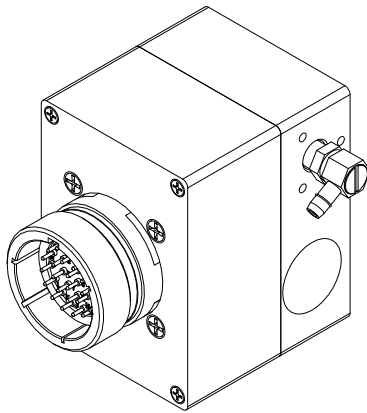


# **Trans-Cal Industries, Inc.**

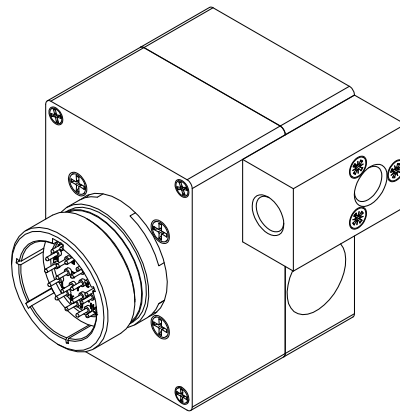
**Model SSD120-(XX)NEH-RS  
&  
Model SSD120-(XX)NEH1-RS**

**All Solid-State  
Altitude Encoder/Digitizer  
Owner/Installation Manual**

**FAA TSO-C88a Approved  
EASA ETSO-C88a Approved**



**SSD120-(XX)NEH1-RS**



**SSD120-(XX)NEH-RS**

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#### **What's in the Box:**

Qty.	Part Number	Description
1 ea.	SSD120-(XX)NEH( )-RS	Altitude Digitizer with RS232 Ports
1 ea.	882204	Owner/Installation Manual
1 ea.	103069	1/8-27NPT Plug, Brass

#### **History of Revision**

Revision	Date	Description
N/C	3/2009	Prototype release.
A	3/2009	Production release.
B	1/2014	Updated copyright notice, added KXP 755 data, and Century Flight Systems data. Updated FAQ for RS485 termination resistors. Updated serial data transmission rate data. Added serial data offset, updated Environmental Qualification Form DO-160E §10 Cat. W to cat. R, and §24 no test to Cat. C. Updated AC43-6B reference to AC43-6C.
C	5/2015	Added §1.3.1 Limitations, Deviations & Compliance DO-178 Cat., updated Environmental Qualification Form §14 no test to Cat. T. Added 14 CFR text edits to §1.1. Added Silicone Sealant ref. to §3.1, and FAR 23.1325 reference. Revised calibration block diagram for clarity. Revised NOTES & CAUTION statements §§3.0-4.7.

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## Abbreviations, Acronyms and Symbols

A	Amperes
AC	Advisory Circular
ARINC	Aeronautical Radio Incorporated
ASCII	American Standard for Coded Information Interchange
ATCRBS	Air Traffic Control Radar Beacon System
bps	Bits per second.
CFR	Code of Federal Regulations
<sup>C</sup> <sub>R</sub>	Carriage Return
EASA	European Aviation Safety Agency
EEPROM	Electrically Erasable Read Only Memory
EIA	Electronic Industries Association
ETSO	European Technical Standard Order
FAA	Federal Aviation Administration
FAR	Federal Aviation Regulation
ft.	Distance in feet.
GPS	Global Positioning System
Hz	Hertz
H/W	Hardware
ICAO	International Civil Aviation Organization
I.F.F.	Identification Friend or Foe
In. Hg.	Inches of Mercury
Kbps	Kilobits per Second
KHz	Kilohertz
<sup>L</sup> <sub>F</sub>	Line Feed
LSB	Least Significant Bit
mA	Milliamperes
max.	Maximum
MB	Millibar
MHz	Megahertz
MFD	Multi-Function Display
MSL	Mean Sea Level
min.	Minimum
ms	Time in milliseconds.
MSB	Most Significant Bit
mW	Milliwatt
NIST	National Institute of Standards and Technology
oz	Ounce
P/N	Part Number
psi	Pounds per Square Inch
RAM	Random Access Memory
RS	Recommended Standard
RTCA	RTCA Inc. (Radio Technical Commission for Aeronautics)
SAE	Society of Automotive Engineers
sec.	Time in seconds.
SSR	Secondary Surveillance Radar
S/W	Software
TCI	Trans-Cal Industries, Inc.
TIA	Telecommunication Industries Association
TSO	Technical Standard Order
Vdc	Volts Direct Current
VSI	Vertical Speed Indicator
W	Watt
Ω	Electrical resistance measured in Ohms.
°C	Temperature in degrees centigrade.
±	Plus or minus.

## **Section 1.0 Introduction**

### **1.1 Scope**

This manual provides detailed installation, calibration and operating instructions for Trans-Cal Industries' Model SSD120-(XX)NEH( )-RS <sup>1</sup> series of altitude encoder/digitizer, and applies to units with operating ceilings of 30,000 to 80,000 feet. This manual assumes use by competent, qualified avionics professionals utilizing installation methods in accordance with 14 CFR and other industry accepted installation practices.

### **1.2 Equipment Description**

Approved under FAA TSO-C88a and EASA ETSO-C88a the Model SSD120-(XX)NEH( )-RS is an all solid-state electronic device which, when connected to an aircraft static and electrical system, converts pressure altitude information into parallel and serial digital data.

The parallel digital altitude data protocol is set forth in the ICAO International Standard for SSR Pressure Altitude Transmission. In accordance with U.S. National Standards for Common System Component Characteristics for the I.F.F. Mark X (SIF)/Air Traffic Control Radar Beacon System SIF/ATCRBS.

The serial altitude data is provided on (2) two asynchronous RS232 output ports and (1) one RS485 output port. The serial data protocol is selectable and may be used to provide pressure altitude data to GPS or other on-board navigation devices. Refer to **Table IX, Table X** and **§4.5**

The Model SSD120-(XX)NEH( )-RS is designed for exposure to an environment where it may be subjected to water, and icing (generally the result of condensation, driving rain and/or water spray) in the normal course of aircraft operations. The instrument case is constructed of anodized aluminum and incorporates a hermetically sealed MIL-DTL-38999 Series III cylindrical connector. See **§3.2.1** for mating connector selection considerations.

### **1.3 General Specifications**

This equipment has been tested and will utilize power in accordance with MIL-STD-704E for 28 Vdc systems.

Operating Voltage: Model SSD120-(XX)NEH( )-RS	+12 to 30 Vdc
Operating Current:	0.055 Amps at 14Vdc 0.060 Amps at 28Vdc (0.09A max. at warm-up)
Operating Temperature:	-55° to +70°C (-67° to +158°F)
Storage Temperature (non-operating) all models:	-65° to +85°C (-85° to +185°F)
Warm-up time:	0 Seconds at -20°C (-4°F) and higher. See Figure 2 for low temp warm-up times.
Weight:	11 oz.

<sup>1</sup> SSD120-(XX)NEH-RS utilizes an 1/8-27NPT static fitting. SSD120-(XX)NEH1-RS utilizes an 1/8" tube swivel static fitting.

### **1.3.1 Limitations, Deviations & Compliance**

#### **NOTE:**

The conditions and tests for TSO approval of this article are minimum performance standards. Those installing this article, on or in a specific type or class of aircraft, must determine that the aircraft installation conditions are within the TSO standards. TSO articles must have separate approval for installation in an aircraft. This article is to be installed in accordance with 14 CFR part 43 or the applicable airworthiness requirements.

#### **NOTE:**

DO-160E lightning induced transient susceptibility tests were not conducted on this device and it is the responsibility of the installing agency to substantiate compliance with FAR25.1316. Advisory Circular AC20-136B provides guidance related to the protection of aircraft electrical systems from the effects of lightning.

#### **Deviation:**

TSO-C88a specifies RTCA/DO-160A for environmental testing. TCI utilized RTCA/DO-160E in testing this device. DO-160E provides an equivalent level of safety and meets or exceeds the standard environmental test condition requirements of TSO-C88a and DO-160A.

### **TSO/ETSO/RTCA Compliance Table**

<b>FAA TSO</b>	C88a
<b>EASA TSO</b>	C88a
<b>RTCA DO-178 Software</b>	Non-Essential Category H/W - S/W P/N: 105001rA-700002rC
<b>RTCA DO-160E Environmental*</b>	[(E1) (D1)]BAB[(SM)(UF)]XRXXXTZBBB(BC)TTBXXCAX

\*See Environmental Qualification form for specifics.

### **1.3.2 Operating Altitude**

Model	Operating Altitude Range
SSD120-30 NEH( )-RS	-1000 to +30,000 feet.
SSD120-35 NEH( )-RS	-1000 to +35,000 feet.
SSD120-42 NEH( )-RS	-1000 to +42,000 feet.
SSD120-50 NEH( )-RS	-1000 to +50,000 feet.
SSD120-62 NEH( )-RS	-1000 to +62,700 feet.
SSD120-65 NEH( )-RS	-1000 to +65,000 feet.
SSD120-80 NEH( )-RS	-1000 to +80,000 feet.

### **1.3.3 Accuracy**

Accuracy when measured from the altitude transition points of the ICAO code and referenced to 29.92 In. Hg. (1013 MB.) See **Figure 6** and **§4.0**.

**Model SSD120-(XX)NEH-RS**

Accuracy through operating temperatures as listed.

Altitude Range	Operating Temperature	Accuracy
-1000 to +42,000 ft.	-30° to +70°C	±30 ft.
42,100 to max. alt.	-30° to +70°C	±50 ft.
-1000 to +42,000 ft.	-55° to -31°C	±50 ft.
42,100 ft to max. alt.	-55° to -31°C	±75 ft.
-1000 to +42,000 ft.	-55°C after 10 min. warm-up	±30 ft.
42,100 to max. alt.	-55°C after 10 min. warm-up	±75 ft.

**1.3.4 Mechanical Characteristics**

Model Number	Dimensions
Model SSD120-(XX)NEH( )-RS	<i>See Outline Drawing</i>
Model SSD120-(XX)NEH1-RS	<i>See Outline Drawing</i>

**1.3.5 Over Range**

The SSD120-(XX)NEH( )-RS series of altitude digitizers will not be damaged when operated beyond their specified maximum altitude up to 100,000 feet MSL, (0.1581psi) or over pressured to -5000 feet (18psi) maximum.

**1.4 Parallel ICAO Altitude Data Port Specifications**

Code Format: In accordance with U.S. National Standard for Common System Component Characteristics for the IFF Mark X (SIF) Air Traffic Control Radar Beacon System, SIF/ATCRBS.

Driver Description: The parallel altitude data output is provided by the “uncommitted” collectors of a transistor array and must be “pulled-up” through a resistive load by the transponder.

Pull-Up Voltage: +3 to 40Vdc.

Maximum Sink Current: 50 mA.

Maximum Cable Length: 4000 ft. (1219 meters)

Input Signal Requirement: Pin A (strobe or signal common) must be either grounded, or connected to and controlled by the transponder.

**1.5 Serial Altitude Data Port Specifications****RS232 Ports (TxD1 and TxD2)**

Electrical Format: Conforming to the TIA/EIA RS-232C standard.

Logic Levels: “0”, +9 Vdc. Logic “1”, -9 Vdc.

Driver Output Maximum Voltage: ±25 Vdc.

Driver Load Impedance: 3KΩ typ.

The RS232E standard recommends one receiver per serial port.

Maximum Cable Length: 50 Feet. (15.24 meters)

Code Format: ASCII

Communication System: Simplex

Transmission Method: Asynchronous. (Talk only.)

Transmission Rate: Selectable, 1200 bps to 9600 bps.

Update Rate: 1/sec.

**RS485 Port (TxA and TxB)**

Electrical Format: conforming to the TIA/EIA RS485A standard.

Logic Levels: Signal A with respect to Signal B. Logic “0”, +1.5 to +6Vdc;



Logic "1" -1.5 to -6Vdc.

**NOTE:** Some RS485 equipment use (+) and (-) connection descriptors. The (-) corresponds to signal TxA and the (+) corresponds to TxB.

Driver output maximum voltage: -7 to +12 VDC

Driver load impedance: 54Ω typ.

Maximum number of receivers on one line: 32.

Maximum cable length: 4000 feet. (1219.2 meters)

Code Format: ASCII.

Communication System: Simplex (Talk Only).

Transmission Method: Asynchronous.

Transmission Rate: Selectable, 1200 bps to 9600 bps.

Update Rate: 1/sec.

### **1.6 Serial Port Altitude Data Resolution**

The default resolution of the altitude digitizer serial data is 100 feet. To enable 10-foot resolution, connect pin c of the digitizer connector to ground (see **Table IX.**) The serial port resolution may also be configured via software, see §4.5.

### **1.7 Serial Communication Format**

Model SSD120-(XX)NEH( )-RS carries out serial communication asynchronously with the "Start/Stop" system. The specifics of the format, ie. the number of data bits, baud rate etc., is determined by the protocol selected. The default message is the UPS AT/Garmin/IIMorrow at 1200bps, 8 data bits, 1 stop bit and no parity.

## **1.8 Serial Communication Protocol**

Refer to **Table IX & X** and **§4.5**

Protocol is user selectable by grounding or leaving open pin S or pin T of the digitizer connector, or by selecting protocols via software see **§4.5**.

### **1.8.1 UPS AT/Garmin AT/IIMorrow Nav. Devices**

Leaving pins S and T of the connector open results in the default protocol compatible with UPS Aviation Technologies' (IIMorrow) Navigation devices. The Digitizer will send a seventeen byte message beginning with # AL, then a space followed by five altitude bytes; the letter "T" and the sensor temperature, two checksum bytes and a carriage return. (1200bps, 8 data bits, 1 stop bit, no parity). The following is an example of the serial message for UPS AT (Garmin AT) (IIMorrow) devices.

Message	Definition
#AL +00800T+25D9 <sup>C<sub>R</sub></sup>	Altitude 800 feet

### **1.8.2 Trimble and Garmin Navigation Devices Protocol**

Grounding pin T of the connector results in a protocol compatible with some navigation devices manufactured by Trimble and Garmin. The Digitizer will send a ten-byte message. The message begins with ALT followed by a space and five altitude bytes; concluding with a carriage return. (9600bps, 8 data bits, 1 stop bit, no parity). The following are examples of serial messages for Trimble or Garmin devices:

Message	Definition
ALT 99900 <sup>C<sub>R</sub></sup>	Digitizer disabled.
ALT 10500 <sup>C<sub>R</sub></sup>	Altitude 10,500 feet

### **1.8.3 Northstar Navigation Devices Protocol**

Grounding pin S of the connector results in a protocol compatible with some navigation devices manufactured by Northstar and Garmin. The Digitizer will send a 10-byte message. The message begins with ALT followed by a space and five altitude bytes; concluding with a carriage return. (2400bps, 8 data bits, 1 stop bit, no parity.) The following are examples of serial messages for these devices:

Message	Definition
ALT 02500 <sup>C<sub>R</sub></sup>	Altitude 2500 feet.
ALT -2500 <sup>C<sub>R</sub></sup>	Digitizer disabled.

### **1.8.4 Magellan Navigation Devices Protocol**

Grounding both pins S and T of the connector results in a protocol compatible with some navigation devices manufactured by Magellan. The Digitizer sends a seventeen-byte message beginning with \$MGL, followed by a +/- sign and five altitude digits, then T+25, a checksum and concludes with a carriage return. (1200bps, 7 data bits, 1 stop bit, even parity.) The following is an example of a serial message for Magellan devices:

Message	Definition
\$MGL+02500T+250C <sup>C<sub>R</sub></sup>	Altitude 2500 feet.

