DTS Current Sensor Configuration

Configuring DTS AC & DC Current Sensors
Revision R23A

TABLE OF CONTENTS

1 SCOPE

1.1 IDENTIFICATION

This document describes the user configuration of different types of current sensors for the Measurlogic DTS series of RGM meters.

This document applies to models **DTS 305**, **DTS 307**, **DTS 310**, **DTS SMX, DTS SKT** and **DTS DC**.

1.2 INTRODUCTION

This document discusses:

- The type of outputs for CTs and the variations that exist.

- The current input hardware type options for a DTS meter.

- The user configurable options for different CTs.

- How to set these configurable options in the DTS meter.

2   CURRENT SENSORS

2.1   Introduction

There are many different current sensors available for AC and DC metering. This section discusses the various type of sensor outputs and the corresponding DTS meter current input hardware required.

2.1.1 Sensor Output Options & Meter Hardware requirements

Current sensors are available with a wide variety of electrical output types, which have unique current input requirements for the meter. Therefore, the current input hardware of the DTS meter must match the type of electrical output from the sensor for proper operation. If there is a mismatch, damage to the meter and/or the current sensor may result.

Where existing current sensors are installed, the DTS meter must be ordered with the correct type of current input hardware to match the output of the existing current sensors.

For new installations, you can choose a commonly used current input for the DTS meter and then match the current sensors to the meter. For example, choosing a 333mV input AC DTS meter gives you access to a wide variety of cost-effective CTs with different current ratings and frame sizes. In addition, the Measurlogic 333mV input AC DTS meters can accept Rogowski Coil CTs directly without an external integrator module.

The "ab" field of the DTS meter model builder specifies the current and voltage input hardware. Here is a list of some of current sensor types showing the "a" field of the DTS model number ("b" field shown as "x"):

- 5A Secondary   AC current   (5x)
- 333mV   AC voltage   (3x)
- Current Shunt   DC voltage   (Tx)
- 20mA Hall Effect   DC current   (Jx)
- 10V Hall Effect   DC voltage   (Vx)

2.1.2 User Configuration

Current sensors with similar output types can have variations. For example:

1. A 20mA output Hall Effect current sensor may have output current ranges. The maximum current outputs are all 20mA, so all are compatible with a 20mA input meter, but the current output for zero input current (offset) and current range from zero to maximum rated input current (span) varies:

   - 0mA – 20mA   (unipolar – Only Positive current measurement)
   - 4mA – 20mA   (unipolar – Only Positive current measurement)
   - 4mA – 12mA – 20mA   (bipolar – Positive and Negative current measurement)

2. Similarly, a 100mV shunt would require a meter input capable of measuring a voltage of at least 100mVdc. A 50mV shunt is electrically compatible with a 100mV meter input, except that at full scale the output of a 50mV shunt is half that of a 100mV shunt, so a 2x scaling needs to be employed for a 50mV shunt on a 100mV input.

3. Unlike 333mV CTs which have an output of 333mV at the rated current of the CT, Rogowski Coil CTs are rated in terms of the mV output per 1000A. This number can vary, with the most common values being 70mV, 120mV, 140mV and 400mV per 1000A. The sensitivity of the meter input must be matched to the output of the Rogowski Coil CT for correct measurement readings.

3 DTS METER CURRENT INPUT HARDWARE TYPE

3.1 Introduction

Previously, DTS AC meters were tailored specifically for one type of current sensor output, and this could not be reconfigured in the field. The DTS meters were setup and calibrated at the factory specifically for 333mV, Rogowski Coils, shunt outputs or Hall Effect with specific offsets and ranges.

Newer DTS firmware allows much greater flexibility in this regard. The current input hardware type of the meter is fixed since this is determined by the actual hardware that is fitted in the meter. However, the user can now configure the DTS meter to accommodate different sensor output variations. The firmware versions that support these new features are detailed in the sections below.

3.2 Configuration Options for DTS Meter Current Inputs (AC)

The current input hardware types for the DTS AC meters are shown in the sections below, together with any firmware version restrictions.

