Attachment for the Digital Line Rate Indicator Option

Conair PB Belt Pullers, PC Belt Pullers and Precision Puller (models 3-20, 4-26, 6-39)

Durant®

Eclipse Series Ratemeter/Process Timers

Models: 5770X-47X
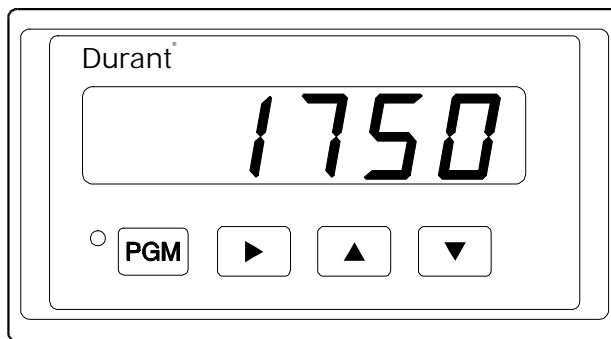
CE

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1750

○ PGM ▶ ▲ ▼

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E·T·N

INTRODUCTION / DESCRIPTION

This manual describes the installation of Durant Eclipse series digital ratemeter/ process timer models 5770X-47X. It begins with a description of the base unit and the plug-in option boards. That is followed by mounting information, wiring diagrams, and programming instructions. This manual concludes with diagnostic test and calibration information and specifications. This device provides a rate or time readout for the operator. Although the unit may be doing other functions as well, the only thing the operator has to do with it is to observe the display.

DESCRIPTION

Base Unit

The Eclipse accepts a digital, pulsed signal from a sensor (that may be on an encoder, proximity or photo sensor, magnetic pickup, flowmeter, limit switch, etc.). It calculates a rate or time, based upon the frequency of the input signal, to be displayed to the observer. The display can read in units of rate such as RPM, feet per minute, barrels per hour, etc., or in units of time such as baking time or mold machine cycle time. In either case, the Eclipse employes the fiendishly clever Tau method of calculation, which means that it very accurately times the period of the pulse (Tau). Once Tau is known, the unit determines rate by the formula:

$$\text{Rate} = \frac{1}{\text{Tau}} \; X \; \text{Scaler}$$

If the Eclipse is programmed to display process time, Tau is plugged into a slightly different formula:

$$\text{Process Time} = \text{Tau} \; X \; \text{Scaler}$$

Either calculation requires that the installer program the unit with a scaler. The scaler is a conversion factor that accounts for three conditions that are specific to the application:

1. The units of time to be displayed, generally seconds, minutes, or hours.
2. The weight of each input pulse.
3. The resolution (decimal point location) of the display.

The installer calculates the scaler by using the appropriate formula below, depending upon whether the Eclipse should display rate or process time.

To display rate:

$$\text{Scaler} = \frac{\text{NOS x DPF}}{\text{PPI}} \; ,$$

where NOS = number of seconds in time unit (1 = seconds, 60 = minutes, 3600 = hours, etc.).

DPF = decimal point factor. From the table below, select the DPF that matches the display decimal point location:

Displayed Decimal Point	D P F
XXXXX	1
XXXX.X	10
XXX.XX	100
XX.XXX	1000
X.XXXX	10000

And PPI = pulses per item, the number of pulses the unit receives from the sensor per physical unit (revolution, foot, gallon, etc.) on the rate display.

To display process time:

$$Scaler = \frac{PPI \times DPF}{NOS} ,$$

where NOS = number of seconds in the process time unit (1 = seconds, 60 = minutes, 3600 = hours, etc.).

DPF = decimal point factor, and is selected from the table above.
PPI = pulses per item, the number of pulses the unit receives from the sensor per process cycle (oven length, mold machine cycle, etc.).

An inherent ability of devices that use the Tau method of calculation is that they can calculate rate or process time and update the display each time an input pulse is received. There is a practical limit to how fast the display should update, however, especially when the process speed is changing and when there may be minor variations in pulse input frequency at a "steady" speed. The Eclipse has a programmable display update time that sets the minimum time between updates. Each time the display updates, the unit waits until the update timer times out and then updates the display when the next pulse comes in. The Eclipse counts the number of pulses received and times the total periods for all pulses received for each update. The calculation averages Tau for all periods in the update effectively "smoothing" out the display. The installer programs an update time in the range of 0.1 to 99.9 seconds to obtain a display that is smooth, yet responsive.

