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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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Programming

Rather than fix functions to certain design limits, the FENCODER allows access to most of the many variables that mold the instrument to fit the performance envelope of different aircraft, as well as personal preferences of the pilot.

Programming, as used here, is more akin to choosing COOK or DEFROST on a microwave oven rather than the art/science of computer programming, so don't face this section with apprehension.

The majority of this section will only be used once after installation. There will be portions that will be used to fine-tune the FENCODER as experience dictates.

It is recommended that you first read the operations section of this manual that provides descriptions and/or definitions necessary for understanding the options and limits that can be selected during programming. It also helps to fill in Appendix C to use as a programming aid.

Menu Selection & Programming Controls

Once the programming mode is entered, menu selection makes it easy to find the desired option or limit to be changed or operation to be performed. In the FENCODER, selection from the first menu leads to another menu where another choice is selected. After two or three selections from the menus, the actual operation will be performed.

Once in the programming mode, only four controls are used: **[DALT], [SET], [ACK]**, and **[ALRT]**.

SET performs two functions 1) dialing through the menu selections and 2) changing digit values where data entry is necessary. Think of it as MENU SELECT and CHANGE DIGIT VALUE.

[DALT] is a menu selector. Pressing it at a particular menu choice leads to the next menu level for that choice. Think of it as FORWARD into menus.

[ALRT] is a conclude signal and acts opposite to **[DALT]**. Pressing it backs up through the menus so another choice can be made or eventually returns the FENCODER to normal operation. Think of it as BACK out of menus.

[ACK] is normally used to start the process of entering a number and stepping to the next digit. Think of it as START and NEXT.

Menu Alphabet

The menu selections during programming are shown as 3 to 5 letter words, abbreviations, or acronyms that will give the user as much information as possible in the small amount of space available. Some letters are difficult or impossible to represent on a display that is designed for numbers. Use your imagination when interpreting messages. Some letters like L work well while others like T are converted to lower case t. The lower case letter t still is not perfect but close. Letters like K that are impossible are not used. The alphabet and numbers used on the display looks like this:

AbCdEFGHIJ_LMnOP_rStUu__Y_ 0123456789

In particular, note the difference between the letter B (shown on display as lower case b) and the number 6.

Entering Program Mode

The program mode can be entered at any time when the FENCODER is operating in its normal mode, which is after **tESt** has cleared the display after the unit is turned on. Press and hold **[ACK]** and then press both **[ALRT] & [DALT]** until the display blanks and **OPt** appears in the lower left. The **OPt** is one of the 1st level menu choices. The control combination was chosen to be awkward so there is no possibility of entering program mode by mistake.

Menu Map

When the only item on the display is a three letter abbreviation in the lower left, the FENCODER is in the 1st level menu. Turning **[SET]** either direction will select different 1st level menu selections. When either end of the menu is reached, the list will repeat over. The three letter 1st level menu selections as they appear on the display and their meanings are:

OPt	AUd	ALt	IAS	CAL	tbL	SEr	Srv
Options	Audio	Alert	Airspeed	Calibrate	Tables	RS232	Service

At this point, turning **[SET]** will change 1st level menu selections, pressing **[DALT]** will enter the 2nd level menu group that belongs to the 1st level selection displayed and pressing **[ALRT]** will return to normal operation.

At the 2nd level, menu selection is continued using the **[SET]** knob. All 2nd level menu items will appear on the display in the altimeter position. Pressing **[DALT]** at this point will enter the 3rd level where the selections or entries are made. Pressing **[ALRT]** will return to the 1st level.

At the 3rd level, menu selection and entries are made using the **[SET]** and **[ACK]** controls. Where possible, the 3rd level menu items are shown in a third portion of the display. However, because of the limited space, many of the 3rd level menu items replace the 2nd level items in the altimeter portion of the display so you can only see the 1st level and 3rd level menus. See the examples at the end of this section explaining the two methods of changing/entering new options or values.

The menu map following contains a description of the function that will be changed by each selection. 2nd/3rd level menu selections that need additional explanation are described more fully later in this section of the manual.

1st level menu	2nd level menu	3rd level menu/action	Description
OPt (Options)	brSEt	InHg or Mb	altimeter setting in InHg or millibar
	AStyP	KTS or MIAS	airspeeds in knots or mph
	ASdIS	IAS, TAS, TAS & TAT or M	airspeed normal indicate in IAS, TAS, TAS & true air temp or Mach
	ALtFt	1 or 10	normal altitude display in feet or 10's of feet
	APPFt	1 or 10	approach altitude display in feet or 10's of feet
	TOSEC	2 to 10	timeout delay in seconds
	rCFt	1000 to 6000	VSI (rate of climb) bar graph maximum FPM
	rCSEn	0 to 2	VSI (rate of climb) bar graph sensitivity
	rCSEC	3 to 10	VSI (rate of climb) display damping action in secs
	AStIS	1 to 10	airspeed trend indicator sensitivity
	HdGvP	YES or NO	replace the digital portion of the VSI with compass heading when a compass module is used
	HdGvt	YES or NO	show compass heading in the VSI portion of the display when **[DALT]** is pressed (when a compass module is used)
	GPSAt	P or I	select pressure altitude or indicated altitude to be transmitted in serial data stream to GPS systems
	tEMP	EC or EF	temperature display in degrees centigrade or Fahrenheit
AUd (Audio)	APP	YES or NO	approach mode audio alarm
	ALErt	YES or NO	converge/hold mode audio alarm
	StALL	YES or NO	stall range audio alarm
	yEL	YES or NO	Vno warning audio alarm
	rEd	YES or NO	Vne warning audio alarm
	FLCHG	YES or NO	Flight level change (18000ft) audio alarm
	APSEC	1 to 10	approach mode audio alarm duration in seconds
ALt (Altitude)	GndSn	view/enter ground station altitude and temperature used for true altitude calculation	
	COnvG	view/enter converge warning distance	
	HOLd	view/enter hold alarm distance	
	APP	view/enter approach alarm distance	
	FLCHG	view/enter altitude for automatic baro change when entering flight levels	
IAS (Airspeed)	rEd	view/enter Vne speed (red line)	
	yEL	view/enter Vno speed (bottom of yellow arc, top of green arc)	
	GEAr	view/enter safe gear extension speed	
	FLAP	view/enter safe flap extension speed (top of white arc)	
	StLHI	view/enter upper stall range speed (bottom of green arc)	
	StLLO	view/enter lower stall range speed (bottom of white arc)	
	GEArA	view/enter external gear warning trigger speed	
	MACHL	view/enter Mach limit speed	

CAL	IAS	calibrate indicated airspeed
(Calibrate)	ALt	calibrate altimeter
	OAt	calibrate outside air temperature
	ECdr	encoder correspondence with external flight reference altimeter

tbL	TbL 1	view/enter altitude sensor table data
(Tables)	TbL 2	view/enter internal temperature sensor table data
	TbL 3	view/enter airspeed sensor table data

SEr	OUtPt	tOFF, Std, MFr, GPS or CUSt	select serial port transmission mode
	InPUt	rOFF, C-HdG	select serial port receive mode
	bAUd	1200 to 19200	select serial port baud rate
	CUStL	YES/NO - 00	create custom serial output format of up to 15 different functions (See Appendix A)
	GPSty	MOrrO, nOStr, trMbL, bEndA, bEndB, ShAdZ, ShAdS, trFLT, trAnS	select loran C or GPS type (needed if **SEr/OUtPt/GPS** selected

Srv	SHO1	active demonstration of unit (self generated)
(Service)	SHO2	static display for photo purposes
	SHO3	manufacturer's demonstration (externally generated)
	ECdr1	control individual or all encoder altitude data lines for test
	ECdr2	internal test of each altitude data line with outside jumpers (see detail)
	bArO	not implemented
	SrLn	view/change this units serial number
	vEr	display installed EPROM software version number
	COrr	displays the maximum altitude for encoder correspondence with external flight reference altimeter
	dSPLy	turns on all display segments for display test
	GtESt	control gear warning output to external circuit to test gear warning system
	bEEP	audio alarm test

TO CHANGE MENU LEVELS - Using the previous menu map as a reference, pressing **[DALT]** moves to the right and pressing **[ALRT]** moves to the left. Pressing **[ALRT]** when at the 1st level returns the FENCODER to normal operation.

TO CHANGE SELECTIONS AT EACH LEVEL - Turn **[SET]** in either direction and observe the menu selection change on the display. The order of menu selections is as they are shown in the menu map and a selection can be reached by turning the knob either direction until that selection shows on the display, or you can figure out the shortest route and turn the knob in that direction.

The 1st level menu appears in the first three altimeter setting digits at the lower left of the display. When at the 1st level the rest of the display is blank and **[SET]** will change 1st level selections.

The 2nd level menu appears in the altitude digits in the center of the display. When at the 2nd level only the 1st and 2nd level menus are on the display and **[SET]** will change 2nd level selections.

