Honeywell

Honeywell Process Solutions

TCI
Direct-mount, Electronic Temperature Compensating Index

User Manual

October 2010

V 2.12
Honeywell

Contents

1 Brief Description

1.1 Overview

The Mercury Instruments **Temperature Compensating Index (TCI)** is a self-contained, battery operated, electronic gas meter display and interface that compensates for the real-time thermal characteristics of a volume of constant-pressure gas. The TCI is an electronic equivalent to a mechanical index. The TCI is designed to mount on rotary gas meter bodies having an internal rotating shaft output that is magnetically coupled. The unit includes standard Mercury rotary pulse sensors as well as an electronic temperature sensor.

Total temperature-compensated gas **volume** is **continuously displayed on the LCD** and is readable even at extremely cold environmental temperatures. In addition, the LCD allows for normal viewing without physically rotating the display by having a configurable viewing orientation parameter. This is helpful in applications that require the instrument to be rotated.

The TCI is powered by a single lithium battery pack (2 D cells) located inside the case. The batteries have a useful life of **20 years of normal operating usage**, after which time they should be replaced.

Stored in the TCI are several **Items** pertaining to gas measurement parameters. In addition, alarms and hardware/software information are also available. Items are data parameters that are identified by individual numbers and functional names such as: Compensated Volume and Gas Temperature. Every Item has an assigned default value, and nearly all are user configurable. The complete list of Item Codes may be found in Section 14.

Serial communicates with the TCI are handled by means of an **IrDA** data port. The IrDA interface is an advanced infra-red interface that is electrically isolated providing robust error checking. The physical connection to the TCI is accomplished by sliding a USB to IrDA Dongle with a special rubber boot on to the side of the TCI. For most applications, the IrDA Dongle is connected to a USB extension cable and then connected to the PC / laptop making a reliable isolated connection.

The TCI has a broad range of configurable parameters (Items) proving flexibility to suit most rotary applications. Field configurations of the TCI will normally require using Mercury MasterLink32 software.

1.2 Features

- ❖ Nominal **20 year battery life** with supplied lithium battery pack
- ❖ Reliable - "set it and forget it" operation – 20 year calibration
- ❖ Redundant meter volume input sensors
- ❖ Durable, UV resistant, clear polycarbonate enclosure
- ❖ Potted electronics to safe-guard against moisture / water ingress
- ❖ Immersion tested to 1 meter under water for 72 hours (No AMR connections)
- ❖ Large 8-character alphanumeric LCD display with Icons (always on)
- ❖ Configurable Meter Reader list for displaying up to 12 Item values
- ❖ Infrared data port (IrDA) – isolated communications interface

- ❖ Historical data log - stores last 90 days of compensated and uncompensated volume totals along with three additional Item values
- ❖ Two Form-A (normally open) outputs for Volume
- ❖ One Form-B (normally closed) output for an Alarm signal
- ❖ Compatible with Itron, Sensus, Hexagram, Cellnet, Badger, and other AMR devices
- ❖ The preferred AMR device can be installed and pre-wired at our facility – ship complete
- ❖ Direct mount to many rotary meters including: Dresser LMMA / B3, Romet, and AMCO
- ❖ Field programmable firmware updates
- ❖ Total accuracy: +/- 0.25 %
- ❖ Ambient temperature -40 to +160 F (-40 to +71 C)
- ❖ Regulatory compliance including IEC, CSA and FCC

1.3   Certifications

- ❖ IEC 61000-4-2 testing (Electrostatic discharge)
- ❖ IEC 61000-4-3 testing (Electromagnetic fields)
- ❖ Measurement Canada
- ❖ CSA --- Class 1, Div 1 & Div 2, Group D certifications
- ❖ FCC Part 15

2   LCD Display

The TCI incorporates an eight (8) character alphanumeric display with ICONS. So that it can be viewed without physically accessing the unit, the **LCD is always on**.
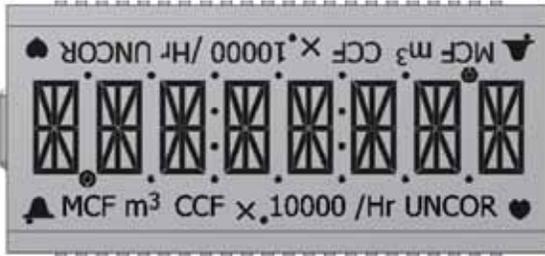
LCD Display

2.1   Display icons

Along with eight (8) alphanumeric characters, the LCD has several Icons to supply the User with additional status information.

Units

Imperial and Metric unit Icons are both supported by the TCI. The Units Icons are automatically handled by selecting the desired units of volume. When Temperature Items are shown on the display, a degree character is shown just to right of the value. Other text characters may be shown on the display depending on the type of Item and the units involved.

Volume type

The TCI shows the corresponding Icon for Corrected (compensated) and Uncorrected (uncompensated) volume Items when they are displayed on the LCD. The Units Icons are automatically handled by selecting the desired units of volume.

Alarm bell

Two Alarm Bell Icons (alternate corners of the LCD) will be activated if the TCI is in an Alarm condition (one or more active Alarms). These Alarm Bell Icons remain on solid until the unit is no longer in an Alarm condition.

Heart beat

A Heart beat Icon is shown on the display during normal Compensation mode to indicate the TCI is actively running. During other operating modes, the Heart beat is not active (beating).

2.2   Reversible

A reversible LCD display of the TCI allows the User to select the desired viewing orientation for the particular meter mounting. Left or right side viewing is possible via a User configuration.

2.3   Extended temperature range

The LCD display of the TCI is operational even at extreme cold temperatures of **– 40 $^{\circ}$C**.

3 Connections

3.1 AMR pulse output connections

The TCI provides two Form-A Volume pulse outputs, along with one Form-B Alarm output. These outputs are electronic switches. The first two pulse outputs may be configured as either Compensated Volume or Uncompensated Volume. The third output pulse is for Alarm output use only.

Connections to the 3 channels of output pulses are made by means of "**loose un-terminated wires**" (individual wires from a cable) and **Insulation Displacement Connector (IDC)**. The TCI unit comes with **six (6**) loose un-terminated **wires** and six IDC type connectors (402712) to enable pulse connections to ancillary devices. These wires are located inside the gray adapter plate, behind the black strain relief fitting.

The three "switch contacts" on the TC Index pc board are MOSFET output type **opto-isolators** that **provide high voltage isolation** between the sensitive processor components of the TC Index board and the outside world.

TCI Pulse Output Wire Connections (3 wire pairs):

Wire Color	Description	Function
Orange	Volume Output Channel **A**	Comp/Uncomp volume pulse
Yellow	Volume Output Channel **A**	(configurable Pulse timing)
White	Volume Output Channel **B**	Comp/Uncomp volume pulse
Green	Volume Output Channel **B**	(configurable Pulse timing)
Brown	Alarm Channel	Alarm event signal
Blue	Alarm Channel	(1 second Pulse timing)

ⓘ Each switch is independently isolated from the others. There are no "common" connections and no polarity concerns – non-polarized interface.

3.1.1 Connecting the un-terminated wires

To make pulse connections, please follow the procedure below:

1. Identify and remove strain relief fitting by unthreading from the gray adapter plate.

☀ Do not remove the hex nut of the fitting; <u>Instead, unthread the entire fitting</u> from the gray adapter plate. A tether line is secured to the strain relief fitting. When the strain relief fitting is removed, the tether line pulls the un-terminated wires from the inside of the adapter plate for connection access.
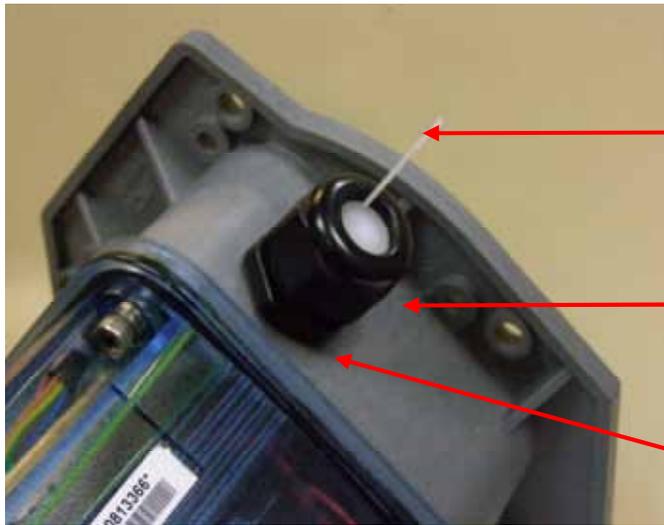
Tether Line

Do not loosen middle nut!

Un-thread fitting at bottom of entire nut assembly

2. Loosen the hex nut of the strain relief fitting and remove the white plug from center of the strain relief fitting.

3. Place the strain relief fitting onto the field pulse cable.

4. If field pulse cable is <u>smaller than 0.2" diameter</u>, install rubber tube supplied with unit onto cable such that the strain relief will clamp onto the tube once re-installed.

5. Connect individual conductors of the external pulse cable to the proper un-terminated wires. Do so by **inserting** one un-terminated wire in to one of the openings of the Insulation Displacement Connector (IDC) and one field cable wire into the other opening of the IDC.

Six IDC's (40-2712) are included with the TCI instrument for connections to the cable wires.

ⓘ Note: IDC make/model: 3M / E-9E or E-9Y
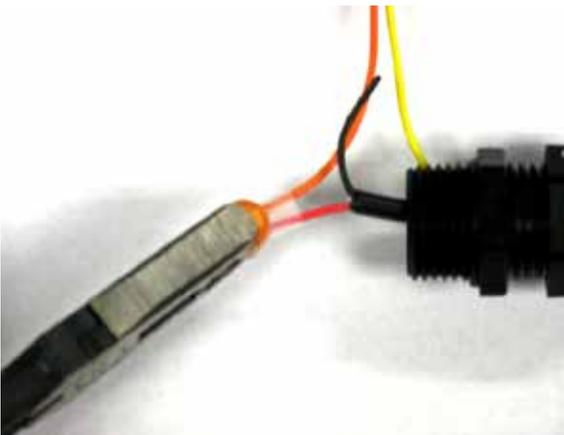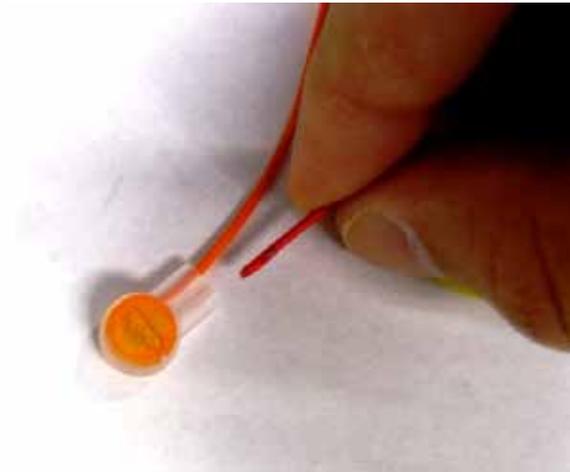
6. Once both wires are fully inserted into the IDC - squeeze the IDC connector closed with pliers to activate insulation displacement contacts. ☞ Ensure both wires are completely inside the IDC *before* squeezing closed.
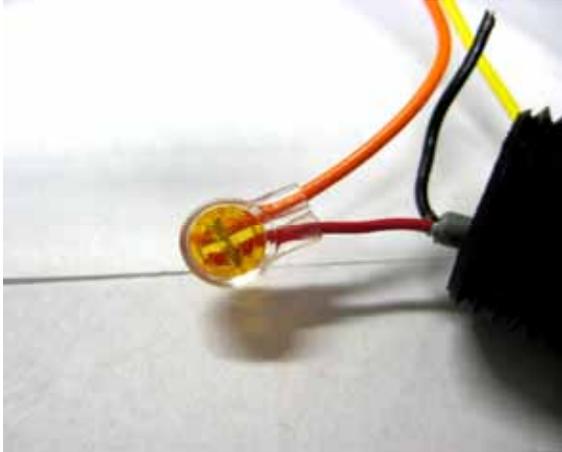
7. Next, insert the IDC(s) with connected field pulse cable back into threaded hole of gray adapter plate.

Threaded hole in adapter plate (IDCs being re-inserted)

8. Thread the strain relief fitting into threaded hole of adapter plate and wrench tighten. Tighten fitting nut to assure a water tight seal with cable jacket. The fitting will accommodate a 0.20" to 0.35" diameter cable.

ⓘ The strain relief fitting contains a small hole drilled into the hex surface of the nut. This hole will accommodate a sealing wire for tamper sealing, if warranted.

Tamper sealing hole

4   Instrument Mounting

4.1   Main assembly drawing

MOUNTING PLATE ASSEMBLY

20-9362 MOISTURE CONTROL PACK (SEE SHEET 2)

TCI ENCLOSURE 22-1429 OR 22-1429-1

22-1706

22-1782

60-1341

60-5062

60-1341

22-1782   60-5062

HARDWARE ATTACHMENT KIT (22-1784)
TIGHTEN ALL 4 SCREWS TO 18-20 IN-LBS

4.1.1 Main wiring drawing

4.2 Mounting plates

	1 VPDR/HPDU	2 VPDD/HPDR	3 VPDL/HPDD	4 VPDU/HPDL

LMMA/ROMET

ASSY #
22-1542	22-1554	22-1562	22-1567	22-1577	22-1582	22-1718	22-1726	22-1731
22-1543	22-1555	22-1563	22-1568	22-1578	22-1583	22-1722	22-1727	22-1732
22-1544	22-1556	22-1564	22-1574	22-1579	22-1715	22-1723	22-1728	22-1733
22-1545	22-1560	22-1565	22-1575	22-1580	22-1716	22-1724	22-1729	22-1734
22-1553	22-1561	22-1566	22-1576	22-1581	22-1717	22-1725	22-1730	22-1735

LMMA/ROMET 7-16M

ASSY #
22-1546	22-1559	22-1720
22-1547	22-1569	22-1721
22-1548	22-1570	
22-1557	22-1571	
22-1558	22-1719	

B3

ASSY #
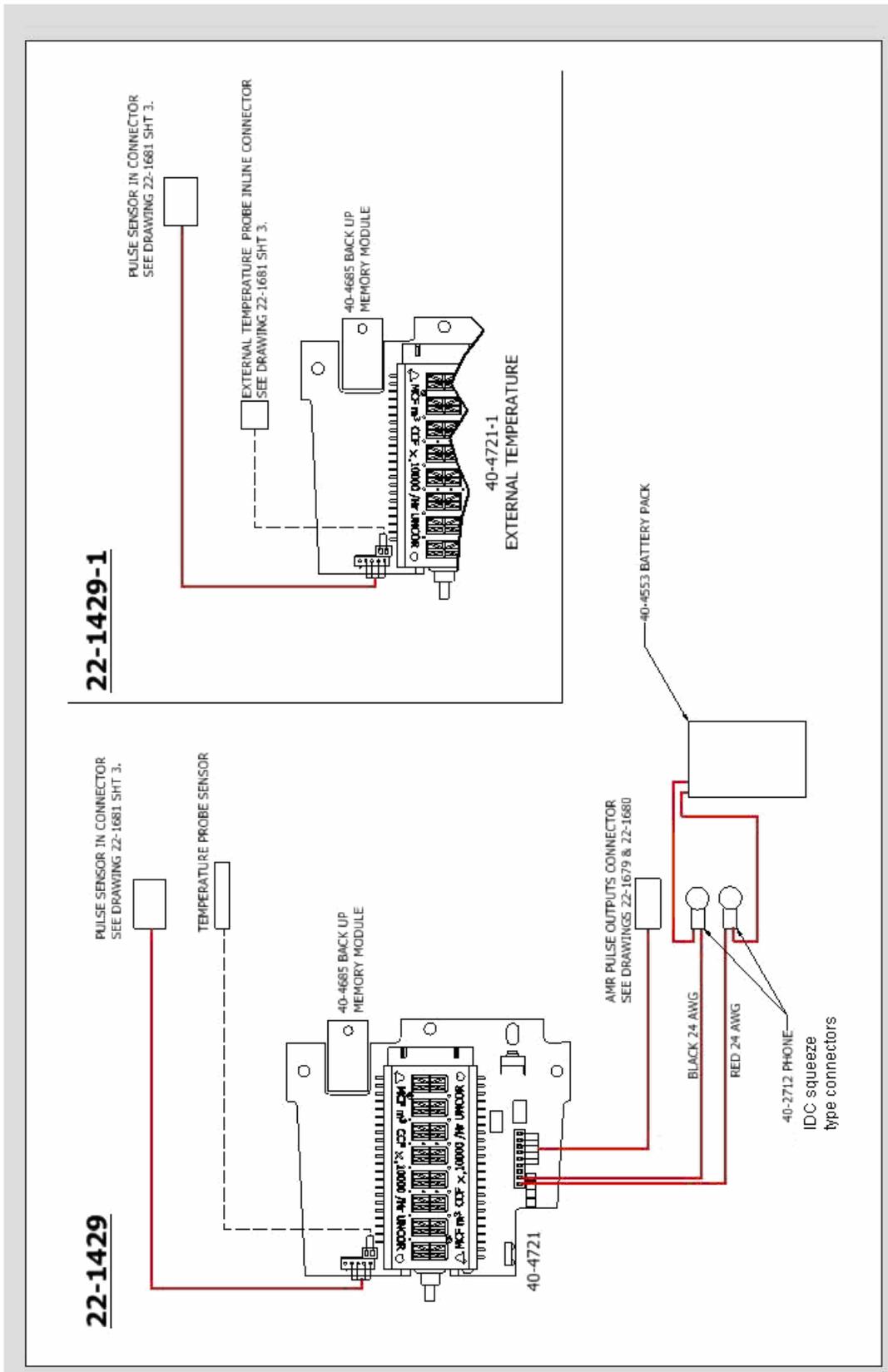|							
22-1584	22-1589	22-1599	22-1604	22-1609	22-1738	22-1743	22-1748
22-1585	22-1590	22-1600	22-1605	22-1610	22-1739	22-1744	22-1749
22-1586	22-1591	22-1601	22-1606	22-1611	22-1740	22-1745	
22-1587	22-1592	22-1602	22-1607	22-1736	22-1741	22-1746	
22-1588	22-1593	22-1598	22-1603	22-1608	22-1737	22-1742	22-1747

AMCO "C" TYPE

ASSY #
22-1628	22-1633	22-1638	22-1643	22-1754
22-1629	22-1634	22-1639	22-1750	22-1755
22-1630		22-1640	22-1751	22-1756
22-1631	22-1636	22-1641	22-1752	22-1757
22-1632	22-1637	22-1642	22-1753	

20-9362
20-9362
20-9362
20-9362

4.3   Mounting orientations

4.3.1   Vertical pipe mounting

Shown here are the four (4) mounting orientation options for vertictal pipe mount applications using the TCI. With the adjustable (reversible) LCD using Item 1001 – the display can be electronically rotated to suit all four mounting possibilities.

Display – Right Side Facing
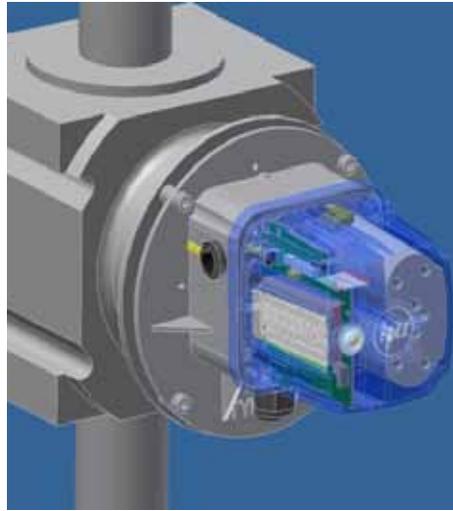
Item 1000 = 1

Display – Left Side Facing
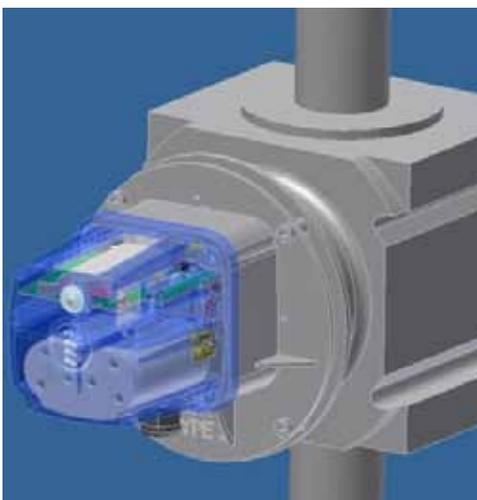
Item 1000 = 0

Display - Top Facing
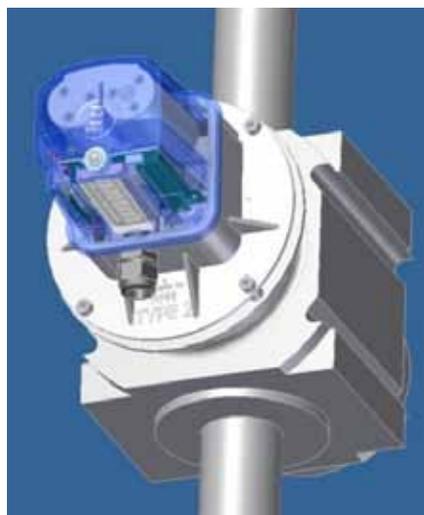
Item 1000 = 1

Display - Bottom Facing

Item 1000 = 1

4.3.2   Horizontal pipe mounting

Shown here are the four (4) mounting orientation options for horizontal pipe mount applications using the TCI. With the adjustable (reversible) LCD using Item 1001 – the display can be electronically rotated to suit all four mounting possibilities.

Display – Right Side Facing
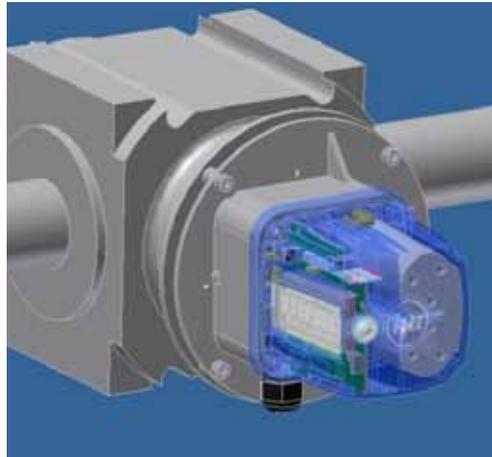
Item 1000 = 1

Display – Left Side Facing
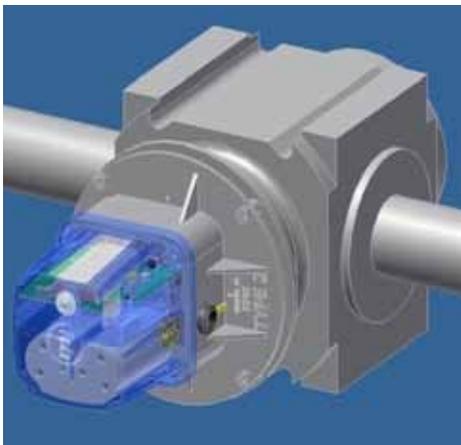
Item 1000 = 0

Display – Top Facing
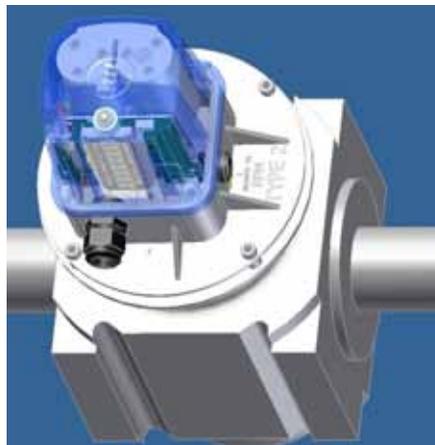
Item 1000 = 1

Display – Bottom Facing

Item 1000 = 1

4.4 Mounting to LMMA meters - Except 7M -16M

QTY.	PART NO.	DESCRIPTION
1	20-9674	GASKET, MOUNTING, LMMA
3	60-1339	SCREW, 10-24 X 1/2", ALLEN CAP
2	60-1340	SCREW, 10-24 X 1/2", ALLEN CAP, CROSS DRILLED
1	22-1660	KIT CONTENTS
1	90-2542	8 X 10 POLYBAG, CLOSEABLE
1	20-3260	4 X 4 BAG, CLOSEABLE
1	22-1048	CAP PLUG, 1.5 X 1"
1	60-5029	WASHER, #10 FLAT

NOTES:
1) TORQUE SCREWS FROM 18 TO 20 IN-LBS.

