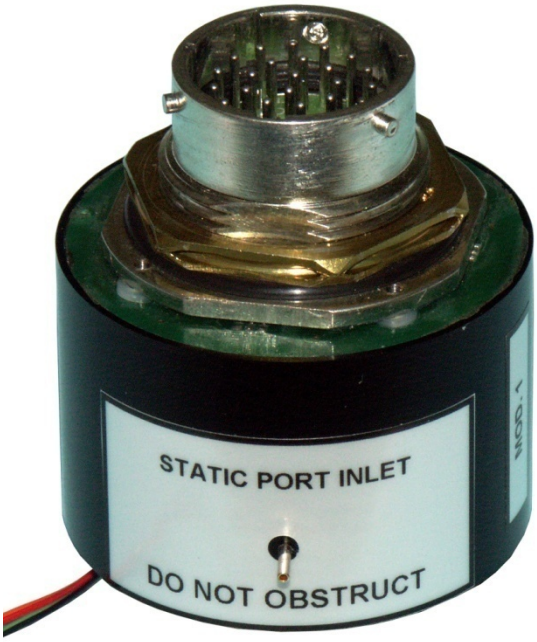
Trans-Cal Industries, Inc.

Model SSD120-(XX)M
Modular Altitude Encoder/Digitizer Series
TSO-C88a Approved

Owner/Installation Manual



Trans-Cal Industries, Inc.
16141 Cohasset St.
Van Nuys, CA 91406
(818) 787-1221 FAX (818)787-8916
www.trans-cal.com

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16141 Cohasset Street
Van Nuys, CA 91406-2908

CAGE Code 57323

818/787-1221
FAX 818/787-8916
E-Mail: support@trans-cal.com
www.trans-cal.com

History of Revision

Revision	Date	Description
N/C	07/00	Production release.
A	08/00	Removed protocol jumper info., added prgm. pin Y data. Added baro set pin and external wire data.
B	09/00	Changed outline drawing to revision C.
C	06/05	Updated document layout, added wiring diagram 101802.dwg
D	06/09/2015	Added limitations, deviations & compliance §1.3.1. Updated Copyright page, insert abbreviations table, update calibration procedure, add figure 2.

Table of Contents

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
C_R	Carriage Return
EASA	European Aviation Safety Agency
EEPROM	Electronically 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
H/W	Hardware
Hz	Hertz
ICAO	International Civil Aviation Organization
I.F.F.	Identification Friend or Foe
In. Hg.	Pressure in Inches of Mercury
Kbps	Kilobits per Second
KHz	Kilohertz
L_F	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	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.
ºC	Temperature in degrees Celsius.
±	Plus or minus.
§	Section

Section 1.0 Introduction

1.1 Scope

This manual provides detailed installation, calibration and operating instructions for Trans-Cal Industries' Model SSD120-(XX)M series of altitude encoder/digitizer. This manual assumes use by competent, qualified avionics professionals utilizing installation methods in accordance with 14CFR and other industry accepted installation practices.

1.2 Equipment Description

Approved under F.A.A. TSO-C88a, the Model SSD120-(XX)M is an all solid state electronic device which, when installed within a flight altimeter and connected to the aircraft's electrical system, converts pressure altitude information into parallel and serial digital data.

The parallel digital data 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. The serial data protocol is individually selectable for each port (refer to **Table V,** and **§4.4**)

This unit is also designed to be programmed to match the flight altimeter error curve utilizing an IBM compatible PC with an available serial port.

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)M	+9 to 30 Vdc
Operating Current all models:	0.25 Amps at 14Vdc 0.27 Amps at 28Vdc
Operating Temperature: Model SSD120-(XX)N-RS232	-20° to +70°C (-4° 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 and higher. See Figure 2 for low temp warm-up times.
Weight:	3.82 oz. (108.2 grams)

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 may be installed only 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/RTCA Compliance Table

FAA TSO	C88a
RTCA DO-178 Software	Non-Essential Category H/W - S/W P/N: 101804rA-700001rC
RTCA DO-160E Environmental*	D1BAB[(SM)(UF)]XXXXXXZBBB(BC)TTBXXXAX

*See Environmental Qualification form for specifics.

1.3.2 Operating Altitude

Model	Operating Altitude
SSD120-50M	-1000 to +50,000 feet
SSD120-62M	-1000 to +62,000 feet
SSD120-65M	-1000 to +65,000 feet
SSD120-80M	-1000 to +80,000 feet

1.3.3 Accuracy

Digitizer accuracy is ±50 feet from -1000 to +30,000 feet, and ±75 feet from 30,100 to maximum altitude, when measured from the altitude transition points of the ICAO code and referenced to 29.92 In. Hg. (1013 MB.) See **§4.0**.

1.3.4 Mechanical Characteristics

Model Number	Dimensions	Weight
Model SSD120-50M	*See Outline Drawing*	3.82 oz. (108.2 g)
Model SSD120-62M	*See Outline Drawing*	3.82 oz. (108.2 g)
Model SSD120-65M	*See Outline Drawing*	3.82 oz. (108.2 g)
Model SSD120-80M	*See Outline Drawing*	3.82 oz. (108.2 g)

1.3.5 Over Range

The SSD120-(XX)M 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 –5721 feet (18psi) maximum.

1.4 Parallel 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: 50mA.
Maximum Cable Length: 4000 ft. (1219 meters)
Input Signal Requirement: Pin 6 (strobe or signal common) must be either grounded or connected to the transponder.

1.5 Serial Altitude Data Port Specifications

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.)
Baud Rate: Selectable, 1200 bps to 9600 bps.
Transmission 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, the serial port resolution may be configured via software, see **§4.8**.

1.7 Serial Communication Format

Model SSD120-(XX)M and carries out serial communication asynchronously with the “Start/Stop” system. This system puts a start bit at the head of a character, and then in turn adds data bits, a parity bit, and a stop bit. The specifics of the protocol are determined by user selection, see **§4.4.**

1.8 Serial Communication Protocol

The serial data protocol is user selectable via software see **§4.4**. If the installation calls for two separate protocols to be transmitted on the serial data ports the second protocol may be software assigned. The following list of protocols is referred to in **§4.4**.

1.8.1 UPS AT/Garmin AT/IIMorrow Nav. Devices

A 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$^{C}_{R}$	Altitude 800 feet

1.8.2 Trimble Garmin Navigation Devices Protocol

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 -9900 $^{C}_{R}$	Digitizer disabled.
ALT 10500 $^{C}_{R}$	Altitude 10,500 feet

1.8.3 Northstar Navigation Devices Protocol

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 $^{C}_{R}$	Altitude 2500 feet.
ALT -2500 $^{C}_{R}$	Digitizer disabled.

