TRA-100B Mode S Transponder (TRA-100B)
Honeywell

Component Maintenance Manual (CMM)

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1.1 TRA-100B MODE S TRANSPONDER - LIST OF ABBREVIATIONS

Table 1-1 - List of Abbreviations

Symbol	Instruction
AC	Alternate Current
AD, A/D	Analogue to Digital
BIT	Built In Test
BITE	Built In Test Equipment
CBIT	Continuous Built In Test
DC	Direct Current
GND	GrouND
HF	High Frequency
IBIT	Interruptive Built In Test
LRU	Line Replaceable Unit
MT	Mounting Tray
NSN	Nato Stock Number
PBIT	Power-on Built In Test
RF	Radio Frequency
RX	Receiver
TX	Transmitter

1.2 TRA-100B MODE S TRANSPONDER – CONFIGURATION

This manual is applicable to the following TRA-100B Mode S Transponder Part Numbers (Table 1-2):

Table 1-2 – TRA-100B - Configuration Data

2 Ref. Figure 1-1	Description	Part Number	Qty
1	TRA-100B Mode S Transponder TRA-100B Mode S Transponder TRA-100B Mode S Transponder	TAC-6001/03 TAC-6003/03 TAC-6004/03	1
2	Wired Chassis (WC)	TAE-6001/03	1
3	Data Processor and I/O (DPIO)	TAQ-5432/03	1
4	RF – Subassembly (RF)	TAG-5501/03	1
5	AC Power Supply (ACPS)	TAG-5433/03	1
6	DC Power Supply (DCPS)	TAG-5435/03	1
NI	TRA-100B Operative SW	TBR-6001/01	1

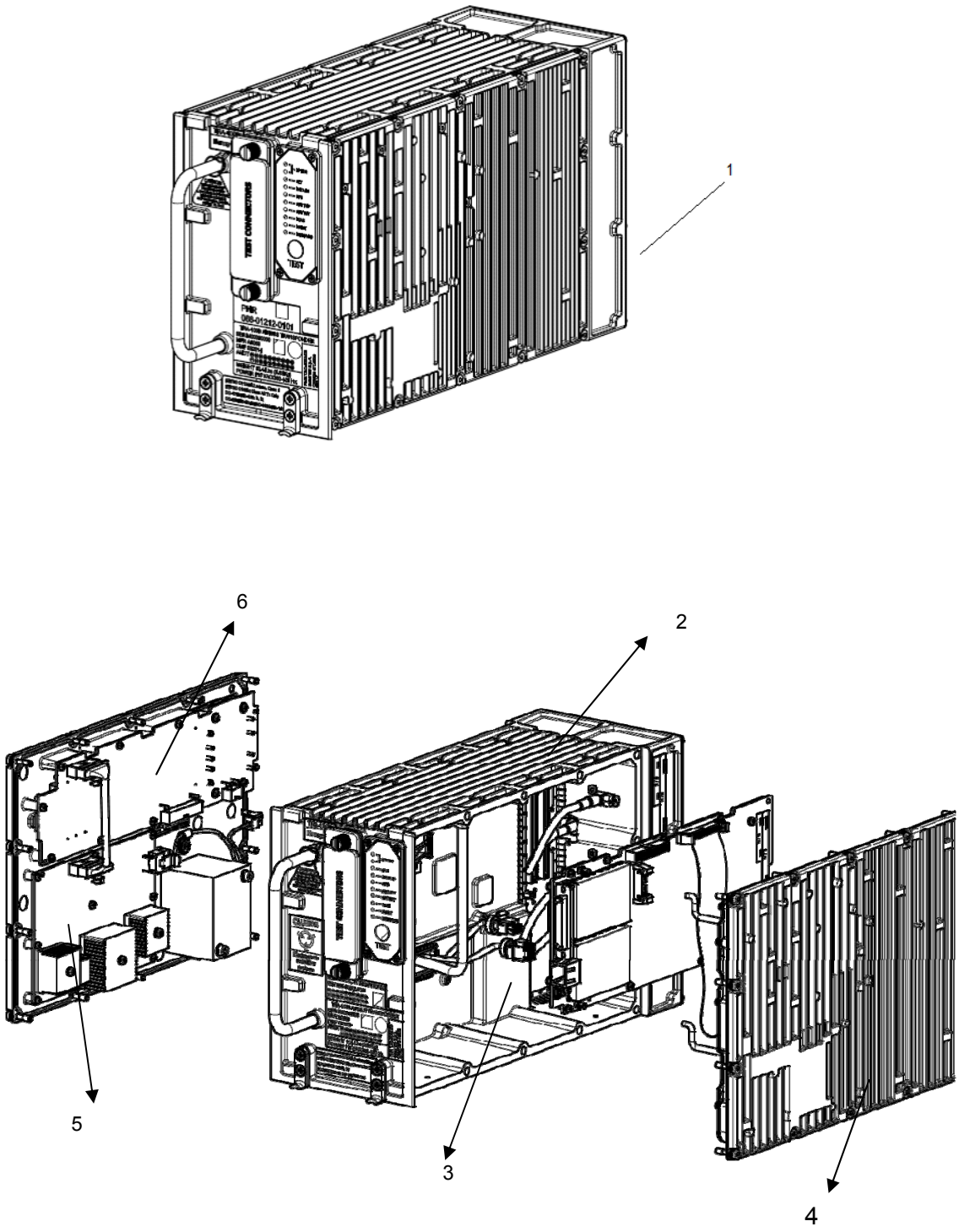


Figure 1-1 – TRA-100B Mode S Transponder - Configuration

2.1 TRA-100B Mode S TRANSPONDER – INTRODUCTION

The TRA-100B Mode S Transponder is a remote mounted avionics device which provides the Mode S Transponder function required by Technical Standard Order (ETSO-C112d).

The XPDR also provides Extended Squitter ADS-B Out function required by ETSO-C166b/.

The TRA-100B Modes S Transponder is designed to be a Level 2 transponder.
It includes the capabilities of a Level 1 Transponder:

- Mode A identity and Mode C pressure-altitude reporting,
- Air Traffic Control Radar Beacon System (ATCRBS)/Mode-S and Mode S all-call transactions,
- Addressed surveillance altitude and identity transaction,
- Lockout protocols,
- Basic data protocols except data link capability reporting, and
- Air-to-air service and squitter transactions.

The TRA-100B includes the capabilities of a Level 2 Transponder:

- Bi-directional air-to-air information exchange
- Ground-to-air data uplink, Comm-A
- Air-to-ground data downlink, Comm-B
- Multisite message protocol
- Data link capability reporting
- Aircraft identification reporting
- Traffic Alert and Collision Avoidance System (TCAS)/Airborne Collision Avoidance System (ACAS) crosslink capability
- Overlay Command Capability

In addition, the Transponder contains the following optional additional features:

- TCAS Compatibility (a)
- Antenna Diversity (d)
- Extended Squitter (e)
- Enhanced Surveillance (including Elementary Surveillance) (n)
- Surveillance Identifier Code (s)

2.2 TRA-100B Mode S TRANSPONDER - SCHEMATIC DIAGRAM

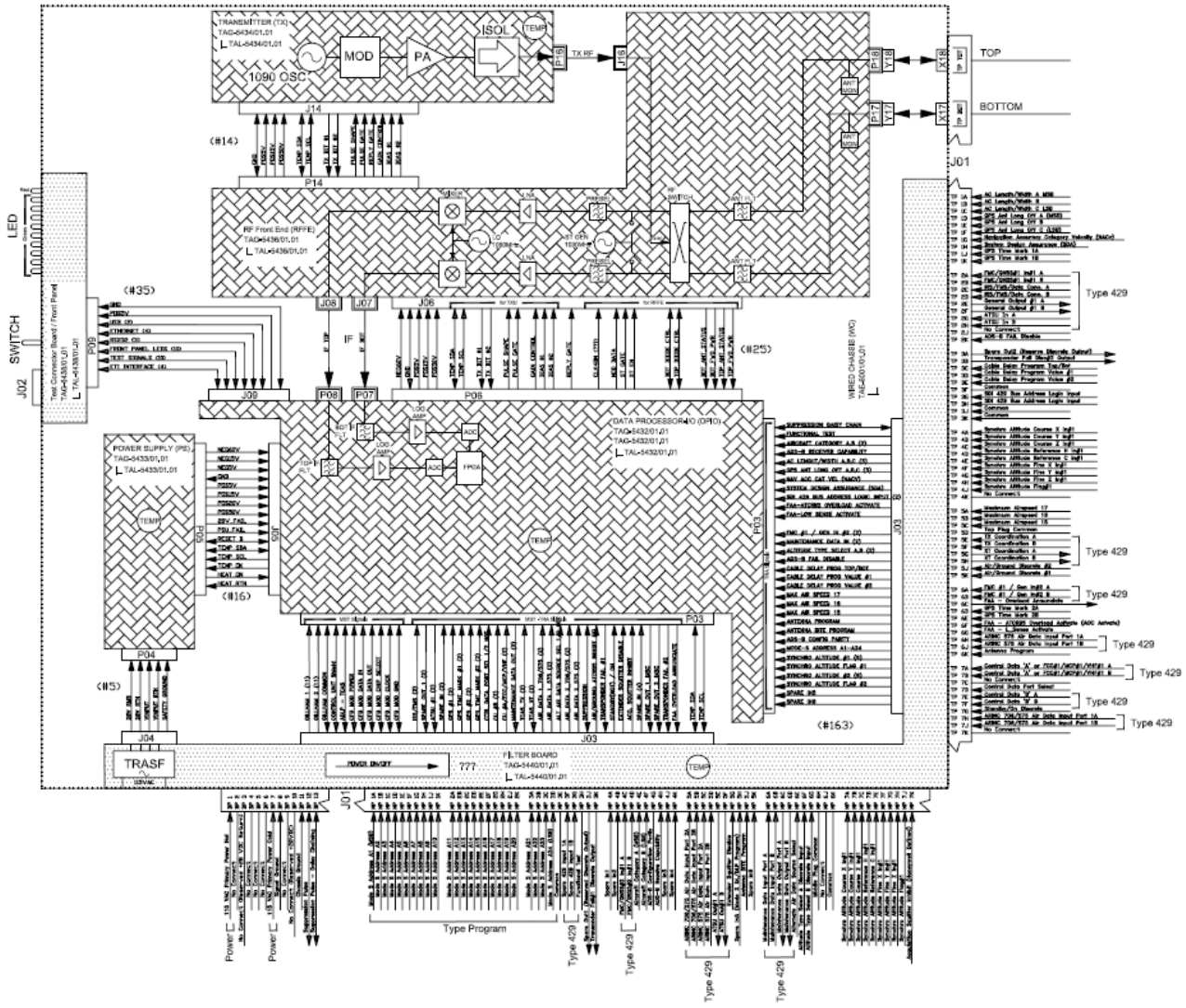


Figure 1-2 – TRA-100B Mode S Transponder - Schematic Diagram

2.3 TRA-100B MODE S TRANSPONDER – GENERAL WARNINGS AND CAUTIONS AND RELATED SAFETY DATA

2.3.1 General Safety

- Before you do maintenance procedures on the Unit make sure that you know the necessary safety data.
- Before you work on the Unit, make sure that the electrical power supply is Removed from the Unit. Energized circuits can cause injury to persons.
- Before you work on the Unit, make sure that you have the correct personal safety equipment. You must use or wear the correct personal safety equipment to prevent injuries.
- Handle all the equipment carefully. This will help to prevent damage to it.

2.3.2 List of Warnings and Cautions

Table 1-3 - TRA-100B – General Warnings, Cautions And Related Safety Data

Symbol	Message
	WARNING Make sure that the equipment is disconnected from all electrical power sources before you do any maintenance work.
	WARNING The internal components use high voltages that can cause injury or death to personnel.
	WARNING Perform task in ventilated area and use protective clothing.
	WARNING Denatured Alcohol, Electro Contact Cleaner and Conductive Anti-seizure Compound are dangerous materials. Make sure that you know the safety precautions and the first aid instructions.

	CAUTION The internal components of the equipment are Electro-Static Discharge (ESD) sensitive devices. Do not touch the pins of the electrical connectors. Electrostatic discharge can cause damage to these components. Install protective caps on all electrical connectors immediately after you disconnect them to prevent the ingress of dirt.
	WARNING Always handle the equipment with care to prevent damage.

2.4 TRA-100B MODE S TRANSPONDER – SUPPORT EQUIPMENT AND TOOLS

2.4.1 Standard AGE and Tools

Table 1-4 - TRA-100B – Standard AGE and Tools

Nomenclature	Identification	Qty
Soft Brush	Local Supply	1
Torque Screwdriver bit holder	Local Supply	1
Bit cross-point sz. 2	Local Supply	1
Bit hex open end 8 mm.	Local Supply	1

2.4.2 Software

Table 1-5 – TRA-100B - Software

Nomenclature	Identification
TRA-100B_MPC STTE Software	TIU-0077/01.01*

*The STTE Software is applicable for the Transponder configurations described in this manual.

2.4.3 Consumables, Material and Expendables

Table 1-6 – TRA-100B - Consumables, Material and Expendables

Nomenclature	Specification	Commercial designation	Manufacturer	Qty	Remarks
Denatured Alcohol	AA-M-L.422e	S-738	D9478	A/R	Dangerous material
Electro Contact Cleaner		QD 02130 1	02344	1	Dangerous material
Lint free cloth				1	Local supply

2.5 TRA-100B MODE S TRANSPONDER – PACKAGING, HANDLING, STORAGE AND TRANSPORTATION

These procedures are applicable to the Transponder and to all its units.

2.5.1 Packaging - General

Packaging includes all the activities necessary to prepare the units for transportation.
The packaging procedures are mandatory to avoid any damage to the units during transport, handling and storage.

- Each unit is packed separately in its own container.
- The packaging procedures are applicable to all the units of the system.
- Packaging is carried out according to “Commercial Standard”.
- The packaging procedures are applicable to the initial packaging of the units, the return after repair packaging as well as the reshipment procedure.

2.5.1.1 Packaging Procedure

Insert the unit in a shielding envelope and close it with a warning ESD adhesive label
Wrap the unit in protective ‘bubble wrap’, hold together with adhesive tape.
Put the wrapped item in a commercial cardboard box of suitable dimensions.
Line the box with “Instapak foam” or ‘Pluriball” in a way to prevent the unit from moving inside the box.
Seal the box with adhesive tape.
Place an identification label on the outside of the IP package describing the contents.

2.5.1.2 Identification Label

The label on the box must include the following data:
Company Name or Logo (Sender)
Quantity of items per pack
Contract Number
Description of part
Part Number
Gross Weight
NSN (if applicable)
Details of receiver.

2.5.1.3 Reshipment Packaging Procedure

Follow the packaging procedures described above.
The units do not require any special preparation for reshipment. Observe general methods and conditions requested for handling electronic equipment.

2.5.1.4 Original Packaging

Commercial Standard packaging is generally considered as not reusable. It is the responsibility of the packing personnel to decide whether packaging material can be safely reused.

2.5.1.5 Instruction of Reshipment

No special disassembly is required prior to shipping the entire units. Follow the instructions described in the Initial packaging procedures to pack the units for reshipment.

2.5.2 Handling

The TRA-100B does not require special procedures for unit removal and installation

The gross weight is indicated on the identification label placed on the outside of each box.

The weight of each LRU of the TRA-100B Mode S Transponder is less 7 Kg excluding packaging.

Special provisions and equipment (forklift etc.) are not required for handling the units.

The containers of the equipment do not have handles or lifting devices.

No lifting requirements are indicated on the containers.

Handle the units with care to avoid damage.

2.5.3 Storage

The conditions listed in this document are relative to storage in a closed depot/warehouse and do not take into consideration water exposure, salt spray etc.
The equipment must remain in the original shipment containers during storage.
If containers have been opened for shipment acceptance and they are stored in a humid environment, put dehumidifying bags inside the containers.
The containers must be sealed again by using adhesive tape, this precaution is necessary to avoid damage from dust and humidity. Commercially available, desiccant (dehumidifying bags) can be used.

2.5.3.1 Storage Data

The environmental conditions while in storage must respect the following limits:

- Maximum Relative Humidity <75%
- Storage Temperature: Between -55 °C and +70°C;
- Storage Life: 10 years
- Store far from magnetic, electrical and electrostatic sources

2.5.4 Transportation

The following transport conditions are applicable to the equipment and its components:

- Temperature: Between -55 °C and +70 °C

- Maximum Relative Humidity: <75%
- Thermal shock: 10 °C/min
- Altitude: Max. 15000m (70 000ft)

The equipment must remain within its package during transport.

2.5.5 ESD Handling Procedure

The Unit contains static devices. Be careful when you work on electrostatic discharge sensitive devices:

- Use an approved wrist strap that is connected to a ground point only when no electrical power is supplied to the system.
- Do not touch the electric pins.
- Use conductive blanking caps.
- Use always an antistatic transport tray to move the equipment.
- Install the protective caps on the electrical pins, after their disconnection, to protect them from electrostatic charge and avoid the entry of dust.
- Do not open the Unit except in an approved static-free workshop.
- Electrostatic discharge can cause damage to equipment or injury personnel.

2.5.6 Hazardous Materials

None.

3 DESCRIPTION

3.1 TRA-100B MODE S TRANPONDER – DESCRIPTION OF HOW IT IS MADE AND ITS FUNCTION

The TRA-100B Mode S Transponder unit is made up of the modules shown in Figure 3-1 and listed below:

- Wired Chassis (WC)
- Data Processor and I/O (DPIO)
- RF – Subassembly (RF)
- AC Power Supply (ACPS)
- DC Power Supply (DCPS)

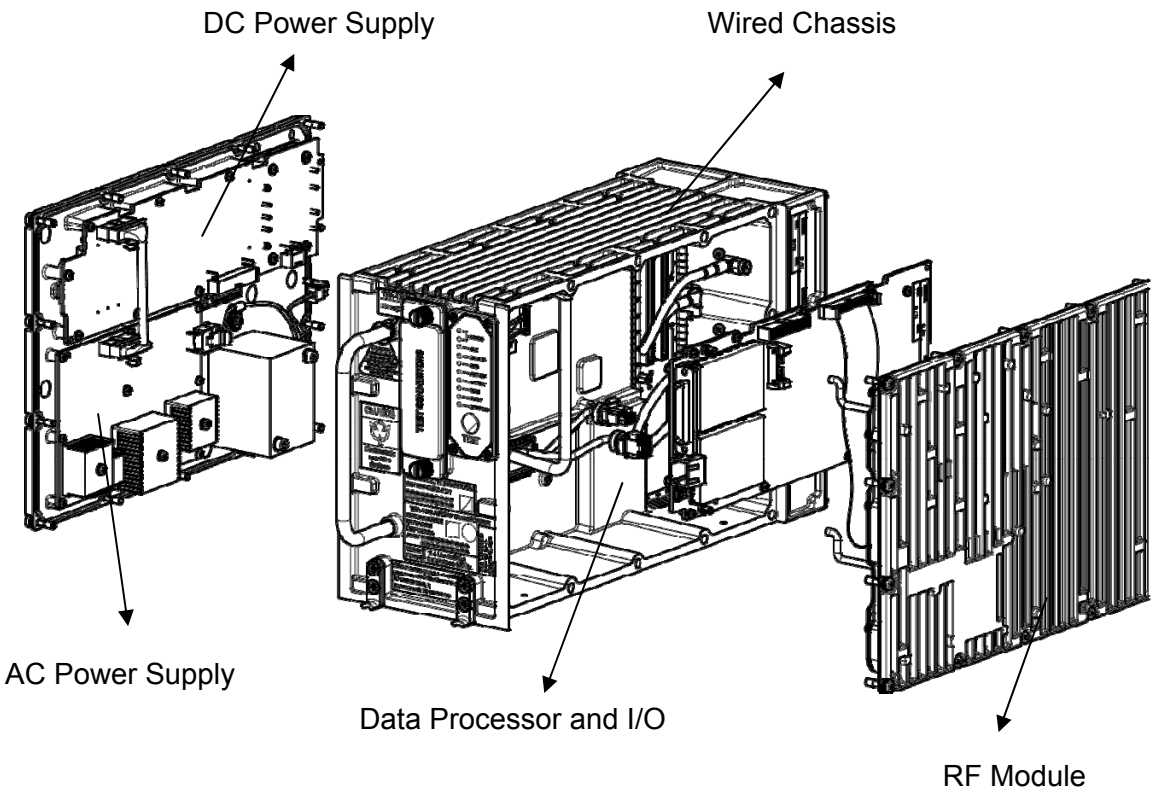


Figure 3-1 – TRA-100B Mode S Transponder - Description of how it is made

The RFD, TXA and RXA modules combined are referred to as the RF module, and are responsible for reception and transmission functions. The processing functions are carried out by the Data Processor as well as the Transponder Software (TS).
The I/O Interface Module together with the Wired Chassis include all the internal and external interfaces, while the AC and DC Power Supply are responsible for the supply of power to the unit (see Figure 3-2).

The Wired Chassis (WCH) implements all mechanical functions and electrical interconnections between modules; it includes:

- I/O lines filtering
- Power lines filtering
- IO lines transient protection
- AC input transformer
- Front panel LEDs

The ACPS module receives 24 and 48 VAC from WCH transformer and generates internal 28VDC to DCPS.
It generates AC INPUT FAIL signal to DCPS for BIT purposes

The DCPS module receives 28 VDC from ACPS and generates internal voltages to all modules:

- It manages internal ON/OFF state
- It manages power interruptions
- It manages Power Supply BIT and protections

The DPIO-RX module includes two main sections:

1. DPIO for Processing and I/O
2. RX for RX IF processing

The processing section includes FPGA, Controller and Memories (RAM, FLASH) and manages:

- all I/O processing
- Interrogation/Reply protocols
- TCAS and ADS-B functions
- its own board BIT and Equipment BIT by collecting information from all modules
- RF modules control (RFFE/TX)
- I/O Section includes all I/O circuitry to implement discretes, 429 and other interfaces

The RX Section performs dual channel (TOP/BOT) IF RX processing:

- IF Selectivity filtering
- Log detection
- ADC

The RFFE Module performs dual (TOP/BOT) antenna interface implementing the following functions:

- TX/RX selection
- TX path antenna switch (TOP/BOT)
- TX path harmonic filtering
- RX dual channel (TOP/BOT) independent pre-selection and LNA
- RX dual channel (TOP/BOT) independent IF down conversion including LO generation
- Self test signal generation
- Self test Path selection

The TX Module performs all TX functions:

  - 1090 MHz LO generation
  - Pulse modulation
  - RF amplification up to required level
- It includes Tank capacitor to support fast current delivery to TX devices during reply pulse trains generation
- Tank Capacitor is also used to support hold-up during power interruption between 10ms and 200ms

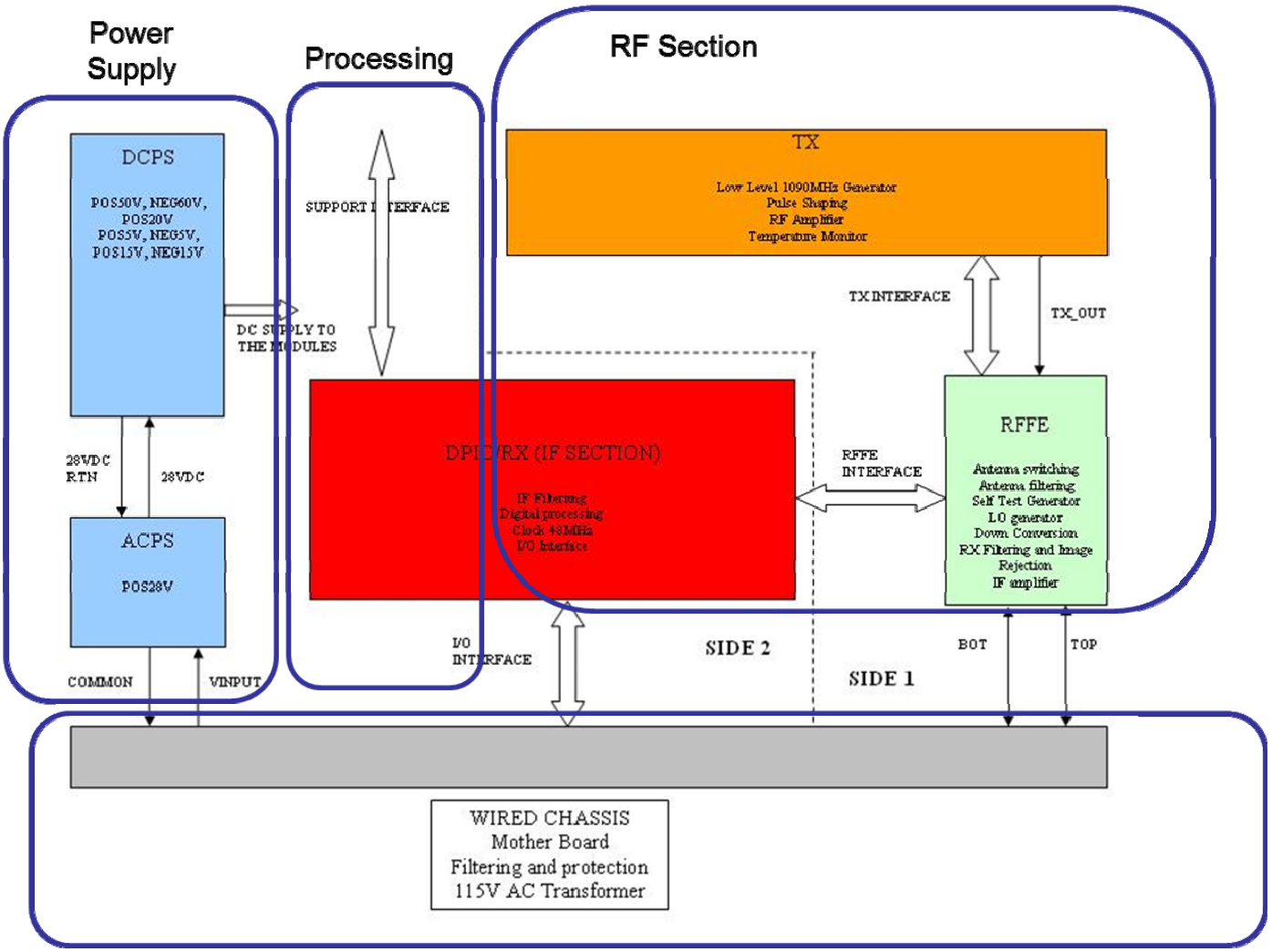


Figure 3-2 – TRA-100B Mode S Transponder – Functional Diagram

4 TECHNICAL DATA

4.1 TRA-100B MODE S TRANSPONDER – TECHNICAL DATA

4.1.1 General Technical Data

Table 4-1 – TRA-100B - Technical data – General

Data	Value
Manufacturers Part Numbers	TAC-6001/03 TAC-6003/03 TAC-6004/03
Weight (Total mass)	< 7 kg
Dimensions	194 mm x 124 x 318 (Height x Width x Depth)
Output power	400W ± 100 W
Operating temperature	-55°C +70°C
Storage Conditions	-55°C +70°C

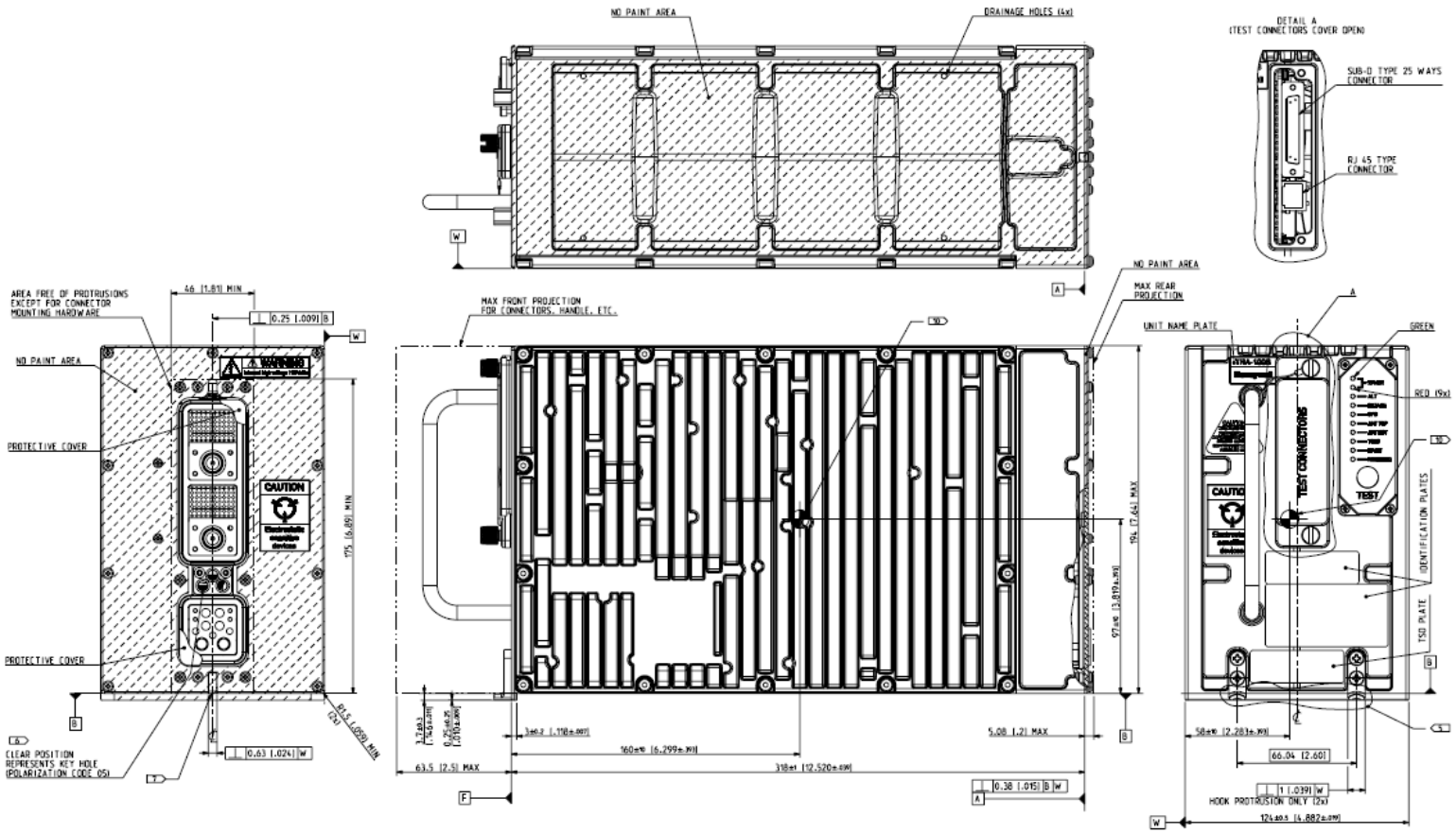


Figure 4-1 – TRA-100B Mode S Transponder – Technical Data

4.1.2 Labels Data

The TRA-100B provides three different labels (ref. 3):

Leonardo Finmeccanica Id. Label (1)
Honeywell Id. Label (2)
Certifications Label (3)

The Leonardo Finmeccanica Id. Label contains the following info:

Data	Value
Manufacturers Part Numbers	TAC-6001/03 TAC-6003/03 TAC-6004/03
Manufacturer	Leonardo Finmeccanica
Manufacturing Site	Montevarchi
Manufacturing Country	Italy
SER.	Serial Number
MFR.	Manufacturer SNS (A0610)
DMF	Date of Manufacturing (mmyyy)
AMDT	Amendement
Weight (Total mass)	14.5 Lbs. (6,58 Kg)
Power	115 VAC/380-420 Hz.

