Installation and Maintenance Manual

TopFlight Satcom

SDU – 82155A Series
SCM – 82158A Series

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RECORD OF REVISIONS

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CONTENTS

1. *INTRODUCTION*

1.1. Purpose of Manual

This manual sets forth installation and maintenance guidelines for the THALES TopFlight Satcom (TFS) Satellite Data Unit (SDU), and SDU Configuration Module (SCM). The SDU and SCM installation specific and general guidelines contained within this manual are supported by mechanical and electrical interconnection drawings. Drawings should be reviewed by the installation organisation, and any requirements specific to a particular airframe should be assessed before installation is commenced.

The Manual covers the following topics:

- Title Page
- Record of Revisions
- Table of Content
- Introduction
- Description
- Installation Guidelines
- Inspection and System Checkout
- Maintenance
- Testing and Fault Isolation
- Instructions for Continued Airworthiness

NOTE: This manual does not cover aircraft system commissioning test procedures.

Advisory notes presented within this manual such as: 'Warnings, Cautions and Notes' are applicable to the TFS system as follows:

- A **WARNING** is used to alert the reader to possible hazard which may cause loss of life or physical injury
- A **CAUTION** is used to denote the possibility of damage to materiel but not danger to personnel
- A **NOTE** is used to convey, or draw attention to, information that is extraneous to the immediate subject of the text

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1.2. Scope

The Thales SDU and SCM comply with the design requirements set forward in the ARINC 781 Characteristic. An ARINC 781 compliant system is intended to support one or more of the Inmarsat aeronautical services known as 'Classic-Aero', 'Swift 64', and 'SwiftBroadband.

This manual provides information specific for the SDU and SCM capable of providing SwiftBroadband (SBB) services for Single Aisle (SA) aircraft configuration. The SDU and SCM covered in this manual support the single channel Inmarsat Class 3A and Class 7 services only.

1.3. References

1.2.1. THALES SCM Component Maintenance Manual 44-35-33.

1.2.2. THALES SDU Component Maintenance Manual 44-35-32.

1.2.3. EMS AMT-3500 Intermediate Gain Antenna Subsystem Installation Manual MN-1242-20047.

1.2.4. ARINC 429: Mark 33 Digital Information Transfer System.

1.2.5. ARINC 600 Characteristic: Air Transport Avionics Equipment Interfaces.

1.2.6. ARINC 615 Characteristic: Airborne Computer High speed Data Loader.

1.2.7. ARINC 615A Characteristic: Ethernet Based Data loading.

1.2.8. ARINC 781 Characteristic: Mark III Aviation Satellite Communication (Satcom) System Avionics.

1.2.9. Transmitter Certification of FCC ID: KV6-TFS-SDU82155A Series TFS SDU to Federal Communications Commission rule part 87 and Confidentiality: A111/STE-012/006.

1.2.10. RTCA DO-160E/EUROCAE ED-14E: Environmental Conditions and Test Procedures for Airborne Equipment.

1.4. Compliance to Regulations

1.4.1. FCC:

- The SDU is designed to be compliant with part 15 and part 87 of the Federal Communication Commission (FCC) regulations.

1.4.2. The installation must be compliant to:

- EASA/FAR 25.869 Fire protection: systems
- EASA 25X0899 Electrical bonding and protection against lightning and static electricity
- EASA/FAR 25.1301 Equipment, general, function and installation
- EASA/FAR 25.1309 Equipment, systems and installations
- EASA 25X1316 System lightning protection
- EASA/FAR 25.1353 Electrical equipment and installations
- EASA/FAR 25.1357 Circuit protective devices
- EASA 25X1360 Precautions against injury
- EASA/FAR 25.1431 Electronic equipment
- EASA 25.561 Emergency Landing

1.5. List of Abbreviations

ac	Alternating Current
ACARS	Aircraft Communication Addressing and Reporting System
ADL	Airborne Data Loader
AES	Aeronautical Earth Station
AGS	Airborne GSM Server
AIM	Antenna Interface Mounting
AMO	Approved Maintenance Organization
AOR-E	Atlantic Ocean Region-East
AOR-W	Atlantic Ocean Region-West
APM	Avionics Processor Module
ARINC	Aeronautical Radio Inc.
ATE	Automatic Test Equipment
BGAN	Broadband Global Area Network
BITE	Built In Test Equipment
BSU	Beam Steering Unit
CCM	Channel Card Module
CDU	Control Display Unit
CMM	Component Maintenance Manual
CPM	Communication Processor Module
dc	Direct Current
DLNA	Diplexer and Low Noise Amplifier
EASA	European Aviation Safety Agency
ECM	External Configuration Memory
ECS	Environmental Control System
EMC	Electromagnetic Compatibility
ESD	Electro Static Discharge
ESDS	Electro Static Discharge Sensitive
FPL	Front Panel LED
GES	Ground Earth Station
GNSS	Global Navigation Satellite System
GPS	Global Positioning System
HPA	High Power Amplifier
IGA	Intermediate Gain Antenna
IMEI	International Mobile Equipment Identity
IMM	Installation and Maintenance Manual
IMSI	International Mobile Subscriber Identity

INMARSAT	International Maritime Satellite Organization
IOR	Indian Ocean Region
IP	Internet Protocol
IPC	Illustrated Parts List
IRS	Inertial Reference System
I/O	Input/Output
ISDN	Integrated Service Digital Network
LED	Light Emitting Diode
LES	Land Earth Station
LRU	Line Replaceable Unit
mA	MilliAmpere
MCDU	Multi-function Control and Display Unit
MCU	Modular Concept Unit
MEL	Minimum Equipment Level
MES	Mobile Earth Station
MIB	Management Information Base
NVM	Non Volatile Memory
OMS	Onboard Monitoring System
ORT	Owner Requirements Table
OCXO	Oven Controlled Crystal Oscillator
PAST	Person Activated Self Test
PC	Personal Computer
PLMN	Public Land Mobile Network
P/N	Part Number
POR	Pacific Ocean Region
POST	Power On Self-Test
PPPoE	Point To Point Protocol over Ethernet
PSM	Power Supply Module
PSTN	Public Switched Telephone Network
RF	Radio Frequency
SA	Single Aisle
SATCOM	Satellite Communication
SBB	SwiftBroadband
SCDU	Satellite Control Display Unit
SCM	SDU Configuration Module
SDU	Satellite Data Unit
SIM	Subscriber Identity Module
SIS	Standalone Interface System
SNMP	Simple Network Management Protocol
SRU	Shop Replaceable Unit
STC	Supplemental Type Certificate
SW	Software
TCP/IP	Transmission Control Protocol/Internet Protocol
TFS	TopFlight Satcom
UMTS	Universal Mobile Telecommunication System
USIM	Universal Subscriber Identity Module
Wi Fi	Wireless Fidelity
WLAN	Wireless Local Area Network
WOW	Weight On Wheels

2. DESCRIPTION

2.1. TFS Satellite Communication System Domain

SATCOM (Satellite Communications) systems provide users with long-range voice and data communication by accessing global satellite and ground communications networks. The introduction of Pico-Cells on aircrafts, and the new I4 INMARSAT constellation of geostationary satellites have been the enabling technologies for the development of significantly smaller, more capable terminals such as the Thales TopFlight Satcom system.

SwiftBroadband is the aeronautical service, which operates on the INMARSAT BGAN (Broadband Global Area Network) infrastructure. SwifBroadband supports Circuit Switched and always-on TCP/IP data (packet switched) services. Thales SBB TopFlight Satcom system supports the Inmarsat Classes of service 3A and 7.

Figure 2-1 below depicts the TFS communication system.

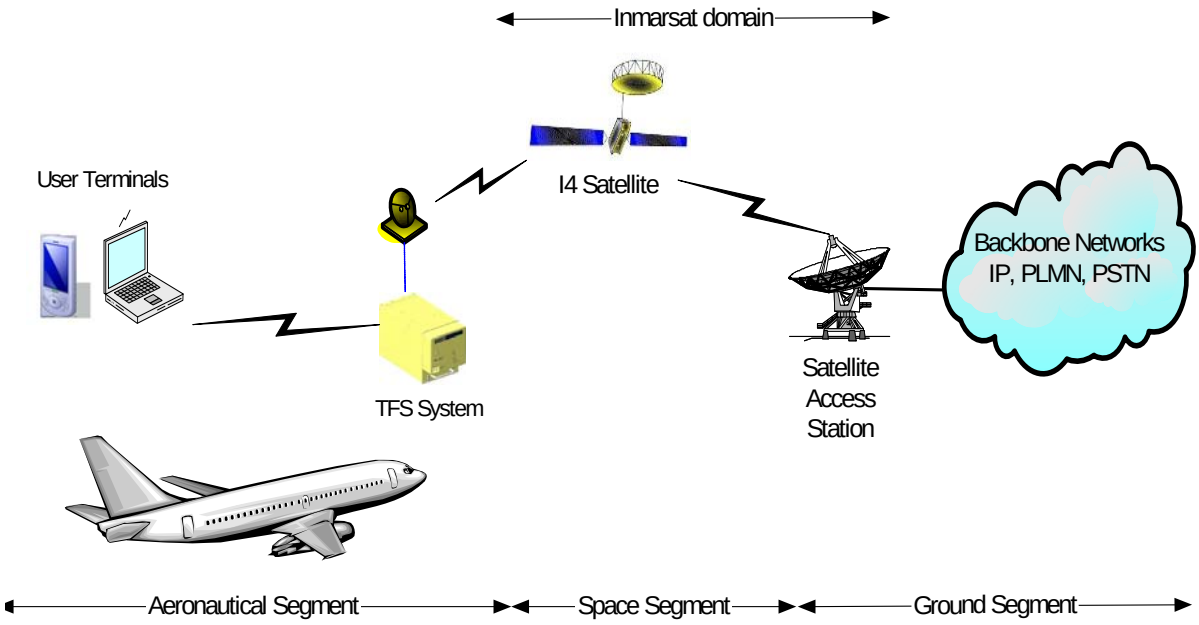

Figure 2-1: Example of TFS communications system overview.

2.2. TFS System Overview

The TFS system conforms to the ARINC-781 Characteristic, and interfaces with onboard avionics and communication equipment to provide the aircraft with a range of communication services by transmitting and receiving L Band signals to and from the fourth generation of INMARSAT satellites. For this purpose the INMARSAT satellite constellation is connected to the ground backbone telecommunication network through Satellite Access Stations (SAS) operated by service providers.

The TFS system consists of the following LRUs (Line Replaceable Unit):

- One SDU (Satellite Data Unit)
- One SCM (SDU Configuration Module)
- One DLNA (Diplexer Low Noise Amplifier)
- One IGA (Intermediate Gain Antenna)

Figure 2-2 below depicts TFS system interfacing for the Single Aisle configuration.

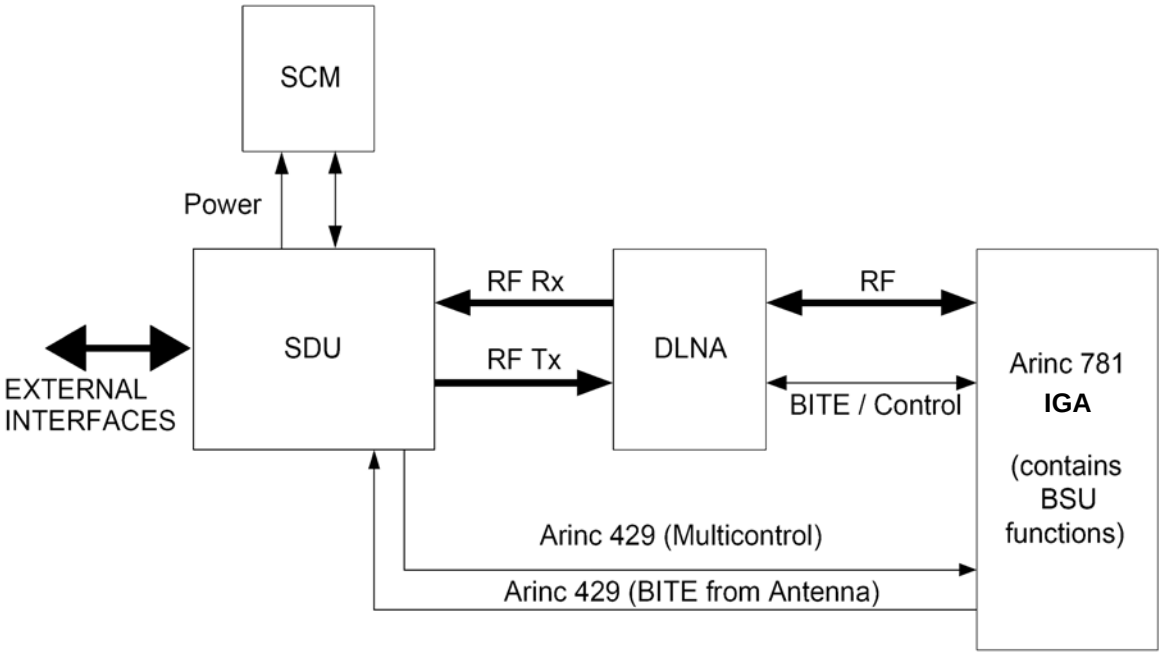

Figure 2-2: Example of Single Aisle TFS system interfacing.

2.3. SDU General Description

2.3.1. Hardware

The SDU hardware meets RTCA/DO-254 level D requirements, and it is composed (see Fig 2-3) of the following internal sub-assemblies:

- High Power Amplifier (HPA)
- Channel Card Module (CCM) x 1
- Communication Processor Module (CPM)
- Power Supply Module (PSM)
- Oven Controlled Crystal Oscillator (OCXO)
- Avionics Processor Module (APM)
- Backplane
- Front Panel

The SDU enclosure is constructed of machined lightweight aluminium alloy and it is packaged in an ARINC 600 6 MCU (Modular Concept Unit) housing suitable for mounting in the equipment bay of an aircraft.

Two hold-down clamps are used to secure the SDU, permitting it to be firmly held in position in the mounting rack. A handle fitted on the front panel of the SDU permits removal, installation and carrying of the SDU.

