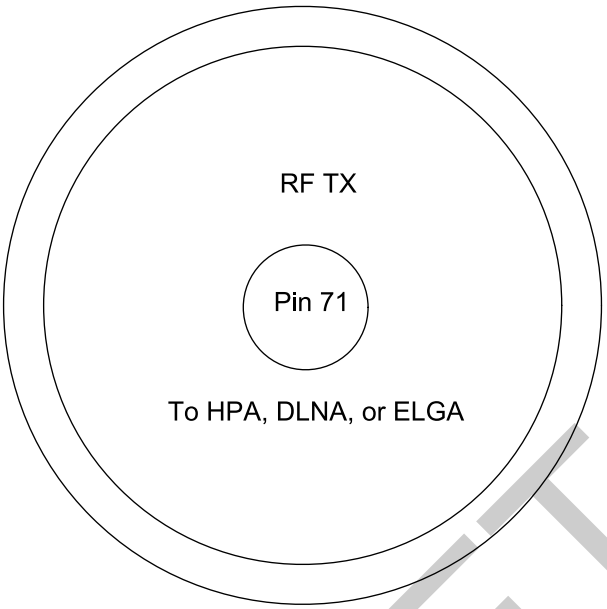
B. The following sections contain information on the pin assignments for the top, middle and bottom plug of the rear panel receptacle for the SDU.

C. **SDU Top Plug (TP)**

(1) The following figure is provided to aid in understanding of the pin assignments for the Top Plug of the rear panel receptacle. This is guidance only; explicit requirements have been written to capture the required details. The shaded boxes show the SDU allocation of pins that are different from that defined in ARINC 781. The names specified in the shaded boxes indicate the actual use of the pin by the SDU.

(2) The Top Plug is an ARINC 600 arrangement 08 receptacle.



	A	B	C	D	E	F	G	H	I	J
1	ACD RS232 RxD	ACD RS353 TxD	Spare Discrete Input 8	ARINC Secturity Disc. Input	Spare Discrete Input 10	Regulatory Test Mode	CCA RS232 TxD	CCA RS232 RxD	CC B RS232 TxD	CC B RS232 RxD
2	Dataload Security Disc. Input	ACD RS232 GND	GND	Spare Discrete Input 12	Spare Discrete Input 9	Spare Discrete I/O/I	Spare Discrete I/O 2	CC A RS232 GND	GND	CC B RS232 GND
3	Ethernet 1 (AISD) from SDU to User +	Ethernet 1 (AISD) from User to SDU +	GND	Config Pin 1	Config Pin 2	Config Pin 3	Config Pin 4	GND	Ethernet 11 (AISD) from SDU To User +	Ethernet 11 (AISD) from User to SDU +
4	Ethernet 1 (AISD) from User to SDU -	Ethernet 1 (AISD) from User to SDU -	GND	Config Pin 5	Config Pin 6	Config Pin 7	Config Pin 8	GND	Ethernet 11 (AISD) from User To SDU -	Ethernet 11 (AISD) from SDU To User -
5	GND	GND	GND	Config Pin 9	Config Pin 10	Config Pin 11	Config Pin 12	GND	GND	GND
6	Ethernet 2 (PIESD) from SDU to User +	Ethernet 2 (PIESD) from User to SDU +	GND	Config Pin 13 (SPARE)	Config Pin 14 (SPARE)	Config Pin 15 (SPARE)	Config Pin 16 (SPARE)	GND	Ethernet 12 (PIESD) from SDU to User +	Ethernet 12 (PIESD) from User to SDU +
7	Ethernet 2 (PIESD) from User to SDU -	Ethernet 2 (PIESD) from SDU to User +	GND	Config Pin 17 (SPARE)	Config Pin 18 (SPARE)	Config Pin 19 (SPARE)	Config Pin 20 (SPARE)	GND	Ethernet 12 (PIESD) from User to SDU -	Ethernet 12 (PIESD) from SDU to User -

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Figure 4-5. Top Plug Pin Assignment

D. SDU Middle Plug (MP)

(1) The following figure is provided to aid in understanding of the pin assignments for the Middle Plug of the rear panel receptacle. This is guidance only; explicit requirements have been written to capture the required details. The shaded boxes highlight the SDU allocation of pins that are different from that defined in ARINC 781. The names specified in the shaded boxes indicate the actual use of the pin by the SDU.

(2) The Middle Plug is an ARINC 600 arrangement 118Q2 receptacle.

	A	B	C	D	E	F	G	H	J	K
1	Data from MCDU 1 A	Data from MCDU 1 B	Call Place/End Discrete Input 1	SCM Par +8 to +15V	Multi-Control Output A	Multi-Control Output B	Resv Ext Reset Discrete Input	Call Place/End Discrete Input 2	Data from MCDU 2 A	Data from MCDU 2 B
2	Data from Primary IRS/GNSS A	Data from Primary IRS/GNSS B	Cockpit Voice Chime Signal Contact 1	SCM Par Return OV	BITE Input From HPA A	BITE Input From HPA B	RSVD Mfr - Specific D-28V Discrete Output	Cockpit Voice Chime Signal Contact 2	Data from Secondary IRS A	Data from Secondary IRS B
3	Data from CMU 1 A	Data from CMU 1 B	Cockpit Voice Call Light Output 1	SDU Data to SCM A	Spare Discrete Output	Spare Discrete Input	SPARE	Cockpit Voice Call Light Output 2	Data from CMU 2 A	Data from CMU 2 B
4	Cockpit Audio Input 1 High	Cockpit Audio Input 1 Low	Cockpit Voice Mic-On Input 1	SDU Data to SCM B	Spare Discrete Output	Spare Discrete Input	SPARE	Cockpit Voice Mic-On Input 2	Cockpit Audio Input 2 High	Cockpit Audio Input 2 Low
5	Cockpit Audio Output 1 High	Cockpit Audio Output 1 Low	Cockpit Voice Go Ahead Chime Reset 1	SCM Data to SDU A	Spare Discrete Output	Spare Discrete Input	Spare ARINC 429 Output A	Spare ARINC 429 Output B	Cockpit Audio Outpost 2 High	Cockpit Audio Outpost 2 Low
6	Spare Discrete Input	Spare Discrete Input	Spare Discrete Input	SCM DATA to SDU B	Ethernet 5 (ACD from) SDU to User+	Ethernet 5 (ACD from) SDU to User+	Space ARINC 429 Input A	Spare ARINC 429 Input B	Data from GNSS to SDU A	Data from GNSS to SDU B
7	AES ID Input A	AES ID Input B	Spare Discrete Input	WOW Input 1	Ethernet 5 (ACD) from User to SDU+	Ethernet 5 (ACD) from User to SDU-	Space ARINC 429 Input B	Spare ARINC 429 Output B	Data to CMU 1 & 2 A	Data to CMU 1 & 2 B
8	Data from CFDS A	Data from CFDS B	BITE Input Top/Port BSU/Ant A	BITE Input Top/Port BSU/Ant B	Data Loader Link A	TX Mute Input	BITE Input STBD BSU A	BITE Input STBD BSU B	Data to CFDS A	Data to CFDS B
9	From Airborne Data Loader A	From Airborne Data Loader B	Crosstalk from other SDU A	Crosstalk from other SDU B	Dual System Select Discrete I/O	Dual System Disable Discrete I/O	Crosstalk to other SDU A	Crosstalk to other SDU B	To Airborne Data Loader A	To Airborne Data Loader B
10	Data from MCDU 3 A	Data from MCDU 3 B	Reserved (No Connection	Reserved (No Connection	LGA LNA On/Off Control	BITE Input from LGA LNA	Reserved (No Connection	Reserved (No Connection	Data to MCDU 1,2,3 A	Data to MCDU 1,2,3 B
11	Reserved (No Connection	Reserved (No Connection	Cabin CEPT-E1 Data Output A	Cabin CEPT-E1 Data Output B	Service Availability Discretes 1	Service Availability Discretes 2	Cabin CEPT-E1 Data Input A	Cabin CEPT-E1 Data Input B	Reserved (No Connection	Reserved (No Connection
12	1T: 1 Ethernet 3 (ACD) from SDU to User +	2 Ethernet 3 (ACD) from User to SDU +			Service Availability Discretes 3	Service Availability Discretes 4	2T: 2 Ethernet 4 (ACD) from User to SDU +	3 Ethernet 4 (ACD) from SDU to User -		
13					Service Availability Discretes 5	Service Availability Discretes 6				
14	4 Ethernet 3 (ACD) from User to SDU -	3 Ethernet 3 (ACD) from SDU to User -			Service Availability Discretes 7	Service Availability Discretes 8	1 Ethernet 4 (ACD) from SDU to User +	4 Ethernet 4 (ACD) from User to SDU -		
15					Service Availability Discretes 9	Service Availability Discretes 10				

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Figure 4-6. Middle Plug Allocation

E. SDU Bottom Plug (BP)

(1) The following figure is provided to aid in understanding of the pin assignments for the Bottom Plug of the rear panel receptacle. This is guidance only, explicit requirements have been written to capture the required details.

(2) The Bottom Plug is an ARINC 600 arrangement 12F5C2 receptacle.

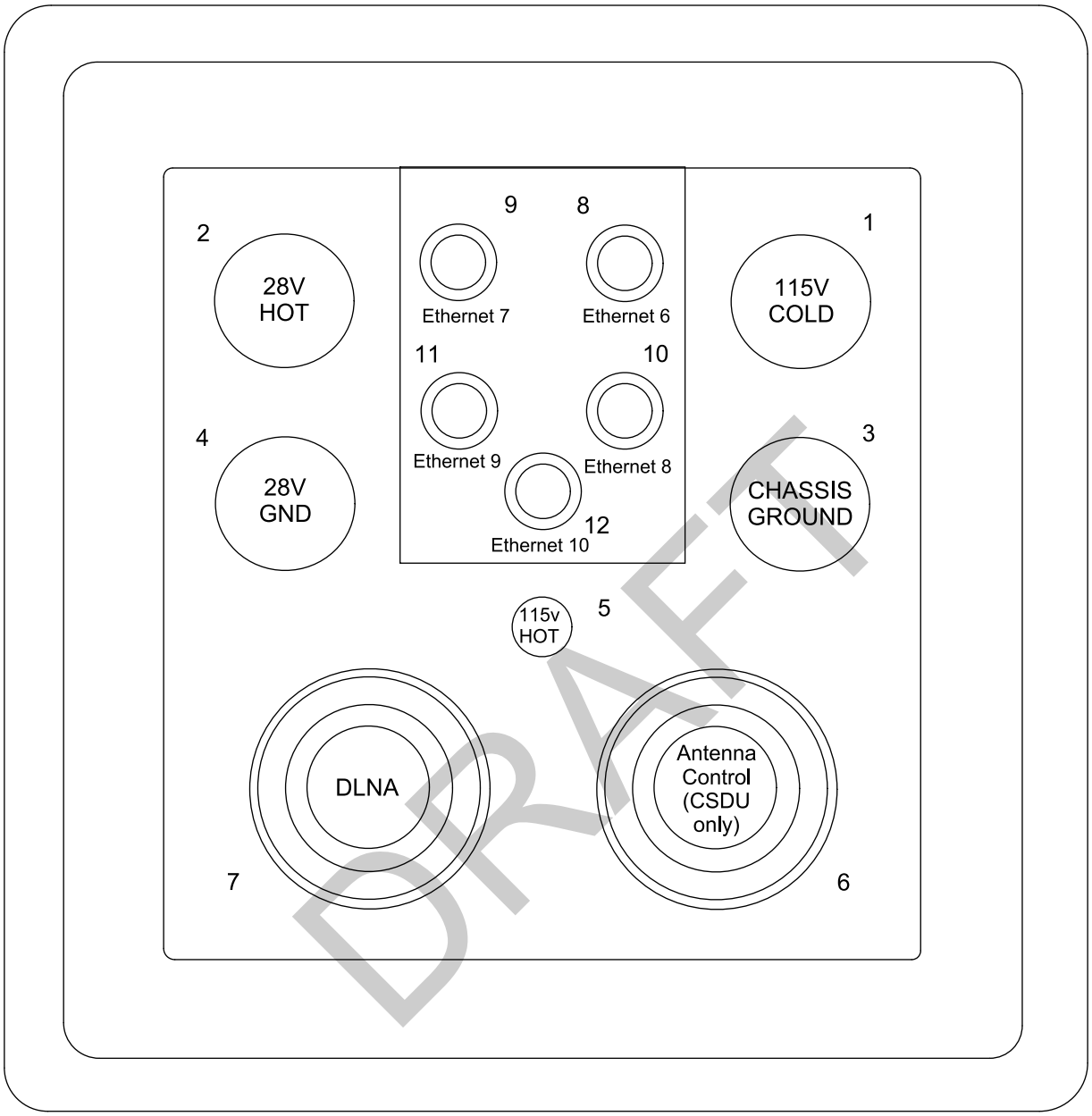

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Figure 4-7. ARINC 781-6 Bottom Plug Pin Assignments

F. SDU Front Panel Interfaces

(1) All silk screen labels for front panel interfaces have the following characteristics:

(a) Color: White

(b) Font: Honeywell Sans Medium.

G. SDU LED Indication

(1) The front panel of the SDU has a GREEN LED labeled 'Power' that is in one of the following software selectable states:

(a) Deactivated

(b) LED flashed at 1 Hz ± 0.5Hz

(c) LED flashed in anti-phase with the 1 Hz ± 0.5Hz clock

(d) Illuminated steady (Default).

(2) The front panel of the SDU has a RED LED labeled 'Fault' that is in one of the following states:

(a) Deactivated

(b) LED flashed at 1 Hz ± 0.5Hz

(c) LED flashed in anti-phase with the 1 Hz ± 0.5Hz clock

(d) Illuminated steady (Default) (3) The SDU LEDs is illuminated.

(3) The SDU LEDs are illuminated by default from application of power until commanded by software.

H. SDU Standalone Identification System (SIS) Interface

(1) The SDU has a 9-way D-SUB Standalone Identification System (SIS) Connector labeled "SIS" that is accessible on the Front-Panel.

(2) The SDU Standalone Identification System (SIS) Interface has the following characteristics Table 4-1:

Table 4-1. SDU Standalone Identification System (SIS) Interface Characteristics

Characteristic		Value
14	Connector flange depth below front panel	0.78 inch (20 mm) maximum
15	Access clearance around connector shield	0.32 inch (8 mm) minimum on short edge 0.16 inch (4 mm) minimum on long edge
16	Serial Link Interface Type	I2C Bus
17	Serial Link Interface Speed	100 kbps (standard mode)
18	SDA, SCL lines VOL	0.7 V at 3 Ma
19	IDD (with 4.5 V<VDD<5.5 V	<150 mA steady-state <200 mA inrush <500 ms
20	Memory addressing	2-byte I2C address

Table 4-1. SDU Standalone Identification System (SIS) Interface Characteristics (Continued)

21	Access protection	Read only from SIS Connector
22	Memory endurance	>100,000 cycles
23	Memory data retention	>30 years
24	VDD, SCL, SDA, VSS Out-of-Range protection	No loss of other SDU operational functions for voltages in the range -12.6 < V < +12.6 applied for 5 s

(3) The Front-Panel 9-way D-SUB connector has a green symbol beside it to indicate that this is the SDU Standalone Identification System (SIS) Interface Connector.

(4) The SDU Standalone Identification System (SIS) Interface is routed to the ACD Processor.

(5) No single failure of the SDU Standalone Identification System (SIS) Interface causes the loss of other SDU operational functions.

(6) The SDU Standalone Identification System (SIS) Interface has the memory addresses 0xFFB0 - 0xFFFF.

4. General Interface Requirement

A. Output Power Detector Function

(1) The HPA provides a sample of the power amplifier output for forward and reflected energy.

(2) The samples of forward and reflected output power are implemented with a directivity > 23 dB.

(3) The output power detector functions for the forward sample and the reflected sample are able to measure signals in a logarithmic response over the output dynamic range so modified to account for insertion loss from the Power Amplifier to Tx output port, with an accuracy of less than ±0.5 dB over level, temperature and frequency.

(4) The output detector functions provides broadband (Tx-band) rms power detection with a nominal response time of 1 ms. The output power detector analog to digital conversion oversampling capability should be at least two times that of the detector response time.

(5) For the current ARINC-429 label 143 HPA Status word reporting interval the following applies:

(a) When the state of indication of "Actual Power Out Status" is assessed as "Actual Power" then the largest forward output power sample is reported as the "Actual Peak Power".

(b) When the state of indication of "Actual Power Out Status" is assessed as "Held Power" then the largest forward output power sample of the most recent reporting interval when the "Actual Power Out Status" was "Actual Power" is reported for the "Actual Peak Power".

(6) For purposes of conveyance in ARINC-429 label 143 HPA Status word "Actual Peak Power", the largest forward output power sample is expressed as a 2's complement signed binary number of the numeric value derived in accordance with the following formulation:

(a) The forward output power sample is expressed in dB with respect to +46 dBm (40W) to the closest 0.5dB resolution.

(b) If computed result is > +3 dB then the computed result is clamped as +3 dB.

(c) If computed result is < -28 dB then the computed result is clamped as -28 dB.

(d) The numeric value to be conveyed is "Numeric Value" = computed result / 0.5 dB.

(e) The numeric value is expressed as a 2's complement signed binary number MSB truncated to 6-bit.

(7) For the current ARINC-429 label 357 Aero Power word reporting interval the computed average output level over the interval is reported as "Aero Power Out" in accordance to the following:

(a) Only output power samples with a synchronous input sample > -30 dBm are used in computation.

(b) Power samples are averaged in dB.

(c) Default value of +15 dBm is declared if no input power samples > -30 dBm.

(8) For purposes of conveyance in ARINC-429 label 357 Aero Power word, the computed average output level in dBm over the interval is expressed as a binary number in accordance with the following formulation:

(a) The computed average input level is expressed in dBm to the closest 0.1 dB resolution.

(b) The numeric value to be conveyed is "Numeric Value" = ("computed average input level (dBm)" - (+15 dBm)) / 0.1 dB.

(c) The numeric value is expressed as a 9-bit unsigned binary number.

(9) For the current ARINC-429 label 350 reporting interval the following applies:

(a) If the PA function is disabled then the "Output VSWR" status is reported as "VSWR Unknown" in ARINC-429 label 350 HPA Maintenance word.

(b) Only output power samples when the PA function is enabled are candidates for VSWR assessment.

(c) Only output power samples with a synchronous input sample > -30 dBm are used for VSWR assessment.

(d) Instantaneous VSWR is calculated from the correlated output detectors incident and reflected power levels.

(e) If all computed Instantaneous VSWR calculations are less than 2.0:1 in the reporting interval then the "Output VSWR" status is reported as "VSWR OK" in ARINC-429 label 350 HPA Maintenance word.

(f) If any computed Instantaneous VSWR calculations is greater than or equal to 2.0:1 in the reporting interval then the "Output VSWR" status is reported as "VSWR Unknown" in ARINC-429 label 350 HPA Maintenance word.

(g) Should the Instantaneous VSWR calculations in the reporting interval result in "VSWR Unknown" and the PA function is operating normally then the RED LED flashs until such time as a subsequent reporting interval Instantaneous VSWR computation results in "VSWR OK".

(h) If all of the input power samples in the reporting interval are < -30 dBm then the "Output VSWR" status is reported as "VSWR Unknown" in ARINC-429 label 350 HPA Maintenance word.

5. Electrical Installation

A. Input Power Interfaces

(1) An AC powered SDU variant and a DC powered SDU variant will be produced. The requirements in the AC and DC power input sections apply only to the matching variant.

(2) When operating in Class 6 or Class 7 and installed in a system with a HPA, the SDU powering the SCM has a maximum steady-state power consumption of 75 W or no more than 150VA when supplied with 115 VAC.

NOTE: The HPA is not powered by the SDU.

(3) The SDU automatically powers-on when primary power is applied.

(4) With the exception of small signal (<30V) communication signals and discretes the SDU ensures that a single conductor carries current on only one ground or return.

B. AC Power Input

(1) AC Power Input characteristics and test requirements are further specified in the Environmental Qualification Test Requirements section from the Aspire 400 Environmental Qualification Test Plan document listed in Appendix A.

C. AC Primary Power Interruptions

(1) The AC variant SDU maintains full functionality of the SDU (excluding Power-Over-RF supply) and of the SCM (including heaters) for at least 200ms after the loss of primary input power at -67ºF (-55ºC).

D. DC Power Input

(1) DC Power Input characteristics and test requirements are further specified in the Environmental Qualification Test Requirements section from the Aspire 400 Environmental Qualification Test Plan document listed in Appendix A.

E. DC Momentary Power Interruptions

(1) The DC variant SDU maintains full functionality of the SDU (excluding Power-Over-RF supply) and of the SCM (including heaters) for at least 200ms after the loss of primary input power at -67ºF (55ºC).

F. Ground Reference Fluctuation

(1) The different ground reference fluctuation tests are all applicable to the equipment under test, independent of the type of power supply (i.e. the DC tests and AC tests apply to DC powered Units-under-Test and AC powered Units-under-Test).

6. Electrical Drawings

A. Electrical Drawings

(1) Refer to Figure 4-8 for the Aspire-400 Interconnect Diagram.

NOTES:

1. TX LOSS SDU TO HPA: 0-18dB OVER FREQUENCY RANGE OF 1626.5MHz to 1660.5MHz
   TX LOSS HPA TO ANTENNA: 0-2.5dB OVER FREQUENCY RANGE OF 1626.5MHz to 1660.5MHz
   TX LOSS HPA TO DLNA: 0-1.4dB OVER FREQUENCY RANGE OF 1626.5MHz to 1660.5MHz
   TX LOSS IN DLNA: 0-0.8dB OVER FREQUENCY RANGE OF 1626.5MHz to 1660.5MHz
   TX LOSS DLNA TO ANTENNA: 0-0.3dB OVER FREQUENCY RANGE OF 1626.5MHz to 1660.5MHz

2. RX LOSS: 6-25dB OVER FREQUENCY RANGE OF 1525MHz to 1559MHz

3. POWER CABLE BETWEEN SDU AND SCM BASED ON CABLE SIZE:
   10 METERS MAXIMUM IF USING 22 AWG CABLE
   6.2 METERS MAXIMUM IF USING 24 AWG CABLE

4. - IN STANDALONE CONFIGURATION, IF THE NUMBER OF OTHER CONFIGURATION PINS IS EVEN, THEN STRAP CONFIGURATION PIN 3 (TP3F) TO SERVICE AVAILABILITY DISCRETE (MP11E).
   - WHEN THE SDU IS USED AS SDU #1 IN A DUAL SATCOM CONFIGURATION:
     - CONNECT PIN TP3F TO TP3D
     - LEAVE THE FOLLOWING PINS OPEN AND NOT CONNECTED:
       - TP3E
       - TP3G
       - TP4D
       - TP4E
       - TP4F
       - TP4G
       - TP5D
       - TP5E
       - TP5F
       - TP5G
       - TP6D
       - TP6E
       - TP6F
       - TP6G
       - TP7D
       - TP7E
       - TP7F
       - TP7G

     NOTE: TP4D IS CONFIGURATION PIN #5 USED TO DETERMINE SDU NUMBER.
   - WHEN THE SDU IS USED AS SDU #2 IN A DUAL SATCOM CONFIGURATION:
     - CONNECT PIN TP4D TO TP3D
     - LEAVE THE FOLLOWING PINS OPEN AND NOT CONNECTED:
       - TP3E
       - TP3F
       - TP3G
       - TP4E
       - TP4F
       - TP4G
       - TP5D
       - TP5E
       - TP5F
       - TP5G
       - TP6D
       - TP6E
       - TP6F
       - TP6G
       - TP7D
       - TP7E
       - TP7F
       - TP7G

     NOTE: TP4D IS CONFIGURATION PIN #5 USED TO DETERMINE SDU NUMBER.

5. P DENOTES TWISTED PAIR (TP). P DENOTES TWISTED SHIELDED PAIR (TSP). P DENOTES SHIELDED TWISTED CABLE (2 PAIR).
   DENOTES QUADRAX TERMINATION WITH STAR QUAD WIRING. DENOTES CHASSIS GOUND. DENOTES POWER CABLE.

6. ALL CABLING SHOULD BE IN ACCORDANCE EITHER WITH SAE AS50881: WIRING AEROSPACE VEHICLE STANDARD OR AS PER AIRFRAME MANUFACTURER'S REQUIREMENTS.

7. ALL CABLE SHIELDS SHOULD BE BONDED TO THE EMI BACKSHELL OR CONNECTOR BODY EXCEPT AS EXPLICITLY NOTED OTHERWISE.

8. ALL SHIELDED PAIR CABLES HAVE SHIELDS INDIVIDUALLY TERMINATED TO GROUND AT BOTH ENDS WITH 3 INCH MAX DRAIN WIRES, EXCEPT 4-WIRE INTERFACES WHICH HAVE SHIELDS INDIVIDUALLY TERMINATED TO GROUND WITH 3 INCH MAX DRAIN WIRES ONLY AT THE TRANSMITTING END OF EACH CABLE.

9. MATING PLUGS, FOR ALL EXCEPT THE SCM, SHOULD BE NICKEL-PLATED ALUMINUM, NICKEL-PLATED COMPOSITE OR STAINLESS STEEL. TIN PLATED CONNECTOR TE 205205-2 RECOMMENDED FOR SCM.

10. THE CABLES FOR ETHERNET 1, 2, 11 AND 12 HAVE THE SHIELDS INDIVIDUALLY TERMINATED TO GROUND AT BOTH ENDS, WITH .5 INCH MAXIMUM DRAIN WIRES TERMINATED TO THE NEIGHBORING GROUND PIN IN THE ARINC 600 CONNECTOR.

11. THE CABLE FOR ETHERNET 5 HAS THE SHIELDS INDIVIDUALLY TERMINATED TO GROUND AT BOTH ENDS WITH 3 INCH MAXIMUM DRAIN WIRES.

12. FOR QUADRAX ETHERNET 3 AND 4:
    A. CABLES SHOULD HAVE 360° SHIELDING, TERMINATED AT BOTH ENDS OF THE CABLE.
    B. TERMINATING SHOULD NOT DISTORT THE NATURAL TWIST OF THE CABLE.
    C. NO WIRES ARE TO BE LEFT EXPOSED OUTSIDE (TO THE REAR) OF THE QUADRAX CONTACT SHELL.

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Figure 4-8. (Sheet 1 of 9) Aspire 400 - Electrical Drawings

13. FOR WIRING SIZE AND TYPE RECOMMENDATIONS SEE TABLES BELOW.

INTERFACE	SATCOM INTERCONNECTION CABLES
115 VAC HOT	M22759/9-20-0, 20 AWG, BLACK
115 VAC COLD	M22759/9-20-9, 20 AWG, WHITE
CHASSIS GROUND	M22759/9-20-5, 20 AWG, GREEN, <44 INCHES TO GROUND PLANE
ARINC 429 SERIAL I/O (RECEIVED SIGNALS)	PIC D620224, OR EQUIVALENT (ONE FOR EACH SIGNAL) 1. DATA FROM TCP 1; 2. DATA FROM TCP 2; 3. DATA FROM PRIMARY IRS/GNSS; 4. DATA FROM SECONDARY IRS/GNSS; 5. DATA FROM CMU 1; 6. DATA FROM CMU 2; 7. BITE INPUT FROM HPA; 8. DATA FROM GNSS TO SDU; 9. SPARE INPUT 1; 10. DATA FROM CFDS; 11. AES ID INPUT; 12. BITE INPUT TOP/PORT BSU/ANT; 13. BITE INPUT STBD BSU; 14. CROSSTALK FROM OTHER SDU; 15. FROM AIRBORNE DATA LOADER; AND 16. DATA FROM TCP 3. 24 AWG, 1 SHIELDED TWISTED PAIR, 70 OHM, 30.0 PF/FT, DC RESISTANCE OR 25.2 OHMS/1000 FT., 95% SHIELDED, ETFE OUTER INSULATION
ARINC 429 SERIAL I/O (TRANSMITTED SIGNALS)	PIC D620224, OR EQUIVALENT (ONE FOR EACH SIGNAL) 1. MULTI-CONTROL OUTPUT; 2. DATA TO CMU 1 & 2; 3. SPARE OUTPUT 1; 4. SPARE OUTPUT 2; 5. DATA TO CFDS; 6. TO AIRBORNE DATA LOADER; 7. CROSSTALK TO OTHER SDU; AND 8. DATA TO TCP 1, 2, 3. 24 AWG, 1 SHIELDED TWISTED PAIR, 70 OHM, 30.0 PF/FT, DC RESISTANCE OR 25.2 OHMS/1000 FT., 95% SHIELDED, ETFE OUTER INSULATION
4-WIRE AUDIO (COCKPIT AUDIO INPUT 1)	M27500-24SD2T23,24 AWG, SHIELDED PAIR CABLE.
4-WIRE AUDIO (COCKPIT AUDIO OUTPUT 1)	M27500-24SD2T23,24 AWG, SHIELDED PAIR CABLE.
4-WIRE AUDIO (COCKPIT AUDIO INPUT 2)	M27500-24SD2T23,24 AWG, SHIELDED PAIR CABLE.
4-WIRE AUDIO (COCKPIT AUDIO OUTPUT 2)	M27500-24SD2T23,24 AWG, SHIELDED PAIR CABLE.
ETHERNET 1, 2, 5, 11, 12	ECS 922604, PIC E10424 OR EQUIVALENT; 10/100 BASE-T ETHERNET, 24 AWG, 4 CONDUCTORS, 2 TWISTED PAIRS, FOAM SHIELD, SILVER-PLATED COPPER BRAID OVER-SHIELD, FEP OUTER INSULATING JACKET, 100 OHMS
ETHERNET 3, 4	ECS 422404, PIC E51424 OR EQUIVALENT; STAR QUAD ETHERNET, 24 AWG, 4 CONDUCTORS, TIN-COATED FLAT COPPER SHIELD, TIN-COATED COPPER BRAID OVER-SHIELD, EXTRUDED FEP OUTER INSULATING JACKET, 100 OHMS

INTERFACE	SATCOM INTERCONNECTION CABLES
SCM POWER	M27500-22SD2T23,22 AWG, SHIELDED PAIR CABLE; MAXIMUM LENGTH OF 10 METERS M27500-24SD2T23,24 AWG, SHIELDED PAIR CABLE; MAXIMUM LENGTH OF 6.2 METERS
SCM DATA TO SDU	M27500-24SD2T23,24 AWG, SHIELDED PAIR CABLE; MAXIMUM LENGTH OF 10 METERS
SCM DATA FROM SDU	M27500-24SD2T23,24 AWG, SHIELDED PAIR CABLE; MAXIMUM LENGTH OF 10 METERS
SCM CHASSIS GROUND	M22759/9-14-5, 14 AWG, GREEN, <12 INCHES TO GROUND PLANE
CONFIGURATION STRAPPING	STRAPPED AT ARINC CONNECTOR, WIRES CONSTRAINED IN THE BACKSHELL
OPEN/GROUND DISCRETES	M22759/9-24-X (ONE FOR EACH SIGNAL); WHERE X IS THE COLOR OF THE INSULATION: 0- BLACK 1- BROWN 2- RED 3- ORANGE 4- YELLOW 5- GREEN 6- BLUE 7- VIOLET 8- GRAY 9- WHITE 24 AWG, SINGLE CONDUCTOR, STRANDED, SILVER-PLATED COPPER, PTFE OUTER INSULATING JACKET
SWITCHED CONTACT OUTPUT	M22759/9-24-X (ONE FOR EACH SIGNAL); WHERE X IS THE COLOR OF THE INSULATION: 0- BLACK 1- BROWN 2- RED 3- ORANGE 4- YELLOW 5- GREEN 6- BLUE 7- VIOLET 8- GRAY 9- WHITE 24 AWG, SINGLE CONDUCTOR, STRANDED, SILVER-PLATED COPPER, PTFE OUTER INSULATING JACKET
RF CABLE FOR: RF TX RF RX RF OUTPUT	ECS 311901, OR EQUIVALENT COAXIAL, 19 AWG CENTER CONDUCTOR, HIGH-TEMPERATURE FLUOROPOLYMER DIELECTRIC, SILVER-PLATED COPPER BRAID INNER SHIELD, ALUMINUM FOIL, 36 AWG SILVER-PLATED COPPER BRAID OUTER SHIELD, HIGH-TEMPERATURE FLUOROPOLYMER OUTER INSULATING JACKET, 50-OHM.

