Trans-Cal Industries, Inc.

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

All Solid State

Altitude Encoder/Digitizer

Owner/Installation Manual

T.S.O. C88a Approved

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	10/99	Program Update Info.
B	03/31	Changed. current pg. 1.
C	08/04	Updated manual.
D	08/06	Updated manual changed warranty from 40 to 42 months

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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-RS and SSD120-(XX)AE-RS[1] series of altitude encoder / digitizer.

1.2 Equipment Description

Approved under F.A.A. TSO-C88a, the Model SSD120-(XX)A-RS and SSD120-(XX)AE-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 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 protocol has selectable resolution (refer to **Tables V** & **VI** and **§4.6**) and is provided on two (2) RS232 outputs (**TxD1** and **TxD2**) and one (1) **RS485** output which may be used to provide pressure altitude data to GPS or other on board navigation devices. The RS485 data will utilize the same data protocol and format as assigned to TxD1.

1.3 General Specifications

Operating Voltage: Model SSD120-(XX)A-RS   +12 to 30 VDC.
                               Model SSD120-(XX)AE-RS[2]+12 to 30 VDC.

Operating Current all models: 0.55 Amps. (550MA)

Operating Temperature:
                        Model SSD120-(XX)A-RS   -20° to +70°C.
                        Model SSD120-(XX)AE-RS -55° to +70°C.

Storage Temperature (non-operating) all models: -65°C to +85°C.

Warm-up time: 30 second self-test, see Figure 2.

Weight: 10 oz.

1.3 General Specifications(continued)

1.3.1 Operating Altitude:

Model SSD120-30A( )-RS	-1000 to +30,000 feet.
Model SSD120-35A( )-RS	-1000 to +35,000 feet.
Model SSD120-42A( )-RS	-1000 to +42,000 feet.

1.3.2 Accuracy:

Digitizer accuracy is ±50 feet from -1000 to +30,000 feet, and ±75 feet from 30,100 to +42,000 feet, when measured from the altitude transition points of the digital code and referenced to 29.92 In. Hg. (1013 MB.)

1.3.3 Serial Port Altitude Data Resolution:

The default resolution of the altitude digitizer serial data is 100 feet on both **TxD1** and the **RS485** port. To enable 10 foot resolution, connect pin 2 of the 15 pin D-Subminiature connector to ground (see **Table V** & **VI**.) The serial port resolution may also be configured via software, see **§4.6**.

1.3.4 Mechanical Characteristics:

Model Number	Dimensions	Weight
Model SSD120-30A( )-RS	*See Outline Drawing*	10 oz.
Model SSD120-35A( )-RS	*See Outline Drawing*	10 oz.
Model SSD120-42A( )-RS	*See Outline Drawing*	10 oz.

1.3.5 Environmental:

All model SSD120-(XX)A( )-RS digitizers have been designed and tested to meet 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( )-RS series of altitude digitizers will not be damaged when operated beyond their specified maximum altitude up to 100,000 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: 50 milliamperes.

Maximum Cable Length: 50 feet.(15.24 meters).

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

1.5 Serial Port Specifications RS232 (TxD1 and TxD2):

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: 3KΩ 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 Port Specifications RS485

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

Signal State	Threshold Voltages (Signal A with respect to signal B)
0	+1.5 to +6 VDC (Transmitter)
1	-1.5 to -6 VDC (Transmitter)

Note: Some RS485 equipment use A+@ and A-@ connection descriptors. The A-@ corresponds to AA@ and theA+@ corresponds to AB@.

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: 10/sec.

1.7 Serial Communication Format:

Model SSD120-(XX)A( )-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.

1.8 Serial Communication Protocol :

Protocol is user selectable by grounding or leaving open pins 2 ,9 or 10 of the 15 pin D-Subminiature connector, or by selecting protocols via software see **§4.6.** *Hardware jumpers override software settings!*

<u>Leaving pin 9 and 10 of the DA-15S connector open</u> results in the default 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:

<u>Message:</u>	<u>Definition:</u>
#AL+00800T+25D8 ⌐R	Altitude 800 feet.

<u>Grounding pin 10 of the DA-15S connector</u> 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:

<u>Message:</u>	<u>Definition:</u>
ALT 99900 ⌐R	Digitizer disabled.
ALT 10500 ⌐R	Altitude 10,500 feet.

<u>Grounding pin 9 of the DA-15S connector</u> 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:

<u>Message</u>	<u>Definition:</u>
ALT 02500 ⌐R	Altitude 2500 feet.
ALT -2500 ⌐R	Digitizer disabled.

<u>Grounding both pins 9 and 10 of the DA-15S connector</u> 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:

<u>Message</u>	<u>Definition:</u>
$MGL+02500T+25D6 ⌐R	Altitude 2500 feet.

