TRT 600
Mode A, A-C, S
ATC Transponder

Installation Manual

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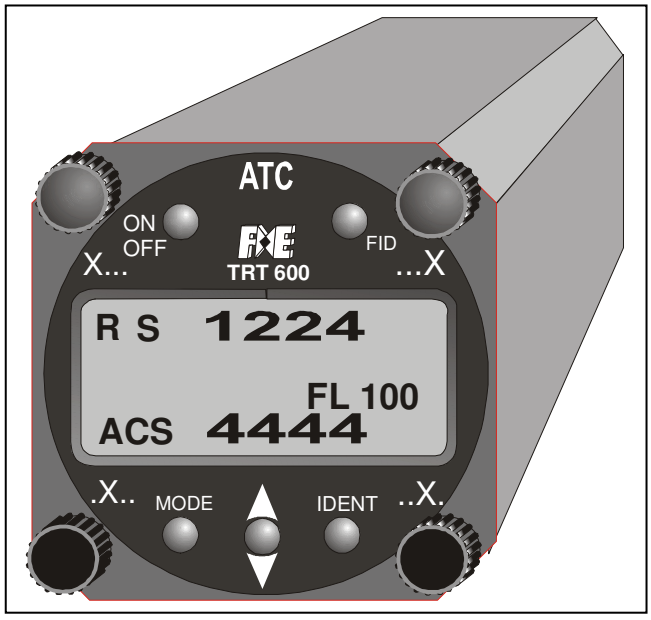
Revision 1.5

29. June 2005



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Record of Revisions

Record of Revisions			RETAIN THIS RECORD IN THE FRONT OF THE MANUAL. ON RECEIPT OF REVISIONS, INSERT REVISED PAGES IN THE MANUAL, AND ENTER DATE INSERTED AND INITIALS.				
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1.0			None				
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1 GENERAL INFORMATION

This manual describes the physical, mechanical and electrical characteristics and the installation requirements for the
TRT600 Mode S Transponder and it contains suggestions and factors to consider before installing the TRT600. Close adherence to these suggestions will assure optimum performance from the equipment.

Information relative to operating procedures is found in the TRT600 Operation Manual. (Document Number 03.200.010.11)

Information relative to the maintenance, alignment, and procurement of replacement parts may be found in the TRT600 Maintenance Manual (Document Number 03.200.010.13). The TRT600 is to be used on airborne vehicles operating VFR. Such vehicles should have a service ceiling of max 15000 ft and a MAS of 175 knots.

Overview of Capabilities

- Specified as postulated in EUROCAE ED-115 and AIC IFR 06, AIC VFR 9 of the DFS
- Level 2 transponder (restricted to elementary surveillance)
- Class 2 equipment with a RF peak output power of at least 20,8dBW and at least 18,5dBW at the antenna
- 14VDC operating voltage
- ICAO 24 bit aircraft address
- SSR Mode 3/A
- Altitude reporting in 100ft intervals from an integral pressure-altitude sensor up to 15.000ft
- Flight Status
- Data link capability reporting (downlink)
- Mode A identity and Mode C pressure-altitude reporting
- Intermode and Mode S All-Call transactions (UF/DF11)
- Mode S addressed surveillance altitude and identity transaction (UF4, UF5)
- Lockout protocols
- Aircraft identification reporting
- ACAS Active Resolution Advisory
- Surveillance Identifier (SI) and Interrogator Identifier (II) code capability

1.1 Manufacturer

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1.2 Equipment Description

The TRT600 is a German LBA NTS-23 Level 2 transponder (restricted to elementary surveillance) with Comm A/B Capability Reporting only, providing downlink of aircraft information and meets the EUROCAE ED-115 and the AIC IFR 06, AIC VFR 9 of the DFS. It is the principal component of the airborne equipment of Mode A/C and Mode S SSR. It performs the elementary surveillance functions by providing the appropriate reply to Mode A/C and/or Mode S interrogations.

All Mode S transmissions, uplink as well as downlink, are protected by a 24 bit parity code. The transponder performs decoding and encoding as required, so that the surveillance function as well as the message content is protected.