3.2.1 Legacy

This section applies to DTS AC meters with firmware before V3.1250. Even though the current input hardware type used for these DTS meters falls into the categories below, the sensor output variation was pre-configured at the factory and could not be changed in the field.

- The CT Current Rating must be set to the rated current of the Current Sensor.
- The only CurrentSensor value is zero and applies to all firmware to firmware older than V3.1250.

DTS Meter Current Input Hardware Type = Legacy		
Compatible Current Sensor	**Current Sensor Variation Description**	**CT Rating**
0	Varying current sensors – Not Configurable	Sensor Rating

3.2.2 1V (1x)

The 1V current input is designed for 1V output CTs only. The voltage output from 1V CTs is about 3 times that of 333mV CTs.

- 1V output CTs cannot be used with meters with 333mV current inputs.
- The 1V current input cannot be configured for Rogowski Coil CTs.
- The only CurrentSensor value is zero and applies to all firmware versions.

DTS Meter Current Input Hardware Type = 1V (1x)		
Compatible Current Sensor	**Current Sensor Variation Description**	**CT Rating**
0	1V CT	CT Rating

3.2.3 333mV (3x)

The 333mV current input is one of the most versatile current input hardware types and is available for most of the meter in the DTS Series. A wide variety of cost-effective CTs with numerous current ratings and frame size options. In addition, the Measurlogic 333mV input AC DTS meters can accept Rogowski Coil CTs directly without an external integrator module.

The CurrentSensor values below apply to firmware versions between V3.1250 and V3.1270, as well as any firmware version greater than V3.1900.

- The CurrentSensor register to select the 333mV CTs or the Rogowski Coil sensitivity.
- The CT Current Rating must be set to the Rated Current of the CT for 333mV CTs.
- The CT Current Rating must be set to either the maximum or panel current for Rogowski Coils.

DTS Meter Current Input Hardware Type = 333mV (3x)		
Compatible Current Sensor	**Current Sensor Variation Description**	**CT Rating**
0	333mV CT	CT Rating
140,000	140mV / 1000A @ 60Hz Rogowski Coil Max 2500A	Max or Panel
70,000	70mV / 1000A @ 60Hz Rogowski Coil Max 5000A	Max or Panel
120,000	120mV / 1000A @ 60Hz Rogowski Coil Max 3000A	Max or Panel
400,000	400mV / 1000A @ 60Hz Rogowski Coil Max 800A	Max or Panel
Other	Any 40mV to 400mV Rogowski Coil is supported	Max or Panel

3.2.4 5A Secondary (5x)

The secondary 5A is measured directly by the meter. The following is user configurable:

- The CT Current Rating must be set to the Rated Current of the CT
- The CT Secondary register can be select between 1A and 5A to support XXX:1A and XXX:5A CTs.
- The only CurrentSensor value is zero and applies to all firmware versions.

DTS Meter Current Input Hardware Type = 5A Secondary (5x)		
Compatible Current Sensor	**Current Sensor Variation Description**	**CT Rating**
0	5A Secondary Current Output CT	CT Rating

3.2.5 Internally Burdened (9x)

This current input hardware type is used where the current sensor hardware input is customized for a particular current sensor. The meter and the CTs are then calibrated as a set, thus associating any of the CTs to a particular meter serial number and phase. These days, this is only used for special cases and for meters where the CTs are contained within the meter itself, for example: self-contained socket meters.

- This current input hardware type does NOT support any user configuration of the sensor, including the CT Rating, which is fixed and CANNOT be changed.
- The only CurrentSensor value is zero and applies to all firmware versions.

DTS Meter Current Input Hardware Type = Internally Burdened (9x)		
Compatible Current Sensor	**Current Sensor Variation Description**	**CT Rating**
0	Custom Sensor Configurations	**Fixed**

3.3 Configuration Options for DTS Meter Current Inputs (DC)

The current input hardware types for the DTS DC meters are shown in the sections below. DTS DC meters with firmware V3.1990 and later allow for more flexible handling of sensor output current variations.