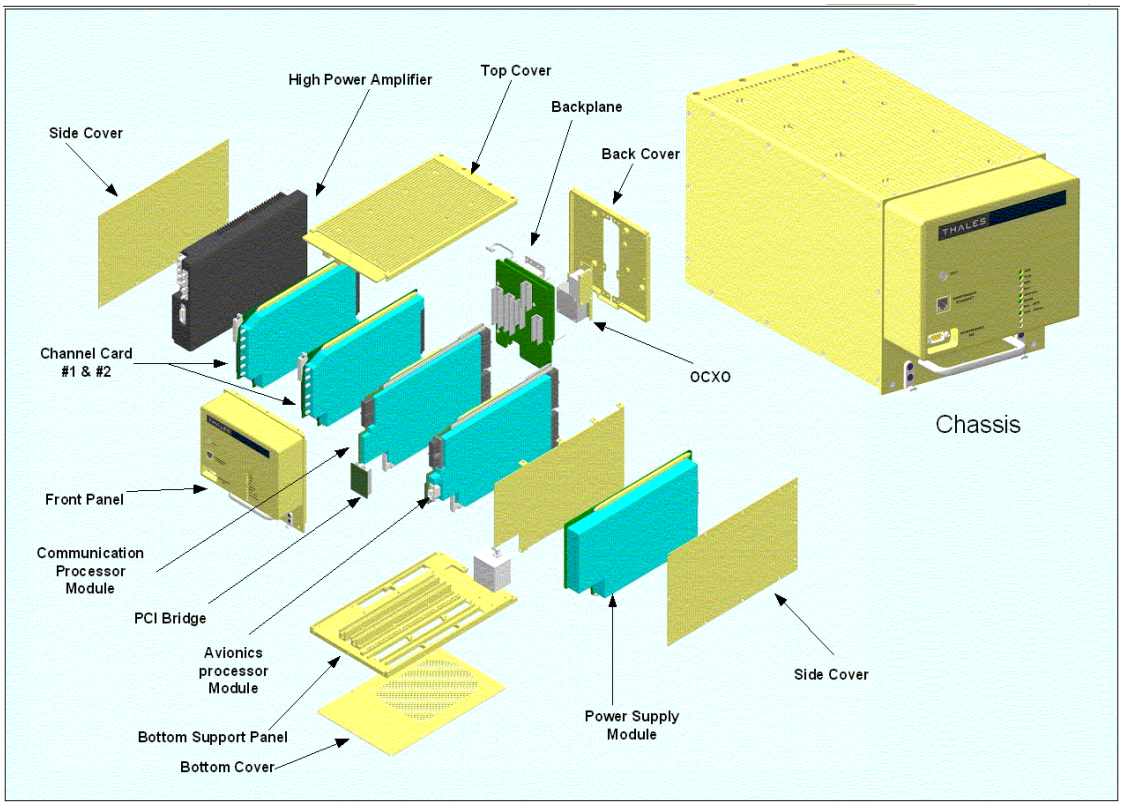

Figure 2-3: Example of SDU sub-system modules exploded.

2.3.2. Software

The software in the SDU can be considered as being supplied in two elements, one contained within the CCM the other operating on the SDU processors (CPM & APM).

The SDU's application software primarily functions as the system controller providing system level tasks such as CCM control, BITE reporting, Avionics interfacing via ARINC-429 (including IRS (Inertial Reference System)) and providing external interfaces (such as Ethernet) as well as routing functions between the external interfaces and the CCM as necessary.

The SDU's APM and CPM application software meets RTCA/DO-178B level D requirements, and the CCM application software meets RTCA/DO-178 level E requirements.

2.3.3. ORT Parameters

The SCM ORT (Owner Requirement Table) is also stored inside the SDU. The ORT database contains configuration data that is used to customize the operation of the TFS system. It allows various preferences to be set to enable the efficient use of the equipment in normal operation. The SDU is delivered to customers with a default ORT.

2.3.4. General Operation

The SDU controls and processes all essential data in order to manage the reception and transmission of data through the satellite link. The SDU controls the set-up of the required channel types, providing modulation/demodulation, error correction, coding, and data rates associated with the satellite communication channel(s).

The SDU is of modular design and can be configured for use on a wide variety of aircraft. It meets requirements for cabin only, cockpit only and cabin and cockpit services. This manual however covers the SA cabin only configuration.

The SDU converts digital/audio inputs to Radio Frequency (RF), and contains a High Power Amplifier (HPA) function providing the necessary output power to support communication between the aircraft and the satellite. It also controls the associated antenna sub-system and uses the SCM for its own configuration data purposes.

The SDU operates within set frequency bandwidths:

- RX range is between 1525 to 1559 MHz
- TX is tuned over the range 1626.5 to 1660.5 MHz
- TX operational range is between 1631.5 to 1660.5 MHz

2.3.5. Sub-modules Basic Detailed Operation

- The Front Panel assembly gives visual indications for system status, external maintenance interface connections and the SDU Person Activated Self Test (PAST) push button
- The Backplane assembly makes interconnections between external interfaces and the SDU internal sub-assemblies
- The APM provides interfacing to external avionics. It receives aircraft position, speed and heading information from external avionics via ARINC 429 (Aeronautical Radio Incorporated), and updates the CCM with position information every second. The APM manages satellite selection based on aircraft position, and maintains antenna pointing to the wanted satellite beam steering via ARINC 429. The APM manages RF (Radio Frequency) resources and set CCM transmit power levels, taking into consideration antenna gain and cable losses stored within the ORT
- The CPM handles and controls all communications interfaces (Ethernet, RS232 and RS422)
- The CCM converts user's input/output data to signals suitable for transmitting and receiving L-Band signals using the satellite link

- The High Power Amplifier (HPA) module amplifies the low level RF signals from the CCM to produce high power output prior to connection to the antenna
- The PSM operates from 115 Vac and supplies low level dc power supplies to SRUs within the SDU and 12 Vdc to the SCM
- The OCXO provides 10 MHz clock reference signal for the CCM circuit

2.3.6. Operating Environment

- Operating temperature: between -15^{o} C (5^{o} F) and +55^{o} C (131^{o} F)
- Cooling: Forced air type in accordance with ARINC 600, requiring airflow rate of 50 kg/hr, blowing from top to bottom. Maximum inlet temperature +40^{o} C
- Heat dissipation: 220 W (assuming 100% duty cycles with HPA operating at 30 W output

2.3.7. Environmental Conditions

The SDU complies with the RTCA/DO-160-E (ED-14E). The environmental qualifications categories complied with, are as per listed in Figure 2-4.

RTCA DO-160E (ED-14E) Environmental Categories		
1	Temperature/Altitude	A2
2	Loss of Cooling	V
3	Temp Var.	B
4	Humidity	B
5	Shock/Crash	E
6	Vibration	R
	Vibration Curve	BC
7	Explosion	E
8	Waterproof	X
9	Fluids	X
10	Sand/Dust	X
11	Fungus	F
12	Salt Fog	X
13	Magnetic Effect	A
14	Power Input	A(WF)
	Harmonics	H
15	Voltage Spike	A
16	Conducted Audio	R(WF)
17	Induced	ZW
18	RF Susceptibility	TR
19	RF Emissions	M
20	Lightning Induced	A3G33
21	Lightning Direct	X
22	Icing	X
23	ESD	A
24	Fire	C

Figure 2-4: Environmental test categories for SDU & SCM.

2.3.8. Identification Label

Figure 2-5 represent the SDU Front Panel Identification Label for detailed description of the numbered field refer to the legend in Figure 2-6.

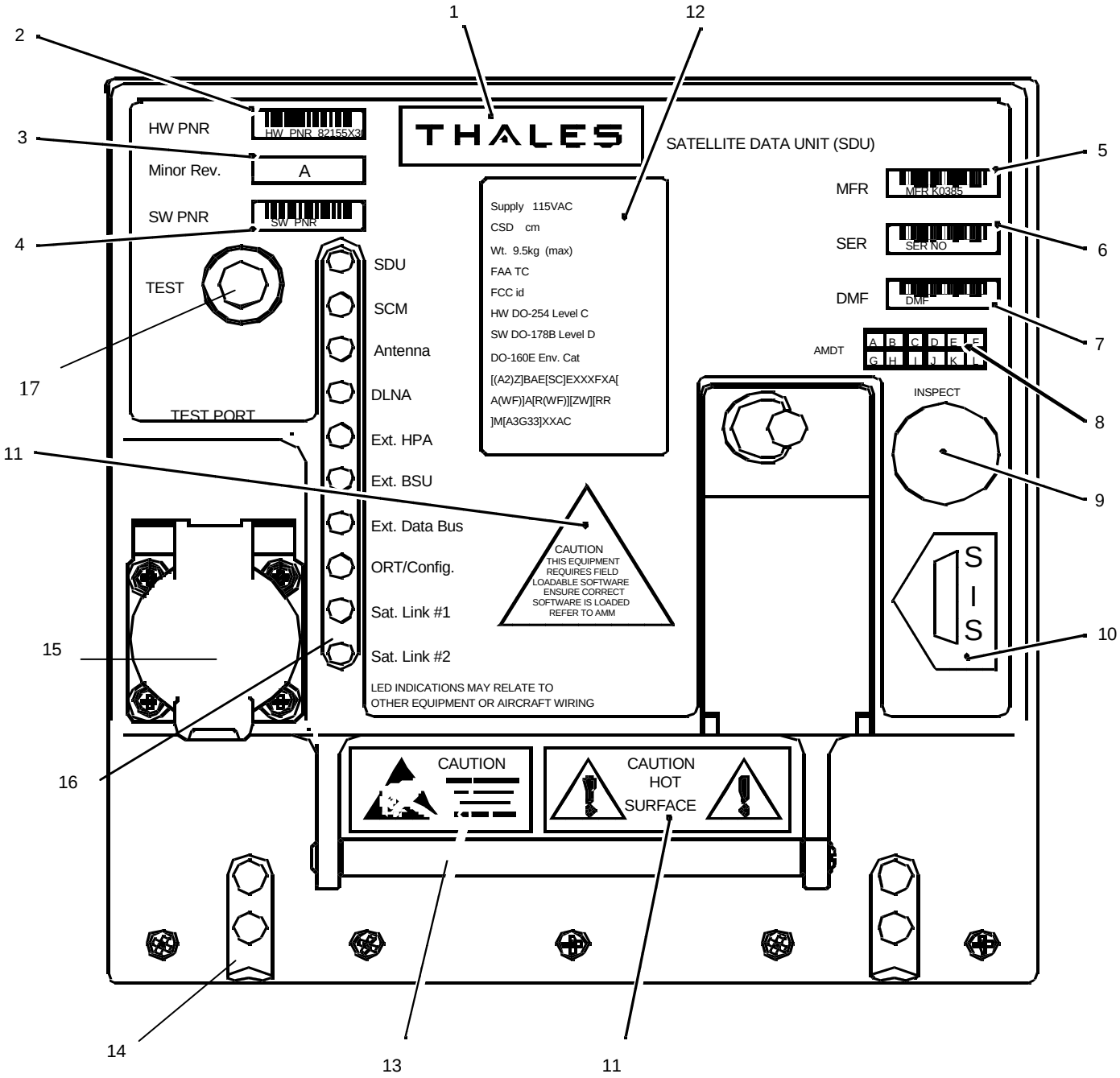

Figure 2-5: Example of SDU Front Panel.

SDU Front Panel legend	
1	Manufacturer's Name
2	Hardware Part Number
3	Hardware Minor Revision
4	Software Part Number
5	Manufacturer's Code
6	Equipment Serial Number
7	Date of Final Factory Inspection (month and year)
8	Amendment Label
9	Inspection Stamp
10	Standalone Identification System
11	Field Loadable Software Warning
12	Voltage Supply, Compass Safe Distance, Weight of Equipment, FCC (Federal Communication Commission) ID, Hardware and Software Compliance references
13	Carrying Handle
14	Hold Down Lugs
15	Ethernet RJ45 Maintenance Connector
16	Status Light Emitting Diodes (LEDs)
17	Push To Test Switch

Figure 2-6: SDU Front Panel legend.

2.3.9. Weight and Dimensions

- For overall dimensions refer to Figure 2-7
- Form Factor: ARINC 600, 6 MCU
- Mass: 9.5 kg (21 lb) maximum

2.3.10. SDU Electrical Characteristics

- Supply voltage: 100 to 122 Vrms, ac, Frequency Range 360 to 800 Hz
- Power consumption: 255 W maximum
- RF Power Rating: variable up to 30W for continuous operation
- Max Power Rating, Watts: 120W peak RF power 4 channels @ 7.5W each

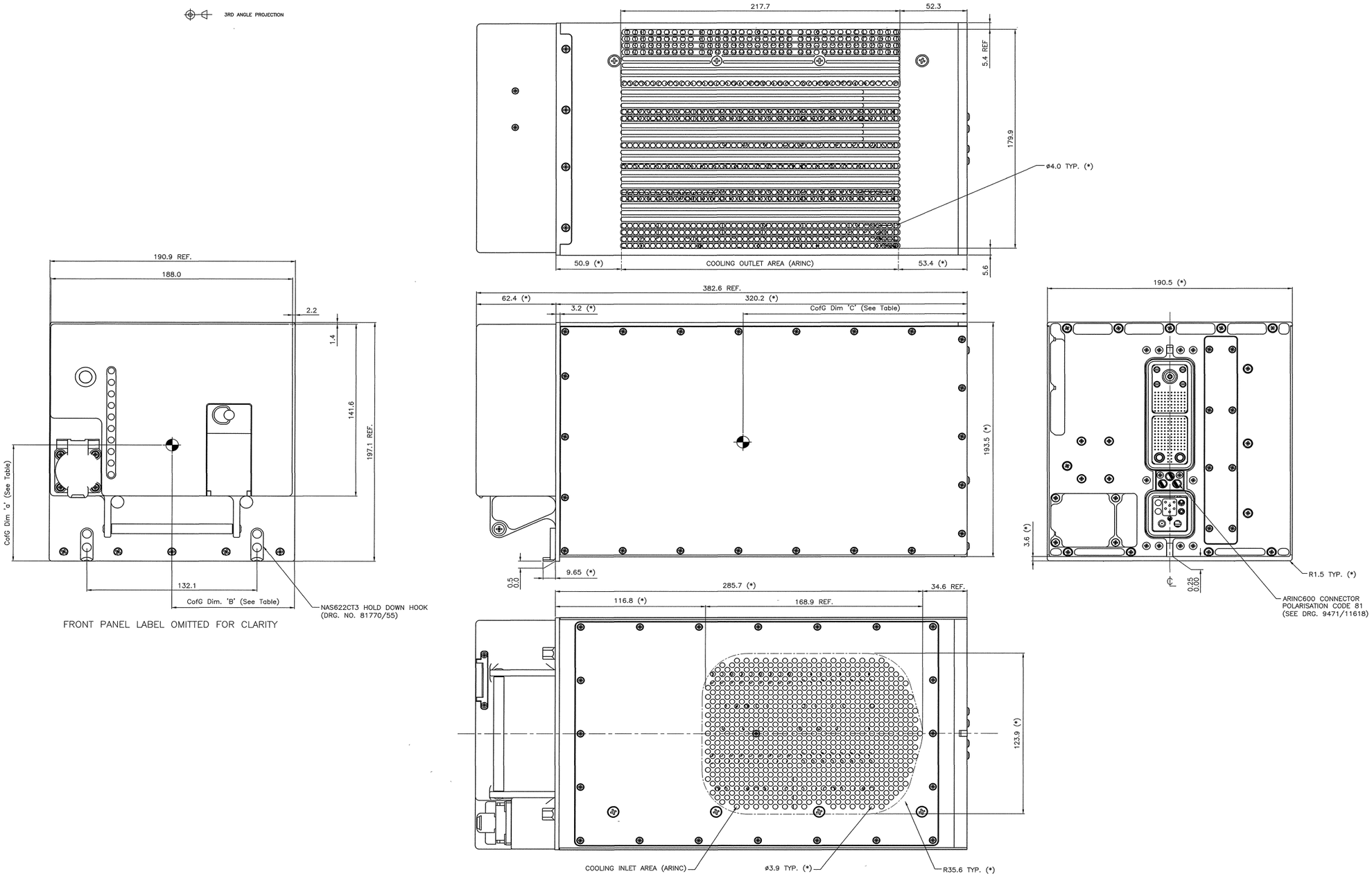

Figure 2-7: SDU Overall Dimensions. NOTE: all measurements given are in mm.