1.8.4 Magellan Navigation Devices Protocol

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 $^{C}_{R}$	Altitude 2500 feet.

1.8.5 ARNAV Systems Protocol

Leaving pins 6 and 7 of the 9 pin connector open, the ARNAV Systems protocol *MUST* be software selected see **§4.6** 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 $^{C}_{R}{}^{L}_{F}$ETX	Altitude 33 meters.

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 ±125'.

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

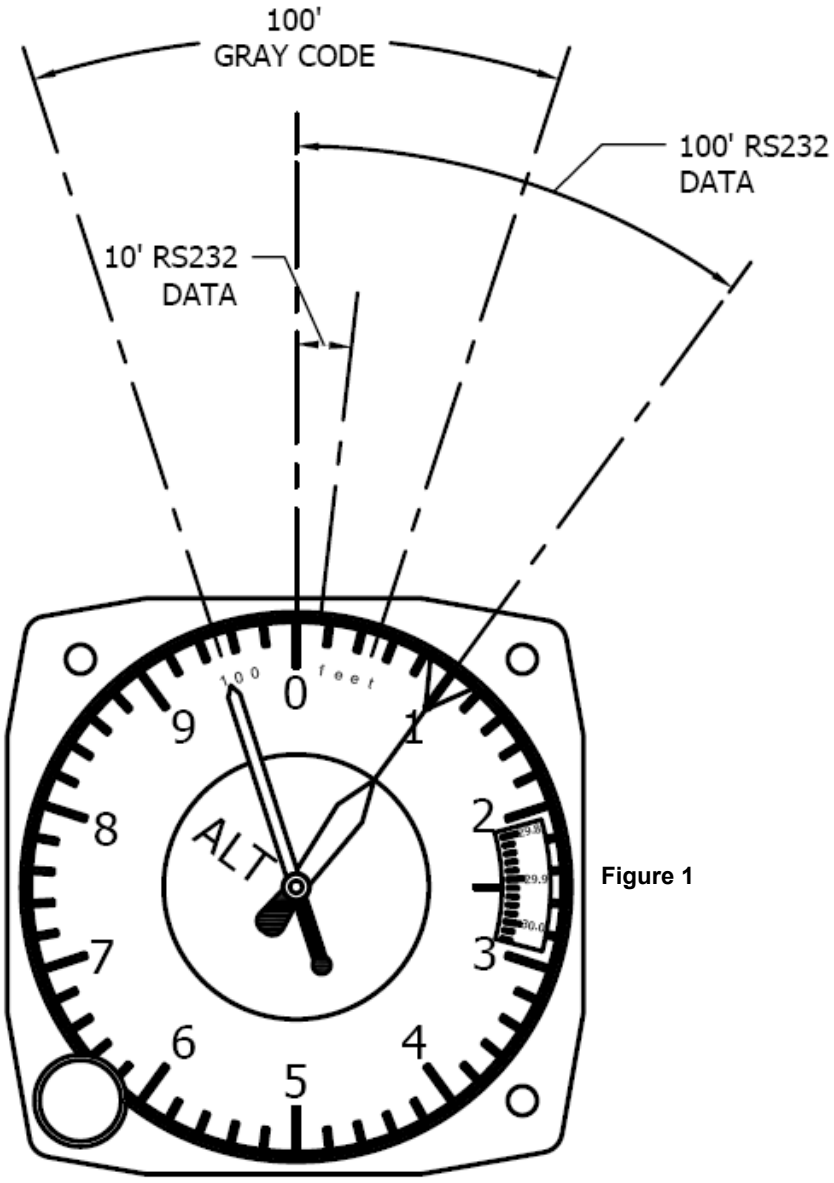


Figure 1

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 ±125'.

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 SSD120-(XX)M series of altitude encoder/digitizer's are designed to be mounted within the body of a flight altimeter operated up to 80,000 MSL. The encoder/digitizer is fully automatic in operation. The parallel data output is controlled by the transponder while the serial data is transmitted asynchronously. (Half duplex, talk only. Full duplex in calibration and configuration modes only.)

2.2 Operating Instructions

2.2.1 Parallel Altitude Data

Place the transponder in Mode 'C', altitude reporting mode, and apply power to the transponder and the encoder/digitizer. In some installations, the encoder/digitizer will be automatically supplied power when the transponder is energized; in others, power to the encoder/digitizer is provided directly from the avionics buss, follow the power-up procedures recommended by the transponder manufacturer.

In some installations the transponder controls the encoder/digitizer by enabling and disabling its outputs. In other installations, the encoder/digitizer's output is not controlled by the transponder and is continuously enabled, (encoder/digitizer pin A is grounded.)

2.2.2 Serial Altitude Data

The serial data communication is fully automatic and transmission begins immediately upon power up to the encoder/digitizer. The serial communication is not affected by the strobe function on the parallel data.

Section 3.0 Installation and Calibration

3.1 Mechanical Installation

The SSD120-(XX)M should 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 properly and safely installed, the installer should perform a visual inspection and conduct an overall operational check of the system prior to flight.

The SSD120-(XX)M series altitude encoder/digitizer may be mounted in any attitude within the body of the altimeter, but should be mounted to insure no interference with the altimeter mechanism, and no obstruction of the SSD120-(XX)M static pressure inlet. The mounting position should insure that the 26 pin mating connector does not interfere with the altimeter static port connection or other electrical or mechanical connections required for the altimeter's operation.

Manufacture an opening in the altimeter case per the outline drawing for the **Connector Panel Cutout 881667**. Be sure to provide a flat surface to which the connector O-Ring can seal. Secure the encoder/digitizer to the altimeter case using the 1.125-18UNEF nut provided. Refer to the outline drawing for mechanical dimensions and the sample installation diagram.

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. Shielded cable is recommended for both serial and parallel data wiring harnesses. 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.

The encoder/digitizer is designed to operate with a +9 to +28VDC power source. This voltage can be A+ switched power provided by the transponder or may be provided by the avionics buss, protected with the appropriate fuse or circuit breaker.

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. REMOVE POWER BEFORE INSTALLING THE DIGITIZER.

3.2.1 Parallel Altitude Data Connection

The outline drawing provides electrical connector pin/function data. Use this information when connecting the encoder/digitizer to the transponder. In some installations where older transponders are in use, the transponder may not provide an “altitude disable” function. In this case a panel mounted switch may be required.

3.2.2 Serial Altitude Data Connection

Connect the TxD (transmit data) pin X (TxD1) or pin U (TxD2) from the connector to the receive data RxD port on the GPS or other navigation device. See connection **Table V** as well as the **GPS Connection Data.** Be sure to connect a ground from the encoder/digitizer to the receiving GPS unit to ensure good data transmission. Shielded cable is recommended for both serial and parallel data wiring assemblies.