GENERIC METER END

60-5029 FLAT WASHER
60-1339 SCREW
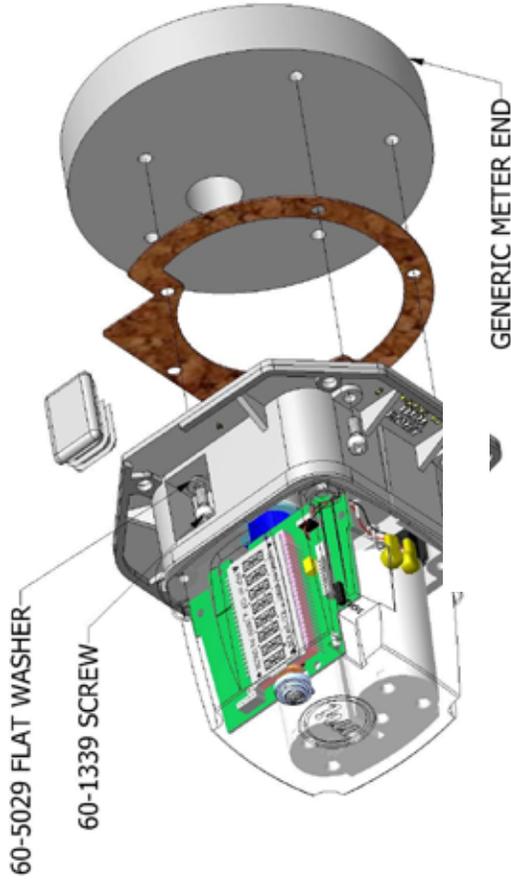
22-1660 LMMA Mounting Kit

60-5029 · 60-1339 · 60-1340 · 20-9674 SCALE: .25:1 · 22-1048

4.5 Mounting to LMMA 7M-16M meters

QTY.	PART NO.	DESCRIPTION
1	20-9675	GASKET, MOUNTING, LMMA 7M-16M
4	60-1339	SCREW, 10-24 X 1/2", ALLEN CAP
2	60-1340	SCREW, 10-24 X 1/2", ALLEN CAP, CROSS DRILLED
1	22-1661	KIT CONTENTS
1	90-2542	8 X 10 POLYBAG, CLOSEABLE
1	20-3260	4 X 4 BAG, CLOSEABLE
1	22-1048	CAP PLUG, 1.5 X 1"

NOTES:
1) TORQUE SCREWS FROM 18 TO 20 IN-LBS.

60-1339

60-1340

20-9675
SCALE: .25:1

22-1048

GENERIC METER END
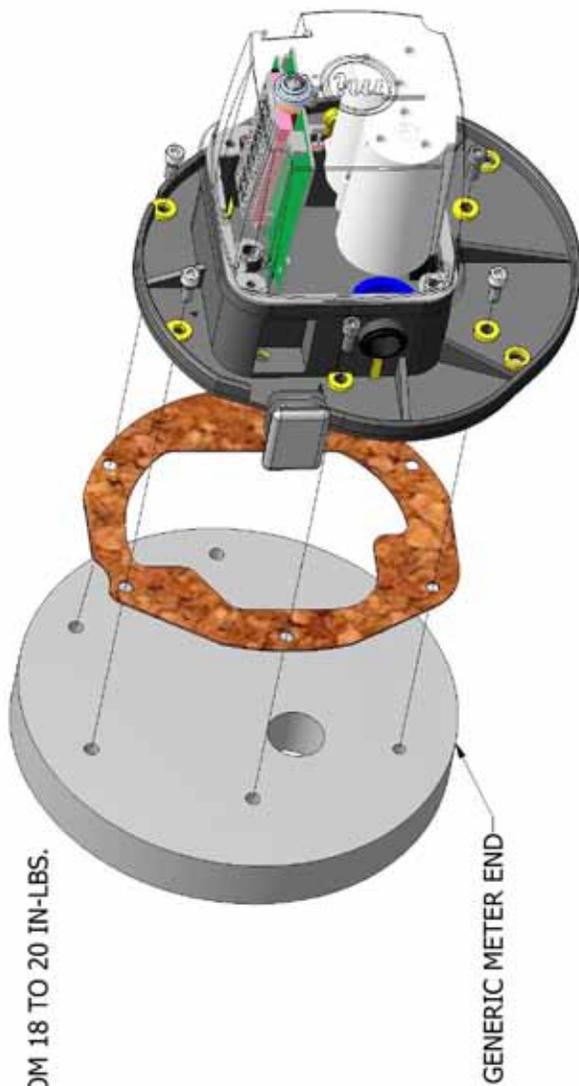
22-1661   TCI to LMMA 7M-16M Mounting Kit

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4.6 Mounting to B3 series meters

QTY.	PART NO.	DESCRIPTION
1	20-9598	GASKET, MOUNTING, B3
2	60-1345	SCREW, 10-24 X 5/8", ALLEN CAP
2	60-1346	SCREW, 10-24 X 5/8", ALLEN CAP, CROSS DRILLED
1	22-1662	KIT CONTENTS
1	90-2542	8 X 10 POLYBAG, CLOSEABLE
1	20-3260	4 X 4 PLASTIC BAG
1	22-1048	CAP, PLUG 1.5 X 1"

NOTES:
1) TORQUE SCREWS FROM 18 TO 20 IN-LBS.

METER END

60-1345 SCREW

60-1345

60-1346

20-9598
SCALE: .25:1

22-1048

22-1662   TCI to B3 mounting kit
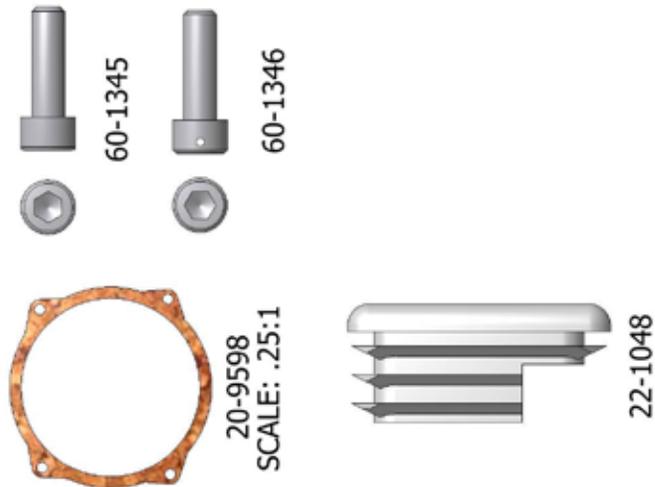
4.7 Mounting to Romet meters – Except 7000-16000

QTY.	PART NO.	DESCRIPTION
1	20-9672	GASKET, MOUNTING ROMET
3	60-1405	SCREW, 1/4-20 X 1/2", ALLEN CAP HD
2	60-1415	SCREW, 1/4-20 X 1/2", ALLEN CAP HD, CROSS DRILLED
1	22-1677	KIT CONTENTS
1	90-2542	8 X 10 POLYBAG, CLOSEABLE
1	20-3260	4 X 4 BAG, CLOSEABLE
1	22-1048	CAP PLUG, 1.5 X 1"

NOTES:
1) TORQUE SCREWS FROM 18 TO 20 IN-LBS.

GENERIC METER END

60-1405

60-1415
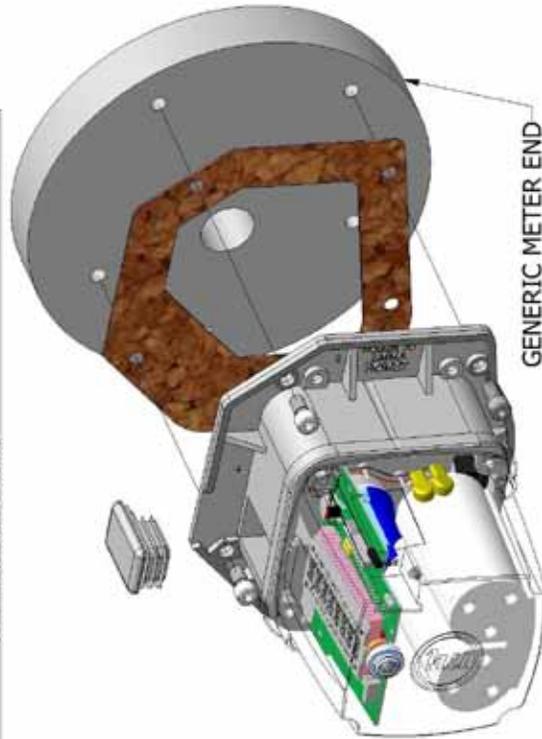
20-9672
SCALE: .25:1

22-1048

22-1677   TCI to Romet Mounting Kit
(excluding RM 7000-16000)

4.8   Mounting to Romet RM 7000-16000 meters

QTY.	PART NO.	DESCRIPTION
1	20-9806	GASKET, MOUNTING ROMET 7000-16000
2	60-1405	SCREW, 1/4-20 X 1/2", ALLEN CAP HD
2	60-1415	SCREW, 1/4-20 X 1/2", ALLEN CAP HD, CROSS DRILLED
1	22-1678	KIT CONTENTS
1	90-2542	8 X 10 POLYBAG, CLOSEABLE
1	20-3260	4 X 4 BAG, CLOSEABLE
1	22-1048	CAP PLUG, 1.5 X 1"

NOTES:
1) TORQUE SCREWS FROM 18 TO 20 IN-LBS.

60-1405 SCREW

60-1405

60-1415

GENERIC METER END

20-9806
SCALE: .25:1

22-1048
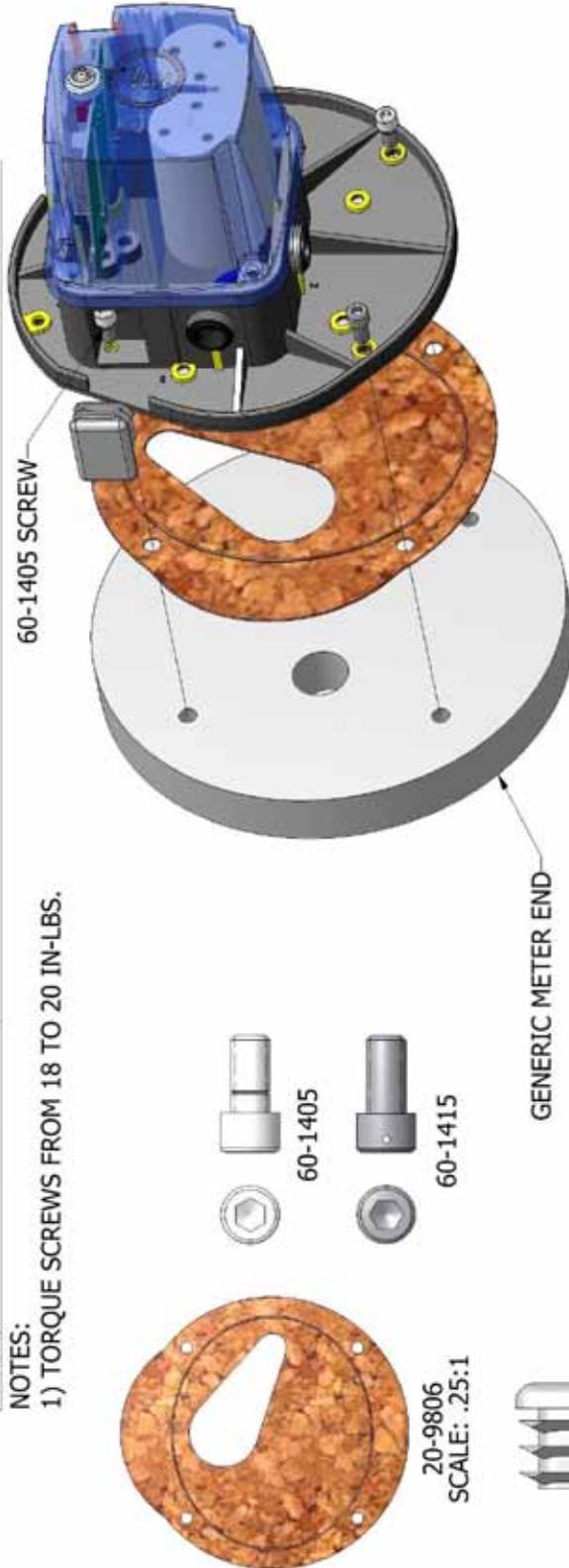
22-1678   TCI to Romet RM7000–16000 Mounting Kit

TCI TO ROMET EXTERNAL TEMP. MOUNTING KIT

QTY.	PART NO.	DESCRIPTION
1	20-9479	GASKET, MOUNTING ROMET, EXTERNAL TEMP.
1	60-1405	SCREW, 1/4-20 X 1/2", ALLEN CAP HD
2	60-1415	SCREW, 1/4-20 X 1/2", ALLEN CAP HD, CROSS DRILLED
1	22-1769	KIT CONTENTS
1	90-2542	8 X 10 POLYBAG, CLOSEABLE
1	20-3260	4 X 4 BAG, CLOSEABLE
1	60-1406	SCREW, 1/4-20 X 2", ALLEN CAP HD.
1	22-1048	CAP PLUG, 1.5 X 1"

GENERIC METER END

NOTES:
1) TORQUE SCREWS FROM 18 TO 20 IN-LBS.

20-9479
SCALE: .25:1

60-1415

60-1405

60-1406

22-1048

22-1769   TCI to Romet with – external Temperature mounting Kit
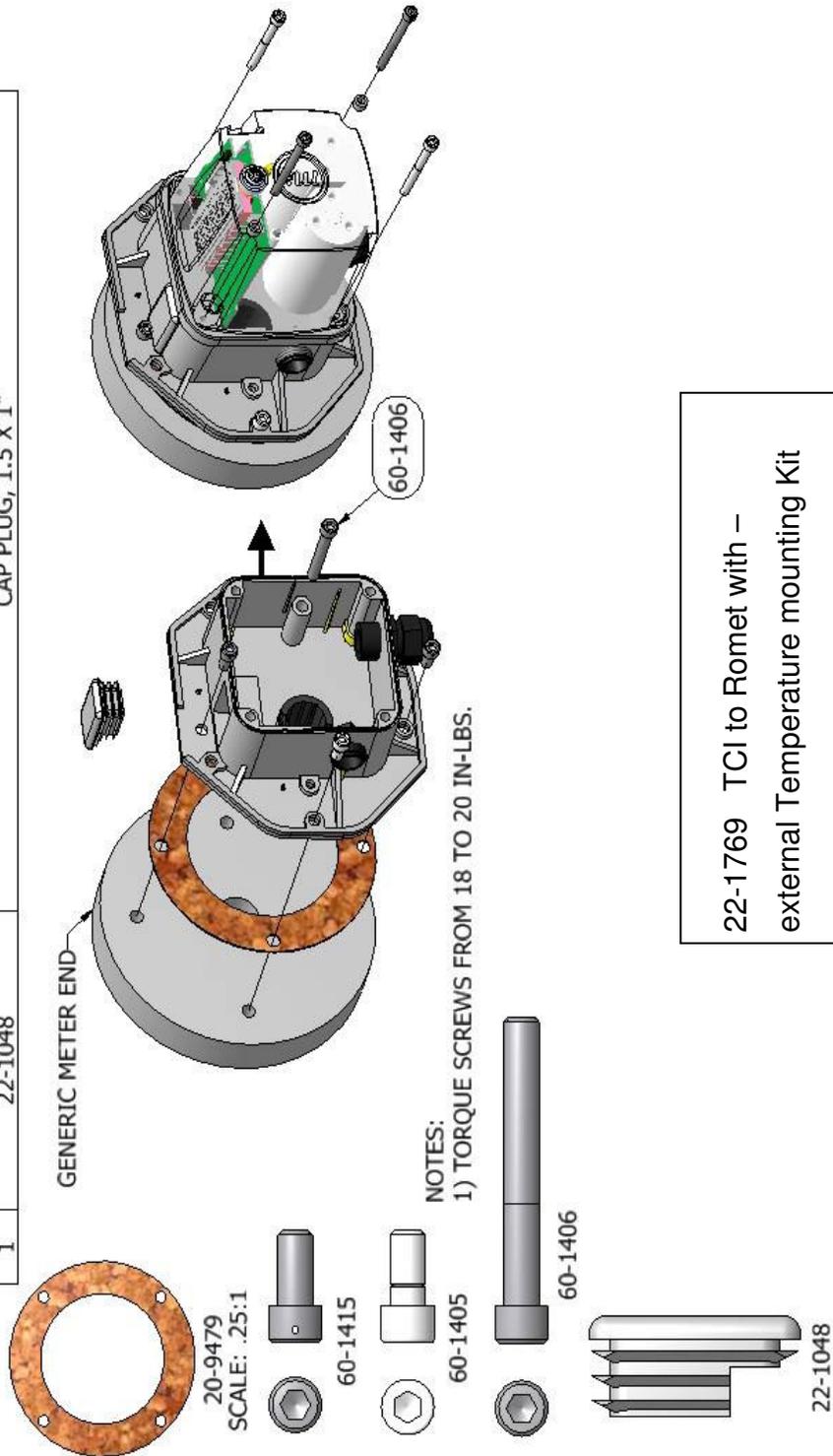
4.10 Mounting to AMCO RPM B/C meters

TCI TO AMCO RPM C-TYPE MOUNTING KIT		
QTY.	PART NO.	DESCRIPTION
1	22-1220	GASKET, MOUNTING, AMCO RPM, C-TYPE
2	60-5024	SCREW, M6 X 20mm, ALLEN CAP HD
2	60-5025	SCREW, M6 X 20mm, ALLEN CAP HD, CROSS DRILLED
1	22-1786	KIT CONTENTS
1	90-2542	8 X 10 POLYBAG, CLOSEABLE
1	20-3260	4X4 BAG, CLOSEABLE

NOTES:
1) TORQUE SCREWS FROM 18 TO 20 IN-LBS.

60-5024

60-5025

METER END

22-1220
SCALE: .25:1
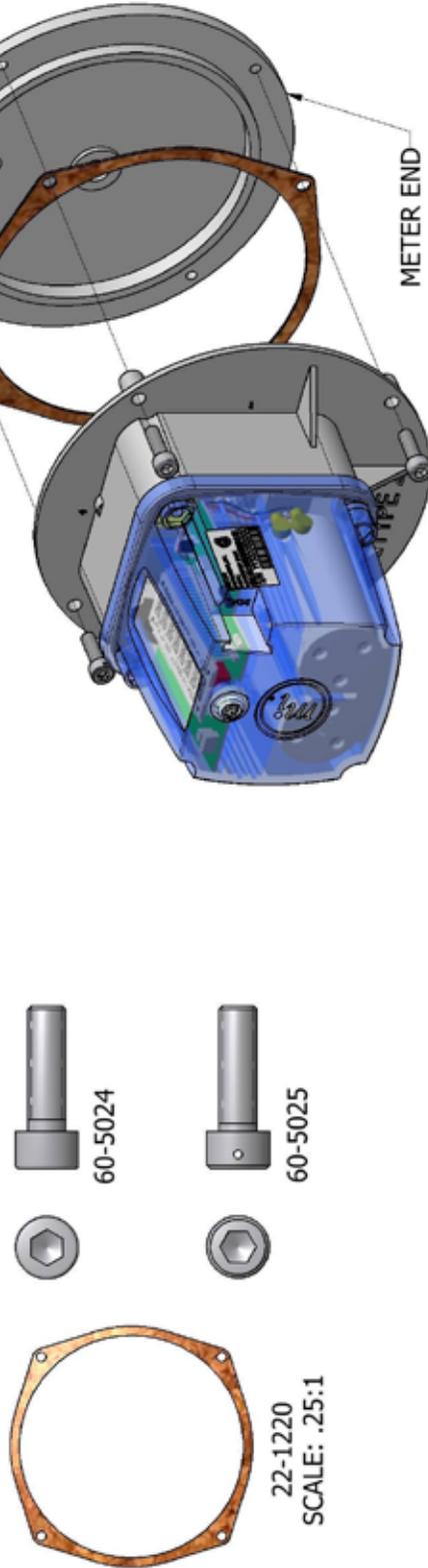
22-1769   TCI to AMCO RPM B\C-Type Mounting Kit

23

4.11 Inserting Temperature probe into meter base

4.11.1 Recommend procedure:

1. Pull the temperature probe out of the mounting plate.

TCI shown as received

Temperature probe now extended

2. Using the Temperature probe as a measuring device, insert probe until it bottoms out in the thermowell of the meter.

Insert Temperature probe

Temperature probe fully in thermowell

3. Mark the Temperature probe <u>cable</u> at the point where the cable protrudes out from the meter body.

Marking of Temperature probe

4. The temperature probe cable is held in place by a rubber gland in the mounting plate. Push the cable back into the TCI until the mark is 1" from the mounting plate.

Temperature probe marked 1" from mounting plate

ⓘ The 1" additional length will insure the probe bottoms out at the end of the thermowell.

5. Re-insert the Temperature probe into the meter thermo well and proceed with attachment of the TCI to the meter.

Re- insert Temperature probe

TCI now ready for final mounting hardware

4.12 AMR connections to TCI

4.12.1   AMR mounting hardware kit – 22-1932

A special mounting bracket kit is available for installing various AMR (Automatic Meter Reader) devices directly on to the TCI. The following AMR devices can be easily installed using the 22-1932 AMR bracket kit: Aclara/Hexagram, Cellnet, and Itron 40G & 100G. Other AMR devices from various manufacturers are able to use this bracket with some minor modifications.
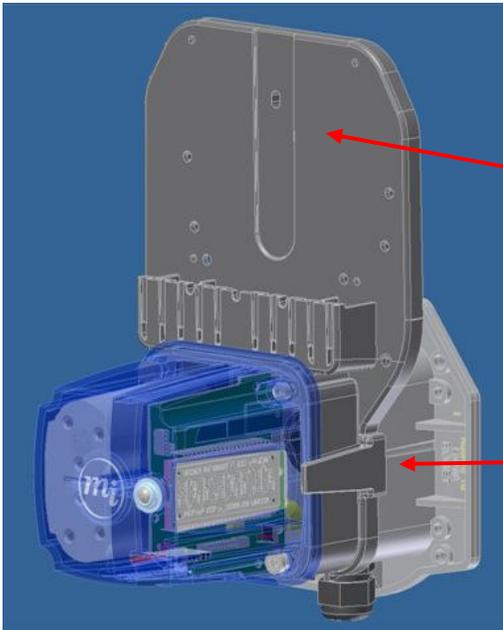
22-1929

AMR mounting bracket

Meter mounting plate

AMR mounted to 22-1929 bracket
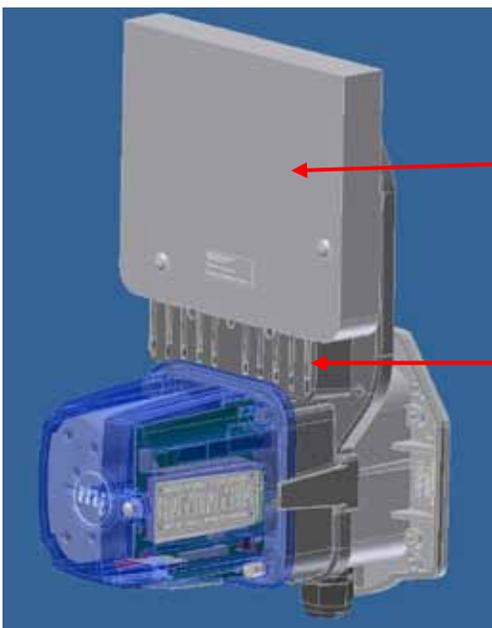
AMR device

(various)

22-1929

AMR mounting bracket

5   Operating Modes

While in service, the TCI is always in one of 3 operating modes. These operating modes are well defined and are suited to a particular purpose. A very brief description of each mode is described below.

ⓘ The LCD display of the TCI is active (segments on) in all modes of operations.

5.1   Compensation mode

The **TCI normally operates in Compensation Mode**. Other modes of operations always return to the Compensation Mode when completed. Through the many years of service, the TCI will spend a vast majority of its time in Compensation mode. When the TCI is in Compensation mode, the default display Item value will be displayed on the LCD (normally Item 000 Compensated Volume). The default display Item is updated as new data is processed.

Uncompensated Volume is measured by counting meter revolutions from a magnetically based sensor. When new volume input is detected, the index applies a total compensation factors to the new volume and thus computes a new Compensation Volume. The total compensation factor is based on the current Gas Temperature, fixed Pressure factor, and a configurable auxiliary factor. When new volume is processed, the LCD is updated to show the new value of the default display Item (typically Compensated Volume). Instrument Alarm status is also updated with each volume input processing cycle. After processing the new volume input, the TCI returns to a '**sleep**' state to conserve battery power until the next time volume is processed.

5.2   Meter Reader mode

The TCI can be programmed to display **up to 12 selectable Items on the LCD**. This provides the meter reader with the ability to view Item values in additional to the default display Item (normally Compensated Volume). By depressing the main push-button, the meter reader can sequence through a configurable list of Item readings.

The Meter Reader list is configured using **Item numbers 075 through 086**.

Pressing the main button shows the Items' description and then the numerical value on the LCD as set in the Meter Reader list Items.

Some values to be displayed are "live" readings, such as gas flow rates and pulse testing, which are real time display updates. The Meter Reader list Items have a 60 second timeout for each Item. If pressing the push button is not within the timeout period, the TCI will exit the Meter Reader mode and return to Compensation mode (Volume processing and sleep).

While in Meter Reader mode, the TCI queues any incoming volume pulses and waits to convert them to Compensated and Uncompensated Volume totals until returning back to Compensation mode after leaving Meter Reader mode.

ⓘ It is important to note that the Temperature Compensation factor used for processing all of the volume input queued during Meter Reader mode is not updated until this mode ends and the unit returns back to Compensation mode.

5.3   Serial Access mode

Full access to the TCI Items for both configuration and measurement data retrieval is possible within the Serial Access mode of operations. This is considered a lower level access to index functions and is gained through the use of a computer or PDA.