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2.4. Interfaces

The SDU interfaces with various aircraft systems.

2.4.1. Aircraft Power Utility Service

The TFS interfaces with the aircraft primary power generator as per depicted in Figure 2-8 below.

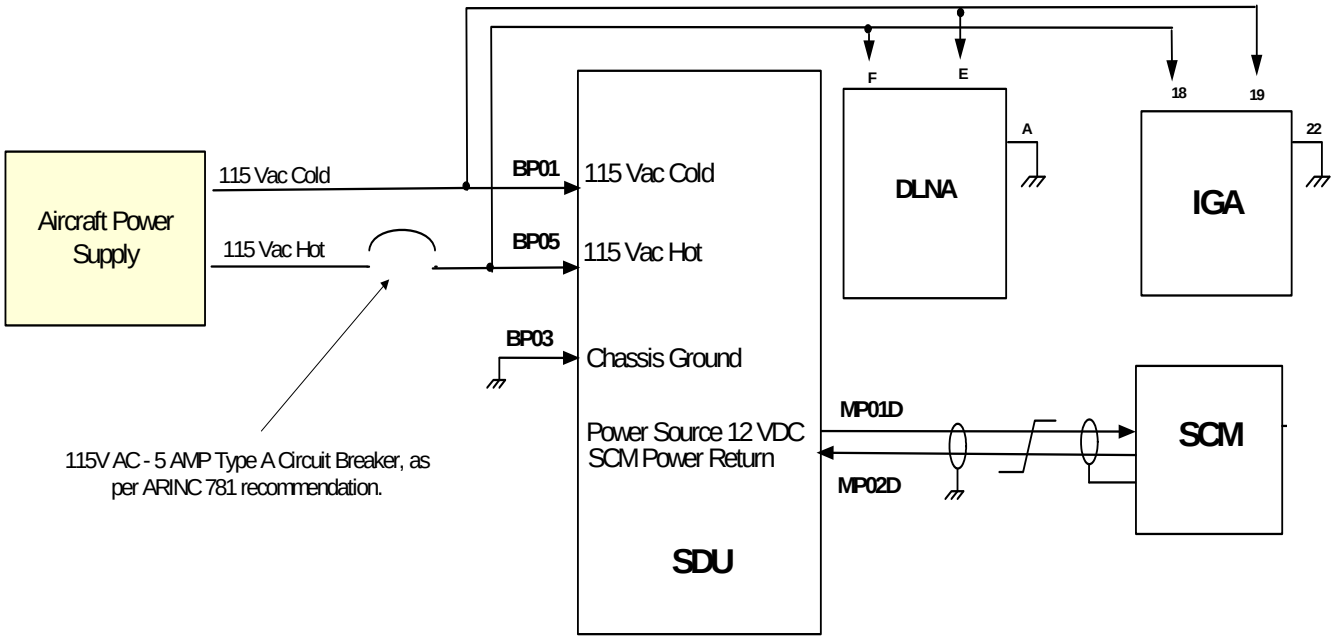


Figure 2-8: TFS example of aircraft power distribution diagram.

2.4.2. Avionics interfaces

The following avionics interfaces are supported:

- Specific to type Cabin Network domain
- ADL (Aircraft Data Loader), PDL (Portable Data Loader)
- IRS, GPS (Global Positioning System)

In order to comply with transmit burst time, INMARSAT requires the SDU to be provided with the aircraft present position within 1500m in three dimensions, referenced to WGS-84 (GPS). In order to comply with this requirement the TFS SDU requires ARINC 429 Nav Data labels as referenced in Figure 2-9. The values apply to aircraft configurations where only on Nav Data bus is connected.

PARAMETER	ARINC 429 LABEL
Latitude GNSS – Hybrid	254
Longitude GNSS – Hybrid	255
Ground Speed GNSS – Hybrid	175
Track Angle True GNSS – Hybrid	137
True Heading – Hybrid	132
Pitch Angle	324
Roll Angle	325
GNSS Height (HAE) or Hybrid Altitude MSL	370 or 261
GNSS UTC (Binary)	150
GNSS Date	260
GNSS Sensor Status	273
GNSS HDOP	101

Figure 2-9: ARINC 429 Nav Data Labels – Hybrid.

2.4.3. Maintenance Interfaces

The SDU supports the following maintenance interfaces:

- Aircraft Data Loader (ADL), ARINC 615/615A
- Portable Data Loader (PDL), ARINC 615A
- Thales Maintenance Terminal

NOTE: For more information concerning data loading tools contact the Thales TFS product support representative at the following address:

86 Bushey Road
Raynes Park, London
SW20 0JW, UK
Tel. +44 (0)20 8946 8011 (Switchboard)
Tel. +44 (0)20 8946 5169 (Hot desk).

2.5. Configuration Straps

In the case of using the mandatory configuration straps the SDU is configurable via the SDU ARINC 600 configuration straps as defined in ARINC 781.

The straps input values will be read only at unit power-up to determine the system configuration. The SDU configuration will be selectable by multiplexing the Configuration Straps inputs with the service availability discrete outputs as per ARINC 781 Attachment 1-4 Note 17.

2.5.1. Mandatory Configuration Pins

Pins TP (Top plug) 3D and TP3E must be used on all aircraft installations as they may be used as hardware implemented safety override to force the internal HPA function into low power mode when connected to an external HPA.

Pin TP3G must be used on all aircraft installations since one of its functions is to indicate whether all other configuration pins (excluding TP3D, TP3E, TP3F, TP3G, and TP4D) should be used by the SDU. Pin TP4D should be used on all aircraft installations since it indicates the SDU number (1 or 2).

Pin TP3F must be used on all aircraft installations since it indicates that the number of all configuration pins (excluding TP3D) including the parity pin itself connected to service availability discrete (or TP3D) is odd.

2.6. SDU Interconnections

2.6.1. ARINC 600 Standard Interwiring Connector

The SDU ARINC 600 connector provides:

- Input/Output connections
- DO160E EMC filtering to input and output interfaces
- ESD (Electrostatic Discharge) protection for ATE connections

The SDU is provided with a low insertion force, size 2-shell receptacle in accordance with ARINC 600 Attachment 19. This connector accommodates coaxial and signal interconnections in the top plug (TP) insert, Quadrax and signal interconnections in the middle plug (MP) insert, and coaxial, fibre and power interconnections in the bottom plug (BP) insert. The contact arrangements are as follows:

- Insert arrangement 08 receptacle in accordance with ARINC Specification 600, Attachment 11 for the top insert (Size 1 Coax cavity and Size 22 Signal sockets)
- Insert arrangement 120Q2 receptacle in accordance with ARINC Specification 600, Attachment 20, Figure 20-6.5.5 for the middle insert (Size 8 Quadrax cavities for pin components and Size 22 Signal sockets)
- Insert arrangement 12F5C2 receptacle in accordance with ARINC Specification 600, Attachment 19, and Figure 19-49.19 for the bottom insert (Size 12 Electrical pins, Size 16 Electrical pin, Size 5 Coax cavities, and Size 16 Optical cavities).
- Index pin code 081 in accordance with ARINC Specification 600, Attachment 18 should be used on both the SDU and the aircraft rack connectors

2.6.1.1. ARINC 600 Pin Assignment

The layout of the rear panel ARINC 600 connector and the Pin assignment are shown in the figures 2-10, 2-11, 2-12, and 2-13. For further Information regarding the ARINC 600 connector refer to Figure 2-15.

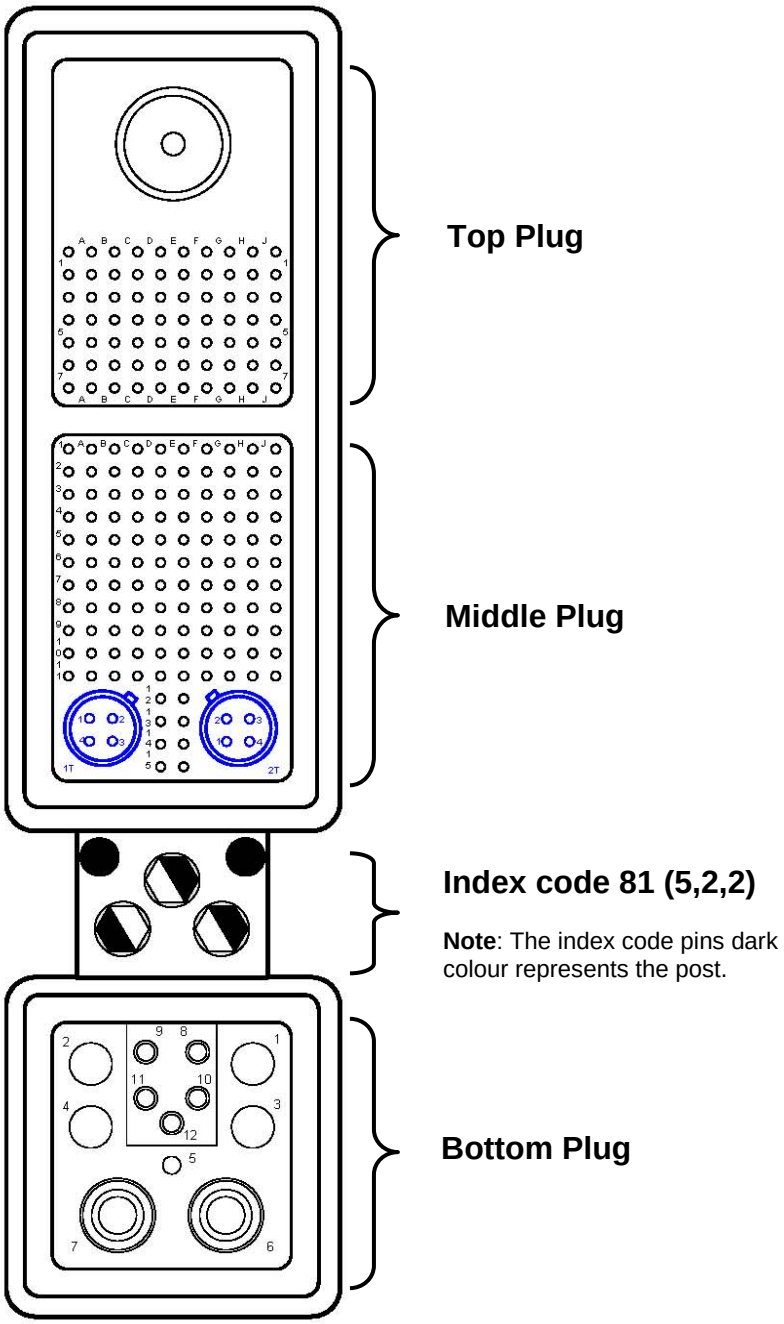
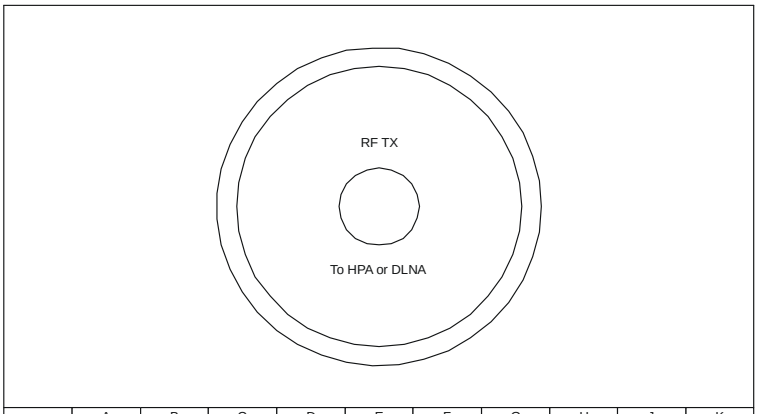


Figure 2-10: ARINC 600 Connector Layout.