Any other display format will indicate that the 3rd level is active. Sometimes the 2nd level menu display in the altitude position will be replaced by the function being shown or entered.

The actual program changes are made at the 3rd menu level. The 1st and 2nd menu levels are just a means to get to the proper function to change.

Following are programming examples that represent the two ways of changing program data. The examples assume that the program mode has just been entered from normal operation and that <u>the 1st level selection **OPt** is already on the display</u>.

EXAMPLE 1 - Disable the Vne audio alarm.

Turn **[SET]** one click CW. The 1st level menu changes to **AUD**. Press **[DALT]** to select audio as the 1st level menu to use. **APP** appears in the altitude position. Turn **[SET]** CCW three clicks (or CW four clicks) until **rEd** appears as the 2nd level menu selection. Press **[DALT]** to select Vne redline as the 2nd level menu to use. **YES** appears on the display. Turn **[SET]** one click either direction and **NO** replaces **YES**. Since there are only two selections, additional turning of the knob in either direction will alternate between the yes and no selections. Press **[ALRT]** to return to the 2nd level menu. If you wish to change other audio selections you can select them from this point without having to return to the 1st level. Press **[ALRT]** to return to the 1st level menu.

EXAMPLE 2 - Change the Converge Warning distance from 500 to 800 feet.

Turn **[SET]** two clicks CW. The 1st level menu reads **ALT**. Press **[DALT]** to select altitude alert as the 1st level menu to use. **GndSn** appears in the altitude position. Turn **[SET]** one click CW and **COnvG** will appear. Press **[DALT]** to select converge as the 2nd level menu to use. **0 5 0 0** appears on the display in place of the 2nd level menu selection and **CONV** appears below the altitude as a reminder of the function being changed. If you just wanted to see what the current Converge Warning Distance is, you would return to the 2nd level menu at this point. Converge Warning Distance must be in hundreds so the 3rd and 4th digits are not adjustable. The following will finish the entry:

action	display	comment
press **[ACK]**	**0 - 0 0**	begin the entry process (1st digit already zero)
press **[ACK]**	**0 0 0 0**	leave 1st digit at zero and start 2nd digit
turn **[SET]**	**0 8 0 0**	two clicks CCW to 8 (or 8 clicks CW)
press **[ACK]**	**C O n v G**	leave 2nd digit at 8 and return to 2nd level menu

At this point press **[ALRT]** to return to the 1st level menu or make additional 2nd level menu selections. At any time before the final **[ACK]** on the last digit, pressing **[ALRT]** would return to the 2nd level menu and leave the Converge Warning Distance equal to 500 feet.

Options Menu

AStyP - The airspeed type option determines whether all airspeeds are displayed in knots or miles per hour. The FENCODER was not originally intended to handle mph and therefore there is no "MPH" indicator on the display. As a compromise, when miles per hour units are displayed, the indicator "MIAS" or "M & TAS" will be used. This is a combination of the Mach indicator and indicated or true airspeed indicators. When the "M" indicator is used alone, Mach is being displayed. Also, a decimal point in the result is another reminder of when Mach number is being displayed.

ASdIS - The airspeed display options control which type of airspeed is normally shown on the display when the **[TAS/T]** switch is in its center (normal) position. The following table shows the results of the four display options. The option column is what is shown on the display in the ASdIS menu. The normal column shows what is normally displayed and the TAS switch pressed column shows what is displayed when the **[TAS/T]** switch is pressed.

Option Shown on Display	Normal Display		TAS Switch Pressed	
	Airspeed	**Temperature**	**Airspeed**	**Temperature**
IAS	indicated	indicated	true	true
TAS	true	indicated	indicated	true
TAS & TAT	true	true	indicated	indicated
M	Mach	indicated	true	true

The appropriate indicators will always be displayed for all options and switch positions.

Note that "**M**" (Mach) selection overrides **AStyP** selection of knots or miles per hour.

rCSEn - The VSI sensitivity setting controls when the inner segments (lower rates of climb) of the bargraph are turned on. Three settings are available with the turn-on points in feet per minute as follows:

Turn On Points in FPM for Different Sensitivity Settings									
rCSEn setting	inner bar	2nd bar	3rd bar	4th bar	5th bar	6th bar	7th bar	outer bar	blink bars
0	30	90	190	320	460	620	800	1000	1010
1	20	70	160	280	430	610	800	1000	1010
2	10	50	120	230	400	600	800	1000	1010

The above turn-on points are for a maximum bargraph scale setting of 1000 FPM. For higher maximum scale settings, multiply the table values by the number of thousands of FPM that the maximum is set. For example,

with the maximum bargraph scale set to 3000 FPM and the sensitivity set to 1, the inner segment would turn on at 20 x 3 = 60 FPM.

First set the maximum bargraph scale to fit the performance of the aircraft and then experiment with the sensitivity setting to suit your preference.

Note that **0** is the **LEAST** sensitive setting. Also, the **rCSEn** setting works in conjunction with the VSI damping action setting. A **rCSEn** sensitivity setting of **2** combined with an **rCSEC** damping setting of **3** seconds is the most sensitive setting (good for a glider). Most users are comfortable with the **rCSEn** set at **0** and the **rCSEC** set at 10 as this duplicates the action of mechanical VSIs.

AStIS - The Airspeed Trend Indicator (ATI) sensitivity varies from 1 to 10 with 1 being the most sensitive. These settings represent the number of 1/10's of knots increase or decrease in one second needed to turn on the ATI. With a setting of 3, a speed change of 3/10 knot in one second (3/10 x 60 = 18 knots/minute) is needed before the ATI is turned on. The proper setting will depend on both aircraft performance and pilot preference. Recommended starting setting is 2 and then adjust after some experience with the FENCODER.

HdGvP - A **NO** selection will leave the VSI normal with the graphical bargraphs and a digital rate of climb between the bargraphs. A **YES** selection will replace the digital portion of the rate-of-climb with the compass heading. A special flux-gate type of compass must be connected to the serial input port of the FENCODER for this function to operate. If the compass is not connected or inoperative, the display will indicate **EEE** for error. See the **SEr/InPUt/HdGvP** menu selection for more detailed information.

HdGvt - This is similar to the **HdGvP** option above. It allows replacement of the digital portion of the rate-of-climb with compass heading **WHILE** the **[DALT]** switch is pressed. A **NO** selection will leave the rate-of-climb portion of the display normal. A **YES** selection will allow compass heading to replace the rate-of-climb with compass heading. If the compass is not connected or inoperative, the display will indicate **EEE** for error. See the **SEr/InPUt/HdGvt** menu selection for more detailed information.

GPSAt - The air data function of the FENCODER uses the serial port to provide information to a GPS system. This information includes altitude that the GPS may use for vertical navigation or help in avoiding warning or restricted areas. All other air data transmitters send pressure altitude to outside equipment because they do not have the capability to set/enter the local barometric pressure (altimeter setting). If the GPS system receives pressure altitude, the pilot must enter every altimeter setting change into the GPS so it can adjust the pressure altitude to indicated altitude. When the **GPSAt** is set to **P** the FENCODER will transmit pressure altitude the same as other air data systems. By setting **GPSAt** to **I** the unit will send indicated altitude in place of pressure altitude. The GPS system's altimeter setting can be set and left at 29.92 InHg (1013mb), saving you a lot of trouble. In this case it is important that you keep the FENCODER's altimeter setting current. This option affects all GPS serial formats.

WARNING! - If you elect to use the **I** setting to send indicated altitude to a GPS system, and there may be others that use your aircraft, it is **IMPERATIVE** that you placard the GPS system: GPS ALTIMETER SETTING MUST REMAIN AT 29.92 InHg (1013 mb).

Audio Menu

All the yes/no selections control whether an audio alarm is desired **in addition** to the blink warning that is always given on the display.

APSEC - The approach mode audio alarm duration controls how long the audio **and** blink warning will be given when the decision height warning altitude is reached. Even if the approach mode audio alarm is disabled, this value will still control the length of time that the blink warning will be given. This feature allows the audio and/or blink warning at the warning altitude to cancel itself without pilot involvement.

Altitude/Alert Menu

GndSn - The elevation and local temperature of the ground station where you received your barometric altimeter setting from are necessary for the accurate calculation of true altitude (feet above ground). Both altitude and temperature are entered, one after the other in this one menu. After normal entry of the ground station altitude, the display will show three bars (- - -) in the temperature position. The **first bar is the minus sign** so that negative temperatures can be entered. Rotation of the **[SET]** knob will turn the minus on/off and pressing **[ACK]** will step to the first digit so the rest of the temperature can be entered normally.

Note that temperatures may be entered in degrees centigrade only.

> **WARNING:** Do not use true altitude for terrain clearance. True altitude calculations even with accurate ground station elevation and temperature are approximate only and can not replace instruments such as a radar altimeter.

