Honeywell | EC 350

EC 350 User Manual

FD-583 | 1.4 | 2016

Honeywell Process Solutions

Mercury Instruments 1280 Kemper Meadow Dr. Cincinnati, OH 45240

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About this document

This document is for operators and technicians working in the natural gas industry. This document provides an overview of EC 350 and instructions to install EC 350 on any meter equipped with an instrument drive capability (common to diaphragm and turbine meters) using a Universal Mounting Bracket (UMB) or a rotary mount. To be able to perform the tasks in this document, you must have knowledge about the physical properties of gas (volume, pressure, temperature, and supercompressibility).

Terms and definitions

The following table lists some special terms that are used across this document and provides their definitions.

Term	Definition
Meter gasket	It is used as an environmental seal for mounting EC 350 on a meter.
Opto-isolators	Devices that prevent unwanted current flow or possible damage from high voltage or/and from external devices connected to the instrument.
Rivets	Used to install the slides on the index.
Slide	A small piece of plastic used for covering the digits on the index.
Spline wrench.	Used to loosen and tighten set screw in order to move the Thimble gear assembly **UP** or clock- wise (CW) direction or **DOWN** for counter clock-wise (CCW) direction.
Thimble gear assembly	Rotates the digits on the index in CW direction when it is set **UP** or CCW when it is set **DOWN**.

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CHAPTER 1

1 About EC 350

This section provides information about the main interfaces of EC 350 - LCD, Keypad, and External connections. It also lists the safety instructions that must be followed while installing and commissioning EC 350.

- Safety instructions
- Theory of Operation
- Main interfaces of EC 350

1.1 EC 350 specifications

This section provides the specifications and certifications for EC 350.

1.1.1 Certifications

- Electrostatic Discharge Immunity Test (EN61000-4-2)
- Radiated, Radio-Frequency Electromagnetic Field Immunity Test (EN61000-4-3)
- Electrical Fast Transient/Burst Immunity Test (EN61000-4-4)
- Conducted Radio-Frequency Electromagnetic Field Immunity Test (EN61000-4-6)
- Radiated Emissions (EN 61000-6-4)
- FCC Part 15
- Measurement Canada (pending)
- CSA C/US--- Class I, Div 1/Zone 0 (pending)
- CSA C/US Class I, Division 2, Groups C and D, T3C
- IECEx --- Class I, Zone 0 (pending)
- IECEx --- Class I, Zone 2 (pending)

1.1.2 Power

- Battery
    - 7 Volt 2 cell lithium battery pack
    - 6 Volt 4 cell alkaline battery pack
- External DC supply 5 - 15 Volts DC
- Battery can optionally serve as back-up for external DC voltage

1.1.3 Environmental

- Ambient Temperature Range: -40 °F to +158 °F (-40 °C to +70 °C).
    - If you are using an EC 350 device with a modem, then it is recommended to consider the operational temperature range of the modem. The temperature system will continue providing accurate measurements even if the modem is unable to operate because of environmental conditions.
        - -22 °F to +158 °F (-30 °C to +70 °C) when used with CNI2
        - -13 °F to +158 °F (-25 °C to +70 °C) when used with CloudLink 4G modem
- Humidity: 0-95% non-condensing

1.1.4 Temperature measurement

- Highly stable, solid state temperature sensor (thermistor)
- Range: -40 °F to +158 °F (-40 °C to +70 °C).

1.1.5 Pressure measurement

Ambient temperature range: -40°F to 158°F (-40° to 70°C)

Min/Max pressures per pressure transducer type and range:

Type	Pmin	Pmax	Units
Gauge	-4.6	6	psig
Gauge	-3.1	30	psig
Gauge	-2.5	60	psig
Gauge	8.2	100	psig
Gauge	48	300	psig
Gauge	110	600	psig
Gauge	190	1000	psig
Gauge	290	1500	psig
Absolute	10	30	psia
Absolute	20	100	psia
Absolute	60	300	psia
Absolute	120	600	psia
Absolute	200	1000	psia
Absolute	300	1500	psia

1.2 Safety instructions

EC 350 complies with the general safety standards and regulations. However, failure to operate EC 350 as per the safety instructions available in this document may lead to hazards.

EC 350 is approved for use in hazardous areas (Class I Division 1 or Class I Division 2). Different versions of EC 350 are available depending on the operating conditions. The permitted operating conditions are marked on each EC 350. Check the operating condition limits of EC 350 before installing. You must be familiar with the currently applicable electrical installation standards and regulations before installing and operating EC 350 in hazardous areas.

Warning: Denotes an explosion hazard. Ensure you follow all instructions described in the warning notification.

To avoid explosion hazard, ensure to note the following:

- Install EC 350 depending on the operating conditions permitted for that particular EC 350 unit.
- EC 350 device for Class I Division 1 is intrinsically safe and must be connected to other circuits as per the installation drawing specified on each EC 350.
- EC 350 device for Class I Division 2 must be connected to other circuits as per the installation drawing specified on each EC 350.
- Substitution of components may impair suitability for use in a hazardous location.

Caution: The caution warns you of possible damage to property and provides instructions to avoid damage to EC 350.

Honeywell recommends you to observe the warning information described in this document and other generally applicable safety rules.

No warranty claims can be asserted if there is an unauthorized interference with the device.

1.2.1 Things to remember

1.2.1.1 Usage of EC 350 in hazardous areas

You are allowed to use EC 350 in hazardous areas, under some permitted operating conditions. Ensure to comply with the applicable laws and regulations, and company policies for the usage of EC 350.

Installation and commission EC 350 in hazardous areas

EC 350 must be installed and commissioned only by specially trained and qualified staff. The device is designed in accordance with the IP 65 degree of protection as per EN 60529. The installation of the intrinsically safe circuits must comply with the applicable local laws or regulations. Operate EC 350 only if the instrument is completely intact.

1.2.1.2 Service, maintenance, and troubleshooting EC 350

The service, maintenance and troubleshooting of EC 350 device operating in hazardous areas must be performed only by specially trained and qualified staff.

Replacement of EC 350 battery pack

To maintain acceptability of use in hazardous locations, you must use replacement batteries supplied by Honeywell. For further information about changing the EC 350 battery pack, refer to the section, “Installing or replacing battery”

1.3 Theory of Operation

1.3.1 Correction Factors to Metered Volume

Ideal or perfect gases follow the relationship of Boyle's Law for pressure effect and Charles' Law for temperature effect, which can be stated: The volume of any definite weight of a perfect gas varies inversely with change in absolute pressure and directly with change in absolute temperature. The equation for this relationship of the two laws is expressed as follows:

$$\frac{V1*P1}{T1} = \frac{V2*P2}{T2}$$

The Symbols V1, P1 and T1 refer to the original volume, pressure and temperature while V2, P2 and T2 refer to the volume, pressure and temperature of the new or changed conditions. Rearranging the equation and rewriting subscripts, we can express it as follows:

$$Vb = Vm * \frac{(Pm * Tb)}{(Pb * Tm)}$$

Where:

Vb = gas volume (cu. Ft.) at base condition corrected

Pb = absolute base pressure (psia)

Tb = absolute base temperature (deg. R)

Vm = gas volume metered (cu. Ft.) uncorrected

Pm = absolute meter pressure (psia)

Tm = absolute meter temperature (deg. R)

1.3.2 Pressure Factor Fp

The pressure factor (Fp) to apply to metered volume is expressed by the Boyle's Law relationship as follows:

$$Fp = \frac{Pm}{Pb} = \frac{\text{Meter Pressure (PSIG)} + \text{Atmospheric Pressure (PSIA)}}{\text{Base Pressure (PSIA)}}$$

Each increment of meter pressure represents a different pressure factor. As the flowing gas pressure (Pm) changes, the EC 350 automatically applies the pressure factor (Fp) to the metered volume (Vm).

1.3.3 Temperature Factor Ft

The temperature factor (Ft) to apply to metered volume is expressed by the Charles' Law relationship as follows:

$$Ft = \frac{Tb}{Tm} = \frac{\text{Base Temperature, deg F} + 459.67}{\text{Meter Temperature, deg F} + 459.67}$$

Each increment of meter temperature represents a different temperature factor. Therefore, as the flowing gas temperature changes, the EC 350 automatically applies the temperature factor (Ft) to the metered volume.

1.3.4 Supercompressibiity Factor Fpv

Gases actually behave slightly different than what the ideal gas laws indicate. This deviation depends on the molecular composition of the gas and the specific gravity as well as the pressure and temperature. Natural gas, for instance, compresses by a greater amount than that computed by Boyle's law and hence the term "supercompressibility" is used for this deviation. It is small at very low pressure, but becomes substantial as the pressure increases. The EC 350 automatically applies the supercompressibility factor and therefore the equation for total volume correction that the EC 350 applies to metered volume, is expressed as:

$$Vb = Vm * Fp * Ft * (Fpv)^2$$

Where:

Vb = gas volume (cu. Ft.) at base condition corrected

Vm = metered volume read from meter index

Fp = pressure factor

Ft = temperature factor

Fpv = supercompressibility determined from NX-19 or AGA-8

The EC 350 automatically squares the supercompressibility factor displayed, which is based on the pressure and temperature sensed at the meter. The resulting volume readout is corrected for pressure, temperature, and supercompressibility.

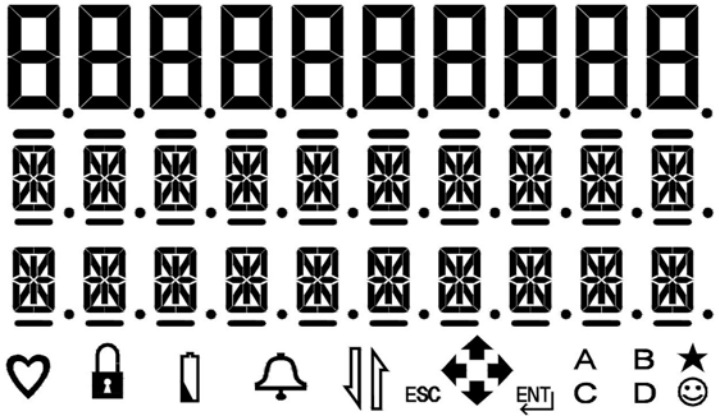
1.4 Main interfaces of EC 350

The main interfaces of the EC 350 are:

- LCD
- Keypad
- External connections

1.4.1 LCD

EC 350 provides a ten character, configurable, alphanumeric LCD display with icons to display the status information and alarm conditions. The LCD display can be configured to on or off at different times of day. During normal operation (Correction mode), the corrected volume is displayed on the LCD. Following is an LCD display illustration, showing all segments ON.



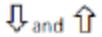
The following table lists the icons on the LCD display.

Icon	Description
	**Heart Beat** : flashes every 3 seconds to indicate normal operation (Correction mode).
	**Lock** : Indicates that the instrument is in a metrologically protected mode
	**Unlock** : Indicates that the instrument is not in a metrologically protected mode
	**Battery** : indicates a low battery condition. Refer to the section Installing or replacing battery. Battery alarm is also indicated by this icon.

Icon	Description
	**Alarm** : indicates the alarm for low pressure, volume sensor, system, temperature, flow rate, pressure limit, and daily corrected volume limit.
	**IrDA** : indicates that communication with the device via the front panel IR port is enabled.
	**Navigation key function indicator** : as you navigate through the options in each operating mode, this icon indicates the keys that are active for the selected option.
	**Pulse output channel indicator** : indicates which of the 4 pulse output channels are enabled, and flashes when a pulse is transmitted.
	**Smile** : indicates the HMI is unlocked. The navigation keys are functional.
	**Star** : The Star icon turns on during pressure and temperature measurement, which typically occurs every 30 seconds.

1.4.2 Keypad

The keypad is used for scrolling through the menu options. The following table lists the keys.

Option	Description
	Use these keys for unlocking the keypad and activating the display. To unlock the keypad, press and hold **ESC** and **UP arrow** at the same time until display text appears.
	Use these keys for scrolling up and down in a menu. You can also use to enter input by increasing and decreasing a value at the current position.
	Use these keys for navigating to the next and/or previous digit. Use these keys to move the cursor one character at a time, in forward or backward directions.
	Use this key to access the main menu or display the submenu of the current menu. It is also used for accepting an input value.
	Use this key to display the Home screen, cancel an entry, or go back to the previous menu.

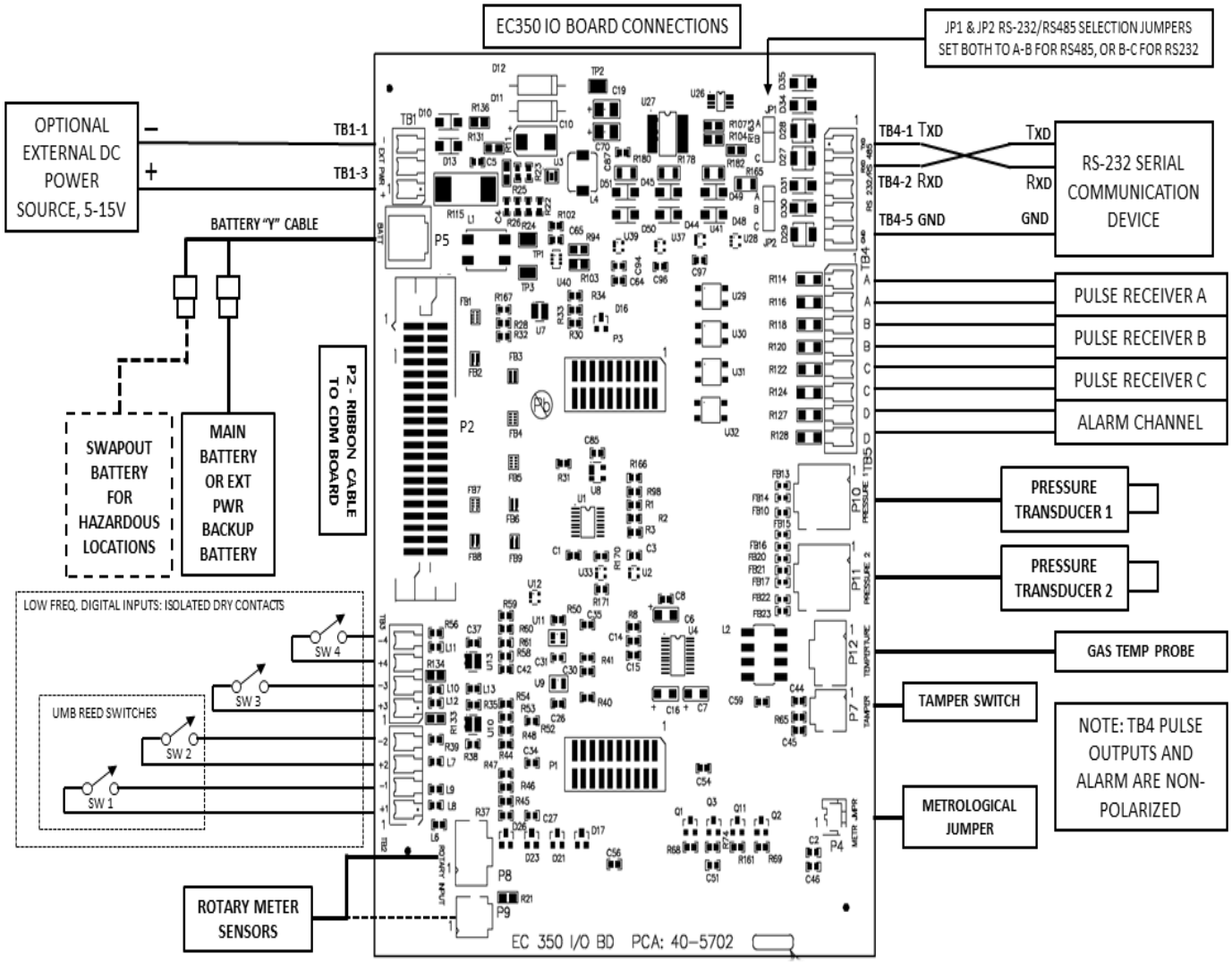
To conserve battery power, after each processing cycle the EC 350 keypad is locked, if there is no input received within the time out period (1 to 10 minutes).

1.4.3 External connections

The external connections from EC 350 are:

- Pulse outputs
- Serial port
- Alarm outputs
- External supply voltage (TB1)
- Battery pack (P5)

The figure below illustrates the purpose of different jumpers and other connections on an EC 350 IO board:


EC350 IO BOARD CONNECTIONS
JP1 & JP2 RS-232/RS485 SELECTION JUMPERS SET BOTH TO A-B FOR RS485, OR B-C FOR RS232
OPTIONAL EXTERNAL DC POWER SOURCE, 5-15V
TB1-1
TB1-3
BATTERY "Y" CABLE
SWAPOUT BATTERY FOR HAZARDOUS LOCATIONS
MAIN BATTERY OR EXT PWR BACKUP BATTERY
P2 - RIBBON CABLE TO CDM BOARD
LOW FREQ. DIGITAL INPUTS: ISOLATED DRY CONTACTS
UMB REED SWITCHES
SW 1
SW 2
SW 3
SW 4
ROTARY METER SENSORS
TB4-1 TXD
TB4-2 RXD
TB4-5 GND
TXD
RXD
GND
RS-232 SERIAL COMMUNICATION DEVICE
PULSE RECEIVER A
PULSE RECEIVER B
PULSE RECEIVER C
ALARM CHANNEL
PRESSURE TRANSDUCER 1
PRESSURE TRANSDUCER 2
GAS TEMP PROBE
TAMPER SWITCH
METROLOGICAL JUMPER
NOTE: TB4 PULSE OUTPUTS AND ALARM ARE NON-POLARIZED
EC 350 I/O BD PCA: 40-5702

CHAPTER 2

2 EC 350 installation

This chapter deals with the installation of EC 350 on conventional gas meters (such as rotary, diaphragm, and turbine). This chapter also provides procedures for installing and replacing the battery and output wire connections to obtain pulse output from EC 350.

2.1 EC 350 contents verification

The following components are installed and connected inside EC 350 when shipped.

- Pressure transducers (upto 2 transducers, if ordered)
- Temperature probe (if ordered)

After you receive EC 350:

1. Remove the contents from the box and from the mounting kit bag.
2. Check the shipment against the invoice to ensure that the components ordered are installed in EC 350.
3. Report any shortage or shipping damages to your nearest Honeywell Account Manager.

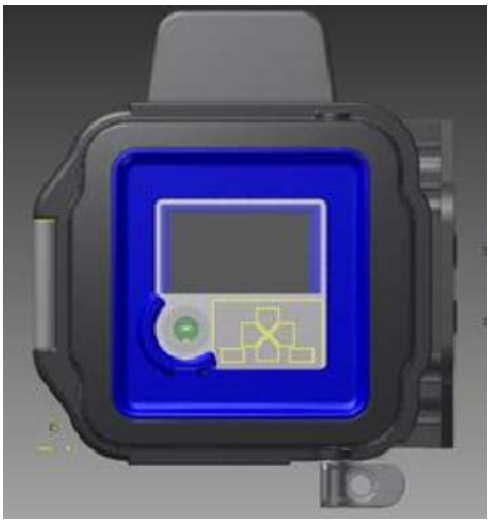
2.2 Overview of installation

The EC 350 installation consists of mounting and wiring EC 350 according to the instructions given in this section. Before proceeding, read the installation information provided in this section and refer to the section "Model number interpretation ", to familiarize yourself with the EC 350 model you have selected.

Based on the mounting selected, refer to one of the following two methods for installing EC 350 on a meter.

- Installing EC 350 on conventional diaphragm, rotary or turbine gas meters. The following image illustrates with a UMB.

- Installing EC 350 on a rotary mount. The following image illustrates EC 350 configured for a rotary mount. (Adapter plate, which varies by meter model, not shown.)



2.3 Model number interpretation

EC 350 is available in different models. Refer to the Model Selection Guide (MSG), available from your Mercury sales representative, for details.

2.4 Prerequisites

Ensure that the following components are installed and connected inside EC 350, before installing EC 350 on meters.

- Battery pack
- Pressure transducer (if ordered)
- Temperature probe (if ordered)

2.5 Installing EC 350 on conventional diaphragm, rotary or turbine gas meters

This section describes the procedures to install EC 350 on conventional diaphragm, rotary or turbine gas meters, equipped with instrument drive capability.

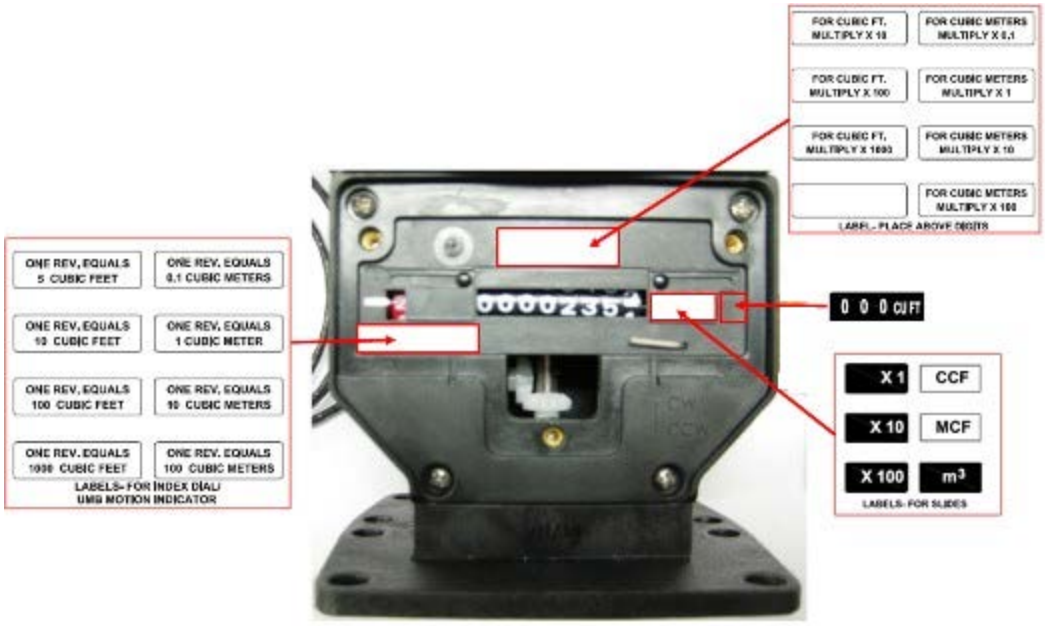
- Installing the index slide and label
- Changing the drive rotation
- Mounting EC 350 on the meter
- Connecting a pressure line to EC 350

2.5.1 Installing the index slide and label

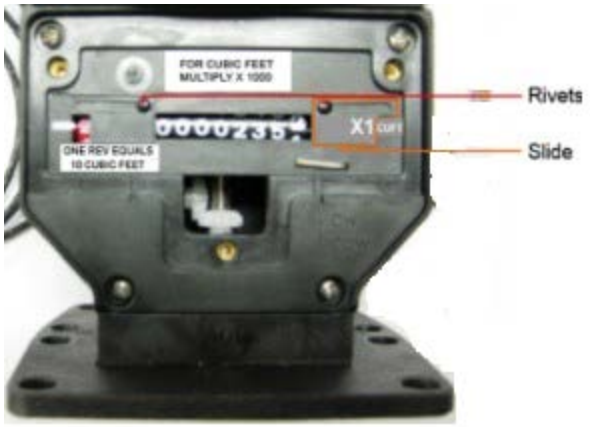
The UMB has a digital index for indicating uncorrected volume. You can move the slide on the mechanical counter to cover the digits that are not used, based on customer configuration.

To install the index slide and label

- Based on your application, apply **labels** to the UMB. Refer to the following image for applying the labels.



The following image illustrates the labels applied to the UMB, slides, and rivets.



2.5.1.1 Next steps

Verify if the digital index reading rotates in the proper direction. If not, perform the tasks described in the following section, " Changing the drive rotation ", to position the bevel-gear thimble of EC 350 to ensure the reading rotates in the proper direction.

2.5.2 Changing the drive rotation

The bevel-gear Thimble assembly or the Thimble gear assembly in the UMB permits either clockwise (CW) or counterclockwise (CCW) rotation. Before installing EC 350, note whether the output shaft of the meter rotates CW or CCW. You can change the driver rotation by positioning the Thimble gear assembly of EC 350 to match the meter rotation.

To change the driver rotation to match the meter rotation

1. Remove the supplied **Spline wrench** from the front plate storage.
   The following image illustrates the Spline wrench in the front plate storage.

2. Loosen the **Set screw** on the Thimble gear assembly.
   The Thimble gear assembly position can be adjusted without removing the front plate of the UMB assembly.
3. Shift the Thimble gear assembly **Up** to set the drive rotation in the CW direction or **Down** to set the drive rotation in the CCW direction.
4. Tighten the set screw after the Thimble gear assembly is properly positioned and fully meshed with the Vertical miter gear on the horizontal shaft.
5. Replace the transparent index cover and the three Phillips-head screws after stowing the Spline wrench.

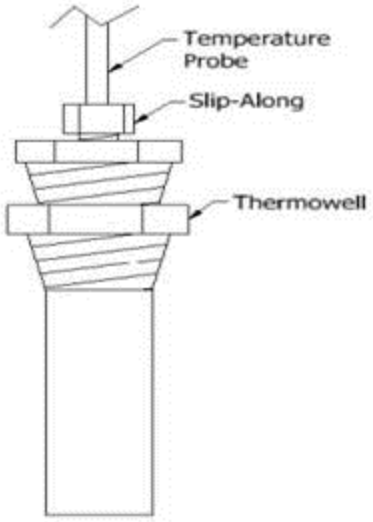
2.5.3 Mounting EC 350 on the meter

Ensure that you have the right mounting kit. Refer to the MSG or the image provided along with EC 350 to ensure it is the right mounting kit.

Use the base plate to rotate EC 350 about 360 degrees in any four directions. To rotate EC 350, remove all four screws, which attach the base plate to the bracket housing.

To mount EC 350 on the meter:

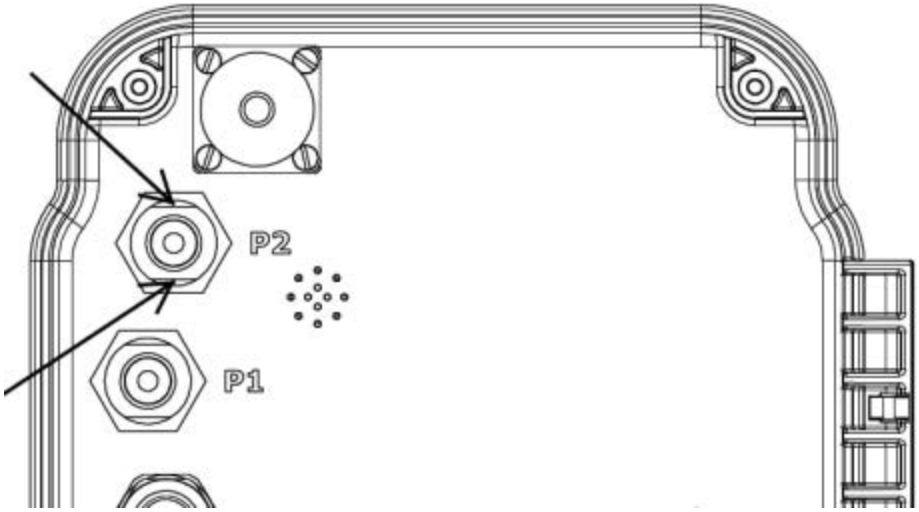
1. Place the meter gasket against the meter end and attach EC 350 with the UMB to the meter mounting plate.
2. Install the four meter mounting bolts (provided with the kit) and tighten the bolts after you have positioned the UMB.
3. Thread the slip-along fitting into the thermowell and place the temperature probe into the slip-along fitting, sliding the probe down until it bottoms out from the thermowell before tightening the slip-along nut.



2.5.4 Connecting a pressure line to EC 350

Use a pressure connection kit, and connect the pressure line to the ¼ inch NPT fitting.

Hold wrench on flats when installing pressure line on Pressure transducer to ensure proper seal and avoid loads on composite case.



Warning: To avoid explosion, it is extremely important to ensure the pressure transducer is capable of handling the pressure in the gas line. Check item entry 137 (user units) or item entry 25(PSI) on the EC 350 for maximum pressure transducer information before applying live gas pressure to the EC 350.

2.6 Installing EC 350 on a rotary mount

This section describes the procedures to install EC 350 on a rotary mount.

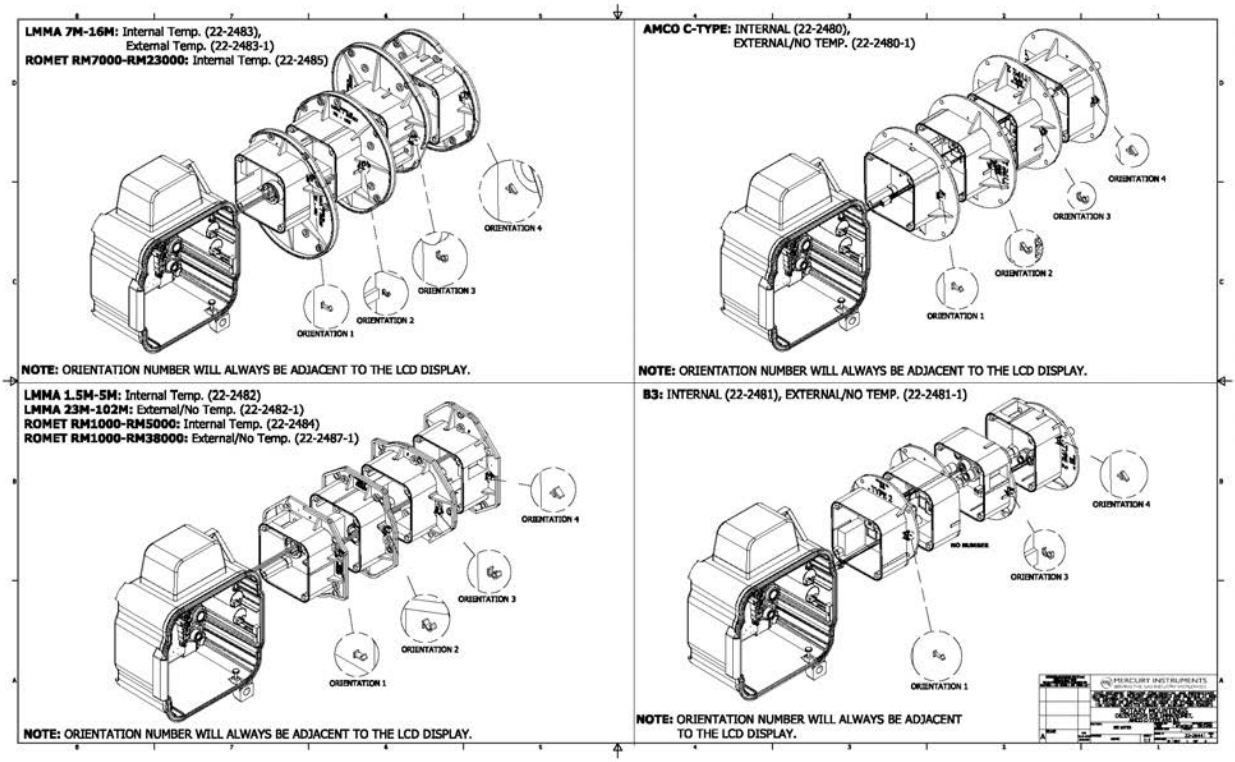
- Selecting the mounting orientation
- Installing the temperature probe
- Connecting a pressure line to the EC 350
- Installing EC 350 on rotary mounts

2.6.1 Selecting the mounting orientation

EC 350 supports four orientations for instruments and mounting plates. The EC 350 can be rotated about 90 degrees increments based on your meter configuration.

To select the mounting orientation:

1. Loosen and remove the four mounting screws holding the mounting plate.
2. Rotate the mounting plate to the required orientation.
3. Reinstall and tighten the four mounting screws to 18–20 inch LBS. The following image illustrates the mounting orientation of EC 350.



2.6.2 Installing the temperature probe

Insert the temperature probe into the meter thermowell before mounting the EC 350 on the meter.

To mount the temperature probe into the meter base:

1. Pull the temperature probe out of the mounting plate as illustrated in the following image.

2. Use the temperature probe as a measuring device, and insert the probe until it bottoms out from the thermowell of the meter as illustrated in the following image.

3. Mark the temperature probe cable at the point where the cable comes out from the meter body as illustrated in the following image.

4. The temperature probe is held in place with a rubber gland in the mounting plate. Push the probe into EC 350 until the mark is one inch from the mounting plate, as illustrated in the following image.

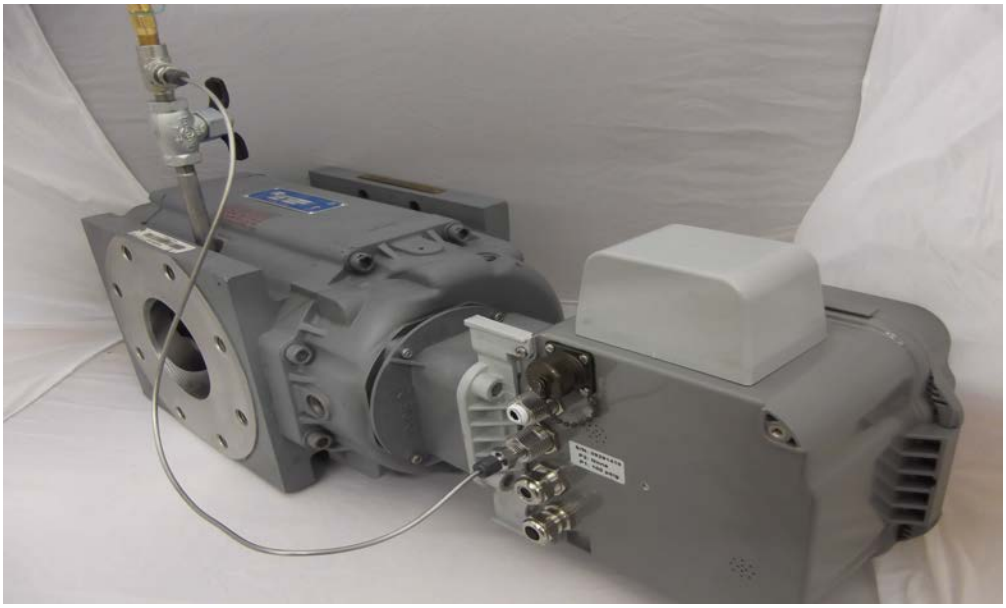
   The one inch additional length ensures that the probe bottoms out at the end of the thermowell.

5. Insert the temperature probe into the thermowell as illustrated in the following image.

The temperature probe is mounted into the meter base.

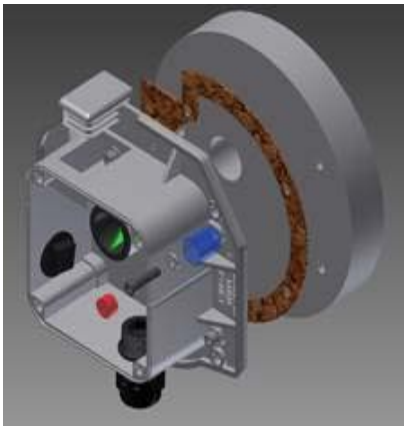
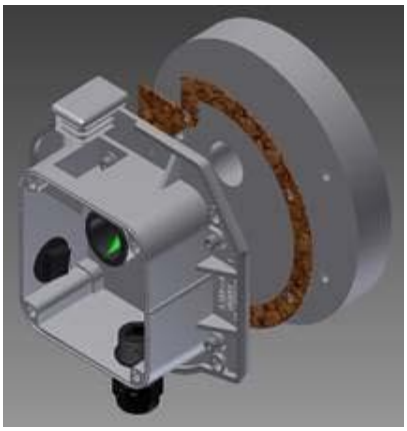
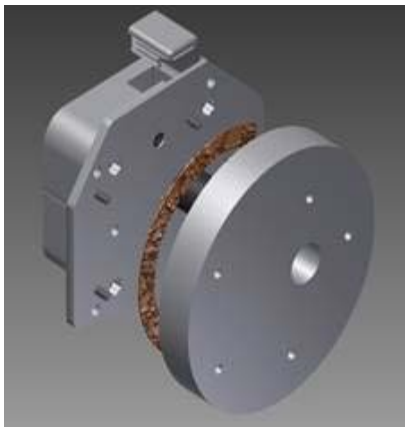
2.6.3 Connecting a pressure line to the EC 350

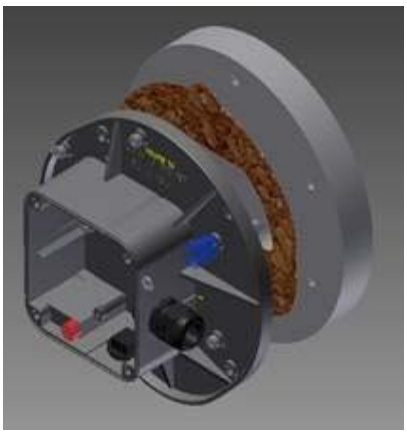
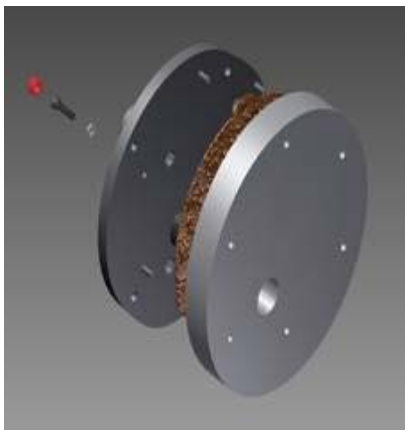
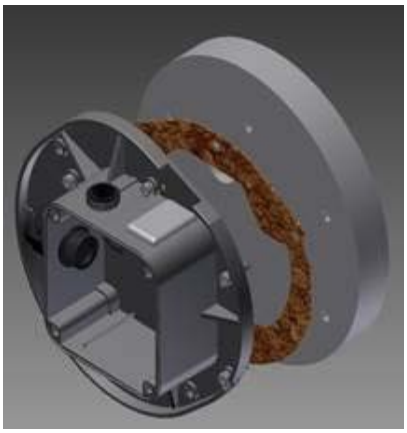
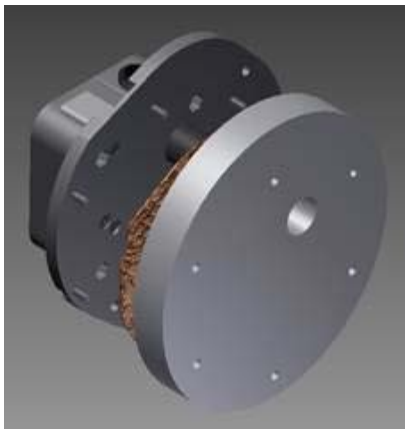
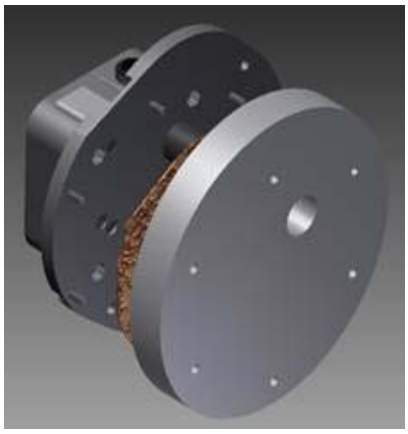
Use a pressure connection kit and connect the pressure line to the ¼ inch NPT fitting. The following images illustrates a pressure transducer connected to a pressure line using the pressure connection kit.

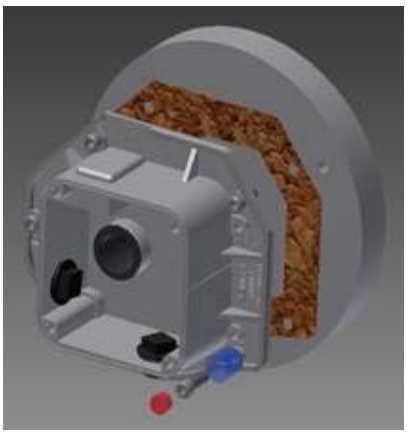
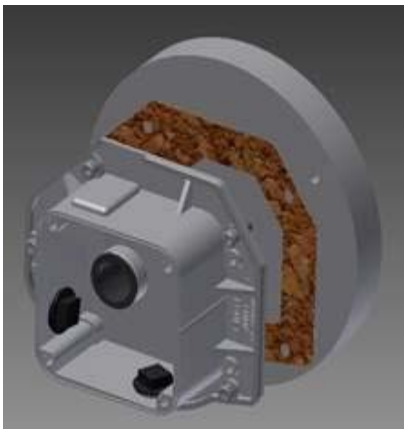
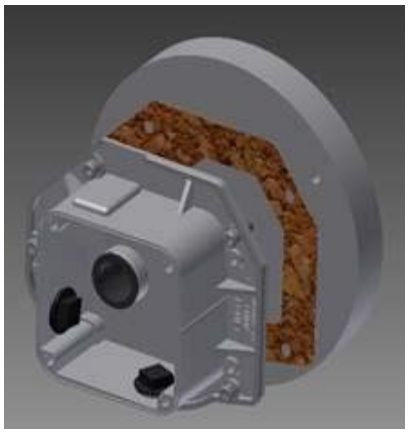
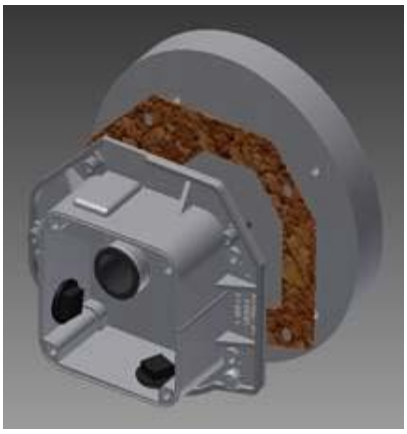
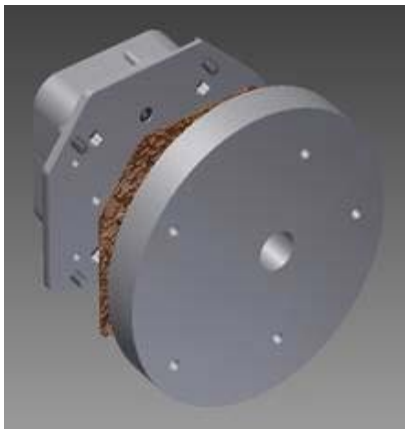


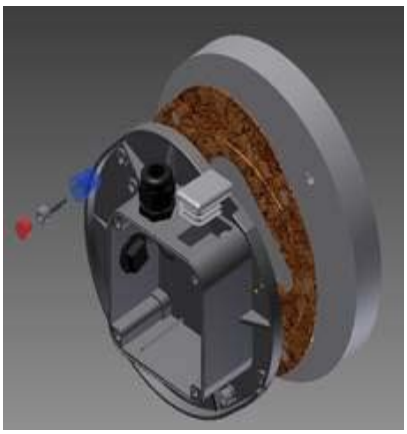
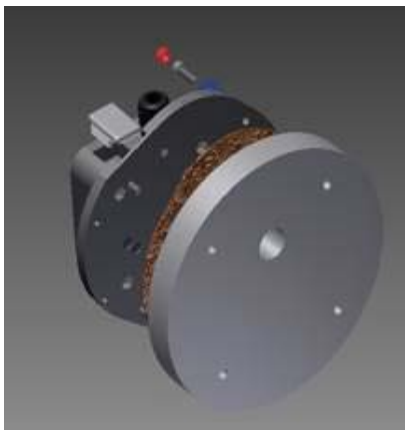
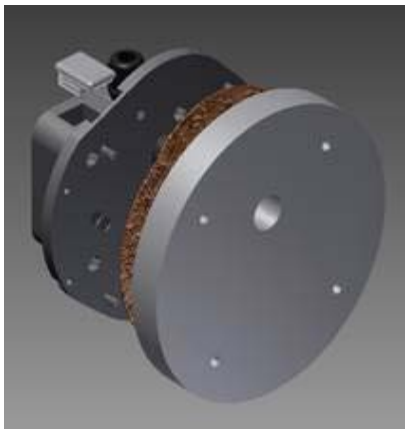
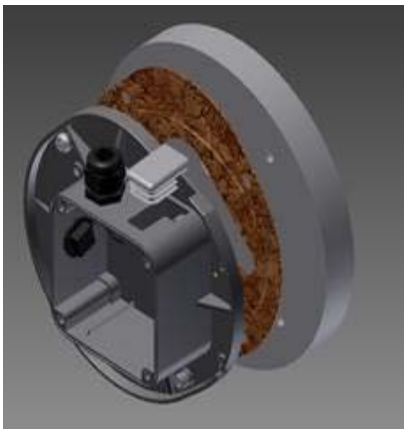
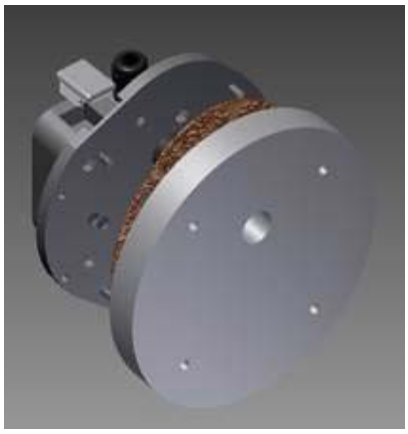
2.6.4 Installing EC 350 on rotary mounts

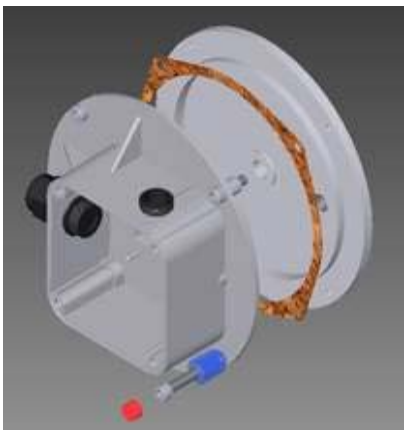
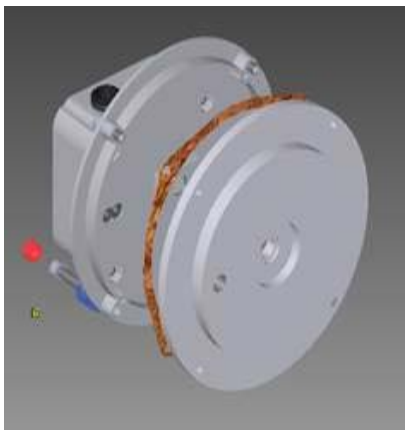
This section describes the various types of rotary meter mounting kits. The following table illustrates the mounting of EC 350 on each type of rotary mounts.

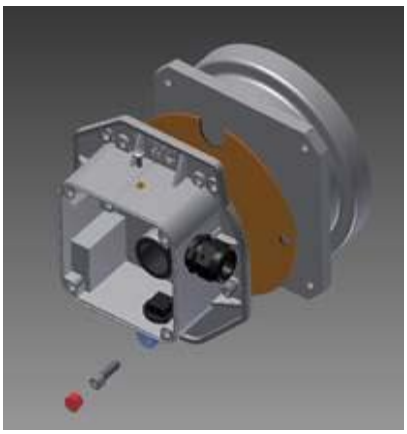
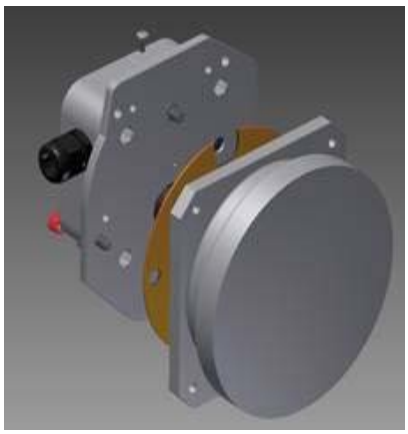
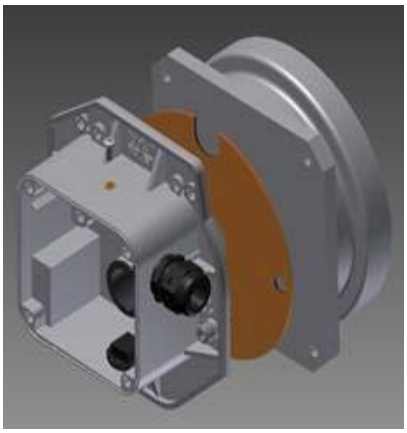
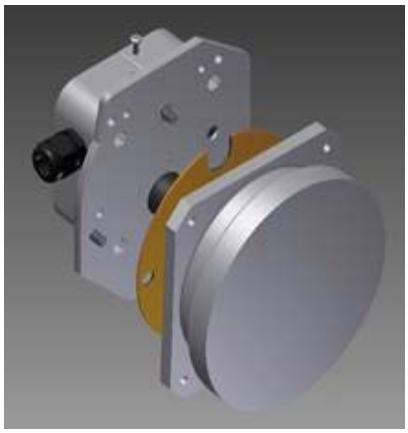
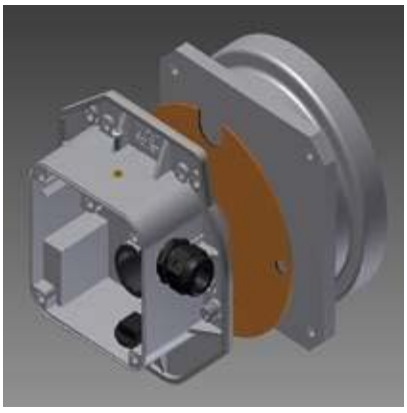
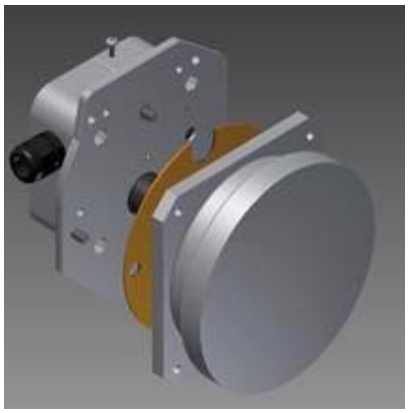
Rotary meter mounting kit	Rotary mount illustration		Part Number
LMMA 1.5m to 5m and 23m to 102m mounting kit with snap seals.			22-2089
LMMA 1.5m to 5m and 23m to 102m mounting kit with cross-drilled screws.			22-2089-1
LMMA 1.5m to 5m and 23m to 102m mounting kit with McGARD screw, PG and E Key			22-2089-2

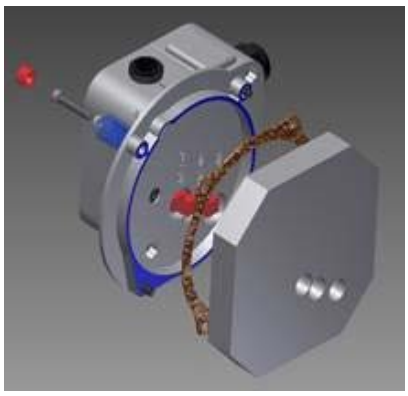
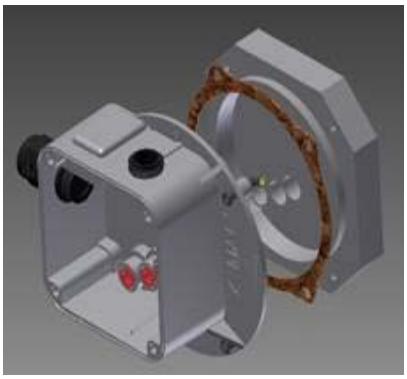
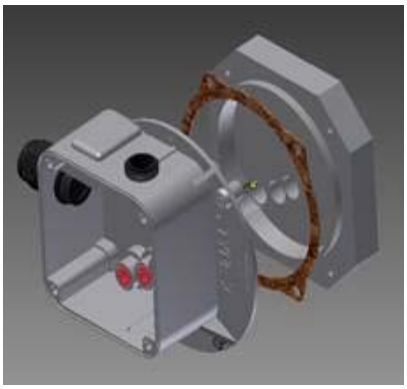
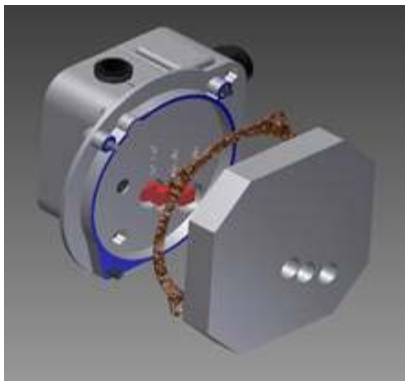
Rotary meter mounting kit	Rotary mount illustration		Part Number
LMMA 7m to 16m mounting kit with snap seals.			22-2090
LMMA 7m to 16m mounting kit with cross-drilled screws			22-2090-1
LMMA 7m to 16m mounting kit with McGARD screw, PG and E key			22-2090-2

Rotary meter mounting kit	Rotary mount illustration		Part Number
Romet RM1000 to RM5000 mounting kit with snap seals.			22-2104
Romet RM1000 to RM5000 mounting kit with cross-drilled screws			22-2104-1
Romet RM1000 to RM5000 mounting kit with McGARD screw, PG and E key			22-2104-2

Rotary meter mounting kit	Rotary mount illustration		Part Number
Romet 7000 to 23000 mounting kit with snap seals.			22-2105
Romet 7000 to 23000 mounting kit with cross-drilled screws			22-2105-1
Romet 7000 to 23000 mounting kit with McGARD screw, PG and E key			22-2105-2

Rotary meter mounting kit	Rotary mount illustration		Part Number
AMCO C-type mounting kit with snap seals			22-2106
AMCO C-type mounting kit with cross-drilled screws.			22-2106-1
AMCO C-type mounting kit with McGARD screw, PG and E key			22-2106-2

Rotary meter mounting kit	Rotary mount illustration		Part Number
Romet external temperature mounting kit with snap seals.			22-2107
Romet external temperature mounting kit with cross-drilled screws			22-2107-1
Romet external temperature mounting kit with McGARD screw, PG and E key			22-2107-2

Rotary meter mounting kit	Rotary mount illustration		Part Number
B3 or TQM mounting kit with snap seals.			22-2108
B3 or TQM mounting kit with cross- drilled screws.			22-2108-1
B3 or TQM mounting kit with McGARD screw, PG and E key			22-2108-2

2.7 Power Supply Options

The EC 350 has flexible power supply options. The unit can operate from an externally supplied DC power source or from a 4-cell Alkaline, a 2-cell Lithium, or dual 2-cell Lithium Battery Packs.

