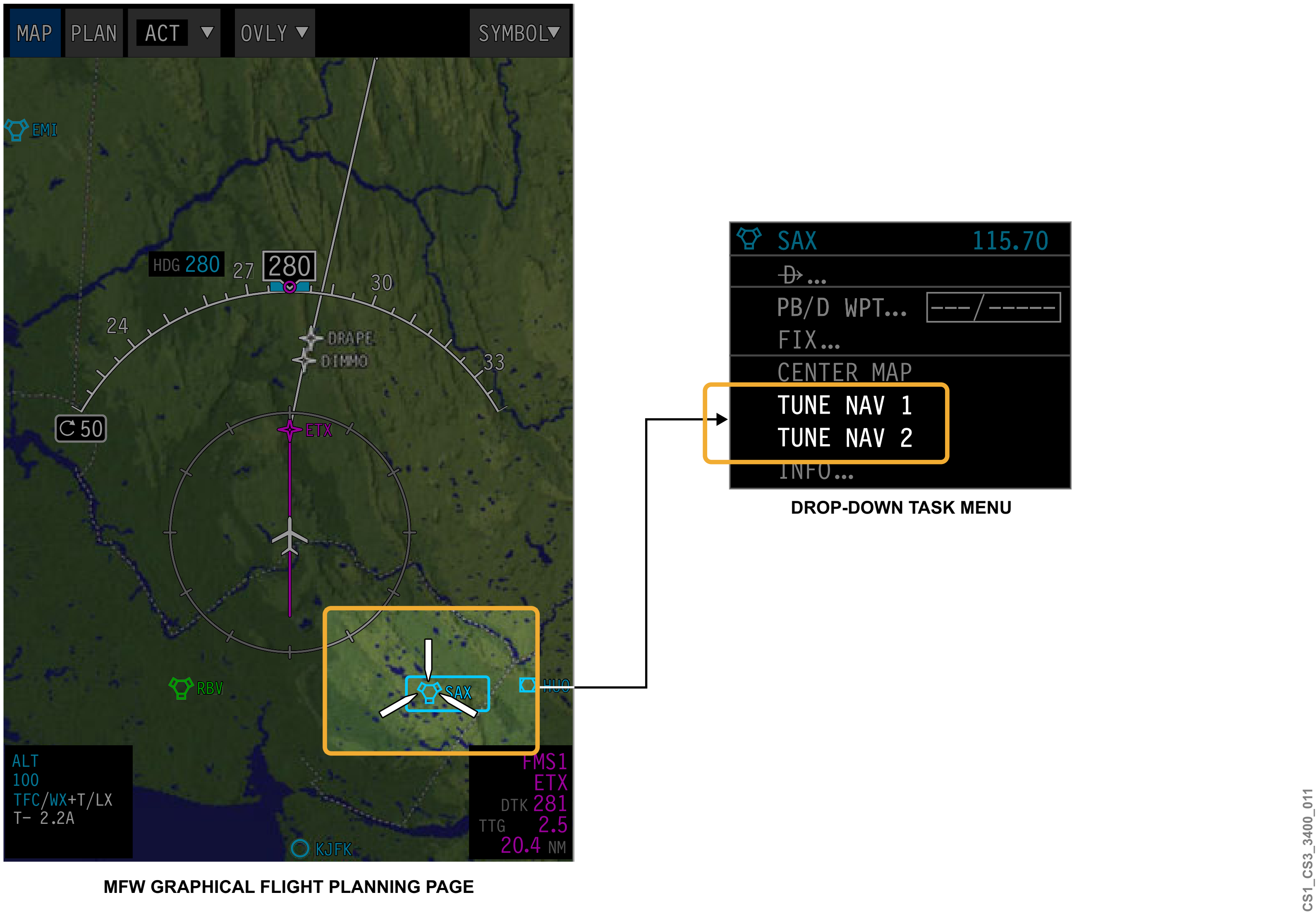


Figure 32: Graphical Navigation Tuning (L2)

34-51 VHF NAVIGATION SYSTEM

GENERAL DESCRIPTION

The VHF-NAV receiver receives, decodes, and processes the signals transmitted by the ground stations and sends the information to the display units (DUs). It also contains the self-monitoring circuits which check the reliability of the decoded signals.

The four NAV antennas supply RF signals to NAV 1 and NAV 2 systems.

The control tuning panels (CTPs), the radio tuning system application (RTSA), and the graphical tuning are the three means to manually tune the VHF-NAV receivers. Automatic tuning is carried out by the flight management system (FMS).

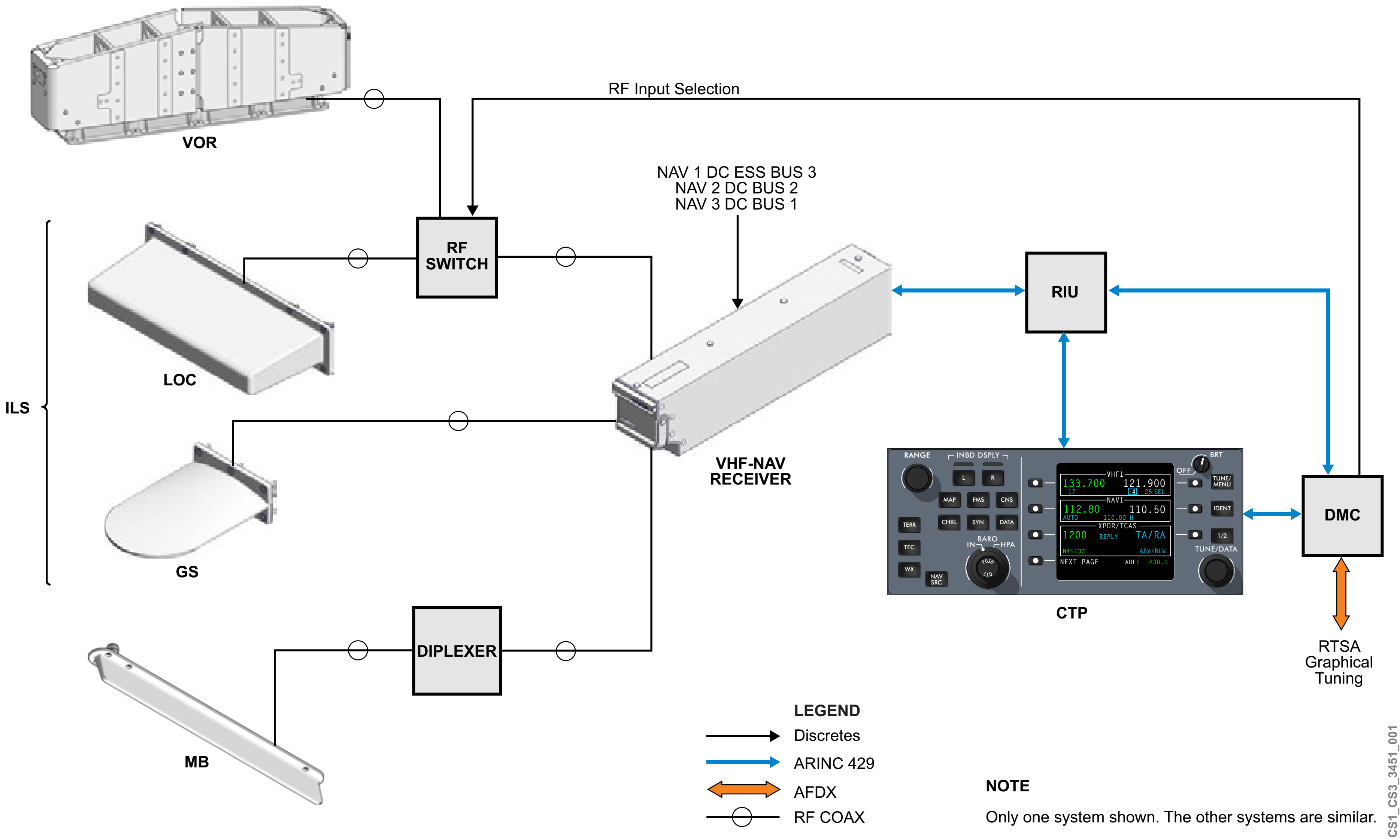
The marker beacon receivers operate on a fixed frequency and do not require tuning.

The CTP exchanges tuning information with the radio interface unit (RIU), and relays RTSA and graphical tuning information coming from the data concentrator module cabinet (DMC) to the RIU.

Based on the frequency selected, the RF switch allows the VHF-NAV to switch between the VHF omnidirectional radio (VOR) antenna and the localizer (LOC) antenna inputs.

The marker beacon antenna diplexer splits the MB antenna signal and feeds the two NAV receivers.

The VHF-NAV receiver 1 is powered by 28 VDC ESS BUS 3, while DC BUS 2 powers VHF-NAV 2. The optional VHF-NAV 3 uses DC BUS 1.



NOTE

Only one system shown. The other systems are similar.

Figure 33: VHF Navigation System (L2)

COMPONENT LOCATION

The VHF navigation system consists of the following components:

- VOR antenna
- ADF antenna (for ADF option)
- LOC antenna
- Glideslope (GS) antenna
- Marker beacon (MB) antenna
- VHF-NAV receivers
- Marker beacon antenna diplexer
- Radio frequency switches
- ADF receiver (optional)

Additional components, for Cat IIIb option:

- Third VHF-NAV receiver
- Second LOC antenna
- Second GS antenna

VOR ANTENNA

The VOR antenna has a dual output and is located inside the vertical stabilizer tip.

ADF ANTENNA

The ADF antenna has a dual output and feeds the two NAV receivers. It is located in the lower aft fuselage.

LOC ANTENNA

The dual output LOC antenna is installed in the radome compartment below the radar antenna.

GLIDESLOPE ANTENNA

The dual-glideslope (GS) antenna is installed at the bottom left of the radome compartment.

MARKER BEACON ANTENNA

The marker beacon antenna is installed on the lower aft fuselage along the aircraft centerline.

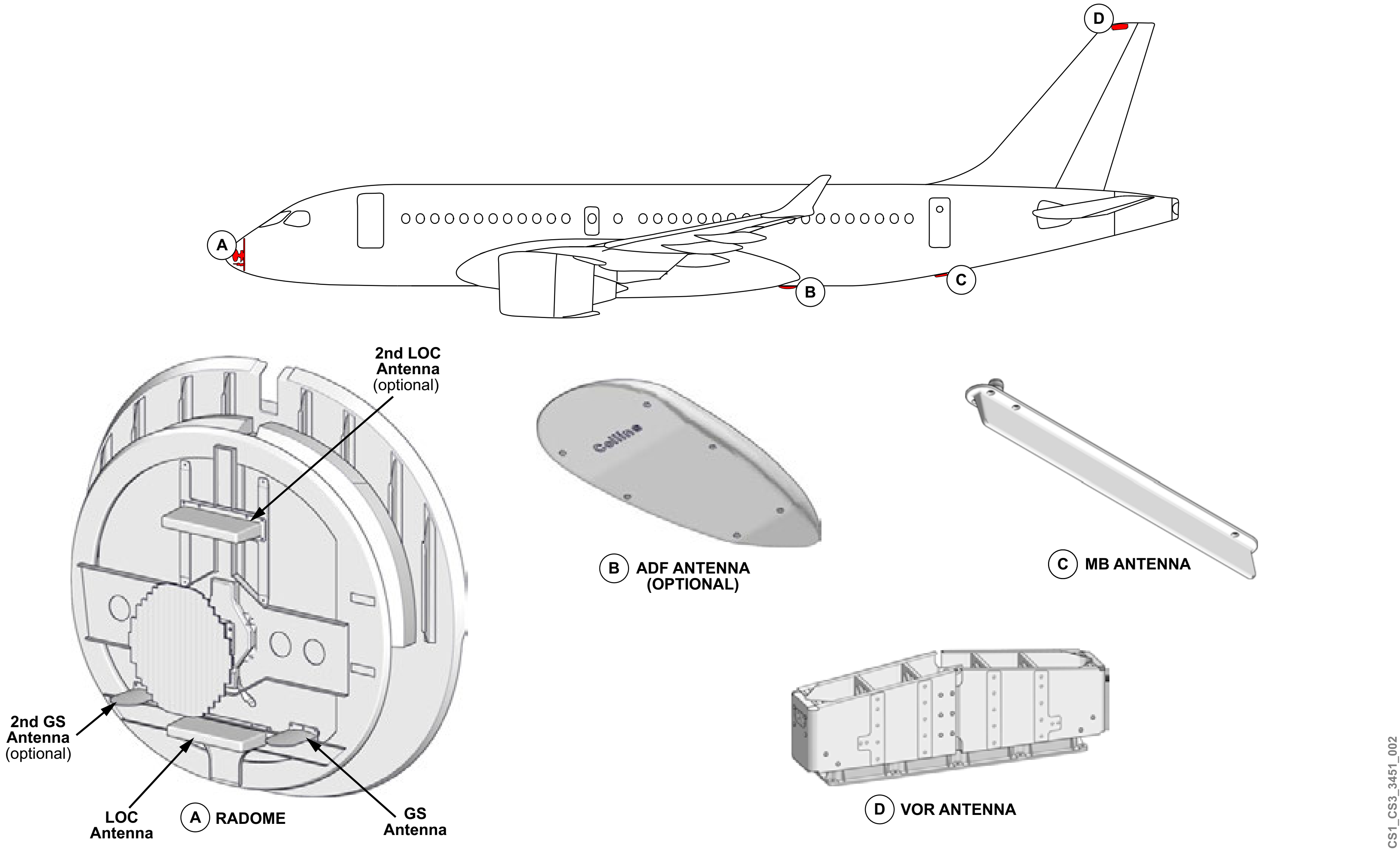


Figure 34: VHF-NAV Component Location (L2)

VHF-NAV RECEIVERS

The VHF-NAV 1 and VHF-NAV 2 are located in the mid equipment bay. The 3rd optional receiver, VHF-NAV 3, is in the forward equipment bay.

MARKER BEACON ANTENNA DIPLEXER

The marker beacon (MB) antenna diplexer is located in the mid avionics bay.

RADIO FREQUENCY SWITCHES

The two radio frequency (RF) switches are located in the mid avionics bay.

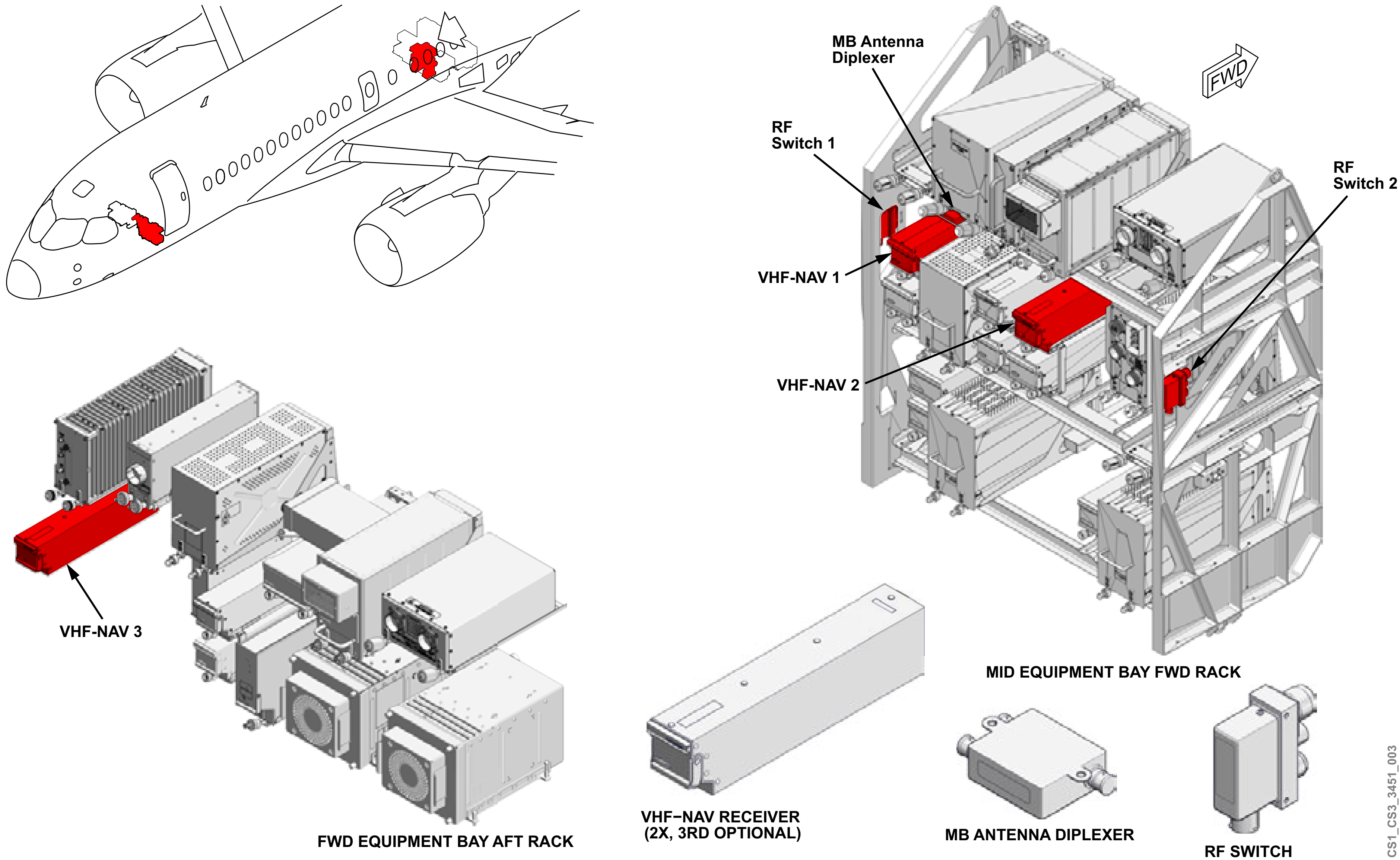


Figure 35: VHF-NAV Receivers, Marker Beacon Antenna Diplexer, and Radio Frequency Switches (L2)

CONTROLS AND INDICATIONS

The NAV system provides navigation information to the crew on:

- Primary flight display (PFD)
- Standby NAV display
- Standby flight instrument system (SFIS)

PRIMARY FLIGHT DISPLAY

During an approach, the instrument landing system (ILS) information appears on the primary flight display (PFD).

The following NAV data appears on the PFD:

- NAV source
- Identifier/frequency
- Localizer
- Glideslope
- Marker beacon
- Bearing source

The NAV source is green when onside source is selected, and amber for cross-side.

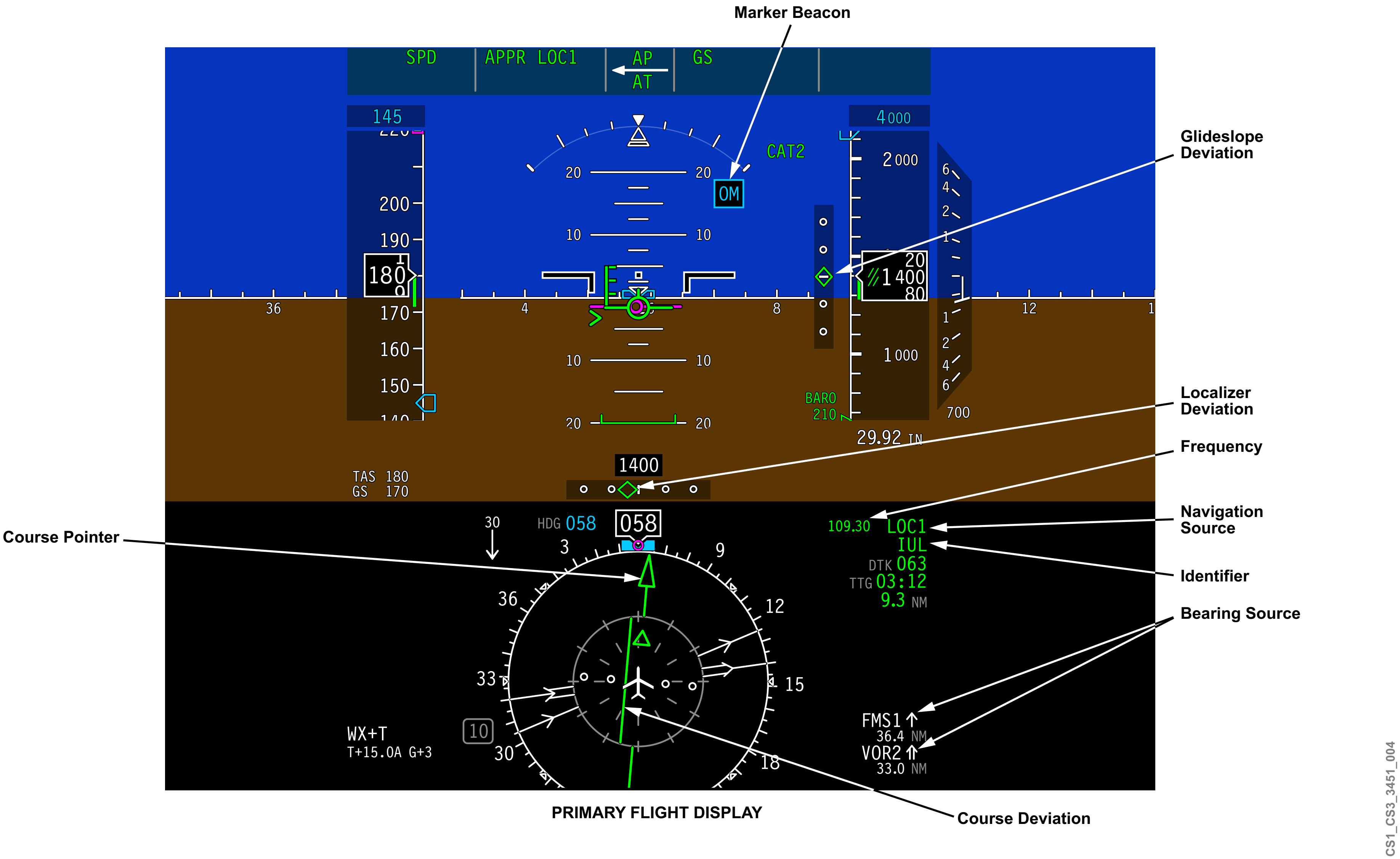


Figure 36: Primary Flight Display (L2)

BEARING SOURCE SELECTION

Pressing the PFD/NAV line select key brings up the next menu, where it is possible to select the source for bearing 1 and 2. The selected source is shown in cyan and larger font.

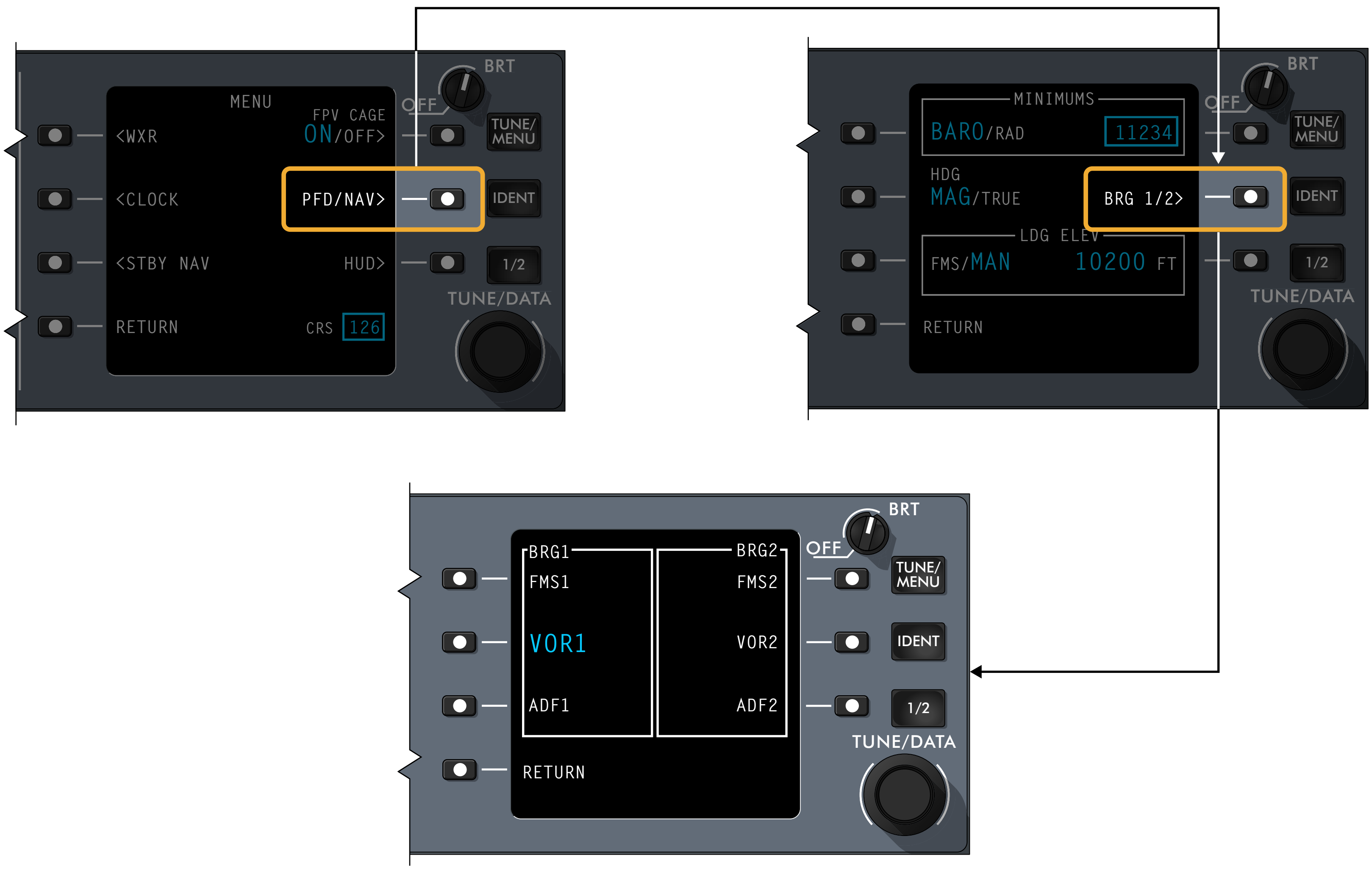


Figure 37: Bearing Source Selection (L2)

STANDBY NAV DISPLAY

The control tuning panel (CTP) includes a standby navigation display (STBY NAV) in case all display units (DU) fail.

The STBY NAV display is accessible through a line select key (LSK) from the MENU page and provides NAV source data.

STANDBY FLIGHT INSTRUMENT SYSTEM

The standby flight instrument system (SFIS) also uses information from LOC and GS. The data is supplied by the VHF-NAV receiver 1. If the instrument landing system (ILS) information from the NAV receiver is lost, an ILS red flag is displayed on the SFIS. Any loss of the LOC or GS signal from the ground stations will cause either an LOC yellow box or a GS yellow box to be displayed on the SFIS.

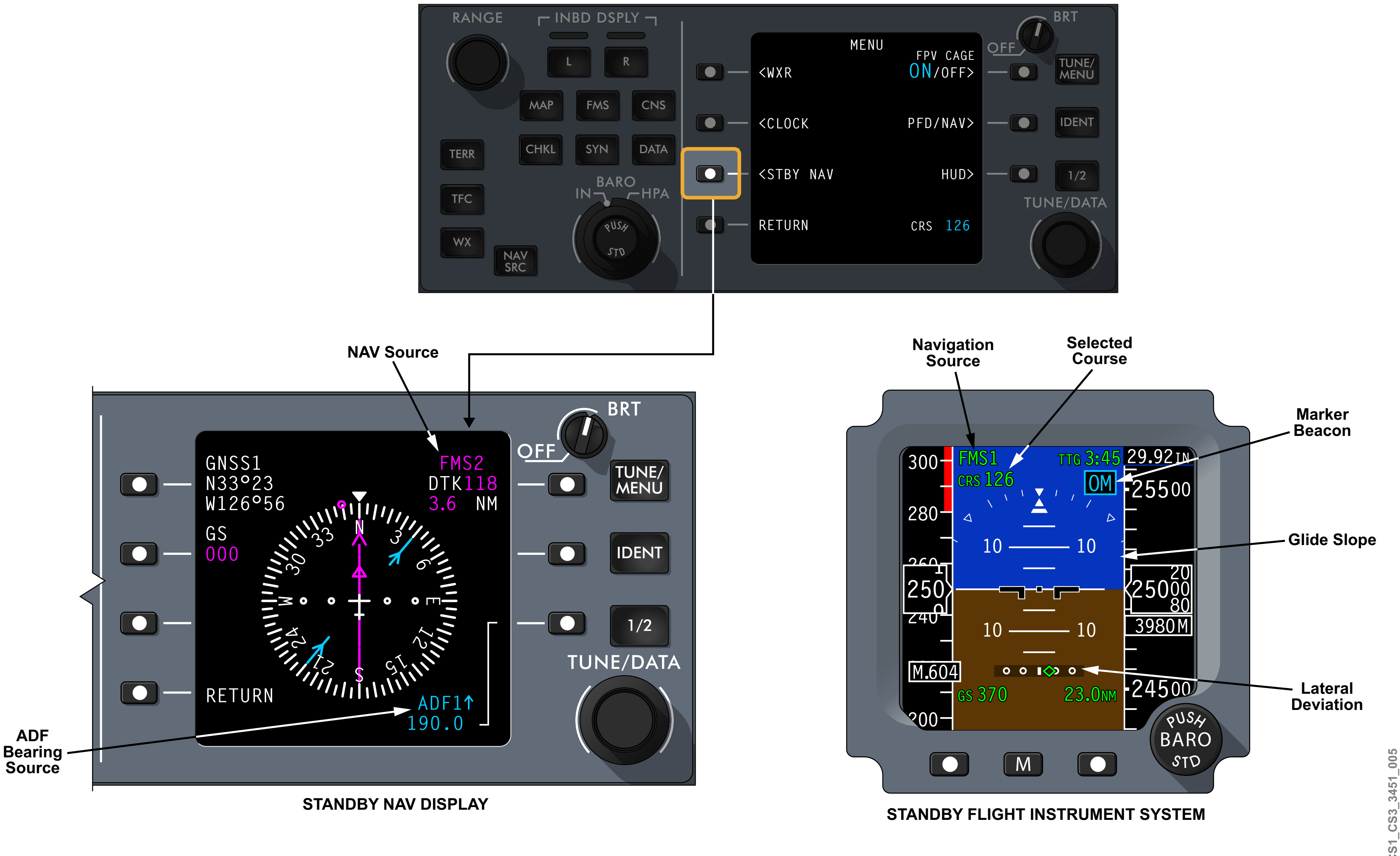


Figure 38: Standby Displays (L2)

DETAILED DESCRIPTION

SYSTEM INTERFACE

The control, monitoring, and display functions for the VHF-NAV system operate through the radio interface unit (RIU).

The CTPs and RTSA provide integrated control and tuning of the receivers. The RTSA tuning word is routed to the CTPs through the DMCs.

The crew may also tune the system using graphical NAV tuning via the cursor control and the graphic map display presented on the MFW.

Automatic tuning may also be carried out by the flight management system (FMS).

The VHF-NAV receiver interfaces with the onside RIU via ARINC 429 to:

- Receive tuner command words and audio
- Send data to the RIU for routing of radio echo frequency, navigation information and audio

The radio interface unit (RIU) also communicates via ARINC 429 to receive tuning information from onside and cross-side CTPs.

The DMCs relay the PFCCs command, via a discrete line, to control the RF switches for the VOR and LOC antenna selection. The RF switch sends a monitor signal back to the DMC to confirm the switch position.

Each NAV receiver provides glideslope and localizer information to the PFCCs to support their functionalities.

During approach, the primary flight control computers (PFCC) send a test inhibit discrete signal to the receivers to prevent them from going into self-test mode.

The DMCs send the navigation information to the FMS application.

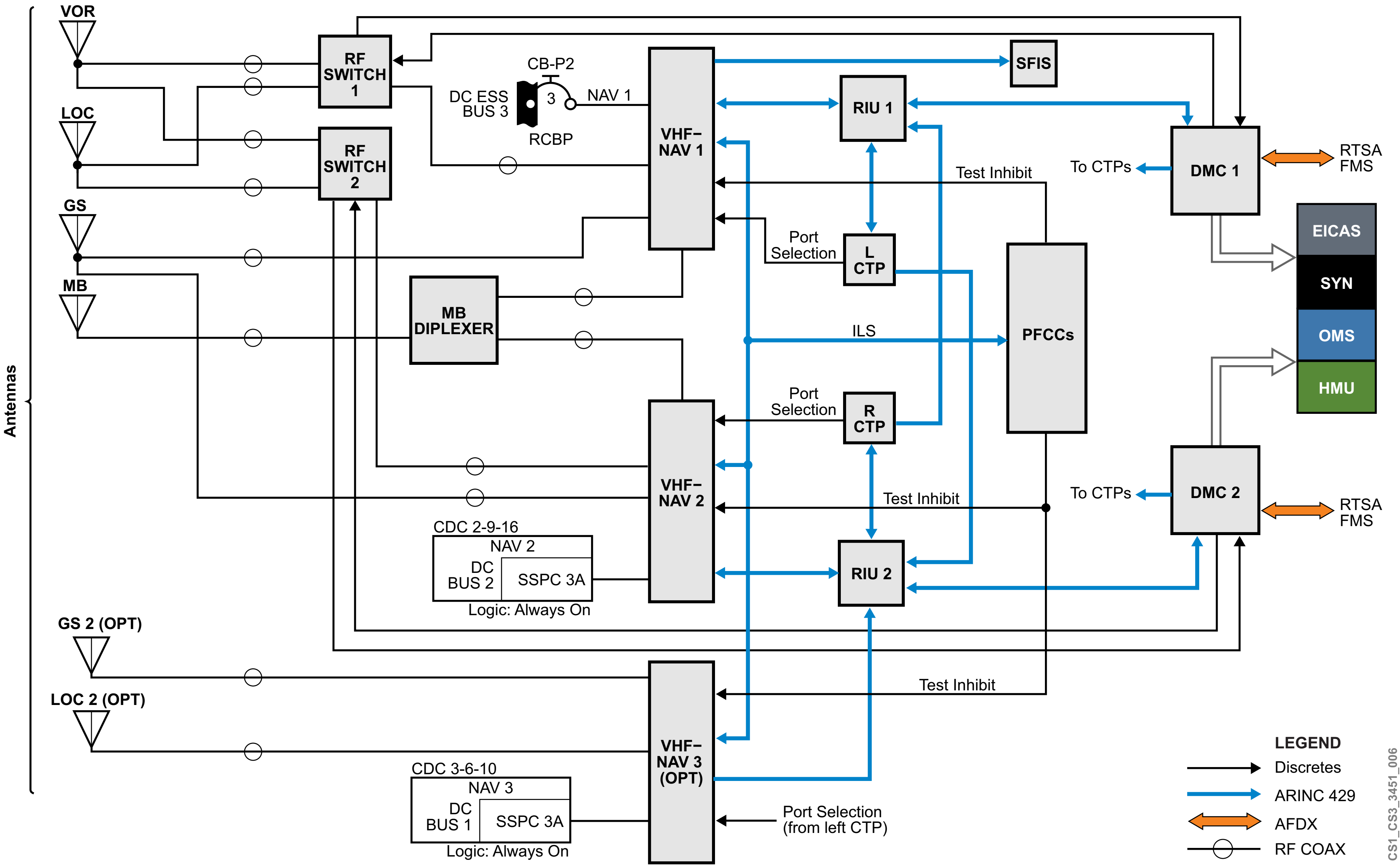


Figure 39: System Interface (L3)

MONITORING AND TESTS

SYSTEM MONITORING

NAV data is continuously monitored for validation.

The two basic types of failures that can occur in the system during its operation are no computed data (NCD) and failure warning (FW).

Logic for the flags and indications are hosted in the DUs.

NCD is used to warn of unreliable or suspected data.

The FW is the result of a malfunction within the receiver.

The following warnings appear on the display unit, when data from NAV system is NCD:

- VOR fail flag above the lateral deviation scale.
- Pointer and course deviation indicator (CDI) disappear

The following warnings appear on the display unit, in case of NAV system failure (FW):

- VOR fail flag in place of the NAV source indicator
- Pointer and CDI disappear
- VOR fail flag above the lateral deviation scale.

Glideslope and marker beacon failures generate similar indications.

The frequencies appear in yellow on the CTPs and DUs when the NAV receivers fail to tune to the commanded frequencies.

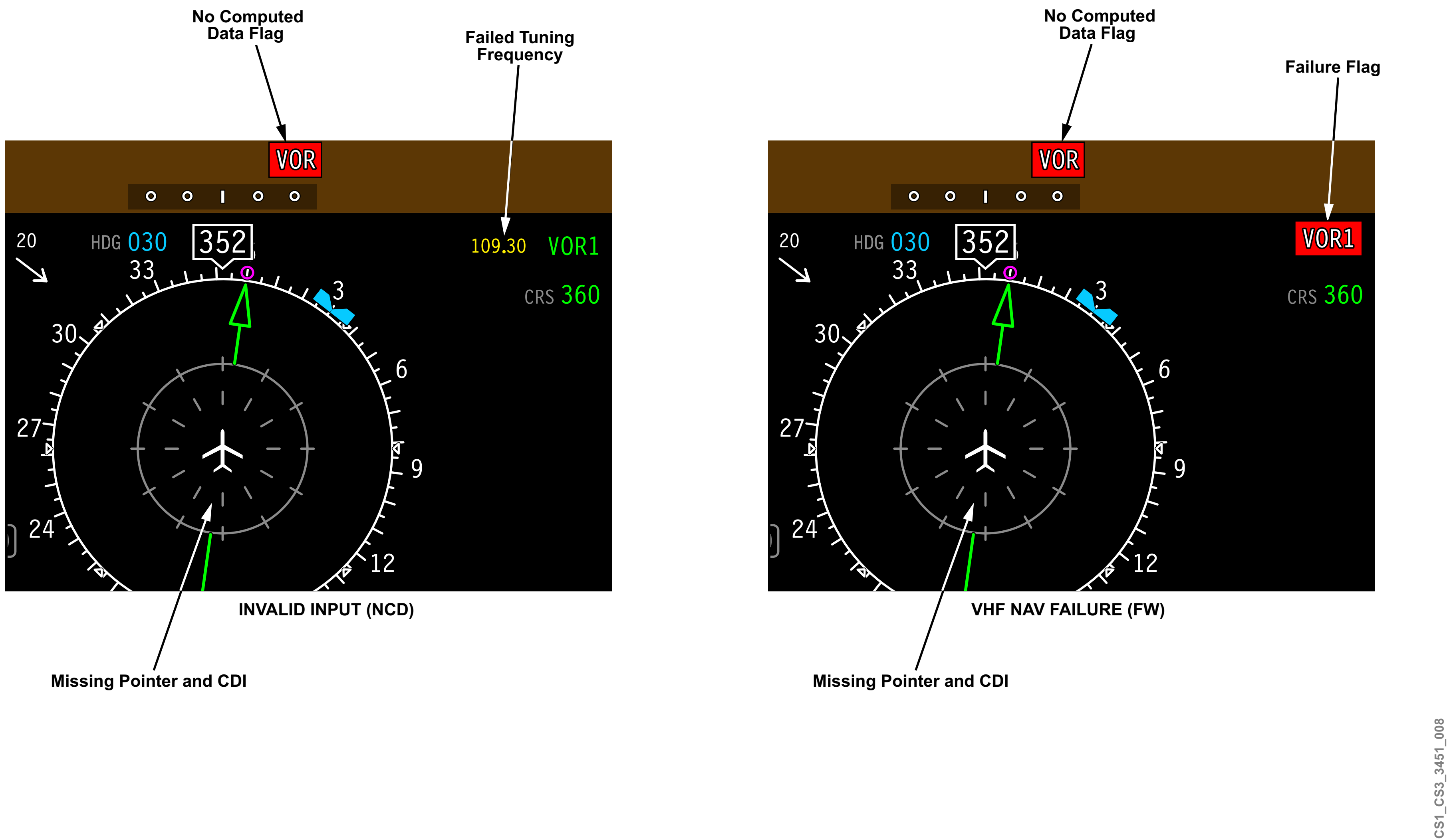


Figure 40: System Monitoring (L2)

SYSTEM TEST

The self-test is user-initiated and can be accessed either through the CTP or the RTSA. It verifies the integrity of each receiver and sends a diagnostic message via ARINC 429 back to the CTP or RTSA, indicating the results of the self-test.

The test duration is approximately 10 seconds. During this time the word TEST on the CTP becomes cyan and larger; and the following indications appear on the horizontal situation indicator (HSI):

- DME distance is 100 NM
- TTG indicates: 1:00
- The Station ID is AOK
- If a VOR frequency is tuned, the VOR bearing goes 360°

Marker annunciators, OM (cyan), MM (amber), IM (white) are alternately displayed on the attitude direction indicator (ADI).

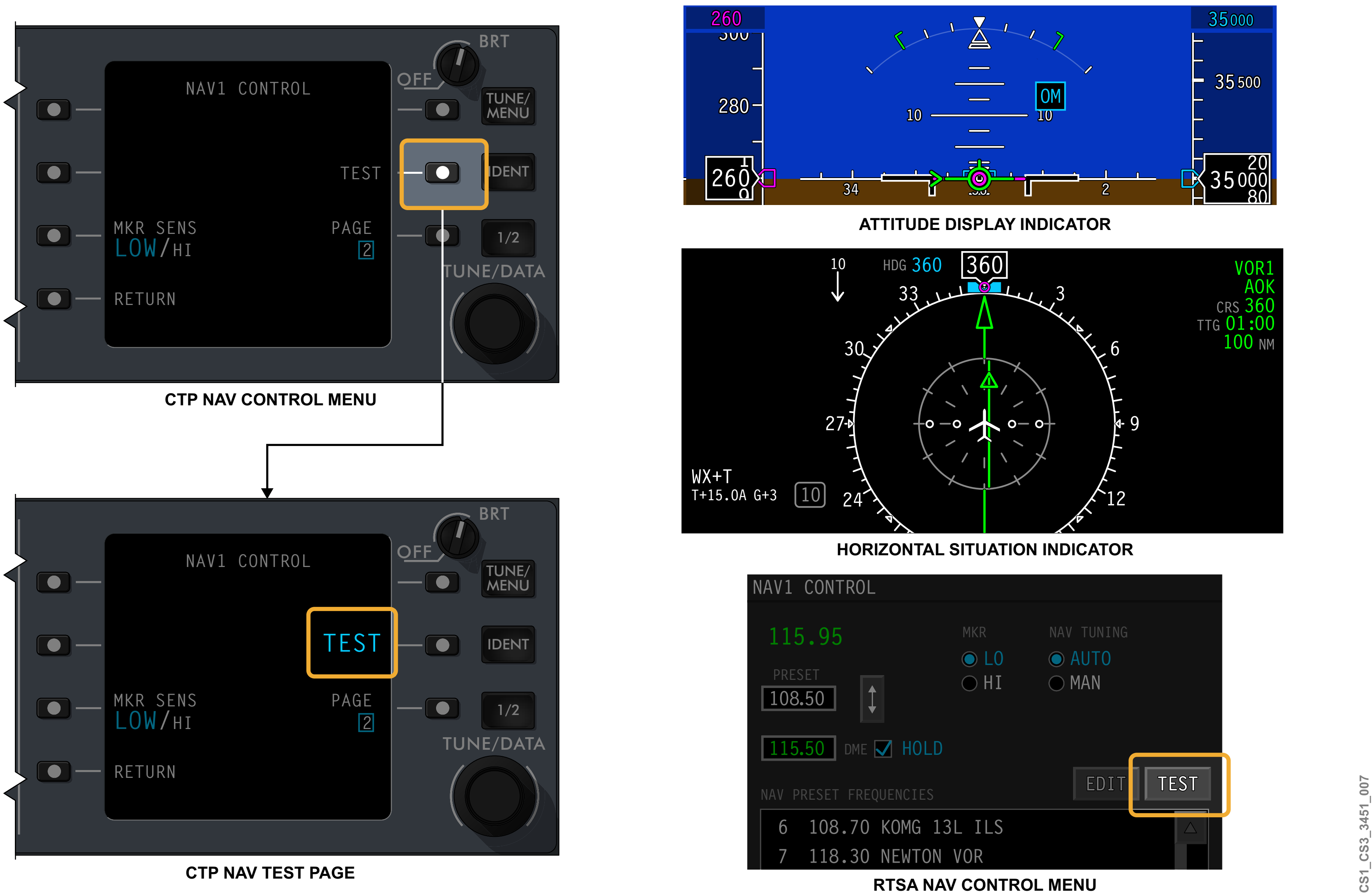


Figure 41: System Test (L2)

34-53 DISTANCE MEASUREMENT SYSTEM

GENERAL DESCRIPTION

The distance measuring equipment (DME) transceiver is the main component of the system. The control, monitor, and display functions for the DME system operate through the radio interface unit (RIU), using either the control tuning panel (CTP) or the radio tuning system application (RTSA). The DME transceiver has three channels and uses its own antenna. The first channel is normally paired with the VOR frequencies, except when in DME HOLD mode. The flight management system (FMS) tunes the second and third channels.

During transmission, the DME sends a suppression pulse to the traffic surveillance system.

To operate, DME 1 is powered by 28 VDC BUS 1, and DME 2 by 28 VDC BUS 2.

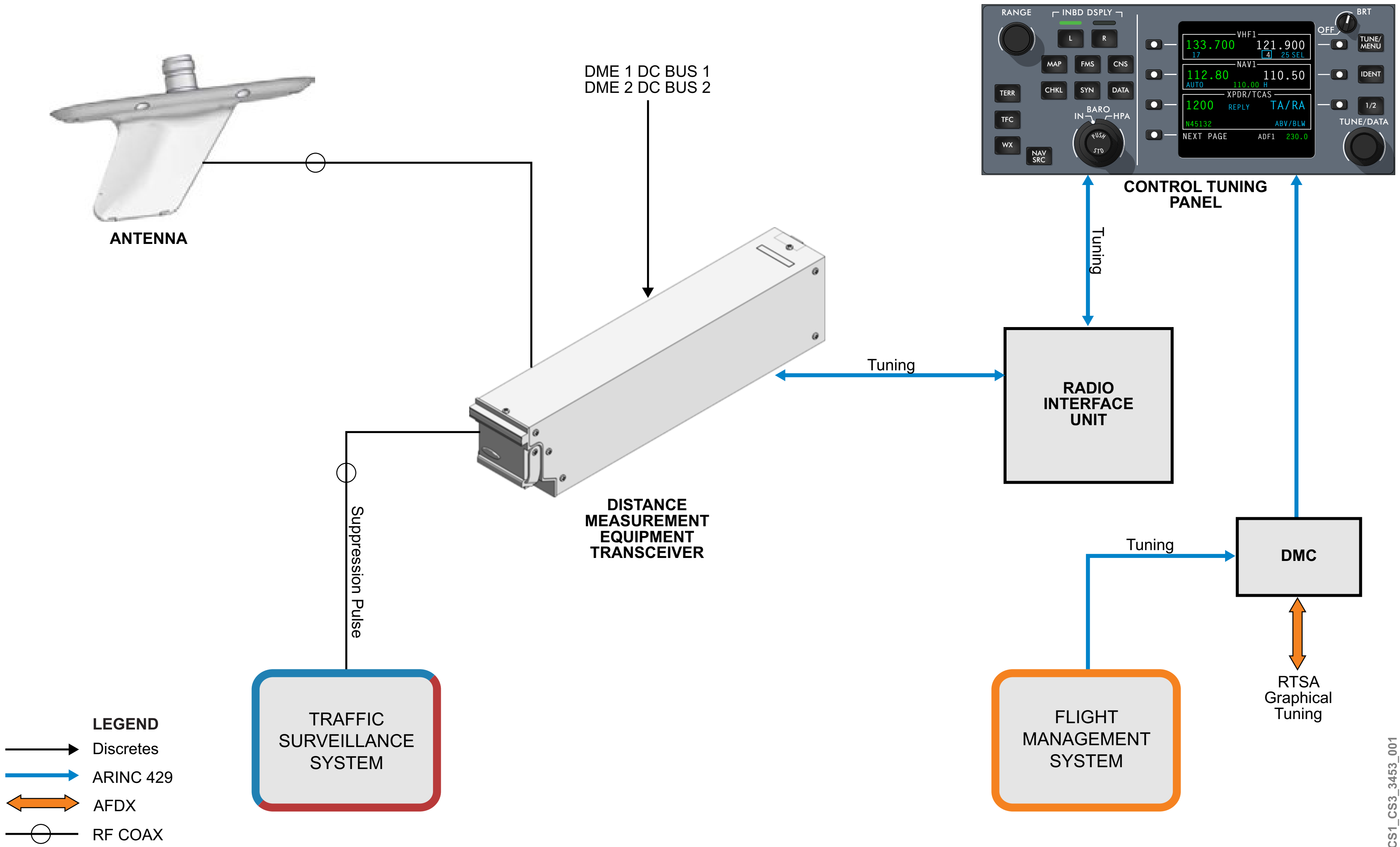


Figure 42: Distance Measurement System (L2)

COMPONENT LOCATION

The DME navigation system consists of the following components:

- Antennas
- DME transceivers

ANTENNAS

The DME antennas are installed on the bottom fuselage, along the aircraft centerline. The DME 1 antenna is on the forward fuselage, and the DME 2 antenna is on the aft fuselage.

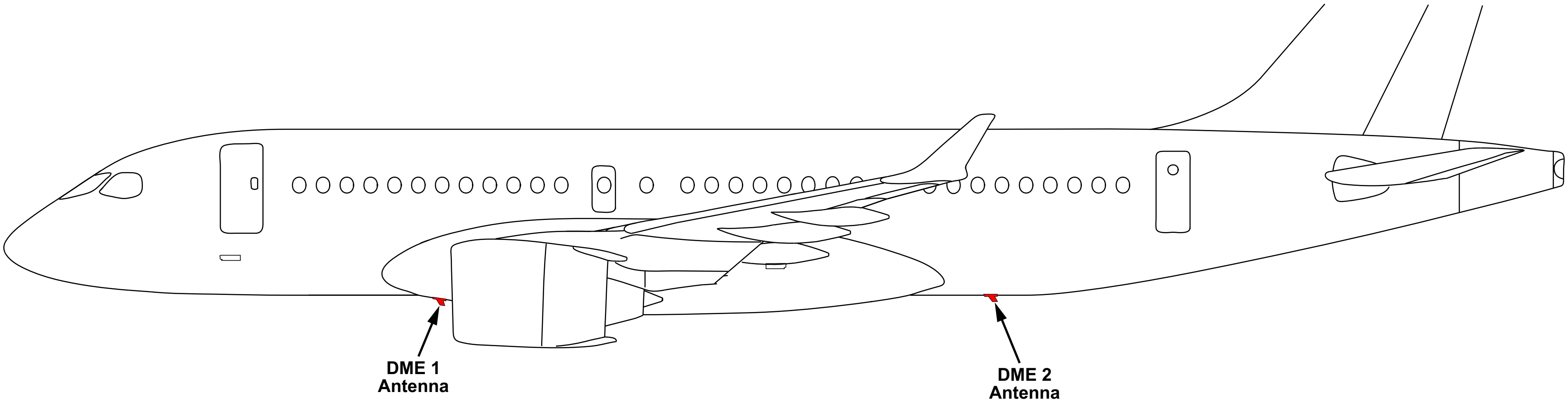


Figure 43: Distance Measuring Equipment Antennas (L2)

DME TRANSCEIVERS

The DME 1 transceiver is located in the forward equipment bay, and DME 2 is in the mid equipment bay.

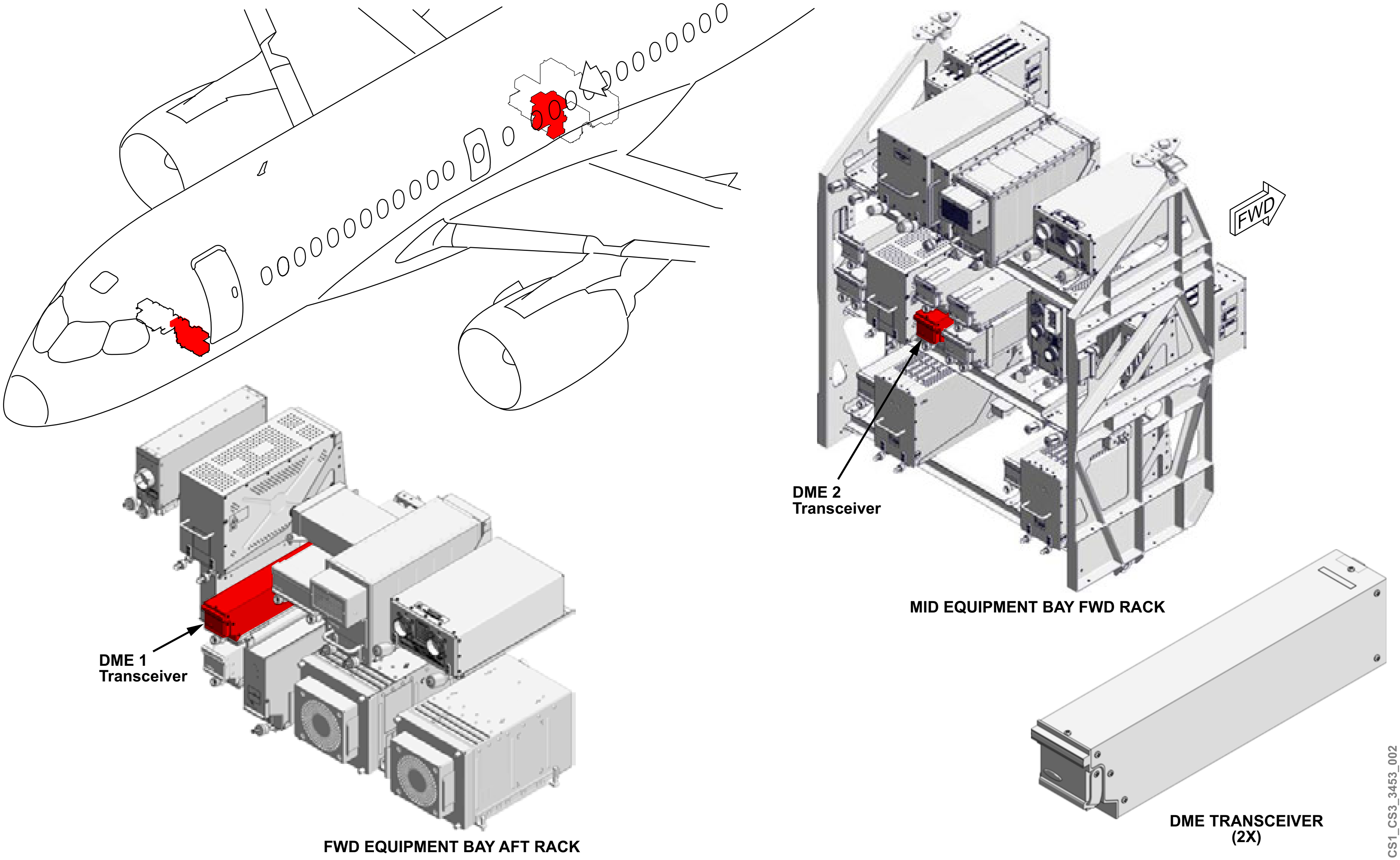


Figure 44: Distance Measuring Equipment Transceivers (L2)

CONTROLS AND INDICATIONS

The DME HOLD function allows to split the VHF-NAV pairing with the DME frequencies. When the DME is in HOLD, the crew can maintain DME channel 1 tuned to the last frequency while tuning the VHF-NAV to a new frequency.

PRIMARY FLIGHT DISPLAY

The DME sends the following information to the primary flight display (PFD):

- Station identification
- Time-to-go (TTG)
- Distance in nautical miles (NM)

STANDBY NAV DISPLAY

The CTP includes a standby navigation display (STBY NAV) in case all display units (DUs) fail. STBY NAV is accessible via a line select key (LSK) from the MENU page.

The standby navigation display provides the following DME data:

- Station identification
- Distance in nautical miles

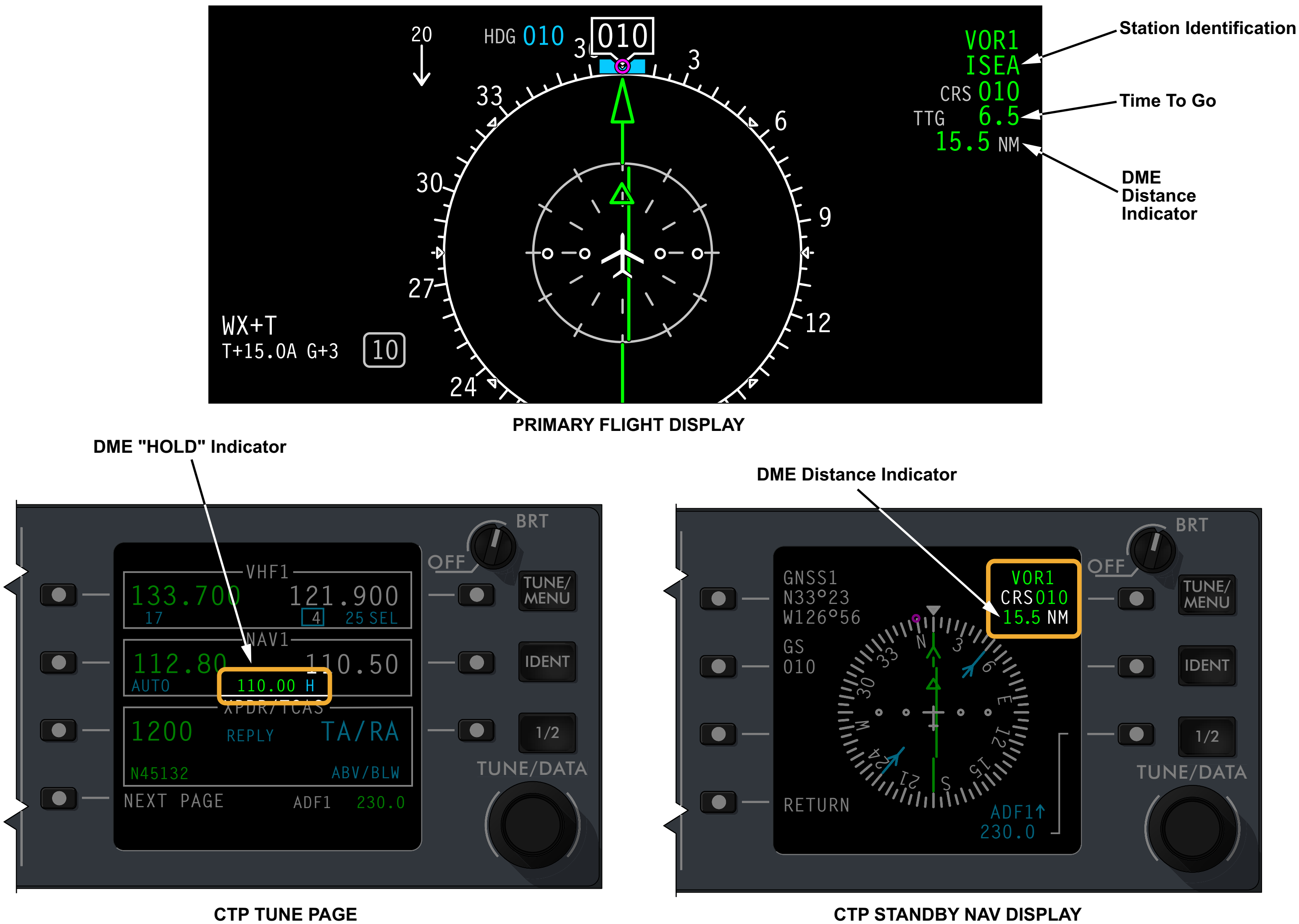


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Figure 45: Primary and Standby Flight Displays (L2)

DETAILED DESCRIPTION

SYSTEM INTERFACE

The DME transceiver uses the ARINC 429 to receive tuning information from the RIU. Tuning data to the RIU comes from the CTP or the RTSA/FMS via the data concentrator module cabinet (DMC). The DME sends information to the RIU including:

- Time-to-go
- Ground speed
- Distance
- DME diagnostics

The RIU sends this information to the DMC for display on DUs and converts all audio from analog to digital for the audio control panels (ACPs).

When the DME is transmitting, it generates a suppression pulse, which prevents interference and possible damage to other transceivers on the aircraft that operate in the same frequency band. This momentarily inhibits the other DME transceiver, ATC transponder, and traffic surveillance system (TSS). These units also generate a blanking pulse output when transmitting which temporarily inhibits the DME.

The DME receives discrete signals from CTP for port selection.

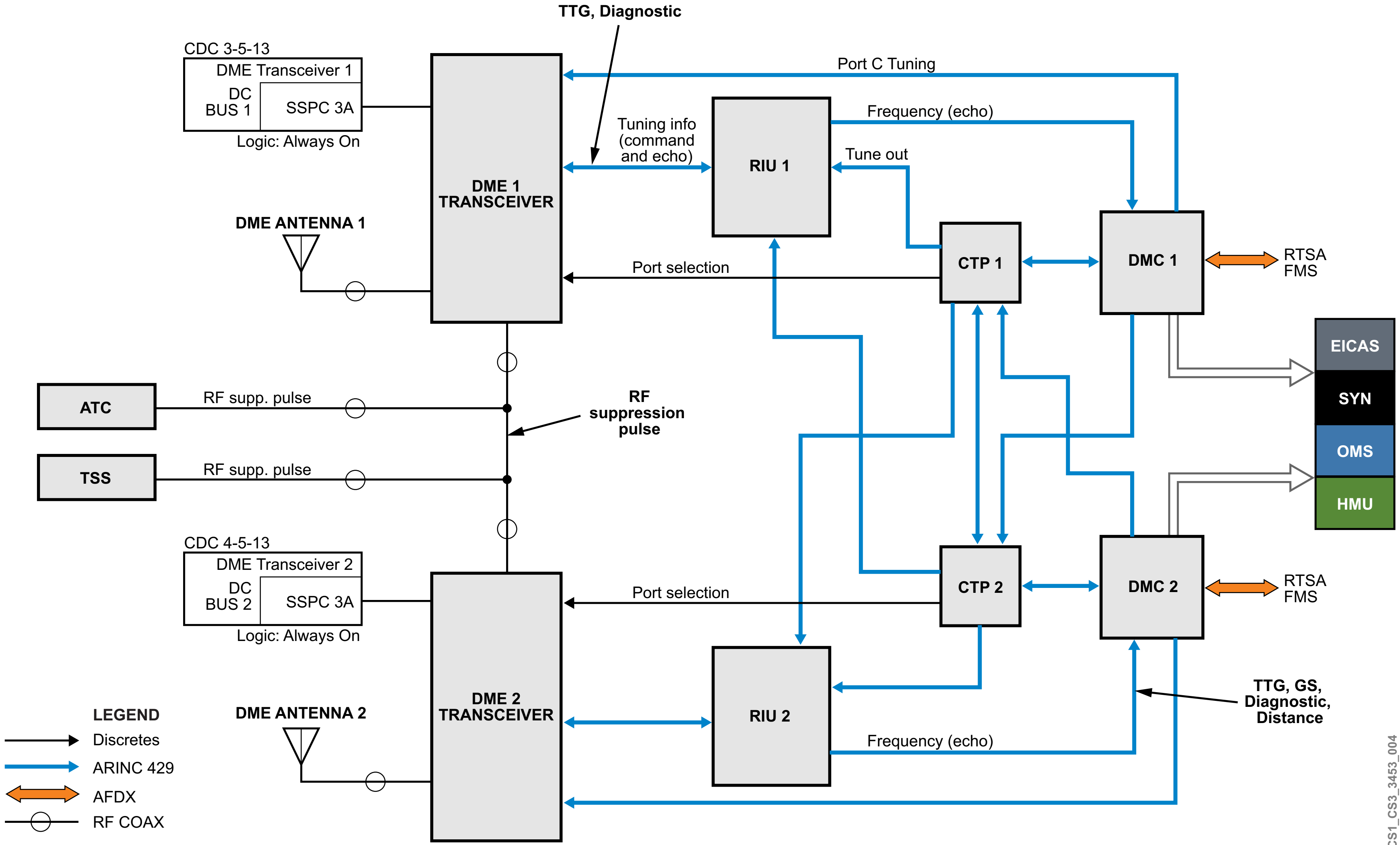


Figure 46: System Interface (L3)

MONITORING AND TESTS

SYSTEM MONITORING

If the paired DME frequency on the RTSA or CTP does not match the echo frequency within 3 seconds, the numbers change from green to yellow on the CTP and RTSA. If the distance value is not available or not valid, four dashes appear before the NM symbol. The station ID is blank if the identifier data is not valid or missing.

The DME transceiver provides continuous reports of internal health and external interfaces to the onboard maintenance system (OMS).

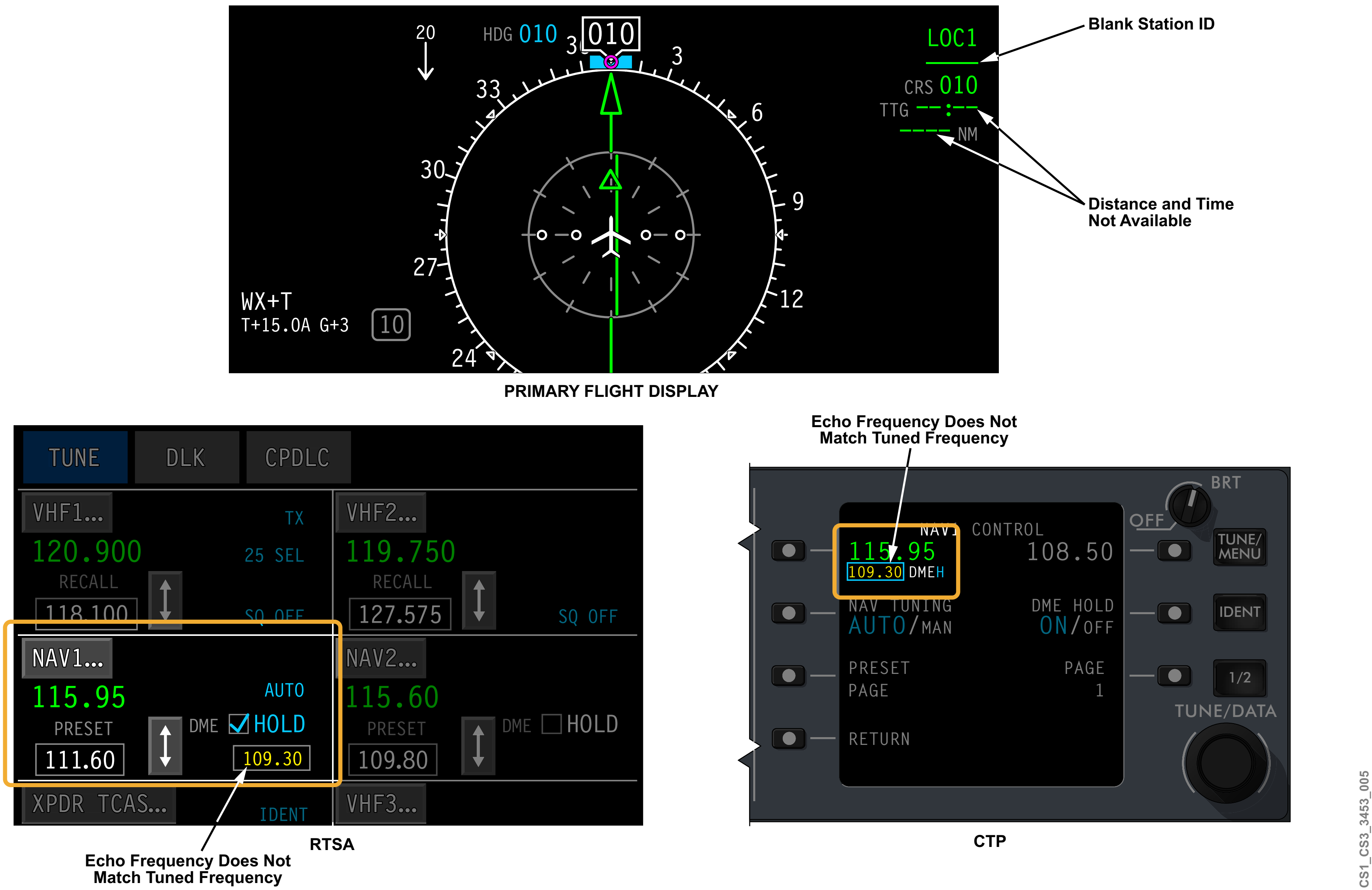


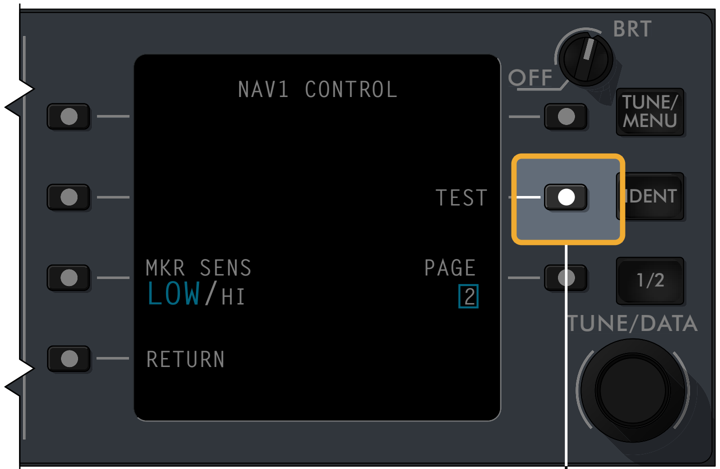
Figure 47: System Monitoring (L2)

SYSTEM TEST

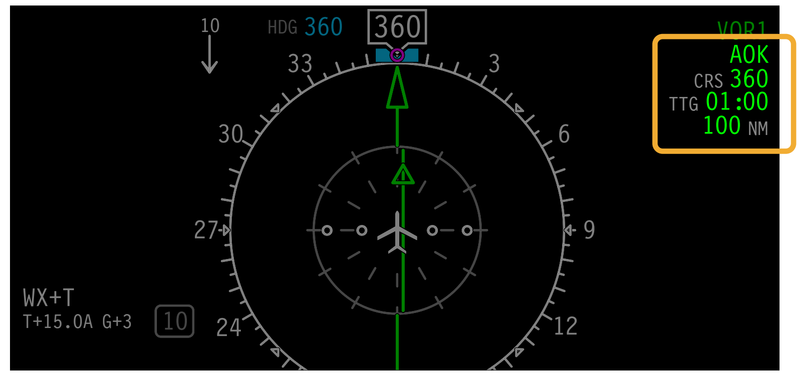
The initiated built-in test (IBIT) is activated at the same time as the VHF-NAV manual test.

The test duration is approximately 10 seconds. During this time the word TEST on the CTP becomes cyan and larger; and the following indications appear on the horizontal situation indicator (HSI):

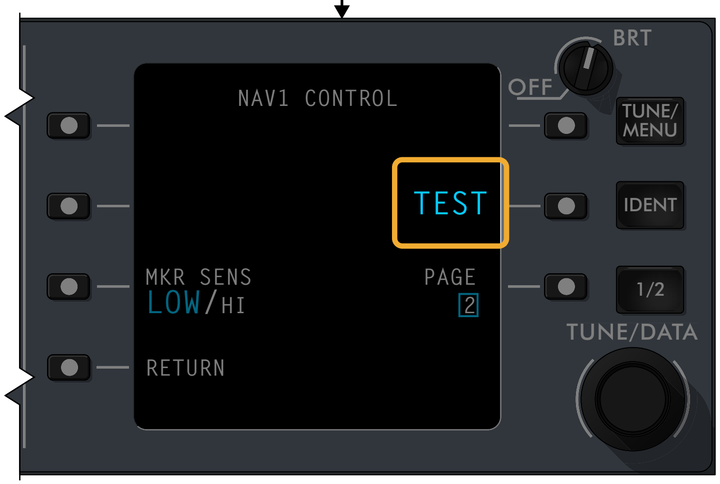
- DME distance is 100 NM
- TTG indicates: 1:00
- The station ID is AOK
- If a VOR frequency is tuned, the VOR bearing goes 360°



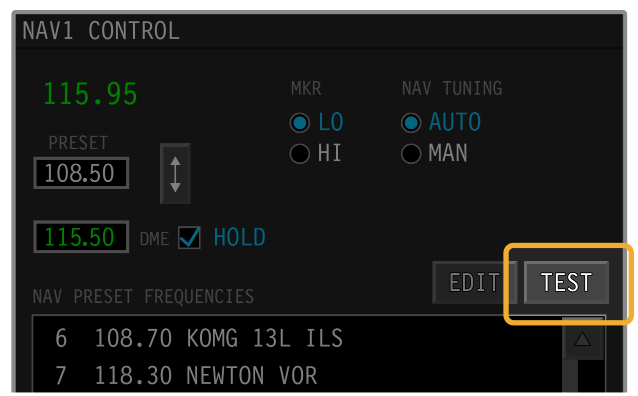
CTP NAV CONTROL MENU



HORIZONTAL SITUATION INDICATOR



CTP NAV TEST PAGE



RTSA NAV CONTROL MENU

CS1_CS3_3453_007

Figure 48: System Test (L2)

34-55 GLOBAL NAVIGATION SATELLITE SYSTEM

GENERAL DESCRIPTION

The global navigation satellite system (GNSS) uses two independent receivers. It requires a minimum of four serviceable satellites to determine precise position, velocity, and time measurements. This information is used for enroute, terminal, approach, and departure operations.