3.3 Serial Data Port Test Equipment

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

a) Use a TCI Model ATS-400 Test Set or ECP-100 Programmer to display the 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 9 Vdc square wave group transmitted about twice a second.

3.4 Parallel 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 directly from the digitizer.

Section 4.0 Calibration and Configuration

4.1 Calibration Overview

Reference: FAR 91.217; FAA Advisory Circular AC 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.

The following procedure(s) will allow adjustment to the calibration curve of the SSD120-(XX)M as an aide in matching the digitizer output to flight altimeter or NIST traceable pressure standard.

The maximum allowed error between the primary flight altimeter and the altitude digitizer is ±125 feet as required by TSO-C88a. All Trans-Cal digitizers are calibrated to within ±50 feet of a NIST traceable pressure standard; however, the error allowed on flight altimeters at higher altitudes can lead to a combined error in excess of ±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. Model SSD120-(XX)M is designed to be field calibrated to meet this requirement, as per the procedure described in **§4.2**.

The correspondence required for altitude digitizers is fully addressed in SAE Aerospace Standard AS8003 §3.11. The correspondence described by the SAE standard requires the digitizer to report altitude within ±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 ±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 code occurs 50 feet prior to the altitude in question.

This calibration procedure assumes the SSD120-(XX)M is installed within an altimeter referenced to 29.92 In.Hg.(1013.25MB) The technician must be capable of adjusting the input pressure to run the encoder/digitizer and altimeter to a stable pressure altitude, and then enter this altitude into an IBM compatible computer which will transmit the correction to the digitizer's error table.

4.2 SSD120-(XX)M Calibration Adjustment Procedure

This procedure is used to match the encoder/digitizer output to the flight altimeter.

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 **Wiring Harness Diagram 881668**.

2. Connect the digitizer, computer and altimeter as shown in the **Calibration Block Diagram 881669**, and energize. Set the altimeter barometric reference to 29.92In.Hg. 1013.25MB.

3. Open the **Hyper Terminal** program as described in **§4.3**.

4. The digitizer output should now be displayed on the PC screen with 10-foot resolution.

   (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 **<enter>** and begin again.

5. Change 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. **§4.7** provides a table to give the technician a record of changes required and implemented.

   NOTE: No digitizer correction is possible at the -1000 foot mark.)

6. Change the input pressure to -1000 feet and begin to compare the altitude digitizeroutput, 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. (**§ 4.7** provides a table to give the technician a record of changes required and implemented.)

   (Note: no digitizer correction is possible at the -1000 foot mark.)
   The following procedure allows changes to the error curve of the digitizer.

7. Connect the encoder/digitizer as shown in the **Calibration Block Diagram 881669.**
8. Adjust the input pressure until the altimeter is exactly reading a 1000 footmark. Note the difference between the digitizer and the altimeter. For example:
9. Adjust the input pressure until the altimeter is reading 10,000 feet. In this case the altimeter reads 20,000 feet and the encoder/digitizer reads 20,080.

   Type "**ADJ<enter>**" the computer should now display "**A=**"
   Type "**S20 <enter>**"
   (**S20** represents **Save 20,000feet**)

   The digitizer will now output 20,000 based on the altimeter reading. And the PC will display the altitude at which the digitizer will make this change. In the example above the PC would display **>20000.**

10. Proceed to the next 1000 foot mark and repeat the procedure as in step 3 above until the entire operating range of the altimeter encoder/digitizer is complete.

(Note: If no correction is required at an altitude, simply do not enter a correction.)

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

00= 000	01= 000	02= 000	03= 000	04= 000	05= 000
06= 000	07= 000	08= 000	09= 000	10=-080	11= 000
12= 000	13= 000	14= 000	15= 000	16= 000	17= 000
18= 000	19= 000	20= -080	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	46= 000	47= 000
48= 000	49= 000	50= 000	51= 000	52= 000	53= 000
54= 000	55= 000	56= 000	57= 000	58= 000	59= 000
60= 000	61= 000	62= 000	63= 000	64= 000	65= 000
66= 000	67= 000	68= 000	69= 000	70= 000	71= 000
72= 000	73= 000	74= 000	75= 000	76= 000	77= 000
78= 000	79= 000	80= 000	81= 000	82= 000	83= 000
84= 000	85= 000	86= 000	87= 000	88= 000	89= 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.

Type **Q** twice to exit the **ADJ** mode.

4.3 Required Equipment for Calibration:

(See Calibration Block Diagram 881669.)

1. SSD120-(XX)M installed within a flight altimeter.

2. +12 to 28VDC power supply.

3. IBM compatible computer with an available serial port.
   Software requirement: **Windows 98®** using **Hyper Terminal** Ver. 5.0 by Hilgraeve.
   (Available as a free download at http://www.hilgraeve.com)(Software Note: The **Hyper Terminal** program which is shipped with **Windows 98®** will not function correctly. You must download version 5.0 or better to use this calibration program.)

4. Digitizer/PC interface cable. (See wiring harness diagram or order 881668 from
   Trans-Cal Industries.)

5. Vacuum/pressure source and control capable of exercising the digitizer/altimeter, pressure standard over the digitizer's operating range. (Optional: ATS-400 or equal device which will allow the display of the parallel 100 foot altitude data.)

4.4 Hyper Terminal Software Set-Up on the IBM Compatible PC

Boot up the computer and start the **Hyper Terminal** program. **Hyper Terminal** may be located in the **Programs Section** or in the **Accessories Section** under **Communications** .

Under the **New Connection** window. (Identifies the new connection.) - Choose an icon then select an identifying title such as “Test.” Select **OK** after you have made your choices.

Under the **Connect to** window (Selects the Com port to use.) -Choose **Connect Using Com 1** or whatever **Com** port you have chosen to use. After your selection click on **OK.**

Under the **Com ? Properties**, (Sets communication properties.) Under the **Port Settings** tab, set the following:

Bits per second:	**9600**
Data bits:	**8**
Parity:	**None**
Stop Bits:	**1**
Flow Control:	**None**

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.

4.5 SSD120-(XX)M Serial Port Software Configuration

This device incorporates two separate RS232E compatible outputs which may be configured via software to transmit 2 different altitude data protocols simultaneously.

1. Construct a wiring harness per the **Wiring Harness Diagram 881668**. (This harness may be ordered directly from Trans-Cal Industries. Please specify 9 pin or 25 pin connector.)