Serial Mode requires Mercury Instrument's **MasterLink32** software and a **USB to IrDA adapter**. The TCI uses IrDA (infra-red) for serial communications to provide an electrically isolated and robust interface.

In Serial Access mode, the User has access to the entire set of Items (data), including: general configurations, measurement data, calibration, Alarms clearing, Audit-Trail reading, and more. Also, if authorized, firmware can be loaded (upgraded) using the IrDA interface with the appropriate Mercury software.

When attempting to establish a serial link to the TCI, the software may request the user to input a five-digit Instrument Access Code. This access code is necessary to maintain security.

ⓘ The default Instrument Access Code is: "**33333**".

While in Serial Access mode, the TCI queues any incoming volume pulses and waits to convert them to Compensated and Uncompensated Volume totals until returning back to Compensation mode after leaving Serial Access mode.

ⓘ It is important to note that the Temperature Compensation factor used for processing all of the volume input queued during Serial Access mode is not updated until this mode ends and the unit returns back to Compensation mode.

6   Compensation mode

6.1   Volume measurement

6.1.1   Volume input sensors

The TCI employs two volume input sensors providing **redundant** input signals for reliable measurement of Gas volume. These volume input sensors are specially designed for rotary meter applications. If one of the input sensors fails or has a temporary fault – no volume measurement is lost due to the redundant sensor technique. If the TCI microprocessor detects that one of the input sensor is not operating properly, an Alarm Item will be set for that specific sensor and the TCI will be in an Alarm condition.

6.1.2   Rotary volume scaling

Measurement of the Rotary meter Gas volume is performed by using the input signals supplied by the two redundant volume sensors and multiplying that value by the appropriate scaling factor for the particular Rotary meter. The TCI supports numerous Rotary meter models – currently 45 different models are handled. Selection of the particular Rotary meter model is achieved through the use of the Rotary Integral Mount.

Rotary Integral Mount - Item 432

When a particular Rotary Integral Mount is selected, the TCI will then compute the proper Rotary volume scaling factor. There are two key Items involved with this volume scaling factor. The first is the Rotary Displacement value and the other is the Meter Scaling. Rotary Displacement is an Item that indicates the actual cubic feet (CF) of Gas volume per a single revolution of the meter. ⓘ The Rotary Displacement Item value comes directly from the meter manufacturer's catalog specifications of that Rotary meter. Some meter manufacturers state this value as a gear ratio, while others list this value as the actual CF/Rev - or both. The Meter Scaling value is derived directly from the manufacturer's Rotary Displacement value.

Rotary Displacement - Item 439

Meter Scaling - Item 114

⚠ Do not change the Meter Scaling unless you intend to alter the basic volume input scaling factor. Rotary Displacement is a Read-Only Item and thus cannot be changed. The selection of Rotary Integral Mount may be changed as needed per the installation.

Rotary meter models selectable from the Rotary Integral Mount:

Dresser/Roots LMMA	Dresser/Roots B3	Romet RM	AMCO RPM
1.5M	8C175/200	1000 (older)	9.0C
2M	11C175/200	1000 (newer)	1.5M
3M	15C175/200	1500	3.5M
5M	1M300	2000	5.5M
7M	2M175/200	3000	7.0M
11M	3M175/300	5000	11.0M
16M	5M175	7000	16.0M
23M	7M175	11000	23.0M
38M	11M175	16000 (older)	
56M	16M175	16000 (newer)	
102M	23M175	23000	
	23M232	38000	
	38M175		
	56M175		

6.1.3   Compensated Volume

The main objective of the TCI is to measure and maintain an accurate measurement of the total compensated Volume as seen by the rotary meter on which it is installed. Additionally, uncompensated volume is also measured. Compensated Volume is computed by multiplying a total compensation factor with the raw meter volume and scaling the result in the proper volume units with respect to the particular rotary meter used. To show a more detailed value for both Compensated and Uncompensated Volumes, the TCI includes Items that indicate a fractional part of their respected volumes. These Items are normally called "Hi-Res" volumes.

Compensated Volume - Item 000   **High Resolution Compensated Volume - Item 113**

Uncompensated Volume - Item 002   **High Resolution Uncompensated Volume - Item 892**

Total compensation factor is obtained from a combination of a measured temperature factor, a fixed pressure factor (normally 1.0), and an auxiliary factor (normally 1.0).

Total compensation factor - Item 043

Temperature compensation factor - Item 045

Fixed Pressure factor - Item 044

Auxiliary factor - Item 046

ⓘ TCI FW v1.04 has no provision for a "fixed" temperature factor – only measured is possible. This option is planned for a future release.

The TCI supports a large range of units for volume measurement. Included in this list are the following units possible: CF, CFx10, CFx100, CCF, CFx1000, MCF, CFx10000, m3x0.1, m3, m3x10, m3x100, and m3x1000. These units can be configured independently for both Compensated and Uncompensated Volume Items.

Compensated Volume units - Item 090

Uncompensated Volume units- Item 092

6.1.4   Energy

Along with Compensated and Uncompensated Volume measurements, the TCI is also able to measure and maintain Energy as seen by the rotary meter on which it is installed.

The TCI supports a large range of units for energy measurement. Included in this list are the following units possible: Therms, Decatherms, Mega Joules, Giga Joules, Kilo Calories, and Kilo Watts. For additional scaling, the TCI supports a user configurable Item for adjusting the particular Energy Value.

Energy - Item 140

Energy Units - Item 141

Gas Energy Value - Item 142

6.1.5   High Resolution mode

To obtain a very high degree of Gas volume measurement resolution, the TCI supports an option called High Resolution mode. This option is selected through the use of an Item called Input Volume Mode. While in this setting, the TCI will measure Gas volume using a very low divider ratio for the input signals supplied by the two volume input sensors. Normally the divider ratio is much higher to make a sensible trade-off between measurement resolution and instrument battery life. This mode is intended to be used as a test and verification tool for obtaining accurate volume measurement within a shorter period of time (less Gas passing through the meter). High Resolution mode consumes more battery power while achieving a greater degree of volume measurement resolution.

Input Volume Mode - Item 433

ⓘ It should be noted that nearly all applications will not want to use this High Resolution mode for day to day volume measurement since the gain in volume resolution is not worth the inherent battery life drain.

6.1.6   Volume statistics

As a useful statistic, the TCI supports several Gas volume statistical Items. Included in this group are the following Items:

Daily Cor-Vol - Item 223

Previous Day Cor-Vol - Item 183

Daily Unc-Vol - Item 224

Previous Day Unc-Vol - Item 184

Max Day Cor-Vol - Item 253

Max Day Cor-Vol Date- Item 254

6.2   Temperature measurement

6.2.1   Temperature probe

The Gas Temperature probe uses a highly stable and accurate "NTC" (Negative Temperature Coefficient) **thermistor** temperature sensor. The Temperature probe cable is18 inches in length with water-tight connections back to the TCI main board. Each Gas Temperature probe is factory calibrated against certified calibration equipment.   *See Section 15 – Specifications*.

6.2.2   Temperature readings

The TCI obtains Gas temperature probe readings on a timed based approach as opposed to reading temperature only when it receives volume input. In compliance with industry regulatory measurement requirements**, Gas temperature readings are always within 30 seconds of the most recent volume input**. If the Gas **flow stops** (no volume input), the TCI will still measure Gas Temperature and update both the Temperature and Total Compensation factors every **ten (10) minutes**.

By utilizing timed based temperature measurement described above, the TCI can detect high and low temperature alarm conditions even when there is no volume input. When making a temperature measurement, the TCI samples the Gas temperature probe a large number of times to produce a very accurate final reading. In addition, the temperature readings are improved by applying **linearization** compensation. With each Gas temperature measurement, both the temperature compensation and the total compensation factors are updated to reflect the new reading.

Gas Temperature - Item 026

The TCI supports four options for Temperature units: Fahrenheit, Celsius, Kelvin, and Rankine.

Gas Temperature Units - Item 089

Temperature compensation factor is derived from a formula that includes Base Gas temperature (normally 60 F). Base temperature is user configurable to suit various application requirements.

Temperature compensation factor - Item 045

Base Temperature - Item 034

As previously mentions, the TCI supports both a High and Low Gas temperature Alarm Items along with adjustable Alarm limits Items.

Temperature Low Alarm - Item 144

Temperature Low Alarm Limit- Item 027

Temperature High Alarm- Item 146

Temperature High Alarm Limit- Item 028

6.2.3   Temperature statistics

As a useful statistic, the TCI supports several Gas temperature statistical Items. Included in this group are the following Items:

Daily High Gas Temperature - Item 216

Daily 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**

6.2.4   Fixed Pressure factor

As previously mentioned, the TCI allows for a fixed pressure value or pressure factor that can be incorporated in the overall gas measurement compensation when the gas pressure is known to be constant. The User has the choice of entering a fixed pressure value (Fixed Pressure), or the actual fixed pressure factor (Pressure Factor). If the any of the Pressure Items are changed, the other related Pressure Items and the Total Compensation factor Items are then updated to reflect the change. Most applications will not need to make adjustments to Pressure.

Fixed Gas Pressure - Item 008

Base Pressure - Item 013

Atmospheric Pressure - Item 014

Fixed Pressure compensation factor - Item 044

☼ Do not change any of the above mentioned Pressure Items unless you intend to alter the over-all (Total) compensation factor!

6.3   Alarms

While in normal Compensation mode, the TCI 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, the TCI will create an Alarm.

The TCI 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	099	Battery Low Limit	049	Battery life 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
Temperature Low	144	Temperature Low Limit	027	Gas temperature < set low limit
Temperature High	146	Temperature Low 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

When any of the above mentioned Alarm Items have been tripped, the LCD will activate the two **(2) Alarm Bell Icons** ⌂ on the display. Alarms can be read and cleared via the serial interface (IrDA) communications mode as well as in Meter Reader mode. See: Meter Reader section mode for more details on accessing Alarms in that mode. See: Using MasterLink32 section for more details on reading and clearing Alarms in serial access mode.

6.4 Telemetry outputs

While in Compensation mode of operations, the TCI will process the incoming gas volume data and then output pulse signals on either or both of the two AMR pulse output channels if configured accordingly. The TCI is designed mechanically to easily connect with various manufacturers' AMR transmitters. In some cases, the AMR transmitter unit can be part of the complete TCI assembly – greatly reducing labor cost.

6.4.1 Pulse output channels

The TCI allows for two independently configurable Pulse output channels. These two channels are designated as Channel A and Channel B. See Section 2 for details on wiring and connections for the AMR Pulse output channels.

6.4.2 Configuring Pulse outputs

To enable the Pulse output functionality, select which volume type is desired for the particular Pulse output channel. This configuration is done by using Chan-A Pulse Output Select and Chan-B Pulse Output Select. The output options for these two channels are: Compensated Volume, Uncompensated Volume, and No output. Both channels are independently configurable.

Chan-A Pulse Output Select - Item 093

Chan-B Pulse Output Select - Item 094

Along with select which volume type is desired for the particular Pulse output channel, there are several timing options to suit a variety of AMR device models. Select either the appropriate AMR device model, or one of the timing options from the MasterLink32 drop-down selection list when connected in Serial access mode.

Chan-A Pulser Timing - Item 1014

Chan-B Pulser Timing - Item 1015

6.5 Audit Trail (Backup log)

The TCI has a historical log that records five (5) fixed Items at 24 hour intervals (daily). At the Gas Day Start Time, the TCI records those five Items into the historical memory. This Audit Trail / Backup log maintains the **last 90 days** (operational) of daily historical data.

ⓘ The TCI's Audit Trail log is sometimes referred to as the "**Backup memory**" log.

Start Time (Gas Day) – Item 205

Audit Trail Backup memory Items (Fixed list):

Item Name	Item No.	Logged Item Description	Item No.
Audit Trail Item # 1	258	Compensated Volume	0
Audit Trail Item # 2	259	Uncompensated Volume	2
Audit Trail Item # 3	260	Total Correction Factor	43
Audit Trail Item # 3	261	Daily Average Temperature	257
Audit Trail Item # 5	229	Battery Months Remaining	1001

7 Meter Reader mode

7.1 Entering Meter Reader mode

To gain access to the Meter Reader Mode**, press the external pushbutton** located on the side of the case where the MI logo appears (only one external button available).

External Pushbutton
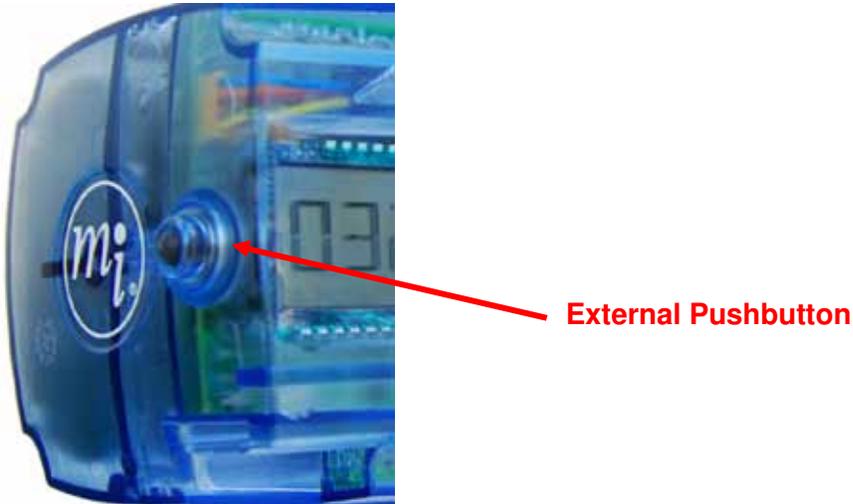
External Push Button located on end panel of TCI

7.2 Meter Reader display sequence

The order or sequence of what information displayed by the TCI on the LCD is listed below.

Note that some of these information fields depend on how the TCI is configured.

1. **DISPLAY TEST**
2. **ACTIVE ALARM(S)** (only if in Alarm state)
3. **ALARM CLEAR INDICATOR** (only if in Alarm state)
4. **METER READER LIST ITEMS** (1–12 depending on configuration)
5. **METER READER LIVE ITEMS** (Items must be selected)
6. **SENSOR TEST** (must be enabled)
7. **LIST END or TIMEOUT** (end of Meter Reader mode)

7.3   Description of display information

7.3.1   Display Test

With the first press of the front panel pushbutton, the display will first activate all of the LCD segments for a "**Display Test**" indication. The Display Test screen will remain active on the LCD until the Pushbutton is pressed again, a Serial IrDA link is started, or the 60 second timeout has elapsed.

ⓘ Display Test provides a visual means of verifying that all LCD segments, Icons, and decimal points are fully functional.

7.3.2   Display of active Alarms

If the TCI is in an Alarm condition, the display will first put eight 'E' characters on the LCD to indicate that active Alarms number indicators are to follow (with subsequent button presses). The Alarm Item number with an 'E' character preceding the number to indicate an Alarm Item.

⊃ Example: " **E 099** " on the LCD indicates a Battery Low alarm (Item 099).

⊃ Example: " **E 144** " on the LCD indicates a Low Temperature alarm (Item (144).

7.3.3   Clearing of active Alarms

If the TCI is in an Alarm condition, the TCI is designed to allow manual clearing of Alarms using the push button. Clearing of Alarms in Meter Reader mode requires the Clear Alarms with Push Button option to be enabled.

Clear Alarms w Button - Item 128

To clear all instrument alarms, scroll through the alarm codes until the LCD displays: **EEEEEEEE**.   Then, **wait** for just over **1 minute** (without pressing the push button) to allow the TCI display to update to the next display option. At this point, the active Alarms have now been cleared and the LCD will display the first Item of the Meter Reader List. If the push button is pressed during the display of **EEEEEEEE**, the Alarms will are not cleared and the sequence moves on to the next operation.

Alarms may also be cleared using the "Display and Clear Alarms" feature in MasterLink32.

7.3.4   Display of Meter Reader list Items

Subsequent button presses will cause the TCI to cycle through the configurable Meter Reader list for displaying Item information. The Meter Reader list consists of up to twelve (12) User configurable Items for selecting the desired information to be displayed.

Meter Reader List Item numbers:

Item Description	Item No.
Meter Reader Item #1:	075
Meter Reader Item #2:	076
Meter Reader Item #3:	077
Meter Reader Item #4:	078
Meter Reader Item #5:	079
Meter Reader Item #6:	080
Meter Reader Item #7:	081
Meter Reader Item #8:	082
Meter Reader Item #9:	083
Meter Reader Item #10:	084
Meter Reader Item #11:	085
Meter Reader Item #12:	086

The information at the Item number that is placed in the "Item-to-Display List" is displayed on the LCD each time the external Pushbutton is pressed on TCI. The Items that are displayed will **time out after one minute** (60 seconds), at which time the Total Compensated Volume will continuously be displayed on the LCD. A value of 255 will indicate the End-of-List. If a non-zero code is programmed into Item 129 (Live Display Enable), a live temperature and/or live flow rate will be displayed after the last "255" end-of-list in this "LCD Display List".

As each Item is displayed, the name of the Item will be displayed first. If the pushbutton is pressed while the name is displayed, the LCD will scroll to the next Item name without showing the Item code value. This allows the operator to quickly scroll down to the desired Item. When the last Meter Reader Item is being displayed, a pushbutton input will cause the LCD to go blank for 2-seconds while the instrument processes any stored uncompensated input pulses, prior to returning to the Compensation Mode.

7.3.5   Live Item Display

The Live Item Display feature gives the ability to show near real-time updates of **Gas Temperature** and/or Meter **Dial Rate** (Uncompensated flow). The Live Item update period is approximately two (2) seconds. If enabled, the Live Item Display feature follows the last Meter Reader list Item.   ⓘ Live Item Display mode will exit after ten (10) minutes of operation to conserve battery.

7.3.6   Volume Sensor test

The TCI supports a special test feature available through the use of the Meter Reader mode that allows **checking** of both **Volume** input pulse **sensors** called Volume Sensor Test. This test mode follows the Live Item Display feature (if so enabled). This feature also provides a method to witness the operation of both Volume Sensors, and to **detect ultra-low flow rates** that may not be discernable in normal TC mode.

To enable Sensor Test, set **Item 1005** to one (1) or select '**On**' in MasterLink32 drop-down list. While in the Sensor Test mode, the right-side of the LCD displays a 4-digit, count of the pulses 'seen' by Sensor-A. The left most 2 digits represent the count difference of Sensor-A from Sensor-B. Normally, the left 2 digits should remain at 0 or +/- 1. This means both Volume Sensors are responding the same to the rotating magnetic field of the Mag Coupler. If there is a Volume Sensor problem, the 2 digit error count will increment upwards to a maximum value of 99 before stopping.

In Sensor Test mode, the Volume Sensors inputs are at a **direct 1-to-1 ratio** (no divide down prescaler) giving the most accurate resolution possible. The Sensor counter rolls over at 9999 and continues counting again from 0.   ⓘ Sensor Test mode will exit after ten (10) minutes of operation to conserve battery.

8 Serial Access mode

8.1 Requirements

This section provides instructions for establishing communication between the TCI and a desktop or laptop PC using an IrDA interface.

8.1.1 Hardware

Laptop or desktop PC running under Microsoft Windows™

USB-to-IrDA (Infrared) dongle -including a USB adapter cable. ☞ The IrDA Dongle device (front lens side) **must be within 8 inches** and be aimed at the IrDA port (side of the TCI case).

Rubber boot – used to attach the USB-to-IrDA dongle directly to the TCI.

8.1.2 Software:

MasterLink32 (v3.60 or higher) – Mercury Instruments communications software

USB-to-IrDA Dongle driver

IrDA-to-COM Link driver (IrCOMM2k) –links the IrDA stack and the COMM port of the PC.

☞ See Section: "**Setup of IrDA**" for more details on installing the IrDA drivers.

8.2 Select communications port

From the MasterLink32 software main menu – click on **S**etup \ **C**ommunication Port to open a selection box from which you can choose the proper port for the IrDA communications.
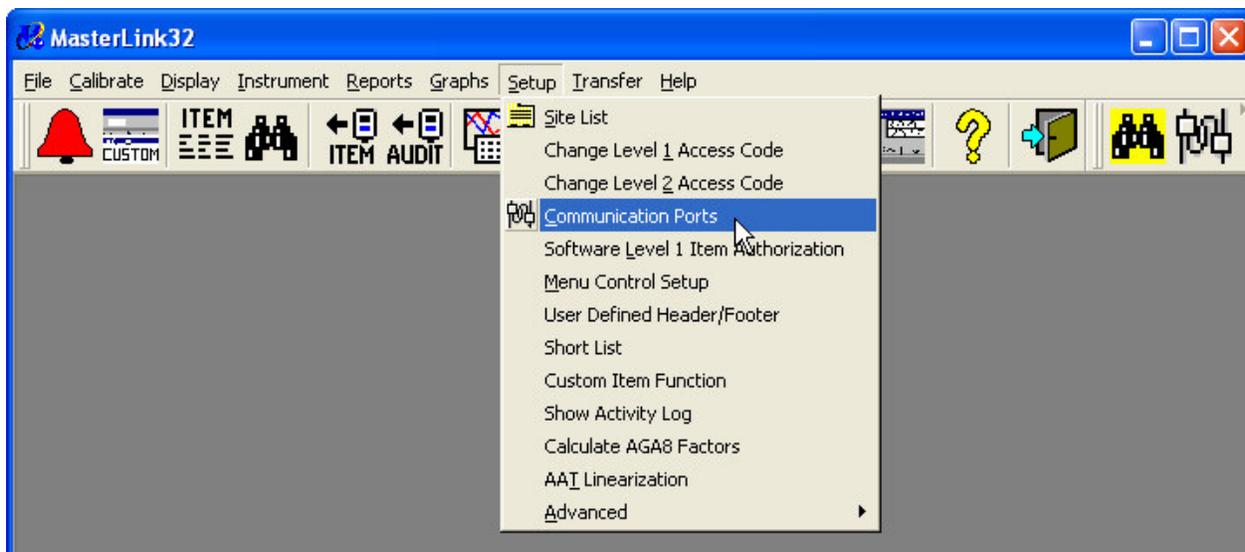
After selecting the proper Port from the drop-down list – click the OK button. Once selected, MasterLink32 will continue to use this Port until a new one is selected.
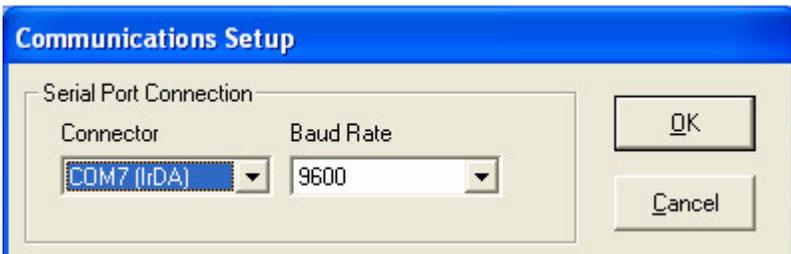
8.3   Entering Serial Access mode

To gain access to Serial Communications mode using the IrDA interface, **press the external pushbutton** located on the end of the case where the MI logo appears.

Once the external pushbutton is pressed, the LCD should 1st show the Display Test message. The TCI is then waiting for the User to either begin a Serial access session or to continue on with Meter Reader mode operations by subsequent button pressing.

ⓘ Serial access can be made any time the TCI unit is in Meter Reader mode (excluding Pushbutton Proving state). Once Serial access begins, the TCI terminates Meter Reader mode.

External Pushbutton
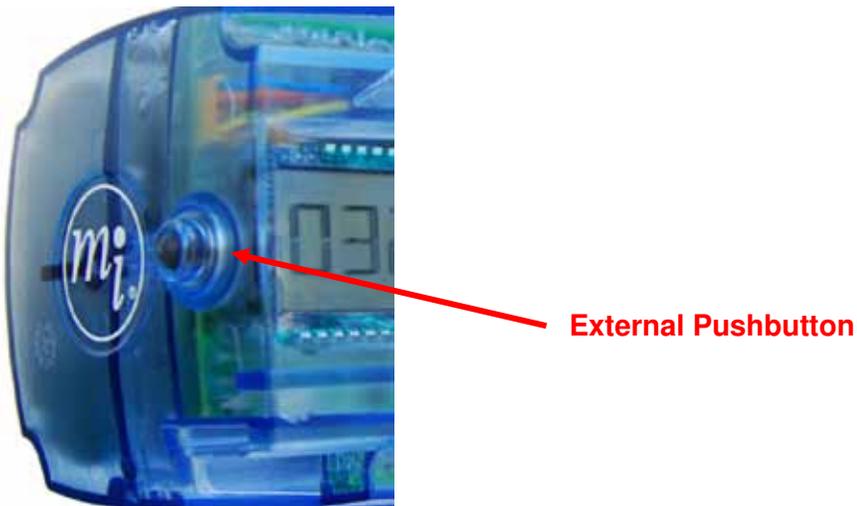
External Push Button located on front panel of TCI

8.3.1   Serial Access display text

As the TCI begins initial communications in Serial Access mode, the display will first show the text message: **LINKING**. This message will remain on the LCD for a maximum of 60 seconds.

