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Conforming Meter Framework

Itron SENTINEL®

Issue 2.0

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Table of Changes

Reference (Section and Paragraph)	Description of Change
	Version 2.0 document revised to update content.

1. Introduction

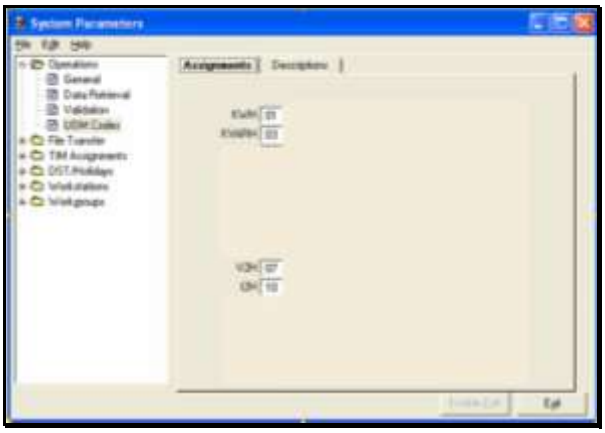
The Independent Electricity System Operator (IESO) has prepared this document to assist Meter Service Providers (MSP) and Metered Market Participants (MMP) with the configuration of new conforming meters in a manner that enables efficient registration of the meter into the IESO's MV-90 system supplied by Itron. A secondary purpose is to improve the reliability of daily communication with each registered wholesale meter (RWM) by sharing the IESO's experience with different types of meters, modems, their configuration and ongoing performance reliability.

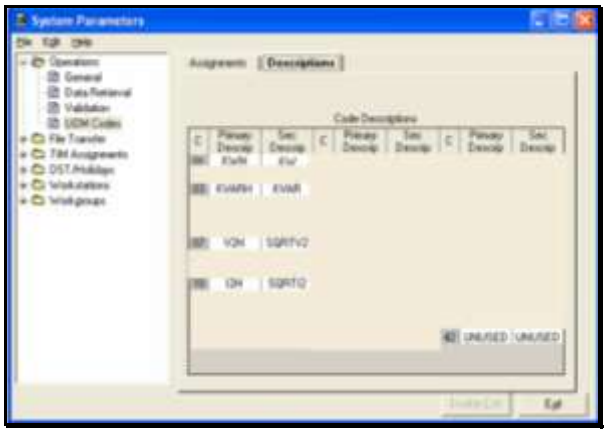
Figure 1. Typical Socket Meter for the Itron SENTINEL® Meter

2. IESO MV-90 System Configuration

2.1 MV-90 UOM Codes

The IESO's MV-90 system has been configured to accept **only UOM** codes **01 (kWh), 03 (kVARh), 07 (V^2h), 10 (I^2h)**, and **42 (UNUSED)** for all incoming MIRT files for new and upgraded meter registrations. Once the legacy meters have been deregistered, these will be the only UOM codes used in the IESO's MV-90 system.

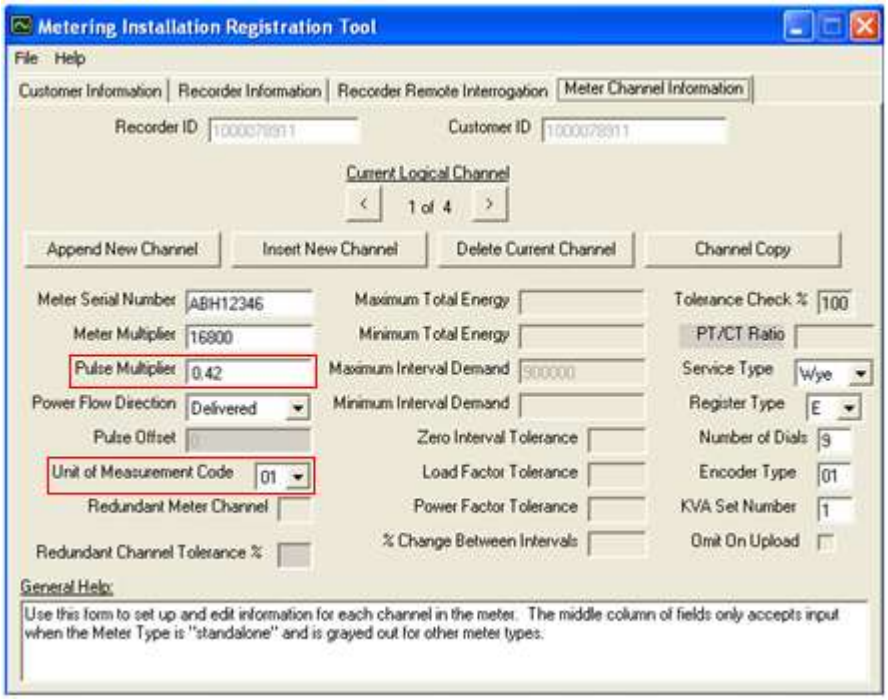


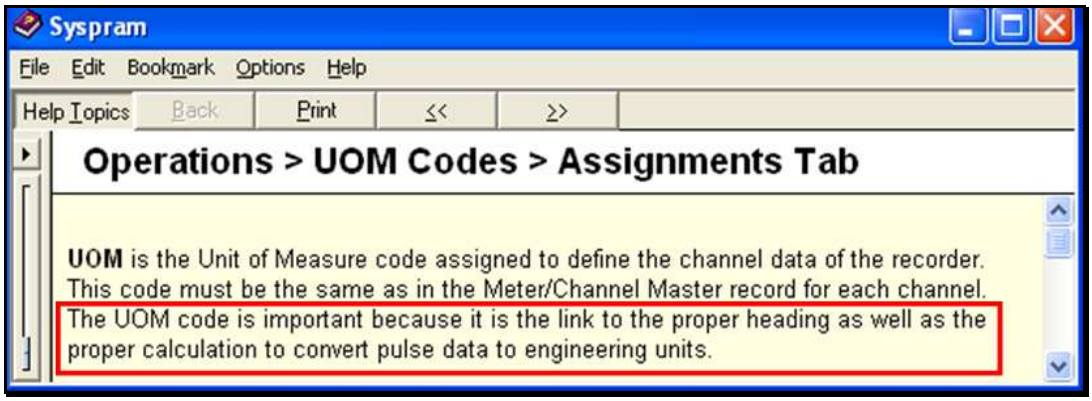


Conforming meters that have been programmed to record information on any channels beyond 10 (for Main meters) or beyond 4 (for Alternate meters) **must** be submitted with a Metering Installation Registration Tool (MIRT) file that has been configured with UOM code 42 ("UNUSED") for all additional channels that are not used by the IESO.

All pulse weight values that are entered into the "**Pulse Multiplier**" field of every channel record in a MIRT file **must be in units that are dimensionally consistent with the IESO's MV-90 system's UOM code definitions as shown on the previous page.** For example, all pulse weight values that are entered for UOM code 01 **MUST** be in units of **kWh/pulse**. Similarly UOM code 03 pulse weights must be in units of **kVARh/pulse**, UOM code 07 must be in units of **V^2h/pulse**, and UOM code 10 must be in units of **I^2h/pulse**.

Some conforming meters offer load profile programming options that specify pulse weights for UOM codes 01 and 03 in base units per pulse (i.e. Wh/pulse and VARh/pulse). The MSP preparing the MIRT file submission must ensure that all pulse weight units are properly converted into the format required by the IESO's MV-90 system at the time they create the MIRT file. If the units for the pulse weight as submitted are not dimensionally correct with the UOM codes, MV-90 will not properly convert the pulse data into engineering units.





– End of Section –

3. Meter Specific Issues

3.1 Meter Manufacturer's Programming Software

The Itron SENTINEL® meter is programmed using the Itron PC-PRO+® Advanced software application program. This software was formerly known as PC-Pro+® 98 Advanced.

Additional information on this software and the Itron SENTINEL® meter is available at www.itron.com.

3.2 Meter Programming Requirements

Conforming Meters used in the IESO Markets must be approved and must be programmed to comply with the requirements of section 5 of the current issue of the Wholesale Revenue Metering Standard – Hardware.

The "**Meter ID**" field in the PC-PRO+® Advanced meter programming software is mapped to the "**Device ID**" field in MV-90. As detailed in section 5.8 of the Wholesale Revenue Meter Standard – Hardware, the "Meter ID" field for an Itron SENTINEL® meter must be unique, start with the letter "**S**", and consist of an alphanumeric string that is **at least seven (7) characters in length and no more than 15 characters in length**. To prevent duplication within the IESO's MV-90 database, many MSPs have successfully created unique Meter IDs by concatenating the letter S with the meter's inspection (or badge) number. For example if AB Hydro's normal meter inspection number is ABH12346, they would create a Meter ID of "SABH12346" when programming the Itron SENTINEL® meter.

Similar to the Itron QUANTUM® Q1000 meter, the Itron SENTINEL® meter's internal energy registers record energy accumulation in base units of Wh and VARh. These registers can be displayed in base units, kilo units, or mega units on the meter's six digit LCD display. Special consideration must be given to this issue when MSPs are programming the meter and creating MIRT files for interrogating this meter with MV-90. The IESO strongly recommends that the SENTINEL® meter's **display** for the Wh (delivered and received) and VARh (delivered and received) registers be programmed to show these register values in kilo units (kWh, kVARh) with a length of **6 digits** to maintain consistency with the way this data is reported by MV-90.

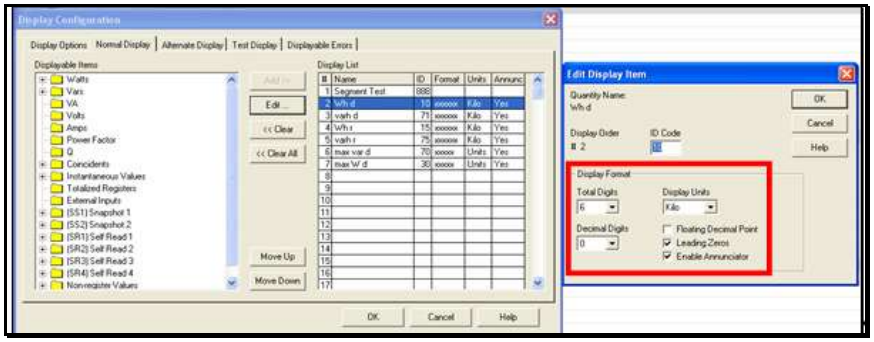
However, unlike the Itron QUANTUM® Q1000 meter, the Itron SENTINEL® meter's internal encoded energy registers do not rollover for all practical purposes. The internal registers will continue to accumulate energy independent of the rollover condition of the meter's physical display registers. The Itron SENTINEL® meter's display registers are limited to a maximum display of six digits and will rollover based on the settings that are programmed into the meter using PC-PRO+® Advanced. The IESO recommends programming the SENTINEL® meter's Normal display to show the Wh delivered, VARh delivered, Wh received, and VARh received registers in **kilo units** to maintain consistency with the units the IESO's MV-90 system uses for storing the SENTINEL® meter's internal encoded energy register readings.