### **1.8.5 ARNAV Systems Protocol**

Leaving pins S and T of the connector open, the ARNAV Systems protocol *MUST* be software selected see §4.5 for protocol selection details. Once selected, the Digitizer will send a 24-byte message. Beginning with a \$PASHS followed by a comma and ALT, then a +/- sign followed by five altitude digits (in meters,) then an asterisk and a checksum followed by a carriage return and a line feed. (9600bps, 8 data bits, 1 stop bit, no parity.) The following is an example of an ARNAV serial altitude message:

Message	Definition
STX\$PASHS,ALT,+00033*1B <sup>C<sub>R</sub></sup> <sub>F</sub> ETX	Altitude 33 meters.

### **1.8.6 UPS AT 618 Loran Devices Protocol (IIMorrow)**

Leaving pins S and T of the connector open, the UPS AT 618 Loran devices protocol *MUST* be software selected see §4.5 for protocol selection details. Once selected, the Digitizer will send a seventeen byte message beginning with # AL, then a space followed by five altitude bytes; the letter "T" and the number "25"; two checksum bytes and a carriage return. (1200bps, 7 data bits, 1 stop bit, odd parity). The following is an example of an UPS AT 618 Loran serial altitude message:

Message	Definition
#AL +00800T+25D9 <sup>C<sub>R</sub></sup>	Altitude 800 feet

### 1.8.7 One-Foot Resolution Protocol

Leaving pins S and T of the connector open, the one-foot resolution protocol *MUST* be software selected see §4.6 for protocol selection details. Once selected, the Digitizer will send a seventeen byte message beginning with RMS, then a space followed a sign, five altitude bytes; the letter "T" and the number "55"; two checksum bytes and a carriage return. (9600bps, 8 data bits, 1 stop bit, no parity). The following is an example of the one-foot resolution serial altitude message:

Message	Definition
RMS +00859T+552C <sub>R</sub>	Altitude 859 feet

### 1.9 Figure 1 - Serial Data Offset

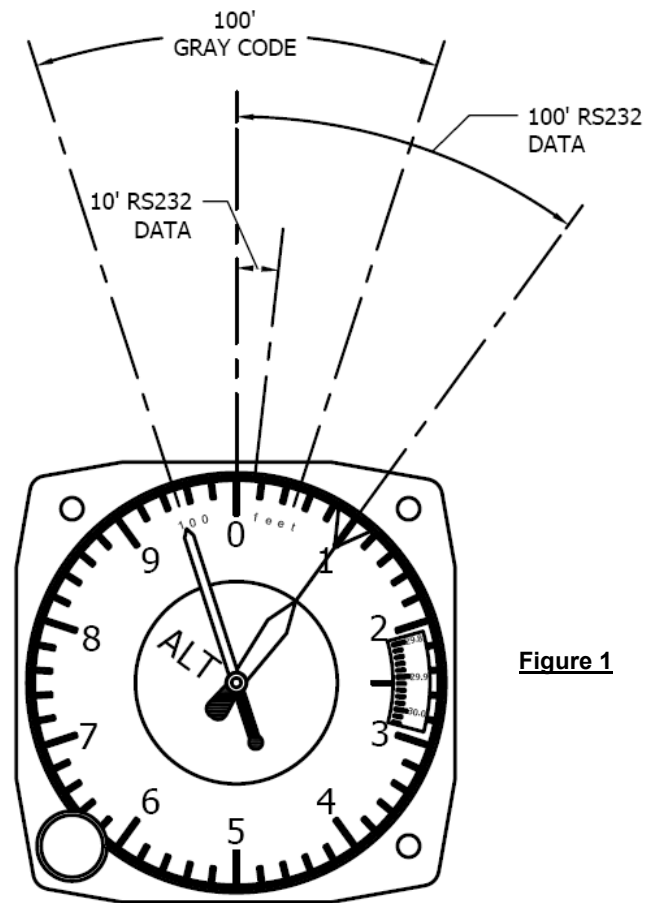
When using serial data from the altitude encoder for ADS-B or other navigational instrument installations, verify that the 10' resolution data is selected to prevent data conflicts.

It is important to note that the Serial RS232 data is offset from the parallel grey code data by 50'.

The calibration requirement for altitude encoders requires the 100' resolution grey code to transition at the 50' mark with a tolerance of  $\pm 125'$ .

**Figure 1** displays the ideal case for 11,000 feet.

The ideal altitude encoder grey code output will read 11,000' when the primary flight altimeter reads from 10,950' to 11,050' with a tolerance of  $\pm 125'$ .



**Figure 1**

The encoder's 10-foot RS232 data will output 11,000' from 11,000' to 11,010' nominally.

The encoder's 100-foot RS232 data will read 11,000' from 11,000' to 11,100' nominally.

## **Section 2.0 Operation**

### **2.1 General**

The SSD-120(XX)NEH( )-RS series of altitude digitizers are designed to be mounted within a pressurized or non-pressurized, but temperature controlled area within aircraft operating up to the maximum altitude listed on the nameplate. Usually remotely located, the digitizer is fully automatic in operation. The ICAO parallel altitude data output is controlled by the transponder while the serial altitude data is transmitted asynchronously. (Half duplex, talk only. Full duplex in calibration and configuration modes only.)

### **2.2 Operating Instructions**

#### **Parallel Data:**

Place the transponder in mode "C", altitude-reporting mode, and apply power to the transponder and to the digitizer. In some installations the digitizer will automatically be supplied power when the transponder is energized; in others, power to the digitizer may be through a separate circuit breaker. If power to the digitizer is provided directly from the aircraft's avionics buss, follow the power-up procedures recommended by the transponder manufacturer. All parallel outputs will be pulled low for a self-test (approximately 3 seconds) at power up, then assume the value for the present input pressure. In some installations, the transponder controls the digitizer by enabling and disabling its output. In other installations, the digitizer's output is not controlled by the transponder and is continuously enabled, (Digitizer pin A is grounded.)

#### **Serial Data**

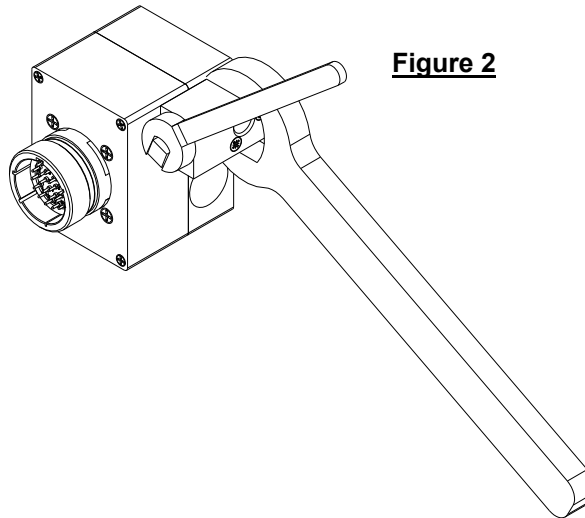
The serial communication is fully automatic and transmission begins after the self-test is complete. "Strobing" or disabling (pin A) the ICAO parallel altitude data output of the digitizer will not affect the serial data transmission.

## **Section 3.0 Installation**

### **3.1 Mechanical Installation**

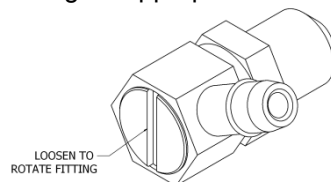
The SSD120-(XX)NEH( )-RS is to be installed in a manner consistent with the requirements of 14 CFR Part 43. Good workmanship and installation practices in accordance with the instructions given in this publication are to be observed. To verify the digitizer has been installed properly and safely, the installer should perform a visual inspection and conduct an overall operational check of the system prior to flight.

The SSD120-(XX)NEH( )-RS series of digitizer may be mounted in any attitude within the internal structure of the aircraft. DO NOT mount the digitizer in the direct air stream of either hot or cold air ducts. The mounting position should allow for a short static pressure line from the digitizer to the altimeter, access to the digitizer's connections, and ample room for a service loop for the interconnecting cabling to the transponder or other navigation devices. The SSD120-(XX)NEH( )-RS is provided with two static port inlets, either or both may be used to connect the digitizer to the aircraft static system. If only one static port inlet is used, install the 1/8-27NPT plug packaged with the Digitizer into the unused static port. Apply pipe sealant (not included) or equal to the plug. **Loctite RTV Clear Silicone Sealant (59530)** is recommended and is used to seal static line connections during all environmental testing at Trans-Cal. Exercise care to prevent excess sealant from plugging the inlet to the pressure sensor. To prevent damage to the Digitizer, use a double wrench technique to support the digitizer when installing or removing fittings.



**Figure 2**

The SSD120-(XX)NEH1-RS utilizes an 1/8" swivel tube fitting in place of 1/8-27NPT fittings. See Figure 3. Loosen the slotted screw on top of the fitting to rotate to its desired position, and then lock into place using the same screw. Attach 1/8" ID tube over the barbed hose fitting and secure using an appropriate tube clamp (not included).

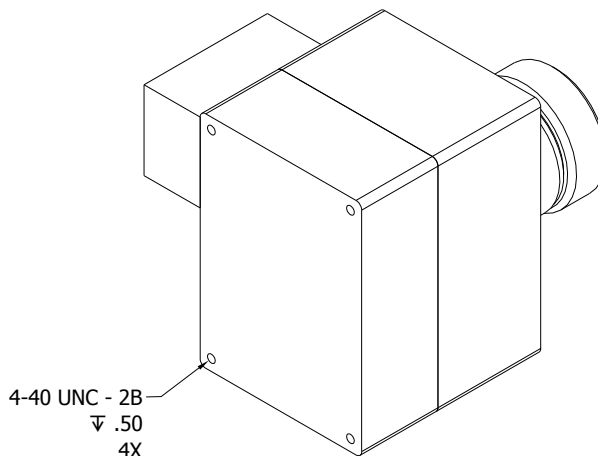


**Figure 3**

On SSD120-(XX)NEH-RS devices where the operating temperature range is expected to drop below -20°C, the use of metal fittings on all static line connections is required. The coefficient of thermal expansion for nylon is roughly three times that of aluminum. Nylon and plastic fittings will leak at low temperatures due to thermal contraction.

To prevent the accumulation of condensation in the digitizer pressure sensor, locate this device away from the lowest section of the static system, and ensure a proper condensation trap and system drain is installed and functional, reference FAR 23.1325. Also verify that the digitizer mounting is oriented in a manner to allow condensation to run away from the Digitizer's electrical connector. A suitable mating connector and back shell should be selected to resist the effects of condensation and corrosion.

Use #4-40 machine screws and lock washers to attach the digitizer to the airframe. See Figure 4 and refer to the **Outline Drawing** for mechanical dimensions and the **Mounting Accessories Drawing** for alternate installation configurations.



**Figure 4**

### **3.2 Electrical Installation**

#### **NOTE**

Proper solder or crimp techniques should be observed when attaching wires to the mating connectors. Failure to do so could result in damage, intermittent operation or non-operation of the digitizer. Wire and harnesses should be installed in such a way that the weight of the cable does not exert a force on the connector pins. Harnesses must be fully supported to prevent movement and should be protected against chaffing.

#### **CAUTION!**

AFTER INSTALLING THE WIRING HARNESS AND BEFORE INSTALLATION OF THE DIGITIZER, A CONTINUITY CHECK OF ALL WIRES IN THE HARNESS SHOULD BE MADE TO VERIFY HARNESS CONSTRUCTION. A TEST SHOULD THEN BE MADE WITH THE AIRCRAFT POWER SUPPLIED TO THE DIGITIZER'S CONNECTOR TO VERIFY POWER, GROUND AND DATA ARE ROUTED TO THE CORRECT PINS AS DETAILED IN THE **OUTLINE DRAWING** AND **TABLE IX**. REMOVE POWER BEFORE INSTALLING THE DIGITIZER.

The digitizer is designed to operate with either a +12 or +28 Vdc power source. These voltages may be A+ switched power provided by the transponder or may be provided by the avionics buss. If using the avionics buss, protect the circuit with a ¼ amp fuse or circuit breaker.

#### **Parallel Data Connection**

The **Outline Drawing** and **Table IX** provide electrical connector pin/function information. Use this data when connecting the digitizer to the transponder. In some installations where older transponders are used, the transponder may not provide an

“altitude disable” function. In this case, an instrument panel mounted switch for this function may be required.

#### Serial Data Connection

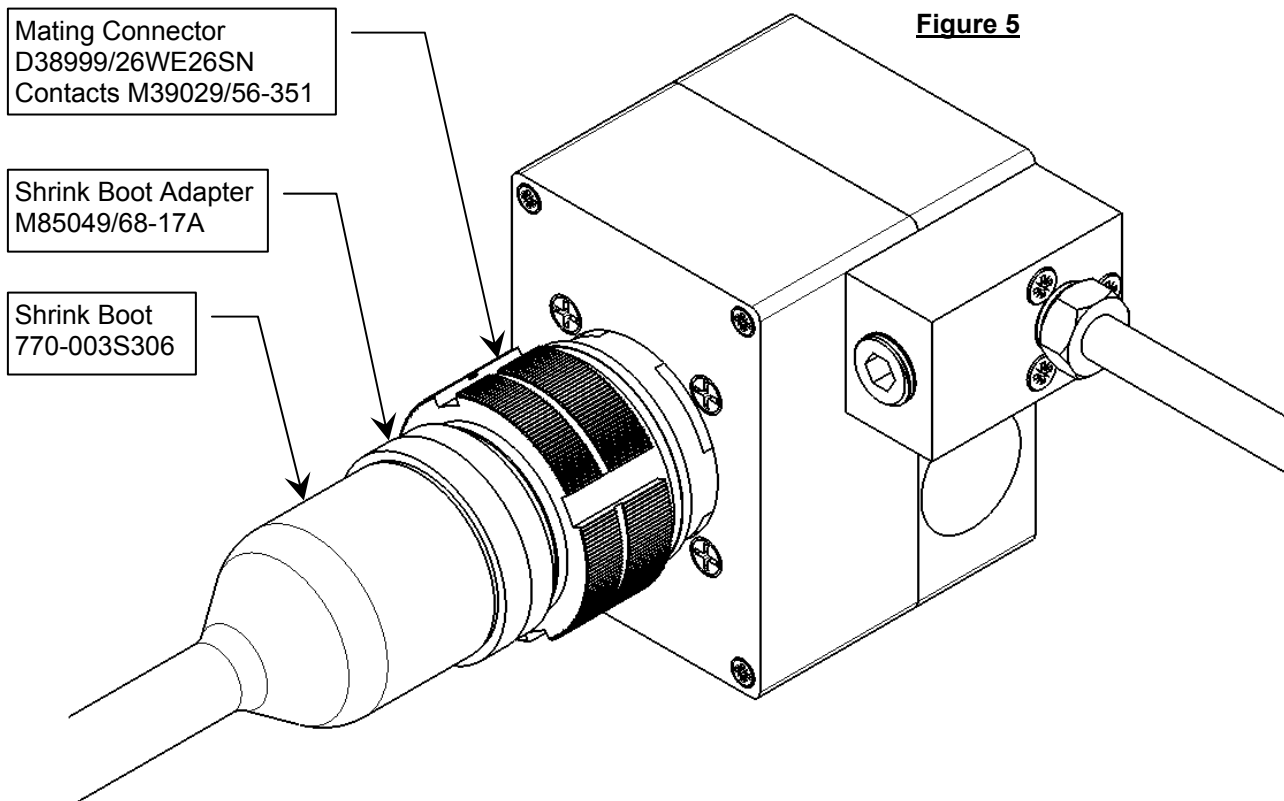
Connect the TxD1 or TxD2<sup>2</sup> (transmit data) from the digitizer connector to the RxD (receive data) port on the GPS or other navigation device. All data grounds on the digitizer connector are internally connected to ground and may be used to ground protocol pins, as well as provide data ground to the receiving GPS or other device. Pins P (TxA) and R (TxB) are RS485 outputs and should be connected to a compatible receiving device. Pin V (Rx) of the connector is used for calibration only. Shielded cable is recommended for both serial and parallel data wiring harnesses.

