ARIS SCU5 C(E)/MC(E)

Ethernet/IP Configuration Manual

Copyright Information

Introduction

The ARIS SCU5 controller can be used for standalone sensing application or for web guiding application; the letter M is added to the controller for web guiding. The ARIS SCU5 controller can be equipped with industrial ethernet option such as an Ethernet/IP communication option that can be used to integrate with Allen-Bradley PLC's such as the ControlLogix, CompactLogix and MicroLogix with Ethernet/IP ports. Other compatible devices include any Ethernet/IP I/O scanner with implicit messaging capabilities. When an industrial ethernet option is enabled the controller will include either C(E) for Ethernet/IP or C(P) for PROFINET in the model name. This document details the Ethernet/IP option for the ARIS SCU5 C(E) and ARIS SCU5 MC(E).

ARIS SCU5 C(E)/MC(E) is an I/O adapter that communicates using implicit messaging. The implicit messaging typically uses User Datagram Protocol (UDP) for real-time connected messaging between the I/O scanner (PLC) and the I/O adapter (ARIS SCU5 C(E)/MC(E)). To enable high speed communication, both the I/O scanner and I/O adapter are pre-configured to implicitly know the meaning of the messages exchanged.

Roll-2-Roll Technologies is providing add-on instruction for AB PLCs to enable quick and hassle free integration of the ARIS SCU5 C(E)/MC(E) into any compatible AB PLC.

This manual provides the following:

- Input and output data register structure and meaning
- Step-by-step instructions for integrating ARIS SCU5 C(E)/MC(E) to an AB PLC
- Importing add-on instructions for quick integration
- Use of add-on instructions to monitor and control the sensors as well as the web guide

Two sets of add-on instructions are provided; one for the sensor and one for web guiding functions.

Remote Control and Monitoring

A set of input and output registers are available to monitor and control the sensor and the web guiding system remotely.

Output registers

The output registers from the ARIS SCU5 C(E)/MC(E) provide information from the sensor(s) and the web guide. The data include status/fault information, sensor position information, sensor measurement quality information, web guide status/fault information, etc. The data from the ARIS SCU5 C(E)/MC(E) is organized in the following registers. Registers 5 to 7 are only available in the ARIS SCU5 MC(E) controller option.

Register #	bit 15	bit 14	bit 13	bit 12	bit 11	bit10	bit 9	bit 8	bit 7	bit 6	bit 5	bit 4	bit 3	bit 2	bit 1	bit 0
0	Sensor 1 status/fault register															
1	Sensor 2 status/fault register															
2	Sensor 1 position output															
3	Sensor 2 position output															
4	Sensor 1 quality factor								Sensor 2 quality factor							
5	Web guide status/fault register															
6	Guide point percentage								Diagnostic index							
7	Motor speed percentage															

Sensor 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
13-15	0/2	Sensing mode	0: edge sensing mode 2: contrast position sensing 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

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.

Quality factor registers

The quality of the sensor measurement from the two sensors are provided in register 4. Higher number corresponds to good quality measurement while a low number indicates lower quality. The value of the

quality factor ranges from 0 to 256. The eight most significant bits of register 4 corresponds to the 8-bits quality factor from sensor 1 while the eight least significant bits corresponds to the quality factor of sensor 2.

Web guide status and fault registers

Bit #	Value	Label	Description
0	0/1	No operator interface	0: if no operator interface is detected 1: if an operator interface is detected
1	0/1	No motor driver	0: if no motor driver is detected 1: if a motor driver is detected
2	0/1	Motor fault detected	0: if motor motor function is normal 1: if a motor fault is detected
3	0/1	Disturbance detected	0:if no disturbance is detected 1: if a disturbance is detected
4	0/1	Traction issue detected	0: if no traction issue is detected 1: if a traction issue is detected
5	0/1	Upstream misalignment	0: if no upstream misalignment is detected 1: if an upstream misalignment is detected
6	0/1	Guide extreme position	0: if the web guide is within the normal position 1: if the web guide is in an extreme position
7	0/1	High frequency disturbance detected	0: if a high frequency disturbance is detected 1: if no high frequency disturbances are detected
8	0/1	Manual/Auto	0: if the web guide is in manual mode 1: if the web guide is in automatic mode

9	0/1	Jog Left operation	0:if the web guide is not jogging left 1: if the web guide is jogging left
10	0/1	Jog Right operation	0: if the web guide is not jogging right 1: if the web guide is jogging right
11	0/1	Servo Centering operation	0: if the web guide is not servo centering 1 if the web guide is servo centering
12	0/1	Good guiding performance	0: if the guiding performance is not good 1: if the guiding performance is good
13-15	NA		Reserved for future use

Guide point percentage

The guide point for the web guide is provided in this register. The value of the guide point range between 0 and 100, representing the guide point as a percentage of the sensor range. A value of 50 indicates that the guide point is at the middle of the sensing window while a value of 25 means the guide point is at the 25% of the sensor window (left of the middle) while a value of 75 means the guide point is at 75% of the sensor window (right of the middle). The eight most significant bits of register 5 provide the guide point percentage output.