The GNSS receivers use their respective antennas to receive input from a satellite-based augmentation system (SBAS).

The following systems use position data from the GNSS:

- Inertial reference system (IRS)
- Flight management system (FMS)
- Integrated clock system (ICS)
- Traffic surveillance system (TSS)
- Terrain awareness and warning system (TAWS)
- Surface management system (SMS, optional)

The GNSS receives data from the IRS, FMS, and the air data system (ADS).

The current position information can be viewed on the flight management system (FMS) format page.

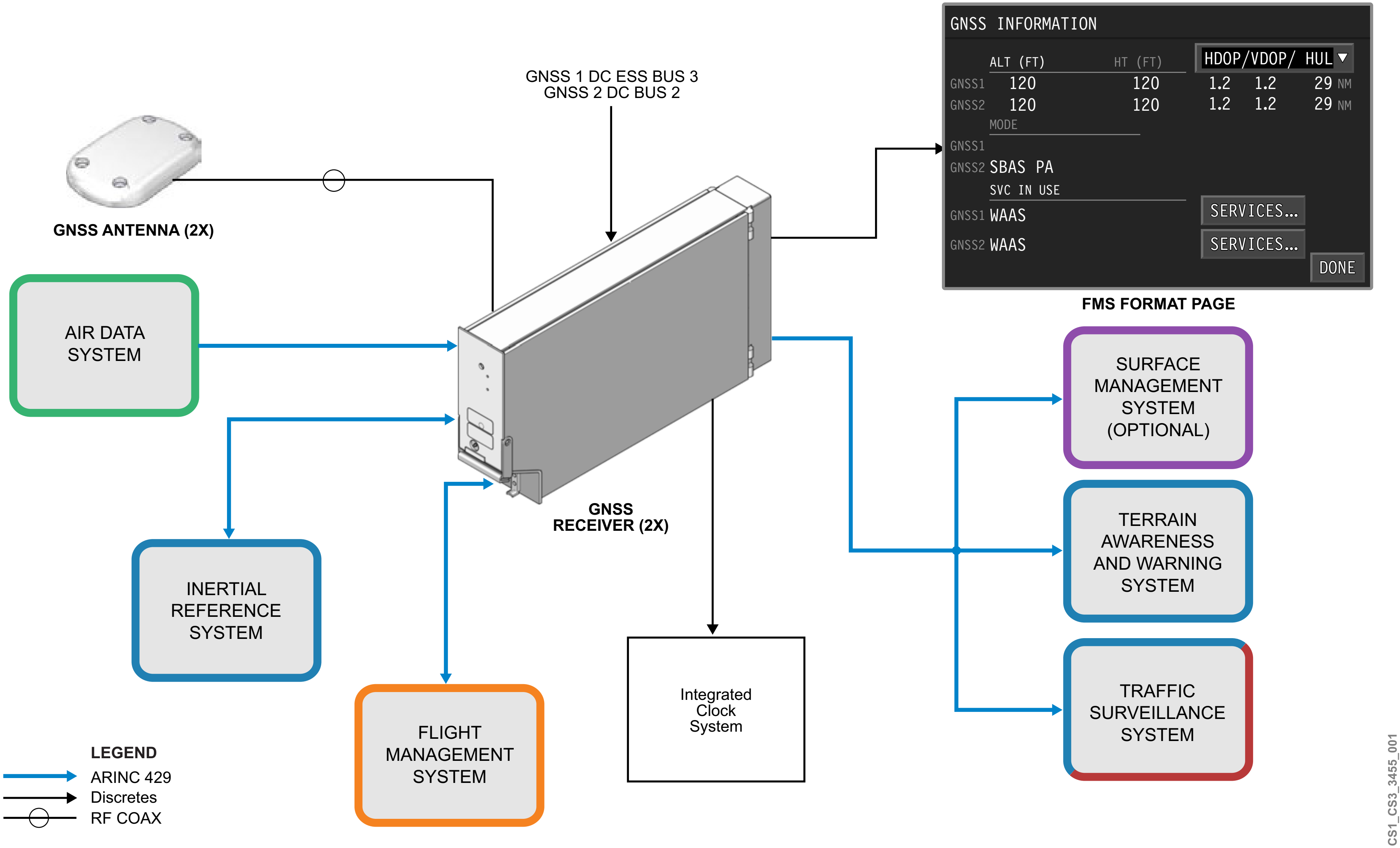


Figure 49: Global Navigation Satellite System (L2)

COMPONENT LOCATION

The global navigation satellite contains the following components:

- GNSS receivers
- GNSS antennas

GNSS RECEIVERS

The two GNSS receivers are located in the FWD avionics equipment bay.

GNSS ANTENNAS

The two GNSS antennas are directly connected to their respective receiver and are located at the top of the fuselage.

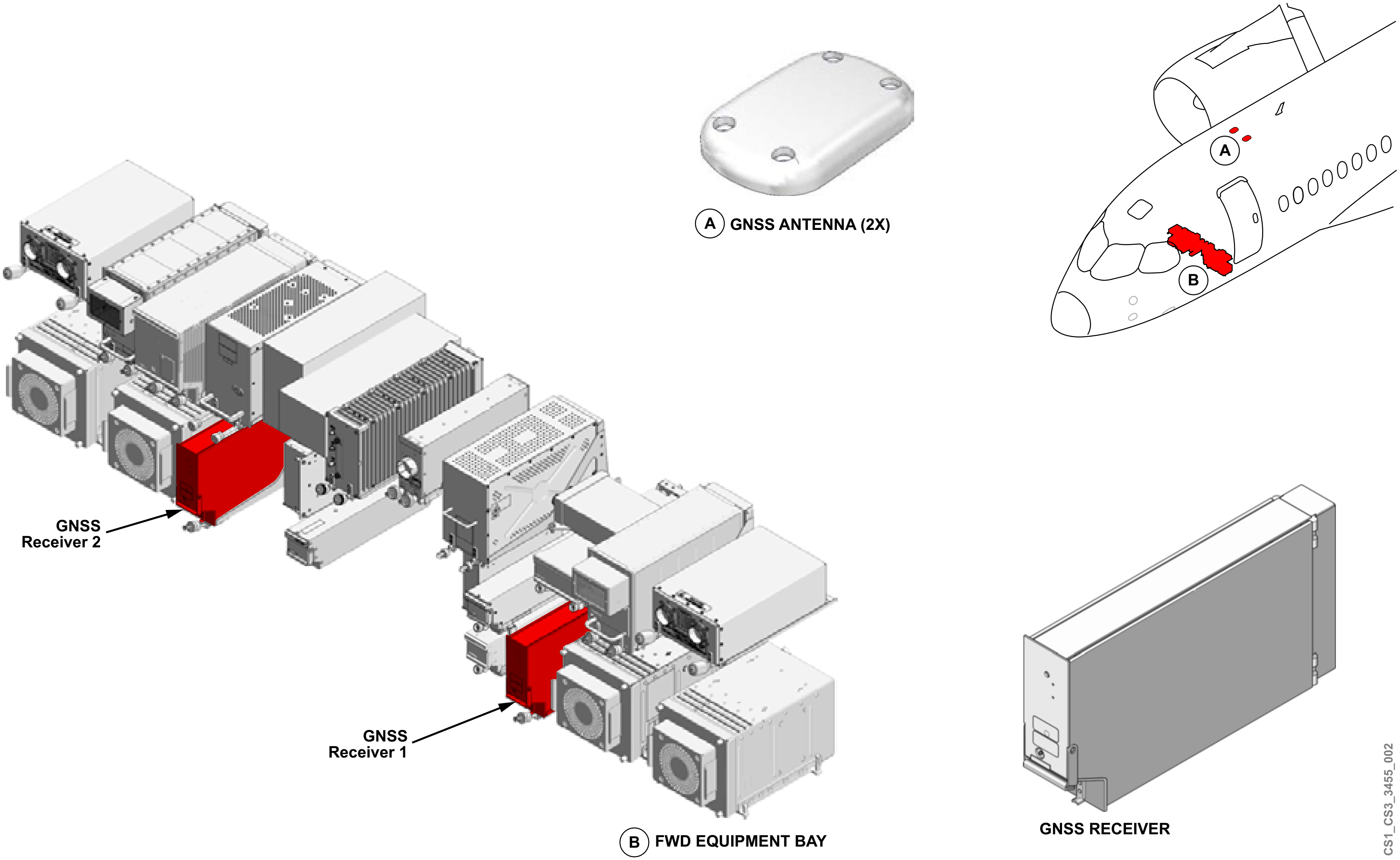


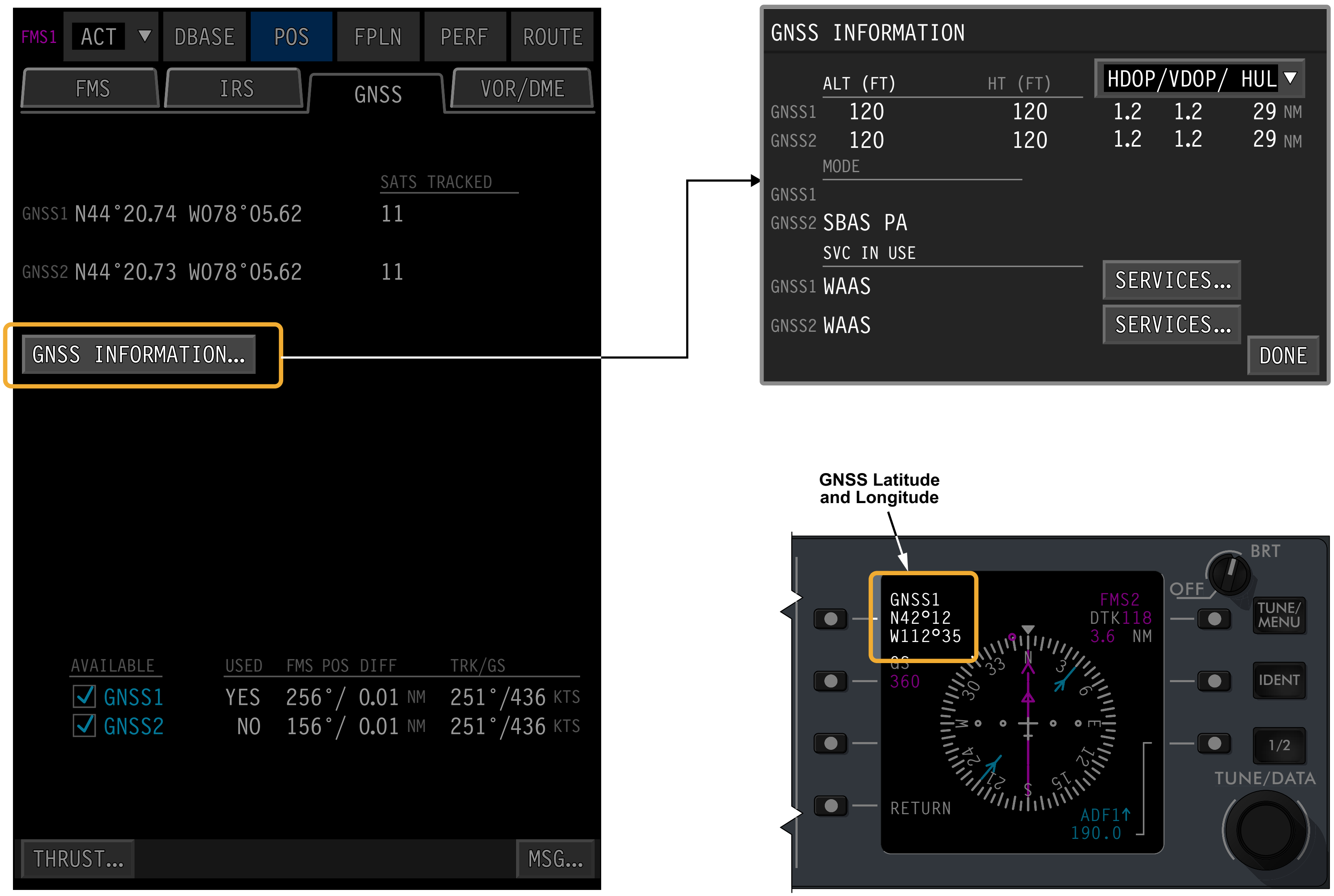
Figure 50: Global Navigation Satellite System Component Location (L2)

CONTROLS AND INDICATIONS

There are no pilot controls for normal operation of the global navigation satellite system (GNSS) receiver.

The current GNSS position and status information is displayed on the flight management system (FMS) format page in a multifunction window (MFW), under the GNSS tab, and on the standby NAV display on the control tuning panel (CTP).

The GNSS 1 provides a position to CTP 1, and GNSS 2 provides a position to CTP 2. The CTP displays the cross-side GNSS if the onside receiver is not available.



FMS PAGE - GNSS TAB

CONTROL TUNING PAGE

CS1_CS3_3455_003

Figure 51: Global Navigation Satellite System Indications (L2)

DETAILED DESCRIPTION

SYSTEM INTERFACE

The GNSS receivers interface directly with the inertial reference system (IRS), providing ground speed, discrete time marking, and positioning data. It is used by the inertial reference units (IRUs) to produce hybrid data.

The GNSS receivers connect directly to the onside data concentrator unit module cabinet (DMC) to provide universal time coordinated (UTC) to the master time and date (MTD) function, which is hosted in the input/output concentrator (IOC) application.

The IOC application routes GNSS data to the flight management system application (FMSA), and other components in the avionics system.

The DMC provides the GNSS with consolidated signals from various aircraft systems including the air data system (ADS), inertial reference system (IRS), and flight management system (FMS). Together they provide initialization, control, and position information. The GNSS uses the information from the FMS to ensure monitoring and integrity of the data.

The GNSS provides position, velocity, and time (PVT) data to the following systems:

- Inertial reference system (IRS)
- Flight management system (FMS)
- Terrain awareness and warning system (TAWS)
- TSS unit
- ATC Transponder (ATC)
- Aircraft clock

The time mark discrete outputs are used to synchronize the GNSS with the IRUs, transponder, and the TSS.

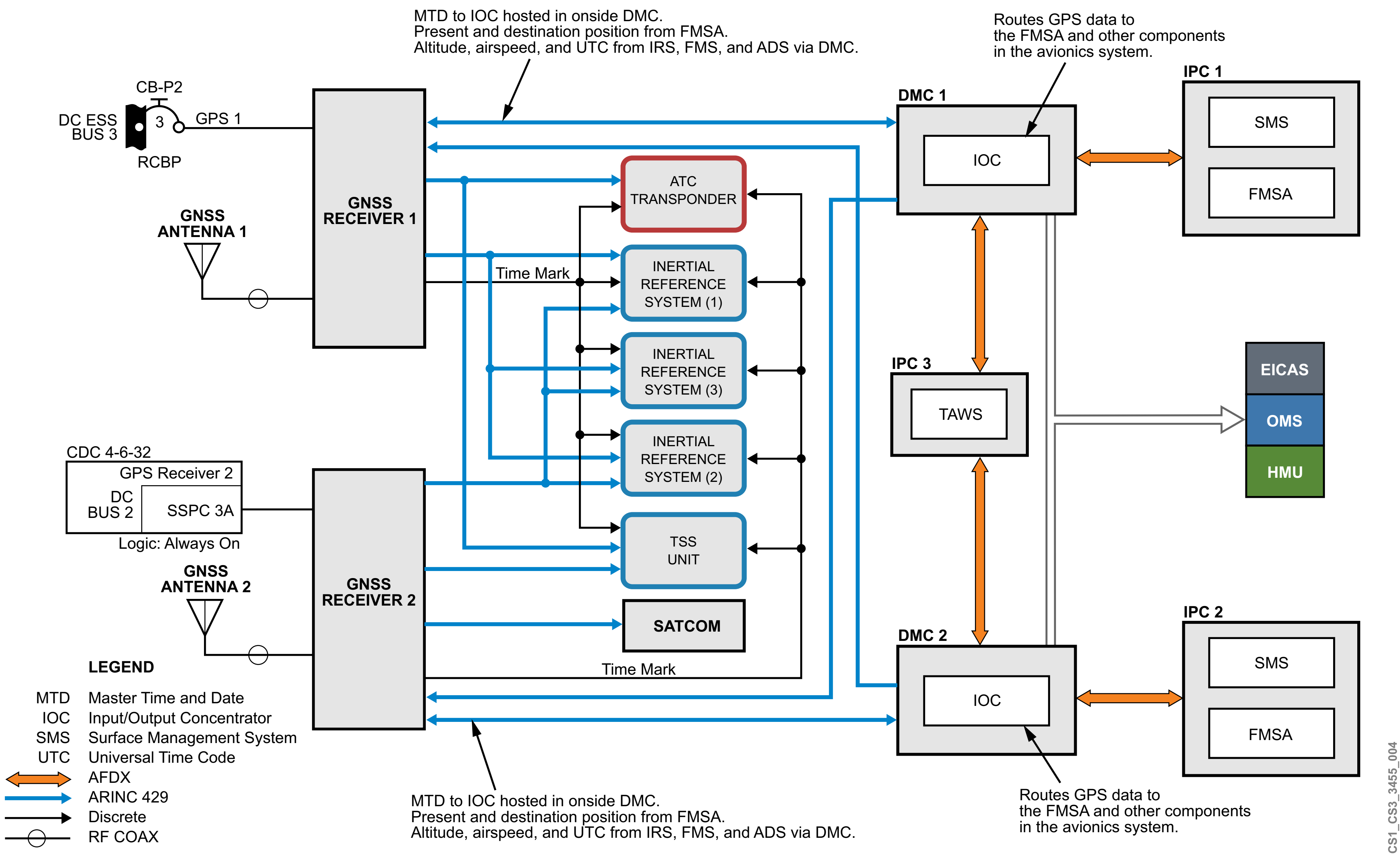


Figure 52: System Interface (L3)

MONITORING AND TESTS

The following page provides the CAS and INFO messages for the global navigation satellite system.

CAS MESSAGES

Table 7: ADVISORY Message

MESSAGE	LOGIC
AVIONICS FAULT	Avionics system fault. Refer to INFO message.

Table 8: INFO Messages

MESSAGE	LOGIC
34 AVIONIC FAULT - GPS 1 INOP	One DMC channel is reporting the GPS has failed. GPSs power is working.
34 AVIONIC FAULT - GPS 2 INOP	One DMC channel is reporting the GPS has failed. GPSs power is working.

SYSTEM TEST

Test progress can be observed by monitoring the front panel light-emitting diode (LED) status. During the self-test, the front panel LED indicators operate according to the following illumination sequence:

- Lamp test

  Both LEDs are activated and indicating RED for the first 2 seconds, followed by the LRU status LED indicating GREEN with the antenna LED continuing to indicate RED for 2 seconds

- Self-test in progress

  All LEDs are extinguished for at least the next 2 seconds while self-test operation is being performed

- Test results

  After completion of the self-test sequence, the GNSS displays the appropriate results

  The LRU green LED indicates that the GNSS receiver passed the test. A red LED means the receiver failed the self-test

  There is no green LED indicating that the antenna passed the test. If the LED is red, the antenna failed, if the LED is OFF, the antenna passed

- The LEDs continue to display the self-test results for 30 seconds, or until a new self-test operation sequence is started by a subsequent activation of the TEST button

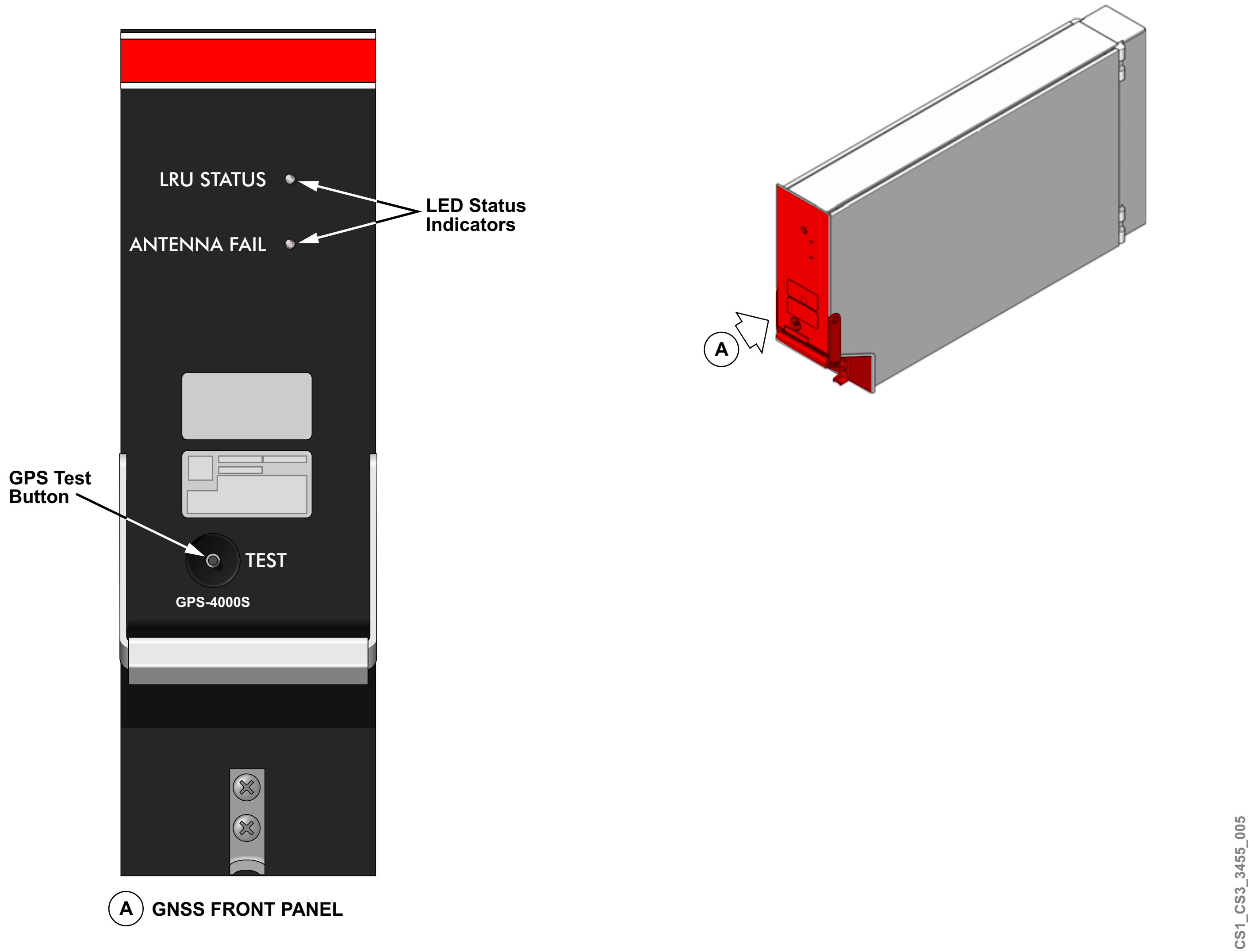


Figure 53: Global Navigation Satellite System Test (L2)

34-44 RADIO ALTIMETER

GENERAL DESCRIPTION

The radio altimeter (RA) system consists of two radio altimeter transceivers. Each transceiver has two antennas, one for transmitting and one for receiving.

The radio altimeter transceiver provides radio altitude above ground up to 2500 ft.

The system provides radio altitude to the terrain awareness and warning system (TAWS), the traffic surveillance system (TSS), the primary flight control computers (PFCCs), weather radar (WXR) and the primary flight displays (PFD).

The status of the RA system is displayed on the engine indication and crew alerting system (EICAS) and the avionic synoptic page. The system reports faults to the onboard maintenance system (OMS), and sends operational parameters to the health management unit (HMU).

RA 1 uses power from DC ESS BUS 3 and RA 2 uses power from DC BUS 2. The optional RA 3 uses power from DC BUS 1.

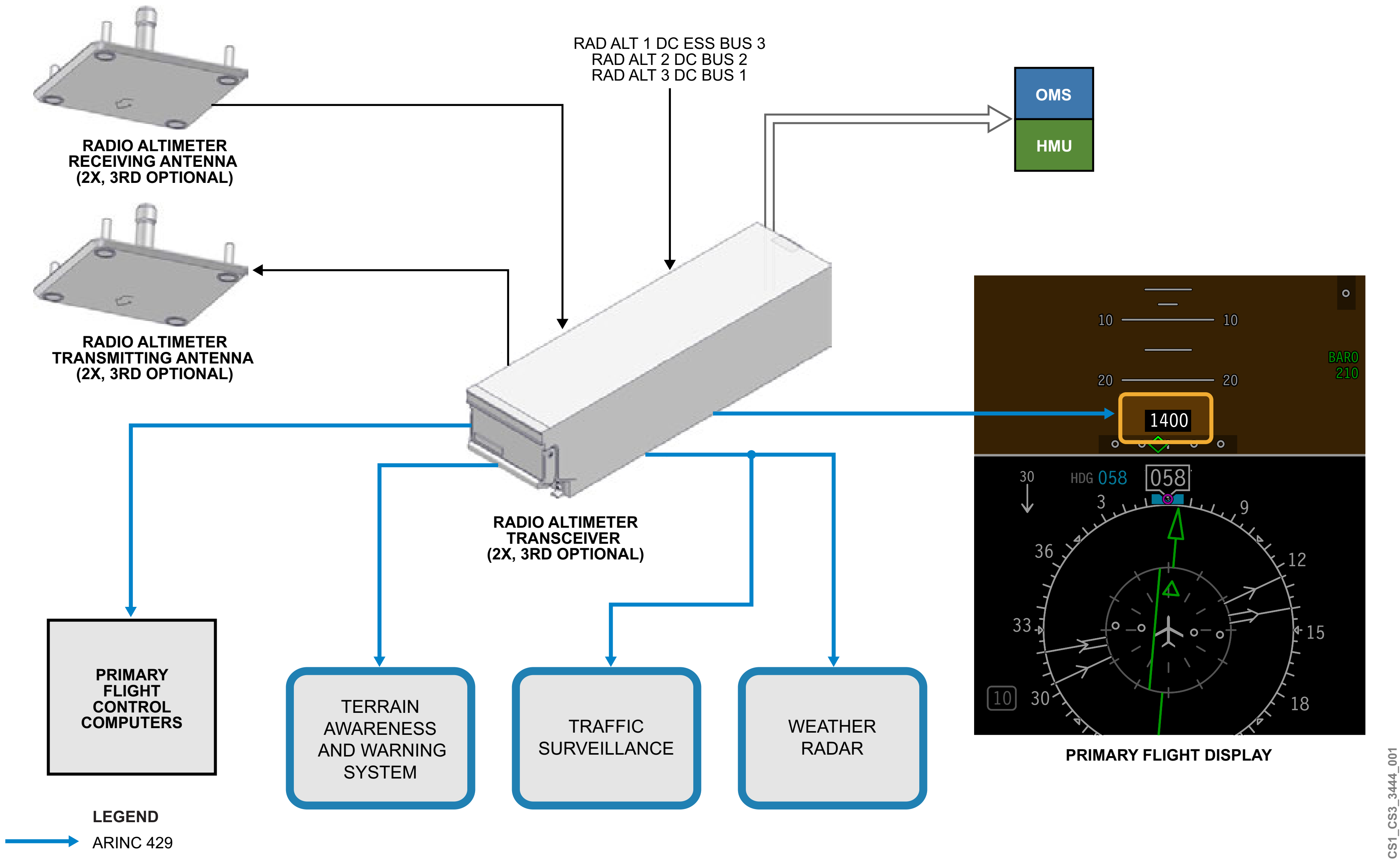


Figure 54: Radio Altimeter (L2)

COMPONENT LOCATION

The radio altimeter system contains the following components:

- Radio altimeter transceivers
- Radio altimeter antennas

RADIO ALTIMETER TRANSCEIVERS

Both RA transceivers are located in the mid avionics equipment bay.

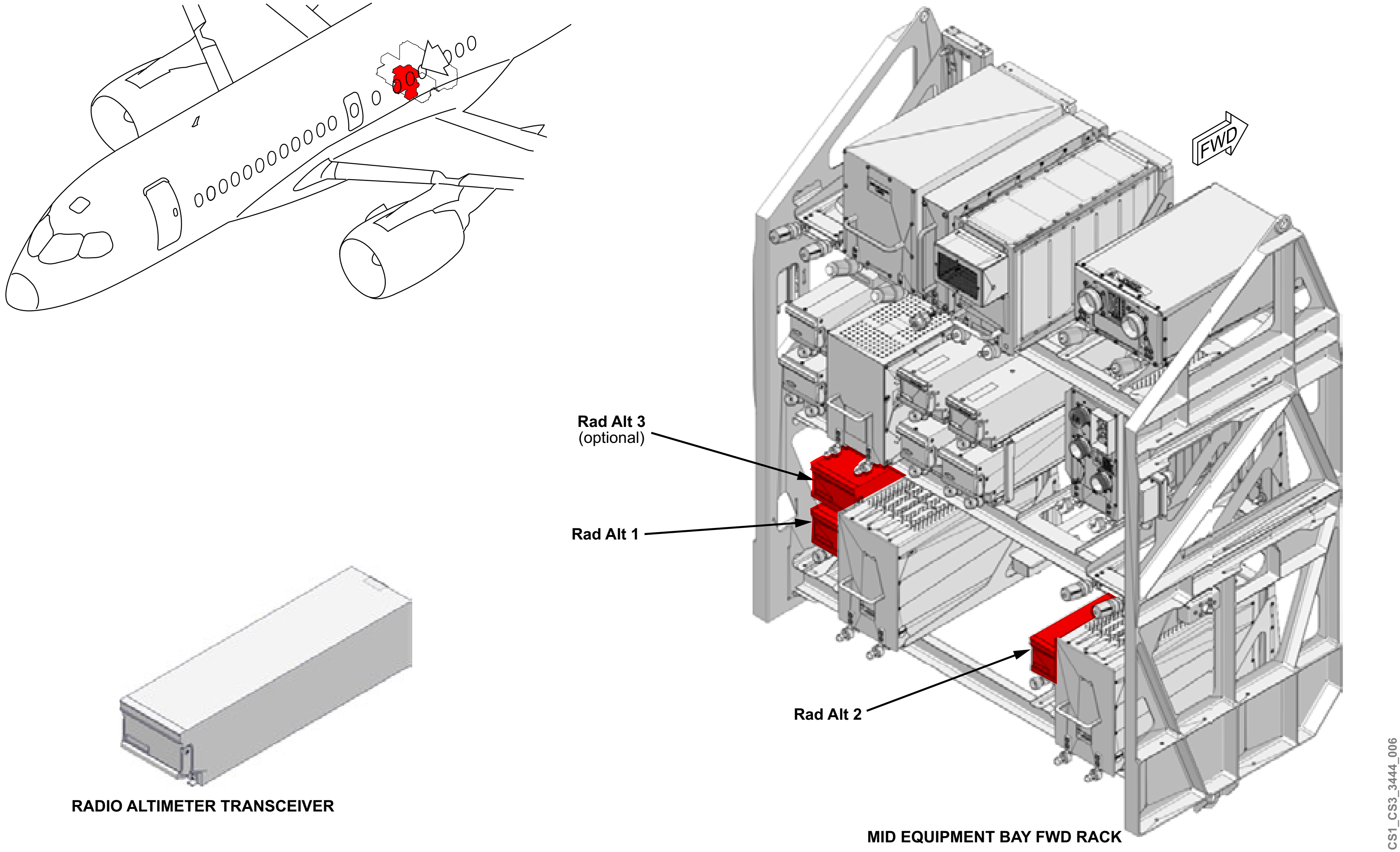


Figure 55: Radio Altimeter Transceivers (L2)

RADIO ALTIMETER ANTENNAS

Each radio altimeter system uses two antennas, one for transmission and one for reception. They are located under the belly fairing, aft of the main wheel well.

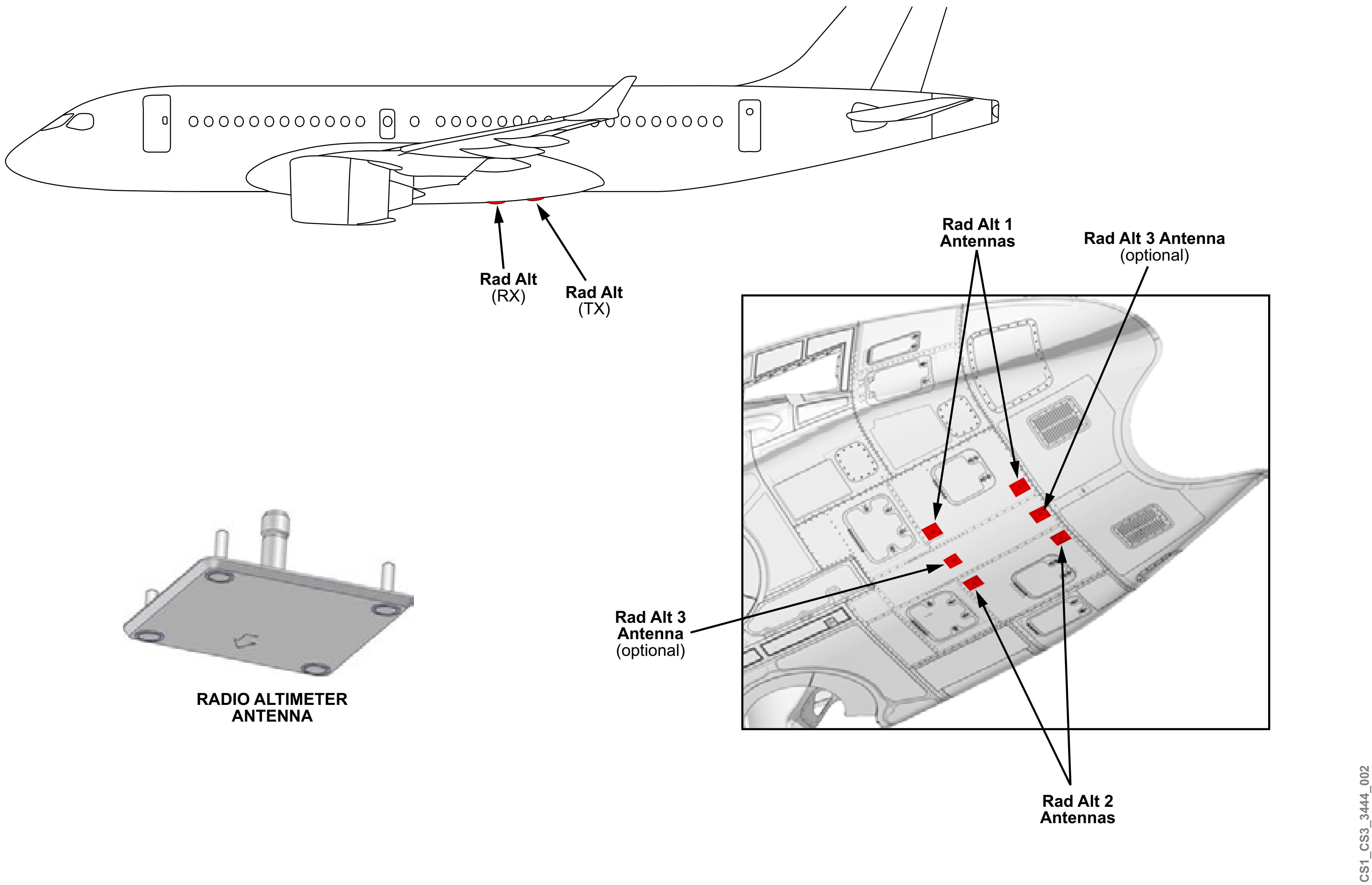


Figure 56: Radio Altimeter Antennas (L2)

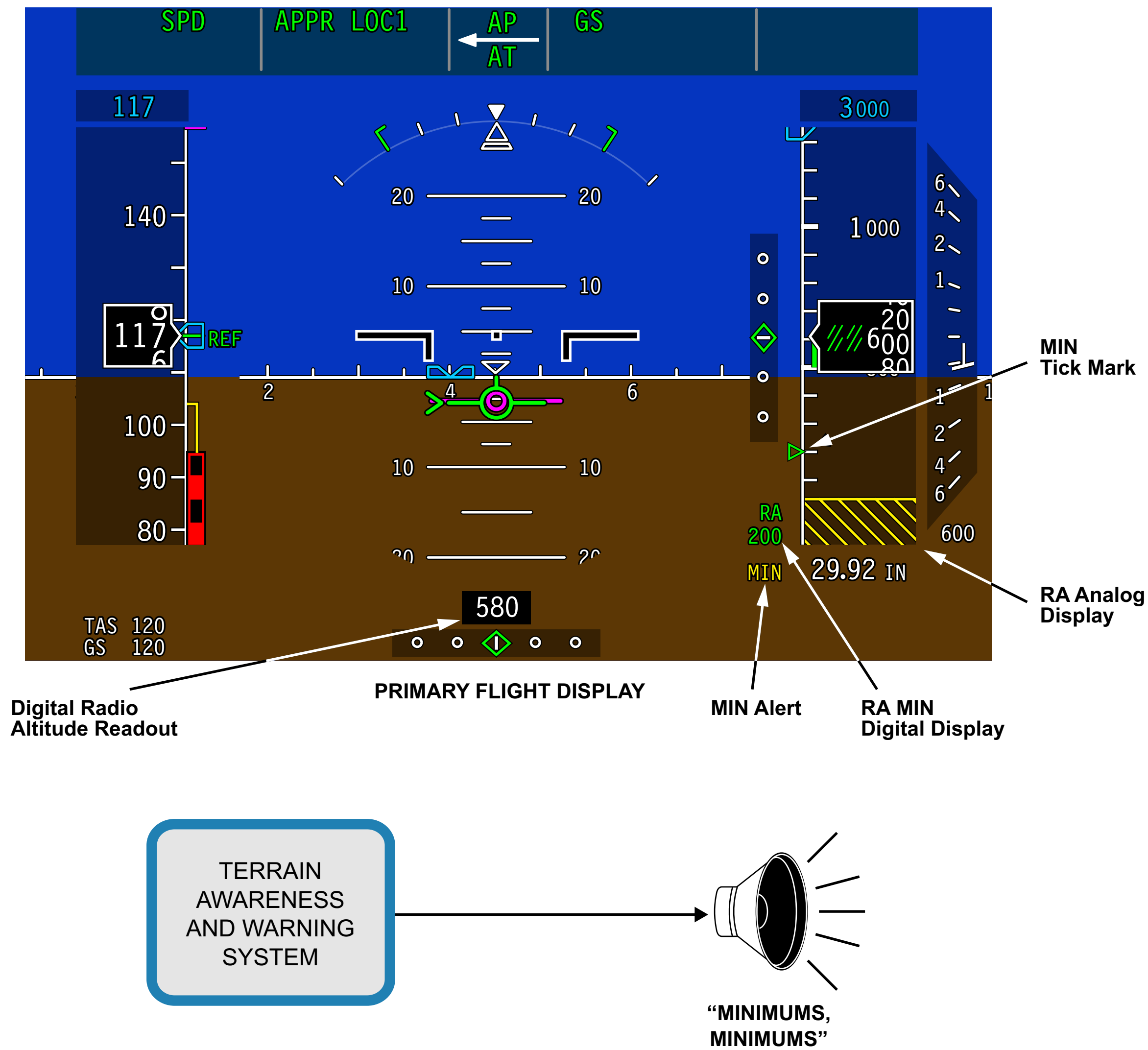
CONTROLS AND INDICATIONS

The RA system automatically provides a digital readout of radio altitude data from 2500 ft through touchdown. Setting the minimum altitude is done through the control tuning panel (CTP).

The following information is available to the crew on the PFD:

- Digital radio altitude readout
- MIN alert
- MIN tick mark
- RA analog low altitude awareness

Altitude information is sent to the terrain awareness and warning system (TAWS) to generate an aural alert “MINIMUMS, MINIMUMS”, indicating that the minimum has been reached.



CS1_CS3_3444_003

Figure 57: Controls and Indications (L2)

DETAILED DESCRIPTION

SYSTEM INTERFACE

The RA system provides altitude information to the data concentrator unit module cabinet (DMC) to be used by the following systems:

- Terrain awareness warning system (TAWS)
- Traffic surveillance system (TSS)
- Primary flight display (PFD)
- Weather radar (WXR)

The RA also sends altitude information to the PFCCs.

The altimeter minimums are set on the CTP and are sent to the TAWS for aural alert activation via the DMC.

The left side DU (PFD) use data from RA 1, and the right side DU (PFD) use RA 2. In the event of an RA transceiver failure the system automatically reverts to the other radio altimeter. A radio altimeter common source annunciation is displayed when both DUs (PFDs) are using the same source.

If a third optional radio altimeter is installed and RA 1 or RA 2 fail, it will automatically revert to RA 3.

The DC ESS BUS 3 supplies power to RA 1, and DC BUS 2 to RA 2. The optional RA 3 uses power from DC BUS 1.

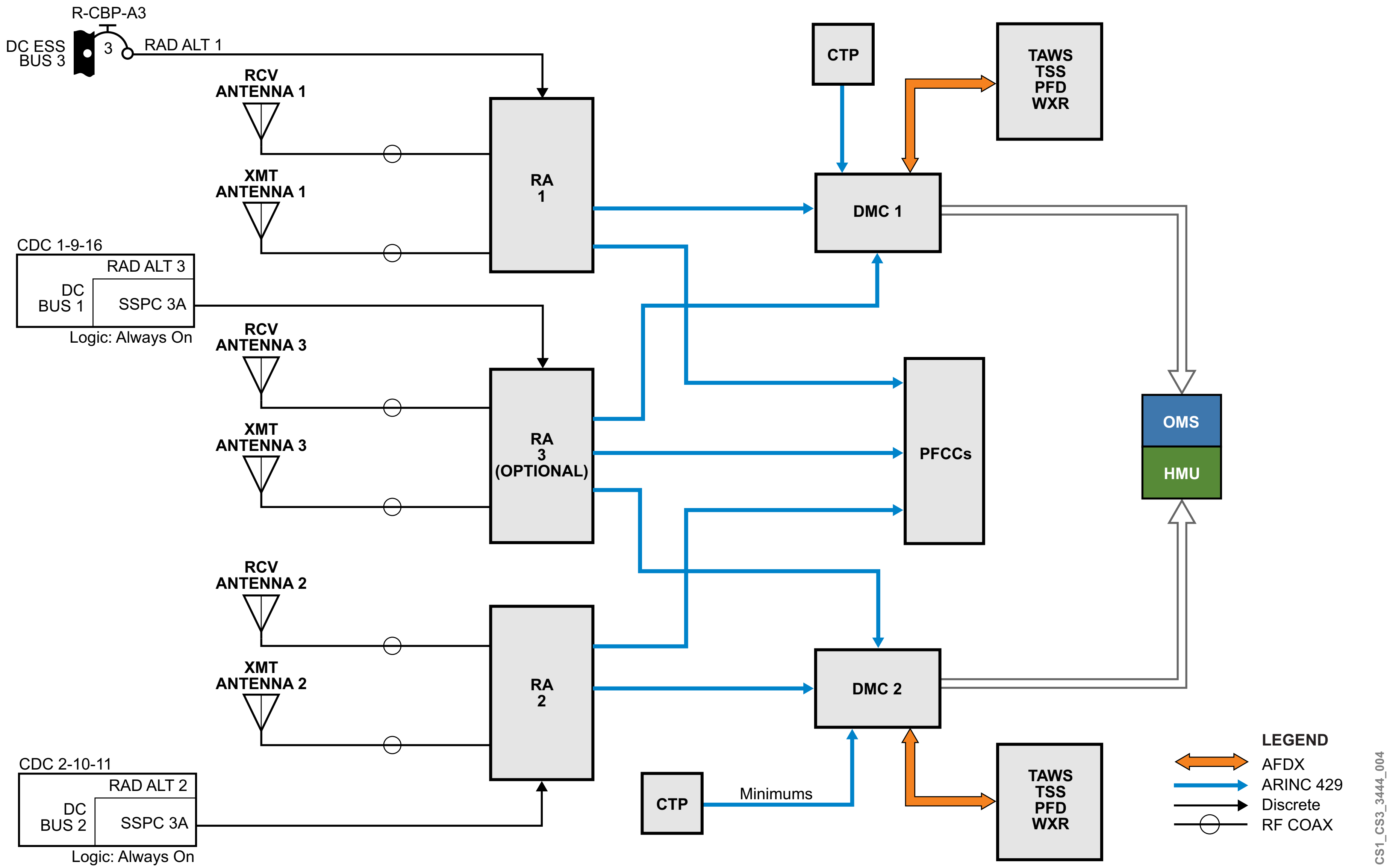


Figure 58: System Interface (L3)

MONITORING AND TESTS

RADIO ALTIMETER MONITORING

Any red flag indicates invalid or missing information. If information from only one transceiver is available, a common source indicator appears on the PFD.

Figure 59: Radio Altimeter Monitoring (L2)

SYSTEM MONITORING

The following page provides the CAS and INFO messages for the radio altimeter system.

CAS Messages

Table 9: ADVISORY Message

MESSAGE	LOGIC
AVIONICS FAULT	Collector message indicating an info message (radio altimeter 1,2, or 3 failed). Refer to INFO messages.

Table 10: AURAL Message

MESSAGE	LOGIC
“MINIMUMS, MINIMUMS”	Indicate that the MINIMUM altitude has been reached.

Table 11: INFO Messages

MESSAGE	LOGIC
34 AVIONICS FAULT - RAD ALT 1 INOP	Radar altimeter 1 has failed.
34 AVIONICS FAULT - RAD ALT 2 INOP	Radar altimeter 2 has failed.
34 AVIONICS FAULT - RAD ALT 3 INOP	Radar altimeter 3 has failed.

34-41 WEATHER RADAR

GENERAL DESCRIPTION

The weather radar system (WXR) is a single integrated unit. The system performs multiple radar scans in order to detect short-range, midrange, and long-range weather.

The WXR is directly connected to DU1 and DU 4 to provide the crew with visual weather indication and fault information.

The control tuning panel (CTP) provides control for setting the radar mode, tilt, gain, and inputs for other controls, as well as WXR status indication. Each crew member display is controlled by the onside CTP.

The system receives navigation data from the following systems:

- Global navigation satellite system (GNSS)
- Inertial reference system (IRS)
- Air data system (ADS)
- Radio altimeter (RA)

The system outputs aural messages to the flight deck audio system via the radio interface unit (RIU).

The system reports faults to the onboard maintenance system (OMS) and sends operational parameters to the health management unit (HMU).

The DC BUS 2 supplies power to the system.

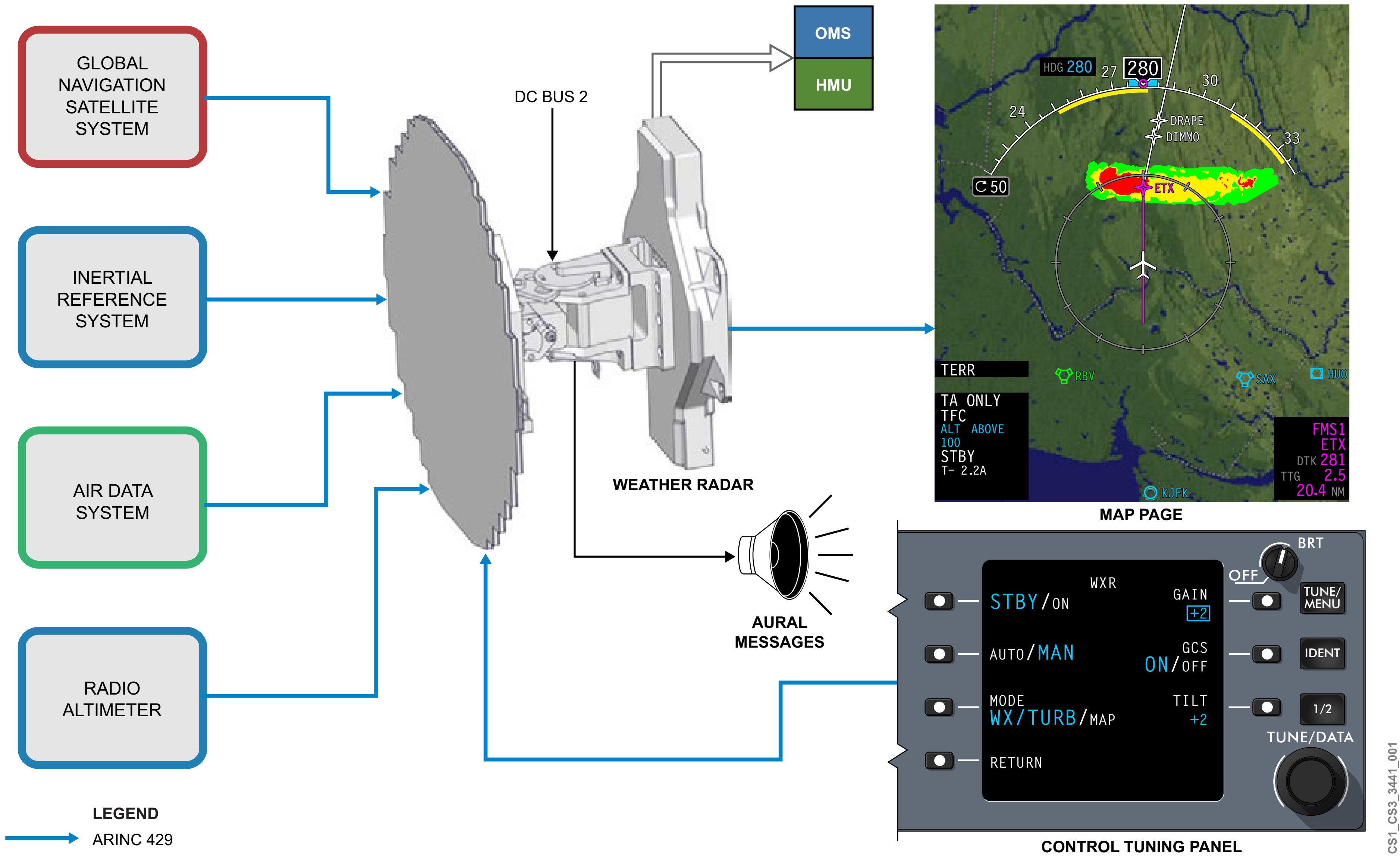


Figure 60: Weather Radar (L2)

COMPONENT LOCATION

The weather radar consists of the following components:

- Receiver-transmitter antenna (RTA)

RECEIVER-TRANSMITTER ANTENNA

The system consists of a combined weather radar and turbulence weather radar receiver-transmitter antenna (RTA) assembly, mounted in the radome.

The antenna is directly connected to the radio frequency (RF) assembly for direct coupling. As a result, there is no requirement for an external waveguide.

The antenna and RF assemblies are mounted on a drive assembly, which also contains the tilt/scan motors.

The drive assembly is mounted on a base assembly, which contains the power supply and signal processing circuits.

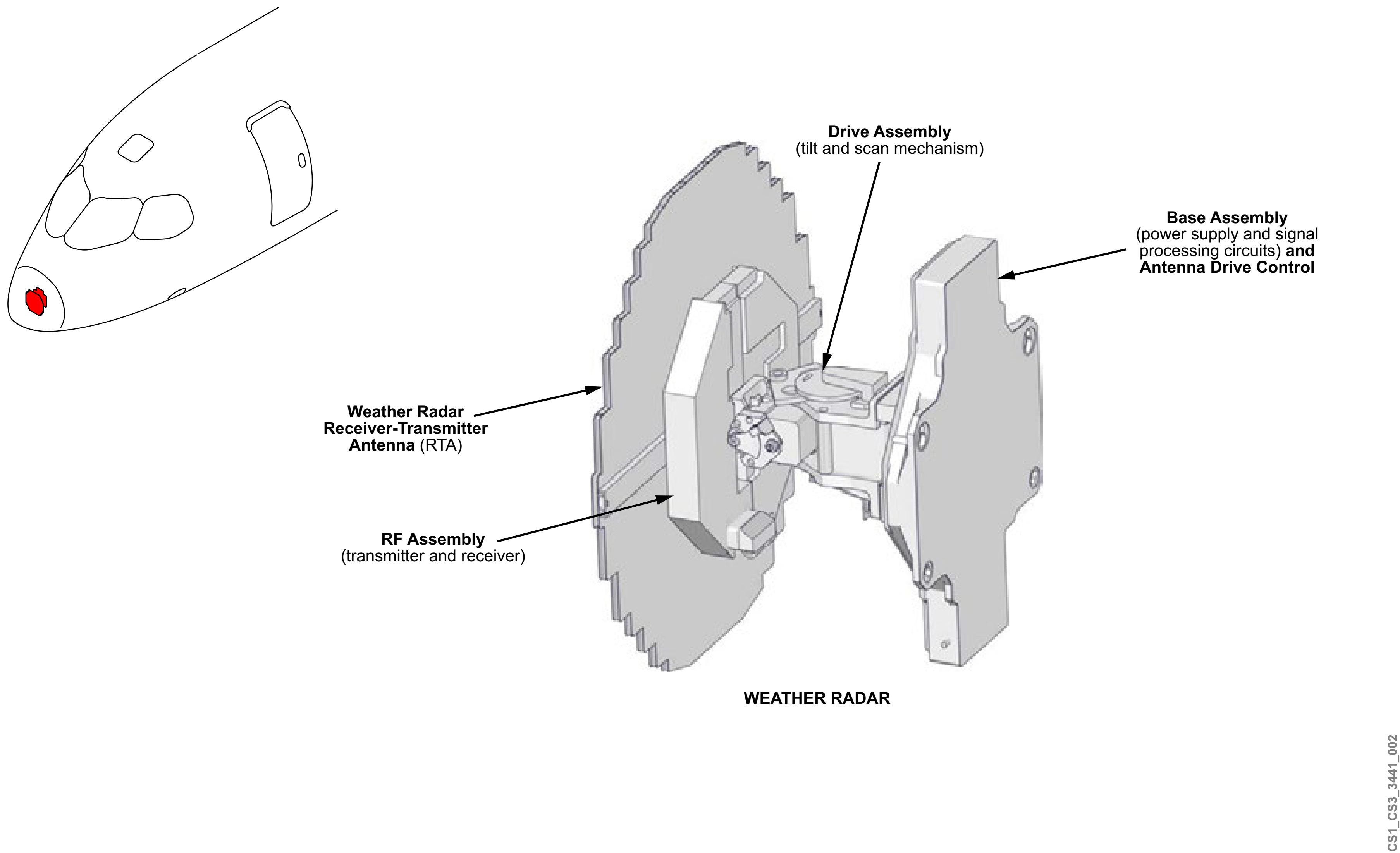


Figure 61: Receiver-Transmitter Antenna Component Location (L2)

CONTROLS AND INDICATIONS

The crew can select the radar operating mode via the CTP as follows:

- STBY - standby
- ON - on
- AUTO - automatic
- MAN - manual
- WX - weather (only)
- WX/TURB - weather plus turbulence
- TURB - turbulence only
- MAP - ground mapping

The STBY mode inhibits the radar display, radar transmitter, and antenna scan drive.

If the WXR system is manually selected ON while on the ground, a yellow WXR ON message is displayed in the horizontal situation indicator (HSI) portion of the PFD. This indicates that the system is operational and the antenna is transmitting.

WARNING

OPERATORS SHOULD TAKE ALL THE NECESSARY PRECAUTIONS TO ENSURE PERSONNEL AND SENSITIVE EQUIPMENT ARE NOT EXPOSED TO MICROWAVE RADIATION.

In AUTO mode, the radar continuously scans short-range, midrange, and long-range weather. During automatic operation gain control is available to the pilot, but tilt control is disabled.

MAN operation is used during automatic operation failure. In this mode, tilt and gain control are manually controlled.

The WX submode is used for normal weather radar operation to detect precipitation targets.

The WX/TURB submode provides detection of both precipitation and precipitation-based turbulence.

The TURB submode is used to detect areas of precipitation-related turbulence only.

The MAP submode is used to purposely map the terrain in front of the aircraft. The ground mapping submode is most effective when used with a shorter display range and with the antenna tilted downward.

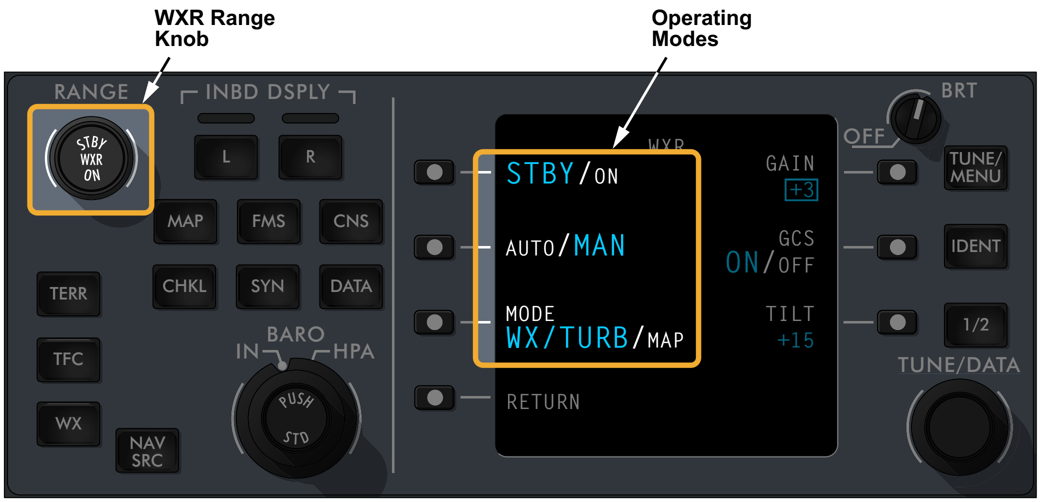
Selected mode are shown on the HSI along with the tilt and gain values.

The weather radar system automatically transitions to standby mode following initial system power up. It remains in standby (STBY) until takeoff, then transitions to the ON mode as soon there is weight-off-wheels (WOFFW). The system returns to standby 60 seconds after landing.

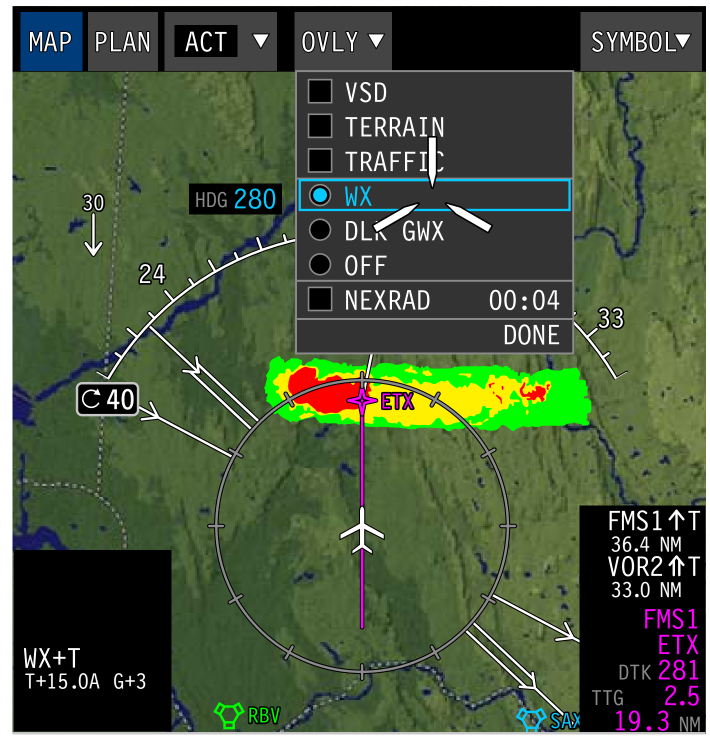
WINDSHEAR INDICATIONS

Windshear detection warnings are prioritized to avoid confusion with the terrain awareness and warning system (TAWS), which also provides windshear detection. The priorities are in the following order:

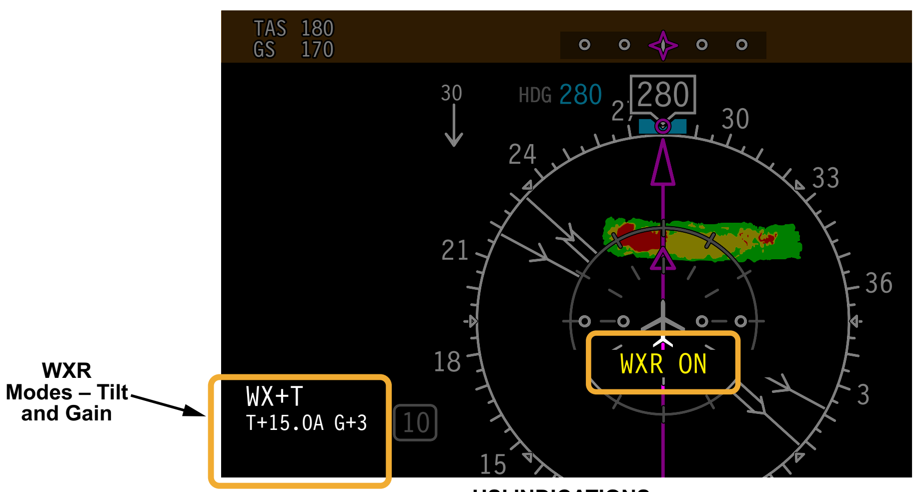
- Reactive windshear warning from TAWS
- Predictive windshear warning from WXR
- Predictive windshear caution from WXR



WXR PAGE ON CONTROL TUNING PANEL



WXR OVERLAY ON MAP PAGE



HSI INDICATIONS

WINDSHEAR AUDIO ALERTS PRIORITY	
ALERT AUDIO	**ALERT SOURCE**
Windshear, Windshear, Windshear	Reactive Windshear Warning • from TAWS
Windshear Ahead, Windshear Ahead	Predictive Windshear Warning • from WXR
Go Around, Windshear Ahead	Predictive Windshear Warning • from WXR
Monitor Radar Display	Predictive Windshear Caution • from WXR

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Figure 62: Controls and Indications (L2)

PREDICTIVE WNDSHEAR OPERATION

The predictive windshear function is automatically enabled when the aircraft is in the takeoff or landing phase. The system automatically detects and displays precipitation related windshear events within 5 nm and ±30° of the nose of the aircraft. The system approximately takes 15 seconds to detect a windshear event.

During takeoff, the system is active in any WX mode including standby and test when the following conditions are met:

- Both engines running and N1 > 55%
- TLA set to takeoff thrust
- Parking brake released
- Weight-on-wheels (WOW)

During takeoff roll, the predictive windshear function is inhibited when the airspeed is greater than 80 kt until the aircraft reaches a 50 ft radio altitude. The predictive windshear function is re-enabled above 50 ft radio altitude and continues monitoring until 1200 ft. At 2400 ft, the predictive windshear function is deactivated.

On approach, the predictive windshear function is enabled at 2300 ftradio altitude. At 50 ft radio altitude, the predictive windshear function is inhibited.

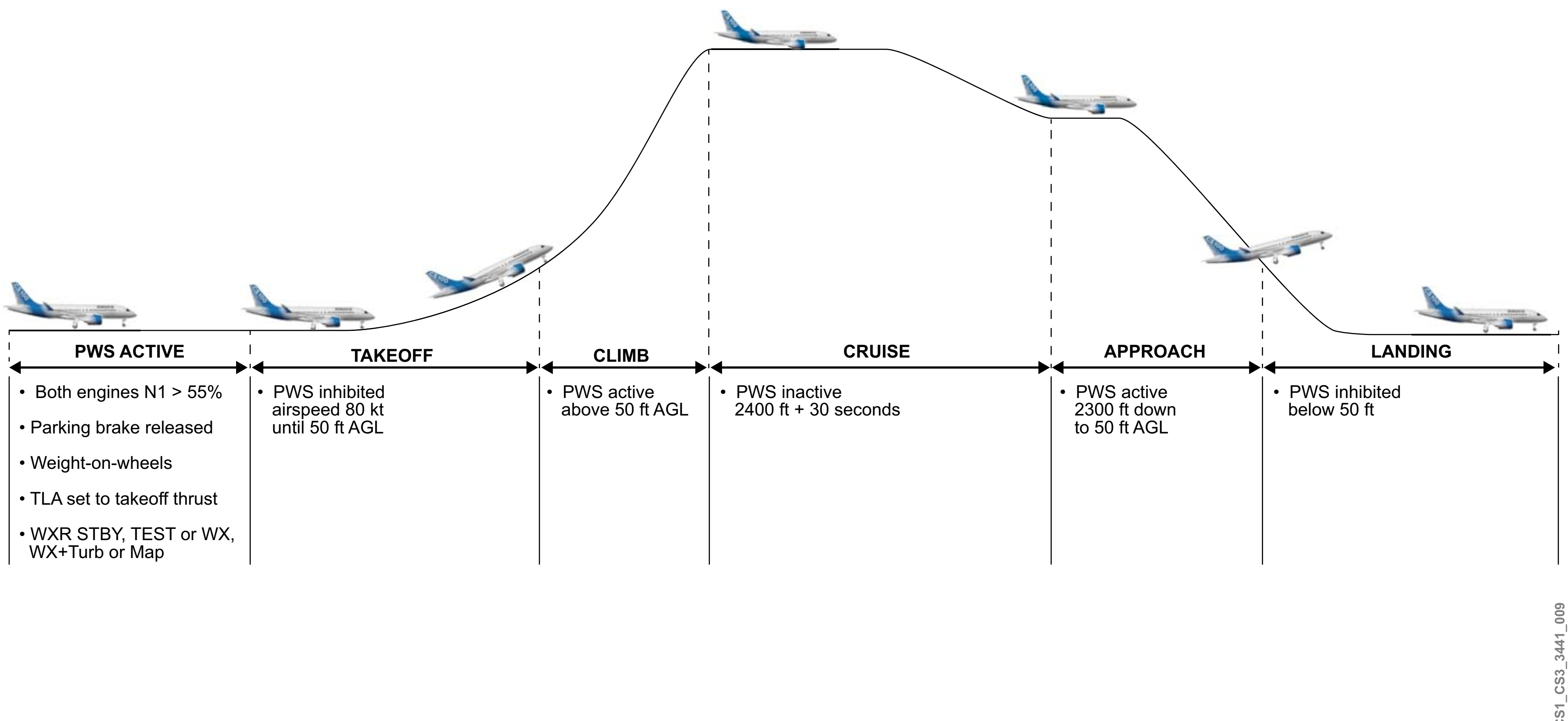


Figure 63: Predictive Windshear Operation (L2)

DETAILED DESCRIPTION

SYSTEM INTERFACE

The WXR sends weather digital data to the two outboard DUs via ARINC 708. The outboard DUs transfer the weather digital data to the other display units. The WXR sends fault information to all DUs via the ARINC 429.

The weather radar transceiver receives navigation information via the data module cabinet (DMC) from the following:

- Position from the GNSS
- Attitude information from the IRS for radar scan stabilization
- Setting information from the CTP
- Environment information from the air data system for optimal gain setting
- Altitude information from the RA for antenna tilt optimization during takeoff and landing

The system uses power from the DC BUS 2.

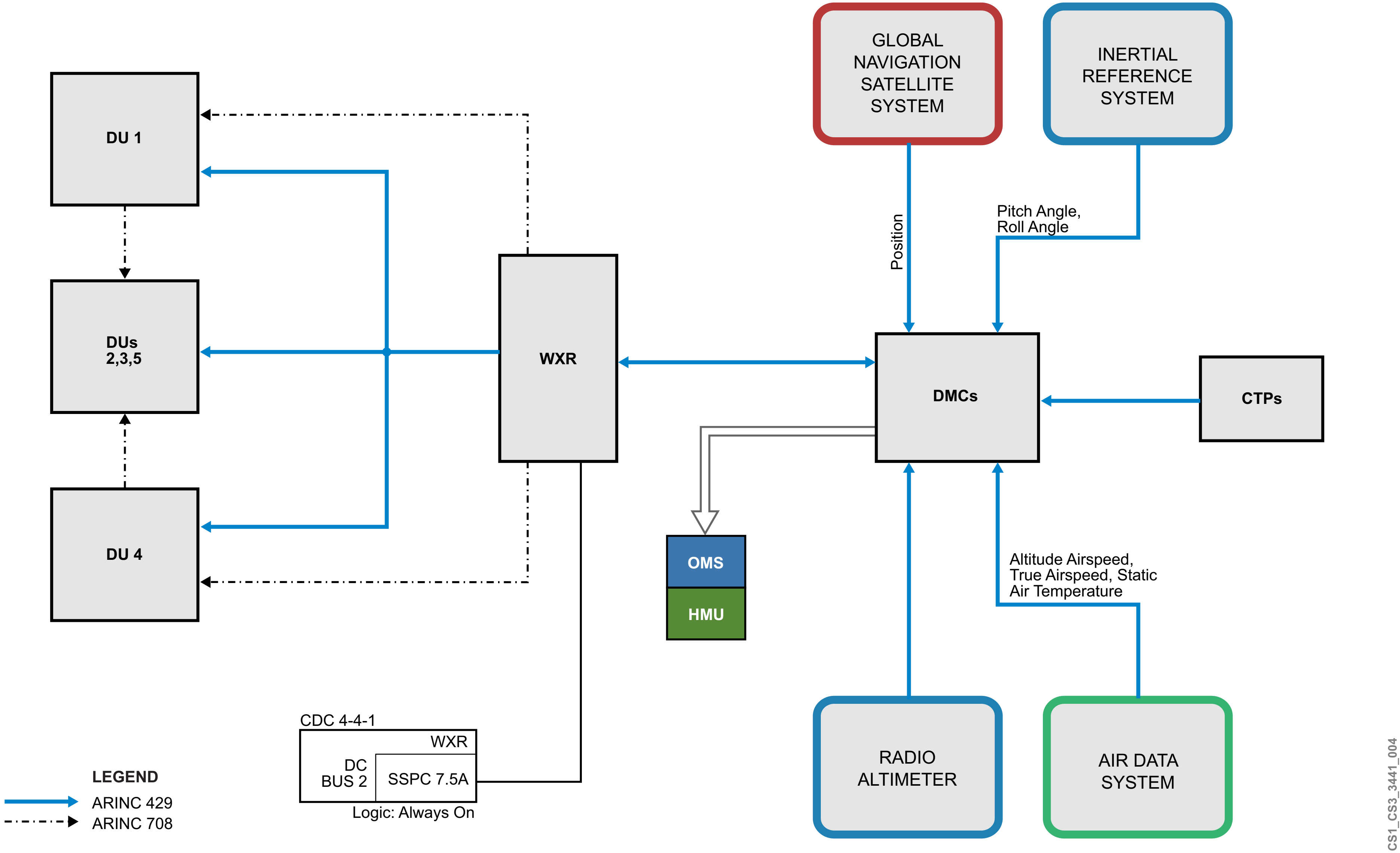


Figure 64: System Interface (L3)

MONITORING AND TESTS

WEATHER RADAR MONITORING

The WXR data is continuously monitored for validation. Any failed information appears on the primary flight display as follow:

- WXR FAIL - No weather data, indicating loss of radar video bus
- WXR FAULT - Radar degraded or is inoperative, a failed radar internal BIT, or a loss of aircraft pitch and roll data will cause this fault
- TURB FAULT - Turbulence function is not available
- AUTO FAULT - Automatic mode degraded or is inoperative
- PWS FAIL - Unable to detect predictive windshear conditions, fault displayed below 2500 ft radio altitude only

The HSI also shows WXR range and status.

- WXR RANGE- Displays the selected range in nautical miles
- WXR ON- Weather radar is on, and aircraft has weight-on-wheels (WOW)

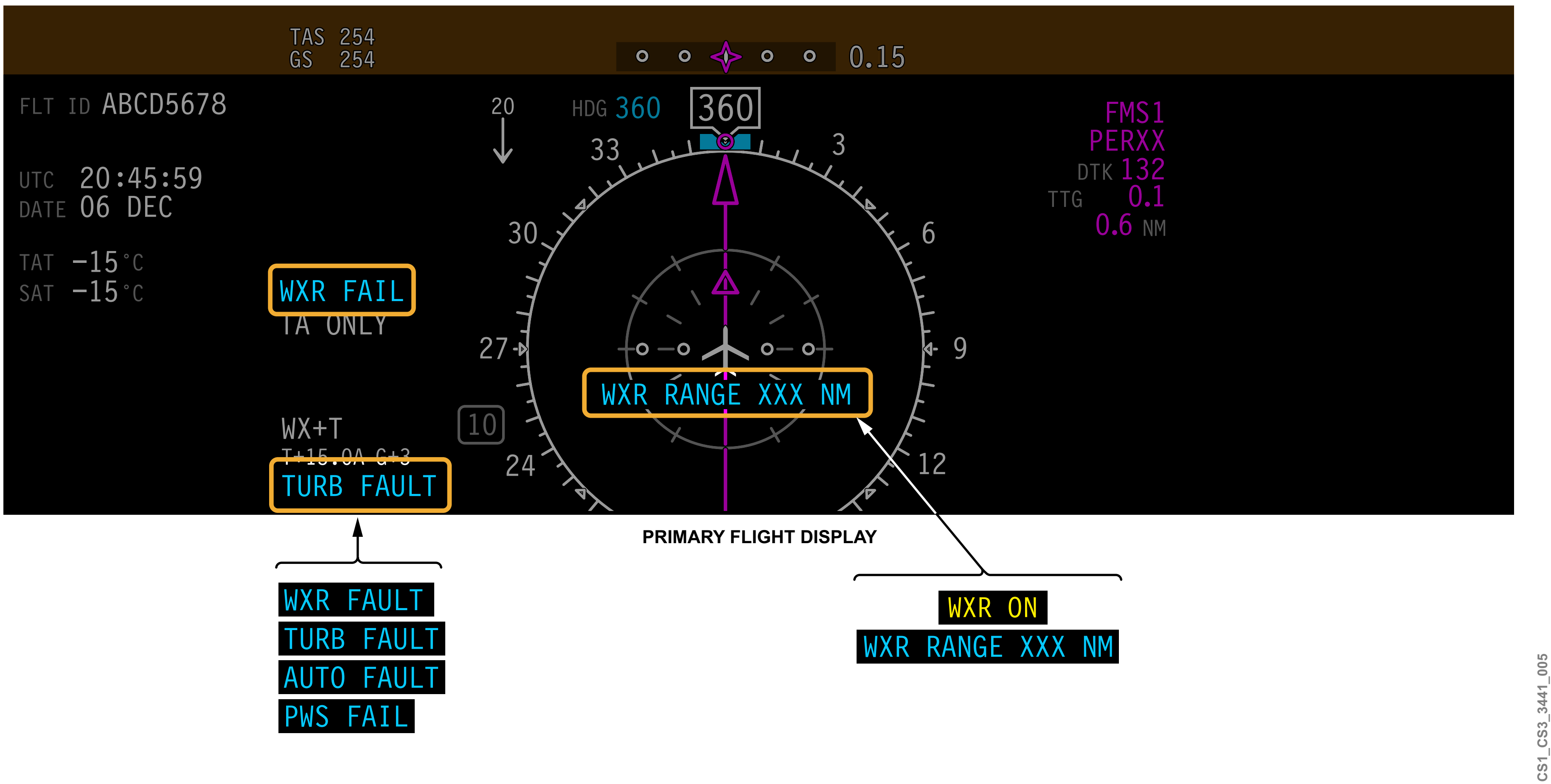


Figure 65: System Monitoring (L2)

SYSTEM MONITORING

The following page provides the CAS and INFO messages for the weather radar system.

