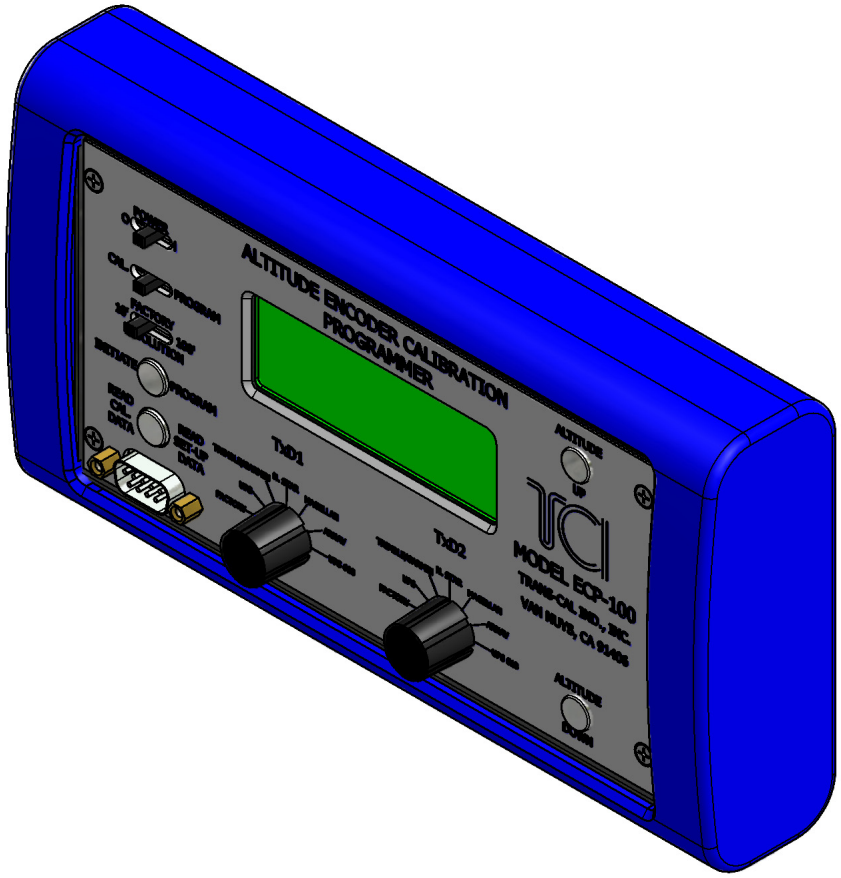
Trans-Cal Industries, Inc.

Model ECP-100
Altitude Encoder Calibration Programmer

Owner/Operation Manual



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Please Note:

There is no substitute for common sense and experience. Please exercise caution when connecting the ECP-100 and only connect this device to altitude encoders manufactured by Trans-Cal Industries. The ECP-100 should be operated only by personnel qualified and thoroughly familiar with the test and certification of aircraft systems.

What's in the Box:

Qty.	Part Number	Description
1 ea.	ECP-100	Altitude Data Simulator
1 ea.	882206	Owner/Operation Manual
1 ea.	No part number	+9Vdc Alkaline Battery
1 ea.	107010	Power Supply
1 ea.	107011	9-Pin D-Sub Harness

History of Revision

Revision	Date	Description
N/C	3/2009	Prototype release.
A	4/2009	Production release.
B	4/2013	Revise §4.4 add §4.6 and serial data offset section & illustration, operating ceiling §1.2, updated copyright notice.
C	12/2013	Standard copyright notice, updated what's in the box table, added clearing encoder memory §4.6.

Table of Contents

Abbreviations, Acronyms and Symbols

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

Section 1.0 Introduction to the ECP-100

1.1 Scope

This manual provides detailed operating instructions for Trans-Cal Industries' Model ECP-100 Altitude Encoder Calibration Programmer.

1.2 Equipment Description

The Model ECP-100 is an all solid-state device that displays and programs the serial data protocol output of altitude encoders/digitizers manufactured by Trans-Cal Industries using serial (RS232) data outputs and operating ceilings up to +30,000 feet. Altitude encoder models operating in excess of 30,000 feet and models in the SSD120-(XX)NEH-RS series cannot be calibrated with the ECP-100.

The ECP-100 is designed to display and digitally adjust the calibration offset curve of Trans-Cal altitude encoders. This function is designed to aide the technician in achieving correspondence between the primary flight altimeter and the altitude encoder as required by Federal Aviation Regulations.

The ECP-100 utilizes an internal 9-volt battery which will provide up to 2 hours of uninterrupted operation. Optionally, an AC adapter is available to provide continuous power to the ECP-100. The output and programming data are displayed on a four-line 20 character alpha-numeric LCD display. Front panel switches and selectors control the device power as well as program and calibration functions. A 9-pin D-Subminiature connector that is pin for pin compatible with Trans-Cal encoders provides an easy connection point to the equipment under test.

1.3 General Specifications

Operating Voltage:	Internal 9V battery. 2 hrs continuous operation. (Optional AC adapter.)
Operating Current:	0.065 Amps
Operating Temperature:	-20° to +70°C (-4° to +158°F)
Storage Temperature (non-operating):	-55° to +85°C (-67° to +185°F)
Humidity	90% Non-Condensing at 50°C
Weight:	1.26 lbs.

1.4 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: Duplex
Transmission Method: Asynchronous.
Baud Rate: Selectable 9600 bps.
Transmission Rate: 2/sec.

Section 2.0 Serial Altitude Data Communication Format

2.1 Serial Port Altitude Data Resolution

The default resolution of Trans-Cal Altitude Encoder serial data is 100 feet. (1 meter in ARNAV mode.) Ten-foot resolution is programmed by setting the ***Altitude Data Resolution Selector*** to 10'. **See Section 3.1 and 4.0**

2.2 Serial Communication Format

Model ECP-100 carries out serial communication asynchronously with the "Start/Stop" system. The default protocol is the Trimble/Garmin 9600bps, 8 data bits, 1 stop bit and no parity.