The ICAO 24 bit aircraft address and the Flight ID is stored in a external memory (EEPROM) which is located in the connector of the installation cable set. The ICAO 24 bit aircraft address can only be read out of the EEPROM but can not be changed by the operator, whereas the Flight ID can be read and changed. Because the cable with the EEPROM adapter has to be installed permanently into the aircraft a change of the transponder will not effect the ICAO 24 bit aircraft address.

The TRT600 is specified as a CLASS 2 equipment with a RF peak output power of at least 18,5dBW (71W) at the antenna. It operates at 14VDC and is designed as a single block unit with 57 mm diameter for instrument panel or console mounting. The TRT600 is certified for use on airborne vehicles operating VFR .Such vehicles should have a service ceiling of 15000 ft maximum and a MAS of 175 knots.

The TRT600 is designed to meet all operational requirements encountered in General Aviation flying.

2 TECHNICAL CHARACTERISTICS

Compliance:	LBA NTS-23
Physical Dimensions: Height: Width: Length: Weight:	Panel 57mm 2,6 in. 6,6 cm. 2,6 in. 6,6 cm. 7,1 in. 18 cm. 1,5 lbs. 0,7 kg.
Applicable Documents	ED-115, ED-73B, ED-26, RTCA DO-160D, RTCA DO-178B, ICAO Annex 10, AIC IFR 6/03, AIC VFR 9 12/03
Mounting: Temperature: Altitude Range: Cooling: Vibration: Shock: Power Input: Voltage Range:	Panel 57mm -20 °C to +55 °C ≤15.000 ft No forced-air cooling required, but recommended Constant Curve M DO160D Rigid mounting 6 G operational 20 G crash safety 10 Watts (max) typical: 0.40 A @ 13.8 Vdc maximum: 0.7A @ 13.8 Vdc between 10 and 16 Vdc
Receiver Characteristics: Sensitivity and Dynamic Range	The minimum triggering level (MTL) is defined as the minimum input power level that results in a 90% reply ratio if the interrogation has nominal pulse characteristics. A. The MTL for A/C and Mode ACSI interrogations is -73 dBm +4 dB. B. The MTL for Mode S interrogations is -74dBm ± 3 dB.
Transmitter Characteristics: Reply Transmission Frequency: RF Peak Power Output:	 The transmitter frequency of the reply will be 1090MHz ± 1 MHz. The transmitter output power is 71 watt peak power minimum at the terminals of the transponder antenna.
Squitter:	Random Intervals Uniformly Distributed over the range from 0.8sec- 1.2 sec, full self verification of every squitters data and occurrence

2.1 UNPACKING AND INSPECTING EQUIPMENT

Unpack the equipment carefully and inspect each item for evidence of damage incurred during shipment. If a damage claim has to be filed, save the shipping container and all packing materials to substantiate your claim. The claim should be filed with the transportation company as soon as possible. The shipping container and packing material should be saved in any case in the event that storage or reshipment of the equipment is necessary.

3 EQUIPMENT INSTALLATION

The TRT600 installation will conform to standards designated by the customer, installing agency, and existing conditions as to the unit location and type of installation. However, the following suggestions should be considered before installing the TRT600. The installing agency should supply and fabricate all external cables (Interconnect diagrams are included at the end of this manual).

3.1 COOLING REQUIREMENTS FOR PANEL MOUNT

The most important contribution to improved reliability of avionics equipment is to limit the maximum operating temperature of each unit. While modern designs consume less total energy, the heat dissipated per unit volume (Watts/cubic inch) remains much the same due to contemporary high density packaging techniques. While each individual unit may or may not require forced air cooling, the combined heat, generated by several units operating in a typical panel or rack, can significantly degrade the reliability of the equipment if provisions for adequate cooling are not incorporated in the initial installation.

3.1.1 MUTUAL SUPPRESSION PULSES

Other equipment on board the aircraft may transmit on the same frequency band as the transponder, such as DME or another transponder. Mutual suppression is a synchronous pulse that is sent to the other equipment to suppress transmission of a competing transmitter for the duration of the pulse train transmission. The transponder transmission may be suppressed by an external source and other equipment on board may be suppressed by the transponder. This feature is designed to limit mutual interference.

3.1.2 MOUNTING INSTALLATION

A. The TRT600 is mounted rigidly in the aircraft panel. Select a position in the panel that is not too close to any high external heat source. Remember to allow adequate space for installation of cables and connectors. Avoid sharp bends and placing the cables too near to the aircraft control cables.

