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NOTE TO THE USER

The FENCODER manuals are open to revision based on your needs. If you have suggestions for improvement or clarification, please write or call.

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Technical Specifications

ELECTRICAL

Operating Voltage	+14 to +28 VDC
Operating Current	150 mA typical, 220 mA maximum
Audio Output	200 mW into 600 ohm load at max volume
Encoder Output Code	S.S.R. Automatic Pressure Altitude Transmission (meets FAA TSO-C88a requirements)

PHYSICAL

Height 3.2 inches (8.13 cm)
Width 3.2 inches (8.13 cm)
Length 7.5 inches (19.1 cm) behind panel (add 3.5 inches for connectors provided). Can be reduced by using 90E connectors.

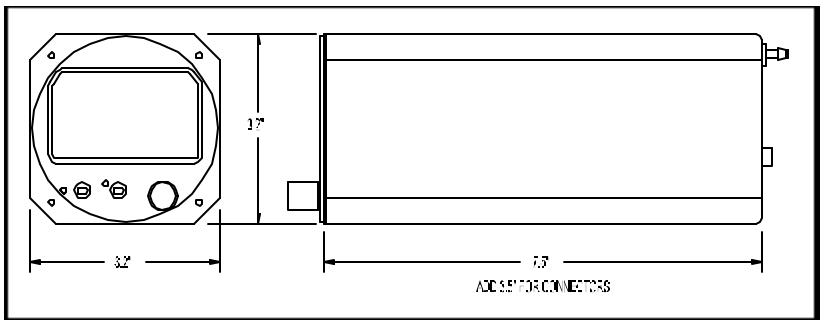

Figure 1 µENCODER dimensions.

Weight 1.4 pounds (.65 kg)

MECHANICAL

Backlight	Aviation Green EL with front panel intensity control
Display	Custom wide-temperature-range LCD
Operating Temperature	-20EC to +55EC
Operation Altitude	-2000 to +35,000 feet
Warm-Up Time	10 seconds to operation 5 minutes to full rated accuracy

PERFORMANCE

Altitude Range	-2000 feet to +46,000 feet
Encoder Range	-1250 feet to +46,000 feet
Airspeed Range	25 to 473 knots (optional .05 to 1.00 mach)
Vertical Speed Indicator Range	Digital readout 0 to 9990 feet per minute Bargraph max range 1000 to 6000 FPM user adjustable
Outside Air Temperature Range	-50EC to +99EC

List of Compatible Transponders

Becker	ATC 3401, ATC 3401-(1)-R, ATC 4401-1
Bendix	TPR-2060, TRP-660, TR641A/B
Cessna	RT359A, RT459A, RT859A
Collins/STEC	TDR-950/950L
Edo-Aire	RT-777
Garmin	GTX 320, GTX 327,GTX330/330D
Genave	Beta 5000
King	KT-75, KT-76/78, KT-76A/78A, KT-76C, KT-79, KXP750A
Microair	T2000
Narco	AT5/6, AT-6A, AT-50/50A, AT-150, AT-155
Radair	250
Terra	TRT-250, TRT-250D
UPS	SL70
Wilcox	1014A

See wiring tables in Appendix A.

The following data will help judge compatibility with transponders not listed above:

Output:	open collector transistor
	50 volt maximum off voltage for '0' output and 100µA leakage current
	100 mA maximum sink current for '1' output
Strobe:	1µS maximum delay strobe low to outputs valid

Installation

An installation checklist is provided in Appendix B for those already familiar with the following details.

SELECT A MOUNTING LOCATION

The µENCODER mounts in a standard 3-1/8 inch instrument hole without cutouts. Be careful to choose a location that is not close to sources of hot/cold air or where the unit might be exposed to water. A location where the ambient temperature is stable and above -20°C (-4°F) is best. Close proximity to the static and pitot system lines is recommended. Locating the µENCODER in the normal VSI instrument hole is an ideal location to act as a graphic/digital VSI and allow easy access to the front panel controls for altitude alert, true airspeed, pressure altitude, density altitude and true air temperature in addition to acting as a backup to standard instruments.

SELECT A MOUNTING LOCATION FOR THE OUTSIDE AIR TEMP PROBE

See Appendix A of the µENCODER assembly manual for construction of the outside air temperature probe. The probe should be mounted in a location with free air flow across the sensor on the outside of the aircraft. Locations on a wing, gear strut or similar, away from cabin heat and out of the exhaust slipstream are the best. Placement in a NACA duct can result in a couple of degrees of error and will affect calculations such as TAS that depend on outside temperature.

If the µENCODER detects that the temperature probe has not been installed the outside air temperature readout on the display will be "**EE**" (error). Selecting a function that depends on outside air temperature such as density altitude or true airspeed will also display E's in the appropriate place.

The outside air temperature cable can be cut shorter than that provided. If there is enough, the cut off section can be used for audio, RS232 serial port and/or power input.

INSTALL THE MAIN UNIT

Install the unit from the rear of the instrument panel using the four #6-32 x 3/16 black screws. If longer screws are required due to panel thickness, assure that the length of the substitute screws are not **more** than 3/16 inch longer than the panel thickness as the four mounting holes are blind holes.

CONNECT STATIC & PITOT LINES

Follow appropriate procedures per FAR 23.1325 when altering the aircraft static or pitot systems.

Locate the static and pitot system lines. If an existing airspeed indicator and altimeter are to remain, tee fittings need to be installed in each line as shown in Figure 2. Provide for positive drainage of moisture. If the static/pitot line is plastic or rubber cut the line with a sharp knife. If the static/pitot line is metal use a tubing cutter so the line will not be contaminated with metal chips.

When installing the 1/8" ID plastic tubing over the µENCODER barbs, use a little liquid soap or saliva for lubrication to avoid excess pressure on the barb mounts.

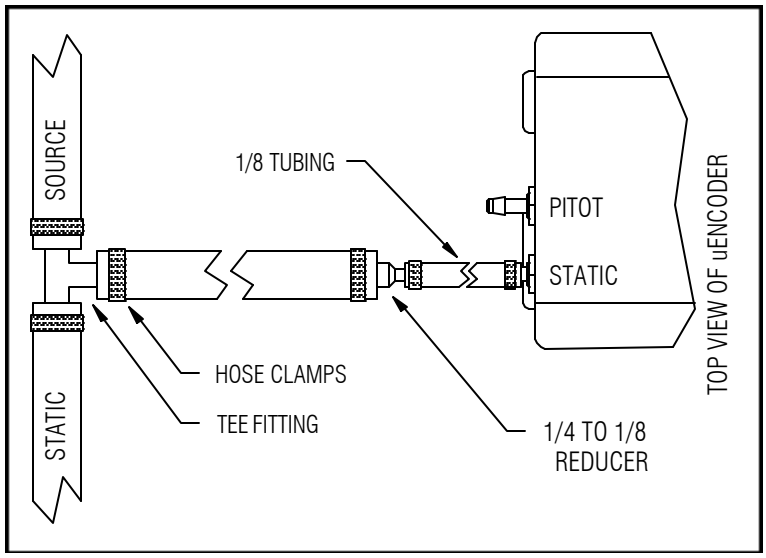

Figure 2 µENCODER static line connection to an existing static system. Use a little liquid soap or saliva when installing tubes to barbs on the µENCODER.

ELECTRICAL WIRING

Wiring connections to the µENCODER are for power, outside air temperature, headset/mixer audio for alarms, serial airdata to an RS232 type transponder or GPS, and the standard Gray Code altitude data interface to the transponder.