2.3 Serial Communication Protocols

The altitude data protocol is programmed by rotating the TxD1 and TxD2 Output Data Protocol Selector knobs to the desired protocol and pushing the ***Initiate Program*** pushbutton. **See Section 3.1**. The seven possible protocols are described below.

2.3.1 Trimble/Garmin Navigation Devices Protocol

The Trimble and Garmin protocol is a ten-byte message. The message begins with ALT followed by a space and five altitude bytes; concluding with a carriage return. (9600bps, 8 data bits, 1 stop bit, no parity). The following are examples of serial messages for Trimble or Garmin devices:

Message	Definition
ALT 99900 $^{C}_{R}$	Digitizer disabled.
ALT 10500 $^{C}_{R}$	Altitude 10,500 feet

2.3.2 UPS Aviation Technologies/Garmin AT/IIMorrow Nav. Devices

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

Message	Definition
#AL +00800T+25D8$^{C}_{R}$	Altitude 800 feet

2.3.3 Northstar Navigation Devices Protocol

The Northstar/Garmin protocol is 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.

2.3.4 UPS AT 618 Loran Devices Protocol (IIMorrow)

The UPS AT 618 Loran protocol is a seventeen byte message beginning with # AL, then a space followed by five altitude bytes; the letter “T” and the number “25”; two checksum bytes and a carriage return. (1200bps, 7 data bits, 1 stop bit, odd parity). The following is an example of a UPS AT 618 Loran serial altitude message:

Message	Definition
#AL +00800T+25D8 $^{C}_{R}$	Altitude 800 feet

2.3.5 Magellan Navigation Devices Protocol

The Magellan protocol is 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+25D6 $^{C}_{R}$	Altitude 2500 feet.

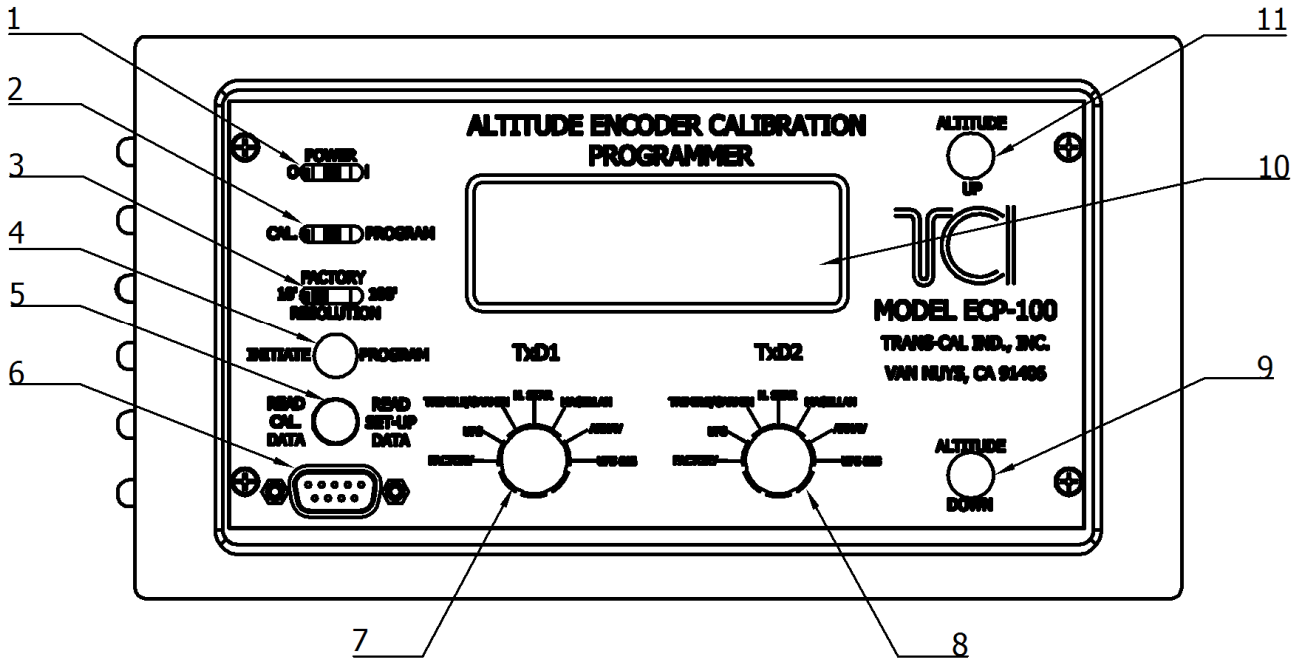
2.3.6 ARNAV Systems Protocol

The ARNAV protocol is a 24-byte message. Beginning with a $PASHS followed by a comma and ALT, then a +/- sign followed by five altitude digits (in meters,) then an asterisk and a checksum followed by a carriage return and a line feed. (9600bps, 8 data bits, 1 stop bit, no parity.) The following is an example of an ARNAV serial altitude message:

Message	Definition
STX$PASHS,ALT,+00033*1B $^{C}_{R}{}^{L}_{F}$ETX	Altitude 33 meters.