B. Standard 57mm cut-out is required for panel mounting the TRT600.

C. It is fastened by four 6mm special cavity screws leading through the 4 axis of the rotating knobs. Before installation the knobs and the cavity screws have to be removed.

D. When installing two or more panel mounted units into a stack, the mounting trays must be spaced 0.050 inches (0.127 cm) apart. Current production mounting trays have 0.025 inch (0.064 cm) dimples built into top and bottom and both sides so that the trays will automatically be spaced properly.

3.1.3 ELECTRICAL CONNECTIONS

All electrical connections, except for the antenna are made through a single, 15 pin D-sub miniature connector. Only the supplied 15 pin D-sub miniature connector may be used because it contains the EEPROM with the ICAO Aircraft code. The TRT600 has to be protected by an external slow blow fuse of 2 Ampere.

3.1.4 ANTENNA INSTALLATION

Particular attention must be paid to the proper antenna installation on the aircraft so that the specified minimum radiation is ensured. The radiation pattern needs to be verified per aircraft type. Satisfactory performance of an antenna installation used for a previous type of transponder should be suitable for the TRT600.
Normally the antenna should be mounted at the bottom of the aircraft. However, sufficient field strength should also be available above the aircraft so that proper detection by ACAS equipped aircraft is ensured.
The electrical interference between the antenna and any other antenna/equipment must be taken into account in such way that no reduction of the performance of any of those other systems decreases below the required level.

Particular care should be taken to ensure that interference with the TRT600 antenna subsystem, caused by static electricity, is minimized.

The electrical connection to the antenna should be protected to avoid loss of efficiency as a result of the presence of liquids or moisture.

All antenna feeders are to be installed in such way that a minimum of radio frequency energy is radiated inside the aircraft. RF hazard exposure to persons on board the aircraft should be minimized by appropriate precautions.

The antenna type chosen is to be compatible with the vehicle on which it is used and its location.

Caution:

Radiation Hazards
In order to avoid the possibility of human body damage (e.g. to eyes) and/or ignition of combustible materials by radiated energy, a safe distance to the installed antenna must be ensured by adequate installation provisions.

Location Considerations

- The antenna should be mounted on the underside of the aircraft and in a vertical position when the aircraft is in level flight.
- Avoid mounting the antenna within three feet of the ADF sense antenna or any other communication antenna and six feet from the DME antenna.
- If the antenna is being installed on a composite aircraft, ground planes must be added or a symmetrical Antenna can be installed. The ground plane should be as large as possible but not less than 30 x 30 cm for satisfactory performance (see chapter 3.1.5).

Install the antenna according to any instructions provided by the antenna manufacturer.

3.1.5 Asymmetrical antenna TRT-ANT-A

The asymmetrical antenna is a normal ground plane antenna for installation in metal aircrafts or where a ground plane (metal plate, min. size 30x30 cm) can be installed.

Other antenna will be offered by Filser Electronic GmbH when they are available. For mounting on aircraft made of composites the ground plane should be as large as possible but not less than 30 x 30 cm for satisfactory performance. If in doubt please refer to the aircraft manufacturer.

3.1.6 Antenna Cable Installation

When routing antenna cables, observe the following precautions:

- All cable routing should be kept as short as possible and as direct as possible.
- Avoid sharp bends.
- Avoid routing cables near power sources (e.g., 400 Hz generators, trim motors, etc.), ignition coil or near power for fluorescent lighting.
- Avoid routing cable near ADF antenna cable (allow at least a 12 inch (25 cm) separation).

A special cable type (CELLFOIL, or AIRCELL) has low attenuation at 1090 MHz but it is not very resistant against mechanical stresses such as sharp bends or from repeated flexing. Therefore, when installing the cable careful design and installation is called for.
The following table lists examples of the recommended antenna cable and the type of cable to be used for specific lengths of cable. Any cable meeting specifications is acceptable for the installation but Filser Electronic GmbH can offer pre-assembled cables, as set out below.

