# Durham Geo-Enterprises Inc.

## E-400
## DIGITAL TRANSDUCER
## READOUT

*All information, illustration and specifications in this manual are based on the latest information available at the time of publication. We reserve the right to make changes at any time without notice and without incurring any obligation.*

## First Record This Information

Locate your machine's Model and Serial Number.
Should you ever need to call for service, you will need these numbers. You'll find them on a plate on the front side of your equipment.

Model # _____

Serial # _____

• Give both these numbers if you ever need to call for service.

You will also find it convenient to have the following information.

Sold by: _____

Date Purchased: _____

### THE OPERATOR SHOULD READ THIS ENTIRE MANUAL CAREFULLY BEFORE ATTEMPTING TO OPERATE THIS MACHINE.

| | |
|---|---|
| **DANGER** | Indicates serious injury or death WILL result if instructions are not followed. |
| **WARNING** | Indicates a strong possibility that serious personal injury or death may result if instructions are not followed. |
| **CAUTION** | Indicates a possibility that minor injury could result if instructions are not followed. |
| **NOTICE** | Indicates that equipment or property damage could result if instructions are not followed. |
| **NOTE** | Gives helpful information. |
| **WARNING** | Do not attempt to remove any panels with the unit plugged in. Before examining the interior of the machine, disconnect power to the machine. Either 110V or 220V are painful and cause serious injury to yourself and the machine. |

## SAFETY SUMMARY

This instrument is designed to prevent accidental shock to operator when properly used. However, no engineering design can ensure the safety of an instrument used negligently. Therefore, read this manual carefully and completely prior to operating this instrument. Do not remove the instrument or use it for purposes other than that for which it was intended without consulting the factory. Failure to do so could seriously damage the instrument or injure the operator.

## UNIT DESCRIPTION

This unit is a microprocessor-based, intelligent digital panel meter, with a +-9999 (1) display. It features 3 front panel soft keys that allow the user to select various setup features and to access various software features of the device.

## AUTOCALIBRATION

An internal self-calibrating circuit replaces the need for potentiometer adjustments of the A/D section. The unit will self-calibrate once every 4 seconds to compensate for the internal drift that would be expected of the electronics.

## SPECIFICATIONS

Power: 115V AC (220V AC on request)
Display Rate: 2 updates per second nominal
Response Time: 750 ms typical for input step change
Environment: 0 to 45 degrees C operating temperature
-10 to +85 degrees C storage temperature
20-80% relative humidity, non condensing
Range: +-100mV (+-30.00mV on request)

## INSTALLATION

This unit has been setup and calibrated at the factory. Further adjustments by the user are not necessary and should not be attempted until you have read and understood this manual. Any unauthorized changing of scale factors, offsets, or other internal settings will void all written or implied warranties.

## USING THE E-400

Congratulations! You have purchased a Durham Geo-Enterprises' E-400 series Digital Readout. Before using your readout, please read the following sections carefully. The basic operation of the unit is simple, however by taking a few minutes to familiarize yourself with the unit and its many features, you will be able to use the device to its full capabilities.

SETTING UP

To set up the device, remove it from its packing and place it on a flat, level surface. The handle on the readout is designed to be used as a stand. To turn the unit on, plug it into a 110V AC outlet. The display will come on. Attach the mating transducing device by plugging it into the input socket on the back panel of the Readout. The unit should now be displaying a stable reading around 0.

> EACH READOUT AND TRANSDUCER HAVE BEEN CALIBRATED AT THE FACTORY AND ARE A MATCHED PAIR. IN GENERAL, PRESSURE TRANSDUCERS, LOAD CELLS AND LDT'S ARE NOT INTERCHANGEABLE. NO USER ADJUSTMENTS ARE NECESSARY AT THIS TIME.

The units displayed by the Readout are standard English engineering units (unless otherwise requested). Table 1 lists the readability of the standard Durham Geo-Enterprises' transducing devices.

| Device | Readability |
|---|---|
| E-110 Thru E-126 | .1 psi |
| E-140 | 10psi or 100lbs |
| E-210 | .1 lbs |
| E-212 | 1.0 lbs |
| E-214 | 1.0 lbs |
| E-216 | 10 lbs |
| E-310 | .0001 in |
| E-311 | .001 in |
| E-312 | .001 in |

To use the unit, simply apply a load, pressure, or displacement to the transducing device. The display will show the load applied.