Alert Altitude Distances - See the operations section of this manual for full definitions of the alert altitude distances.

When entering the three alert distances, certain digits will not **[SET]** through the full range from 0 to 9 so that an entry cannot exceed the maximum allowed for that alert distance. The maximums for each of the alert distances are:

Converge Warning Distance	2500 feet
Hold Alarm Distance	250 feet
Approach Alarm Distance	250 feet

Also the hold and approach distances are to the nearest 10 feet, so the 3rd digit is not adjustable and the converge distance is to the nearest 100 feet so the 3rd and 4th digits are not adjustable.

When adjusting the Approach Alarm Distance you may wish to know approximately how many seconds before actual decision height that the alarm will sound. To calculate the number of feet to enter for a 5 second warning when the aircraft normal rate of descent on approach is 500 FPM:

$SEC(FPM/60) = 5(500/60) = 41$ feet (round to 40)

FLCHG - This is the altitude (default is 18000 feet for US) that the unit will automatically change the altimeter setting to 29.92 InHg (1013 mb) when climbing into flight levels. A blink warning is given and an audio warning is given if activated. During desent through this altitude a blink warning (and audio if activated) is given to alert you to enter a current altimeter setting.

Airspeed Menu

> **CAUTION:** Be sure that you have selected the proper airspeed display type (knots or MPH) using the **OPt/AStyP** menu before programming airspeeds.

GEAr/FLAP - Program the gear or flap speeds to zero to prevent that indicator from being shown on the display if the aircraft does not have retractable landing gear or flaps.

StLHI - The stall high airspeed represents the bottom of the green arc (normal operating range) on dial altimeters. This speed is the flaps up, gear up, power-off stall speed at gross weight.

StLLO - The stall low airspeed represents the bottom of the white arc (flap operating range) on dial altimeters. This speed is the stall speed at gross weight with the flaps in the landing position.

> **CAUTION:** If you plan to use the FENCODER airspeed for your primary stall warning, be aware of the following limitation: unlike a dial-type airspeed indicator, the FMONITOR cannot tell you how **close** to the stall speed the aircraft is unless you **know** what that speed is. For this reason, we suggest setting the stall speeds a comfortable measure above the actual stall speeds so that a warning is given **before** the speed is reached.

If the aircraft does not have flaps, set the stall low speed at the actual power off gross weight stall speed and the stall high speed somewhat higher where you would like a blink warning.

GEArA - The gear warning airspeed should be set to **000** (gear warning disabled) if the aircraft has fixed gear or you have not installed an external gear warning circuit as shown in the installation manual. If the external gear warning circuit is installed, the airspeed entered should be carefully selected depending on the aircraft's performance. When the airspeed drops below the limit, the FENCODER outputs a signal that enables an external warning circuit that is also controlled by a gear position switch on the gear handle or the gear itself. If the gear has not been lowered when the aircraft speed goes below the limit, a warning will activate. Select the airspeed to give a warning with plenty of time to either lower the gear and make a safe landing or make a go-around.

The FENCODER signal to the external circuit is disarmed when the unit is first powered up. The aircraft speed must first exceed the limit before the gear warning can take place. This prevents a false warning on takeoff if the airspeed is below the limit when the gear is retracted.

The external warning can only be canceled by increasing airspeed above the limit or lowering the gear.

MACHL - The Mach number limit warning airspeed should be set to **000** (Mach limit warning disabled) if this feature is not applicable to your aircraft. You may wish to enter a Mach number that is somewhat below the actual Mach number limit of the aircraft so the warning (and optional audio alarm) is triggered as the limit is

approached. Since the normal display of indicated or true airspeed is cancelled and replaced with Mach number whenever the programmed limit is exceeded, this allows for the most critical speed to be followed on the display. Even though Mach number is being displayed, the normal Vne and Vno warnings, based on indicated airspeed, are still active. It is **important** to observe the following when entering the Mach number limit:

The airspeed type (**Opt/AStyP** menu) MUST be set to **KTS** before entering the Mach limit. A selection of MPH (MIAS on the display) will result in an incorrect entry. The Mach number limit MUST be entered as a three digit number with an **assumed** decimal point before the first digit. Be sure the "KTS" descriptor is on the display. To enter a limit of .46 Mach, enter 460. To enter a limit of .536 Mach, enter 536. The Mach number is calculated and compared with the limit to three decimal points internally, even though only two digits are displayed.

Calibrate Menu

Providing relatively easy access to the calibration of the FENCODER is a mixed blessing. It makes it simple for both the owner/pilot and the technician to perform calibration, but if the owner/pilot is doing the calibration, it is imperative that he assures that the reference data being used is **accurate** and is aware of calibrations effect on other functions of the instrument. The actual calibration process is no more complicated than changing any of the other functions. Just be careful regarding the reference data.

Although a warm up time is not required for operation, calibrations should not be performed until the FENCODER has been operating for at least 10 minutes for maximum accuracy.

Since the FENCODER does not use a mechanical mechanism, tapping the faceplate during calibration to take out friction errors is not necessary.

AIRSPEED - There is really only one method to calibrate the airspeed section of the FENCODER, by using an accurate reference such as an air data test set or an accurate manometer (see Appendix B for manometer construction). The best time to calibrate the airspeed is during the required initial or biennial pressure system, transponder and encoder inspection, test and certification (FAR Part 43, Appendix E). The air data test set is first stabilized at approximately 70 knots and the FENCODER airspeed is observed in normal operation with the indicated airspeed in knots. If the FENCODER differs more than 2 knots from the air data test set **then** the **IAS** calibration menu is selected. The FENCODER speed is displayed. Press **[ACK]** to start the entry process of the actual air data test set airspeed to the nearest knot. Upon entry of the last digit of the air data test set airspeed, the computer will calculate and store a correction factor that will be used for all future airspeed calculations.

ALTIMETER - There are two methods to calibrate the altimeter section of the FENCODER. The first is with an air data test set and the second is with an **accurate** altimeter setting and an accurate **known** absolute altitude.

The best time to calibrate the FENCODER with an air data test set is during the required initial or biennial pressure system, transponder and encoder inspection, test and certification (FAR Part 43, Appendix E). The air data test set is first stabilized at approximately 2000 feet and the FENCODER altitude is observed in normal operation with the **altimeter setting of 29.92 for both the air data test set and the FENCODER**. If the FENCODER differs more than 20 feet from the air data test set **then** the **ALt** calibration menu is selected. The FENCODER altitude is displayed. Press **[ACK]** to start the entry process of the actual air data test set altitude to the nearest foot. Upon entry of the last digit of the air data test set altitude, the computer will calculate and store a correction factor that will be used for all future altimeter calculations.

> **CAUTION:** The altimeter correction factor is used in computing the pressure altitude which is the base altitude for all other FENCODER altitudes. Pressure altitude is also the altitude that is coded for the mode C transponder. Be aware that altitude calibration will change the encoder output **IF** the FENCODER has been corresponded with another external altimeter used for actual flight reference. For this reason it is essential, if the altimeter used for flight reference is external to the FENCODER, that the altimeter/encoder correspondence check per FAR Part 91.217(b) be performed following altitude calibration and the encoder calibrated if necessary. If the FENCODER altimeter is the flight reference, altitude calibration will not affect the altimeter/encoder correspondence.

See the installation section of this manual for detailed air data test set calibration and correspondence.

The FENCODER altimeter can also be easily calibrated with the aircraft parked at a **known** field elevation and the **current** field altimeter setting from the tower or ground control. During normal FENCODER operation, enter the current altimeter setting. Add the FENCODER's height above the ground to the known field elevation. If the difference between the actual altitude and the FENCODER altitude is more than 30 feet, change the FENCODER to **CAL**ibration **ALt**imeter mode and enter the actual altitude. Upon entry of the last digit of the actual altitude, the computer will calculate and store a correction factor that will be used for all future altimeter calculations.

OUTSIDE AIR TEMPERATURE - Use an accurate thermometer to measure the actual temperature of the OAT probe. Initial accuracy of the OAT probe is 3EC without any calibration, so be sure the reference is more accurate than that. Select the **OAt** calibration and press **[ACK]** to start the entry process of the actual temperature to the nearest degree. Calibration temperature range is 0 to +49EC only.

There is no provision for entering a negative number in the FENCODER program process so the calibration temperature must be in the range of 0EC to 49EC. Calibration must use degrees centigrade only.

ENCODER CORRESPONDENCE - When an altimeter external to the FENCODER is used for flight reference, the encoder portion of the FENCODER must match the external altimeter so the digitized altitude provided the transponder agree with the flight reference. This process is very simple compared to most other encoders.

At the 3rd level for the **CAL/ECdr** menu the FENCODER immediately starts the entry process for one of **two necessary** numbers. One of the entries must be sea level **0 0 0 0 0** and the other entry is maximum altitude that defines the encoder correspondence range (usually an altitude somewhat above the aircraft service ceiling).