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Figure 4-8. (Sheet 2 of 9) Aspire 400 - Electrical Drawings

14. SYSTEM INTERFACES ARE AS FOLLOWS:

1 EXTERNAL SYSTEM INTERFACES
1.1 ARINC 429 INTERFACES
1.1.1 ARINC 429 SERIAL INPUTS ELECTRICAL CHARACTERISTICS

- LOGIC HIGH VOLTAGE (A PIN REFERENCED TO B PIN)	7.25V TO 13V
- NULL VOLTAGE (A PIN REFERENCED TO B PIN)	0.5V TO -0.5V
- LOGIC LOW VOLTAGE (A PIN REFERENCED TO B PIN)	-7.25V TO -13V
- DIFFERENTIAL INPUT RESISTANCE	MIN 12KOHM
- DIFFERENTIAL INPUT CAPACITANCE	MAX 50PF
- RESISTANCE TO GROUND	MIN 12KOHM
- CAPACITANCE TO GROUND	MAX 50PF
- SUSTAINED INPUT VOLTAGE	30VAC DIFFERENTIAL ±29VDC BALANCE ARM TO GROUND
- OUT-OF RANGE CLAMPING	YES

1.1.2 ARINC 429 SERIAL INPUTS TIMING CHARACTERISTICS

- HIGH-SPEED BIT RATE	100KBPS ±1%
- LOW-SPEED BIT RATE	12.0 - 14.5 KBPS
- INTER-WORD GAP	MIN 4 BITS

1.1.3 ARINC 429 SERIAL OUTPUTS ELECTRICAL CHARACTERISTICS

LOGIC HIGH VOLTAGE	
- LINE A TO B	10±1.0V
- LINE A TO GROUND	5±0.5V
- LINE B TO GROUND	-5±0.5V
NULL VOLTAGE	
- LINE A TO B	0±0.5V
- LINE A TO GROUND	0±0.25V
- LINE B TO GROUND	0±0.25V
LOGIC LOW VOLTAGE	
- LINE A TO B	-10±1.0V
- LINE A TO GROUND	-5±0.5V
- LINE B TO GROUND	5±0.5V

DIFFERENTIAL OUTPUT RESISTANCE:	75±5 OHMS
CAPACITIVE LOAD	29 NF FOR LOW SPEED OPERATION 9 NF FOR HIGH SPEED OPERATION
OUTPUT CONTROL	ACTIVE OR HIGH IMPEDANCE UNDER SW CONTROL INITIALIZED IN HIGH IMPEDANCE STATE ON POWER UP UNTIL COMMANDED BY SW

1.1.4 ARINC 429 SERIAL OUTPUTS TIMING CHARACTERISTICS

- HIGH-SPEED BIT RATE	100KBPS ±1%
- HIGH-SPEED RISE/FALL TIME	1.5 ±0.5μS WHEN MEASURED AT 10%/90%
- LOW-SPEED BIT RATE	12.0-14.5KBPS
- LOW-SPEED RISE/FALL TIME	10 ±5μS WHEN MEASURED AT 10%/90%
- INTER-WORD GAP	MIN 4 BITS

1.2 HPA RS-232 TX AND RX INTERFACES' DEFAULT CHARACTERISTICS

- BAUD RATE:	SOFTWARE-SELECTABLE UP TO A MAXIMUM OF 115200 BAUD
- DATA BITS:	8
- STOP BITS:	1
- PARITY:	NONE
- FLOW CONTROL:	NONE

1.3 SCM POWER AND DATA INTERFACES
1.3.1 SDU POWER TO THE SCM:
- 12VDC OUTPUT (RANGE OF 11VDC TO 12.6VDC) CAPABLE OF SUPPLYING UP TO 12W.

NOTES:
1. THE SCM CAN HANDLE A POWER RANGE OF 9.8V TO 18V AT ITS INPUTS
2. WHEN OPERATING WITH ASPIRE 400 SDU, THE SCM CAN EXPECT A VOLTAGE RANGE OF 9.8V TO 12.6V AT ITS INPUTS
3. WHEN THE SCM HAS HEATERS ON, IT WILL CONSUME A MAXIMUM 10.7 W - (INPUT: CURRENT 1.092 A AND VOLTAGE 9.8 V BASED ON A 22 AWG, 10 M CABLE)
4. THE SDU OUTPUT POWER, SUPPLIED TO THE SCM, IS PROTECTED FROM LOAD SHORT-CIRCUITS
5. SCM INPUT POWER RETURN IS ISOLATED FROM SCM CHASSIS GND

1.3.2 RS-422 TRANSMIT AND RECEIVE INTERFACES' DEFAULT CHARACTERISTICS:

- BAUD RATE:	230400 BAUD
- DATA BITS:	8
- STOP BITS:	1
- PARITY:	NONE
- FLOW CONTROL:	NONE

1.4 SDU ETHERNET INTERFACES
- ALL SDU ETHERNET PORTS ARE IEEE 802.3 INTERFACES CAPABLE WITH PORTS 1, 2, 3, 4, 11 AND 12 OPERATING AT 10BASE-T / 100BASE-TX WHILE PORT 5 OPERATES AT 10BASE-T.

1.5 POWER INPUT
1.5.2 SDU POWER INPUT

- SDU AC SUPPLY:	97 VAC TO 134 VAC SINGLE PHASE / 300HZ TO 900HZ
- POWER CONSUMPTION	<75W DELIVERING FULL RF RATED OUTPUT (INCLUDES SCM POWER)

1.5.2 HPA POWER INPUT

- HPA AC SUPPLY:	97 VAC TO 134 VAC SINGLE PHASE / 300HZ TO 900HZ
- POWER CONSUMPTION	<200W DELIVERING FULL RF RATED OUTPUT

1.6 4-WIRE INTERFACES
1.6.1 SDU 4-WIRE ANALOG INPUTS' CHARACTERISTICS

- INTERFACE TYPE	ANALOG MICROPHONE INPUT
- INPUT IMPEDANCE	150 OHMS ±30 OHMS
- INPUT VOLTAGE	20 MV TO 1.5 V RMS
- SHIELD TERMINATION	UNGROUNDED
- MICROPHONE EXCITATION	NOT REQUIRED
- GAIN CONTROL	MONOTONIC SW ADJ., AT LEAST 32 STEPS FROM 0DB TO AT LEAST +30DB

1.6.2 SDU 4-WIRE ANALOG OUTPUTS' CHARACTERISTICS

- INTERFACE TYPE	DIFFERENTIAL FLOATING (BALANCED) OUTPUT CAPABLE OF SINGLE-ENDED (UNBALANCED) OUTPUT
- LOAD IMPEDANCE	600 OHMS ±20% RESISTIVE
- NOMINAL OUTPUT LEVEL	10MW INTO NOMINAL LOAD
- SHIELD TERMINATION	GROUNDED
- GAIN CONTROL	MONOTONIC SW ADJ. IN AT LEAST 31 STEPS FROM -3DB TO +6DB (5MW TO 40MW)

1.6.2 SDU 4-WIRE ANALOG INTERFACE COMMON CHARACTERISTICS
RELATIVE ATTENUATION, RELATIVE TO THE NOMINAL CONVERSION GAIN:
- FROM THE 4-WIRE AUDIO INPUT PORT TO THE OUTPUT OF THE AUDIO CODEC
OR
- FROM THE INPUT OF THE AUDIO CODEC TO THE 4-WIRE AUDIO OUTPUT PORT

FALLS WITHIN THE FOLLOWING MASK:

FREQUENCY	VALUE
- 300 TO 400 HZ	-2.0 TO +4.4 DB
- 400 TO 600 HZ	-1.2 TO +2.6 DB
- 600 TO 2400 HZ	-1.2 TO +1.2 DB
- 2400 TO 2700 HZ	-1.2 TO +2.6 DB
- 2700 TO 3400 HZ	-1.2 TO +4.4 DB

1.7 DISCRETE INTERFACES
1.7.1 SDU OPEN/GROUND DISCRETE INPUTS CHARACTERISTICS

- REVERSE CURRENT PROTECTION	PROTECTED (E.G. BY A DIODE)
- LOW PASS FILTER CUTOFF	5HZ TO 50HZ
- CAPACITANCE	10NF OR LESS AT LRU PIN
- INTERNAL PULLUP	28V OR LESS
- INPUT RANGE	-4V TO +49V
- SWITCHING LOW THRESHOLD	5V OR MORE
- SWITCHING HIGH THRESHOLD	10V OR LESS
- HYSTERESIS	3V OR MORE BETWEEN SWITCHING THRESHOLDS
- INPUT SHORT CIRCUIT CURRENT	1MA ±15%

1.7.2 SDU OPEN/GROUND DISCRETE OUTPUTS CHARACTERISTICS

- INRUSH CURRENT	≤500MA
- STEADY STATE CURRENT	≤50MA
- HOLD-OFF VOLTAGE	≤49VDC
- OPEN STATE IMPEDANCE	≥1M OHM
- GROUND STATE VOLTAGE	≤1V WHEN MEASURED AT 50MA
- POWER UP STATE	INITIALIZED TO 'OPEN STATE' ON POWER UP UNTIL COMMANDED BY SW

NOTE:
1. THE OPEN/GROUND DISCRETE OUTPUT INTERFACES WILL NOT PROVIDE DIODE ISOLATION DUE TO THE LOW GROUND STATE VOLTAGE REQUIREMENT. THE SDU THEREFORE DOES NOT PREVENT EXCESS CURRENTS FROM DEVELOPING IN THE CASE OF GROUND VOLTAGE FLUCTUATIONS BETWEEN THE SDU AND ANOTHER LRU WHEN THESE HAVE THEIR OPEN/GROUND DISCRETE OUTPUTS CONNECTED IN AN OR CONFIGURATION. WHEN AN SDU OPEN/GROUND DISCRETE OUTPUT IS WIRED ONLY TO OPEN/GROUND DISCRETE INPUTS OF OTHER EQUIPMENT, THIS LIMITATION DOES NOT APPLY.

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Figure 4-8. (Sheet 3 of 9) Aspire 400 - Electrical Drawings

1.7.3 SDU SWITCHED-CONTACT DISCRETE OUTPUT (VOICE CHIME SIGNAL)
- COCKPIT VOICE CHIME SIGNAL CONTACT 1 & CALL 1 CD2 MP02C
- COCKPIT VOICE CHIME SIGNAL CONTACT 2 MP02H

NOTES:
1. THE MP02C PIN MAY ALSO BE USED FOR THE CALL 1 CD2 DISCRETE AS PART OF THE CD1 / CD2 METHOD OF CALL PROGRESSION SIGNALING. WHEN THE SDU MP02C PIN IS USED FOR CD1 / CD2 SIGNALING THEN SDU MP02H PIN MUST BE CONNECTED BACK TO AN SDU SIGNAL GROUND AT THE AIRCRAFT CONNECTOR BACKSHELL TO PROVIDE A SWITCH PATH TO GROUND.
2. THE SDU SWITCHED-CONTACT DISCRETE OUTPUT PAIR IS NOT CURRENT-LIMITED SO THE CHIME VOLTAGE SOURCE (IF USED) SHOULD BE CURRENT LIMITED TO PROTECT SDU AND AIRCRAFT WIRING.

SDU SWITCHED-CONTACT DISCRETE OUTPUT PAIR CHARACTERISTICS:
- MAX ON-STATE RESISTANCE (MP02C TO MP02H) 1-OHM
- MIN ON-STATE CURRENT (MP02C TO MP02H) 1A
- MIN OFF-STATE HOLD-OFF VOLTAGE 49V
- MIN OFF-STATE RESISTANCE (MP02C TO MP02H) 1-M OHM
- POWER UP STATE: INITIALIZED TO 'OPEN STATE' ON POWER UP UNTIL COMMANDED BY SW

1.7.4 HPA DISCRETES
HPA OPEN/GROUND DISCRETE INTERFACE INPUTS CHARACTERISTICS:
- OPEN STATE RESISTANCE: ≥100 KΩ TO GROUND
- CLOSED STATE RESISTANCE: ≤10Ω TO GROUND
- HOLD-OFF VOLTAGE: 0 TO 36V
- REVERSE CURRENT PROTECTION: DIODE PROTECTED
- LOW PASS FILTER CUTOFF: 5 HZ TO 50 HZ
- CAPACITANCE: ≤10 NF
- INTERNAL PULL-UP: ≤28 VDC
- INPUT RANGE: -4V TO +49V
- SWITCHING LOW THRESHOLD: ≥5V
- SWITCHING HIGH THRESHOLD: ≤10V
- HYSTERESIS: ≥3V
- INPUT SHORT CIRCUIT CURRENT: 1MA ±15%
- LOGIC STATES: BINARY "1" AS THE CLOSED STATE
  BINARY "0" AS THE OPEN STATE

1.8 RF INTERFACE
1.8.1 SDU RX CHARACTERISTICS
- RF INPUT PORT (BP07) VSWR: <2:1, REFERENCED TO A 50 OHM LOAD.
- MAXIMUM RF INPUT POWER WITHOUT DAMAGE: +10 DBM

1.8.2 SDU DC RETURN
- THE CENTER CONDUCTOR OF THE RF INPUT (BP07) OF THE SDU SHALL PROVIDE A DC RESISTANCE TO GROUND OF LESS THAN OR EQUAL TO 1000 OHMS, CAPABLE OF DISSIPATING THE POWER INDUCED BY ±3 VDC.

1.8.3 SDU TX CHARACTERISTICS
- MAXIMUM PER CARRIER AVERAGE POWER: +10DBM ±1.75DB
- TX OUTPUT VSWR (LOOKING INTO RF TX OUTPUT) <2:1, REFERENCED TO A 50 OHM LOAD

1.8.4 HPA RF INTERFACE GROUND UNCERTAINTY
- CENTER CONDUCTOR OF THE RF TX INPUT AND RF TX OUTPUT PORTS IS INTERNALLY GROUNDED WITH A DC RESISTANCE TO GROUND OF LESS THAN OR EQUAL TO 1000 OHMS CAPABLE OF DISSIPATING THE POWER INDUCED BY ±3V DC.
- RF INTERFACES ARE DESIGNED TO BLEED DC FROM AC COUPLED LINES.

1.8.5 HPA RF OUTPUT TO DLNA
- MAXIMUM PER CARRIER AVERAGE POWER: +42.5DBM
- TX OUTPUT VSWR <1.5:1, REFERENCED TO A 50 OHM LOAD

1.8.6 HPA RF INPUT FROM SDU
- MAXIMUM INPUT DAMAGE LEVEL: +20DBM

1.9 SDU CONFIGURATION STRAPPING
1.9.1 SDU ARINC 781 CONFIGURATION DISCRETE INPUTS' CHARACTERISTICS
- OPEN STATE RESISTANCE ≥100,000 OHMS TO SDU GROUND
- CLOSED STATE RESISTANCE ≤10 OHMS TO SDU GROUND
- HOLD-OFF VOLTAGE NOT SPECIFIED

NOTE: CONFIG PIN 1 (TP03D) IS A GROUND PIN INTERNALLY STRAP TO GROUND AND IS NOT CONSIDERED AN INPUT.

1.9.2 SDU SERVICE AVAILABILITY DISCRETE OUTPUTS' CHARACTERISTICS
- INRUSH CURRENT ≤500MA, FOR ≤1 SEC
- STEADY STATE CURRENT ≤50MA
- HOLD-OFF VOLTAGE ≤39VDC
- OPEN STATE IMPEDANCE ≥1M OHM
- GROUND STATE VOLTAGE ≤1V WHEN MEASURED AT 50MA

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Figure 4-8. (Sheet 4 of 9) Aspire 400 - Electrical Drawings

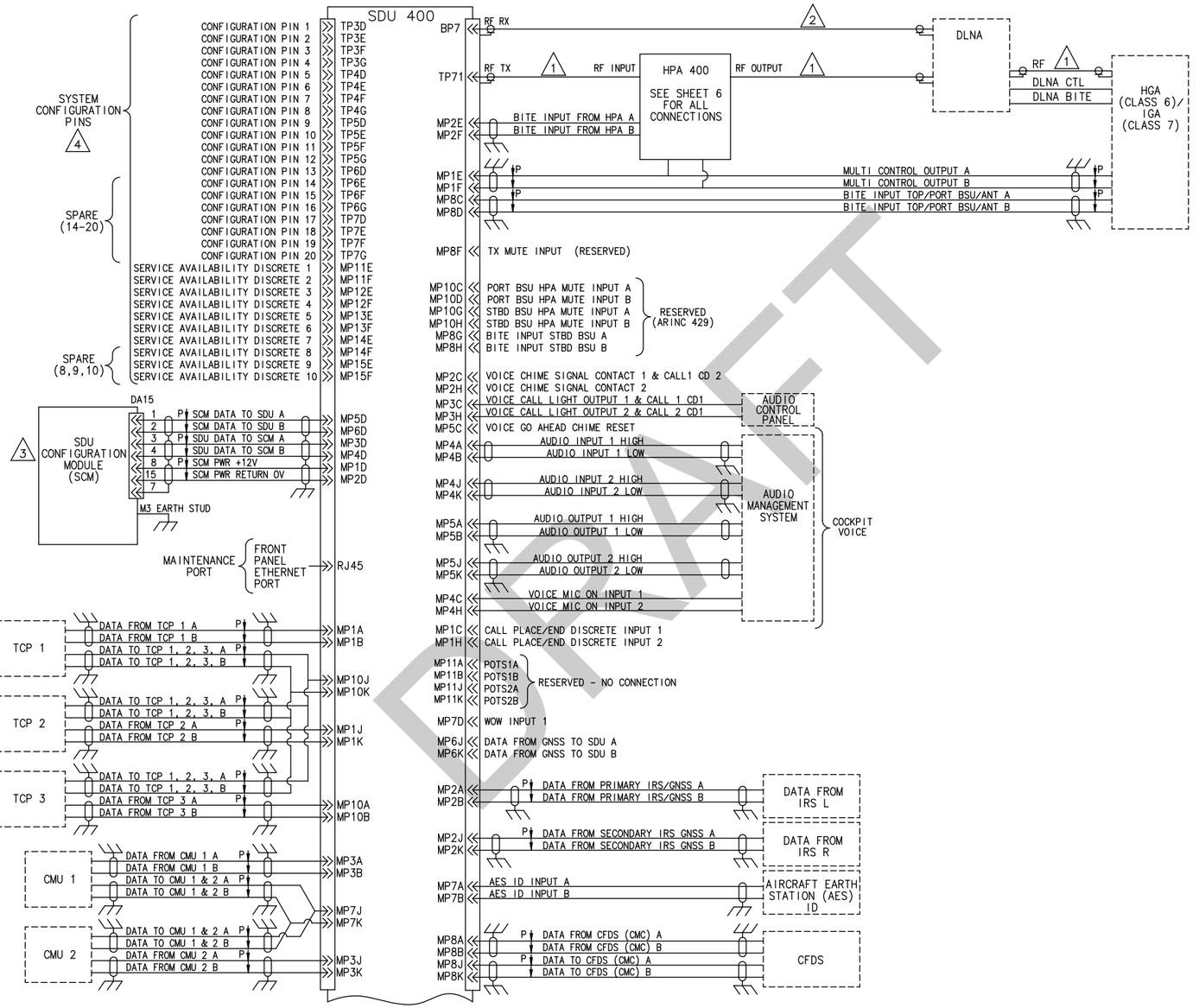

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Figure 4-8. (Sheet 5 of 9) Aspire 400 - Electrical Drawings

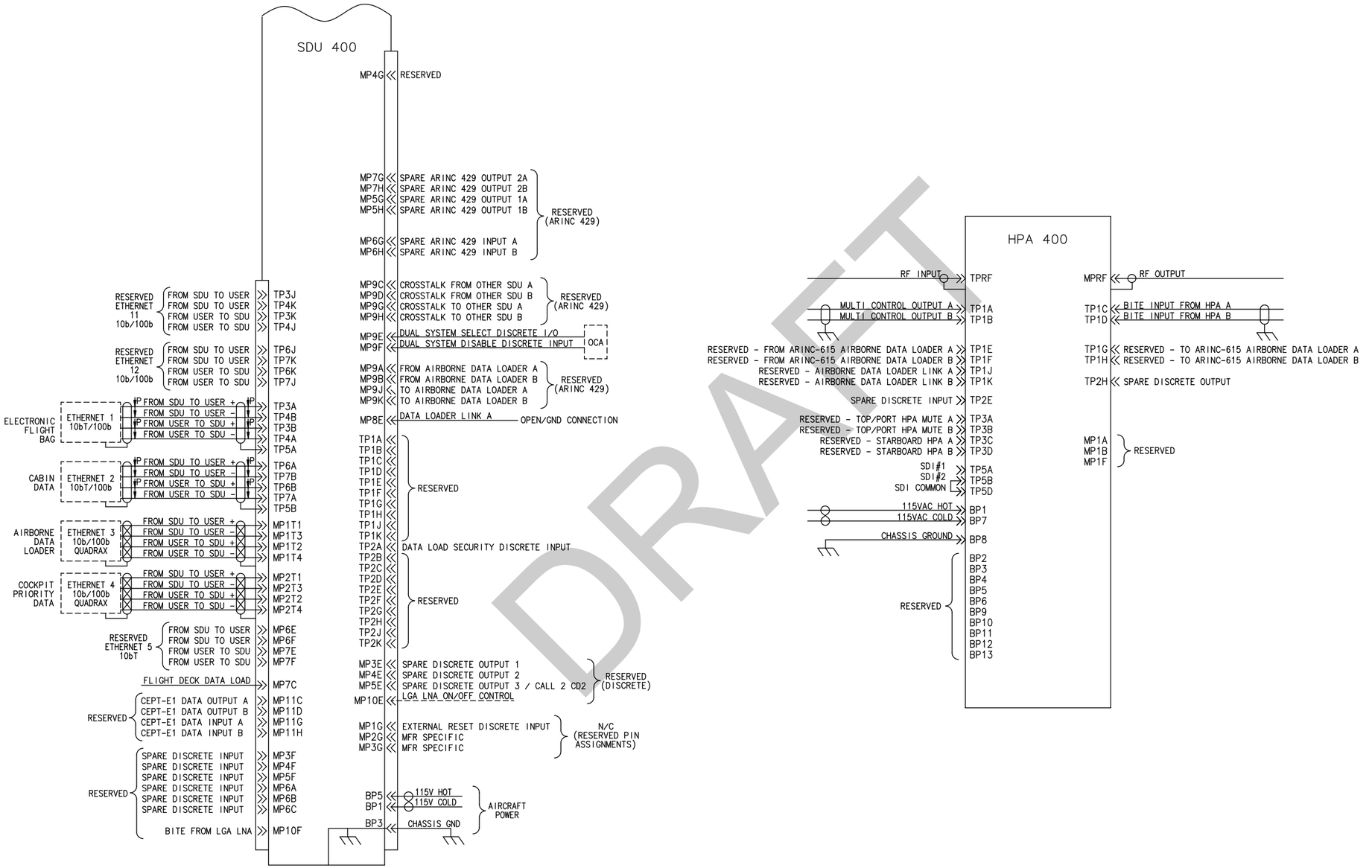

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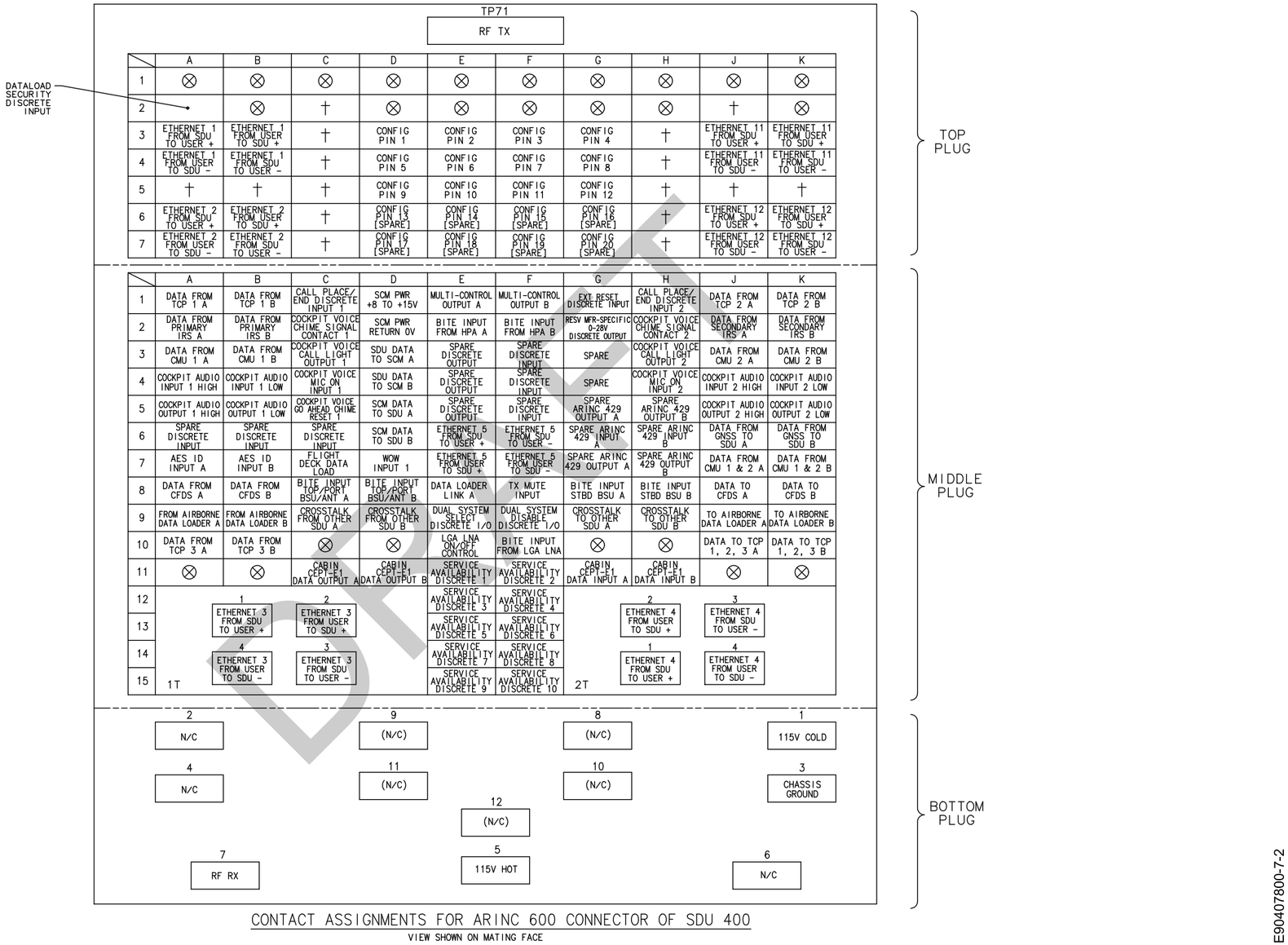
Figure 4-8. (Sheet 6 of 9) Aspire 400 - Electrical Drawings



	A	B	C	D	E	F	G	H	J	K
1	⊗	⊗	⊗	⊗	⊗	⊗	⊗	⊗	⊗	⊗
2		⊗	⏚	⊗	⊗	⊗	⊗	⊗	⏚	⊗
3	ETHERNET 1 FROM SDU TO USER +	ETHERNET 1 FROM USER TO SDU +	⏚	CONFIG PIN 1	CONFIG PIN 2	CONFIG PIN 3	CONFIG PIN 4	⏚	ETHERNET 11 FROM SDU TO USER +	ETHERNET 11 FROM USER TO SDU +
4	ETHERNET 1 FROM USER TO SDU -	ETHERNET 1 FROM SDU TO USER -	⏚	CONFIG PIN 5	CONFIG PIN 6	CONFIG PIN 7	CONFIG PIN 8	⏚	ETHERNET 11 FROM USER TO SDU -	ETHERNET 11 FROM SDU TO USER -
5	⏚	⏚	⏚	CONFIG PIN 9	CONFIG PIN 10	CONFIG PIN 11	CONFIG PIN 12	⏚	⏚	⏚
6	ETHERNET 2 FROM SDU TO USER +	ETHERNET 2 FROM USER TO SDU +	⏚	CONFIG PIN 13 [SPARE]	CONFIG PIN 14 [SPARE]	CONFIG PIN 15 [SPARE]	CONFIG PIN 16 [SPARE]	⏚	ETHERNET 12 FROM SDU TO USER +	ETHERNET 12 FROM USER TO SDU +
7	ETHERNET 2 FROM USER TO SDU -	ETHERNET 2 FROM SDU TO USER -	⏚	CONFIG PIN 17 [SPARE]	CONFIG PIN 18 [SPARE]	CONFIG PIN 19 [SPARE]	CONFIG PIN 20 [SPARE]	⏚	ETHERNET 12 FROM USER TO SDU -	ETHERNET 12 FROM SDU TO USER -

	A	B	C	D	E	F	G	H	J	K
1	DATA FROM TCP 1 A	DATA FROM TCP 1 B	CALL PLACE/ END DISCRETE INPUT 1	SCM PWR +8 TO +15V	MULTI-CONTROL OUTPUT A	MULTI-CONTROL OUTPUT B	EXT RESET DISCRETE INPUT	CALL PLACE/ END DISCRETE INPUT 2	DATA FROM TCP 2 A	DATA FROM TCP 2 B
2	DATA FROM PRIMARY IRS A	DATA FROM PRIMARY IRS B	COCKPIT VOICE CHIME SIGNAL CONTACT 1	SCM PWR RETURN 0V	BITE INPUT FROM HPA A	BITE INPUT FROM HPA B	RESV MFR-SPECIFIC 0-28V DISCRETE OUTPUT	COCKPIT VOICE CHIME SIGNAL CONTACT 2	DATA FROM SECONDARY IRS A	DATA FROM SECONDARY IRS B
3	DATA FROM CMU 1 A	DATA FROM CMU 1 B	COCKPIT VOICE CALL LIGHT OUTPUT 1	SDU DATA TO SCM A	SPARE DISCRETE OUTPUT	SPARE DISCRETE INPUT	SPARE	COCKPIT VOICE CALL LIGHT OUTPUT 2	DATA FROM CMU 2 A	DATA FROM CMU 2 B
4	COCKPIT AUDIO INPUT 1 HIGH	COCKPIT AUDIO INPUT 1 LOW	COCKPIT VOICE MIC ON INPUT 1	SDU DATA TO SCM B	SPARE DISCRETE OUTPUT	SPARE DISCRETE INPUT	SPARE	COCKPIT VOICE MIC ON INPUT 2	COCKPIT AUDIO INPUT 2 HIGH	COCKPIT AUDIO INPUT 2 LOW
5	COCKPIT AUDIO OUTPUT 1 HIGH	COCKPIT AUDIO OUTPUT 1 LOW	COCKPIT VOICE GO AHEAD CHIME RESET 1	SCM DATA TO SDU A	SPARE DISCRETE OUTPUT	SPARE DISCRETE INPUT	SPARE ARINC 429 OUTPUT A	SPARE ARINC 429 OUTPUT B	COCKPIT AUDIO OUTPUT 2 HIGH	COCKPIT AUDIO OUTPUT 2 LOW
6	SPARE DISCRETE INPUT	SPARE DISCRETE INPUT	SPARE DISCRETE INPUT	SCM DATA TO SDU B	ETHERNET 5 FROM SDU TO USER +	ETHERNET 5 FROM SDU TO USER -	SPARE ARINC 429 INPUT A	SPARE ARINC 429 INPUT B	DATA FROM GNSS TO SDU A	DATA FROM GNSS TO SDU B
7	AES ID INPUT A	AES ID INPUT B	FLIGHT DECK DATA LOAD	WOW INPUT 1	ETHERNET 5 FROM USER TO SDU +	ETHERNET 5 FROM USER TO SDU -	SPARE ARINC 429 OUTPUT A	SPARE ARINC 429 OUTPUT B	DATA FROM CMU 1 & 2 A	DATA FROM CMU 1 & 2 B
8	DATA FROM CFDS A	DATA FROM CFDS B	BITE INPUT TOP/PORT BSU/ANT A	BITE INPUT TOP/PORT BSU/ANT B	DATA LOADER LINK A	TX MUTE INPUT	BITE INPUT STBD BSU A	BITE INPUT STBD BSU B	DATA TO CFDS A	DATA TO CFDS B
9	FROM AIRBORNE DATA LOADER A	FROM AIRBORNE DATA LOADER B	CROSSTALK FROM OTHER SDU A	CROSSTALK FROM OTHER SDU B	DUAL SYSTEM SELECT DISCRETE I/O	DUAL SYSTEM DISABLE DISCRETE I/O	CROSSTALK TO OTHER SDU A	CROSSTALK TO OTHER SDU B	TO AIRBORNE DATA LOADER A	TO AIRBORNE DATA LOADER B
10	DATA FROM TCP 3 A	DATA FROM TCP 3 B	⊗	⊗	LGA LNA ON/OFF CONTROL	BITE INPUT FROM LGA LNA	⊗	⊗	DATA TO TCP 1, 2, 3 A	DATA TO TCP 1, 2, 3 B
11	⊗	⊗	CABIN CEPT-E1 DATA OUTPUT A	CABIN CEPT-E1 DATA OUTPUT B	SERVICE AVAILABILITY DISCRETE 1	SERVICE AVAILABILITY DISCRETE 2	CABIN CEPT-E1 DATA INPUT A	CABIN CEPT-E1 DATA INPUT B	⊗	⊗
12	1T: 1 ETHERNET 3 FROM SDU TO USER +	1T: 2 ETHERNET 3 FROM USER TO SDU +			SERVICE AVAILABILITY DISCRETE 3	SERVICE AVAILABILITY DISCRETE 4	2T: 2 ETHERNET 4 FROM USER TO SDU +	2T: 3 ETHERNET 4 FROM SDU TO USER -		
13					SERVICE AVAILABILITY DISCRETE 5	SERVICE AVAILABILITY DISCRETE 6				
14	1T: 4 ETHERNET 3 FROM USER TO SDU -	1T: 3 ETHERNET 3 FROM SDU TO USER -			SERVICE AVAILABILITY DISCRETE 7	SERVICE AVAILABILITY DISCRETE 8	2T: 1 ETHERNET 4 FROM SDU TO USER +	2T: 4 ETHERNET 4 FROM USER TO SDU -		
15					SERVICE AVAILABILITY DISCRETE 9	SERVICE AVAILABILITY DISCRETE 10				