2. Connect the digitizer to an IBM compatible computer running Hyperterminal as described in **§ 4.3** and as shown in the **Calibration Block Diagram 881669.** Assign the serial port protocols as follows:

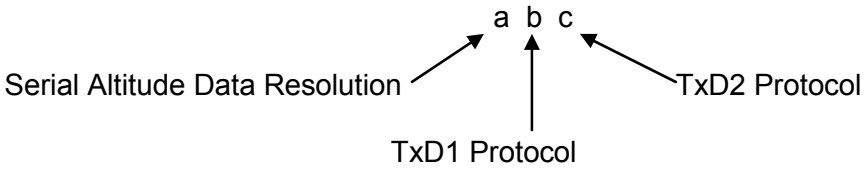
Apply power to the digitizer and after the data appears on the PC screen type the following:

Type <enter> The Digitizer will return "?> current altitude"

Type ADJ <enter> Access the digitizer adjustment program.
The Digitizer will return A=

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

The Interface Adapter responds with a three-digit number as follows:



(a) The first digit represents the serial altitude data resolution.
- 0 = Use D-Sub connector protocol hardware jumpers.
- 1 = 100 foot resolution on TxD1 and TxD2.
- 2 = 10 foot resolution on TxD1 and TxD2.

(b) The second digit represents the protocol selection for TxD1.
- 0 = Use D-Sub connector protocol hardware jumpers.
- 1 = UPS Aviation Technologies. 1200 bps.
- 2 = Trimble/Garmin. 9600bps.
- 3 = Northstar. 2400bps.
- 4 = Magellan. 1200bps.
- 5 = ARNAV. 9600bps.

(c) The third digit represents the protocol selection for TxD2.
- 0 = Use D-Sub connector protocol hardware jumpers.
- 1 = UPS Aviation Technologies. 1200 bps.
- 2 = Trimble/Garmin. 9600bps.
- 3 = Northstar. 2400bps.

4 = Magellan. 1200bps.
5 = ARNAV 9600bps.

Example:

Type **P212<enter>** Defined as **10 foot** resolution on TxD1 and TxD2. **UPS Aviation Technologies** protocol transmitted on TxD1. **Trimble/Garmin** protocol transmitted on TxD2.

Type **Q** twice to exit the adjustment mode.

4.6 Configuration and Calibration Command List

Following is a list of commands which will operate in this Calibration mode.

Top Level Menu

ADJ <enter> Enter adjustment mode.

Q **Quit command.** Returns to normal operation.

Sub-Menu

CLR <enter> **Clear** command clears error table data.

D <enter> **Dump** to list all error table data.

P<enter> **Port status** command, displays the current port status. See **§ 4.4.**

Pabc<enter> **Port command,** sets the serial port resolution and protocol. See **§4.4.**

Q **Quit command.** Returns to top level menu.

Saa<enter> **Save** to error table, 1000 foot altitude (aa) mark at current input pressure.

NOTES:

Backspace does not function. If a typing error occurs hit **<enter>** and begin again.

A maximum error of ±499 feet may be introduced at any one altitude.

CLR clears all error data in the EEPROM.

4.7 Error Correction Table

Altitude	Correction		Altitude	Correction		Altitude	Correction
-1000			26000			53000	
0			27000			54000	
1000			28000			55000	
2000			29000			56000	
3000			30000			57000	
4000			31000			58000	
5000			32000			59000	
6000			33000			60000	
7000			34000			61000	
8000			35000			62000	
9000			36000			63000	
10000			37000			64000	
11000			38000			65000	
12000			39000			66000	
13000			40000			67000	
14000			41000			68000	
15000			42000			69000	
16000			44000			70000	
17000			45000			71000	
18000			46000			72000	
19000			47000			73000	
20000			48000			74000	
21000			50000			75000	
22000			48000			76000	
23000			50000			77000	
24000			51000			78000	
25000			52000			79000	
						80000	

Encoder/Digitizer / Transponder Interconnections

The following encoder/digitizer/transponder 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 transponder manufacturer.

Table I

SSD120 26 Pin Conn.	Function	King KT76/78 Pin Number	King KT-76A/78A Pin Number	King KXP Pin Number
N	D2	**1	**1	**1
L	D4	**1	**1	V
K	A1	6	M	G
J	A2	7	K	H
H	A4	9	J	J
G	B1	4	E	K
F	B2	1	C	L
E	B4	2	B	M
D	C1	3	D	P
C	C2	8	L	R
B	C4	10	H	S
A	Strobe (Signal Common)	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.
b	Ground	Connect to aircraft ground.	Connect to aircraft ground.	Connect to aircraft ground.

Data for this connection is not available at this time.

Table II

SSD120 26 Pin Conn.	Function	Cessna RT359A, RT459A,RT859A Pin Number	Narco AT-150, AT-50, AT-50A Pin Number	Narco AT-6A AT-5, AT-6 Pin Number	Garmin GTX 327 Pin Number
N	D2	No connection	No connection	No connection	No connection
L	D4	10	No connection	No connection	18
K	A1	14	7	2	3
J	A2	13	6	4	5
H	A4	15	8	8	6
G	B1	19	12	9	9
F	B2	17	10	10	11
E	B4	16	9	11	12
D	C1	21	14	1	10
C	C2	18	11	3	4
B	C4	20	13	5	7
A	Strobe (Signal Common)	11	5	12	13 or 25 or aircraft ground.
a	14 to 28VDC Input	9	18	13	14 to 28VDC Input
b	Ground	Connect to aircraft ground.	Connect to aircraft ground.	14	Connect to aircraft ground.

Serial Data Connection for the Garmin GTX327 Transponder

SSD120-(XX)M 26 Pin Connector	Function	GTX 327 25 Pin Conn.
U or X	TxD to RxD	19
R or W	Ground	13 or 25

Configure the SSD120-(XX)M for Trimble/Garmin protocol. See § 4.4.

To allow the Garmin GTX 327 transponder to communicate with the SSD120-(XX)M go to the Setup **Page** and set the **Altitude Source** (ALT SRC) to receive data in the Icarus RS232 format.

Table III

SSD120 26 Pin Conn.	Function	Edo-Air RT-777 Pin Number	Genave Beta 5000 Pin Number	Collins TDR950 Pin Number	Radair 250 Pin Number
N	D2	No connection	No connection	No connection	No connection
L	D4	15	0	3	15
K	A1	7	4	12	7
J	A2	5	5	10	6
H	A4	3	6	7	13
G	B1	12	7	6	9
F	B2	13	8	5	10
E	B4	14	9	4	11
D	C1	8	10	8	14
C	C2	6	11	11	16
B	C4	4	12	9	12
A	Strobe (Signal Common)	2	3	Connect to aircraft ground.	19
a	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	Ground	2	Connect to aircraft ground.	Connect to aircraft ground.	Connect to aircraft ground.