Sooner or later, the process being monitored will be brought to a halt. Pulses will stop coming in from the sensor. What happens once the update timer has timed out and the Eclipse is patiently waiting for the next pulse to come in so that it can update the display, but the next pulse is not coming? Like the bride who has been stood up at the altar, something must tell the Eclipse that it is waiting in vain and it is time to get on with its life. The Eclipse is equipped with a zero timer for this purpose. The zero timer sets the unit's patience between pulses. The installer programs a zero

time in the range of 0.1 to 99.9 seconds. Should the time between pulses ever exceed the zero time, the Eclipse will immediately update the display to zero, whether in rate or process time mode.
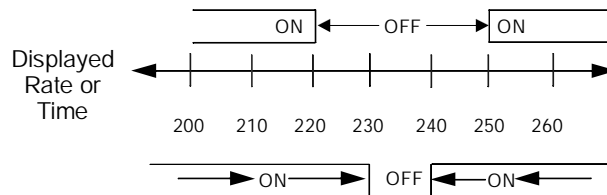
Relay Output Option Board

The optional relay board contains two form C (normally open and normally closed contacts) relays. Each relay has an adjustable high and low setpoint. The relays act as alarms by turning ON when the displayed rate or time is greater than the high setpoint OR less than the low setpoint. If the low setpoint is greater than the high setpoint, the relay turns ON when the rate or time meets both conditions; less than the low setpoint AND greater than the high setpoint.

Once a relay turns ON, it stays ON until the rate or time returns back across the setpoint "and then some". The "and then some" is called hysteresis. Hysteresis is a programmable value that is common to both setpoints and both relays. This means that a relay turns OFF when the display is less than or equal to the high setpoint minus the hysteresis value, or when the display is greater than or equal to the low setpoint plus the hysteresis value. Should an overlap occur between ON and OFF conditions, the ON condition overrides the OFF condition.

Example: Relay Output Operation

High Setpoint = 250   Relay ON above 250
Low Setpoint = 220   Relay ON below 220
Hysteresis =   10   Relay OFF between 230 and 240

Analog Retransmission Option Board

The optional analog output board provides linear 0-10 V and 4-20 mA signals proportional to the displayed rate or time. When the displayed value is equal to the programmed output offset value, the output voltage is zero and the output current is 4 mA. When the displayed value is equal to the programmed output full scale value, the output voltage is 10 V and the output current is 20 mA.

DESCRIPTION cont.

When the displayed value is between the output offset and output full scale value:

1. The output voltage = 10 $\dfrac{\text{(displayed rate - offset value)}}{\text{(Full scale value - offset value)}}$ V,

2. The output current = 16 $\dfrac{\text{(displayed rate - offset value)}}{\text{(Full scale value - offset value)}}$ mA + 4 mA

RS 485 Serial Communications Option Board

The optional serial communication board allows a host device to download and read programming parameters and to read status information from the rate meter, such as display value, relay status, etc.

This manual does not contain information on the serial communication protocol or the serial command list. That information is contained in the 57700 serial specification and is obtainable by contacting the Durant Literature Department at 800-540-9242 (U.S. and Canada), or 920-261-4070, or by FAX at 920-261-9097.

Mounting
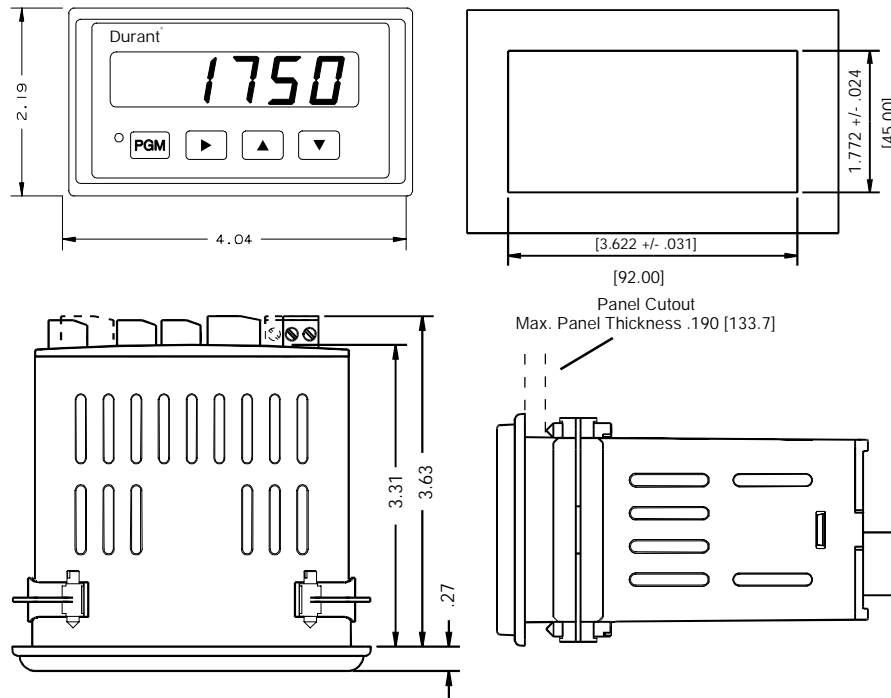
Mounting clips and screws shown in installed positions.