USING THE SOFT KEYS

The soft-keys on the front panel are used to access the various functions available with the E-400. The functions include:

1. Tare
2. Peak-Hold
3. Set-up

A brief discussion of the use and function of the Tare and Peak Hold keys follow. The set-up function will be discussed in the section on calibration.

Tare Function:

The Tare function allows the user to define a new zero point. Typically, this function is used to zero an LDT when setting up to measure displacement, or to zero a preload on a load cell or pressure transducer. This feature activates a change in the memory of the Readout. To activate the tare, depress the "down arrow" key. To return the Readout to its original conditions simply return the transducing device to its zero state and depress the "down arrow" key again.

Peak Hold Function:

The Peak Hold function allows the E-400 to save and display the highest value input to the device between Peak Hold clears. To view the peak value, depress the "up arrow" key. The Readout will display the peak value as long as you hold down the "up arrow" key. To reset the peak function, depress the "up arrow" key and the "S" key at the same time. The Readout will display -9999. This indicates that a peak reset has occurred. When you see -9999, release both keys.

There are several other features of the E-400 Digital Readout that you should be aware of. If you are using a Durham Geo-Enterprises' transducing device, you now have enough information to begin using the device. If you have a non-Durham Geo transducer or want to know more about setting up and calibrating the readout, please continue.

Power Supply

The E-400 generates 10V DC to energize its mating transducer. All Durham Geo-Enterprises' pressure transducers, load cell, and LDT's are compatible with this excitation voltage. If you are using non-Durham Geo products with your unit, please check with the manufacturer to insure that no damage will occur to the readout or transducer.

Input

The E-400 will accept a maximum of +-100mV from a transducing device. An output of more than 100mV will result in a display of "OFLO".

Wiring Configuration

The input socket on the back of the Readout is wired as follows:

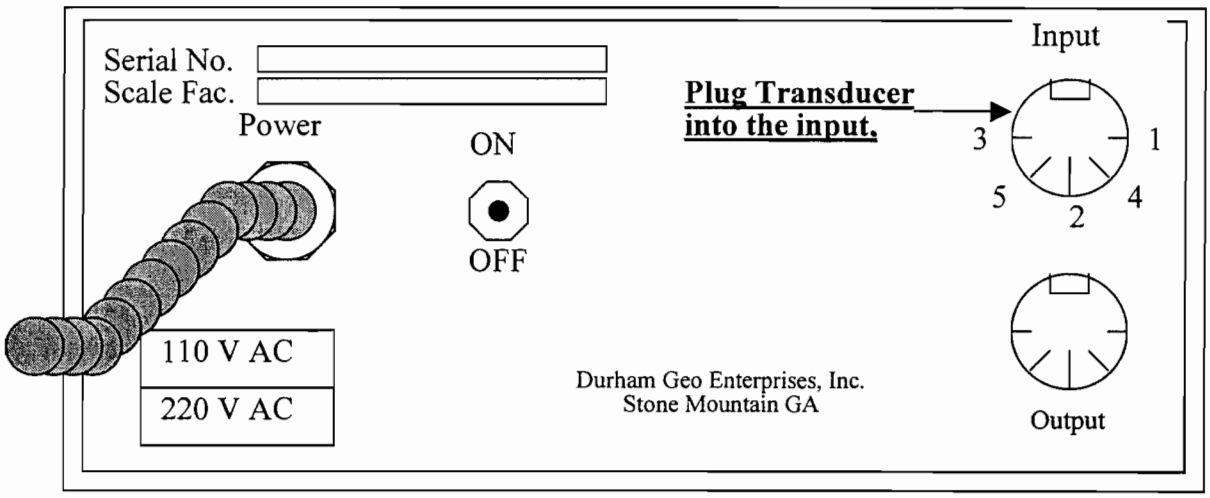
| | |
|---|---|
| Pin 1 | -Signal 100mV |
| Pin 2 | +Signal |
| Pin 3 | not attached |
| Pin 4 | -Supply 10V DC |
| Pin 5 | +Supply |

The pin position is shown on the data sheer at the back of this manual. To prevent damage to the Readout or transducer, please conform to this wiring specification when using non-Durham Geo transducers.

