

**TRT 250
TRANSPONDER**
INSTALLATION MANUAL



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TERRA CORPORATION
TRT 250 TRANSPONDER

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SECTION I

1. INTRODUCTION

1.1. SCOPE

This publication contains specifications, installation and operating instructions for the Terra model TRT 250 ATC Radar Transponder designed and manufactured by Terra Corporation, Albuquerque, New Mexico.

1.2. GENERAL DESCRIPTION

The Terra TRT 250 Transponder is designed for mounting in the instrument panel or panel radio rack of General Aviation aircraft and functions in the environment of the Air Traffic Control Radar Beacon System (ATCRBS). In response to interrogations from the groundbased secondary radar transmitter, the Model TRT 250 replies with coded transmissions that are received and processed at the Air Traffic Control Center. The aircraft's position relative to the airway route structure is displayed on the Air Traffic Controller's radarscope and, if the Center is equipped with ARTS-III computers, the aircraft's discrete assigned identification is also displayed. If the aircraft is equipped with an altimeter/encoder, the aircraft altitude is also displayed in 100 foot increments.

The TRT 250 Transponder is entirely solid state in construction, using only a small number of integrated circuits to accomplish the many steps in the decode-encode process involved in detecting interrogations and generating the proper reply codes. Front panel controls permit selection of four-digit reply codes in response to ATC instructions, and selection of OFF, ON or ALTtitude. In the ALT mode, the TRT 250 responds to interrogations for both identification and altitude replies. In the ON mode, only the identification is transmitted.

Because of its all solid-state design, the TRT 250 will begin operating immediately after being switched to ON or ALT. A Yellow REPLY indicator produces a bright flash each time the unit replies to an interrogation. When the REPLY switch is depressed, it causes the unit to develop the SPIP (Reply) pulse for a period of 20 seconds. The REPLY indicator is dimmed by a photocell to compensate for ambient light conditions.

1.2. GENERAL DESCRIPTION (Continued)

The TEST switch initiates a complete internal interrogate/response cycle, performing a test of all circuits within the unit and verifying its readiness for use. The REPLY lamp will blink several times a second if the unit is operating satisfactorily. This feature is particularly important in that the operational readiness of the unit can be verified prior to every flight. The front panel controls of the transponder are listed in Table 1-1.

1.3. SPECIFICATIONS

The TRT 250 Transponder has been type accepted by the Federal Communications Commission under its Rules pertaining to radio devices in the aviation services and has been approved by the Federal Aviation Administration under the Technical Standard Order (TSO) C74C of Part 37 of its Rules and Regulations. It may, therefore, legally be installed and operated in civil aircraft of United States registry and in aircraft of other countries that accept FAA TSO approval as proof that the equipment meets their regulations. Specifications of the TRT 250 are listed in Table 1-2.

1.4. ACCESSORIES

The only accessory not supplied with the TRT 250 is an encoding altimeter. The unit will operate with most manufacturer's encoding altimeters; however, Terra Model AT 3000 is recommended. Consult Section II, Installation, for details of interconnections.

1.5. POWER SOURCE

The TRT 250 is designed for either 14 volt or 28 volt operation. No wiring changes or internal modifications are required to change operation from one voltage source to another.

Table 1-1. Front Panel Controls of Terra TRT 250 ATC Radar Transponder

CONTROL OR INDICATOR	FUNCTION
Function/Power Switch	Selects Power OFF, ON and ALT. When switch is at ON, unit is operating in Mode A (identification only). When switch is at ALT, unit is operating in Mode A/C transmitting identification and encoded altitude (with encoding altimeter installed and connected).
Reply Indicator	Yellow indicator blinks when unit responds to ground radar interrogation.
REPLY/TEST switch	Unit transmit SPIP (REPLY) for approximately 20 seconds when REPLY switch is depressed. When TEST switch is listed, complete receive, decode, encode and transmit cycle is checked. Blinking REPLY indicator is confirmation of valid test.
Code Selectors	Four pushbutton switches with eight positions labeled 1,2,3,4,5,6 and 7 control coding of reply pulses. Numbers selected in response to ATC instructions.