Mounting Instructions

1. Slide mounting gasket (not shown) over unit body until adhesive surface makes contact with the front bezel.

2. Slide unit into cutout in panel.

3. Attach mounting clips and screws.

4. Tighten screws until unit is firmly in place. DO NOT OVERTIGHTEN screws to the point of squeezing the gasket out from behind the bezel.

WIRING

All wiring to the ratemeter is done via rear terminal, de-pluggable connectors. Up to five headers accept the wired connectors on the ratemeter. All units have at least two headers, power input and signal input. Any combination of three additional circuit boards with headers may be installed. These option boards are relay output, RS 485 serial communications, and analog retransmission. The option boards occupy specific locations in the ratemeter and are not interchangeable.

Rear Terminal Layout
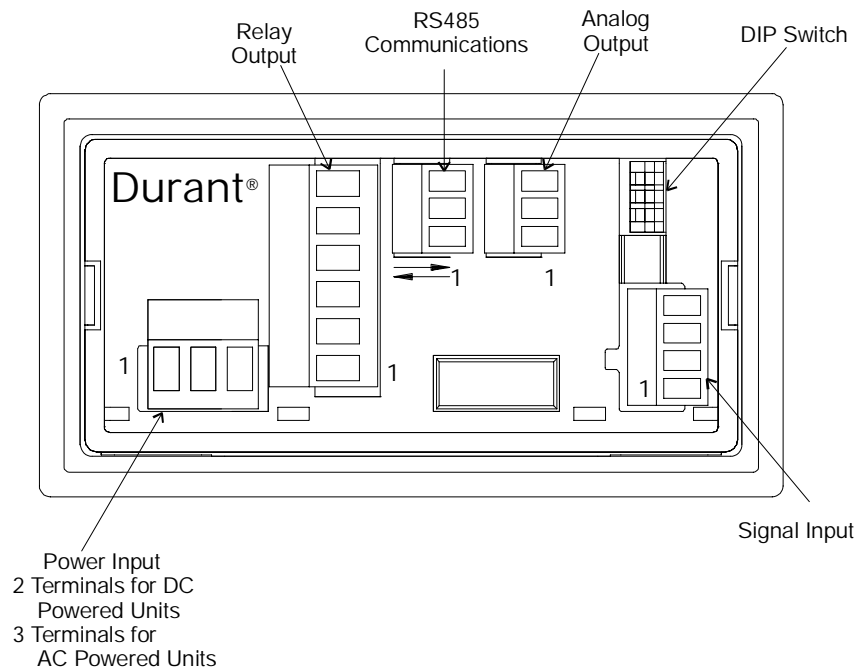
WIRING

Disconnect all power before wiring terminals. A safety hazard exists if this precaution is not observed. Treat all signal inputs as hazardous since they may carry line voltage.

A switch shall be included in the building installation:
- It shall be in close proximity to the equipment and within easy reach of the operator.
- It shall be marked as the disconnecting device for the equipment.
- Switches and circuit breakers in Europe must comply with IEC 947.

Terminal Connector Ratings

AC or DC Power Input / Relay Output: 10A, 250VAC;
Wire size: 12-24AWG (3.1mm^2 - 0.24mm^2), 600V.
RS485 / Analog Output / Signal Input: 8A, 125VAC;
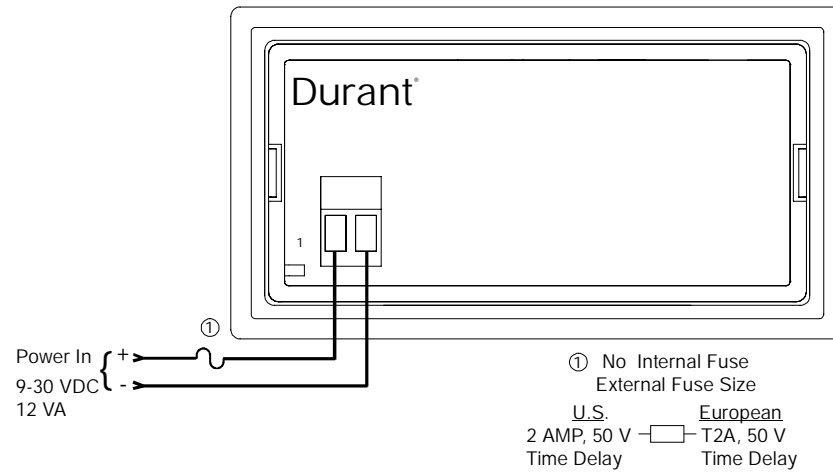Wire size: 16-28AWG (1.3mm^2 - 0.1mm^2), 300V.