If you have purchased a Readout with a analog output, the output pins are connected as follows:

| | |
|---|---|
| Pin 4 | +DC out |
| Pin 5 | Ground |

For further information on wiring and hookups, please call the factory.




## CALIBRATION AND SET-UP

The E-400 is classified as an intelligent digital display. The unit controlled by a microprocessor. This allows the user a great deal of flexibility in setting up the readout for specific applications. The microprocessor allows for ease in changing engineering units, configuring options, and permits customization of calibration fits for specific needs.

The E-400 has a dual scale calibration fit. This feature is unique among digital readouts in this price range. The dual scale fit allows the user to linearize two sections on the calibration curve instead of one. This results in much greater accuracy of measurement.

Using the Set-Up Program
The calibration data for the E-400 is contained in the SETUP program which is permanently stored in memory. Access to the SETUP program is protected by a lockout code. The lockout code for this Readout is "28".

To enter the SETUP program, depress the"S" key on the front panel of the Readout. The display will prompt "SETUP", then go to "0". At this point, use the "up arrow" and "down arrow" keys to display the lockout code. Press "S" to enter the code. If you have entered the correct code, the display will flash "InPut", then display a numeric value. This value is the actual mV output of the attached transducing device.

By depressing the "S" key, you can scroll through the menu of choices available in the SETUP program. These choices are:

| DISPLAY | VALUE |
|---|---|
| InPut | varies |
| SP 1H | +9999 |
| SP 1L | -9999 |
| OFFS1 | varies |
| SCAL1 | varies |
| BrPt | varies |
| OFFS2 | varies |
| SCAL2 | varies |
| tArE | 0 |
| dP | varies (decimal pt. flashes) |
| Run | varies |

By using the "up arrow" and "down arrow" keys, the display value can be changed to the proper values. In the following calibration discussion and example, use of these keys and the "S" key allow movement through the program.

**Calibration**

To calibrate the E-400 and a transducing device, you will need a few items specific to the task. These include:

1. Some type of variable load application device. For example: a deadweight tester for pressure, height gauges for displacement, calibration load cells for load.
2. Pencil and paper.
3. Calculator

Calibrating the E-400 consists of gathering mV input data at 3 predefined loads and then using this data to calculate scale factors and offsets. In mathematical terms, the scale factor is the slope of a linear approximation of the gathered calibration points. The offset is the deviation of this line through the origin.
Three data points should be taken. Typical behavior of transducing elements suggest that readings should be taken at no load (0), a point 15%-20% of full range and at full load. For example, on a 150 psi transducer, input mV readings would be taken at 0 PSI, 30 PSI and 150 PSI. Set up a chart like the one below to record data.

| load (psi) | mV (input) | The mV are recorded by placing |
|---|---|---|
| 0 | -12 | the Readout in the "INPUT" mode |
| 30 | 1382 | of the SETUP program. The values |
| 150 | 6898 | displayed in "INPUT" are actual |
| | | mV coming from the transducer. |

For example, a display of 1382 is a 13.82mV signal from the transducer.
After recording the input data, the next step in calibrating is to calculate the scale factors and offsets. The scale factors are calculated by using the following formulas.

$$SCAL1 = \frac{BRPT\ (DISPLAY) - LO(DISPLAY)}{BRPT(mv) - LO(mv)}$$

$$SCAL2 = \frac{HI(DISPLAY) - BRPT(DISPLAY)}{HI(mv) - BRPT(mv)}$$

When putting the values for (DISPLAY) into the equation, ignore the decimal point. For example, a BRPT(DISPLAY) of 30.0 PSI would be entered into the formula as 300. For our example:

$$SCAL1 = \frac{BRPT\ (DISPLAY) - LO(DISPLAY)}{BRPT(mv) - LO(mv)} = \frac{300-0}{1382-(-12)} = \frac{300}{1394} = .2152$$

$$SCAL2 = \frac{HI(DISPLAY) - BRPT(DISPLAY)}{HI(mv) - BRPT(mv)} = \frac{1500-300}{6898-1382} = \frac{1200}{5516} = .2175$$

The offsets are calculated by the following formulas:

OFFS1 = LO(DISPLAY) - [(SCAL1)*LO(mv)]

OFFS2 = BRPT(DISPLAY) - [(SCAL2)*BRPT(mv)]

