Trans-Cal Industries, Inc.

Model SSD120-(XX)A & Model SSD120-(XX)AE

All Solid State

High Altitude Series 85,000 to 100,000 Feet

Altitude Encoder/Digitizer

Owner/Installation Manual

T.S.O. C88a Approved

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Please Note:

It is the responsibility of the installer of this equipment, within a specific type or class of aircraft,
to determine that the aircraft operating conditions are within TSO standards.

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	07/98	Production release.
A	03/00	Added TDR950 & SL70 data Table IV. Changed Oper. Voltage +14 to +9 page 1.
B	04/00	Added GTX327 Data Table II & GPS Connection Data.
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D	12/00	Revised serial port data.
E	9/04	Updated Manual.

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Section 1.0 Introduction

1.1 Scope

This manual provides detailed installation, calibration and operating instructions for Trans-Cal Industries' Model SSD120-(XX)A and SSD120-(XX)AE[1] series of high altitude (85,000 feet and above) encoder/digitizer.

1.2 Equipment Description

Approved under F.A.A. TSO-C88a, the Model SSD120-(XX)A and SSD120-(XX)AE 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. The serial data protocol is individually selectable for each port (refer to **Table V** & **VI** and **Section 4.4**) and may be used to provide pressure altitude data to GPS or other on board navigation devices.

1.3 General Specifications

Operating Voltage:	Model SSD120-(XX)A	+9 to 30 VDC.
	Model SSD120-(XX)AE [2]	+26 to 30 VDC.
Operating Current:	Model SSD120-(XX)A	0.1 Amps.
	Model SSD120-(XX)AE	0.1 Amps. 0° to +70°C.
	Model SSD120-(XX)AE	1.0 Amps. 0° to -55°C.

Operating Temperature: Model SSD120-(XX)A -20° to +70°C. Model SSD120-(XX)AE -55° to +70°C.
Storage Temperature (non-operating) all models: -65°C to +85°C.
Weight: 17 oz.

1
SSD120-(XX)AE Extended operating temperature range: -55°C to +70°C.

2
The low temperature heat circuit is designed to be operated at +28VDC, but the SSD120-(XX)AE model may be operated at +12VDC if the operating temperature does not fall below 0°C.

1.3.1 Operating Altitude

Model SSD120-85A( ) -1000 to +85,000 feet. Model SSD120-100A( ) -1000 to +100,000 feet.

1.3.2 Accuracy

Model SSD120-(XX)A:
Accuracy throughout operating temperature range -20° to +70°C
-1000 to +42,000 feet ±50 feet.
+42,100 to +62,000 ±75 feet.
+62,100 to maximum altitude ±125 feet.

Model SSD120-(XX)AE
Accuracy from -30° to +70°C:
-1000 to +42,000 feet ±50 feet.
+42,100 to +62,000 feet ±75 feet.
+62,100 to maximum altitude ±125 feet.

Accuracy from -55° to -31°C:
-1000 to +42,000 feet ±75 feet.
+42,000 to +62,000 feet ±125 feet.
+62,100 to maximum altitude ±175 feet.

Accuracy after 15 minute warm-up at -55°C: (See figure 1 for warm-up/start-up time.) -1000 to +42,000 feet ±50 feet. +42,100 to +62,000 feet ±75 feet. +62,100 to maximum altitude ±125 feet.

1.3.3 Serial Port Altitude Data Resolution

The default resolution of the altitude digitizer serial data is 100 feet. To enable 10 foot resolution, connect pin 2 of the 9 pin D-Subminiature connector to ground (see **Table V**.) The serial port resolution may also be configured via software, see **Section 4.4.**

1.3.4 Mechanical Characteristics

Model Number	Dimensions	Weight
Model SSD120-85A( )	*See Outline Drawing*	17 oz.
Model SSD120-100A( )	*See Outline Drawing*	17 oz.

1.3.5 Environmental

All model SSD120-(XX)A( ) digitizers have been designed, tested and approved under the requirements of TSO-C88a, in accordance with RTCA Document DO160b, dated July 1984 (specifics provided upon request.)

1.3.6 Over Range

The SSD120-(XX)A( ) series of altitude digitizers will not be damaged when operated beyond their specified maximum altitude up to pure vacuum feet MSL, or over pressured to 18 psi max.

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 50VDC.

Maximum Sink Current:

25 milliamperes.

Maximum Cable Length:

4000 feet.(1219 meters)

Input Signal Requirement:

Pin 6 (strobe or signal common) must be either grounded or connected to the transponder.

1.5 Serial Port Specifications

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

Logic Levels:
"0", +9 volts. Logic "1", -9 volts.

Driver Output Maximum Voltage:
±25 VDC.

Driver Load Impedance:
3KOhm typ.

The TIA/EIA RS232E standard recommends one receiver per serial port.

Maximum Cable Length:
50 Feet.(15.24 meters)

Code Format:
ASCII

Communication System:
Simplex (Talk Only).

Transmission Method:
Asynchronous.

Transmission Rate:
Selectable, 1200 bps to 9600 bps.

Update Rate:
10/sec.

1.6 Serial Communication Format

Model SSD120-(XX)A( ) carries out serial communication asynchronously with the "Start/Stop" system. The specifics of the format, i.e. the number of data bits, baud rate etc., is determined by the protocol selected.

1.7 Serial Communication Protocol
(Refer to Table V & VI and Section 4.4)

Protocol is user selectable by grounding or leaving open pin 6 or pin 7 of the 9 pin D-Subminiature connector, or by selecting protocols via software see **Section 4.4. Note: The following hardware jumpers will override any software settings described in Section 4.4.**

Leaving pin 6 and 7 of the 9 pin connector open results in a protocol compatible with UPS Aviation Technologies' (IIMorrow) Navigation devices. At a baud rate of 1200 bps the Digitizer sends 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. Examples of serial messages for (IIMorrow) devices:

Message: Definition:
#AL +00800T+25D8r Altitude 800 feet

Grounding pin 7 of the 9 pin connector results in a protocol compatible with some navigation devices manufactured by Trimble and Garmin. At a baud rate of 9600 bps the Digitizer sends a ten byte message. The message begins with ALT followed by a space and five altitude bytes; concluding with a carriage return. Examples of serial messages for Trimble or Garmin devices:

Message:	Definition:
ALT 99900 ⏎	Digitizer disabled.
ALT 10500 ⏎	Altitude 10,500 feet.