2 N/C	9 (N/C)	8 (N/C)	1 115V COLD	
4 N/C	11 (N/C)	10 (N/C)	3 CHASSIS GROUND	
	12 (N/C)			
7 RF RX	5 115V HOT		6 N/C	

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Figure 4-8. (Sheet 7 of 9) Aspire 400 - Electrical Drawings

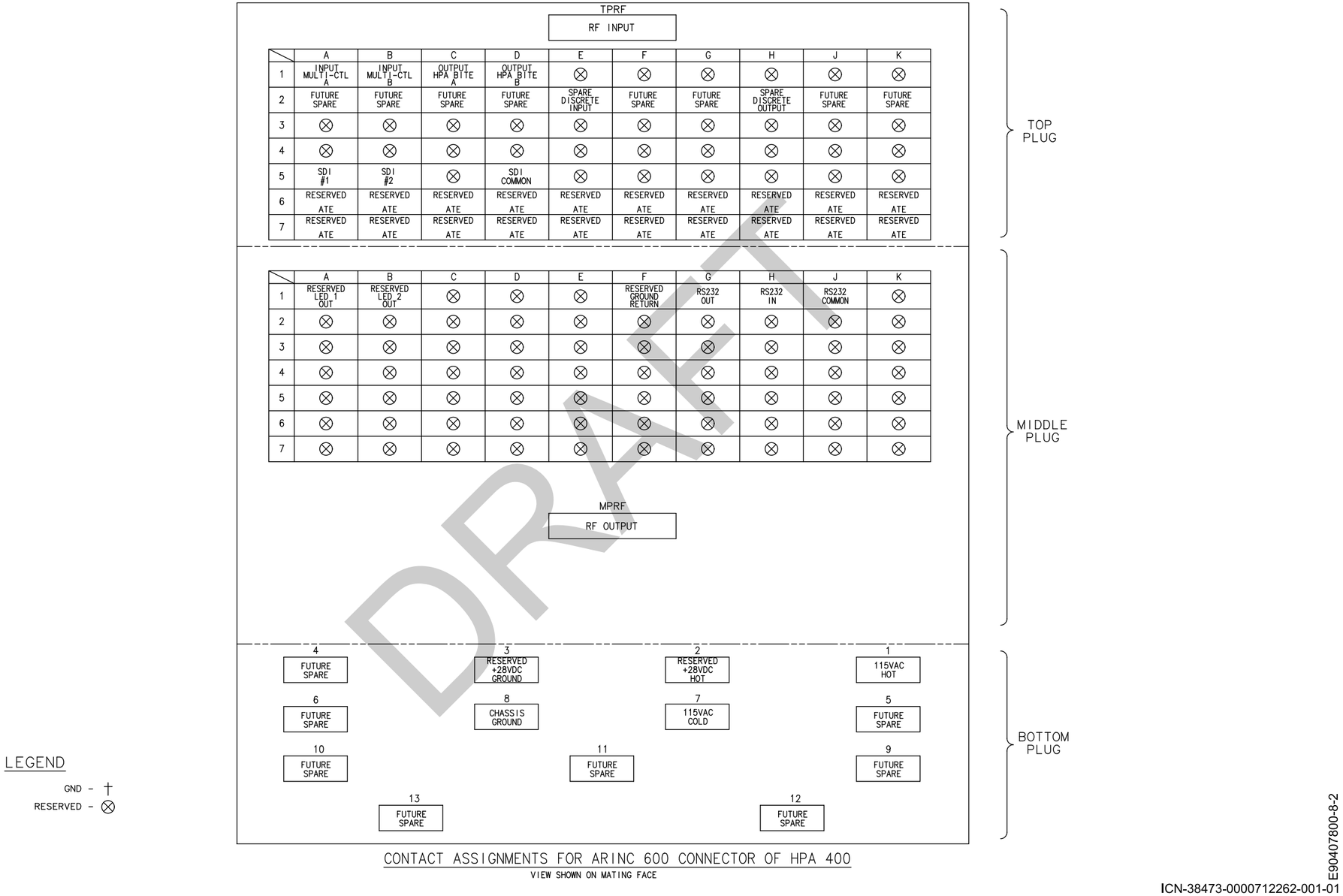
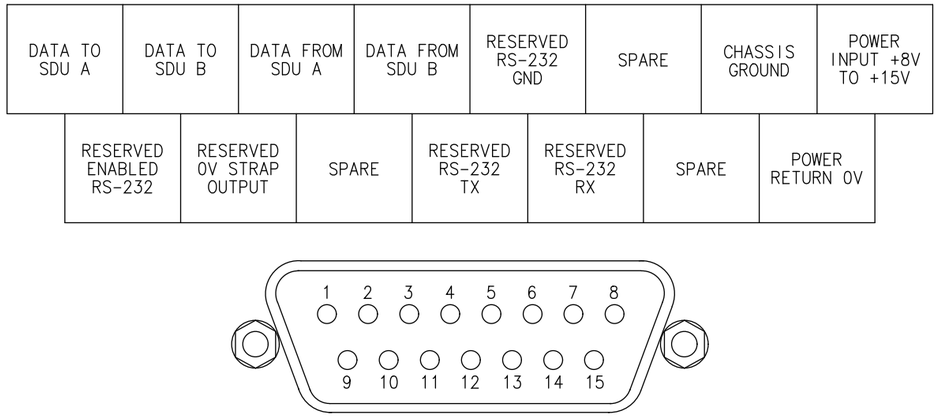


Figure 4-8. (Sheet 8 of 9) Aspire 400 - Electrical Drawings

SDU CONFIGURATION MODULE CONNECTOR LAYOUT
SCM CONNECTOR IS A 15 PIN D-TYPE MALE



1- DATA TO SDU A (RS-422)
2- DATA TO SDU B (RS-422)
3- DATA FROM SDU A (RS-422)
4- DATA FROM SDU B (RS-422)
5- NOT CONNECTED
6- SPARE
7- CHASSIS GROUND
8- POWER INPUT
9- NOT CONNECTED
10- NOT CONNECTED
11- SPARE
12- NOT CONNECTED
13- NOT CONNECTED
14- SPARE
15- POWER RETURN

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Figure 4-8. (Sheet 9 of 9) Aspire 400 - Electrical Drawings

7. Power Conditioning Characteristics

A. Secondary Power Monitoring and Control

(1) All secondary power rails are monitored for in-tolerance/in-alarm assessment.

(2) The power supply design implements overload protection measures to mitigate harm to primary supply or internal failure. Overload protection schemes such as clamping, current limiting, current foldback or other methods are deployed as deemed necessary. The power supply design should consider evaluation assessment of protection measures for determination of in- tolerance/in-alarm status.

(3) On detection of the occurrence of a monitored condition exceeding its alarm threshold the HPA identifies the offending sensor as "in alarm" and record that event to the fault log (L2=04) with status as Active.

(4) A monitored power supply metric established as "in alarm" relinquishes that status on the occurrence of transition to in-tolerance condition and record that event by setting the corresponding event in the fault log status as Inactive.

(5) For the current ARINC-429 label 350 HPA Maintenance word reporting interval the following applies:

(a) When the voltage/current sensors persist in an alarm state greater than 500ms then the "Internal Power Supply" status is reported as "Power Fail" and the SSM is set as FW in the ARINC-429 label 350 HPA Maintenance word.

(b) When the voltage/current sensors persist in an alarm free state greater than 500ms then the "Internal Power Supply" status is reported as "Power OK" in the ARINC-429 label 350 HPA Maintenance word.

(c) When the voltage/current sensors persist in an alarm state less than 500ms then the "Internal Power Supply" status remains the same as the status reported in the previous ARINC-429 label 350 HPA Maintenance word.

(6) The PSU provides a hardware derived "Power Good" status indicator when the secondary power rails of the power supply is operating within specification.

(7) The power supply design implements current limiting on secondary rails with the capability of over-current sense and restart hysteresis reaction.

(8) The HPA provides overcurrent limiting protection to no more than 1.5 times the full load capability. The design considers timed electronic circuit breaker features and active current limiting with foldback features.

(9) Hardware implemented thermal failsafe switches is used for survival purposes.

(10) The design integrates software initiated survival features to protect from over-temperature conditions by mitigating power consumption when the temperature exceeds severe limits.

(11) The design initiates survival features to protect from over-temperature conditions by disabling primary power when the temperature exceeds critical limits.

(12) Secondary power utilization is designed to be robust against latch-up or other unexpected behaviors.

(13) Considerations to holding processors in reset during power-On or last gasp is given to assure controlled restart.

B. Hold-Up Capacity / Power Interruption

(1) The PSU function provides a hardware indication to the Control Processor of "Power Interruption" on the occurrence of end of transparency time.

(2) The HPA is functionally transparent to a power interrupt of at least 10 ms (transparency time) target 30 ms. Where power interruption is defined as primary power not being sensed within the range suitable for conversion purposes.

(3) The HPA has at least 300 ms of power interruption power supply hold-up capacity that is capable of sustaining at least all secondary functionality and intercommunication throughout that duration.

(4) When the transparency time has elapsed, the Control Processor may evoke power conservation measures by disabling the PA function until such time as the PSU provides notification to the Control Processor that recovery of primary power has occurred.

(5) If power conservation is implemented in response to a power interruption requiring the PA function to be disabled then the inhibition of "power interruption exceeding the transparency time" is identified while power conservation remains in force.

(6) When primary power restoration occur while power conservation is in effect, the software:

(a) Writes a momentary power interruption event to the Event Record.

(b) Terminates power conservation.

(c) Clears the reset reason register of any pre-emptive "Hold-Up capacity depleted" status.

(7) When primary power restoration occur before the hold-up capacity is exhausted then full hardware capability reestablishes for the Operating State within 50 ms from the restoration of normal operating voltage.

NOTE: Allocation is for GaN sequencing of drain voltage. Allocation does not include regeneration time of hold-up capacity that continues after return to service exists. Allocation assumes a power supply architecture that permits immediate secondary generation from primary input power.

(8) When primary power restoration occur before the hold-up capacity is exhausted then full restoration of hold-up capacity is established within 250 ms from the restoration of normal operating voltage.

(9) For power interruption periods greater than the hold-up capacity the HPA may shut down if necessary.

(10) Prior to electing to shut down the HPA for interruption greater than the hold-up capacity the software latches the reset reason register to identify "Hold-Up capacity depleted". This may be done pre- emptively when entering power conservation.

SECTION 5 – SOFTWARE CONFIGURATION

1. Overview: (TASK 23-15-49)

A. Software Part Numbers

(1) SATCOM Products are identified by the software part numbers indicated in the following table:

Table 5-1. Software Part Numbers

SATCOM Product	Software Part Number
SDU	EMG33-L011-0101
SCM	Not Applicable
HPA	Not Applicable

B. Software

(1) The SDU software is non-partitioned and is developed to Design Assurance Level D based on the failure classification provided in the FHA/PSSA. It contains COTS software, and uses Object Orientated methodologies. SE Linux provides part of security domain segregation.

(2) The SDU application software is on-wing data loadable, and is configured by parameter data items.

C. Aspire 400 Licensing

(1) Some ORT configurable features require the installation of a license to activate. These licenses are stored on the SCM either by Honeywell or by the Customer using a license entry feature accessed by the Maintenance Web GUI, which also reports which licenses are present. The licenses map directly to an ORT selection and thus the ORT files fully define the SDU configuration. Cockpit licensed features are permanent, however cabin licenses may have expiry dates.

(2) The presence of necessary licensing is only checked during on-ground power up, and never during flight even if repowered. If a necessary license is missing, the SDU enters the Safe Mode until either the license is loaded or the ORT configuration is changed to selections that do not require licensing.

D. Aspire 400 Configuration

(1) The Aspire 400 functionalities are enabled/disabled and customized by a combination of hardware discrete interfaces, and parameter data items within Owner Requirement Table (ORT) Secure and User files. The SDU manages all hardware discrete and parameter data item configuration for the SATCOM system.

(2) Installation options (for example: which ARINC 429 interfaces are in use and the expected labels, and SATCOM LRUs present) are contained in the Secure ORT file. User configurations of preferences that are not related to the installation (e.g. telephone numbers) are typically in the User ORT files, however in some cases they are in the secure file.

(3) Secure and User ORTs can be field loaded into the SCM via the Aspire 400 SDU using the ARINC 615A [ID1] Data Loader. At power up the SDU reads the ORT files on the SCM and aligns its local working copy if necessary. This alignment will occur if the local

copy is corrupt or is a different version than the one on the SCM. The SCM files always remain as data loaded. The SDU permits some modifications to its local copy of the User ORT (for example: addition of telephone numbers), but no modification of the Secure ORT is permitted. On power up the SDU also checks the validity of each ORT file including checks on the version compatibility, completeness, compatibility of related parameters, range checking, and unsupported options. Faults are raised if ORTs are corrupted. If no valid Secure ORT is present or if the pin strapping is invalid the SDU enters a "Safe Mode" which prohibits RF transmission until the issue is resolved by data loading valid Secure ORT, or correcting the strapping.

(4) Based on the configuration the SDU sends the commands necessary to support the loaded configuration to the other SATCOM LRUs.

(5) For the Aspire 400 SDU, Secure and User ORTs will be created by using the Aspire 400 ORT Tool. This tool will take entered values for ORT parameters, check their validity and create a loadable software part that can be directly uploaded to the SDU. The tool can be configured to permit the creation of User and Secure ORTs, or only User ORTs. The tool flags if any selected features require licensing. The tool is qualified separately as documented in the Aspire 400 ORT tool qualification plan as per DO-330 [RD14].

(6) ORTs may be created by Honeywell or OEM customers. The tool provides for assignment of ARINC 665 [ID2] part numbers, which are under the management and control of the creator. The certification of any customer-developed secure ORT is the responsibility of the customer.

(7) The data loaded ORT files always reside within SCM. If the SDU is removed for repair the replacement SDU will align to the files in the SCM without a new data load being required. Thus, it is not necessary to preserve the work copy of the ORT files within the SDU when returned from repair.

2. Certification Basis

A. TCCA CAN-TSO Applicability

(1) Honeywell uses the TCCA's Transport Canada Civil Aviation (CAN-TSO) program [RD5], outlined in Title 14 CFR Part 21, Subpart O [RD6], as a means to obtain certification for the Aspire 400. The TCCA Technical Standard Order (CAN-TSO) [RD5] and associated MOPS define the regulatory requirements and performance listed in Table 5-2.

Table 5-2. TCCA CAN-TSOs for the Aspire 400

CAN-TSO Number	CAN-TSO Title	MOPS	Aspire 400 Function
CAN-TSO-C159d [RD8]	Next Generation Satellite Systems (NGSS) Equipment	DO-262D [RD12] (1)	SATVOICE & SATDATA

NOTE: Deviation listed to correct DO-262D [RD12] to DO-262D [RD15].

(2) The CAN-TSO submittals are itemized in Table 5-3:

Table 5-3. CAN-TSO submittals

CAN-TSO Submittals	Class or Subclass	Applicable Aspire 400 LRUs
Initial Major	AES6F subclass	SDU, SCM, HPA
Follow-on Major (after AES6F approved)	AES7F	SDU, SCM, HPA

3. Deviations with ARINC 781-7

A. General

(1) The ACD processor provides a Watchdog 'keep alive' signal within 1.2 s ± 0.2 s.

NOTE: HW watchdog triggers if it does not receive a periodic 'keep alive' signal' within 1.6 s± 0.2 s from software running on the ACD Processor.

(2) If POST is interrupted by a power failure longer than the transparency period and for sufficient time to cause brownout, the SDU restarts POST once power is restored.

(3) When a Secure ORT file is not present, the following values are used for the default start-up ACD interface configuration:

(a) Ethernet port 3 configuration

1 If the SDU is strapped as SDU1, then Set the Ethernet port 3 configuration as follows:

a Enabled: 100 Base-T / Full Duplex

b Speed: Automatically negotiated

c Address: 172.30.3.11

d Gateway Address: 172.30.3.1

e Network Mask: 255.255.255.0

2 If the SDU is strapped as SDU2, then set the Ethernet port 3 configuration as follows:

a Enabled: 100 Base-T / Full Duplex

b Speed: Automatically negotiated

c Address: 172.30.3.12

d Gateway Address: 172.30.3.1

e Network Mask: 255.255.255.0

(4) The SDU performs an Air/Ground status determination.

(5) On application start-up, the SDU determines which of the following caused the SDU to startup:

(a) Power Cycle.

1 External Reset Discrete asserted for greater than 0.5 seconds.

2 SW triggered BITE recovery,

3 SW triggered mode dependent (data load programming NVM variable set, restricted test mode entry).

4 Watchdog restart.

NOTE: The startup cause is memorized in the Historical Logs and used to determine further startup behavior.

5 The SDU performs a Normal-Switching-On for the following startup causes:

6 Hardware indicated Long Power Cycle when aircraft is on-ground (> approximately 5 seconds).

7 External Reset Discrete asserted on ground for greater than 0.5 seconds.

NOTE: Requirements for specific SDU behavior during Normal-Switching-On can be found in subsequent requirements where the term Normal-Switching-On has been used.

8 The SDU performs a Rapid-Switching-On for the following startup causes:

a Hardware indicated Short Power Cycle when aircraft is on-ground (<= approximately 5 seconds).

b Power Cycle when aircraft is in-flight.

c Software triggered BITE recovery Reset.

d Hardware indicated Watchdog Reset.

e External Reset Discrete asserted in flight for greater than 0.5 seconds.

NOTE: Requirements for specific SDU behavior during Rapid-Switching-On can be found in subsequent requirements where the term Rapid-Switching-On has been used.

(6) On start-up, the ACD:

(a) Validates:

1 Strapping.

2 ACD software validation.

3 Operationally critical ACD non-volatile memory.

(b) Verifies the presence and correct functionality of the security smart card.

(c) Validates FPGA operation.

(7) On completion of power-on boot, the ACD validates startup domain segregation by confirming each Atheros switch configuration aligns to the disable state.

(8) The ACD does not release the APP and CC from reset until each Atheros switch configuration check successfully passes.

(9) On start-up, the ACD tests the operation of the cooling fan if the temperature exceeds 0° C (32°F) and ensure the fan can operate if needed to provide cooling during normal SDU operation.

(10) During "Normal Switching-On", the ACD POST and Commanded Self-Test enable the Maintenance RS-232 serial port with the following characteristics:

(a) The baud rate is 115200 baud.

(b) The number of data bits is 8 bits.

(c) The number of stop bits is 1 bit.

(d) The parity is None.

(e) The flow control is None.

(11) During "Normal Switching-On", the ACD POST and Commanded Self-Test de-assert the Dual System Select (DSS) discrete.

(12) If SDU startup is due to automatic reset for "data load programming NVM variable set" the SDU enters Data Loading Mode.

(13) The SDU transmits within 40 seconds of powering on the following labels:

(a) CFDS Label 350.

NOTE: This does not indicate self-test is completed. However, the SSM fields need to indicate self-test if POST has not completed. When SSM fields indicate self-test, the data is assumed to have no validity.

4. SDU Application Startup and Test

A. SDU Equipment Configuration

(1) With the exception of Boot Stage 1 errors, the SDU tolerates single bit errors of the Non-Volatile Memory used to store program and data structures that are critical to the operation of the system function.

NOTE: The functions considered critical to the system are the Channel Card Side A and the ACD Processor which are used to provide the SBB Safety Services.

B. Validation

(1) During SDU Application Start-up and Test, the CC verifies the presence and correct functionality of the USIM in the SCM.

NOTE: POST will not complete if the SCM does not reach operating temperature.

(a) The ACD:

1 Performs AISD and PIESD User ORT validation

2 Merges the SDU User ORT domain validation results.

(b) The SDU:

1 Performs APP and CC software validation

2 Validates operationally critical APP and CC non-volatile memory

3 Performs ACD, AISD, and PIESD Secure ORT content validation

4 Merges the SDU Secure ORT domain validation results

5 Performs licensing validation to determine if all licenses that are required to enable ORT selected features are valid in the SCM

6 Validates the AP processor PIES/AIS security segmentation.

(2) An ORT file is considered valid if:

(a) The file checksum is correct.

(b) The file part number and version are compatible with the SDU Application Software.

(3) At application startup the SDU confirms the validity and synchronization between SCM and SDU Secure ORTs as outlined below:

(a) SCM/SDU secure ORT files are valid and identical (Normal Operation)

(b) SCM/SDU Secure ORT files are valid/different which overwrites SDU ORT with SCM -> Normal Operation, do not raise any failures.

(c) SCM secure ORT is Valid while SDU secure ORT is invalid:

1 Overwrite SDU ORT with SCM values:

a Normal Operation if repaired.

b Raise failure.

(d) Only local SDU copy is valid, use SDU copy, raise failure, Continue Operation.

(e) Both ORT copies are invalid, raise failure.

(4) At application startup the SDU confirms the validity and synchronization between SCM and SDU User ORTs as outlined below:

(a) SCM/SDU ORT files are valid and identical (Normal Operation)

(b) SCM/SDU ORT files are valid, but the local SDU ORT has been user modified, do not raise any failures. Normal Operation using local SDU values.

(c) SCM/SDU ORT files are valid, but the files are different and the difference was not caused by user modification of the local SDU ORT, do not raise any failures. Overwrite SDU ORT with SCM.

(d) Only SCM User ORT is valid while SDU User ORT is invalid, Overwrite SDU ORT with SCM. Normal Operation.

(e) Only local SDU ORT valid, raise failure. Normal Operation.

(f) SDU/SCM ORT both invalid, raise failure.

NOTE: The local SDU copy can be modified by the user to reflect his preferences. The SCM copy always remains as data loaded, to allow reverting to its settings.

(5) The SDU validates its ORT content by checking:

(a) parameters within valid range

(b) cross parameter consistency

(c) completeness (all necessary parameters present).

(6) The ACD considers a license active if:

(a) The last stored Network Date is present is before the end date.

(b) If no stored Network Date is present, the aircraft provided date is prior to the end date.

NOTE: Permanent licenses will have an infinite end date.

(7) The SDU is not required to adopt a Secure ORT that changes after application startup.

(8) During a Rapid-Switching-On, the ACD bypasses ORT content and license validation if the validation passed since the last "Normal Switching-On".

(9) During Normal-Switching-On or Commanded Self-Test, the SDU attempts the repair of corrupted software images that are on any of the following:

(a) ACD

(b) CC Side A

(c) CC Side B.

(10) During POST and Commanded Self-Test, the ACD provides the APP the following:

(a) Enabled / disabled configuration of AISD

(b) Enabled / disabled configuration of PIESD

(c) Commands the APP into power-save mode.

C. SBB Timing Mode Due to Change in Nav. Info. Source

(1) The ACD configures the SDU Aero Class Timing Mode based on the navigation interface enabled on start-up.

(2) On loss of navigation with GPS accuracy, the ACD does not need to reconfigure the SDU to "Aero Class Timing Mode No GPS".

D. Data Matrix Encoding

(1) The SDU nameplate with permanent information includes a 26x26 module UII Static Data Matrix with a module size of at least 0.010 inches (0.254 mm) using ISO 15434 syntax with the following encoding:

(a) [)>RS 12_{GS} CAG X_{GS} PNO Y_{GS} SEQ Z_{RSEoT}

1 With the following human readable data identifier and associated data:

a CAG X: The numeric CAGE code of the Design Authority

b PNO Y: The model- specific Original Part Number (PNO), and is between 1 and 15 characters in length

c SEQ Z: The sequential numeric serial number (SEQ) with no leading zeros, prefixes or suffixes that is unique to the PNO and is between 1 and 13 digits in length.

(2) The SDU shows modification status using a separate label with the title Modifications that shows a minimum of 10 mod dots.

E. AAP V2 Protocol

(1) The following functions are provided via the AAPv2 protocol:

(a) Log on

(b) Log off

(c) Keep alive

(d) Ping response

(e) Traffic test

(f) Invalid message handling

(g) Single block ACARS transfer

(h) Multi block ACARS transfer

(i) ATN/OSI message transfer.

(2) The ACD ADGW uses the ICAO address for AAP addressing.

(3) When the SDU receives an AAP test message, the ACD:

(a) Sends a test Acknowledgment if the message was valid.

(b) Responds with a Message NACK if the message was invalid.

F. Air to Ground

(1) AAP messages sent to the ground are time-stamped with UTC time synchronized over the SBB air/ground link.

(2) The ACD ADGW populates all Air-to-Ground AAP messages with the current spot beam ID.

(3) When the ORT enables SBB safety location reporting, the ACD populates current location information in every Air-to-Ground AAP message including the following as available:

(a) Current latitude and longitude

(b) Altitude

(c) True Heading

(d) Ground speed

(e) Source of the position data

(f) Location timestamp indicating time of location data retrieval

(g) Vertical rate.

G. Ground to Air

(1) The ACD discards AAP variable parameters received from the GDGW that are unknown or not applicable to the supported services and treats the remainder of the message as valid.

(2) When the SDU receives a message from the GDGW containing:

(a) Invalid indication (e.g. incorrect ICAO)

OR

(b) Out of bounds parameter.

(3) The ACD:

(a) Discards the message

(b) NAK the message indicating invalid message.

H. Security Gateway Functions (SecGW)

(1) The air security gateway parameters (timers, counters) are downloaded through the VPN using HTTP GET and persist in the AES for use with next VPN setup.

I. PKI Certificate Check

(1) The ACD ASGW obtains the Safety channel authentication information from the safety USIM.

(2) The ACD ASGW verifies:

(a) Presence

(b) Correct functionality.

(3) Of the security SmartCard during:

(a) Normal-Switching-On

(b) Commanded self-test.

(4) The ACD ASGW:

(a) Obtains the latest Certificate Revocation List and ground certificates by issuing an over the air HTTP GET to the PKI proxy server

(b) Checks the validity of the aircraft stored on the security SmartCard.

(5) At minimum for any of the following:

(a) Normal-Switching-On

(b) Air/Ground status changes from in-air to on-ground and current CRL expired

(c) Reset of the The air-ground VPN occurs for any reason.

(6) If unable to receive the Certificate Revocation List from the ground based PKI server, the ACD ASGW uses the last received valid list for the purposes of logging on to a GSGW.

(7) The ACD does not provide a PKI Certificate expiry warning as expired Certificates are handled automatically over-the-satellite.

J. PKI Certificate Request

(1) If the aircraft certificate on the Smart Card is detected to be:

(a) Absent (aircraft enrolment)

OR

(b) Within the expiration window defined in ORT

OR

(c) Expired.

(2) The AES:

(a) Posts the Certificate Signing Request (CSR) to the PKI proxy server defined in ORT using an over the air HTTP POST

(b) Attempts to retrieve the required certificate using over the air HTTP GET to the server

(c) Stores new certificate in the smart card.

K. Safety Voice Services

(1) ACD PBX function connects aircraft users with the Ground Safety voice network, which is independent from the Ground ACARS gateway. Voice services are provided over circuit switched and packet switched voice services. The underlying services are not expected to be tariffed differently, and the service in use for a given call is largely transparent to the user.

(2) The implementation of safety voice has been aligned as much as possible to the classic safety voice model and supports the same number of priority levels. The following guidance is provided in DO-262 as to the intended use for the priority levels:

(a) Distress 1 (High)

(b) Air Traffic Service 2

(c) Airline Operational control 3

(d) Airline Admin Control 4

(e) Passenger Communications 5 (Low).

(3) The network algorithm for allocating the CS voice channel and the VOIP voice channel to the two highest priority calls is based on preferring the CS service when possible.

(4) The ACD PBX supports up to two simultaneous Priority service voice calls on the following ORT enabled User interfaces:

(a) 4-wire1

(b) 4-wire2.

(5) Using the following INMARSAT Safety SBB services:

(a) One over circuit switch using a AMBE +2 vocoder;

(b) One over multi-voice VOIP using a G729A vocoder.

(6) Any PS or CS Ground-to-Air Call with priority other than public is routed to the 4-wire interfaces.

(7) Initiation or termination of a call on any of the satellite facing or aircraft facing interfaces does not impair a pre-existing call that is not terminated.

(8) When the channel card indicates the safety voice AES activation is not "logged on" for reasons other than the SATCOM system equipment failures, the ACD configures ARINC label 270 (SDU to MU/CMU) to the following:

(a) Set bit 13 to "1"

ELSE

(b) Set bit 13 to "0"

5. AISD / PIESD Processor (APP)

A. APP Boot

(1) The APP stage1 (mini) boot code activates:

(a) The primary stage2 boot image

OR

(b) The secondary stage2 boot image if the primary stage2 boot image is non-functional.

B. APP Control

(1) The AP processor provides both the AIS and the PIES domains. Each domain operates independent of the other, but only the AISD is classed as a trusted domain in the APP since it does not interact with the cabin. The AISD is tasked with performing all APP configuration based on information from the ACD, including any configuration associated

with the PIESD. The AISD also provides the vehicle for data exchange between the ACD and the PIESD.

C. APP Application Start up

(1) The APP reports results of AIS / PIES segregation testing to the ACD on ACD command.

(2) When queried by the ACD, the APP:

(a) Validates the ORT parameters received from the ACD and provides the validation results to the ACD;

(b) Indicates all feature licensing codes required by the APP ORT configuration;

(c) Reports its POST results to the ACD when requested by the ACD.

(3) The AISD configures its Ethernet port based on the following ORT settings received from ACD:

(a) IP address

(b) Subnet mask

(c) Port Speed.

(4) If the PIESD is ORT enabled, the AISD configures the PIESD Ethernet port based on the following ORT settings received from ACD:

(a) IP address

(b) Subnet mask

(c) Port Speed.

(5) The AISD configures the cabin Ethernet ports to always support Auto MDIX.

D. Post Start-up APP ACD Interaction

(1) The APP responds to ACD commands to:

(a) Perform integrated built-in tests and reports the results;

(b) Perform data loading and report the data loading status.

6. Aircraft Information Services Domain (AISD)

A. INMARSAT SBB Aircraft Information Services

(1) The AISD provides the following PDP context management interfaces:

(a) Auto Background (Multiple User with Single Background):

1 This option provides an external AIS client interface when a single static PDP context (background context) is specified. The context is automatically initiated by the ACD. The option has two mutually exclusive forms:

a Static IP - The SDU provides one IP address to the connected user terminal equipment.

b DHCP Host - Enables a DHCP server (which provides dynamically assigned IP addresses to connected user equipment), also enables a NAT service to forward user traffic over a shared connection.

(b) Dynamic (Multiple User with Multiple Background):

1 This option provides an external AIS client interface when one or more dynamic PDP contexts are specified and PPPoE is the means of accessing the SATCOM network. The contexts are initiated by the ACD in response to user requests collected from the AISD.

2 The following control functions are provided:

a PPPoE with AC Service names - to set up primary contexts

b Out of band control via AT command - to set up secondary or modify primary contexts

c SNMP - to communicate operational and link status.

3 When notified by the ACD that a requested context is available, the AISD:

a Supports the ORT defined PDP contexts

b Connects the requesting IP or PPPoE session to the associated Tunneled PPP Transport over Ethernet (TPToE).

(2) The AISD provides the user interface with the gateway IP address based on the ORT as follows:

(a) Using the fixed host IP address and subnet mask provided by the ORT;

AND

(b) When AISD is ORT-configured as a DHCP server it also does the following:

1 Assigns user IP address derived from the base address and range provided by the ORT;

2 Employs a NAT service to forward user traffic over the air.

B. Satellite Handover

(1) The AISD retains active contexts during handover and handles orderly termination of any pending or established data sessions in the event of a handover failure.

(2) If a new data session is initiated during handover, the AISD accepts the data session, but postpones the data session initiation until:

(a) Safety Logon is achieved at the 1st satellite link Network Logon attempt, the AISD initiates the data session.