The same rule of ignoring decimal points when entering DISPLAY values into the formulas applies here. The "OFFS" feature will only allow you to enter an integer, so we will round off our final answer to the nearest whole number. For our example:

OFFS1 = LO(DISPLAY)-[(SCAL1)*LO(mv)]=0-[(.2152)*(-12)]=0-(-2.5)
OFFS1 = +3
OFFS2 = BRPT(DISPLAY)-[(SCAL2)*BRPT(mv)]=300-[(.2175)*1382)]=300-(300.6)
OFFS2 = -1

With these values calculated, we can now enter them into the SETUP program. By depressing the "S" key, scroll through the menu until you see "OFFS1". Using the "up arrow" and "down arrow" keys, enter the value you have calculated for OFFS1. Press the "S" key to enter this value and to scroll to "SCAL1". Enter the mV value of the break point you have chosen. For example, it will be the mV input at 30 psi (1382).

Depress the "S" key and scroll to "OFFS2". Enter the calculated value for "OFFS2". Depress the "S" key and scroll to "SCAL2". Enter the calculated value for "SCAL2". Depress the "S" key and scroll to "dP'. Using the "up arrow" and "down arrow" keys, move the decimal point to the proper place. For our example, we would move the decimal point to display .1 psi. Depress the "S" key again and release it at the "run" prompt. The unit will go blank, flash "run" again, then display numeric data. The E-400 has now memorized the calibration settings and is ready for use. A quick check of the unit should verify that it is displaying the proper readings.

In summary, the following steps should be taken to set the calibration of the unit.

1. Place the E-400 in the "INPUT" mode of the "SETUP" menu
2. Take three readings of mV input and record them. Suggested readings are at 0, 15%-20% of full load, and at full load.
3. Calculate OFFS1, SCAL1, OFFS2, SCAL2.
4. Enter the calculated values for the scales and offsets as well as the mV value for your breakpoint.
5. Set the decimal point.
6. Exit the SETUP mode into the RUN mode and test your calibration.

Hopefully, these instructions have provided you with some insight into the operation of the E-400. If you have any questions about this manual, your Readout or applications, please contact Durham Geo-Enterprises Inc. at:

1-800-837-0864 (domestic-toll free)
1-770-465-7557 (local)

## E-40010 OPTION
## RS-232 SERIAL OUTPUT

The E-40010 option provides a TTl-compatible serial output. The serial output is a 4-wire implementation with 2 data transmission lines and 2 busy lines. The specifications are as follows:

| | |
|---|---|
| Output: | RS-232 |
| Baud Rate: | 300 bits/sec (1200bits/sec available upon request) |
| Transmission Sequence: | ASCII characters comprised of polarity, 5 digits (with dp location) and CR LF |
| Busy: | Logic 0 = .5V(max) to -50V(min), hold transmissions<br>Logic 1 = 1.5V(min) to 50V(max) at 20 mA source, resume |
| Distance: | 75 ft. (max) |

The output socket in the back of the Readout is wired as follow:

| | | |
|---|---|---|
| Pin 1 | (TX) | (RS232 data out) |
| Pin 2 | Ground | (RS232 GND) |
| Pin 3 | unused | |
| Pin 4 | unused | |
| Pin 5 | unused | |

9-PIN CONNECTOR

| LEAD | | 9-PIN |
|---|---|---|
| RED | DTR | PIN 4 |
| GREEN | SIG GR | PIN 5 |
| WHITE | TRANSM | PIN 2 |

25-PIN CONNECTOR

| LEAD | | 25-PIN |
|---|---|---|
| RED | DTR | PIN 20 |
| GREEN | SIG GR | PIN 7 |
| WHITE | TRANSM | PIN 3 |

300 BAUD RATE
8 DATA BITS
1 STOP BITS
NO PARITY
HIGH RTS
HIGH DTS

If you need more information or have a question about the Readout, please contact Durham Geo-Enterprises Inc. at:

1-800-837-0864 (domestic - toll free)
1-770-465-7557 (local)

**WARNING:** DISCONNECT POWER BEFORE REMOVING COVER!

TRANSDUCER INPUT: 5 PIN DIN SOCKET (180 DEGREES)