	A	B	C	D	E	F	G	H	J	K
1	ATE Pin 1 A	ATE Pin 2 B	ATE Pin 3	ATE Pin 4	ATE Pin 5	ATE Pin 6	ATE Pin 7	ATE Pin 8	ATE Pin 9	ATE Pin 10
2	ATE Pin 11	ATE Pin 12	ATE Pin 13	ATE Pin 14	ATE Pin 15	ATE Pin 16	ATE Pin 17	ATE Pin 18	ATE Pin 19	ATE Pin 20
3	Ethernet 1 TX A	Ethernet 1 RX A	Empty Cavity	Config Pin 1	Config Pin 2	Config Pin 3	Config Pin 4	SPARE	ISDN 1 TX A	ISDN 1 RX B
4	Ethernet 1 RX B	Ethernet 1 TX B	Empty Cavity	Config Pin 5	Config Pin 6	Config Pin 7	Config Pin 8	SPARE	ISDN 1 RX A	ISDN 1 TX B
5	Empty Cavity	Empty Cavity	Empty Cavity	Config Pin 9	Config Pin 10	Config Pin 11	Config Pin 12 (Spare)	SPARE	SPARE	SPARE
6	Ethernet 2 TX MCDU 3 A	Ethernet 2 RX MCDU 3 A	Empty Cavity	Config Pin 13 (Spare)	Config Pin 14 (Spare)	Config Pin 15 (Spare)	Config Pin 16 (Spare)	SPARE	ISDN 2 TX A	ISDN 2 RX B
7	Ethernet 2 RX B	Ethernet 2 TX B	Empty Cavity	Config Pin 17 (Spare)	Config Pin 18 (Spare)	Config Pin 19 (Spare)	Config Pin 20 (Spare)	SPARE	ISDN 2 RX A	ISDN 2 TX B

Figure 2-11: ARINC 600 Connect Arrangement For Top Plug (TP) Insert

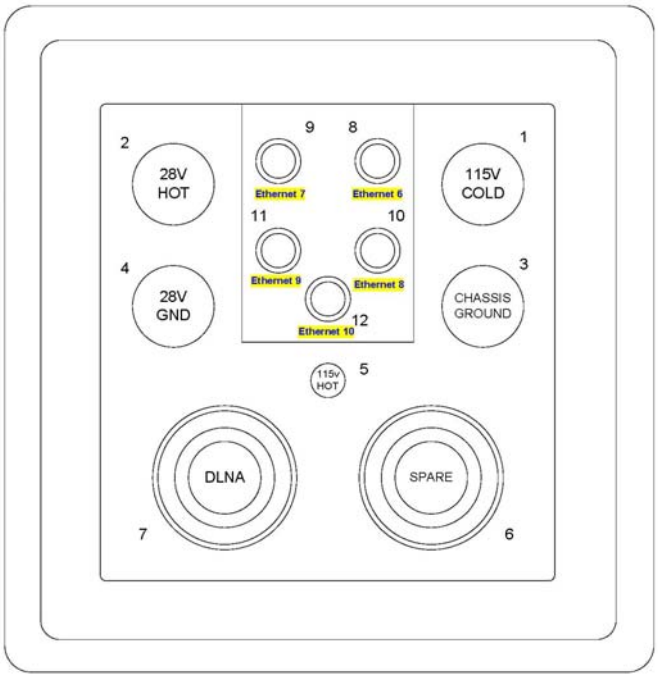


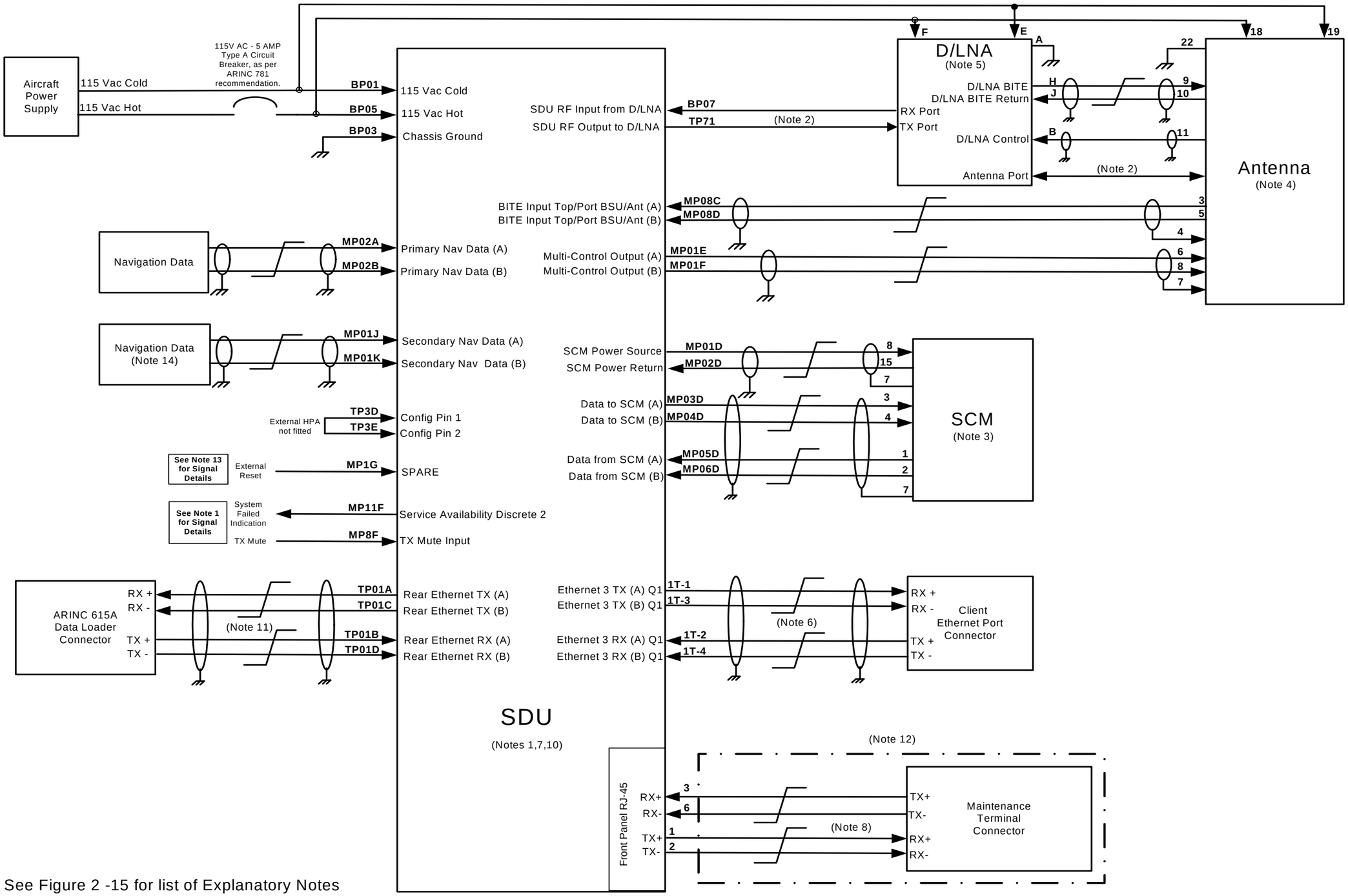
Figure 2-12: ARINC 600 Connections Arrangement For Bottom Plug (BP) Insert.

	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 Pwr +8 to+15V	Multi-Control Output A	Multi-Control Output B	**Resv Ext Reset Discrete Input**	Call Place/ End Discrete Input2	Data from MCDU 2 A	Data from MCDU 2 B
2	Data from Primary IRS/GNSS A	Data from Primary IRS/GNSS B	CockpitVoice Chime Signal Contact1	SCM Pwr Return 0V	BITE Input from HPA A	BITE Input from HPA B	**Rsvd Mfr-Specific 0-28V Discrete Output**	Cockpit Voice Chime Signal Contact2	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 Output1	SDU Data to SCM A	Spare Discrete Output	Spare Discrete Input	SPARE	Cockpit Voice Call Light Output 2	Data From CMU2 A	Data From CMU2 B
4	Cockpit Audio Input 1 High	Cockpit Audio Input 1 Low	Cockpit Voice Mic On Input1	SDU Data to SCM B	Spare Discrete Output	Spare Discrete Input	SPARE	Cockpit Voice Mic On Input 2	Cockpit Audio Input2 High	Cockpit Audio Input2 Low
5	Cockpit Audio Output 1 High	Cockpit Audio Output1 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 Output2 High	Cockpit Audio Output2 Low
6	Spare Discrete Input	Spare Discrete Input	Spare Discrete Input	SCM Data to SDU B	**Ethernet 5 10 Base T (Spare)** from SDU to User +	**Ethernet 5 10 Base T (Spare)** from SDU to User -	Spare ARINC 429 Input A	Spare ARINC 429 Input B	Spare ARINC 429 Input A	Spare ARINC 429 Input B
7	AES ID Input A	AES ID Input B	Spare Discrete Input	WOW Input 1	**Ethernet 5 10 Base T (Spare)** from User to SDU +	**Ethernet 5 10 Base T (Spare)** from User to SDU -	Spare ARINC 429 Output A	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 MCDU3 A	Data from MCDU3 B	Port BSU HPA Mute Input A	Port BSU HPA Mute Input B	LGA LNA On/Off Control	BITE Input From LGA LNA	STBD BSU HPA Mute Input A	STBD BSU HPA Mute Input B	Data to MCDU 1,2,3 A	Data to MCDU 1,2,3 B
11	POTS1 A	POTS1 B	Cabin CEPT-E 1 Data Output A	Cabin CEPT-E 1 Data Output B	Service Availability Discretes 1	Service Availability Discretes 2	Cabin CEPT-E 1 Data Input A	Cabin CEPT-E 1 Data Input B	POTS2 A	POTS 2 B
12	1 Ethernet3 from SDU to User + 2 Ethernet3 from User to SDU + 4 Ethernet 3 from User to SDU - 3 Ethernet3 from SDU to User - 1 T				Service Availability Discretes 3	Service Availability Discretes 4	2 Ethernet 4 from User to SDU + 3 Ethernet4 from SDU to User - 1 Ethernet 4 from SDU to User + 4 Ethernet 4 from User to SDU - 2 T			
13					Service Availability Discretes 5	Service Availability Discretes 6				
14					Service Availability Discretes 7	Service Availability Discretes 8				
15					Service Availability Discretes 9	Service Availability Discretes 10				

Figure 2-13: ARINC 600 Connect Arrangement For Middle Plug (MP) Insert.

2.6.2. Electric Interconnection Diagram

The SDU interconnection diagram is given in Figure 2-14. It illustrates all the necessary connection between the SDU and all the other interfaced equipment.



NOTE: See Figure 2 -15 for list of Explanatory Notes

Figure 2-14: TFS System Interconnection Block Diagram – Single Aisle Configuration.

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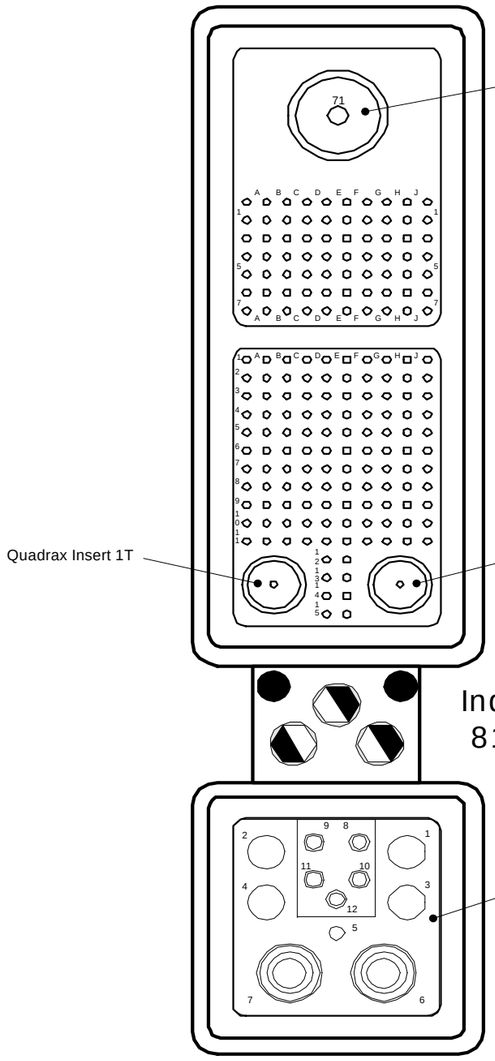
ARINC 600
SDU Connector
defined in ARINC 781 - see Note 1



Size 1 Coax Plug. Radiall
P/N: 620 001 (male center contact)

Size 5 Coax Plug. Radiall P/N:
620 121 (female center contact)
See Note 9.

- ARINC 600 - Shell Size #2 Connector
- View above is looking at the SDU mount connector, Radiall Part Number: 620-600-703.
- Tray-mount mating half is supplied with all necessary inserts, except 1 x Size 5 Socket Coax insert (male centre contact) (Radiall P/No: 620-021), which should be ordered separately. See Radiall specification for 620-600-700 for further details on supplied inserts.
- Fibre inserts are not required and will not be populated on the SDU mount connector, filler plugs will be used to fill cavities. Size 5 Coax insert BP-6 is not required on the SDU mount connector and will not be populated, a filler plug will be used to fill cavity.
- Index Code: 81 (5,2,2)
- (Top Insert: 08 / Middle Insert: 120Q2 / Bottom Insert: 12F5C2)
- For the index code pins above, the dark colour represents the post.

Notes

Note 1: System interconnections are as per ARINC781 - refer to ARINC 781 for clarification / further detail.

Note 6: Uses “Star-Quad” cable as defined in ARINC 664 Part 2. Cross-over to be provided in cable.

Note 7: Pins not required are not listed and should be left ‘Not-Connected’.

Note 8: Cross-over to be provided in cable, when using standard RJ-45 Ethernet connections.

Note 9: Radiall P/No: 620-600-700 does not include all necessary contacts; 1 x Size 5 Crimp Socket Coaxial Contact must also be ordered: Radiall P/No: 620-021.

Note 10: Pigtails for wiring shields/screens are to be made as short as possible to reduce susceptibility to interference.

Note 11: Uses “Shielded, Twisted Pair” cable as defined in ARINC 664 Part 2.

Note 12: The Maintenance Terminal interface will only be connected during maintenance activities.

Note 13: For the External Reset discrete input signal, ground state defined as input voltage less than 3.5V and resistance to airframe dc ground less than 20 mohms. Open state defined as input voltage higher than 14V and resistance to airframe dc ground higher than 100000 ohms.

Note 14: A second Nav Data bus might be required for some aircraft installations.