Grounding pin 6 of the 9 pin connector results in a protocol compatible with some navigation devices manufactured by Northstar and Garmin. At a baud rate of 2400 bps the Digitizer sends a 10 byte message. The message begins with ALT followed by a space and five altitude bytes; concluding with a carriage return. Examples of serial messages for these devices:
Message Definition:
ALT 02500 r Altitude 2500 feet.
ALT -2500 r Digitizer disabled.

Grounding both pins 6 and 7 of the 9 pin connector results in a protocol compatible with some navigation devices manufactured by Magellan. At a baud rate of 1200 bps 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. Examples of serial messages for Magellan devices:
Message Definition:
$MGL+02500T+25D6 r Altitude 2500 feet.

Section 2.0 Operation

2.1 General

The SSD-120(XX)A( ) series of altitude digitizer's are designed to be mounted within a pressurized or non-pressurized, but temperature controlled area within aircraft operating up to 100,000 feet MSL. Usually remotely located, the digitizer is fully automatic in operation. The parallel data output is controlled by the transponder while the serial altitude data is transmitted asynchronously.

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. Upon power-up the parallel data will assume the value for the present input pressure. In some installations, the transponder controls the digitizer by enabling and disabling its outputs. In other installations, the digitizer's output is not controlled by the transponder and is continuously enabled, (Digitizer pin 6 is grounded.)

Serial Data The serial communication is fully automatic and transmission begins after the self-test/warm-up is complete. Strobing the parallel data output of the digitizer will not affect the serial data transmission.

Section 3.0 Installation and Calibration

3.1 Mechanical Installation

The SSD120(XX)A( ) series of digitizer may be mounted in any attitude within the internal structure of the aircraft. DO NOT mount the digitizer in the direct airstream of either hot or cold air ducts. The mounting position should allow for a short pressure line from the digitizer to the altimeter, access to the digitizer's adjustments, and ample room for a service loop for the interconnecting cabling to the transponder.

Use #4-40 machine screws, sheet metal screws, or pop rivets to attach the digitizer or the mounting tray to the airframe. Secure mating connectors to the digitizer housing using the #4-40 screws provided. Refer to the outline drawing for mechanical dimensions and the installation block diagram.

3.2 Electrical Installation

The digitizer is designed to operate with either a 14 or 28 VDC power source. These voltages can be A+ switched power provided by the transponder or can be provided by the avionics buss. If using the avionics buss, protect the circuit with a fuse or circuit breaker.

Parallel Data Connection The outline drawing provides 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 (**Table V** lists the pin assignments for the serial port connector.) Connect the TxD1 or TxD2[3] (transmit data) from the 9 pin D-Subminiature connector to the RxD (receive data) port on the GPS or other navigation device. All grounds on the 9 pin D-subminiature 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. Pin 3 (RxD) of the 9 pin connector is used for calibration only. See **Table V** for connector pin assignments, **Section 4.4** for software assigned protocols, and **Section.**

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

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 ways to test the output of the serial port:

1. 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).

2. Use a dedicated serial data test box such as the BLACK BOX™ RS232 Monitor.
   c) Test for a serial output using an oscilloscope to view the 9 VDC square wave
   transmitted about ten times a second.

3.4 Parallel Altitude Data Port Test Equipment

The output of the parallel altitude data may be monitored by any number of transponder ramp test sets which allow display of the altitude digitizer/encoder code. Alternatively, the Trans-Cal Industries' ATS-200 may be used to display the parallel data.

The selected serial data protocol is transmitted simultaneously on both TxD1 and TxD2, unless assigned separately via **Serial Port Software Configuration** see **Section 4.4** .

Section 4.0 Calibration and Configuration

4.1 Calibration Overview

This procedure will allow adjustment to the calibration curve of the SSD120-(XX)A or SSD120-(XX)AE 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 ±125 feet as required by TSO-C88a. All Trans-Cal digitizers are calibrated to NIST traceable pressure standards; however, the error allowed on altimeters at higher altitudes can lead to a combined error in excess of ±125 feet. This device may be adjusted utilizing an externally addressable EEPROM which is configured to accept an alternate altitude error curve entered to the digitizer via an IBM compatible PC.

As an alternative to Dynamic Calibration the span of the transducer itself may be adjusted via the span adjust procedure. The technician may perform which ever procedure seems best suited for the application at hand. It is not required to perform both procedures.

4.2 Required Equipment Dynamic Calibration:

(See dynamic calibration block diagram.)

1. Primary flight altimeter or NIST traceable pressure standard.

2. +12 to 28VDC power supply.

3. IBM compatible computer with an available serial port.

4. 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 calibrate this device.)

5. A pitot-static test set, capable of exercising the altimeter and digitizer over a range of -1000 feet to the maximum altitude of the digitizer.

6. *Optional*: ATS-200 or equal device which will allow the display of the 100 foot resolution parallel altitude data.

4.3 Hyper Terminal 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.

4.4 Serial Port Software Configuration

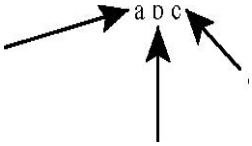
This device incorporates two separate RS232E compatible outputs which may be configured via software to transmit 2 different altitude data protocols simultaneously.

Connect the digitizer to an IBM compatible computer running Hyperterminal as described in **Section 4.3** 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 data will appear on the PC screen.

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

Serial Altitude Data Resolution



TxD2 Protocol

TxD1 Protocol

1. 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.
2. The second digit represents the protocol selection for TxD1.0= 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.
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.

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.

4.5 Dynamic Calibration Adjustment Procedure

1. Construct a wiring harness per the wiring harness diagram. (This harness may be ordereddirectly from Trans-Cal Industries. Please specify 9 pin or 25 pin connector. Request P/N: 881404.)
2. Connect the digitizer, computer and altimeter as shown in the test set-up diagram, andenergize.
3. Open the **Hyper Terminal** program as described in **Section 4.5.**
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. Set the altimeter barometric input to 29.92 In. Hg. 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. (Section 4.9 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. Type **<enter**> the Digitizer will respond with **?>(current altitude)**
7. Type **ADJ <enter>** The computer will respond with **A=**

CAUTION: Always refer to the altimeter and VSI manufacturer's data for maximum rate of climb or descent and any special test conditions which must be complied with.