Table 1-2. Specifications for Terra TRT 250 Transponder

Frequency, Transmit	1090 MHz +3 MHz
Receive	1030 MHz +3 MHz
Power Output	200 Watts nominal
Receiver Sensitivity	-72 dBm nominal
Power Requirements	11 to 32 VDC, .75 amperes maximum
Reply Modes	Mode A and A/C
Code Capability	
Mode A	4096 plus SPIP (REPLY)
Mode C	Altitude capability
TSO Category	C74C Class IIA
Altitude	To 55,000 feet MSL
Environmental Category	DO-160A Env. Cat.
Size	A1F1/A/PKS/XXXXXXXXBBBA 1.6"H x 3.2"W x 10"D (4.06cm x 8.13cm x 25.5cm)
Weight	1.7 pounds (.77kg)

SECTION II

2. GENERAL

2.1. SHIPPING INSPECTION

On receipt of the equipment, inspect the exterior of the carton for signs of shipping damage. If the carton shows water damage, has been crushed or punctured, note such damage on the waybill and obtain the carrier driver's signature thereon as acknowledgment. Remove the equipment from the carton and inspect for physical damage noting the action of all controls, the condition of the panel and case and of the mounting tray. If any physical damage is noted, file a claim immediately with the carrier. Do not return the unit to Terra without prior permission.

2.2. EQUIPMENT SUPPLIED

All equipment necessary for installing the TRT 250 is listed in Table 2-1. The only items not supplied that are required for installation are the antenna cable and the connector for the antenna end of the cable. These are not supplied as they will be determined by the requirements of the installation, primarily the length of the cable required between the antenna and the unit. The cable types and connector types permissible are listed in Drawing 9-1130-0250-04 Interconnect Diagram.

Table 2-1. Equipment Supplied

Part Number	Description	Quantity
0900-0250-00	Transponder, Terra Model TRT 250 (Flat version) Mounting Tray Assembly Installation Kit	1 1 1 1
0900-0250-20	3" Round version	1
<u>Other Items Included</u>		
9-1203-103-00	Antenna, Rod and ball w/BNC	1

2.3. LICENSE REQUIREMENTS

The owner of the aircraft in which the TRT 250 is installed must apply for an Aircraft Station License. Application is made to the Federal Communications Commission using Form 404. Although an Aircraft Radio Station License may be currently in effect, the FCC rules require that when a transponder is installed, the aircraft owner must apply for modification of his license. A copy of the Form 404 application, retained in the aircraft, serves as a temporary license for a period of thirty days. When filing the application, the transponder must be identified as the CCX8GITRT250 under Type Acceptance Number, frequency as 1090 MHz and power output at 200 Watts peak.

2.4. INSTALLATION CERTIFICATION

Installation of any equipment in an aircraft requires that the work be performed by or under the supervision of an FAA Certificated Airframe Mechanic who is responsible for compliance with Federal Air Regulations pertaining to methods and workmanship. The mechanic must complete an FAA Form 337 and compute a new weight and balance for the aircraft for insertion in the Aircraft Flight Manual. Unless the mechanic is the designated inspector for a Certificated Repair Station or holds an Inspection Authorization, the work is subject to inspection and approval of an FAA Inspector or the holder of an Inspection Authorization.

2.5. MECHANICAL INSTALLATION

The selection of location for the TRT 250 should be made in company with the aircraft owner, of course. However, there are a number of considerations that the installer must keep in mind if the installation is to be accomplished without complication. Accessibility to the pilot is of prime consideration, and the unit should be located where its controls are within reach and its indicators visible to the pilot without his attention diverted from the instrument panel for more than a second or two during instrument flight.

2.5. MECHANICAL INSTALLATION (Continued)

The location must also be chosen so there is ample room for the unit between the panel and the firewall with sufficient clearance for connectors and cable bends.

The antenna should be mounted on the underside of the aircraft and well clear of other antennas, (especially those associated with the ADF), antenna masts, landing gear doors and other major protrusions that could alter its radiation pattern or present a major obstruction between it and the ground-radar antenna. The antenna lead should be routed separately from any other antenna leads or electrical wires or cables, particularly those associated with the ADF.

If the unit is to be mounted in a panel-mounted rack with other avionics equipment, air circulation sufficient to maintain the ambient temperature at or below 55 degrees C at all times during operation must be provided. Elevated temperatures have an adverse effect on all electronic equipment and a ram air kit installation will extend the useful life and reliability of all of the avionics installed in the aircraft.