Section 2.0 Operation

2.1 General:

The SSD-120(XX)A( )-RS 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 42,000 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. All parallel outputs will be pulled low for a 30 second self test 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 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( )-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 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, GPS or other navigation device.

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 one amp 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 and/or the RS485 port (transmit data) from the DA-15S D-Subminiature connector to the RxD (receive data) port on the GPS or other navigation devices. All grounds on the DA-15S 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 DA-15S connector is used for calibration only. See **Table V** for connector pin assignments and **§4.6** for software assigned protocols, and **§4.7** 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.

3. Test for a serial output using an oscilloscope to view the 9 VDC square wave transmitted about once a second.

4. Consult the factory for RS485 test equipment.

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.

Section 4.0 Calibration and Configuration

4.1 Calibration Overview:

This procedure will allow adjustment to the calibration curve of the SSD120-(XX)A-RS or SSD120-(XX)AE-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 ±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.

There are two different methods used to affect the calibration of this device. The technician need only perform the method which is best suited for the application in question. There is no need to perform both methods. The digitizer may be adjusted using the two potentiometers which are the traditional method of adjusting the span and reference of a solid state digitizer. This device may also be adjusted utilizing an externally addressable EEPROM which is configured to accept an alternate error curve entered to the digitizer via an IBM compatible PC.

The **Span Adjust** calibration **(§4.4)** is normally used in applications where the only a slight modification is required to bring the altitude digitizer curve up or down.

The **Dynamic Calibration** procedure **(§4.7)** is another method used to match the altitude digitizer to the primary flight altimeter. It assumes the digitizer and altimeter are connected through the static line 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.

4.2 Required Equipment Span Adjust:
(See span adjust block diagram.)

1. Primary Flight Altimeter.

2. +12 to 28VDC power supply.

3. 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.

4. A ramp checker or test set capable of interrogating the transponder.(Optional: ATS-200 or equal device which will allow the display of the 100 foot resolution parallel altitude data.)

4.3 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.

4.4 Span Adjust Procedure

1. Connect the pitot-static test equipment to the aircraft's static line, and connect the transponder test set per the manufacturer's recommendations. The digitizer's two altitude adjustment potentiometers are identified as L and H, representing low and high altitude. The low adjustment is closest to the edge of the housing, and the high adjustment is closer to the center of the housing.

2. Apply power to the altitude digitizer/transponder.

3. Set the primary flight altimeter barometric pressure to 29.92 In. Hg. (1013 MB).

4. Interrogate the transponder with the ramp tester, while observing the altitude code, decrease pressure to the point where the altitude code just makes a transition to the maximum altitude encoded. Verify that the digitizer is within ±125 feet of the altimeter's reading. If not, adjust the high potentiometer until the transition point is within 30 feet of the altimeter reading.

5. Increase pressure until the digitizer's output just makes the transition from 0 feet to -100 feet. Verify that the altimeter reads within ±125 feet of the digitizer. If not, adjust the low potentiometer until the transition point is within 30 feet of the altimeter reading.

6. Repeat steps (4) and (5) until the ±125 foot tolerance is achieved for both the maximum calibration altitude and the minimum calibration altitude.

7. 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 digitizer and primary flight altimeter correspond within the ±125 foot tolerance. Lightly tap the altimeter before each reading to eliminate friction. If correspondence is not achieved at any test point, the altimeter may require calibration.

8. Verify that the digitizer's output is disabled when the transponder is not in mode "C", or when the "Altitude Disable" switch is in the off position.

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.

4.5 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.

4.6 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. Thus eliminating the need for the hardware jumpers detailed in **Tables V** and **VI**. The RS485 output will repeat the TxD1 protocol and data settings. *Hardware jumpers override software settings!*

Connect the digitizer to an IBM compatible computer running Hyperterminal as described in **§4.5** and as shown in the **Dynamic Calibration Block Diagram.** Assign the serial port protocols as follows:

Apply power to the digitizer and after the 30 second 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:

a b c

Serial Altitude Data Resolution

TxD1 Protocol
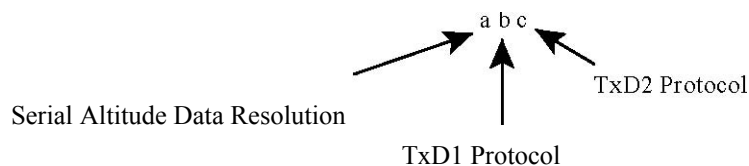
TxD2 Protocol

1. The first digit represents the serial altitude data resolution.
        0 = Use DA-15S connector protocol hardware jumpers.
        1 = 100 foot resolution on **TxD1** and **RS485** and **TxD2** output.
        2 = 10 foot resolution on **TxD1** and **RS485** and **TxD2** output.