MV-90 reads the Itron SENTINEL® meter's internal encoded energy registers when it interrogates the meter and **by default (without any Config file statements)** returns the internal encoded energy register value in **kilo units**. Itron Canada Technical Support confirmed on January 18, 2005 that the Itron SENTINEL® meter's internal encoded energy registers do not rollover until they accumulate 2^{64} or 1.8×10^{19} Wh. Thus the meter's internal encoded registers will not rollover in the normal six year seal life of a meter. For this reason, the IESO requires all MSPs to use a default value of **9** in the "Number of Dials" field in the MIRT file for Channels 1 to 4 for the Itron SENTINEL® meter. MV-90 presently requires the value entered into the "Number of Dials" field to be an integer between 3 and 9.

Appendix B provides a summary of the calculations that were prepared by IESO staff to determine a standard minimum pulse weight (K_e) value for Wh/pulse and VARh/pulse of **0.025 unit hours per pulse** for the Itron SENTINEL® meter. MSPs should revisit these calculations for their specific circumstances prior to programming a new Itron SENTINEL® meter if they plan to install a meter on a metering installation that uses an input secondary voltage other than 120 Volts or if they plan to operate the meter with a maximum input secondary current in excess of 7.5 Amps.

The following highlights must be addressed when a PC-PRO+® Advanced program is developed for use with an Itron SENTINEL® meter for use in the IESO markets.

Table 1. IESO Items of Interest within PC-PRO+® Advanced Programs for the Itron SENTINEL® Meter

Program Section	Item	IESO Setting	Comments
Description	Measurement Level	Level 2 – and Bi-Directional	Measurement level 2 is the minimum level required plus Bi-directional measurement capabilities required for IESO conforming alternate meter.
Device Operation	Use DST Dates	No	All meters in the IESO markets use **EST only**.
	Enable Bi-Directional Measurement	Yes	Bi-directional measurement capability is required by the IESO.
Device Multipliers	Register Multiplier	1.0	
	CT Ratio	1.0	The Itron SENTINEL® meter must be programmed to record true secondary values. ***No loss adjustments or correction calculations are allowed to be calculated in the meter.***
	VT Ratio	1.0	The Itron SENTINEL® meter must be programmed to record true secondary values. ***No loss adjustments or correction calculations are allowed to be calculated in the meter.***
Display Configuration	Date Format	YY/MM/DD	Recommended to maintain consistency with IESO's MV-90 system parameters.
	Normal Display	kWh del., kVARh del, kWh rec., kVARh rec.	The meter's display should be programmed to show the current contents of each of these energy registers in **kilo units** with a display of **6 digits**. This will maintain consistency with the default format MV-90 uses to store energy register readings taken from the Itron SENTINEL® meter. The Itron SENTINEL® meter's internal encoded energy registers store values in base units (Wh, VARh, etc.).
			
Program Section	**Item**	**IESO Setting**	**Comments**

Load Profile Configuration	Interval Length	5 Minutes	
	Storage Capacity	Must be >= 10 days (2,880) intervals	Meter must be configured to store at least 10 days of 5-minute interval data. Meter can be ordered with either 48 kB or 96 kB of RAM.
Option Board Configuration	Option Board Configuration	SENTINEL Modem Enabled	This is the normal selection for an internal modem. The meter can be ordered with an optional RS-232/RS-485 board (2 versions). This optional board can provide either one or two RS-232 or RS-485 interfaces that can be connected to an external modem. For additional details, please refer to Chapter 5. Communications in the Itron SENTINEL® Meter Technical Reference Guide.
Event Configuration			No specific IESO programming requirements at this time.
Service Configuration	Clock Synchronization	Line Sync	
	Service Type	Auto Service Sense	No specific IESO programming requirements at this time

3.2.1 Power Outage Length Definition

The Itron SENTINEL® meter allows the user to define the minimum time period to allow the interruption of voltage to the meter's internal power supply before the meter assigns a Power Outage Status flag to a load profile interval. This is defined in PC-PRO+® Advanced using the "Outage Length" field on the Load Profile Configuration tab. MSPs are encouraged to use this functionality to reduce the number of nuisance MTRs resulting from momentary power outages caused by distribution system circuit breaker autoreclosures. This can be achieved by defining a time period of between 3 and 15 seconds before a "valid" Power Outage Status will be assigned by the meter to a load profile interval.

IESO staff will review meter programming selections during metering installation audits. The IESO will not allow MSPs to program any conforming meter in a manner that unreasonably masks power outage events that exceed 15 seconds. This ensures that any interval for which voltage supply to the meter is interrupted for more than 5% of its 5 minute duration is properly flagged with a power outage status in MV-90. Where the IESO becomes aware that an MSP has programmed a meter to unreasonably mask short term power outage events, the IESO will require the MSP to replace the meter with one that has been properly programmed.

The Itron SENTINEL® has a single Load Profile section that can each be programmed to record up to 8 quantities. Due to the fact that the Itron SENTINEL® meter is approved for use in the IESO Markets as an ALTERNATE meter only, the IESO will only support reading information from channels 1 to 4. If channels 5 to 8 are configured to measure other quantities, the IESO considers these channels as **UNCONNECTED** and the MSP must assign **UOM 42** to each of these channels in the MIRT file.

Table 2. Itron SENTINEL® Meter Load Profile Configuration #1 Settings – 3 Phase, 4 Wire, 3 Element Meter or 3 Phase, 3 Wire, 2 Element Meter

Parameter		Value					
Storage Capacity:		Minimum value set to 2,880 intervals (10 days of 5-minute intervals)					
Interval Length:		5 Minutes (12 intervals/hr)					
Load Profile Channel	Recorded Value	K_e Value	MV-90 Default Channel Parameters				
			UOM Code	Register Type	Encoder Type	Meter Multiplier	Pulse Multiplier
1	kWh delivered	0.025	01	E	01	PT*CT	(PT*CT*K_e)/1000
2	kVARh delivered	0.025	03	E	02	PT*CT	(PT*CT*K_e)/1000
3	kWh received	0.025	01	E	03	PT*CT	(PT*CT*K_e)/1000
4	kVARh received	0.025	03	E	04	PT*CT	(PT*CT*K_e)/1000
5	Unconnected / Unused		42				
6	Unconnected / Unused		42				
7	Unconnected / Unused		42				
8	Unconnected / Unused		42				

The minimum IESO REQUIREMENT for both 3 element meters and 2 element meters for channels 1-4 is as indicated above.

For additional details, please refer to the sample 3-element PC-PRO+® Advanced program listing provided in Appendix C.

3.3 Itron SENTINEL® Meter Security Code Setup

The Itron SENTINEL® meter must be programmed to use passwords in accordance with the requirements specified in section 5.4.2 of the Wholesale Revenue Metering Standard – Hardware. This functionality is referred to as "Security Codes" within the PC-PRO+® Advanced meter programming software. Each level of security code must be unique and may use an alphanumeric string of up to **20** (twenty) characters in length. The definition and capability of each level of these security codes is provided in the following table.

Table 3. Itron SENTINEL® Security Code Definitions

Security Code	Description	Comments
Primary	Provides read/write access to the meter including all programming options. The only function not available to this permission level is the ability to download new firmware to the meter.	
Limited Reconfigure	Provides read and limited write access including the ability to reset demand, change the time in the device, and reconfigure the device. Does not allow clearing of billing data, change of display modes, or change of security codes.	
Secondary	The Secondary security code provides read-only access to the meter plus the ability to Reset Demand Registers, reconfigure communications, change the meter's Display Mode to Alternate, and set the device clock. The IESO will use the **Secondary** security code to obtain read access to the meter with time reset capability.	When SENTINEL® meter's Event Log is full MV-90 will return Error 22 and time synchronization will not be performed. The meter's Event Log will have to be reset using PCPRO+® Advanced software.
Tertiary	The Tertiary security code provides read-only access to the meter. No operation that writes to the meter is allowed.	
Firmware Download Access	This security code provides unrestricted access to the meter that includes the ability to download new firmware to the meter.	For meters that have been initialized using the Canadian version of PC-PRO+® Advanced, the firmware can only be upgraded if the meter's seal is first cut to allow a "3 button reset" to be performed prior to attempting to upgrade the meter's firmware.

While PC-PRO+® Advanced will allow security codes of up to 20 characters in length to be programmed into the Itron SENTINEL® meter, MV-90 manages this string by taking the entire 20 character string in the **"Reader Password"** field of the Recorder Master File. For additional details, refer to the sample MIRT file screen images shown in Appendix D.

3.4 MV-90 Operations

Similar to the Itron QUANTUM® Q1000 meter, there are two key characteristics of the Itron SENTINEL® meter that have challenged MV-90 and its users since the meter's introduction. These are the SENTINEL®'s method of storing its internal encoded energy registers in base units and its ability to store pulse counts with 16-bit resolution. Fortunately these two issues were addressed early in the SENTINEL® meter's life.

Traditional energy meters have presented accumulated energy consumption data in units of kWh. As a result, MV-90 was designed to use UOM code 01 in units of kWh. When the SENTINEL® meter was developed, they chose to record accumulated energy in base units such as Watt hours and VAR hours to take advantage of 32-bit software storage capability. This created a scaling challenge for MV-90 as it normally receives encoded energy register readings in the same units of measure (kWh, kVARh) as the pulse weights used for measuring load profile interval energy consumption.

The Itron TIM development team learned from the experience they gathered in working with the Itron QUANTUM® Q1000 meter. In early 2002 when Itron developed the initial TIM for the Itron SENTINEL® meter, they designed the TIM module to properly interrogate the SENTINEL® meter's encoded energy registers and by default store the energy register readings in **kilo units** within MV-90. This enabled most MV-90 users to treat the MV-90 Master File set up for the Itron SENTINEL® meter in a "traditional" manner that is used for most multi-function electronic meters with load profile capability. Specifically, in the MV-90 Master File for channel data, the pulse weights used for UOM codes 01 (kWh) and 03 (kVARh) are entered in kilo units per pulse and the meter multiplier is entered as the product of (PT ratio * CT ratio). This enables the normal MV-90 validation tolerance of 100% of the meter multiplier to work properly for reliable and consistent automatic validation of total load profile pulse accumulation vs. difference in encoded register readings for this meter.