Section 3.0 ECP-100 Front Panel Indicators and Controls

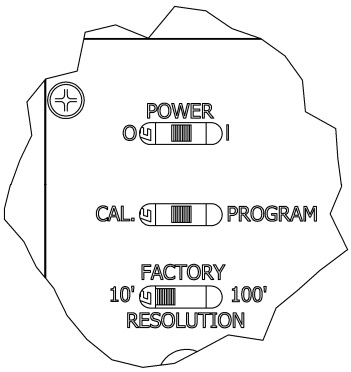
Figure 1



Item #	Function
1	Power On-Off Switch
2	Calibration/Program Selector
3	Altitude Data Resolution Selector
4	Initiate Program Button
5	Read Cal. Data/Read Set-up Data
6	Serial Data Connector DE-9P

Item #	Function
7	TxD1 Output Data Protocol Selector
8	TxD2 Output Data Protocol Selector
9	Calibration Altitude Increment Down Button
10	4-Line Alpha Numeric Display
11	Calibration Altitude Increment Up Button

3.1 Indicators and Control Definitions

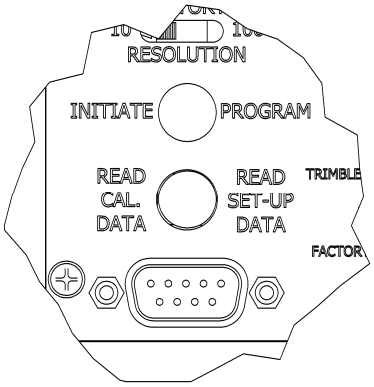


[1] Power Switch
This slide switch controls the application of power to the ECP-100.

[2] Calibration / Program Selector
Sliding this switch to the leftmost position accesses the calibration functions of the ECP-100, and allows adjustment of the Altitude encoder calibration curve. Sliding the switch to the right accesses the serial port programming functions, and allows the user to assign serial port data protocols.

[3] Altitude Data Resolution Selector
The center position will command the altitude encoder to the factory default 100' resolution serial data. The leftmost position will command the altitude encoder to output 10-foot resolution data. The rightmost

position will command the encoder to output 100-foot resolution serial data. These commands will take effect only when the ***Initiate Program*** button is pressed.



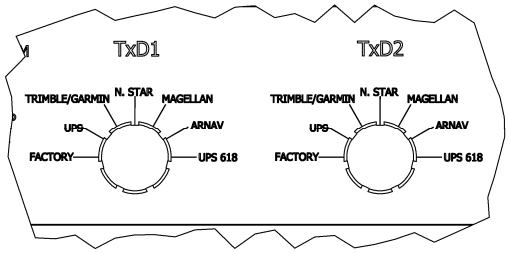
[4] Initiate Program Pushbutton
Pushing this button will program the altitude encoder to output altitude data on the two serial ports in the protocol and resolution set by the ***TxD1*** and ***TxD2 Output Program Selector*** knobs and the ***Altitude Data Resolution Selector***.

This pushbutton also controls the calibration error offset when the ***Calibration/Program Selector*** switch is in the ***Cal.*** position. **See §4.3**

[5] Read Cal. Data / Read Set-Up Data Pushbutton
When the ***Calibration/Program Selector*** is in the leftmost calibration position, pushing this button once will display the altitude error offsets at the 1000-foot increments. When the ***Calibration/Program Selector*** is in the rightmost ***Program*** position, pressing this button once will display the current Altitude Encoder port assignments for protocol and data resolution.

When the ***Calibration/Program Selector*** is in the rightmost ***Cal.*** position, pushing this button once will scroll through the calibration error offset data. This display will flag any offset error that is in excess of ±200 feet from the previous offset.

[6] Serial Data Connector
9-Pin D-Subminiature serial data connector. Connect to the Trans-Cal Altitude Encoder serial data connector.



[7] TxD1 Output Data Protocol Selector
With the ***Calibration/Program Selector*** in the rightmost ***Program*** position, rotate this selector to the desired serial output data protocol for TxD1.

[8] TxD2 Output Data Protocol Selector
With the ***Calibration/Program Selector*** in the rightmost ***Program*** position, rotate this selector to the desired serial output data protocol for TxD2.

[9] Calibration Altitude Increment Down
With the ***Calibration/Program Selector*** in the leftmost ***Cal.*** position, push this button to decrease the desired altitude for calibration. Calibration points are set in 1000-foot increments.

[10] 4-Line Alpha-Numeric Display
Four-Line, 20 Character Liquid Crystal Display.

[11] Calibration Altitude Increment Up
With the ***Calibration/Program Selector*** in the leftmost ***Cal.*** position, push this button to increase the desired altitude for calibration. Calibration points are set in 1000-foot increments.

Section 4.0 Operation

Following are procedures for assigning the encoder port protocols and calibration of a Trans-Cal Altitude Encoder with RS232 Ports. While only two common connection scenarios are discussed in this section, many variations exist.

There is no substitute for common sense and experience. Please exercise caution when connecting the ECP-100 to altitude encoders.