8. Adjust the input pressure until the altimeter is exactly reading a 1000 foot mark. Note thedifference between the digitizer and the altimeter and adjust as required.

Example:

The altimeter reads 10,000 and the digitizer reads 10,080.
Type "S10 <enter>"
(S10 represents Set 10,000feet)
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 above the PC would display >10000.

9. Proceed to the next 1000 foot mark and repeat the procedure, as in step 8 above, until the entire operating range of the digitizer is completed.

4.5 Dynamic Calibration Adjustment Procedure(continued)

(Note: If no correction is required at an altitude simply do not enter a correction. The technician does not have to enter 000.)
You may quit the adjustment program at any time by typing "**Q**" twice, the digitizer output will then be displayed on the PC screen.

10. After completing the above procedure you may examine the corrections entered into theEEPROM. Type "**D<enter>**" to dump 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=-080	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	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	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	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.

4.6 Configuration and Dynamic Calibration Command List

Following is a list of commands which will operate in the **ADJ** mode using **Hyper Terminal**.

Top Level Menu:

ADJ <enter> Enter Adjustment mode.

Q <enter> Quit and return to operate mode.

Sub-Menu

CLR <enter> **Clear** all EEPROM data.

D <enter> **Dump** to list all EEPROM data.

P <enter> Displays current serial **Port** settings, see **Section 4.6 Serial Port Software Configuration.**

Pabc<enter> **Port** protocol select, see **Section 4.6 Serial Port Software Configuration.**

Q<enter> **Quit** and return to top level menu.

Saa<enter> **Set** digitizer to 1K altitude (**aa**) mark at current input pressure.

NOTES:

1. Backspace does not function. If a typing error occurs hit <enter> and begin again.
2. 1K altitude values 90 to 99 in EEPROM contain factory calibration data and are not customer accessible.
3. A maximum error of ±499 feet may be introduced at any one altitude.
4. CLR clears *all* error data in the EEPROM.
5. ERR indicates syntax error.

4.7 Error Correction Table

Altitude	Correction	Altitude	Correction	Altitude	Correction	Altitude	Correction
-1000		25000		51000		77000	
0		26000		52000		78000	
1000		27000		53000		79000	
2000		28000		54000		80000	
3000		29000		55000		81000	
4000		30000		56000		82000	
5000		31000		57000		83000	
6000		32000		58000		84000	
7000		33000		59000		85000	
8000		34000		60000		86000	
9000		35000		61000		87000	
10000		36000		62000		88000	
11000		37000		63000		89000	
12000		38000		64000		90000	
13000		39000		65000		91000	
14000		40000		66000		92000	
15000		41000		67000		93000	
16000		42000		68000		94000	
17000		43000		69000		95000	
18000		44000		70000		96000	
19000		45000		71000		97000	
20000		46000		72000		98000	
21000		47000		73000		99000	
22000		48000		74000			
23000		49000		75000			
24000		50000		76000			

4.8 Required Equipment Span Adjust: (See span adjust block drawing.)

1. NIST traceable pressure standard. Accuracy better than 0.05% FS is required, 0 to 15 psi.
2. +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 special order from Trans-Cal.)
5. Vacuum and pressure source and control capable of exercising the digitizer/pressure standard over the digitizer's operating range. (Note: The static system needs to be very stable or nearly leak free.)

   (Optional: ATS-200 or equal device which will allow the display of the parallel 100 foot altitude data.)

4.9 Span Adjust Procedure

1. Construct a wiring harness per the wiring harness diagram.
2. Connect the digitizer and computer as shown in the span adjust test set-up diagram, andenergize.
3. Open and configure the **Hyper Terminal** program as described in Section 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**.)
5. Adjust input pressure until the pressure standard reads the maximum operating altitude of the

Note: Backspace does not function in **Hyper Terminal**. If a typing error occurs, hit **<return>** and begin again.
digitizer.

SSD120-50A(E)	50,000 feet	3.4247 In.Hg.
SSD120-62A(E)	62,000 feet	1.9237 In.Hg
SSD120-65A(E)	65,000 feet	1.6654 In.Hg.
SSD120-80A(E)	80,000 feet	0.8155 In. Hg.

4.9 Span Adjust Procedure(continued)

6. Note the digitizer pressure as displayed on the **Hyper Terminal**. Calculate the digitizer error:

Example:

The pressure standard reads **62,000** and the digitizer serial output on the PC reads: **ALT 61,910**
Error = (61910 - 62000= -90) Adjust the **Z** parameter to correct this error. Each number added or subtracted from the **Z** parameter results in an approximate 10' correction at 62,000 feet.

Note: If the digitizer reads low in relation to the manometer, as in the case above, then a negative correction is required. In the above case a command of ***00Z= -9<return>** would yield approximately a 90 foot change.

Note: If the digitizer transition is high in relation to the manometer reading then a positive correction is applied.

7. Access the adjustment feature and read the current **Z** parameter value:

   Type **<enter>**, until the digitizer returns a **?** along with the current pressure.

   Type **XD <enter>** to enter the **Span Adjust** mode.

   Type ***00Z= <enter>** The digitizer will return the current **Z** parameter value.

Note: The **Z** parameter is set at the factory when compared to a NIST traceable pressure standard. Write down the current factory value before proceeding so that you may return to the original factory setting, if required.

8. Change the **Z** parameter value as required:Type ***00WE <enter>** to write enable the EEPROM.
   Type ***00Z=N<enter>** Where **N** represents a number to correct the digitizer **Z** parameter. (No sign required for a positive value.) The factory error must be taken into account when changing any parameter. Example:

Factory Setting	Change Required	Change Z to	Approx. Change in Feet
Z=0	-9	***00Z=-9**	+90
Z=5	-4	***00Z=1**	+40
Z=-8	-17	***00Z=-25**	+170
Z=12	3	***00Z=15**	-30

4.9 Span Adjust Procedure(continued)

(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**.)
Compare the digitizer altitude data to the pressure standard at 62,000 feet. If further adjustments are required, repeat the Z parameter correction as above.