Figure 3 shows an overall diagram of wiring and static/pitot connections.

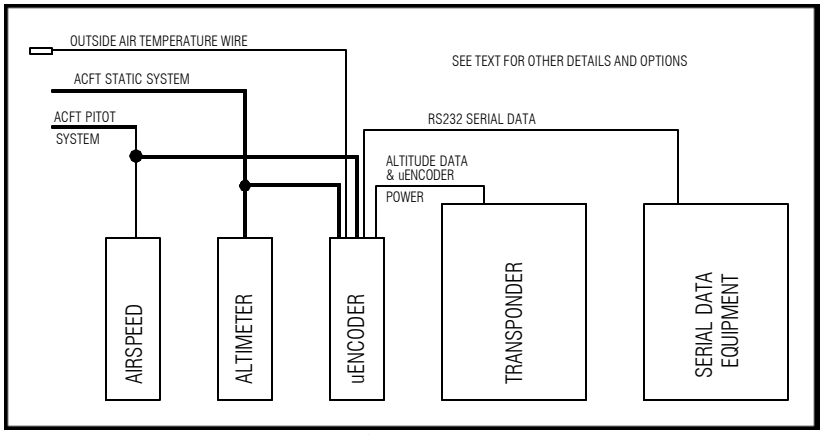

Figure 3 Block diagram of µEncoder wiring and static/pitot connection.

The 14/28 volt power to the unit may be provided by the transponder as shown in Figure 3 or by connection to the aircraft/avionics bus through a 3 amp circuit breaker. The recommended method is to bring the power connection in through its own circuit breaker rather than using the switched power output of the transponder. That way, the transponder can be turned off if necessary without losing the µENCODER functions. In any case, DO NOT connect BOTH ways, or try to power your transponder through the µENCODER.

A wire harness will supply Gray Code altitude data information to the transponder. A separate shielded twisted pair connects the outside air temperature probe. A shielded twisted pair should be used for the serial output data if the RS232 interface is used. Another shielded twisted pair is used for the headset or mixer audio alarm.

Gray Code altitude data and the alternate power connection terminate at the 15-pin D-sub connector on the back of the unit. The 9-pin D-sub connector provides connection for outside air temperature, audio, the serial interface and the preferred power connection.

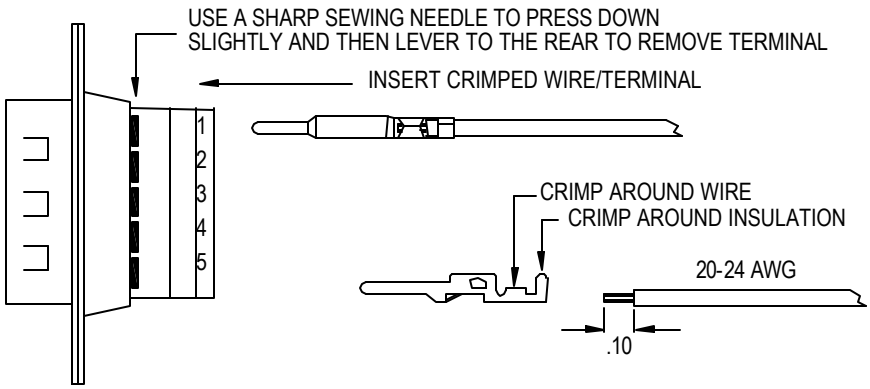

Figure 4 Installing D-sub terminals and inserting into housing. Crimp terminals only, do not solder. Be sure to install the black shell nut over the cable before inserting terminals into housing.

WIRE PREPARATION - Strip and attach terminals as shown in Figure 4. When inserting the terminals into the housing, they must be properly oriented. Rotate the terminal 90E or 180E until it slips in. The terminal will lock in with a click. Make up all the connections for each plug and install the shield before connecting the plugs to the µENCODER or the transponder.

POWER CONNECTION – The preferred power connection is through a 3 amp circuit breaker to pin 2 of the 9-pin D-sub. Note that the unit does not have a power switch. The power is best provided by a switched avionics buss so that the µENCODER is not on during engine start. This precaution is not because it would damage the unit, but rather that the µENCODER would be operating outside its input voltage specification as the aircraft voltage can drop to approximately nine volts during engine start. This can cause inaccurate readings that can trigger built-in features like resetting the altimeter setting to 29.92.

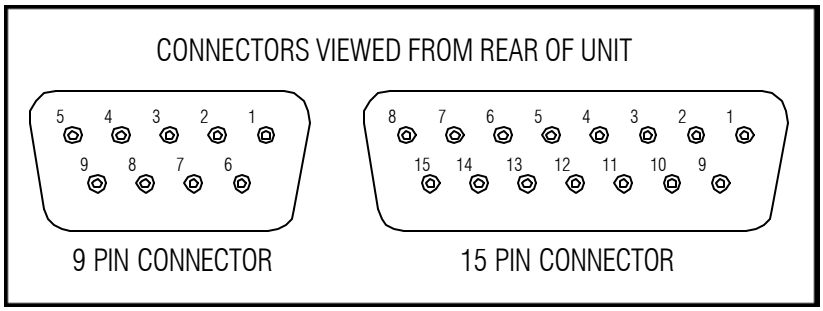

Figure 5 The 9-pin connector is used for various connections, including power. The 15-pin connector is for the transponder Gray Code (altitude) interface. The pin numbers are molded into the plastic if you have Superman vision.

GROUND CONNECTION is pin 1 of the 9-pin D-sub. Make a secure connection to the aircraft ground buss. Pigtail this pin if multiple grounds are necessary.

OUTSIDE AIR TEMPERATURE CONNECTION - The outside air temperature probe assembly connects to the 9-pin D-sub with the positive lead to pin 9 and the negative lead to pin 5. The supplied cable length may be shortened or extended if necessary. The OAT sensor assembly instructions are in Appendix A of the assembly manual, and repeated in Appendix D of this manual.

PIN	9-PIN CONNECTOR DESCRIPTION
1	Aircraft ground – if additional grounds are needed, this can be pigtailed
2	Aircraft power
3	T1 – transponder interface test pin – also used for gear warning output
4	T2 – transponder interface test pin (seldom used)
5	Outside air temperature minus (NOT a ground)
6	SO – RS232 output
7	SI – RS232 input
8	Audio output for headsets
9	Outside air temperature plus (also used to provide power to the RMI compass module)

SERIAL DATA OUTPUT - An RS232 serial output is available at pin 6 of the 9-pin D-sub. The voltages are referenced to aircraft ground. Use a shielded twisted pair to reduce electromagnetic noise. Refer to the receiving equipment for proper connection to that equipment. See the programming section for serial output baud rates and format information.

SERIAL DATA INPUT – An RS232 serial input is provided at pin 7 of the 9-pin D-sub. This input is used to input data from the RMI compass module. See the compass module manual for more details.

AUDIO CONNECTION - A 600 ohm output is provided at pin 8 of the 9-pin D-sub (this is referenced to aircraft ground). This should be connected direct to a headset(s). Volume control adjustment is available using a screwdriver through a small hole just left of **DALT** on the front faceplate. Use a shielded twisted pair to reduce RFI entry into the unit. Connection of this audio to AUX inputs of intercoms or mixer inputs of some communication radios may result in low audio noise amplification, so be sure to test well before "buttoning up" the installation.