- External Power Supply
- Battery Powered
- Battery Life/ Usage Tracking
- Replacing the Battery Pack
- Low battery/ External Power shutdown mode
- User Shelf/ Shutdown mode

2.7.1 External Power Supply

The input voltage range for using an externally supplied **DC power source** is **+5.0 VDC to +15.0 VDC**. The Honeywell power 9 VDC pack p/n: **40-2291** can be used as an external voltage source.

Connections for the external supply are made at the **TB1** connector on the EC 350 IO Board. Terminal-1 nearest the top of the IO Board is GND and Terminal-3 is the positive (+) input. When operating from an externally supplied DC power source, a backup battery pack may also be installed with the intent of powering the instrument in situations where the external (remote) power is interrupted.

Installations requiring CLASS 1 - DIV 2 approval, the following Battery Packs are approved: 40-6048 (2-cell Lithium), 40-6050 (4-cell Alkaline), and 40-6064 (4-cell Alkaline with 47 ohm Res). These Battery Packs can be connected to the P5 Battery connector using cable p/n: 40-6045.

Installations requiring CLASS 1 - DIV 1 approval, only the Battery Pack 40-6064 is approved.

When operating from an externally supplied DC power source, configure the External Supply Low Alarm Limit (**Item 795**) to be a value greater than 5.0 and generally less than 7.0 V. The default value of Item 795 is -1.0 to effectively disable the Alarm Item 796. The External Supply voltage is measured on a 10 minute interval. Three consecutively low readings are required to the trip the Low Voltage Alarm (Item 796) – this is done to help guard against falsely setting alarm due to a power supply glitch.

2.7.2 Battery Powered

Connections for the Battery pack are made at the P5 connector on the EC 350 IO Board. There are three Battery choices for operating the EC 350 from battery power:

- 40-6050 (4-cell Alkaline) – 5 year operating life under specified conditions
- 40-6048 (2-cell Lithium)
- Dual set of 40-6048 (2-cell Lithium) – extended life or heavy usage / comms applications.
- Use the Battery Type (Item 1061) to select the type of Battery pack that is being used to power the instrument.
    - 0= 4 Cell Alkaline (default type)
    - 1= 2 Cell Lithium
    - 2= 4 Cell Lithium (dual set of p/n 40-6048)

The Battery voltage is measured on a 10 minute interval. Three consecutively low readings are required to the trip the Low Voltage Alarm (Item 99) – this is done to help guard against falsely setting alarm due to a supply glitch.

Note: The Low Battery Voltage Alarm (Item 99) will not set if an External Supply voltage is present at TB1 with a voltage level greater than the Battery voltage by over 1.0 VDC. When a Low Battery Voltage Alarm is tripped (set), an Alarm Log record entry is generated along with updates to time stamp Items 462 and 463.

2.8 General Wiring connections

This section describes the pulse outputs from EC 350.

- Three Form-A volume pulse outputs
- One Form-B alarm output

These outputs are electronic switches. The first three pulse outputs are configured as either corrected volume or uncorrected volume. The fourth pulse output is used only for alarm output.

Note: Outputs are conventionally called “pulse outputs”, but it should be understood that they are actually solid state (transistor) switches and do not produce any voltage. The external device to which they are connected must provide wetting voltage with current limiting, and be able to respond to the contact closures.

2.8.1 Pulse output communication

EC 350 provides four pulse outputs, three (channels A, B, and C) normally-open Form A type, and one (channel D) normally closed Form B type. The pulse outputs are typically used for connection to an AMR (Automatic Meter Reader) device.

These outputs are electronic switches that operate like an isolated bidirectional switch. Channels A, B, and C (normally open type) can be configured as corrected volume or uncorrected volume. Channel C can alternatively be configured as a (normally open) alarm output. Channel D (normally-closed type) is only for alarm output use. All the pulse outputs of the EC 350, including the alarm pulse output, use opto-isolators for isolating the EC 350 circuitry from the devices receiving the pulses. Opto-isolators are devices that prevent unwanted current flow or possible damage from high voltage.

Alarm pulse outputs

An alarm pulse (on channel C or D) is generated when EC 350 enters an alarm condition. Use channel C (NO or Normally Open) or channel D (NC or Normally Closed) depending on the AMR device accepting the alarm pulse. Use of channel D (NC) allows for a cut wire to be interpreted as an alarm condition to the AMR device.

Volume pulse outputs

EC 350 provides three Form-A pulse outputs (channels A, B, and C) for volume output pulses.

Volume pulses can correspond to either uncorrected volume (as counted in item 2) or corrected volume (as counted in item 0). The type of volume pulse (and whether the channel is enabled) is configured through items 93-95.

The "weight" of each pulse (e.g. whether a pulse corresponds to 10 cubic feet or 1 cubic meter) is configured via items 1193-1195.

Note: In prior Mercury products the pulse weight was configured differently through items 93-95. These are now read-only values provided for reference.

Pulse output timing is configurable via items 1014, 1015, and 1024. Various pulse ON and OFF times can be chosen. Default is a pulse ON time of 62.5 milliseconds and a pulse OFF time of at least 62.5 milliseconds, for a minimum pulse period of 125 milliseconds.

Pulse Output Configuration Summary

Channel	Item function	Item number	Parameters	Description
A	Enable/Type	93	0 = CorVol pulses 2 = UncVol pulses 3 = Off	Channel A pulse output selection. Select the type of information to be transmitted out of Channel A.
	Weight	1193	100 CF (Default)	Volume associated with a single pulse on channel A.
	Timing	1014	50/250 ms	Channel A pulse output timing. Select the On and Off timing requirements for Channel A output.
	Queue	5	0 (Default)	Channel A pulses waiting. Provides the number of pulses waiting to be sent to the remote device. Pulse queue = 2 x the number of Channel A output pulse remaining from the previous wakeup period.

Channel	Item function	Item number	Parameters	Description
B	Enable/Type	94	0 = CorVol pulses 2 = UncVol pulses 3 = Off	Channel B pulse output selection. Select the type of information to be transmitted out of Channel B.
	Weight	1194	100 CF (Default)	Volume associated with a single pulse on channel B.
	Timing	1015	50/250 ms	Channel B pulse output timing. Select the On and Off timing requirements for Channel B output.
	Queue	6	0 (Default)	Channel B pulses waiting. Provides the number of pulses waiting to be sent to the remote device. Pulse queue = 2 x the number of Channel B output pulse remaining from the previous wakeup period.
C	Enable/Type	95	0 = CorVol pulses 2 = UncVol pulses 3 = Off 4 = Alarm	Channel C pulse output selection. Select the type of information to be transmitted out of Channel C.
	Weight	1195	100 CF (Default)	Volume associated with a single pulse on channel C.
	Timing*	1024	50/250 ms	Channel C pulse output timing. Select the On and Off timing requirements for Channel C output.
	Queue	7	0 (Default)	Channel C pulses waiting. Provides the number of pulses waiting to be sent to the remote device. Pulse queue = 2 x the number of Channel C output pulse remaining from the previous wakeup period.

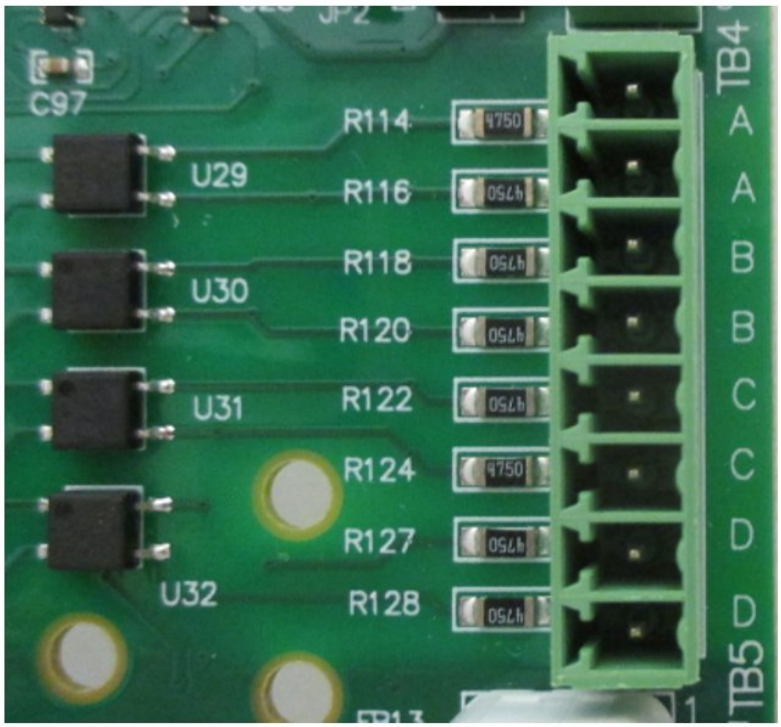
Channel	Item function	Item number	Parameters	Description
D	Alarm Channel On time	1016	Default = 10 seconds	Alarm pulse width. Since this channel is Normally Closed, the channel goes open for this duration on an alarm event.

Note: If channel C is used as an alarm output, the pulse width is fixed at 100 milliseconds.

2.8.2 Pulse output specification

Following are the specifications for pulse output.

- All outputs are isolated from ground and each other.
- Outputs are rated for DC values from 0 to 30.0 volts, non polarized in non-hazardous locations.
- In Division 1 or Zones 1 & 2 hazardous locations, voltage rating is reduced to 8 volts maximum.
- Each circuit includes 100 ohms of current limiting resistance.
- Maximum load current 20 mA.



Channel A output terminals

Channel B output terminals

Channel C output terminals

Alarm output terminals

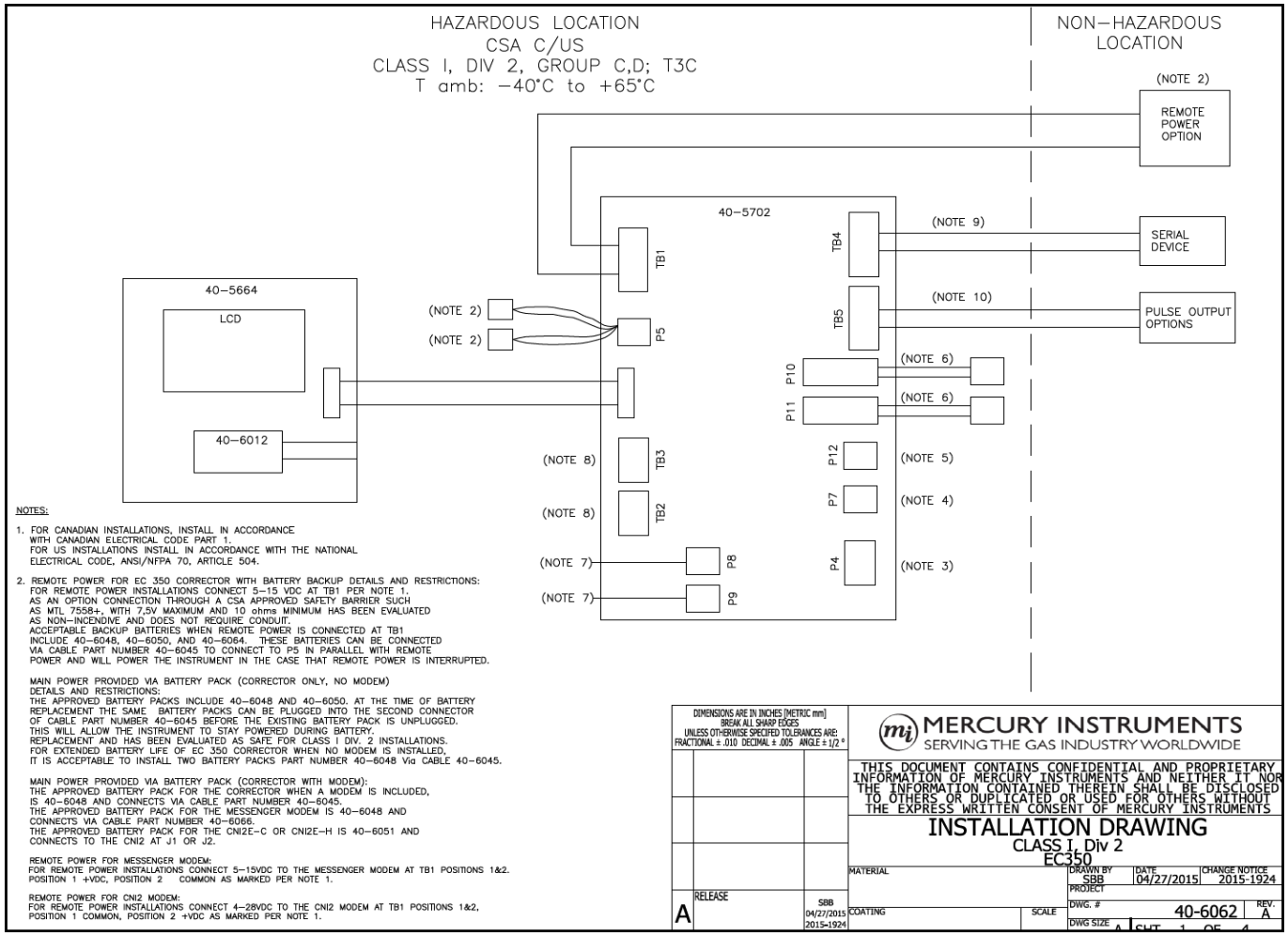
2.8.3 Pulse outputs via the case connector option

A 6 pin Amphenol case connector can be ordered to provide for the connection of two of the three pulse outputs plus the alarm from outside the instrument. The connector as shown below is viewed from outside the instrument. Pins A – F are labeled clockwise with pin A at the top. The table below shows the connections.

Note: Note that since the outputs are non-polarized, wires can be connected in either polarity to each output.

PIN	COLOR	PIN FUNCTION
A	WHITE	OUTPUT A
B	RED	OUTPUT A
C	BLUE	OUTPUT B
D	BLUE	OUTPUT B
E	BLACK	ALARM
F	BLACK	ALARM

2.9 Installation Drawings



3. P4 IS A METROLOGICAL JUMPER THAT HAS BEEN EVALUATED AS NON-INCENDIVE AND CAN BE REMOVED AND/OR REPLACED IN Div 2 HAZARDOUS LOCATION.
4. P7 IS A TAMPER DETECTION REED SWITCH WHICH IS MOUNTED TO CASE AND ACTIVATED BY A MAGNET IN THE DOOR. THIS CONNECTION HAS BEEN EVALUATED AS NON-INCENDIVE.
5. P12 IS A THERMISTOR TEMPERATURE SENSOR AND THE CONNECTION AT P12 HAS BEEN EVALUATED AS NON-INCENDIVE. TEMPERATURE SENSOR OPTIONS INCLUDE 40-5814, 40-6008, 40-6007, 40-6006, 40-6005, 40-6004, 40-6003,40-6002.
6. P10 AND P11 ARE PRESSURE TRANSDUCERS, UP TO TWO PRESSURE TRANSDUCERS CAN BE USED IN CLASS I, Div 2, PART NUMBERS FOR TRANSDUCERS INCLUDE 40-5316
7. P8 AND P9 ARE ROTARY METER SENSOR INPUTS AND OPTIONS INCLUDE 40-4567, 40-3572-1 AND 40-3407-1

8. TB2 AND TB3 ARE FOR DIGITAL PULSE INPUTS: DIV 2 PULSE GENERATOR OPTIONS: PASSIVE, RESISTIVE, NON-ENERGY STORING DEVICE OR DEVICES HAVING ENTITY PARAMETERS CONFORMING TO TABLE 1. THESE PULSE GENERATORS CAN BE LOCATED IN DIV 2 OR NON HAZARDOUS LOCATION. MAXIMUM CABLE LENGTH 200 FEET. ANY COMBINATION OF THE OPTIONS FOR PULSE GENERATORS ARE NOT TO BE CONNECTED SIMULTANEOUSLY.

TABLE 1.

Output parameters For Mercury Instruments EC 350 TB2, TB3			
Open Circuit Voltage	Voc	Uo	3.9V
Short Circuit Current	Isc	Io	0.40mA
Power Output	Po	Po	0.39mW
Maximum allowable Capacitance	Ca	Co	1uF
Maximum allowable Inductance	La	Lo	100mH

THE PARAMETERS OF THE CONNECTED IS APPARATUS MUST MEET THE FOLLOWING CONDITIONS.

Voc Vmax
Isc Imax
Po Pi
Ca ci + Ccable
La Li + Lcable

9. TB4 IS FOR CONNECTION TO SERIAL DEVICE, RS-232 OR RS-485, SELECTED AT JP1 AND JP2, JP1 AND JP2 SHUNTS SHOULD BOTH BE PLACED ON A AND B TO SELECT RS485 AND B AND C TO SELECT RS-232. THE CONNECTION AT JP1 AND JP2 HAS BEEN EVALUATED AS NON INENDIVE AND CAN BE CHANGED IN A CLASS I, Div 2 LOCATION.
CONNECTIONS TO TB4 CAN BE MADE Via CONDUIT PER NOTE 1 OR WITHOUT CONDUIT TO A CLASS I, Div 2 OR CLASS I, Div 2 APPROVED PRODUCT WITH ENTITY PARAMETERS MATCHING THE FOLLOWING OPTIONS:

OPTION 1:
1. AS AN OPTION TO THE CONNECTION SHOWN ON PAGE 1 FOR THE SERIAL PORT CONNECTION AT TB4, TXD AND RXD CONNECTIONS CAN BE MADE FROM SERIAL PORT TB4 TO A SERIAL DEVICE HAVING ENTITY PARAMETERS CONFORMING TO TABLE 1 AND 2 BELOW.
THESE SERIAL DEVICES CAN BE LOCATED IN DIV.1/ZONE 0, DIV. 2/ZONE 2, OR NON-HAZARDOUS LOCATIONS.

TABLE 1.

Input parameters For Mercury Instruments 40-5702 TB4			
Electrical Parameters	Div Marking	Zone Marking	Value
Maximum input Voltage	V_{max}	Ui	30V
Maximum input Current	I_{max}	Ii	35mA
Maximum input Power	Pi	Pi	1W
Maximum internal Capacitance	Ci	Ci	0
Maximum internal Inductance	Li	Li	0

TABLE 2.

Output parameters For Mercury Instruments 40-5702 TB4			
Open Circuit Voltage	Voc	Uo	5.88V
Short Circuit Current	Isc	Io	32.67mA
Power Output	Pt	Po	48.03mW
Maximum allowable Capacitance	Ca	Co	1uF
Maximum allowable Capacitance	La	Lo	70mH

OPTION 2:
AS A SECOND OPTION THE TXD AND RXD LINES CAN BE CONNECTED WITHOUT CONDUIT VIA CSA CERTIFIED BARRIER HAVING PARAMETERS OF 9V MAX AND 90 ohms MIN SUCH AS MTL 7761 AC

10. TB5 IS FOR CONNECTION TO PULSE OUTPUTS FROM THE EC 350. CONNECTION TO TB5 CAN BE MADE VIA CONDUIT WITH MAX 12 VDC PER NOTE 1, OR WITHOUT CONDUIT TO A CLASS 1, Div 1 OR Div 2 APPROVED BARRIER WITH FOLLOWING SPECIFICATIONS OR PRODUCT WITH ENTITY PARAMETERS MATCHING THE FOLLOWING PARAMETERS.

OPTION 1:
AS A FIRST OPTION CONNECTION TO TB5 PULSE OUTPUT CAN BE CONNECTED WITHOUT CONDUIT VIA CSA CERTIFIED BARRIER HAVING PARAMETERS OF EITHER
a) 15V 100 ohms, SUCH AS MTL 7715+
b) 28V 300 ohms, SUCH AS MTL 7728+

OPTION 2:
AS A SECOND OPTION EACH CHANNEL (CHANNELS IDENTIFIED BELOW) CAN BE CONNECTED TO A CLASS I, Div 2 APPROVED PRODUCT WITH ENTITY PARAMETERS. THESE PULSE RECEIIVERS CAN BE LOCATED IN CLASS I, Div 1/Div 2 OR NON HAZARDOUS LOCATION.

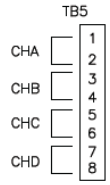
TABLE 1.

Input parameters For Mercury Instruments 40-5702 TB5			
Electrical Parameters	Div Marking	Zone Marking	Value
Maximum input Voltage	V_{max}	Ui	10V
Maximum input Current	I_{max}	Ii	50mA
Maximum input Power	Pi	Pi	125mW
Maximum internal Capacitance	Ci	Ci	4700pF
Maximum internal Inductance	Li	Li	0

THE PARAMETERS OF THE CONNECTED IS APPARATUS MUST MEET THE FOLLOWING CONDITIONS.

Voc/Uo ≤ Vmax/Ui
Isc/Io ≤ Imax/G

Ca/Co ≥ ci + Ccable
La/Lo ≥ Li + Lcable



11. USE OF THE MESSENGER MODEM 40-3000 HAS BEEN EVALUATED AND IS APPROVED FOR CLASS I, DIV 2 HAZARDOUS LOCATIONS, POWER IS CONNECTED AS DISCUSSED IN NOTE 2, SERIAL CONNECTION IS BETWEEN EC 350 TB4 AND MESSENGER MODEM TB1, LAND LINE TELEPHONE LINE TO BE INSTALLED PER NOTE 1.
12. USE OF THE CNI2e 22-2473 HAS BEEN EVALUATED AND IS APPROVED FOR CLASS I, DIV 2 HAZARDOUS LOCATIONS, POWER IS CONNECTED AS DISCUSSED IN NOTE 2. SERIAL CONNECTION IS BETWEEN EC 350 TB5 AND CNI2e TB2.

DIMENSIONS ARE IN INCHES [METRIC mm]
BREAK ALL SHARP EDGES
UNLESS OTHERWISE SPECIFIED TOLERANCES ARE:
FRACTIONAL ± .010 DECIMAL ± .005 ANGLE ± 1/2 °

A	RELEASE	SBB 04/27/2015 2015-1924	

MERCURY INSTRUMENTS
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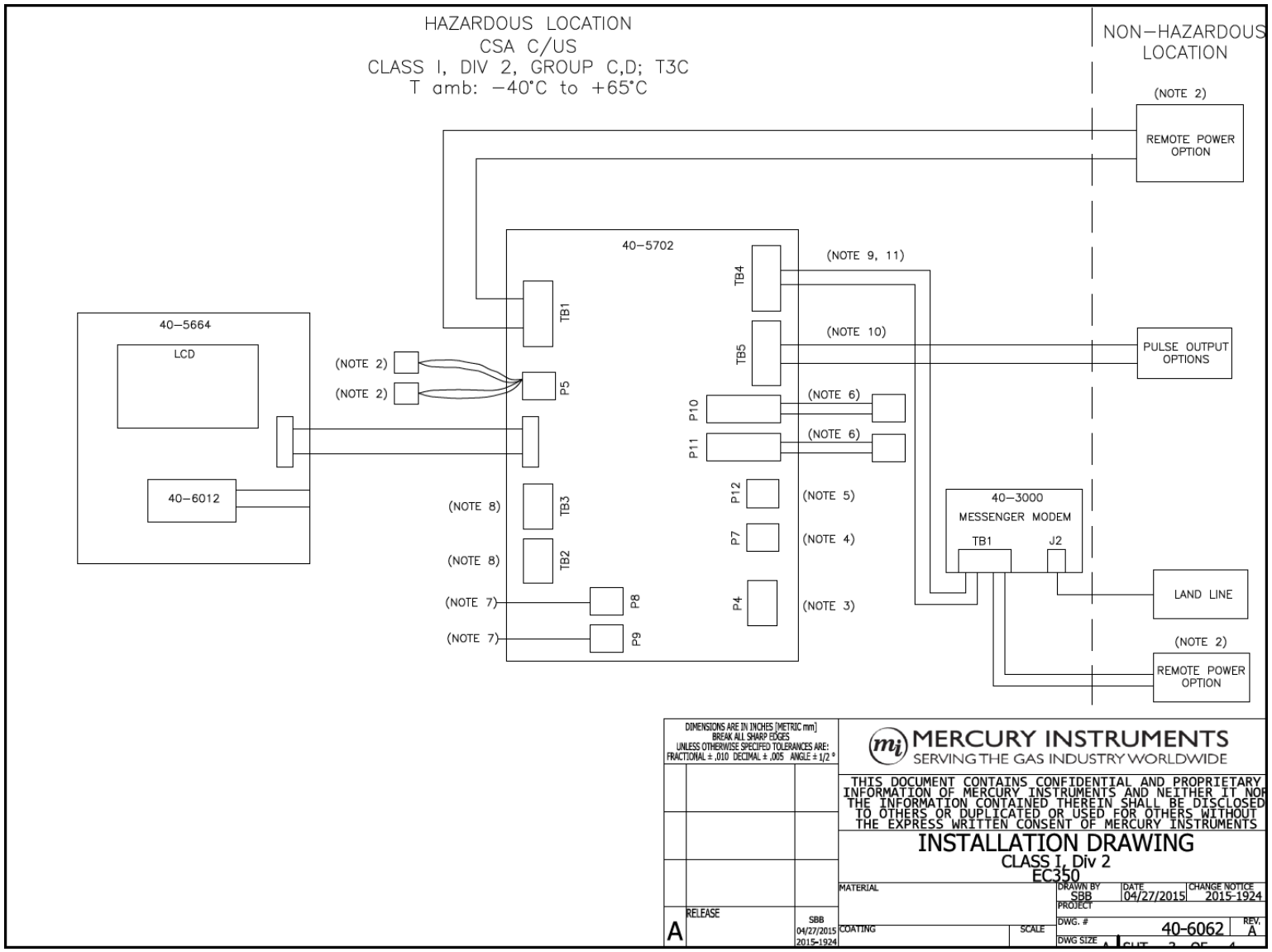
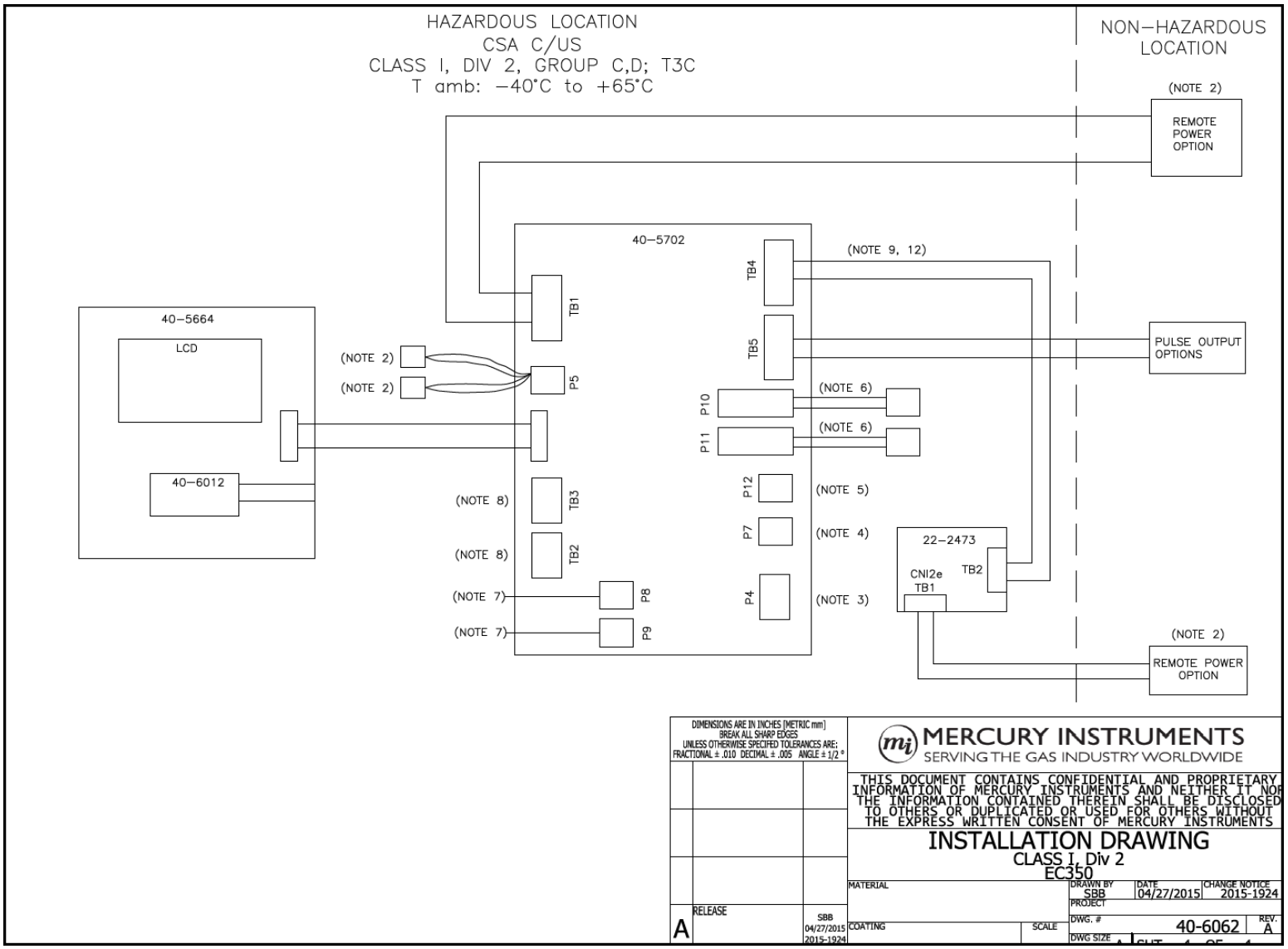
INSTALLATION DRAWING
CLASS I, Div 2
EC350

MATERIAL		DRAWN BY: SBB	DATE: 04/27/2015
		CHANGE NOTICE: 2015-1924	
		PROJECT	
COATING	SCALE	DWG. #: 40-6062	REV.: A
		DWG SIZE: A	SHT 2 OF 4


HAZARDOUS LOCATION
CSA C/US
CLASS I, DIV 2, GROUP C,D; T3C
T amb: −40°C to +65°C
NON−HAZARDOUS LOCATION
(NOTE 2)
REMOTE POWER OPTION
40−5702
TB4
(NOTE 9, 11)
TB1
TB5
(NOTE 10)
PULSE OUTPUT OPTIONS
40−5664
LCD
(NOTE 2)
(NOTE 2)
P5
P10
(NOTE 6)
P11
(NOTE 6)
40−6012
(NOTE 8)
TB3
P12
(NOTE 5)
40−3000
MESSENGER MODEM
TB1
J2
(NOTE 8)
TB2
P7
(NOTE 4)
(NOTE 7)
P8
P4
(NOTE 3)
LAND LINE
(NOTE 7)
P9
(NOTE 2)
REMOTE POWER OPTION
DIMENSIONS ARE IN INCHES [METRIC mm]
BREAK ALL SHARP EDGES
UNLESS OTHERWISE SPECIFIED TOLERANCES ARE:
FRACTIONAL ± .010 DECIMAL ± .005 ANGLE ± 1/2 °
A
RELEASE
SBB
04/27/2015
2015-1924
MERCURY INSTRUMENTS
SERVING THE GAS INDUSTRY WORLDWIDE
THIS DOCUMENT CONTAINS CONFIDENTIAL AND PROPRIETARY INFORMATION OF MERCURY INSTRUMENTS AND NEITHER IT NOR THE INFORMATION CONTAINED THEREIN SHALL BE DISCLOSED TO OTHERS OR DUPLICATED OR USED FOR OTHERS WITHOUT THE EXPRESS WRITTEN CONSENT OF MERCURY INSTRUMENTS
INSTALLATION DRAWING
CLASS I, Div 2
EC350
MATERIAL
COATING
SCALE
DRAWN BY SBB
DATE 04/27/2015
CHANGE NOTICE 2015-1924
PROJECT
DWG. # 40-6062
REV. A
DWG SIZE A


HAZARDOUS LOCATION
CSA C/US
CLASS I, DIV 2, GROUP C,D; T3C
T amb: −40°C to +65°C
NON−HAZARDOUS LOCATION
(NOTE 2)
REMOTE POWER OPTION
40−5702
(NOTE 9, 12)
TB4
TB1
TB5
PULSE OUTPUT OPTIONS
40−5664
LCD
(NOTE 2)
(NOTE 2)
P5
P10
(NOTE 6)
P11
(NOTE 6)
40−6012
(NOTE 8)
TB3
P12
(NOTE 5)
(NOTE 8)
TB2
P7
(NOTE 4)
22−2473
CNI2e
TB1
TB2
(NOTE 7)
P8
P4
(NOTE 3)
(NOTE 7)
P9
(NOTE 2)
REMOTE POWER OPTION
DIMENSIONS ARE IN INCHES [METRIC mm]
BREAK ALL SHARP EDGES
UNLESS OTHERWISE SPECIFIED TOLERANCES ARE:
FRACTIONAL ± .010 DECIMAL ± .005 ANGLE ± 1/2 °
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INSTALLATION DRAWING
CLASS I, Div 2
EC350
RELEASE
A
SBB
04/27/2015
2015-1924
MATERIAL
COATING
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DRAWN BY
SBB
DATE
04/27/2015
CHANGE NOTICE
2015-1924
PROJECT
DWG. #
40-6062
REV.
A
DWG SIZE

CHAPTER 3

3 Securing the device

This chapter describes the different safety and security features of a EC 350 device.

3.1 Case

The case can be locked or tamper sealed with a padlock or seal on the door hasp.

3.2 Metrological protection modes

Item classifications

3.2.1 Item classifications

Each item has a fixed classification – one of those below. Contact Honeywell for classification of each item. These classifications pertain to the access restriction modes below.

Type	ICB Dump Terminology	When Writable	Changes Logged	Example
Always Writable	OPEN	Unless item 139 = 1 (Full Read Only)	If and only if item 139 = 0 or 3	Display list configuration
Read-Only	READONLY	Never (implicitly, per their function)	Never	Battery voltage
Change only if Event Logged	EVENT LOG	If not in Metrological Protection mode OR if event log not full	Always	Gas composition (item 53)
Change only if no restrictions	SEALED	Only if not in metrological protection mode	Always (if changed, but not possible unless 139=0)	Calibration

3.2.2 Access restriction Item 139 configuration options

Item 139	Type	Item Change Restrictions	Event Logging	Firmware Upgradable	Lock Icon
0	Unrestricted	All items (that are not Implicitly Read-Only) can be written.	All item changes are event logged.	Yes	Open
1	Full Read Only	No items may be written.	NA	No	Closed
2	Metrological Event Protection	OPEN items may be modified. SEALED items may not be modified. EVENT items may be modified only if the event log is not full of unread records. (Only log records that have been read can be overwritten.) (This mode corresponds to a Measurement Canada Type B Event Log.)	Only changes to EVENT items are logged. Changes to OPEN items are NOT logged.	No	Closed
3	Metrological Sealed	Only OPEN items may be modified.	All item changes are event logged.	No	Closed
4	Metrological Event Locked	OPEN items may be modified. SEALED items may not be modified. EVENT items may be modified only if the event log is not full of changes since put in protected mode. Reading Event Log has NO affect on allowing write access. Once event log is full of changes since it was put in protected mode (with item 139 change) no more changes to protected items are allowed until item 139 is set back to zero. (This mode corresponds to a Measurement Canada *Type A* Event Log.)	Only changes to EVENT items are logged. Changes to OPEN items are NOT logged.	No	Closed

3.2.3 Event log full note

In modes 2 and 4 (Metrological Event Protection and Metrological Event Locked), changes to EVENT items are blocked *before* overwriting the record that shows the item 139 write putting it into a protected mode. This allows verification that you are seeing *all* of the changes since it was put into a protected mode. In mode 2 it assures that the item 139 change is uploaded, and it mode 4 it assures that the item 139 change is visible in event log in the device.

3.2.4 Changing item 139

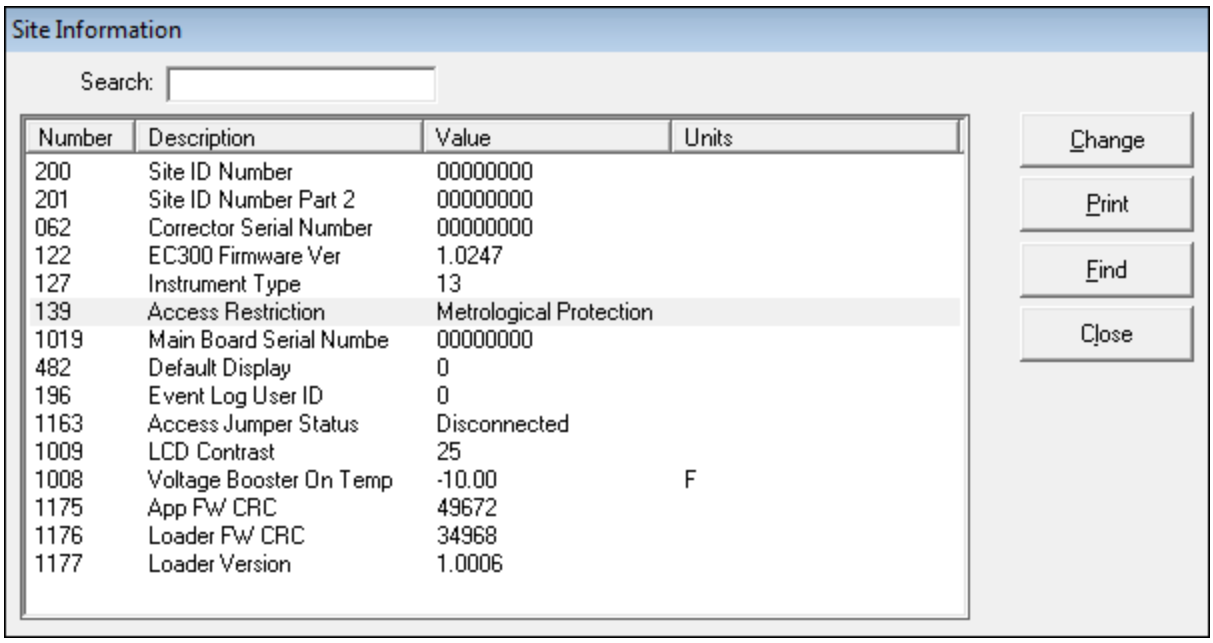
If item 139 is set to any value other than 0 (unrestricted) - it may not be changed unless the METROLOGICAL ACCESS JUMPER is OFF.

> **Attention:** Firmware can be upgraded if either the override jumper is off OR if item 139 is set to unrestricted.

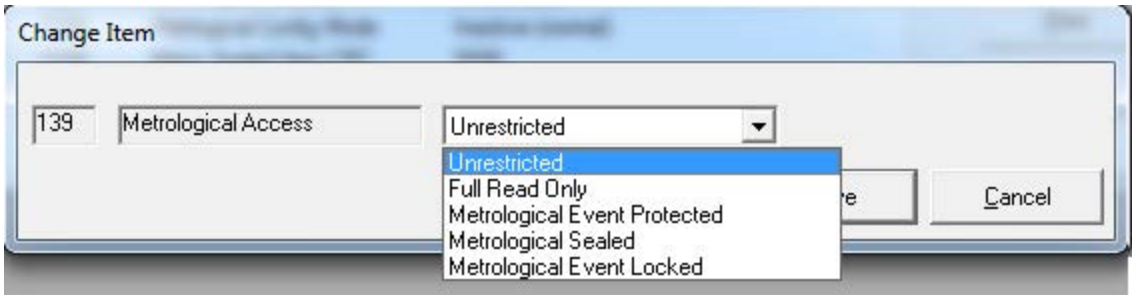
The METROLOGICAL ACCESS JUMPER is located in the lower right corner of the IO Board at the back of the case (labeled “METR JMPR”). If a sealing plate is in place that must first be removed.

3.2.5 Using MasterLinkSQL to change item 139

1. Establish a serial communication between EC 350 and MasterLinkSQL (4.41 or above). Refer to the *MasterLinkSQL User's Guide* for information about establishing a serial connection between EC 350 and MasterLinkSQL.
2. In the MasterLinkSQL window, click **Find Item by Number** icon.
   The **Find Item** dialog box appears.
3. Type **139** and click **OK**.
4. The **Site Information** dialog box appears. The following image illustrates that the **Access Restriction** is set to **Metrological Protection** .



5. Click **Change**.
   The **Change Item** dialog box appears.
6. From the list, select **Unrestricted** and then click **Save**.



The Access Restriction is changed from Metrological Protection to Unrestricted.

7. Disconnect the serial communication between the MasterLinkSQL and EC 350.
8. Restore the METROLOGICAL ACCESS JUMPER.

3.3 Defining access privileges

Access to the EC 350 can be controlled by defining users and assigning them passcodes and privileges. Use MasterLinkSQL (4.41 and above) to set up a User Table and to download it to the device.

- Default User Table
- Creating a user table file
- Sending a user table file

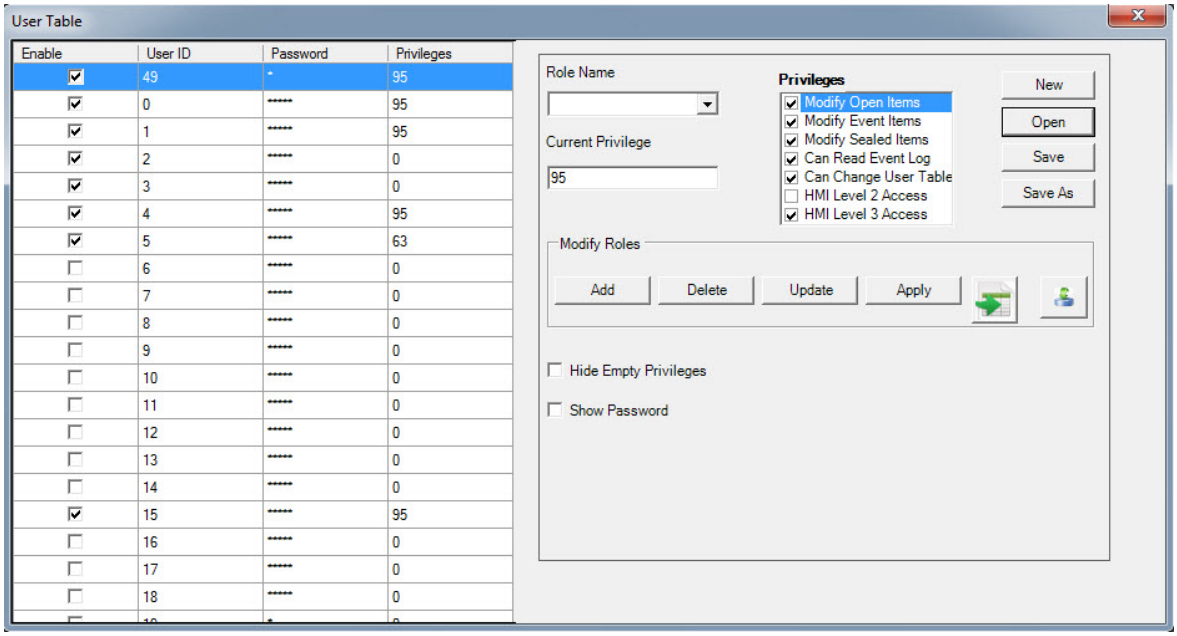
3.3.1 Default User Table

User	Enabled	Passcode	Privileges
0	Yes	33333	All, HMI L3
1	Yes	33333	All, HMI L3
2	Yes	20000	All, HMI L2
3	Yes	30000	All, HMI L3
4-99	No		

Event log records reference this user ID, to identify who made configuration changes.

Full use of multi-user features requires host software supporting the SS protocol command. For backwards compatibility with host software that only supports the older SN sign on command (which does not support multiple users), the user 0 passcode is required for sign on via the SN command. In that case all configuration changes made through an SN sign on are attributed to user 0 in the event log records. The legacy item 196 (event log user ID) is not supported.

The screenshot below shows a typical User Table.



Valid user IDs are 0 through 99 (decimal numeric). Valid passcodes are 0 through 99999 (decimal numeric).

The following privileges can be granted or denied users:

- MODIFY OPEN ITEMS
- MODIFY EVENT ITEMS
- MODIFY SEALED ITEMS
- READ EVENT LOG
- USER TABLE DOWNLOAD
- HMI LEVEL 2 ACCESS
- HMI LEVEL 3 ACCESS

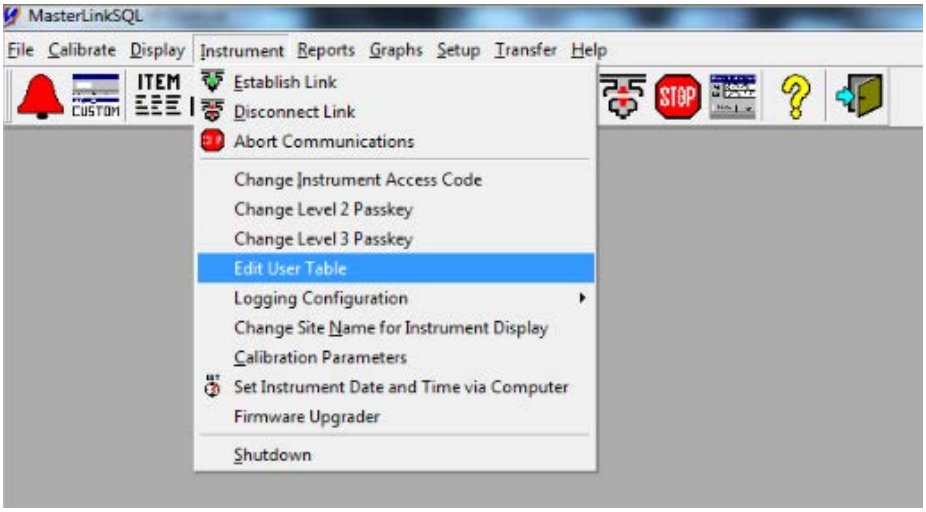
OPEN, EVENT, and SEALED are three classifications of items (the other classification is READONLY, which cannot be modified with any privilege).

A user granted level 3 HMI access will enter level 3 HMI menus after entering their user ID and password into the HMI (regardless of whether they are granted level 2 access). To allow a user to enter level 2, they must not be granted level 3 access. A single user can either have level 2 HMI access or level 3 HMI access or neither, but may not access both level 2 and 3.

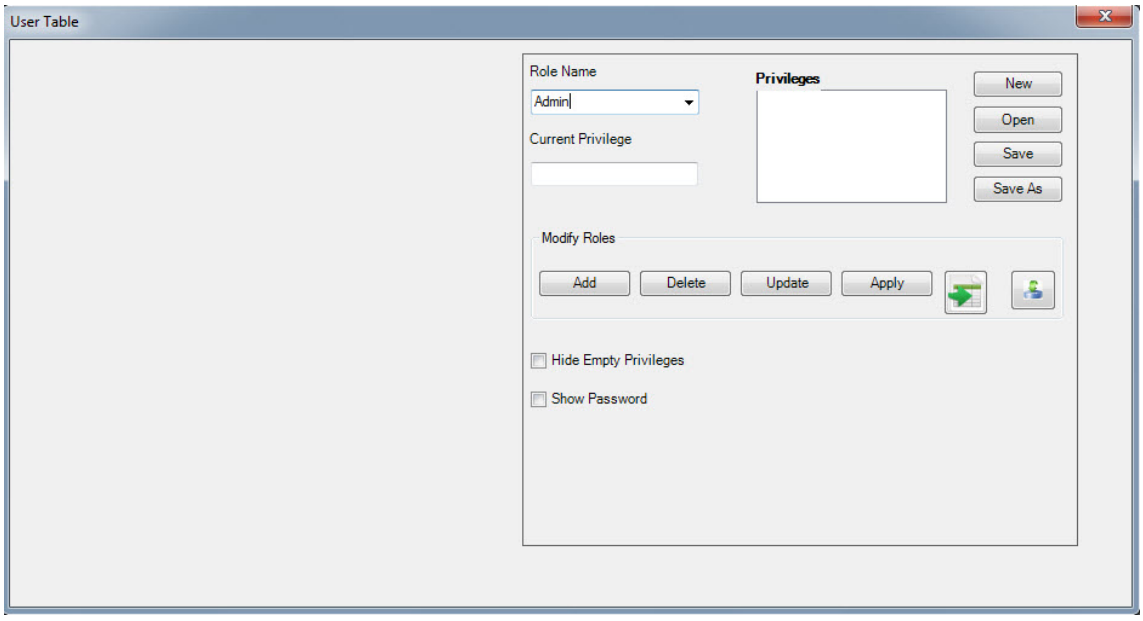
3.3.2 Creating a user table file

To create a user table file:

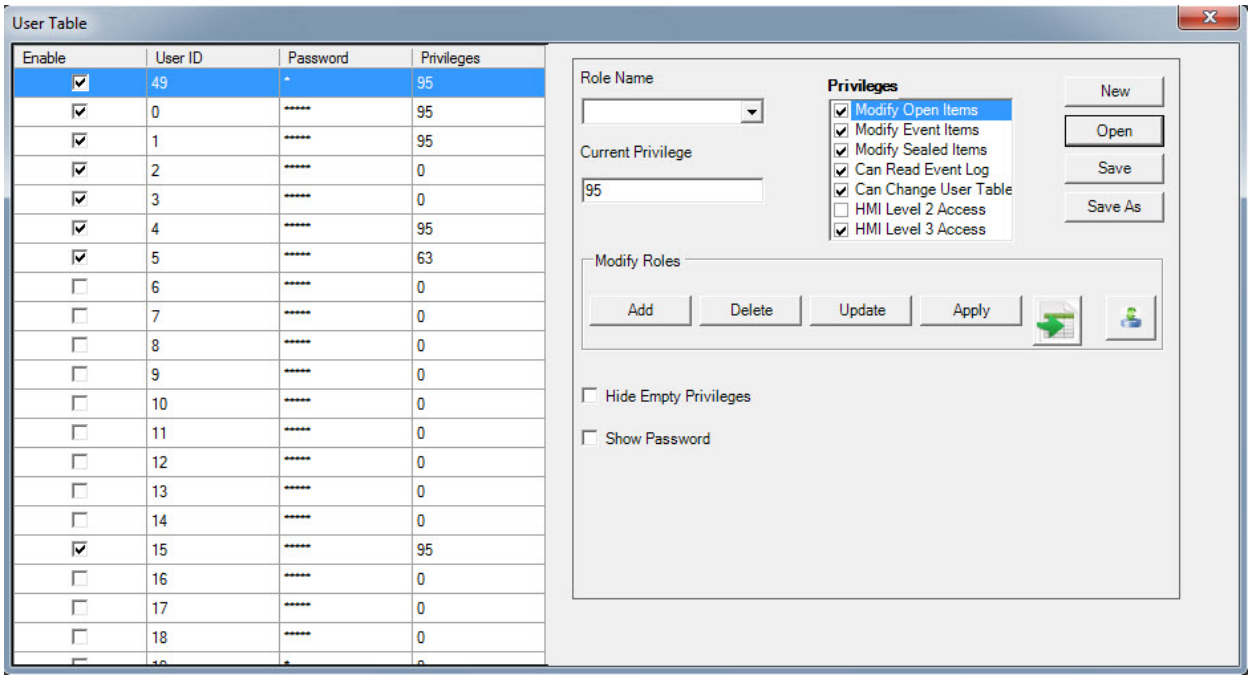
1. Establish a serial communication between EC 350 and MasterLinkSQL. Refer to the *MasterLinkSQL User's Guide* for information about establishing a serial connection between EC 350 and Master-LinkSQL.
2. In the **MasterLinkSQL** window, click **Instrument > Edit User Table**.



3. In the **User Table** dialog box, click **New**.



4. Enter **User ID** and **Password** and select the privileges to want to grant to the user under **Privileges**.

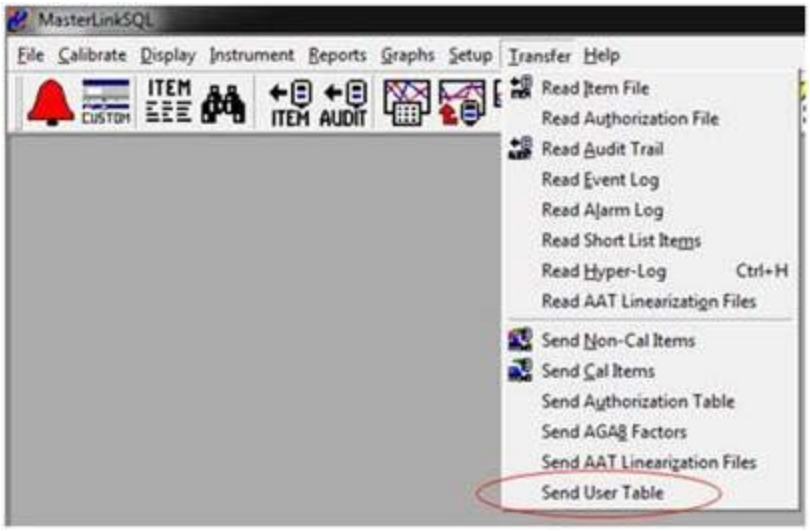


5. Click **Apply** to save the privileges for the newly created user.
6. Click **Save**.
   The **Save User Table File As** dialog box appears.
7. Enter a filename and click **OK**.
   The **Choose Password** dialog box appears.
8. Enter a password and click **OK**. This password is required when you want to send the user table file.

3.3.3 Sending a user table file

To send a user table file:

1. Establish a serial communication between EC 350 and MasterLinkSQL. Refer to the *MasterLinkSQL User's Guide* for information about establishing a serial connection between EC 350 and Master-LinkSQL.
2. In the **MasterLinkSQL** window, click **Transfer > Send User Table**.



The EC 350 ships in unsecure mode with default passwords. Change the default passcodes at least to secure the device.

> **Note:** For convenient device access by users choosing not to secure their devices, Master-LinkSQL will attempt to access user 0 with the default passcode and will only prompt the user if that fails.

3.4 Metrological configuration mode

A special operational mode is available which may be useful when making configuration changes to an instrument already in service. Most changes would not require this, but if multiple changes are being made and there could be dependencies between those changes (in particular if the instrument would measure incorrectly if it received a volume pulse from the meter while the changes are still in progress – only partially completed). The mode is called Metrological Configuration Mode. In this mode, input volume pulses are queued but not processed, and Pressure and Temperature measurements are deferred. Processing continues normally after you exit the mode, with the queued input volume pulses handled per the new configuration.

You enter and exit the mode either through the HMI (L2.9 and L3.11 MET CONFIG), or through Master-Link by setting/clearing item 1239.

Note: The mode will also be exited automatically on an exit from HMI mode (either explicitly or by inactivity time-out) and likewise on a serial comm (MasterLink) disconnect from the instrument (either explicit or by inactivity time-out). (It will exit the mode on either HMI or Serial exit, regardless of which was used to activate the mode.)

