1 YEAR WARRANTY

OMEGA™

User's Guide

Shop online at omega.com

e-mail: info@omega.com
For latest product manuals:
www.omegamanual.info

SP-014

Process Monitoring Smart Probe

omega.com info@omega.com

Servicing North America:

U.S.A. Headquarters: Omega Engineering, Inc.
800 Connecticut Ave. Suite 5N01, Norwalk, CT 06854
Toll-Free: 1-800-826-6342 (USA & Canada only)
Customer Service: 1-800-622-2378 (USA & Canada only)
Engineering Service: 1-800-872-9436 (USA & Canada only)
Tel: (203) 359-1660 Fax: (203) 359-7700
e-mail: info@omega.com

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-014.

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-014 Process Monitoring Smart Probe provides an easy way to integrate process signals to your Layer N Ecosystem. The SP-014 accepts standard process signals through its M12 5-pin connector and Layer N Smart Interfaces through its M12 8-pin connector. The optional M12.5-S-M-FM connector can be utilized to easily connect wire leads to your SP-014. Each of the 3 process inputs may be independently configured as 0-24 mA or 0-1.0 V_{DC} inputs.

The Layer N SP-014 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-014 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-014

- SP-014 Unit
- Quick Start Guide

Additional Material Needed

- Layer N Smart Interface\Computer with Windows OS
- SYNC configuration software

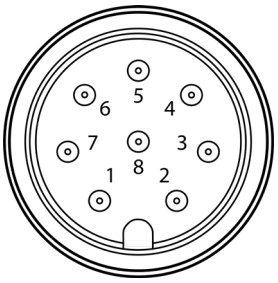
Optional Materials

- M12.5-S-M-FM Screw Terminal Accessory

3 Hardware Setup

3.1 Connecting your Layer N Smart Interface

The SP-014 requires a Layer N Smart Interface to connect to your computer. Use the M12 8-Pin Connector diagram below to connect your SP-014 to your Layer N Smart Interface.

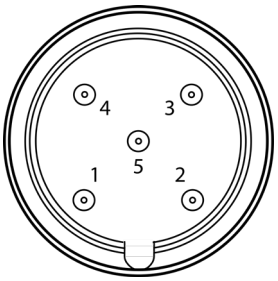


M12 8-Pin Connector

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 Process Input Wiring Diagram

The Layer N SP-014 accepts process inputs through its M12 5-Pin connector. If you are connecting wires directly to the SP-014, view the wiring diagrams provided below:



M12 5-Pin Connector

Pin	mA mV
Pin 1	3.3V Power
Pin 2	Input 0
Pin 3	GND
Pin 4	Input 1
Pin 5	Input 2

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-014 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-014 and Layer N Smart Interface are connected to your computer, SYNC will automatically detect it and begin displaying process readings.

Note: If you have successfully connected your SP-014 to SYNC and have readings appearing in SYNC, skip ahead to the section titled Process Inputs.

4.2 Connecting to SYNC – Manual

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

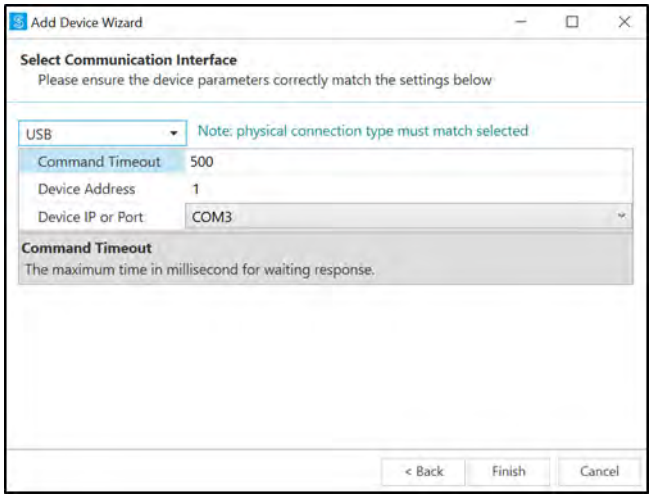
Step 1: Click on the icon located on the top left of the SYNC interface.

