



WEB POSITION SENSOR



ARIS WPS 440

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Product Manual

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# INTRODUCTION

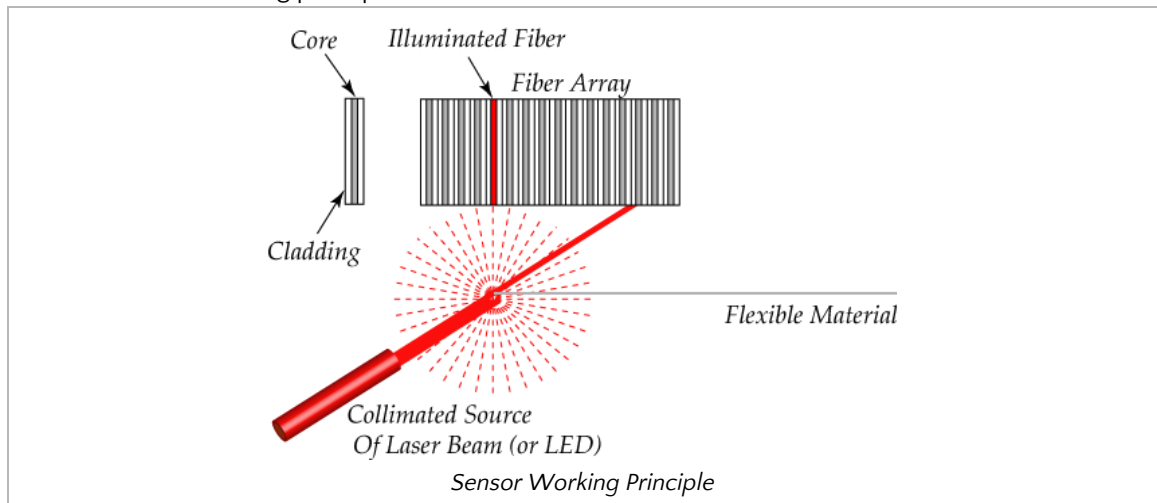
This product manual provides information about installation, use and maintenance of ARIS Web Position Sensor. The sensor is designed for use in indoor industrial and laboratory equipment that process materials in web form as they move through a converting or raw material manufacturing process.

The sensor is powered by a patented sensor technology that does not require any setup or re-calibration when different materials are used. The web position sensor technology adjusts automatically to the physical characteristics of the web material and provides a true web position measurement.

## Working principle

The ARIS Web Position Sensor uses LED light source (infrared, white and ultraviolet) and fiber optic technology to accurately measure the position of the web. The sensing principle relies on light scattering and spatial filtering properties of fiber optics to accurately determine the web position. The spatially filtered light is projected onto a one dimensional line scan camera and the image recorded by the camera is processed using advanced digital signal processing algorithms to accurately determine the position of the material. Since any material, be it opaque, transparent, porous and nonporous, scatters light the sensor is not affected by the material properties. The intelligent digital signal processing automatically adapts to any changes to provide a true measurement.

A schematic of the basic working principle is shown below:



A light source, such as laser or LED is used illuminate the area near the edge of the web. As the light falls on the web, the light is scattered in all directions. The scattering of light is then filtered using fiber optics before it is projected onto a camera. Since the optical fibers are directionally sensitive, light is spatially filtered such that only fiber(s) directly inline with the scattered light get illuminated. All other fibers do not couple light since the scattered light falls on them at an angle. Since any material irrespective of its opacity and porosity scatters (or reflects) light the sensing principle is unaffected by the material properties. Moreover, the measurement is an absolute measurement because of spatial filtering.

## ARIS Web Position Sensor features

ARIS Web Position Sensor is essentially an one-dimensional vision based sensing system which has advantages over the conventional fork/U-shaped sensors as well as camera based sensors. The following table compares the different sensor technologies and their capabilities.

Sensor Characteristics	ARIS WPS	U-Shaped Infrared	U-Shaped Ultrasonic	U-Shaped Pneumatic	Camera
Unaffected by Opacity	✓	X	✓	✓	X
Unaffected by Porosity	✓	✓	X	X	✓
Unaffected by Splices	✓	X	X	X	✓
Unaffected by Dust	✓*	X	X	✓	X
Unaffected by Temperature Change	✓	✓	X	✓	✓
Unaffected by Vacuum	✓	✓	X	X	✓
Unaffected by Ambient Light	✓	✓	✓	✓	X
Unaffected by Vibration or Ringing	✓	✓	X	✓	✓
Analog or Digital Measurement	Digital	Analog	Analog	Analog	Digital
Line Detection	✓	X	X	X	✓
Contrast Detection	✓	X	X	X	✓
Resolution Unaffected by Range	✓	X	X	X	✓
Automatic Calibration	✓	X	X	X	X

\* The dust issue can be reduced by using intelligent digital processing algorithms.