Similar to the Q1000 meter, the Itron SENTINEL® meter is a 16-bit meter that is capable of storing pulse counts of up to 65,535 (2^{16}) pulses per interval. However, MV-90 uses a 15-bit algorithm to store interval data in P-files and only supports reading interval data to a maximum of 32,766 pulses per interval. While the Itron SENTINEL® can store up to 65,535 pulses per interval, it is not possible to take full advantage of this functionality when using 5 minute intervals. The range of load profile channel pulse weights (K_e) for the Itron SENTINEL® meter available in the PC-PRO+® Advanced software is between 0.025 and 800.000 unit hours per pulse in increments of 0.025. The calculations provided in Appendix B illustrate that when the SENTINEL® is programmed to use the smallest available pulse weight of 0.025 unit hours per pulse it is still highly unlikely (even with extreme values for secondary meter inputs) that MV-90's interval pulse limit of 32,766 will be exceeded in a 5 minute interval. For this reason, the IESO has adopted **0.025** unit hours per pulse as its **standard pulse weight** for the Itron SENTINEL® meter for UOM codes 01 and 03 (Alternate Meters).

3.5 Interval Data and Channel Data Status Codes

The Itron SENTINEL® meter provides two types of interval data status codes. MV-90 properly returns and identifies the following types of standard interval data and channel data status codes from this meter.

Table 4. Standard MV-90 Interval Data and Channel Data Status Codes Returned from the Itron SENTINEL® Meter and Corresponding PC-PRO+® Advanced Standard Load Profile Status Codes

MV-90 Status Code	MV-90 Status Code Type	MV-90 Status Code Definition	IESO MTR Automatically Generated When Detected	Itron SENTINEL® Meter "Standard" Load Profile Status Code Displayed within PC-PRO+® Advanced	PC-PRO+® Advanced Standard Load Profile Status Code Definition
PO	Interval	Power Outage	**YES**	O	Outage
SI	Interval	Short Interval		S	Short Interval
LI	Interval	Long Interval		L	Long Interval
TR	Interval	Time Reset		A	Time Adjust
CL	Interval	Clock Error	**YES**	C	Clock Error
RA	Interval	RAM Checksum Error		R	Checksum Error
OV	**Channel**	Pulse Overflow	**YES**	V	Overflow
TM	Interval	Test Mode		T	Test Mode

All interval data and channel data status codes that do not result in automatic MTRs are reviewed daily by IESO staff to determine whether a manual MTR should be issued. The IESO's procedure for checking interval status codes with MV-90 is summarized in detail in Market Manual 5.2 Meter Data Processing, Appendix B – Validation Tests for Metering Installations, section B.3 – Tests Required. Please refer to this document for additional details.

The standard load profile interval data status codes used by the SEINTEL® meter can be viewed by using the PC-PRO+® Advanced software to view the meter's load profile data in tabular format. For additional information, please refer to the Itron PC-PRO+® Advanced SENTINEL® Device User's Manual.

3.6 Meter Event Codes

The Itron SENTINEL® meter contains a circular event log file that will track the most recent 188 to 412 events. The number of events recorded before the log wraps around is dependent on the size of the information recorded with the specific type of event. The event log records and event code along with the date and time at which specific meter events and meter diagnostic errors occurred. For additional details on this topic, please refer to Chapter 3 of the Itron SENTINEL® Meter Technical Reference Guide.

The IESO's MV-90 system has been configured to utilize the MV-90 Event Reference Database functionality for enhancing its meter data validation procedures. The IESO is currently utilizing a subset of these event codes within its validation procedures to support the identification of abnormal meter events such as battery failure etc. We expect this capability will be expanded in the future as the IESO, MSPs and MMPs gather more experience working with MV-90 and the event log functionality of both the Itron SENTINEL® meter and other conforming meters.

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Appendix A: Calculation of the Practical MV-90 Energy Register Rollover Value for the Itron SENTINEL® Meter

Unlike the Itron QUANTUM® Q1000 meter, the Itron SENTINEL® meter's internal encoded energy registers do not rollover for all practical purposes.[1.] The internal encoded energy registers will continue to accumulate energy independent of the rollover condition of the meter's physical display registers. The Itron SENTINEL® meter's display register's are limited to a maximum display of six digits on the meter's LCD display and these registers will rollover based on the settings that are programmed into the meter using PC-PRO+® Advanced.

MV-90 reads the Itron SENTINEL® meter's internal encoded energy registers when it interrogates the meter and by default returns the register value in **kilo units**. Notional register rollover values for this meter were investigated as shown below during the development of this document. Based on this review, the IESO has determined that the default value to be used in the "Number of Dials" field in MIRT files for channels 1 to 4 for all SENTINEL meters is **9**.

Projected Maximum Energy Register Accumulation Over The Normal Seal Life of an Itron SENTINEL® Meter

Seal Life [Years]: 10
Number of Days: 3,650
Number of Hours 87,600
5 Min Intervals: 1,051,200

Meter Inputs - assume worst case continuous operation at these levels.

Elements	Volts	Amps	Power Factor
3	140	7.5	1.0

Wh and VARh Registers						
Energy per Interval	262.50 Wh	Number of Digits	**If offered, the** PC-PRO+® Advanced Register Rollover Selection would be	Number of Digits	Maximum Number of Required Digits on Meter's Internal Energy Register [Wh - base units]	**MIRT File "Number of Dials" Value to be used by MV-90 (TIM 30) for Channels 1 to 4 [kWh / kVARh]**
Energy over 10 Year Period	275,940,000 Wh	9	**1,000,000,000**	10	**9**	**9**

By default, the IESO will force MV-90 to use the largest rollover setting possible in MV-90 for the Itron SENTINEL® meter - 9 Dials

[1.] Itron Canada Technical Support confirmed on January 18, 2005 that the Itron SENTINEL® meter's internal encoded energy registers do not rollover until they accumulate 2^{64} or 1.8×10^{19} Wh.

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Appendix B: Minimum Pulse Weight Calculations for Load Profile Channels of the Itron SENTINEL® Meter

Load profile channel pulse weights (K_e) used for the Itron SENTINEL® meter must be selected from a range of PC-PRO+® Advanced supported values for this meter between 0.025 and 800.000 unit hours per pulse in increments of 0.025. The channel pulse weights must also be selected in a manner that limits the allowable maximum number of pulses per 5 minute interval to 32,766 to comply with an MV-90 limitation.

The IESO has adopted **0.025** unit hours per pulse as its **standard pulse weight** for the Itron SENTINEL® meter for UOM codes 01 and 03 (Alternate Meters). The following calculations demonstrate that a pulse overflow condition within MV-90 is highly unlikely for a SENTINEL® meter when it is used in a typical IESO wholesale metering installation.

Calculations of Minimum Internal Pulse Weights for Programming Itron SENTINEL® Meters

Case 1. Watthours - 3 Element Meter - 3 Phase, 4 Wire Load with CT current of 7.5 A (150% of Nominal Limit)

Voltage [V]	Current [A]	Power Factor	No. of Phases	Instantaneous Watts [W]	Interval Length [min.]	Energy per Interval [Wh]	MV-90 Restricted Meter Pulse Limit per Interval [pulses]	Calculated Ke (min) [Wh/pulse]	IESO STANDARD Pulse Weight [Wh/pulse, VARh/pulse]
140	7.5	1	3	3,150.0	5	262.5	32,766	0.00801	**0.025**

Projected maximum number of pulses per interval base on IESO STANDARD pulse weight: 10,500

Case 2. Watthours - 2 Element Meter - 3 Phase, 3 Wire Load with CT Current of 7.5 A (150% of Nominal Limit)

Voltage [V]	Current [A]	Power Factor	No. of Phases	Instantaneous Watts [W]	Interval Length [min.]	Energy per Interval [Wh]	MV-90 Restricted Meter Pulse Limit per Interval [pulses]	Calculated Ke (min) [Wh/pulse]	IESO STANDARD Pulse Weight [Wh/pulse, VARh/pulse]
140	7.5	1	2	2,100.0	5	175.0	32,766	0.00534	**0.025**

Projected maximum number of pulses per interval base on IESO STANDARD pulse weight: 7,000

NOTE: Unlike the Itron QUANTUM® Q1000 meter, the smallest available pulse weight supported by the SENTINEL® meter is 0.025 Wh / pulse.

Note: The units of measure WITHIN the Itron SENTINEL® meter for UOM 01 and 03 are base units (not kilo units) of Watthours (Wh) and VARhours (VARh).

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Appendix C: Sample Itron PC-PRO+® Advanced Program Listing for the Itron SENTINEL® Meter

The following sample program listing was produced using Itron PC-Pro+® Advanced for with IESO recommended settings for a 3 Element, Alternate meter (4 Channel) with internal modem. Key fields and IESO mandatory settings are highlighted in yellow.

PC-PRO+® Advanced

Item	Program Value
Description	
Program Name	IMO SAMPLE FILE 3 EL SENTINEL
Program ID	3234
Measurement Level	Level 4 (Wh/P.F./VAh/4Q Varh/Qh) Bi-Directional
Measurement Sublevel	None
Description	SS4A4L, 20A, 3EL, 120-480V, Ks=3.6, x1,MM, KYZ (0.05) 4Q
Date Created	2005-01-18 6:00:53 PM
Date Modified	2005-03-17 7:14:31 AM
Device Operation	
Demand Calculation	Rolling Demand
Enable Time of Use	No
Use DST Dates	No
Demand Only Meter	No
Enable Bi-Directional	Yes
Enable Voltage and Current	No
Enabled Totalized Registers	No
Device Multipliers	
Multiplier Type	Transformer Rated
Register Multiplier	1.000000
CT Ratio	1.0
VT Ratio	1.0
Meter Multiplier (Kr)	1.000000
Register Full Scale	7.200 KW
Time of Use Selection	
TOU Schedule ID	None selected.