2. The second digit represents the protocol selection for **TxD1** and the **RS485** output.
        0 = Use DA-15S 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 DA-15S connector protocol hardware jumpers.
    1 = UPS Aviation Technologies. 1200bps.
    2 = Trimble/Garmin. 9600bps.
    3 = Northstar. 2400bps.
    4 = Magellan, 1200bps.

Example:

Type **P210<enter>**   Defined as **10 foot** resolution on **TxD1, TxD2** and **RS485**. **UPS Aviation Technologies** protocol transmitted on **TxD1** and **RS485**. **Trimble/Garmin** protocol transmitted on **TxD2**.

4.7 Dynamic Calibration Adjustment Procedure:

1. Construct a wiring harness per the wiring harness diagram. (This harness may beordered directly 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,and energize.

3. Open the **Hyper Terminal** program as described in **§4.5.**

4. The digitizer output should now be displayed on the PC screen with 10 footresolution.

(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. (**§4.9** provides a table to record the changes 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 the difference 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.
    (Note: If no correction is required at an altitude simply do not enter a correction. The
    technician does not have to enter 000.).

(Note: If no correction is required at an altitude simply do not enter a correction. The technician does not have to enter 000.)

4.7 Dynamic Calibration Adjustment Procedure(continued)

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 enteredinto the EEPROM. 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		
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: 1.) 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** mode using **Hyper Terminal**.

Top Level Menu

       ADJ <enter>   Enter **Adjustment** mode.

       Q <enter>   **Quit** and return to normal operating 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 **§ 4.6 Serial Port Software Configuration.**

            Pabc<enter>   **Port** protocol select, see **§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.

4.9 Error Correction Table

Altitude	Correction	Altitude	Correction
-1000		24000	
0		25000	
1000		26000	
2000		27000	
3000		28000	
4000		29000	
5000		30000	
6000		31000	
7000		32000	
8000		33000	
9000		34000	
10000		35000	
11000		36000	
12000		37000	
13000		38000	
14000		39000	
15000		40000	
16000		41000	
17000		42000	
18000			
19000			
20000			
21000			
22000			
23000			

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	King KT76/78 Pin Number	King KT76A/78A Pin Number	King KXP Pin Number
1	D4	*₃	*₃	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 *4	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.

3
Data for this connection not available at this time.
4
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	*5	*5	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 *6	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.

Serial Data Connection for the Garmin GTX327 Transponder

SSD120-(XX)A-RS DA-15S Conn.	Function	GTX 327 25 Pin Conn.
4 or 12	TxD to RxD	19
1 or 5 or 8	Ground	13 or 25
Protocol, Connect pin 10 to ground.		

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

5
Data for this connection not available at this time.

6
Pins 8 and 14 are connected internally.

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 *7	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.

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	*8	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 *9	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-RS DA-15S Conn.	Function	UPS AT SL70
4 or 12	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-RS 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**.

8
Data for this connection not available at this time.
9
Pins 8 and 14 are connected internally.

Table V
Serial Port Connector, 15 Pin D-Subminiature DA-15S

Pin	Function
1	Ground 10
2	Ground for 10' resolution.
3	RxD
4	TxD111
5	Ground10
6	RS485B(+)
7	RS485A(-)
8	Ground10
9	Protocol Select see Table VI
10	Protocol Select see Table VI
11	Spare
12	TxD211
13	Program Enable
14	Spare
15	Spare

Table VI
Protocol Selection: DA-15S D-Subminiature Connector Function Table

Protocol Selection	Pin 2	Pin 9	Pin 10
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.

Note: These hardware jumpers will override any software settings from §4.6!
10
Pins 1 and 5 and 8 are internal grounds provided for protocol selection and serial data ground.
11
 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 **§4.6 Serial Port Software Configuration.**

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-RS DA-15S D-SubConnector
RxD2	21	4 or 12
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-RS DA-15S D-SubConnector
RxD2	21	4 or 12
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	IA-RS232C-R Serial I/O Connector DA-15S
RxD+	7	24	1 or 5
RxD-	8	36	4 or 12
Ground	3 or 20	3 or 20	1 or 5
			Protocol assignment, jumper pin 10 to ground on pins 1 or 5 or 8
			Optional, jumper pin 2 to ground for 10' resolution.3

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	IA-RS232C-R Serial I/O Connector DA-15S
RxD+	J1-7	J1-24	1 or 5
RxD-	J1-8	J1-36	4 or 12
Ground	J1 - 3 or 20	J1 - 3 or 20	1 or 5
			Protocol assignment, jumper pin 10 to ground on pins 1 or 5 or 8
			Optional, jumper pin 2 to ground for 10' resolution.[15]

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**.

