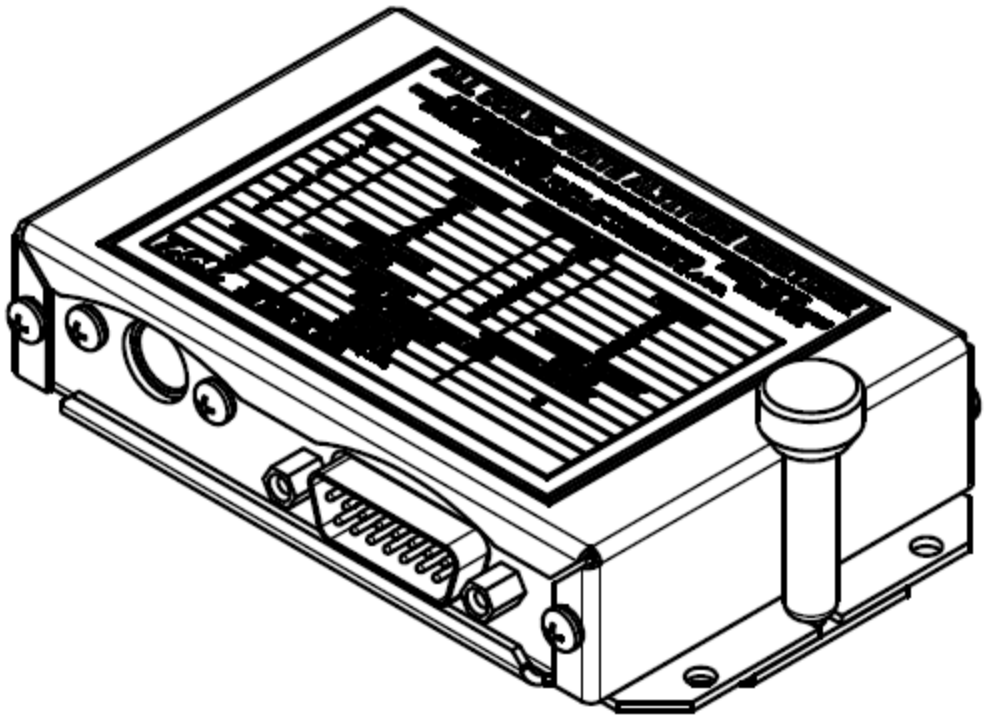
Trans-Cal Industries, Inc.

Altitude Encoder/Digitizer
Owner / Installation Manual Model SSD120-35C-RS232

FAA TSO-C88a Approved
EASA ETSO-C88a Approved



Trans-Cal Industries, Inc.
16141 Cohasset St.
Van Nuys, CA 91042
(818)787-1221 FAX (818)787-8916
www.trans-cal.com

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16141 Cohasset Street
Van Nuys, CA 91406
CAGE Code 57323
818/787-1221
FAX 818/787-8916
E-Mail: support@trans-cal.com
www.trans-cal.com

What's in the Box:

Qty.	Part Number	Description
1	SSD120-35C-RS232	Altitude Digitizer with RS232 Outputs
1	881625	Owner/Installation Manual
1	DA-15S	15-Pin D-Subminiature Mating Connector
1	600016	15-Pin Connector Back Shell
1	600019	1/8NPT Nylon Tube Fitting
1	600020	¼" Tube Tee Fitting
1	881616	Tray
1	881023-3	Knob

History of Revision

Revision	Date	Description
A	28 June 2016	Production Release

Reference Publications

- EASA ETSO-C88a Automatic Pressure Altitude Code Generating Equipment
- FAA Advisory Circular 43-6C Altitude Reporting Equipment and Transponder System Maintenance and Inspection Practices
- FAA TSO-C88a Automatic Pressure Altitude Code Generating Equipment
- FAR 23.1325 Static Pressure System
- FAR 43-Appendix E, Altimeter System Test and Inspection
- FAR 43-Appendix F ATC Transponder Tests and Inspections
- FAR 91.217 Data Correspondence Between Automatically Reported Pressure Altitude Data and the Pilot's Altitude Reference
- FAR 91.411 Altimeter System and Altitude Reporting Equipment Tests and Inspections
- RTCA/DO-160E Environmental Conditions and Test Procedures for Airborne Equipment
- RTCA/DO-178 Software Considerations in Airborne Systems and Equipment Certification
- SAE AS8003 Minimum Performance Standard for Automatic Pressure Altitude Reporting Code Generating Equipment

Table of Contents

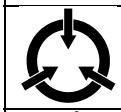
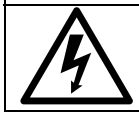
Table of Figures

Safety Notes

CAUTION! INCORRECT TOOLING OR TEST EQUIPMENT CAN RESULT IN DAMAGE TO THIS INSTRUMENT AFFECTING ITS AIRWORTHINESS.

This manual calls out chemicals and other commercially available materials. The installer must obtain the Material Safety Data Sheets from the manufacturer or supplier of the materials. It is the installer’s responsibility to know and follow the procedures, recommendations, warnings and cautions set forth for the safe use, handling, storage and disposal of the materials.

Abbreviations, Acronyms and Symbols

A	Amperes	**max.**	Maximum
AC	Advisory Circular	**MB**	Millibar
ADS-B	Automatic Dependent Surveillance-Broadcast	**MHz**	Megahertz
ARINC	Aeronautical Radio Incorporated	**MFD**	Multi-Function Display
ASCII	American Standard for Coded Information Interchange	**MM**	Distance in Millimeters
ATCRBS	Air Traffic Control Radar Beacon System	**MSL**	Mean Sea Level
bps	Bits per second.	**min.**	Minimum
CAGE	Commercial and Government Entity	**ms**	Time in milliseconds.
CFR	Code of Federal Regulations	**MSB**	Most Significant Bit
$^{C}_{R}$	Carriage Return	**mW**	Milliwatt
EASA	European Aviation Safety Agency	**NIST**	National Institute of Standards and Technology
EEPROM	Electronically Erasable Read Only Memory	**oz**	Ounce
EIA	Electronic Industries Association	**P/N**	Part Number
ESDS	Electrostatic Discharge Sensitive Device	**psi**	Pounds per Square Inch
ETSO	European Technical Standard Order	**RAM**	Random Access Memory
FAA	Federal Aviation Administration	**RS**	Recommended Standard
FAR	Federal Aviation Regulation	**RTCA**	Radio Technical Commission for Aeronautics
ft.	Distance in feet.	**SAE**	Society of Automotive Engineers
GPS	Global Positioning System	**sec.**	Time in seconds.
H/W	Hardware	**SSR**	Secondary Surveillance Radar
Hz	Hertz	**S/W**	Software
ICAO	International Civil Aviation Organization	**TCI**	Trans-Cal Industries, Inc.
I.F.F.	Identification Friend or Foe	**TIA**	Telecommunication Industries Association
In. Hg.	Pressure in Inches of Mercury	**TSO**	Technical Standard Order
Kbps	Kilobits per Second	**Vdc**	Volts Direct Current
KHz	Kilohertz	**VSI**	Vertical Speed Indicator
$^{L}_{F}$	Line Feed	**W**	Watt
LSB	Least Significant Bit	**Ω**	Electrical resistance measured in Ohms.
M	Distance in Meters	**ºC**	Temperature in degrees Celsius.
mA	Milliamperes	**±**	Plus or minus.
	ESD Caution		Caution
	Electrical Hazard		Do Not Expose To Moisture

Section 1.0 Introduction

1.1 Scope

This manual provides detailed installation, calibration and operating instructions for Trans-Cal Industries' Model SSD120-35C-RS232 series of altitude encoder/digitizer. This manual assumes use by competent, qualified avionics professionals utilizing installation methods in accordance with 14 CFR and other industry accepted installation practices.

1.2 Equipment Description

Approved under FAA TSO-C88a and EASA ETSO-C88a the Model SSD120-35C-RS232 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 outputs. The serial data protocol is selectable and may be used to provide pressure altitude data to GPS or other on board navigation devices.

1.3 General Specifications

Operating Voltage: Model SSD120-35C-RS232	 +12 to 30 Vdc
Operating Current all models:	0.25 Amps at 14Vdc 0.27 Amps at 28Vdc
Operating Temperature: Model SSD120-35C-RS232	 -20° to +55°C (-4° to +158°F)
Storage Temperature (non-operating)	-65° to +85°C (-85° to +185°F)
Warm-up time:	0 Seconds at 20°C (68°F). See Figure 9 for low temperature warm-up times.
Weight:	4.3 oz. (5.3 oz. with tray and knob)

1.3.1 Limitations, Deviations and Compliance

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

Note:
DO-160E lightning induced transient susceptibility tests were not conducted on this device and it is the responsibility of the installing agency to substantiate compliance with FAR 25.1316. Advisory Circular AC 20-136B 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.

1.3.2 TSO/ETSO/RTCA Certification and Compliance Table

FAA TSO	C88a
EASA TSO	C88a
RTCA DO-178 Software	Non-Essential Category H/W - S/W P/N: 881603rA-700001rC
RTCA DO-160E Environmental*	D1BAB[(SM)(UF)]XXXXXXZBBB(BC)TTBXXXAX

*See environmental Qualification Form for Specifics.

1.3.3 Operating Altitude

Model	Operating Altitude
SSD120-35C-RS232	-1000 to +35,000 feet.

1.3.4 Accuracy

Digitizer accuracy is ±50 feet from -1000 to +30,000 feet, and ±75 feet from 30,100 to +35,000 feet, when measured from the altitude transition points of the ICAO code and referenced to 29.92 In. Hg. (1013 MB.) See **Figure 1** and **§4.0**.

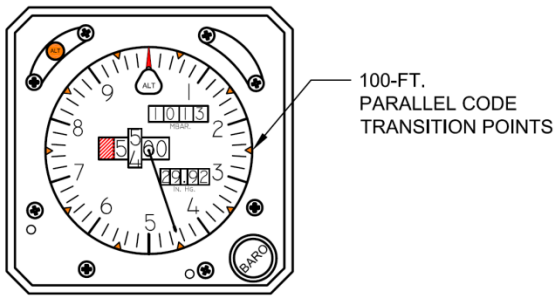


Figure 1 Parallel Code Transitions

1.3.5 Mechanical Characteristics

Model Number	Dimensions	Weight
Model SSD120-35C-RS232	*See Outline Drawing*	4.3 oz.

Tray 881616 and knob 881023 adds 1 oz. to weights above.