CAS Messages

Table 12: CAUTION Message

MESSAGE	LOGIC
WXR ON	Weather Radar is transmitting while aircraft is on ground and no engine running.

Table 13: ADVISORY Messages

MESSAGE	LOGIC
WXR FAIL	WXR transceiver inoperative.
WXR CTRL FAULT	Both WXR controls have faults.
WXR FAULT	WXR minor failure.
WXR AUTO FAULT	WXR is reporting a autotilt mode fault and other WXR functions are working.
WXR TURB FAULT	WXR is reporting a turbulence mode fault and other WXR functions are working.
WXR PWS FAIL	WXR is reporting a PWS failure and other WXR functions are working.

SYSTEM TEST

The user can initiate a system self-test from the avionics synoptic page, and observe a self-test pattern, depicting operational system colors.

The TEST pattern appears on the MAP or HSI format. If the WX overlay was not previously selected, the test pattern automatically forces the HSI to show the WX TEST overlay.

The user can stop the test by pressing the WXR button again on the AVIO synoptic page.

The weather radar does not transmit during this test, therefore, the transmitter is not tested. All other functions are tested, including the antenna movements.

The test sequence lasts approximately 15 seconds. When completed a TEST COMPLETE appears on the pattern.

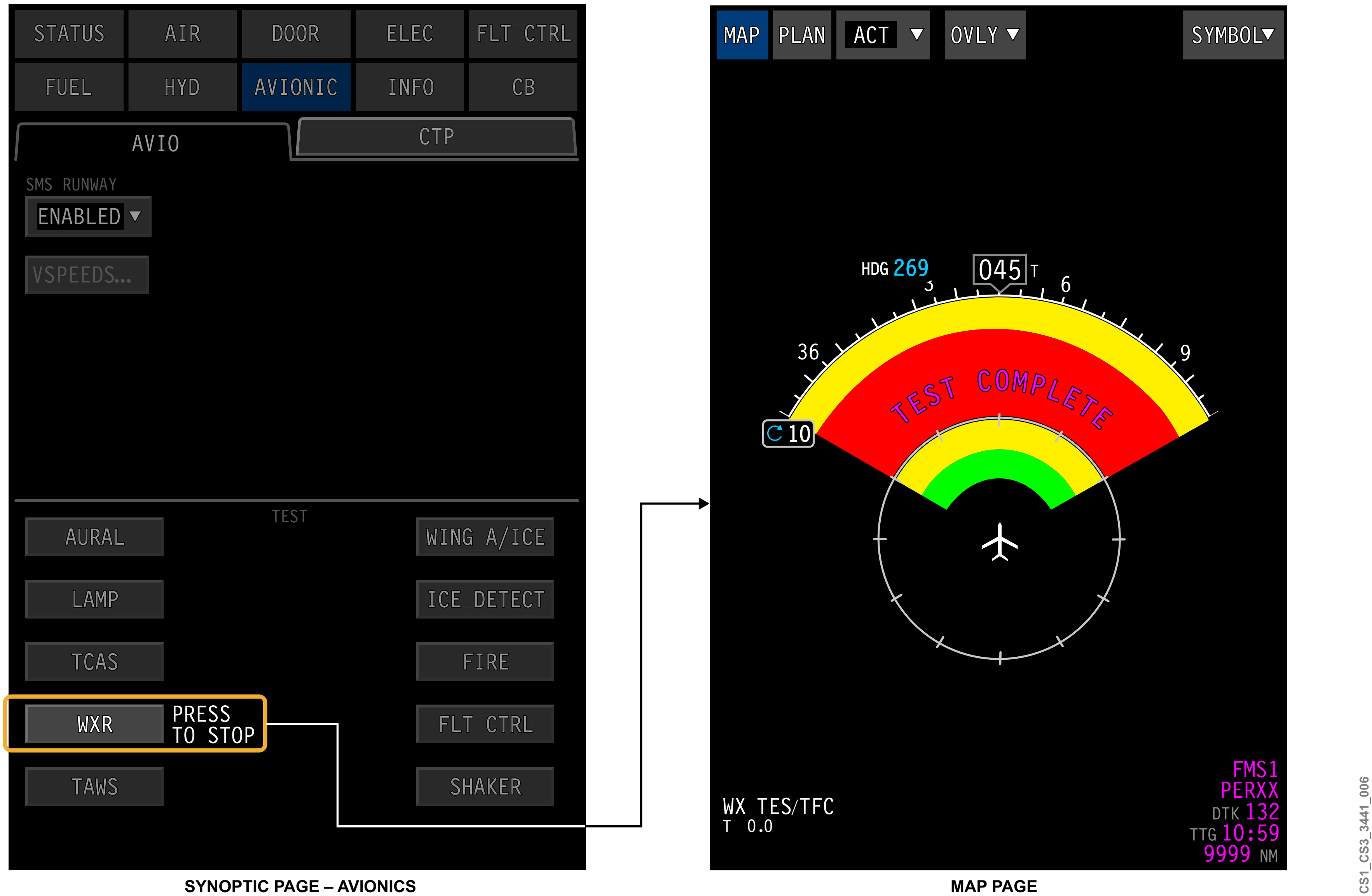


Figure 66: System Test (L2)

34-42 TERRAIN AWARENESS AND WARNING SYSTEM

GENERAL DESCRIPTION

The terrain awareness and warning system (TAWS) consists of a common computing module (CCM), a TAWS processing module (TPM), and a TAWS control panel.

The system provides the basic and enhanced ground proximity warning system (GPWS) functions in addition to forward-looking terrain, and obstacle alerting features.

Basic GPWS TAWS functions consist of the following:

- Mode 1: Excessive rates of descent
- Mode 2: Excessive closure rate to terrain
- Mode 3: Negative climb rate or altitude loss after takeoff
- Mode 4: Flight into terrain when not in landing configuration
- Mode 5: Excessive downward deviation from an instrument landing system (ILS) glideslope
- Mode 6: Altitude, minimums, and excessive bank angle callouts
- Mode 7: Reactive windshear alerting

The enhanced features complete the basic GPWS modes with the following functions:

- Terrain clearance floor (TCF)
- Terrain look ahead alerting

The TAWS control panel allows the crew to inhibit the operation of certain basic ground proximity modes.

The TAWS CCM receives input from other navigation subsystems in conjunction with a vendor database stored on the CCM. These inputs help create a visual display of absolute terrain.

The following systems provide input to the TAWS:

- Radio altimeter
- VHF-NAV
- Inertial reference system
- Air data system
- Flight management system
- Global navigation satellite system

The input power required for the CCM and TPM is provided from DC BUS 1 through the integrated processing cabinet (IPC) input power.

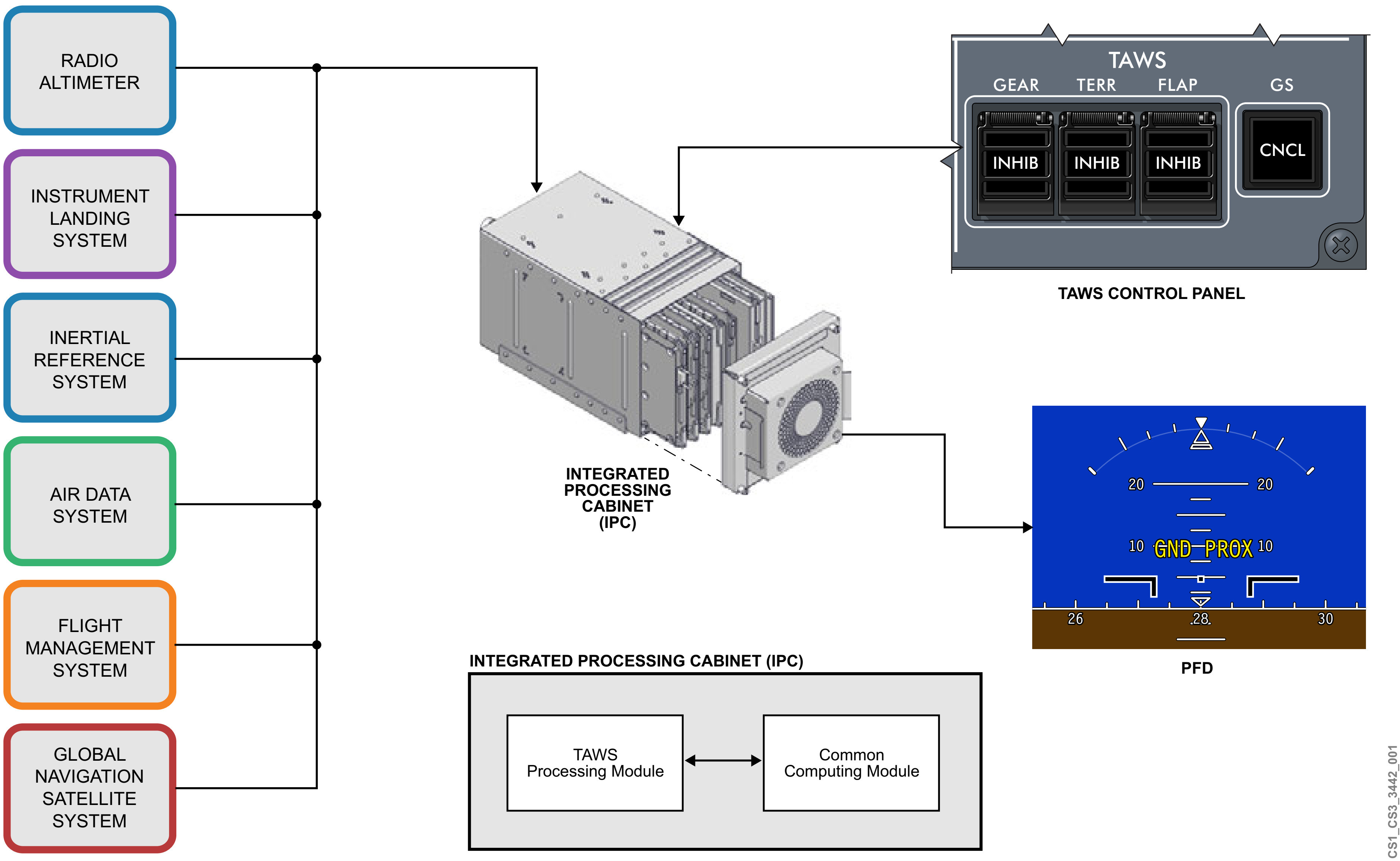


Figure 67: Terrain Awareness and Warning System (L2)

COMPONENT LOCATION

The TAWS consists of the following components:

- TAWS common computing module (CCM)
- TAWS processing module (TPM)
- TAWS control panel

TAWS COMMON COMPUTING MODULE

The TAWS CCM is housed in the third integrated processing cabinet (IPC 3), which is located in the FWD equipment bay.

TAWS PROCESSING MODULE

The TAWS TPM is housed in the third integrated processing cabinet (IPC 3).

TAWS CONTROL PANEL

The TAWS control panel is located on the left inboard overhead module.

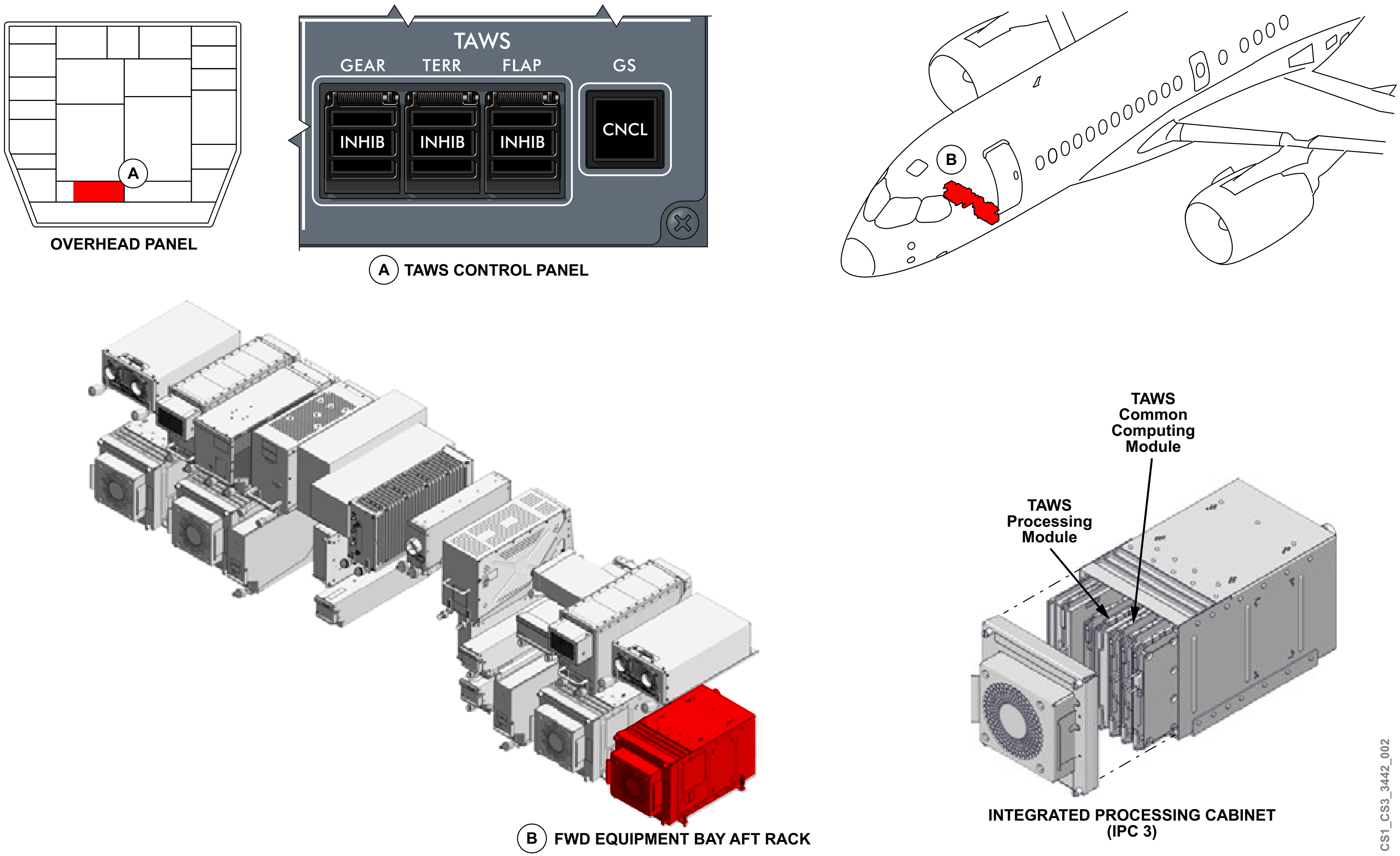


Figure 68: Component Location (L2)

CONTROLS AND INDICATIONS

When the path of the aircraft is predicted to collide with terrain, the TAWS system provides aural and visual alerts to the flight crew. These alerts apply to both caution and warnings. The TAWS control panel allows the crew to inhibit certain basic ground proximity mode annunciations.

The panel has four pushbutton annunciators (PBAs):

- The GS CNCL PBA allows the crew to mute the glideslope warning
- The GEAR INHIB allows the crew to inhibit the “TOO LOW GEAR” aural alert
- The TERR INHIB is used to inhibit clearance floor, terrain awareness alerting, and display functions in a case where landing at an airport is not in the TAWS database
- The FLAP INHIB PBA allows the flight crew to mute the flap aural warning if the flaps are not in the correct landing configuration

The TAWS display consist of two principal groups:

- Alert annunciations
- Overlays

TAWS ALERT ANNUNCIATIONS

The TAWS alert annunciations can be visual and aural. A caution visual alert is issued in advance of a critical situation, while a warning visual alert indicates the situation has become critical. Accompanying voice alerts are heard on the flight deck speakers and headsets.

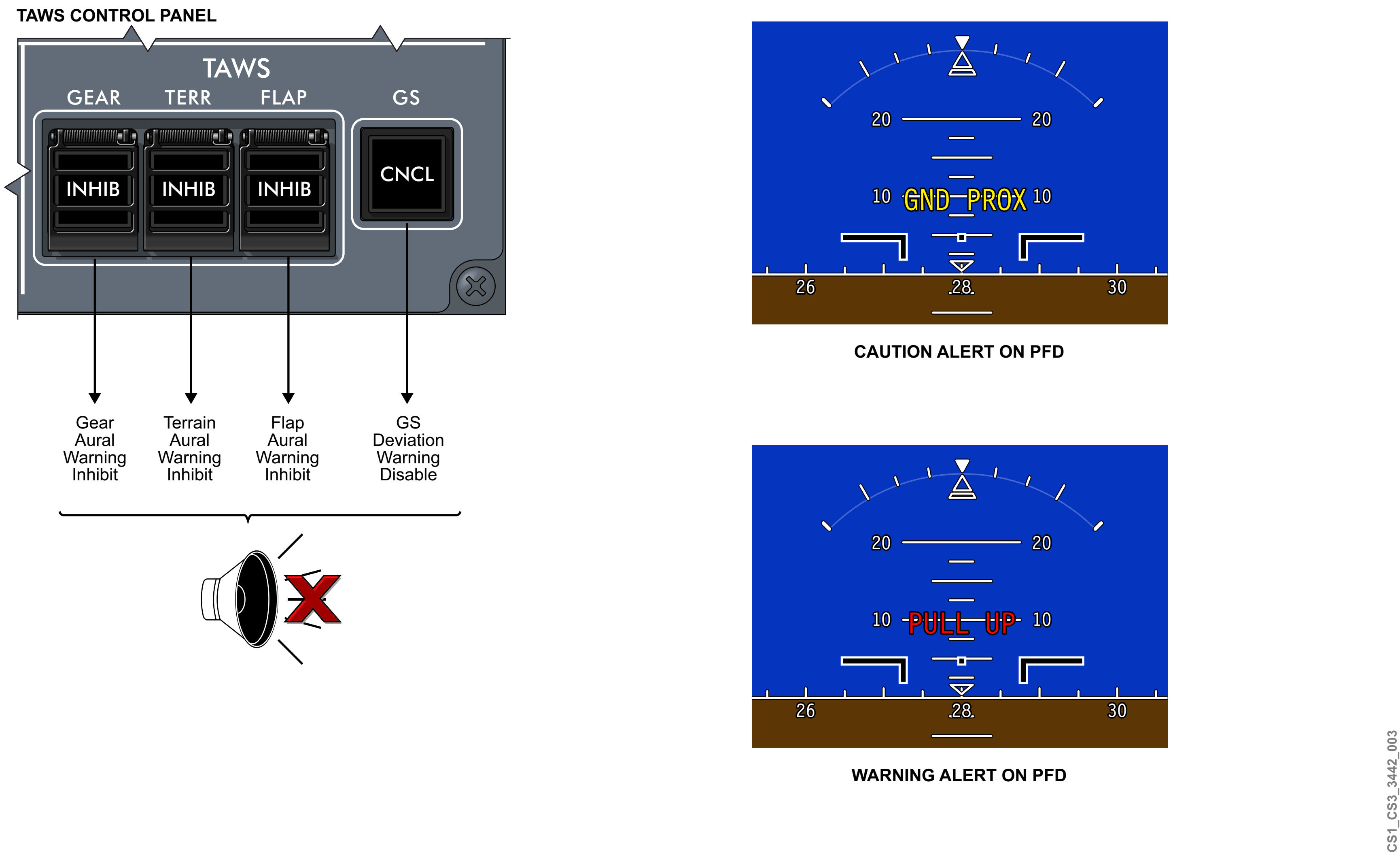


Figure 69: TAWS Alert Annunciations (L2)

TERRAIN OVERLAYS

The TAWS terrain overlays are displayed on the lateral maps and vertical situation display (VSD). TAWS information is sent to the display units (DUs). The crew can select overlays on any multifunction window (MFW) using the CTP TERR button, and the TERRAIN overlay menu on the map.

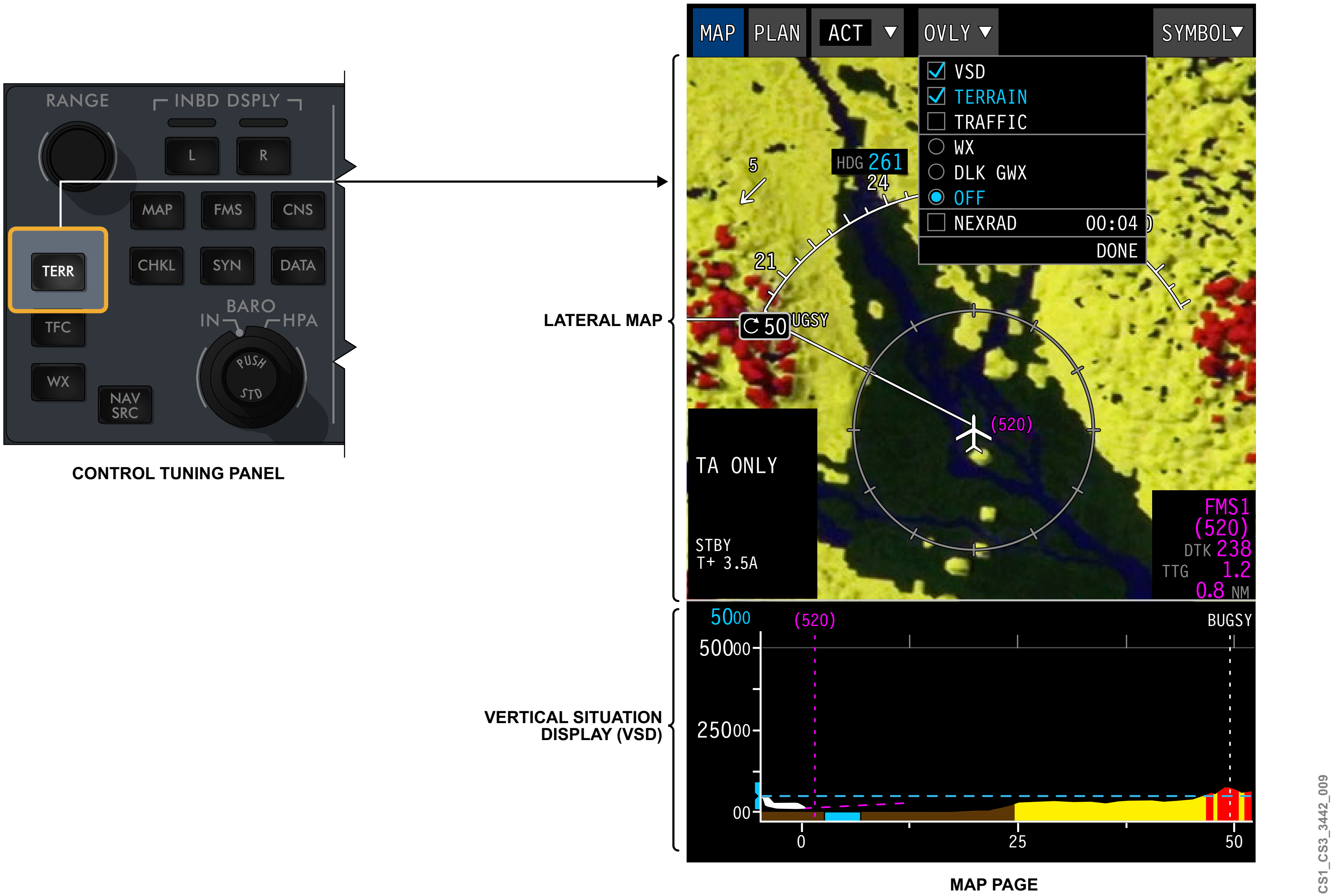


Figure 70: Terrain Overlays (L2)

DETAILED DESCRIPTION

SYSTEM DESCRIPTION

The data concentrator unit module cabinets (DMCs) relay data to the TAWS from the following systems:

- TAWS control panel - Inhibit and cancel pushbutton annunciators
- IRS - Pitch and roll angle, acceleration, inertial altitude, ground speed, track angle, altitude, inertial vertical velocity, and true heading
- ADS - Pressure altitude, airspeed, vertical speed, static air temperature, and angle-of-attack (AOA)
- Radio altimeter - Providing radio altitude
- GNSS - Position, velocity, altitude, sensor status, and date and time
- LGSCU - Landing gear position
- SFECU - Flap position

The radio interface unit (RIU) relays information to the TAWS from the VHF-NAV receiver for ILS deviation data.

These inputs are used to compute potential terrain conflicts.

The TAWS outputs aural annunciation cues to the RIU, which hosts the audio files and generates aural messages for the audio integrating system.

The system receives the following flight plan data from the flight management system (FMS) over AFDX bus:

- Selected landing altitude
- Runway heading
- Ground speed
- Flight path angle
- Trajectory intent

The system applies this information from the FMS to the internal databases, inside common computing module CCM 6210 and TAWS processing module TPM 6000, to perform terrain, and obstacle awareness functions.

The database is used with the selected flight plan and aircraft position to provide forward-looking terrain avoidance (FLTA).

The input power required for the CCM 6210 and TPM hosted in IPC 3 is provided by the DC BUS 1.

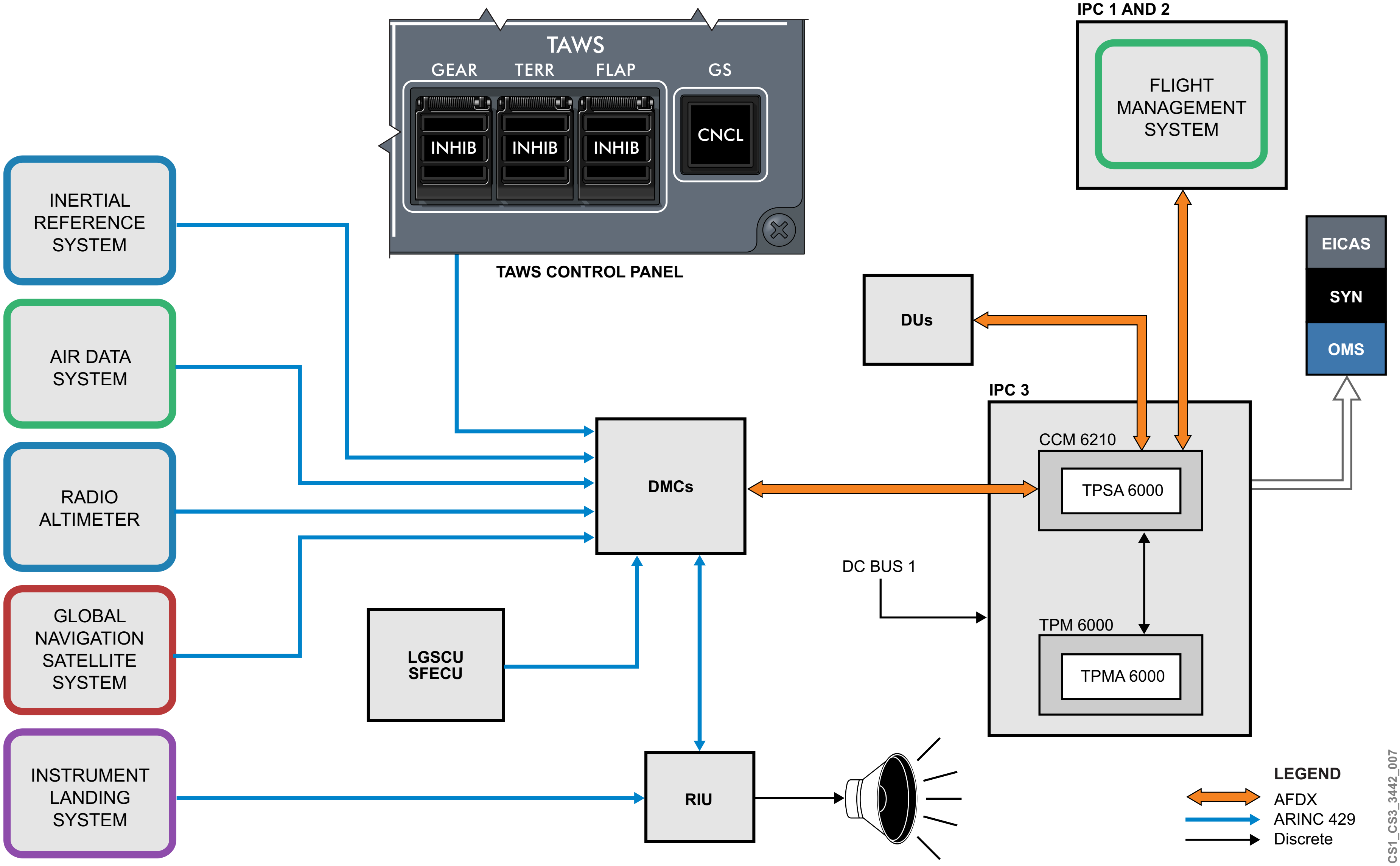


Figure 71: System Description (L3)

SYSTEM INTERFACE

The TAWS processing module (TPM) and the TAWS common computing module (CCM) communicate with each other over the low-voltage differential signaling (LVDS) bus.

The input processing in the CCM verifies the validity of input data from the AFDX network, and reformats it for transmission to the TPM over the LVDS.

The TPM runs the terrain processing module application (TPMA), and stores an envelope database and a terrain awareness and warning system database (TAWSDb). These databases contain worldwide terrain, obstacle, and airport data.

The TPM uses these parameters to compute and generate TAWS alerts, windshear alerts, and relative terrain display. The module prioritizes the audio alerts, and sends them to the CCM over the LVDS bus.

The CCM merges terrain alert information from the TPM with absolute horizontal terrain from the high-resolution terrain database (HRTDb) and formats the image for transmission to the displays over the AFDX.

If there are any audio or visual alerts requested by the TPM, the CCM transmits them to the crew alerting system (CAS) and display system, as well to the audio system.

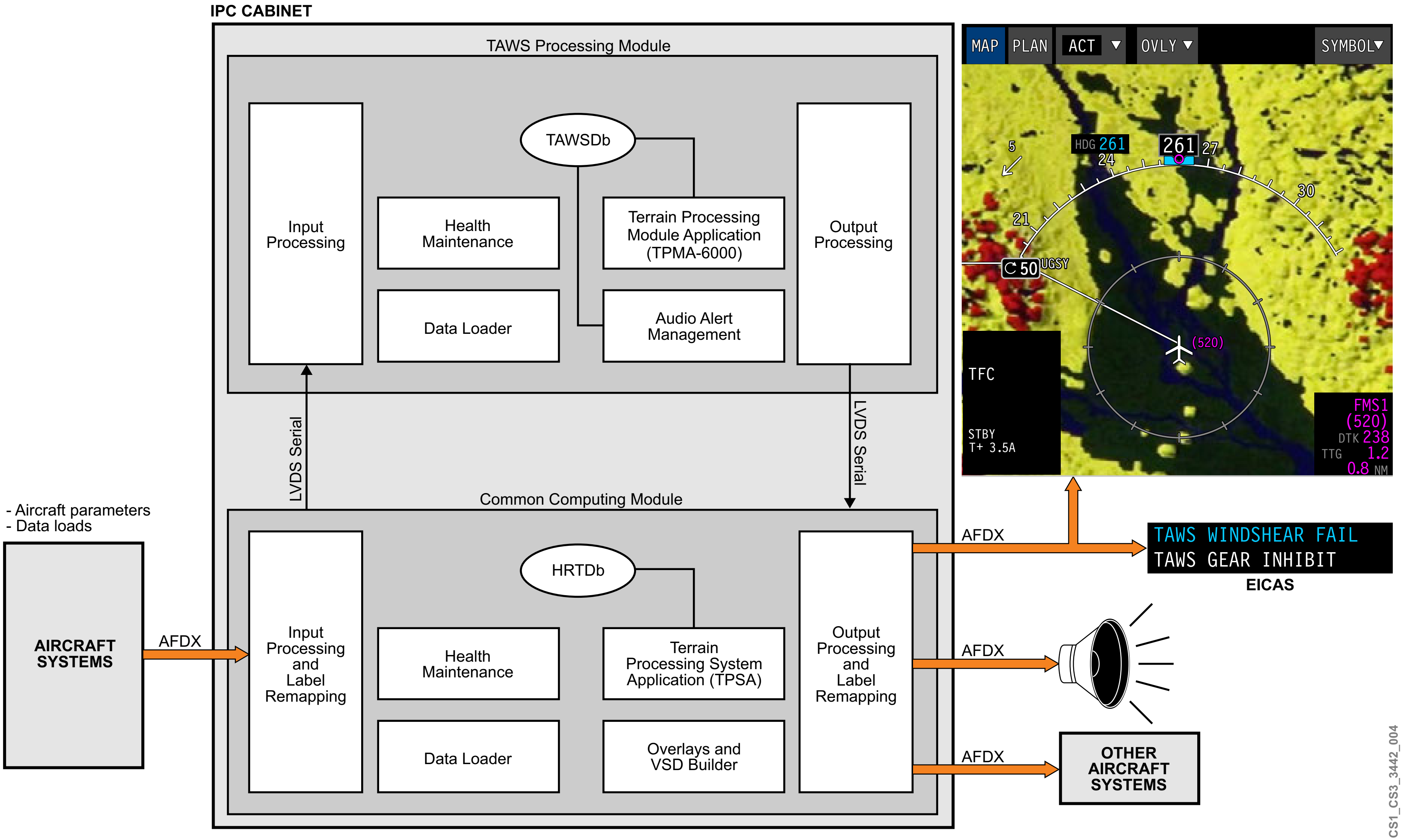


Figure 72: System Interface (L3)

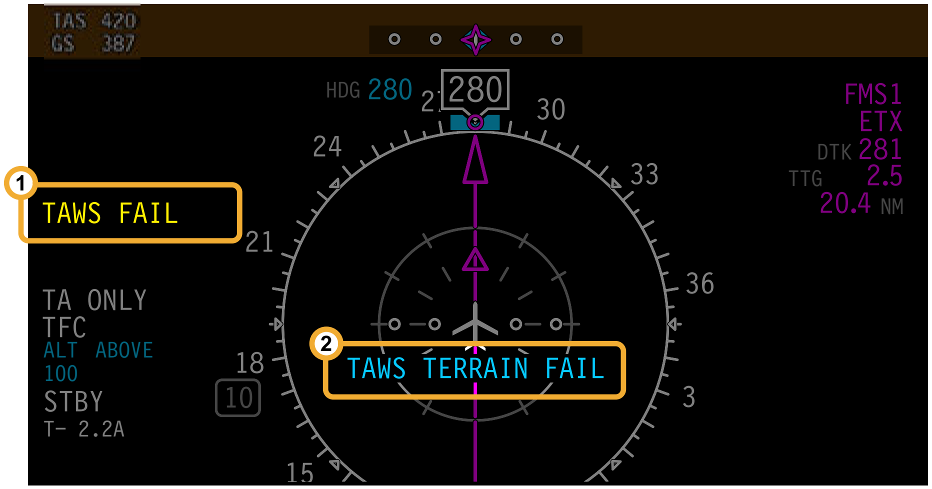
MONITORING AND TESTS

SYSTEM MONITORING

The TAWS provides failed/degraded and system status annunciations via CAS, and status overlay messages.

Status of the terrain overlays is provided on the MFW or the primary flight display (PFD), via the following terrain overlay status annunciators:

- TAWS FAIL - TAWS CCM failure, or simultaneous failures
- TAWS Map FAIL - TAWS high-resolution database failed
- TAWS Terrain FAIL - Forward looking terrain avoidance (FLTA) and terrain clearance floor (TCF) failure
- TAWS TERRAIN INHIB - TERRAIN PBA on the TAWS panel is pressed



PFD

TAWS FAIL

TAWS MAP FAIL

1 TAWS MESSAGE FIELD

TAWS TERRAIN FAIL

TAWS TERRAIN INHIB

2 OVERLAY FAULT FIELD

MAP PAGE

CS1_CS3_3442_005

Figure 73: System Monitoring (L2)

CAS Messages

The following page provides the CAS and INFO messages for the TAWS.

Table 14: CAUTION Message

MESSAGE	LOGIC
TAWS FAIL	TAWS system failed.

Table 15: ADVISORY Messages

MESSAGE	LOGIC
TAWS MAP FAIL	TAWS hi-resolution database failed.
TAWS TERRAIN FAIL	Forward looking terrain avoidance (FLTA) and terrain clearance floor (TCF) failure.
TAWS GPWS FAIL	TAWS mode 1-6 not available and the other TAWS functions are working.
TAWS WINDSHEAR FAIL	TAWS mode 7 not available and the other TAWS functions are working.

Table 16: STATUS Messages

MESSAGE	LOGIC
TAWS TERR INHIB	TAWS terrain alerts inhibited by the flight crew.
TAWS GS CNCL	TAWS glideslope alerts canceled by the flight crew.
TAWS FLAP INHIBIT	TAWS flaps alerts inhibited by the flight crew.
TAWS TERR INHIBIT	Terrain_Awareness_Override_TAWS1 = true.
TAWS GEAR INHIBIT	TAWS gear alerts inhibited by the flight crew.

SYSTEM TEST

The maintenance crew can initiate a manual test (IBIT) through the onboard maintenance system (OMS). This test is inhibited when airborne.

The flight crew can start a self-test through the avionics synoptic page. The self-test is not a test to determine the functionality of the TAWS CCM-6210 and TPM-6000. It is a test to show the path of communication from the TPM-6000 to the display, and to verify that the aural system is working correctly.

The self-test lasts approximately 2.5 minutes. During this test, messages appear on the PFD in the following sequence:

- GND PROX
- PULL UP
- WINDSHEAR
- PULL UP
- GND PROX

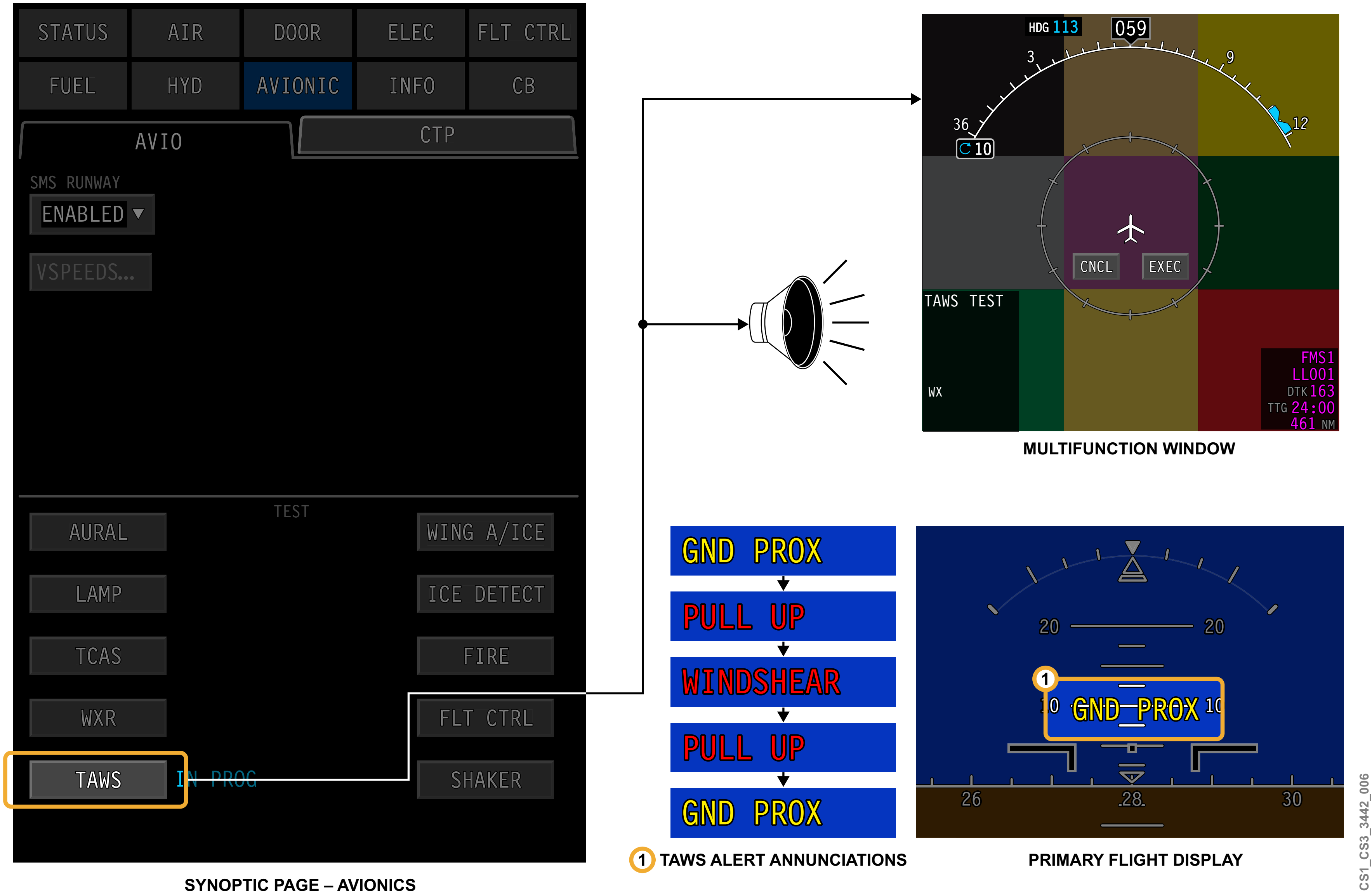


Figure 74: System Test (L2)

PRACTICAL ASPECTS

INSTALLATION CONSIDERATIONS

The TPM has an ON/OFF switch in the back. This switch must be in the ON position when installing the line replaceable module (LRM).

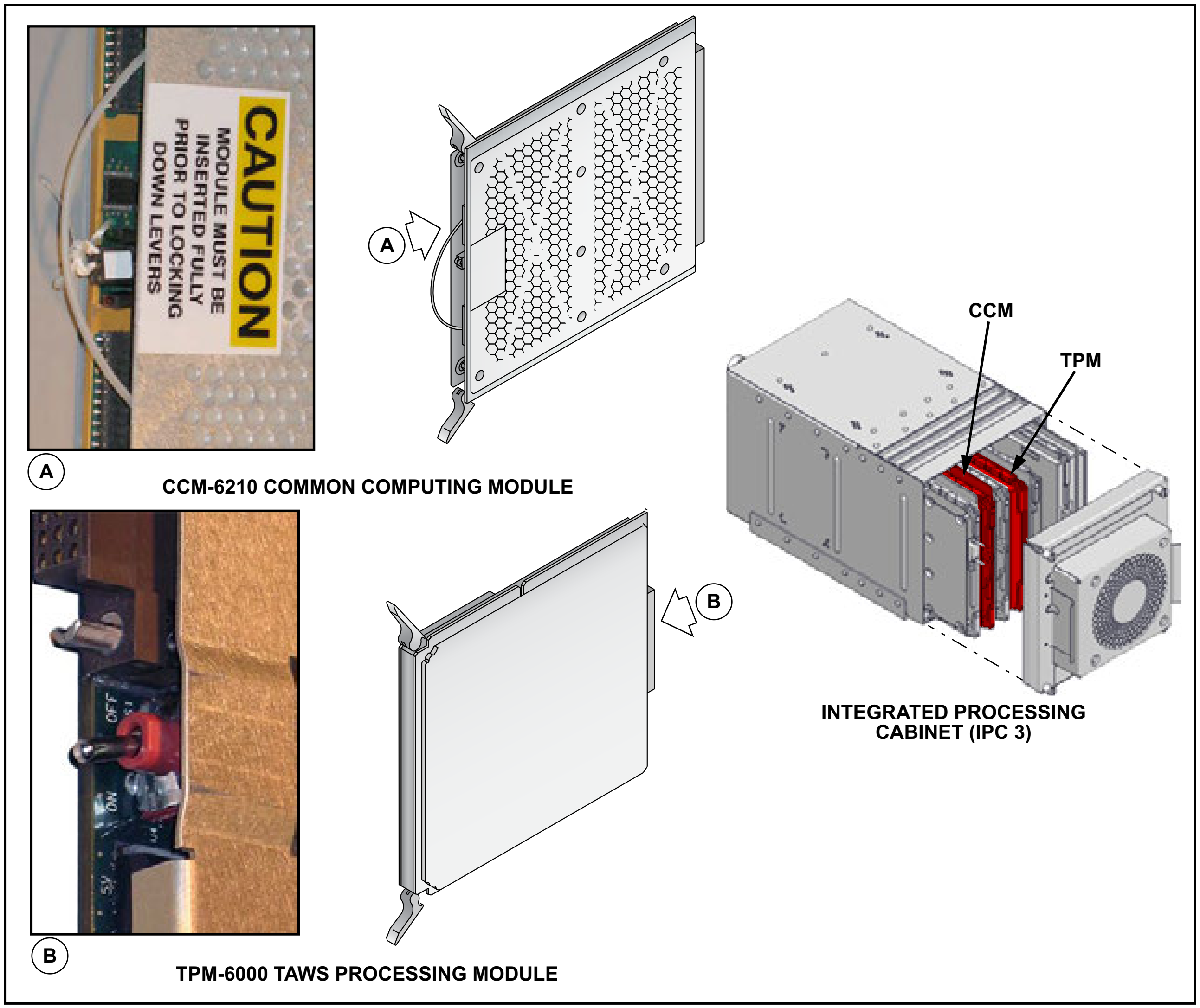
The CCM has a shunt located on the front of the modules. A green LED (functional), and a red LED (fault) are located on the sides of the shunt.

The shunt can be disconnected to remove power from the module. It is possible to stow the shunt by connecting it in the reverse position. To confirm that there is no power on the module, no LED should be lit.

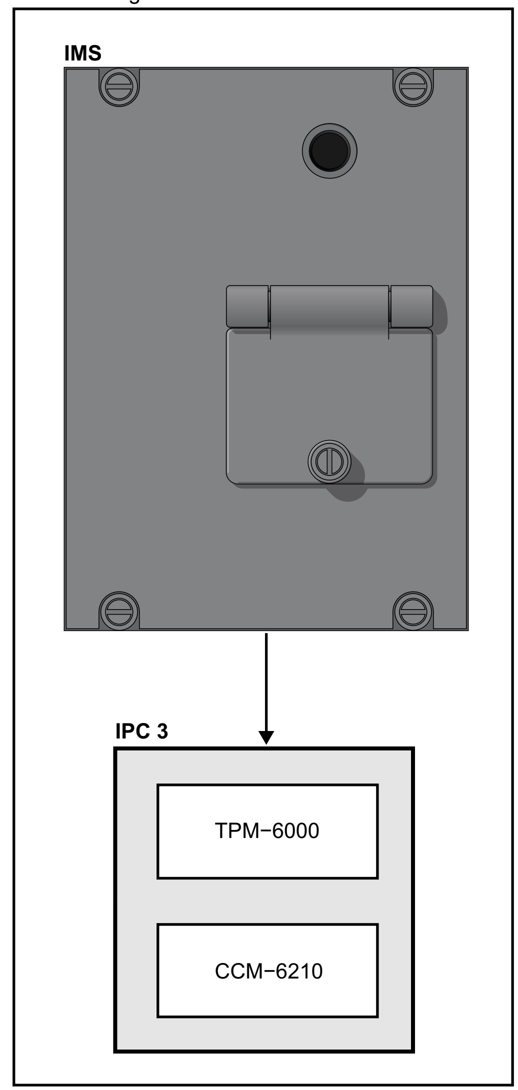
DATA LOADING

The TAWS requires installation of several field-loadable databases and applications.

Installation Considerations



Data Loading



CS1_CS3_3442_008

Figure 75: Practical Aspects (L2)

34-43 TRAFFIC SURVEILLANCE SYSTEM

GENERAL DESCRIPTION

The traffic surveillance system (TSS) consists of a TSS processing unit, an air traffic control (ATC) transponder, an external compensation unit (ECU), and antennas.

The TSS processing unit combines the traffic collision avoidance system (TCAS) and ATC transponder functions. The use of one integrated TSS and one stand-alone ATC transponder system provides a dual air traffic control surveillance system. The TSS is mounted on a rack assembly equipped with a dedicated 28 VDC cooling fan. Fan operation is monitored by the TSS unit.

The TCAS function of the TSS provides visual display and aural warnings to the crew.

The control, monitor, and display functions for the TSS operate by interfacing with the following:

- Control tuning panel
- Radio interface units
- Display units

The TSS also interfaces with the following systems:

- Distance measuring equipment (DME)
- Global navigation satellite system (GNSS)
- Inertial reference system (IRS)
- Radio altimeter (RA)
- Landing gear and steering control unit (LGSCU)
- Air data system (ADS)
- Flight management system (FMS)

The external compensation unit (ECU) is an erasable, programmable, read-only memory. The ECU is divided in two halves. The first half is programmed by the supplier and contains the information necessary to set up the TSS. The second half is field-loadable with aircraft specific configuration data and mode S address.

There are two TSS antennas. An upper directional traffic surveillance antenna and a lower omnidirectional TCAS antenna. As an option, the lower antenna is replaced with a directional antenna.

The TSS unit is powered by DC BUS 2.

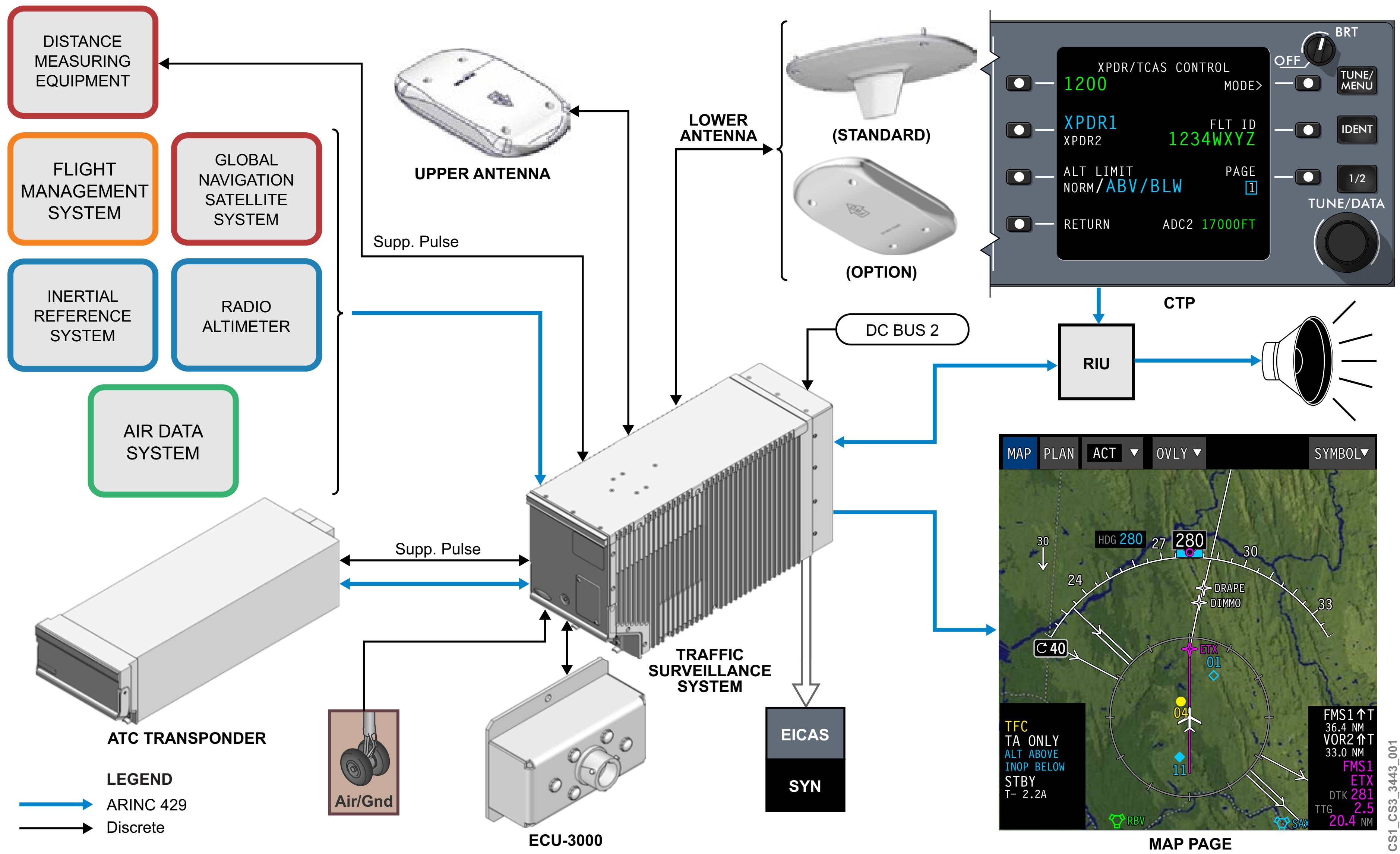


Figure 76: Traffic Surveillance System (L2)

AIR TRAFFIC CONTROL TRANSPONDER

The stand-alone air traffic control (ATC) transponder unit functions as a redundant transponder to the ATC function within the TSS. It is capable of operating in mode A, C, or S, and provides all of the same transponder functions as the transponder inside the TSS.

The transponder provides antenna diversity operation, allowing automatic use of the upper and lower aircraft antennas. When the stand-alone transponder is selected for use, it coordinates with the TSS to provide the TCAS function.

The transponder receives the ICAO Mode S address from a strapping module.

The transponder also interfaces with the following:

- Distance measuring equipment (DME) - Suppression pulse
- Global navigation satellite system (GNSS) - Time mark, position
- Inertial reference system (IRS) - Magnetic heading, attitude

Operator control of the ATC transponder function is limited to entering the ATC identification code and selecting the active ATC transponder unit.

The ATC transponder is powered by the DC ESS BUS 3.

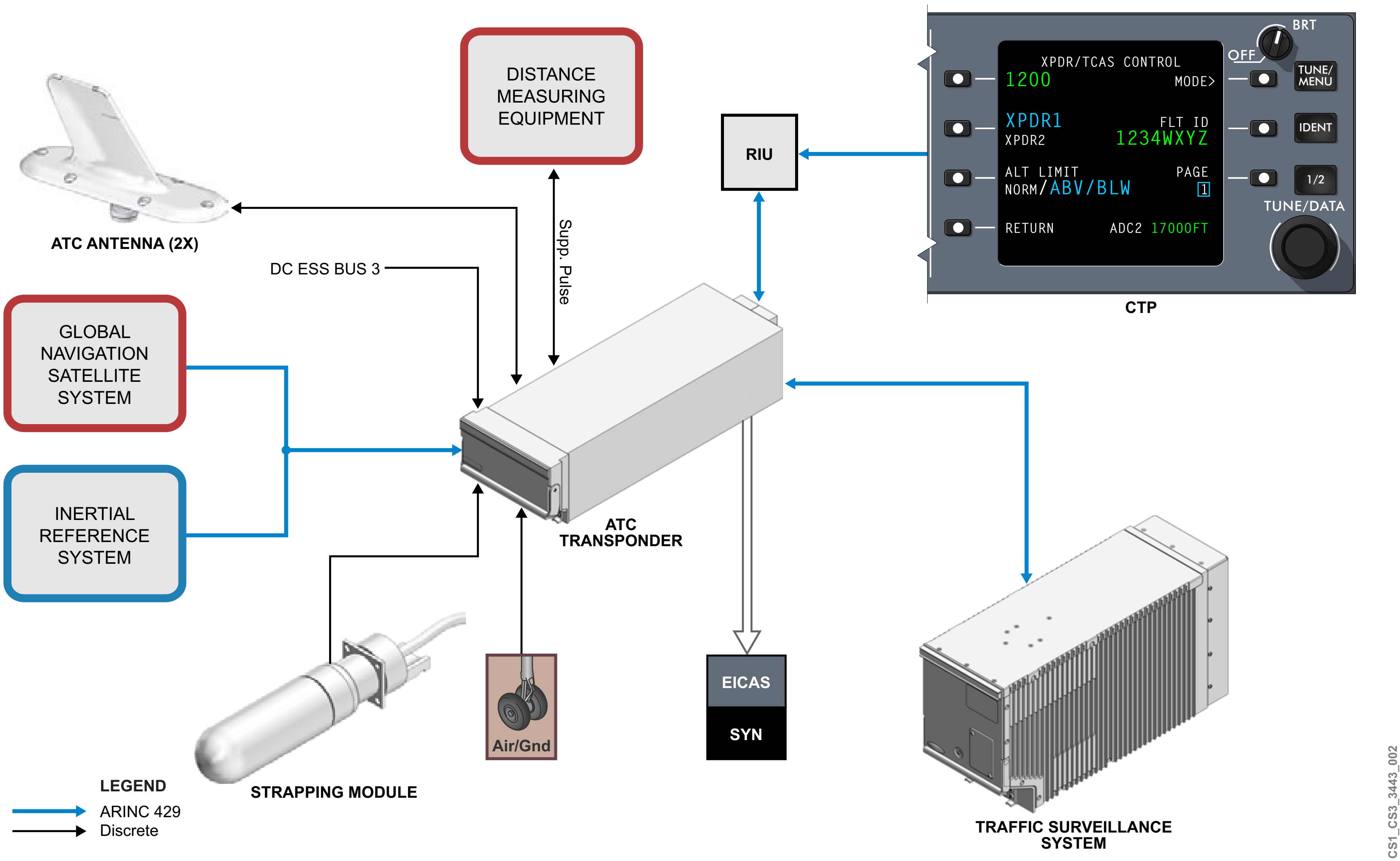


Figure 77: Air Traffic Control Transponder (L2)

COMPONENT LOCATION

TRAFFIC SURVEILLANCE SYSTEM PROCESSING UNIT

The traffic surveillance system (TSS) is located in the forward equipment bay, mounted on a fan equipped rack assembly.

AIR TRAFFIC CONTROL TRANSPONDER

The air traffic control (ATC) transponder is located in the forward equipment bay.

STRAPPING MODULE

The strapping module is located on the aft shelf of the forward equipment bay.

EXTERNAL COMPENSATION UNIT

The external compensation unit is located behind the aft shelf in the forward equipment bay.

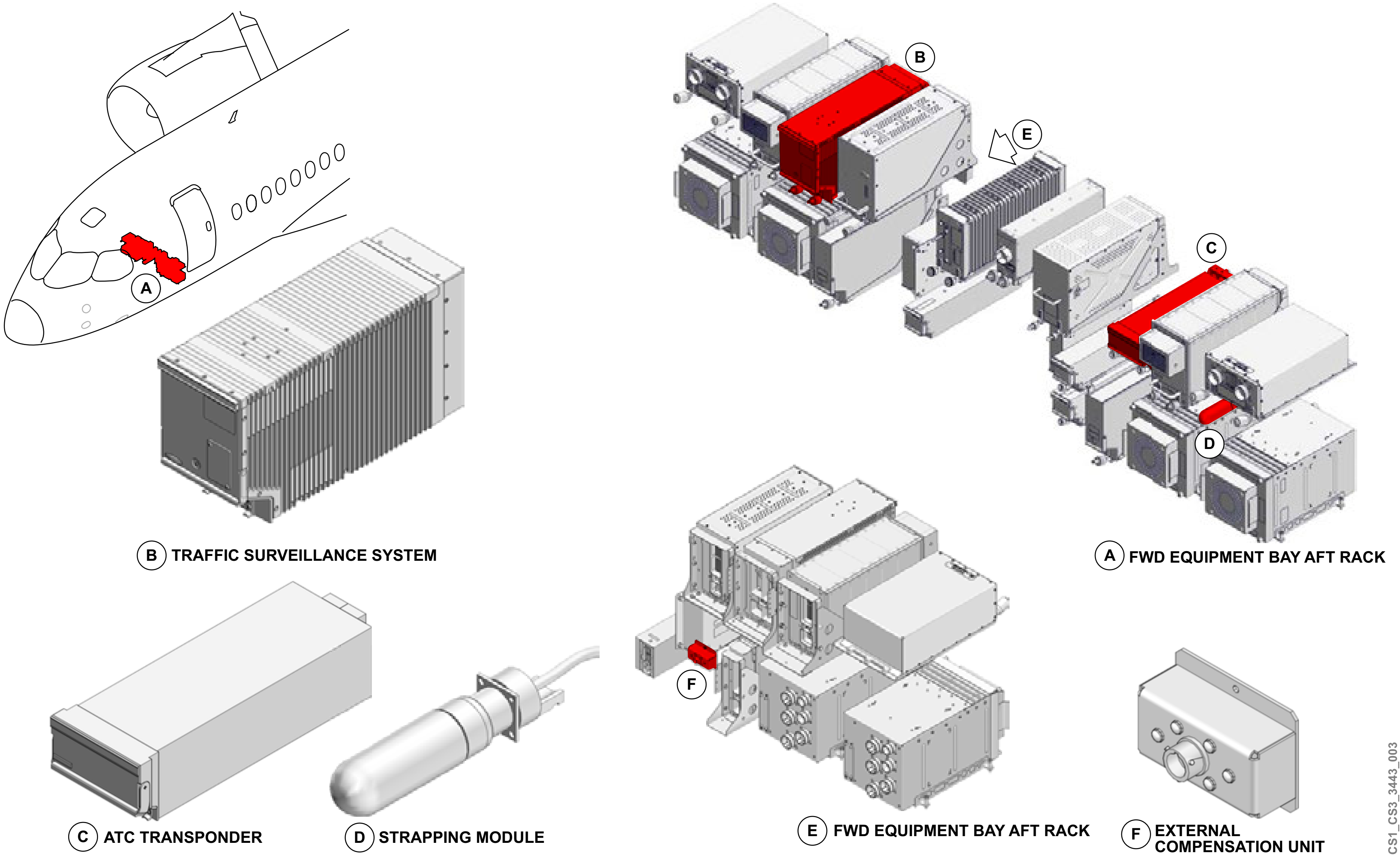


Figure 78: Component Location (L2)

ANTENNAS

Traffic Alert and Collision Avoidance System Antenna

The traffic alert and collision avoidance system (TCAS) antenna is located on the lower forward fuselage. This antenna is either omnidirectional, or as an option, directional.

Traffic Surveillance Antenna

The traffic surveillance antenna is located on the upper forward fuselage.

Air Traffic Control Antenna

The two air traffic control (ATC) antennas are located on the upper and lower forward fuselage.

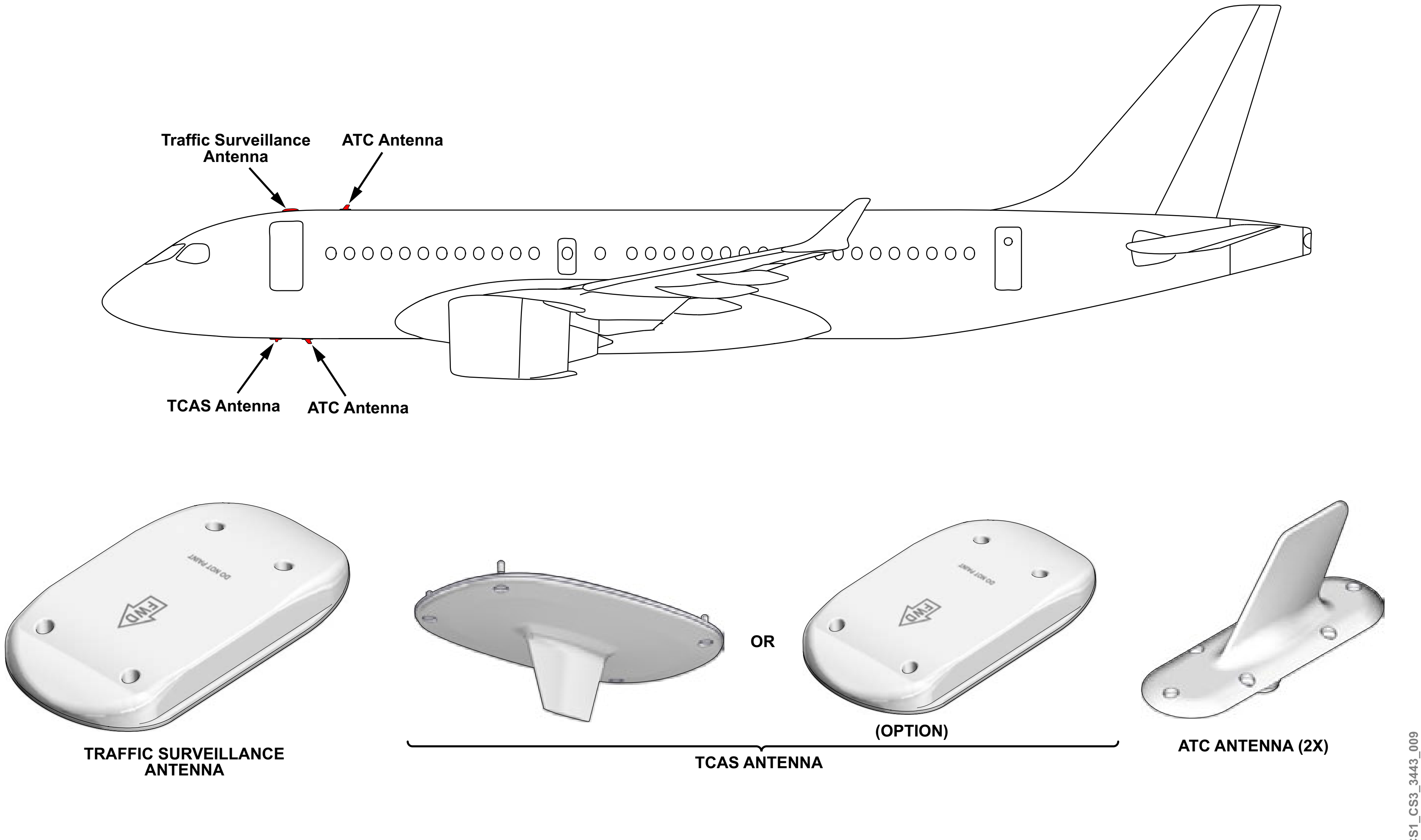


Figure 79: Antennas (L2)

CONTROLS AND INDICATIONS

TRAFFIC SURVEILLANCE SYSTEM CONTROLS

The traffic surveillance system (TSS) and transponder controls are selected and displayed through the control tuning panel (CTP) pages and the radio tuning system application (RTSA).

The XPDR/TCAS CONTROL pages are accessed from the main CTP or RTSA, and allow the crew to select between XPDR1 or XPDR2 (inside the TSS) as the active transponder.

In addition to the active transponder, the crew can also control the following functions:

- Mode selection
- Transponder code
- Flight number ID
- ALT TAG
- ALT LIMIT
- Traffic ON/OFF
- IDENT
- TEST

XPDR/TCAS mode is set to AUTO at power-up. In this mode, the ATC transponder and TCAS are automatically controlled. The crew can manually select STBY or any other mode via the CTP or RTSA. STBY places the ATC transponder and TCAS on standby, preventing the system from sending replies.

On the CTP, the transponder code, and flight number ID can be entered by rotating the outer and inner TUNE/DATA knob. The user can also enter this data through the RTSA.

The ALT TAG control allows selection of the altitude reference between relative (REL) and absolute altitude (ABS).

The ALT LIMIT selection toggles through NORM, ABOVE, BELOW, and ABOVE/BELOW.

Selecting the ALT ON or OFF allows the transponder to report squawk code and altitude, or squawk code only.

The crew can select the IDENT function when the ground ATC requests a squawk identification.

Selecting TEST puts the transponder and the TSS in test mode.

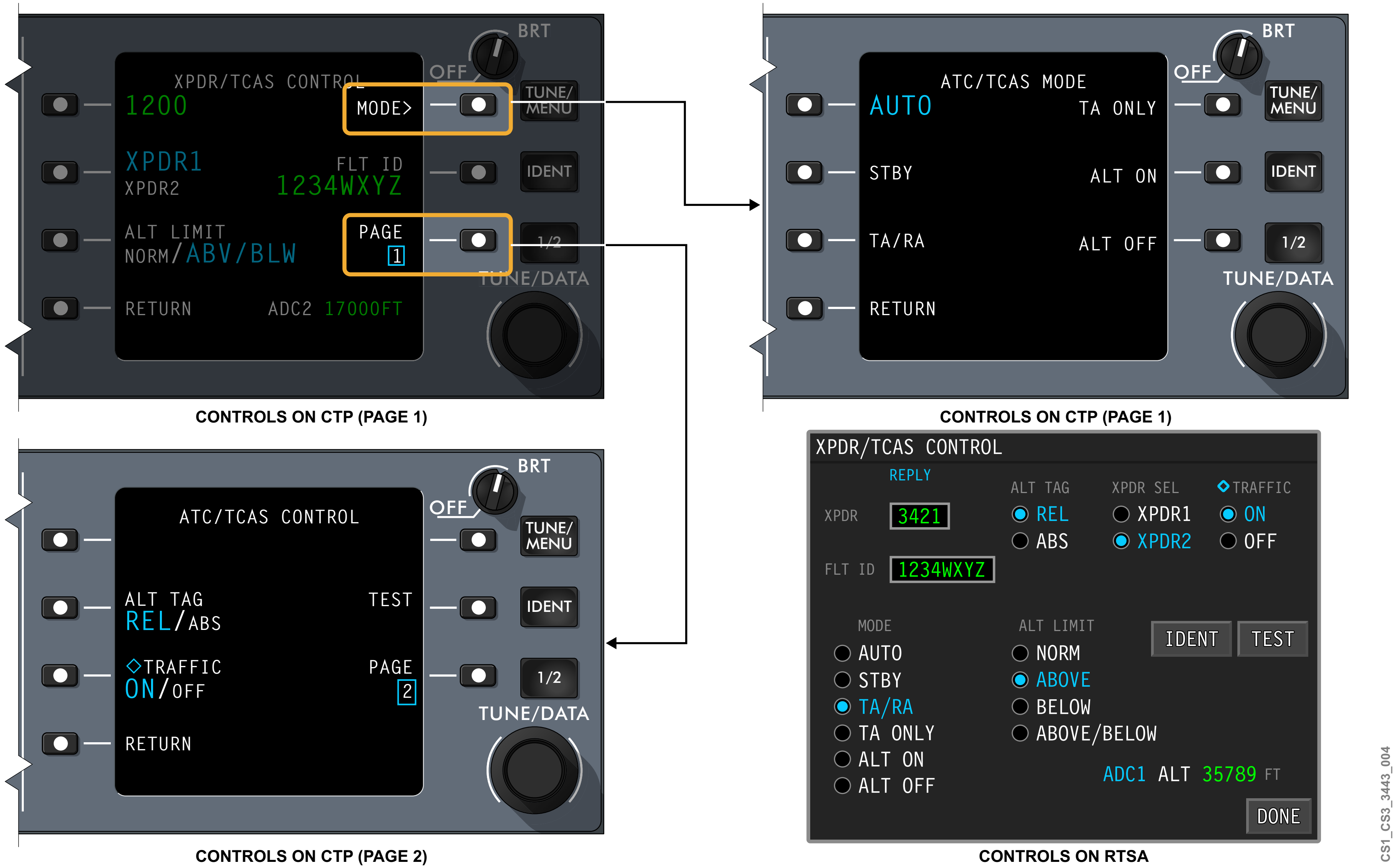


Figure 80: Traffic Surveillance System Controls (L2)

TRAFFIC SURVEILLANCE SYSTEM INDICATIONS

For each detected aircraft, the traffic surveillance system (TSS) displays a color-coded symbol on the traffic map overlay to indicate the level of threat.

If the TSS line replaceable unit (LRU) determines that a potential or real threat to the aircraft exists, aural warnings and visual displays of both threat level and, if necessary, avoidance maneuvering directives are provided to the flight crew.

The TSS processing unit classifies detected traffic into four categories:

- Resolution advisory (RA)
- Traffic advisory (TA)
- Proximate traffic (PT)
- Other traffic (OT)

Resolution advisory (RA) cues are issued by the TSS when aircraft corrective maneuvering is required to avoid a potential collision. RA traffic is shown on the traffic overlay as a solid red square.

The TCAS RA pitch cues are shown on the PFD as a red avoidance zone and a green fly to box zone. Aural messages are also issued.

Traffic advisory (TA) is detected traffic that is determined not be an immediate threat to the aircraft, but that could become a threat requiring resolution advisory action. TA traffic is shown on the traffic overlay as a solid amber circle.