Both the external flight reference altimeter and the FENCODER must be set to 29.92 InHg (or 1013 Mb). With an air data test set, the static system pressure is changed so that the flight reference altimeter is as close as possible to zero feet. Select the encoder calibration and enter five zeros. The menu will again display the 2nd level menu **ECdr**. Use the air data test set and run the altitude to a point above the service ceiling of the aircraft. Read the flight reference altimeter as close as possible, enter the 3rd level menu and enter that altitude into the FENCODER. See more detailed data in the installation portion.

Tables Menu

The tables menu is fully explained in the FENCODER assembly manual. Programming the tables is only necessary after initial start-up during assembly or the remote possibility of a sensor being replaced.

If you enter into the table menu by accident, use **[ALRT]** to back out. No changes are made to the existing tables until a full entry is made at the 3rd level.

Serial Port Menu

OUtPt - If no serial output is necessary from the FENCODER, turn the serial port transmission off using the **SEr/OUtPt/tOFF** menu selection.

The RMI **SEr/OUtPt/Std** standard output format is described in Appendix A of this section.

The beginning of the RMI **SEr/OUtPt/mFr** output format is the same as the **Std** format. Additional data is added for manufacturing tests.

The **SEr/OUtPt/GPS** output format is compatible with the type of GPS selected with the **SEr/GPSty** menu described below.

The **SEr/OUtPt/CUSt** output format transmits those FENCODER functions that have been selected using the **SEr/CUStL** procedure described below.

InPUt - If no serial input is necessary to the FENCODER, turn the serial port reception off using the **SEr/InPUt/rOFF** menu selection.

The **SEr/InPUt/C-HdG** selection allows compass heading to be received through the serial input port from a Model 303 RMI compass module. The compass heading is then also inserted into the output data stream from the FENCODER serial output port. The compass heading can also be displayed using the **OPt/HdGvP/YES** or **Opt/HdGvt/YES** menu.

bAUd - Baud rate selections are 1200, 2400, 4800, 9600 and 19200.

CUStL - This custom output loading procedure allows the user to select which FENCODER functions are included in the custom output format. The loading procedure is described in Appendix A of this section. The custom output format can also include some of the GPS formats.

GPSty - This menu lets you select the type of GPS format transmitted when the **Ser/OUtPt/GPS** menu item is selected. The format sent by the FENCODER is compatible with the GPS type selected with one improvement. You have the option of commanding the FENCODER to send **indicated** altitude instead of **pressure** altitude which is normally sent by other brands of serializers. This eliminates having to continually set the altimeter setting into the GPS system. **HOWEVER**, it is important that the loran/GPS system altimeter setting be set and left at 29.92 InHg (1013 mb). Of course, the FENCODER altimeter setting must be correct. See Appendix A for more information regarding different GPS formats.

Note that the **Ser/GPSty, trAns** menu selection will ignore the **Opt/GPSAt** setting and always send pressure altitude, as this selection is only for the newer transponders that receive altitude from their serial port. Transponder altitude must ALWAYS be pressure altitude.

WARNING! - If you elect to send indicated altitude to a GPS system, and there may be others that use your aircraft, it is **IMPERATIVE** that you placard the GPS system: GPS ALTIMETER SETTING MUST REMAIN AT 29.92 InHg (1013 mb).

Be sure to select the proper baud rate in the **Ser/bAUd** menu for the GPS system being used. Some GPS output formats may be combined with the custom output format (see Appendix A).

Service Menu

SHO1 - This third level menu starts an internally generated active demonstration of the FENCODER that ignores the actual sensor inputs. If you back out of this menu with the selection set to **YES**, the unit will appear to be in-flight, with the altitude, airspeed, OAT and VSI performing a climb, level, descend, level routine. During the simulated operation, you may operate the controls to experiment with all of the FENCODER functions including the altitude alert feature. This enables you to experiment with the unit with only a source of power connected.

To cancel the flight simulation, enter the program mode to the first menu level. You do not have to go back to the **Srv/SHO1** menu to turn it off.

SHO2 - This third level menu shows a sample static, in-flight display for photo purposes. The display should match the photo on our literature.

SHO3 - This third level menu is for a manufacturer's flight simulation using external computer generated data and will not operate without special equipment.

ENCODER 1 TEST - See **Encoder Service Checks** in the installation section of this manual.
ENCODER 2 TEST - See **Encoder Service Checks** in the installation section of this manual.

The **bArO** menu is not implemented and will not go past the 2nd level.

SERIAL # - The serial number of your FENCODER should be entered. This is a five digit number, use leading zeros if necessary. This entry may facilitate any service problems.

VERSION - The version number of the EPROM software installed in the unit is displayed. Four digits are shown. The number 1000 shown on the display means version 10.00 is installed.

CORRESPONDENCE - The upper encoder correspondence altitude is displayed. This altitude is the maximum altitude that the FENCODER altimeter and external flight reference altimeter have been calibrated during the initial or biennial static system, altimeter, transponder and encoder check. If the FENCODER altimeter is also the flight reference altimeter, the maximum altitude is 46,350. See the correspondence adjustment section of the installation manual for more details.

DISPLAY - This service test turns on all display segments. The display should match the drawing shown in the Operating Controls paragraph in the operations section of this manual.

GtESt - This service test allows manual control of the output to the external gear warning circuit if installed per the installation manual. Turning **[SET]** to select **YES** or **NO** simultaneously turns the external gear warning circuit on or off for ground testing.

bEEP - This service test allows manual control of the audio output alarm. Turning **[SET]** to select **YES** or **NO** turns the audio on or off for ground testing. Both the internal and headset audio are activated.

* APPENDIX A *

Serial Output Formats

Many serial port output formats are provided for those of you that have the capability and desire to interface to the FENCODER with your own computer or equipment or to supply air data information to any of the GPS systems on the market. The serial output voltages will work with RS232, RS422 and RS485 equipment.

STANDARD FORMAT - The standard Rocky Mountain Instrument serial port output format (**SEr/OUtPt/Std** menu selection) contains all of the FENCODER functions including those not shown on the display. The string of data is output once per second with a baud rate set using the **SEr/BAUd/xxxxx** programming menus. Voltage levels meet the RS232 standard, but with maximum voltage levels that will work with RS422 and RS485 equipment. Protocol is 1 start bit, 8 data bits and 1 stop bit. Each byte of data is an ASCII character (with exceptions noted).

Each field is output with the most significant digit first which may contain leading blanks or a minus sign. The sign byte is not in a fixed position, ie -1234 and (blank)-567 are two valid outputs for the same function. Positive numerical fields are assumed unless a minus is present. If a field is out of limits for the FENCODER the field will be filled with **E**s (for error). If the temperature probe of the FENCODER is inoperative or disconnected, temperature dependent functions such as true airspeed, density altitude etc. will have their fields filled with **E**s.

The standard output format is:

Byte#	Ck	Name	Description
01		ID#1	hex ident byte - always FF hex (FF81h can't be duplicated in following string)
02		ID#2	hex ident byte - always 81 hex
03	*	Mode	output format code - always **BINARY** 1 for standard format
04 - 08	*	IALT[1]	indicated altitude
09 - 13	*	PALT[1]	pressure altitude
14 - 18	*	DALT[1]	density altitude
19 - 23	*	TALT[1]	true altitude (**see WARNING in ALt/GndSn menu**)
24 - 28	*	AlertALT	alert altitude currently set (use indicator flags to see if alert is active)
29 - 31	*	IAS	indicated airspeed in knots or MPH
32 - 34	*	TAS	true airspeed in knots or MPH
35 - 38	*	Mach	indicated airspeed in Mach (assume decimal, (blank)453 = .453 Mach)
39 - 42	*	VSI[1]	VSI in 10's of FPM - multiply output times 10
43 - 45	*	OAT[1]	indicated outside air temperature (ĒC only)
46 - 48	*	TAT[1]	true air temperature (static temperature) (ĒC only)
49 - 52	*	InHg	altimeter setting in inches of mercury OR millibars (decimal assumed between 2nd and 3rd digits for inches of mercury)
53 - 56	*	Inds	**BINARY** bytes containing bit indicator flags (gear, flap etc.) - bit=1 means indicator is being shown on display - see below for breakdown
57 - 60	*	Hdg	compass heading from external heading sensor (assume decimal ddd.d)
61		CkByte	**BINARY** checkbyte for all bytes in list marked with "*" - CkByte added to string byte total (mod 256) will equal zero if a valid string received

[1] Can contain minus sign.