1.3.6 Over Range

The SSD120-35C-RS232 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 Data Port Specifications

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

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

Pull-Up Voltage: +3 to 40Vdc.
Maximum Sink Current: 50 mA.
Maximum Cable Length: 4000 ft. (1219 meters)
Input Signal Requirement: Pin 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 Configuring the Serial Data Output

The SSD120-35C-RS232 must be configured through a series of shunts to transmit the correct serial data protocol. These shunts are found under the cover of the unit and allow changes to the serial data resolution, message and baud rate. Remove the four screws and cover to access the shunts. See **Figure 2**. The serial port protocol may also be configured via RS232 communication. See **§4.8**

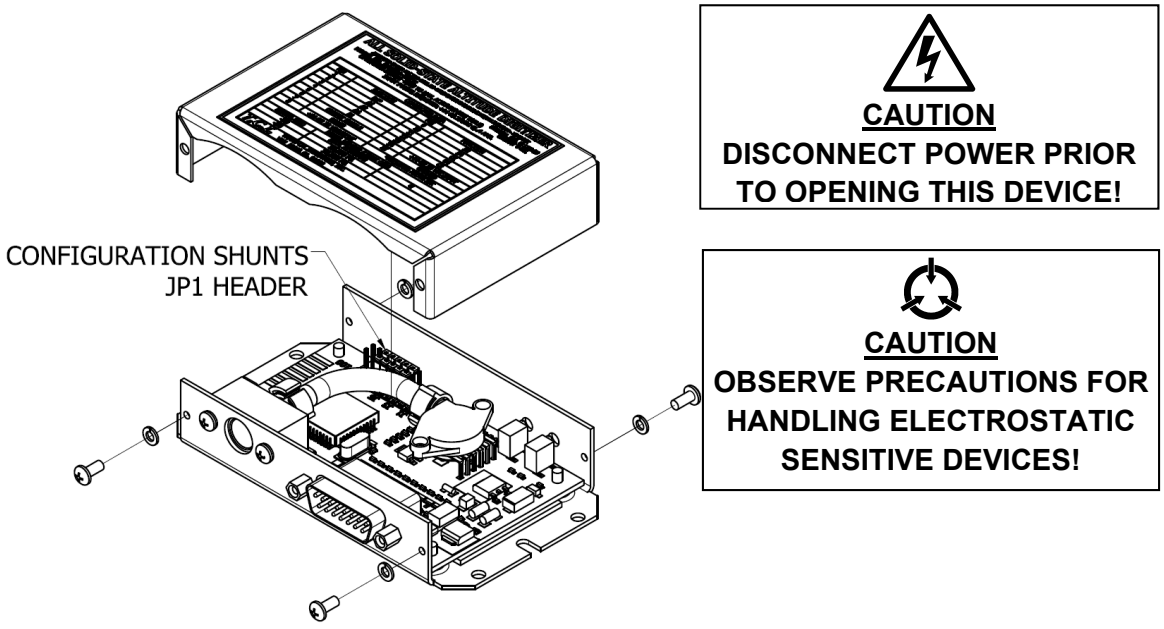


Figure 2 Cover Removal and Configuration Shunt Location

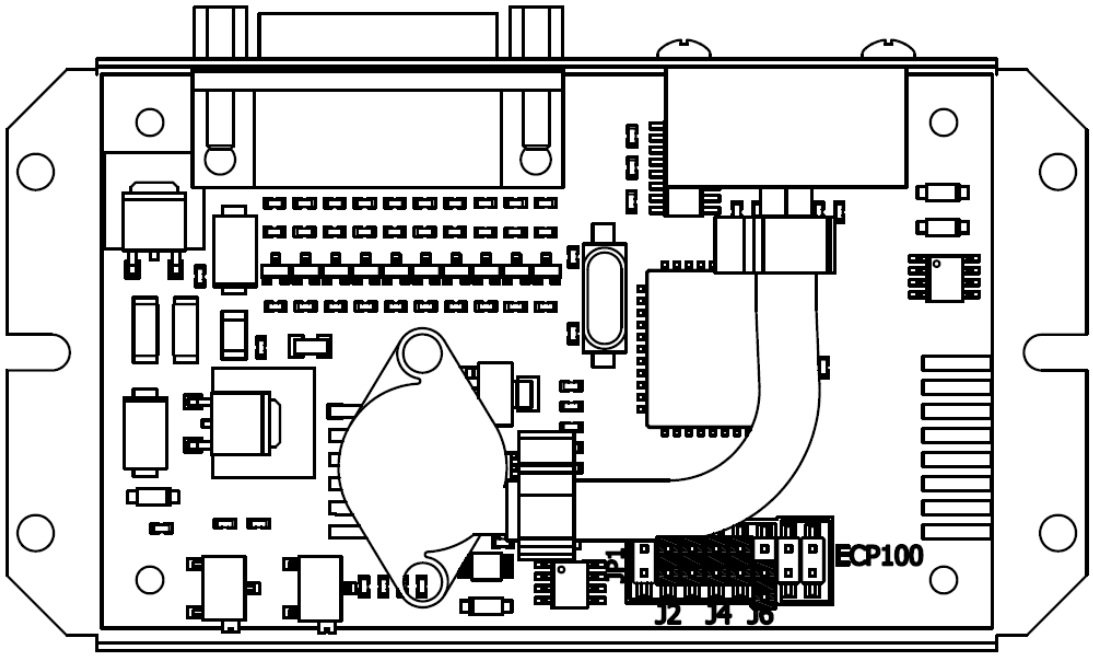


Figure 3 Cover Removed

JP1 Header SSD120-35C-RS232 Configuration Shunts	
J1	Always open Model SSD120-35C-RS232
J2	Always closed Model SSD120-35C-RS232
J3	Always closed Model SSD120-35C-RS232
J4	Close for 10' resolution serial data. Open for 100' resolution data.
J5	Protocol See **§1.9**
J6	Protocol See **§1.9**

1.7 Serial Port Altitude Data Resolution

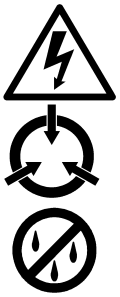
The default resolution of the altitude digitizer serial data is 100 feet. To enable 10-foot resolution, close **J4** of the **JP1** Header. The serial port resolution may also be configured via software. See **§4.8**. and **Figure 3.**

1.8 Serial Communication Format

Model SSD120-35C-RS232 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. As shipped from the factory, the default protocol is the UPS message at 1200bps, 8 data bits, 1 stop bit and no parity.

1.9 Serial Communication Protocol

Serial data protocol is user selectable by using shunts to close or open J5 and J6 of the JP1 Header, or by selecting protocols via software. See **§4.8**, refer to **FIGURES 4** through **7**.



CAUTION! DISCONNECT ELECTRICAL POWER BEFORE REMOVING THE COVER.

CAUTION! OBSERVE PRECAUTIONS FOR ELECTROSTATIC SENSITIVE DEVICES.

CAUTION! DO NOT EXPOSE THIS DEVICE TO MOISTURE.

1.9.1 UPS AT/Garmin AT/IIMorrow Nav. Devices

Leaving J5 and J6 of the JP1 Header open results in 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 accepted by some UPS AT (Garmin AT) (IIMorrow) devices

Message	Definition
#AL +00800T+25D9$^{C}_{R}$	Altitude 800 feet

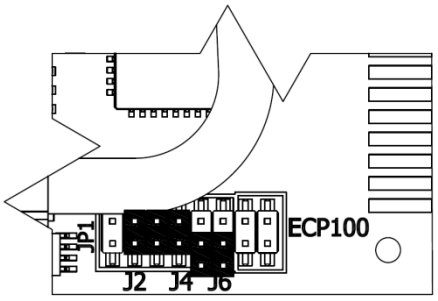


Figure 4 Configured for UPS AT with 10' Resolution

1.9.2 Trimble Garmin Navigation Devices Protocol

Closing J6 and leaving J5 open on the JP1 Header results in a protocol compatible with some Trimble and Garmin devices. 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 accepted by some Trimble, Garmin and Bendix/King devices:

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

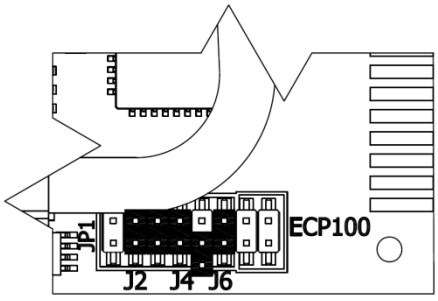


Figure 5 Configured for Trimble with 10' Resolution

1.9.3 Northstar Navigation Devices Protocol

Closing J5 and leaving J6 open on the JP1 Header results in a protocol compatible with some navigation devices manufactured by Northstar and Garmin. The Digitizer will send a 10-byte message. The message begins with ALT followed by a space and five altitude bytes; concluding with a carriage return. (2400bps, 8 data bits, 1 stop bit, no parity.) The following are examples of serial messages for these devices:

Message	Definition
ALT 02500 $^{C}_{R}$	Altitude 2500 feet.
ALT -2500 $^{C}_{R}$	Digitizer disabled

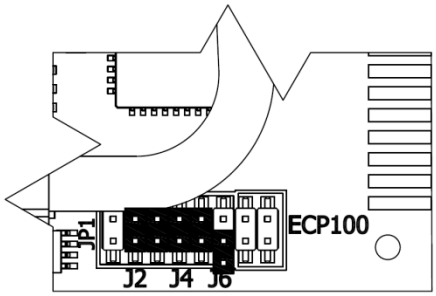


Figure 6 Configured for Northstar with 10' Resolution

1.9.4 Magellan Navigation Devices Protocol

Closing both J5 and J6 on the JP1 Header results in a protocol compatible with some navigation devices manufactured by Magellan. The Digitizer sends a seventeen-byte message beginning with $MGL, followed by a +/- sign and five altitude digits, then T+25, a checksum and concludes with a carriage return. (1200bps, 7 data bits, 1 stop bit, even parity.) The following is an example of a serial message for Magellan devices:

Message	Definition
$MGL+02500T+250C $^{C}_{R}$	Altitude 2500 feet

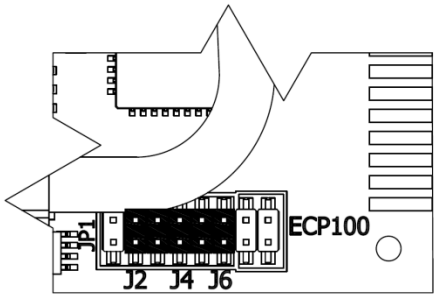


Figure 7 Configured for Magellan with 10' Resolution

1.9.5 ARNAV Systems Protocol

Leave pins J5 and J6 of the JP1 Header open, the ARNAV Systems protocol *MUST* be software selected. See **§4.8** for protocol selection details. Once selected, the Digitizer will send a 24-byte message. Beginning with a ASCII code 02 = STX (Start of Text) then $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. Concluding with an ASCII code 03 = ETX (End of Text). (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

1.9.6 UPS AT 618 Loran Devices Protocol (IIMorrow)

Leave pins J5 and J6 of the JP1 Header open, the UPS AT 618 Loran devices protocol *MUST* be software selected. See **§4.8** for protocol selection details. Once selected, the Digitizer will send a seventeen byte message beginning with # AL, then a space followed by a positive/negative sign, five altitude bytes; the letter “T” and the number “25”; two checksum bytes and a carriage return. (1200bps, 7 data bits, 1 stop bit, odd parity). The following is an example of an UPS AT 618 Loran serial altitude message:

Message	Definition
#AL +00800T+25D9$^{C}_{R}$	Altitude 800 feet

Section 2.0 Operation

2.1 General

The SSD-12035C-RS232 series of altitude digitizers are designed to be mounted within a pressurized or non-pressurized, but temperature controlled area within aircraft operating up to 35,000 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. (Half duplex, talk only. Full duplex in calibration and configuration modes only.)

2.2 Operating Instructions

Parallel Data:
Place the transponder in mode “C”, altitude-reporting mode, and apply power to the transponder and to the digitizer. In some installations the digitizer will automatically be supplied power when the transponder is energized. In other installations, power to the digitizer may be through a separate circuit breaker. If power to the digitizer is provided directly from the aircraft’s avionics buss, follow the power-up procedures recommended by the transponder manufacturer. All parallel outputs will be pulled low for a self-test (3 seconds) at power up, then assume the value for the present input pressure.