(b) Safety Logon is failed at the 1st satellite link Network Logon attempt, the AISD rejects the data session.

(c) The user terminates the data session, the AISD terminates the data session.

C. Auto Background

(1) When configured to Auto Background based on the ACD ORT, the AISD:

(a) Responds to an ACD context query by requesting a background context;

(b) Supports username and password transmission to the ground via the AISD default service string;

(c) Does not initiate PPPoE service handling;

(d) Disables AT handler port 22222.

D. AIS Domain SNMP and MIB

(1) The scope of the AISD .arincSwift MIB only applies to AISD services. The ARINC 781 MIB supported in this domain has been pruned to align.

(2) The AISD does not support any Channel Card Side A or B reset via the AISD .arincSwift MIB.

(3) The AISD provides access to the AISD .arincSwift MIB using SNMP version 2c.

(4) The SDU always disables IP forwarding functionality in the .ip branch of the AISD MIB.

(5) The AISD .arincSwift MIB entry point is 1.3.4.1.4.1.13712.781.

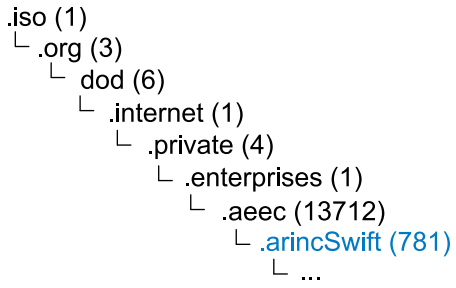

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Figure 5-1. AISD ARINC Swift MIB Entry Point

(6) The AISD .arincSwift MIB supports the following mandatory branches shown in Table 5-4:

(a) .asVersion(1);

(b) .asLinks (2);

(c) .asSystem(3);

(d) .asUnits(4);

(e) .asUserDefArea(5).

Table 5-4. ARINC Swift MIB Branches

Description	Branch(es)			Value
.asVersion Branch[1]	.asvMajor(1)			1
	.asvMinor(2)			0
.asLinks Branch	AISD .asLinks(2) branch	.aslServices(1)	.aslsNumbers(1)	N/A
			.aslsTable(2)	
		.aslInfos(2)		
.asSystem Branch	.assConfig(1)	.asscTrapDest(1);		N/A
		.asscTrapDestPort(2).		
	.assInfos(2)	.assiHealthStatus(1);		
		.assiVendor(2);		
		.assiHWPN(3);		
		.assiSerialNumber(4);		
		.assiHWFunction(5);		
		.assiShortName(6).		
	.assTraps(3)	.asstHealthStatusTrap(1)		
		.asstLinkStatusTrap(2)		
		.asstLinkBeamIDTrap(3)		
		.asstServiceAvailabilityTrap(4)		
		.asstLinkInsertedTrap(5)		
		.asstLinkRemovedTrap(6)		
		.asstSatHandoverPending(7)		
	.assSelfTestAvailable(4)			False
	.assSelfTest(5)			N/A

Table 5-4. ARINC Swift MIB Branches (Continued)

Description	Branch(es)	Value
.asUnits Branch[2]	N/A	N/A
.asUserDefArea Branch[2]	N/A	N/A

NOTES:

1 MIB objects are stored in the application software by object ID numbers. For these objects the object name in the published MIB disagrees with the object name in ARINC 781-6. This requirement has been written to align with the ARINC 781-6.

2 MIB is terminated to indicate no support for this branch by not responding to user queries.

7. Passenger Information and Entertainment Services Domain (PIESD)

A. Inmarsat PIESD Services

(1) When configured by the ORT, the PIESD provides the following non-safety services:

(a) SBB packet switched service: Provides up to 11 PDP contexts that can be partitioned between data only and combined data / multi-voice services. For applications supporting multi-voice service, two contexts are allocated to voice while the rest are allocated to data.

(b) SBB circuit switched service: Provides 1 channel of AMBE+2.

(c) SNMP and MIB: Supports SNMP version 2c.

(d) AT commands: Provides both in-band support via the PPP service tag as well as out of band via an AT Side Handler.

(2) When the PIESD performs a "PIESD polite disconnect", it:

(a) Terminates all PDP Contexts on Channel Card Side B;

(b) Informs PPPoE PDP Contexts consumers of the termination;

(c) Terminates cabin side voice calls.

B. Cabin Router Functions

(1) The PIESD provides the following PDP context management interfaces:

(a) Auto Background (Multiple User with Single Background)

1 This option provides an external PIESD client interface when a single static PDP context (background context) is specified. The context is automatically initiated by the PIESD. The option has two mutually exclusive forms:

a Static IP: The IP address is defined by the ORT.

b DHCP Host: Used when a DHCP server is the means of accessing the SATCOM system so NAT is used to determine the IP address.

(b) Dynamic (Multiple User with Multiple Background)

1 This option provides an external PIESD client interface when one or more dynamic PDP contexts are specified and PPPoE is the means of accessing the SATCOM network. The following control functions are provided:

a PPPoE with AC Service names: To set up primary contexts

b Out of band control via AT command: To set up secondary or modify primary contexts

c SNMP: To communicate operational and link status PPPoE, can support either:

(1) Up to 11 PDP contexts, (actual number defined by ORT) for allocation as either:

– Data only;

– A combination of data and voice. When voice service is supported, two of the ORT number of PDP contexts are dedicated to voice, (one for control, the other for the service).

(2) INMARSAT X-Stream service. The Inmarsat X-stream service provides for streaming rates above 128 kbps. The rate provided will be dependent on elevation angle, link conditions and availability. The service must be explicitly enabled via ORT. The X-Stream streaming service cannot be mixed with SBB streaming contexts or voice.

d The PIESD:

(1) Connects PPPoE sessions to the associated Tunneled PPP Transport over Ethernet (TPToE);

(2) Prevents leakage of data between sessions by mapping individual user traffic to individual sessions.

e The PIESD provides the user interface with the gateway IP address based on the ORT as follows:

(1) Using the fixed host IP address and subnet mask provided by the ORT;

(2) When PIESD is ORT-configured as a DHCP server it also does the following:

– Assigns user IP address derived from the base address and range provided by the ORT;

– Employ a NAT service to forward user traffic over the air.

2 The PIESD sends session control commands to the CC via BCL over Ethernet.

C. Satellite Handover

(1) If a new cabin data session is requested during handover, the PIESD accepts the data session but postpones the data session initiation to the ground until:

(a) Non-safety Logon is achieved at the 1st satellite link Network Logon attempt:

1 The PIESD initiates the data session.

2 Non-safety Logon is failed at the 1st satellite link Network Logon attempt:

a The PIESD rejects the data session.

(b) The user terminates the data session:

1 The PIESD terminates the data session.

D. Auto Background

(1) When configured to Auto Background based on the ACD ORT, the PIESD:

(a) Automatically connects to the ACD indicated TPToE tunnel (corresponding to the single background context);

(b) Supports username and password transmission to the ground via the PIESD default service string;

(c) Does not initiate PPPoE service handling;

(d) Disables AT handler TCP port 22222.

E. Dynamic

(1) When configured to provide X-Stream service, the PIESD supports a single context of X-Stream streaming packet service over the non-safety SBB channel.

NOTE: The X-Stream streaming service cannot be mixed with SBB streaming contexts or voice.

(2) When configured to Dynamic based on the ACD ORT, the PIESD supports the following named PPPoE services:

(a) SBB: Background

(b) SBB: STREAM8K

(c) SBB: STREAM16K

(d) SBB: STREAM32K

(e) SBB: STREAM64K

(f) SBB: STREAM128K

(g) SBB: XSTREAM

(h) SBB: 'AT Command String'

NOTE: The 'AT Command String' in the service name will be one of the following:

1 SBB: AT+CGEQREQ

2 SBB: AT+CGEQMIN

3 SBB: AT+CGEQNEG and provides the access of additional rates.

F. PPPoE / PPP Protocol

(1) When configured to Dynamic based on the ACD ORT, the PIESD:

(a) Permits primary context initiation and termination using PPPoE with the following features supported:

1 PADI (PPPoE active discovery initiation)

2 PADO (PPPoE active discovery offer)

3 PADR (PPPoE active discovery request)

4 PADT (PPPoE active discovery termination)

5 Error codes in PPPoE error tag.

(b) Transfers username and password when the service user name and password are provided at the user interface via the following:

1 The service name in the PPP initiation

2 PAP in PPP negotiation.

(c) Supports the PADT error codes associated with 3GPP 24.008 Appendix G: Mobility Management;

(d) Supports the PADT error codes associated with 3GPP 24.008 Appendix I: GPRS Session Management.

G. AT Handler

(1) Only a subset of AT commands is required at the User interface to provide for the provisioning of Virtual Contexts and for querying the system. For security purposes, it is important not to allow a user control line access to commands that apply system wide or that could change the operation of contexts that are owned by other users. Provisioning of system wide selectable parameters is through the ORT.

(2) If ORT configured to Dynamic, the PIESD:

(a) Enables AT handler support via TCP port 22222.

ELSE

(b) Disables AT handler support via TCP port 22222.

H. User AT Handler Supported Commands

(1) The PIESD responds to the following General AT commands:

(a) +CGMI (Request Manufacturer Identification) read mode returns the general Aviation Equipment ID Company.

(b) +CGMM (Request Model Identification) read mode returns the SDU Name.

(c) +CGMR (Request Revision Identification) read mode returns the SDU HW Part Number.

(d) +CGSN (Request Product Serial Number Identification) read mode returns the SDU Serial Number.

(e) +CIMI (Request International Mobile Subscriber Identity) read mode returns the non-safety channel IMSI.

(2) The PIESD supports the following Mobile Termination Control and Status AT commands:

(a) +CLAC which lists all available AT commands available to the user in the current state.

(3) The PIESD relays to the Channel Card the following PDP Context AT commands:

(a) +CGDCONT PDP Context AT command with primary context set up by PPPoE - only for syntax query and state query; cannot be set by user.

(b) +CGDSCONT (Defines a Secondary PDP Context),

(c) +CGTFT (Defines a TFT for a Secondary PDP Context),

(d) +CGEQREQ (Defines the requested 3G QoS Profile for a Primary PDP Context),

(e) +CGEQMIN (Defines the minimum acceptable 3G QoS Profile for a PDP Context),

(f) +CGEQNEG (Negotiated 3G Quality of Service Profile - PDP Context) read only returns the Negotiated 3G QoS Profile for the specified Primary PDP Context,

(g) +CGACT (PDP Context Activates or Deactivates) Activates or deactivates contexts, (deactivate a primary, activate and deactivate a secondary)

(h) +CGCMOD (PDP Context Modify) Modifies a context,

(i) +CGPADDR (Show PDP Address - PDP Context) read returns a list of PDP addresses for the specified context identifiers,

(j) +CGEREP (Sets Packet Domain Event Reporting preference for whole channel card).

(4) The PIESD relays to the Channel Card the following Additional BGAN AT command:

(a) _ITFT (UT Traffic Flow Template - PDP Context): Specifies a traffic filter for a TFT for a secondary context.

(5) The PIESD supports the following ITU-T V.25TER Generic AT Control command:

(a) _IPDPS (Binding AT session to PPPoE - PDP Context): Binds a control line session to a PPPoE context.

I. User Not Supported AT Handler commands

(1) The PIESD rejects the following PDP Context AT command if it is received at the PIESD user interface of the SDU:

(a) +CGATT (PS Attach or Detach) Read indicates if Mobile terminal is attached from Packet domain service.

(2) The PIESD rejects the following ITU-T-V.25TER Generic AT commands:

(a) +GMI (Request Manufacturer Identification) read mode returns the General Aviation Equipment ID Company.

(b) +GMM (Request Model Identification) read mode returns the SDU Name.

(c) +GMR (Request Revision Identification) read mode returns the SDU HW Part Number.

(d) +GSN (Request Product Serial Number Identification) read mode returns the SDU Serial Number.

(3) The PIESD rejects the following SMS Service - General Configuration AT commands if they are received at the PIESD user interface of the SDU:

(a) +CSMS (Select Message Service)

(b) +CPMS (Preferred Message Storage)

(c) +CMGF (Message Format).

NOTE: These AT commands are mandated in A781 but are not supported since SBB does not support SMS.

(4) The PIESD rejects the following SMS Service - General Configuration AT response when it is received is +CMS ERROR (Message Service Failure Result Code)

(5) The PIESD rejects the following Message Configuration AT commands if they are received at the PIESD user interface of the SDU:

(a) +CSCA (Service Centre Address)

(b) +CSMP (Set Text Mode Parameters)

(c) +CSAS (Save Settings)

(d) +CRES (Restore Settings).

(6) The PIESD rejects the following Message Receiving and Reading AT commands if they are received at the PIESD user interface of the SDU:

(a) +CNMI (New Message indications to TE)

(b) +CMGL (List Messages)

(c) +CMGR (Read Messages).

(7) The PIESD rejects the following Message Sending and Writing AT commands if they are received at the PIESD user interface of the SDU:

(a) +CMGS (Send Message)

(b) +CMSS (Send Message from Storage)

(c) +CMGW (Write Message to Memory)

(d) +CMGD (Delete Message).

(8) The PIESD rejects the following General AT commands if they are received at the PIESD user interface of the SDU:

(a) +CSCS (Select TE Character Set)

(b) +CMUX (Multiplexing mode).

(9) The PIESD rejects the following ITU-T V.25TER TE-TA Interface AT commands if they are received at the PIESD user interface of the SDU:

(a) S0 (Number of rings until auto answer)

(b) S2 (Escape character)

(c) S3 (Command line termination character)

(d) S4 (Response formatting character)

(e) S5 (Command Line editing character)

(f) S6 (Pause before blind dialing)

(g) S7 (Connection completion timeout)

(h) S8 (Comma dial modifier time)

(i) S10 (Automatic disconnect delay)

(j) S12 (Escape guard time - 0.02s)

(k) A (Go on-line in answer mode)

(l) D (Go on-line in originating mode)

(m) E (Echo (SBB Channel card scope, available on a per context basis))

(n) H (Hang up)

(o) O (Return to on-Line state)

(p) P (Set Pulse dial)

(q) Q (Result code display)

(r) S (S registers)

(s) T (Set tone dial)

(t) V (select word or digit result code. SBB Channel card scope - available on a per context basis)

(u) X (Select result codes)

(v) &C (Select DCD options)

(w) &D (Select DTR options)

(x) &V (View configuration profile)

(y) &W (Store current configuration profile)

(z) = (Write to selected S register)

(aa) ? (Read from selected S register)

(ab) +IPR (Fixed TE data rate)

(ac) +ICF (TE-TA character framing)

(ad) +IFC (TE-TA local flow control)

(ae) +ILRR (Report local TE-TA data rate).

(10) PIESD rejects the following ITU-T V.25TER Generic TA Control AT commands if they are received at the PIESD user interface of the SDU:

(a) &F (Fetch factory defaults)

(b) I (Request Manufacturer Information)

(c) +GOI (Request ISO Identification)

(d) +GCAP (Request Overall Capabilities of TA)

(e) +GCI (Selects the country of installation).

(11) The PIESD rejects the following Call Control Commands and Methods if they are received at the PIESD user interface of the SDU:

(a) D (ITU-TV.25terdial command. Command is Context specific and called automatically)

(b) +CHUP (Hangup Call)

(c) +CEER (Extended error report)

(d) +CSDF (Settings Date format)

(e) +CSIL (Silence Command)

(f) +CSTF (Settings time format).

(12) The PIESD rejects the following Network Service Related AT commands if they are received at the PIESD user interface of the SDU:

(a) +CNUM (Subscriber Number)

(b) +CREG (Network registration)

(c) +COPS (In set mode selects or deregisters PLMN network. Impacts other users.)

(d) +CLCK (Facility Lock)

(e) +CPWD (Change Password)

(f) +CLIP (Calling Line Identification presentation)

(g) +CLIR (Calling line identification restriction)

(h) +COLP (Connected line identification presentation)

(i) +CDIP (Called line identification presentation)

(j) +CCUG (Closed User Group)

(k) +CCFC (Call Forwarding Number and conditions)

(l) +CCWA (Call waiting)

(m) +CHLD (Call related supplementary services)

(n) +CTFR (Call deflection)

(o) +CUSD (Unstructured Supplementary services)

(p) +CAOC (Advice of Charge)

(q) +CSSN (Supplementary service notifications)

(r) +CLCC (List current calls - not context specific, and will return other users' calls)

(s) +CAEMLPP (eMLPP Priority Registration and Interrogation)

(t) +CPPS (eMLPP subscriptions)

(u) +CFCS (Fast call setup conditions)

(v) +CAAP (Automatic answer for eMLPP Service).

(13) The PIESD rejects the following Mobile Termination Control and Status AT commands if they are received at the PIESD user interface of the SDU:

(a) +CPAS (Phone Activity Status)

(b) +CFUN (Set Phone Functionality)

(c) +CPIN (Enter Pin)

(d) +CBC (Battery Charge)

(e) +CSQ (Signal Quality)

(f) +CMEC (Mobile Termination control mode)

(g) +CKPD (Keypad control)

(h) +CDIS (Display Control)

(i) +CIND (Indicator Control)

(j) +CMER (Mobile Termination event reporting)

(k) +CCLK (Clock)

(l) +CSIM (Generic SIM access)

(m) +CRSM (Restricted SIM access)

(n) +CALM (Alert sound mode)

(o) +CRSL (Ringer Sound Level)

(p) +CMUT (Mute control)

(q) +CACM (Accumulated call meter)

(r) +CSVM (Set Voice Mail Number)

(s) +CMAR (Master Reset).

(14) The PIESD rejects the following Mobile Equipment Errors AT commands if they are received at the PIESD user interface of the SDU:

(a) +CMEE (Sets Error Verbosity for SBB Channel Card. Impacts other users).

(15) The PIESD rejects the following PDP Context AT commands if they are received at the PIESD user interface of the SDU:

(a) +CGQREQ (Quality of Service Profile, Requested for a Primary PDP Context)

(b) +CGQMIN (Minimum Acceptable Quality of Service Profile - PDP Context)

(c) +CGDATA (Enter Data State)

(d) +CGCLASS (GPRS Mobile Station Class)

(e) +CGREG (GPRS Network Registration Status. Impacts other users)

(f) +CGSMS (Select service for MO SMS messages).

NOTE: These commands are mandated in A781 but are not supported for reasons listed under rationale.

(16) The PIESD rejects the following Voice Control AT commands if they are received at the PIESD user interface of the SDU:

(a) +VTS (DTMF and tone generation).

(17) The PIESD rejects the following BGAN Specific AT commands if they are received at the PIESD user interface of the SDU:

(a) _IPOINT (Antenna pointing)

(b) _IGPS (GNSS Location Information)

(c) _INIS (Network Interface Status).

(18) The PIESD rejects the following Bluetooth AT commands if they are received at the PIESD user interface of the SDU:

(a) _IBLTH (Manage Bluetooth Pairing)

(b) _IBTIF (Configure U T Bluetooth Interface)

(c) _IBTINQ (Sets the Bluetooth Interface in Device Inquiry Mode).

(19) The PIESD rejects the following Additional BGAN AT commands if they are received at the PIESD user interface of the SDU:

(a) _ITEMP (UT Temperature)

(b) _ILOG (Retrieve UT log file)

(c) _ISLEEP (UT Sleep Mode Timeout)

(d) _IMETER (Call Metering)

(e) _ISIG (Signal quality indication)

(f) _IBALARM (Report the Alarm State of the Terminal)

(g) _IBNOTIFY (Control the sending of unsolicited result codes)

(h) _ICSEV (Circuit Switch Domain Event reporting ARINC 781 Attachment 5).

J. PIES AT Header Compression

(1) The PIESD enables/disables RFC 2507 IP Header Compression for each context on Channel Card B for Non-Safety data.

(2) The PIESD applies RFC 2507 header compression if any of the following conditions are true:

(a) the HCOMP parameter in +CGDCONT (PPPoE dial string) is not specified,

(b) the HCOMP parameter in +CGDSCONT (+AT side handler command) is not specified,

(c) the HCOMP parameter in +CGDCONT or +CGDSCONT is set to 1 (on manufacturer preferred compression),

(d) the HCOMP parameter in +CGDCONT or +CGDSCONT is set to 3 (RFC 2507).

(3) If the HCOMP parameter in +CGDCONT or +CGDSCONT is set to 0 (off - no compression), the PIESD does not apply RFC 2507 header compression.

(4) The PIESD rejects the context definition if any of the following conditions are true:

(a) the HCOMP parameter in +CGDCONT or +CGDSCONT is set to 2 (on - RFC1144 compression),

(b) the HCOMP parameter in +CGDCONT or +CGDSCONT is set to 4 (on- RFC3095 compression).

K. NTP

(1) If configured on by ORT, the SDU is a NTP (Network Time protocol) Master on cabin side Ethernet employing NTP v4.

L. FOIP

(1) The SDU does not provide any direct fax functionality, but can be invoked by user equipment over data links provided.

M. Cabin Voice Communications

(1) Non-safety SBB does not have priority settings for voice calls, thus PIES voice calls are all at public priority.

(2) The PIES attempts to route Air-to-Ground calls to the CS channel before using any PS channels (VoIP).

(3) CS call setup messages are sent via the serial control link between the PIESD and the Non-Safety Channel Card.

(4) If a new cabin Air to Ground call is requested during handover, the PIESD accepts the call but postpones the call initiation to the ground until:

(a) Non-safety Logon is achieved at the 1st satellite link Network Logon attempt the PIESD initiates the call.

(b) Non-safety Logon is failed at the 1st satellite link Network Logon attempt the PIESD rejects the call.

(c) The user terminates the call the PIESD terminates the call.

(5) When configured by ORT, the PIES supports voice calls on following user interfaces the Ethernet port 2 using VoIP.

(6) The PIESD supports loopback echo of voice calls on the CEPT-E1 interface.

N. Cabin VOIP

(1) When all the supported off aircraft channels are in use, the PIESD is able to communicate with at least one additional cabin side VOIP call request sufficiently to cleanly reject it.

(2) The User VoIP interface supports calls using the G.711.

(3) The PIESD supports loopback echo on the VOIP interface.

O. Receive RF Signal Selection

(1) The SDU selects the RF RX input source under software control from either the:

(a) RF RX Input

OR

(b) RF TX Output.

8. <u>Satellite Selection and Handover</u>

A. Overview:

(1) Automatic Satellite Handover controls the timing of the log-off from the current Satellite Link. The subsequent log-on behavior is determined by the satellite selection criteria.

(a) The ORT parameter "Startup Login" policy defines the algorithm initiation:

<u>1</u> Automatic log-on policy initiates both automatic selection and automatic handover algorithms when needed, without manual intervention.

<u>2</u> Manual log-on policy suspends satellite logon initiation until a user selected operation occurs via the cockpit display.

(b) Cockpit display Log-On selections:

<u>1</u> CONSTRAINED: Log-on is constrained to the cockpit display selected satellite link. Log-off occurs when manually triggered by the user or the signal is lost. No subsequent log-on will occur automatically.

<u>2</u> AUTO: on selection, activates automatic satellite selection and automatic satellite handover. The selection of the satellite link is based on the priorities specified in the ORT.

(2) To differentiate with the Classic logon definition, the SDU is considered "logged on" to Safety Services once a background context is established and the SDU safety channel is

logged onto the Ground Datalink Gateway (GDGW), e.g. the SDU has received the logon response message from the GDGW.

(3) When attempting a Network Logon, the ACD does the following:

(a) Registers on to the network

(b) PSCS Attach.

(4) When attempting a Safety Logon, the ACD does the following:

(a) Sets up a safety background PDP context

(b) Logs on to the ground data gateway (GDGW).

B. Satellite Selection

(1) When the ORT selects Manual-logon, the ACD awaits pilot's logon command before commanding the Channel Card to attempt a Network Logon.

(2) When the pilot selects Manual-logon, the ACD attempts a Network Logon using the pilot selected satellite link.

(3) Automatic satellite selection occurs under either of the following conditions:

(a) The pilot has selected Auto-logon.

(b) The ORT selects Auto-logon and no manual override (e.g. logoff) has occurred.

(4) When automatic satellite selection is active, the ACD selects from valid available satellite links based on the following ordered preference criteria:

(a) Priority of Satellite Link from the ORT

(b) Closest Satellite

(c) Sufficient EIRP towards satellite.

NOTES:

1 Satellite links are considered valid if they are present in the System Information Broadcast. The stored copy of the Satellite Table on the ACD is updated with the satellite's System Information Broadcast when new information is available.

2 Satellite links are considered unavailable for any of the following conditions:

- The elevation look angle (from horizontal) to the satellite ≤ - 4 degrees.
- All Satellite Links for that satellite have been marked as permanent or temporary failures.

(5) When automatic satellite selection is active, the ACD tells the Channel Card on which valid satellite link to attempt a Network Logon.

(6) When all the following occurs:

(a) Automatic satellite selection is active.

(7) In Standalone mode, The ACD:

(a) Repeatedly loops through valid and available satellite links in order of preference

(b) Clears the list of temporarily blacklisted satellites before restarting the loop

(c) For each valid satellite link, attempts Network Logon until Network Logon is achieved.

(8) When all the following occurs:

(a) Automatic satellite selection is active.

(b) In Dual SATCOM mode.

(c) "SATCOM Select Mode" is Auto.

(d) SDU is Active SDU.

(9) The ACD:

(a) Loops through valid and available satellite links in order of preference once each;

(b) For each valid satellite link, attempts Network Logon.

(c) If after going through entire satellite links, the Network Logon cannot be achieved:

1 De-asserts the SDU DSS.

NOTE: This will allow the Standby SDU to go to Active if it believes it can provide service, but in 20 minutes if still in coverage the preferred satellite will attempt again.

(10) The ACD holds non-safety channels (e.g. channel B of the DABC) from registering and attaching until Safety Logon is achieved.

(11) When Network Logon has been achieved, the ACD attempts a Safety Logon.

(12) When automatic satellite selection is active and the attempt to the Safety Logon fails, the ACD blacklists the satellite link (temporary or permanent based on cause code) and looks for the next available valid satellite link.

(13) When the ACD is safety logged on to the GDGW, the ACD sets bit 17 of the CMU Status Label 270 to:

(a) 0 (SATCOM logged on)

ELSE

(b) 1 (SATCOM not logged on).

(14) When a logoff is received from the pilot selection, the ACD logs-off the current satellite.

C. Satellite Handover

(1) The SDU can handover to a different satellite if a preferred satellite is available and when configured to Dual Safety SATCOM mode, it can also handover to a companion SDU if it cannot provide safety services. Refer to the Dual Safety SATCOM section for more information on handing over to a companion SDU.

(2) The SDU maintains logged on status to the GDGW while doing a handover to another satellite.

NOTE: It is expected that the PDP Context will remain active while doing the handover.

(3) If the SDU has Network Logged on using automatic satellite selection, the SDU enables automatic satellite handover.

(4) If the SDU has Network Logged on using constrained satellite selection, the SDU disables automatic satellite handover.

(5) If automatic satellite handover is activated, the SDU prohibits initiated handover for the time provided by the "non-preferred service dwell timer" (see Gateway Configuration section) on all logons except for:

(a) The initial automatic logon on power-up (ORT enabled).

(b) The initial logon after the pilot has selected Auto-logon.

(6) The SDU prohibits a handover attempt (initiated satellite link logoff) under any of the following conditions:

(a) Active cockpit call is present;

OR

(b) Active AIS Streaming Class;

OR

(c) Dwell time has not been achieved, except on initial Auto-logon.

(7) If automatic satellite handover is activated and handover is not currently prohibited, the SDU initiates a satellite link logoff when all the following occur:

(a) A candidate satellite has higher preference;

(b) There is sufficient EIRP towards that candidate satellite;

(c) The SDU has a valid spot beam map from the spot beams listed on the global beam common channel for that candidate satellite and the candidate satellite is within coverage for its current location.

(d) A candidate satellite has equal preference;

AND

(e) There is sufficient EIRP towards that candidate satellite;

AND

(f) The SDU has a valid spot beam map from the spot beams listed on the global beam common channel for that candidate satellite and the candidate satellite is within coverage for its current location;

AND

(g) That candidate satellite is closer to the AES.

(8) If automatic satellite handover is triggered, the SDU temporarily blacklists the current satellite.

(9) The ACD communicates the Satellite Handover status to the APP.

9. Safety Data Session

A. Safety Data VPN Establishment

(1) The AES only attempts to setup the VPN when:

(a) A valid Certificate Revocation List (CRL) is available;

AND

(b) Valid aircraft certificate is available;

AND

(c) At least one valid Ground Security Gateway certificate is available.

(2) There is no requirement for the ACD to take any action if its certificate appears in the Certificate Revocation List.

(3) When the safety Channel Card indicates it has successfully registered and attached to the BGAN network the ACD automatically commands the Channel Card to create an ACD context with the following properties:

(a) Using the following ORT defined Access Point Names (APN)s

(b) for the Secure Gateway

(c) for the Communication Service Provider

(d) Background with priority

(e) QoS Parameters: traffic class (Background), Maximum bit rate Upload, Maximum bit rate Download

(f) No IP Header Compression.

B. IPsec Tunnel creation

(1) When the PDP SB primary context is established, the ACD Datalink Gateway automatically:

(a) Performs DNS lookup for the ORT-defined Security Gateway Domain Name string to determine the IP address of the GSGW;

(b) Uses HTTP GET to the GSGW IP address to obtain latest certificates and CRLs;

(c) Establishes IPsec VPN with the GSGW using the IKEv2 protocol with authentication provided by the Smart Card;

(d) Through the established IPsec VPN tunnel logs on to GDGW for the ORT-defined services, using the AAPv2 protocol, then reports "Join" to the CMU for the successfully established services.

C. AAP (Safety Data Gateway) Log On

(1) When making a AAP logon request, the ACD populates one of the following logon reasons:

(a) 1st logon after Factory Settings Restart

(b) 1st logon after power up

(c) Constrained (Manual) logon

(d) Automatic logon (except 1st logon after power up)

(e) Satellite handover

(f) Logon after using a lower priority satellite link (non-preferred service) e.g. after dwell timer ac_aap_t4 expired

(g) Log on after entering SB coverage

(h) Log on after failure

(i) Log on after being logged out by GDGW.

NOTE: If multiple reasons are applicable, the first applicable one should be used.

(2) In the AAP logon request, the ACD ADGW populates the following information identifying the SATCOM configuration:

(a) The class of terminal based on ORT settings

(b) The Satellite ID

(c) SBB Type approval code retrieved from the ORT

(d) SDU HW and SW part numbers

(e) Antenna HW and SW part numbers

(f) SDU-vendor

(g) System designator (short descriptive name)

(h) Aircraft tail number

(i) Aircraft type

(j) Flight ID.

NOTE: Not all this information is available in all installations.

(3) When notified of a successful AAP login, the ACD configures the following based on the direction from the GDGW:

(a) ac_aap_t1 forward message timeout period

(b) ac_aap_t2 acknowledgement timeout period

(c) ac_aap_t3 range of randomized reconnection timer

(d) ac_aap_t4 non-preferred service timer.

(e) ac_aap_t5 IP recovery timer

(f) ac_aap_t6 DNS server check timer

(g) ac_aap_r1 keep alive retry times

(h) ac_aap_r2 max. keep alive retry attempts

(i) ac_aap_r3 max. log out retry attempts

(j) ac_aap_r4 max. Air-to-Ground message attempts

AND

(k) Stores in non-volatile memory for use in next logon.

(4) The ACD:

(a) Temporarily blacklists the GDGW.

(b) Re-attempts log on.

(5) When the ACD ADGW receives one of the following login failure response codes from the GDGW:

(a) 1001 0001 no service provider for this aircraft

(b) 1001 0010 no service provider for any aircraft

(c) 1111 1111 undefined reason

(d) Undefined code.

(6) The ACD waits until the next power cycle to attempt a re-log in after the ACD ADGW receives one of the following logon failure response codes from the GDGW:

(a) 1000 1111 Invalid parameter of undefined type

(b) 1011 0001 ICAO not authorized for safety services

(c) 1011 0010 IMSI not authorized for safety services

(d) 1011 0011 AES deactivated

(e) 1011 0100 Radius Authentication failure.

NOTE: If all requested services are rejected, this implies that safety data goes idle until power cycle, but voice, AISD, and PIESD may run.

(7) The ACD uses the following configurations sent from the ground in the AAPv2 ADGW logon-response message for ACARS messaging:

(a) ac_acr_t1 time out period for ACARS messages

(b) ac_acr_r1 Air-to-Ground retry times.

NOTE: There is no ACARS queueing in the ADGW so any new message arriving before acknowledgement of a previous message results in the discard of the previous message and any associated timers/ counters.