9. If the digitizer is within ±20 feet of the pressure standard at the digitizer maximum operating altitude, adjust the input pressure to 1000 feet or 28.8557 In. Hg.
10. Note the digitizer pressure as displayed on the **Hyper Terminal**. Calculate the digitizer error at 1000 feet: Example: the pressure standard reads **1,000** and the digitizer serial output on the PC reads: **ALT 990** Error = (990 - 1000= -10) Adjust the **X** parameter to correct this error. Each number added or subtracted from the **X** parameter results in an approximate 1' correction at 1,000 feet.

Note: If the digitizer reads low in relation to the manometer, as in the case above, then a negative correction is required. In the above case a command of ***00X= -10<return>** would yield approximately a 10 foot change.

Note: If the digitizer transition is high in relation to the manometer reading then a positive correction is applied.

11. Access the adjustment feature and read the current **X** parameter value:

    Type **<enter>**, until the digitizer returns a **?** along with the current pressure.

    Type **XD <enter>** to enter the transducer **Span Adjust** mode.

    Type ***00X= <enter>** The digitizer will return the current **X** parameter value.

Note: The **X** parameter is set at the factory when compared to a NIST traceable pressure standard. Write down the current factory value before proceeding so that you may return to the original factory setting, if required.

12. Change the **X** parameter value as required:

Type ***00WE <enter>** to write enable the E^2PROM.

4.9 Span Adjust Procedure(continued)

Type ***00X=N<enter>** Where N represents a number to correct the digitizer **X** parameter. (No sign required for a positive value.) The factory error must be algebraically added to the new required error, when changing any parameter. Example:

Factory Setting	Change Required	Change Z to	Approx. Change in Feet
X=0	-5	***00X=-5**	+5
X=5	-2	***00X=3**	+2
X=-8	-10	***00X=-18**	+10
X=12	3	***00X=15**	-30

Type **Q** to quit the adjustment program and return to read the current input pressure.

Note: 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**.

Compare the digitizer altitude data to the pressure standard at 1,000 feet. If further adjustments are required, repeat the **X** parameter correction as above.

13. The **X** and **Z** parameter adjustments do slightly affect one another. Adjust the input pressure until the pressure standard reads the maximum digitizer operating altitude and compare the digitizer output, as displayed on the PC, to the pressure standard. If an adjustment is required, return to the **Z** parameter and repeat steps 5 thru 12.

14. After verifing the calibration is correct at 1000 feet and the maximum altitude, store yourchanges in the transducer memory. Type ***00WE <enter>** to write enable the EEPROM.

Type ***00SP=ALL<enter>** to store all current parameters.

4.10 Span Adjust Command List

Following is a list of commands which will operate in the **Span Adjust** mode.

Top Level Menu

XD <return> Access transducer span adjustment mode.

Q<enter> Quit and return to operate mode.

Sub-Menu

Command	Definition
***00WE<enter>**	Write enable the EEPROM.
***00Z=<enter>**	Returns the current **Z** parameter value Set this value at the maximum operating altitude of the digitizer.
***00Z=N<enter>**	"**N**" defines a number between 0 and 50 or 0 and -50 which will affect a change in the **Z** parameter of the transducer. (No sign is required for a positive number.) Example: ***00Z=5<enter>**
***00X=<enter>**	Returns the current **X** parameter value
***00X=N<enter>**	"**N**" defines a number between 0 and 100 or 0 and 100 which will affect a change in the reference span of the transducer. (No sign is required for a positive number.) Example: ***00X=5<enter>**
***00SP=ALL<enter>**	Stores the all current parameter settings.
Q	**Quit** adjustment program and return to top level menu.

Digitizer / Transponder Interconnections

The following 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 15 Pin Conn.	Function	KT76/78 Pin Number	King KT76A/78A Pin Number	King KXP Pin Number
1	D4	*4	*4	V
2	A1	6	M	G
3	A2	7	K	H
4	A4	9	J	J
5	B1	4	E	K
9	B2	1	C	L
10	B4	2	B	M
11	C1	3	D	P
13	C2	8	L	R
12	C4	10	H	S
6	Output Enable	Connect to aircraft ground.	Connect to aircraft ground.	Connect to aircraft ground.
8 or 14 *5	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.
15	Ground	Connect to aircraft ground.	Connect to aircraft ground.	Connect to aircraft ground.

*4 Data for this connection not available at this time.
*5 Pins 8 and 14 are connected internally.

Table II

SSD120 15 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
1	D4	10	*6	*6	18
2	A1	14	7	2	3
3	A2	13	6	4	5
4	A4	15	8	8	6
5	B1	19	12	9	9
9	B2	17	10	10	11
10	B4	16	9	11	12
11	C1	21	14	1	10
13	C2	18	11	3	4
12	C4	20	13	5	7
6	Output Enable	11	5	12	13 or 25 or aircraft ground
8 or 14 *7	14 to 28VDC Input	9	18	13	14 to 28VDC Input
15	Ground	Connect to aircraft ground.	Connect to aircraft ground.	14	Connect to aircraft ground.

*6 Data for this connection not available at this time.

*7 Pins 8 and 14 are connected internally.

Serial Data Connection for the Garmin GTX327 Transponder

SSD120-(XX)A 9 Pin Conn.	Function	GTX 327 25 Pin Conn.
4 or 9	TxD to RxD	19
1 or 5 or 8	Ground	13 or 25
Protocol, Connect pin 7 to ground.		

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

Table III

SSD120 15 Pin Conn.	Function	Edo-Air RT-777 Pin Number	Genave Beta 5000 Pin Number	Collins TDR 950 Pin Number	Radair 250 Pin Number
1	D4	15	0	3	15
2	A1	7	4	12	7
3	A2	5	5	10	6
4	A4	3	6	7	13
5	B1	12	7	6	9
9	B2	13	8	5	10
10	B4	14	9	4	11
11	C1	8	10	8	14
13	C2	6	11	11	16
12	C4	4	12	9	12
6	Output Enable	2	3	Connect to aircraft ground.	19
8 or 14 *8	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
15	Ground	2	Connect to aircraft ground.	Connect to aircraft ground.	Connect to aircraft ground.

*8 Pins 8 and 14 are connected together internally.