Quantity Selections

Energy Registers	
Energy Register #1	Wh d
Energy Register #2	Wh r
Energy Register #3	varh d
Energy Register #4	varh r
Energy Register #5	VAh Vec d
Energy Register #6	VAh Vec r
Energy Register #7	Unassigned
Energy Register #8	Unassigned
Demand Registers	
Demand Register #1	max W d
Demand Register #2	var d @ max W d
Demand Register #3	max W r
Demand Register #4	max var d
Demand Register #5	W d @ max var d
Demand Register #6	max var r
Demand Register #7	max VA Vec d
Demand Register #8	max VA Vec r
Demand Register #9	Unassigned
Demand Register #10	Unassigned

Display Configuration

Display Options	
Display Scroll On Time	7 Seconds
Meter Rating	Secondary
Date Format	YY/MM/DD
Enable EOI	Yes
Enable Load Indicator	Yes
Enable Nominal Voltage Indicator	No
Enable Phase Indicator	Yes
Missing Phase Indicator	Blink
Display Tool Box at Power Up	No
Displayable Errors	
Low Battery	Scroll
Loss of Phase	Ignore
Clock, TOU Error	Ignore
Reverse Power Flow	Ignore
Load Profile Error	Scroll
Full Scale Overflow	Ignore
Reserved	Ignore
Reserved	Ignore
SiteScan Error	Ignore

Normal Display

Item 1	Segment Test
Item 2	Wh d
Item 3	varh d
Item 4	Wh r

Item 5	varh r
Item 6	max W d
Item 7	max var d
Item 8	max W r
Item 9	max var r
Item 10	Current Date
Item 11	Current Time
Item 12	Unassigned
Item 13	Unassigned
Item 14	Unassigned
Item 15	Unassigned
Item 16	Unassigned
Item 17	Unassigned
Item 18	Unassigned
Item 19	Unassigned
Item 20	Unassigned
Item 21	Unassigned
Item 22	Unassigned
Item 23	Unassigned
Item 24	Unassigned
Item 25	Unassigned
Item 26	Unassigned
Item 27	Unassigned
Item 28	Unassigned
Item 29	Unassigned
Item 30	Unassigned
Item 31	Unassigned
Item 32	Unassigned

Alternate Display

Item 1	Segment Test
Item 2	ins W
Item 3	ins var
Item 4	ins VA Vec
Item 5	ins PF
Item 6	Minutes on Battery
Item 7	Firmware Revision
Item 8	Software Revision
Item 9	Unassigned
Item 10	Unassigned
Item 11	Unassigned
Item 12	Unassigned
Item 13	Unassigned
Item 14	Unassigned
Item 15	Unassigned
Item 16	Unassigned
Item 17	Unassigned
Item 18	Unassigned
Item 19	Unassigned
Item 20	Unassigned

Item 21	Unassigned
Item 22	Unassigned
Item 23	Unassigned
Item 24	Unassigned
Item 25	Unassigned
Item 26	Unassigned
Item 27	Unassigned
Item 28	Unassigned
Item 29	Unassigned
Item 30	Unassigned
Item 31	Unassigned
Item 32	Unassigned

Test Display

Item 1	Wh d
Item 2	Wh r
Item 3	varh d
Item 4	varh r
Item 5	max W d
Item 6	max W r
Item 7	max var d
Item 8	max var r
Item 9	Unassigned
Item 10	Unassigned
Item 11	Unassigned
Item 12	Unassigned
Item 13	Unassigned
Item 14	Unassigned
Item 15	Unassigned
Item 16	Unassigned

Normal Display Format

Item 1 ID	888
Item 1 Format	Text Field
Item 2 ID	11
Item 2 Format	xxxxxx; Kilo; Annunciator; Leading Zero;
Item 3 ID	31
Item 3 Format	xxxxxx; Kilo; Annunciator; Leading Zero
Item 4 ID	12
Item 4 Format	xxxxxx; Kilo; Annunciator; Leading Zero
Item 5 ID	32
Item 5 Format	xxxxxx; Kilo; Annunciator; Leading Zero
Item 6 ID	15
Item 6 Format	xxxx.xx; Units; Annunciator; No Leading Zero;
Item 7 ID	35
Item 7 Format	xxxx.xx; Units; Annunciator; No Leading Zero;
Item 8 ID	16
Item 8 Format	xxxx.xx; Units; Annunciator; No Leading Zero;
Item 9 ID	36
Item 9 Format	xxxx.xx; Units; Annunciator; No Leading Zero;

Item 10 ID	90
Item 10 Format	Text Field
Item 11 ID	91
Item 11 Format	Text Field
Item 12 ID	0
Item 12 Format	Text Field
Item 13 ID	0
Item 13 Format	Text Field
Item 14 ID	0
Item 14 Format	Text Field
Item 15 ID	0
Item 15 Format	Text Field
Item 16 ID	0
Item 16 Format	Text Field
Item 17 ID	0
Item 17 Format	Text Field
Item 18 ID	0
Item 18 Format	Text Field
Item 19 ID	0
Item 19 Format	Text Field
Item 20 ID	0
Item 20 Format	Text Field
Item 21 ID	0
Item 21 Format	Text Field
Item 22 ID	0
Item 22 Format	Text Field
Item 23 ID	0
Item 23 Format	Text Field
Item 24 ID	0
Item 24 Format	Text Field
Item 25 ID	0
Item 25 Format	Text Field
Item 26 ID	0
Item 26 Format	Text Field
Item 27 ID	0
Item 27 Format	Text Field
Item 28 ID	0
Item 28 Format	Text Field
Item 29 ID	0
Item 29 Format	Text Field
Item 30 ID	0
Item 30 Format	Text Field
Item 31 ID	0
Item 31 Format	Text Field
Item 32 ID	0
Item 32 Format	Text Field
Alternate Display Format	
Item 1 ID	888
Item 1 Format	Text Field
Item 2 ID	10

Item 2 Format	xxxx.xx; Units; Annunciator; No Leading Zero;
Item 3 ID	30
Item 3 Format	xxxx.xx; Units; Annunciator; No Leading Zero;
Item 4 ID	40
Item 4 Format	xxxx.xx; Units; Annunciator; No Leading Zero;
Item 5 ID	50
Item 5 Format	xxxx.xx; Units; Annunciator; No Leading Zero;
Item 6 ID	92
Item 6 Format	Text Field
Item 7 ID	93
Item 7 Format	Text Field
Item 8 ID	94
Item 8 Format	Text Field
Item 9 ID	0
Item 9 Format	Text Field
Item 10 ID	0
Item 10 Format	Text Field
Item 11 ID	0
Item 11 Format	Text Field
Item 12 ID	0
Item 12 Format	Text Field
Item 13 ID	0
Item 13 Format	Text Field
Item 14 ID	0
Item 14 Format	Text Field
Item 15 ID	0
Item 15 Format	Text Field
Item 16 ID	0
Item 16 Format	Text Field
Item 17 ID	0
Item 17 Format	Text Field
Item 18 ID	0
Item 18 Format	Text Field
Item 19 ID	0
Item 19 Format	Text Field
Item 20 ID	0
Item 20 Format	Text Field
Item 21 ID	0
Item 21 Format	Text Field
Item 22 ID	0
Item 22 Format	Text Field
Item 23 ID	0
Item 23 Format	Text Field
Item 24 ID	0
Item 24 Format	Text Field
Item 25 ID	0
Item 25 Format	Text Field
Item 26 ID	0
Item 26 Format	Text Field
Item 27 ID	0

Item 27 Format	Text Field
Item 28 ID	0
Item 28 Format	Text Field
Item 29 ID	0
Item 29 Format	Text Field
Item 30 ID	0
Item 30 Format	Text Field
Item 31 ID	0
Item 31 Format	Text Field
Item 32 ID	0
Item 32 Format	Text Field
Test Display Format	
Item 1 ID	11
Item 1 Format	xxxxxx; Kilo; Annunciator; Leading Zero;
Item 2 ID	12
Item 2 Format	xxxxxx; Kilo; Annunciator; Leading Zero;
Item 3 ID	31
Item 3 Format	xxxxxx; Kilo; Annunciator; Leading Zero;
Item 4 ID	32
Item 4 Format	xxxxxx; Kilo; Annunciator; Leading Zero;
Item 5 ID	15
Item 5 Format	xxxx.xx; Units; Annunciator; No Leading Zero;
Item 6 ID	16
Item 6 Format	xxxx.xx; Units; Annunciator; No Leading Zero;
Item 7 ID	35
Item 7 Format	xxxx.xx; Units; Annunciator; No Leading Zero;
Item 8 ID	36
Item 8 Format	xxxx.xx; Units; Annunciator; No Leading Zero;
Item 9 ID	0
Item 9 Format	Text Field
Item 10 ID	0
Item 10 Format	Text Field
Item 11 ID	0
Item 11 Format	Text Field
Item 12 ID	0
Item 12 Format	Text Field
Item 13 ID	0
Item 13 Format	Text Field
Item 14 ID	0
Item 14 Format	Text Field
Item 15 ID	0
Item 15 Format	Text Field
Item 16 ID	0
Item 16 Format	Text Field

Demand Thresholds

Demand Threshold 1	
Quantity	Unassigned
Threshold	1.000
Demand Threshold 2	

Quantity	Unassigned
Threshold	1.000
Demand Threshold 3	
Quantity	Unassigned
Threshold	1.000
Demand Threshold 4	
Quantity	Unassigned
Threshold	1.000

Normal Mode Register Operation

Demand Interval Length	15 Minutes
Number of Subintervals	3
Cold Load Pickup Time	5 Minutes
Outage Length before Cold Load Pickup	900 Seconds
Demand Reset Lockout Time	1 Minutes

Test Mode Register Operation

Test Interval Length	3 Minutes
Number of Subintervals	3

LED Operation

LED Normal Mode Quantity	Wh d
LED Normal Mode Kh (Normal Kh)	3.600
LED Alternate Mode Quantity	varh d
LED Alternate Mode Kh (Normal Kh #2)	3.600
LED Test Mode Quantity	Wh r
LED Test Mode Test Kh	3.600
LED Test Alt Mode Quantity	varh r
LED Test Alt Mode Test Kh	3.600

Switch Operation

Mode Timeout	30 Minutes
Disable Demand Reset Switch	No
Disable Test Mode Switch	No

Load Profile Configuration

Number Channels	4
Interval Length	5 Minutes
Memory Size	96 KBytes
Outage Length	3 Seconds
Channel 1	Wh d
Pulse Weight	0.025
Channel 2	varh d
Pulse Weight	0.025
Channel 3	Wh r
Pulse Weight	0.025
Channel 4	varh r
Pulse Weight	0.025
Channel 5	Unassigned

Pulse Weight	1.000
Channel 6	Unassigned
Pulse Weight	1.000
Channel 7	Unassigned
Pulse Weight	1.000
Channel 8	Unassigned
Pulse Weight	1.000

Self Read Configuration

Self Read Schedule	Self Read on Nth Day of Month
Scheduled Day	1
Scheduled Hour	0
Scheduled Minute	1
Reset Demand after Read	No

Billing Schedule Configuratio n

Billing Schedule	None Scheduled

SiteScan Configuration

#1 Cross Phase, Polarity, Energy Flow Check	Scroll
Current Lead/Lag Tolerance	90.0 Degrees
#2 Phase Voltage Deviation Check	Scroll
Percent Tolerance for Phase Voltage Deviation	10%
#3 Inactive Phase Current Check	Disable
#4 Phase Angle Displacement Check	Ignore
Tolerance for Phase Angle Displacement	65.0 Degrees
Minimum Current Threshold	0.5%
#5 Current Waveform Distortion Check	Scroll

I/O Configuration

I/O Board Type	Solid State Contacts with 2 KYZ, 1 LC, and 2 Pulse/State Inputs
Disable Output in Test Mode	No
Output 1	
Output Type	Toggle on Energy
Output Quantity	Wh d
Pulse Weight	0.050
Pulse Width	0 msec
Output 2	
Output Type	Toggle on Energy
Output Quantity	varh d
Pulse Weight	0.050
Pulse Width	0 msec
Output 5	

Output Type	Pulse on Event
Output Quantity	Demand EOI
Pulse Width	10 msec
Input 1	
Desired Action	None selected.
Input 2	
Desired Action	None selected.