Proximate traffic (PT) is traffic that the TSS does not consider to be a threat to the aircraft. This traffic appears on the traffic overlay as a solid cyan diamond to aid the flight crew in visually locating the traffic.

Other traffic (OT) is any traffic that falls within the selected traffic display range and altitude settings, and is shown on the traffic overlay as an open cyan diamond.

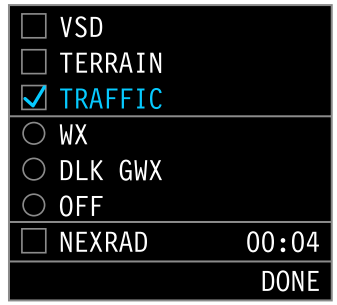
PT and OT can be turned off by selecting TA/RA mode on the XPDR/TCAS control menu.

The traffic overlay on the MAP format is selectable through the CTP TFC button, or the MAP overlay menu.

In case of TA or RA alert, the traffic overlay automatically appears on the MAP as follows:

- In case of a TA alert, the TFC label becomes yellow
- In case of a RA alert, the TFC label becomes red

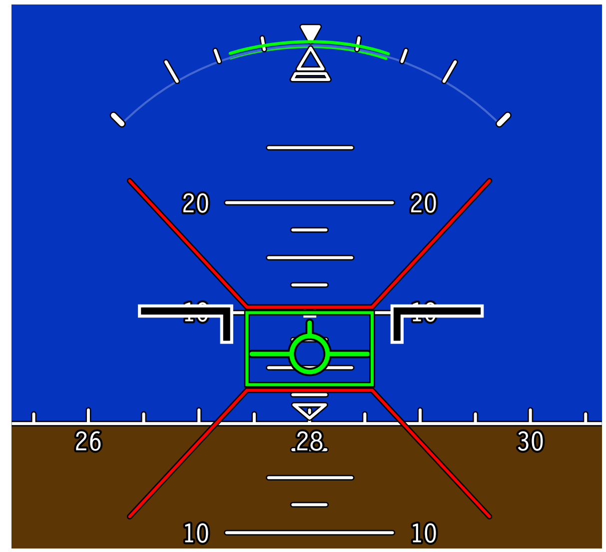
MFW HALF MAP
WITH TCAS SYMBOLS



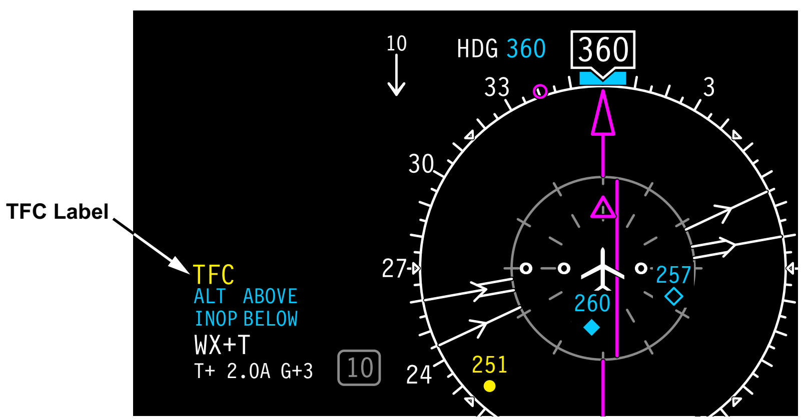
1 OVERLAY MENU

LEGEND

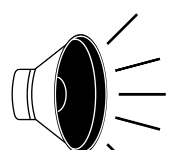
- Resolution Advisory Target
- Traffic Advisory Target
- Proximate Traffic Target
- Other Traffic Target



RA PITCH CUES ON PFD



TCAS INDICATIONS ON HSI



AURAL
MESSAGES

CONTROL TUNING PANEL

CS1_CS3_3443_005

Figure 81: Traffic Surveillance System Indications (L2)

DETAILED DESCRIPTION

SYSTEM INTERFACE

The TSS processing unit receives TCAS and transponder controls, altitude data, mode A, and flight ID codes from the following two sources:

- CTPs via RIUs
- RTSA via DMCs

The DMCs also relay information to the system from:

- Inertial reference system (IRS) - Magnetic heading, pitch/roll angle
- Flight management system (FMS) - True heading
- Global navigation satellite system (GNSS) - Altitude, position, ground speed
- Air data system (ADS) - Flight environment information
- Radio altimeter (RA) - Radio height

The GNSS provides a time mark signal directly to the TSS processing unit and transponder.

The TSS and XPDR receive a suppression pulse from the transmitting DME. This momentarily inhibits both transponders, as well as the TCAS transceiver. The TSS and XPDR also generate a blanking pulse output when transmitting, which temporarily inhibits the DME receivers.

The XPDR receives the ICAO 24-bit address from the strapping module over discrete lines.

The TSS transmits the following data:

- Aural annunciation request to the RIUs for prioritization and broadcast
- TCAS controls (to ECU, cooling fan, and ATC transponder)
- Mode A and C responses
- Mode S interrogations and responses with flight ID and International Civil Aviation Organization (ICAO) address to the RIU
- TCAS/transponder controls, intruder information, RA advisory detail and TCAS diagnostic to DUs

The TSS and XPDR also provide the functionality to automatically change the transponders' code in case of an emergency. These codes are programmed by the RTSA as follows:

- 7700 - For general emergency (including emergency descent mode)
- 7600 - For no communications
- 7500 - For unlawful interference

Both transponders communicate with each other through ARINC 429 (x-talk). A discrete link between the two units determines which system is in standby.

The TSS processor unit reads the ECU on power-up via a serial data bus to download configuration data and mode S ICAO address.

The rack mount, external fan is controlled by the TSS through a discrete link. The TSS uses the fan monitor output to determine if the fan has failed. In case of a fan failure, a CAS message appears on the EICAS but the TSS still operates.

The DC ESS BUS 3 powers the XPDR. The TSS processing unit and the cooling fan use power input from DC BUS 2.

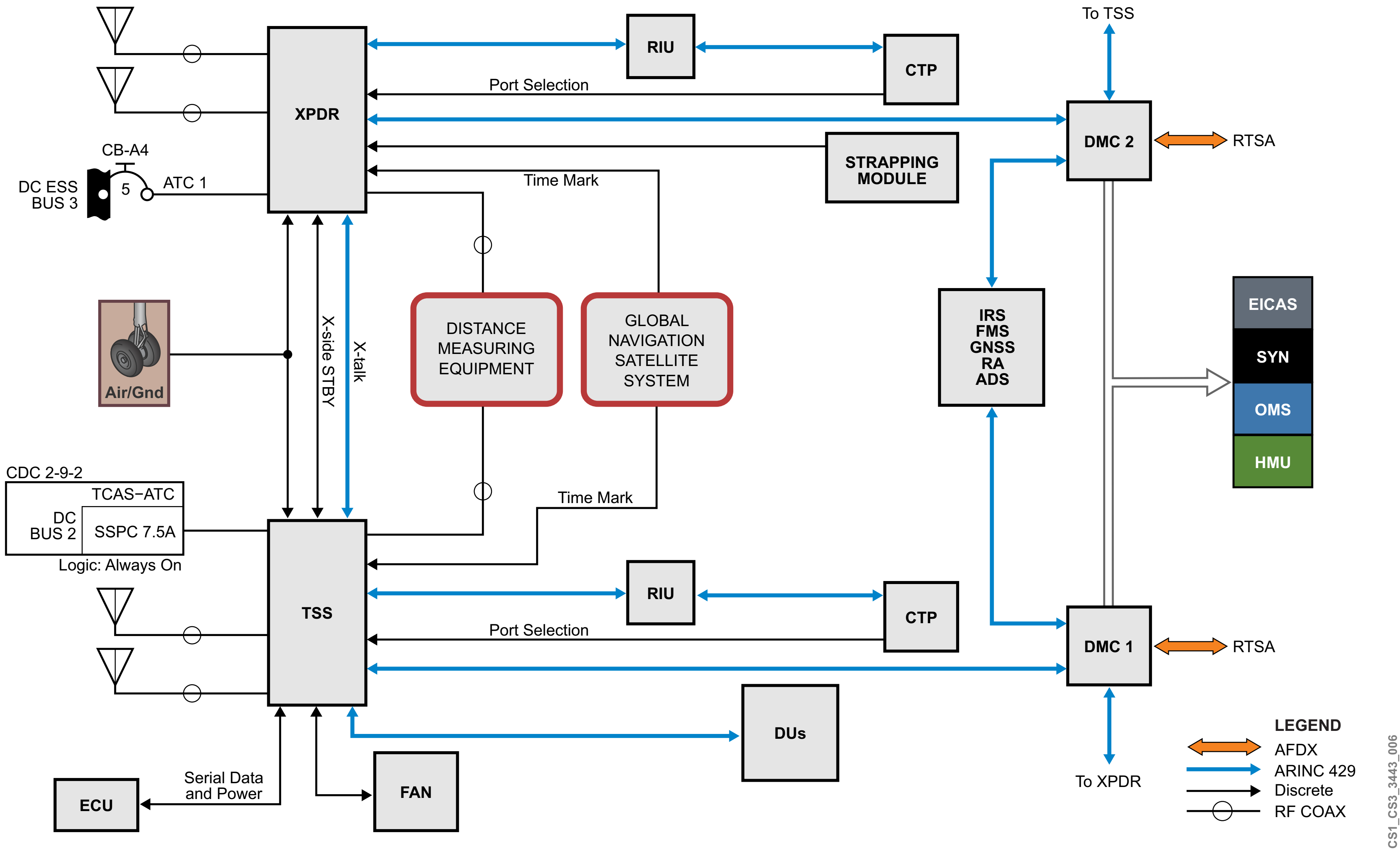


Figure 82: System Interface (L3)

MONITORING AND TESTS

SYSTEM TEST

While on ground, the system self-test can be initiated through:

- CTP XPDR/TCAS control page
- RTSA XPDR/TCAS control page
- Avionic synoptic page
- LRU front panel

The TCAS self-test routine takes approximately 10 seconds.

If the test is successful, the TSS returns to its previous operating mode and an aural “TCAS SYSTEM TEST OK” message is broadcast over the digital audio system. This ensures that the TSS is properly connected to the audio system.

If the TSS self-test fails, a yellow TCAS FAIL alert message appears on the primary flight displays and an aural “TCAS SYSTEM TEST FAIL” message is broadcast.

On the LRU front panel, the LRU STATUS led is green when the self-test is successful, and red if the self-test fails.

If there is a fail, all other LEDs are either off or red.

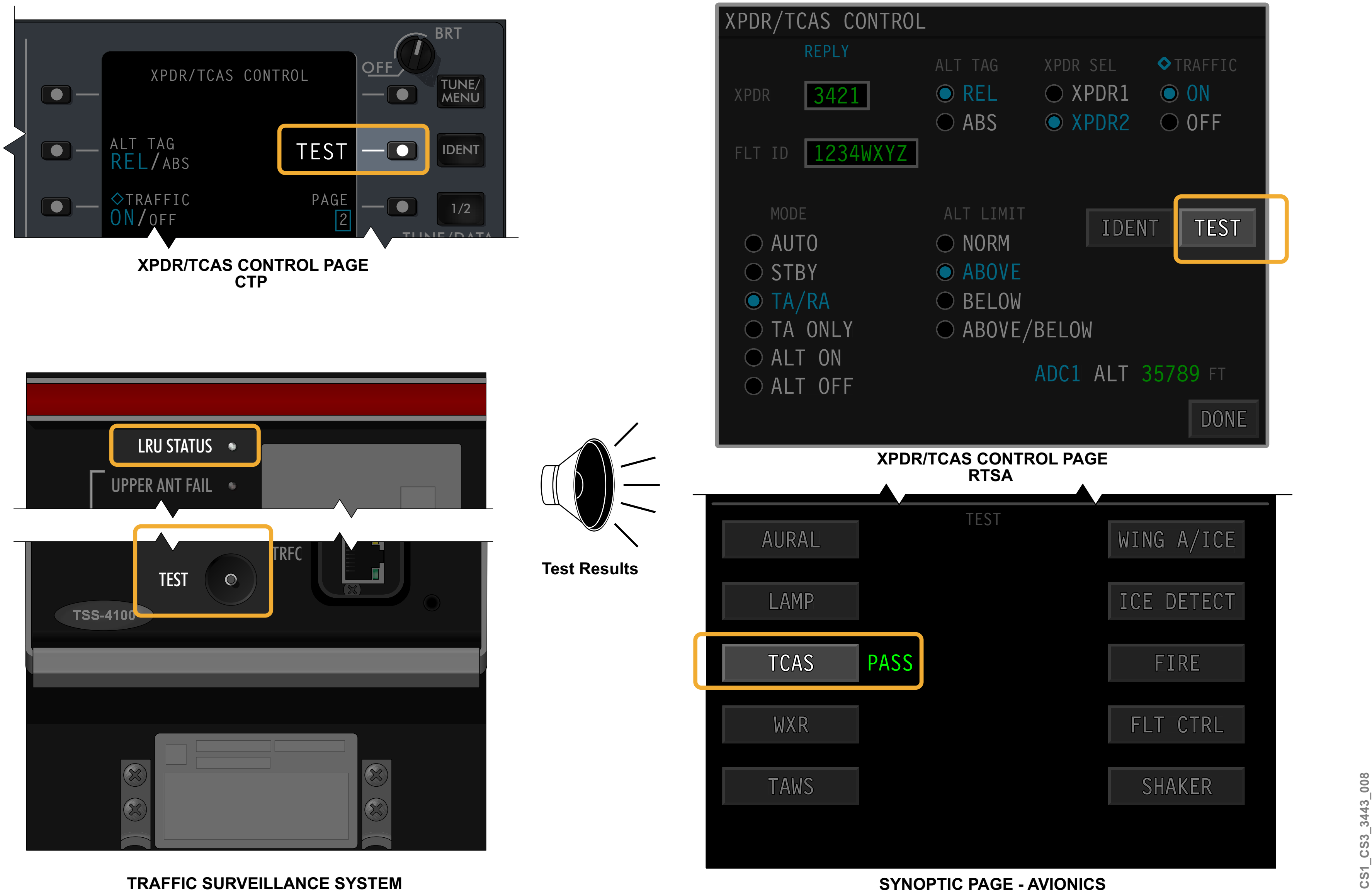
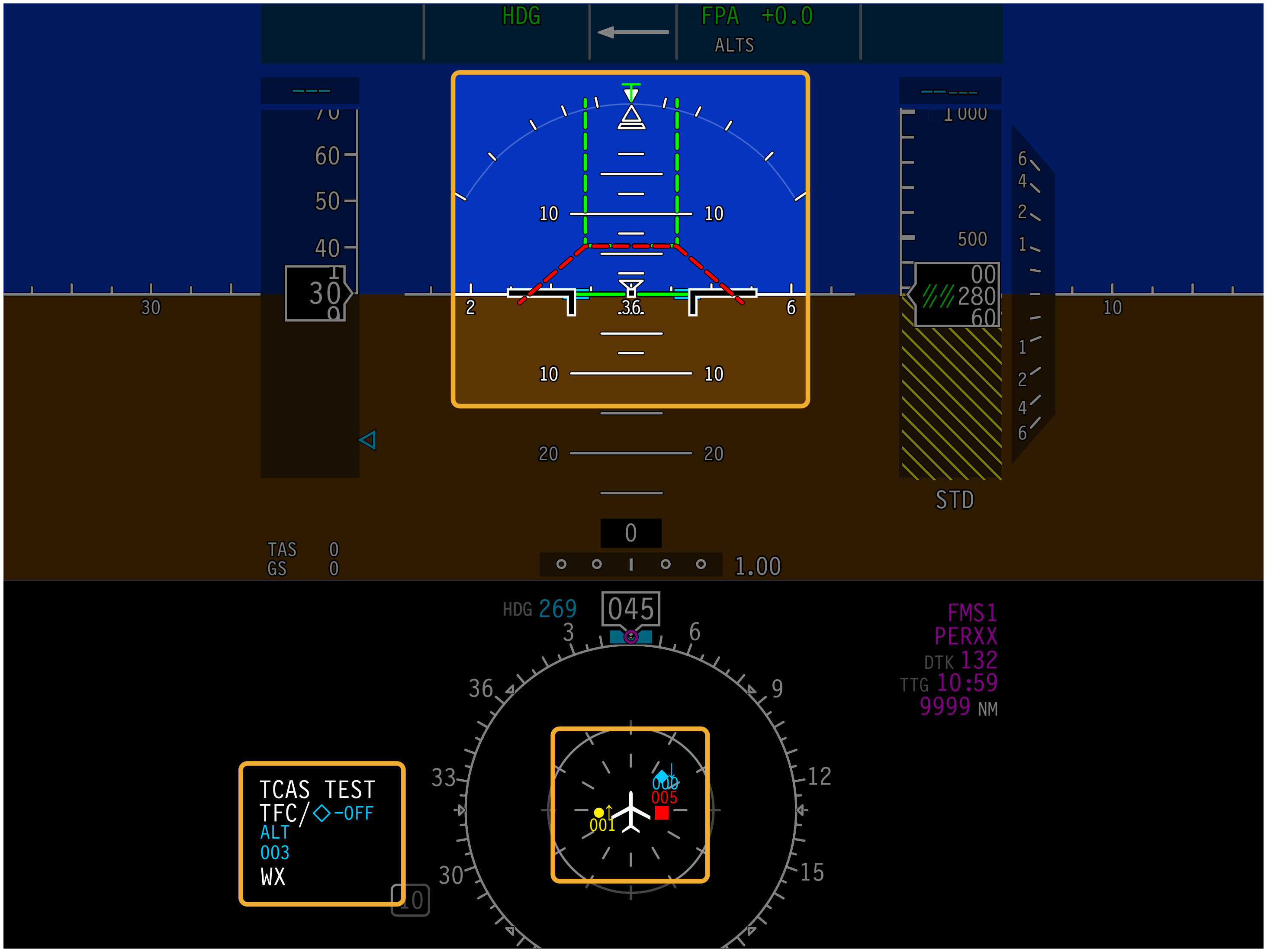


Figure 83: System Test (L2)

TEST INDICATIONS

During the system test, the following symbology appears on the primary flight display (PFD):

- On the attitude director indicator (ADI), red avoidance zone and a green fly to box zone
- On the center of the horizontal situation indicator (HSI), a yellow, a blue, and a red traffic symbol
- On the left HSI, white and blue text appear as shown in the figure



PRIMARY FLIGHT DISPLAY

Figure 84: Test Indications (L2)

SYSTEM MONITORING

Detected TSS malfunctions are indicated by a light-emitting diode (LED) on the front face of the TSS processing unit, PFD annunciation, and by CAS messages.

These LEDs indicate TCAS status during and following self-test, as well as results of any continuous monitoring errors detected during normal operations.

The following table explains the meaning of each status LED:

Table 17: Status LEDs

NAME	MEANING
LRU STATUS	Green: OK; Red: failure.
UPPER ANT FAIL	Impedance of upper antenna does not meet specifications.
LOWER ANT FAIL	Impedance of lower antenna does not meet specifications.
CONTROL INPUT	Control panel failure detected.
ALTITUDE INPUT	Selected altitude source is failed or missing.
RAD ALT INPUT	Selected radio altitude inputs missing or two radio altitude inputs disagree.
HEADING INPUT	One of the following is missing: selected heading, pitch angle, roll angle, true heading.
R/A DISPLAY	Missing discrete input from DU confirming proper display of R/A.
T/A DISPLAY	Missing discrete input from DU confirming proper display of T/A.

CS1.CS3_TB34.001

CS1_CS3_3443_007

Figure 85: Traffic Surveillance System Monitoring (L2)

CAS Messages

The following page provides the CAS and INFO messages for the traffic surveillance system.

Table 18: CAUTION Messages

MESSAGE	LOGIC
TCAS FAIL	TCAS failed.
TCAS OFF	TCAS is in the STBY mode.
ADS-B OUT FAIL	ADS-B not capable of reporting it's position due to either GPS or XPDR failure (TBC).

Table 19: INFO Messages

MESSAGE	LOGIC
34 AVIONIC FAN FAULT - TSS FAN INOP	TSS unit is reporting a failed fan.
34 AVIONIC FAULT - XPDR 1 INOP	Indicated transponder has failed, and there are no RIU or DCU failures that could account for that, and the LRU has power.
34 AVIONIC FAULT - XPDR 2 INOP	Indicated transponder has failed, and there are no RIU or DCU failures that could account for that, and the LRU has power.

34-61 FLIGHT MANAGEMENT SYSTEM

GENERAL DESCRIPTION

The aircraft is equipped with a dual-flight management system (FMS). Each system consists of a flight management system application (FMSA) on two different CCM-5110 common computing modules (CCM).

Each FMS is integrated with the navigation system and auto flight.

The system generates output to the display units that provide the flight crew with visual indications of FMS performance.

The FMS interfaces with the following navigation systems:

- Dependent position determining
  - Global navigation satellite system (GNSS)
  - Distance measuring equipment (DME)
  - VHF-NAV
- Flight environment
  - Air data system (ADS)
- Independent position determining
  - Inertial reference system (IRS)
  - Weather radar (WXR)
  - Terrain awareness and warning system (TAWS)
  - Traffic surveillance system (TSS)

The information management system (IMS) provides the interface to upload the navigation and performance databases, flight plan routes, and waypoints to the FMS. Waypoints can also be manually entered by the crew.

DC ESS BUS 3 provides power to IPC 1, and DC ESS BUS 2 to IPC 2. Each IPC has a power supply and environmental module (PEM). The PEM converts the input power to the regulated 12 VDC required by the CCMs.

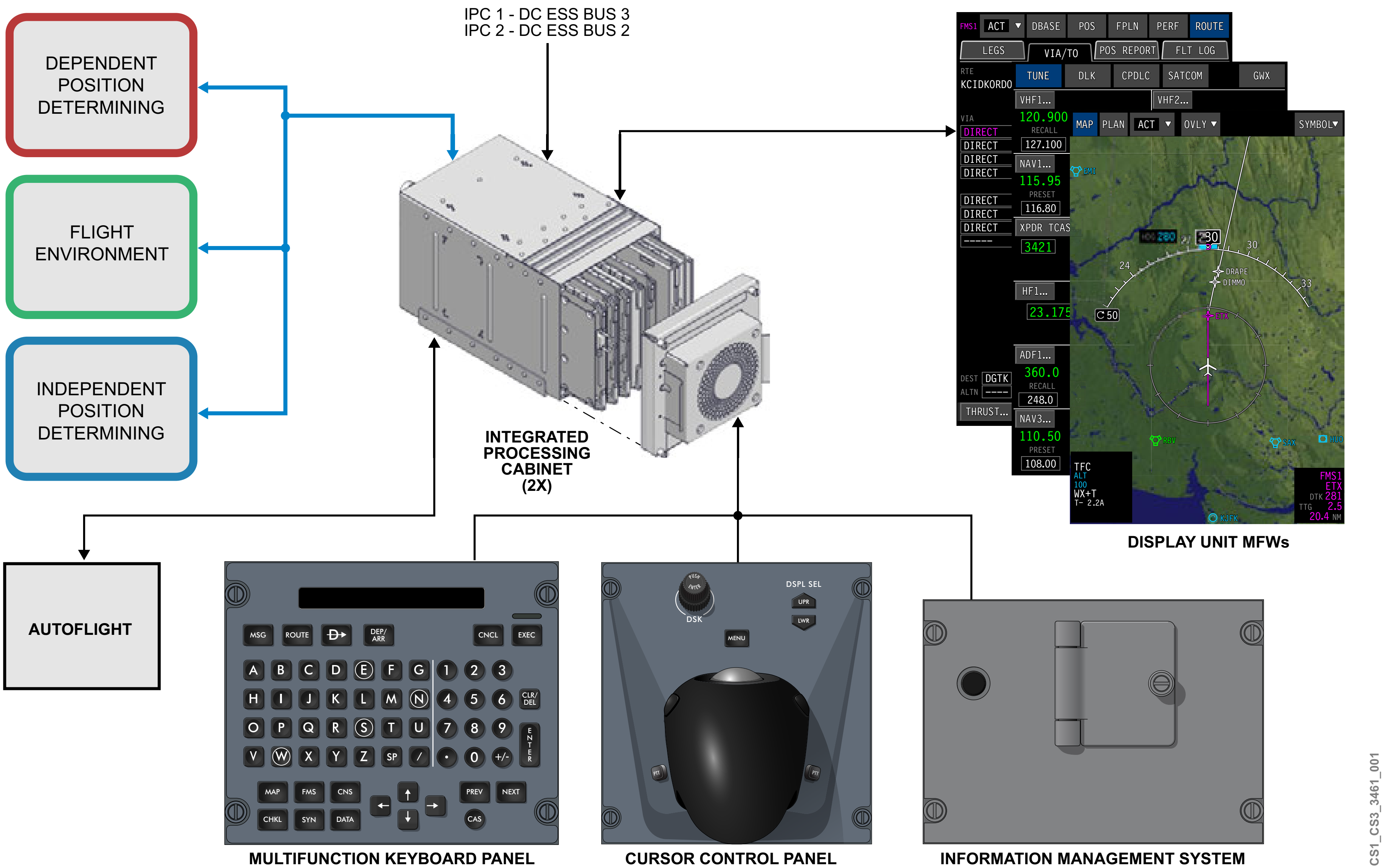


Figure 86: Flight Management System (L2)

COMPONENT LOCATION

The CCMs containing the FMSA are installed in slot 2 in IPC 1 and IPC 2. The IPCs are located in the forward equipment bay.

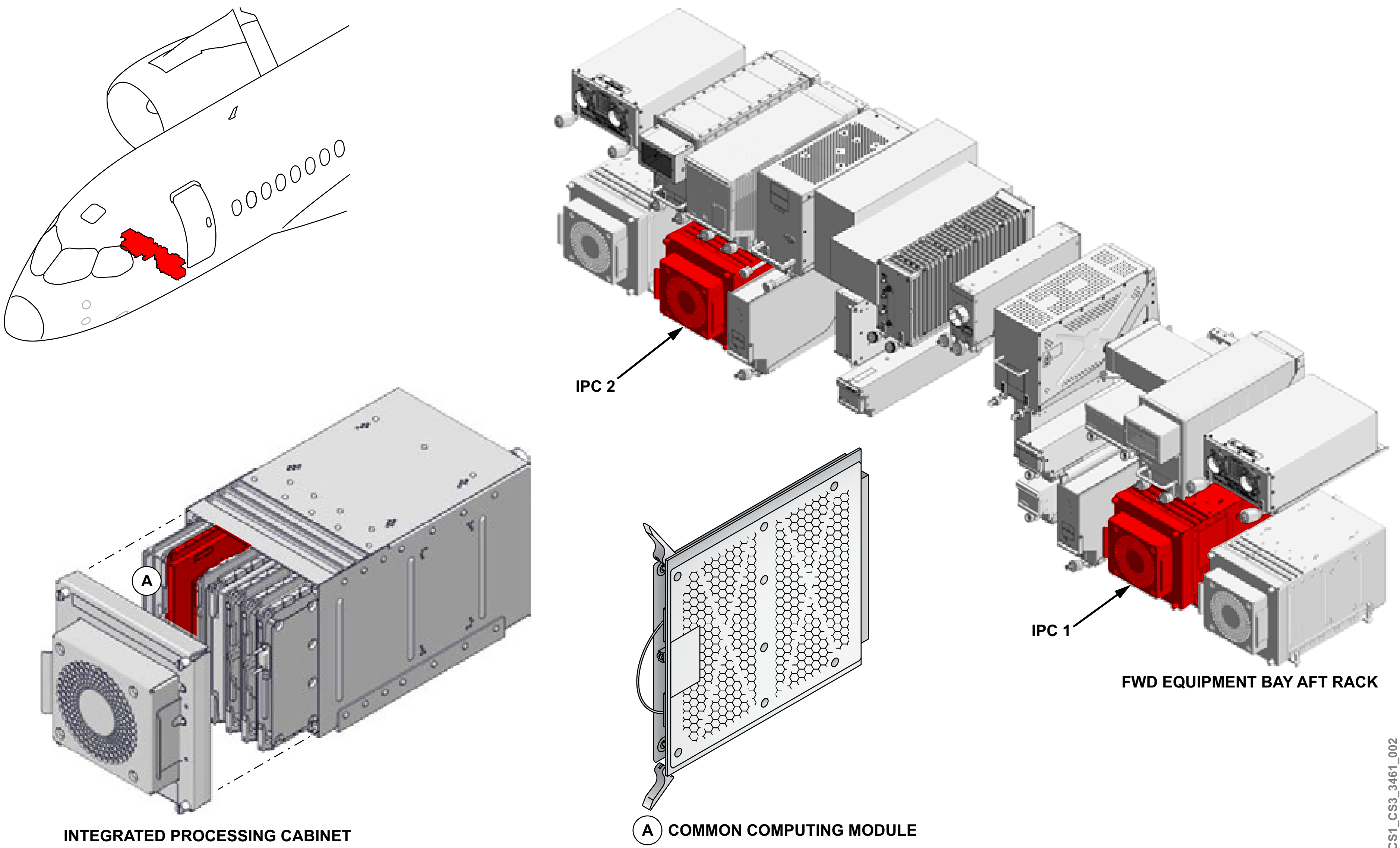


Figure 87: Component Location (L2)

CONTROLS AND INDICATIONS

Crew members can control the FMS from either side of the flight deck, using the multifunction keyboard panels (MKPs), the control tuning panels (CTPs), the cursor control panels (CCPs) and a multifunction window (MFW).

MULTIFUNCTION KEYBOARD PANEL

The MKP has the following FMS quick-access keys:

- MSG - Displays the FMS MESSAGES dialog box on the onside MFW
- ROUTE - Displays the ROUTE format
- Direct to/Offset - Displays a DIRECT TO dialog box
- DEP/ARR - Opens the departure or arrival dialog box
- CNCL - Cancels an inprocess flight plan edit
- EXEC - Executes a modified flight plan
- FMS - Displays a FMS format on the MFW

CONTROL TUNING PANEL

The control tuning panel (CTP) provides quick-access buttons to select the FMS format window on left or right MFW of inboard DUs. The CTP allows selection of FMS 1 or FMS 2 as the navigation source. By default, FMS 1 source is selected on the left primary flight display (PFD), and FMS 2 source on the right PFD.

FMS FORMAT WINDOWS

The FMS format windows are a set of FMS display formats within any multifunction window.

The format windows contain a permanent top tile bar with the following menus:

- D BASE (database operations)
- POS (position initialization)
- FPLN (including initialization, winds, fuel and extended-range operation (ETOPS)
- PERF (including VNAV, thrust, weight and balance, dep/arr perf)
- ROUTE (route planning)

The FMS source is shown on the left of the top tile bar and indicates which FMS has been selected as NAV source.

GRAPHICAL FLIGHT PLANNING

Graphical flight planning allows the crew to highlight and select flight plan graphic objects displayed on a MFW. Selecting an object opens a task menu or dialog box. This menu/dialog box contains numerous interactive functions which can be used to edit, or modify the flight plan.

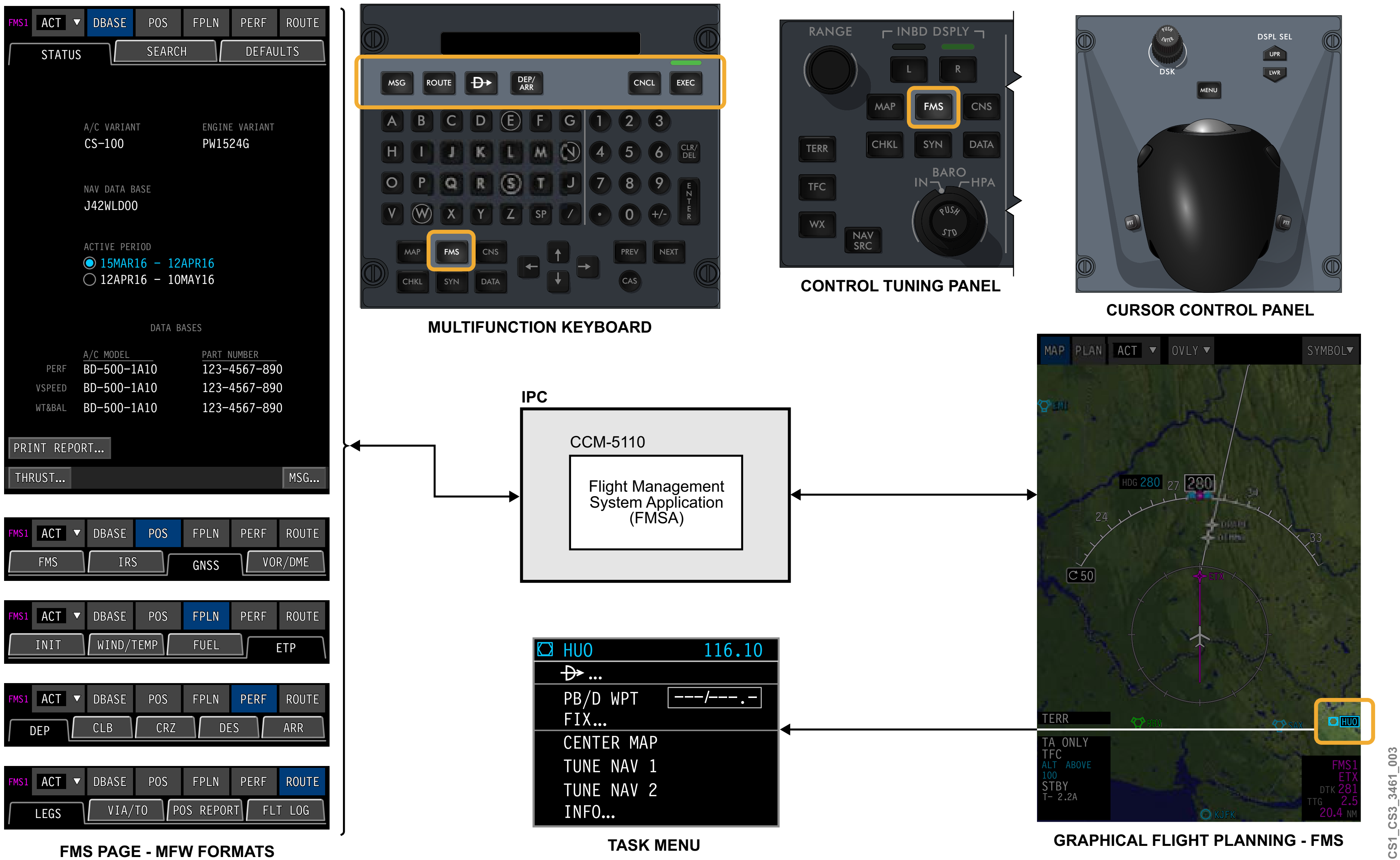


Figure 88: Controls and Indications (L2)

OPERATION

The FMS has three modes of operation:

- Synchronized mode
- Single mode
- Split mode

SYNCHRONIZED MODE

The synchronized mode is the normal mode of operation, where both systems are operational, and they communicate with each other (cross-talk).

SINGLE MODE

When one of the systems is no longer functional, the remaining FMS goes in single mode.

SPLIT MODE

FMS 1 and FMS 2 are not able to synchronize flight plan changes between the systems. Sensor data is independently provided to each FMS.

A message is displayed to indicate the situation to the pilots.

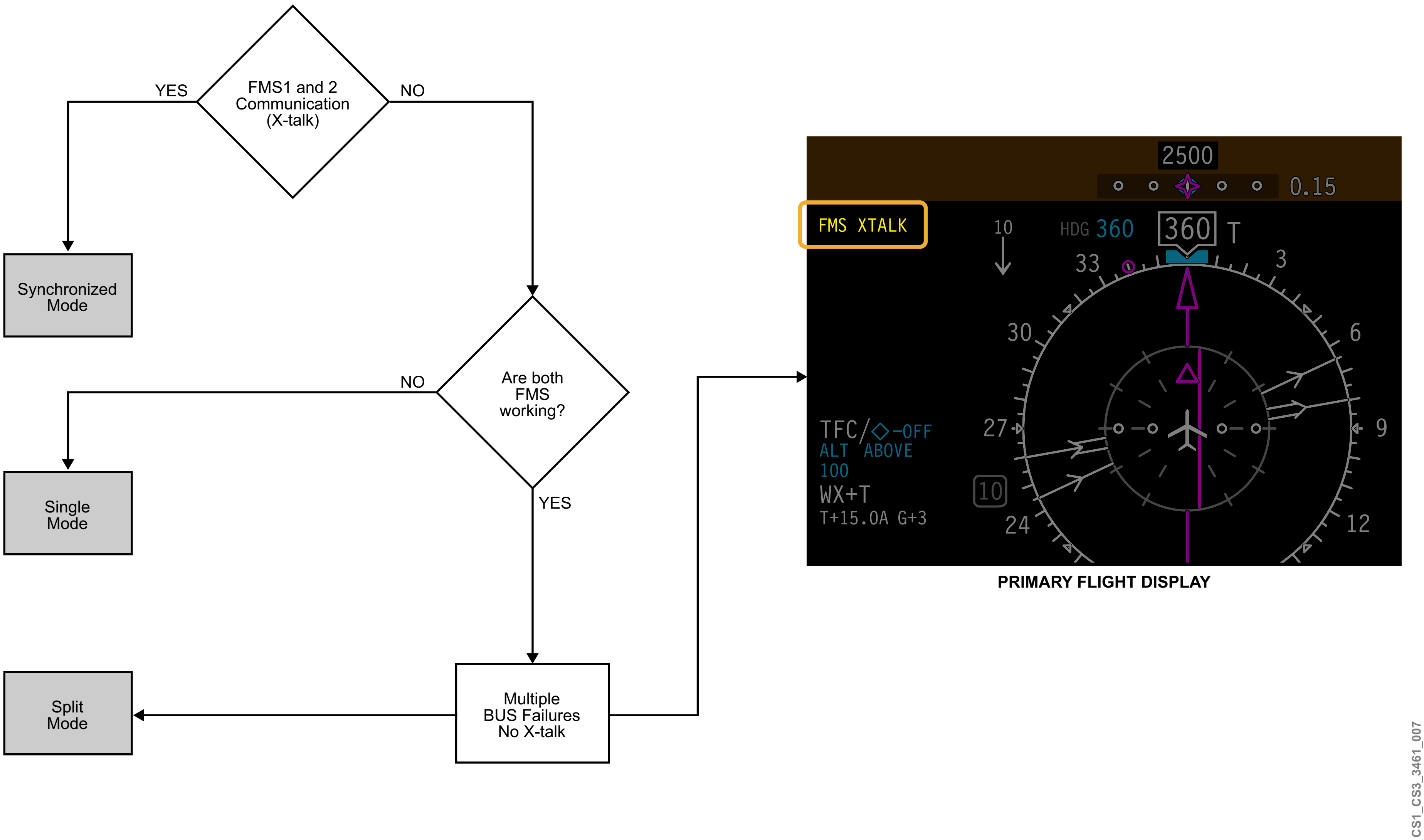


Figure 89: Operation (L2)

DETAILED DESCRIPTION

SYSTEM INTERFACE

Each FMS is capable of receiving data from both data concentrator module cabinets (DMCs) via avionics full duplex switched Ethernet (AFDX).

The system interfaces with the following navigation system groups:

- Independent position determining
- Flight environment
- Dependent position determining

Independent Position Determining

The FMS receives latitude and longitude, true and magnetic heading, true velocity, pitch and roll angle, present position, primary NAV mode, and inertial vertical acceleration from the inertial reference system (IRS). The IRS sends the data to the FMS via the DMC.

The DMC also relays initialization data from the FMS to the IRS.

The FMS provides reference data, including aircraft trajectory, to the terrain awareness and warning system (TAWS) for overlaying information on the displays. Based on a solution determined by the FMS, flight path and vertical situation display information is sent by the FMS so TAWS can overlay the appropriate terrain map on the flight path and vertical situation display (VSD).

Flight Environment

The FMS receives barometric altitude, vertical speed, indicated air speed, and true air speed from the air data system (ADS).

Dependent Position Determining

The global navigation satellite system (GNSS) interfaces with the FMS via the DMCs.

The VHF-NAV and distance measuring system (DME) data is routed through the radio interface unit (RIU) and the DMCs, to the FMS.

The system sends tuning commands to the VHF-NAV and DME via DMC and RIU.

Other Interfacing Systems

The FMS interfaces via the DMC with the following systems:

- Engine electronic control (EEC) providing fuel flow
- Auto flight system, for thrust management information, auto pilot and autothrottle status
- Landing gear and steering control unit (LGSCU), for weight-on-wheels (WOW) status
- Engine indication and crew alerting system (EICAS), fuel quantity information
- Information management system (IMS), for data upload

The system also sends data to the health management monitoring unit (HMU), and faults to the onboard maintenance system (OMS).

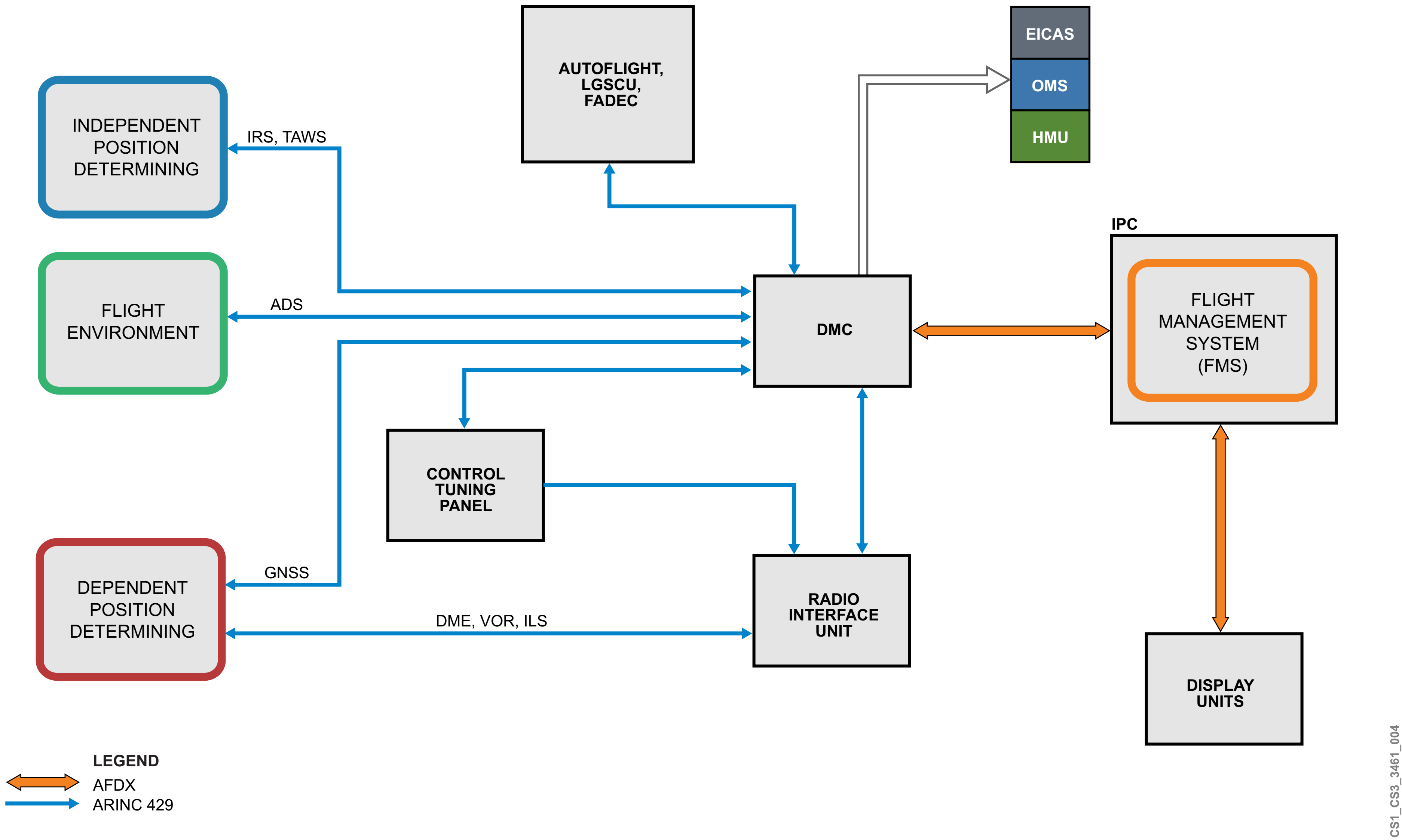


Figure 90: System Interface (L3)

MONITORING AND TESTS

The operational and status messages from the FMS may be shown on one or more locations on the primary flight display (PFD), and the multifunction window (MFW).

The FMS messages are divided as follow:

- Dialog box
- Horizontal situation indicator (HSI) message fields and lines
- Flags
- Aural

DIALOG BOX

The FMS messages dialog box is accessible by selecting the MSG soft key at the bottom of any FMS format page. This allows the crew to view current and historical messages.

The current highest priority yellow messages appear in the HSI area.

Another way to access the dialog box is by selecting the MSG key on the MKP.

HORIZONTAL SITUATION INDICATOR MESSAGE FIELDS AND LINES

To ensure the immediate attention of the crew, message fields and crew awareness messages appear in the HSI area as a complement to the dialog box messages.

FLAGS

When an FMS associated data is missing or failed, indications are displayed on the PFD in the form of a red or yellow flag.

When the FMS is the selected NAV source, a flag at the top right HSI indicates that data is missing or invalid.

The bottom PFD flag indicates that the FMS data is missing or failed.

AURAL

The VNAV vertical track alert is announced by a double C chord sound from the flight deck speaker, when approaching top of descent.

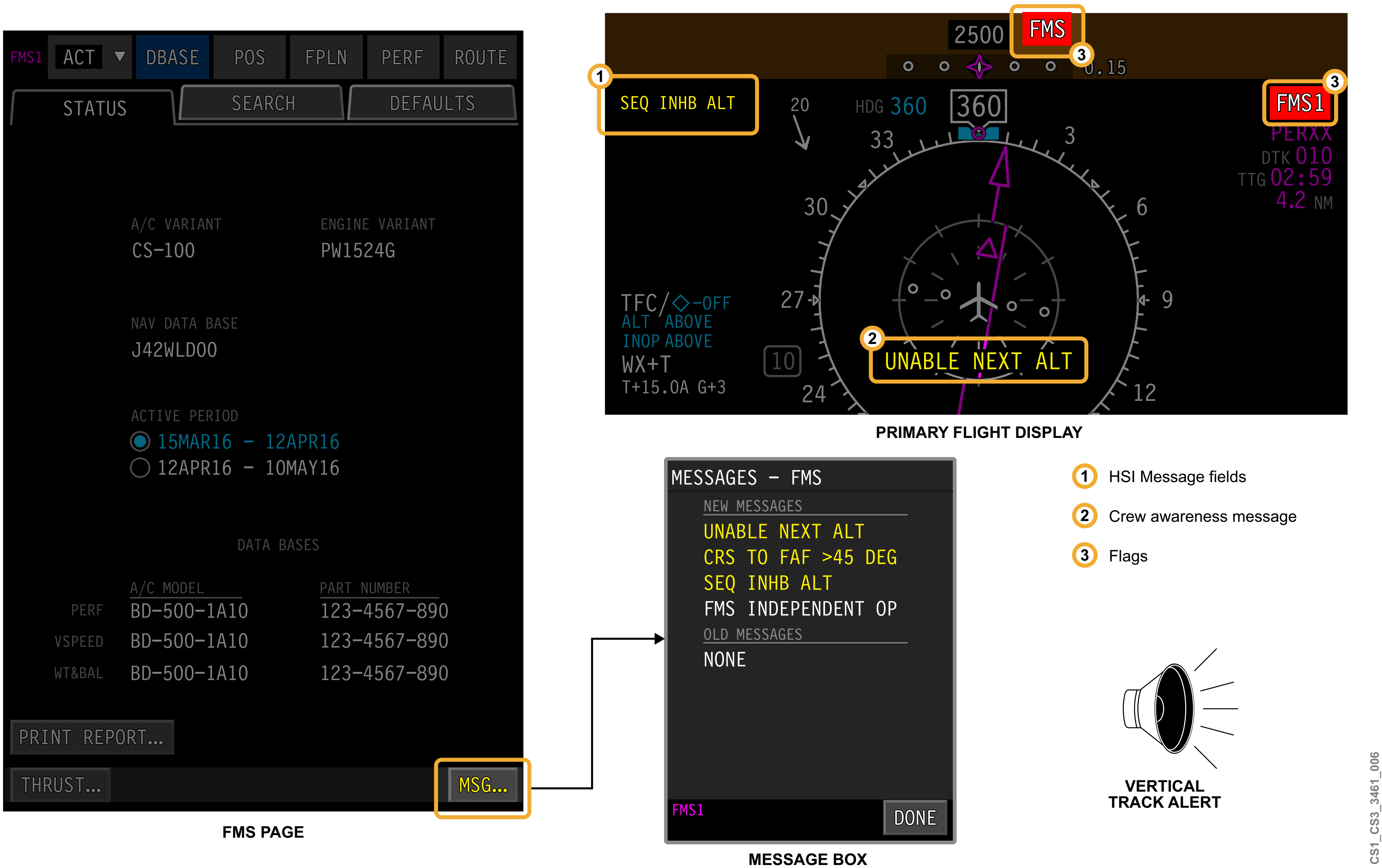


Figure 91: Monitoring and Tests (L2)

CAS MESSAGES

The following page provides the CAS and INFO messages for the flight management system.

Table 20: CAUTION Messages

MESSAGE	LOGIC
FMS PERF DEP CONFIG	Mismatch between sensed A/C Configuration state (bleeds, anti-ice switches, slat/flap lever position) and FMS entered configuration.
FMS PERF DEP VSPEEDS	FMS cross speed check has found V-speeds values entered not between minimum/maximum operational allowed values.
FMS 1 FAIL	FMS 1 detected a failure.
FMS 2 FAIL	FMS 2 detected a failure.
APPROACH NOT AVAIL	Shows when a GNSS approach is selected, the aircraft is in the arrival terminal area, the FMS navigation mode is not GNSS base or the SBAS service provider is not available (for an LPV only approach) or the GNSS accuracy is less than required for the approach.
LPV NOT AVAIL	Shows when a GNSS LPV approach is selected, the aircraft is in the arrival terminal area, and the FMS navigation mode is not GNSS based, or the SBAS service provider is not available, or the GNSS accuracy is less than required for the approach.
GNSS NOT AVAIL	Shows when the FMS is not using GNSS position data as part of its calculations to determine position. Shows if any of the conditions that follow is true: • All GNSS sensors are not available and at least one sensor is enabled, or • At least one sensor is disabled and one sensor is enabled and no enabled sensor is available
UNABLE RNP	Shows when a loss of integrity (LOI) condition exits. The aircraft may not be able to maintain the required RNP accuracy when this message shows.

Table 20: CAUTION Messages

MESSAGE	LOGIC
FMS POSITION	Will be posted when FMS messages INITIALIAZE POSITION or RE-ENTER SET POS or RESET INITIAL POS is posted.
FMS FUEL	Will be posted when FMS messages CHECK FUEL AT ALTN or CHECK FUEL AT DEST or CHECK FUEL PLAN is posted.

PRACTICAL ASPECTS

DATA LOADING

To load and update the various databases required by the FMS, the system interfaces with the information management system (IMS).

The onboard data loader (ODL) application, within the IMS, permits loading of all required data and software, including performance and 28-day navigation databases.

Upload progress can be observed on the DATALOAD page. At the end of the process, a green notification message appears, indicating that all files have been uploaded without errors. If an error occurs, a yellow message appears under the status column to identify the file.

Figure 92: Data Loading (L2)

SHUNT CONFIGURATION

The module containing the FMSA has a shunt located on the front to allow power removal from the CCM.

By using this feature, the CCM can be disabled without removing the LRM.

A green LED (functional), and a red LED (fault) are located on the sides of the shunt. To confirm that there is no power on the module, no LED should be lit.

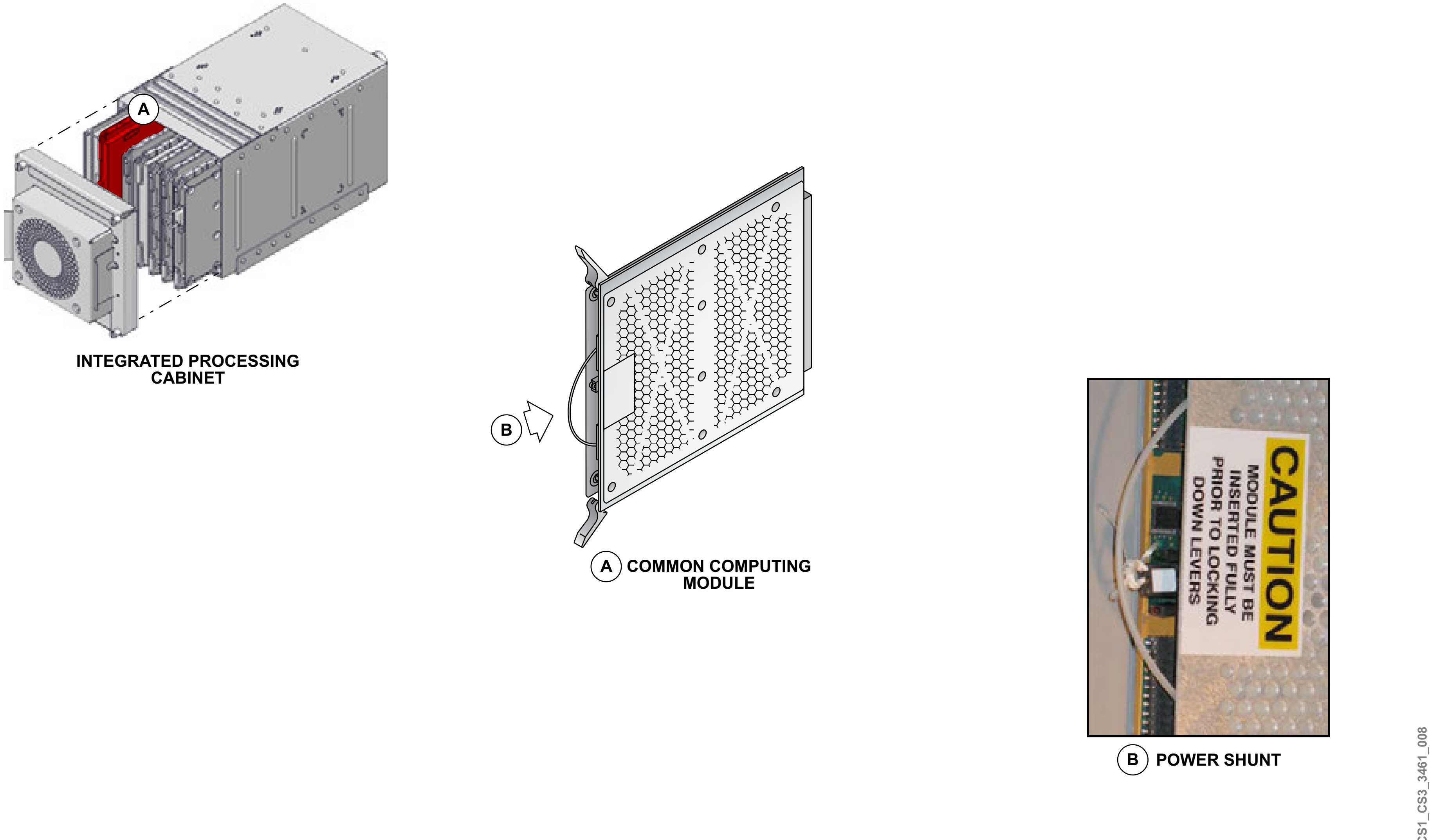


Figure 93: Shunt Configuration (L2)

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ATA 44 - Cabin Systems

BD-500-1A10
BD-500-1A11

Table of Contents

44-11 Cabin Management System 44-2
General Description 44-2
Cabin Distribution System.. 44-4
Cabin Management System Power 44-6
Passenger Address.. 44-8
Cabin Interphone System 44-10
Emergency Evacuation 44-12
Hijack Warning (Optional)... 44-14
Lighting 44-16
Passenger Service System....................................... 44-18
Boarding Music System and Prerecorded Announcements 44-20
Component Location 44-22
Cabin Controller 44-22
Crew Terminal... 44-22
Handsets 44-22
Passenger Service Unit Controllers 44-22
Zone Boxes 44-22
Component Information 44-24
Cabin Controller 44-24
Handset... 44-26
Customer Service Display (Optional)......................... 44-28
Controls and Indications 44-30
Operation 44-32
Cabin Management System Crew Terminal Screen Map... 44-32
CMS Screen Header and Footer 44-34
Log in Screen.. 44-36
Flight Data Screen 44-38
Prerecorded Announcements and Messages Screen 44-40
Boarding Music Screen 44-42
Passenger Calls Screen.. 44-44
Passenger Reading Lights Screen............................ 44-46
Messages Screen 44-48
Electronic Cabin Logbook Screen (Optional) 44-50
Customer Service Display (Optional) 44-52
Maintenance Screens 44-54
Detailed Description 44-128
Cabin Management System Modes 44-128
Cabin Management System Interface 44-130
Cabin Management System Failure Modes 44-132
Monitoring and Tests 44-152
CAS Messages 44-153
Practical Aspects 44-154
Cabin Management Data Loading 44-154

List of Figures

Figure 1: Cabin Management System Interface (L2)...........44-3
Figure 2: Cabin Distribution System (L2).............................44-5
Figure 3: Cabin Management System Power (L2) 44-7
Figure 4: Passenger Address System (L2)...........................44-9
Figure 5: Cabin Interphone System (L2) 44-11
Figure 6: Emergency Evacuation System (L2) 44-13
Figure 7: Hijack Warning (Optional) (L2) 44-15
Figure 8: Cabin Lighting (L2) 44-17
Figure 9: Passenger Service System (L2)...........................44-19
Figure 10: Boarding Music and Prerecorded Announcement Schematic (L2) 44-21
Figure 11: Cabin Management System Component Location (L2) 44-23
Figure 12: Cabin Controller (L2) 44-25
Figure 13: Handset (L2)..44-27
Figure 14: Customer Service Display (L2)...........................44-29
Figure 15: Cabin Interphone System Controls and Indications (L2)...44-31
Figure 16: Crew Terminal Screen Map (L2) 44-33
Figure 17: CMS Screen Header and Footer (L2) 44-35
Figure 18: Log In Screen (L2)..44-37
Figure 19: Flight Data Screen (L2) 44-39
Figure 20: Prerecorded Announcements and Messages Screen (L2) 44-41
Figure 21: Boarding Music Screen (L2)................................44-43
Figure 22: Passenger Calls Screen (L2) 44-45
Figure 23: Reading Lights Screen (L2) 44-47
Figure 24: Messages Screen (L2)....................................... 44-49
Figure 25: Electronic Cabin Logbook Screen (L2) 44-51
Figure 26: Customer Service Display Screen (L2).............. 44-53
Figure 27: Maintenance Screen Access (L2)....................... 44-55
Figure 28: Maintenance Password Screen (L2).................. 44-57
Figure 29: Maintenance Screen Layout (L2)....................... 44-59
Figure 30: Layout of Passenger Area (L2).......................... 44-61
Figure 31: System Tests Screen (L2) 44-63
Figure 32: Quick Test and Quick Test Details Screens (L2) 44-65
Figure 33: All Test and Review All Test Details Screens (L2) 44-67
Figure 34: Decompression Test Screen (L2) 44-69
Figure 35: Lamp Test Screen (L2) 44-71
Figure 36: PA Test Screen (L2) 44-73
Figure 37: Review Flight Legs Screen (L2)......................... 44-75
Figure 38: Fault Trends Screen (L2)................................... 44-77
Figure 39: View Reboots Log Screen (L2).......................... 44-79
Figure 40: System Status Screen 44-81
Figure 41: Maint Aircraft Information Screen (L2)............... 44-83
Figure 42: Discrete/Comm Status Screen (L2).................... 44-85
Figure 43: LRU Status Screen (L2)..................................... 44-87
Figure 44: LRU Commanded Output Screen (L2) 44-89
Figure 45: System Status Reset Screen (L2) 44-91
Figure 46: System Maint Screen (L2) 44-93

Figure 47: RJ-45 Port Configuration Screen (L2) 44-95
Figure 48: Flight Mode Screen (L2)....................................44-97
Figure 49: Network Readdress Screen (L2) 44-99
Figure 50: Redundancy Settings Screen (L2) 44-101
Figure 51: System Setting Screen (L2) 44-103
Figure 52: Brightness Setting Screen (L2) 44-105
Figure 53: Speaker Volume Setting Screen (L2)................44-107
Figure 54: Configuration Screen (L2) 44-109
Figure 55: Config Check Screen (L2) 44-111
Figure 56: Content Status Screen (L2)..............................44-113
Figure 57: Content Report Screen (L2) 44-115
Figure 58: Media Report Screen (L2) 44-117
Figure 59: Data Offload Screen (L2) 44-119
Figure 60: Data Offload and Capture Debug Data Screen (L2) 44-121
Figure 61: Loading Screen (L2)..44-123
Figure 62: Load Software Screen (L2) 44-125
Figure 63: Load Media/Content Screen (L2) 44-127
Figure 64: Cabin Management System Modes (L3)...........44-129
Figure 65: Cabin Management System Interface (L3)........44-131
Figure 66: Normal Operation (L3)......................................44-133
Figure 67: Single PSUC Failure (L3) 44-135
Figure 68: Double PSUC Failure (L3)................................44-137
Figure 69: Zone Box Failure (L3).......................................44-139
Figure 70: Cabin Controller Failure (L3) 44-141
Figure 71: Cabin Controller to Zone Box BUS Failure (L3) 44-143
Figure 72: Single LED Lighting Unit Failure (L3) 44-145
Figure 73: Multiple LED Lighting Unit Failures (L3) 44-147
Figure 74: RS-485 BUS Failure Between Two LED Lighting Units (L3)................................... 44-149
Figure 75: Multiple BUS Failures Between LED Lighting Units (L3)... 44-151
Figure 76: Cabin Management Data Loading (L2)............. 44-155

CABIN SYSTEMS - CHAPTER BREAKDOWN

1. Cabin Management System
2. Aircraft Systems
3. Passenger Services
4. Onboard Communications
5. In-Flight Entertainment and Connectivity (IFEC) System (Optional)

44-11 CABIN MANAGEMENT SYSTEM

GENERAL DESCRIPTION

The cabin management system (CMS) provides monitoring and control of the cabin area temperature, lighting, and passenger services. The CMS also provides a means of communication between the cabin and the flight deck and interfaces with aircraft systems through the data concentrator unit module cabinets (DMCs).

A touchscreen crew terminal (CT) provides a graphical user interface to control the CMS. Ethernet communication is used to connect the CT to the cabin controller (CC) through zone box (ZB) 1. An optional CT may be installed in the aft galley to communicate with the CC through ZB 2. The CMS monitors and controls the in-flight entertainment and connectivity system (IFEC), and provides the necessary data for proper operation of the system.

The CC contains all of the software and media files that are used by the CMS and distributes them to the CMS components through the Ethernet bus. The CC also performs data processing for the CMS system in normal operation. The ZBs send and receive commands for their respective cabin zones and convert received information to the required signal type for the end user.

The CMS provides analog audio interfaces with the audio control panels (ACPs) for passenger address and communication between the flight deck and cabin.

The CMS has an optional printer that can be connected to the crew terminal.

The CMS has field-loadable software. Software loading is independent of the aircraft data loading system (ATA 46) for security reasons. The software can be loaded at the CMS port on the flight deck maintenance panel or at the crew terminal.

The CMS has a centralized maintenance function for all integrated and connected cabin systems, collecting and displaying faults on the crew terminal for CMS faults, and Panasonic in-flight entertainment (IFE) system faults.

A CMS data link option enables the CMS to communicate with the ground using the aircraft communications addressing and reporting system (ACARS). Interface between the ACARS and the CMS is done through the DMCs.

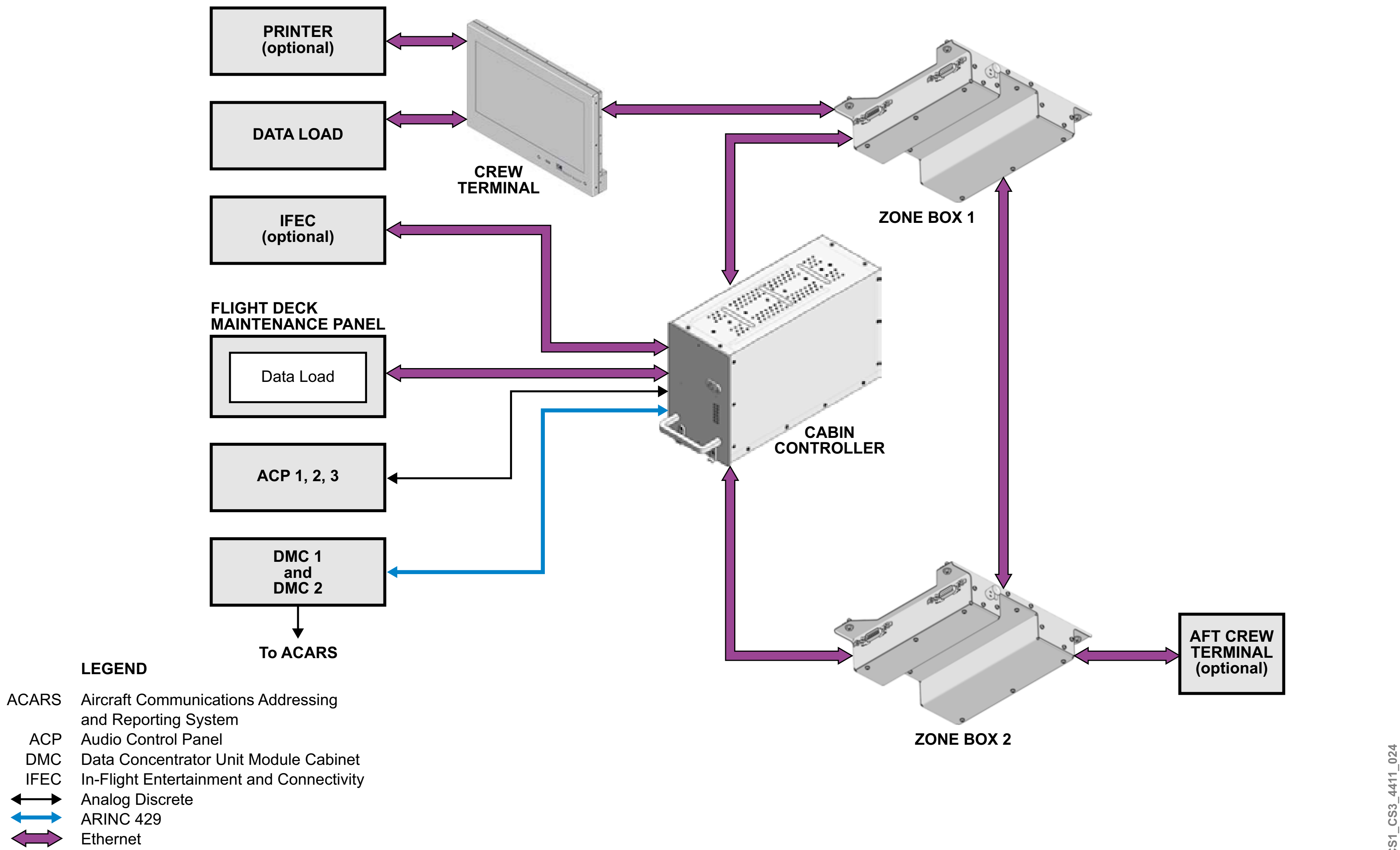


Figure 1: Cabin Management System Interface (L2)

CABIN DISTRIBUTION SYSTEM

The cabin distribution system is responsible for distributing CMS network data from the cabin controller. The crew terminal is the interface for control of the cabin systems and related aircraft systems.

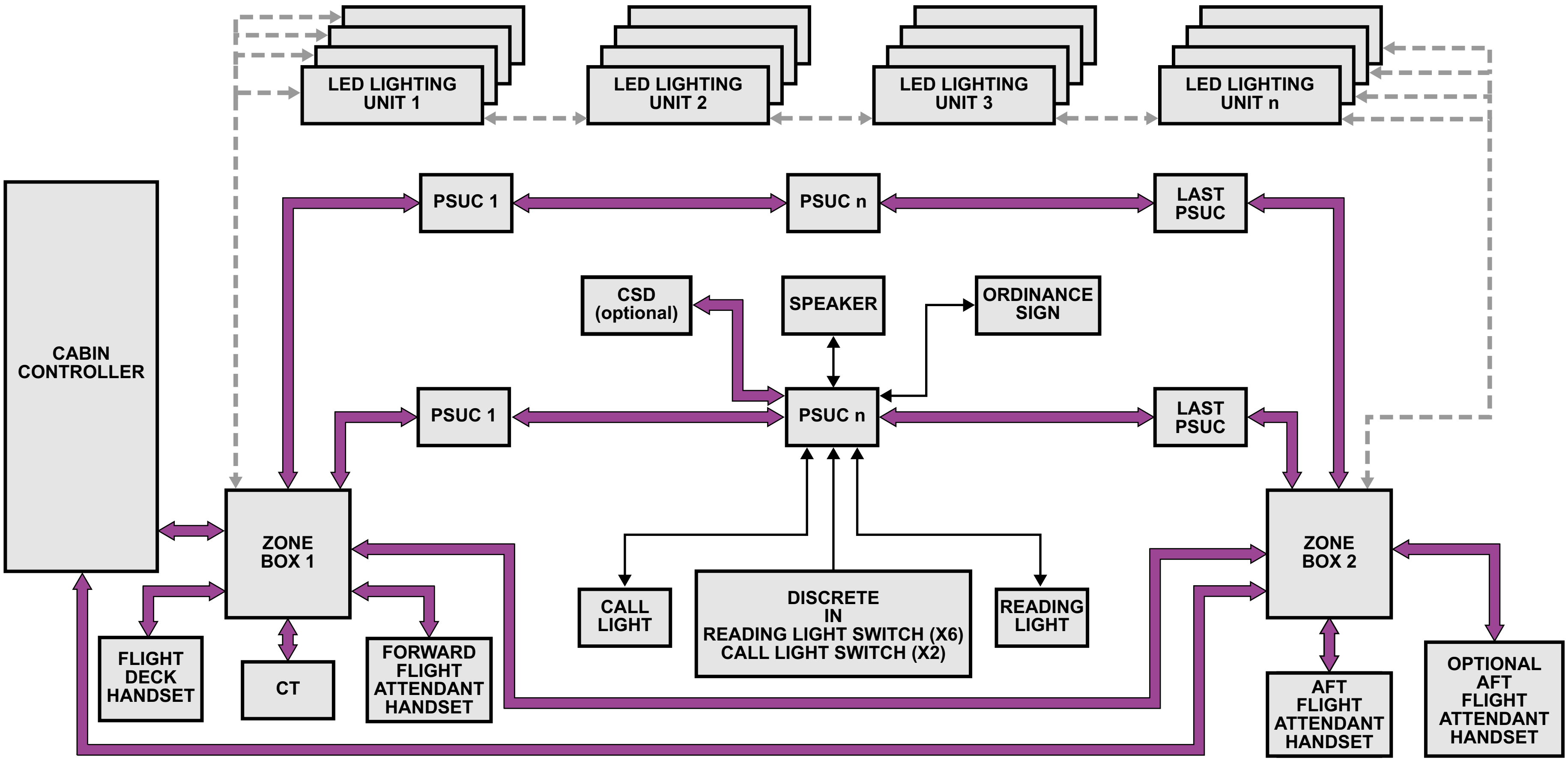
The zone box (ZB) is the main interface with the cabin controller. The ZB acts as a network switch, routing network messages between the cabin controller (CC) and the passenger service unit controller (PSUC). The ZB distributes network data, controls cabin lighting, interfaces with cabin handsets, and supports addressing the PSUCs.

The ZB controls the cabin light units, based on lighting scenarios selected from the lighting menu on the crew terminal. The LED lighting units interface with both ZBs, ensuring continued operation should one ZB fail.

Three handsets interface with the ZBs to provide an interphone and passenger address system. An optional handset may be installed in the aft entryway.

The ZB provides two PSUC Ethernet interfaces to support up to 18 PSUCs. The redundancy cable is connected from ZB 1 to ZB 2. The redundancy cable provides an additional control path in the event of a PSUC cable failure or PSUC processor failure.

Each PSUC controls two passenger service units equipped with reading lights and reading light switches, a call light and switch, a speaker, and either an ordinance sign or an optional customer service display (CSD). The PSUCs receive audio inputs from the CCs through the ZBs to reproduce boarding music, prerecorded announcements, or passenger address audio over the speakers. The PSUCs also generate audio tones for the passenger call system, passenger address, and cabin interphone systems.



LEGEND

CSD	Customer Service Display
CT	Crew Terminal
PSUC	Passenger Service Unit Controller
→	Discrete
⇔	Ethernet
⇠⇢	RS-485

Figure 2: Cabin Distribution System (L2)

CABIN MANAGEMENT SYSTEM POWER

The following components receive power from DC ESS BUS 1 for normal operation:

- Zone box 1
- Left PSUCs

The following components receive power from DC ESS BUS 2 for normal operation:

- Cabin controller
- Zone box 2
- Right PSUCs

Secondary power is supplied by DC BUS 1 to the following components:

- Cabin controller
- Zone box 1
- Zone box 2
- Left PSUCs

Secondary power is supplied by DC BUS 2 to the following components:

- Right PSUCs

This allows these components to operate when the aircraft is powered in the ground service mode to provide lighting for maintenance and servicing.