Table IV

SSD120 26 Pin Conn.	Function	Bendix TPR-2060 Pin Number	Bendix TR641 A/B Pin Number	Wilcox 1014A pin Number	UPS AT Apollo SL70 Pin Number
N	D2	**4	**4	**4	**4
L	D4	0	N	c	35
K	A1	4	A	k	13
J	A2	6	B	C	31
H	A4	8	C	W	12
G	B1	9	D	T	33
F	B2	10	E	L	14
E	B4	11	F	D	32
D	C1	3	H	P	16
C	C2	5	J	f	34
B	C4	7	K	Z	15
A	Strobe (Signal Common)	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.
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)M 26 Pin Connector	Function	UPS AT SL70
U or X	TxD to RxD	4
R or W	Ground	3

To allow the **UPS AT SL70** transponder to accept serial data from the SSD120-(XX)M-RS232 go to the **Test Mode** on the **SL79 Conf** page and set the **Altitude Source (ASrc)** to receive **Serial (Ser)** data. On the **BAUD** page select **1200**. See **§ 4.4** for SSD120-(XX)M protocol assignment data.

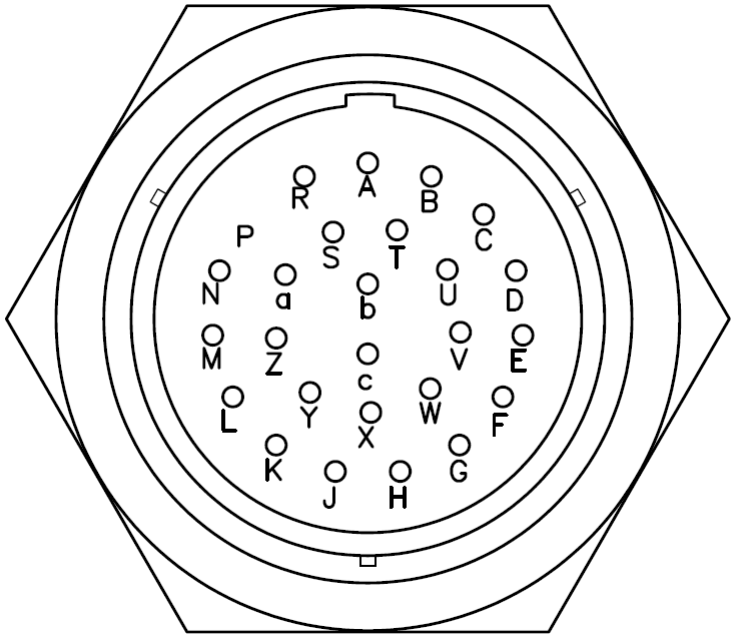
26 Pin Connector Assignments

Table V

Pin	Function	Pin	Function
A	Strobe (Signal Common)	**P**	+28Vdc Vibrator (#28AWG Red External Wire)
B	C4	**R**	Serial Data Ground
C	C2	**S**	Baro. Set (+) (#28AWG Yellow External Wire)
D	C1	**T**	Baro. Set Signal (#28AWG Blue External Wire)
E	B4	**U**	TxD2
F	B2	**V**	RxD
G	B1	**W**	Serial Data Ground
H	A4	**X**	TxD1
J	A2	**Y**	Program
K	A1	**Z**	Baro. Set (-) (#28AWG Brown External Wire)
L	D4	**a**	+28Vdc Encoder Power Input
M	Vibrator Ground (#28AWG Black External Wire)	**b**	Encoder Ground
N	D2	**c**	+28Vdc Flag Power (#28AWG Orange External Wire)

Figure 2 Connector Pin Locations

Top View



GPS Connection Data

Given the speed with which new GPS 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 manufacturer.

UPS Aviation Technologies (IIMorrow)

Apollo GX50, GX60, GX65 Signal	Apollo 37 Pin D-Sub Connector	SSD120-(XX)M 26 Pin Connector
RxD2	21	U or X
Ground	20	R or W
		Optional, configure the SSD120-(XX)M for 10' resolution. See § 4.4.

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

Apollo MX20 Signal		Apollo 37 Pin D-Sub Connector	SSD120-(XX)M 26 Pin Connector
RxD2		21	U or X
Ground		3	R or W
			Optional, configure the SSD120-(XX)M for 10' resolution. See § 4.4.

Apollo MX20 Software Configuration Under External Data Source set altitude source to **Port 2**.

Trimble 2101 Approach Plus GPS Receiver

Trimble Signal	Trimble 2101 Port 1	Trimble 2101 Port 2	SSD120-(XX)M 26 Pin Connector
RxD+	7	24	R or W
RxD-	8	36	U or X
Ground	3 or 20	3 or 20	R or W
			Configure the SSD120-(XX)M for Trimble/Garmin protocol. See § 4.4.
			Optional, configure the SSD120-(XX)M for 10' resolution. See § 4.4.

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)M 26 Pin Connector
RxD+	J1-7	J1-24	R or W
RxD-	J1-8	J1-36	U or X
Ground	J1 - 3 or 20	J1 - 3 or 20	R or W
			Configure the SSD120-(XX)M for Trimble/Garmin Protocol. See § 4.4.
			Optional, configure the SSD120-(XX)M for 10' resolution. See § 4.4.

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**.