Option Board Configuration

Option Board Configuration	SENTINEL Modem Enabled
Modem Configuration	
Off Hook Detect Enabled	No
Phone Line Sharing Enabled	No
Answer Outside Call Window	No
Outside Call Window Answer Delay	10
Inside Call Window Answer Delay	4
Answer Baud Rate	2400
Weekday Window 1 Start	00:00
Weekday Window 1 Stop	23:59
Weekday Window 2 Start	00:00
Weekday Window 2 Stop	23:59
Saturday Window 1 Start	00:00
Saturday Window 1 Stop	23:59
Saturday Window 2 Start	00:00
Saturday Window 2 Stop	23:59
Sunday Window 1 Start	00:00
Sunday Window 1 Stop	23:59
Sunday Window 2 Start	00:00
Sunday Window 2 Stop	23:59
Holiday Window 1 Start	00:00
Holiday Window 1 Stop	23:59
Holiday Window 2 Start	00:00
Holiday Window 2 Stop	23:59
Phone Home Configuration	
Blind Dialing Enabled	No
Blind Dialing Wait Time	5
Allow Call Outside Call Window	No
Time to Wait for Answer	60
Number of Attempts	16
Limit Retries	No
Dial Type	Tone Dialing
Phone Number 1	None
Phone Number 1 Baud Rate	2400
Phone Number 2	None
Phone Number 2 Baud Rate	2400
Phone Number 3	None
Phone Number 3 Baud Rate	2400
Phone Number 4	None

Phone Number 4 Baud Rate	2400
Initial Phone Home Type	No Initial Call Scheduled
Phone Home Event Configuration	
Number of Events	0

Event Configuration

Log Events	
Clear Billing Data	Yes
Configuration Error	Yes
Demand Reset	Yes
Demand Threshold Exceeded	Yes
Demand Threshold Restored	Yes
Diagnostic 1 Off	Yes
Diagnostic 1 On	Yes
Diagnostic 2 Off	Yes
Diagnostic 2 On	Yes
Diagnostic 3 Off	No
Diagnostic 3 On	No
Diagnostic 4 Off	Yes
Diagnostic 4 On	Yes
Diagnostic 5 Off	Yes
Diagnostic 5 On	Yes
DST Time Change	No
Event Log Cleared	No
Full Scale Overflow	Yes
Input High	No
Input Low	No
Load Profile Error	No
Logon Successful	No
Loss of Phase	Yes
Loss of Phase Restored	Yes
Low Battery	Yes
Meter Reprogrammed	No
Option Board	No
Power Outage	Yes
Power Restored	Yes
Register Self Read	Yes
Reverse Power Flow	Yes
Reverse Power Flow Restored	Yes
Season Change	No
Security Fail	Yes
Security Pass	No
SiteScan Error	No
Test Mode Entered	No
Test Mode Exited	No
Time Changed	Yes
TOU Schedule Error	No

Service Configuration

Clock Synchronization	Line Sync
Service Type	Auto Service Sense
Delay until Service Sense	15 Seconds
Auto Detect 6S in 9S	No

User Data

User Data #1
User Data #2
User Data #3

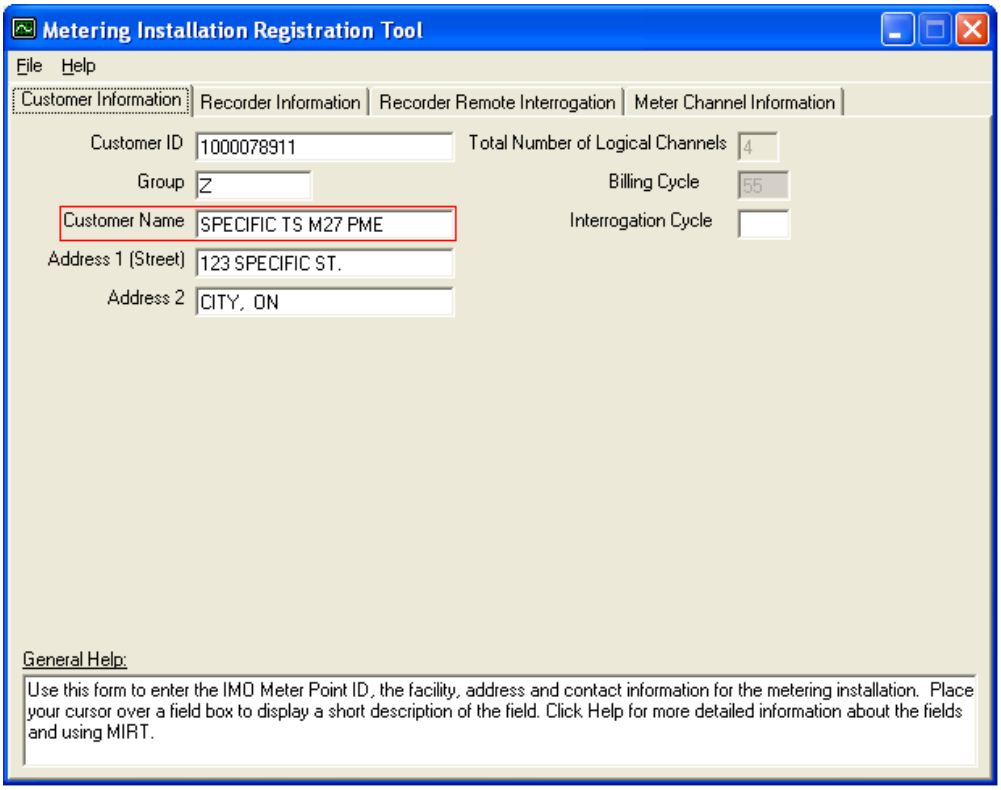
– End of Section –

Appendix D: Sample MIRT File Screen Images for the Itron SENTINEL® Meter

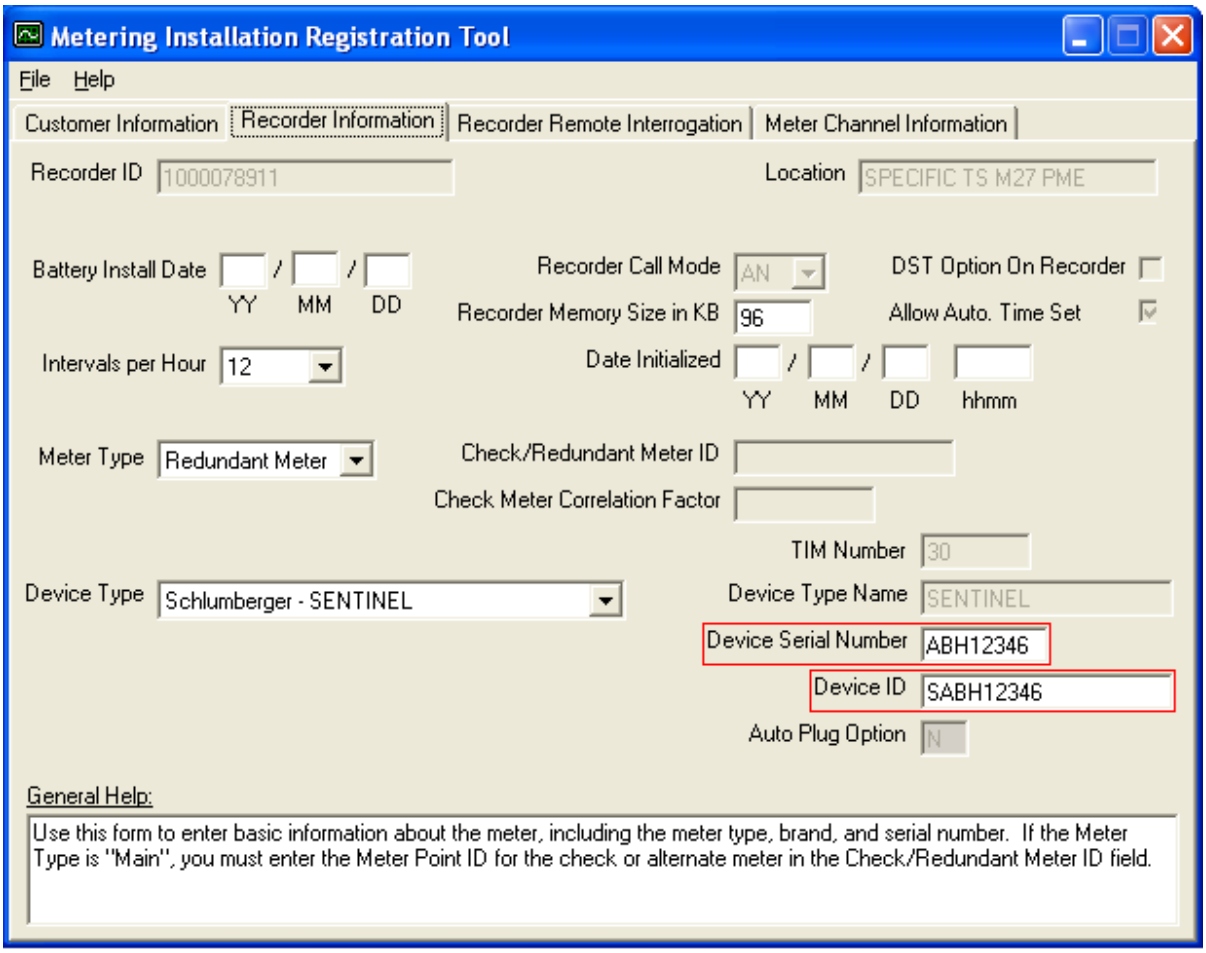
The following screen images were developed using the MIRT version 1.05.a software. MSPs and MMPs should use the following link to ensure they check for updated versions of the MIRT software prior to creating a new MIRT file submission. www.ieso.ca/imoweb/metering/mirt.asp

MSPs normally submit completed MIRT files to the IESO via e-mail to MV90MasterFiles@ieso.ca. Where the MSP has programmed the meter with any non-standard value (i.e. Ke, register rollover, etc.), the body of the e-mail message to which the MIRT file is attached should be used to document this information to ensure the incoming MIRT file review process can be completed efficiently and accurately. For Alternate Meters where the MIRT file does not contain the connected CT and PT ratios, the MSP should confirm the connected CT and PT ratio in the body of the e-mail message as well.

The example shown in this appendix is for a 3 element Itron SENTINEL® meter that has been programmed for use as an Alternate meter (4 channel) in the IESO markets. The instrument transformer ratios used for developing the screen images in this example are PT ratio of 16800:120 (140) and CT ratio of 600:5 (120).



The "Customer Name Field" must be populated with the meter point's circuit description as shown in the example above.

