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SP-005

Thermocouple and RTD Smart Probe

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Table of Contents

1 Notes, Warnings, and Cautions

If the equipment is used in a manner not specified in this manual, the protection by the equipment may be impaired.

Do not operate the equipment in flammable or explosive environments.

It is important to read and follow all precautions and instructions in this manual before operating or commissioning this device as it contains important information relating to safety and EMC. Failure to follow all the safety precautions may result in injury and / or damage to your equipment.

The following labels identify information that is especially important to note:

Note: Provides you with information that is important to successfully setup and use the SP-005.

Caution or Warning: Tells you about the risk of electrical shock.

Caution, Warning, or Important: Tells you of circumstances that can affect the instruments functionality and must refer to accompanying documents.

2 Introduction

The Layer N SP-005 Thermocouple and RTD Smart Probe provides an easy way to integrate your thermocouple and RTD probes to the Layer N Ecosystem. The SP-005 accepts standard M12 thermocouples and RTDs through its M12 4-pin connector and Layer N Smart Interfaces through its M12 8-pin connector. The optional M12-S-M-FM connector can be utilized to easily connect wire leads typically found on thermocouples or RTD probes to your SP-005. The SP-005 supports up to 2 thermocouple inputs or a single 2, 3, or 4-wire RTD input.

The Layer N SP-005 features 2 configurable digital I/O pins. These can be used for a myriad of applications including driving relays, physical alarms, or sensing dry contacts like door switches. The SP-005 can also be utilized as an edge controller, with autonomous independent decision-making capabilities to generate local alarms or provide control outputs based on sensor inputs.

Included with your SP-005

- SP-005 Unit
- Quick Start Guide

Additional Material Needed

- Layer N Smart Interface\Computer with Windows OS
- SYNC configuration software
- RTD or Thermocouple Probe

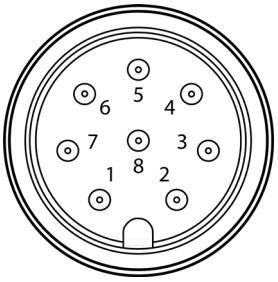
Optional Materials

- M12-S-M-FM Screw Terminal Accessory

3 Hardware Setup

3.1 Connecting your Layer N Smart Interface

The SP-005 requires a Layer N Smart Interface to connect to your computer. Use the M12 8-Pin Connector diagram below to connect your SP-005 to your Layer N Smart Interface.

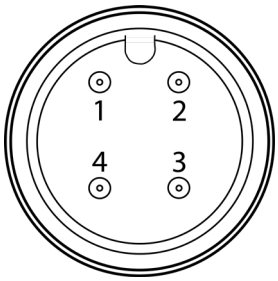


M12 8-Pin Connector

Pin	Name	Function
Pin 1	DIO 0	Discrete I/O Signal 0
Pin 2	INTR	Interrupt Signal
Pin 3	SCL	I2C Clock Signal
Pin 4	SDA	I2C Data Signal
Pin 5	Shield	Shield Ground
Pin 6	DIO 1	Discrete I/O Signal 1
Pin 7	GND	Power Ground
Pin 8	3.3VDD	Power Supply

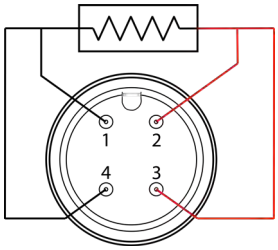
3.2 Thermocouple and RTD Wiring Diagram

Most M12 thermocouple and RTD probes can be connected directly to the SP-005. If you are connecting wire directly to the SP-005, view the wiring diagrams provided below:

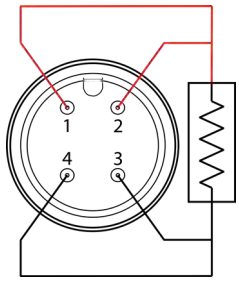


M12 4-Pin Connector

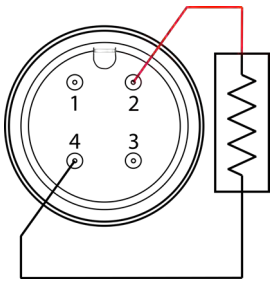
Pin	Thermocouple
Pin 1	TC 2 Negative
Pin 2	TC 1 Positive
Pin 3	TC 1 Negative
Pin 4	TC 2 Positive



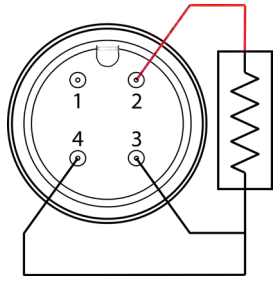
RTD 4 Wire Option 1



RTD 4 Wire Option 2



RTD Wire 2



RTD Wire 3

4 SYNC Configuration

Layer N Smart Probe products are easily configurable through SYNC configuration software. Ensure SYNC is running on your Windows OS computer before continuing. Connect your SP-005 to your computer through your Layer N Smart Interface.

Note: SYNC is available to download for free on the OMEGA website.

4.1 Connecting to SYNC - Automatic Detect

Once the SP-005 and Layer N Smart Interface are connected to your computer, SYNC will automatically detect it and begin displaying temperature readings.

Note: If you have successfully connected your SP-005 to SYNC and have readings appearing in SYNC, skip ahead to the section titled **Thermocouple Interface** or **RTD Interface**.

4.2 Connecting to SYNC – Manual

If SYNC does not automatically detect your device, follow these instructions to manually connect it.