#### 3.2.1 Mating Connector Selection

The SSD120-(XX)NEH-RS utilizes a 26 pin MIL-DTL-38999 Series III connector with a triple start thread. (D38999/21NE26PN) A watertight mating connector harness assembly is critical to a successful installation in wet areas. Trans-Cal does not supply mating connectors, back shells, adapters or shrink boots due to the wide variety of installation variables. The “as tested” configuration is detailed in figure 5 for your reference. This mating connector was used during both water spray and icing tests at Trans-Cal.

Connector Cable Mount Socket D38999/26WE26SN  
Crimp Contacts M39029/56-351  
Shrink Boot Adapter M85049/68-17A  
Shrink Boot (Glenair) 770-003S306

**Figure 5**



<sup>2</sup>The selected serial data protocol is transmitted simultaneously on both TxD1 and TxD2, unless assigned separately via **Serial Port Software Configuration** see §4.5. The RS485 output on pins P and R will transmit the same protocol as selected for TxD1.



### **3.3 Serial Altitude Data Port Test Equipment**

The output of the serial port may, or may not be directly displayed by the GPS or other device receiving the serial data. There are several methods available to test the output of the serial port:

- a) Use a TCI Model ATS-400 Test Set to display both the RS232 and RS485 serial altitude data.
- b) Connect to an open serial port on a personal computer using serial data capture software such as PROCOMM™, VERSATERM™, SOFTWARE WEDGE™, TERMINAL (Windows® 3.x) or HYPERTERMINAL (Windows® 95, 98, 2000 or XP).
- c) Use a dedicated serial data test box such as the BLACK BOX™ RS232 Monitor.
- d) Test for serial output using an oscilloscope to view the square wave groups transmitted about once a second.

### **3.4 Parallel ICAO Altitude Data Port Test Equipment**

The output of the parallel ICAO altitude data may be monitored by any number of transponder ramp test sets, which allow display of the ICAO altitude digitizer/encoder code. The IFR Model ATC-600A Portable Transponder Test Set is one example. Alternatively, the Trans-Cal Industries' ATS-400 may be used to display the parallel data.

## **Section 4.0 Calibration and Configuration**

### **4.1 Calibration Overview**

**Reference: FAR 91.217, FAA Advisory Circular 43-6C,  
FAR 91.411, FAR 43-Appendix E and F,  
FAA TSO-C88a, EASA ETSO-C88a, SAE AS8003**

**NOTE: To ensure correspondence with all on-board pressure altitude systems, altitude digitizers that are not providing information to the ATC transponder should be tested to ensure correspondence to the primary flight altimeter, as per FAA AC43-6C.**

This procedure will allow adjustment to the calibration curve of the SSD120-(XX)NEH( )-RS as an aide in matching the Digitizer output to a primary flight altimeter or NIST traceable pressure standard. The maximum allowed error between the primary flight altimeter and the Altitude Digitizer is  $\pm 125$  feet as required by TSO-C88a and ETSO-C88a. All Trans-Cal Digitizers are calibrated to within  $\pm 50$  feet of an NIST traceable pressure standard; however, the error allowed on altimeters at higher altitudes could lead to a combined error in excess of  $\pm 125$  feet. When the Altitude Digitizer is installed in an aircraft for use as the transponder's source of mode "C" information the Digitizer must be recalibrated for correspondence to the aircraft's primary flight altimeter, as required by FAR 91.217 and 91.411. The model SSD120-(XX)NEH( )-RS are designed to be field calibrated to meet this requirement, as per the procedure described in either §4.3 or §4.7. The correspondence required for Altitude Digitizers is fully addressed in SAE Aerospace Standard AS8003 §3.11. The correspondence described by this standard requires the Digitizer to report altitude within  $\pm 125$  feet of the primary flight altimeter's reading when the pressure datum is set to 29.92 In. Hg., (1013 MB) absolute. The SAE standard also requires a transition accuracy of  $\pm 75$  feet of the nominal transition point for that altitude. A transition is defined as the point at which the Digitizer

changes from one altitude to the next, either increasing or decreasing altitude. The nominal transition point of the ICAO altitude code occurs 50 feet prior to the altitude in question. See **Figure 1**.

There are two different methods used to change the calibration of this device. The technician need only perform the method that is best suited for the application in question. *There is no need to perform both methods.*

**Method One:** The **Span Adjust** calibration (§4.3) is normally used in applications where only a slight modification is required to bring the Altitude Digitizer curve up or down. This method enters a digital correction via an IBM PC to the span and reference voltages of the Digitizer pressure sensor. These adjustments are made at 1000 feet and at the maximum rated altitude of the Digitizer.

**Method Two:** The **Dynamic Calibration** procedure (§4.7) is an alternate method used to match the Altitude Digitizer to the primary flight altimeter or NIST pressure standard. It assumes the Digitizer and altimeter are connected as shown in the **Calibration Block Diagram** and the technician may adjust the input pressure to run the Digitizer and primary flight altimeter to the same altitude and then enter this altitude into an IBM compatible computer, which will transmit the correction to the Digitizer's EEPROM. This calibration procedure differs from the **Span Adjust** procedure in that the adjustments are made at every 1000-foot interval, not just the two end points. This is a time consuming method, but it is also the most accurate method of achieving correspondence between the Digitizer and the altimeter or NIST traceable pressure standard.

#### **4.2 Required Equipment Span Adjust and Dynamic Calibration**

1. Primary Flight Altimeter or NIST traceable pressure standard.
- 2 +12 or 28Vdc power supply.
3. IBM compatible computer with an available RS232 port.
4. Digitizer/PC interface cable. (see Calibration Wiring Harness Diagram)
5. Software requirement: **Windows 98®, Windows 2000® or Windows XP®** using **Hyper Terminal Ver. 5.0** by Hilgraeve. (Available as a free download at <http://www.hilgraeve.com> ) Or equal serial data capture software. See §3.3b.
6. A pitot-static test set, capable of exercising the altimeter and Digitizer over a pressure range equivalent to -1000 feet to the maximum operating altitude of the Digitizer.
7. Optional: ATS-400 or equal device which will allow the display of the 100-foot resolution ICAO parallel altitude data.

#### **4.3 Span Adjust Procedure**

This procedure enters an error correction at a pressure equivalent to 1000 feet labeled the X parameter, and another correction at the maximum operating altitude labeled the Z parameter.

***NOTE:*** *The X and Z parameters you are about to change are compared at the factory to an NIST traceable pressure standard. Changing these settings should not be undertaken without the proper equipment and knowledge.*

**CAUTION**

**ALWAYS DETERMINE THE DESIGN LIMITS OF THE INSTRUMENTS ATTACHED TO THE STATIC SYSTEM. LOCATE AND IDENTIFY ALL INSTRUMENTS ATTACHED TO THE SYSTEM AND REFER TO THE MANUFACTURER'S DATA FOR MAXIMUM RATE OF CLIMB OR DESCENT, AND ANY SPECIAL TEST CONDITIONS WHICH MUST BE COMPLIED WITH TO PREVENT DAMAGE.**

1. Construct a harness as per the **Calibration Wiring Harness Diagram**.
2. Connect the pitot-static test equipment, Altitude Digitizer, computer, flight altimeter and/or NIST standard as shown in the **Calibration Block Diagram**.
3. Apply power to the equipment.
4. Set the primary flight altimeter barometric pressure adjustment to 29.92 In. Hg. (1013 MB).
5. Open the RS232 capture program or **Hyper Terminal** program as described in §4.4. Altitude data should be displayed on the computer with ten-foot resolution.
6. Reduce the input pressure to the *maximum* operating altitude of the Digitizer and compare the output, as displayed on the computer, to the altimeter or pressure standard.
7. Calculate the Digitizer Error Correction for the Z parameter as follows:

**(Digitizer Output – Altimeter Reading) (0.1) = Z Parameter**

For Example: The flight altimeter reads **62,000** feet and Digitizer reads **61,910**. The Z parameter error correction required is equal to  $(61910-62000)(0.1) = -9$

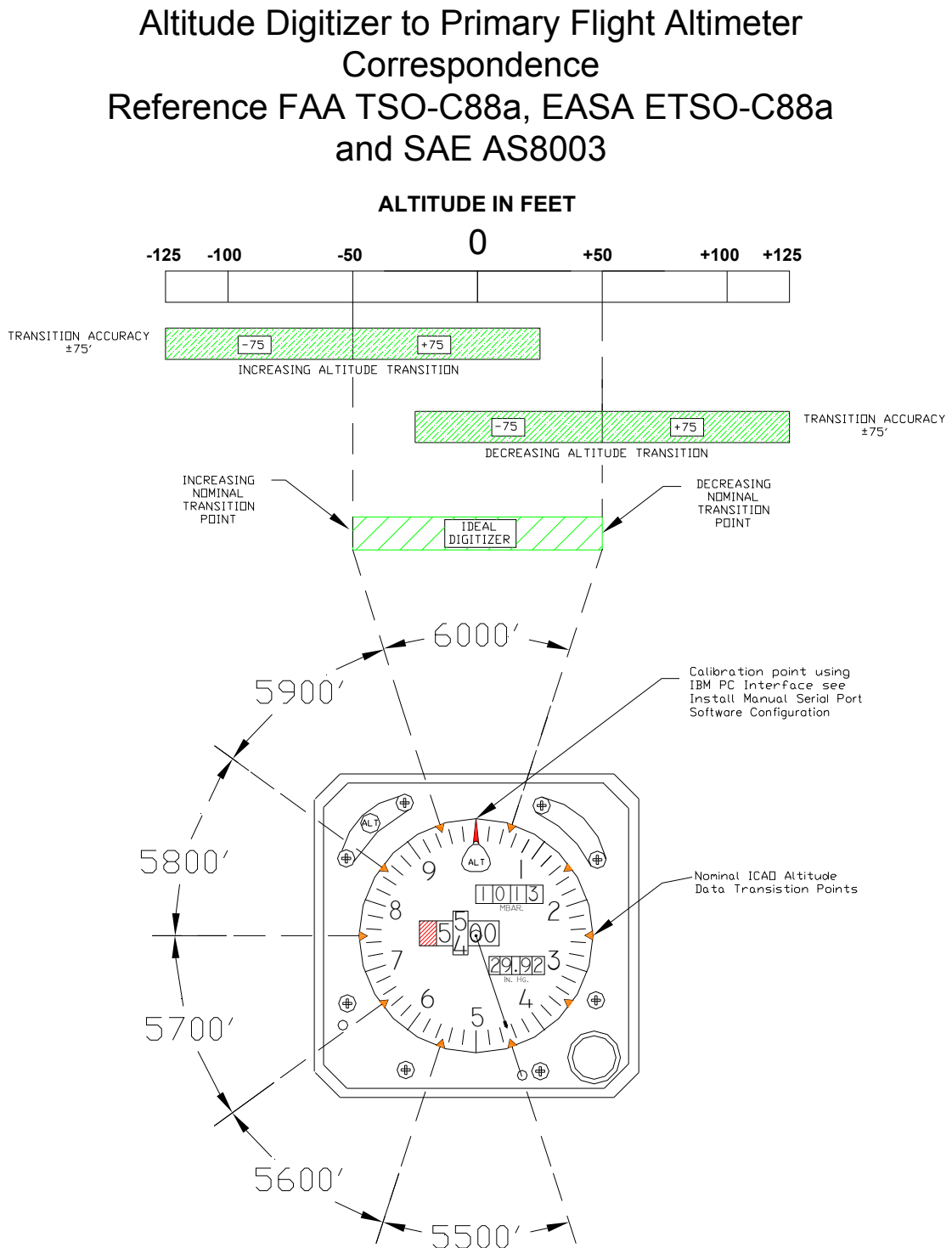
8. Strike the **<enter>** key or any other key on the computer. **?<current pressure altitude>** should appear on the computer display.
9. Type **XD<enter>**. This will access the **Span Adjust** mode of the Digitizer and **XD=** should be displayed on the computer.
10. Type **\*00Z=<enter>**. The Digitizer will display the current factory Z parameter setting on the computer. **Write this value down before you change it!**
11. To change the **Z** parameter type **\*00WE<enter>**. This will "write enable" the Digitizer EEPROM.
12. Enter the desired Digitizer Error Correction as **\*00Z=N<enter>** Where **N** is equal to the error correction you have calculated as in step 7. (No sign required for positive values.) For example type **\*00Z=-9<enter>** to enter a -9 correction to the Z parameter.
13. Exit the adjustment program by typing **Q Q** and compare the current Digitizer output to the altimeter reading. If the Digitizer output is within  $\pm 25$  feet of the altimeter proceed to the next step. If not, then return to step 7 and repeat the Z parameter adjustment.
14. Increase the input pressure until equivalent to 1000 feet, and compare the Digitizer output, as displayed on the computer, to the altimeter.
15. Calculate the X Parameter Digitizer Error Correction as follows:

**(Digitizer Output – Altimeter Reading) = X Parameter Digitizer Error Correction**

For Example: The flight altimeter reads **1,000** feet and Digitizer reads **990**. The Digitizer X parameter error correction required is equal to  $990 - 1,000 = -10$

16. Type **<enter>** until the computer displays **?(current pressure altitude)**.
17. Type **XD<enter>** the computer will display an **XD=**.
18. Type **\*00X=<enter>** The Digitizer will display the current factory X parameter setting on the computer. ***Write this value down before you change it!***
19. To change the **X** parameter type **\*00WE<enter>**. This will “write enable” the Digitizer EEPROM.
20. Enter the desired X parameter correction as **\*00X=N<enter>** Where **N** is equal to the error correction you have calculated as in step 15. (No sign required for positive values.)
21. Exit the adjustment program by typing **Q Q** and compare the current Digitizer output to the altimeter reading. If the Digitizer output is within  $\pm 20$  feet of the altimeter proceed to the next step. If not, then return to step 15 and repeat the **X** parameter adjustment.
22. The **X** and **Z** parameters do slightly affect one another. Adjust the input pressure to verify the maximum digitizer altitude is still within  $\pm 25$  feet of the altimeter reading. If an adjustment is required repeat the **Z** and **X** parameter adjustment procedure.
23. Exercise the aircraft’s static system over the operating range of the Altitude Digitizer and, with increasing and decreasing pressure, verify at a minimum of ten test points that the Altitude Digitizer and primary flight altimeter correspond within a  $\pm 125$  foot tolerance. Lightly tap the altimeter before each reading to eliminate error due to friction. If correspondence is not achieved at any test point, the altimeter may require calibration.
24. After verifying the Digitizer and the altimeter are within tolerance type **<enter>** The computer should display a **?(current pressure altitude)**.
25. Type **XD<enter>** The computer should display **XD=**
26. Type **\*00SP=ALL<enter>** This command will store the parameter changes entered above.
27. Type **Q Q** to exit and resume normal operation.