The Honeywell Id. Label contains the following info:

Data	Value
Owner	HONEYWELL, International
Owner Part Number	PNR 066-01212-0101 PNR 066-01212-0301 PNR 066-01212-0301

Amendement	-

The Certification Label contains the following info:

Data	Value
ETSO/TSO Certification	ETSO C112d: L2 adens, Class 1 ETSO C166b: Class A2 Tx only
DO/ED	178B/12B B: D 254/80 B 160/14G

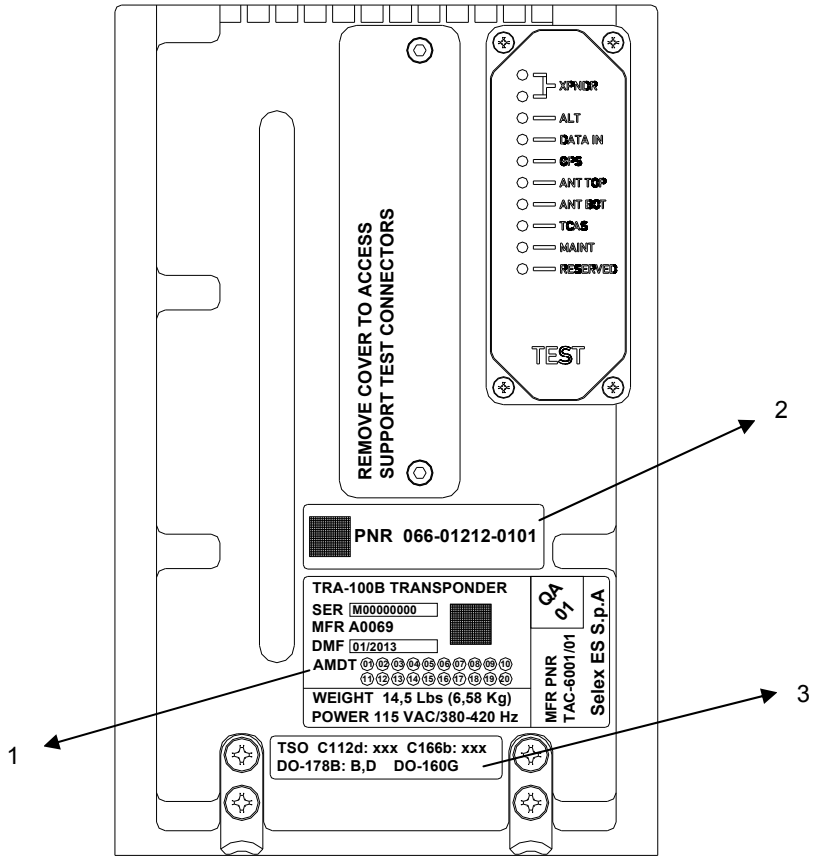


Figure 4-2 – TRA-100B Mode S Transponder – Labels layout

4.1.3 Environmental Certification and Characteristics

The TRA-100B meets the environmental conditions of the Radio Technical Commission for the Aeronautics (RTCA) document number DO-160G “Environmental Conditions and Test Procedures for Airline Electronic/Electrical Equipment and Instruments” (Table 4-2).

Additionally to the DO-160G, the following documents have been used to further certification:

- ABD100 1.2 G (Table 4-3)
- ABD100 1.6 D (Table 4-4)
- ABD100 1.8 E (Table 4-5)
- D6-44800-1 (**Table** 4-6)
- D6-81926 (Table 4-7)
- MIL STD 810F (Table 4-8)
- ASTM D1149 (**Table** 4-9)
- D6/ 16050-4 (**Table** 4-10)
- D6-44800-1 (

Table 4-11)

Table 4-2 – TRA-100B – DO-160G Certification Categories

DO-160G	Title	Category
4.5.1	Ground Survival Low Temperature Test	A2
4.5.1	Ground Survival Low Temperature Test Short-Time Operating Low Temperature	F2
4.5.2	Operating Low Temperature Test	A2
4.5.2	Operating Low Temperature Test	F2
4.5.3	Ground Survival High Temperature Test Short-Time High Operating	A2F2
4.5.4	Operating High Temperature Test	A2F2
4.6.1	Altitude Test	A2
4.6.1	Altitude Test	F2
4.6.2	Decompression Test	A2
4.6.3	Overpressure Test	A2
5	Temperature Variation	B
6	Humidity	A, B
7	Operational Shocks and Crash Safety	B, D, A
8	Vibrations	S H
9	Explosive Atmosphere	E
10	Waterproofness	W Y
11	Fluids Susceptibility	F
12	Sand and Dust	D
13	Fungus Resistance	F
15	Magnetic Effect	A, Z
16	Power Input	A, A(CF)HZPI
17	Voltage Spike	A
18	Audio Frequency Conducted Susceptibility - Power Inputs	R(CF), K
19	Induced Signal Susceptibility	ZCX
20	Radio Frequency Susceptibility Radiated	R
20	Radio Frequency Susceptibility Conducted	R
21	Emission of Radio Frequency Energy	M, L

DO-160G	Title	Category
22	Lightning Induced Transient Susceptibility	A3J3L3
24	Icing	A
25	Electrostatic Discharge (ESD)	A
26	Fire Flammability	C

Table 4-3 – TRA-100B – ABD100 1.2 G Certification Categories

ABD100 1.2 G	Title	Category
1.2.2	Decompression Test	A2
1.2.3	Overpressure Test	A2
1.6.1	Vibration	Operational Vibrations: random and sinusoidal: a) Curve 1 b) Curve 2 of the note " Environmental directives for new equipment installed on SA program " §3.7.1. Operational Vibrations Vibrations due to Engine Fan Blade Loss/WINDMILLING: See PTS Appendix 1 (SINE 3-30Hz SINE, 5.5 G max) and PTS Appendix 2 (SINE 3-15.5 Hz SINE, 2.2 Gmax). The procedures and the levels given in both these appendices shall be used.
1.18	Constant Acceleration Functional Test	B
3.3.3	Radio Frequency Susceptibility Radiated	R
3.3.2	Radio Frequency Susceptibility Conducted	Doc ref 483.0156/95 issue 6 or issue 8.1 cat C The test procedure and set-up i.a.w. DO- 160 Sect. 20
3.2	Lightning Induced Transient Susceptibility	Damage testing ABD0100.1.2 §3.2 Doc ref 483.0156/95 issue 6 or issue 8.1 cat C The Supplier shall use the Pin injection test method. Note: The note 483.0156/95 is applicable for

ABD100 1.2 G	Title	Category
		levels for damage testing and functional upset Functional Upset Testing (Multiple Stroke/Pulse) ABD0100.1.2 §3.2 Doc ref 483.0156/95 issue 6 or issue 8.1 cat C Note 1: For Multiple Strokes and Multiple Burst bundle injection, the shield of any other shielded cable of the bundle (except coaxial cables) shall be disconnected from any ground point. Note 2: Wave form for Multiple Burst shall be the one defined in DO-160F with levels and procedures defined in 483.0156/95
3.5	Electrostatic Discharge (ESD)	B

Table 4-4 – TRA-100B – ABD100 1.6 D Certification Categories

ABD0100 1.6 D	Title	Category
4.6	Fire/Flammability/Toxicity/Smoke/Gas Emission	Pressurized Area

Table 4-5 – TRA-100B – ABD100 1.8 E Certification Categories

ABD100 1.8 E	Title	Category
1.3	Dielectric and Insulation Resistance Testing	ABD0100.1.8 §1.3
2	Power Input	ABD0100.1.8 ADB0100 1.8 §1.2 ABD0100.1.8 §2.0 ABD0100.1.8 Table A
2.4	Voltage Spike	ABD0100.1.2 §3.4.2 ABD0100.1.8, tables 3-A

Table 4-6 – TRA-100B – D6-44800-1 Certification Categories

D6-44800-1	Title	Category
4.2.5.7	Temperature Variation	B

Table 4-7 – TRA-100B – D6-81926 Certification Categories

D6-81926	Title	Category
3.1	Bench Handling Shock	N/A
8	Random Vibration	B2
8	Sinusoidal Vibration	Zone 2, Cat. C
4	Constant Acceleration Functional Test	Zone 2, Cat. C
3.2	Shipping Container Shock Test	Packaged Equipment free fall from 30in (75cm)

Table 4-8 – TRA-100B – MIL STD 810F Certification Categories

MIL STD 810F	Title	Category
516.5	Bench Handling Shock	MIL STD 810F Method 516.5 Procedure VI

Table 4-9 – TRA-100B – ASTM D1149 Certification Categories

ASTM D1149	Title	Category
ASTM D1149	Ozone Testing	Ozone environment of 0.25 ppm per volume sea level equivalent

Table 4-10 – TRA-100B – D6/ 16050-4 Certification Categories

D6/ 16050-4	Title	Category
7.2.2	Audio Frequency Electric Filed Susceptibility	Perform Test as specified in D6- 16050-4
7.2.3	Audio Frequency Magnetic Field Susceptibility - Wiring	Perform Test as specified in D6- 16050-4
7.2.4	Audio Frequency Magnetic Field Susceptibility -	Perform Test as specified in

D6/ 16050-4	Title	Category
	Equipment	D6- 16050-4
7.5.2	Induced Spike Transient Susceptibility	Perform Test as specified in D6- 16050-4
7.5.3	Bus Switching Transient Susceptibility	Perform Test as specified in D6- 16050-4
8.1	Interference Voltage on Signal Lines	Perform Test as specified in D6- 16050-4
8.3.1	AC Capacitive Coupling	Perform Test as specified in D6- 16050-4
8.3.2	AF Inductive Coupling	Perform Test as specified in D6- 16050-4
7.3.1	Radio Frequency Susceptibility Conducted	R
8.4.2	RF Radiated Emissions	Perform Test as specified in D6- 16050-4
8.4.1	RF Conducted Emissions	Perform Test as specified in D6- 16050-4
7.4.4	Lightning Induced Transient Susceptibility	L2
7.1	Electrostatic Discharge (ESD)	Perform test per section 7.1 of D6- 16050-4

Table 4-11 – TRA-100B – D6-44800-1 Certification Categories

D6-44800-1 Section	Title	Category
5.19	Loss of Cooling	330 minutes loss of cooling per Table 2.4 of D6-84901 Rev B. Test is per D6-44800-1, Table 2b, for Long Term Loss of Cooling (Class: IIb - Case cooled, robust temperature condition). The test can be perform using an ambient temperature by using the procedure in D6-44800-1, Section 5.19 Procedure B, in lieu of performing the test via controlling the sidewall temperature of the equipment. Make special notice to the Flag Notes in table 2b for how this test is performed.

4.1.4 Connectors Data

Table 4-12 – TRA-100B - Technical data – Connectors

Ref. Figure 4-3	**Connector**	**Function**
1	Main Connector	Data and Control I/O
2	Test Connector	Maintenance Retrieval

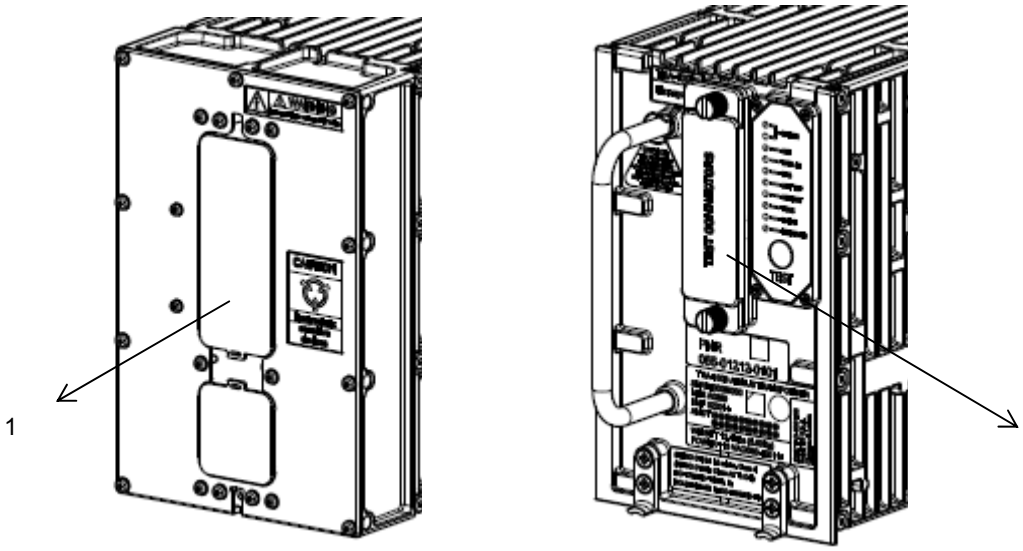


Figure 4-3 – TRA-100B Mode S Transponder – Connectors

Table 4-13 – TRA-100B - Technical data – Main Connector Pin Mapping

TP Section			
Pin	**I/O**	**Type**	**Description**
TP 1A	Input	Program	AC Length/Width A MSB
TP 1B	Input	Program Strobed	AC Length/Width B
TP 1C	Input	Program Strobed	AC Length/Width C LSB
TP 1D	Input	Program Strobed	GPS Ant Long Off A (MSB)
TP 1E	Input	Program Strobed	GPS Ant Long Off B
TP 1F	Input	Program Strobed	GPS Ant Long Off C (LSB)
TP 1G	Input	Program Strobed	Navigation Accuracy Category Velocity (NAC_V)
TP 1H	Input	Program Strobed	System Design Assurance (SDA)
TP 1J	Input	Differential	GPS Time Mark 1A
TP 1K	Input	Differential	GPS Time Mark 1B
TP 2A	Input	429	FMC/GNSS #1 In #1 A
TP 2B	Input	429	FMC/GNSS #1 In #1 B
TP 2C	Input	429	IRS/FMS/Data Conc. A
TP 2D	Input	429	IRS/FMS/Data Conc. B
TP 2E	Output	429	General Output #1 A
TP 2F	Output	429	General Output #1 B
TP 2G	Input	429	ATSU In A
TP 2H	Input	429	ATSU In B
TP 2J	Input	Discrete	Data Load Enable
TP 2K	Input	Program	ADS-B FAIL Disable
TP 3A	Output	Discrete	ADS-B Fail Disc Out
TP 3B	Output	Discrete	Transponder fail #2 Disc output
TP 3C	Input	Program	Cable Delay Program Top/Bot
TP 3D	Input	Program	Cable Delay Program Value #1
TP 3E	Input	Program	Cable Delay Program Value #2
TP 3F	Common	Common	Common
TP 3G	Input	Discrete	SDI 429 Bus Address Logic Input
TP 3H	Input	Discrete	SDI 429 Bus Address Logic Input
TP 3J	Common	Common	Common
TP 3K	Common	Common	Common
TP 4A	N/A	N/A	No Connect
TP 4B	N/A	N/A	No Connect
TP 4C	N/A	N/A	No Connect
TP 4D	N/A	N/A	No Connect
TP 4E	N/A	N/A	No Connect
TP 4F	N/A	N/A	No Connect
TP 4G	N/A	N/A	No Connect
TP 4H	N/A	N/A	No Connect
TP 4J	N/A	N/A	No Connect
TP 4K	N/A	N/A	No Connect
TP 5A	Input	Program	Maximum Airspeed 17
TP 5B	Input	Program	Maximum Airspeed 16
TP 5C	Input	Program	Maximum Airspeed 15
TP 5D	Common	Common	Top Plug Common
TP 5E	Input	429	TX Coordination A
TP 5F	Input	429	TX Coordination B
TP 5G	Output	429	XT Coordination A

TP Section			
Pin	**I/O**	**Type**	**Description**
TP 5H	Output	429	XT Coordination B
TP 5J	Input	Discrete	Air/Ground Discrete #2
TP 5K	Input	Discrete	Air/Ground Discrete #1
TP 6A	Input	429	FMC #1 / Gen In #2 A
TP 6B	Input	429	FMC #1 / Gen In #2 B
TP 6C	Output	Discrete	Reserved
TP 6D	Input	Discrete	GPS Time Mark 2A
TP 6E	Input	Discrete	GPS Time Mark 2B
TP 6F	Input	Discrete	Reserved
TP 6G	Input	Discrete	Reserved (-0101/-0301); FAA - L_Sense Activate (-0201)
TP 6H	N/A	N/A	No Connect
TP 6J	N/A	N/A	No Connect
TP 6K	Input	Program	Antenna Program
TP 7A	Input	429	Control Data 'A' or FCC #1/MCP #1/VHF #1 A
TP 7B	Input	429	Control Data 'A' or FCC #1/MCP #1/VHF #1 B
TP 7C	N/A	N/A	No Connect
TP 7D	Input	Discrete	Control Data Port Select
TP 7E	Input	429	Control Data 'B' A
TP 7F	Input	429	Control Data 'B' B
TP 7G	Input	Discrete	Standby/On Discrete
TP 7H	Input	429	ARINC 706/575 Air Data Input Port 1A
TP 7J	Input	429	ARINC 706/575 Air Data Input Port 1B
TP 7K	N/A	N/A	No Connect

MP Section			
Pin	**I/O**	**Type**	**Description**
MP 1A	Input	Program	Mode S Address A1 (MSB)
MP 1B	Input	Program	Mode S Address A2
MP 1C	Input	Program	Mode S Address A3
MP 1D	Input	Program	Mode S Address A4
MP 1E	Input	Program	Mode S Address A5
MP 1F	Input	Program	Mode S Address A6
MP 1G	Input	Program	Mode S Address A7
MP 1H	Input	Program	Mode S Address A8
MP 1J	Input	Program	Mode S Address A9
MP 1K	Input	Program	Mode S Address A10
MP 2A	Input	Program	Mode S Address A11
MP 2B	Input	Program	Mode S Address A12
MP 2C	Input	Program	Mode S Address A13
MP 2D	Input	Program	Mode S Address A14
MP 2E	Input	Program	Mode S Address A15
MP 2F	Input	Program	Mode S Address A16
MP 2G	Input	Program	Mode S Address A17
MP 2H	Input	Program	Mode S Address A18
MP 2J	Input	Program	Mode S Address A19
MP 2K	Input	Program	Mode S Address A20

MP Section			
Pin	**I/O**	**Type**	**Description**
MP 3A	Input	Program	Mode S Address A21
MP 3B	Input	Program	Mode S Address A22
MP 3C	Input	Program	Mode S Address A23
MP 3D	Input	Program	Mode S Address A24 (LSB)
MP 3E	Common	Common	Common
MP 3F	Input	429	Spare 429 Input 1A
MP 3G	Input	429	Spare 429 Input 1B
MP 3H	Input	Discrete	Functional Test
MP 3J	Output	Discrete	Out Spare 1
MP 3K	Output	Discrete	Transponder Fail # 1 discrete output
MP 4A	Input	Discrete	Spare In1
MP 4B	Input	Discrete	Spare In2
MP 4C	Input	429	FMC/GNSS #2 In #1 A
MP 4D	Input	429	FMC/GNSS #2 In #1 B
MP 4E	Input	Program Strobed	Aircraft Category A (MSB)
MP 4F	Input	Program Strobed	Aircraft Category B (LSB)
MP 4G	Input	Program	ADS-B Configuration Parity
MP 4H	Input	Program Strobed	ADS-B Receive Capability
MP 4J	Input	Discrete	Spare In3
MP 4K	Input	Discrete	Spare In4
MP 5A	Input	429	ARINC 706/575 Air Data Input Port 2A
MP 5B	Input	429	ARINC 706/575 Air Data Input Port 2B
MP 5C	N/A	N/A	No Connect
MP 5D	N/A	N/A	No Connect
MP 5E	Output	429	ATSU Out #1 A
MP 5F	Output	429	ATSU Out #1 B
MP 5G	Input	Discrete	Extended Squitter Disable
MP 5H	Input	Discrete	Spare In5 (Mode S DL/DLP Program)
MP 5J	Input	Program	Antenna BITE Program
MP 5K	Input	Discrete	Spare In6
MP 6A	Input	429	Maintenance Data Input Port A
MP 6B	Input	429	Maintenance Data Input Port B
MP 6C	Output	429	Maintenance Data Output Port A
MP 6D	Output	429	Maintenance Data Output Port B
MP 6E	Input	Discrete	Alternate Air Data Source Select
MP 6F	Input	Program	Altitude Type Select A Discrete Input
MP 6G	Input	Program	Altitude Type Select B Discrete Input
MP 6H	Common	Common	Middle Plug Common
MP 6J	N/A	N/A	No Connect
MP 6K	Common	Common	Common
MP 7A	N/A	N/A	No Connect
MP 7B	N/A	N/A	No Connect
MP 7C	N/A	N/A	No Connect
MP 7D	N/A	N/A	No Connect
MP 7E	N/A	N/A	No Connect

MP Section			
Pin	**I/O**	**Type**	**Description**
MP 7F	N/A	N/A	No Connect
MP 7G	N/A	N/A	No Connect
MP 7H	N/A	N/A	No Connect
MP 7J	N/A	N/A	No Connect
MP 7K	Input	Discrete	Acquisition Squitter Inhibit (Honeywell Defined)

BP Section			
Pin	**I/O**	**Type**	**Description**
BP 1	Input	Power	115 VAC Primary Power Hot
BP 2	N/A	N/A	No Connect
BP 3	N/A	N/A	No Connect
BP 4	N/A	N/A	No Connect
BP 5	N/A	N/A	No Connect
BP 6	N/A	N/A	No Connect
BP 7	Input	Power	115 VAC Primary Power Cold
BP 8	Input	Ground	Signal Ground
BP 9	N/A	N/A	No Connect
BP 10	N/A	N/A	No Connect
BP 11	Input	Ground	Chassis Ground
BP 12	Input/Output	Suppression	Suppression Pulse
BP 13	Input/Output	Suppression	Suppression Pulse - Daisy Chaining

Test Connector				
Pin	**Signal Name**	**I/O**	**Type**	**Description**
1	SWITCH_ETH		Discrete In 1	Switch Ethernet
2	TEST_RESET	Out	Test Point	Test Point
3	GND		Power GND	
4	UP_HRESET	Out	Test Point	Test Point
5	VID_ENV_TOP_TP	Out	Test Point	Test Point
6	TEST_DG18			Internal Purpose Only
7	ST_GATE	Out	Test Point	Test Point
8	TEST_DG19			Internal Purpose Only
9	TEST_DG20			Internal Purpose Only
10	TEST_DG21			Internal Purpose Only
11	TEST_DG22			Internal Purpose Only
12	ACQ_SQ_INH_EN	In	Discrete In 1	Acquisition Squitter Inhibit Enable
13	PULSE_GATE	Out	Test Point	Test Point
14	OP_MAINT_1	In	Discrete In 1	Maintanance Mode Selection
15	OP_MAINT_0	In	Discrete In 1	Maintanance Mode Selection
16	VID_ENV_BOT_TP	Out	Test Point	Test Point
17	FPGA _SIN			Internal Purpose Only

18	FPGA _SOUT			Internal Purpose Only
19	DG_INT_PWRFL	Out	Test Point	Test Point
20	SUPP_TP	Out	Test Point	Test Point
21	E2C_SCL_PN	In	Service I2C Bus Ctrl/Clk In	Service I2C Bus Serial Clock
22	E2C_SDA_PN	Bdir	Service I2C Bus Data	Service I2C Bus Serial Data
23	WR_UNPROTECT	In	Service I2C Bus Ctrl/Clk In	Service I2C Bus Control Signal
24	GND_EXT		Service I2C Bus Supply In	Service I2C Bus Power Supply Ground
25	5V_EXT	In	Service I2C Bus Supply In	Power Supply Source for Service I2C Bus

5 OPERATION

5.1 TRA-100B MODE S TRANSPONDER – MODES OPERATION

The basic XPDR System consists of a transponder, a control unit, two antennas, and installation hardware. Communications for the control of the remote transponder are by one-way ARINC 429 bus.

If the transponder is part of a TCAS installation, two-way communications by ARINC 429 data bus are also utilized between the transponder and the TCAS. The transponder will perform normal Air Traffic Control (ATC) functions whether it is or is not part of the TCAS system; however the TCAS system cannot function without the transponder. Antenna diversity operation of the transponder is a requirement for TCAS installations.

The transponder is capable of accepting altitude (air data) information from a variety of optional sources. These include the ARINC 575 and ARINC 706 Air Data Computers. Furthermore, selection between a primary and secondary input for each of these sources is provided.

An input and output ARINC 429 Maintenance Interface is provided that conforms to ARINC 604 and OEM specific requirements.

The transponder may also receive ARINC 429 data from a variety of equipment (i.e. Inertial Reference System (IRS)/Flight Management System (FMS), Data Concentrator, Flight Management Computer (FMC)/Global Navigation Satellite System (GNSS), FMC Gen, Flight Control Computer (FCC)/Maintenance Computer Program (MCP), Control Head, and Air Data System (ADS)).

This data will be utilized to populate:

- Flight Identification required for Elementary Surveillance
- Downlink Aircraft Parameters required for Enhanced Surveillance
- ADS-B Extended Squitters.

The XPDR performs its intended function and not create a hazard to users of the National Airspace System (NAS).

