Thrane & Thrane A/S

Aero-HSD+

Installation and Maintenance Manual

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Record of Revisions

Rev.	Description	Release Date	Initials
A	Original document	23 May 2003	RP
B	Change of naming: TT-5000H changed to Aero-HSD^{+} and Configuration Data Module changed to Configuration Module	30 September 2003	HOC
C	Ethernet connector pin naming, SDU and HPA Power supply requirements, RF Cables requirements and editorial changes.	17 December 2003	RP
D	Chapters rearranged + new layout. **Introduction chapter:** Added list of external units to which the Aero-HSD^{+} system can interface. **Equipment Drawings chapter:** HSU outline drawing, HSU tray drawing and HSU tray connector drawing added. **Connectors and Pin-out:** Changed HPA connector drawing (key holes). Changed pin-out for SDU rear receptacle. Added pin-out for HSU. Added “Mating connectors in aircraft”. **Installation chapter:** Added sections with Mounting Considerations and Cable requirements. Added section with recommended cables. ARINC 429 interfaces wiring drawing has been split into three: AHRS/IRS, ACARS/CMU and CPDF. MCDU/FMS wiring drawing added. Wiring of MPDS, ISDN and Ethernet corrected. MagnaStar wiring corrected + added #3 interface as alternative. WH-10 wiring drawing corrected (only three handsets connected).		CC

D (continued)	**Installation chapter (continued):** Sigma7 and 2.4GHz Cordless wiring added. Dual Side Panel wiring added. HSU wiring added. ARINC 429 data format added Commissioning section added. **Configuration chapter** enhanced. **Check Procedures chapter** added. **Service and maintenance chapter** added **Equipment Specifications:** Max temperature for HPA and DLNA changed to 70 ºC. Specs for Rx Splitter and Tx Coupler added. Dimensions and Mounting added for all units. **System Messages appendix** added. Lists of Cause codes and BITE codes updated. Cause codes for MPDS and ISDN added. DO-160 forms corrected. **AT Profiles appendix** added. **DO-160C/D Specifications appendix:** DO-160 forms added for handsets. All DO-160 forms corrected. **"Using Commands" appendix** added.		CC

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About This Manual

1.1 Purpose

The purpose of this manual is to provide information for installation, maintenance and troubleshooting of the Aero-HSD^{+} system.

Important! The information, drawings and wiring diagrams contained in this manual are intended as a reference for engineering planning only. The drawings and wiring diagrams contained herein do not represent any specific Supplemental Type Certificate (STC). It is the installer's responsibility to compose installation drawings specific to the aircraft. This manual and the drawings and wiring diagrams contained herein may not be used as a substitute for an STC package.

1.2 Organization

The chapters of this Installation Manual provide the following information:

- **Introduction**
  A short overview of the Aero-HSD^{+} system and services.
- **Equipment Drawings**
  Outline drawings of the units, trays and connectors of the Aero-HSD^{+} system.
- **Connectors**
  Drawings and pin-out for the connectors, and a description of the required mating connectors.
- **Installation**
  Wiring drawings and detailed installation and wiring requirements.
- **Configuration**
  An introduction to the HSD+ Configuration Program and a short description of how to configure the Aero-HSD^{+} system. Also a short description of how to configure some of the 3rd party handsets.
- **Check Procedures**
  An overview of the recommended check procedures and checklists.
- **Maintenance and Troubleshooting**
  Descriptions of Airworthiness, software update, LEDs and BITE test. Also a flow chart of how to perform initial troubleshooting.
- **Appendices**
  Equipment specifications, DO-160C/D Forms, Lists of error messages.

1.3 Related Documentation

The following documentation is related to this manual:

Part Number	Description
TT-98-119959	Aero-HSD$^+$ User Manual
TT-99-119960	Aero-HSD$^+$ Quick Guide

Table 1-1: List of Related Documentation

1.4 Precautions

Warnings, Cautions and Notes

Text marked with “Warning”, “Caution”, “Note” or “Important” show the following type of data:

- **Warning**: A Warning is an operation or maintenance procedure that, if not obeyed, can cause injury or death, or jeopardize the flight safety on the aircraft.
- **Caution**: A Caution is an operation or maintenance procedure that, if not obeyed, can cause damage to the equipment.
- **Note**: A Note gives information to help the reader.
- **Important**: A text marked Important gives information that is important to the user, e.g. to make the system work properly. This text does **not** concern damage on equipment, flight safety nor personal safety.

General precautions

All personnel who operate equipment or do maintenance as specified in this manual must know and follow the safety precautions.
The warnings and cautions that follow apply to all parts of this manual.

WARNING! Before using any material, refer to the manufacturers’ material safety data sheets for safety information. Some materials can be dangerous.

CAUTION! Do not use materials that are not equivalent to materials specified by Thrane & Thrane. Materials that are not equivalent can cause damage to the equipment.

CAUTION! The Aero-HSD$^+$ system contains items that are electrostatic discharge sensitive. Use approved industry precautions to keep the risk of damage to a minimum when you touch, remove or insert parts or assemblies.

Introduction to Aero-HSD+

2.1 General Description

This Installation manual describes the administrative and technical aspects, features, functions and components of the Aero-HSD+ system.

All comments or recommendations regarding the installation, acceptance or operation of the Aero-HSD+ system or its accessories and components should be directed to Thrane & Thrane.

2.1.1 The Aero-HSD+ System

Important!

The design of the system is **not** intended to support the requirements of safety and regularity of flight communications, in particular for Air Traffic Services (ATS) or Aeronautical Operational Control (AOC) during the flight time.

The software used to control the unit operation complies with RTCA specification DO-178B level E software.

Non-Safety Interfaces

The following interfaces in the Aero-HSD+ system are strictly for non-safety usage:

- Cockpit voice (future use)
- ACARS/CMU
- CPDF (future use)
- MCDU/FMS (future use)

Services

Housed in one system, the Aero-HSD$^+$ combines the global voice, fax and PC modem data capabilities of the Inmarsat® Aero-H$^+$ service with the new Inmarsat Swift64 aeronautical High Speed Data service.

- The Aero-H$^+$ part provides three channels for global voice, fax, PC modem data and cockpit communication.
- The Swift64 part provides a fourth channel, dedicated to high-speed data requirements. The Swift64 channel may operate either using the Integrated Services Digital Network (ISDN @ 64 kbit/s) or the IP-based Mobile Packet Data Service (MPDS up to 64 kbit/s).
  The Swift64 channel may also be used for speech or for 3.1 kHz audio e.g. for fax.

PBX

The built-in PBX Unit connects up to four 4-wire handsets and two direct 2-wire POTS interfaces for faxes, PC modems, auxiliary phones, headset interface boxes etc.

Configuration Module

The Configuration Module (CM) contains all system and user settings for easy replacement of the Satellite Data Unit (SDU). Access to these settings are provided with the HSD$^+$ Configuration Program (HSD$^+$CP). For further information on the HSD$^+$CP, see **HSD+ Configuration Program** on page 6-1.

Different layers of write protection protect the CM contents; this includes hardware protection of installation settings and optional pin code protection of user data.

The Configuration Module is designed as a “plug-in” module for the SDU, making it easier to replace the SDU while retaining all system and user settings.

Antenna Systems

The Aero-HSD$^+$ may be acquired with an electronically steered High Gain Antenna, HGA-7000, which is designed for fuselage mounting. The Aero-HSD$^+$ system has built-in antenna control (ACU/BSU) for the HGA-7000 antenna.

Alternatively, an ARINC 741 antenna, such as the AMT-50 antenna for tail mounting, may be used.

2.1.2 Standard Features

- Unique multi-channel solution, integrating the Inmarsat Aero-H$^+$ and Swift64 services
- A total of four channels (optionally five):
  - two global H$^+$ channels for voice, G3 fax or PC modem data
  - one global H$^+$ packet data channel for cockpit communications
  - one spot beam High Speed Data (HSD) channel for ISDN or MPDS

  As an option, one additional HSD channel can be installed, providing a total data rate of 128 kbit/s.
- Extremely small, compact and lightweight
- ISDN for large file transmissions, video conferences, G4 fax etc.
- Pay only “by the bit” with MPDS – ideally suited for Internet, e-mails etc.
- Connect MPDS to airborne LAN via Ethernet or RS-422
- 3.1 kHz audio (14.4 kbit/s) for modems, G3 fax, high quality voice etc. via HSD channel
- STE/STU for secure transmissions
- Chelton HGA-7000 antenna compatibility
- ARINC 741 antenna compatibility
- Built-in PBX interfacing to four 4-wire and two 2-wire connections

2.2 Application

2.2.1 Minimum System

A minimum working system has at least:

- one TT-5035A SDU
- one TT-5035A-001 CM
- one TT-5014A HPA
- one handset and cradle, e.g. a TT-5620A 4-Wire Handset and a TT-5622A 4-Wire Cradle
- one antenna system. As antenna system, use either the AMT-50 Antenna Subsystem or the HGA-7000 Antenna with a TT-5012A DLNA.

The minimum wiring required for an Aero-HSD$^+$ system is described in the section **Minimum System Drawing** on page 5-3.

2.2.2 Part Numbers

Applicable Thrane & Thrane Model- and Part Numbers

This Installation Manual is for the Aero-HSD$^+$ system and is applicable to the model- and part numbers below:

T&T Part Number	Model Number	Description
405035A	TT-5035A	Satellite Data Unit (SDU) [without CM]
405035A-001	TT-5035A-001	Configuration Module (CM)
405038A	TT-5038A	High Speed data Unit (HSU). Additional Swift64 channel for a total of 128 kbit/s (optional)
405038A-002	TT-5038A-002	HSU Tx Coupler (optional)
405038A-003	TT-5038A-003	HSU Rx Power Splitter (optional)
405014A	TT-5014A	High Power Amplifier (HPA)
405012A-THR	TT-5012A	Diplexer / Low Noise Amplifier (DLNA)
405620A-THW	TT-5620A	4-Wire Handset (white)
405620A-THR	TT-5620A	4-Wire Handset (black)
405622A-THW	TT-5622A	4-Wire Cradle (white)
405622A-THR	TT-5622A	4-Wire Cradle (black)
405621B-THW	TT-5621B	2-Wire Handset (white)
405621B-THR	TT-5621B	2-Wire Handset (black)
405622B-THW	TT-5622B	2-Wire Cradle (white)
405622B-THR	TT-5622B	2-Wire Cradle (black)
TT 37-112940		Maintenance Cable (SDU Front Connector Maintenance via PC)
TT 83-119958		CD with HSD$^+$ Configuration Program

Table 2-1: Model and Part Numbers for the Aero-HSD$^+$ System (T&T Units)

Applicable antenna systems

Part Number	Model Number	Description
677-A0106	HGA-7000	Chelton Electronically Steered High Gain Antenna
0881-A-0001	AMT-50	EMS Antenna Control Unit (ACU)
0476-A-00364	AMT-50	EMS Diplexer/LNA (DLNA)
0476-A-00377	AMT-50	EMS Antenna Frame Assembly (Antenna)

Table 2-2: Model and Part Numbers for Antenna Systems

Circuit Breakers

Part Number	Recommended Aircraft Circuit Breakers
4310-001-4	Klixon 2TC series, 4 A current rating (SDU)
4310-001-20	Klixon 2TC series, 20 A current rating (HPA)

Table 2-3: Part Numbers for Klixon Circuit Breakers

Installation Kit

Complete installation kits including harness wiring can be obtained through ECS (Electronic Cable Specialists, Inc.). The part number for a basic installation kit is stated below. For further information, contact:

ECS, USA
Phone: +1 414.421.5300
Email: sales@ecsdirect.com
Homepage: www.ecsdirect.com

Part Number	Installation Kit
120-94981-102	ECS Basic Installation Kit for Aero-HSD^{+}

Table 2-4: Part Number for Basic Installation Kit from ECS

Trays and Connectors

Part Number	Recommended Trays for Jet Aircraft
200-86686-101	ECS Tray Assembly 3/8-size ATR (for HPA and SDU)
200-92045-102	ECS Tray Assembly 1/4-size ATR (for HSU)
Part Number	**Required Plug for SDU Tray**
DPX2NA-67322-463	ITT Cannon Connector, Dual Plug
Part Number	**Recommended Plug for HPA Tray**
616 697 173	RADIALL Dual Plug Connector
Part Number	**Required Plug for optional HSU Tray**
DSXN2PS33C45X00500	ECS Dual Plug Connector
P924	Size #5 Twinax contact

Table 2-5: Part Numbers for Trays and Connectors

2.2.3 Applicable External Units

Apart from the antennas listed in the previous section, the Aero-HSD$^+$ system has been tested with various other external units. Below is a list of tested units. Note that the Aero-HSD$^+$ system may also be able to interface to other units not mentioned below.

Product Name	Product Description	Manufacturer
2.4GHz Cordless	Cordless handset system	**ICG**, USA Phone: 1-800-279-1991 or (757)947-1030 Email: sales@intcomgrp.com. Homepage: www.intcomgrp.com
Sigma[7]	Handset system	**ICG** (see contact info above)
AeroRouter 700	LAN router	**ICG** (see contact info above)
JetLAN	Cabin file server	**Pentar Avionics**, USA Phone: 1-888-655-3755 or (425)424-3370 Fax: 425.424.3380 Email: sales@pentar.com Homepage: www.pentar.com
AMAR (Advanced Mobile Access Router)	LAN Router	**Lufthansa Technik AG**, Germany Homepage: www.lufthansa-technik.com (The homepage lists regional sales office).

Table 2-6: List of Applicable External Units

2.3 System Block Diagrams

2.3.1 Overview

The following block diagrams show basic system component interconnection.

The first three diagrams show the wiring differences according to antenna choice and antenna steering source.

The following system block diagrams show the user interface options and how the system can be interfaced with MagnaStar system PBX communication.

2.3.2 HGA-7000 High Gain Antenna

The Aero-HSD^{+} system has built-in antenna control (ACU/BSU) for the electronically steered HGA-7000 antenna.

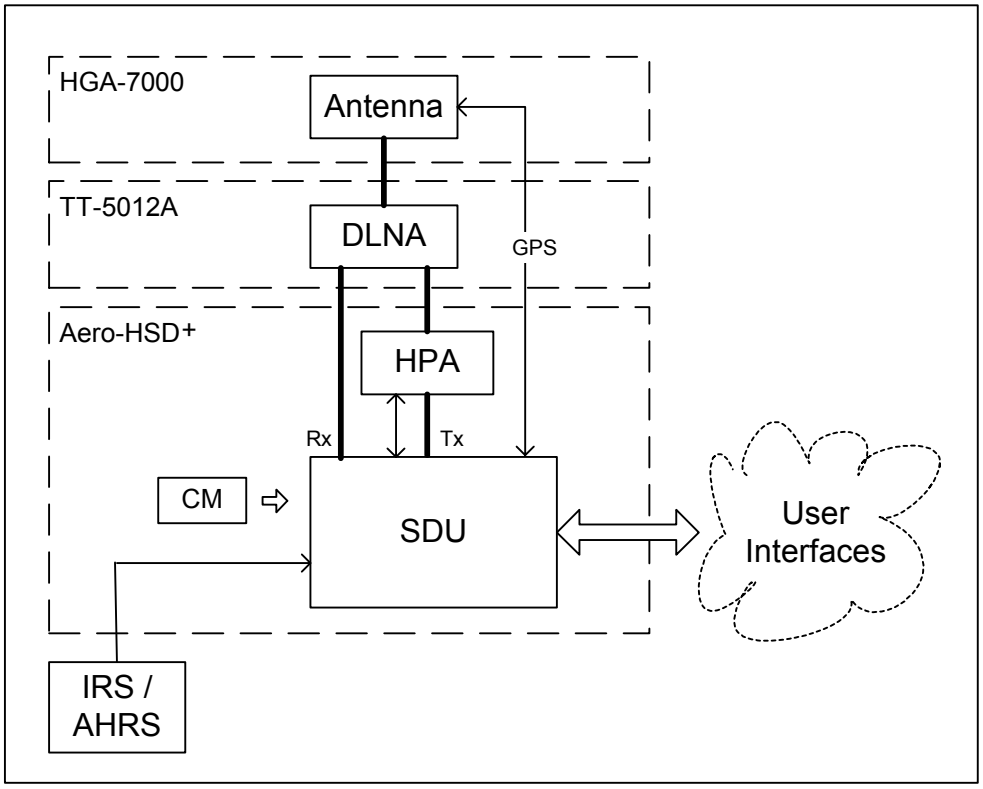


Figure 2-1: System Configuration with Electronically Steered HGA

2.3.3 ARINC 741 Compatible High Gain Antenna

The Aero-HSD$^+$ system also supports ARINC 741 compatible antenna systems, such as the mechanically steered AMT-50 subsystem.

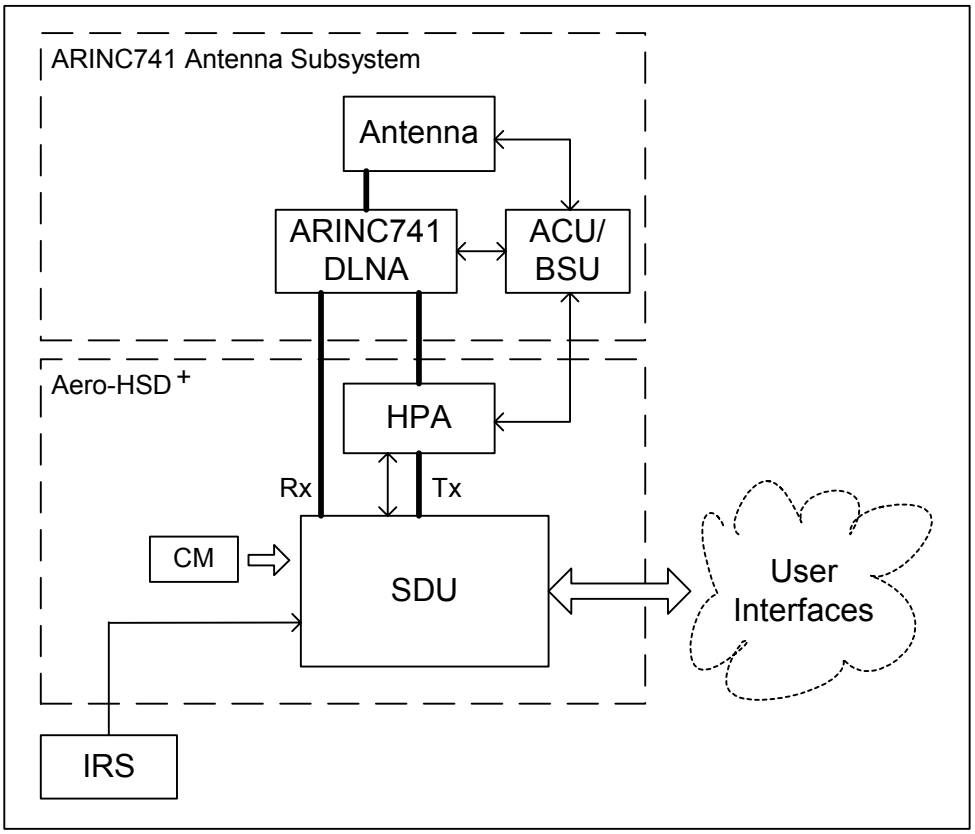


Figure 2-2: System Configuration with ARINC 741 Compatible HGA

2.3.4 Dual Side Panel Antenna System (Future Use)

An ARINC 741 dual side panel antenna system may be installed, in order to improve the view to the satellite.

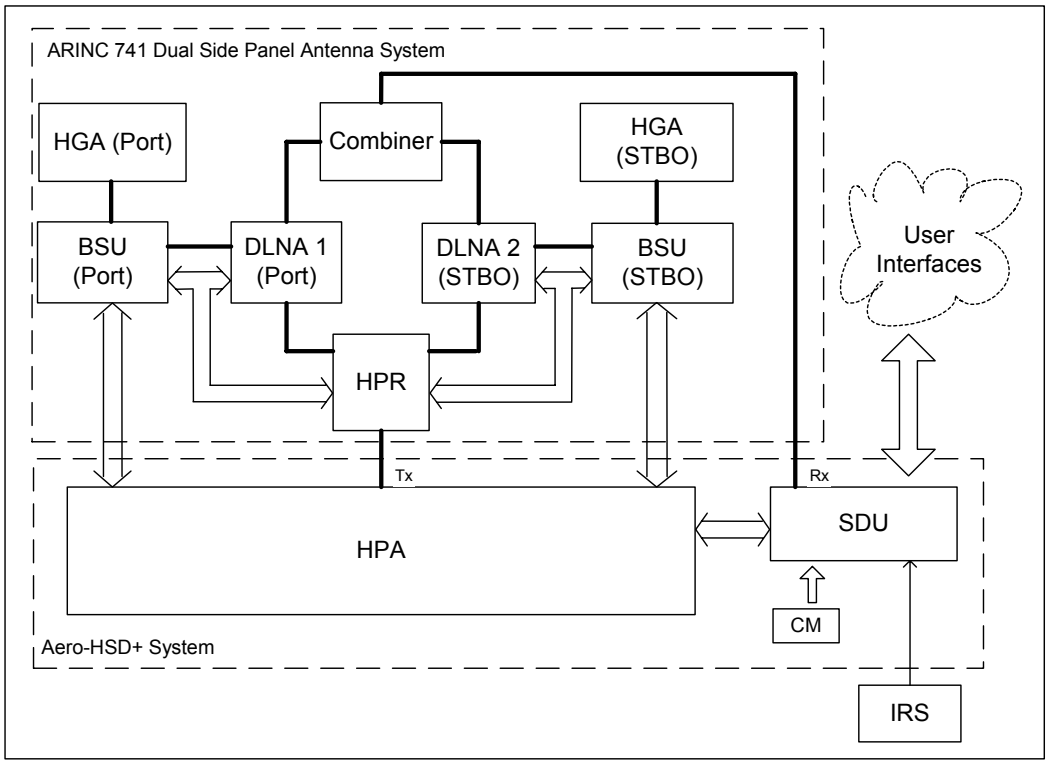


Figure 2-3: System Configuration with Dual Side Panel Antenna System (Future Use)

2.3.5 User Interfaces

The Aero-HSD^{+} system has the following user interfaces:

- Four 4-wire PBX interfaces, which can be used e.g. for the TT-5620A handset and TT-5622A cradle.
  The TT-5622A cradle has an RJ11 connector to which additional 2-wire terminals can be connected, e.g. for fax or modem data.
- Two 2-wire POTS interfaces, which can be used for the TT-5621B handset and TT-5622B cradle or other POTS handsets.
  The TT-5622B cradle has an RJ11 connector to which additional 2-wire terminals can be connected, e.g. for fax or modem data.
- MPDS via RS-422 or 10BaseT Ethernet interface.
- Euro ISDN S-bus interface for PC, Fax or STE
- ARINC 429 interfaces for e.g. CMU/ACARS or MCDU/FMS.
- Discrete outputs for annunciators.

The following drawing shows most of the possible user interfaces.

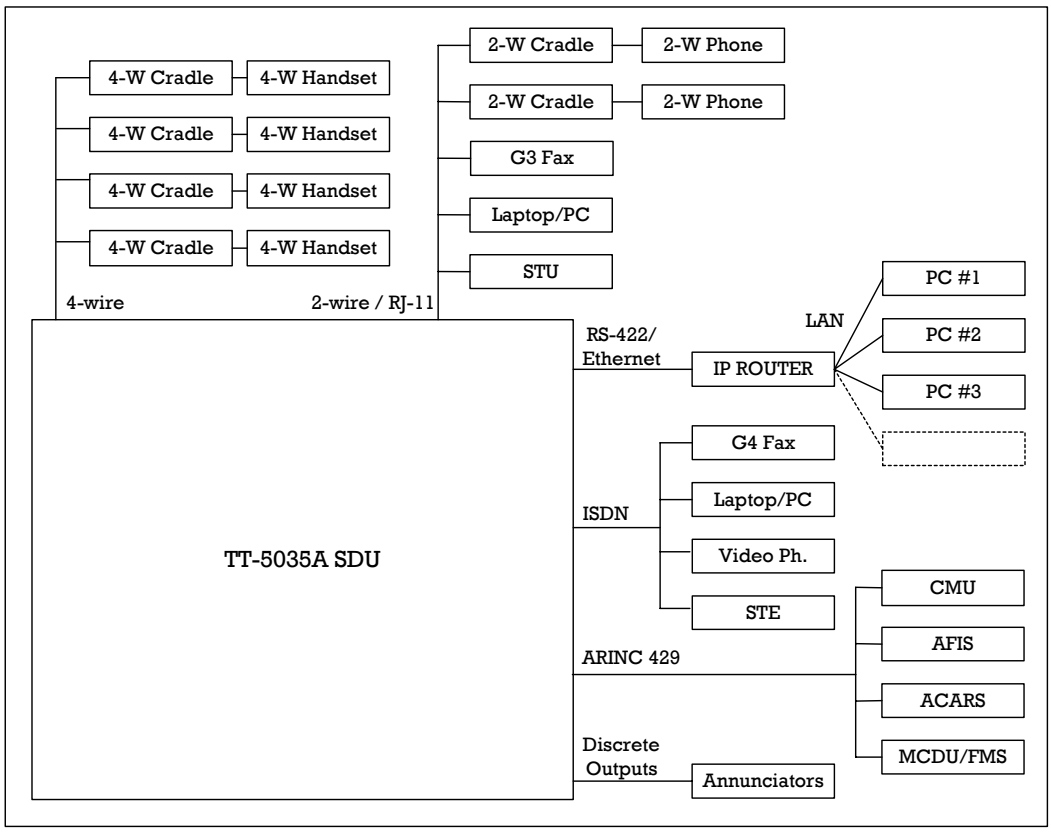


Figure 2-4: System Configuration with Different User Interfaces

2.3.6 MagnaStar® System

The MagnaStar system is a terrestrial-based telephone system that can be connected to the 4-wire interfaces of the Aero-HSD$^+$ system.

The connections between the SDU and AIU1 and AIU2 are standard 4-wire WH-10 Interfaces, with one additional discrete interface (Service Unavailable).

Note: The block diagram below is a simplified overview of one of the MagnaStar systems. For information on the MagnaStar system, refer to the relevant MagnaStar installation manual.

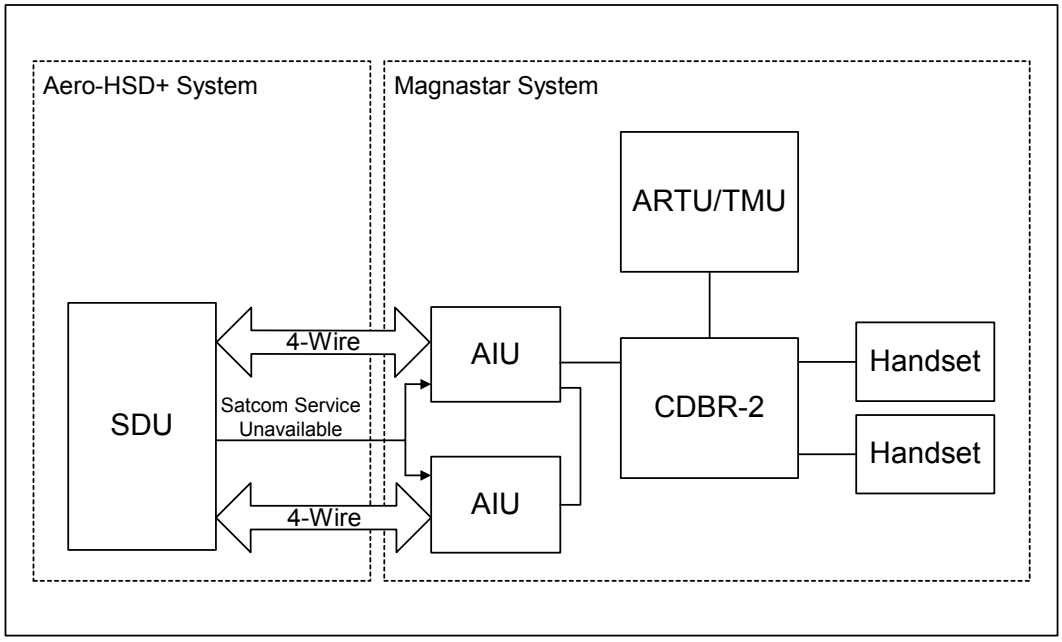


Figure 2-5: System Configuration with MagnaStar System

2.4 Operation Overview

Note: The Aero-HSD$^+$ system should not be used during take-off and landing.

2.4.1 Configuration

The main configuration tool for the Aero-HSD$^+$ system is the HSD$^+$ Configuration Program (HSD$^+$CP), which can be launched from a standard PC connected to the front connector of the SDU.

For further information, see **HSD+ Configuration Program** on page 6-1.

2.4.2 User Interface

The Aero-HSD$^+$ System uses the 4-wire handset as the main interface between the operator and the system. The display and keypad of the handset give access to the menu system.

Refer to the Aero-HSD$^+$ User Manual for operating procedures. The Aero-HSD$^+$ User Manual introduces and explains system capabilities and features, handset controls and functions, placing and receiving calls, and use of the menu system.

Equipment Drawings

3.1 Introduction

The following pages show copies of mechanical drawings of important system units relevant for an installation.

IMPORTANT NOTE

The drawings in this manual are for reference only. Contact Thrane & Thrane to obtain the latest version of the outline drawings.

3.2 TT-5035A Satellite Data Unit

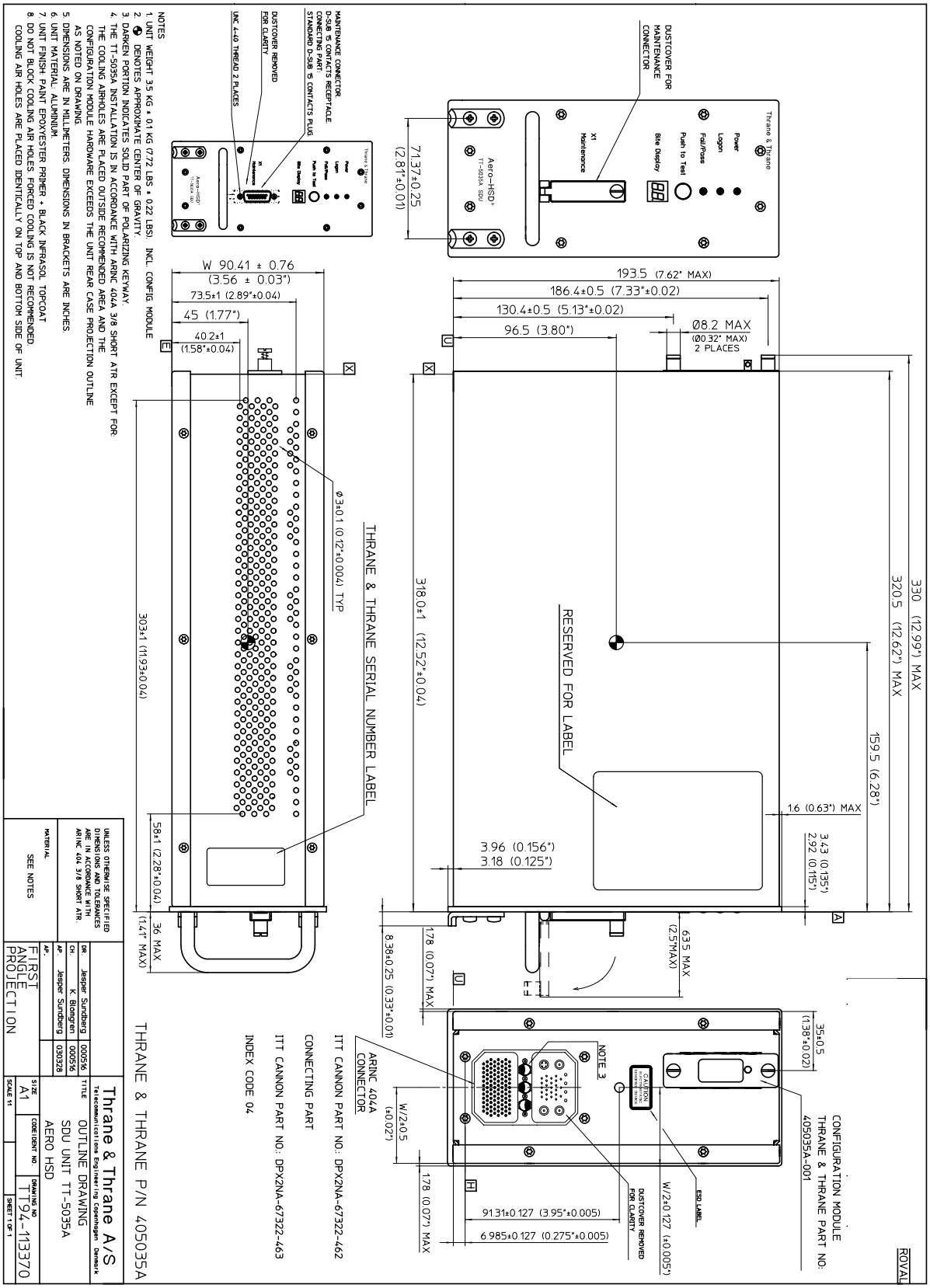


Figure 3-1: Outline Drawing: Satellite Data Unit

3.2.1 TT-5035A-001 Configuration Module

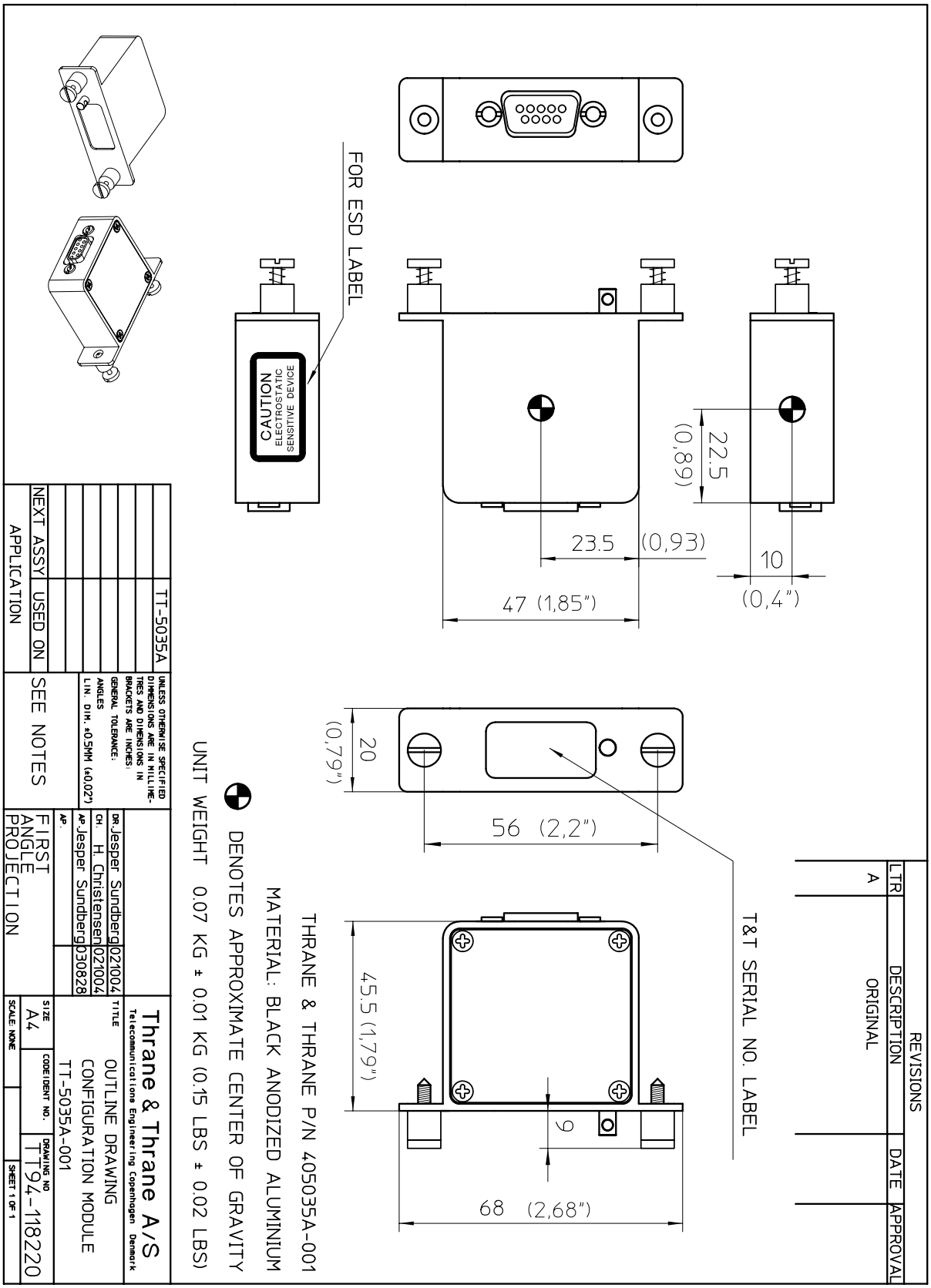


Figure 3-2: Outline Drawing: Configuration Module

3.3 TT-5014A High Power Amplifier

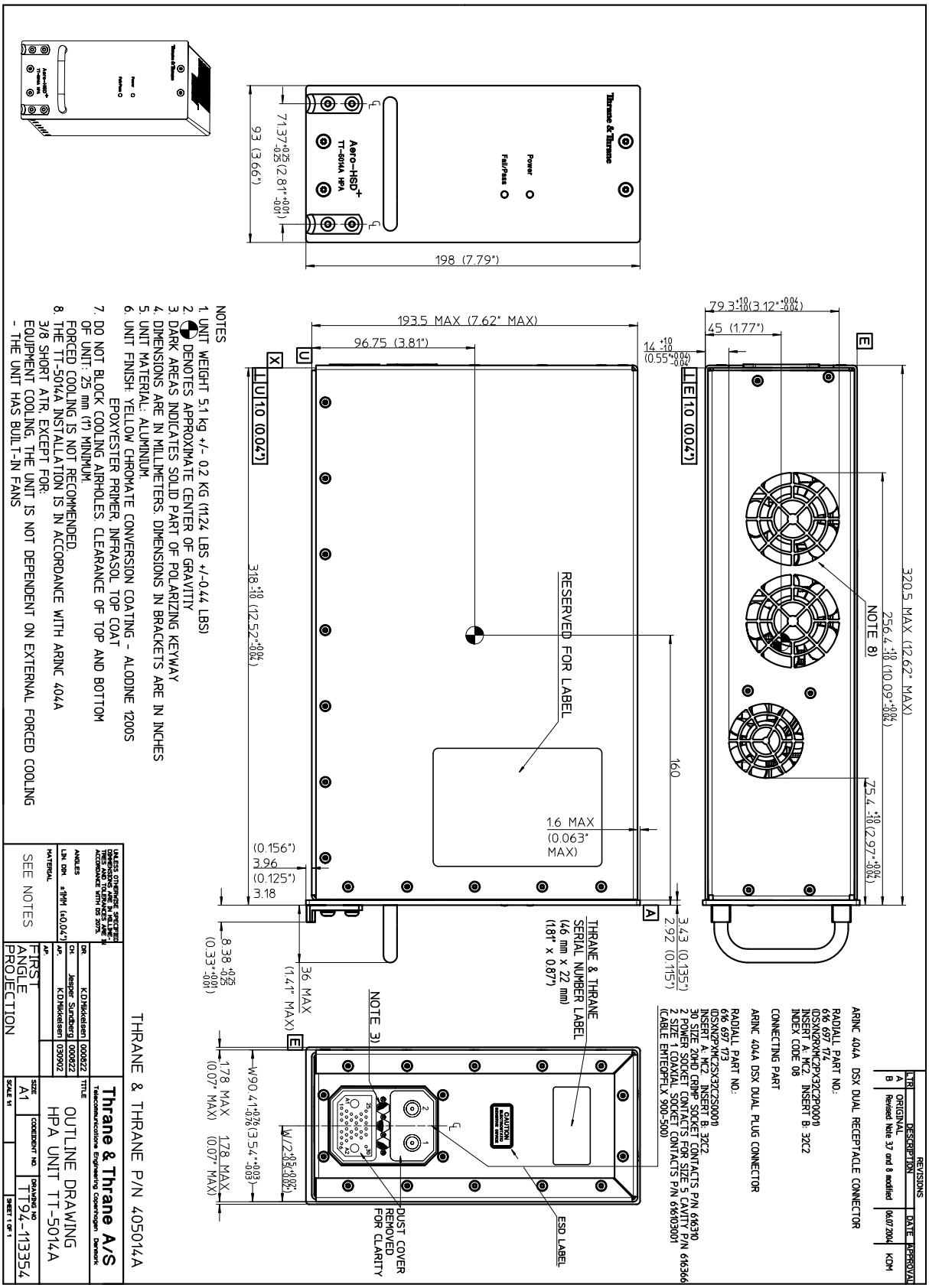


Figure 3-3: Outline Drawing: High Power Amplifier

3.4 TT-5012A Diplexer Low Noise Amplifier

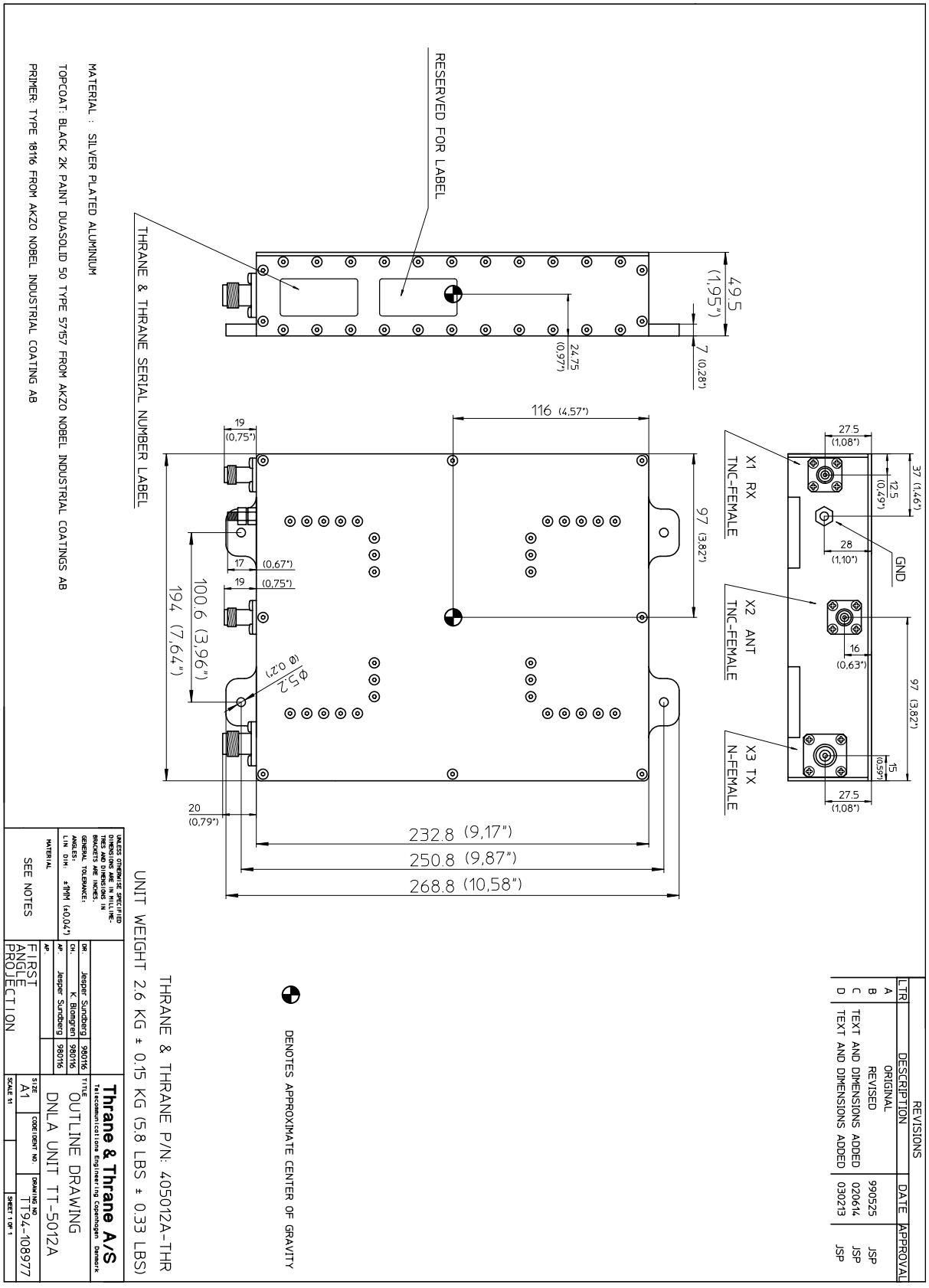


Figure 3-4: Outline Drawing: Diplexer and Low Noise Amplifier

3.5 TT-5038A High Speed Data Unit (Optional)

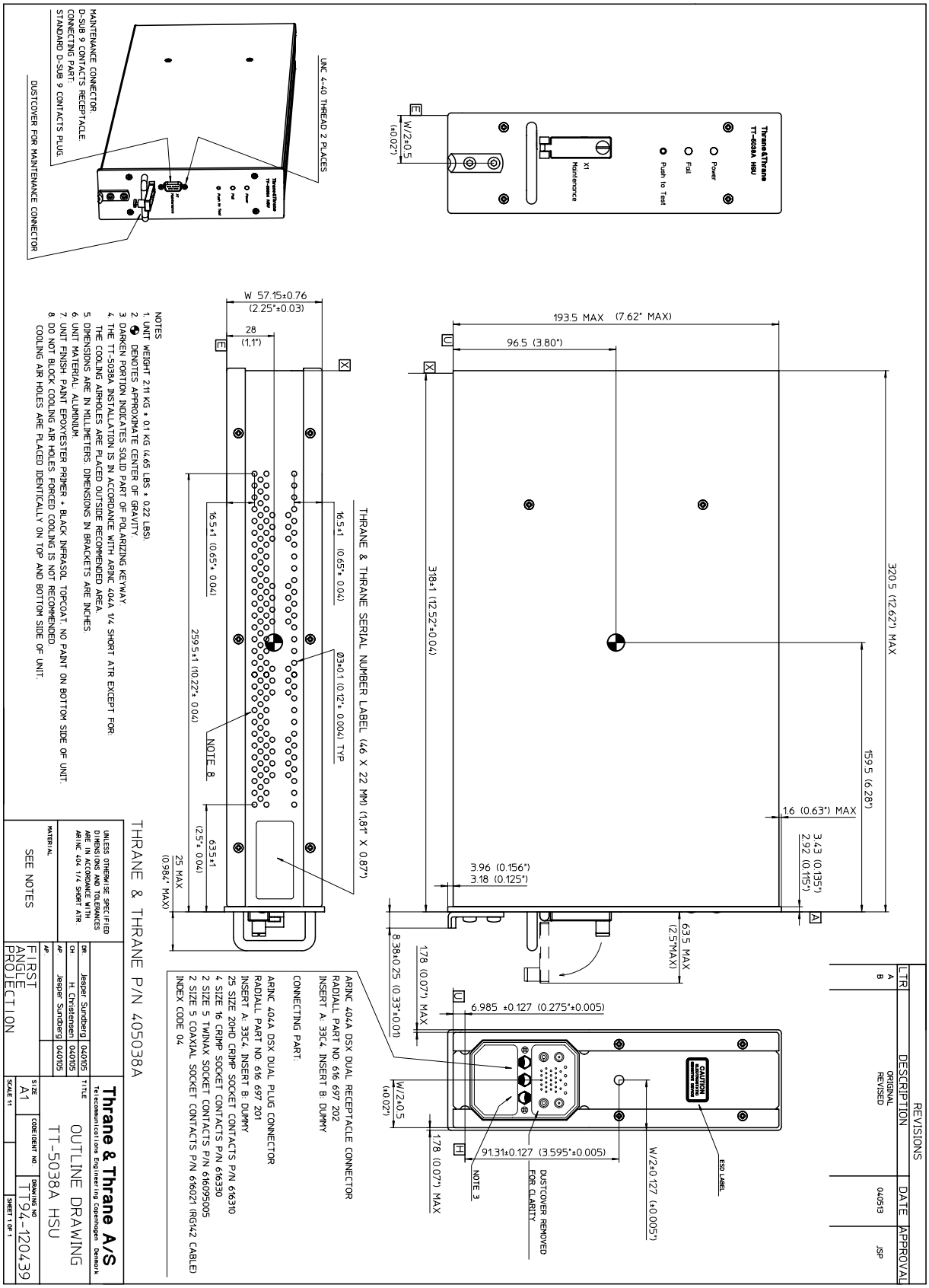


Figure 3-5: Outline Drawing: High Speed Data Unit

3.5.1 TT-5038A-002 Tx Coupler for Optional HSU

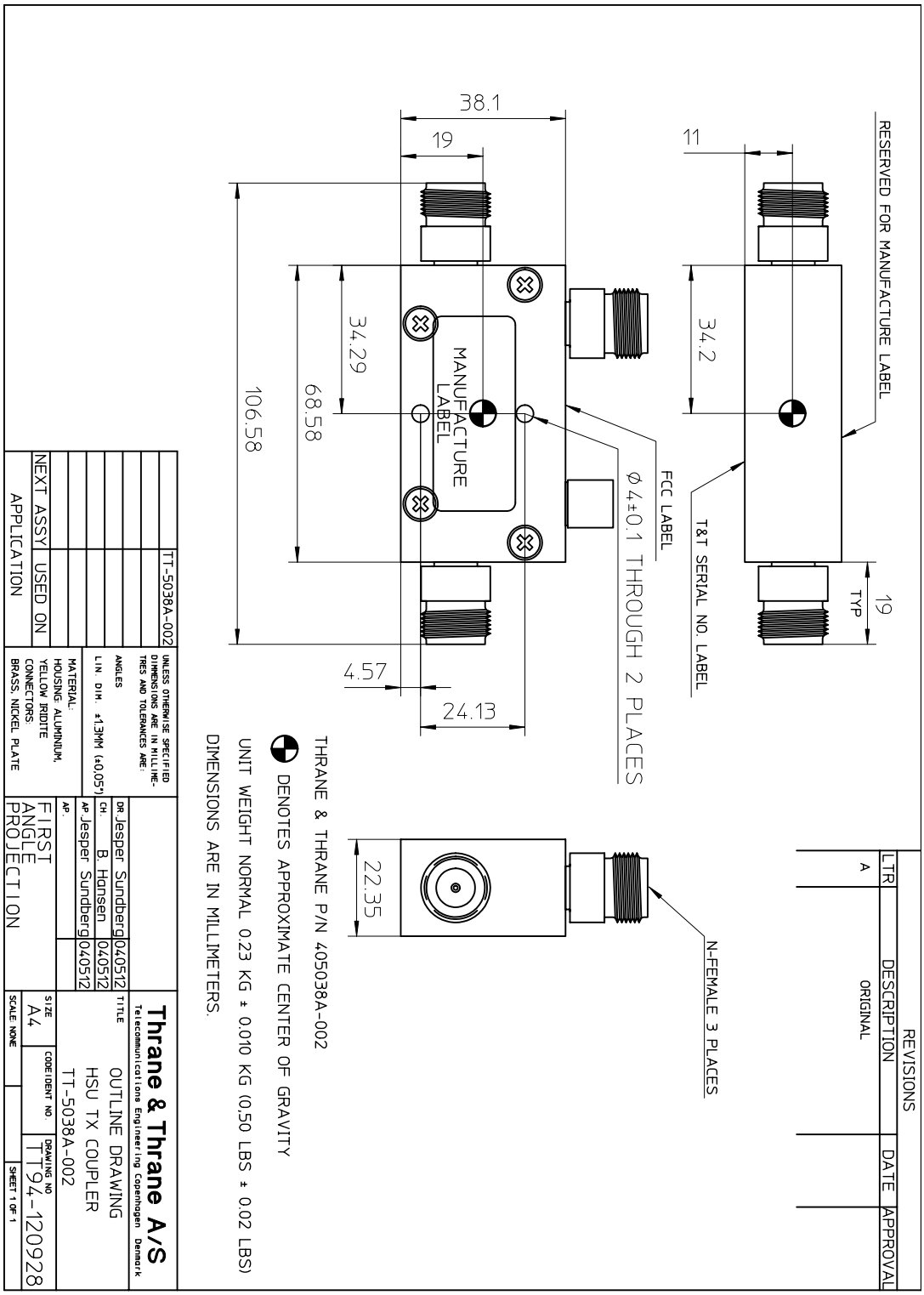


Figure 3-6: Outline Drawing: Tx Coupler for Optional HSU

3.5.2 TT-5038A-003 Rx Power Splitter for Optional HSU

Note: If the Rx Power Splitter is to be mounted on a flat surface, mount it on a 3 mm mounting plate to provide enough space for mounting of the connectors. For further information see **Rx Power Splitter** on page 5-5.

