EE-2 Encoder Emulator / Gray code Generator
Operating Instructions

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FAA CRS VFAR714K

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SECTION I
GENERAL

The modern avionics shop is continually troubleshooting encoder/gray code problems in GA aircraft. Common problems occur from bad encoders, bad harnesses, mis-wired harnesses, etc. The faster a shop can pinpoint the source of the mode c problem the faster the aircraft is back in the air.

Most shops are installing a large number of devices that need Mode C data. After installation of any device that is interfaced to the existing mode C encoder a systems check is required to verify any code line problems.

It is extremely time consuming to remove the static line from the aircraft encoder and use an external pump to run the encoder up and verify the code line connections. The EE-2 is designed to plug in place of the existing encoder and allow the technician to manipulate the code lines, and check the status of existing power/ground/strobe lines.

The EE-2 features include:

- Altitude word generator in 9 bit gray code format
- Altitude word generator in 9600 baud serial ICARUS format (with I/O option)
- 9 code line LEDS. Either monitor the aircraft bus, or EE-2 output
- 4 status LED's for Encoder power pins, and encoder enable valid
- Internal 9v battery, or any valid power pin on DB 15 connector 12-28v
- Small easy to use design

The EE-2 emulator is a microprocessor based gray code word generator. The EE-2 is designed with the avionics technician in mind. The EE-2 will allow rapid diagnosis of aircraft encoder system problems. The EE-2 will also generate gray code data for system testing. The altitude format is both 9 bit gray code, and 9600-baud serial Icarus format (9600 with I/O option)

The EE-2 is contained in a small 2 x 1 x 4 case with a 36" external harness terminated into a DB 15 pin male connector. The EE-2 has an internal 9v battery. The EE-2 can be powered from either the internal 9v battery or from the standard power pins on the aircraft encoder harness (pin 7 or 8, or 14). The EE-2 has an internal regulator and is compatible with either 14v or 28v aircraft.

The EE-2 has four selector switches to program the output code or select the mode of operation. Five LED indicators indicate the state of selected pins on the 15-pin I/O connector.

The internal Microprocessor in the EE-2 can run several different programs to generate various out bit patterns. Once a program is started no further used input is required. The Technician can start the EE-2 then watch the gray code without having to continuously manipulate knobs to generate different output codes.

SECTION II
LIMITATIONS

The EE-2 is designed to be operated by FAA licensed aircraft technicians. The EE-2 is for troubleshooting only and is not intended for installation in any aircraft. Any Technician using the EE-2 must refer to the approved manufactures installation and maintenance manuals before making any conclusions based on the information given by the EE-2. Any time the Mode C system of an aircraft is repaired the Technician must comply with 91.413, or 91.411 before the aircraft is returned to service.

During use of the EE-2, avoid shorting any data lines to the power bus of the aircraft.

SECTION IV

NORMAL PROCEDURES

1. OPERATING PROCEDURES

Identify the location of the existing aircraft encoder. Determine if the existing encoder uses he standard DB15 pin format (ACK A-30, Ameri-King, Terra AT3000, Trans-cal, Narco AR-850 25K). If the existing encoder is of the DB15 pin format remove the plug to the encoder and connect it directly to the harness on the EE-2. If the existing encoder is not pin compatible with the EE-2 (Narco AR-500, AR-850, Serial Icarus, etc), select the appropriate adapter harness and connect it in series with the EE-2 and the existing encoder harness.

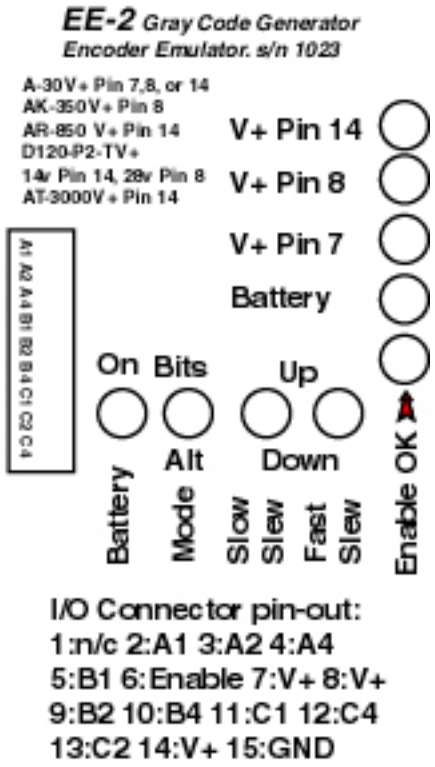
For serial altitude output, select the serial output I/O cable. The serial mode is enabled with switch 8 in the aft position. See the switch 8 operation for serial output format.