NOTE: A short warm-up time may affect the actual data enable time. Typically, at 0ºC a one-minute period is required before the data will enable. See **§2.3** & **Figure 8.**

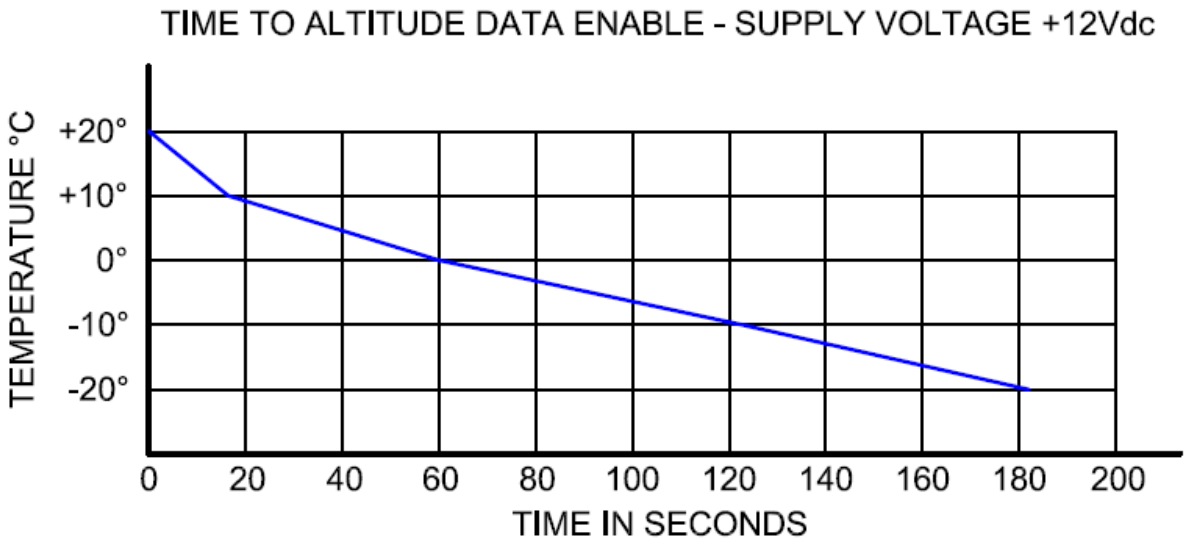
In some installations, the transponder controls the digitizer by enabling and disabling its output. In other installations, the digitizer’s output is not controlled by the transponder and is continuously enabled, (Digitizer pin 6 is grounded.)

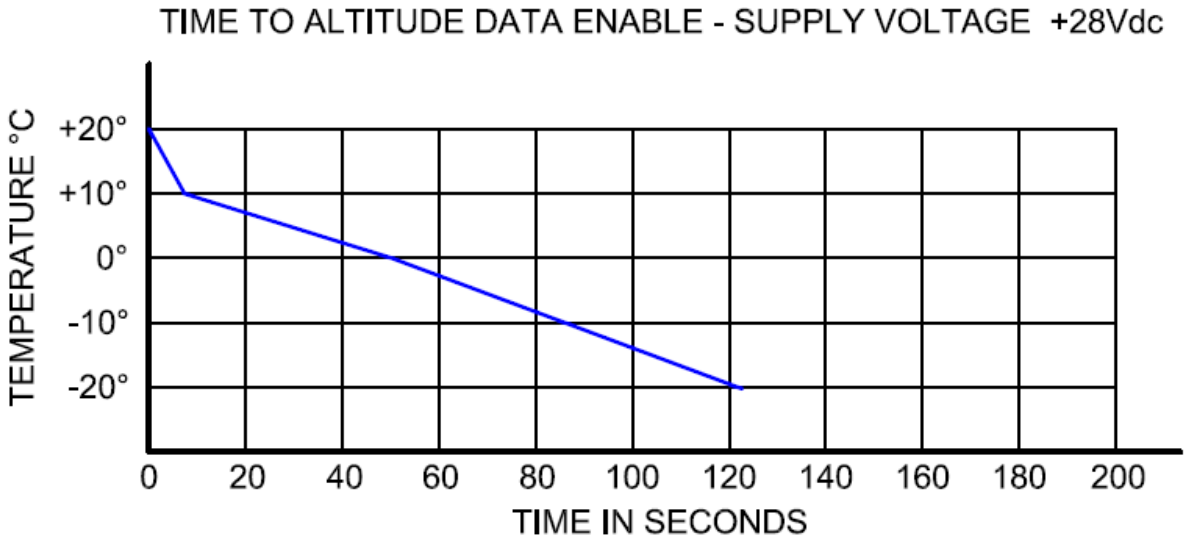
Serial Data:
The serial communication is fully automatic and transmission begins after the self-test is complete. Strobing (pin 6) the parallel data output of the digitizer will not affect the serial data transmission.

2.3 Time to Altitude Data Enable

The altitude digitizer requires a warm-up time for its pressure sensor to reach operating temperature prior to enabling its output. This time to data enable will vary based on the ambient temperature and the supply voltage as shown in **Figure 8**.

Figure 8 Time to Altitude Data Enable





Section 3.0 Installation

3.1 Mechanical Installation

The SSD120-35C-RS232 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 SSD120-35C-RS232 series of digitizer may be mounted in any attitude within the internal structure of the aircraft. DO NOT mount the digitizer in any location that could interfere with the safe operation of the aircraft. DO NOT mount the digitizer in the direct air stream of either hot or cold air ducts. The mounting position should allow for a short static pressure line from the digitizer to the altimeter, access to the digitizer's adjustments, and ample room for a service loop for the interconnecting cabling. The SSD120-35C-RS232 is provided with an 1/8-27NPT static port inlet, used to connect the digitizer to the aircraft static system. Apply an anti-seize pipe sealant (not included) or equal to the mating fitting. Exercise care to prevent excess sealant from plugging the inlet to the pressure sensor. **Loctite RTV Clear Silicone Sealant (59530)** is recommended and Is used to seal static line connections during all environmental testing at Trans-Cal.

Use #4-40 or #6-32 machine screws, sheet metal screws, or rivets to attach the digitizer or the mounting tray **881616** to the airframe. Secure mating connectors to the digitizer housing using the #4-40 screws provided. Refer to the **Outline Drawing** for mechanical dimensions.

Installations that orient the digitizer in an upside down position utilizing the mounting tray **881616** and knob **103023**, will require the use of a few drops of removable **Loctite® Threadlocker 242**. Follow the manufacturer's instructions to apply a few drops into the knob's threaded hole then use the knob to secure the digitizer to the mounting tray. The application of Loctite will ensure that the knob will remain secured and vibration will not cause the knob to work loose allowing the digitizer to drop down out of the mounting tray.

Avoid mounting the SSD120-35C-RS232 near any equipment operating with high pulse currents or high power outputs such as strobe power supplies, radar, and or satellite communications equipment.

To prevent the accumulation of condensation in the digitizer pressure sensor, locate this device away from the lowest section of the static system, and ensure a proper condensation trap and system drain is installed and functional, reference FAR 23.1325.

Verify that moisture resulting from condensation will run away from the digitizer electrical connections.

Adapter plates are available to convert older Trans-Cal and competing digitizer installations for use with the SSD120-35C-RS232 series of altitude digitizers. See ordering information in **§8.0**.

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. Wiring harnesses must be fully supported to prevent movement and should be protected against chaffing.

CAUTION!

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

The digitizer is designed to operate with either a +14 or 28 Vdc power source. These voltages may be switched power provided by the transponder or may be provided by the avionics buss. If using the avionics buss, protect the circuit with a ½ amp fuse or circuit breaker.

Parallel Data Connections - **Table XIV** and the outline drawing provide electrical connector pin/function information. Use this data when connecting the digitizer to the transponder. In some installations where older transponders are used, the transponder may not provide an "altitude disable" function. In this case, an instrument panel mounted switch for this function may be required utilizing pin 6 of the digitizer connector.

Serial Data Connection - Connect the TxD1 (pin 14) or TxD2 (pin 7) from the digitizer connector to the RxD (receive data) port on the GPS or other receiving device. It is important to provide a data ground from the digitizer to the receiving GPS or other device.

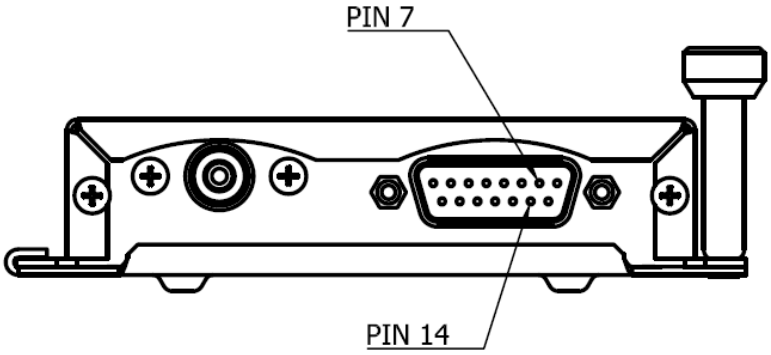


Figure 9 Serial Data Output Pins

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:

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 ICAO Altitude Data Port Test Equipment

The output of the parallel ICAO altitude data may be monitored by any number of transponder ramp test sets, which allow display of the ICAO altitude digitizer/encoder code. The IFR Model ATC-600A Portable Transponder Test Set is one example. Alternatively, the Trans-Cal Industries' ATS-400 or EET-200 may be used to display the parallel data directly from the digitizer.

Section 4.0 Calibration and Configuration

4.1 Calibration Overview

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

NOTE: To ensure correspondence with all on-board pressure altitude systems, altitude digitizers that are not providing information to the ATC transponder should be tested to ensure correspondence to the primary flight altimeter, as per FAA AC 43-6C.

The following procedures will allow adjustment to the calibration curve of the SSD120-35C-RS232 or 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 and ETSO-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 SSD120-35C-RS232 is designed to be field calibrated to meet this requirement, as per the procedure described in either **§4.3,** or **§4.4**.

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. See **Figure 13**.

There are two different methods used to adjust the calibration of the SSD120-35C-RS232. The technician need only perform the method that is best suited for the application in question. *There is no need to perform both methods*. The digitizer may be adjusted using two potentiometers, which affect the span and reference of the pressure transducer. 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 Trans-Cal's **ECP-100** or alternatively, via an IBM compatible PC.

The **Span Adjust** calibration **(§4.3)** is normally used in applications where only a slight modification is required to bring the altitude digitizer curve up or down.

The **Dynamic Calibration** procedure **(§4.4)** is an alternate method used to match the altitude digitizer to the primary flight altimeter or NIST standard. It assumes the digitizer and altimeter are connected as shown in **Figure 11**. The technician may adjust the input pressure to the digitizer and primary flight altimeter to the same pressure altitude and then enter this altitude into the **ECP-100** or an IBM compatible computer, which will transmit the correction to the digitizer's EEPROM.

This calibration procedure differs from the **Span Adjust** procedure in that the adjustments are made at 1000-foot intervals and the Digitizer is adjusted at the 0 foot mark *NOT* the ICAO data nominal transition point.

4.2 Required Equipment Span Adjust

(See span adjust block diagram.)

1. Primary Flight Altimeter.
2. +12 or 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-400 or equal device which will allow the display of the 100 foot resolution parallel altitude data.

4.3 Span Adjust Procedure

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. 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 HIGH adjustment is closest to the edge of the housing, and the LOW adjustment is closer to the center of the housing.

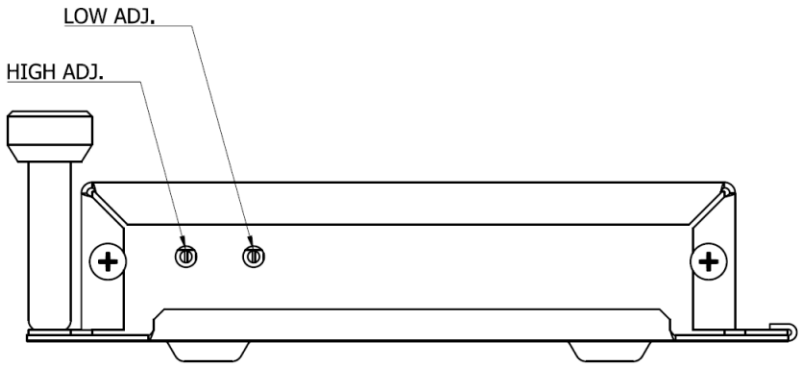


Figure 10 Low & High Calibration Adjustments

NOTE:
Changing either potentiometer will affect the other. An adjustment made to correct the low transition point, will move the high transition point, and require an adjustment of the high potentiometer.