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

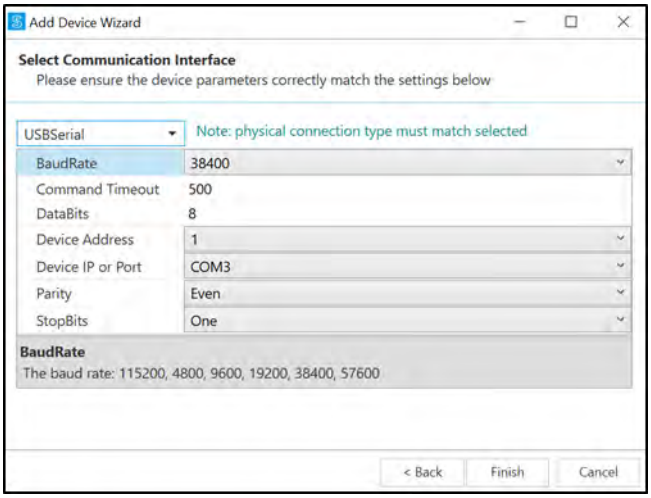
4.2.1 Communication Interface

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-014 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.

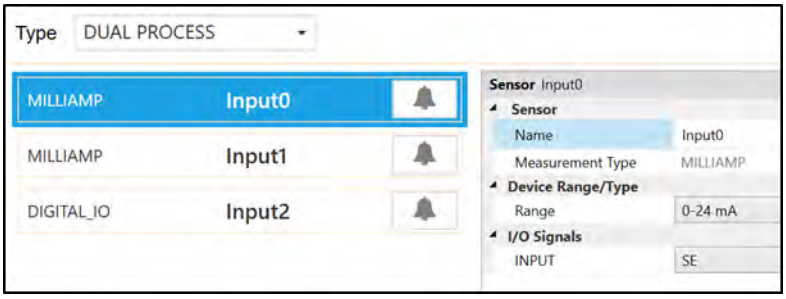
Important: The following parameters should **NOT** be changed. These settings should **NOT** be changed unless the configuration has been done on the interface.

- **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**.