3.5 Validating setup configuration

After installing EC 350 on the meter and updating its configuration settings, ensure to perform the following final checkout tasks:

- Verify the pulse input. Refer to the section “Testing the pulse input”.
- Verify corrected and uncorrected volume. Refer to the section “Selecting the unit of measure”.
- Verify pressure/temperature factors. Refer to the section “Verifying pressure” or "Verifying temperature".

CHAPTER 4

4 Key features

This chapter describes the key features of an EC 350 device.

4.1 Volume measurement

EC 350 generally operates in the Corrector mode. In this mode, EC 350 receives and processes uncorrected volume, pressure, and temperature inputs to produce corrected volume information.

The following image illustrates a typical Corrector mode display.

1. Top line of LCD display indicates the totalized corrected volume value.
2. Second line indicates the corrected volume unit of measure (e.g. MCF).
3. Third line indicates the item's name (e.g. CORVOL, which is corrected volume).
4. Bottom line shows active icons to indicate various system status information.

4.1.1 Corrected volume

EC 350 accurately measures and maintains the total uncorrected volume passing through the meter on which it is installed. In addition to the uncorrected volume, EC 350 also computes the corrected volume.

The corrected volume is computed by multiplying a *total correction factor* by the uncorrected volume input from the meter.

EC 350 maintains items called *Hi-Res* (High Resolution) volumes for indicating a fractional part of the corrected and uncorrected volumes that are not visible in the primary items (0 and 2).

Total Correction Factor = Temperature Factor X Pressure Factor X Auxiliary Factor (normally 1.0) X Squared Supercompressibility Factor.

EC 350 supports a large range of units for measuring volume; some of them are as follows:

CF, CFx10, CFx100, CCF, CFx1000, MCF, CFx10000, m3x0.1, m3, m3x10, m3x100, and m3x1000.

You can independently configure corrected and uncorrected volume items.

4.1.2 Uncorrected volume

The gas flowing through rotary meter is measured by multiplying the input signals supplied by the two redundant volume sensors with the appropriate scaling factor (in item 114) for a particular rotary meter (selected in item 432). Generally, 114 value is set automatically when the meter model is selected, but 114 can also be set manually for other meters models.

Currently, EC 350 supports over 140 meter models explicitly. Others can be supported with manual configuration.

4.1.3 Energy

In addition to the corrected and uncorrected volume, EC 350 also calculates the energy (in item 140) corresponding to the corrected volume, based on a fixed user-configurable conversion factor (item 142).

EC 350 supports a large range of units for measuring energy; some of them are as follows: Therms, Decatherms, Mega Joules, Giga Joules, Kilo Calories, and Kilo Watts.

Refer to the section "Items reference" for information about *Energy (item 140)*, *Energy units (item 141)*, and *Gas energy value (item 142)* .

4.1.4 Volume statistics

The EC 350 supports numerous gas volume statistical related items (Mins. Maxs, Peaks, Avgs) for Cor-Vol, Unc-Vol, Flow rate, and Dial rate.

Refer to "Items reference" for information about the gas volume statistical Items.

4.1.5 Volume Input Modes

Refer to the "Items reference" for information about Input volume mode (item 433) and Rotary Integral mount (item 432).

4.1.5.1 UMB, Instrument Drive & Remote input

EC 350 supports gas volume measurement from UMB (Universal Mounting Bracket) and Instrument Drive interfaces. Select the meter model from the list provided from item 432. If the meter is not in the list, use item 433 to set selection: LF-UMB/Instrument Drive and configure meter index rate (item 98) and meter scaling (item 114) to match the application. Note that item 114 is typically set to value 1.000.

Note that two switch inputs are normally used in these applications to provide for switch input redundancy (one switch can backup the other).

4.1.5.2 Direct Rotary mount input

EC 350 supports gas volume measurement from directly mounted Rotary meters. Select the meter model from the list provided from item 432. In doing so, the EC 350 will automatically set items 114 to its proper value based on item 439. Note that item 98 is not used in Direct mount rotary and is assumed to be value 1.0 CF or 1.0 m3 depending on Volume units. Item 433 will also be set automatically to low resolution mode for rotary input. Low resolution rotary mode uses a pulse input divider to increase battery life while still proving adequate volume measurement resolution.

For direct-mount Rotary configurations only, EC 350 also supports an option called high resolution mode for obtaining a higher degree of gas volume measurement resolution. Use the Input volume mode (item 433) for selecting the high resolution mode option. In this mode, EC 350 measures the gas volume using a very low divider ratio for the input signals supplied by the two volume input sensors. In low resolution rotary mode, the divider ratio is much higher for making a sensible trade-off between the measurement resolution and the instrument battery life. High resolution mode is a useful test and verification tool for obtaining accurate volume measurement within a shorter period of time (less gas passing through the meter) – but consumes more battery power.

Note: EC350 battery life specifications are based on using the low resolution mode (not high resolution).

4.1.5.3 Bidirectional volume or Reverse flow

EC 350 supports another volume input option called Bidirectional volume input mode (Reverse flow) for obtaining gas volume measurement in applications where flow direction is desired. Two configuration options are possible for Bidirectional volume modes: Forward direction = Clockwise rotation, and Forward direction = Counter-clockwise direction. Use the Input volume mode (item 433) for selecting either of these two input mode options.

Listed here are the main volume items used for Bidirectional mode:

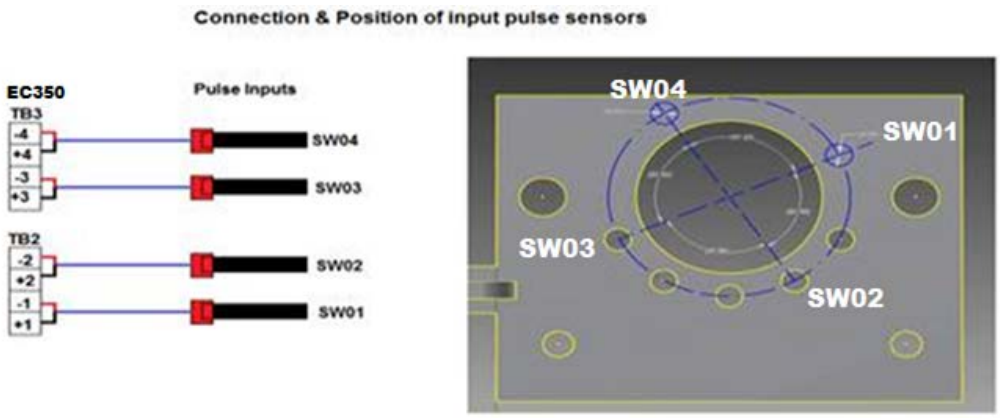
- CorVol (item 000) – always counts up regardless of rotation direction
- UncVol (item 002) – always counts up regardless of rotation direction
- Forward CorVol (item 896) – counts up based solely on forward rotation direction per item 433 configuration
- Forward UncVol (item 898) – counts up based solely on forward rotation direction per item 433 configuration
- Reverse CorVol (item 902) – counts up based solely on reverse rotation direction per item 433 configuration

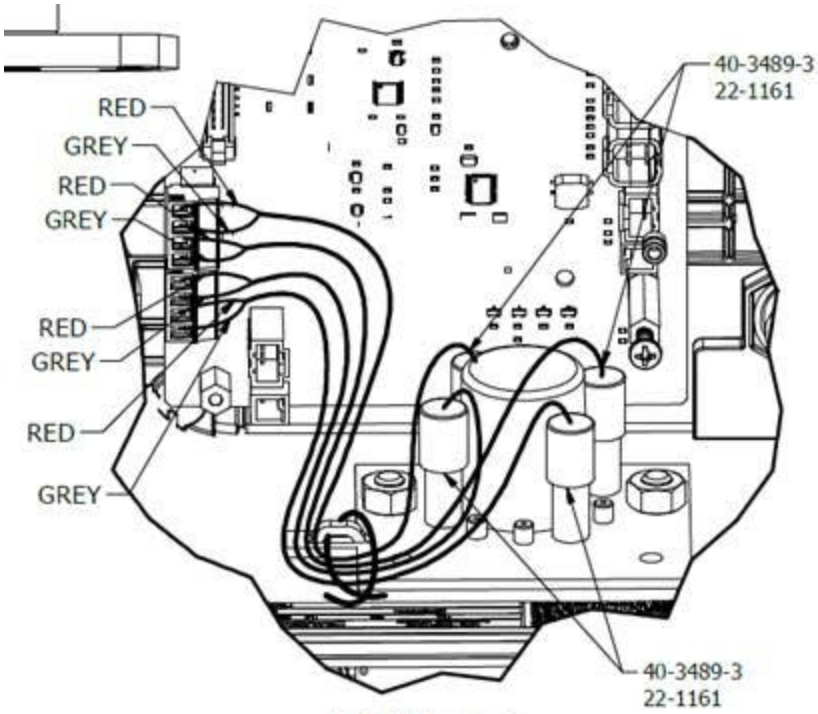
- Reverse UncVol (item 906) – counts up based solely on reverse rotation direction per item 433 configuration
- Net CorVol (item 900) – is the difference between Forward and Reverse Cor-Vol (item 896 – item 902)
- Net UncVol (item 904) – is the difference between Forward and Reverse Cor-Vol (item 898 – item 906)

Four switch sensors are utilized in Bidirectional volume mode to allow for direction detection as well as redundancy protection. If one of the four switch sensors is not detected after completing a full revolution, the EC 350 will trigger a switch Alarm for that particular 'missing' switch sensor. For example: switch sensor input sequence of: 1-2-4-1-2... will trigger a Switch-3 sensor Alarm.

Attention: Three switch sensors are required to count volume input. If two switch sensors fail the EC 350 will trigger a switch Alarm for the second 'missing' switch sensor and will then stop counting Volume input as it can no longer distinguish between back and forth partial rotations and full rotations. Example: switch sensor input sequence of: 1-3-1-3-1 can either be partial rotation or full rotation

Bidirectional volume mode has four switch sensors installed on the switch plate where standard UMB/ID input has only two switch sensors installed. Shown below is wiring and switch plate diagram for Bidirectional Volume. Also see: 'section, " Changing the drive rotation ", to position the bevel-gear thimble of EC 350 to ensure the reading rotates in the desired direction of rotation.





DETAIL D-3

CORRECTED SWITCH (REVERSE FLOW)
(SWITCH POSITION: 3, 4, 5, 7)

4.2 P-T-Z Measurement

4.2.1 Gas Pressure

Gas pressure is measured on a time-based approach (every 30 seconds), as opposed to being based on volume input. With each 30 second measurement, the gas pressure correction factor is computed and high and low Pressure alarms are checked (regardless of flow rate conditions).

The EC 350 uses a high resolution analog to digital conversion process to produce a very accurate final reading.

Up to two Pressure Transducer can be used with the EC 350. The Pressure Transducer connected to the P1 input is used for computing the Gas pressure correction factor (item 044). If a second Pressure transducer is connected at P2 input, this serves to monitor pressure but is not used for correction. Gas pressure measurement can be disabled for either transducer by use of items 1052 (P1 Enable) or 1053 (P2 Enable).

Refer to “Items reference” for information about the following pressure items and several other additional pressure Items.

- Gas Pressure (item 008)
- Gas Pressure units (item 087)
- Gas Pressure no. of decimal points (item 088)
- Pressure correction factor (item 044)
- Base Pressure (item 013)
- Atmospheric Pressure (item 014)
- Pressure Low alarm (item 143)
- Pressure Low alarm limit (item 011)
- Pressure High alarm (item 145)
- Pressure High alarm limit (item 010)

4.2.1.1 Gas Pressure statistics

EC 350 supports various pressure statistical items.

Following are several of the P1 pressure statistical items:

- P1 Max pressure (item 285)
- P1 Max pressure date (item 287)
- P1 Max pressure time (item 286)

- P1 Min pressure (item 289)
- P1 Min pressure date (item 291)
- P1 Min pressure time (item 290)
- Prev day average P1 pressure (item 185)
- P1 Interval average pressure (item 206)
- P1 Interval high pressure (item 214)
- P1 Interval low pressure (item 215)
- P1 Daily average pressure (item 256)
- Following are several of the P2 pressure statistical items:
- P2 Interval average pressure (item 421)
- P2 Interval high pressure (item 422)
- P2 Interval low pressure (item 423)
- P2 Daily average pressure (item 424)
- P2 Previous daily average pressure (item 425)
- P2 Max pressure (item 426)
- P2 Max pressure time (item 427)
- P2 Max pressure date (item 428)
- P2 Min pressure (item 429)
- P2 Min pressure time (item 430)
- P2 Min pressure date (item 431)

4.2.1.2 Fixed Gas pressure

The EC 350 can be configured to function as a fixed pressure device by setting item 109 to fixed pressure. In this mode, the pressure value configured in item 1161–Fixed pressure value (instead of the live pressure at item 8) is used for pressure correction.

Refer to “Items reference” for information about the gas temperature statistical items.

4.2.2 Gas Temperature

EC 350 Gas temperature is measured on a time-based approach (every 30 seconds), as opposed to being based on volume input. With each 30 second measurement, the gas temperature correction factor is computed and high and low Temperature alarms are checked (regardless of flow rate conditions).

The EC 350 uses a high resolution analog to digital conversion process to produce a very accurate final reading.

Only one Temperature probe can be used with the EC 350. The Temperature probe is used for computing the Gas temperature correction factor (item 045). Gas temperature measurement can be disabled for either transducer by use of item 1055 (T1 Enable).

Refer to “Items reference” for information about the following temperature items and several other additional temperature Items.

- Gas temperature (item 026)
- Gas temperature units (item 089)
- Temperature correction factor (item 045)
- Base temperature (item 034)
- Temperature low alarm (item 144)
- Temperature low alarm limit (item 027)
- Temperature high alarm (item 146)
- Temperature high alarm limit (item 028)

4.2.2.1 Temperature statistics

EC 350 supports various gas temperature statistical items. Following are the supported gas temperature statistical items:

- Interval high gas temperature (item 216)
- Interval low gas temperature (item 216)
- Daily average gas temperature (item 257)
- Previous day gas temperature (item 186)
- Max gas temperature (item 293)
- Max gas temperature date/time (item 294/295)
- Min gas temperature (item 297)
- Min gas temperature date/time (item 298/299)

4.2.2.2 Fixed Gas temperature

The EC 350 can be configured to function as a fixed temperature device by setting item 111 to fixed temperature. In that mode, the temperature value configured in item 1162–Fixed temperature value (instead of the live temperature at item 26) is used for temperature correction.

4.2.3 Supercompressibility

Gases actually behave in a manner slightly different from what the ideal gas laws indicate. This deviation depends on the molecular composition of the gas as well as the pressure and temperature. Natural gas, for instance, compresses by a greater amount than that computed by Boyle's law and hence the term "supercompressibility" is used for this deviation. It is small at very low pressure, but becomes substantial as the pressure increases.

4.2.3.1 Supercompressibility Factor

Gases actually behave in a manner slightly different from what the ideal gas laws indicate. This deviation depends on the molecular composition of the gas as well as the pressure and temperature. Natural gas, for instance, compresses by a greater amount than that computed by Boyle's law and hence the term "supercompressibility" is used for this deviation. It is small at very low pressure, but becomes substantial as the pressure increases. The EC 350 automatically applies the supercompressibility factor and therefore the equation for total volume correction that EC 350 applies to metered volume is expressed as:

$Vb = Vm * Fp * Ft * (Fpv)^2$

Where:

- Vb (item 0) = volume corrected to base conditions
- Vm (item 2) = volume from the meter (at measured conditions)
- Fp (item 44) = pressure factor
- Ft (item 45) = temperature factor
- Fpv (item 47) = supercompressibility factor per NX-19 or AGA-8 standard (derived for orifice meters)
- (Fpv)2 (item 116) = supercompressibility factor used for diaphragm, rotary, and turbine meters

The EC 350 can calculate the supercompressibility factor according to the following standards:

- AGA-8
    - Gross method 1
    - Gross method 2
    - Detail method
- NX-19

4.2.3.2 Item Description for Supercompressibility factors

Item Number	Item Description	NX-19	AGA-8 Gross Method1	AGA-Gross Method2	AGA-8 Detail
147	SuperCompress Tbl Used	✓	✓	✓	✓
53	Specific Gravity	✓	✓	✓	
142	Gas Energy Value		✓		
141	Gas Energy Units		✓		
54	% Nitrogen	✓		✓	✓
55	% Carbon Dioxide	✓	✓	✓	✓
373	% Methane				✓
374	% Ethane				✓
375	% Propane				✓
376	% Iso-Butane				✓
377	% N-Butane				✓
378	% Iso-Pentane				✓
379	% N-Pentane				✓
380	% N-Hexane				✓
381	% N-Heptane				✓
382	% N-Octane				✓
383	% N-Nonane				✓
384	% Hydrogen Sulfide				✓
385	% Hydrogen				✓
386	% Helium				✓
387	% Oxygen				✓
388	% Carbon Monoxide				✓
389	% Argon				✓

Item Number	Item Description	NX-19	AGA-8 Gross Method1	AGA-Gross Method2	AGA-8 Detail
390	% N-Decane				✓
391	% Water				✓
34	Base Temperature	✓	✓	✓	✓
13	Base Pressure	✓	✓	✓	✓
26	Flow Temperature*	✓	✓	✓	✓
8	Flow Pressure*	✓	✓	✓	✓
1161	Fixed Pressure Value*	✓	✓	✓	✓
1162	Fixed Temperature Value*	✓	✓	✓	✓

Note: (*) Items 8 and 26 are live readings (not user configurable). They are used for super-compressibility calculations when pressure and/or temperature calculations are “live” per items 109 and 111, respectively. If pressure and/or temperature is fixed, items 1161 and/or 1162 (user configurable fixed pressure and fixed temperature values, respectively) are used instead of items 8 and/or 26 in supercompressibility calculations.

4.3 Meter proving

The public utility commissions or various governmental regulations may require you to check the accuracy of the actual volume of gas flowing through a gas meter. Prover devices such as the Dresser Model 5 Prover and the Elster/American Meter SNAP Sonic Nozzle Prover are used for verifying the accuracy of the volume of gas flowing through a gas meter. Prover devices pass a known volume and temperature of gas through the meter being tested. They compare their own standard volume to the volume reported by EC 350, which is mechanically connected to the rotary gas meter.

EC 350 uses switch closure pulse counts for providing volume data to the Prover device. The meter bodies and EC 350 are tested at various rates such as 10%, 50%, and 100% of rated capacity. You can connect EC 350 to a prover to test both uncorrected and temperature corrected volumes.

EC 350 has a special operating mode that makes meter proving process very easy and fast. This mode is called *Pushbutton Proving* . No special configuration settings are required to use the *Pushbutton Proving* feature of EC 350.

- Connecting the USB cable to the prover dongle
- Proving dongle indicators
- Starting Pushbutton proving
- Volume per proving output pulse

4.3.1 Connecting the USB cable to the prover dongle

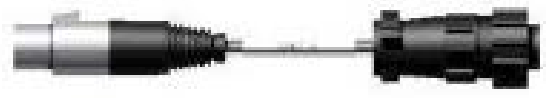
The following image illustrates a proving kit.

The proving kit includes the following components for connecting the EC 350 to a Dresser Model 5 Prover:

- EC 350 prover dongle
- Cable assembly (USB and Model 5 connectors)
- Magnetic coupler

4.3.1.1 Cable adapter for the SNAP prover system

The cable adapter assembly is used with an Elster/American Meter SNAP prover system. This cable adapter is included in the 40-4913-1 prover kit along with all of the components in the 40-4913 base prover kit. The following image illustrates the cable adapter for the SNAP prover system.



4.3.2 Proving dongle indicators

4.3.2.1 Proving dongle

The infrared prover dongle is a device that can be connected to the IrDA data port on EC 350. It receives IR LED pulses from EC 350 and converts the appropriate pulses into electronic switch contacts. This allows a rotary meter with the EC 350 to be tested as a unit without breaking the meter seal. The following image illustrates an IR proving dongle.

Prover dongle indicators

The following image illustrates a prover dongle indicators.

- PULSE: A red light appears to indicate that the electronic switch to the Model-5 prover is closed.
- LINKED: A green light appears to indicate that EC 350 and the prover dongle are synchronized. This must be ON when you are in the *Pushbutton Proving* mode.
- CPU OK: A yellow light appears to indicate that the prover dongle is powered and is operational. Ensure that the yellow light is always ON during operation. If the light goes off, it indicates that the prover dongle does not receive the 5V power supplied by the computer.

4.3.3 Starting Pushbutton proving

The basic operation of the *Pushbutton Proving* mode is as follows:

1. The prover dongle receives uncorrected or temperature corrected volume in the form of infrared light pulses from EC 350.
2. The prover dongle converts the received infrared light pulses to electronic switch closure pulses that can be handled directly by the supplied prover.
3. These electronic switch closure pulses are sent to the prover. Each electronic switch closure pulses represents either one (1), ten (10), or one hundred (100) cubic feet of gas volume, depending upon the model of the rotary meter.
4. When EC 350 is in *Meter Proving* mode, the volume pulse inputs from the meter are read at a much higher resolution than what is normally processed. This allows the most rapid proving cycle time for a given accuracy. Most proving runs can be accomplished within 60 seconds.
   Attention: When EC 350 is in *Pushbutton Proving* mode, the IrDA Serial communications are disabled. Before you enter the *Pushbutton Proving* mode, ensure that the prover dongle is connected to EC 350.

   - Entering Pushbutton Proving mode

4.3.3.1 Entering Pushbutton Proving mode

To enter Pushbutton Proving mode:

1. Unlock the keypad and type the **PASSCODE** to enter level 3 mode. Refer to the section "Accessing level 3 configuration mode" for accessing level 3 mode. By default, in level 3 mode the following appears on the display.
   MAIN MENU

   ALARMS
2. Using the **UP arrow** and **DOWN arrow** scroll through the options in level 3 mode until **MTR PROVER** appears.
3. Press **OK**. The following appears on the display.
   UC

   IDIAL RATE

   This represents the current meter Dial Rate for uncorrected volume.
4. Press and hold **OK** for five seconds. The following message appears on the LCD.
   PROVE

   UC

This indicates that EC 350 is in *Pushbutton Proving* mode.

5. To exit uncorrected proving and proceed on with temperature corrected proving, press **OK**. The following message appears on the display.
   UC

   IDIAL RATE
6. Press the **DOWN arrow**, the following appears on the display.
   TC

   IDIAL RATE

   This represents the current meter Dial Rate for temperature corrected volume.
7. Press and hold **OK** for five seconds. The following message appears on the LCD.
   PROVE

   TC

This indicates that EC 350 is in *Pushbutton Proving* mode.

4.3.4 Volume per proving output pulse

In *Pushbutton Proving* mode, EC 350 writes electronic switch closure pulses to the prover system with a predefined volume scaling factor of: one (1), ten (10), or one hundred (100) cubic feet (CF) of gas volume, depending upon the rotary meter model *Rotary integral mount (item 432)* . The following table represents the predefined volume scaling factor for the rotary meter models.

	Output Pulse Amount		
	1.0 CF	10.0 CF	100.0 CF
Dresser B3 Meters	B3 8C175 200	B3 23M175	
	B3 11C175 200	B3 23M232	
	B3 15C175 200	B3 38M175	
	B3 1M300	B3 56M175	
	B3 2M175 200		
	B3 3M175 300		
	B3 5M175		
	B3 7M175		
	B3 11M175		
	B3 16M175		
Dresser LMMA Meters	LMMA 1dot5M	LMMA 23M	LMMA 102M
	LMMA 2M	LMMA 38M	
	LMMA 3M	LMMA 56M	
	LMMA 5M		
	LMMA 7M		
	LMMA 11M		
	LMMA 16M		

	Output Pulse Amount		
	1.0 CF	10.0 CF	100.0 CF
Elster RPM Meters:	RPM 9C		
	RPM 1dot5M		
	RPM 2M		
	RPM 3dot5M		
	RPM 5dot5M		
	RPM 7M		
	RPM 11M		
	RPM 16M		
Romet RM Imperial Meters	RM600	RM38000	
	RM1000	RM56000	
	RM1500		
	RM2000		
	RM3000		
	RM5000		
	RM7000		
	RM11000		
	RM16000 24		
	RM16000 20		
	RM23000		
	RM25000		

	Output Pulse Amount		
	1.0 CF	10.0 CF	100.0 CF
Romet RM Metric Meters	RM16	RM700	
	RM30	RM1100	
	RM40	RM1600	
	RM55		
	RM85		
	RM140		
	RM200		
	RM300		
	RM450		
	RM650		
Romet G series Metric Meters:	G10	G400	
	G16	G400 150	
	G25	G650	
	G40	G1000	
	G65		
	G100		
	G160		
	G250		

4.4 Alarms

EC 350 monitors a list of parameters and compares their measured values to configurable limits to determine if a fault condition has occurred. When any of these measured parameters has exceeded their respective limit, EC 350 will create an Alarm.

EC 350 currently supports monitoring eight (8) parameters and supplies an Alarm Item for each. Shown below are the eight Alarm Items.

Alarm Item	Alarm Item No.	Alarm Limit Item	Alarm Limit Item No.	Basic Operational Description
Battery Low	99	Battery Low Limit	49	Battery life remaining < set limit
Battery Cycles Alarm	100	Battery Months Remaining	1001	Battery life months remaining < set limit
Volume Sensor 1	102	n/a	n/a	Internal tests
Volume Sensor 2	103	n/a	n/a	Internal tests
System Alarm	104	n/a	n/a	Internal tests
Pressure Low	143	Pressure low limit	11	Gas pressure < set low limit
Pressure High	145	Pressure high limit	10	Gas pressure > set high limit
Temperature Low	144	Temperature low limit	027	Gas temperature < set low limit
Temperature High	146	Temperature high limit	028	Gas temperature > set high limit
Flow Rate high	163	Flow rate high limit	164	Flow rate > set high limit
Daily Cor volume	222	Daily cor volume limit	221	Daily CorVol > set limit
P2 Press High Alarm	451	P2 Press High Alarm Limit	455	Alarm is raised when P2 goes above its high limit
P2 Press Low Alarm	452	P2 Press Low Alarm Limit	456	Alarm is raised when P2 goes below its low limit

Alarm Item	Alarm Item No.	Alarm Limit Item	Alarm Limit Item No.	Basic Operational Description
Extern Supply Low Alarm	796	External Supply Low Limit	795	Alarm is raised when external supply voltage goes below its low limit
Super Compress Alarm	1025	n/a - internal error	n/a - internal error	Any one of several errors in super comp calculation process
Metro Cnfg Chng Alarm	1035	n/a - internal error	n/a - internal error	An attempt was made to change an item not appropriate for current metrological state / jumper
P1 Transducer Alarm	1058	n/a - internal error	n/a - internal error	Any one of several internal failures of pressure transducer
P2 Transducer Alarm	1059	n/a - internal error	n/a - internal error	Any one of several internal failures of pressure transducer
Temp Probe Alarm	1335	n/a - internal error	n/a - internal error	Any of several internal failures of probe itself
Comms Login Alarm	1388	n/a - internal error	n/a - internal error	Attempt to login serially with invalid credentials
HMI Login Alarm	1392	n/a - internal error	n/a - internal error	Attempt to login to HMI with invalid credentials
Alarm Log Record CRC Alarm	1409	n/a - internal error	n/a - internal error	if > 0, some number of corrupt records were encountered during record search/read
Event Log Record CRC Alarm	1410	n/a - internal error	n/a - internal error	if > 0, some number of corrupt records were encountered during record search/read
Audit Log Record CRC Alarm	1411	n/a - internal error	n/a - internal error	if > 0, some number of corrupt records were encountered during record search/read
Vol Sensor-3 Alarm	1424	n/a - internal error	n/a - internal error	malfunction indicated by volume sensor 3
Vol Sensor-4 Alarm	1425	n/a - internal error	n/a - internal error	malfunction indicated by volume sensor 4

Report By Exception (RBX)

RBX (Report By Exception) is an alarm mode that is enabled via item 165. RBX controls the behavior of the following alarms.

- Pressure 1 High
- Pressure 1 Low
- Temperature High
- Temperature Low
- Pressure 2 High
- Pressure 2 Low
- Flow Rate High

When enabled, the RBX function automatically clears an instrument alarm after an alarm parameter has returned to its normal operating range, buffered by a user specified deadband (hysteresis). The deadband values are specified in items 166 (Pressure 1), 167 (Temperature), 169 (Flow Rate), and 459 (Pressure 2). When disabled, the alarms remain in their current state until the user manually clears it.

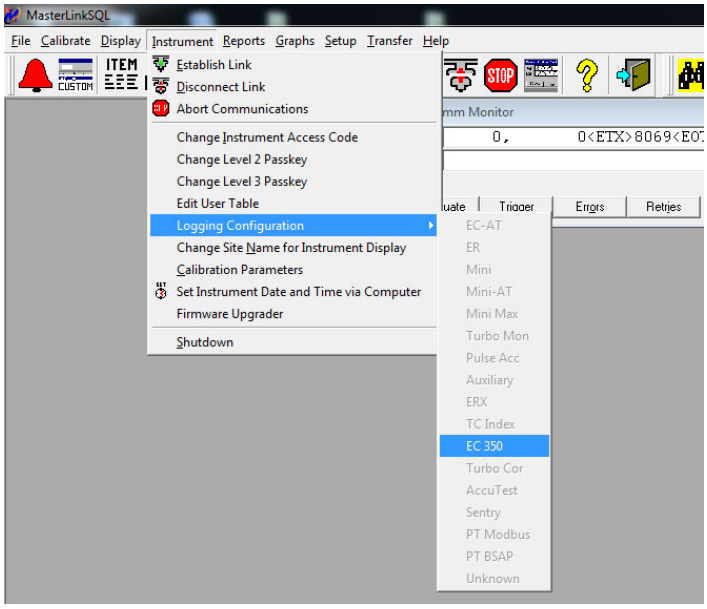
4.5 Logging

4.5.1 Audit Trail Logging Configuration

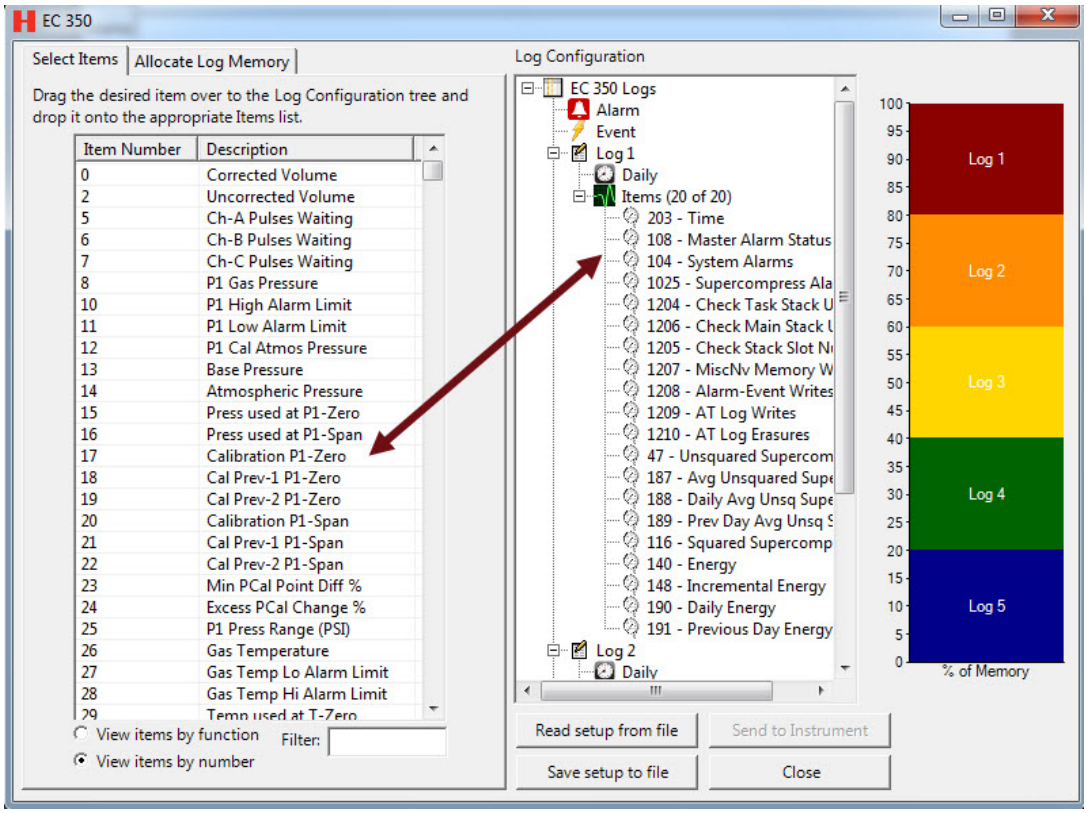
Using MasterLink software, an EC 350 device can be configured to contain as many as 5 independent logs, each with its own collection of item values and collection (sample) frequency. Each log can be configured to collect values for up to 20 items.

To configure logs:

1. Ensure that MasterLink is linked to the EC 350.
2. In Masterlink, select **Instrument**, **Logging Configuration** and then **EC 350**.



3. Drag and drop the desired items from the Select Items list over to the log configuration tree.

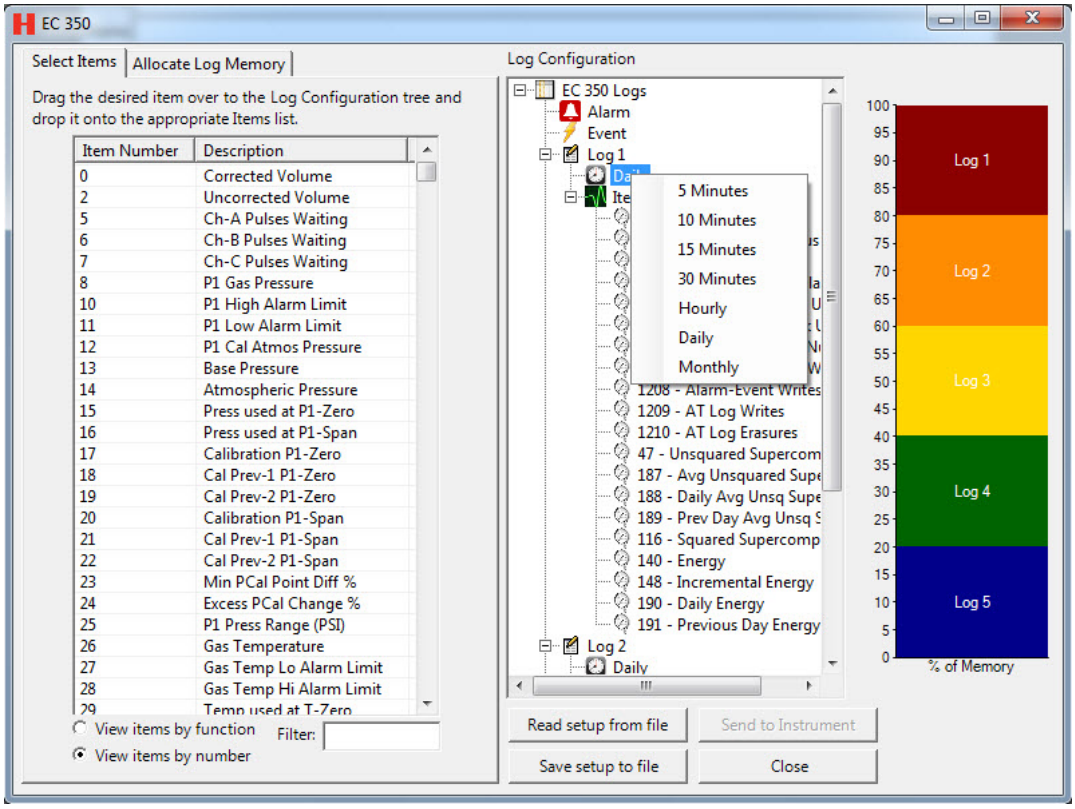


In order to remove an item from the log configuration tree, highlight it and press the ‘Delete’ key.

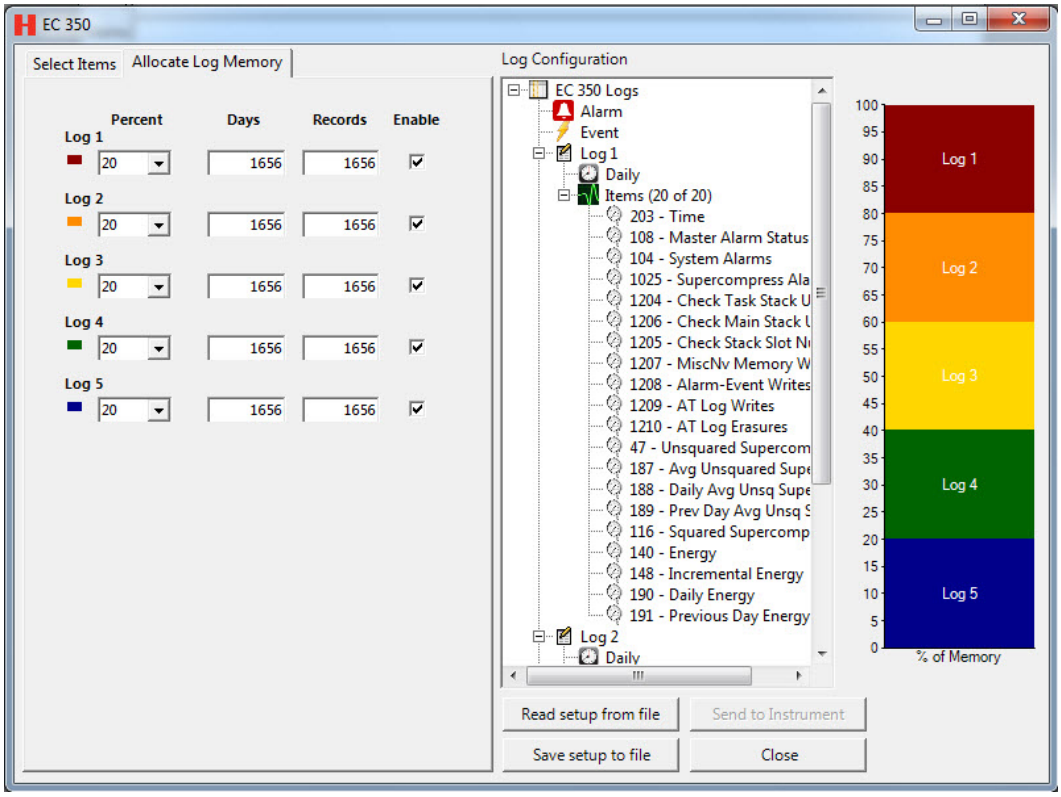
4. The order of the items in the Log Configuration list determines the order in which the values are stored and thus the order in which they will later appear in a report. Items in the list can be ‘grabbed’ and moved up and down to change the order.

5. You can save a configuration for future reference to a configuration file (*.cnfg) with the Save setup to file button. It can later be retrieved with the **Read setup form file** button. Only *.cnfg files can be read; item files (*.ie3) are not compatible.

6. You can right click on the time interval displayed in the Log Configuration tree, to configure the period at which log records are recorded.



7. In the Allocate log memory tab, configure the percentage of available memory allocated to each log.



For each log, you can select the percentage of memory allocated, if fewer than 5 logs are desired the percent of the unused ones must be set to zero.

> **Note:** The sum total of memory allocated for all logs must be equal to 100%.

The smaller a log's allocation, the less data it will be able to store. When the limit is reached, the oldest records will be overwritten with the newer ones. The consequence of a particular allocation setting is reflected in the number of **Days** worth of data as well as the Number of records that can be written before overwriting will occur.

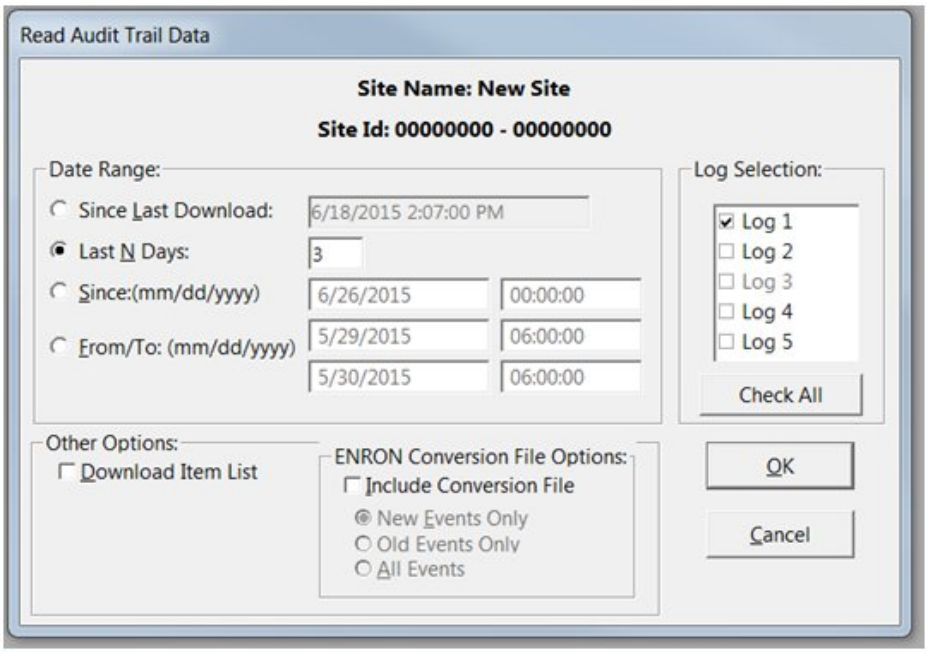
> **Note:** A log's interval setting will impact Days, but not **Numbers**.

8. The Enable checkboxes may be used to suspend data collection for one or more logs. A log's existing records will not be affected when the log is disabled. The fact that a log is disabled will be reflected in the Log Configuration window by the presence of a red 'x' at the top of that log's item tree. In addition, the area for that log in the bar graphic will be grayed and marked as 'Disabled'
9. Finally, click **Send to Instrument** to push the log configuration to the EC 350 Device. A few seconds will be required for the transfer. A window should appear indicating 'Successfully Configured'.

4.5.2 Reading Audit Trail from the EC 350

Once audit trail logging is configured and some amount of data has been collected, it may be transferred to the host. The process can be initiated from the Transfer menu or icon 

using the Read Audit Trail Data window.



You must specify the number of logs to read and the amount of data to transfer. All configured and enabled logs can be checked in the **Log Selection frame**. If a log is not configured it cannot be checked. The amount of data is specified by date/time ranges. The simplest option is **Since Last Download**. The host will examine its database for the most recent record for each log for this instrument and construct a command to the EC 350 for all data it has collected since then. Using this option each time will ensure that the host database contains a complete set of audit trail records for each log in each instrument. There are three other options if a specific data range of data is desired.

> **Note:** Reading of audit trail records does not remove them from EC 350's memory. They can be read any number of times until they are overwritten, as explained above.

Once Masterlink finishes reading all data for all logs the user is given the chance to view all the down-loaded records. This is a useful practice to ensure that the transfer succeeded and that all the expected records were read.

- Displaying/Viewing Audit Trail reports

4.5.2.1 Displaying/Viewing Audit Trail reports

Note: This operation only involves the host computer and its database. No connection to an EC 350 is necessary.

1. In the MasterLinkSQL window, click Reports and select one of the following options:
    - Audit Trail Report (With Summary)
    - Audit Trail Report (Without Summary)
    - Audit Trail Report (Summary Only)
    - Audit Trail Report (Daily Summary)
    - Audit Trail Report (Monthly Summary)

    Based on the option selected, a corresponding dialog appears allowing the user to specify the Audit Trail data to view.
2. Click the Select Sites button to browse to the desired EC 350 unit by SITE ID/ Site name.
3. Click on the Date Range tab to bring up a control window to select date range display options for the log report.
4. Click Preview to view the Audit Trail report, or click the Print to send the report to a specified printer.

4.5.3 Event logger

The function of the Event Logger is to record configuration changes and significant system events. Each record includes:

- Date
- Time
- User ID
- Sequence Number (starts at 1, wraps from 65535 to 0)
- Before and After for changes made to instrument parameters.

Event Log capacity is 1024 records

See section Metrological Protection Modes for details of Event Log behavior in different item 139 modes.

- Supported Event Codes
- Clearing Event Log

4.5.3.1 Supported Event Codes

EVENT TYPE	EVENT
NON CAL ITEM CHANGE	0
CAL ITEM CHANGE	1
INSTR SHUTDOWN	3
DEFAULT BY ITEM 264	8
CLOCK TIME REPAIRED	10
EE MEMORY CORRUPT	11
UNEXPECTED RESETS	13
WATCHDOG RESET	14
CPU RESET	15
POWER CYCLE RESET	16
SYSTEM EVENTS DAILY LIMIT	23
BATTERY LIFE RESET	24
FIRMWARE UPGRADE	25

4.5.3.2 Clearing Event Log

To clear the event log:

Write a value of 19230429 to item 264 using **Setup** > **Advanced**>**Raw Instrument Access** >**Raw Item Access in MastgerLinkSQL**.

4.5.4 Log record integrity verification

Audit Trail and Event Log records have a CRC value associated with them to allow verification that they have not been corrupted or modified. CRCs of log records that have been uploaded to a computer using MasterLinkSQL can be compared to log record CRCs displayed on the HMI. Since records cannot be modified in the device, the CRC values shown through the HMI are always correct and so if the CRC values shown in MasterLinkSQL do not match, then the log record on the computer may have been corrupted or otherwise modified.

First view the log records uploaded with MasterLinkSQL. Audit Trail record CRCs can be viewed through the Audit Trail CSD Conversion feature in the File menu. That outputs a Comma Separated Value file that includes the record CRC as transmitted by the device and also as computed by MasterLinkSQL of the record as stored in the MasterLinkSQL database. Event Log record CRCs can be viewed through the Event Log Report. In the report configuration, select the option to view the CRC values.

To view records in the HMI, select the corresponding menu item, select the desired log (Audit Trail 1 through 5, or Event Log), enter a Sequence Number for a record (as seen in MasterLinkSQL). The corresponding record will be shown with the sequence number, the CRC value (in decimal), and the date and time of the record. (Other record values cannot be displayed via the HMI.

Compare the CRC value on the device display with the one in the Audit Trail CSD file or the Event Log report. The UP and DOWN arrow keys can be used to show the previous or next record.

4.6 Battery Life/ Usage Tracking

- **Alkaline Battery**– Item 48 tracks the Battery voltage and Item 49 is the configurable Low Limit for tripping a low Battery Alarm condition. Item 50 is the configurable Low Limit for putting the EC 350 in to a low Battery 'shutdown' condition – ending most of its operations to greatly conserve the battery power.
- **Lithium Battery -** Items 1001 and 1002 indicate the remaining months and percentage of the Lithium Battery pack based on estimated 'usage cycles'. Item 59 tracks the battery usage cycles – but only for a limited amount (mainly for testing purposes). Item 60 is the configurable Low Limit for tripping a low Battery Alarm condition based on too high of battery usage cycles. Item 59 value represents micro-Amp-seconds usage of the Battery.

Battery / External Supply Alarms – RBX Mode

- **Non-RBX Mode (Item 165 = 0)**– No automatic clearing of alarm condition. User must clear (acknowledge) the alarm condition of Item 99 or 796 before a new Alarm Log entry or timestamp update can be made for any subsequent Low Voltage Alarm conditions.
- **RBX Mode (Item 165 = 1)**- RBX Mode enabled will allow for automatic clearing of a Low Voltage alarm condition of Item 99 or 796 if the measured voltage reaches a value greater than 0.60 VDC above the Low Limit value in Item 49 or 795 respectively (Battery or External Voltage).

4.7 Display ON/OFF

The EC 350 display can be configured to turn on and off at specific times during the day.

You can configure this in the MasterLink software using the following itemcodes:

Item Code	Name / Description	Default
1056	LCD display ON time	06 00 00
1057	LCD display OFF time	18 00 00

CHAPTER 5

5 User Access

This chapter provides an overiew on using a EC 350 device. It includes information on how to work with HMI displays and how the connections must be done between EC 350 and MasterLink.

5.1 Getting started with the keypad

Unlocking the keypad

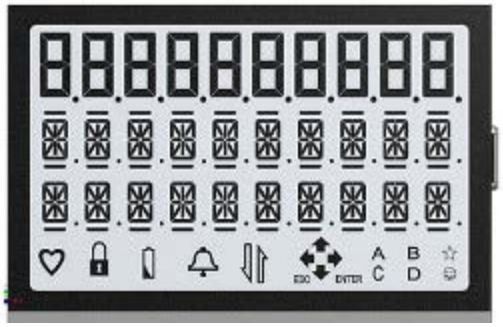
- Unlocking the keypad
- Human Machine Interface (HMI)

5.1.1 Unlocking the keypad

Perform the following steps to unlock the keypad.

1. Press and hold **ESC** and **UP arrow** (

) at the same time until the following **Display test** appears.



2. Press the **DOWN arrow** to enter Scroll List/ Meter Reader mode or press **OK** to access any one of the HMI keypad modes.

5.1.2 Human Machine Interface (HMI)

It provides access to the information about EC 350. You can configure the information using the integral LCD panel and keypad. HMI keypad mode can be classified into the following four sub-levels.

- Level 0 mode- It is the scroll list mode where the customer-configured list of items appear on the display. No passkey is required to access this mode. After the keypad is active, use the **UP arrow** and **DOWN arrow** to scroll through the items in this mode. The items in this mode are read-only.
- Level 1 read only mode- It is used for viewing the instrument settings and live parameters. You do not require any passkey to access this mode. In this mode, the instrument functions are categorized into 11 submenus. By scrolling through the 11 submenus, you can view over 60 factory-defined instrument parameters. The items in this mode are read-only.
- Level 2 mode- It is used for accessing the less sensitive parameters and configuration options of EC 350. This mode provides six submenus. You can view and configure the items in this mode by scrolling through the six submenus. A passkey is required to access this mode.
- Level 3 mode- It is used for accessing all the parameters, configuration, and functions of EC 350. This mode provides nine submenus. A passkey is required to access this mode.

- Level 0 mode
- Level 1 mode
- Level 2 mode
- Level 3 mode

5.1.2.1 Level 0 mode

The level 0 mode is also known as the Scroll List Mode (or Meter Reader Mode). The following table lists the factory-default items that appear on the display when you enter the level 0 mode (in the order in which they appear as you press the **DOWN arrow)**. This list is configurable. The *Configurable item* column identifies the item number at which each list item is programmed.

Scroll list	Displayed on LCD	Item description	Item code	Configurable item
1	UNCVOL	Uncorrected volume	002	130
2	CORVOL	Corrected volume	000	131
3	MTR MODEL	Meter model	077	132
4	P1 Pressure			
5	GAS TEMP	Gas temperature	026	76
6	REMAIN BAT	Remaining Battery		
7	PRESS FACT	Pressure factor	044	75
8	TEMP FACT	Temperature factor	045	77
9	TOTAL FACT	Total correction factor	043	78
10	HI RES CV	High resolution corrected volume	113	133
11	HI RES UV	High resolution uncorrected volume	892	134
12	MTR SCALING	Meter scaling	114	79
13	FW VERSION	Firmware version	122	80
14-18	Reserved		255	81-86

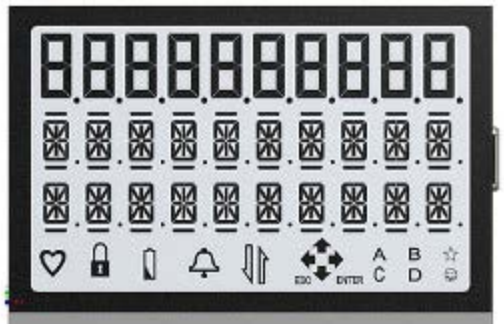
Using the UP arrow and DOWN arrow you can scroll through this list of item readings. The list (12 items) is configured using items 130 through 135 and items 075 through 086. All values that are displayed in this mode are static readings, which means that they are sampled when you enter the level 0 mode and the displayed values will not change while you remain in the scroll list mode. Scroll List mode has a 60-

second inactivity time-out. If you do not press any key for 60 consecutive seconds, EC 350 exits the level 0 mode and returns to the normal Corrector mode.

Accessing level 0 scroll list mode

To access level 0 scroll list mode:

1. Press and hold the **ESC** and **UP arrow** at the same time for about three seconds or until the following **Display Test** appears.



   This unlocks the EC 350 keypad and EC 350 enters the HMI keypad mode.

2. Press the DOWN arrow.
   EC 350 enters the level 0 mode.

3. Use the UP arrow and DOWN arrow to scroll through the available menus.

   Attention: When one of the arrows on the display disappears, it indicates that you have reached either the bottom or top of the scroll list, and therefore you must scroll the opposite direction..

4. Press **ESC** to exit level 0 mode and return to the Corrector mode.

Refer to the section "Level 0 mode" for information about level 0 mode.