The main advantage of the fork/U-shaped sensors, that work on the principle of blocking/unblocking, is their simplicity. The simple sensor principle is cost effective and provides a robust measurement as long as the material properties do not change. However, they require setup and calibration whenever the material or environmental conditions change, as shown above in the table. While the camera based sensors have better functionality than the traditional fork/U-shaped sensors, they are expensive and typically require calibration because of the effect of ambient light; focusing is often another issue with camera based sensors. The unique sensing principle of the ARIS Web Position Sensor essentially overcomes the limitations of traditional sensors, as well as the camera based sensor.

# SAFETY INSTRUCTIONS

The ARIS Web Position Sensor is an electronic device operating under low voltage (24 VDC). However, it does present a few safety requirements that must be followed in order to assure safe operation.

## Instructions for use

The ARIS Web Position Sensor must be properly transported and stored. Sensors with any sign of physical damage must not be used. Only persons who have the necessary qualifications should work on the installation, commissioning, operation, and maintenance of the sensor.

Notes:

- Please read the product manual and properly follow its instructions.
- Be aware of all national, state, and local requirements for accident prevention and environmental protection.

## Proper use

The ARIS Web Position Sensor is made for indoor uses only. The sensor is designed for use in industrial and lab equipment that process materials in web form as they move through a converting or raw material manufacturing process. Other applications include non-web based industrial measurement and sensing applications.

## Improper use

- The sensor uses high powered LED light source (visible or invisible) that may be harmful to human eye. Staring directly at the light source may harm vision and should be avoided.
- Outdoor use is considered improper.
- Any use outside the technical specifications shall be considered improper use and voids any warranty of the equipment.
- Any replacement parts or modification necessities should be made by Roll-2-Roll Technologies LLC.