FILSER PART NUMBER	DESCRIPTION
P/N 800EM-(xxx)-(xxx)	AC Address Adapter EM800 with power cable
Install kit 1 optional P/N TRKABEL2	Cable, Coax TNC 2,5 m, 8,2ft, 0,4dB loss
Install kit 2 optional P/N TRKABEL3	Cable, Coax TNC 4,0 m, 13,2ft, 0,62dB loss
Install kit 3 optional P/N TRKABEL4	Cable, Coax TNC 6,5 m, 21,3ft, 1,0dB loss
Antenna kit 1 optional P/N CI-105	Transponder/ DME antenna TSO C66b,C74c CI105 Comant Industries Inc., height 3.25", weight 0.2 lb

Caution: The maximum coaxial cable attenuation between unit and antenna at 1090 MHz must not exceed 1.5 dB.

3.2 PLUMBING INSTALLATION

Install an approved soft tubing fitting the 5mm static port at the back side of the transponder.

When all connections are made, secure plumbing with appropriate clamps.

3.3 AIRCRAFT Address Programming

3.3.1 ICAO 24 Bit Aircraft Address

All Mode S transponders are identified with their unique, 24 bit, ICAO Mode S Aircraft Address. This address is assigned to each aircraft operating a Mode S transponder by the governing regulatory agency. Furthermore the Mode S transponder has the capability to store a Flight Identification(FID, in most countries the tail number of the aircraft).

A Mode S transponder shall include means to ensure that it is using the ICAO 24 bit aircraft address allocated to the airframe on which it is installed in all applicable Mode S transactions.

The ICAO 24 bit aircraft address must be correct at all times, as it is used for the technical addressing of the aircraft. Any duplication of an address in a particular airspace would put the data surveillance and integrity figures of Mode S in jeopardy.

NOTE: Any intervention of the user may accidentally result in a wrong ICAO 24 bit address and may therefore cause serious technical problems in ACAS or ATC systems.

The transponder must include means to input and store the aircraft address (AA) and the flight identification (FID). To meet this specifications the TRT600 has an external memory (EEPROM) inside the connector housing of the cable set, which will be delivered with the unit.

This cable with memory will remain installed in the aircraft after the unit is removed to insure that the ICAO 24 bit aircraft address is fixed to the aircraft.

3.3.2 ICAO 24 Bit Aircraft Address Entry Page

When the unit is turned on for the first time, or an invalid address is recognized, the unit will prompt the user to enter a valid aircraft address (ID).
Without entering an ID the Transponder will not have any Mode S functions but will still be in Mode A/C operative.

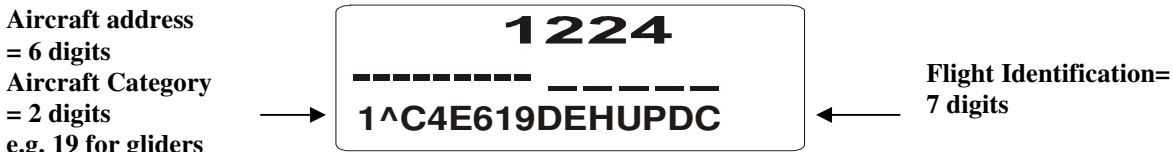
NOTE:. Only approved maintenance shop have the personal and equipment to insure that the programming of the aircraft address/category/squitter and the installation are performed and tested properly.

A. Case of no valid ICAO 24 Bit Aircraft Address in memory (factory setting)

1. Switch the unit to "**ON**" condition.
   The display will show
   "**CRADLE OFF-- OUT OF ORDER**"
   Press and hold the "**FID**" button and a number on the right top side of the display starts counting up **1, 2, 3**… Release the button at **47**.
2. On the display the lower line shows a long number as described in the picture below. The first 6 digits are the aircraft address (ICAO 24 bit AA in HEX-format, received from your local aviation authority) followed by 2 digits for the aircraft category (e.g. 19 for gliders) and then 7 digits for the Flight Identification (FID).

CAUTION: The ICAO Flight Plan specifies only 7 characters as Flight Identification. Filser reserves 8 characters as stated in ED- 73B for further expansion of the flight plan. The user shall only program 7 characters for FID. Please refer to chapter 3.6.3 for guiding instructions.

3. Insert the **valid** ICAO aircraft address in HEX format, the aircraft category and the Flight Identification (which is usually the aircrafts tail-sign, see chapter 3.6.3) by using
   - the lower right rotating knob (**..X.**) as a cursor "**^**" position
   - the lower left knob (**.X..**) to change the contents of the selected position (0-9 and A-F).
4. Confirm the entered code by pressing the "**MODE"** button.
5. The new code is now activated and stored to the external memory.



