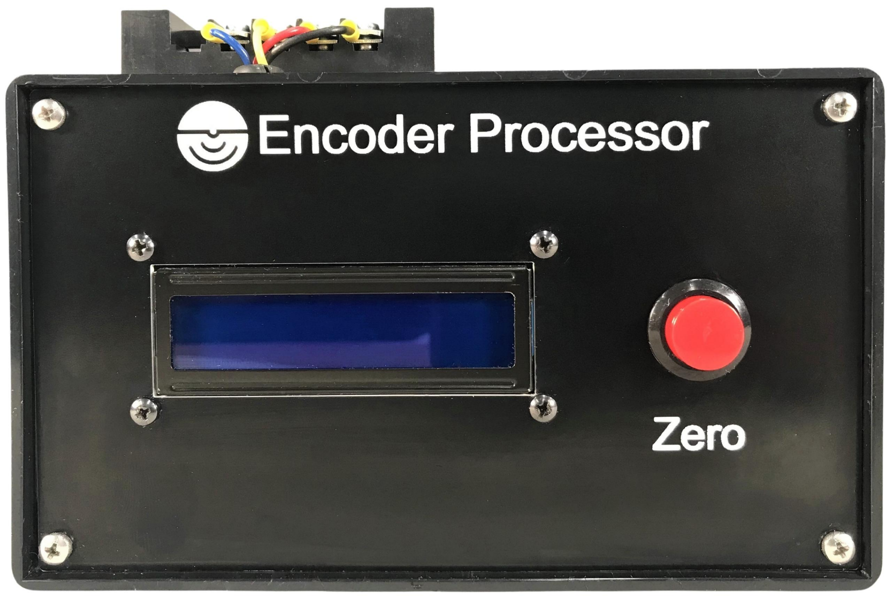
LEEMAN GEOPHYSICAL LLC



Encoder Processor

User's Guide

⚠WARNING: Cancer and Reproductive Harm - www.P65Warnings.ca.gov

⚠WARNING: CHOKING HAZARD Small Parts. Not for children under 3 years.

Contents

1 Safety Considerations

The following general safety precautions must be observed during all phases of operation, service, and repair of this instrument. Failure to comply with these precautions or with specific warnings elsewhere in this manual violates safety standards of design, manufacture, and intended use of the instrument. Leeman Geophysical LLC assumes no liability for the customer's failure to comply with these requirements.

- Do not operate the device around flammable gases or fumes, vapor, or wet environments.
- Instruments that appear damaged or defective should be made inoperative and secured against unintended operation until they can be repaired by qualified service personnel.
- Because of the danger of introducing additional hazards, do not install substitute parts or perform any unauthorized modification to the instrument. Return the instrument to Leeman Geophysical LLC for service and repair to ensure that safety features are maintained.
- Use the instrument as specified. If the device is used in a manner not specified by manufacturer, the device protection may be impaired.
- Do not block any of the ventilation holes of the device.
- Observe all markings on the device before connecting any wiring to the device.
- Turn off the device power before connecting to the output terminals.
- Do not operate the device with protective covers removed or loosened.
- Use wire/cable with the correct voltage and AWG rating based on the intended setup.

2 Overview

Thank you for purchasing the Leeman Geophysical LLC Encoder Processor. This unit enables you to record the position of an encoder, calibrate that value to engineering units, and receive that data at regular intervals or on a poll only basis. This unit offloads the work of constantly monitoring encoders for pulses and makes interfacing them to a host system trivial. This unit is decided to work with any two-wire encoder that will operate with 5 VDC logic and power supply signals. If your encoder has a "Z" terminal (positional terminal that goes high once per revolution for absolute positioning work) it is still compatible with this product, but the "Z" terminal will be unused. The encoder processor is a relatively simple unit with only four connections to the encoder, a USB connection, display, and zero button. The zero button will zero out the readings from the encoder. All other functionality is controlled via the serial interface.