---

3 10 foot resolution altitude data must be provided to the interface adapter from the source altitude reporting device.

Garmin International

Garmin 400 Series GPS Devices

Garmin 78 Pin Conn. (P4001)	Function	IA-RS232C-R Serial I/O Connector DA-15S
57	TxD	4 or 12
77 or 78	Ground	1 or 5
		Protocol, jumper pin 10 to ground.
		Optional, jumper pin 2 to ground for 10' resolution.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.**

---

4 10 foot resolution altitude data must be provided to the interface adapter from the source altitude reporting device.

Narco AT-50 and AT-50A Installations

The Narco AT-50 or AT-50A transponder will not accept data from the Trans-Cal SSD120-(XX)A until the following modifications have been completed:

  1. The strobe modification as outlined in Narco service bulletin no. AT-50A-5 dated 19 February 1975 has been performed on the transponder.

  2. A modification to the Trans-Cal SSD120-(XX)A removing the data line decoupling capacitor network.

  The SSD120-(XX)A may be ordered from the factory with Mod. 1 completed, or the altitude digitizer may be modified in the field as outlined below.

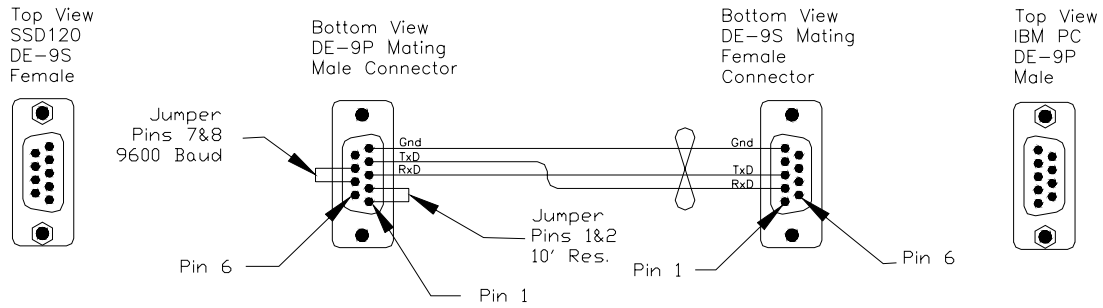Instructions for field modification:

  1. Remove the 4 screws, lockwashers and cover plate. Do not remove the D-Sub serial data connector.

  2. Remove and discard the C1 capacitor network (refer to figure 1 below.) The network may be removed using a pair of pliers to slowly rock the network back and forth until it breaks away.

  3. Replace the cover plate, 4 lockwashers and screws.

  4. A modification label is located on the side of the altitude digitizer. Using an indelible ink pen, place an "X" in the box identifying modification 1 as complete.
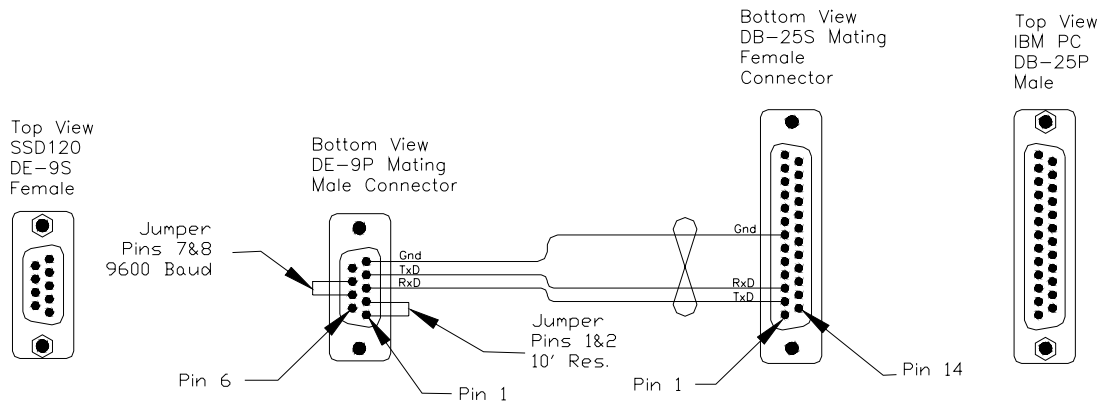
Figure 1