5.1.2.2 Level 1 mode

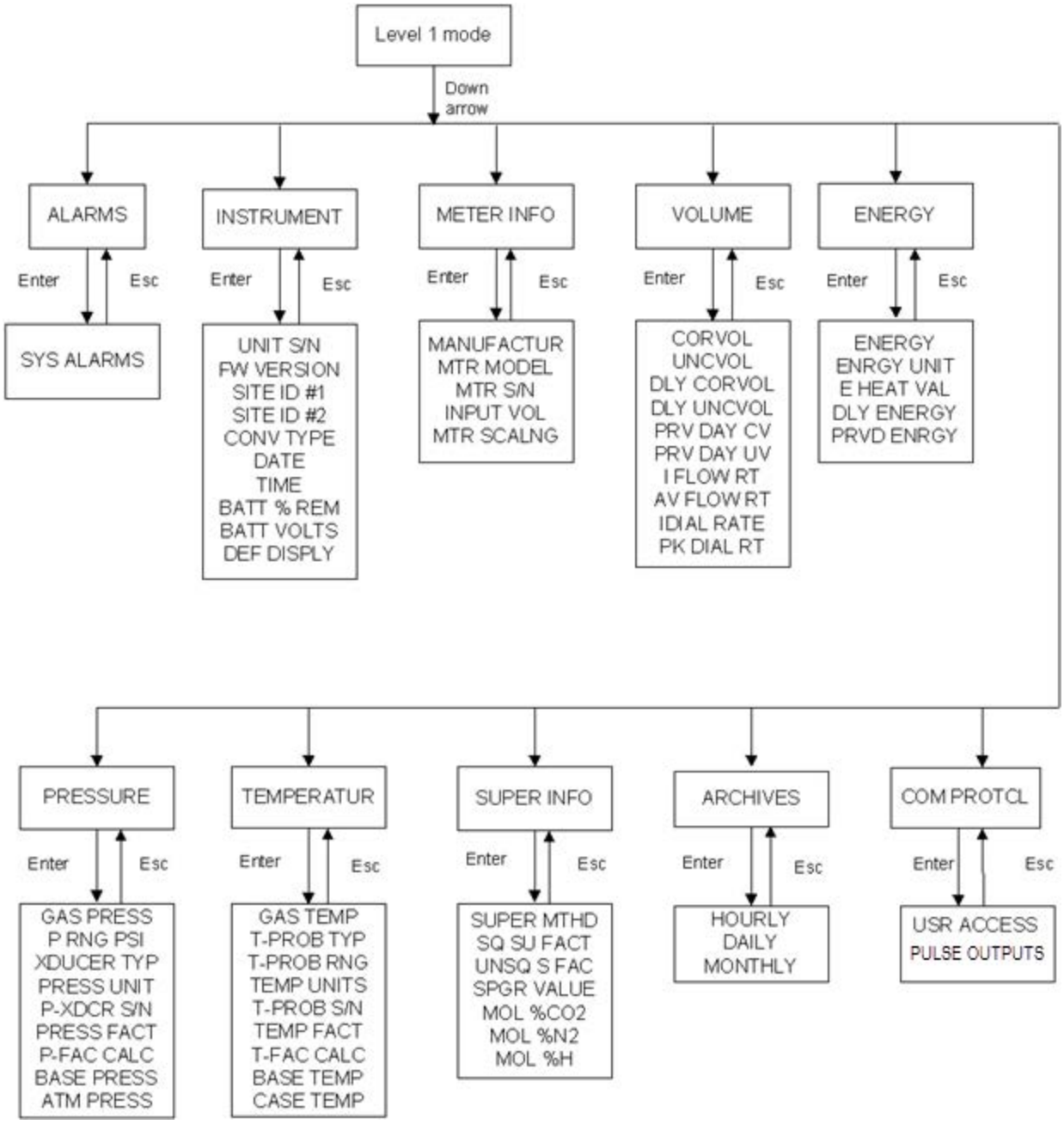
Level 1 mode provides read-only information on the following:

- Scroll list items
- Alarms
- Instrument
- Meter Info
- Volume
- Energy
- Pressure
- Temperature

- Supercompressibility
- Archives
- Communication Protocol
- Pulse Outputs

The level 1 mode is read-only mode where you can view alarms, firmware, and configuration information. Perform the following steps to enter the level 1 mode.

The following flowchart illustrates the items in level 1 mode.



The following table lists the factory-defined list for level 1 mode.

Level 1 main menu ID number	Level 1 main menu categories	Level 1 main menu as displayed on LCD	Level 1 sub-menu as displayed on LCD	Item code	Description
L1.1	Security code	PASSKEY			

Level 1 main menu ID number	Level 1 main menu categories	Level 1 main menu as displayed on LCD	Level 1 sub-menu as displayed on LCD	Item code	Description
L1.2	Alarm Information	ALARMS			Displays individual alarms. Press **OK**, the active alarms appear on the display. The individual alarm items are not displayed in the L1.2 menu, unless that particular alarm is active.
			BAT LO ALM	99	Battery Voltage Lo Alarm
			BAT WC ALM	100	Battery Consumption Hi Alarm
			SW-1 ALARM	102	Input Vol Switch-1 Fault Alarm
			SW-2 ALARM	103	Input Vol Switch-1 Fault Alarm
			SYS ALARM	104	System Error Alarm
			P LO ALARM	143	Gas Pressure Lo Alarm
			P HI ALARM	144	Gas Pressure Hi Alarm
			T LO ALARM	145	Gas Temperature Lo Alarm
			T HI ALARM	146	Gas Temperature Hi Alarm
			FLOW HI ALM	163	Flow Rate Hi Alarm
			DLY CV ALM	222	Daily CorVol Exceeded Alarm
			P2 LO ALRM	452	P2 Pressure Low Alarm
			P2 HI ALRM	453	P2 Pressure High Alarm
			EXTERN L AL	796	External Supply Low Voltage Alarm
			P1 XDCR AL	1058	P1 Transducer Alarm
			P2 XDCR AL	1059	P2 Transducer Alarm

Level 1 main menu ID number	Level 1 main menu categories	Level 1 main menu as displayed on LCD	Level 1 sub-menu as displayed on LCD	Item code	Description
			T PROBE AL	1335	T1 Probe Alarm
			SUPR ALAM	1025	Super Compressibility calculation Alarm
			COM LOG FL	1388	Serial Comms Login Failure (count)
			HMI LOG FL	1392	HMI Login Failure (count)
			LR CNFG AL	1035	Metrological Config Changed Alarm
			ALM LOG ER	1409	Alarm Log Record Error (CRC)
			EV LOG ER	1410	Event Log Record Error (CRC)
			AT LOG ER	1411	Audit Trail Record Error (CRC)
			SW-3 ALARM	1424	Input Vol Switch-3 Fault Alarm
			SW-4 ALARM	1425	Input Vol Switch-4 Fault Alarm

Level 1 main menu ID number	Level 1 main menu categories	Level 1 main menu as displayed on LCD	Level 1 sub-menu as displayed on LCD	Item code	Description
L1.3	Instrument Information	INSTRUMENT			Displays information about the instrument. Press **OK**. The following items appear on the display. Use **UP arrow** and **DOWN arrow** keys to scroll through the items.
			UNIT S/N	062	Unit Serial Number
			FW VERSION	122	Firmware Version
			SITE ID #1	200	Site Identification #1
			SITE ID #2	201	Site Identification #2
			CONV TYPE	1188	Volume Conversion Type
			DATE	204	Instrument Date
			TIME	203	Instrument Time
			BATT % REM	1002	Battery % Life Remaining
			BATT VOLTS	048	Battery Voltage Reading
			DEF DISPLAY	482	LCD Default Display
			BATT TYPE	1061	Battery Type
			EXTERNL PWR	1046	External Supply Voltage

Level 1 main menu ID number	Level 1 main menu categories	Level 1 main menu as displayed on LCD	Level 1 sub-menu as displayed on LCD	Item code	Description
L1.4	Gas Meter Information	METER INFO			Displays information about the meter. Press **OK**, the following items appear on the display.
			MANUFACTUR	432	Meter Manufacturer
			MTR MODEL	432	Meter Model Number
			MTS S/N	1190	Meter Serial Number
			INPUT VOL	098	Input Volume Value
			MTR SCALNG	114	Meter Scaling Factor
L1.5	Volume Information	VOLUME			Displays the gas volume and flow information. Press **OK**, the following items appear on the display.
			CORVOL	000	Corrected Volume Total
			UNCVOL	002	Uncorrected Volume Total
			DLY CORVOL	223	Daily Corrected Volume
			DLY UNCVOL	224	Daily Uncorrected Volume
			PRV DAY CV	183	Previous Day CorVol
			PRV DAY UV	184	Previous Day UncVol
			I FLOW RATE	209	Instantaneous Flow Rate
			AV FLOW RT	208	Average Flow Rate
			I DAIL RATE	218	Instantaneous Dial Rate
			PK DIAL RT	219	Peak Dial Rate

Level 1 main menu ID number	Level 1 main menu categories	Level 1 main menu as displayed on LCD	Level 1 sub-menu as displayed on LCD	Item code	Description
L1.6	Energy Information	ENERGY			Displays the energy and heat information. Press **OK**, the following items appear on the display.
			ENERGY	140	Energy Total
			ENRGY UNIT	141	Energy Units
			E HEAT VAL	142	Gas Heat Value
			DLY ENERGY	190	Daily Energy
			PRVD ENRGY	191	Previous Day Energy
L1.7	Pressure Information	PRESSURE			Displays the pressure information. Press **OK**, the following items appear on the display.
			GAS PRESS	008	Gas Pressure
			P RNG PSI	025	Press Transducer Range (psi)
			XDUCER TYP	112	Press Transducer Type
			PRESS UNIT	087	Pressure Units
			P-XDCR S/N	138	Press Transducer Serial No.
			PRESS FACT	044	Pressure Factor
			P-FAC CALC	109	Press Factor Calculation Type
			BASE PRESS	013	Base Pressure
			AMT PRESS	014	Atmospheric Pressure

Level 1 main menu ID number	Level 1 main menu categories	Level 1 main menu as displayed on LCD	Level 1 sub-menu as displayed on LCD	Item code	Description
L1.8	Temperature Information	TEMPERATURE			Displays the temperature information. Press **OK**, the following items appear on the display.
			GAS TEMP	026	Gas Temperature
			T-PROB TYP	1185	Temp Probe Type
			T-PROB RNG	1186	Temp Probe Range
			TEMP UNITS	089	Temperature Units
			T-PROB S/N	1187	Temp Probe Serial No.
			TEMP FACT	045	Temp Factor
			T-FAC CALC	111	Temp Factor Calculation Type
			BASE TEMP	034	Base Temperature
			CASE TEMP	031	Case Temperature

Level 1 main menu ID number	Level 1 main menu categories	Level 1 main menu as displayed on LCD	Level 1 sub-menu as displayed on LCD	Item code	Description
L1.9	Super-compressibility Information	SUPER INFO			Displays super-compressibility information. Press **OK**, the following items appear on the display.
			SUPER MTHD	147	Super Method
			SQ SU FACT	116	Squared Super Factor
			UNSQ S FAC	047	Un-squared Super Factor
			SPGR VALUE	053	Specific Gravity Value
			MOL %CO2	055	Mol. %CO2 Value
			MOL %N2	054	Mol. %N2 Value
			MOL %CH	373	MOL %CH Value
			MOL %C2H6	374	MOL %C2H6 Value
			MOL %C3H8	375	MOL %C3H8 Value
			MOL%iC4H10	376	MOL%iC4H10 Value
			MOL%nC4H10	377	MOL%nC4H10 Value
			MOL%iC5H12	378	MOL%iC5H12 Value
			MOL%nC5H12	379	MOL%nC5H12 Value
			MOL %C6H14	380	MOL %C6H14 Value
			MOL %C7H16	381	MOL %C7H16 Value
			MOL %C8H18	382	MOL %C8H18 Value
			MOL %C9H20	383	MOL %C9H20 Value
			MOL %H2S	384	MOL %H2S Value
			MOL %H2	385	MOL %H2 Value
			MOL %He	386	MOL %He Value

Level 1 main menu ID number	Level 1 main menu categories	Level 1 main menu as displayed on LCD	Level 1 sub-menu as displayed on LCD	Item code	Description
			MOL %O2	387	MOL %O2 Value
			MOL %CO	388	MOL %CO Value
			MOL %Ar	389	MOL %Ar Value
			MOL %C10H22	390	MOL %C10H22 Value
			MOL %H2O	391	MOL %H2O Value
L1.10	Communication Protocol	COM PROTCL			Displays information about the communication protocol. Press **OK**, **USR** **ACCESS** appears on the display.
			USR ACCESS	139	User Access Type
			COMM BAUD	272	User Access Type
			COM FORMAT	995	Serial Comm Format
			COMM TYPE	1220	Serial Comm Type
			HANDSHAKE	1221	Serial Handshake Type
			COMWAKEUP	1219	Serial Wakeup Method
			TIMEOUT 2	172	Timeout Delay 2

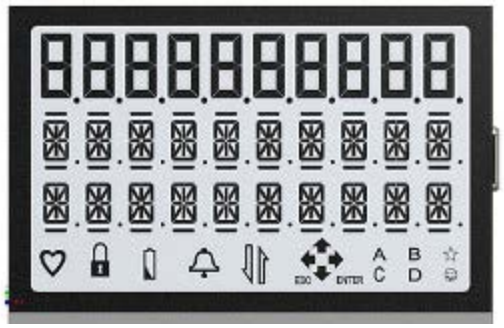
Level 1 main menu ID number	Level 1 main menu categories	Level 1 main menu as displayed on LCD	Level 1 sub-menu as displayed on LCD	Item code	Description
L1.11	Pulse Output	PULSE OUT			Displays Pulse Output channels' configuration information.
			CH-A SELCT	93	Pulse Channel A Selection
			CH-B SELCT	94	Pulse Channel B Selection
			CH-C SELCT	95	Pulse Channel C Selection
			CH-A TIME	1014	Pulse Channel ATiming
			CH-B TIME	1015	Pulse Channel B Timing
			CH-C TIME	1024	Pulse Channel C Timing
			CH-A PULSE	5	Pulse Channel AValue
			CH-B PULSE	6	Pulse Channel B Value
			CH-C PULSE	7	Pulse Channel C Value
L1.12	Cloud Link	CLOUD LINK	DEVICE S/N		
			RADIO IME		
			BATT TYPE		
			CHARGE AMT		Charge amount in percentage
			CHARGE TM		Charge amount in time
			BATT VOLTS		
			SCAP VOLTS		
			SSL STATUS		
			SSL-CERT		
			SIM CARD #		
			CARRIER ID		
			LAST RSSI		

Level 1 main menu ID number	Level 1 main menu categories	Level 1 main menu as displayed on LCD	Level 1 sub-menu as displayed on LCD	Item code	Description
			LAST IP AD		
			LAST IP PT		
			COMM STAT		
			CL CELL FW		
			MODEM TYPE		
			BLE SECURT		
			CL MAIN FW		
			FW CHKSUM		
			PULSE CNT		
			PAIRED DEV		

Accessing level 1 read only mode

To access level 1 read only mode:

1. Press and hold the **ESC** and **UP arrow** at the same time for about three seconds or until the following **Display Test** appears.



   This unlocks the EC 350 keypad and EC 350 enters the HMI keypad mode.

2. Press **OK** to enter level 1 mode.
   The following level 1 mode **PASSCODE** screen appears.

3. Press the **DOWN arrow** to enter level 1 mode.
4. Use the **UP arrow** and **DOWN arrow** to scroll through the main menu items (L1.2 through L1.11) in level 1 mode.
   Attention:**L1.1 through L1.11 provides a numeric indicator of the menu item being accessed.**
5. Press **OK** to select the necessary main menu item.
6. After the main menu item is selected, use the **UP arrow** and **DOWN arrow** to scroll through the list of read-only items.
7. Press **ESC** to return to the main menu item.
8. From the main menu item, press **ESC** to exit level 1 mode.

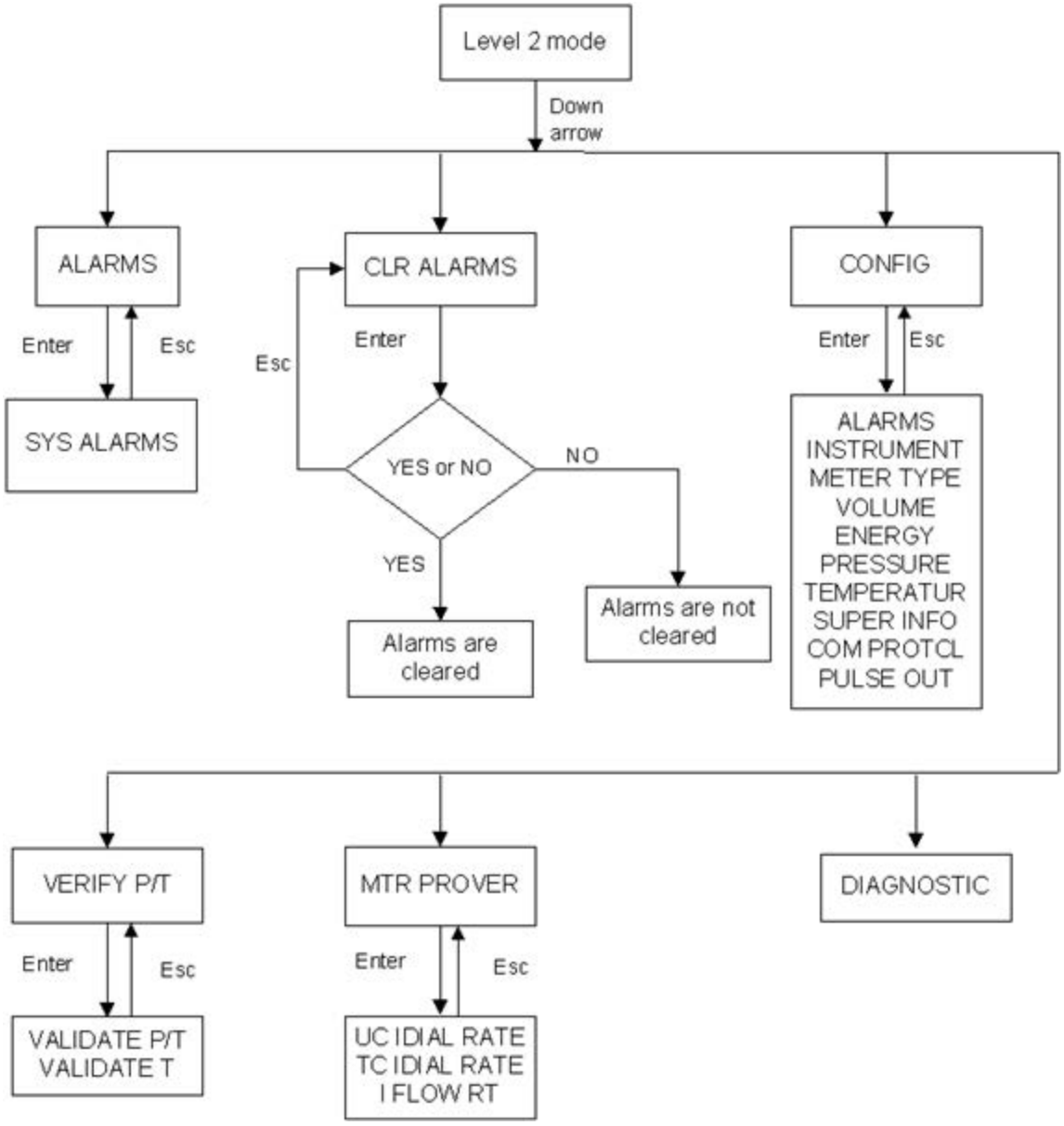
Refer to the section "Level 1 read only mode" for information about level 1 mode.

5.1.2.3 Level 2 mode

Level 2 mode is the limited-access configuration mode and provides read-only information on the following:

- Passcode
- Alarms
- Clear Alarms
- Configuration
- Verify Pressure
- Verify Temperature
- Meter Prover
- Diagnostics

The following flowchart illustrates the main menus and submenus in the level 2 mode.



After you enter level 2 mode, the items listed in the table appear on the display; by default, **ALARMS** appear. Use the **UP arrow** and **DOWN arrow** to scroll through the items in level 2 mode.

Level 2 ID Nr	L2 main menu categories	L2 main menu as displayed on LCD	L2 submenu as displayed on LCD	Item code	Description
L2.1	PASSCODE				

Level 2 ID Nr	L2 main menu categories	L2 main menu as displayed on LCD	L2 submenu as displayed on LCD	Item code	Description
L2.2	ALARMS		Displays active alarms. Press OK The active alarms appear on the display.		
L2.3	CLR ALARMS		Allows you to clear the active alarms on the display. If the condition that caused the alarm is still present, a new alarm is activated on the next measurement.		
L2.4	CONFIG		Allows you to configure the Level 2 sub-menu 1 items.		
L2.4.1		ALARMS			
L2.4.1.1			LIMITS		
L2.4.1.1.1				P HI LIMIT	
L2.4.1.1.2				P LO LIMIT	
L2.4.1.1.3				T LO LIMIT	
L2.4.1.1.4				T HI LIMIT	
L2.4.1.1.5				BAT LO LIM	
L2.4.1.1.6				BAT MO LIM	
L2.4.1.1.7				FLOWHI LIM	
L2.4.1.1.8				D CV LIMIT	
L2.4.2		INSTRUMENT			
L2.4.2.1			SITE INFO		
L2.4.2.1.1				UNIT S/N	
L2.4.2.1.2				FW VERSION	

Level 2 ID Nr	L2 main menu categories	L2 main menu as displayed on LCD	L2 submenu as displayed on LCD	Item code	Description
L2.4.2.1.3				SITE ID #1	
L2.4.2.1.4				SITE ID #2	
L2.4.2.1.5				CONV TYPE	
L2.4.2.1.6				DATE	
L2.4.2.1.7				TIME	
L2.4.2.1.8				DEF DISPLY	
L2.4.2.2			BATTERY		
L2.4.2.2.1				BAT MO LIM	
L2.4.2.2.2				REMAIN BAT	
L2.4.2.2.3				BATT % REM	
L2.4.2.2.4				BATT VOLTS	
L2.4.3		METER TYPE			
L2.4.3.1			DRESSER		
L2.4.3.1.1				I-D B3	
L2.4.3.1.2				I-D LMMA	
L2.4.3.1.3				ROT B3	
L2.4.3.1.4				ROT LMMA	
L2.4.3.2			ELSTER AMC		
L2.4.3.2.1				ROT RPM	

Level 2 ID Nr	L2 main menu categories	L2 main menu as displayed on LCD	L2 submenu as displayed on LCD	Item code	Description
L2.4.3.2.2				I-D DIAPHR	
L2.4.3.2.3				I-D TURBIN	
L2.4.3.2.4				PULSE RABO	
L2.4.3.3			ROMET ®		
L2.4.3.3.1				ROT RM IMP	
L2.4.3.3.2				ROT RM MET	
L2.4.3.3.3				ROT G MET	
L2.4.3.4			SENSUS		
L2.4.3.4.1				I-D DIAPHR	
L2.4.3.4.2				I-D ROTARY	
L2.4.3.4.3				I-D TURBIN	
L2.4.3.5			OTHER		
L2.4.3.5.1				I-D/PULSE	
L2.4.3.5.2				ROTARY MNT	
L2.4.4		VOLUME			
L2.4.4.1			INPUT TYPE		
L2.4.4.2			CORVOL		
L2.4.4.2.1				CORVOL	
L2.4.4.2.2				CV UNITS	
L2.4.4.2.3				CV DIGITS	

Level 2 ID Nr	L2 main menu categories	L2 main menu as displayed on LCD	L2 submenu as displayed on LCD	Item code	Description
L2.4.4.3			UNCVOL		
L2.4.4.3.1				UNCVOL	
L2.4.4.3.2				UV UNITS	
L2.4.4.3.3				UV DIGITS	
L2.4.5		ENERGY			
L2.4.5.1			ENERGY		
L2.4.5.2			ENERGY UNIT		
L2.4.5.3			E HEAT VAL		
L2.4.6		PRESSURE			
L2.4.6.1			GAS PRESS		
L2.4.6.1.1				GAS PRESS	
L2.4.6.1.2				PRESS UNIT	
L2.4.6.1.3				P-DECIMALS	
L2.4.6.1.4				xDUCER TYP	
L2.4.6.1.5				P-RNG USER	
L2.4.6.1.6				P-XDCR S/N	
L2.4.6.1.7				PRESS FACT	
L2.4.6.1.8				P-FAC CALC	
L2.4.6.1.9				FIXED P	

Level 2 ID Nr	L2 main menu categories	L2 main menu as displayed on LCD	L2 submenu as displayed on LCD	Item code	Description
L2.4.6.2			BASE PRESS		
L2.4.6.3			ATMS PRESS		
L2.4.7		TEMPERATUR			
L2.4.7.1			GAS TEMP		
L2.4.7.1.1				GAS TEMP	
L2.4.7.1.2				TEMP UNITS	
L2.4.7.1.3				T-PROB TYP	
L2.4.7.1.4				T-PROB RNG	
L2.4.7.1.5				T-PROB S/N	
L2.4.7.1.6				TEMP FACT	
L2.4.7.1.7				T-FAC CALC	
L2.4.7.1.8				FIXED TEMP	
L2.4.7.2			BASE TEMP		
L2.4.7.3			CASE TEMP		
L2.4.8		SUPER INFO			
L2.4.8.1			SUPER TYPE		
L2.4.8.2			SUPER FACT		
L2.4.8.2.1				SQ SU FACT	
L2.4.8.2.2				UNSQ S FAC	

Level 2 ID Nr	L2 main menu categories	L2 main menu as displayed on LCD	L2 submenu as displayed on LCD	Item code	Description
L2.4.8.3			PARAMETERS		
L2.4.8.3.1				SPGR VALUE	
L2.4.8.3.2				MOL %N2	
L2.4.8.3.3				MOL %CO2	
L2.4.8.3.4				E HEAT VAL	
L2.4.8.3.5				MOL %H2	
L2.4.9		COM PROTCL			
L2.4.9.1			COM ACCESS		
L2.4.9.2			COM-1		
L2.4.9.2.1				COMM BAUD	
L2.4.9.2.2				COMM FORMAT	
L2.4.9.2.3				COMM TYPE	
L2.4.9.2.4				HANDSHAKE	
L2.4.9.2.5				COMMWAKEUP	
L2.4.9.2.6				TMOUT DEL1	
L2.4.9.2.7				TMOUT DEL2	
L2.4.10		PULSE OUT			
L2.4.10.1			CH-A		
L2.4.10.1.1				CH-A SELCT	

Level 2 ID Nr	L2 main menu categories	L2 main menu as displayed on LCD	L2 submenu as displayed on LCD	Item code	Description
L2.4.10.1.2				CH-A VALUE	
L2.4.10.1.3				CH-A TIME	
L2.4.10.2			CH-B		
L2.4.10.2.1				CH-B SELCT	
L2.4.10.2.2				CH-B VALUE	
L2.4.10.2.3				CH-B TIME	
L2.4.10.3			CH-C		
L2.4.10.3.1				CH-C SELCT	
L2.4.10.3.2				CH-C VALUE	
L2.4.10.3.3				CH-C TIME	
L2.4.11		CLOUD LINK			
L2.4.11.1			PULSE CNT		
L2.5	VERIFY P/T		Allows you to validate the accuracy of the pressure/temperature measured by EC 350.		
L2.5.1		VALIDATE P	To verify or validate the accuracy of the items (for example, VALIDATE P); after the appropriate item appears on the display, Use the keypad to enter or change the value of pressure/ temperature that EC 350 must measure. After you enter the value, press . The EC 350 calculates the % ERROR.		
L2.5.2		VALIDATE T	%ERROR is the difference between the pressure/temperature value measured by EC 350 and the value (the entered value) that EC 350 must measure.		

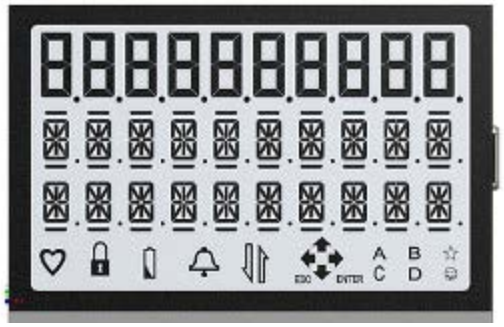
Level 2 ID Nr	L2 main menu categories	L2 main menu as displayed on LCD	L2 submenu as displayed on LCD	Item code	Description
L2.6	MTR PROVER		Allows you to check the accuracy of the actual volume of gas flowing through a gas meter. Press OK . The following items appears. UC IDIAL RATE - Uncorrected Input Dial Rate. TC IDIAL RATE - stands for Temperature Corrected Input Dial Rate. I FLOW RT - stands for Input Flow Rate.		
L2.7	DIAGNOSTIC		Functions as a sensor, and ensures that the pulse inputs provided to EC 350 are functioning.		
L2.7.1		SENSOR TST			
L2.8	VIEW LOGS		Allows you to view a specified Log Record's Date, Time, and CRC value (in decimal).		
L2.8.1		AT-LOG1	Actual Log Item Values are not available. This function is mainly to serve the needs of Compliance verification. Specify a Log Record number to begin and then press the Enter Key to view the actual record's parameters (Date, Time, and CRC).		
L2.8.2		AT-LOG2			
L2.8.3		AT-LOG3			
L2.8.4		AT-LOG4			
L2.8.5		AT-LOG5			
L2.8.6		EVENT LOG			
L2.9	MET CONFIG		Special mode to make updates to Legally Relevant (metrological) type items.		

Level 2 ID Nr	L2 main menu categories	L2 main menu as displayed on LCD	L2 submenu as displayed on LCD	Item code	Description
L2.10	SHUTDOWN		Special mode to take the unit out of service – i.e. to put in long term storage (shelf mode) Limited functionality is enabled in this mode –just time update. No volume or measurements are performed. HMI is active.		
L2.11	BATT CHNG		Enter this mode when replacing the battery – includes resetting battery gauge.		
L2.12	RESET BATT		Allows resetting the battery gauge (assumes installing a new battery).		
L2.13	RESET COMMS		Resets Serial Comms – generally should not be needed.		
L2.14	MODEM CALLS	ALARM CALL	Allows user to force an Alarm Call in to occur – assuming proper configurations		
L2.15		SCHED CALL	Allows user to force a Scheduled Call in to occur – assuming proper configurations		
L2.16		STOP CALLS	Allows user to cancel both Alarm and Scheduled Call retires – Note: does not disable Call-in		
L2.17		BT PAIRING			
			BT PAIRING		
L2.18		FORGET DEV			
			YES /NO		

Accessing level 2 mode

To access level 2 mode:

1. Press and hold the **ESC** and **UP arrow** at the same time for about three seconds or until the **Display Test** (all segments on) appears.



This unlocks the EC 350 keypad and EC 350 enters the HMI keypad mode.

2. Press **OK** to enter level 2 mode.
The level 1 mode **PASSCODE** screen appears.

3. To access the passkey screen, in level 2 mode press **OK**. The following appears on the display.
0000000

PASSCODE

For firmware versions before 1.0068, you must enter a five digit security code followed by a two digit user ID code to enter level 2 mode. The default value for the level 2 passcode is **20000**. The default value of the last two digit user ID is **00**. Enter a two digit user ID code followed by a five

digit security passcode to enter level 2 or level 3 mode. You can enter any value for the event log user ID. If the unit is configured to log events in an event log, the user ID identifies the user who made the changes in the event log.

For firmware version 1.0068 and later, of the 7 digits entered, the *first two* are the user id and the *last five* are the passcode. By default only user 02 is permitted access to Level 2. The default passcode is 20000, so the value entered would be 0220000. Other users can be granted access to level 2 menus, but a user can only access level 2 if they are **not** granted access to level 3. (A single user can access level 2, level 3, or neither, but cannot access *both* level 2 and level 3. Level 2 functionality is a subset of level 3 functionality.)

4. To enter passcode, press the **UP arrow** or the **DOWN arrow** at the current position to change the displayed digit to the required numeral.
5. For example, press the **UP arrow** twice at the current position, the value **0000000** changes to **2000000**.
6. Press the **RIGHT arrow** to move one position to the right. Using the **UP arrow** or the **DOWN arrow** change the displayed digit to the required numeral.
7. For example, press the **RIGHT arrow** until you reach the sixth digit. At the sixth digit press the **UP arrow** twice. The value *2000000* changes to *2000020*.
8. Repeat this step until you enter the passcode of the instrument.
9. To accept changes after entering the last digit (all seven digits of passcode), press the **RIGHT arrow**.
   Attention: You can also press **OK** for entering the passkey value.
   The **OK** key enters the displayed digit at the current position and advances to the next position.

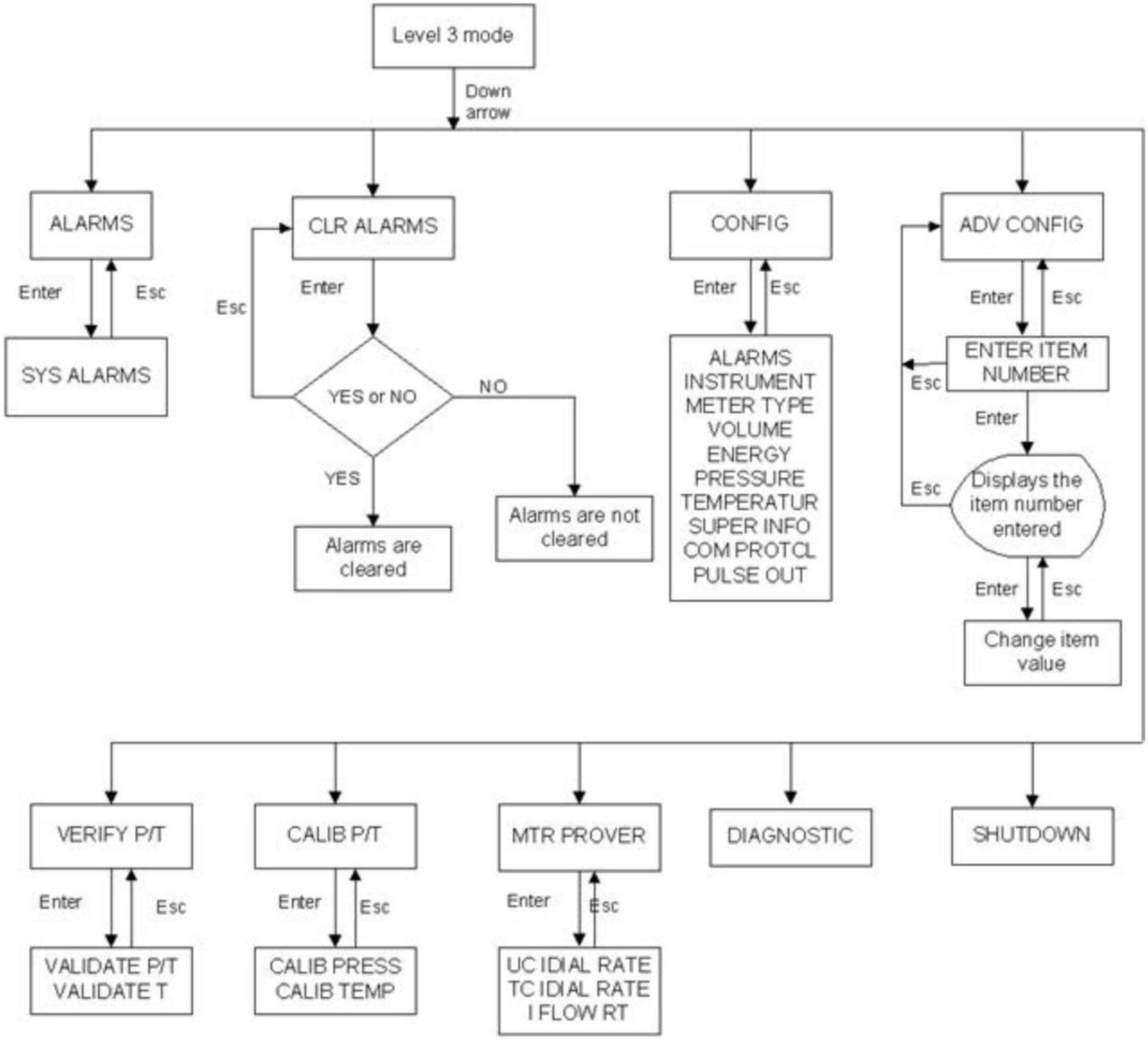
   If the log in was successful, the display indicates that you are in level 2 mode. If the user ID or passcode were invalid, you will be returned to the main level 1 menu.
10. Use the **UP arrow** and **DOWN arrow** to scroll through the main menu items (L2.2 through L2.7) in level 2 mode.
11. Press **OK** to select the necessary main menu item.
12. Use the **UP arrow** and **DOWN arrow** to scroll through the submenu items in level 2 mode.
13. Press **OK** to select the necessary submenu.
14. Press **ESC** to return to the main menu item.
15. From the main menu item, press **ESC** to exit level 2 mode.

5.1.2.4 Level 3 mode

Level 3 mode is the limited-access configuration mode and provides read-only information on the following:

- Passcode
- Alarms
- Clear Alarms
- Configuration
- Advance Configuration
- Verify Pressure
- Verify Temperature
- Calibrate Pressure
- Calibrate Temperature
- Meter Prover
- Diagnostics
- Shutdown

The following flowchart illustrates the items in level 3 mode.



After you enter the level 3 mode, the items listed in the table appear on the display; by default, **ALARMS** appear. Use **UP arrow** and **DOWN arrow** to scroll through the items in the level 3 mode.

Level 3 ID Nr	L3 main menu categories	L3 main menu as displayed on LCD	L3 submenu as displayed on LCD	Item code	Description
L3.1	PASS KEY				
L3.2	ALARMS		Displays active alarms. Press OK. The active alarms appear on the display.		
L3.3	CLR ALARMS		Clears the alarms. Press OK and then press YES to clear the alarms.		

Level 3 ID Nr	L3 main menu categories	L3 main menu as displayed on LCD	L3 submenu as displayed on LCD	Item code	Description
L3.4	CONFIG		Allows you to configure the Level 3 submenu 1 items.		
L3.4.1		ALARMS			
L3.4.1.1			LIMITS		
L3.4.2		INSTRUMENT			
L3.4.2.1			SITE INFO		
L3.4.2.2			BATTERY		
L3.4.3		METER TYPE			
L3.4.3.1			DRESSER		
L3.4.3.1.1				I-D B3	
L3.4.3.1.2				I-D LMMA	
L3.4.3.1.3				ROT B3	
L3.4.3.1.4				ROT LMMA	
L3.4.3.2			ELSTER AMC		
L3.4.3.2.1				ROT RPM	
L3.4.3.2.2				I-D DIAPHR	
L3.4.3.2.3				I-D TURBIN	
L3.4.3.2.3				PULSE RABO	
L3.4.3.3			ROMET ®		
L3.4.3.3.1				ROT RM IMP	
L3.4.3.3.2				ROT RM MET	
L3.4.3.3.3				ROT G MET	
L3.4.3.4			SENSUS		
L3.4.3.4.1				I-D DIAPHR	

Level 3 ID Nr	L3 main menu categories	L3 main menu as displayed on LCD	L3 submenu as displayed on LCD	Item code	Description
L3.4.3.4.2				I-D ROTARY	
L3.4.3.4.3				I-D TURBIN	
L3.4.3.5			OTHER		
L3.4.3.5.1				I-D/PULSE	
L3.4.3.5.2				ROTARY MNT	
L3.4.4		VOLUME			
L3.4.4.1			INPUT TYPE		
L3.4.4.2			CORVOL		
L3.4.4.3			UNCVOL		
L3.4.5		ENERGY			
L3.4.5.1			ENERGY		
L3.4.5.2			ENERGY UNIT		
L3.4.5.3			E HEAT VAL		
L3.4.6		PRESSURE			
L3.4.6.1			GAS PRESS		
L3.4.6.2			BASE PRESS		
L3.4.6.3			ATMS PRESS		
L3.4.7		TEMPERATUR			
L3.4.7.1			GAS TEMP		
L3.4.7.2			BASE TEMP		
L3.4.7.3			CASE TEMP		
L3.4.8		SUPER INFO			
L3.4.8.1			SUPER TYPE		

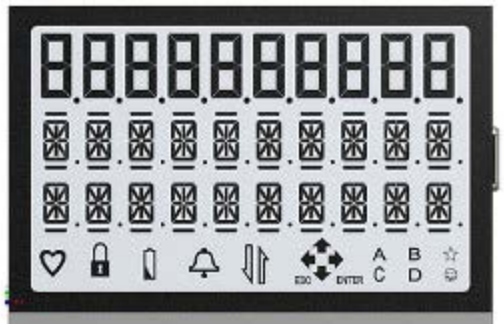
Level 3 ID Nr	L3 main menu categories	L3 main menu as displayed on LCD	L3 submenu as displayed on LCD	Item code	Description
L3.4.8.2			SUPER FACT		
L3.4.8.3			PARAMETERS		
L3.4.9		COM PROTCL			
L3.4.10		PULSE OUT			
L3.4.10.1			CH-A		
L3.4.10.2			CH-B		
L3.4.10.3			CH-C		
L3.4.11		CLOUD LINK			
			PULSE CNT		
L3.5	ADV CONFIG		Allows you to enter the item number. Press OK. The following appears.		
			ENTER		
			ITEM NUMBR		
			Using the keypad, you can enter the required item number. After you enter the item number, the respective item appears on the display. You can modify/set the value of the item. For example, if you enter the item number 0000008, GAS PRESS appears on the display.		
L3.6	VERIFY P/T		Allows you to validate the accuracy of the pressure or temperature measured by EC 350.		
L3.6.1		VALIDATE P	Select VALIDATE P/VALIDATE T and press OK. Use the keypad to enter or change the value of pressure/ temperature that the EC 350 must measure. After you enter the value, press OK. The EC 350 calculates the % ERROR. %ERROR is the difference between the pressure/temperature value measured by EC 350 and the value (the entered value) that EC 350 must measure.		
L3.6.2		VALIDATE T			
L3.7	CALIB P/T		Allows you to calibrate the pressure and temperature measured by EC 350.		

Level 3 ID Nr	L3 main menu categories	L3 main menu as displayed on LCD	L3 submenu as displayed on LCD	Item code	Description
L3.7.1		CALIB PRES	Select CALIB PRESS/CALIB TEMP and press OK. Use the keypad and enter the value of pressure/temperature that EC 350 must measure. After you enter the value, press OK. The EC 350 calculates the % ERROR. %ERROR is the difference between the pressure/temperature value measured by EC 350 and the value (the entered value) that EC 350 must measure. The calibration allows you to make changes to the instrument to bring the % ERROR to zero.		
L3.7.2		CALIB TEMP			
L3.8	MTR PROVER		Allows you to check the accuracy of the actual volume of gas flowing through a gas meter. Press OK. The following items appear.		
			UC IDIAL RATE		
			TC IDIAL RATE		
			I FLOW RT		
			UC IDIAL RATE, stands for Uncorrected Input Dial Rate, TC IDIAL RATE stands for Temperature Corrected Input Dial Rate, and I FLOW RT stands for Input Flow Rate.		
L3.9	DIAGNOSTIC		Functions as a sensor, and ensures that the pulse inputs provided to EC 350 are functioning.		
L3.9.1		SENSOR TST			
L3.10	VIEW LOGS		Allows you to view a specified Log Record's Date, Time, and CRC value (in decimal).		
			Actual Log Item Values are not available. This function is mainly to serve the needs of Compliance verification. Specify a Log Record number to begin and then press the Enter Key to view the actual record's parameters (Date, Time, and CRC).		
L3.10.1		AT-LOG1			
L3.10.2		AT-LOG2			
L3.10.3		AT-LOG3			
L3.10.4		AT-LOG4			

Level 3 ID Nr	L3 main menu categories	L3 main menu as displayed on LCD	L3 submenu as displayed on LCD	Item code	Description
L3.10.5		AT-LOG5			
L3.10.6		EVENT LOG			
L3.11	MET CONFIG		Special mode to make updates to Legally Relevant (metrological) type items.		
L3.12	SHUTDOWN		Special mode to take unit out of service – i.e. to put in long term storage (shelf mode).		
			Limited functionality is enabled in this mode –just time update. No volume or measurements are performed. HMI is active.		
L3.13	BATT CHNG		Enter this mode when replacing the battery – includes resetting battery gauge.		
L3.14	RESET BATT		Allows resetting the battery gauge (assumes installing a new battery)		
L3.15	RESET COMMS		Resets Serial Comms – generally should not be needed		
L3.16	MODEM CALLS	ALARM CALL	Allows user to force an Alarm Call in to occur – assuming proper configurations		
L3.17		SCHED CALL	Allows user to force a Scheduled Call in to occur – assuming proper configurations		
L3.18		STOP CALLS	Allows user to cancel both Alarm and Scheduled Call retires – Note: does not disable Call-in		
L.3.19	BT PAIRING				
		BT PAIRING			
L.3.20	FORGET DEV				
		YES /NO			

To access level 3 mode:

1. Press and hold the **ESC** and **UP arrow** at the same time for about three seconds or until the following **Display Test** (all segments on) appears.



This unlocks the EC 350 keypad and EC 350 enters the HMI keypad mode.

2. Press **OK** to enter level 3 mode.
   The level 3 mode **PASSCODE** screen appears.

3. To access the passkey screen, in level 3 mode press **OK**. The following appears on the display.
   0000000

   PASSCODE appears.

   For firmware versions before 1.0068, you must enter a five digit security code followed by a two digit user ID code to enter level 3 mode. The default value for the level 3 passcode is 30000. The default value of the last two digit user ID is 00. Enter a two digit user ID code followed by a five digit security passcode to enter level 2 or level 3 mode. You can enter any value for the event log

user ID. If the unit is configured to log events in an event log, the user ID identifies the user who made the changes in the event log.

For firmware version 1.0068 and later, of the 7 digits entered, the *first two* are the user id and the *last five* are the passcode. By default only user 03 is permitted access to Level 3. The default passcode for user 03 is 30000, so the value entered would be 0330000. Other users can be granted access to level 3 menus, but a user can only access level 2 if they are **not** granted access to level 3. (A single user can access level 2, level 3, or neither, but cannot access *both* level 2 and level 3. Level 2 functionality is a subset of level 3 functionality.)

4. To enter the passcode, press the **UP arrow** or the **DOWN arrow** at the current position to change the displayed digit to the required numeral.
5. For example, press the **UP arrow** thrice at the current position, the value **0000000** changes to **3000000**.
6. Press the **RIGHT arrow** to move one position to the right. Using the **UP arrow** or the **DOWN arrow** change the displayed digit to the required numeral.
7. For example, press the **RIGHT arrow** until you reach the sixth digit. At the sixth digit, press the **UP arrow** thrice. The value *3000000* is changed to *3000030*.
8. Repeat this step until you enter the passcode of the instrument.
9. To accept the changes after entering the last digit (all seven digits of passcode), press the **RIGHT arrow**.
   Attention: You can also press **OK** for entering the passkey value.
   The **OK** key enters the displayed digit at the current position and advances to the next position.

   If the log in was successful, the display indicates that you are in level 3 mode. If the user ID or passcode were invalid, you will be returned to the main level 1 menu.
10. Use the **UP arrow** and **DOWN arrow** to scroll through the main menu items (L3.2 through L3.10) in level 3 mode.
11. Press **OK** to select the necessary main menu item.
12. Use the **UP arrow** and **DOWN arrow** to scroll through the submenu items in level 3 mode.
13. Press **OK** to select the required submenu.
14. Press **ESC** to return to the main menu item.
15. From the main menu item, press **ESC** to exit level 3 mode.

5.2 Working with HMI

Choosing the meter type

5.2.1 Choosing the meter type

1. Unlock the keypad and type the **PASSCODE** to enter level 2 mode or level 3 mode. Refer to the section "Access level 2 mode" for accessing level 2 mode or section " Access level 3 mode " for accessing level 3 mode.
2. By default, in level 2 mode or level 3 mode the following appears on the display.
   MAIN MENU

   ALARMS

   Using the **UP arrow** and **DOWN arrow** scroll through the options in level 2 mode or level 3 mode until **CONFIG** appears.
3. Press **OK**. The following appears on the display.
   CONFIG

   ALARMS
4. Using the **UP arrow** and **DOWN arrow** scroll through the options until **METER TYPE** appears.
5. Press **OK**.
   The following default meter maker appears on the display.

   METER TYPE

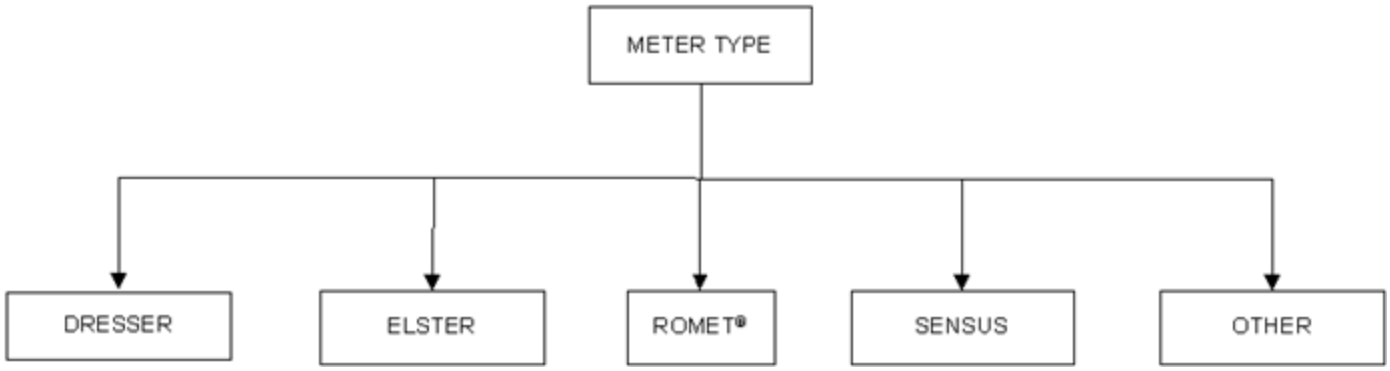
   DRESSER

   The following preconfigured types of makers of meters appear. Using the UP arrow and DOWN arrow scroll through the options.

- DRESSER
- ELSTER AMC
- ROMET
- SENSUS
- OTHER

6. Press **OK** to select the required type of meter maker.
7. Using the **UP arrow** and **DOWN arrow** scroll through the options and press **OK** to select the required type of meter.

The following image illustrates the preconfigured types of meter makers and the meters available under each maker.



5.2.2 Verifying pressure

To verify the pressure:

1. Unlock the keypad and type the **PASSCODE** to enter level 2 mode or level 3 mode Refer to the section " Accessing level 2 mode " for accessing level 2 mode or section " Access level 3 mode " for accessing level 3 mode.
2. By default, the following appears on the display.
   MAIN MENU

   ALARMS
3. Using the **UP arrow** and **DOWN arrow** scroll through the options in level 2 mode or level 3 mode until **VERITY P/T** appears.
4. Press **OK**. For example, the following appears on the display.
   VERIFY P/T

   VALIDATE P
5. Press **OK**. The live pressure measurement made by the instrument appears on the display. For example:
   51.00

   PSI

   LIVE PRESS

   The pressure value that appears in this step is the value that EC 350 reads.
6. Press **OK**. For example, the following appears on the display.
   50.00

   PSI

   INPUT REFP
7. Enter the reference pressure (the actual/exact pressure being piped to EC 350) using the keypad and press
   OK.

   The percentage difference between the pressure that EC 350 reads and the reference pressure appears on the display. For example:

   2.00

   % ERROR LIVE

   PRESS

8. Press **OK**. The control returns back to the following:

VERIFY P/T

VALIDATE P

5.2.3 Verifying temperature

To verify the temperature:

1. Unlock the keypad and type the **PASSCODE** to enter level 2 mode or level 3 mode. Refer to the section " Accessing level 2 mode " for accessing level 2 mode or section " Accessing level 3 mode " for accessing level 3 mode.
2. By default, the following appears on the display.
   MAIN MENU

   ALARMS
3. Using the **UP arrow** and **DOWN arrow** scroll through the options in level 2 mode or level 3 mode until **VERITY P/T** appears.
4. Press **OK**. The following appears on the display.
   VERIFY P/T

   VALIDATE P
5. Press the **DOWN arrow**, the following appears on the display.
   VERIFY P/T

   VALIDATE T
6. Press **OK**, the temperature read by EC 350 appears on the display.
   For example:

   75.20

   F

   LIVE TEMP

   Here, **75.20** is the value that EC 350 reads and **F** stands for the unit of temperature that is Fahrenheit.
7. Press **OK**. The following appears on the display.
   75.20

   F

   INPUT REFT

   Here, **REFT** stands for reference temperature.
8. Enter the reference temperature (the temperature that EC 350 must read) by using the keypad and then press
   OK.

The percentage difference between the temperature that EC 350 reads and the reference temperature appears on the display. For example, the following appears.

0.04

% ERROR LIVE

TEMP

9. Press **OK**, the control returns back to the following:

VERIFY P/T

VALIDATE T

5.2.4 Testing the pulse input

To test the pulse input:

1. Unlock the keypad and type the **PASSCODE** to enter level 2 mode or level 3 mode. Refer to the section " Accessing level 2 mode " for accessing level 2 mode or section " Accessing level 3 mode " for accessing level 3 mode.
2. By default, in level 2 mode or level 3 mode the following appears on the display.
   MAIN MENU

   ALARMS
3. Using the **UP arrow** and **DOWN arrow** scroll through the options in level 2 mode or level 3 mode until **DIAGNOSTIC** appears.
4. Press **OK**.
   By default, the following appears on the display.

   DIAGNOSTIC SENSOR TST
5. Press **OK**. The following appears on the display.

0 0

ERR CNTS

SENSOR TST

Ensure that the value of **ERR** remains zero +/- one count, whereas the value of **CNTS** must increase with each volume input.

5.2.5 Entering the site ID

1. Unlock the keypad and type the **PASSCODE** to enter level 2 mode or level 3 mode. Refer to the section " Accessing level 2 mode " for accessing level 2 mode or section " Accessing level 3 mode " for accessing level 3 mode.
2. By default, in level 2 mode or level 3 mode the following appears on the display.
   MAIN MENU

   ALARMS
3. Using the **UP arrow** and **DOWN arrow** scroll through the options in level 2 mode or level 3 mode until **CONFIG** appears.
4. Press **OK**. The following appears on the display.
   CONFIG

   ALARMS
5. Using the **UP arrow** and **DOWN arrow** scroll through the options in level 2 mode or level 3 mode until **INSTRUMENT** appears.
6. Press **OK**.
   The following appears on the display.

   INSTRUMENT

   SITE INFO
7. Press **OK**, the following appears on the display.
   UNIT S/N
8. Using the **UP arrow** and **DOWN arrow** scroll through the options until **SITE ID #1** appears.
9. To change the **SITE ID #1**, press **OK** and then using the keypad enter the eight-digit **SITE ID**.
10. **SITE ID** is in addition to the **UNIT S/N**. Follow the site-specific rules for configuring the site ID number.
11. Once you enter all the eight digits, press **OK**.

5.2.6 Setting the date and time

- Setting the date
- Setting the time

5.2.6.1 Setting the date

To set the date:

1. Unlock the keypad and type the **PASSCODE** to enter level 2 mode or level 3 mode. Refer to the section "Accessing level 2 mode" for accessing level 2 mode or section "Access level 3 mode" for accessing level 3 mode.
2. By default, in level 2 mode or level 3 mode the following appears on the display.
   MAIN MENU

   ALARMS
3. Using the **UP arrow** and **DOWN arrow** scroll through the options in level 2 mode or level 3 mode until **CONFIG** appears.
4. Press **OK**. The following appears on the display.
   CONFIG

   ALARMS
5. Using the **UP arrow** and **DOWN arrow** scroll through the options in level 2 mode or level 3 mode until **INSTRUMENT** appears.
6. Press **OK**.
   The following appears on the display.

   INSTRUMENT

   SITE INFO
7. Press **OK**, the following appears on the display.
   UNIT S/N
8. Using the **UP arrow** and **DOWN arrow** scroll through the options until **DATE** appears.
9. Press **OK**.
10. Using the keypad set the **DATE** and press **OK**.