The Transponder TRA-100B is a avionics equipment capable to provide the Mode S Transponder function required by Technical Standard Order (ETSO-C112d/TSO-C112e).
It also provides Extended Squitter ADS-B Out function required by ETSO-C166b/TSO-C166b.

The TRA-100B is designed to be a Level 2 transponder.

For Level 1 includes the following capabilities:

- Mode A identity and Mode C pressure-altitude reporting,
- Air Traffic Control Radar Beacon System (ATCRBS)/Mode-S and Mode S all-call transactions,
- Addressed surveillance altitude and identity transaction,
- Lockout protocols,
- Basic data protocols except data link capability reporting, and
- Air-to-air service and squitter transactions.

For Level 2 includes the following capabilities:

- Bi-directional air-to-air information exchange
- Ground-to-air data uplink, Comm-A
- Air-to-ground data downlink, Comm-B
- Multisite message protocol
- Data link capability reporting
- Aircraft identification reporting
- Traffic Alert and Collision Avoidance System (TCAS)/Airborne Collision Avoidance System (ACAS) crosslink capability

Furthermore the TRA-100B contains the following optional additional features (associated ID code for transponder marking):

- TCAS Compatibility (a)
- Antenna Diversity (d)
- Extended Squitter (e)
- Enhanced Surveillance (including Elementary Surveillance) (n)
- Surveillance Identifier Code (s)

Among the above characteristics, the Transponder TRA-100B:

- exceeds the minimum output power level of 125 watts required by Class 1 equipment as defined in RTCA/DO-181E. Therefore, the XPDR transponder marking for TSO-C112e is Level 2adens, Class 1.

- exceeds the minimum output power level of 125 watts required by Class A1 transmit only equipment as defined in RTCA/DO-260B. Therefore, the XPDR transponder marking for TSO-C166b is Class A1 transmit only.

5.1.1 ATCRBS System Operation

The ATCRBS system can be defined as “a secondary surveillance radar system developed for use within the air traffic control system for more precise position reporting of planes. It is used in conjunction with the primary radar, which is used to determine the presence of planes in the airspace. ATCRBS supplements this positional information with positive identification and altitude information allowing controllers to track each plane more precisely and efficiently .”1

In this scenario the ATC ground based interrogator transmits an interrogation by means of sequence of pulses at a frequency of 1030 MHz and call all transponders for a response on the mode being used to reply. The received replies will be displayed on the ATC radar screen.

Analog to the ground based interrogator, an airborne TCAS device may transmits interrogation for airborne traffic. TCAS can detects direction and altitude of an aircraft equipped with a transponder.

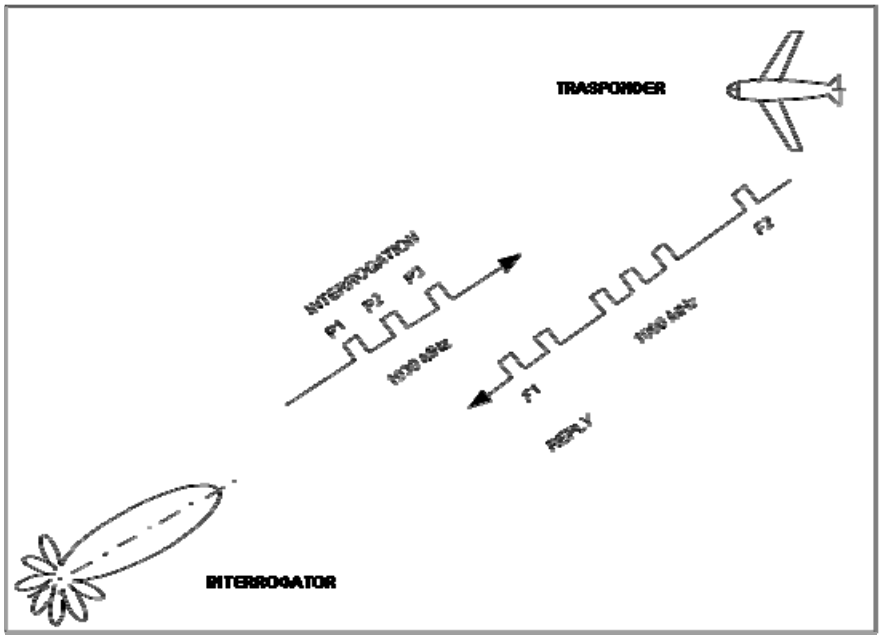


Figure 5-1 – ATCRBS System

[1]"The Story of Mode S: An Air Traffic Control Data-Link Technology" (Emily Chang, Roger Hu, Danny Lai, Richard Li, Quincy Scott, Tina Tyan)

5.1.2 ATCRBS Transmission Overview

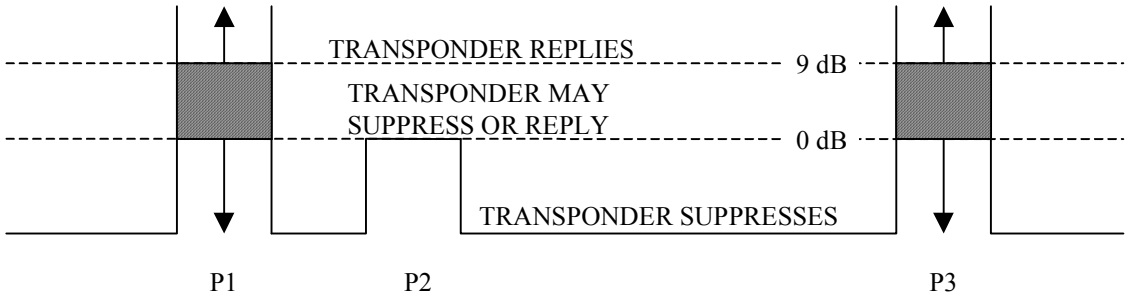
The Air Traffic Control Radar Beacon System (ATCRBS) interrogates aircraft with either Mode A or Mode C. The Mode A interrogation requests the aircraft identification code. The Mode C interrogation requests the aircraft altitude. Any aircraft in the beam of the radar replies.

In order to prevent an undesired reply from an aircraft which are not in the main beam the Side Lobe Suppression (SLS) technique is used.

Looking at the radius antenna diagram, leaking signals (called side lobes), can be identified as interrogation by aircrafts which are not the desired targets.

The interrogation represented in Figure 5-2 would has multiplies replies from Target 1, 2 and 3.

The interrogation represented in Figure 5-3 will receive a reply from Target 1 according to the following diagram:



SLS can also be used to avoid the reflection effects.

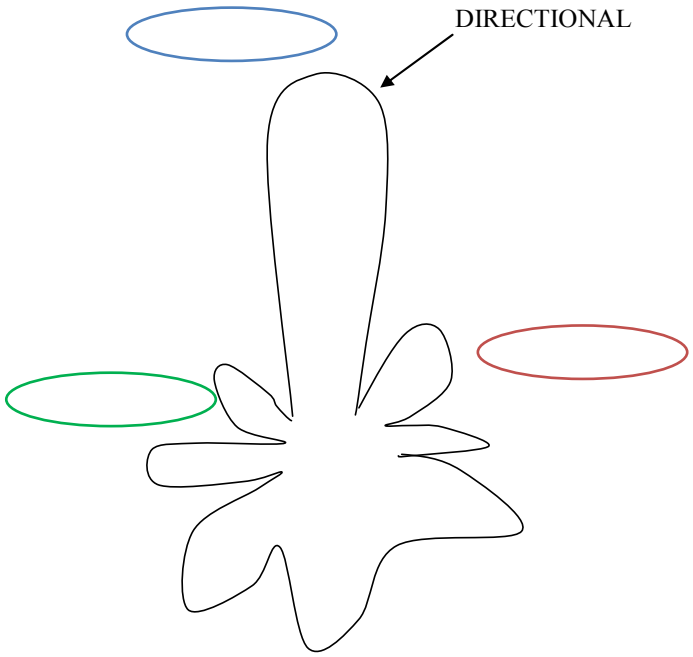


Figure 5-2 – ATCRBS Interrogation without Side Lobe Suppression (SLS)

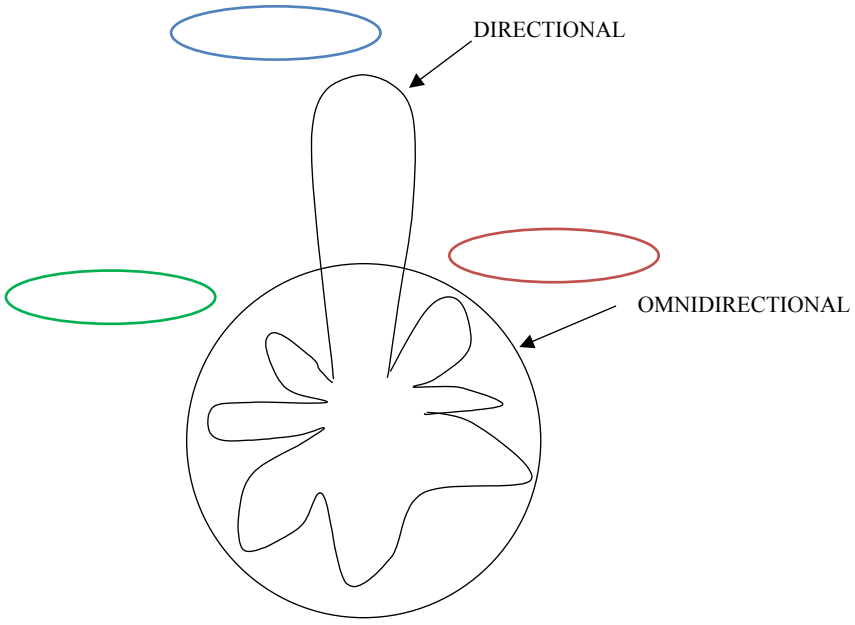


Figure 5-3 – ATCRBS Interrogation with Side Lobe Suppression

5.1.3 OVERVIEW OF MODE S

Mode Select (Mode S) is a combined secondary surveillance radar beacon system with ground-air-ground and air-air data link capability.

It includes a 24-bit aircraft technical address which provides more than 16 million unique addresses, allowing the interrogator to select then interrogate a specific aircraft of interest.

Each discrete interrogation contains the unique address of the aircraft for which it is intended and elicits a response dependent upon the level of capability of the corresponding transponder.

Civil aircraft have a permanently assigned technical address.

Implementation of a Mode S interrogation capability improve the existing systems in the following ways:

- Aircraft state (heading, speed, etc.) and aircraft intent information is available via Mode S selective interrogations.
- Adaptive re-interrogation will significantly improve the probability of detecting an aircraft that is in a marginal signal condition.
- The Mode S signal structure will provide improved error detection and correction.
- More than sixteen million transponder addresses will allow unique identification of all aircraft.
- Refined range and position accuracy is made possible via Mode S GPS squitter and/or Mode S datalink.

5.1.3.1 Signal Characteristics

Mode S is fully backwards compatible with the existing Air Traffic Control Radar Beacon System (ATCRBS).
Mode S transponders respond to Mode S interrogations.
Mode S interrogators can interrogate ATCRBS or Mode S transponders.
Both systems use the same interrogation and reply frequencies (1030 MHz and 1090 MHz, respectively).

Mode S-only interrogations use binary differential phase shift keying modulation (DPSK) at 4 MB/sec and Mode S replies have binary pulse position modulation (PPM) at 1 MB/sec.

The Mode S coding structure provides enhanced error detection and correction (less than 1 undetected error in 108 messages). Mode S is not secure or jam-resistant and is not intended to replace the encrypted military Mode 4.

Mode S has two basic message lengths: 56 bits and 112 bits.
The 56 bit surveillance formats include a 32 bit command field and a 24 bit address field.
The 112 bits communication formats include a 32 bit command field, a 56 bit data field and a 24 bit address field.
The 112 bit extended length message formats include an 8 bit command field, an 80 bit data field and a 24 bit address field.

5.1.3.2 Interrogation Process

Fully operational Mode S interrogators or clusters of interrogators are allocated on interrogator identification (II) code which, in conjunction with the unique aircraft technical address, enables linking between the interrogator and the aircraft of interest.

All-call interrogations are sent to all aircraft in a region to obtain the corresponding 24-bit technical addresses. These addresses are maintained in an internal database and, once the address is obtained, the all-call acquisition doesn't need to be repeated for that aircraft.

Upon receiving the technical address, the interrogator sends a lockout message to inhibit the corresponding transponder form replying to further Mode S all-call interrogations from any sensor with that interrogator identification code. Lockout is refreshed each antenna scan as part of the normal surveillance protocol and time-out occurs in 18 seconds if no further lockout commands are received. The interrogator also has the provision (lockout override") to command a transponder to respond regardless of the lockout status effect.

Once it has the unique transponder address, the interrogator can selectively interrogate to obtain altitude and Mode 3/A codes for Mode S to Mark XII correlation or other useful information.

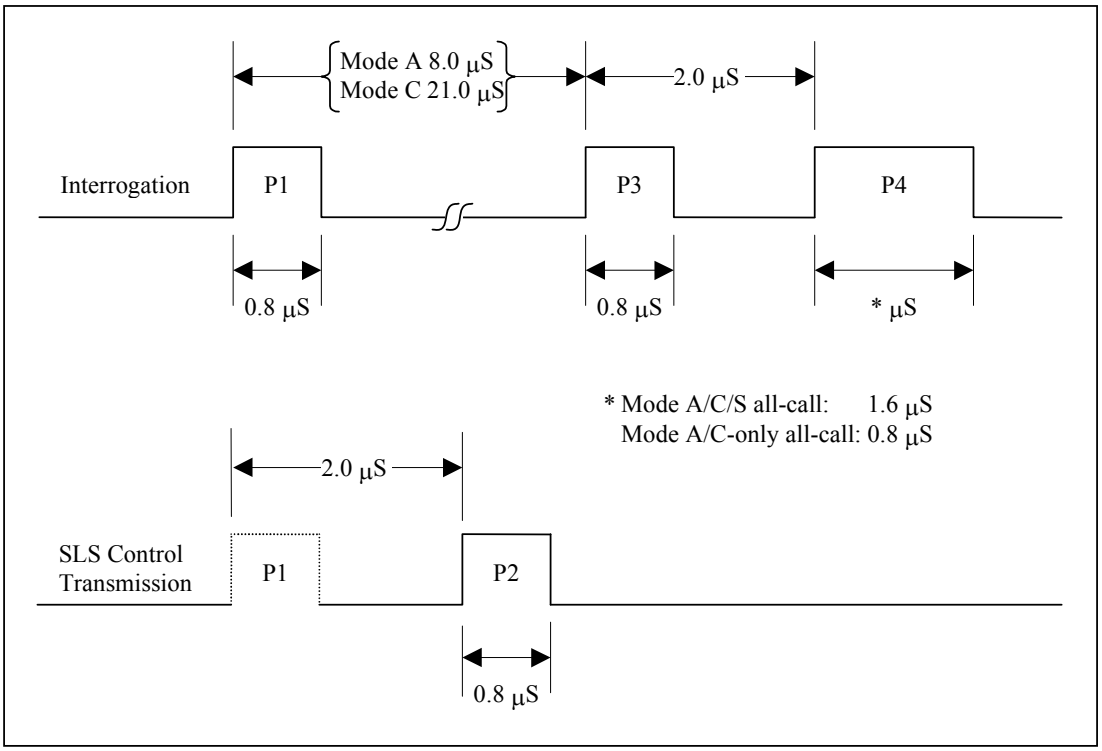


Figure 5-4 – Intermode (Mode A/C and S) Interrogation **Pulse Sequence**

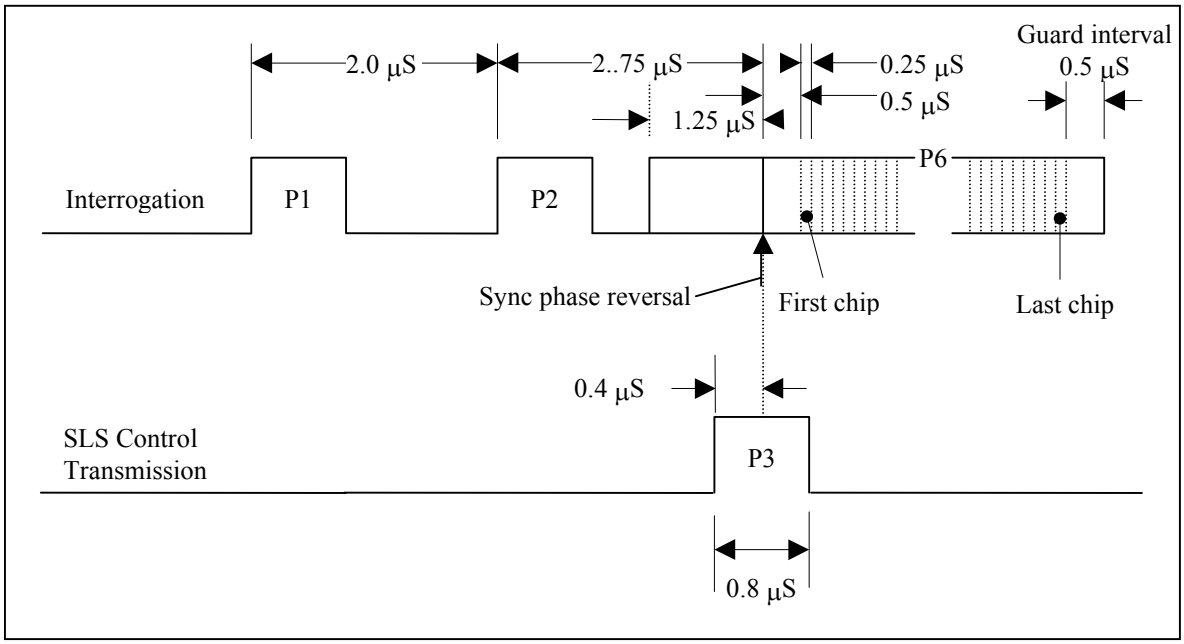


Figure 5-5 – Mode S Interrogation Pulse Sequence

The mode S reply consist of a long train of 0.5 μs and 1.0 μs pulses lasting for up to 130 μs. It is possible that such a train of pulses would give rise to multiple SSR bracket detections which could overload the plot extractor and effect its proper operation. It is advisable that an SSR plot extractor design should anticipate the introduction of Mode S and include circuitry to provide protection against Mode S replies.
In order to detect a Mode S reply it is only necessary to detect the four Mode S preamble pulses. These pulses are detected as follows:

- a second pulse leading edge occurs 7-9 clock periods after detection of the first pulse leading edge;
- a third pulse leading edge occurs 28-30 clock periods after detection of the first pulse leading edge;
- a fourth pulse leading edge occurs 36-38 clock periods after detection of the first pulse leading edge.

The detection of a Mode S preamble should suppress bracket detection for a period of 120 μs (994 clock periods). After preamble detection the train of pulse leading edges should be monitored for a gap of at least 22 clock periods. Such a gap would exceed that which is possible in a Mode S reply and would indicate that the preamble had been spurious, possibly owing to chance overlapping fruit replies. If a gap of that size is detected, the bracket detection suppression should be released so that SSR reply processing can resume.

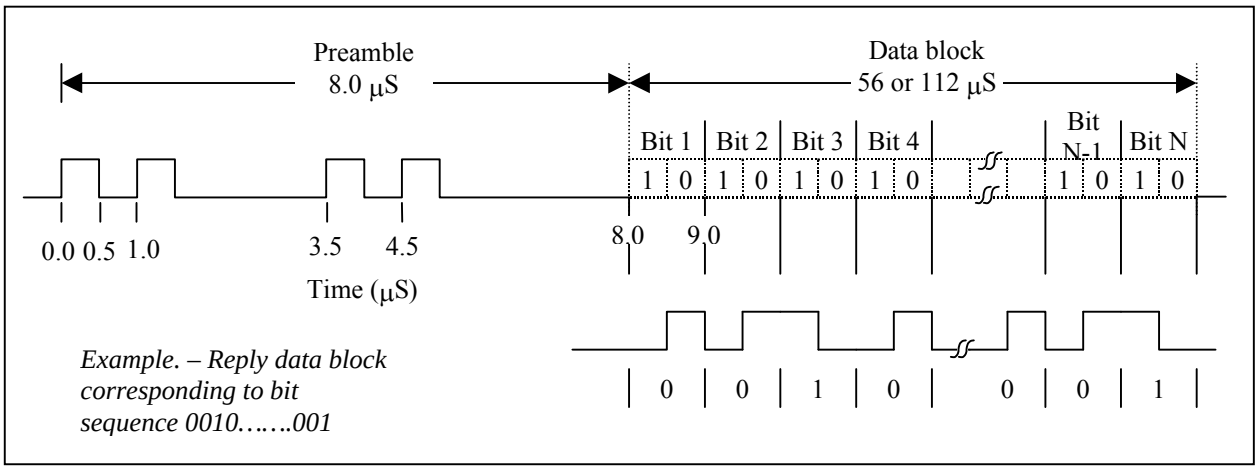


Figure 5-6 – Mode S Reply

6 INSTALLATION

6.1 TRA-100B MODE S TRANSPONDER – REPLACE PROCEDURES

Standard Equipment		
Description	***Identification Nr.***	***Qty***
None		

Materials		
Description	***Identification Nr.***	***Qty***
None		

Spares		
Description	***Identification Nr.***	***Qty***
TRA-100B Mode S Transponder	TAC-6001/03	1

Safety Precautions

WARNING

MAKE SURE THAT THE EQUIPMENT IS DISCONNECTED FROM ALL ELECTRICAL POWER SOURCES BEFORE YOU DO ANY MAINTENANCE WORK.

Preliminary Operations

1. Make sure the platform is safe for maintenance

Procedure

- Removal Procedure
  1. Loosen by hand the two hold-down screws on the front of Mounting Tray (1)
  2. Pull the Transceiver by the handle
  3. Carefully slide the Transponder from the Mounting Tray

- Install Procedure
  1. Carefully put the TRA-100 B Modes S Transponder into the Mounting Tray, aligning the TRA-100B connector guide pins with the platform connector.
  2. Tighten by hand the two hold-down screws (1) on the front of Mounting Tray

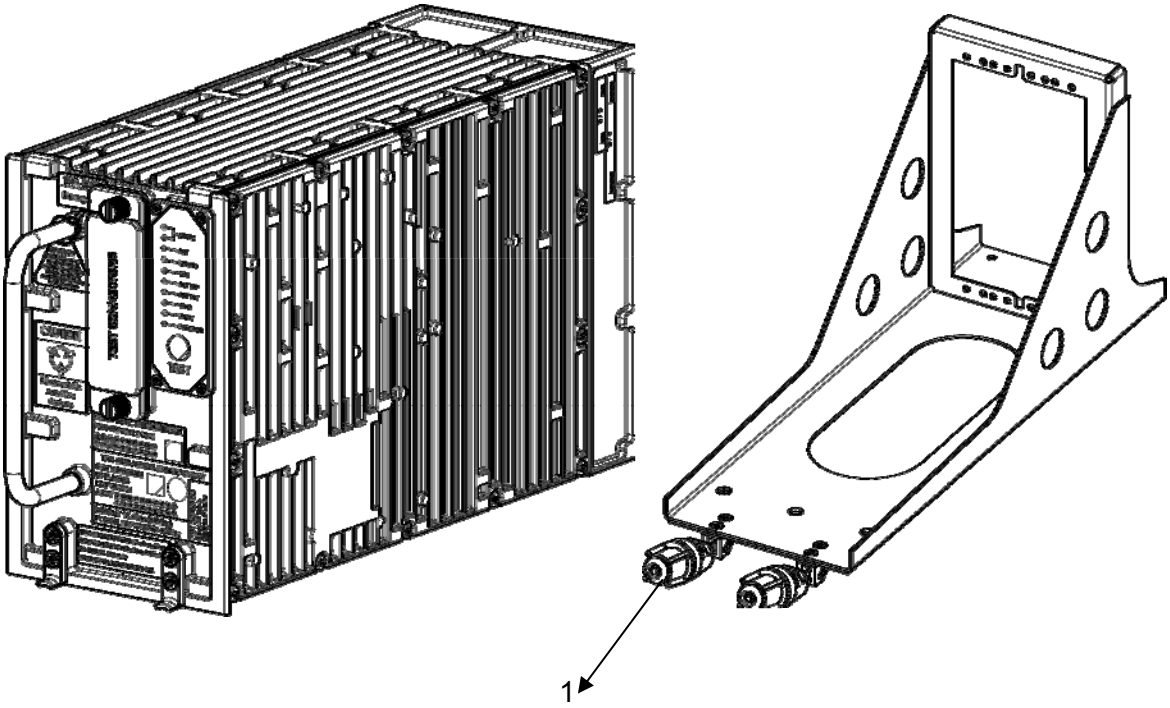


Figure 6-1 – TRA-100B Mode S Transponder - Replace Procedures

Close up

1. Removal all the tools, the materials and the equipment from your work area.

7 FAULT ISOLATION

7.1 GENERAL

Fault Location procedure allows the maintainer to isolate the failure the source of a failure at the system level or aircraft wiring level. Furthermore the fault location can be performed even on the Transponder itself in order to identify the failed module.
The TRA-100B Transponder provides a Built-In-Test function strictly for the purpose of annunciation to the crew of a faulty Transponder system and for the purpose of providing maintenance information for the repair function.
The TRA-100B provides several Input/Output interfaces for Built-In-Test capability necessary to perform a diagnostic process to isolate the failure and provide the information related to its location.

7.2 FAILURE DATA STRUCTURE

The diagnostic results are stored in a NVM in accordance with the following data::

a) One Hundred (100) Flight legs of storage.
b) Ten (10) subassembly and external faults per flight segment.
c) Three (3) subassembly faults for ground tests.
d) Two Hundred Thirty (230) bytes of storage per Current Flight leg and One Hundred Sixty Seven (167) bytes for each other Flight leg segment.

7.2.1 Flight Information Header

For each flight leg, currently available flight information is stored in a fixed header.
The flight leg is incremented upon reception from the CFDS of a command label with code of 2, which occurs during the aircraft take-off.