2. Apply power to the altitude digitizer and 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 digitizer ICAO 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 primary flight altimeter's reading. If not, adjust the high potentiometer until the digitizer transition point is within ±30 feet of the nominal transition point. E.g., while ascending, the digitizer should transition from 29,900 feet to 30,000 feet at 29,950 feet nominally.

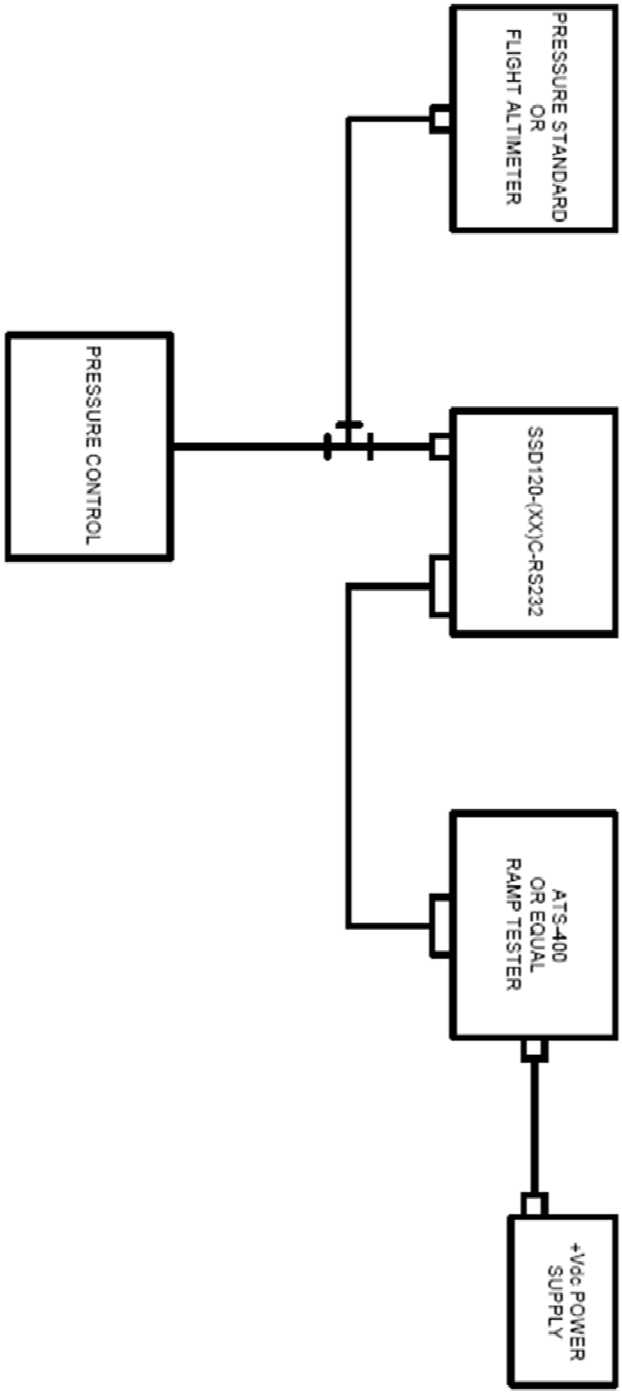
5. Increase pressure until the digitizer's output just makes the transition from 100 feet to 0 feet. Verify that the altitude digitizer reports within ±125 feet of the primary flight altimeter. If not, adjust the low potentiometer until the transition point is within ±30 feet of the nominal transition point. E.g. while descending, the digitizer should transition from +100 to 0 feet at +50 feet nominally.

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 altitude 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 primary flight 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.

Figure 11 Span Adjust Block Diagram



4.4 Dynamic Calibration Adjustment Procedure using the ECP-100

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

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

This procedure will allow adjustment to the calibration curve of the SSD120-35C-RS232 or using the ECP-100 as an aide in matching the digitizer output to a primary flight altimeter or NIST traceable pressure standard. This procedure differs significantly from the **Span Adjust Procedure** described in **§4.3**. The **Dynamic Calibration Procedure** makes adjustments to the altitude data stored in the digitizer's EEPROM. The technician may make adjustments to the digitizer error curve in 1000 foot increments, over the entire operating range with the single exception of the negative 1000 foot mark. The technician will make the adjustments at the 0 or whole altitude mark, ***NOT*** at the parallel data's nominal transition point. See **Figure 13.** The digitizer will automatically adjust the ICAO parallel altitude data to transition 50 feet prior to the 0 mark. E.g., the digitizer's ICAO parallel altitude code will transition from 900 to 1000 feet while the serial altitude data is transmitting 950 feet.

CAUTION!

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

1. Connect the digitizer, ECP-100, and NIST standard or flight altimeter as shown in the **Figure 13** and apply power.

2. Slide the **ECP-100 CAL. PROGRAM** selector to the leftmost **PROGRAM** position.

3. Apply power to the altitude digitizer and slide the **ECP-100** power switch to the on position.

4. Set the altimeter barometric input to 29.92In.Hg. (1013MB). Adjust the static system pressure and stabilize at the first altitude to be calibrated. The first possible correction for Trans-Cal digitizers is at 0 feet. All adjustments to the digitizer calibration curve occur at 1000-foot intervals. Use the **ALTITUDE UP**

and **ALTITUDE DOWN** buttons to adjust the **ECP-100** to the current pressure altitude prior to pushing the **INITIATE PROGRAM** pushbutton.

5. Press the **INITIATE PROGRAM** pushbutton once. The **ECP-100** will enter a digital correction into the digitizer's **EEPROM** at the current pressure altitude.

6. Adjust the input pressure to the next 1000-foot increment and adjust the **ECP-100** to the next 1000-foot increment and repeat step 5. Continue throughout the operating range of the altitude digitizer and altimeter.

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 altitude 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.

NOTE: If an error is entered into the digitizer, adjust the pressure to the correct altitude and re-enter the correction. To clear *ALL* corrections to the digitizer error curve press the **ALTITUDE UP PROGRAM** pushbutton once. Then press and hold the **ALTITUDE DOWN** pushbutton for two seconds. If the digitizer and flight altimeter are within the ±125-foot requirement, then no further correction is required. DO NOT adjust the digitizer's high and low potentiometers during this procedure.

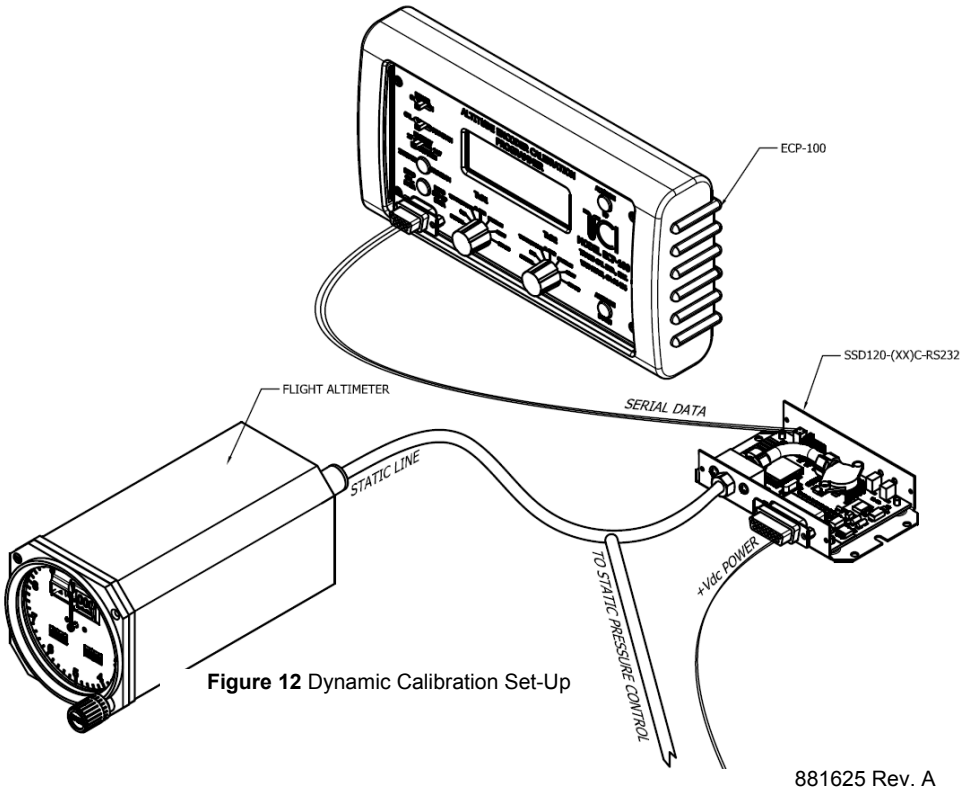
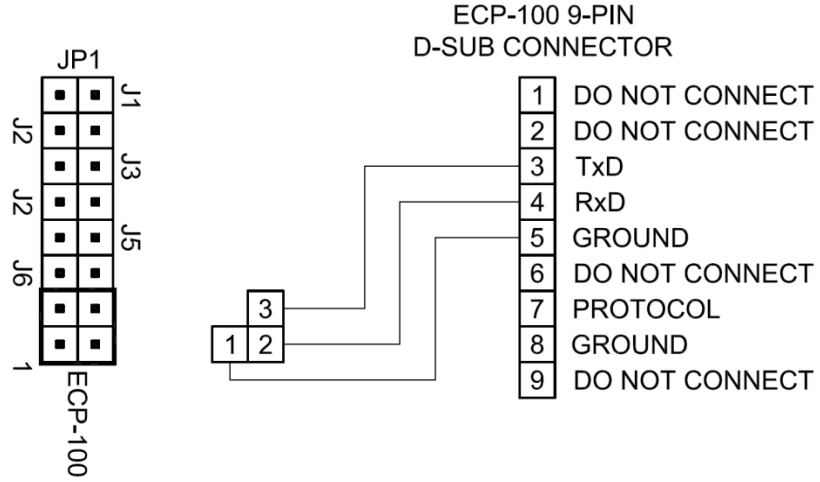