Once a valid serial link has been established (Signed-On), the message on the LCD will then change to show: **LL** [Item 482 value] indicating the TCI is fully in Serial Access mode. Serial Access mode will **timeout after ten (10) minutes of inactivity** in order to save battery life. Extensive use of the Serial Access mode of operations will greatly diminish battery life.

ⓘ The markers: **LL** will remain showing on the LCD during the entire Serial Access mode.
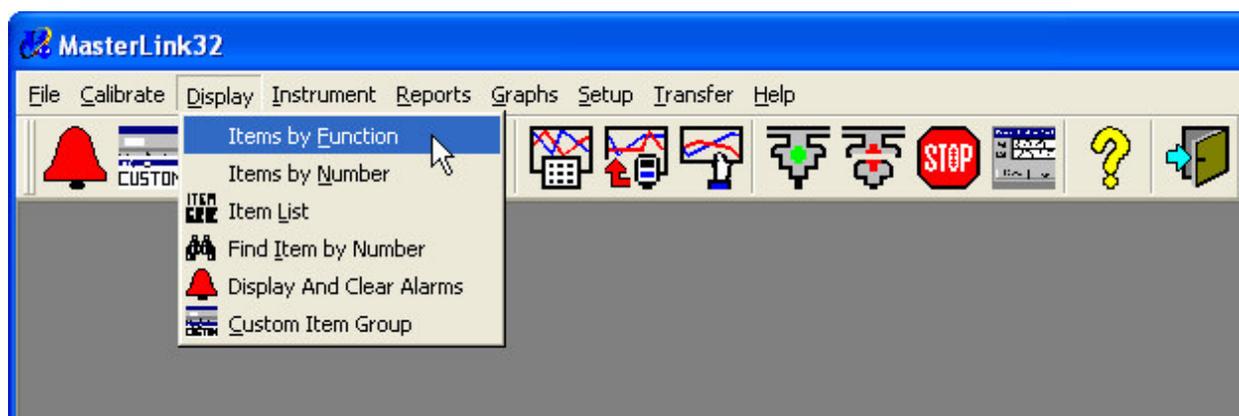
9   Using MasterLink32 Software

## 9.1   Accessing Items

9.1.1   Items by Function:

From the MasterLink32 software main menu – click on **D**isplay \ Items by **F**unction to begin a Serial Access session with the TCI to obtain and edit Item data.

☞ Remember to press the Button on the end of the TCI **before** attempting to connect.

Once the Serial connection has been made (via IrDA), a window is then available from which all Items can be viewed and changed (if needed). Items are grouped by functionality for easier navigation.

Shown below is the Display/Change Items By Function window with a serial connection made to a demo TCI unit.
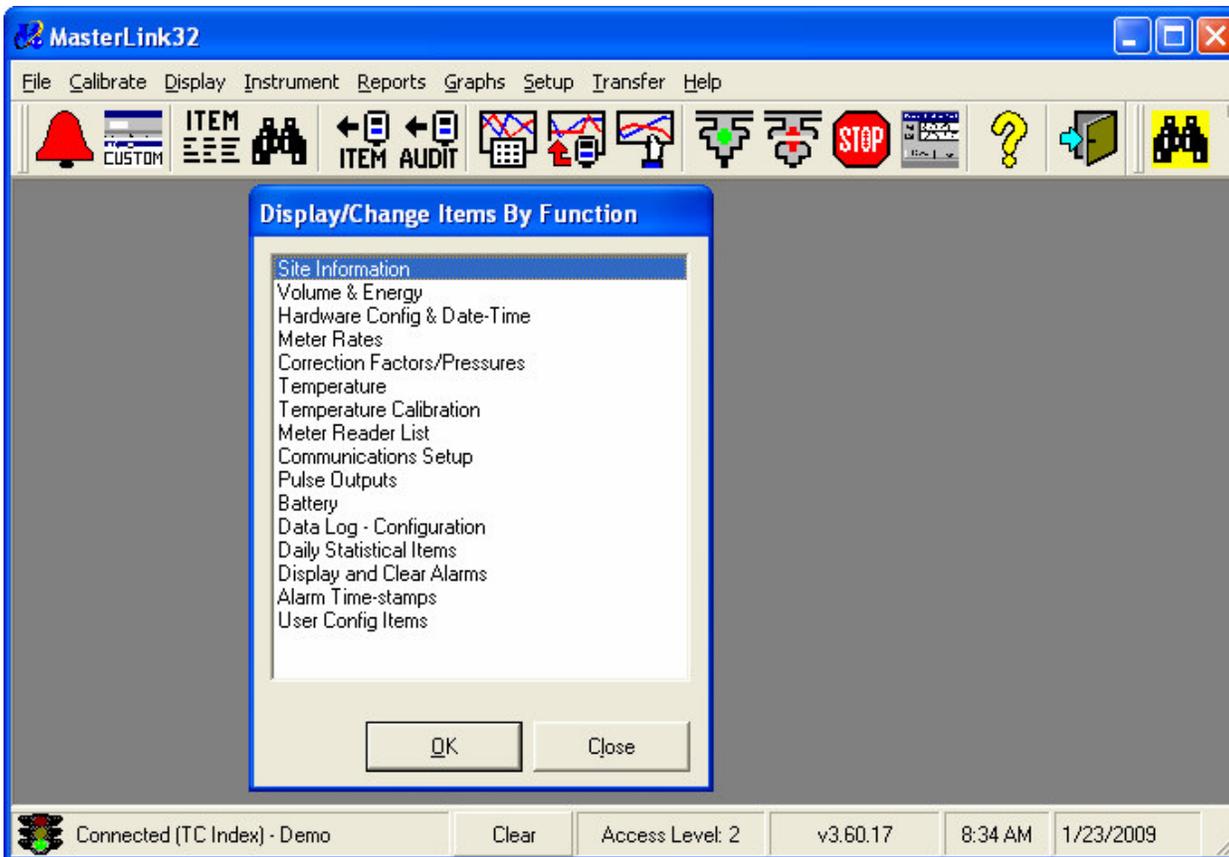
9.1.2   SITE information group

Shown below are the Items that are part of the Site Information group.

To change any of the Items listed in a particular group, select the Item and then click on the **C**hange button, or double click on the particular Item itself and a dialog box will appear allowing you to modify Item's value. Once the modification is finished – click on the **S**ave button to have that value written back to the TCI.

9.1.3   Volume & Energy group

Shown below are the Items that are part of the Volume & Energy group.

Number	Description	Value	Units
000	Corrected Volume	00000000	CFx100
090	Corr Volume Units	CFx100	
002	Uncorrected Volume	00000000	CFx100
092	Uncorr Volume Units	CFx100	
113	High Resolution Cor Vol	0.0901	CFx100
892	High Resolution Unc Vol	0.0940	CFx100
096	Cor Vol # of Digits	8 Digits	
097	Uncor Vol # of Digits	8 Digits	
433	Input Volume Mode	Normal Rotary Input	
432	Rotary Integral Mount	Romet RM5000	
098	Meter Index Rate	1 CF	
114	Meter Scaling Factor	3.134694	
439	Rotary Displacement	0.036734	CF/rev
140	Energy	00000000	Therms
141	Energy Units	Therms	
142	Gas Energy Value	1000.00	BTU/cu.ft.

To select the proper Rotary Meter model for the application – click on **Item 432 Rotary Integral Mount** and select the desired meter type using the Change button or double click method. After selecting the appropriate meter – click on the Save button to update the TCI.

9.1.4   Correction Factors / Pressure

Shown below are the Items that are part of the Correction Factors / Pressure group.

In the Correction Factors / Pressure group, a Fixed Pressure or a Fixed Pressure Factor value may be entered to account for line pressure affects if required the application. Changes to the Fixed Pressure items will cause a change to the Total Compensation (correction) factor and thus affect overall Gas volume measurement.

A warning dialog box appears when attempting to change Fixed Pressure type Items. ☼ Only change the Pressure Items if you intend to alter the overall Total Compensation factor. This applies to Items: 008, 013, 014, and 044.

9.1.5   Temperature

Shown below are the Items that are part of the Temperature group.

9.1.6   Meter Rates

Shown below are the Items that are part of the Meter Rates group.

9.1.7   Meter Reader list

Shown below are the Items that are part of the Meter Reader List group.

Change Item

| 80 | Meter Reader Item 6 | 255 | Reserved |

Save   Cancel

Change Item

| 80 | Meter Reader Item 6 | 43 | Total Correction Factor |

Save   Cancel

9.1.8 Pulse Outputs

Shown below are the Items that are part of the Pulse Outputs (Telemetry) group.

Pulse Outputs

Search: [   ]

Number	Description	Value	Units
093	Ch-A Pulse-out Select	Pulse Out Disabled	
094	Ch-B Pulse-out Select	Pulse Out Disabled	
1014	Ch-A Pulser Timing	50 ms On, 250 ms Mi...	
1015	Ch-B Pulser Timing	50 ms On, 250 ms Mi...	
005	Ch-A Pulses Waiting	00000000	
006	Ch-B Pulses Waiting	00000000	
056	Ch-A Pulse-out Scaling	2.0000	
057	Ch-B Pulse-out Scaling	2.0000	
1016	Alarm Chan Pulse Timing	1 sec On	

Change
Print
Find
Close

Change Item

| 93 | Ch-A Pulse-out Select | Cor Vol ▼ |

Save   Cancel

To select the proper Pulse Output (AMR/Telemetry) timing for the application – click on **Item 1014 Ch-A Pulser Timing and/or Item 1015 Ch-B Pulser Timing** and select the desired AMR device type or the required timing option listed using the Change button or double click method. A drop-down list will display the selection options for Pulse Output device timing. After selecting the appropriate device type or timing value – click on the Save button to update the TCI.
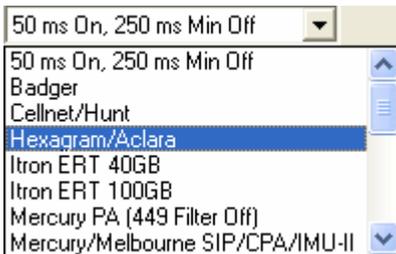
9.1.9   Battery life

Shown below are the Items that are part of the Battery group.

9.1.10   Daily Statistical Items

Shown below are the Items that are part of the Daily Statistical Items group.

9.1.11 Alarm Time-stamps

Shown below are the Items that are part of the Alarm Time-stamps group.

9.2 Display and Clear Alarms

To display / clear the Alarm Items supported by the TCI, click on the red bell Icon in the far left corner of main menu of MasterLink32. After doing so, a window will appear showing the status of the TCI Alarm items. From that window, active Alarms can be cleared.

Shown below are the **Alarm Items** that are supported by the TCI.
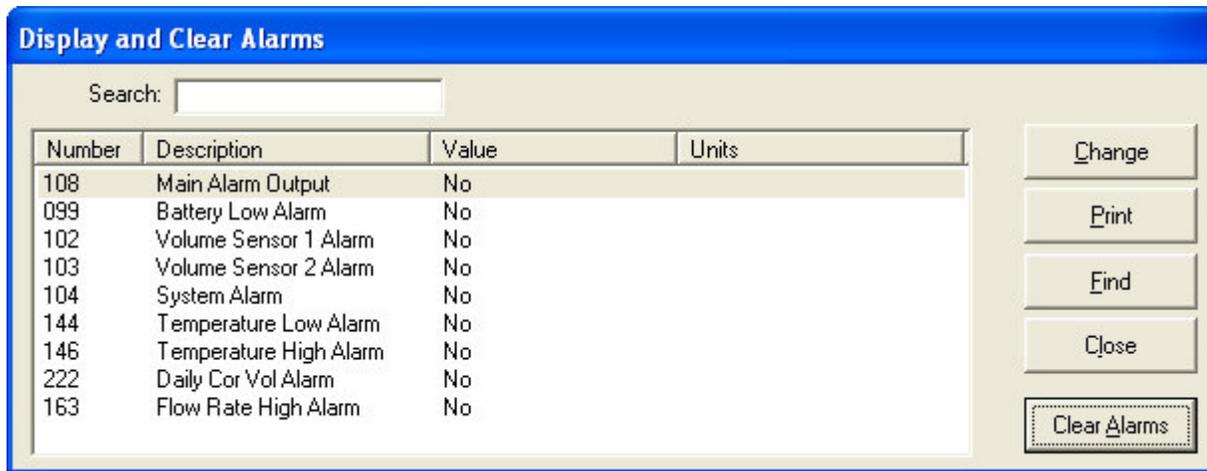
Use the Clear **A**larms button to clear active Alarms in the TCI.

ⓘ If the Alarm condition has not been resolved (e.g. low Gas temperature still exists), the Alarm will again be active after disconnecting the Serial link session.

9.3   Setting Date and Time

From the MasterLink32 software main menu – click on **I**nstrument \ Set Instrument Date and Time via Computer option to update the TCI with the current PC's Date and Time.
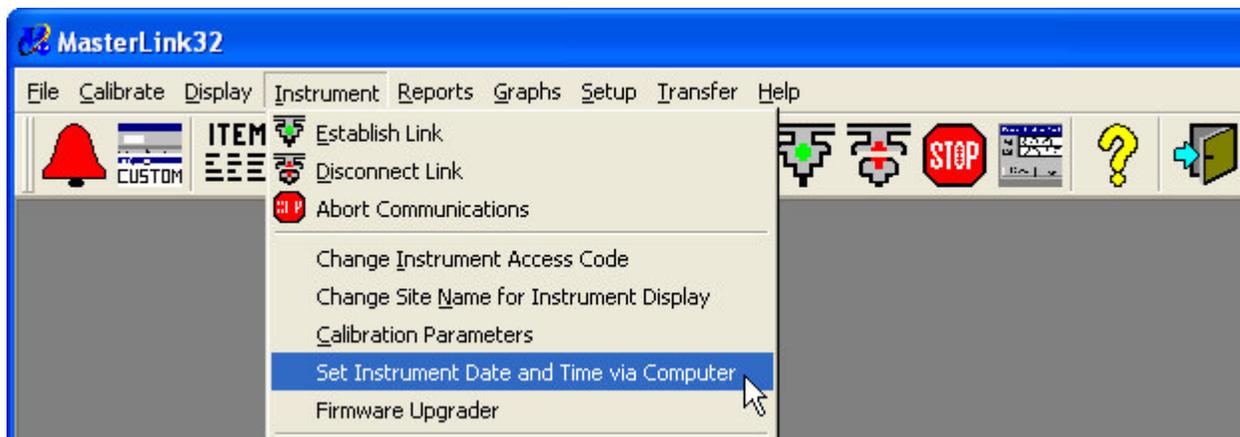
A dialog window will then appear allowing the User to accept the Date and Time update.

Click the **Y**es button to proceed with the Date/Time update. MasterLink32 will always re-read the PC's clock date & time just before sending the data packet over to the TCI.

9.4 Changing Access code (security)

From the MasterLink32 software main menu – click on **I**nstrument \ Change **I**nstrument Access Code to change the Access code (password) used by the TCI for serial protocol access.
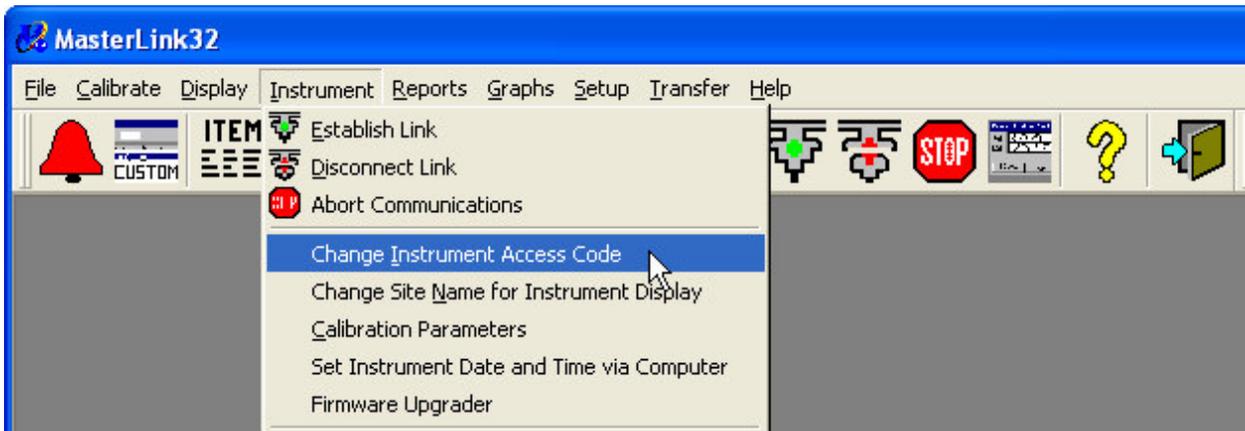
A dialog window will appear allowing the User to change the Access code (password) of the connected TCI to a new code value for security access concerns. Enter the new security access code in the **New** as well as the **Confirm** entry boxes, and then click the **O**K button to proceed with the update.

9.5 Item files

9.5.1 Reading/Creating Item file

To create an Item File (report) of all of the Items with their current values, click on the **ITEM** Icon from the MasterLink32 software main menu. A dialog window will appear allowing the User to specify a suitable file name for the Item file being created. MasterLink32 will automatically name the file (using the TCI's S/N) if one is not entered. Click the Save button in the window and then MasterLink32 will proceed to read all of the Items values from the connected TCI unit.
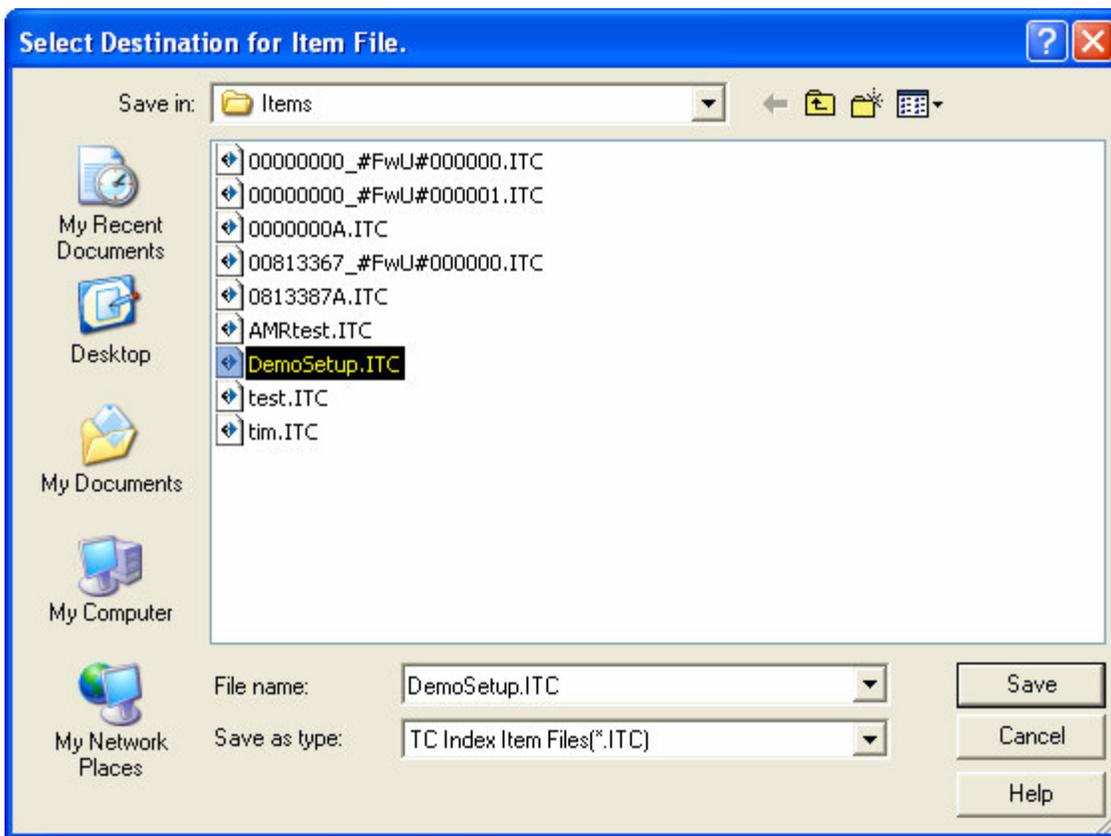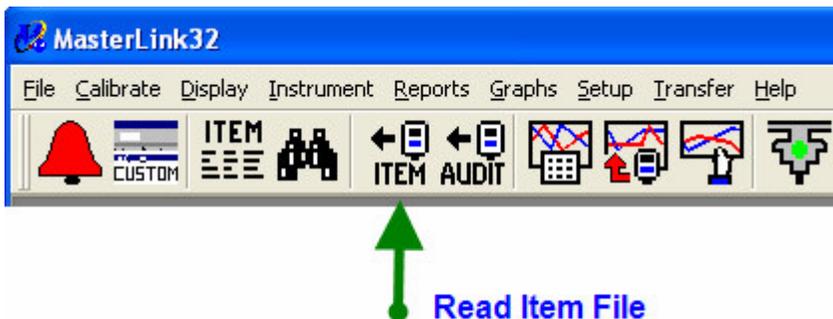
Read Item File

9.5.2   Display/Viewing Item files

From the MasterLink32 software main menu – click on **R**eports \ **I**tems Report to view any Item file previously read from a TCI. A dialog window will appear allowing the User to specify the Item file to view. Click the **S**elect button to browse to the desired Item file.

Once the Item file is selected, click the P**r**eview button to view the Item Report, or click the **P**rint button to send the Item file report out to a specified printer.
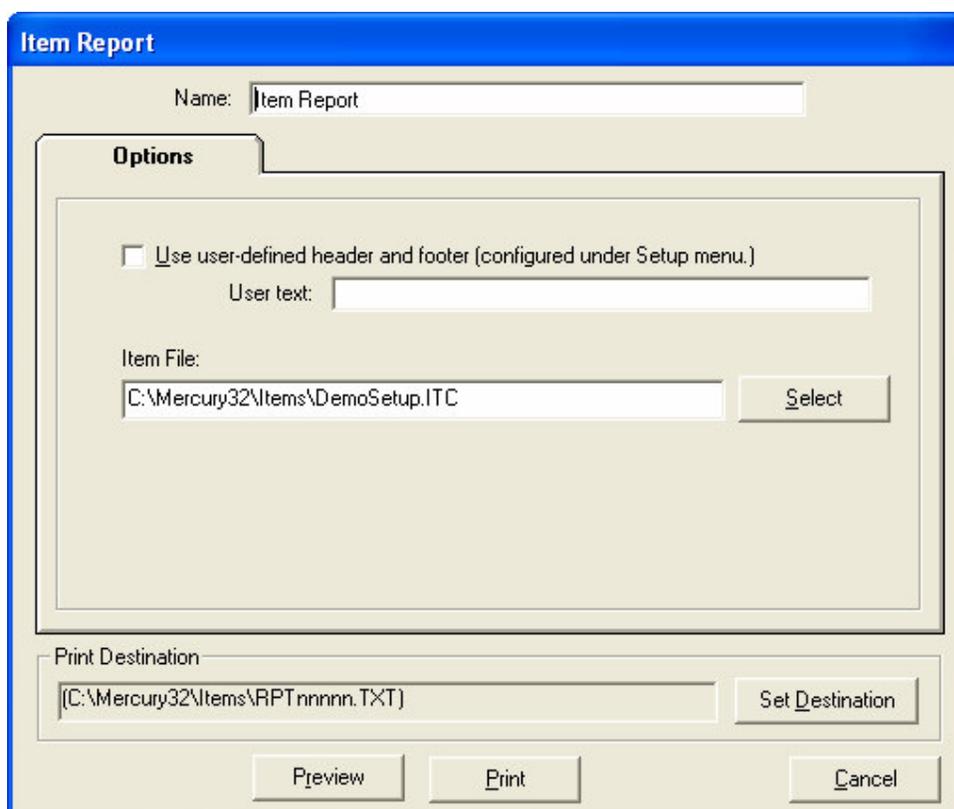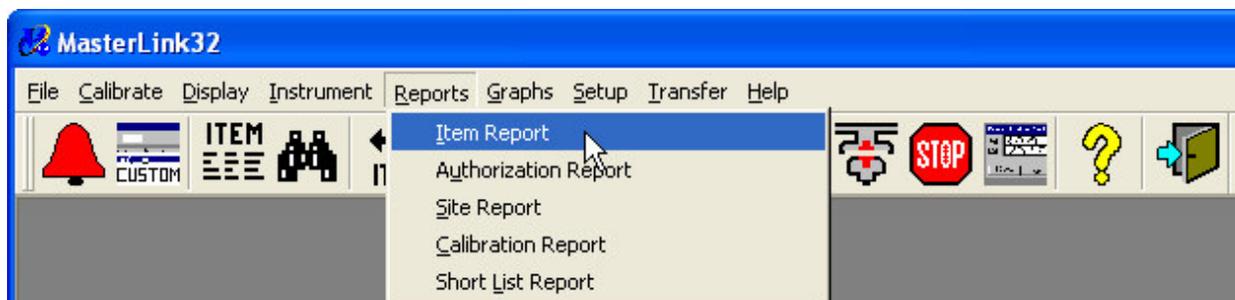
9.5.3   Sending an Item file

To send (write) an Item File back in to a TCI unit, select the **T**ransfer \ Send **N**on-Cal Items from the main menu of MasterLink32. This menu option is used primarily to configure an Instrument (TCI) with a known set of Item values – perhaps from a preset template file. The Send Non-Cal

Items tool transfers all Non-calibration type Items in the selected file to the Instrument in one simple process. This can help save time and eliminate Item entry mistakes.
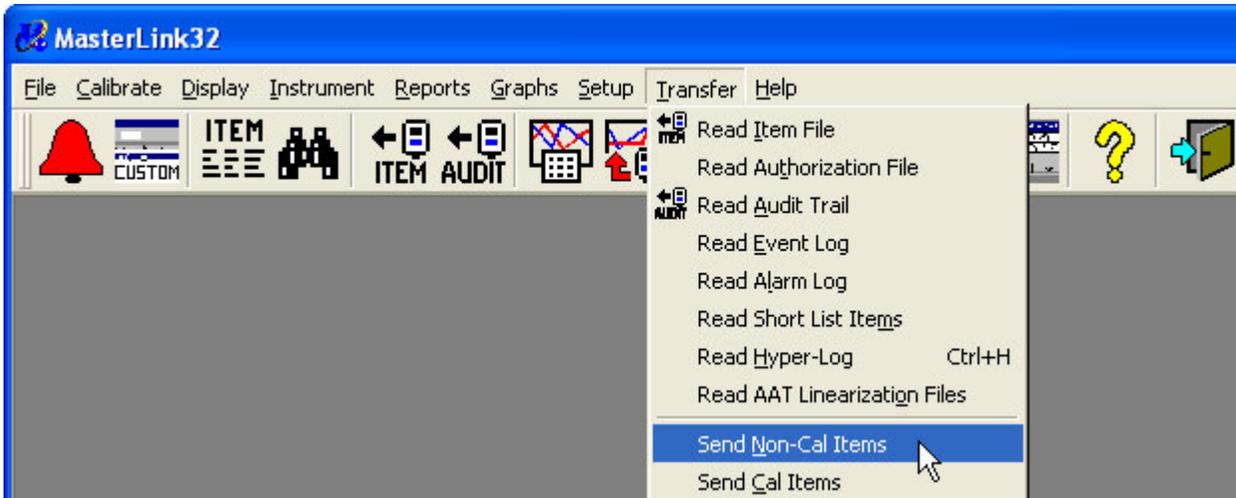
A dialog window appears allowing the User to specify the Item file to view. Click the **S**elect button to browse to the desired Item file.