15 Pin D-Subminiature Connector

C1 Capacitor Network
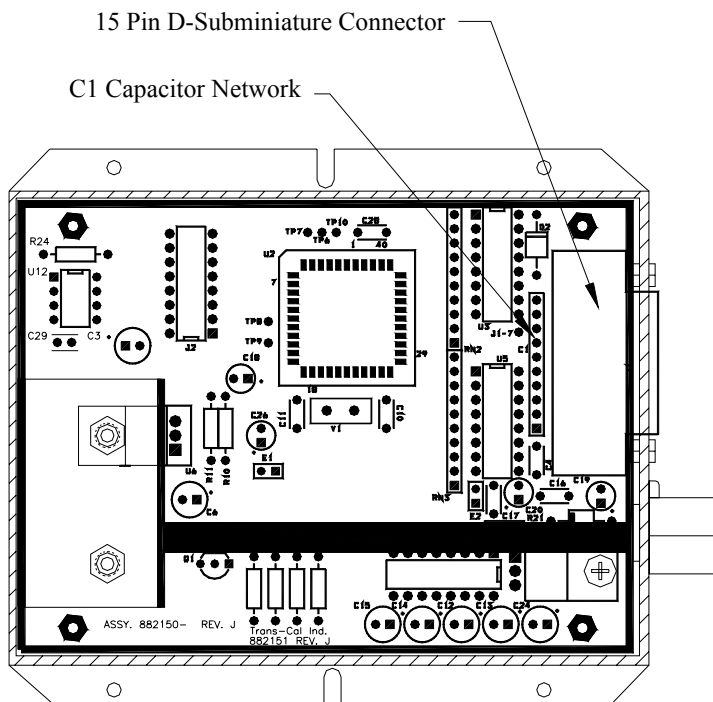
Wiring Harness Diagram Part Number 881404

Trans—Cal Ind. Part Number 881404
IBM PC with 9 Pin D—Sub.

IBM PC with 25 Pin D—Sub.
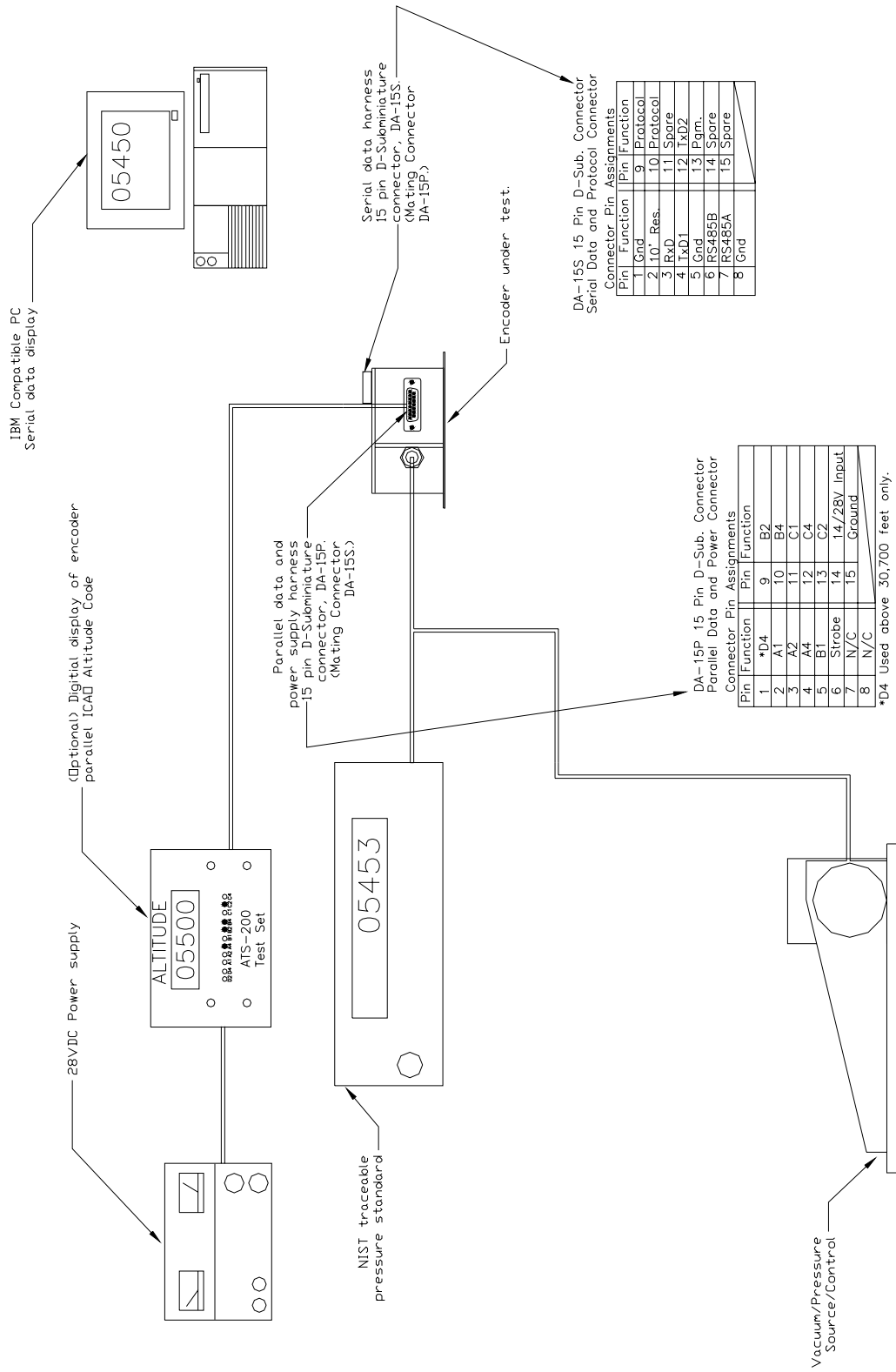
Block Diagram Span Adjust.
Models SSD120-30A(XX)-RS thru 42A.