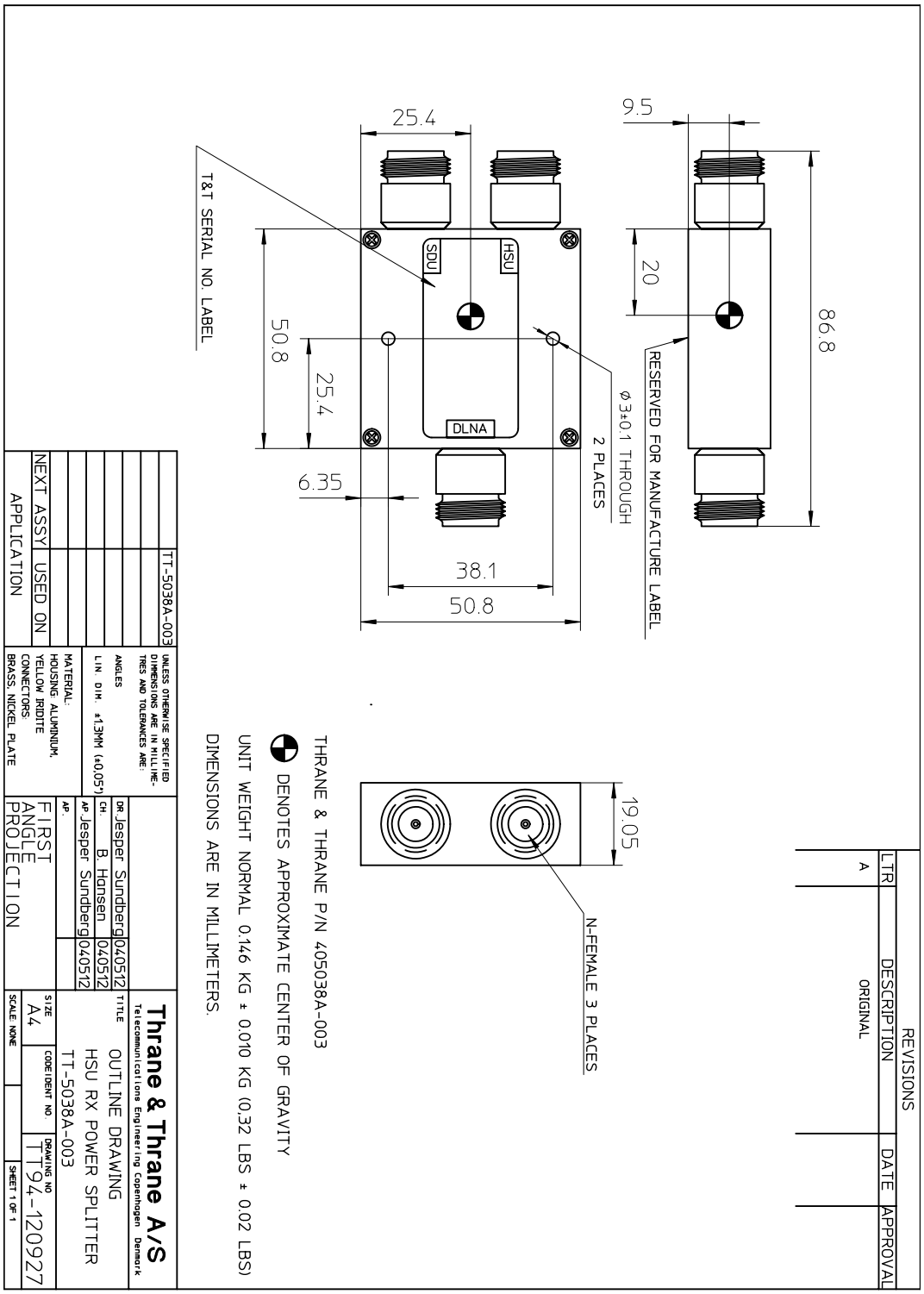


Figure 3-7: Outline Drawing: Rx Power Splitter for Optional HSU

3.6 TT-5620A 4-Wire Handset

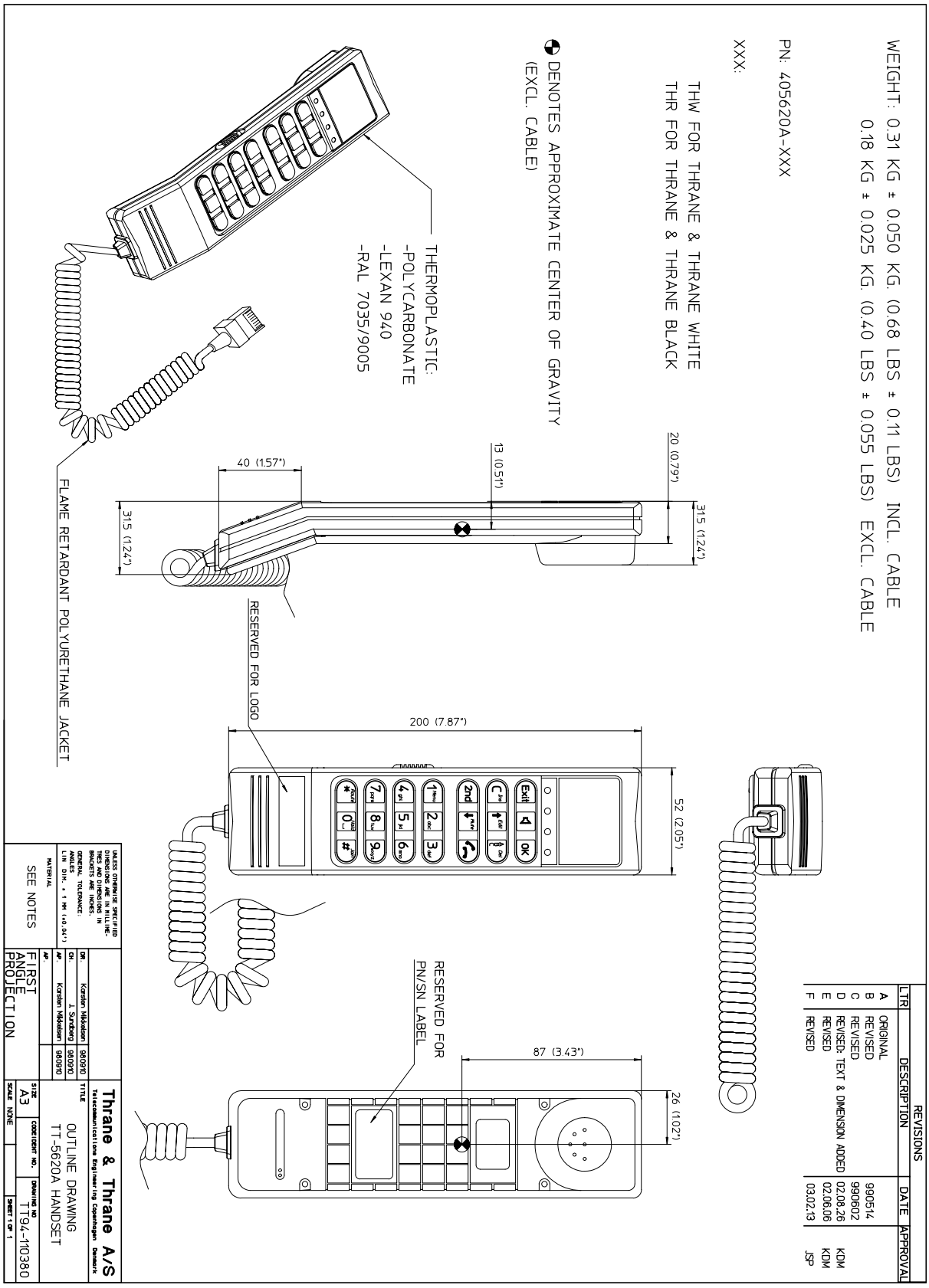


Figure 3-8: Outline Drawing: 4-Wire Handset

3.7 TT-5622A 4-Wire Cradle

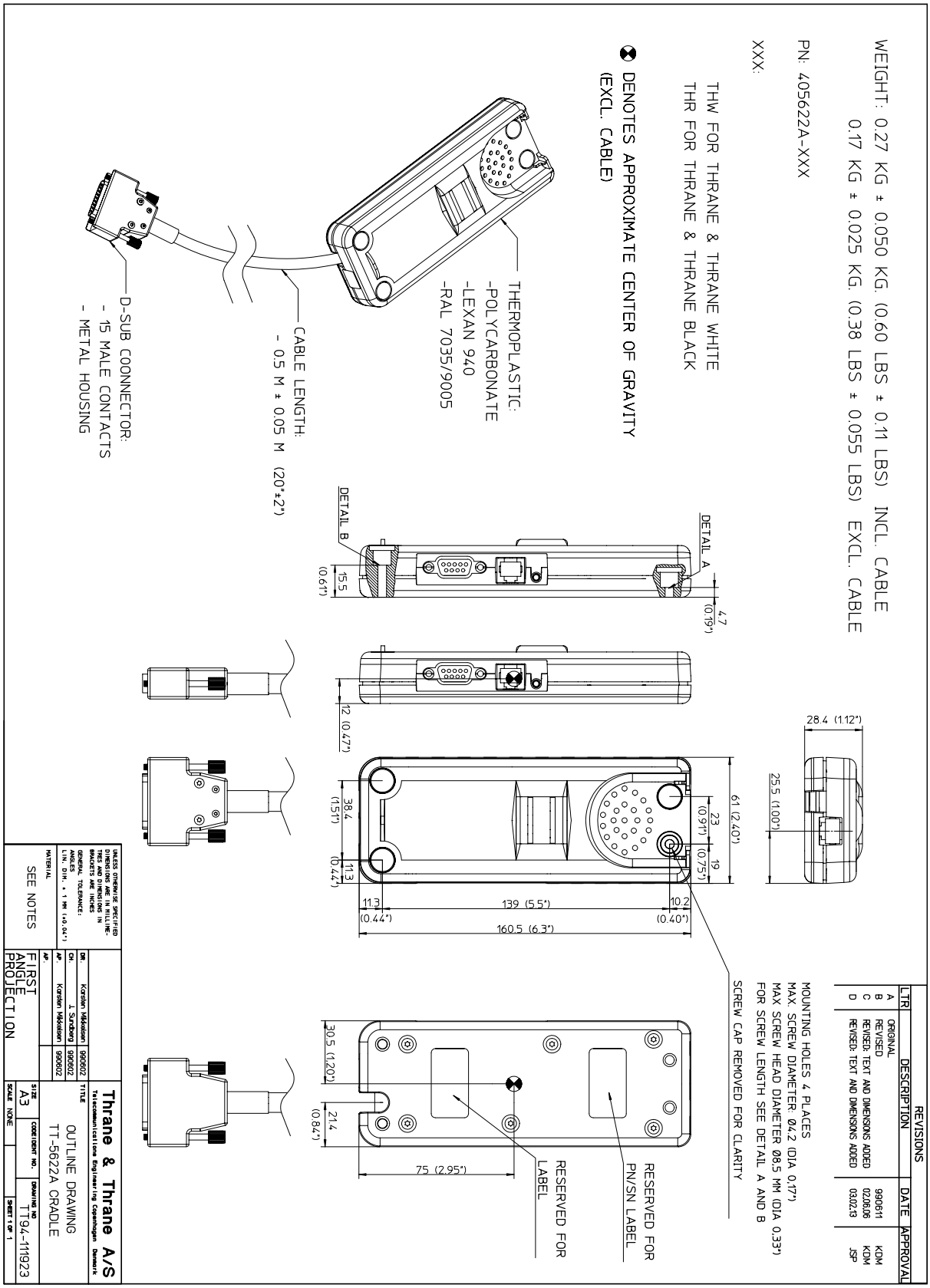


Figure 3-9: Outline Drawing: 4-Wire Cradle

3.8 TT-5621B 2-Wire Handset

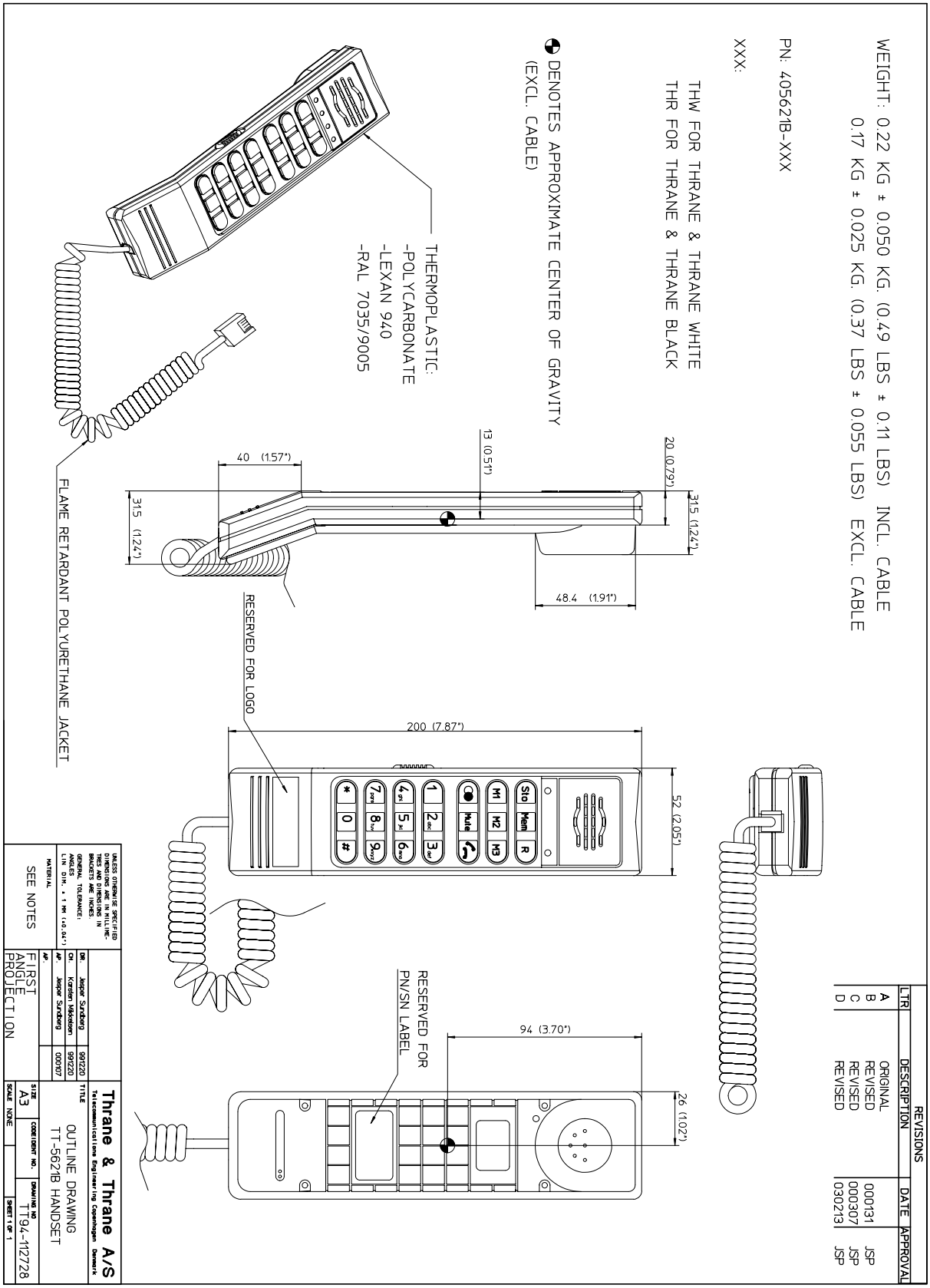


Figure 3-10: Outline Drawing: 2-Wire Handset

3.9 TT-5622B 2-Wire Cradle

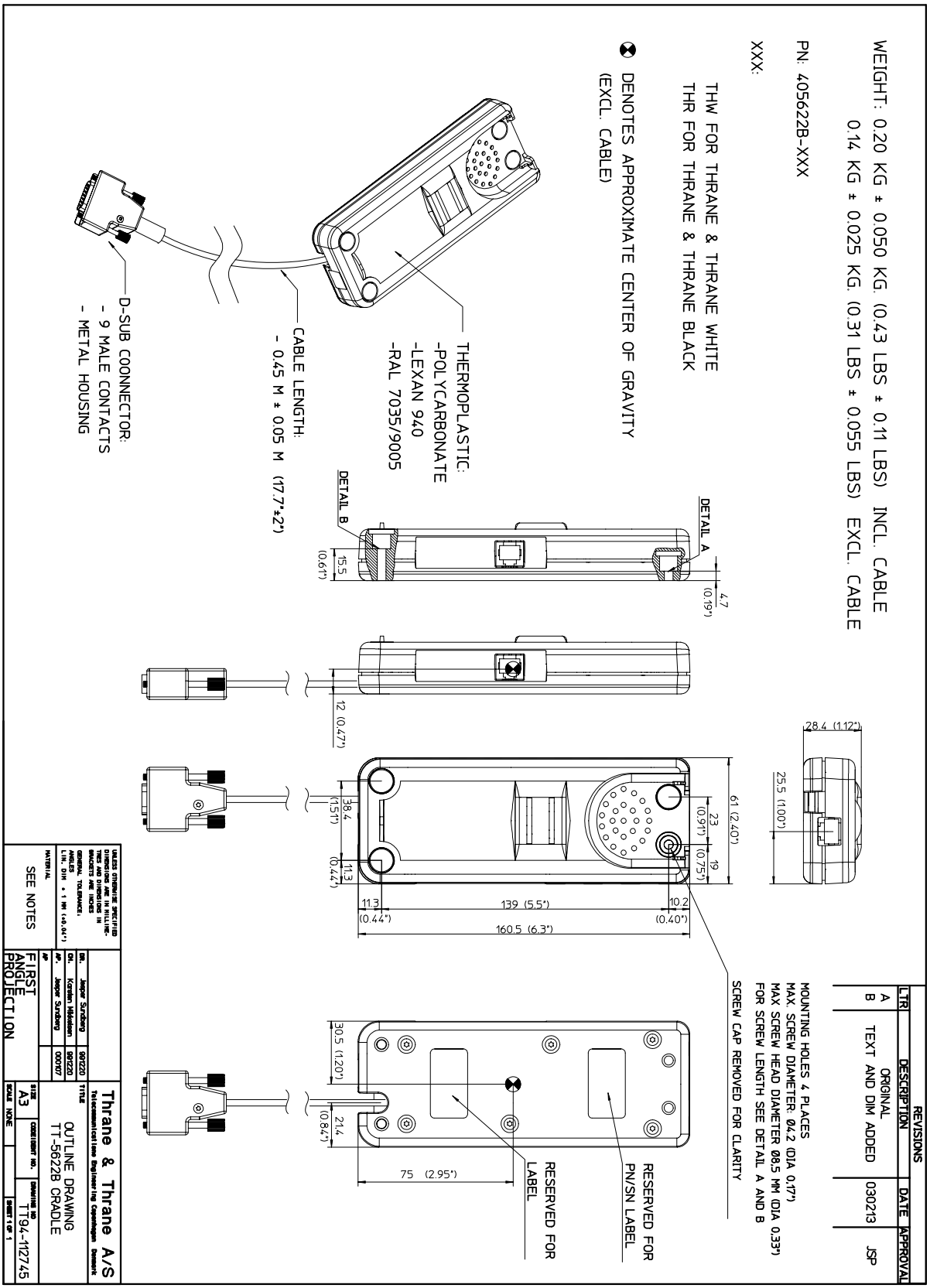


Figure 3-11: Outline Drawing: 2-Wire Cradle

3.10 SDU and HPA Tray

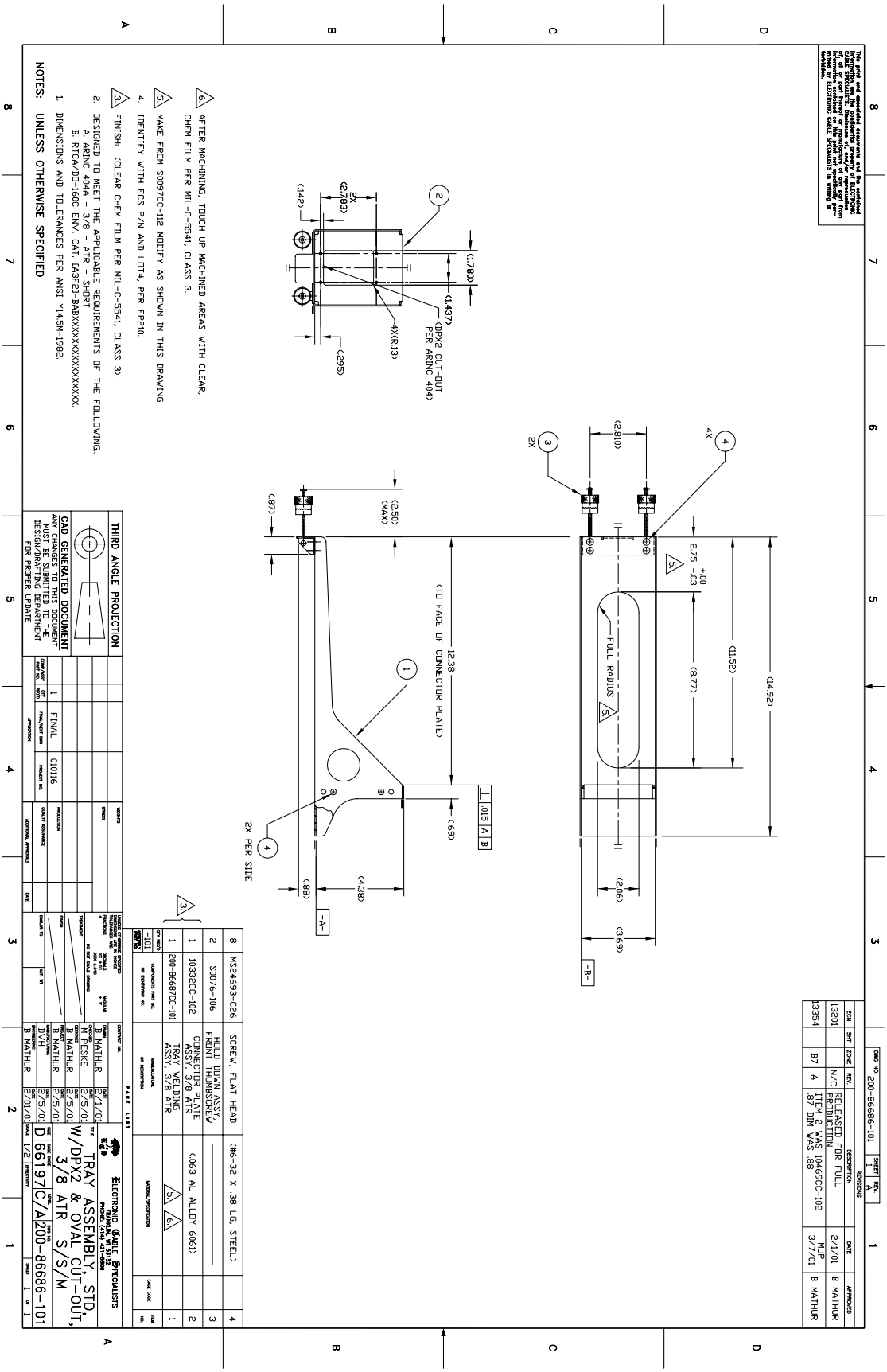


Figure 3-12: Outline Drawing: Tray for SDU and HPA.

3.11 SDU Tray Connector

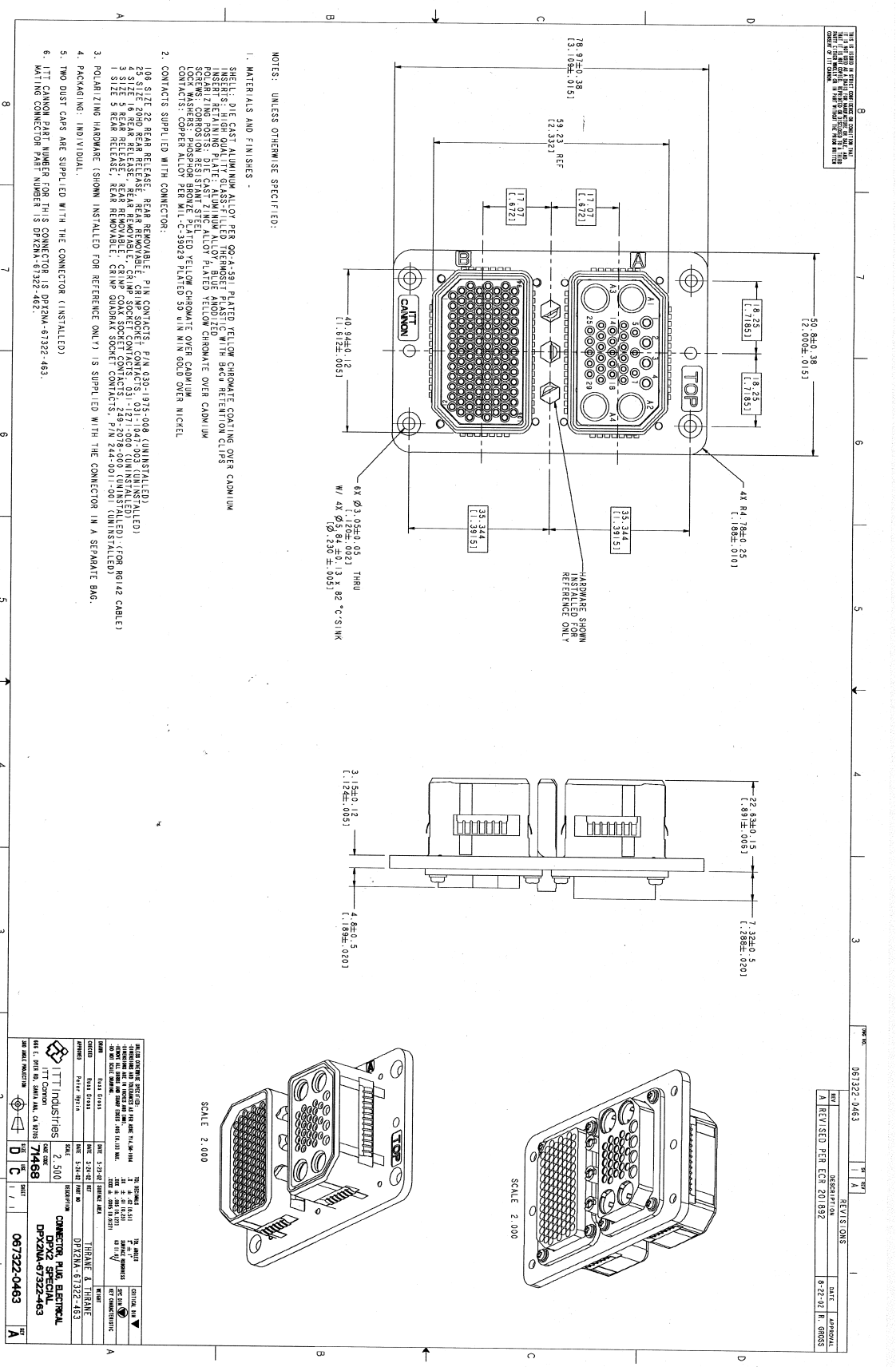
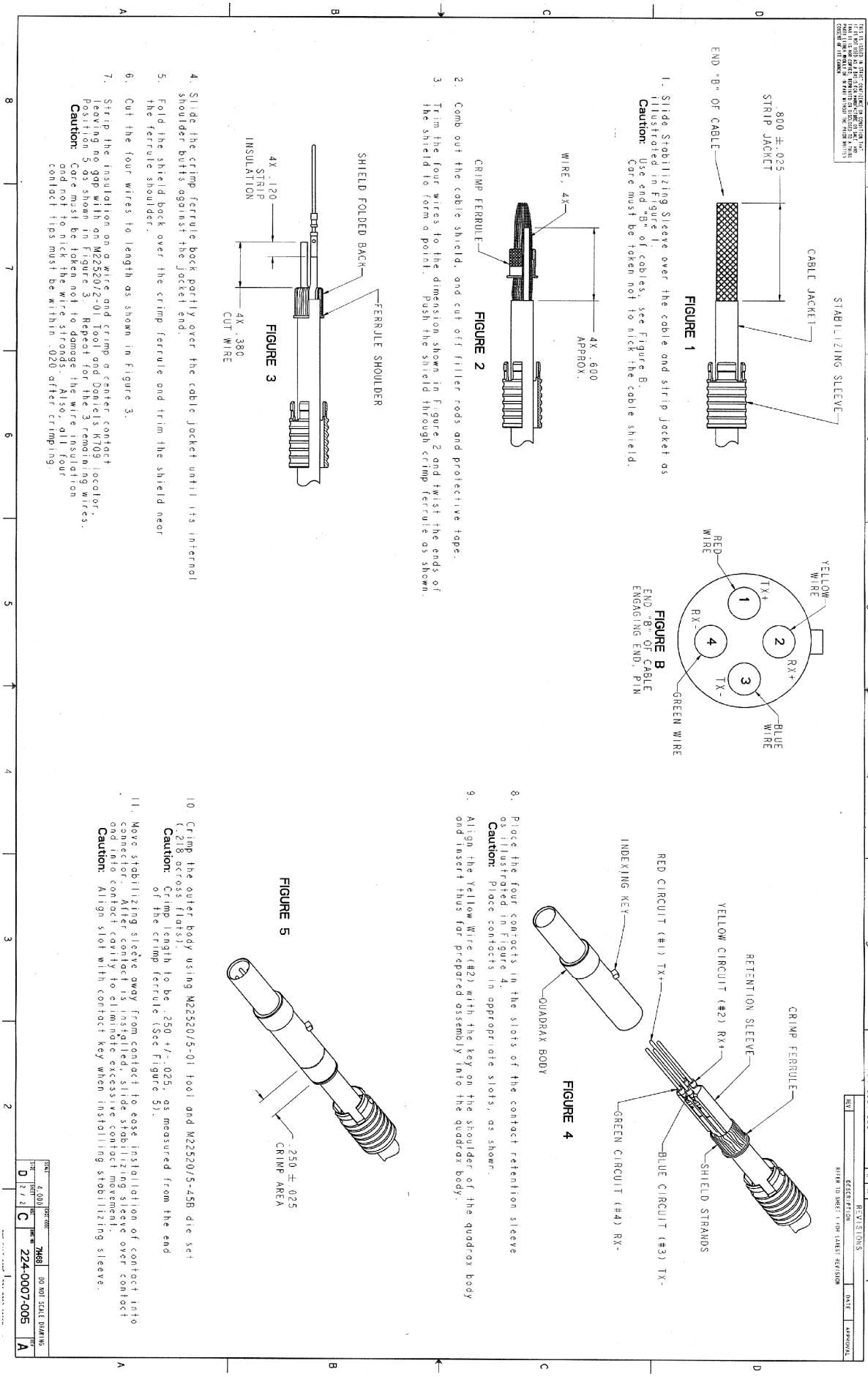


Figure 3-13: SDU Tray Connector: ITT Cannon DPX2NA-67322-463



1. Slide Stabilizing Sleeve over the cable and strip jacket as illustrated in Figure 1.
   Caution: Use end "B" of cables, see Figure B. Care must be taken not to nick the cable shield.
2. Comb out the cable shield, and cut off filler rods and protective tape.
3. Trim the four wires to the dimension shown in Figure 2 and twist the ends of the shield to form a point. Push the shield through crimp ferrule as shown.
4. Slide the crimp ferrule back partly over the cable jacket until its internal shoulder butts against the jacket end.
5. Fold the shield back over the crimp ferrule and trim the shield near the ferrule shoulder.
6. Cut the four wires to length as shown in Figure 3.
7. Strip the insulation on a wire and crimp a center contact leaving no gap with an M22520/2-01 Tool and Daniels K709 locator, Position 5 as shown in Figure 3. Repeat for the 3 remaining wires.
   Caution: Care must be taken not to damage the wire insulation and not to nick the wire strands. Also, all four contact tips must be within .020 after crimping.
8. Place the four contacts in the slots of the contact retention sleeve as illustrated in Figure 4.
   Caution: Place contacts in appropriate slots, as shown.
9. Align the Yellow Wire (#2) with the key on the shoulder of the quadrax body and insert thus far prepared assembly into the quadrax body.
10. Crimp the outer body using M22520/5-01 tool and M22520/5-45R die set (.218 across flats).
    Caution: Crimp length to be .250 +/- .025, as measured from the end of the crimp ferrule (See Figure 5).
11. Move stabilizing sleeve away from contact to ease installation of contact into connector. After contact is installed, slide stabilizing sleeve over contact and into contact cavity to eliminate excessive contact movement.
    Caution: Align slot with contact key when installing stabilizing sleeve.

Figure 3-14: Contact Assembly: Quadrax Pin size 5 special: ITT Cannon 244-0011-001

3.12 HPA Tray Connector

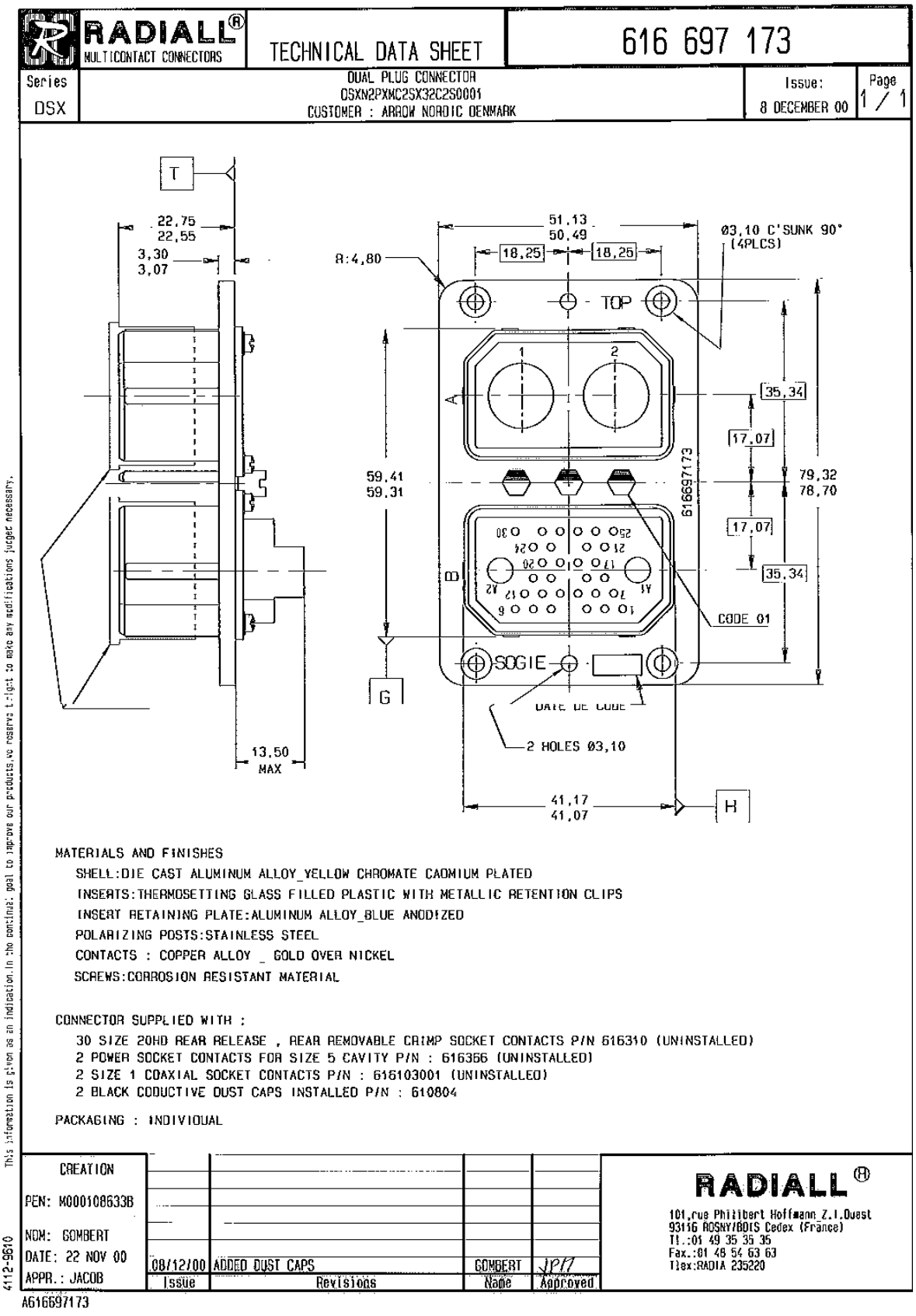


Figure 3-15: HPA Tray Connector

3.13 HSU Tray

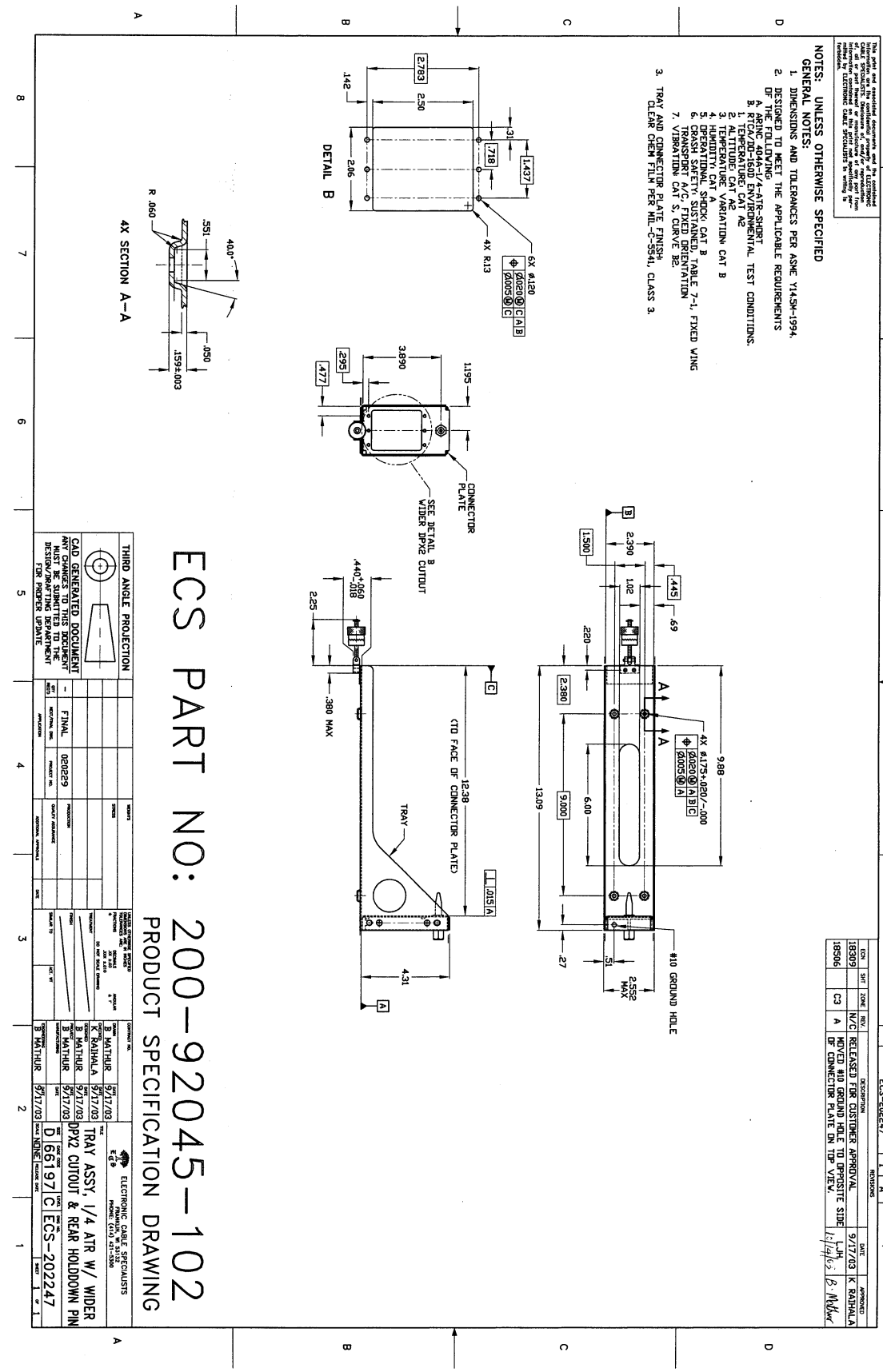


Figure 3-16: Outline Drawing: Tray for HSU

3.14 HSU Tray Connector

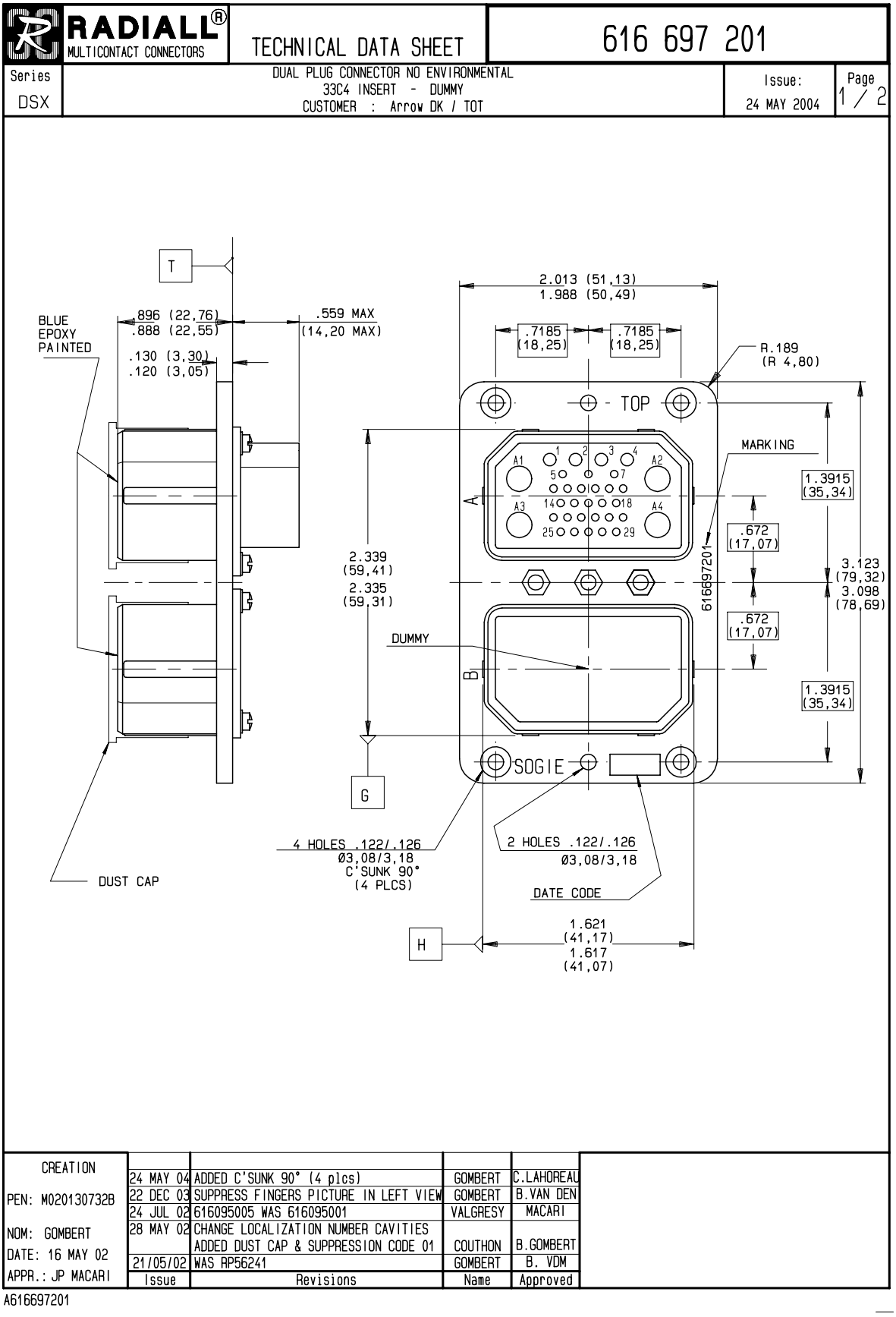


Figure 3-17: HSU Tray Connector, page 1 of 2

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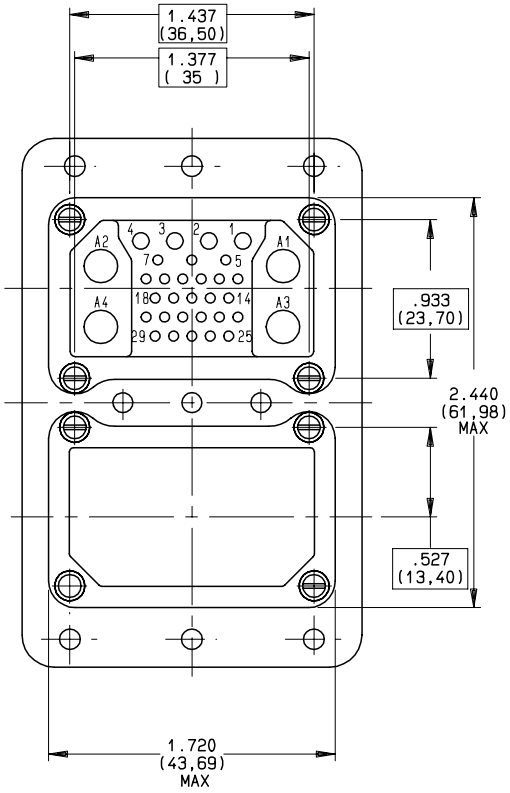
REAR VIEW



*MATERIAL:
- SHELL: AL ALLOY PER QQ-A-591, A-380
- INSULATOR RETENTION PLATE : AL ALLOY PER QQ-A-200 OR QQ-A-591
- POLARIZING POST : STAINLESS STEEL PER ASTM 582-M-95b, TYPE 303
- INSULATOR: THERMOSETING MOLDED COMPOUND PER MIL-M-14
- CONTACTS RETENTION CLIPS : BERYLLIUM COPPER PER ASTM-B-194
- SOCKET CONTACTS : BERYLIUM COPPER PER ASTM-B-196
- PROTECTION SLEEVE : STAINLESS STEEL PER AINSI 305
- SCREWS AND CLINCH NUTS: CORROSION RESISTANT

*FINISH:
- SHELL: YELLOW CHROMATE OVER CADMIUM PER QQ-P-416, TYPE II
- INSULATOR RETENTION PLATE : BLUE ANODIZED PER MIL-A-8625
- POLARIZING POST : PASSIVATED PER QQ-P-35
- PROTECTION SLEEVE : PASSIVATED PER QQ-P-35
- CONTACTS: PLATING .00005 INCH OF GOLD PER MIL-G-45204 TYPE I OR II GRADE C OR D CLASS 1 OVER NICKEL PER QQ-N-290

*CONNECTOR FITTED WITH :

_ 27 SIZE 20HD REAR REALESE ,REAR REMOVABLE CRIMP SOCKET CONTACTS P/N 616310 (UNINSTALLED)
_ 4 SIZE 16 REAR REALESE ,REAR REMOVABLE CRIMP SOCKET CONTACTS P/N 616330 (UNINSTALLED)
_ 2 SIZE 5 TWINAX REAR RELEASE ,REAR REMOVABLE SOCKET CONTACTS P/N 616095005 (UNINSTALLED)
_ 2 DUST CAPS P/N: 610 803 INSTALLED

*SIZE 5 COAXIAL SOCKET CONTACTS MUST BE ORDER SEPARATELY

*THE POLARIZING MUST BE SUPPLY UNASSEMBLED IN A SEPARATE BAG

*INSERTION/EXTRACTION TOOLS MUST BE ORDER SEPARATLY
SIZE 20HD : P/N 282886
SIZE 16 : P/N 282546
SIZE 5 : P/N 282946 (ONLY EXTRACTION)

*PACKAGING : INDIVIDUAL

4113_9306

A616697201

Figure 3-18: HSU Tray Connector, page 2 of 2

Connectors and Pin-out

4.1 TT-5035A Satellite Data Unit

4.1.1 Connectors on SDU

There are three connectors on the SDU:

- Maintenance (front connector):
  Interface to PC and Handset for maintenance purposes.
  A 15 pin Female Sub-D Filter connector
- ARINC 404 (rear connector):
  Interfaces to Aircraft and SATCOM interconnections.
  An ARINC 404 Shell Size 2 Receptacle.
- Configuration Module (rear, inside connector):
  A 9 pin Sub-D Female Connector. This is an internal connector used only as interface to the Configuration Module.

4.1.2 SDU Front Connector

Connector Drawing

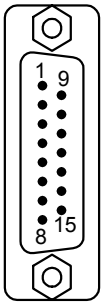


Figure 4-1: SDU Front Connector,
Face View of Engaging End. (DB15F)

Functions

The front connector is a 15 pin Female Sub-D Filter connector, and contains the following interfaces:

- EIA/TIA-232-E PC port
- 4-Wire Thrane & Thrane Handset
- RS-485 Data interface for T&T Handset
- +12 V DC for powering the Handset
- Write Enable Input for Configuration Module.