From one take-off point to the next, faults is stored for the 'current' flight leg.
The flight information header records all the data received on the maintenance port for each flight leg with the exception of GMT, and flight phase as per the following table:

The flight information header records all the data received on the maintenance port for each flight leg with the exception of GMT, and flight phase as per the following table:

DESCRIPTION
Date, Day
Date, Month
Date, Year
Flight Number - 1st ISO 5 Character
Flight Number – 2nd ISO 5 Character
Flight Number - 3rd ISO 5 Character
Flight Number - 4th ISO 5 Character
Flight Number - 5th SO 5 Character
Flight Number - 6th ISO 5 Character
Flight Number - 7th ISO 5 Character
Flight Number - 8th ISO 5 Character
Aircraft Identification – 1st Tail Character
Aircraft Identification – 2nd Tail Character
Aircraft Identification – 3rd Tail Character
Aircraft Identification – 4th Tail Character
Aircraft Identification – 5th Tail Character
Aircraft Identification – 6th Tail Character
Aircraft Identification – 7th Tail Character

The flight information header records all the data received on the maintenance port for each flight leg with the exception of GMT, and flight phase as per the following table:

DESCRIPTION
Date, Day
Date, Month
Date, Year
City Pairs - 1st "FROM" ISO 5 Character
City Pairs – 2nd "FROM" ISO 5 Character
City Pairs – 3rd "FROM" ISO 5 Character
City Pairs – 4th "FROM" ISO 5 Character
City Pairs - 1st "TO" ISO 5 Character
City Pairs – 2nd "TO" ISO 5 Character
City Pairs – 3rd "TO" ISO 5 Character
City Pairs – 4th "TO" ISO 5 Character
Flight Number - 1st ISO 5 Character
Flight Number – 2nd ISO 5 Character
Flight Number - 3rd ISO 5 Character
Flight Number - 4th ISO 5 Character
Flight Number - 5th SO 5 Character
Flight Number - 6th ISO 5 Character
Flight Number - 7th ISO 5 Character
Flight Number - 8th ISO 5 Character
Aircraft Identification – 1st Tail Character
Aircraft Identification – 2nd Tail Character
Aircraft Identification – 3rd Tail Character
Aircraft Identification – 4th Tail Character
Aircraft Identification – 5th Tail Character
Aircraft Identification – 6th Tail Character
Aircraft Identification – 7th Tail Character

7.2.2 Fault Record format

Each fault record contains the time, flight phase, failure code, number of occurrences (up to 4) of the failure.
The Ground fault records contains the first three faults recorded.
The failure codes are organized as follows:

- Log of internal faults

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Table 7-1 – TRA-100B – Internal Faults

Fault Code	Failed Assembly	Failure Symptom
00_H	None	No Faults
10_H	Power Supply +20V DC	Out of Specification
11_H	Power Supply -5VDC	Out of Specification
12_H	Power Supply +15V DC	Out of Specification
13_H	Power Supply -15VDC	Out of Specification
14_H	Power Supply +50V DC	Out of Specification
15_H	Power Supply -60VDC	Out of Specification
16_H	DPIO Board	Hw pn fault at the startup
17_H	DPIO Board	Hw pn fault during power cycle
18_H	DPIO Board	Illegal Mode S Address
19_H	N/A	Not Used
$1A_H$	ACPS Board	Out of Specification
20_H	DPIO Board	RAM Failure
21_H	DPIO Board	ROM Failure
22_H	N/A	Not Used
23_H	DPIO Board	FPGA Failure
24_H	DPIO Board	EEPROM Failure
25_H	DPIO Board	ATCRBS TX Data Failure
26_H	N/A	Not Used
27_H	DPIO Board	Squitter TX Data Failure
28_H	DPIO Board	Squitter Rate Out of Spec
29_H	N/A	N/A
$2A_H$	DPIO Board	Watchdog Fault
30_H	N/A	Not Used
31_H	TX Assy	Transmitter Failure
32_H	RFFE Assy	Pin Diode Failure
33_H	N/A	Not Used
34_H	N/A	Not Used
35_H	N/A	Not Used
36_H	TX Assy	Top Transmitter Failure
37_H	TX Assy	Bottom Transmitter Failure
40_H	RFFE/DPIO Assy	Top Receiver IF Failure
41_H	RFFE/DPIO Assy	Bottom Receiver IF Failure
42_H	RFFE/DPIO Assy	Top Video Failure
43_H	RFFE/DPIO Assy	Bottom Video Failure
44_H	N/A	Not Used
45_H	RFFE/DPIO Assy	DPSK Receiver Failure
46_H	N/A	Not Used
60_H	RFFE Assy	RF Top TX Self-Test Failure
61_H	RFFE Assy	RF Bottom TX Self-Test Failure
62_H	TX/RFFE/DPIO Assy	RF Self-Test Failure
$E0_H$	Antenna	Both Antennas Open Circuit
$E1_H$	Antenna	Top Antenna Open Circuit
$E2_H$	Antenna	Bottom Antenna Open Circuit
$E3_H$	Control Panel	No Control Data

- Log of external faults

Table 7-2 – TRA-100B – External Faults

Fault Code	Failed Interface	Failure Symptom
$F0_H$	Maintenance	No Maintenance Data
$F1_H$	24 bit discrete Address	Intermittent Mode S Address
$F2_H$	TCAS	TCAS Periodic Data Failure
$F3_H$	Power Interruption >10MSEC	Power Supply Interruption
$F4_H$	Altitude – 706 (L203)	Altitude 706 Air Data Failure
$F5_H$	Altitude – 575 (L203)	Altitude 575 Air Data Failure
$F6_H$	Altitude – 706 (all labels)	706 Air Data Failure
$F7_H$	FMC/GNSS#2	FMC/GNSS#2 Failure
$F8_H$	FMC/GNSS#1/#2	FMC/GNSS#1/#2 Failure
$F9_H$	IRS/FMS	IRS/FMS Failure
FA_H	FMC/GNSS#1	FMC/GNSS#1 Failure
FB_H	FMC GEN	FMC GEN Failure
FC_H	Altitude – 575 (all labels)	575 Air Data Failure
FD_H	FCC/MCP	FMC/MCP Failure
FE_H	Landing Gear Input	Landing Gear Failure
FF_H	ADS-B Configuration Pins	ADS-B Parity Failure

7.3 FAILURE LOCATION ON AIRCRAFT

The Fault Location procedure permits to find out the origin of a undesired symptoms.

LED on the front panel of the TRA-100B transponder illuminate when TRA-100B system failures are detected (Figure 7-3).
The TRA-100B transponder's Built-In-Test equipment (BITE) continually monitors the equipment (both internal and external sources) and if a failure is detected will cause the transponder lamp. System failure indications displayed on the front of the transponder are detected during Functional-Self-Test. The Functional-Self-Test is manually initiated from the TEST pushbutton on the front of the transponder.
Some of the transponder faults, are indicated with red LED's on the transponder front panel. The following is a list of the transponder fault LED's.

During Power-Up the XPNDR red LED is set and remain set until the equipment is initialized (i.e. Software and Firmware started up).

The XPNDR red LED is set while the failure discrete output pins are in the active state.

The XPNDR green LED is set to indicate that the equipment is initialized (i.e., Software and Firmware started up) and the failure discrete output pins are not in the active state.

The front panel LED's provide a real time report of the validity of the Transponder internally and the external interfaces.

The LED's are activated by the Test Push-button. The tests for the "on-ground" condition are performed at the time of the activation of the test push-button.

The data from this self-test and the data from the latest passive test sequence is then displayed by the LED's in the following manner:

- Within 1 second from the time the push-button is activated, NOGO (RED) and external interfaces LED's is turned on for 3 seconds.
- NOGO (RED) and external interfaces LED's then go off for 3 seconds.
- The appropriate LED then is set on and stays lit until the push-button is released.
- The appropriate LED above is green for the Transponder, if no internal faults are identified, and red for the Transponder, if any internal fault is identified.

The test cycle that is initiated by the push-button re-runs after the 3 second, 3 second, 3 second sequence described above is completed, if the push-button is still active.

However, the LEDs remains in their status annunciation state, and will change in response to any new array of fault data picked up by the latest test cycle.

7.3.1 ON A/C Troubleshooting procedure

TRA-100B failure indication and associated corrective action procedures are described in Table 7-3

Table 7-3 – TRA-100B – Malfunction Symptoms

Ref.	Symptoms	Prioritized Corrective Action
1.	Primary power is not present on bus input to the transponder.	1. Check/repair aircraft primary power source and associated aircraft wiring. 2. Check/replace any external relays that may be present in the primary power input lines to transponder.
2.	Platform primary power circuit breaker not remain closed.	1. Check/repair short circuit in aircraft wiring or system equipment.
3.	Fail lamp remains lit on transponder related control unit.	1. Follow procedure to Ref. 18 if TRA-100B transponder is selected on control unit or replace ATCRBS transponder if ATCRBS transponder is selected from control unit.
4.	ATC 1 or ATC 2 annunciation does not appear on control unit display window when transponder #1 (ATC 1) is selected from control unit.	1. Replace control unit.
5.	Without having pressed the TEST pushbutton on the front panel of the TRA-100B, XPNDR red LED failure indication is lit on the front of transponder (i.e. red lamp illuminated on TRA-100B).	1. Replace transponder if a TRA-100B transponder is being checked. If failure indication appears on an ATCRBS transponder please refers to appropriate maintenance manual
6.	When TEST pushbutton on front panel of transponder is pressed to initiate functional test, all the lamps on front of the TRA-100B transponder do not light for approximately three seconds and then extinguish (or, if applicable, proper initial functional test	1. Replace transponder if a TRA-100B transponder is being checked. If failure indication appears on an ATCRBS transponder please refers to appropriate maintenance manual

Ref.	Symptoms	Prioritized Corrective Action
	indications are not present on an ATCRBS transponder).	
7.	Approximately six seconds after the TEST pushbutton on the front of the transponder is pressed and held, a transponder "good" indication is not present on the transponder or a "fail" indication is present. For the TRA-100B, Transponder "good" is indicated by a LED (green) XPNDR and a "fail" condition is indicated by a LED (red) XPNDR.	1. Follow procedure to Ref. 18 if TRA-100B transponder is selected on control unit or replace ATCRBS transponder if ATCRBS transponder is selected from control unit
8.	XPNDR Green LED on front of TRA-100B transponder remains permanently lit after TEST pushbutton on transponder has been released (or, if applicable, a similar faulty indication appears on an ATCRBS transponder).	1. Replace transponder if a TRA-100B transponder is being checked. If failure indication appears on an ATCRBS transponder please refers to appropriate maintenance manual
9.	When TEST procedure is initiated from the control unit, the ATC FAIL lamp on the control unit itself does not light for first three seconds or remains lit.	1. Press and hold TEST pushbutton on front of transponder selected on the control unit. Check for fail indication on front of transponder. If a lit red fail LED is present on a TRA-100B transponder follow the procedure to Ref. 18. If failure indication appears on an ATCRBS transponder please refers to appropriate maintenance manual. 2. Replace the control unit. 3. Check/repair Functional Test signal wiring between the control unit and the transponder.
10.	Control unit's ATC IDENT CODE display window does not indicate 8888 during TEST mode initiated from control unit.	1. Replace control unit.
11.	ATC Code Select switches/controls on the control unit do not properly control the ATC Code display on the control unit.	1. Replace control unit.
12.	Mode C ramp tests: proper altitude	1. Follow procedure to Ref. 18 if TRA-100B

Ref.	Symptoms	Prioritized Corrective Action
	reports are not displayed on ramp tester.	transponder is selected on control unit or replace ATCRBS transponder if ATCRBS transponder is selected from control unit 2. Check/replace altitude source. 3. Check ramp tester.
13.	Mode C ramp tests: the ramp tester indicates that the transponder's transmit frequency is not within 1090 MHz ± 1 MHz.	Same as Ref. 12
14.	Mode A ramp tests: proper ATC Code is not displayed on ramp tester.	Same as Ref. 12
15.	Mode A ramp tests: the ramp tester indicates that the transponder transmit frequency is not within 1090 MHz ± 1 MHz.	Same as Ref. 12
16.	An altitude report display is visible on ramp tester when the appropriate control unit switch is set to inhibit altitude reporting during ramp testing.	1. Replace control unit. 2. Replace transponder. 3. Check/repair the Altitude Reporting ON/OFF signal wiring between the control unit and transponder.
17.	a Special Position Identifion (SPI) pulse indication is not visible on ramp tester when the ATC IDENT switch is pressed during ramp testing.	1. Replace control unit. 2. Replace transponder. 3. Check/repair the IDENT signal wiring between the control unit and transponder
18.	On front panel of TRA-100B transponder, press and hold the TEST pushbutton while observing indicators on front of transponder: One or more of the red XPNDR, ALT, DATA IN, TOP, BOT, TCAS, MAINTENANCE, GPS or RESERVED LED remain lit.	FAULT LED FAILURE XPDR green (No other lights on): System good XPDR red: XPNDR is defective ALT: ADC source is defective DATA IN: Check ATC control unit/wiring TOP: Top ATC ant/coax is "OPEN" BOT: Bottom ATC ant/coax is "OPEN" GPS: GPS source is defective TCAS: Check TCAS processor/wiring MAINT Check input from CFDS, if used RESERVED Not Active RESERVED Not Active

7.3.2 NVM Download procedure

In addition to the above procedures, maintainer can download the NVM contents in order to verify the status of fault code as per Table 7-1 and Table 7-2.
Following procedure describes step by step actions to be performed in order to download NVM fault log data from TRA-100B Mode S Transponder.
The procedure is tailored to TechSat Net Loader tool but can be easily translated to any other A615A compliant tool.
The main goal is to send one of the attached files (HNR-XPDR_1.LNR or HNR-XPDR_1.LNR depending on XPDR side installation) in order to command the Transponder to download the NVM fault log data.

7.3.2.1 Techsat Net Loader procedure:

1) Change the PC's IP Address and Subnet mask (remember current setting).
   Control Panel -> Network and Internet -> Network Connections then change Local Area Connection Properties of the Internet Protocol Version 4 (TCP/IPv4 Properties) to:
   - IP Address = 10.129.0.1 (for side 1, 10.128.0.1 for side 2)
   - Subnet mask = 255.255.255.0

2) Standard Ethernet cable connected from PC to the TRA-100B Ethernet port.

3) Maintenance Key plugged into the maintenance port. Note this will tie the Maintenance Port pins 1, 14 & 15 to Pin 3 (GND).

4) The unit must be configured to be on-ground by grounding TP5K & TP5J.
   Note: steps 5-9 can be skipped if the tool has been previously installed
5) Install MediaCreator PartMaker and NetLoader software (see how to install them)

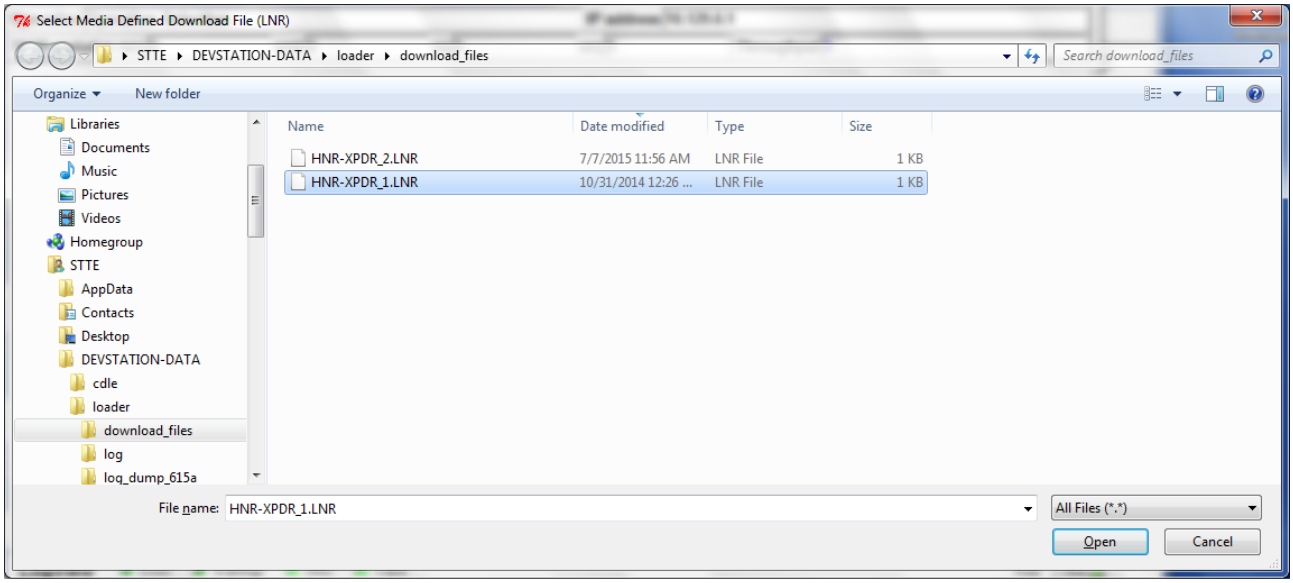
6) The default working directory is : C:\Users\ UserName\DEVSTATION-DATA (%HOME%/DEVSTATION-DATA)
   a. Copy attached files HNR-XPDR_1.LNR and HNR-XPDR_2.LNR in: %HOME%/DEVSTATION-DATA/loader/download_files
7) Start NetLoader and press "OK" button in Error window

8) Click "Edit Configuration" button
   a. Set subnetmask = 255.255.255.0
   b. Set ip = 10.129.0.1
   c. Set a615a_version = 3
   d. Press Commit and then Close

9) Press “Shutdown” button

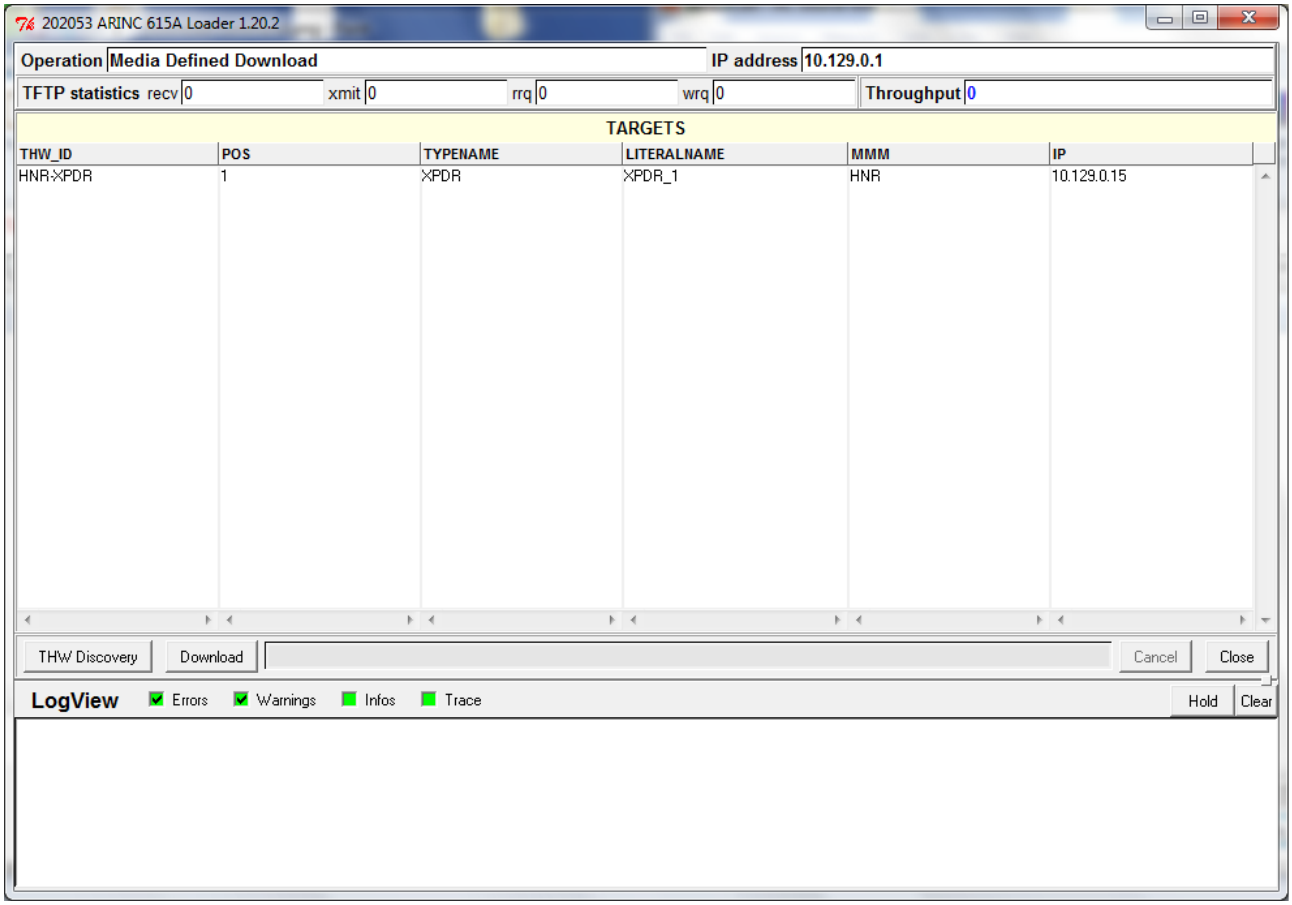
10) Start NetLoader and press “OK” button in Error window

11) Press “Download Media defined” button, following window will appear



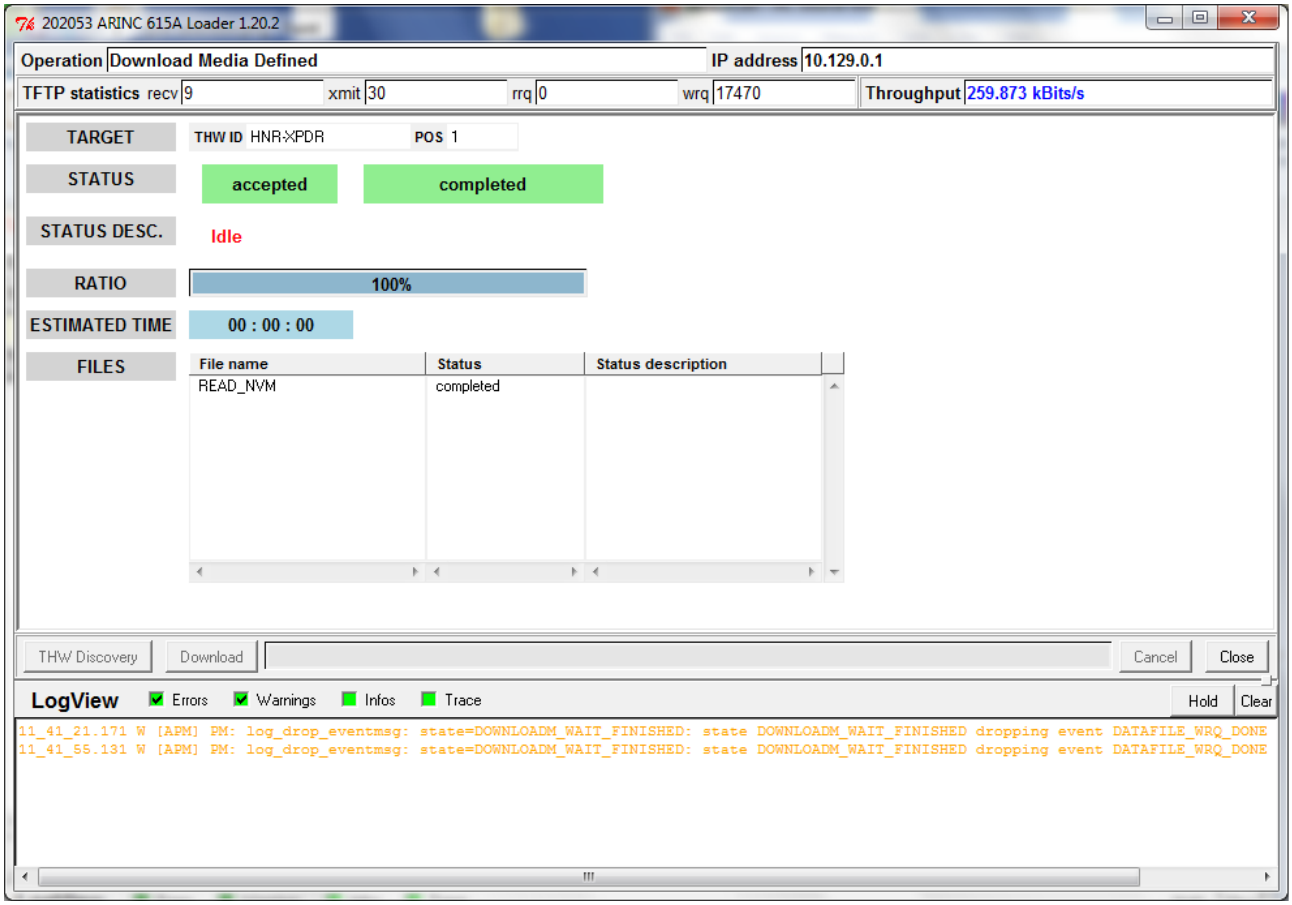
12) Click on HNR-XPDR_1.LNR file for side 1 XPDR, HNR-XPDR_2.LNR for side 2 XPDR and then press “Open” button.

13) If the XPDR is correctly found by the loader the following mask will appear (side 1 example)



14) Select the HNR-XPDR THW_ID row and press “Download” button.

15) NVM download process will start automatically and if successfully the following window will appear. Binary file “READ_NVM” with NVM fault log content will be stored in %HOME%/DEVSTATION-DATA/loader/download_files folder.



16) Press “Close” button

17) Press “Shutdown” button

7.3.3 NVM Data

The Table 7-1 – TRA-100B – Internal Faults provides fault log for internal faults and consequently for off aircraft info, the Table 7-2 – TRA-100B – External Faults provides fault log for failures detected on external sources. In case of failure indication provided on this area, the first step is verify the connections between the TRA-100B and related external equipment.

The following table (Table 7-4) reports the troubleshooting procedure to perform against each fault log.

Table 7-4 - External Faults Maintenance Procedure

Fault Code	Failed Interface	Failure Symptom	Maintenance action
$F0_H$	Maintenance	No Maintenance Data	Verify connection with CFDS if used
$F1_H$	24 bit discrete Address	Intermittent Mode S address	Verify the connection with Address bus
$F2_H$	TCAS	TCAS Periodic Data Failure	Verify connection with TCAS
$F3_H$	Power Interruption>10MSEC	Power Supply Interruption	Verify connection with primary power from platform
$F4_H$	Altitude – 706 (L203)	Altitude 706 Air Data Failure	Verify connection with ADC source
$F5_H$	Altitude – 575 (L203)	Altitude 575 Air Data Failure	Verify connection with ADC source
$F6_H$	Altitude – 706 (all labels)	706 Air Data Failure	Verify connection with ADC source
$F7_H$	FMC/GNSS#2	FMC/GNSS#2 Failure	Verify connection with FMC/GNSS#2
$F8_H$	FMC/GNSS#1#2	FMC/GNSS#1#2 Failure	Verify connection with FMC/GNSS#2
$F9_H$	IRS/FMS	IRS/FMS Failure	Verify connection with IRS/FMS
FA_H	FMC/GNSS#1	FMC/GNSS#1 Failure	Verify connection with FMC/GNSS#1
FB_H	FMC GEN	FMC GEN Failure	Verify connection with FMC
FC_H	Altitude – 575 (all labels)	575 Air Data Failure	Verify connection with

Fault Code	Failed Interface	Failure Symptom	Maintenance action
			ADC source
FD_H	FCC/MCP	FCC/MCP Failure	Verify connection with FCC/MCP
FE_H	Landing Gear Input	Landing Gear Failure	Verify the connection with platform
FF_H	ADS-B Configuration Pins	ADS-B Parity Failure	Verify connection with platform

7.4 FAILURE LOCATION OFF AIRCRAFT

7.4.1 STTE Description

As mentioned above the TRA-100B Built-In-Test is capable to perform internal diagnostic and provide results to the STTE.
The TRA-100B STTE is designed to perform troubleshooting procedure and provides after the fault isolation the step by step procedure to restore the Transponder in its operating condition.