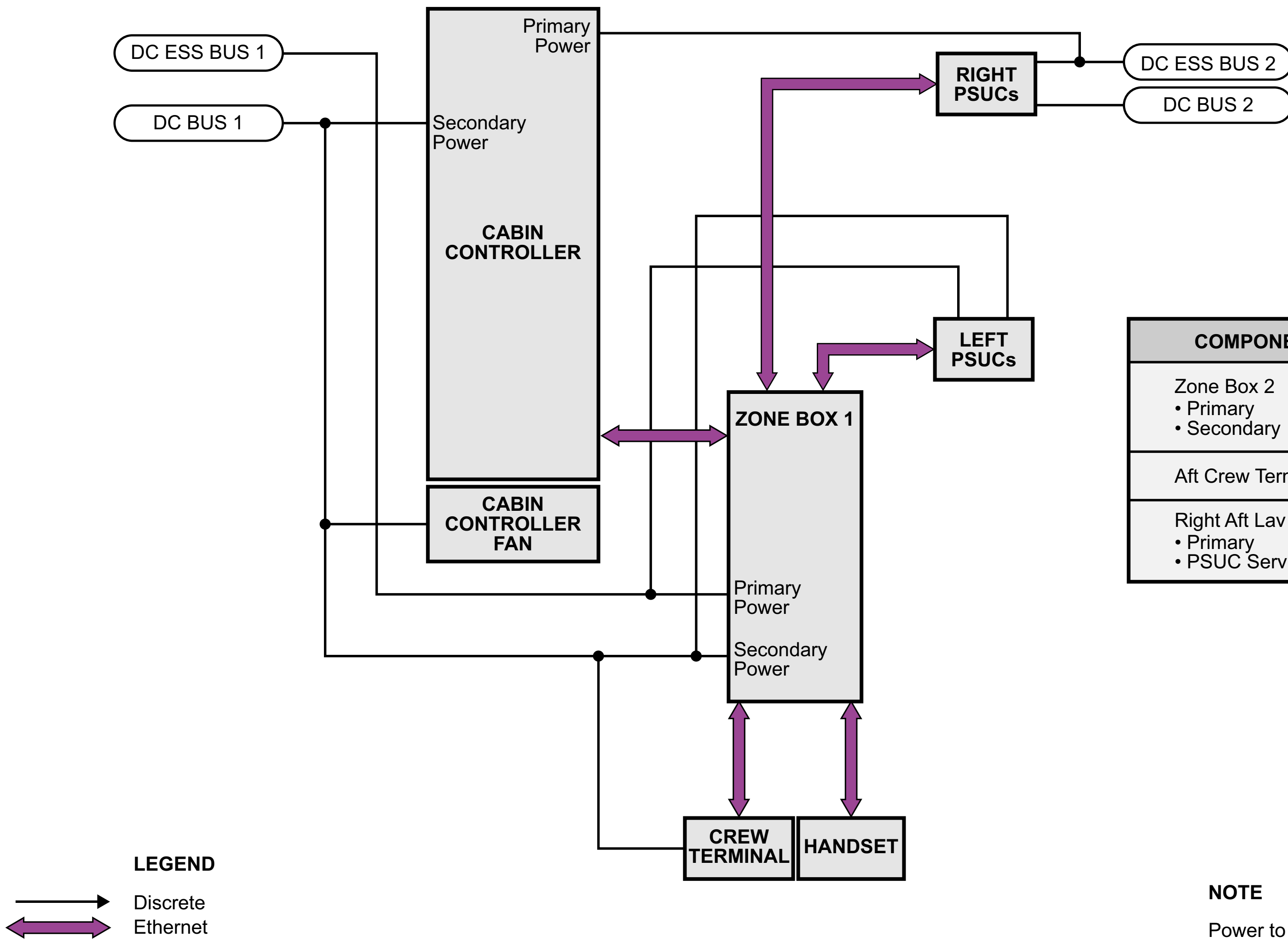
The cabin controller fan is powered by DC BUS 1.

The optional right aft lavatory PSUCs receive primary power from DC ESS BUS 2 and secondary power from DC BUS 1. This allows the lavatory and galley lighting to remain powered in ground service mode.

The crew terminal is powered by DC BUS 1. The optional aft terminal is powered by DC BUS 1 as well.

Each handset receives power over the Ethernet from the zone box.

Power to the CMS system can only be removed by opening the SSPCs in the eCB synoptic page.



COMPONENT	POWER
Zone Box 2 • Primary • Secondary	DC ESS BUS 2 DC BUS 1
Aft Crew Terminal	DC BUS 1
Right Aft Lav PSUC • Primary • PSUC Service	DC ESS BUS 2 DC BUS 1

NOTE

Power to the CMS system can only be removed by opening the SSPCs in the eCB synoptic page.

Figure 3: Cabin Management System Power (L2)

PASSENGER ADDRESS

The CMS permits any handset to initiate a passenger address (PA) announcement. The PA is accessed using the handset dial pad and push-to-talk (PTT) button.

PA announcements from the flight deck can be made through the flight deck handset or the audio control panel (ACP) PA selection at any crew station. PA audio from the flight deck ACPs is routed through the CC for processing and distribution by the zone boxes. The zone boxes feed the passenger service unit controllers (PSUCs). Each PSUC drives two cabin speakers. The CC also provides feedback to the ACPs so the PA audio can be heard in the headsets.

The PA system has a priority order:

- Flight deck
- Forward cabin handset
- Aft cabin handset
- Prerecorded announcements
- Boarding music

When a PA announcement is made, the CMS plays a Lo chime and illuminates the green PA master call light in the zones where the PA is active, and indicates on the CT that a PA announcement is in progress.

Video and audio entertainment is paused and muted when a PA announcement is made. Upon completion of the PA announcement, the paused video and audio resumes where it left off.

To operate the PA system, remove the handset from the cradle, dial the destination code (i.e. 11 for PA ALL). Use the push-to-talk (PTT) button and speak into the handset microphone.

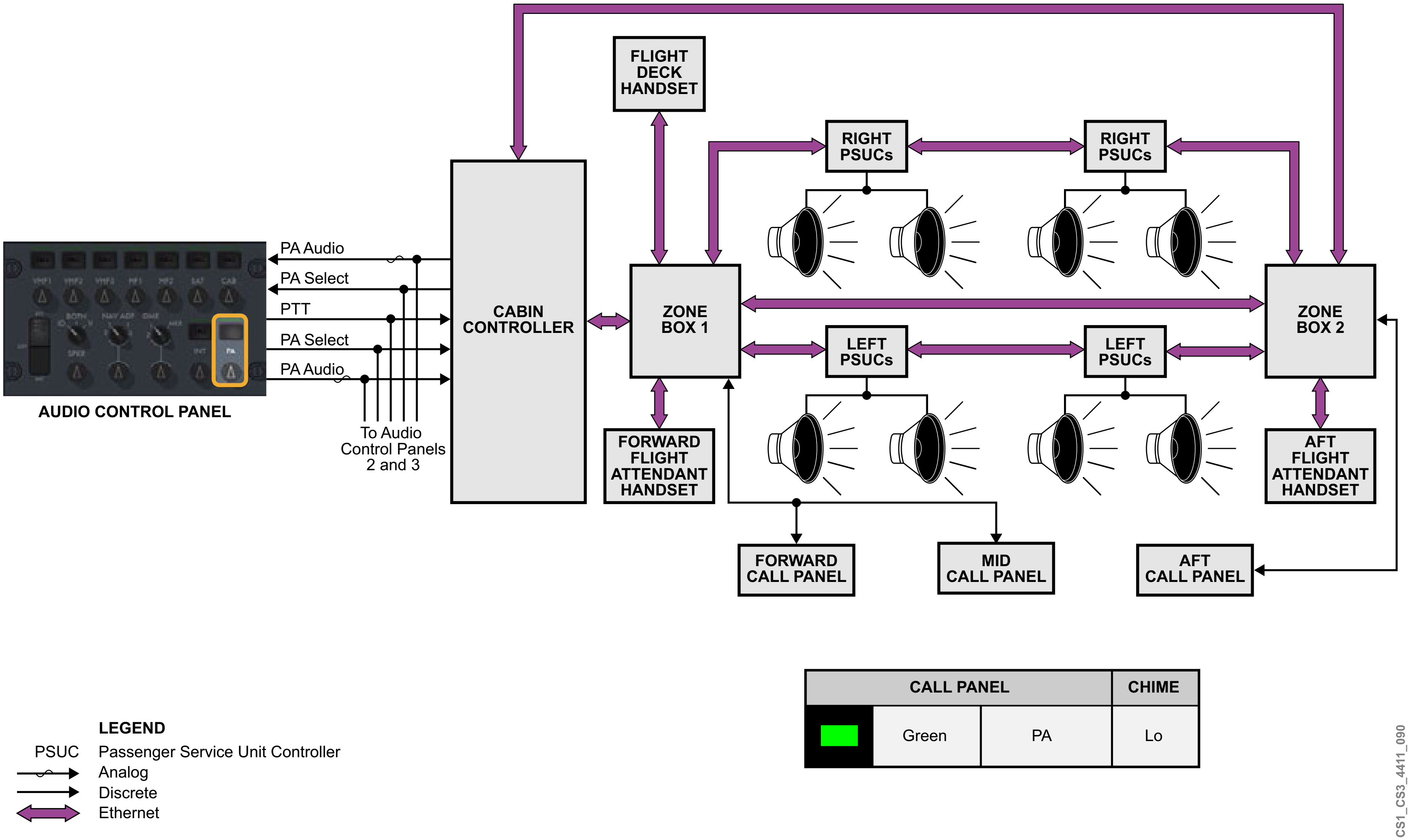
To end communication, release the push-to-talk (PTT) button or put the handset back on the base.

When a PA is initiated:

- CMS displays PA IN PROGRESS
- Cabin handsets display PA IN PROGRESS
- Green advisory call light illuminates
- Lo chime sounds in the passenger cabin. PA chimes can be customized based on the destination code
- Call ends when last handset is placed on cradle or the [PTT] button is released

NOTE

In case of a decompression, the PA volume goes to HI and all lights turn on.



CALL PANEL			CHIME
	Green	PA	Lo

Figure 4: Passenger Address System (L2)

CABIN INTERPHONE SYSTEM

The cabin interphone system consists of three handsets that interface with each other through the zone boxes. Any handset can call a single handset, or can call both other handsets on a party line.

Handsets are located in the flight deck and at each flight attendant station in the forward and aft entryways. A fourth optional handset can be installed at the left side aft entryway. The handset is stored in a handset cradle when not in use. The handset is deactivated when it is seated in the cradle.

An interphone call can be made using the audio control panels in the flight deck. Pushing the CABIN mic select button once on the audio control panel initiates an all call. Either or both cabin handsets can answer. To call a specific cabin handset from the flight deck, the flight deck handset must be used.

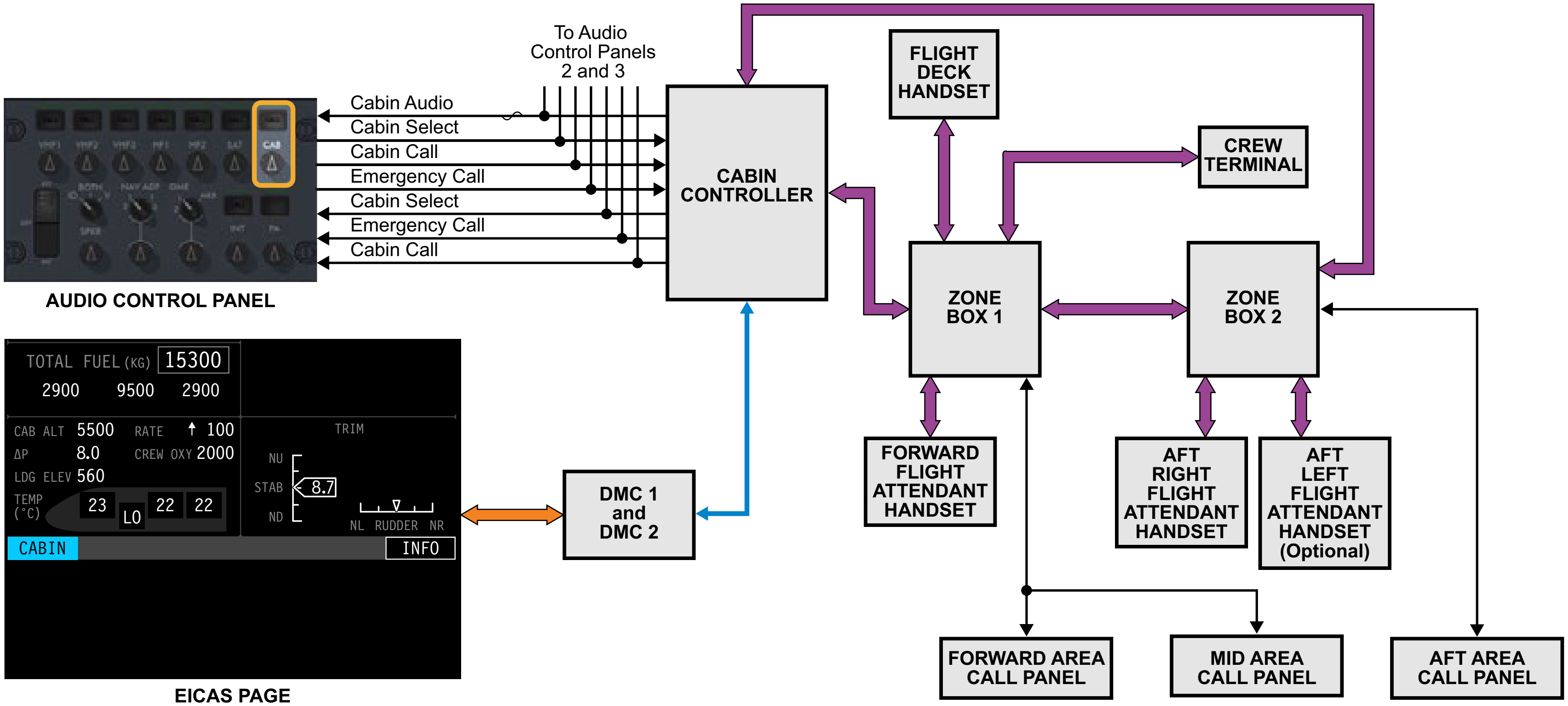
An emergency call from the flight deck is initiated from the handset by dialing the specific emergency call code. An emergency call from the audio control panel is made by holding the CABIN mic select button for more than 2 seconds. A cabin emergency call is indicated by a flashing red light on the area call panel.

Cabin calls from the flight deck are annunciated by a red call light on the area call panels. A cabin-to-cabin call is indicated by a high/low chime only.

A cabin call to the flight deck is indicated by a CABIN flag on the engine indication and crew alerting system (EICAS). The handset can also be used to indicate the cabin is ready for takeoff or landing by displaying a READY flag.

The CABIN and READY flags display on the EICAS page. The CABIN flag indicates an incoming call. The cyan CABIN flag flashes for 5 seconds and a high/low chime is heard when a routine call to the flight deck is initiated. An amber CABIN message and a triple HI/LO chime indicate a priority call from the cabin. The green READY flag flashes for 5 seconds when the cabin icon on the crew terminal is pressed, or if the CABIN READY selection is made on a handset.

If the EICAS is in compressed mode, the READY flag is replaced with a > CABIN READY advisory message. The CABIN flag is replaced with a > CABIN CALL advisory message and the amber CABIN flag is replaced by a >CABIN PRIORITY caution message.



CALL LIGHT		CHIME
CABIN (yellow)	Priority Call	High/low (3x)
CABIN (blue)	Call	High/low
READY (green)	Cabin ready for Takeoff or Landing	None

LEGEND

- DMC — Data Concentrator Unit Module Cabinet
- AFDX
- Analog
- ARINC 429
- Discrete
- Ethernet

AREA CALL PANEL			CHIME
	Red (Steady)	Flight Deck Call	High/low
	Flashing	Emergency Crew Call	High/low (3x)

CS1_CS3_4411_091

Figure 5: Cabin Interphone System (L2)

EMERGENCY EVACUATION

The CMS generates an emergency evacuation horn and distributes it over the cabin speakers. The evacuation horn can be turned on from the:

- Flight deck EVAC CMD PBA
- Forward flight attendant EVAC HORN switch
- Aft flight attendant EVAC HORN switch

The EVAC CMD PBA feeds the CMS through the data concentrator unit module cabinet (DMC). The EVAC CMD PBA also provides a hardwired output to zone box 1.

Each flight attendant EVAC HORN switch provides a discrete output to its zone box.

Any switch can be used to turn on the horn. When the evacuation horn sounds, the flight deck EVAC CMD PBA ON legend illuminates white. The flight attendant EVAC HORN switch legend illuminates red.

The evacuation horn can be silenced by pressing the EVAC CMD PBA or either EVAC HORN switches.

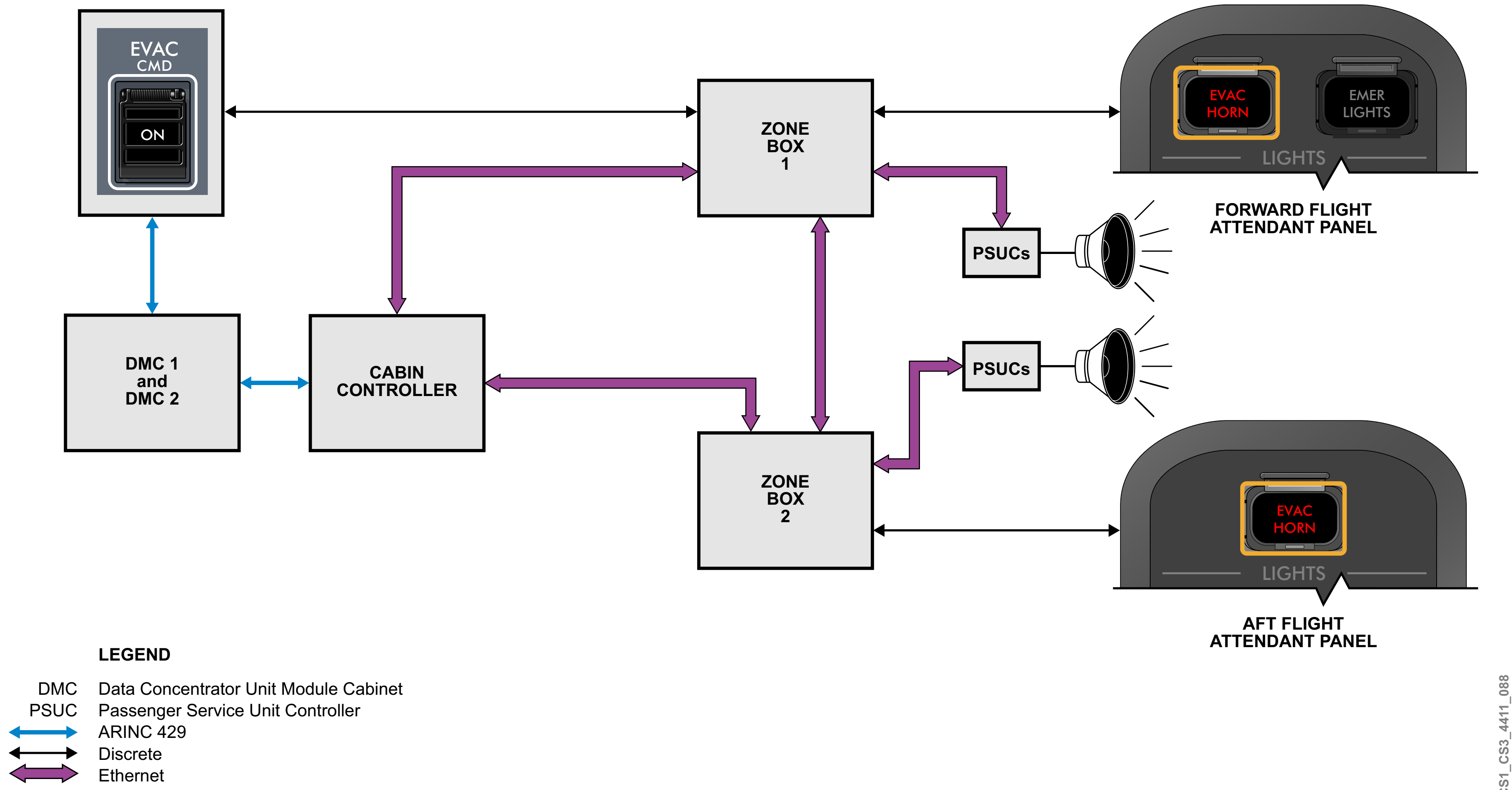


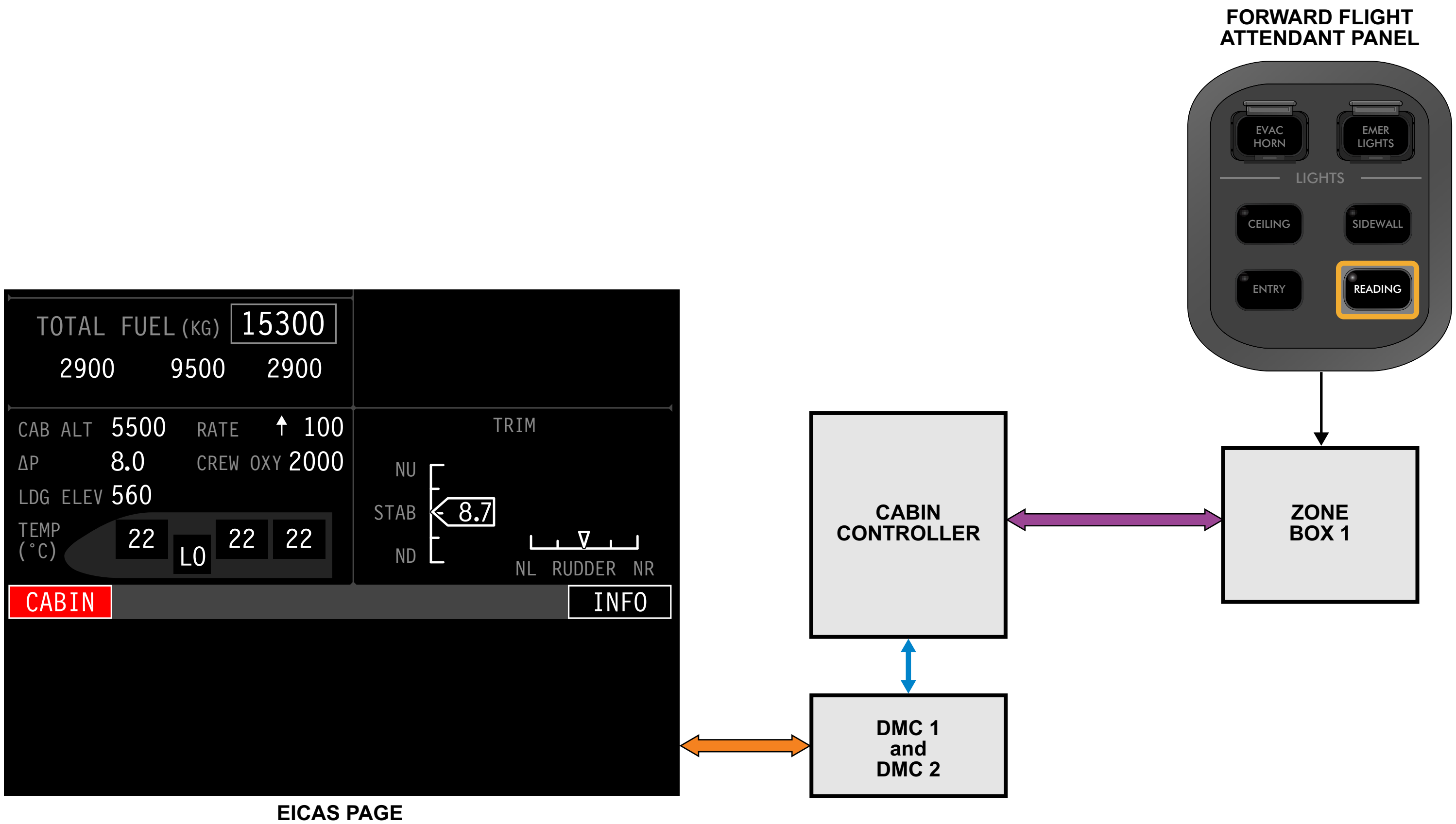
Figure 6: Emergency Evacuation System (L2)

HIJACK WARNING (OPTIONAL)

The hijack warning alerts the flight deck of a possible hijacking. Pressing and holding the READING light switch on the FORWARD ATTENDANT panel for 3 seconds illuminates the CABIN flag red and generates six high-low chimes.

The red CABIN flag cannot be reset until the aircraft is on the ground or the electrical power is cycled.

If the EICAS is in compressed mode, the red CABIN flag is replaced with a > CABIN EMER warning message.



CALL LIGHT		CHIME
CABIN	Hijack	High/low (6x)

LEGEND

DMC Data Concentrator Unit Module Cabinet
AFDX
ARINC 429
Discrete
Ethernet

CS1_CS3_4411_123

Figure 7: Hijack Warning (Optional) (L2)

LIGHTING

The zone box (ZB) provides discrete outputs to the area call panel lights to alert the flight attendants of events requiring their attention (passenger call or LAV smoke). The area call panel lights are powered by 28 VDC. The ZB provides a ground to turn on the appropriate light.

The ZB provides a discrete to control the aisle lights, based on the cabin lighting scenarios.

The CMS controls the entry area lights. The entry area lights are part of the main cabin lighting and are controlled as part of the cabin lighting scenarios.

The CMS provides discrete inputs via the FWD and AFT galley light switches to control the state of the galley area lights. The ZB also provides an RS-485 interface to the galley area lights which are part of the main cabin lighting.

The CMS provides discrete inputs to the crew reading light switches via the PSUCs located in lavatory A and galley 4 to control the crew reading lights.

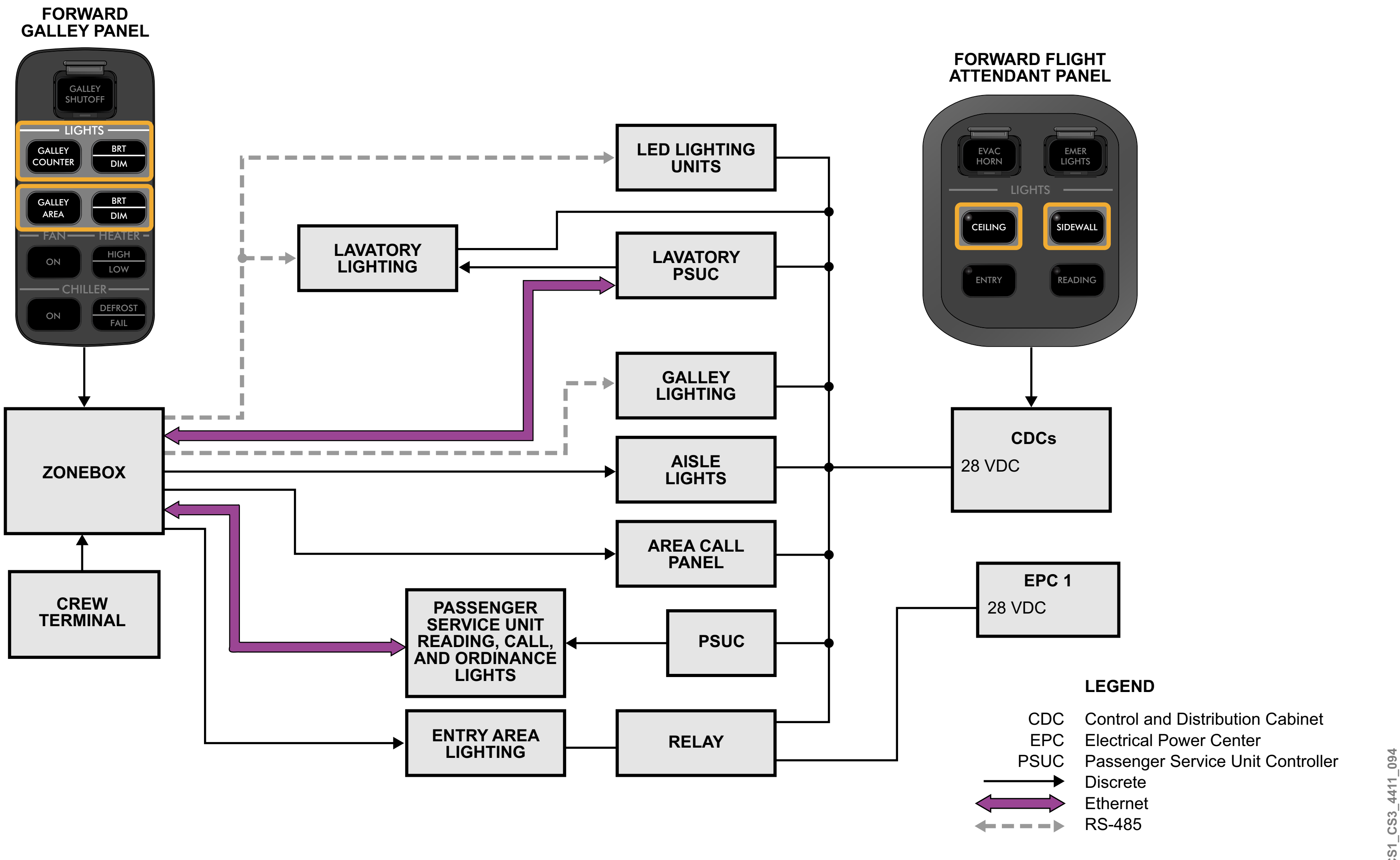


Figure 8: Cabin Lighting (L2)

PASSENGER SERVICE SYSTEM

Reading Lights

The reading lights are located in each passenger service unit (PSU). A switch is mounted next to each reading light. The reading light switch provides a request to the passenger service unit controller (PSUC) to turn on the reading light.

The reading lights can be controlled individually, or all together at the crew terminal on the PAX SERVICES page.

Call Lights

The call lights enable passengers to call for flight attendant assistance. Call buttons are located on passenger service units (PSUs) above passenger seats and in lavatories.

Each switch permits both activation and deactivation of the call. When active, the overhead call buttons illuminate blue. The flight attendant call button is connected to the PSUC. The PSUC turns on the seat or lavatory call light. The PSUC also generates the chime heard over the cabin speakers.

Active attendant calls, and their location on the crew terminal PAX SERVICES page, are displayed by the CMS. The calls can be cleared on the crew terminal individually by area, or all at one time.

Passenger Call

Pushing the attendant call switch on the passenger seat PSU:

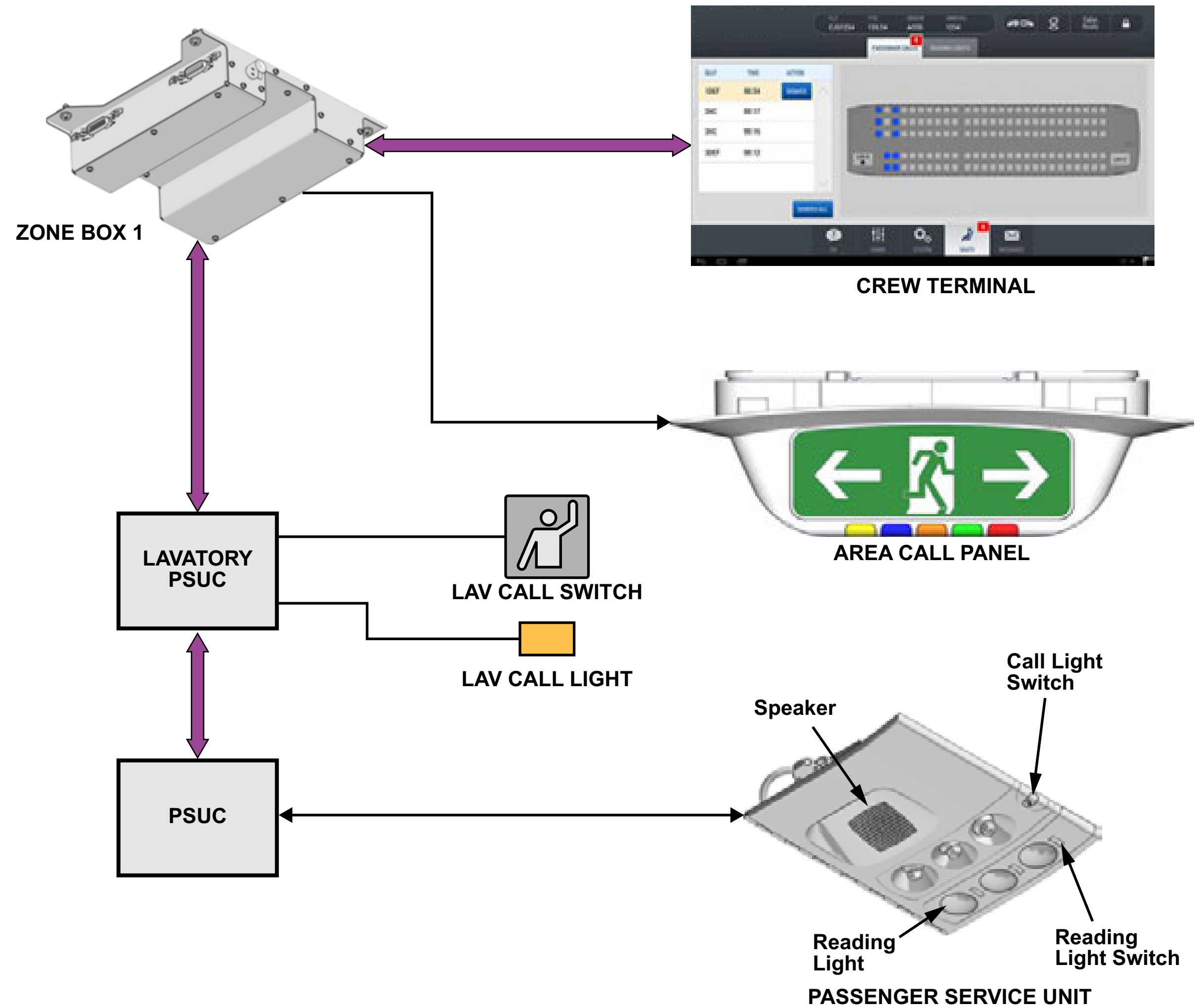
- Illuminates the attendant call light located on the aisle side of the PSU where the call originates
- Displays the passenger call information on the CMS terminal passenger call screen
- Illuminates the blue passenger call light on the area call panels
- Sounds a single high chime

The passenger call light extinguishes when the flight attendant call switch is pressed a second time.

Lavatory Call

Pushing the lavatory attendant call switch:

- Displays the lavatory call information on the CMS terminal
- Illuminates the amber lavatory call light on the area call panels
- Sounds a single high chime
- Illuminates the amber lavatory call light located outside the lavatory



CALL PANEL		CHIME
(orange)	Lavatory Call	High
(blue)	Passenger Call	High

LEGEND

PSUC Passenger Service Unit Controller

Discrete

Ethernet

Figure 9: Passenger Service System (L2)

BOARDING MUSIC SYSTEM AND PRERECORDED ANNOUNCEMENTS

The CMS incorporates boarding music (BGM) and prerecorded announcements and messages (PRAMs) functions that allow the selection and playback of music and recorded announcements over the cabin speakers and passenger headsets.

The cabin controller (CC) stores up to 180 minutes of BGM and PRAM content. Uploading of BGM and PRAM audio files is done through the crew terminal (CT). The PRAM audio files are also stored in the CT and the ZBs for redundancy in the event that the CC fails.

The selection and queuing of BGM and PRAM audio files is available from the CT. The BGM and PRAM files can be previewed prior to playback. The CT also has volume controls for the BGM and PRAM.

BGM and PRAM audio are overridden by PA announcements from the cabin or flight deck. When the PA announcement is completed, the BGM and PRAM audio resumes from where it left off.

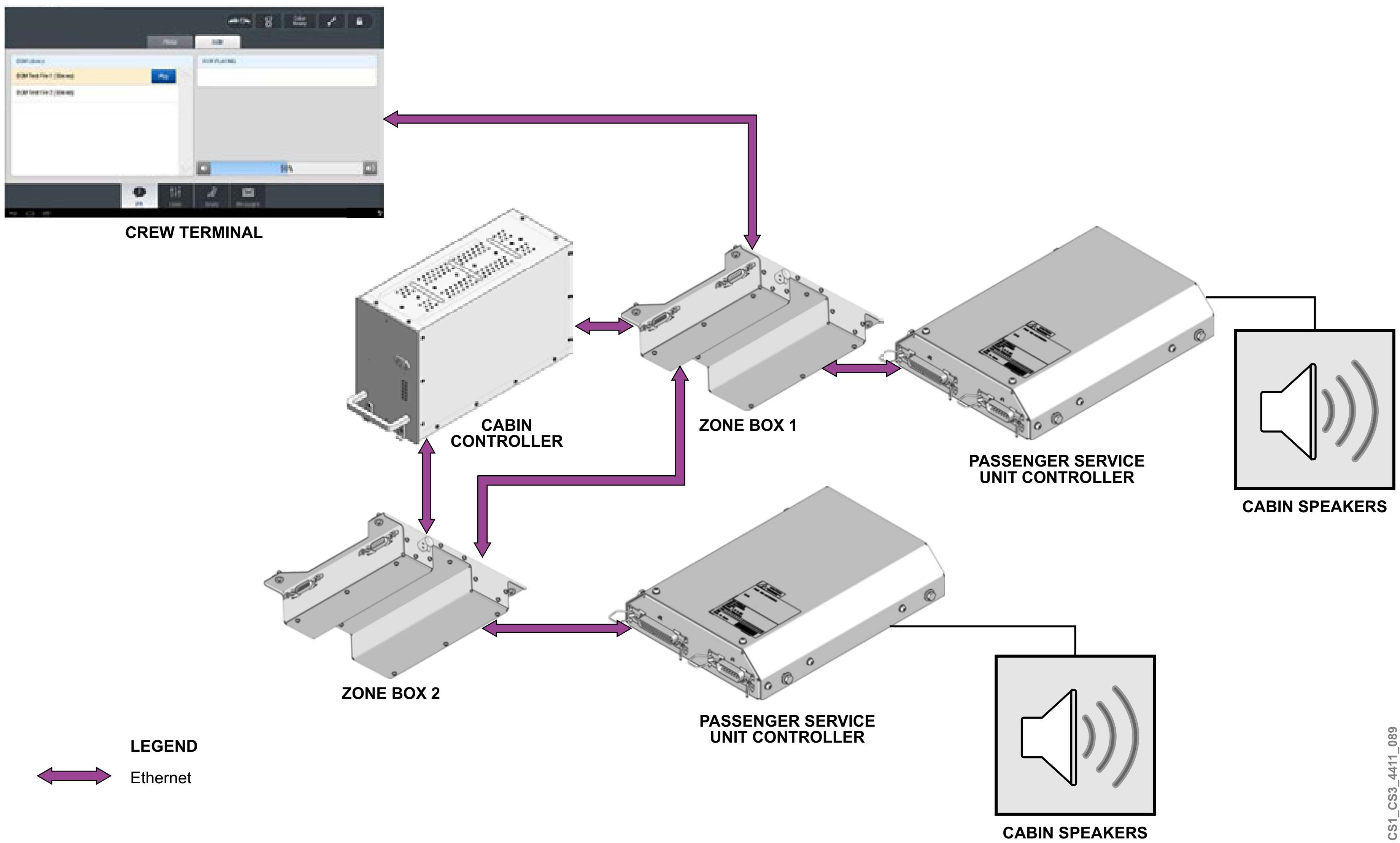


Figure 10: Boarding Music and Prerecorded Announcement Schematic (L2)

COMPONENT LOCATION

The cabin management system includes the following components:

- Cabin controller
- Crew terminal
- Handsets
- Passenger service unit controllers
- Zone boxes

CABIN CONTROLLER

The cabin controller is located in the forward equipment bay.

CREW TERMINAL

The crew terminal is installed in the forward entryway, above the flight attendant seats.

HANDSETS

Handsets are located at each of the flight attendant seats in the forward and aft entryways.

There is one handset for the flight crew installed on the center pedestal in the flight deck.

PASSENGER SERVICE UNIT CONTROLLERS

The passenger service unit controllers are installed above the passenger service units. One PSUC services two seat rows. The total number of PSUCs installed is dependent on the aircraft seating configuration.

There is one PSUC installed in each lavatory and galley area.

ZONE BOXES

The zone boxes are installed in the forward and aft cabin ceiling.

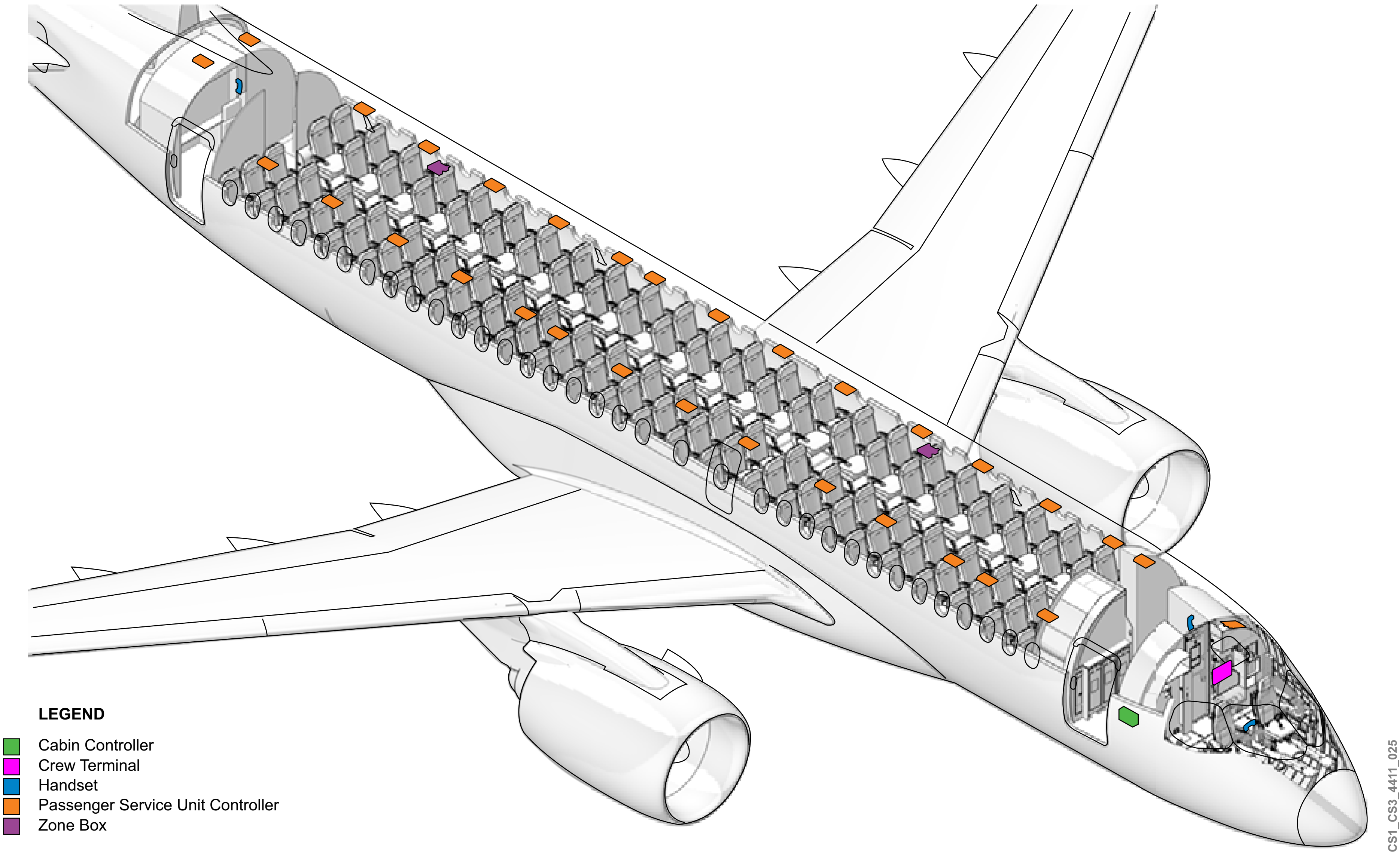


Figure 11: Cabin Management System Component Location (L2)

COMPONENT INFORMATION

CABIN CONTROLLER

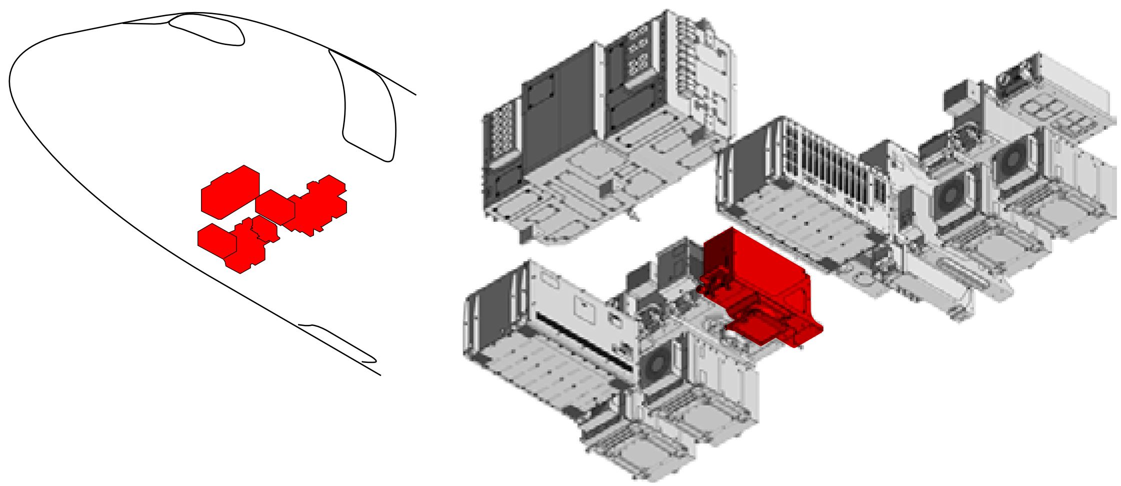
The CC has a fan installed to provide additional cooling. The fan has a replaceable filter to provide clean air to the CC.

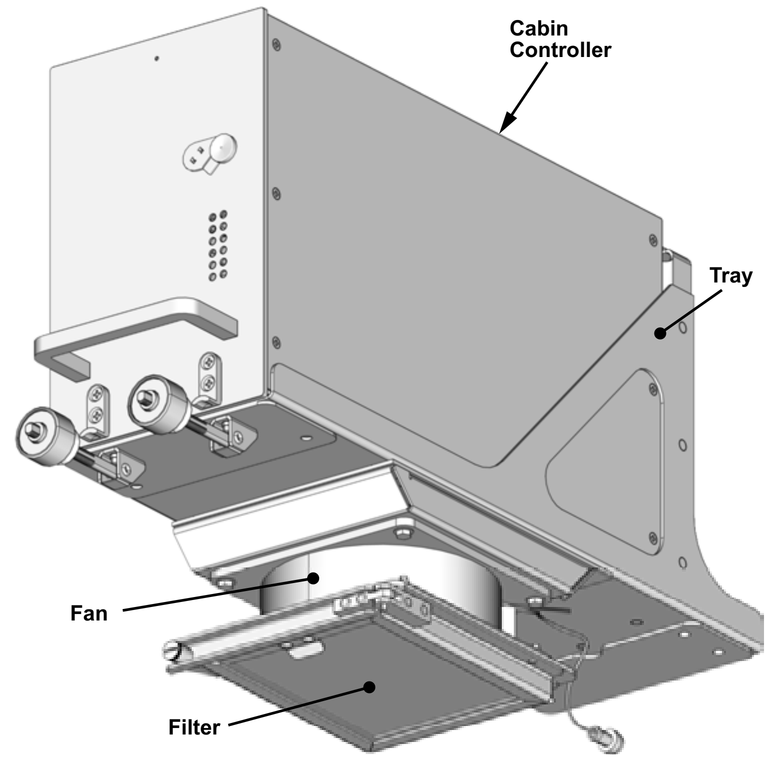
The fan is mounted on the cabin controller tray and is monitored. When the CMS is powered, the fan turns on. If the fan stops, a maintenance message is sent to the onboard maintenance system (OMS).

The LED lights on the front panel provide the connection and activity status between the CC and ZBs. Not all of the LEDs are used in the baseline CMS configuration.

The LED indications are as follows:

- Solid green means a connection is available
- Blinking green means communication in progress
- No light indicates a connection is not available





LED	INDICATORS
ZB1	Link/Activity status
ZB2	Link/Activity status
PRV CC	Not used
NEXT CC	Not used
IFE1	Not used
IFE2	Not used
E1	Not used
E2	Not used
E3	Not used
E4	Not used
NORM	CC is running in normal mode
SPR GE	Spare Link/Activity status indicator

LED STATUS	CONDITION
SOLID GREEN	Steady connection available.
FLASHING GREEN	Blinking communicating.
BLACK	No connection.

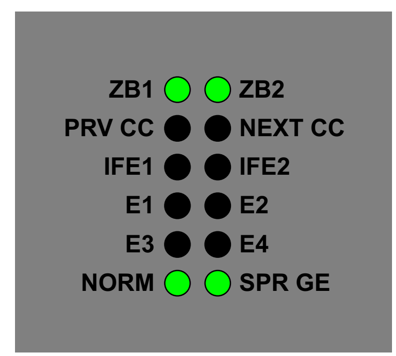


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Figure 12: Cabin Controller (L2)

HANDSET

The handset is used to make or receive interphone calls, or to make passenger address (PA) announcements. The CMS handset also provides backup CMS functions.

The handset has the following features:

- LCD screen
- Soft-touch keypad
- Push-to-talk (PTT) button
- Reset button
- Side menu scroll/select buttons

A display on the front of the CMS handset shows a list of functions that can be selected using the side scroll/select buttons, or the first two digits or characters displayed on the handset screen can be pushed on the keypad to initiate functions.

The LCD screen displays the two-digit code for each available function. Up and down keys on the side of the handset enable scrolling through the functions displayed. The desired function is selected by pushing the center side button.

An interphone call is made by dialing the handset destination number. One handset can communicate with more than one station at a time. The caller ID is displayed on the CMS crew terminal.

The cabin handset provides the following functions as backup in case the crew terminal fails:

- Cabin light control and scenarios
- Temperature trim
- PRAM control
- Attendant call control
- Cabin ready command
- Ordinance signs control

CABIN INTERPHONE	
1* PA ALL	All Cabin PA
21 CI F/D	Cabin Interphone – Flight Deck
22 CI FWDHS	Cabin Interphone – Forward Handset
24 CI RH AFTHS	Cabin Interphone – RH Aft Handset
2* CI ALL	Cabin Interphone – All
2# CI CABIN	Cabin Interphone – Cabin Only
29 CI EMER	Cabin Interphone – Emergency

BACKUP FUNCTIONS	
30 CABIN READY	Cabin Ready
40 L. SCENE	Lighting Scene – Sublevel Controls
41 L. BRTNESS	Lighting Brightness – Sublevel Controls
50 CAB TEMP	Cabin Temperature – Sublevel Controls
60 PRAM START	Start PRAM – Sublevel Controls
61 PRAM STOP	Stop PRAM
80 ATT CALL	Attendant Call
90 SCR BRTNESS	Screen Brightness

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Figure 13: Handset (L2)

CUSTOMER SERVICE DISPLAY (OPTIONAL)

The optional customer service display (CSD) is installed in the PSU in place of the ordinance sign. The CSD is capable of displaying the digital data that includes customized pictures, safety videos, short movies, advertisements, and passenger service information. The CSD is powered from the PSUC through the Ethernet cable.

CS1_CS3_4411_098

Figure 14: Customer Service Display (L2)

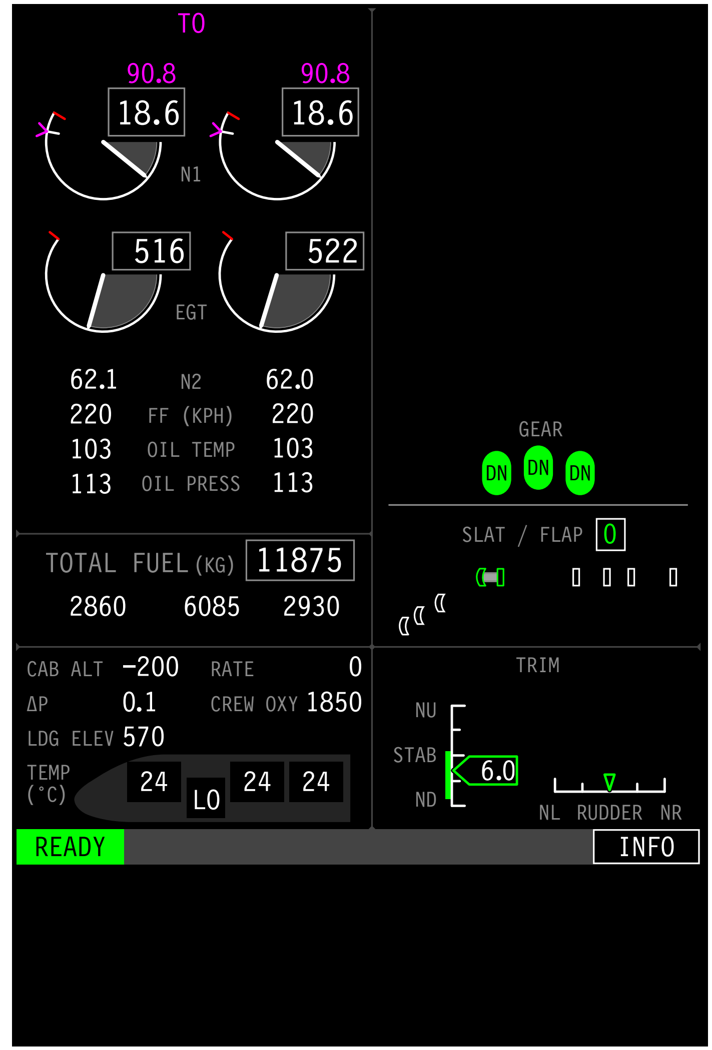
CONTROLS AND INDICATIONS

The CABIN and READY icons appear on the EICAS page to indicate incoming interphone calls and cabin readiness.

The CABIN icon is cyan for a normal call and amber for a priority call.

The green READY icon comes on to indicate the cabin is secure for takeoff or landing.

CABIN / READY ICONS		
COMM Flag	Aural	Description
CABIN	High/low Chime (3x)	Signals an incoming priority communication from the cabin (color: Amber). Shared location with cabin call. Reset after the call is taken.
CABIN	High/low Chime	Signals that a cabin call is pending. Reset after the call is taken.
READY	None	Signals that the cabin crew is ready for takeoff or landing. Reset after a user customizable delay (delay set in cabin management system) or aircraft parameter.



EICAS PAGE

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Figure 15: Cabin Interphone System Controls and Indications (L2)

OPERATION

CABIN MANAGEMENT SYSTEM CREW TERMINAL SCREEN MAP

The cabin management system (CMS) crew terminal is a graphical user interface (GUI) that provides a series of touchscreens to view and manage cabin systems. The screens can be accessed after logging in to the system.

The CMS provides an interface with the following functions:

- PA:
  - CSD
  - PRAM
  - BGM
- Cabin:
  - In-seat power supply (ISPS)
  - Temperature
  - Lighting
  - Galley
  - Doors
  - Lavatory
- Seats:
  - Passenger calls
  - Reading lights
- Messages

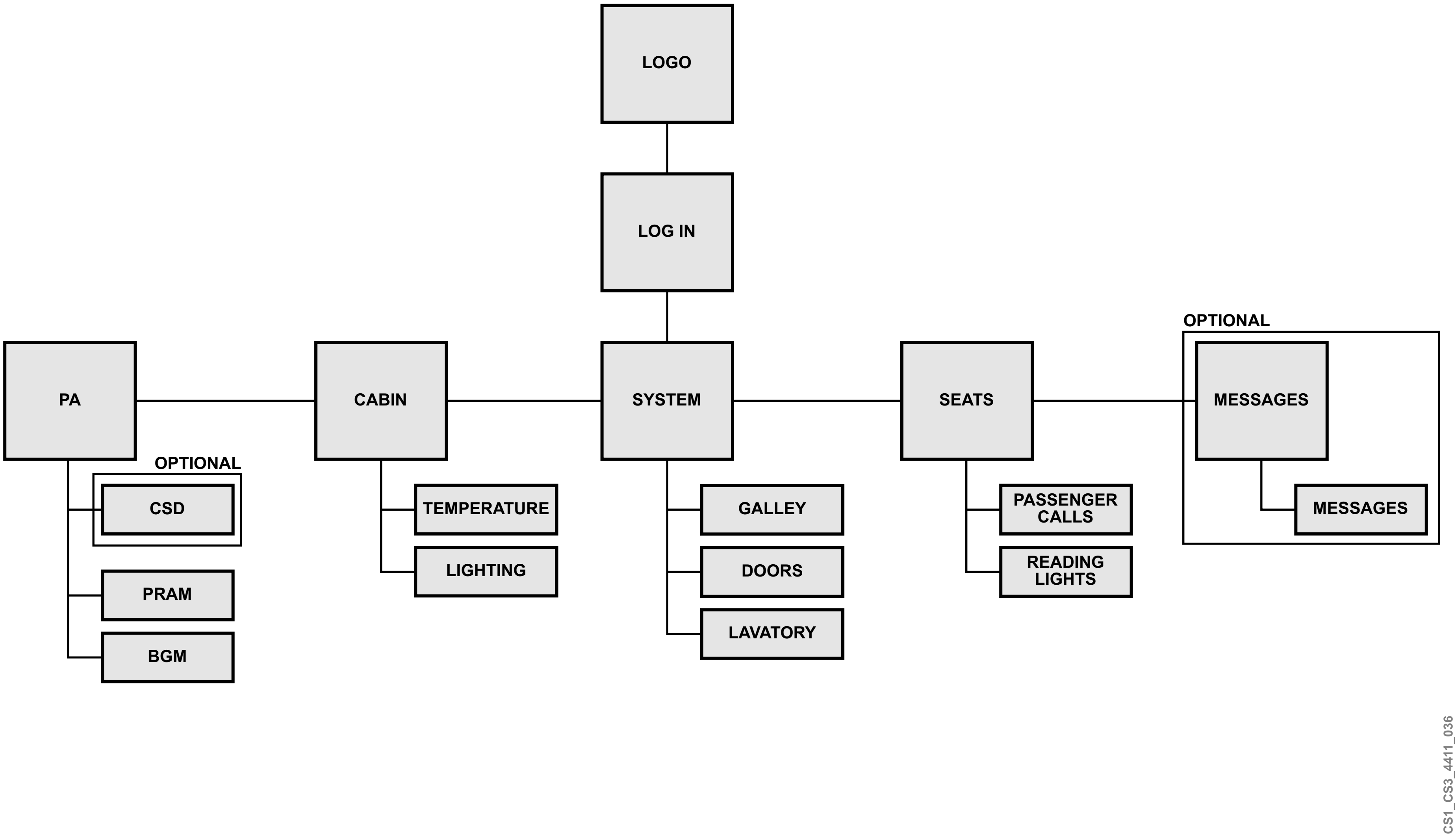

Figure 16: Crew Terminal Screen Map (L2)

CMS SCREEN HEADER AND FOOTER

Header

The CMS screen header includes:

- Customer logo
- Flight information
    - Flight number
    - Origin/destination city pairs
    - Time at origin
    - Time at destination
    - Time to destination
- Fasten seatbelt button
- No personal electronic devices (NO PEDs) button
- Cabin ready button
- Tools button (maintenance access)
- Screen lock/screensaver button
- Elapsed time and estimated time to destination (optional)
- Flight progress bar indicating percentage of total flight completed (optional)

If the optional flight progress bar is included in the header configuration, the header alternately displays the flight progress bar and flight parameters

Footer

The left of the CMS screen footer includes:

- Back button
- Home button
- Application button

At present, the application button is not active.

The right of the footer includes maintenance functions:

- Aircraft button
- Tool button
- Flag button

The flag button illuminates when a fault occurs. When the flag icon is pressed, a list of all faults display. Each fault links to a maintenance page. The aircraft button navigates to the CMS cabin crew screens. The tool button navigates to the CMS maintenance screens.

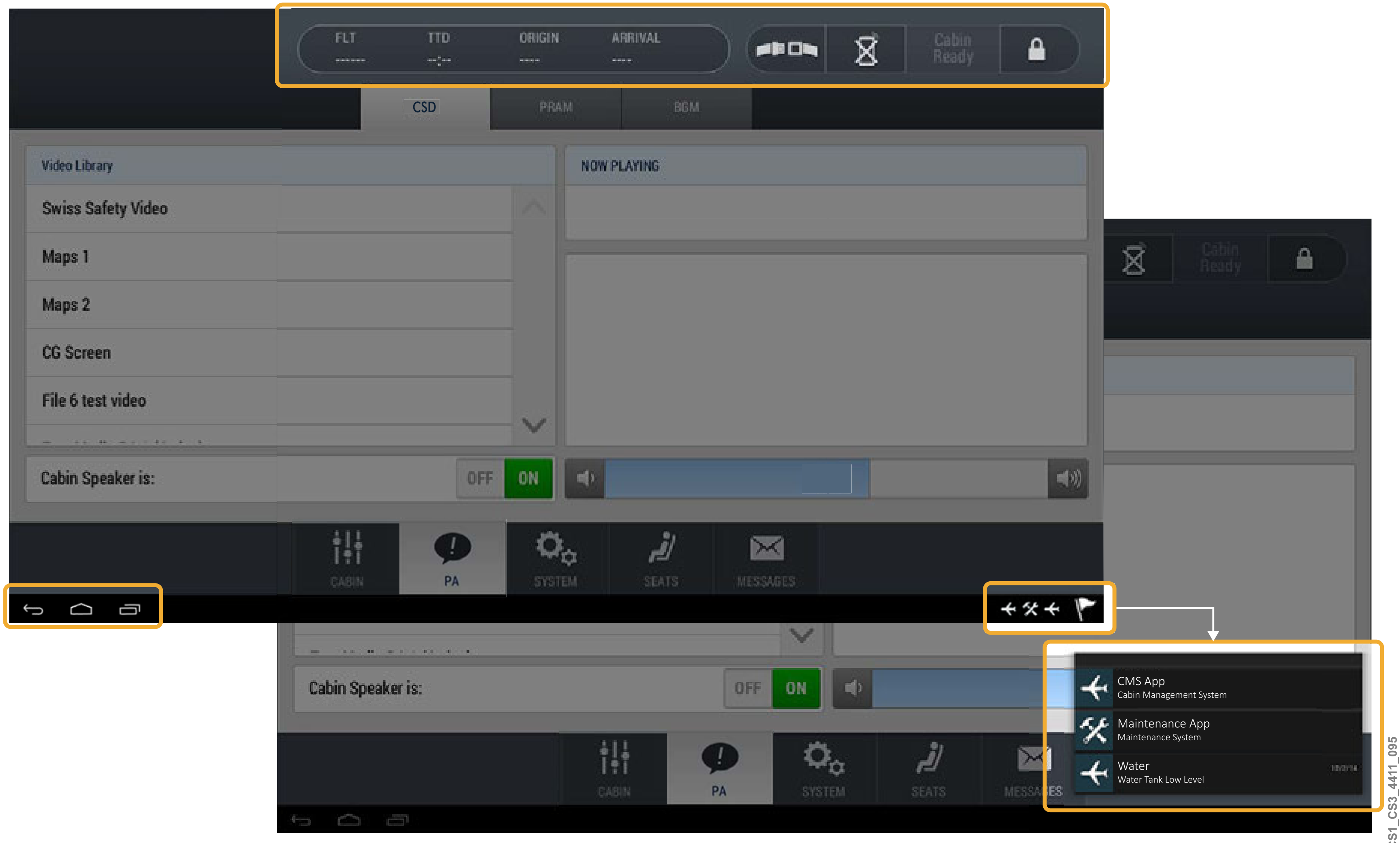

Figure 17: CMS Screen Header and Footer (L2)

LOG IN SCREEN

When the CMS is powered up, it enters the power-up mode and performs an initialization and check of the system units. The CMS display has a customizable login screen that may require entry of a username and/or a password using the onscreen keyboard.The LOG IN screen displays an onscreen keyboard to enter the username and/or password.

To log in:

1. Press the USERNAME field and type username if applicable
2. Press the PASSWORD field and type password if applicable
3. Press the [Log In] button

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Figure 18: Log In Screen (L2)

FLIGHT DATA SCREEN

The Flight Data screen allows the crew member to enter and save flight data if the data provided by the aircraft systems is incorrect.

To enter flight data:

1. Press flight data information or flight progress bar (optional) on the screen header to access the Flight Data screen
2. Press flight data fields to display the on-screen keyboard
3. Type the necessary information and then press a confirmation or navigation button ([Save], [Ok], [Apply], [Next], or [Previous])

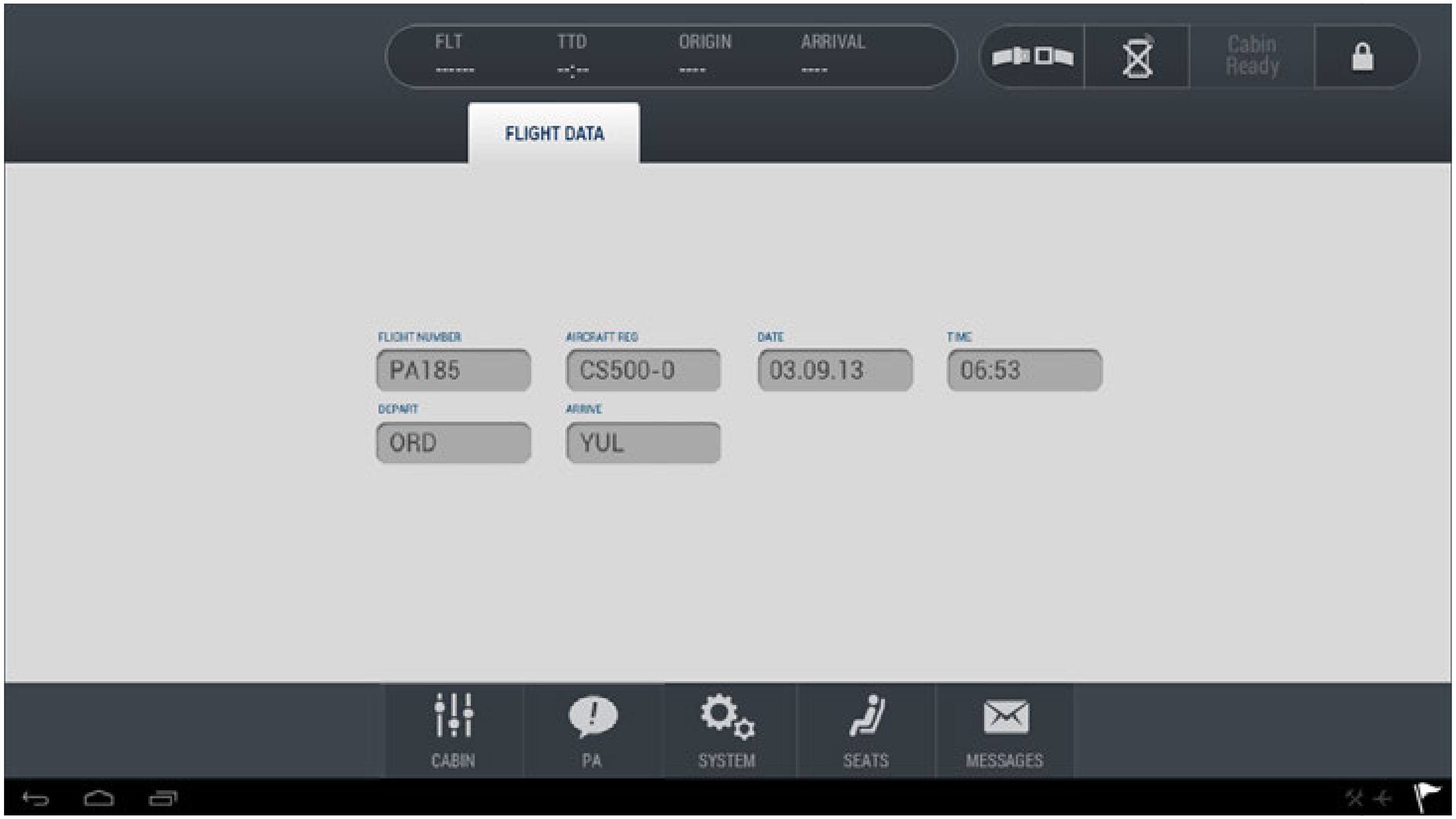

Figure 19: Flight Data Screen (L2)

PRERECORDED ANNOUNCEMENTS AND MESSAGES SCREEN

The prerecorded announcements and messages (PRAMs) screen enables the selection and playing of audio announcements.

When [Play] is pressed, the selected title plays directly without starting the queue or adding the title to the queue. Titles play in each of the selected languages, according to the customer's language priority. [STOP] halts the further play of the selected title.

When a PRAM is playing, [Play] is disabled.

[Play] and [+Queue] buttons are visible only on the row that is currently highlighted. [+Queue] adds the title to the queue and the button changes to [-Queue]. Titles added to the queue are indicated with a checkmark. [Play Queue] begins the queue. [Stop Queue] is displayed once the queue is playing. Items are removed from the queue when they have completed playing.

Queued titles display their runtime as MM:SS. The cumulative time for all items remaining in the queue displays as Queue MM:SS.

NOTE

1. Preview audio files by connecting a headset to the audio jack on the front of the crew terminal. Volume is controlled from the PRAM screen.
2. Attempting to play video media when a PRAM is playing results in an error notification.

To play audio announcements:

1. Select [PA] from the menu bar.
2. Select [PRAM] tab.
3. Press [Languages] to display available languages. Select language option and then press [OK].
4. Select a PRAM title from the Library list.
5. Press [Play] to play an individual PRAM title.
6. Press [STOP] to stop an individual PRAM title.
7. Press [+Queue] to add a PRAM title to the queue.
8. Press [Play Queue] to play all PRAM titles in the queue.
9. Press [STOP] to stop playing all PRAM titles in the queue.

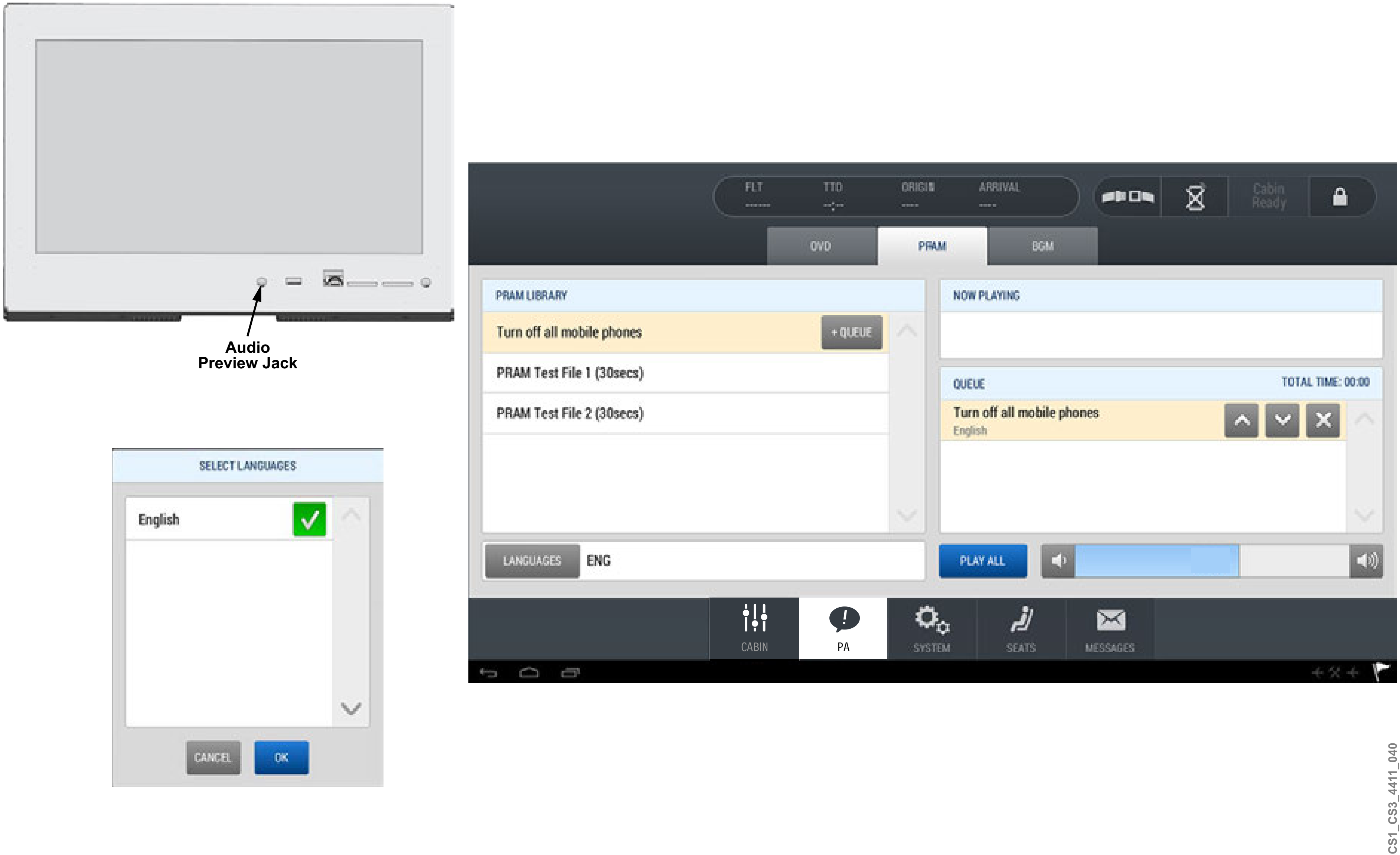

Figure 20: Prerecorded Announcements and Messages Screen (L2)

BOARDING MUSIC SCREEN

The boarding music (BGM) screen allows selection and control of boarding music that plays throughout the cabin.