Pin-out for SDU Front Connector

Pin. No.	Pin Name
FP1	Maintenance Handset Audio In Hi
FP2	Maintenance Handset Audio In Lo
FP3	Maintenance Handset Audio Out Hi
FP4	Maintenance Handset Audio Out Lo
FP5	Signal Ground SGND
FP6	Maintenance Handset RS-485 Data A
FP7	Maintenance Handset RS-485 Data B
FP8	+12 V DC/120 mA
FP9	GND, Power Return (for +12 V DC)
FP10	PC EIA/TIA-232-E RxD Output
FP11	PC EIA/TIA-232-E TxD Input
FP12	PC EIA/TIA-232-E CTS Output
FP13	PC EIA/TIA-232-E RTS Input
FP14	GND
FP15	Configuration Module Write Enable In

Table 4-1: Pin-out for SDU Front Connector

4.1.3 SDU Rear Receptacle

Connector Drawing

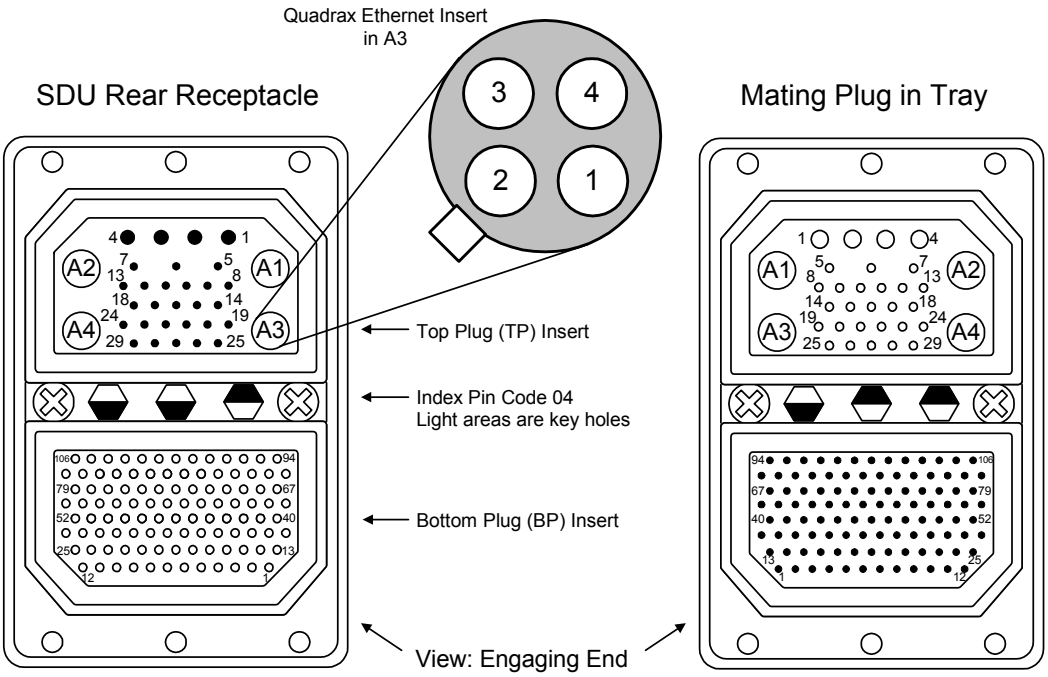


Figure 4-2: SDU Rear Receptacle and Mating Plug in Tray, Engaging End

Functions, Top Plug

The Top Plug (TP) connects the following signals:

Power, RF Interfaces and Antenna Modem:

- +28 V DC Power + chassis ground
- +28 V DC/600 mA 4-wire handset supply
- Remote ON/OFF (nON)
- RF Tx signal to HPA
- RF Rx signal from DLNA
- Antenna Modem Interface

Handset interfaces (analog):

- 4 analog four wire interfaces for Thrane & Thrane Handsets Systems (incl. +28 V DC Handset supply with nON/OFF power supply control)

Voice/Fax/Modem interfaces:

- 2 VOICE/FAX/MODEM/STU-III, analog 2-wire standard POTS interfaces

Functions, Bottom Plug

The Bottom Plug connects the following signals:

Aircraft Avionics Interfaces:

- 24 bit discrete hardwire strapped ICAO address
- 2 high speed ARINC 429 Inertial Reference System (IRS) or
- 2 high or low speed ARINC 429 Attitude and Heading Reference System (AHRS)
- 2 high or low ARINC 429 Communication Management Units (ACARS/CMU)
- 2 low speed ARINC 429 Cabin Packet-mode Data Function (CPDF)
- 3 high or low speed ARINC 429 MCDU/FMS (1 output, 2 inputs) or 1 high or low speed ARINC 429 AES ID input (ICAO address, for future use)
- 2 Discrete inputs for “Weight On Wheels”
- Discrete Inputs/Outputs for WH-10/MagnaStar AIU control or, for future use, Cockpit Voice

High Speed Interfaces:

- 1 MPDS RS-422, with RS-422 CTS/RTS Hardware Handshake
- 1 Euro ISDN S-bus connection

SATCOM Interfaces:

- 1 RS-422 Multi Control HPA Interface (Tx)
- 1 RS-422 BITE/Status HPA Interfaces (Rx)
- 1 Discrete HPA Remote nON/OFF output

Maintenance Interfaces:

- 1 Discrete SDU Hardware Reset

Handset interfaces (digital):

- 4 RS-485 data interfaces for Thrane & Thrane Handsets

Other interfaces:

- 1 RS-422 SIMCARD Reader Interface (future use)
- 3 Annunciators for: “Service Available”, “Call” and “FAX” -annunciator
- 3 ATE pins (Automatic Test Equipment) - **not used**

Pin-out for SDU Rear Receptacle (Top Plug)

Pin No.	Pin Name
TP A1	RF Rx input from DLNA 12 V DC power to DLNA (Coax)
TP A2	RF Tx output to HPA (Coax)
TP A3.1	Tx + 10BaseT Ethernet (Quadrax pin 1)
TP A3.2	Rx + 10BaseT Ethernet (Quadrax pin 2)
TP A3.3	Tx - 10BaseT Ethernet (Quadrax pin 3)
TP A3.4	Rx - 10BaseT Ethernet (Quadrax pin 4)
TP A4	Antenna Modem Interface (Coax)
TP1	+28 V DC Power
TP2	GND, Power Return
TP3	Chassis Ground and Handset Power Return
TP4	+28 V DC/600 mA Handset Supply
TP5	Remote ON/OFF (nON)
TP6	2-Wire Voice/Fax/Modem #5 (Ring)
TP7	2-Wire Voice/Fax/Modem #6 (Ring)
TP8	2-Wire Voice/Fax/Modem #6 (Tip)
TP9	Not Connected
TP10	Handset #1 Audio In Hi / (For future use: Cockpit Voice Audio #1 In Hi)
TP11	Handset #1 Audio In Lo / (For future use: Cockpit Voice Audio #1 In Lo)
TP12	Handset #1 Audio Out Hi / (For future use: Cockpit Voice Audio #1 Out Hi)
TP13	Handset #1 Audio Out Lo / (For future use: Cockpit Voice Audio #1 Out Lo)
TP14	Not Connected
TP15	Handset #2 Audio In Hi / (For future use: Cockpit Voice Audio #2 In Hi)
TP16	Handset #2 Audio In Lo / (For future use: Cockpit Voice Audio #2 In Lo)
TP17	Handset #2 Audio Out Hi / (For future use: Cockpit Voice Audio #2 Out Hi)
TP18	Handset #2 Audio Out Lo / (For future use: Cockpit Voice Audio #2 Out Lo)
TP19	2-Wire Voice/Fax/Modem #5 (Tip)
TP20	AGND
TP21	Handset #3 Audio In Hi
TP22	Handset #3 audio In Lo
TP23	Handset #3 audio Out Hi
TP24	Handset #3 audio Out Lo
TP25	Do not connect! (+12 V DC / 25 mA)
TP26	Handset #4 audio In Hi
TP27	Handset #4 audio In Lo
TP28	Handset #4 audio Out Hi
TP29	Handset #4 audio Out Lo

Table 4-2: Pin-out for SDU Rear Receptacle (Top Plug)

Pin-out for SDU Rear Receptacle (Bottom Plug)

Pin No.	Pin Name
BP1	ICAO Address Bit #1 (MSB)
BP2	ICAO Address Bit #2
BP3	ICAO Address Bit #3
BP4	ICAO Address Bit #4
BP5	ICAO Address Bit #5
BP6	ICAO Address Bit #6
BP7	ICAO Address Bit #7
BP8	ICAO Address Bit #8
BP9	ICAO Address Bit #9
BP10	ICAO Address Bit #10
BP11	ICAO Address Bit #11
BP12	ICAO Address Bit #12
BP13	ICAO Address Bit #13
BP14	ICAO Address Bit #14
BP15	ICAO Address Bit #15
BP16	ICAO Address Bit #16
BP17	ICAO Address Bit #17
BP18	ICAO Address Bit #18
BP19	ICAO Address Bit #19
BP20	ICAO Address Bit #20
BP21	ICAO Address Bit #21
BP22	ICAO Address Bit #22
BP23	ICAO Address Bit #23
BP24	ICAO Address Bit #24
BP25	ICAO Address Common
BP26	Data from primary IRS 429 A / Data from primary AHRS 429 A

Pin No.	Pin Name
BP27	Data from primary IRS 429 B / Data from primary AHRS 429 B
BP28	Data from second. IRS 429 A / Data from second. AHRS 429 A
BP29	Data from second. IRS 429 B / Data from second. AHRS 429 B
BP30	Data bus from MCDU / FMS #2 / AES ID input 429 A (future use)
BP31	Data bus from MCDU / FMS #2 / AES ID input 429 B (future use)
BP32	Data bus from CPDF #1 429 A/ HSU control input
BP33	Data bus from CPDF #1 429 B/ HSU control input
BP34	Data bus to CPDF #1 429 A/ HSU control output
BP35	Data bus to CPDF #1 429 B/ HSU control output
BP36	Data bus from CPDF #2 429 A
BP37	Data bus from CPDF #2 429 B
BP38	Data bus to CPDF #2 429 A
BP39	Data bus to CPDF #2 429 B
BP40	Data bus from ACARS/CMU #1 429 A
BP41	Data bus from ACARS/CMU #1 429 B
BP42	Data bus to ACARS/CMU #1 & #2 429 A
BP43	Data bus to ACARS/CMU #1 & #2 429 B
BP44	Data bus from ACARS/CMU #2 429 A
BP45	Data bus from ACARS/CMU #2 429 B

Pin No.	Pin Name
BP46	Data bus from MCDU / FMS #1 429 A
BP47	Data bus from MCDU / FMS #1 429 B
BP48	Data bus to MCDU / FMS #1 & #2 429 A
BP49	Data bus to MCDU / FMS #1 & #2 429 B
BP50	Reserved for Weight-On-Wheels Input #1
BP51	Reserved for Weight-On-Wheels Input #2
BP52	For future use: CP Voice Chime Signal Contact #1; Current from Chime
BP53	For future use: CP Voice Chime Signal Contact #2; Current to Chime
BP54	MagnaStar: Satcom Service Unavailable
BP55	WH-10/MagnaStar: Hook switch #3
BP56	HSU disable
BP57	HPA remote nON/OFF output
BP58	MPDS TxD-B RS-422 (I)
BP59	MPDS TxD-A RS-422 (I)
BP60	MPDS RxD-B RS-422 (O)
BP61	MPDS RxD-A RS-422 (O)
BP62	MPDS RTS-B RS-422 (I)
BP63	MPDS RTS-A RS-422 (I)
BP64	MPDS CTS-B RS-422 (O)
BP65	MPDS CTS-A RS-422 (O)
BP66	ISDN RxP (c)

Pin No.	Pin Name
BP67	ISDN TxP (d)
BP68	ISDN TxN (e)
BP69	ISDN RxN (f)
BP70	Future use: SIMCARD Reader Control Output B, RS-422
BP71	Future use: SIMCARD Reader Control Output A, RS-422
BP72	Future use: SIMCARD Reader Data Input B, RS-422
BP73	Future use: SIMCARD Reader Data Input A, RS-422
BP74	Do not connect! (ATE 1)
BP75	Do not connect! (ATE 2)
BP76	Do not connect! (ATE 3)
BP77	SDU Reset, Active Low
BP78	HPA Control Output A, RS-422
BP79	HPA Control Output B, RS-422
BP80	HPA Data/BITE Input A, RS-422
BP81	HPA Data/BITE Input B, RS-422
BP82	WH-10/MagnaStar Hook Switch #1 or, for future use, CP Voice Call Cancel Input #1 (Discrete I)
BP83	WH-10/MagnaStar Ringer Output A1 or, for future use, CP Voice Mic On Input #1 (Discrete I/O)
BP84	WH-10/MagnaStar Ringer Output B1 or, for future use, CP Voice Call Light Output #1 (Discrete O)
BP85	WH-10/MagnaStar Hook Switch #2 or, for future use, CP Voice Call Cancel Input #2 (Discrete I)
BP86	WH-10/MagnaStar Ringer Output A2 or, for future use, CP Voice Mic On Input #2 (Discrete I/O)

Pin No.	Pin Name
BP87	WH-10/MagnaStar Ringer Output B2 or, for future use, CP Voice Call Light Output #2 (Discrete O)
BP88	Chime/ Lamps Inhibit Input (Discrete I)
BP89	WH-10/MagnaStar Ringer Output A3 or Service Available Annunciator (Discrete I/O)
BP90	WH-10/MagnaStar Ringer Output B3
BP91	For future use: CP Voice Chime Reset Input #1 (Discrete I)
BP92	Call Annunciator (Discrete I/O)
BP93	Fax Annunciator (Discrete Output)
BP94	4-Wire Handset #1 RS-485 Data A
BP95	4-Wire Handset #1 RS-485 Data B
BP96	4-Wire Handset #2 RS-485 Data A
BP97	4-Wire Handset #2 RS-485 Data B
BP98	4-Wire Handset #3 RS-485 Data A
BP99	4-Wire Handset #3 RS-485 Data B
BP100	4-Wire Handset #4 RS-485 Data A
BP101	4-Wire Handset #4 RS-485 Data B
BP102	MPDS DTR-B RS-422 (I)
BP103	MPDS DTR-A RS-422 (I)
BP104	MPDS DCD-B RS-422 (O)
BP105	MPDS DCD-A RS-422 (O)
BP106	Port 1 GND

Table 4-3: Pin-out for SDU Rear Receptacle (Bottom Plug)

4.2 TT-5014A High Power Amplifier

4.2.1 HPA Rear Receptacle

The HPA has one connector:

An ARINC 404, shell size 2, rear receptacle, used for connection to the antenna system and the SDU.

Connector Drawing

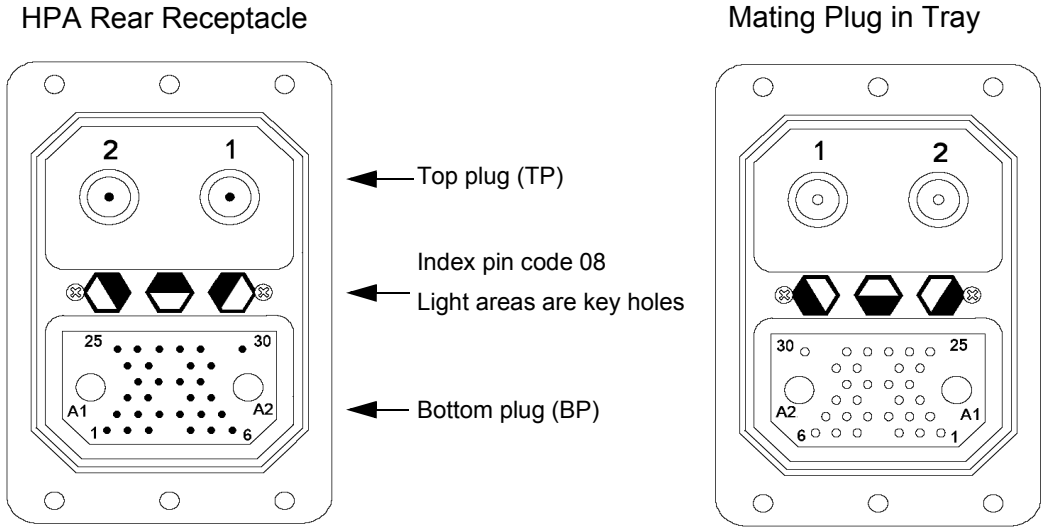


Figure 4-3: HPA Receptacle, Face View of Engaging End. Index Code is 08

Functions

The **Top Plug** connects the following signals:

- RF Tx signal to DLNA
- RF Tx signal from SDU

The **Bottom Plug** connects the following signals:

- +28 V DC Power (Aircraft Power Bus)
- Chassis ground
- ARINC 429 Tx and Rx connections for interfacing to ARINC 741 antennas
- Remote ON/OFF (nON) from SDU
- RS-422 data interface to SDU

Pin-out for HPA Receptacle

Top Pin	Pin Name
TP1	RF Tx output to DLNA
TP2	RF Tx input from SDU

Table 4-4: Pin-out for HPA Receptacle (Top Plug)

Bottom Pin	Pin Name
BP A1	+28 V DC Power
BP A2	GND, Power Return
BP1	ATE 1
BP2	ATE 2
BP3	ATE 3
BP4	ATE 4
BP5	Spare
BP6	nON
BP7	Spare
BP8	A429 Tx A
BP9	A429 Tx B
BP10	A429 Tx A
BP11	A429 Tx B
BP12	Spare
BP13	A429 Rx1 A
BP14	A429 Rx1 B
BP15	A429 Rx2 A
BP16	A429 Rx2 B

Bottom Pin	Pin Name
BP17	HPA Mute 1 A
BP18	HPA Mute 1 B
BP19	HPA Mute 2 A
BP20	HPA Mute 2 B
BP21	Spare
BP22	Spare
BP23	Spare
BP24	Spare
BP25	RS-422 Tx A, HPA Data/BITE Output A, from HPA to SDU
BP26	RS-422 Tx B, HPA Data/BITE Output B, from HPA to SDU
BP27	RS-422 Rx A, HPA Control Input A, from SDU to HPA
BP28	RS-422 Rx B, HPA Control Input B, from SDU to HPA
BP29	Spare
BP30	Chassis

Table 4-5: Pin-out for HPA Receptacle (Bottom Plug)

4.3 TT-5038A HSU (Optional)

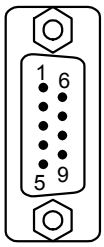
4.3.1 Connectors on HSU

There are two connectors on the HSU:

- Maintenance (front connector):
  Interface to PC for maintenance purposes.
  A 9 pin female Sub-D connector.
- ARINC 404 (rear connector):
  Interfaces to Aircraft and SATCOM interconnections.
  An ARINC 404 Shell Size 2 Receptacle.

4.3.2 HSU Front Connector

Connector Drawing



9 pin
SUB-D
female

Figure 4-4: HSU Front Connector.
Face View of Engaging End.

Functions

The front connector is a 9 pin Female Sub-D connector, and contains the following interfaces:

- EIA/TIA-232-E port for #1 RS-232 PC interface
- #2 I/F Disable Input

Pin-out for HSU Front Connector

Pin no.	Pin Name
FP1	Not used
FP2	#1 RxD Output (EIA/TIA-232-E)
FP3	#1 TxD Input (EIA/TIA-232-E)
FP4	#2 I/F Disable Input
FP5	#1 GND (EIA/TIA-232-E)
FP6	#1 +12 V DC (to pull up FP4)
FP7	Not Used
FP8	Not Used
FP9	Not used

Table 4-6: Pin-out for HSU Front Connector

4.3.3 HSU Rear Receptacle

Connector Drawing

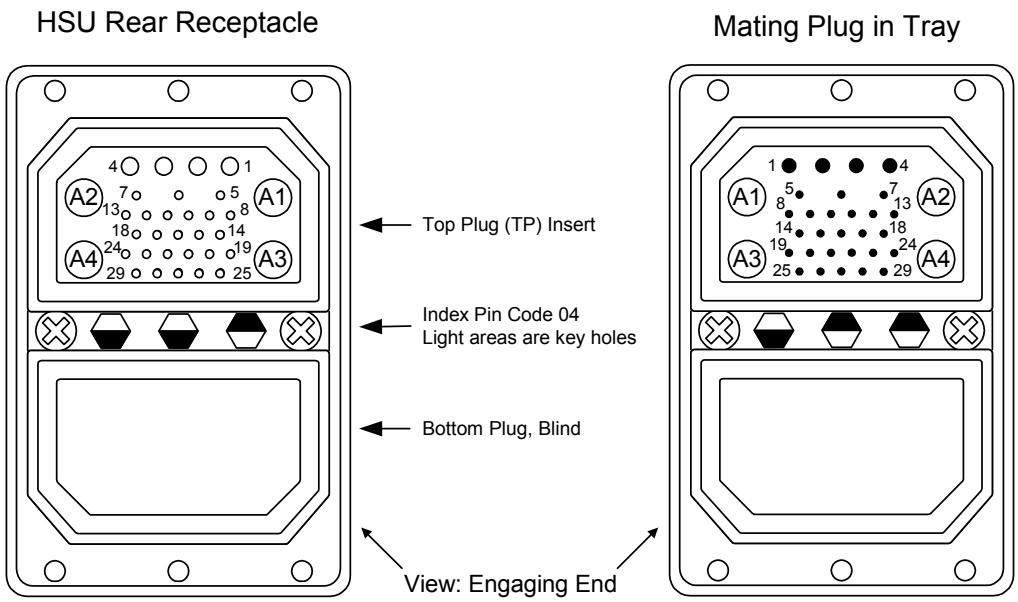


Figure 4-5: HSU Rear Receptacle and Mating Plug in Tray, Engaging End.

Functions

The Top Plug of the HSU rear receptacle connects the following signals:

Power & RF Interfaces:

- +28 V DC and chassis ground
- RF Tx signal to HPA
- RF Rx signal from DLNA

User Interfaces:

- MPDS, 10BaseT Ethernet
- MPDS, EIA/TIA-232 with CTS/RTS Hardware Handshake
- Euro ISDN S-bus connection

Control & Maintenance Interfaces:

- EIA/TIA-232 PC interface (#2)
- ARINC 429 High Speed HSU Control Interface
- HSU Failure Discrete Output
- 1 MPDS Service Available Output
- 1 ISDN Service Available Output
- HSU Disable Discrete Input
- 2 ATE Discrete inputs

Pin-out for HSU Rear Receptacle

Pin	Function
TP A1	RF Rx input from DLNA
TP A2	RF Tx output to HPA
TP A3	10BaseT Rx output (Center: RxD+)
TP A4	10BaseT Tx input (Center: TxD+)
TP1	+28 V DC Power
TP2	GND, Power Return
TP3	Chassis Ground
TP4	Not Used
TP5	#2 GND (EIA/TIA-232-E)
TP6	#2 TxD Input (EIA/TIA-232-E)
TP7	#2 RxD Output (EIA/TIA-232-E)
TP8	HSU Disable, Discrete Input
TP9	ATE #1, Discrete Input
TP10	ATE #2, Discrete Input
TP11	MPDS TxD Input (EIA/TIA-232-E)
TP12	MPDS RxD Output (EIA/TIA-232-E)
TP13	MPDS RTS Input (EIA/TIA-232-E)
TP14	MPDS CTS Output (EIA/TIA-232-E)

Pin	Function
TP15	MPDS DTR Input (EIA/TIA-232-E)
TP16	MPDS DCD Output (EIA/TIA-232-E)
TP17	MPDS DSR Output (EIA/TIA-232-E)
TP18	MPDS GND (EIA/TIA-232-E)
TP19	Data bus output to SDU (ARINC 429-A)
TP20	Data bus output to SDU (ARINC 429-B)
TP21	Data bus input from SDU (ARINC 429-A)
TP22	Data bus input from SDU (ARINC 429-B)
TP23	ISDN Rx+ (c) input
TP24	ISDN Tx+ (d) output
TP25	ISDN Tx- (e) output
TP26	ISDN Rx- (f) input
TP27	HSU Failure, Discrete Output (Lamp Type)
TP28	ISDN Service Available, Discrete Output (Lamp Type)
TP29	MPDS Service Available, Discrete Output (Lamp Type)

Table 4-7: Pin-out for HSU Rear Receptacle

4.4 Cradle Connectors

4.4.1 Connectors on 4-Wire Cradle

There are four connectors on the 4-wire cradle, two on the side of the cradle and two at the end:

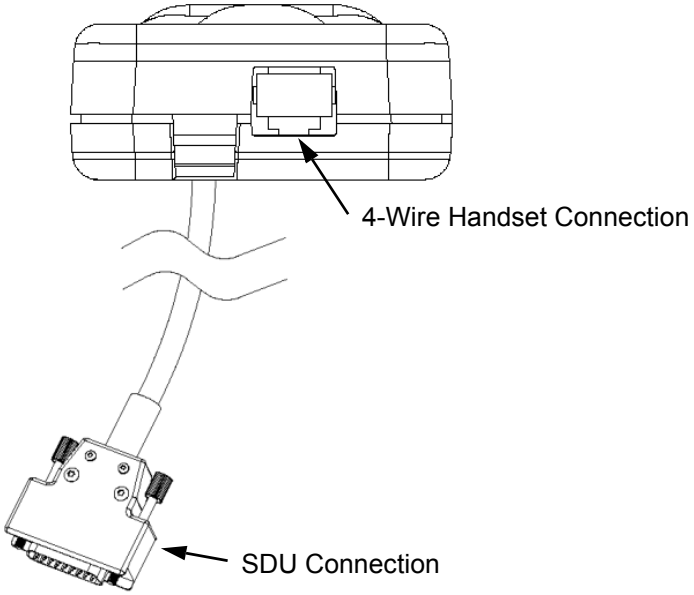


Figure 4-6: 4-Wire Cradle Connectors, End View of Cradle

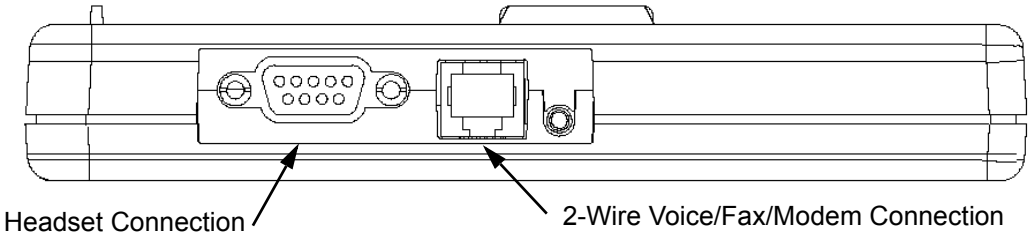


Figure 4-7: 4-Wire Cradle Connectors, Side View of Cradle

4.4.2 4-Wire Connector to SDU

Connector Drawing

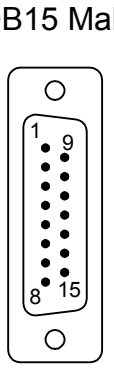


Figure 4-8: 4-Wire Cradle Connector (DB15M). View: Solder Side

Functions

The 15 pin Sub-D male connector on the “pigtail” at the end of the 4-wire cradle connects the following signals on the SDU:

Handset interface (analog):

- analog 4-wire interface (incl. +28 V DC Handset supply)

Handset interface (digital):

- RS-485 data interface

Voice/Fax/Modem interface:

- Voice/Fax/Modem/STU-III, analog 2-wire standard POTS interface

OR

Maintenance handset interface:

- Maintenance 4-wire handset connection to SDU front connector

Pin-out for DB15 Connector

The 4-wire cradle connector for connection to the SDU has the following pin-out:

Pin	Function
1	2 wire Tip (Fax/PC_modem/Auxiliary)
2	2 wire Ring (Fax/PC_modem/Auxiliary)
3	GND
4	+28 V DC
5	GND, Power Return
6	SDU Audio in +
7	SDU Audio in -

Pin	Function
8	GND
9	GND
10	RS-485 Data A
11	RS-485 Data B
12	GND
13	SDU Audio out +
14	SDU Audio out -
15	NC

Table 4-8: Pin-out for 15 Pin Sub-D Male Connector on “pigtail” in 4-Wire Cradle

4.4.3 Connectors on 2-Wire Cradle

There are three connectors on the 2-wire cradle, one at the side and two at the end:

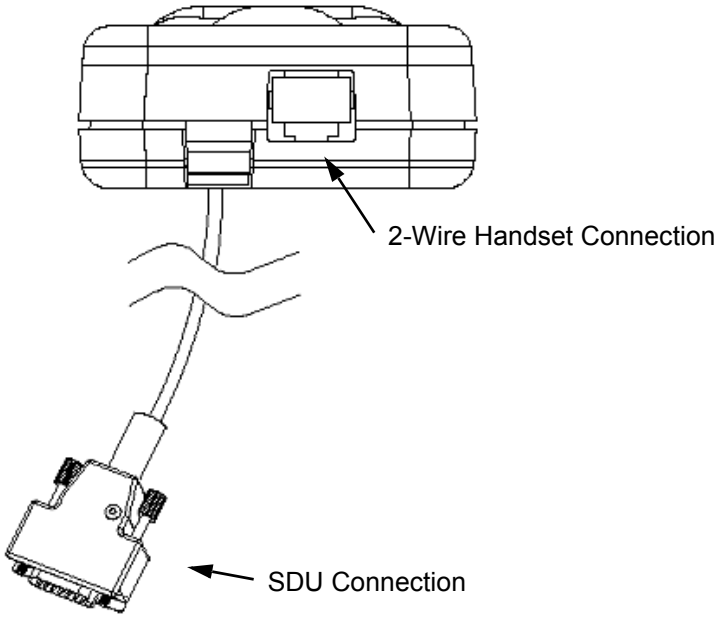


Figure 4-9: 2-Wire Cradle Connectors, End View of Cradle

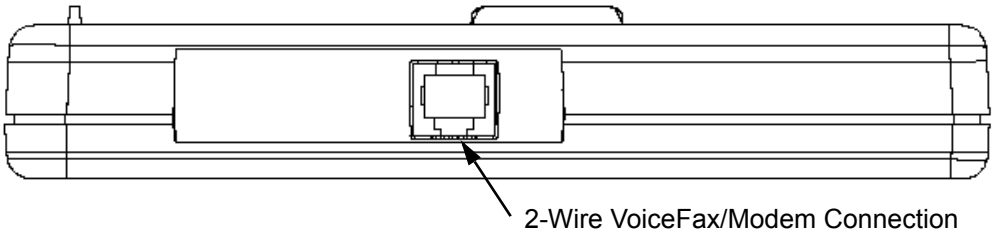


Figure 4-10: 2-Wire Cradle Connectors, Side View of Cradle

4.4.4 2-Wire Connector to SDU

Connector Drawing

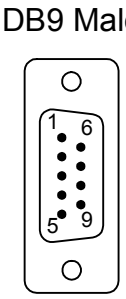


Figure 4-11: 2-Wire Cradle Connector (DB9M). View: Solder Side

Functions

The 9 pin Sub-D male connector on the “pigtail” at the end of the 2-wire cradle connects the following signals on the SDU:

- Voice/Fax/Modem/STU-III, analog 2-wire standard POTS interface

Pin-out for Cradle Connector

The 2-wire cradle connector for connection to the SDU has the following pin-out:

Pin	Function
1	Auxiliary Tip
2	Auxiliary Ring
3	Shield
4	NC
5	NC
6	NC
7	NC
8	NC
9	NC

Table 4-9: Pin-out for 9 Pin Sub-D Male Connector on “pigtail” in 2-Wire Cradle.

4.5 Mating Connectors in Aircraft

Connection With SDU

The installation tray for the SDU is equipped with the following connector:

Connector	Mating Connector Type
Front Panel Connector	15 pin SUB-D male
Rear I/O Connector	ARINC 404 shell size 2 plug, with the following contact arrangements: Insert A (Top Plug): 33C4 • 4 #16 pin socket contacts • 25 #20HD socket contacts • 3 #5 coax socket contacts • 1 #5 Quadrax socket contact Insert B (Bottom Plug): 106 • 106 #22 pin contacts ITT Cannon Part number DPX2NA-67322-463
Internal connector for Configuration Module	9-pin SUB-D male

Table 4-10: Mating Connectors in Aircraft for SDU

Connection With HPA

The installation tray for the HPA is equipped with the following connector:

Connector	Mating Connector Type
Rear I/O Connector	ARINC 404 shell size 2 plug, with the following contact arrangements: Insert A (Top Plug): MC2 • 2 #1 coax socket contacts for RG142B Insert B (Bottom Plug): 32C2 • 2 #5 socket contacts for AWG 8-10 • 30 #20 HD socket contacts for AWG 20-24 Radiall part number 616 697 173

Table 4-11: Mating Connector in Aircraft for HPA

Connection With Optional HSU

The installation tray for the HSU is equipped with the following connector:

Connector	Mating Connector Type
Front Panel Connector	9 pin SUB-D male
Rear I/O Connector	ARINC 404 shell size 2 plug with the following contact arrangements: Insert A (Top Plug): 33C4 • 4 #16 socket contacts • 25 #20 socket contacts • 2 #5 coax socket contacts • 2 #5 Twinax socket contacts Insert B (Bottom Plug): Blind • Not used ECS part number DSXN2PS33C45X00500

Table 4-12: Mating Connectors in Aircraft for HSU

Installation

5.1 General

5.1.1 Overview

This chapter contains considerations and recommendations for installation of the Aero-HSD$^+$ System. Interconnect harness wiring and physical mounting must satisfy all applicable regulations.

Note: Complete installation kits including wiring can be obtained through ECS (Electronic Cable Specialists, Inc.). For information, contact

ECS, USA
Phone: +1 414.421.5300
Email: sales@ecsdirect.com
Homepage: www.ecsdirect.com

The Installation chapter is organized in the following sections:

- **Mounting Considerations** on page 5-4.
  This section provides guidelines for the mechanical installation of the units in the Aero-HSD$^+$ system.
- **Electrical Installation and Wiring** on page 5-7.
  This section provides wiring drawings and guidelines for the electrical installation of the Aero-HSD$^+$ system. It also lists the requirements to the cables.
- **Electrical Installation and Wiring, HSU** on page 5-63.
  This section provides wiring drawings and guidelines for the electrical installation of the Aero-HSD$^+$ system with an HSU installed. It also lists the requirements to the cables.
- **Recommended Cables** on page 5-81.
  This section provides lists of recommended cables and maximum cable lengths.

The information, drawings and wiring diagrams contained in this manual are intended as a reference for engineering planning only. The drawings and wiring diagrams contained herein do not represent any specific STC. It is the installer's responsibility to compose installation drawings specific to the aircraft. This manual and the drawings and wiring diagrams contained herein may not be used as a substitute for an STC.

Note: To ensure optimal performance from the Aero-HSD$^+$ System, strict adherence to the installation considerations found in this section must be maintained.

5.1.2 Minimum System

A minimum working system has at least:

- one TT-5035A SDU
- one TT-5035A-001 CM
- one TT-5014A HPA
- one handset and cradle, e.g. a TT-5620A 4-Wire Handset and a TT-5622A 4-Wire Cradle.
- one antenna system. As antenna system, use either the AMT-50 Antenna Subsystem or the HGA-7000 Antenna with a TT-5012A DLNA.

The following drawing shows the minimum installation required in the Aero-HSD^{+} system.

Minimum System Drawing

Note: This drawing is an overview of which units to connect as a minimum. For specific information on wiring, refer to the appropriate section of **Electrical Installation and Wiring** on page 5-7 onwards.

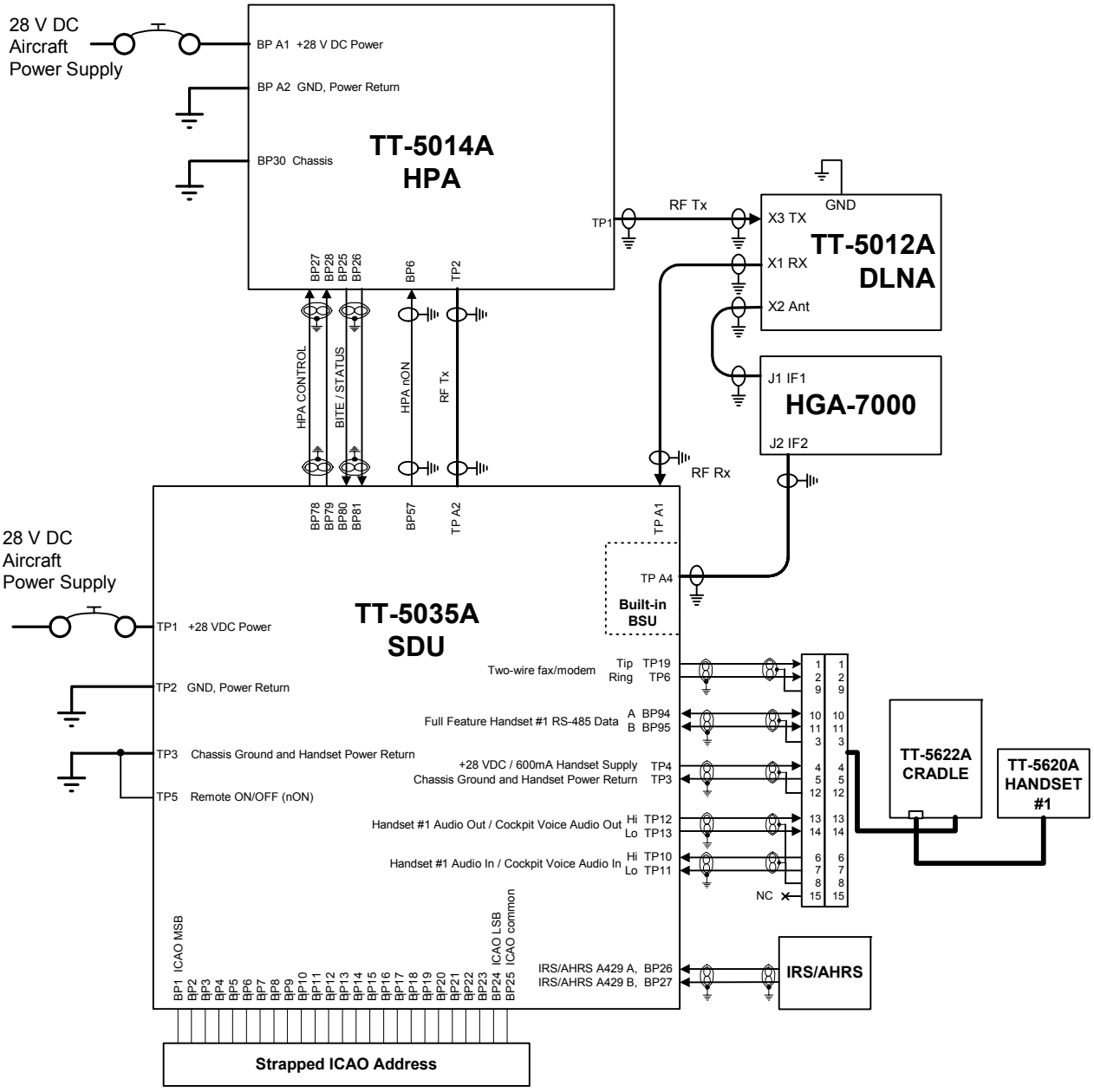


Figure 5-1: Minimum System

Note: This example includes an HGA-7000 Antenna with a TT-5012A DLNA, but the antenna system may as well be e.g. an AMT-50 subsystem.

Note: Another type of 4-wire handset or a 2-wire handset may be connected instead of the Thrane & Thrane 4-wire handset.

5.2 Mounting Considerations

5.2.1 Overview

For optimum system performance, some guidelines on where to install or mount the different components of the Aero-HSD^{+} System must be followed. Mounting and placement details are included in this section.

For information on requirements to cables, see the individual sections in **Electrical Installation and Wiring** on page 5-7 or **Electrical Installation and Wiring, HSU** on page 5-63.
For information on recommended cable types and lengths, see **Recommended Cables** on page 5-81.

Note: When mounting the units, make sure that there is enough space to provide a sufficient bend radius for the cables. See the cable data sheet for minimum bend radius.

5.2.2 SDU

Forced cooling is not recommended for the SDU.

- Place the SDU in a temperature controlled area (e.g. avionics bay).
- Place the SDU where the cooling air holes are not blocked. Note that cooling air holes in the SDU are placed outside the recommended area for ARINC 404A 3/8 ATR short units.
- Mount the SDU in an ARINC 404A 3/8 ATR short standard tray.

5.2.3 HSU

Forced cooling is not recommended for the HSU.

- Place the HSU in a temperature controlled area (e.g. avionics bay).
- Place the HSU where the cooling air holes are not blocked. Note that cooling air holes in the HSU are placed outside the recommended area for ARINC 404A 1/4 ATR short units.
- Mount the HSU in an ARINC 404A 1/4 ATR short standard tray.

5.2.4 Rx Power Splitter

If the Rx Power Splitter is to be mounted on a flat surface, mount it on a 3 mm mounting plate to provide enough space for mounting of the connectors.

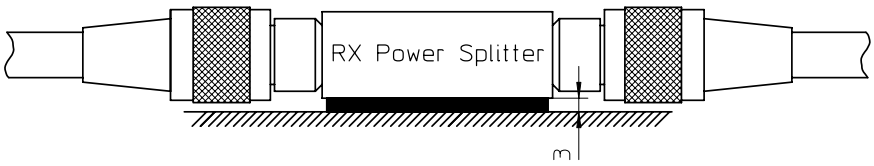


Figure 5-2: Mounting the Rx Power Splitter

5.2.5 HPA

The HPA can be installed in a non-temperature controlled area.

The HPA is designed with built-in forced cooling (fans).
Internal temperature monitoring prevents damage caused by overheating.

Important! Respect the minimum clearance of 25 mm from top and bottom.

- Mount the HPA vertically on a panel to ensure maximum cooling. Mount the HPA in an ARINC 404A 3/8 ATR short tray with oval cut-out as shown in **Figure 3-12: Outline Drawing: Tray for SDU and HPA.**
- Install the HPA as close to the DLNA as possible.
  The cable between the HPA and the DLNA must be a special low-loss coax cable. See **Wiring Antenna Systems** on page 5-14 and the wiring drawings **Figure 5-5: Wiring HGA-7000 Antenna and TT-5012A DLNA** and **Figure 5-6: Wiring AMT-50 Subsystem**.

5.2.6 DLNA

The DLNA can be installed in a non-temperature controlled area. The DLNA can be mounted in an upright position.

- Install the DLNA as close to the antenna as possible.
- Place the DLNA with sufficient contact to the surface, respecting the max. resistance of 3 mΩ. The DLNA can be mounted on a shelf or directly on the fuselage.

  Important! If the DLNA is mounted directly on fuselage, mount with Cadmium plated washers between the DLNA and fuselage.

The coax cable between the DLNA and the antenna must be a low-loss coax cable. See **Wiring Antenna Systems** on page 5-14 for requirements to the cable.

5.2.7 Antenna

General Mounting Considerations

Refer to the antenna manual for details on mounting the antenna. Make sure all requirements in the antenna mounting instructions are met.

Place the antenna with unobstructed view to the satellite.

WARNING! Respect a safety distance of minimum 6.6 feet (2 metres) of the antenna when the system is transmitting, unless the antenna manual or the specific system configuration presents different requirements.

Note: The antenna installation must be in accordance with the aircraft manufacturers requirements and/or FAA AC 43.13 - 1B/2A and approved by the appropriate Civil Aviation Authorities.

Satcom filter

If the GPS antenna for the existing GPS receiver on board the aircraft does not provide sufficient filtering it may be necessary to install a Satcom filter for the GPS antenna.

Cables to the antennas

Be aware that the shorter the cable is, the better the system performance is.

Do not bend the cables to a radius smaller than the minimum bend radius stated for the cables.

For further information on cables, see **Wiring Antenna Systems** on page 5-14, **Wiring Antenna Systems With HSU Installed** on page 5-65 and **Recommended Cables** on page 5-81

5.3 Electrical Installation and Wiring

5.3.1 Wiring Symbols

Throughout the wiring section these common symbols are used:


Coax


Shield


Ground


Twisted


Twisted and shielded

5.3.2 Wiring Power Supply

Important! Do not use the same 20 A circuit breaker for both the SDU and the HPA. Use separate circuit breakers as described in this section, and with the current rating stated here.

Wiring of Satellite Data Unit

The Aircraft Power Bus provides the electric power required to operate the SDU, and a chassis connection to the aircraft chassis and the installation tray. The +28 V DC Power wire must include a circuit breaker capable of carrying the required current continuously under the required environmental conditions.

The following drawing shows the wiring of the SDU power supply. Requirements to the wiring are stated in the notes on the drawing and in the section **Cable Requirements, SDU Power Supply** on page 5-10.

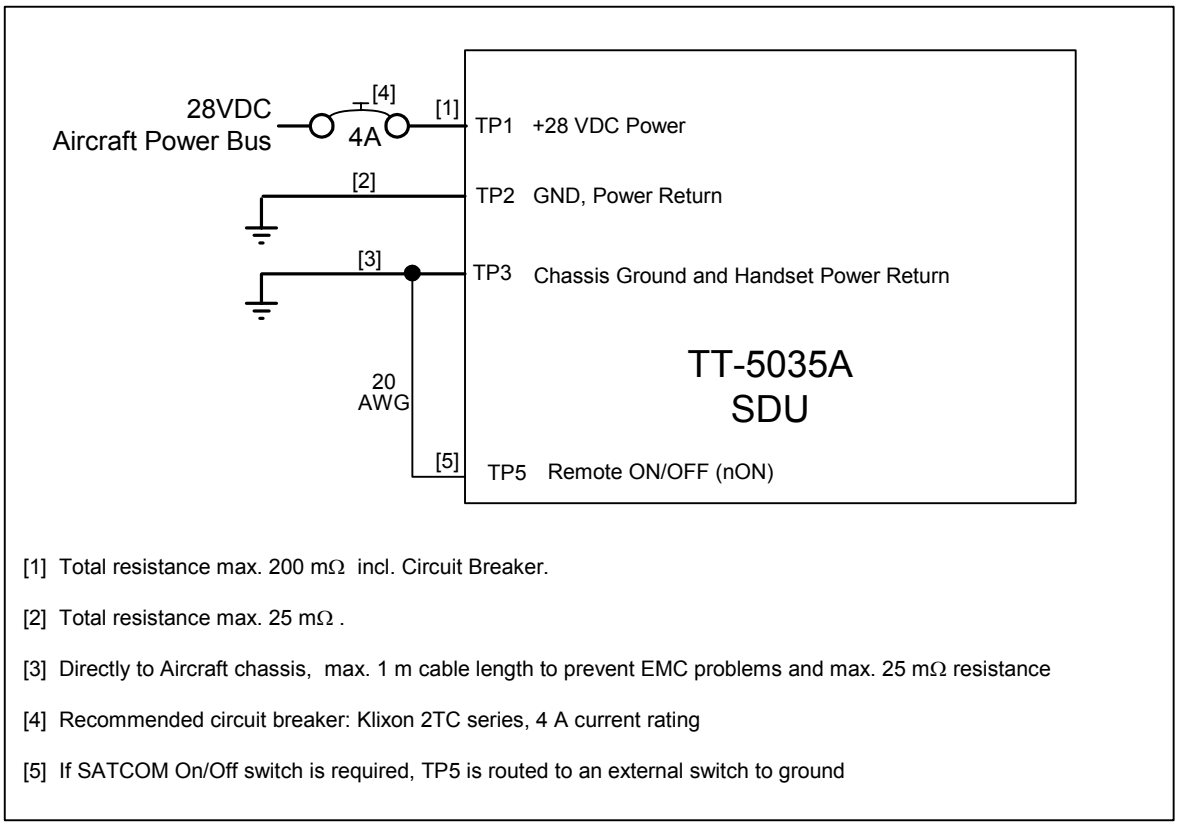


Figure 5-3: Wiring SDU Power Supply

The following list shows the pins used for the SDU power supply.

SDU pin	Name	Description
TP1	+28 V DC Power	+28 V DC Power input from Aircraft power bus.
TP2	GND, Power Return	Aircraft Ground connection
TP3	Chassis Ground and Handset Power Return	Chassis connection, connected to installation tray and Aircraft chassis. Also used for handset power return.
TP5	Remote ON/OFF (nON)	Power On/Off for the SDU and handsets.

Table 5-1: Pins for SDU Power Supply

+28 V DC Power (TP1)

It is essential to keep the line impedance below the specified limits. See **Cable Requirements, SDU Power Supply** on page 5-10.
Reverse polarity protection is only guaranteed if the suggested circuit breaker is used.

Required current capability for the Circuit Breaker: 48 W @ 17.3 V DC which equals 2.8 A DC at the required environmental conditions.
A suitable circuit breaker would be **Klixon 2TC series** with 4 A current rating.

Important! Do not use the HPA 20 A circuit breaker for both the HPA and the SDU.

Chassis Ground / Handset Power Return (TP3)

The Chassis connection makes sure that the HPA cabinet and the installation tray has the same potential, and that there is a connection from the wiring shields to the cabinet for EMC purposes.

Connect the wire directly to the installation tray, and to aircraft chassis.

TP3 also connects to the Handset Power Return.

Remote On/Off (nON) input (TP5)

The nON input is used to turn the SDU and the power supply to the handsets on and off. Connection of this input to ground turns on the SDU and all other units in the SATCOM system (Handsets, DLNA, HPA and HGA-7000 Antenna). However, ARINC 741 Antennas and DLNAs are **not** turned off when the SDU is turned off.

The electrical specifications are defined like the discrete WOW input type. Please refer to **Discrete type and description:** on page 5-57.

Cable Requirements, SDU Power Supply

Cable[a]	Max. Resistance	Other Requirements
[1] (+28 V DC)	200 mΩ, incl. circuit breaker	
[2] (GND, Power Return)	25 mΩ	The cable should be as short as possible.
[3] (Chassis Ground)	25 mΩ	Connect directly to aircraft chassis.

Table 5-2: Requirements to SDU Power Cables

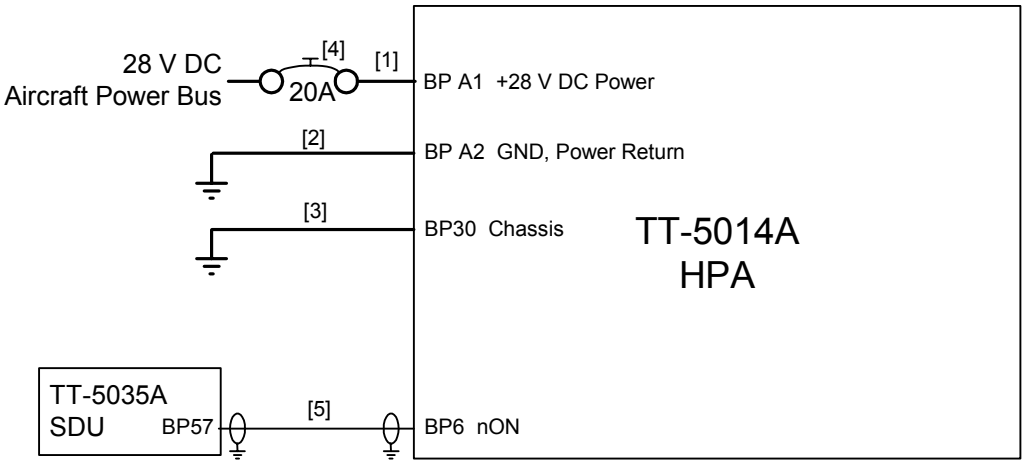
a. The cable numbers refer to the numbers stated on the wiring drawing in the section **Wiring of Satellite Data Unit** on page 5-8.

Note: Maximum cable lengths are calculated and listed in the section **Power Cables, Allowed Cable Lengths** on page 5-81.

Wiring of High Power Amplifier

The Aircraft power bus provides the electric power required to operate the HPA, and a chassis connection to the aircraft chassis and the installation tray. The +28 V DC Power wire must include a circuit breaker capable of carrying the required current continuously under the required environmental conditions.

The following drawing shows the wiring of the HPA power supply. Requirements to the wiring are stated in the notes on the drawing and in the section **Cable Requirements, HPA Power Supply** on page 5-13.



[1] Total resistance max. 100 mΩ incl. Circuit Breaker.

[2] Total resistance max. 25 mΩ.

[3] Directly to Aircraft chassis, max. 0.6 m cable length (AWG 20) to prevent EMC problems and max. resistance 25 mΩ.

[4] Recommended circuit breaker: Klixon 2TC series, 20 A current rating.

[5] Must be shielded to prevent EMC problems.

Figure 5-4: Wiring HPA Power Supply

The following list shows the pins used for the HPA power supply.

HPA pin	Name	Description
BP A1	+28 V DC Power	+28 V DC Power input from Aircraft power bus.
BP A2	GND, Power Return	Aircraft ground connection.
BP30	Chassis	Chassis connection, connected to installation tray and Aircraft chassis.
BP6	nON	HPA power on/off controlled by the SDU.

Table 5-3: Pins for HPA Power Supply

SDU pin	Name	Description
BP57	HPA remote nON/OFF output	Power On/Off control for the HPA.

Table 5-4: Pin for Remote HPA Power on/off by SDU

This section describes the installation requirements for HPA power supply interface. The connection from the HPA to the Aircraft power bus normally goes through the tray connector. The connector also supports other signals. For information on pin-out, please refer to **TT-5014A High Power Amplifier** on page 4-11.

+28 V DC Power

It is essential to keep the line impedance below the specified limits. See **Cable Requirements, HPA Power Supply** on page 5-13.
Reverse polarity protection is only guaranteed if the suggested circuit breaker is used.

Required current capability for the Circuit Breaker: 235 W @ 15.7 V DC, which equals 15 A DC, at the required environmental conditions.

A suitable circuit breaker would be **Klixon 2TC series** with 20 A current rating.

Chassis (BP30)

The Chassis connection makes sure that the HPA cabinet and the installation tray has the same potential, and that there is a connection from the wiring shields to cabinet for EMC purposes.

Connect the wire directly to the installation tray, and to aircraft chassis.

nON (BP6)

The nON input is used by the SDU (BP57) to turn the HPA on and off. The SDU connects this input to ground to turn on the HPA.

Cable Requirements, HPA Power Supply

Cable[a]	Max. Resistance	Other Requirements
[1] (+28 V DC Power)	100 mΩ, incl. circuit breaker	
[2] (GND, Power Return)	25 mΩ	
[3] (Chassis)	25 mΩ	Connect directly to aircraft chassis.
[5] (nON)	-	Must be shielded to avoid EMC problems.

Table 5-5: Requirements to HPA Power Cables

a. The cable numbers refer to the numbers stated on the wiring drawing in the section **Wiring of High Power Amplifier** on page 5-11.

Note: Maximum cable lengths are calculated and listed in the section **Power Cables, Allowed Cable Lengths** on page 5-81.

5.3.3 Wiring Antenna Systems

Cable Losses

During installation, it is important that you write down the cable losses of the RF cables. For this purpose, you may use the last part of the check sheet in **Pre-Installation Check** on page 7-2.

The cable losses must be registered in the HSD^{+}CP during configuration of the system. For further information, see **Basic Configuration** on page 6-6 or the online help in the HSD^{+}CP.

Wiring of HGA-7000 Antenna

The following drawing shows the wiring for an Aero-HSD^{+} system using an HGA-7000 antenna.

Note: For information on wiring an HGA-7000 Antenna when the TT-5038A HSU is installed, see **HGA-7000 Antenna with HSU** on page 5-65.

Requirements to the cables are stated on the drawing and in the section **Cable Requirements, HGA-7000 Antenna** on page 5-17.

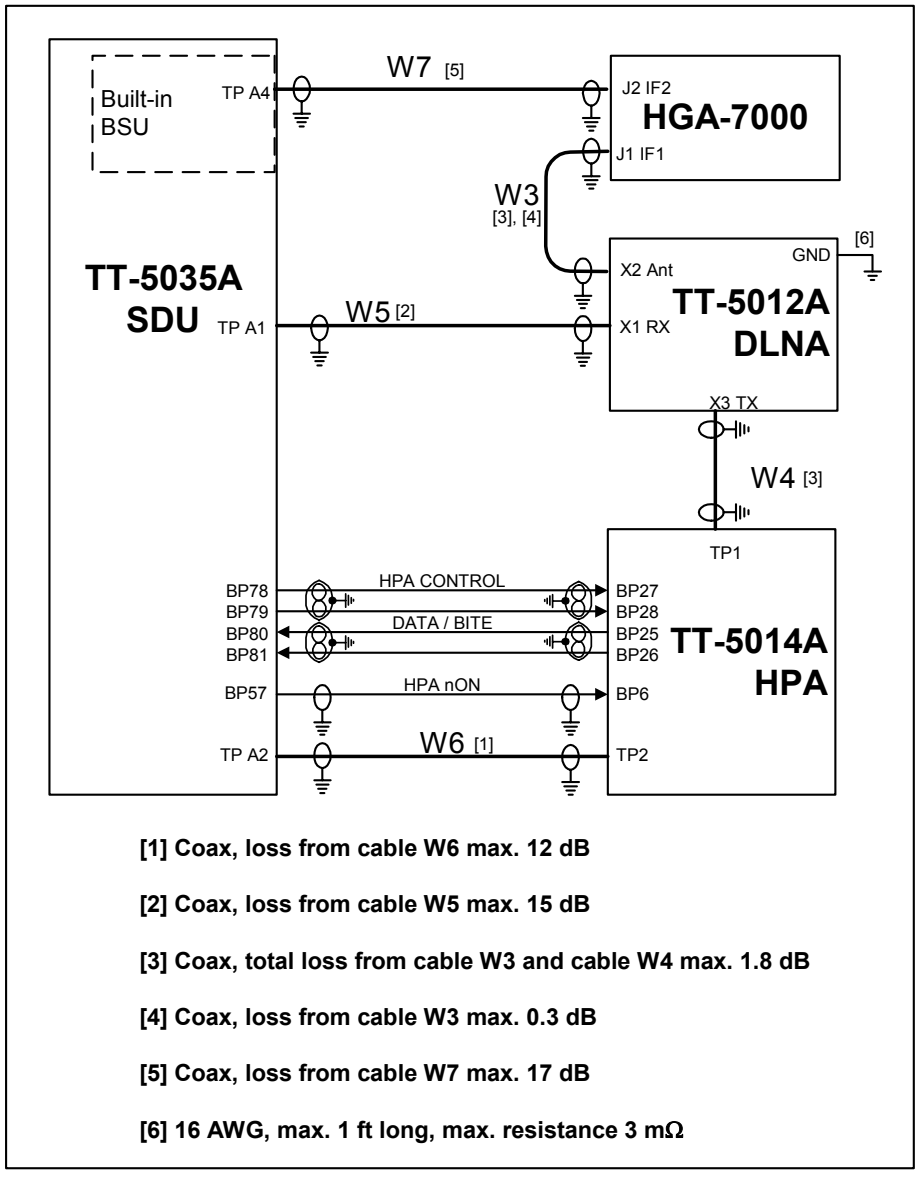


Figure 5-5: Wiring HGA-7000 Antenna and TT-5012A DLNA

Important! Remember to write down the cable losses. See **Cable Losses** on page 5-14.

The following list shows the pins in the Aero-HSD^{+} system used for connecting the HGA-7000 antenna.

SDU pin	Name/Description
TP A1	RF Rx input from TT-5012A DLNA/12V DC power to DLNA **(Coax)**
TP A2	RF Tx output to HPA **(Coax)**
TP A4	Antenna Modem Interface **(Coax)**
BP57	HPA remote nOn/Off output
BP78	HPA Control Output A, RS-422
BP79	HPA Control Output B, RS-422
BP80	HPA Data/BITE Input A, RS-422
BP81	HPA Data/BITE Input B, RS-422

Table 5-6: SDU Pins for HGA-7000 Antenna

HPA pin	Name/Description
TP1	RF output to TT-5012A DLNA **(Coax)**
TP2	RF input from SDU **(Coax)**
BP6	Remote nOn/Off input from SDU
BP25	Tx Data/BITE Output A, RS-422, to SDU
BP26	Tx Data/BITE Output B, RS-422, to SDU
BP27	Rx Control Input A, RS-422, from SDU
BP28	Rx Control Input B, RS-422, from SDU

Table 5-7: HPA Pins for HGA-7000 Antenna

Cable Requirements, HGA-7000 Antenna

The following list shows the cable requirements to the RF cables in the Aero-HSD$^+$ system when using an HGA-7000 antenna.

Cable[a]	Type	Min. Cable Loss @1.6 GHz	Max. Cable Loss @1.6 GHz	Other Requirements
W3 (DLNA-Antenna)	Coax	0 dB	0.3 dB	
W4 (HPA-DLNA)	Coax	0 dB	1.8 dB - W3	
W3 and W4	Coax	0 dB	Total: 1.8 dB	
W5 (TT-5012A DLNA to SDU)	Coax	0 dB	15 dB	
W6 (RF Tx output from SDU to HPA)	Coax	0 dB	12 dB	
W7 (Antenna modem interface)	Coax	0 dB	17 dB	
GND on DLNA	-	-	-	Resistance: Max. 3 mΩ

Table 5-8: Requirements to RF Cables, HGA-7000 Antenna

a. The “W” cable numbers refer to the numbers stated on the wiring drawing in the section **Wiring of HGA-7000 Antenna** on page 5-15.

Note: For recommended cable types, see **Recommended RF Cables** on page 5-84.

Wiring ARINC 741 Antenna Systems

The following drawing shows the wiring for an Aero-HSD^{+} system using the AMT-50 antenna subsystem.

Note: For information on wiring an AMT-50 subsystem when the TT-5038A HSU is installed, see **AMT-50 Subsystem With HSU** on page 5-69.