1. Configure the aircraft as you would for a 91.413 transponder certification.
2. Before generating any gray code with the EE-2, place the mode selector switch in the center position to initially turn off all EE-2 outputs. This places the EE-2 in the bus analyzer mode. Note if any bit lights are lit. If so, the aircraft harness (or some other device on the mode C bus) has a line shorted to ground. Also note if all the bit lights are lit dim. This is an indication there may be another device on the bus that needs isolation diodes. You may want to try powering off other deices known to be on the mode C bus to see if they will pull the bus down (as indicated by one, or all of the bit lights being lit on the EE-2). We have seen this with Collins TDR-950 units if no isolation diodes are installed. Also if you have a bit light lit we have seen failed IC's in Narco AT50/50A units holding a bit high. Pull the xpdr out of the tray and observe the bit light. If it goes out you have a bad XPDR mode C gate. *Note: If you tie a Collins TDR-950 to a Garmin 430/530, we have seen a race condition problem. If the 430/530 is powered up before the TDR-950, the TDR-950 will not come on line. If the TDR-950 is powered up first, then the 430/530, no problem.*
3. Select the desired mode of operation on the EE-2 and verify the gray code output on a transponder test set (ATC-600A or equiv), or view alt data on any other installed devices (GPS, MFD, Alt Pre-select, etc).
4. Note the indication of the power LEDs. Verify that the correct LED is lit for the encoder that is installed in the aircraft. (see chart page 7).
5. Verify that the "Enable OK" LED is lit.
6. To track down an intermittent code line on the aircraft harness select the "bit" mode. Hold the "Fast Slew" switch forward for 3 sec. Toggle the "fast slew" switch aft to step through the bit patterns until all bit lights are lit on the EE-2. View the bit lamps on the 600A test set. Gently shake/move the aircraft xpdr harness, or move the xpdr

in its tray. Note if any of the code lights flicker on the 600A test set. If so, identify which bit light flickers & check the integrity of that line in the aircraft harness.

7. See the "Field Notes" at the end of this document for some helpful hints.

2. CONTROLS AND INDICATIONS



LED's 1,2,3 indicate which pin on the aircraft encoder harness has voltage applied. Use these indicators to verify the existing aircraft harness has power applied to the appropriate pin. See chart below for some common encoders. The information given below is for reference only. The Technician must verify all data with the appropriate manufactures installation manuals before drawing any conclusions.

ACK A-30	Power input pins either 7,8, or 14 (for units s/n 04400 and higher)
America-King AK-350	Power input Pin 8
Narco AR-850 20K	Power input pin 14
Trans Cal D120-P2-T	Power input pins 14 (14v) pin 8 (28v)
Terra AT-3000	Power input pin 14 (reduce warm up if pin 8 is tied to power)

LED 4: Internal battery in use. LED will be lit when internal 9v battery is used for power. Normally this will not be necessary since the EE-2 can be powered from the aircraft harness on any valid power input pin (7,8, or 14).

LED 5: Enable OK. This led will be lit when the enable line (pin 6) is low. If this LED is not lit the technician can assume there is an enable line problem that must be corrected before the encoder will output gray code. *The EE-2 will output gray code regardless of the status of the strobe line.*

LED Array: Bus status LEDS. If an LED is lit the corresponding bus pin is at ground. When the mode switch is placed in the center position, all outputs from the EE-2 are off and the LED array will act as a bus status monitor. Once the operator uses the up/down switches, the EE-2 will now start to output data as indicated on the LED array.