**WIRING CONFIGURATION - TRANSDUCERS**

| LOAD CELL | PRESSURE | DISPLACEMENT | SOCKET PIN |
|---|---|---|---|
| SUPPLY + RED | RED | RED | +5 |
| SUPPLY - BLACK | BLACK | YELLOW | -4 |
| SIGNAL + WHITE | GREEN | BLUE | +2 |
| SIGNAL - GREEN | WHITE | GREEN | -1 |

**SUPPLY VOLTAGE 10.00V DC at maximum 90mA**

OUTPUT DATA: 5 PIN DIN SOCKET (180 DEGREES) OPTIONS SOCKET PIN #

PIN 1 =
PIN 2 =
PIN 3 =
PIN 4 =
PIN 5 =

---

NOTE: STANDARD OUTPUT SOCKET FITTED, NOT INTERNALLY CONNECTED UNLESS OPTIONS PURCHASED.

SERIAL NUMBER: _____

SCALE FACTOR: _____

TRANSDUCER SERIAL NO. _____

## E-40020
## 5 DIGIT READOUT

The E-40020 Readout is the same as an E-400 indicator with the added benefit of an extra digit of precision. While using the E-40020 however, keep in mind that the extra digit displays some undesirable traits of the transducing device such as thermal drift, instability at zero and changes in barometric pressure. It is suggested that special precautions be taken when using 5 digit readouts in laboratory settings.

All options available with the E-400 are available with the E-40020. Applications for which 5 digit readouts are especially suited include:

1. High range load cells
2. LDT's
3. High accuracy transducers

## E-40040 OPTION
## 0-10V DC ANALOG OUTPUT

The E-40040 Option contains a 12 bit, D/A converter and current transmitter that enables the E-400 to interface with analog devices. Analog output is derived from the display. Since the meter allows you to scale and offset the display, this should be done before setting up the analog output. Do not confuse the offset and scale in the following discussion with the scale and offset discussed in the E-400 manual.

### SPECIFICATIONS

| | |
|---|---|
| Operating Temp: | 0 - 35 degrees C |
| Stability: | .35% +- .02%/C after 1 hr warmup |
| Linearity: | Adjustable scaling (+-.5 setability) |
| Offset Error: | Adjustable offset (+- 1% setability) |
| Offset Range w/ trimpot: | From -100% of output to +36% of output |
| Output: | Voltage, 10V DC at 17 mA (max) |
| DAC Resolution: | 2 Bit (1 part in 4096) |
| Output Resolution: | 2.5 mV/2.5 counts |
| Scale range w/ trimpot: | .5 to 5 (normal), 5 to 20(extended) |

The output socket on the readout is wired as follows:

PIN 4 +10V DC
PIN 5 Ground

Output Attachment

Before setting the Analog Output on the Readout, make sure the Readout has been setup and calibrated. For information on setup and calibration, refer to the Setup and Calibration section of this manual.

To adjust the Analog Output you must first move the Readout from the case. Unplug the unit. Turn the case upside down and unscrew the two phillips head screws in the bottom of the case. Turn the unit right side up and remove the top of the case. The Readout must be plugged in and have a transducing device attached in order to set up the Analog Output.

BE EXTREMELY CAREFUL WHILE SETTING UP. THERE ARE 110V AC ON THE UNIT. DO NOT TOUCH ANY WIRES.

Plug the unit in. Attach a voltmeter to the wires on the output socket. With the display reading "0", turn trimpot R12 (see drawing) until the voltage at the output socket reads 0. Apply a full scale load to the transducer. Turn trimpot R17 (see drawing) until the voltmeter reads 10. Repeat these steps until the output is adjusted satisfactorily.

UNDER NO CONDITIONS TURN TRIMPOT NEAR THE CONNECTOR CARD. THIS IS THE SUPPLY VOLTAGE TO THE TRANSDUCER. ADJUSTMENTS TO THIS POT WILL VOID ALL CALIBRATIONS.

## E-40060 DUAL ANALOG OUTPUT OPTION

This option is available for use with an X-Y plotter when digital display of one axis (usually displacement) is not necessary. The second input socket is wired in such a way that the Readout supplies power to two transducing devices. The output socket is wired to drive both axis of the plotter. Normal adjustments of the Analog Output are made as described for the E-40040.