The definition of the aircraft categories are:

1A=Balloon & airship	11= vehicle,	22=G/I -class
1B=Paraglider	19=Glider,	
1C=UL,	12=emergency vehicle	27=Helicopter,
1E=Drone	21=E-class	

B. Modification of an existing ICAO 24 Bit Aircraft Address

1. press the **MODE** button until **STBY** is displayed
2. go to step 3 of the procedure above and insert the aircraft address.

C. Modification of an existing Flight Identification

1. press the **MODE** button until **STBY** is displayed
2. go to step 3 of the procedure above and insert the Flight Identification

(please refer to chapter 3.6.3 for guidance).

The contents of the aircraft code line will be stored into the external aircraft connector (EEPROM memory).

3.3.3 Guidance for Entering the Flight Identification

ICAO Document 8168-OPS/611 Volume I (Procedures for Air Navigation Services) requires that flight crew of aircraft equipped with Mode S shall set the aircraft identification, commonly called Flight-ID, into the transponder. That is necessary to ensure that the correlation between flight plan and radar data will work automatically. ATC providers have reported that their radar has seen many aircraft with an incorrect Flight-ID.

The Flight-ID setting is required to correspond to the aircraft identification that has been (correctly!) specified at item 7 of the ICAO flight plan and consists of no more than seven charters. If the aircraft identification consists of less than seven characters, it shall be entered left-aligned with no zeros, dashes or spaces added.

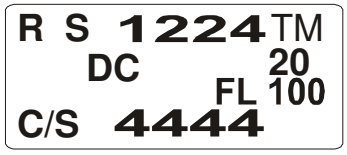
For an aircraft using a company call sign, the Flight-ID consists of the ICAO three-letter designator for the aircraft operator, followed by an identification code, e.g. KLM511, BAW213, JTR25.

If no company call sign is used or even no flight plan is filed, the default Flight-ID to be set consists of the registration marking of the aircraft, e.g. GXXXX, 4XBCD, DEABC, again with no additional zeros, dashes or spaces. Don´t use dashes even if they are included in the registration marking painted on the aircraft (tail number).

Caution: After the installation is complete, a certified maintenance shop must verify proper operation of the transponder by testing in accordance with Appendix F to 14 CFR Part 43 – ATC Transponder Tests and Inspections.
The most important factor in the transponder configuration is the checking of the Mode S address. Verify proper operation of the transponder during a flight test under VFR conditions.
If no valid ICAO aircraft address is programmed to the unit or if the memory is inoperative the transponder will inhibit the S-Mode functions. Only A/C mode function will be available**.**

3.4 Access to the TEST MODE

While pressing the button “FID” (upper right) a number will start to count up once per second. When the button is released at the number 7 the TRT600 will change to the test mode.
In this mode all transponder functions are still active except that errors will not result in changing the mode to STBY. The error codes for receiver signal quality (Sn) will now be displayed. This mode is used for troubleshooting.