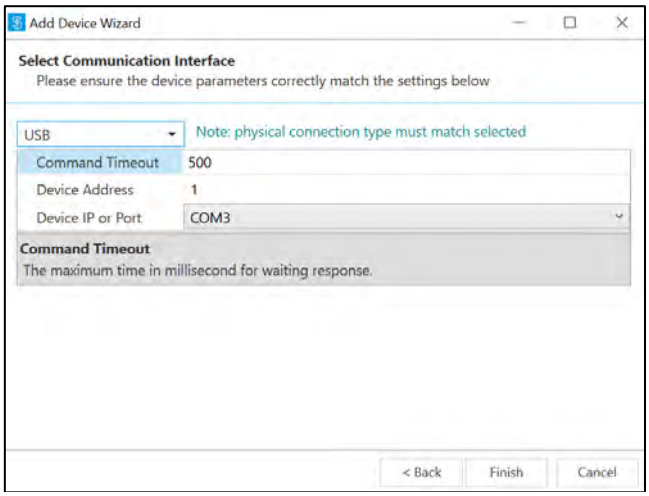
Step 1: Click on the [+] icon located on the top left of the SYNC interface.

Step 2: Proceed through the Add Device Wizard and click **End Device / Probe**.

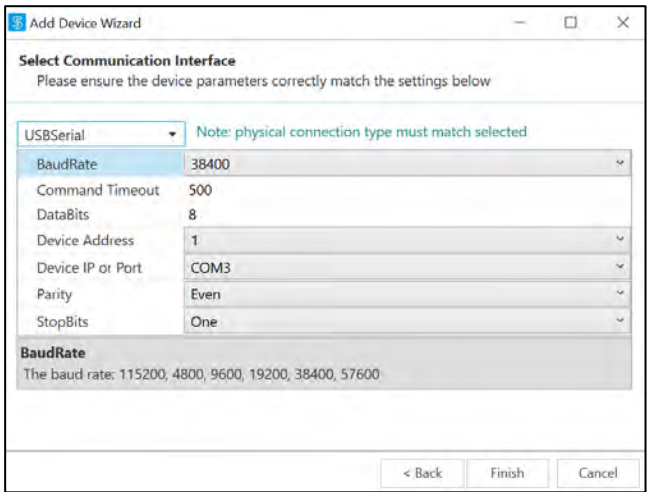
4.2.1 Communication Interface

Set the communication parameters for the Layer N Smart Interface that you are connecting.

Note: The connection type and parameters must be accurate for a proper connection to be established. Failure to accurately setup communication parameters may result in communication errors.



USB Communication Interface



USB Serial Communication Interface

- **Connection Type:** Select the type of connection you have between your SP-005 and your computer.
- **Command Timeout:** The maximum time (in milliseconds) for a command to be completed before the command is aborted.

Note: The default command timeout is 500 milliseconds. It is recommended that this section be left alone to avoid communication errors.

- **Device Address:** If your Smart Interface is part of a Network, enter the Network Address here. The default network address is 1 for most devices. Please refer to the manual of your Smart Interface for more information.

Note: The default Device Address is 1.

- **Device IP or Port:** The COM port number that your device is connected to on your computer.

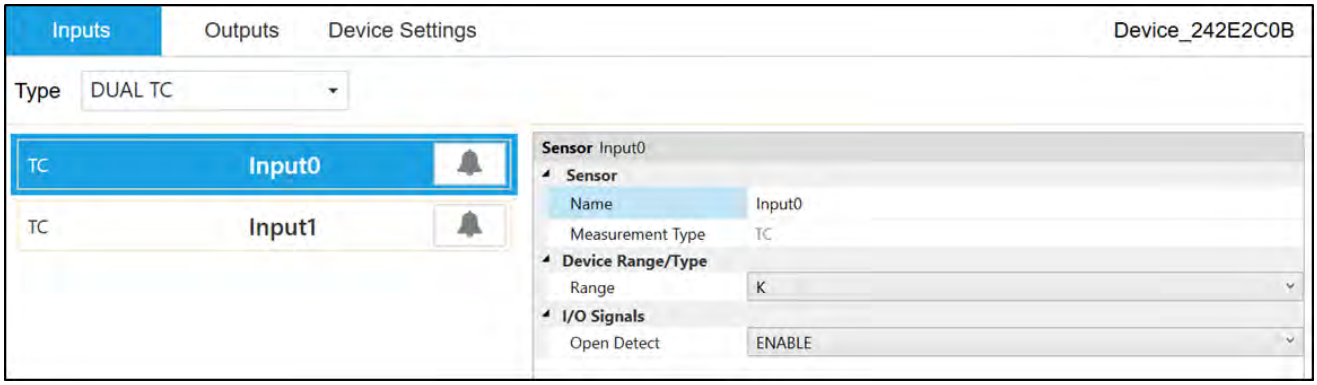
Important: The following parameters should **NOT** be changed. These settings should **NOT** be changed unless the configuration has been done on the interface.

- **BaudRate:** Controls bits per second
- **DataBits:** The number of 'bits' in each character sent.
- **Parity:** A means of checking correctness of character by adding an extra 'bit' to the character and setting the value based on all the other bits in the character.
- **StopBits:** The number of 'bits' used to indicate the end of the character.

Once you have completed setting the communication parameters for your device, click **Finish**.