ALTITUDE DATA CONNECTIONS - The parallel data connections between the µENCODER and the transponder (Gray Code) may be made using this table pin out data or the connection tables for the proper transponder in Appendix A. The Appendix A tables are the easiest if the transponder is listed and the provided cable is used as the tables also show the cable color code. The strobe connection on pin 15 must be connected to ground (pin 14) if the transponder does not have an altitude output enable line (strobe).

PIN	15 PIN CONNECTOR DESCRIPTION
1	A2
2	A4
3	B1
4	B2
5	B4
6	C1
7	C2
8	C4
9	A1
10	D4
12	Alternate power input from transponder. Power input into pin 2 of the 9-pin connector through a circuit breaker is preferred. Never connect both.
14	Common (ground)
15	Altitude enable (strobe). Must connect to pin 14 if the transponder does not have an enable output.

Installation of a small toggle switch between pin 14 and pin 15 allows the pilot to disable the output of the µENCODER to the transponder if the transponder does not have a separate switch position for Mode A. When the connection between pin 14 and pin 15 is open, the µENCODER output to the transponder is disabled.

TRANSPONDERS WITH RS232 INPUTS – Some of the newer transponders have the capability of inputting altitude data by both the standard parallel Gray Code shown in the table and RS232 serial format. The µENCODER can be programmed to serially send either serial altitude or serial air data that also contains the altitude. Generally, you will want to use our serial air data output to feed your GPS system. Some transponders can receive the air data input, pick out the altitude it needs and then output that same information so that it can feed the GPS. This is the best of all worlds as it cuts down on all the parallel wiring. However, some transponders only pass on the altitude without the other airdata, and some can only receive the altitude only format and send it on. In both of these cases, it is best to use the Gray Code to feed the transponder, and the RS232 to feed the GPS. In this case, there will be no RS232 connection between the transponder and the GPS. There is never any need to use our Gray Code connection to feed altitude data to a GPS.

SHIELD ASSEMBLY - After all wire terminals have been installed, assemble the shield covers on the 9-pin and 15-pin D-sub connectors using the steps below and Figure 6.

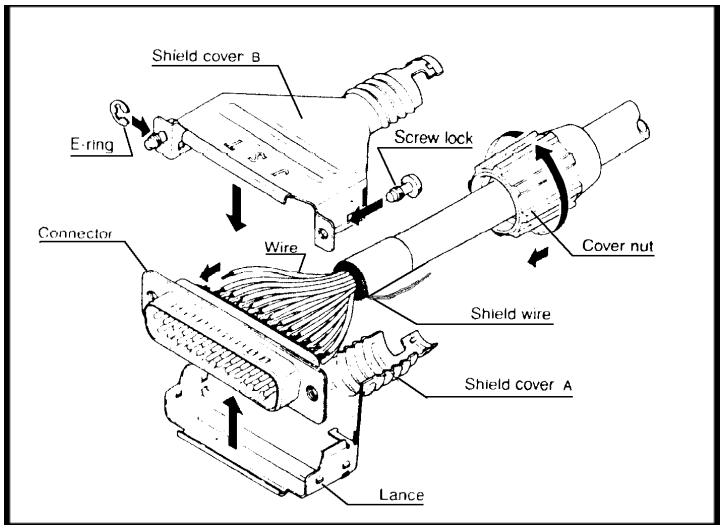

Figure 6 Shield assembly procedure.

1. Fold back the foil/braided shielding and/or drain wire along the outside insulation. Ignore copper foil tape as shown in the figure.

2. Install the connector housing into shield cover A and fold the two tall tabs on the cover over the loose wires.

When the top and bottom covers are snapped together, they leave an opening for passing the shield wire(s) through. Make sure all the shields pass through this opening before completing the next step.

3. Align shield cover B over shield cover A and press shield cover B until it snaps over the lances of shield cover A.

4. Roll the shield wires up over the "thread" of the two metal shells before tightening the cover nut. This makes sure that the shield wires make good contact with the metal shield.

5. Install the lock screws and E-rings.

FINAL CONNECTION - When the two D-sub connectors are completed, connect each to the µENCODER. Tighten the two retaining screws on each connector.

Calibration/Correspondence Adjustment

After installation of the µENCODER has been completed, the altimeter portion must be calibrated. Then, the µENCODER encoder output may be adjusted to correspond with the primary flight reference altimeter. This procedure should be performed by qualified personnel at an FAA approved facility to comply with FARs 91.36, 91.172 and FAA Advisory Circular 43-6A.

While altimeter calibration should always be performed, correspondence adjustment for the µENCODER is **VERY SELDOM** required. Correspondence is intended to get blind type encoders to reasonably "track" the aircraft's altimeter. The allowed error between encoder and altimeter is an astounding ±125 feet! The typical accuracy of a properly calibrated µENCODER is ±10 up to 20,000 feet of altitude. If you have another altimeter installed that you will being used for your flight reference, and it is a decent altimeter, the µENCODER will track it within ±125 without any problem without correspondence adjustment. The following correspondence procedure is provided primarily to comply with encoder TSO standards.

The µENCODER should be warmed up for at least 10 minutes for maximum accuracy before performing

calibration/correspondence.

NOTE: Since the µENCODER does not use a mechanical mechanism, tapping the faceplate during calibration to take out friction errors is not necessary. Also, there are no limits on the maximum rate of climb when changing altitudes.

µENCODER ALTIMETER CALIBRATION

After warm-up, the altimeter calibration is performed as follows:

1. Using the air data test set, stabilize the altitude at approximately 2000 feet with the air data test set and µENCODER altimeters both set to 29.92 InHg. If the µENCODER altitude differs more than 20 feet from the air data test set altitude then calibrate by:

a. Press and hold the **[ACK]** knob in and then press both **[ALRT]** and **[DALT]** at the same time until **OPt** appears in the lower left of the display.

b. Turn the **[SET]** knob in either direction until **CAL** appears in the lower left of the display.

c. Press and release **[DALT]**. **IAS** will appear in the center of the display.

d. Turn **[SET]** until **ALt** appears in the center of the display.

e. Press and release **[DALT]**. The µENCODER altitude (at 29.92 InHg) will appear in the center of the display.

f. Press and release **[ACK]**. **0 - - -** will appear on the display. Now the **[SET]** knob will adjust the **0** digit.

g. Turn the **[SET]** knob until the first digit of the air data test set altitude shows in the first digit position.

h. Press and release **[ACK]**. The first digit will remain as set and the second digit will turn to a **0**.

i. Continue to **[SET]** and **[ACK]** through the remaining three digits. After the last digit, the display will again show **CAL** and **ALt**.

At this point, the µENCODER has read the entered altitude, compared it to its own internal altitude and calculated a correction factor to match the air data test set. Even though the µENCODER altimeter may be reading only to the nearest ten feet, the correction factor is calculated to the nearest foot. This correction factor is stored in the nonvolatile memory of the unit for all further pressure altitude calculations.

CORRESPONDENCE CALIBRATION

This calibration is again carried out with flight reference altimeter, air data test set altimeter and µENCODER altimeter all set to 29.92 InHg.

Now that the µENCODER altimeter is calibrated to the air data test set, correspondence to the actual reference flight altimeter can be done. If the µENCODER altimeter is also the reference flight altimeter, the correspondence is different than if another altimeter is used. Both begin with the same steps:

a. Turn **[SET]** until **ECdr** appears in the center of the display.

b. Press and release **[DALT]**. **0 - - - -** appears in the center of the display.