General Wiring Practices

- Use shielded cables for signal and control inputs.
- Keep all signal lines as short as possible (<30M or 100 ft.).
- Do NOT bundle or route signal lines with power or machine control wiring.
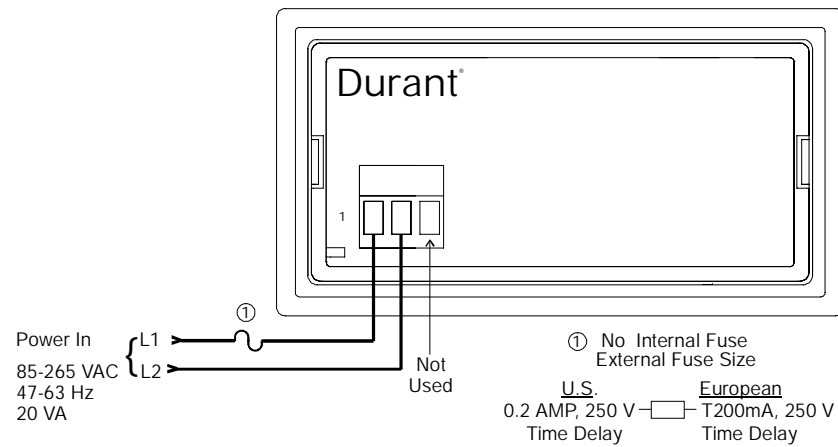- Do not allow signal or control wires to leave the building.

Wiring and DIP Switches

DC Power Input (for DC powered models 57700-47X)

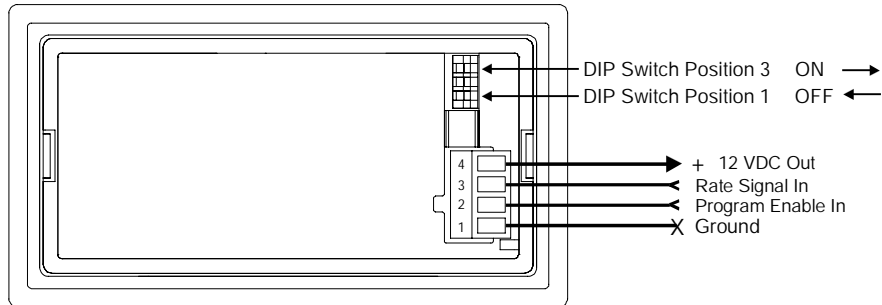Power In
9-30 VDC
12 VA

+
-

① No Internal Fuse
External Fuse Size

U.S.   European
2 AMP, 50 V   T2A, 50 V
Time Delay   Time Delay

AC Power Input (for AC powered models 57701-47X)

Power In
85-265 VAC
47-63 Hz
20 VA

L1
L2

Not
Used

① No Internal Fuse
External Fuse Size

U.S.   European
0.2 AMP, 250 V   T200mA, 250 V
Time Delay   Time Delay

Signal Input

DIP Switch Position 3   ON →
DIP Switch Position 1   OFF ←

4   + 12 VDC Out
3   Rate Signal In
2   Program Enable In
1   Ground

Rate Input DIP Switch Settings

Position	ON	OFF
1	Sink (NPN)	Source (PNP)
2	200 Hz Max.	10 kHz Max.
3	Mag Pickup	Single Ended

12 VDC Out @ 75 mA Max.
See Specifications (pages 17-18) for input impedances and threshholds.
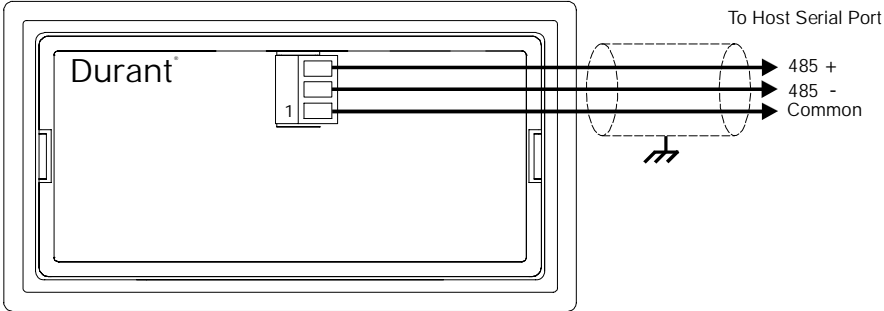
Relay Output Option Board
Typical Wiring