The recommended installation of the mounting tray is shown in Drawing no. 9-1120-0001-04.

NOTE: A vertical support between the rear of the unit and an overhead structure of the airframe is required. In Beech Bonanza/Baron aircraft where it is desired that the complete avionics rack be removed as a unit, a support to the other avionics packages in the rack will suffice. The desired result is that the unit not be cantilevered from the front mountings alone.

2.6. TRAY MOUNTING

The mounting tray measures 3.05 inches in width which will be accommodated in the panel radio racks of most current light aircraft. Remove the transponder from the mounting tray and place the mounting tray in the panel radio rack in the desired location making allowances for the spacing required from other equipment for air circulation

2.6. TRAY MOUNTING (Continued)

and for the height of the transponder panel, which is greater than that of the mounting tray. Mark the vertical angles of the rack through the holes in the tray. Remove the tray and drill the angles (number 27 drill) along their centerlines where they are intersected by the marks made from the tray. Complete the fabrication of the electrical harness as directed in the following paragraphs as shown in Drawing no. 9-1130-0250-04. Install the tray in the rack using 6-32 head screws, flat washers, lock washers and flat nuts. Alternately, flat washers and AN 365-6 nuts may be used. Fabricate a support strap or bracket and attach it between the rear of the unit and the airframe (or other avionics equipment in the rack). Attachment to the rear of the tray may be accomplished with existing hardware or by additional hardware as required.

CAUTION: If additional hardware is to be installed, determine that it will not interfere with the installation of the TRT 250 in the tray. Slip TRT 250 into place and lock it by turning the recessed Allen head screw to the right. Do not over-tighten. The TRT 250 is removed from the instrument panel by loosening one Allen head screw and sliding it out of its mounting tray. This removal also disconnects the power, encoding altimeter and antenna connections. Replacement is accomplished in the reverse manner.

The 3" version is designed to mount directly into a standard 3 1/8" instrument hole with no rear support required. Refer to Drawing no. 9-1120-0011-03.

2.7. ANTENNA MOUNTING

Select a location for the antenna that is as far removed from the DME and ADF antennas as possible, keeping the cable length between the TRT 250 and the antenna as short as possible to minimize cable losses. The antenna should be mounted on the bottom of the aircraft and clear of antenna masts and landing gear doors.

2.7. ANTENNA MOUNTING (Continued)

CAUTION: Before drilling any mounting hole for the antenna, determine that there is adequate clearance inside the fuselage for the antenna and its cable connector.

NOTE: To protect the aircraft skin from damage, install a 2 inch square or circular doubler of the same thickness as the aircraft skin on the inside of the aircraft skin. Attach with rivets of type and quantity as required by current FAA regulations.

Be sure that a good electrical connection exists between the antenna and the skin of the aircraft. All paint or protective coatings should be removed from the inside of the aircraft skin prior to installation of the antenna and the doubler, if used. The doubler should not be painted before installation. Tighten the nut securely to insure that the lockwasher completes the electrical connection between the antenna assembly and the aircraft skin.

2.8. ELECTRICAL INSTALLATION

All electrical connections, except for the antenna, are made through a single 25 pin D connector furnished as part of the mounting hardware kit. Electrical connections between the TRT 250 and the aircraft electrical system are shown in Figure 2-2. The power input and power ground should be No. 20 AWG, all other interconnect wiring can be 24 AWG of a type approved for use in aircraft installations.

NOTE: A trip-free circuit breaker or fuse not greater than 2-ampere rating must be installed between the aircraft's electrical buss and the TRT 250. Do not connect other equipment to the same circuit protector.

If a DME is installed, interference may be noted when the transponder is turned on with the DME tuned to certain frequencies. This will be manifested in a change of any of the DME readings: distance, groundspeed or time to station; or erratic indications.

2.8. ELECTRICAL INSTALLATION (Continued)

Though such interference is rare in modern equipment, a suppression circuit is included in the TRT 250 which, when connected to the DME suppression output, will suppress the transponder at appropriate times so as to eliminate the interference. Operation of the transponder will not be noticeably affected. Input characteristics of the DME suppression circuit are in accordance with ARINC standards.