Table IV

SSD120 15 pin Conn.	Function	Bendix TPR-2060 Pin Number	Bendix TR641A/B Pin Number	Wilcox 1014A Pin Number	UPS AT Apollo SL70 Pin Number
1	D4	*9	N	C	35
2	A1	4	A	k	13
3	A2	6	B	c	31
4	A4	8	C	W	12
5	B1	9	D	T	33
9	B2	10	E	L	14
10	B4	11	F	D	32
11	C1	3	H	P	16
13	C2	5	J	f	34
12	C4	7	K	Z	15
6	Output Enable	Connect to aircraft ground.	Connect to aircraft ground.	Connect to aircraft ground.	Connect to aircraft ground.
8 or 14 *10	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.
15	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)A 9 Pin Conn.	Function	UPS AT SL70
4 or 9	TxD to RxD	4
1 or 5 or 8	Ground	3

To allow the **UPS AT SL70** transponder to accept serial data from the SSD120-(XX)A 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**.

*9 Data for this connection not available at this time.

*10 Pins 8 and 14 are connected internally.

Table V

Serial Port Connector, 9 Pin D-Subminiature DE-9S

Pin	Function
1	Ground *11
2	Ground for 10' resolution.
3	RxD
4	TxD1 *12
5	Ground *11
6	Protocol select, see function Table VI below.
7	Protocol select, see function Table VI below.
8	Ground *11
9	TxD2 *12

Table VI

Protocol Selection: DE-9S D-Subminiature Connector Function Table

Protocol Selection	Pin 2	Pin 6	Pin 7
UPS AT 100' resolution, 1200bps.	Open	Open	Open
UPS AT 10' resolution, 1200bps.	Gnd.	Open	Open
Trimble/Garmin, 100' resolution, 9600bps.	Open	Open	Gnd.
Trimble/Garmin, 10' resolution, 9600bps.	Gnd.	Open	Gnd.
Northstar/Garmin, 100' resolution, 2400bps.	Open	Gnd.	Open
Northstar/Garmin, 10' resolution, 2400bps.	Gnd.	Gnd.	Open
Magellan, 100' resolution, 1200bps.	Open	Gnd.	Gnd.
Magellan, 10' resolution, 1200bps.	Gnd.	Gnd.	Gnd.

*11 Pins 1 and 5 and 8 are internal grounds provided for protocol selection and serial data ground.

*12 TxD1 and TxD2 are two (2) separate RS232 outputs which will transmit the protocol selected by grounding the pins above, or will transmit separate protocols as assigned via software, see **Section 4.4 Serial Port Software Configuration. Note: The hardware jumpers override any software serial port settings.**

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 Model GX50, GX60, GX65

Apollo GX50, GX60, GX65 Signal	Apollo 37 Pin D-Sub Connector	SSD120-(XX)A 9 Pin D-SubConnector
RxD2	21	4 or 9
Ground	20	1 or 5 or 8
		Optional, jumper pin 2 to ground for 10' resolution.

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)A 9 Pin D-SubConnector
RxD2	21	4 or 9
Ground	3	1 or 5 or 8
		Optional, jumper pin 2 to ground for 10' resolution.

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

Trimble

Trimble 2101 Approach Plus GPS Receiver

Trimble Signal	Trimble 2101 Port 1	Trimble 2101 Port 2	SSD120-(XX)A 9 Pin D-Sub Connector Pin
RxD+	7	24	1 or 5
RxD	8	36	4 or 9
Ground	3 or 20	3 or 20	1 or 5
			Protocol assignment, jumper pin 7 to ground on pins 1 or 5 or 8
			Optional, jumper pin 2 to ground for 10' resolution.

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)A 9 Pin D-Sub Connector Pin
RxD+	J1-7	J1-24	1 or 5
RxD-	J1-8	J1-36	4 or 9
Ground	J1 - 3 or 20	J1 - 3 or 20	1 or 5
			Protocol assignment, jumper pin 7 to ground on pins 1 or 5 or 8
			Optional, jumper pin 2 to ground for 10' resolution.