Slow Slew switch: Allows the operator to slowly increase or decrease the output altitude in steps of 100 feet when the EE-2 is in the manual mode. When the EE-2 is placed in the manual mode the output will always be pre-loaded to 0 feet. The operator can increase or decrease from this starting point.

Fast Slew switch: Allows the operator to quickly increase or decrease the output altitude in steps of 100 feet when the EE-2 is in the manual mode. When the EE-2 is placed in the manual mode the output will always be pre-loaded to 0 feet. The operator can increase or decrease from this starting point.

Mode switch: Mode select. The mode select is a 3-position toggle. (Serial mode Enable)

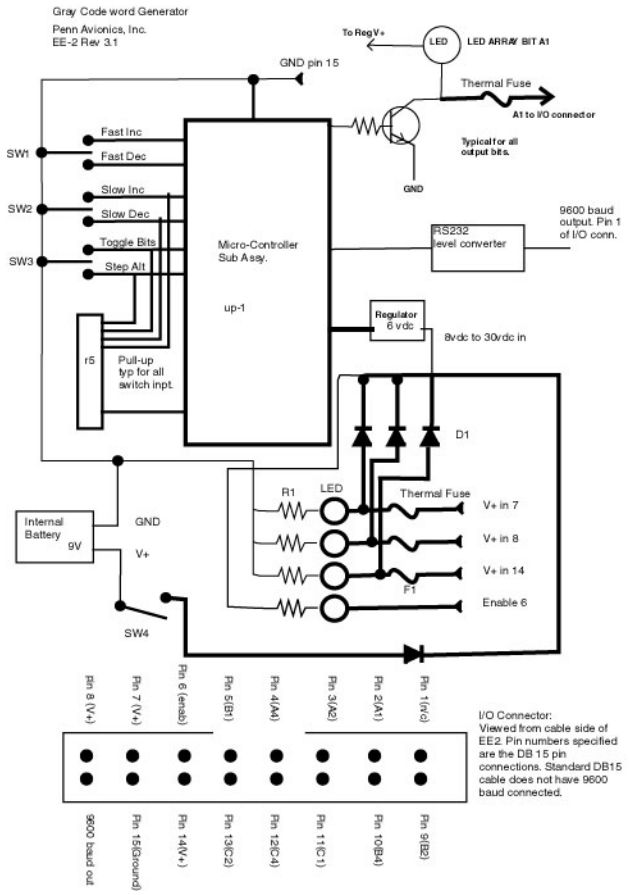
- In the center position the EE-2 is placed in the manual mode and the outputs are all set to a high level initially. This is the bus monitor mode. Use this mode to check for shorted code lines in the aircraft harness. The operator can then use switch 6 or 7 to modify the output to the desired value. Once switch 6 or 7 is toggled the EE-2 will take control of the state of the 9-bit bus and the unit will no longer be in the monitor mode. To re-enter the monitor mode select the forward or aft position, then re-select the center position.
- In the Forward position the EE-2 is in the automatic alt mode. In this mode the EE-2 will generate a continuous altitude output starting from –1000 ft to 30000 ft in increasingly larger steps. When the last valued is reached the outputs will return to –1000ft and the loop will start again. This will continue indefinitely until the EE-2 is placed into another mode. This mode is useful for hands-free verification of code lines. The technician can watch the "alt" display on and external devices (such as GPS, MFD, Alt-alter etc) and verify the correct altitude is being displayed.
- In the Aft position the EE-2 is in the bits mode and serial step mode. In this mode the EE-2 will slowly step through the bits in sequence (C4, C2, C1, B4, B2, B1, A4, A2, A1….). The loop will repeat indefinitely until the EE-2 is placed into another mode. This mode can be helpful to identify which bit or bits are missing. During this mode the Serial output will step from 100' to 900' in 100ft steps. The sequence will stop with an altitude of 12345, then 54321, then the sequence will repeat. The operator can single step through the bit mode by holding the "Fast Slew" switch forward for 3 seconds while the unit is in the "bit" mode. The operator can then toggle through the bits by pressing the "fast slew" switch aft. This mode can be helpful in finding a bad harness code line. Toggle through the bit pattern until all bits are lit. Leave the EE-2 in this mode and look at the bit lights on the 600A xpdr test set. Gently shake/move the transponder harness in the aircraft, or try and shift the transponder in its tray. If any code line lights flicker on the 600A, check that code line for intermittent.