3.3.1 Legacy

This section applies to DTS DC meters with firmware before V3.1960. Even though the current input hardware type used for these DTS meters falls into the categories below, the sensor output variation was pre-configured at the factory and could not be changed in the field.

- The CT Current Rating must be set to the rated current of the Current Sensor.
- The only CurrentSensor value is zero and applies to all firmware to firmware older than V3.1960.

DTS Meter Current Input Hardware Type = Legacy		
Compatible Current Sensor	Current Sensor Variation Description	CT Rating
0	Varying current sensors – Not Configurable	Sensor Rating

3.3.2 100mV Shunt (Tx)

The 100mV current input of the DTS meter is suitable for current shunts. Different current shunt sensitivities are supported. The 100mV input is capable of measuring from -100mV to +100mV so can measure currents in either direction.

- The CT Current Rating must be set to the rated current of the Current Shunt.
- The CurrentSensor values below apply to firmware V3.1960 and later.

DTS Meter Current Input Hardware Type = 100mV Shunt (Tx)		
Compatible Current Sensor	Current Sensor Variation Description	CT Rating
0	100mV Shunt (Default if not explicitly specified)	Shunt Rating
100,000	100mV Shunt	Shunt Rating
50,000	50mV Shunt	Shunt Rating
60,000	60mV Shunt	Shunt Rating
75,000	75mV Shunt	Shunt Rating
Other	Any 40mV to 120mV Shunt is supported	Shunt Rating

DTS Current Sensor Configuration

3.3.3 20mA Hall Effect (Jx)

The 20mA current input of the DTS meter is suitable for 20mA Hall Effect current sensors. Different output variations are supported. The 20mA input is capable of measuring from - -20mA to +20mA. Current is either direction can be measured.

- The CT Current Rating must be set to the rated current of the Hall Effect Current Sensor.
- The CurrentSensor values below apply to firmware V3.1990 and later.

DTS Meter Current Input Hardware Type = 20mA Hall Effect (Jx)		
Compatible Current Sensor	Current Sensor Variation Description	CT Rating
0	-20mA - 0mA - 20mA (Bipolar Full Range)	HE Rating
1	0mA - 20mA (Unipolar Full Range)	HE Rating
10	4mA - 12mA - 20mA (Bipolar with 12mA being zero)	HE Rating
9	4mA - 20mA (Unipolar with 4mA being zero)	HE Rating

3.3.4 10V Hall Effect (Vx)

The 10V current input of the DTS meter is suitable for 10V Hall Effect current sensors. The 10V input is capable of measuring from -10V to +10V so can measure currents in either direction.

- The CT Current Rating must be set to the rated current of the Hall Effect Current Sensor.
- The CurrentSensor values below apply to firmware V3.1990 and later.

DTS Meter Current Input Hardware Type = 10V Hall Effect (Vx)		
Compatible Current Sensor	Current Sensor Variation Description	CT Rating
0	-10V - 0V - 10V (Bipolar 10V Sensor Output)	HE Rating
1	0V - 10V (Unipolar 10V Sensor Output)	HE Rating
2	0V - 5V - 10V (Bipolar with 5V being zero)	HE Rating
3	-5V - 0V - 5V (Bipolar 5V Sensor Output)	HE Rating
4	0V - 5V (Unipolar 5V Sensor Output)	HE Rating

3.3.5 HE9 Hall Effect Only (Wx)

The HE9 Hall Effect input of the DTS meter is a special 5V input specifically created for the Measurlogic HE9 Hall Effect Sensor with a 1.5V – 2.5V – 3.5V voltage output range.

- The CT Current Rating must be set to the rated current of the Hall Effect Current Sensor.
- This input is NOT compatible with any other type of Hall Effect current sensor.
- The CurrentSensor values below apply to firmware V3.1990 and later.