The TRA-100B STTE is composed as follows

Table 7-5 – TRA-100B STTE Composition

Pos.	Item	P/N
1	Double Rack 37U 600x800	HPI-1358/01.01
2	Lab Equipment _ (9 KHz - 6 GHZ)	9401151M0019
3	PXI INTERFACE	TAD-5055/01.01
4	UUT FRONT PANEL FIXTURE	TAG-5486/01.01
5	ANTENNA INTERFACE - MOUNTING	TAD-5056/01.01
6	Rack Guide ACCIAIO TELESCOPICA	8100485M0437
7	For Cabinets ACCIAIO	8100081M0419
8	Lab Equipment _ (IFF SIMULATOR)	9401131M0014
9	Lab Equipment _ (AC SOURCE/A	9401163M0015
10	DIGITAL SCOPE	TAG-5497/01.01
11	Monitor _ (17" LCD DISPLAY -	9401149M0014
12	PC Periph or Assembly _ (RAC	9401140M0013
13	Ethernet Switch (16 PORT FAS	9300164M0018
14	WORKSTATION 2U RACK	HPI-1400/01.01
15	CAVO ICON ITA-ICON ITA L300mm	TAN-5358/01.01
16	RF Cable SUCOFLEX 104 PTFE _m	1301783M0015
17	CAVO BNC 90-BNC 90 L2600mm	TAN-5361/01.01
18	CAVO BNC 90-BNC 90 L1500mm	TAN-5362/01.01
19	CAVO HI-PWR PER ATE MST-TRA	TAN-5368/01.01
20	CABLE 37P BREAKOUT PXI - ANTE	TAN-5380/01.01
21	TARGHETTA RACK	TAK-7180/01.01
22	Cable AWG28 PVC _m**2 _ _ (C	1301273M0012
23	Cable 26/28AWG LSZH _m**2 COP	1301688M0011
26	TRA-100B_MPC STTE Software	TIU-0077/01.01

Figure 7-1 and Figure 7-2 show the STTE composition

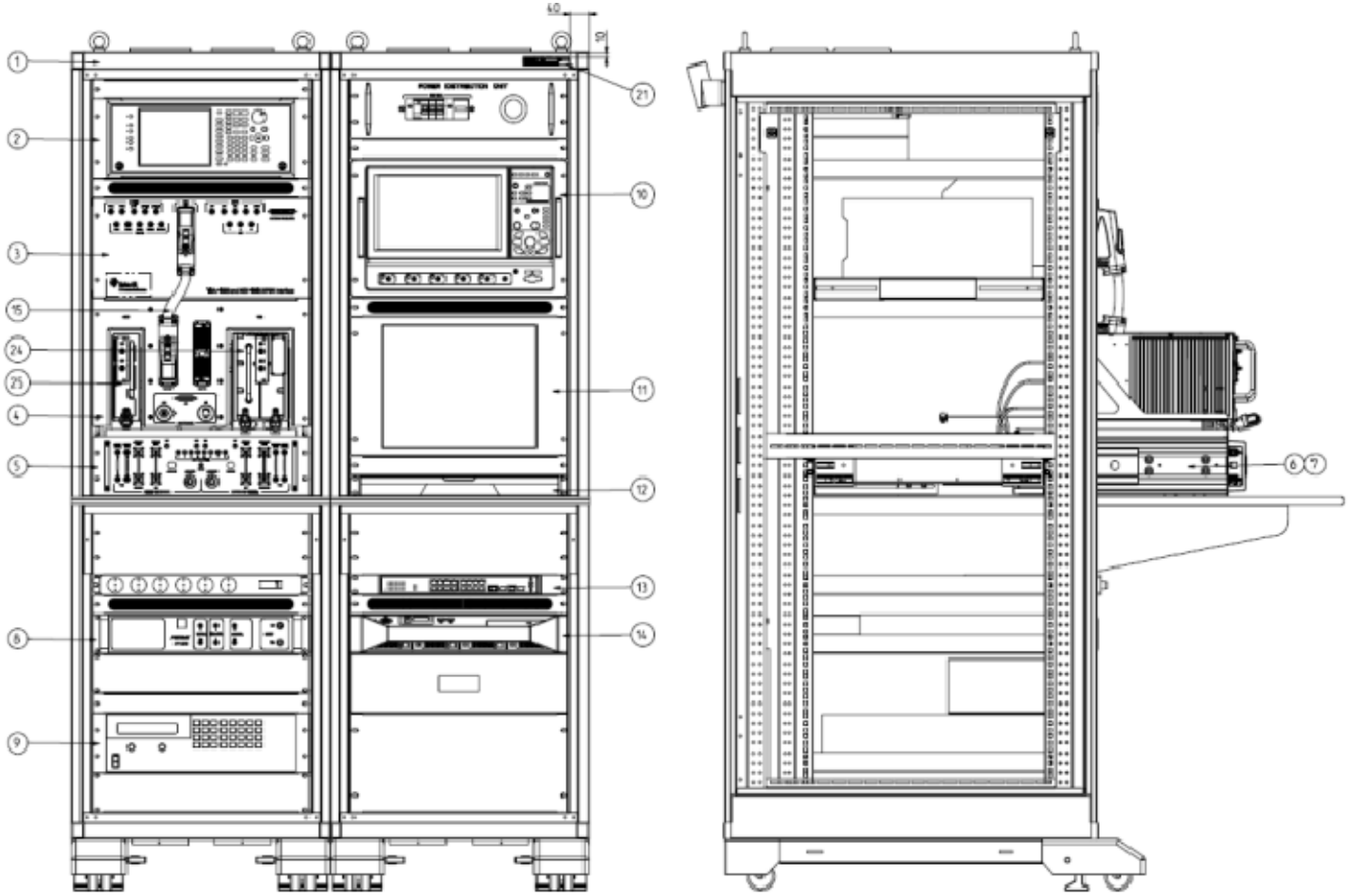


Figure 7-1 – TRA-100B STTE (Front and right views)

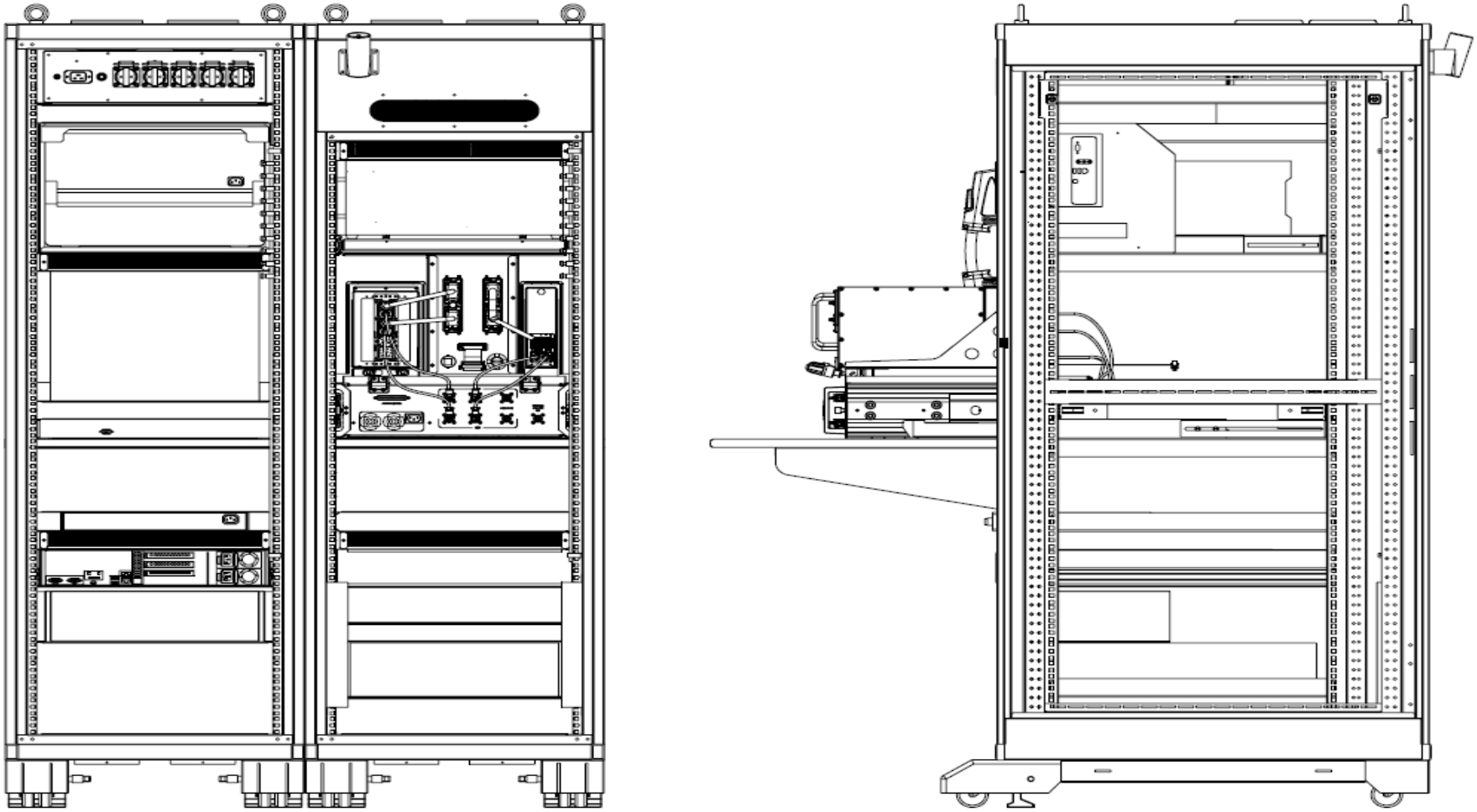


Figure 7-2 – TRA-100B STTE (Rear and left views)

7.4.2 OFF A/C Troubleshooting procedure

The OFF A/C troubleshooting procedure is performed in the Repair Station in order to identify or confirm the failure of received equipment.
It starts with a visual inspection of the Transponder to verify eventual damage that can be occurred during the handling, packaging and/or transportation.

In case of damage the maintainer has to verify if it is reported on the Failure Report supplied with the Equipment. In case of missing information the maintainer shall record the damage updating the Failure Report.

Therefore the equipment shall be connected to the STTE (see Figure 7-1) and shall verify the data reported in the NVM (see Figure 7-7).
The STTE provides the necessary supplies, command and control signals and maintenance interface.

The first information on the Transponder health status is provided by the Front Panel. The TRA-100B is equipped with a set of LED which provide the status of the Transponder itself and the status of the Transponder interfaces.

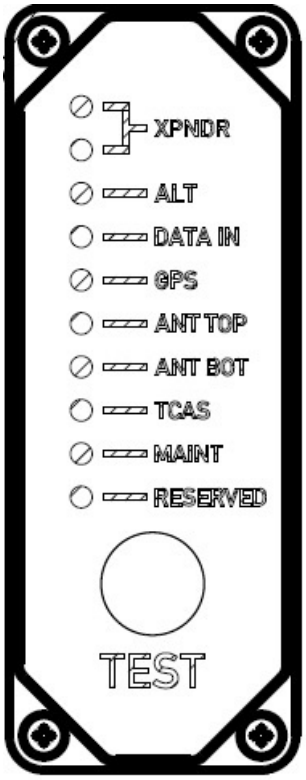


Figure 7-3 – TRA-100B - Front Panel LED

As showed in Figure 7-3 the following LED are present on the Front Panel with the following meaning:

Table 7-6 – TRA-100B - Front Panel LED indicators

CONTROL / INDICATOR	DESCRIPTION	FUNCTION
XPNDR	Green	Transponder GO. The Transponder is correctly operating.
XPNDR	Red	Transponder NOGO. The Transponder is not operating.
ALT	Green/Red	This LED provides the status of external Altitude data. Color green the data are correct
DATA IN	Green/Red	This LED provides the status of external Control data. Color green the data are correct
GPS	Green/Red	This LED provides the status of external GPS data. Color green the data are correct
ANT TOP	Green/Red	This LED provides the status of external Antenna Top status. Color green the Antenna Top is correctly operating.
ANT BOT	Green/Red	This LED provides the status of external Antenna Bot status. Color green the Antenna Bot is correctly operating.
TCAS	Green/Red	This LED provides the status of external TCAS data. Color green the data are correct
MAINT	Green/Red	This LED provides the status of Maintenance interface. Color green the data are correct
RESERVED	N/A	

During Power-Up the NOGO (RED) LED is set and remain set until the equipment is initialized (i.e. Software and Firmware started up).
The NOGO (RED) LED is set while the failure discrete output pins are in the active state.
The GO (GREEN) LED is set to indicate that the equipment is initialized (i.e., Software and Firmware started up) and the failure discrete output pins are not in the active state.
The front panel LED's provide a real time report of the validity of the Transponder internally and the external interfaces.
The LED's are activated by the Test Push-button. The tests for the "on-ground" condition are performed at the time of the activation of the test push-button.
The data from this self-test and the data from the latest passive test sequence is then displayed by the LED's in the following manner:

- Within 1 second from the time the push-button is activated, NOGO (RED) and external interfaces LED's is turned on for 3 seconds.
- NOGO (RED) and external interfaces LED's then go off for 3 seconds.
- The appropriate LED then is set on and stays lit until the push-button is released.
- The appropriate LED above is green for the Transponder, if no internal faults are identified, and red for the Transponder, if any internal fault is identified.

The test cycle that is initiated by the push-button re-runs after the 3 second, 3 second, 3 second sequence described above is completed, if the push-button is still active.
However, the LEDs remains in their status annunciation state, and will change in response to any new array of fault data picked up by the latest test cycle.

7.4.3 Connection procedure

The procedure to connect the TRA-100B to the STTE is following reported (ref. Figure 7-1):

1. Install the TRA-100B into the mounting tray (pos. 6 and 7) and push it until the rear connectors are mated.
2. Securing the TRA-100B to the mounting tray using the two hold down screws
3. Connect the Ethernet connector
4. Connect the Test connector.

7.4.4 Fault Finding

The TRA-100B stores the failures occurred during the operation in the NVM. Nevertheless if a failure arise in a section of DPIO the Transponder is not operative and the NVM content cannot be read.
The procedure to perform the fault finding on TRA-100B is following reported:

1. Verify the status of the front panel LED.
2. If the red LED “NO GO” is on the DPIO SRU is failed but no data cannot be written in the NVM.
   Therefore follows the procedure for DPIO Removal (Ref. 8.4.1).
3. If the green LED “GO” is on, the TRA-100B is able to perform the auto test phase.

After 30 sec. the results of test will be reported in the “NVM Maintenance Interface” box (see Figure 7-7)

4. The data are organized as follows:
   a. Current Flight Information data pack: This field contains data related to flight information such as departure location (From), arrival location (to), flight number (Flight Nr.), aircraft identification (Aircraft Id.) and date (Date)
   b. Failure Localization data pack (flight): This field contains data related Failure code as per plus time of occurrence (GMT), Flight Phase, Error Repetition Counter (Fail

Rep), Check Sum, Temperatures info (Temp 1XX, Temp 2XX, Temp 3XX), ETI Counter (ETI High, ETI Low).

5. After the completion of test cycle, the operator shall select “Diagnostic Procedure” from Tool Menu (Figure 7-8)
6. The Diagnostic Procedure screen (Figure 7-9) shows the Fail Code information together with Module affected and Fail Description. The last column of section “Page” reports the CMM number of page where the maintenance procedure to be performed in order to restore the Transponder is recalled.
7. Clicking on the number of page reported in this column, the “Maintenance” section of this manual will be opened showing the maintenance task to be performed to replace the failed module.

7.4.5 Checkout procedure

In order to verify if the maintenance procedure restored the TRA-100B to its operating conditions, a checkout procedure has to be performed.
This checkout consist mainly in running the ATP procedure as described following:

*7.4.5.1 **Check of lightning protection devices presence***

The testing in this section consists of applying an AC voltage through a current-limit resistor to the UUT rear connector discrete pins.
The voltage level has been selected to provide enough current to activate the transzorbs. With this AC voltage applied, the Minimum and Maximum DC voltage levels on discrete output pins are measured to ensure that the transzorbs perform voltage clamping at the device rated values.
Care is taken to apply the AC voltage for less than 15 seconds in order to prevent damage to the discrete output circuit in case of a transzorb failure.

The following table defines the series resistor value, the external AC voltage to be used for each single pin and the expected clamping voltage to be verified.

Table 7-7 – TRA-100B - Transzorb Test Parameters

Pin	I/O	Type	Description	Series Resistor 1%	AC Voltage	Clamping Voltage
TP 1A	Input	Program	AC Length/Width A MSB	4.75KΩ 1/2W	80±0.5VAC, 50±0.5Hz	± 72.7 V
TP 1B	Input	Program Strobed	AC Length/Width B	4.75KΩ 1/2W	80±0.5VAC, 50±0.5Hz	± 72.7 V
TP 1C	Input	Program Strobed	AC Length/Width C LSB	4.75KΩ 1/2W	80±0.5VAC, 50±0.5Hz	± 72.7 V
TP 1D	Input	Program Strobed	GPS Ant Long Off A (MSB)	4.75KΩ 1/2W	80±0.5VAC, 50±0.5Hz	± 72.7 V
TP 1E	Input	Program Strobed	GPS Ant Long Off B	4.75KΩ 1/2W	80±0.5VAC, 50±0.5Hz	± 72.7 V
TP 1F	Input	Program Strobed	GPS Ant Long Off C (LSB)	4.75KΩ 1/2W	80±0.5VAC, 50±0.5Hz	± 72.7 V
TP 1G	Input	Program Strobed	Navigation Accuracy Category Velocity (NAC_V)	4.75KΩ 1/2W	80±0.5VAC, 50±0.5Hz	± 72.7 V
TP 1H	Input	Program Strobed	System Design Assurance (SDA)	4.75KΩ 1/2W	80±0.5VAC, 50±0.5Hz	± 72.7 V
TP 1J	Input	Differential	GPS Time Mark 1A	560Ω 1/2W	40±0.5VAC, 50±0.5Hz	± 24.4 V
TP 1K	Input	Differential	GPS Time Mark 1B	560Ω 1/2W	40±0.5VAC, 50±0.5Hz	± 24.4 V
TP 2A	Input	429	FMC/GNSS #1 In #1 A	560Ω 1/2W	40±0.5VAC, 50±0.5Hz	± 11.2 V
TP 2B	Input	429	FMC/GNSS #1 In #1 B	560Ω 1/2W	40±0.5VAC, 50±0.5Hz	± 11.2 V
TP 2C	Input	429	IRS/FMS/Data Conc. A	560Ω 1/2W	40±0.5VAC, 50±0.5Hz	± 11.2 V
TP 2D	Input	429	IRS/FMS/Data Conc. B	560Ω 1/2W	40±0.5VAC, 50±0.5Hz	± 11.2 V
TP 2E	Output	429	Spare Out 1A	560Ω 1/2W	40±0.5VAC, 50±0.5Hz	± 11.2 V
TP 2F	Output	429	Spare Out 1B	560Ω 1/2W	40±0.5VAC, 50±0.5Hz	± 11.2 V
TP 2G	Input	429	ATSU In A	560Ω 1/2W	40±0.5VAC, 50±0.5Hz	± 11.2 V
TP 2H	Input	429	ATSU In B	560Ω 1/2W	40±0.5VAC, 50±0.5Hz	± 11.2 V
TP 2J	Input	Discrete	Data Load Enable	4.75KΩ 1/2W	80±0.5VAC, 50±0.5Hz	± 72.7 V
TP 2K	Input	Program	ADS-B FAIL Disable	4.75KΩ 1/2W	80±0.5VAC, 50±0.5Hz	± 72.7 V
TP 3A	Output	Discrete	ADS-B FAIL Disc Out	4.75KΩ 1/2W	80±0.5VAC, 50±0.5Hz	± 72.7 V
TP 3B	Output	Discrete	Transponder Fail Disc #2 Output	4.75KΩ 1/2W	80±0.5VAC, 50±0.5Hz	± 72.7 V
TP 3C	Input	Program	Cable Delay Program Top/Bot	4.75KΩ 1/2W	80±0.5VAC, 50±0.5Hz	± 72.7 V
TP 3D	Input	Program	Cable Delay Program Value #1	4.75KΩ 1/2W	80±0.5VAC, 50±0.5Hz	± 72.7 V
TP 3E	Input	Program	Cable Delay Program Value #2	4.75KΩ 1/2W	80±0.5VAC, 50±0.5Hz	± 72.7 V
TP 3G	Input	Discrete	SDI 429 Bus Address Logic Input	4.75KΩ 1/2W	80±0.5VAC, 50±0.5Hz	± 72.7 V
TP 3H	Input	Discrete	SDI 429 Bus Address Logic	4.75KΩ	80±0.5VAC,	± 72.7 V

Pin	I/O	Type	Description	Series Resistor 1%	AC Voltage	Clamping Voltage
			Input	1/2W	50±0.5Hz	
TP 5A	Input	Program	Maximum Airspeed 17	4.75KΩ 1/2W	80±0.5VAC, 50±0.5Hz	± 72.7 V
TP 5B	Input	Program	Maximum Airspeed 16	4.75KΩ 1/2W	80±0.5VAC, 50±0.5Hz	± 72.7 V
TP 5C	Input	Program	Maximum Airspeed 15	4.75KΩ 1/2W	80±0.5VAC, 50±0.5Hz	± 72.7 V
TP 5E	Input	429	TX Coordination A	560Ω 1/2W	40±0.5VAC, 50±0.5Hz	± 11.2 V
TP 5F	Input	429	TX Coordination B	560Ω 1/2W	40±0.5VAC, 50±0.5Hz	± 11.2 V
TP 5G	Output	429	XT Coordination A	4.75KΩ 1/2W	50±0.5VAC, 50±0.5Hz	± 11.2 V
TP 5H	Output	429	XT Coordination B	560Ω 1/2W	40±0.5VAC, 50±0.5Hz	± 11.2 V
TP 5J	Input	Discrete	Air/Ground Discrete #2	4.75KΩ 1/2W	80±0.5VAC, 50±0.5Hz	± 72.7 V
TP 5K	Input	Discrete	Air/Ground Discrete #1	4.75KΩ 1/2W	80±0.5VAC, 50±0.5Hz	± 72.7 V
TP 6A	Input	429	FMC #1 / Gen In #2 A	560Ω 1/2W	40±0.5VAC, 50±0.5Hz	± 11.2 V
TP 6B	Input	429	FMC #1 / Gen In #2 B	560Ω 1/2W	40±0.5VAC, 50±0.5Hz	± 11.2 V
TP 6D	Input	Discrete	GPS Time Mark 2A	4.75KΩ 1/2W	40±0.5VAC, 50±0.5Hz	± 24.4 V
TP 6E	Input	Discrete	GPS Time Mark 2B	4.75KΩ 1/2W	40±0.5VAC, 50±0.5Hz	± 24.4 V
TP 6F	Input	Discrete	Reserved	4.75KΩ 1/2W	80±0.5VAC, 50±0.5Hz	± 72.7 V
TP 6G	Input	Discrete	Reserved (-0101/-0301); FAA - L_Sense Activate (-0201)	4.75KΩ 1/2W	80±0.5VAC, 50±0.5Hz	± 72.7 V
TP 6K	Input	Program	Antenna Program	4.75KΩ 1/2W	80±0.5VAC, 50±0.5Hz	± 72.7 V
TP 7A	Input	429	Control Data 'A' or FCC #1/MCP #1/VHF #1 A	560Ω 1/2W	40±0.5VAC, 50±0.5Hz	± 11.2 V
TP 7B	Input	429	Control Data 'A' or FCC #1/MCP #1/VHF #1 B	560Ω 1/2W	40±0.5VAC, 50±0.5Hz	± 11.2 V
TP 7D	Input	Discrete	Control Data Port Select	4.75KΩ 1/2W	80±0.5VAC, 50±0.5Hz	± 72.7 V
TP 7E	Input	429	Control Data 'B' A	560Ω 1/2W	40±0.5VAC, 50±0.5Hz	± 11.2 V
TP 7F	Input	429	Control Data 'B' B	560Ω 1/2W	40±0.5VAC, 50±0.5Hz	± 11.2 V
TP 7G	Input	Discrete	Standby/On Discrete	4.75KΩ 1/2W	80±0.5VAC, 50±0.5Hz	± 72.7 V
TP 7H	Input	429	ARINC 706/575 Air Data Input Port 1A	560Ω 1/2W	40±0.5VAC, 50±0.5Hz	± 11.2 V
TP 7J	Input	429	ARINC 706/575 Air Data Input Port 1B	560Ω 1/2W	40±0.5VAC, 50±0.5Hz	± 11.2 V
MP 1A	Input	Program	Mode S Address A1 (MSB)	4.75KΩ 1/2W	80±0.5VAC, 50±0.5Hz	± 72.7 V
MP 1B	Input	Program	Mode S Address A2	4.75KΩ 1/2W	80±0.5VAC, 50±0.5Hz	± 72.7 V
MP 1C	Input	Program	Mode S Address A3	4.75KΩ 1/2W	80±0.5VAC, 50±0.5Hz	± 72.7 V
MP 1D	Input	Program	Mode S Address A4	4.75KΩ	80±0.5VAC,	± 72.7 V

Pin	I/O	Type	Description	Series Resistor 1%	AC Voltage	Clamping Voltage
				1/2W	50±0.5Hz	
MP 1E	Input	Program	Mode S Address A5	4.75KΩ 1/2W	80±0.5VAC, 50±0.5Hz	± 72.7 V
MP 1F	Input	Program	Mode S Address A6	4.75KΩ 1/2W	80±0.5VAC, 50±0.5Hz	± 72.7 V
MP 1G	Input	Program	Mode S Address A7	4.75KΩ 1/2W	80±0.5VAC, 50±0.5Hz	± 72.7 V
MP 1H	Input	Program	Mode S Address A8	4.75KΩ 1/2W	80±0.5VAC, 50±0.5Hz	± 72.7 V
MP 1J	Input	Program	Mode S Address A9	4.75KΩ 1/2W	80±0.5VAC, 50±0.5Hz	± 72.7 V
MP 1K	Input	Program	Mode S Address A10	4.75KΩ 1/2W	80±0.5VAC, 50±0.5Hz	± 72.7 V
MP 2A	Input	Program	Mode S Address A11	4.75KΩ 1/2W	80±0.5VAC, 50±0.5Hz	± 72.7 V
MP 2B	Input	Program	Mode S Address A12	4.75KΩ 1/2W	80±0.5VAC, 50±0.5Hz	± 72.7 V
MP 2C	Input	Program	Mode S Address A13	4.75KΩ 1/2W	80±0.5VAC, 50±0.5Hz	± 72.7 V
MP 2D	Input	Program	Mode S Address A14	4.75KΩ 1/2W	80±0.5VAC, 50±0.5Hz	± 72.7 V
MP 2E	Input	Program	Mode S Address A15	4.75KΩ 1/2W	80±0.5VAC, 50±0.5Hz	± 72.7 V
MP 2F	Input	Program	Mode S Address A16	4.75KΩ 1/2W	80±0.5VAC, 50±0.5Hz	± 72.7 V
MP 2G	Input	Program	Mode S Address A17	4.75KΩ 1/2W	80±0.5VAC, 50±0.5Hz	± 72.7 V
MP 2H	Input	Program	Mode S Address A18	4.75KΩ 1/2W	80±0.5VAC, 50±0.5Hz	± 72.7 V
MP 2J	Input	Program	Mode S Address A19	4.75KΩ 1/2W	80±0.5VAC, 50±0.5Hz	± 72.7 V
MP 2K	Input	Program	Mode S Address A20	4.75KΩ 1/2W	80±0.5VAC, 50±0.5Hz	± 72.7 V
MP 3A	Input	Program	Mode S Address A21	4.75KΩ 1/2W	80±0.5VAC, 50±0.5Hz	± 72.7 V
MP 3B	Input	Program	Mode S Address A22	4.75KΩ 1/2W	80±0.5VAC, 50±0.5Hz	± 72.7 V
MP 3C	Input	Program	Mode S Address A23	4.75KΩ 1/2W	80±0.5VAC, 50±0.5Hz	± 72.7 V
MP 3D	Input	Program	Mode S Address A24 (LSB)	4.75KΩ 1/2W	80±0.5VAC, 50±0.5Hz	± 72.7 V
MP 3F	Input	429	Spare 429 Input 1A	560Ω 1/2W	40±0.5VAC, 50±0.5Hz	± 11.2 V
MP 3G	Input	429	Spare 429 Input 1B	560Ω 1/2W	40±0.5VAC, 50±0.5Hz	± 11.2 V
MP 3H	Input	Discrete	Functional Test	4.75KΩ 1/2W	80±0.5VAC, 50±0.5Hz	± 72.7 V
MP 3J	Output	Discrete	Spare Out 1	4.75KΩ 1/2W	80±0.5VAC, 50±0.5Hz	± 72.7 V
MP 3K	Output	Discrete	Transponder Fail #1 Discrete Output	4.75KΩ 1/2W	80±0.5VAC, 50±0.5Hz	± 72.7 V
MP 4A	Input	Discrete	Spare In1	4.75KΩ 1/2W	50±0.5VAC, 50±0.5Hz	NA
MP 4B	Input	Discrete	Spare In2	4.75KΩ 1/2W	80±0.5VAC, 50±0.5Hz	± 72.7 V

Pin	I/O	Type	Description	Series Resistor 1%	AC Voltage	Clamping Voltage
MP 4C	Input	429	FMC/GNSS #2 In #1 A	560Ω 1/2W	40±0.5VAC, 50±0.5Hz	± 11.2 V
MP 4D	Input	429	FMC/GNSS #2 In #1 B	560Ω 1/2W	40±0.5VAC, 50±0.5Hz	± 11.2 V
MP 4E	Input	Program Strobed	Aircraft Category A (MSB)	4.75KΩ 1/2W	80±0.5VAC, 50±0.5Hz	± 72.7 V
MP 4F	Input	Program Strobed	Aircraft Category B (LSB)	4.75KΩ 1/2W	80±0.5VAC, 50±0.5Hz	± 72.7 V
MP 4G	Input	Program	ADS-B Configuration Parity	4.75KΩ 1/2W	80±0.5VAC, 50±0.5Hz	± 72.7 V
MP 4H	Input	Program Strobed	ADS-B Receive Capability	4.75KΩ 1/2W	80±0.5VAC, 50±0.5Hz	± 72.7 V
MP 4J	Input	Discrete	Spare In3	4.75KΩ 1/2W	80±0.5VAC, 50±0.5Hz	± 72.7 V
MP 4K	Input	Discrete	Spare In4	4.75KΩ 1/2W	80±0.5VAC, 50±0.5Hz	± 72.7 V
MP 5A	Input	429	ARINC 706/575 Air Data Input Port 2A	560Ω 1/2W	40±0.5VAC, 50±0.5Hz	± 11.2 V
MP 5B	Input	429	ARINC 706/575 Air Data Input Port 2B	560Ω 1/2W	40±0.5VAC, 50±0.5Hz	± 11.2 V
MP 5E	Output	429	ATSU Out A	560Ω 1/2W	40±0.5VAC, 50±0.5Hz	± 11.2 V
MP 5F	Output	429	ATSU Out B	560Ω 1/2W	40±0.5VAC, 50±0.5Hz	± 11.2 V
MP 5G	Input	Discrete	Extended Squitter Disable	4.75KΩ 1/2W	80±0.5VAC, 50±0.5Hz	± 72.7 V
MP 5H	Input	Discrete	Spare In5 (Mode S DL/DLP Program)	4.75KΩ 1/2W	80±0.5VAC, 50±0.5Hz	± 72.7 V
MP 5J	Input	Program	Antenna BITE Program	4.75KΩ 1/2W	80±0.5VAC, 50±0.5Hz	± 72.7 V
MP 5K	Input	Discrete	Spare In6	4.75KΩ 1/2W	80±0.5VAC, 50±0.5Hz	± 72.7 V
MP 6A	Input	429	Maintenance Data Input Port A	560Ω 1/2W	40±0.5VAC, 50±0.5Hz	± 11.2 V
MP 6B	Input	429	Maintenance Data Input Port B	560Ω 1/2W	40±0.5VAC, 50±0.5Hz	± 11.2 V
MP 6C	Output	429	Maintenance Data Output Port A	560Ω 1/2W	40±0.5VAC, 50±0.5Hz	± 11.2 V
MP 6D	Output	429	Maintenance Data Output Port B	560Ω 1/2W	40±0.5VAC, 50±0.5Hz	± 11.2 V
MP 6E	Input	Discrete	Alternate Air Data Source Select	4.75KΩ 1/2W	80±0.5VAC, 50±0.5Hz	± 72.7 V
MP 6F	Input	Program	Altitude Type Select A Discrete Input	4.75KΩ 1/2W	80±0.5VAC, 50±0.5Hz	± 72.7 V
MP 6G	Input	Program	Altitude Type Select B Discrete Input	4.75KΩ 1/2W	80±0.5VAC, 50±0.5Hz	± 72.7 V
MP 7K	Input	Discrete	Acquisition Squitter Inhibit (Honeywell Defined)	4.75KΩ 1/2W	80±0.5VAC, 50±0.5Hz	± 72.7 V
BP 1	Input	Power	115 VAC Primary Power Hot	4.75KΩ 1/2W	330±0.5VAC, 50±0.5Hz	± 291 V
BP 7	Input	Power	115 VAC Primary Power Cold	4.75KΩ 1/2W	330±0.5VAC, 50±0.5Hz	± 291 V
BP 12	Input/Output	Suppression	Suppression Pulse	4.75KΩ 1/2W	150±0.5VAC, 50±0.5Hz	± 113.0 V
BP 13	Input/Output	Suppression	Suppression Pulse - Daisy Chaining	4.75KΩ 1/2W	150±0.5VAC, 50±0.5Hz	± 113.0 V

7.4.5.2 *Test of hardware/software performances in normal use*

7.4.5.2.1 *Receiver Characteristics*

Step 1 Sensitivity

a. Interrogate the transponder with a standard Mode C ATCRBS/Mode S All-Call interrogation on Top antenna.
b. Determine the minimum RF signal level required to produce 90% transponder reply efficiency (MTL).
c. Verify that MTL is in the range -75dBm ± 3dB
d. Repeat steps a,b,c interrogating the transponder on Bottom antenna.