IBM Compatible PC
Serial data display

Serial data harness
15 pin D-Subminiature
connector, DA-15S.
(Mating Connector
DA-15P.)

Encoder under test.

(Optional) Digital display of encoder
parallel ICAO Altitude Code

Parallel data and
power supply harness
15 pin D-Subminiature
connector, DA-15P.
(Mating Connector
DA-15S.)

28VDC Power supply

NIST traceable
pressure standard

Vacuum/Pressure
Source/Control

ALTITUDE 05500

ATS-200
Test Set

05450

05453

DA-15S 15 Pin D-Sub. Connector
Serial Data and Protocol Connector

Connector Pin Assignments

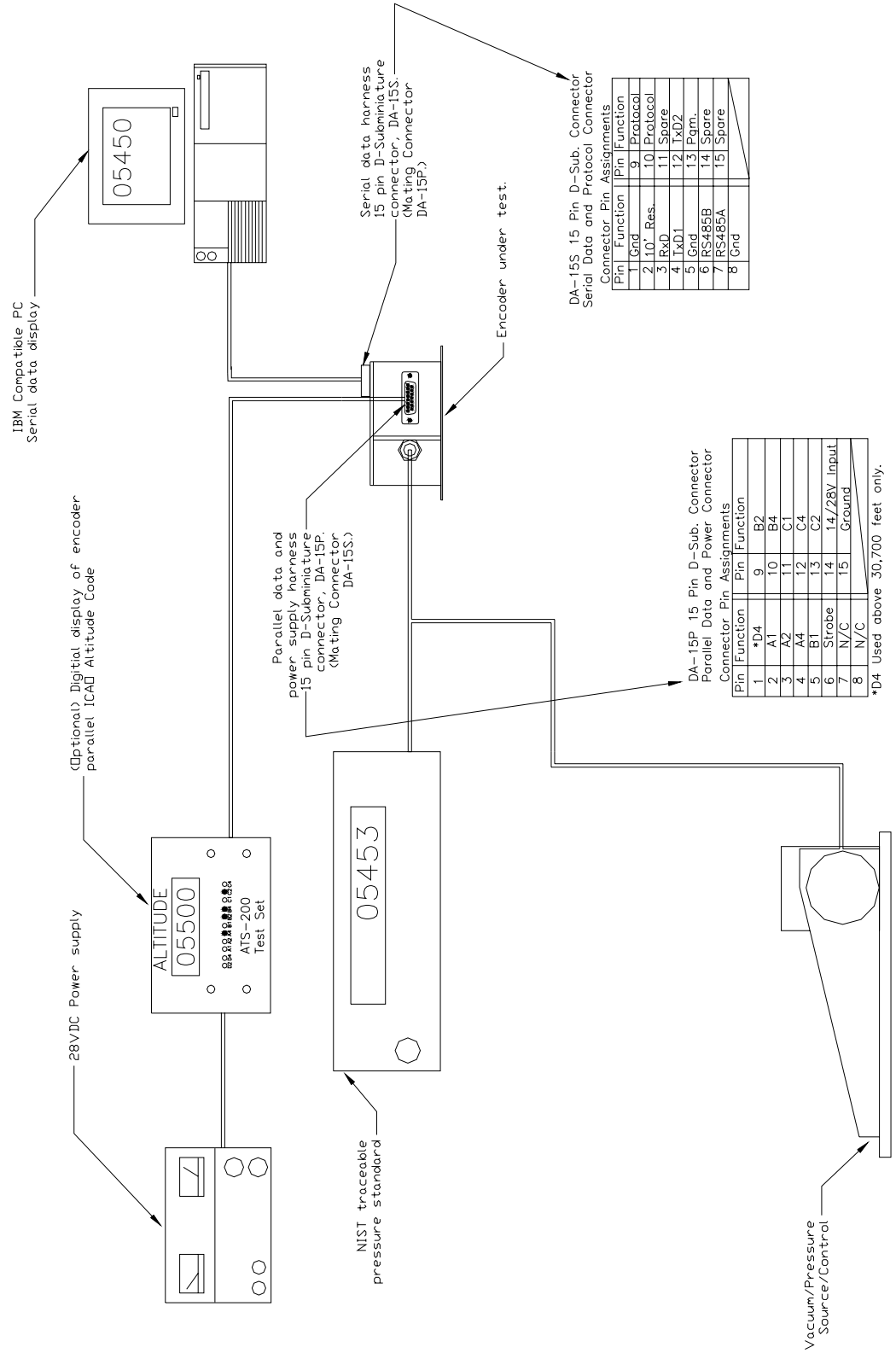| Pin	Function	Pin	Function
1	Gnd	9	Protocol
2	10' Res.	10	Protocol
3	RxD	11	Spare
4	TxD1	12	TxD2
5	Gnd	13	Pgm.
6	RS485B	14	Spare
7	RS485A	15	Spare
8	Gnd		