The encoding altimeter manufacturer will designate which pins of his equipment's connector control lines A2, A1, D2, etc. It is only necessary to correlate that information with the information in Figure 2-2 to obtain the correct interface with the encoding altimeter. The TRT 250 is compatible with all currently manufactured encoding altimeters intended for use in General Aviation aircraft. Additional information on the interface characteristics will be found in Table 2-3. If routing the wires from the transponder requires that they be bent in close proximity to the connector, individual wires must have a 1/2 inch minimum bend radius. If the harness is bent as a unit, the bend radius should be a minimum of 1 1/2 inches.

Do not rely upon the mechanical attachment of the mounting tray to the aircraft structure for an electrical ground. It is necessary that a ground wire be installed on the connector and its other end properly bonded to the aircraft structure.

2.8. ELECTRICAL INSTALLATION (Continued)

Table 2-3. Electrical Characteristics of Interface

ALTITUDE INPUTS (Pins 2-5,9,14-18) - Standard TTL input characteristics with 4.7K-ohm internal pull-up resistors, negative logic, i.e., low level (1V) is recognized as a "1"
SWITCHED POWER (Pin 8,20) - May be used to power encoder if total current drain is less than 0.4 ampere
EXTERNAL SUPPRESSION IN (Pin 6) - Accepts standard (ARINC) suppression pulses from DME
POWER INPUT (Pin 7, 19) - 14V or 28V input, provide a 2-ampere circuit breaker between Pins 7,19 and Power Buss
GROUND (Pin 11,21) - Power ground
LAMP COMMON (Pin 22) - LAMP POWER INPUTS (Pins 10 and 23) Totally floating inputs to provide series or parallel connection to suit virtually any panel lighting system

The antenna cable is critical if the requirements under which the unit was TSO approved are to be maintained. Permissible types and lengths of cable as well as permissible types of connectors are listed in Figure 2-2. Because of the high frequencies at which transponders operate, antenna-cable losses can materially affect the overall performance of the system if an excessively long cable or a cable of the wrong type is used.

NOTE: It is crucial to make the antenna lead as short as possible.

SECTION III

3. OPERATION

3.1. GENERAL

The TRT 250 Transponder is designed to operate in the environment of the Air Traffic Control Radar Beacon System. The secondary radar system interrogates transponders such as the TRT 250, which in turn reply with discrete coded signals that can identify the aircraft from all others in the same area if the ground facility has ARTS-III equipment installed. In addition, if an encoding altimeter is installed in the aircraft, the air traffic controller is supplied with the altitude of the aircraft on his radarscope in addition to the primary position and identification information. The TRT 250 is useful to pilots, though they may not be instrument rated, in that it permits the center to identify their aircraft and furnish radar advisories on conflicting traffic. With the proliferation of Terminal Control Areas around the country, it is necessary in some TCA's that all aircraft entering the area be equipped with a radar transponder. For the instrument pilot, the need for a radar transponder is as great as the instrument rating itself. Few flights operate under Instrument Flight Rules without a functioning transponder. It eliminates the need for identifying turns as the aircraft is immediately identified by its discrete code or by response to "INDENT" from the controller. The TRT 250 is TSO'd in categories that permit its operation up to 55,000 feet MSL.

3.2. CODE SELECTION

If the flight is to be conducted under Visual Flight Rules, select code 1200 with the four pushbutton switches. If the aircraft climbs to 10,000 feet MSL or above, the code should be changed to 1400. If the flight is to be conducted under Instrument Flight Rules, the code will be assigned by ATC in the clearance delivery. As the flight progresses, ATC will assign different codes which are then selected by the pilot.

3.2. CODE SELECTION (Continued)

Care should be taken in selecting codes so that codes 0000, 7777 or 7700 are never momentarily selected while changing from one assigned code to another.

CAUTION

Never select 0000, 7777 or 7700 with the pushbutton code selectors. 7700 is the emergency or distress code.

3.3. FUNCTION SELECTION

As previously mentioned, the function control should be turned to OFF during taxi and run-up. The function control should be turned to ON after take-off clearance is received. However, if an encoding altimeter is installed, the function control should be turned to ALT after take-off clearance is received. On occasion, the controller will request "stop altitude squawk", indicating that he does not desire to see the altitude information. The function selector should then be turned to ON until you are requested to "squawk altitude."