4.1 ECP-100 Connection Diagrams

Figure 2

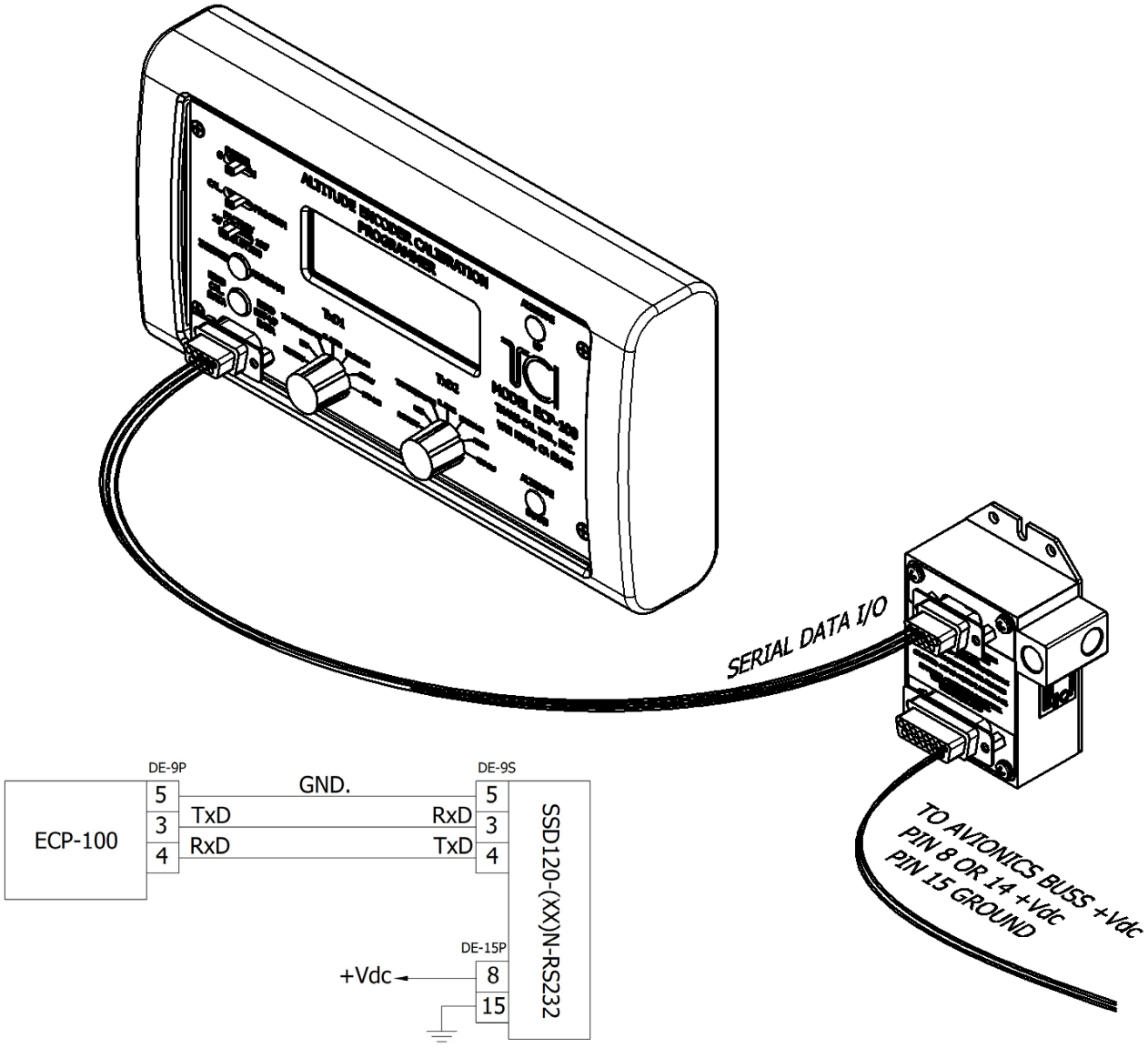
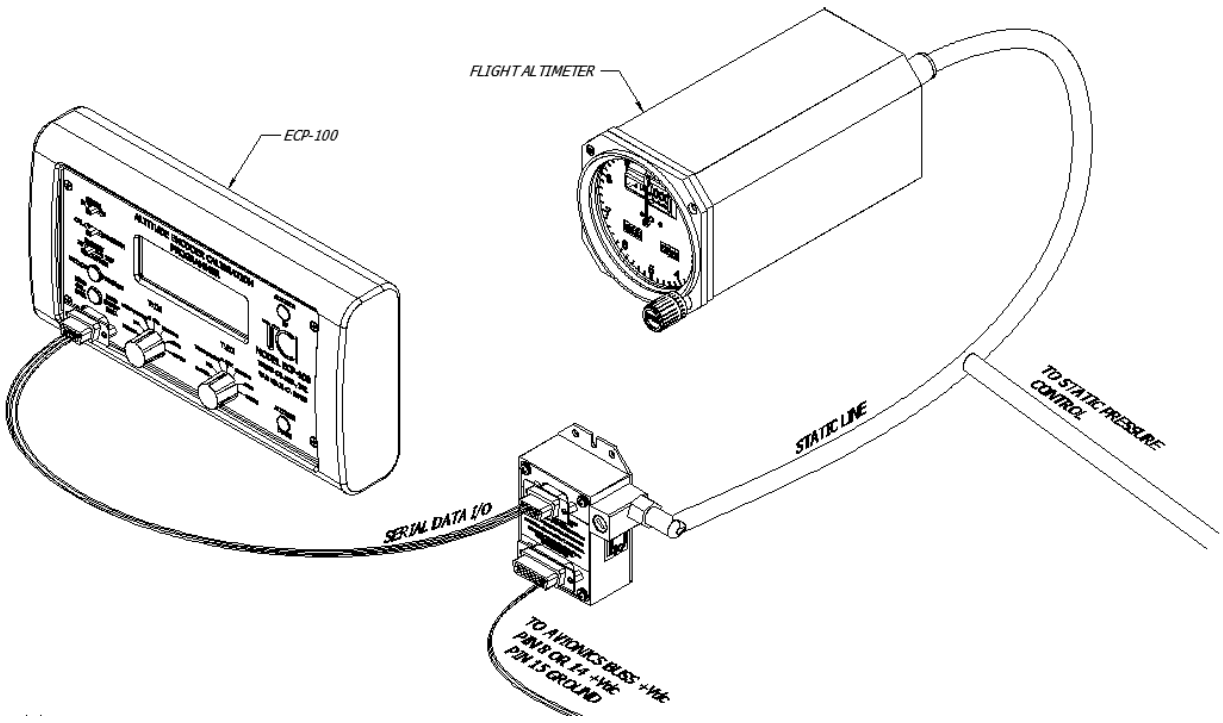


Figure 3



4.2 Serial Port Programming

Overview & Procedure:

This procedure will allow the technician to assign serial data output protocols to the altitude digitizer output ports. Connect the **ECP-100** to the altitude encoder as shown in **Figure 2.**

Step 1: With the **ECP-100** and avionics buss power **off**, Slide the CAL. Program switch to its rightmost **PROGRAM** position and connect the ECP-100 to the altitude encoder, as shown in **Figure 2**. The altitude data output connector is wired identically to most Trans-Cal altitude reporting devices. The connector pin assignments are found in **Table I**.