Note: Newer transponders such as the Garmin GTX-327 will not output any altitude or bits unless a valid gray code word is generated. Because of this you cannot view the bits one by one on the Garmin unit. With transponders such as these the EE-2 should be placed into the auto alt, or manual mode

Battery Switch: Battery select. When this switch is forward the EE-2 will run off it's internal battery and LED 4 will be lit. Normally this will not be necessary since the EE-2 can be powered from the aircraft harness on any valid power input pin (7,8, or 14). *Note: The EE-2 will run as soon as power is applied to pin 7 or 8 or 14. It is not necessary to turn the battery switch to on.*

1. DIAGRAMS

Standard DB15 encoder Connector pin-out:
1:n/c 2:A1 3:A2 4:A4
5:B1 6:Enable 7:V+ 8:V+
9:B2 10:B4 11:C1 12:C4
13:C2 14:V+ 15:GND



Specifications:

Input power: 9-volt internal battery or 8-28 VDC external

Overload protection: All code lines and power line protected by thermal fuses

Input current sink code lines: 300ma each

Serial output: 9600 baud, 8 data, 1 stop, no parity (for 9600 baud output, order I/O option. This option can be installed at any time)

Serial format: ICARUS sequence ALT<sp>12345<CR>

LED monitor: 9 code lines (active low), 3 power pins (active high), 1 enable (active low)

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Accessories:

Description	Part number
EE-2 Gray code Gen	EE-2
Interface cable standard 15 pin I/O 48”	RB48-15
Interface adapter Narco AR-850 25 pin	IF15-25
Interface cable serial	RB48-SER
9600 baud output	option I/O

Field Notes:

1. Narco AT-50/50A do not have pull up resisters on the mode C code lines. If you are installing an ICURUS 3000U serialize (or some other device on the mode C bus) you may have to add these pull-ups. A value of 7K to 5volt works well. Look at the AT-150 manual for suggestions. The AT-150 has these pull ups installed by the factory. The suitability / legality of this mod is up to the technician to decide.
2. Garmin GTX-327 units will not output any altitude unless the altitude is valid. There fore if you are looking at the bit lamps on your 600A while stepping through bit patterns to the GTX-327, you will not see any bit lamps lit unless it is a good mode C code you are generating.
3. If you tie a Collins TDR-950 to a Garmin 430/530, we have seen a race condition problem. If the 430/530 is powered up before the TDR-950, the TDR-950 will not come on line. If the TDR-950 is powered up first, then the 430/530, no problem.
4. If your are trying to chase down a no mode C problem where the EE-2 can supply good mode C code, but the existing encoder will not work, and the encoder is not bad, check your strobe line. If the strobe line is being strobed instead of grounded this may be causing your problem. You may be able to just ground the strobe line, rather than interfacing it to the xpdr. Check your install manual. Remember the EE2 will output valid codes regardless of the strobe line state.
5. Collins TDR-950 xpdrs seem to give the most problem when paralleled with other items. Always use isolation diodes when at Collins TDR-950 is involved.

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Warranty

The EE-2 is designed to be used by certified avionics technicians. Penn Avionics, Inc warrants the EE-2 to be free from defect in material and workmanship for a period of one year from the date of sale. During this one-year period Penn Avionics, Inc at its option, will either repair or replace the EE-2 at our expense.

This Warranty is not transferable. Any implied warranties expire at the expiration date of this warranty. Penn Avionics, Inc SHALL NOT BE LIABLE FOR INCIDENTAL OR CONSEQUENTIAL DAMAGES. This warranty does not cover a defect that has resulted from improper or unreasonable use or maintenance as determined by us. This warranty is void if there is any attempt to disassemble this product without factory authorization. This Warranty gives you specific legal rights, and you may also have other rights, which may vary from state to state. Some states do not allow the exclusion of limitation of incidental or consequential damages, so the above limitation or exclusions may not apply to you.

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