NOTE: The function control should not be turned to ON or ALT while the aircraft is on the ground before take-off except when performing a ramp check. Such operation will produce confusing returns on the radarscope if the radar transponder is within range of the radar.

The yellow reply indicator blinks brightly each time the TRT 250 replies to a ground-radar interrogation, indicating to the pilot that he is being "seen" on the radarscope.

3.4. IDENT

On occasion, the controller will request "Ident". The correct response is to depress and then release the IDENT switch. This starts a timer that runs for 15 to 30 seconds. During this period, the SPIP (REPLY) pulse is added to the normal reply information and produces a "bloom" at a point on the radarscope corresponding to the position of the aircraft.

3.4. INDENT (Continued)

In those areas where the FAA has installed ARTS-III equipment in centers and approach control facilities, the assignment of discrete codes to each aircraft is reducing the need for the use of the "Ident" feature that was necessary when all aircraft in a given area were using the same code. when the "Ident" feature is in operation, the REPLY indicator glows continuously.

3.5. TEST

There are two occasions when the TEST switch is used. First, it may be advisable to turn the TRT 250 unit to ON briefly during run-up and lift the TEST switch. The REPLY indicator should blink several times a second indicating that the unit is operational. The second occasion will come when the REPLY indicator has not been seen to blink for sometime. Lifting the TEST switch determines whether the unit is or is not functioning. Very often the aircraft will periodically be out of range of radar. Lifting the TEST switch and obtaining verification that the unit is working is reassuring at such times.

3.6. LIGHTING

The Code Selector Switches are illuminated by incandescent lamps. These are usually connected to the instrument or avionics lamp circuits and will be on whenever the instrument lamps are on and the brilliance will be controlled by the dimmer control.

The REPLY indicator is dimmed by the TRT 250 front panel photocell.

SECTION IV

4. WARRANTY

4.1. LIMITED WARRANTY OF TERRA PRODUCTS

All equipment manufactured by TERRA Corporation is guaranteed against defective materials and workmanship for a period of one year from date of shipment. An extended second and third year limited warranty becomes valid at the end of this first year, which warrants that the original owner will not pay more than \$100.00 in each of the second and third years should repairs be necessary. Should warranty not be required in the second year and only in the third year, then the original owner will not pay more than \$200.00 should repairs be necessary. Any unit found to be defective due to material and workmanship during the warranty period will be repaired and put in original manufactured operating condition. Any labor charges which are incurred as a result of said defects are included in this warranty.

TERRA Corporation's liability under this warranty is limited to servicing, repairing or adjusting any equipment returned prepaid to the factory by express written or oral authorization for that purpose and to repair or replace defective parts thereof. Fuses and batteries are specifically excluded from any liability.

If, upon examination, it is determined that a malfunction has been caused by misuse of the equipment, installation or operation not in accordance with factory instructions, accident or negligent damage, alterations of any manner, or repair by other than factory, the repairs will be billed at cost. In such cases, an estimate will be submitted for approval before repair is initiated.

Warranty Assurance to the Aircraft Owner/End-user cannot be maintained if the equipment is not installed in a certified aircraft by an authorized TERRA Dealer. Exception, to assure warranty for the Aircraft Owner/End-user, for homebuilt/experimental aircraft without installation by an authorized TERRA Dealer, is allowed when the end-user notifies Terra that the homebuilt/experimental aircraft has been issued a special airworthiness certificate by the FAA.

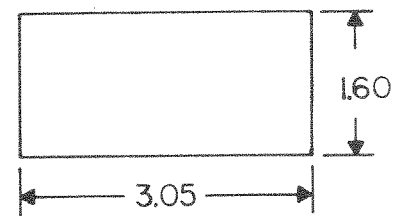
4.1. LIMITED WARRANTY OF TERRA PRODUCTS (Continued)

No warranty will be activated for TERRA products unless the installation is approved and the warranty card is completed by the supplying Dealer or upon receipt by TERRA of FAA forms(s) 337 or 8130-().