Step 2: With the **ECP-100** power switch in the **OFF** position, apply power to the avionics buss supplying power to the altitude encoder, 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 to the desired 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

4.3 Calibrating the Trans-Cal Altitude Encoder

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

This procedure will allow adjustment to the calibration curve of any Trans-Cal altitude encoder with RS232 I/O and operating ceilings up to 30,000 feet. The ECP-100 functions 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 an NIST traceable pressure standard; however, the error allowed on altimeters at higher altitudes could 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. Trans-Cal Altitude encoders are designed to be field calibrated to meet this requirement, as per this procedure or via the procedure described in the altitude encoder manual. 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 6**.

The digitizer may be adjusted using two potentiometers, which affect the span and reference of the pressure transducer. Trans-Cal altitude encoders 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 or the **ECP-100**.

The calibration procedure 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 the **Figure 1** 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 the **ECP-100**, which will transmit the correction to the digitizer's EEPROM. Using this calibration procedure the adjustments are made at every 1000-foot interval and the Digitizer is adjusted at the 0 foot mark *NOT* the ICAO data nominal transition point.

This procedure assumes the altitude encoder and the primary flight altimeter are both connected to a common static system and that power and a Pressure/Vacuum controller is connected to that system.

Calibration Procedure:
Step 1: Slide the **ECP-100 CAL. PROGRAM** selector to the leftmost **PROGRAM** position.

Step 2: Connect the **ECP-100** to the serial port on the altitude encoder.

Step 3: Apply power to the altitude encoder and the **ECP-100**.

Step4: Adjust the static system pressure and stabilize at the first altitude to be calibrated. The first possible correction for Trans-Cal encoders is at 0 feet. All adjustments to the encoder calibration curve occur at 1000-foot intervals. Use the Altitude Up and Altitude Down buttons to adjust the **ECP-100** to the proper altitude.

Step5: Press the **INITIATE PROGRAM** pushbutton once. The ECP-100 will enter a digital correction into the altitude encoder's EEPROM at this pressure. Continue this process throughout the operating range of the encoder.

4.4 Serial Data Offset

The calibration requirement for altitude encoders specifies the 100’ resolution ICAO grey code to transition at the 50’ mark with a tolerance of ±125’ when compared to the primary flight altimeter.

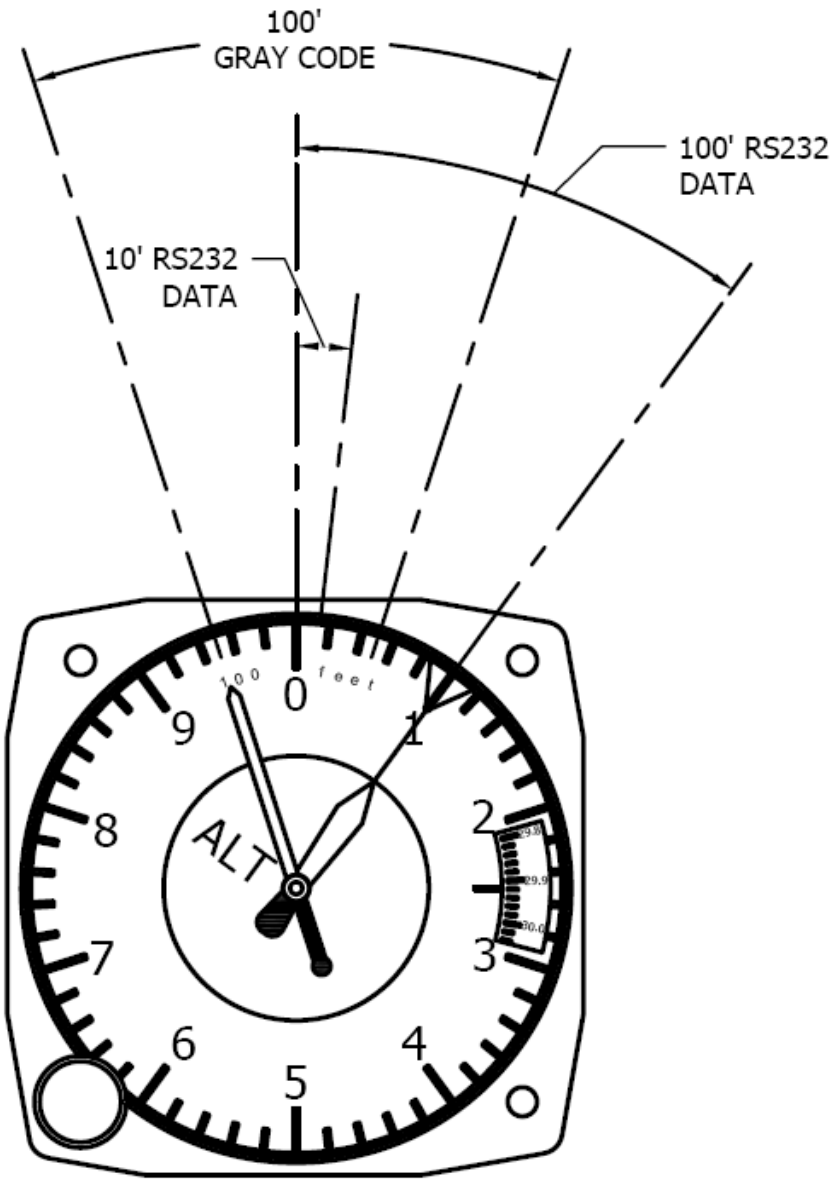
Figure 4 displays the ideal case for 11,000 feet.