Indicator byte	Bit#	Desc	Indicator byte	Bit#	Desc
Ind1	0	FT/ALT	Ind2	0	CONV
	1	EF		1	TAS
	2	HOLD		2	KT
	3	Vno		3	IAS
	4	Vne		4	UPATI
	5	APP		5	DOWNATI
	6	FLAP		6	M
	7	GEAR		7	Mach decimal point

Indicator byte	Bit#	Desc	Indicator byte	Bit#	Desc
Ind3	0	FPM	Ind4	0	ignore
	1	TAT		1	ignore
	2	EC		2	ignore
	3	LGT		3	ignore
	4	HDG		4	ignore
	5	InHg		5	ignore
	6	Mb		6	ignore
	7	baro setting decimal		7	ignore

CAUTION: Do not use true altitude for terrain clearance. See Operations manual.

NOTE: You can use the TAS, KT, IAS and M indicators in Ind2 byte to resolve whether the unit is using knots or miles per hour for airspeed. If both M and IAS are set to 1 at the same time OR both M and TAS are set to 1 at the same time, then MPH is being used. By the same token if either both KT and IAS are set to 1 OR both KT and TAS are set to 1 at the same time, then knots are being used for airspeed.

CUSTOM FORMAT - The custom serial port output format (**SEr/OUtPt/CUSt** menu selection) is determined by the selections made using the **SEr/OUtPt/CUStL** menu. The string of data is output once per second with a baud rate set using the **SEr/BAUd/xxxx** programming menus. Voltage levels meet the RS232 standard but with reduced maximum voltage that will work with RS422 or RS485 equipment. Protocol is 1 start bit, 8 data bits and 1 stop bit. Each byte of data is an ASCII character (with exceptions noted).

Each field is output with the most significant digit first which may contain leading blanks or a minus sign. The sign byte is not in a fixed position, ie -1234 and (blank)-567 are two valid outputs for the same function. Positive numerical fields are assumed unless a minus is present. If a field is out of limits for the FENCODER the field will be filled with **E**s (for error). If the temperature probe of the FENCODER is inoperative or disconnected, temperature dependent functions such as true airspeed, density altitude etc. will have their fields filled with **E**s.

The custom output format is:

Byte#	Ck	Name	Description
01		ID#1	hex ident byte - always FF hex (FF81h can't be duplicated in following string)
02		ID#2	hex ident byte - always 81 hex
03	*	Mode	output format code - always **BINARY** 4 for custom format
04 - xx	*	Custom	user chosen (see custom loading procedure below)
xx+1		CkByte	**BINARY** checkbyte for all bytes in list marked with "*" - CkByte added to string byte total (mod 256) will equal valid string received
xx+2		GPS/loran	GPS/loran output format string added after checkbyte if selected using **CUStL** loading procedure below. Some GPS formats are too long to add to the custom output.

CUSTOM LOADING PROCEDURE - Selections made using the **SEr/CUStL** menu item allow you to custom select which internal FENCODER functions will be included in the serial port output string. Up to 16 different functions can be included in the string.

Press **[DALT]** at the **SEr/CUStL** menu to enter the loading procedure. A two digit number (00 to start) will appear in the VSI position of the display. This two digit number represents the function to be selected/deselected. If the **YES** indicator is on the display, the function will appear in the serial output data string. If the **NO** indicator is on the display, the function will not be in the data string.

From this point on, turning the **[SET]** knob in either direction will alternately chose **YES** or **NO** and pressing the **[ACK]** knob will step to the next two digit function number. The numbers will increase from 00 to 15. Pressing **[ACK]** at 15 will return you back to the 2nd menu level. If you make a mistake, you must step back through the list to correct.

The following table shows the function/number pairing:

Num.	Name	Length	Description
00	IALT[1]	5	indicated altitude
01	PALT[1]	5	pressure altitude
02	DALT[1]	5	density altitude
03	TALT[1]	5	true altitude (**see WARNING in ALt/GndSn menu**)
04	AlrtAlt	5	alert altitude currently set (use indicator flags to see if alert is active)
05	IAS	3	indicated airspeed in knots or MPH
06	TAS	3	true airspeed in knots or MPH
07	Mach	4	indicated airspeed in Mach (assume decimal, (blank)453 =0.453 Mach)
08	VSI[1]	4	VSI in 10's of FPM - multiply output times 10
09	OAT[1]	3	indicated outside air temperature (̄EC only)
10	TAT[1]	3	true air temperature (static temperature) (̄EC only)
11	InHg	4	altimeter setting in inches of mercury OR millibars (decimal assumed between 2nd and 3rd digits for inches of mercury)
12	EcdrAlt	5	altitude being presented to the transponder
13	Hdg	4	compass heading from KVH sensor in ddd.d format
14	Inds	4	**BINARY** bytes containing bit indicator flags (gear, flap etc.) - bit=1 means indicator is being shown on display - see indicator byte breakdown at end of standard serial output format section
15	GPS		include GPS/loran C data if allowed (as determined by GPSty)

[1] Can contain minus sign.

The length of the output string will depend on how many and what functions are selected. It is up to you to keep track of the length of the string so your application programming knows the position of the checkbyte. The order of the selected functions in the data string will be in increasing order as in the above table.

As an example, the output string format when functions 00,05 and 15 are selected would be:

Byte#	Ck	Name	Description
01		ID#1	hex ident byte - always FF hex (FF81h can't be duplicated in following string)
02		ID#2	hex ident byte - always 81 hex
03	*	Mode	output format code - always **BINARY** 4 for custom format
04 - 08	*	IALT	indicated altitude
09 - 11	*	IAS	indicated airspeed in knots or MPH
12		Ckbyte	**BINARY** checkbyte for all bytes in list marked with "*" - CkByte added to string byte total (mod 256) will equal zero if a valid string received
13+		GPS	airdata output added after checkbyte (format depends on GPS/loran type selected) - not all GPS formats can be added... see GPS Air Data Formats following.

GPS AIR DATA FORMATS - The FENCODER outputs all known formats for GPS systems on the market. Different formats are selected with the **SEr/GPSty/xxxxx** menu. All of the GPS formats contain altitude information, and all GPS systems are expecting pressure altitude from the air data unit. You may program the FENCODER to output indicated altitude in place of pressure altitude to save you having to enter altimeter setting

changes into the GPS system. Use the **OPt/GPSAt/X** menu to select **"P"** for pressure or **"I"** for indicated altitude.

WARNING! - If you elect to send indicated altitude to a GPS system, and there may be others that use your aircraft, it is **IMPERATIVE** that you placard the GPS system: GPS ALTIMETER SETTING MUST REMAIN AT 29.92 InHg (1013 mb).

Some additional information on each of the formats follows.

NOTE: Some GPS/Loran systems are capable of using more than one format. See the manuals for the equipment being supplied with data. Also be sure to use the **SEr/bAUd/xxxxx** menu to select the proper baud rate for the equipment connected.

MOrrO   This format is for the IIMorrow Loran C and GPS equipment. The only data contained is altitude. This format can be added to the custom output string.

nOStr   This format is for the Northstar GPS equipment. The only data contained is altitude. This format can be added to the custom output string.

TrMbL   This format is for the Trimble GPS equipment when the Trimble equipment is programmed for RMI input. The only data contained is altitude. This format can be added to the custom output string. Trimble used an early RMI format similar to our standard format, only in binary instead of ASCII. This format is described in their manual. Our Trimble format only contains the first two data fields since the Trimble equipment only uses that information. You may wish to use our Shadin output format which the Trimble equipment can accept.

bEndA   This format is for the Bendix/King KLN90 and KLN90A equipment. Data supplied to the KLN equipment is: indicated airspeed, true airspeed, Mach number, pressure altitude (indicated altitude if **OPt/GPSAt/I** selected), density altitude, total air temperature in EC, vertical speed, magnetic heading (if compass engine connected), and static air temperature. No fuel data is supplied.

bEndB   This format is for the Bendix/King KLN90B equipment. Data supplied to the KLN90B equipment is the same as for the bENdA format with the addition of: altimeter setting and indicated altitude. No fuel data is supplied.

SHadZ   This format duplicates the standard Shadin air data format compatible with many of the GPS systems. The AZ@ in the menu looks like the number 2. Data supplied to the equipment connected is: indicated airspeed, true airspeed, Mach number, pressure altitude (indicated altitude if **OPt/GPSAt/I** selected), density altitude, outside air temperature in EC, total air temperature in EC, vertical speed and heading (if compass engine connected). We do not supply any fuel information to the GPS equipment. This is the AZ@ format... see the AS@ fomat below.