5.2.6.2 Setting the time

To set the time:

1. Unlock the keypad and type the **PASSCODE** to enter level 2 mode or level 3 mode. Refer to the section " Accessing level 2 mode " for accessing level 2 mode or section " Accessing level 3 mode " for accessing level 3 mode.
2. By default, in level 2 mode or level 3 mode the following appears on the display.
   MAIN MENU

   ALARMS
3. Using the **UP arrow** and **DOWN arrow** scroll through the options in level 2 mode or level 3 mode until **CONFIG** appears.
4. Press **OK**. The following appears on the display.
   CONFIG

   ALARMS
5. Using the **UP arrow** and **DOWN arrow** scroll through the options in level 2 mode or level 3 mode until **INSTRUMENT** appears.
6. Press **OK**.
   The following appears on the display.

   INSTRUMENT

   SITE INFO
7. Press **OK**, the following appears on the display.
   UNIT S/N
8. Using the **UP arrow** and **DOWN arrow** scroll through the options until **TIME** appears.
9. Press **OK**.
10. Using the keypad set the **TIME** and press **OK**.

5.2.7 Selecting the unit of measure

Using EC 350 you can select the unit of measurement for volume (corrected and uncorrected volume), energy, pressure, and temperature.

- Selecting the unit of measurement for volume
- Selecting the unit of measurement for energy
- Selecting the unit of measurement for pressure
- Selecting the unit of measurement for temperature

5.2.7.1 Selecting the unit of measurement for volume

To select the unit of measurement for volume:

1. Unlock the keypad and type the **PASSCODE** to enter level 2 mode or level 3 mode. Refer to the section " Accessing level 2 mode " for accessing level 2 mode or section " Accessing level 3 mode " for accessing level 3 mode.
2. By default, in level 2 mode or level 3 mode the following appears on the display.
   MAIN MENU

   ALARMS
3. Using the **UP arrow** and **DOWN arrow** scroll through the options in level 2 mode or level 3 mode until **CONFIG** appears.
4. Press **OK**. The following appears on the display.
   CONFIG

   ALARMS
5. Using the **UP arrow** and **DOWN arrow** scroll through the options in level 2 mode or level 3 mode until **VOLUME** appears.
6. Press **OK**.
   By default, following appears on the display.

   VOLUME

   INPUT TYPE
7. Press the **DOWN arrow** key.
   The following appears on the display.

   VOLUME

   CORVOL
8. For corrected volume, press **OK**.
   By default, the following appears on the display.

   00000000

   CCF CORVOL
9. To select the unit for corrected volume, press the **DOWN arrow** key.
   The following appears on the display.

   5

CCF

CV UNITS

10. Press **OK** and then using the **UP arrow** and **DOWN arrow** increase or decrease the value of Code.

    The corresponding unit associated with the code appears. For example, **Code 0** represents **CF**.

    Following are the codes and the corresponding units of measurement for **VOLUME**.

Code	Units
Code 0	CF
Code 1	CFX10
Code 2	CFX100
Code 3	CFX1K
Code 4	CFX10K
Code 5	CCF
Code 6	MCF
Code 7	M3X0.1
Code 8	M3
Code 9	M3X10
Code 10	M3X100
Code 11	M3X1K

11. Press **OK** to select the required unit.
    For example, if you press **OK** at Code 0, CF is selected as the unit of corrected volume.
12. Repeat step 6 through step 10 for selecting the unit for uncorrected volume. Selecting the unit of measurement for energy

5.2.7.2 Selecting the unit of measurement for energy

To select the unit of measurement for energy:

1. Unlock the keypad and type the **PASSCODE** to enter level 2 mode or level 3 mode. Refer to the section " Accessing level 2 mode " for accessing level 2 mode or section " Accessing level 3 mode " for accessing level 3 mode.
2. By default, in level 2 mode or level 3 mode the following appears on the display.
   MAIN MENU

   ALARMS
3. Using the **UP arrow** and **DOWN arrow** scroll through the options in level 2 mode or level 3 mode until **CONFIG** appears.
4. Press **OK**. The following appears on the display.
   CONFIG

   ALARMS
5. Using the **UP arrow** and **DOWN arrow** scroll through the options in level 2 mode or level 3 mode until **ENERGY** appears.
6. Press **OK**.
   By default, the following appears on the display.

   00000000

   THERMS

   ENERGY
7. Press the **DOWN arrow** key.
   The following appears on the display.

   THERMS

   ENERGY UNIT
8. Press **OK** and then using the **UP arrow** and **DOWN arrow** increase or decrease the value of **Code**.
   The corresponding unit associated with the code appears. For example, **Code 0** represents **THERMS** .

   Following are the codes and the corresponding units of measurement for **ENERGY**.

Code	Units
Code 0	THERMS
Code 1	DECATHERMS
Code 2	MEGAJOULES
Code 3	GIGAJOULES
Code 4	KILOCALS
Code 5	K-WATT HRS

9. Press **OK** to select the required unit.
   For example, if you press **OK** at Code 0, THERMS is selected as the unit of **ENERG Y** .

5.2.7.3 Selecting the unit of measurement for pressure

To select the unit of measurement for pressure:

1. Unlock the keypad and type the **PASSCODE** to enter level 2 mode or level 3 mode. Refer to the section " Accessing level 2 mode " for accessing level 2 mode or section " Accessing level 3 mode " for accessing level 3 mode.
2. By default, in level 2 mode or level 3 mode the following appears on the display.
   MAIN MENU

   ALARMS
3. Using the **UP arrow** and **DOWN arrow** scroll through the options in level 2 mode or level 3 mode until **CONFIG** appears.
4. Press **OK**. The following appears on the display.
   CONFIG

   ALARMS
5. Using the **UP arrow** and **DOWN arrow** scroll through the options in level 2 mode or level 3 mode until **PRESSURE** appears.
6. Press **OK**.
   By default, the following appears on the display.

   PRESSURE

   GAS PRESS
7. Press **OK**.
   By default, the following appears on the display.

   0

   PSI

   GAS PRESS
8. Press the **DOWN arrow** key.
   The following appears on the display.

   0

   PSI

   PRESS UNIT
9. Press **OK** and then using the **UP arrow** and **DOWN arrow** increase or decrease the value of **Code**.
   The corresponding unit associated with the code appears. For example, **Code 0** represents **PSI**.

Following are the codes and the corresponding units of measurement for **PRESSURE**.

Code	Units
Code 0	PSI
Code 1	kPa
Code 2	mPa
Code 3	Bar
Code 4	bar
Code 5	KGcm2
Code 6	In WC
Code 7	In HG
Code 8	mm HG

10. Press **OK** to select the required unit.
    For example, if you press **OK** at Code 0, PSI is selected as the unit of **PRESSURE**.

5.2.7.4 Selecting the unit of measurement for temperature

To select the unit of measurement for temperature:

1. Unlock the keypad and type the **PASSCODE** to enter level 2 mode or level 3 mode. Refer to the section " Accessing level 2 mode " for accessing level 2 mode or section " Accessing level 3 mode " for accessing level 3 mode.
2. By default, in level 2 mode or level 3 mode the following appears on the display.
   MAIN MENU

   ALARMS
3. Using the **UP arrow** and **DOWN arrow** scroll through the options in level 2 mode or level 3 mode until **CONFIG** appears.
4. Press **OK**. The following appears on the display.
   CONFIG

   ALARMS
5. Using the **UP arrow** and **DOWN arrow** scroll through the options until **TEMPERATURE** appears.
6. Press **OK**.
   By default, the following appears on the display.

   TEMPERATURE

   GAS TEMP
7. Press **OK**.
   By default, the following appears on the display.

   60.00

   F

   GAS TEMP
8. Press the **DOWN arrow** key.
   The following appears on the display.

   F

   TEMP UNITS
9. Press OK and then using the UP arrow and DOWN arrow increase or decrease the value of **Code**.
   The corresponding unit associated with the code appears. For example, **Code 0** represents **F**.

   Following are the codes and the corresponding units of measurement for **PRESSURE**.

Code	Units
Code 0	F
Code 1	C
Code 2	R
Code 3	K

10. Press **OK** to select the required unit.

For example, if you press **OK** at Code 0, F is selected as the unit of **TEMPERATURE** .

5.2.8 Single point temperature and pressure calibration

- Calibrating temperature
- Calibrating pressure

5.2.8.1 Calibrating temperature

To calibrate temperature:

1. Unlock the keypad and type the **PASSCODE** to enter level 3 mode. Refer to the section "Accessing level 3 mode " for accessing level 3 mode.
2. By default, the following appears on the display.
   MAIN MENU

   ALARMS
3. Using the **UP arrow** and **DOWN arrow** scroll through the options in level 3 mode until **CALIB P/T** appears.
4. Press **OK**. The following appears on the display.
   CALIB P/T

   CALIB PRES
5. Press the **DOWN arrow**, the following appears on the display.
   CALIB P/T

   CALIB TEMP

   Press **OK**, the temperature read by EC 350 appears on the display.

   For example:

   75.20

   F

   LIVE TEMP

   Here, **75.20** is the value that EC 350 reads and **F** stands for the unit of temperature that is Fahrenheit.
6. Press **OK**. The following appears on the display.
   75.20

   F

   INPUT REFT

Here, **REFT** stands for reference temperature.

7. Enter the reference temperature (the temperature that EC 350 must read) by using the keypad and then press **OK**.
   The percentage difference between the temperature that EC 350 reads and the reference temperature appears on the display. For example, the following appears.

   0.04

   % ERROR LIVE TEMP

8. Press **OK**, the control returns back to the following:
   CALIB P/T

   CALIB TEMP

5.2.8.2 Calibrating pressure

To calibrate pressure:

1. Unlock the keypad and type the **PASSCODE** to enter level 3 mode. Refer to the section "Accessing level 3 mode " for accessing level 3 mode.
2. By default, the following appears on the display.
   MAIN MENU

   ALARMS

3. Using the **UP arrow** and **DOWN arrow** scroll through the options in level 3 mode until **CALIB P/T** appears.
4. Press **OK**. The following appears on the display.
   CALIB P/T

   CALIB PRES

5. Press **OK**, the pressure read by EC 350 appears on the display.
   51.00

   PSI

   LIVE PRESS

   The pressure value that appears in this step is the value that EC 350 reads.

6. Press **OK**. The following appears on the display.
   50.00

   PSI

INPUT REFP

7. Enter the reference pressure (the actual/exact pressure being piped to EC 350) using the keypad and press **OK**.
   The percentage difference between the pressure that EC 350 reads and the reference pressure appears on the display. For example:

   2.00

   % ERROR

   LIVE PRESS

8. Press **OK**, the control returns back to the following:

CALIB P/T

CALIB TEMP

5.3 Connecting to EC 350 via MasterLinkSQL

5.3.1 About MasterLinkSQL software

MasterLinkSQL is a communication software package that enables interaction with EC 350. Using MasterLinkSQL you can:

- Configure EC 350 to meet particular needs.
- Calibrate EC 350.
- Read the collected data such as volumes, pressures, temperature, and alarms.
- Generate reports for the collected data.
- Provide computer to instrument communication. Computer to instrument communication can be through the IrDA (infrared) port on the front panel, an optional direct serial link (RS-232/485), modem (CNI2 for cellular or Messenger for land line).

5.3.2 Connecting the IrDA communication USB dongle to the computer

To connect the IrDA communication USB dongle to the computer, insert the IrDA USB dongle in the USB port of the computer.

If the IrDA USB dongle is connected properly, a small LED on the dongle flashes intermittently, which indicates that the computer can communicate with the IrDA USB dongle. Using the MasterLinkSQL communications configuration menu, confirm that the IrDA interface has been configured properly.

5.3.3 Connecting the IrDA communication USB dongle to EC 350

To connect the IrDA communication USB dongle to EC 350

1. Insert the dongle into the magnetic pipe boot. Ensure that the cable passes through the hook provided in the magnetic pipe boot to prevent the dongle from displacing.
2. Place the boot on EC 350. Ensure that the leg of the boot is above the eyebrow.

The following image illustrates the IrDA communication USB dongle connected to EC 350.

5.3.4 Signing on to the EC 350

Open MasterLinkSQL and fill in any fields in the opening screen. You can connect to a specific site through the Site List (this is required for remote connections through a modem), or, for local connections you can simply request some operation and MasterLinkSQL will initiate the connection automatically.

If requested, enter a user ID and passcode. Your organization should provide you with this information. User ID can be any value from 0 to 99. By default only users 0 through 3 are activated. Passcode can be any value 0 to 99999. Given below are the default passcodes for users 0 to 3.

Table 1.

User	Default passcode
User 0 and 1	33333
User 2	20000
User 3	30000

Default users 2 and 3 are primarily intended for HMI access (levels 2 and 3 respectively) but serial access with MasterLinkSQL through those users is also possible with those passcodes.

5.3.5 Updating EC 350 firmware

EC 350 is provided with a built-in firmware loader that allows new versions of firmware to be installed easily. Firmware can be upgraded using the Firmware Upgrader option available in the MasterLinkSQL software. When you select this option, the MasterLinkSQL software works with the built-in loader of EC 350 and provides a very robust system for upgrading the EC 350 firmware.

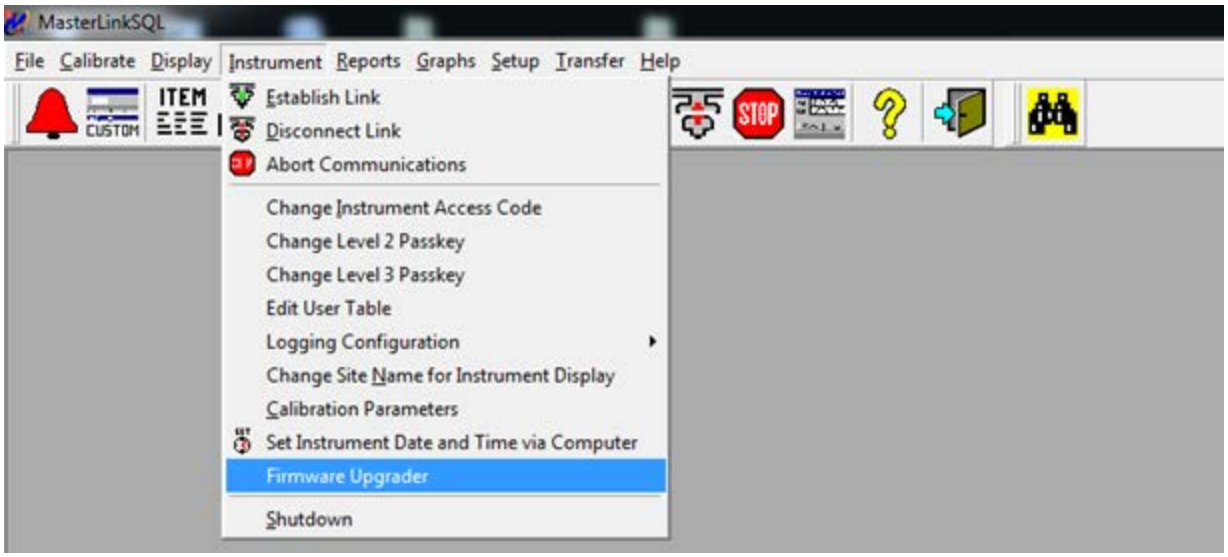
The firmware upgrade is performed through the IrDA serial interface that is used by the MasterLinkSQL software. The IrDA serial interface provides an electrically isolated interface and requires no additional hardware or software beyond what is already needed to utilize the MasterLinkSQL software. (Firmware upgrades can also be performed over the RS-232 port but not the RS-485 port.)

CAUTION:

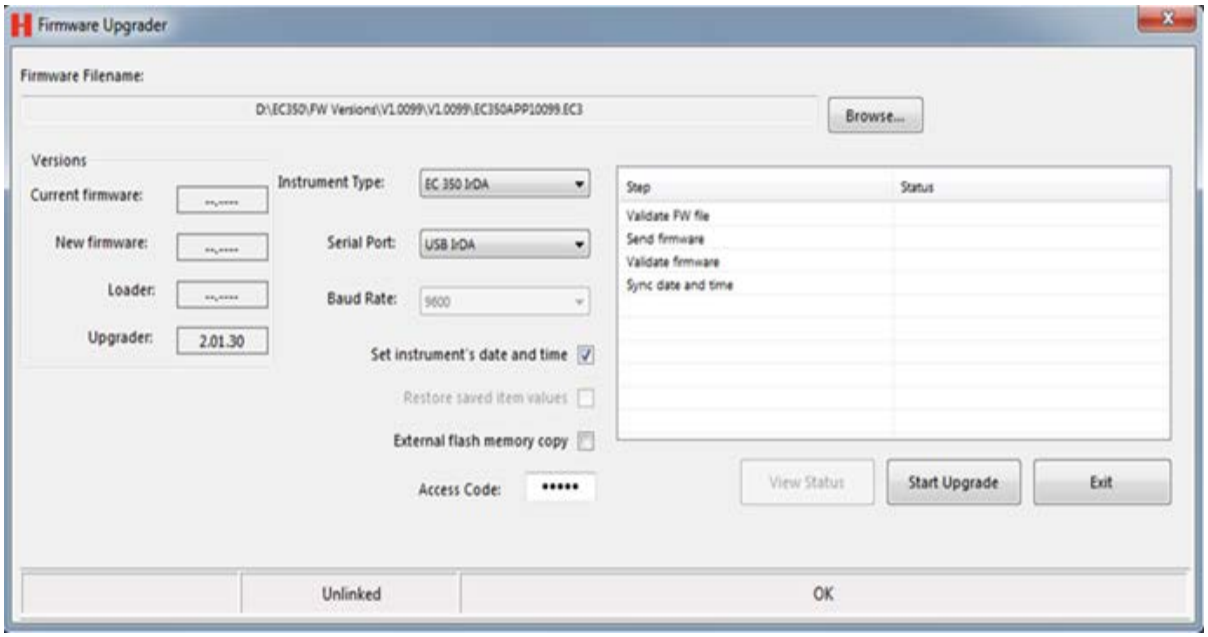
It is important that you read all items and logs (audit trail logs, event log, alarm log) before performing a firmware upgrade because most items will be set to default values and the audit trail logs will be erased.

Running Firmware Upgrader

1. In the MasterLinkSQL window, click **Instrument** > **Firmware Upgrader** .



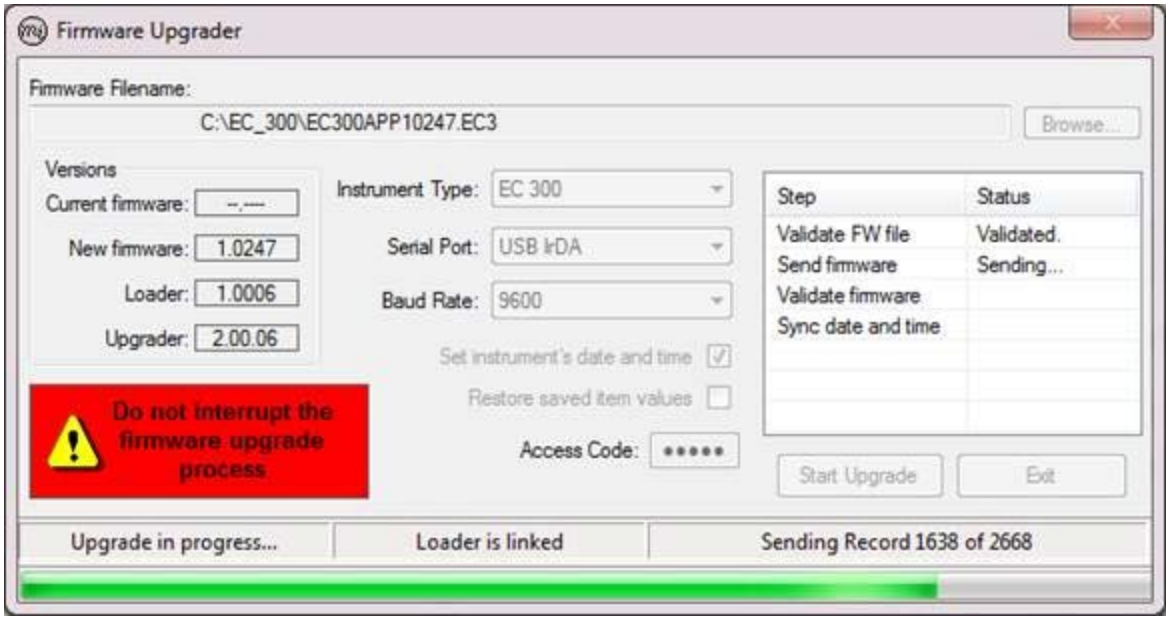
The **Firmware Upgrader** dialog box appears.



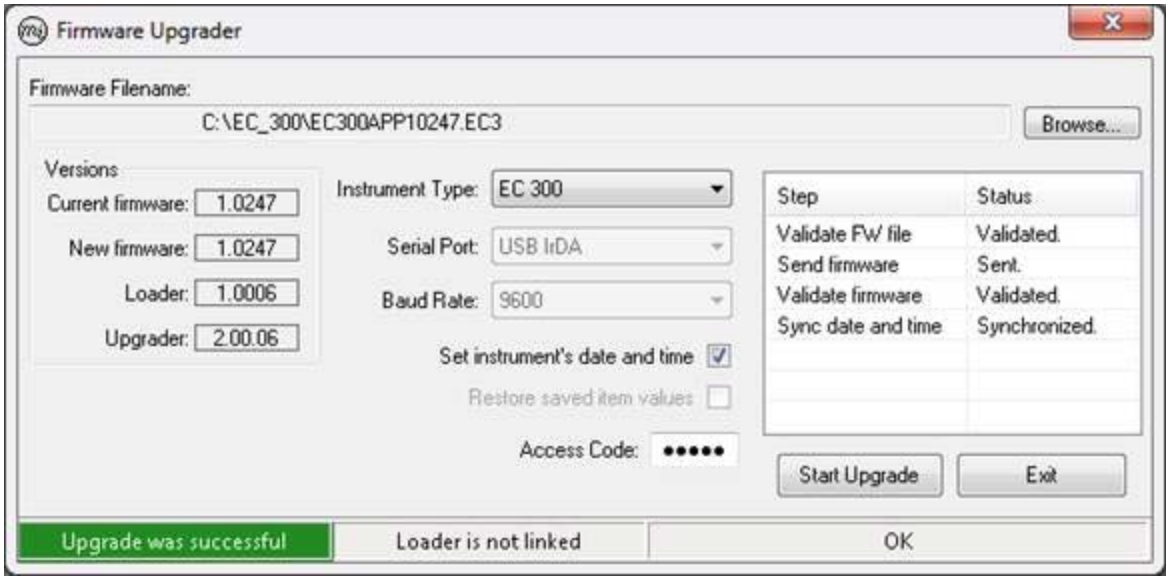
2. To select the firmware file, click **Browse** and navigate to the path where the EC 350 firmware file is saved.
3. From the **Serial Port** list, select **USB IrDA**.
   Ensure to select the proper serial port for communicating with EC 350.

4. Select the **Set instrument's date and time** check box.
5. Click **Start Upgrade**.
   The program begins to read the current item file from EC 350. The **WARNING** dialog box appears.

6. Click **OK** only if you have saved ALL (Calibration and non-Calibration) items in EC 350.
   The program begins to load the new firmware and then validates its integrity. Once the firmware is validated, the firmware is sent to the MasterLinkSQL software, as illustrated in the following image.
7. Click **OK** only if you have saved ALL (Calibration and non-Calibration) items in EC 350.
   The program begins to load the new firmware and then validates its integrity. Once the firmware is validated, the firmware is sent to the MasterLinkSQL software, as illustrated in the following image.



8. After the upgrade is complete, **Upgrade was successful** (in green) appears at the lower left corner of the main **Firmware Upgrader** dialog box.



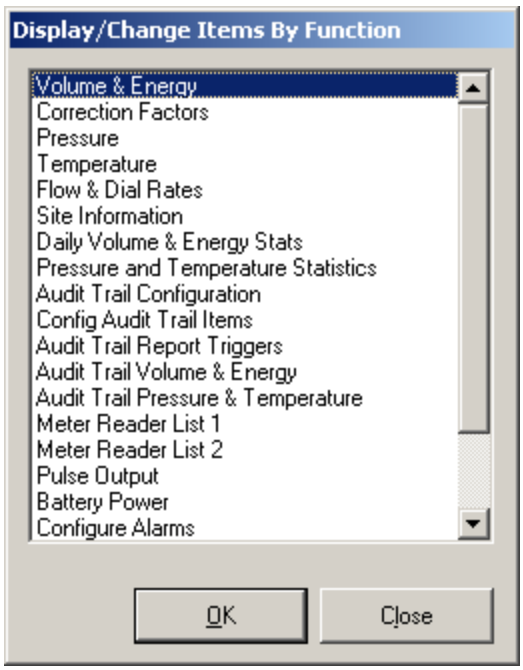
9. Click **Exit** to close the **Firmware Upgrader** dialog box.

5.4 Working with MasterLinkSQL

5.4.1 Items by function

To select items (for viewing and modifying) by their functional categories:

1. Establish a serial communication between EC 350 and MasterLinkSQL. Refer to the *MasterLinkSQL User's Guide* for information about establishing a serial connection between EC 350 and Master-LinkSQL.
2. In the MasterLinkSQL window, click **Display** > **Items by Function**.
   The **Display/Change Items By Function** dialog box appears.



   You can select and configure all the items that are displayed in the **Display/Change Items By Function** dialog box.

For example, if you want to configure **Volume & Energy**, perform the following:

a. Select **Volume & Energy** and click **OK**. The **Volume & Energy** dialog box appears.

b. Select Corr Volume Units and click Change. The **Change Item** dialog box appears.

c. From the list, select the required unit for volume and then click **Save**.

Similarly you can select and configure all the items in the **Volume & Energy** dialog box.

Attention: Follow the same procedure to change other functions.

5.4.2 Setting time and date

1. Establish a serial communication between EC 350 and MasterLinkSQL. Refer to the *MasterLinkSQL User's Guide* for information about establishing a serial connection between EC 350 and Master-LinkSQL.
2. In the MasterLinkSQL window, click on **Instrument > Set Instrument Date and Time via Computer** to update EC 350 with the current PC's date and time.
   A dialog appears allowing the user to accept the date and time update.
3. Click the **Yes** button to proceed with the Date/Time update. MasterLinkSQL will always re-read the PC's clock date and time just before sending the data packet over to EC 350.

5.4.3 Item files

- Reading/Creating item files
- Displaying/Viewing item files

5.4.3.1 Reading/Creating item files

To read or create item files:

1. Establish a serial communication between EC 350 and MasterLinkSQL. Refer to the *MasterLinkSQL User's Guide* for information about establishing a serial connection between EC 350 and Master-LinkSQL.
2. In the MasterLinkSQL window, click the **ITEM**  icon
   The **Select Destination for Item File** dialog box appears.
3. Select a location and enter the name of the file. MasterLinkSQL will automatically name the file if one is not entered.
4. Click **Save**.
   MasterLinkSQL proceeds to read all of the items values from the connected EC 350 unit.

5.4.3.2 Displaying/Viewing item files

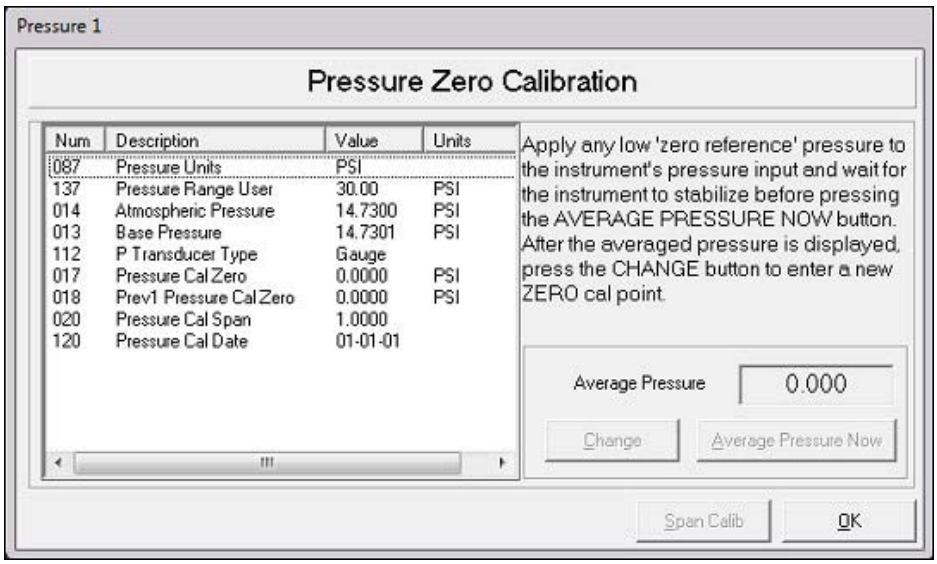
To display or view item files:

1. Establish a serial communication between EC 350 and MasterLinkSQL. Refer to the *MasterLinkSQL User's Guide* for information about establishing a serial connection between EC 350 and Master-LinkSQL.
2. In the MasterLinkSQL window, click on **Reports > I tems Report** to view any item file previously read from EC 350.
   The **Item Report** dialog box appears.
3. Click **Select** and browse to the file you want to view
4. Click **Preview** to view the item report, or click the **Print** to send the item file report out to a specified printer

5.4.4 Calibrating pressure

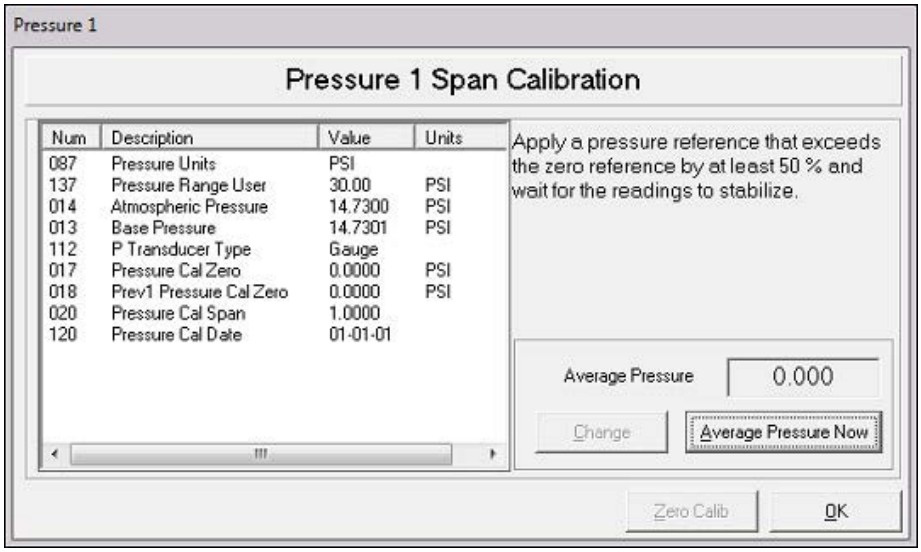
Attention: Check the sensors before calibrating pressure.
To calibrate pressure:

1. In the **MasterLinkSQL** window, click **Calibrate** > **Pressure** .
   The **Pressure 1** dialog box appears.



2. Apply a zero reference pressure (0.00 PSI) to the P1 pressure transducer of EC 350.
   Wait for the pressure reading displayed on the **Pressure 1** dialog box to stabilize.
3. After the reading stabilizes, click **Average Pressure Now** .
   MasterLinkSQL averages the reading and displays the average pressure.

4. Click **Change**.
   The **Change Pressure Calibration Value** dialog box appears.
5. Change the value to accurately match the zero reference pressure applied to the pressure transducer.
6. Click **OK**.
7. Click **Span Calib**.
   The **Pressure 1 Span Calibration** page appears.



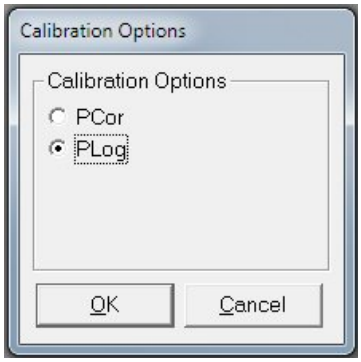
8. Apply a high pressure such that the pressure applied is at least 50% more than the zero reference pressure.
   Wait for the pressure reading displayed on the **Pressure 1** dialog box to exceed the zero reference pressure by 50%. For example, if the zero reference pressure on a 100 PSI transducer equals 0.00 PSI, then the span reference pressure must be between 50.00 and 100.00 PSI. If the zero reference pressure on a 600 PSI transducer equals 0.00 PSI, then the span reference pressure must be between 300.00 and 600.00 PSI.
9. After the pressure stabilizes, click **Average Pressure Now**.
   MasterLinkSQL averages the reading and displays the average pressure.
10. Click **Change**.
    The Change Pressure Calibration Value dialog box appears.
11. Change the value to accurately match the high reference pressure applied to the pressure transducer.
12. Click **OK**.
    The **Restore Line Pressure** dialog box appears.

13. Restore the normal pressure line to EC 350 and click **Done** to exit the calibration.

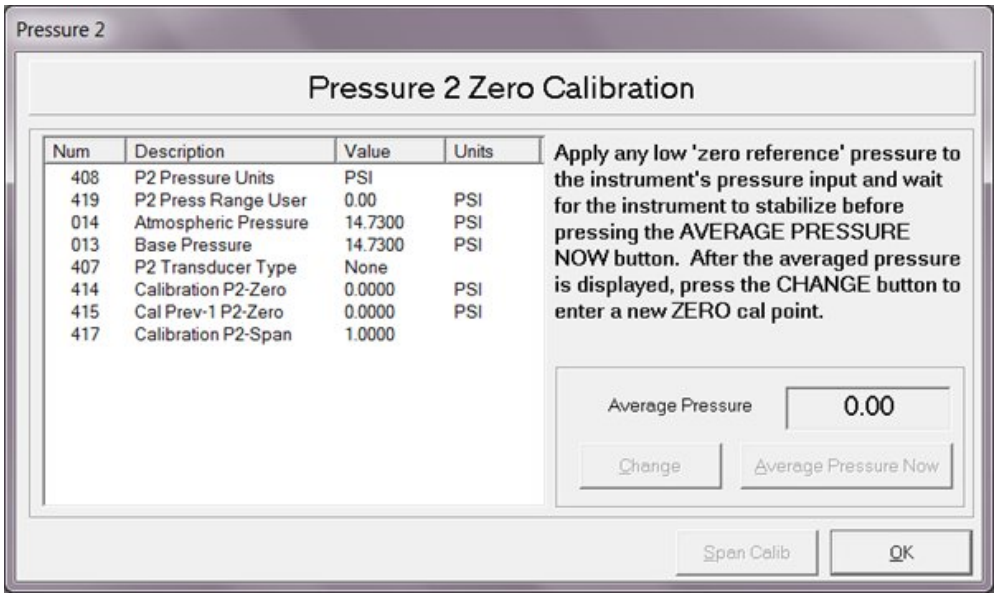
5.4.5 Calibratign PLog pressure

To calibrate PLog pressure or P2:

1. In the **MasterLinkSQL** window, click **Calibrate**> **Ressure**.
   The **Calibration Options** dialog box appears. Select **PLog**.

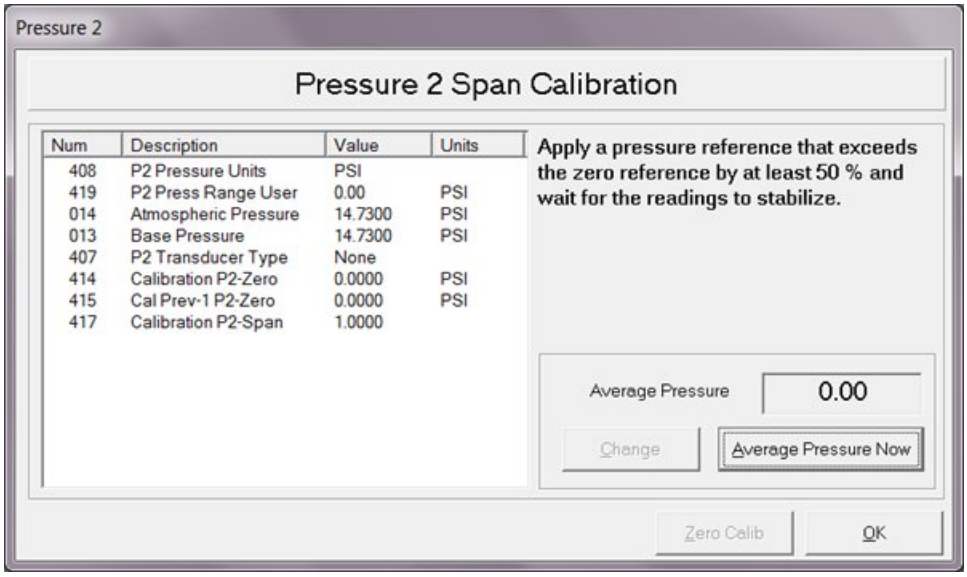


2. The **Pressure 2** dialog box appears.



3. Apply a zero reference pressure (0.00 PSI) to the pressure transducer of EC 350. Wait for the pressure reading displayed on the Pressure 2 dialog box to stabilize.
4. After the reading stabilizes, click **Average Pressure Now**.
   MasterLinkSQL averages the reading and displays the average pressure.
5. Click **Change**.
   The **Change PressureCalibration Value dialog** box appears.
6. Change the value to accurately match the zero reference pressure applied to the pressure transducer.

7. Click **OK**.
8. Click **Span Calib**.
   The **Pressure 1 Span Calibration** page appears.



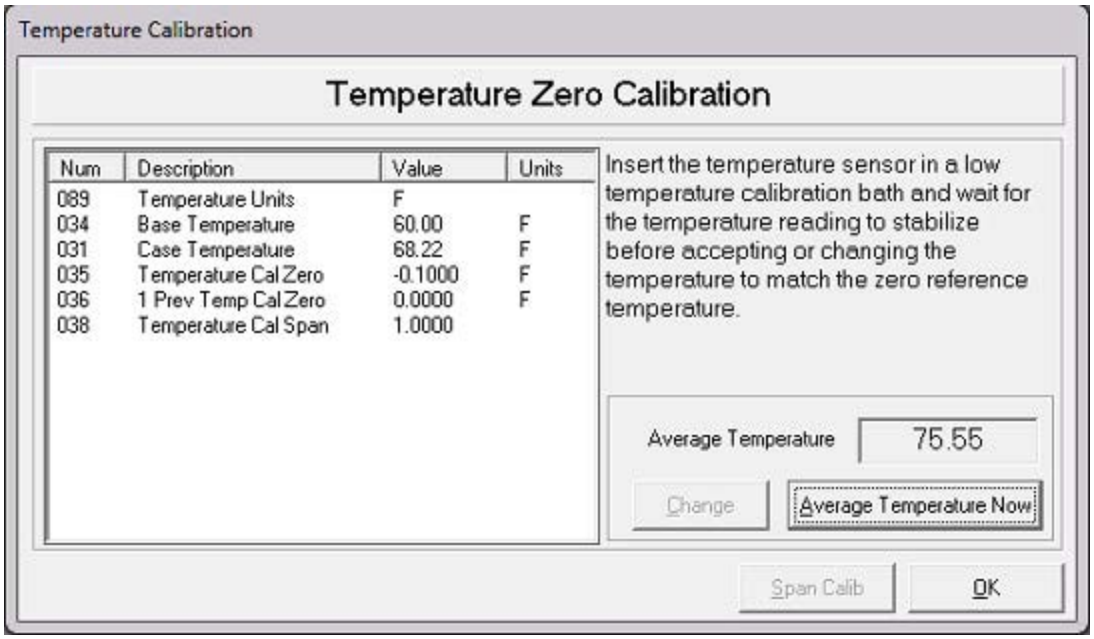
9. Apply a high pressure such that the pressure applied is at least 50% more than the zero reference pressure.
   Wait for the pressure reading displayed on the **Pressure2** dialog box to exceed the zero reference pressure by 50%. For example, if the zero reference pressure on a 100 PSI transducer equals 0.00 PSI, then the span reference pressure must be between 50.00 and 100.00 PSI. If the zero reference pressure on a 600 PSI transducer equals 0.00 PSI, then the span reference pressure must be between 300.00 and 600.00 PSI.
10. After the pressure stabilizes, click **Average Pressure Now**.
    MasterLinkSQL averages the reading and displays the average pressure.
11. Click **Change**.
    The **Change Pressure Calibration Value** dialog box appears.
12. Change the value to accurately match the high reference pressure applied to the pressure transducer.
13. Click **OK**.
    The **Restore Line Pressure** dialog box appears.
14. Restore the normal pressure line to EC 350 and click **Done** to exit the calibration.

5.4.6 Calibrating temperature

Attention: Check the sensors before calibrating temperature.

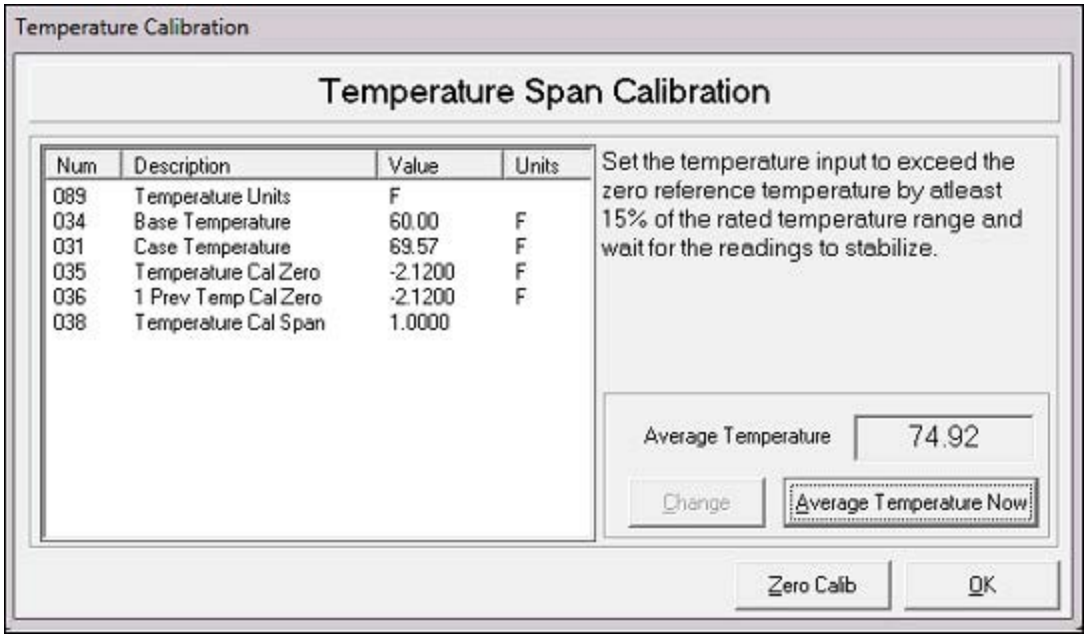
To calibrate temperature:

1. In the MasterLinkSQL window, click **Calibrate > Temperature** .
   The **Temperature Calibration** dialog box appears.



2. Insert the temperature probe of EC 350, along with an accurately calibrated thermometer calibrated thermometer into a low temperature bath or dry well, which provides the temperature zero reference.
   Wait for the temperature reading displayed on the **Temperature Calibration** dialog box to be stabilized.
3. After the reading stabilizes, click **Average Temperature Now** .
   MasterLinkSQL averages the reading and displays the average temperature.
4. Click **Change**.
   The **Change Temperature Calibration Value** dialog box appears.
5. Change the value to accurately match the temperature measured by the calibrated thermometer placed in the low temperature bath.
6. Click **OK**.

7. Click **Span Calib**.
   The **Temperature Span Calibration** page appears.



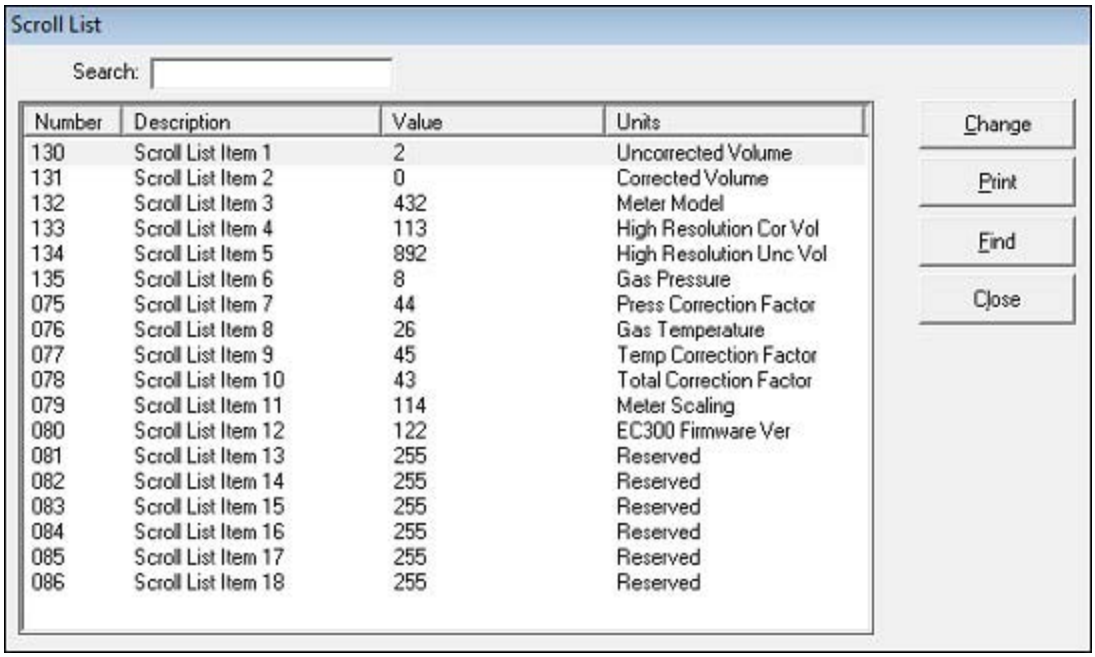
8. Insert the temperature probe of EC 350 and the calibrated thermometer into a high temperature bath, which provides the temperature span reference.
   The temperature reading displayed on the **Temperature Calibration** dialog box must exceed the zero reference temperature by at least 15% to proceed with span calibration.
9. After the reading stabilizes, click **Average Temperature Now** .
   MasterLinkSQL averages the reading and displays the average temperature.
10. Click **Change**.
    The **Change Temperature Calibration Value** dialog box appears.
11. Change the value to accurately match the temperature measured by the calibrated thermometer placed in the high calibration bath.
12. Click **OK** .

5.4.7 Configuring the Meter reader list

When you access the Meter reader mode of EC 350, 12 default items are available on the LCD display. Press the down arrow to sequentially scroll through items. Refer to the section " Level 0 mode " for the 12 default items. You can configure the Meter reader list to display the items of your choice, in the order of your choice.

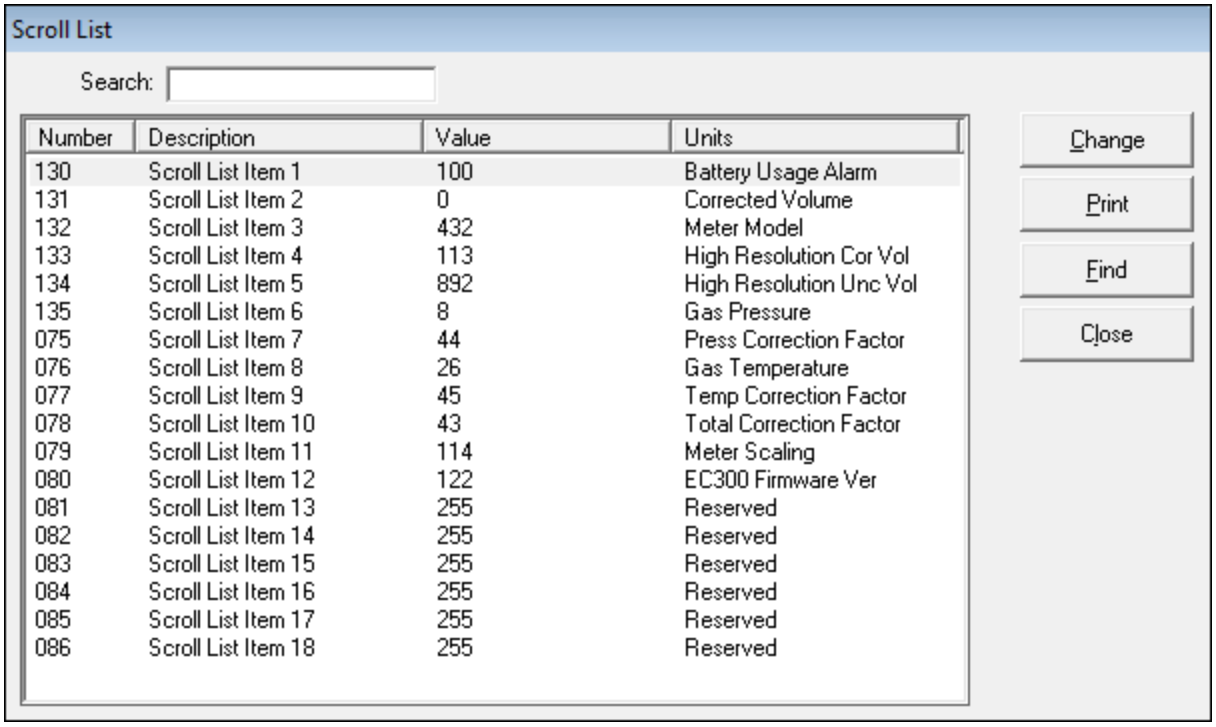
To configure the Meter reader list

1. Establish a serial communication between EC 350 and MasterLinkSQL. Refer to the *MasterLinkSQL User's Guide* for information about establishing a serial connection between EC 350 and Master-LinkSQL.
2. In the **MasterLinkSQL** window, click **Find Item by Number** icon.
   The **Find Item** dialog box appears.
3. Type **130** and click **OK**.
   The **Scroll List** dialog box appears. By default, Uncorrected V olume (item 002) is configured to appear first in the list (item 130, which is the scroll list) that appears on the LCD display.



4. Click **Change**.
   The **Change Item** dialog box appears.
5. Type the item number of your choice that must be listed first in the Meter reader list and then click **Save**. For example, if you want *Battery usage alarm (item 100)* to appear first in the Meter reader list, then type item number **100** and then click **Save**.
   The **Scroll List** dialog box appears and the item 130 (first list in Meter reader list) is configured to

Battery usage alarm (item 100).

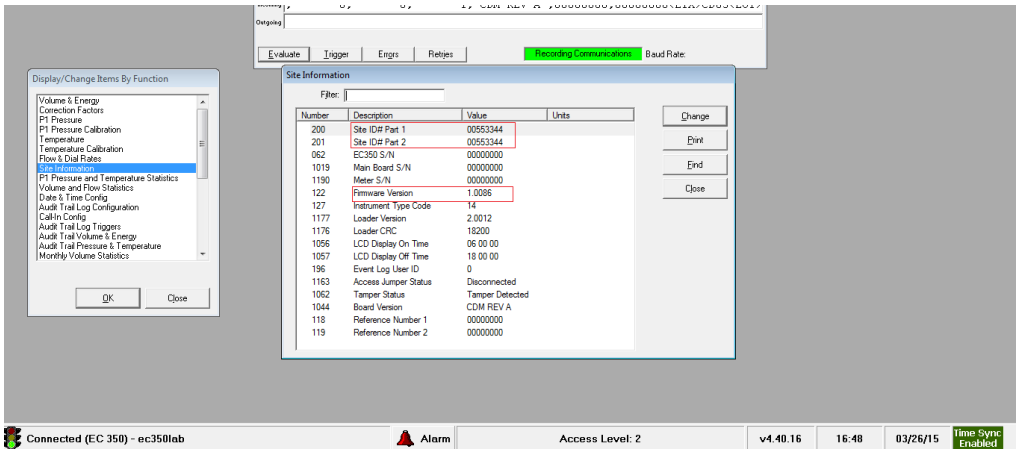


6. Perform step 3 through step 5 sequentially to change items 130 through 135 and 75 through 86, if you want to change all the 12 default items.