The ideal altitude encoder grey code output will read 11,000’ when the primary flight altimeter reads from 10,950’ to 11,050’ with a tolerance of ±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 4



It is critical when using the ECP-100 to calibrate at the “0” mark. In other words, to calibrate 11,000 feet you set the input pressure to exactly 11,000 and then push the initiate calibration button on the ECP-100.

4.5 Reading the Altitude Encoder Calibration Memory

When the ***Calibration/Program Selector*** is in the rightmost ***Cal.*** position, pushing the **Read Cal. Data / Read Set-Up Data** button once will scroll through the calibration error offset data. This display will flag any offset error that is in excess of ±200 feet from the previous offset.

4.6 Clearing the Altitude Encoder Calibration Memory

To clear an error entered at a specific altitude, adjust the input pressure to the correct altitude and re-enter the correction.

Should you desire to clear *ALL* the calibration corrections you have entered into the EEPROM memory and return to the factory "0" condition, do the following:

1. Slide the **CAL. PROGRAM** (Fig. 5 Item 2) selector to the **PROGRAM** position.
2. Press the **ALTITUDE UP** (Fig. 5 Item 11) button once.
3. Then press and hold the **ALTITUDE DOWN** (Fig. 5 Item 9) button for two seconds.

This will return all the calibration data to the factory "0". You *CANNOT UNDO* this action. Once cleared of data the encoder may be reprogrammed as per **§4.3**.

Figure 5

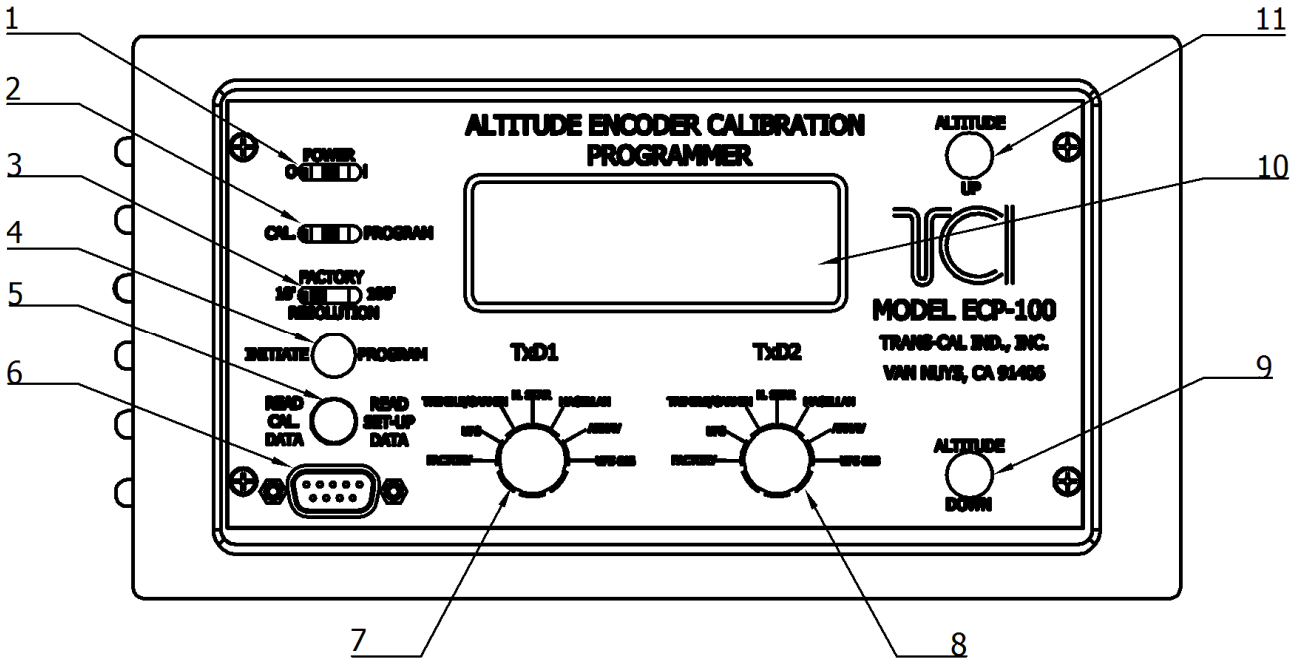
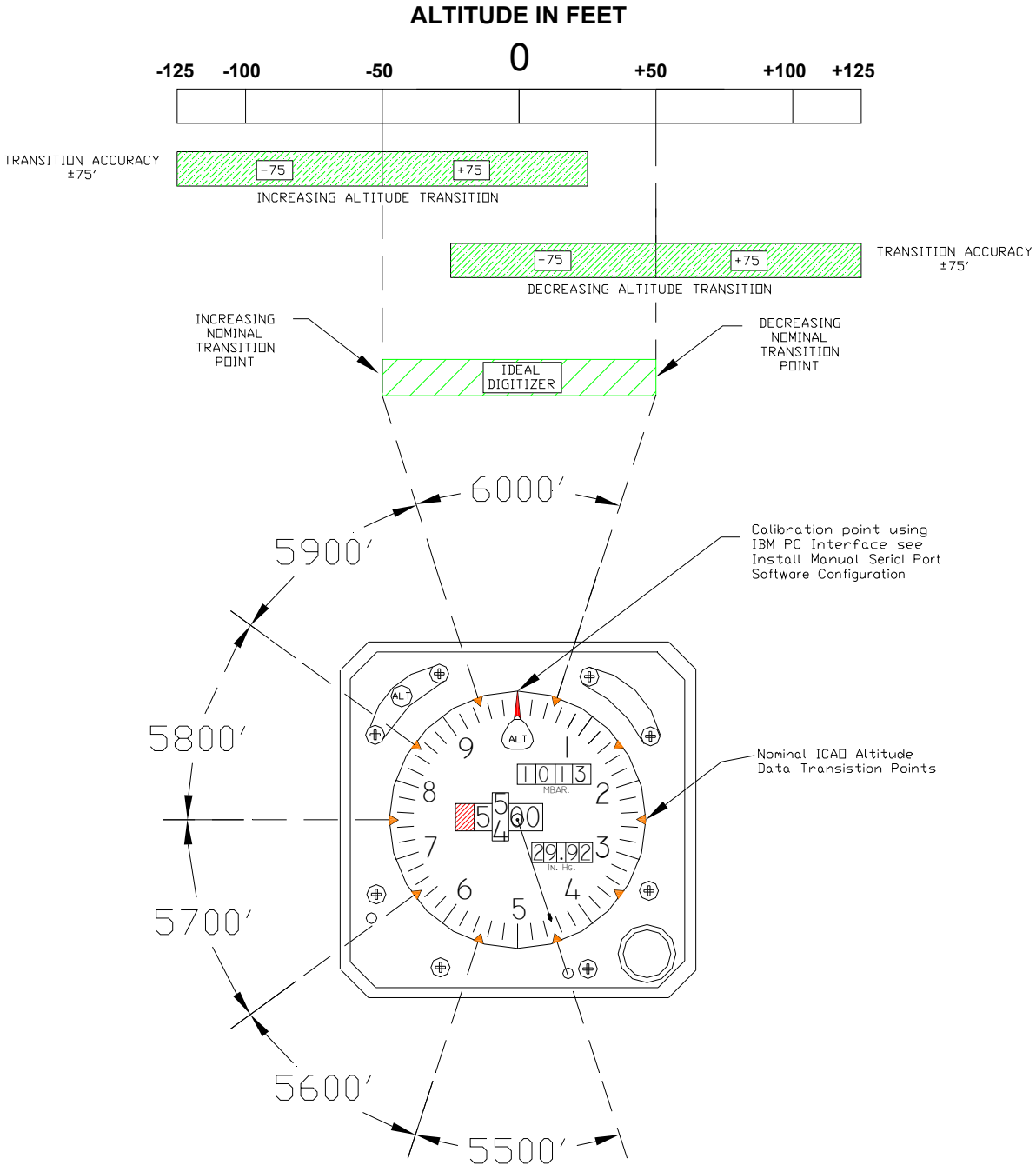