IF µENCODER IS REFERENCE ALTIMETER:

c. Enter **4 6 3 5 0** using the same procedure in **f** through **i** above. This tells the µENCODER to use itself as the reference altimeter for the encoder correspondence. This completes the correspondence when the µENCODER internal altimeter is also the flight reference altimeter.

IF AN EXTERNAL ALTIMETER IS FLIGHT REFERENCE:

Again, the following correspondence should only be performed if the reference altimeter and the µENCODER altitude do not track each other within ±125 feet.

Choose an altitude above the service ceiling of the aircraft but less than the 46,000 feet of the µENCODER. This will be the 2nd of two altitudes to be entered into the µENCODER for correspondence. The 1st altitude is **always zero**. Continue at step c:

c. Use the air data test set to set the altitude **of the external reference altimeter** (not the air data test set altimeter) to as near sea level as possible.

d. Press and release **[DALT]** to start the entry procedure. **0 - - - -** appears in the center of the display.

e. Enter **0 0 0 0 0** using the same procedure in **f** through **i** above. The allows the µENCODER to calculate an encoder correction factor for sea level as shown on the reference altimeter. On entering the final digit, the display will return to **ECdr**.

f. Press and release **[DALT]** to start the entry procedure for the 2nd altitude. Use the air data test set to set the altitude **of the external reference altimeter** to as near as possible to the 2nd altitude above the service ceiling.

g. Read the reference altimeter to the nearest foot and enter that altitude into the µENCODER using the same entry procedure. The upper correction factor will be stored in nonvolatile memory.

h. Press and release **[ALRT]** twice to resume normal operation. Confirmation of correspondence can now be done.

i. Placard the altimeter showing the maximum altitude that the system has been calibrated.

SSR ALTITUDE CODES

The following table shows SSR Automatic Pressure Altitude Transmission Codes for selected altitudes:

Altitude	A1	A2	A4	B1	B2	B4	C1	C2	C4	D4
-1050 to -950	0	0	0	0	0	0	0	1	0	0
-50 to +50	0	0	0	0	1	1	0	1	0	0
450 to 550	0	0	0	0	1	0	0	1	0	0
950 to 1050	0	0	0	1	1	0	0	1	0	0
1050 to 1150	0	0	0	1	1	0	1	1	0	0
1250 to 1350	0	0	0	1	1	1	1	0	0	0
1450 to 1550	0	0	0	1	1	1	0	1	0	0
1750 to 1850	0	0	0	1	0	1	0	0	1	0
1950 to 2050	0	0	0	1	0	1	0	1	0	0
2550 to 2650	0	0	0	1	0	0	0	1	1	0
2950 to 3050	0	0	1	1	0	0	0	1	0	0
3950 to 4050	0	0	1	1	1	1	0	1	0	0
5950 to 6050	0	0	1	0	0	1	0	1	0	0
6950 to 7050	0	1	1	0	0	0	0	1	0	0
7950 to 8050	0	1	1	0	1	1	0	1	0	0
9950 to 10050	0	1	1	1	0	1	0	1	0	0
11950 to 12050	0	1	0	1	1	1	0	1	0	0
13950 to 14050	0	1	0	0	0	1	0	1	0	0
14950 to 15050	1	1	0	0	0	0	0	1	0	0
15950 to 16050	1	1	0	0	1	1	0	1	0	0
18950 to 19050	1	1	1	1	0	0	0	1	0	0
20950 to 21050	1	1	1	0	1	0	0	1	0	0
24950 to 25050	1	0	1	1	1	0	0	1	0	0
27950 to 28050	1	0	0	1	1	1	0	1	0	0
29950 to 30050	1	0	0	0	0	1	0	1	0	0
31950 to 32050	1	0	0	0	1	1	0	1	0	1
34950 to 35050	1	0	1	1	0	0	0	1	0	1
36950 to 37050	1	0	1	0	1	0	0	1	0	1
39950 to 40050	1	1	1	0	1	1	0	1	0	1
42950 to 43050	1	1	0	1	0	0	0	1	0	1
44950 to 45050	1	1	0	0	1	0	0	1	0	1
46250 to 46350	1	1	0	0	0	0	1	0	0	1
Altitude	A1	A2	A4	B1	B2	B4	C1	C2	C4	D4

0 denotes absence of pulse from transponder (high impedance at µENCODER output)
1 denotes presence of pulse from transponder (low impedance at µENCODER output)

µENCODER Service Tests

There are two internal µENCODER service routines that can help diagnose encoder/transponder interface

problems.

The first test routine can toggle between pulse and no pulse for each individual data line or all data lines together (strobe enable line must be grounded).

The second test routine is only practical as a bench test because two jumper wires need to be connected between the 9-pin and 15-pin D-sub connectors. It uses two test lines available at the 9-pin D-sub to control the strobe enable and test the encoder output.

Both tests are included in the service menu when in the program mode and begin the same way.

a. With the µENCODER operating normally (after turn-on **tESt** clears the display), press and hold **[ACK]** and then press both **[ALRT]** and **[DALT]** until **OPt** appears in the lower left of the display. This is the program mode.

b. Turn **[SET]** one click CCW so **Srv** is shown in the lower left.

c. Press and release **[DALT]**. Turn **[SET]** until **ECdr1** appears in the center of the display.

ENCODER 1 TEST

d. Press and release **[DALT]**. **d4 1** will appear in the center of the display. The **d4** indicates the line to be toggled and the **1** indicates the state of the µENCODER output data line (0 = high impedance, 1 = low impedance).

e. Each press of **[ACK]** will toggle the data line from one state to the other. When the data line is in a 0 pulse state (high impedance), the display will indicate **d4 0**.

f. Turn **[SET]** in either direction to select another data line. Choose **AL** to toggle all data lines at once.

g. When testing is complete, press and release **[ALRT]** three times to return to normal operation.

ENCODER 2 TEST

The second encoder diagnostic test is normally done after assembly to verify proper operation of each of the data lines. If pins 3, 7 & 9 on the 9-pin D-sub cannot be reached through the back of the housing plug, remove the cover and apply power using jumper clips to L1 (ground) and L2 (14/28 volt). This is so that the jumper wires can be freely inserted into the holes of the 9-pin and 15-pin D-sub connectors. Insert the leads of a 1k to 31k resistor into pin 7 and pin 9 as shown. The 30.9k outside air temperature test resistor included with the unit is ideal.

Cut and strip two 20 (max 18) gage solid wires about one foot long. Insert one jumper wire in **T1** at the 9-pin connector and **STROBE** at the 15-pin connector as shown in Figure 7. This wire will remain in place for the remainder of the test.

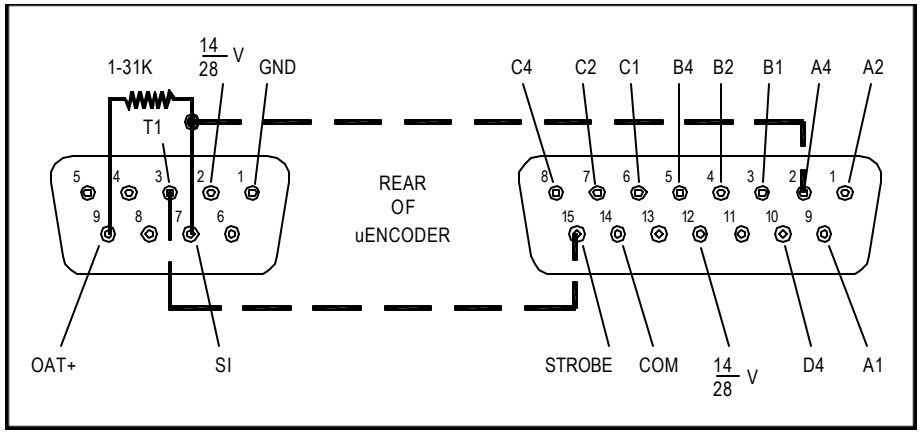

Figure 7 Performing encoder test 2. The jumper connections show data line A4 under test.