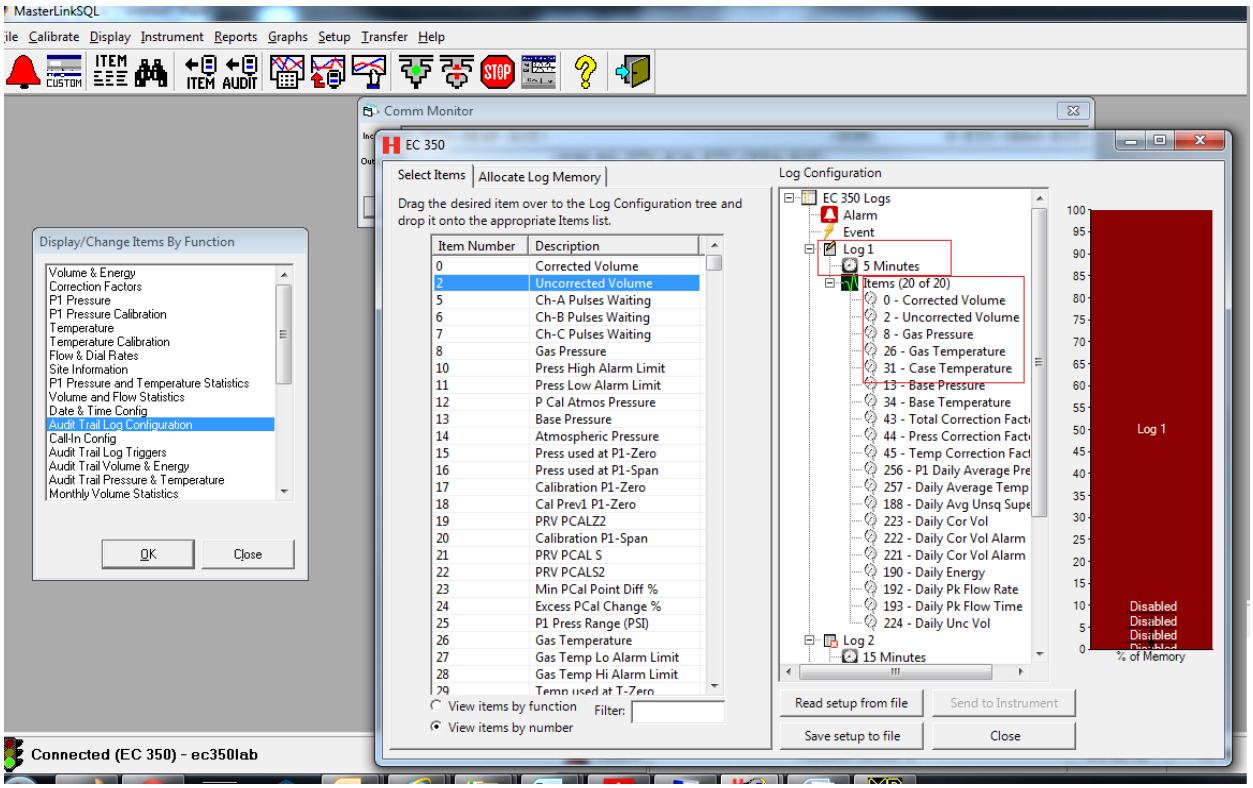
5.4.8 Configuring Call in feature

To configure the Call in feature

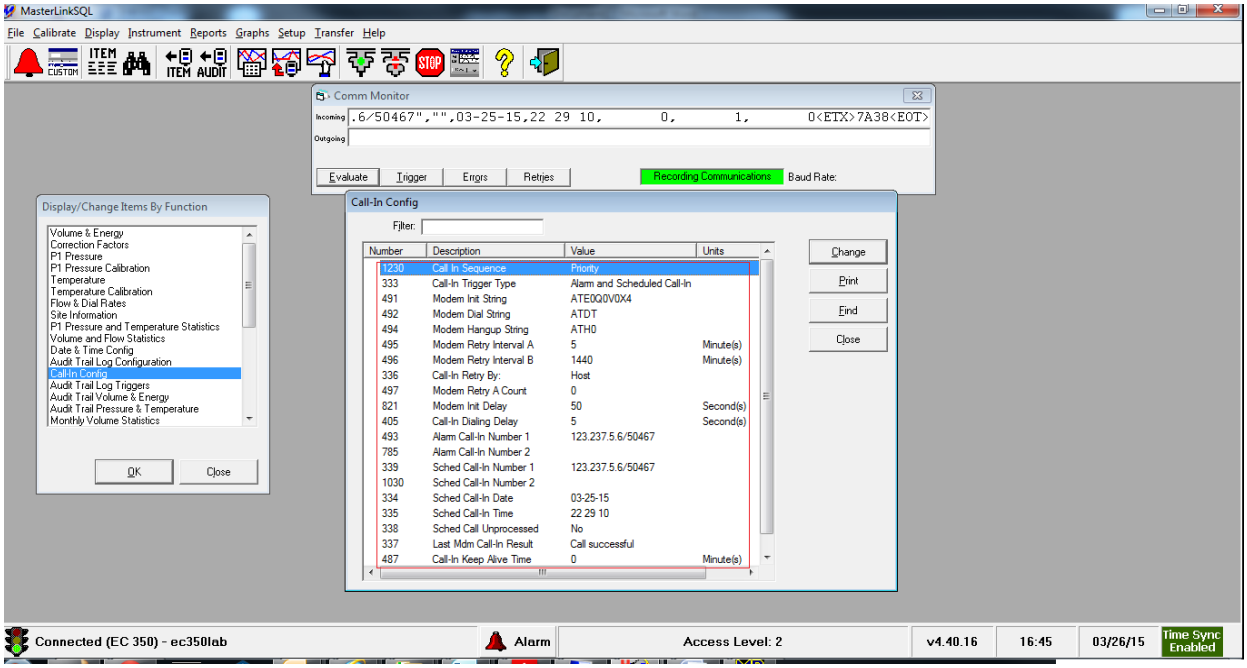
1. Launch **MasterLink**. From the **Display** tab select and click the **Item by Function** option. The **Display/Change Items By Funtcion** dialog box appears.
2. Double click the **Site Information** option and enter the site ID.



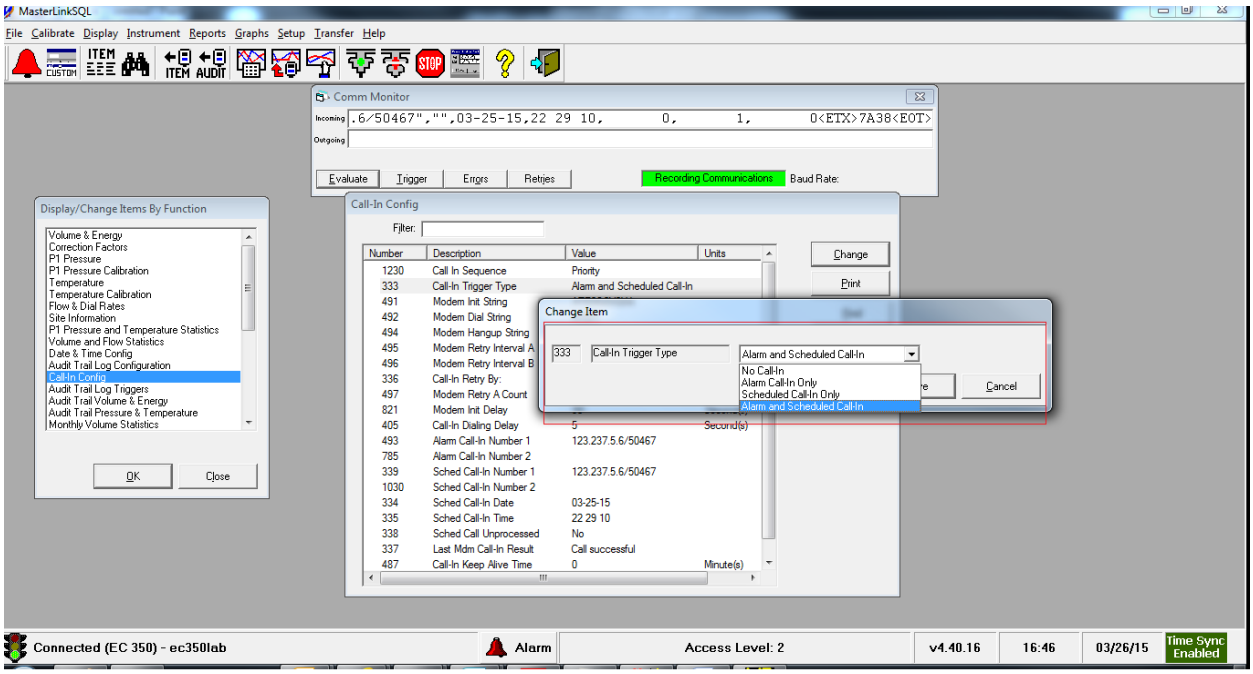
3. The site ID must be identical to the one configured in PowerSpring during the EC 350 product addition. It is a six digit, hexadecimal number.
4. Click **OK** to close the **Site Information** window.
5. Double click the **Audit Trail Log Configuration** option from the **Display/Change Items By Function** dialog box. The EC 350 audit log appears.



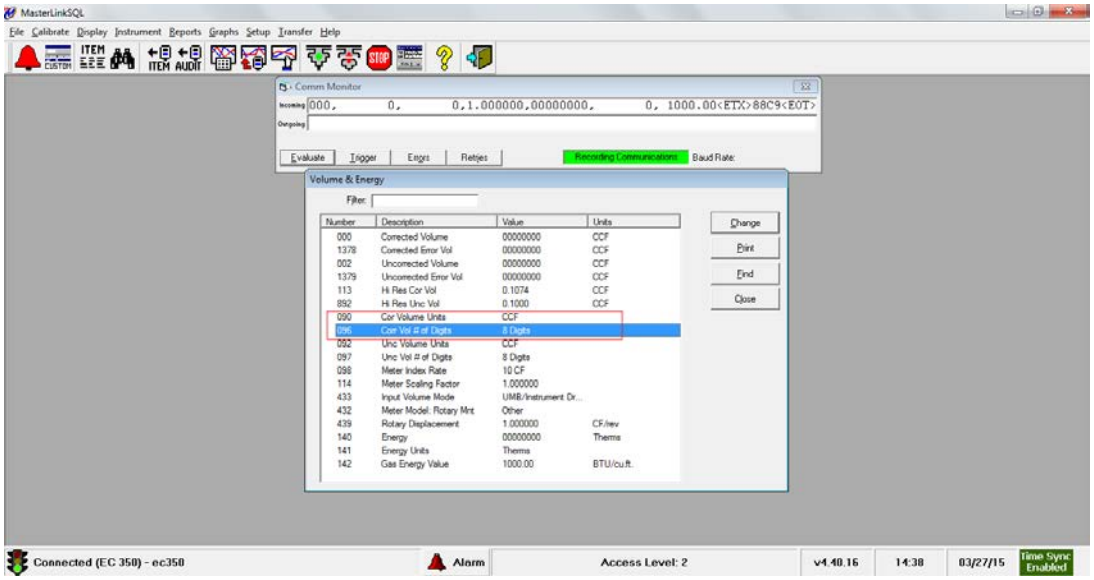
6. Specify the log interval size (this should match the interval size specified in the **Input** field definition in PowerSpring). Configure the **Audit Trail** items of EC 350 from the left pane. The sequence and number of Audit Trail items must match the inputs provided for **RUID Inputs** on **Definiton** page in PowerSpring.
7. Click **OK** to close the **Configuration** window.
8. Double click the **Call-In Config** option from the **Display/Change Items By Function** dialog box. The **Call-In Config** dialog box appears.

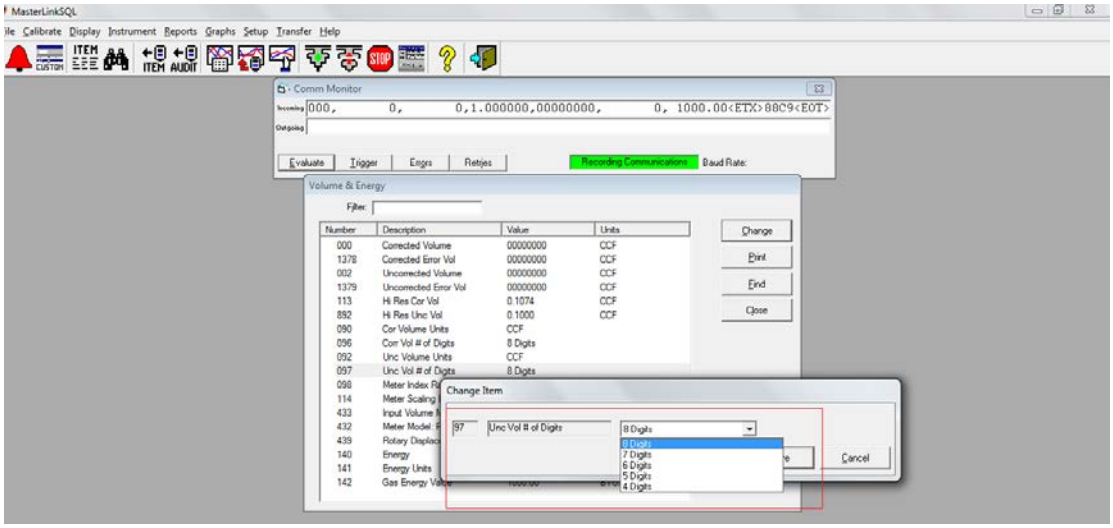


9. Type the information as shown, items: 1230, 333 (you may choose some other item numbers as well, 491, 492, 494,495, 496, upto last). Critical items are, 339 & 493, where the Host machine's IP Address for MERCURYSERVER and TCP Port (50467) should be correctly specified. The remaining fields can be defined by the user.



Note: The Corrected Volume # of digits is defined for item-90, 97 and the Uncorrected Volume # of digits is defined for item-92, 97 These values must match the **No. of Dials** field in the **Unit Configuration** tab in PowerSpring.





5.5 Working with PowerSpring

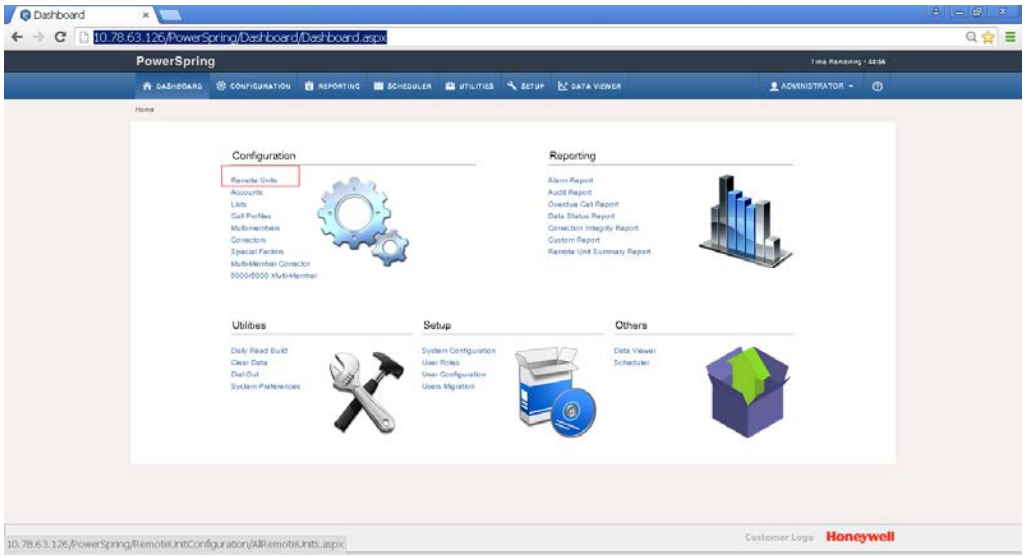
Once the EC 350 is added to PowerSpring, the configuration can be done based on your requirement.

- Adding EC 350 to PowerSpring

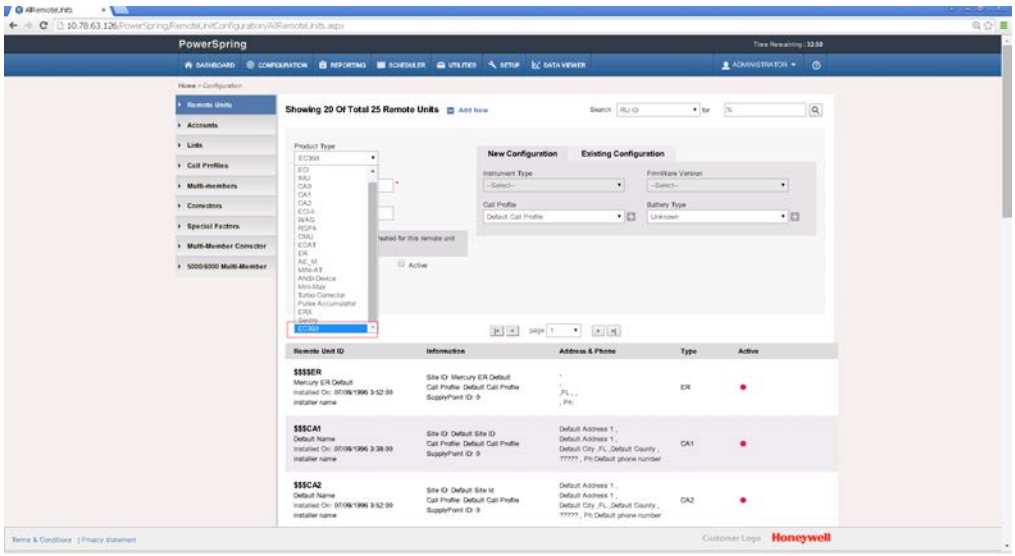
5.5.1 Adding EC 350 to PowerSpring

To add EC 350 to PowerSpring

1. Go to the PowerSpring Dashboard, select and click **Remote Units** listed under **Configuration**.

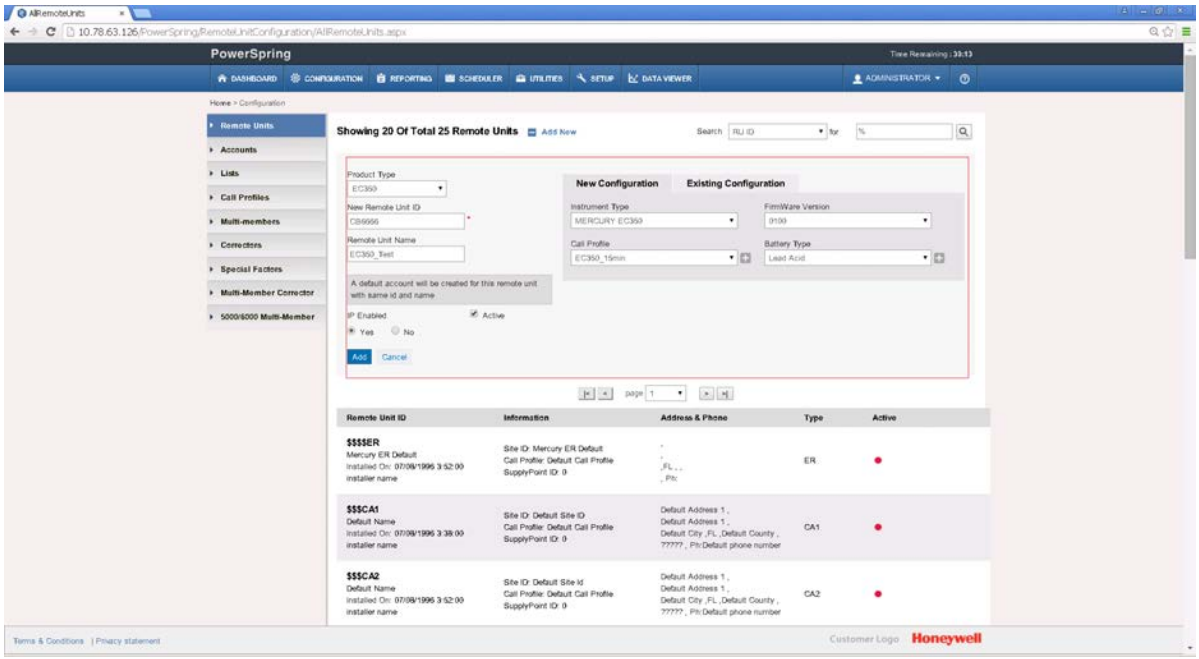


2. The **Remote Units** page appears. Click **Add New**.
3. In the selection pane, select EC 350 from the **Product Type** selection list.



4. Specify the device configuration details.

> **Note:** **Remote Unit ID** (RUID) and **FirmWare version** must be the same as specified in EC 350. The Instrument Type must be selected as MERCURY EC 350.



5.6 Connecting EC 350 with PowerSpring using a Messenger Modem

Follow the steps below to connect a EC 350 device with PowerSpring using a Messenger Modem:

- Configure EC 350 using MasterLink
- Configure EC 350 in PowerSpring

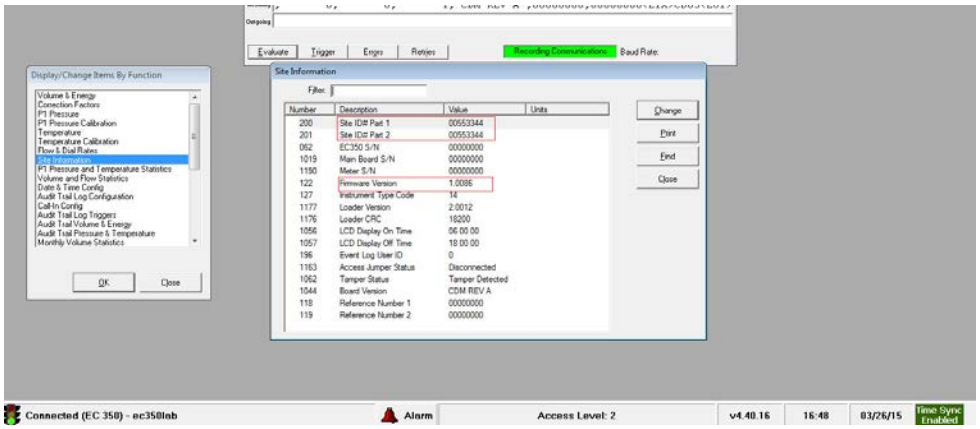
5.6.1 Configure EC 350 using MasterLink

Launch MasterLink, and go to **DISPLAY** tab in tool bar and click on ***Item by Function*** option.

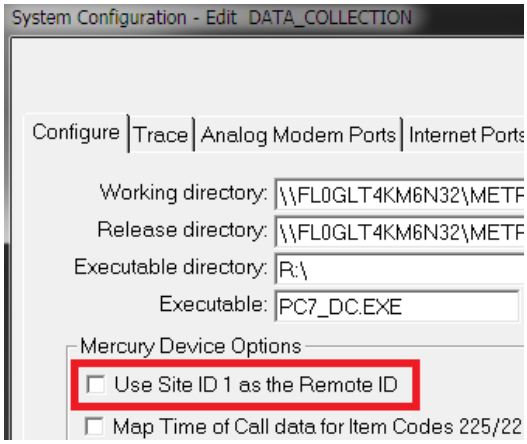
Inside the **Display/Change Items By Function** window double click the ***Site Information*** option.

Configure the following parameters:

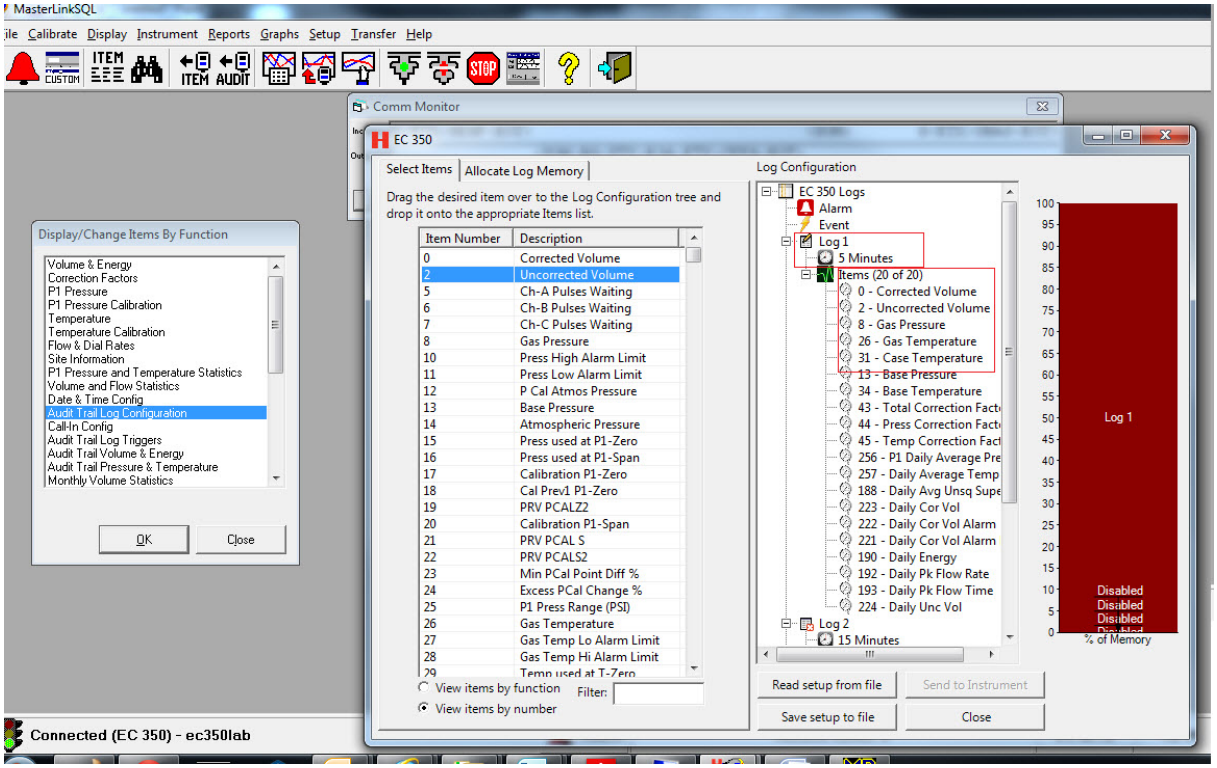
1. **SITE INFORMATION:** The site ID should be identical to (six digit, hexadecimal) the one configured in **PowerSpring** during the EC 350 product addition.



PowerSpring can use Site ID 1 or Site ID 2, that is setup in ***System Configuration -> Data Collection settings***. The default is Site ID 2.

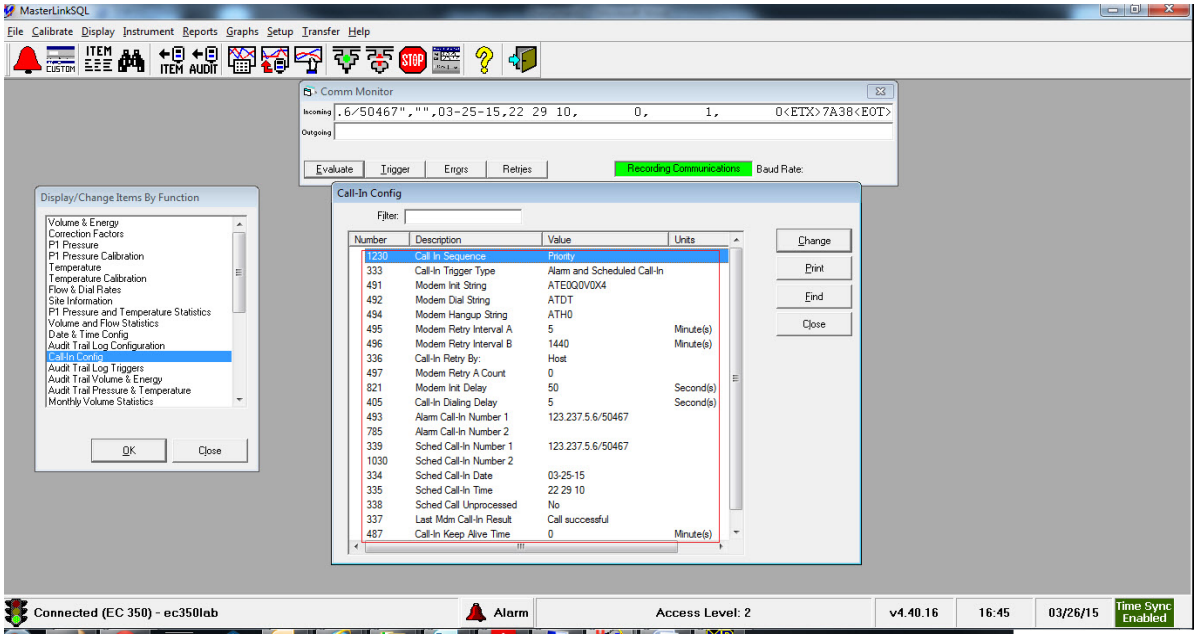


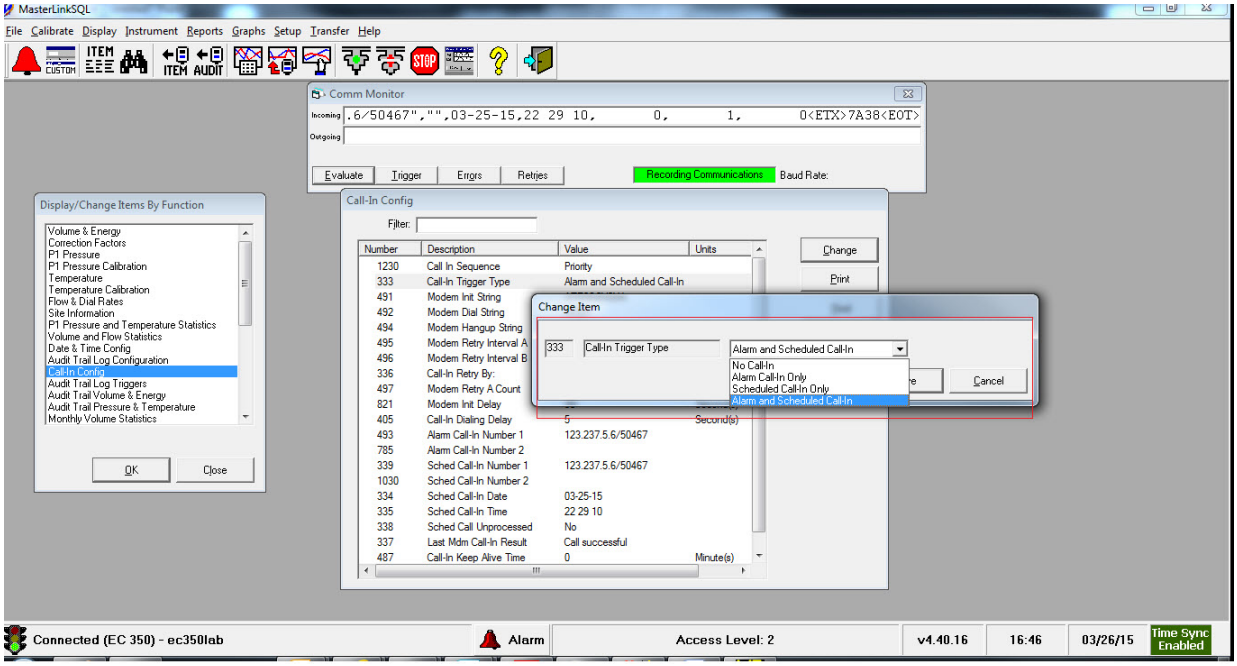
2. Inside the **Display/Change Items By Function** sub-window, double click on **Audit Trail Log configuration** option. This will open the audit trail configuration window. Specify the information marked in red window, i.e. LOG INTERVAL size (this should match with the interval size given in **Input** definition of the PowerSpring.) Configure the AUDIT TRAIL items of EC 350, from left pane with the sequence & number of Audit Trail items equal to PowerSpring **RUID Inputs** Definition page.



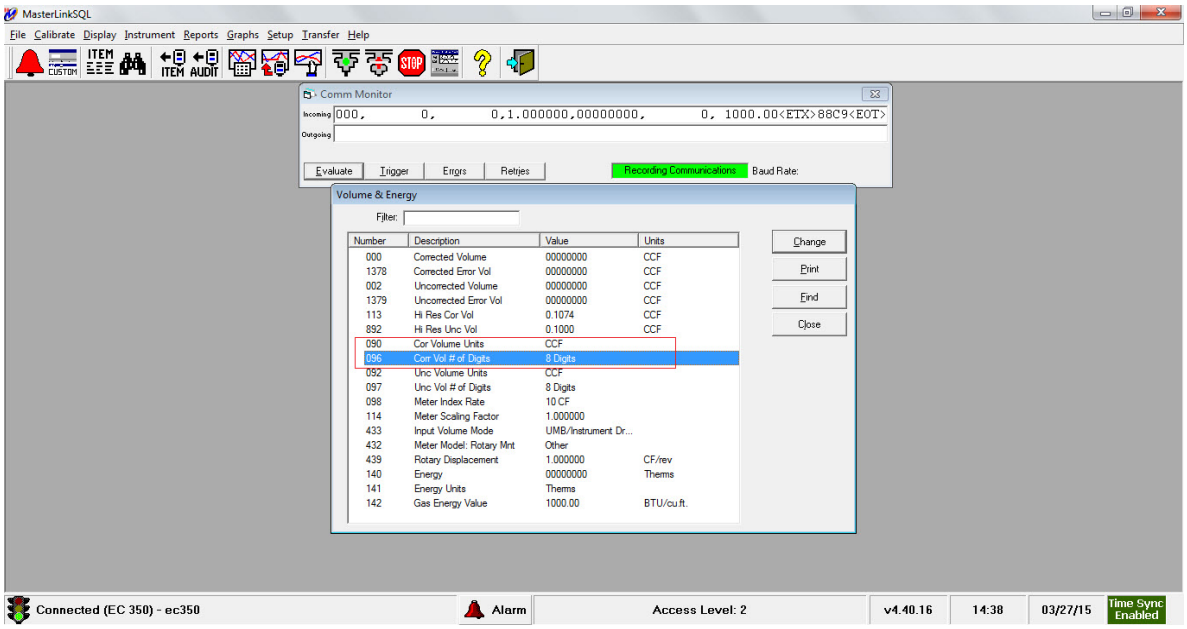
3. Call-In Configuration: Inside the **Display/Change Items By Function** sub-window, double click on **Call-In Config** option. Enter the information as shown in the region marked in red.
i.e. items 1230, 333, 491, 492, 494,495, 496, upto last – depending on how the user wants the Call-in to happen.

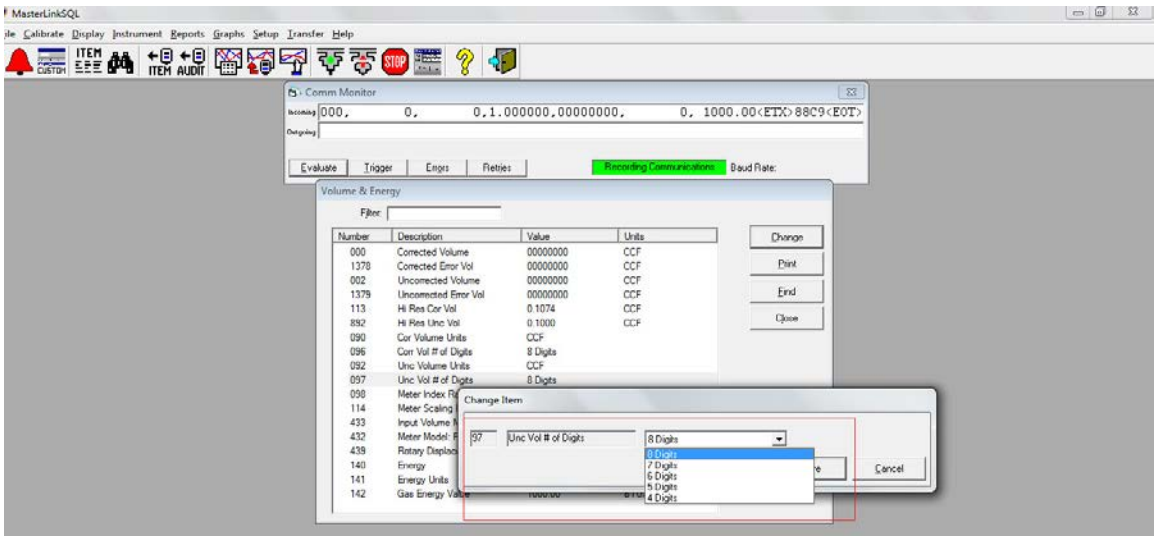
   Critical items are- 339 & 493, where the HOST machine IP Address for MERCURY SERVER and TCP Port (50467) should be correctly specified. The rest items are user dependent.





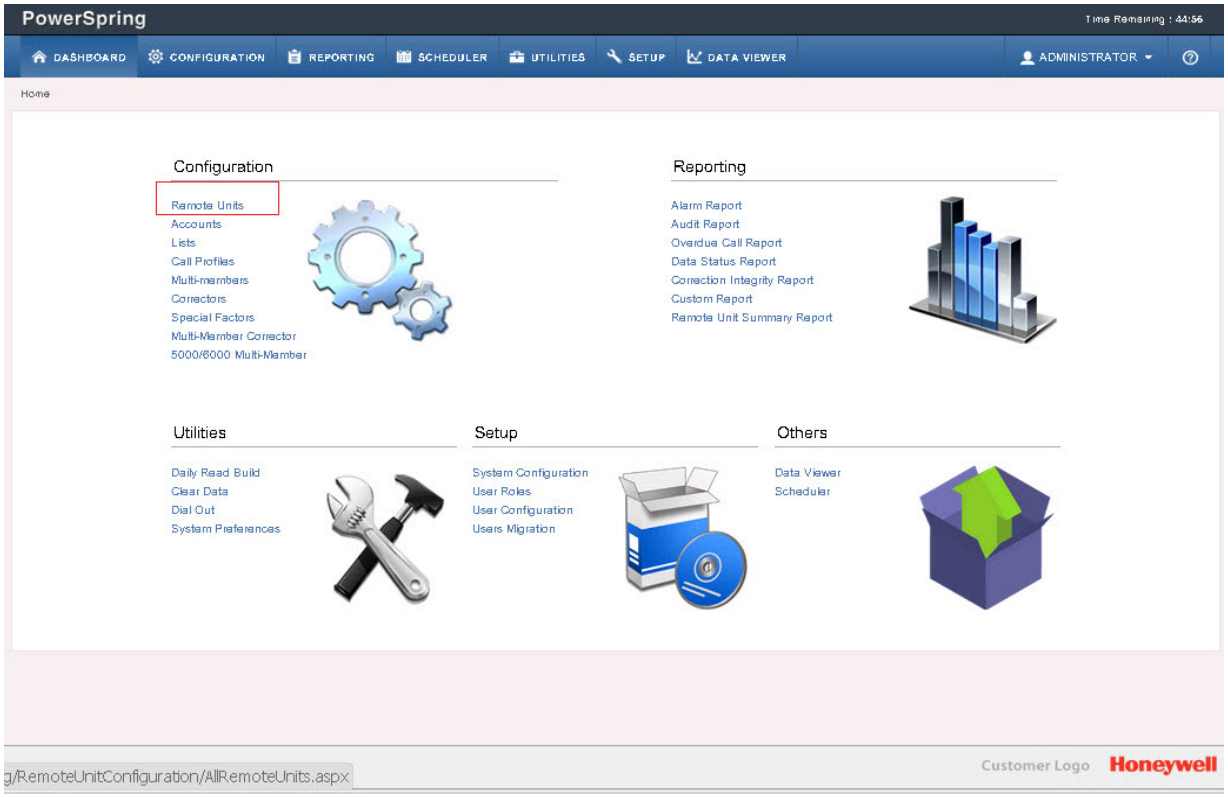
4. Corrected Volume # of digits: item-90, 97
   Uncorrected Volume # of digits: item-92, 97
   These values should be match with the "**No. of Dials field**", in **UNIT** configuration in PowerSpring input configuration.


MasterLinkSQL
File Calibrate Display Instrument Reports Graphs Setup Transfer Help
Comm Monitor
Evaluate Trigger Errors Retries
Recording Communications
Baud Rate:
Volume & Energy
Filter:
Number Description Value Units
000 Corrected Volume 00000000 CCF
1378 Corrected Error Vol 00000000 CCF
002 Uncorrected Volume 00000000 CCF
1379 Uncorrected Error Vol 00000000 CCF
113 Hi Res Cor Vol 0.1074 CCF
892 Hi Res Unc Vol 0.1000 CCF
090 Cor Volume Units CCF
096 Cor Vol # of Digits 8 Digits
092 Unc Volume Units CCF
097 Unc Vol # of Digits 8 Digits
098 Meter Index Rate 10 CF
114 Meter Scaling Factor 1.000000
433 Input Volume Mode UMB/Instrument Dr...
432 Meter Model: Rotary Mnt Other
439 Rotary Displacement 1.000000 CF/rev
140 Energy 00000000 Therms
141 Energy Units Therms
142 Gas Energy Value 1000.00 BTU/cu.ft.
Change
Print
Find
Close
Connected (EC 350) - ec350
Alarm
Access Level: 2
v4.40.16
14:38
03/27/15
Time Sync Enabled

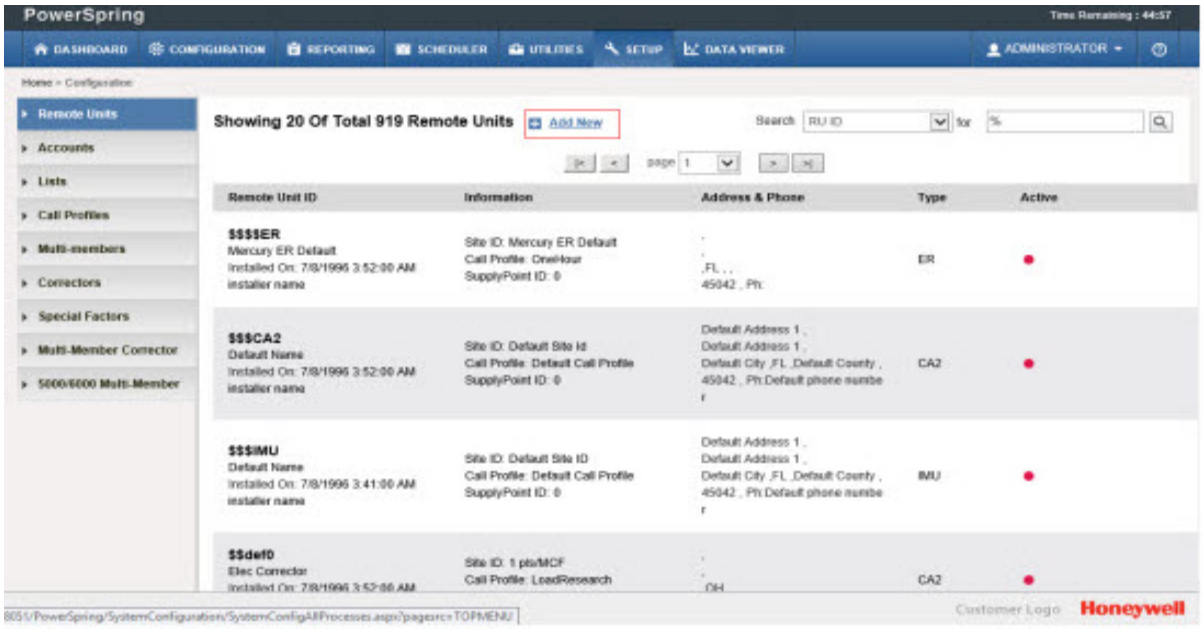

MasterLinkSQL
Comm Monitor
Volume & Energy
Change Item
Unc Vol # of Digits
8 Digits
7 Digits
6 Digits
5 Digits
4 Digits
Cancel

5.6.2 Configure EC 350 in PowerSpring

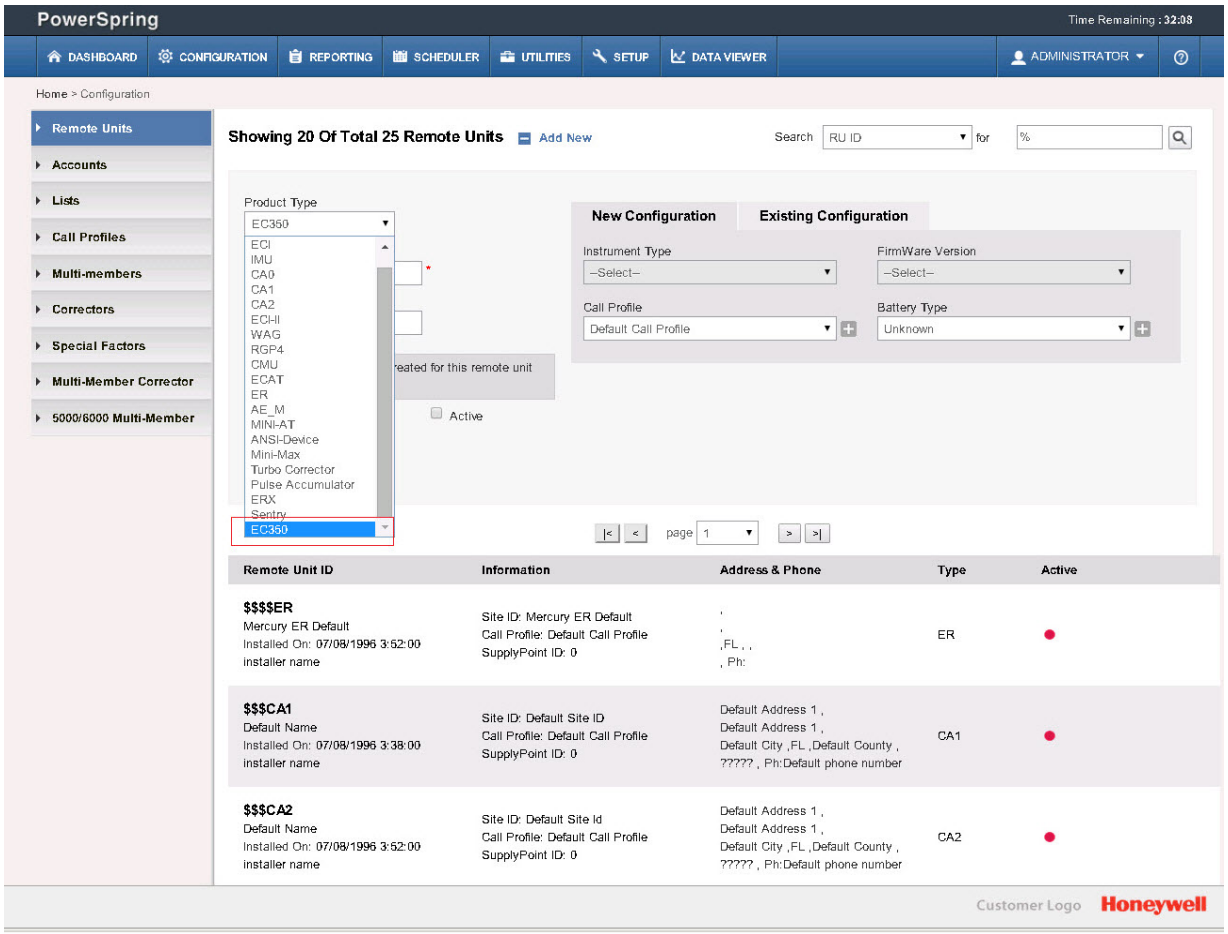
1. Go to the PowerSpring dashboard and inside the **Configuration** list, click on the **Remote Units**.



Click on **ADD NEW** button.


PowerSpring
Time Remaining : 44:57
DASHBOARD
CONFIGURATION
REPORTING
SCHEDULER
UTILITIES
SETUP
DATA VIEWER
ADMINISTRATOR
Home » Configuration
Remote Units
Accounts
Lists
Call Profiles
Multi-members
Correctors
Special Factors
Multi-Member Corrector
5000/6000 Multi-Member
Showing 20 Of Total 919 Remote Units
Add New
Search
RU ID
for
%
page 1
Remote Unit ID
Information
Address & Phone
Type
Active
$$$$ER
Mercury ER Default
Installed On: 7/8/1996 3:52:00 AM
installer name
Site ID: Mercury ER Default
Call Profile: OneHour
SupplyPoint ID: 0
ER
$$$CA2
Default Name
Installed On: 7/8/1996 3:52:00 AM
installer name
Site ID: Default Site Id
Call Profile: Default Call Profile
SupplyPoint ID: 0
Default Address 1 ,
Default Address 1 ,
Default City ,FL ,Default County ,
45042 , Ph:Default phone numbe
r
CA2
$$$IMU
Default Name
Installed On: 7/8/1996 3:41:00 AM
installer name
Site ID: Default Site ID
Call Profile: Default Call Profile
SupplyPoint ID: 0
Default Address 1 ,
Default Address 1 ,
Default City ,FL ,Default County ,
45042 , Ph:Default phone numbe
r
IMU
$$def0
Elec Corrector
Site ID: 1 pts/MCF
Call Profile: LoadResearch
CA2
8051/PowerSpring/SystemConfiguration/SystemConfigAllProcesses.aspx?pagesrc=TOPMENU
Customer Logo
Honeywell

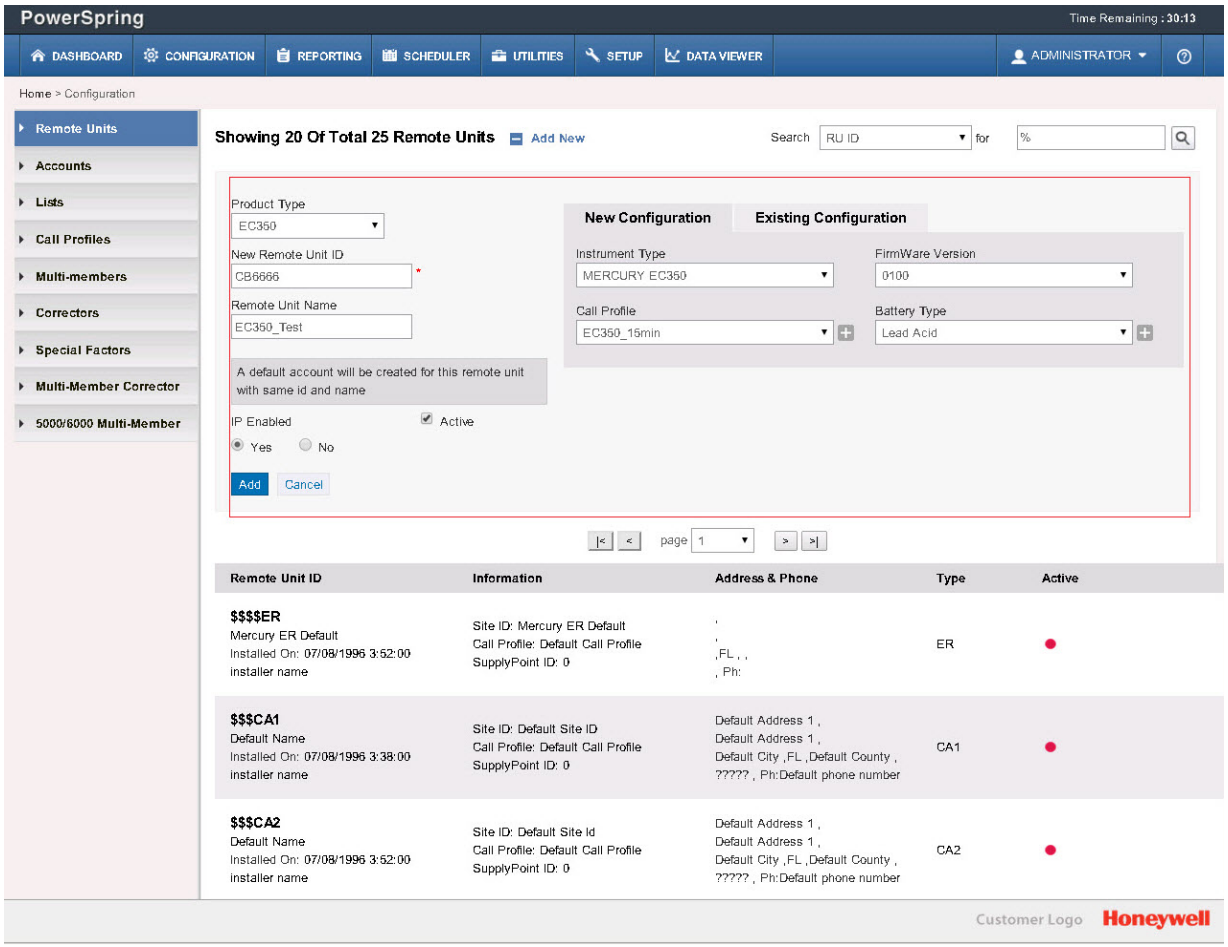
2. In the **Product type** dropdown, select the EC 350 product type.



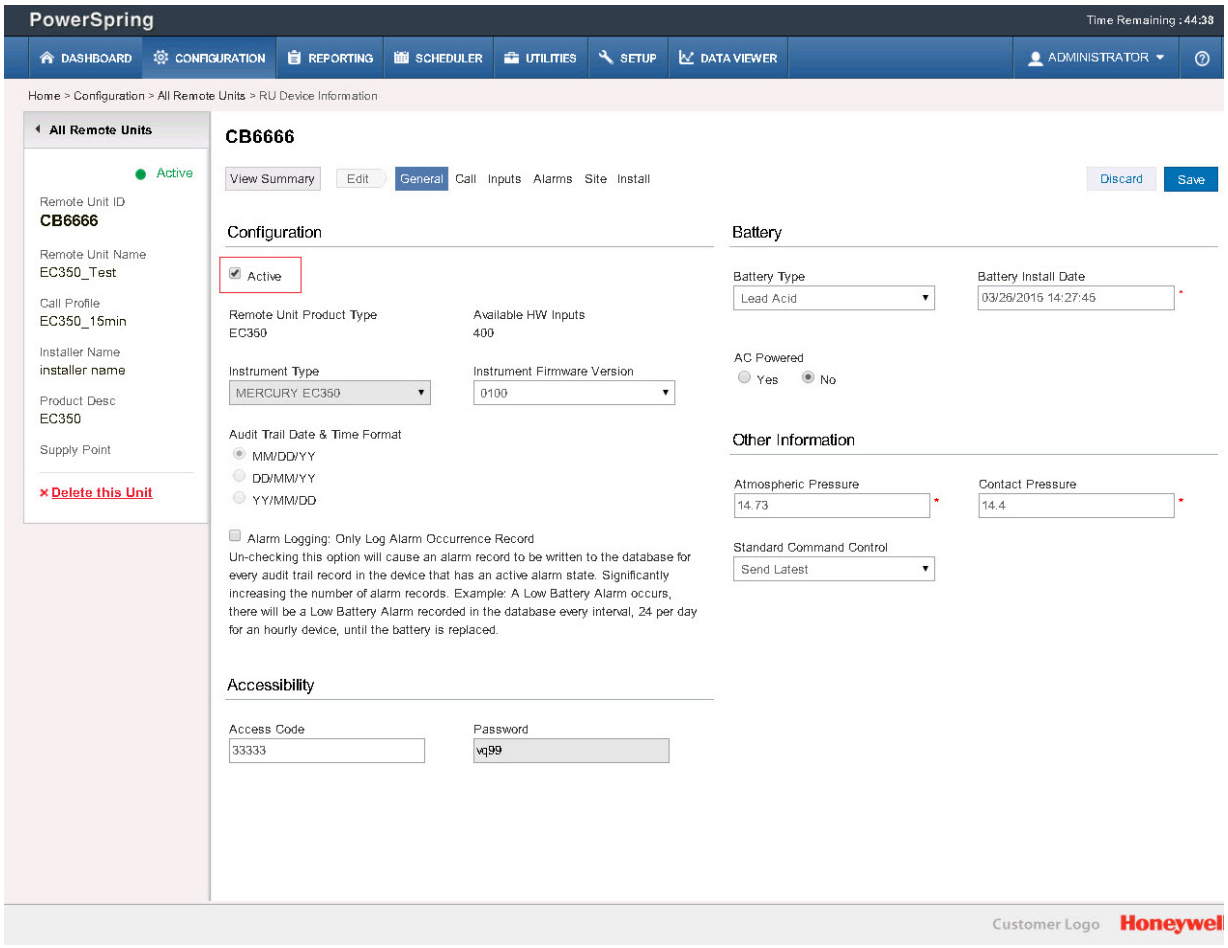
Enter the device configuration details.

Note: Remote Unit ID (entered in New Remote Unit ID), FirmWare version, should be same as is specified in EC 350 corrector and the Instrument Type must be selected as MERCURY EC350.