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6
5
4
3
2
1

Terminal Designation

6
5   Relay 2
4

Load ①

External 3
Power 2   Relay 1
1
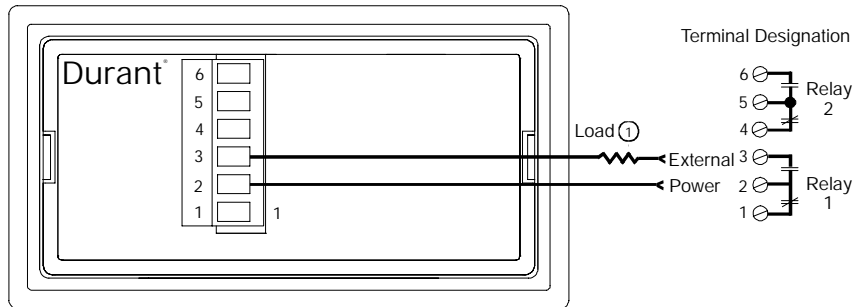
① An RC surge suppressor is recommended across all inductive loads.

Contact Ratings
        5 A @250 VAC or 30 VDC maximum

RS 485 Communication Option Board

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To Host Serial Port

485 +
485 -
Common

Analog Output Option Board

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4-20mA +
0-10 V +
Common
$\left(\begin{array}{c}\text{4-20mA -}\\\text{0-10 V -}\end{array}\right)$
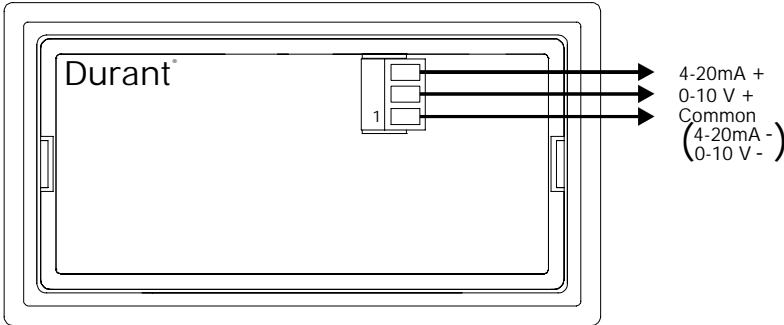
Output Ratings
        4-20 mA into 750 Ω (Ohms) maximum
   0-10 V into 2500 Ω (Ohms) minimum
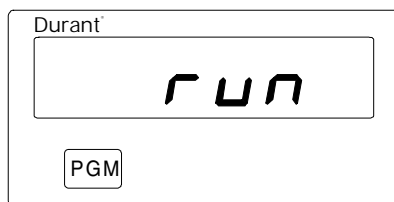
PROGRAMMING

Entering the Program Mode

⚠ Note: If the optional relay output and/or analog output board(s) are installed in the ratemeter, entering the program mode will cause both relays to turn OFF and the analog output to go to its minimum values (0V and 4 mA) regardless of the input signal.
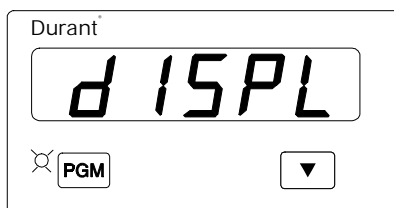
To enter the program mode:

1. Connect Program Enable input terminal to Ground.
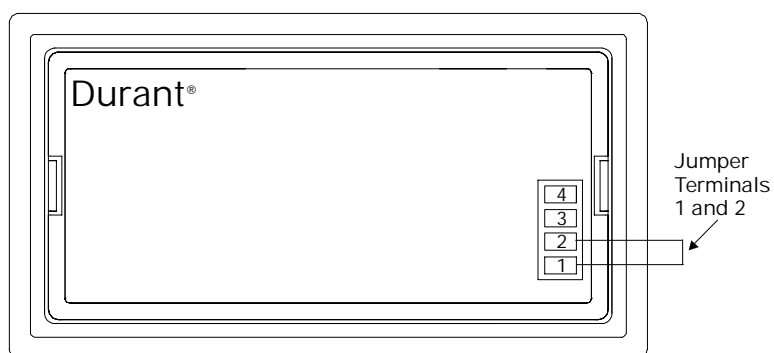
2. Press and hold the front panel program key ([PGM]); the display will say run:

3. Press the up or down arrow key ([▲] or [▼]) while holding ([PGM]); the program LED will turn on and the display will show a parameter name.