Requirements to the cables are stated on the drawing and in the section **RF Cable Requirements, AMT-50 Subsystem** on page 5-20.

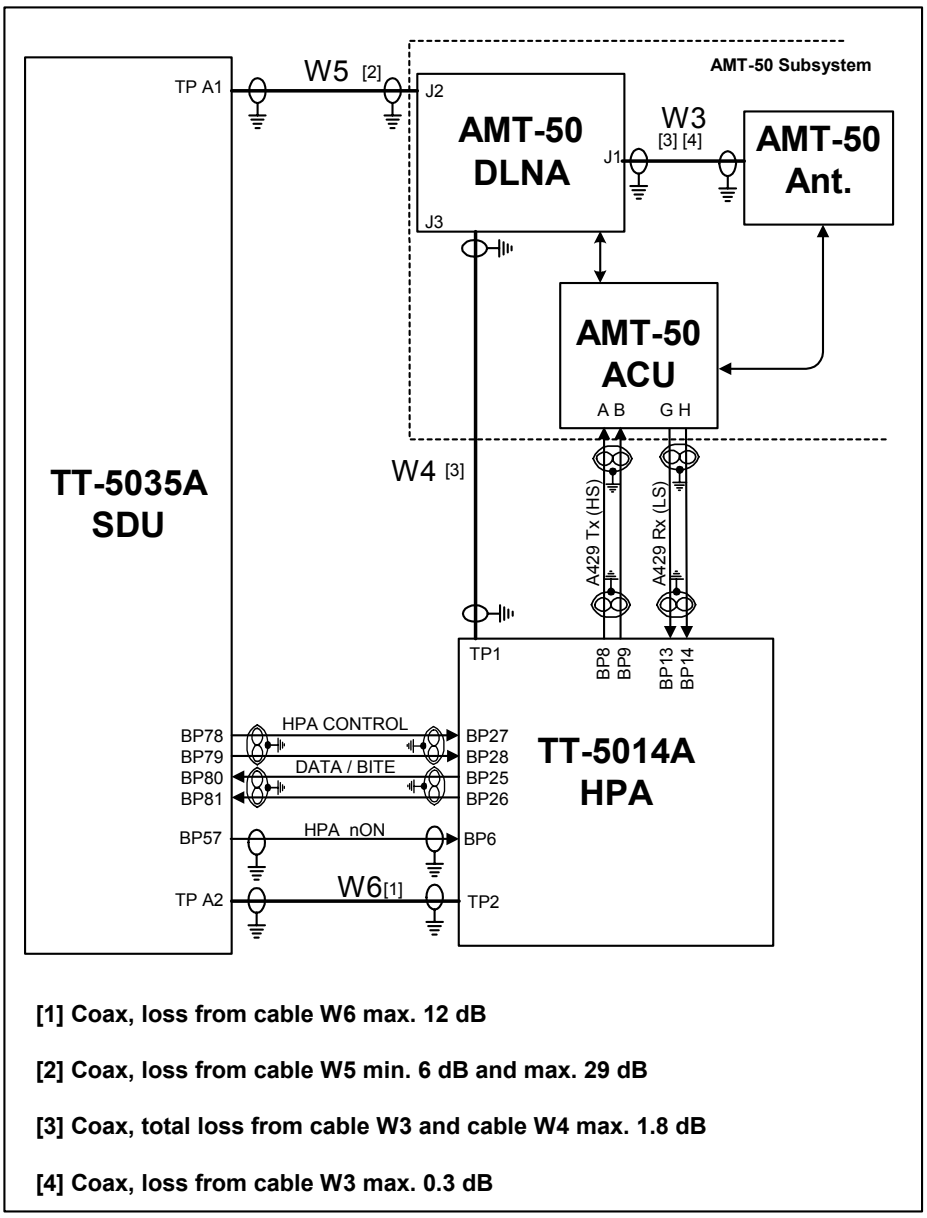


Figure 5-6: Wiring AMT-50 Subsystem

Important! Remember to write down the cable losses. See **Cable Losses** on page 5-14.

The following list shows the pins in the Aero-HSD^{+} system used for connecting the AMT-50 Subsystem.

SDU pin	Name/Description
TP A1	RF Rx input from ARINC 741 DLNA **(Coax)**
TP A2	RF Tx output to HPA **(Coax)**
BP57	HPA remote nOn/Off output
BP78	HPA Control Output A, RS-422
BP79	HPA Control Output B, RS-422
BP80	HPA Data/BITE Input A, RS-422
BP81	HPA Data/BITE Input B, RS-422

Table 5-9: SDU Pins for AMT-50 Subsystem

HPA pin	Name/Description
TP1	RF output to ARINC 741 DLNA **(Coax)**
TP2	RF input from SDU **(Coax)**
BP6	Remote nOn/Off input from SDU
BP8	A429 Tx A output to AMT-50 ACU
BP9	A429 Tx B output to AMT-50 ACU
BP13	A429 Rx1 A input from AMT-50 ACU
BP14	A429 Rx1 B input from AMT-50 ACU
BP25	Tx Data/BITE Output A, RS-422, to SDU
BP26	Tx Data/BITE Output B, RS-422, to SDU
BP27	Rx Control Input A, RS-422, from SDU
BP28	Rx Control Input B, RS-422, from SDU

Table 5-10: HPA Pins for AMT-50 Subsystem

RF Cable Requirements, AMT-50 Subsystem

The following list shows the cable requirements to the RF cables in the Aero-HSD$^+$ system when using an AMT-50 antenna subsystem.

Cable[a]	Type	Min. Cable Loss @1.6 GHz	Max. Cable Loss@1.6 GHz
W3 (DLNA-Antenna)	Coax	0 dB	0.3 dB
W4 (HPA-DLNA)	Coax	0 dB	1.8 dB - W3
W3 and W4	Coax	0 dB	Total: 1.8 dB
W5 (ARINC 741 DLNA to SDU)	Coax	6 dB	29 dB
W6 (RF Tx output from SDU to HPA)	Coax	0 dB	12 dB

Table 5-11: Requirements to RF Cables, AMT-50 Subsystem

a. The "W" cable numbers refer to the numbers stated on the wiring drawing in the section **Wiring ARINC 741 Antenna Systems** on page 5-18.

Note: For recommended cable types, see **Recommended RF Cables** on page 5-84.

Cable Requirements, ARINC 429

The cables for the ARINC 429 interfaces must be twisted and shielded and conform to the standards for aeronautical use.

For recommended cable types, see **Recommended Cables for ARINC 429** on page 5-84.

Wiring ARINC 741 Dual Side Panel Antenna System (Future Use)

The following drawing shows the wiring of an ARINC 741 dual side panel antenna system.

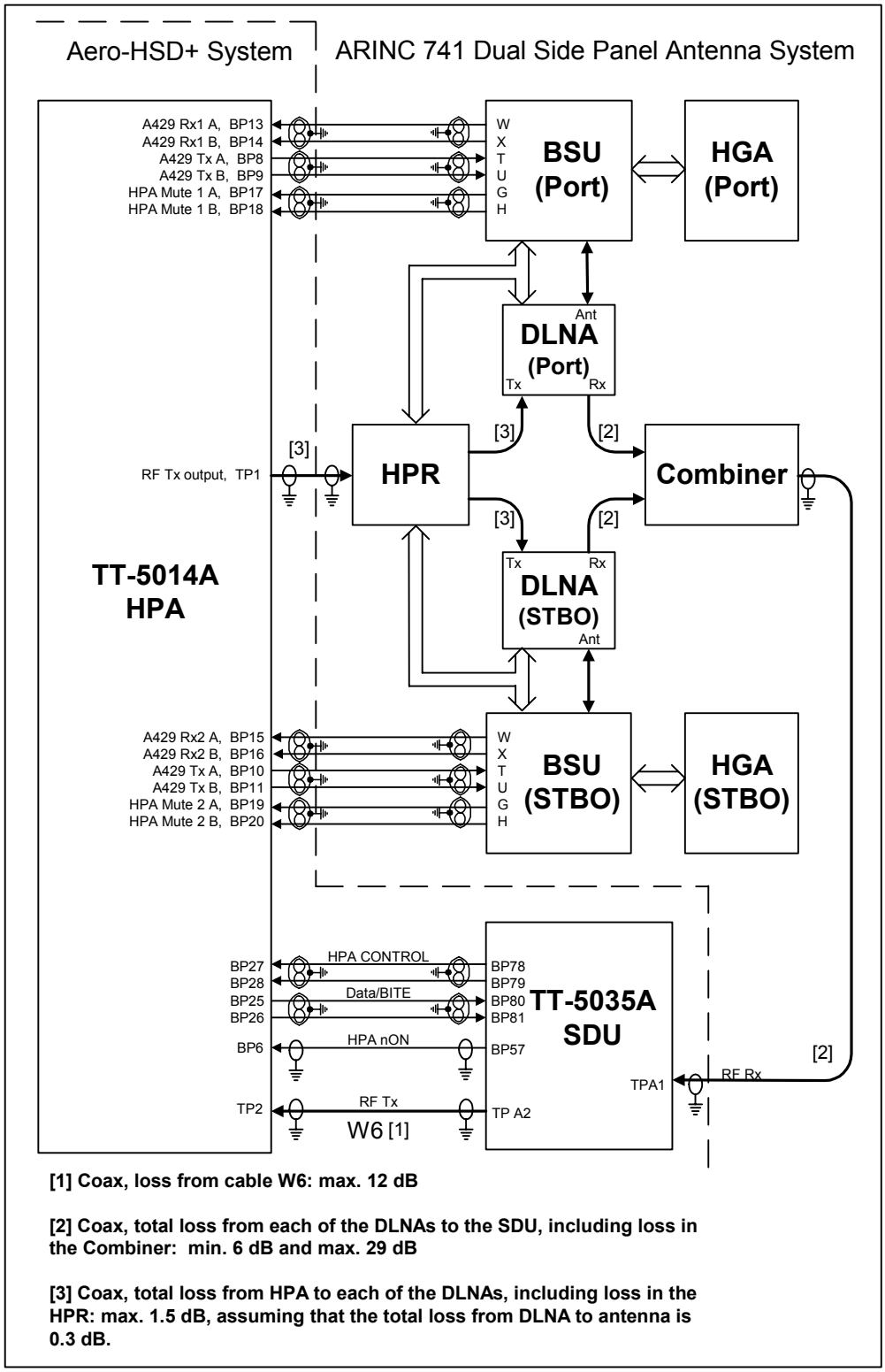


Figure 5-7: Wiring ARINC 741 Dual Side Panel Antenna System

Important! Remember to write down the cable losses. See **Cable Losses** on page 5-14.

The following list shows the pins in the Aero-HSD^{+} system used for connecting a Dual Side Panel antenna system.

HPA pin	Name/Description
TP1	RF Tx output to HPR **(Coax)**
TP2	RF Tx input from SDU **(Coax)**
BP6	Remote nOn/Off input from SDU
BP8	A429 Tx A output to BSU (Port)
BP9	A429 Tx B output to BSU (Port)
BP10	A429 Tx A output to BSU (STBO)
BP11	A429 Tx B output to BSU (STBO)
BP13	A429 Rx1 A input from BSU (Port)
BP14	A429 Rx1 B input from BSU (Port)
BP15	A429 Rx2 A input from BSU (STBO)
BP16	A429 Rx2 B input from BSU (STBO)
BP17	HPA Mute 1 A input from BSU (Port)
BP18	HPA Mute 1 B input from BSU (Port)
BP19	HPA Mute 2 A input from BSU (STBO)
BP20	HPA Mute 2 B input from BSU (STBO)
BP25	Tx Data/BITE Output A, RS-422, to SDU
BP26	Tx Data/BITE Output B, RS-422, to SDU
BP27	Rx Control Input A, RS-422, from SDU
BP28	Rx Control Input B, RS-422, from SDU

Table 5-12: HPA Pins for Dual Side Panel Antenna System

SDU pin	Name/Description
TP A1	RF Rx input from Combiner **(Coax)**
TP A2	RF Tx output to HPA **(Coax)**
BP57	HPA remote nOn/Off output
BP78	HPA Control Output A, RS-422
BP79	HPA Control Output B, RS-422
BP80	HPA Data/BITE Input A, RS-422
BP81	HPA Data/BITE Input B, RS-422

Table 5-13: SDU Pins for Dual Side Panel Antenna System

RF Cable Requirements, ARINC 741 Dual Side Panel Antenna System

The following list shows the cable requirements to the RF cables in the Aero-HSD$^+$ system when using an ARINC 741 Dual Side Panel Antenna System.

Cable[a]	Type	Min. Cable Loss @1.6 GHz	Max. Cable Loss@1.6 GHz
RF Rx input from each DLNA to SDU, incl. loss in Combiner	Coax	6 dB	29 dB
RF Tx output from HPA to DLNA, incl. loss in HPR	Coax	0 dB	1.5 dB, assuming that the loss from DLNA to antenna is 0.3 dB.
W6 (RF Tx output from SDU to HPA)	Coax	0 dB	12 dB

Table 5-14: Requirements to RF Cables, ARINC 741 Dual Side Panel Antenna System

a. The “W” cable numbers refer to the numbers stated on the wiring drawing in the section **Wiring ARINC 741 Dual Side Panel Antenna System (Future Use)** on page 5-21.

Note: For recommended cable types, see **Recommended RF Cables** on page 5-84.

5.3.4 Wiring ARINC 429 Interfaces

AHRS/IRS

The SDU has two high or low speed ARINC 429 input interfaces for IRS #1 and IRS #2. These inputs can also be used as Attitude and Heading Reference System inputs (AHRS).

Important! ARINC specifies that when installing AHRS, a switch must be installed, in order to be able to switch to Direct Gyro Mode when the aircraft is on ground.
This is done to avoid magnetic interference, which can influence the AHRS heading.

The following drawing shows the wiring of AHRS/IRS. Requirements to the cables are stated in the section **Cable Requirements, ARINC 429** on page 5-28.

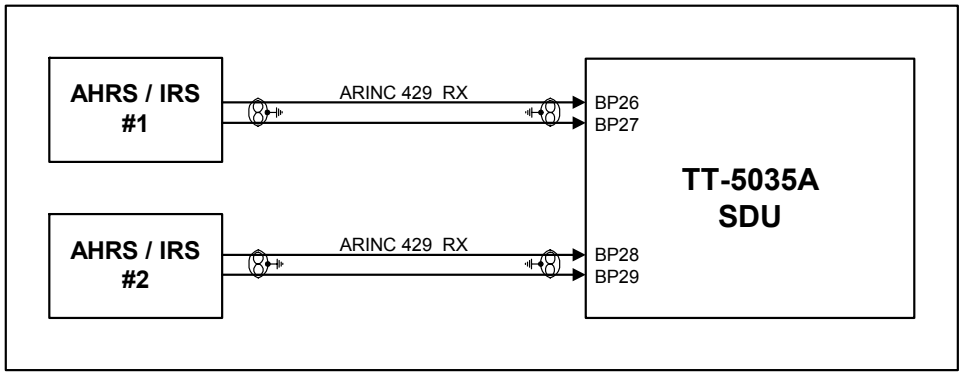


Figure 5-8: Wiring AHRS/IRS

The following list shows the pins used for AHRS or IRS:

SDU Pin	Name/Description
BP26	Data from primary IRS 429 A /Data from primary AHRS 429 A
BP27	Data from primary IRS 429 B /Data from primary AHRS 429 B
BP28	Data from secondary IRS 429 A /Data from secondary AHRS 429 A
BP29	Data from secondary IRS 429 B /Data from secondary AHRS 429 B

Table 5-15: SDU Pins for IRS and AHARS

When the system is configured with the HSD+ Configuration Program, the Configuration Module will contain the information of:

- IRS or AHRS is installed.
- IRS/AHRS # 1 or #2 or both are installed.

  Note: If #1 and #2 are both installed, they must be of the same type (IRS or AHRS).

- ARINC 429 Speed (High or Low).

If IRS is used, the Antenna positioning data and Doppler correction are computed from the IRS data alone, but if AHRS is used, the GPS must provide the SDU with 3D ECEF position and speed.

Note: AHRS can only be used with the HGA-7000 antenna, which contains a built-in GPS antenna.

ARINC Data Format for IRS

The required ARINC data format for IRS is listed in the following table:

Label (octal)	Name	Minimum Update rate
310	Latitude	1 Hz
311	Longitude	1 Hz
312	Ground speed	1 Hz
313	Track angle	1 Hz
314	True heading	10 Hz
324	Pitch angle	10 Hz
325	Roll angle	10 Hz
336	Pitch rate	10 Hz
337	Roll rate	10 Hz
361	Altitude	1 Hz

Table 5-16: ARINC Data Format for IRS

ARINC Data Format for AHRS

The required ARINC data format for AHRS is listed in the following table:

Label (octal)	Name	Minimum Update rate
320	Magnetic heading	10 Hz
324	Pitch angle	10 Hz
325	Roll angle	10 Hz
336	Pitch rate	10 Hz
337	Roll rate	10 Hz

Table 5-17: ARINC Data Format for AHRS

ACARS/CMU

The SDU has ARINC 429 interfaces for 2 high or low speed (HS/LS) ACARS/CMU including one output port and 2 input ports.

The following drawing shows the wiring of ACARS/CMU. Requirements to the cables are stated in the section **Cable Requirements, ARINC 429** on page 5-28.

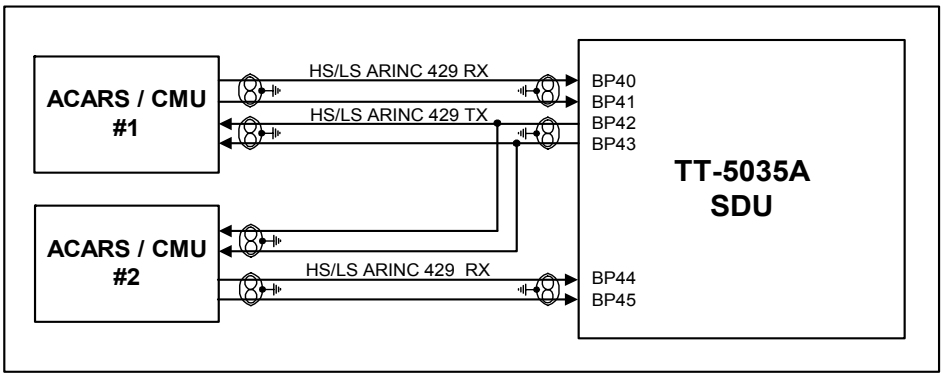


Figure 5-9: Wiring ACARS/CMU

The following list shows the pins used for an Airborne Communications Addressing and Reporting System (ACARS) or a Communications Management Unit (CMU):

SDU Pin	Name/Description
BP40	Data bus from ACARS/CMU #1 429 A
BP41	Data bus from ACARS/CMU #1 429 B
BP42	Data bus to ACARS/CMU #1 & #2 429 A
BP43	Data bus to ACARS/CMU #1 & #2 429 B
BP44	Data bus from ACARS/CMU #2 429 A
BP45	Data bus from ACARS/CMU #2 429 B

Table 5-18: SDU Pins for CMU

The data speed can be configured to high or low (HS/LS), defined by the Configuration Module.

CPDF (Future Use)

The SDU has interfaces prepared for two future Cabin Packet Data Functions.

The interfaces for CPDF #1 and #2 are high or low speed ARINC 429 input and output.

The two ports are connected to separate serial ports.

The following drawing shows the wiring of CPDF. Requirements to the cables are stated in the section **Cable Requirements, ARINC 429** on page 5-28.

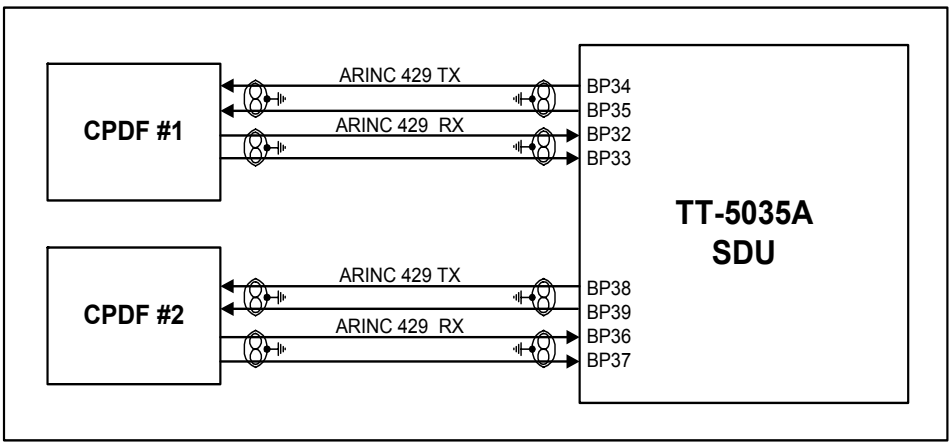


Figure 5-10: Wiring CPDF

Note: CPDF #1 will not be available when the TT-5038A HSU is installed.

MCDU/FMS (Future Use)

The SDU has interfaces prepared for two future high or low speed ARINC 429 interfaces for communication with MCDU/FMS #1 and MCDU/FMS #2. One common output and two inputs.

The following drawing shows the wiring of MCDU/FMS. Requirements to the cables are stated in the section **Cable Requirements, ARINC 429** on page 5-28.

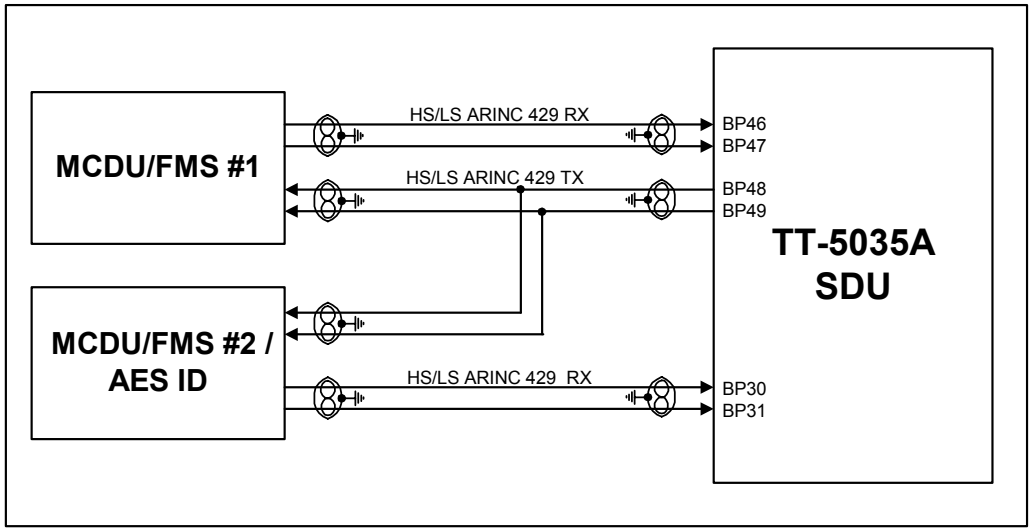


Figure 5-11: Wiring MCDU/FMS

The Configuration Module contains information if the FMS is installed, and which data rate is used (high or low).

MCDU/FMS input #2 may also, in the future, be configured to AES ID input (ARINC 429 ICAO Address). However, this is not yet implemented.

Cable Requirements, ARINC 429

The cables for the ARINC 429 interfaces must be twisted and shielded and conform to the standards for aeronautical use.

For recommended cable types, see **Recommended Cables for ARINC 429** on page 5-84.

5.3.5 Wiring ICAO Address

Strapped ICAO Address

A unique aircraft identification code (ICAO address) must be assigned at installation. The national authority of aeronautical identification coordinates assignment of the code.

The ICAO address must be defined in the Configuration Module, using the Aero-HSD$^+$ Configuration Program.

The SDU obtains the ICAO address from the 24 bit discrete address (must be hardware strapped using the 24 discrete inputs on the SDU).

The strapped ICAO address is compared to the ICAO address in the Configuration Module. If they do not match, the Aero-HSD$^+$ system suspends all RF communication.

Other Sources for the ICAO Address (future use)

In the future, the SDU will be able to obtain the ICAO address from various sources.

- the CMUs
- the AES_ID from the ARINC bus
- the 24 bit discrete address (hardware strapped)

The SDU will search for the ICAO address to ensure it is operating in the right aircraft. When the SDU tries to retrieve the ICAO address, it will first check the CMUs, then the AES_ID from the ARINC bus, and last the hardware strapped ICAO address.

The found ICAO address is then compared to the ICAO address in the Configuration Module. If they do not match, the Aero-HSD$^+$ system will suspend all RF communication.

Wiring ICAO Address

The following drawing shows the wiring of the 24 bit discrete ICAO address and the AES ID (future use). Requirements to the AES ID ARINC 429 cable are stated in the section **Cable Requirements, ARINC 429** on page 5-28.

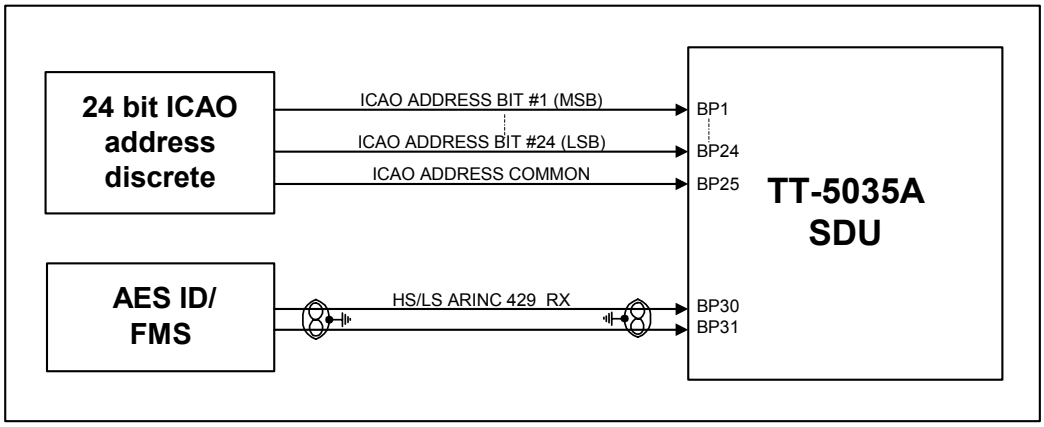


Figure 5-12: Wiring ICAO

Wiring 24 bit Discrete ICAO Address

The SDU has 24 discrete inputs used to encode the 24-bit ICAO address, in which the SDU is installed.

Each ICAO address consists of eight digits, and each digit value is determined by strapping 3 bits (octal).

Note: The HSD+ Configuration Program shows which pins to connect if you type in the wanted ICAO address in the Config Module field in the Identification window.

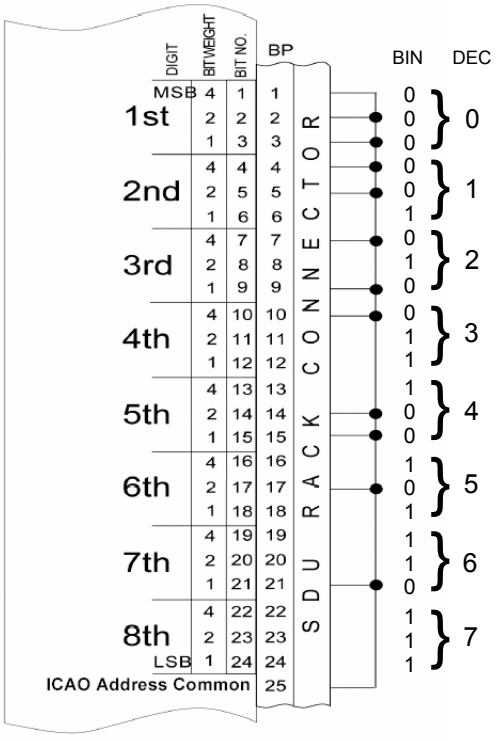


Figure 5-13: Example of Wiring the Fictional ICAO Address 01234567

Do as follows to strap the ICAO address:

1. Leave pins assigned to the binary “one” state open (internal pull up).
   Binary “one” (open circuit) is ≥100 kΩ.
2. Strap pins assigned to the binary “zero” state to BP25 (ICAO Address Common) on the airframe side of the connector.
   Binary “zero” (strapped to BP25) is ≤10 Ω.
3. Enter the ICAO address in the HSD+ Configuration Program.
   If the aircraft uses a US N-type registration number, the HSD+ Configuration Program can calculate the ICAO address from this number. Use the **US N-Type Calculator** button in the Identification window of the HSD+CP.

When the system is powered, the SDU reads the strapped ICAO address from the SDU rack connector and compares it to the ICAO address entered in the Configuration Module. If the SDU does not detect or recognize the strapped ICAO address, the Aero-HSD^{+} system will suspend all RF transmission until the error is corrected.

5.3.6 Wiring MPDS RS-422, MPDS Ethernet and ISDN

The SDU supports 56/64 kbit/s data rate and G4 fax on the High Speed Channel connection. The interface can address up to 8 ISDN Phones. Note that the satellite channel only supports one B channel and one Inmarsat signalling channel.

Note: For information on wiring a TT-5038A HSU to MPDS and ISDN, see **Wiring HSU to MPDS RS-232 , MPDS Ethernet and ISDN** on page 5-73.

The following drawing shows the wiring of the SDU to MPDS RS-422, MPDS Ethernet and ISDN. Requirements to the cables are stated in the sections **Cable Requirements, MPDS RS-422** on page 5-33, **Cable Requirements, ISDN** on page 5-35 and **Cable Requirements, MPDS Ethernet 10BaseT** on page 5-34.

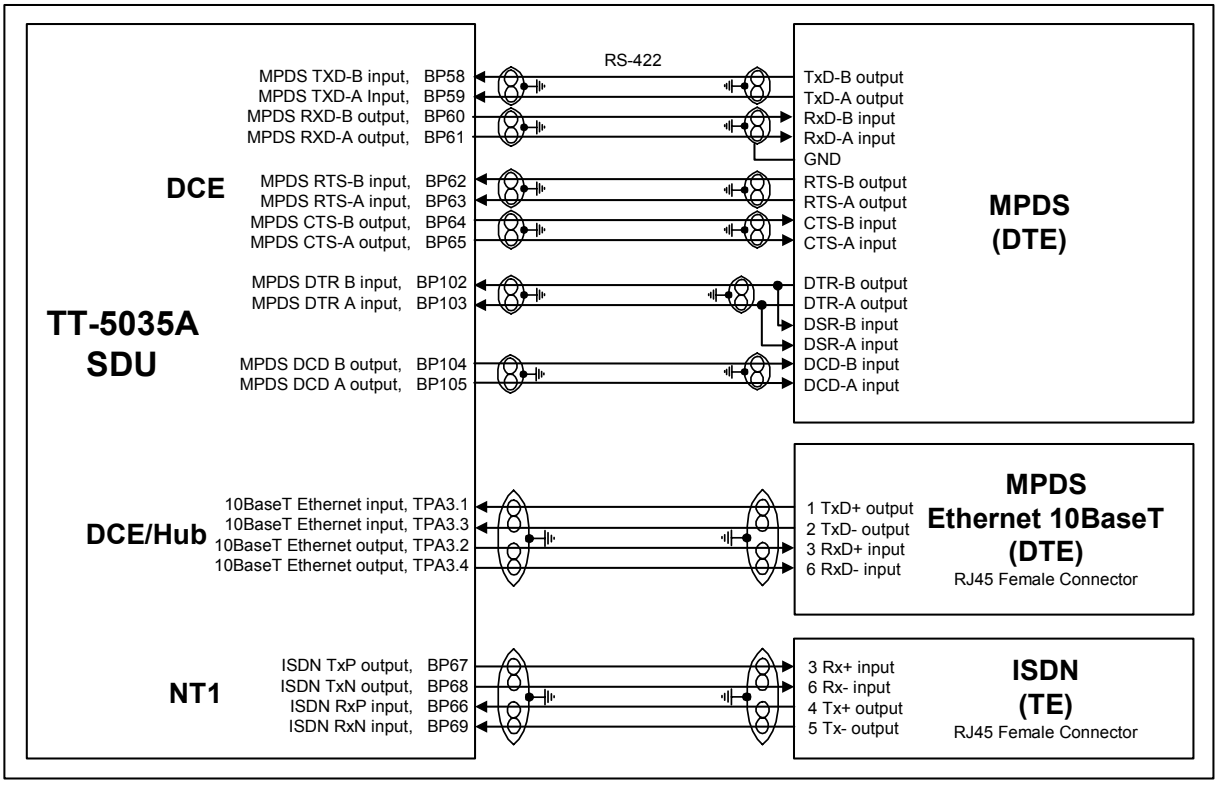


Figure 5-14: Wiring MPDS RS-422, MPDS Ethernet and ISDN

MPDS RS-422 Pins

SDU pin	Name	Description
BP58	MPDS TxD B	Input A RS-422 115.2 kbit/s
BP59	MPDS TxD A	Input B RS-422 115.2 kbit/s
BP60	MPDS RxD B	Output A RS-422 115.2 kbit/s
BP61	MPDS RxD A	Output B RS-422 115.2 kbit/s
BP62	MPDS RTS B	Input A RS-422 DCE hardware flow control
BP63	MPDS RTS A	Input B RS-422 DCE hardware flow control
BP64	MPDS CTS B	Output A RS-422 DCE hardware flow control
BP65	MPDS CTS A	Output B RS-422 DCE hardware flow control
BP102	MPDS DTR B	Input A RS-422 DCE hardware flow control
BP103	MPDS DTR A	Input B RS-422 DCE hardware flow control
BP104	MPDS DCD B	Output A RS-422 DCE hardware flow control
BP105	MPDS DCD A	Output B RS-422 DCE hardware flow control

Table 5-19: SDU Pins for MPDS RS-422

RS-422 115.2 kbit/s Asynchronous RFC 1549 HDLC (www.ietf.org)

Configuration: DCE with hardware flow control (RTS and CTS as RS-422 signals).

The SDU supports an effective data rate of 64 kbit/s on the MPDS connection.

Cable Requirements, MPDS RS-422

The cable for the MPDS RS-422 interface must be a 100 Ω twisted and shielded cable.

MPDS Ethernet 10BaseT Pins

The SDU Rear Connector Top Plug (TP) has a Quadrax connector insert in TP A3, used for MPDS over Ethernet.

Important! Make sure the coding pin is inserted properly when you plug in the Quadrax connector. It is possible to accidentally misplace the coding pin, which could damage the connector or the SDU.

Refer to **Figure 3-14: Contact Assembly: Quadrax Pin size 5 special: ITT Cannon 244-0011-001** for information on assembly of the Quadrax connector.

SDU pin	Name	Description	RJ45 PIN (F)	Name
TP A3.1	Tx+	Input	1	TxD+
TP A3.2	Rx+	Output	3	RxD+
TP A3.3	Tx-	Input	2	TxD-
TP A3.4	Rx-	Output	6	RxD-

Table 5-20: SDU Pins for MPDS 10BaseT Ethernet

The 10 Mbit/s Ethernet interface physical layer conforms to [1] (IEEE standard 802.3, Chapter 14: “Twisted Pair medium attachment unit”), except for the connector type. To be compliant with [1], an RJ45 female connector must be used for the user interface. The connector pin assignment must be according to [1] and [2] as shown in **Figure 5-15: MPDS Ethernet RJ45 Connector and Cable Connection to SDU.**

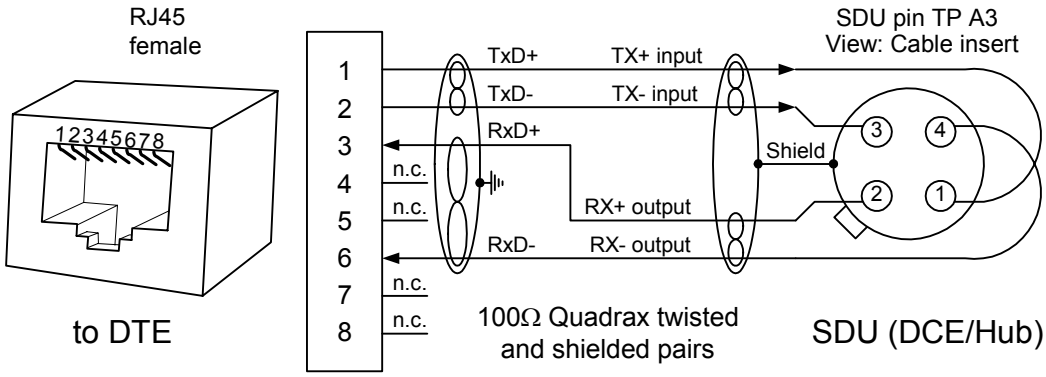


Figure 5-15: MPDS Ethernet RJ45 Connector and Cable Connection to SDU.

The SDU is defined as a DCE or a Hub i.e. TxD is input and RxD is output.

Cable Requirements, MPDS Ethernet 10BaseT

The cable for the MPDS Ethernet 10BaseT interface must be a 100 Ω 4-wire twisted and shielded cable.

Recommended cable types are listed in **Cables for MPDS Ethernet on SDU (Quadrax Connector)** on page 5-85.

ISDN Pins

SDU pin	Name	Description	RJ45 PIN (F)	Name
BP67	ISDN TxP	Output	3	Rx+
BP68	ISDN TxN	Output	6	Rx-
BP66	ISDN RxP	Input	4	Tx+
BP69	ISDN RxN	Input	5	Tx-

Table 5-21: SDU Pins for ISDN

The Euro ISDN S-bus interface on the SDU is configured as the network side of the NT1 interface i.e. Rx is an input and Tx is an output. Please note that this configuration of input and output differs from the configuration of the 10BaseT Ethernet, RS-422 MPDS and RS-232 PC interface input/output.

An RJ-45 Female Connector must be connected to the four wire ISDN lines from the SDU in order to be compliant with [2] (ISO8877 ISO/IEC 8877) and the ISDN connector specification defined by [5] (ITU-T Recommendation I.420).
The SDU includes an internal 100 Ω termination resistor to support cable lengths longer than 3 meters.

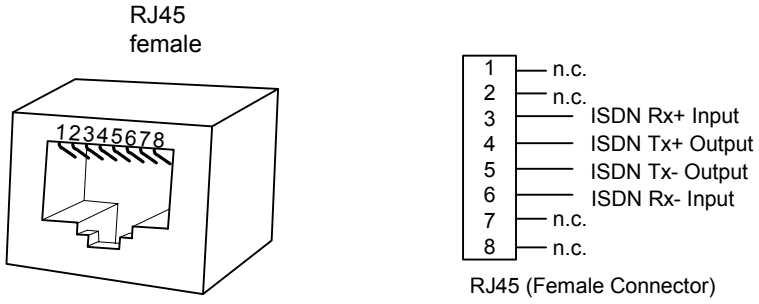


Figure 5-16: ISDN RJ45 Connector

The Euro ISDN S-bus interface can power supply 4 ISDN phones but supports 8 phones (where 4 of them must have their own power supply). At power hold-up, only power for one phone is available i.e. if more than one phone is connected, the SDU may reset if an incoming call is received, or if more than one phone is off-hook, during a power hold-up session.

Cable Requirements, ISDN

The cable for the ISDN interface must be a 100 Ω 4-wire shielded cable. The conductors must be twisted in pairs.

5.3.7 Wiring Telephone Systems

Built-In Private Branch Exchange (PBX)

The built-in PBX controls four 4-wire audio interfaces, two 2-wire POTS interfaces and one ISDN interface.

4-Wire Audio

The 4-wire interfaces can be connected and configured to the 4-wire systems listed below:

- TT-5020A/TT-5022A Handset/cradle system
- Up to two MagnaStar AIU (Analog Interface Units)
- Up to three 2.4 GHz Wireless handset base stations with WH-10 Satcom interface
- Up to three WH-10 handsets
- Up to two Cockpit Voice Interfaces (for future use)

The four 4-wire handset interfaces are numbered handset interface #1 to #4.

- Handset interface #1 and #2 may interface to all systems mentioned above.
- Handset interface #3 may interface to all systems mentioned above except Cockpit Voice.
- Handset interface #4 may only interface to TT-5020A/TT-5022A Handset/cradle system.

The TT-5020A/TT-5022A Handset/cradle system is also used for configuration of the handsets, phone book etc., and as a BITE and Satcom Status display. In order to take advantage of these features, the SDU must be connected to at least one TT-5020A/TT-5022A Handset/cradle system (typically handset #4).

2-wire POTS

The 2-wire interfaces may be connected and configured to the 2-wire systems listed below:

- TT-5021B / TT-5022B Cradle/Handset
- 2.4 GHz Wireless Phone with POTS interface
- Sigma7 phone with POTS interface
- FAX or Modem data with POTS interface

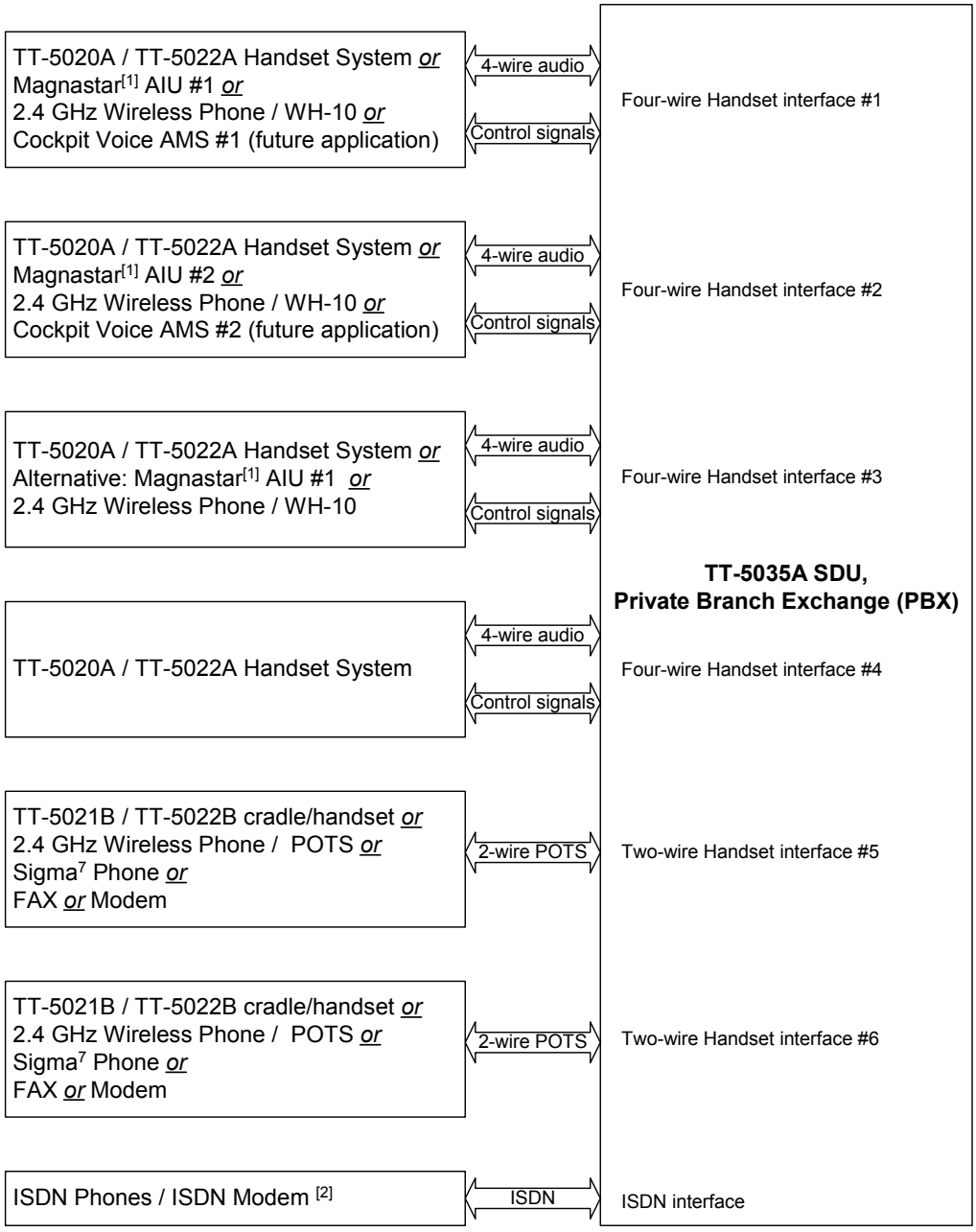
The maximum number of phones on each 2-wire POTS interface is:
Two TT-5021B / TT-5022B Cradle/Handsets or two Sigma7 phones, but only one at the time should be active (off-hook) in order to avoid echo problems.

ISDN

The ISDN interface may be used with an ISDN phone and/or an ISDN data modem. Only the ISDN phone is routed through the PBX, while the ISDN data modem is routed directly to the RF High Speed Data channel. A maximum of 8 ISDN units (ISDN phones, ISDN fax or ISDN data modem) may be connected to the ISDN interface, but only one unit may be active at the time.

Configuration of Handset Interfaces

The following drawing shows the possible combinations of devices connected to the handset interfaces.



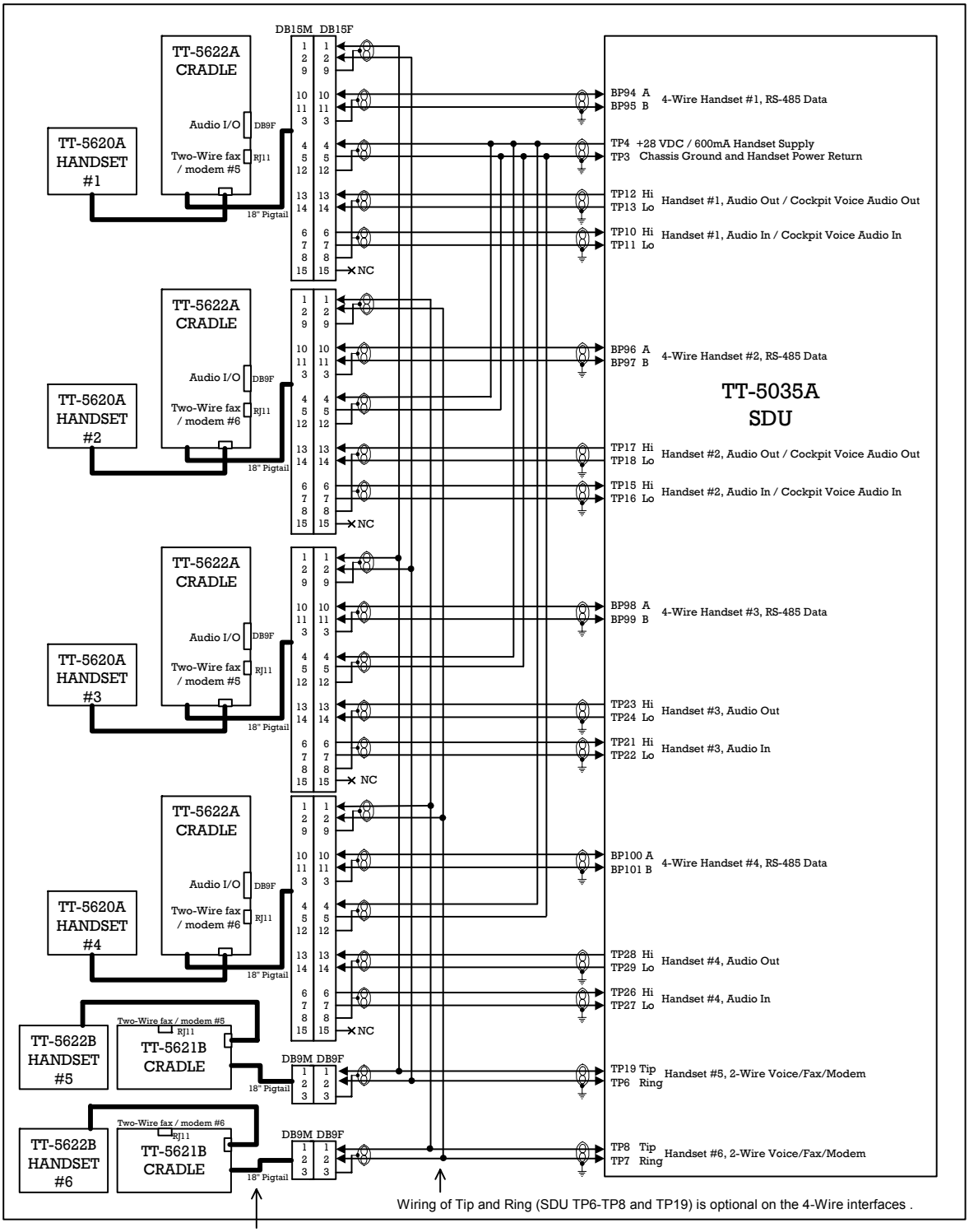
[1]: Maximum two MagnaStar AIUs may be installed. The preferred installation of AIU #1 is to the four-wire Handset #1 interface, but AIU #1 may alternatively be connected to the four-wire Handset #3 interface instead.

[2]: A Maximum of 8 ISDN units may be installed, and a maximum of two ISDN units may be active (off hook) at the time. ISDN phones may be routed to any four-wire, two-wire or RF channel, but ISDN modem data is only routed to the High Speed RF channel.

Figure 5-17: Handset Interfaces, Possible Combinations of Connected Devices.

5.3.8 Wiring Thrane & Thrane Handset Systems

The following drawing shows the wiring of the TT-5622A/TT-5620A 4-wire handsets and the TT-5621B/TT-5622B 2-wire handsets from Thrane & Thrane.



Note: 18" Pigtail with Sub-D connector is mounted on each cradle.

Figure 5-18: Wiring T&T Handset Systems

4-Wire Interfaces

The below list shows the pins used for the 4-wire interfaces on the SDU.

Pin no.	Name/Description
TP10	Handset #1 Audio In Hi / (Future use: Cockpit Voice Audio #1 In Hi)
TP11	Handset #1 Audio In Lo / (Future use: Cockpit Voice Audio #1 In Lo)
TP12	Handset #1 Audio Out Hi / (Future use: Cockpit Voice Audio #1 Out Hi)
TP13	Handset #1 Audio Out Lo / (Future use: Cockpit Voice Audio #1 Out Lo)
BP94	Handset #1 RS-485 Data A
BP95	Handset #1 RS-485 Data B
TP15	Handset #2 Audio In Hi / (Future use: Cockpit Voice Audio #2 In Hi)
TP16	Handset #2 Audio In Lo / (Future use: Cockpit Voice Audio #2 In Lo)
TP17	Handset #2 Audio Out Hi / (Future use: Cockpit Voice Audio #2 Out Hi)
TP18	Handset #2 Audio Out Lo / (Future use: Cockpit Voice Audio #2 Out Lo)
BP96	Handset #2 RS-485 Data A
BP97	Handset #2 RS-485 Data B
TP21	Handset #3 Audio In Hi
TP22	Handset #3 Audio In Lo
TP23	Handset #3 Audio Out Hi
TP24	Handset #3 Audio Out Lo
BP98	Handset #3 RS-485 Data A
BP99	Handset #3 RS-485 Data B
TP26	Handset #4 Audio In Hi
TP27	Handset #4 Audio In Lo
TP28	Handset #4 Audio Out Hi
TP29	Handset #4 Audio Out Lo
BP100	Handset #4 RS-485 Data A
BP101	Handset #4 RS-485 Data B
TP4	+28 V DC / 600 mA Handset supply, remote On/Off control by TP5 (nON)
TP3	Handset Power Return
TP25	+12 V DC Spare Supply for test only - do not connect!

Table 5-22: SDU Pins for 4-Wire Interface

The SDU has four 4-wire analog interfaces for the TT-5620A/ TT-5622A Thrane & Thrane aeronautical handset system on the rear connector. The handsets use an RS-485 data bus for on/off hook signalling, display control, keyboard control, background light, etc.

Three of the 4-wire interfaces, #1, #2 and #3, can alternatively be used for connection of MagnaStar or WH-10 phones. For information on possible combinations, see **Configuration of Handset Interfaces** on page 5-38.
The handset interfaces must be configured in the HSD+ Configuration Program.

For information on wiring of MagnaStar, refer to **Wiring MagnaStar Handsets** on page 5-42.

For information on wiring of WH-10 phones, refer to **Wiring WH-10 Handsets** on page 5-45.

For information on wiring of 2.4GHz Cordless phones, refer to **Wiring 2.4GHz Cordless (4-Wire) Phone** on page 5-48.

2-Wire Interfaces

The below list shows the pins used for the 2-wire interfaces of the SDU.

Pin no. (X2)	Name/Description
TP6	2-Wire Voice/Fax/Modem #1 (Ring)
TP7	2-Wire Voice/Fax/Modem #2 (Ring)
TP8	2-Wire Voice/Fax/Modem #2(Tip)
TP19	2-Wire Voice/Fax/Modem #1 (Tip)

Table 5-23: SDU Pins for 2-Wire Interface

The SDU has two 2-wire voice/fax/modem POTS interfaces connected to the built-in PBX. The interfaces comply with 2-wire 600 Ω standard US DTMF telephones. The 2-wire interface is not galvanically isolated from the aircraft frame, and galvanic isolation is required at the external 2-wire terminal.

Two TT-5621B 2-wire phones can be connected in parallel on each interface.