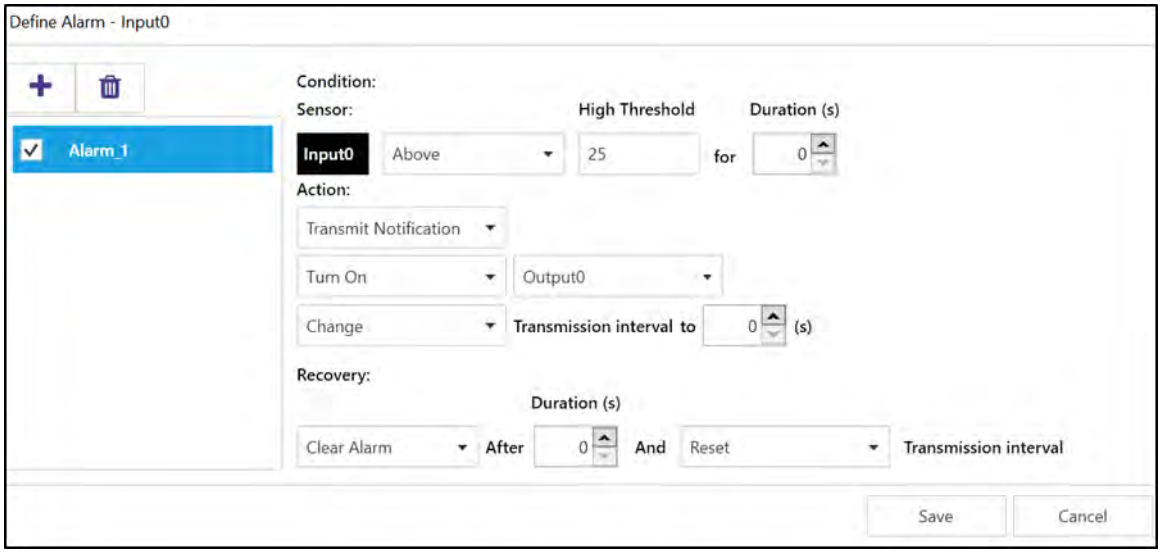
4.3 Process Inputs Interface

The SP-014 can accept up to three 0-24 mA or 0-1.0 VDC process inputs. To customize your process inputs, follow these steps:



Step 1: Click the **Inputs** configuration tab on SYNC and choose your input type from the **Type** dropdown.
Step 2: Choose between mA and mV from the Device Range/Type drop down.

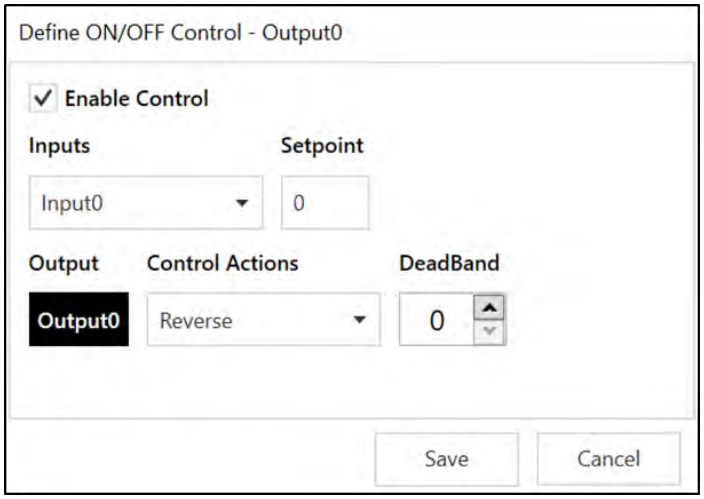
4.4 Setting Alarms



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.

4.5 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-014 Registers

The following Appendix provides the registers and list index for the Layer N SP-014 Process Monitoring Smart Probe. This information is intended to aid users who will be making configurations and adjustments to their Layer N SP-014 Process Monitoring 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	Enumerated Sensors	
0	0x0060 (0xf030)	0x08a8 (0xf454)	Process 0	
1	0x0068 (0xf034)	0x09a8 (0xf4d4)	Process 1	DIO (SP-014-1)
2	0x0070 (0xf038)	0x0aa8 (0xf554)	Process 2	DIO (SP-014-1)
3	0x0078 (0xf03c)	0x0ba8 (0xf5d4)	DIO (SP-014-1)	

5.1 Process Interface

The Process Input interface provides single ended voltage and current loop inputs. The Sensor Configuration and Sensor Device fields may be written to provide control of the overall function of the channel and the signal types used.

Offset	Name	Value	Description
0x00	Measurement Type	0x??	Analog Voltage and Current – set by Sensor Type field in Configuration byte.
0x01	Data Type/Format	0x46	Float, writeable
0x02	Configuration	0x??	Determines Process input type/range
0x03	Sensor Device	0x??	Determines AIO signal types
0x04..0x08	UOMR	“??”	Units of measure

5.1.1 Process Measurement Types

The Process interface provides a measurement dependent on the input range/type selected. The units of measure may be changed by the user.

Sensor Type	SI Derived Units	Measurement
0x11	mV	Process Voltage (0 - 1.0 V)
0x13	mA	Process Current (0-24 mA current loop, common return)

5.1.2 Process Data Type/Format

The SP-014 supports extended configuration and provides factory calibration. All data values are returned as 32-bit floating point values.

Process Input Data Type/Format							
7	**6**	**5**	**4**	**3**	**2**	**1**	**0**
Smart 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

The writable bit is cleared, indicating that the sensor values may not be overwritten.