Note 2

RF Cable Losses

	RF Loss
SDU to D/LNA	Loss ≤ 1.4 dB
D/LNA to Antenna	Loss ≤ 0.3 dB
D/LNA to SDU	6 dB ≤ Loss ≤ 25 dB

The IGA mount RF connector (J2), the DLNA mount Antenna connector (J1) and the DLNA mount RX (SDU input) connector (J2) are all TNC Jack (female) type connectors.

The DLNA mount TX (SDU output) connector (J3) is a N-Type Jack (female) type connector.

Note 3

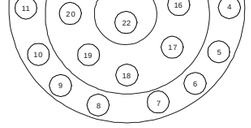
SCM Connector

Pin	Signal	Description
1	Data to SDU A (RS422)	Data to SDU A
2	Data to SDU B (RS422)	Data to SDU B
3	Data from SDU A (RS422	Data from SDU A
4	Data from SDU B (RS422)	Data from SDU B
5	Reserved – RS232 GND [1]	Connection Not required
6	Spare	Connection Not required
7	Chassis Ground	Chassis Ground
8	Power Input +8 to +15V	SCM Power Input
9	Reserved - Enable RS232 [1]	Connection Not required
10	Reserved – 0V strap output [1]	Connection Not required
11	Spare	Connection Not required
12	Reserved – RS232 Tx [1]	Connection Not required
13	Reserved – RS232 Rx [1]	Connection Not required
14	Spare	Connection Not required
15	Power Return 0V	SCM Power Return

The SCM connector is a DB15 male connector, mating with a DB-15 female connector on the cable, in accordance with MIL-DTL-24308 (15 pins - gauge 20).

Note 4

IGA/HGA Power and Control Connector

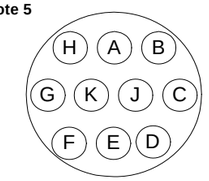


The IGA/HGA Connector is a receptacle - 13-35 insert of the MIL-C-38999 Series III family: D38999/24FC35PN which mates with D38999/26FC35S on the cable

PIN No	SIGNAL	DESCRIPTION
1	+28 Vdc	Connection Not Required
2	28 Vdc RTN	Connection Not Required
3	Antenna BITE A	ARINC 429 from antenna
4	Antenna BITE SCRN	Screen for ARINC 429
5	Antenna BITE B	ARINC 429 from antenna
6	Antenna Control A	ARINC 429 to antenna
7	Antenna Control SCRN	Screen for ARINC429
8	Antenna Control B	ARINC 429 to antenna
9	D/LNA BITE	BITE from D/LNA
10	D/LNA SCRN	Screen/RTN for D/LNA
11	D/LNA CTL	D/LNA on/off control from antenna
12	Serial SCRN [1]	Connection Not Required
13	RS422 RXD A [1]	Connection Not Required
14	RS422 RXD B [1]	Connection Not Required
15	RS422 TXD A [1]	Connection Not Required
16	RS422 TXD B [1]	Connection Not Required
17	ATE Pin	Connection Not Required
18	115 Vac Hot	Aircraft ac power
19	115 Vac Return	Aircraft ac power
20	--	Connection Not Required
21	--	Connection Not Required
22	Chassis Ground	Chassis Ground

Note 5

D/LNA Power and Control Connector



The D/LNA Connector is MS3470L1210P which mates with MS3476L1210S on the cable

Pin	Signal	Description
Pin A	Chassis Ground	Chassis Ground
Pin B	LNA Control	LNA Control
Pin C	Future Spare	Connection Not required
Pin D	Future Spare	Connection Not required
Pin E	115 Vac Cold	Aircraft AC Power
Pin F	115 Vac Hot	Aircraft AC Power
Pin G	+28V DC Hot	Connection Not required
Pin H	LNA BITE	LNA Bite
Pin J	LNA BITE Return	LNA BITE Return
Pin K	+28V DC Return	Connection Not required

Figure 2-15: TFS Interconnection Block Diagram – Single Aisle Configuration.

2.6.3. Interconnection Cables

2.6.3.1. RF Coaxial Cables

The SDU is connected to the DLNA and Antenna (see Figure 2-14), by means of a RF low loss coaxial cable. The distance between the devices, and the cable selected for the installation must be such that the cable losses remains within the limits indicated within Figure 2-15, Note 2. All coaxial cable should be 50 Ohms nominally.

NOTE: Interconnect cables should be routed away from sources of potential electromagnetic interference. Use shielded wires and cables where necessary.

2.6.3.1.1. RF cable characteristics for the SDU to DLNA Tx port

Maximum Path Loss	Nominal Max Power	Frequency Range
1.4 dB (see Note)	60 Watts	1626.5 – 1660.5 MHz

2.6.3.1.2. RF cable characteristics for the DLNA to SDU Rx port

Loss Range	Nominal Max Power	Frequency Range
6 – 25 dB (see Note)	0.5 Watts	1525 – 1559 MHz

2.6.3.1.3. RF cable characteristics for the DLNA to Antenna port

Maximum Path Loss	Nominal Max Power	Frequency Range
0.3 dB (see Note)	46 Watts	1525 – 1660.5 MHz

NOTE: Applied to the complete RF cable path and not to each component within the RF path.

2.6.3.2. Power Cables

The SDU mains power cable must be able to handle 115 Vac/5A (see note). The recommended size is 20 AWG.

NOTE: Switch on surge is approximately 7A for the duration of 200ms.

The SDU to SCM power cable must be able to handle 12Vdc. Cable size is 22 AWG.

2.6.3.3. ARINC 429 connections

ARINC 429 connection cable must be a size 22 single twisted and shielded pair of wires cable.

2.6.3.4. ETHERNET

The recommended Aerospace Grade 100Base-T Ethernet cable is P/N NF 24Q100. The conductor AWG size (19 strands) is size 24.

Flammability requirements for this cable meet or exceed FAR25.869 requirements.

2.7. SCM General Description

2.7.1. Hardware

The only SCM Part Number available is 82158A Series. This SCM is compatible with the SA SDU Part Number 82155A Series and all other different SDU configurations. The SCM hardware meets RTCA/DO-254 level D requirements.

The SCM contains four USIM (Universal Subscriber Identity Module) cards. The SCM also contains an External Configuration Memory (ECM) storing the Owner Requirement Table.

2.7.1.1. External Description

The SCM is composed by the following external elements:

- The mounting plate with four attaching holes (1)
- The 15-way D-type (male) socket (2)
- The body of the SCM with one main identification label (3)

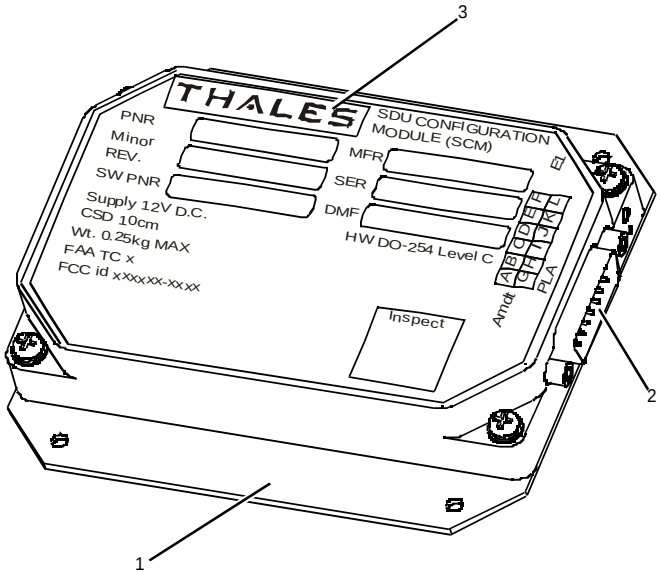


Figure 2-16: Example of SCM external view.

2.7.1.2. Internal Description

The SCM is composed of the following internal parts:

- One gasket between the D-type connector and the Body of the SCM (1)
- One PEC card with a D-type connector attached (2)
- Four USIM cards holders (3)
- A plate attached to the body by four screws and washers (4)
- A body attached to the single PEC card by four screws and washers (5)

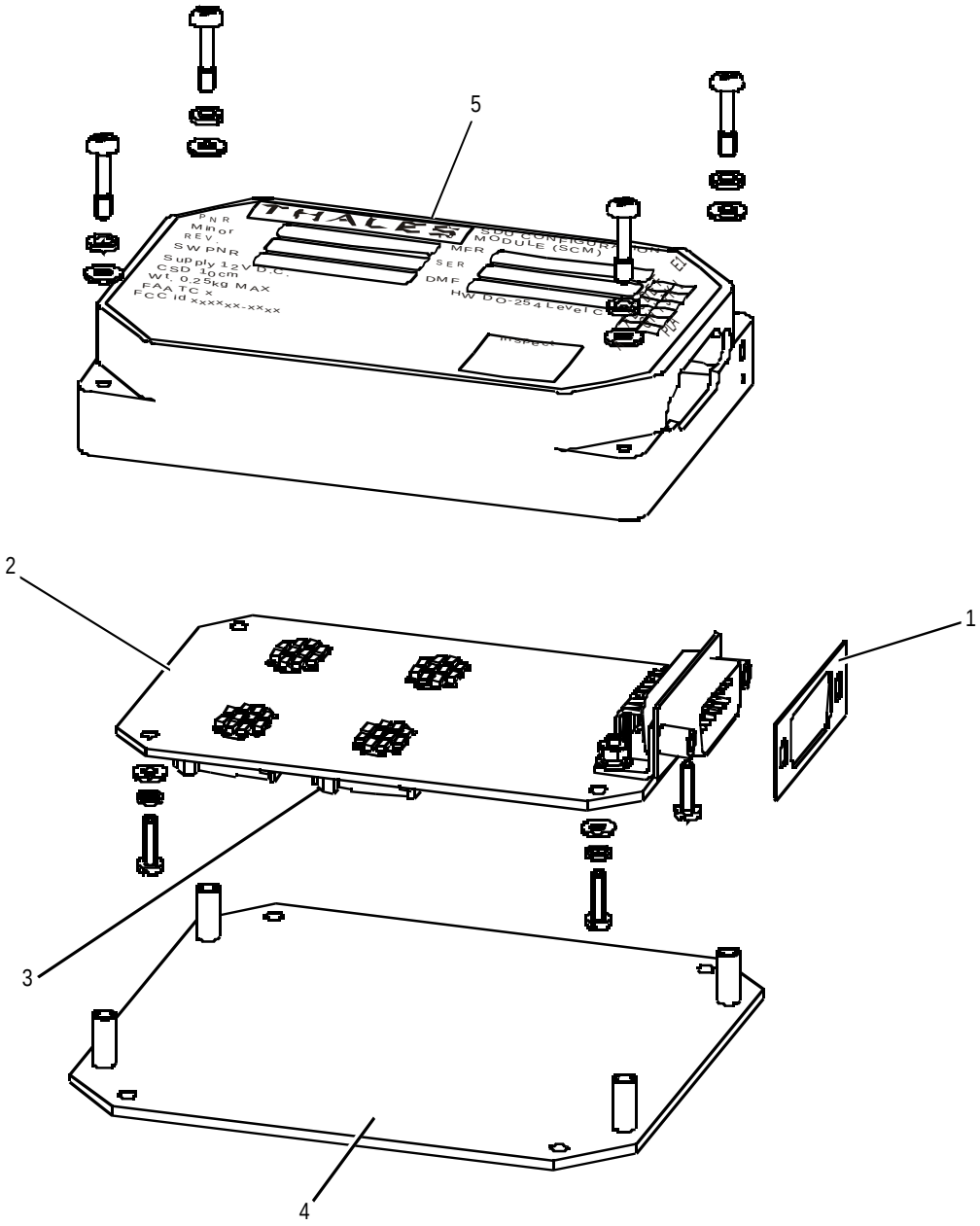


Figure 2-17: SCM exploded view.

2.7.2. ORT Parameters

The ORT is represented by a database containing a set of configuration data for the exclusive use of the SDU. The ORT is partitioned for two types of parameters in accordance with ARINC 781:

- User parameters, for operator use
- Secure parameters, for aircraft specific configurations

The ORT parameters are stored within the SCM and SDU, and are used to customise the operation of the TFS system, allowing various preferences to be set to enable the efficient use of the equipment within different platform configurations. The SDU and SCM are delivered with a default ORT.

2.7.3. ORT Synchronisation

At each power up the SDU reads the ORT from the SCM, and compares it with its locally stored copy. In normal condition the SDU and SCM ORTs should be the same, but if different the SDU overwrites its local copy with the ORT read from the SCM. The SDU uses that ORT until the SDU is powered down.

The SDU stores the local copy of the SCM Secure and User ORTs over a power down in case one of the ORTs from the SCM is not valid when the SDU next powers up.

NOTE: For more information concerning the operation of the SDU when it determines that an ORT is not valid refer to the ARINC 781 specification section 3.4.2 'Configuration & Identification Data'.

NOTE: For more information concerning changes or updates regarding ORT contact the Thales TFS product support representative.

2.7.4. Basic Operation

When operating, the SCM interfaces with the SDU CCM via the SDU CPM. The SCM operation will not commence until an input voltage from the SDU is detected. Alternatively, when removed form the aircraft the SCM will also acknowledge an input voltage from a personal computer (PC), and will operate as if it were connected to an SDU.

A single USIM card is required for each Swift Broadband channel operated by the SDU.

The SCM contains an External Configuration Memory (ECM). The ECM is a non-volatile memory, which stores the ORT database.

2.7.5. Environmental Condition

Refer to Table 2-4.

2.7.6. Identification Label

The main manufacturer label gives the following information (Figure 2-18):

- HW PNR: Equipment part number in alphanumeric form and bar code form
- Minor rev: Minor revisions
- SW PNR: For Owner Requirement Table (ORT)
- MFR: Manufacturer code in alphanumeric and bar code form
- SER: Basic part number and serial numbering alphanumeric and barcode from.
- DMF: Date of final factory inspection (month and year)
- Amdt: Amendments
- CSD: Compass Safe Distance
- Wt: Weight
- FAA TC: Federal Aviation Administration Type Certificate
- FCC id: Federal Communications Commission identification

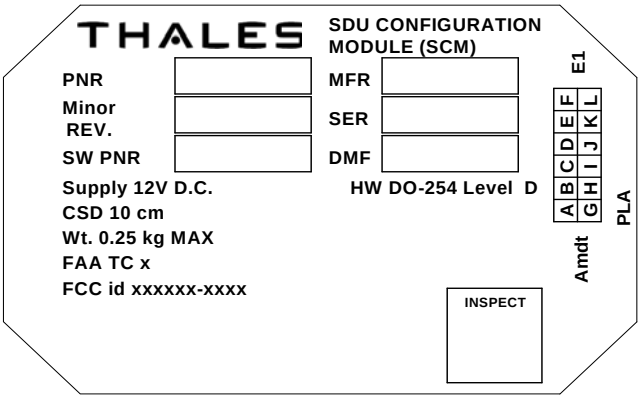


Figure 2-18: Example of SCM Identification Label.