**NOTE: The X and Z changes entered in this procedure will not be stored if power is interrupted during the procedure or if the \*00SP=ALL<enter> command is not completed!**

**Figure 6 Altitude Digitizer Correspondence**

#### **4.4 Hyper Terminal Set-Up on the IBM Compatible PC**

Boot up the computer and start the serial data capture software such as the **Hyper Terminal** program. **Hyper Terminal** may be located in the **Programs** section or in the **Accessories** section under **Communications**, and Hyper Terminal will be used for the balance of the examples used in this manual.

Under the **New Connection** window:

Choose an icon then select an identifying title such as "Test."  
Select **OK** after you have made your choices.

Under the **Connect to** window:

-Choose **Connect Using Com 1** or whatever **Com** port you have chosen to use. After your selection click on **OK**.

Under the **Com ? Properties** window:

Select the **Port Settings** tab and set the following:

Bits per second:	<b>9600</b>
Data bits:	<b>8</b>
Parity:	<b>None</b>
Stop Bits:	<b>1</b>
Flow Control:	<b>None</b>

Select **OK**

In the **Hyper Terminal** window select **File** then click on **Properties**.

Under the **Com ? Properties** window click on the **Settings** tab.

Set the following:

Function, arrow, ctrl keys to act as **Terminal Keys**.  
Emulation to **Auto Detect**

Under **ASCII Setup**

Set the following:

**Echo off.**  
**Wrap lines that exceed terminal width.**  
Select **OK**.

The software is now configured for operation.

**NOTE:** Past versions (Ver. 5 thru 6) of HyperTerminal have a known issue when communicating with serial protocols of 7 data bits, 1 stop bit, odd parity. This Windows® program will not correctly auto detect the protocol, but will display the data when manually configured.

#### **4.5 Serial Port Software Configuration**

The SSD120-(XX)NEH( )-RS incorporates two separate RS232 compatible outputs, which may be configured via software to transmit two (2) different altitude data protocols simultaneously. The RS485 port will transmit the same protocol as assigned to TxD1.

Connect the digitizer to an IBM compatible computer running **HyperTerminal** as described in §4.4 and as shown in the **Dynamic Calibration Block Diagram**. Assign the serial port protocols as follows:

Apply power to the digitizer and after the self-test time has elapsed, altitude data will appear on the PC screen.

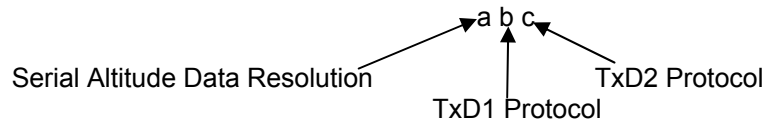
Type **<enter>** The digitizer will respond with **?>(current altitude)**

Type **ADJ<enter>** This command accesses the digitizer adjustment program.

The Digitizer responds **A=**

Type **P<enter>** To identify the current serial port settings.

The digitizer will respond with a three-digit number as follows:



1. The first digit represents the serial altitude data resolution.
  - 0 = Use D-Sub connector protocol hardware jumpers.
  - 1 = 100 foot resolution on all serial data outputs.
  - 2 = 10 foot resolution on all serial data outputs.
2. The second digit represents the protocol selection for TxD1 and the RS485 output.
  - 0 = Use D-Sub connector protocol hardware jumpers.
  - 1 = UPS Aviation Technologies. 1200bps.
  - 2 = Trimble/Garmin. 9600bps.
  - 3 = Northstar. 2400bps.
  - 4 = Magellan, 1200bps.
  - 5 = ARNAV, 9600bps.
  - 6 = UPS AT 618 Loran 1200 bps. (IIMorrow)
3. The third digit represents the protocol selection for TxD2.
  - 0 = Use D-Sub connector protocol hardware jumpers.
  - 1 = UPS Aviation Technologies. 1200bps.
  - 2 = Trimble/Garmin. 9600bps.
  - 3 = Northstar. 2400bps.
  - 4 = Magellan, 1200bps.
  - 5 = ARNAV, 9600bps.
  - 6 = UPS AT 618 Loran 1200 bps. (IIMorrow)

##### **Software Configuration Example: Type P215<enter>**

Defined as **10 foot** resolution on all serial data outputs.

**UPS Aviation Technologies** protocol transmitted on TxD1 and the RS485 port.

**ARNAV Systems** protocol transmitted on TxD2.

#### **4.6 Serial Port One-Foot Resolution Configuration**

The SSD120-(XX)NEH( )-RS incorporates two separate RS232 compatible outputs. The TxD2 output may be configured via software to transmit one-foot resolution altitude data protocol via the following procedure.

Connect the digitizer to an IBM compatible computer running **HyperTerminal** as described in §4.4 and as shown in the **Calibration Block Diagram**. Assign the TxD2 serial port protocol as follows:

Apply power to the digitizer and after the self-test time has elapsed, altitude data will appear on the PC screen.

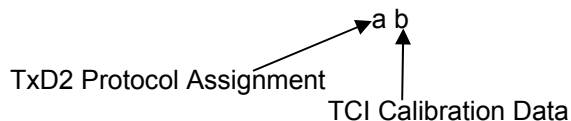
Type **<enter>** The digitizer will respond with **?(current altitude)**

Type **TCICAL<enter>** This command accesses the digitizer adjustment program.

The Digitizer responds **T=**

Type **P<enter>** To identify the current port settings.

The digitizer will respond with a two-digit number as follows:



The first digit represents the serial altitude data resolution protocol on TxD2.

1 = TxD2 standard resolution 10' or 100'.

2 = TxD2 One-Foot Resolution Protocol.

The second digit represents TCI Calibration data and is factory set to 2.

Software Configuration Example: Type **P22<enter>**

Defined as **One-foot** resolution protocol on TxD2 only.

Type **QQ** to exit the configuration mode and return to normal operation.

*NOTE: This change will lock the protocol assignment for TxD2. Jumpers on the connector and software settings will affect TxD1 and the RS485 port only.*



#### **4.7 Dynamic Calibration Adjustment Procedure**

**Reference: FAR 91.217; FAA Advisory Circular 43-6C  
FAR 91.411; FAR 43-Appendix E and F  
FAA TSO-C88a, EASA ETSO-C88a, SAE AS8003**

**NOTE: To ensure correspondence with all on-board pressure altitude systems, altitude digitizers that are not providing information to the ATC transponder should still be tested to ensure correspondence to the primary flight altimeter, as per FAA AC43-6C.**

This procedure will allow adjustment to the calibration curve of the SSD120-(XX)NEH( )-RS as an aide in matching the Digitizer output to a primary flight altimeter or NIST traceable pressure standard. This procedure differs significantly from the **Span Adjust Procedure** described in §4.3. The **Dynamic Calibration Procedure** makes adjustments to the altitude data stored in the Digitizer's EEPROM. The technician may make adjustments to the Digitizer error curve in 1000 foot increments, over the entire operating range with the single exception of the -1000 foot mark. The technician will make these adjustments at the 0 or whole altitude mark, **NOT** at the parallel data's nominal transition point. See **Figure 1**. The Digitizer will automatically adjust the ICAO parallel altitude data to transition 50 feet prior to the 0 mark. (i.e. the Digitizer's ICAO parallel altitude code will transition from 900 to 1000 feet while the serial altitude data is transmitting 950 feet.)

#### **CAUTION**

**ALWAYS DETERMINE THE DESIGN LIMITS OF THE INSTRUMENTS ATTACHED TO THE STATIC SYSTEM. LOCATE AND IDENTIFY ALL INSTRUMENTS ATTACHED TO THE SYSTEM AND REFER TO THE MANUFACTURER'S DATA FOR MAXIMUM RATE OF CLIMB OR DESCENT, AND ANY SPECIAL TEST CONDITIONS WHICH MUST BE COMPLIED WITH TO PREVENT DAMAGE.**

1. Construct a wiring harness per the **Calibration Wiring Harness Diagram**.
2. Connect the Digitizer, computer and altimeter or NIST standard as shown in the **Calibration Block Diagram**, and energize.
3. Open the **Hyper Terminal** program as described in §4.4.
4. The Digitizer output should now be displayed on the PC screen with 10-foot resolution.
5. (You may use the **Hyper Terminal "Clear Screen"** function to remove any extra characters that may be cluttering the screen. Click on **Edit** then click on **Clear Screen**.)

**NOTE: Backspace does not function in Hyper Terminal. If a typing error occurs, hit Q and begin again.**

6. Set the altimeter barometric input to 29.92 In. Hg. Increase the input pressure to -1000 feet and begin to compare the Altitude Digitizer output, as displayed on the computer, to the altimeter reading at every 1000-foot mark. When the Digitizer output begins to differ from the altimeter by more than ±30 feet begin to change the Digitizer error curve. (§4.9 provides a table to record the changes entered.)

**NOTE: No Digitizer correction is possible at the -1000 foot mark.**

7. Type **<enter>** the Digitizer will respond with **?>(current altitude)**.
8. Type **ADJ <enter>** the Digitizer will respond with **A=**.
9. Adjust the input pressure until the altimeter or NIST standard is exactly reading a 1000-foot mark. Note the difference between the Digitizer and the altimeter and adjust as follows.

**Example:**

The altimeter reads 10,000 and the Digitizer reports 10,080. Type **"S10 <enter>"** (**S10** represents **Set 10,000 feet**) The Digitizer will now output 10,000 feet based on the current input pressure. The PC will display the altitude at which the Digitizer will make this change. In the example referenced above, the PC would display **>10000**.

10. Proceed to the next 1000-foot mark and repeat the procedure, as in step 9 above, until the entire operating range of the Digitizer is completed.

**NOTE:**

- a) If no correction is required at an altitude simply do not enter a correction.
- b) Do not adjust the X or Z parameters during this procedure.
- c) You may quit the adjustment program at any time by typing **Q Q** ; the Digitizer output will then be displayed on the PC screen in normal operation mode.

11. After completing the above procedure you may examine the corrections entered into the EEPROM. Type **"D<enter>"** to display the EEPROM data and read the current error curve on the PC screen. The following table should appear:

00= 000	01= 000	02= 000	03= 000	04= 000	05= 000
06= 000	07= 000	08= 000	09= 000	10= 000	11= 000
12= 000	13= 000	14= 000	15= 000	16= 000	17= 000
18= 000	19= 000	20= 000	21= 000	22= 000	23= 000
24= 000	25= 000	26= 000	27= 000	28= 000	29= 000
30= 000	31= 000	32= 000	33= 000	34= 000	35= 000
36= 000	37= 000	38= 000	39= 000	40= 000	41= 000
42= 000	43= 000	44= 000	45= 000		
90= 000	91= 000	92= 000	93= 000	94= 000	95= 000
96= 000	97= 000	98= 000	99= 000		

>current altitude

The first two digits represent altitude x1000 feet and the last three digits after the equal sign represent the amount of error introduced at the altitude in feet.

**NOTE:** Fields **90 = 000** through **99 = 000** contain TCI calibration data and are not user accessible.

## 4.8 Configuration and Calibration Command List

Following is a list of commands, which will operate in the **ADJ**, the **XD** and the **TCICAL** mode.

Top-Level Menu Commands	Action
<b>XD &lt;enter&gt;</b>	Enter <b>Span Adjust</b> mode.
<b>ADJ &lt;enter&gt;</b>	Enter <b>Dynamic Calibration</b> mode.
<b>TCICAL&lt;enter&gt;</b>	Enter <b>TCICAL</b> mode.
<b>Q</b>	<b>Quit</b> and resume normal operation.

Sub-Menu XD Mode Commands	Action
<b>*00WE&lt;enter&gt;</b>	<b>Write Enable</b> Digitizer EEPROM.
<b>*00X=&lt;enter&gt;</b>	<b>Display</b> current X parameter setting.
<b>*00X=N&lt;enter&gt;</b>	<b>Enter</b> new X parameter setting. <i>N is a calculated value, see §4.3.</i>
<b>*00Z=&lt;enter&gt;</b>	<b>Display</b> current Z parameter setting.
<b>*00Z=N&lt;enter&gt;</b>	<b>Enter</b> new Z parameter setting. <i>N is a calculated value, see §4.3.</i>
<b>*00SP=ALL&lt;enter&gt;</b>	<b>Store Parameters</b> in EEPROM.
<b>Q</b>	<b>Quit</b> and return to top level commands.

Sub-Menu ADJ Mode Commands	Action
<b>CLR &lt;enter&gt;</b>	<b>Clear</b> all EEPROM data.
<b>D &lt;enter&gt;</b>	<b>Display</b> to list all EEPROM error correction data.
<b>P &lt;enter&gt;</b>	Displays current serial <b>Port</b> settings, see §4.5 <b>Serial Port Software Configuration</b> .
<b>Pabc&lt;enter&gt;</b>	<b>Port</b> protocol assign, see §4.5 <b>Serial Port Software Configuration</b> .
<b>Q</b>	<b>Quit</b> and return to top-level commands.
<b>Saa&lt;enter&gt;</b>	<b>Set</b> Digitizer to 1K altitude ( <b>aa</b> ) mark at current input pressure. See §4.7 <b>Dynamic Calibration Adjustment Procedure</b> .

Sub-Menu TCICAL Mode Commands	Action
<b>P&lt;enter&gt;</b>	Displays current serial <b>Port</b> settings, see §4.6 <b>Serial Port One-Foot Resolution Configuration</b> .
<b>Pab&lt;enter&gt;</b>	<b>Port</b> protocol assign, see §4.6 <b>Serial Port One-Foot Resolution Configuration</b> .
<b>Q</b>	<b>Quit</b> and return to top-level commands.

### NOTE:

1. Backspace does not function. If a typing error occurs hit **Q** and begin again.
2. Altitude values 90 to 99 in EEPROM contain factory calibration data and are not customer accessible.
3. A maximum error of  $\pm 499$  feet may be introduced at any one altitude.
4. **CLR** clears all error data in the EEPROM, and returns the Digitizer to the original factory calibration.
5. **ERR** indicates a syntax error.

**4.9 Error Correction Table**

Altitude	Correction	Altitude	Correction	Altitude	Correction
-1000		34000		70000	
0		35000		71000	
1000		36000		72000	
2000		37000		73000	
3000		38000		74000	
4000		39000		75000	
5000		40000		76000	
6000		41000		77000	
7000		42000		78000	
8000		43000		79000	
9000		44000		80000	
10000		45000		81000	
11000		46000			
12000		47000			
13000		48000			
14000		49000			
15000		50000			
16000		51000			
17000		52000			
18000		54000			
19000		55000			
20000		56000			
21000		57000			
22000		58000			
23000		59000			
24000		60000			
25000		61000			
26000		62000			
27000		63000			
28000		64000			
29000		65000			
30000		66000			
31000		67000			
32000		68000			
33000		69000			

## Section 5.0 Tables I through X Digitizer Interconnection

The following digitizer interconnections are provided as a quick reference only, and though they are correct to the best of our knowledge, always consult the latest installation, operation, and service bulletins from the equipment manufacturer.