Once the Item file is selected, click the Open button to send the Item file to the TCI. ⓘ TCI Item files have the file extension **.ITC**.

57
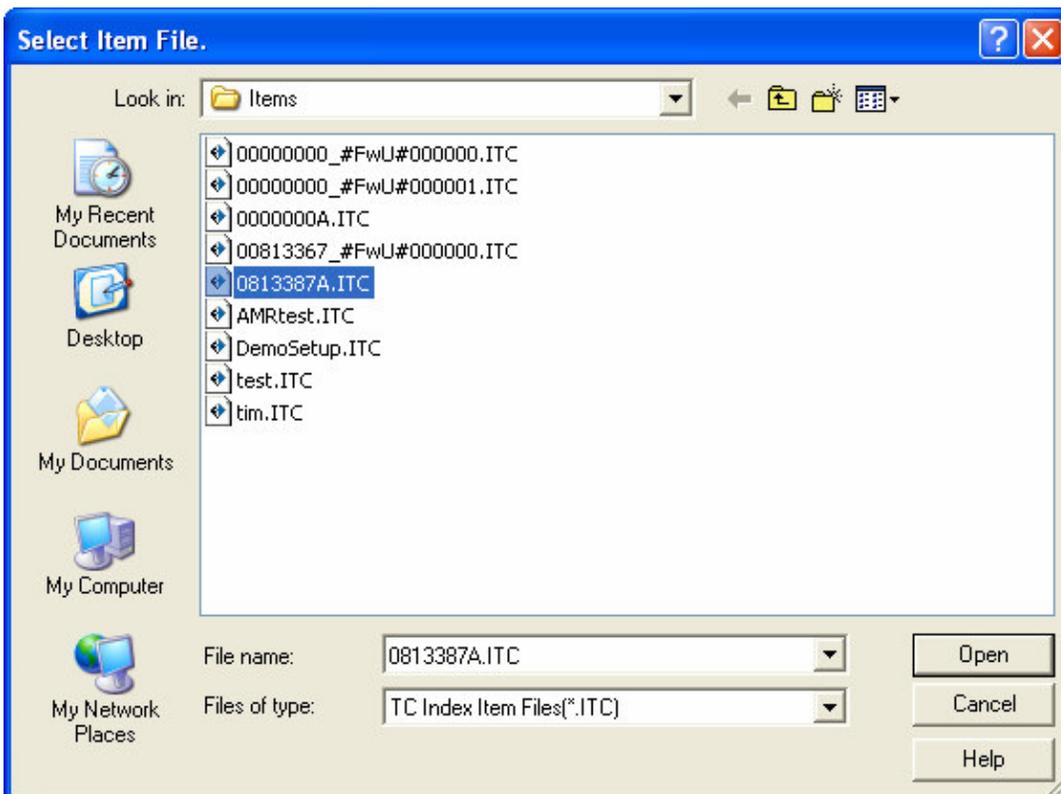
9.6　Daily Backup Log (Audit-Trail)

9.6.1　Reading Audit Trail

To create an Audit Trail (report) of the Daily Log records (max last 90 days), click on the **AUDIT** Icon from the MasterLink32 software main menu. MasterLink32 will proceed to read all of the Daily Log backup records from the connected TCI unit.

ⓘ This data will be then added to the MasterLink32 main database on a per SITE ID basis.
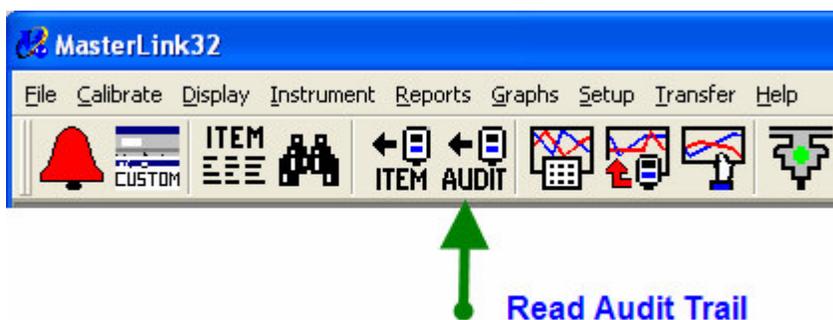
Read Audit Trail

9.6.2　Display/Viewing Audit Trail reports

From the MasterLink32 software main menu – click on **R**eports \ Audit Trail Report to view any of the Audit Trail report data previously read from a TCI.
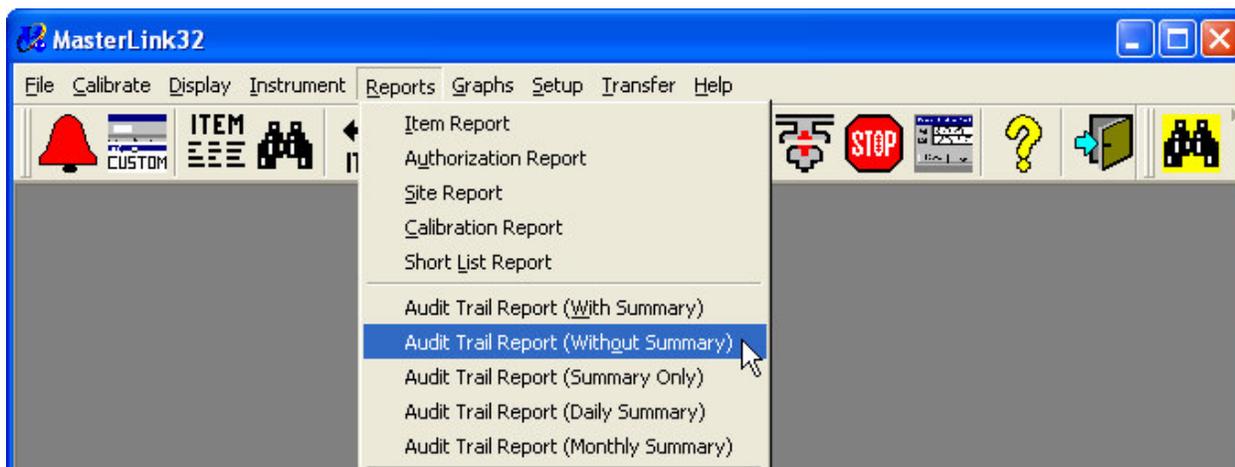
A dialog window will appear allowing the User to specify the Audit Trail (Daily backup log) data to view. Click the **Se**l**ect Sites** button to browse to the desired TCI by SITE ID/ Site name. Click on the Date Range tab to bring up a control window to select date range display options for the log report.

Shown below is the Date Range tab window for an Audit Trail report.

Click on the **From/To** option and then the **Calculate Date Range** button to have MasterLink32 calculate the available data use for generating the log report.

Once the Audit Site and Date range have been selected, click the **P**review button to view the Audit Trail report, or click the **P**rint button to send the report to a specified printer.

The TCI supports only a **fixed** Item Daily Backup record (Audit Trail) for the last 90 days of operations. The record consists of five Items – See Section Audit Trail for details.

9.7 Comm Monitor display

A useful feature of MasterLink32 is the Comm Monitor window which can be enabled to display serial communications (Mercury protocol) as it transpires. This feature can serve as a troubleshooting tool when communications issues arise. To enable the Comm Monitor feature, click on the **Enable/Disable Comm Display** Icon from the MasterLink32 software main menu

Enable/Disable Comm Display

The Comm Monitor display window has two modes of operations: **Record** and **Evaluate**.

Shown below is the normal **Record** mode – where communications protocol is shown in *real time* in the monitor window.
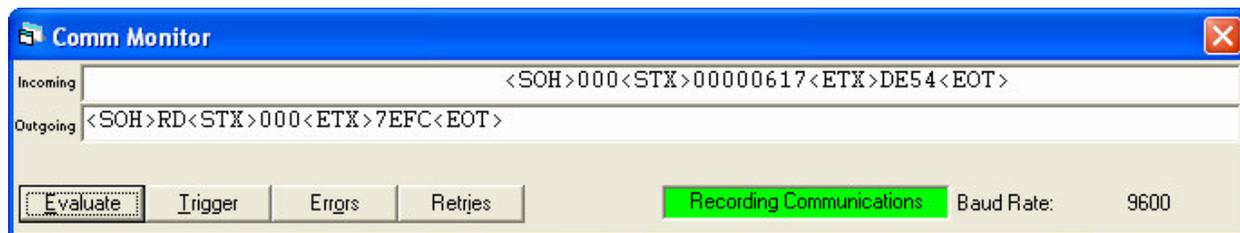
Shown below is the **Evaluate** mode – where communications monitoring is stopped and a portion of the previous communications transactions that has been captured can then be shown.

The Comm Monitor has a 1Kb buffer so you can scroll back to see a portion of the previous activity.
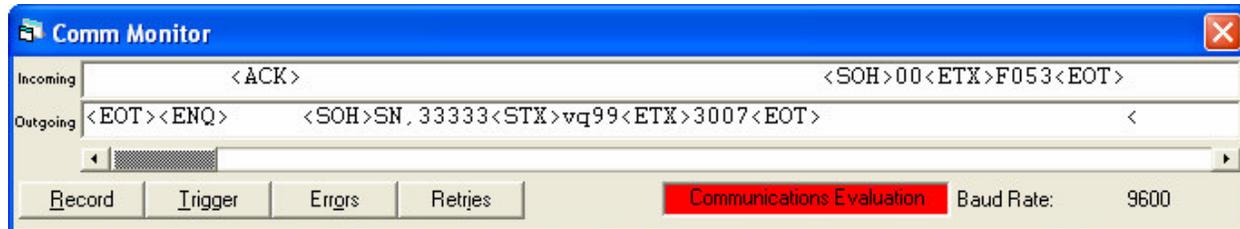
To switch from the Record mode to the Evaluate mode, click on the Evaluate button. To then resume recording again (return to Record mode), click on the Record button.

9.8   Write-Access security

Write access control is provided in the TCI by selecting one of the protective options for **Serial Link Access**. This feature provides three options that control serial data communications behavior: Read-Write (2-way), Read-Only, and Metrological Items Read-Only.

Read-Write (2-way) allows for full access to changing Item values – including metrological.

Read-Only prevents all Items from being changed.

Metrological Items Read-Only allows Items **not** pertaining to Volume **billing** (such as Meter Reader list or Temperature Units) to be changeable. Metrological Items are Read-Only.

Serial Link Access - Item 139

By default, the TCI is in Read-Write setting and grants access to Items being changed as needed. However, if security is needed to protect metrological Items or all Items from unauthorized changes – set **Serial Link Access** to the required level of access protection.

See dialog boxes below.
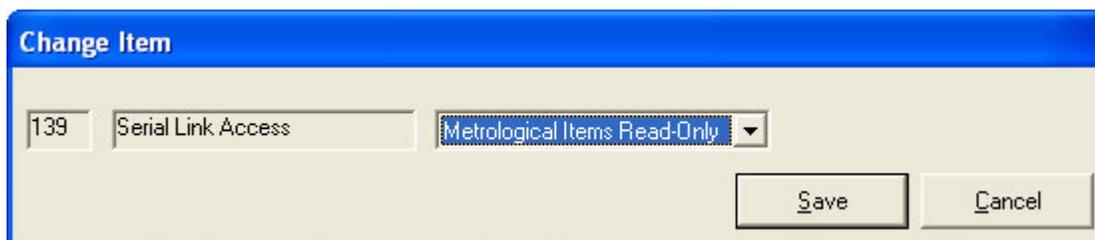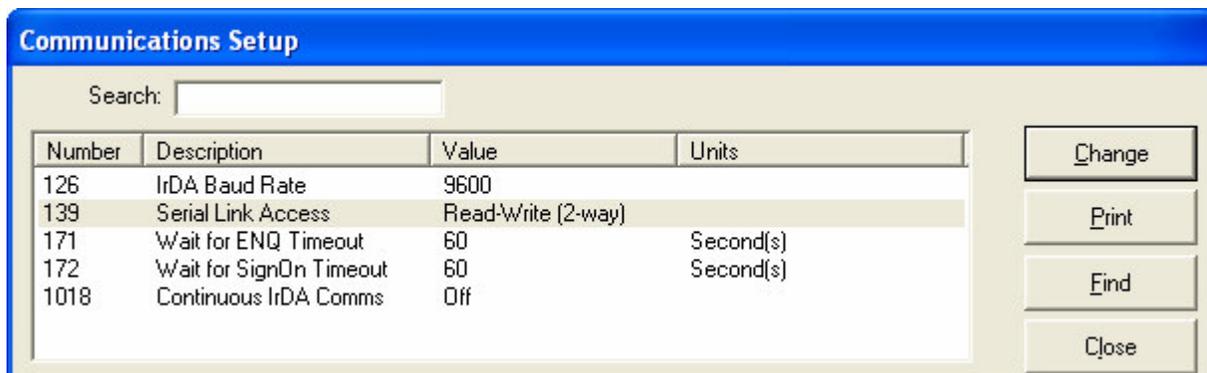
Once **Serial Link Access** has been set to one of the two secure settings, Write-access can be turned back on by means of a small **pushbutton** located inside the TCI unit. This pushbutton is just under the potting material. The photo below shows the location of this pushbutton. Pressing this internal pushbutton enables write access to all Items (including Item 139) for the Serial Access session that follows. Once that Serial Access session has ended, the write access control resumes again to the state of Item 139.
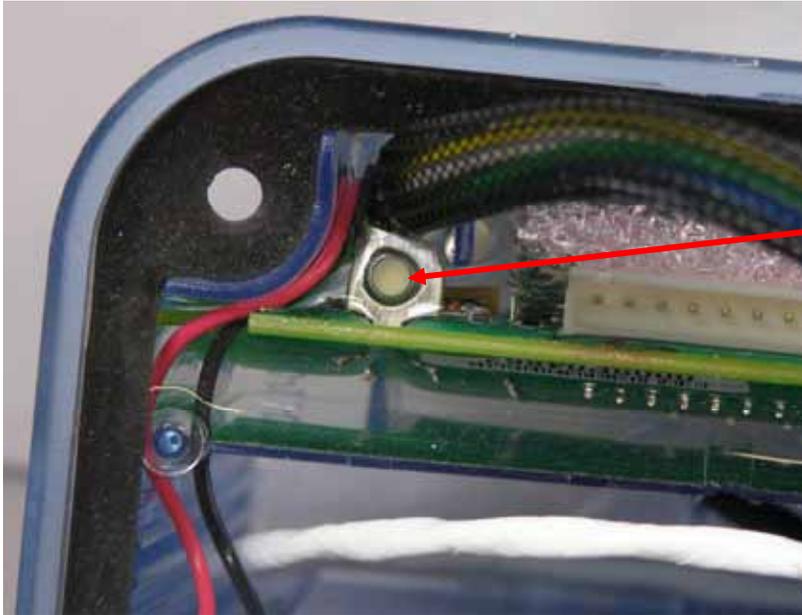
Write-Access button

Write-Access pushbutton

9.8.1   Using the Write-Access pushbutton

1. Open the TCI unit – disconnect from meter adapter plate (tamper sealing is broken)

2. Once the unit is open - press the external pushbutton on the TCI

3. Next - press the smaller Write-Access pushbutton

4. The LCD should then display the message: **UNLOCKED**

5. Using MasterLink32 - connect serially (IrDA) to the TCI and change Item(s) as needed

6. When finished – end the Serial link (Sign-Off) and reinstall the TCI back on the meter

7. Apply tamper sealing if required

⚠ The pushbutton is delicate and can be damaged by sharp objects

Always use a blunt object (like a pencil eraser) to press the button. Use only enough force to activate the button (look for: UNLOCKED on the LCD). ☞ If "UNLOCKED" message continues to be displayed, the pushbutton may be stuck or possibly damaged. If this is the case, remove the potting material around the pushbutton to free the pushbutton.

Firmware Upgrade protection

Firmware Upgrading is also subject to the Serial Link Access control. If a firmware upgrade is intended and the TCI is set to one of the two secure settings, the Write-Access pushbutton must be used. Follow steps 1 – 4 above.

10 Maintance

10.1 Temperature calibration

If directed by public utility commissions or various governmental regulations, it is sometimes necessary to verify temperature accuracy of the TCI.

Temperature calibration can be performed by the following steps:

1. Cut the meter sealing tag and then remove the meter sealing type screws holding the adapter plate to the meter body for access to the temperature probe.

2. With a permanent marker, mark the cable just where it enters the adapter plate to verify correct probe depth upon completion in case temperature probe was extended to reach fully in to water batch.

3. Remove the temperature probe and cable from the temperature well.

4. Place the temperature probe into a water bath along with a sufficiently accurate temperature measuring device calibrated to a traceable standard.

5. Run the temperature Zero calibration function in the Mercury Instruments MasterLink32software.

6. Place the temperature probe into warm water if performing two points of calibration in MasterLink32.

7. When the calibration is complete, dry the probe and cable and place it back into the thermal well of the meter body.

8. Attach TCI / adapter plate assembly to meter body (4 screws)

9. Attach meter sealing tag.

10.2 Battery Replacement

There is a single battery pack which resides inside the TCI case. After 20 years of service the battery pack will need to be replaced. A red wire (+) and a black wire (-) exits the battery pack potting material and is then connected to wires of the same color which exit the potting material of the main printed circuit board. Sealed IDC connectors are used to connect the battery leads.

Battery replacement is as follows:

1. Save data in the TCI by reading out an Item file and the Audit Trail data using MasterLink32.

2. Enter Meter Reader mode and scroll to the point where the LCD shows: **BATTLIFE** - indicating Battery life (note: Item 1001 or 1002 must be in the Meter Reader list.)

3. When the remaining battery life **value** is then displayed, <u>press</u> and <u>hold</u> the main pushbutton for at least **five (5)** seconds - until the message: "**BAT CHNG**" is shown on the display. This button hold step informs the TCI to save/restore all Item data and to reset the Battery life remaining Items once the battery has been replaced.

☞ At this point – the battery pack can now be removed.

Disconnect the old battery from the circuit as follows:

1. Cut the red wire with the 3M crimping tool "E-9Y" where it exits the sealed 3M connector from the battery pack. Never cut the black and red wires at the same time – this could short circuit the remaining energy stored in the old battery!

2. Cut the black wire with the 3M crimping tool where it exits the sealed 3M connector from the battery pack.

3. Remove the battery pack from its slot in the case. See diagram below.

4. Discard the battery pack for disposal in an approved location (⚠ Lithium cells)

5. Press the pushbutton and **wait 30** seconds for the TCI circuits to fully discharge.

6. Install / connect a new battery pack using the 3M crimping tool (E-9Y) and 3M connectors.

System verification after battery installed:

Once the battery is connected, the TCI performs a cold-boot (restarts program).

☞ Verify the Battery life Items are reset back to: 100% or proper number of months remaining.

☞ If the unit has a dead battery, connect the new battery pack, perform the above operations, including cutting <u>one</u> of the battery leads for 30 seconds, and reconnect.

View of Battery packed removed from TCI enclosure
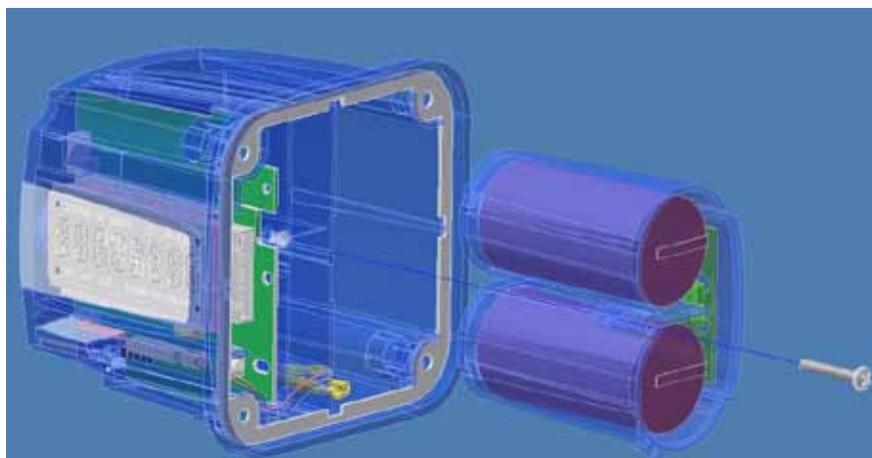
10.3 Cleaning, chemicals list

Acceptable cleaning and degreasing agents for TCI enclosure and mounting plate: Mineral Spirits, Isopropyl Alcohol, mild soap and water, VM&P Naptha, Fantastik, Windex, Joy dishwashing soap, Top Job, Mr. Clean, Formula 409.

⚠ Chemicals to Avoid on TCI enclosure and mounting plate: Xylene, toluene, strong alkalines, esters, solvents, ketone.

10.4 Recommended tightening torque of fasteners

Meter mounting hardware (mounting plate to meter end): 18-20 in lbs.

TCI Enclosure to Mounting Plate screws (4) places: 10-12 in lbs.

Battery Pack mounting screw: 8-10 in lbs.

Silicone boot, Pushbutton: Not to exceed 1 in. lb.

10.5 Backup Memory module

A Backup Memory module is plugged into the main pc board inside the TCI. The 10-pin connector and mating plug is submerged in flexible potting material for long life. It contains enough memory to maintain the **last 90 days** of daily compensated volume, uncompensated volume. This Memory Module is non-volatile memory and does not require a power source to retain its information.

☞ In the unlikely event of a complete TCI failure, this module may be removed by slicing the potting material around the module connector with a sharp knife such as an X-Acto.

The Backup Memory module can then be removed and then plugged into a special TCI instrument without potting compound. MasterLink32 then is capable of reading the Backup Memory Module retrieve the Audit Trail data logged for the last 90 days of operations.

Log data (Audit Trail) is written to the Backup Memory module at the Gas Day Start Time (per Item 205) on a daily interval.

11 Installing IrDA drivers

This section provides instructions for installing the IrDA drivers needed to use the IrDA Dongle with MasterLink32 software and the TCI.

Included with **MasterLink32** are the following drivers:

- IrDA-to-COM Link Software (IrCOMM2k)
- Star-Tech USB-to-IrDA dongle driver
- Sigma-Tel USB-to-IrDA dongle driver

☞ **Install MasterLink32 *before* connecting the IrDA Dongle**.

Near the end of the MasterLink32 installation process, a message dialog box will appear allowing the User to **I**nstall IrDA or **S**kip IrDA installations.