3 Hookup Guide

A qualified electrician may be required to perform steps of the hookup. Always consult local codes, guidelines, and professional guidance for installation.

3.1 Equipment Hookup

The encoder is connected to the processor through the terminal strips on the back of the unit. This terminal strip contains power (+5VDC), ground, and encoder A/B terminals. Refer to your encoder data sheet to determine where these connections go for your encoder. Table 3.1 shows the wire connection points on the back of the encoder. To connect your sensor, remove the protective cover, loosen the screws opposite the connections coming from inside the box, insert your encoder wiring, and tighten the screws. After installation is complete, replace the protective cover by snapping it back onto the terminal strip.

Power can be supplied from a USB power adapter (not included) if the unit will be used free standing or via the USB port of a connected computer if the serial data/command interface will be used. For initial setup we recommend connecting directly to a computer's USB port to allow setup of the encoder and calibration.

After connecting your encoder and powering the system, turn the encoder. You should see counts accumulate on the screen of the processor. If nothing happens, turn off power to the unit and recheck all connections. See the troubleshooting section if problems persist.

Position	Color	Description
1	Black	GND
2	Red	5V
3	Yellow	Encoder A
4	Blue	Encoder B

Table 1: Pinout of the encoder terminal strip on the back of the encoder processor.

4 Serial Interface

The serial command set allows operation of every function of the unit, including zeroing readings, modifying constants, and even setting display parameters. Commands are all followed by a newline character. The valid commands are outlined below as well as the procedure to connect to the unit with a serial terminal program. If you plan to interface with the encoder processor from LabView, Python, or another language, contact support for recommendations on driver implementation.

4.1 Connecting

Connect the encoder processor to a computer using the provided USB cable. You will need to connect to the processor with a serial terminal application such as CoolTerm, FreeTerm, etc. The default baud rate for the processor is 115200 baud. Once the connection has been established, the processor will reboot. If you have set the baud rate to another setting, it will persist through power cycles and should be used for serial communication.

4.2 Command Set

Command	Description
ZERO	Zeroes the counts/position readouts - equivalent to pressing the zero button and holding it for more than one second.
SETCAL XX.XX	Sets the calibration in units per pulse. This number can be a floating point value.
SETPUL XXX	Sets the number of pulses per revolution of the encoder. This number must be an integer value.
SETBAUD XXX	Sets the baud rate that the unit uses to communicate with the host. The unit will restart the serial connection after this setting is modified. Valid baud rates are: 1200, 2400, 4800, 9600, 19200, 38400, 57600, 74880, 115200
SETCONT XXX	Sets the contrast of the LCD text. Must be an integer in the range 0-255.
SETBRIGHT XXX	Sets the brightness of the LCD backlight. Must be an integer in the range 0-255.
SETMILLIS XXX	Sets the number of milliseconds between sending encoder data back over the serial connection. Set to zero for polling only operation. Set in range 10-60000 milliseconds.
GETPOS	Displays the current encoder position in calibrated engineering units.
GETCAL	Displays the calibration factor set in units per pulse.
GETCNT	Displays the number of counts currently recorded from the encoder.
GETPUL	Displays the number of pulses per revolution of the encoder.
GETMILLIS	Displays the millisecond interval to send data packets back over serial.
TIMED XXXX	Sets the unit to output readings at XXXX milliseconds. Set to 0 for none.
HELP	Displays a help menu with a list of available commands.
DEFAULTS	Resets all stored values to the factory default values.

5 Setup

The encoder processor needs to know a few critical constants to produce accurate and useful data. These values are the pulses per revolution of your encoder (found in your encoder's data sheet) and the calibration you wish to apply to these data. To determine your calibration, you need to calculate what physical unit (linear distance, degrees, or otherwise) you desire output in and how many of those units there are in a single increment of the encoder. Connect to the encoder processor as described in the serial interface section.