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

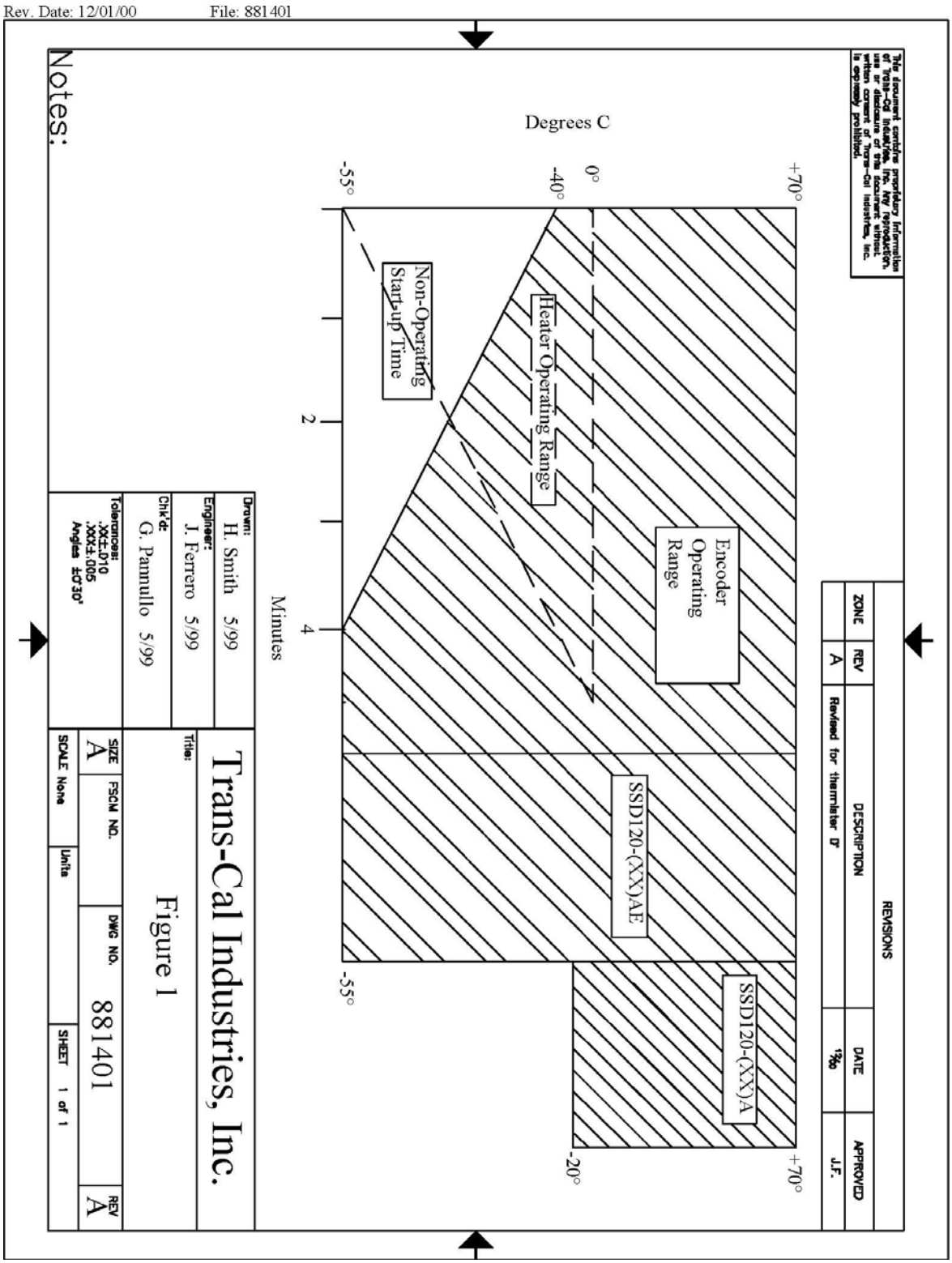
Garmin 400 Series GPS Devices

Garmin 78 Pin Conn. (P4001)	Function	SSD120-(XX)A 9 Pin Conn.
57	TxD	4 or 9
77 or 78	Ground	1 or 5
		Protocol, jumper pin 7 to ground.
		Optional, jumper pin 2 to ground for 10' resolution.

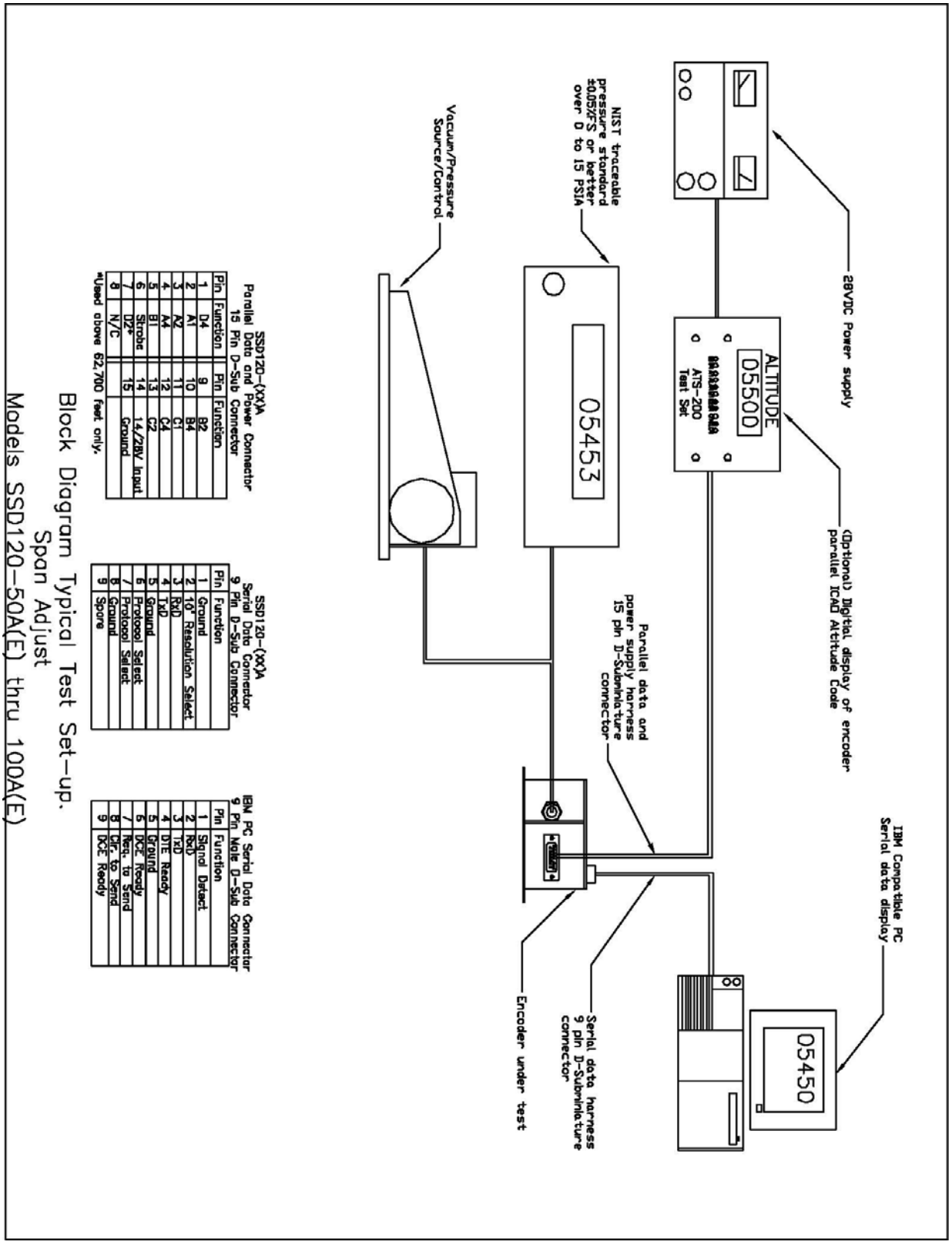
Garmin 400 series GPS software configuration