Clip or solder one end of the other jumper to the resistor lead at pin 7 as shown. Insert the other end into the data line to be tested (recommend start with d4).

Continue from steps a,b and c above:

d. Turn **[SET]** one click CW so **ECdr2** appears in the center of the display.

e. Press and release **[DALT]**. **d4** will appear in the center of the display. The **d4** indicates the line to be tested. This should agree with the test jumper position in the 15-pin connector.

f. Each press of **[ACK]** will then test the data line. **Gd** will appear if the test is good and **Er** will appear if the test shows an error in operation. The test for the data line is 1) the stobe is enabled, the data line is set to a 0 pulse output and tested for 0 pulse; 2) the data line is set to a 1 pulse output and tested for a 1 pulse; 3) the data line is left set at 1, the strobe is removed and the data line is tested for a 0 (high impedence) output.

f. Turn **[SET]** in either direction to select another data line and move the test jumper to the corresponding hole in the 15-pin connector. Repeat for all data lines.

g. When testing is complete, press and release **[ALRT]** three times to return to normal operation.

* Appendix A *

Transponder Connection Tables

The following tables may be used as a guide while connecting the µENCODER to the transponder. While every effort is made to assure accuracy, the current transponder installation instructions and service bulletins should be consulted.

Wire colors are based on the wire harness provided. All wire sizes are 24 AWG minimum.

Becker ATC 3401, ATC 3401-(1)-R

connection	common	strobe	Sw A+	A1	A2	A4	B1	B2	B4	C1	C2	C4	D4
encoder	14	15[1]	12[2]	9	1	2	3	4	5	6	7	8	10
color	wht	wht	wht	wht	brn	red	orn	yel	grn	blu	vio	gry	wht
stripe	yel	orn	red										blk
xponder	24	none	6	16	15	14	17	19	18	22	21	20	23

notes: [1] Connect to µENCODER pin 14.
[2] Alternate power connection (pin 2 of the 9-pin D-sub with a 3 amp breaker is preferred).
All encoder pin numbers in table are for 15-pin D-sub connector.

Becker ATC 4401-1

connection	common	strobe	Sw A+	A1	A2	A4	B1	B2	B4	C1	C2	C4	D4
encoder	14	15[1]	12[2]	9	1	2	3	4	5	6	7	8	10
color	wht	wht	wht	wht	brn	red	orn	yel	grn	blu	vio	gry	wht
stripe	yel	orn	red										blk
xponder	25	none	6	1	2	3	14	15	16	17	18	19	20

notes: [1] Connect to µENCODER pin 14.
[2] Alternate power connection (pin 2 of the 9-pin D-sub with a 3 amp breaker is preferred).
All encoder pin numbers in table are for 15-pin D-sub connector.

Bendix TPR-2060, TRP-660

connection	common	strobe	Sw A+	A1	A2	A4	B1	B2	B4	C1	C2	C4	D4
encoder	14	15[1]	12[2]	9	1	2	3	4	5	6	7	8	10
color	wht	wht	wht	wht	brn	red	orn	yel	grn	blu	vio	gry	wht
stripe	yel	orn	red										blk
xponder	none	none	none	4	6	8	9	10	11	3	5	7	none

notes: [1] Connect to µENCODER pin 14.
[2] Alternate power connection (pin 2 of the 9-pin D-sub with a 3 amp breaker is preferred).
All encoder pin numbers in table are for 15-pin D-sub connector.

Bendix TR641A/B

connection	common	strobe	Sw A+	A1	A2	A4	B1	B2	B4	C1	C2	C4	D4
encoder	14	15[1]	12[2]	9	1	2	3	4	5	6	7	8	10
color	wht	wht	wht	wht	brn	red	orn	yel	grn	blu	vio	gry	wht
stripe	yel	orn	red										blk
xponder	S	none	none	A	B	C	D	E	F	H	J	K	none

notes: [1] Connect to µENCODER pin 14.
[2] Alternate power connection (pin 2 of the 9-pin D-sub with a 3 amp breaker is preferred).
All encoder pin numbers in table are for 15-pin D-sub connector.

Cessna RT359A/459A/859A

connection	common	strobe	Sw A+	A1	A2	A4	B1	B2	B4	C1	C2	C4	D4
encoder	14	15[1]	12[2]	9	1	2	3	4	5	6	7	8	10
color	wht	wht	wht	wht	brn	red	orn	yel	grn	blu	vio	gry	wht
stripe	yel	orn	red										blk
xponder	11	none	9	14	13	15	19	17	16	21	18	20	10

notes: [1] Connect to µENCODER pin 14.
[2] Alternate power connection (pin 2 of the 9-pin D-sub with a 3 amp breaker is preferred).
All encoder pin numbers in table are for 15-pin D-sub connector.

Collins TDR-950/950L

connection	common	strobe	Sw A+	A1	A2	A4	B1	B2	B4	C1	C2	C4	D4
encoder	14	15[1]	12[2]	9	1	2	3	4	5	6	7	8	10
color	wht	wht	wht	wht	brn	red	orn	yel	grn	blu	vio	gry	wht
stripe	yel	orn	red										blk
xponder	none	none	none	12	10	7	6	5	4	8	11	9	3

notes: [1] Connect to µENCODER pin 14.
[2] Alternate power connection (pin 2 of the 9-pin D-sub with a 3 amp breaker is preferred).
All encoder pin numbers in table are for 15-pin D-sub connector.

Edo-Aire RT-777

connection	common	strobe	Sw A+	A1	A2	A4	B1	B2	B4	C1	C2	C4	D4
encoder	14	15[1]	12[2]	9	1	2	3	4	5	6	7	8	10
color	wht	wht	wht	wht	brn	red	orn	yel	grn	blu	vio	gry	wht
stripe	yel	orn	red										blk
xponder	2	none	none	7	5	3	12	13	14	8	6	4	none

notes: [1] Connect to µENCODER pin 14.
[2] Alternate power connection (pin 2 of the 9-pin D-sub with a 3 amp breaker is preferred).
All encoder pin numbers in table are for 15-pin D-sub connector.

Garmin GTX 320, GTX 327

connection	common	strobe	Sw A+	A1	A2	A4	B1	B2	B4	C1	C2	C4	D4
encoder	14	15[1]	12[2]	9	1	2	3	4	5	6	7	8	10
color	wht	wht	wht	wht	brn	red	orn	yel	grn	blu	vio	gry	wht
stripe	yel	orn	red										blk
xponder	13 or 25	none	14	3	5	6	9	11	12	10	4	7	18

notes: [1] Connect to µENCODER pin 14.
[2] Alternate power connection (pin 2 of the 9-pin D-sub with a 3 amp breaker is preferred).
All encoder pin numbers in table are for 15-pin D-sub connector.