(8) When enabled for ATN/OSI service, the ACD uses the following configurations sent from the ground in the AAPv2 ADGW logon-response message for ATN messaging:

(a) ac_atn_t1 time out period for ATN messages

(b) ac_atn_r1 Air-to-Ground ATN retry times.

10. Aircraft Facing Voice Handling

A. 4-Wire Interface Configuration

(1) The ACD sets the Cockpit (4-Wire) output audio levels according to ORT values:

(a) Within at least the range 5 mW to 40 mW for a nominal digital voice level of - 9.8 dBm0 (-3 dB to +6 dB with respect to a level of 10 mW measured into a 600-ohm load.);

(b) Where the values provide monotonic gain control with a nominal step size of 1.5 dB.

(2) The ACD sets the side tone audio levels for the Cockpit (4-Wire) audio interfaces according to ORT values:

(a) Muted

(b) Within at least the range 0 to -12 dB with respect to the speaker output level when:

1 Speaker level 9.8 dBm0 at the A law pulse code modulation decoder

2 The microphone input level at the A law pulse code modulation encoder is also 9.8 dBm.

(c) Where the values provide monotonic gain control with a nominal step size of 3 dB.

NOTE: Thus, when the audio output is adjusted the sidetone level adjusts with it.

B. 4-wire Call States and Annunciation

(1) The ACD tracks the following call control states per 4-wire channel:

(a) NOT CONNECTED: 4-wire interface is not wired

(b) NOT READY: SDU is not yet logged on, including when a fault prevents it from logging on

(c) AVAILABLE: SDU is logged on and has an available channel ready for use

(d) CALL INIT: Call has been initiated, CCI:Make Call has been sent to call control

(e) RINGING: Call has been connected at the ground

(f) CONNECTED: Call has been answered at the ground

(g) INCOMING: Call is being announced at the SDU, but is unanswered.

(2) The following ARINC 741 options are not described in ARINC 781 and are not within scope:

(a) Multi-stroke chime

(b) Go Ahead Chime Reset (only applicable to multi-stroke chime)

(c) Flashing lights

(d) Call via ACP to a number stored in ATC call register

(e) Generation of speech messages.

(3) The ACD connects the 4-wire Audio path for the speakers for calls:

(a) From when the call is connected

(b) Until the call is terminated

NOTE: This applies to Air-to-Ground and Ground-to-Air Calls.

(4) The ACD provides a ringback tone on the initiating interface when an Air-to-Ground call is ringing.

(5) The following figure shows the call control and annunciation states for the 4-wire interfaces:

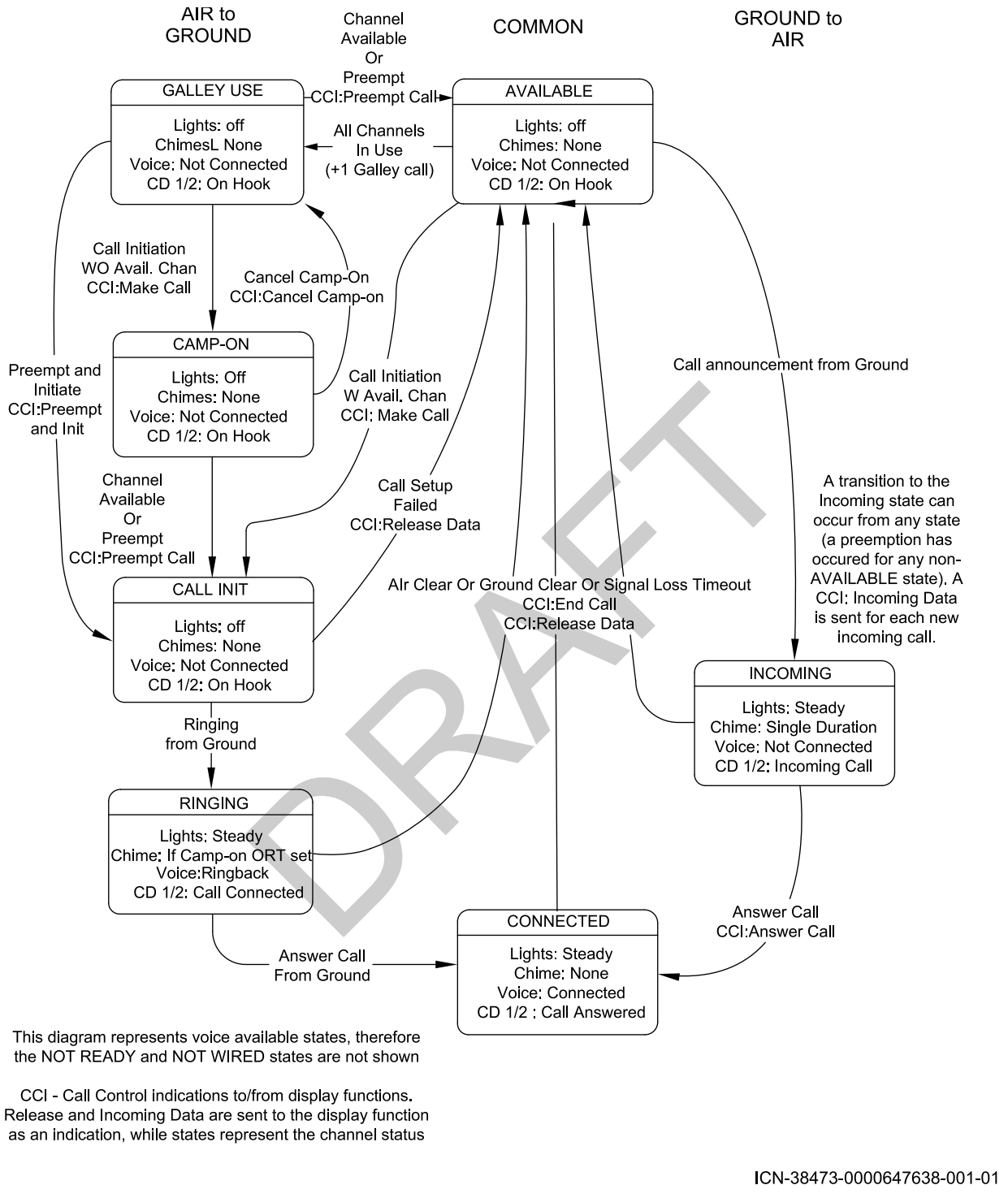


Figure 5-2. Call Annunciation State Machine

11. Device Management

A. APP Management

(1) The AIS / PIES Processor (APP) hosts the AIS and PIES domains in SELinux containers.

(2) The ACD performs APP management via a serial control path to the APP that is separate from any data paths.

(3) The ACD:

(a) Initiates all communications with the APP;

(b) Ignores unexpected communications from the APP;

(c) Ignores incorrectly formatted messages from the APP.

12. Channel Card Management

A. Channel Card Common Management Functions

(1) The ACD performs channel card management. The ACD control path to each of the Channel Card sides is a serial control link that is separate from data paths. The Serial control links are used for:

(a) Configuration

(b) Power control

(c) Cockpit context management (Side A)

(d) BITE management.

(2) Channel Card A and B are controlled independently of each other but have common control features.

NOTES:

1 There is an additional serial data path from the ACD to Side A used for voice data.

2 There is an additional serial data path from the APP to Side B used for voice data.

(3) The ACD:

(a) Performs a white list verification to drop invalid or malformed CC messages;

(b) Rates limit individual CC messages based on message specific criteria;

(c) Commands the Channel Cards to select application.

(4) The ACD processor sends the following configuration information related to Satellite operation to the Channel Cards before commanding SwiftBroadband application:

(a) UE Class

(b) IMEI software version

(c) Satellite Table

(d) Ciphering activation

(e) Maximum EIRP

(f) IP Header Compression

(g) Extended L-Band for Single Channel System.

(5) The ACD sends the following operational information to the Channel Cards:

(a) Location (latitude, longitude, altitude),

(b) UTC Time,

(c) Doppler Correction factor,

(d) Antenna Gain,

(e) Required Transmit back off.

(6) The ACD processor sends the following position information related to Satellite operation to the Channel Cards:

(a) Fix time

(b) Fix type

(c) Number of Satellites

(d) Horizontal dilution of precision (HDOP)

(e) Error Estimate

(f) Position dilution of prediction (PDOP)

(g) User equivalent range error (UERE)

(h) User range accuracy (URA).

(7) The ACD sends the following operational information to the Channel Cards BGAN Ocean Region.

(8) The ACD permits or denies the following Channel Card requests transmit power and frequency.

(9) The ACD provides access to the following channel cards spontaneous information reports:

(a) Transmit and Receive Frequencies

(b) BGAN data rate (bearer status) report

(c) PS and CS call progress and status,

(d) Progress of the automatic PLMN search

(e) Satellite selection and spot beam handover status

(f) Progress of the CS or PS register sequence.

(g) Progress of the CS or PS deregister sequence.

(h) Access Stratum Network Deregistration cause code.

(i) CBITE information.

(10) The ACD commands the Channel Cards to provide:

(a) Burst statistics.

(b) PIMBIT information.

(c) Temperature sensor data.

(d) SW version and CRC checksum.

(e) Spot beam ID for the spot beams listed on the global beam common channel.

(f) Position (latitude, longitude) of the vertices for each spot beam listed on the global beam common channel to 1-degree resolution.

(g) UTC Network time.

(h) Context IDs in use.

(i) USIM status.

(j) Stack State.

(k) PS session byte/packet counters.

(l) Demodulator signal condition.

(m) Call status reports.

B. Safety Channel Card Management (Side A)

(1) Only the ACD can request creation or deletion of PDP Contexts on the Safety Channel Card. It does so for both the contexts needed by ACD and those needed by the AISD.

(2) The SDU prevents any direct control of PDP context activation from the AIS domain. Only those contexts permitted by the Secure ORT will be activated by the ACD.

(3) Primary PDP Contexts are each mapped to its own TPTOE session (a proprietary protocol).

(4) Secondary PDP Contexts are embedded within their parent Primary PDP.

(5) Control of Circuit switched voice is over a separate Serial Voice control link.

(6) When ORT enabled, the ACD enables outbound caller ID on the Safety Channel Card.

(7) The ACD processor enables Tunneled PPP Transport over Ethernet (TPToE) on the Safety Channel Card via BCL over the serial control interface, specifying the TPToE ACD destination address.

(8) The ACD processor sends the following configuration information related to Satellite operation to the Safety Channel Card:

(a) GSM UE Access Class 14 activation

(b) Support of extended L-band.

(9) The ACD:

(a) Permits IP Header Compression on a per context basis for the AISD.

(b) Provides access to the following safety channel cards spontaneous reports the SB-Safety CS Supplementary service status.

C. Non-Safety Channel Card Management (Side B)

(1) The ACD has a serial control path to the non-safety Channel Card for:

(a) Initial configuration

(b) Bite management

(c) Transmission and RF power control.

NOTE: Specific context establishment and service configuration is under the control of the APP.

(2) During application mode and if ORT directed, the ACD holds the Non- Safety Channel Card in reset.

(3) The ACD sends an IP address to the Channel Card Side B with the following characteristics valid IP address is selected at random from private IP address range 10.0.0.0 to 10.255.255.255

(4) When ORT configured, the ACD processor sends the following configuration information to the Non-Safety Channel Card HDR Mode.

D. CFDS to SDU - Fixed Format Labels

(1) The ACD receives the following fixed format ARINC-429 Broadcast Data labels that are ORT enabled, on the "Data from CFDS" bus for logging purposes and any additional purposes as indicated, with a period of 900 ms to 1.1 s for each label:

(a) Label 125 UTC (BCD)

(b) Label 150 UTC (Binary)

(c) Label 260 Date

(d) Label 126 Flight Phase (for Air/Ground determination) with ORT determined content

(e) Labels 233-237 Flight Number

(f) Labels 301-304 A/C identification (tail number).

NOTES:

1 Absence of these labels does not prevent SDU operation.

2 Only some aircraft CFDS use Label 237 as part of the Flight Number communication.

3 Only some aircraft CFDS use Label 304 as part of the A/C IDENT communication.

E. Configuration Reporting via Transmitting Protocol Encapsulating Labels

(1) Protocol Encapsulating labels are used to exchange data between the SDU and the CFDS where the labels' content contains different content for the same label number.

(2) In order to accommodate the transmission of a record of data to the CFDS, multiple Protocol Encapsulating labels may be sent.

(3) One or more records may be sent in a block.

NOTES:

1 Where messages are to be displayed on the CFDS screen a record equates to a line and a block equates to a page and only displayable ISO 5 characters are sent.

2 Some CFDS expect records to contain all binary.

(4) When ORT selected to CFDS Type 1, the ACD transmits SATCOM LRU Configuration Display Data to the CFDS in blocks of Label 356 Configuration Block on the "Data to CFDS" interface using the following words:

(a) STX

(b) SYN

(c) Data

(d) EOT (end of block).

(5) With the following constraints:

(a) A block comprises one page of display data

(b) A record uses the associated authorized set of ISO 5 characters

NOTE: There is no specific inter-word timing for transmission of the 429 words of a block to the CFDS.

F. Type 1 Configuration Report Format

(1) The SDU reports the SW part number as "Invalid" under the following circumstances:

(a) Either primary or secondary images are corrupt

(b) The active software part does not match the expected configuration.

(2) The ACD reports the Software Part Number, Hardware Part Number and Serial Number as "Not Available" for any external LRU (except the SCM) when the SDU has not yet received configuration data from the LRU

(3) The ACD reports the following information provided by the SCM as "NOT AVAILABLE," if it cannot be read from the SCM:

(a) SCM Hardware Part Number

(b) SCM Serial Number

(c) IMSI Channel 1

(d) IMSI Channel 2.

(4) When ORT configured to CFDS Type 1, the ACD provides the Software Location ID and software location description based on ORT setting and configuration strapping in the configuration report to the CFDS.

(5) When ORT configured to CFDS type 1, the Configuration Data, sent from the SDU to the CFDS, is populated with the configuration information of each component, as shown in Figure 5-3:

```
   1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34
 1 SDU  HARDWARE
 2 HARDWARE  PART  NUMBER:
 3 XXXXXXXXXX X X X X X
 4 SERIAL  NUMBER:
 5 XXXXXXXXXX X X X X X

   SDU  SOFTWARE
 6 SOFTWARE LOCATION  ID:
 7 XXXXXXXXX
 8 SOFTWARE  LOCATION  ID  DESCRIPTION:
 9 XXXXXXXX
10 SOFTWARE  PART  NUMBER  OPS:
11 XXXXXXXXXX X X X X X

   ORT
12 SOFTWARE  PART  NUMBER  SECURE:
13 XXXXXXXXXX X X X X X
14 SOFTWARE  PART  NUMBER  USER:
15 XXXXXXXXXX X X X X X
16
17 SCM
18 HW  PN:  XXX X X X X X X X X
19 SN:  XXXXXX X X X X X X X X X
20 IMSI 1
21 XXXXXXX  XX X X X X X X X X
   IMSI 2
   XXXXXXX  XX X X X X X X X X
22
23 HPA
24 HARDWARE  PART  NUMBER:
25 XXXXXXXXXX X X X X X
26 SERIAL  NUMBER:
27 XXXXXXXXXX X X X X X
28
29 ANTENNA
30 HARDWARE  PART  NUMBER:
31 XXXXXXXXXX X X X X X
32 SERIAL  NUMBER:
33 XXXXXXXXXX X X X X X
```


ICN-38473-0000647674-001-01

Figure 5-3. Configuration Report Format

NOTE: Each X and grey shading indicates a live data field.

G. Receiving Command Label

(1) Protocol Encapsulating labels are used to exchange data between the CFDS and the SDU where the labels' content contains different content for the same label number.

(2) Only protocol words are sent in this direction (i.e. no records and blocks).

(3) For CFDS Type 1, the ACD receives the following label from the "Data from CFDS" interface with a period of 108 ms to 1.1 s:

(a) Label 227 CFDS to SDU Command Summary Word

NOTE: This word is transmitted even when there is no requested command function.

(4) When ORT selected to CFDS Type 1, the ACD processes Label 227 commands on the ARINC 429 "Data from CFDS" interface:

(a) No Request

(b) Commanded Self-Test

(c) Request Configuration

(d) New Flight Leg

(e) Previous Page

(f) Next Page.

(5) The ACD only responds once in response to configuration data requests received within a 4 second period.

(6) The SDU sends the configuration data page in response to a "Next Page" command or a "Last Page" command.

H. CFDS Commanded Self-Test

(1) When ORT selected to CFDS Type 1, the SDU supports Self-test commanded by Label 227 (with equipment id 041H) command word, including:

(a) Commanded self-test preconditions are satisfied;

(b) Reporting via Label 350 to the CFDS if Self-test is enabled or disabled;

(c) Triggering Self-test of SATCOM member system LRUs (e.g. Antenna, Power Amplifier);

(2) The ACD transmits applicable CFDS fault summary words (Minimum of Label 350) within 12 seconds of receiving the Self-test command.

I. Shop Fault Reporting

(1) There is no requirement to support Shop Fault Reporting for CFDS Type 1.

13. Navigation System Interfaces

A. IRS1 Interface ("Data from Primary IRS/GNSS")

(1) The ACD sets the ARINC 429 interface, "Data from Primary IRS/GNSS", to high-speed operation.

(2) The ACD processes the following labels received on the "Data from Primary IRS/GNSS" interface as specified by the ORT:

Table 5-5. Data from Primary IRS/GNSS

Label	Description	Period
Label 076	GNSS Altitude	200 ms to 1.2 s
Label 101	GNSS HDOP	200 ms to 1.2 s
Label 103	True Track Angle GNSS	200 ms to 1.2 s
Label 110	Latitude GNSS	200 ms to 1.2 s
Label 111	Longitude GNSS	200 ms to 1.2 s
Label 112	Ground Speed GNSS	200 ms to 1.2 s
Label 132	True Heading, Hybrid	25 ms to 50 ms
Label 137	True Track Angle GNSS	25 ms to 50 ms
Label 150	UTC (BNR)	200 ms to 1.2 s
Label 175	Ground Speed GNSS, Hybrid	25 ms to 50 ms
Label 254	Latitude GNSS, Hybrid	50 ms to 100 ms
Label 255	Longitude GNSS, Hybrid	50 ms to 100 ms
Label 260	Date	200 ms to 1.2 s
Label 261	Hybrid Altitude MSL	25 ms to 50 ms
Label 262	Hybrid Height Above Ellipsoid (HAE)	50 ms to 100 ms
Label 273	GNSS Sensor Status	200 ms to 1.2 s
Label 310	Present Position - Latitude	100 ms to 200 ms
Label 311	Present Position - Longitude	100 ms to 200 ms
Label 312	Ground Speed	25 ms to 50 ms
Label 313	Track Angle - True	25 ms to 50 ms
Label 314	True Heading, Inertial	25 ms to 50 ms
Label 324	Pitch Angle	25 ms to 50 ms
Label 325	Roll Angle	25 ms to 50 ms
Label 361	Inertial Altitude	31 ms to 65 ms
Label 370	GNSS Height (HAE)	200 ms to 1.2 s
Label 377	Equipment Identifier	900 ms to 1.1 s

B. IRS2 Interface ("Data from Secondary IRS/GNSS")

(1) The ACD sets the ARINC 429 interface, "Data from Secondary IRS/GNSS", to high-speed operation, if activated by the ORT setting.

(2) The ACD processes the following labels received on the "Data from Secondary IRS/GNSS" interface as specified by the ORT:

Table 5-6. Data from Secondary IRS/GNSS

Label	Description	Period
Label 076	GNSS Altitude	200 ms to 1.2 s
Label 101	GNSS HDOP	200 ms to 1.2 s
Label 103	True Track Angle GNSS	200 ms to 1.2 s
Label 110	Latitude GNSS	200 ms to 1.2 s
Label 111	Longitude GNSS	200 ms to 1.2 s
Label 112	Ground Speed GNSS	200 ms to 1.2 s
Label 132	True Heading, Hybrid	25 ms to 50 ms
Label 137	True Track Angle GNSS, Hybrid	25 ms to 50 ms
Label 175	Ground Speed GNSS, Hybrid	25 ms to 50 ms
Label 254	Latitude GNSS, Hybrid	50 ms to 100 ms
Label 255	Longitude GNSS, Hybrid	50 ms to 100 ms
Label 261	Hybrid Altitude MSL	25 ms to 50 ms
Label 262	Hybrid Height Above Ellipsoid (HAE)	50 ms to 100 ms
Label 273	GNSS Sensor Status	200 ms to 1.2 s
Label 310	Present Position - Latitude	100 ms to 200 ms
Label 311	Present Position - Longitude	100 ms to 200 ms
Label 312	Ground Speed	25 ms to 50 ms
Label 313	Track Angle - True	25 ms to 50 ms
Label 314	True Heading, Inertial	25 ms to 50 ms
Label 324	Pitch Angle	25 ms to 50 ms
Label 325	Roll Angle	25 ms to 50 ms
Label 361	Inertial Altitude	31 ms to 65 ms
Label 370	GNSS Height (HAE)	200 ms to 1.2 s
Label 377	Equipment Identifier	900 ms to 1.1 s

C. GNSS Interface ("Data from GNSS to SDU")

(1) The ACD sets the ARINC 429 interface, "Data from GNSS to SDU", to high- speed operation, if activated by the ORT setting.

(2) The ACD processes the following labels received on the "Data from GNSS to SDU" interface as specified by the ORT:

Table 5-7. Data from GNSS to SDU

Label	Description	Period
Label 076	GNSS Altitude	200 ms to 1.2 s
Label 101	GNSS HDOP	200 ms to 1.2 s
Label 103	True Track Angle GNSS	200 ms to 1.2 s
Label 110	Latitude GNSS	200 ms to 1.2 s
Label 111	Longitude GNSS	200 ms to 1.2 s
Label 112	Ground Speed GNSS	200 ms to 1.2 s
Label 150	UTC (BNR)	200 ms to 1.2 s
Label 260	Date	200 ms to 1.2 s
Label 273	GNSS Sensor Status	200 ms to 1.2 s
Label 370	GNSS Height (HAE)	200 ms to 1.2 s
Label 377	Equipment Identifier	900 ms to 1.1 s

D. AES ID Interface

(1) The ACD enables and sets the speed for the "AES ID Input" of the ARINC 429 interface, as indicated by ORT setting.

(2) The ACD processes the following labels received on the "AES ID Input" interface as specified by the ORT:

Table 5-8. AES ID Input

Label	Description	Period
Label 147	Air/Ground word	N/A
Label 275	ICAO address part 1	500 ms to 1.5 s
Label 276	ICAO address part 2	500 ms to 1.5 s
Label 310	Present Position - Latitude	100 ms to 200 ms
Label 311	Present Position - Longitude	100 ms to 200 ms
Label 377	Equipment Identifier	900 ms to 1.1 s

(3) The ACD receives label 050 Coded Discrete Command Word, on the AES ID Interface, when enabled by ORT setting.

Table 5-9. Label 050 Coded Discrete Command Word

Bit Range	Field (Discrete Format)	Valid Values or Ranges
1-8	Label	172o
9-16	SDU SAL	307o – SDU #1 173o – SDU #2
17	Classic Aero (Satelite System Type)	0
18	BOPv3 capability	0 – Not capable 1 – Capable (When ATN Test Feature enabled)
19	Iridium	0
20-29	Spare	0
30-31	SSM (Note bits 30-31)	0 00 – Normal Operation 10 – Functional Test
32	Parity	Odd

(4) When the AES ID Bus is ORT enabled, there is no requirement for the SDU to process Labels 150 (Time) and 260 (Date).

E. MCDU Interface

(1) The ACD:

(a) Sets each of the three ARINC 429 MCDU receive interfaces, "Data from MCDU 1", "Data from MCDU 2", and "Data from MCDU 3", which are activated by the ORT to low speed.

(b) Disables each of the three ARINC 429 MCDU receive interfaces, "Data from MCDU 1", "Data from MCDU 2", and/or "Data from MCDU 3", when disabled by the ORT.

(c) Transmits on the ARINC 429 "Data to MCDU 1,2,3" interface using the following System Address Labels in Subsystem Identifier Messages:

1 307o when configured as SDU 1; OR

2 173o when configured as SDU 2.

NOTE: The SDU number is determined by configuration pin #5 (config. input pin TP04D).

(2) The ACD transmits the Equipment ID Label 377 on the ARINC 429 "Data to MCDU 1,2,3" interface with a period of 1 s ± 100 ms and an SDU Equipment ID encoded as 41 BCD.

Table 5-10. Label 377 Subsystem Identifier

Bit Range	Field Name (Discrete Format)	Valid Values/Ranges
Bit Range	Field (Discrete Format)	Valid Values or Ranges
1-8	1-8	377o
9-10	SDI	01b – SDU 1

Table 5-10. Label 377 Subsystem Identifier (Continued)

Bit Range	Field Name (Discrete Format)	Valid Values/Ranges
		10b – SDU 2
11-14	Equipment ID Code (LSD)	0000b = 0x1
15-18	Equipment ID Code	0100b = 0x4
19-22	Equipment ID Code (MSD)	0000b = 0x0
23-29	Spare	0
30-31	SSM (Notes bits 30-31)	00 – Normal Operation 10 – Functional Test
32	Parity	Odd

(3) The ACD transmits the following Label 172o Subsystem Identifier Word on the "Data to MCDU 1,2,3" interface, with a period of 1 s +/- 500 ms:

Table 5-11. Subsystem Identifier Word

Bit Range	Field Name (Discrete Format)	Valid Values/Ranges
1-8	Label	172 (octal)
9-16	Subsystem SAL	307 = SDU 1 173 = SDU 2
17	Master/Slave Dual SATCOM	1 = Master or Standalone 0 = Slave
18-29	18-29	0
30-31	SSM (Note bits 30-31)	00 – Normal Operation 10 – Functional Test
32	Parity	Odd

NOTE: this label encodes the SDU SAL although it is not required by the WSCI Protocol its presence is specifically permitted for possible use.

(4) The ACD permits Label 172o on any of the ORT activated A429 MCDU receive interfaces. No action is taken on the content of this label. This label may or may not be present on all A429 receive interfaces.

F. MCDU ARINC 739 Variant

(1) If ORT indicates ARINC 739 MCDU, the ACD enables and setS the speed of the "Data to MCDU 1,2,3" interface based on the ORT.

G. SDU to MCDU - ARINC 739 Transmit Labels

(1) If ORT configured for the following:

(a) Aircraft Directed Dual Safety SATCOM

(2) The ACD transmits on the ARINC 429 "Data to MCDU 1,2,3" interface, Label 274 SATCOM OCA Discrete Data Definition, at a period of 100 ms ±10 ms.

Table 5-12. SATCOM OCA Discrete Data Definition

Bit Range	Field Name (Discrete Format)	Valid Values/Ranges
8-1	Label	274o
274o	SDI	01b = SDU 1 10b = SDU 2
11	Network Coverage Status	0 = Network coverage Not Expected 1 = Network Coverage Expected
12	SAT OCA Command Status	0 = Not Available 1 = Available
13	SAT Manual Logoff	0 = False 1 = True
29-14	Reserved	0
31-30	SSM	00b = Normal Operation 10b = Functional Test
32	Parity	Odd

(3) If ORT configured for Aircraft Directed Dual Safety SATCOM, the ACD transmits on the ARINC 429 "Data to MCDU 1,2,3" interface, Label 270 SDU to TCP "ACARS" Status Word, at a period of 1 second ±100 ms.

NOTE: The content of this label is the same as the Label 270 SDU to "ACARS" MU/CMU Status Word sent to the CMU; however, this does not imply any synchronization with transmission of Label 270 on the CMU bus.

(4) If ORT configured for Aircraft Directed Dual Safety SATCOM, the ACD sets the bits of Label 270 SDU to TCP "ACARS" Status Word to be identical to those of Label 270 SDU to "ACARS" MU/CMU Status Word.

H. MCDU to SDU - ARINC 739 Receive Labels

(1) If ORT configured for the following:

(a) Aircraft Directed Dual Safety SATCOM

(2) The ACD receives on any of the ORT activated A429 MCDU receive interfaces, Label 272 SATCOM Operational Mode Command word, at a period of 1s ±100 ms.

Table 5-13. SATCOM Operational Mode Command Word (OCA to SDU)

Bit Range	Field Name (Discrete Format)	Valid Values/Ranges
8-1	Label	272 (octal)
10-9	SDI	01b if strapped to SDU 1 10b if strapped to SDU 2

Table 5-13. SATCOM Operational Mode Command Word (OCA to SDU) (Continued)

Bit Range	Field Name (Discrete Format)	Valid Values/Ranges
12-11	Operational Mode Command	00 = Not Defined 01 = SDU1 Active & SDU2 Standby 10 = SDU2 Active & SDU1 Standby 11 = Not Defined
29-13	Reserved	0 = Not Defined
31-30	SSM	00 = Normal Operation 01 = No Computed Data 10 = Functional Test 11 = Failure Warning
32	Parity	Odd

NOTE: Although present, no action is taken on the SDI value.

(3) When all the following is true:

(a) ORT configured for Aircraft Directed Dual Safety SATCOM.

AND

(b) ARINC 429 MCDU 1 receive interface is enabled.

AND

(c) SSM of Label 272 is set to normal (NO) or functional test (FT) on ARINC 429 "Data from MCDU 1" interface for at least 3 consecutives labels.

(4) The ACD uses Label 272 received from ARINC 429 "Data from MCDU 1" interface.

(5) When all the following is true:

(a) ORT configured for Aircraft Directed Dual Safety SATCOM.

AND

(b) ARINC 429 MCDU 2 receive interface is enabled.

AND

(c) SSM of Label 272 is NOT set to either normal (NO) or functional test (FT) on ARINC 429 "Data from MCDU 1" interface for at least 3 consecutives labels.

AND

(d) SSM of Label 272 is set to normal (NO) or functional test (FT) on ARINC 429 "Data from MCDU 2" interface for at least 3 consecutives labels.

(6) The ACD uses Label 272 received from ARINC 429 "Data from MCDU 2" interface.

(7) When all the following are true:

(a) ORT configured for Aircraft Directed Dual Safety SATCOM.

AND

(b) ARINC 429 MCDU 3 receive interface is enabled.

AND

(c) SSM of Label 272 is NOT set to either normal (NO) or functional test (FT) on ARINC 429 “Data from MCDU 1” interface for at least 3 consecutive labels.

AND

(d) SSM of Label 272 is NOT set to either normal (NO) or functional test (FT) on ARINC 429 “Data from MCDU 2” interface for at least 3 consecutive labels.

AND

(e) SSM of Label 272 is set to normal (NO) or functional test (FT) on ARINC 429 "Data from MCDU 3" interface for at least 3 consecutive labels.

(8) The ACD uses Label 272 received from ARINC 429 "Data from MCDU 3" interface.

(9) The ACD executes on the content of Label 272 on the selected ARINC 429 MCDU interface only when the SSM is set to normal (NO) for at least 3 consecutive labels.

(10) Although Label 350o Maintenance Word #1 may be present with a period of 50 ms to 250 ms on receive MCDU interfaces there is no necessity to process it.

I. MCDU ARINC 739 Protocol

(1) Intercommunication between the SDU and MCDUs specified below is consistent with the messaging protocol of ARINC 739 section 3.7. ARINC 739A does not add any changes that impact the protocol to the SDU.

(2) If ORT indicates MCDU, the ARINC 739 protocol for pilot display and control information transfer is supported using:

(a) The appropriate SDU 1 or SDU 2 SAL for received words;

(b) Transmitted words to any of the following MALs of 220o, 221o, 222o, and 230o.

NOTES:

1 MCDU protocol timing is not bus speed dependent.

2 This implementation does not fix a MAL to a physical MCDU interface.

(3) If the ORT indicates a MCDU controller type, upon receipt of a push button word with a push button code of 6F, the ACD acknowledges the word with a period of less than 200 ms.

J. CMU Interfaces

(1) This section describes Intercommunication between the SDU and Communications Management Units (CMUs) on ARINC 429 data busses.

(2) ARINC 741 P2 section 4.7 details the expected SATCOM behavior with ARINC 758 CMUs which support ACARS on Williamsburg V1. This protocol is also documented in ARINC 429 Part 3 section 2.0.

(3) Additional/different requirements are expected to emerge as this interface is modified to handle ATN as well as ACARS on Williamsburg V3. Williamsburg V3 is documented in ARINC 429 P3 section 3.

(4) If the "Data from CMU 2" interface is enabled by ORT, the ACD selects the active CMU from two CMUs in an Active/Standby configuration.

(5) If the "Data from CMU 2" interface is not enabled by ORT, the ACD interacts with CMU1 as a single active CMU.

(6) The ACD sets the same ORT defined speed for all the following busses:

(a) The "Data to CMU 1 & 2" transmit interface;

(b) The "Data from CMU 1" receive interface; and

(c) The ORT enabled "Data from CMU 2" receive interface.