Figure 12 Dynamic Calibration Set-Up

4.5 Calibration Wiring Harness Using the ECP-100



4.6 Calibration Harness Using a PC with RS232 Input

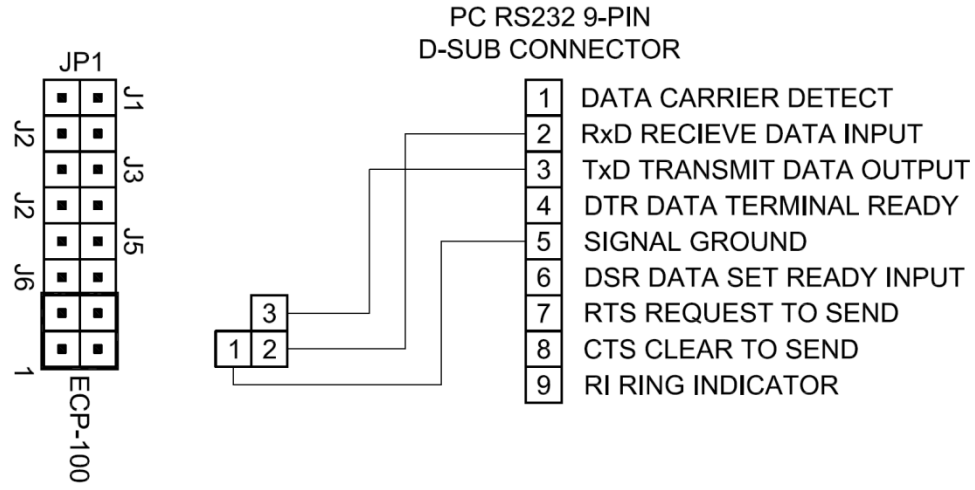
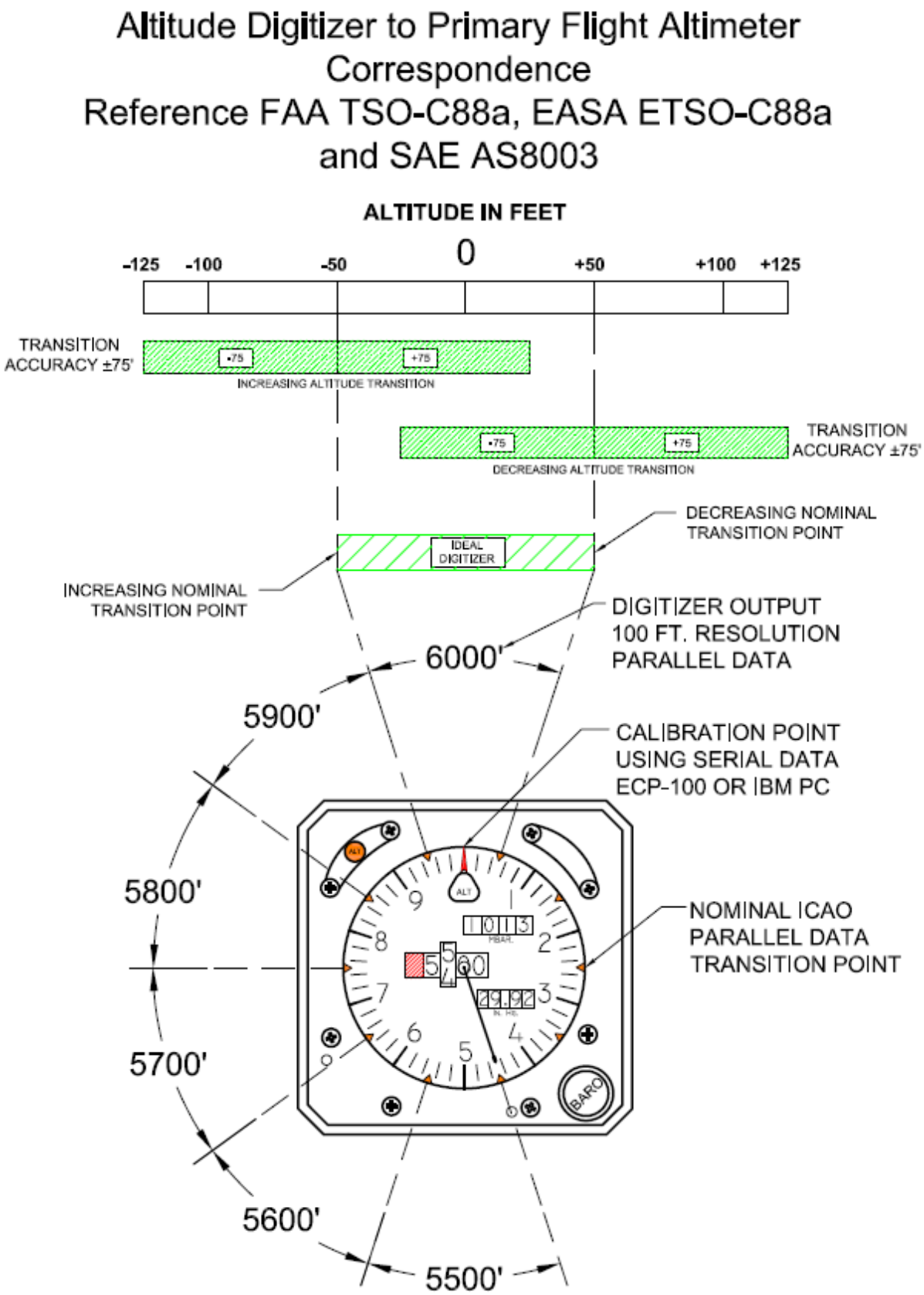


Figure 13 Digitizer Correspondence



4.7 Serial Data Offset

When using serial data from the Altitude Digitizer 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 Digitizers requires the 100' resolution grey code to transition at the 50' mark with a tolerance of ±125'.

Figure 14 displays the ideal case for 11,000 feet.

The ideal Altitude Digitizer 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.

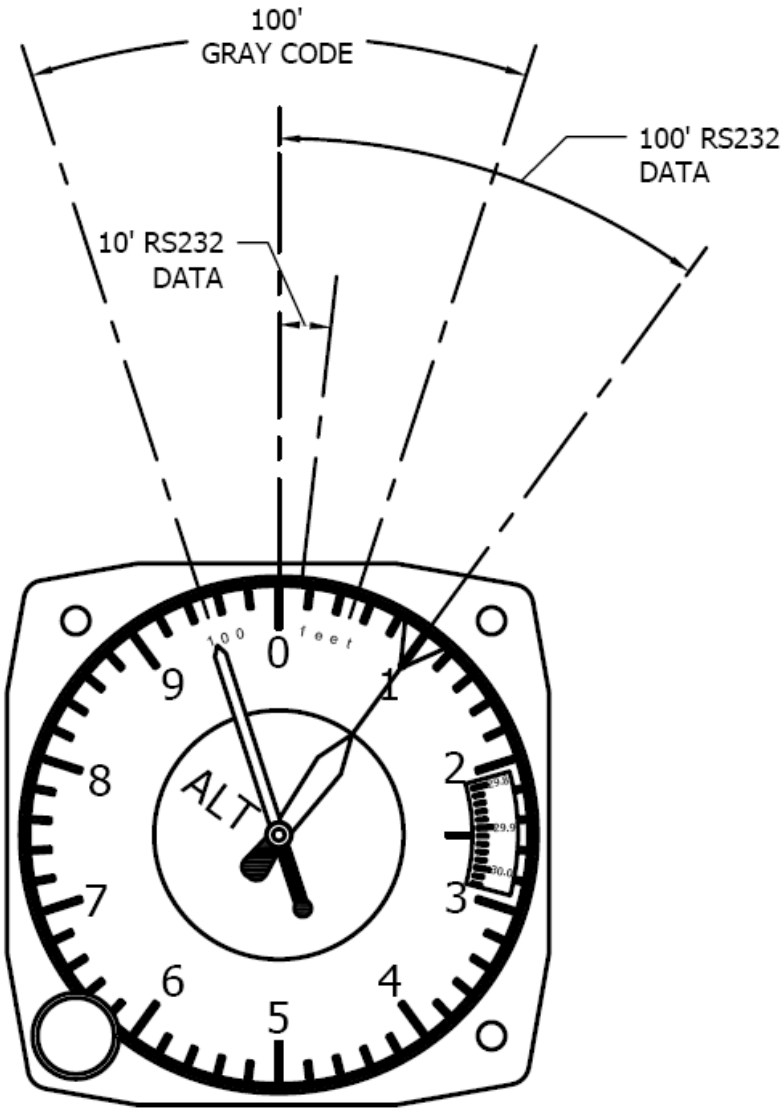


Figure 14 Serial Data Offset

4.8 Serial Port Software Configuration Using the ECP-100

This procedure will allow the technician to assign separate serial data output protocols to the altitude digitizer output ports. Connect the ECP-100 to the altitude digitizer as shown in **Figure 14**.

Step 1: Remove power from the Altitude Digitizer, remove the four screws and cover as shown in **Figure 2**. Slide the CAL. Program switch to its rightmost **PROGRAM** position and connect the ECP-100 to the Altitude Digitizer as shown in **Figure 14**.

Step 2: With the **ECP-100** power switch in the **OFF** position, apply power to the Altitude Digitizer, then slide the **ECP-100** power switch to the on position. The **ECP-100** will beep twice then display the current pressure altitude transmitted from the altitude digitizer.

ALTITUDE PROGRAMMER
ALT 00800

Step 3: Push the **READ SET-UP DATA** pushbutton once. The **ECP-100** will display the current serial port protocol settings for 15 seconds, and then return to the altitude programmer display page. The factory setting is pictured below.

DATA = 000
100 Foot Resolution
TxD1= UPS 1200bps
TxD2= UPS 1200bps

Step 4: Slide the **RESOLUTION** selector switch to the desired serial altitude data resolution 10’ or 100’.

Step 5: Rotate the TxD1 and TxD2 selector knobs to the desired output protocol. For the purpose of this example we will set TxD1 to transmit the UPS protocol and TxD2 to transmit the Trimble/Garmin protocol.

Step 6: Press the **INITIATE PROGRAM** pushbutton once. The display will beep then flash PROGRAMMING and display the protocols to be programmed. Wait until the **ECP-100** emits a long beep and displays OPERATION COMPLETED then returns to the ALTITUDE PROGRAMMER display.

PROGRAMMING
10 Foot Resolution
TxD1= UPS 1200bps
TxD2= Trimble/Garmin

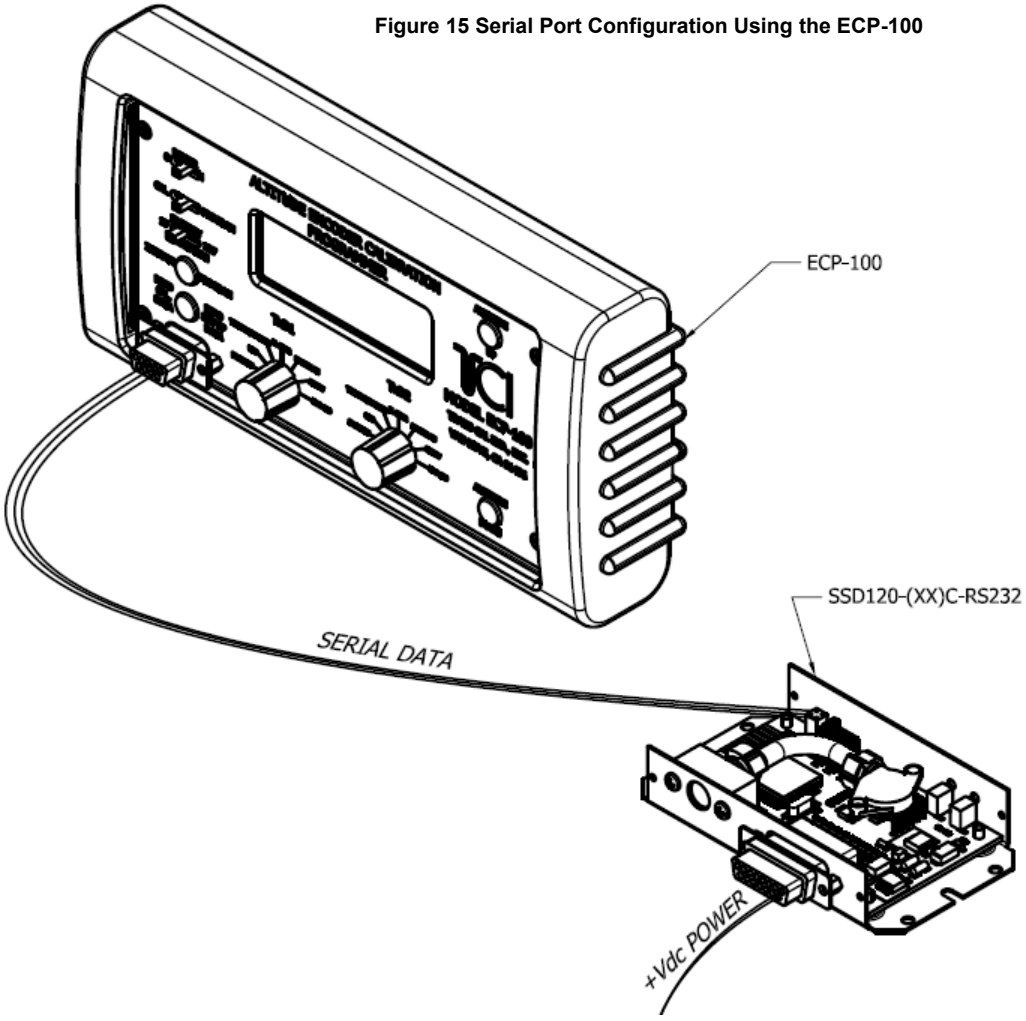
Step 7: Confirm the port programming by pressing the **READ SET-UP DATA** pushbutton. It should display the settings applied in the previous steps. In the case of our example the display would appear as below.