Programming Parameters

Programming customizes the ratemeter's functions to fit the application. All programming may be done by using the front panel program (PGM) and arrow keys - up (▲), down (▼), and right (▶). Programming is done by entering the proper value into each programming parameter. The parameters each have a name and a value, and are shown in the parameter list starting on page 12. The programming parameters associated with the optional RS 485 communications board, the analog retransmission board, and the relay output board only show in the program list if the corresponding option board is installed in the ratemeter.

To navigate through the parameter list, use the program key and the up and down arrow keys.

1. The parameter name is displayed by pressing and holding the program key (PGM).

2. The value of the parameter is displayed by releasing the program key.

3. While holding the program key (PGM), the unit scrolls down one parameter name each time the down arrow (▼) key is pressed, and scrolls up one parameter name each time the up arrow (▲) key is pressed. When the PGM key is released, the display shows the value of the selected parameter.

To change the value of the selected parameter:

1. Press the right arrow key (▶). For parameters that have selection lists (such as display, decimal point, baud rate, etc.), the value will descent one selection through the list each time the right arrow key is pressed. When the desired value appears on the display, press PGM to go back to the parameter name. For numeric values such as scaler, offset, full scale, setpoints, and hysteresis; the most significant digit will flash.

2. Press [▶] to select which digit to change (flash), then use [▼] or [▲] to change the value of the flashing digit.

Durant*

1.000

☼   [▼]

3. After all digits have been edited, press [PGM] to go back to the parameter name.

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$SCALE$

☼ [PGM]

The Parameter List

The following list shows all programming parameter names, the default value for each, and the selection range for each. A programmed unit may be restored to default settings by pressing both the program ([PGM]) and right arrow ([▶]) keys for one second. The display will show dFL while the keys are pressed and blink off momentarily when the default is done.

Parameter Name	Default Value	Description/ Range
$dISPL$	$rATE$	Display rate or display process time.

$rATE$ Rate

TAU Process time

`dP`	`10000`

Display decimal point location. This selection nails the ratemeter or process time display decimal point to a specific location and was considered when the scaler was calculated.

`10000` No decimal point

`1.0000`

`10.000`

`100.00`

`1000.0`

`SCLdP`	`1.000`

Scaler decimal point. The scaler is in the range of 0.001 to 9999 and is entered in the parameter below. Set the decimal point location for the scaler here.

`1.000`

`10.00`

`100.0`

`1000`

`SCALE`	`1.000`

Scaler. Enter the calculated scaler here. The decimal point location on this screen was selected in the scaler decimal point parameter above.
Range: 0.001 to 9999

`UPdAt`	`01.0`

Display update time. Sets the minimum time, in seconds, between display updates.
Range: 0.1 to 99.9 seconds

`2Ero`	`01.0`

Display zero time. Sets the maximum time that the unit will wait between pulses before forcing the display to zero.
Range: 0.1 to 99.9 seconds

`Add`	`00`

Serial Address. Enter the serial address for the ratemeter. All commands sent to the ratemeter must contain this address. If two or more ratemeters are connected in a network, each must have a unique address.
Range: 00 to 99.

`br`	`1.20`	Baud Rate. Select the rate in kBaud at which to receive and transmit serial information. *1.20* *2.40* *4.80* *9.60* *19.2*
`PAr`	`no`	Parity. Select the type of parity used for serial communications. *no* none *Eun* even *odd* odd
`oOF`	`00000`	Analog Output Offset Value. Enter the rate or time that corresponds to the minimum analog output (0V and 4 mA). Range: 0 to 99999
`oFS`	`99999`	Analog Output Full Scale Value. Enter the rate or time that corresponds to the maximum analog output (10V and 20 mA). Range: 0 to 99999
`1Hi`	`99999`	Relay 1 High Alarm Setpoint. Enter the rate or time at which relay 1 will turn on if the rate or time goes above this value. Range: 0 to 99999.
`1Lo`	`00000`	Relay 1 Low Alarm Setpoint. Enter the rate or time at which relay 1 will turn ON if the rate or time goes below this value. Range: 0 to 99999.
`2Hi`	`99999`	Relay 2 High Alarm Setpoint. Enter the rate or time at which relay 2 will turn ON if the rate or time goes above this value. Range: 0 to 99999.
`2Lo`	`00000`	Relay 2 Low Alarm Setpoint. Enter the rate or time at which relay 2 will turn ON if the rate or time goes below this value. Range: 0 to 99999.

| HYS | 00000 |

Relay Hysteresis. Enter the difference in rate or time units between relay turn ON values (setpoints) and relay turn OFF values. Range: 0 to 999

DIAGNOSTICS

Self Diagnostics and Error Messages

Each time power is applied to the ratemeter, it performs a series of internal diagnostic tests. A lamp test (all display segments ON) is conducted while these tests are in progress. If a failure occurs, an error message will appear on the display.