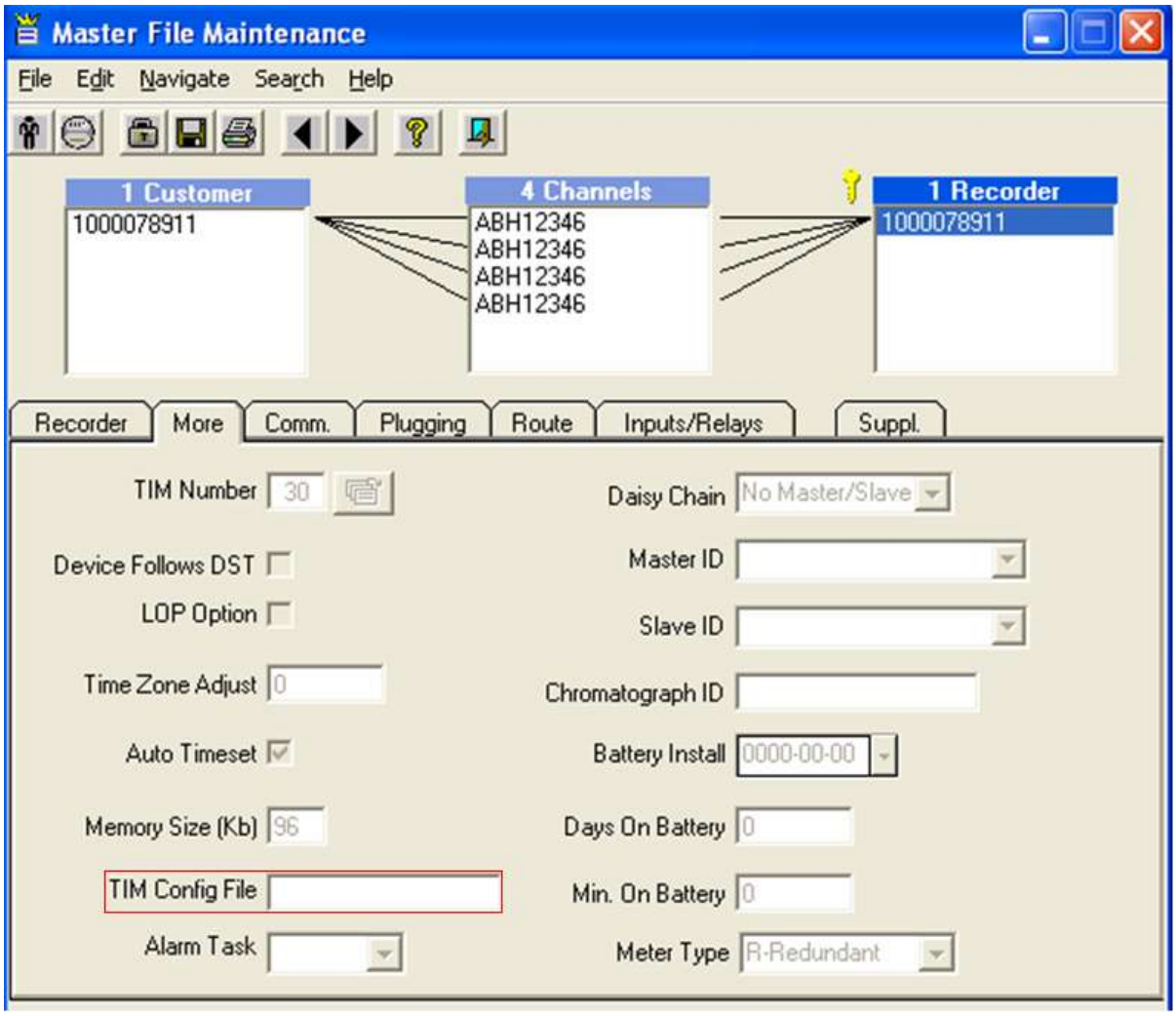


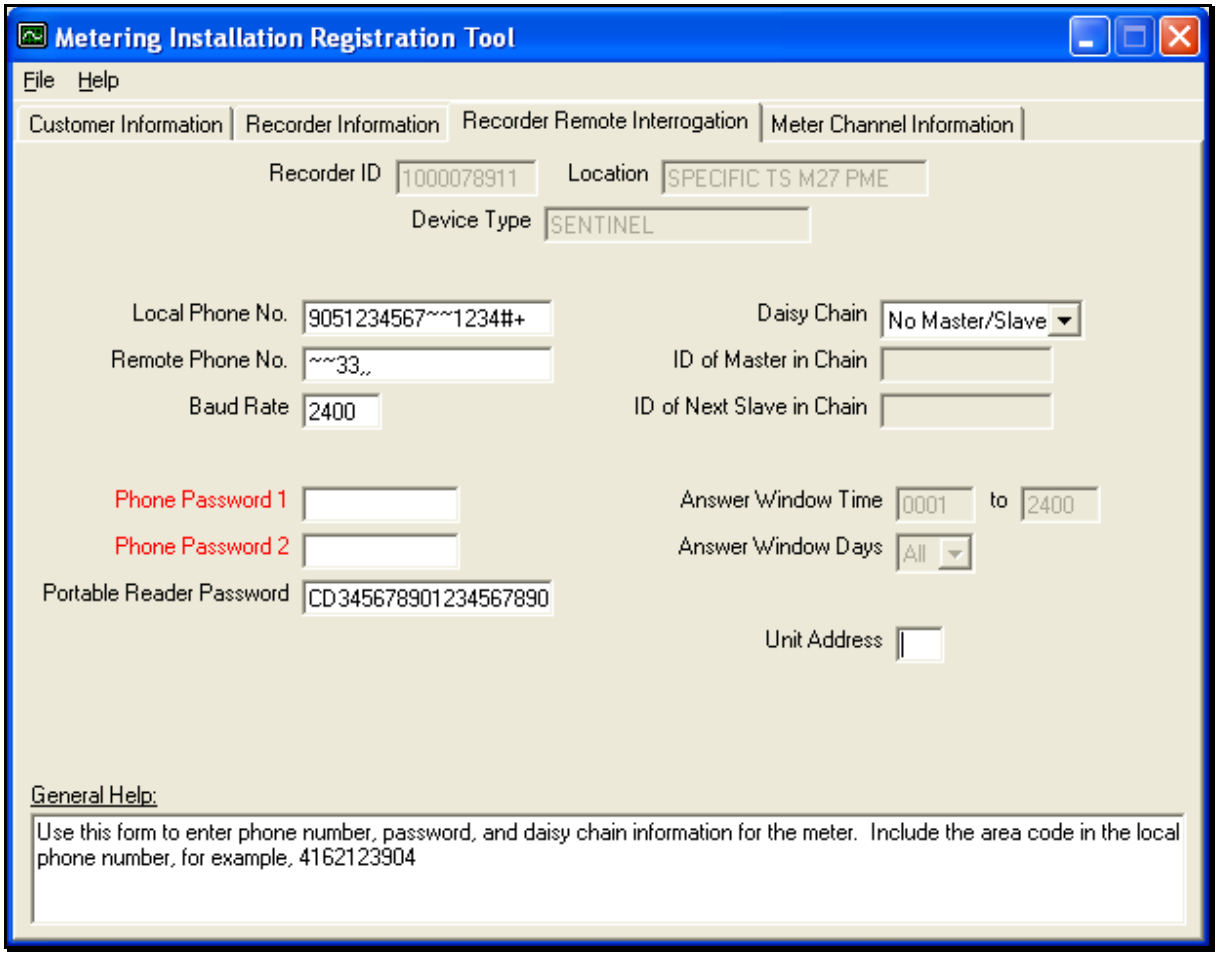
The IESO requires the SENTINEL's meter inspection number (also referred to as the meter badge number) in the "Device Serial Number" field.

The "Device ID" must contain an alphanumeric string that begins with the letter "S", is at least 7 and not more than 15 characters in length, and is unique in the IESO MV-90 database.

The IESO has experienced meter registration difficulties when MSPs create MIRT files using their own MV-90 system and include a config file name in the "**TIM Config File**" field located on the "More" tab of the Recorder data record. For any MSP that chooses to create a MIRT file using their own MV-90 system to export a MIRT file rather than composing the MIRT file using the MIRT software, it is imperative that the "**TIM Config File**" field be blank within the MIRT file submitted to the IESO. Failure to do this will result in the MSP being assessed with a Meter Registration Error.

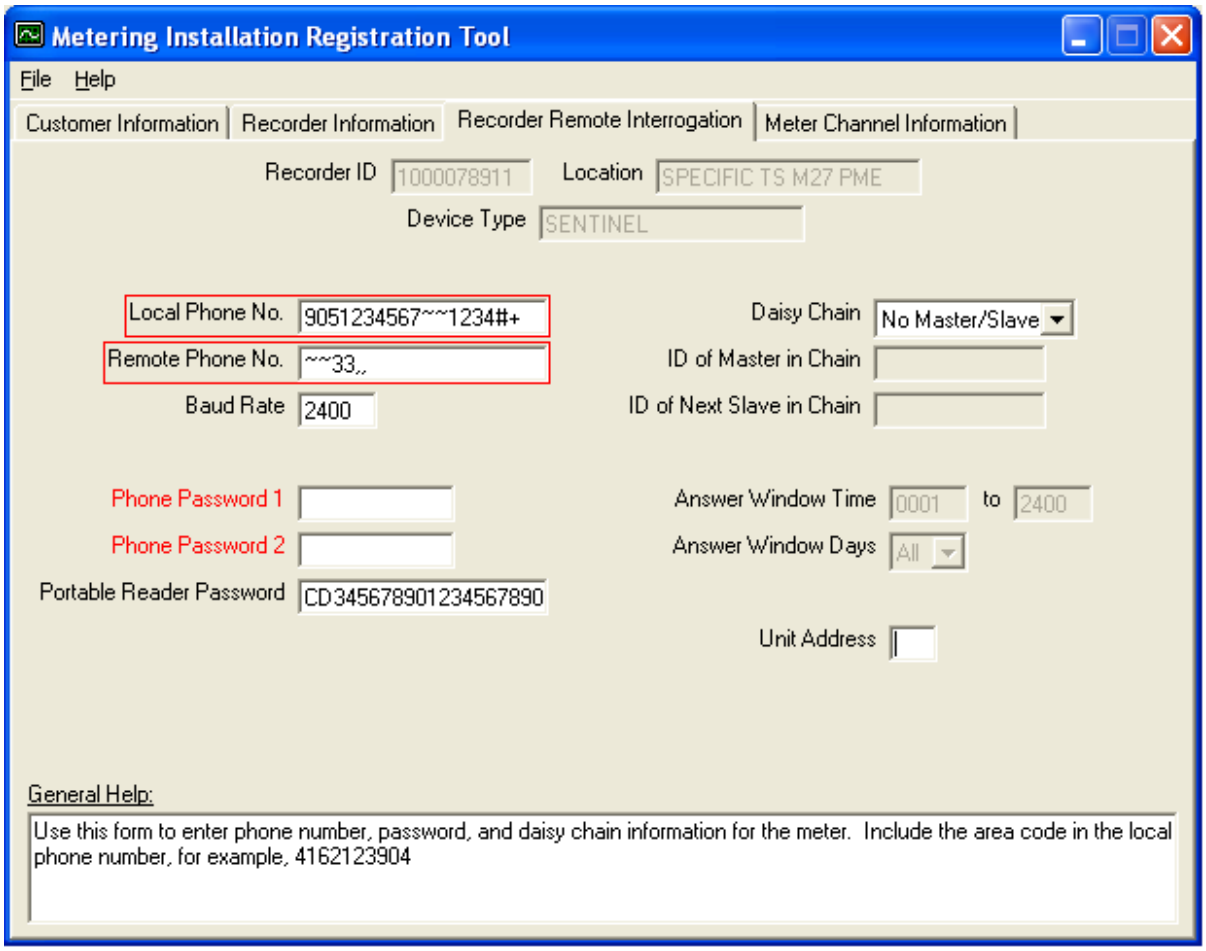
The IESO is presently modifying its internal MIRT file review process to verify this field is blank and will not accept any MIRT file that contains a non blank "**TIM Config File**" field. When incoming MIRT files are discovered with characters in the "**TIM Config File**" field, the IESO will not process the MIRT file and will request the MSP to submit a replacement MIRT file.