When boarding music is playing, [Play] is disabled.

NOTES

Preview audio files by connecting a headset to the audio jack on the front of the crew terminal. Volume is controlled from the BGM screen.

Attempting to play boarding music when higher priority media (i.e. video passenger announcement (VPA) or prerecorded announcement and message (PRAM)) is playing results in an error notification.

To play boarding music:

1. Select [PA] from the menu bar.
2. Select [BGM] tab.
3. Select a boarding music title from the Library list.
4. Press [Play] to play a boarding music title.
5. Adjust cabin speaker volume using volume controls.
6. Press [STOP] to stop playing boarding music.

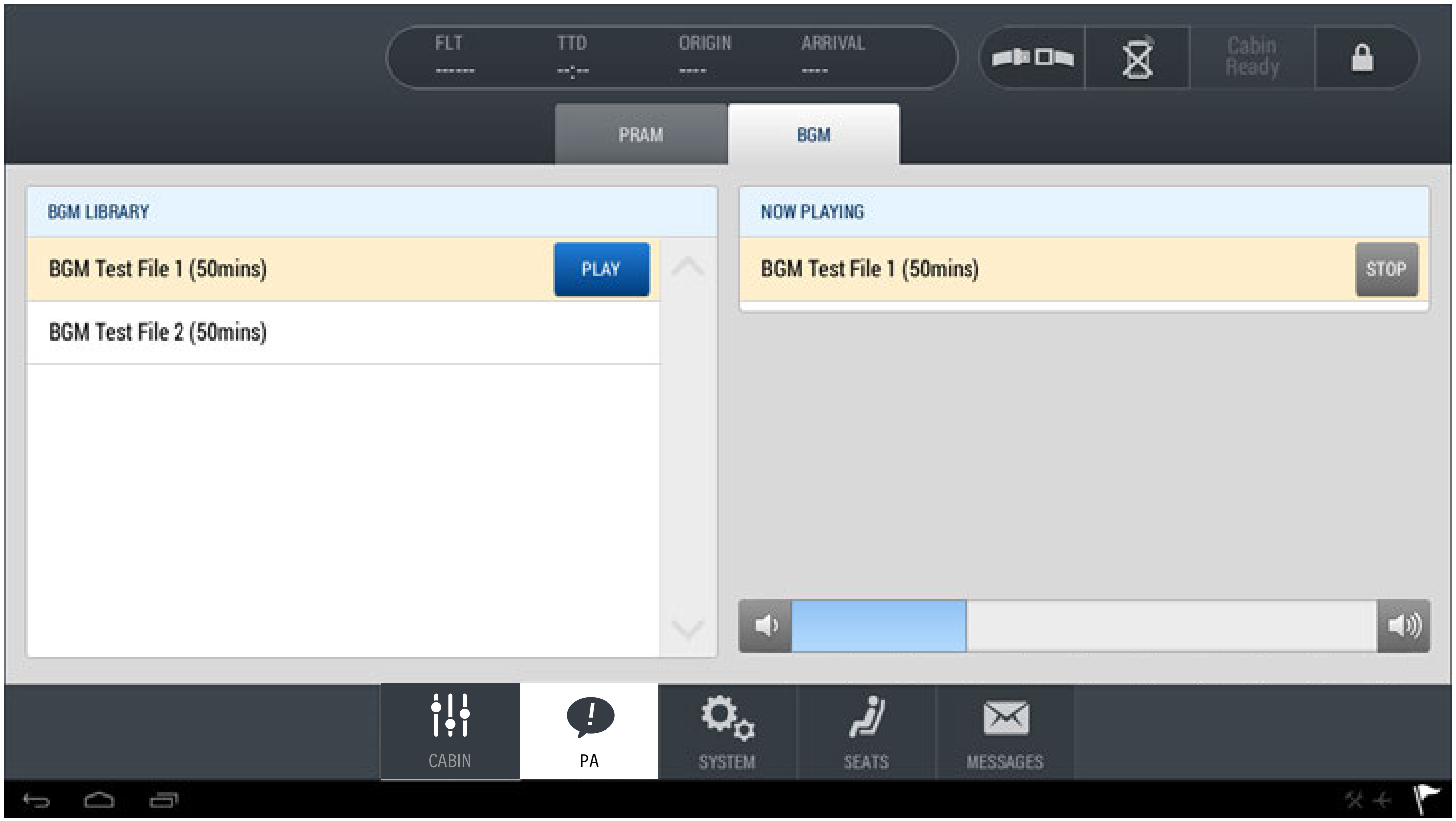

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Figure 21: Boarding Music Screen (L2)

PASSENGER CALLS SCREEN

A list of all active attendant calls are displayed on the Passenger Calls screen. Active calls are displayed in priority order.

1. Lavatory
2. Business class (if installed)
3. Economy class

The lavatory calls are displayed in amber and the business and economy class calls are shown in blue. Calls display with the elapsed time since the call was made (optional).

Calls can be dismissed individually or with [DISMISS ALL] button.

To view/dismiss passenger calls:

1. Select [Seats] from the menu bar.
2. Press [DISMISS] in the call list to dismiss an individual call.
3. Press [DISMISS ALL] to dismiss all calls.

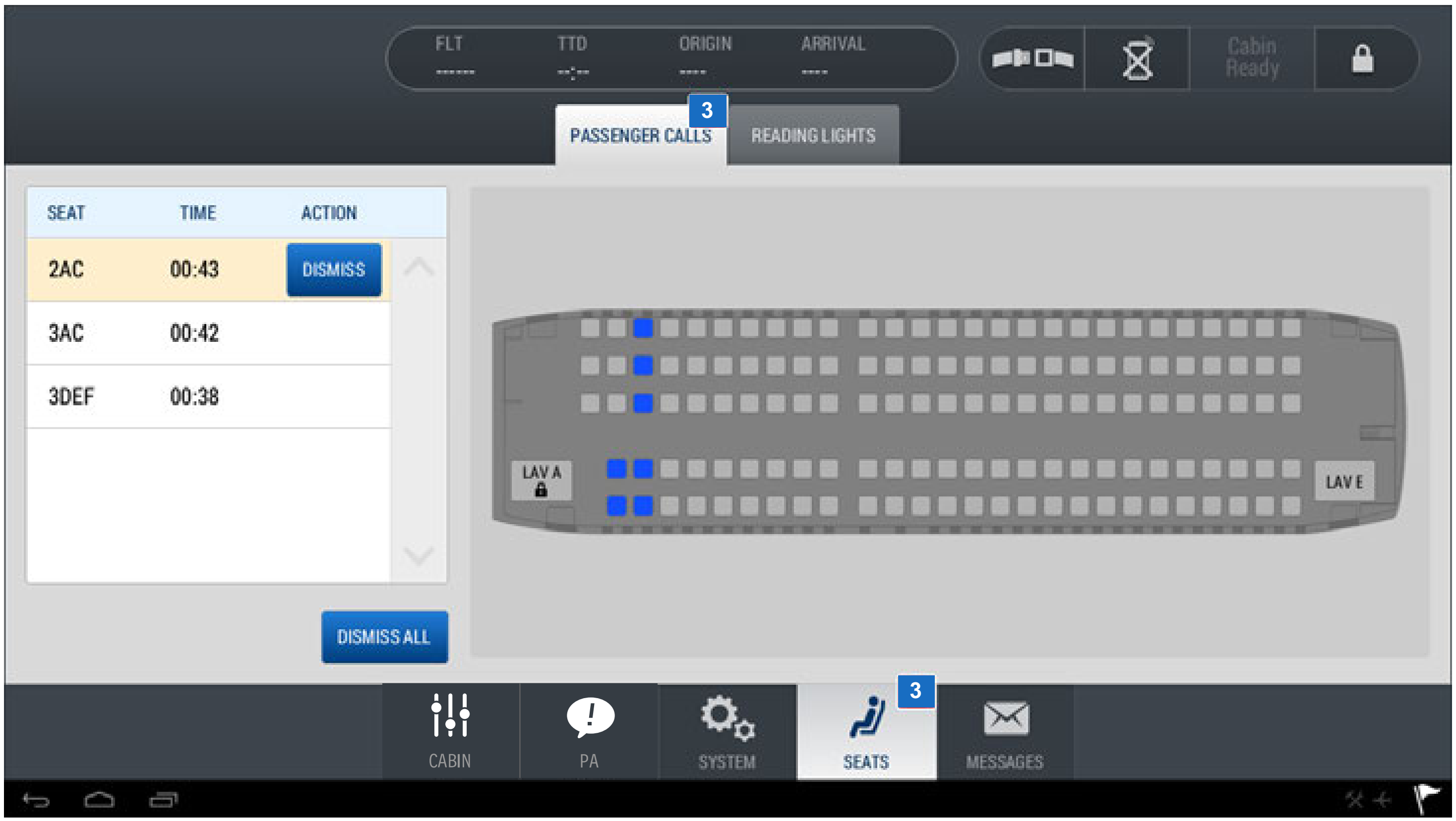

Figure 22: Passenger Calls Screen (L2)

PASSENGER READING LIGHTS SCREEN

The Reading Lights screen controls reading lights for the entire cabin or the light at a single seat. The layout of passenger area (LOPA) displays all reading lights that are currently on.

When the single seat option is selected and a seat number is entered, that seat is highlighted on the LOPA and an [ON/OFF] toggle button is displayed.

If any reading light fault exists, a fault message is displayed on the screen.

To control reading lights:

1. Select Single Seat or Cabin to view current reading light status.
2. For Single Seat, select Enter seat number field and enter a seat from the pop-up.
3. Select [ON] or [OFF] to control the selected seat(s).

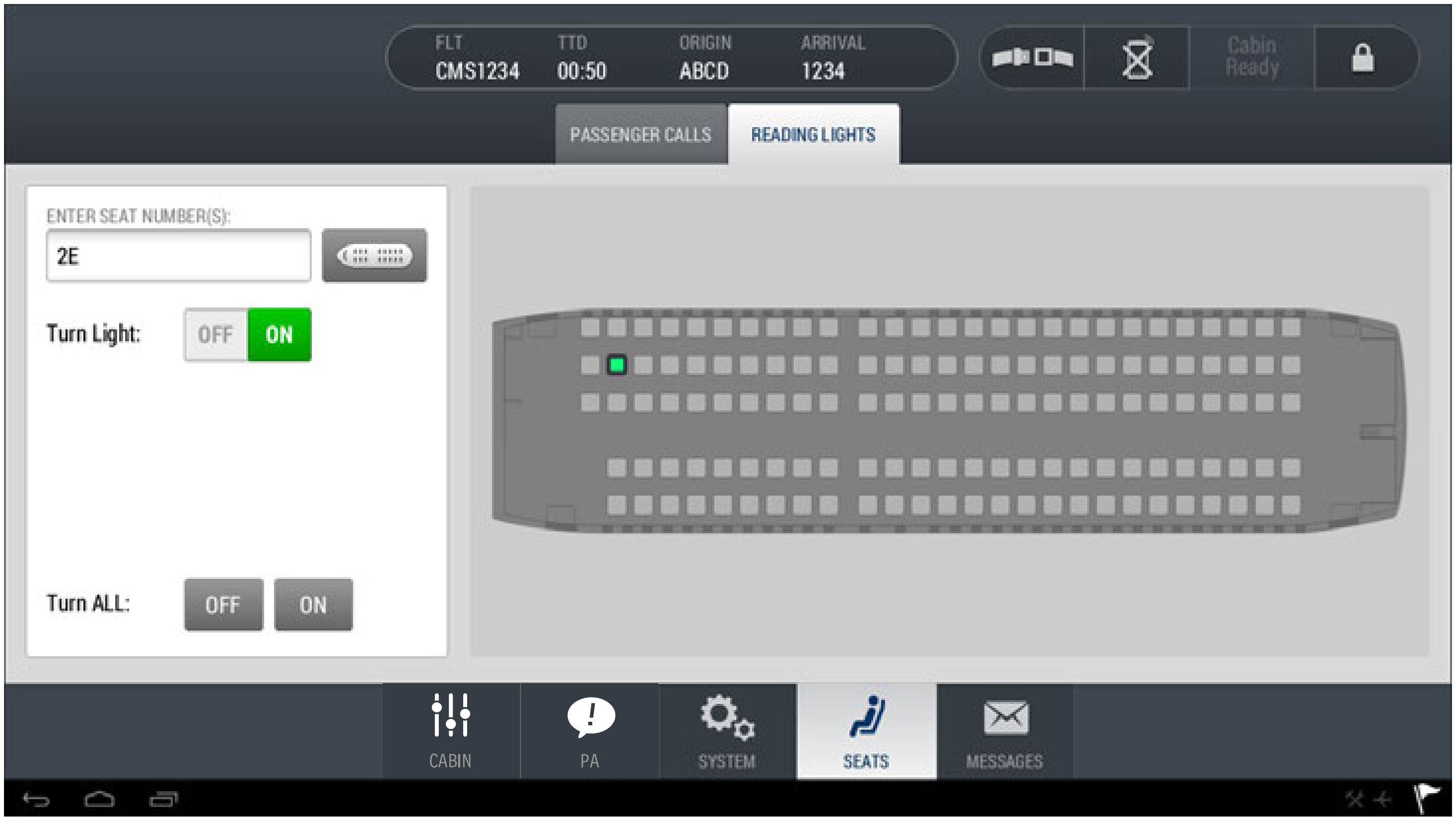

Figure 23: Reading Lights Screen (L2)

MESSAGES SCREEN

The Messages screen allows messages to be sent and received to and from the ground using ACARS. Messages that are sent and received during the current flight are displayed on the screen. Sent messages display on the right, while received messages show on the left side of the messaging area.

Received messages display as NEW until the [MARK READ] button is pressed. A notification tag on the menu bar indicates the number of unread messages.

Press [+NEW] to create a message. A keyboard is displayed under the text area. The text area is scrollable and includes navigation arrows (up, down, left, right) for message editing. A cursor indicates where the message is being edited.

A saved draft message is displayed with the word DRAFT in the heading in place of the sent time.

If a printer is available, the message can be printed by selecting the printer button (optional).

To view/reply to messages:

1. Select [Messages] from the menu bar.
2. Select [MARK READ] to indicate a message has been read.
3. Select [REPLY] to reply to a message.
4. Type a message and then select [SEND].

To create/send messages:

1. Select [+New] to display onscreen keyboard and message fields.
2. Select message recipient from the CONTACTS list.
3. Type a message and then select [SEND].

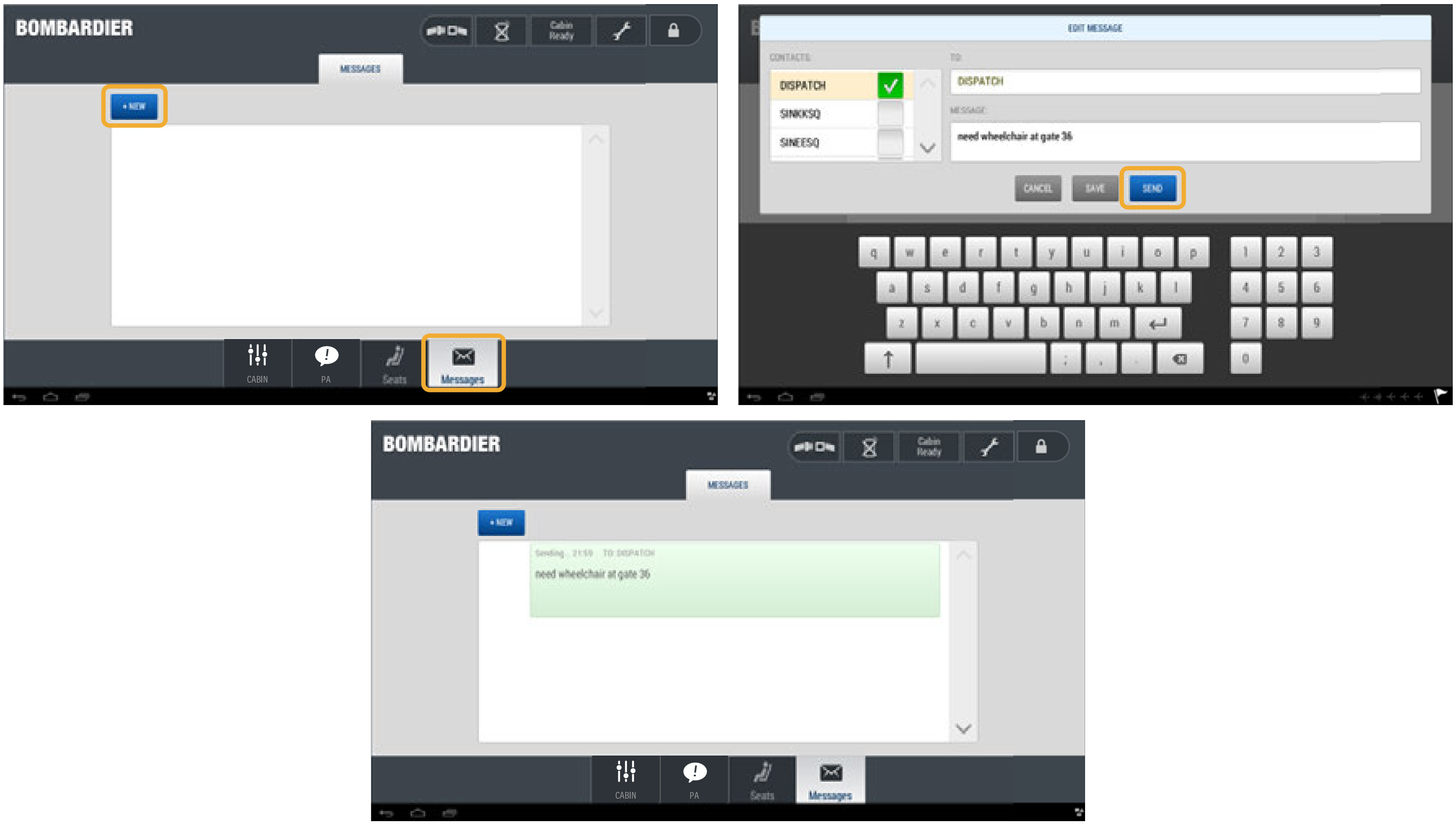

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Figure 24: Messages Screen (L2)

ELECTRONIC CABIN LOGBOOK SCREEN (OPTIONAL)

The electronic cabin logbook (eLOG) screen allows the selection of defects from a list of faults. Defects can be viewed with sorting tools. Flight attendants can add corrective actions performed onboard the aircraft.

The electronic cabin logbook allows for the rapid review of all faulty seats, their location, and the associated defects.

eLOG is an electronic cabin logbook designed to capture equipment problems, attempted in-flight remedies, and other events that impact the passenger's experience. Once the aircraft lands, the data can be accessed by maintenance staff to speed along repairs and document actions taken. eLOG information can be offloaded from the aircraft using USB memory devices.

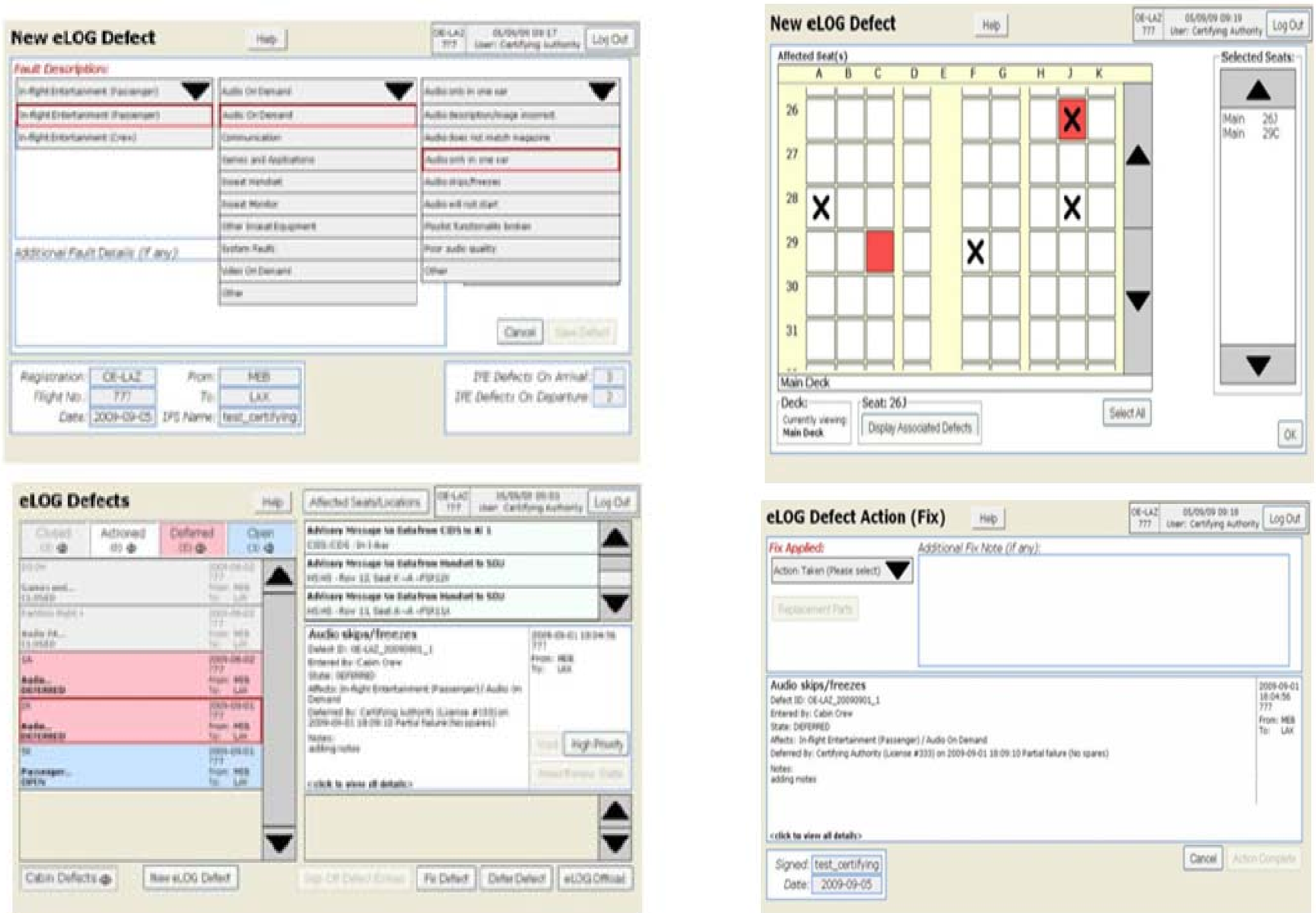

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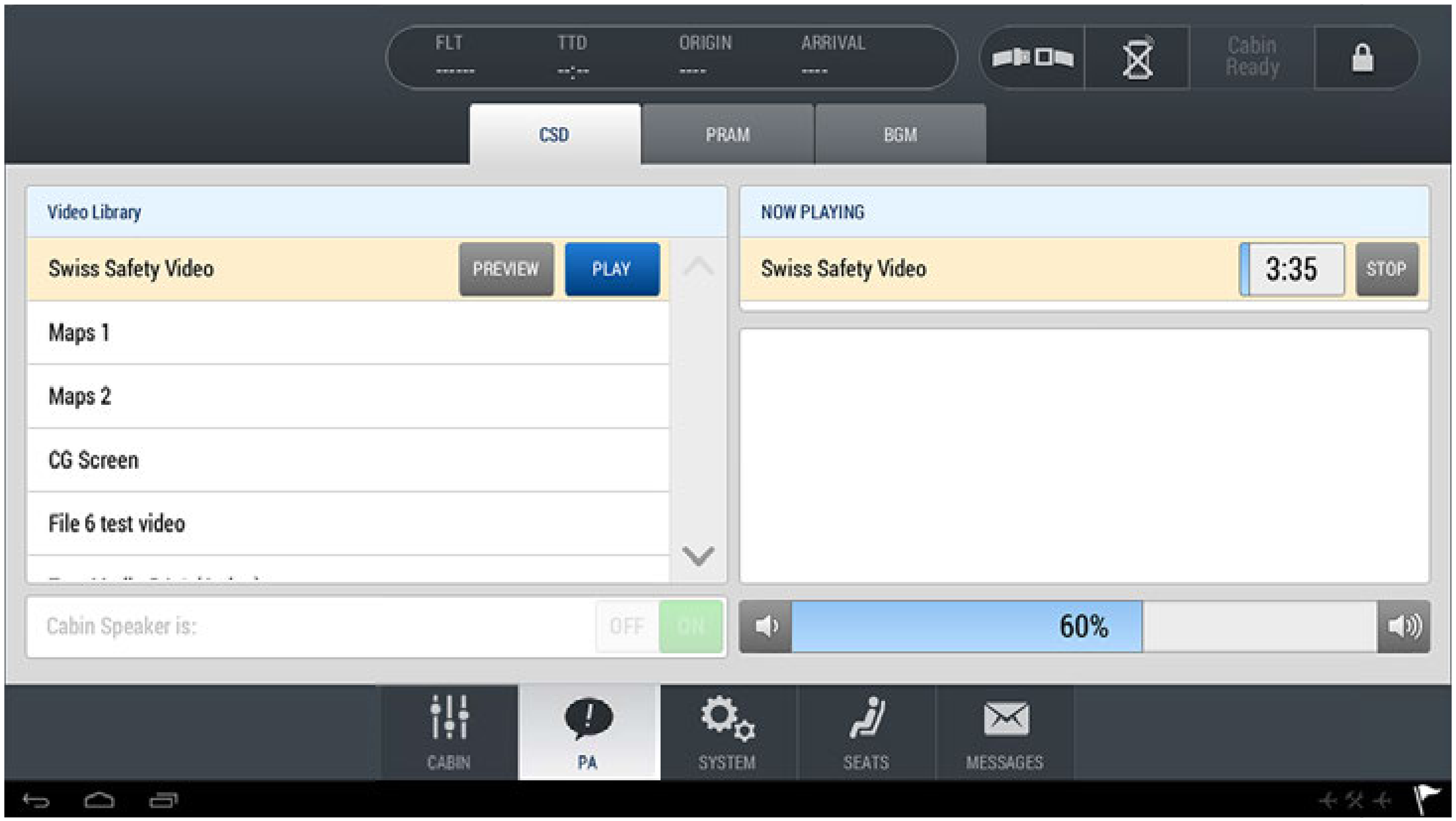
Figure 25: Electronic Cabin Logbook Screen (L2)

CUSTOMER SERVICE DISPLAY (OPTIONAL)

The optional customer service display (CSD) screen allows the flight attendant to select, preview, and control video announcements throughout the cabin. When [Play] is pressed, the selected video plays on all CSD monitors in the seat PSUs.

To play video announcements:

1. Select a video from the Library list.
2. Press [Play].



CS1_CS3_4411_047

Figure 26: Customer Service Display Screen (L2)

MAINTENANCE SCREENS

Maintenance Screen Access

The MAINT screen is accessed on the ground only by selecting the flag on the CMS CT. Select the Maintenance App icon to enter the maintenance mode.

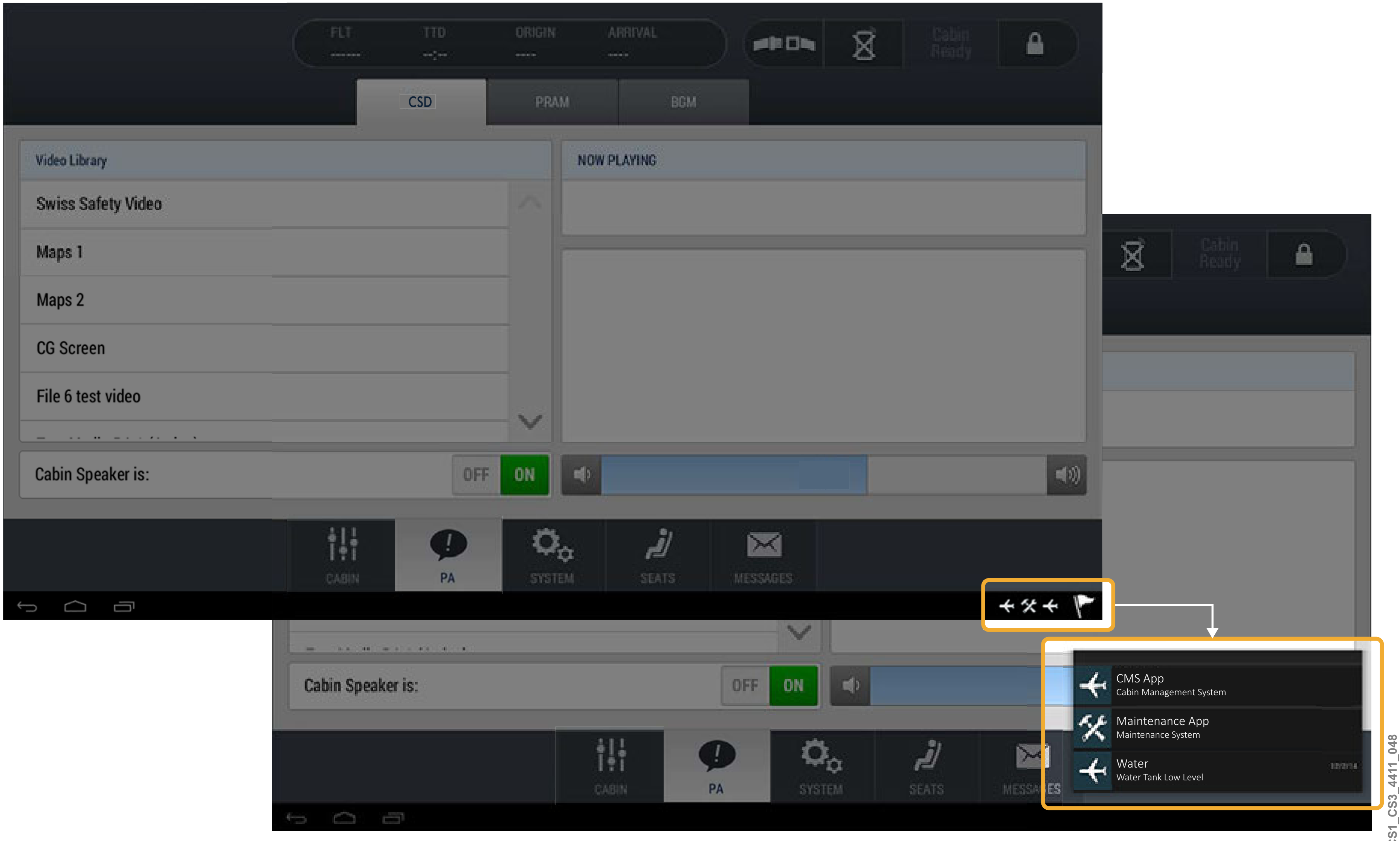


Figure 27: Maintenance Screen Access (L2)

Maintenance Password Screen

The Maintenance screen is password protected. Touching the text box area brings up a virtual keyboard. The password (TBD) is entered and appears in the text box as a series of dots. Maintenance mode is then entered by selecting the enter button.

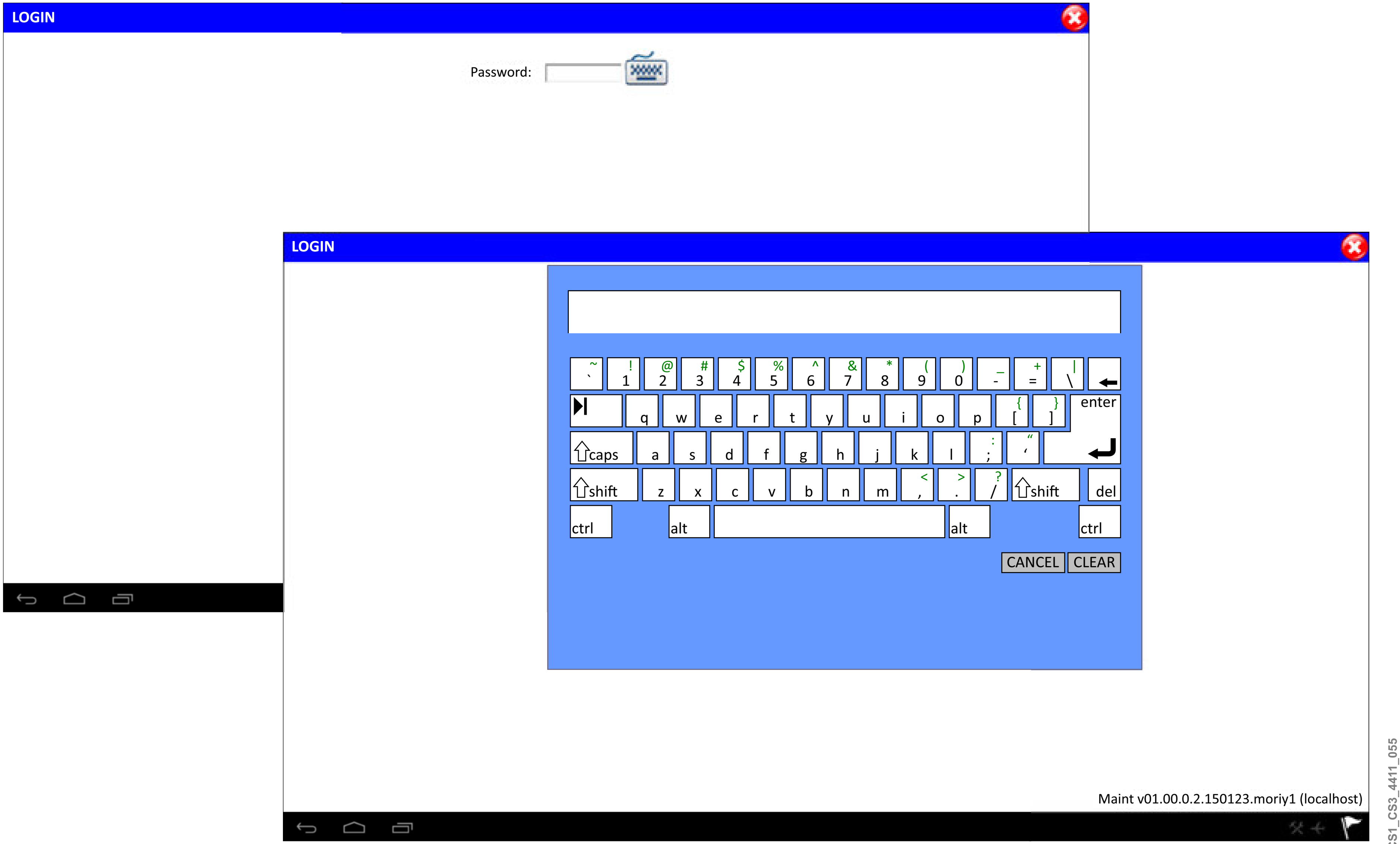


Figure 28: Maintenance Password Screen (L2)

Maintenance Screen Layout

The Maintenance screen consists of:

- Header
- Navigation pane
- Main window

Header

The header has the following buttons:

- Navigation - The navigation button minimizes or brings back the NAVIGATION pane
- Exit - Exits maintenance function

If a button is grayed out, the selection is not valid.

Navigation Pane

The Navigation pane shows the Cabin Maintenance menu. The Maintenance menu shows the heading of each main category. A + sign next to each menu category is used to display, or collapse the submenu for that category.

Main Window

The Main window displays the Maintenance screen selected on the Navigation pane.

MAINTENANCE SCREEN BUTTONS		
Key	Function	Description
	Navigation	Opens navigation side pane.
	Exit	Exits back to GUI screen.

CS1_CS3_4411_056

Figure 29: Maintenance Screen Layout (L2)

Layout of Passenger Area

The layout of passenger area (LOPA) provides a graphical representation of the airline specified cabin layout with all CMS related components shown. Each component is identified by a two letter code:

- Cabin controller (CC)
- Zone box (ZB)
- Passenger service unit controller (PSUC)
- Handset (HS)

Optional customer service display units are shown as thin rectangular boxes in front of each seat group.

Light emitting diode (LED) lighting units are shown as thin rectangular boxes along the sidewall, for sidewall lighting, and along the cabin for ceiling lights.

Each seat row is identified by a number across the bottom of the LOPA. Seat letters are displayed along the left side of the LOPA.

Lavatories and galleys are represented by the PSUCs that control them.

The system faults are displayed on the LOPA screens for easy identification of faults.

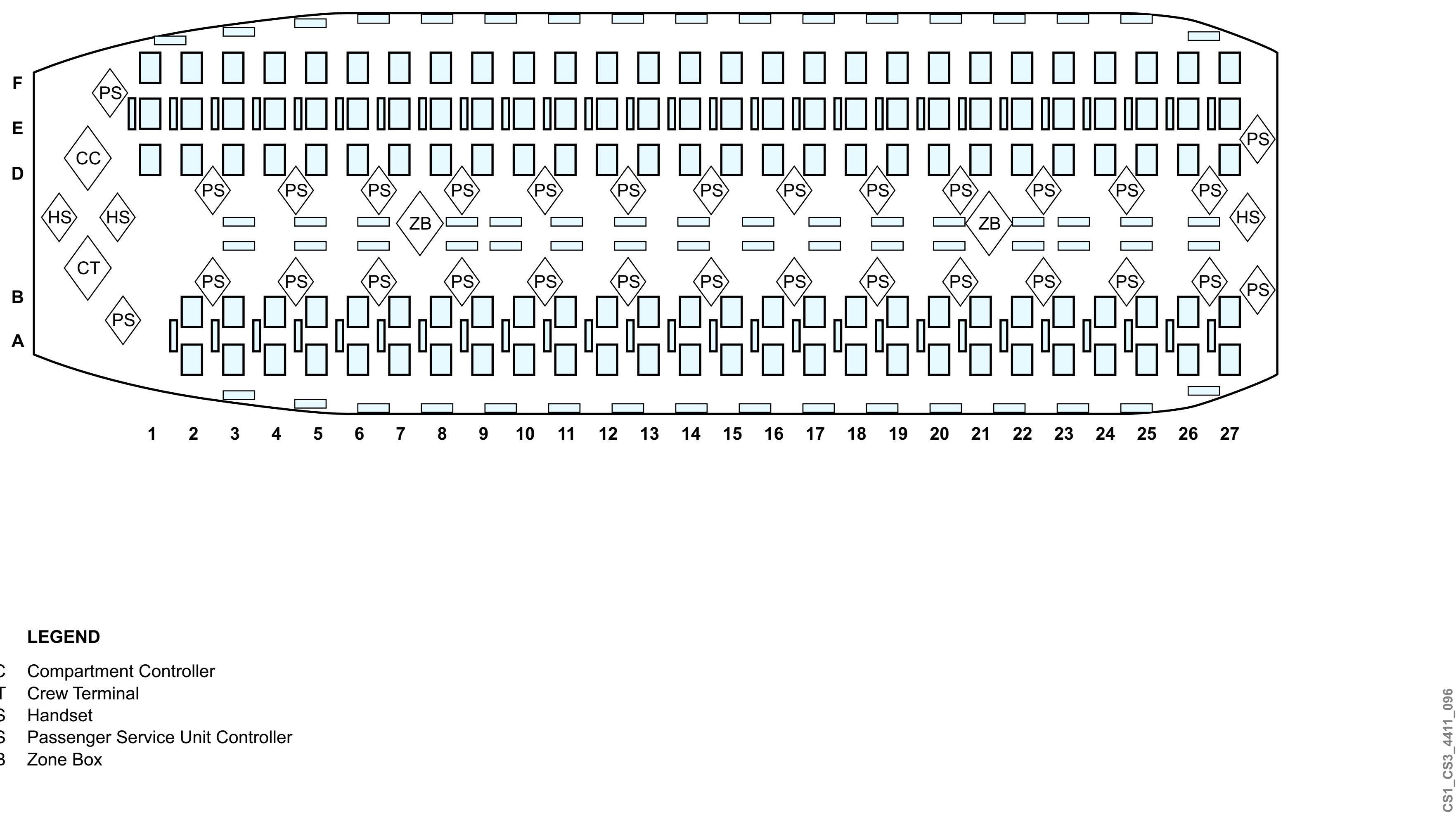


Figure 30: Layout of Passenger Area (L2)

System Tests

System Tests include the maintenance functions to perform various tests and to view test results. The following maintenance tests are included in this category:

- Start Quick Test
- Start All Test
- Decompression Test
- Lamp Test
- Passenger Address (PA) Test

Review Flight Legs

The submenu review flight legs gives the following categories:

- Flight Leg 1
- Fault Trends
- View Reboot Log

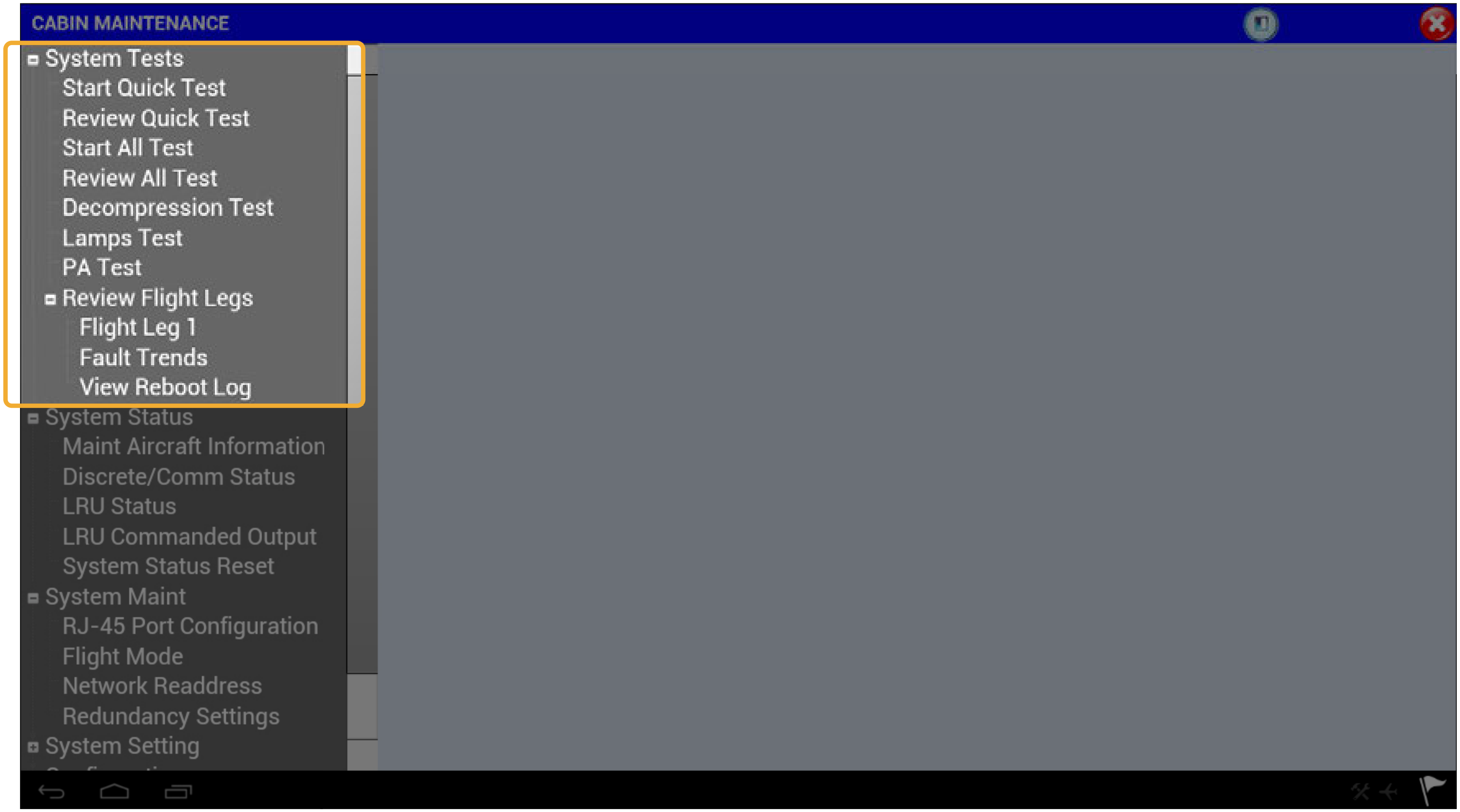


Figure 31: System Tests Screen (L2)

Start Quick Test

The Quick Test allows the initiation of built-in test equipment (BITE) for the selected line replaceable unit (LRU) categories. The Quick Tests are non-intrusive and do not interfere with other system operations.

A LOPA is displayed as the graphical representation of the locations of BITE faults during the Quick Test.

If the Quick Test report contains no faults, a pop-up message indicates no faults are detected.

If BITE faults are detected, they are displayed one at a time and can be scrolled through. Each fault contains the following information:

- Date and time
- Graphical representation of the fault on the LOPA
- Maintenance message ID (MMID)
- Fault class
- One line fault description
- Troubleshooting information

The component associated with the BITE being reviewed blinks in the LOPA display to help locate the faulty unit.

Maintenance message IDs are used in conjunction with the Aircraft Maintenance Manual (AMM) for troubleshooting.

The fault class is usually either hardware or software.

The BITE details give recommended maintenance actions, troubleshooting suggestions, and probable causes.

Review Quick Test

Review Quick Test displays the most recent quick test results. The Review Quick Test screen is the same as Quick Test screen.

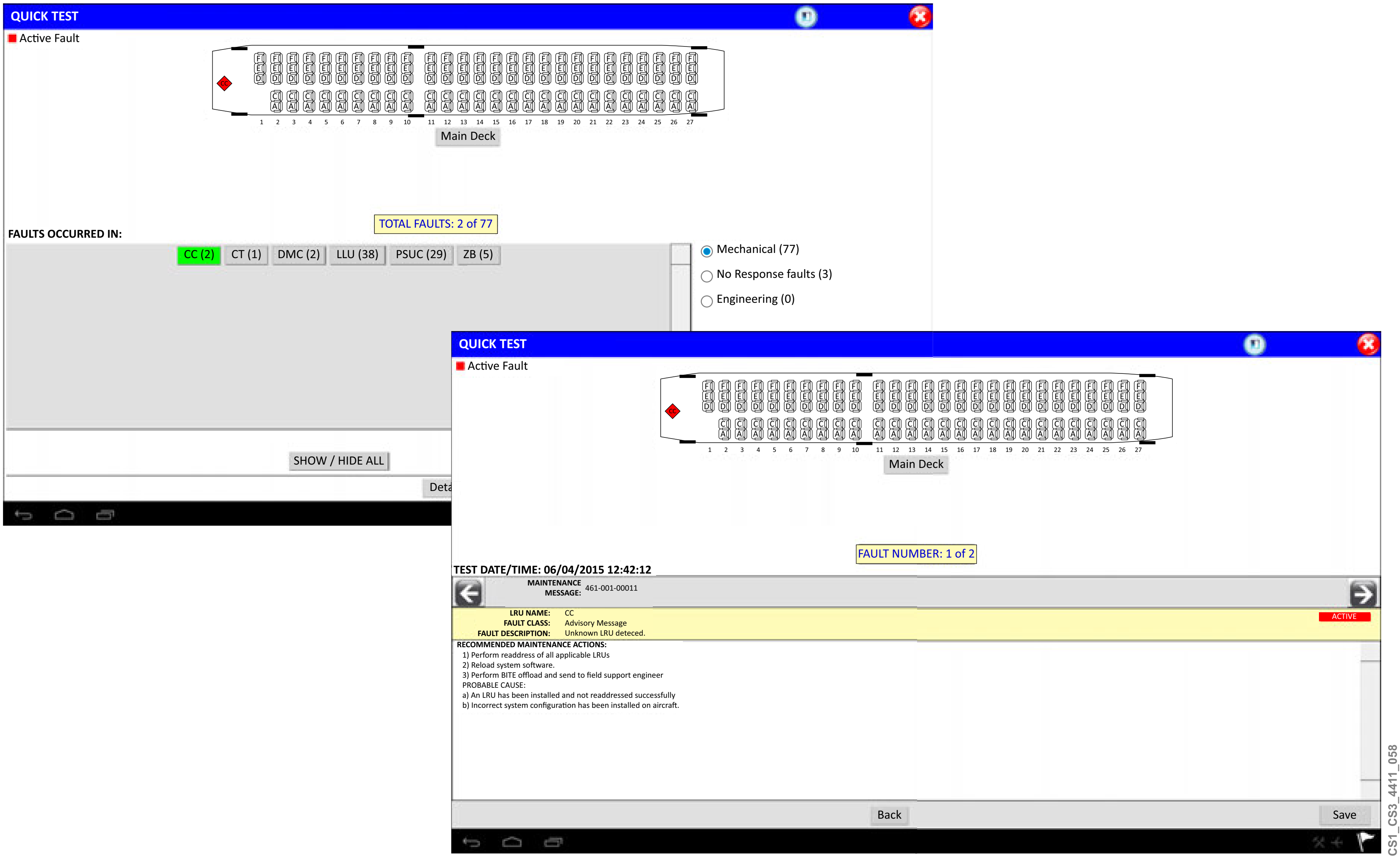


Figure 32: Quick Test and Quick Test Details Screens (L2)

Start All Test

All Test is a snapshot of the system BITE status and is composed of the faults sent from the individual LRUs during the 5 minute test interval. All Tests can take up to 5 minutes, therefore a Stop All Test function is included to end the test before it is completed.

Since All Test has the highest priority over all other system functions; it is inhibited in flight. During All Test, the BGM, PRAM, and all cabin interphone activations are inhibited or terminated.

If faults are detected, they can be reviewed by a LRU category where more information is available.

The All Test screen is the same as the Quick Test screen. The All Test details provides more information on the BITE faults reported.

Review All Test

Review All Test displays the most recent all test results. The Review All Test screen is the same as the All Test screen.

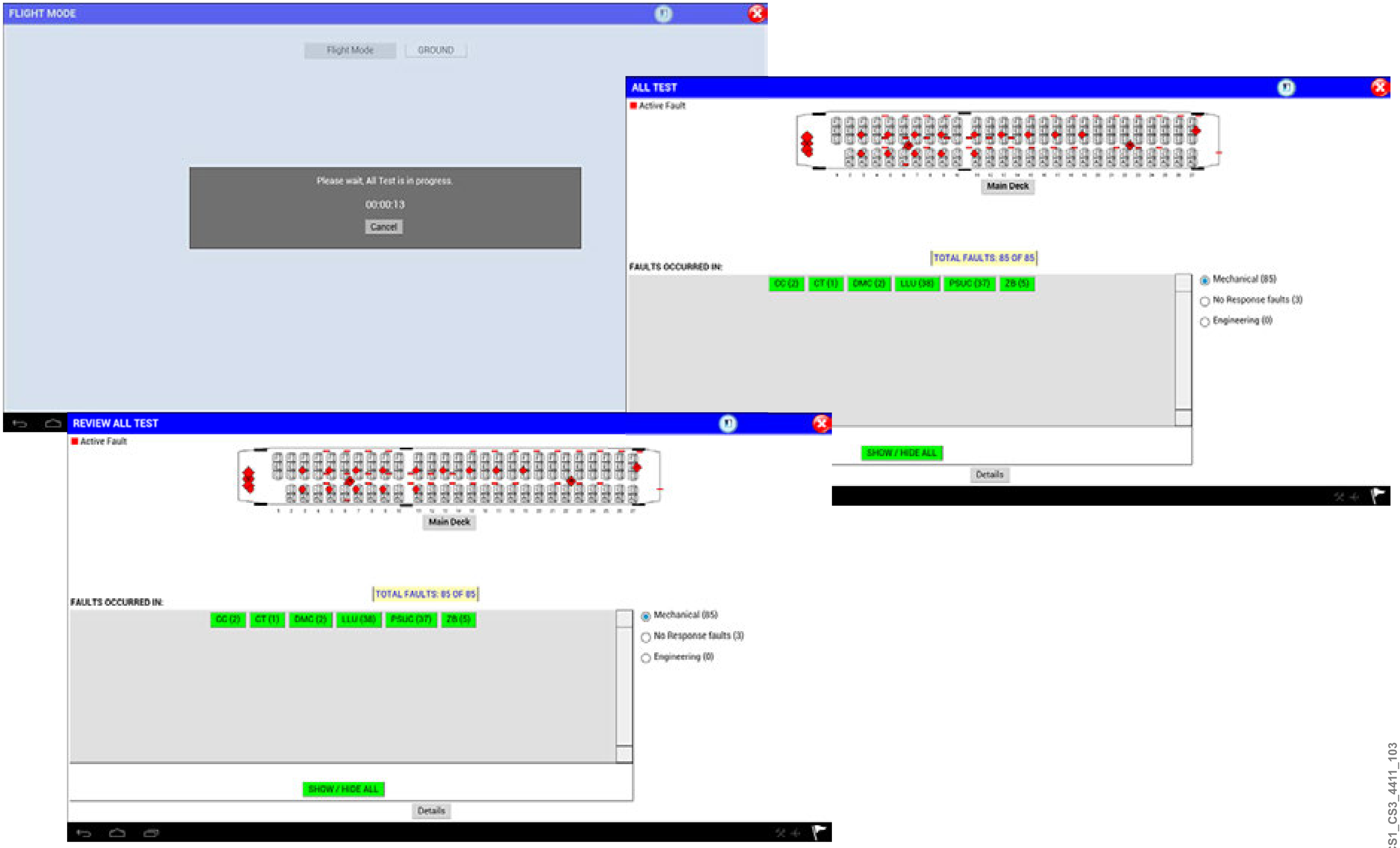


Figure 33: All Test and Review All Test Details Screens (L2)

Decompression Test

The Decompression Test screen allows initiation of a decompression test. The test is only available when the aircraft is on the ground and verifies the operation of the light, audio and ordinance that would be initiated in the event of a real decompression.

When the test is started, the CMS:

- Displays a Decompression Test In Progress indication on the crew terminal (CT)
- Displays a STOP button on the CT
- Outputs a high chime three times
- Turn on all ordinance signs
- Increase all cabin speaker PA volume
- Sidewall and lavatory lights go BRT

All test indications return to normal when the test is complete. The decompression test can be canceled during the test by pressing the stop button.

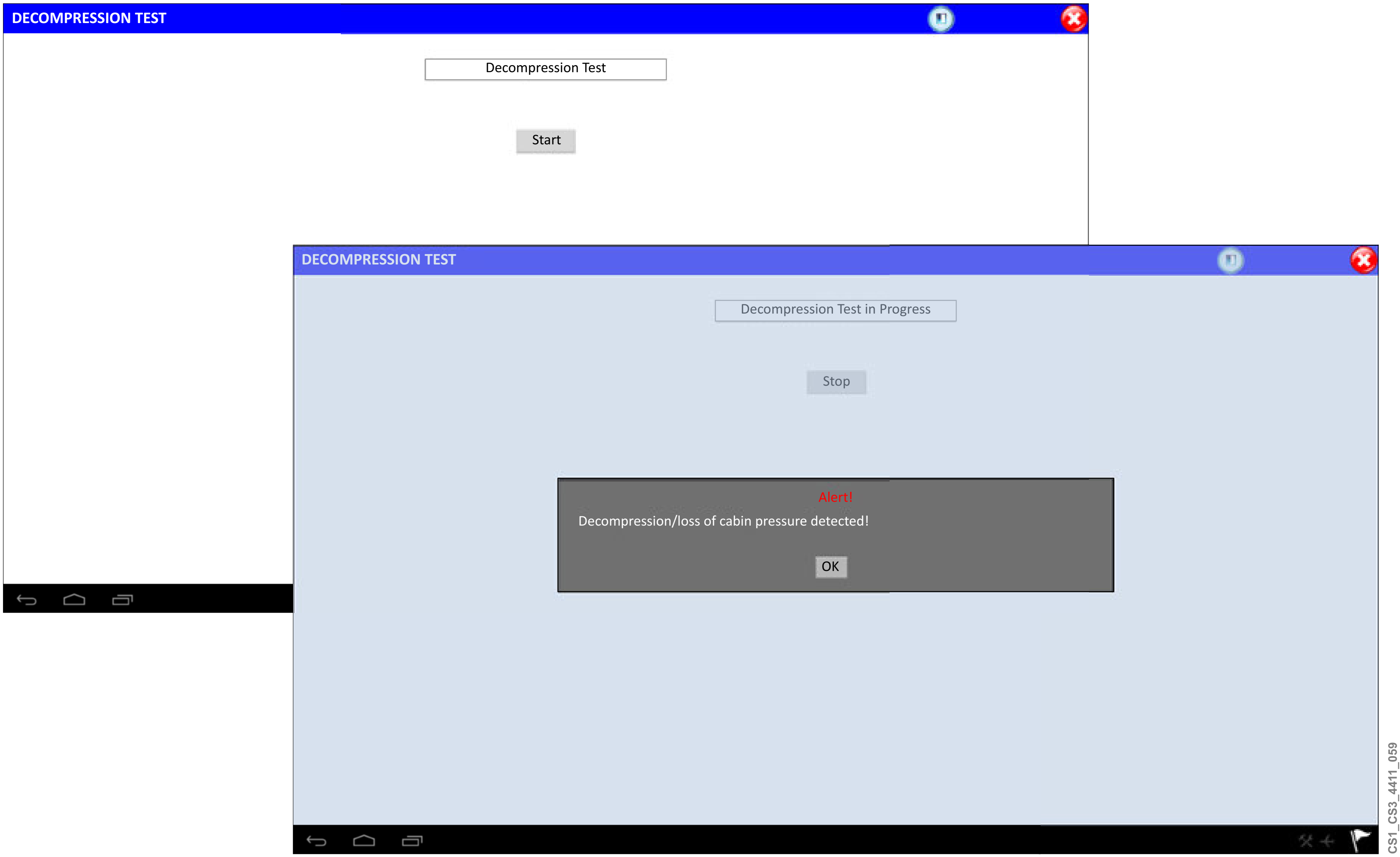


Figure 34: Decompression Test Screen (L2)

Lamps Test

The Lamp Test screen provides the test features for the lighting modules. The following lights can be controlled ON/ OFF.

- Reading lights
- Call lights
- Lavatory lights (excluding RS-485 controlled lights)
- Lavatory call lights
- Lavatory occupied signs
- Ordinance signs
- Advisory lights
- Door lamps

The following light types can be controlled BRT/ NORM/ DIM/OFF:

- Sidewall lights
- Ceiling lights
- Galley lights
- Entry lights
- Lavatory lights

Call light tests include the associated chime.

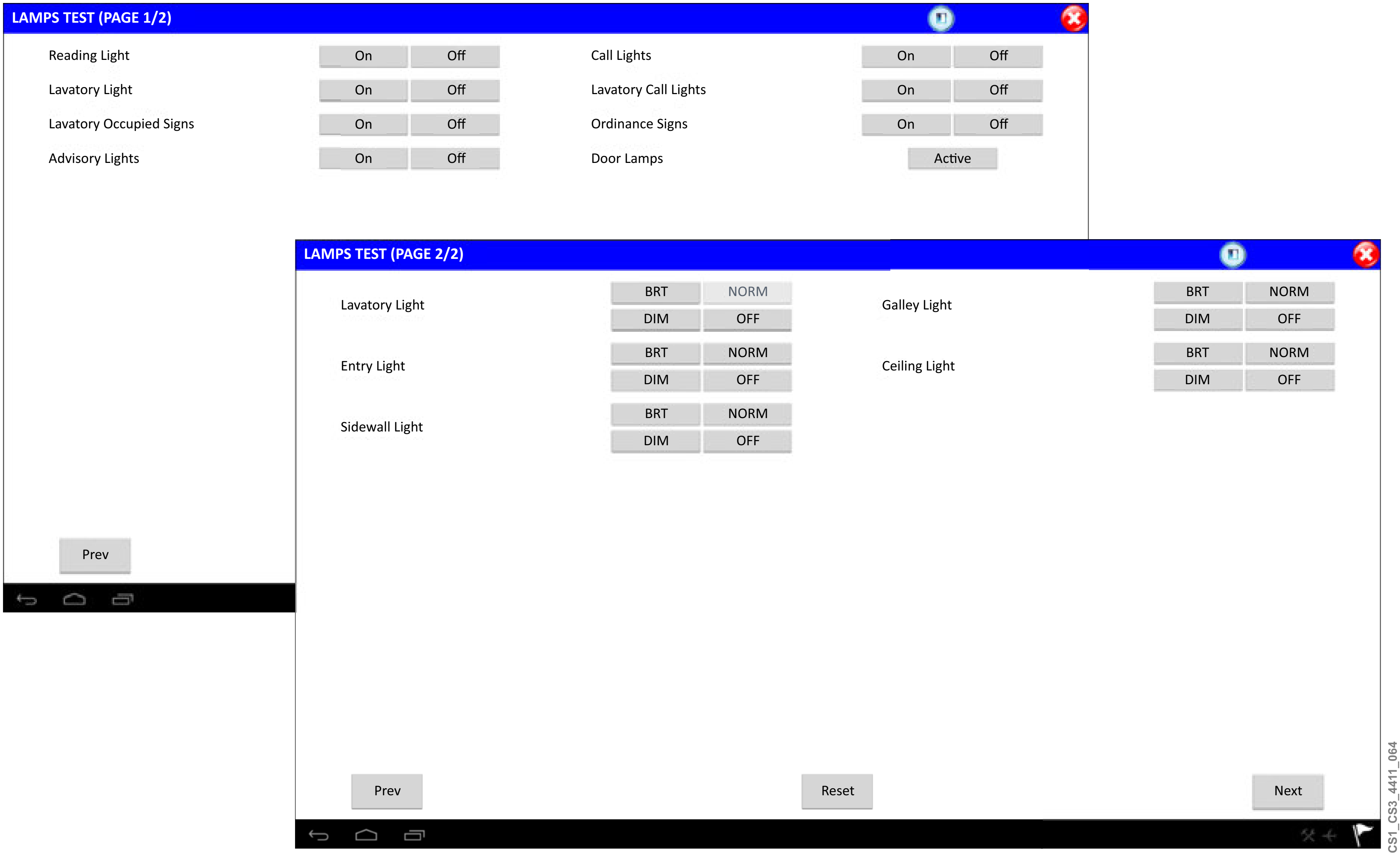


Figure 35: Lamp Test Screen (L2)

Passenger Address (PA) Test

The PA test function is used to test the PA system and for cabin audio calibration.

When the Start button is pressed, the PA Test:

- Outputs pink noise from all PA speakers
- Illuminates the call panel green advisory light
- Displays the PA TEST IN PROGRESS text on the maintenance screen
- Displays a Stop button to end the test

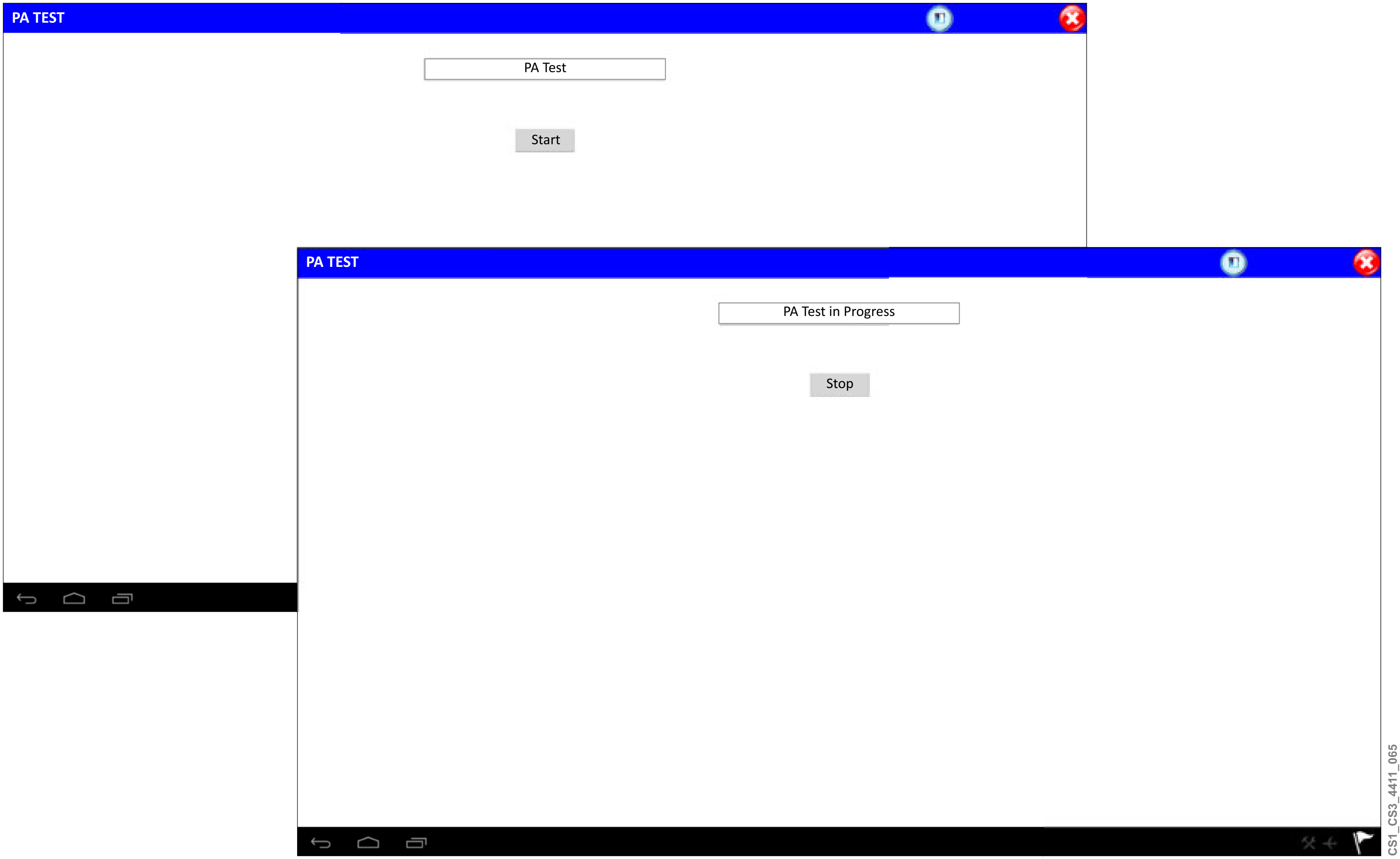


Figure 36: PA Test Screen (L2)

Review Flight Leg History

Review Flight Leg history submenu includes the maintenance reports that examine the CMS using the BITE data obtained from previous flight records. The following maintenance functions shall be included in this category:

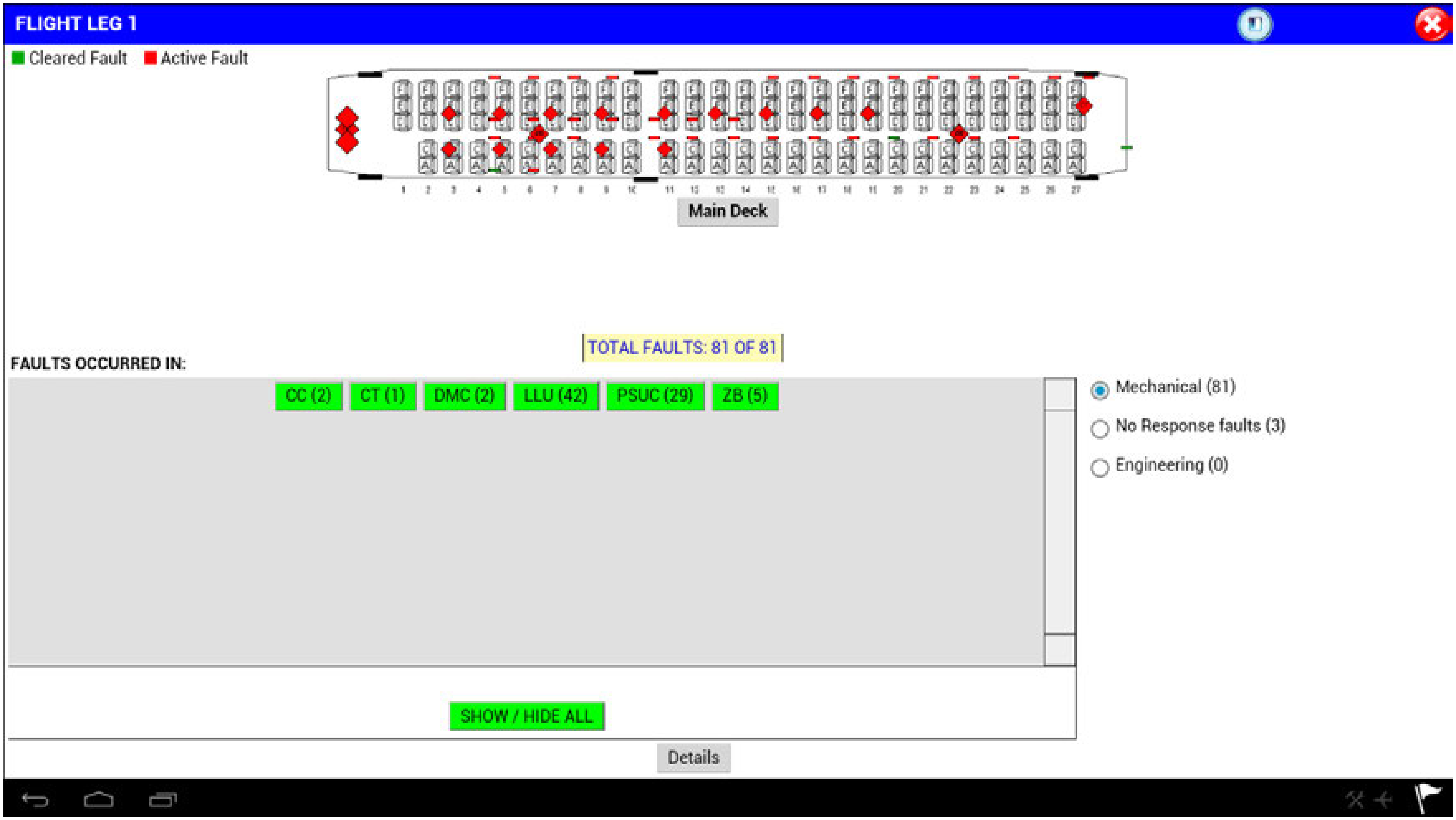
- Flight Leg 1
- Fault Trends
- View Reboot Log

Flight Leg 1

Flight leg is a report that consists of BITE faults that were active at the end of the flight leg. The most recent flight is flight leg 1 and the second most recent flight leg is flight leg 2. Up to a maximum of eight flight legs are available for display.

NOTE

Even thought the cabin controller will store up to 100 flight legs at a time, the CMS only displays the last eight flight legs.



CS1_CS3_4411_060

Figure 37: Review Flight Legs Screen (L2)

Fault Trends

The Fault Trends screen displays the same information as the Quick Test menu, with the exception that fault trends allow viewing of the last eight flight legs faults. The faults are either displayed as active or inactive in the LOPA. The active or inactive status is displayed as follows:

- LRUs/seats which currently have a fault blink red-yellow
- LRUs/seats which currently don’t have a fault blink green-yellow

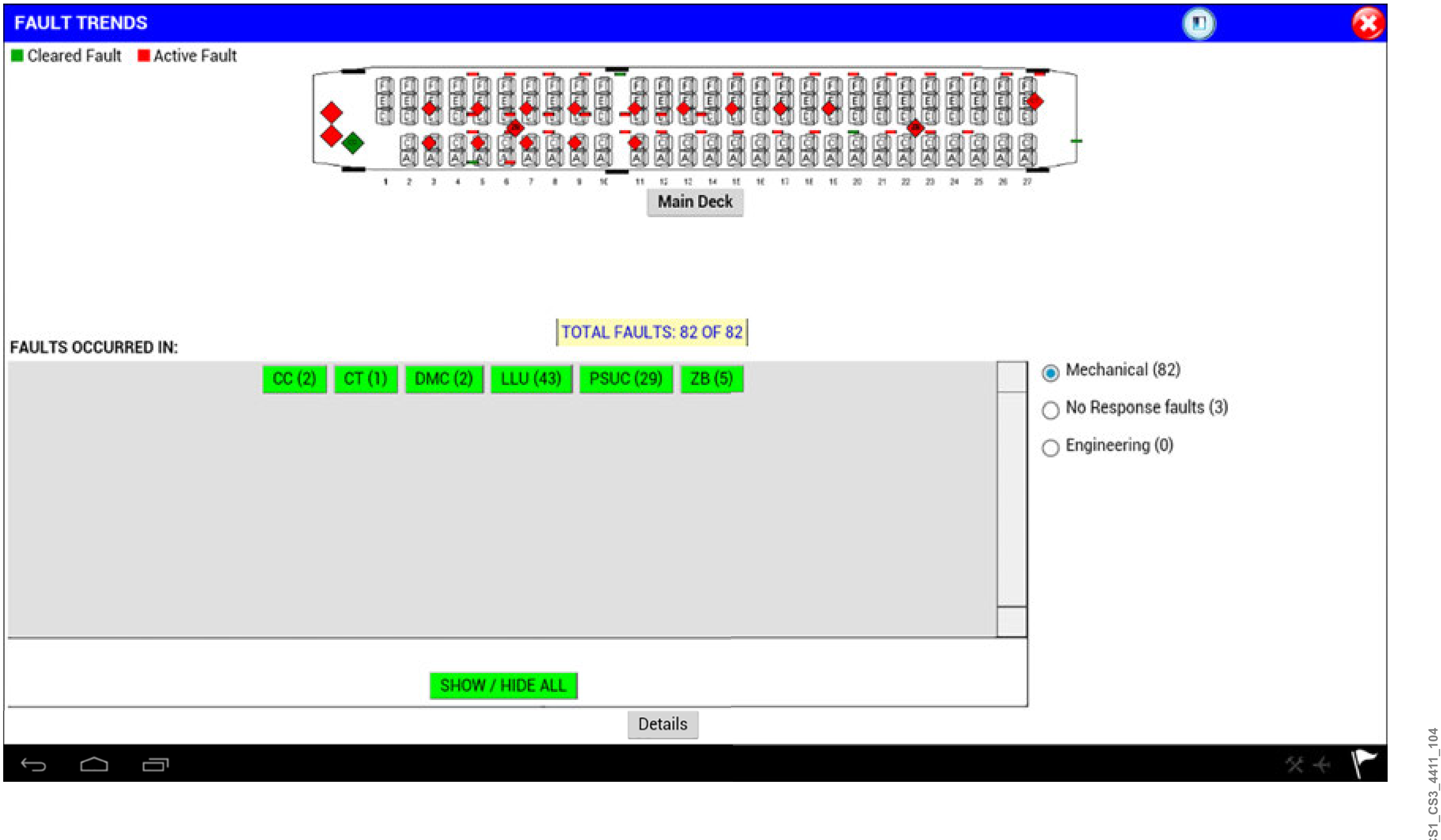


Figure 38: Fault Trends Screen (L2)

View Reboot Log

The view reboot log retrieves a report that shows the LRU reboot activity during the eight most recent flight legs. This report includes only the LRU reboots that occurred while the system was in flight. The reboot log can be displayed in two different views.