2.7.7. SCM Electrical Characteristics

- Power input: 8 to 15 Vdc. SDU typical supplied voltage 12 Vdc
- Power consumption: 3.6 W or less
- Max current: 300 mA at 12 Vdc

2.7.8. Weight and Dimensions

- For overall dimensions refer to Figure 2-19
- Mass = 0.25kg (0.44Lbs)

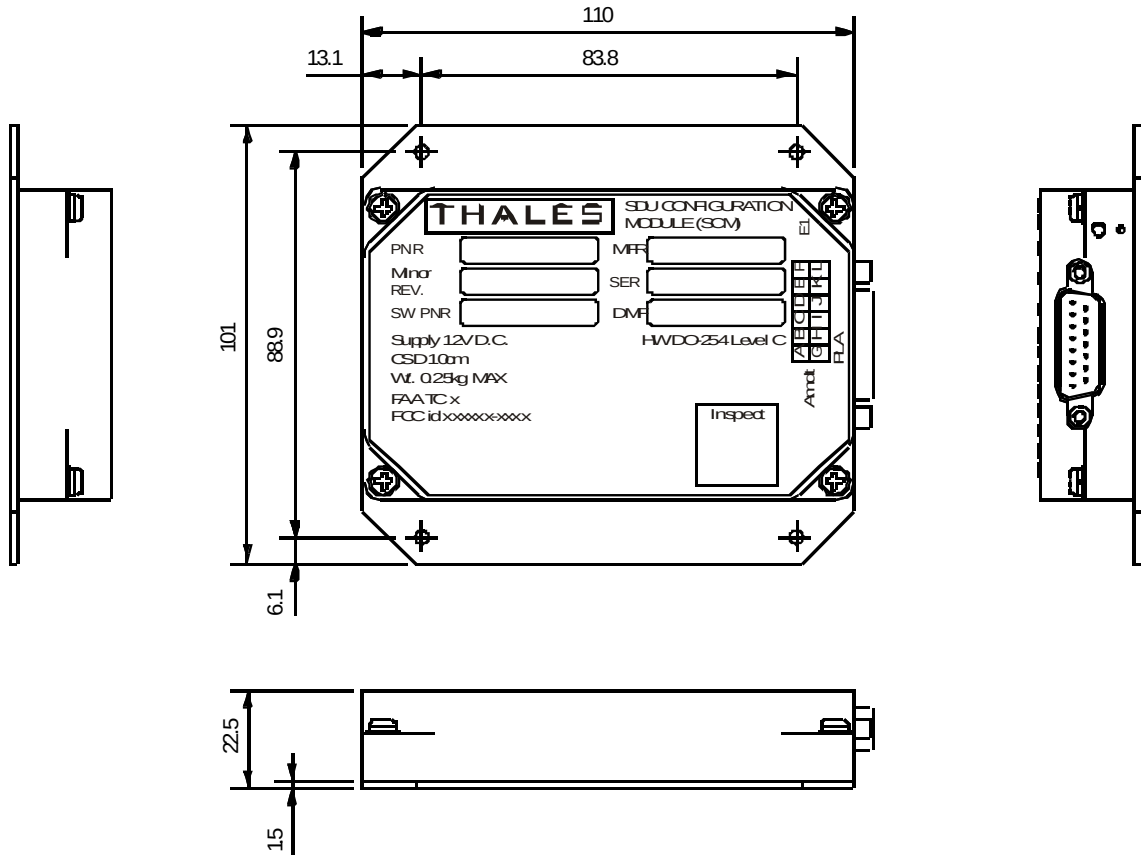


Figure 2-19: SCM Overall Dimensions.

NOTE: All measurements given in Figure 2-19 are in mm.

2.7.9. SCM Connector

The SCM connector is a DB15 (15 pins – gauge 20) male connector (see Figure 2-20 below), mating with a DB-15 female connector on the cable. For complete description of Pin Assignment refer to Figure 2-15, Note 3.

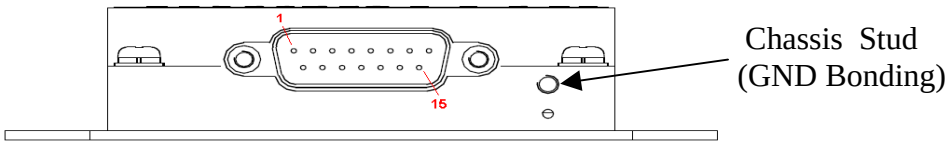


Figure 2-20: Front View of the 15 Pin D-Type Connector.

2.7.10. Equipment Electric Interconnection Diagram

The SDU interconnection diagram is given in Figure 2- 21 below. The diagram illustrates all the necessary connection between the SCM and the SDU. For description of detailed pin-to-pin connection refer to Figure 2-14 and 2-15.

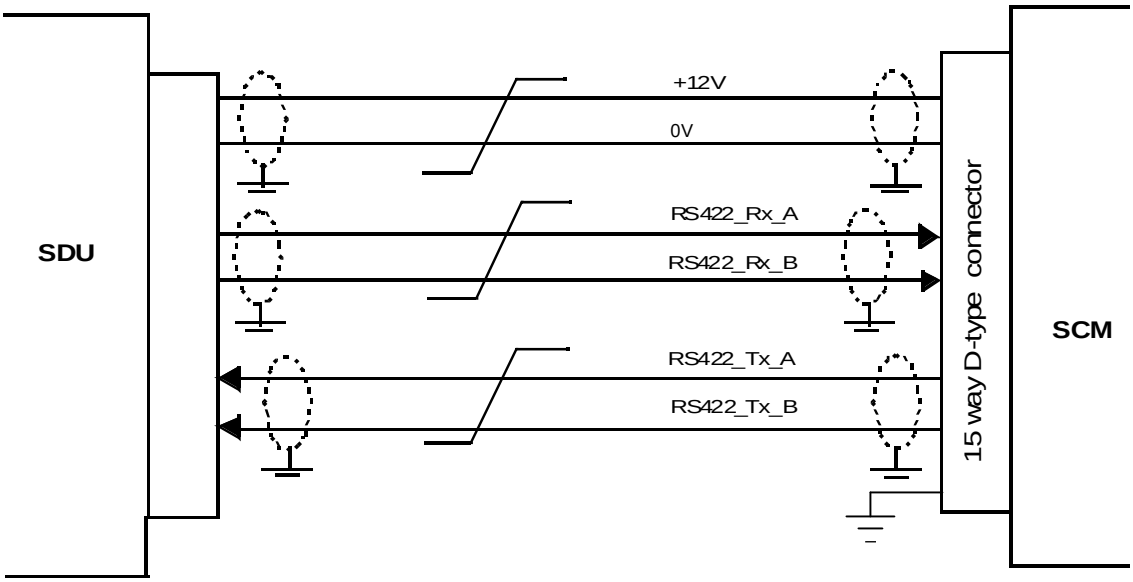


Figure 2-21: SDU/ SCM Interconnection Diagram.

3. INSTALLATION GUIDELINES

3.1. Introduction

The SDU and SCM should be installed in the aircraft in a manner consistent with acceptable workmanship and engineering practices, and in accordance with the instructions set forth in this manual.

To ensure that the system has been properly and safely installed in the aircraft the installer should make a through visual inspection and conduct an overall operational check of the system on the ground prior to commissioning to the Customer and or a flight.

NOTE: Before installing any components or cabling, read all notes contained within drawings.

3.2. Interchangeability

The SDU and SCM will operate in any installation that complies with ARINC 781. Therefore, the SDU and SCM are interchangeable only with identical system components as covered in this manual.

3.3. SDU / SCM Location and Accessibility Guidelines

Where possible the SDU should be installed in a pressurized zone that is also partially temperature controlled, and mounted on an appropriate ARINC 600 compliant mounting rack. The SDU requires external forced air-cooling.

The SCM should be installed as close to the SDU as possible in order to keep the cable runs to a minimum.

To determine the best location, the installer must select equipment locations to allow easy access to these components and their connectors. Equipment location will vary with aircraft type and design/installation specifications.

The electronic bay, and the cabin hat rack are suitable places to install this unit.

The SDU must be installed in a location that allows the following facilities to be accessible:

- Front Panel LEDs
- Front Panel TFS system Test Push Button
- Software loading RJ45 connector

CAUTION

BEFORE EQUIPMENT INSTALLATION ENSURE THAT THE AIRCRAFT POWER SUPPLY CIRCUIT BREAKER IS POSITIONED IN THE OFF CONDITION.

3.4. Mounting Tray

The mounting tray used for the installation of the SDU must comply with the design specifications for the 6 MCU (Modular Concept Unit) form factor. Refer to the ARINC 600 Specification for detailed information regarding the design of compatible equipment and airframe installations.

Figure 3-1: Example of an ARINC 600, 6 MCU Mounting Tray.

3.5. Cooling

The SDU is designed to accept an installation configuration able to provide forced air-cooling as defined in Section 3.5 of the ARINC Specification 600.

In normal operation the SDU will be cooled by forced convection with air supplied from the platform services at a maximum flow rate of 50 kg/hr and a temperature of up to 40^0 C. The cooling air will enter the equipment chassis at the bottom via a plenum chamber and exhaust at the top.

3.6. Power Requirements

It is the responsibility of the installer to select the appropriate gauge of wire for power connections, and to ensure that the required safety and voltage drop requirements are complied with.

For SDU power supply specifications refer to:

- 2.3.10: ‘SDU Electrical Characteristics’
- Figure 2.8: ‘ Aircraft Power Distribution’
- Figure 2-14: ‘TFS System Interconnection Diagram’

For SCM power supply specifications refer to:

- 2.7.8: ‘SCM Electrical Characteristics’
- Figure 2-14: ‘TFS System Interconnection Diagram’

3.7. SDU RF Connections

The SDU is connected to the DLNA through a RF coaxial cable. Installation designer must be aware that the shorter the cable is, the better system performance.

As the SDU/DLNA low loss cable is sometimes almost rigid and it could have a diameter not compatible with the IGA and DLNA connectors, it is recommended to install a short portion of a smaller and more flexible cable at each end of this low loss cable (pig tail type installation).

If necessary, secure the cable by means of evenly spaced collars to prevent the cable from chafing on aircraft parts and surfaces. These collars must be of a design, which avoids damaging the cable.

CAUTION

DO NOT EXCEED MINIMUM CABLE RADIUS OF CURVATURE FOR THE COAXIAL CABLE. USE DUMMY CABLES FOR A FIRST INSTALLATION TO DETERMINE CABLE RUNS. INSTALL FINAL CABLES ONLY AFTER THIS MODELING OPERATION.

CAUTION

ONLY PREFORMED RF CABLES SHALL BE CONNECTED TO THE SATCOM SYSTEM EQUIPMENT. ATTEMPTING TO FORM CABLES OR APPLYING STRESS TO THE CABLES WHILE THEY ARE CONNECTED TO THE EQUIPMENT CONNECTORS MAY CAUSE DAMAGE TO THE EQUIPMENT.

NOTE: Interconnect cables should be routed away from sources of potential electromagnetic interference. Use shielded wires and cables where necessary.

3.7.1. RF Insertion Losses

The SDU RF interface with the Antenna via a DLNA device. The diplexer and LNA are combined into one unit for installation. The Diplexer function couples transmit signals from the SDU to the respective antenna. The LNA amplifies the very low level L-band receive signal from its respective antenna and couples this amplified signal to the SDU.

For detailed RF insertion losses refer to Figure 2-15 Note 2. To ensure these requirements are met, some installations need the SDU to be installed in close proximity to the antenna subsystem components or the use of low loss coaxial cable.

The total loss between the DLNA and the SDU must be in the range 6 to 25 dB. If the RF cable type being used for a short cable length is less then 6 dB, an attenuator must be fitted to ensure the required loss is achieved.

3.7.2. VSWR

The Voltage Standing Wave Ratio (VSWR) of all RF cables should be 1.2:1 or better.

3.8. Bonding Requirements

The bonding of all LRUs to the airframe must not exceed 20 milliohms. However some aircraft manufacturers or design/installation organisation may require a lower value than the recommended 20 milliohms.

3.9. SDU Fitting Instructions

Unpack the SDU from the transportation packaging. Perform a visual inspection of the unit for evidence of damage incurred during transportation. If a claim for damage is to be made, save the shipping container to substantiate the claim, and contact your Thales representative. Remove the ESD protection cap on the ARINC 600 connector.

CAUTION

THE SDU IS ELECTROSTATIC DISCHARGE SENSITIVE EQUIPMENT. OBSERVE STANDARD ESD PROCEDURES WHEN HANDLING THE EQUIPMENT.

Ensure that the electrical supply to the mounting tray back connector is removed.

Carefully place the SDU on its mounting tray and slide it towards the mounting tray back connector, following the direction of the arrow indicated in figure 3-3.

When the SDU is fully engaged into the connector raise the mounting tray Hold Down Clamps (see Figure 3-3), over the hooks of the SDU and hand tight in the clockwise direction.

As the LRU is tightened into position, and in order to prevent electrical pins from bending, ensure that the SDU is uniformly inserted into the mounting tray back connector.

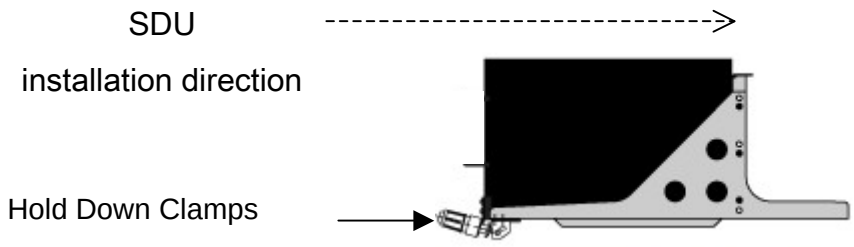


Figure 3-3: SDU Installation on to ARINC 600 Mounting Tray.