In this example, both the "Phone Password 1" and the "Phone Password 2" fields are shown in red. The MIRT software expects both the "Phone Password 1" and "Phone Password 2" fields to be completed before saving the file. However, MV-90 requires that the SENTINEL meter's **Secondary security code** (as defined in the PC-PRO+® Advanced meter programming software) to be stored in the "**Portable Reader Password**" field in order to handle its maximum 20 character length in a single string. The IESO will use the **Secondary** security code to obtain read access to the meter with time reset capability.

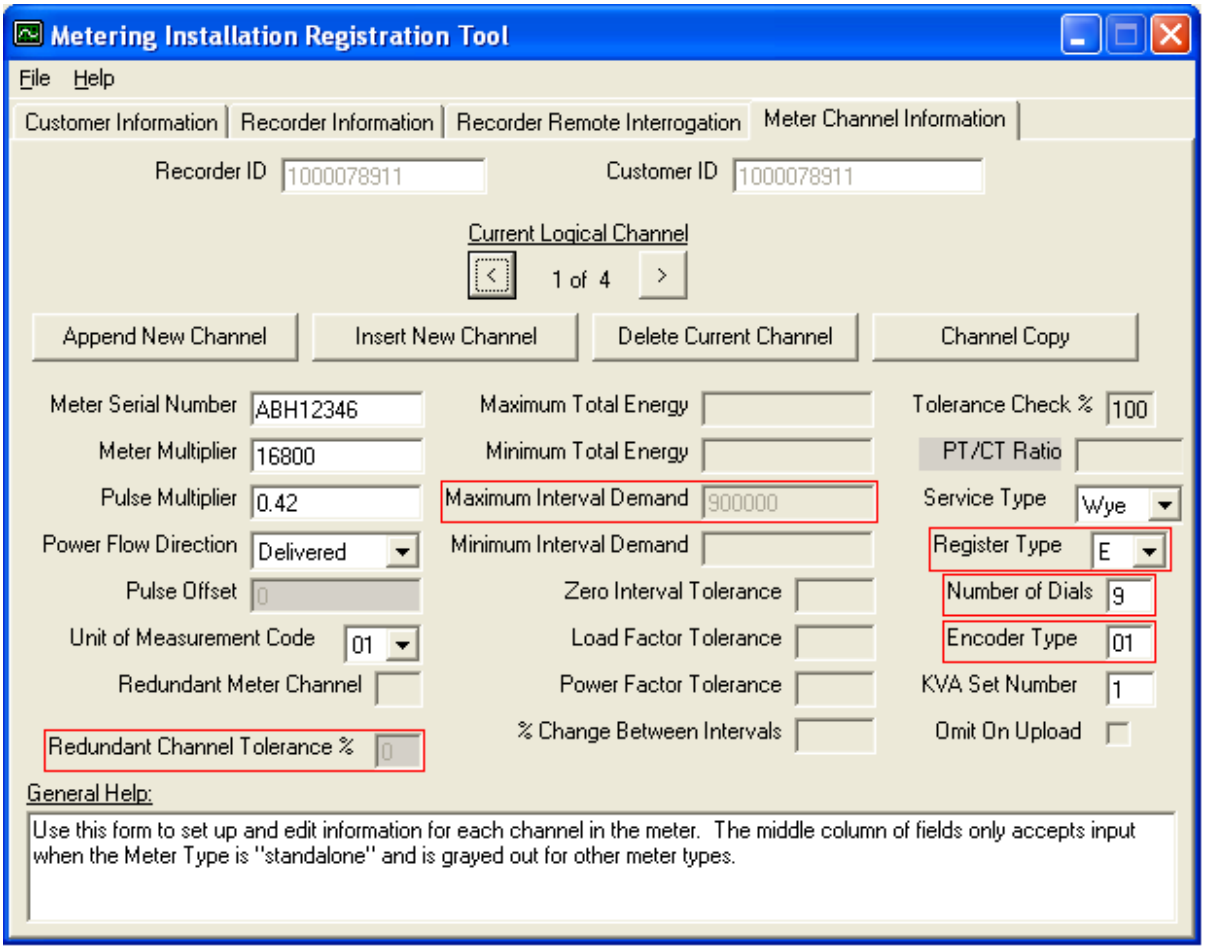
The "Portable Reader Password" field is used to hold the specific address of the meter if a multi-drop RS-232 or RS-485 interface bus is used to communicate with multiple meters at the same site. Valid addresses are numbers between 1 and 254. The IESO recommends that the MSP only populate this field after they have proven reliable communication with the meter using their own MV-90 system.



Note: When a MIRT file is submitted, the first 10 characters in the "Local Phone No." field must consist of the exact 10 digit telephone number (3 digit area code plus 7 digit local telephone number) without any other characters such as commas, hyphens, etc.

The "Local Phone No." field above shows the complete 10 digit phone number for the meter including the leading area code (9051234567), the dialing delay characters (a comma is typically a 0.5 to 2 second delay and the tilde symbol (~) is equivalent to 5 commas),the internal telephone extension number (1234), and the transfer character (#) some automated telephone attendants require.

IESO staff will add any leading characters (typically 9 if it is a local call for the IESO or 91 if it is a long distance call) to the telephone number in this field when they initially attempt to call the meter using the IESO's MV-90 system. If the meter has a complicated dial string that exceeds 17 digits in the MIRT file, then the MSP must enter a "+" symbol at the 18th character position in the "Local Phone No." field and then enter the balance of the dial string (to a maximum of 20 additional digits) in the "Remote Phone No." field such as additional dialing delay codes (~~), and the address of the port that the meter is connected to on the telephone line sharing switch (33 in this example). The "Local Phone No." field will accept up to a 20 character dial string. The 17 limit reserves space for two additional characters for the IESO staff to add in a leading "91" and one additional character for the "+" symbol to instruct MV-90 to look for the balance of the dial string in the "Remote Phone No." field.



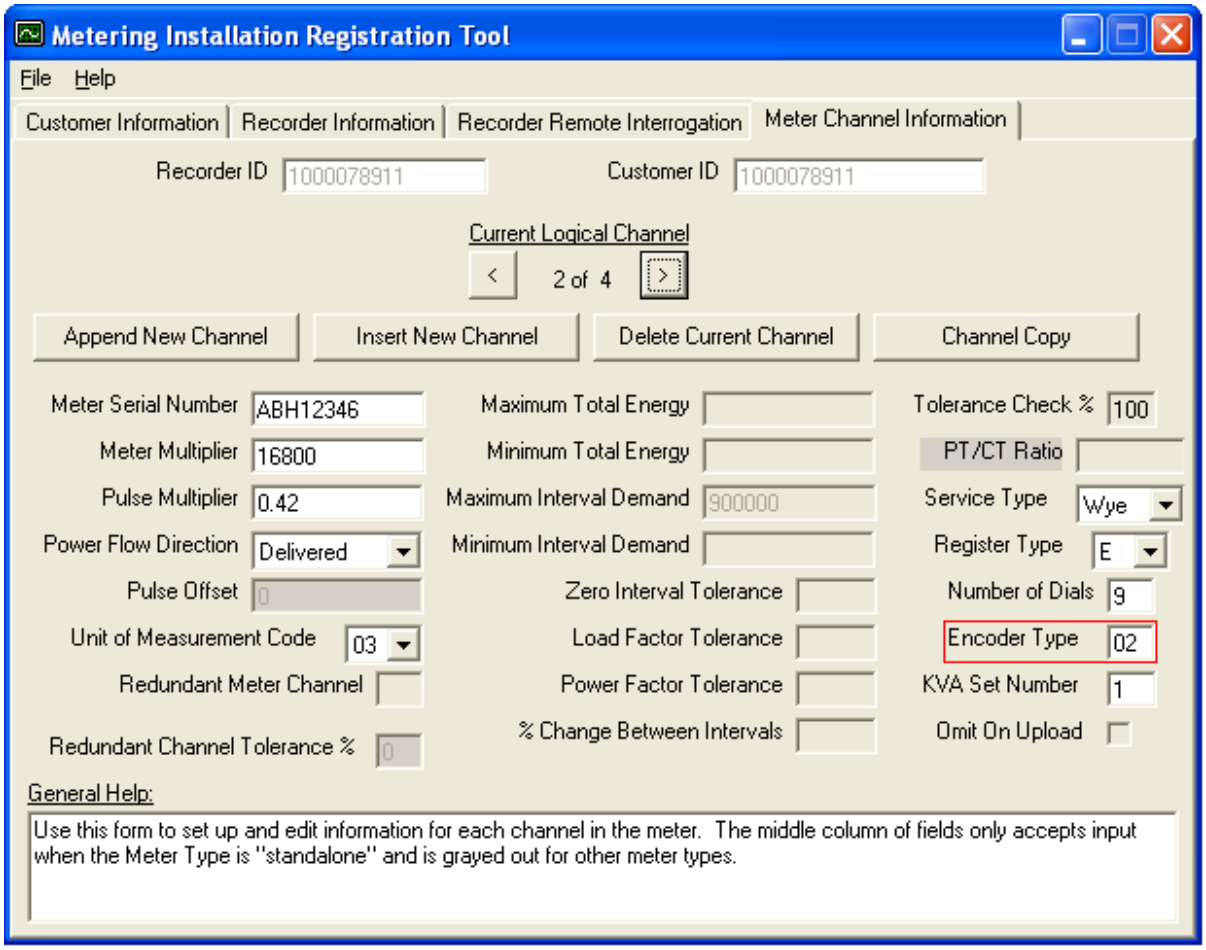
The "Number of Dials" field for Channels 1 to 4 should always be 9. This field represents the maximum number of digits that the Itron SENTINEL® meter's internal encoded register readings will be stored in by MV-90 before MV-90 interprets a register rollover. By default, MV-90 returns the encoded energy register readings for all Itron SENTINEL® meters in **kilo units**