K. SDU to CMU - Transmit Labels

(1) The ACD transmits the SDU Subsystem Identifier Word ARINC 429 Label 172 on the "Data to CMU 1 & 2" interface at a period of 1 second ±100 ms with the bit fields as follows:

Table 5-14. Label 172: SDU Subsystem Identifier Word

Bit Range	Field Name (Discrete Format)	Valid Values/Ranges
1-8	Label	172o
9-16	SDU SAL	307o – SDU #1 173o SDU #2
17	Classic Aero (Satellite System Type)	0
18	18	0 – Not capable 1 – Capable (When ATN Test Feature enabled)
19	Iridium	0
20-29	Spare	0
30-31	SSM (Note bits 30-31)	00 – Normal Operation 10 Functional Test
32	Parity	Odd

NOTE: When the ATN test feature is enabled, bit 18 will be set.

(2) The ACD transmits the SDU to ACARS MU/CMU Status Word ARINC 429 Label 270 on the "Data to CMU 1 & 2" interface at a period of 1 second ±100 ms with the bit fields as follows:

Table 5-15. Label 270: SDU to "ACARS" MU/CMU Status Word

Bit Range	Field Name (Discrete Format)	Valid Values/Ranges
1-8	Label	270o
9-10	SDI	01b if strapped to SDU1 10b if strapped to SDU2
11	Data Link to MU/CMU Not Available	1 = Not Available 0 = Available – De-asserted by Mater only for dual
12	Mu/CMU #1 Inactive	1 = Inactive – No Label 270 Activity from CMU #1

Table 5-15. Label 270: SDU to "ACARS" MU/CMU Status Word (Continued)

Bit Range	Field Name (Discrete Format)	Valid Values/Ranges
		0 = Active – Label270 Activity from CMU #1
13	SATCOM Voice Unavailable	1 = Not Available 0 = Available
14	SELCAL	1 = Unanswered Ground Call – Asserted by Master only for dual 0 = No Unanswered Ground Call
15	Message alert with chime	0 = No Message Alert With Chime
16	Message alert without chime	0 = No Message Alert Without Chime
17	SATCOM not logged on	1 = SATCOM not logged on 0 = SATCOM logged on
18	SATCOM Master Slave	1 = SATCOM is the slave/inactive 0 = SATCOM is the master/active (or only 1 SATCOM installed)
19	Mu/CMU #2 Inactive	1 = Inactive – No Label 270 Activity from CMU #2 0 = Active – Label 27- Activity from CMU #2
20	SATCOM Cockpit Fault	1 = Fault 0 = No Fault
21	21	1 = Fault 0 = No Fault
22	SATCOM Voice Call 1	1 = Unanswered Priority 4 Ground Call on 4-Wire1 0 = No Unanswered Priority 4 Ground Call on 4-Wire1
23	SATCOM Voice Call 2	1 = Unanswered Priority 4 Ground Call on 4-Wire2 0 = No Unanswered Priority 4 Ground Call on 4-Wire2
24	SATCOM Voice Alert 1	1 = Unanswered Priority 1-3 Ground Call on 4-Wire1 0 = No Unanswered Priority 1-3 Ground Call on 4-Wire1
25	SATCOM Voice Alert 2	1 = Unanswered Priority 1-3 Ground Call on 4-Wire2 0 = No Unanswered Priority 1-3 Ground Call on 4-Wire2
26	SATCVOM Cockpit Voice Communication 1	1 = Cockpit Voice Call Connected on 4-Wire1 0 = No Cockpit Voice Call Connected on 4-Wire1

Table 5-15. Label 270: SDU to "ACARS" MU/CMU Status Word (Continued)

Bit Range	Field Name (Discrete Format)	Valid Values/Ranges
27	SATCOM Cockpit Voice Communication 2	1 = Cockpit Voice Call Connected on 4-Wire2 0 = No Cockpit Voice Call Connected on 4-Wire2
28	Spare	N/A
29	SATCOM Data	1 = No Safety data link service available (see Note) 0 = Safety data link services available
30-31	SSM (Note bits 30-31)	00 – Normal Operation 10 Functional Test
32	Parity	Odd

NOTE: Bit 29 is an extension of ARINC 741 definition.

(3) There is no support for message alert bits 15-16 in the Label 270 SDU to ACARS MU/CMU Status Word.

(4) The ACD sets Label 270 Bit 14 SELCAL with the following timing:

(a) Set for a minimum of 4 seconds even if the call is answered or terminated within 4 seconds.

(b) Cleared for a minimum of 2 seconds before setting again.

(c) Continues to be set past the minimum of 4 seconds until the call is answered or terminated.

(d) If a second call of higher priority occurs within 4 seconds of the first call being answered, the Set state due to the first call must be a minimum of 4 seconds followed by a 2 second clear, followed by a minimum 4 second Set for the second call.

NOTE: The last bullet differs from ARINC 741 in that the Set state due to the first call must be a minimum of 4 seconds followed by a 2 second clear instead of 2 seconds followed by a 2 second clear.

(5) When any of the following bits get set (1b) due to the receipt of an incoming voice call:

(a) Bit 24 SATCOM Voice Alert 1

(b) Bit 25 SATCOM Voice Alert 2.

(6) The ACD sets the bit for a minimum of 4 seconds, even if the call is answered within 4 seconds of the bit being set.

(7) The ACD transmits the SDU to ACARS MU/CMU Join/Leave Word ARINC 429 Label 271 on the "Data to CMU 1 & 2" interface at a period of 1 second ± 100 ms with the bit fields as follows:

Table 5-16. Label 271: SDU to ACARS MU/CMU Join/Leave Word

Bit Range	Field Name (Discrete Format)	Valid Values/Ranges
1-8	Label	271o
9-16	GES ID	00000000b – When Not Available AAP Logon GES ID field
17-22	Satellite ID	00000000b – When Not Available Satellite ID when logged on to ground gateway
23-25	Aero Service Type	100b – SBB
26	Legacy ACARS Available	0 Classic Aero not supported
27	ACARS over SBB (SB-S) available	0 – Not Available 1 Available
28	ATN/OSI over SBB available	0 – Not Available 1 – Available (Future)
29	Data Link via MU/CMU Not Available	0 – Available 1 – Not Available
30-31	SSM	00b – Normal Operation 10b – Functional Test
32	Parity	Odd

(8) The ACD transmits the Equipment ID Label 377 on the ARINC 429 "Data to CMU 1 & 2" interface with a period of 1 s ± 100 ms and an SDU Equipment ID encoded as 41 BCD.

Table 5-17. Label 377 Subsystem Identifier

Bit Range	Field Name (Discrete Format)	Valid Values/Ranges
1-8	Label	377o
9-16	SDI	01b – SDU 1 10b – SDU 2
11-14	Equipment ID Code (LSD)	0000b = 0x1
15-18	Equipment ID Code	0100b = 0x4
19-22	Equipment ID Code (MSD)	0000b = 0x0
23-31	Spare	0
32	Parity	Odd

L. CMU to SDU - Receive Labels

(1) The ACD processes the ARINC 429 Label 270 ACARS MU/CMU to SDU Status Word, received on the enabled CMU interfaces, "Data from CMU 1" and "Data from CMU 2", with a period of 900 ms to 1.1 s for the following:

(a) Determining active CMU receive interface

Table 5-18. Label 270 Subsystem Identifier

Bit Range	Field Name (Discrete Format)	Valid Values/Ranges
1-8	Label	270o
9-10	SDI	00b – Single CMU 01b – Left 10b – Right
11-15	Not Applicable	
16	MU/CMU Fail	MU/CMU Fail
17-19	Not Applicable	
20	Active/Standby	0 – Standby 1 – Active
30-31	SSM	00b – Normal Operation 10b – Functional Test
32	Parity	Odd

(2) When configured by ORT, the ACD processes the following ARINC 429 labels, received on the enabled CMU interfaces, "Data from CMU 1" and "Data from CMU 2", with a period of 500 ms to 1.5 s:

(a) Label 214 and Label 216 (ICAO address, part 1 & part 2).

(3) The ACD permits Label 172o on the ORT activated CMU interfaces. No action is taken on the content of this label. This label may or may not be present on all A429 receive interfaces.

M. Williamsburg Protocol

(1) Williamsburg protocol is used to transfer file data to and from the CMU. During protocol setup, the version used is negotiated on the interface (CMU, and MCDU when configured for WSCI). For the future, it is anticipated that ACARS and ATN data will share the same Williamsburg connection for data transfer.

(2) Once the Williamsburg version has been negotiated on the CMU interface, the following occurs regardless of the version negotiated:

(a) The ACD transmits data to the active CMU using CMU SAL = 304o.

(b) The ACD receives data from the active CMU with the following SAL:

1 SDU #1 SAL = 307o when configuration strapped for SDU #1

2 SDU #2 SAL = 173o when configuration strapped for SDU #2

(c) The ACD transfers ACARS data using a General Format Identifier (GFI) value of 1110b.

(d) If the ACD cannot deliver an enveloped message to the destination (ACARS MU/ CMU or GDGW), the message is discarded.

NOTE: There is no support by the SDU for Williamsburg protocol command/ control messages on the CMU interface.

(3) When disabled for ATN/OSI service, the ACD negotiates a Williamsburg Version 1 data transfer on the CMU Interface with the following data transfer speeds:

(a) When the CMU Interface is configured for high speed, the ACD transfers data using Williamsburg V1 with standard high speed timing with the extension T16 Timer = 600 ms

(b) When the CMU Interface is configured for low speed, the ACD transfers data using Williamsburg V1 with standard low speed timing.

(4) The ACD transmits and receives data using Williamsburg V1 protocol with the following protocol words asynchronously shown in Table 5-19:

Table 5-19. ACP Transmit/Recieve Codes

ACP Transmit	ACP Recieve
RTS	
CTS	
NCTS	
BUSY	
NAK	
ACK	
ALO	
ALR	
SYN	
SOT	
EOT	
DATA	
LOOP	TEST

NOTE: There are no timing requirements between words or LDUs.

(5) Williamsburg V1 protocol for CMU ACARS information transfer is supported on all ORT activated CMU interfaces using:

(a) O_1 Duplex Operation = Half Duplex

(b) O_2 Bus Speed = aligned to the ORT set CMU rate

(c) O_3 Automatic CTS when ready = No

(d) O_4 Accept Auto CTS =No

(e) O_5 Sys priority to resolve RTS conflict = Yes - SDU

(f) O_8 Support of Solo Word = yes (TEST/LOOP)

(g) O_{10} Destination Code in RTS/CTS/NCTS/BUSY used = Yes

(h) O_{11} Bit protocol verification = Yes

(i) O_{12} Use Subsystem SAL from ALO word = No

NOTES:

1 O_6, O_7, O_9 are reserved

2 Both high and low speeds are required but the transmit and receive bus speeds are always aligned, thus only Symmetric CMU timing is supported.

3 Destination codes of M for destination of CMU, and S for destination of SDU are per A741P2 4.7.4.1.

(6) When enabled for ATN/OSI service, the ACD negotiates a Williamsburg Version 3 data transfer on the CMU Interface and transmits data to the active CMU with the following protocol words asynchronously:

(a) Command Frame SOF

(b) DATA

(c) Command Frame EOF

(d) TEST.

NOTES:

1 There are no timing requirements between words or FDUs.

2 If the CMU refuses Williamsburg Version 3 during negotiation, the ACD disables ATN services when enabled for ATN/OSI service.

(7) When enabled for ATN/OSI service, the ACD:

(a) Transfers data using Williamsburg V3 with high speed timing

(b) Transfers FDUs with payload up to 1024 bytes in length

(c) Adds a single byte header to the payload of all Williamsburg Version 3 FDUs as follows:

1 3 MSBs = 101b (Protocol ID)

2 5 LSBs = 00000b (Protocol version).

(d) Silently discards the single byte payload header of incoming Williamsburg Version 3 FDUs

(e) Transfers ATN data using a GFI value of 0101b.

(f) Implements Williamsburg V3 protocol (BOP) for the transfer of ACARS and/or ATN data between the ground and ACARS/ATN CMUs, using:

1 O_1 Duplex Operation = Full Duplex

2 O_2 Bus Speed for busses = high speed

3 O_3 Automatic CTS when ready = No

4 O_8 Support of Solo Word = yes

5 O_{11} Bit protocol verification = Yes

6 O_{12} Use Subsystem SAL from ALO word = No

7 O_{13} Use of information or Command Frames = Command frame

8 O_{14} Use of Pause Function = No

NOTES:

1 Options O_6, O_7, O_9 are reserved.

2 Options O_3, O_4, O_5 ,O_{10}, O_{15} are N/A.

3 No Solo words are currently defined.

Blank Page

SECTION 6 – MAINTENANCE PRACTICES

1. Records: (TASK 23-15-49)

A. Historical Logs and Records

(1) Historical Logs are provided for manufacturing, product support and maintenance purposes.

(2) Corruption of a Historical Log such that it cannot perform its function:

(a) Does not inhibit any other SDU function

(b) Causes the corrupted log to be archived (for later inspection in the shop)

(c) Causes a new log to be created for ongoing usage.

(3) The ACD stores the distinct types of Historical Logs in separate structures within non-volatile memory.

(4) The ACD stores the following information in all Historical Records:

(a) LRU Ticks since power up (32 bits)

(b) LRU Real Time Clock (when available)

(c) UTC Time (when available)

(d) LRU Power on Count (0-65535)

(e) Flight Phase

(f) Aircraft Position and Ground Speed

(g) Antenna pointing information (when available)

(h) Temperature

(i) Transmit power and constellation information

(j) Receive C/No

(k) Beam ID.

B. Historical Usage Log and Records

(1) The ACD maintains a Historical Usage Log that:

(a) Is clearable by user maintenance or factory maintenance action;

(b) Supports a minimum of 15000 Historical Usage Records pertaining to all aspects of the SDU;

(c) Stores the most recent Historical Usage Records should the capacity be exceeded.

NOTE: When the Historical Usage Log is full it is acceptable to "age out" a significant block of the oldest records (e.g. 1500), rather than doing this one record at a time, if this provides a substantial overall saving in CPU processing time.

C. Historical Security Log and Records

(1) The ACD maintains a Historical Security Log that:

(a) Is clearable only by Factory maintenance action;

(b) Supports a minimum of 5000 Historical Security Records;

(c) Stores the most recent Historical Security Records should the capacity be exceeded.

NOTE: When the Historical Security Log is full it is acceptable to "age out" a significant block of the oldest records (e.g. 500), rather than doing this one record at a time, if this provides a substantial overall saving in CPU processing time.

(2) For each security log Fault and Event that has occurred in the current flight leg, the ACD maintains an occurrence count and record its value in any stored records.

(3) The ACD limits the maximum number of Security Log Fault and Events records of a specific type entered per hour to 3, with additional occurrences in the hour only counted, and all counts cleared with new flight leg.

NOTE: for intermittent faults 3 Set records and 3 clear records are expected.

(4) When the Syslog ORT option is enabled;

(a) The ACD streams 'INFO' and 'WARNING' level security records via the Syslog protocol over the Ethernet 3 interface to the ORT configured destination IP address.

NOTE: The INFO and WARNING levels refer to Syslog RFC3164 definitions and not historical logging levels

(5) When the Syslog ORT option is enabled;

(a) The ACD formats Syslog messages as follows:

1 [<service>‘-‘<group>‘]:‘<sp><message-text>

2 Where the values of <service> are shown in Table 6-1 below.

Table 6-1. Service Descriptions of Syslog Messages Formatted by ACD

Service	Service Description
DATALOAD	Data load service
FTST FTS	Translation Function
EMU	Engine Management Unit
DFDAU	Digital Flight Data Acquisition Unit
CSS	Cabin Services System

3 The values for <group> are shown in Table 6-2 below.

NOTE: Please note the associated PRI section with each message group.

Table 6-2. Group Descriptions and Associated PRI Sections of Message Groups

Message Group	Group Description	Associated PRI section
FAULT	Fault-Related Messages	local3.warning
SECURITY	Security-Related Messages (authentication, authorization, etc.)	local0.warning
INFO	Information Only Messages	local3.info

D. BITE Flight Leg

(1) A Flight Leg for BITE purposes denotes a period of time for which the aircraft is in the air, usually while it is in transit between one city airport and another. A Flight Leg is identified by a unique number.

(2) BITE fault records can be organized depending upon the Flight Leg(s) in which the faults were first detected and remain active.

(3) Each Flight Leg is assigned a unique number.

(4) The source of flight leg transition information is either:

(a) Internally generated when there is a transition of "BITE Air/Ground Status" from On Ground to In-Air;

OR

(b) CFDS messaged as directed by ORT settings.

(5) At the end of a flight leg, the ACD declares a fault as either:

(a) An intermittent fault, if the fault monitor determines the fault to have cleared prior to end of the flight leg in which it was detected;

(b) A hard fault, if the fault monitor determines the fault still exists prior to end of the flight leg in which it was detected.

E. Historical ORT Records

(1) The Historical ORT Records:

(a) Are only clearable by factory maintenance action.

(b) Store the most recent 3 User and Secure ORTs.

2. <u>Web Interface:</u>

A. WEB GUI

(1) The ACD hosts a Web GUI interface accessible from either:

(a) The ACD Ethernet port during operation;

(b) The Front Panel Ethernet Maintenance Port when enabled by ORT at start up and the aircraft is on the ground.

(2) The ACD Web GUI interface is:

(a) Compatible with Internet Explorer 11;

(b) HTTP 1.1 RFC2616 compliant;

(c) HTML5 compatible.

(3) The ACD Web GUI output consists of the following elements:

(a) Standard HTML tags (Version 4)

(b) Graphics files (JPEG, GIF)

(c) JavaScript ECMA-262 5th Edition.

B. Display Format

(1) The ACD Web GUI presents a login page as the root page of its interface, allowing entry of the user name and password.

(2) The ACD Web GUI login page appears in the following format showing:

(a) A horizontal Title Bar that extends across the GUI and contains the application name;

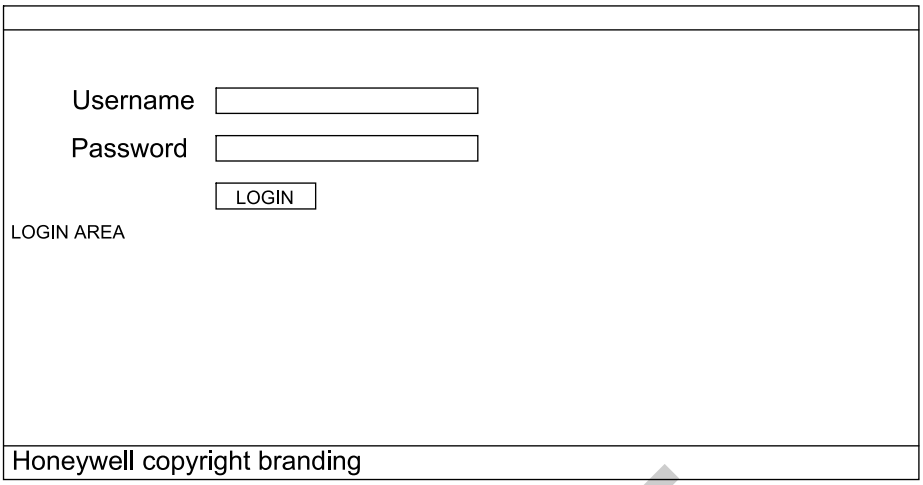
(b) A Login area that extends across the GUI below the Title bar and contains:

1 User name field;

2 Password field;

3 Login button used to initiate login once user name and password entered;

4 A horizontal Footer bar that extends across the GUI below the Login Area and contains Honeywell copyright information text.



ICN-38473-0000647675-001-01

Figure 6-1. Web GUI Login Page

(3) The ACD Web GUI has the following login accounts:

(a) "User"

(b) "Maint"

(c) "Advanced"

(d) "Integration"

(e) "Factory"

(f) "Eng"

(4) The ACD Web GUI validates the user name and password entered before allowing access to the applicable account pages.

(5) Upon login at any level, the ACD Web GUI displays a page that allows navigation to all applicable menu options.

(6) Upon login, the ACD Web GUI appears in the following multi window format showing:

(a) A horizontal Title Bar that extends across the GUI and contains the application name;

(b) A horizontal Status Strip that extends across the GUI below the title bar and contains the AES status summary information that is to be visible all the time;

(c) A Menu Area along the left side of the GUI below the Status Strip that contains a flat non-hierarchal vertically scrollable menu list which operates in a hub-and-spoke fashion;

(d) A scrollable Center Stage next to the Menu Area that contains input fields, control buttons, and information displays;

(e) A horizontal Footer extends across the GUI below the Menu Area and Center Stage that contains Honeywell copyright information text.

C. Maintenance Access Levels

(1) The SDU provides a maintenance/configuration interface with the following password protected access levels:

(a) User - Purpose - Status Only.

(b) Maint - Purpose - Normal Operational Airline Maintenance.

(c) Advanced - Purpose - Advanced maintenance options requiring additional technical training or support.

(d) Integration - Purpose - Customer Integration and Product Acceptance Testing.

(2) The SDU provides a maintenance/configuration interface with the following password access levels for use only off the aircraft:

(a) Factory - Purpose - Manufacturing Data Management.

(b) Eng - Purpose - Developer.

NOTES:

1 The Eng level includes access to the ACD operating system and associated utilities.

2 Undesirable modifications made to SDU Operation in Levels Eng and Admin can be reversed within the level (i.e. by undoing the change) or by

performing a Data Load of configured Application Software. However, any deleted logs cannot be recovered unless they had previously been retrieved.

(3) Once the password level has been entered, for the Integration, Factory, and Eng maintenance levels, the SDU requires entry of a PIN code before providing any access to these levels.

(4) The SDU ensures that the PIN code used to provide access to the Integration, Factory, and Eng levels is based on the SDU serial number.

(5) At each password protected level, execution of any displayed option is only permitted if the necessary conditions associated with the option have been satisfied.

D. User Level

(1) The ACD allows the "User" level to be accessed with an empty password field.

(2) At the "User" level, the ACD provides the ability to display the following information:

(a) Configuration information of the SATCOM equipment:

1 Hardware part numbers

2 Software:

a SATCOM LRU part numbers

b User and Secure ORT part numbers;

c SDU software components and checksums;

d Software Status.

3 ORT content

4 Strapping.

(3) At the "User" level, the ACD provides the ability to display the following information:

(a) Licensing information;

1 license number

2 feature identity

3 usage state

4 expiry date

5 validity.

(b) SATCOM Status

1 LRU status

2 Interface Status including strapping

3 Power On Count

4 Hours of Operation.

(c) Network:

1 Service connectivity

2 Active call and data sessions.

(d) Input Bus Activity

1 Aircraft ID

2 ICAO.

(e) Operational Air/Ground status.

(f) Satellite information.

(g) Navigation information.

(h) Time and Date

(i) Login name.

(4) The ACD provides the following information via the Web GUI:

(a) State of DSS and DSD discretes

(b) Which SDU is currently active (permitted to transmit, may or may not be logged on) if applicable

(c) Service availability of the companion SDU if applicable

(d) Operational status of the companion SDU if applicable.

E. Maint Level

(1) At the "Maint" level, the ACD provides the following interactive access to:

(a) Retrieve the "User" access level information;

(b) Retrieve the SDU Temperature Profile;

(c) Retrieve Historical Usage Log;

(d) Clear Historical Usage Log;

(e) Retrieve manufacturing configuration settings.

(2) At the "Maint" level, the ACD provides the following interactive access to configure of data report generation:

(a) Selection of standard reports

(b) Selection of internal parameters

(c) Selection of report rate

(d) Selection of trigger

(e) Selection of reporting options

(f) Selection of storing of settings for activation on subsequent restarts.

(3) At the "Maint" level, the ACD provides interactive access to:

(a) Clear User ORT

(b) Clear Secure ORT.

(c) Optional features license key installation/renewal.

(d) Commanded Self-Test of SATCOM.

(e) Audio Tone Test (Aircraft Test Mode)

(f) Audio Loop Back Test (Aircraft Test Mode).

(g) Activation/Deactivation of Antenna Pass-through mode

(h) Activation/Deactivation of Power Amplifier Pass-through Mode.

F. Advanced Maint Level

(1) At the "Advanced" level, the ACD provides access to all the services provided at the "Maint" access level.

(2) At the "Advanced" level, the ACD provides the following interactive access to configuration of report generation:

(a) Selection of standard reports

(b) Selection of internal parameters

(c) Selection of internal messages

(d) Selection of report rate

(e) Selection of trigger

(f) Selection of reporting options

(g) Selection of storing of settings for activation on subsequent restarts.

(3) At the "Advanced" level, the ACD provides the ability to perform PIMBIT (when in a Dual Channel Install - Class 6 / Class 7) including:

(a) Launching PIMBIT

(b) Displaying PIMBIT results as evaluated

(c) Aborting PIMBIT.

(4) At the "Advanced" level, the ACD provides the ability to perform the GPS Intermodulation Test (when in a Dual Channel Install - Class 6 / Class 7) including:

(a) Launching the RF Carrier Test

(b) Displaying RF Carrier Test antenna and frequency settings

(c) Aborting the RF Carrier Test.

G. System Integration Test Level

(1) At the "Integration" level, the ACD provides the ability to:

(a) Select

(b) Indicate if preconditions are met

(c) Deselect

(d) Activate.

(2) The following mutually exclusive restricted test modes:

(a) MTR Test Mode

(b) Dual Channel Active

(c) Channel Card Side A in BTA mode

(d) Channel Card Side B in IBIT mode

(e) Functional Test Mode.

(3) At the "Integration" level, the ACD provides the ability to:

(a) Activate/deactivate an RF Carrier test

(b) Set the frequency

(c) Set the power.

H. Factory Level

(1) At the "Factory" level, the ACD provides the ability to display and modify the following manufacturing configuration values:

(a) Serial numbers

(b) Hardware part numbers

(c) Calibration

(d) MAC addresses for Ethernet ports.

(2) At the "Factory" level, the ACD provides the ability to:

(a) Retrieve the Historical Logs

(b) Clear the Historical Logs

(c) Retrieve the temperature profile and

(d) Clear the temperature profile.

(3) At the "Factory" level, the ACD provides the ability to retrieve the following from the Channel Card:

(a) Branding String

(b) Serial Number

(c) Production Date

(d) Unique ID.

I. Eng. Level

(1) At the "Eng." level, the ACD provides the ability to:

(a) Use all the capability provided at other password levels excluding:

1 Factory level

2 The features necessary for development of the software

3 Additional features to allow verification of the software.

J. Maintenance Functions

(1) Maintenance Functions are to support items that are not essential to normal operation. They include functions needed by airline staff to perform maintenance activities (e.g. troubleshooting faults, data loading etc.) and they also include functions needed to manufacture and certify the SDU. These activities may be disruptive to user services. Hence, during Maintenance Mode, user services are not supported.

3. Maintenance Functions

A. Interactive Tests PIMBIT

(1) The Aspire 400 Class 6F Transceiver supports Passive Intermodulation Built-In Test (PIMBIT) per Section 3.7 of the ARINC 781.

B. Interactive Tests RF Carrier Test

(1) The Aspire 400 Class 6F Transceiver provides the ability in a test/maintenance mode to perform the GPS Intermodulation Test (when in a Dual Channel Install) including:

(a) Launching the RF Carrier Test

(b) Displaying RF Carrier Test antenna and frequency settings

(c) Aborting the RF Carrier Test.

(2) In the test/maintenance mode, the Aspire 400 Class 6F Transceiver provides:

(a) Means for an operator to control antenna beam pointing with beam steering information (input: Azimuth, Elevation).

(b) Means to transmit any two simultaneous carrier frequencies in L-Band spectrum (input: Carrier 1 frequency, Carrier 2 frequency).

(c) Means for a user to identify the antenna direction and carrier test frequencies (provided via the WEB GUI interface).

(3) The Aspire 400 Class 6F Transceiver only allows initiation of the RF Carrier test when the following conditions are met:

(a) The SDU is in the test/maintenance mode

(b) A launch RF Carrier test command has been received

(c) The aircraft is on the ground;

(d) The SDU is not currently in self-test or PIMBIT

(e) The SDU is receiving Valid navigation data

(f) No hardware failures exist in the system that affect the RF Carrier test operation.

(4) The Aspire 400 Class 6F Transceiver aborts the RF carrier test if either:

(a) An abort RF Carrier Test command has been received.

OR

(b) The aircraft is no longer on the ground.

4. Interrupt Request Lines

A. Interrupt Request Lines

(1) The ACD FPGA has a separate IRQ line and register for each of the following Trusted zone functions:

(a) ARINC 429 RX/TX (Trusted)

(b) SCM - Security SmartCard.

B. The ACD FPGA has a separate IRQ line and register for each of the following functions:

(1) ARINC 429 RX/TX (non-Trusted)

(2) UARTs associated with:

(a) ACD processor to AISG and AISG to ACD processor

(b) FPGA to AP processor and AP processor to FPGA

(c) Control MPC to CC_A and Control CC_A to MPC

(d) Control MPC to CC_B and Control CC_B to MPC.

(3) SCM - EEPROM

(4) PSC Discretes.

C. ARINC 429 and UART Transmit FIFO

(1) Each FIFO status register for ARINC 429 and the noted UARTs provides the word count, referring how many words are already in the FIFO.

NOTE: UARTS associated with:

(a) ACD processor to AISG and AISG to ACD processor

(b) FPGA to AP processor and AP processor to FPGA

(c) Control MPC to CC_A and Control CC_A to MPC

(d) Control MPC to CC_B and Control CC_B to MPC.

5. Standalone Identification System (SIS)

A. Aircraft Test Mode

(1) Aircraft Test Mode is available in Maintenance Mode and allows airline maintenance personnel to execute certain BITE utilities that are not available during normal Continuous Built-In Test (CBIT).

(2) Aircraft Test Mode utilities may or may not have an intrusive effect on normal SATCOM operations.

(3) Spurious faults are not reported to the CFDS during Aircraft Test Mode.

NOTE: It is permissible to reduce BITE monitoring and or reporting during Aircraft Test Mode.

(4) Prior to executing Commanded Self-Test, PIMBIT, or RF Carrier Test, the ACD:

(a) Configures the Data Arbitration Ethernet switch to:

1 Disable all internal interfaces with ACD, APP, and CC.

2 Retain the external interface with the front panel Ethernet, if ORT enabled

3 Disable the following external interfaces:

a Ethernet #4

b Ethernet #11.

(5) Configures the Enhanced Ethernet Routing Switch to:

(a) Disable all internal interfaces with APP and CC.

(b) Disable the external interface with:

1 Ethernet #1

2 Ethernet #2

3 Ethernet #12.

(c) Disable Ethernet #5

(d) Command the APP to disable the CEPT-E1 external interface:

NOTE: Use of Ethernet #5 port is a future feature, but has been left here to indicate how it is handled in this instance.

B. Commanded Self-Test

(1) Commanded self-test performs invasive tests on the SDU and RF LRUs, similarly to the tests performed on start-up. It can be invoked either via the CFDS or the Web GUI.

(2) Upon entry into Commanded Self-Test the SDU automatically on each active channel:

(a) Terminates all data contexts.

(b) Terminates all circuit switch voice connections.

(c) Commands CC into Inert Power On Mode.

(d) Prevents activation of data contexts.

(e) Prevents activation of voice connections.

NOTE: This cleanly disconnects the channel from the ground network and then prevents it from transmitting and receiving protocol data over the air. This is safe for intrusive Maintenance Mode activities.

(3) The SDU permits commanded self-test when the following preconditions are satisfied:

(a) Operational Air/Ground status indicates the aircraft is on ground AND;

1 When enabled by ORT setting, Label 050 bits 17-14 are set to 0100b or 0001b

OR

2 The Data Loader Link A discrete (MP08E), is set to 'ground'.

(4) The SDU invokes commanded self-test within 12 s if:

(a) A self-test command has been received, and

(b) The commanded self-test preconditions are satisfied, and

(c) The SDU is not currently in self-test otherwise:

(d) Inhibits commanded self-test, and

(e) Sets CFDS Label 350 bit 28 to 1.

(5) During commanded self-test, the SDU:

(a) Logs-off

(b) De-asserts the Dual System Select (DSS) discrete

(c) Requests a commanded self-test of RF SATCOM LRUs'

(d) Completes its own self-test, and

(e) Performs a SATCOM test.

NOTE: Commanded self-test always retains communications with the CFDS and never results in the SDU being rebooted.

(6) The ACD management of the external SATCOM LRUs providing antenna or amplifier functions includes a commanded self-test.

C. PIMBIT

(1) PIMBIT provides the capability to measure intermodulation products falling in the receive band. It is only applicable to configurations supporting dual channel operation.

(2) Upon entry into PIMBIT the SDU automatically on each active channel:

(a) Terminates all data contexts.

(b) Terminates all circuit switch voice connections.

(c) Commands CC into Inert Power On Mode.