Note: the -78dBm is obtained from best sensitivity (-77dBm) + best cable loss (-1dB), -72dBm is obtained from worst sensitivity (-69dBm) + worst cable loss (-3dB)

Step 2 Sensitivity @ Low Sensitivity

a. Interrogate the transponder with a standard Mode C ATCRBS/Mode S All-Call interrogation on Top antenna at MTL+3dB.
b. Verify that the reply ratio is ≥ 99%.
c. Set Low_Sense Activate discrete to GND
d. Verify that the reply ratio is 0%.
e. Increase the level of the interrogation to MTL+9dB
f. Verify that the reply ratio is ≥ 99%.
g. Set Low_Sense Activate discrete to OPEN

Step 3 ATCRBS and ATCRBS/Mode S All-Call Dynamic Range

a. Interrogate the transponder with a standard Mode A interrogation at RF levels at the following levels: MTL +3 dB, -60dBm, -50dBm, -40dBm, -30dBm, -22dBm
b. For each of the above levels determine reply ratio and verify that it is ≥ 99%.
c. Interrogate the transponder with a standard Mode C ATCRBS/Mode S All-Call interrogation at RF levels at the following levels: MTL +3 dB, -60dBm, -50dBm, -40dBm, -30dBm, -22dBm
d. For each of the above levels determine reply ratio and verify that it is ≥ 99%.

Note: -22dBm is obtained from -21dBm considering the best antenna cable attenuation equal to 1dB

Step 4 Mode S Sensitivity

a. Interrogate the transponder with a Mode S Only All-Call interrogation at a standard rate with PR=0.
b. Determine the minimum RF level to produce 90% proper reply efficiency (MTL).
c. Verify that MTL is in the range -76dBm ± 2dB

Note: the -78dBm is obtained from best sensitivity (-77dBm) + best cable loss (-1dB), -74dBm is obtained from worst sensitivity (-71dBm) + worst cable loss (-3dB)

Step 5 Mode S Dynamic Range

a. Interrogate the transponder with a Mode S Only All-Call interrogation at a standard rate with PR=0 with RF levels of MTL+3dBm -50dBm and -22dBm.
b. For each of the above levels determine reply ratio and verify that it is ≥ 99%.

Note: -22dBm is obtained from -21dBm considering the best antenna cable attenuation equal to 1dB

7.4.5.2.2 Reply Transmission Frequency

Step 1 Reply Transmission Frequency

a. Modify the label 016 on Control A429 to set all A1,A2,A4,B1,B2,B4,C1,C2,C4,D1,D2,D4 to '1' (setup for 7777 pulse reply)
b. Interrogate the transponder with a standard Mode A interrogation.
c. Verify that reply center frequency is 1090MHz±1Mhz.
d. Interrogate the transponder with a standard Mode A ATCRBS/Mode S All-Call.
e. Verify that reply center frequency is 1090MHz±1Mhz.

7.4.5.2.3 RF Peak Power Output

Step 1 ATCRBS Power Output

a. Modify the label 016 on Control A429 to set all A1,A2,A4,B1,B2,B4,C1,C2,C4,D1,D2,D4 to '1' (setup for 7777 pulse reply)
b. Interrogate the transponder with a standard Mode A interrogation at 1200 interrogations (maximum available)
c. Measure the power of each single pulse
d. Verify that the lowest value is in the range 24dBW÷28dBW

Note: 24dBW is obtained from minimum required 21dBW at the antenna considering the worst antenna cable attenuation equal to 3dB. 28dBW is obtained is obtained from maximum required 27dBW at the antenna considering the best antenna cable attenuation equal to 1dB

Step 2 Short Mode S Power Output (§2.2.3.2)

a. Interrogate the transponder with a standard Mode A ATCRBS/Mode S All-Call interrogation at the standard rate
b. Measure the power of each single pulse
c. Verify that the lowest value is in the range 24dBW÷28dBW

Note: 24dBW is obtained from minimum required 21dBW at the antenna considering the worst antenna cable attenuation equal to 3dB. 28dBW is obtained is obtained from maximum required 27dBW at the antenna considering the best antenna cable attenuation equal to 1dB

Step 3 Long Mode S Power Output

a. Interrogate the transponder with a standard Mode S UF4 interrogation requesting for DF20 at 100 interrogations per second (this exceeds the 16 requested by MOPS and include equivalent extended squitters)
b. Measure the power of each single pulse
c. Verify that the lowest value is in the range 24dBW÷28dBW

Note: 24dBW is obtained from minimum required 21dBW at the antenna considering the worst antenna cable attenuation equal to 3dB. 28dBW is obtained is obtained from maximum required 27dBW at the antenna considering the best antenna cable attenuation equal to 1dB

7.4.5.2.4 Reply Rate Capability

Step 1 ATCRBS Reply Rate Capability + Continuous Reply Rate Capability

a. Modify the label 016 on Control A429 to set all A1,A2,A4,B1,B2,B4,C1,C2,C4,D1,D2,D4 and SPI to '1' (setup for 15 pulse reply)
b. Interrogate the transponder at a constant rate of 1200 Mode A ATCRBS interrogations per second plus 100 Mode S UF4 requesting for DF20
c. Measure the output power and frequency and reply ratio for each type of interrogation
d. Verify that the measured power is in the range 24dBW÷28dBW
e. Verify that reply center frequency is 1090MHz±1Mhz.
f. Verify that the reply ratio is ≥ 99% for both Mode A and Mode S

Note: 24dBW is obtained from minimum required 21dBW at the antenna considering the worst antenna cable attenuation equal to 3dB. 28dBW is obtained is obtained from maximum required 27dBW at the antenna considering the best antenna cable attenuation equal to 1dB

7.4.5.2.5 Power Consumption

Step 1 Power Consumption at max duty cycle at nominal power supply conditions

a. When running the Reply rate capability test measure:
    i. Power consumption in W and verify that is always less than 60W
    ii. Power factor, verify that is greater than 0,8

Step 2 Power Consumption at max duty cycle at max voltage and max emergency frequency

a. Set the power supply voltage at 122 Vrms (maximum normal voltage)
b. Set the power supply frequency at 440 Hz (maximum emergency frequency)
c. When running the Reply rate capability test measure:
    i. Power consumption in W and verify that is always less than 60W
    ii. Power factor, verify that is greater than 0,8

Step 3 Power Consumption at max duty cycle and min voltage and min emergency frequency

a. Set the power supply voltage at 104 Vrms (minimum normal voltage)
b. Set the power supply frequency at 360 Hz (minimum emergency frequency)
c. When running the Reply rate capability test measure:
    i. Power consumption in W and verify that is always less than 60W
    ii. Power factor, verify that is greater than 0,8

7.4.5.2.6 I/O Discrete Interface

Step 1 Mode S All-Call Addresses

a. Set the ATC test set to generate a Mode-S Only All-Call interrogation with PR, IC and CL fields set to ZERO.

b. Verify that the AA field of the transponder reply is AAAAAAH
c. Verify that XPDR FAIL#1, XPDR FAIL#2 and ADSB FAIL discrete are set in off condition (No Failure condition)
d. Power off the transponder addresses
e. Set the MS Address discrete at 555555H.
f. Power on the transponder
g. Set the ATC test set to generate a Mode-S Only All-Call interrogation with PR, IC and CL fields set to ZERO.
h. Verify that the AA field of the transponder reply is 555555H
i. Removal power from the Unit Under Test

Step 2: Address set to ALL ZEROs

a. Set the ICAO 24-Bit Address provided to the UUT to ALL ZEROs.
b. Apply power to the UUT.
c. Verify that XPDR FAIL#1, XPDR FAIL#2 and ADSB FAIL discrete are set in on condition (Failure condition)
d. Removal power from the Unit Under Test

Step 3: Address set to ALL ONEs

a. Set the ICAO 24-Bit Address provided to the UUT to ALL ONEs.
b. Apply power to the UUT.
c. Verify that XPDR FAIL#1, XPDR FAIL#2 and ADSB FAIL discrete are set in on condition (Failure condition)
d. Removal power from the Unit Under Test.

Step 4 Pressure Altitude Interface

a. Setup the ATC test set to send standard ATCRBS Mode C interrogation
b. Verify that the replies code is equal to 3329 feet.
c. Set Alternate Air Data Source Select discrete input to OPEN
d. Verify that the replies code is equal to -336 feet.
e. Power off the UUT.
f. Apply default setup
g. Set Alternate Air Data Type Select A (Pin MP 6F) to GND.
h. Apply power to the UUT.
i. Verify that the replies code is equal to 1664 feet.
j. Set the bit 11 of label 016 and 031 of control bus (Control Port B) to ‘1’ to disable altitude reporting
k. Verify that only the framing pulses are present
l. Set Control Data Port Select (TP-7D) to GND
m. Verify that the replies code is equal to 1664 feet.
n. Set Air/Ground Discrete #2 to GND
o. Verify that no replies are transmitted by the transponder
p. Set Air/Ground Discrete #2 to OPEN

q. Set Air/Ground Discrete #1 to GND
r. Verify that no replies are transmitted by the transponder
s. Set Air/Ground Discrete #2 to OPEN
t. Set Air/Ground Discrete #1 to OPEN
u. Verify that the replies code is equal to 1664 feet.
v. Set Standby/On discrete to GND
w. Verify that no replies are transmitted by the transponder

Step 5 Aircraft Identification Data

a. Provide the UUT with an Aircraft Identification Data of "UJUJUJUJ" through FMC/GEN interface with each char updated at 1 Hz
b. For up to 10.0 seconds after completing Step a, set the ATC test set to generate a Mode S interrogation with the following GICB Extraction interrogation in order to extract the Register 20_{16} - Aircraft Identification.
    i. UF=4, PC = 0, RR = 18, DI = 0, IIS = 0
c. Within FIVE (5) seconds of starting the interrogations, verify that the transponder replies with a DF=20 reply with:
    i. DR =4 or 5
    ii. MB = 20_{16} + "UJUJUJUJ" *(MB=0x2054A54A54A54A)*
d. Provide the UUT with an Aircraft Identification Data of "6 9 6 9 XY" through FMC/GEN interface (a SPACE is present between 6 and 9, 9 and 6, 6 and 9, 9 and X) with each char updated at 1 Hz
e. For up to 10.0 seconds after completing Step d, set the ATC test set to generate a Mode S interrogation with the following GICB Extraction interrogation in order to extract the Register 20_{16} - Aircraft Identification.
    i. UF=4, PC = 0, RR = 18, DI = 0, IIS = 0
f. Within TEN (10) seconds of completing Step a, verify that the transponder replies with a DF=20 reply with:
    i. MB = 20_{16} + "6969XY " (last two characters set to SPACE) "
    (MB=0x20DB9DB9619820)
g. Disable all Aircraft Identification labels on every A429 bus
h. Wait 20 seconds and verify that the transponder replies with a DF=20 reply with:
    i. MB = 20_{16} + "TAIL123 " (last two characters set to SPACE) "

Step 6 ADSB Discrete

a. Verify the transmission of acquisition squitter
b. Set the Acquisition Squitter inhibit (MP-7K) to GND
c. Verify that the acquisition squitter is no longer transmitted
d. Set the Acquisition Squitter inhibit (MP-7K) to OPEN
e. Verify the transmission of any of Extended Squitters
f. Set the Extended Squitter Disable (MP-5G) to GND
g. Verify that the Extended Squitters are no longer transmitted
h. Set the Extended Squitter Disable (MP-5G) to OPEN

i. Verify that the Squitters are transmitted on both the antennas
j. Verify that Label 353 from Maintenance Bus has the following fields:
    i. SDI set to 2_d
    ii. Max Cruise Air Speed set to 4_d
    iii. Length/Width set to 10_d
    iv. GPS Antenna Offset set to 4_d
    v. Aircraft Category set to 3_d
    vi. 1090ES IN set to 0
    vii. UAT Receiver set to 0
    viii. ADSB Conf Parity set to 0
k. Verify that Label 352 from Maintenance Bus has the following fields:
    i. SDI set to 2_d
    ii. Antenna BITE set to 0
    iii. NACv set to 1_d
    iv. SDA set to 2_d
    v. ADSB Fail Disable set to 0
l. Power off the UUT.
m. Apply default setup
n. Set AC Length/Width A,B,C to Open/Gnd/Open
o. Set GPS Ant Long Off A/B/C to Gnd/Open/Open
p. Set NACv to Open
q. Set SDA to Open
r. Set Aircraft Category A/B to Open/Gnd
s. Set ADSB Receive Capability to GND
t. Set ADSB Config Parity to GND
u. Set SDI to Gnd/Open
v. Set Antenna BITE to Gnd
w. Set ADSB Fail Disable to Gnd
x. Set Antenna Program to Gnd
y. Power on the UUT.
z. Verify that Label 353 from Maintenance Bus has the following fields:
    i. SDI set to 1_d
    ii. Max Cruise Air Speed set to 4_d
    iii. Length/Width set to 3_d
    iv. GPS Antenna Offset set to 10_d
    v. Aircraft Category set to 1_d
    vi. 1090ES IN set to 1_d
    vii. UAT Receiver set to 0
    viii. ADSB Conf Parity set to 1_d
aa. Verify that Label 352 from Maintenance Bus has the following fields:
    i. SDI set to 1_d
    ii. Antenna BITE set to 1_d
    iii. NACv set to 0_d

iv. SDA set to 0_d
v. ADSB Fail Disable set to 1_d

bb. Verify that the squitters are transmitted only on Bottom Antenna.

Step 7 Suppression Out Discrete

a. Verify that for each transmitted squitter a suppression pulse is generated on BP12 output with the following characteristics:
b. Distance between rising edge of suppression pulse and leading edge of first rf pulse is less than 10 us
c. Distance between trailing edge of last rf pulse and falling edge of suppression pulse is less than 10 us
d. Amplitude of suppression pulse is greater than 18V

7.4.5.2.7 A429 Interface Health

a. Verify that Label 351 from Maintenance Bus has the following fields:
   i. MCP/FCU Bus set to 0 – Active
   ii. ATC Control set to 0 – Active
   iii. FMS # 1 Flight ID set to 0 – Active
   iv. GNSS #1 Bus set to 0 – Active
   v. GNSS #2 Bus set to 0 – Active
   vi. IRS #1 Bus set to 0 – Active
   vii. IRS #2 Bus set to 0 – Active
   viii. FMS Gen. #1 Bus set to 0 – Active
   ix. FMS Gen. #2 Bus set to 0 – Active
b. Stop the transmission of all the labels from the MCP, Control, FMS#1, GNSS#1, GNSS#2, IRS#1, IRS#2, FMS Gen#1, FMS Gen#2 busses:
c. Verify that Label 351 from Maintenance Bus has the following fields:
   i. MCP/FCU Bus set to 1= Inactive
   ii. ATC Control set to 1= Inactive
   iii. FMS # 1 Flight ID set to 1= Inactive
   iv. GNSS #1 Bus set to 1= Inactive
   v. GNSS #2 Bus set to 1= Inactive
   vi. IRS #1 Bus set to 1= Inactive
   vii. IRS #2 Bus set to 1= Inactive
   viii. FMS Gen. #1 Bus set to 1= Inactive
   ix. FMS Gen. #2 Bus set to 1= Inactive

7.4.5.2.8 Front Panel LEDS

a. Verify that the GO led is active
b. Press the Test Button (keep the button pressed)
c. Verify that all others LEDs are active
d. Release the Test Button

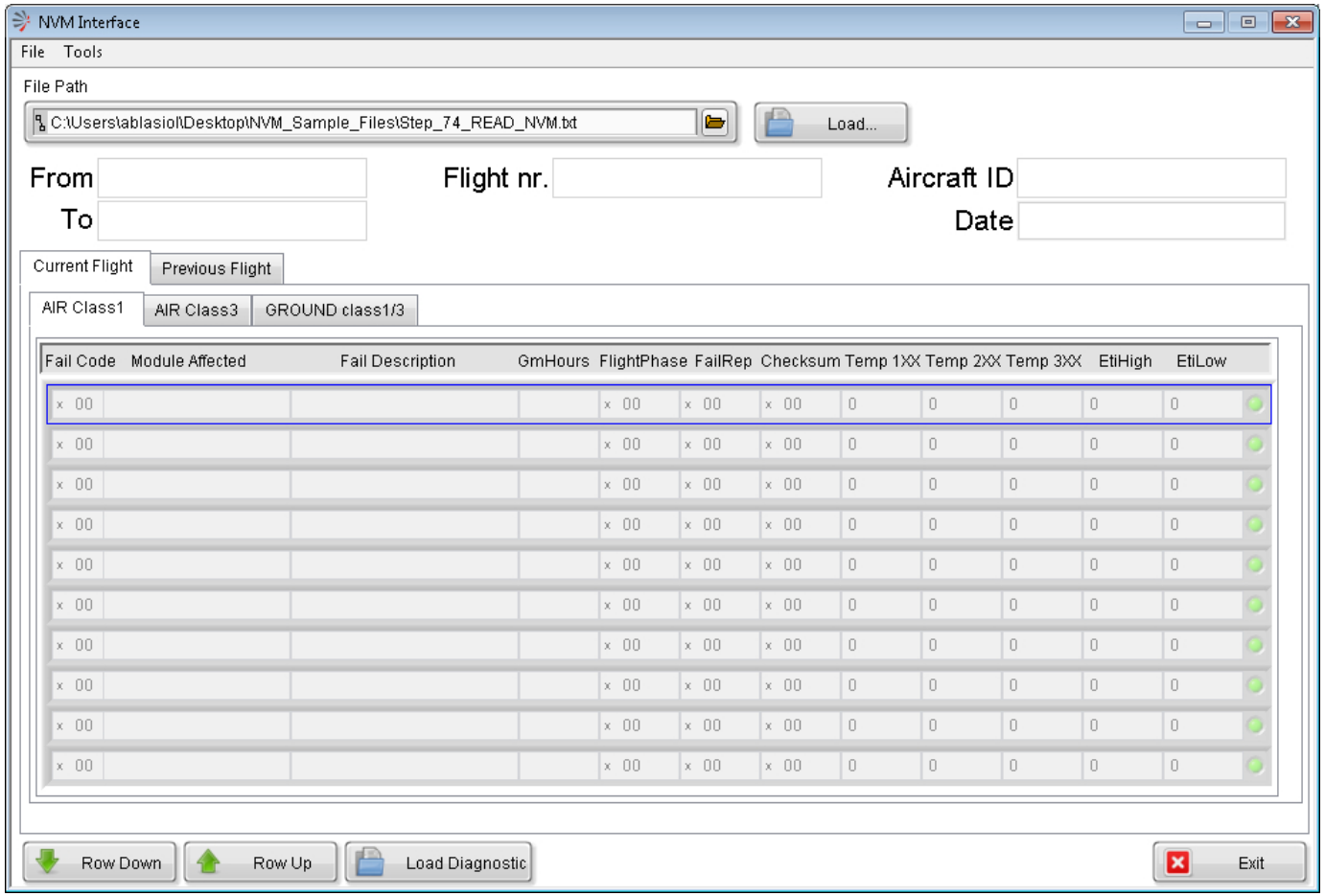


Figure 7-4 – TRA-100B – OFF A/C Troubleshooting STTE NVM Interface

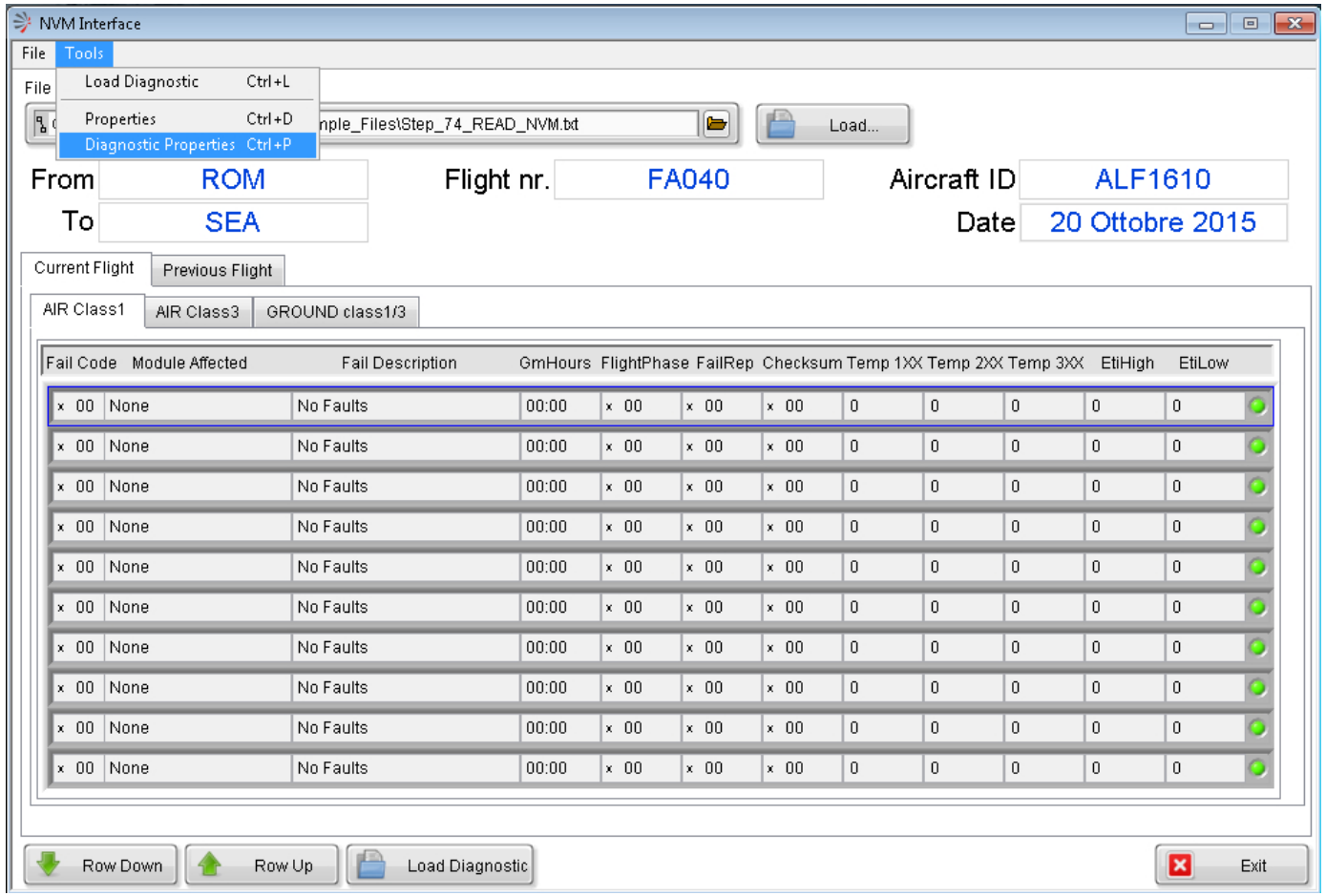


Figure 7-5 – TRA-100B – OFF A/C Troubleshooting – Diagnostic Properties (1)

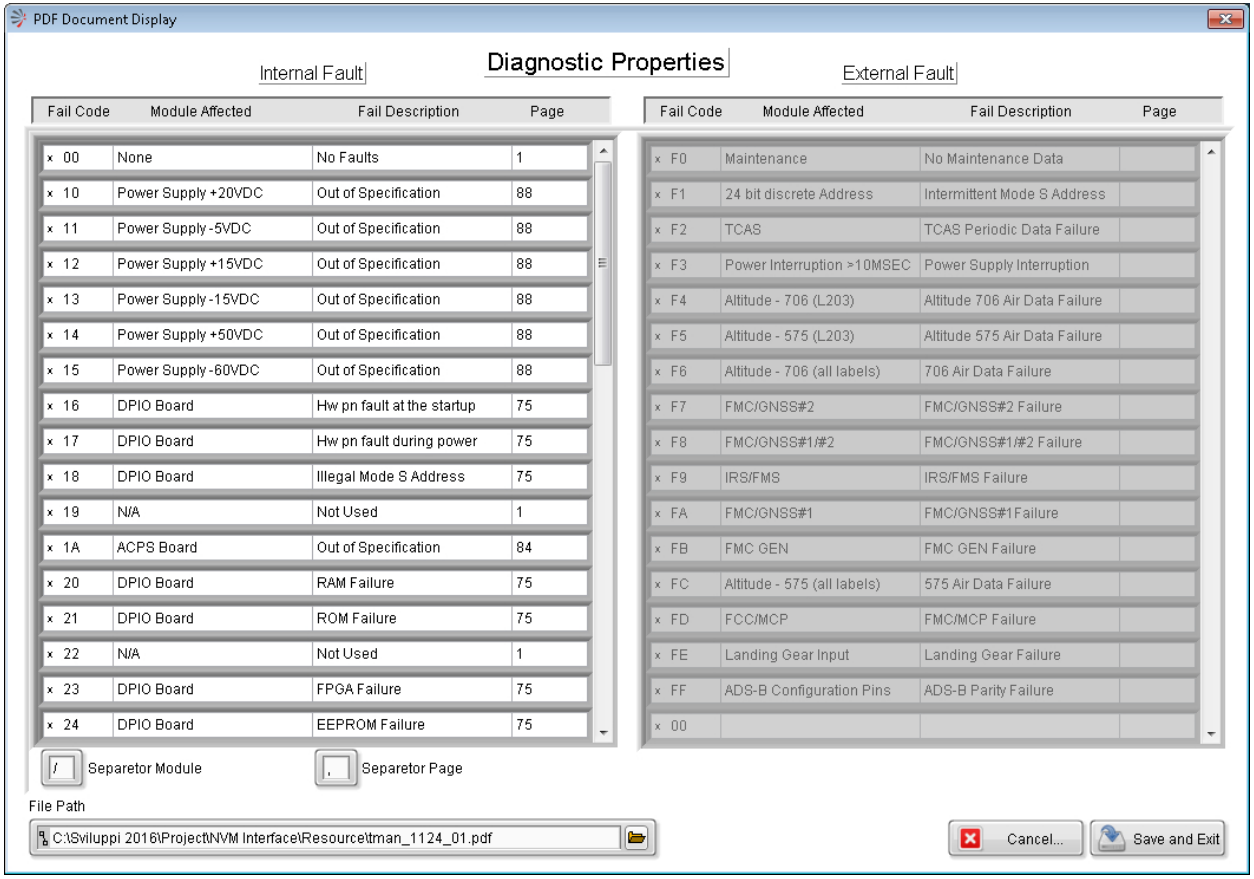


Figure 7-6 – TRA-100B – OFF A/C Troubleshooting – Diagnostic Properties (2)