The output socket for an E-40060 option is wired as follows:

PIN 1 +mV (from second transducer)
PIN 2 ground (from second transducer)
PIN 4 +10V DC (first transducer, from readout)
PIN 5 ground (first transducer, from readout)

If you have any questions about your Readout, or its application, please contact Durham Geo-Enterprises Inc. at:

## Option T - Serial Output (ASCII)

Option T provides 20mA and TTL-compatible serial output capability. The optically isolated 20mA current source interface can be operated 4-wire half-duplex while providing up to 1500V peak isolation.

## SPECIFICATIONS

- Output: Half duplex, isolated ASCII 20mA current source or RS - 232

- Baud Rate: 300 or 1200 bits/sec, external jumper selectable. For 1200 baud, short pin 12 and Pin N on P2 connector. For 300 baud, leave both pins open.

- Format: 1 start bit; 7 data bits, no parity check; 2 stop bits

- Transmission Sequence: ASCII characters comprised of polarity, 5 digits (with dp location), and CR LF.

- Serial Select (pin 15): Logic 0 = -0.5V (min) to 0.8V (max) at 1 mA sink, selected.
  Logic 1 = 2.0V (min) to 5.0V (max) internal 5.6k pull up not selected.

When SERIAL SELECT is pulled to Logic Low, a new line of data is transmitted over RS-232 and 20mA lines. For continuous printing, short Pin 15 to Pin S.

- BUSY (pin 8): Logic 0 = 0.5V (max) to -50V (min), hold transmissions.
  Logic 1 = 1.5V (min) to 50V (max) at 20mA source, resume transmission.The BUSY line functions as a handshake to control the flow of data. If BUSY is taken Low, the meter will terminate the transmission of data after the character currently in transmission is transmitted. Transmission will resume where it left off when BUSY is returned High. If BUSY is not used, it must be jumpered to Pin 7 to pull it High.

- 6610A ENABLE: The RTS line (Pin 4 of Digitec Model 6610A Printer
  Connector) functions as an interval output and as a handshake line during :6610A Enable" operation. The pulse output by the real time clock (from the 6610AK printer) on timed interval is input into the BUSY line (Pin 8).

- Distance: 20mA current loop = 4000 ft. at 300 or 1200 baud; RS-232-C-75 ft max.

## Option T Connections

Data Transmission

The BUSY line functions as a handshake to control the flow data. If BUSY is taken Low, data transmission will terminate after the last character being transmitted complete transmission. Data transmission will resume where it left off when BUSY is returned High. If BUSY is not used, jumper Pin 8 to Pin 7.

Single Line Transmission

To transmit one line of data output only, the serial select line must be pulsed Low for 10ms to 50ms and then returned High. If serial select is held Low longer than 50ms. multiple outputs will occur.

Interval Output (Data-logging)

The "6610A Enable" works specifically with Digitec 6610A series printers. With the printer, the meter becomes a simple data-logging system.

The only difference in wiring between normal operation and using "6610A Enable" is the jumper between Pin 14 and Pin R on the option board connector.

The 6610AK printer is a serial input impact printer with a real time clock. The real time clock can output a pulse on a timed interval. The pulse can then be used to trigger the meter to output one line of data. This line consists of the 6610AK's print date command (1BH, 44H), print clock command (1BH, 54H), and the meter's data, allowing date, time, and data to be printed on the same line.

The RTS line (6610AK connector pin 4) then functions as both an interval output and handshake line. A pulse is output from the RTS line (pin 4) and input into the meter's BUSY line (pin 8).

## WARRANTY STATEMENT

Durham Geo-Enterprises Inc. warrants that equipment shall be free from defects in material and workmanship for a period of **90 days** from the time the equipment is put into service. In any event, the warranty period will not exceed **6 months** from the date of shipment.

Durham Geo-Enterprises' liability shall be limited to replacement of components or equipment (at the manufacturer's discretion) that has been determined by the manufacturer to be faulty. No claims in excess of component replacement value will be recognized. Durham Geo-Enterprises will not be held liable for damages or lost business relating to a warranty claim.

**Specifically excluded from this warranty are claims deemed by the manufacturer to have resulted from normal wear and tear, improper use, or abuse of the equipment.**

For complete warranty disclosure, please call 1-800-837-0864 (outside GA) or 770-465-7557 (local).