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

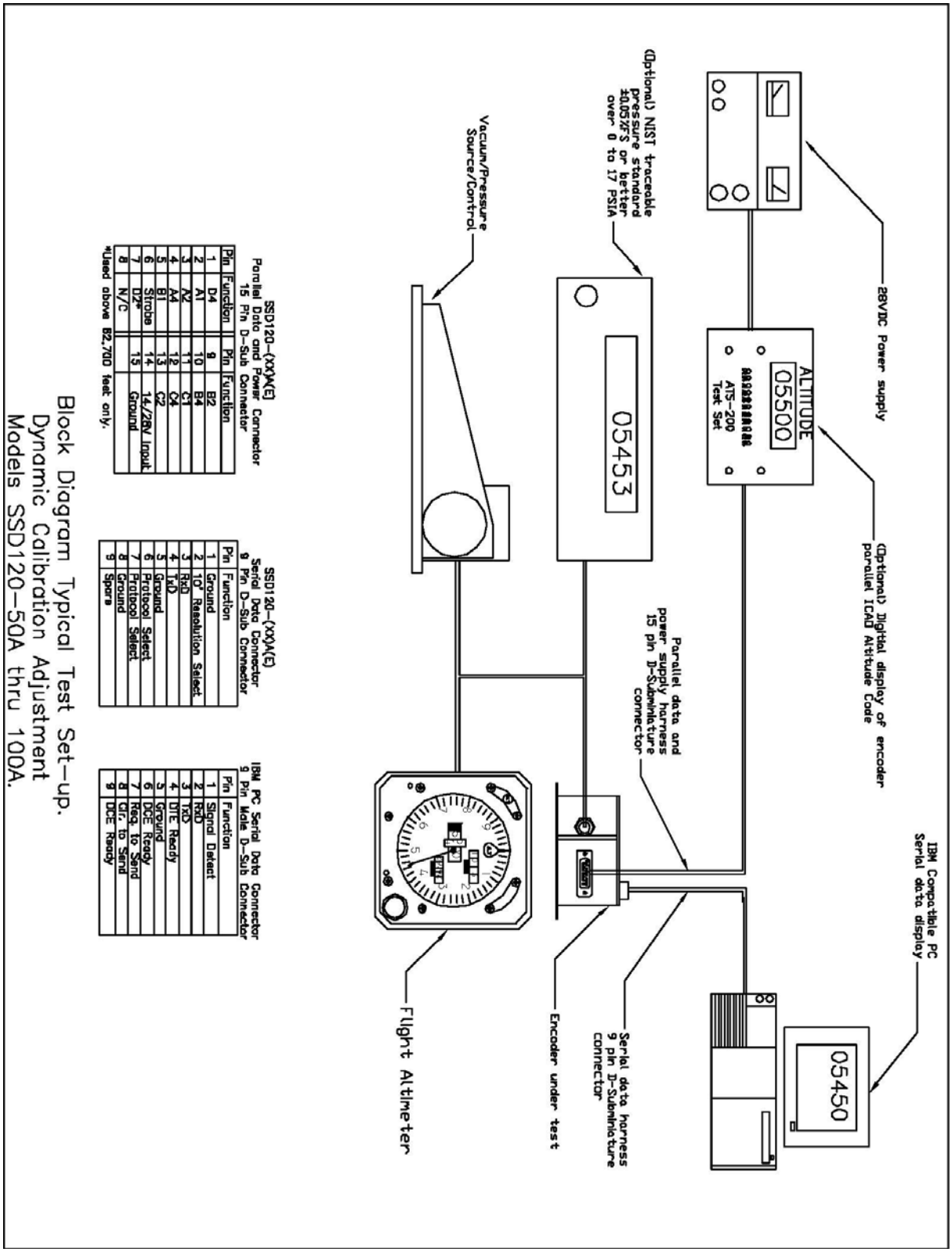
Temperature vs. Warm-up Time



Span Adjust Block Diagram

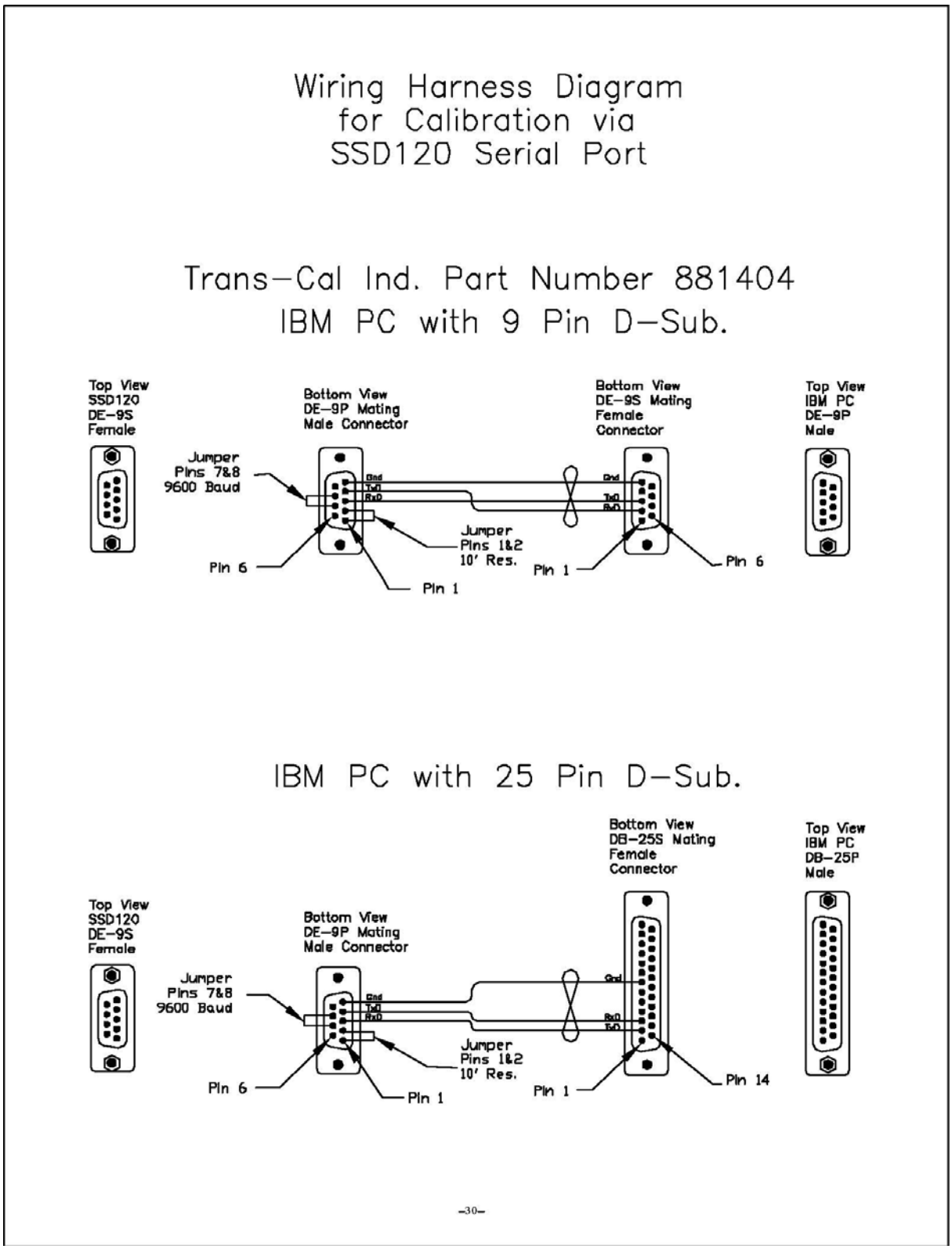


Dynamic Calibration Block Diagram

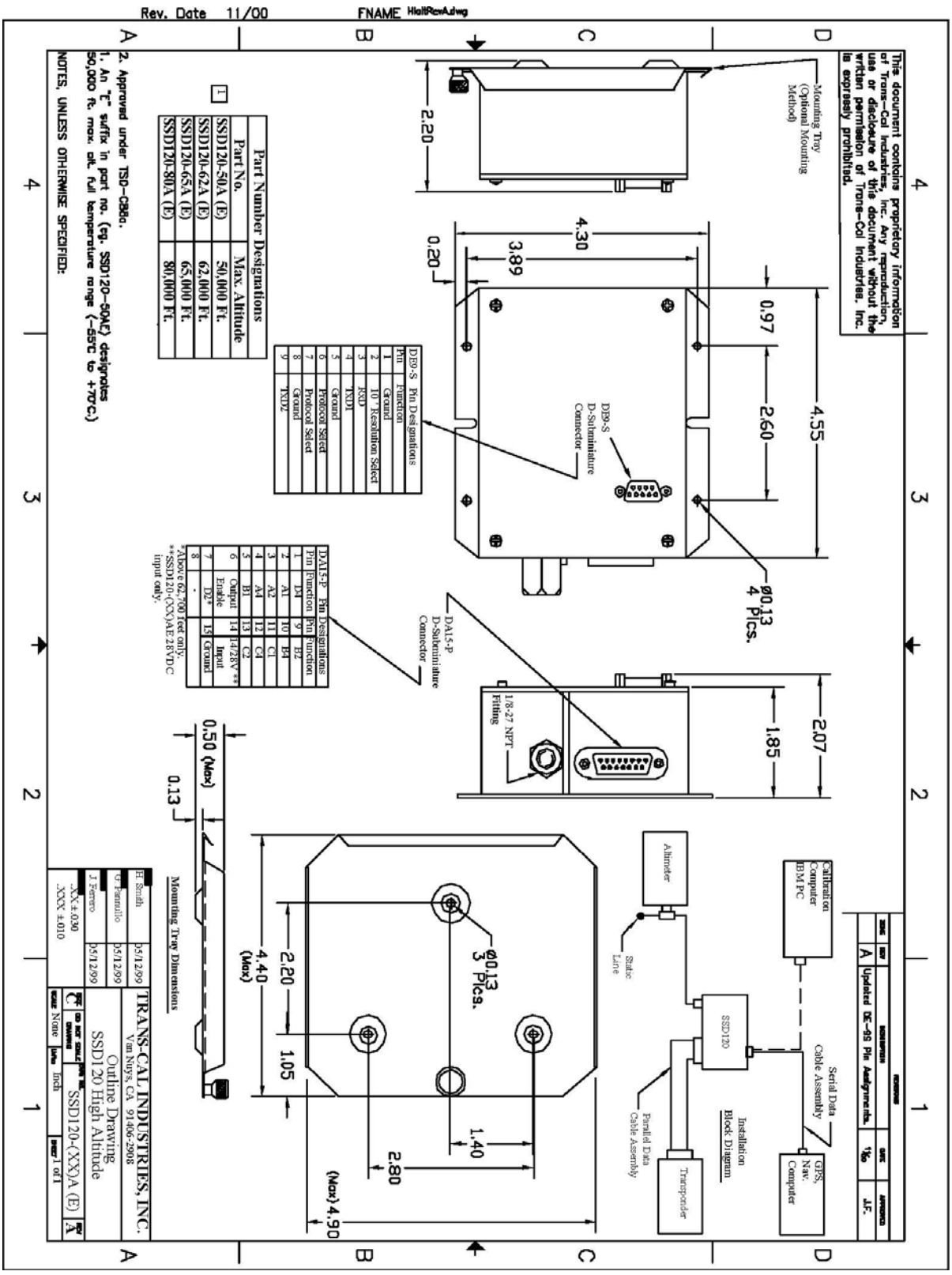


Block Diagram Typical Test Set-up.
Dynamic Calibration Adjustment
Models SSD120-50A thru 100A.

Wiring Harness Diagram



Outline Drawing



Trans-Cal Industries, Inc.
Solid State Altitude Digitizer
Part Number Ordering Information

SSD120-XX X X-XXXX

Max. Operating Altitude (Feet)	
30,000	-30
35,000	-35
42,000	-42
50,000	-50
62,000	-62
65,000	-65
80,000	-80
85,000	-85
100,000	-100

Model Nomenclature	Identifier
Encoder / Digitizer	A
Modular Encoder	M
Servo Module	SM

Operating Temperature Range	
Blank	-20˚ to +70˚C
E	-55˚ to +70˚C

Additional Ports and Features	
-RS232	Dual RS232 Ports
-RS	RS485 and Dual RS232 Ports
-RS1	RS485 and 1' Resolution on TxD2

Part Number Example: SSD120-42AE-RS232
Note: On models operating at 50,000 to 100,000 feet, dual RS232 ports are included as a standard feature.

WARRANTY REGISTRATION

Trans-Cal Industries warrants each Model SSD120-(XX)A(E)-RS1 Solid State digitizer / serializer to be free of defects in workmanship and materials for a period of eighteen (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-( )A(E)-RS1 SERIAL NO: RS-_____

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:_____