Figure 6

Altitude Digitizer to Primary Flight Altimeter Correspondence
Reference FAA TSO-C88a, EASA ETSO-C88a and SAE AS8003



Section 5.0 Model ECP-100 Interconnection

Table I Serial Data Connector

ECP-100 Serial Port Connector, 9-Pin D-Subminiature DE-9P

Pin	Function
1	DO NOT CONNECT
2	DO NOT CONNECT
3	TxD
4	RxD
5	GROUND
6	DO NOT CONNECT
7	PROTOCOL GROUND
8	GROUND
9	DO NOT CONNECT

Section 6.0 Calibration, Care and Battery Replacement

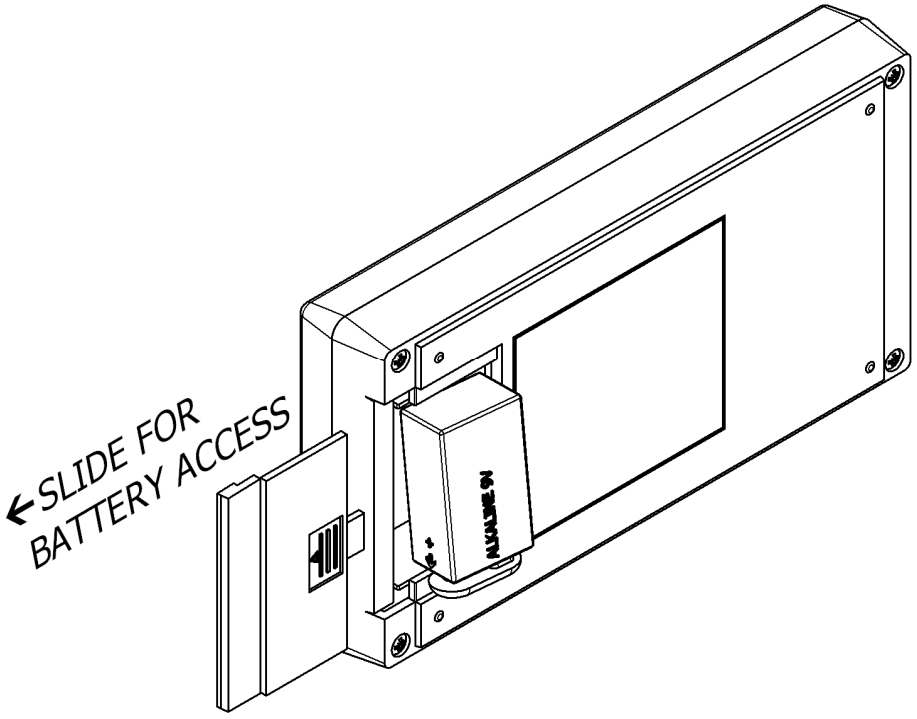
Calibration:
The **ECP-100** is an all solid-state device that requires no periodic maintenance to maintain its calibration. The **ECP-100** is not field serviceable and if an programming error is detected, then the unit is to be factory repaired. Contact Trans-Cal Industries for further information.