DA-15P 15 Pin D-Sub. Connector
Parallel Data and Power Connector

Connector Pin Assignments

Pin	Function	Pin	Function
1	*D4	9	B2
2	A1	10	B4
3	A2	11	C1
4	A4	12	C4
5	B1	13	C2
6	Strobe	14	14/28V Input
7	N/C	15	Ground
8	N/C		

*D4 Used above 30,700 feet only.

05450

Serial data harness
15 pin D-Subminiature
connector, DA-15S.
(Mating Connector
DA-15P.)

Encoder under test.

DA-15S 15 Pin D-Sub. Connector
Serial Data and Protocol Connector
Connector Pin Assignments

Pin	Function	Pin	Function
1	Gnd	9	Protocol
2	10' Res.	10	Protocol
3	RxD	11	Spare
4	TxD1	12	TxD2
5	Gnd	13	Pgm.
6	RS485B	14	Spare
7	RS485A	15	Spare
8	Gnd		

IBM Compatible PC
Serial data display

(Optional) Digital display of encoder
parallel ICAO Altitude Code

Parallel data and
power supply harness
15 pin D-Subminiature
connector, DA-15P.
(Mating Connector
DA-15S.)

ALTITUDE
05500

ATS-200
Test Set

DA-15P 15 Pin D-Sub. Connector
Parallel Data and Power Connector
Connector Pin Assignments

Pin	Function	Pin	Function
1	*D4	9	B2
2	A1	10	B4
3	A2	11	C1
4	A4	12	C4
5	B1	13	C2
6	Strobe	14	14/28V Input
7	N/C	15	Ground
8	N/C		

*D4 Used above 30,700 feet only.