4.3 Thermocouple Interface

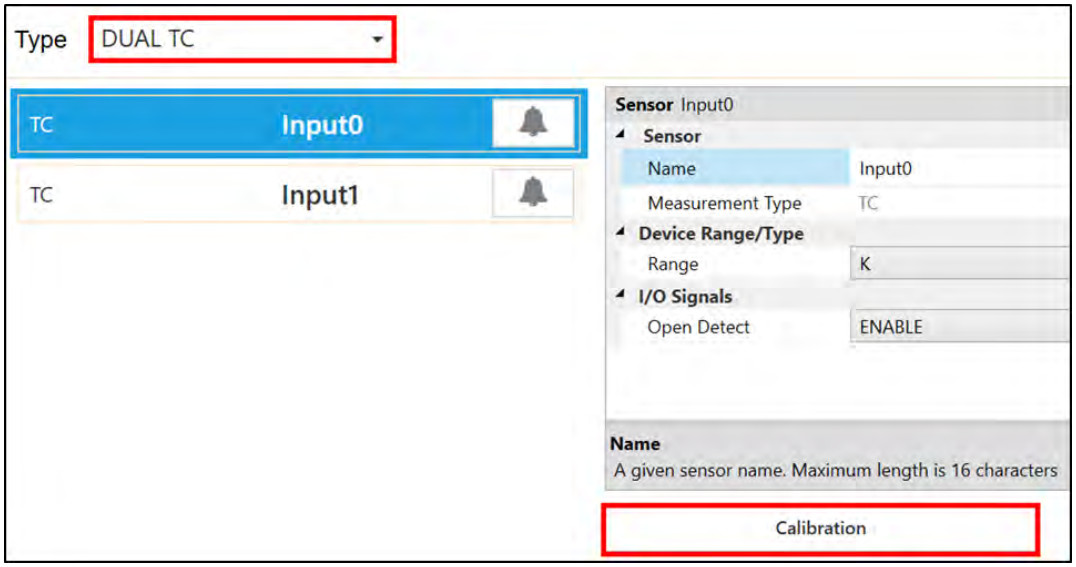
The SP-005 provides interfaces to type J, K, T, E, N, R, S, B and C thermocouples with the capability of enabling or disabling the open detect feature. To use these features, follow these steps:



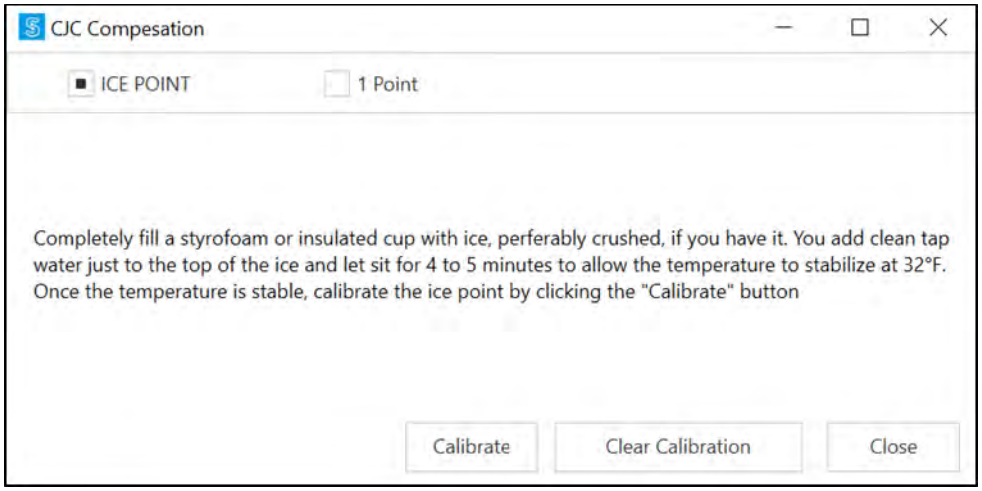
Step 1: Click the **Inputs** configuration tab on SYNC and choose your input type from the **Type** dropdown.
Step 2: Click the input you wish to configure and select your thermocouple type from the **Device Range/Type** dropdown.
Step 3: Click the **Open Detect** dropdown and choose to enable or disable it.

4.3.1 Cold Junction Calibration

The SP-005 has automatic Cold Junction Compensation and is factory calibrated so that in most cases it needs no adjustment. If increased accuracy is desired, Cold Junction Calibration can be performed as described below:



Step 1: Ensure your thermocouple has been configured in the previous section and click **Calibration** beneath the input interface.



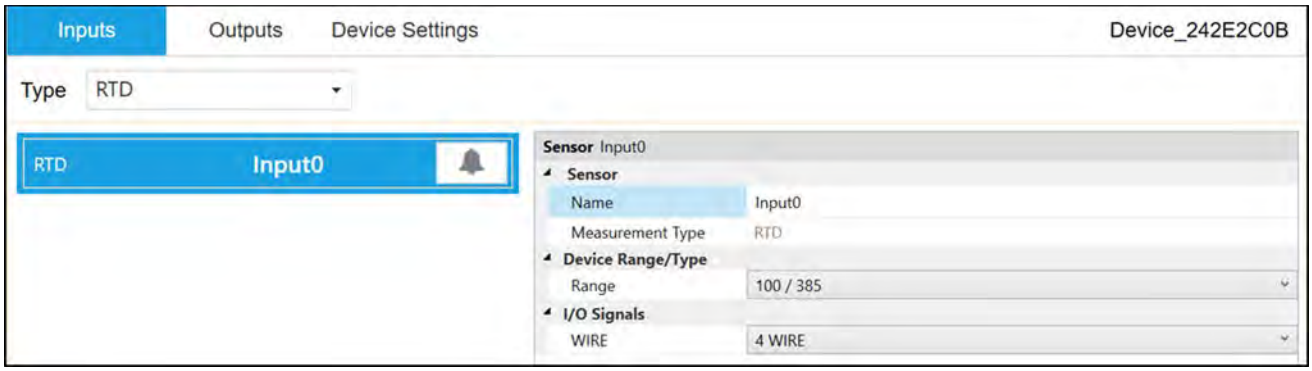
Step 2: Insert the probe into 0°C (32°F) reference as outlined in SYNC and allow it to stabilize. Once the thermocouple is stable in a 0°C environment, click **Calibrate**.