In the summary view, the reboot log is grouped by LRU with multiple reboot logs displayed under one line.

In the details view reboot logs are displayed individually per line with the time and date the reboot occurred.

The following information is available in both views:

- LRU name
- LRU type
- IP address
- Logic address
- Location
- Reboot count (in summary view only)
- Occurred on (in details view only)

In the LOPA, solid yellow icons indicate the location of the LRUs that have rebooted.

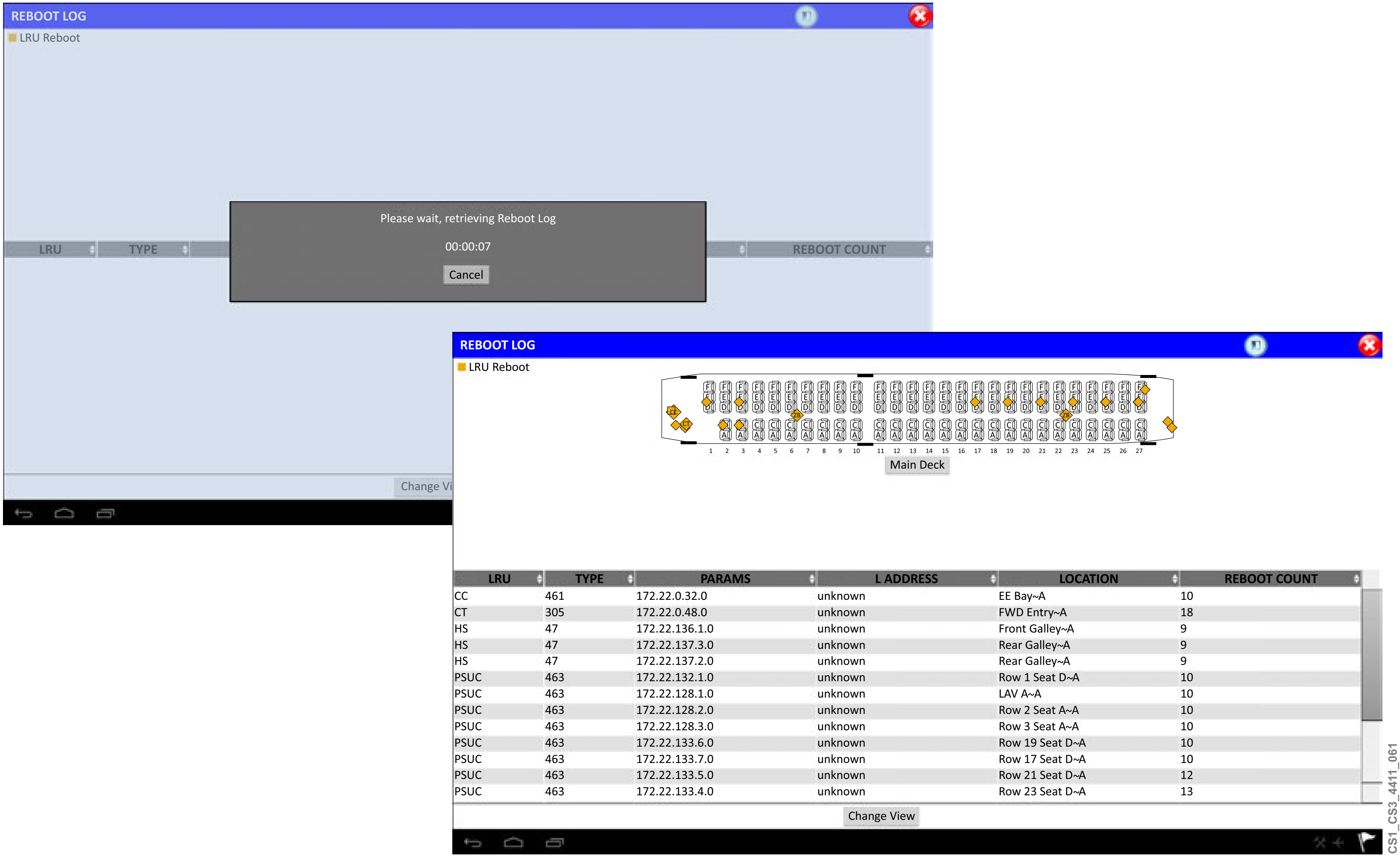


Figure 39: View Reboots Log Screen (L2)

System Status

System Status includes the maintenance functions to review status of CMS components and to change the CMS outputs. The following maintenance functions are included in this category:

- Maint Aircraft Information
- Discrete/Comm Status
- LRU Status
- LRU Commanded Output

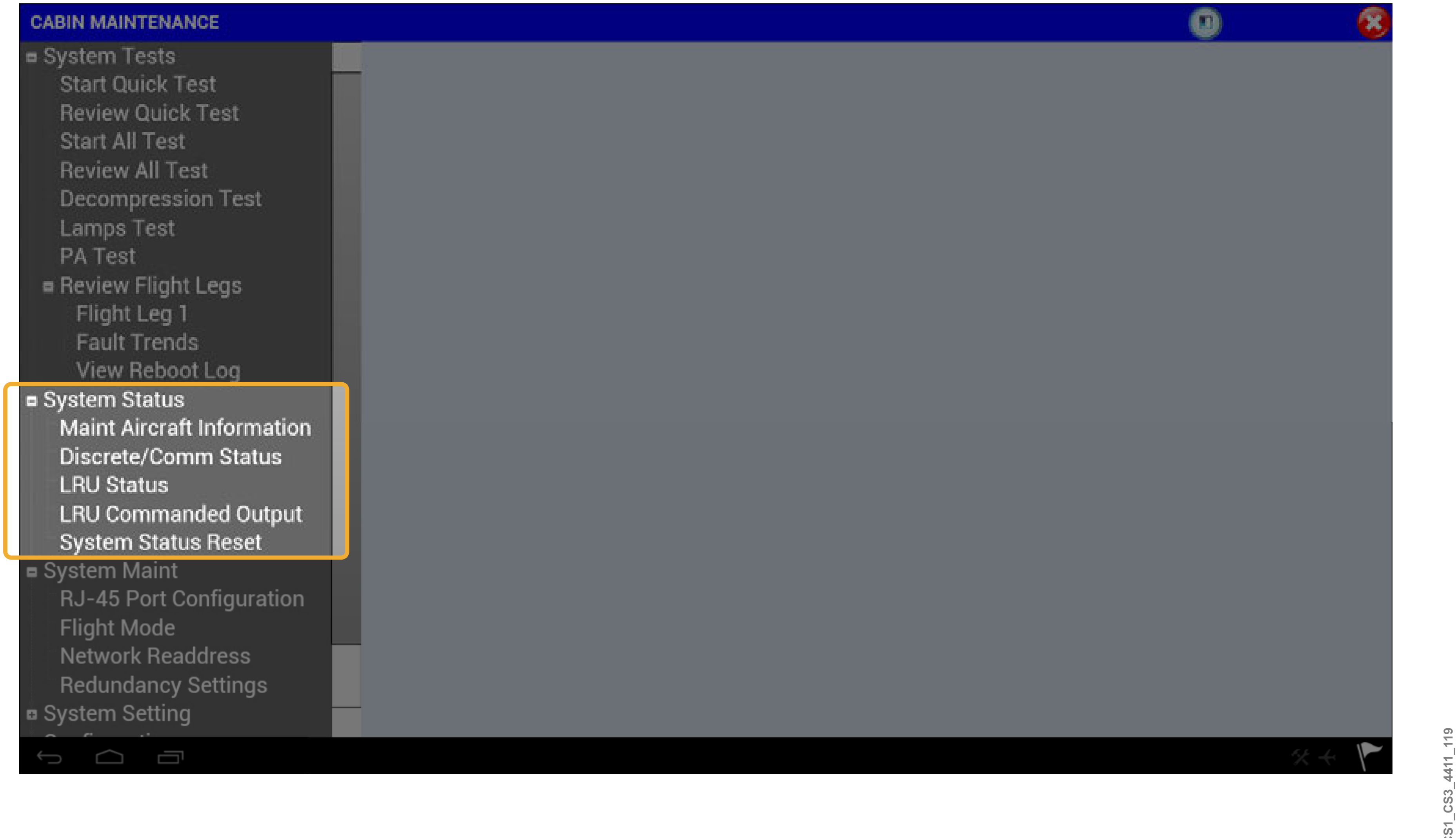


Figure 40: System Status Screen

Maint Aircraft Information

If the aircraft data from the data concentrator unit module cabinet (DMC) is not available, the Maint Aircraft Information screen allows the user to view and modify the following information:

- System date and time
- Aircraft tail number
- Aircraft serial number
- Aircraft registration number

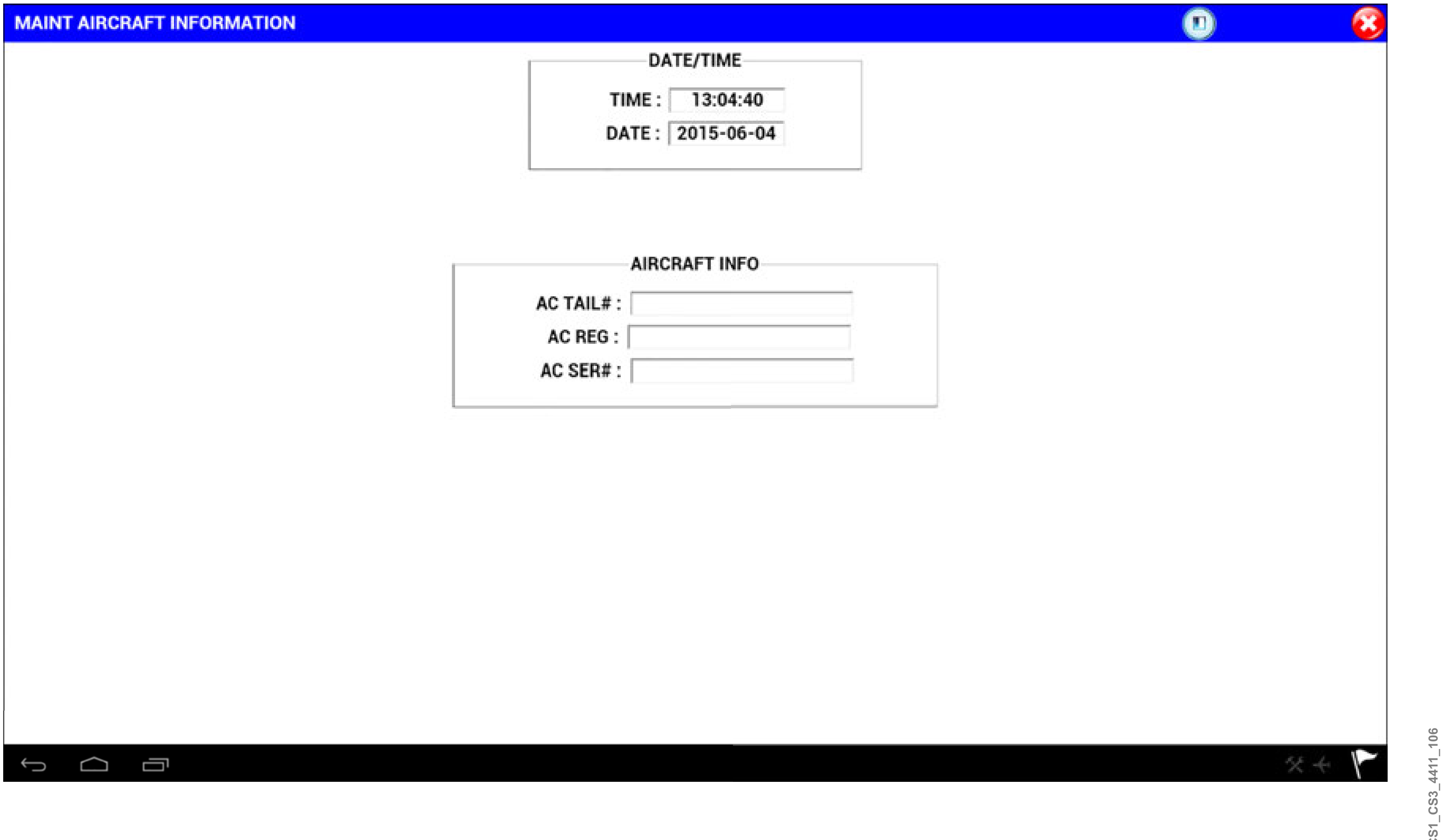
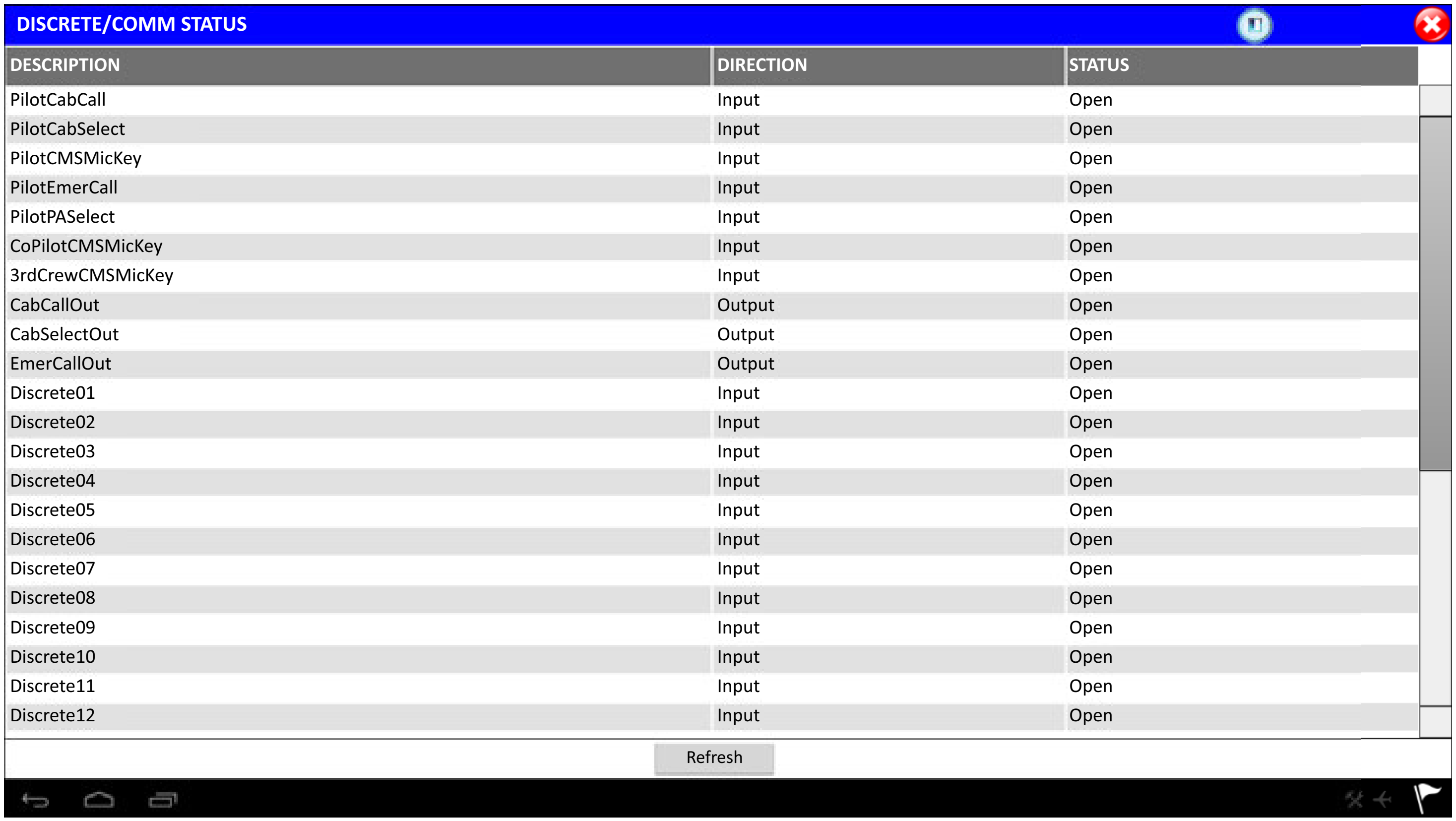


Figure 41: Maint Aircraft Information Screen (L2)

Discrete/Comm Status

The Discrete/Comm status provides the current discrete/comm values which input directly to the cabin controller (CC). The maintenance GUI is able to configure the discrete/comm status features that are displayed. Each available discrete is described and its status displayed on the maintenance screen.


DISCRETE/COMM STATUS

DESCRIPTION	DIRECTION	STATUS
PilotCabCall	Input	Open
PilotCabSelect	Input	Open
PilotCMSMicKey	Input	Open
PilotEmerCall	Input	Open
PilotPASelect	Input	Open
CoPilotCMSMicKey	Input	Open
3rdCrewCMSMicKey	Input	Open
CabCallOut	Output	Open
CabSelectOut	Output	Open
EmerCallOut	Output	Open
Discrete01	Input	Open
Discrete02	Input	Open
Discrete03	Input	Open
Discrete04	Input	Open
Discrete05	Input	Open
Discrete06	Input	Open
Discrete07	Input	Open
Discrete08	Input	Open
Discrete09	Input	Open
Discrete10	Input	Open
Discrete11	Input	Open
Discrete12	Input	Open

Refresh

CS1_CS3_4411_107

Figure 42: Discrete/Comm Status Screen (L2)

LRU Status

The LRU Status screen displays an LRU selection page. Once an LRU selection is made, the LRU interface status is listed as follows:

- Cabin controller
  - ARINC 429 input/output
  - Discrete input/output
  - Ethernet switch status
- Crew terminal
  - Ethernet switch status
- Zone box
  - Discrete input/output
  - Ethernet switch status
- Passenger service unit controller
  - Discrete input/output
  - Ethernet switch status

Once the LRU status selection is made, an LRU type selection prompt allows the user to select one of the four LRUs listed above.

If more than one LRU can be displayed once an LRU type selection has been made, prompt keys are used to select the next LRU.

Once the above selections are completed, the discrete inputs and outputs to the unit selected are displayed along with their current status.

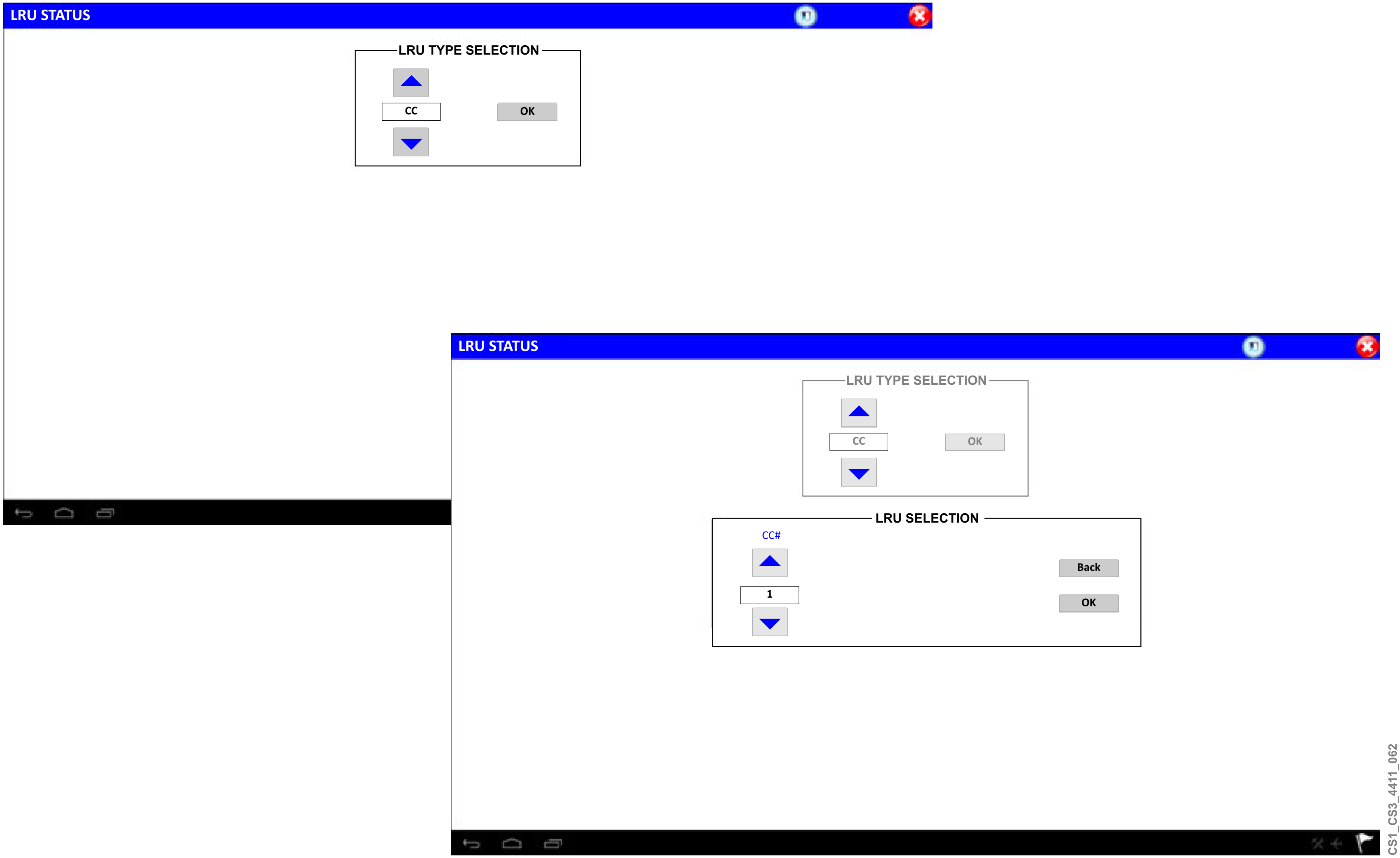


Figure 43: LRU Status Screen (L2)

LRU Commanded Output

The LRU Commanded Output screen allows the output of each of the following LRU interfaces to be changed:

- Cabin controller
  - Discrete outputs
- Zone Box
  - Discrete outputs
- Passenger service unit controller
  - Discrete outputs
  - Speaker outputs

The selection of discrete output allows the output to be toggled from open or ground and to view its effect.

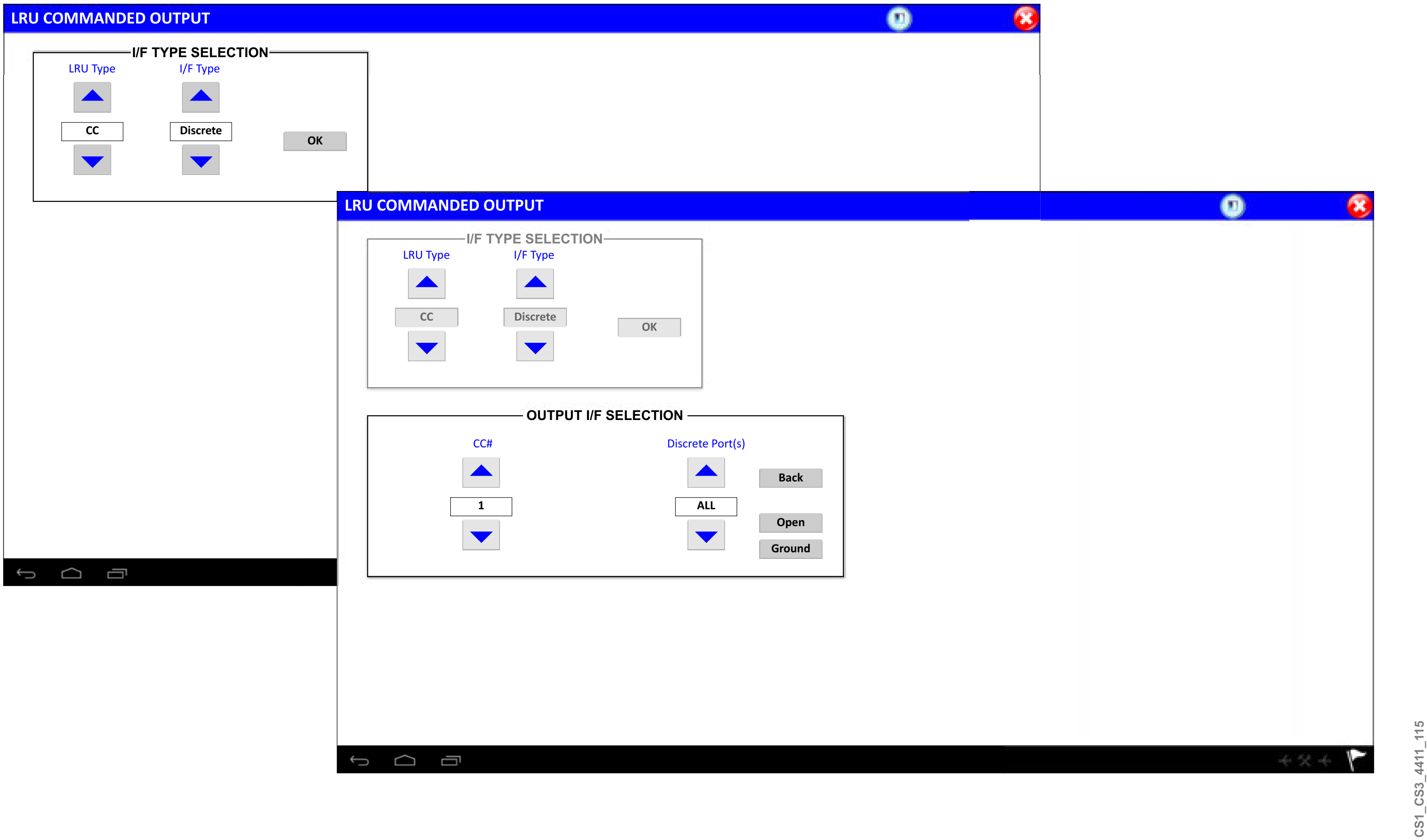


Figure 44: LRU Commanded Output Screen (L2)

System Status Reset

The System Status reset screen allows the following systems internal statuses to be reset:

- Passenger reading light status
- Passenger call status
- Lavatory call light status
- All status

This function is used to reset call light and reading light status in case of network or passenger service unit controller (PSUC) failure.

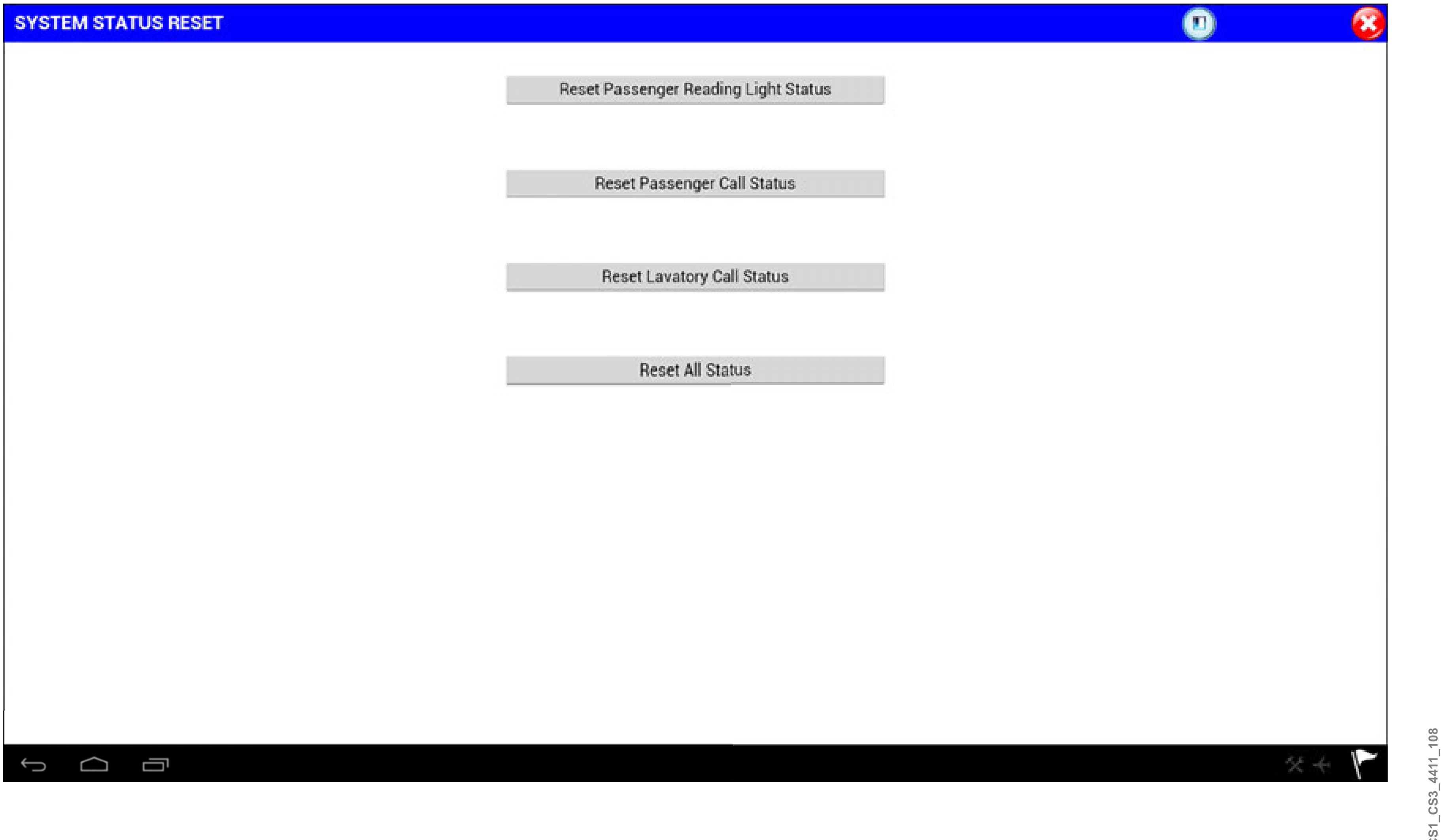


Figure 45: System Status Reset Screen (L2)

System Maintenance

The System Maint screen provides functions that are used for system level maintenance activities.

The following maintenance functions are included in this category:

- RJ-45 Port Configuration
- Flight Mode
- Network Readdress
- Redundancy Settings

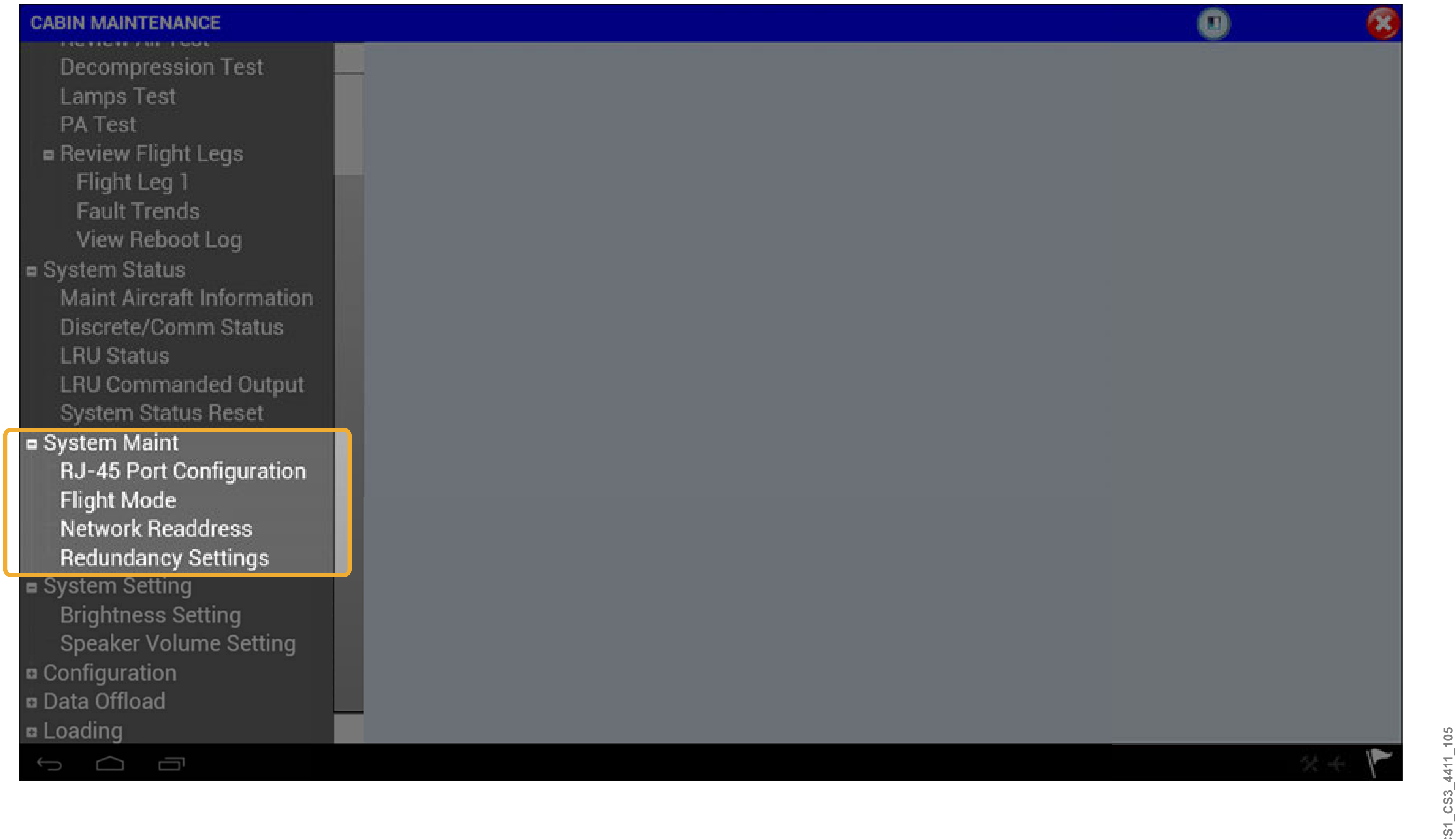


Figure 46: System Maint Screen (L2)

RJ-45 Port Configuration

The RJ-45 Port Configuration screen indicates whether the RJ-45 port on the CT is enabled or disabled.

The RJ-45 Port Configuration button enables the port so that an RJ-45 portable device can be used at the crew terminal. The portable device is used for troubleshooting.

When the maintenance screen is exited, the RJ-45 port configuration is disabled automatically, if it was enabled. The RJ-45 port is always disabled when the aircraft goes into the air. The flight mode changed via the Maint screen does not disable the RJ-45 port.

Figure 47: RJ-45 Port Configuration Screen (L2)

Flight Mode

The Flight Mode screen displays the current state of weight-on-wheels (WOW) detected by the CMS.

The Flight Mode button switches between air and ground mode for CMS testing without generating a real flight leg. At the end of testing, the Flight Mode reverts to the actual aircraft state.

Figure 48: Flight Mode Screen (L2)

Network Readdress

The Network Readdress screen allows the user to readdress or obtain a topology report of selected LRUs.

Readdress reassigns the correct IP address or logical address to any component associated with a ZB when there is a wrong address. It is also used when a new PSUC, HS, CSD, or LLU is installed on the aircraft.

After a successful readdress, the readdressed LRUs turn green. In case of a readdress failure, the affected LRUs turn red.

The analyze topology submenu generates an engineering report that lists all of the LRUs configured under the selected zone box. This shows recommended readdress flags after comparing the current topology with the topology history. The text file of this report can be printed at the printer or saved to the USB memory device.

The readdress function is inhibited during flight.

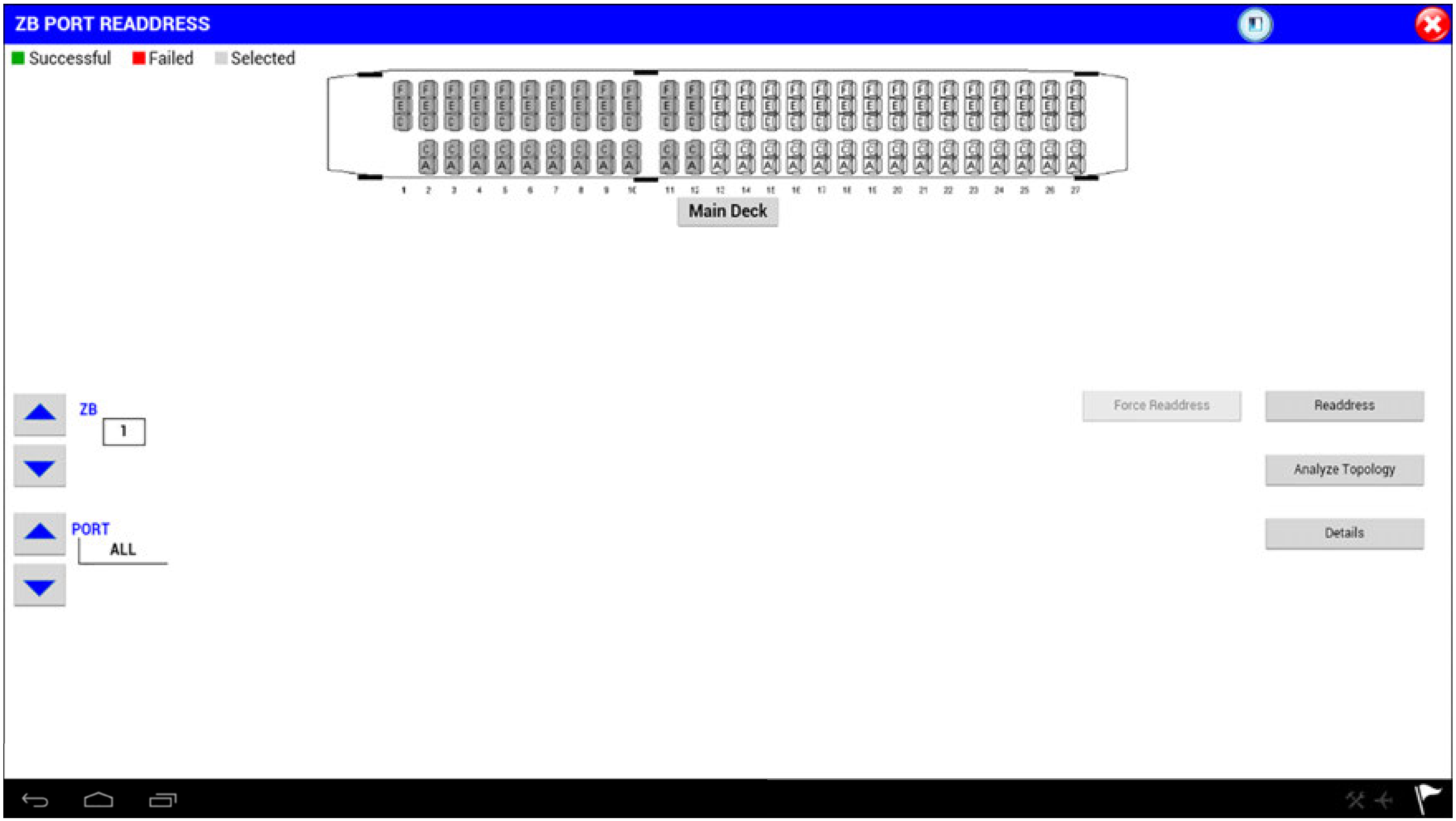


Figure 49: Network Readdress Screen (L2)

Redundancy Settings

The Redundancy Settings enables the setting of the redundancy status to ON or OFF. If the Redundancy Settings is on and a PSUC-PSUC or ZB-PSUC network fault occurs, the system continues to function, bypassing the failed component. The Redundancy Settings should always be set to ON for normal operation, however, it can be turned off for troubleshooting purposes.

Figure 50: Redundancy Settings Screen (L2)

System Setting

The Lighting Control screen has the following functions:

- Brightness Setting
- Speaker Volume Setting

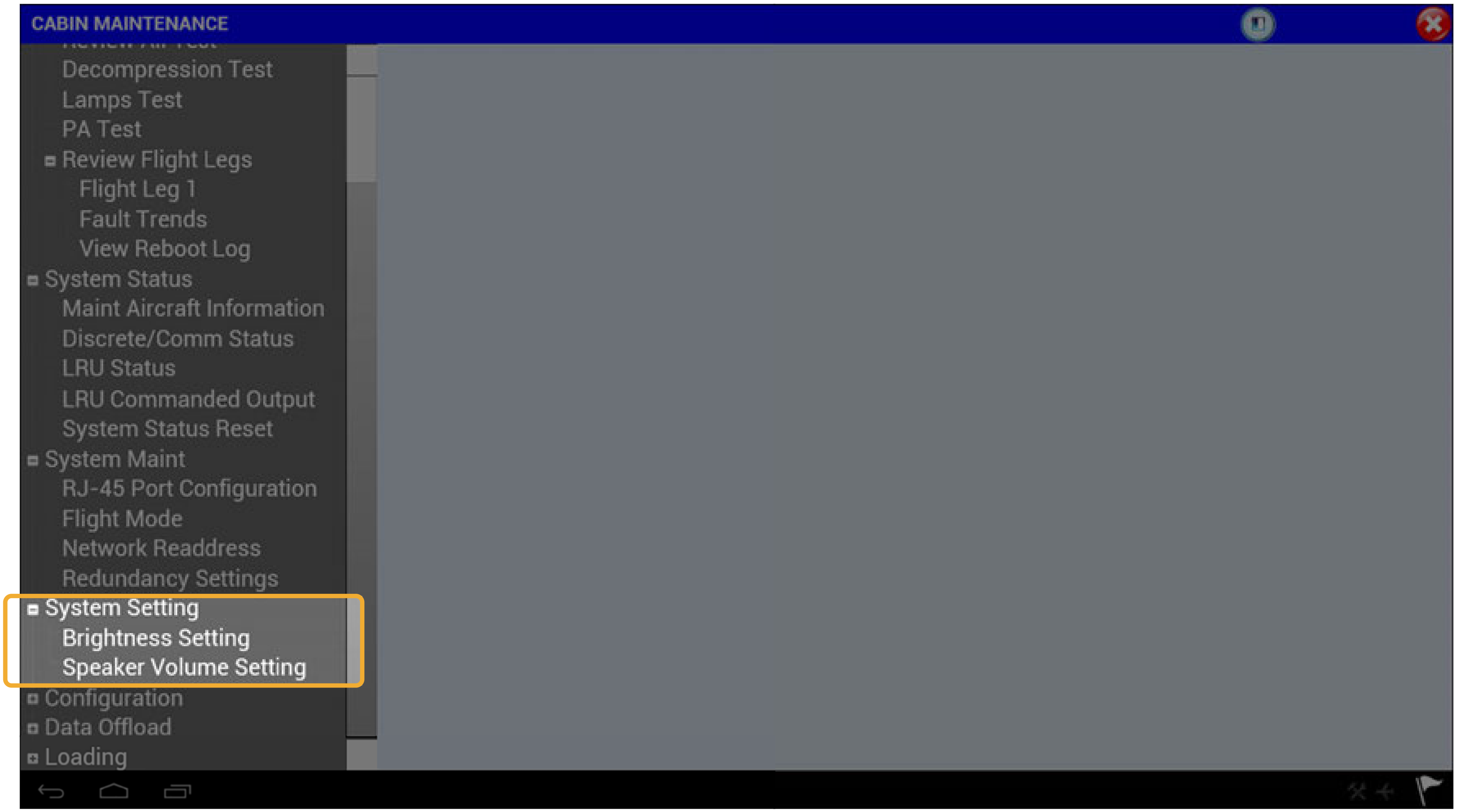


Figure 51: System Setting Screen (L2)

Brightness Setting

The following lights have customizable brightness settings:

- Sidewall light (Zone 1)
- Sidewall light (Zone 2)
- Ceiling light (Zone 1)
- Ceiling light (Zone 2)
- Galley light
- Galley light (crew task light)
- Entry light
- Entry light (crew task light)
- Entry light (dome light)
- Lavatory light

The Brightness Setting page configures the NORM and DIM brightness level by percentage, with 0% being off and 100% being full brightness.

By default, the DIM value of all types of lights is set to 50% and the NORM value of all types of lights is set to 70%. This value can be changed in the configuration database.

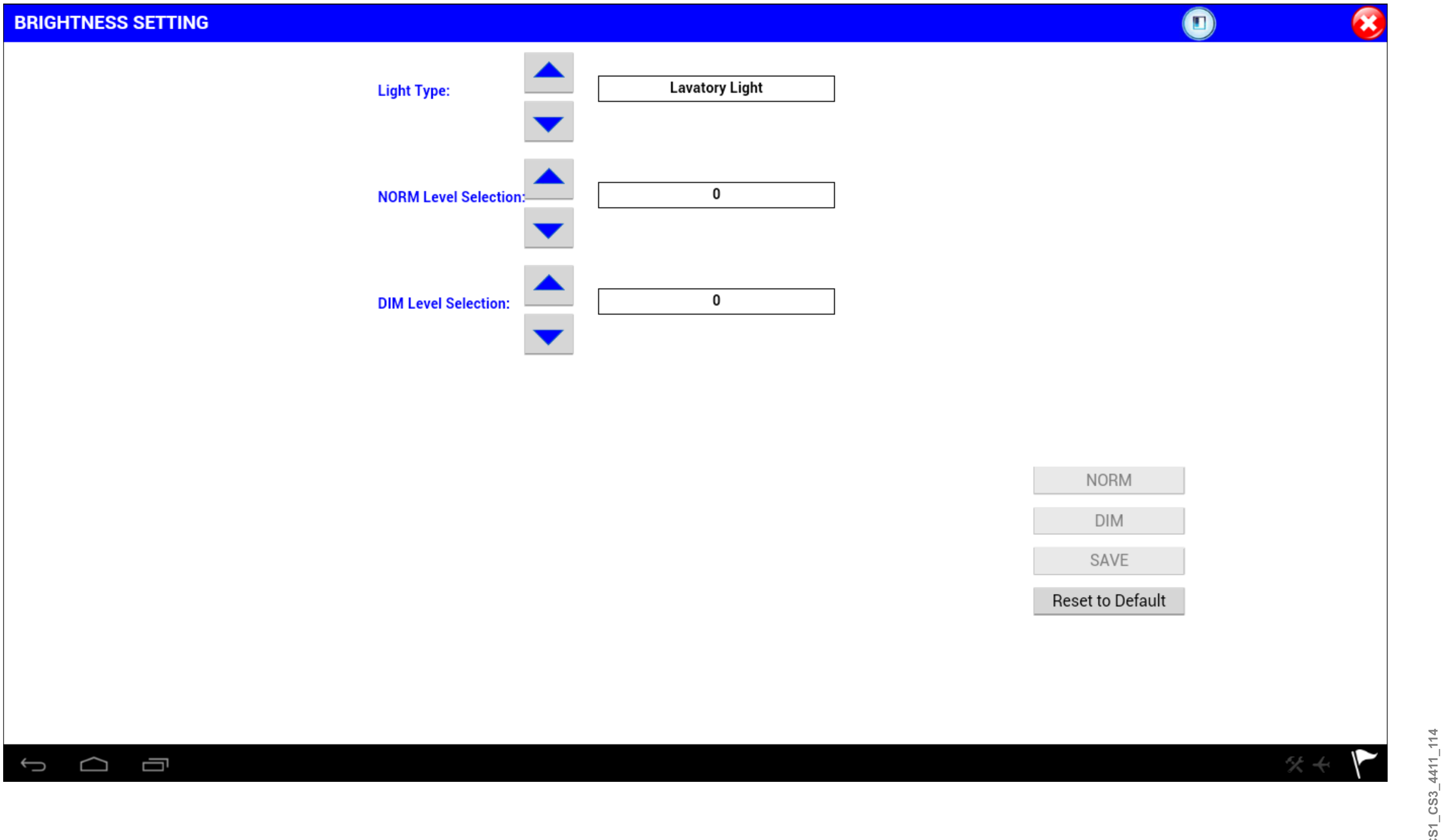
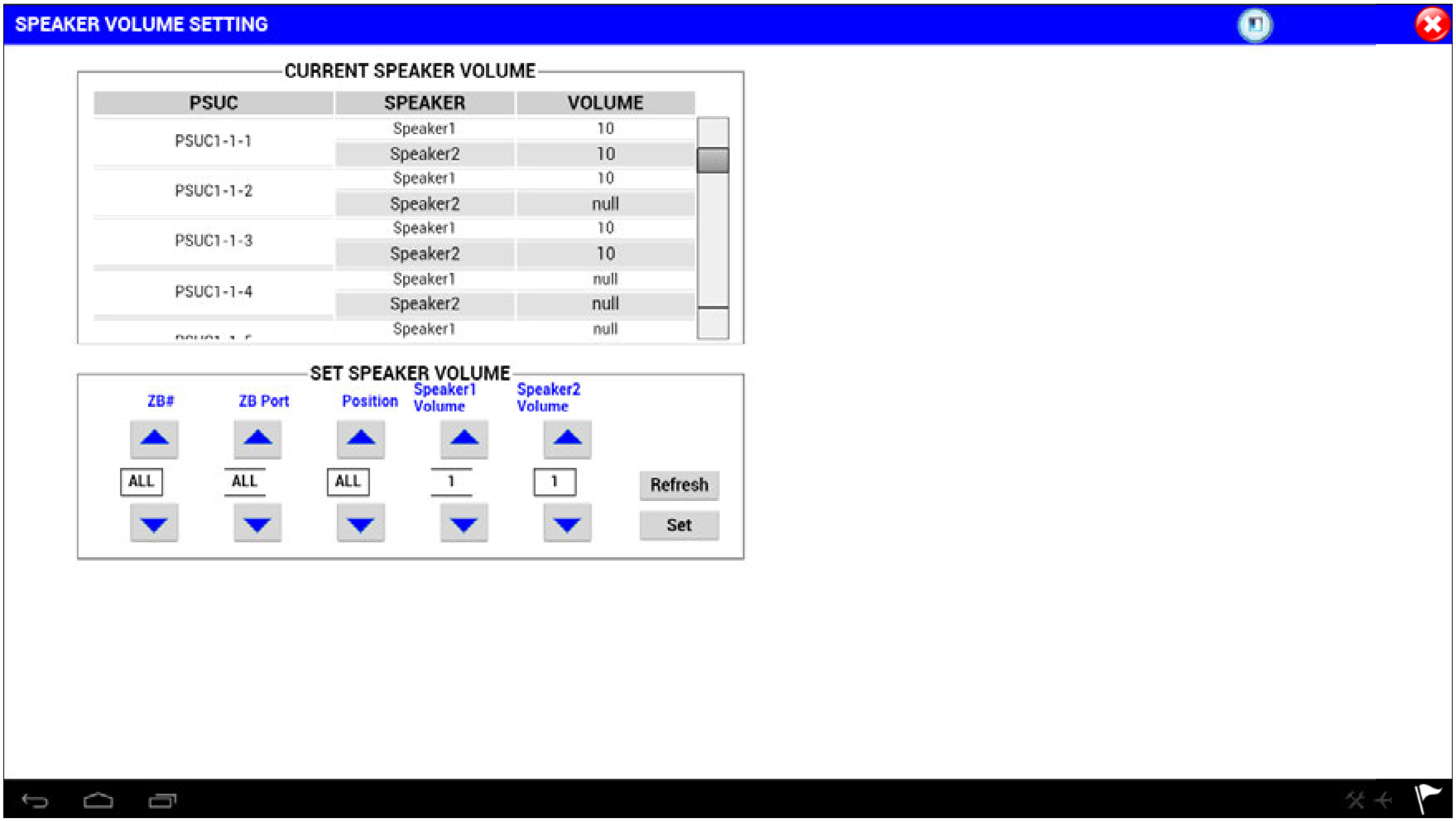


Figure 52: Brightness Setting Screen (L2)

Speaker Volume Setting

The Speaker Volume Setting menu allows the user to change the volume setting of the cabin speakers. Speaker volume can be set by the Zonebox, Zonebox port, PSUC, or the speaker itself.

The speaker volume levels can be adjusted up to a maximum level of 20, but cannot be set below the minimum level set by the database. Once the volume levels have been set, they are maintained even after a system reboot.



CS1_CS3_4411_102

Figure 53: Speaker Volume Setting Screen (L2)

Configuration

The Configuration menu is divided in the following submenus:

- Config Check
- Content Status
- Content Report
- Media Report

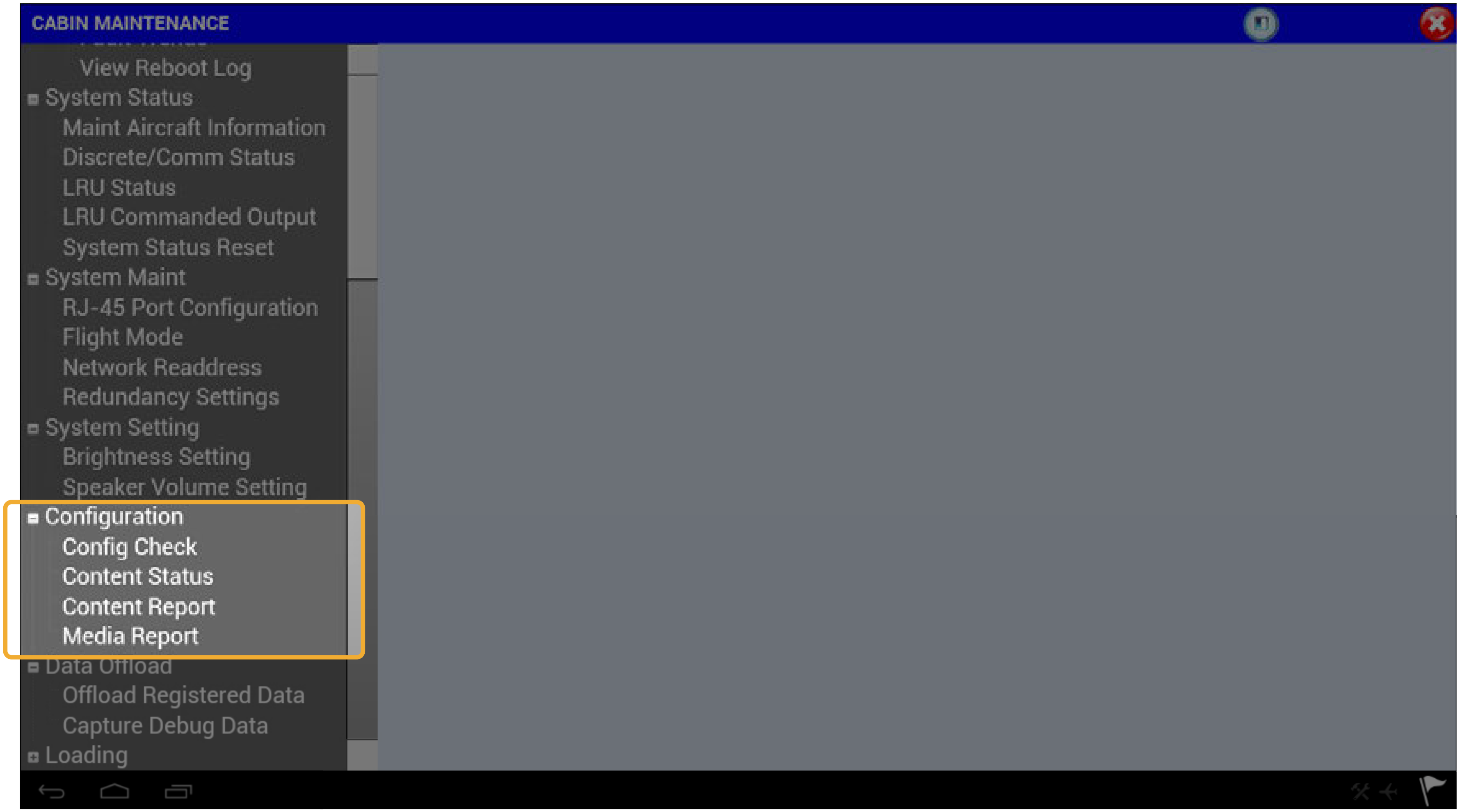


Figure 54: Configuration Screen (L2)

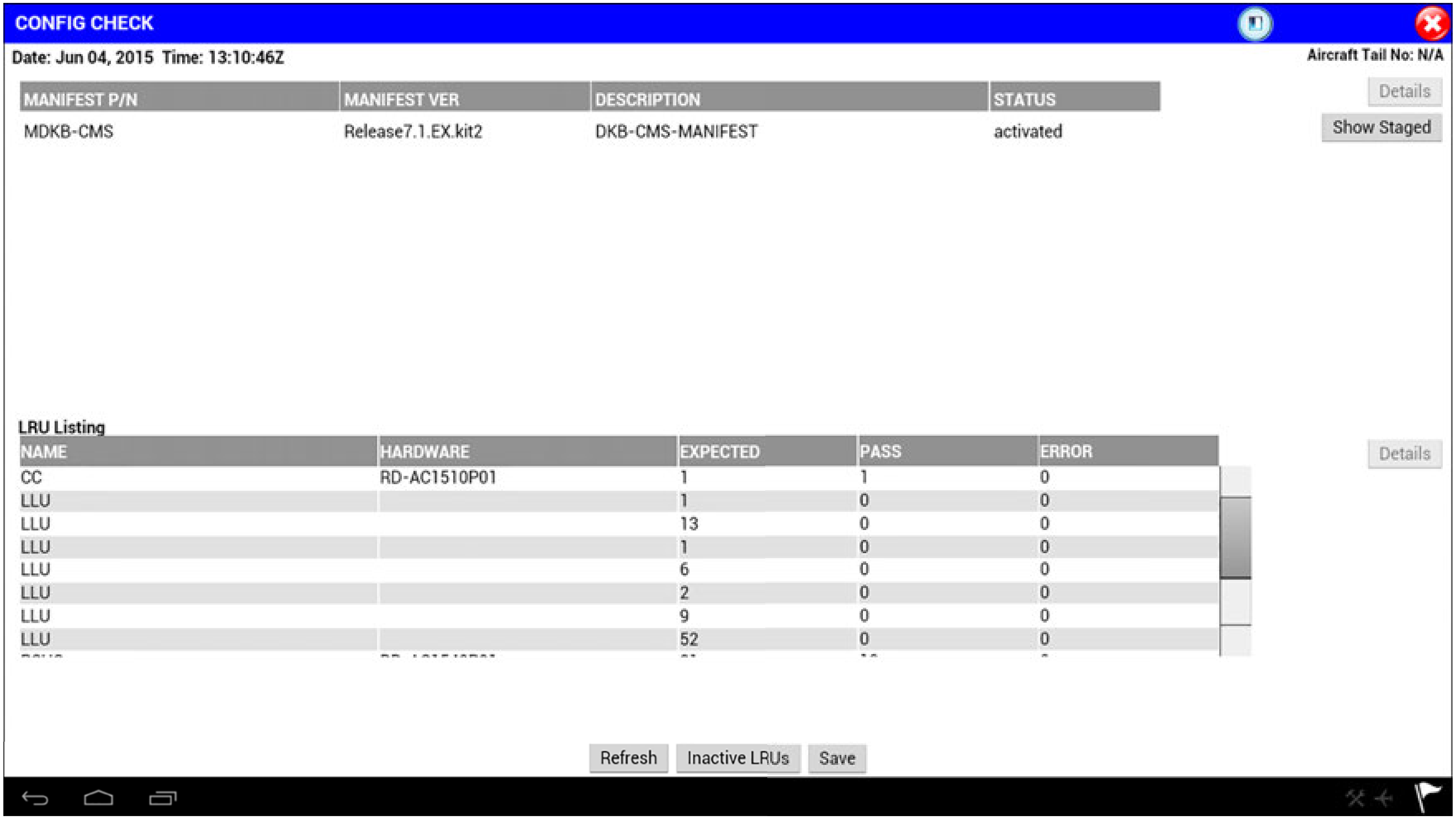
Config Check

The Config Check screen displays the LRU and LLU configuration in two tables with the following information:

- All loaded collection
- Version of each collection
- Description of each collection
- Status of each collection (staged or activated)
- List of all configured LRU and LLU types
- Expected number and error status of each LRU and LLU type

In addition, the Config Check screen has the following buttons:

- Details button - This button is enabled once a software collection or LRU type is selected. The details include:
  - Name
  - Part number
  - Version
  - LRU type and sub-type of the LRUs that contain this software
- Hide staged button - This hides the staged software collections. Once pressed, the button changes to Show Staged, which displays staged software collections again
- Refresh button - Refreshes the information on the Config Check screen
- Inactive LRUs button - Displays the list of non-responding LRUs
- Save button - Saves the configuration information to a USB memory device



CS1_CS3_4411_111

Figure 55: Config Check Screen (L2)

Content Status

The following CMS content is displayed on the Content Status screen:

- Name
- Part number
- Version
- Status

There is a save button at the bottom of the screen that allows the content status information to be saved on a USB memory device.

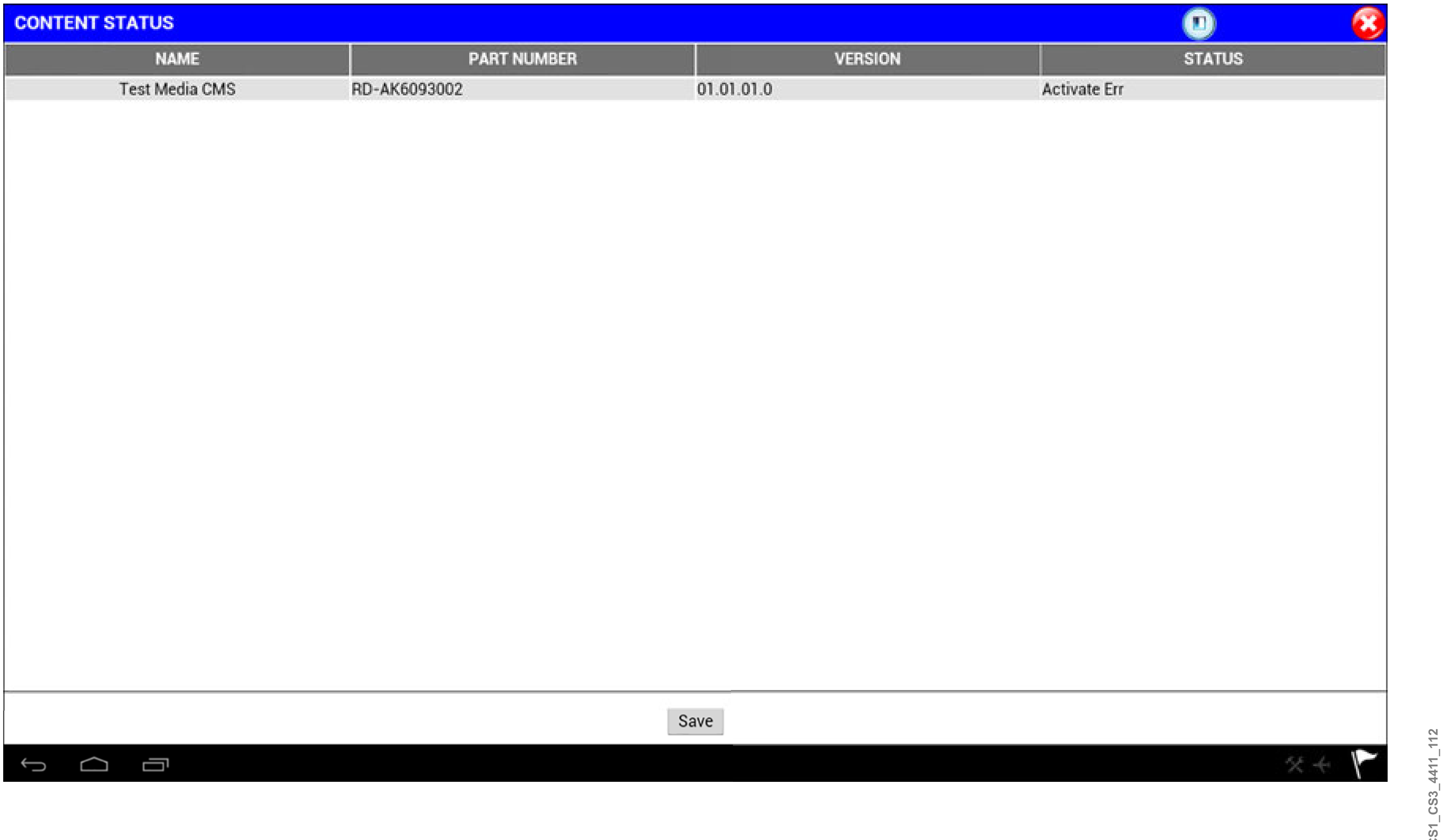
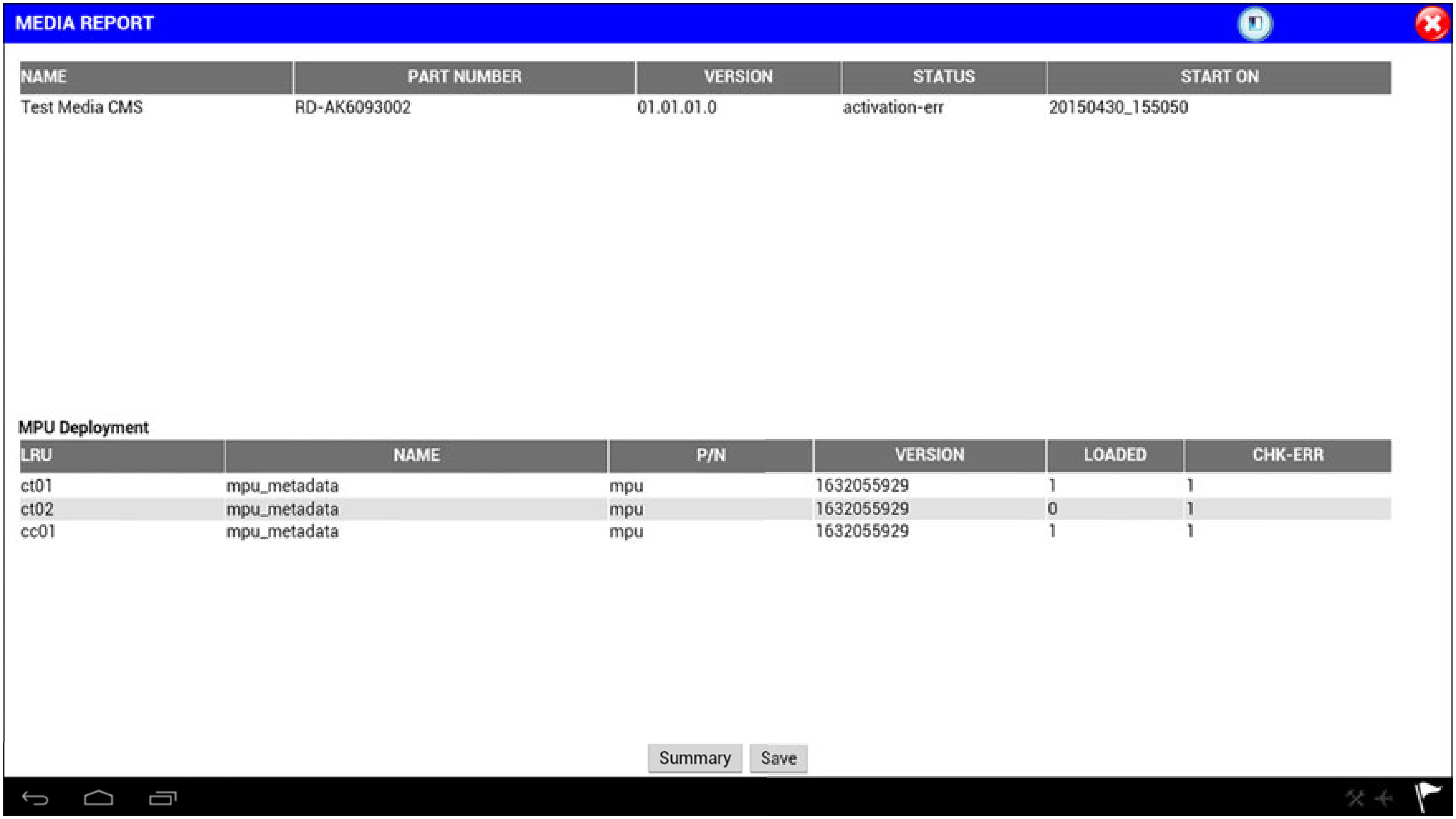


Figure 56: Content Status Screen (L2)

Content Report

The CMS content loaded on an LRU is displayed on the Content Report screen. The summary button provides a complete list of content and load location. The following information is available in the content report:

- Name
- Part number
- Version
- Status
- Date when the content is to be available



MEDIA REPORT

NAME	PART NUMBER	VERSION	STATUS	START ON
Test Media CMS	RD-AK6093002	01.01.01.0	activation-err	20150430_155050

MPU Deployment

LRU	NAME	P/N	VERSION	LOADED	CHK-ERR
ct01	mpu_metadata	mpu	1632055929	1	1
ct02	mpu_metadata	mpu	1632055929	0	1
cc01	mpu_metadata	mpu	1632055929	1	1

CS1_CS3_4411_113

Figure 57: Content Report Screen (L2)

Media Report

The Media Report screen displays the media information and the LRUs in which the media is deployed.

The following information about the loaded media is provided in the Media Report:

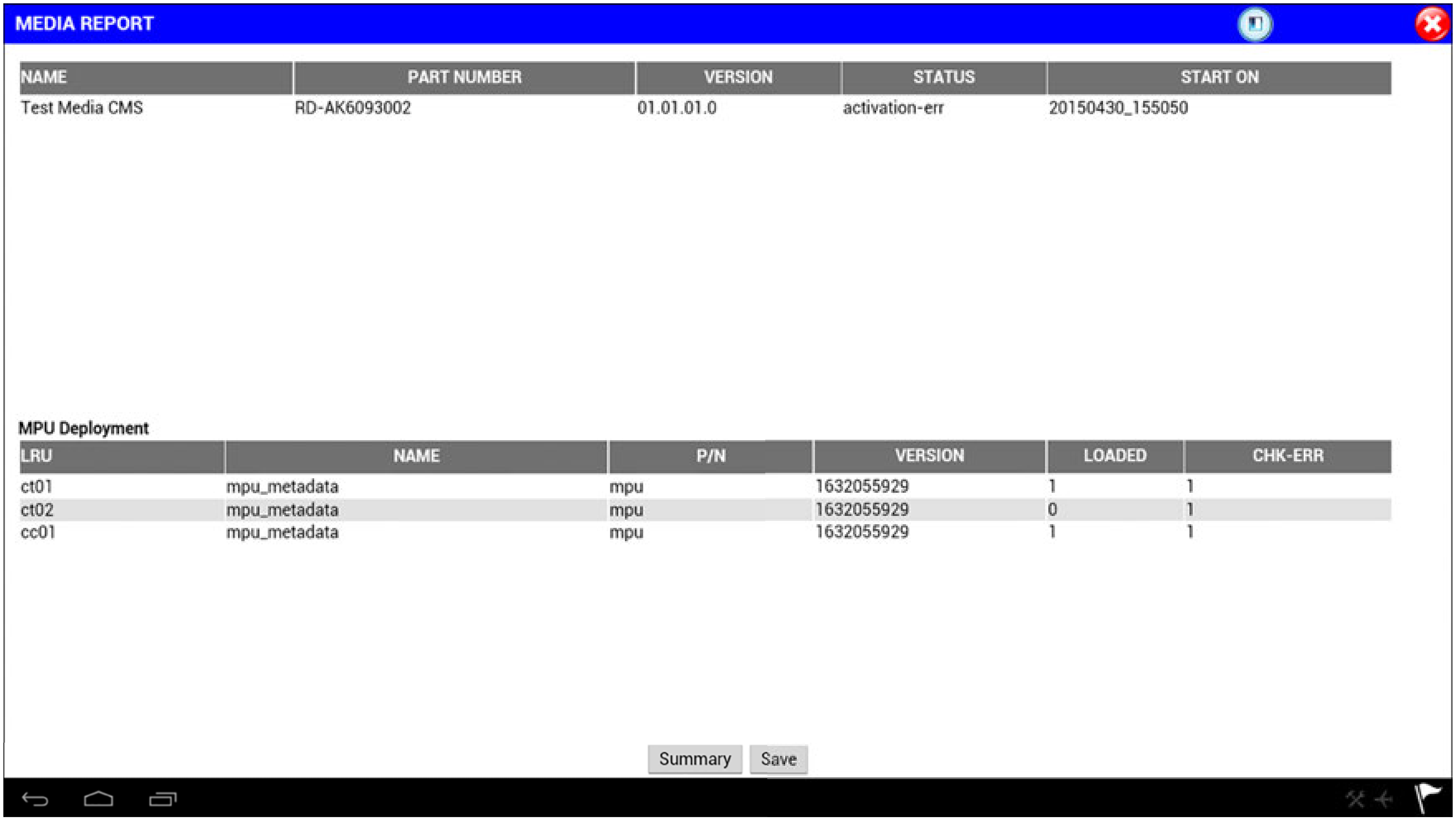
- Name
- Part number
- Version
- Status
- Date when the content is to be available

The following information about the loaded media is provided in the Media Report:

- LRU Identification
- Media Name
- Media Part Number
- Version
- Media Load Status
- Error Status

The summary button at the bottom of the screen displays a summary of the selected LRUs media status.