**Table I Bendix/King**

SSD120 Conn.	Function	Bendix/King KT73 Pin Number	Bendix/King KT76/78 Pin Number	Bendix/King KT76A/78A Pin Number	Bendix/King KXP Pin Number	Bendix/King KXP 755 Pin Number
L	D4	8	*3	*4	V	X
K	A1	M	6	M	G	A
J	A2	K	7	K	H	D
H	A4	J	9	J	J	k
G	B1	E	4	E	K	f
F	B2	C	1	C	L	g
E	B4	B	2	B	M	Y
D	C1	D	3	D	P	U
C	C2	L	8	L	R	T
B	C4	H	10	H	S	W
A	Output Enable	Connect to aircraft ground.	Connect to aircraft ground.	Connect to aircraft ground.	Connect to aircraft ground.	Connect to aircraft ground.
a	14 to 28Vdc Input.	Connect to aircraft's avionics buss protected by a fuse or circuit breaker.	Connect to aircraft's avionics buss protected by a fuse or circuit breaker.	Connect to aircraft's avionics buss protected by a fuse or circuit breaker.	Connect to aircraft's avionics buss protected by a fuse or circuit breaker.	Connect to aircraft's avionics buss protected by a fuse or circuit breaker.
b	Ground	Connect to aircraft ground.	Connect to aircraft ground.	Connect to aircraft ground.	Connect to aircraft ground.	Connect to aircraft ground.

### Serial Data Connection for the Bendix/King KT 73 Transponder

SSD120-(XX)NEH-RS Conn.	Function	KT 73 24 Pin Conn.
U or X	TxD to Rx D	7
N, W, Y, or Z	Data Ground	1 or A
Software select protocol. Select UPSAT 618 Protocol.		

### Bendix/King (Honeywell) KT 73 Transponder with Serial Altitude Data Input

<sup>3</sup> Data for this connection is not available at this time.

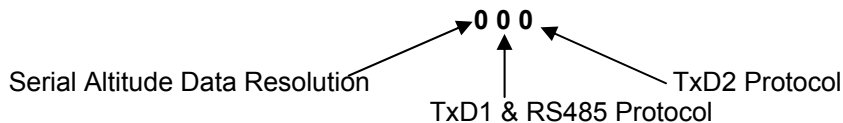
The KT 73 must be configured to accept serial altitude data on pin 7 of the main connector, and software configured for *High Resolution M* (IIMorrow). 1200bps, 7 data bits, 1 stop bit and odd parity.

The Trans-Cal SSD120-(XX)NEH( )-RS must be software configured to transmit the correct serial data protocol to the Bendix/King KT 73 transponder as described below.

1. Connect the SSD120 to an IBM compatible computer running **HyperTerminal** as described in §4.4 and as shown in the **Calibration Block Diagram**. Assign the serial port protocols as follows:
2. Apply power to the digitizer and after the self-test time has elapsed, altitude data will appear on the PC screen.

Type: <enter>	The SSD120 will respond with ?>(current altitude)
Type: ADJ<enter>	Accesses the SSD120 adjustment program. The digitizer will respond with A=
Type: P<enter>	Identifies the current serial port settings. Default factory setting is 000.

The SSD120 will respond with a three-digit number as follows:



*The first digit represents the serial altitude data resolution.  
The second digit represents protocol selection for TxD1 & RS485.  
The third digit represents protocol selection for TxD2.*

Type: P266<enter>	This selects 10' resolution and transmits the IIMorrow data format/message on serial data outputs.
-------------------	--

Type: P<enter>	The digitizer should return <b>266&gt;current altitude</b> . This confirms the change has been stored in the EEPROM.
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Type: QQ	The encoder is now configured to transmit the 10' resolution IIMorrow protocol on both TxD1 (pin U) and RS485 (Pins P & R) and TxD2 (Pin X). <b>REMOVE ALL PROTOCOL JUMPERS FROM THE SSD120-(XX)NEH( )-RS CONNECTOR!</b>
----------	--

**Table II Cessna, Narco, Microair**

<b>SSD120 Conn.</b>	<b>Function</b>	<b>Cessna RT359A, RT459A, RT859A Pin Number</b>	<b>Narco AT-150 AT-50, AT-50A Pin Number</b>	<b>Narco AT-6A AT-5, AT-6 Pin Number</b>	<b>Microair T2000</b>
<b>L</b>	D4	10	*4	*4	21
<b>K</b>	A1	14	7	2	9
<b>J</b>	A2	13	6	4	10
<b>H</b>	A4	15	8	8	11
<b>G</b>	B1	19	12	9	12
<b>F</b>	B2	17	10	10	13
<b>E</b>	B4	16	9	11	17
<b>D</b>	C1	21	14	1	18
<b>C</b>	C2	18	11	3	19
<b>B</b>	C4	20	13	5	20
<b>A</b>	Output Enable	11	5	12	Connect to aircraft ground.
<b>a</b>	14 to 28Vdc Input	9	18	13	2
<b>b</b>	Ground	Connect to aircraft ground.	Connect to aircraft ground.	14	Connect to aircraft ground.

**Narco AT-50 and AT-50A Installations**

The Narco AT-5A, AT-6A, AT-50 or AT-50A transponder will not accept data from the SSD120-(XX)NEH( )-RS Altitude Digitizer. A modification to remove the output decoupling capacitors is required and the unit may be ordered from the factory with this modification. Order Model Number SSD120-(XX)NEH( )-RS with Mod 1.

Please note! The Narco AT-50 and earlier transponder models require a modification before they will function correctly with any altitude encoder. This modification is outlined in Narco Service Bulletin AT-50A-5.

<sup>4</sup> Data for this connection is not available at this time.

**Table III Garmin**

SSD120 Conn.	Function	Garmin GTX 320 & 327 Pin Number	Garmin GTX 330 & 330D Pin Number	Garmin GNC 300 Pin Number	
<b>L</b>	D4	18	11	N/C <sup>5</sup>	
<b>K</b>	A1	3	2	15	
<b>J</b>	A2	5	4	16	
<b>H</b>	A4	6	5	17	
<b>G</b>	B1	9	7	18	
<b>F</b>	B2	11	9	19	
<b>E</b>	B4	12	10	20	
<b>D</b>	C1	10	8	21	
<b>C</b>	C2	4	3	22	
<b>B</b>	C4	7	6	23	
<b>A</b>	Output Enable	13 or 25 or aircraft ground	50	Connect to aircraft ground	
<b>a</b>	14 to 28Vdc Input	14 to 28VDC Input	Pin 62 through a 3 amp 50V reverse rated diode.	Connect to aircraft's avionics buss protected by a fuse or circuit breaker.	
<b>b</b>	Ground	Connect to aircraft ground.	Connect to aircraft ground.	Connect to aircraft ground.	

<sup>5</sup> Data for this connection not available at this time.



**Table IV Garmin****Serial Data Connection for the Garmin GTX327 Transponder**

<b>SSD120-(XX)NEH-RS Connector Pin</b>	<b>Function</b>	<b>GTX327 25 Pin Connector</b>
<b>U or X</b>	TxD to RxD	19
<b>N or W or Y or Z</b>	Data Ground	13 or 25
Protocol: connect pin <b>T</b> to ground. Connect pin <b>c</b> to ground for 10' resolution.		

**Serial Data Connection for the Garmin GTX330 and 330D Transponder**

<b>SSD120-(XX)NEH-RS Connector Pin</b>	<b>Function</b>	<b>GTX330 62 Pin Connector</b>
<b>U or X</b>	TxD to RxD	24 (RS232 In 2)
<b>N or W or Y or Z</b>	Data Ground	DataGround
Protocol: connect pin <b>T</b> to ground. Connect pin <b>c</b> to ground for 10' resolution.		

To allow the **Garmin GTX 327, 330 and 330D** transponders to communicate with the SSD120-(XX)NEH( )-RS go to the **Setup Page** and set the **Altitude Source (ALT SRC)** to receive data in the **Icarus RS232** format.

**Table V Edo-Air, Genave, Collins, Radair**

<b>SSD120 Conn.</b>	<b>Function</b>	<b>Edo-Air RT-777 Pin Number</b>	<b>Genave Beta 5000 Pin Number</b>	<b>Collins TDR 950 Pin Number</b>	<b>Radair 250 Pin Number</b>
<b>L</b>	D4	15	0	3	15
<b>K</b>	A1	7	4	12	7
<b>J</b>	A2	5	5	10	6
<b>H</b>	A4	3	6	7	13
<b>G</b>	B1	12	7	6	9
<b>F</b>	B2	13	8	5	10
<b>E</b>	B4	14	9	4	11
<b>D</b>	C1	8	10	8	14
<b>C</b>	C2	6	11	11	16
<b>B</b>	C4	4	12	9	12
<b>A</b>	Output Enable	2	3	Connect to aircraft ground.	19
<b>a</b>	14 to 28Vdc Input	Connect to aircraft's avionics buss protected by a fuse or circuit breaker.	2	Connect to aircraft's avionics buss protected by a fuse or circuit breaker.	22
<b>b</b>	Ground	2	Connect to aircraft ground.	Connect to aircraft ground.	Connect to aircraft ground.

**Table VI Bendix, Wilcox, UPS AT**

SSD120 Conn.	Function	Bendix TPR-2060 Pin Number	Bendix TR641A/B Pin Number	Wilcox 1014A Pin Number	UPS AT Apollo SL70 Pin Number
<b>L</b>	D4	*6	N	C	35
<b>K</b>	A1	4	A	k	13
<b>J</b>	A2	6	B	c	31
<b>H</b>	A4	8	C	W	12
<b>G</b>	B1	9	D	T	33
<b>F</b>	B2	10	E	L	14
<b>E</b>	B4	11	F	D	32
<b>D</b>	C1	3	H	P	16
<b>C</b>	C2	5	J	f	34
<b>B</b>	C4	7	K	Z	15
<b>A</b>	Output Enable	Connect to aircraft ground.	Connect to aircraft ground.	Connect to aircraft ground.	Connect to aircraft ground.
<b>a</b>	14 to 28Vdc Input	Connect to aircraft's avionics buss protected by a fuse or circuit breaker.	Connect to aircraft's avionics buss protected by a fuse or circuit breaker.	Connect to aircraft's avionics buss protected by a fuse or circuit breaker.	Connect to aircraft's avionics buss protected by a fuse or circuit breaker.
<b>b</b>	Ground	Connect to aircraft ground.	Connect to aircraft ground.	Connect to aircraft ground.	Connect to aircraft ground.

**Serial Altitude Data Connection for the Apollo SL70 Transponder**

SSD120-(XX)NEH-RS Connector Pin	Function	UPS AT SL70
<b>U or X</b>	TxD to Rx D	4
<b>N or W or Y or Z</b>	Ground	3

*Optional: Connect pin c to ground for 10' resolution.*

To allow the **UPS AT SL70** transponder to accept serial data from the SSD120-(XX)NEH( )-RS go to the **Test Mode** on the **SL70 Conf** page and set the **Altitude Source (ASrc)** to receive **Serial (Ser)** data. On the **BAUD** page select **1200**.

<sup>6</sup> Data for this connection is not available at this time.

**Table VII Becker, Terra, Trig**

SSD120 Conn.	Function	Becker Avionic Systems ATC3401 ATC2000	Becker Avionic Systems ATC4401	Terra TRT-250 TRT-250D	Trig TT31 Mode S
L	D4	23	20	9	8
K	A1	16	1	5	M
J	A2	15	2	17	K
H	A4	14	3	16	J
G	B1	17	14	15	E
F	B2	19	15	2	C
E	B4	18	16	14	B
D	C1	22	17	3	D
C	C2	21	18	4	L
B	C4	20	19	18	H
A	Output Enable	24	25	12	Connect to aircraft ground.
a	+14 to 28Vdc	6	6	20	Connect to aircraft's avionics buss protected by a fuse or circuit breaker.
b	Ground	24	25	Connect to aircraft ground.	Connect to aircraft ground.

**Serial Altitude Data Connection for the Trig TT31 Transponder**

SSD120-(XX)N-RS232 9 Pin Conn.	Function	Trig TT31
U or X	TxD to RxD	7
N or W or Y or Z	Ground	A or 1
<i>Digitizer protocol pins c and T should be connected to ground. Unless software selected in the TCI digitizer set-up.</i>		

The TT31 will accept either parallel or serial altitude data inputs in either the Trimble/Garmin or the one-foot "RMS" data formats. The TT31 will select the parallel inputs if both are connected. Serial data inputs are recommended for better Mode S data resolution. Ground pin c to select 10-foot resolution. See §1.8.7 to select the one-foot resolution data

**Table VIII Honeywell**

<b>SSD120 Conn.</b>	<b>Function</b>	<b>Honeywell Bendix/King 560EGPWS &amp; MK XXI EGPWS</b>	<b>Honeywell Bendix/King KGP 860 GA-EGPWS</b>	<b>Honeywell Bendix/King KMH 870 IHAS Processor</b>
<b>L</b>	D4	No connection	No Connection	18
<b>K</b>	A1	12	J1-12	11
<b>J</b>	A2	52	J1-52	10
<b>H</b>	A4	33	J1-33	9
<b>G</b>	B1	14	J1-14	14
<b>F</b>	B2	34	J1-34	13
<b>E</b>	B4	73	J1-73	12
<b>D</b>	C1	32	J1-32	17
<b>C</b>	C2	13	J1-13	16
<b>B</b>	C4	72	J1-72	15
<b>A</b>	Output Enable	Connect to aircraft ground	Connect to aircraft ground	Connect to aircraft ground
<b>a</b>	+14 to 28Vdc	Connect to avionics buss via circuit breaker	Connect to avionics buss via circuit breaker	Connect to avionics buss via circuit breaker
<b>b</b>	Ground	Connect to aircraft ground	Connect to aircraft ground	Connect to aircraft ground

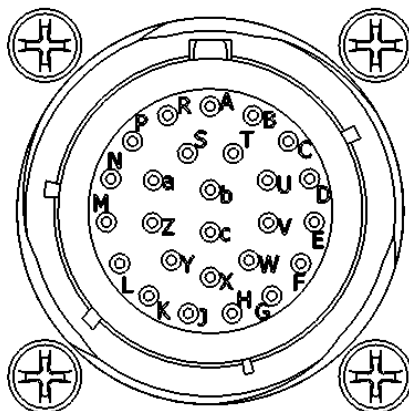
The Honeywell Bendix/King 860 EGPWS install manual lists an RS232 serial altitude data input on pin J1-45 with a data common on pin J1-46. Several TCI compatible serial data protocols are listed, but at the time of this printing, Trans-Cal has not tested the 860 EGPWS data input for compatibility.