DATA=212
10 Foot Resolution
TxD1= UPS 1200bps
TxD2= Trimble/Garmin

Step 8: Slide the **ECP-100** power switch to the off position and remove power from the Altitude Digitizer.

Step 9: Replace the cover and screws. The encoder is now programmed and ready to operate.

Figure 15 Serial Port Configuration Using the ECP-100



Section 5.0 Digitizer Interconnection Tables

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

Table I Bendix King

SSD120 15 Pin Conn.	Function	Bendix/King KT73 & KT 74 Pin Number	Bendix/King KT76/78 Pin Number	Bendix/King KT76A/78A Pin Number	Bendix/King KXP Pin Number	Bendix/King KXP 755 Pin Number
1	D4	8	*[1]	*[1]	V	X
2	A1	M	6	M	G	A
3	A2	K	7	K	H	D
4	A4	J	9	J	J	k
5	B1	E	4	E	K	f
9	B2	C	1	C	L	g
10	B4	B	2	B	M	Y
11	C1	D	3	D	P	U
13	C2	L	8	L	R	T
12	C4	H	10	H	S	W
6	Output Enable	Connect to aircraft ground.	Connect to aircraft ground.	Connect to aircraft ground.	Connect to aircraft ground.	Connect to aircraft ground.
8	+14 to 28Vdc Input.	Connect to aircraft's avionics buss protected by a fuse or circuit breaker.	Connect to aircraft's avionics buss protected by a fuse or circuit breaker.	Connect to aircraft's avionics buss protected by a fuse or circuit breaker.	Connect to aircraft's avionics buss protected by a fuse or circuit breaker.	Connect to aircraft's avionics buss protected by a fuse or circuit breaker.
15	Ground	Connect to aircraft ground.	Connect to aircraft ground.	Connect to aircraft ground.	Connect to aircraft ground.	Connect to aircraft ground.

Serial Data Connection for the Bendix/King KT 73 & KT 74 Transponder

SSD120-35C-RS232 DA-15P Connector	Function	KT 73 24 Pin Conn.	KT 74 J2 Conn.
7 or 14	TxD to RxD	7	3
15	Ground	1 or A	1
KT 73 - No shunts, software select only.		KT-73 Only - Software select UPSAT 618 Protocol.	KT 74 Close shunt J4 and J6.
KT 74 – Close shunt pins J4 and J6. Leave J5 open.			
Connect serial OR parallel data not both! The KT 73 & KT 74 will default to the 100' resolution parallel code, if both data formats are connected.			

[1] Data for this connection is not available at this time.

Table II Cessna, Narco, Microair

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	Microair T2000
1	D4	10	*[2]	*[2]	21
2	A1	14	7	2	9
3	A2	13	6	4	10
4	A4	15	8	8	11
5	B1	19	12	9	12
9	B2	17	10	10	13
10	B4	16	9	11	17
11	C1	21	14	1	18
13	C2	18	11	3	19
12	C4	20	13	5	20
6	Output Enable	11	5	12	Connect to aircraft ground.
8	+14 to 28Vdc Input	9	18	13	2
15	Ground	Connect to aircraft ground.	Connect to aircraft ground.	14	Connect to aircraft ground.

Narco AT-50 and AT-50A Installations

The Narco AT-5A, AT-6A, AT-50 and AT-50A transponder will not accept parallel data from the SSD120-35C-RS232 Altitude Digitizer. A modification to remove the output decoupling capacitors is required and the unit may be ordered from the factory with this modification. Order Model Number SSD120-35C-RS232 with Mod 1.

NOTE: The Narco AT-50 and earlier transponder models require a modification before they will function correctly with any Altitude Digitizer. This modification is outlined in Narco Service Bulletin AT-50A-5.

[2] Data for this connection is not available at this time.

Table III Garmin

SSD120 15 Pin Conn.	Function	Garmin GTX 320 & 327 Pin Number	Garmin GTX 330 & 330D Pin Number	This column left blank intentionally.	This column left blank intentionally.
1	D4	18	11		
2	A1	3	2		
3	A2	5	4		
4	A4	6	5		
5	B1	9	7		
9	B2	11	9		
10	B4	12	10		
11	C1	10	8		
13	C2	4	3		
12	C4	7	6		
6	Output Enable	13 or 25 or aircraft ground	50		
8	14 to 28Vdc Input	14 to 28Vdc Input	Pin 62 through a 3 amp 50V reverse rated diode.		
15	Ground	Connect to aircraft ground.	Connect to aircraft ground.		

Table IV Garmin

Serial Data Connection for the Garmin GTX327 Transponder

SSD120-35C-RS232 DA-15P Connector	Function	GTX327 25 Pin Connector
14 or 7	TxD to RxD	19
15	Data Ground	13 or 25
JP1 Header: Open shunt J5 Close shunt J6		

Table V Garmin

Serial Data Connection for the Garmin GTX330 and 330D Transponder

SSD120-35C-RS232 DA-15P Connector	Function	GTX330 62 Pin Connector
14 or 7	TxD to RxD	24 (RS232 In 2)
15	Data Ground	Data Ground
JP1 Header: Open shunt J5 Close shunt J6		

To allow the **Garmin GTX 327, 330 and 330D** transponders to communicate with the SSD120-35C-RS232 go to the **Setup Page** and set the **Altitude Source (ALT SRC)** to receive data in the **Icarus RS232 format.**

Table IVI Edo-Air, Genave, Collins, Radair

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	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.

Table VII Bendix, Wilcox, UPS AT

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	*[3]	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	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.

Table VIII UPS AT

Serial Altitude Data Connection for the Apollo SL70 Transponder

SSD120-35C-RS232 DA-15P Connector	Function	UPS AT SL70
14 or 7	TxD to RxD	4
15	Ground	3

To allow the **UPS AT SL70** transponder to accept serial data from the SSD120-35C-RS232 go to the **Test Mode** on the **SL70 Conf** page and set the **Altitude Source (ASrc)** to receive **Serial (Ser)** data. On the **BAUD** page select **1200**.

[3] Data for this connection is not available at this time.

Table IX Becker, Terra

SSD120 15 pin Conn.	Function	Becker Avionic Systems ATC3401 ATC2000	Becker Avionic Systems ATC4401	Terra TRT-250 TRT-250D	This column left blank intentionally.
1	D4	23	20	9	
2	A1	16	1	5	
3	A2	15	2	17	
4	A4	14	3	16	
5	B1	17	14	15	
9	B2	19	15	2	
10	B4	18	16	14	
11	C1	22	17	3	
13	C2	21	18	4	
12	C4	20	19	18	
6	Output Enable	24	25	12	
8	+14 to 28Vdc	6	6	20	
15	Ground	24	25	Connect to aircraft ground	

Table X Trig, Avidyne

Serial Altitude Data Connection for the Trig TT31 and Avidyne AXP340 Mode S Transponder

SSD120-35C-RS232	Function	Trig TT31 Avidyne AXP340
14 or 7	TxD to RxD	7
15	Ground	A or 1
JP1 Header: Close shunt J4 Open shunt J5 Close shunt J6		

NOTE: The TT31 and the AXP340 will accept either parallel or serial altitude data inputs in either the Trimble/Garmin or the Shadin “RMS” data formats. The TT31 will select the parallel data inputs if both are connected. Serial data inputs are recommended for better Mode S data resolution. Ground J4 to select 10-foot resolution.

Table XI Bendix King EGPWS

SSD120 15 pin Conn.	Function	Bendix/King 560EGPWS & MK-XXI EGPWS	Bendix/King KMH 870 IHAS Processor	This column left blank intentionally.
1	D4	No connection	18	
2	A1	12	11	
3	A2	52	10	
4	A4	33	9	
5	B1	14	14	
9	B2	34	13	
10	B4	73	12	
11	C1	32	17	
13	C2	13	16	
12	C4	72	15	
6	Output Enable	Connect to aircraft ground	Connect to aircraft ground	
8	+14 to 28Vdc	Connect to avionics buss protected by a fuse or circuit breaker	Connect to avionics buss protected by a fuse or circuit breaker	
15	Ground	Connect to aircraft ground	Connect to aircraft ground	

Table XII NavWorx ADS600-B

Serial Altitude Data Connection for the ADS600-B UAT Data Link Transceiver

SSD120-35C-RS232 DA-15P	Function	ADS600-B Connector P1
14 or 7	TxD to RxD	3
15	Ground	4
JP1 Header: Close shunt J4 Open shunt J5 Close shunt J6		

Table XIII NavWorx ADS600-EXP

Serial Altitude Data Connection for the ADS600-EXP UAT Data Link Transceiver

SSD120-35C-RS232 DA-15P	Function	ADS600-EXP Connector P1
14 or 7	TxD to RxD	3
15	Ground	4
JP1 Header: Close shunt J4 Open shunt J5 Close shunt J6		

Table XIV Connector Pin Assignments SSD120-35C-RS232

SSD120-35C-RS232 DA-15 Connector	Function
1	D4
2	A1
3	A2
4	A4
5	B1
6	Strobe/ Output Enable
7	TxD2
8	+14 to 28Vdc Input
9	B2
10	B4
11	C1
12	C4
13	C2
14	TxD1
15	Ground

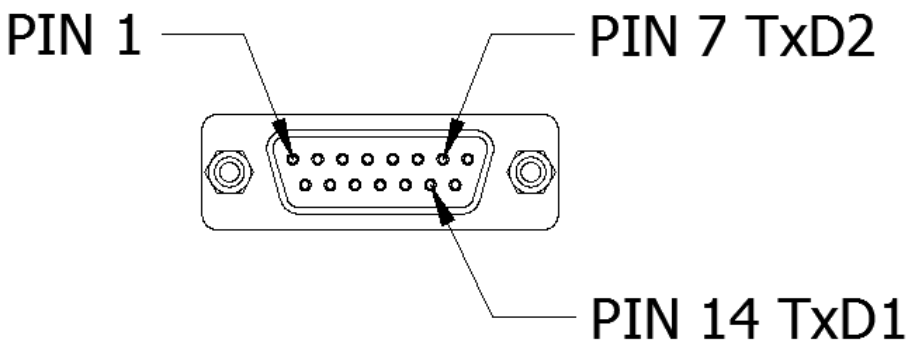


Figure 16 DA-15P D-Subminiature Connector Front View

Table XV Quick Guide to Common Serial Data Interconnects

For ALL applications, closing J4 enables 10' data resolution.

Device	Baud Rate/Data Bits/Stop Bits/Parity	TCI SSD120-35C-RS232 JP1 Header Shunt Position.
ARNAV (data in meters) 5000 MFD 505/506/512 DR-100 Wx Link	9600/8/1/None	Software Set-up Only
Bendix/King KT 73	1200/7/1/Odd	Software Set-up Only
Bendix/King KT 74	9600/8/1/None	J4 Closed J5 Open J6 Closed
Garmin 400 & 500 Series GPS GNC300, GTX327, GTX330	9600/8/1/None	J4 Closed J5 Open J6 Closed
NavWorx ADS600-B & ADS600-EXP	9600/8/1/None	J4 Closed J5 Open J6 Closed
Trig TT31	1200/8/1/None	None
Trimble 2101	9600/8/1/None	J5 Open J6 Closed
UPS AT GX50, GX60, GX65 MX20, SL70	1200/8/1/None	J5 Open J6 Open
UPS AT 618 Loran	1200/7/1/Odd	Software Set-up Only

Section 6.0 GPS/MFD & Miscellaneous Connection Data

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

Table XVI Apollo GX Series

Apollo Model GX50, GX60, GX65

Apollo GX50, GX60, GX65 Signal	Apollo 37 Pin D-Sub Connector	SSD120-35C-RS232 DA-15P Pin Connector
RxD2	21	14 or 7
Ground	20	15
		JP1 Header: Close shunt J4 for 10' resolution Open shunt J5 Open shunt J6

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.