The save button outputs the information displayed in the screen to a USB memory device.



CS1_CS3_4411_113

Figure 58: Media Report Screen (L2)

Data Offload

Data Offload collects data from the CMS and saves it to a USB memory device. There are two Data Offload options:

- Offload Registered Data
- Capture Debug Data

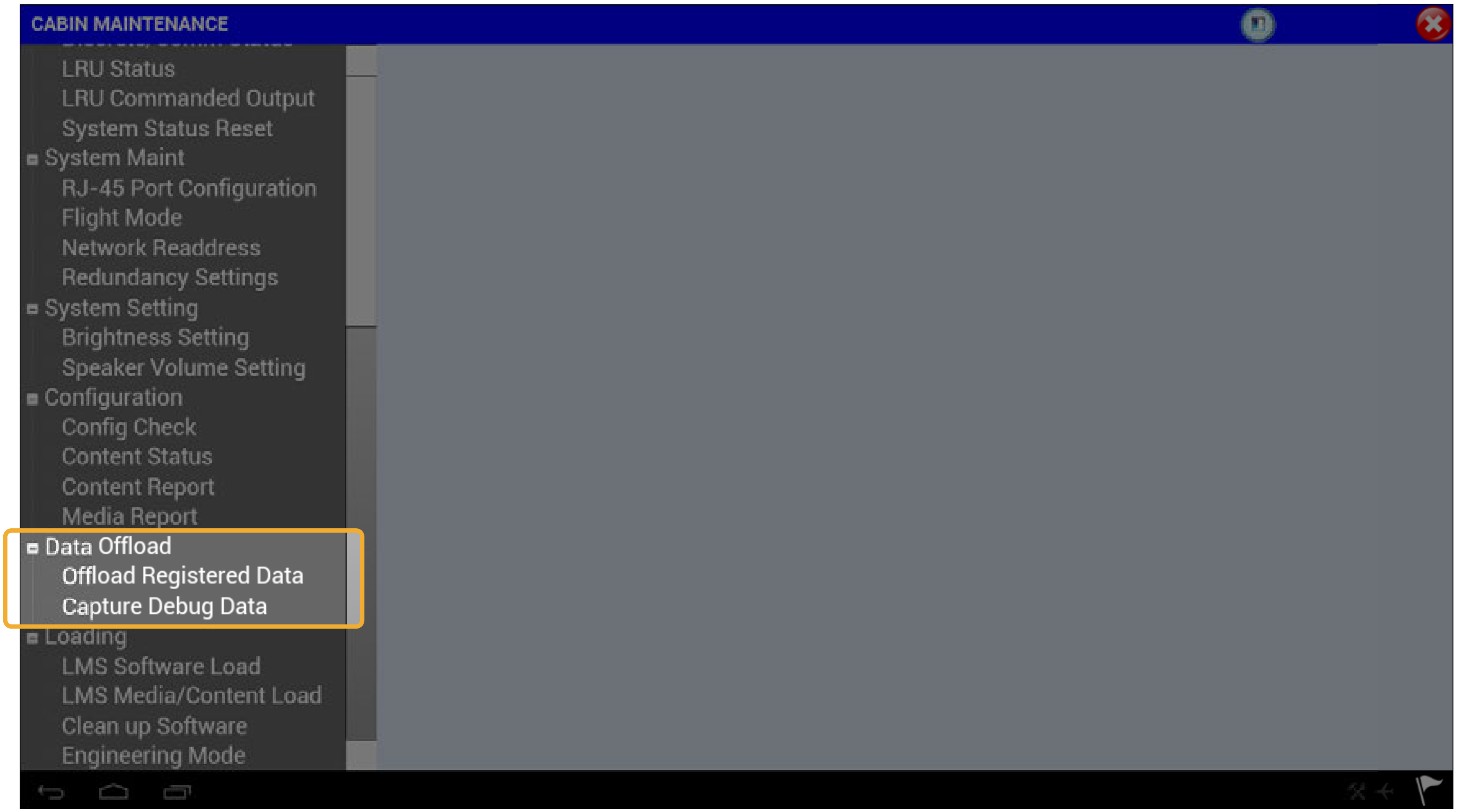


Figure 59: Data Offload Screen (L2)

Offload Registered data

Offload Registered Data, which is configurable by aircraft, includes all in flight entertainment (IFE) data offload options, such as passenger usage data and BITE fault data. The offload registered data screen shows the following:

- APPLICATION NAME- Allows the user to select data to offload
- TARGET DESTINATION - Allows the user to select data offload destination such as a USB data storage device

Capture Debug Data

Capture Debug Data prompts all LRUs to transfer their debug (BITE) log files to the storage in the cabin controller. During the data capture process there is a pop-up window that has a cancel button that allows the user to stop the download.

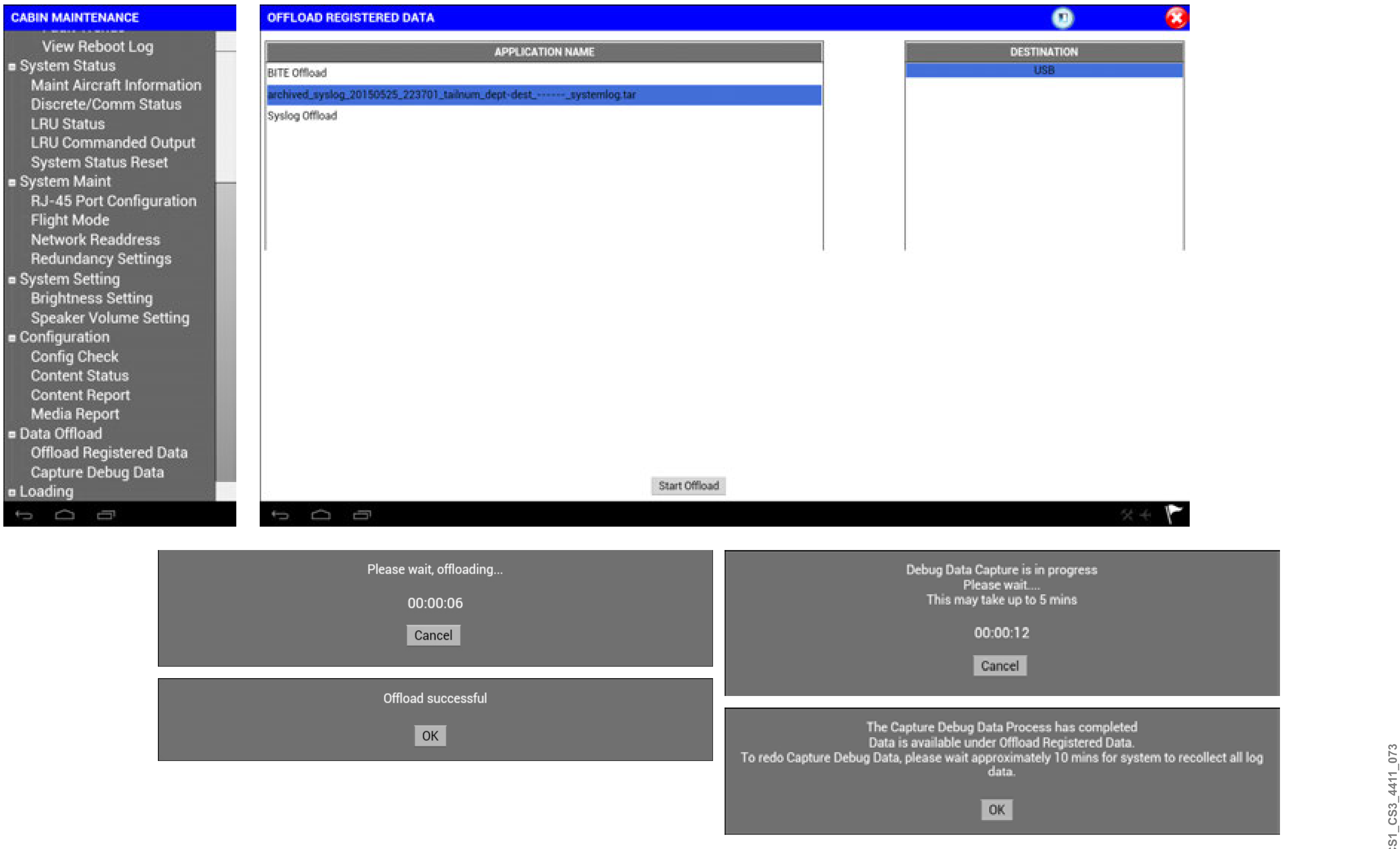


Figure 60: Data Offload and Capture Debug Data Screen (L2)

Loading

The Loading menu consists of:

- Software Load
- Media Content Load

Figure 61: Loading Screen (L2)

LOAD SOFTWARE

The software load provides all types of software loading from crew terminal USB port, SD card port or Ethernet port, as well as setting the software-related options. There is also an Ethernet port able to load software on the cabin controller. Loading software can only be done when the aircraft is on ground.

The screen has a LOAD checkbox to select the desired software. The screen also provides and description and version number of the software.

The STATUS display shows if the software is ACTIVATED or NA (not activated).

The LOAD SOFTWARE screen provide three options:

- Stage - Loads the software to the cabin controller or crew terminal mass storage device. The staging process may be performed by remote terminal via Ethernet. At the staging process, the CMS verifies that the software is authentic. If the authentication fails, CMS does not allow the software to be loaded to the system
- Activate - Activates one of the staged software on each LRU. The activation process can only be performed at the maintenance screen
- Remove - Removes the selected software collection(s)

Once one of these options is selected, a pop-up window shows the user the selected operation and asks for confirmation to proceed. The following information appears in a pop-up window:

- A status bar or text to show percent complete in real time and elapsed
- Log messages for loading status
- An Abort button to abort the software loading
- Status of the operations

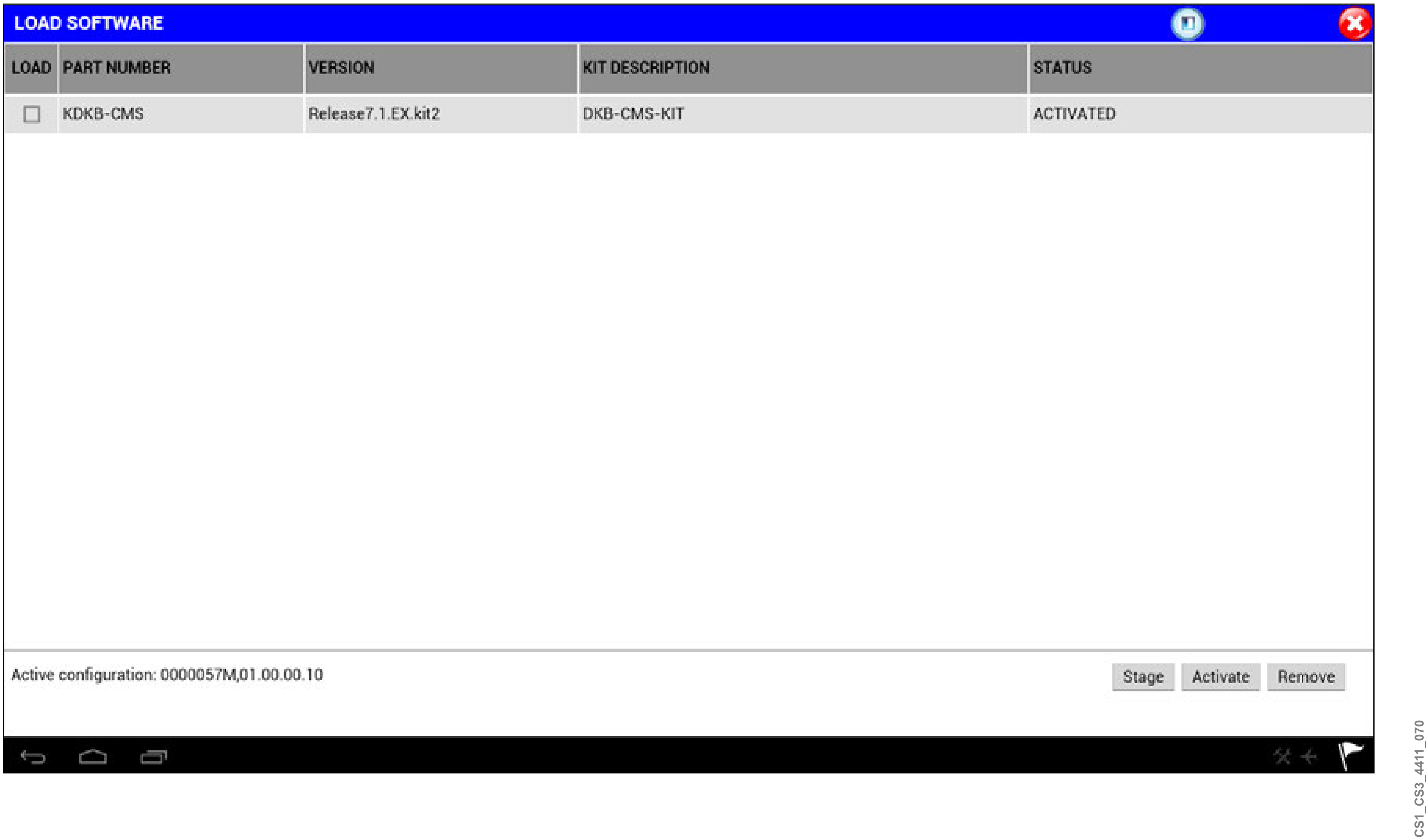


Figure 62: Load Software Screen (L2)

LOAD MEDIA/CONTENT

The Load Media Content is used to activate, stage, or remove collections to/from the system. Each collection consists of various media components.

The Load Media Content provides loading from crew terminal USB port, SD card port and CT Ethernet port. Loading software can only be done when the aircraft is on ground. If more than one screen is installed on the aircraft, the maintenance screen function on the screen not being used is inhibited until the software load is complete.

The LOAD MEDIA/CONTENT screen provides the following options:

- Activate
- Stage
- Remove

The screen also provides the following information:

- Part number
- Version
- Collection description
- Status

The activate, stage, or remove options can be done in single or multiple collections by checking the desired collection(s) checkbox.

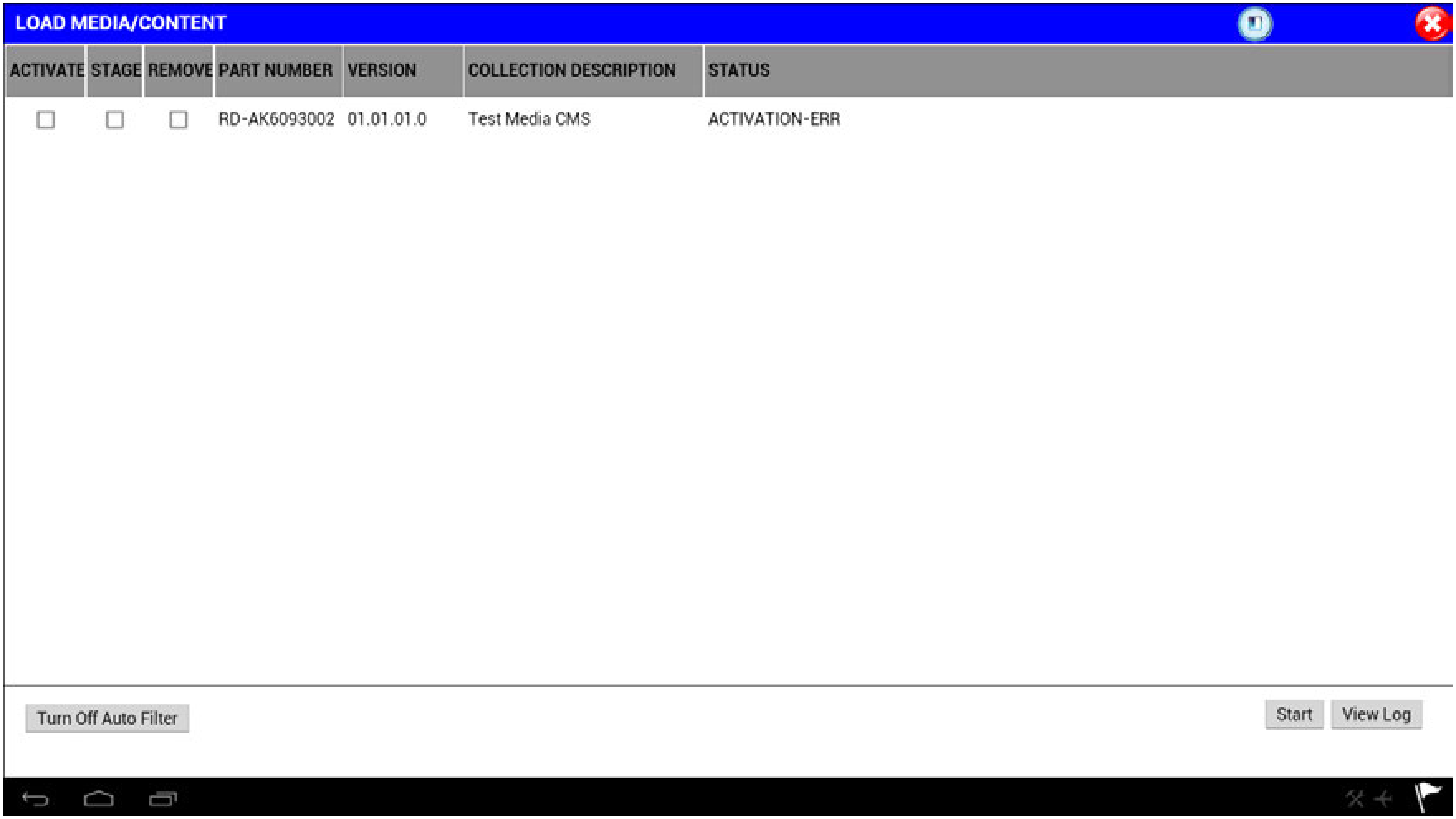
The screen also has the following buttons:

- Turn Off Auto Filter (TBD)
- Start
- View log

Selecting the START button initiates the process.

The VIEW LOG button displays a pop-up window that shows further details about the collection.

Once a load or removal is selected, the same pop-up boxes are displayed similar to the software load.



CS1_CS3_4411_071

Figure 63: Load Media/Content Screen (L2)

DETAILED DESCRIPTION

CABIN MANAGEMENT SYSTEM MODES

When the CMS is powered, it enters in a power-up mode. During this time, the system performs the initialization and initial checks of the units.

The normal mode is the operational mode for the CMS. In the normal mode, the CMS provides control and indication of cabin systems, and interfaces with aircraft systems.

In case of decompression, the CMS enters the emergency mode. When the passenger oxygen system deploys (ATA 35), the PA volume increases, all lights turn on, and a chime sounds. In addition, a PRAM emergency message is automatically played.

The ground service mode provides cabin lighting to perform maintenance in the cabin, such as lavatory service and cleaning. In this mode, only the cabin controller, zone boxes, and the passenger service unit controllers are powered.

The maintenance mode is used to check the health of the system or update system software. Maintenance mode is accessed using the crew terminal. The crew terminal can be used to:

- Initiate and view the results of system tests
- View configuration details of the CMS
- Load system software updates, databases, and media files, as well as perform BITE data offloads

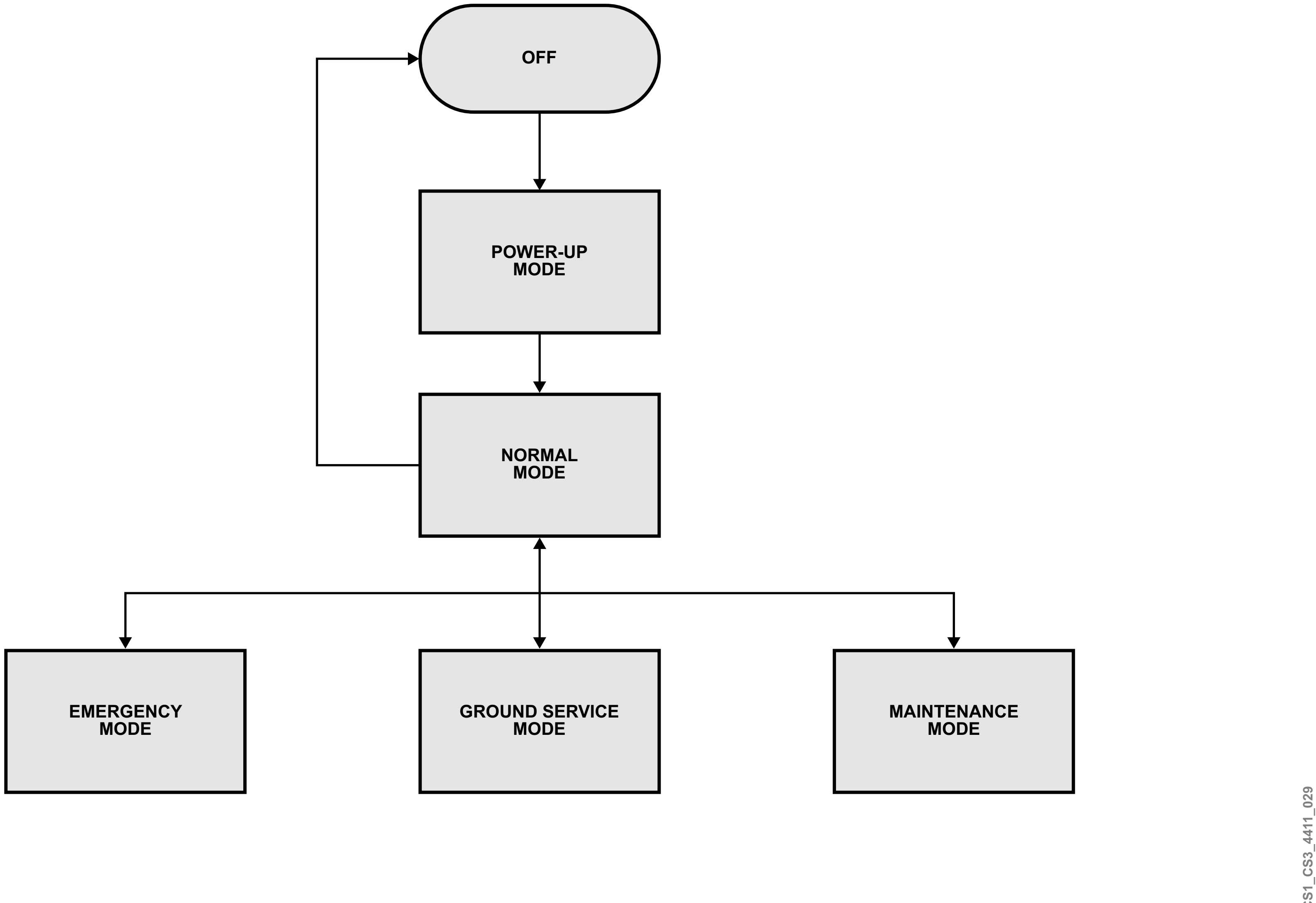


Figure 64: Cabin Management System Modes (L3)

CABIN MANAGEMENT SYSTEM INTERFACE

The CMS interfaces to aircraft systems through the DMCs using an ARINC 429 BUS. Although it uses both DMCs, the left DMC is the primary interface as it has the data link interface.

The fire detection and extinguishing (FIDEX) control unit provides the lavatory smoke detector status and a smoke alarm warning for display on the crew terminal.

The CMS monitors the passenger oxygen solid-state power controllers (SSPCs). When the passenger oxygen deploys, the SSPCs turn on and the CMS enters the emergency mode.

The CMS receives data from the electrical system control and distribution cabinets (CDCs) regarding the status of the galley equipment and cabin lighting SSPCs. The crew terminal can be used to monitor and control the power to the galley equipment and galley heaters.

The integrated air system controllers (IASCs) interface with the CMS to provide forward and aft cabin zone temperatures for display on the crew terminal. The IASCs also provide the status of the trim air system. If the trim air system is available, the cabin temperature selection on the crew terminal is enabled. The IASCs also provide galley heater status.

Each emergency light battery pack reports its status to the CMS for failure monitoring.

The fuel quantity computer provides the refuel and defuel status for crew awareness.

The WWS provides monitoring of the water and waste level, preselection of water quantity, water purge in flight, and maintenance status.

The CMS receives inputs from the integrated cockpit control panel (ICCP) for the ordinance signs and the evacuation command.

The CMS interfaces with the landing gear steering control unit (LGSCU) to monitor door position and indication failures.

The air data system (ADS) provides aircraft altitude, Mach data, and outside air temperature. The parameters are used to provide information for display on the optional customer service displays (CSDs) or the optional in-flight entertainment and connectivity (IFEC) system.

The CMS receives aircraft magnetic heading information from the inertial reference system (IRS) for display on the CSDs or IFEC system.

The CMS provides an interface to the FADEC to receive aircraft engine status information. The information is used to provide aircraft status.

The CMS receives brake status information from the brake data concentrator unit (BDCU) for aircraft status reporting.

The optional IFEC system is connected to the cabin controller via an Ethernet bus. The crew terminal is used to control and monitor the IFEC system.

The CMS provides real-time fault reports to the onboard maintenance system (OMS) for CMS LRU functions. The OMS monitors the faults reported by the cabin controller and faults generated by other aircraft systems interfacing with the CMS. The CMS faults can be viewed on the control terminal or downloaded from the non-volatile memory for shop use only.

The CMS interfaces with the aircraft data link system to allow messages to be sent and received from the crew terminal message page.

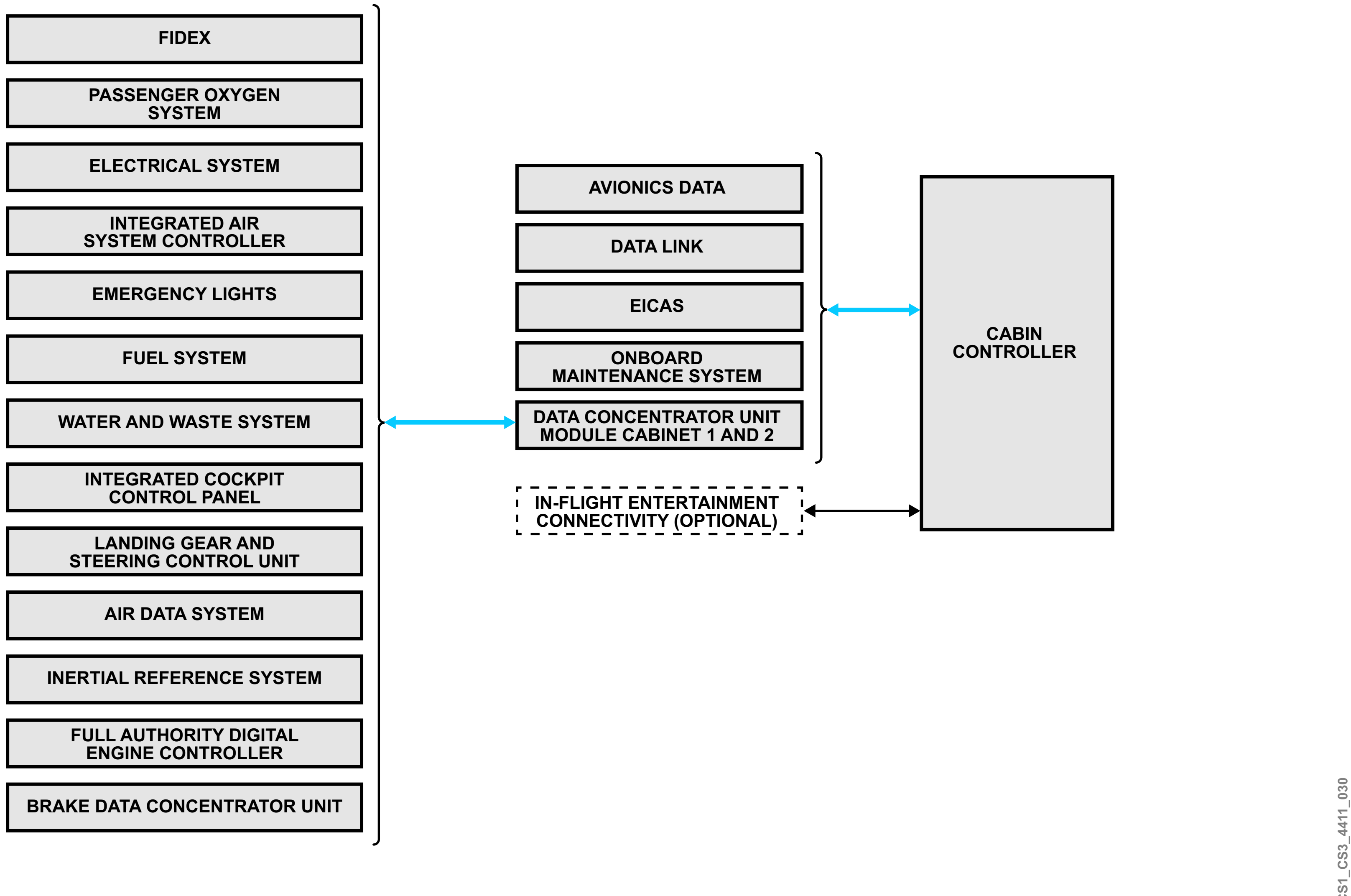


Figure 65: Cabin Management System Interface (L3)

CABIN MANAGEMENT SYSTEM FAILURE MODES

The CMS system architecture has built-in redundancy to minimize the effects of any component or bus failures. There are two paths to most zone boxes (ZBs), passenger service unit controllers (PSUCs), and LED lighting units (LLUs).

Normal Operation

In normal operating mode, each ZB shares the PSUC load. ZB 1 drives the forward PSUC columns and ZB 2 drives the aft PSUC columns. The ZBs communicate with the CC via Ethernet.

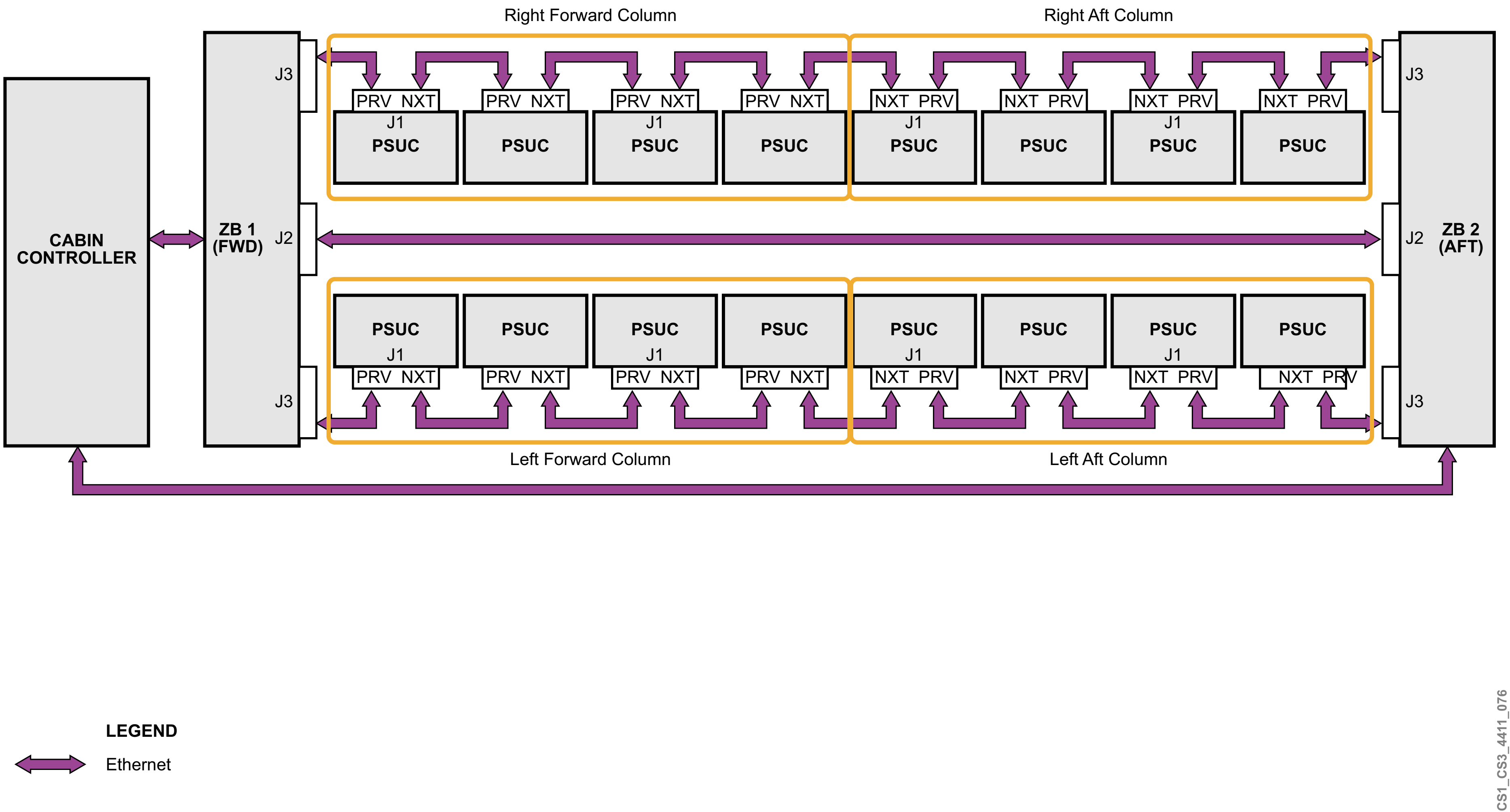


Figure 66: Normal Operation (L3)

Single PSUC Failure

If a single PSUC failure occurs in the same column, the PSUC ports at both ends of the redundancy cable in the column where the failure occurred are enabled. ZB 1 drives the PSUCs to the left of the failed PSUC and ZB 2 drives the units to the right of the failed PSUC.

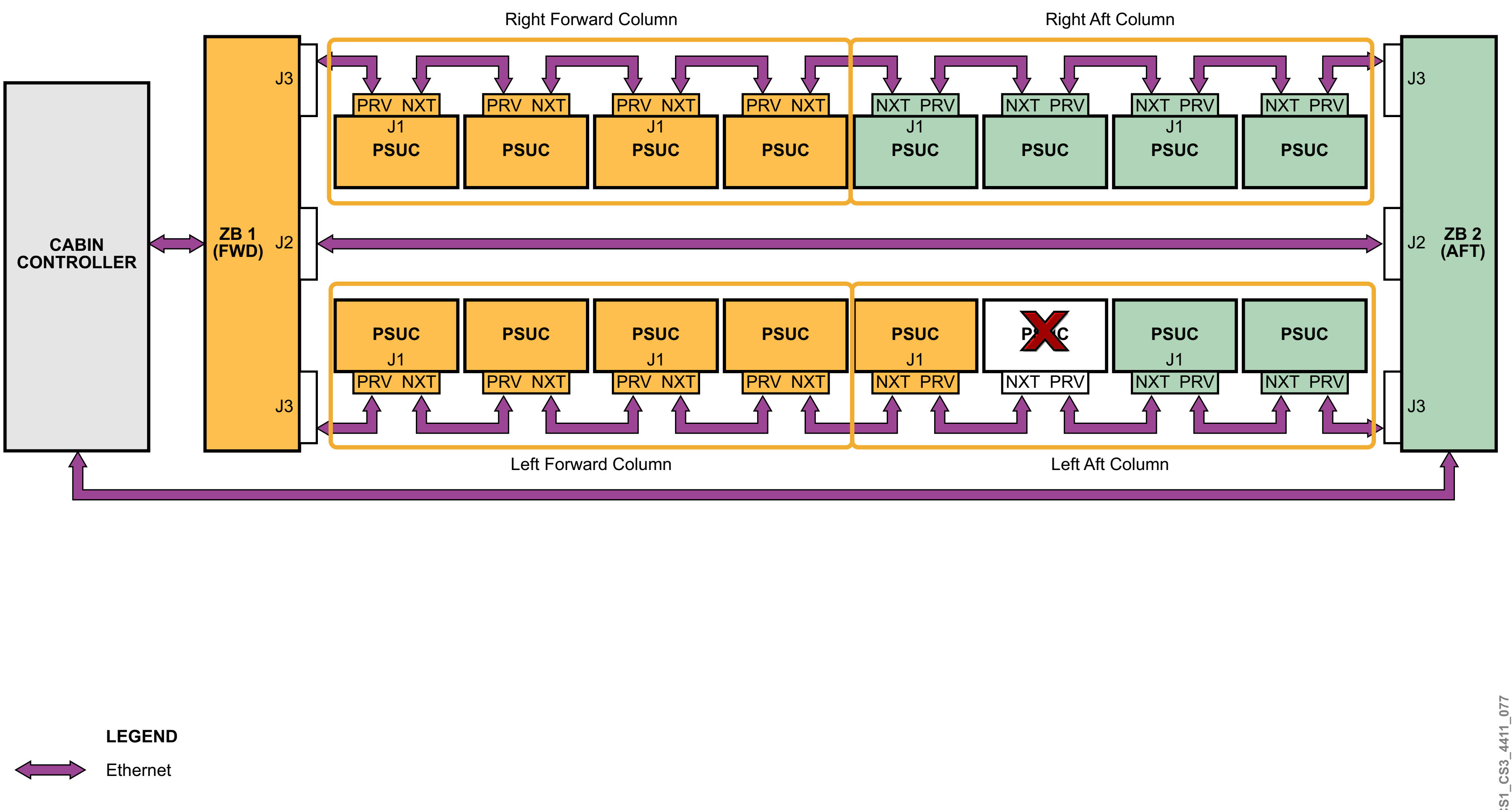


Figure 67: Single PSUC Failure (L3)

Double PSUC Failure

If multiple PSUC failures occur in the same column, the PSUC ports at both ends of the redundancy cable in the column where the failure occurred are enabled. ZB 1 drives the PSUCs to the left of the failed PSUC and ZB 2 drives the units to the right of the failed PSUC. Any PSUCs between the two failed PSUCs are inoperative.

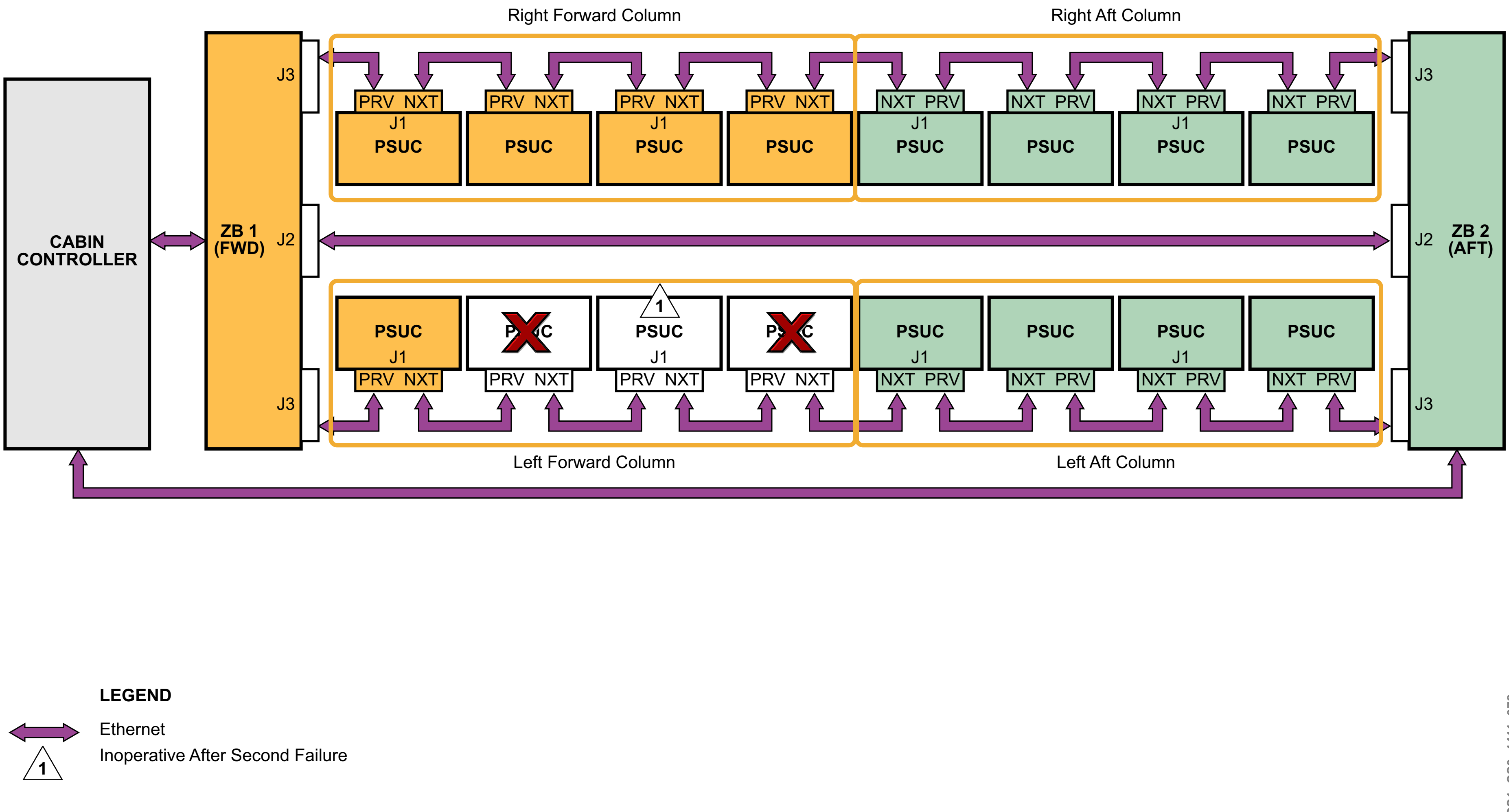


Figure 68: Double PSUC Failure (L3)

Zone Box Failure

If a ZB failure occurs, the remaining ZB can drive the entire PSUC columns for both sides.

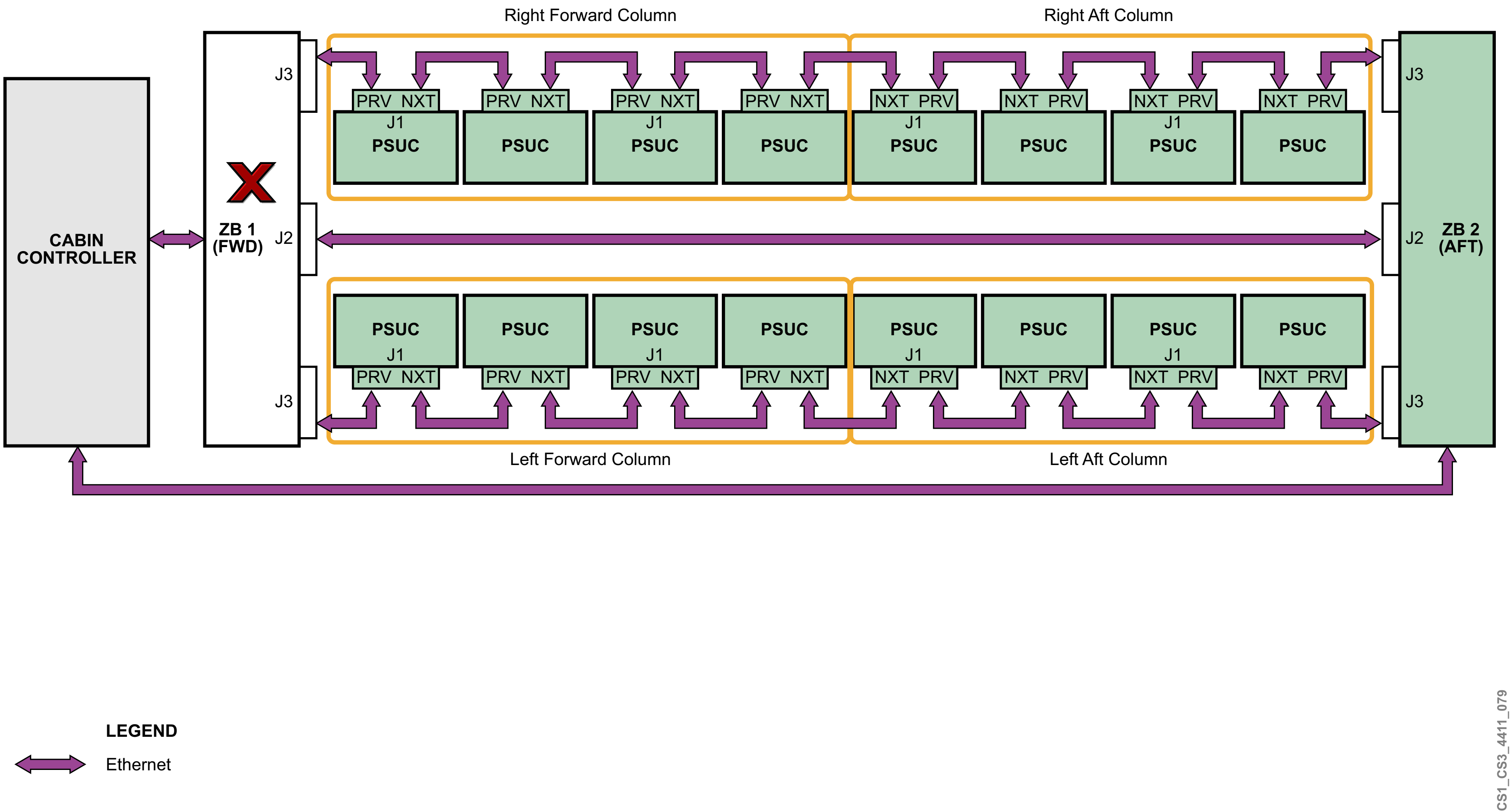


Figure 69: Zone Box Failure (L3)

Cabin Controller Failure

If the CC fails, the ZB ports at each end of the redundancy cable are enabled and the communication between the ZBs is maintained.

If the cabin controller fails, the lighting, reading and call lights, and the cabin interphone system are available.

Communication with the flight deck audio control panels is lost, however, communication with the flight deck is still available using the handsets.

Communication with the data concentrator unit module cabinet (DMC) is lost. Aircraft systems that are normally controlled through the crew terminal are unavailable. The following systems cannot be operated or monitored from the crew terminal:

- Ordinance signs
- Cabin temperature control
- Cabin doors test
- Water and waste
- Smoke detection
- Galley electrical status
- Flight information
- Decompression warning

In addition, reporting to the onboard maintenance system (OMS), EICAS, and optional data link and in-flight entertainment systems are lost.

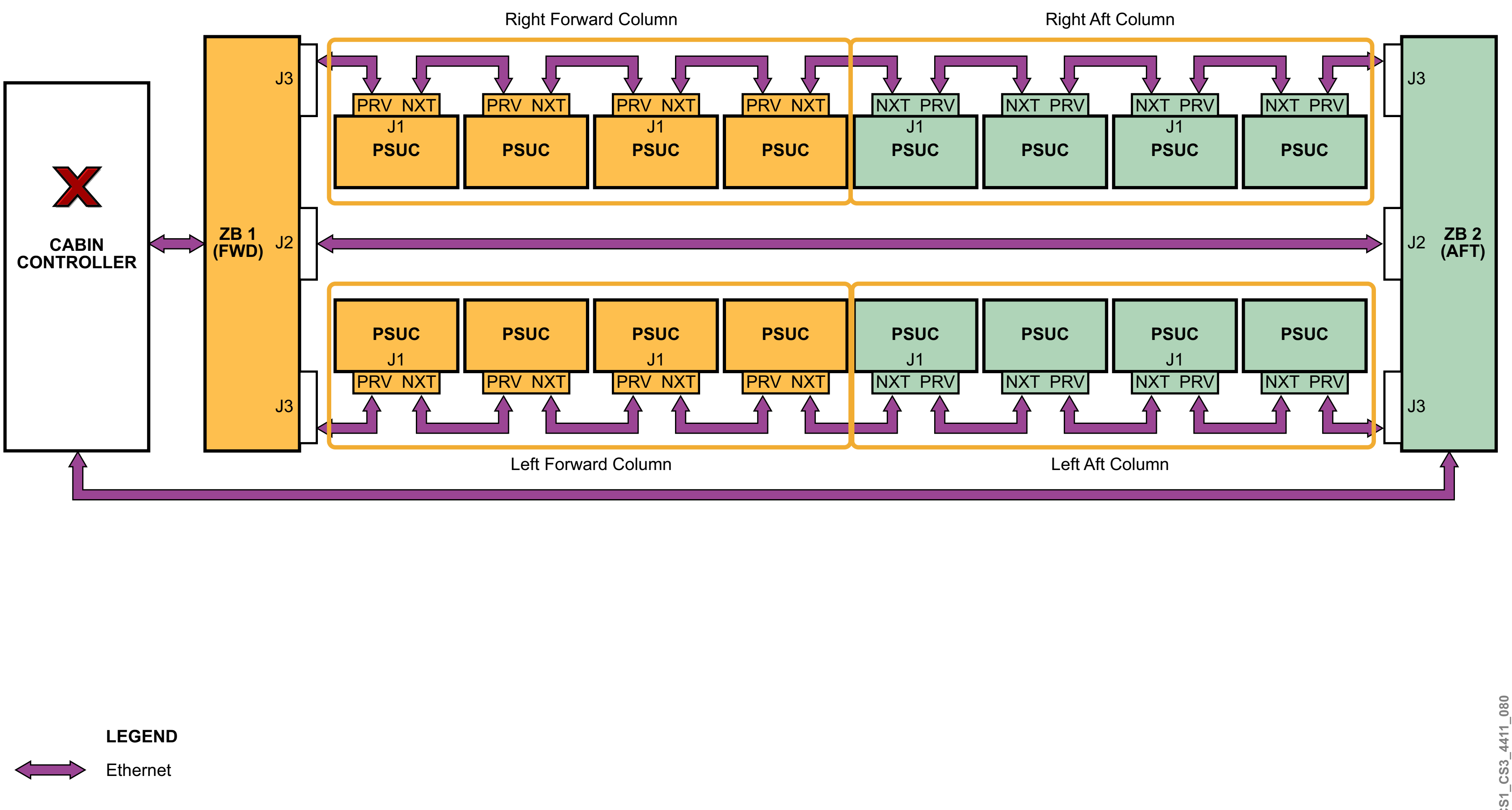


Figure 70: Cabin Controller Failure (L3)

Cabin Controller to Zone Box BUS Failure

If a cable break occurs between the CC and the ZB, the ZB ports at each end of the redundancy cable are enabled and both ZBs can maintain communication with the CC.

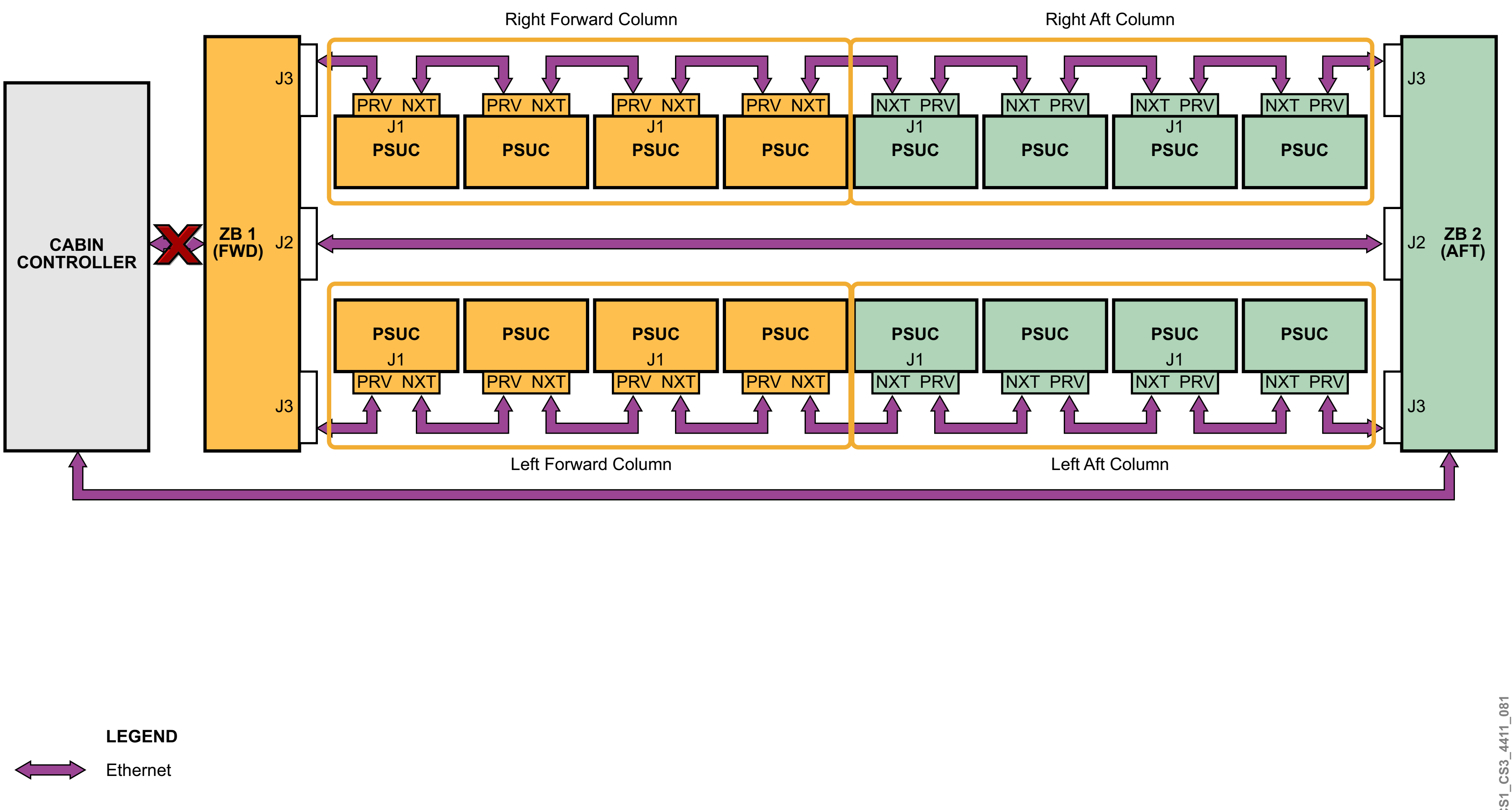


Figure 71: Cabin Controller to Zone Box BUS Failure (L3)

Single LED Lighting Unit Failure

If a single LLU failure occurs, the ZB 1 no longer communicates with the LLUs after the failed unit. At this point ZB 2 detects that it is no longer receiving commands and begins to control the LLUs to the right of the failed LLU. The failed LLU defaults to the ON (bright) mode.

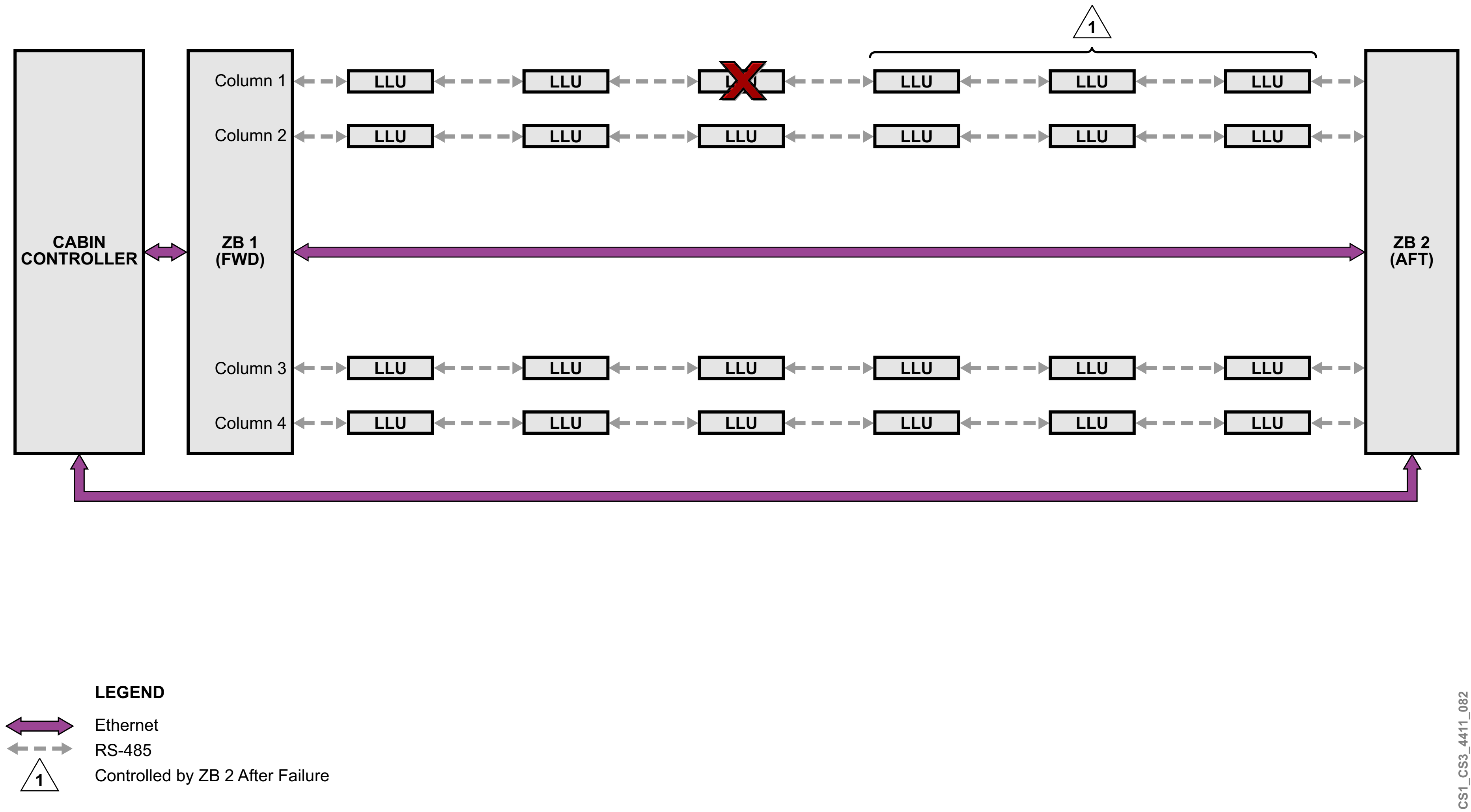


Figure 72: Single LED Lighting Unit Failure (L3)

Multiple LED Lighting Unit Failures

If multiple LLU failures occur in the same column, after the first failure occurs, ZB 1 will no longer be able to reach the LLUs past the failed unit. ZB 2 detects that it is no longer receiving commands through the column and it begins to control the LLUs to the right of the failed LLU.

When the second failure occurs, the units to the left of the second failed LRU also lose communication with the network as well. The failed LLUs, as well as the LLUs in between, default to ON (bright) mode.

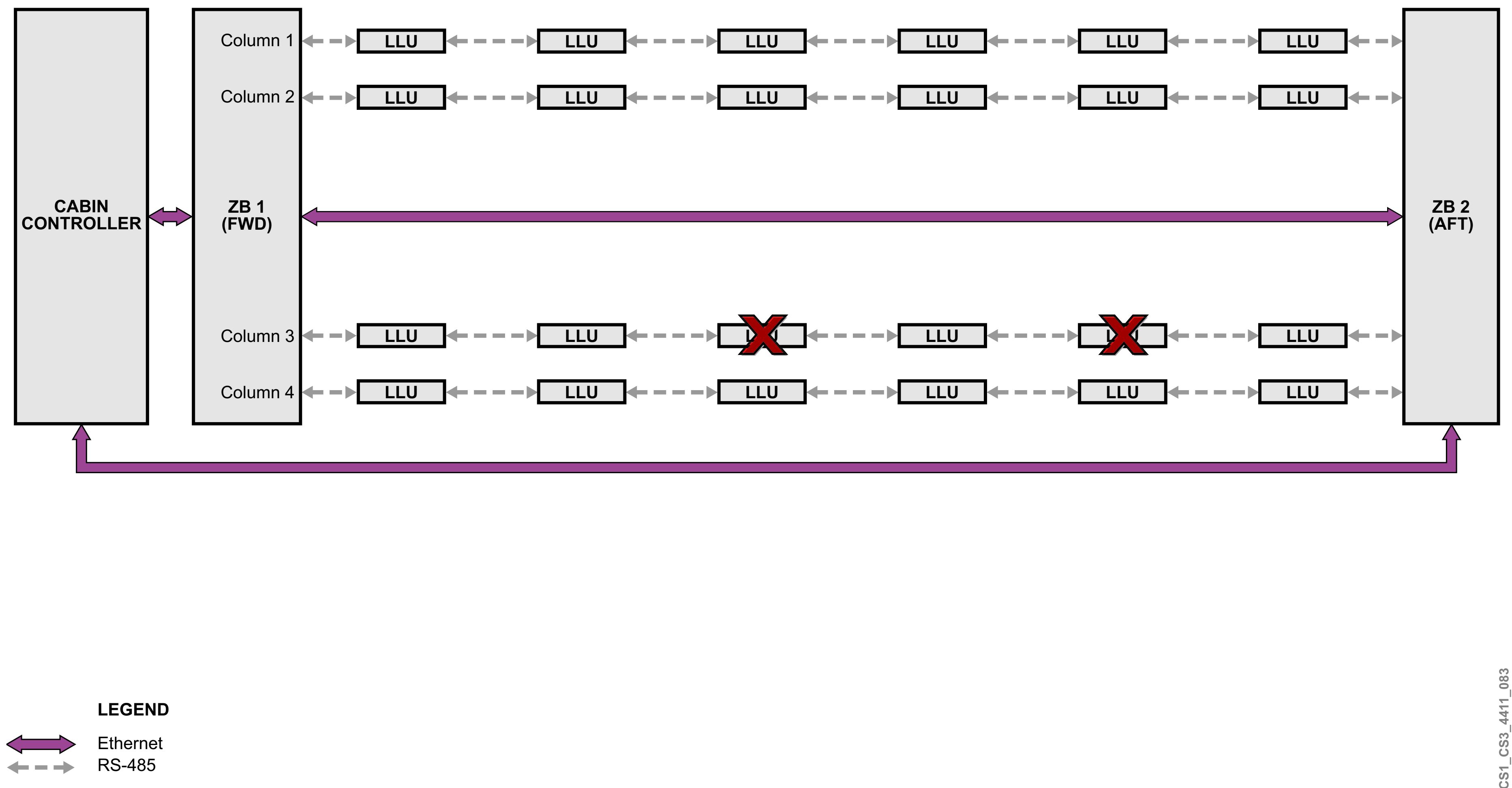


Figure 73: Multiple LED Lighting Unit Failures (L3)

RS-485 BUS Failure Between Two LED Lighting Units

If a single RS-485 BUS failure occurs in a column, ZB 1 no longer communicates with the LLUs past the failed unit. At this point, ZB 2 detects that it is no longer receiving commands and it begins to control the LLUs to the right of the BUS failure. Under this failure mode, the control for all the LLUs in that column is maintained.

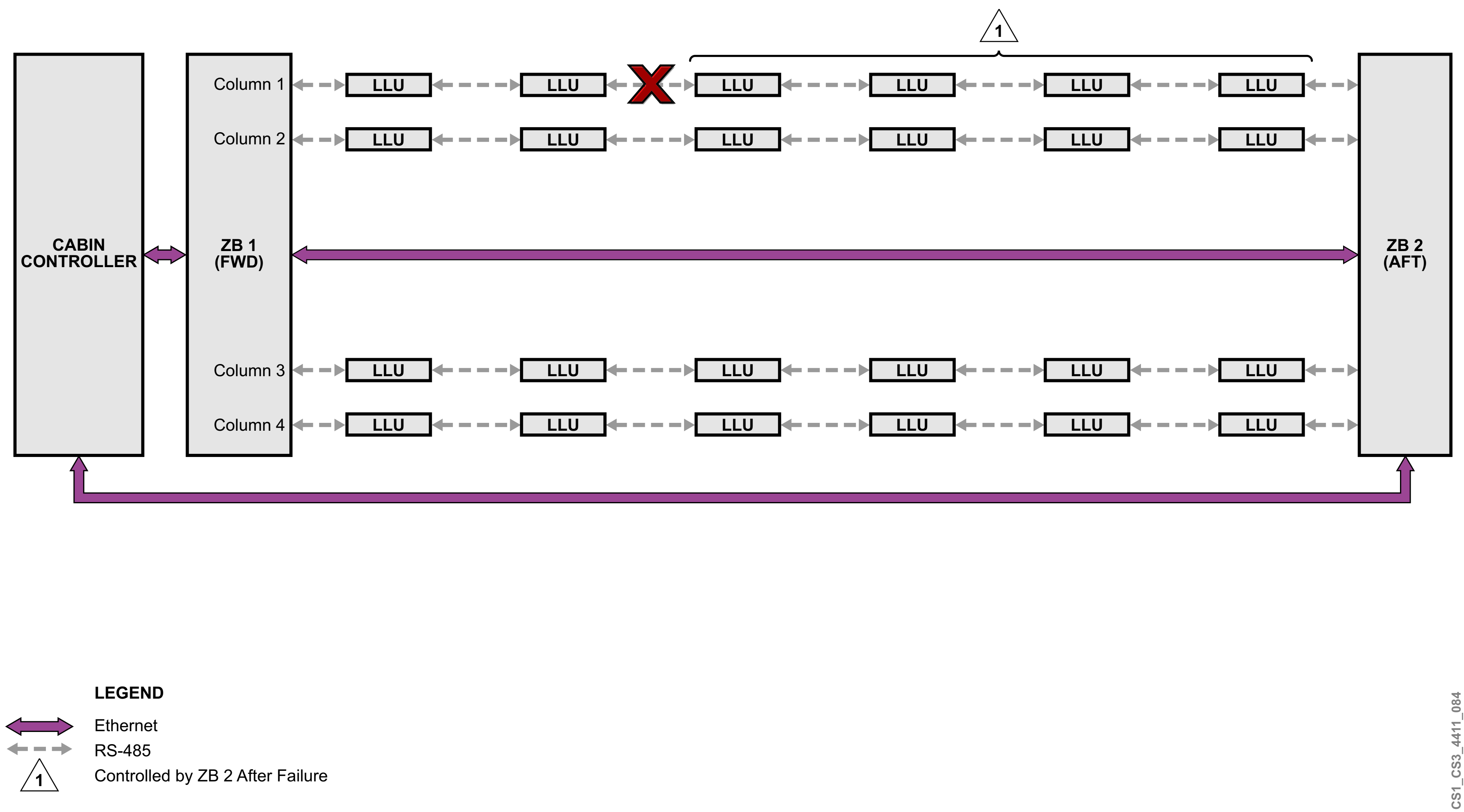


Figure 74: RS-485 BUS Failure Between Two LED Lighting Units (L3)

Multiple RS-485 BUS Failures Between LED Lighting Units

After the first BUS failure occurs, ZB 1 no longer communicates with LLUs past the failure. At this point, ZB 2 detects that it is no longer receiving commands and begins to control the LLUs to the right of the failed BUS. At this point all the LLUs are still working properly. When the second BUS failure occurs, the units to the left of the second failed BUS lose communication with the network. At this point, the LLUs in between the BUS failures default to ON (bright) mode.

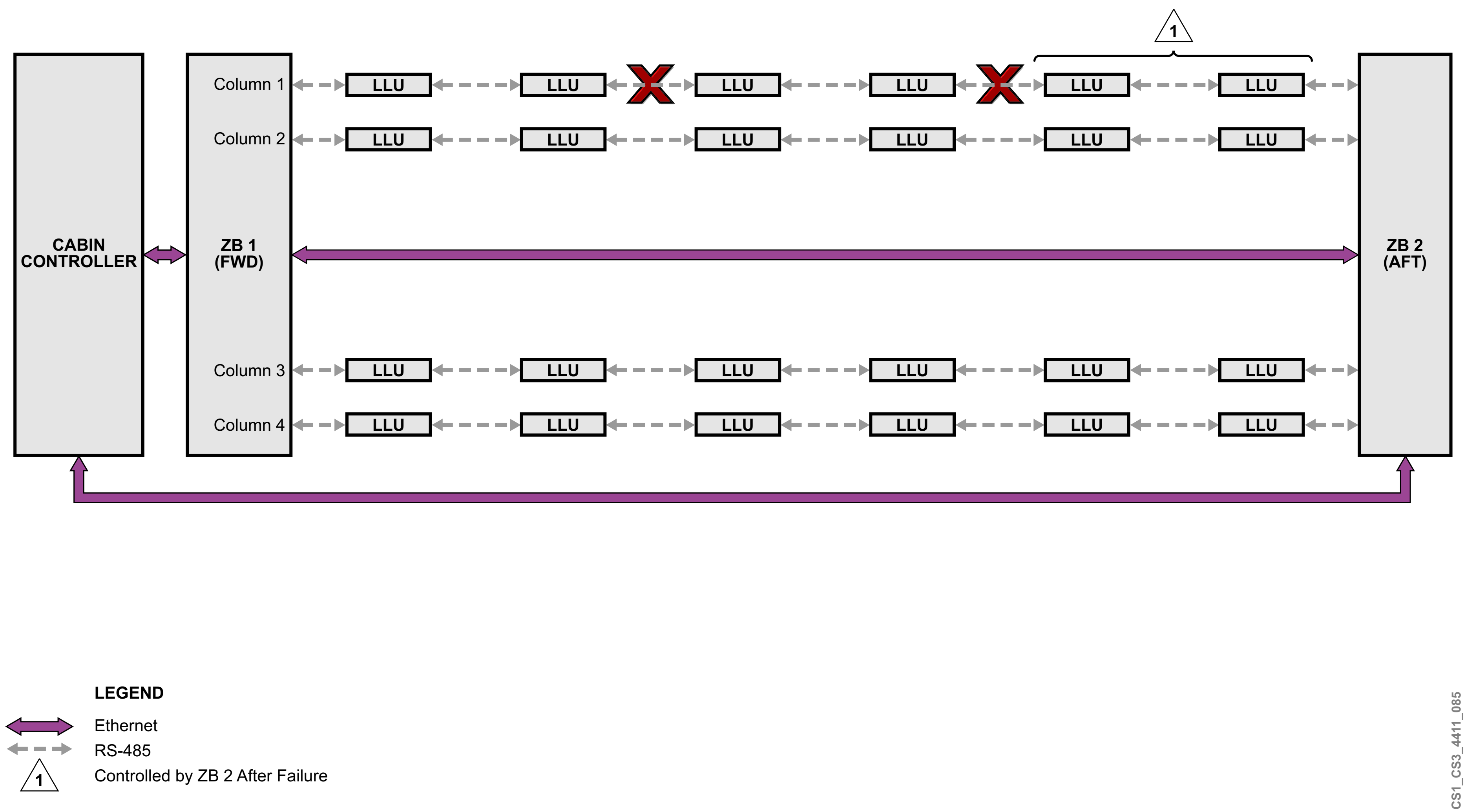


Figure 75: Multiple BUS Failures Between LED Lighting Units (L3)

MONITORING AND TESTS

The following crew alerting system (CAS) and INFO messages apply to the cabin management system.

CAS MESSAGES

Table 1: WARNING Message

MESSAGE	LOGIC
> CABIN EMER	Signals an incoming hijack alert from the cabin.

Table 2: CAUTION Message

MESSAGE	LOGIC
> CABIN PRIORITY	Cabin is calling for a priority event. No checklist. Associated cabin chime.

Table 3: ADVISORY Messages

MESSAGE	LOGIC
CABIN COM FAULT	Loss of either PA/intercom through audio control panel or loss of PA/intercom through handset.
> CABIN READY	Cabin is ready for takeoff or landing.
> CABIN CALL	Cabin is calling for a normal situation. Associated cabin chime

Table 4: STATUS Messages

MESSAGE	LOGIC
SEATBELTS	Seatbelt signs activated (auto or manual) in the cabin.
NO PED	No PED signs activated (auto or manual) in the cabin.

Table 5: INFO Messages

MESSAGE	LOGIC
44 CABIN COM FAULT - CKPT HANDSET INOP	Cabin controller has declared cockpit handset failure.
44 CABIN COM FAULT - CABIN CTRL INOP	CMS CC reports Cabin_Ctrl_Inop OR CMS BUS is invalid, but in this case the message will not be displayed for 10 minutes after DMC power-up and when on ground (unless another DMC channel has detected the fault before - this is to avoid CAS MISCOMPARE nuisance when a DMC channel is restarted on ground).

PRACTICAL ASPECTS

CABIN MANAGEMENT DATA LOADING

The cabin management data loading is carried out from the RJ-45 port for the CMS on the flight deck maintenance panel or the RJ-45 port on the crew terminal.

Figure 76: Cabin Management Data Loading (L2)

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