Diagnostic index

The diagnostic index output is only available with web guiding that include the KOIOS diagnostic index. The value ranges between 0 and 100. For more details please refer to the KOIOS diagnostics product manual. The eight least significant bits of register 5 provide the diagnostic index output.

Motor speed percentage

The motor positioning speed as a percentage of maximum speed is output in register 7. The value ranges between 0 and 100.

Input registers

Input registers allow the remote PLC to configure and control the parameters of the sensor(s) and web guiding system. One 16-bit command register for each sensor is available for configuration and control. Three 16-bit registers are available to control and configure the web guiding system. The input registers are mapped as shown below:

Register #	bit 15	bit 14	bit 13	bit 12	bit 11	bit1 0	bit 9	bit 8	bit 7	bit 6	bit 5	bit 4	bit 3	bit 2	bit 1	bit 0
0	Sensor 1 command register															
1	Sensor 2 command register															
2	Guide command register															
3	Guide point offset register															
4	Motor speed percentage register															

Sensor command register

Bit #	Value	Label	Description
0-1	0/2	Sensor orientation	0: set sensor orientation to be right sensor 2: set sensor orientation to be left sensor Note: Changing this value will take effect only if bit 5 is set to 1. The auto switch mode needs to be disabled to take control of the sensor orientation through this register.
2-3	0/1		Reserved for future use
4	0/1	Sensing mode	0: set the sensing mode to be edge mode 1: set the sensing mode to be contrast mode
5	0/1	Disable auto switch off	0: Automatic switch is enabled 1: Automatic switch is disabled Note: This bit needs to be set in order to force the sensor orientation externally. If this bit is cleared to zero the sensor will maintain the previous orientation until the sensor automatically detects the sensor orientation when (1) find sensor is enabled or (2) when a new sensor is plugged into the sensor port.
6	0/1	Find sensor	0: Disable find sensor operation 1: Enable find sensor operation by resetting the orientation and allowing the sensor to detect the web orientation. Note: This bit is momentary when set to one. Every time the find sensor operation needs to be enabled the bit needs to be cleared to zero before setting it to one.
7	0/1	Disable analog output	0: Enables the analog output for the sensor 1: Disables the analog output for the sensor

8-15	0-255	Minimum contrast	Minimum contrast: Minimum contrast required to accept an edge in contrast mode Default value is 50.

Web guide command register

Bit #	Value	Label	Description
0-7	NA		Reserved for future use
8	0/1	Remote control	0: if cleared to zero, the local operator interface have control over the web guide 1: if set to one, the remote ethernet controller has control over the web guide. The interface icons to control the web guide on the local operator interface will be disabled. Information for monitoring purposes will be displayed on the screen.
9	0/1	Manual/Auto mode	0: if cleared to zero, the web guide will be placed in the manual mode 1: if set to one, the web guide will be placed in the automatic mode
10	0/1	Jog Left or decrease guidepoint	This bit performs two functions based on bit 9. If bit 9 is cleared: ● 0: Stop Jog Left operation ● 1: Start Jog Left operation Note that this register is a write only register and will not change state if the web guide reaches the extreme position. If bit 9 is set: ● 0: will clear the register and has no effect ● 1: will decrease the guide point by 0.254 mm or 1/100th of an inch from the current value. Note that this value on this register is momentary. Before decreasing the guidepoint the bit needs to be cleared before setting it to one. Note that the guide point cannot at the extremes of the sensing window and will automatically truncated if the extreme limit is reached. The extreme limit depends on the sensor resolution and sensor width.
11	0/1	Jog Right or increase guidepoint	This bit performs two functions based on bit 9. If bit 9 is cleared: ● 0: Stop Jog Right operation ● 1: Start Jog Right operation Note that this register is a write only register and will not change state if the web guide reaches the extreme position. If bit 9 is set: ● 0: will clear the register and has no effect ● 1: will increase the guide point by 0.254 mm or 1/100th of an inch from the current value.