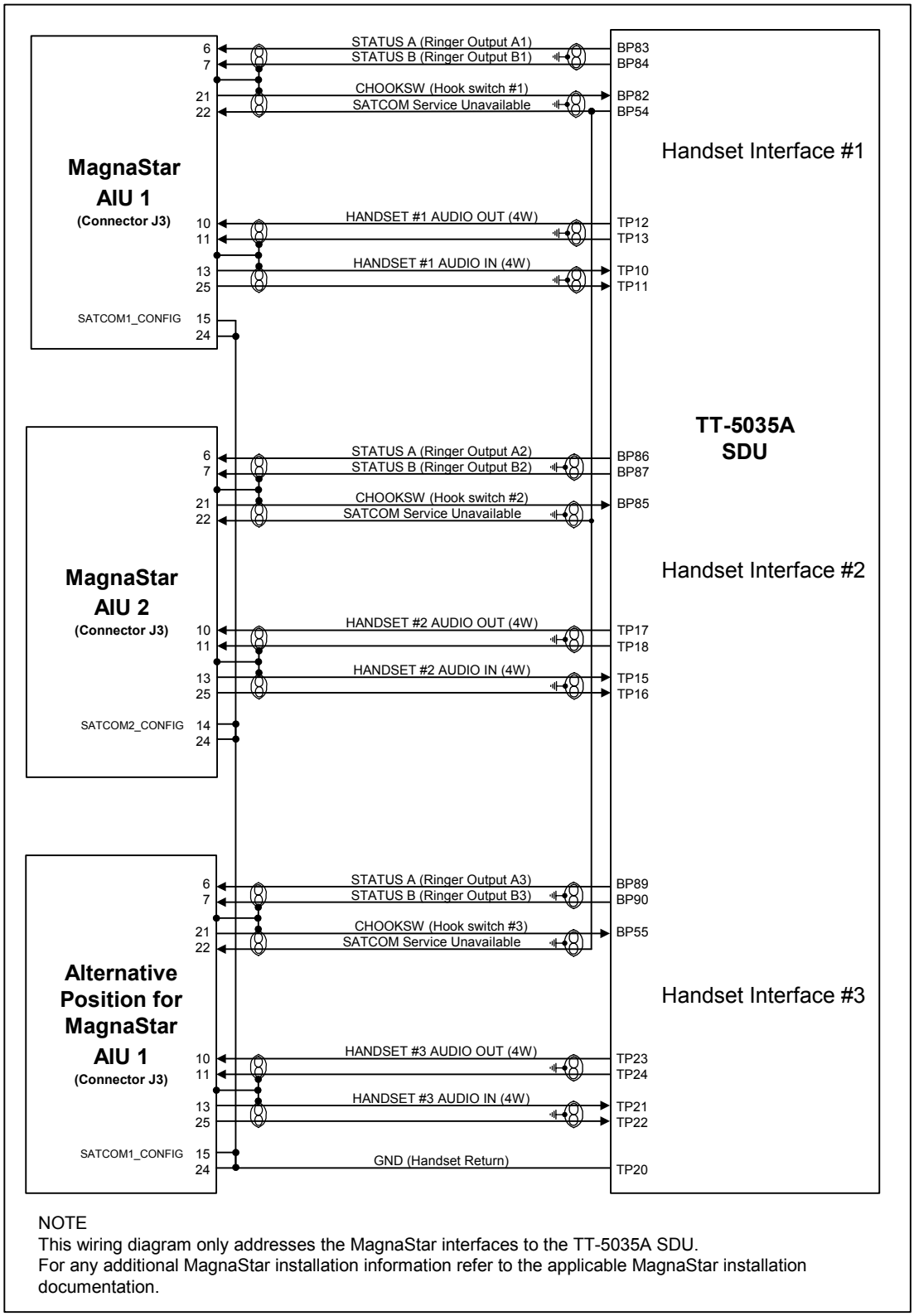
This interface is used for the TT-5621B/ TT-5622B Thrane & Thrane aeronautical handset system, but may also be used for e.g. the Sigma7 or 2.4GHz Cordless phones, or for a fax or a modem.

For information on wiring of Sigma7 phones, see **Wiring Sigma7 (2-Wire) Handsets** on page 5-52.

For information on wiring of 2.4GHz Cordless phones, see **Wiring 2.4GHz Cordless (2-Wire) Phone** on page 5-53.

5.3.9 Wiring MagnaStar Handsets

The following drawing shows the wiring of the MagnaStar handsets.



NOTE
This wiring diagram only addresses the MagnaStar interfaces to the TT-5035A SDU.
For any additional MagnaStar installation information refer to the applicable MagnaStar installation documentation.

Figure 5-19: Wiring MagnaStar Interface

The below list shows the pins used for the MagnaStar interfaces on the SDU.

Pin no.	Name/Description
TP10	Handset #1 Audio In Hi / (Future use: Cockpit Voice Audio #1 In Hi)
TP11	Handset #1 Audio In Lo / (Future use: Cockpit Voice Audio #1 In Lo)
TP12	Handset #1 Audio Out Hi / (Future use: Cockpit Voice Audio #1 Out Hi)
TP13	Handset #1 Audio Out Lo / (Future use: Cockpit Voice Audio #1 Out Lo)
BP54	MagnaStar: Satcom Service Unavailable. Discrete output.
BP82	WH-10/MagnaStar Hook Switch #1 (Future use: CP Voice Call Cancel Input #1). Discrete input.
BP83	WH-10/MagnaStar Ringer Output A1 (Future use: CP Voice Mic On Input #1). Discrete I/O.
BP84	WH-10/MagnaStar Ringer Output B1 (Future use: CP Voice Call Light Output #1). Discrete output.
TP15	Handset #2 Audio In Hi / (Future use: Cockpit Voice Audio #2 In Hi)
TP16	Handset #2 Audio In Lo / (Future use: Cockpit Voice Audio #2 In Lo)
TP17	Handset #2 Audio Out Hi / (Future use: Cockpit Voice Audio #2 Out Hi)
TP18	Handset #2 Audio Out Lo / (Future use: Cockpit Voice Audio #2 Out Lo)
BP85	WH-10/MagnaStar Hook Switch #2 (Future use: CP Voice Call Cancel Input #2). Discrete input.
BP86	WH-10/MagnaStar Ringer Output A2 (Future use: CP Voice Mic On Input #2). Discrete I/O.
BP87	WH-10/MagnaStar Ringer Output B2 (Future use: CP Voice Call Light Output #2). Discrete output.
TP21	Handset #3 Audio In Hi
TP22	Handset #3 Audio In Lo
TP23	Handset #3 Audio Out Hi
TP24	Handset #3 Audio Out Lo
BP55	WH-10/MagnaStar: Hook switch #3
BP89	WH-10/MagnaStar Ringer Output A3 or Service Available Annunciator. Discrete I/O.
BP90	WH-10/MagnaStar Ringer Output B3
TP20	AGND

Table 5-24: SDU Pins for MagnaStar Interface

One or two MagnaStar Analog Interface Units (AIUs) can be connected to the Aero-HSD$^+$ system, using the handset interfaces #1, #2 or #3.

If two MagnaStar AIUs are connected, the pins “SATCOM1_CONFIG” and “SATCOM2_CONFIG” are used to signal which channel is used (connect pin 15 on AIU1 to GND and pin 14 on AIU2 to GND).

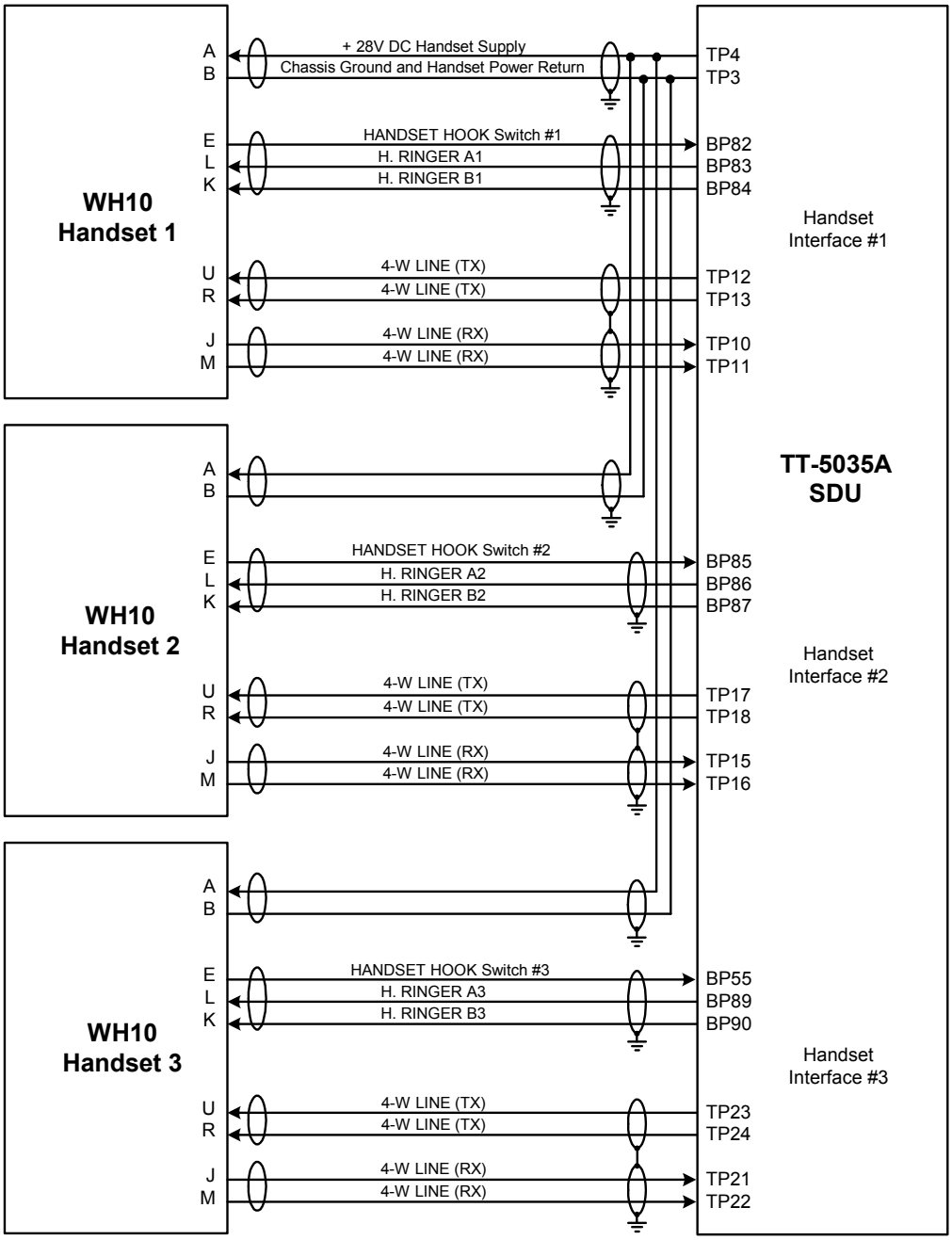
Note: The 4-wire handset system #1, #2 and #3 interfaces are used for either the 4-Wire Handset System, MagnaStar, 2.4GHz Cordless **or** WH-10 phones, as configurations share the same interface. For information on possible combinations, see **Configuration of Handset Interfaces** on page 5-38.
The handset interfaces must be configured in the HSD$^+$ Configuration Program

For further information on the handset interfaces, see **4-Wire Interfaces** on page 5-40.

Apart from the handset interfaces, the SDU has a number of discrete inputs/outputs used for MagnaStar/WH-10 systems. For information on these interfaces, see **Discretes for MagnaStar/WH-10 Handset Systems** on page 5-51.

5.3.10 Wiring WH-10 Handsets

The following drawing shows the wiring of WH-10 handsets.



Note: + 28 V and Chassis Ground must be connected as close as possible to TP3/TP4

Figure 5-20: Wiring WH-10 Handsets

The below list shows the pins used for the WH-10 interfaces on the SDU.

Pin no.	Name/Description
TP3	Chassis Ground and Handset Power Return
TP4	+28 V DC/600 mA Handset Supply
TP10	Handset #1 Audio In Hi / (Future use: Cockpit Voice Audio #1 In Hi)
TP11	Handset #1 Audio In Lo / (Future use: Cockpit Voice Audio #1 In Lo)
TP12	Handset #1 Audio Out Hi / (Future use: Cockpit Voice Audio #1 Out Hi)
TP13	Handset #1 Audio Out Lo / (Future use: Cockpit Voice Audio #1 Out Lo)
BP82	WH-10/MagnaStar Hook Switch #1 (Future use: CP Voice Call Cancel Input #1). Discrete input.
BP83	WH-10/MagnaStar Ringer Output A1 (Future use: CP Voice Mic On Input #1). Discrete I/O.
BP84	WH-10/MagnaStar Ringer Output B1 (Future use: CP Voice Call Light Output #1). Discrete output.
TP15	Handset #2 Audio In Hi / (Future use: Cockpit Voice Audio #2 In Hi)
TP16	Handset #2 Audio In Lo / (Future use: Cockpit Voice Audio #2 In Lo)
TP17	Handset #2 Audio Out Hi / (Future use: Cockpit Voice Audio #2 Out Hi)
TP18	Handset #2 Audio Out Lo / (Future use: Cockpit Voice Audio #2 Out Lo)
BP85	WH-10/MagnaStar Hook Switch #2 (Future use: CP Voice Call Cancel Input #2). Discrete input.
BP86	WH-10/MagnaStar Ringer Output A2 (Future use: CP Voice Mic On Input #2). Discrete I/O.
BP87	WH-10/MagnaStar Ringer Output B2 (Future use: CP Voice Call Light Output #2). Discrete output.
TP21	Handset #3 Audio In Hi
TP22	Handset #3 Audio In Lo
TP23	Handset #3 Audio Out Hi
TP24	Handset #3 Audio Out Lo
BP55	WH-10/MagnaStar: Hook switch #3
BP89	WH-10/MagnaStar Ringer Output A3 or Service Available Annunciator. Discrete I/O.
BP90	WH-10/MagnaStar Ringer Output B3

Table 5-25: SDU Pins for WH-10 Interface

Up to three WH-10 systems can be connected to the Aero-HSD^{+} system, using the interfaces #1, #2 or #3.

Note: The 4-wire handset system #1, #2 and #3 interfaces are used for either the 4-Wire Handset System, MagnaStar, 2.4GHz Cordless **or** WH-10 phones, as configurations share the same interface. For information on possible combinations, see **Configuration of Handset Interfaces** on page 5-38.
The handset interfaces must be configured in the HSD^{+} Configuration Program.

For further information on the interfaces, see **4-Wire Interfaces** on page 5-40.

Apart from the handset interfaces, the SDU has a number of discrete inputs/outputs used for MagnaStar/WH-10 systems. For information on these interfaces, see **Discretes for MagnaStar/WH-10 Handset Systems** on page 5-51.

5.3.11 Wiring 2.4GHz Cordless (4-Wire) Phone

The following drawing shows the wiring of 2.4GHz Cordless 4-wire handsets.

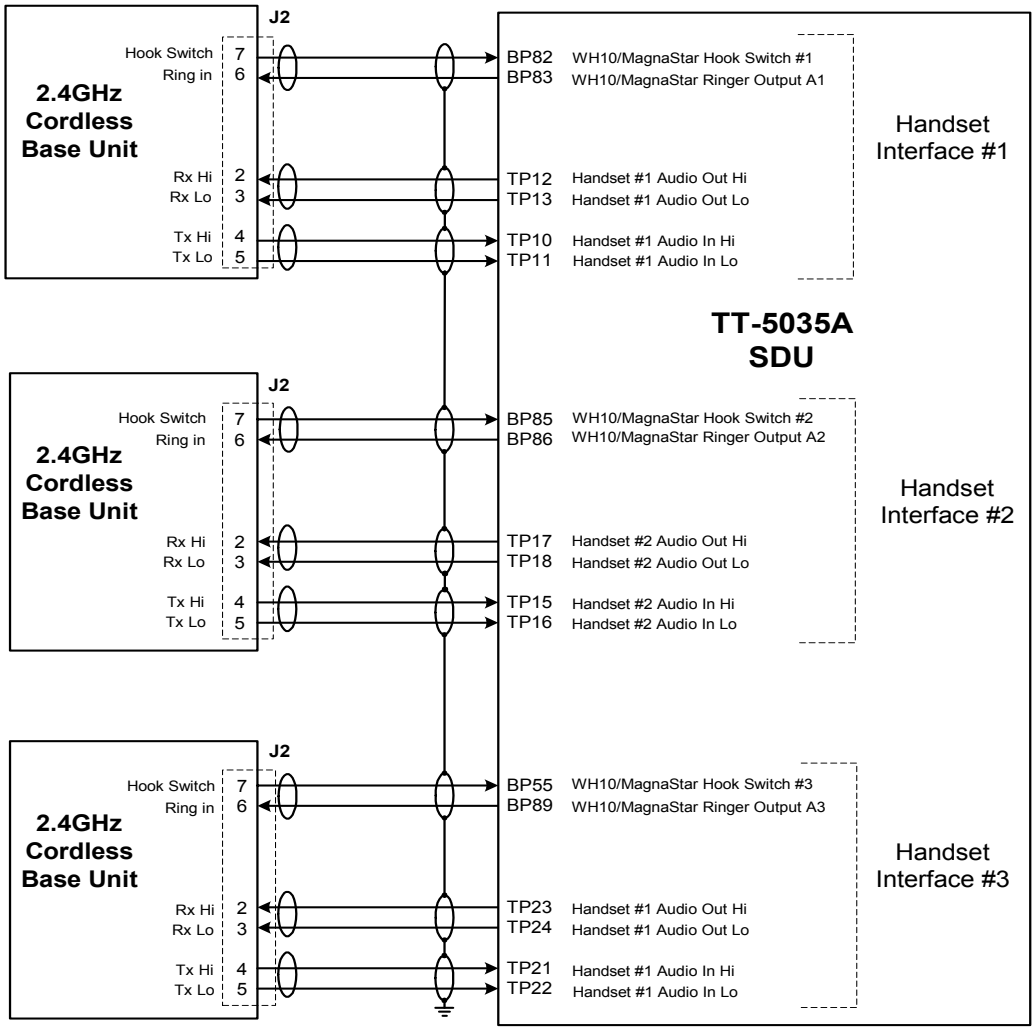


Figure 5-21: Wiring 2.4GHz Cordless 4-Wire Handsets

Note: The power for the 2.4GHz Cordless base unit must be supplied from an external power supply. See the 2.4GHz Cordless manual for details.

The below list shows the pins used for the 2.4GHz Cordless (WH-10) interfaces on the SDU.

Pin no.	Name/Description
TP10	Handset #1 Audio In Hi / (Future use: Cockpit Voice Audio #1 In Hi)
TP11	Handset #1 Audio In Lo / (Future use: Cockpit Voice Audio #1 In Lo)
TP12	Handset #1 Audio Out Hi / (Future use: Cockpit Voice Audio #1 Out Hi)
TP13	Handset #1 Audio Out Lo / (Future use: Cockpit Voice Audio #1 Out Lo)
BP82	WH-10/MagnaStar Hook Switch #1 (Future use: CP Voice Call Cancel Input #1). Discrete input.
BP83	WH-10/MagnaStar Ringer Output A1 (Future use: CP Voice Mic On Input #1). Discrete I/O.
TP15	Handset #2 Audio In Hi / (Future use: Cockpit Voice Audio #2 In Hi)
TP16	Handset #2 Audio In Lo / (Future use: Cockpit Voice Audio #2 In Lo)
TP17	Handset #2 Audio Out Hi / (Future use: Cockpit Voice Audio #2 Out Hi)
TP18	Handset #2 Audio Out Lo / (Future use: Cockpit Voice Audio #2 Out Lo)
BP85	WH-10/MagnaStar Hook Switch #2 (Future use: CP Voice Call Cancel Input #2). Discrete input.
BP86	WH-10/MagnaStar Ringer Output A2 (Future use: CP Voice Mic On Input #2). Discrete I/O.
TP21	Handset #3 Audio In Hi
TP22	Handset #3 Audio In Lo
TP23	Handset #3 Audio Out Hi
TP24	Handset #3 Audio Out Lo
BP55	WH-10/MagnaStar: Hook switch #3
BP89	WH-10/MagnaStar Ringer Output A3 or Service Available Annunciator. Discrete I/O.

Table 5-26: SDU Pins for 2.4GHz Cordless (WH-10) Interface

Up to three 2.4GHz Cordless Handsets can be connected to the Aero-HSD$^+$ system, using the interfaces #1, #2 or #3.

Note: The 4-wire handset system #1, #2 and #3 interfaces are used for **either** the 4-Wire Handset System, MagnaStar, 2.4GHz Cordless **or** WH-10 phones, as configurations share the same interface. For information on possible combinations, see **Configuration of Handset Interfaces** on page 5-38. Handset interface #4 can only be used for the 4-Wire Handset System.
The handset interfaces must be configured in the HSD$^+$ Configuration Program.

For further information on the interfaces, see **4-Wire Interfaces** on page 5-40.

Apart from the handset interfaces, the SDU has a number of discrete inputs/outputs used for MagnaStar/WH-10 systems. For information on these interfaces, see **Discretes for MagnaStar/WH-10 Handset Systems** on page 5-51.

5.3.12 Discretes for MagnaStar/WH-10 Handset Systems

The below list shows the discretes used for the MagnaStar/WH-10 interfaces on the SDU. For more information on the discrete types, refer to **Description of the Discrete Types** on page 5-57.

Pin no.	Name/Description	Discrete Type
BP54	MagnaStar: Satcom Service Unavailable	Lamp Driver output
BP55	WH-10/MagnaStar: Hook switch #3	WOW input
BP82	WH-10/MagnaStar Hook Switch #1 (Future use: CP Voice Call Cancel Input #1)	WOW input
BP83	WH-10/MagnaStar Ringer Output A1 (Future use: CP Voice Mic On Input #1). Discrete I/O.	Lamp Driver output (Future use: Mic On Input)
BP84	WH-10/MagnaStar Ringer Output B1 (Future use: CP Voice Call Light Output #1). Discrete output.	Lamp Driver output (Future use: Call Light output)
BP85	WH-10/MagnaStar Hook Switch #2 (Future use: CP Voice Call Cancel Input #2)	WOW input
BP86	WH-10/MagnaStar Ringer Output A2 (Future use: CP Voice Mic On Input #2). Discrete I/O.	Lamp Driver output (Future use: Mic On Input)
BP87	WH-10/MagnaStar Ringer Output B2 (Future use: CP Voice Call Light Output #2). Discrete output.	Lamp Driver output (Future use: Call Light output)
BP89	WH-10/MagnaStar Ringer Output A3 or Service Available Annunciator. Discrete I/O.	Lamp Driver output
BP90	WH-10/MagnaStar Ringer Output B3	Lamp Driver output

Table 5-27: SDU Discretes for MagnaStar/WH-10 Systems

5.3.13 Wiring Sigma^7 (2-Wire) Handsets

The following drawing shows the wiring of Sigma^7 handsets.

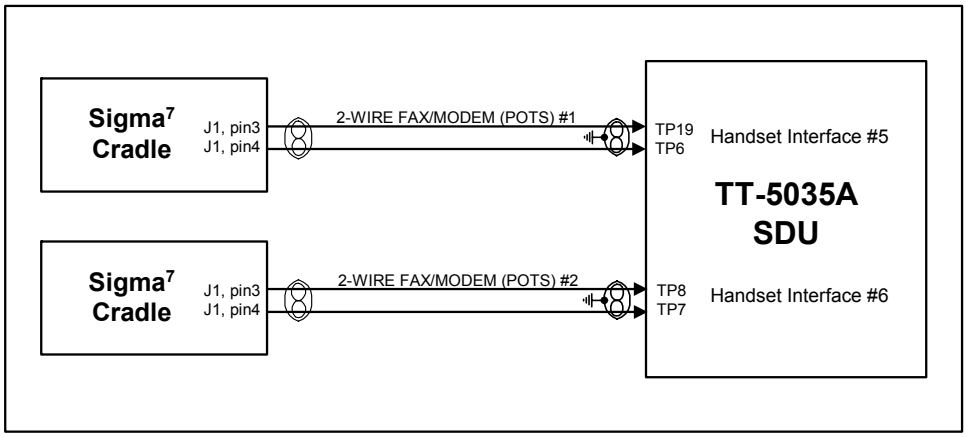


Figure 5-22: Wiring Sigma^7 Handsets

One or two Sigma^7 handsets can be connected to the 2-wire interfaces of the Aero-HSD$^+$ system.

Connect J1 on the Sigma^7 handset to the rear receptacle of the SDU according to the wiring drawing above.

Important! In order for the volume in the Sigma^7 handset to be sufficient, it is normally necessary to adjust the "ear volume" using the menu system of the handset. For information on how to do this, see **Sigma^7** on page 6-9.

For information on the 2-wire interface, see **2-Wire Interfaces** on page 5-41.

5.3.14 Wiring 2.4GHz Cordless (2-Wire) Phone

The following drawing shows the wiring of 2.4GHz Cordless 2-wire phones.

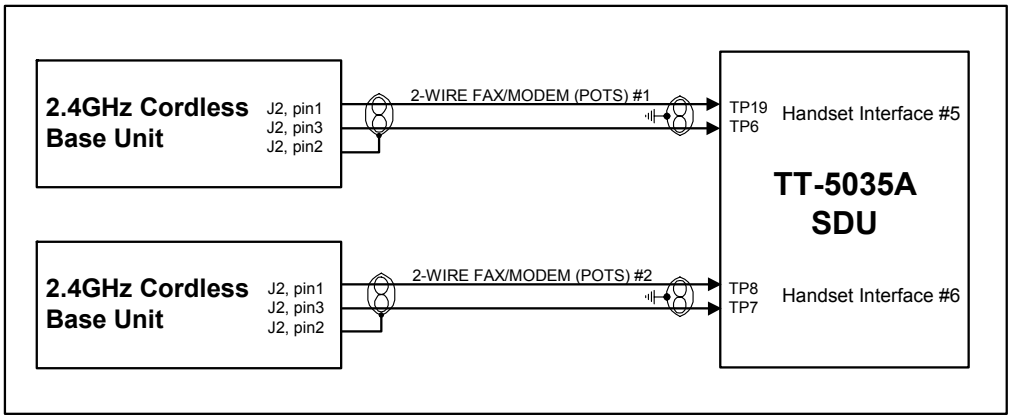


Figure 5-23: Wiring 2.4GHz Cordless Handsets

One or two 2.4GHz Cordless phones can be connected to the 2-wire interfaces of the Aero-HSD^{+} system.

Connect J2 on the base unit of the 2.4GHz Cordless phone to the rear receptacle of the SDU according to the wiring drawing above.

Important! In order for the 2.4GHz Cordless phone to work properly, it is normally necessary to make a few initial adjustments of the handset. For information on how to do this, see **2.4GHz Cordless** on page 6-10.

For information on the 2-wire interface, see **2-Wire Interfaces** on page 5-41.

5.3.15 Wiring Discretes

Discrete Annunciators and WOW

The following drawing shows the wiring of discrete annunciators and Weight-on-Wheels (WOW).

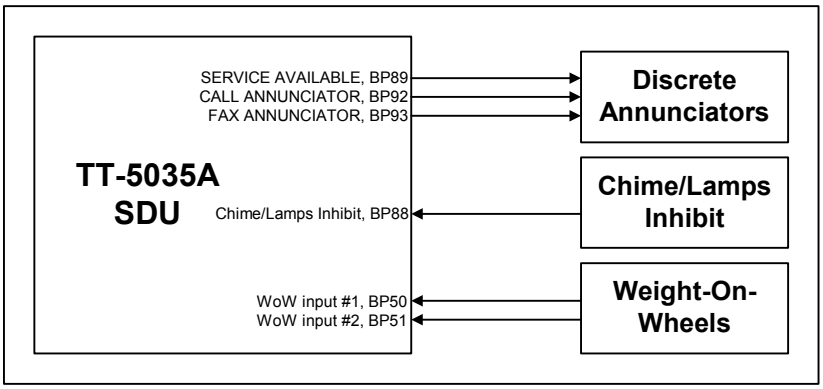


Figure 5-24: Wiring Discrete Annunciators and Weight-on-Wheels

Discrete Annunciators

The following list shows the pins used for Discrete Annunciators:

SDU Pin	Name/Description	Specification of discrete type[a]
BP89	Service Available Annunciator (Discrete I/O)	Output: Lamp Driver
BP92	Call Annunciator (Discrete I/O)	Output: Lamp Driver
BP93	Fax Annunciator (Discrete Output)	Output: Lamp Driver

Table 5-28: SDU Pins for Discrete Annunciators

a. The discrete interfaces are described in **Description of the Discrete Types** on page 5-57.

Note: The Service Available Annunciator on pin BP89 is not available if you are using handset interface #3 for MagnaStar, 2.4GHz Cordless (4-wire) or WH-10 Handsets.

The function of the Annunciators is as follows:

- Service Available Annunciator.
  This Annunciator is used for indicating service availability. The Annunciator is "steady ON" when H^+ service is available.
- Call Annunciator.
  This Annunciator is used for signalling incoming voice calls. The Annunciator is "flashing" like the Connection LED on a 4-wire handset and is turned off when the call is answered or terminated by initiator.
- Fax Annunciator.
  This Annunciator is used for signalling incoming fax. The Annunciator is "steady ON" until a receipt for the fax has been given in the handset.

Chime/Lamps Inhibit Input

Pin used for the Chime/Lamps Inhibit input:

SDU Pin	Name/Description	Specification of discrete type[a]
BP88	Chime/Lamps Inhibit Input	Input: WOW (active low)

Table 5-29: SDU Pins for WOW

a. The discrete interfaces are described in **Description of the Discrete Types** on page 5-57.

The SDU has one discrete input for the Chime/Lamps Inhibit function. This input is used to inhibit Satcom activation of the chime and call lights during take-off and landing. The Inhibit function is activated by connecting this input to ground. The Inhibit function also activates the ring profile "TakeOfLandng".

The ring profiles are defined using the HSD+ Configuration Program where call inhibit/non-inhibit is set up for each of the 4-wire and 2-wire interfaces and annunciators.

Weight-On-Wheels (not currently in use)

The following list shows the pins used for Weight-On-Wheels (WOW):

SDU Pin	Name/Description	Specification of discrete type[a]
BP50	Weight-on-Wheels Input #1	Input: WOW
BP51	Weight-on-Wheels Input #2	Input: WOW

Table 5-30: SDU Pins for WOW

a. The discrete interfaces are described in **Description of the Discrete Types** on page 5-57.

The SDU has 2 discrete inputs for Weight-On-Wheels (WOW), which can detect whether the aircraft is airborne or not. Currently this information is not used in the SDU.

The interpretation of the polarity (airframe DC ground or open circuit) of the input is defined by the Configuration Module (WOW Active Polarity).
The Configuration Module also defines if WOW is installed or not. For further information, see the online help in the Aero-HSD^{+} Configuration Program.

Description of the Discrete Types

Discrete type and description:

Discrete Type	Description
Lamp Driver	The SDU has several discrete Lamp Driver outputs. The output configuration forms a switch closure to ground. The electrical specification for the Lamp type switch is: Open switch hold-off voltage: max. +39.5 V DC Closed switch voltage: max. 1 V DC at 500 mA Open switch resistance (OFF): min. 100 kΩ
WOW	The discrete WOW input detects the following states: “Open” voltage: 7 V DC to 39.5 V DC or ≥100 kΩ to ground. “Short” voltage: 0 ±3.5 V DC or ≤1500 Ω to ground. Input characteristics: Reaction time is <500 ms. The internal interface is diode-isolated for parallel connection externally to any other LRU(s), with at least 200 kΩ of isolation, when power is not applied.

Table 5-31: Specification of Discrete Types.

5.3.16 Cockpit Voice and SIM Card Reader (Future Use)

The following drawing shows the wiring of Cockpit Voice and SIM Card reader:

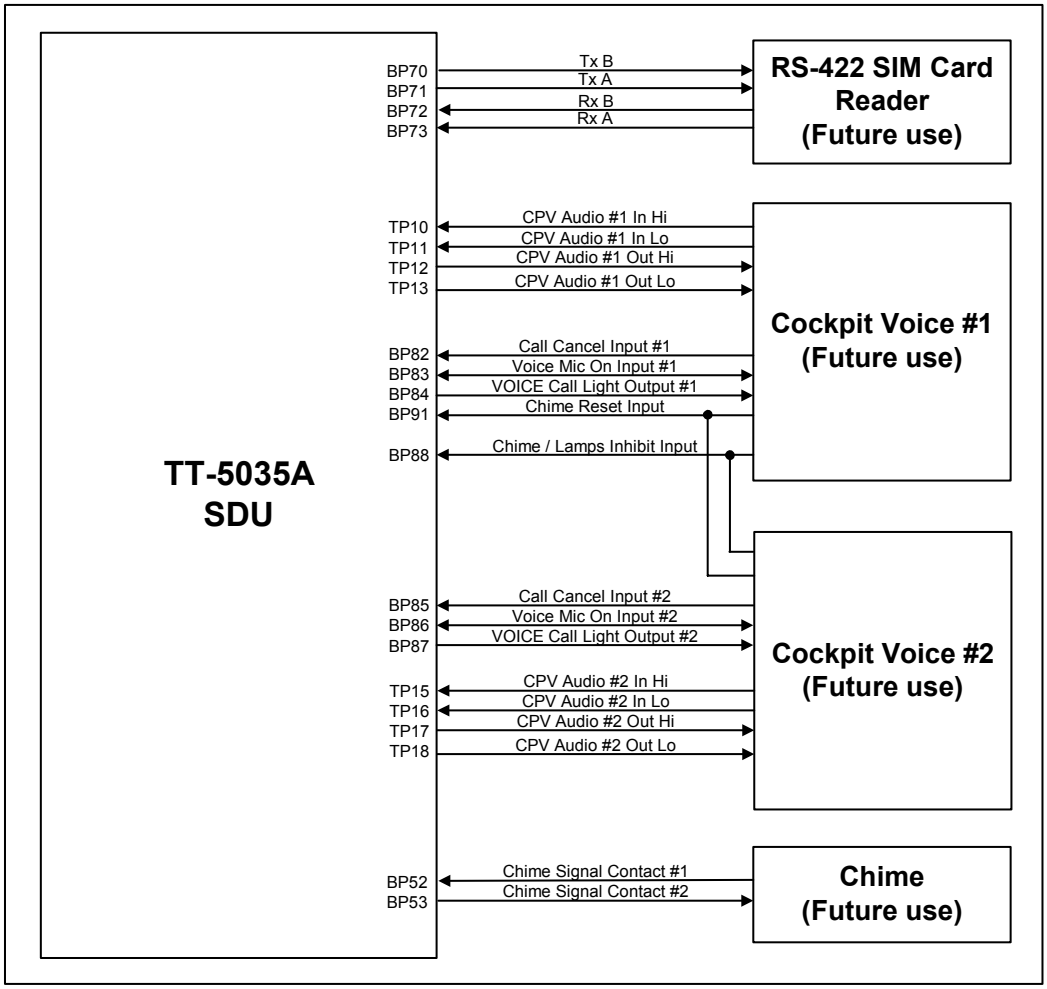


Figure 5-25: Wiring Cockpit Voice and SIM Card Reader

Do not connect equipment to the SIM Card pins, as any implementation of a SIM CARD system must wait for a future interface definition.

The Cockpit Voice interface is physically prepared, but the software is not implemented yet.

5.3.17 Wiring Maintenance Handset, PC and Reset

Maintenance PC, CM Write Enable, SDU Reset and ATE

The following drawing shows the wiring of:

- the RS-232 PC connection,
- SDU Reset,
- Write enable for the Configuration Module and
- ATE interface (for test only)

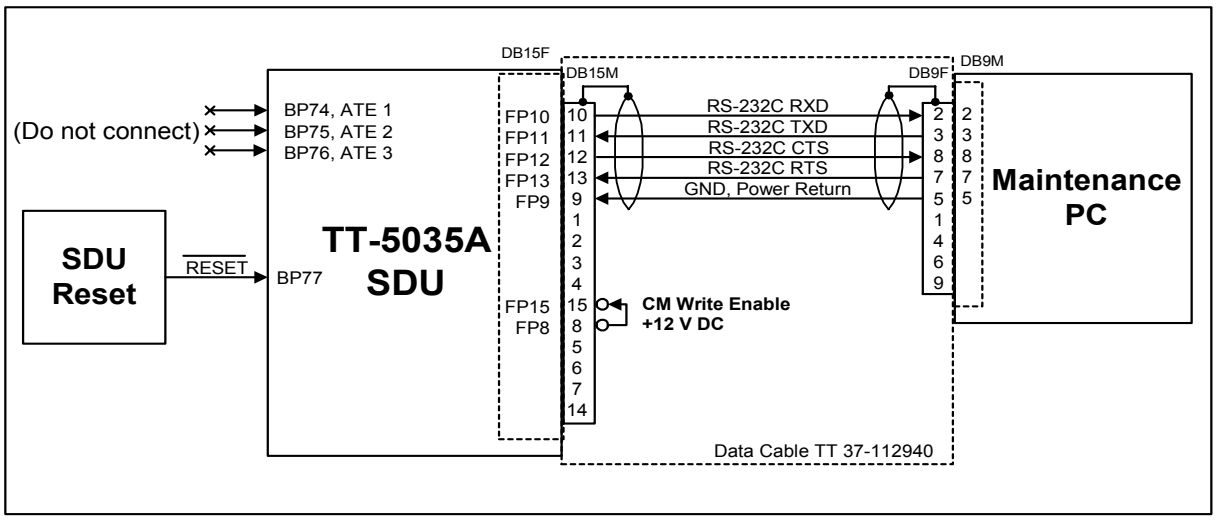


Figure 5-26: Wiring Maintenance PC and Reset

RS-232 Maintenance PC Interface and “Write Enable” Input for Configuration Module

The following list shows the SDU pins used for RS-232 PC interface and for CM Write Enable. Both interfaces are included in the TT 37-112940 data cable described at the end of this section.

SDU Pin	Name/Description
FP10	TxD Input
FP11	RxD Output
FP12	RTS Input
FP13	CTS Output
FP9	GND, Power Return (for +12 V DC)
FP8	+12 V DC/120 mA
FP15	Configuration Module Write Enable In

Table 5-32: SDU Pins for RS-232 PC Interface

The SDU has a PC interface at the front connector, supporting the RS-232 standard. The front PC interface can also be used for uploading software, or it can serve as a printer interface.
The interface is configured as DCE on the SDU (i.e. TxD + RTS are inputs and RxD + CTS are outputs).

The PC interface has the following characteristics:

- Baud rate: 115.2 kbit/s fixed
- Data bits: 8
- Parity: None
- Stop bit: 1
- Flow control: Hardware (RTS/CTS only)

The Write Enable Input - FP15 - enables write cycles to the write protected area in the Configuration Module. FP15 must be connected to +12 V DC (FP8) in order to have access to the write protected area. Electrical specifications:

Enable Write cycles: +10.0 V ≤ VFP15 ≤ +13.0 V

Write Protected: VFP15 ≤ +1.9 V

The following drawing shows the wiring of the data cable for the front connector.

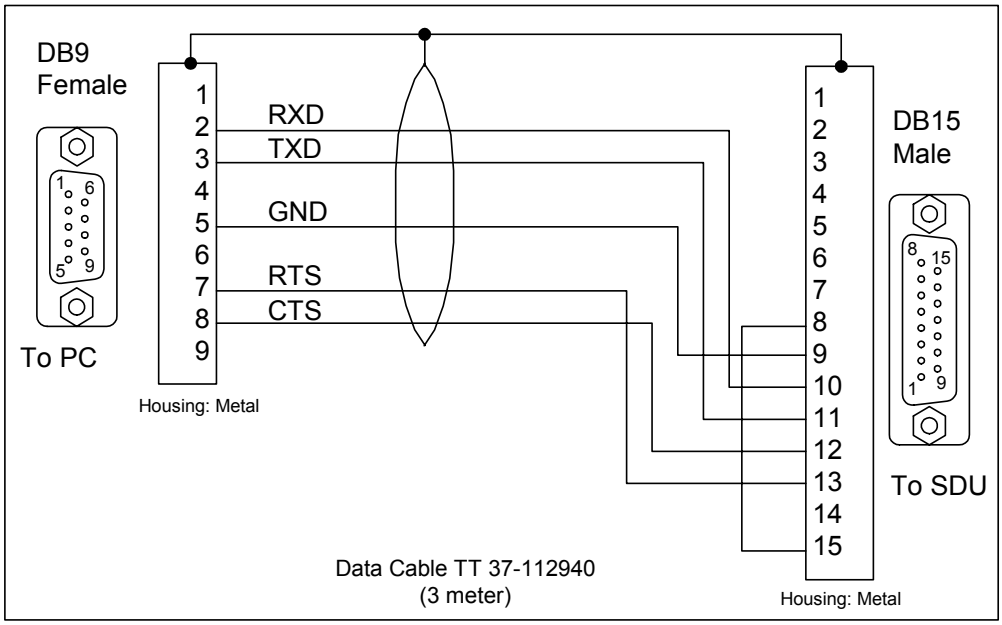


Figure 5-27: TT 37-112940 Data Cable Compliant with Front Connector

Reset

The SDU has a discrete input (BP77) on the rear connector, which can be used for SDU hardware reset. The specification complies with the discrete WOW input.

Note: You only need to connect this input if you have special requirements to the reset function. For normal use, the push-button on the front panel of the SDU should be sufficient.

SDU hardware reset is initiated by connecting the input to ground. This input is filtered carefully, and the input must be activated for approximately 5 sec. before the reset procedure takes action. It is highly recommended to use a guarded switch to avoid accidental operation of the switch.

Electrical DC characteristics: WOW Input type, refer to **Description of the Discrete Types** on page 5-57.

Automatic Test Equipment Pins

The TT-5035A SDU Rear Connector Bottom Plug (BP) has pins for automatic test equipment (ATE): ATE 1 (BP74), ATE 2 (BP75) and ATE 3 (BP76).

Important! Do not connect anything to the ATE pins, not even ground, as lightning-induced effects can potentially harm the internal circuits, and even grounding these pins can cause unintended function of the system.

Maintenance Handset Interface

The following drawing shows the wiring of the maintenance handset interface to the front connector of the SDU.

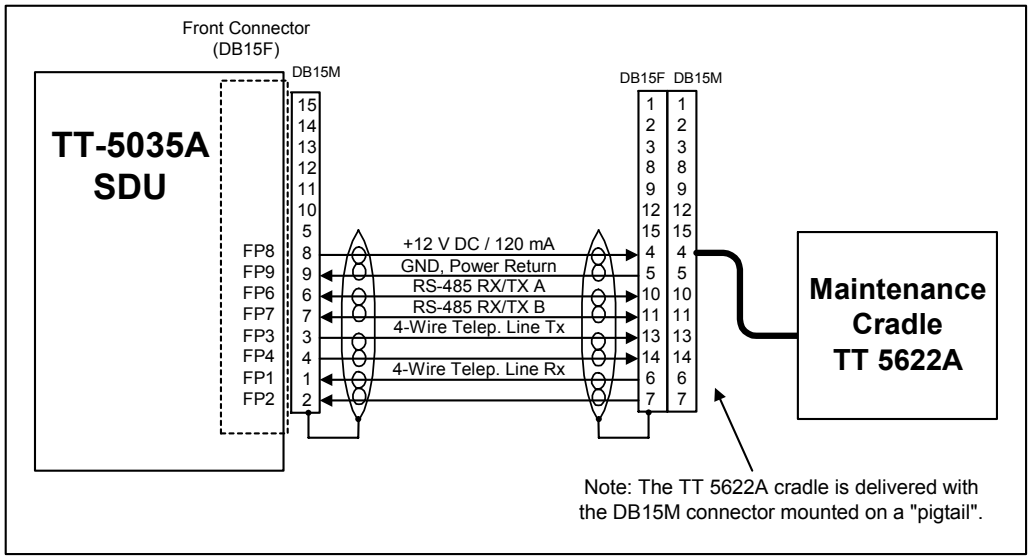


Figure 5-28: Wiring Maintenance Handset

The following list shows the pins used for maintenance handset interface.

SDU Pin	Function: Handset Interface
FP1	Maintenance Handset Audio In Hi
FP2	Maintenance Handset Audio In Lo
FP3	Maintenance Handset Audio Out Hi
FP4	Maintenance Handset Audio Out Lo
FP6	Maintenance Handset RS-485 Data A
FP7	Maintenance Handset RS-485 Data B
FP8	+12 V DC/120 mA
FP9	GND Power Return (for +12 V DC)

Table 5-33: SDU Pins for Maintenance Handset Interface

The SDU has a handset interface for the TT-5620A Handset for maintenance use. This interface can be used to access the menu system using a 4-wire handset.

The front connector provides +12 V DC handset power (FP8). The RS-485 bus on the front connector is common with the RS-485 bus for Handset #4 on the rear connector. The Maintenance handset provides a common mode voltage (2.5 V DC) on the Audio In lines to the SDU. This voltage is used to detect the presence of the handset on the front connector, so the RS-485 #4 can be redirected to the front connector.

5.4 Electrical Installation and Wiring, HSU

5.4.1 Introduction to HSU

As an option, a High Speed data Unit (HSU) containing one additional HSD channel is available for the Aero-HSD$^+$ system, providing a total data rate of 128 kbit/s.

The following pages provide information on wiring of the units in the Aero-HSD$^+$ system with an additional High Speed data Unit (HSU) installed.

5.4.2 Wiring HSU Power Supply

The SDU to Aircraft power bus interfaces supply the electric power required to operate the HSU, and for EMC purposes a chassis connection to the aircraft chassis and the installation tray. The +28 V DC Power wire must include a circuit breaker capable of carrying the required current continuously under the required environmental conditions.

The following drawing shows the wiring of the HSU to the Aircraft Power Bus.

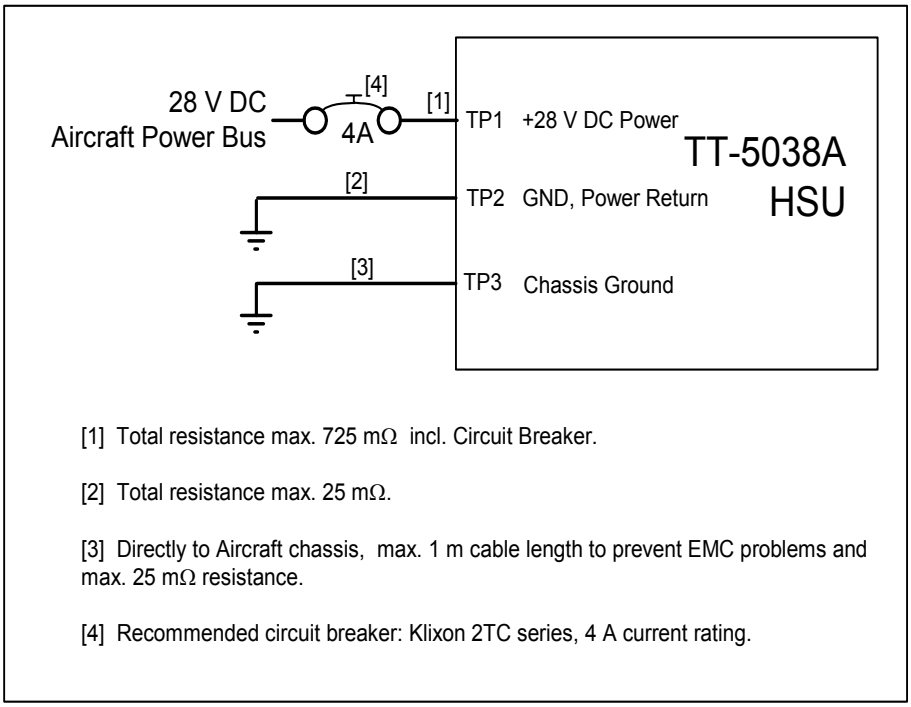


Figure 5-29: Wiring HSU Power

+28 V DC Power

It is essential to keep the line impedance below the specified limits. See **Cable Requirements, HSU Power Supply** on page 5-64.
Reverse polarity protection is only guaranteed if the suggested circuit breaker is used.

Required current capability for the Circuit Breaker: 23 W @ 17.7 V DC which equals 1.3 A DC at the required environmental conditions.

A suitable circuit breaker with sufficient low resistance would be Klixon 2TC series with 4 A current rating.

Chassis Ground

The Chassis connection ensures that the HSU cabinet and the installation tray has the same potential, and that there is a connection from the cable shields to the cabinet for EMC purposes.

Connect the wire directly to the installation tray and to aircraft chassis.

Cable Requirements, HSU Power Supply

Cable[a]	Max. Resistance	Other Requirements
[1] (+28 V DC Power)	725 mΩ, incl. circuit breaker	
[2] (GND, Power Return)	25 mΩ	The cable should be as short as possible.
[3] (Chassis Ground)	25 mΩ	Connect directly to aircraft chassis.

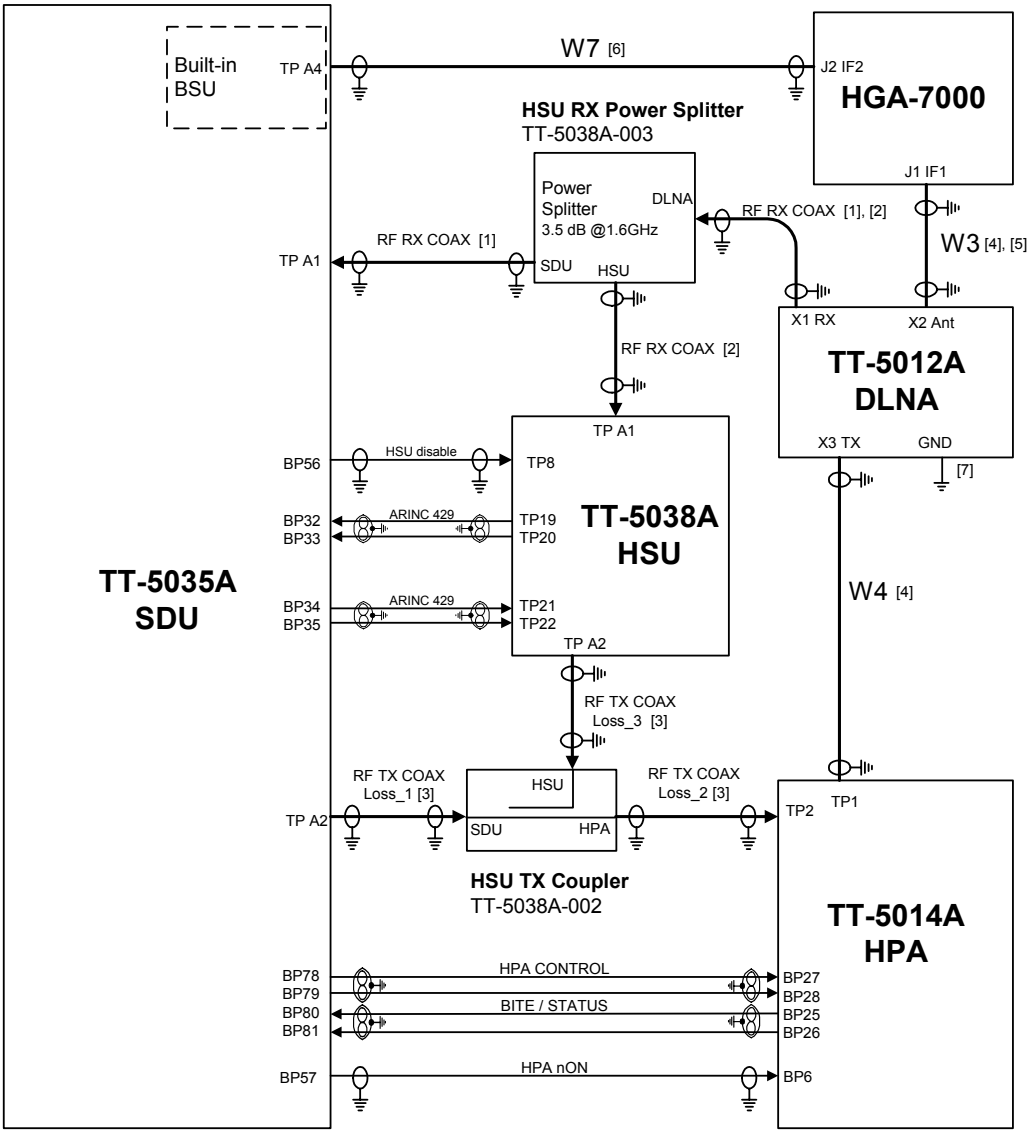
Table 5-34: Requirements to HSU Power Cables

a. The cable numbers refer to the numbers stated on the wiring drawing in the section **Figure 5-29: Wiring HSU Power**.

Note: For maximum allowed cable lengths, see **Power Cables, Allowed Cable Lengths** on page 5-81.

5.4.3 Wiring Antenna Systems With HSU Installed

HGA-7000 Antenna with HSU



[1] The total cable loss - including the power splitter loss (3.5 dB) - between the DLNA and the SDU must be: 0 to 15 dB @ 1.6 GHz

[2] The total cable loss - including the power splitter loss (3.5 dB) - between the DLNA and the HSU must be: 0 to 12 dB @ 1.6 GHz

[3] The cable losses from HSU/SDU to HPA are:
Loss_1: The cable loss from SDU to Tx Coupler
Loss_2: The cable loss from Tx Coupler to HPA
Loss_3: The cable loss from HSU to Tx Coupler
The cable loss limits are:
Loss_3 <= 2.5 dB + Loss_1 @ 1.6 GHz
Loss_1 + Loss_2 <= 11.0 dB @ 1.6 GHz

[4] Coax, total loss from cable W3 and cable W4 max. 1.8 dB @ 1.6 GHz

[5] Coax, loss from cable W3 max. 0.3 dB @ 1.6 GHz

[6] Coax, loss from cable W7 max. 17 dB @ 1.6 GHz

[7] 16 AWG, max. 1 ft long, max. resistance 3 mΩ

Figure 5-30: Wiring HSU to HGA-7000 Antenna System

Important! The Power Splitter must be connected correctly, because the HSU port has a built-in DC block.

Requirements to the cables are stated in the drawing and in the section **RF Cable requirements, HGA-7000 Antenna With HSU** on page 5-68.

The following lists show the HSU, SDU and HPA pins in the Aero-HSD$^+$ system used for connecting a HGA-7000 antenna system.

HSU pin	Description
TP A1	RF Rx input from HSU Rx Power Splitter
TP A2	RF Tx output to HSU Tx Coupler
TP8	HSU Disable input
TP19	Data bus output to SDU (ARINC 429-A)
TP20	Data bus output to SDU (ARINC 429-B)
TP21	Data bus input from SDU (ARINC 429-A)
TP22	Data bus input from SDU (ARINC 429-B)

Table 5-35: HSU Pins for HGA-7000 Antenna System

SDU pin	Description
TP A1	RF Rx input from HSU Rx Power Splitter
TP A2	RF Tx output to HSU Tx Coupler
TP A4	Antenna Modem Interface
BP32	Data bus input from HSU (ARINC 429-A)
BP33	Data bus input from HSU (ARINC 429-B)
BP34	Data bus output to HSU (ARINC 429-A)
BP35	Data bus output to HSU (ARINC 429-B)
BP56	HSU Disable output
BP57	HPA remote nOn/Off output
BP78	HPA Control Output A, RS-422
BP79	HPA Control Output B, RS-422
BP80	HPA Data/BITE Input A, RS-422
BP81	HPA Data/BITE Input B, RS-422

Table 5-36: SDU Pins for HGA-7000 Antenna System

HPA pin	Description
TP1	RF Tx output to DLNA
TP2	RF Tx input from HSU Tx Coupler
BP6	Remote nOn/Off input from SDU
BP25	Tx Data/BITE Output A, RS-422, to SDU
BP26	Tx Data/BITE Output B, RS-422, to SDU
BP27	Rx Control Input A, RS-422, from SDU
BP28	Rx Control Input B, RS-422, from SDU

Table 5-37: HPA Pins for HGA-7000 Antenna System

ARINC 429 Interface (TP19-TP22)

The ARINC 429 interface is used by the SDU to control the HSU. The HSU operates as a slave to the SDU. The Interface is a 100 kbit/s High Speed ARINC 429 duplex data bus to/from the SDU. For electrical specifications refer to the ARINC 429 standard [6].