☞ Important! Choose the **Install IrDA** option at the bottom of the dialog box.
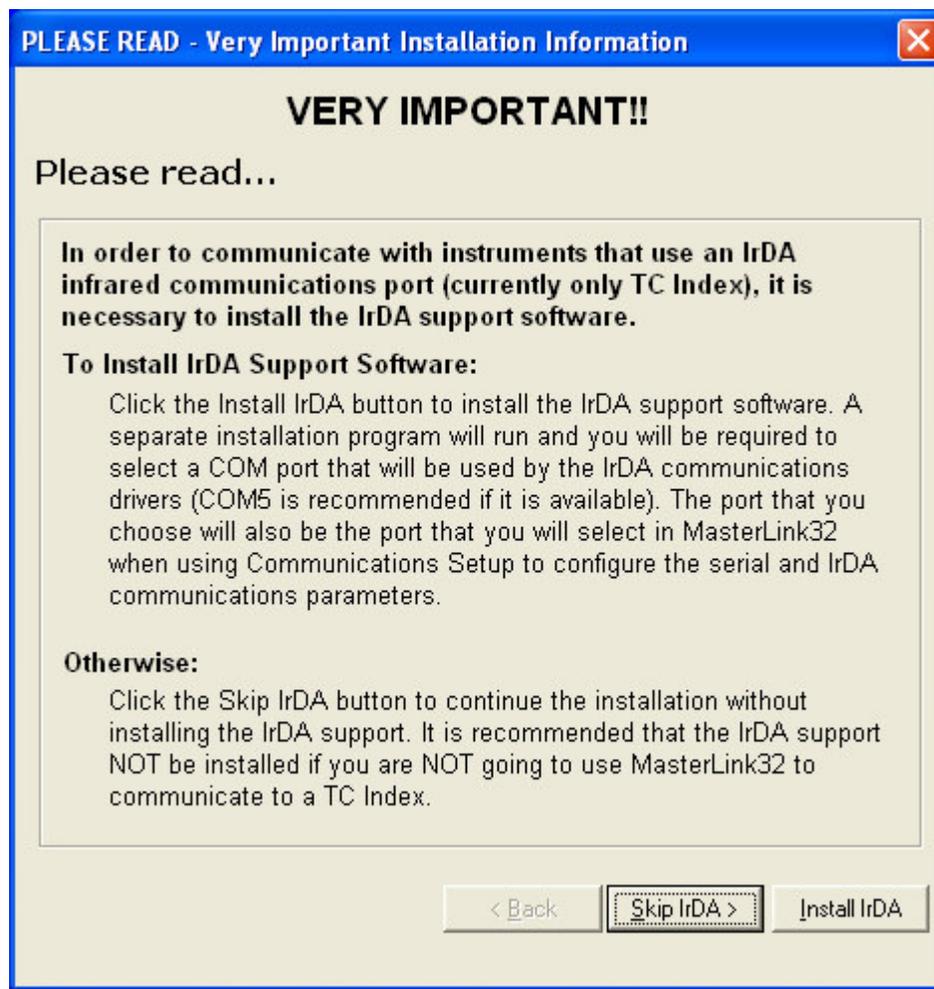
11.1 IrCOMM2K Driver

After the Install IrDA button is selected – a new dialog box will appear that supports the installation of the IrCOMM2K driver which is part of the total setup process.
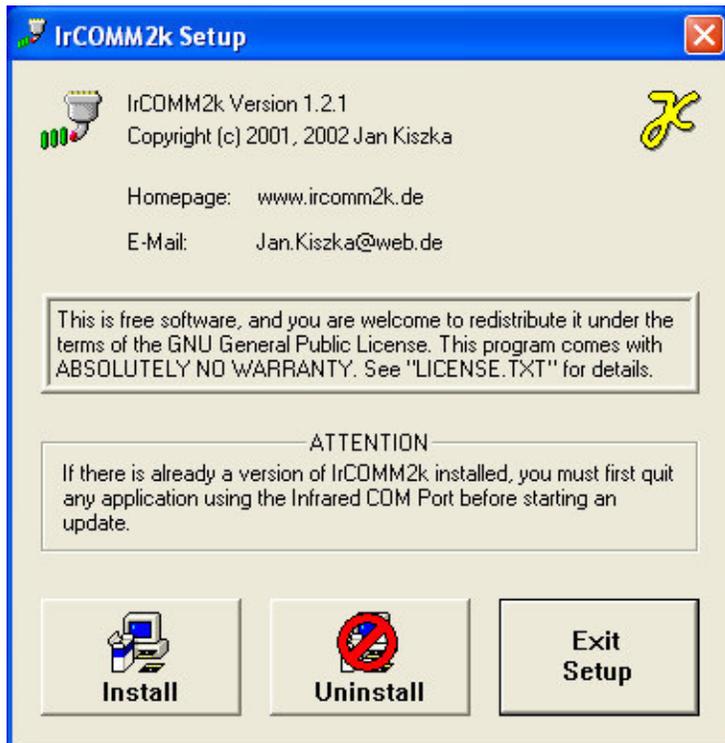
☞ Choose the **Install** option at the bottom of the dialog box

After clicking on the Install button – a warning message box may appear informing you that the IrDA Dongle has not yet been installed.
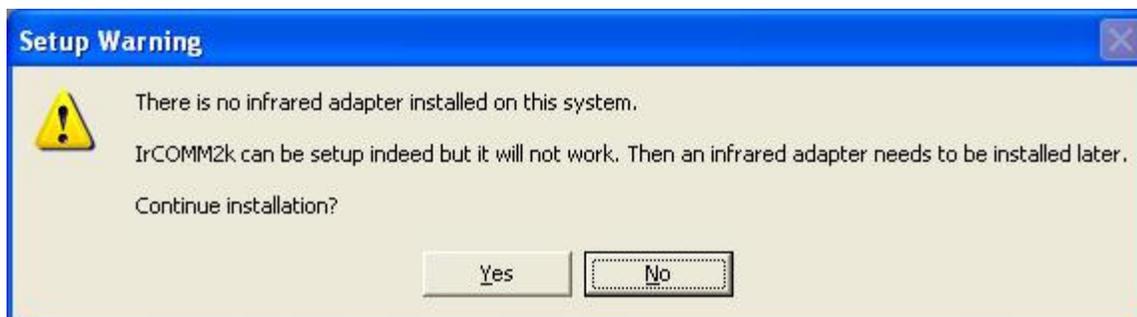
☞ Click <u>**Yes**</u> (*ignore this warning*) and proceed on with the IrCOMM2K installation process.

The IrDA Dongle driver will be installed after MasterLink32 has finished the installation process.
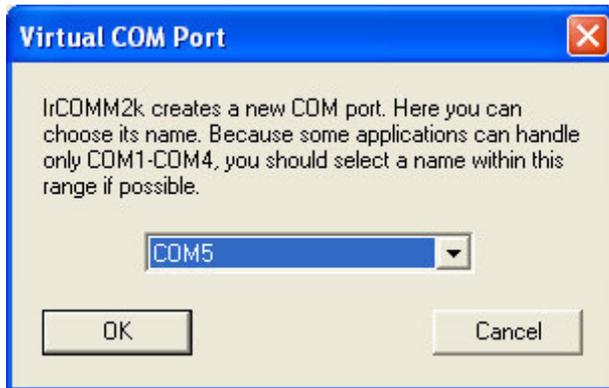
☞ Select a **COMM port** to use with the IrDA Dongle and then click the OK button.

The dialog box will choose (suggest) an available COMM port number automatically.

Next, the normal Windows Logo testing warning will then appear.

☞ Choose the **Continue Anyway** option at the bottom of the dialog box.

When finished, a message box will appear indicating successful installation of IrCOMM2K.

Click the **OK** button to exit.
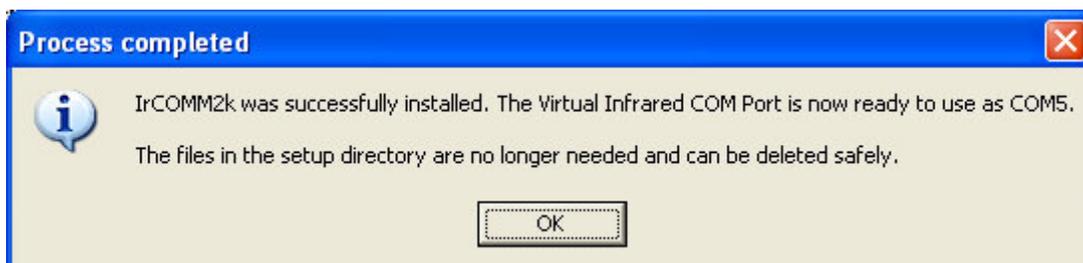
11.2 IrDA Dongle Driver

MasterLink32 installs IrDA Dongle drivers on the PC for both **SigmaTel** and **StarTech** brands of USB-IrDA adapters. SigmaTel drivers are normally included with Windows XP Professional OS.

☞ **Connect the IrDA Dongle with supplied USB cable to the PC or laptop**.

When the IrDA Dongle is connected to most PCs, Windows software will normally locate the appropriate driver and load it automatically. ⓘ A small software disk is included with the USB-to-IrDA dongle that contains the software drivers in case Windows does not find the drivers.

☞ Click the **Next** button to proceed.
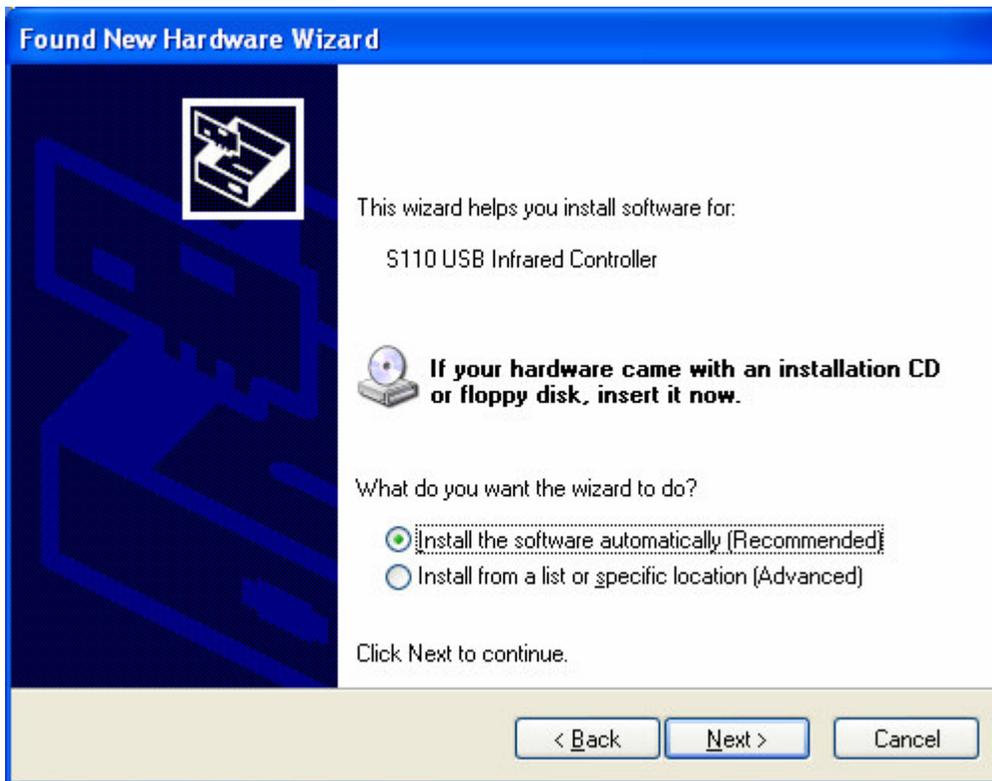
☞ Allow the Windows Hardware wizard to **install the software automatically**.

☞ Click the **Next** button to proceed.

Next, the normal Windows Logo testing warning will then appear.

☞ Choose the **Continue Anyway** option at the bottom of the dialog box.

After installing the driver software, a message box will appear indicating successful installation.

☞ Click the **Finish** button to exit.

Shortly after the installation a message will appear in the System Tray indicating the IrDA hardware is installed and ready to use.
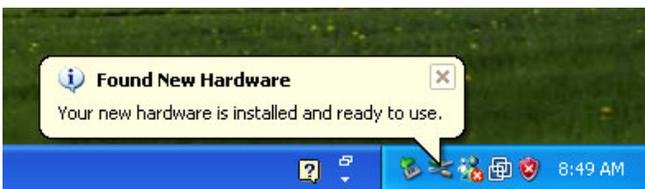
11.2.1 Installing USB-to-IrDA driver - Windows 2000

A drivers and utility disc is provided with the USB-to-Infrared adapter. Load the CD-ROM and use Explorer to navigate to the folders contained on this disc. Open the SigmaTel folder, then the STIR4XXX folder, then the Windows folder, and double-click on the setup icon to install the USB 2.0 IrDA Bridge. As prompted, complete the installation by plugging the device (USB-to-Infrared adapter) into the USB port. If the port is functioning correctly, the green LED on the dongle (adapter) will flash intermittently. Click on Finish.

11.2.2 Checking the IrDA Dongle

Ensure the USB-to-IrDA Dongle is connected to the USB connector on the PC/laptop.

When properly connected, a small LED on the dongle should flash rapidly about 6 times and then pause for about 5 seconds. This blinking process should continuously repeat. Use this blinking LED as an indicator that the PC can communicate with the IrDA Dongle.

☼ No LED blinking indicates an improperly / uninstalled IrDA Dongle.

11.2.3 MasterLink32-IrDA debugging

Since the TCI communicates via an IrDA link (using the IR COM Kit p/n 40-4914), IrDA communication drivers need to be installed.

☞ Therefore, make sure the IrCOMM2K driver is installed and that a virtual COM port has been assigned. The IrCOMM2K driver can be installed during the installation of MasterLink32 (v3.60 or later) or afterwards from the **Setup** / **Communications Ports** control window of masterLink32.

☞ Always remember to press the pushbutton on the TCI to before starting Serial IrDA access.

☞ Check that the USB-to-IrDA Dongle is in proper range and point at the IrDA port of the TCI. Simply slide the rubber boot and dongle into the TCI to make the connection.

☞ Check the Serial Port Connector setting for MasterLink32 is for the correct COM Port. MasterLink32 will show: **(IrDA)** next to the correct COM port number.

☞ Check that the Serial Port Connector is set to baud rate **9600**.

☼ If communications issues still exist – **restart** the **Virtual COM Port service** of Microsoft Windows.

To restart the Virtual COM Port service used by the IrDA – follow the procedure below:

1. Click on the **Run** from the Windows Start button.

2. In the Command line, entrer: **services.msc** and then click **OK**.
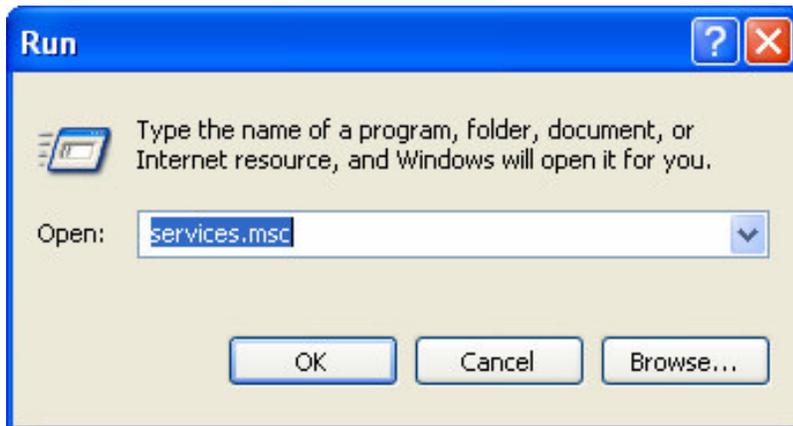
3. A control window will then appear showing a list of services provided by Windows. ☞ Scroll down to the **Virtual IR COM Port**, Service Program.

4. Single left-click on this line (highlight this service).

5. From the Services main menu or to the left of the list of services, click on **Restart** the service link or the Restart Icon (main menu).
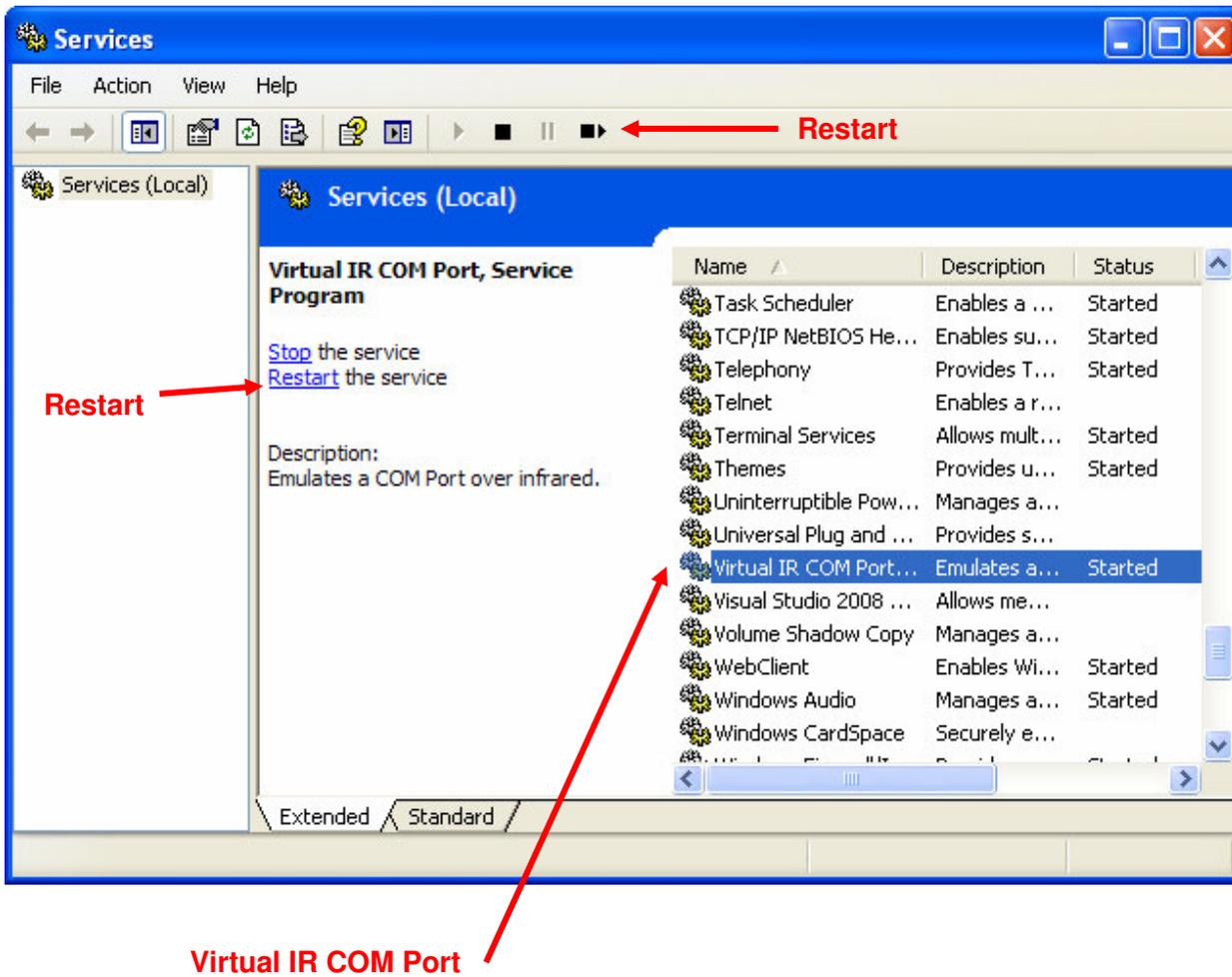
6. When complete, close the Services window and retry Serial communications again.

12   Meter Proving

12.1 Overview

Regulations often require that the accuracy of the actual volume of gas flowing through a gas meter be checked. Devices such as the Dresser Model 5 Prover and the Elster/American Meter SNAP Sonic Nozzle Prover, direct a known volume and temperature of gas through the meter being tested. These Provers compare their own "standard" volume to the volume that is reported by the TCI, which is mechanically connected to the rotary gas meter.

The TCI supplies it volume data to the Prover system by means of switch closure pulse counts. Meter bodies and the TCI are tested at various rates such as 10%, 50% and 100% of rated capacity.

Both **Uncompensated** and **Temperature Compensated volumes** can be tested using the TCI along with a Prover.

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

12.2 System Connections
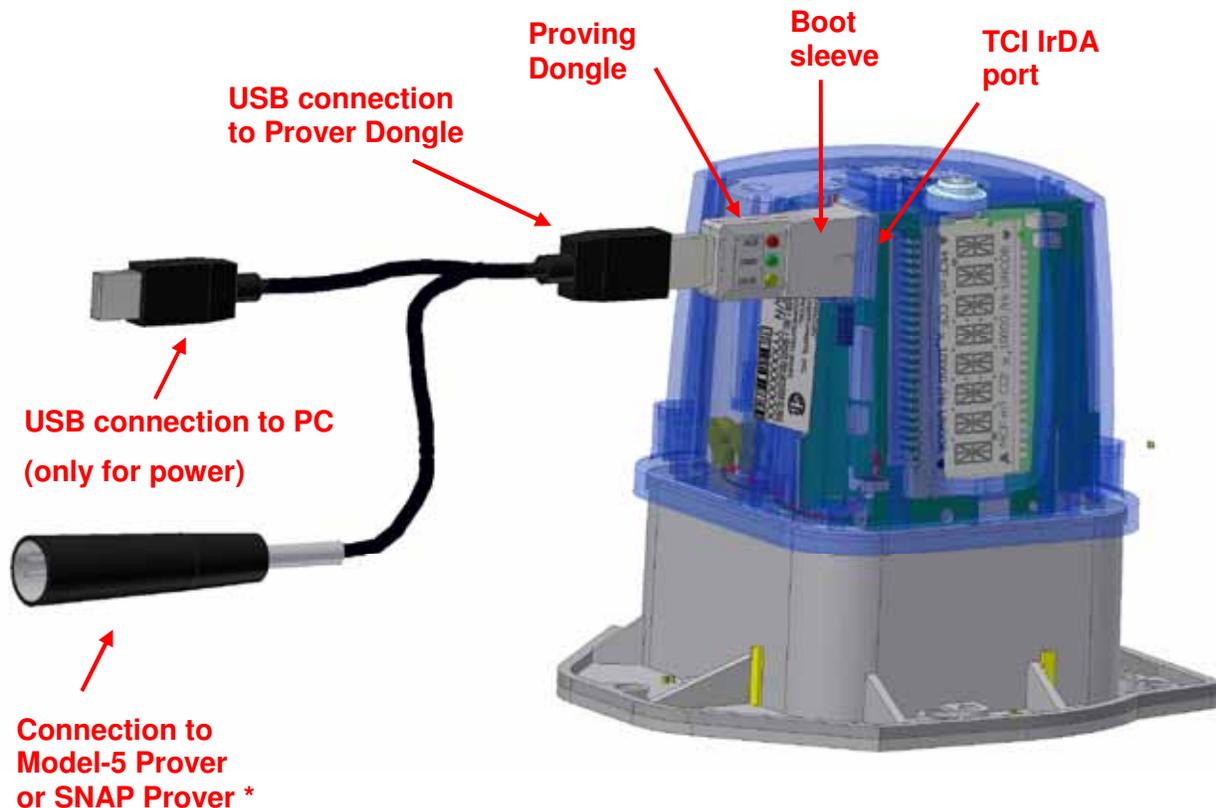
12.2.1 40- 4913 Proving Kit – for Model 5 Prover

The **40 – 4913** Proving Kit includes the components for connecting the TCI to a Dresser Model 5 Prover. Included in this kit are the following parts:

- TCI Prover Dongle
- Cable assembly (USB & Model 5 connectors)
- Rubber Sleeve for Dongle

* 40- 4970 Cable adapter for the SNAP Prover system

The 40 – 4970 Cable adapter assembly is for use 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.

12.3 Proving Dongle

The Infrared Prover Dongle is a device that plugs into the IrDA data port on the bottom of the TCI case. It receives the IR LED pulses and converts the appropriate pulses into electronic switch contacts that can be handled directly by the supplied Prover. This allows a rotary meter with the TCI to be tested as a unit without breaking a gas company meter seal.

Infrared LED (towards TCI)

USB connector
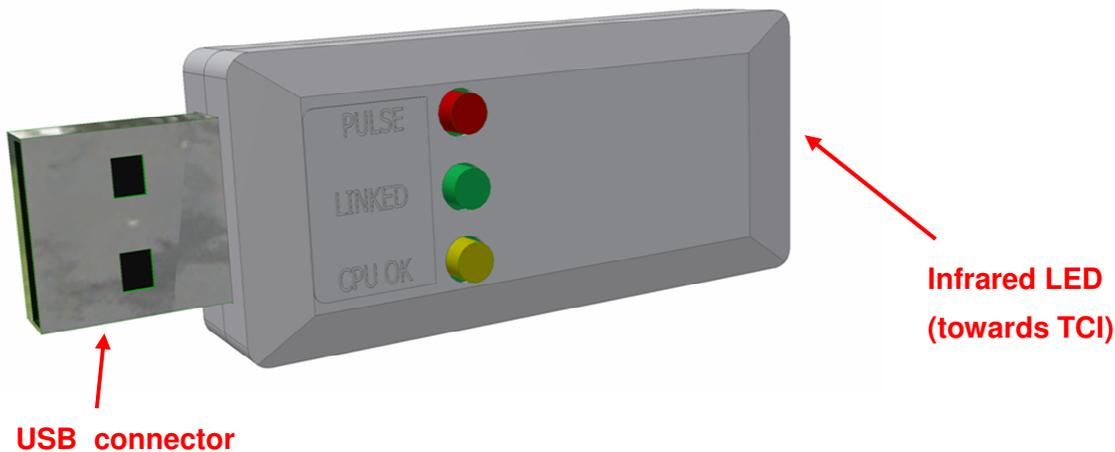
12.4 Prover Dongle indicators

PULSE [Red LED] – "On" when the electronic switch to the Model-5 Prover is closed.