5.1.2.4 Smart Sensor

Refer to the *Smart Sensor Device Interface* documentation.

5.1.3 Process Input Configuration

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

5.1.3.1 Sensor Type / Range

Sensor Range / Type	Sensor Input Type (Range)	Measurement Type	
0x01	0-24 mA	0x13	Current (mA)
0x03	0-1.0 Vdc	0x11	Millivolts (mV)

5.1.3.2 Apply Scaling

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

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 Process Input Sensor Device

The Sensor Device field determines the signal types for each of the channel bits.

CHANNEL 0								
	A	SIG 0 .. 2 (Analog Input)						
7	**6**	**5**	**4**	**3**	**2**	**1**	**0**	**Description**
1	X	0	0	0	0	0	0	Single Ended

5.1.5 Process IPSO Definition

The IPSO process definition provides signal range, measured min/max values, IPSO object type information.

Offset	Name	Value	Description
0x00	Sensor Type	**Value**	**Description**
		3317	Current (mA)
		3318	Voltage (mV)
0x02	Precision	0-24 mA	1 - display as xx.x
		0-1000 mV	-1 - display as xxx0.0
0x04	Sensor Trigger	??	Write any value to force reset of min / max
0x08	Min Measured	??	Minimum reading since last reset
0x0c	Max Measured	??	Maximum reading since last reset
0x10	Min Range	**Range**	**Minimum** / **Maximum**
0x14	Max Range	0-24 mA	0 / 24 mA
		0 – 1 Vdc	0 / 1000 mV

5.1.5.1 Sensor Trigger Function

The Sensor Trigger function is used to reset the IPSO min/max values as well as controlling the 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	0	0	0	0	0	0

Setting the Reset Min/Max bit to 1 will reset the Min/Max values recorded by the IPSO process.

No User Calibration process is supported on the Process inputs and all configuration bits should be written as 0.

5.2 Digital Input / Output Descriptor

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.

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

5.2.1 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

5.2.2 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.

5.2.2.1 Data Type

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

5.2.2.2 Factory Calibrate

The Factory Calibrate bit is not used for DIO types.

5.2.2.3 Sensor Writeable

If the Sensor Writeable bit is set the sensor value may be overwritten with a preset value.

5.2.2.4 Smart Sensor

Refer to the *Smart Sensor Device Interface* documentation.

5.2.3 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			

5.2.3.1 Lock

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

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 Assigned

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

5.2.3.4 Available

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

5.2.4 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

5.2.4.1 Invert

If the Invert bit is set the input is active LOW.

5.2.4.2 Enable

If the Enable bit is set the input is enabled.

5.2.5 DIO IPSO Definition

The DIO input IPSO definition provides signal range, measured min/max values, IPSO object type information. The SP-014 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 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

5.2.5.1 Sensor Trigger Function

The Sensor Trigger function is used to reset the IPSO min/max values as well as controlling the Calibration process.