HSU Disable (TP8)

The SDU uses the HSU Disable input to reset and inhibit the transmitter output signal from the HSU. The electrical specification is defined as for the discrete Weight-On-Wheels input type.

RF Cable requirements, HGA-7000 Antenna With HSU

Cable[a]	Type	Min. Cable Loss @1.6 GHz	Max. Cable Loss @1.6 GHz	Other Requirements
W3 (TT-5012A DLNA to Antenna)	Coax	0 dB	0.3 dB	
W4 (HPA to TT-5012A DLNA)	Coax	0 dB	1.8 dB - W3	
W3 and W4	Coax	0 dB	Total: 1.8 dB	
TT-5012A DLNA to SDU (including Power Splitter loss 3.5 dB)	Coax	0 dB	15 dB	
TT-5012A DLNA to HSU (including Power Splitter loss 3.5 dB)	Coax	0 dB	12 dB	
RF Tx output from SDU/HSU to HPA	Coax	0 dB	NOTE[b]	
W7 (Antenna modem interface)	Coax	0 dB	17 dB	
GND on TT-5012A DLNA				Resistance: Max. 3 mΩ

Table 5-38: Requirements to RF Cables, HGA-7000 Antenna

a. The "W" cable numbers refer to the numbers stated on the wiring drawing in **Figure 5-30: Wiring HSU to HGA-7000 Antenna System**.

b. With an HSU installed, the cable losses from HSU/SDU to HPA are as follows:
Loss_1: The cable loss from SDU to Directional Coupler
Loss_2: The cable loss from Directional Coupler to HPA
Loss_3: The cable loss from HSU to Directional Coupler
The cable loss limits are:
Loss_3 <= 2.5 dB + Loss_1 @ 1.6 GHz
Loss_1 + Loss_2 <= 11.0 dB @ 1.6 GHz

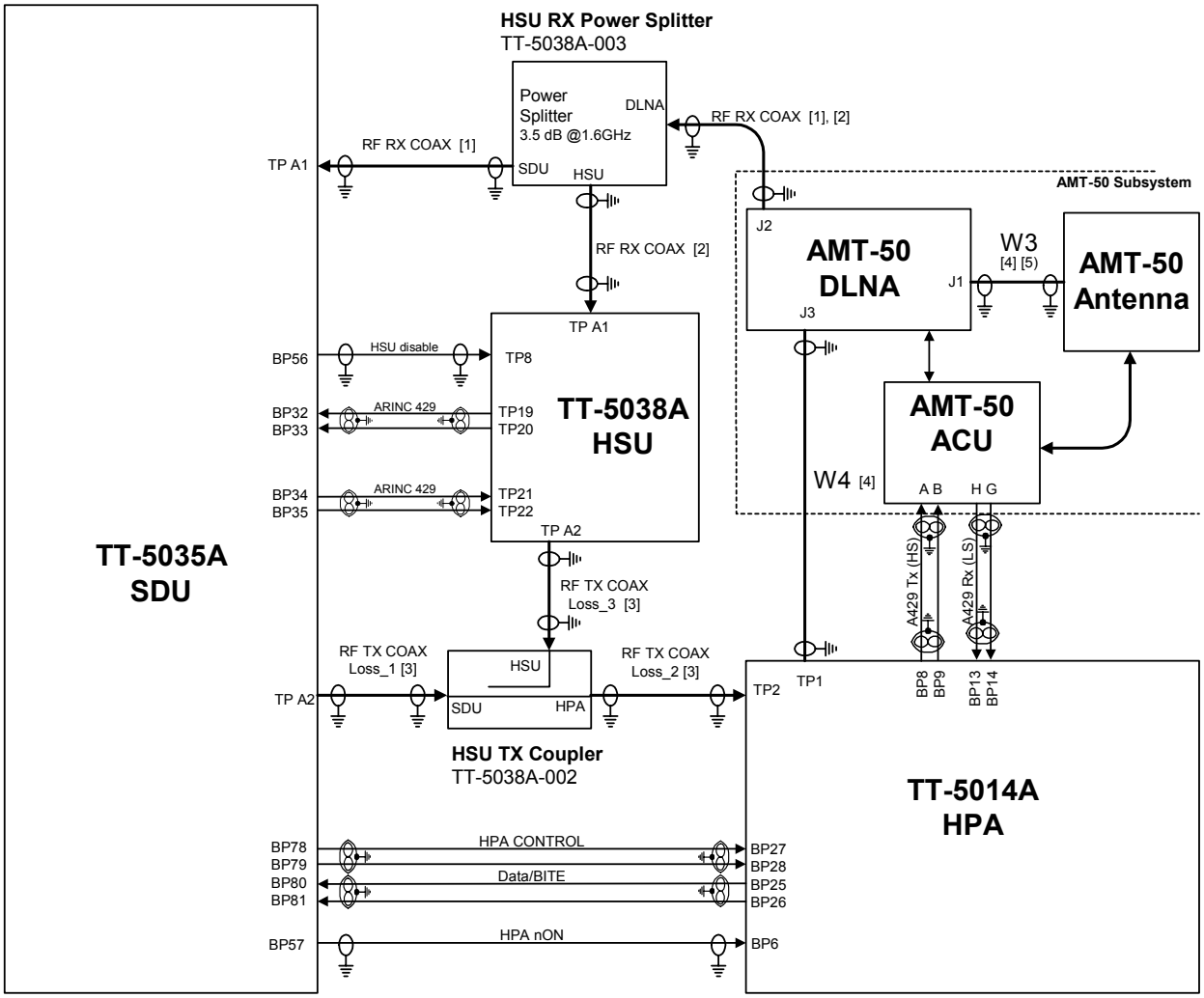
Note: For recommended RF cable types, see **Recommended RF Cables** on page 5-84.

ARINC 429 Cable requirements, HGA-7000 Antenna With HSU

The cables for the ARINC 429 interfaces must be twisted and shielded and conform to the standards for aeronautical use.

For recommended cable types, see **Recommended Cables for ARINC 429** on page 5-84.

AMT-50 Subsystem With HSU



[1] The total cable loss - including the power splitter loss (3.5 dB) - between the DLNA and the SDU must be: 6 to 29 dB @ 1.6 GHz

[2] The total cable loss - including the power splitter loss (3.5 dB) - between the DLNA and the HSU must be: 6 to 25 dB @ 1.6 GHz

[3] The cable losses from HSU/SDU to HPA are:
Loss_1: The cable loss from SDU to Tx Coupler
Loss_2: The cable loss from Tx Coupler to HPA
Loss_3: The cable loss from HSU to Tx Coupler
The cable loss limits are:
Loss_3 <= 2.5 dB + Loss_1 @ 1.6 GHz
Loss_1 + Loss_2 <= 11.0 dB @ 1.6 GHz

[4] Coax, total loss from cable W3 and cable W4 max. 1.8 dB @ 1.6 GHz

[5] Coax, loss from cable W3 max. 0.3 dB @ 1.6 GHz

Figure 5-31: Wiring HSU to AMT-50 Subsystem

The following lists show the HSU, SDU and HPA pins in the Aero-HSD^{+} system used for connecting an AMT-50 antenna subsystem.

HSU pin	Description
TP A1	RF Rx input from HSU Rx Power Splitter
TP A2	RF Tx output to HSU Tx Coupler
TP8	HSU Disable input
TP19	Data bus output to SDU (ARINC 429-A)
TP20	Data bus output to SDU (ARINC 429-B)
TP21	Data bus input from SDU (ARINC 429-A)
TP22	Data bus input from SDU (ARINC 429-B)

Table 5-39: HSU Pins for HGA-7000 Antenna System

SDU pin	Description
TP A1	RF Rx input from HSU Rx Power Splitter
TP A2	RF Tx output to HSU Tx Coupler
BP32	Data bus input from HSU (ARINC 429-A)
BP33	Data bus input from HSU (ARINC 429-B)
BP34	Data bus output to HSU (ARINC 429-A)
BP35	Data bus output to HSU (ARINC 429-B)
BP56	HSU Disable output
BP57	HPA remote nOn/Off output
BP78	HPA Control Output A, RS-422
BP79	HPA Control Output B, RS-422
BP80	HPA Data/BITE Input A, RS-422
BP81	HPA Data/BITE Input B, RS-422

Table 5-40: SDU Pins for HGA-7000 Antenna System

HPA pin	Description
TP1	RF Tx output to DLNA
TP2	RF Tx input from HSU Tx Coupler
BP6	Remote nOn/Off input from SDU
BP8	A429 Tx A output to AMT-50 ACU
BP9	A429 Tx B output to AMT-50 ACU
BP13	A429 Rx1 A input from AMT-50 ACU
BP14	A429 Rx1 B input from AMT-50 ACU
BP25	Tx Data/BITE Output A, RS-422, to SDU
BP26	Tx Data/BITE Output B, RS-422, to SDU
BP27	Rx Control Input A, RS-422, from SDU
BP28	Rx Control Input B, RS-422, from SDU

Table 5-41: HPA Pins for HGA-7000 Antenna System

HSU ARINC 429 Interface (TP19-TP22)

The ARINC 429 interface on HSU pins TP19-TP22 is used by the SDU to control the HSU. The HSU operates as a slave to the SDU. The Interface is a 100 kbit/s High Speed ARINC 429 duplex data bus to/from the SDU. For electrical specifications refer to the ARINC 429 standard [6].

HPA ARINC 429 Interface (BP8, BP9, BP13, BP14 on HPA)

An ARINC 429 high speed Tx interface and an ARINC 429 low speed Rx interface is used for communication between the HPA and the AMT-50 ACU.

HSU Disable (TP8)

The SDU uses the HSU Disable input to reset and inhibit the transmitter output signal from the HSU. The electrical specification is defined as for the discrete Weight-On-Wheels input type.

RF Cable requirements, AMT-50 Subsystem With HSU

Cable[a]	Type	Min. Cable Loss @1.6 GHz	Max. Cable Loss@1.6 GHz
W3 (ARINC 741 DLNA to Antenna)	Coax	0 dB	0.3 dB
W4 (HPA to ARINC 741 DLNA)	Coax	0 dB	1.8 dB - W3
W3 and W4		0 dB	Total: 1.8 dB
ARINC 741 DLNA to SDU (including Power Splitter loss 3.5 dB)	Coax	6 dB	29 dB
ARINC 741 DLNA to HSU (including Power Splitter loss 3.5 dB)	Coax	6 dB	25 dB
RF Tx output from SDU/HSU to HPA	Coax	0 dB	NOTE[b]

Table 5-42: Requirements to RF Cables, AMT-50 Subsystem

a. The "W" cable numbers refer to the numbers stated on the wiring drawing in **Figure 5-31: Wiring HSU to AMT-50 Subsystem**.

b. With an HSU installed, the cable losses from HSU/SDU to HPA are as follows:
Loss_1: The cable loss from SDU to Directional Coupler
Loss_2: The cable loss from Directional Coupler to HPA
Loss_3: The cable loss from HSU to Directional Coupler
The cable loss limits are:
Loss_3 ≤ 2.5 dB + Loss_1 @ 1.6 GHz
Loss_1 + Loss_2 ≤ 11.0 dB @ 1.6 GHz

ARINC 429 Cable requirements, AMT-50 Subsystem System With HSU

The cables for the ARINC 429 interfaces must be twisted and shielded and conform to the standards for aeronautical use.

For recommended cable types, see **Recommended Cables for ARINC 429** on page 5-84.

5.4.4 Wiring HSU to MPDS RS-232 , MPDS Ethernet and ISDN

The following drawing shows the wiring of the HSU to MPDS RS-232, MPDS 10BaseT Ethernet and ISDN.

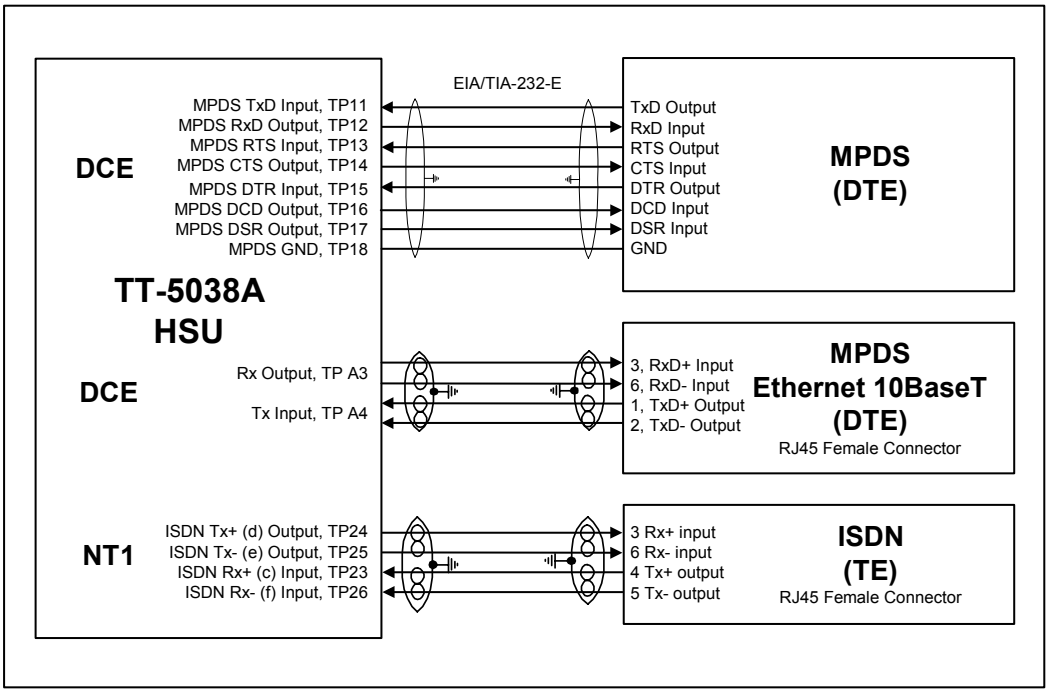


Figure 5-32: Wiring HSU to MPDS RS-232, MPDS Ethernet and ISDN

MPDS RS-232 Pins

HSU pin	Name/Description	Equivalent DB9F Pin no.	Equivalent DB25F Pin no.
TP11	MPDS TxD Input (EIA/TIA-232-E)	3	2
TP12	MPDS RxD Output (EIA/TIA-232-E)	2	3
TP13	MPDS RTS Input (EIA/TIA-232-E)	7	4
TP14	MPDS CTS Output (EIA/TIA-232-E)	8	5
TP15	MPDS DTR Input (EIA/TIA-232-E)	4	20
TP16	MPDS DCD Output (EIA/TIA-232-E)	1	8
TP17	MPDS DSR Output (EIA/TIA-232-E)	6	6
TP18	MPDS GND (EIA/TIA-232-E)	5	7

Table 5-43: HSU Pins for MPDS RS-232

The MPDS interface is an EIA/TIA-232-E 115.2 kbit/s Asynchronous RFC 1549 HDLC interface (www.ietf.org).

Configuration: DCE (i.e. TxD is an input and RxD is an output), with hardware flow control (RTS, CTS, DTR, DCD, DSR as EIA/TIA-232-E signals).

Baud rate (Rx Output): 115.2 kbit/s ± 1 ppm.

Baud rate (Tx Input): 115.2 kbit/s ± 4%

To be compliant with EIA/TIA 232-E a female 25 pin SUB D connector or a female 9 pin SUB D connector must be connected to the MPDS lines from the HSU. The lines must be connected as shown in the table above.

MPDS Ethernet 10BaseT Pins

The following list shows the pins used for the MPDS Ethernet interface

HSU pin	Name	Description	RJ45 PIN (F)	Name
TP A4 (center)	Tx+	Input	1	TxD+
TP A4	Tx-	Input	2	TxD-
TP A3 (center)	Rx+	Output	3	RxD+
TP A3	Rx-	Output	6	RxD-

Table 5-44: HSU Pins for MPDS 10BaseT Ethernet

The pin-outs for TP A3 and TP A4 are specified in **Figure 5-33: Ethernet RxD Twinax Contact Pin-out Definition** and **Figure 5-34: Ethernet TxD Twinax Contact Pin-out Definition**.

TP A3 is a 10BaseT Ethernet Rx twinax output for 100 Ω twisted pair medium. The pin-out is as follows:

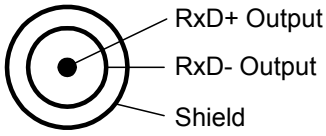


Figure 5-33: Ethernet RxD Twinax Contact Pin-out Definition

TP A4 is a 10BaseT Ethernet Tx twinax input for 100 Ω twisted pair medium. The pin-out is as follows:

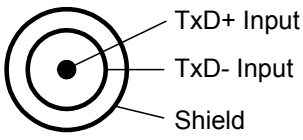


Figure 5-34: Ethernet TxD Twinax Contact Pin-out Definition

The 10 Mbit/s Ethernet interface physical layer conforms to [1] (IEEE standard 802.3, Chapter 14: "Twisted Pair medium attachment unit"), except for the connector type. To be compliant with [1], an RJ45 female connector must be used for the user interface. The connector pin assignment must be according to [1] and [2] (ISO8877 ISO/IEC 8877) as shown in **Figure 5-35: Ethernet RJ45 Connector and Cable Connection to HSU.**

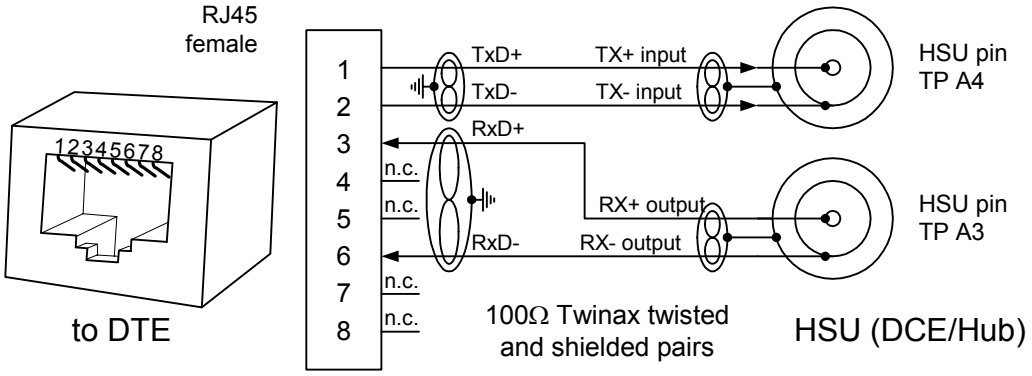


Figure 5-35: Ethernet RJ45 Connector and Cable Connection to HSU.

The HSU is defined as a DCE or a Hub i.e. TxD is input and RxD is output.

Cable Requirements, MPDS Ethernet 10BaseT on HSU

The cable for the MPDS Ethernet 10BaseT interface for the HSU must be a 100 Ω 2-wire twisted and shielded cable.

ISDN Pins

The following list shows the pins used for the ISDN interface.

HSU pin	Name	Description	RJ45 PIN (F)	Name
TP23	ISDN Rx+ (c)	Input	3	Rx+
TP24	ISDN Tx+ (d)	Output	4	Tx+
TP25	ISDN Tx- (e)	Output	5	Tx-
TP26	ISDN Rx- (f)	Input	6	Rx-

Table 5-45: HSU Pins for ISDN

The HSU is configured as the network side of the NT1 interface i.e. Rx is an input and Tx is an output. Please note that this configuration of input and output differs from the configuration of the 10BaseT Ethernet, the MPDS RS-232 interface and RS-232 PC interface input/output.

To be compliant with ISO8877 [2] and the ISDN connector specification defined by ITU I.420 [5], an RJ-45 Female Connector must be connected to the four wire ISDN lines from the HSU. The HSU includes an internal 100 Ω termination resistor to support cable lengths longer than 3 meters.

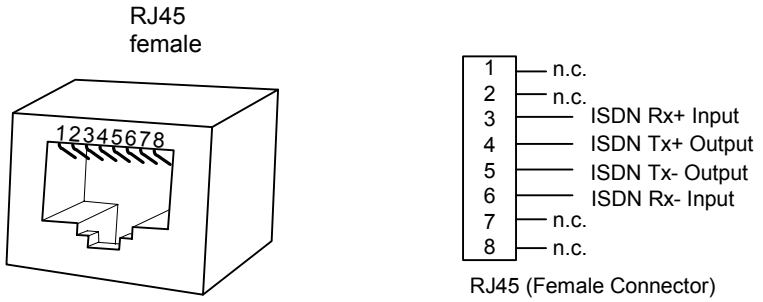


Figure 5-36: ISDN RJ45 Connector

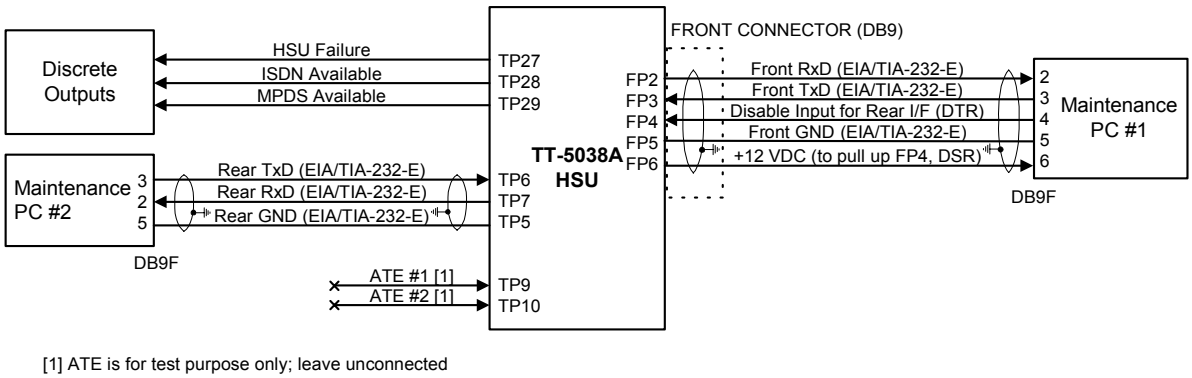
The ISDN interface can power supply 4 ISDN phones but supports 8 phones (where 4 of them must have their own power supply). At power hold-up, only power for one phone is available i.e. if more than one phone is connected, the HSU may reset if an incoming call is received, or more than one handset is off-hook, during a power hold-up session.

Cable Requirements, ISDN

The cable for the ISDN interface must be a 100 Ω 4-wire shielded cable. The conductors must be twisted in pairs.

5.4.5 Wiring HSU to Discretes and Maintenance PC Interface

The following drawing shows the wiring of the front maintenance interface and discretes and RS-232 PC connection.



[1] ATE is for test purpose only; leave unconnected

Figure 5-37: Wiring HSU to Discretes and RS-232 PC Maintenance Interfaces

Maintenance Interface

The HSU has two RS-232 PC interfaces for maintenance, one at the front panel connector and one at the rear panel connector. Both interfaces support the EIA/TIA-232-E standard and may also be used as a printer interface. Both interfaces may be used for software upload.

The interfaces are configured as DCE on the HSU (i.e. TxD is input and RxD is output).

Front Maintenance Connector Interface EIA/TIA-232-E (FP2, FP3, FP5)

For information on pin-out for the Front Maintenance Connector interface, see **Pin-out for HSU Front Connector** on page 4-14.

The Front Maintenance Connector Interface has the following characteristics:

- Baud rate: 115.2 kbit/s fixed
- Data bits: 8
- Parity: None
- Stop bit: 1
- Flow control: None

Disable input for the Rear Maintenance Connector Interface (FP4)

The front panel connector contains an input pin to disable the Rear Maintenance Connector Interface. The Rear Maintenance Connector Interface will be disabled when the Front Maintenance Connector Interface is used, since the two interfaces share the same internal serial I/O port.

The Rear Maintenance Connector Interface is disabled by connecting FP4 to +12V. This can be done by mounting a jumper from FP4 to FP6 in the serial cable connector. If a fully populated RS-232 serial cable is used, no jumper is needed. FP4 corresponds to the RS-232 DTR signal, which is normally +12 V from the PC-terminal.

FP4 is pulled down internally in the HSU to -12V with 15 kΩ.

+12 V DC for Front Maintenance Connector Interface (FP6)

FP6 provides a +12 V DC supply to pull up FP4 with a jumper as described above. The +12 V DC is provided internally in the HSU with a 220 Ω pull up resistor from FP6 to +12 V. FP6 corresponds to the RS-232 DSR signal.

Rear Maintenance Connector Interface EIA/TIA-232-E (TP5-TP7)

The following list shows the pins used for the Rear Maintenance Connector Interface.

HSU pin	Name/Description
TP5	Rear Maintenance Connector Interface GND (EIA/TIA-232-E)
TP6	Rear Maintenance Connector Interface TxD Input (EIA/TIA-232-E)
TP7	Rear Maintenance Connector Interface RxD Output (EIA/TIA-232-E)

Table 5-46: HSU Pins for Rear Maintenance Connector Interface, RS-232

The Rear Maintenance Connector Interface has the same characteristics as the Front Maintenance Connector Interface. Also refer to **Maintenance Interface** on page 5-78.

- Baud rate: 115.2 kbit/s fixed
- Data bits: 8
- Parity: None
- Stop bit: 1
- Flow control: None

Discrete Inputs

The HSU has three discrete inputs, one for HSU Disable and two for ATE. The ATE inputs are for test purpose only and must not be connected.

The HSU Disable input is described in **HSU Disable (TP8)** on page 5-67.

Discrete Outputs

The HSU has 3 discrete lamp driver outputs: HSU Failure, ISDN Available and MPDS Available.
The output configuration forms a switch closure to ground.

The following list shows the pins used for the discrete lamp driver outputs.

Pin no (X2)	Function	Reference / Spec
TP27	HSU Failure Discrete Output	Lamp type, active low
TP28	ISDN Available Discrete Output	Lamp type, active low
TP29	MPDS Available Discrete Output	Lamp type, active low

Table 5-47: HSU Pins for Discrete Outputs

The **HSU Failure** Discrete Output (TP27) is active whenever a BITE error with the severity essential or fatal is active on the HSU.

The **ISDN Available** discrete output (TP28) is active when:

- The ISDN channel is actually in use, **or**
- The following conditions are **all** fulfilled:
  - the HSU is ocean region registered
  - no BITE error prohibits the ISDN service
  - the current ISDN LES supports Swift64 ISDN
  - the channel is not in use by MPDS
  - power is available

The **MPDS Available** discrete output (TP29) is active when:

- The MPDS channel is actually in use, **or**
- The following conditions are **all** fulfilled:
  - the HSU is ocean region registered
  - no BITE error prohibits the MPDS service
  - the current MPDS LES supports Swift64 ISDN
  - the channel is not in use by ISDN
  - power is available

5.5 Recommended Cables

5.5.1 Introduction

This section lists recommended cables and allowed cable lengths for the cables in the Aero-HSD^{+} system.

Important! For specific requirements to the cables, see the applicable section in **5.3 Electrical Installation and Wiring** or **5.4 Electrical Installation and Wiring, HSU**.

5.5.2 Power Cables, Allowed Cable Lengths

Allowed Cable Lengths, SDU

The following table shows the allowed SDU cable lengths for selected AWG types. If other AWG types are used, make sure the contact type supports the AWG type.

Note: It is generally recommended to keep cable lengths as short as possible, specially on cables for **Chassis GND**.

Description	Pin	Contact Type	Max. resistance	Max Length (at 70°C)			
				AWG20	AWG18	AWG16	AWG14
SDU +28 V DC Power	TP1	16	87.5 mΩ [a] (200 mΩ-112.5 mΩ in circuit breaker)	7 ft[a] (2.1 m)	11 ft[a] (3.4 m)	18 ft[a] (5.4 m)	(not suitable for this contact size)
SDU GND, Power Return	TP2	16	25 mΩ	2 ft (0.6 m)	3 ft (0.9 m)	5 ft (1.5 m)	(not suitable for this contact size)
SDU Chassis Ground	TP3	16	25 mΩ (additional requirement: max. length 1 m)	2 ft (0.6 m)	3 ft (0.9 m)	3 ft (1.0 m)	(not suitable for this contact size)

Table 5-48: Allowed Lengths for SDU Power Cables

a. The max. cable resistance is calculated using the resistance of a Klixon 2TC circuit breaker. If another circuit breaker is used, the max. resistance and cable length may differ from these values.

Allowed Cable Lengths, HPA

The following table shows the allowed HPA cable lengths for selected AWG types. If other AWG types are used, make sure the contact type supports the AWG type.

Note: It is generally recommended to keep cable lengths as short as possible, specially on cables for **Chassis**.

Description	Pin	Contact Type	Max. resistance	Max Length (at 70°C)		
				AWG12	AWG10	AWG8
HPA +28 V DC Power	BP A1	5	87.5 mΩ [a] (100 mΩ-12.5 mΩ in circuit breaker)	(not suitable for this contact type)	71 ft[a] (21.6 m)	126 ft[a] (38.4 m)
HPA GND, Power Return	BP A2	5	25 mΩ	(not suitable for this contact type)	20 ft (6.1 m)	36 ft (11.0 m)

Table 5-49: Allowed Lengths for HPA Power Cables

a. The max. cable resistance is calculated using the resistance of a Klixon 2TC circuit breaker. If another circuit breaker is used, the max. resistance and cable length may differ from these values.

Description	Pin	Contact Type	Max. resistance	Max Length (at 70°C)	
				AWG20	AWG18
HPA Chassis	BP30	20HD	25 mΩ	2 ft (0.6 m)	(not suitable for this contact size)

Table 5-50: Allowed Lengths for HPA Chassis Cable

Allowed Cable Lengths, HSU

The following table shows the allowed HSU cable lengths for selected AWG types. If other AWG types are used, make sure the contact type supports the AWG type.

Note: It is generally recommended to keep cable lengths as short as possible, specially on cables for **Chassis GND**.

Description	Pin	Contact Type	Max. resistance	Max Length (at 70°C)			
				AWG20	AWG18	AWG16	AWG14
HSU +28 V DC Power	TP1	16	612.5 mΩ [a] (725 mΩ-112.5 mΩ in circuit breaker)	49 ft[a] (15.0 m)	79 ft[a] (24.0 m)	125 ft[a] (38.1 m)	(not suitable for this contact size)
HSU GND, Power Return	TP2	16	25 mΩ	2 ft (0.6 m)	3 ft (0.9 m)	5 ft (1.5 m)	(not suitable for this contact size)
HSU Chassis Ground	TP3	16	25 mΩ (additional requirement: max. length 1 m)	2 ft (0.6 m)	3 ft (0.9 m)	3 ft (1.0 m)	(not suitable for this contact size)

Table 5-51: Allowed Lengths for HSU Power Cables

a. The max. cable resistance is calculated using the resistance of a Klixon 2TC circuit breaker. If another circuit breaker is used, the max. resistance and cable length may differ from these values.

5.5.3 Recommended RF Cables

The following cable types are recommended for the RF cables.

Note: Equivalent cable types, which meet the requirements, may also be used.

CABLE TYPE	SPECIFICATIONS		
Part Number	**Diameter (mm/ in.)**	**Minimum Bend Radius (mm/ in.)**	**Attenuation (dB/100ft) @ 1.6 GHz**
RG 142/400	NOTE 1	NOTE 1	Approx. 18.0
PIC S22089	11.0 / 0.43	63.5 / 2.5	4.8
PIC S33141	6.9 / 0.27	35.6 / 1.4	8.6
ECS 310801	11.48 / 0.452	57.4 / 2.26	4.6
ECS 311201	8.05 / 0.317	40.6 / 1.6	6.7
ECS 311501	5.82 / 0.229	30.5 / 1.2	9.1
EMTEQ TFLX165 100	4.19 / 0.17	21.6 / 0.85	16.8
EMTEQ TFLX295 100	7.95 / 0.31	40.6 / 1.6	7.9
EMTEQ TFLX480 100	12.2 / 0.48	57.2 / 2.25	4.5

Table 5-52: List of Recommended RF Cables

NOTE 1:

In some applications, RG 142 or RG 400 may be used where strict attenuation requirements are not an issue. Cable specifications may vary depending on manufacturer.

5.5.4 Recommended Cables for ARINC 429

The cables for the ARINC 429 interfaces must be twisted and shielded and conform to the standards for aeronautical use.

The following cable types meet the requirements:

- Part number **422202**, 22 Awg, from ECS
- Part number **422402**, 24 Awg, from ECS
- Part number **522402**, 24 Awg Hi-Tensile (Gulfstream), from ECS
- Part number **F 2703-48-U AG** from Draka Fileca
- Part number **D620224** from PIC Wire and Cable
- Part number **D771553** from PIC Wire and Cable

5.5.5 Recommended Cables for MPDS Ethernet

Cables for MPDS Ethernet on SDU (Quadrax Connector)

The cable for the MPDS Ethernet 10BaseT interface on the SDU must be a 100 Ω 4-wire twisted and shielded cable.

The following cable type meets the requirements:

- Part number **422404**, Quadrax 24 Awg, from ECS
- Part number **922404**, 10BaseT 24 Awg, from ECS
- Part number **F 4704-4** from Draka Fileca

Cables for MPDS Ethernet on HSU (Twinax Connector)

The cable for the MPDS Ethernet 10BaseT interface on the HSU must be a 100 Ω 2-wire twisted and shielded cable.

The following cable types meet the requirements:

- Part number **F 2703-37** from Draka Fileca
- Part number **41483-002-03** from Habia Cable

5.6 Commissioning

5.6.1 Inmarsat Aeronautical Service & Solution Providers

After obtaining an Aero-HSD^{+} system, the owner must settle a contract with an Inmarsat Aeronautical Service & Solution Provider who will handle terminal activation, billing and technical support on the network side.

Inmarsat has divided Aeronautical Service & Solution Providers into 2 categories:

- Service Providers
- Solution Providers

Service Providers

Service Providers operate or have direct access to Inmarsat aeronautical Ground Earth Stations. They supply the network capacity to the Solution Providers. The services are particularly well-suited for airlines and large fleets of aircrafts.

An updated list of Service Providers is available here:
http://aero.inmarsat.com/how_to_buy/service_providers.aspx

Solution Providers

Solution Provider supply airtime packages, integration and installation expertise. The services are particularly suited to corporate, VIP and government operators.

An updated list of Solution Providers is available here:

http://aero.inmarsat.com/how_to_buy/solution_providers.aspx

5.6.2 Activation

Administrative process

The activation is mainly an administrative process. The customer has to fill-in and sign 2 documents:

- The Aeronautical SARF: The Service Activation Registration Form (SARF) is the document required by Inmarsat for Service Activation. It includes information such as the identity of the applicant, the type of equipment applied for and the services required.
- The Provider subscription form: Some Service & Solution Providers require a specific subscription form from the terminal owner.

Contact the providers for more details on this administrative process. They provide the form for download on their website. Some also provide assistance in filling in the documents.

When all the documents are signed, they must be sent by fax or mail to the chosen provider. The activation can take from one day to one week, depending on the provider and the country of registration.

Phone numbers and identifiers

When a terminal is activated, the terminal can be used on the network. The terminal owner receives the phone numbers and identifiers:

- IMN (Inmarsat Mobile Numbers) on Swift64.
- DDI (Direct Dial-In) on Aero-H$^+$.
- Direct phone number: to call the Aero-HSD$^+$ terminal from the ground without specifying the satellite region the terminal is located in (supported by a few providers).

For information on how to make a call to the terminal, see Aero-HSD$^+$ User Manual, part number TT98-119959.

5.7 Verifying the Installation

Certain check procedures must be performed during and after installation of the Aero-HSD^{+} system. The first check procedures are performed after wiring, but before inserting LRUs.

For information on the required and recommended check procedures, see **Check procedures** on page 7-1.

Configuring the System

6.1 HSD+ Configuration Program

6.1.1 Overview

Configuration parameters from the SDU and HSU are stored in the Configuration Module (CM), which is controlled using the HSD+ Configuration Program (HSD+CP).

To access the CM and configure and store necessary operating parameters, a configuration terminal consisting of a PC with the HSD+CP is used. The configuration terminal makes it possible to:

- set up the system with all configurable parameters
- read, write and edit a complete set of operating parameters for the system
- save/load a configuration to/from a file
- import/export selected settings from/to a file
- print settings to a printer
- get help on specific topics through the Help menu, by pressing F1, or by using the “What’s This?” button

6.1.2 Installation

Installation Requirements

- HSD^{+}CP Installation CD (Part number TT 83-119958-xxx, where xxx is the software version).
- A PC running Windows® 95, Windows 98, Windows ME, Windows 2000, Windows XP, or Windows NT systems.
  Note: To use online help or to print settings, Internet Explorer 4.0 or greater is required.
- 1024×768 or higher display resolution. The program is best viewed using small fonts.
- Data Cable (Part number TT 37-112940 or equivalent).
- An available serial COM port (DB9) for the Data Cable.

Installation procedure

Locate and start the “setup.exe” file from the root directory on the HSD^{+}CP Installation CD and follow the instructions on screen.

6.1.3 Description of HSD+CP

Navigation

The following picture shows the HSD+CP user interface.

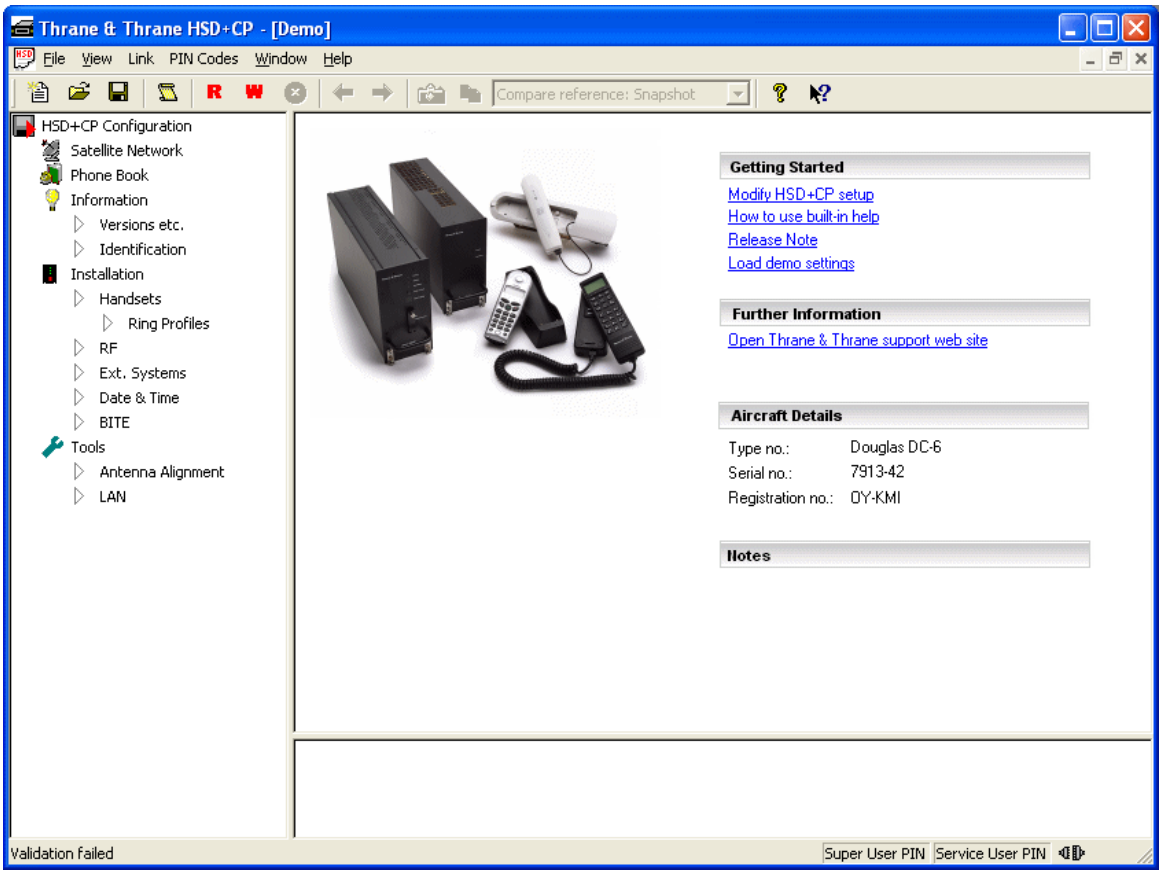


Figure 6-1: HSD+CP User Interface

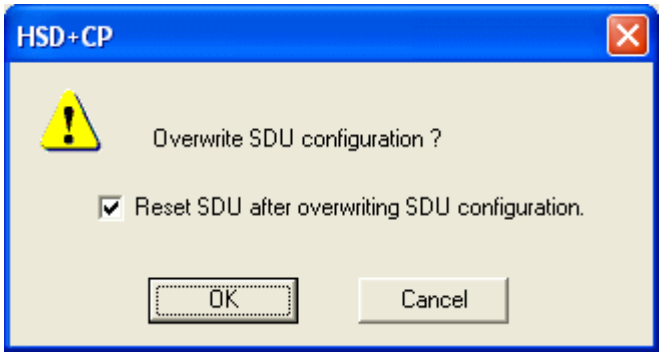
The HSD+CP has a selection tree at the left side of the program window. Click with the mouse or use the keyboard arrows up and down to select the scope of interest. Then adjust the settings in the main window to the right.

Applying Settings

There is no Apply function during a configuration session. When the view is changed to another session, the settings entered in the first session are maintained.

- To apply all settings from the active session to the Aero-HSD$^+$ system, click the **W** button on the toolbar or select **Write configuration to SDU** from the **Link** menu.

  Note: Settings are only applied to the system after a reset. By default, the option to automatically reset the SDU is enabled when a Write operation is performed from the HSD$^+$CP.



- Likewise, to read the settings from the SDU into the active session in the HSD$^+$CP, click the **R** button or select **Read configuration from SDU** from the **Link** menu.

The configuration file can be created off-line (i.e. without an SDU connected to the PC). The settings can then be transferred to the SDU at a later stage. Before transferring the settings, connect the TT 37-112940 data cable between the serial port of the PC and the front connector of the SDU. See **Figure 5-27: TT 37-112940 Data Cable Compliant with Front Connector**.

A short description of each menu is provided in the following section.

Basic setup is described in the section **Basic Configuration** on page 6-6. For further information on the HSD$^+$ Configuration Program, please refer to the built-in help system of the program.

Comparing Configurations

When comparing configurations, it can be useful to have two or more sessions open at the same time.

The HSD$^+$CP is a Multiple Document Interface (MDI) program. This means that multiple (in this case four) configuration sessions can be open at the same time, presented as tab pages. Switch between these sessions simply by selecting the tabs or using the Windows menu on the Menu bar.

6.1.4 Menu Overview

The HSD$^+$CP comprises the following sub-items:

- **HSD$^+$CP Configuration** - start-up window
- **Satellite Network** - setup of the conditions for logon to the satellite network, including automatic/manual logon, setup of GESs for the H$^+$ service and LESs for the HSD service and initial satellite data.
- **Phone Book** - a list of up to 100 phone numbers. From this window you can add, edit and delete information in the phone book and assign quick-dial numbers.
- **Information**

- **Versions etc.** - shows
  - the versions of the software installed in the SDU, the Handsets #1 through 4 and the Antenna.
  - the PCB numbers of the individual boards in the system.
  - the serial numbers of the LRUs in the system.
  - the LRU Revision numbers of the SDU, the HPA and the antenna system.
  - the build dates and the CRCs of the current builds.
- **Identification** - setup of ICAO address and ISN numbers.

- **Installation**

- **Handsets** - setting of handset type, volume, ring tones etc. of the handsets in the system.
  - **Ring Profiles** - setup of ring profiles that each determine the behavior of all handsets and annunciators.
- **RF** - setup of antenna and DLNA types, EIRP settings and RF cable losses.
- **Ext. Systems** - setup of external systems such as IRS/AHRS, CMU/ACARS, MCDU/FMS etc.
- **Date & Time** - setup of date and time in the SDU and synchronization.
- **BITE** - List of BITE codes with the option to disable display of selected codes.

- **Tools**

- **Antenna Alignment** - Point to a position on the map and view Azimuth and Elevation.
- **LAN** - IP parameters for LAN connection. Under normal conditions, these parameters should not be changed.

6.1.5 Basic Configuration

For detailed information on how to use the HSD^{+}CP, please refer to the built-in help system of the program (press F1 or use the Help menu).

Minimum Setup

As a minimum, you need to set up

- **ICAO address.**
  In the navigation window of the HSD^{+}CP, select **Identification** under **Information.**
  Then click the **Copy** button to copy the strapped ICAO address to the Config Module, or type in the ICAO address in the **Config Module** field.
- **Antenna type and heading.**
  Select **RF** under **Installation** and select the antenna type. Then enter the Heading, Roll and Pitch offset.
- **DLNA type and Diplexer loss.**
  In the **RF** window select the DLNA type and the Diplexer loss of the DLNA.
- **Cable loss.**
  In the **RF** window, enter the cable losses in the **Cable Loss** fields.
- **Navigation parameters, IRS/AHRS.**
  Select **Ext. Systems** under **Installation**.
  Then select IRS or AHRS, select which interfaces are connected and whether they run at low or high speed.
- **Preferred LES and Logon Policy**
  Select **ISDN** or **MPDS** service and set up the list of preferred LESs.
  Set **H^{+} Logon Policy** to **Automatic** or **Manual**.
- **Handset parameters, Broadcast Ring Tone.**
  Select **Handsets** under **installation**. Then select a ring tone from the **Broadcast Ring Tone** scroll list.

It is also recommended to set up

- **Preferred GES.**
  Select **Satellite Network** and set up the list of preferred GESs.

External Equipment

Depending on the connected equipment, it may be necessary to enter information on some of the following items:

- **Handsets**.
  Select **Handsets** under **Installation**.
  Then enter which handset is installed on which interface and set the parameters for each handset.
- **Fax**.
  In the **Handsets** window, select **Connected** for the 2-wire interface that is connected to a fax. This means the interface will not ring on a broadcast call.
- **Ring Profiles**.
  Select **Ring Profiles** under **Handsets**. Set up one or more profiles that determine which interfaces should ring when a broadcast call is received, and which should not.
  There are five possible profiles. One of them, “TakeOfLandng”, is preset and cannot be changed. If the “Chime/Lamps Inhibit” input is activated, the “TakeOfLandng” profile is automatically used. This input should be activated during take-off and landing.
- **CMU/ACARS/MCDU/FMS/WOW**.
  Select **Ext. Systems** under **Installation**.
  Then enter which systems are connected and enter the requested parameters for each system.

6.2 Configuration of 3rd Party Phone Systems

6.2.1 MagnaStar

Some initial setup of the MagnaStar system is necessary for the system to work properly.

Note: The information in this section is only meant as a guideline. For complete information on the function and menus of the MagnaStar system, refer to the MagnaStar manual.

To Set up the AIUs

Use the handset menus to set up the AIUs as follows:

1. Enter the Maintenance menu and navigate to the AIU SATCOM settings.
2. Set Impedance to **High**.
3. Set the mode to **Handset**.

To Assign the AIUs to the Handsets

When the AIUs are configured, air-to-ground calls can be made, but in order to be able to make ground-to-air calls, an AIU must be assigned for each handset.

For each handset, enter the handset menu system and do as follows:

1. From the Maintenance menu, navigate to the **Satcom Term ID** setting.
2. Select **Station** and set the Terminal ID to **001** or **002**.

To Set the Gain and Side Tone (Older Versions)

For some older versions of the MagnaStar system, each handset must be set up as follows, in order to ensure correct operation:

1. From the Maintenance menu in the handset, navigate to the following parameters and set them as specified:
   - Typical Tx Gain: 070
   - Side tone: 005

6.2.2 Sigma[7]

There are a few adjustments that are typically made at the time of installation testing. Normally it is necessary to set the ear volume of the handset initially, in order to obtain sufficient volume in the ear piece.

Note: The information in this section is only meant as a guideline. For complete information on the function of the Sigma[7] handset, refer to the Sigma[7] manual.

To Set up the Ear Volume

To set up the ear volume of the handset, do as follows:

1. Take the handset out of the cradle and enter the menu system.
2. Use the volume control keys to scroll to the EARVOL setting.
3. Press the **Flash** key to select EARVOL.
4. Change the volume setting to **4** using the volume control keys.
5. Press # to store the setting.
   To adjust other settings, press **Flash** to return to the menu.
6. Place the handset back into the cradle.

For further information on the Sigma[7] handset, refer to the manual for the Sigma[7] handset.

6.2.3 2.4GHz Cordless

It is sometimes necessary to adjust the volume of the 2.4GHz Cordless handset, in order to obtain sufficient volume in the ear piece. Also, the setting of the handset might have to be changed from pulse to tone, if this is not already set.

Note: The information in this section is only meant as a guideline. For complete information on the function of the 2.4GHz Cordless phone, refer to the manual for your 2.4GHz Cordless phone.

Setting the Volume

To change the volume setting, enter the handset menus and do as follows:

1. Scroll to **Audio Sett** and press **OK.**
2. Select **H/Set Vol** and press **OK**.
   The current volume is heard in the ear piece and the level is displayed.
3. Scroll to the desired volume and press **OK**.

To Switch to Tone Dialling

To change the dialling mode, do as follows:

1. Open the handset menu.
2. Scroll to **Temp Tone** and press **OK.**
   Tone dialling is now active.

Check procedures

7.1 Basic Check Flow

Important Note!

None of the check procedures described in this chapter can serve as a replacement for any of the required approvals and certifications.

Check Procedures

In order to ensure the correct function of the system, the below check flow should be followed.

1. **Pre-Installation Check.**
   Perform this check after wiring, but before inserting the LRUs.
   This is a check of the most important connections, the circuit breakers, cable losses etc. Refer to **Pre-Installation Check** on page 7-2.
2. **Configuration.**
   After performing the Pre-Installation Check, configure the system using the HSD$^+$ Configuration Program.
   Refer to **HSD+ Configuration Program** on page 6-1, or consult the built-in online help of the HSD$^+$CP.
3. **Functional Test, on Ground.**
   When the system is configured and commissioned, a functional test should be performed. The functional test should check all user interfaces, such as voice, fax, high speed data, annunciators, satcom on/off switch etc.
   Refer to **Functional Test, on Ground** on page 7-4.
4. **Interference Test.**
   After the functional test, an interference test should be performed. This test is to verify that transmission from the Aero-HSD$^+$ system has no effect on the avionics of the aircraft, particularly navigation equipment.
   Refer to **Interference Test** on page 7-5.

   Note: If additional avionics are installed in the aircraft at a later stage, the interference test should be performed again to ensure correct operation.
5. **Functional Test, Airborne.**
   After the interference test, a functional test should be performed while the aircraft is airborne. This test is basically the same as the functional test on ground. Refer to **Functional Test, Airborne** on page 7-6.

7.2 Pre-Installation Check

It is recommended to check the installation before inserting LRUs. The following list provides some of the most important issues, but other additional checks may be relevant for the specific installation.

Item	Description of Check	Reference Section	√	Value/ Comment
Mounting trays	Ensure service/maintenance accessibility.	5.2		
	Check that environmental considerations are met (Cooling, air-flow and pressure)	B.2		
Coding of tray connectors	Check orientation of coding pins in SDU tray connector	4.1.3		
	Check orientation of coding pins in HPA tray connector	4.2		
	Check orientation of coding pins in HSU tray connector	4.3.3		
Quadrax insert orientation	Check that the Quadrax connector is oriented correctly in the SDU tray connector.	4.1.3		
Grounding stud	Check that the grounding stud on the DLNA is connected correctly to aircraft chassis.			
Circuit breaker rating	Check the SDU circuit breaker: 4 A	5.3.2		
	Check the HPA circuit breaker: 20 A	5.3.2		
	Check the HSU circuit breaker: 4 A	5.4.2		

Table 7-1: Check Sheet: Installation Check Before Inserting LRUs.

Item	Description of Check	Reference Section	√	Value/ Comment
Polarity of 28 V DC Power	Check 28 V DC polarity on SDU tray connector (TP1: +28 V DC Power and TP2: GND, Power Return)	4.1.3 5.3.2		
	Check 28 V DC polarity on HPA tray connector (BPA1: +28 V DC Power and BPA2: GND, Power Return)	4.2 5.3.2		
	Check 28 V DC polarity on HSU tray connector (TP1: +28 V DC Power and TP2: GND, Power Return)	4.3.3 5.4.2		
Handset power	Check power to the handsets on DB15 connector to be inserted in cradle	5.3.8 4.4.2		
nOn	Check that TP5 (nOn) on the SDU tray connector is connected to a switch or directly to Chassis GND (TP3).	5.3.2 4.1.3		
Handset connections to Cradles	Check that 2-wire handsets are not connected to 4-wire cradles.			
RF cable losses	Check loss from SDU to DLNA	5.3.3 6.1.5		
	Check loss from SDU to HPA			
	Check loss from HPA to DLNA			
	Check loss from DLNA to Antenna			
Software version	Check the software version of the SDU.			

Table 7-1: Check Sheet: Installation Check Before Inserting LRUs.

After a successful check of the installation, use the HSD$^+$ Configuration Program to configure the system. For further information, refer to **HSD+ Configuration Program** on page 6-1, or the built-in help system of the HSD$^+$CP.

Note: The cable loss values registered in the above table must be entered into the HSD$^+$ CP during configuration.

7.3 Functional Test, on Ground

Note: The system must be commissioned before performing this test. Refer to **Commissioning** on page 5-86.

The following list provides some of the most important checks to perform after power-up, but other additional checks may be relevant for the specific installation.

If any of the checks should fail, guidance is provided in the section **Initial Troubleshooting** on page 8-11.

Item	Description of Check	Reference	√	Value/ Comment
SDU LEDs	Check that the Power LED is green			
	Check that the Fail/Pass LED is green			
	Check that the Logon LED is green			
Voice handsets #1 to #6	Make an aircraft to ground call	Aero-HSD+ User Manual		
	Make a ground to aircraft call	Aero-HSD+ User Manual		
Fax	Send an H^+ fax from aircraft to ground	Aero-HSD+ User Manual		
	Send an H^+ fax from ground to aircraft	Aero-HSD+ User Manual		
	Send an HSD fax from aircraft to ground	Aero-HSD+ User Manual		
	Send an HSD fax from ground to aircraft	Aero-HSD+ User Manual		
ISDN	Connect to the internet from a laptop, using the ISDN connection.	Aero-HSD+ User Manual		
MPDS (Ethernet)	Connect to the internet from a laptop, using the MPDS Ethernet connection.	Aero-HSD+ User Manual		
AFIS/ACARS	Send test message and verify reply or request for weather data and verify the data is downloaded. Both is done from the FMS. Refer to FMS manual for more info.	FMS Manual		

Table 7-2: Check Sheet: Functional Test, on Ground

7.4 Interference Test

Introduction

It is recommended to perform an interference test to ensure that transmission from the Aero-HSD$^+$ system does not influence any of the primary avionics on the aircraft.