Table XVII Apollo MX20
Apollo Model MX20 Multi-Function Display

Apollo MX20 Signal	Apollo 37 Pin D-Sub Connector	SSD120-35C-RS232 DA-15P Pin Connector
RxD2	21	14 or 7
Ground	3	15
		JP1 Header: Close shunt J4 for 10' resolution Open shunt J5 Open shunt J6

Apollo MX20 Software Configuration

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

Table XVIII Trimble

Trimble 2101 Approach

Trimble Signal	Trimble 2101 Port 1	Trimble 2101 Port 2	SSD120-35C-RS232 DA-15P Pin Connector
RxD+	7	24	15
RxD-	8	36	14 or 7
Ground	3 or 20	3 or 20	15
			JP1 Header: Close shunt J4 for 10' resolution Open shunt J5 Close shunt J6

Trimble Approach Plus GPS Receiver Software Configuration – Installation Setup

Access the 2101 installation setup menu 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.**

Table XIX Trimble

2101 I/O Approach Plus GPS Receiver

Trimble Signal	Trimble 2101 Port 1	Trimble 2101 Port 2	SSD120-35C-RS232 DA-15P Pin Connector
RxD+	J1-7	J1-24	15
RxD-	J1-8	J1-36	14 or 7
Ground	J1-3 or 20	J1-3 or 20	15
			JP1 Header: Close shunt J4 for 10' resolution Open shunt J5 Close shunt J6

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**.

Table XX Garmin
Garmin 400 and 500 Series GPS Devices (Includes 430W and 530W)

Garmin 78 Pin Conn. (P4001)	SSD120-35C-RS232 DA-15P Pin Connector
57	14 or 7
77 or 78	15
	JP1 Header: Close shunt J4 for 10' resolution Open shunt J5 Close shunt J6

Garmin 400 series GPS software configuration

To allow the **Garmin 400 series GPS** to communicate with the SSD120-35C-RS232 go to the **Main RS232 Config** page and set channel 1 input to **Icarus-alt.**

Table XXI Garmin
Garmin GNC 300 GPS/Comm

GNC 300 37 Pin Connector J101	Function	SSD120-35C-RS232 DA-15P Pin Connector
17	RxD to TxD	14 or 7
26 or 22	Data Ground	15
		JP1 Header: Close shunt J4 for 10' resolution Open shunt J5 Close shunt J6

To allow the **Garmin 300 series GPS/Comm** to communicate with the SSD120-35C-RS232 go to the **I/O Test Page** and set channel 1 input to **Icarus-alt.**

Table XXII ARNAV

ARNAV Systems 5000 Series Multi-Function Display

ARNAV 5000 25 Pin Connector	SSD120-35C-RS232 DA-15P Pin Connector
15	14 or 7
13 or 25	15
	Protocol, Software select ARNAV protocol see **§4.8**.

Table XIII ARNAV

ARNAV Systems GPS-505/506/512 GPS Sensor

ARNAV GPS-505/506/512 DB-25 Connector	SSD120-35C-RS232 DA-15P Pin Connector
8	14 or 7
9	15
	Protocol, Software select ARNAV protocol see **§4.8**.

Table XIV ARNAV

ARNAV Systems DR-100 WxLink Receiver/ Multiplexer

ARNAV DR-100 25 Pin Connector	SSD120-35C-RS232 DA-15P Pin Connector
10	14 or 7
13 or 25	15
	Protocol, Software select ARNAV protocol see **§4.8**.

SSD120-35C-RS232 Software Configuration Note for Use with ARNAV Devices

The SSD120-35C-RS232 *must* be software configured per **§4.8** to operate with ARNAV system devices.

Table XXV Century Flight Systems

Digital Altitude Preselect/Alerter 1D960 ICAO Parallel Input		
SSD120 Pin	**Function**	**1D960 Pin**
1	D4	9
2	A1	25
3	A2	40
4	A4	10
5	B1	26
6	STROBE	Connect to Ground
7	TxD2	--
8	+Vdc Input	--
9	B2	22
10	B4	7
11	C1	23
12	C4	8
13	C2	38
14	TxD1	--
15	GROUND	--

Digital Altitude Preselect/Alerter 1D960 Serial Data Input		
SSD120 Pin	**Function**	**1D960 Pin**
14 or 7	TxD to RxD	37

Please Note: The Century 1D960 manual lists an RS232 serial altitude data input on pin 37 with a data common on pin J1-46. At the time of this printing, Trans-Cal has not tested the 1D960 input for compatibility.

Section 7.0 Instructions for Continued Airworthiness

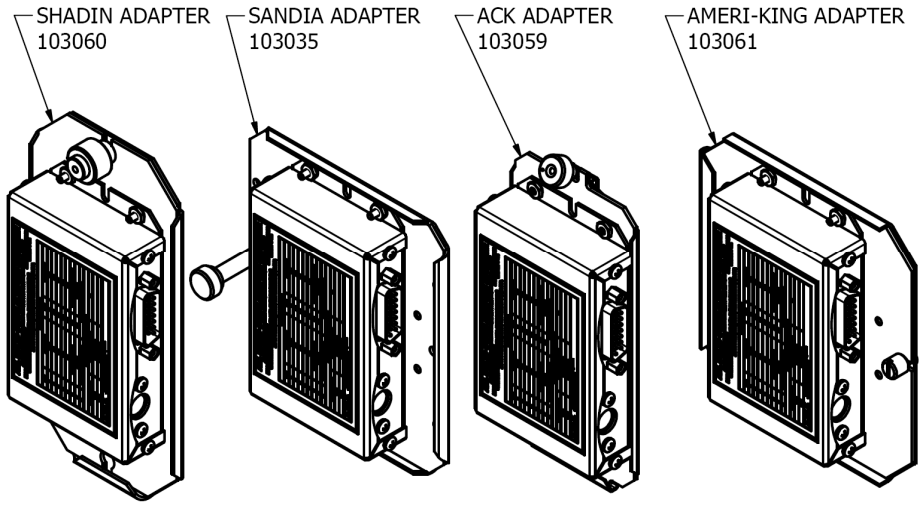
The SSD120-35C-RS232 is an all solid-state device and requires no specific periodic maintenance to maintain its airworthiness, and there are no user serviceable parts. The Altitude Digitizer is to be tested on a biennial basis after initial installation by a qualified avionics facility. The testing carried out during the transponder and pitot-static system tests as required by current Federal Aviation Regulations are considered sufficient to validate proper operation of the Altitude Digitizer. If the Altitude Digitizer reports an error in excess of ±125 feet compared to the primary flight altimeter, then recalibration as per **§4.0** of this manual is required. If the error cannot be corrected through this procedure, then the unit is to be repaired or replaced. Contact Trans-Cal Industries for further information.

Section 8.0 Adapter Plate Ordering Information

The adapter plates listed below will allow the use of competing digitizer manufacturers and older Trans-Cal quick release mounting trays with the SSD120-35C-RS232. These adapter plates are designed to allow quick replacement of Altitude Digitizers. Use the following Trans-Cal part numbers to order adapter plates.

Manufacturer Model	TCI Adapter Plate Part Number
ACK Model A-30	103059
Ameri-King Model AK350 Series	103061
Narco Model AR-850	No adapter required.
Shadin Model 8800-X Series	103060
Sandia Model SAE5-35	103035
Trans-Cal Model D120-P2-T	Not available.
Trans-Cal Model SSD120-(XX)A	103038

Pictured below is the SSD120-35C-RS232 mounted on adapter plates and quick release mounting trays for various devices. Quick release mounting trays are NOT included with the adapter plates.



Section 9.0 Frequently Asked Questions

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

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

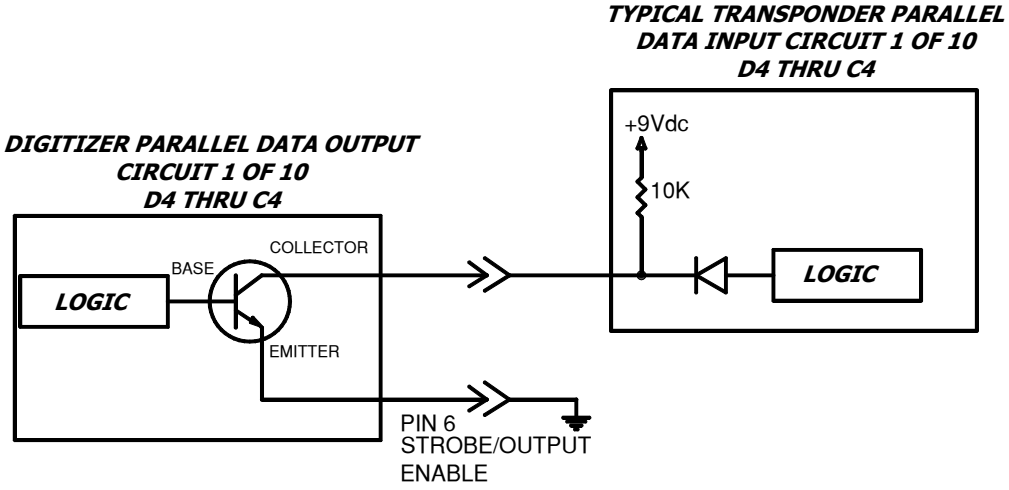
2. *How many devices may be driven off of the parallel ICAO Altitude data port?*

The number of devices that may be connected to the Digitizer ICAO altitude output is a function of the power required. The Digitizer parallel data outputs are "uncommitted" collectors of a transistor array which are "pulled-up" through a resistive load by the transponder (or other device) to some positive voltage. This voltage may range from about +3 to +40Vdc. Each Digitizer data output line (i.e. D4, A1, A2, A4 etc.) is capable of providing 35 mA (0.035 Amperes) with a not to exceed power rating of 100mW (0.1 Watts), when it is "sinking" current in the "on" position. Typical modern applications require about 1 milliampere or less per data line, per device.

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

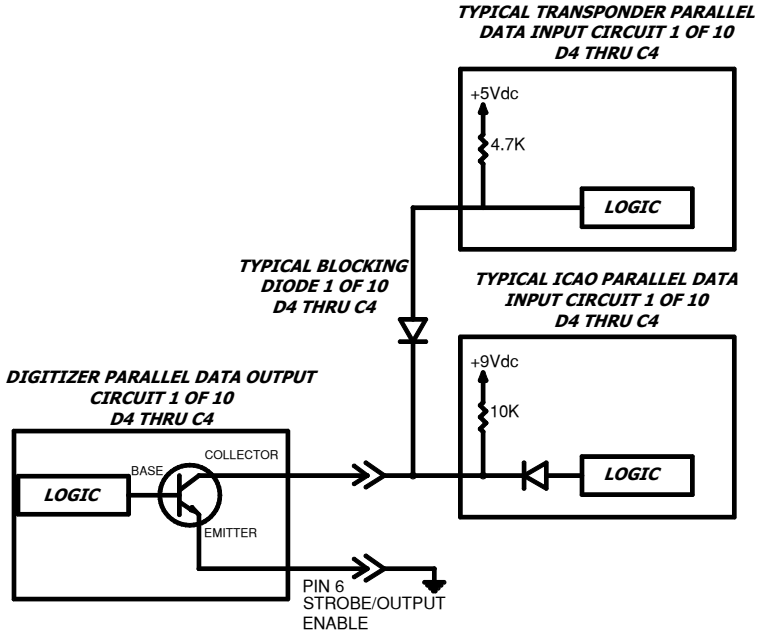
$$V/R = I \qquad 9Vdc/10000\,Ohms = 0.0009\,Amps$$

$$V(I) = P \qquad 9Vdc \times 0.0009\,Amps = 0.0081\,Watts$$



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

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



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

Leave unused data bits unconnected or connect to circuit ground.