DTS Meter Current Input Hardware Type = 10V Hall Effect (Wx)		
Compatible Current Sensor	**Current Sensor Variation Description**	**CT Rating**
0	DTS DC3-Wx meters with firmware before V3.1990	HE Rating
12	1.5V - 2.5V - 3.5V (Bipolar with 2.5V being zero)	HE Rating

4 SETTING THE CURRENT SENSOR CONFIGURATION USING MODBUS

4.1 Modbus Advisories

The **Standard DTS Modbus Map document** should be studied before attempting to use any of the **advanced** registers described in this document. In particular, the **Introduction**, and **General Information** sections on **Modbus Registers** (data types and size, register order, region and 0/1-based issues) should be fully understood.

NOTE

Capabilities are model dependant, so some registers, or register setting values, may not be applicable or relevant to certain models.

HINT

This document contains 32-bit numbers in hexadecimal (HEX) format. In order to convert these HEX numbers to decimal format, use the Windows Calculator in scientific mode.

4.2 Verifying Correct Modbus Communications

ATTENTION
Before proceeding any further, it is imperative to verify that your Modbus client application is correctly configured to access the 32-bit double register values in the DTS meter. This to ensure that any new values are correctly written to the intended registers in the meter. If you do NOT get the expected results from this verification test, or you do not understand the instructions in the rest of this document contact Measurlogic for assistance. DO NOT write anything to the meter.

Before proceeding any further, it is imperative to verify that your Modbus client application is correctly configured to access the 32-bit double register values in the DTS meter. In particular, that it expects 1-based register address numbers, and that the register order for these 32-bit values is LO-Hi.

The easiest way to do this is by performing this simple verification test:

1. Read the 32-bit integer value from the Modbus Holding register at address 10003.

   A. If this value matches the serial number printed on the meter label, then this 32-bit register was read correctly, and you may proceed.

   B. If this value DOES NOT match the serial number printed on the meter label, then you are accessing the 32-bit registers in the DTS meter INCORRECTLY. Therefore, DO NOT proceed any further, and contact Measurlogic for assistance.

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Page 10
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4.3   MODBUS REGISTERS

The following Modbus registers are applicable to the DTS Current Sensor Configuration:

4.3.1   CT Current Rating (Primary) Register

The "CT_Rating" registers contain the CT Current Rating (Primary) for the CTs use with the meter.

- Normally the CTs that are used with the meter must ALL have the same current rating and must be sized appropriately for the panel rating. Please contact Measurlogic Inc for advice on CT selection for your application.

- The "CT_Rating_1" register is normally used for the CT Current Rating for all the CTs. Only some topologies allow different CT Current Ratings on each channel.

- The "Inverter" topology option allows the CT monitoring the Inverter output to have a different current rating, which is suitably sized for the inverter. See our *"Measurlogic DTS Modbus Addendum (Single Phase Inverter Map)"* document for more application details of the DTS meter in a single phase 3-wire system with an inverter.

Description	Units	DTS Resolution	Modbus Address	
CT_Rating_1	A	0.001	16009	CT Rating for CT 1
CT_Rating_2	A	0.001	16061	CT Rating for CT 2
CT_Rating_3	A	0.001	16063	CT Rating for CT 3 (Inverter)

4.3.2   Current Sensor Register

The "CurrentSensor" register contains information about the user configurable options for the Current Sensor Output variation. The sections above contain specific information for each type of sensor.

- This object defines the Current Sensor Type for the CTs on all three phases:
  - Rogowski Coils   - Sensitivity in mV per 1000A @ 60Hz   (e.g. 140mV = 140,000)
  - Shunts   - Sensitivity in mV at Rated Current   (e.g. 100mV = 100,000)
  - CTs (333mV/5A)   - Must be zero (0).
  - Output Variations   - See above sections for codes.

Description	Units	DTS Resolution	Modbus Address	
CurrentSensor (mV Sensors)	mV	0.001	16073	Current Sensor Sensitivity
CurrentSensor (Sensor Type)	None	1	16073	Current Sensor Type

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