## Tables IX and X Connector Pin Assignments and Protocol Selection

**Table IX Connector Pin Assignments**

SSD120-(XX)NEH( )-RS Connector Pin Assignments (D38999/21NE26PN)

Pin	Function	Pin	Function
A	SIGNAL COMMON	P	485 TxA (-)
B	C4	R	485 TxB (+)
C	C2	S	PROTOCOL 1
D	C1	T	PROTOCOL 2
E	B4	U	TXD1 (RS232)
F	B2	V	RxD (RS232)
G	B1	W	DATA GROUND
H	A4	X	TxD2 (RS232)
J	A2	Y	DATA GROUND
K	A1	Z	DATA GROUND
L	D4	a	+12 TO 28Vdc PWR. INPUT
M	D2	b	POWER GROUND
N	DATA GROUND	c	10' RESOLUTION

**Table X**

SSD120-(XX)NEH( )-RS Serial Protocol Selection Connector Function Table

Protocol Selection	Pin c	Pin S	Pin T
UPS AT 100' resolution, 1200bps. UPS AT 10' resolution, 1200bps.	Open Gnd.	Open Open	Open Open
Trimble/Garmin, 100' resolution, 9600bps. Trimble/Garmin, 10' resolution, 9600bps.	Open Gnd.	Open Open	Gnd. Gnd.
Northstar/Garmin, 100' resolution, 2400bps. Northstar/Garmin, 10' resolution, 2400bps.	Open Gnd.	Gnd. Gnd.	Open Open
Magellan, 100' resolution, 1200bps. Magellan, 10' resolution, 1200bps.	Open Gnd.	Gnd. Gnd.	Gnd. Gnd.
ARNAV Systems (Software selectable ONLY)	Open	Open	Open
UPS AT 618 Loran Systems (Software selectable ONLY)	Open	Open	Open

## **Section 6.0 GPS/MFD Connection Data**

Given the speed with which new GPS and MFD units are entering the market, it is impossible to provide data on every device. The following digitizer/GPS interconnections are provided as a quick reference only, and though they are correct to the best of our knowledge, always consult the latest installation, operation, and service bulletins from the GPS or MFD manufacturer.

### **6.1 UPS Aviation Technologies (IIMorrow)**

#### **Apollo Model GX50, GX60, GX65**

<b>Apollo GX50, GX60, GX65 Signal</b>	<b>Apollo 37 Pin D-Sub Connector</b>	<b>SSD120-(XX)NEH( )-RS Connector</b>
<b>RxD2</b>	21	<b>U or X</b>
<b>Data Ground</b>	20	<b>N, W, Y or Z</b>
		<i>Optional, jumper pin c to ground for 10' resolution.</i>

#### **Apollo GX50, GX60, GX65 Software Configuration**

In test mode, rotate the **Large** knob to select serial port configuration **RX**. Press **SEL**, rotate the large knob to select the **RxD2** port, rotate the small knob to select **AltEnc** input.

#### **Apollo Model MX20 Multi Function Display**

<b>Apollo MX20 Signal</b>	<b>Apollo 37 Pin D-Sub Connector</b>	<b>SSD120-(XX)NEH( )-RS Connector</b>
<b>RxD2</b>	21	<b>U or X</b>
<b>Data Ground</b>	3	<b>N, W, Y or Z</b>
		<i>Optional, jumper pin c to ground for 10' resolution.</i>

#### **Apollo MX20 Software Configuration**

Under External Data Source set altitude source to **Port 2**.

## 6.2 Trimble

### Trimble 2101 Approach Plus GPS Receiver

Trimble Signal	Trimble 2101 Port 1	Trimble 2101 Port 2	SSD120-(XX)NEH-RS Connector
RxD+	7	24	R
RxD-	8	36	P
Ground	3 or 20	3 or 20	N, W, Y or Z
			Protocol assignment, jumper pin <b>T</b> to ground on pins <b>N, W, Y or Z</b>
			<i>Optional, jumper pin <b>c</b> to ground for 10' resolution.</i>

### Trimble 2101 Approach Plus GPS Receiver Software Configuration - Installation Setup

Access the 2101 installation setup submenu and go to the SERIAL I/O SETUP. Select the GPS serial port which is to receive the pressure altitude data,

**SERIAL-1 IN** or **SERIAL-2 IN**.

Set data format to **ENCODER**.

### 2101 I/O Approach Plus GPS Receiver

Trimble Signal	Trimble 2101 I/O Serial Port 1	Trimble 2101 I/O Serial Port 2	SSD120-(XX)NHE-RS Connector
RxD+	J1-7	J1-24	R
RxD-	J1-8	J1-36	P
Ground	J1 - 3 or 20	J1 - 3 or 20	N, W, Y or Z
			Protocol assignment, jumper pin <b>T</b> to ground on pins <b>N, W, Y or Z</b>
			<i>Optional, jumper pin <b>c</b> to ground for 10' resolution.</i>

### 2101 I/O Approach Plus GPS Receiver Software Configuration - Installation Setup

Access the 2101 installation setup submenu and go to the SERIAL I/O SETUP. Select the GPS serial port, which is to receive the pressure altitude data, **SERIAL-1 IN** or **SERIAL-2 IN**. Set data format to **ENCODER**.



### **6.3 Garmin International**

#### **Garmin 400 and 500 Series GPS Devices (Includes 430W and 530W)**

<b>Garmin 78 Pin Conn. (P4001)</b>	<b>SSD120-(XX)NHE-RS Connector</b>
<b>57</b>	<b>U or X</b>
<b>77 or 78</b>	<b>N, W, Y or Z</b>
	Protocol assignment, jumper pin <b>T</b> to ground on pins <b>N, W, Y or Z</b>
	<i>Optional, jumper pin <b>c</b> to ground for 10' resolution.</i>

#### **Garmin 400 series GPS software configuration**

To allow the **Garmin 400 series GPS** to communicate with the SSD120-(XX)NEH( )-RS go to the **Main RS232 Config** page and set channel 1 input to **Icarus-alt**.

#### **Garmin GNC 300 GPS/Comm**

<b>GNC 300 37 Pin Connector J101</b>	<b>Function</b>	<b>SSD120-(XX)NEH-RS Connector Pin</b>
<b>17</b>	RxD to TxD	<b>U or X</b>
<b>13 or 25</b>	Data Ground	<b>N, W, Y or Z</b>
		Protocol assignment, jumper pin <b>T</b> to ground on pins <b>N, W, Y or Z</b>
		<i>Optional, jumper pin <b>c</b> to ground for 10' resolution.</i>

To allow the **Garmin 300 series GPS/Comm** to communicate with the SSD120-(XX)NEH( )-RS go to the **I/O Test Page** and set channel 1 input to **Icarus-alt**.

## 6.4 ARNAV Systems, Inc.

### ARNAV Systems 5000 Series Multi-Function Display

ARNAV 5000 25 Pin Connector	SSD120-(XX)NEH-RS Connector
15	U or X
13 or 25	N, W, Y or Z
Protocol, Software select ARNAV protocol see §4.5.	

### ARNAV Systems GPS-505/506/512 GPS Sensor

ARNAV GPS-505/506/512 DB-25 Connector	SSD120-(XX)NEH-RS Connector
8	U or X
9	N, W, Y or Z
Protocol, Software select ARNAV protocol see §4.5.	

### ARNAV Systems DR-100 WxLink Receiver/ Multiplexer

ARNAV DR-100 25 Pin Connector	SSD120-(XX)NEH-RS Connector
10	U or X
13 or 25	N, W, Y or Z
Protocol, Software select ARNAV protocol see §4.5.	

### SSD120-(XX)NEH( )-RS Software Configuration Note for Use with ARNAV Devices

The SSD120-(XX)NEH( )-RS *must* be software configured per §4.5 to operate with ARNAV system devices. Ensure that all hardware jumpers are removed from the connector. Hardware jumpers on Connector *will* override any software settings.

## Section 7.0 Instructions for Continued Airworthiness

The SSD120-(XX)NEH( )-RS is an all solid-state device and requires no periodic maintenance to maintain its airworthiness. The altitude encoder is to be tested during the aircraft biennial transponder and pitot-static system test as required by Federal Aviation Regulations. If the altitude encoder reports an error in excess of  $\pm 125$  feet compared to the primary flight altimeter, then recalibration as per §4.0 of this manual is required. If the error cannot be corrected through this procedure, then the unit is to be repaired or replaced. Contact Trans-Cal Industries for further information.

## Section 8.0 Frequently Asked Questions

### 1. How often must the Altitude Digitizer be calibrated; is there periodic maintenance required?

There is no periodic maintenance required. The Digitizer is tested and calibrated, if required, during the aircraft's biennial certification of the transponder and static system.

### 2. How many devices may be driven off of the parallel ICAO Altitude data port?

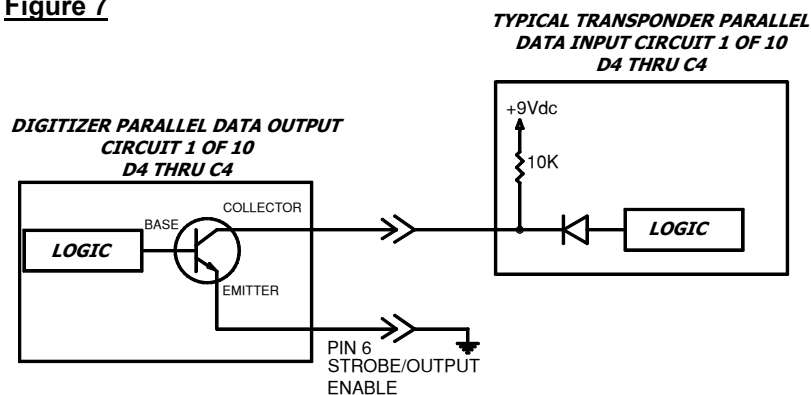
The number of devices that may be connected to the Digitizer ICAO altitude output is a function of the current and power required. The Digitizer parallel data outputs are "uncommitted" collectors of a transistor array which are "pulled-up" through a resistive load by the transponder (or other device) to some positive voltage. This voltage may range from about +3 to +40Vdc. Each Digitizer data output line (i.e. D2, D4, A1, A2 etc.) is capable of providing 35 mA (0.035 Amperes) with a "not to exceed" power rating of 100mW (0.1 Watts), when it is "sinking" current in the "on" position. Typical modern applications require about 1 milliampere or less per data line, per device.

In the circuit illustrated in figure 7, the current is calculated as 0.9mA at 8.1mW. At this current and power rating, a total of 12 identical devices could be connected to the digitizer. *Given the wide variety of input circuits capable of interfacing with the Digitizer and the possibility of cross-talk, careful planning of the electrical loads acting upon the Digitizer output is advised.*

$$\frac{V}{R} = I \quad 9V_{dc} / 10000 \text{ Ohms} = 0.0009 \text{ Amps}$$

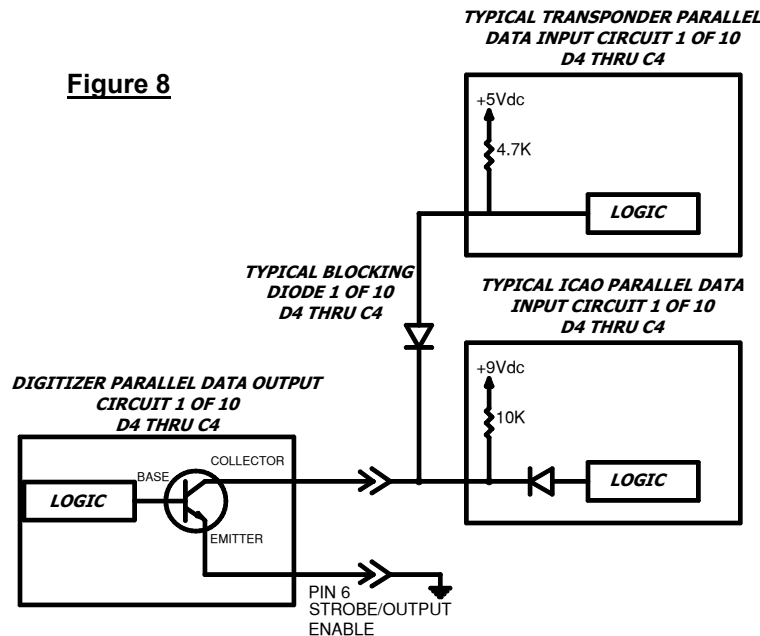
$$V(I) = P \quad 9V_{dc} \times 0.0009 \text{ Amps} = 0.0081 \text{ Watts}$$

**Figure 7**



3. *Why do altitude encoding errors occur when connecting a second or third device to the altitude encoder, but not when only one device is connected?*

This is a symptom of “Cross-Talk.” This condition typically occurs when the devices connected to the altitude encoder are “pulling-up” to different voltages without diode isolation. When the altitude encoder is in the “off” state the data line electrical current may flow in undesired directions due to this pull-up voltage imbalance. Most modern avionics devices are diode isolated, but in applications where older equipment is mixed with new devices, blocking diodes may be required to isolate the older device. Germanium or Schottky blocking diodes are the preferred devices to install due to the low forward voltage drop across the device. Connect as detailed in the illustration below. Use of general purpose silicon diodes are *NOT* recommended, as the larger voltage drop may interfere with the logic threshold detection in the equipment.



4. *My transponder does not have a D2 or D4 input. What do I do with these signals from the Digitizer?*

Leave unused data bits unconnected.

5. *What is the **Strobe** or **Signal Common** or **Output Enable** function on the ICAO altitude data port?*

This is a control signal for the ICAO parallel altitude data. On devices manufactured by Trans-Cal this function is on pin A of the connector. A “high” or “open” on this pin will disable the ICAO altitude data. A “low” or “ground” on this line will enable the altitude data. Some interconnecting devices may use this signal to control the flow of data from the Digitizer. Be aware that when using this signal and connecting multiple devices to the Digitizer, interruptions of the ICAO data will occur when the controlling device “strokes” the Digitizer.

6. *On Altitude Digitizers with serial ports, does the strobe function control the serial data?*

No, the serial data is independent of the parallel ICAO altitude data. Transmission of the serial data is asynchronous. Enabling or disabling the parallel data will not affect the serial data transmission.

7. *Must the parallel ICAO altitude data be connected to use the serial data?*

No, the serial data output is completely independent of the ICAO parallel data output.

8. *How many devices may be driven off of the RS232 port?*

One device may be driven off each serial port. Trans-Cal Digitizers provide two RS232 ports on each Digitizer, so two RS232 receiving devices may be driven off of each Digitizer.

9. *Can the Digitizer transmit two different serial data protocol messages at the same time?*

Yes. The Digitizer may be configured via the serial port and an IBM compatible PC to specify the data protocol to be transmitted on each serial port. **See §4.5.** The RS485 data will match the TxD1 data.

10. *What is the maximum length of an RS232C wiring harness?*

25 feet.

11. *I have connected the serial data from the digitizer to my GPS device, why does the GPS display a "No Pressure Altitude" message?*

There are several possible problem sources.

Electrical Ground Imbalance

RS232 operates in an "unbalanced" (single-ended) transmission method; where the receiving device monitors the difference between the signal voltage and a common ground. If a significant difference in electrical ground potential between the Digitizer and the receiving device exists, then the RS232 signal levels may be adversely affected. Verify the digitizer and receiving device electrical grounds are referenced together by connecting one of the ground pins on the Digitizer RS232 connector to the receiving device's ground.

Receiving Device Configuration

The receiving device is looking for a specific message at a specific baud rate and parity. These messages, baud rates and parity vary from manufacturer to manufacturer. A mismatch on any one of these items will cause a communication failure. In addition, many devices are capable of software configuration to accept RS232 data on different connector pins. Verify the following:

- a. Digitizer data is routed to the correct connector pin on the receiving device.
- b. The receiving device is software configured to accept data on that connector pin.
- c. The receiving device is software configured to accept the correct message protocol at the correct baud rate and parity.
- d. The Digitizer is transmitting the same message, baud rate and parity as configured in item c above.

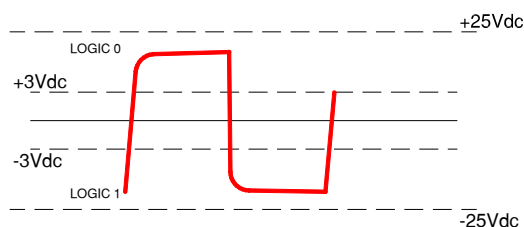
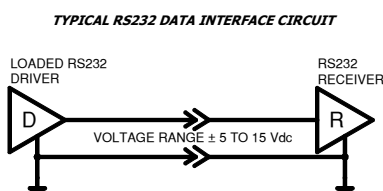
12. How can I verify the RS232 data message, baud rate and parity transmitted from the Digitizer?