4 POST INSTALLATION CHECKOUT

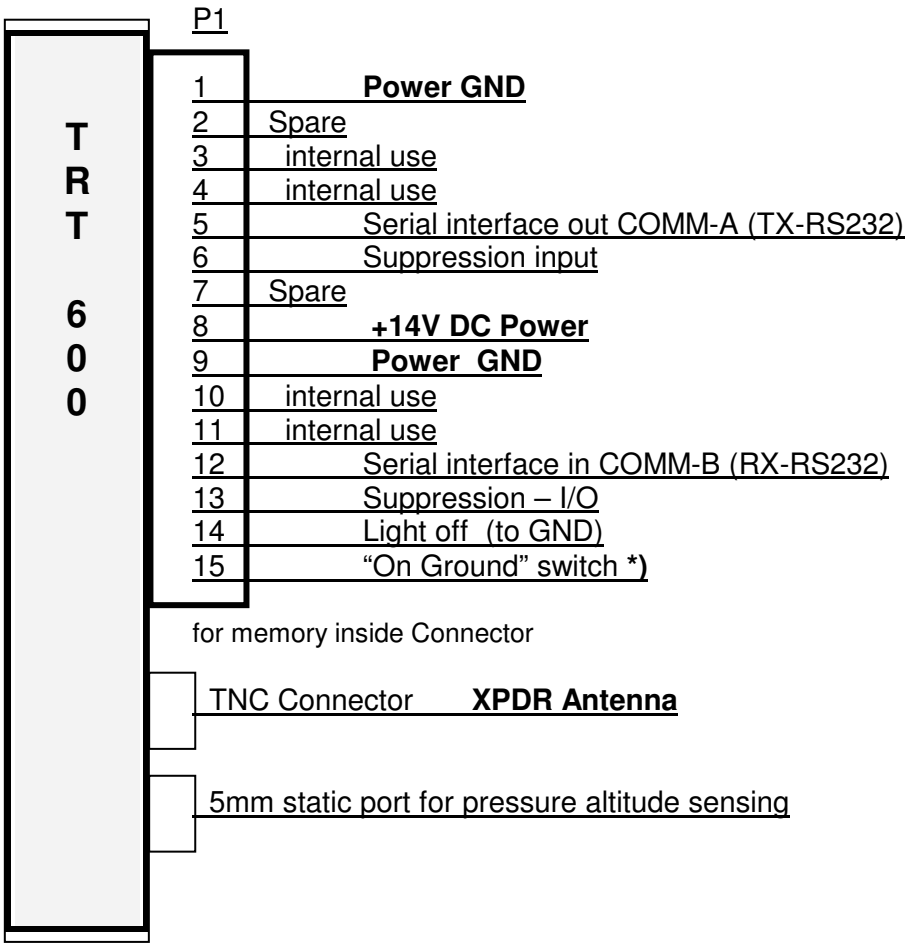
After the installation is complete, verify proper operation of the transponder by testing in accordance with Appendix F to 14 CFR Part 43 – ATC Transponder Tests and Inspections.

Perhaps the most important factor in the TRT600 transponder configuration and checkout is the Mode S address.

Be sure to check all aircraft control movements before flight is attempted to insure that the wiring harness does not touch any moving part.

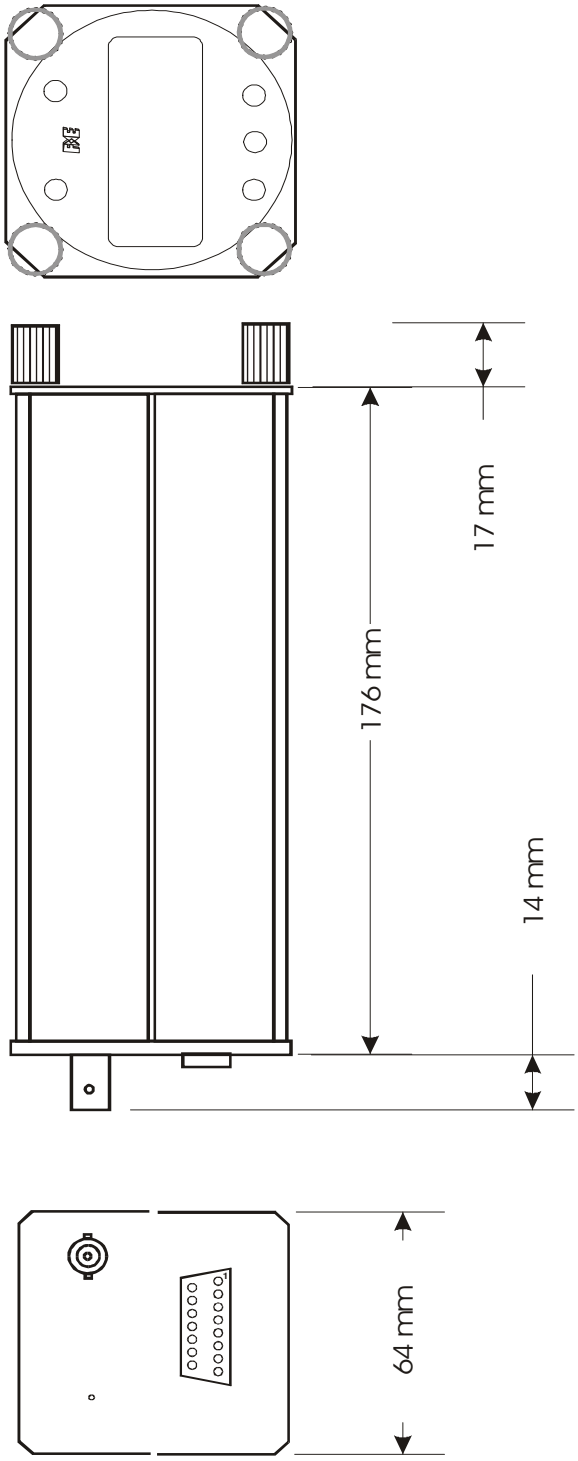
Verify proper operation of the transponder during a flight test under VFR conditions. If the unit detects an internal failure mode the failure code is displayed on the screen.