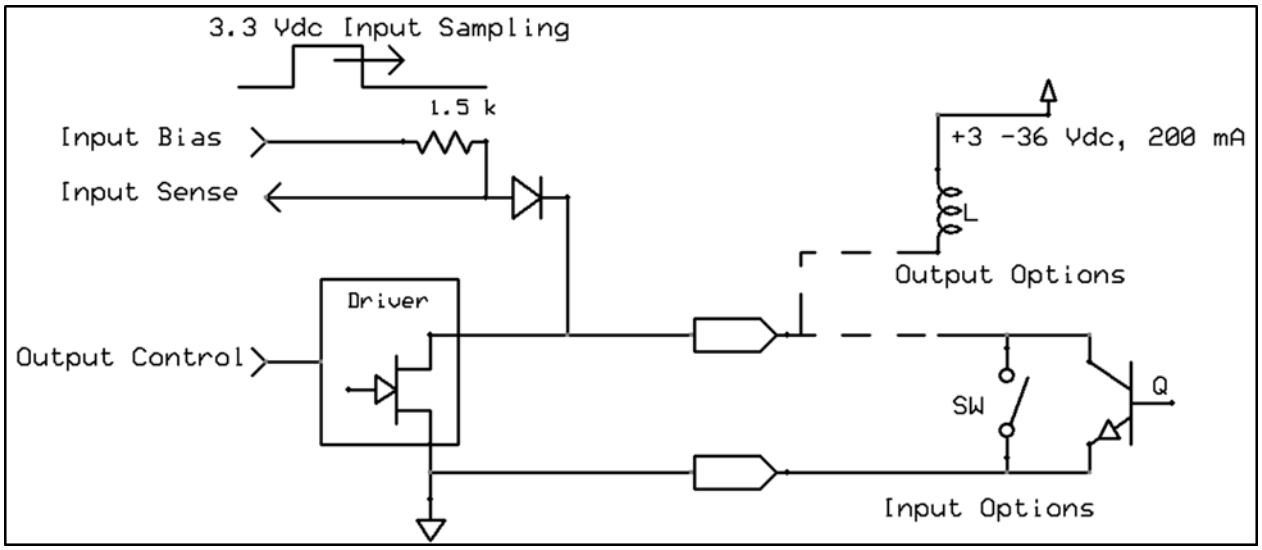
Sensor Trigger Function							
7	6	5	4	3	2	1	0
0	0	0	0	0	0	0	Reset Min/Max
15	14	13	12	11	10	9	8
0	0	0	0	0	0	0	0

Setting the Reset Min/Max bit to 1 will reset the Min/Max values recorded by the IPSO process.

No User Calibration process is supported on the DIO inputs and all bits should be written as 0.

5.2.6 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}.



5.3 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**			

5.3.1 PWM Rate

The SP-014 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

5.3.2 Active State

The SP-014 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.

5.3.3 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.

5.3.4 Output Type

The SP-014 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}

ANALOG INPUTS

Type	Range	Accuracy
Current	0-24 mA	± 0.1 mA
Voltage	0-1 V	± 5.0 mV

Stability over Temperature: ±0.02% FS/C

ENVIRONMENTAL

Operating Temperature: -40 to 85°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

7 Errata

Firmware Version: 1.8.0.0

- IPSO Sensor Type for Voltage Measurements returns 3316 instead of 3318
- IPSO Precision for Voltage Measurements returns 3 instead of -1

WARRANTY/DISCLAIMER

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.

If the unit malfunctions, it must be returned to the factory for evaluation. OMEGA's Customer Service Department will issue an Authorized Return (AR) number immediately upon phone or written request. Upon examination by OMEGA, if the unit is found to be defective, it will be repaired or replaced at no charge. OMEGA's WARRANTY does not apply to defects resulting from any action of the purchaser, including but not limited to mishandling, improper interfacing, operation outside of design limits, improper repair, or unauthorized modification. This WARRANTY is VOID if the unit shows evidence of having been tampered with or shows evidence of having been damaged as a result of excessive corrosion; or current, heat, moisture or vibration; improper specification; misapplication; misuse or other operating conditions outside of OMEGA's control. Components in which wear is not warranted, include but are not limited to contact points, fuses, and triacs.

OMEGA is pleased to offer suggestions on the use of its various products. However, OMEGA neither assumes responsibility for any omissions or errors nor assumes liability for any damages that result from the use of its products in accordance with information provided by OMEGA, either verbal or written. OMEGA warrants only that the parts manufactured by the company will be as specified and free of defects. OMEGA MAKES NO OTHER WARRANTIES OR REPRESENTATIONS OF ANY KIND WHATSOEVER, EXPRESSED OR IMPLIED, EXCEPT THAT OF TITLE, AND ALL IMPLIED WARRANTIES INCLUDING ANY WARRANTY OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE ARE HEREBY DISCLAIMED. LIMITATION OF LIABILITY: The remedies of purchaser set forth herein are exclusive, and the total liability of OMEGA with respect to this order, whether based on contract, warranty, negligence, indemnification, strict liability or otherwise, shall not exceed the purchase price of the component upon which liability is based. In no event shall OMEGA be liable for consequential, incidental or special damages.