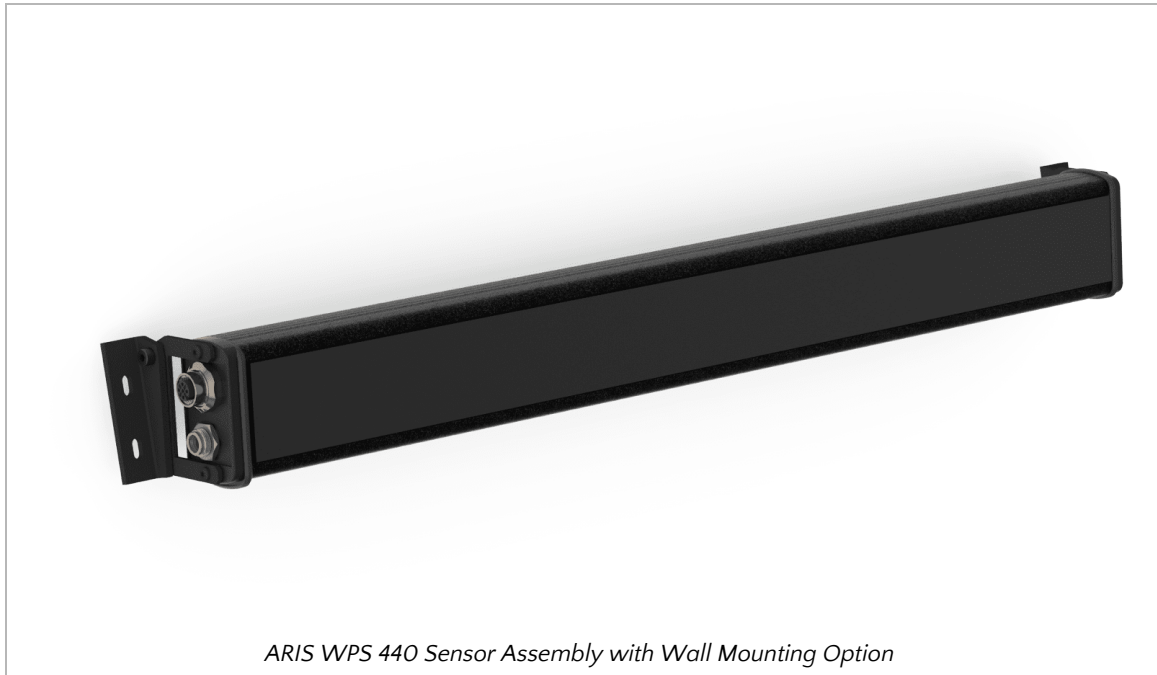
## Static discharges and grounding

The electronic elements of the sensor are sensitive to static discharges. Make sure that the sensor control unit, the power supply, and the machine on which the sensor operates is properly grounded to avoid shock and the effect of static discharge.

# INSTALLATION AND COMMISSIONING

## Sensor Assembly

The sensor assembly houses the LED light source, the optics, the camera sensor and the control electronics. The fully integrated solution is a plug and play system that is ready for commissioning out of the box.



*ARIS WPS 440 Sensor Assembly with Wall Mounting Option*

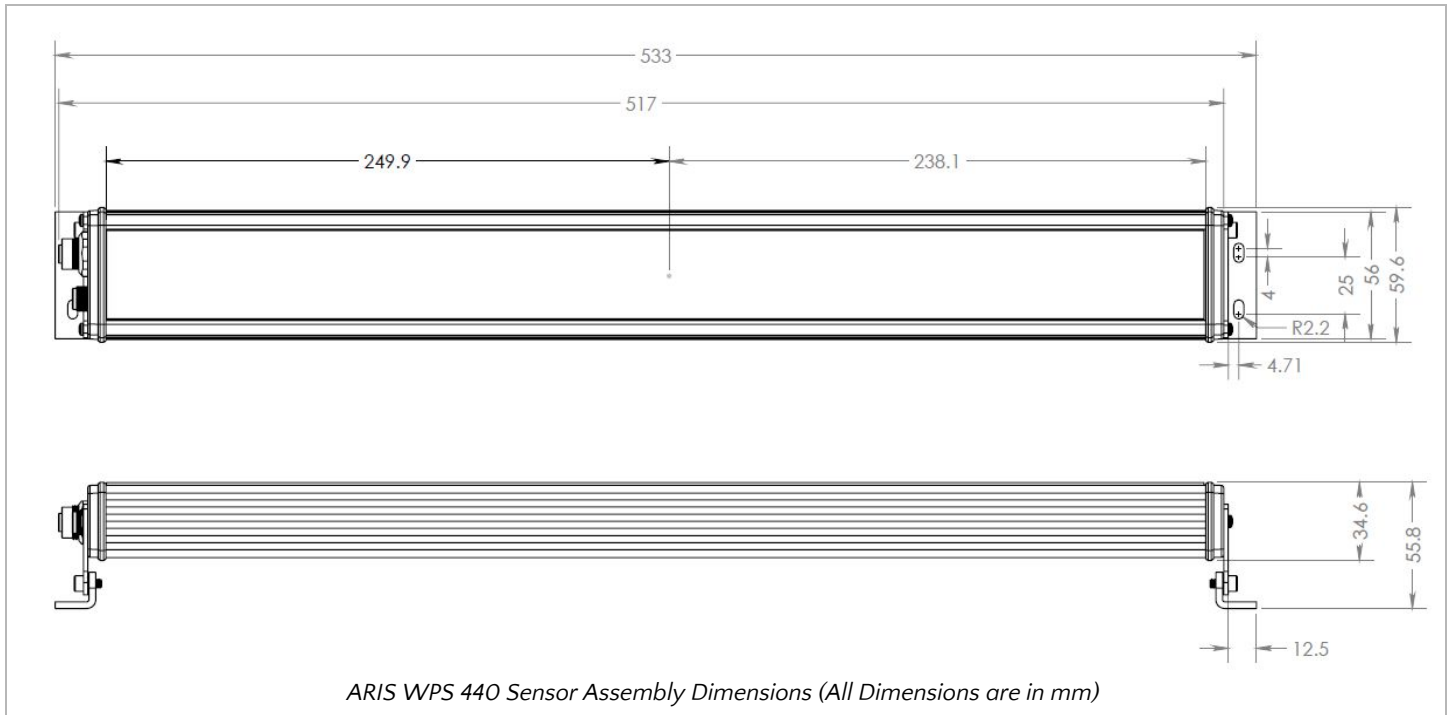
### Attention:

- The sensor should be installed such that the web material is about 5 to 10 mm from the filter lid for the most accurate measurement.
- The length of the sensor should be parallel to the width of the web and the sensor should be positioned normal to the plane of the web.
- The standard convention for the sensor is such that the connectors are on the left while facing the sensor (as shown above).
- Ensure that no object is behind the web, in the viewing direction of the sensor, for a distance of about 150 mm. The presence of any such object within the 150 mm distance may affect the sensor output.