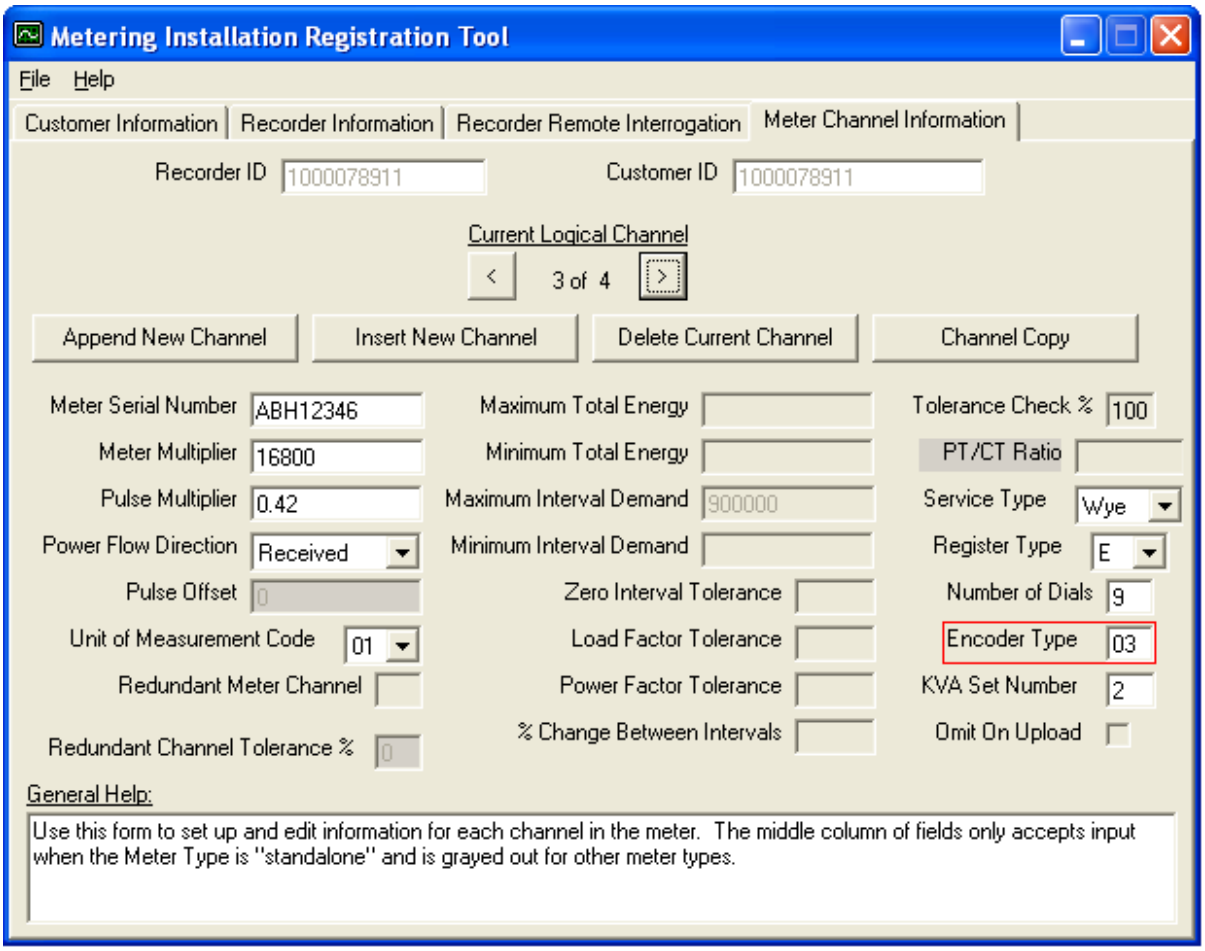
The "Register Type" field should always be set to "E" for "Encoder"' for Channels 1 to 4 of a MIRT file for the Itron SENTINEL® meter. Also, the "Encoder Type" field MUST be set to "01" for Channel 1, "02" for Channel 2, "03" for Channel 3, and "04" for Channel 4.

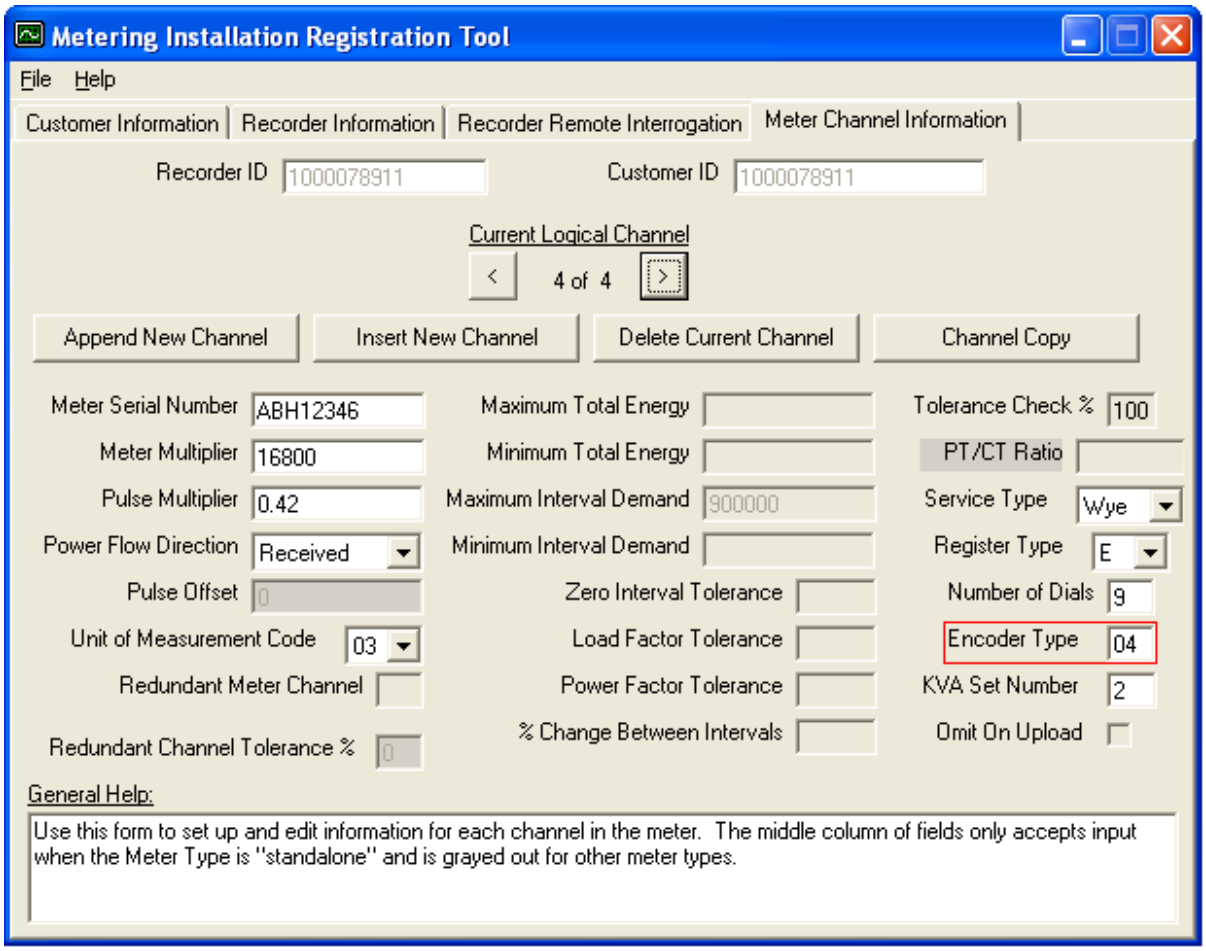
The "Redundant Channel Tolerance %" field is now set to 0 by default for all channels in the MIRT tool. MSPs creating MIRT files using MV-90 should set this value to 0 as well for all channels. The IESO is now using MV-STAR to complete an hourly validation of the interval data in the Conforming Main vs. Alternate meters. For additional details, please refer to Appendix B.3 of Market Manual 5.2: Meter Data Processing.

The MIRT tool also sets a default a value of 900,000 into the "Maximum Interval Demand" field for all channels. After a meter has been registered and the IESO has a reasonable period of actual interval data to review, IESO process includes adjusting the "Maximum Interval Demand" values for channels 1 to 4 of the Main and Alternate meters based on validation principles.

The next three screenshots show the meter information for channels 2, 3 and 4.


Metering Installation Registration Tool
File Help
Customer Information
Recorder Information
Recorder Remote Interrogation
Meter Channel Information
Recorder ID 1000078911
Customer ID 1000078911
Current Logical Channel
2 of 4
Append New Channel
Insert New Channel
Delete Current Channel
Channel Copy
Meter Serial Number ABH12346
Meter Multiplier 16800
Pulse Multiplier 0.42
Power Flow Direction Delivered
Pulse Offset 0
Unit of Measurement Code 03
Redundant Meter Channel
Redundant Channel Tolerance % 0
Maximum Total Energy
Minimum Total Energy
Maximum Interval Demand 900000
Minimum Interval Demand
Zero Interval Tolerance
Load Factor Tolerance
Power Factor Tolerance
% Change Between Intervals
Tolerance Check % 100
PT/CT Ratio
Service Type Wye
Register Type E
Number of Dials 9
Encoder Type 02
KVA Set Number 1
Omit On Upload
General Help:
Use this form to set up and edit information for each channel in the meter. The middle column of fields only accepts input when the Meter Type is "standalone" and is grayed out for other meter types.


Metering Installation Registration Tool
File
Help
Customer Information
Recorder Information
Recorder Remote Interrogation
Meter Channel Information
Recorder ID
1000078911
Customer ID
1000078911
Current Logical Channel
3 of 4
Append New Channel
Insert New Channel
Delete Current Channel
Channel Copy
Meter Serial Number
ABH12346
Meter Multiplier
16800
Pulse Multiplier
0.42
Power Flow Direction
Received
Pulse Offset
0
Unit of Measurement Code
01
Redundant Meter Channel
Redundant Channel Tolerance %
0
Maximum Total Energy
Minimum Total Energy
Maximum Interval Demand
900000
Minimum Interval Demand
Zero Interval Tolerance
Load Factor Tolerance
Power Factor Tolerance
% Change Between Intervals
Tolerance Check %
100
PT/CT Ratio
Service Type
Wye
Register Type
E
Number of Dials
9
Encoder Type
03
KVA Set Number
2
Omit On Upload
General Help:
Use this form to set up and edit information for each channel in the meter. The middle column of fields only accepts input when the Meter Type is "standalone" and is grayed out for other meter types.



– End of Section –

References

Document Name	Document ID
IESO Wholesale Revenue Metering Standard - Hardware	MDP_STD_0004
IESO Market Manual 5: Settlements Part 5.2: Meter Data Processing	MDP_PRO_0032
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