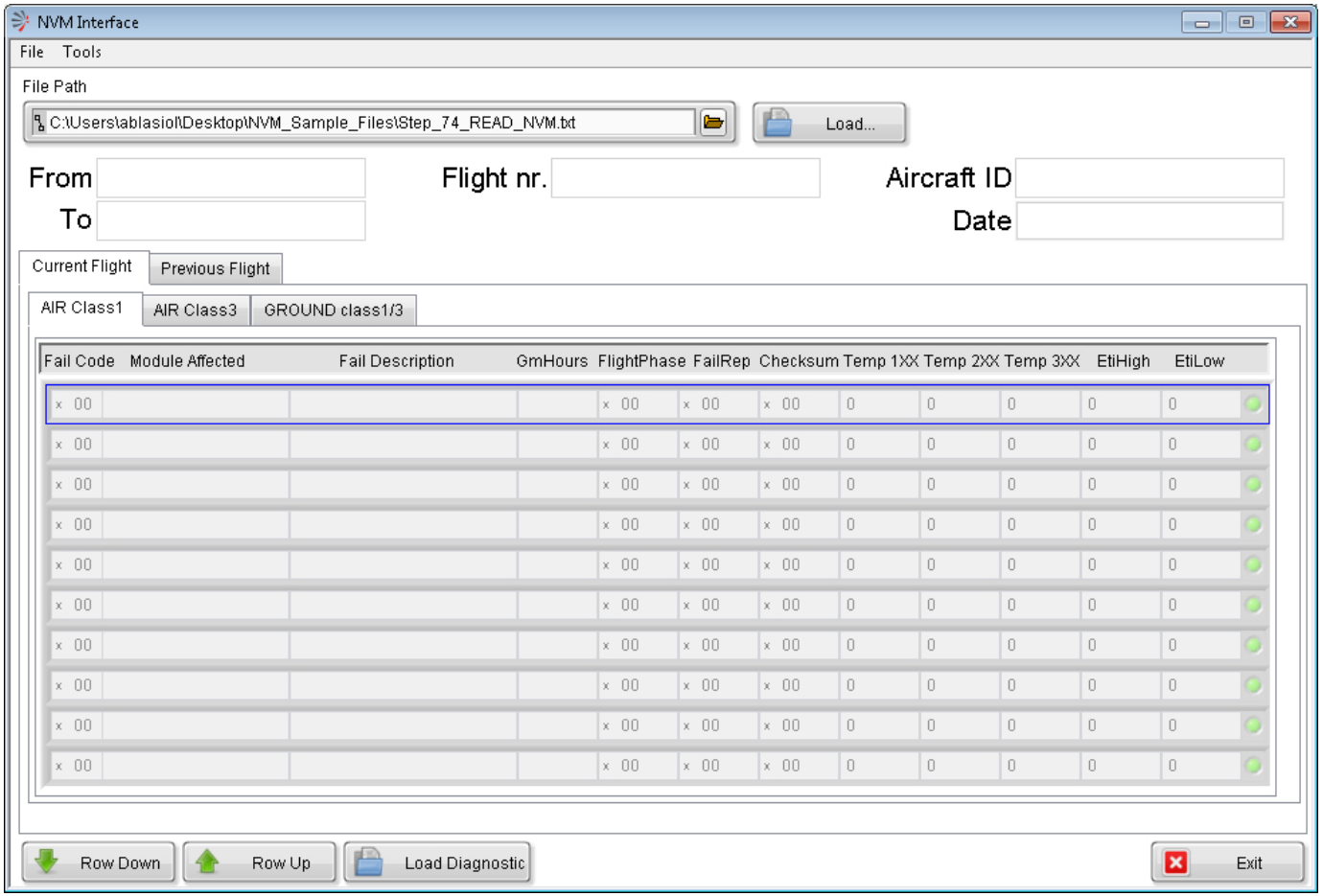


Figure 7-7 – TRA-100B – OFF A/C Troubleshooting STTE NVM Interface

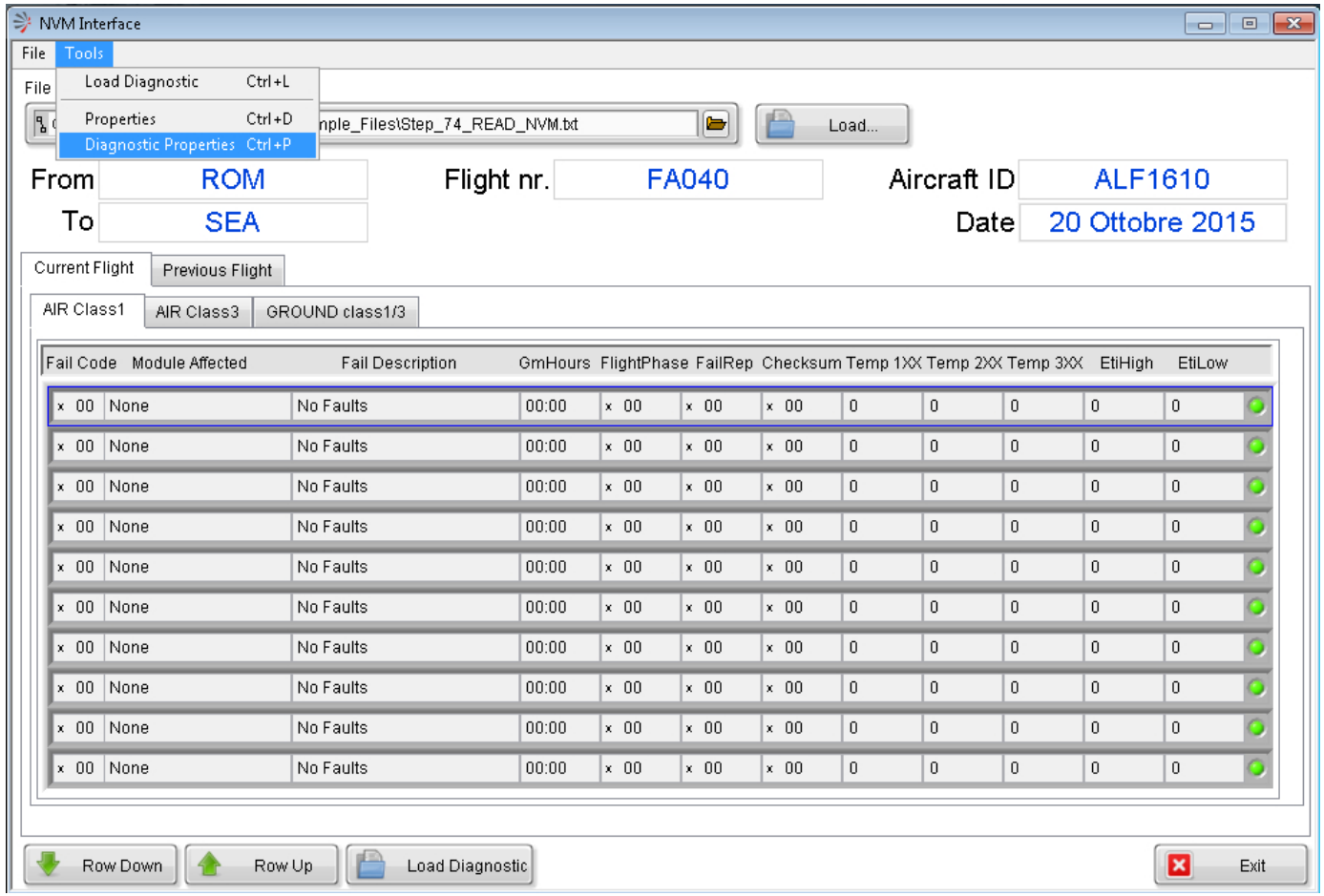


Figure 7-8 – TRA-100B – OFF A/C Troubleshooting – Diagnostic Properties (1)

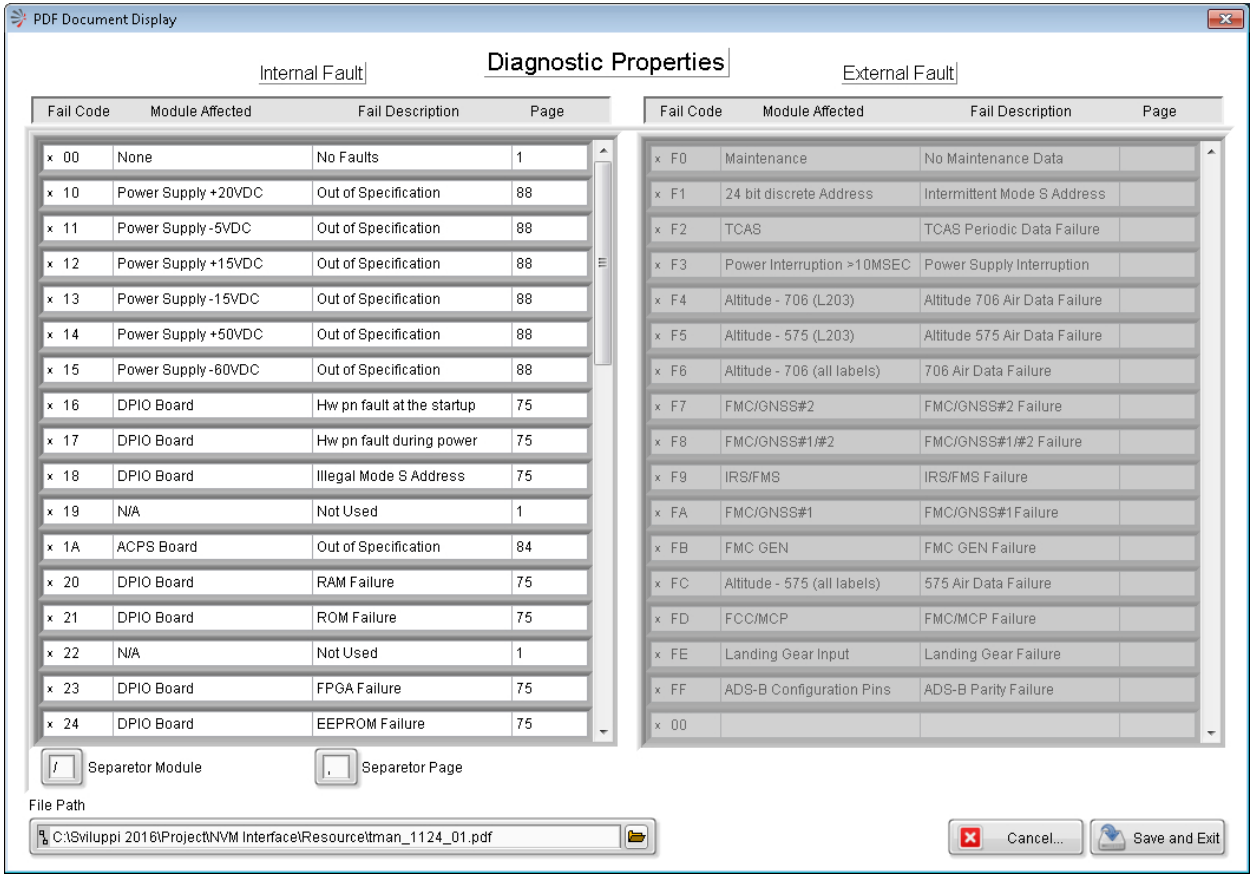


Figure 7-9 – TRA-100B – OFF A/C Troubleshooting – Diagnostic Properties (2)

8 MAINTENANCE

8.1 TRA-100B MODE S TRANSPONDER – FIRST LEVEL MAINTENANCE

8.1.1 On Aircraft Maintenance (Scheduled)

No scheduled maintenance is required; the equipment does not require alignment, calibration, lubrication or other non-operator adjustments or preventive maintenance.
Nevertheless FAA and EASA procedure require to remove the TRA-100B from platform and perform an extensive test in the shop every two (2) years independently from failure occurrences.

8.1.2 On Aircraft Maintenance (Unscheduled)

The On Aircraft maintenance is a repair task by replacement of faulty Line Replaceable Unit (LRU).

LRU	Replace Procedure
TRA-100B Modes S Transponder	TRA-100B Mode S Transponder – Replace Procedures

This procedure can be performed after the fault isolation procedure as para 7.3.

As preliminary check before starting the fault isolation procedure, perform inspection of the LRU as per 8.3

Post-installation check is granted by Power Up BIT results provided at the end of start-up.

8.1.3 Servicing

- Cleaning

If the equipment requires cleaning, follow the instructions given in the cleaning procedure (ref. TRA-100B Mode S Transponder – Cleaning).

8.2 TRA-100B MODE S TRANSPONDER – CLEANING

Standard Equipment		
Description	***Identification Nr.***	***Qty.***
None		

Materials		
Description	***Identification Nr.***	***Qty.***
Soft brush	Local supply	1
Denatured Alcohol	S-738	As Required
Electro Contact Cleaner	QD02130	1
Lint-free cloth	Local supply	1

Spares		
Description	***Identification Nr.***	***Qty.***
None		

Safety Precautions

WARNING

MAKE SURE THAT THE EQUIPMENT IS DISCONNECTED FROM ALL ELECTRICAL POWER SOURCES BEFORE YOU DO ANY MAINTENANCE WORK.

WARNING

PERFORM TASK IN VENTILATED AREA AND USE PROTECTIVE CLOTHING.

WARNING

DENATURED ALCOHOL, ELECTRO CONTACT CLEANER ARE DANGEROUS MATERIALS
MAKE SURE THAT YOU KNOW THE
SAFETY PRECAUTIONS AND THE FIRST AID INSTRUCTIONS.

Preliminary Operations

- None

Procedure

1. Clean the equipment with a soft brush moist with the Denatured Alcohol.
2. Wipe the equipment with a dry Lint-free cloth.
3. Inspect all the visible electric components and connections.
4. Clean electrical connectors with an Electro Contact Cleaner.

Close Up

1. Removal all the tools, the materials and the equipment from your work area.

8.3 TRA-100B MODE S TRANSPONDER – INSPECTION

Standard Equipment		
Description	**Identification Nr.**	**Qty**
None		

Materials		
Description	**Identification Nr.**	**Qty**
None		

Spares		
Description	**Identification Nr.**	**Qty**
None		

Safety Precautions

WARNING

MAKE SURE THAT YOU REMOVAL THE ELECTRICAL POWER SUPPLY BEFORE YOU DO THIS PROCEDURE.

Preliminary operations

- None

Procedure

1. Check for visible damage of equipment.
2. Make sure that connectors are properly installed.
3. Check that ground connections, where existing, are made properly.
4. Switch power off, disconnect cables one at time, and inspect connector pins.

Close up

1. Removal all the tools, the materials and the equipment from your work area.

8.4 TRA-100B MODE S TRANSPONDER – SECOND LEVEL MAINTENANCE

8.4.1 TRA-100B, Data Processor and I/O – Replace procedure

Standard Equipment		
Description	**Identification Nr.**	**Qty**
Torque Screwdriver bit holder	Local Supply	1
Bit cross-point sz. 2	Local Supply	1
Bit hex open end 8 mm.	Local Supply	1

Materials		
Description	**Identification Nr.**	**Qty**

Spares		
Description	**Identification Nr.**	**Qty**
Data Processor and I/O	TAQ-5432/03	1

Safety Precautions

WARNING

MAKE SURE THAT THE EQUIPMENT IS DISCONNECTED FROM
ALL ELECTRICAL POWER SOURCES BEFORE YOU DO ANYMAINTENANCE WORK.

LEONARDO
AIRBORNE & SPACE SYSTEMS

Preliminary operations

- None

Procedure

1. Removal Procedure
   1.1) Removal Transponder cover (right side) unscrewing the related M2,5 fourteen crosshead screws using a torque screwdriver bit holder and appropriate bit (1). (Figure 8-1, Figure 8-2)
   1.2) Unscrew two antenna cables using the related tool starting from the upper one and then the lower one (2)
   1.3) Disconnecting supply voltages loosen the clips of connector (3)
   1.4) Removal RF cables making an a half turn to the block of related connector (4)
   1.5) Extract RFFE module (10)
   1.6) Disconnect and Removal the display flat cable (5)
   1.7) Unscrew nine crosshead screws using a torque screwdriver bit holder and related bit avoiding to loose screws and related washers (each screw is supplied with a flat washer, and spring washer) (6)
   1.8) Removal the Data Processor and I/O module

NOTE: *To Removal the module keep the antenna cables near the wired chassis using your thumbs and with the forefingers pull up the board until the un-mating from wired chassis*

2. Install Procedure

   2.1) Install Data Processor and I/O Module. (Figure 8-1, Figure 8-2)

NOTE: *To install the module keep the antenna cables close the wired chassis using your thumbs and with the forefingers. Furthermore verify that Ethernet and Multipin external connectors have been correctly entered in related housing placed in the frontal of Wired Chassis (8).*

   2.2) In order to connect correctly the Data Processor and I/O module place and tighthen gently the two corners Phillips screws (7).

NOTE: *The spring washer must be installed before the flat washer.*

   2.3) Carefully press the Data Processor and I/O module on the left side of until the connectors are mated (9)

2.4) Fixing the two corners cross head screws using a torque screwdriver bit holder and appropriate bit with a force of 0.45 N/m (7).
2.5) Install and tighten the seven cross head screws using a torque screwdriver bit holder and appropriate bit with a force of 0.45 N/m (6).
2.6) Carefully insert display flat cable (5)
2.7) Insert RF cable and secure it with half turn (4)
2.8) Carefully insert power supply connector securing it with clips (3)
2.9) Install the antenna cables and tighten it with the torque screwdriver bit holder and appropriate bit with a force of 0.45 N/m (6).
2.10) Install Transponder cover (right side) fixing the related M2,5 fourteen crosshead screws using a torque screwdriver bit holder and appropriate bit (1).

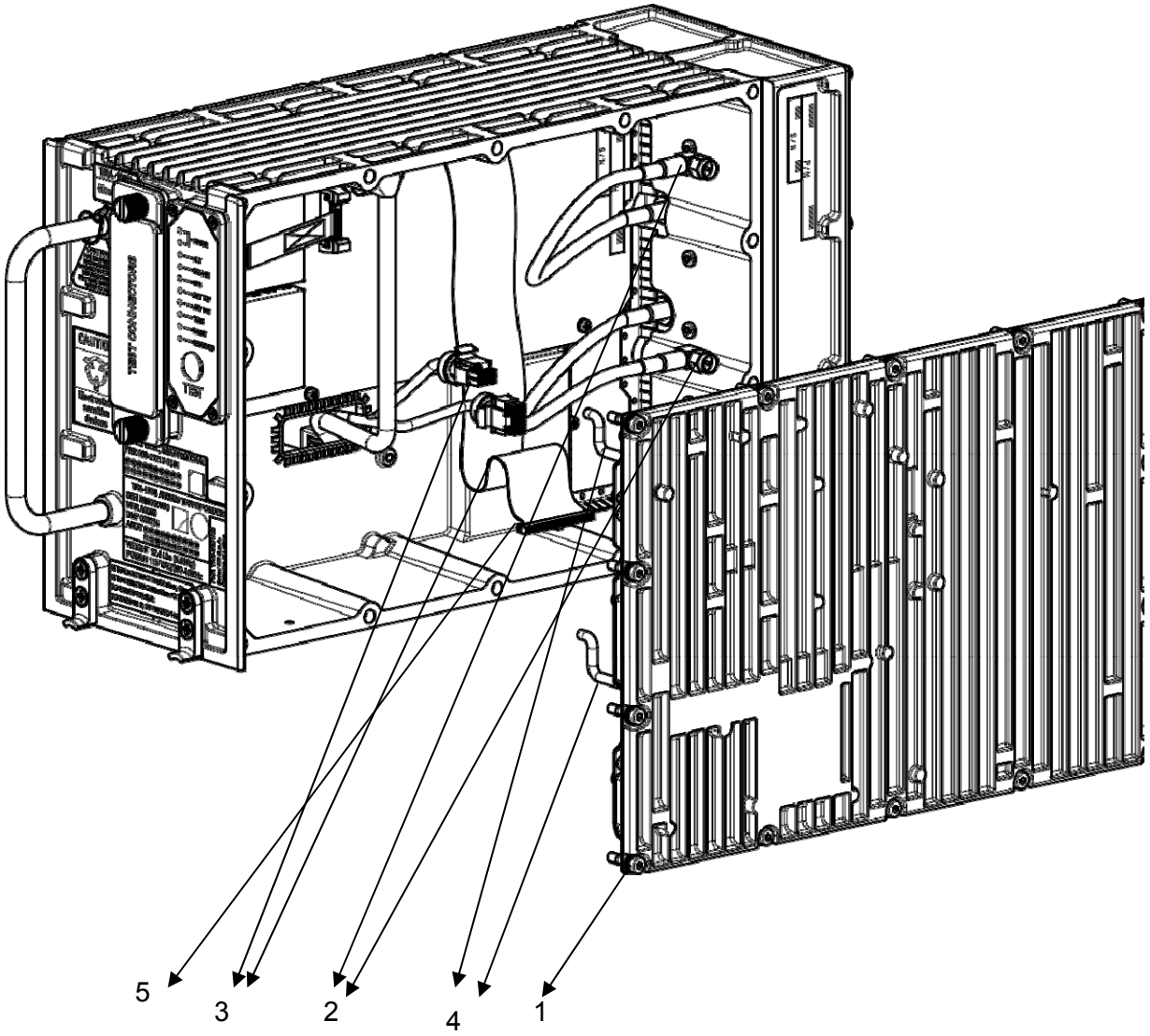


Figure 8-1 – TRA-100B, Data Processor and I/O – Replace procedure

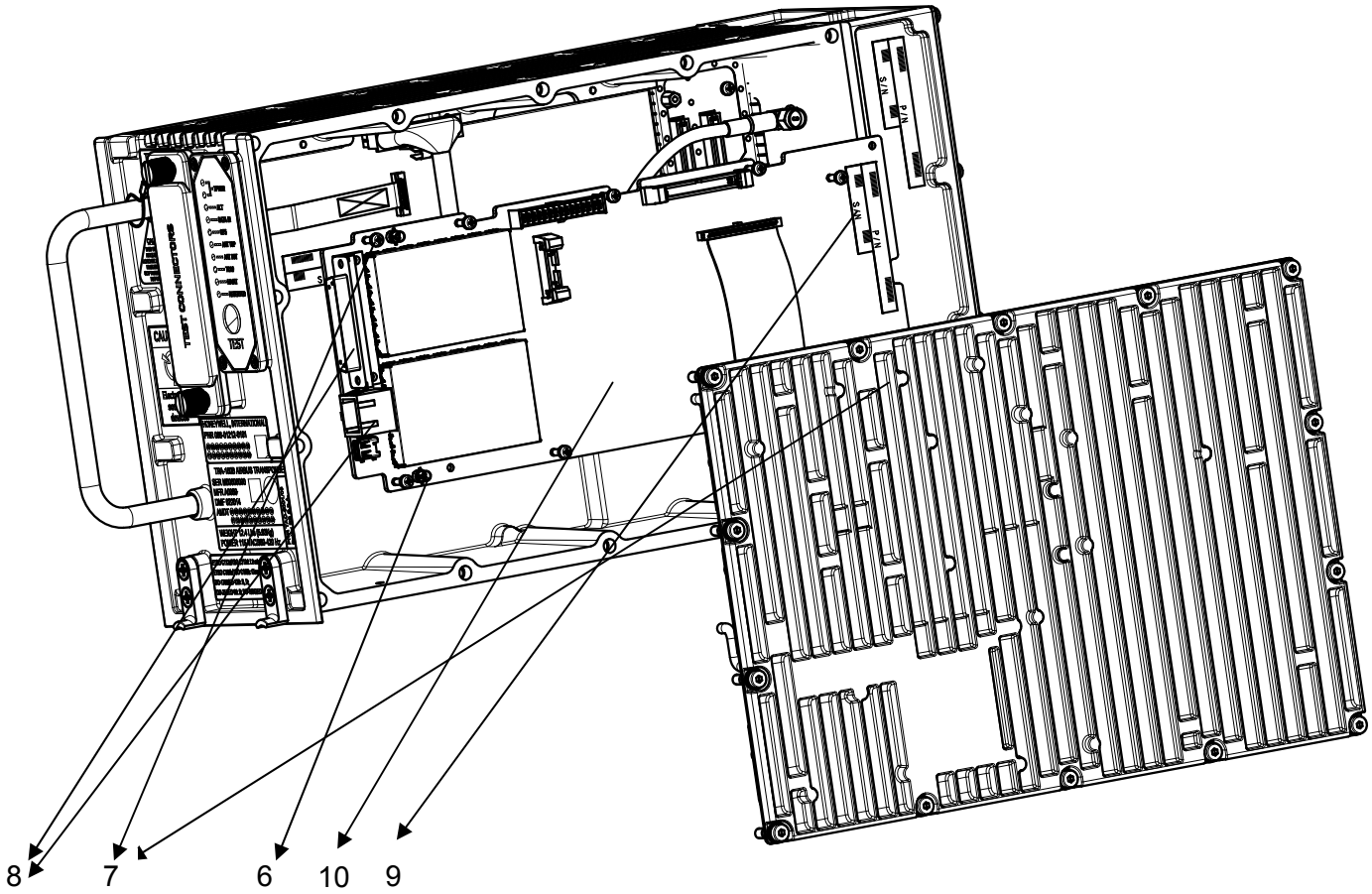


Figure 8-2 – TRA-100B, Data Processor and I/O – Replace procedure (position)

Close up

1. Removal all the tools, the materials and the equipment from your work area. Perform the Check-out procedure as per para. 1.1 to verify the failure removal.

8.4.2 TRA-100B, RF Subassembly – Replace procedure

Standard Equipment		
Description	**Identification Nr.**	**Qty**
Torque Screwdriver bit holder	Local Supply	1
Bit cross-point sz. 2	Local Supply	1
Bit hex open end 8 mm.	Local Supply	1

Materials		
Description	**Identification Nr.**	**Qty**

Spares		
Description	**Identification Nr.**	**Qty**
RF - Subassembly	TAG-5501/03	1

Safety Precautions

WARNING

MAKE SURE THAT THE EQUIPMENT IS DISCONNECTED FROM
ALL ELECTRICAL POWER SOURCES BEFORE YOU DO ANYMAINTENANCE WORK.