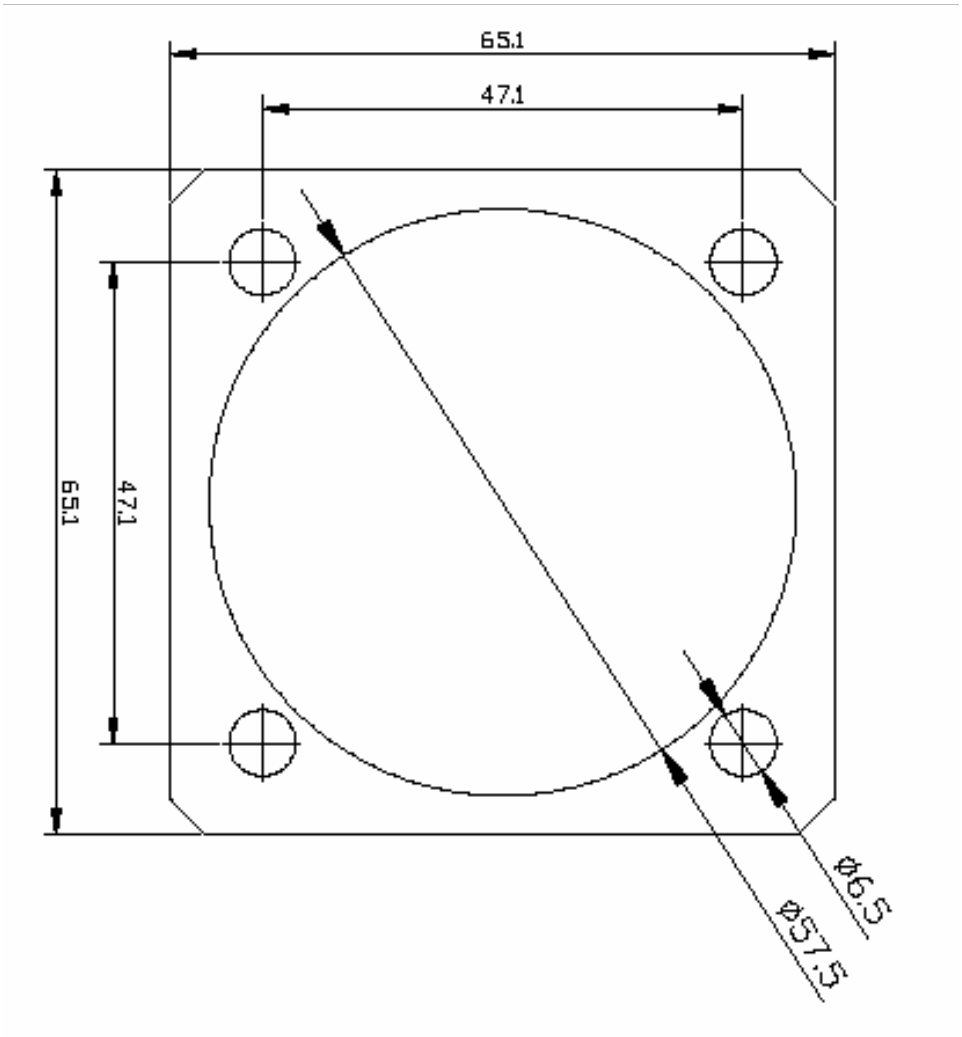
5 INTERCONNECT DIAGRAMS



***) "On Ground" switch**: When the aircraft is in "On Ground" condition switch Pin 15 to Pin 1 (or Pin 9), else leave Pin 15 un-switched open. (For toggling between A_S and ACS Mode for aircraft in flight and STBY Mode for aircraft on ground)

6 DIMENSIONS

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