ShadS   This format is identical with the Shadin AZ@ fomat except the identifiers in the data stream are S instead of Z. Some GPS systems note which type of format it is expecting and some do not. You may have to try both to see which works.

trFLT This format is for the Trimble TrimFlight system. Information contained is true airspeed and magnetic heading (RMI Mdl. 303 compass module must be installed) to allow the TrimFlight to compute winds aloft.

trAnS This format is for the newer transponders that can accept altitude data into a serial port in addition to standard gray code. It=s format is 8 bits, no parity, one stop bit and starts with A#AL@. This AGPS@ format ignores the **IOpt/GPSAtBB@** option and will send ONLY pressure altitude to the transponder.
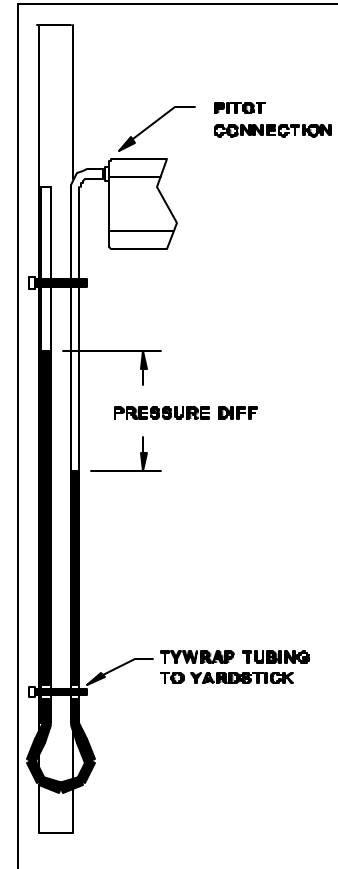
* APPENDIX B *

Homemade Manometer Construction

A simple homemade manometer can be used to accurately calibrate the airspeed indicator portion of the FENCODER. Purchase a number of feet of 3 inch ID clear plastic tubing. About three feet will allow accurate calibration at 70 knots. Bend the tubing into a U-shape and attach to a yardstick as shown in Figure 2.

Fill the U-tube with colored water (food coloring) and a drop of dish soap to a known starting point. Attach the FENCODER pitot port to one end and then add additional water to the open end of the tubing until the **difference** in height is equal to one of the table calibration points. Use of an eyedropper or similar makes it easier to adjust the water level.

Although the table gives additional calibration points, a typical unit will show a maximum error of plus or minus 1 knot throughout the FENCODER range when calibrated at 70 knots (best calibration point). When calibrating at 70 knots, a water height error of .11" is equal to one knot calibration error. Obviously to check at some of the higher airspeeds will take more than three feet of tubing.

CAUTION: Do not allow water to enter the pitot port of the FENCODER.

Airspeed Knots/MPH	Inches H_2O	Airspeed Knots/MPH	Inches H_2O
50/57.5	1.63	17.4/20	0.20
70/80.5	3.20	26/30	0.44
100/115	6.56	34.8/40	0.79
110/126.5	7.95	43.5/50	1.23
120/138	9.48	69.6/80	3.16
130/149.5	11.14	86.9/100	4.94
150/172.5	14.87	104.3/120	7.13
200/230	26.71	130.4/150	11.18
250/287.5	42.27	173.9/200	20.04
300/345	61.70	217.4/250	31.63
350/402.5	85.54	260.9/300	46.09
400/460	114.10	304.3/350	63.58
450/517.5	147.88	347.8/400	84.39

* APPENDIX C *

Programming Checklist

This checklist serves to help select and record your programming option choices and aircraft performance values. The list is in the same order as it appears while the FENCODER is in the programming mode. Refer to the *Menu Map* section and details following it for complete information on each entry.

OPt/brSEt	" InHg " Mb	altimeter setting units
OPt/AStyP	" KTS " MIAS	airspeeds in knots or mph
OPt/ASdIS	" IAS " TAS	airspeed normally indicate
	" TAS&TAT " M	
OPt/ALtFt	" 1 " 10	altitude display increments
OPt/APPFt	" 1 " 10	approach altitude display increments
OPt/TOSEC	_____ 2 to 10	timeout delay in seconds
OPt/rCFt	_____ 1000 to 6000	VSI bargraph maximum FPM
OPt/rCSEn	_____ 0 to 2	VSI bargraph sensitivity
OPt/rCSEC	_____ 3 to 10	VSI display damping action in secs
OPt/AStIS	_____ 1 to 10	airspeed trend indicator sensitivity
OPt/HdGvP	" YES " NO	compass heading in place of VSI digits permanently
OPt/HdGvt	" YES " NO	compass heading in place of VSI digits temporarily
OPt/GPSAt	" P " I	pressure or indicated altitude in air data output
OPt/tEMP	" EC " EF	temperatures in degrees centigrade or Fahrenheit
AUd/APP	" YES " NO	approach mode audio alarm
AUd/ALErt	" YES " NO	converge/hold mode audio alarm
AUd/StALL	" YES " NO	stall range audio alarm
AUd/yEL	" YES " NO	Vno warning audio alarm
AUd/rEd	" YES " NO	Vne warning audio alarm
AUd/FLCHG	" YES " NO	flight level change (default 18000ft) warning audio alarm
AUd/APSEC	_____ 1 to 10	approach mode audio alarm duration in secs
ALt/GndSn	Variable	ground station altitude/temperature
ALt/COnvG	_____	converge warning distance
ALt/HOLd	_____	hold alarm distance
ALt/APP	_____	approach alarm distance
Alt/FLCHG	_____	altitude to flight level changeover
IAS/rEd	_____	Vne speed (red line)
IAS/yEL	_____	Vno speed (btm. of yellow arc, top of green arc)
IAS/GEAr	_____	safe gear extension speed
IAS/FLAP	_____	safe flap extension speed (top of white arc)
IAS/StLHI	_____	upper stall range speed (bottom of green arc)
IAS/StLLO	_____	lower stall range speed (bottom of white arc)
IAS/GEArA	_____	external gear warning trigger speed
IAS/MACHL	_____	Mach limit speed in form .xxx

CAL/IAS	" Completed, date_____	calibrate indicated airspeed	
CAL/Alt	" Completed, date_____	calibrate altimeter	
CAL/Oat	" Completed, date_____	calibrate outside air temperature	
CAL/ECdr	" Completed, date_____	encoder correspondence	

tbL   Tables menu not used after initial manufacture

SEr/OUtPt	" OFF " Std " MFr " GPS " CUSt	serial port (airdata) transmission format
SEr/InPUt	" OFF " C-HdG	serial port receive mode
SEr/bAUd	" 1200 " 2400 " 4800 " 9600 " 19200	serial port baud rate

SEr/CUStL	" YES " NO	00 - indicated altitude
	" YES " NO	01 - pressure altitude
	" YES " NO	02 - density altitude
	" YES " NO	03 - true altitude
	" YES " NO	04 - alert altitude currently set
	" YES " NO	05 - indicated airspeed in knots or MPH
	" YES " NO	06 - true airspeed in knots or MPH
	" YES " NO	07 - indicated airspeed in Mach
	" YES " NO	08 - VSI in 10's of FPM
	" YES " NO	09 - outside air temperature
	" YES " NO	10 - true air temperature
	" YES " NO	11 - altimeter setting
	" YES " NO	12 - altitude being presented to the transponder
	" YES " NO	13 - compass heading from KVH sensor
	" YES " NO	14 - indicator flags
	" YES " NO	15 - include GPS/Loran C

SEr/GPSty	" MOrrO " nOStr " trMbL " bEndA " bEndB " SHadZ " ShasS " trFLt " don't care	GPS/Loran C air data output format

Srv/SHO1	Not settable	active demo mode
Srv/SHO2	Not settable	static demo mode
Srv/SHO3	Not settable	mfr. demo mode
Srv/ECdr1	Maintenance routine	encoder test
Srv/ECdr2	Maintenance routine	encoder test
Srv/bArO	Not implemented	
Srv/SrLn	_____	serial number
Srv/vEr	Not settable	software version
Srv/COrr	Not settable	encoder correspondence
Srv/dSPLy	Not settable	display test
Srv/GtESt	Maintenance routine	external gear warning test
Srv/bEEP	Maintenance routine	audio test

* APPENDIX D *

EPROM Software Upgrades

Installation of this software version on a FENCODER with a current EPROM label marked "**ver 101.73**" or smaller will result in complete initialization which will **ERASE** airspeed and altitude calibrations and other options previously selected. Lookup tables will not be affected. You can also determine your current software version without removing the instrument by using the **Srv/VEr** menu selection. The **Srv/VEr** result will be in one of two forms. Early software versions displayed *101x*, with *x* being between 0 and 7, indicating versions 101.0 through 101.7. Some of versions of 101.72 and 101.73 software showed 0720 or 0730.

RECORD CURRENT OPTIONS

IF your current software version is 101.73 or earlier (settings erased), then you should record your current settings so they can be re-entered after completing the upgrade.

Before removing the FENCODER, turn the unit on and enter the programming mode. Step through **ALL** the menu items and record your current selections for options and values such as airspeeds. Use the checklist in appendix C to record your current settings. Since the checklist is for this software version, it will have more entries than in your older version. You can complete the checklist for items not in previous versions. The selections and settings can then be re-entered after this version is running.

FENCODER EPROM INSTALLATION

__ 1.　　Remove four #4-40 screws and cover from the FENCODER.

__ 2.　　Carefully remove EPROM (white labeled IC at U26). Use two small screwdrivers and work the IC at either end a small amount at a time.