5.1 Pulses Per Revolution

Find the data sheet for your encoder and determine how many pulses per revolution it will produce. Common values are powers of two (2, 4, 8, 16, 32, etc.). Once this number has been located, enter the serial command SETPUL XXX where XXX is replaced by the number of pulses per revolution. All serial commands are followed by a newline character (\n) to indicate the end of the command. You can verify that the number of pulses per revolution was set correctly by issuing the "GETPUL" command and the setting is returned to the serial terminal. This value is stored in the unit, even through power downs and resets.

5.2 Calibration

The calibration value is how the unit turns the pulses from the encoder into the useful engineering units needed for your application. These can be any units you'd like. The calibration value is multiplied by the number of pulses recorded by the encoder to produce the engineering units value displayed. Similar to the pulses per revolution setting, the calibration is set by issuing the command SETCAL XXX where XXX is replaced by the calibration value you'd like to set. This value can be a floating point number. The calibration can be verified by issuing the GETCAL command and the calibration will be returned to the serial terminal. This value is stored in the unit, even through power downs and resets.

When determining what units to use/display it is helpful to keep in mind the floating point precision of the instrument. Calculations are carried to six decimal places. Therefore a calibration factor of 0.0000005 units per pulse will likely result in poor output or even no dimensional output. Likewise large values such as 5783.3 units per pulse will quickly result in a very large number which will eventually "roll over" to zero as the 32-bit signed output resets. Therefore we recommend scaling your units to values in the order of magnitude 0.01-10, but your unique system may allow operation outside of these bounds. Contact support if you have questions on your specific application.

After setting your calibration, zero the readout by pressing and holding the "Zero" button for more than one second. Turn your encoder and ensure that the readings match the values you expect for your system.

5.2.1 Example 1 - Angular Calibration

If you'd like to retrieve the angular displacement of a rotary encoder you'll need to calculate how many degrees are traveled by each pulse of the instrument and set that as the calibration value. In this example (1) we will assume that the encoder produces 256 pulses per revolution. The calibration factor would then be:

$$\frac{360 \text{ degrees per rotation}}{256 \text{ pulses per revolution}} = 1.40625 \text{ degrees / count} \tag{1}$$

5.2.2 Example 2 - Linear Calibration

Assume the encoder is a wheel riding along a moving surface such as a conveyor belt. If the wheel is 10 cm in diameter we can calculate the linear distance traveled per rotation (2) and use that number to determine what distance is covered per pulse(3). For this example we will assume an encoder with 8 pulses per revolution.

$$10\text{cm diameter} = 31.41592 \text{ cm per revolution} \tag{2}$$

$$\frac{31.41592 \text{ cm per revolution}}{8 \text{ pulses per revolution}} = 3.92699 \text{ cm per pulse} \tag{3}$$

6 Warranty

Thank you for purchasing products and services from Leeman Geophysical LLC! We are proud to offer a limited warranty for our product.

What does this warranty cover?
The limited warranty covers any defects in materials or workmanship under normal use during the warranty period. During the warranty period, Leeman Geophysical will repair or replace, at no charge, products or components of a product which are defective and meet these conditions.

What will we do to correct a problem?
Leeman Geophysical LLC will either repair or replace the product at no charge using new or refurbished replacement parts.

How long does the coverage last?
The warranty period covers products for 90 days from the date of purchase.

What does this warranty not cover?
This limited warranty does not cover:

- Conditions, malfunctions, or damage not resulting from defects in material or workmanship.
- This warranty does not cover any connected equipment or damages resulting from the failure of any components for any reason.

What do you have to do?
To obtain warranty service, you must first contact us to determine the problem and the most appropriate course of action to solve the problem. We can be reached by phone, email, or written communication.

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7 Revision History

Revision	Date	Changes
1.3	March 2022	Design Revisions and Reorganization
1.2	December 2020	Initial Release