Garmin GTX330/330D

connection	common	strobe	Sw A+	A1	A2	A4	B1	B2	B4	C1	C2	C4	D4
encoder	14	15[1]	12[2]	9	1	2	3	4	5	6	7	8	10
color	wht	wht	wht	wht	brn	red	orn	yel	grn	blu	vio	gry	wht
stripe	yel	orn	red										blk
xponder	50	none	none	2	4	5	7	9	10	8	3	6	11

notes: [1] Connect to µENCODER pin 14.
[2] Alternate power connection (pin 2 of the 9-pin D-sub with a 3 amp breaker is preferred).
All encoder pin numbers in table are for 15-pin D-sub connector.

Genave Beta 5000

connection	common	strobe	Sw A+	A1	A2	A4	B1	B2	B4	C1	C2	C4	D4
encoder	14	15[1]	12[2]	9	1	2	3	4	5	6	7	8	10
color	wht	wht	wht	wht	brn	red	orn	yel	grn	blu	vio	gry	wht
stripe	yel	orn	red										blk
xponder	3	none	2	4	5	6	7	8	9	10	11	12	none

notes: [1] Connect to µENCODER pin 14.
[2] Alternate power connection (pin 2 of the 9-pin D-sub with a 3 amp breaker is preferred).
All encoder pin numbers in table are for 15-pin D-sub connector.

King KT-75

connection	common	strobe	Sw A+	A1	A2	A4	B1	B2	B4	C1	C2	C4	D4
encoder	14	15	12[1]	9	1	2	3	4	5	6	7	8	10
color	wht	wht	wht	wht	brn	red	orn	yel	grn	blu	vio	gry	wht
stripe	yel	orn	red										blk
xponder	none	5	none	6	7	8	9	10	11	12	13	14	none

notes: [1] Alternate power connection (pin 2 of the 9-pin D-sub with a 3 amp breaker is preferred).
All encoder pin numbers in table are for 15-pin D-sub connector.

King KT-76/78

connection	common	strobe	Sw A+	A1	A2	A4	B1	B2	B4	C1	C2	C4	D4
encoder	14	15[1]	12[2]	9	1	2	3	4	5	6	7	8	10
color	wht	wht	wht	wht	brn	red	orn	yel	grn	blu	vio	gry	wht
stripe	yel	orn	red										blk
xponder	12	none	none	6	7	9	4	1	2	3	8	10	none

notes: [1] Connect to µENCODER pin 14.
[2] Alternate power connection (pin 2 of the 9-pin D-sub with a 3 amp breaker is preferred).
All encoder pin numbers in table are for 15-pin D-sub connector.

King KT-76A/76C/78A, KT-79

connection	common	strobe	Sw A+	A1	A2	A4	B1	B2	B4	C1	C2	C4	D4
encoder	14	15[1]	12[2]	9	1	2	3	4	5	6	7	8	10
color	wht	wht	wht	wht	brn	red	orn	yel	grn	blu	vio	gry	wht
stripe	yel	orn	red										blk
xponder	none	none	none	M	K	J	E	C	B	D	L	H	8[3]

notes: [1] Connect to µENCODER pin 14.
[2] Alternate power connection (pin 2 of the 9-pin D-sub with a 3 amp breaker is preferred).
[3] The D4 connection is applicable to KT-76C only, no connection on other models.
All encoder pin numbers in table are for 15-pin D-sub connector.

King KXP750A

connection	common	strobe	Sw A+	A1	A2	A4	B1	B2	B4	C1	C2	C4	D4
encoder	14	15[1]	12[2]	9	1	2	3	4	5	6	7	8	10
color	wht	wht	wht	wht	brn	red	orn	yel	grn	blu	vio	gry	wht
stripe	yel	orn	red										blk
xponder	B	none	none	G	H	J	K	L	M	P	R	S	none

notes: [1] Connect to µENCODER pin 14.
[2] Alternate power connection (pin 2 of the 9-pin D-sub with a 3 amp breaker is preferred).
All encoder pin numbers in table are for 15-pin D-sub connector.

Microair T2000

connection	common	strobe	Sw A+	A1	A2	A4	B1	B2	B4	C1	C2	C4	D4
encoder	14	15[1]	12[2]	9	1	2	3	4	5	6	7	8	10
color	wht	wht	wht	wht	brn	red	orn	yel	grn	blu	vio	gry	wht
stripe	yel	orn	red										blk
xponder	3	none	2	9	10	11	12	13	17	18	19	20	21

notes: [1] Connect to µENCODER pin 14.
[2] Alternate power connection (pin 2 of the 9-pin D-sub with a 3 amp breaker is preferred).
All encoder pin numbers in table are for 15-pin D-sub connector.

Narco AT5/6, AT6-A

connection	common	strobe	Sw A+	A1	A2	A4	B1	B2	B4	C1	C2	C4	D4
encoder	14	15	12[1]	9	1	2	3	4	5	6	7	8	10
color	wht	wht	wht	wht	brn	red	orn	yel	grn	blu	vio	gry	wht
stripe	yel	orn	red										blk
xponder	14	12	13	2	4	8	9	10	11	1	3	5	none

notes: [1] Alternate power connection (pin 2 of the 9-pin D-sub with a 3 amp breaker is preferred).
2 Jumper pin 6 and 7 together on the transponder to enable mode C.
3 See Narco service bulletins AT-6A-11 (Feb 22, 1973) and AT-6A-14 (Jan 27, 1975).
All encoder pin numbers in table are for 15-pin D-sub connector.

Narco AT-50/50A, AT-150, AT-155

connection	common	strobe	Sw A+	A1	A2	A4	B1	B2	B4	C1	C2	C4	D4
encoder	14	15	12[1]	9	1	2	3	4	5	6	7	8	10
color	wht	wht	wht	wht	brn	red	orn	yel	grn	blu	vio	gry	wht
stripe	yel	orn	red										blk
xponder	none	5	18	7	6	8	12	10	9	14	11	13	none

notes: [1] Alternate power connection (pin 2 of the 9-pin D-sub with a 3 amp breaker is preferred).
2 See Narco service bulletins AT-50A-4 (Sep 27, 1974) & AT-50A-5 (Feb 19, 1975).
All encoder pin numbers in table are for 15-pin D-sub connector.

Radair 250

connection	common	strobe	Sw A+	A1	A2	A4	B1	B2	B4	C1	C2	C4	D4
encoder	14	15[1]	12[2]	9	1	2	3	4	5	6	7	8	10
color	wht	wht	wht	wht	brn	red	orn	yel	grn	blu	vio	gry	wht
stripe	yel	orn	red										blk
xponder	19	none	22	7	6	13	9	10	11	14	16	12	15

notes: [1] Connect to µENCODER pin 14.
[2] Alternate power connection (pin 2 of the 9-pin D-sub with a 3 amp breaker is preferred).
All encoder pin numbers in table are for 15-pin D-sub connector.

Stec Tdr-950/950L (See Collins TDR-950/950L)

Terra TRT-250, TRT-250D

connection	common	strobe	Sw A+	A1	A2	A4	B1	B2	B4	C1	C2	C4	D4
encoder	14	15	12[1]	9	1	2	3	4	5	6	7	8	10
color	wht	wht	wht	wht	brn	red	orn	yel	grn	blu	vio	gry	wht
stripe	yel	orn	red										blk
xponder	none	12	20	5	17	16	15	2	14	3	4	18	9[2]

notes: [1] Alternate power connection (pin 2 of the 9-pin D-sub with a 3 amp breaker is preferred).
[2] TRT-250D only.
All encoder pin numbers in table are for 15-pin D-sub connector.