For thermocouples that do not read to 0°C, One-Point Calibration can be used instead of Ice-Point Calibration.

4.4 RTD Interface

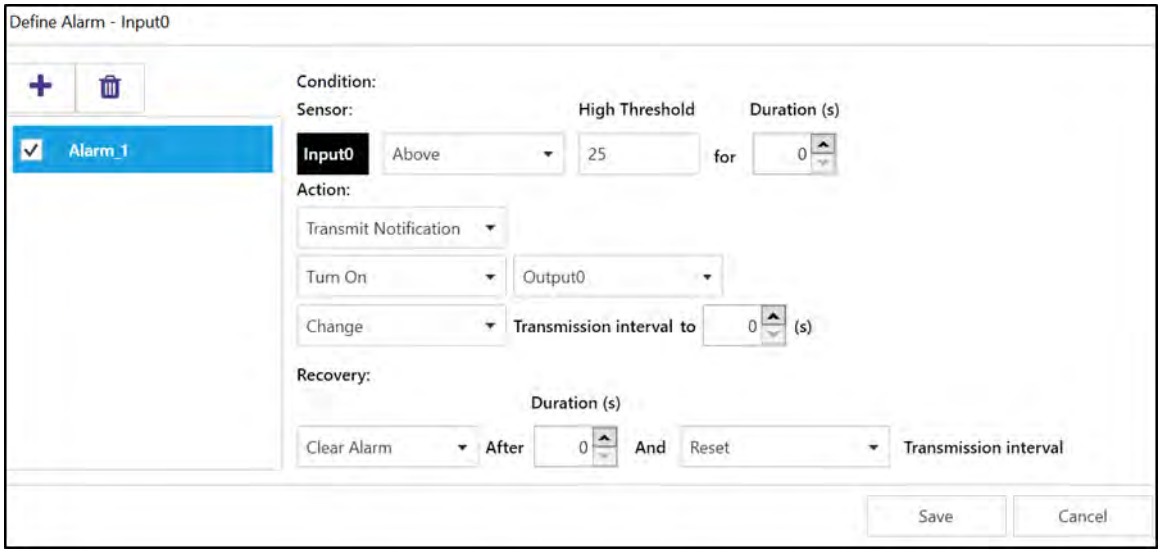
The SP-005 supports 100, 500, and 1000 ohm Platinum RTD sensors in 2, 3, and 4-wire configurations. To use these features, follow these steps:

Note: A single RTD connection is supported.



Step 1: Click the **Inputs Configuration Tab** on SYNC and choose your input type from the **Type** dropdown.
Step 2: Click the input you wish to configure and select your RTD type from the **Device Range/Type** dropdown.
Step 3: Click the **Wire** dropdown and choose your wiring configuration.

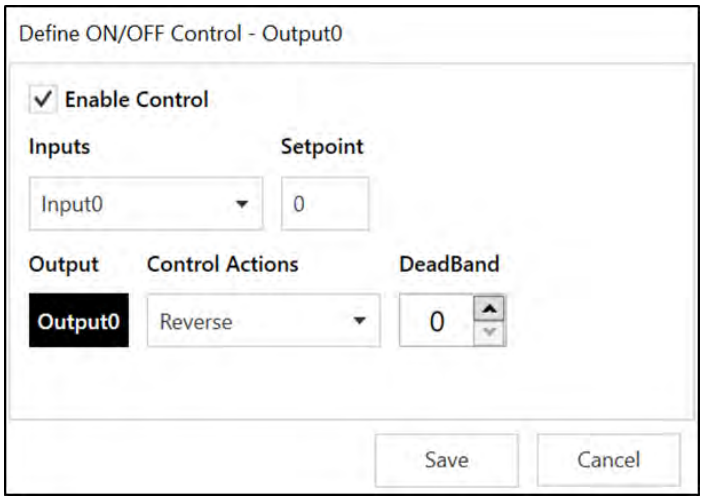
4.5 Setting Alarms



Alarms are set by clicking the  icon in SYNC on the desired input signal found in the **Inputs Configuration Tab**. Setup the threshold and alarm type in the **Condition** section and then select which output to turn on in the **Action** section. The alarm can be set to be latching or non-latching in the **Recovery** section.

4.6 ON/OFF Control

To configure ON/OFF Control on a device, navigate to the **Output Configuration Tab** in SYNC and click on the  icon located to the right of the available outputs. Clicking the icon will open **Define ON/OFF Control** dialog box as seen below. Choose the input with the active alarm that you would like to control and set your preferred parameters.



5 Appendix: SP-005 Registers

The following Appendix provides the registers and list index for the Layer N SP-005 Thermocouple and RTD Smart Probe. This information is intended to aid users who will be making configurations and adjustments to their Layer N SP-005 Thermocouple and RTD Smart Probe through the Command Line Interface or other custom interfaces.

Smart Probe devices share a common platform architecture that provides extensive monitoring and control capabilities thru a set of platform generic registers. These registers may be accessed using I2C based commands directly to the Smart Probe devices or thru a set of Modbus based registers when using Omega Interface devices. Refer to the *Smart Sensor Device Interface* manual for further information.

When powered on or after a device reset each Smart Sensor based device will enumerate 1 or more sensor instances which are described by the device specific Sensor Descriptors which include configuration options, measurement type and units of measure for the corresponding sensor values. Additional sensor information is provided in sensor specific IPSO object descriptions which include extended measurement type, precision and tracking of minimum/maximum readings.