28VDC Power supply
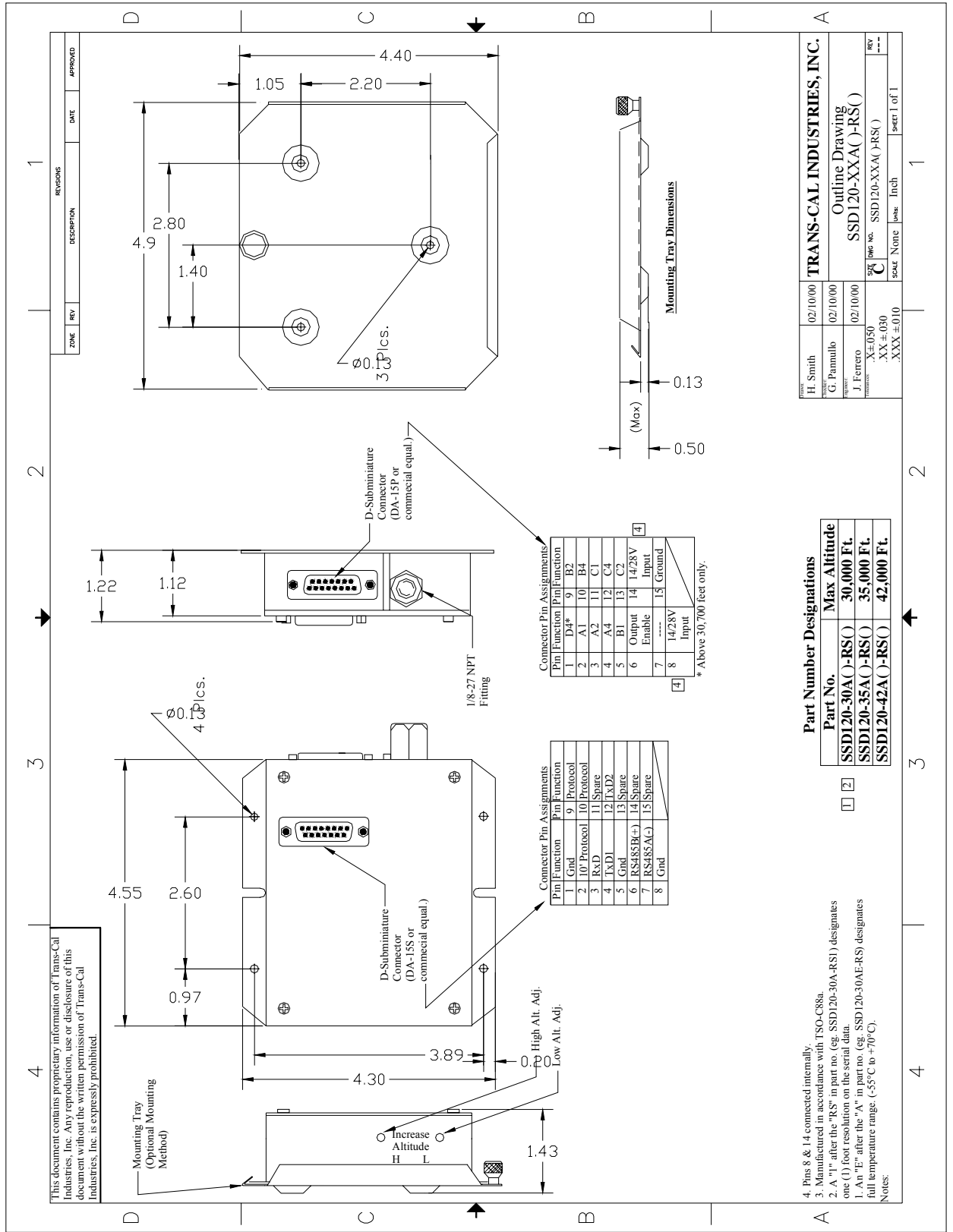
05453

NIST traceable
pressure standard

Vacuum/Pressure
Source/Control

Block Diagram Dynamic Adjust.
Models SSD120-30A(XX)-RS thru 42A.

Figure 3
Temperature vs. Warm-up Time

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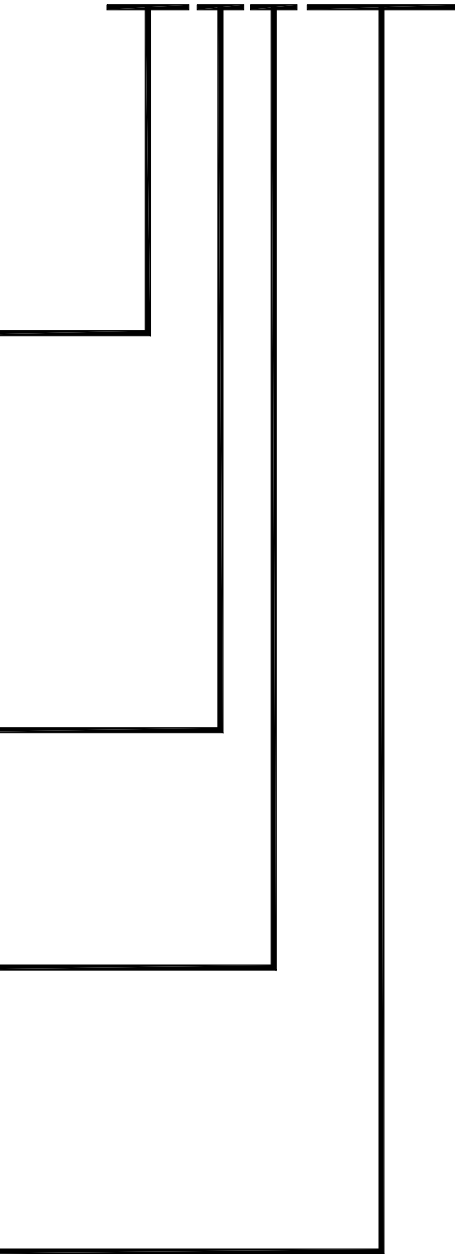
**Part Number Example: SSD120-42AE-RS232
Note: On models operating at 50,000 to 100,000 feet, dual RS232 ports are included as a standard feature.**

WARRANTY REGISTRATION

Trans-Cal Industries warrants each Model SSD120-(XX)A(E)-RS Solid State digitizer / serializer to be free of defects in 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 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)-RS   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:**_____