(d) Prevents activation of data contexts.

(e) Prevents activation of voice connections.

NOTE: This cleanly disconnects the channel from the ground network and then prevents it from transmitting and receiving protocol data over the air. This is safe for intrusive Maintenance Mode activities.

(3) The ACD only allows initiation of the PIMBIT test when the following conditions are met:

(a) The aircraft is on the ground;

(b) The aircraft is disconnected from any satellite;

(c) The SDU is running in maintenance mode;

(d) The SDU is configured with two SBB channels;

(e) The valid transmit and received frequencies were obtained via the SwiftBroadband bulletin board broadcasts in the last 168 hours;

(f) The SDU is receiving Valid navigation data;

(g) The OCXO is ready; and

(h) No hardware failures exist in the system that affect the PIMBIT result.

(4) When the ORT indicates the presence of an HGA, the ACD PIMBIT sets the level of the power amplifier so that:

(a) For an antenna gain of 12 dBic or more:

1 The power at the output of the antenna is 20 dBW EIRP per carrier.

OR

2 For an antenna gain less than 12 dBic the power at the output of the power amplifier is 8 dBW plus the ORT PA to antenna loss value.

(5) When the ORT indicates the presence of an IGA, the ACD PIMBIT sets the level of the power amplifier so that:

(a) For an antenna gain of 6dBic or more:

1 The power at the output of the antenna is 15.1 dBW EIRP per carrier.

OR

2 For an antenna gain less than 6 dBic the power at the output of the power amplifier is 9.1 dBW plus the ORT PA to antenna loss value

(6) The ACD PIMBIT points the antenna based on the:

(a) The azimuth and elevation settings stored in the ORT; and

(b) The hemisphere where the test is being performed.

(7) The ACD PIMBIT determines the PIMBIT pass / fail status by comparing the PIMBIT test results with the following parameters stored in the ORT:

(a) PIMBIT failure threshold

(b) PIMBIT antenna beam pointing angles failure threshold, and

(c) PIMBIT measurement sample discard ratio.

(8) The ACD aborts PIMBIT when commanded by the interface that invoked PIMBIT.

D. PIMBIT Log and Records

(1) The ACD maintains a PIMBIT Log that:

(a) Supports a minimum of 20 Historical PIMBIT Records

(b) Store the most recent Historical PIMBIT Records should the capacity be exceeded.

(2) The ACD stores the following PIMBIT test header information in the PIMBIT Log:

(a) Time and Date of test

(b) Aircraft Tail Number

(c) ICAO address

(d) Antenna serial number (as available).

(3) The ACD stores the following PIMBIT test result information in the PIMBIT Log:

(a) Hemisphere in which test was conducted (Northern or Southern)

(b) PIMBIT ORT item settings

(c) Test frequencies used

(d) Aircraft-relative azimuth and elevation antenna beam pointing angles

(e) Average channel degradation results for each antenna beam

(f) Standard deviation (1σ) of the measurement results of each antenna beam

(g) Pass/Fail indication for each antenna beam

(h) Average channel degradation across all beams

(i) Overall Pass/Fail indication

(j) Antenna serial number (as available).

E. Audio Loop Back Test

(1) When commanded from the web GUI, the ACD does the following without the need to be connected to the satellite network:

(a) Loops back associated 4-wire mic audio input to the headset speaker

(b) Asserts call light discrete associated with 4-wire interface under test

(c) Asserts call chime discrete

(d) Sets unanswered call bits in label 270.

F. RF Carrier Test

(1) Creating carrier frequencies of user defined power, frequency and antenna pointing is provided for development and integration testing. It is considered an advanced maintenance activity, and requires appropriate password to access.

(2) The test allows for the generation of either:

(a) A single carrier test tone

(b) Two carriers (only applicable to configurations supporting dual channel operation).

(3) The SDU only allows initiation of the RF Carrier test when the following conditions are met:

(a) A launch RF Carrier test command has been received

(b) The aircraft is on the ground;

(c) The SDU is not currently in self-test or PIMBIT

(d) The SDU is receiving Valid navigation data;

(e) No hardware failures exist in the system that affect the RF Carrier test operation.

(4) Upon entry into RF Carrier Test, the SDU automatically on each active channel:

(a) Terminates all data contexts

(b) Terminates all circuit switch voice connections

(c) Commands CC into Inert Power On Mode

(d) Prevents activation of data contexts

(e) Prevents activation of voice connections.

NOTE: This cleanly disconnects the channel from the ground network and then prevents it from transmitting and receiving protocol data over the air. This is safe for intrusive Maintenance Mode activities.

(5) Based on valid Web GUI entry, the interactive RF Carrier Test either:

(a) Generates one RF carrier of requested power and L-Band frequency

(b) Generates two RF carriers only if the SDU is ORT configured for dual channel operationof requested L-Band frequencies at preset power levels based on ORT indicated antenna type.

(6) And providse the carrier test frequencies for display on the Web GUI.

(7) Based on valid Web GUI entry, the interactive RF Carrier Test:

(a) Commands the antenna to a directed azimuth and elevation

(b) Provides the current antenna pointing information for display on the Web GUI.

(8) When the ORT indicates the presence of an HGA, for the generation of two RF carriers, the SDU RF Carrier test sets the level of the power amplifier so that:

(a) For an antenna gain of 12 dBic or more:

1 The power at the output of the antenna is 20 dBW EIRP per carrier. OR

(b) For an antenna gain less than 12 dBic:

1 The power at the output of the power amplifier is 8 dBW plus the ORT PA to antenna loss value.

(9) When the ORT indicates the presence of an IGA, for the generation of two RF carriers, the SDU RF Carrier test sets the level of the power amplifier so that:

(a) For an antenna gain of 6 dBic or more:

1 The power at the output of the antenna is 15.1 dBW EIRP per carrier. OR

2 The power at the output of the power amplifier is 9.1 dBW plus the ORT PA to antenna loss value.

(b) For an antenna gain less than 6 dBic:

1 The SDU aborts the RF carrier test if either:

a An abort RF Carrier Test command has been received

b The aircraft is no longer on the ground.

G. Historical Log Retrieval

(1) The ACD facilitates retrieval of logs including the conversion to a human readable format.

H. Faults and Events

(1) The Built-In Test (BIT) requirements specified are consistent with the goals of ARINC 604-1. Goals of the design including:

(a) Not to intrude or degrade the primary function of the equipment while either BITE functional or BITE in failure (fail-safe)

(b) Not increase the power consumption, weight or volume of any element of the system by more than 5%

(c) Not increase the system failure rate more than 5%

(d) Isolate the fault where possible to the Line Replaceable Unit, when ORT selected

(e) Attempt fault recovery where possible.

(2) Operational Mode BIT comprises of:

(a) Power On Self-Test (POST)

(b) SDU POST - Internal to the SDU

(c) SATCOM POST - Utilizes HPA, D/LNA and HGA

(d) Commanded self-test

(e) invasive tests that are commanded (rather than occurring due to power on)

(f) Continuous BITE (CBITE).

(3) POST determines the health of the SATCOM system hardware when it is first powered on. It may run intrusive tests to gather this health status. POST operation is described in

the Modes of Operation and individual processor sections of this document. CBITE executes during the normal operation of the SDU. It monitors health in a non-intrusive manner so as to not adversely affect normal SDU and SATCOM operations. It determines the health of the SDU the SATCOM system and the interfaces to other externally connected systems. Some continuous mode monitoring does not have a predictable period as it is only possible when a specific function is active (e.g. VSWR can only occur when RF transmission occurs).

(4) As well as its own fault detection, the ACD is responsible for the management of fault detection done by the APP processor, the Channel cards, and the external SATCOM LRUs.

I. Fault and Event Annunciation

(1) The ACD annunciates the presence of one or more confirmed faults internal to the SDU via the:

(a) Front panel Fault LED

(b) Web GUI

(c) Applicable Pilot Control and Display schemas.

NOTE: Not all pilot control and display schemas feature fault reporting.

(2) The ACD annunciates the presence of one or more confirmed interface faults, or external LRU faults on the following interfaces:

(a) Web GUI

(b) Applicable Pilot Control and Display schemas.

NOTE: There is no intent to encode the source of the fault nor to indicate the presence of environmental or interface faults on the LED.

J. POST Fault and Event Monitoring

(1) POST refers to tests that are executed at the power on of the system but not continuously. Commanded self-test when permitted can cause a re-execution.

K. SDU POST Monitoring

(1) The SDU records POST faults and events related to:

(a) Configuration strapping including:

(b) Unsupported strapping

(c) Strapped identity (i.e. SDU#1 or SDU#2).

(2) The SDU records POST Operational events for:

(a) SDU SW configuration

(b) SDU HW configuration.

(3) The ACD records POST Security events related to:

(a) The unsigned hash or similar data as calculated for the part or file as part of the system power-up process, for the software parts and files stored in non- volatile memory, and protected from intentional corruption through the use of digital signatures or similar mechanisms.

1 This only applies to software parts or files that persist across multiple powercycles.

2 CRC values, checksums, parity bits, etc., for software parts and files are not included in the security logs.

(4) The SDU records POST faults for ORT validity including:

(a) Missing

(b) Incompatible with application SW

(c) SDU/SCM copies different

(d) Corruption

(5) The SDU records POST operational events related to license keys installed in the SCM including:

(a) If valid format:

1 License number

2 Feature identity

3 Usage state

4 Expiry date

5 Invalid formatted entries.

(6) The SDU records POST faults for non-recoverable invalid SDU configurations, including:

(a) Application Software invalid

(b) Software to Hardware compatibility and enter RF Safe Mode.

(7) The SDU records POST faults for:

(a) Single image corruption of stage 2 boot image

(b) Single image corruption of application software

(c) hardware checks only performed on startup including:

1 Manufacturing NVM values corrupt

2 Critical Software NVM corrupt

3 FPGA post test

4 Cooling Fan start-up failure.

(8) The SDU records POST faults and events related to the configuration and operation of the SATCOM RF interfaces.

(9) The ACD records POST Security faults if the ethernet Switch startup state invalid.

(10) The SDU records POST Faults and Events for:

(a) APP segregation is off in normal operation and enter RF safe mode.

(b) Channel card POST results.

(11) The SDU records POST Events for:

(a) Successful test mode entry

(b) Prohibited test mode entry.

(12) The SDU records a POST Operational Event to indicate which of the following caused SDU startup

(a) Power Cycle.

(b) External Reset Discrete asserted for greater than 0.5 seconds.

(c) SW triggered mode dependent (data load programming NVM variable set, restricted test mode entry).

(13) The SDU records a POST Fault SDU startup due to fault conditions including:

(a) SW triggered BITE recovery,

(b) Watchdog restart.

L. SATCOM POST Monitoring

(1) The SDU records SATCOM POST Operational events for:

(a) Configuration reports from:

1 The antenna function

2 The pa function.

(2) The SDU records SATCOM POST faults if external SATCOM LRUs reports are inconsistent with ORT settings including the antenna reported type and then enter RF Safe mode.

(3) The SDU records SATCOM POST faults and events related to the Automatic Cable calibration if it is ORT selected.

M. Continuous Fault and Event Monitoring

(1) Continuous monitoring includes monitoring that occurs as a regular interval, as well as "mode-dependent" monitoring that occurs only when a specific mode or function occurs.

N. SATCOM System Monitoring

(1) When configured for Dual Safety SATCOM, the SDU records faults related to:

(a) Dual SATCOM Configuration Conflicts, including:

1 Both SDUs have same SDU number

2 Preferred SDU differs

3 "SATCOM Select Mode" differs.

NOTE: These faults will be detected after both SDUs have completed start-up.

(b) When configured for Dual Safety SATCOM, the SDU monitors and records operational events related to Dual SATCOM operation including:

1 SDU Status

2 SDU DSS and DSD Status

3 Companion SDU Status

4 Companion SDU DSS and DSD Status.

5 SDU Active/Standby transitions AND;

6 If ORT configured for Aircraft Directed Dual Safety SATCOM include the following additional information:

a SATCOM Operational Mode Command Word - Label 272

b SATCOM OCA Interface Status Word - Label 274

c CMU Discrete Data Word - Label 270.

O. Internal Monitoring

(1) The SDU records fault and events related to memory errors, including those that are automatically corrected.

(2) The SDU records faults and events related to Channel Card operation.

(3) The ACD records security faults if:

(a) The configuration during differs from the commanded configuration for either:

1 The Data Arbitration switch,

2 The Enhanced Ethernet Routing switch.

(4) The SDU records faults related to power supply operation.

(5) The SDU records faults and events relating to the cooling fan correct operation.

P. Internal Communication Monitoring

(1) SDU records faults in the Historical Fault Log related to the internal control paths to CCA, CCB, PIESD, AISD.

(2) The ACD records security events related to invalid/malformed/rate limit exceeded messaging is received from either channel card or unexpected messages are received from the APP

(3) During application mode, the SDU records faults, related to activated internal Ethernet interfaces.

(4) During data load, the SDU records faults, related to Internal Ethernet interfaces necessary for data load.

Q. Satellite Service Monitoring

(1) The SDU records Usage events relating to:

(a) Satellite registration/de-registration, per domain (ACD and APP)

(b) Spot beam handover

(c) Satellite handover

(d) Counters and Timers.

(e) ACARS or ATN safety data operation including:

1 Logon/Logoff

2 Traffic Statistics

3 Missing acknowledgement.

(f) Errored safety data message with the CMU.

(g) PIESD Satellite registration/de-registration

(h) PIESD Spot beam handover

(i) PIESD Satellite handover.

(j) ACD Context activation, modification (if applicable) and deactivation

(k) ACD Start and end of calls, whether successful or not.

(l) AISD Context activation, modification (if applicable) and deactivation.

(m) PIESD Context activation, modification (if applicable) and deactivation

(n) PIESD Start and end of calls, whether successful or not.

(o) Failure in accessing safety voice network resources

(2) The SDU records the following events related to Data Gateway operation in the Historical Usage Log:

(a) AAP Login Request by the ADGW

(b) AAP Logoff Request/Notification

(c) Unexpected GDGW NAK message (Missing GDGW ACK to message transmission)

(d) Out of Sequence GDGW messages

(e) GDGW ping messages.

(3) When enabled for ATN/OSI service, the ACD ADGW reports the following ATN traffic statistics on a per session basis to the Historical Usage Log at time of log off or link failure:

(a) Number of AAP messages with ATN/OSI payload successfully received excluding duplicates

(b) Number of AAP data messages with ATN/OSI payload sent to ground.

(4) The ACD records an event to the Historical Security log, when the ACD ADGW receives any message from the GDGW containing:

(a) Invalid indication (e.g. incorrect ICAO)

OR

(b) Out of bounds parameter.

(5) The SDU records an Event in the Historical Usage log, on receipt of the following logon success response codes from the GDGW:

(a) 0001 0001 preferred service provider

(b) 0001 0010 non-preferred service provider.

(6) Which includes:

(a) The logon success and response code

(b) The ADGW protocol values for:

(c) the general AAP counters

(d) the general AAP timers

(e) CSP-ID and DP-ID per service type

(f) GDGW-id

(g) GES ID.

1 ARINC, SITA and IRIS CSP are potential CSP service providers.

2 ARINC and SITA are potential DP service providers.

3 The SATCOM is expected to remain with a non-preferred service provider until the next logon.

4 The general AAP counters and timers are used for operating the session between the ADGW and the GDGW. They are different from the specific ACARS / ATN counters and timers used for supporting ACARS / ATN data service.

(7) The SDU records an Event in the Historical Usage log, on receipt of the following logon failure response codes from the GDGW:

1001 0001	no service provider for this aircraft
1001 0010	no service provider for any aircraft
1111 1111	undefined reason
Undefined code	

(a) Undefined code including:

1 The failure and response code.

(8) The SDU records an Event in the Historical Usage log, on receipt of the following logon failure response codes from the GDGW:

1000 1111	Invalid parameter of undefined type
1011 0001	ICAO not authorized for safety services
1011 0010	IMSI not authorized for safety services
1011 0011	AES deactivated
1011 0100	Radius Authentication failure

(9) When the ACD ADGW receives logoff notification from the GDGW with one of the following reason codes:

1001 0001	Failed connection to service provider
1010 0001	By GDGW operator
1010 0010	GDGW performing a site switch
1101 0010	Return link inactivity
1111 1110	Undetermined reason

(10) The ACD records security events related to digital signatures and certificates used to ensure confidentiality, integrity, and availability of parts, data, connections, etc., as a minimum the following:

(a) The serial numbers of the signature/certificate;

(b) The name(s) of the issuer;

(c) The expiry dates; and

(d) The subject name fields.

R. Operational Information Monitoring

(1) The ACD records Security Events, for the following:

(a) Packet drops on Data Arbitration Function

(b) Invalid packets (including reason) received by Secure Gateway VPN.

(2) The ACD records security events for:

(a) Successful authentications; and

(b) Failed authentications (e.g., wireless sessions, SSL/VPN sessions, part authentications).

1 Relates to SDU authentications (e.g. maintenance logon), not logons to the network.

2 Including session renewals and protocol failures.

3 It is not necessary to record data for negotiated symmetric session keys, except for when the authentication fails.

(3) The ACD records security events for changes to User ORT via the Web GUI.

(4) The SDU records Events when historical logs are:

(a) Cleared

(b) Found to be corrupt.

(5) The SDU records an operational event when the mode of operation changes.

(6) The SDU records operational events, when the origin of the navigation solution for any given label changes.

(7) The SDU records a Fault event when there is no navigation solution.

(8) The SDU records Operational events when the active CMU changes.

(9) The SDU records Fault events when any of the following are true:

(a) No CMU Label 270 is received from a CMU for more than 3 seconds

(b) Bit 16 of the CMU Label 270 word is set to 1 (CMU Failed)

(c) The SSM of the CMU Label 270 received from the CMU is a value other than 00 (Normal Operation) and set the corresponding SDU 270 Mu/CMU Inactive (bit 12 set to 1 to indicate inactive CMU#1 while bit 19 set to 1 to indicate inactive CMU#2).

(10) The SDU records an Operational event when:

(a) Each type of invasive self-test is initiated including:

1 Normal

2 Rapid

3 Commanded.

(11) The SDU records and Operational event when a new flight leg occurs.

(12) The SDU records an Historical Operational event containing the first tail number received in a flight leg.

(13) The SDU records an Historical Operational event when the flight number changes.

S. Data Load Monitoring

(1) The ACD records security events for the unsigned hash or similar data as calculated for the part or file at the time the parts or data files are validated, for the software parts and files protected from intentional corruption during the data load or file transfer process, through the use of digital signatures or similar mechanisms.

NOTE: CRC values, checksums, parity bits, etc., for software parts and files are not included in the security logs.

(a) Accepted data load requests including the identity of the initiating device.

(b) Rejected data load requests including the identity of the initiating device.

(c) Each file successfully transferred as part of the data load process; and

(d) Each file unsuccessfully transferred as part of the data load process.

(e) Any data load protocol failures that occur during the data load including those failures that are automatically resolved by the data load process.

T. Software Events

(1) The SDU records events related to:

(a) Critical software errors that do not recover

(b) Software errors that do recover

(c) Informational software events.

U. External Interface Monitoring

(1) The SDU reports faults for:

(a) All enabled internal to the following SATCOM ARINC 429 receive interfaces that are inactive for a minimum of 10 seconds:

1 "BITE Input from HPA"

2 "BITE Input from top/port BSU/Ant"

3 "BITE Input from STDB BSU".

(b) All enabled external to the following SATCOM ARINC 429 receive interfaces that are inactive for a minimum of 5 seconds:

1 "Data from secondary IRS/GNSS"

2 "Data from GNSS to SDU"

3 "AES ID INPUT"

4 "Data from MCDU 1"

5 "Data from MCDU 2"

6 "Data from MCDU 3"

7 "Data from CFDS"

8 "Data from CMU 1"

9 "Data from CMU 2"

10 "IRS1"

11 "IRS2".

(2) And clears the fault when anyone of the ARINC 429 labels is received on the same inactive input bus and considered valid.

NOTE: An ARINC 429 label is considered valid when there is no interface fault for that particular label.

(3) The SDU records faults for inactive SDU ARINC 429 transmit interfaces reported by external LRUs.

(4) The SDU records faults for expected ARINC 429 labels that:

(a) Are not present for a period of 3 times the slowest expected period of that label.

(b) Have the SSM set to Not Computed Data (NCD) or Failure Warning (FW) for 3 consecutive samples.

NOTE: The enabled interfaces expected labels may be ORT setting dependent.

(5) The SDU records Events in this Historical Fault log if Williamsburg protocol errors are detected on a MCDU interface.

(6) The SDU records events for the state of external Ethernet interfaces.

(7) The ACD records historical security events with:

(a) The MAC address and the IP address of any device which communicates with a system:

1 The first time that the communications occurs.

2 At least once per day thereafter.

(8) The SDU records faults if no traffic is present on the CEPT-E1 Interface when configured on.

(9) The SDU records Operational Events related to:

(a) The state of discretes that determine Configuration.

(b) Discrete triggers a Reset.

(10) The ACD records a Security Events when a security discrete changes state.

(11) The SDU records Faults related to discrete states inconsistent with current SDU configuration.

V. Temperature Monitoring

(1) The SDU records operational faults and events for temperature detection points including:

(a) ACD Temperature

(b) APP Temperature

(c) Inlet Air Temperature

(d) Outlet Air Temperature

(e) Channel Card Side A Temperature

(f) Channel Card Side B Temperature

(g) PSC Temperature

(h) Other external SATCOM LRU's.

W. Loss of Cooling

(1) The complete SATCOM is capable of operating in a reduced power consumption mode, providing a minimal set of services that allow essential operation when the SDU or Power Amplifier enter an over-temperature condition A correctly installed system should only enter the over-temperature condition if the cooling provided to the SDU or power amplifier were to fail.

(2) The SDU records faults to the Historical Fault Log if the SDU enters Amplifier Loss of Cooling mode due to the external power amplifier indicates the loss of cooling temperature threshold has been exceeded.

(3) The SDU then proceeds to terminate Channel Card Side B services.

(4) While maintaining at a minimum ACD Safety Services.

(5) The SDU records faults to the Historical Fault Log if the SDU enters SDU Loss of Cooling mode due to the SDU exceeds a critical temperature and continue to maintain all services.

NOTE: The SDU internal fan will activate in this scenario to continue full operation.

X. SATCOM LRU Monitoring

(1) The SDU records faults to the Historical Fault log related to:

(a) SCM connectivity

(b) SCM operation (including USIM availability).

(2) The SDU records faults reported from:

(a) SATCOM LRUs including:

1 Antenna

2 Diplexer

3 External amplifier.

NOTES:

1 Some classes of antenna do not report faults.

2 The components listed above may be packaged in 1, 2 or 3 LRUs.

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SECTION 7 – TROUBLESHOOTING

1. Aircraft Control Domain (ACD)

A. ACD Startup Functions

(1) During the SDU startup sequence, the front panel power and fault LEDs will indicate status as follows:

(a) For regular power-up (Normal or Rapid);

(b) On initial power-up, the LEDs come up solid Green;

(c) During ACD Boot, the LEDs are set to alternately flash Red and Green and remain flashing until the power-up cycle is complete;

(d) Power-up completion is indicated when the Power LED reverts to solid Green;

(e) A successful power sequence results in the Power LED set to solid Green and the Fault LED unlit.

(f) Any critical failure during the power-up cycle results in the fault LED being set RED at the point the failure occurs.

(g) Any non-critical failure during the power-up cycle results in the fault LED being set at the end of the power-up cycle.

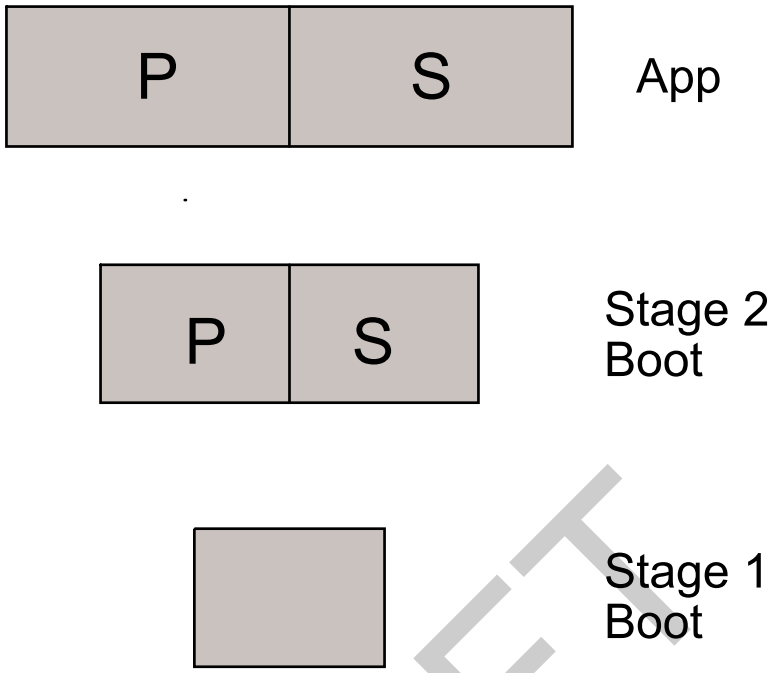
(2) For commanded self-test:

(a) The power LED remains solid green;

(b) The fault LED retains the previous state until results of commanded self-test indicate otherwise.

B. ACD Boot

(1) The following drawing depicts boot stages and application dual images (Primary and Secondary) to aid understanding of the power-on boot process performed on the SDU.



ICN-38473-0000647634-001-01

Figure 7-1. ACD Boot Stages

(2) The SDU uses a dual secure boot mechanism that:

(a) Employs code signature attached to all stage 2 boot and application images for validation:

1 Signatures derived from encryption of a SHA_256 hash of the image using a RSA private key

2 Signatures checked by SW RSA verification that compares a SHA_256 hash of the image with the hash obtained by applying a RSA public key to decrypt the signature

3 The RSA private and RSA public keys are a mated pair.

(b) Follows the startup sequence of:

1 HW implements the stage 1 boot

2 HW (via HW circuitry) authenticates the stage 2 boot image

3 SW RSA authentication of both application images by the stage 2 boot.

(3) ACD Boot preserves the HW power-up state of:

(a) Output discretes open

(b) All subordinate processors shutdown

(c) RF output disabled

(d) All Ethernet ports disabled except for the dedicated ACD Ethernet port

(e) Audio outputs disabled.

(4) ACD Boot keeps all subordinate processors shutdown. The SDU provides a connection for a RS-232 serial port with the following characteristics:

(a) The baud rate is 115200 baud

(b) The number of data bits is 8 bits

(c) The number of stop bits is 1 bit

(d) The parity is None

(e) The flow control is None.

(5) ACD Boot ensures that the power output over coax interface is off. The ACD stage 1 (mini) boot code activates either:

(a) The primary stage 2 boot image

(b) The secondary stage 2 boot image if the primary stage 2 boot image is nonfunctional.

(6) The ACD stage 2 boot image configures the hardware to alternatively flash the front panel green power and red LEDs. The stage 2 boot image increments a count in non-volatile memory to indicate the number of times boot has been activated since the last time application code was activated.

(7) The ACD stage 2 boot image performs the following SDU POST tests:

(a) ACD RAM Memory check

(b) Application Image validity check.

(8) And respond to failures by:

(a) Preventing activation of application code

(b) Attempting to solidly light the FAULT LED.

(9) If the ACD boot self-tests pass, the stage 2 boot image activates either:

(a) The primary ACD application image

(b) The secondary ACD application image if the primary image is non-functional.

(10) On ACD startup, if:

(a) The test mode discrete is selected

AND

(b) The test mode configuration is present,

(11) The ACD:

(a) Places the ACD and AP processors in SE Linux permissive mode

(b) Enters the configured test mode.

(12) On ACD startup, if the test mode discrete is not asserted, the test mode configuration is cleared.

(13) On ACD startup, if the test mode discrete is selected and the test mode configuration is cleared, the ACD starts normally.

C. Satellite Connectivity State (Logon Condition)

(1) The SDU determines the "SATCOM System State" for Side A, as the highest priority state that applies from Table 7-1 below:

Table 7-1. Priority "SATCOM System State" Description

1	SAFE_MODE	SDU has been triggered into “Safe” mode
2	SATCOM_FAULT	SATCOM fault has been detected preventing logon to the Network
3	REJECTED	When permanent rejection has blocked all visible satellite logon attempts
4	SDU_NOT_READY	The SDU is not yet fully ready
5	PA_NOT_READY	Power Amplifier is not yet ready/booted
6	ANT_NOT_READY	Antenna is not yet ready/booted
7	CABLE_CAL	System cable calibration in progress
8	WARMING	SCM is warming and not yet ready
9	AES_ID_NOT_READY	AES ID/ICAO is not yet available/present
10	NAV_DATA_UNAVAIL	At least one of the required navigation data solutions (labels) is not available to the SDU
11	LOGGED_OFF	SDU is logged off and ready to perform a logon

Table 7-1. Priority "SATCOM System State" Description (Continued)

12	SELECTING_SAT	SDU is searching for the best satellite to attempt logon. Only used when logging on automatically, not used during handover
13	CONNECTING_TO	Chosen and pointed to a satellite waiting to hear from it (camp-on or repoint antenna from channel card will end this state)
14	ATTACHING	Ends when attached to SBB network
15	ATTACHED	SBB Network Attached
16	AUTHENTICATING	Ends when Data Gateways have authenticated each other (prior to setting up IPSEC VPN)
17	LOGGING_ON_GDGW	Ends when logged into the secure ground data gateway
18	LOGGING_OFF	SDU was LOGGED ON and is now in the process of logging off the SBB Network. This can happen from the pilot manually logging off or the SDU becoming the Standby SDU in a Dual SATCOM system
19	SAT_HANDOVER	SDU is performing a satellite handover
20	LOGGED_ON_GDGW	SDU is logged into the secure ground data gateway
NOTE: If multiple SATCOM system states exist concurrently, the SDU will set the "SATCOM System State" to the SATCOM system state with the highest priority.		

(2) The SDU determines the "Non-Safety Logon State" and priority for Side B shown in Table 7-2:

Table 7-2. Priority "Non-Safety Logon State" Description

1	DISABLED	Channel Card Side B is ORT configured off
2	LOGGED_OFF	Side B is enabled but Side A has not reached the GDGW Logged on state
3	WAITING_ACK	Ends when attached to SBB network
4	LOGGING_OFF	Side B is in the process of logging off the SBB Network. This will occur when Side A is in the process of logging off the SBB Network
5	SAT_HANDOVER	Power Amplifier is not yet ready/booted
6	LOGGED_ON SBB	Network Attached

NOTE: If multiple non-safety logon states exist concurrently, the SDU will set the "Non-Safety Logon State" to the non-safety logon state with the highest priority.

(3) The ACD provides the logon status for the Safety Services.

(4) The ACD provides the Rejection Reasons when a logon is rejected from either of the following:

(a) The Network

(b) The GDGW.

(5) After the SDU has registered and attached to the BGAN network the ACD :

(a) Automatically command the safety Channel card to create a Primary background context using the ORT specified Safety SIP Server name for RTCP packets with:

(b) Header compression disabled

(c) Use the returned IP address for SIP signaling

(d) Send a SIP:Register Message.

2. Loss of PS/CS Attachment

A. ACD Loss of PS/CS Attachment

(1) When leaving the network, the ACD:

(a) Attempts to logoff from the GDGW if the AAP link is deemed available;

(b) Terminates all PDP Contexts on Channel Card Side A;

(c) Informs PDP Contexts consumers of termination on Channel Card Side A;

(d) Attempts PS de-attachment from the RAN.

(2) When leaving the network and ORT indicates Channel Card Side B is active, the ACD:

(a) Commands the PIES to politely disconnect;

(b) Attempts PS de-attachment from the RAN.

(3) The ACD considers there to be an extended period of PS service outage when there is an unexpected state change from either one of the following:

(a) “IPReady” to “IPNotReady” if PDP contexts are active;

(b) “PSReady” to “PSNotReady” if PDP contexts are active or not;

(c) The state stays in the Not Ready state.

NOTE: If all the PDP contexts are deactivated then “IPNotReady” would be reported and is the expected behavior.

(4) The ACD is considered to be in an extended period of CS service outage when the state changes from:

(a) “CSReady” to “CSNotReady”

(b) It is either:

1 Unexpected

OR

2 Expected but extends longer than anticipated

(5) If either of the following conditions occur:

(a) Loss of PS attachment.

(b) Extended period of PS service outage.

AND

(c) There is a cockpit CS call in progress.

(6) The ACD waits until the call is terminated, then the ACD:

(a) Informs the user that the in-progress PS calls have been terminated.

(b) Politely leaves the network.

(c) Initiates satellite selection without blacklisting of the current satellite link.

(7) If the following conditions occur:

(a) Loss of PS attachment.