Each enumerated Sensor has a Descriptor Base address location and a Sensor IPSO / Configuration structure address location based on the sensor mix selected.

Sensor	Descriptor Base	IPSO/Configuration	Sensor Enumeration		
0	0x0060 (0xf030)	0x08a8 (0xf454)	Thermocouple 1	Thermocouple 1	RTD
1	0x0068 (0xf034)	0x09a8 (0xf4d4)	DIO (SP-005-1)	Thermocouple 2	DIO (SP-005-1)
2	0x0070 (0xf048)	0x0aa8 (0xf554)		DIO (SP-005-1)	
3					

5.1 Thermocouple Descriptor

The Thermocouple Input Interface provides interfaces to type J, K, T, E, N, R, S, B and C thermocouples. The Sensor Configuration and Sensor Device fields may be written to provide control of the overall function of the channel and the thermocouple types used.

Offset	Name	Value	Description
0x00	Measurement Type	0x20	Thermocouple Temperature
0x01	Data Type/Format	0x66	Float, writeable
0x02	Configuration	0x4?	Determines Thermocouple type
0x03	Sensor Device	0x??	Determines connection type
0x04..0x08	UOMR	“°C”	Units of measure

5.1.1 Thermocouple Measurement Type

The Thermocouple interface provides a measurement of temperature in °C.

Sensor Type	SI Derived Units	Measurement
0x20	°C	Thermocouple Temperature

5.1.2 Thermocouple Input Data Type/Format

The SP-005 supports extended configuration and provides factory calibration. All data values are returned as 32-bit floating point values.

Thermocouple Input Data Type							
7	**6**	**5**	**4**	**3**	**2**	**1**	**0**
Smart Sensor	Sensor Writeable	Factory Calibrate	Reserved	Data Type			
0	0	?	0	0x06 == FLOAT			

5.1.2.1 *Data Type*

The 4-bit Data Type field determines the type of data of the specific sensor.

5.1.2.2 *Factory Calibrate*

The Factory Calibrate bit is used during factory calibration. If set, the factory calibration attributes are applied to the sensor reading before the sensor scaling. If clear, not factory calibration attributes are applied. If the sensor does not support factory calibration the Factory Calibrate bit is ignored and will always read as 0.

5.1.2.3 *Sensor Writeable*

If the Sensor Writeable bit is set the sensor value may be overwritten with a preset value. This capability is useful in sensors such as up/down counters, where a preset, or possibly a zero value must be written to the sensor value.

5.1.2.4 *Smart Sensor*

Refer to the *Smart Sensor Device Interface* documentation.

5.1.3 Thermocouple Configuration

Thermocouple Configuration							
7	**6**	**5**	**4**	**3**	**2**	**1**	**0**
Available	Assigned	Apply Scaling	Lock	Sensor Type (Range)			
0	*	?	?	See Below			

5.1.3.1 *Sensor Type / Range*

Sensor Type	Sensor Input Type (Range)	Measurement Type	
0x00	Type J	0x20	Temperature (°C)
0x01	Type K	0x20	Temperature (°C)
0x02	Type T	0x20	Temperature (°C)
0x03	Type E	0x20	Temperature (°C)
0x04	Type N	0x20	Temperature (°C)
0x05	Reserved	0x20	Temperature (°C)
0x06	Type R	0x20	Temperature (°C)
0x07	Type S	0x20	Temperature (°C)
0x08	Type B	0x20	Temperature (°C)
0x09	Type C	0x20	Temperature (°C)

5.1.3.2 *Apply Scaling*

For more information on Gain and Offset, refer to the Smart Sensor Manual. If set, the user defined Offset and Gain values will be used to adjust the sensor reading:

Result = (Raw Reading * Gain) + Offset

5.1.3.3 *Lock*

If set, the user specified units of measure string (4-character maximum) will be used in place of the default units of measure.

5.1.3.4 *Assigned*

Refer to the *Smart Sensor Device Interface* documentation.

5.1.3.5 *Available*

Refer to the *Smart Sensor Device Interface* documentation.

5.1.4 Thermocouple Device Byte

The Sensor Device byte determines whether the Open Circuit detection is enabled.

I/O (TC)							
7	**6**	**5**	**4**	**3**	**2**	**1**	**0**
0	0	0	Open Circuit Detect 0 Disabled **1 Enabled**	0	0	0	0

5.1.5 IPSO Thermocouple Temperature Sensor Definition

The Thermocouple sensor IPSO definition provides signal range, measured min/max values, and IPSO object type information. The Range information is Thermocouple Type dependent.

Offset	Name	Value	Description
0x00	Sensor Type	3303	Temperature (oC)
0x02	Precision	1	Provides reading of xxx.x
0x04	Sensor Trigger Function	??	See 4.1.5.1
0x08	Min Measured	??	Minimum reading since last reset
0x0c	Max Measured	??	Maximum reading since last reset
0x10	Min Range	??	
0x14	Max Range	??	

Type	Min Range	Max Range
J	-210	1200
K	-160	1272
T	-190	400
E	-220	1000
N	-100	1300
R	40	1788
S	100	1768
B	640	1820
X	0	2320

5.1.5.1 *Sensor Trigger Function*

The Sensor Trigger function is used to reset the IPSO min/max values as well as control the ICE Point / Single-Point Calibration process.

Sensor Trigger Function							
7	6	5	4	3	2	1	0
0	0	0	0	0	0	0	Reset Min/Max
15	14	13	12	11	10	9	8
0	0	Calibration Reset	Calibration Status	Calibration Mode	0	Capture Low	Calibration Start

The Calibration mode is entered by writing a 1 to the Calibration Mode bit. While in the calibration mode the calibration registers may be accessed, the Capture may be used to capture real time value and the Calibration Start may be set.