This software version is being supplied in an EPROM with more memory capacity than many earlier versions. If replacing an EPROM with less memory, the CPU PC board underneath the EPROM socket must be modified so as to work with this larger EPROM. Some units may already be modified.

__ 3.　　If your unit has a plastic socket installed with cross-rails, carefully cut out the front cross-rail (may already be done) so as to gain access to the PC board in the location shown in the figure.

__ 4.　　If the words **---CUT 256** and **JMP 256** do NOT appear as shown in the figure, then this unit does not need modification. Skip to step 8.
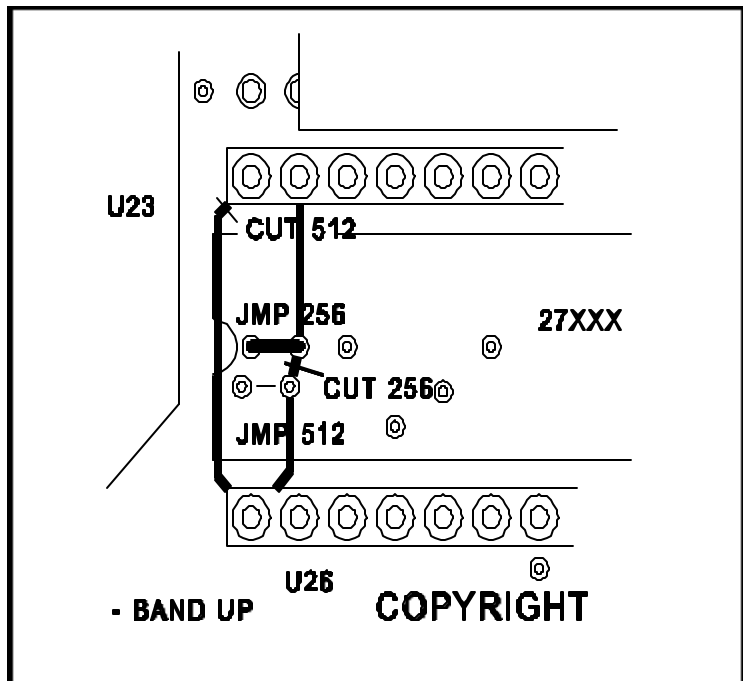
Read the next two steps and check your unit. If both step have already been completed, then your unit has already been modified. Skip to step 8

___ 5.   Using the figure for orientation, cut the small trace underneath the line in front of the descriptor **CCC CUT 256**. The trace is about 1/8" long between the two small thru holes. The trace is only .001" thick so it doesn't take much to cut trough the trace. Use a Dremel-type tool or an Xacto knife and open the trace. Inspect the cut with a magnifying glass and/or test for an "open" between the two thru holes with an ohmmeter to make sure the trace is open.

___ 6.   Use a small bare wire and install a jumper between the two thru holes marked with the white paint line underneath the "**JMP 256**" printing as shown in the figure. Make sure that the length of the two leads going through the PC board a just long enough to stick through the board so you don't have to remove the PC board assembly to cut the leads on the solder side of the PC board. Solder each end of the jumper wire from the component side of the board.

___ 7.   Use a little lacquer thinner on a rag to wipe the flux from the two solder joints. Visually examine the joints for cleanliness and integrity.

___ 8.   Straighten the rows of pins on the new IC if necessary to match the width of the two rows of socket pins (or socket) and insert the new EPROM. Make sure that the half-circle cutout in the end of the EPROM matches the same half-circle in the white designator on the PC board for proper polarity.

All version of software starting with version 10.00 work with a different crystal frequency. The old frequency was 7.86432 MHZ and the new frequency is 7.3728 MHZ.

Locate the crystal about 1.5" to the left of the newly installed EPROM (marked Y1 on the PC board). If it is marked with 7.3728 then skip to step 16.

___ 9.   To remove the current crystal apply the tip of your solder iron to one of the leads and the solder pad of the crystal (ON THE COMPONENT SIDE OF THE PC BOARD) to melt the solder, and then, while continuing to keep heat on the lead/pad, pull the lead up through the hole with a needle nose plier grasping the lead about halfway between the pad and the crystal body. Repeat for the other lead.

___ 10.   Use the same technique as in step 9 to remove **ONE** of the ends of the hold-down wire. Remove the crystal and throw away.

___ 11.   If you have a solder-sucker, remove the excess solder from the three holes that were unsoldered. If you do not have a solder sucker then you may remove the solder in the PC board holes with a .025 to .031 (1/32") diameter drill. **ABSOLUTELY NO LARGER!!!**

___ 12.   Form the two leads on the new 7.3728 MHZ crystal (make sure you can read crystal frequency when installed) to fit into the two lead holes in the PC board. Estimate the amount of lead that needs to be cut off so the leads will just extend through the other side of the PC board. Remove the crystal and trim the leads.

___ 13.   Install the crystal, and form the hold-down wire back into the solder pad from which it was removed. Solder the hold-down wire from the top of the board. Bend wire if necessary to hold the crystal securely.

____ 14.　Solder the two crystal leads from the top of the board.

____ 15.　Use a little lacquer thinner on a rag or Que Tip to wipe the flux from the three solder joints. Visually examine the joints for cleanliness and integrity.

Beginning with version 11.00 the unit must have installed a display that can show degrees Fahrenheit. If your unit already has this LCD installed (you can use the **Srv/dSPLy** menu item to see all portions of the display) skip to step 22.

____ 16.　Carefully unplug the multi-colored ribbon cable, the EL backlight cable and the audio sounder cable from the main PC board.

____ 17.　Remove the four screws holding the faceplate assembly to the chassis. Please note that very short screws are necessary at the two locations marked by labels on the chassis. Some early kits were provided with longer screws and the builder needed to shorten them. It's possible that only two of the four screws were shortened. If one of the longer screws is installed in the "short hole only" location, the new LCD will be broken. Mark the screws or use some method to keep track of what goes where when screws are installed later.

____ 18.　Separate the faceplate assembly from the chassis.

____ 19.　Use the drawing to the right to assist in replacing the old LCD with the new LCD. Further details can be found in the assembly manual in the <u>Faceplate Assembly</u> section.
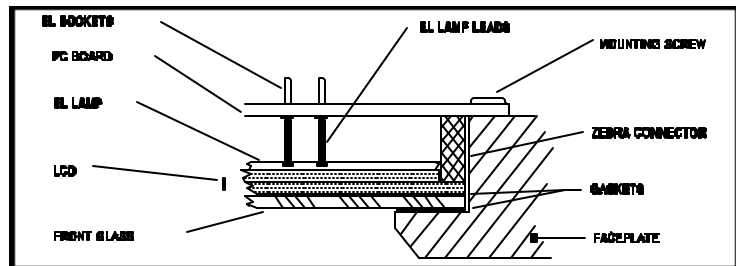
____ 20.　Reverse steps to attach the faceplate assembly to the chassis (watch the screw lengths!) and attach the cables.

____ 21.　The new LCD operates at a lower voltage. Power up the unit and either 1)adjust R5 on the display driver board clockwise until digits appear darkest without off segments "ghosting" or; 2)attach voltmeter between AGND test point on A/D board and test point on display driver board and then adjusting R5 until voltage is approximately 3.8 volts.

____ 22.　Install the cover and four #4-40 screws and lockwashers.

____ 23.　Power up the FENCODER. If the words **Err** and **InIt** appear on the display, then continuing on will erase your current settings and calibrations. There isn't any choice however, if you wish to install the new software. Hold the **[ACK]** button down with one hand and press both **[ALRT]** & **[DALT]** at the same time to continue on. Be sure to re-enter all your options, speeds etc.

Software Version Details

The following list shows changes made to each version of software. Note new features that have been added since your previous version and refer to the current Operation and Programming manuals for details on the additions.

Version 101.0 changes (visible by user)
1. Airspeed look-up table accuracy improved from 25 to 100 knots.
2. Corrected TAS/IAS/KTS/TAT indicator bug (indicators would toggle if TAS/T switch was hit before PALT switch.
3. Added EPROM diagnostic check. Detected error in EPROM shows on display as **Err EPrOM**. FENCODER will not function past error message. Replace EPROM to correct.
4. Menu item **Srv/vEr** added to display eprom version. See programming manual.
5. Menu item **Srv/COrr** added to display external flight reference altimeter-FENCODER maximum altitude correspondence. See programming manual.
6. Bug in encoder test 2 routine fixed. A1 and D4 on display was reversed from actual encoder output.
7. Actual encoder output display added. See operations manual.

Version 101.1 changes (visible to user)
1. Baud rate setting of **OFF** added.