The diagnostic tests are checksum calculations of internal ROM and NOVRAM memory and a read/write test for internal RAM. Programming and calibration data is stored in NOVRAM (non-volatile RAM). The checksum test verifies that data stored in NOVRAM at power down is still there, uncorrupted, at power up. The first tests are performed on ROM and RAM. Failure results in an error message Err. This error is non-recoverable, and the unit should be returned to the factory for repair. A failure in the programming section of NOVRAM results in the displayed error message PrG. This message remains on the display until power to the ratemeter is cycled OFF, then ON, or until a key is pressed. This error is recoverable by re-programming the unit. If subsequent PrG errors occur, the NOVRAM itself may have failed, and the unit should be returned to the factory for repair. An error message CAL indicates that the calibration section of NOVRAM has been corrupted. THERE IS NO DIAGNOSTIC TEST TO DETERMINE THAT THE RATEMETER IS CALIBRATED! Turn power to the unit OFF, and then ON. If CAL appears on the display, return the unit to the factory for repair. if the ratemeter powers up normally, the unit can be used only after it has been calibrated.

Keyboard Diagnostic Mode

The keyboard diagnostics allows the user to test each of the front panel keys, the display, and the analog retransmission and relay outputs if those optional boards are installed.

⚠ Caution: performing the diagnostic tests will turn ON the analog transmission and relay outputs if those options are installed. Remove power from the ratemeter and disconnect the outputs before entering the keyboard diagnostic mode. If the optional RS 485 communication board is installed, the ratemeter will respond with the rate or process time to the QST command.
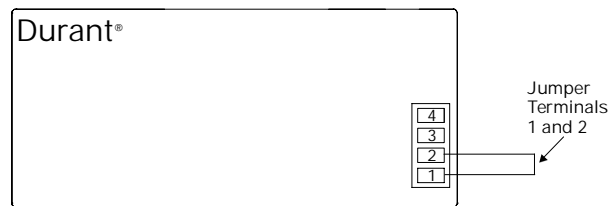
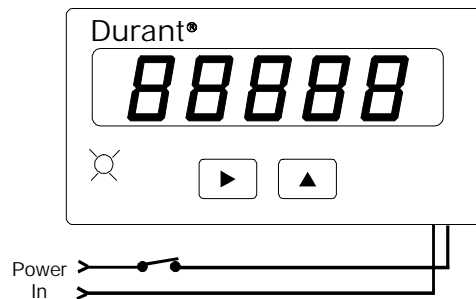To enter the keyboard diagnostic mode:

1. Turn power to the unit OFF.
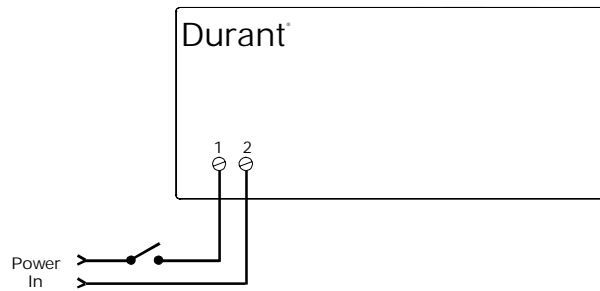
2. Connect the rear terminal program enable input to ground.

3. While holding both the right arrow key (▶) and the up arrow key (▲), turn unit power ON.

The program LED and all display segments will be ON. If present, both relays will be OFF (coils de-energized) and the analog output will be at minimum value (4 mA and 0V).

DIAGNOSTICS cont.

There are four keyboard diagnostic tests, one for each key. The tests are performed by pressing each key. The ratemeter's response is maintained as long as the key is held.

Test Key		Unit Response
Program	PGM	Display shows software part number.
Right Arrow	▶	All display segments and the program LED turn off and the analog output goes to maximum value (20 mA and 10V).
Up Arrow	▲	Each display digit will turn on, one at a time, and relay 2 will turn on.
Down Arrow	▼	Each display segment of all displays will turn on, one segment at a time, and relay 1 will turn on.

To exit the diagnostic mode, turn unit power OFF.