LINKED [Green LED] – "On" when the TCI and the Prover Dongle are synchronized. Linked is should be On solid while you are in the "Pushbutton Proving" mode.

CPU OK [Yellow LED] – "On" when the Prover Dongle powered and operational. This must be on all of the time otherwise you do not have 5V power (supplied by the PC).
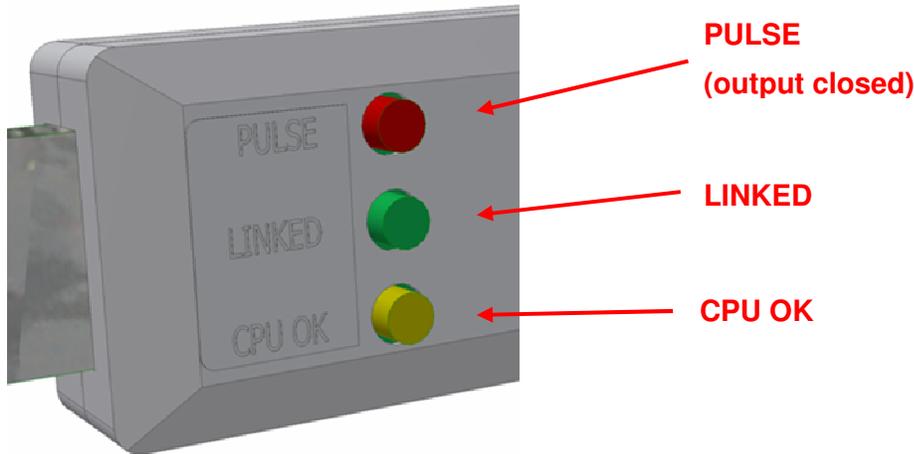
12.5 Pushbutton Proving

12.5.1 Basic operations

Uncompensated or temperature compensated volume is sent to the Prover by means of electronic contact closures generated by the Prover Dongle as it receives infrared light pulses from the TCI. Each pulse to the Prover represents either one (1), ten (10), or one hundred (100) cubic feet of gas volume, depending upon the model of the rotary meter. When 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 about 60 seconds.

ⓘ While in "Pushbutton Proving" mode, IrDA Serial communications are disabled.

12.5.2 Starting Pushbutton Proving mode

To enter Pushbutton Proving mode, use the external pushbutton to first sequence to the point in the Meter Reader list that shows **LIVEDIAL** on the LCD. After four seconds, the display then will show the message: **WAIT** for a maximum period of 10 seconds before it then shows the current meter Dial Rate. Once the TCI display is showing: WAIT or the actual Dial Rate value, **press and hold the main pushbutton for a minimum duration of 5 seconds** - waiting for the message: **PROVE TC** to be displayed. When the text message: **PROVE TC** is shown toggling on the display, the TCI is then in Pushbutton Proving mode.

ⓘ Temperature Compensated proving is first in the Pushbutton Proving sequence.

To exit Temperature Compensated proving and **proceed on with Uncompensated proving**, press the main pushbutton once. The LCD should then show the text message: **PROVE UC** to

indicate Uncompensated Proving mode. Just like in TC proving, the LCD will toggle between showing PROVE UC and the actual Dial rate of the rotary meter. To exit Uncompensated proving – simply press the pushbutton once more. Uncompensated proving is second (last) in the Pushbutton Proving sequence

ⓘ Pushbutton Proving mode automatically times out after one hour (60 minutes).

12.5.3   Volume per Proving output pulse

In Pushbutton Proving mode, the TCI will output 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 of gas volume, depending upon the selection of the rotary meter model (Item 432).

Following the initial text message: PROVE TC, the gas volume per output pulse is then displayed (for 5 seconds). This message will be either: **1 CF/P, 10 CF/P, or 100 CF/P**.

Meter Models CF per Pulse Scaling:

1 CF per Pulse	10 CF per Pulse	100 CF per Pulse
LMMA 1.5M	LMMA 23M	LMMA 102M
LMMA 2M	LMMA 38M	
LMMA 3M	LMMA 56M	
LMMA 5M		
LMMA 7M		
LMMA 11M		
LMMA 16M		
B3 - 8C175/200	B3 - 23M-175	
B3 - 11C175/200	B3 – 23M-232	
B3 - 15C175/200	B3 - 38M-175	
B3 - 1M300	B3 - 56M-175	
B3 - 2M175/200		
B3 - 3M175/300		
B3 - 5M175		

B3 - 7M175		
1 CF per Pulse	**10 CF per Pulse**	**100 CF per Pulse**
B3 - 11M175		
B3 - 16M175		
RM 1000 (older)	RM 38000	
RM 1000 (newer)		
RM 1500		
RM 2000		
RM 3000		
RM 5000		
RM 7000		
RM 11000		
RM 16000 (older)		
RM 16000 (newer)		
RM 23000		
RPM 9.0C		
RPM 1.5M		
RPM 3.5M		
RPM 5.5M		
RPM 7.0M		
RPM 11.0M		
RPM 16.0M		
RPM 23.0M		

13   Firmware Upgrades

The TCI is equipped with a built in firmware loader that allows new versions of firmware to be easily installed. Firmware upgrading uses the **IrDA** serial interface that is used by **MasterLink32**.   The IrDA serial interface provides an electrically isolated interface and requires no additional special hardware or software beyond what is already needed to utilize MasterLink32.

13.1 Firmware Upgrader ©

Firmware upgrading is handled by a software utility that is part of MasterLink32 (v 3.60 or later) called: **Firmware Upgrader**.   This utility works together with the built in "**Loader**" of the TCI to handle the firmware upgrading process.

The TCI internal Loader and MasterLink32's Firmware Upgrader together both provide a very robust system for upgrading TCI firmware. Many checks and verifications are implemented to ensure a very reliable firmware upgrading process.

13.1.1   Setup

From the MasterLink32 main menu, select: **I**nstrument \ Firmware Upgrader to run the firmware upgrading utility program.
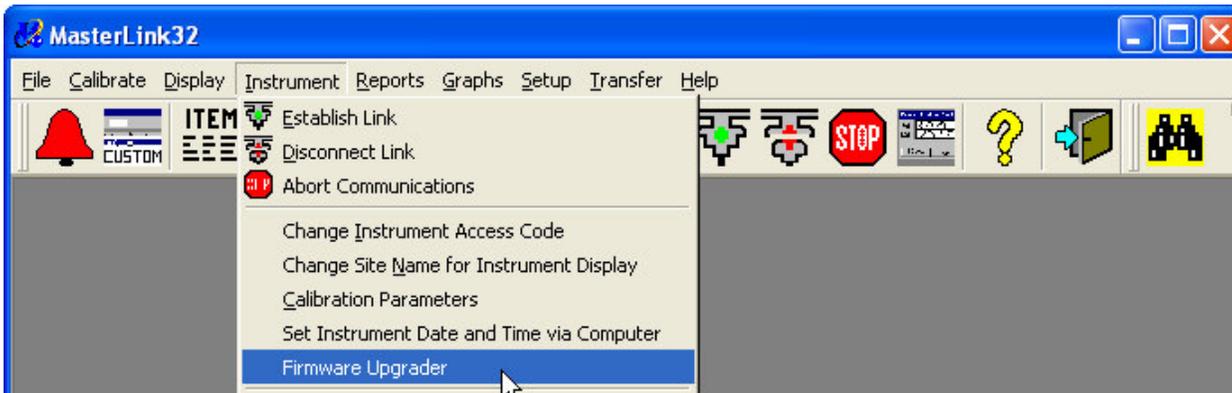
A dialog window will appear allowing the User to specify various options in the Firmware upgrade process. The four main options that can be selected from this control window are as follows: selection of TCI firmware file, selection of Comm port (IrDA), option to have date/Time synched with PC, and the option to have the Items saved before and then restored after the firmware loading process.

Be sure to select the proper serial port for communicating with the TCI. The Serial port should be identified with the word (IrDA) after the com port name.

To select the desired TCI firmware file, click on the **Browse** button at the top right side of the Firmware Upgrader control window.
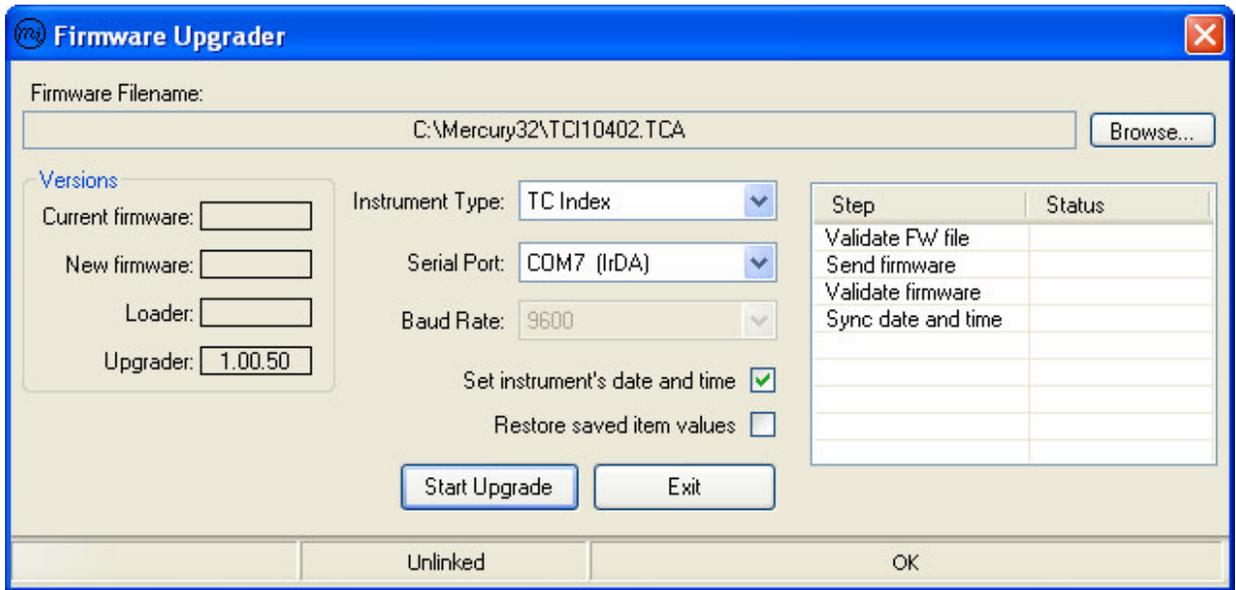
After clicking on the Browse button, a dialog window will appear allowing the User to specify the file to use. Browse to the file and then click the Open button to proceed.
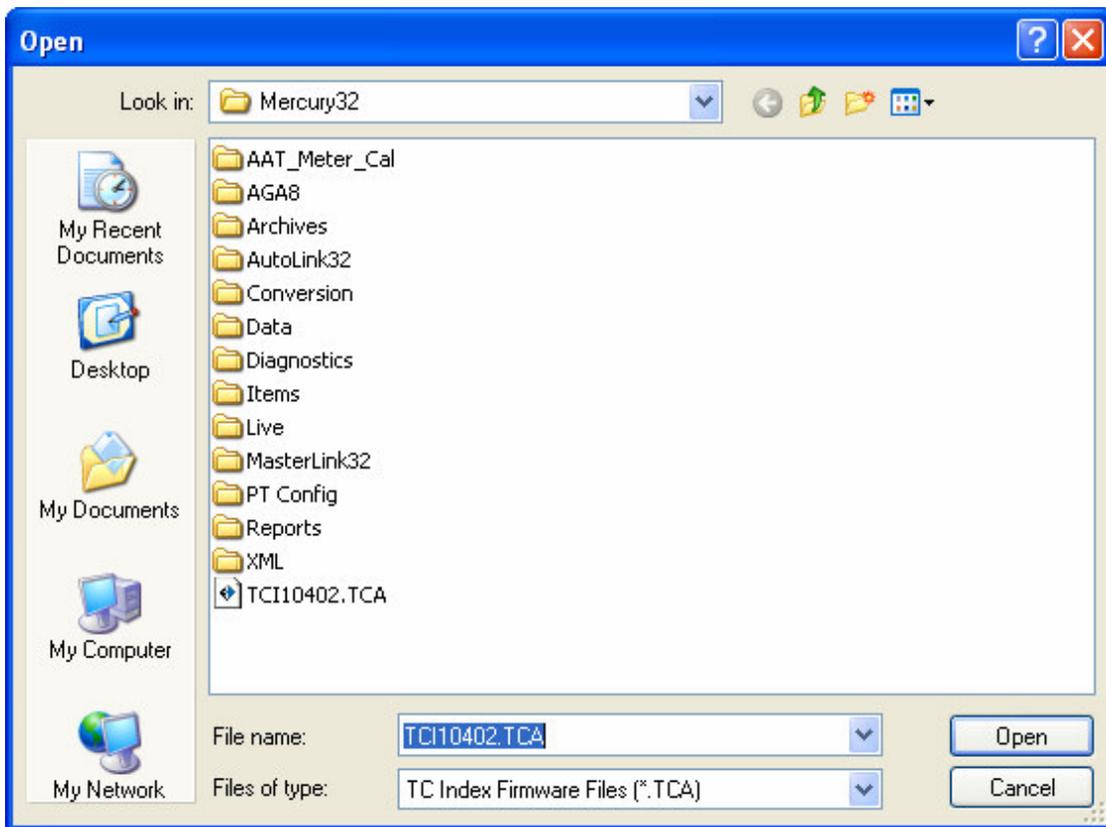
After selecting the appropriate TCI firmware file and serial port, verify that the **Set Instrument's date and time** and **Restore saved Item values** option boxes are checked. These options are highly recommended to help ensure the TCI is properly configured after a firmware upgrade.

13.1.2 Firmware loading

At this point, the user should now press the external pushbutton on the end side of the TCI to activate serial (IrDA) communications mode.

Immediately (within 15 seconds) click the: **Start Upgrade** button.

The program will begin to reading the current Item file out of the TCI and then prompt the User to press the external pushbutton once again to proceed on with the upgrade process.
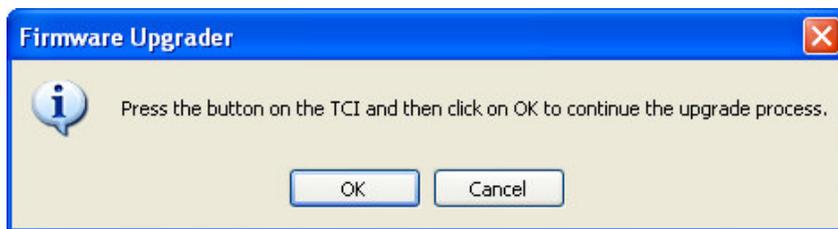
Press the pushbutton on the front of the TCI and then click the OK button.

The program will now begin to load the new firmware and then validate its integrity. This process takes about two (2) minutes to complete.

Once the firmware has been loaded and verified, the software will prompt the User to press the pushbutton again. This allows the software to synchronize its date and time with the TCI and load the saved Items into the TCI. The software should then display a message: Upgrade was successful (green) in the lower left corner of the main Firmware Upgrader control window.
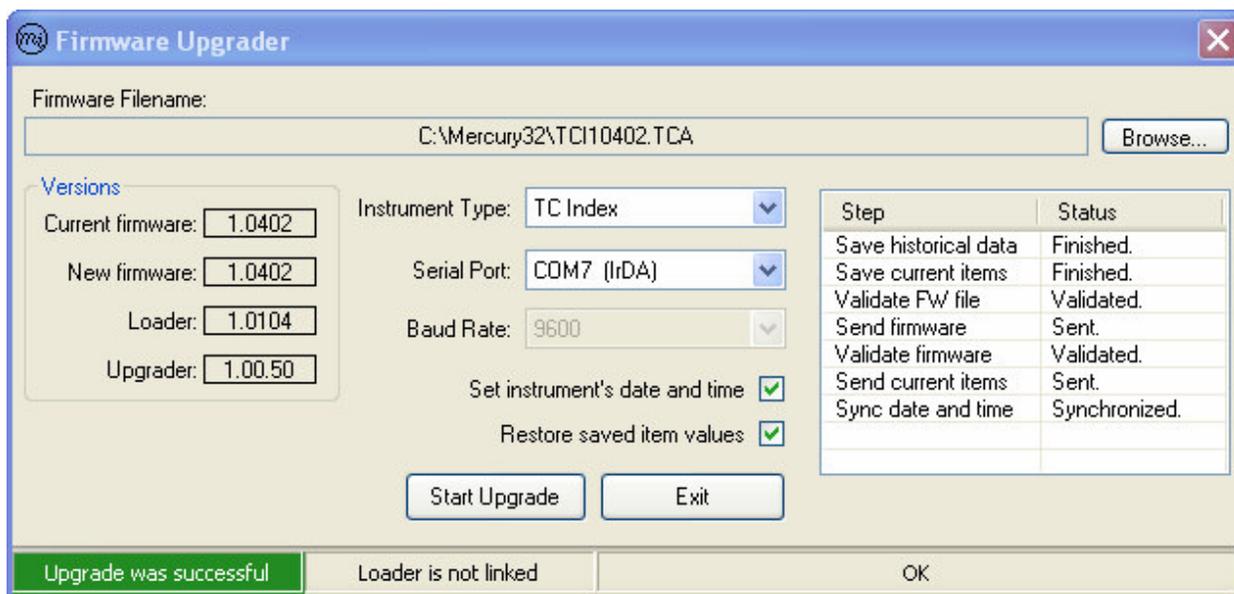
Click on the **Exit** button to close the Firmware Upgrader program utility. This completes the upgrading process.

The Firmware Upgrader utility saves the TCI's historical data (last 90 days of Audit Trail). This log data is saved to a **CSV** formatted file in the **Mercury32**/**Conversion** directory. ⓘ This Audit Trail data **cannot** be imported into the MasterLink32 database.

The file naming structure is as follows:

File's name:　　　　　　　1111111122222222_**V**.CSV

　　　　　　　　　　　　　11111111 is Site ID 1 (Item 200)

　　　　　　　　　　　　　22222222 is Site ID 2 (Item 201)

　　　　　　　　　　　　　V is the copy number.

To save the log data (90 day backup) in the regular Mercury32 database, use the **Read Audit Trail** feature of MasterLink32 prior to running the Firmware Upgrader utility.

14   Complete Item Listing

The following Item code list indicates the Item Number, the Item Name, a brief description of the Item functionality, and the Item's default value.

---

000 - Compensated Volume

Totalized Compensated Volume - compensated to base conditions (T & fixed P).

Default value: 0

---

002 - Uncompensated Volume

Totalized Uncompensated Volume – uncompensated meter volume.

Default value: 0

---

005 – Ch-A Pulses Waiting

# of Pulses Value represents twice the number of Channel A output pulses remaining from last wakeup period, waiting to be sent to remote device.

Default value: 0

---

006 – Ch-B Pulses Waiting

# of Pulses Value represents twice the number of Channel B output pulses remaining from last wakeup period, waiting to be sent to remote device.

Default value: 0

---

008 – Gas Pressure P1

Gas line pressure is entered by an installer. This value is not read from a transducer in the TCI. It is used to calculate the pressure factor. The Base Pressure (Item 013) and the Atmospheric Pressure (Item 014) must be entered by the installer. When Item 008 is changed, a new pressure correction factor will be calculated and stored at Item 044. Also, when 044 (pressure correction factor) is changed, a pressure value is computed and stored in Item 008 (using Base and Atmospheric Pressure as constants). Item 043 will also be updated. ⓘ Note Gas Pressure P1 is always **gauge**.

Default = 0 (PSIG)

013 - Base Pressure

Base pressure per the contract, used in calculating pressure correction factor. When Item 013 is changed, a new pressure correction factor will be calculated at Item 044. Item 043 will also be updated.

Default = 14.7300 (PSIA)

014 - Atmospheric Pressure

Average atmospheric pressure per the contract, used in calculating pressure correction factor (Item 044). When the Atmospheric pressure value is changed a new pressure correction factor will be calculated and written at Item 044. Item 043 will also be updated.

Default = 14.7300 (PSIA)

026 - Gas Temperature

Measured Gas temperature used in calculating the temperature correction factor (Item 045) and the Total factor (Item 043). The temperature value is scaled to the unit of measure selected at Item 089.

Default = 0.00

027 - Gas Temperature Low Alarm Limit

Low limit for temperature, initiates alarm (Item 144) if exceeded.

Default = -40.00

028 - Gas Temperature High Alarm Limit

High limit for temperature, initiates alarm (Item 146) if exceeded.

Default = 165.00

029 – Zero Calibration Temperature

The temperature value used during the most recent Temperature zero point calibration.

Default = 0.0000

030 - Span Calibration Temperature

The temperature value used during the most recent Temperature span calibration.

Default = 1.0000

031 - Case Temperature

Temperature measured inside instrument case.

Default = 0.00

032 - Case Temp Maximum

Highest case temperature measured by unit since Item was reset.

Default = -50.00

033 - Case Temp Minimum

Lowest case temperature measured by unit since Item was reset.

Default = 170.00

034 - Base Temperature

Base temperature used to calculate the temperature correction factor (Item 045).

Default = 60.00 Deg. F

035 - Temperature Cal Zero

The most recent offset value for the temperature transducer, obtained during a Temperature Zero calibration. The value is normally very close to 0.0000 and is recalculated during each Temperature Zero Calibration.

Default = 0.0000

036 - 1 Prev Temp Cal Zero

The previous value of Item 035, updated on each Temperature Zero Calibration.

Default = 0.0000

038 - Temperature Cal Span

The most recent span value for the temperature transducer, obtained during a Temperature span calibration. The value is normally very close to 1.0000 and is recalculated on each T-span calibration.

Default = 1.0000

039 - 1 Prev Temp Cal Span

The previous value of Item 038, updated on each Temperature span calibration.

Default = 1.0000

041 - Min TCal Point Diff %

The configurable difference (percent of full-scale of the temperature range, i.e., -40.00 degrees F to +150.00 degrees F or 190 total F degrees / -40.00 degrees C to +75 degrees C or 115 total C degrees) required between Temperature Zero and Temperature Span calibration points.

Default = 10.0000

042 - Excess TCal change %

The configurable maximum allowable change (expressed in percent of full-scale of temperature range) to Temperature zero and Temperature span calibration points.

Default = 2.00

043 - Total Correction Factor

Total correction factor calculated at the most recent wake-up and used as a multiplier to convert uncompensated volume to compensated volume. It includes the pressure correction factor, temperature correction factor, aux correction factor. It is the product of the values at Items 044, 045, and 046 (i.e., Item 044 x Item 045 x Item 046). Read-Only Item.

Default = 1.0000

044 – Fixed Pressure Factor

Pressure factor calculated at the most recent wake-up using Boyle's Law for values at Items 008, 013, and 014. When Item 044 is changed, a new pressure will be calculated and written into Item 008, using the Base and Atmospheric Pressure as constants (Items 013 and 014). Item 043 will also be updated.

Default = 1.0000

045 - Temperature Factor

Temperature factor calculated using Charles' Law for values at Items 026 and 034.

Default = 1.0000

046 - Auxiliary Factor

Factor to provide for other possible scaling requirements such as: water vapor content. If not applicable, set to 1.0000. Value directly affects Item 043 (Total Correction factor).

Default = 1.0000

049 - Battery Low Limit

Low limit for battery (specified in months). Sets alarm (Item 099) when remaining battery life drops below this value.

Default = 24 (2 yr)

056 – Ch-A Pulse-out Scaling

Scaling factor that determines the volume per pulse for channel A pulse outputs when Item 093 is set to CorVol or UncVol.

Default = 2.000

057 – Ch-B Pulse-out Scaling

Scaling factor that determines the volume per pulse for channel B pulse outputs when Item 094 is set to CorVol or UncVol.

Default = 2.000

062 - Unit Serial Number

Factory assigned Serial Number. Example: 09901234. x9901234 - disregard the leading zero. x99xxxxx - 2 digit year of manufacture. xxx01234 - 5 digit sequence number during the year of manufacture

FW Default = 00000000, actual number is Factory set.

075 - Meter Reader - Item 1

The information at the Item number that is placed in the "Item-to-Display List" is displayed on the LCD each time the select button is pressed on TCI. The Items that are displayed will normally time out after one minute. Setting any of the Meter Reader Items to a value of 255 will indicate the end of the list.

Default = 002 (Uncompensated Volume)

076 - Meter Reader - Item 2

2nd Meter Reader list Item - same rules apply as for Item 075.

Default = 000 (Compensated Volume)

077 - Meter Reader - Item 3

3rd Meter Reader list Item - same rules apply as for Item 075.

Default = 432 (Rotary Meter Model)

078 - Meter Reader - Item 4

4th Meter Reader list Item - same rules apply as for Item 075.

Default = 1001 (Battery Months Remaining)

079 - Meter Reader - Item 5

5th Meter Reader list Item - same rules apply as for Item 075.

Default = 122 (Firmware Version)

080 - Meter Reader - Item 6

6th Meter Reader list Item - same rules apply as for Item 075.