The physical dimensions of the sensor head, the assembly and the rail are shown next.



## Physical Dimensions of ARIS WPS 440



## Power Input

The ARIS Web Position Sensor operates under 24 VDC ( $\pm 5\%$ ) power with a maximum current of 3 Amps. There are two power port options available: (1) pre-wired or (2) power jack connector.

## Prewiring

In the pre-wired option, the unit may come with a 2.5 meter long power cable (through a gland nut) for the customer to connect to an appropriately grounded 24 VDC power source. There are three conductors in the power cable. The red colored conductor is the 24V power, the black colored conductor is the DC return or electronic circuit ground, and the white colored conductor is the earth ground or PE. For safety and for normal operation, the ARIS web sensing system, the equipment to which the sensor is installed must be properly grounded.

## Switchcraft DC Connector

Sealed Switchcraft L712AS power jack port option is available on the SCU. A mating Switchcraft 761KS12 plug connector or a pre-assembled Switchcraft CARA761KS07984 or a pre-assembled Switchcraft CA761KS07984 can be used to supply power. For the plug connector the 24 VDC power should be supplied to the tip/center pin and electronic ground on the sleeve pin. For the cable assembly the 24 VDC should be connected to the red cable and the electronic ground connected to the black cable.

## Industrial DIN Rail Power Supply

Industrial DIN rail mountable power supply such as Mean Well SDR-75-24 can be used to supply the 24VDC power. This is an available purchase option.

## Grounding

For safety and for normal operation, the Low Profile Web Guide, the equipment to which the web guide is installed must be properly grounded. The controller should also be appropriately grounded. The metal enclosure surface or the mounting screws may be used to properly earth ground the controller.

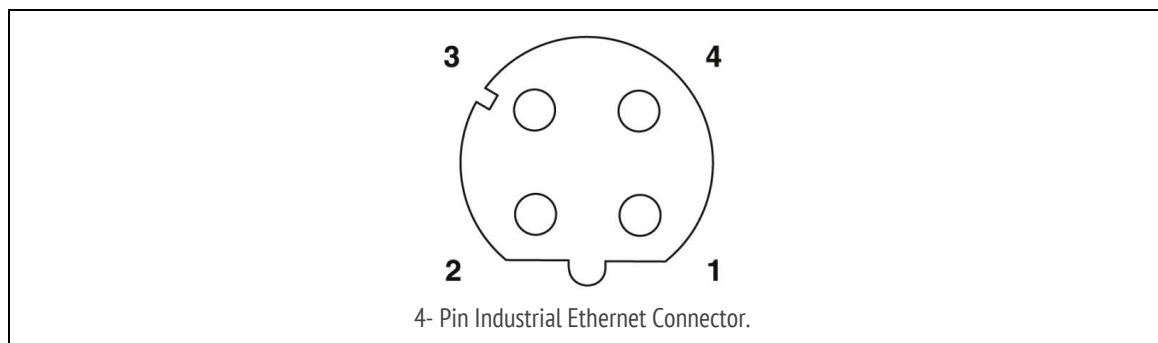
**WARNING:** Even though the mounting holes provide grounding of the Low Profile Web Guide, please use all possible options to safely earth the web guide. Improper grounding may result in static buildup that can potentially result in malfunction of the web guiding system.

## Desktop Adaptor

AC-DC desktop adaptor such as Mean Well GS90A24-P1M can be used to supply the 24VDC power. This is an available purchase option.

## Industrial Ethernet

An optional industrial ethernet connection to the ARIS WPS 440 is available. A 4-pin D-coded M12 socket connect is provided for ethernet connection. Standard network cables such as Phoenix Contact NBC-MSD/1,0-93E/R4AC SCO - 1407360 or VS-MSD-IP20-93E/5,0 - 1403500 can be used to connect the ARIS SCU to an ethernet network using RJ45 plug.