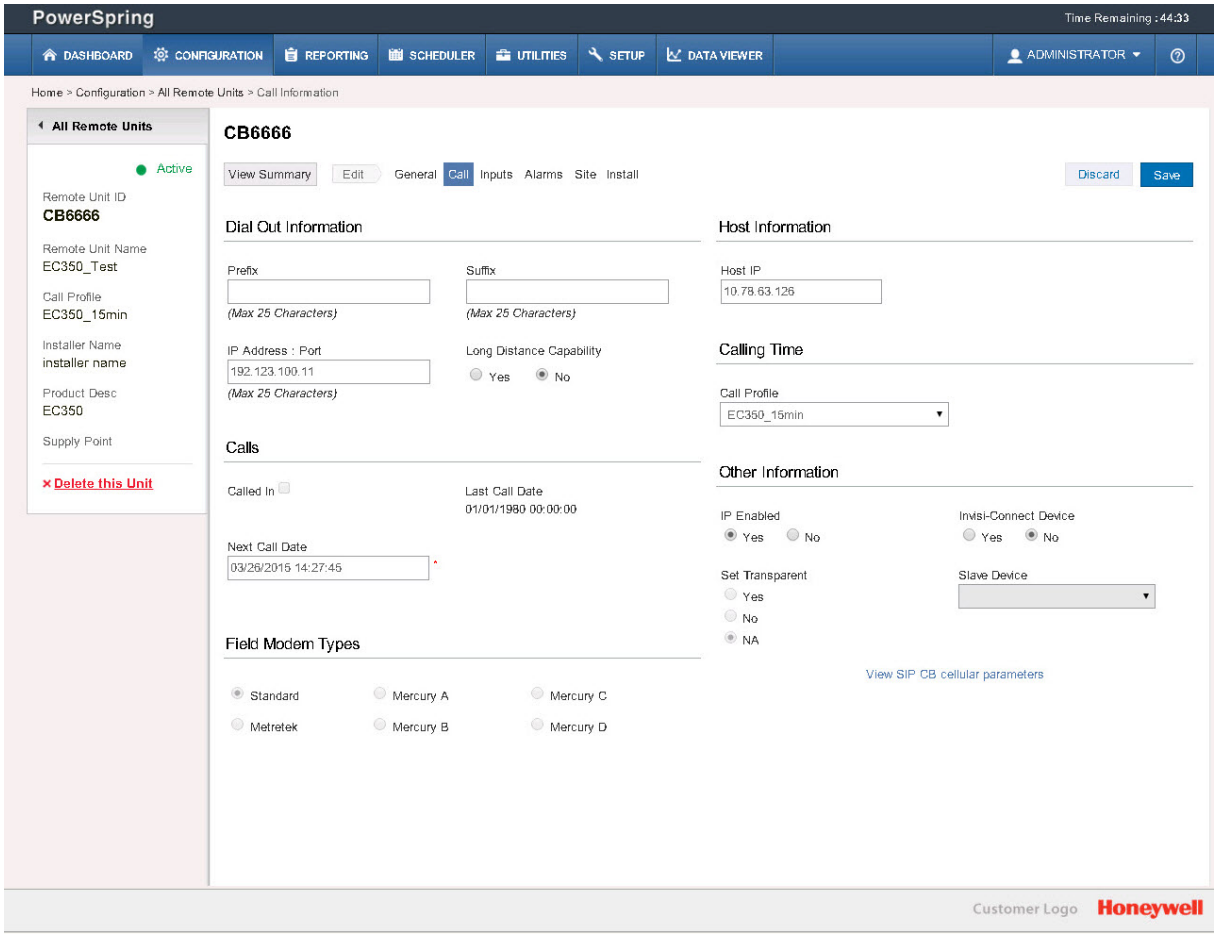
3. Click on **ADD** Button in left bottom.



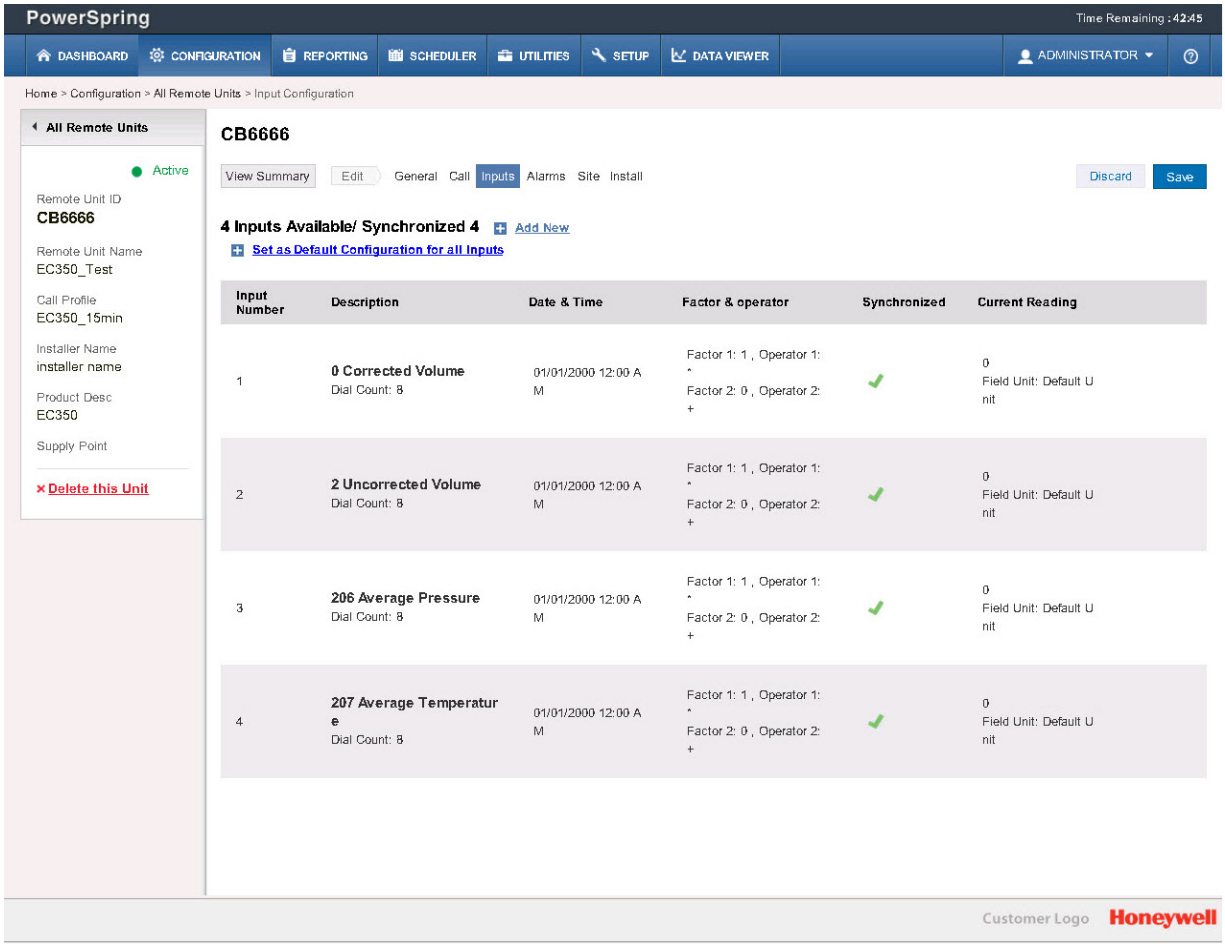
4. In the **General** tab enter all the applicable information and enable the device **ACTIVE** check box.



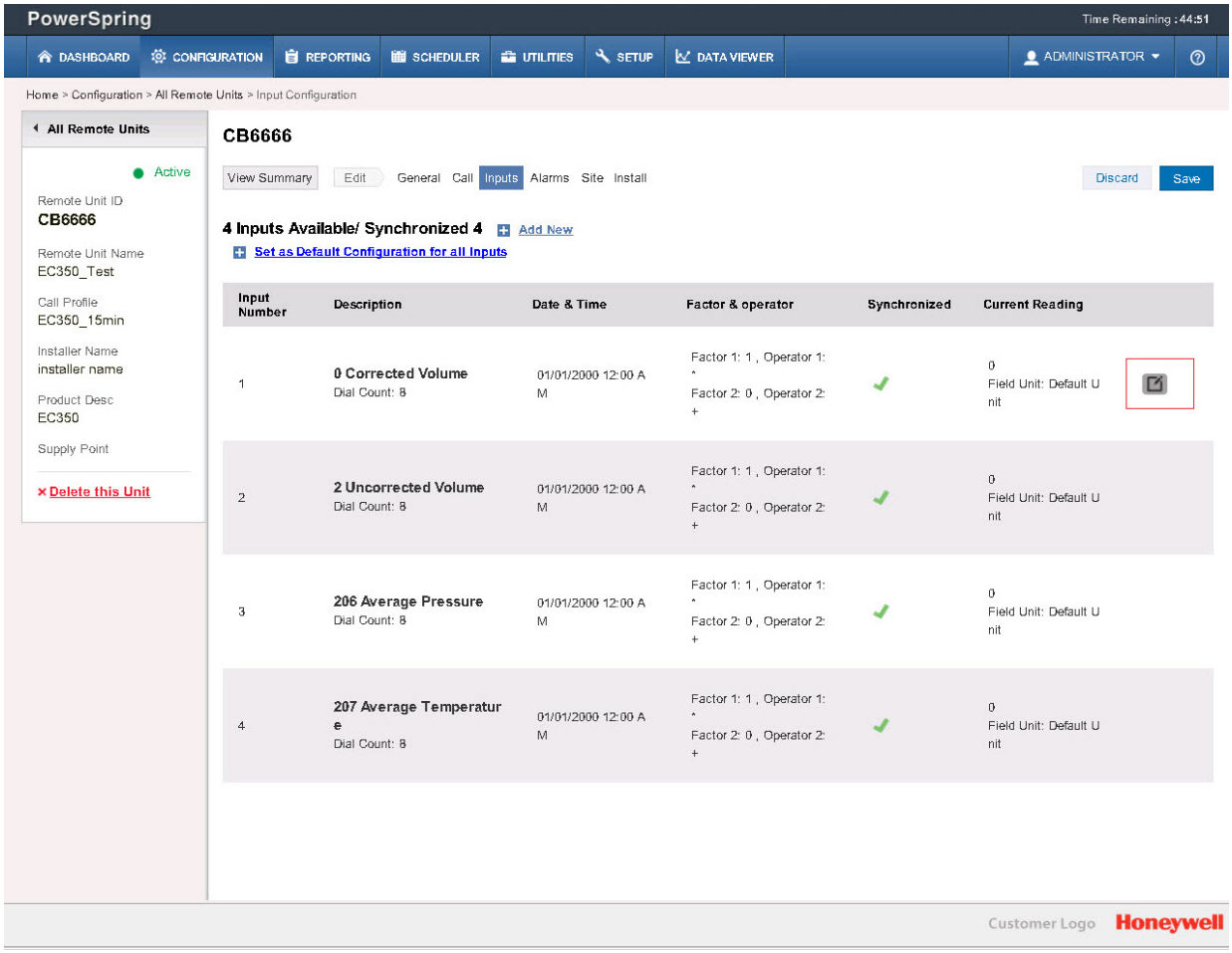
5. In the **Call** tab, in the **Other Information** sub-window, specify the type of communication i.e. IP Enabled or Not.



6. The sequence and number of inputs inside the INPUTS tab must be identical to ***EC350 Audit Trail Log1.***



Click on **EDIT** tab on the Input to be edited.



In **EDIT Input window > Input Definition**, enter the following critical parameters:

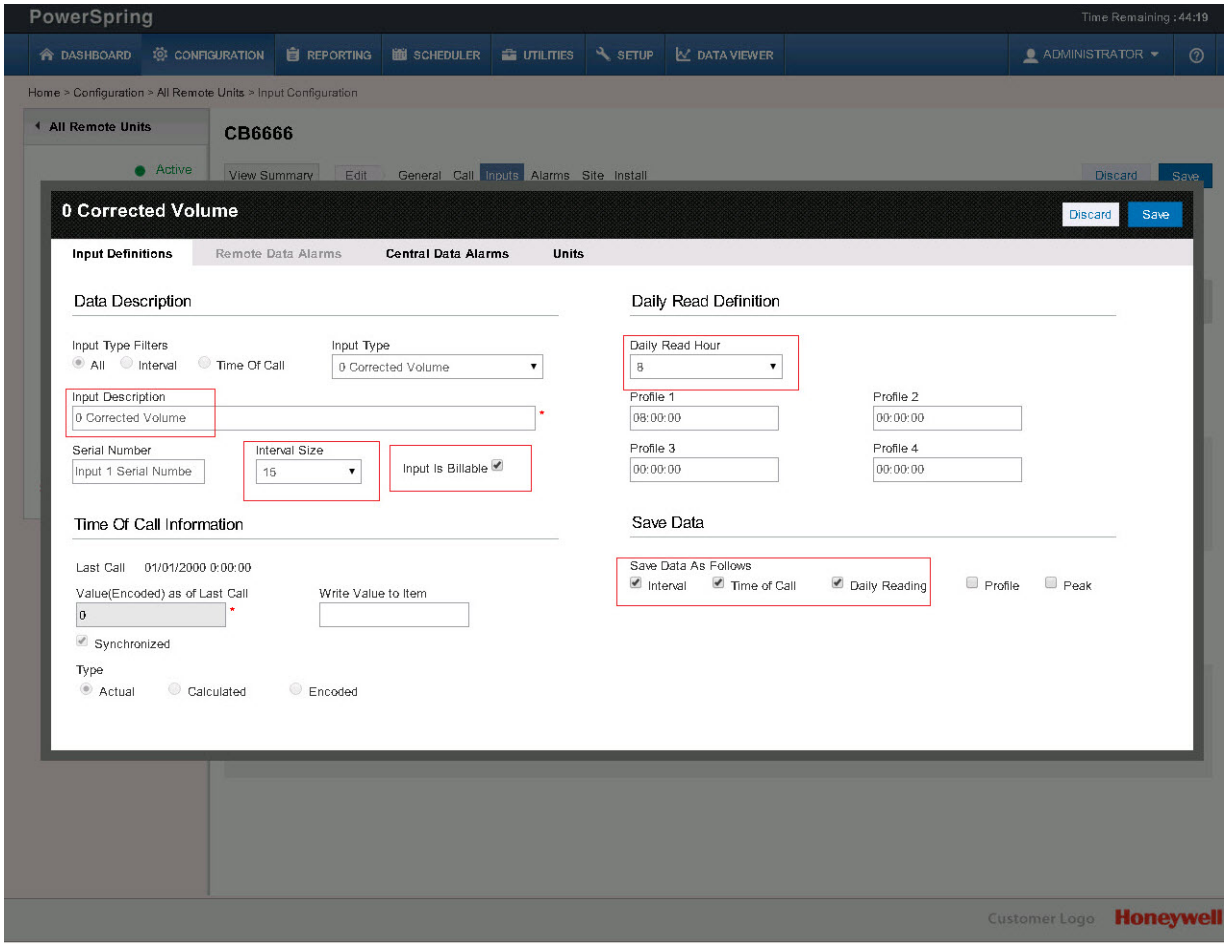
a. Input description

b. Input Interval

c. Enable the Billable option

d. Save Data (enable checkboxes to store the Interval, Time of Call, Daily Reading)

e. Daily Read Hour (specify the hour at which the Remote Unit performs a read on the selected input. Type the hour, (0 to23), minute and second). Profile 1, Profile 2, Profile 3 and Profile 4: To define four profiles for CA0 and CA1 Remote Units that enable you to set up more than one Daily Readings, that is, define four profiles at which the Remote Unit performs a read on the selected input. Type the Hour, Minute, and Second for each Profile. One Profile must match the Daily Read Hour.



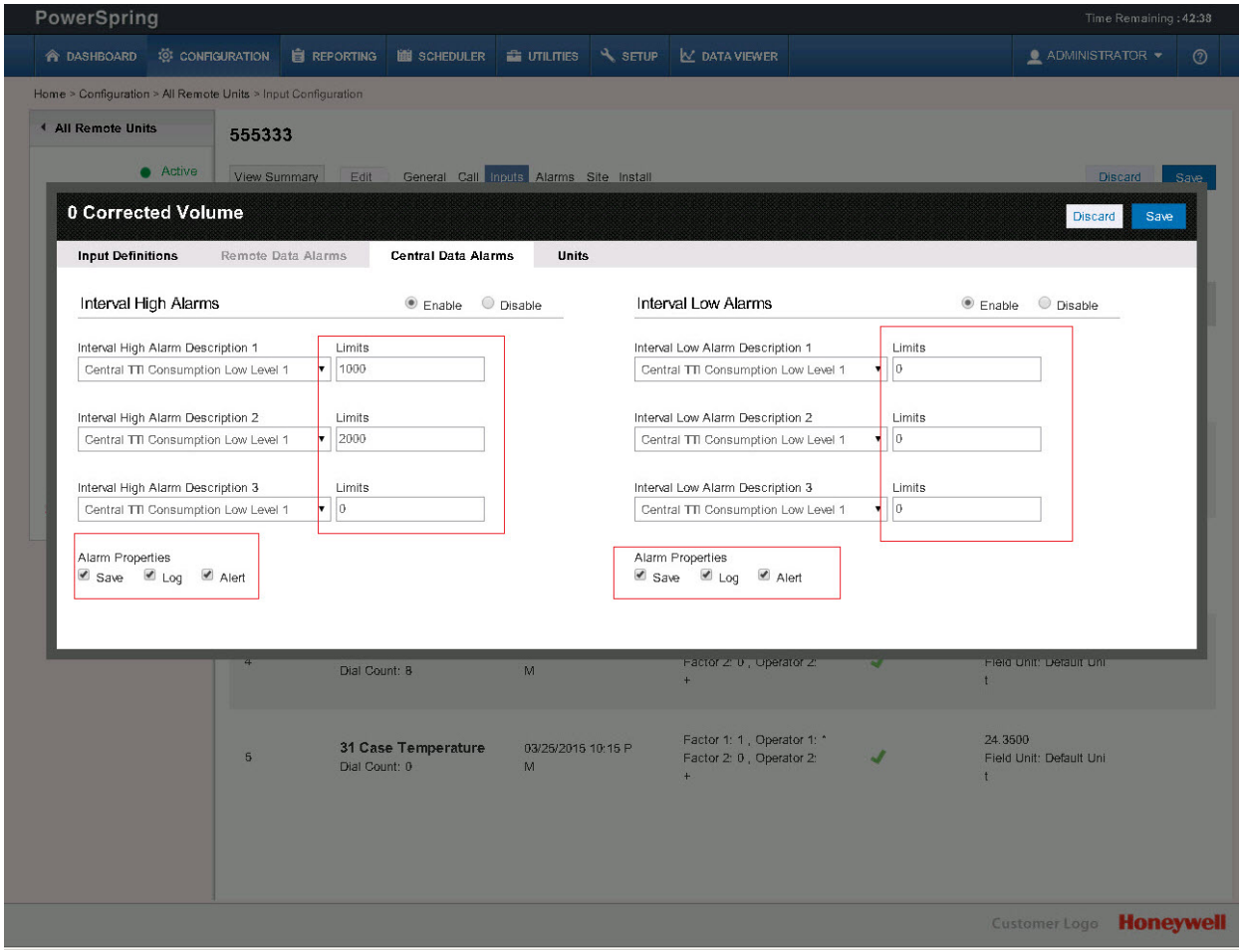
INPUTS>Central Data Alarms tab:

Use this tab to define automatic central limit checking. PowerSpring allows you to set up a simple, yet extremely effective, Central Interval Level Checking scheme that enables you to report on intervals outside user-configured boundaries. You can configure this tri-level checking scheme for both High and Low Intervals; however, you are not required to use both. Let's assume you have a customer that is "interruptible" (curtailed). Of course, you cannot completely shut the gas off because the customer has a large number of pilot lights that must remain operative; therefore, a very small consumption is expected. You could set up the following tri-level central interval high checking scheme:

- Central Interval 1 High - Set this to the lowest level of severity. If consumption rises above this level, monitor this customer more closely.
- Central Interval 2 High - Set this to the middle level of severity. If consumption rises above this level, call the customer.
- Central Interval 3 High - Set his to the highest level of severity. If consumption rises

above this level, you know that the customer is using gas Inside the Edit Input (Corrected Volume) window, go to the UNITS tab.

Inside the Edit Input (Corrected Volume) window, go to the UNITS tab.

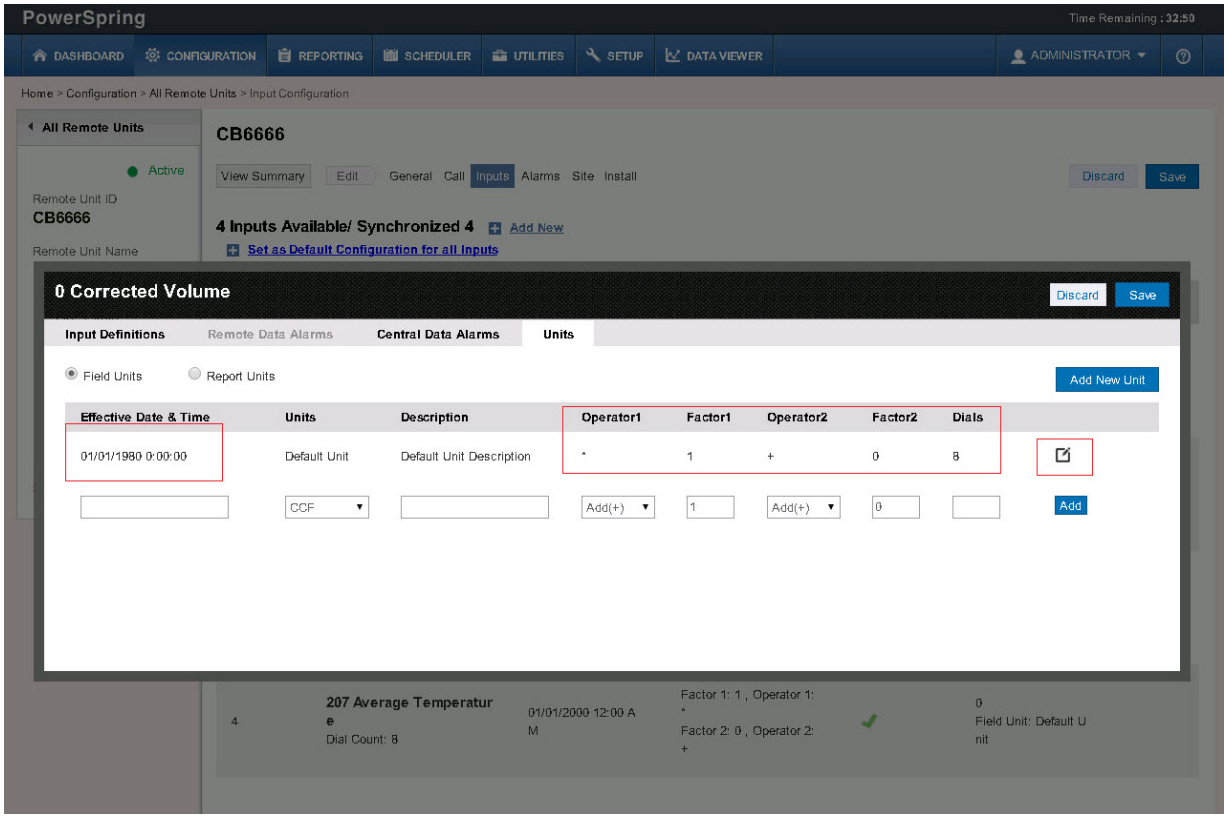


INPUT > UNITS tab:

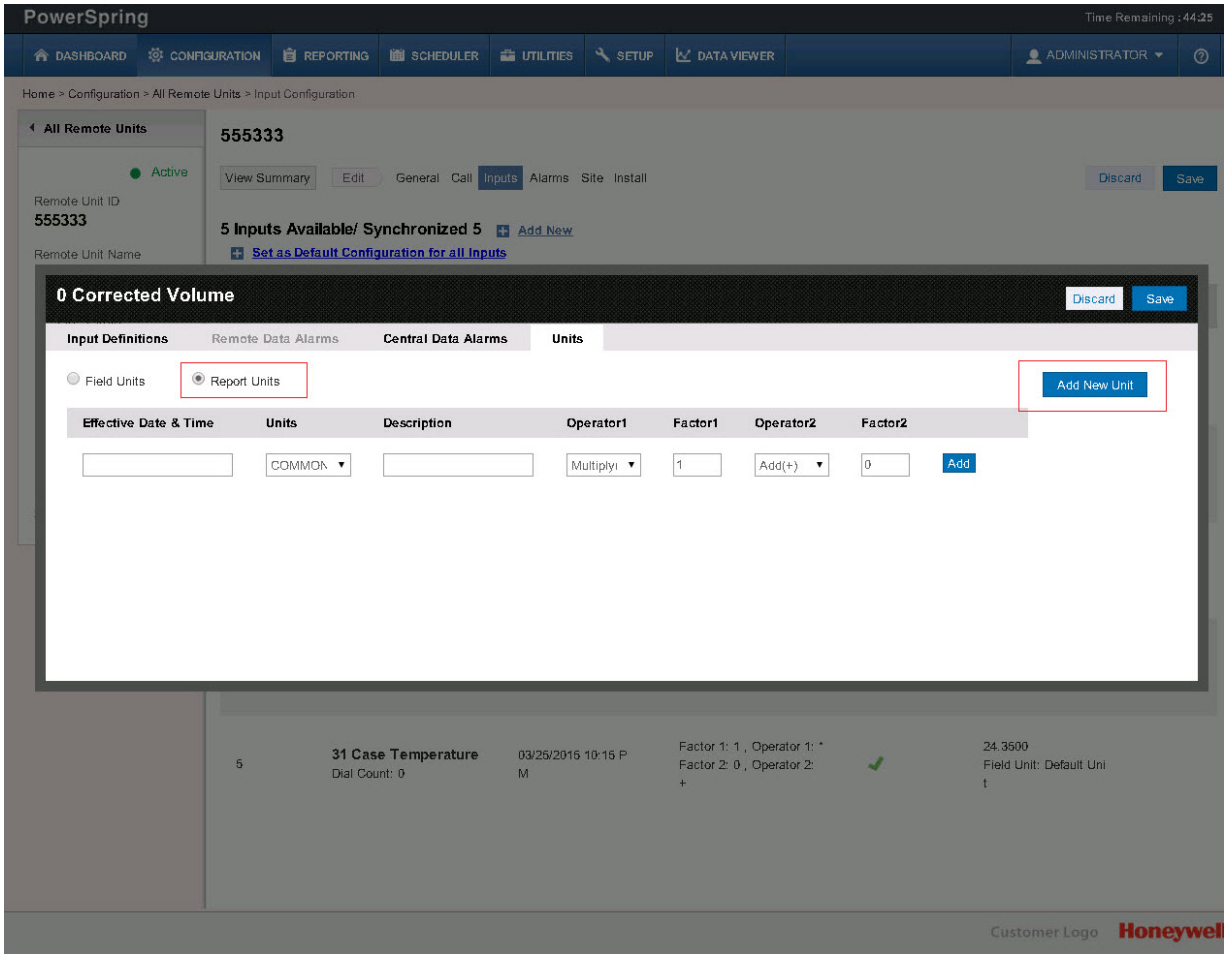
This sub-window can be used to:

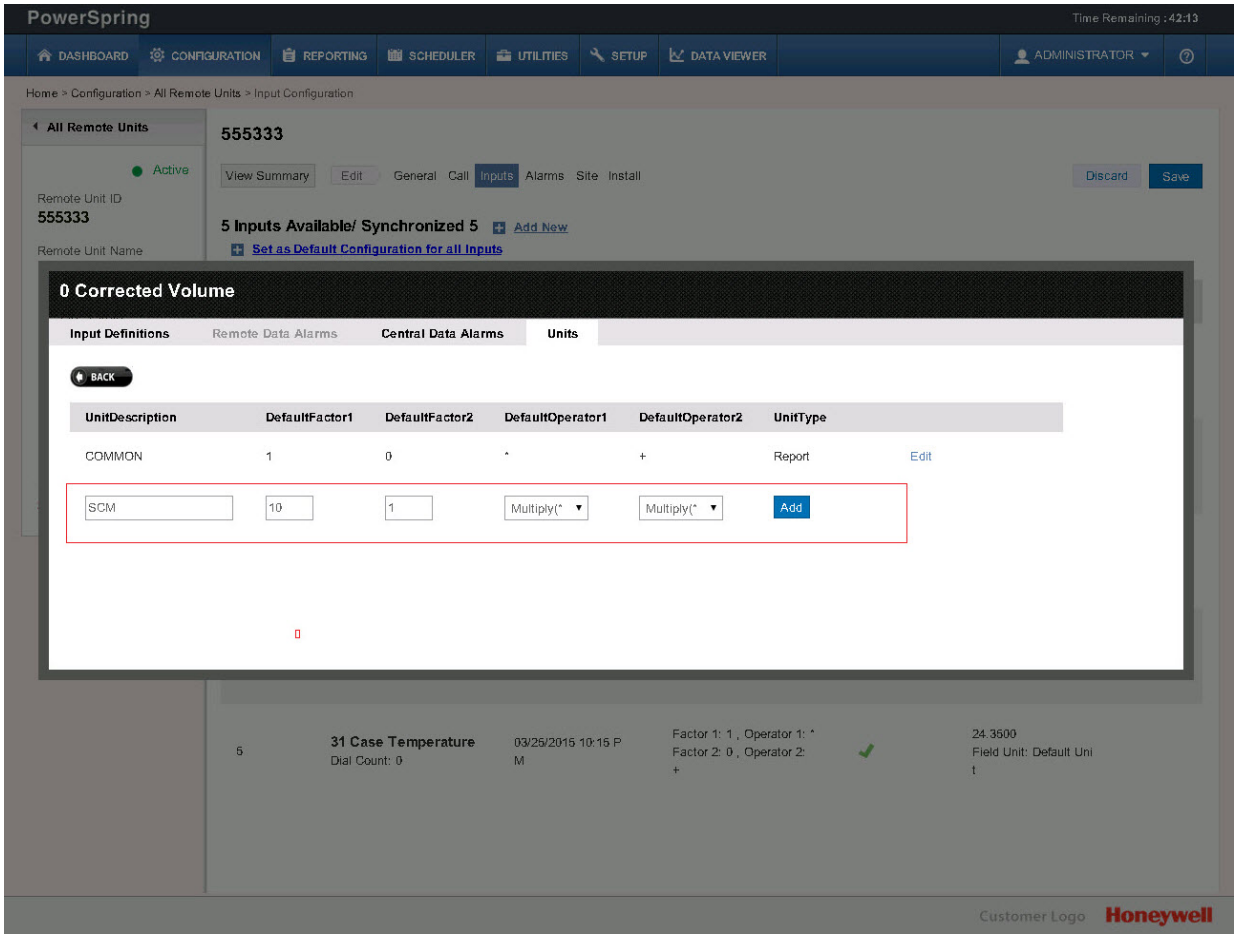
- Add edit, and delete field unit conversions. You use these conversions to convert your raw data to a scaled format before it is saved in the database.
- Add, edit, and delete report unit conversions. You can apply these conversions to your data, using the Custom Report and Data Viewer applications, and view the data in a new format. Most important information, the latest ADDED field or REPORT units will be used to save the data, since when they are created. Previous existing units shall still show the history in the respective units.

Click on the EDIT icon for editing a FIELD UNIT.

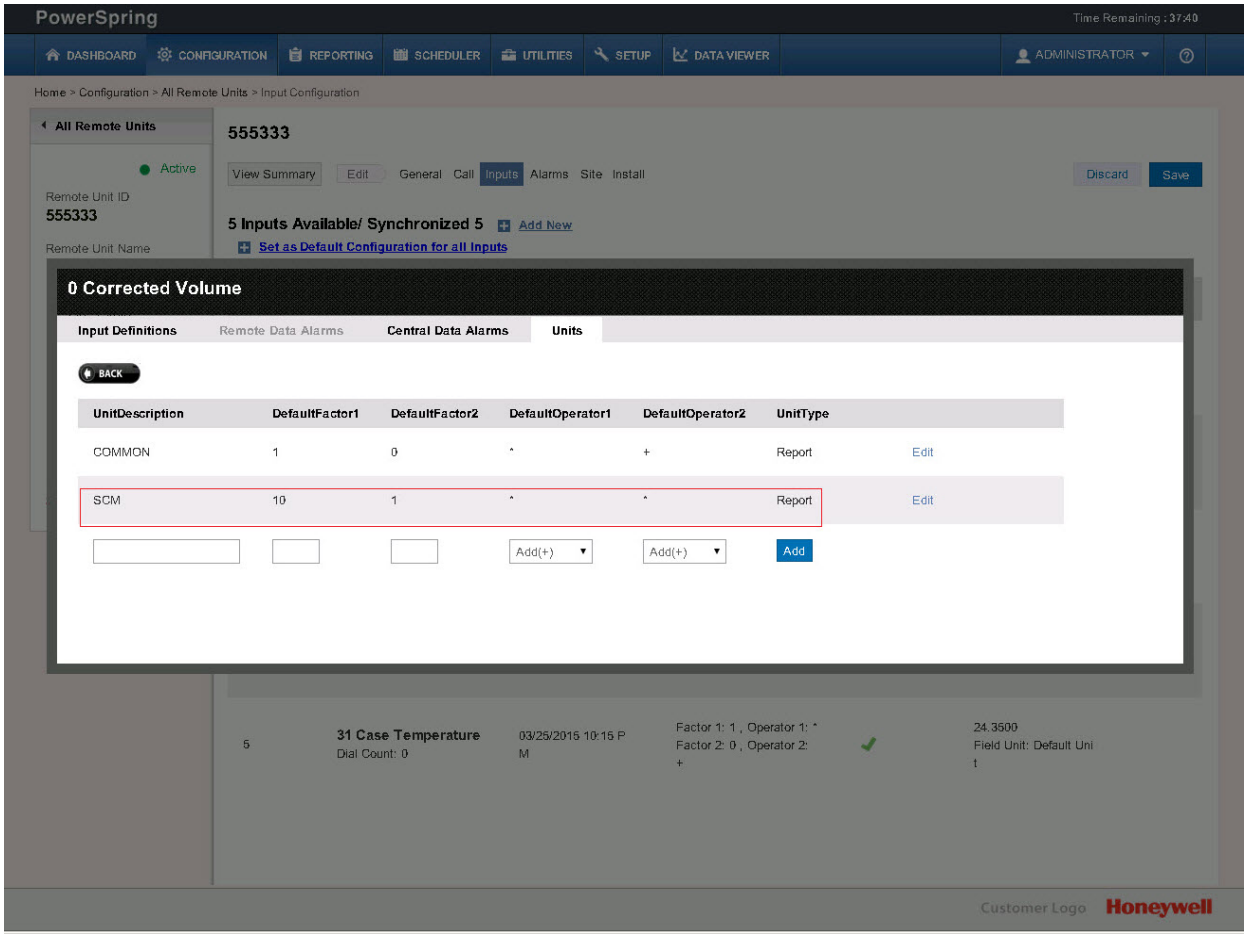


Also user can add customized UNITS with Operator and Factors for calculation and display in Data viewer, as desired. Similarly add the REPORT UNITS for calculating and loading the data in Data Viewer application, shown below. Go to the REPORT UNIT radio button and click on the ADD NEW tab (shown below).

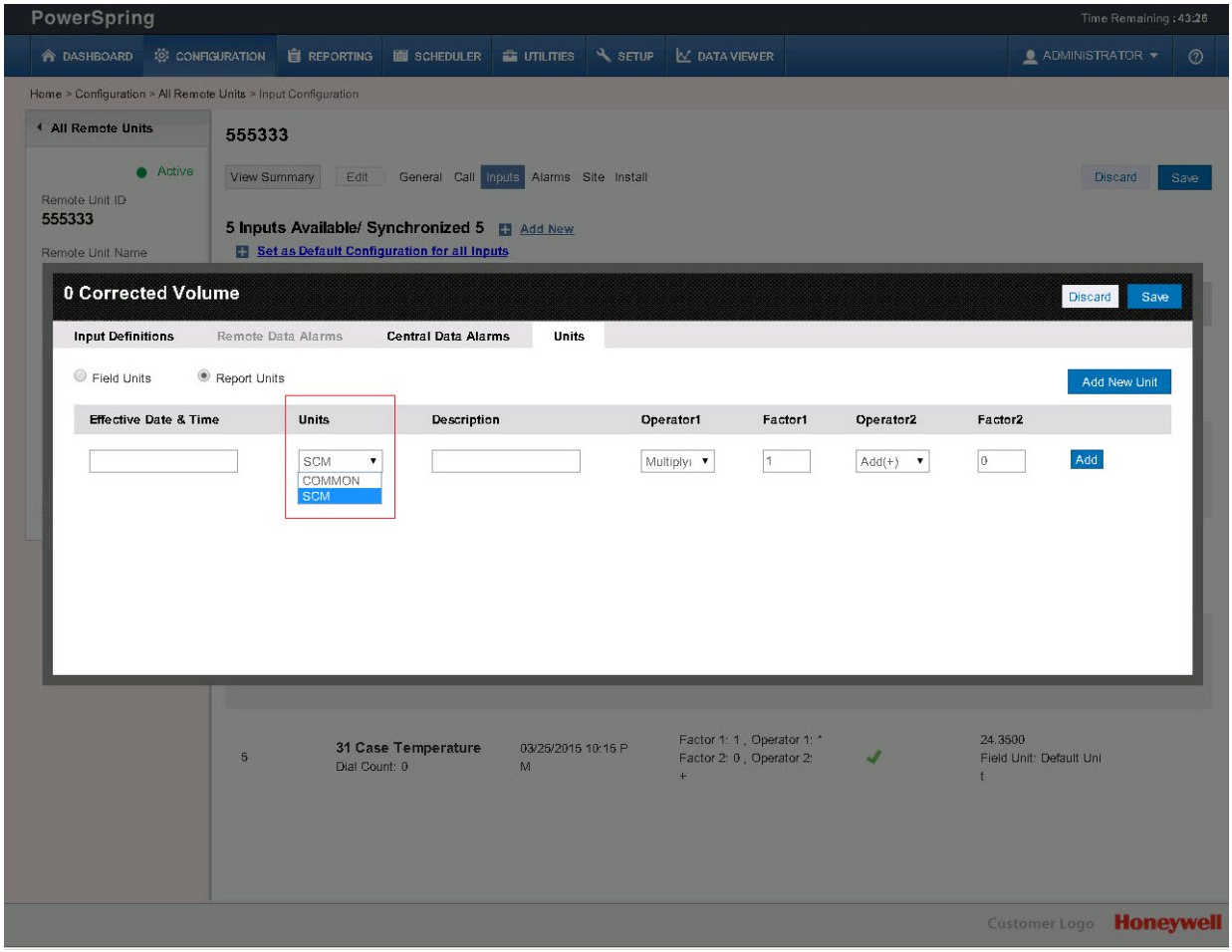

PowerSpring
Time Remaining : 44:25
DASHBOARD
CONFIGURATION
REPORTING
SCHEDULER
UTILITIES
SETUP
DATA VIEWER
ADMINISTRATOR
Home > Configuration > All Remote Units > Input Configuration
All Remote Units
555333
Active
View Summary
Edit
General
Call
Inputs
Alarms
Site
Install
Discard
Save
Remote Unit ID
555333
Remote Unit Name
5 Inputs Available/ Synchronized 5
Add New
Set as Default Configuration for all Inputs
0 Corrected Volume
Discard
Save
Input Definitions
Remote Data Alarms
Central Data Alarms
Units
Field Units
Report Units
Add New Unit
Effective Date & Time
Units
Description
Operator1
Factor1
Operator2
Factor2
COMMON
Multiply
1
Add(+)
0
Add
5
31 Case Temperature
Dial Count: 0
03/25/2015 10:15 P
M
Factor 1: 1 , Operator 1:
Factor 2: 0 , Operator 2:
+
24.3500
Field Unit: Default Uni
t
Customer Logo
Honeywell



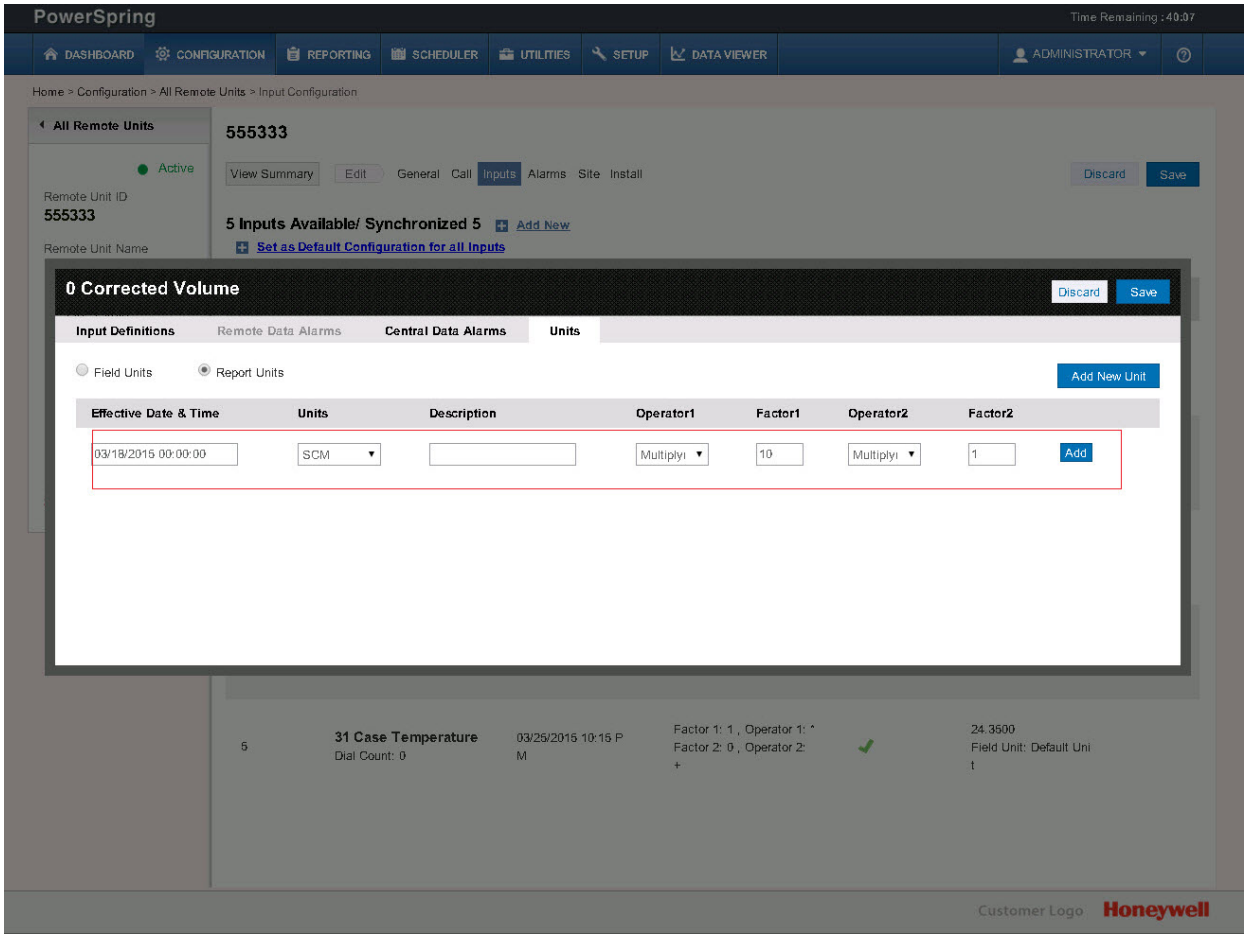
Once user clicks on ADD button, the entered unit and factors should be added and publish in the dropdown list of available UNITS.

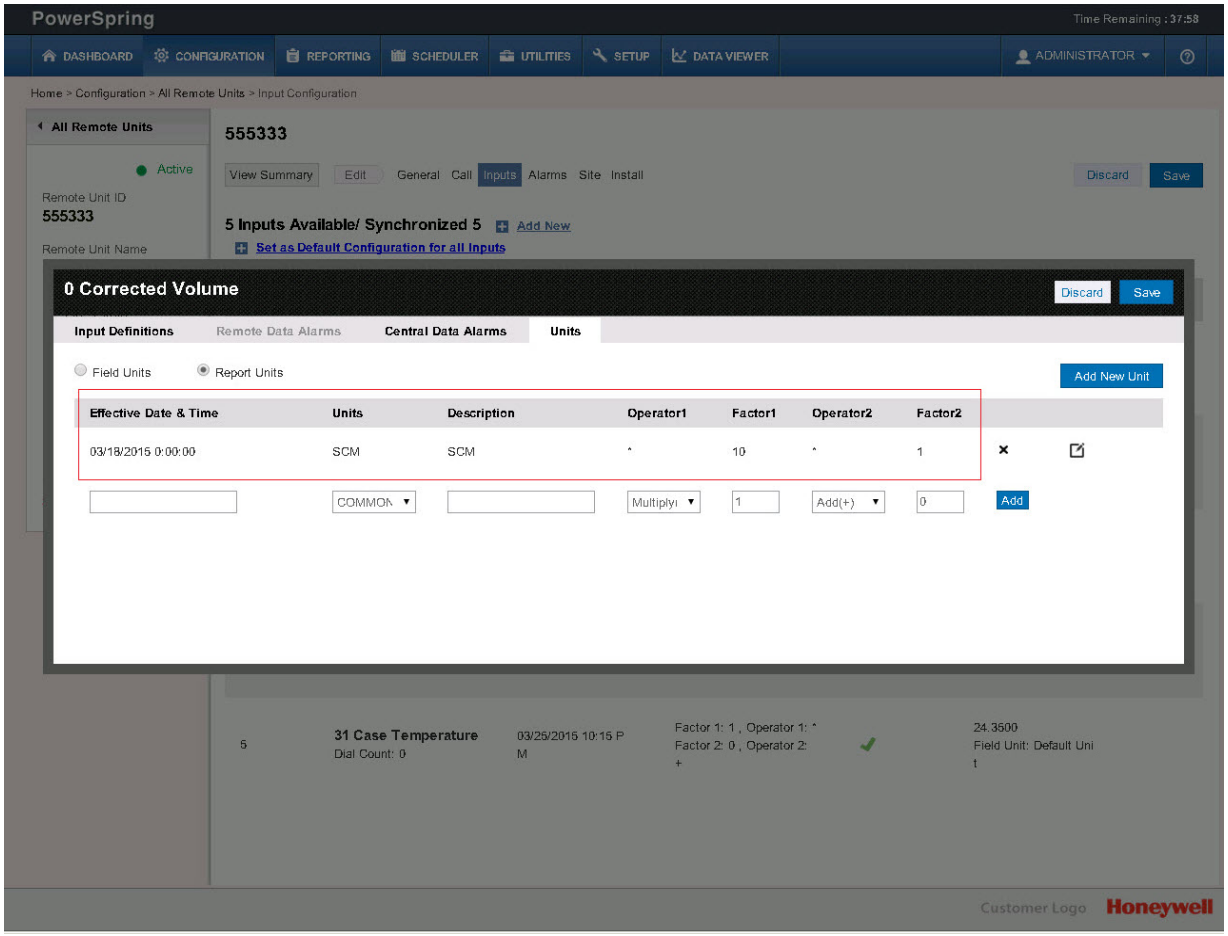


SAVE the changes and reopen the UNITS window for selected input. The added REPORT UNIT should be listed in the REPORT units dropdown as shown below:



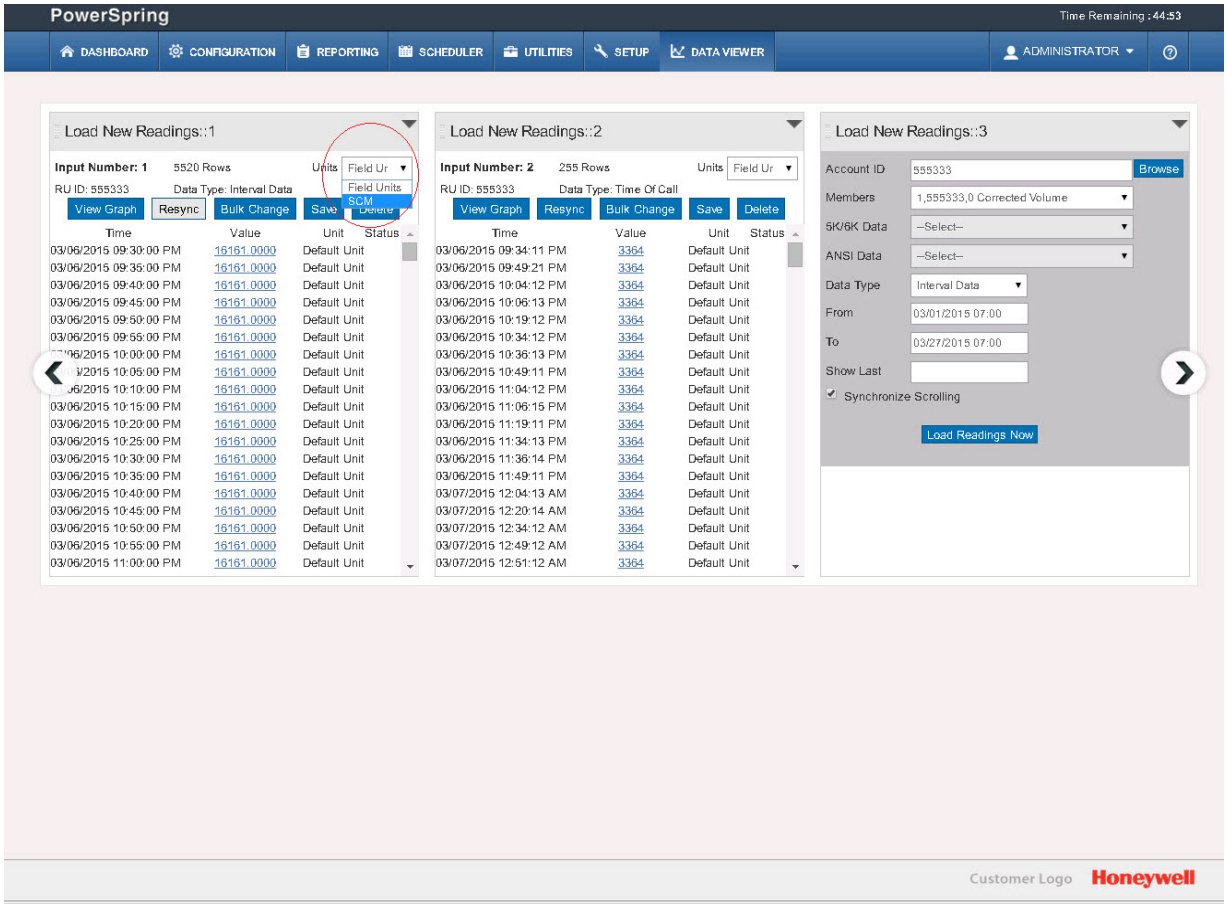
Specify the date from when this report unit will be applicable for data calculation. Also define the description of this report unit for easy identification as is shown in below screenshot:


PowerSpring
Time Remaining : 40:07
DASHBOARD
CONFIGURATION
REPORTING
SCHEDULER
UTILITIES
SETUP
DATA VIEWER
ADMINISTRATOR
Home > Configuration > All Remote Units > Input Configuration
All Remote Units
Active
Remote Unit ID
555333
Remote Unit Name
555333
View Summary
Edit
General
Call
Inputs
Alarms
Site
Install
Discard
Save
5 Inputs Available/ Synchronized 5
Add New
Set as Default Configuration for all Inputs
0 Corrected Volume
Discard
Save
Input Definitions
Remote Data Alarms
Central Data Alarms
Units
Field Units
Report Units
Add New Unit
Effective Date & Time
Units
Description
Operator1
Factor1
Operator2
Factor2
03/18/2015 00:00:00
SCM
Multiply
10
Multiply
1
Add
5
31 Case Temperature
Dial Count: 0
03/25/2015 10:15 P
M
Factor 1: 1 , Operator 1: *
Factor 2: 0 , Operator 2:
+
24.3500
Field Unit: Default Uni
t
Customer Logo
Honeywell

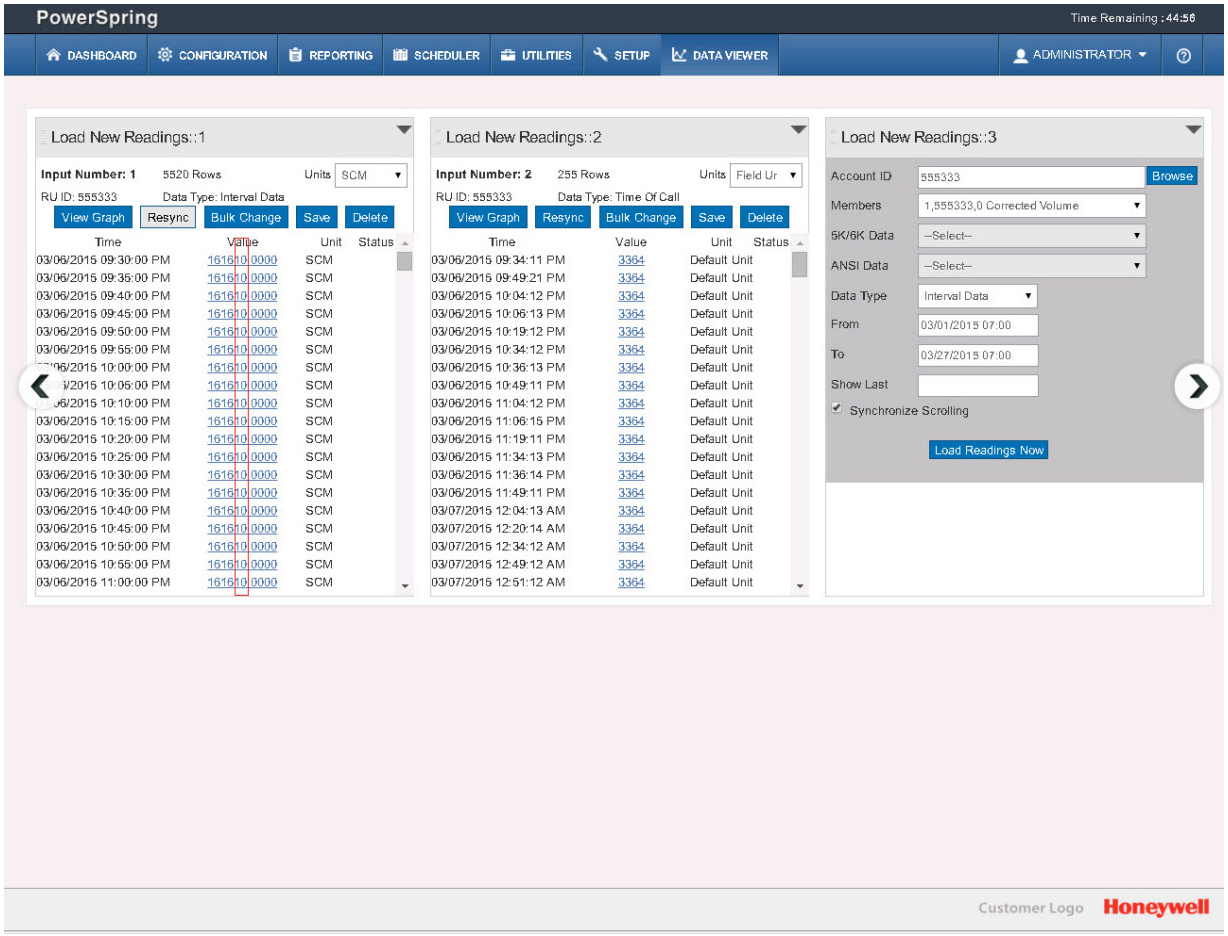


Click on **SAVE** button.