CAUTION

ENSURE THAT THE THUMBSCREW HOLD DOWN CLAMPS HAVE BEEN FASTENED, AND THAT THE LRU IS SECURELY HELD INTO PLACE.

3.10. SDU Removal Instructions

Ensure that the electrical supply to the mounting tray back connector is removed.

Loose mounting tray Hold Down Clamps (counter clockwise). Ensure that the Hold Down Clamps are loosened so that the SDU is uniformly extracted out of the mounting tray back connector. Clear the retaining hooks on the front of the SDU.

Separate the SDU from the mounting tray back connector and extract the SDU by pulling on the carrying handle at the front of the SDU following the direction of the arrow indicated in Figure 3-4.

Install an ESD protection cap on the SDU ARINC 600 back connector.

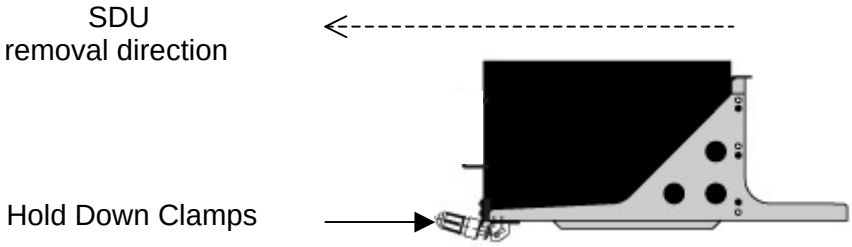


Figure 3-4: SDU Removal from ARINC 600 mounting tray.

3.11. SCM Fitting Instructions

Unpack the SCM from the transportation packaging. Perform a visual inspection of the unit for evidence of damage incurred during transportation. If a claim for damage is to be made, save the shipping container to substantiate the claim, and contact your Thales representative. Remove the ESD protection cap on the D Type connector.

CAUTION

THE SCM IS ELECTROSTATIC DISCHARGE SENSITIVE EQUIPMENT. OBSERVE STANDARD ESD PROCEDURES WHEN HANDLING THE EQUIPMENT.

Place the SCM to the dedicated mounting fixture and insert the four (1) fixing screws to finger tightness only. See Figure 3-5. After all four fixing screw have been inserted tight the screws with an appropriate tool.

Insert the cable from the SDU to the D Type connector (other half from the SDU) and tighten the aircraft mating connector into the two (2) female screw locks.

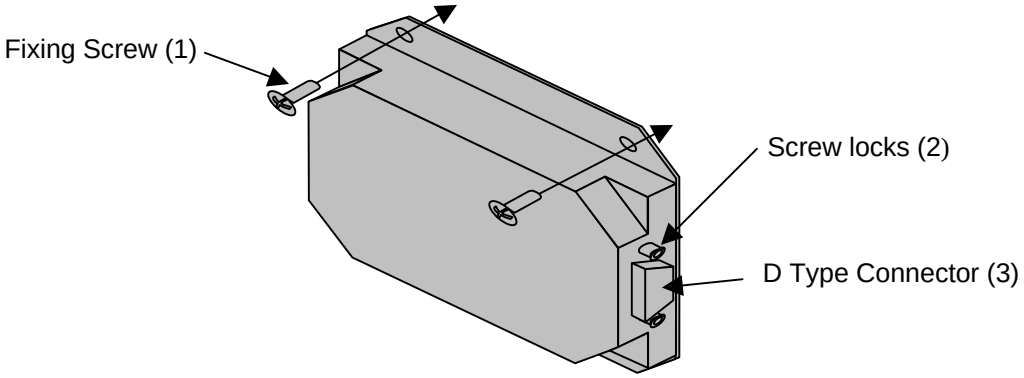


Figure 3-5: SCM Installation.

CAUTION

ENSURE THAT THE FIXING SCREWS HAVE BEEN FASTENED, AND THAT THE LRU IS SECURELY HELD INTO POSITION.

3.12. SCM Removal Instructions

Ensure power to the SDU is disconnected.

Loosen the two (2) screw locks that secure the 15-pin D Type connector to the SCM. See Figure 3-6.

Disconnect the D connector. Bag and stow the cable as required.

Install an ESD protection cap on the SCM D Type connector.

Assuming that the mounting fixture is equipped with anchor nuts, loosen and remove the four fixings screws that retain the SCM to its mounting fixture while supporting the SCM. Retain the screws for future installation.

Remove the SCM, and visually inspect it for any signs of damage.

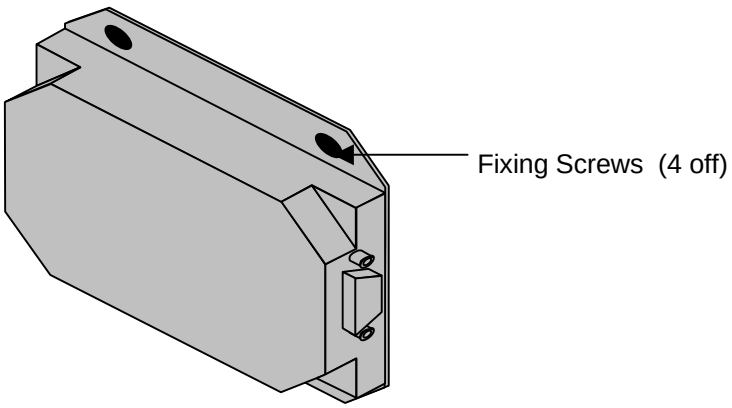


Figure 3-6: SCM Removal.

4. INSPECTION AND SYSTEM CHECKOUT

4.1. Inspection/Check procedure

Table 4.1 below provides a visual inspection/check procedure that should be performed during or after the SDU/SCM installation, or as a periodic maintenance inspection check of the installation.

EQUIPMENT	INSPECTION/CHECK PROCEDURE
Wiring and RF cables	• Ensure that a continuity check of all the installation wiring harness had been carried out, and that all the sources are correctly rated on the correct pins • Check that none of the cables have been damaged, and cannot be damaged by components that are installed later • Check that the cable runs are spaced away from any moving or hot part that could damage cables when in use • Verify that the various RF cables are within their minimum radius of curvature tolerances • Check that any attenuators that may have been used for the installation have not been omitted or mismatched
SDU	• Examine the assembly for external condition (absences of fractures, dents, deformations, cracks, and/or any other abnormal damage) • Check that the unit is properly installed and that hold down clamps are firmly tightened • Check screws and nuts general condition • Check that the contact resistance between the SDU/SCM and a point on the aircraft structure close to the component does not exceed 20 milliohms • Check that the correct air cooling and air flow is provided to the SDU
SCM	• Examine the assembly for external condition (absences of fractures, dents, deformations, cracks, and/or any other abnormal damage) • Check that the unit is properly installed, that all fixing screws are firmly tightened, and the cable to the SDU is secure

Table 1: Installation Inspection/Check procedure.

4.2. System Checkout

At this stage of the installation it is assumed that a continuity check of the wiring has been made, a visual check of the installation harness and RF cabling has been performed, and that the inspection/check procedure has been carried out.

4.2.1. Post-installation Test

This test requires that all the Satcom system LRUs (SDU, SCM, DLNA, Antenna) be connected and operating properly, with a means of displaying any system faults detected by the LRUs during the BITE (Built In Test Equipment) test. The results of the test are indicated on the SDU front panel LEDs. Refer to the Testing and Fault Isolation section for information on the SDU fault detection capabilities.

If no system faults are indicated by the BITE test, then the subsystem installation should be considered acceptable. If any subsystem LRU fails the test, it must be returned to the vendor (refer to your vendor customer support).

WARNING

THE RF POWER RADIATED BY THE TFS SYSTEM ANTENNA CAN CAUSE BODILY HARM. A PERSON IS IN DANGER IN A ZONE WHERE THE POWER FLUX IS 1 MW/CM2, OR GREATER. DURING SATCOM OPERATION THE SAFETY DISTANCE FROM THE ANTENNA MUST BE NO LESS THAN 3.5M OR 12 FEET (INTERMEDIATE GAIN ANTENNA). SINCE THERE ARE VARIOUS POSSIBLE ANTENNA LOCATIONS, IT IS THE RESPONSIBILITY OF THE OPERATOR TO DETERMINE THE AREA OF HAZARD FOR THEIR TFS SYSTEM CONFIGURATION AND TO TRAIN PERSONNEL IN GROUND SAFETY PROCEDURES.

WARNING

DURING ANTENNA OPERATION (TRANSMISSION), ENSURE MINIMUM EXPOSURE OF ALL PERSONNEL TO ANY REFLECTED, SCATTERED, OR DIRECT BEAMS.

CAUTION

WHEN TESTING THE COMPLETE TFS SYSTEM (ANTENNA SYSTEM INCLUDED) REFER TO THE SPECIFIC ANTENNA IMM FOR FURTHER SAFETY REQUIREMENTS AND SPECIFICATIONS. THE SDU MUST NOT BE POWERED WITHOUT AN ANTENNA OR SUITABLE LOAD CONNECTED ON THE HIGH POWER TRANSMIT OUTPUT PORT.

CAUTION

NEVER CONNECT OR DISCONNECT A SATCOM LRU WHEN POWER IS APPLIED, IN ADDITION, NEVER APPLY HIGH-LEVEL RF SIGNAL TO A POWERED-DOWN LRU.

CAUTION

ENSURE THAT THE APPROPRIATE ORT DATABASE IS INSTALLED IN THE SCM AND/OR SDU BEFORE PERFORMING SYSTEM OPERATIONS.

5. MAINTENANCE

5.1. Introduction

Field lubrication or other maintenance procedures are not required. The design of the SDU and SCM is such that they do not require field maintenance to maintain airworthiness. If functional problems occur, the SDU Built-in-Test Equipment (BITE) capability identifies the faulty LRU. The SDU and SCM maintenance is limited to replacement on verified failure.

CAUTION

TO AVOID INJURY TO PERSONNEL OR DAMAGE TO EQUIPMENT, ENSURE ADEQUATE PRECAUTIONS ARE TAKEN WHILE PERFORMING ANY WORK IF THE ELECTRICAL POWER IS APPLIED TO THE LRUs.

CAUTION

TO PREVENT DAMAGE TO EQUIPMENT, TURN AIRCRAFT POWER OFF BEFORE REMOVING OR INSTALLING LRUs.

5.2. Cleaning of Mechanical Parts

Equipment chassis covers give the necessary protection to keep dust away from electronic circuits. If cleaning is required this has to be limited to the removal of particles of dust, oil, grease, condensation, etc and only limited for those equipment accessible parts. Before any cleaning action is carried out ensure that the equipment is disconnected from all electrical power sources, and all the necessary ESD precautions are observed.

For mechanical part cleaning:

- For dust removal use a cleaning wipe, a silk paintbrush or low-pressure compressed air
- For removal of finger marks, grease, etc, clean the parts with a cleaning wipe and isopropyl alcohol, exercising care to not damage information labels

CAUTION

MOISTURE AND DIRT CAN CAUSE DAMAGE TO EQUIPMENT.

5.3. Periodic Checks

See Inspection/ Check procedure in Table 1.

5.4. Cabling and Connections

Periodically check cable connectors (recommended) and if required, tighten connectors as needed with connector manufacturer's specifications.

6. TESTING AND FAULT ISOLATION

Information within this section describes how the TFS system, SDU, SCM, and Antenna failures are monitored detected, and reported.

6.1. BITE Function

The primary purpose of BITE is to assist aircraft maintenance personnel in the correct maintenance of avionics equipment in a cost effective manner. The BITE does not contribute to the required function of the TFS system, but makes it easier to test or debug it.

The SDU controls the TFS system BITE. It collects BITE information from other LRUs, and can request other LRUs to run tests. The BITE automatically detects failures, providing a mechanism to discover erroneous behaviour of TFS system components.

Fault information is reported to a local maintenance system (e.g. CFDS system or other OMS), and this information is made available to maintenance personnel by means of discretes and/or LEDs on the SDU front panel. Failures can also be reported to a dedicated local maintenance function through SNMP (Simple Network Management Protocol) and the MIB (Management Information Base).

The System BITE failure data is stored in the SDU within a Non-Volatile Memory (NVM) area. The BITE operates at various levels as indicated in Figure 4-1 below.

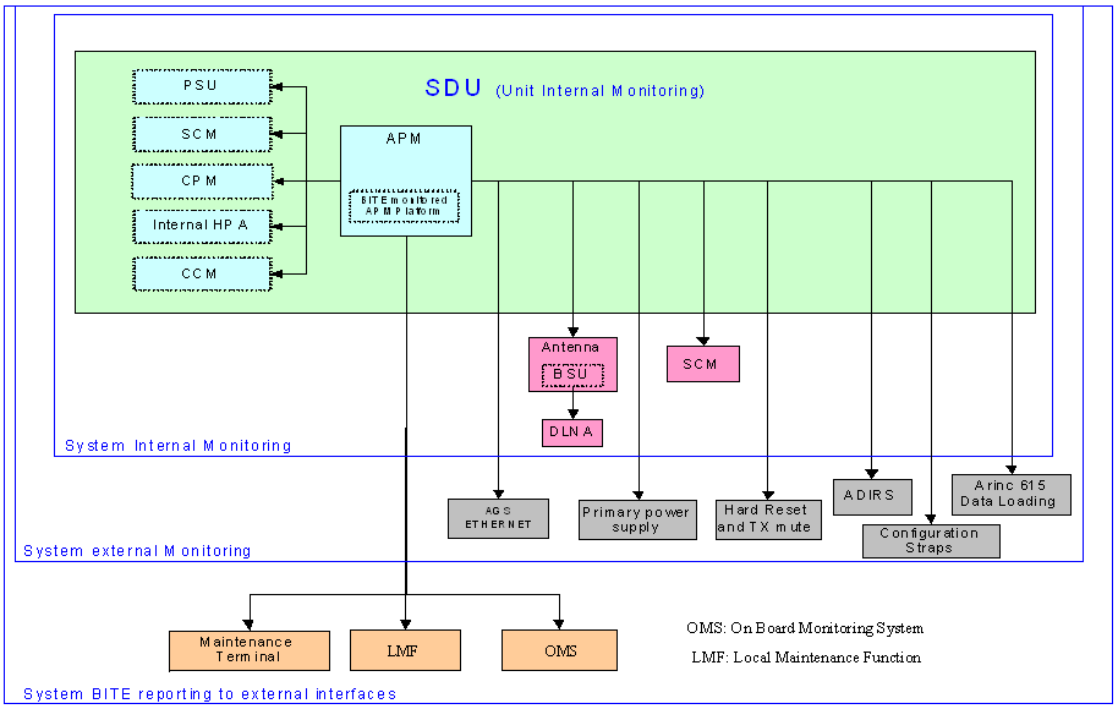


Figure 6-1: Example of BITE communication for TFS system.