When the Calibration Start bit is set the Calibration Status bit will remain set until the calibration process is complete.

Setting the Calibration Reset bit will clear the calculated Offset values.

5.2 RTD Descriptor

The RTD Input interface provides interfaces to type 100, 500 and 1000 ohm 385 Curve, 100 ohm 392 Curve and 100 ohm 3916 Curve RTD devices in 2, 3 and 4 wire configurations. A single RTD connection is supported. The Sensor Configuration and Sensor Device fields may be written to provide control of the overall function of the channel and the RTD type used.

Offset	Name	Value	Description
0x00	Measurement Type	0x21	RTD (Temperature)
0x01	Data Type/Format	0x66	Float, writeable
0x02	Configuration	0x4?	Determines RTD type
0x03	Sensor Device	0x??	Determines connection type
0x04..0x08	UOMR	"°C"	Units of measure

5.2.1 RTD Measurement Types

The RTD interface provides a measurement of Temperature in °C.

Sensor Type	SI Derived Units	Measurement
0x21	°C	RTD Temperature

5.2.2 RTD Input Data Type/Format

The SP-005 supports extended configuration and provides factory calibration. All data values are returned as 32-bit floating point values.

RTD Input Data Type							
7	**6**	**5**	**4**	**3**	**2**	**1**	**0**
Smart Sensor	Sensor Writeable	Factory Calibrate	Reserved	Data Type			
0	0	?	0	0x06 == FLOAT			

5.2.2.1 *Data Type*

The 4-bit Data Type field determines the type of data of the specific sensor.

5.2.2.2 *Factory Calibrate*

The Factory Calibrate bit is used during factory calibration. It is a read only bit that applies to specific sensor types. If set, factory calibration is performed on the raw sensor reading PRIOR to user scaling.

5.2.2.3 *Configurable Enable*

The Configurable bit indicates that the Sensor Configuration and Sensor Device fields may be overwritten by user configuration information. If clear, only the Sensor Configuration LOCK bit may be set, allowing the user to overwrite the Unit of Measure string.

5.2.2.4 *Sensor Writeable*

If the Sensor Writeable bit is set the sensor value may be overwritten with a preset value. This capability is useful in sensors such as up/down counters, where a preset, or possibly a zero value must be written to the sensor value.

5.2.2.5 *Smart Sensor*

Refer to the *Smart Sensor Device Interface* documentation.

5.2.3 RTD Configuration

RTD Configuration							
7	**6**	**5**	**4**	**3**	**2**	**1**	**0**
Available	Assigned	Apply Scaling	Lock	Sensor Type (Range)			
0	*	?	?	See Below			

5.2.3.1 *Sensor Type / Range*

Sensor Type	Sensor Input Type (Range)	Measurement Type	
0x00	100 Ohm, 385 Curve	0x21	Temperature (°C)
0x01	500 Ohm, 385 Curve	0x21	Temperature (°C)
0x02	1000 Ohm, 385 Curve	0x21	Temperature (°C)
0x03	100 Ohm, 392 Curve	0x21	Temperature (°C)
0x04	100 Ohm, 3916 Curve	0x21	Temperature (°C)

5.2.3.2 *Apply Scaling*

If set, the user defined Offset and Gain values will be used to adjust the sensor reading:

Result = (Raw Reading * Gain) + Offset

5.2.3.3 *Lock*

If set, the user specified units of measure string (4-character maximum) will be used in place of the default units of measure.

5.2.3.4 *Assigned*

Refer to the *Smart Sensor Device Interface* documentation.

5.2.3.5 *Available*

Refer to the *Smart Sensor Device Interface* documentation.

5.2.4 RTD Input Sensor Device

The Sensor Device field determines the connector signal configuration.

I/O (RTD)								
7	**6**	**5**	**4**	**3**	**2**	**1**	**0**	**Description**
X	X	X	X	X	X	0	0	Not Available/Used
X	X	X	X	X	X	0	1	2 Wire, configuration
X	X	X	X	X	X	1	0	3 Wire, configuration
X	X	X	X	X	X	1	1	4 Wire, configuration

5.2.5 RTD Input Connector

A (bit 6)	Description	M12-4 Connector Pins			
		1	**2**	**3**	**4**
0x00	Wiring Option #1	S+	P+	P-	S-
0x01	Wiring Option #2	S+	S-	P-	P+

5.2.6 RTD IPSO Definition

The RTD sensor IPSO definition provides signal range, measured min/max values, IPSO object type information. The Min / Max range values depend on the type of RTD.

Offset	Name	Value	Description
0x00	Sensor Type	3303	Temperature (°C)
0x02	Precision	1	Provides reading of xxx.x
0x04	Sensor Trigger Function	??	See 4.2.6.1
0x08	Min Measured	??	Minimum reading since last reset
0x0c	Max Measured	??	Maximum reading since last reset
0x10	Min Range	??	
0x14	Max Range		

Type	Min Range	Max Range
385 / 100 ohm	-200	850
385 / 500 ohm	-200	850
385 / 1000 ohm	-200	850
392 / 100 ohm	-200	660
3916 / 100 ohm	-200	660

5.2.6.1 *Sensor Trigger Function*

The Sensor Trigger function is used to reset the IPSO min/max values.

Sensor Trigger Function							
7	6	5	4	3	2	1	0
0	0	0	0	0	0	0	Reset Min/Max
15	14	13	12	11	10	9	8
0	0	0	0	0	0	0	0

5.3 Digital Input / Output Interface

The DIO Interface provides 2 digital inputs which are hardwired to the Digital outputs. These may be used to detect the state of external switches (output off) or to monitor the state of the outputs. The DIO Input descriptor is at base addresses 0x0068.