(b) Extended period of PS service outages

AND

(c) There is no cockpit CS call in progress.

(8) The ACD:

(a) Terminates any existing calls;

(b) Informs the user that the in-progress PS calls have been terminated;

(c) Politely leaves the network;

(d) Initiates satellite selection without blacklisting of the current satellite link.

(9) If the following conditions occur:

(a) Extended period of CS service outage;

AND

(b) There is a cockpit VoIP call in progress,

(10) The ACD waits until the call is terminated, then the ACD:

(a) Informs the user that the in-progress CS calls have been terminated;

(b) Politely leaves the network;

(c) Initiates satellite selection without blacklisting of the current satellite link.

(11) If the following conditions occur:

(a) Extended period of CS service outage;

AND

(b) There is no cockpit VoIP call in progress,

(12) The ACD:

(a) Terminates the CS call;

(b) Informs the user that the in-progress CS calls have been terminated;

(c) Politely leaves the network;

(d) Initiates satellite selection without blacklisting of the current satellite link.

(13) If a loss of Forward Bearer occurs for longer than the time in the Forward Carrier Loss Parameter, the ACD politely leaves the network.

NOTE: The default value to be used for the Forward Carrier Loss Parameter is 60 seconds but the RNC can instruct the UE to use a value different from the default by transmitting a ForwardCarrierLoss AVP during registration.

(14) The ACD does not cause the SDU to terminate associated user services when the Forward Bearer Synchronization is lost for less than the time in the Forward Carrier Loss Parameter.

NOTE: The default value to be used for the Forward Carrier Loss Parameter is 60 seconds but the RNC can instruct the UE to use a value different from the default by transmitting a ForwardCarrierLoss AVP during registration.

(15) If a network initiated PDP disconnect is received with one of the following codes:

(a) Temporary failure

(b) Normal reason.

(16) The ACD attempts to set up another context needed for safety services.

(17) If a network initiated PDP disconnect is received with a permanent failure code.

(18) The ACD permanently blacklists the current satellite link and initiate satellite selection.

B. PIESD Loss of PS/CS Attachment

(1) The PIESD considers there to be an extended period of PS service outage when there is an unexpected state change from either one of the following:

(a) “IPReady” to “IPNotReady” if PDP contexts are active.

(b) “PSReady” to “PSNotReady” if PDP contexts are active or not.

(2) And the state stays in the Not Ready state.

NOTE: If all the PDP contexts are deactivated then “IPNotReady” would be reported and is the expected behavior.

(3) The PIESD is considered to be in an extended period of CS service outage when the state changes from:

(a) “CSReady” to “CSNotReady”

(b) It is either:

1 Unexpected

OR

2 Expected but extends longer than anticipated.

(4) If any of the following conditions occur on Channel Card Side B:

(a) Loss of PS attachment

(b) Extended period of PS service outage.

(5) The PIESD

(a) Requests a “PIESD polite disconnect”;

(b) Attempt re-attachment and re-registration until successful.

(6) When cabin voice is ORT enabled and there is an extended period of CS service outage.

(7) The PIESD:

(a) Requests a "PIESD polite disconnect";

(b) Attempt re-attachment and re-registration until successful.

C. Short Service Interruption Handling

(1) The SDU software does not take any actions to user service activation based on primary power interruptions of less than or equal to a transparency period of 200 ms.

NOTE: Interruptions in voice and data communication may occur due to power interruption characteristic of RF SATCOM LRUs.

(2) The SDU prevents setting nuisance fault reports in response to any normal electrical power transient or steady state condition applied to that system including:

(a) Normal power transients identified by RTCA/DO-160G Section 17.4

(b) Normal power fluctuations identified by RTCA/DO-160G Sections 16.5 and 16.6.

(3) For primary power interruptions to the antenna and external power amplifier LRUs, for which the LRU meets its full requirements within 5 seconds of restoration of its primary power, the SDU returns within 5 seconds to the previous operating state such that priority voice and data services resume in the same configuration as before the interruption.

(4) For power interruptions longer than 200 milliseconds duration the SDU recovers to an operational state without manual reset or power cycle and register on the network for voice, data and ACARS service (as applicable) automatically.

NOTE: This does not apply if Manual Logon is set.

D. Doppler Compensation

(1) The ACD calculates the expected Doppler correction factor according to satellite position, including satellite state vectors, the aircraft position (latitude, longitude, and altitude), and aircraft velocity (ground speed, true track and true heading).

(2) When calculating the expected Doppler correction factor, the ACD:

(a) Uses True Heading if the Ground Speed is less than 50 knots;

(b) Interpolates the True Track using the True Heading data if True Heading is provided at a rate higher than True Track.

E. Miscellaneous Inmarsat Functions

(1) The SDU does not transmit towards the satellite if any of the following data is not available or not valid:

(a) Altitude

(b) Latitude

(c) Longitude

(d) True Heading

(e) Pitch Angle

(f) Roll Angle

(g) Ground speed

(h) True track (when the speed is > 50 kts.)

F. AAP (Safety Data Gateway) Log Off

(1) The ACD sends a logoff request if any of the following occurs, and populates in the logoff request matching (cause codes) termination reason:

(a) 0010 0001 Pending satellite change

(b) 0010 0010 Leaving SB coverage

(c) 0011 0001 Time-out loss of Ground-to-Air link

(d) 1000 1111 Undefined AES fault.

(2) When the ACD ADGW receives logoff notification from the GDGW with one of the following reason codes:

(a) 1001 0001 Failed connection to service provider

(b) 1010 0001 By GDGW operator

(c) 1010 0010 GDGW performing a site switch

(d) 1101 0010 Return link inactivity

(e) 1111 1110 Undetermined reason.

(3) The ACD:

(a) Indicates LEAVE to CMU via label 271;

(b) Attempts to re-establish logon to GDGW after hold off time specified on logoff notification message.

G. Datalink Service Status Reporting to the CMU

(1) When ACARS and/or ATN/OSI (as defined in the ORT) logon is successfully completed the ACD issues a "join" event to the CMU.

(2) When the AAP connection is recovered for any service after previously issued "leave" for that service the system issues corresponding "join" indication to the CMU.

H. AAP Link interruption

(1) Any service failure leading to a scenario where:

(a) Forward bearer and PDP context are present; and

(b) AAP link is broken.

(2) Is reported to the CMU as "Leave" no later than AAP_timeout + 2 seconds after the last AAP message (data or signaling) has been received from the ground.

(3) Loss of forward link bearer is reported to the CMU as "Leave" event no later than 5 seconds after the loss has been detected by the AES.

(4) Any event leading to explicit or implicit deregistration of AES is reported to the CMU as "Leave" event:

(a) No later than ac_aap_t5+5 seconds; and

(b) No earlier than ac_aap_t5 seconds.

(5) After event is detected in the AES.

I. Counters and Timers

(1) Certain counters and timers relating to power application to the SDU are maintained to provide operational context when troubleshooting failure or usage issues. These counters and timers are:

(a) Stored in the Historical Logs

(b) Viewable from the Web GUI.

(2) The ACD processor stores in non-volatile memory the number of times the equipment initiates application code from boot code.

(3) The ACD processor accumulates and stores in non-volatile memory, the total accumulated time the equipment has been powered.

(4) The ACD Processor maintains the time since the equipment was powered on/reset.

3. Aircraft Fault Reporting

A. CFDS Reporting

(1) The SDU handles reporting of external system connectivity faults to the Central Fault and Display System (CFDS) as follows:

(a) inhibit reporting for 1 minute after power-on

(b) provide reporting no later than 2 minutes after power-on.

(2) The SDU handles reporting of SATCOM LRU connectivity faults to the CFDS as follows:

(a) inhibit reporting for 2 minutes after power-on

(b) provide reporting no later than 3 minutes after power-on.

(3) The ACD reports continuously monitored internal and interface faults to the CFDS within 2s following detection.

(4) When a latched fault is detected during self-test, the ACD latches the corresponding fault report bits in the failed state until another self-test is performed.

(5) When a continuously monitored fault is detected, the ACD asserts and hold the appropriate indication to the CFDS for a minimum of 6 seconds.

(6) Status and fault information received from the external power amplifier and Antenna subsystem is mapped to appropriate bits in the transmitted CFDS Fault Summary Word labels.

B. CMU Fault Reporting

(1) The ACD annunciates any flight deck effect(s) to CMU via bits 11-13, 19-21, 28, 29 of label 270:

(a) Within 2 seconds following the confirmation of a fault and;

(b) Hold the indication for a minimum of 6 seconds.

(2) The SDU sets bit 12 to inactive (1) in label 270 SDU to ACARS MU/CMU Status Word to the CMU for the following condition:

(a) When Label 270 on "Data from CMU 1" is either:

1 Missing for 3.3 seconds.

2 Invalid for 3 consecutive samples (SSM not set to Normal or Functional Test).

ELSE

3 Set bit to active (0).

(3) The SDU sets bit 19 to inactive (1) in label 270 SDU to ACARS MU/CMU Status Word to the CMU for the following condition

(a) When CMU 2 is ORT enabled and Label 270 on "Data from CMU 2" is either:

1 Missing for 3.3 seconds.

2 Invalid for 3 consecutive samples (SSM not set to Normal or Functional Test).

ELSE

3 Set bit to active (0).

(4) The SDU sets bit 20 to fault (1) in label 270 SDU to ACARS MU/CMU Status Word to the CMU under the following circumstances:

(a) Both of the following conditions are met:

1 Bit 21 of Label 270 SDU to ACARS MU/CMU Status Word to the CMU is set to fault (1).

2 Bit 29 of Label 270 SDU to ACARS MU/CMU Status Word to the CMU is set to 1.

OR

(b) If ORT configured to Aircraft Directed Dual Safety SATCOM, Label 272 from all three TCP inputs is missing or invalid.

ELSE

(c) Set bit to no fault (0).

(5) The SDU sets bit 21 to fault (1) in label 270 SDU to ACARS MU/CMU Status Word to the CMU for the following condition:

(a) When a SATCOM Cockpit Fault is detected.

ELSE

(b) Set bit to no fault (0).

NOTE: A SATCOM Cockpit Fault is a fault that prevents the SATCOM system's ability to provide safety voice and safety data and can be present on any SATCOM LRU such as the SDU, the antenna and power amplifier combination, SCM, etc. The SDU has both circuit switched and packet switched cockpit voice channels therefore to have no voice both CS (voice) and PS (data) cockpit voice channels have to have failed.

(6) The SDU sets bit 29 to 1 in label 270 SDU to ACARS MU/CMU Status Word to the CMU for any of the following condition:

(a) No active ACARS MU/CMU.

(b) Any SATCOM failures prohibiting safety data link services.

ELSE

(c) Set bit to 0.

Notes: 1.

1 No active ACARS MU/CMU is true when there is link inactivity for all enabled CMUs or there is no declared active CMU.

2 A SATCOM failure prohibiting safety data link services is a fault that prevents the SATCOM system's ability to provide safety data and can be present on any SATCOM LRU such as the SDU, the antenna and power amplifier combination, SCM, as well as interface failure such as navigation data, ICAO…

(7) When any of the following are true:

(a) There is no activity from enabled CMUs (label 270 SDU to ACARS MU/CMU Status Word bit 12 and bit 19 set to 1 - Inactive)

(b) There is an equipment fault - SATCOM (label 270 SDU to ACARS MU/CMU Status Word bit 20 set to 1 - Fault)

(c) The SATCOM is not logged on

(d) Neither ACARS nor ATN/OSI are available:

1 Label 271 SDU to ACARS MU/CMU Join/Leave Word, bit 27 set to 0 (Not Available)

2 Label 271 SDU to ACARS MU/CMU Join/Leave Word, bit 28 set to 0 (Not Available).

(8) the ACD sets the following bits to 1 (Not Available):

(a) Label 270 SDU to ACARS MU/CMU Status Word, bit 11 - Data Link to MU/CMU Not Available

(b) Label 271 SDU to ACARS MU/CMU Join/Leave Word, bit 29 - Data Link to MU/CMU Not Available.

(9) ELSE set the bits to 0 (Available):

(a) Label 270 SDU to ACARS MU/CMU Status Word, bit 11 - Data Link to MU/CMU Not Available

(b) Label 271 SDU to ACARS MU/CMU Join/Leave Word, bit 29 - Data Link to MU/CMU Not Available.

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APPENDIX A – APPENDIX

1. General:

A. References

(1) Referenced documents use numbering with the following prefixes:

(a) RD for Regulatory Documents

(b) ID for Industry Documents.

B. Regulatory Documents

[RD1]	TCCA AC 20-140C	Guidelines for Design Approval of Aircraft Data Link Communication Systems Supporting Air Traffic Services
[RD2]	TCCA AC 20-150B	Airworthiness Approval of Satellite Voice (SATVOICE) Equipment Supporting Air Traffic Service (ATS) Communication
[RD3]	Order 8110.49 Chg 2	Software Approval Guidelines (TCCA)
[RD4]	Order 8110.105A	Simple And Complex Electronic Hardware Approval Guidance (TCCA)
[RD5]	Order 8150.1D	Transport Canada Civil Aviation Program
[RD6]	14 CFR part 21	Title 14 Aeronautics and Space, Code of Federal Regulation, Part 21 Subpart O Certification Procedures for Products and Articles Technical, Subpart O Standards approvals
[RD7]	47 CFR	Title 47 Telecommunication, Code of Federal Regulations
[RD8]	CAN-TSO-C159c	Next Generation Satellite Systems (NGSS) Equipment
[RD9]	CAN-TSO-C159d	Next Generation Satellite Systems (NGSS) Equipment
[RD10]	RTCA/DO-160G	Environmental Conditions and Test Procedures for Airborne Equipment
[RD11]	RTCA/DO-178C	Software Considerations in Airborne Systems and Equipment Certification.
[RD12]	RTCA/DO-254	Design Assurance Guidance for Airborne Electronic Hardware
[RD13]	RTCA/DO-262B	Minimum Operational Performance Standards for Avionics Supporting Next Generation Satellite Systems (NGSS)
[RD14]	RTCA/DO-262C	Minimum Operational Performance Standards for Avionics Supporting Next Generation Satellite Systems (NGSS)

[RD15]	RTCA/DO-262D	Minimum Operational Performance Standards for Avionics Supporting Next Generation Satellite Systems (NGSS)
[RD16]	RTCA/DO-330	Software Tool Qualification Considerations
[RD17]	SOR/96-484	Radiocommunication Regulations SOR/96-484 (1996)
[RD18]		TCCA and Industry Guide to Product Certification 3rd Edition (May 2017)

C. Industry Documents

[ID1]	ARINC 615A-3	Software Data Loader Using Ethernet Interface
[ID2]	ARINC 665-2	Loadable Software Standards
[ID3]	ARINC 758-2	Communications Management Unit (CMU) Mark 2, ARINC Characteristic 758-2
[ID4]	ARINC 781-7	Mark 3 Aviation Satellite Communication systems, ARINC Characteristic 781-7
[ID5]	ARINC 600-19	Air Transport Avionics Equipment Interfaces
[ID6]	ARINC 429	MARK 33 Digital Information Transfer System
[ID7]	ARINC 739	Multi-Purpose Control and Display Unit

D. Reference Documents

(1) Unless specifically identified by revision level or release date, the most current issue of the following documents is applicable to the extent referenced herein.

E. RTCA, Inc.

RTCA/DO-160G Environmental Conditions and Test Procedures for Airborne Equipment, December 8, 2010.

F. ARINC Inc.

ARINC 781-7 Mark 3 Aviation Satellite Communication Systems, ARINC Characteristic 781-7, August 9, 2017.

G. Regulatory

(1) European Regulation (EC) No. 1907/2006 concerning the Registration, Evaluation, Authorization and Restriction of Chemicals (REACH).

H. Military Standards

(1) MIL-STD_810G Environmental Engineering Considerations and Laboratory Tests.

I. Industry Standards

(1) TIA/EIA-232-F Interface Between Data Terminal Equipment and Data Circuit-Terminating Equipment Employing Serial Binary Data Interchange, 1997 TIA/EIA-422-B Electrical Characteristics of Balanced Voltage Digital Interface Circuits, May 1994.

J. Applicable Documents

(1) Unless otherwise identified, the latest issue of the following documents is applicable to the extent referenced herein.

(2) In the event of any conflict between this specification and referenced documents, this document takes precedence.

2. Standards and Specifications

A. Military Standards and Specifications

(1) MIL-STD-810G Environmental Engineering Considerations and Laboratory Tests

(2) MIL-STD-889 Dissimilar Metals

(3) MIL-STD-1250A Corrosion Prevention and Deterioration Control in Electronic Components and Assemblies

(4) MIL-PRF-23377 Performance Specification Primer Coatings: Epoxy, High-Solids.

B. Federal Aviation Administration

(1) CAN-TSO-C159d Technical Standing Order - Next Generation Satellite Systems (NGSS) Equipment

(2) AC 21-16G Advisory Circular - RTCA Document DO-160 versions D, E, F, and G,

(3) "Environmental Conditions and Test Procedures for Airborne Equipment", 06/22/2011

(4) AC 20-115C Advisory Circular - Airborne Software Assurance

(5) AC 20-152 Advisory Circular - RTCA, Inc., Document RTCA/DO-254, Design Assurance Guidance for Airborne Electronic Hardware.

C. Federal Communication Commission

(1) 47 CFR Part 87 Code of Federal Regulations, Title 47 Telecommunications, Part 87 Aviation Services.

D. Industry Canada

(1) RSS-170 Spectrum Management and Telecommunication, Radio Standards Specification, Mobile Earth Stations (MESs) and Ancillary Terrestrial Component (ATC) Equipment Operating in the Mobile-Satellite Service (MSS) Bands.

E. European Technical Standards Institute (ETSI)

(1) EN 301 473 Satellite Earth Stations and Systems (SES); Aircraft Earth Stations (AES) operating under the Aeronautical Mobile Satellite Service (AMSS)/ Mobile Satellite Service (MSS) and/or the Aeronautical Mobile Satellite on Route Service (AMS(R)S)/ Mobile Satellite Service (MSS), V1.3.1 - to the extent called up by BGAN SDM Volume 5 Chapter 3.

3. Performance and Operational Requirements (TASK 23-15-49)

A. Minimum Performance Standard

(1) The Aspire 400 Class 6F Transceiver meets the applicable Minimum Operational Performance Standards (MOPS) for Class 6F operation.

B. Supported Services

(1) The Aspire 400 Class 6F Transceiver provides on the Safety SBB RF channel:

(a) Two simultaneous flight deck voice calls, and

(b) ACARS datalink communication.

(2) When ORT configured, the Aspire 400 Class 6F Transceiver provides on the Safety SBB RF channel:

(a) Two simultaneous flight deck voice calls,

(b) ACARS datalink communication, and

(c) AISD data communication.

(3) And a dedicated RF channel for:

(a) IFE IP data communications.

4. DO-160G Environmental Conditions and Test Procedures for Airborne Equipment (TASK 23-15-49)

Table A-1. Environmental Conditions and Test Procedures

Section	Condition	Category
Forward Equipment Bay		
DO-160G Operating Temperature, Short Time Operating Temperature, Ground Survival Temperature and In-Flight Loss of Cooling		
4.54	Operating High Temperature Test	A2
4.5.2	Operating Low Temperature Test	A2
4.5.1	Ground Survival Low Temperature Test Short-Time Operating Low Temperature Test	A2
4.5.3	Ground Survival High Temperature Test Short-Time Operating High Temperature Test	A2
4.5.5	In-Flight Loss of Cooling Test	A2 - Loss of Cooling Category P
		A2 - Loss of Cooling Category Z
		A2 - Loss of Cooling Category V
DO-160G Altitude, Decompression, and Overpressure		
4.6.1	Altitude Test	A2
4.6.3	Over Pressure Test	A2
Aircraft Cabin		
DO-160G Operating Temperature, Short Time Operating Temperature, Ground Survival Temperature and In-Flight Loss of Cooling		

Table A-1. Environmental Conditions and Test Procedures (Continued)

Section	Condition	Category
4.5.4	Operating High Temperature Test	A4
4.5.2	Operating Low Temperature Test	A4
4.5.1	Ground Survival Low Temperature Test Short-Time Operating Low Temperature Test	A4
4.5.3	Ground Survival High Temperature Test Short-Time Operating High Temperature Test	A4
4.5.5	In-Flight Loss of Cooling Test	A4 - Loss of Cooling Category P
4.5.4	Operating High Temperature Test	A4
4.5.2	Operating Low Temperature Test	A4
4.5.1	Ground Survival Low Temperature Test Short-Time Operating Low Temperature Test	A4
4.5.3	Ground Survival High Temperature Test Short-Time Operating High Temperature Test	A4
4.5.5	In-Flight Loss of Cooling Test	A4 - Loss of Cooling Category V
DO-160G Altitude, Decompression, and Overpressure		
4.6.1	Altitude Test	A4
4.6.2	Decompression Test	A4
4.6.3	Over Pressure Test	A4
Aft Equipment Bay		
DO-160G Operating Temperature, Short Time Operating Temperature, Ground Survival Temperature and In-Flight Loss of Cooling		
4.5.4	Operating High Temperature Test	F2
4.5.2	Operating Low Temperature Test	F2
4.5.1	Ground Survival Low Temperature Test Short-Time Operating Low Temperature Test	F2
4.5.3	Ground Survival High Temperature Test Short-Time Operating High Temperature Test	F2
4.5.5	In-Flight Loss of Cooling Test	F2 Loss of Cooling Category P
DO-160G Altitude, Decompression, and Overpressure		
4.6.1	Altitude Test	F2
DO-160G Forward Equipment Bay		

Table A-1. Environmental Conditions and Test Procedures (Continued)

Section	Condition	Category
5	Temperature Variation Test	A
DO-160G Aircraft Cabin		
5	Temperature Variation Test	A
		C
DO-160G Aft Equipment Bay		
5	Temperature Variation Test	A
DO-160G Section 6. Humidity		
6	Severe Humidity Environment Test	B
DO-160G Section 7. Operational Shocks and Crash Safety		
7	Operational Shock and Crash Safety	B
7	Low Frequency Shock Test	D
DO-160G Section 8. Vibration		
8	Standard Vibration Test	S, Curve B
8	Robust Random Vibration Test	R, as per test method 8.7.2
8	High-Level Short Duration Vibration Test	S
DO-160G Section 9. Explosion Proofness		
9	Non-Ignition Test	E
DO-160G Section 10. Waterproofness		
10	Condensing Water Proof Test	Y
DO-160G Section 11. Fluids Susceptibility		
11	Fluids Susceptibility Test	F
DO-160G Section 12. Sand and Dust		
12	Sand and Dust Test	S
		D
DO-160G Section 13. Fungus Resistance		
13	Fungus Resistance Test	F
DO-160G Section 14. Salt Spray		
14	Normal Salt Fog Test	S
DO-160G Section 15. Magnetic Effect		

Table A-1. Environmental Conditions and Test Procedures (Continued)

Section	Condition	Category
15	Magnetic Effect Test	Z
DO-160G Section 16. Power Input		
16	Power Input Test	A(WF) extended requirements with test designation HZPI
DO-160G Section 17. Voltage Spike		
17.4	Voltage Spike Test	A
DO-160G Section 18. Audio Frequency Conducted Susceptibility – Power Inputs		
18.3.2	Audio Frequency Conducted Susceptibility Test	R(WF)
DO-160G Section 19. Induced Signal Susceptibility		
19	Induced Signal Susceptibility Test	ZWX
Conducted Susceptibility		
20	Radio Frequency Susceptibility (Radiated and Conducted) Test	R
		T
Radiated Susceptibility		
20.5	Radio Frequency Susceptibility (Radiated and Conducted) Test	R
20.6	Radiated Susceptibility Test Alternate Procedure - Reverberation Chamber	R
Conducted RF Emissions		
21.4	Emission of Radio Frequency Energy Test, Conducted RF Emissions	M
Radiated RF Emissions		
21.5	Emission of Radio Frequency Energy Test, Radiated RF Emissions	M
DO-160 Section 22. Lightning Induced Transient Susceptibility		
22	Lightning Induced Transient Susceptibility Test	A3J3L3
22.5.2.1	Lightning Induced Transient Susceptibility Tests, Subsection Cable Induction Tests	
22	Lightning Induced Transient Susceptibility Test	B2H2L2
DO-160 Section 23. Lightning Direct Effects		
23	Section Lightning Direct Effects	X
DO-160 Section 24. Icing		

Table A-1. Environmental Conditions and Test Procedures (Continued)

Section	Condition	Category
24	Icing	X
DO-160 Section 25. Electrostatic Discharge (ESD)		
25	Electrostatic Discharge (ESD) Test	A
DO-160 Section 26. Fire, Flammability		
26	Flammability Test	C

5. Other Tests (TASK 23-15-49)

A. Thermal Appraisal

(1) The SDU satisfies the environmental qualification test requirements using adjacent slot equipment simulators installed in the two adjacent slots.

B. Audio Frequency Conducted Emissions Tests

(1) The SDU prevents emissions of audio frequency, 20Hz to 150kHz, energy that may capacitively couple to other systems in excess of the 300mVp-p.

6. Industry Standards

A. ARINC Inc.

(1) ARINC Specification 429P1-16 Mark 33 Digital Information Transfer System (DITS), Part 1, Functional Description, Electrical Interface, Label Assignments, and Word Formats. Supplement 16. 27 September, 2001.

(2) ARINC Specification 781-7 Mark 3 Aviation Satellite Communication Systems, ARINC Characteristic, August 9, 2017

(3) ARINC Characteristic 741P1-10 Aviation Satellite Communication Systems, Part 1, Aircraft Installation Provisions, ARINC Characteristic, December 24, 2003

(4) ARINC Specification 600-19 Air Transport Avionic Equipment Interfaces.

B. Institute for Interconnecting and Packaging Electronic Circuits

(1) IPC-A-610 Acceptability of Electronic Assemblies.

(2) IPC-A-600 Acceptability of Printed Boards.

(3) J-STD-001 Requirements to Soldered Electrical and Electronic Assemblies

(4) J-STD-006 Requirements for Electronic Grade Solder Alloys and Fluxed and non-Fluxed Solders for Electronic Soldering Applications

(5) IPC/WHMA-A-620 Requirements for Acceptance of for Cable and Wired Harness Assemblies

(6) IPC-CC-830 Qualification and Performance of Electrical Insulating Compound for Printed Wiring Assemblies

(7) IPC-SM-840 Qualification and Performance Specification of Permanent Solder Mask

(8) IPC-6012Qualification and Performance Specification for Rigid Printed Boards

(9) IPC 4101Specification for Base Materials for Rigid and Multilayer Printed Boards.

C. Telecommunications Industry Association

(1) TIA-232-F Interface Between Data Terminal Equipment and Data Circuit-Terminating Equipment Employing Serial Binary Data Interchange, Rev F, October 1997.

D. RTCA Inc.

(1) RTCA/DO-160G Environmental Conditions and Test Procedures for Airborne Equipment. Revision E. 09 December, 2004.

(2) RTCA/DO-178C Software Considerations in Airborne Systems and Equipment Certification. 01 December, 1992.

(3) RTCA/DO-254 Design Assurance for Airborne Electronic Hardware. 19 April, 2000.

(4) RTCA/DO-262D Minimum Operational Performance Standards for Avionics Supporting the Next Generation Satellite Systems (NGSS), May 31, 2017.

E. Inmarsat

(1) BGAN SDM Vol5 Chp 3 Broadband Global Area Network (BGAN) System Definition Manual (SDM) Volume 5, Chapter 3: Aeronautical User Equipment Technical Requirements

(2) BGAN SDM Vol2 Chp 5 Broadband Global Area Network (BGAN) System Definition Manual (SDM) Volume 2, Chapter 5: Physical Layer Interface.

F. International Electrotechnical Commission (IEC)

(1) IEC 61000-4-2 Electromagnetic Compatibility (EMC) Part 4-2, Testing and Measurement Techniques - Electrostatic Discharge Immunity Test, Edition 1.2, 2001-04.

G. Society of Automotive Engineers (SAE)

(1) GEAI-STD-0005-2 Standard for Mitigating the Effects of Tin Whiskers in the Aero and High Performance Electronic Systems.

H. Other

(1) ATA-300 Air Transport Association Specification for Packaging of Airline Supplies, Revision 2008.1.

7. Certification Basis

A. TCCA CAN-TSO Applicability

(1) This section describes the certification basis for the Aspire 400.

(2) Honeywell will use the TCCA's Transport Canada Civil Aviation (CAN-TSO) program as a means to obtain certification for the Aspire 400. The TCCA Transport Canada Civil Aviation (CAN-TSO) [RD5] and associated MOPS, define the regulatory requirements and performance and are listed in Table A-2 below.

Table A-2. TCCA CAN-TSOs for the Aspire 400

CAN-TSO Number	CAN-TSO Title	MOPS	Aspire 400 Function

Table A-2. TCCA CAN-TSOs for the Aspire 400 (Continued)

CAN-TSO-C159d [RD8]	Next Generation Satellite Systems (NGSS) Equipment	DO-262D [RD12] (1)	SATVOICE & SAT DATA

(3) The planned CAN-TSO submittals are itemized inTable A-3 below.

Table A-3. Planned CAN-TSO submittals

Planned CAN-TSO Submittals	Class or Subclass	Applicable Aspire 400 LRUs
Initial Major	AES6F	SDU, SCM, HPA
Follow-on Major (after AES6F approved)	AES7F subclass	SDU, SCM, HPA

B. Deviations for Aspire 400

(1) Deviations from the RTCA/DO-262 [RD12] for Aspire 400 are as follows:

(a) DO-262 Rev D [RD15] will be followed instead of Rev C indicated in CAN-TSO-C159d [RD9].

(b) For the SDU, SCM and HPA, the Class, and Subclass information will be included in the System Description Installation Manual (SDIM). The physical CAN-TSO nameplate/marking on the exterior of the SDU, SCM and HPA LRU's will have the statement "(Class/Subclass: See IM)" to point to the location of this information.

(c) The AES (Aeronautical Earth Station) allocation of a voice delay may not be met based on analysis. A deviation request will only be made if necessary.

C. CAN-TSO Functions

(1) All functions are CAN-TSO Functions. MOPS identified test data is not provided for the following Aspire 400 functions summarized below, which are deactivated via interlocks in the initial CAN-TSO submittal:

(a) ATN Test Feature

1 Requirements and software are present to permit testing of ATN data. Multiple interlocks are provided to prevent this function from being activated in error. These include:

a ORT parameter that cannot be selected with ORT schemas delivered to customers.

b Software confirmation that if ORT parameter is selected, that a hardware discrete not wired in standard plan wiring is asserted.

2 Support for Classes not in current CAN-TSO submittal (example AES7F at time of AES6F submittal)

a SDU behavior alignment to configured class in the Secure ORT file (parameter data items) is fully tested as described above.

The structure of the ORT, is such that when a specific class is selected all other class specific behavior is deactivated.

3 CAN-TSO electronic marking and maintenance manual will clearly state which classes and subclasses are applicable and thus it will be clear that an STC would be required until the time that the CAN-TSO applicability has been expanded to cover this class of operation.

D. Communication Network Provider Approval

(1) Communication Network Provider approval will be sought from either SITA and/or ARINC and will follow the application procedure (and testing) defined by the specific provider.

E. Non-CAN-TSO Functions

(1) There is no non-CAN-TSO functionality in the Aspire 400 system.

8. Certification Requirements (TASK 23-15-49)

A. Design Assurance Levels

(1) The SDU electronic hardware is designed to RTCA DO-254 DAL D

(2) All software is designed to RTCA DO-178C.

9. Other Considerations

A. TCCA Advisory Circulars

(1) TCCA AC 20-140C [RD1] Guidelines for Design Approval of Aircraft Data Link Communication Systems Supporting Air Traffic Services and TCCA AC 20-150B [RD2] Airworthiness Approval of Satellite Voice (SATVOICE) Equipment Supporting Air Traffic Service (ATS) Communication apply at the aircraft level, and are not part of this CAN-TSO. They have been considered, however, in the requirements development to ensure the aspects that are provided by the SATCOM system are present.

B. Radio Transmission Licensing

(1) The radio transmission is licensed in accordance to 47 CFR part 87 [RD7] by the operator of the aircraft or fleet.

(2) As per 47 CFR part 87.39 the acceptability of the equipment for licensing is achieved by obtaining FCC certification, as per 47 CFR [RD7] part 2 Subpart J Section 2.1033. The FCC ID received is marked on the physical nameplate of all non-prototype certified equipment.

(3) As per Canadian Radio Communication Regulations SOR/96-484 [RD15], 21(1) Innovation, Science and Economic Development Canada (ISEDC) Technical Acceptance Certification is required. The ISEDC ID received is marked on the physical nameplate of all non-prototype certified equipment.

(4) The FCC and ISEDC complies with DO-262D [RD15] section 2.1.3 note 1.