SPECIFICATIONS

MECHANICAL

Cutout Dimensions: 3.62″ W x 1.77″ H (92mm x 45mm) DIN standard
Outline Dimensions: 4.04″ W x 2.19″ H x 3.87″ D (103mm x 56mm x 98mm)
                     3.60″ (92mm) maximum depth in panel
Enclosure: Plastic with polyester front label
Connectors: Up to five de-pluggable terminal blocks

INPUT POWER
  AC Powered Models (57701-4XX)
     Input Power: 85-265 VAC, 47-63 Hz, 20 VA
     External Fuse: 0.2A, 250 VAC, Time Delay (T200mA, 250V)
     Isolation Dielectric Strength: 2300 VAC

  DC Powered Models (57700-4XX)
     Input Power: 9-30 VDC, 12 VA
     External Fuse: 2.0A, 50 VDC, Time Delay, (T2A, 50V)
     Reverse Voltage Protection: Yes
     Isolation Dielectric Strength: 2300 VAC to signal inputs and relays, 500 VAC to
                                     RS 485 and analog outputs

HUMAN INTERFACE

Display: 5 digits
Type: .56″ high, seven segment, red LED
Indicator: One red LED program/calibration indicator
Update Time: 0.1 to 99.9 seconds minimum

DATA RETENTION

Memory Type: EEPROM, no batteries required
Duration: 100 years

SIGNAL INPUT

Rate/Process Time: Signal In
Sensor Type: Sink or source, DIP switch selectable
Input Impedance: 4.75 k ohms to +5 VDC or 34.9 k Ohms to ground
Threshholds: High 3.5 to 28 VDC, low 0 to 1.9 VDC, for single
                      ended signals
Magnetic Pickup Range: 200 mV p-p to 65 VRMS into 34.9 k Ohms
Frequency Response: 200 Hz max. or 10 kHz max. (5 V signals), DIP
                      switch selectable

PROGRAM ENABLE INPUT

Sensor Type: Sink only
Input Impedance: 4.75 k Ohms to +5 VDC

Threshholds: High 3.5 to 28 VDC, low 0 to 1.9 VDC
Response: 25 msec max. (5 V signal)

ACCESSORY POWER OUTPUT

Voltage: 12 VDC +/- 12%
Current: 75 mA max.
Protection: Short circuit protected

OPTIONAL OUTPUTS
  Relay Board
    Number of relays: 2
    Contact type: 1 set form C per relay
    Contact rating: 5A, 250 VAC or 30 VDC
    Isolation dielectric strength: 2300 VAC

  Analog Retransmission
    Output signals: 4-20 mA ($<750\ \Omega$) and 0-10 V ($>2500\ \Omega$)
    Accuracy: 0.13% full scale and 100 PPM /°C (and 0.07% full scale change over 4-20 mA load ranges
    Isolation dielectric strength: 2300 VAC to signal inputs, relays, and AC power inputs, 500 VAC to RS 485 and DC power inputs

RS 485 Serial Communications
    Baud Rate: 1200, 2400, 4800, 9600, or 19,200, programmable
    Parity: Even, odd, or no parity
    Address Range: 00 to 99 decimal
    Protocol: Opto 22® compatible
    Isolation Dielectric Strength: 2300 VAC to signal inputs, relays, and AC power inputs, 500 VAC to analog outputs and DC power inputs

ENVIRONMENTAL
Operating Environment: Indoor use to 2000 meters
Temperature: Operating: 0 to 50°C
    Storage: -20 to 70°C
Humidity: 0 to 85% RH, non-condensing
Vibration: 2.5 g's, 30 to 200 Hz
Shock: 30 g's, 11 msec half sinewave
EMC: Immunity to EN 50082-2 (Heavy Industrial)
    Emissions to EN 50081-2 (Heavy Industrial)
Front Panel: NEMA 4X when mounted with gasket provided
Agency Approval: UL, cUL listed, CE compliant.
    CE EMC immunity and emissions requirements were met using shielded wiring on the RS-485, analog output and pulse input/power lines. The shields were connected to earth ground at the Eclipse end of the shields.
Pollution Degree 2   Overvoltage category II

WARRANTY

Eaton warrants all products against defects in material and workmanship for a period of one (1) year from the date of shipment to Buyer. This is a limited warranty limited to its terms. This warranty is void if the product has been altered, misused, taken apart or otherwise abused. ALL OTHER WARRANTIES, EXPRESS OR IMPLIED, ARE EXCLUDED, INCLUDING BUT NOT LIMITED TO THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR PURPOSE.

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In the construction of the Control described herein, the full intent of the specifications will be met. Eaton Corp., however reserves the right to make, from time to time and without proper written notice, such departures from the detail specifications as may be required to permit improvements in the design of the product.

The information included herein is believed to be accurate and reliable; however no responsibility is assumed by Eaton Corp., for its use; nor for any infringements of patents or other rights of third parties which may result from its use.

This equipment is capable of generating radio frequency energy. If not installed and used in accordance with the instructions, this unit may interfere with radio communications.