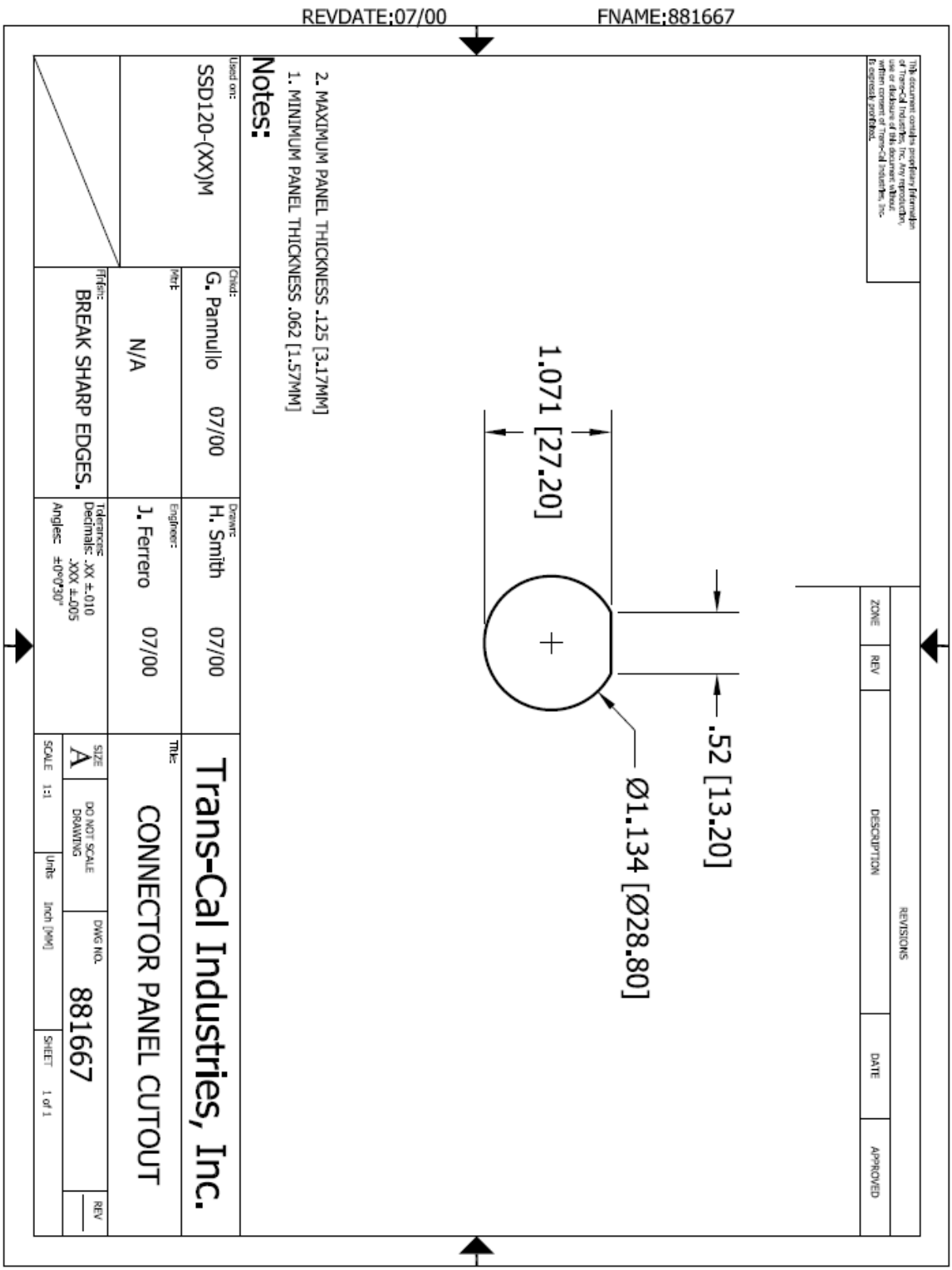
Garmin International Garmin 400 Series GPS Devices

Garmin 78 Pin Conn. (P4001)	Function	SSD120-(XX)M 26 Pin Connector
57	TxD	U or X
77 or 78	Ground	R or W
		Configure the SSD120-(XX)M for Trimble /Garmin Protocol. See § 4.4.
		Optional, configure the SSD120-(XX)M for 10' resolution. See § 4.4.

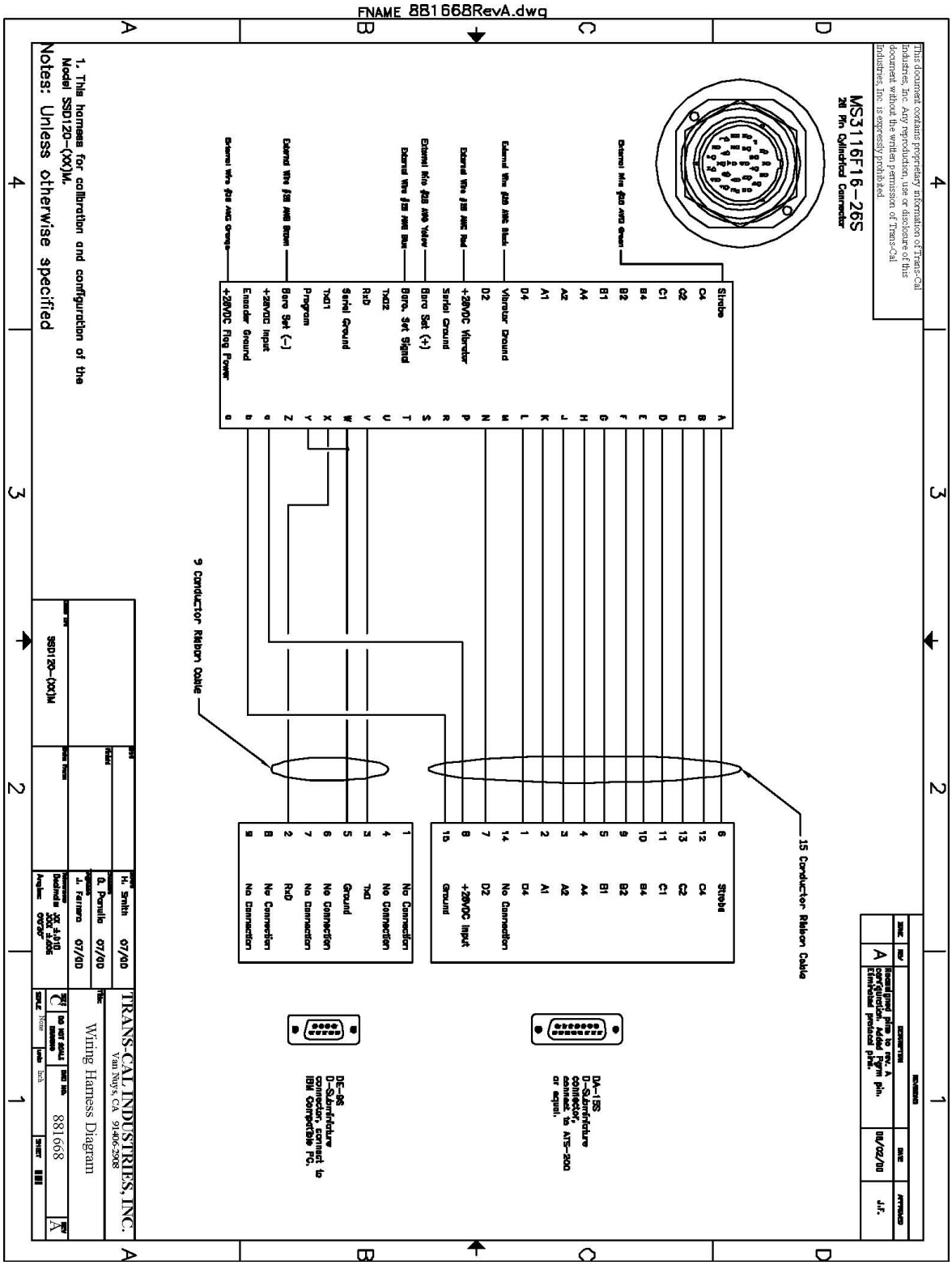
Garmin 400 series GPS software configuration