Important! This test is **not** a replacement for any EMC tests in connection with e.g. an STC, TC or Field Approval. It is only an additional practical test of the application.

Test

During the test, the aircraft must be on ground. A skilled person should be observing the instruments.

1. Log on to the satellite in the lowest possible elevation.
2. Place the aircraft in such a position that the satcom antenna transmits in the direction of the other antennas on the aircraft.

   Example: If the satcom antenna is tail-mounted, place the aircraft with the nose pointing in the direction of the satellite. The antenna will then transmit in the direction of the other antennas placed in front of it.
3. While transmission is ongoing, observe all primary navigation instruments, autopilot, VOR/ILS, ADF and DME etc. and make sure none of the instruments are influenced by the Aero-HSD$^+$ transmission.
4. Monitor all VHF communication and make sure squelch is not opened unintentionally.
5. If TCAS/ACAS is installed, verify that it is not flagged “FAILED” during satcom transmission.

Note: If any additional avionics are installed at a later stage, the interference test should be performed again.

7.5 Functional Test, Airborne

The following list provides some of the most important checks to perform while the aircraft is airborne, after all on-ground tests are passed. Other additional checks may be relevant for the specific installation.

If any of the checks should fail, guidance is provided in the section **Initial Troubleshooting** on page 8-11.

Item	Description of Check	Reference	√	Value/ Comment
Voice	Make an air to ground call and keep it up during a 360º turn. Monitor the C/No for any drops during the turn.	Aero-HSD+ User Manual		
	Make a ground to air call	Aero-HSD+ User Manual		
Fax	Send an H^+ fax from air to ground	Aero-HSD+ User Manual		
	Send an H^+ fax from ground to air	Aero-HSD+ User Manual		
	Send an HSD fax from air to ground	Aero-HSD+ User Manual		
	Send an HSD fax from ground to air	Aero-HSD+ User Manual		
ISDN	Connect to the internet from a laptop, using the ISDN connection.	Aero-HSD+ User Manual		
MPDS (Ethernet)	Connect to the internet from a laptop, using the MPDS Ethernet connection.	Aero-HSD+ User Manual		
AFIS/ACARS	Send test message and verify reply or request for weather data and verify the data is downloaded. Both is done from the FMS. Refer to FMS manual for more info.	FMS Manual		

Table 7-3: Check Sheet: Functional Test, Airborne

Maintenance and Troubleshooting

8.1 Continued Airworthiness

8.1.1 General

Maintenance requirements and instructions for continued airworthiness of the Thrane & Thrane units in the Aero-HSD^{+} System are restricted to the fact that the TT-5035A Satellite Data Unit and the TT-5038A High Speed Data Unit require replacement of an internal battery at a periodic scheduled service task of 7 years (Overhaul). The Overhaul period is defined as the recommended period from production date or last maintenance to next maintenance.

When replacing the TT-5035A Satellite Data Unit (SDU), it is important to leave the TT-5035A-001 Configuration Module (CM) behind, attached to the airframe with a wire.

8.1.2 Instructions

Documentation

Maintenance information for the Aero-HSD^{+} System is contained in this manual.

Wiring diagram information contained in this manual should be placed into the aircraft operator's appropriate aircraft Wiring Diagram Manuals.

Inoperative Units

If a system component is inoperative, remove or replace the unit.

If an inoperative SDU is removed, take out the TT-5035A-001 Configuration Module (CM) and fasten the CM and wiring. Secure all cables, collect applicable switches and circuit breakers, and label them inoperative. Revise the equipment list and weight and balance as applicable prior to flight and make a log book entry that the unit was removed.

For information on how to return a unit for repair, see **Returning Units for Repair** on page 8-15.

Once repaired, reinstall the LRU in the aircraft in accordance with the instructions in this Installation and Maintenance Manual.

Scheduled Maintenance Program

The high-speed data system components are considered on-condition units and no additional maintenance is required other than a check for security and operation at normal inspection intervals.

Scheduled Maintenance Program tasks to be added to the aircraft operator's appropriate aircraft maintenance program are as follows:

Recommended Periodic Scheduled Servicing Tasks:

TT-5035A Satellite Data Unit (SDU)	7 years
TT-5038A High Speed Data Unit (HSU)	7 years
TT-5035A-001 Configuration Module (CM)	none required
TT-5014A High Power Amplifier (HPA)	none required
TT-5620A 4-Wire Handset	none required
TT-5622A 4-Wire Cradle	none required
TT-5621B 2-Wire Handset	none required
TT-5622B 2-Wire Cradle	none required

Recommended Periodic Inspections:

TT-5035A Satellite Data Unit (SDU)	none required
TT-5038A High Speed Data Unit (HSU)	none required
TT-5035A-001 Configuration Module (CM)	none required
TT-5014A High Power Amplifier (HPA)	none required
TT-5620A 4-Wire Handset	none required
TT-5622A 4-Wire Cradle	none required
TT-5621B 2-Wire Handset	none required
TT-5622B 2-Wire Cradle	none required

Recommended Periodic Scheduled Preventative Maintenance Tests:
(Tests to determine system condition and/or latent failures)

TT-5035A Satellite Data Unit (SDU)	none required
TT-5038A High Speed Data Unit (HSU)	none required
TT-5035A-001 Configuration Module (CM)	none required
TT-5014A High Power Amplifier (HPA)	none required
TT-5620A 4-Wire Handset	none required
TT-5622A 4-Wire Cradle	none required
TT-5621B 2-Wire Handset	none required
TT-5622B 2-Wire Cradle	none required

8.2 Software Update

Hardware and Software Requirements

The following items are required before the software can be updated:

- One IBM compatible PC with a 9-pin serial COM port available (or a 25-pin serial COM port with a 25-to-9 converter attached)
- One serial interconnect cable 9-pin to 15-pin Sub-D, Thrane & Thrane part no. TT-37-112940. Refer to **Figure 5-27: TT 37-112940 Data Cable Compliant with Front Connector**.
- A terminal program installed on the PC (e.g. Windows HyperTerminal)
- An unzip program installed on the PC (e.g. WinZip)
- The zipped file containing the new software.
  The new software can be obtained using www.tt.dk/aero/support.

Preparing the Software Update

Note: Software update is only allowed with a JAA/FAA145 approval (Repair Station).

1. On the PC, unzip the zip file containing the new software.
2. Connect the SDU front port to the PC COM port, using the interconnect cable.
3. Set the terminal program baud rate to 115200 baud, No parity, 8 bit symbols.
4. Set the terminal transmission protocol to Xmodem-1K, binary transfer.

Updating the Software

1. Assure that the terminal program communicates with the SDU by striking the <Enter> key a couple of times. Each keystroke must cause the SDU to reply with a prompt line 'H+>'.
2. Turn off the power for the SDU.
3. Using the terminal program, start transmission of the new file from the PC to the SDU.

   Note: The procedure for transmitting a file varies, depending on the terminal program used. Refer to the instructions for the terminal program.
4. Power on the SDU.
   When the file has finished transmission, the SDU will reset itself. Wait until the POST test has finished (the green Pass/Fail LED on the front of the SDU will become steadily green). The first self test after the software upload will take 4½ - 5 minutes (normally it takes 1½ - 2 minutes).
5. Mark the new software version on the SDU label.

Testing Procedure

To verify that the software was updated correctly, do as follows:

1. From the terminal program, issue the command:
   `version`<enter>
2. On the resulting screen output, look for the 5th output line:
   `'Application SW version..... X.YY'`
   -where X.YY stands for the version number of the software.
3. Verify that the version number is correct.

8.3 Troubleshooting

8.3.1 Status Signalling

Built-In Test Equipment

The SDU provides a Built-In Test Equipment (BITE) function in order to make fault diagnostics easy during service and installation.

The BITE test is performed during:

- Power On Self Test (POST), which is automatically performed each time the system is powered on.
- Person Activated Self Test (PAST), which is initiated by pressing the Push To Test button on the SDU front panel.

Also, during operation a Continuous Monitoring BITE function is performed.

Each LRU in the Aero-HSD$^+$ system has its own BITE function but they are all controlled and monitored by the SDU in the system.

The result of the BITE tests for the complete Aero-HSD$^+$ system is a four digit error code. The two most significant digits represent the main group and are displayed on the SDU front panel. The two least significant digits give further details. All four digits are displayed in the user handset display together with more detailed information.

Means of Signalling

The Aero-HSD$^+$ system provides various methods for signalling the status of the system.

- **LEDs** on the front panel of the SDU, optional HSU and the HPA are used to signal:
  - Power on/off
  - Logon
  - Fail/Pass
- The **handset display** in the Thrane & Thrane 4-wire handset is used to display messages concerning:
  - information from the services
  - status information from the system to the user
  - equipment errors.
- The **BITE display** on the SDU is used to display BITE error codes. Refer to **System Messages** on page C-1.

Push to Test (PTT) button on SDU

The SDU has a hardware reset/test button placed on the front panel for BITE purposes. This button is used to reset the SDU and to activate a self test (PAST).

LEDs on the SDU

Power LED

The function of the Power LED on the SDU is:

LED Color	Description
Green	Power OK
Orange	Uploading software
Off	No power

Logon LED (H^+)

The Logon LED on the SDU shows the H^+ logon status.
The HSD logon status is only signalled in the 4-wire handset.

The possible colors are listed below, with a short description of what they indicate:

LED Color	Description
Off	No Acquired Satellite
Red	Acquired a network satellite
Orange	Network synchronization
Green	Network Logon

Fail/Pass LED, SDU

The function of the Fail/Pass LED on the SDU is:

Behavior	Description
Steady red	Fail
Alternating: Short green / long pause	Power On Self Test (POST) or Person Activated Self Test (PAST) in progress.
Alternating: Long green/ short orange 0.5 Hz	No current failure, but a BITE failure / warning is logged in the error log
Steady green	No faults

LEDs on HPA

Power LED

The function of the Power LED on the HPA is:

Behavior	Description
Steady green	Power OK
Off	No power

Fail/Pass LED

The function of the Fail/Pass LED on the HPA is:

Behavior	Description
Steady red	Fail
Off	No Faults

LEDs on Optional HSU

Power LED

The function of the Power LED on the HSU is:

Behavior	Description
Steady green	The unit is turned on and has completed POST test.
Flashes 0.25 s out of every 4 s (together with the red Fail LED – see below)	The unit is turned on but is waiting for the SDU (and has not yet started POST).
Flashes 0.5 s out of every 2 s.	POST or PAST is in process.
Off	No power.

Fail LED

The function of the Fail LED on the HSU is:

Behavior	Description
Steady red	A fault which may degrade the system operation is present in the HSU.
Flashing (together with the Power LED – see above)	The unit is turned on but is waiting for the SDU (and has not yet started POST).
Off	Normal operation. No faults are present, and the unit is no longer waiting for the SDU.

Messages

Two types of messages are displayed in the Thrane & Thrane 4-wire handsets.

- Cause codes are information from the services or status information from the system to the user.
- BITE codes are information about errors in the equipment.

BITE codes are also shown in the BITE display of the SDU and in the display of the 4-wire handset.

For further information and lists of the possible error codes, see the appendix **System Messages** on page C-1.

BITE Display on SDU

The two-digit 7-segment BITE display (green) is used for displaying BITE codes. Only the two most significant digits of the four-digit BITE codes are shown in the SDU display.

For further information and a list of the BITE codes, refer to **BITE Error Codes** on page C-17.

8.3.2 Initial Troubleshooting

Overview

This section describes an initial check of the primary functions of the Aero-HSD$^+$ system, and provides some guidelines for troubleshooting, if one of the checks should fail.

Generally, if a fault occurs without any obvious reason, it is always recommended to observe the LEDs and the BITE display.

For information on the function of the LEDs and the BITE display, refer to **Status Signalling** on page 8-6.

For a list of all the BITE codes and Cause codes, refer to the appendix **System Messages** on page C-1.

It may sometimes be necessary to use terminal commands for debugging, using the front Maintenance port of the SDU.

For information on how to use the front port for debugging, see **Using Commands** on page D-1.

Check of LEDs

The below flow chart shows the initial check of the LEDs on the SDU, HPA and HSU.

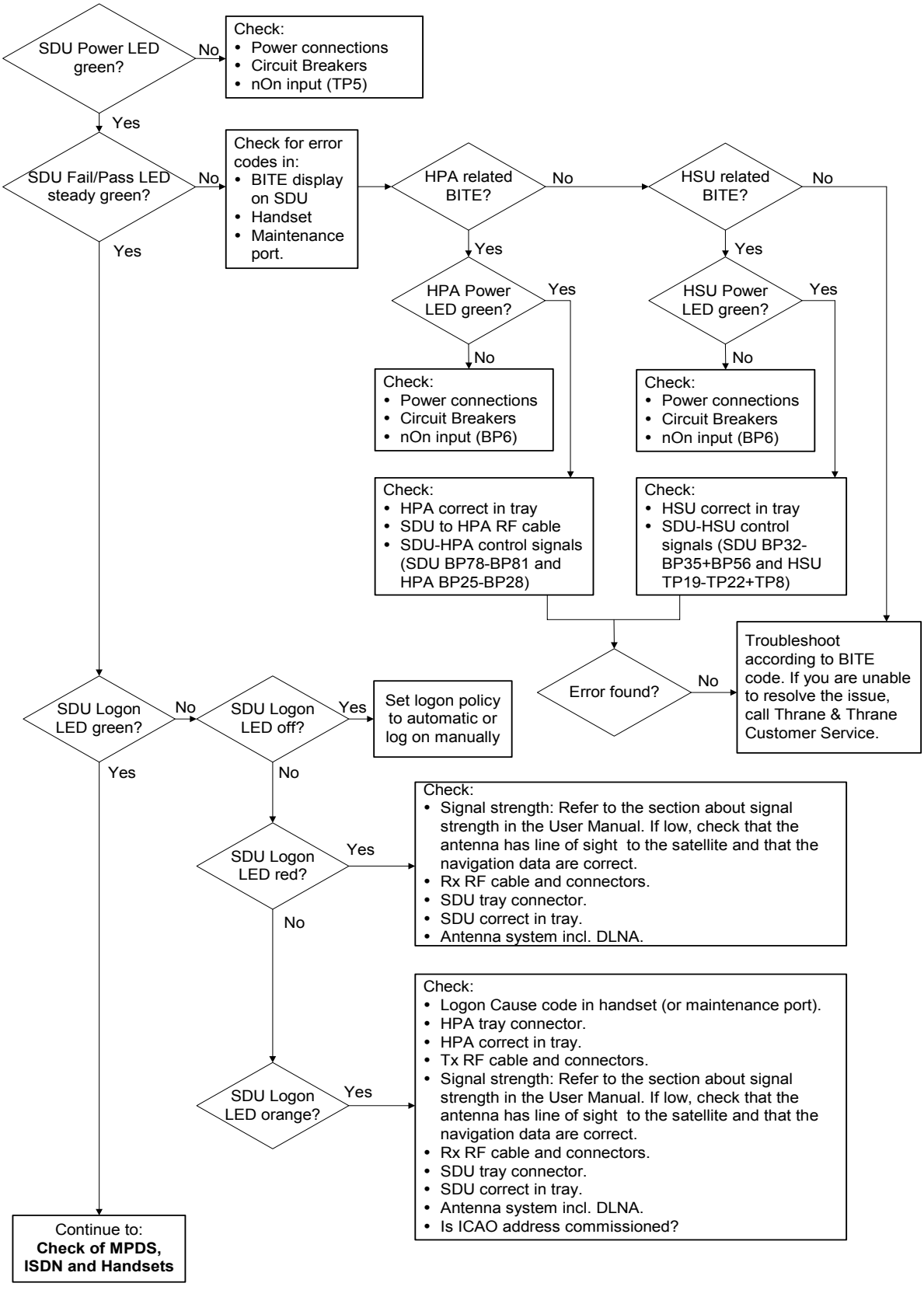


Figure 8-1: Initial Check of LEDs

Check of MPDS, ISDN and Handsets

After checking the LEDs, the user functions should be checked.
The below flow chart shows the initial check of MPDS, ISDN and handsets.

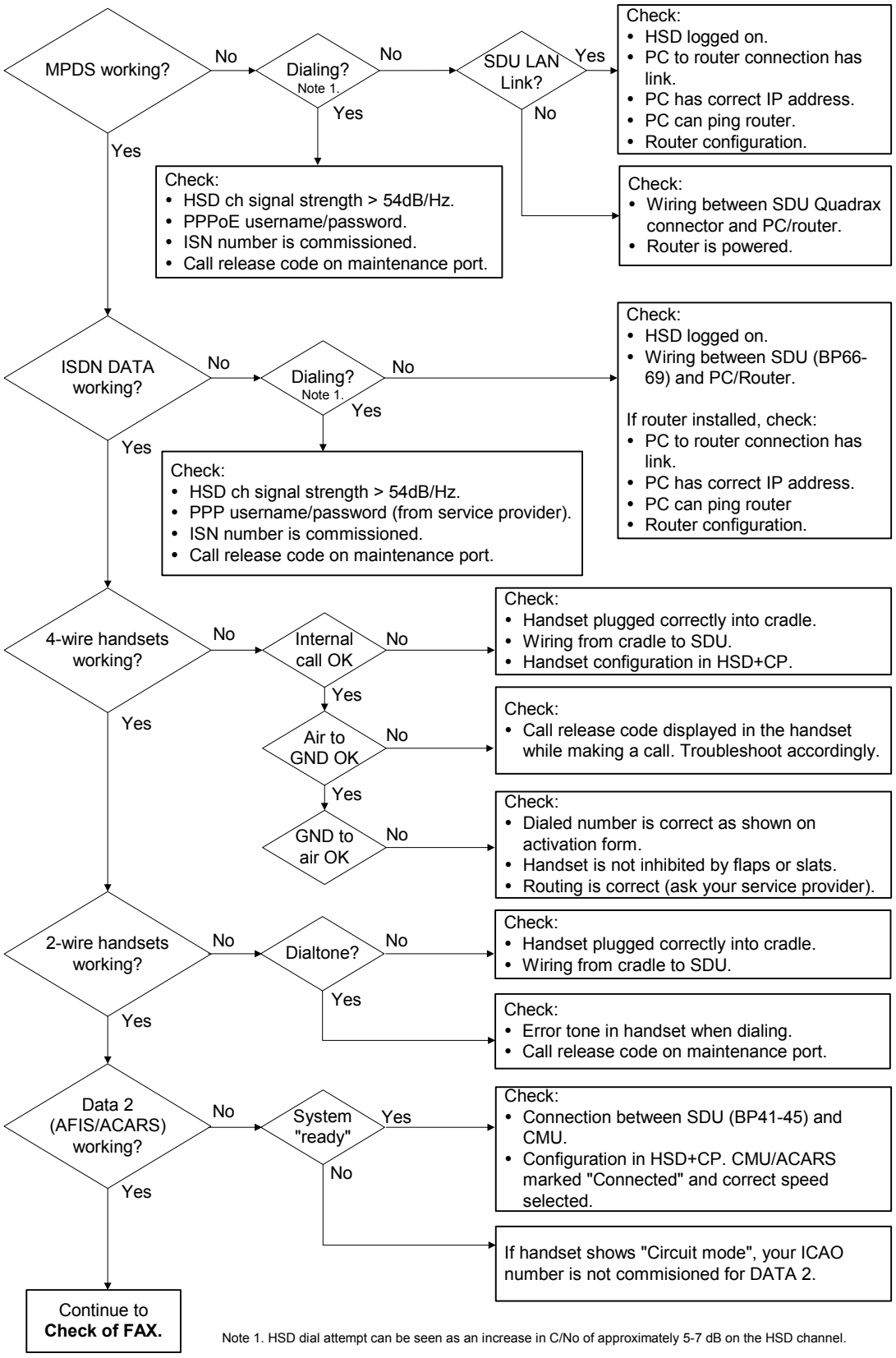


Figure 8-2: Initial Check of MPDS, Fax, 4-Wire Handsets and ISDN

Check of Fax

The below flow chart shows the initial check of the fax interfaces.

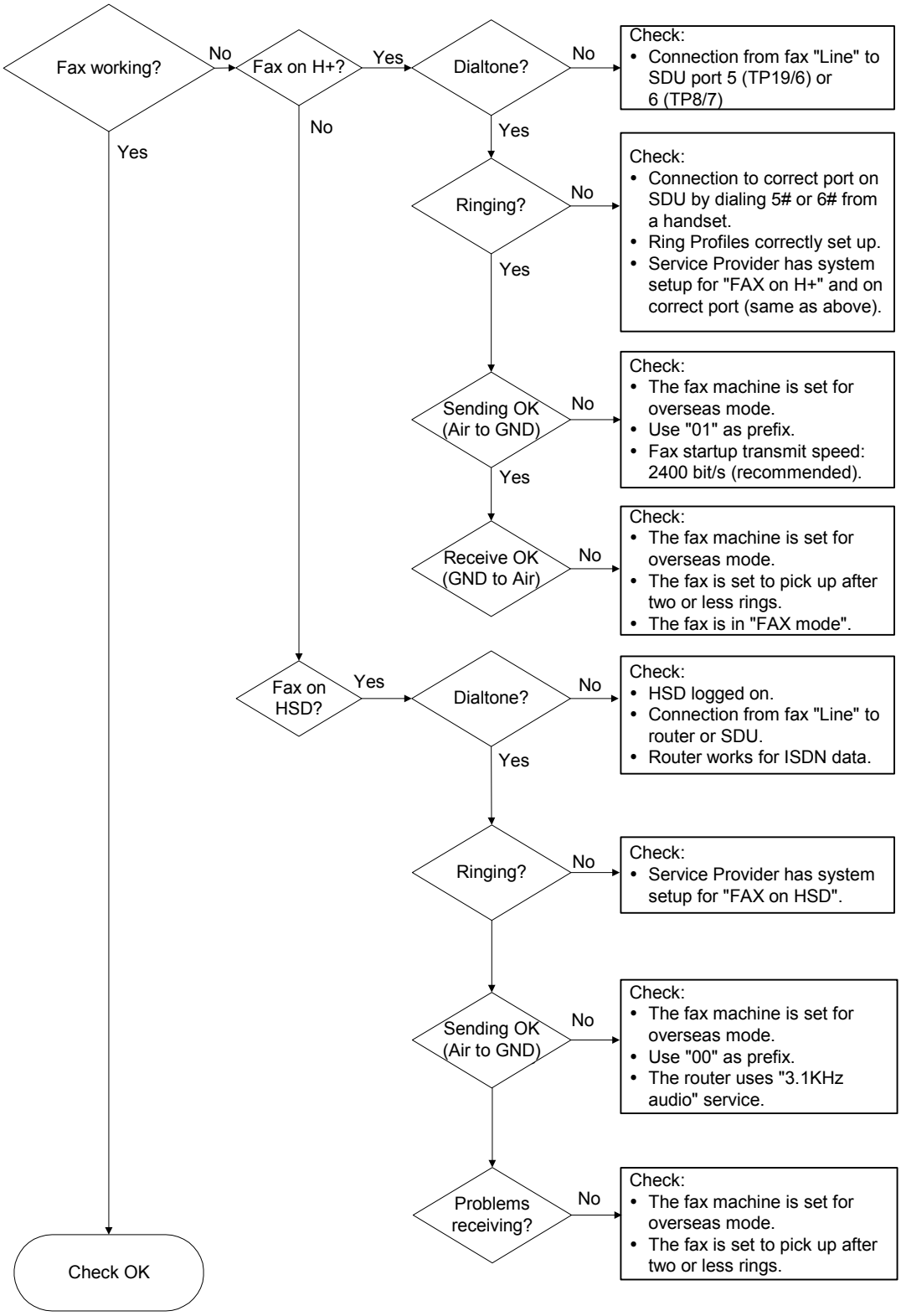


Figure 8-3: Initial Check of Fax

8.4 Returning Units for Repair

8.4.1 Return Material Authorization (RMA)

To return equipment to Thrane & Thrane for repair this RMA procedure must be followed.

Failure to comply with this procedure may cause shipping delays and additional charges.

Warranty Returns

Equipment that qualifies for warranty repair can be returned to Thrane & Thrane for repair or replacement at our discretion. The customer is charged for the shipping costs to Thrane & Thrane, and Thrane & Thrane will pay the shipping costs to return the repaired/replaced unit to the customer.

Non-Warranty Returns

Equipment that fails to work properly because of improper or negligent use, abuse, shipping damaged or any other condition can still be returned to Thrane & Thrane for repair or replacement at our discretion.

The customer will be notified of the cost to repair or replace the unit before invoicing for repair or replacement. The customer is charged for the shipping cost to and from Thrane & Thrane.

Repackaging Requirements

An Aero-HSD+ unit must be returned to Thrane & Thrane in suitable ESD secured shipping containers; failure to do so may invalidate the warranty.

RMA Procedure

Before returning units to Thrane & Thrane for repair, please follow this procedure:

1. Have the following information ready before calling the Customer Service Center:
   - T&T Model number (example: TT405035A SDU).
   - Serial number (example: 00443322).
   - A thorough description of the fault.
   - Aircraft serial number and/or tail number.
2. Call Thrane & Thrane Inc. Customer Service at: **+1-757-463-9557** and ask for Aero-HSD+ support.
3. Describe the fault as thoroughly as possible and ask for assistance. In some cases, the error may be resolved over the phone.
4. If the unit has to be returned for repair, request an RMA number.
5. Request replacement/loan unit if required.
6. Pack the equipment or parts to be returned in approved shipping containers.
7. Write the RMA number on the outside of all shipping containers and ship to:

Thrane & Thrane Inc.
509 Viking Drive Suite
VA 23452 Virginia Beach
USA

Appendices

Equipment Specifications

A.1 Introduction

Important Note!

The information, drawings, and wiring diagrams contained in this manual are intended as a reference for engineering planning only. It is the installer's responsibility to compose installation drawings specific to the aircraft.

A.1.1 Total Weight of the Aero-HSD+ System

The total weight of the basic Thrane & Thrane units in an Aero-HSD+ system is:

26.04 lbs ± 1.21 lbs (11.78 kg ± 0.55 kg).

Note: Cables are not included.

The weight comprises the following units:

- TT-5035A SDU (incl. TT-5035A-001 CM) 7.72 lbs ±0.22 lbs (3.50 kg ±0.10 kg)
- TT-5014A HPA 11.24 lbs ±0.44 lbs (5.10 kg ±0.20 kg)
- TT-5012A DLNA 5.8 lbs ±0.33 lbs (2.60 kg ±0.15 kg)
- TT-5620A Handset 0.68 lbs ±0.11 lbs (0.31 kg ±0.05 kg)
- TT-5622A Cradle 0.60 lbs ±0.11 lbs (0.27 kg ± 0.05 kg)

A.2 Aero-HSD+ System Components

A.2.1 TT-5035A Satellite Data Unit (SDU)

Specification with TT-5035A-001 Configuration Module (CM) mounted.

Characteristics	Specification
Dimensions (L x W x H)	ARINC 404A 3/8 ATR short, 3 MCU 12.62" x 7.62" x 3.56" (320.5 mm x 193.5 mm x 90.4 mm)
Weight	7.72 lbs ±0.22 lbs (3.5 kg ±0.1 kg) incl. Configuration Module
Mounting	Mount in an ARINC 404A 3/8 ATR short tray in a temperature controlled location. Forced cooling is not recommended.
Supply Voltage	Nominal: +28.0 V DC Voltage range continuous operation: +20.5 V DC to 32.2 V DC short time operation: +18.0 V DC to 32.2 V DC
Power Hold-up	5 ms. fully operational, 200 ms. Power Save Mode.
Power Consumption	Max. 48 W[a], typ. 30 W.
Connectors	Rear: ARINC 404A Front: SUB-D 15 Female.
Operating Temperature	-25 ºC to +55 ºC
Altitude	55000 ft
Environmental Categories	Refer to Environmental Qualification form in the appendix **DO-160C/D Specifications** on page B-1 in this manual.

Table A-1: General Specifications for SDU

a. Includes 4 x 4-wire handsets, 2 x 2-wire handsets, 4 ISDN phones and one TT-5012A DLNA.

A.2.2 TT-5014A High Power Amplifier (HPA)

Characteristics	Specification
Dimensions (L x W x H)	ARINC 404A 3/8 ATR short, 3 MCU 12.62" x 7.79" x 3.66" (320.5 mm x 193.5 mm x 93.0 mm)
Weight	11.24 lbs ±0.44 lbs (5.1 kg ±0.2 kg)
Mounting	Can be installed in a non-temperature controlled location. The HPA is designed with built-in forced cooling. Do not block the cooling air holes. Minimum clearance top and bottom: 1" (25 mm) Mount in ARINC 404A 3/8 ATR short tray with oval cut-out as shown in **Figure 3-12: Outline Drawing: Tray for SDU and HPA.**.
Supply Voltage	Nominal: +28.0 V DC Voltage range, continuous operation: +20.5 V DC to 32.2 V DC short time operation: +18.0 V DC to 32.2 V DC
Power Hold-up	5 ms. fully operational, 200 ms. Power Save Mode.
Power Consumption	Max. 200 W, Absolute max. 235 W incl. Chelton HGA-7000 antenna.
Composite Output Power	37.4 W (Burst Mode) 30.0 W (Continuous Mode)
Connectors	Rear: ARINC 404A
Operating Temperature	-55 ºC to +70 ºC
Altitude	55000 ft
Environmental Categories	Refer to Environmental Qualification form in the appendix **DO-160C/D Specifications** on page B-1 in this manual.

Table A-2: General Specifications for HPA

A.2.3 TT-5012A Diplexer Low Noise Amplifier (DLNA)

Characteristics	Specification
Dimensions (L x W x H)	10.58” x 7.64” x 1.95” (268.8 mm x 194.0 mm x 49.5 mm)
Weight	5.8 lbs ±0.33 lbs (2.6 kg ±150 g)
Mounting	Should be mounted as close to the Antenna unit as possible. Place the DLNA with sufficient contact to the surface, respecting the max. resistance of 3 mΩ. The DLNA can be mounted on a shelf or directly on the fuselage. If the DLNA is mounted directly on fuselage, mount with Cadmium plated washers. Make sure the ground stud is connected to fuselage.
Supply Voltage	+12 V DC, provided by SDU via coaxial cable. Short circuit protected.
Power Consumption	Max. 1.6 W (included in SDU power consumption).
Operating Temperature	-55 ºC to +70 ºC
Altitude	55000 ft
Environmental Categories	Refer to Environmental Qualification form in the appendix **DO-160C/D Specifications** on page B-1 in this manual.

Table A-3: General Specifications for DLNA

A.2.4 TT-5038A High Speed Data Unit (HSU)

Characteristics	Specification
Dimensions (L x W x H)	ARINC 404A 1/4 ATR short, 2 MCU 12.62” x 7.62” x 2.25” (320.5 mm x 193.5 mm x 57.2 mm)
Weight	4.63 lbs ±0.22 lbs (2.1 kg ±100 g)
Mounting	Mount in an ARINC 404A 1/4 ATR short tray in a temperature controlled location. Forced cooling is not recommended.
Supply Voltage	Nominal: +28.0 V DC Voltage range, continuous operation: +20.5 V DC to 32.2 V DC short time operation: +18.0 V DC to 32.2 V DC
Power Hold-up	5 ms. fully operational, 200 ms. Power Save Mode.
Power Consumption	Max. 23 W[a], typ. 13 W.
Connectors	Rear: ARINC 404A Front: SUB-D 9 Female.
Operating Temperature	-25 ºC to +55 ºC
Altitude	55000 ft
Environmental Categories	Refer to Environmental Qualification form in the appendix **DO-160C/D Specifications** on page B-1 in this manual.

Table A-4: General Specifications for HSU

a. The ISDN terminals connected to the ISDN interface are assumed to consume maximum 4.5 W.

A.2.5 TT-5038A-002 Tx Coupler for Optional HSU

Characteristics	Specification
Dimensions	ARINC 404A 1/4 ATR short, 2 MCU
(L x W x H)	4.20” x 2.25” x 0.88” (106.6 mm x 57.1 mm x 22.4 mm) including connectors.
Weight	0.50 lbs ±0.02 lbs (230 g ±10 g)
Mounting	Can be mounted in an unpressurized but temperature controlled location.
Connectors	3 x N-connector, Female.
Operating Temperature	-25 ºC to +55 ºC
Altitude	55000 ft
Environmental Categories	Refer to Environmental Qualification form in the appendix **DO-160C/D Specifications** on page B-1 in this manual.

Table A-5: General Specifications for Tx Coupler

A.2.6 TT-5038A-003 Rx Power Splitter for Optional HSU

Characteristics	Specification
Dimensions	ARINC 404A 1/4 ATR short, 2 MCU
(L x W x H)	3.42” x 2.00” x 0.75” (86.8 mm x 50.8 mm x 19.1 mm) including connectors.
Weight	0.32 lbs ±0.02 lbs (146 g ±10 g)
Mounting	If the Rx Power Splitter is to be mounted on a flat surface, mount it on a 3 mm mounting plate to provide enough space for mounting of the connectors. Can be mounted in an unpressurized but temperature controlled location.
Connectors	3 x N-connector, Female. Built-in DC-block on the HSU port.
Operating Temperature	-25 ºC to +55 ºC
Altitude	55000 ft
Environmental Categories	Refer to Environmental Qualification form in the appendix **DO-160C/D Specifications** on page B-1 in this manual.

Table A-6: General Specifications for Rx Power Splitter

A.3 Aero-HSD+ Handsets and Cradles

A.3.1 TT-5620A 4-Wire Handset

Characteristics	Specification
Dimensions (L x W x H)	7.87” x 2.05” x 1.24” (200.0 mm x 52.0 mm x 31.5 mm)
Weight	0.68 lbs ±0.11 lbs (0.31 kg ±50 g) incl. cable.
Mounting	Mount in a pressurized and temperature controlled location.
Supply Voltage	+28 V DC, provided by SDU via Handset Cradle.
Power Consumption	Max. 3.5 W for handset and cradle (included in SDU power consumption).
Operating Temperature	-25 ºC to +55 ºC
Altitude	55000 ft
Environmental Categories	Refer to Environmental Qualification form in the appendix **DO-160C/D Specifications** on page B-1 in this manual.

Table A-7: General Specifications for 4-Wire Handset

A.3.2 TT-5622A 4-Wire Cradle

Characteristics	Specification
Dimensions (L x W x H)	6.30” x 2.40” x 1.12” (160.5 mm x 61.0 mm x 28.4 mm)
Weight	0.60 lbs ±0.11 lbs (0.27 kg ±50 g) incl. connector cable.
Mounting	Mount in a pressurized and temperature controlled location.
Supply Voltage	+28 V DC, provided by SDU.
Power Consumption	See **TT-5620A 4-Wire Handset** on page A-8.
Operating Temperature	-25 ºC to +55 ºC
Altitude	55000 ft
Environmental Categories	Refer to Environmental Qualification form in the appendix **DO-160C/D Specifications** on page B-1 in this manual.

Table A-8: General Specifications for 4-Wire Cradle

A.3.3 TT-5621B 2-Wire Handset

Characteristics	Specification
Dimensions (L x W x H)	7.87” x 2.05” x 1.24” (200.0 mm x 52.0 mm x 31.5 mm)
Weight	0.49 lbs ±0.11 lbs (0.22 kg ±50 g) incl. cable.
Mounting	Mount in a pressurized and temperature controlled location.
Voltage	
On hook, no load DC	20 V DC -10%, +50%
Ringing voltage	39 Vrms ± 5%
Off hook loop current	25 mA ± 15%
Power	Max. 750 mW for handset and cradle (included in SDU power consumption).
Operating Temperature	-25 ºC to +55 ºC
Altitude	55000 ft
Environmental Categories	Refer to Environmental Qualification form in the appendix **DO-160C/D Specifications** on page B-1 in this manual.

Table A-9: General Specifications for 2-Wire Handset

A.3.4 TT-5622B 2-Wire Cradle

Characteristics	Specification
Dimensions (L x W x H)	6.30” x 2.40” x 1.12” (160.5 mm x 61.0 mm x 28.4 mm)
Weight	0.43 lbs ±0.11 lbs (0.20 kg ±50 g) incl. connector cable.
Mounting	Mount in a pressurized and temperature controlled location.
Voltage	See **TT-5621B 2-Wire Handset** on page A-10.
Power	See **TT-5621B 2-Wire Handset** on page A-10.
Operating Temperature	-25 ºC to +55 ºC
Altitude	55000 ft
Environmental Categories	Refer to Environmental Qualification form in the appendix **DO-160C/D Specifications** on page B-1 in this manual.

Table A-10: General Specifications for 2-Wire Cradle

DO-160C/D Specifications

B.1 General

B.1.1 Certifying Agency

Approval of the Aero-HSD^{+} system is not authorized by this installation manual. Acceptance for the installation and use of the Aero-HSD^{+} system and its associated components must be obtained through the appropriate offices of the CAA or other certifying agency. It is recommended that all proposed installations be coordinated with the local jurisdiction of the CAA or other certifying agency prior to performing the installation.

B.1.2 Environmental Qualification Forms

The environmental qualification forms list the environmental categories under which all Thrane & Thrane components of the Aero-HSD^{+} system are approved.

Please refer to RTCA DO-160C/D for further details on the following environmental qualification forms.

B.2 Aero-HSD+ System Components

B.2.1 Satellite Data Unit

T&T Part Number: 405035A

DO-160D string: [(A1)(F1)X]CAB[(S2B2)(SM)]EXXXXXZ[A()B]A[A()B]Z[RR]M[A3E3]XXA

RTCA/DO-160D Change Numbers			
Change Number	**Date of Issue**	**Title**	**Section**
Change No. 1	Dec. 14, 2000	Vibration	8.0
		Radio Frequency Susceptibility	20.0
Change No. 2	June 12, 2001	Power Input	16.0
		Audio Frequency Conducted Susceptibility - Power Inputs	18.0

Table B-1: RTCA/DO-160D Change Numbers, SDU

Conditions	DO-160D	Cat.	Comments
Temperature and Altitude	4.0	A1 and F1	Installation in controlled temperature locations and inside or outside pressurized locations.
Low Temperature	4.5.1		Min. operating low temperature: -25°C
High Temperature	4.5.2 & 4.5.3		Max. operating high temperature: +55°C
In-Flight Loss of Cooling	4.5.4	X	Forced cooling is not recommended.
Altitude	4.6.1		Max. altitude: 55000 ft
Decompression	4.6.2		Decompression at 55000 ft
Overpressure	4.6.3		Overpressure at -15000ft
Temperature Variation	5.0	C	Installation within controlled temperature locations: 2°/min.
Humidity	6.0	A	Standard Humidity: 95% relative humidity at 38°C to 50°C for 48 hours. Installation within environmentally controlled zones.
Operational Shocks and Crash Safety	7.0	B	Equipment tested to: Standard operational shocks and crash safety.

Table B-2: Environmental Qualification Form for SDU

Conditions	DO-160D	Cat.	Comments
Vibration	8.0	S2B2	Standard random vibration: Aircraft type: Fixed wing. Turbojet or turbofan engines.
		SM	Standard sinusoidal vibration: Aircraft type: Fixed wing. Reciprocating or turbopropeller engines. Aircraft zone: Instrument panel, console or equipment rack.
Explosion Proofness	9.0	E	
Waterproofness	10.0	X	No test required
Fluids Susceptibility	11.0	X	No test required
Sand and Dust	12.0	X	No test required
Fungus Resistance	13.0	X	No test required
Salt Spray	14.0	X	No test required
Magnetic Effect	15.0	Z	Magnetic deflection distance: < 0.3 m
Power Input	16.0	A()B	Power supply: +28 V DC. Reconnection of voice and data calls is not required, if a power interrupt less than 200 ms occurs during transfer of power sources.
Voltage Spike	17.0	A	
Audio Frequency Conducted Susceptibility - Power Inputs	18.0	A()B	
Induced Signal Susceptibility	19.0	Z	Equipment intended for operation in systems where interference-free operation is required.
Radio Frequency Susceptibility	20.0	RR	High Intensity Radiated Field (HIRF) associated with normal environment.
Emission of Radio Frequency Energy	21.0	M	

Table B-2: Environmental Qualification Form for SDU

Conditions	DO-160D	Cat.	Comments
Lightning Induced Transient Susceptibility	22.0	A3E3	Equipment and wiring in moderately exposed environment in an all metal airframe. The Configuration Module is an integrated part of the SDU, and so the pin injection tests are not required for the Configuration Module interface.
Lightning Direct Effects	23.0	X	No test required
Icing	24.0	X	No test required
Electrostatic Discharge (ESD)	25.0	A	Operation, installation and repair in an aerospace environment.

Table B-2: Environmental Qualification Form for SDU

B.2.2 Configuration Module

T&T Part Number: 405035A-001

DO-160D string: Please refer to the section **Satellite Data Unit** on page B-2, as the Configuration Module is an integral part of the SDU during normal operation and tests.

B.2.3 High Power Amplifier

T&T Part Number: 405014A

DO-160D string: [(A2)(F2)Z]BBB[SCL]EXXXXXZ[A()B]A[A()B]Z[RR]M[A3E3]XXA

RTCA/DO-160D Change Numbers			
Change Number	**Date of Issue**	**Title**	**Section**
Change No. 1	Dec. 14, 2000	Vibration	8.0
		Radio Frequency Susceptibility	20.0
Change No. 2	June 12, 2001	Power Input	16.0
		Audio Frequency Conducted Susceptibility - Power Inputs	18.0

Table B-3: RTCA/DO-160D Change Numbers, HPA

Conditions	DO-160D	Cat.	Comments
Temperature and Altitude	4.0	A2 and F2	Installation in non-controlled temperature locations and inside or outside pressurized locations.
Low Temperature	4.5.1		Min. operating low temperature: -55°C
High Temperature	4.5.2 & 4.5.3		Max. operating high temperature: +70°C
In-Flight Loss of Cooling	4.5.4	Z	Continuous operation at 40°C, tested with internal fan turned off. Use the recommended tray and leave at least 1 inch (25 mm) of free space above and below the HPA, to allow free airflow. The HPA is overheat protected. External forced cooling is not recommended.
Altitude	4.6.1		Max. altitude: 55000 ft
Decompression	4.6.2		Decompression at 55000 ft
Overpressure	4.6.3		Overpressure at -15000 ft
Temperature Variation	5.0	B	Installation within non-temperature-controlled location: 5°C/min.
Humidity	6.0	B	Severe humidity: 95% relative humidity at 38°C to 65°C for 240 hours. Installation within non-environmentally controlled zones.

Table B-4: Environmental Qualification Form for HPA

Conditions	DO-160D	Cat.	Comments
Operational Shocks and Crash Safety	7.0	B	Equipment tested to: Standard operational shocks and crash safety.
Vibration	8.0	SCL	Standard sinusoidal and random vibration: Aircraft type: Fixed wing. Turbojet, turbofan, reciprocating or turbopropeller engines. Aircraft zone: Fuselage
Explosion Proofness	9.0	E	
Waterproofness	10.0	X	No test required
Fluids Susceptibility	11.0	X	No test required
Sand and Dust	12.0	X	No test required
Fungus Resistance	13.0	X	No test required
Salt Spray	14.0	X	No test required
Magnetic Effect	15.0	Z	Magnetic deflection distance: < 0.3 m
Power Input	16.0	A()B	Power supply: +28 V DC. Reconnection of voice and data calls is not required, if a power interrupt less than 200 ms occurs during transfer of power sources.
Voltage Spike	17.0	A	
Audio Frequency Conducted Susceptibility - Power Inputs	18.0	A()B	
Induced Signal Susceptibility	19.0	Z	Equipment intended for operation in systems where interference-free operation is required.
Radio Frequency Susceptibility	20.0	RR	High Intensity Radiated Field (HIRF) associated with normal environment.
Emission of Radio Frequency Energy	21.0	M	
Lightning Induced Transient Susceptibility	22.0	A3E3	Equipment and wiring in moderately exposed environment in an all metal airframe.
Lightning Direct Effects	23.0	X	No test required
Icing	24.0	X	No test required
Electrostatic Discharge (ESD)	25.0	A	Operation, installation and repair in an aerospace environment.

Table B-4: Environmental Qualification Form for HPA

B.2.4 Diplexer and Low Noise Amplifier

T&T Part Number: 405012A-THR

DO-160C string: [A2F2]-BA[CLY]XXXXXXA[AB]A[AB]Z[UR]ZA3E2XX

RTCA/DO-160C Change Numbers			
Change Number	**Date of Issue**	**Title**	**Section**
Change No. 2	June 19, 1992	Lightning Induced Transient Susceptibility	22.0
Change No. 3	May 13, 1993	Radio Frequency Susceptibility	20.0

Table B-5: RTCA/DO-160C Change Numbers, DLNA

Conditions	DO-160C	Cat.	Comments
Temperature and Altitude	4.0	A2 and F2	Installation in non-controlled temperature locations inside or outside pressurized locations.
Low Temperature	4.5.1		Min. operating low temperature: -55°C
High Temperature	4.5.2 & 4.5.3		Max. operating high temperature: +70°C
In-Flight Loss of Cooling	4.5.4	-	No forced cooling required.
Altitude	4.6.1		Max. altitude: 55000 ft
Decompression	4.6.2		Decompression at 55000 ft
Overpressure	4.6.3		Overpressure at -15000 ft
Temperature Variation	5.0	B	Installation within partially or non-controlled temperature locations: 5°C/min.
Humidity	6.0	A	Standard Humidity: 95% relative humidity at 38°C to 50°C for 48 hours. Installation within environmentally controlled zones
Operational Shocks and Crash Safety	7.0	Yes	Equipment tested to: Standard operational shocks and crash safety.
Operational Shock	7.2	Yes	
Crash Safety	7.3	Yes	

Table B-6: Environmental Qualification Form for DLNA

Conditions	DO-160C	Cat.	Comments
Vibration	8.0	CL	Standard sinusoidal and random vibration: Aircraft type: Fixed wing. Turbojet, turbofan, reciprocating or turbopropeller engines.
		Y	Aircraft type: Helicopter. Turbojet or reciprocating engines.
			Aircraft Zone: Fuselage
Explosion Proofness	9.0	X	No test required
Waterproofness	10.0	X	No test required
Fluids Susceptibility	11.0	X	No test required
Sand and Dust	12.0	X	No test required
Fungus Resistance	13.0	X	No test required
Salt Spray	14.0	X	No test required
Magnetic Effect	15.0	A	Magnetic deflection distance: 0.3 m to 1 m
Power Input	16.0	AB	+12 V DC power is provided by the SDU through the Rx coax cable.
Voltage Spike	17.0	A	+12 V DC power is provided by the SDU
Audio Frequency Conducted Susceptibility - Power Inputs	18.0	AB	+12 V DC power is provided by the SDU
Induced Signal Susceptibility	19.0	Z	Equipment intended for operation in systems where interference-free operation is required.
Radio Frequency Susceptibility	20.0	UR	
Emission of Radio Frequency Energy	21.0	Z	Equipment intended for operation in systems where interference-free operation is required.
Lightning Induced Transient Susceptibility	22.0	A3E2	Equipment and wiring in moderately exposed environment in an all metal airframe.
Lightning Direct Effects	23.0	X	No test required
Icing	24.0	X	No test required

Table B-6: Environmental Qualification Form for DLNA

B.2.5 High Speed Data Unit (Optional)

T&T Part Number: 405038A

DO-160D string: [(A1)(F1)X]CBB[(S2B2)(SM)]EXXXXXZ[A()B]A[A()B]Z[RR]M[A3E3]XXA

For the environmental qualification form for the HSU, please refer to the section **Satellite Data Unit** on page B-2, as the forms are identical for the SDU and the HSU, except for:
Humidity, DO-160 section 6.0, tested to category **B**, Severe Humidity Environment (240 hours, 65°C, 95% humidity).

B.2.6 Tx Coupler and Rx Power Splitter for Optional HSU

T&T Part Numbers: 405038A-002 and 405038A-003

DO-160D string: [(A1)(F1)X]CBB[SCL]EXXXXXZXXXZ[RR]M[A3E3]XXA

RTCA/DO-160D Change Numbers			
Change Number	**Date of Issue**	**Title**	**Section**
Change No. 1	Dec. 14, 2000	Vibration	8.0
		Radio Frequency Susceptibility	20.0
Change No. 2	June 12, 2001	Power Input	16.0
		Audio Frequency Conducted Susceptibility - Power Inputs	18.0

Table B-7: RTCA/DO-160D Change Numbers, Tx Coupler and Rx Power Splitter

Conditions	DO-160D	Cat.	Comments
Temperature and Altitude	4.0	A1 and F1	Installation in controlled temperature locations and inside or outside pressurized locations.
Low Temperature	4.5.1		Min. operating low temperature: -25°C
High Temperature	4.5.2 & 4.5.3		Max. operating high temperature: +55°C
In-Flight Loss of Cooling	4.5.4	X	Forced cooling is not recommended.
Altitude	4.6.1		Max. altitude: 55000 ft
Decompression	4.6.2		Decompression at 55000 ft
Overpressure	4.6.3		Overpressure at -15000 ft
Temperature Variation	5.0	C	Installation within controlled temperature locations: 2°/min.
Humidity	6.0	B	Severe humidity: 95% relative humidity at 38°C to 65°C for 240 hours. Installation within non-environmentally controlled zones.
Operational Shocks and Crash Safety	7.0	B	Equipment tested to: Standard operational shocks and crash safety.

Table B-8: Environmental Qualification Form for Tx Coupler and Rx Power Splitter

Conditions	DO-160D	Cat.	Comments
Vibration	8.0	SCL	Standard sinusoidal and random vibration: Aircraft type: Fixed wing. Turbojet, turbofan, reciprocating or turbopropeller engines. Aircraft zone: Fuselage
Explosion Proofness	9.0	E	
Waterproofness	10.0	X	No test required
Fluids Susceptibility	11.0	X	No test required
Sand and Dust	12.0	X	No test required
Fungus Resistance	13.0	X	No test required
Salt Spray	14.0	X	No test required
Magnetic Effect	15.0	Z	Magnetic deflection distance: < 0.3 m
Power Input	16.0	X	No test required
Voltage Spike	17.0	X	No test required
Audio Frequency Conducted Susceptibility - Power Inputs	18.0	X	No test required
Induced Signal Susceptibility	19.0	Z	Equipment intended for operation in systems where interference-free operation is required
Radio Frequency Susceptibility	20.0	RR	High Intensity Radiated Field (HIRF) associated with normal environment.
Emission of Radio Frequency Energy	21.0	M	
Lightning Induced Transient Susceptibility	22.0	A3E3	Equipment and wiring in moderately exposed environment in an all metal airframe.
Lightning Direct Effects	23.0	X	No test required
Icing	24.0	X	No test required
Electrostatic Discharge (ESD)	25.0	A	Operation, installation and repair in an aerospace environment.

Table B-8: Environmental Qualification Form for Tx Coupler and Rx Power Splitter

B.3 Aero-HSD+ Handsets and Cradles

B.3.1 4-Wire Handset and 4-Wire Cradle

T&T Part Number: 405620A-THW / 405620A-THR / 405622A-THW / 405622A-THR

DO-160C String: A1-BA[MNB]XXXXXXAXXXB[UR]ZXXE3XX

RTCA/DO-160C Change Numbers			
Change Number	**Date of Issue**	**Title**	**Section**
Change No. 2	June 19, 1992	Lightning Induced Transient Susceptibility	22.0
Change No. 3	May 13, 1993	Radio Frequency Susceptibility	20.0

Table B-9: RTCA/DO-160C Change Numbers, 4-wire Handset and Cradle

Conditions	DO-160C	Cat.	Comments
Temperature and Altitude	4.0	A1	Installation in controlled temperature and pressurized location.
Low Temperature	4.5.1		Min. operating low temperature: -25°C
High Temperature	4.5.2 & 4.5.3		Max. operating high temperature: +55°C
In-Flight Loss of Cooling	4.5.4	-	No forced cooling required.
Altitude	4.6.1		Max. altitude: 55000 ft
Decompression	4.6.2		Decompression at 55000 ft
Overpressure	4.6.3		Overpressure at -15000 ft
Temperature Variation	5.0	B	Installation within partially or non-controlled temperature locations: 5°C/min.
Humidity	6.0	A	Standard Humidity: 95% relative humidity at 38°C to 50°C for 48 hours. Installation within environmentally controlled zones
Operational Shocks and Crash Safety	7.0	Yes	Equipment tested to: Standard operational shocks and crash safety.
Operational Shock	7.2	Yes	
Crash Safety	7.3	Yes	

Table B-10: Environmental Qualification Form for 4-Wire Handset and Cradle

Conditions	DO-160C	Cat.	Comments
Vibration	8.0	MB	Standard sinusoidal and random vibration: Aircraft type: Fixed wing. Turbojet, turbofan, reciprocating or turbopropeller engines.
		N	Aircraft type: Helicopter. Turbojet or reciprocating engines.
			Aircraft zone: Instrument panel, console or equipment rack.
Explosion Proofness	9.0	X	No test required
Waterproofness	10.0	X	No test required
Fluids Susceptibility	11.0	X	No test required
Sand and Dust	12.0	X	No test required
Fungus Resistance	13.0	X	No test required
Salt Spray	14.0	X	No test required
Magnetic Effect	15.0	A	Magnetic deflection distance: 0.3 m to 1 m
Power Input	16.0	X	No test required. DC power is provided by the SDU.
Voltage Spike	17.0	X	No test required
Audio Frequency Conducted Susceptibility - Power Inputs	18.0	X	No test required
Induced Signal Susceptibility	19.0	B	Installation where interference is controlled to a tolerable level.
Radio Frequency Susceptibility	20.0	UR	
Emission of Radio Frequency Energy	21.0	Z	Equipment intended for operation in systems where interference-free operation is required.
Lightning Induced Transient Susceptibility	22.0	XXE3	Cable Bundle Test: Equipment and wiring in moderately exposed environment in an all metal airframe.
Lightning Direct Effects	23.0	X	No test required
Icing	24.0	X	No test required

Table B-10: Environmental Qualification Form for 4-Wire Handset and Cradle

B.3.2 2-Wire Handset and 2-Wire Cradle

T&T Part Number: 405621B-THW / 405621B-THR / 405622B-THW / 405622B-THR

DO-160D String: [A1X]CAB[(SMB2)(SM)(UFF1)]XXXXXXAXXXB[RRR]M[A2E3]XXA

RTCA/DO-160D Change Numbers:
Original DO-160D. Date of issue: July 29, 1997

Conditions	DO-160D	Cat.	Comments
Temperature and Altitude	4.0	A1	Installation in controlled temperature and pressurized location.
Low Temperature	4.5.1		Min. operating low temperature: -25°C
High Temperature	4.5.2 & 4.5.3		Max. operating high temperature: +55°C
In-Flight Loss of Cooling	4.5.4	X	No forced cooling required.
Altitude	4.6.1		Max. altitude: 55000 ft
Decompression	4.6.2		Decompression at 55000 ft
Overpressure	4.6.3		Overpressure test at -15000 ft
Temperature Variation	5.0	C	Installation within controlled temperature locations: 2°/min.
Humidity	6.0	A	Standard Humidity: 95% relative humidity at 38°C to 50°C for 48 hours. Installation within environmentally controlled zones.
Operational Shocks and Crash Safety	7.0	B	Equipment tested to: Standard operational shocks and crash safety.
Vibration	8.0	S2B2	Standard random vibration: Aircraft type: Fixed wing. Turbojet or turbofan engines.
		SM	Standard sinusoidal vibration: Aircraft type: Fixed wing. Reciprocating or turbopropeller engines.
		UFF1	Robust Sine-on-Random vibration: Aircraft type: Helicopter. Turbojet or reciprocating engines.
			Aircraft zone: Instrument panel, console or equipment rack.
Explosion Proofness	9.0	X	No test required

Table B-11: Environmental Qualification Form for 2-Wire Handset and Cradle

Conditions	DO-160D	Cat.	Comments
Waterproofness	10.0	X	No test required
Fluids Susceptibility	11.0	X	No test required
Sand and Dust	12.0	X	No test required
Fungus Resistance	13.0	X	No test required
Salt Spray	14.0	X	No test required
Magnetic Effect	15.0	A	Magnetic deflection distance: 0.3 m to 1 m
Power Input	16.0	X	No test required
Voltage Spike	17.0	X	No test required
Audio Frequency Conducted Susceptibility	18.0	X	No test required
Induced Signal Susceptibility	19.0	B	Installation where interference is controlled to a tolerable level.
Radio Frequency Susceptibility	20.0	RRR	High Intensity Radiated Field (HIRF) associated with normal environment.
Emission of Radio Frequency Energy	21.0	M	
Lightning induced Transient Susceptibility	22.0	A2E3	Cable bundle test: Equipment and wiring in moderately exposed environment in an all metal airframe.
Lightning Direct Effects	23.0	X	No test required
Icing	24.0	X	No test required
Electrostatic Discharge (ESD)	25.0	A	Operation, installation and repair in an aerospace environment.