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

This is a control signal for the ICAO parallel altitude data. On devices manufactured by Trans-Cal this function is always on pin 6 of the ICAO altitude port. A “high” or “open” on this pin will disable the ICAO altitude data. A “low” or “ground” on this line will enable the altitude data. Some interconnecting devices may use this signal to control the flow of data from the Digitizer. Be aware that when using this signal and connecting multiple devices to the Digitizer, interruptions of the ICAO data will occur when the controlling device “*strobes*” the Digitizer.

Section 10.0 Known Compatibility Issues

10.1 Narco Older Transponders and the SSD120-35C-RS232

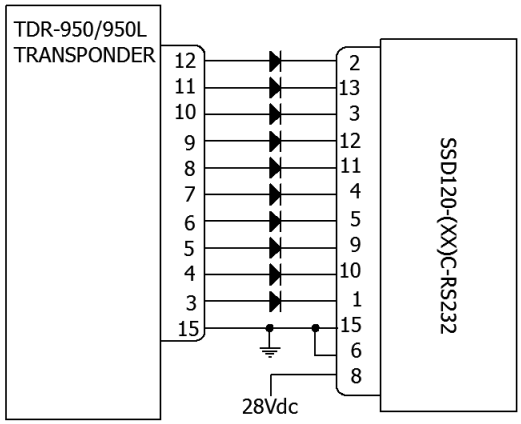
The Narco AT-5A, AT-6A, AT-50 or AT-50A transponder will not accept data from the SSD120-35C-RS232 Altitude Digitizer. Order Model Number SSD120-35N-RS232 with Mod. 1. ***Please note!*** **This modification may NOT be performed in the field.** ***Please also note!*** The Narco AT-50 and earlier transponder models require a modification before they will function correctly with any Altitude Digitizer. This modification is outlined in Narco Service Bulletin AT-50A-5.

10.2 King KT-75

The King KT-75/75R uses the old RTL (resistor transistor logic) pulling up to about 3 volts; consequently the open collectors of the SSD120-35C-RS232 will not pull the signal past the KT-75 logic threshold.

10.3 S-Tec (Collins) TDR-950

The TDR950 must be powered-up first, or the SSD120-35C-RS232 must be diode isolated to prevent the TDR 950 from invalidating the digitizer data.
All diodes 1N4454 (CPN 353-3741-010).



10.4 Trans-Cal SSD120-35C-RS232 Backwards Compatibility

All Model SSD120-35C-RS232 are pin-for-pin replacements for all D120-P2-T and Model SSD120-(XX), with ONE exception. The older SSD120-(XX) utilized a 28V heater ground on pin 1 of the D-Subminiature connector. Pin 1 is the D4 data bit on the SSD120-35C-RS232 models. Rewire the harness appropriately, if D4 is an active bit. No action is required if D4 is unused. All Model SSD120-35C-RS232 are pin-for-pin replacements for all Model SSD120-(XX)A.

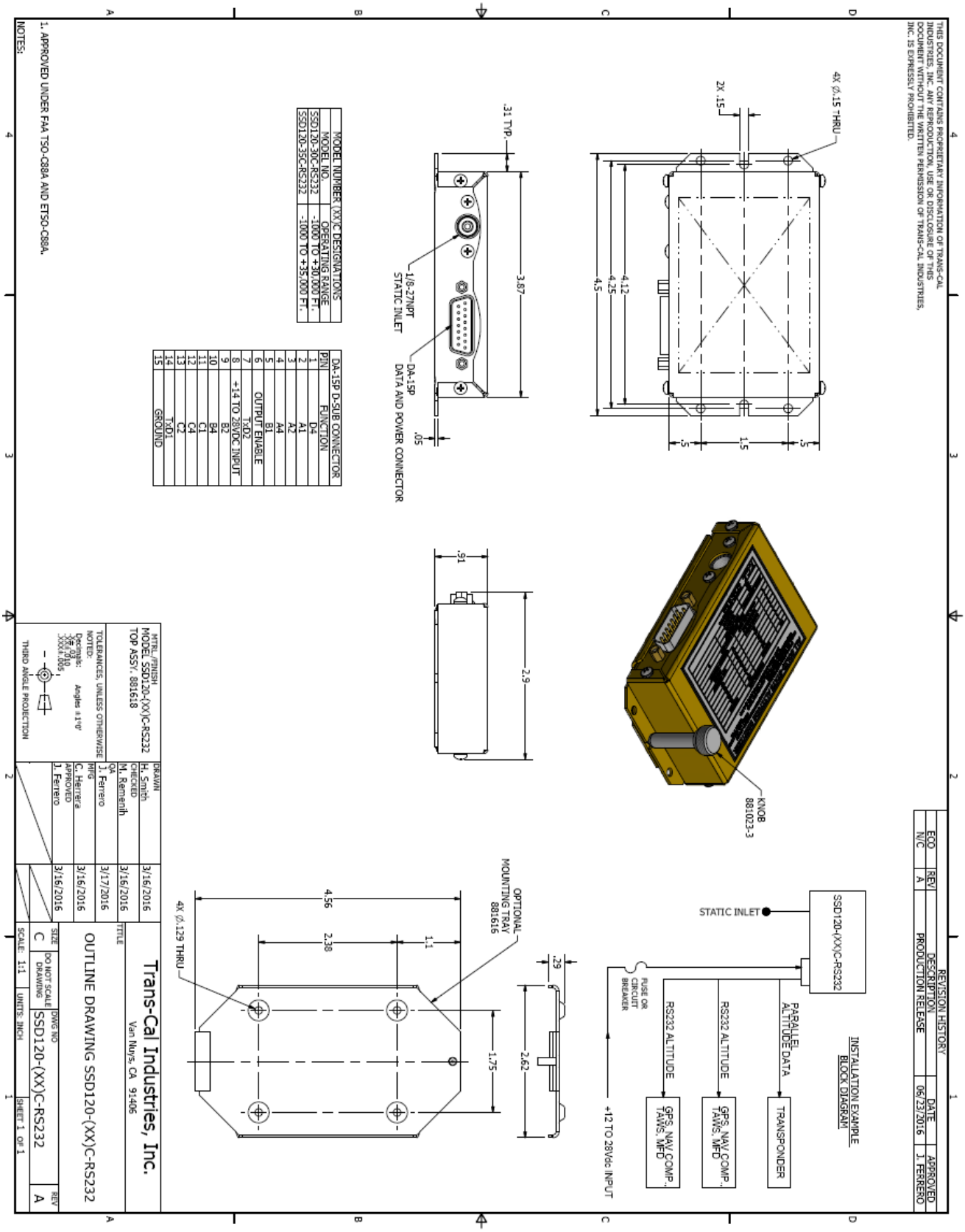
Model	Compatibility with SSD120-35C-RS232
D120-P2-T	Rewire +Vdc to Pin 8
SSD120-(XX)	Rewire +Vdc to Pin 8
SSD120-(XX)A	Rewire +Vdc to Pin 8
SSD120-(XX)N	Rewire +Vdc to Pin 8

10.5 SSD120-35C-RS232 Compatibility to Competitor's Products

Manufacturer	Compatibility with Model SSD120-35C-RS232
ACK Technologies	Model A-30.9 Pin-for-pin compatible.
Ameri-King Corp.	Model AK-350 Pin-for-pin compatible.
Becker Avionic Systems	Model BE6400-01-(XX) Utilizes an RS422 interface and in *NOT* compatible with Trans-Cal Encoders
Narco	Model AR-850 Rewire +Vdc on Pin 8
Narco	Model AR-500 Uses a 25 Pin D-Sub connector and must be rewired to use SSD120-35C-RS232.
Rocky Mountain Instrument	Model µEncoder no display function and requires rewiring the harness to use SSD120-35C-RS232.
Shadin	See chart below.
Sandia	Model SAE5-35 ICAO data is pin-for-pin compatible. Rewire +Vdc on Pin 8
Terra	Model AT3000 Rewire +Vdc on Pin 8

Manufacturer	Compatibility with Model SSD120-35C-RS232
Shadin Model 8800M	ICAO data is pin-for-pin compatible, Requires rewire to use +Vdc on pin 8, serial data on pins 7 and or 14 Configure for UPS AT serial data message.
Shadin Model 8800G	ICAO data is pin-for-pin compatible, RS232 data is output on pin 14 and 7. Requires use of TCI model SSD120-35C-RS232 and rewire to use +Vdc on pin 8. Configure for Magellan serial data message.
Shadin Model 8800T	ICAO data is pin-for-pin compatible, RS232 data is output on pin 14 and 7. Requires use of TCI model SSD120-35C-RS232 and rewire to use +Vdc on pin 8. Configure for Trimble serial data message.
Shadin Model 8800A	ICAO data is pin-for-pin compatible, RS232 data is output on pin 14 and 7. Requires use of TCI model SSD120-35C-RS232 and rewire to use +Vdc on pin 8. Configure for ARNAV serial data message.

Outline Drawing



Environmental Qualification Form

Nomenclature: Altitude Digitizer
Model No.: SSD120-35C-RS232 FAA TSO-C88a and EASA ETSO-C88a
Manufacturer: Trans-Cal Industries, Inc., 16141 Cohasset St. Van Nuys, CA 91406
DO-160E Tested: October 2007

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

Remarks:

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

Part Number Builder

SSD120-XX X X X-XXXX

Max. Operating Altitude (ft.) Dash Numbers	
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	
Encoder/Digitizer	**A**
Ø2.0" Module	**M**
Servo Module	**SM**
Nano Encoder Series	**N**
Encoder/Digitizer (Std. Temp. Only)	**C**

Operating Environment	
Standard -20° to +70°C	**Blank**
Extended -55° to +70°C	**E**
Extended Hermetic -55° to +70°C	**EH**
Nano Series Hermetic	**NH**

Static Port Connection	
Female 1/8-27NPT	**Blank**
Ø.125" Swivel	**1**

Additional Ports/Features	
Dual RS232 Ports	**-RS232**
Dual RS232 Ports and One RS485 Port	**-RS**

Model Number Example: **SSD120-30C-RS232**
Solid State Altitude Digitizer -1000 to +30,000 Ft.,Standard Temperature Range, 1/8-27NPT Female Static Port, Dual RS232 Ports.

Manufacturer Direct Warranty
Do Not Return to Place of Purchase

Trans-Cal Industries warrants each Model SSD120-35C-RS232 solid state altitude digitizer to be free of defects in workmanship and materials for a period of 42 months after the original date of purchase *from an authorized dealer,* not to exceed 60 months from the date of manufacture. **Do NOT send this unit to a distributor or retailer for repair.** Contact the factory directly if you experience problems (818) 787-1221.

This warranty applies to the original purchaser of the instrument and is NOT transferrable. 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 Trans-Cal, **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.
(4) The unit is returned with a copy of the purchase receipt from the authorized dealer. *(Online auction sites are not authorized dealers.)*

Trans-Cal **DOES NOT** reimburse labor or shipping 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: SSD120-35C-RS232 **SERIAL NO: SRC-_____**

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 14 CFR, industry standards and the instructions of Trans-Cal Industries. I further certify the instrument was functioning properly on the date noted below.

SIGNED:_____

PRINT NAME:_____

DATE:_____