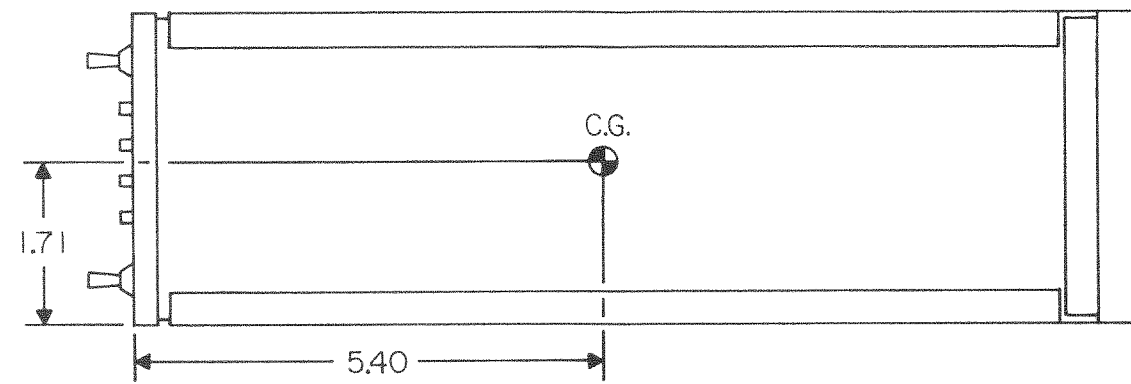
This Terra Corporation Limited Warranty is void unless the Warranty Registration Card is filled out and returned within 10 days after purchase.

THE IMPLIED WARRANTY AND ALL OTHER IMPLIED WARRANTIES ARE HEREBY EXCLUDED.

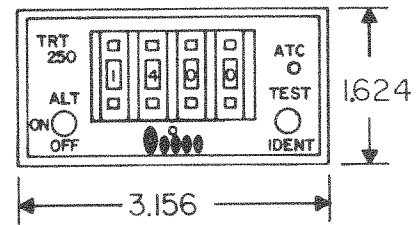
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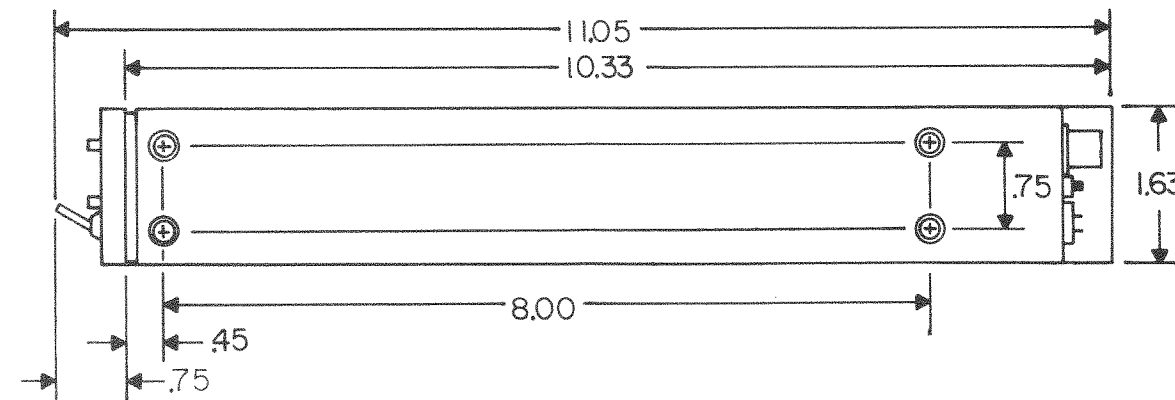
CUTOUT