Default = 255 (End-of-List)

081 - Meter Reader - Item 7

7th Meter Reader list Item - same rules apply as for Item 075. Default = 255 (End-of-List)

082 - Meter Reader - Item 8

8th Meter Reader list Item - same rules apply as for Item 075. Default = 255 (End-of-List)

083 - Meter Reader - Item 9

9th Meter Reader list Item - same rules apply as for Item 075. Default = 255 (End-of-List)

084 - Meter Reader - Item 10

10th Meter Reader list Item - same rules apply as for Item 075. Default = 255 (End-of-List)

085 - Meter Reader - Item 11

11th Meter Reader list Item - same rules apply as for Item 075. Default = 255 (End-of-List)

086 - Meter Reader - Item 12

12th Meter Reader list Item - same rules apply as for Item 075. Default = 255 (End-of-List)

087 - Pressure Units

Selects the unit of measure for Gas Pressure and other pressure related Items. Options: PSIG, KPa, MPa, Bar, MBar, KGcm2, inch WC, inch Hg, mm Hg.

Default = PSIG (Gauge only).

089 Temperature Units

Selects the unit of measure for Gas Temperature and other temperature related Items. Options: Deg F (Fahrenheit), Deg C (Celsius), Deg R (Rankine), and Deg K (Kelvin)

Default = Deg F

090 - Compensated Volume Units

Selects the unit of measure for Compensated Volume and other Comp-Vol related Items. Options: CF, CFx10, CFx100, CCF, CFx1000, MCF, CFx10000, m3x0.1, m3, m3x10, m3x100, m3x1000.

Default = CCF (CFx100)

092 - Uncompensated Volume Units

Selects the unit of measure for Uncompensated Volume and other Uncomp-Vol related Items. Options: CF, CFx10, CFx100, CCF, CFx1000, MCF, CFx10000, m3x0.1, m3, m3x10, m3x100, m3x1000.

Default = CCF (CFx100)

093 – Ch-A Pulse-out Select

Selects the type of information to be transmitted out Pulse Channel A. Options: CompVol, Uncomp Vol.

Default = No output (disabled)

094 – Ch-B Pulse-out Select

Selects the type of information to be transmitted out Pulse Channel B. Options: Comp Vol, Uncomp-Vol.

Default = No output (disabled)

096 - Cor Vol # of Digits

Selects the number of digits (max 8) to be used for displaying Compensated volume (Item 000). Options: 8 digits, 7 digits, 6 digits, 5 digits, 4 digits.

Default = 8 Digits.

097 - Uncor Vol # of Digits

Selects the number of digits (max 8) to be used for displaying Uncompensated volume (Item 002). Options: 8 digits, 7 digits, 6 digits, 5 digits, 4 digits.

Default = 8 Digits.

098 - Meter Index Rate

Indicates the value of the uncompensated input pulse. Read Only Item (reference)

Value is fixed at **1.0**

099 - Battery Low Alarm

This Item indicates that the Battery(s) has reached or exceeded the limit set by Item 049 (Battery Low Limit). Item 099 will show a value of: "11111111" in the Alarm state, and "00000000" when there is no Low Battery Alarm. The alarm remains active until cleared manually (by software) or automatically when the batteries are replaced. See Item 108.

Default = 00000000

102 –Volume Sensor 1 Alarm

This Item indicates a faulty Volume Sensor 1. A value of: "11111111" indicates an Alarm state and "00000000" indicates there is no Volume Sensor 1 alarm. The alarm remains active until manually cleared (by software). See Item 108.

Default = 00000000

103 –Volume Sensor 2 Alarm

This Item indicates a faulty Volume Sensor 2.   See Volume Sensor 1 Alarm description.

Default = 00000000

104 System Alarm

This Item indicates an alarm if there is a hardware fault on the CPU circuit board or components. See Item 108.

Default = 00000000

108 – Main Alarm Output

This Item is used to indicate if the unit has any active Alarms.

A value of: "11111111" indicates that one or more of the Alarm Items have become active. The **Alarm Bell Icon** will switch **on**. A value of: "00000000" indicates there are no active Alarms. Item 108 cannot be cleared directly! ⓘ Note: when Item 108 is 1st set, a single alarm pulse is transmitted out the Alarm Channel.

Default = 00000000

113 - High Resolution Cor Vol

Display of the fractional portion (to the 4th decimal) of Item 000 (Totalized Compensated Volume) with the last three CorVol integers for reference. Example: if the value at Item 000 equals "12345678 MCF" Item 113 may appear as 678.2477 MCF". The four decimal places are useful during field calibration checks when using a small number of meter revolutions.

Default = 000.0000

114 - Meter Scaling

This scaling value describes the volume per meter pulse input. This will be set by the CPU from an internal table when a particular Rotary Meter Model is selected using Item 432.

Default = 1.0000

118 – Reference number 1

Temporary storage for any 8 digit non-fractional number.

Default = 0

119 – Reference number 2

Same as Item 118

---

121 Temperature Cal Date

Date of the most recent change to Temperature Cal Zero (Item 035). The date is automatically inserted into Item 121 when exiting the Temperature Zero calibration function.

Default = 01-01-08

---

122 – Firmware Version

This Item is used to display the instrument's operating firmware version number. **Read-Only**

---

126 – IrDA Serial Baud Rate

Indicates the instrument's baud rate for the IrDA serial connection.

Default = 9600 bps

---

127 – Instrument Type

TCI is denoted as: **12**.

---

128 – Clear Alarms w/ Push Button

Enable or disable the clearing of all active alarms using the push button. During the Meter Reader List, an "**E.E.E.E.E.E.E.E**" display will appear after scrolling through all active alarms. Allowing the instrument to time out (1- minute) at this display will clear all alarms. If the push button is pressed before the "E.E.E.E.E.E.E.E" display times out, the alarms are not cleared.

Default = Enabled

---

129 Live Display Enable

Select the display of live temperature and/or dial rate as part of the Meter Reader List. If enabled, the live parameter(s) will appear *after* the display of the last Meter Reader list Item. Live temperature and dial rate have a **10 minute time-out**. Option: None, Live Temp, Live Dial Rate, Live Temp & Dial Rate.

Default = Live Temperature & Dial Rate.

139 – Serial Link Access

Select the write access serial data communications link to provide various means of **Item write access security**. Options: 2- way communications (full R/W access), Read Only (no write access), Metrological R-O (not possible to write to metrological Items).

Default = 2-way (R/W)

140 - Energy

Totalized gas energy, equivalent to the totalized compensated volume multiplied by the Gas Energy Value (Item 142) and updated with every volume input processing.

Default = 00000000

141 - Energy Units

Selects the unit of measure for Energy (140). Options: THERMS, DKTHERMS, MJOULES, GJOULES, KILOCAL, and KILOWATTHR.

Default = THERMS

142 - Gas Energy Value

Value indicates the amount of energy contained in each volumetric unit of compensated volume. This value is a multiplier used to calculate Energy at Item 140. The nominal Gas Energy Values for the Energy Units (Item 141) are: THERMS = 1000.0 BTU per CuFt, DKTHERMS = 1000.0 BTU per CuFt, MJOULES = 37259.00 Kilojoules per m3, GJOULES = 37259.00 Kilojoules per m3, KILOCAL = 8905.00 Kilocalories per m3, KILOWATTHR = 10349.73 Watt/Hr per m3.

Default = 1000.0 (BTU)

144 - Temperature Low Alarm

This Item indicates that the Temperature has exceeded the low limit set by Item 027 (Temperature Low Limit). Item 144 will show a value of: "11111111" in the Alarm state, and "00000000" when clear. The alarm indicators will remain active until manually cleared (by software). The Temperature Low Limit value (Item 027) is normally set somewhere between 0 and 50% of transducer range. See Item 108.

Default = 00000000

146 - Temperature High Alarm

This Item indicates that the Temperature has exceeded the high limit set by Item 028 (Temperature High Limit). Item 146 will show a value of: "11111111" in the Alarm state, and "00000000" when clear. The alarm indicators will remain active until manually cleared (by software). See Item 108.

Default = 00000000

163 - Flow Rate High Alarm

This Item indicates if the measured instantaneous Flow Rate (Item 209) is greater than the limit set by Item 164 (Flow Rate High Limit). Item 163 will show a value of: "11111111" in the Alarm state, and "00000000" when clear. The alarm indicators will remain active until manually cleared (by software). The Flow Rate High Limit value (Item 164) is user selectable. See Item 108.

Default = 00000000

164 - Flow Rate High Limit

Upper limit for High Flow Rate Alarm (163).

Default = 99999999 (cu ft / hr.)

171 – Wait For ENQ Timeout

The time (in seconds) to wait for the control character "ENQ" at the start of a serial session before issuing an error "21" (timeout error). This function is provided as a convenience for some 3rd party communication interfaces and normally should not be changed. Range: 7 to 60,

Default = 60 seconds (Fixed)

183 - Previous Day Cor Vol

The daily-compensated volume that is one Gas Day old at the time the instrument is accessed. This information is updated with the value at Item 223 at the beginning of every new gas day. Note: The gas day begins at the time entered at Item 205.

Default = 00000000

184 - Previous Day Unc Vol

The daily uncompensated volume that is one Gas Day old at the time the instrument is accessed. This information is updated with the value at Item 224 at the beginning of every new gas day. Note: The gas day begins at the time entered at Item 205.

Default = 00000000

186 - Previous Day Average Temperature

The daily average temperature that is one Gas Day old at the time the instrument is accessed. This information is updated with the value at Item 257 at the beginning of every new gas day. The gas day begins at the time entered at Item 205.

Default = 0.00

200 - Site ID Part 1

User assigned eight-digit numeric site number (limited to characters: 0-9). Used by MasterLink32 software for storing data in the Mercury32 Database.

FW Default = 00000000, Factory set to match Unit's Serial Number.

201 - Site ID Part 2

Second part of User assigned eight-digit numeric site number (limited to characters: 0-9). Used by MasterLink32 software for storing data in the Mercury32 Database.

Default = 00000000

202 - Log Interval

Time period (hours) that determines how often a time- stamp Audit Trail record is placed in the non-volatile log memory. **Fixed** Interval = **24 Hrs** (Daily) Read –Only.

203 - Time

Instrument's time. Real Time clock that displays hours, minutes, and seconds in 24-hour "military" time, i.e., 14:30:02 would be 2 seconds past 2:30 PM.

Default = 12:00:00

204 - Date

Instrument's date. Real Time Clock that displays date in one of the following formats: MM DD YY, DD MM YY, or YY MM DD.

Default = 01-01-08 (MM DD YY)

205 - Start Time

Time to begin the start of the GAS DAY, which by definition of other Items, is the time of day when daily computations are re-zeroed to begin the next day's computations.

Default = 09 00 00

209 - Instantaneous Flow Rate

The instantaneous rate of flow for Compensated Volume (000), expressed in the selected CorVol units (Item 090) per hour. The value is equal to the most recent increment of Compensated Volume, divided by the length of time between the last two volume input cycles. ⓘ Rate measurements require a minimum time of 60 seconds between updates. If the meter is rotating faster than 1 RPM, the rate calculation is not updated for at least one full minute.

Default = 0.00

216 - Interval High Temperature

Highest Gas Temperature (Item 026) measured during the time interval selected at Item 202. The value at Item 216 is initialized (re-zeroed) at the beginning of each Gas Day (per Item 205).

Default = 0.00

217 - Interval Low Temperature

Lowest Gas Temperature (Item 026) measured during the Time interval selected at Item 202. The value at Item 214 is initialized (re-zeroed) at the beginning of each Gas Day (per Item 205).

Default = 9999.99

218 - Inst Dial Rate

The instantaneous rate of flow for Uncompensated Volume (002), expressed in either cubic feet or cubic meters per hour (depending on UncVol units. The value is equal to the most recent increment of UncVol divided by the length of time between the last two volume input cycles. (The minimum acceptable time between correction cycles is one minute.) If the meter is rotating faster than 1 RPM, the calculation is delayed until the time is at least one full minute.

Default = 0.0

221 - Daily Cor Vol Alarm Limit

Upper limit value for daily contract volume (Item 223).

Default = 99999999

222 - Daily Cor Vol Alarm

This Item indicates if the measured value for Daily contract volume (Item 223) is greater than the value of Daily Cor Vol limit (Item 221). Item 163 will show a value of: "11111111" in the Alarm state, and "00000000" when clear. The alarm indicators will remain active until manually cleared (by software) or **automatically cleared** at the beginning of **each Gas Day** (Item 205).

Default = 00000000

223 - Daily Cor Volume

Same as Compensated volume (Item 000) but is initialized (re-zeroed) at Start Time (Item 205) each Gas Day. If the instrument is accessed, this Item will display the current value for that point in the day.

Default = 00000000

224 - Daily UnCor Volume

Same as Uncompensated volume (Item 002) but is initialized (re-zeroed) at Start Time (Item 205) each Gas Day. If the instrument is accessed, this Item will display the current value for that point in the day.

Default = 00000000

229 – Audit-Trail - Item 5

Used only as a reference to indicate the 5th Item value logged in the Backup Memory module.

Fixed Value = 1001 (Battery Months Remaining)

253 - Max Day Cor Vol

The highest Daily Compensated Volume (Item 223) since last manually reset.

Default = 00000000

254 - Max Day Date

The date the Max Day CorVol (253) occurred. Format: Determined by Item 262

Default = 01-01-08

257 - Daily Average Temperature

The daily average of Gas Temperature (026). Resets at the start of each Gas Day.

Default = 0.00

258 – Audit-Trail - Item 1

Used only as a reference to indicate the 1st Item value logged in the Backup Memory module.

Fixed Value = 000 (Compensated Volume)

259 – Audit-Trail - Item 2

Used only as a reference to indicate the 2nd Item value logged in the Backup Memory module.

Fixed Value = 002 (Uncompensated Volume)

260 – Audit-Trail - Item 3

Used only as a reference to indicate the 3rd Item value logged in the Backup Memory module.

Fixed Value = 043 (Total Correction Factor)

261 – Audit-Trail - Item 4

Used only as a reference to indicate the 4th Item value logged in the Backup Memory module.

Fixed Value = 257 (Daily Avg. Temperature)

262 - Date Format

Code (0-2) selects the format in which the Date is entered and displayed at Item 204. The format for all date related Items will also be governed by the selection of Item 262. Options: MM DD YY, DD MM YY, and YY MM DD. **Default** = MM DD YY (Month/Day/Year).

264 – Misc. Action

Perform a special operation on a one time basis. ⚠ Not for general use!

Default = 00000000.

265 – Memory Address

Special Engineering Address control codes to obtain data using Item 266. ⚠ Not for general use!

266 – Memory Data

Special Engineering data value. See Item 265. ⚠ Not for general use!

267 – Misc. Configuration

This is used to set the TCI to special configuration / test modes. ⚠ Not for general use!

281 - Maximum Dial Rate

The highest value of Inst Dial Rate (Item 218) since last manually reset.

Default = 0.00

282 - Maximum Dial Rate Time

The time when Max Dial Rate (Item 281) occurred.

Default = 00 00 00, Format: HH:MM:SS

283 - Maximum Dial Rate Date

The date when Max Dial Rate (Item 281) occurred.

Default =01-01-08, Format set per Item 262

293 - Maximum Gas Temperature

The highest value of Gas Temperature (Item 026) since last manually reset.

Default = -50.00

294 - Maximum Gas Temp Time

The time when the Max Gas Temp (Item 293) occurred.

Default = 00 00 00. Format: HH:MM:SS

295 - Maximum Gas Temp Date

The date when the Max Gas Temp (Item 293) occurred.

Default = 01-01-08. Format set by Item 262

296 - Max Gas Temp Flow Rate

The Instantaneous Flow Rate (Item 209) when the Max Gas Temperature (Item 293) occurred.

Default = 0.00

297 - Minimum Gas Temperature

The lowest value of Gas Temperature (Item 026) since last manually reset.

Default = 170.00

298 - Minimum Gas Temperature Time

The time when the Min Gas Temperature (Item 297) occurred.

Default = 00 00 00, Format: HH:MM:SS

299 - Minimum Gas Temperature Date

The date when the Min Gas Temp (Item 297) occurred.

Default = 01-01-08, Format per Item 262

300 - Minimum Gas Temperature Flow Rate

The Instantaneous Flow Rate (Item 209) when the Min Gas Temp (Item 297) occurred.

Default = 0.00

432 - Rotary Integral Mount

Used to select the type of Rotary Meter model / mount. 45 Rotary meter models options are currently available.

Default (0) = Select Meter Model

433 - Input Volume Mode

Used to select operating modes for the Volume input processing. (Selections other than "1" may cause battery life issues). Options: Normal Rotary mode, High Resolution Input mode - decreases Battery life).

Default = Normal Rotary mode.

439 - Rotary Meter Displacement

The amount of base gas volume associated with 1 revolution of the meter. See Item 432. Read-Only

Default = 0.00

462 - Battery Low Alarm Time

The Time when the Battery Low Alarm occurred (Item 099).

Default = 00:00:00 (Format: HH:MM:SS)

463 - Battery Low Alarm Date

The Date when the Battery Low Alarm occurred (Item 099).

Default: 01-01-08

464 – Volume Sensor 1 Alarm Time

The Time when the Volume Sensor 1 Alarm occurred (Item 102).

Default = 00:00:00 (Format: HH:MM:SS)

465 – Volume Sensor 1 Alarm Date

The Date when the Volume Sensor 1 Alarm occurred (Item 102).

Default: 01-01-08

466 – Volume Sensor 2 Alarm Time

The Time when the Volume Sensor 2 Alarm occurred (Item 103).

Default = 00:00:00 (Format: HH:MM:SS)

467 – Volume Sensor 2 Alarm Date

The Date when the Volume Sensor 2 Alarm occurred (Item 103).

Default: 01-01-08

468 - System Fault Alarm Time

The Time when a System Alarm occurred (Item 104).

Default = 00:00:00 (Format: HH:MM:SS)

469 - System Fault Alarm Date

The Date when a System Alarm occurred (Item 104).

Default: 01-01-08

474 - Temperature Low Alarm Time

The Time when the Temperature Low Alarm occurred (Item 144).

Default = 00:00:00 (Format: HH:MM:SS)

475 - **Temperature** Low Alarm Date

The Date when the Temperature Low Alarm occurred (Item 144).

Default: 01-01-08.

476 - Temperature High Alarm Time

The Time when the Temperature High Alarm occurred (Item 146).

Default: 00:00:00 (Format: HH:MM:SS)

477 - Temperature High Alarm Date

The Date when the Temperature High Alarm occurred (Item 146).

Default =01-01-08.

478 - Daily CorVol Alarm Time

The Time when the Daily CorVol Alarm occurred (Item 222).

Default: 00:00:00 (Format: HH:MM:SS)

479 - Daily CorVol Alarm Date

The Date when the Daily CorVol Alarm occurred (Item 222).

Default = 01-01-08.

482 - Default Display Item

Selects which Item will be displayed on the LCD when the instrument is in normal operating mode. Item displayed is updated on each Volume processing cycle.

Default = 000 (Compensated Volume)

892 - High Resolution Unc Vol

Display of the fractional portion (to the 4th decimal) of Item 002 (Totalized Uncompensated Volume) with the last three UncVol integers for reference. Example: if the value at Item 002 equals "12345678 CCF" Item 892 may appear as 678.2477 MCF". The four decimal places are useful during field calibration checks when using a small number of meter revolutions.

Default = 000.0000

1000 – LCD Viewing Position

Sets the viewing orientation of the LCD display. Options: Normal LCD viewing for a **right-hand** rotary meter mount, and Inverted LCD viewing for a **left-hand** rotary meter mount.

Default = Normal (Right-hand) view.

1001 – Battery Months Remaining

Battery life is displayed in effective remaining months. Based on the value from the Total Battery Amp-Hours (Item 1003). Range: 240 – 0. Read-Only

Default = 240 (20 Yr)

1002 – Battery Percent Remaining

Battery life is displayed as percent remaining. Similar to Battery Months Remaining but expressed in percent. Read-Only

Default = 100 %

1003 – Total Battery(s) Amp-Hours

The effective number of Amp-Hours of the 2 Lithium batteries powering the TCI. This value is used to calculate effective battery life and includes aging factors and other battery life compensation values. See Items 1001, 1002.

Default = 25.0 ⚠: Factory set parameter

1004 – Real-Time-Clock Oscillator Correction

Default = 0 ⚠ Factory set parameter

1005 – Sensor Test Mode

This enables a special display function which is placed after the display Items. The TCI displays a 4-digit count of the highest number of both sensors and a 4-digit value of the difference of both sensors. The count values are the direct sensor inputs (no prescaler or divider).

Default = Enabled

1006 – Unit Cal and Test Status

When non-zero, this Item will cause the TCI to display the following text "**NOT CALB**" on the LCD continuously instead of the normal default display Item value. After factory calibration and testing is completed, the factory will set this Item to a zero. The "NOT CALB" text is to alert our factory people that the unit is not ready to be shipped to a customer.

Default = Not Calb: ⚠ Factory set parameter

1007 – Volume Sensor Type

Default = Dual Polarity: ⚠ Factory set parameter

1008 – Voltage Booster On Temperature

Default = -20.0 ⚠ Factory set parameter

1009 – LCD Default Contrast

Selects the contrast setting for the installed LCD.

Default = 0 ☼ Factory set parameter

1010 – Case Temperature Zero Point

Default = 27.0 C ☼ Factory set parameter

1011 – Memory Module Serial No.

Serial number used to identify the Memory Module. This Item tracks Item 062. Read-Only

Default = 00000000

1012 – Memory Module Site ID Part-1

Part 1 of the number of the Memory Module used by Mercury software to handle the TCI Mem Module's Backup memory data. This Item tracks Item 200. Read-Only.

Default = 00000000

1013 – Memory Module ID Part-2

Part 2 of the number of the Memory Module used by Mercury software to handle the TCI Mem Module's Backup memory data. This Item tracks Item 201. Read-Only.

Default = 00000000

1014 – Ch-A Pulse Output Timing

Selects both On and Off timing requirements for the Channel **A** output. See Table below.

Default = No Output

Pulse Output timing selection table – Items 1014 and 1015.

Item 1014 / 1015 codes	Output timing On / Off (minimum)
0	10 ms / 20 ms
1	20 ms / 40 ms
2	30 ms / 60 ms
3	50 ms / 100 ms
4	75 ms / 150 ms
5	100ms / 200 ms
6	200 ms / 400 ms
7	500 ms / 1 Sec
8	50ms / 250 ms (default)
9	Badger
10	Cellnet/Hunt
11	Hexagram / Aclara
12	Itron ERT 40GB
13	Itron ERT 100G
14	Mercury PA (Item 449 Off)
15	Mercury SIP/CPA/IMU-II
16	Mercury SIP-CB
17	50 ms / 50 ms
18	50 ms / 150 ms
19	50 ms / 500 ms
20	150 ms / 150 ms
21	Sensus

1015 – Ch-B Pulse Output Timing

Selects both On and Off timing requirements for the Channel **B** output. See Table above.

Default = No Output

1016 – Alarm channel Pulse Timing

Selects the timing requirements for the pulse outputs of this channel. On and Off parameters.

Fixed value: 1 second

1017 – XTAL Inflection Temperature

Default = 0.0 Factory set parameter

1018 – Continuous IrDA Comms mode

Default = 0   Factory set parameter

1019 – Main Board S/N

The S/N of the TCI main board.

Default = 00000000 Factory set parameter

15   Specifications

Certifications

- IEC 61000-4-2 testing (Electrostatic discharge)
- IEC 61000-4-3 testing (Electromagnetic fields)
- Measurement Canada
- CSA --- Class 1, Div 1 compliance
- FCC Part 15

Power

- 2.5 to 3.6 VDC
- Battery life: Nominal **20 years** (with dual D cell Lithium batteries)

Temperature measurement system

- Highly stable, solid state temperature sensor (thermistor)
- Range: -40°F. to 170°F. (-40°C. to 70°C.)
- Temperature sensor accuracy from - 4 °F to 104 °F (-20 °C to +40 °C)

    ±0.1% of reference to absolute temperature
- Temperature sensor accuracy from -40°F to 170°F (-40°C to 70°C)

    ±0.25% of reference to absolute temperature
- Computational accuracy: ±0.3% of compensated volume reading

Note: maximum error at reference conditions including linearity, repeatability and hysteresis.

Long Term Stability:

- Total: ±0.5% reference to absolute temperature

Environmental conditions

- Ambient Temperature range: -40 °F to 170 °F (-40 °C to 70 °C)
- Ambient humidity range: 0 to 100% Non-condensing

Ambient Temperature effects

- Total: ±0.1% of compensated volume per 100 °F from -40 °F to 170 °F (-40 °C to 70 °C)

Enclosure

- Clear polycarbonate with Lexan window over LCD
- Designed and tested at Mercury Instruments to comply with NEMA 6 and IP-67 ratings
- Immersion test: **immersion under 1 meter** of **water for** duration of **72 hours** (No AMR connections)
- Mounting plate with gasket and bolts to accommodate most rotary meters

System Memory

- Backup memory: Last 90 days (running) of daily fixed Item data
- Flash: System firmware (upgrade via IrDA)
- E^2PROM: Configuration and calibration Items

Telemetry outputs

- Two Form-A for Volume and one Form-B for Alarms
- Configurable pulse widths to match various AMR units
- All outputs are isolated from ground and each other
- Outputs are rated from 3.0 volts to 24.0 volts, any polarity
- Sink or source up to 10 milliamperes (DC)

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