A set of input and output registers are available to monitor and control the ARIS WPS 440.

**NOTE:** Either the Ethernet or the Analog output connector is available. Both cannot be made available.

## Sensor output registers

The output registers from the sensor provide information from the sensor. The data include status/fault information, sensor position information and sensor measurement quality information. The data from the sensor is organized in the following registers:

Register #	bit 15	bit 14	bit 13	bit 12	bit 11	bit 10	bit 9	bit 8	bit 7	bit 6	bit 5	bit 4	bit 3	bit 2	bit 1	bit 0
0	Sensor status/fault register															
1	Edge position 1 (left edge)															
2	Edge position 2 (right edge)															
3	Width of first thread/string															
4	Minimum width															
5	Maximum width															
6	Mean width															
7	Thread/string count															

### Status and fault registers

The sensor status/fault register is organized as follow. The eight least significant bits correspond to fault information while the eight most significant bits correspond to status information.

Bit #	Value	Label	Description
0	0/1	No sensor	0: if a sensor is present 1: if no sensor is connected
1	0/1	Low contrast	0: if measurement contrast is high 1: if measurement contrast is low
2	0/1	No web	0: if web is detected by the sensor 1: if the sensor cannot detect a web
3	0/1	Wrong orientation	0: if sensor orientation is correct 1: if the sensor see an edge in the opposite orientation to which it is set up
4	NA		Reserved for future use
5	0/1	Flutter	0: if no flutter is detected

			1: if the sensor detects flutter or out of plane movement in the web
6-7	NA		Reserved for future use
8	0/1	Left Sensor	0: if the sensor not set as a left sensor 1: if the sensor is set as a left sensor
9	0/1	Right Sensor	0: if the sensor not set as a right sensor 1: if the sensor is set as a right sensor
10-12	0-4	Number of pixels	The number of pixels in the sensor 0: 256 1: 768 2: 1774 3: 3530
13-15	0/2/6	Sensing mode	0: edge sensing mode 2: contrast position sensing mode 6: Thread count mode

*Note: If both the left sensor and the right sensor bits are set then the configuration corresponds to center sensor mode. For wide sensors (such as ARIS WPS 221) a single sensor may be used to measure the position of the two edges of the web, if the width of the web is smaller than the sensing window of the sensor.*

### Sensor position output register

The sensor position output register provides the absolute measurement in pixels. The output ranges from 0 to number of pixels in the sensor, and depending on the sensor orientation the output corresponds to edge position or contrast position. In order to convert the position into a physical unit, such as millimeters or inches, the sensor resolution and the total pixel number of the sensor head are necessary. The following table provides a summary of the resolution and pixel count information for the different ARIS WPS models.

Model	Resolution	Total Pixel Count
ARIS WPS 16	0.0635 mm or 0.0025 in	256
ARIS WPS 48	0.0635 mm or 0.0025 in	768
ARIS WPS 221	0.125 mm or 0.005 in	1774

ARIS WPS 440	0.125 mm or 0.005 in	3530
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In either sensor orientation (left or right) the measured position increases as the web moves from left to right.

*Note: The output when the web completely covers the sensor or when the web is completely outside the sensor window would be different based on the sensor orientation.*

Sensor Orientation	Completely open	Fully covered
Left sensor orientation	Number of pixels	0
Right sensor orientation	0	Number of pixels

If no sensor is present then the value in the sensor position output register is meaningless.

With a wide sensor (such as ARIS WPS 221) center guiding with one sensor is possible if the width of the web is smaller than the sensing window of the sensor. When a single sensor acts as center sensor both the left and the right edge will be output via the industrial ethernet option. Irrespective of the sensor number the output for the left edge of the web is always available at the Sensor 1 position output register and the right edge of the web is available at the Sensor 2 position output register.

*Note: If two sensors are connected and both are in center sensor mode the Sensor 1 position output and Sensor 2 position output will always correspond to the left and the right edge of the web seen by Sensor 1. Likewise for guiding purposes, the web guide will guide to the center of the web as measured by Sensor 1. The Sensor 2 output will be disregarded.*

**Edge Position 1 (Left Egde)**

The leftmost edge of the web or the leftmost edge of a collection of threads is provided.

**Edge Position 2 (Right Edge)**

The rightmost edge of the web or the rightmost edge of a collection of threads is provided.