Preliminary operations

- None

Procedure

1. Removal Procedure
   1.1) Follow the procedure to remove the Data Processor and I/O module (Para. 8.4.1). (Figure 8-3, Figure 8-2)
   1.2) Unscrew nine crosshead screws using a torque screwdriver bit holder and related bit avoiding to loose screws and related washers (each screw is supplied with a flat washer, and spring washer) (6)
   1.3) Removal the RF Subassembly

   NOTE: *To remove the module keep the antenna cables near the wired chassis using your thumbs and with the forefingers pull up the board until it is separated from wired chassis*

2. Install Procedure

   2.1) Install the RF Subassembly. (Figure 8-3, Figure 8-2)

   NOTE: *To install the module keep the antenna cables close the wired chassis using your thumbs and with the forefingers. Furthermore verify that Ethernet and Multipin external connectors have been correctly entered in related housing placed in the frontal of Wired Chassis (8).*

   2.2) In order to connect correctly the Data Processor and I/O module place and tighten gently the two corners Phillips screws (7).

   NOTE: *The spring washer must be installed before the flat washer.*

   2.3) Carefully press the Data Processor and I/O module on the left side of until the connectors are mated (9)
   2.4) Tighten the two corners cross head screws using a torque screwdriver bit holder and appropriate bit with a force of 0.45 N/m (7).
   2.5) Install and tighten the seven cross head screws using a torque screwdriver bit holder and appropriate bit with a force of 0.45 N/m (6).
   2.6) Carefully insert display flat cable (5)
   2.7) Insert RF cable and secure it with half turn (4)
   2.8) Carefully insert power supply connector securing it with clips (3)
   2.9) Install the antenna cables and tighten it with the torque screwdriver bit holder and appropriate bit with a force of 0.45 N/m (6).
   2.10) Install Transponder cover (right side) fixing the related M2,5 fourteen crosshead screws using a torque screwdriver bit holder and appropriate bit (1).

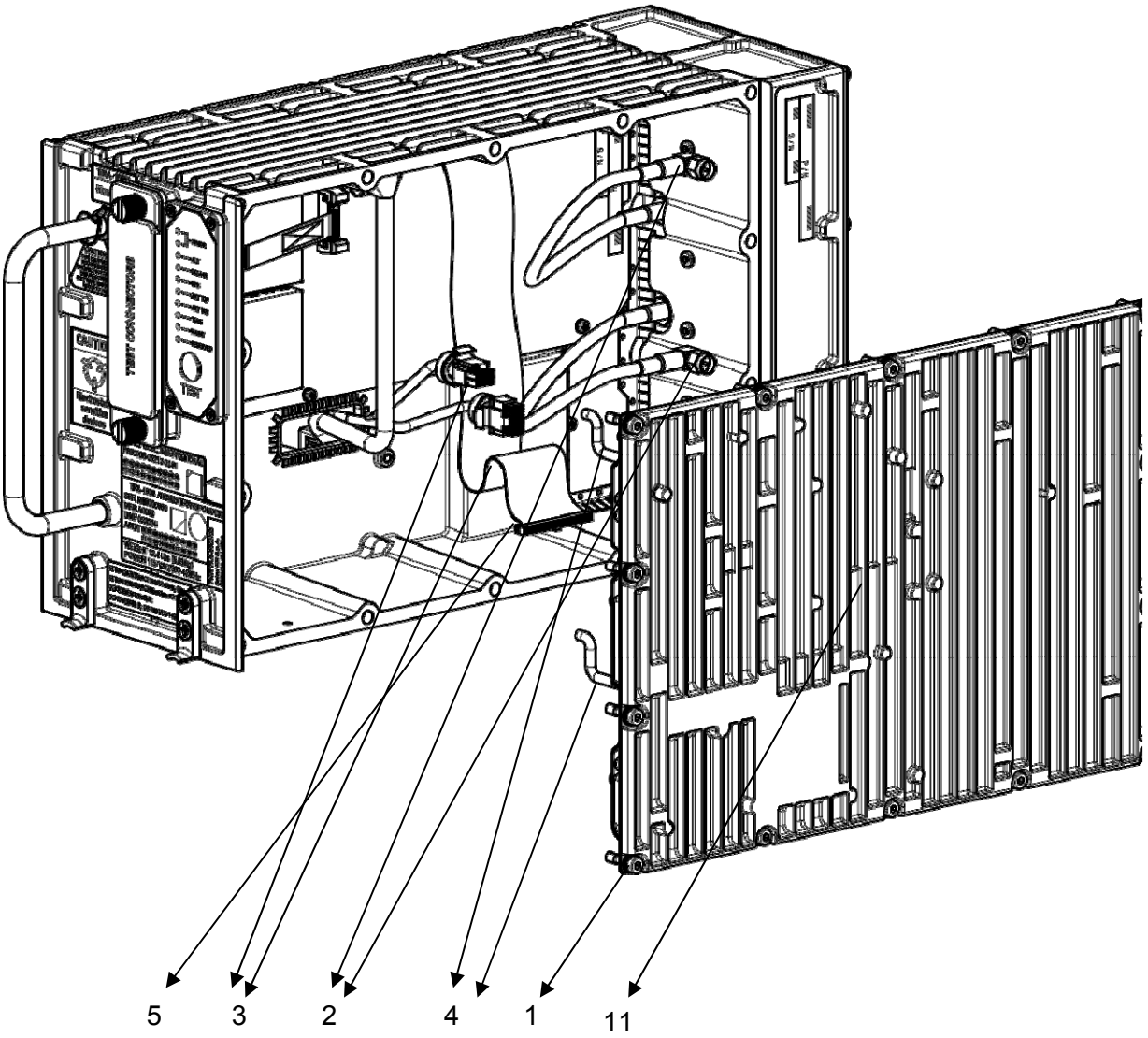


Figure 8-3 –TRA-100B, RF Subassembly – Replace procedure

Close up

1. Removal all the tools, the materials and the equipment from your work area.
2. Perform the Check-out procedure as per para. 1.1 to verify the failure removal.

8.4.3 TRA-100B, AC Power Supply (ACPS) – Replace procedure

Standard Equipment		
Description	**Identification Nr.**	**Qty**
Torque Screwdriver bit holder	Local Supply	1
Bit cross-point sz. 2	Local Supply	1

Materials		
Description	**Identification Nr.**	**Qty**

Spares		
Description	**Identification Nr.**	**Qty**
Power Supply (ACPS)	TAG-5433/03	1

Safety Precautions

WARNING

MAKE SURE THAT THE EQUIPMENT IS DISCONNECTED FROM
ALL ELECTRICAL POWER SOURCES BEFORE YOU DO ANYMAINTENANCE WORK.

Preliminary operations

- None

Procedure

1. Removal Procedure
   1.1. Removal Transponder cover (left side) unscrewing the M2,5 fourteen crosshead screws using a torque screwdriver bit holder and related bit (1). (Figure 8-4, Figure 8-5)
   1.2. Removal the two cables connecting Wired Chassis to DC Power Supply (2).
   1.3. Removal the cable connecting AC Power Supply to DC Power Supply (3)
   1.4. Unscrew the four crosshead screws placed on the lower border of DC Power Supply module using a torque screwdriver bit holder and appropriate bit (4)
   1.5. Unscrew the five crosshead screws using a torque screwdriver bit holder and appropriate bit. (5)
   1.6. Removal the DC Power Supply module from the failed AC Power Supply module.

2. Install Procedure
   2.1. Insert the DC Power Supply module on a serviceable AC Power Supply module. (Figure 8-4, Figure 8-5)
   2.2. Tighten the related five screws using a torque screwdriver bit holder and appropriate bit with a force of 0.45 N/m (5).
   2.3. Tighten the related 4 screws using a torque screwdriver bit holder and appropriate bit with a force of 0.45 N/m (4).
   2.4. Connect the cable connecting AC Power Supply to DC Power Supply (3).
   2.5. Connect the two cables connecting Wired Chassis to DC Power Supply. (2)
   2.6. Install the Transponder cover (left side) and tighten the related fourteen crosshead screws using a torque screwdriver bit holder and related bit (1) with a force of 0.95 N/m.

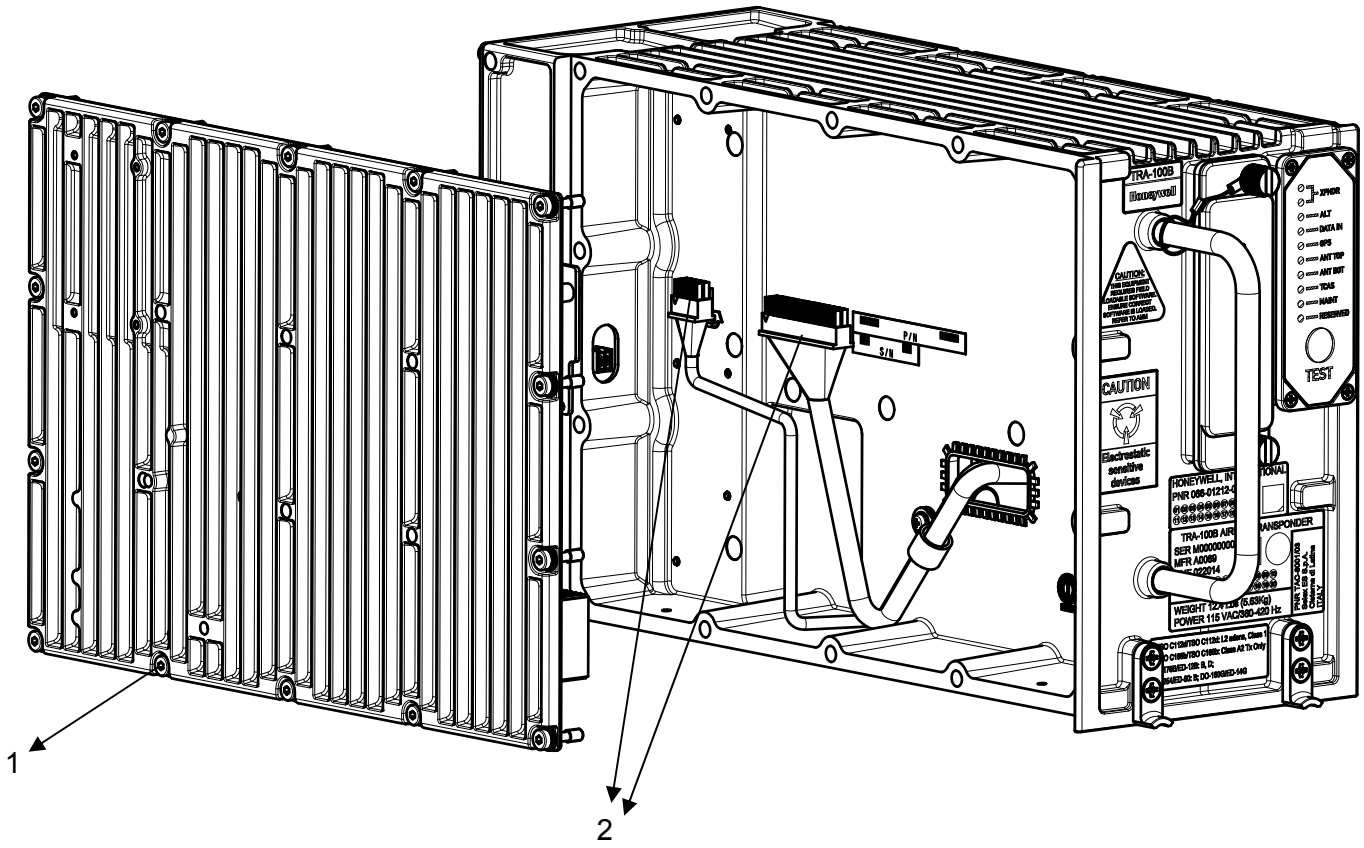


Figure 8-4 – TRA-100B, AC Power Supply (ACPS) – Replace procedure

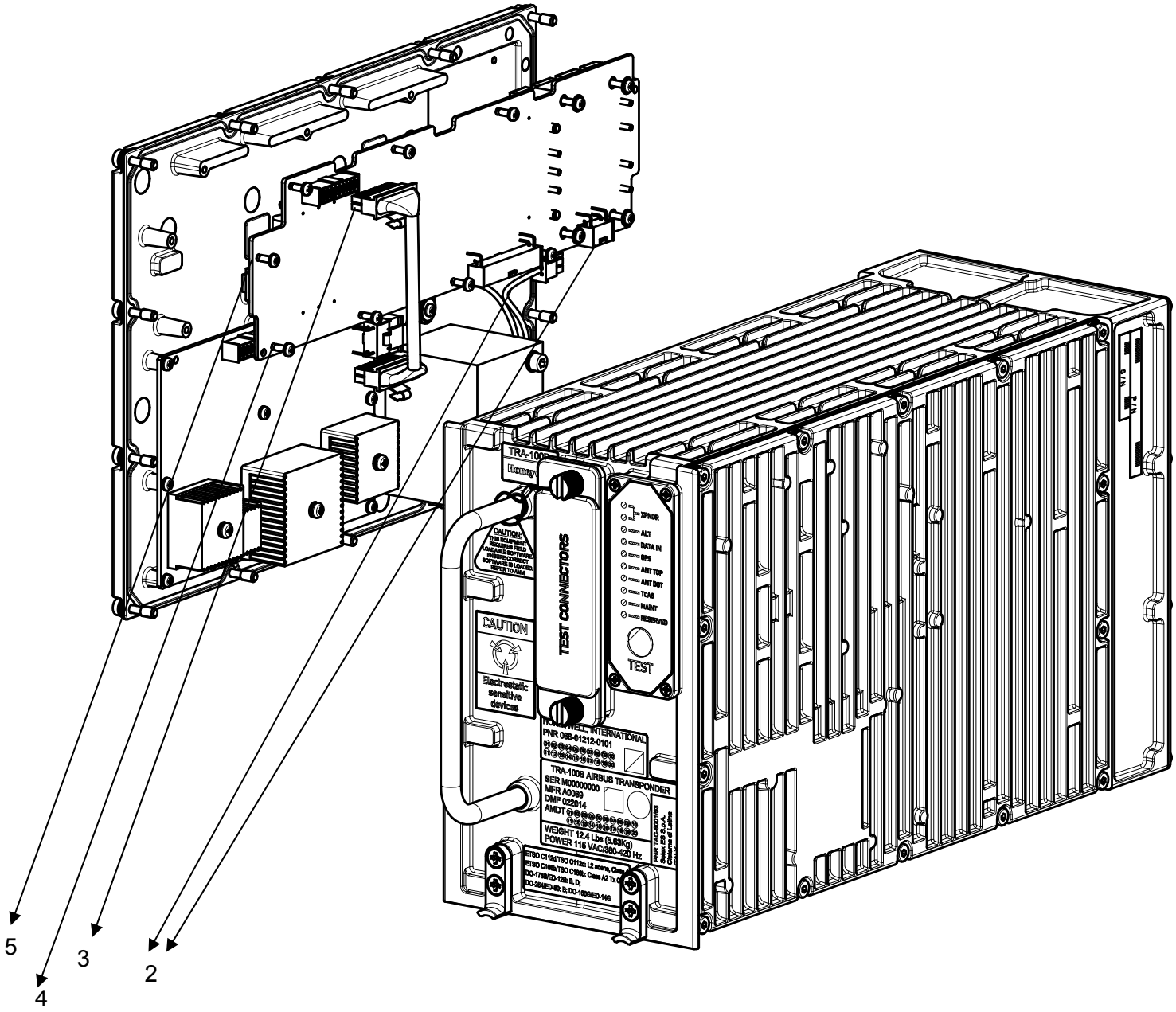


Figure 8-5 – TRA-100B, ACPS and DCPS – Replace procedure (position)

Close up

1. Removal all the tools, the materials and the equipment from your work area.
2. Perform the Check-out procedure as per para. 1.1 to verify the failure removal.

8.4.4 TRA-100B, DC Power Supply (DCPS) – Replace procedure

Standard Equipment		
Description	**Identification Nr.**	**Qty**
Torque Screwdriver bit holder	Local Supply	1
Bit cross-point sz. 2	Local Supply	1

Materials		
Description	**Identification Nr.**	**Qty**

Spares		
Description	**Identification Nr.**	**Qty**
DC Power Supply (DCPS)	TAG-5435/03	**1**

Safety Precautions

WARNING

MAKE SURE THAT THE EQUIPMENT IS DISCONNECTED FROM
ALL ELECTRICAL POWER SOURCES BEFORE YOU DO ANYMAINTENANCE WORK.

Preliminary operations

- None

Procedure

1. Removal Procedure
   1.1. Removal Transponder cover (left side) unscrewing the relative M2,5 fourteen crosshead screws using a torque screwdriver bit holder and related bit (1). (Figure 8-6, Figure 8-7)
   1.2. Removal the two cables connecting Wired Chassis to DC Power Supply (2).
   1.3. Removal the cable connecting AC Power Supply to DC Power Supply (3)
   1.4. Unscrew the four crosshead screws placed on the lower border of DC Power Supply module using a torque screwdriver bit holder and appropriate bit (4)
   1.5. Unscrew the five crosshead screws using a torque screwdriver bit holder and appropriate bit. (5)
   1.6. Removal the DC Power Supply module.

2. Install Procedure
   2.1) Insert the DC Power Supply module. (Figure 8-6, Figure 8-7)
   2.2) Fixing it tighten the related five screws using a torque screwdriver bit holder and appropriate bit with a force of 0.45 N/m (5).
   2.3) Tighten the related 4 screws using a torque screwdriver bit holder and appropriate bit with a force of 0.45 N/m (4).
   2.4) Connect the cable connecting AC Power Supply to DC Power Supply (3).
   2.5) Connect the two cables connecting Wired Chassis to DC Power Supply. (2)
   2.6) Install the Transponder cover (left side) and fix it tightening the related fourteen crosshead screws using a torque screwdriver bit holder and related bit (1) with a force of 0.95 N/m.

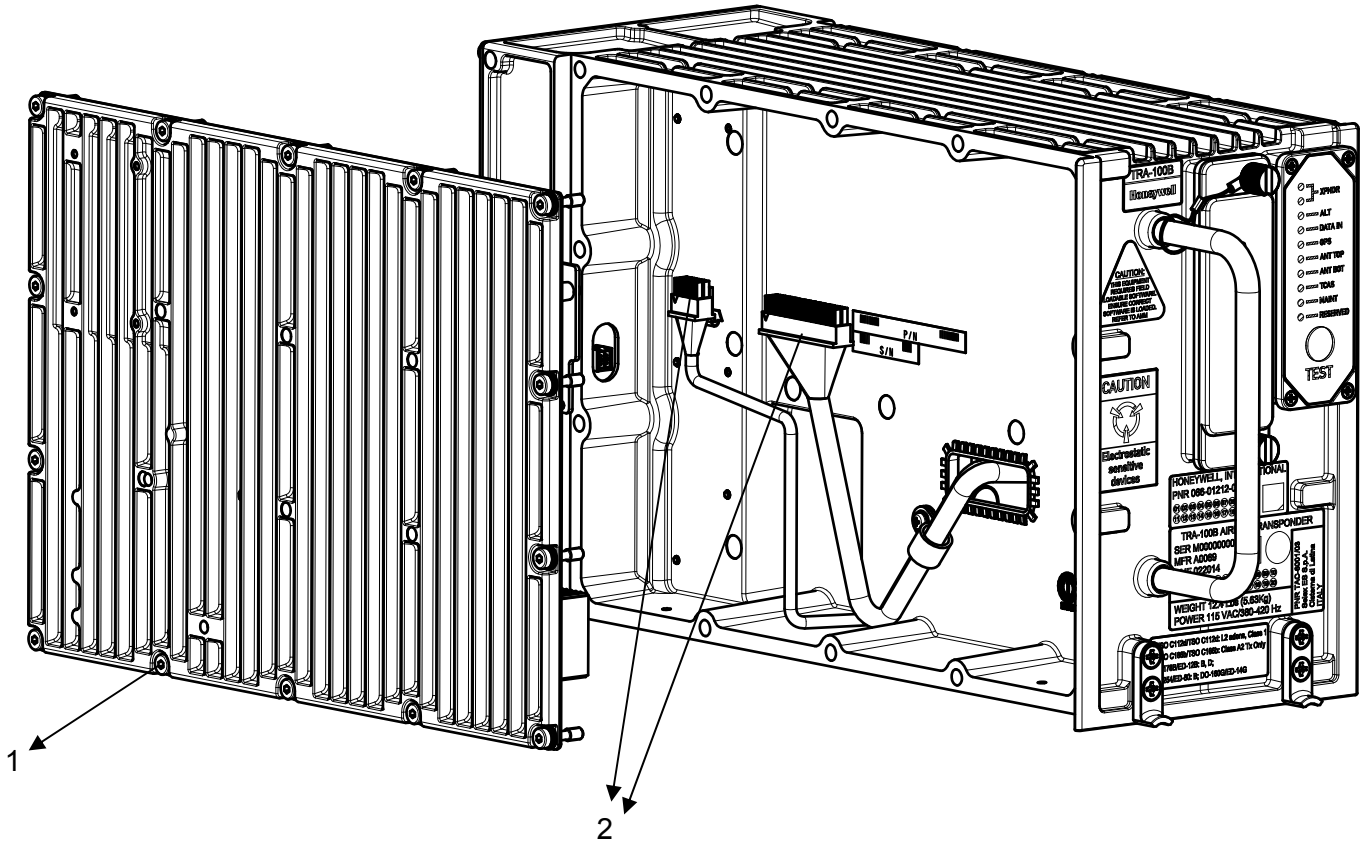


Figure 8-6 – TRA-100B, DC Power Supply (DCPS) – Replace procedure

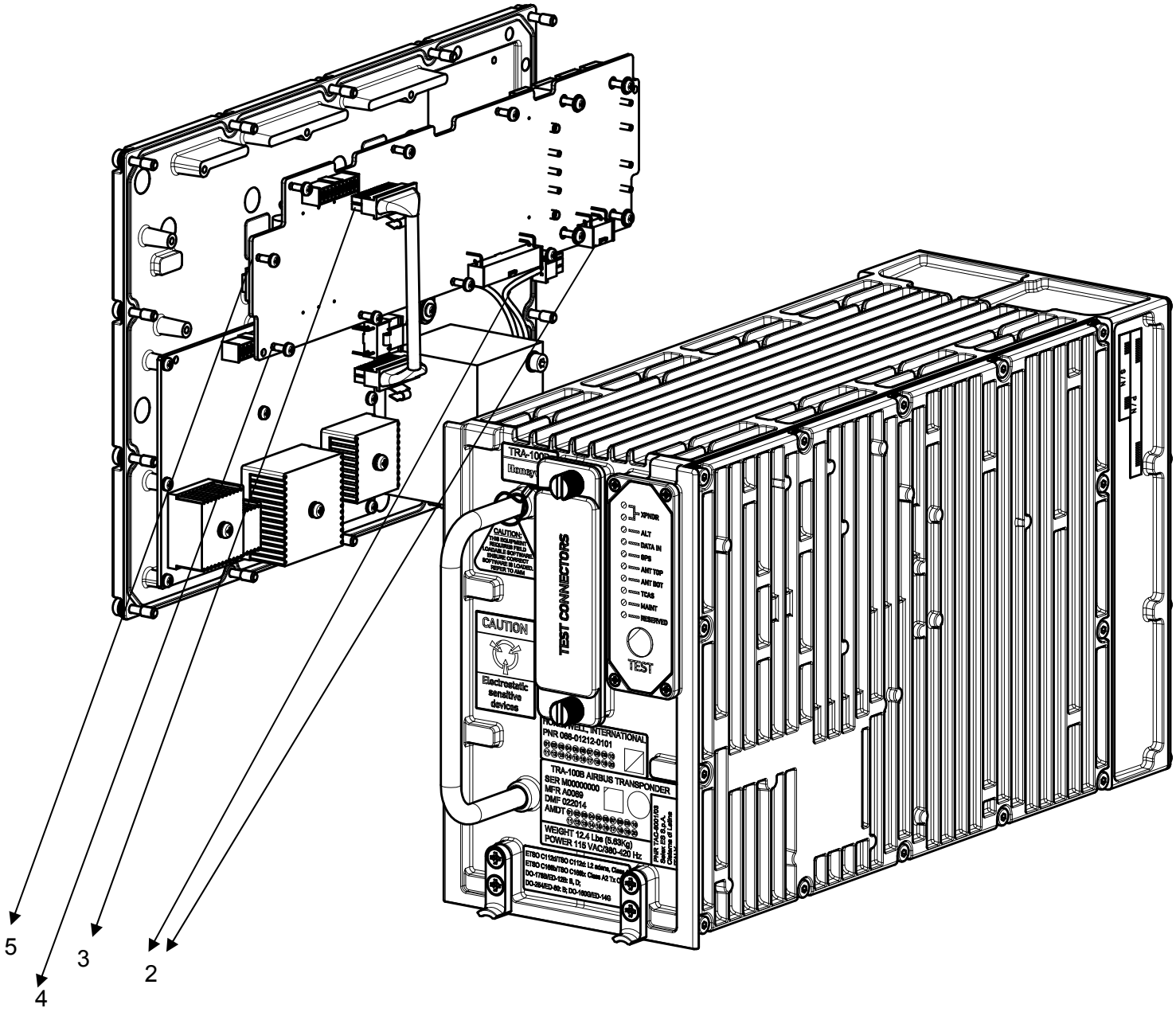


Figure 8-7 – TRA-100B, ACPS and DCPS – Replace procedure (position)

Close up

1. Removal all the tools, the materials and the equipment from your work area.
2. Perform the Check-out procedure as per para. 1.1 to verify the failure removal.

8.4.5 TRA-100B, Wired Chassis (WC)– Replace procedure

Standard Equipment		
Description	**Identification Nr.**	**Qty**
Torque Screwdriver bit holder	Local Supply	1
Bit cross-point sz. 2	Local Supply	1
Bit hex open end 8 mm.	Local Supply	1

Materials		
Description	**Identification Nr.**	**Qty**

Spares		
Description	**Identification Nr.**	**Qty**
Wired Chassis (WC)	TAE-6001/03	**1**

Safety Precautions

WARNING

MAKE SURE THAT THE EQUIPMENT IS DISCONNECTED FROM
ALL ELECTRICAL POWER SOURCES BEFORE YOU DO ANYMAINTENANCE WORK.

Preliminary operations

- None

Procedure

1. Removal Procedure
   1.1. Removal Data Processor and I/O module and RF Sub Assembly module following the procedures described in Figure 8-1, Figure 8-2 and Figure 8-3.
   1.2. Removal the AC Power Supply together with DC Power Supply following the procedure reported in Figure 8-4 and Figure 8-5
   1.3. Removal the Wired Chassis

2. Install Procedure

   2.1. Install Data Processor and I/O module and RF Sub Assembly module following the procedures described in Figure 8-1, Figure 8-2 and Figure 8-3.
   2.2. Install the AC Power Supply together with DC Power Supply following the procedure reported in Figure 8-4 and Figure 8-5.

Close up

1. Removal all the tools, the materials and the equipment from your work area.
2. Perform the Check-out procedure as per para. 1.1 to verify the failure removal.

9 ILLUSTRATED PARTS DATA

9.1 TRA-100B MODE S TRANSPONDER - ILLUSTRATED PARTS DATA

Pos	Indent	CAGE	Part Number	Description	Qty
001		A0069	**TAC-6001/03**	**TRA-100B Mode S Transponder**	1
NI		A0069	TAD-6001/03	Hardware Equipment TRA-100B	
	2	A0069	TAE-6001/03	Wired Chassis (WC)	1
	2	A0069	TAQ-5432/03	Data Processor and I/O	1
	2	A0069	TAG-5501/03	RF - Subassembly	1
	2	A0069	TAG-5433/03	AC Power Supply (ACPS)	1
	2	A0069	TAG-5435/03	DC Power Supply (DCPS)	1
	3	A0069	TAN-7002/01	DPIO-RFFE SIGNAL CABLE	1
	3	A0069	TAN-7006/01	DCPS-ACPS CABLE	1
	3	A0069	5106876R0012	TWINAX CABLE	2
	3	A0069	61170-06/123	WASHER EL INOX M2.5-5.1mm .6T	9
	3	A0069	61530-27/006	SCREW INOX TCC/C M2.5x8mm (V	9
	3	A0069	61530-27/013	SCREW INOX TCC/C M2.5x22mm (	4
	3	A0069	62380-12/019	Plate ACRYLIC SINGLE 14mm 70m	1
	3	A0069	61170-03/127	WASHER PLANE - INOX M2.5-5mm	27
	3	A0069	61530-27/005	SCREW INOX TCC/C M2.5x6mm (V	18
	3	A0069	61170-01/124	WASHER PLANE INOX M2.5-6.5mm	4