- Use the Trans-Cal ATS-400 Test Set to display the serial data.
- Use a PC with an open RS232 port and serial data capture/analyzer software. Some possible software solutions include: HYPER TERMINAL (Windows® 95 & 98 & XP), SOFTWARE WEDGE™, PROCOMM™, COMMFONT™.
- Use a dedicated serial data test box such as the BLACK BOX™ RS232 MONITOR.
- An oscilloscope may be used to view the 9Vdc square wave transmitted about 1/second.

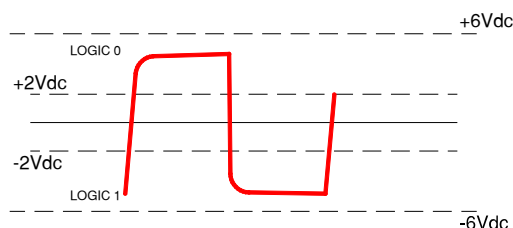
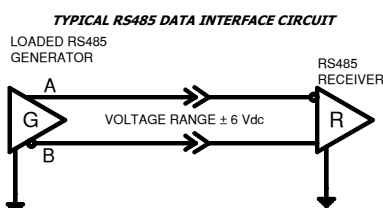
13. What is the difference between RS232 and RS485?

RS232 operates in an “unbalanced” (single-ended) transmission method; where the receiving device monitors the difference between the signal voltage and a common ground.

RS485 is a balanced (differential) transmission method; where each signal has a dedicated pair of wires, with the voltage on one wire equal to the complement of the voltage on the other. The receiving device monitors the difference between these voltages to determine the signal.



**Figure 9**



**Figure 10**

When the “A” terminal is negative with respect to the “B” terminal the logic “1” state exists. When the “A” terminal is positive with respect to the “B” terminal then a logic 0 state exists. Consult Trans-Cal engineering for termination resistor recommendations when connecting more than 2 devices on a RS485 port or if interference with the digitizer data is suspected due to RF noise considerations.

14. How many devices may be driven off of the RS485 port?

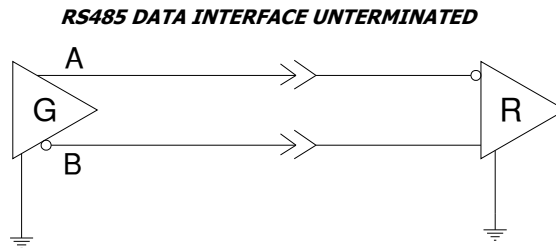
32 Devices.

15. What is the maximum length of an RS485 wiring harness?

4000 feet.

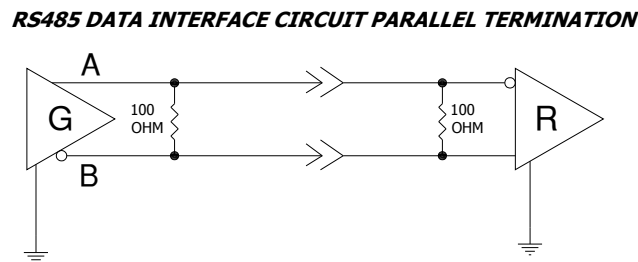
16. Do I need to terminate the RS485 data lines with resistors?

The RS485 data lines may be parallel terminated or un-terminated. Un-terminated data lines are acceptable for the low data rate we are dealing with in this application. (9600 bps and 1 message/sec.) Leaving the data lines un-terminated has the added advantage of keeping the power requirement low. See the illustration below.



**Figure 11**

For applications where superior immunity to noise is required then a parallel termination as illustrated below is often recommended. *Trans-Cal does NOT recommend the use of termination resistors! Appropriate signal grounds and shielded cable are usually all that is required for noise-free operation in the data rate ranges of this device. Be aware that termination resistors complicate your installation and will increase current consumption.*

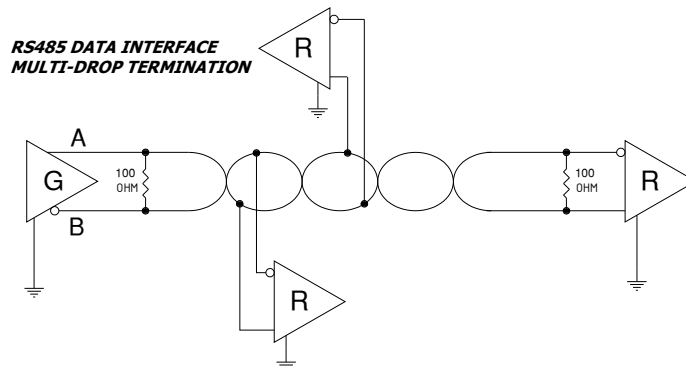


**Figure 12**

For a more “in depth” RS485 discussion, see National Semiconductors’ Application Note AN-1057 “Ten Ways to Bulletproof RS485 Interfaces.” This note is available on the National Semiconductor’s website.

17. Do I need to use termination resistors on all the receivers I connect to the RS485 port?

No, in a multi-drop environment, connect termination resistors to the encoder and the unit furthest away from the altitude encoder, as illustrated below.



**Figure 13**

18. Can I connect an RS485 or RS422 signal to an RS232 input?

*No! See the discussion in question 13.*

19. What is the difference between RS485 and RS422?

RS422 and RS485 are both balanced (differential) interfaces. The major differences lies in the load that may be driven and the common mode voltage tolerated. RS422 will drive a maximum of ten devices RS485 will drive 32 devices. The "common mode" voltage tolerated by RS422 is  $\pm 7\text{Vdc}$  and for RS485 common mode voltage tolerated is  $+12$  to  $-7\text{Vdc}$ . Common mode voltage is defined as the mean voltage of terminals A and B with respect to signal ground.

20. Can I connect an RS485 signal to an RS422 input?

No. While some RS422 receivers may tolerate the full common mode voltage of RS485, it is best not to take the chance.

## **Section 9.0 Known Compatibility Issues**

### **9.1 Honeywell KT 73 Transponder with Serial Altitude Data Input**

The **KT 73** must be configured to accept serial altitude data on pin 7 of the main connector, and software configured for *High Resolution M* (II Morrow). 1200bps, 7 data bits, 1 stop bit and odd parity. The Trans-Cal **SSD120-(XX)NEH( )-RS** must be software configured to transmit the correct serial data protocol to the Bendix/King KT 73 transponder as described in **§5.0** of this manual.

### **9.2 Narco AT-5A, AT-6A, AT-50 and AT-50A Installations**

The Narco AT-5A, AT-6A, AT-50 or AT-50A transponder will not accept data from the SSD120-(XX)NEH( )-RS Altitude Digitizer. A modification to remove the output decoupling capacitors is required and the unit may be ordered from the factory with this modification. Order Model Number SSD120-(XX)NEH( )-RS with Mod. 1. **This mod may NOT be performed in the field. Please note!** The Narco AT-50 and earlier transponder models require a modification before they will function correctly with any altitude encoder. This modification is outlined in Narco Service Bulletin AT-50A-5.

### **9.3 King KT-75**

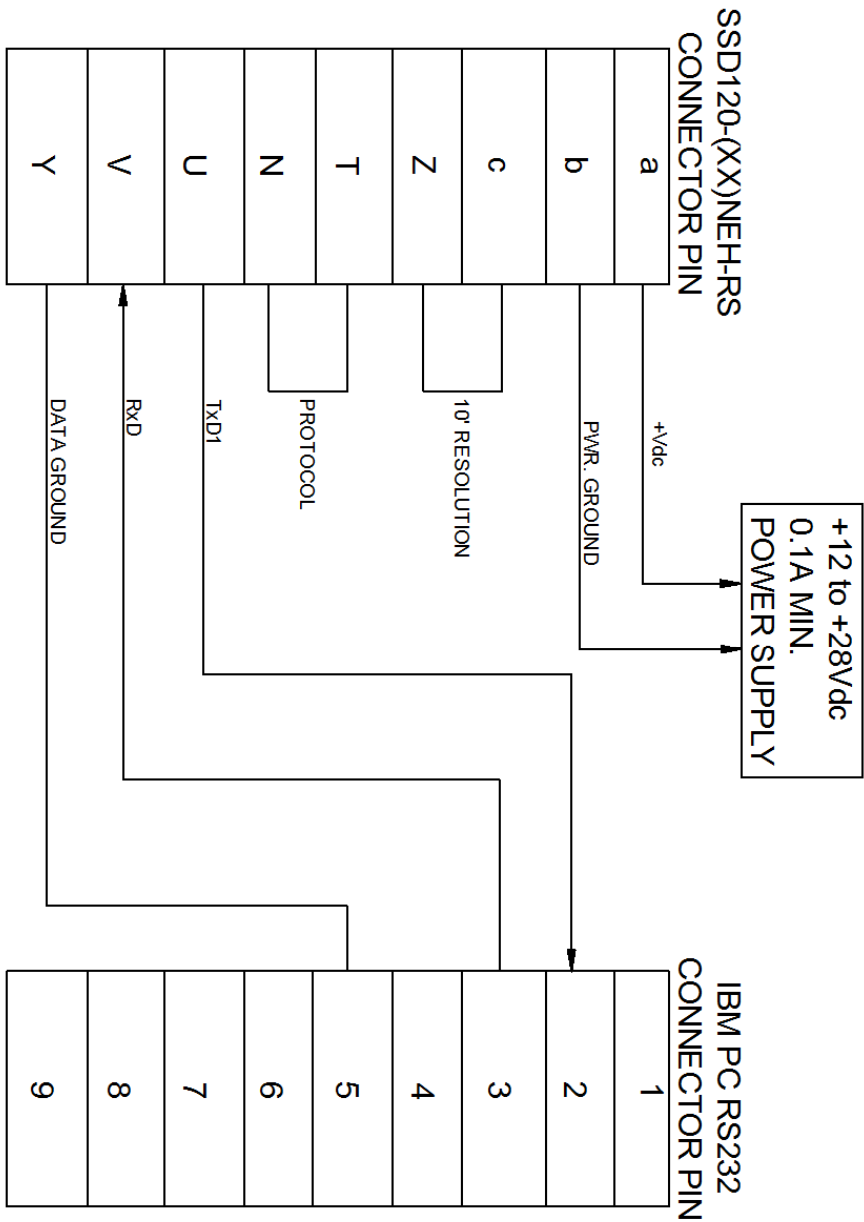
The King KT-75/75R uses the older RTL (resistor transistor logic) pulling up to about 3 volts; consequently the open collectors of the SSD120-(XX)NEH-RS will not pull the signal below the KT-75 logic threshold.

### **9.4 S-Tec (Collins) TDR950**

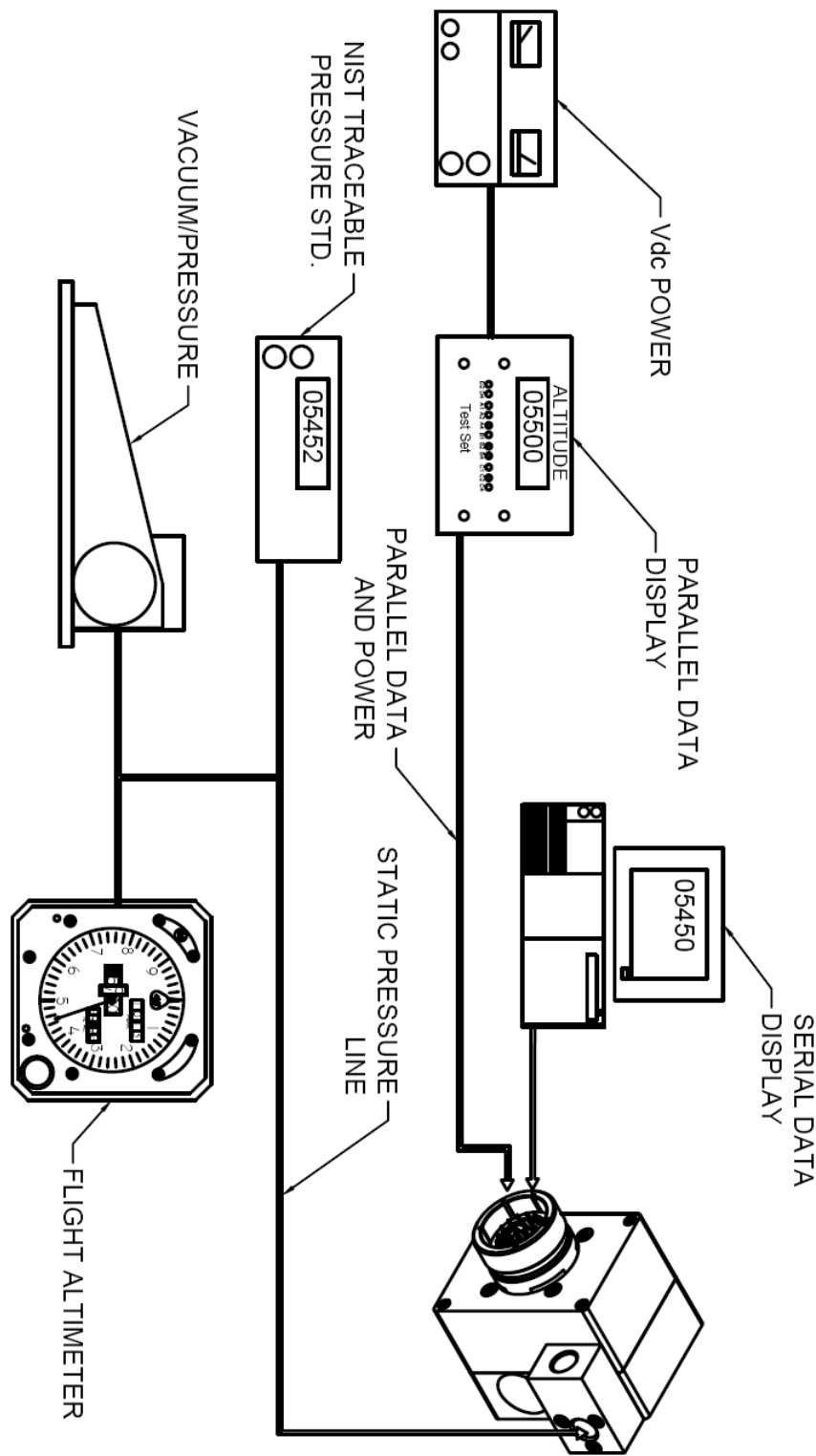
The TDR950 must be powered-up first, or the SSD120-(XX)NEH-RS must be diode isolated to prevent the TDR 950 from invalidating the encoder data.