**Width of first thread/string**

The width of the first thread/string is provided. In a single web application this provides the web width.

**Minimum Width**

The minimum width of thread/string within all the strings is provided. The information can be used to monitor multiple thread/strings for fault conditions when this number changes significantly.

**Maximum Width**

The maximum width of thread/string within all the strings is provided. The information can be used to monitor multiple thread/strings for fault conditions when this number changes significantly.

## Mean Width

The mean width of all the thread/string is provided. This information can be used to monitor multiple threads/strings for fault conditions when this number changes significantly.

## Thread/string count

Provides a total number of threads/strings seen by the sensor. This information can be used to monitor multiple threads/strings for fault conditions when this number changes significantly.

## Commissioning

The ARIS Web Position Sensor is real plug-and-play system. The following section describes the steps and conditions required for automatic operation of the ARIS Web Position Sensor.

1. Connect the sensor cable to the 12 pin M12 connector to the sensor controller unit.
2. Power ON the unit.
3. From the factory the sensor is always configured to either left or right sensor orientation.
4. Plug the sensor cable into the 12 pin M12 connector. The sensor will automatically detect the correct configuration.
5. If an operator interface is available then the find sensor button can be used to automatically detect the correct configuration without unplugging the sensor cable.
6. If the industrial ethernet is available, the the orientation of the sensor can be forced through the industrial ethernet communication option. Note for some inspection applications, the sensor would be pre-configured with an orientation and that setting cannot be changed.

A sensor configured for one configuration will not work properly for the other configuration.

## General Maintenance

The ARIS Web Position Sensor is virtually maintenance free. However, the sensor lid can be cleaned to remove any dust particles that might accumulate on the surface.

- You may use any lens cleaning solutions available in the market.
- Do not use use petroleum based products as these can damage the sensor cover and affect its performance.

This cleaning can be done as part of a weekly maintenance schedule.

# TECHNICAL SUPPORT AND SERVICE

## Contact information

Roll-2-Roll Technologies LLC is dedicated to providing exceptional service and support to its customers. Please feel free to contact us for any technical support, installation support and service requirements.

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General Support Email: [support@r2r-tech.com](mailto:support@r2r-tech.com)

## Return shipping instructions

Please contact us to obtain a return merchandise authorization (RMA) number before returning the product to us. If returning the product please follow the instructions on the RMA form for quick and efficient service.



# REVISION HISTORY

## Document Revision

Version	Date	Author	Description
1.0	Nov 2015	AS	Initial Release Version
1.1	Jan 2016	AS	RS485/Modbus RTU Protocol
1.2	May 2016	AS	Added analog output and modified SCU dimensions
2.0	Dec 2016	AS, CB	Additional cable options, sensor digital I/O options.
2.4	Jun 2017	AS	Updated the documentation for new hardware and firmware
2.4a	Dec 2017	AS	Updated for new registers for Ethernet communication.

## Hardware Revision

Version	Date	Description
SCU V2	Dec 2014	Initial version with 12 VDC input
SCU V3	Jun 2015	Expanded version with 24 VDC input
SCU V4 Rev B	Oct 2015	Two sensor option, WDT, RTCC
SCU V4 Rev C	Mar 2016	Analog Output
SCU V4 Rev D	July 2016	Industrial ethernet option
SCU5	May 2017	Updated hardware with smaller form factor
WPS 440	June 2017	Compatibility for WSP 440 hardware
SCU5 Rev B	Nov 2017	Minor hardware changes
SCU5 Rev C	Dec 2017	Hardware changes with new LCD connector and ESD improvements

## Firmware Revision

Version	Date	Description
1.0	Jan 2015	Initial version, single sensor
1.1	Aug 2015	Firmware update for SCU V3, automatic sensor state detection
1.2	Nov 2015	Firmware update for SCU V4 Rev B. Modified sensor algorithm to increase precision and accuracy
1.3	Dec 2015	Two sensor option with automatic pixel detection

1.4	Mar 2016	Background suppression algorithm
1.5	Apr 2016	Analog output
2.1a	Aug 2016	Firmware update for SUC Rev4 D
2.2b	Dec 2016	Ethernet/IP implicit messaging, edge detection algorithm updates
2.4a	May 2017	Updates to edge detection algorithm and industrial ethernet capabilities
2.4a	Dec 2017	Updates to the industrial ethernet capabilities



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