UPS Aviation Technologies SL70

connection	common	strobe	Sw A+	A1	A2	A4	B1	B2	B4	C1	C2	C4	D4
encoder	14	15[1]	12[2]	9	1	2	3	4	5	6	7	8	10
color	wht	wht	wht	wht	brn	red	orn	yel	grn	blu	vio	gry	wht
stripe	yel	orn	red										blk
xponder	30	none	none	13	31	12	33	14	32	16	34	15	35

notes: [1] Connect to FENCODER pin 14.
[2] Alternate power connection (pin 2 of the 9-pin D-sub with a 3 amp breaker is preferred).
All encoder pin numbers in table are for 15-pin D-sub connector.

Wilcox 1014A

connection	common	strobe	Sw A+	A1	A2	A4	B1	B2	B4	C1	C2	C4	D4
encoder	14	15[1]	12[2]	9	1	2	3	4	5	6	7	8	10
color	wht	wht	wht	wht	brn	red	orn	yel	grn	blu	vio	gry	wht
stripe	yel	orn	red										blk
xponder	t	none	none	k	c	W	T	L	D	p	f	Z	C

notes: [1] Connect to µENCODER pin 14.
[2] Alternate power connection (pin 2 of the 9-pin D-sub with a 3 amp breaker is preferred).
All encoder pin numbers in table are for 15-pin D-sub connector.

* Appendix B *

Installation Checklist

The page number for further detail is shown for each checklist item.

__ 1. Select µENCODER mounting location. (2)

__ 2. Select outside air temperature probe location. (2)

__ 3. Install µENCODER in 3-1/8" instrument hole. Watch length of #6-32 screws. (3)

__ 4. Connect static and pitot lines. Hose clamps on all tubing connections. (3)

__ 5. Install outside air temperature probe and route connecting shielded twisted pair. (5)

__ 6. Connect and route RS232 serial port shielded twisted pair wire if applicable. (5)

__ 7. Decide if transponder switched power will be used or seperate connection to bus.

__ 8. Decide if audio to be connected to headset, mixer or left unused.

__ 8a. Connect and route audio shielded twisted pair. (5)

__ 9. Complete connections to 9-pin D-Sub plug. (4,5)

__ 9a. Connect seperate power to pin 2 of 9-pin D-sub if applicable. Use 3 amp breaker.

__ 9b. Connect serial port if applicable.

__ 9c. Connect audio if applicable.

__ 9d. Connect outside air temperature probe.

__ 9e. Install shield cover. (5)

__ 10. Complete assembly of data interface cable and install shield cover. (4,5)

__ 11. Perform µENCODER altimeter calibration. (8)

__ 12. Perform tests per FARs 91.36, 91.172 and FAA AC-43-6A.

* Appendix C *

Gear Warning Circuit

A cockpit gear warning system can be activated by the µENCODER using the circuit explained in this appendix. The µENCODER provides an external trigger when the airspeed drops below a pre-programmed limit. The circuit shown in Figure 8 can use this trigger to activate a light and/or horn (see CAUTION below) if the gear handle is not in the down position.

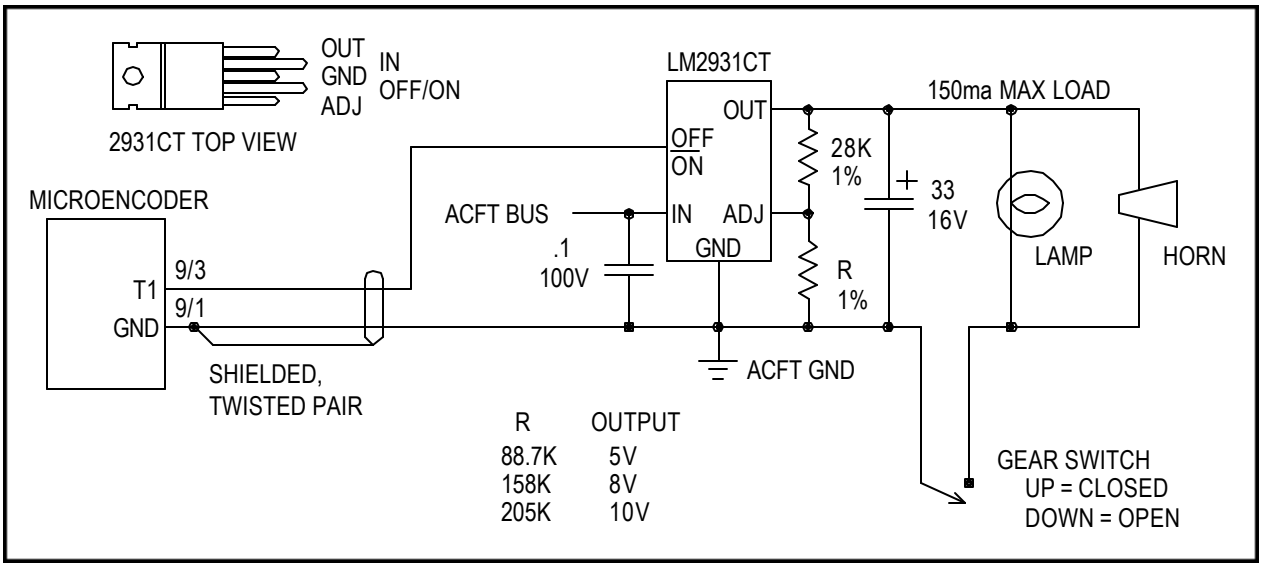

Figure 8 Using the µENCODER for a cockpit gear warning system.

Select a warning light and/or horn that operate on 5, 8 or 10 volts. Self contained audio transducers are made by Mallory and other companies. Be sure to get one that contains its own oscillator as the gear warning circuit acts the same as a switch. Select the value of resistor R in the figure to provide the proper voltage.

The 33µFD 16 volt capacitor can be tantalum (smallest size) or electrolytic. The .1 100 volt capacitor should be ceramic for small size. Resistors and capacitors can be purchased at Radio Shack.

The LM2931CT voltage regulator and related parts can be purchased from Digi-Key (see note below).

NOTE: Two excellent mail-order suppliers of electronic parts and tools are Digi-Key 800-344-4539 and Mouser Electronics 800-346-6873. Call and get catalogs. They are handy for most all your electronic and electrical needs for your aircraft.

The micro switch should be activated by your gear handle. With the gear handle down and the switch open, no current is allowed to flow to the warning light and/or horn.

For the µENCODER external gear warning trigger to function, the **IAS/GEArA** airspeed limit must be other than zero. See the programming section of this manual on how to set the gear warning airspeed limit.

The µENCODER trigger is activated when the airspeed drops below the **IAS/GEArA** airspeed limit. The trigger then turns on and off at half second intervals. This in turn will turn the voltage regulator and the light/horn on and off at half second intervals which should get your attention. Lowering the gear or increasing the airspeed back above the **GEArA** limit will stop the warning.

The gear warning trigger will not activate on gear retraction just after takeoff when the µENCODER is first turned on even though the airspeed is below the gear warning limit. The airspeed first has to go above the **GEArA** limit before the gear warning is armed.

Select the **GEArA** airspeed limit for your aircraft so that the gear warning will activate at a point in your approach that will give you time for the gear to extend and lock or for you to make a safe go-around.

Occasionally, check the gear warning system during practice air work by slowing below the **GEArA** limit with the gear up.

Ground testing of the external gear warning circuit can be performed using the **Srv/GtESt** menu item as explained in the programming section of this manual.

CAUTION: We recommend that the gear warning circuit be only used to drive a warning light and not an audio horn. Since the only way to stop the warning is to increase airspeed above the gear warning airspeed or lower the gear, an unceasing horn during an emergency engine-out glide or during practice air work could be annoying.