CONDITIONS: Equipment sold by OMEGA is not intended to be used, nor shall it be used: (1) as a "Basic Component" under 10 CFR 21 (NRC), used in or with any nuclear installation or activity; or (2) in medical applications or used on humans. Should any Product(s) be used in or with any nuclear installation or activity, medical application, used on humans, or misused in any way, OMEGA assumes no responsibility as set forth in our basic WARRANTY/DISCLAIMER language, and, additionally, purchaser will indemnify OMEGA and hold OMEGA harmless from any liability or damage whatsoever arising out of the use of the Product(s) in such a manner.

RETURN REQUESTS/INQUIRIES

Direct all warranty and repair requests/inquiries to the OMEGA Customer Service Department. BEFORE RETURNING ANY PRODUCT(S) TO OMEGA, PURCHASER MUST OBTAIN AN AUTHORIZED RETURN (AR) NUMBER FROM OMEGA'S CUSTOMER SERVICE DEPARTMENT (IN ORDER TO AVOID PROCESSING DELAYS). The assigned AR number should then be marked on the outside of the return package and on any correspondence.

The purchaser is responsible for shipping charges, freight, insurance and proper packaging to prevent breakage in transit.

FOR **WARRANTY** RETURNS, please have the following information available BEFORE contacting OMEGA:

1. Purchase Order number under which the product was PURCHASED,
2. Model and serial number of the product under warranty, and
3. Repair instructions and/or specific problems relative to the product.

FOR **NON-WARRANTY** REPAIRS, consult OMEGA for current repair charges. Have the following information available BEFORE contacting OMEGA:

1. Purchase Order number to cover the COST of the repair,
2. Model and serial number of the product, and
3. Repair instructions and/or specific problems relative to the product.

OMEGA's policy is to make running changes, not model changes, whenever an improvement is possible. This affords our customers the latest in technology and engineering.

Where Do I Find Everything I Need for Process Measurement and Control? OMEGA...Of Course!

Shop online at omega.com

TEMPERATURE

- Thermocouple, RTD & Thermistor Probes, Connectors, Panels & Assemblies
- Wire: Thermocouple, RTD & Thermistor
- Calibrators & Ice Point References
- Recorders, Controllers & Process Monitors
- Infrared Pyrometers

PRESSURE, STRAIN AND FORCE

- Transducers & Strain Gages
- Load Cells & Pressure Gages
- Displacement Transducers
- Instrumentation & Accessories

FLOW/LEVEL

- Rotameters, Gas Mass Flowmeters & Flow Computers
- Air Velocity Indicators
- Turbine/Paddlewheel Systems
- Totalizers & Batch Controllers

pH/CONDUCTIVITY

- pH Electrodes, Testers & Accessories
- Benchtop/Laboratory Meters
- Controllers, Calibrators, Simulators & Pumps
- Industrial pH & Conductivity Equipment

DATA ACQUISITION

- Communications-Based Acquisition Systems
- Data Logging Systems
- Wireless Sensors, Transmitters, & Receivers
- Signal Conditioners
- Data Acquisition Software

HEATERS

- Heating Cable
- Cartridge & Strip Heaters
- Immersion & Band Heaters
- Flexible Heaters
- Laboratory Heaters

ENVIRONMENTAL MONITORING AND CONTROL

- Metering & Control Instrumentation
- Refractometers
- Pumps & Tubing
- Air, Soil & Water Monitors
- Industrial Water & Wastewater Treatment
- pH, Conductivity & Dissolved Oxygen Instruments

M5752/0720