Table B-11: Environmental Qualification Form for 2-Wire Handset and Cradle

System Messages

C.1 Types of Messages

The Aero-HSD$^+$ system announces messages in the 4-wire handset.

One type of messages is Cause codes, which are information from the satcom services or status information from the system to the user.

Another type is BITE codes, which are information from the Aero-HSD$^+$ system. This information is a result of a POST or PAST sequence or Continuous Monitoring performed by the Built-In Test Equipment.

C.2 Cause Codes

C.2.1 H+ Cause Codes

Logon Reject Cause Codes

Display Text	ID	Description	Guidance
ClassReject	0x88	Class rejected	The GES does not support this class.
GlobChanLoss	0x82	Global channel loss	
GlobCunavlb	0x09	Global C channel not available at GES	
ManualLogRej	0x89	Manual login rejected	Manual logon is not allowed when logon policy is automatic.
NetworkFail	0x03	Network Failure	
NoGesSignal	0x81	No GES signal	
NoInitData	0x86	No valid system table available	
NoSatSignal	0x80	No satellite signal	Verify that there is no obstacle between the Satellite and the AES antenna.
NotAuthorizd		AES not authorized	Verify that the ICAO address used is correct; if it is, contact the service provider to verify that the ICAO address is registered.
OtherReason	0x0E	Other Reason	
OutsideCover	0x84	Outside spot beam coverage	The AES is not under a spot beam of the specified GES.
P/R/Tunavlb	0x07	Packet data channel unavailable	
PkdtaUnavlb	0x08	Packet data service unavailable	
SDUfailure	0x8A	SDU failure	Check the current BITE errors.
SpotChanLoss	0x83	Spot channel loss	
TableFull	0x00	Table Full	
UserLogoff	0x87	User logoff	
VCC&dUnavlb	0x0A	Voice not available at GES	

Table C-1: List of H+ Logon Reject Cause Codes

Display Text	ID	Description	Guidance
VoiceUnavlb	0x01	Voice Unavailable	
WrongGES	0x85	GES not existing	Check GES id validity.
WrongGESid	0x06	Wrong GES identifier	Check GES id validity.
WrongParam	0x02	Wrong Parameter	
WrongSatID	0x05	Wrong Satellite identifier	Check satellite id validity.

Table C-1: List of H+ Logon Reject Cause Codes

Call Reject Cause Codes

Display Text	ID (S-C-V)[a]	Description	Guidance
	0-1-0	Normal clearing	
AddrComplete	1-0-1	Address complete	
AESabsent	1-7-3	AES absent	
AnalogFail	1-2-3	Analog data equipment not available	
AnalogRate	1-6-2	Required analog data rate not supported	
Busy	0-1-1	User busy	
CallBared	1-4-3	Incoming calls barred	
CallPreempt	1-1-1	Call pre-empted	
CallRejected	0-1-5	Call rejected	
CardInvalid	1-6-1	Credit card type not supported	
CardRejected	1-3-1	Credit card number rejected	
ChanAbsent	0-4-2	Channel type not implemented	
DigitalFail	1-2-4	Digital data equipment not available	
DigitalRate	1-6-3	Required digital data rate not supported	
GndDestFail	0-1-11	Destination out of service	

Table C-2: List of H+ Call Reject Cause Codes

Display Text	ID (S-C-V)[a]	Description	Guidance
Handover	1-7-4	Spot beam handover	
InvalidAddr	1-3-2	Invalid/incomplete address	
InvalidNumbr	0-1-12	Invalid number format	
Network busy	1-5-1	Continuity failure	One end of the line has unexpectedly lost communication with the other, in most cases because the network is busy.
NetworkFail	0-2-6	Network Failure	
NoAnswer	0-1-2	No user responding	
NoChanAvail	1-2-1	No channel available	
NoCircuit	0-2-2	No circuit/channel available	
NoRoute	0-0-3	No route to destination	
NoUnitAvail	1-2-2	No channel unit available	Possible causes: 1. Both H^+ voice channels are already in use, and none of the existing calls can be pre-empted. 2. Not enough EIRP to initiate a call, and no other call can be pre-empted. 3. All allocated H^+ channels on the GES are in use.
SatDestFail	1-4-1	Destination out of service	
ServiceType	1-6-5	Service type not supported	
SwitchBusy	0-2-10	Switching equipment congestion	
UnassignedNo	1-7-2	Unassigned number	
Unauthorized	1-4-2	AES not authorized	
Undefined	1-7-15	Undefined cause	
Unspecified	0-1-15	Normal, unspecified	
User Busy	1-7-1	User busy	
VoiceTypeErr	1-6-4	Voice channel type not supported	
WrongNumber	0-0-1	Unassigned number	

Table C-2: List of H^+ Call Reject Cause Codes

a. S=Coding Standard, C=Cause Class, V=Cause Value

C.2.2 MPDS Cause Codes

Layer 2 Reason Codes

L2 Reason Number	Interpretation
700	Reason Unspecified
701	L3 Release
702	L3 Deregister
703	L3 Reject
716	SAN Idle Timer Expiry
717	MAN Idle Timer Expiry
718	SAN Connect Timer
719	SAN Modify Timer
720	SAN Handover Timer
721	SAN Connection Timer
722	MAN Connection Timer
732	Insufficient operating system resources at MAN
733	Insufficient memory at MAN
748	Invalid L3 Call Ref in Establish SDU
749	Invalid L3 Call Ref in Modify SDU
764	Unsupported IPDS MAC version
765	Invalid Bearer Connection type in Establish SDU
766	Invalid Bearer Control type in Establish SDU
767	Invalid Bearer Connection ID in Establish SDU
768	Invalid Bearer Connection type in Modify SDU
769	Invalid Bearer Control type in Modify SDU
770	Invalid Bearer Connection ID in Modify SDU
771	Invalid Handover SDU
772	Invalid SDU type

Table C-3: List of MPDS Layer 2 Reason Codes

L2 Reason Number	Interpretation
773	SDU Incorrectly Formatted
780	Connection sub-layer protocol failure (MAN specific signalling)
781	Connection sub-layer protocol failure (HDLC signalling)
796	Control sub-layer protocol failure
812	Channel Unit failure
813	Hardware failure
814	MAN not responding to frequency corrections
815	MAN not responding to power corrections
816	MAN not responding to timing corrections
828	Internal SAN failure
829	SAN Shutting Down
844	Bearer Control - No satellite link
845	Bearer Control - No suitable contention slot
846	Bearer Control - Status Acknowledgement failure
847	Bearer Control - Incorrect SAN ID
860	No such MAN
861	Invalid L3 Call Reference

Table C-3: List of MPDS Layer 2 Reason Codes

Layer 3 Reason Codes

L3 Reason Number	Interpretation
500	Unknown Error
501	LES Access Code does not support IPDS
502	Network does not recognize Mobile ID
503	Network does not recognize SIM Card
504	Authentication Failed to Complete
505	Authentication Failure
506	Authorization Failure
507	Authorization Failure - Mobile Barred
508	Authorization Failure - Mobile Barred on this LES Access Code
509	Authorization Failure - SIM Card Barred on this LES Access Code
510	Authorization Failure - Temporarily Unable to Accept Credit Cards
511	Authorization Failure - Unable to Accept Credit Cards
512	Authorization Failure - Credit Card Refused
513	Authorization Failure - This Service not Allowed
514	Authorization Failure - Service Option(s) not Allowed
515	Authorization Failure - QoS not Allowed
516	Unsupported Service Option(s)
517	QoS Option(s) Unsupported by Mobile
518	QoS Option(s) Unsupported by Network
519	Satellite Network Congestion
520	Satellite Network Unavailable
521	Service Congestion
522	Service Unavailable
523	Terrestrial Network Congestion
524	Terrestrial Network Unavailable
525	Terrestrial Network Destination - Busy

Table C-4: List of MPDS Layer 3 Reason Codes

L3 Reason Number	Interpretation
526	Terrestrial Network Destination - No Answer
527	Terrestrial Network Destination - Unavailable
528	Terrestrial Network Destination - No Carrier
529	Service Timed Out
530	Terminated by Network Operator
531	Insufficient Resources at Mobile
532	Mobile Failure
533	Mobile - Connection to DTE Lost
534	Mobile - Unrecoverable DTE Protocol Error
535	Mobile Reset
536	User Cancellation of Connection Establishment
600	Unable to Find Satellite Access Node
601	Unable to Establish Communication with Satellite Access Node
602	Link with Satellite Access Node Lost
1100	Registration Session Pre-empted by Host System (Proprietary - not taken from IPDS System Definition Manual)
1101	Registration Session Pre-empted for Priority Call 1 by Host System (Proprietary - not taken from IPDS System Definition Manual)
1102	Registration Session Pre-empted for Priority Call 2 by Host System (Proprietary - not taken from IPDS System Definition Manual)
1103	Registration Session Pre-empted for Priority Call 3 by Host System (Proprietary - not taken from IPDS System Definition Manual)

Table C-4: List of MPDS Layer 3 Reason Codes

C.2.3 ISDN Cause Codes (SLCV)

The SLCV codes refer to: S = Coding Standard, L = cause Location, C = cause Class, V = cause Value.

Code (Hex)				Interpretation
S	L	C	V	
1	0	0	1	MES is clearing the call as instructed by the relevant MES terminal equipment (i.e., normal clearing due to MES terminal “on-hook” etc.).
1	0	1	1	MES is rejecting the call because the specified MES terminal number is currently busy, and MES has not been authorized to divert calls which are addressed to that number.
1	0	1	2	MES is clearing the fixed-originated call because subsequent to the acceptance of the call and the signalling of the identity of the mobile terminal to which the call will actually be routed, that terminal has become busy and hence cannot be rung.
1	0	2	1	MES is clearing the call because appropriate “off-hook” signalling has not been received from the addressed MES terminal (including any authorized diversions) within the allowed time limit.
1	0	8	1	MES is rejecting the call because the specified MES terminal number has not been installed, and MES has not been authorized to divert calls which are addressed to that number.
1	0	9	1	MES is rejecting the call because the specified MES terminal number is currently out-of-service, and MES has not been authorized to divert calls which are addressed to that number.
1	0	9	2	MES is clearing the fixed-originated call because subsequent to the acceptance of the call and the signalling of the identity of the mobile terminal to which the call will actually be routed, that terminal has become out-of-service and hence cannot be rung.
1	1	4	3	MES is prematurely clearing the fixed-originated call which is in the process of being established because the MES user has initiated a call from a terminal which is authorized to automatically pre-empt an existing fixed-originated call.
1	1	4	4	MES is prematurely clearing the MES-originated call which is in the process of being established because the MES user has initiated a higher priority call.
1	1	4	5	MES is prematurely clearing the mobile-originated call which is in the process of being established because the MES user has initiated a call from a terminal which is authorized to automatically pre-empt an existing mobile-originated call.

Table C-5: List of ISDN Cause Codes (SLCV)

Code (Hex)				Interpretation
S	L	C	V	
1	1	4	6	MES is prematurely clearing the mobile-originated call which is in the process of being established because the MES user has abandoned the call (by placing the originating terminal “on-hook”).
1	1	D	1	LES is rejecting the call because the “Service Nature” and/or “Service Type” and/or “Channel parameter” information received from the MES is invalid (e.g., not currently defined in the SDM, mutually contradictory, or not applicable to a MES originated call).
1	1	D	2	LES is clearing the call because the “service address” information received from the MES is invalid (i.e., less than 2 digits).
1	1	D	3	LES is clearing the call because the “service address” information received from the MES is a 2-digit address which is either undefined or which is currently unavailable at this LES.
1	1	D	5	LES is clearing the call because the “service address” information received from the MES contains a country code which is regarded (by this LES) as invalid.
1	1	D	6	LES is clearing the call because the “PID” information received from the MES in the “scrambling vector” message (type 8D H) is not consistent with the PID information in the Fixed/MES Originated (PID) and PID/MES Registration Tables at the LES as it relates to this call.
1	2	0	2	(Spot Beam Handover): MES is ready to make the transition from the current beam to the next beam.
1	2	8	1	MES is rejecting the call because the MES is not equipped to provide the specified service.
1	2	9	1	MES is rejecting the call because although it is equipped to provide the specified service, it is not currently able to do so.
1	2	B	1	MES is rejecting or clearing the call for a reason which is not covered by any of the currently defined “Cause” events.
1	2	C	3	MES is clearing the call because a “LES Connect” message (type 8C H) has not been received by the MES within the allowed time limit.
1	2	C	4	MES is clearing the call because the “authentication query” ISU message (type B4 H) and/or the “authentication query” SSU message (type B5 H) have not been received by the MES within the allowed time limit.
1	2	C	5	MES is clearing the call because an expected supplementary services SU(s) has (have) not been received by the MES within the allowed time limit.

Table C-5: List of ISDN Cause Codes (SLCV)

Code (Hex) S	L	C	V	Interpretation
1	2	C	6	MES is clearing the call because the “supplementary services interrogation” ISU (type B2 H), and/or “subscriber digits” SSU (type AD H) messages have not been received by the MES within the allowed time limit.
1	2	C	7	MES is clearing the call because a “SCPC channel release” SU (type 8A H) has not been received by the MES, in response to the transmission of a “notification acknowledge” message (type BA H) during the supplementary services call diversion information retrieval process, within the allowed time limit.
1	2	C	8	(Spot Beam Handover): MES is clearing the call session in the next beam because the MES did not detect the LESH carrier on the new frequency.
1	2	D	1	LES is rejecting the call because the “spot-beam ID” information received from the MES is invalid (i.e., ID is not allocated on satellite in use).
1	2	D	2	LES is clearing the call because the “Scrambling Vector” information received from the MES is invalid (i.e., 0000H, 6959H or 7FFFH).
1	3	6	2	MES is clearing the call because a long-term interruption in reception has occurred (the definition of a “long-term interruption” depends upon the service type, see Section B).
1	3	6	3	A Secondary Functional Centre of a Multi-channel MES is clearing the call because the Primary Functional centre has commanded the Above-decks equipment to re-point to a different Ocean Region. **Note:** The above text is specific to a Fleet system. However, for the Aero HSD^{+} system this SLCV code is relevant when the H^{+} sub-system is repointing the antenna from one ocean region to another. That will cause the Swift64 sub-system to be pre-empted with the SLCV 1363.
1	3	9	1	MES is clearing the call because the call has lasted more than 700 km in linear travelled distance.
1	3	9	2	MES is clearing the call because it has moved out of spot beam coverage.
1	3	9	3	MES in “cooperative mode” is clearing the call because of a pre-emption request from the master entity.
1	4	5	1	LES is rejecting the call because an appropriate terrestrial circuit is not currently available at this specific LES.

Table C-5: List of ISDN Cause Codes (SLCV)

Code (Hex)				Interpretation
S	L	C	V	
1	4	5	2	LES is rejecting the call because an appropriate channel unit and associated terrestrial circuit are not currently available at this LES. [This "cause" is only utilized when there is a permanent "one-to-one" connection between appropriate channel units and their terrestrial circuits].
1	5	0	2	(Spot Beam Handover): LES is ready to make the transition from the current beam to the next beam and is clearing the call session in the current beam (normal clear).
1	5	5	1	LES is rejecting the call because an appropriate satellite channel is not currently available at this specific LES.
1	5	8	1	LES is rejecting the call because the requested service is not provided by this specific LES.
1	5	9	1	LES is rejecting the call because the requested service is temporarily not available at this specific LES.
1	5	A	1	LES is rejecting the call because the specified MES is not authorized for any service at this specific LES.
1	5	A	2	LES is rejecting the call because the specified MES is not authorized to use specific requested service via this specific LES.
1	5	A	3	LES is clearing the call because the "credit card data" information received from the MES has been rejected by the credit card authorization process.
1	5	A	4	LES is clearing the call because the data received from the MES in the "authentication reply" message (type B6 H) has been declared "invalid" by the LES authentication process.
1	5	A	5	LES is rejecting the call because the specified PID is not authorized for any service at this specific LES.
1	5	A	6	LES is rejecting the call because the specified PID is not authorized to use specific requested service via this specific LES.
1	5	A	7	LES is clearing the call because the service address received from the MES is not authorized for the requested priority.
1	5	B	1	LES is rejecting or clearing the call for a reason which is not covered by any of the currently defined "Cause" events.
1	5	C	1	LES is rejecting the call because an appropriate "Channel Assignment" message has not been received by the LES within the allowed time limit.

Table C-5: List of ISDN Cause Codes (SLCV)

Code (Hex)				Interpretation
S	L	C	V	
1	5	C	2	LES is clearing the call because the “service address” information has not been received by the LES within the allowed time limit.
1	5	C	3	LES is clearing the call because a “Scrambling Vector” message (type 8D H) has not been received by the LES within the allowed time limit.
1	5	C	4	LES is clearing the call because neither the “service address” information nor a “Scrambling Vector” message (type 8D H) has been received by the LES within the allowed time limit.
1	5	C	7	LES is clearing the call because a “MES Connect” message (type 99 H) has not been received by the LES within the allowed time limit.
1	5	C	9	LES is clearing the call because a “authentication reply” message (type B6 H) has not been received by the LES within the allowed time limit.
1	5	C	A	LES is clearing the call because a “notification acknowledge” message (type BA H) has not been received by the LES within the allowed time limit.
1	5	C	B	LES is clearing the call because the request sequence number contained in the received “notification acknowledge” message (type BA) is not valid (i.e. either not ‘0’ or not the next value in the sequence).
1	5	C	C	(Spot Beam Handover): LES is terminating the procedure because it did not receive a response to the Handover Request from the NCS.
1	5	C	D	(Spot Beam Handover): LES is clearing the call session in the next beam because the MES did not indicate that it was ready to make the transition (possibly because the MES did not receive the Channel Assignment).
1	5	D	1	LES is rejecting the call because the “Channel Assignment” message received from the NCS contains inappropriate or conflicting information.
1	5	D	2	LES is clearing this MES ID and channel number in the busy lists at LES and NCS because a new call to/from this MES is being set-up (and thus any previous call to/from this MES must have cleared).
1	5	E	1	LES is attempting to clear an MES which has sent an SCPC channel release message but is found still to be transmitting 5.12 s later.
1	6	5	1	LES is rejecting the call because an appropriate channel unit is not currently available at this specific LES.

Table C-5: List of ISDN Cause Codes (SLCV)

Code (Hex)				Interpretation
S	L	C	V	
1	6	6	1	LES is clearing the call because of an interruption in reception of the MES carrier exceeding the allowed time limit.
1	6	C	2	LES is clearing the call because an appropriate SCPC MES carrier has not been received by the LES (at the commencement of the call) within the allowed time limit.
1	6	C	3	(Spot Beam Handover): LES is clearing the call session in the next beam because the LES did not detect the MESH carrier on the new frequency.
1	7	9	1	LES is clearing the call because of a malfunction in the authentication checking database or in the communications links thereto.
1	8	1	1	NCS is rejecting the call because the specified MES ID is in the “MES busy” list at the NCS.
1	8	1	2	NCS is rejecting the call because the specified MES is busy with an IPDS call at the NCS.
1	8	1	3	NCS is rejecting the call because the specified MES is busy with an IPDS call at the NCS, and the call waiting notification was declined or timed out by the MES.
1	8	1	4	NCS is rejecting the call because the specified MES is busy with an IPDS call at the NCS, and call waiting notification is unavailable.
1	8	5	1	NCS is rejecting the call because an appropriate SCPC channel is not currently available.
1	8	5	2	NCS is rejecting the call because no SCPC channel exists at the NCS which matches the contents of the Channel Parameters, Service Nature, Service Type, MES Category, Spot Beam ID and Priority fields contained in the Request for Channel Assignment.
1	8	5	3	NCS is rejecting the call because no SCPC channel is currently available for the specified lease marked MES.
1	8	5	4	NCS is rejecting the call because the MES is outside the spot beam coverage area.
1	8	5	5	NCS is rejecting the call because an appropriate SCPC channel is not currently available and channel pre-emption failed.
1	8	5	6	NCS is rejecting the call because the requested spot beam indicates failed spot beam selection (“FF”) and an appropriate global SCPC channel is not currently available.

Table C-5: List of ISDN Cause Codes (SLCV)

Code (Hex) S	L	C	V	Interpretation
1	8	5	7	(Spot Beam Handover) NCS is rejecting the Handover Request because an appropriate SCPC channel is not available in the next beam.
1	8	A	1	NCS is rejecting the call because the specified MES ID was not found in the “Forward and Return MES ID” cross-reference table.
1	8	A	2	NCS is rejecting the call because the specified MES is not authorized for any service (except for Distress calls) at the NCS.
1	8	A	3	NCS is rejecting the call because the specified LES is not authorized for the requested service at the NCS.
1	8	B	1	NCS is rejecting or clearing the call for a reason which is not covered by any of the currently defined “Cause” events.
1	8	B	2	NCS is rejecting the call because the requested service variant is invalid.
1	8	C	1	NCS is rejecting the call because no message was received from the specified MES (in reaction to a Call Announcement message) within the allowed time limit.
1	8	C	3	NCS is rejecting the call because the specified MES was busy and the MES pre-emption failed (i.e. no response within the allowed time limit).
1	8	D	1	NCS is rejecting the call because the Request for Call Announcement or Request for Channel Assignment contains invalid or inappropriate information.
1	8	E	1	NCS is rejecting the call because the specified MES ID is in the “MES busy” list at the NCS, and is listed as being busy with a call through the same LES as that now requesting a “call announcement” addressed to that MES.
1	8	E	2	NCS is rejecting the call because the specified MES is busy with an IPDS call through the same LES which is requesting the call announcement.
1	8	E	4	NCS is rejecting the call because the specified MES is busy with an IPDS call through the same LES which is requesting the call announcement, and the call waiting notification was declined or timed out by the MES.
1	8	E	5	NCS is rejecting the call because the specified MES is busy with an IPDS call through the same LES which is requesting the call announcement, and call waiting notification is unavailable.

Table C-5: List of ISDN Cause Codes (SLCV)

Code (Hex)				Interpretation
S	L	C	V	
1	F	0	1	LES is clearing the call because of the receipt of “on-hook” signalling from the relevant terrestrial circuit (i.e., normal clearing).
1	F	1	1	LES is clearing the call because the terrestrial called party is engaged (busy).
1	F	2	1	LES is clearing the call because appropriate “off-hook” signalling from the terrestrial called party has not been received by the LES within the allowed time limit.
1	F	6	1	LES is clearing the call because of the detection of a failure in the relevant terrestrial circuit.
1	F	6	2	The LES is clearing the call because the terrestrial calling party or the terrestrial network has cleared the call before the “MES connect” message has been received by the LES.

Table C-5: List of ISDN Cause Codes (SLCV)

C.3 BITE Error Codes

C.3.1 Definition of Severity Levels

Severity	Definition
Fatal	Total loss of service – Ongoing calls are terminated and no further calls are allowed.
Essential	Partial loss of service, action taken to isolate the fault – some services / calls may work.
Non-E	Non-Essential, no action taken, not displayed in handset – only stored in BITE log.

Table C-6: Definition of severity levels for BITE Codes

The 4-wire handset and the SDU BITE display will show Fatal and Essential faults when possible. Access to the full BITE log is only possible through the SDU maintenance Front connector.

C.3.2 List of BITE Codes

Code (Hex)	LRU	Description	Severity
5F07	SDU	Missing DSP Code, H^+	Essential
AC01	ACU	Communication ACU-HPA	Essential
AC02	ACU	Communication HPA-ACU	Essential
AC03	ACU	Any Internal Parameter	Essential
AC04	ACU	Cross-talk Input	Non-E.
AC05	ACU	Control Bus Input	Non-E.
AC06	ACU	Internal RAM	Non-E.
AC07	ACU	Internal ROM	Non-E.
AC08	ACU	Internal Power Supply	Non-E.
AC09	ACU	Temperature	Non-E.
AA01	HGA	High Gain Antenna	Essential
AL01	LNA	LNA/Diplexer	Essential
AP01	HPR	High Power Relay	Essential
C601	Cable	SDU - HPA Cable Test	Fatal
C705	Cable	Communication Test with HGA-7000 Antenna	Fatal
C801	Cable	Communication Test with HPA	Fatal
C802	Cable	No GPS Signal to GPS Module	Fatal
C957	HPA	HPA Communication with PSM Module	Fatal
CA30	CM	Invalid ICAO Number	Fatal
E108	CM	Configuration Module Fitted Test	Fatal
H201	HPA	HPA Software Integrity	Fatal
H202	HPA	HPA Communication with Main Module EEPROM	Fatal
H203	HPA	HPA Essential Data Integrity	Fatal
H204	HPA	HPA Non-Essential Data Integrity	Non-E.
H401	HPA	HPA Communication with Main Module UART	Fatal
H502	HPA	HPA Communication with RFHP Module	Fatal

Table C-7: List of BITE Codes

Code (Hex)	LRU	Description	Severity
H701	HPA	HPA FPGA Version Conflict	Fatal
H803	HPA	HPA Gain Adjustment Limit	Fatal
H804	HPA	HPA Frequency Calibration	Fatal
H901	HPA	HPA Communication Failure	Fatal
HP01	HPA	HPA Thermal Safe Operational Limits	Fatal
HP11	HPA	ARINC 429 Interface Voltage (-12 VD)	Fatal
HP13	HPA	HPA Internal Voltage (+5V1A)	Fatal
HP14	HPA	ARINC 429 Interface Voltage (+12 VD)	Fatal
HP15	HPA	HPA HGA-7000 Supply Voltage (+26 VA)	Fatal
HP17	HPA	HPA RFHP Module Voltage (+26 VC)	Fatal
HPF1	HPA	HPA Forced Cooling (FAN1, FAN2 and FAN3)	Essential
U402	SDU	HPLUS Files Existing Test	Fatal
U403	SDU	HPLUS Files CRC Test	Essential
U405	SDU	HPLUS Software Versions Inconsistency Test	Essential
U901	Cable	IRS/AHRS 1 Failure	Non-E.
U902	Cable	IRS/AHRS 2 Failure	Non-E.
U908	Cable	IRS/AHRS/GPS Data Invalid	Fatal
U915	SDU	SDU needs SW update to support HPA	Fatal
UA01	SDU	BITE Display Interface Data Loop Test	Non-E.
UC00	SDU	5.Lo Lock Detector Test	Essential
UC01	SDU	5.Lo Minimum Frequency Lock Test	Essential
UC02	SDU	5.Lo Maximum Frequency Lock Test	Essential
UC04	SDU	C-channel 1 AGC Test	Essential
UC0G	SDU	5.Lo Lock Failure	Essential
UC0P	SDU	Interface to C-FDM DSP Channel 1 Test	Essential
UC0Q	SDU	Interface to TIF DSP Channel 1 Test	Essential
UC10	SDU	6.Lo Lock Detector Test	Essential
UC11	SDU	6.Lo Minimum Frequency Lock Test	Essential

Table C-7: List of BITE Codes

Code (Hex)	LRU	Description	Severity
UC12	SDU	6.Lo Maximum Frequency Lock Test	Essential
UC14	SDU	C-channel 2 AGC Test	Essential
UC1G	SDU	6.Lo Lock Failure	Essential
UC1P	SDU	Interface to C-FDM DSP Channel 2 Test	Essential
UC1Q	SDU	Interface to TIF DSP Channel 2 Test	Essential
UC1R	SDU	SDU needs SW update (C-Channel)	Essential
UE01	SDU	HSD Rx Cable Test	Non-E.
UF01	SDU	1.Lo Lock Detector Test	Fatal
UF02	SDU	2.Lo Lock Detector Test	Fatal
UF03	SDU	3.Lo Lock Detector Test	Fatal
UF04	SDU	4.Lo Lock Detector Test	Fatal
UF11	SDU	1.Lo Minimum Frequency Lock Test	Fatal
UF12	SDU	2.Lo Minimum Frequency Lock Test	Fatal
UF13	SDU	3.Lo Minimum Frequency Lock Test	Fatal
UF14	SDU	4.Lo Minimum Frequency Lock Test	Fatal
UF21	SDU	1.Lo Maximum Frequency Lock Test	Fatal
UF22	SDU	2.Lo Maximum Frequency Lock Test	Fatal
UF23	SDU	3.Lo Maximum Frequency Lock Test	Fatal
UF24	SDU	4.Lo Maximum Frequency Lock Test	Fatal
UF30	SDU	RT Channel ALC Test	Fatal
UF31	SDU	P Channel AGC Test	Fatal
UF51	SDU	1.Lo Lock Failure	Essential
UF52	SDU	2.Lo Lock Failure	Essential
UF53	SDU	3.Lo Lock Failure	Essential
UF54	SDU	41.Lo Lock Failure	Essential
UF70	SDU	GPS Internal BITE Test	Fatal
UF71	SDU	GPS Communication Test	Fatal
UH01	SDU/HSU	1.LO Low Lock Detector Test	Essential

Table C-7: List of BITE Codes

Code (Hex)	LRU	Description	Severity
UH02	SDU/HSU	2.LO Low Lock Detector Test	Essential
UH03	SDU/HSU	3.LO Low Lock Detector Test	Essential
UH04	SDU/HSU	1.LO High Lock Detector Test	Essential
UH05	SDU/HSU	21.LO High Lock Detector Test	Essential
UH06	SDU/HSU	3.LO High Lock Detector Test	Essential
UH11	SDU/HSU	1.LO Minimum Frequency Test	Essential
UH12	SDU/HSU	2.LO Minimum Frequency Test	Essential
UH13	SDU/HSU	3.LO Minimum Frequency Test	Essential
UH18	SDU/HSU	1.LO Lock Time Test	Essential
UH19	SDU/HSU	2.LO Lock Time Test	Essential
UH20	SDU/HSU	3.LO Lock Time Test	Essential
UH21	SDU/HSU	1.LO Maximum Frequency Test	Essential
UH22	SDU/HSU	2.LO Maximum Frequency Test	Essential
UH23	SDU/HSU	3.LO Maximum Frequency Test	Essential
UH24	SDU/HSU	1.LO DDS Divider Test	Essential
UH25	SDU/HSU	3.LO DDS Divider Test	Essential
UH30	SDU/HSU	ALC Carrier off Test	Essential
UH31	SDU/HSU	ALC Carrier on Test	Essential
UH32	SDU/HSU	RF BER Loop Back Test	Essential
UH33	SDU/HSU	Average Amplitude Test	Non-E.
UH35	SDU/HSU	Step Attenuator Test	Non-E.
UH3B	SDU/HSU	Rx Tx frequency offset to big Test	Essential
UH3D	SDU/HSU	Loop Back Switch Test	Essential
UH51	SDU/HSU	1.LO Lock Failure	Essential
UH52	SDU/HSU	2.LO Lock Failure	Essential
UH53	SDU/HSU	3.LO Lock Failure	Essential
UH61	SDU/HSU	ALC Level to Low Test	Essential
UH62	SDU/HSU	ALC Level to High Test	Essential

Table C-7: List of BITE Codes

Code (Hex)	LRU	Description	Severity
UH63	SDU/HSU	Master Oscillator to low	Essential
UH64	SDU/HSU	Master Oscillator to high	Essential
UH70	SDU/HSU	Communication problem with H+ system	Essential
UH78	SDU/HSU	Position Unavailable	Essential
UH79	SDU/HSU	Velocity Unavailable	Essential
UH7D	SDU/HSU	Software Versions Consistency Test	Non-E.
UH7F	SDU/HSU	ATE pins connected. The ATE pins should not be connected, as they are only for test purposes.	Non-E.
UH7G	SDU/HSU	ATE pins connected. The ATE pins should not be connected, as they are only for test purposes.	Non-E.
UH82	SDU/HSU	Parameter Block Checksum Test HSD	Essential
UH83	SDU/HSU	CPU Application CRC Test	Essential
UH84	SDU/HSU	CPU RAM Test	Essential
UH85	SDU/HSU	Battery Check Test HSD	Non-E.
UH87	SDU/HSU	All Files Exist in Flash Test	Essential
UH88	SDU/HSU	Flash Files CRC Test	Essential
UH89	SDU/HSU	SDU needs SW update (HSD)	Essential
UH91	SDU/HSU	DSP Debug Port Test	Non-E.
UH95	SDU/HSU	Frame DSP Interface Test	Essential
UH96	SDU/HSU	Turbo FPGA Interface Failure	Essential
UH97	SDU/HSU	Frame DSP to VFC DSP interface	Essential
UH98	SDU/HSU	VFC DSP Interface Test	Essential
UHA1	SDU/HSU	Burst Duration Monitor Circuit Test	Non-E.
UHA4	SDU/HSU	TDM Burst Duration Test	Essential
UHA5	SDU/HSU	Carrier On Signals Test	Essential
UHA6	SDU/HSU	Turbo FPGA Load Test	Essential
UHA7	SDU/HSU	ISDN Transceiver Interface Test	Essential
UHA8	SDU/HSU	ISDN Supply Voltage Test	Essential

Table C-7: List of BITE Codes

Code (Hex)	LRU	Description	Severity
UHA9	SDU/HSU	ISDN Rx Voltage Test	Essential
UHAA	SDU/HSU	Turbo FPGA RAM Test	Essential
UHAB	SDU/HSU	Power Fail sensor false alarm	Essential
UHAC	SDU/HSU	ISDN 38 V shorted. The current limit on the 38V power output has been exceeded and the output power has therefore been turned off. Remove the device(s) connected and restart the system.	Essential
UHB0	SDU/HSU	Environment temperature to low	Non-E.
UHB1	SDU/HSU	Temperature Sensor Test	Non-E.
UHEE	SDU/HSU	EEPROM Essential Data Test	Essential
UHEU	SDU/HSU	EEPROM Test	Non-E.
UHP0	SDU/HSU	Communication Test with HSD-CPU	Essential
UHW2	SDU/HSU	Master Oscillator needs calibration	Non-E.
UU02	SDU	Parameter Block Checksum Test	Essential
UU05	SDU	UART Loop Back, PC Front (COM1) Test	Non-E.
UU06	SDU	UART Loop Back, HGA-7000 Antenna (COM2) Test	Fatal
UU07	SDU	UART Loop Back, HPA (COM11) Test	Fatal
UU08	SDU	UART Loop Back, GPS (COM4) Test	Fatal
UU10	SDU	PRT DSP Interface Test	Essential
UU11	SDU	UART Loop Back, Handset1 (COM5) Test	Essential
UU12	SDU	UART Loop Back, Handset2 (COM6) Test	Essential
UU13	SDU	UART Loop Back, Handset3 (COM7) Test	Essential
UU14	SDU	UART Loop Back, Handset4 (COM8) Test	Essential
UU15	SDU	UART Loop Back, Rear Debug (COM3) Test	Non-E.
UU16	SDU	UART Loop Back, CPDF (COM12) Test	Essential
UU17	SDU	UART Loop Back, HSD - H^+ (COM13) Test	Essential
UU18	SDU	UART Loop Back, External SIM Card (COM10) Test	Non-E.

Table C-7: List of BITE Codes

Code (Hex)	LRU	Description	Severity
UU19	SDU	SDU needs SW update (H^+)	Essential
UU1C	SDU	Temperature Sensor Test	Non-E.
UU1D	SDU	Environment Temperature Failure, H-Plus	Fatal
UU20	SDU	H^+ EEPROM Non Essential Data Test	Non-E.
UU21	SDU	H^+ EEPROM Essential Data Test	Fatal
UU23	SDU	H^+/HSD SW Version Inconsistency Test	Essential
UU60	SDU	PBX DSP Interface Test	Essential
UU6H	SDU	Communication Problem with HSD CPU, H^+ Detected	Essential
UUB1	SDU	Battery Check Test	Non-E.
UUCU	CM	Configuration Module Test	Fatal

Table C-7: List of BITE Codes

Using Commands

D.1 Getting Started

Hardware and Software Requirements

The following items are required to run terminal commands:

- One IBM compatible PC with a 9-pin serial COM port available (or a 25-pin serial COM port with a 25-to-9 converter attached)
- One serial interconnect cable 9-pin to 15-pin Sub-D, Thrane & Thrane part no. TT-37-112940. Refer to **Figure 5-27: TT 37-112940 Data Cable Compliant with Front Connector**.
- A terminal program installed on the PC (e.g. Windows HyperTerminal)

Preparing the Terminal

Do as follows to set up the terminal:

1. Connect the SDU front connector to the PC COM port using the TT 37-112940 Data Cable.
2. Set the terminal program to 115200 baud, No parity, 8 bit symbols.
3. Press <Enter> a couple of times and confirm that the prompt “H+>” appears on the terminal monitor.

D.2 Commands for Troubleshooting

Introduction

In this section, some of the useful commands for troubleshooting are listed.

BITE List ("list" command)

To get a list of BITE errors, use the **list** command.

The following options are available with the list command:

Command to Type in (Followed by <Enter>)	Result/Explanation
`list`	Lists all errors for the current flight session.
`list a`	Lists all errors for all flight sessions.
`list <leg>`	Lists all errors for flight session number: leg[a].
`list <id> a`	Lists errors with error id: id, for all flight sessions.
`list <id><leg>`	Lists errors with error id: id, for flight session number: leg[a].

Table D-1: "list" Commands

a. In this context, a leg is defined as a session, that is the time from the system was turned on until it is turned off.

Response Example:

The following example shows a response to the command "`list`", that is a list of all errors for the current session. "Session number" corresponds to <leg> "Error ID" corresponds to <id>, which is the BITE code for the error.

```
H+> list
H+>
LOGFILEMANAGER:Displaying contents of session 11
------------------------------
Session number: 11  Severity: Fatal              Active
Error ID: C705-Communication Test with HGA-7000 Antenna
Error occurrence: 001            Found during:  CM
Additional Information: '      ' Location: Cabling
First error: 09:40:14-27/08  Last error: 09:40:14-27/08
```

System Log ("slog" command)

To access the system log, use the **slog** command. The following options are available with the slog command:

Command to Type in (Followed by <Enter>)	Result/Explanation
`slog l<prio> ...`	Inserts text into the system log with priority <prio>[a].
`slog t`	Shows the priority thresholds.
`slog tp <prio>`	Sets the print threshold. Log entries with priority <prio>[a] or higher will be printed.
`slog ts <prio>`	Sets the store threshold. Log entries with priority <prio>[a] or higher will be stored.
`slog v[arl] [-p<prio>] [-t<text>] [<count>]`	Shows the system log as defined by the parameters. Explanation of parameters: a : All entries r : Reverse order l : Long time format (toggles between long/short time format) (sticky[b]) <prio> : [a] (See table footnote) <text> : Only entries containing <text> <count>: Max. number of entries shown (sticky[b])
`slog R`	Reset system log.

Table D-2: "slog" Commands

a. <prio>: Priority limit (one of {facewnid} or 0-7).
The priority parameters {facewnid} are defined as:
f: System is unusable.
a: Action must be taken immediately.
c: Critical conditions.
e: Error conditions.
w: Warning conditions.
n: Normal but significant condition.
i: Informational.
d: Debug-level messages.

b. "Sticky" means this setting is maintained during future command sessions until the setting is changed by the user.

Response Example:

The following example shows a part of a response to the command "`slog va`":

```
H+> slog va

H+>

    Time     Severity  Process   Info

09:15:05.661 WARNING:LogServe:0:System log invalid - reset

09:15:05.663 WARNING:LogServe:0:System log options invalid -
reset

09:14:53.005  NOTICE:    Boot:0:Starting up

09:14:54.523   ERROR:  SATMGR:0:System table checksum failed

09:14:54.525   ERROR:Nav_Main:0:Static RAM failure!!

09:14:55.057 WARNING:FlashDis:0:PIT 1ms tick: Interrupts
disabled too long: 531058 us.

09:14:55.505 WARNING:FlashDis:0:PIT 1ms tick: Interrupts
disabled too long: 505840 us.
```

Call Log ("call_log" command)

To access the call log, use the **call_log** command.

The following options are available with the call_log command:

Command to Type in (Followed by <Enter>)	Result/Explanation
`call_log -p`	Prints the call log.
`call_log -i <number> <device>`	Inserts a call into the call log, with the given phone number and device number.
`call_log -g <device>`	Returns the last call in the call log from the given device.
`call_log -d <device> <index>`	Deletes the call with index <index> from the given device in the call log.

Table D-3: "call_log" Commands

Response Example:

The following example shows a part of a response to the command "`call -p`":

```
H+> call -p
Current Time is: 1093609507
Entry time: 1081251724, number: 004539558227 Device: 68
          : 1081251553, number: 004539558227 Device: 68
          : 1081251698, number: 004539558227 Device: 68
Entry time: 1081251586, number: 004539558227 Device: 67
Entry time: 1081251551, number: 004539558681 Device: 67
Entry time: 1080547957, number: 004540921481 Device: 58
Entry time: 1080547909, number: 004539558227 Device: 55
          : 1080547873, number: 004539558227 Device: 55
```

Flight Test ("flight" command)

To trace flight data, use the **flight** command. The flight test data comprises position data, signal strength and EIRP.

The following options are available with the flight command:

Command to Type in (Followed by <Enter>)	Result/Explanation
`flight -c <time>`	Change the update rate to <time>.
`flight -e`	End flight test traces.
`flight -s`	Start trace of flight test data with an update rate of 1 second.
`flight -s <time>`	Start trace of flight test data with an update rate of <time>. The unit for <time> is 10 ms, that is: <time>=2 corresponds to 20 ms.

Table D-4: "flight" Commands

Response Example:

The following example shows a response to the command "`flight -s`", that is flight test data with an update rate of 1 second. The command "`flight -e`" stops the tracing.

```
H+> flight -s


H+> Fri Aug 27 12:26:32 2004 H+Temp 44
NAV POS: Lon   9.13, Lat 55.73, Alt 117 m
NAV ATT: Roll  0.41, Pitch -0.97, Hea 135.71, Speed 0 m/s
DSP: Azi  73.11, Ele 23.60, VDopp 0 m/s
PRT: C/No 54.0 EIRP  09.1 FreqOff 006
C0:  C/No 45.1 EIRP  06.5
C1:  C/No 54.1 EIRP  18.5
HSD: C/No 57.3 EIRP  22.5 FreqOff -01
--
flight -e
```

AT Profiles

Overview

As a part of the RS-422 AT-interface in the SDU, there are two AT-profiles on the internal modem. These profiles are the same as those found on any normal modem. The profiles store settings used by the serial port, standard AT variables and some values used by the satellite protocols.

Besides the two stored profiles, there is a third profile, which is called the Active Profile. The Active Profile is stored in RAM and holds the settings currently used by the SDU. All AT commands only change the settings of the Active Profile.

E.1 Frequently Used AT Commands

- To **store** the Active Profile in the Stored Profile, use the command
  AT&W#
  where # is either 0 or 1, depending on which Stored Profile the settings should be saved in.
- Likewise, to **restore** a Stored Profile as an Active Profile, use the command
  ATZ#
  where # is either 0 or 1, depending on which Stored Profile is to be restored.

When the system boots up, it will copy one of the Stored Profiles to the Active Profile. It is the value of the &Y parameter, that governs which one of the two Stored Profiles is used for initialization.

- To set the SDU to use a specific Stored Profile # to initialize the Active Profile, use the command
  AT&Y#
  where # is either 0 or 1.
- To see the current value of &Y, use the command
  AT&V
  which also shows the settings of all 3 profiles.

For more information on AT commands in general, please refer to the Hayes Command Set.

E.2 LES settings for AT-calls

It is important to know that the AT profiles have nothing to do with LES settings and satellite selection.

The LES used for AT initiated calls is distinct from the LES used for PPPoE initiated calls. When booting up, the LES used for AT-calls will automatically be set to the most preferred LES for the given ocean region, which is the same way the PPPoE LES is configured.

When the LES's have been configured, they are now distinct. This means an **AT+WLES** command only changes the LES used for AT-calls and *not* the LES used for PPPoE calls.

However, if an **AT&W** command is issued, and the most preferred LES is different from the LES used for AT-calls, the AT-call LES will be made the most preferred LES. This also means that PPPoE will now use the new LES for calls.

The following list shows the behavior of the SDU when an **AT+WLES** command is issued:

1. Preferred LES is 001.
2. `AT+WLES=002` is executed.
3. An MPDS registration is started through the AT-interface. LES 002 is used.
4. An MPDS deregistration is executed through the AT-interface.
5. An MPDS registration is started with PPPoE. LES 001 is used.
6. An MPDS deregistration is executed through the PPPoE interface.
7. An MPDS registration is executed through the AT-interface. LES 002 is still used.

Note that if the ocean region is changed, both the AT LES and PPPoE LES are automatically set to the default LES for that Ocean Region.

Note: If the preferred LES is changed on the Handset, this change will not have any effects on the LES used for AT calls. The LES must be manually changed by issuing an **AT+WLES** command or by a renewed logon.

References

F.1 Applicable Standards

[1] IEEE Standard for Information technology - Telecommunications and information exchange between systems - Local and metropolitan area networks - Specific requirements Part 3: Carrier sense multiple access with collision detection (CSMA/CD) access method and physical layer specifications. IEEE Std 802.3, 2000 Edition (Incorporating IEEE Std 802.3, 1998 Edition, IEEE Std 802.3ac-1998, IEEE Std 802.3ab-1999, and IEEE Std 802.3ad-2000) [Adopted by ISO/IEC and re-designated as ISO/IEC 8802-3:2000(E)].

[2] ISO/IEC 8877:1992 Information technology -- Telecommunications and information exchange between systems -- Interface connector and contact assignments for ISDN Basic Access Interface located at reference points S and T

[3] RTCA/DO-160C and RTCA/DO-160D
Environmental Conditions and Test Procedures for Airborne Equipment
RTCA Inc. July 29, 1997, incl. Change No. 1 (Dec. 14, 2000) and Change No. 2 (June 12, 2001).

[4] Integrated Services Digital Network (ISDN)
Basic User-Network Interface (UNI)
ETSI EN 300 012-1 V1.2.2 (ITU I.430))

[5] Integrated Services Digital Network (ISDN)
ISDN User Network Interfaces
ITU-T Recommendation I.420

[6] ARINC 429
Mark 33 Digital Information Transfer Systems (DITS)

[7] ARINC 404A
Air Transport Equipment Cases and Racking.

[8] ARINC 404B-1
Connectors, Electrical, Rack and Panel, Rectangular, Rear Release Crimp Contacts.

[9] ARINC 702A-1
Advanced Flight Management Computer System
ARINC, January 31, 2000

[10] ARINC 741 P1-10
Aviation Satellite Communication System
Part 1, Aircraft Installation Provisions

[11] ARINC 741 P2-7
Aviation Satellite Communication System
Part 2, System Design and Equipment Functional Description

[12] RFC 1549: PPP in HDLC Framing. December 1993. (Obsoleted by RFC 1662)

[13] CCITT Rec. G.473
Standard US DTMF Telephone.

[14] EIA/TIA-232-E: Interface Between Data Terminal Equipment and Data Circuit-Terminating Equipment Employing Serial Binary Data Interchange (superseded by TIA-232-F) Published: January 1, 1900. Category: Telecommunications.

[15] RTCA DO-160C and D
Environmental Conditions and Test Procedures for Airborne Equipment

F.2 Other References

[16] Aero-HSD^{+} User Manual, Part number TT-98-119959

Glossary

A

a very simple device which literally points towards the station that is tuned in.

ACARS	Airborne Communications Addressing and Reporting System
ACAS	Aircraft Collision Avoidance System. Early relative of the now operational TCAS (Traffic Alert and Collision Avoidance System) which warns pilots of potential conflicts with other aircrafts.
ACU	Antenna Control Unit
ADF	Automatic Direction Finder. A navigation receiver based on the AM radio band
AES	Aircraft Earth Station
AGC	Automatic Gain Control
AHRS	Attitude and Heading Reference System
AIU	Analog Interface Unit
ALC	Automatic Level Control
AOC	Aeronautical Operational Control. One of the categories within Aeronautical Mobile Satellite Services (AMSS) in the DO-160 standard.
APS	Aircraft Power Supply
ARINC	Aeronautical Radio INC.
ARTU	Air Radio Telecommunications Unit
ATS	Air Traffic Services. One of the categories within Aeronautical Mobile Satellite Services (AMSS) in the DO-160 standard.

B

BSU	Beam Steering Unit

C

CDBR	Cabin Distribution Bus Repeater
C-FDM	C-channel Frame Demodulator/Modulator

CM	Configuration Module
CMU	Communications Management Unit
CP	Cockpit
CPDF	Cabin Packet-mode Data Function
CPU	Central Programming Unit
CRC	Cyclic Redundancy Check
CTS	Clear To Send

D

DCE	Data Circuit-terminating Equipment
DME	Distance Measuring Equipment
DSP	Digital Signal Processor
DTMF	Dual Tone Multi Frequency. The signal to the phone company that is generated when you press an ordinary telephone's touch keys. DTMF has generally replaced loop disconnect ("pulse") dialling.

E

ECEF	Earth Centered Earth Fixed coordinates. An international coordinate frame of reference.
EEPROM	Electrically Erasable Programmable Read Only Memory
EIA	Electronic Industries Alliance. A US national trade organization that includes the full spectrum of U.S. manufacturers, representing more than 80% of the electronics industry. The alliance provides several standards for the electronics industry.
ETSI	European Telecommunication Standard Institute

F

FMS	Flight Management System
FPGA	Field Programmable Gate Array

G

GPS	Global Positioning System

H

HDLC	High-level Data Link Control
HGA	High Gain Antenna
HS	High Speed
HSU	High Speed data Unit. An optional Thrane & Thrane unit providing an additional high speed channel.

I

ICAO	International Civil Aviation Organization
ILS	Instrument Landing System. A system of tightly focused transmitters located at the end of a runway that provides flight guidance information to flight crews.
IRS	Inertial Reference System
ISDN	Integrated Services Digital Network
ITU	International Telecommunication Union

L

LRU	Line Replaceable Unit. A separate unit or module which can easily be replaced. Examples are the SDU and the HPA.
LS	Low Speed

M

MES	Mobile Earth Station
MPDS	Mobile Packet Data Service

N

nON	normally ON

NT	Network Termination. A device connecting the customer's data or telephone equipment to the local ISDN exchange carrier's line. The NT device provides a connection for terminal equipment (TE) and terminal adaptor (TA) equipment to the local loop.

P

PAST	Person Activated Self Test. A system test that is activated when the PTT button on the SDU is pressed.
PBX	Private Branch Exchange (private telephone switchboard)
PID	Packet IDentifier
POST	Power On Self Test. A system test that is activated each time the system is powered on.
PSM	Phase Shift Modulation

R

RAM	Random Access Memory
RF	Radio Frequency
RFC	Request For Comments
RFHP	Radio Frequency High Power
RMA	Return Material Authorization
RTS	Request To Send

S

SCPC	Single Channel Per Carrier. A VSAT satellite transmission system that uses a separate carrier for each of its channels. In an SCPC system, transmissions are sent to the satellite continuously on a single satellite carrier.
SDM	System Definition Manual
SIM	Subscriber Identification Module
SLCV	S = coding Standard, L = cause Location, C = cause Class, V = cause Value
STC	Supplemental Type Certificate. FAA certification document issued to companies that perform significant modifications on an aircraft.

STU	Secure Telephone Unit
Swift64	Inmarsat full ISDN service + full IP service (MPDS)

T

TCAS	Traffic Alert and Collision Avoidance System. A system which warns pilots of potential conflicts with other aircrafts.
TDM	Time Division Multiplex
TIA	Telecommunications Industry Association. TIA is a U.S. non-profit trade association serving the communications and information technology industry. TIA provides several standards for these industries.
TMU	Telecommunication Management Unit

U

UART	Universal Asynchronous Receiver/Transmitter

V

VFC	Voice Fax Codec
VHF	Very High Frequency. 30-300 MHz, a "straight-line" signal used for communication and navigation.
VOR	VHF Omnidirectional Range

W

WH-10	Wulfsberg Handset

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