6.2. Test Functions

An operator can verify the operational serviceability of the SDU and SCM by means of a set of testing facilities installed within the SDU. The SDU performs two distinctive types of test:

- A Power On Self-Test (POST) is automatically activated at SDU start up
- A Person Activated Self Test (PAST) can be initiated by an operator by depressing a Self-Test push button located on the front panel of the SDU, (see Figure 2-5 item 17)

6.2.1. POST

At SDU start up (Power On), and with aircraft in the 'on ground' condition the FPL (Front Panel LEDs) will display the following test sequence:

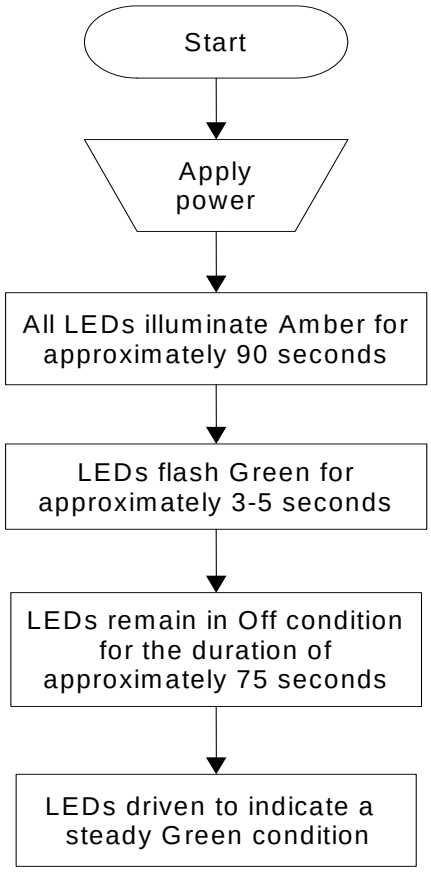


Figure 6-2: POST LEDs sequence.

6.2.2. PAST

The PAST function is initiated by depressing the front panel Test Button (This function is only possible with aircraft on ground). To acknowledge PAST initialisation all the front panel LEDs start to flash green at the frequency of 2Hz. After approximately 75 seconds the SDU will transit into Operational Mode with the LEDs displaying the TFS system serviceability condition.

This feature represents an interactive, manual test facility, which assists in the following:

- Active search of failures by triggering a series of system diagnostic tests
- Verification testing e.g. after the installation of a replacement unit
- Failure confirmation purpose

NOTE: PAST test can only be initiated after the POST test has completed.

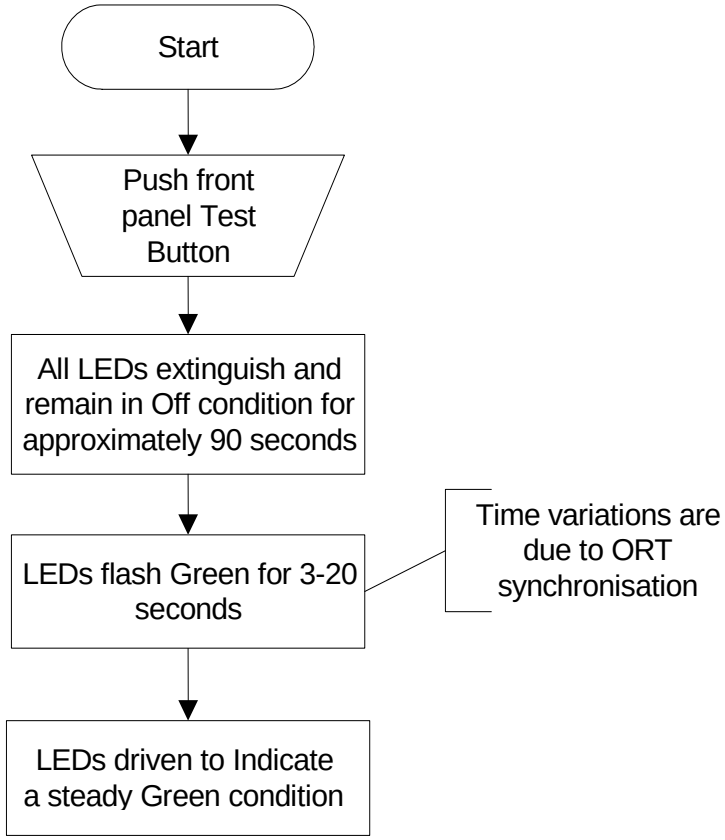


Figure 6-3: PAST LEDs sequence.

6.3. Fault Isolation

6.3.1. Failures

Failures are reported to an operator by means of a set of multicoloured LEDs located on the SDU front panel. LEDs can enter the following steady states:

- Normal equipment operation indicated by the relevant LEDs displayed in a steady Green condition
- Equipment Hard Failures are indicated by all relevant LEDs displayed in a steady Red condition
- Partial equipment failures are indicated by all relevant LEDs displayed in a steady Amber condition
- An LED in OFF (extinguished) condition indicates that the relevant equipment and or a resource is not active or not installed

6.3.2. Front Panel Indications

Table 2 provides LED status decoding information.

LED Name	Flashing Green	Steady Green	Amber	Red	Off
SDU	SDU in Self-Test	SDU OK	Partial Failure (Not Indicted)[1] or ARINC 429 / AFDX / RS-422 Bus Failure[3]	SDU Failed (Indicted)[2]	SDU Not Powered
SCM	SDU in Self-Test	SCM/USIM(s) OK	SCM Memory Fail (Not Indicted)[1] or RS-422 Bus Failure[3]	USIM Read/Write Fail. No attempt at SBB registration	SCM Not Installed or SDU Not Powered
Antenna	SDU in Self-Test	Antenna OK	Partial Failure (Not Indicted)[1] or ARINC 429 Bus Failure [3]	Antenna Failed (Indicted) [2]	SDU Not Powered
DLNA	SDU in Self-Test	DLNA OK	N/A	DLNA Failed (Indicted)[2]	SDU Not Powered
Ext. HPA	SDU in Self-Test	NA	NA	NA	NA
Ext. BSU	SDU in Self-Test	NA	NA	NA	NA
Ext. Data Bus	SDU in Self-Test	All Data Buses (ARINC 429 / AFDX / RS-422) OK	Nav Data not available. ARINC 429 Bus from IRS(s) inactive or IRS Data invalid [4]	Bus Failed[3] (ARINC 429 / AFDX / RS-422)	SDU Not Powered
ORT/Config.	SDU in Self-Test	ORT(s)/Hardware Configuration Straps	ORT Minor Failure[5] (Not Indicted)[1]	ORT Major Failure[6] or Hardware Configuration Straps Parity Failure (Indicted)[2]	SDU Not Powered
Sat. Link #1	SDU in Self-Test	Channel #1 Service Available, ie Logged-On or Registered	Channel #1 attempting Log-On or Registration	N/A	Channel #1 Not attempting Log-On or Registration[7]
Sat. Link #2	SDU in Self-Test	Channel #2 Service Available, ie Logged-On or Registered	Channel #2 attempting Log-On or Registration	N/A	Channel #2 Not attempting Log-On or Registration[7]

NOTE: See next page for list of Explanatory Note.

Table 2: Front Panel indications.

List of Explanatory Notes for Table 2

1. Not Indicted means that there is an equipment 'partial' failure such that service Registration / Log-On is still attempted.

2. Indicted means that there is an equipment failure such that Registration / Log-On is not attempted.

3. In the event of a Bus Inactive Failure, the 'Data Bus' LED illuminates Red and the appropriate LRU status LEDs illuminate Amber, e.g. if the SDU reports that the Antenna to SDU bus is inactive or the Antenna reports that the SDU to Antenna bus is inactive, then the 'Data Bus' LED illuminates Red and the SDU and Antenna LEDs illuminates Amber.

4. This is a special case. There will be frequent legitimate occurrences of IRS(s) being switched off whilst On-Ground and even after an IRS is switched on; there is an alignment period, during which the Nav Data is invalid. Under these circumstances, the only action is to illuminate the 'Data Bus' LED Amber, irrespective of whether in On-Ground or In-Air state.

5. The ORT/Configuration LED illuminate Amber in the following circumstances:

    a. Type 1 ORT Synchronization Minor Failure – Secure ORT within SCM - If the Secure ORT read from the SCM is not valid and if 'local copy' Secure ORT is valid.
    b. Type 4 ORT Synchronization Failure - User ORT within SCM - If the User ORT read from the SCM is not valid AND if 'local copy' User ORT is valid.
    c. Type 5 ORT Synchronization Failure - User ORT in SDU - if SDU User ORT is invalid.

6. The ORT/Configuration LED illuminates Red in the following circumstances:

    a. Type 1 ORT Synchronization Major Failure - Secure ORT within SCM - If the Secure ORT read from the SCM is not valid AND if 'local copy' Secure ORT is not valid.
    b. Type 2 ORT Synchronization
    c. Type 3 ORT Synchronization Failure - Secure ORT in SDU that is integral part of SW - if SDU Secure ORT is invalid.
    d. Hardware Straps Parity Failure. SDU be indicted.

7. There are many reasons why a channel will not attempt Log-On or Registration, including (but not limited to), OCXO warming up, equipment indictment, commanded Log-Off or De-Registration.

6.3.3. Fault Logging

All information of degraded and abnormal equipment function will be logged internally and made available to a dedicated local maintenance system (e.g. CFDS).

6.3.4. Service Availability Discretes

The status of various system functions can be reported by means of the Service Availability Discretes available on the ARINC 600 connector.

Function	Pin Allocation	Steady State Open Circuit	Steady Ground[1]
SDU Not Powered	MP 15F	SDU Powered	SDU Not Powered
System Failed	MP 11F	System OK	System Failed[2]
SDU Failed	MP 12E	SDU OK	SDU Failed[3]
SCM Failed	MP 12F	SCM OK or not installed	SCM Failed[4]
Ext HPA Failed	MP 13E	Ext HPA OK or not installed	Ext HPA Failed
DLNA Failed	MP 13F	DLNA OK	DLNA Failed
Antenna Failed	MP 14E	Antenna OK	Antenna Failed
Ext BSU Failed	MP 14F	BSU OK or not installed	BSU Failed
Bus Failed[5]	MP 15E	All external data buses OK (ARINC 429/AFDX/RS422)	Bus Failed (ARINC 429/AFDX/RS422)
Sat Link #1 Not Available	MP 11E	Satcom Channel #1 Logged On/Registered	Satcom Channel #1 Not Logged On/Not Registered
Sat Link #2 Not Available	TP 01K	Satcom Channel #2 Logged On/Registered	Satcom Channel #2 Not Logged On/Not Registered

Table 3: SDU Service Availability Discretes.

List of Explanatory Notes for Table 3

1. The ‘Steady Ground’ state corresponds to the equivalent LED Red state, except for the Sat Link #1 and #2 Not Available discretes, for which the ‘Steady Ground’ state corresponds to the equivalent LED Off or Amber states.

2. The System Failed discrete ‘Steady Ground’ state corresponds to one or more LEDs being illuminated red.

3. SDU Failed discrete only to be asserted in the event that an SDU H/W or S/w failure is detected, not in the event that there is an ORT or configuration straps parity failure. In the latter case, only the System Failed discrete should be asserted.

4. SCM Failed discrete only to be asserted in the event that an SCM H/W failure is detected, not in the event that there is an ORT failure. In the latter case, only the System Failed discrete should be asserted.

5. The Bus Failed discrete provides no indication of activity on the Ethernet buses.

6.3.5. Service Availability Discrete Lamps

The Service Availability Discretes have open circuit and ground states that are capable of driving incandescent lamps connected to an external supply.

Typically, each discrete is fed via one or two (in parallel) incandescent lamps to an aircraft 28 Vdc supply. This 28 Vdc supply can be dimmed to approximately 14 Vdc for night time operation. The 28 Vdc is a nominal value and can vary as defined in RTCA/DO-160E. A typical incandescent lamp would be 28Vdc, 20mA.

Each Service Availability Discrete is able to continuously sink at least 50mA and be capable of holding a cold inrush current of up to 490 mA during the first 10 millisecond of activation as per ARINC 781.

7. INSTRUCTIONS FOR CONTINUED AIRWORTHINESS

Maintenance requirements and instructions for continued airworthiness of the TFS SDU and SCM components are contained in the paragraphs that follow.

Installation of SDU and SCM on an aircraft by an amendment to the Type Certificate (TC), Supplemental Type Certificate (STC) or Form 337 obligates the aircraft operator to include the maintenance information supplied by this manual (and listed below) in the operator's Aircraft Maintenance Manual and the operator's Aircraft Scheduled Maintenance Program.

- Maintenance information for SDU and SCM, TFS LRUs (system description, removal, installation, testing, etc.)

- The part numbers (see section 2) of the LRUs being installed (SDU and SCM) should be placed into the aircraft operator's appropriate aircraft Illustrated Parts Catalogue (IPC).

- Wiring connection information contained in this manual (see sections 2 and 3) should be placed into the aircraft operator's appropriate Wiring Diagram Manual.

- The SDU maintenance is considered as an "On-condition", and as such no additional maintenance is required other than a check for security and operation at normal inspection intervals.

- The SCM equipment is subject to minimal preventative maintenance, which is specific to life limitations associated to the internal USIM cards. For further details refer to your Thales representative.

- If a system LRU is inoperative remove the specific unit, secure cables and wiring, collar applicable switches and circuit breakers, and placard them inoperative. Revise equipment list and weight and balance as applicable prior to flight and make a log book entry that the unit was removed (refer to section 91.213 of the FAR or the aircraft's Minimum Equipment List (MEL).

- SDU and SCM can be repaired by an Approved Maintenance Organization

- Once repaired, reinstall the LRU in the aircraft in accordance with the original Form 337 approved data or instructions in this manual. Perform a Return to Service test of the system and approve it for return to service with a logbook entry required by section 43.9.