Ground testing of the external gear warning circuit can be performed using the **Srv/GtESt** menu item as explained in the programming section of this manual.

* Appendix D *

Outside Air *Temperature* Probe

Figure 9 shows the AD590 temperature sensor and AD590 assembly. When handling the sensor, be sure to observe reasonable static protection precautions.

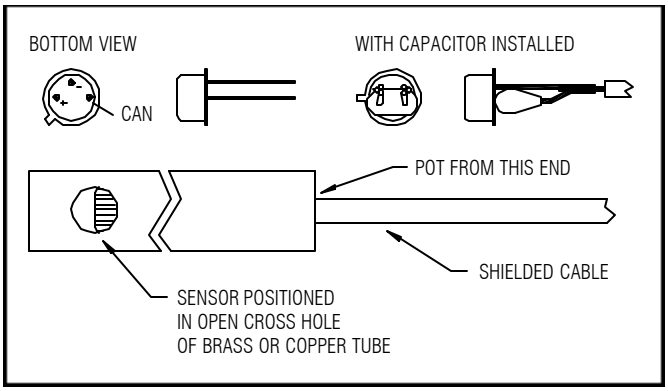

Figure 9 Outside air temperature sensor details. Bottom of figure is one possible OAT probe.

Prepare one end of a proper length (OK to shorten) of the supplied twisted pair, shielded cable as follows:

__ 1. Remove the outer insulation for 1 inch (don't cut shield wires!). Use a needle or sharp tool to unbraid the shield wires. Gather about a third of the shield wires and twist them into a wire and fold it out of the way for now. Gather the remaining shield wires and cut them completely off.

__ 2. Strip 3/16 inch from each of the two black and white wires. Heat your solder iron, apply a small blob of solder to the tip and "tin" each of the bare leads. This keeps the stranded wire together and makes it easier to solder the lead to the sensor later.

__ 3. Cut two 1/2 inch pieces of the small shrink tubing and slide one over each insulated wire. You may want to wrap a temporary piece of electrical tape around the assembly to hold the shrink tubing so that they won't keep falling off during assembly and soldering.

__ 4. Cut a 1-1/2 length of the large shrink tubing and slip over the entire cable for later use.

__ 5. Locate the temperature sensor (marked AD590) and the .1FFD ceramic capacitor (marked 104) from the black anti-static box. Use the figure to identify the lead marked "CAN" and bend it about 45E out of the way. Trim the capacitor leads to about 3/8 inch long. Position and hold the capacitor as shown in the figure and then trim the "+" and "-" leads off so the ends of the sensor leads match the ends of the capacitor leads.

__ 6. Hold the capacitor and sensor in one hand so that the end of a capacitor lead and the end of a sensor lead are touching. Melt a small blob of solder on the tip of your solder iron to and temporarily solder tack the two leads together. Now that the assembly is better held together, position and solder the other capacitor and sensor lead together.

__ 7. Lightly clamp the previously prepared cable in a vise so the black and white wires are in a position to solder the sensor assembly to them.

__ 8. Overlap the "+" lead of the joined capacitor and sensor with the WHITE wire and with your free hand apply the solder iron with a little solder on the tip to the junction. Make sure you have a good joint. Repeat with the "-" lead and the BLACK wire.

__ 9. Slip the two small shrink tubes down over the two completed joints and shrink into place.

__ 10. Overlap the twisted shield wire with the "CAN" lead from the sensor and trim the shield wire so the overlap will be about 1/4 inch. Solder the shield and "CAN" lead.

__ 11. Slide the large shrink tube up until it touches the back of the AD590. Shrink into place. This completes the attachment of the AD590 sensor to the wire cable.

__ 12. You may wish to test the sensor before potting and installing by cutting the cable to length and adding the wires to the 9 pin D-sub housing. Reverse connection of the sensor will not damage the sensor.

Since the variety of possible installation locations is so large, a specific design can not be given, but the following points are universal:

- If the metal case of the transducer itself is not exposed to the outside air, the thermal connection between the transducer and the probe material that is exposed to the air should be metal to metal with little if any insulating adhesives etc. between them.

- The mass of the probe material should be as small as possible. The intent of this and the previous instruction is to minimize the time for the transducer to respond to a change in temperature.

- Use minimum solder heat when connecting the leads to the wiring harness. Cover the finished joints with shrink tubing and mark both ends of the wires with the proper polarity.

- Minimize the strain placed on the leads entering the transducer. If the transducer can be inserted into a probe far enough, pot the wires with RTV cement or similar compounds.

- Direct moisture contact between the two leads (on bare wires) will affect the accuracy of the temperature readout.

- It is OK to clip off the little polarity tab with diagonal cutters if necessary.

We would appreciate any sketches or descriptions of your design to pass on to other builders. Thanks.

*** Appendix E ***

Encoder Wire Harness

The thirteen wire shielded cable provides the coded altitude data to the transponder. The ìENCODER end of the cable should be made up first, and then the transponder end will be connected during installation using the transponder installation instructions and/or the wiring tables in Appendix A of the ìENCODER Installation Manual.

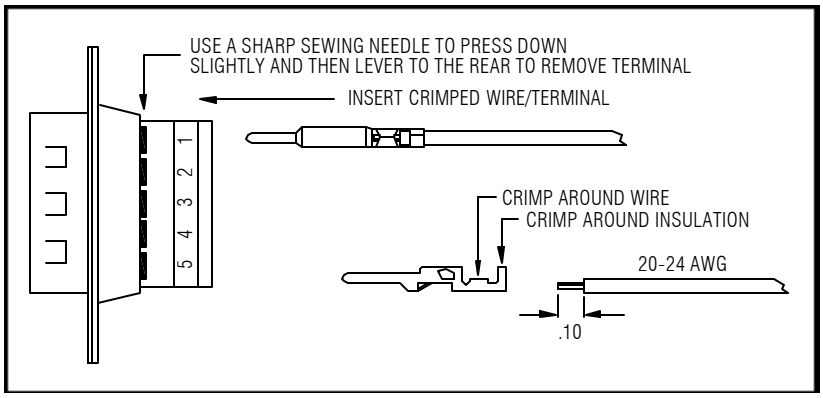

Figure 10 D-sub assembly.

__ 1. Locate the 15 wire cable provided. Strip off .9 inches of the outer insulation and foil shield by SCORING the outside of the cable and flexing it to break the insulation. Cut off the two unused black wires (one is just a filler) and the white wire with brown stripe near the edge of the outer insulation.

__ 2. Fold the bare drain wire back over the insulation.

__ 3. Strip each remaining wire and install crimp terminals as shown in the figure. If you do not have access to a terminal crimping tool, use a needle-nose plier to bend each arm, one at a time, around the wire/insulation like a person folding his arms, and then apply a SMALL amount of solder on the terminal/wire connection.

__ 4. Install the terminals into their proper stalls from the back of the 15-pin D-sub housing according to the following table.

stall#	color/stripe	function
1	brown	A2
2	red	A4
3	orange	B1
4	yellow	B2
5	green	B4
6	blue	C1
7	violet	C2
8	grey	C4
9	white	A1
10	white/black	D4 (only needed for operation over 30,750 feet)
12	white/red	14/28v
14	white/yellow	com
15	white/orange	strobe

__ 5. Locate the metal shield cover and install per the SHIELD ASSEMBLY steps, page 7 of the Installation manual. Trim any protruding excess shield and drain wire.