Version 101.2 changes (visible to user)
1. Add **Srv/InIt** menu item. This initializes the first 256 bytes of Xram without having to enter the tables again. Protected by password to limit user access. NOTE: This version (101.2) must use InIt because new calibration routines required changes in XRAM layout.
2. New airspeed and altitude calibration routines improves overall accuracy.
3. Bug in outside air temperature fixed. Negative calibration factor would result in large reading.
4. Operation of converge/hold mode changed. When in converge mode and approaching an alert altitude during climb or descent, a blink warning begins when the altitude remaining to the alert altitude is less than the Converge Warning Distance. When the converge blink warning starts the audio sounds a short beep to alert the pilot. When the aircraft reaches the Hold Alarm Distance, another short beep will sound and the FENCODER will automatically enter the hold mode. See operations manual.

Version 101.3 changes (visible to user)
1. Short beep added in hold mode when blink warning starts when passing from inside to outside 1/2 hold alarm distance.

Version 101.4 changes (visible to user)
1. **Srv/dSPLy** menu item added. This turns on all display segments to check for proper operation of LCD and display driver. See programming manual.
2. When changing the serial output from Std to 618, the FENCODER had to be turned off and back on for the change to be recognized. Fixed.
3. Eliminated double beep on automatic change from converge mode to hold mode.
4. Density altitude calculations changed to extend range of operation. Density altitude range is now calculated for all pressure altitude inputs from -2000 feet up to 46000 feet. Calculation accuracy improved for high speed aircraft by using true air temperature instead of indicated air temperature.

Version 101.5 changes (visible to user)
1. Fix bug in encoder. Encoder output was being disabled during altitude blink warnings.

Version 101.6 changes (visible to user)
1. Altitude calibration range extended to accept negative pressure altitudes (still cannot enter minus indicated altitudes!) for calibration close to sea level with high barometric settings.

Version 101.7 changes (visible to user)
1. When changing the serial port baud rate, the FENCODER had to be turned off and back on for the change to be recognized. Fixed.
2. Feature added for external gear warning based on airspeed and gear position. See installation and programming manuals.
3. **Srv/SHO1** and **Srv/SHO2** menu items added. These are demonstration features with 1 being an active demonstration of the unit and 2 being a fixed display demonstration.

4.   Minimum airspeed range changed to 30 knots from 25 knots.
5.   Altitude calculations changed to reduce nonlinearity errors above 25000 feet.
6.   Backlighting on/off status is now maintained in nonvolatile memory and restored the next time the unit is turned on.

Version 8.00, 8.01, 8.02 changes (visible to user)
1.   Pressing in on the SET knob while adjusting the altimeter setting changes the tenths digit for faster altimeter setting. Let up on the knob to change the hundredths digit.
2.   New method of entering hold mode added. If already level, instead of going through the enter Alert Altitude procedure, just hold up on the ALRT switch until the timeout expires and the display reverts to indicated altitude. When the switch is released, the unit will automatically enter an Alert Altitude based on current indicated altitude rounded to the nearest 100 feet and then automatically enter hold mode.
3.   True altitude added. View true altitude the same as true airspeed and true air temperature by holding down the TAS switch. True altitude will appear in the normal altitude position. **ALt/GndSn** menu item added to enter the elevation and temperature of the ground station that determined your current altimeter setting.
4.   Service routine **Srv/ECdr1** was not displaying "**0**" or "**1**". Fixed.
5.   Altitude calibration changed so the PALT and IALT can be negative, but the new entered altitude must still be positive.
6.   **SEr/bAUd/OFF** menu item deleted. **SEr/OUtPt/tOFF** now turns off serial transmission.
7.   Serial port **Std** output format changed. See appendix A in programming manual.
8.   **SEr/OUtPt/Mfr** menu item added for factory service.
9.   **SEr/OUtPt/CUSt** menu item added to allow custom serial output formats.
10. Serial port input added. **SEr/InPUt/rOFF** turns off serial reception.
11. Compass heading can now be displayed in place of the digital VSI. An external sensor must be added to the serial input port for the feature to work. **SEr/InPUt/Hdg** turns on serial reception from the external sensor. The three digit compass heading is inserted into the **Std** serial output stream. Menu item **OPt/Hdg/YES** selects display of the compass heading instead of the VSI digits. The VSI bargraph functions in normal mode.
12. Input/output serial port baud rates changed. **SEr/bAUd** menu now has 300, 600, 1200, 2400, 4100 and 8200 baud.
13. **Srv/InIt** menu item deleted. Future software updates will save all settings, including tables and calibrations.
14. **Srv/SrLn** menu item added to view/change your unit's serial number.
15. Mach and true airspeed calculation accuracy increased.
16. TAS display was totally blank when airspeed was zero... bug fixed.
17. Accuracy increased on Mach number and TAS.
18. II Morrow 618 serial format bug fixed.
19. Added Northstar serial format output.
20. Added low airspeed option for light aircraft. Range is 15 to 156 knots.
21. Mile per hour option added for airspeeds.

Version 8.03 changes (visible to user)
1.   Added serial format (abbreviated) for Trimble series 2000 equipment.

Version 10.0 changes (visible to user)

NOTE: The 7.86432MHZ crystal used in previous versions must be replaced with a 7.3728 crystal. This hardware change enables the serial output to operate at standard baud rates for new GPS systems.
1.   Hardware change crystal frequency to 7.3728MHZ. Serial port baud rates available now are: 1200, 2400, 4800, 9600 and 19200.
2.   Add audio and/or visual alarm for 18,000 feet passage. When ascending, altimeter setting is automatically changed to 29.92 and warning issued in case other altimeter need adjusting. When descending through 18,000 feet, an audio and/or visual warning reminds the pilot to enter the new altimeter setting. A new menu item **AUd/FLCHG** added to allow selection of visual only or visual/audio warning on 18,000 passage.
3.   Menu item **SEr/OUtPt/LOrAn** changed to **SEr/OUtPt/GPS** for clarity since most airdata if for GPS units vs. loran C. Menu item **SEr/LtyPE** changed to **SEr/GPSty** for clarity.
4.   Bendix/King KLN90, KLN90A and KLN90B airdata formats added to possible serial output formats. New menu items **SEr/GPSty/bEndA** and **SEr/GPSty/bEndB** added.
5.   Shadin airdata format added to possible serial output formats. This format feeds airdata information (airspeeds, altitudes, temperatures etc.) to many of the newer GPS navigation units. A new menu item **SEr/GPSty/Shd** added to select the standard Shadin format.
6.   A new menu item **OPt/GPSAt** added with a **P** (pressure) or **I** (indicated) option to allow the option to send normal pressure altitude or indicated altitude in all GPS systems serial formats. Normal serial format outputs pressure altitude and requires the pilot to enter the current altimeter setting into the GPS system that is receiving air data information from the unit. With the **I** option, the GPS altimeter setting can be set and left at 29.92 InHg (1013 mb).

7. A new menu item **OPt/HdGb** added to allow compass heading to be viewed in the altimeter setting portion of the display when the DALT switch is pressed. The **OPt/HdG** menu item to view heading in VSI is changed to **OPt/HdGv** to help distinguish between the two.
8. Extended altimeter setting range from 28.00-31.00 InHg to 27.50-31.50 InHg.

Version 11.00 changes (visible to user)

NOTE: The LCD used in previous versions must be replaced with a new version that has the ability to display degrees Fahrenheit.

1. **OPt/tEMP** menu item added to select option of viewing temperatures in degrees centigrade or degrees Fahrenheit.
2. **OPt/HdGv** menu item changed to **OPt/HdGvP** to signify that selection will permanently show compass heading in the digital portion of the VSI. The new LCD has a descriptor HDG on the display when heading is being shown.
3. **OPt/HdGb** menu item changed to **OPt/HdGvt** to signify that selection will temporarily show compass heading in the digital portion of the VSI.

Version 11.10 changes (visible to user)

1. The altitude that altimeter setting automaticaly changes to 29.92 InHg (1013 mb) is now changed by using the **Alt/FLCHG** menu item. Default remains at 18000 feet (USA).
2. **SEr/InPUT/C100** entry for selecting compass heading input is changed to **Ser/InPUT/C-HdG** to better correspond with the RMI Mdl. 303 compass module.
3. Old **SEr/GPSty/SHAd** has been changed to **Ser/GPSty/SHAdZ** to differentiate from the Shadin AS@ format.
4. Added new serial format **SEr/GPSty/SHAdS**. Very similar to AZ@ format with one letter changed.
5. Added new serial format **Ser/GPSty/trFLt** for the Trimble TrimFlight system.

Version 11.20 changes (visible to user)

1. Added new serial format **Ser/GPSty/trAnS** for serial transponders.

Version 11.21 changes (visible to user)

1. Corrected bug in calculation of degrees F of true air temperature.

Version 11.30 changes (visible to user)

1. Added smoothing function to compass heading to reduce compass heading jitter.
2. Added new Mach limit warning for high-speed aircraft **IAS/MACHL**.

Version 12.00 changes (visible to user)

1. None. Hardware change only from EL to fiber-optic backlight.