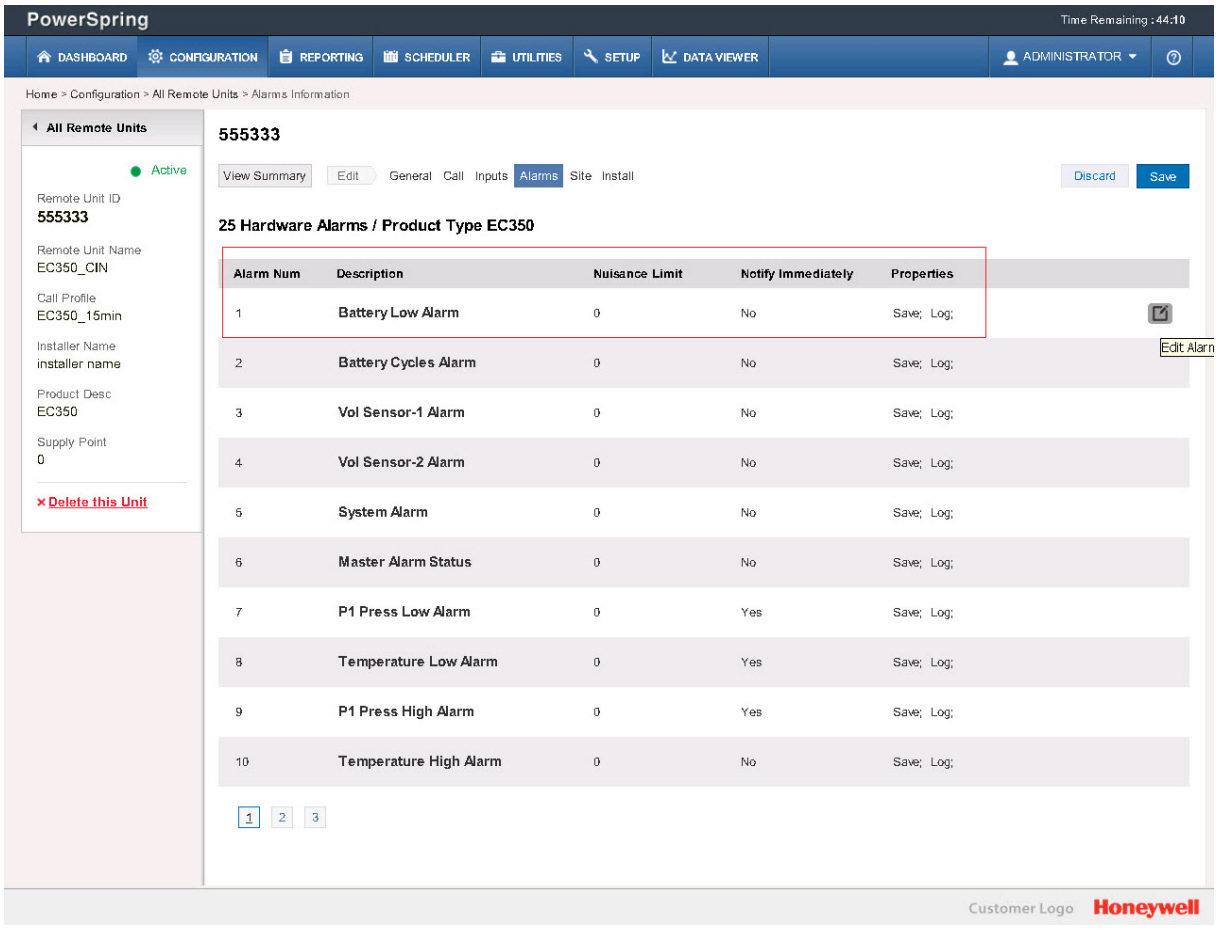
Once the new report unit is available in dropdown, now user can associate this report unit to any inputs existing in the database. To validate this UNIT is available for calculation; verify it in DATA VIEWER application, shown below:



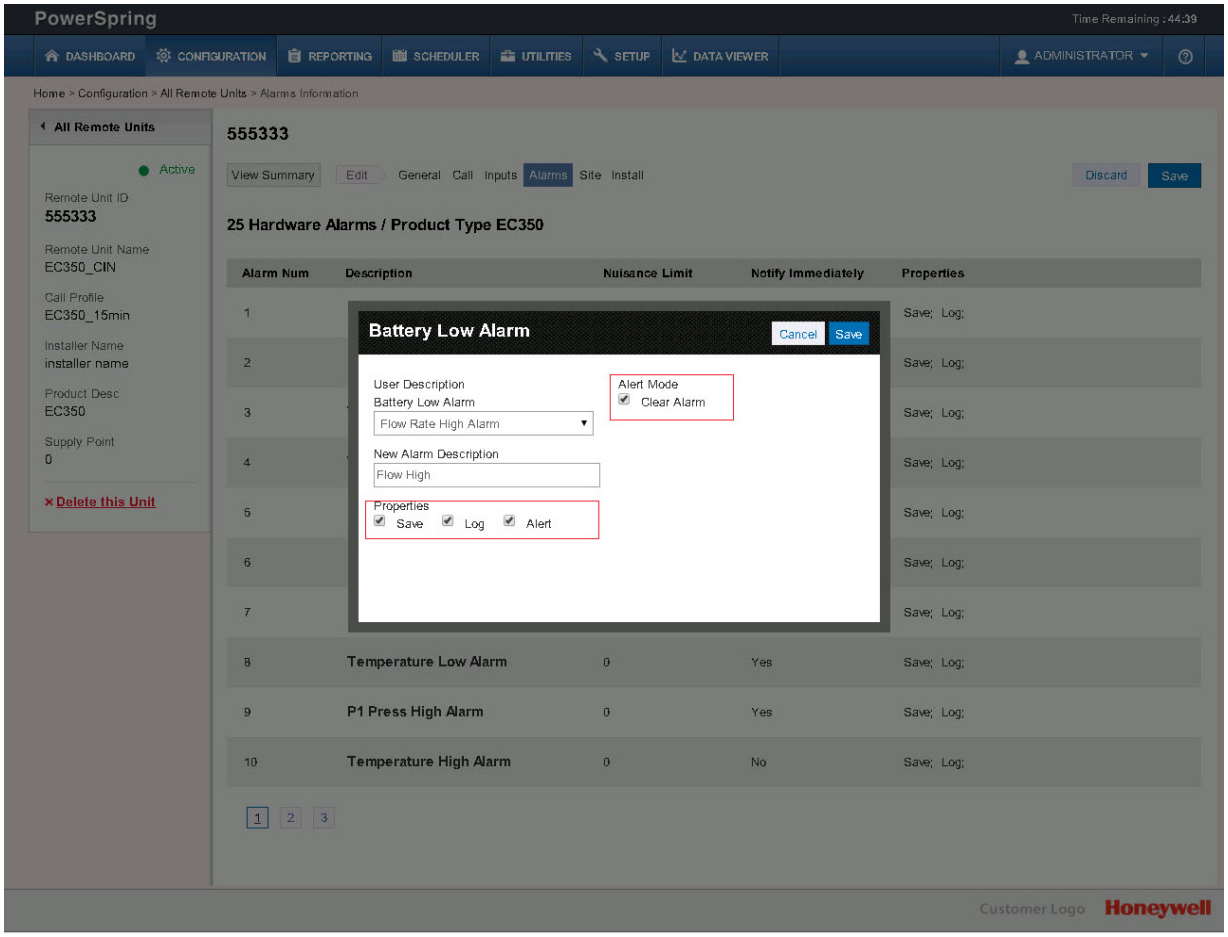
Note: The Operator and Factors given for the REPORT or FIELD UNITS should be used correctly in DATA VIEWER. In the below screenshot user can see the SCM report unit contains the Operator1=* and Factor1=10. It means the multiplication by 10 should be done in data viewer, if user displays the data in data-viewer application for report unit selected as SCM .


PowerSpring
Time Remaining : 44:58
DASHBOARD
CONFIGURATION
REPORTING
SCHEDULER
UTILITIES
SETUP
DATA VIEWER
ADMINISTRATOR
Load New Readings::1
Input Number: 1
5520 Rows
Units SCM
RU ID: 555333
Data Type: Interval Data
View Graph
Resync
Bulk Change
Save
Delete
Time
Value
Unit
Status
Load New Readings::2
Input Number: 2
255 Rows
Units Field Ur
RU ID: 555333
Data Type: Time Of Call
Load New Readings::3
Account ID
555333
Browse
Members
1,555333,0 Corrected Volume
6K/6K Data
ANSI Data
--Select--
Data Type
Interval Data
From
03/01/2015 07:00
To
03/27/2015 07:00
Show Last
Synchronize Scrolling
Load Readings Now
Customer Logo
Honeywell

7. **Alarms tab** for **Remote Unit**



Navigate to ALARMS tab as and configure the ALARMS for EC 350 device, user can configure the alarms thathe wants to display in PowerSpring Alarm/System Monitor application. As shown below user has to EDIT the existing alarm.



Use this tab to edit the Remote Unit Hardware Alarms' information. However, there are certain hardware alarms that are "non-maskable;" that is, the hardware alarms are always active and you are only permitted to customize the name (user description). When you select one of these hardware alarm types, (from the Hardware alarm list), the Immediate alarm notification check box and Nuisance limit box, (under Alarm Specification), appear dimmed and are unavailable for modification.

Note: Alert Mode: Select the Notify Immediately check box to enable the Remote Unit to call immediately when the selected hardware alarm is detected. Another critical purpose of CLEAR ALARMS checkbox is that, it will clear the hardware alarms in the device (i.e. EC350) once the call is successful in PowerSpring.

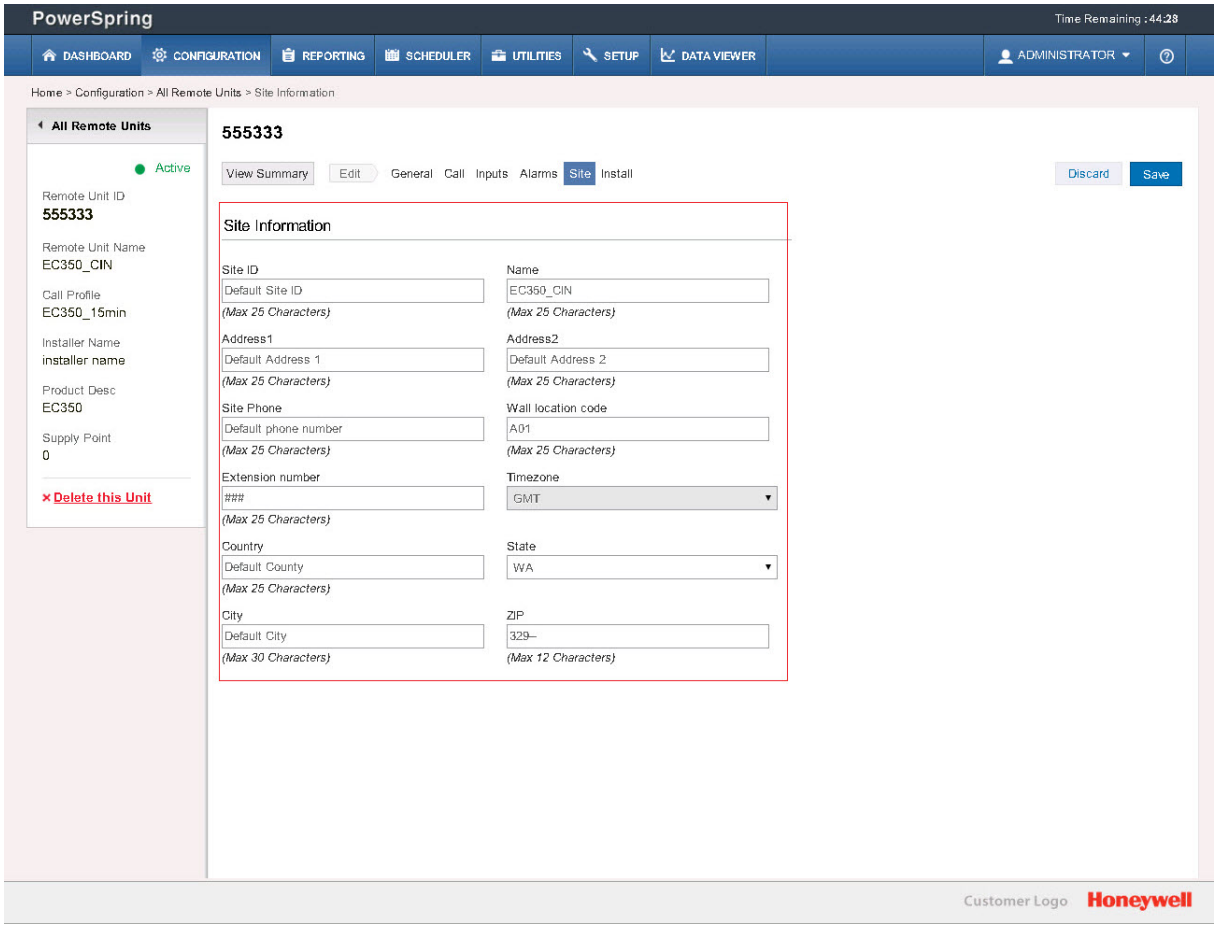
Nuisance Limit: Specifies the number of times that the selected alarm can occur prior to being disabled. Type a number and if the "Nuisance limit" is met, the alarm notifies the selected Remote Unit to repeat the alarm. Properties: You can save, log, or select to alert an alarm.

Save - Saves the selected Hardware alarm occurrence to the database (Alarm Data File).

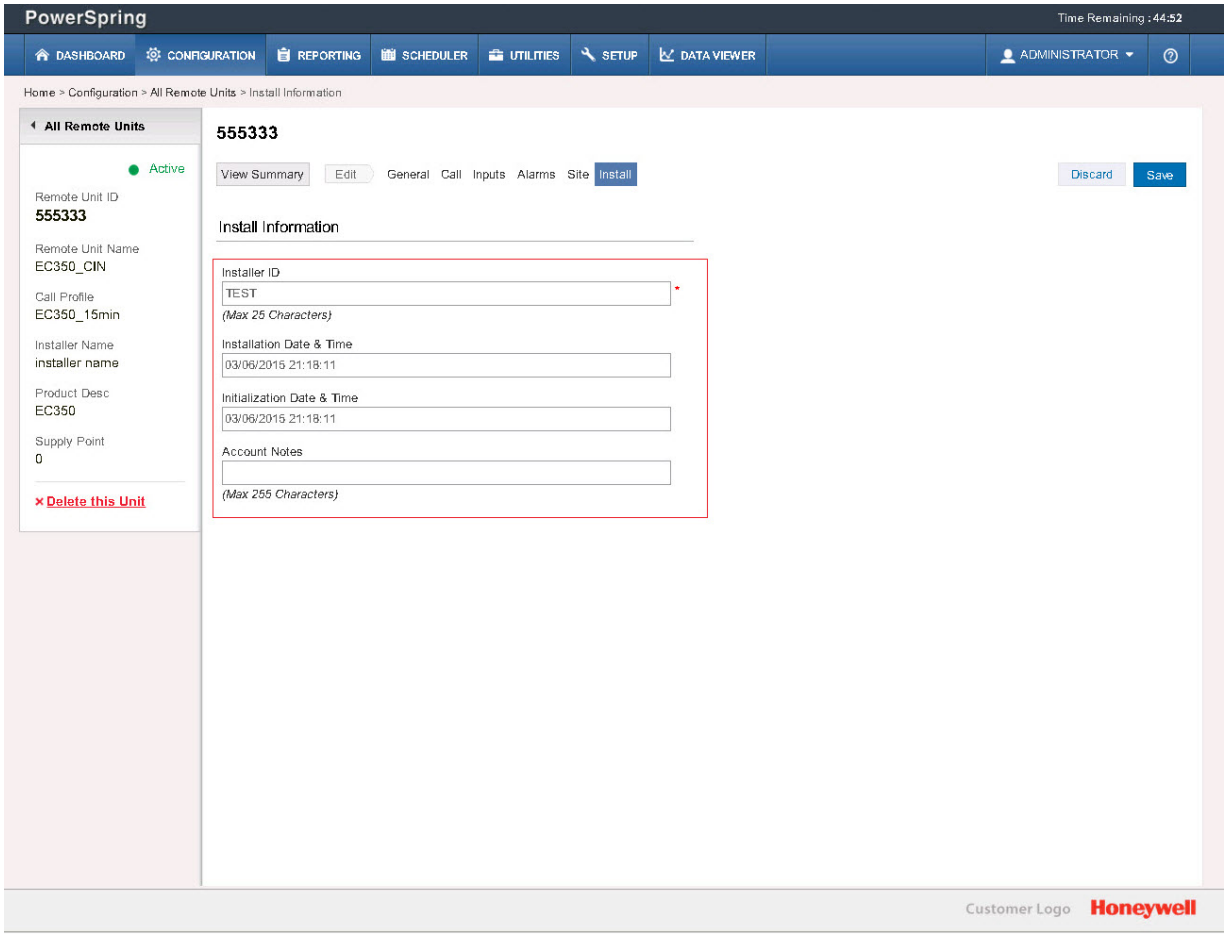
Log - Logs the selected Hardware alarm occurrence to your alarm logging device. This logging device, usually a printer, is specified in the Alarm Maintenance application.

Alert - an alarm (beep) is sounded by the printer when the selected Hardware alarm is detected.
Site Information tab for Remote Unit:

Site Information tab for Remote Unit:



Install tab for Remote Unit:


PowerSpring
Time Remaining : 44:52
DASHBOARD
CONFIGURATION
REPORTING
SCHEDULER
UTILITIES
SETUP
DATA VIEWER
ADMINISTRATOR
Home > Configuration > All Remote Units > Install Information
All Remote Units
Active
Remote Unit ID
555333
Remote Unit Name
EC350_CIN
Call Profile
EC350_15min
Installer Name
installer name
Product Desc
EC350
Supply Point
0
Delete this Unit
555333
View Summary
Edit
General
Call
Inputs
Alarms
Site
Install
Discard
Save
Install Information
Installer ID
TEST
(Max 25 Characters)
Installation Date & Time
03/06/2015 21:18:11
Initialization Date & Time
03/06/2015 21:18:11
Account Notes
(Max 255 Characters)
Customer Logo
Honeywell

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CHAPTER 6

6 Remote Communications

This chapter describes the different communication mechanisms featured in a EC 350 device.

- Use of RS232/ 485
- Call in and call out
- Modbus Host Communication

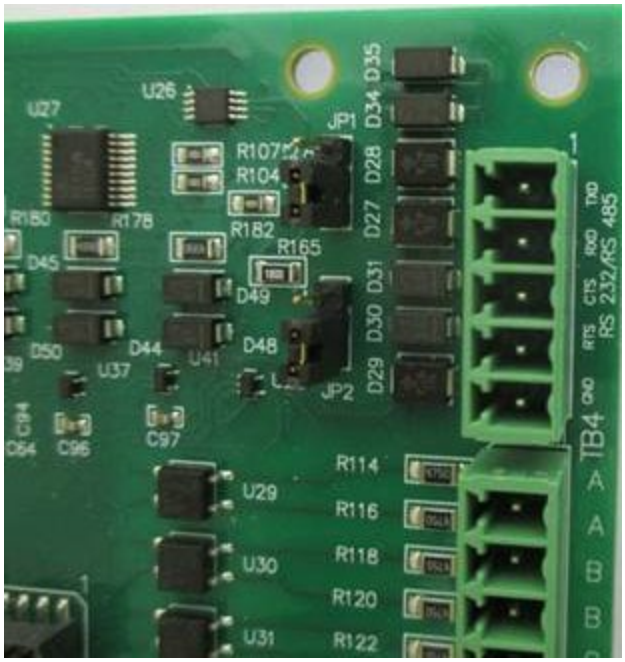
6.1 Use of RS232/ 485

Application

EC 350 is capable of communicating with a number of types of external devices, such as cellular or land-line modems, and RTUs. EC 350 supports the following protocols: MI Protocol, Modbus RTU, Modbus ASCII. The description of those protocols is beyond the scope of this manual, although a basic discussion of Modbus operation is presented later in this chapter. This section describes the physical connections and instrument configuration parameters that are required.

Connections

Wiring connections are made to TB4, see below:



For RS-232, only 3-wire communications is supported: pin 1 TXD (Transmit Data), pin 2 RXD (Receive Data), and pin 5 GND (Ground). (The TB4 RTS/CTS connections are not used.) TXD and RXD are labelled as a DTE device (EC 350 transmits on TXD).

For RS-485, use TB4 pin 1 (TXD) as line A, pin 2 (RXD) as line B, and pin 5 (GND) as Ground.

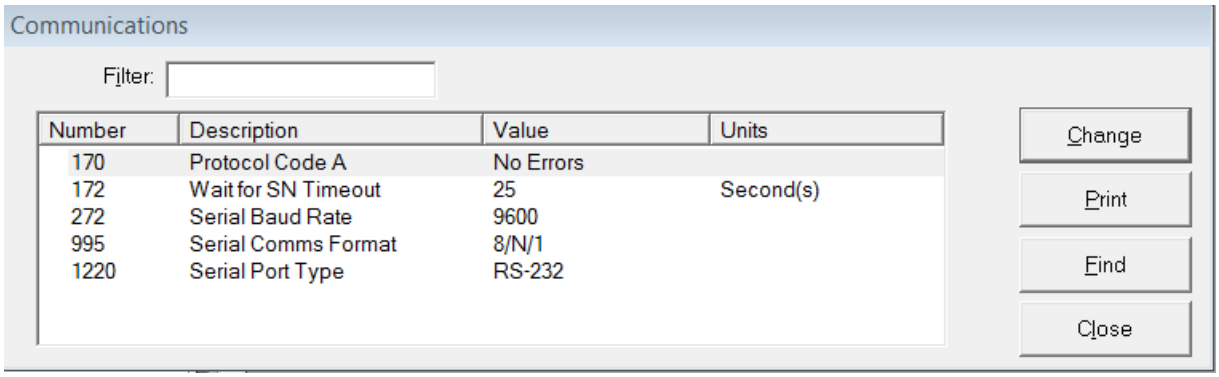
The RS-232 and RS-485 standard specifications should be consulted for the proper wire type, maximum cable length, etc.

Jumpers

In addition to wiring, jumpers on JP1 and JP2 must be properly positioned. For RS-232, both jumpers must be set to B and C as shown in the picture above. They must be placed on A and B for RS-485.

Configuration Parameters

EC 350 items in the 'Communications' group in MasterLink may need to be modified to accommodate a particular external device.



Items 170 and 172 are primarily associated with the behavior of MI Protocol. These should normally left as default (shown here). The remainder will vary depending on the external devices. See also Modbus section below for settings relevant to the Modbus protocol.

6.2 Call in and call out

- Call in
- Call out

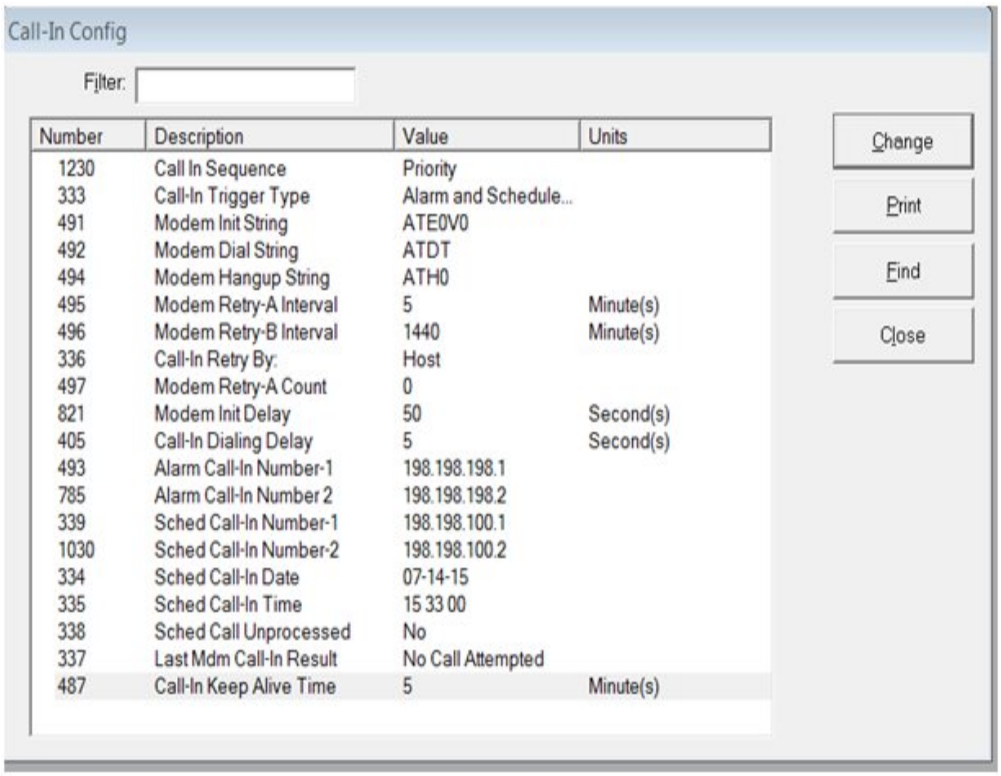
6.2.1 Call in

EC 350 has the capability to initiate a modem to modem telephone call. This is called call in and can happen under two circumstances.

- Alarm Call-In
- Scheduled Call-In.

6.2.1.1 Call in

When connected to either a cellular or landline modem the EC 350 can be configured to autonomously dial and connect to a host computer. It can do this according to a preset schedule or in the event of an alarm condition. Previous Mercury Instruments products have incorporated similar features, but the EC 350 is unique in its support of four phone numbers (or IP addresses); two for scheduled calls and two for alarms. This provides the ability to communicate with four different hosts. In turn, this feature leads to some differences in the retry algorithm. Call in configuration items are:



Modem items are shared between the scheduled and alarm call in features. If the modem requires an initialization string it must be set into item 491 along with an Init Delay (Item 821). The initialization delay is applied so that the modem, having just been powered up, has a chance to stabilize before being sent the initialization string. A dial prefix must be configured in item 492 and a hangup string in 494. The Dialing Delay will take place following the issuance of the initialization string. Call in sequence, Trigger Type and retry parameters are also shared between scheduled and alarm calls. Those will be discussed later.

6.2.1.2 Scheduled Call In

The EC 350 can initiate a call at a preset time. The time may have been manually specified, but on an ongoing basis the host(s) is responsible for the schedule. At the end of each call the host is must set item values that determine when the next call is to take place. That time will always be contained in items 334 and 335. Items 338 and 337 indicate the result of the latest call (or call attempt). If only one host exists, its phone number is set in item 339. If a second host exists, its number is set in item 1030. To enable scheduled call in, at least phone number must be configured and item 333 must be set to either Alarm and Scheduled Call In or Scheduled Call In Only.

6.2.1.3 Alarm Call In

If alarm call in is configured and enabled, a call will be initiated whenever a new alarm occurs or, if in RBX mode, an alarm condition clears. This requires a phone number in item 493 (and optionally in 785) and item 333 must be set to either Alarm and Scheduled Call In or Alarm Call In Only.

6.2.1.4 Management of Multiple Phone Numbers

If multiple phone numbers are configured, item 1230 determines (along with the retry strategy) when and if the second number is called. The setting will affect the behavior of scheduled and alarm calls identically.

Call In Sequence = BOTH:

When a call is triggered, the EC 350 will dial the first number first. Regardless of whether that call succeeds or fails, the second number will also be called. The BOTH algorithm ensures that both hosts will (eventually) receive notification. If a call to a host fails, it will be retried as many times as necessary until the call succeeds. The two numbers are independent – whatever happens on phone number 1 will not affect phone number 2 and vice-versa.

Call In Sequence = PRIORITY:

This algorithm ensures that someone will (eventually) receive notification, and it will be whoever succeeds first. As soon as either one succeeds the process is complete. Some possible sequences are:

1 S. Done.

1 F, 2 S. Done.

1 F, 2 F, 1 S. Done.

1 F, 2 F, 1 F, 2 S. Done.

(where 1 and 2 represent the first and second phone numbers, S denotes success, F denotes failure)

6.2.1.5 Retry Timing

Not all call failures are resolved with 'retries'. 'Retries' is defined as the termination of the current attempt and the scheduling of another attempt some minutes or hours hence. In some cases the EC 350 may try to resolve the failure immediately. If, for instance, an initialization string is sent to the modem but no positive response is received within several seconds, it will simply send it again. If several initialization attempts fail, then it will be deemed hopeless (for now) and a future retry will be scheduled. The same is true if a dial string goes unanswered. But after a certain point another immediate attempt would be futile and a future retry is scheduled.

There are three retry timing parameters – two delays (A and B) and a counter. For any given trigger (schedule or alarm) the first retry will be scheduled to take place Retry A minutes in the future. Retry A will be used for subsequent retries until Modem Retry A count is exhausted. The next (and subsequent) failures will be scheduled at intervals of Retry B minutes. Once the call finally succeeds (or another trigger occurs) the counter, and thus the retry sequence, will be reset.

6.2.1.6 LCD indications

When a call is triggered, the information on the 2nd and 3rd lines of the LCD will be replaced with messages indicating the progression of the call, such as 'INIT MODEM', 'DIALING #', 'DIAL FAILED', 'CONNECTED', 'WAIT FOR CONN RESPONSE', 'CONNECTED', 'WAITING +-+CLRALMS', and 'HOST SYSTEM CONNECTED'.

6.2.1.7 Forcing a Test Call

During initial commissioning as well as subsequent troubleshooting, it is useful to be able to manually evoke a call. This can be done by writing the proper value to item 264: 20139796 will trigger a scheduled call; 20139813 will force an alarm call. The same can be done using the HMI. See the HMI section for details.

6.2.2 Call out

The Call Out window (COW) allows EC 350 to accept remote communications during one or two blocks of time during the day.

When used with a CNI2 cellular modem, the CNI2 will be set to “server mode” during the call out window (s) so it can accept calls from a host system during those times. The CNI2 consumes more power in server mode, regardless of whether communication occurs.

EC 350 can also be kept “awake” during the call out window(s) such that even the initial characters of a communication session are accepted. Otherwise, the initial characters “wake up” the EC 350. The MI Protocol includes such wake up characters in its protocol so that this feature is not required for MI Protocol communication. But the Modbus protocol includes no wake-up characters, so this feature can be used so that the EC 350 processes the first Modbus packet. Without it, the first packet is not processed and the Modbus host system must send a “retry” packet. More power is consumed during the call out window in this mode, regardless of whether communication occurs or not. To use this mode, in addition to specifying a call out window, set item 1236 (Port Active During COW) to enabled. This mode consumes more battery power but reduces retries on Modbus activity.

There are items for specifying the start and stop times for two call out windows. Set the start and stop times equal to disable a call out window. (Do so for both if they have no call out window.) Times are specified in 24-hour format. The maximum value is “23 59 00”. Seconds other than “00” are ignored. The resolution for the times is one minute. No single call out window can be longer than 18 hours, but greater than 18 hours can be achieved by scheduling two call out windows “back to back” (e.g. 00 00 00 - 12 00 00, 12 00 00 - 23 59 00 would effectively give you a call out window for the entire day except one minute before midnight).

The modem will stay active until a stop time is reached or when the current call (if after the stop time) has ended. EC 350 goes back to sleep if there is no call out.

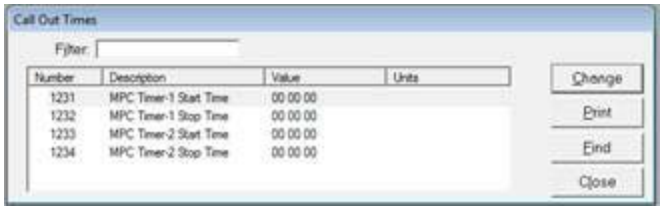
- Set Call Out time
- Set a call out stop time

6.2.2.1 Set Call Out time

To set a call out start time:

1. Establish a serial communication between EC 350 and MasterLinkSQL. Refer to the *MasterLinkSQL User’s Guide* for information about establishing a serial connection between EC 350 and MasterLinkSQL.
2. In the **MasterLinkSQL** window, click **Find Item by Number**  icon.
   The **Find Item** dialog box appears.

3. Type **1231** and click **OK**.
   The Call Out Times dialog box appears.

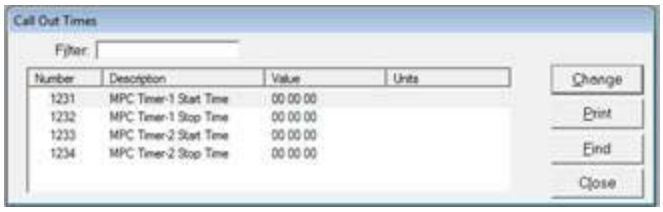


4. Click **Change**.
   The **Change Item** dialog box appears.
5. Enter the desired start time and click **Save**.
6. Repeat steps 2 to 5 if you want to change item 1233.

6.2.2.2 Set a call out stop time

To set a call out stop time

1. Establish a serial communication between EC 350 and MasterLinkSQL. Refer to the *MasterLinkSQL User's Guide* for information about establishing a serial connection between EC 350 and Master-LinkSQL.
2. In the **MasterLinkSQL** window, click **Find Item by Number** icon.
   The **Find Item** dialog box appears.
3. Type **1232** and click **OK**.
   The **Call Out Times** dialog box appears.



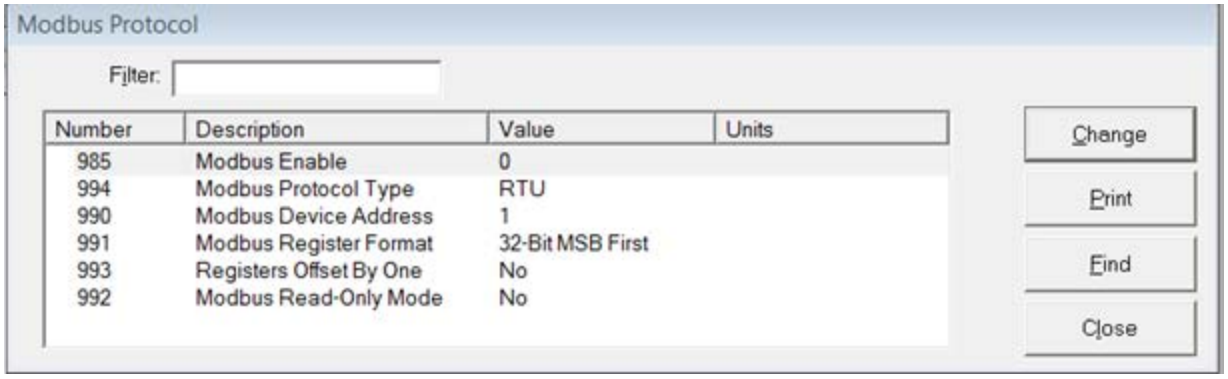
4. Click **Change**.
   The **Change Item** dialog box appears.
5. Enter the desired stop time and click **Save**.
6. Repeat steps 2 to 5 if you want to change item 1234.

6.3 Modbus Communication

Modbus is a common industrial communication protocol. The EC 350 supports the Modbus protocol (as a slave device) on the TB4 RS-232/485 port as well as the front panel IrDA port. Through the RS-232/485 port it can also be used with modems including Messenger, CNI2, and Cloud Link. Function codes 01, 02, 03, 04, 05, 06, 15 and 16 are supported, in both RTU and ASCII modes.

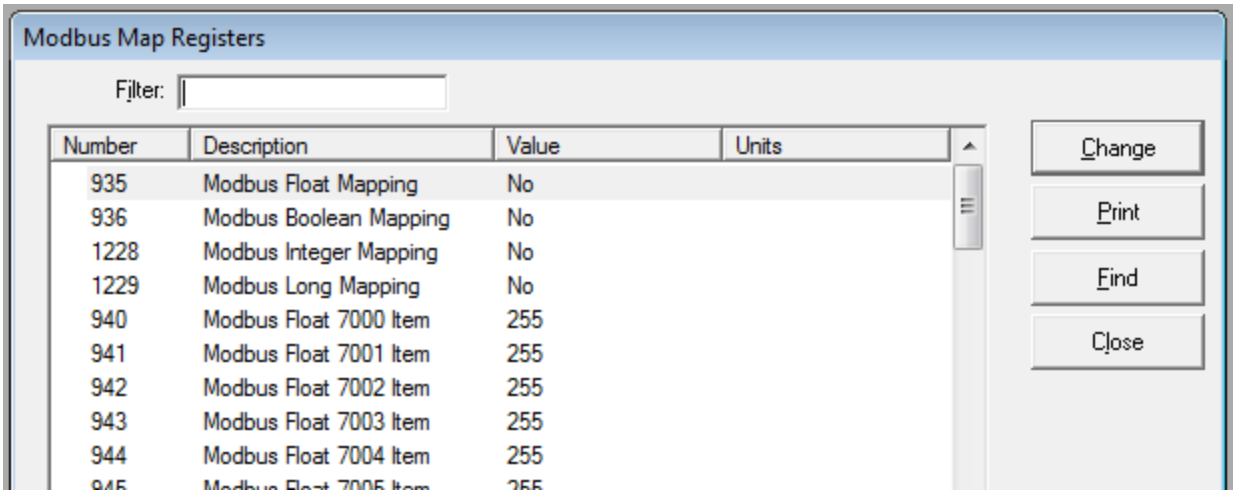
The Modbus protocol standard defines the format of the data and the techniques used to control the flow of data. It supports one master device and up to 247 slave devices on one bus (although a maximum of 32 slave devices are permitted on an RS-485 network, due to physical layer limitations). The master always initiates a communication exchange. Each slave on a Modbus network has its own unique address (1...247) so that it can be addressed independently from other slaves. This address is sent by the master as part of every message. All slaves on the network see the message, but only the slave with the matching address will respond to the message. A message sent to a slave from the master is called a request, the answer sent back to the master is called a response. Request and response messages are also called packets or frames. The master can also broadcast a message to all slave devices, using a slave address of 0. In that case there is no response.

Modbus configuration items are found in the 'Modbus Protocol' and 'Modbus Map Registers' function groups of MasterLink:



If the external device communicates via Modbus protocol, item 985 must be set to 1. Item 994 will need to be set to the proper Modbus variation, either RTU or ASCII. The correct setting for all of these items will be determined by the external device used.

Modbus registers can be 'mapped' to items in the EC 350 via the items in the following group. For example, pressure can be mapped to register 7003 by enabling Float mapping in item 935 and setting item 943 to '8'.


Modbus Map Registers
Filter:
Number
Description
Value
Units
935
Modbus Float Mapping
No
936
Modbus Boolean Mapping
No
1228
Modbus Integer Mapping
No
1229
Modbus Long Mapping
No
940
Modbus Float 7000 Item
255
941
Modbus Float 7001 Item
255
942
Modbus Float 7002 Item
255
943
Modbus Float 7003 Item
255
944
Modbus Float 7004 Item
255
Change
Print
Find
Close

CHAPTER 7

7 Maintenance

This chapter lists out the temperatue and transducer related kits. It also includes information on how to remove the HF cover.

7.1 Temperature Probe Measurement Kits

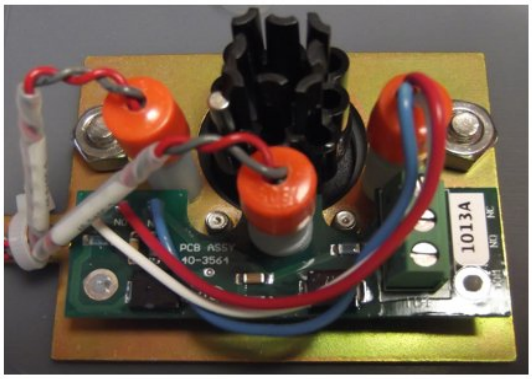
40-5814-KIT	Internal (Rotary ONLY)
40-6008-1-KIT	6" Armored 6' Cable
40-6008-2-KIT	9" Armored 6' Cable
40-6008-3-KIT	9" Armored 30' Cable
40-6007-KIT	3" Pete’s Plug Armored
40-6005-1-KIT	2-1/8" Pete’s Plug Teflon
40-6005-2-KIT	3" Pete’s Plug Teflon 3' Cable
40-6005-3-KIT	3" Pete’s Plug Teflon 10 ' Cable
40-6002-KIT	External Teflon
40-6003-KIT	3/16" Sheath Teflon
40-6004-KIT	6" Sheath 6' Teflon Cable

7.2 Transducer Replacement Kits

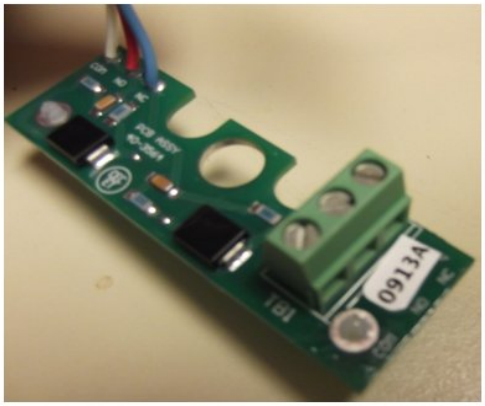
22-2950-1-KIT	6 psig
22-2950-2-KIT	30 psig
22-2950-3-KIT	60 psig
22-2950-4-KIT	100 psig
22-2950-5-KIT	300 psig
22-2950-6-KIT	600 psig
22-2950-7-KIT	1000 psig
22-2950-8-KIT	1500 psig
22-2950-9-KIT	15 psig
22-2950-10-KIT	150 psig
22-2950-11-KIT	200 psig
22-2950-12-KIT	30 psia
22-2950-13-KIT	60 psia
22-2950-14-KIT	100 psia
22-2950-15-KIT	300 psia

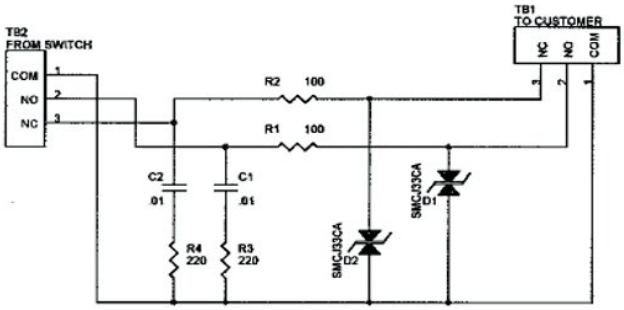
22-2950-16-KIT	600 psia
22-2950-17-KIT	1000 psia
22-2950-18-KIT	1500 psia
22-2950-19-KIT	150 psia
22-2950-20-KIT	200 psia

7.3 Redundant Uncorrected Switch



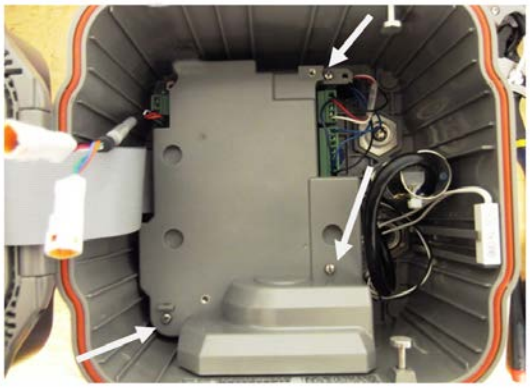
NC	Normally Closed
NO	Normally Open
COM	Common



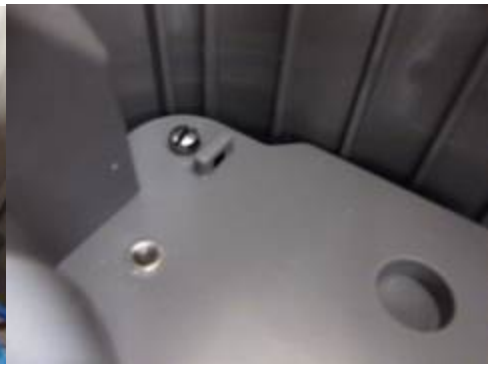


7.4 Metrological Sealing Cover (MC)

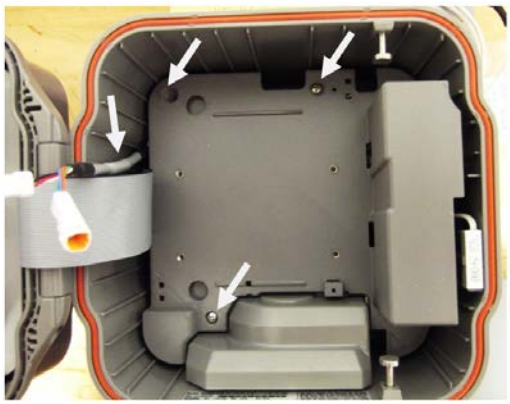
1. The following figure shows MC Cover installed with 3 Cross-Drilled security screws at locations indicated by arrows.



2. Using sealing wire and lead seal, seal cover at these locations. Run wire through the screw head, and then through the MC cover sealing features.

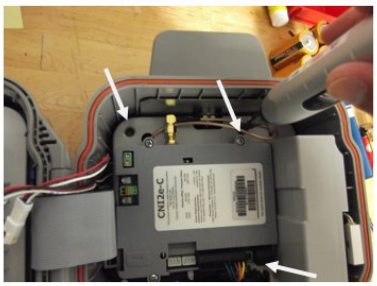



3. Re-install Human Factor cover tightening the screws to 9 +/- 1 in-lbs of torque at these locations. Ensure power cable is routed in the orientation shown for battery connection.



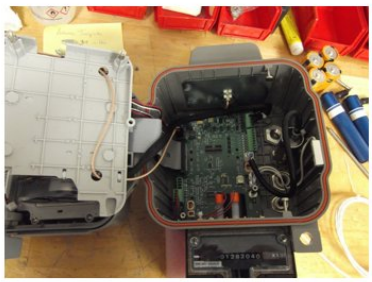
7.5 Removing and Re-Installing Human Factor (HF) Cover

1



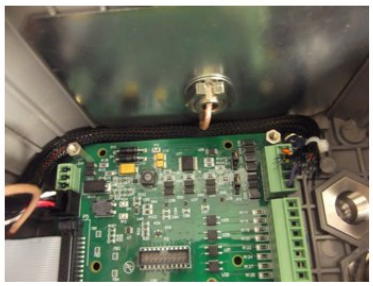
Loosen screws in 3 positions

2



Remove HF Cover

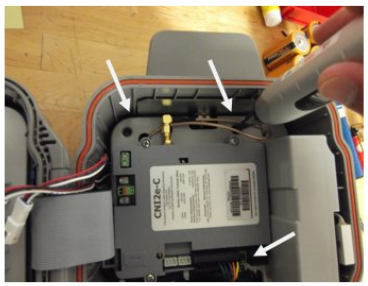
3a



3b

Route cables in the orientations as shown, before re-assembling HF cover

4



Tighten screws to 8-10 in-lbs

7.6 Replacing the Battery Pack

If your EC 350 displays **REPLACE BATTERY**, it indicates that EC 350 has gone into a power conservation mode due to low battery voltage.

- Replacing the battery in a hazardous DIV-1/ZONE-0 environment
  A special operating mode is provided to allow changing of a battery pack in a hazardous location. (If the location is known to be non-hazardous, for example, if the location has been tested for the presence of gas and it has been determined that gas is not present, this section can be skipped. Go to the Replacing the battery in a non-hazardous environment section). The special operating mode puts the corrector in a standby condition in which volume continues to be accumulated and event logging and alarms are still active, but all other functions are stopped to ensure very low power drain. This allows a low power battery (40-6054) to be plugged in while the main battery pack is changed, and then removed after the new battery is plugged in.
- Replacing the battery in a non-hazardous environment

7.6.1 Replacing the battery in a hazardous DIV-1/ZONE-0 environment

A special operating mode is provided to allow changing of a battery pack in a hazardous location. (If the location is known to be non-hazardous, for example, if the location has been tested for the presence of gas and it has been determined that gas is not present, this section can be skipped. Go to the Replacing the battery in a non-hazardous environment section). The special operating mode puts the corrector in a standby condition in which volume continues to be accumulated and event logging and alarms are still active, but all other functions are stopped to ensure very low power drain. This allows a low power battery (40-6054) to be plugged in while the main battery pack is changed, and then removed after the new battery is plugged in.

To replace the battery in a hazardous DIV-1/ZONE-0 environment, perform the following steps:

1. Enter **HMI** and set the EC 350 to **Battery Change** mode. You can use the L2.11 or L3.13 HMI menus.
2. The **BATT CHNG** message is displayed on the LCD screen. Press the **Enter** key.
3. Select **Yes** and press **Enter**. The unit is now ready for a battery change out. **CHNG BATT THEN ESC** is dispalyed on the LCD screen.
4. Plug the *Swapout Battery* (part no. 40-6054) into the open connector on the battery Y cable.
5. Unplug the old battery.
6. Plug in the fresh battery where the old battery was plugged in.
7. Remove the *Swapout Battery*.
8. Press the **ESC**key twice to exit the battery change mode. When the **ESC** key is pressed, all the battery life items are automatically set to 100% new values and the battery usage cycle is set to zero.

7.6.2 Replacing the battery in a non-hazardous environment

To replace the battery in a non-hazardous environment, perform the following steps:

1. Plug in the fresh battery into the open connector on the battery Y cable.
2. Unplug the old battery.
3. Reset Battery Life Items to defaults (100% new) by following steps shown below:
    - Unlock the keypad and type the PASSCODE to enter level 2 or level 3 menus. Refer to the section "Accessing level 2 mode " for accessing level 2 mode or section "Access level 3 mode" for accessing level 3 mode.
    - Scroll down in to HMI menu to **L2.12** or **L3.12** where it displays: "**RESET BATT**" on LCD and then press the Enter key.
    - Press **YES** key to confirm (see note below).
    - EC 350 resets the battery usage Items to factory default values: (Item 59 = 0, Item 1001 = 60 mo, Item 1002 = 100%).
    - Press **ESC** until you have exited the HMI.

7.7 Low battery/ External Power shutdown mode

EC 350 automatically enters a low battery shutdown mode when the battery voltage measurement falls below the value of Item 50 (Battery Shutdown Limit) for three (3) consecutive times.

Note: Item 50 Shutdown Limit applies to both Battery Voltage and External Supply Voltages.

While in low power shutdown mode, the LCD displays the following (except if user enters HMI mode):

– – – – – – – – – –

“REPLACE”

“BATTERY”

To **exit** Low Power Shutdown, the Battery voltage must be above the Item 50 limit value and the user must enter HMI mode. User enters HMI and menus down arrow to the screen showing: **SHUTDOWN** - HMI menus: L2.10 or L3.12. Next, the User presses Enter key and display will show: ‘ENTER MODE’ as first selection. Arrow down to ‘**EXIT** MODE’ selection. User again presses the Enter key to confirm – the unit leave (exit) Shutdown/Shelf mode. When the User exits the HMI menus – the LCD will then return to normal default screen.

Refer to the table below to see which functionality is limited or blocked in low battery shutdown mode.

Functionality	What Happens
Pressure measurement	Stopped
Temperature measurement	Stopped
Supercompressibility calculations	Stopped
Battery measurements	Stopped
External Supply measurements	Stopped
Volume	Calculates volume input using PTZ factors from before entering Shutdown mode
Pulse Outputs	No output pulses sent. Items 5 to7 continue to update per new volume input and will be sent only after exiting Shutdown mode
Alarm Output	No Alarm output signal is sent. If pending, it will be sent only after exiting Shutdown mode
IrDA communications	Stopped
RS-232/485 communications	Stopped

Functionality	What Happens
Scheduled / Alarm Call-in	Stopped
Date and Time	Continues to update as normal
Audit Trail logging	Stopped

Refer to the table below to see which functionality is not blocked in shutdown mode.

Functionality	What Happens
Alarm logging	Runs as normal. However it is unlikely to have any alarms
Event logging	Runs as normal
HMI Menus and Scroll List	Active- No live readings are taken

7.8 User Shelf/ Shutdown mode

The EC 350 can be placed in to a User Shelf / Shutdown mode to take it out of service for extended periods of time. This mode is useful to conserve battery life when the instrument is not in use. In this mode **EC 350** conserves battery energy by limiting most of its normal functionality while preserving data and keeping time.

You can enter user shutdown mode using:

- HMI menu levels 2 or 3
- MasterLinkSQL
- To enter user shutdown mode using HMI mode 2 or 3
- To enter user shutdown mode using MasterLinkSQL

7.8.1 To enter user shutdown mode using HMI mode 2 or 3

1. Unlock the keypad and type the **PASSCODE** to enter level 2 mode or level 3 mode Refer to the section "Accessing level 2 mode" for accessing level 2 mode or section "Access level 3 mode " for accessing level 3 mode.
2. By default, the following appears on the display.
   MAIN MENU

   ALARMS
3. Using the **UP arrow** and **DOWN arrow** scroll through the options in level 2 mode or level 3 mode until **SHUTDOWN** appears.
4. Press **OK**. The following appears on the display.
   ENTER MODE
5. Press **OK** to confirm.
   EC 350 enters shutdown/shelf mode.
6. Press **ESC** to exit HMI mode 2 or 3.

7.8.2 To enter user shutdown mode using MasterLinkSQL

1. Establish a serial communication between EC 350 and MasterLinkSQL. Refer to the *MasterLinkSQL User's Guide* for information about establishing a serial connection between EC 350 and MasterLinkSQL.
2. In the **MasterLinkSQL** window, click **Instrument > Shutdown**.
3. Click **Yes**.

Functionality	What Happens
Pressure measurement	Stopped
Temperature measurement	Stopped
Supercompressibility calculations	Stopped
Battery measurements	Stopped
External Supply measurements	Stopped
Volume	Volume input fully disabled
Pulse Outputs	Output pulses disabled
Alarm Output	NoAlarm output signal is sent. If pending, it will besentonly after exiting Shutdown mode
IrDA communications	Stopped
RS-232/485 communications	Stopped
Scheduled / Alarm Call-in	Stopped
Date and Time	Continues to update as normal
Audit Trail logging	Stopped

Refer to the table below to see which functionality is not blocked in User Shelf mode.

Functionality	What Happens
Alarm logging	Runs as normal. However it is unlikely to have any alarms
Event logging	Runs as normal

Functionality	What Happens
HMI Menus and Scroll List	Active- No live readings are taken