TOP

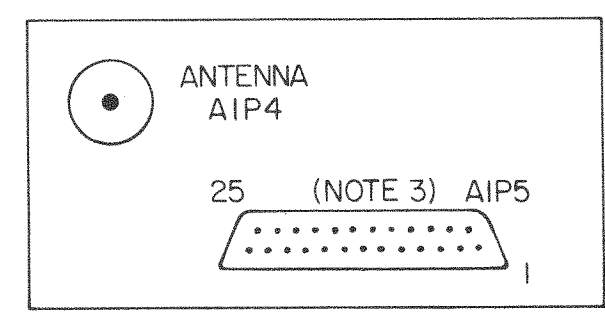
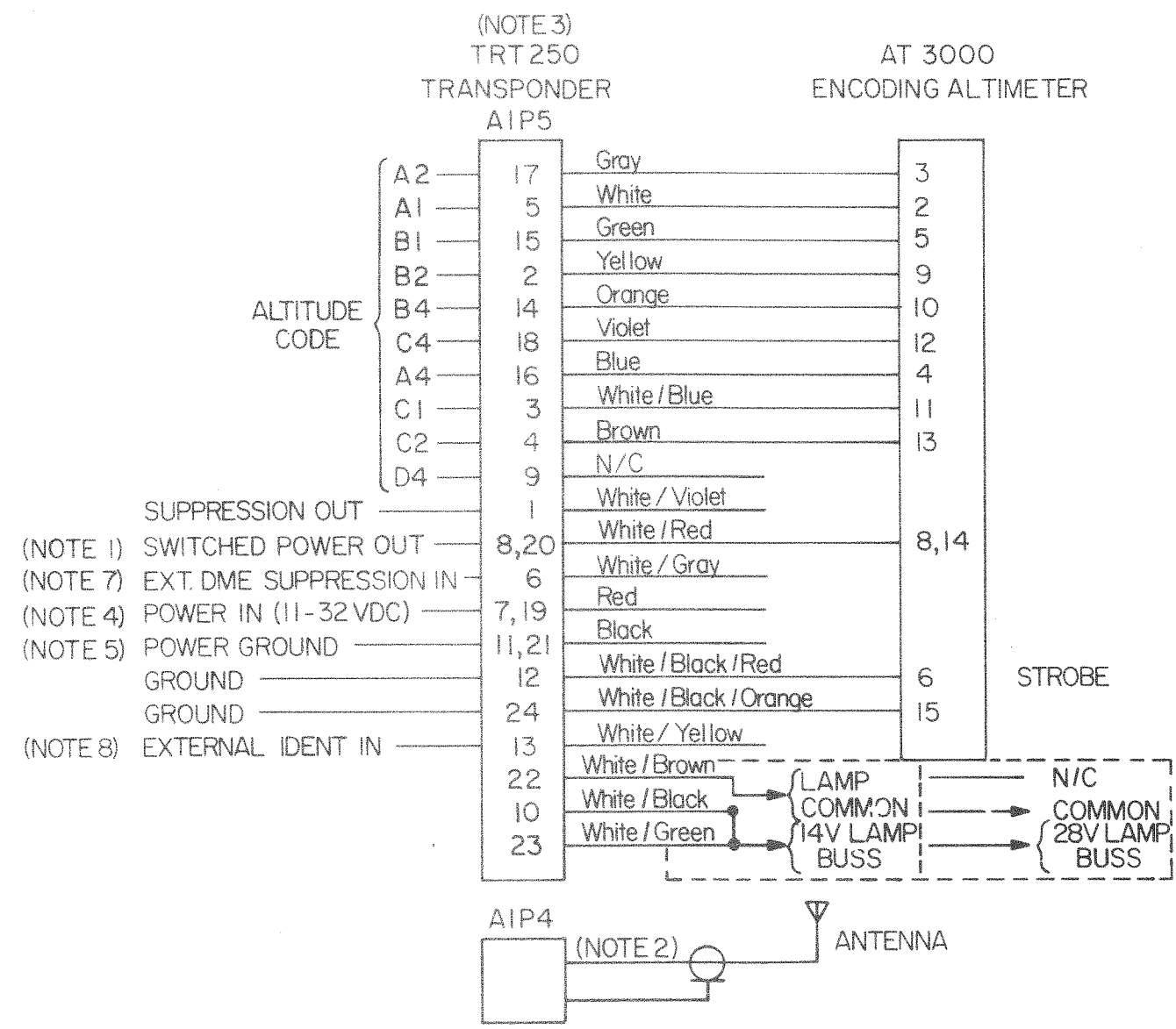


FRONT



SIDE

PART NUMBER		DESCRIPTION		ITEM
DASH NO		PART NUMBER	SCHEDULE	
		ALBUQUERQUE, NEW MEXICO		
SCALE		Tolerance Unless Noted: .XX ±.01 Fractions ±1/64 .XXX ±.005 Angles ±1/2°		
1:1				
DRAWN BY		TITLE		
MECH ENGR		TRT 250		
APPROVAL		OUTLINE DRAWING		
ELECT ENGR		SHEET		
APPROVAL		SIZE NUMBER		
PROJ ENGR		1 of 1 D 9-1120-0001-04		