5.3.1 DIO Descriptor

Offset	Name	Value	Description
0x00	Sensor Type	0x18	Digital Type (Bit mapped)
0x01	Data Type/Format	0x46	Configurable, Float type
0x02	Configuration	0x23	Scaling applied, Bits 0 and 1 enabled
0x03	Sensor Device	0x0f	DIN bits enabled / inverted
0x04..0x08	UOMR	“DIN”	Units of measure

5.3.1.1 *DIO Sensor Type*

The interface provides a bit mapped input of the 2 digital signal lines.

Sensor Type	SI Derived Units	Measurement
0x18	DIN	Bit mapped digital inputs

5.3.1.2 *DIO Data Type/Format*

DIO Data Type							
7	**6**	**5**	**4**	**3**	**2**	**1**	**0**
Smart Sensor	Sensor Writable	Factory Calibrate	reserved	Data Type			
0	0	0	0	6 == Floating point			

Note: Please refer to the Smart Sensor Interface Technical Guide for more information regarding this descriptor.

5.3.1.3 *Data Type*

The 4-bit Data Type field determines the type of date of the specific sensor.

5.3.1.4 *Factory Calibrate*

The Factory Calibrate bit is not used for DIO types.

5.3.1.5 *Sensor Writeable*

If the Sensor Writeable bit is set the sensor value may be overwritten with a preset value. This capability is useful in sensors such as up/down counters, where a preset, or possibly a zero value must be written to the sensor value.

5.3.1.6 *Smart Sensor*

Refer to the *Smart Sensor Device Interface* documentation.

5.3.2 DIO Input Configuration

DIO Input Configuration							
7	**6**	**5**	**4**	**3**	**2**	**1**	**0**
Available	Assigned	Apply Scaling	Lock	Sub Channel Selection			
0	0	1	?	0x03 == bits 0 and 1			

5.3.2.1 *Lock*

If set, the user specified units of measure string (4-character maximum) will be used in place of the default **DIN.**

5.3.2.2 *Apply Scaling*

If set, the user defined Offset and Gain values will be used to adjust the sensor reading:
Result = (Raw Reading * Gain) + Offset

5.3.2.3 *Assigned*

The Assigned bit will always read as 0. Refer to the *Smart Sensor Device Interface* documentation for further information.

5.3.2.4 *Available*

The Available bit will always read as 0. Refer to the *Smart Sensor Device Interface* documentation for further information.

5.3.3 DIO Device Configuration

The DIO Device Configuration allows enabling each of the 2 input bits and selecting whether the input is active HIGH or active LOW. If the Invert Bit is set the signal will be Active Low.

DIO Device Configuration							
7	**6**	**5**	**4**	**3**	**2**	**1**	**0**
Reserved				DIN 1		DIN 0	
0	0	0	0	ENABLE	INVERT	ENABLE	INVERT
				1	1	1	1

5.3.4 DIO IPSO Definition

The DIO input IPSO definition provides signal range, measured min/max values, IPSO object type information. The SP-010 DIO IPSO definition is at base address 0x08a8.

Offset	Name	Value	Description
0x00	Sensor Type	3349	Bit Mapped Digital
0x02	Precision	0	Provides reading of xxx
0x04	Sensor Trigger Function	??	See section Sensor Trigger Function
0x08	Min Measured	??	Minimum reading since last reset
0x0c	Max Measured	??	Maximum reading since last reset
0x10	Min Range	0	Minimum reading
0x14	Max Range	3	Maximum reading

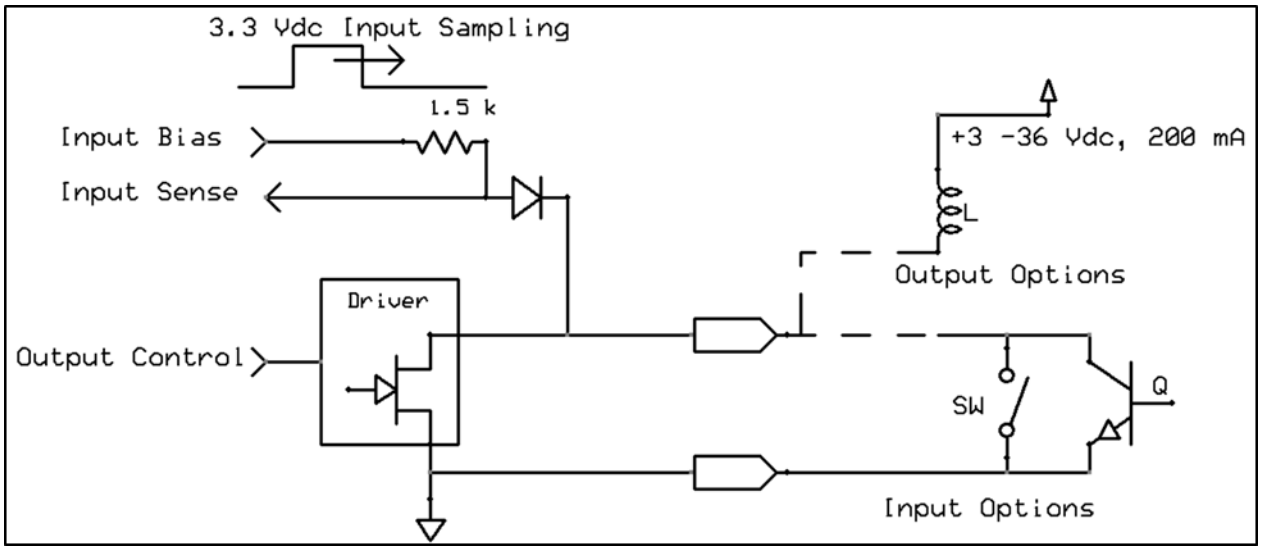
5.3.4.1 *Sensor Trigger Function*

The Sensor Trigger function is used to reset the IPSO min/max values.