Cleaning:
The case of the **ECP-100** is impact resistant plastic and the front panel is powder coated aluminum. The **ECP-100** liquid crystal display is covered with a clear glass lens incorporating an anti-glare coating. Some concentrated glass cleaners containing ammonia may damage the plastic case and/or the lens. A weak solution of soap and water should be sufficient to keep the majority of grease and oils off the case and front panel. Cleaning the display lens with a lint free cloth and eyeglass lens cleaner suitable for use on anti-reflective coatings is recommended.

Battery Replacement:

Remove the protective rubber boot and slide the battery access door as shown below. Replace with a 9V alkaline battery. Replace the battery door and rubber boot.

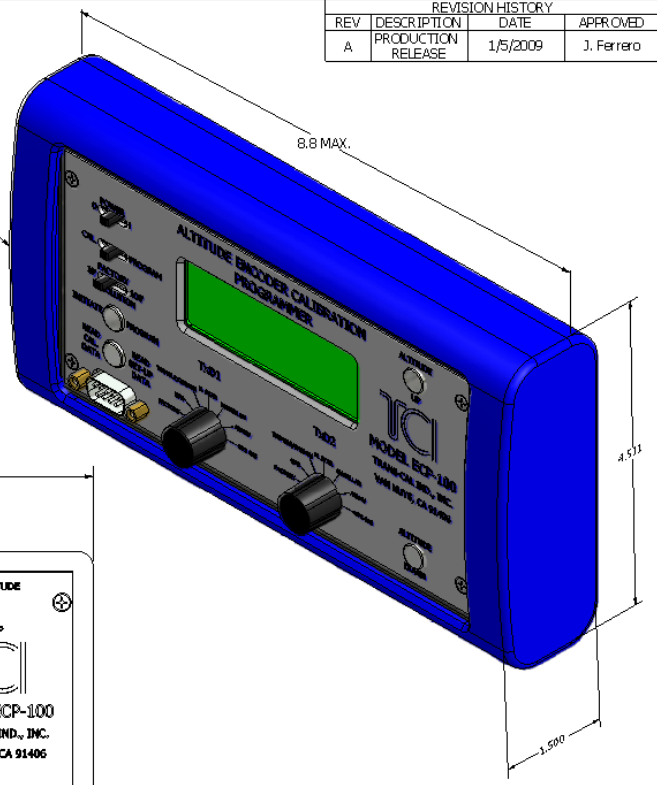
Figure 6

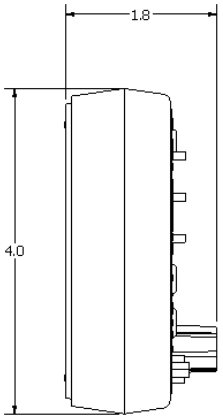


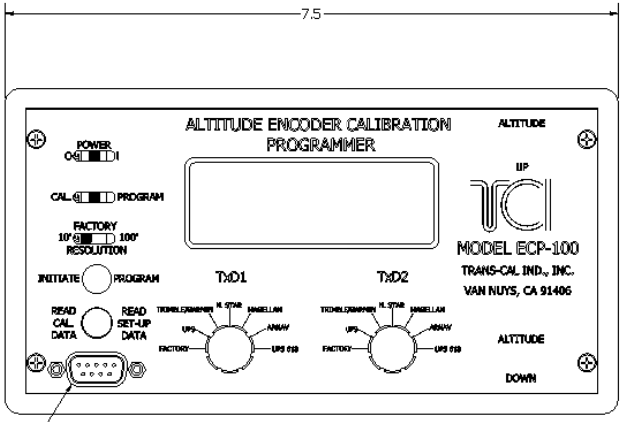
Outline Drawing

REVISION HISTORY			
REV	DESCRIPTION	DATE	APPROVED
A	PRODUCTION RELEASE	1/5/2009	J. Ferrero

PICTURED WITH REMOVABLE RUBBER BOOT.
CASE IS IMPACT RESISTANT PLASTIC.
WEIGHT 1.5 LBS
ONE (1) 9V BATTERY REQUIRED.
OPTIONAL AC POWER ADAPTER AVAILABLE.
ONE RS232 I/O PORT.







SERIAL DATA CONNECTOR

PIN	FUNCTION
1	DO NOT CONNECT
2	DO NOT CONNECT
3	TxD
4	RxD
5	GROUND
6	DO NOT CONNECT
7	PROTOCOL GROUND
8	GROUND
9	DO NOT CONNECT

TOLERANCES, UNLESS OTHERWISE NOTED
Decimals: Angles ±1°0'
.X±.03
.XX±.010
.XXX±.005
THIRD ANGLE PROJECTION

DRAWN	H. Smith	3/24/2009
CHECKED	M. Remenih	3/24/2009
QA	J. Ferrero	3/24/2009
MFG	C. Herrera	3/24/2009
APPROVED	J. Ferrero	3/24/2009

Trans-Cal Industries, Inc.
Van Nuys, CA 91406

TITLE
Outline Drawing, Altitude Encoder Calibration Programmer Model ECP-100

SIZE	DO NOT SCALE DRAWING	DWG NO	REV
C		Outline Dwg. Model ECP-100	A

SCALE 1:1 | UNITS: INCH | SHEET 1 OF 1

Manufacturer Direct Warranty
Do Not Return to Place of Purchase

Trans-Cal Industries warrants each Model ECP-100 Altitude Data Simulator to be free of defects in workmanship and materials for a period of 18 months after purchase. **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. Trans-Cal's obligation under this warranty is limited to repairing or replacing any ECP-100 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, weather related damage 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

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MODEL: ECP-100 **SERIAL NO: ECP-_____**

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:_____