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

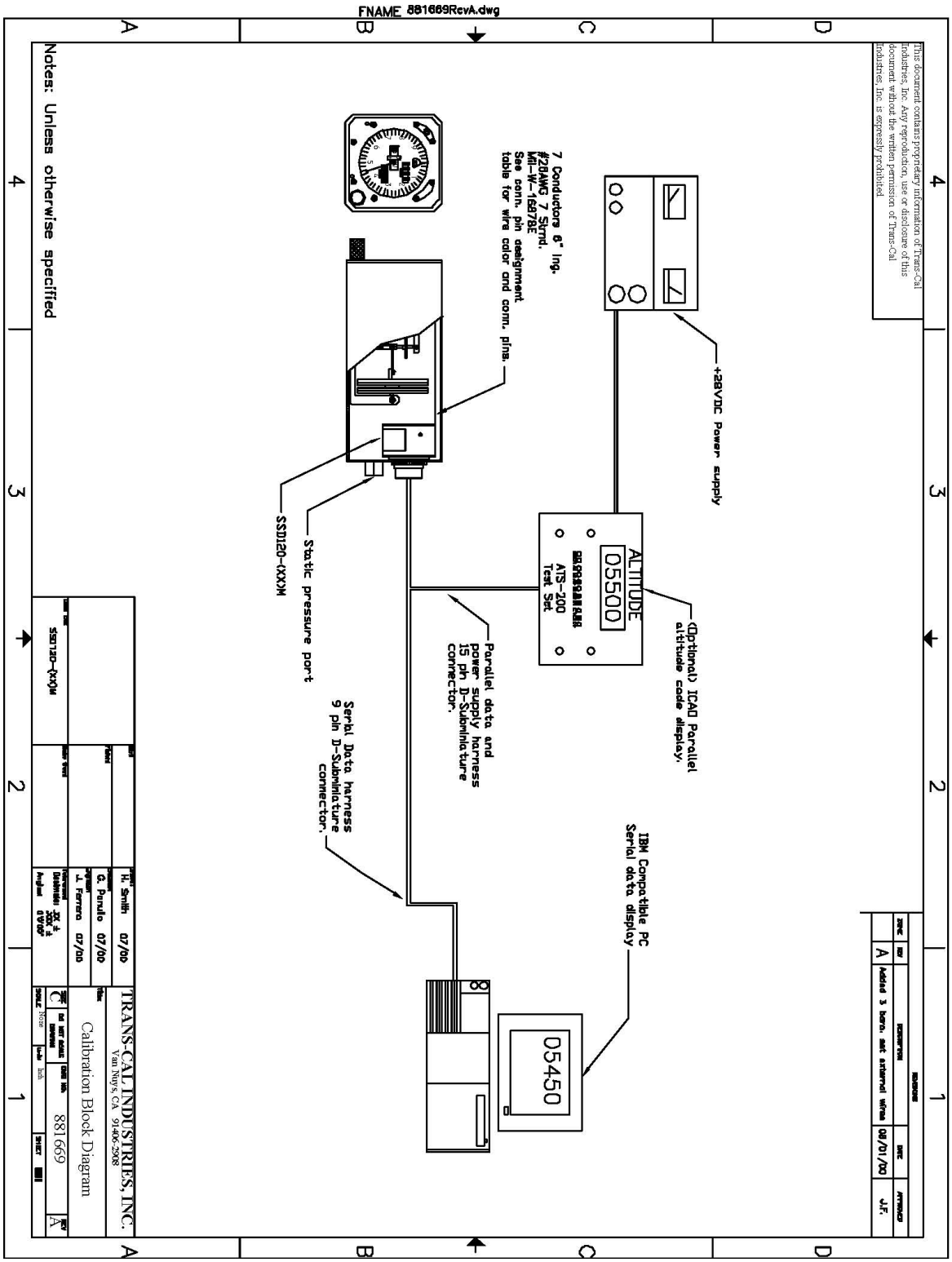
26 Pin Connector Cutout 881667

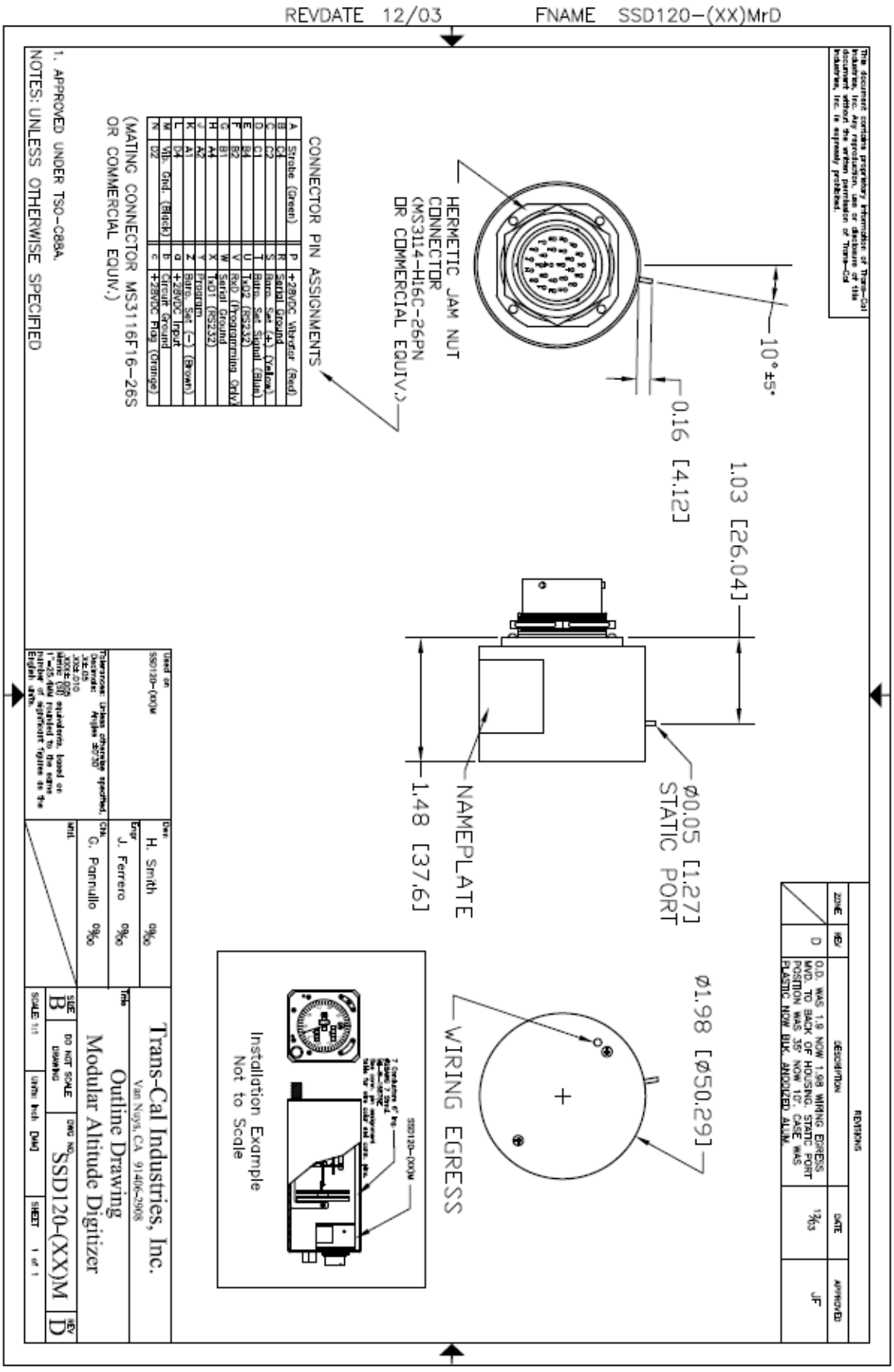


Wiring Harness Diagram 881668

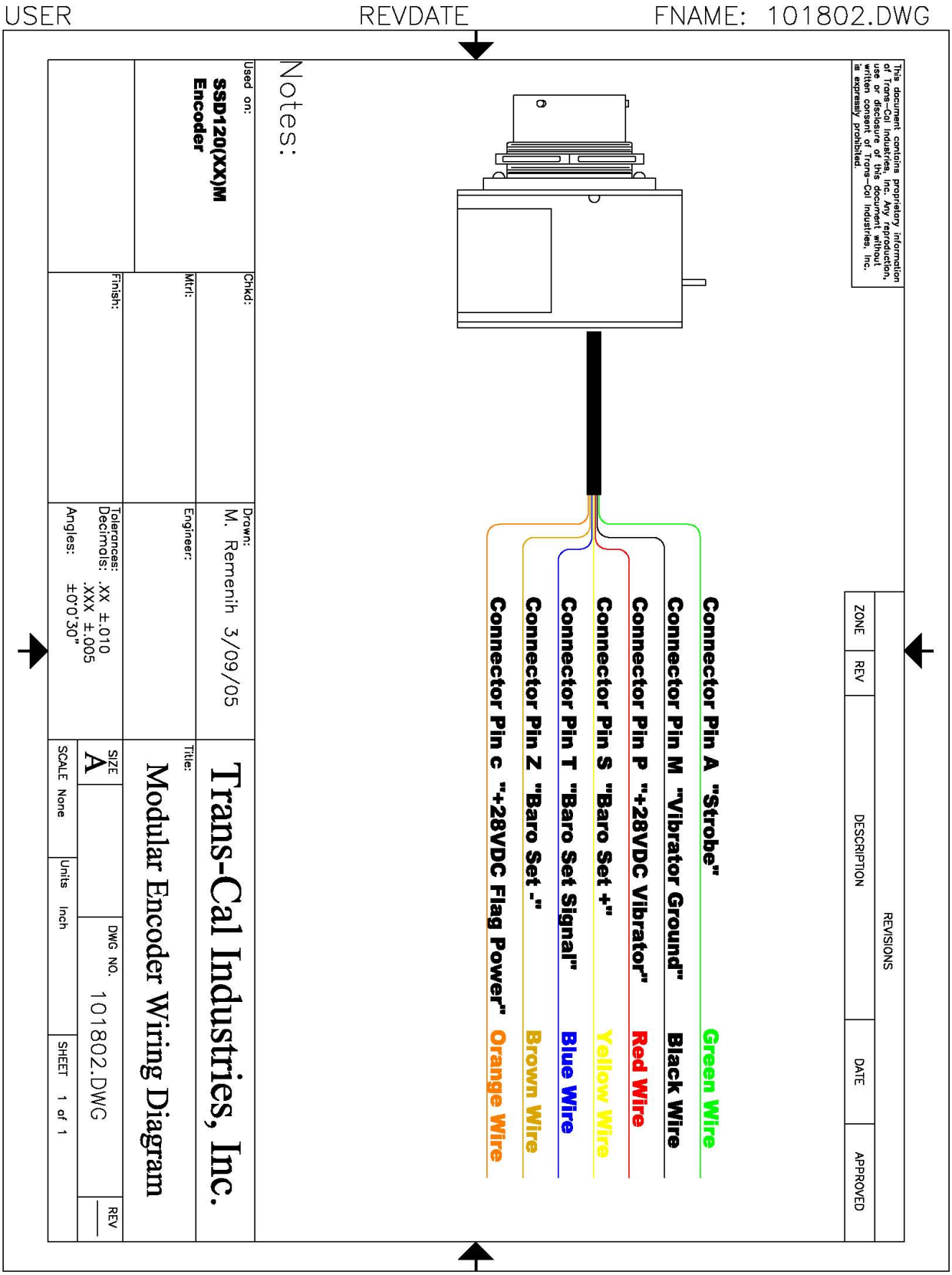


Calibration Block Diagram 881669




REVDATE 12/03
FNAME SSD120-(XX)MrD
10°±5°
0.16 [4.12]
1.03 [26.04]
HERMETIC JAM NUT CONNECTOR (MS3114-H16C-26PN OR COMMERCIAL EQUIV.)
CONNECTOR PIN ASSIGNMENTS
Ø0.05 [1.27] STATIC PORT
NAMEPLATE
1.48 [37.6]
Ø1.98 [Ø50.29]
WIRING EGRESS
Installation Example Not to Scale
SSD120-(XXX)M
(MATING CONNECTOR MS3116F16-26S OR COMMERCIAL EQUIV.)
NOTES: UNLESS OTHERWISE SPECIFIED
1. APPROVED UNDER TSO-C88A.
REVISIONS
ZONE REV DESCRIPTION DATE APPROVED
D O.D. WAS 1.9 NOW 1.98 WIRING EGRESS MVD. TO BACK OF HOUSING. STATIC PORT POSITION WAS 35° NOW 10°. CASE WAS PLASTIC NOW BLK. ANODIZED ALUM. 12/03 JF
Trans-Cal Industries, Inc.
Van Nuys, CA 91406-2908
Outline Drawing
Modular Altitude Digitizer
SSD120-(XX)M
SIZE B
DO NOT SCALE DRAWING
SCALE 1:1
SHEET 1 of 1

Wiring Diagram 101802



WARRANTY REGISTRATION

Trans-Cal Industries warrants each Model SSD120-(XX)M Solid State digitizer / serializer to be free of defects in workmanship and materials for a period of 18 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 filled out 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-(XX)M SERIAL NO: M-_____
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 done to industry standards. I further certify the instrument was properly working on the above date.

SIGNED:_____

PRINT NAME:_____