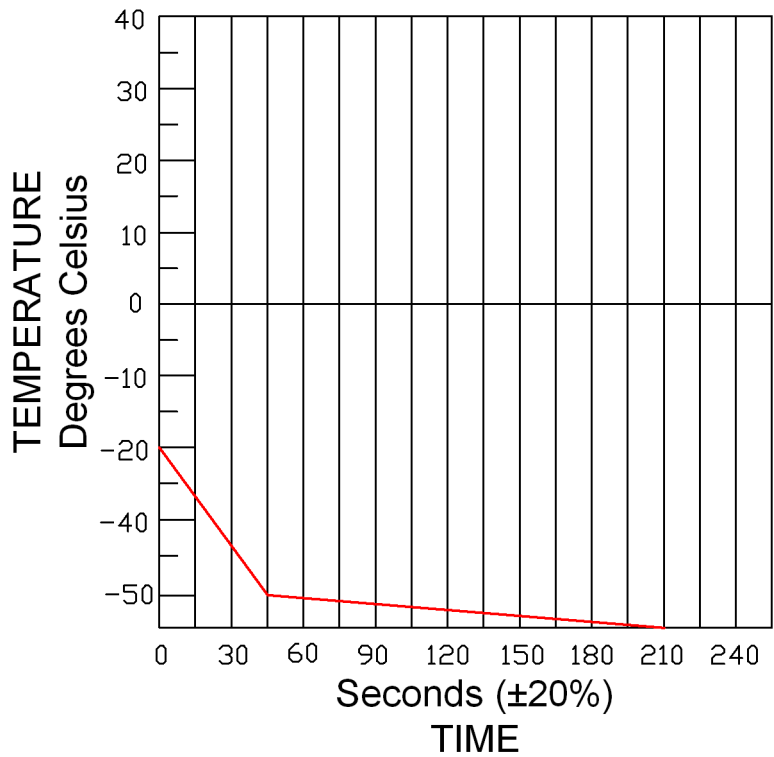
**Calibration Wiring Harness Diagram**



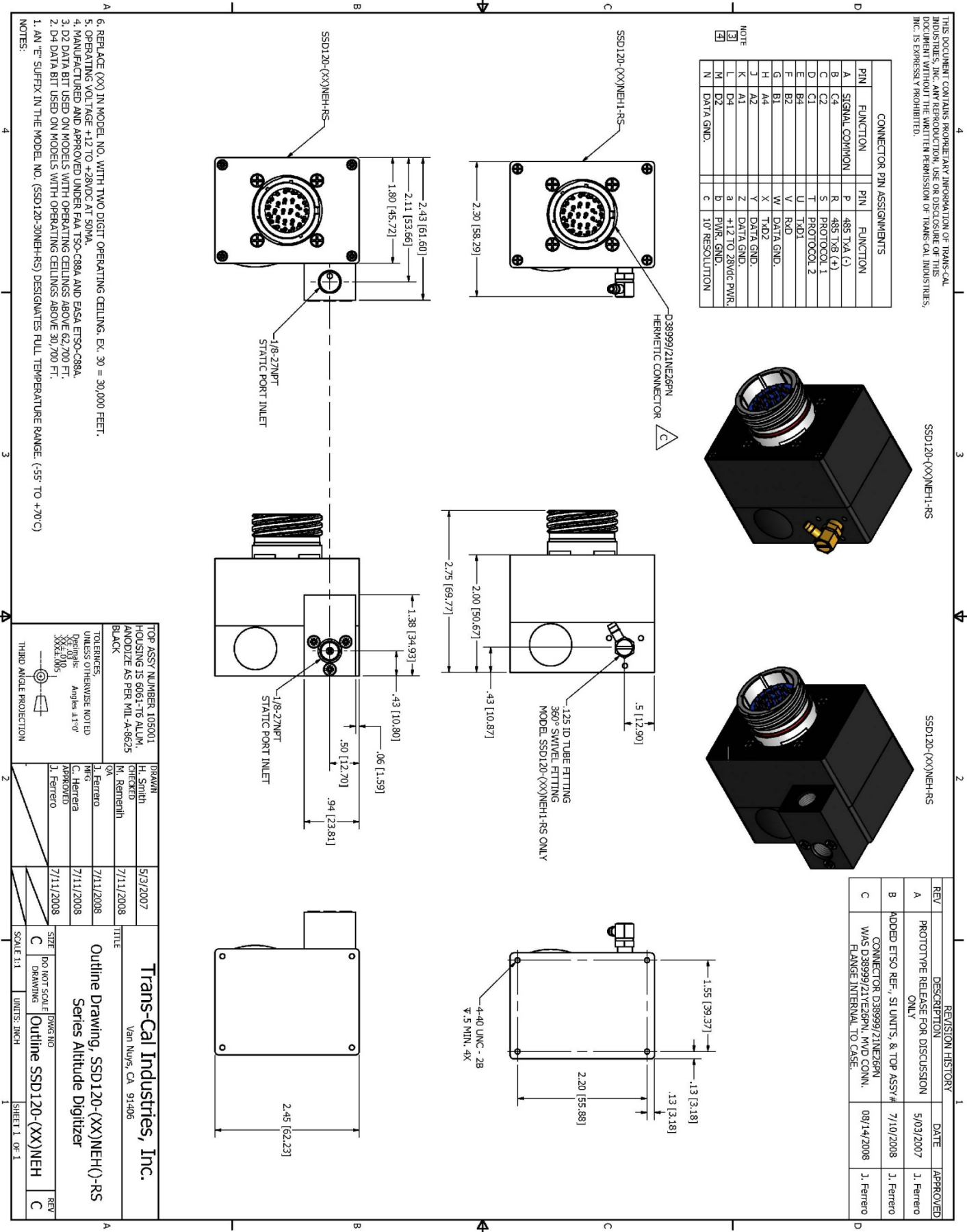
Calibration Block Diagram



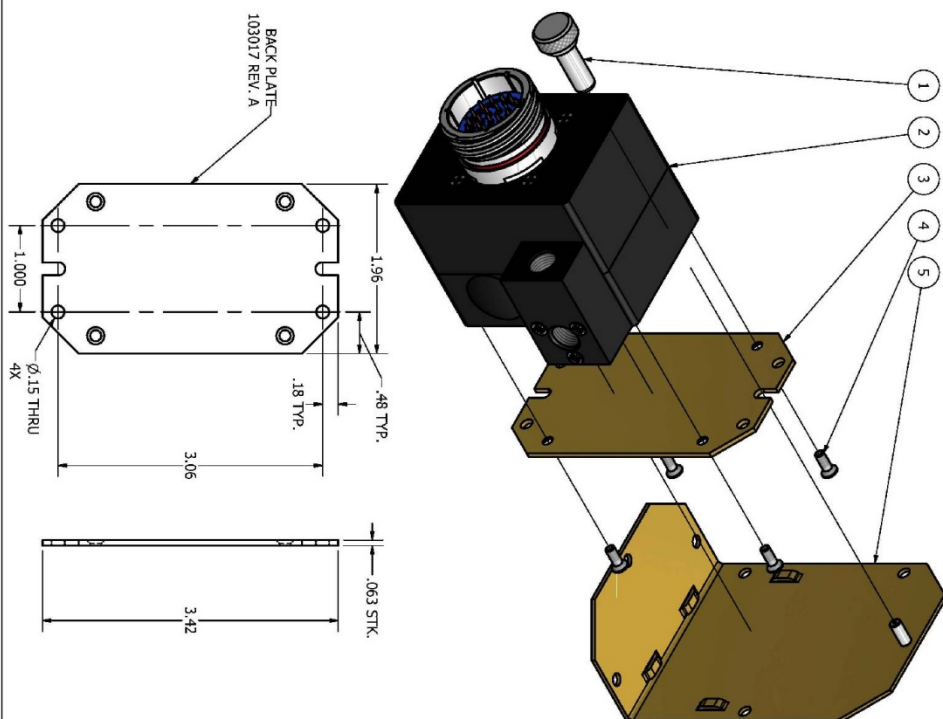
**Figure 14 Temperature vs. Warm-up Time**



Outline Drawing SSD120-(XX)NEH( )-RS



(Order mounting accessories using part numbers listed below.)



Parts List		
ITEM	QTY	DESCRIPTION
1	1	861023-2
2	1	109001
3	1	103017
4	1	600026-4
5	1	103018

Trans-Cal Industries, Inc.					
Van Nuys, CA 91406					
TITLE					
Assembly, Mounting Accessories SSD12D-(xx)NEH(-)RS					
DRAWN H. Smith	9/3/2008				
CHECKED	9/3/2008				
IN REVISION					
TOLERANCES UNLESS OTHERWISE NOTED DECIMALS: .0005 ±.10° ANGLES: ±.10° XXX±.005					
THIRD ANGLE PROJECTION					
SIZE	DO NOT SCALE	DWG NO.	SCALE 1:1	LIMITS: INCH	SHEET 1 OF 1
	DRAWING	105009			A

1. ALL ALUMINUM CHEMICALLY TREATED AS PER MIL-C-5541 TO INHIBIT CORROSION

**Environmental Qualification Form****Nomenclature:** Altitude Digitizer**Model No.:** SSD120-100NEH( )-RS

FAA TSO-C88a and EASA ETSO-C88a

**Manufacturer:** Trans-Cal Industries, Inc., 16141 Cohasset St. Van Nuys, CA 91406**DO-160E Tested:** October 2007

Conditions	Section	Description of Tests Conducted
<b>Temp. and Altitude</b>	<b>§4.0</b>	Tested to Category E1 and D1.
<b>Low Temperature</b>	<b>§4.5.1</b>	No cooling required.
<b>High Temperature</b>	<b>§4.5.2 &amp; 4.5.3</b>	
<b>In-Flight Loss of Cooling</b>	<b>§4.5.4</b>	
<b>Altitude</b>	<b>§4.6.1</b>	
<b>Decompression</b>	<b>§4.6.2</b>	
<b>Overpressure</b>	<b>§4.6.3</b>	
<b>Temp. Variation</b>	<b>§5.0</b>	Tested to Category B.
<b>Humidity</b>	<b>§6.0</b>	Tested to Category A.
<b>Operational Shock and Crash Safety</b>	<b>§7.0</b>	Tested to Category B.
<b>Vibration</b>	<b>§8.0</b>	Tested to Category S Fixed Wing Zone 1, 2, 3 & 5 Curve M and Tested to Category U Helicopter Zone 1 & 2 Curve F & F1.
<b>Explosive Atmosphere</b>	<b>§9.0</b>	Identified as Category X, no test performed.
<b>Waterproofness</b>	<b>§10.0</b>	Tested to Category R.
<b>Fluids Susceptibility</b>	<b>§11.0</b>	Identified as Category X, no test performed.
<b>Sand and Dust</b>	<b>§12.0</b>	Identified as Category X, no test performed.
<b>Fungus Resistance</b>	<b>§13.0</b>	Identified as Category X, no test performed.
<b>Salt Fog</b>	<b>§14.0</b>	Tested to Category T.
<b>Magnetic Effect</b>	<b>§15.0</b>	Tested to Category Z.
<b>Power Input</b>	<b>§16.0</b>	Tested to Category B.
<b>Voltage Spike</b>	<b>§17.0</b>	Tested to Category B.
<b>Audio Frequency Conducted Susceptibility – Power Inputs</b>	<b>§18.0</b>	Tested to Category B.
<b>Induced Signal Susceptibility</b>	<b>§19.0</b>	Tested to Category BC.
<b>RF Susceptibility (Radiated and Conducted)</b>	<b>§20.0</b>	Tested to Category T for Radiated Susceptibility and Category T for Conducted Susceptibility.
<b>Emission of RF</b>	<b>§21.0</b>	Tested to Category B.
<b>Lightning Induced Transient Susceptibility</b>	<b>§22.0</b>	Identified as Category X, no test performed.
<b>Lightning Direct Effects</b>	<b>§23.0</b>	Identified as Category X, no test performed.
<b>Icing</b>	<b>§24.0</b>	Tested to Category C.
<b>Electrostatic Discharge</b>	<b>§25.0</b>	Tested to Category A.
<b>Fire, Flammability</b>	<b>§26.0</b>	Identified as Category X, no test performed.

**Remarks:**

During power input tests, the device was subjected to subparagraph 16.6.1.4b, requirement for devices with digital circuits.

During Icing tests §24.4.4 an ice build-up of .14" [3.56mm] max. on the electrical connector surface was achieved.

**Part Number Builder****SSD120-XX-X-X-X-XXXX**

MAX. OPERATING ALTITUDE (FT.)	
30,000	<b>-30</b>
35,000	<b>-35</b>
42,000	<b>-42</b>
50,000	<b>-50</b>
62,000	<b>-62</b>
65,000	<b>-65</b>
70,000	<b>-70</b>
80,000	<b>-80</b>
85,000	<b>-85</b>
100,000	<b>-100</b>

MODEL NOMENCLATURE	
ENCODER/DIGITIZER	<b>A</b>
2" MODULAR ENCODER	<b>M</b>
SERVO DRIVE MODULE	<b>SM</b>
NANO SERIES ENCODER	<b>N</b>

OPERATING ENVIRONMENT	
STANDARD -20° TO +70°C	<b>BLANK</b>
EXTENDED -55° TO +70°C	<b>E</b>
EXTENDED HERMETIC	<b>EH</b>

STATIC PORT CONNECTION	
1/8-27 NPT	<b>BLANK</b>
1/8" ID TUBE SWIVEL	<b>1</b>

ADDITIONAL PORTS AND FEATURES	
DUAL RS232 PORTS	<b>RS232</b>
DUAL RS232 PORTS AND ONE RS485 PORT	<b>RS</b>

MODEL NUMBER EXAMPLE: SSD120-30NE-RS232

SOLID STATE ALTITUDE DIGITIZER -1000 TO +30,000 FT., NANO STYLE,  
 EXTENDED TEMPERATURE RANGE, 1/8-27NPT FEMALE STATIC PORT,  
 DUAL RS232 PORTS.

**WARRANTY REGISTRATION**

Trans-Cal Industries warrants each Model SSD120-(XX)NEH( )-RS Solid State altitude digitizer to be free of defects in the pressure transducer for 12 months after purchase. TCI warrants the balance of the solid-state electronics for workmanship and materials for a period of 42 months after purchase. This warranty applies to the original purchaser of the instrument.

Trans-Cal's obligation under this warranty is limited to repairing or replacing any unit returned to Trans-Cal during the life of this warranty provided:

- (1) The defective unit is returned to us, **transportation pre-paid.**
- (2) Prior approval is obtained from Trans-Cal.
- (3) The unit has not been damaged by misuse, neglect, improper operation, accident alteration or improper installation.

Trans-Cal **DOES NOT** reimburse labor costs on warranty repairs. Trans-Cal Industries will be the sole judge as to the cause of the malfunction and wherein the responsibility lies. No other obligation or liability is expressed or implied.

For the above warranty to become effective, the attached registration card **must** be completed and returned to Trans-Cal Industries, properly completed and signed by the dealer selling or installing this equipment.

Mail to: Trans-Cal Ind., Inc., 16141 Cohasset St., Van Nuys, CA 91406

✂----- cut here -----

**MODEL:** SSD120-(     )N( )-RS                      **SERIAL NO:** H-\_\_\_\_\_

**AIRCRAFT:**\_\_\_\_\_ **NUMBER:**\_\_\_\_\_

**OWNER:**\_\_\_\_\_

**ADDRESS:**\_\_\_\_\_

**CITY:**\_\_\_\_\_ **STATE:**\_\_\_\_\_ **ZIP:**\_\_\_\_\_

**DEALER:**\_\_\_\_\_

**INSTALLED BY:**\_\_\_\_\_

**LICENSE NO:**\_\_\_\_\_

**INSTALLATION DATE:**\_\_\_\_\_

I hereby certify the above instrument was installed in accordance with the instructions of Trans-Cal Industries, and the installation was performed to industry and FAR standards. I further certify the instrument was properly working on the above date.

**SIGNED:**\_\_\_\_\_

**PRINT NAME:**\_\_\_\_\_