Sensor Trigger Function							
7	6	5	4	3	2	1	0
0	0	0	0	0	0	0	Reset Min/Max
15	14	13	12	11	10	9	8
0	0	0	0	0	0	0	0

5.3.5 **DIO Input Circuitry**

The DIO input circuitry shares the output circuitry. The internal processor drives the Output Control signal to turn on the output driver which will force the output LOW. When the state of the DIO input signal is to be read the processor applies 3.0 V_{DC} to the Input Bias signal and reads the level detected at the Input Sense. If the output is inactive, an external signal may be used to force the input level LOW. A diode provides protection of external positive voltages, allowing the Output driver to activate loads greater than the internal 3.3 V_{DC}.



5.4 Outputs

Two output signals are available which may be configured for ON/OFF or PWM outputs through the Output Configuration registers 0x0124 and 0x0126 (Modbus 0xf092 and 0xf093).

Note: The Output Drive Type (Open Drain, inverting driver) is fixed.

Outputs

7	6	5	4	3	2	1	0
Output Driver: 0 = Open Drain, Non inverting Driver; 1 = Open Drain, Inverting Driver; **3 = Open Drain, Inverting Driver**			**Active State**: LOW = 0, HIGH = 1			**PWM Rate**: 100 Hz = 0 0, 10 Hz = 0 1, 1 Hz = 1 0, 0.1 Hz = 1 1	

15	14	13	12	11	10	9	8

Output Type

Null	**0**	**0**	**0**	**0**
ON/OFF	**0**	**0**	**0**	**1**
PWM	**0**	**0**	**1**	**0**
Reserved	**x**	**1**	**x**	**x**
	1	**x**	**x**	**x**

5.4.1 PWM Rate

The SP-005 probe outputs support the following PWM frequencies:

PWM Rate	Name	Description
0	100 Hz	PWM signal has constant 100 Hertz frequency (10 msec repetition rate) with 0 – 100 % duty cycle
1	10 Hz	PWM signal has constant 10 Hertz frequency (100 msec repetition rate) with 0 – 100 % duty cycle
2	1 Hz	PWM signal has constant 1 Hertz frequency (1 second repetition rate) with 0 – 100 % duty cycle
3	0.1 Hz	PWM signal has constant 0.1 Hertz frequency (10 second repetition rate) with 0 – 100 % duty cycle

5.4.2 Active State

The SP-005 probe outputs may be configured as Active HIGH or Active LOW. When set to 1 (Active HIGH), the output will be high impedance when active. When set to 0 (Active LOW), the output will be low impedance when active. The Factory reset value is 0.

5.4.3 Output Drive

The Output Drive is permanently set to 3, indicating that the output is configured as an Open Drain driver, allowing the DIN signal to override and read back the state of the output signal.

5.4.4 Output Type

The SP-005 probe supports NULL (0), ON/OFF (1) or PWM (2) outputs. When set to NULL the output signal will be left in a high impedance state. When set to ON/OFF the Rate information has no affect.

6 Specifications

INPUT POWER

Voltage: 2.8 V_{DC} - 3.3 V_{DC}

DIO DIGITAL INPUTS

$V_{inHighThreshold}$ = 2.2 V_{MAX}

$V_{inLowThreshold}$ = 0.3 V_{MIN}

V_{inMAX} = 30 V_{DC}

DIO DIGITAL OUTPUTS

2x Open Drain 100 mA max

V_{MAX} = 30 V_{DC}

ENVIRONMENTAL

Operating Temperature: -40 to 850°C (-40 to 185°F)

Rating: IP67 when mated

MECHANICAL

Dimensions: 22.1 mm W x 96.7 mm L (0.87" x 3.80") not including mounting tabs

GENERAL

Agency Approvals: CE, EMC 2014/30/EU, LVD 2014/35/EU

Compatibility: Compatible with OEG, SYNC configuration software, Layer N Cloud, and Modbus Networks

THERMOCOUPLE ACCURACY TABLE

Type	Range	Accuracy
J	-210°C to 1200°C	0.4°C
K	160°C to 1372°C	0.4°C
T	-190°C to 400°C	0.4°C
E	-200°C to 1000°C	0.4°C
N	-100°C to 1300°C	0.4°C
R	40°C to 1788°C	0.5°C
S	100°C to 1768°C	0.5°C
B	640°C to 1820°C	0.5°C
C	0°C to 2320°C	0.4°C

Temperature Stability @25°C: 0.04 C/C

RTD ACCURACY TABLE

Type	Range	Accuracy
385, 4 Wire	-200°C to 850°C	0.3°C
385, 3 Wire	-200°C to 850°C	0.3°C
385, 2 Wire	-200°C to 850°C	0.6°C
392, 4 Wire	-200°C to 660°C	0.3°C
392, 3 Wire	-200°C to 660°C	0.3°C
392, 2 Wire	-200°C to 660°C	0.6°C

Temperature Stability @ 25°C: 0.01 C/C

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OMEGA ENGINEERING, INC. warrants this unit to be free of defects in materials and workmanship for a period of **13 months** from date of purchase. OMEGA's WARRANTY adds an additional one (1) month grace period to the normal **one (1) year product warranty** to cover handling and shipping time. This ensures that OMEGA's customers receive maximum coverage on each product.

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1. Purchase Order number to cover the COST of the repair,
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