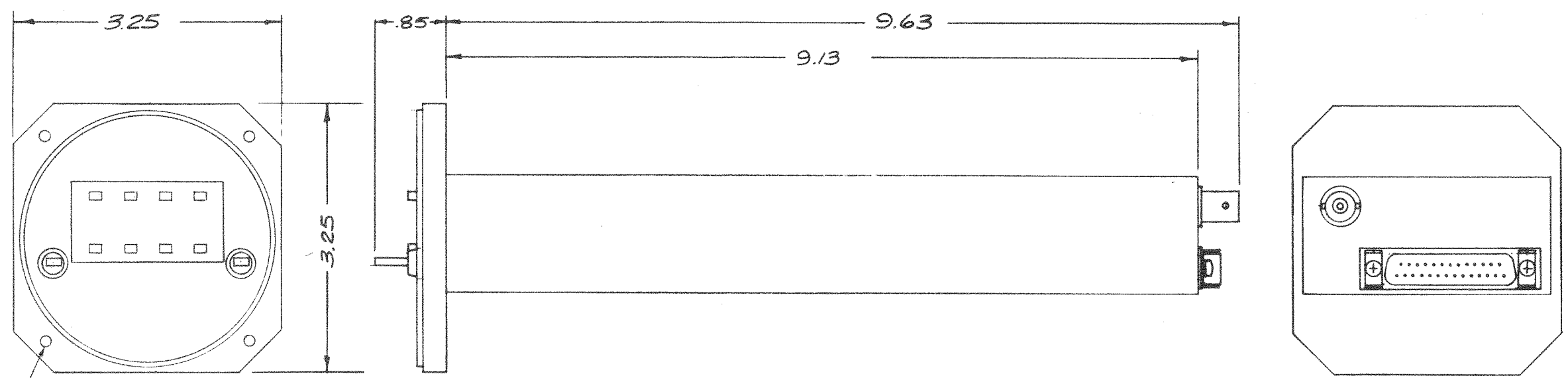


REAR OF TRT 250

NOTES:

- .5AMPS MAX.
- SELECT 1 EACH TYPE CABLE AND CONNECTOR FROM THOSE LISTED
CABLE LENGTHS:
RG-58/U 9 FT. MAX
RG-8/U 17 FT. MAX
CONNECTORS:
RG-58/U: UG-88C, UG-88D, UG-88E, AMPHENOL 31-320, 31-357, 36775
RG-8/U: UG-959, AMPHENOL 6775
- CONNECTOR - 25 PIN "D" TYPE (ITT CANNON TYPE DB-25S OR EQUIVALENT)
- PINS 7,19 MUST BOTH BE CONNECTED THROUGH A COMMON 2 AMP CIRCUIT BREAKER
- PINS 11,21 MUST BOTH BE GROUNDED
- WIRE SIZE : 20 AWG FOR POWER INPUT AND POWER GROUND
24 AWG FOR ALL OTHERS
- MUST BE CONNECTED TO APPROPRIATE PIN ON DME IF USED.
- USE ONLY MOMENTARY SWITCH TO GROUND TO ENABLE IDENT FUNCTION.

PART NUMBER		DESCRIPTION		ITEM
DASH NO	PART NUMBER	SCHEDULE		
	00000	ALBUQUERQUE, NEW MEXICO		
SCALE	Tolerance Unless Noted: .XX ±.01 Fractions 2/164 .XXX ±.005 Angles 2 1/2°			
DRAWN BY	V. SCHWEBACH			TITLE
MECH ENGR	APPROVAL			TRT 250 INSTALLATION
ELECT ENGR	APPROVAL			WIRING DIAGRAM
PROJ ENGR	APPROVAL			SHEET NUMBER
				1 of 1 D 9-1130-0250-04



.171 DIA. HOLES OR 6-32-NC-2B TAPPED HOLES,
 4 PLACES, ON 3.500 DIA. BOLT CIRCLE FOR
 BEHIND THE PANEL MOUNTING IN A 3 1/8
 INSTRUMENT HOLE.

PART NUMBER		REV. 1:1	
DATE		5-20-88	
MATERIAL		3" TRT 250	
FINISH		OUTLINE DRAWING	
DESIGNER		D.S.	
CHECKED		9-1120-0011-03 A	
APPROVED		1900-0250-00 1/1	