			Note that this value on this register is momentary. Before increasing the guidepoint the bit needs to be cleared before setting it to one. Note that the guide point cannot at the extremes of the sensing window and will automatically truncated if the extreme limit is reached. The extreme limit is set such that at least ±3.175 mm is available on either side of the adjusted guide point.
12	0/1	Servo Center operation or set guide point	This bit performs two functions based on bit 9. If bit 9 is cleared: ● 0: No effect ● 1: Start Servo Center operation Note that this register is a write only register and will not change state if the web guide reaches the center position. Note that this value on this register is momentary. Before a servo center operation the bit needs to be cleared to zero before setting it to one. If bit 9 is set: ● 0: will clear the register and has no effect ● 1: will set the guide point to be at 50% of the sensing window. Note that this value on this register is momentary. Before decreasing the guidepoint the bit needs to be cleared before setting it to one. The extreme limit is set such that at least ±3.175 mm is available on either side of the adjusted guide point.
13	0/1	Enable arbitrary gross guide point adjustment	This bit allows arbitrary gross adjustment of the guide point offset through the industrial ethernet interface. 0: if cleared to zero, gross guide point adjustment is disabled 1: if set to one, the remote ethernet controller can make arbitrary gross adjustment to the guide point by writing a 16-bit signed integer to the guide point register.
14-15	NA		Reserved for future

WARNING: *All the remote control operations may cause the web guide to move without operator intervention. This process may cause process upsets. Caution must be exercised when performing these function and should be done by those who completely understand the consequence of this change.*

WARNING: *ARIS Web Guiding System is an automatic control device that may stop and start at any time without notice, especially when controlled remotely. Hence standard safeguards must be in place to prevent any kind of injury.*

WARNING: *The remote control options provides significant access and control of the web guide and the sensor. A combination of the settings may create conditions that might not be ideal for web guiding. Hence only the personnel familiar with the web guide operation should program the remote control interface. Contact Roll-2-Roll Technologies' technical support team for any question or assistance.*

Guide point offset register

If the 13th bit of the web guide command register is set, then arbitrary guide point adjustment can be made by writing a 16-bit signed integer value to the guide point offset register. The offset value is the distance from the desired guide point location to the middle of the sensor window. A positive offset value will result in a guide point location towards the right half of the sensor window while a negative offset will result in a guide point location towards the left half of the sensor window. The guide point offset in mm = 0.0635*(the 16-bit guide point offset register).

Motor speed register

The positioning speed of the actuator can be changed by setting the 7th bit of the register to 1 and writing a value between 0 and 100 in the 7 least significant bits. If the 7th bit is low then the value written in the register is be ignored. Any value in the 15th to 8th bit within the register is also ignored.

Communication Module

Off-shelf industrial ethernet modules from HMS industrial, are used in the ARIS SCU5 C(E)/MC(E) to provide ethernet connectivity. A 4-pin D-coded M12 socket connect is provided for ethernet connection. Standard network cables can be used to connect the ARIS SCU5 C(E)/MC(E) to an ethernet network using RJ45 plug.

IP Address

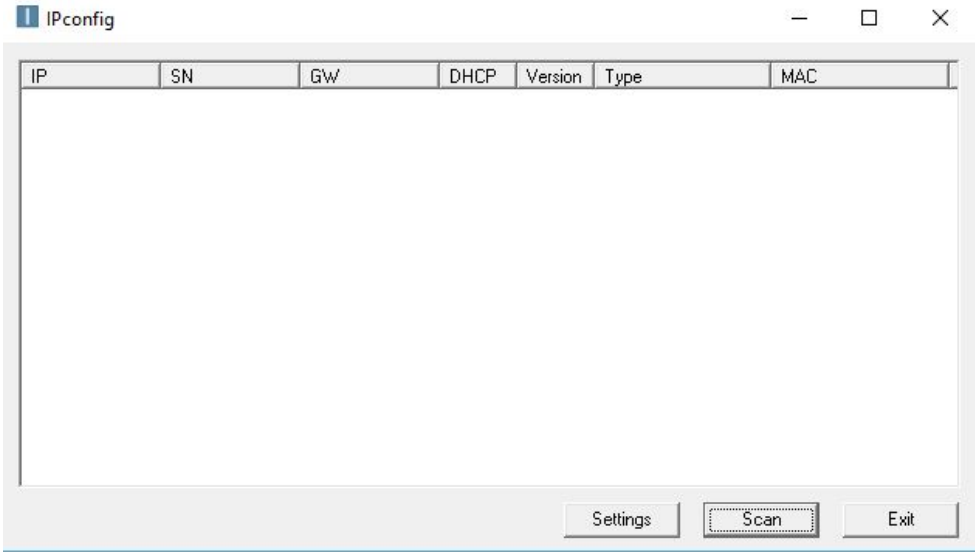
The ARIS SCU5 C(E)/MC(E) is configured to automatically acquire an IP address from a DHCP router or a server. As soon as the controller is connected to a network, an IP address is automatically assigned to the device. Before starting the configuration procedure find the IP address of the controller on the network.

Finding the IP Address

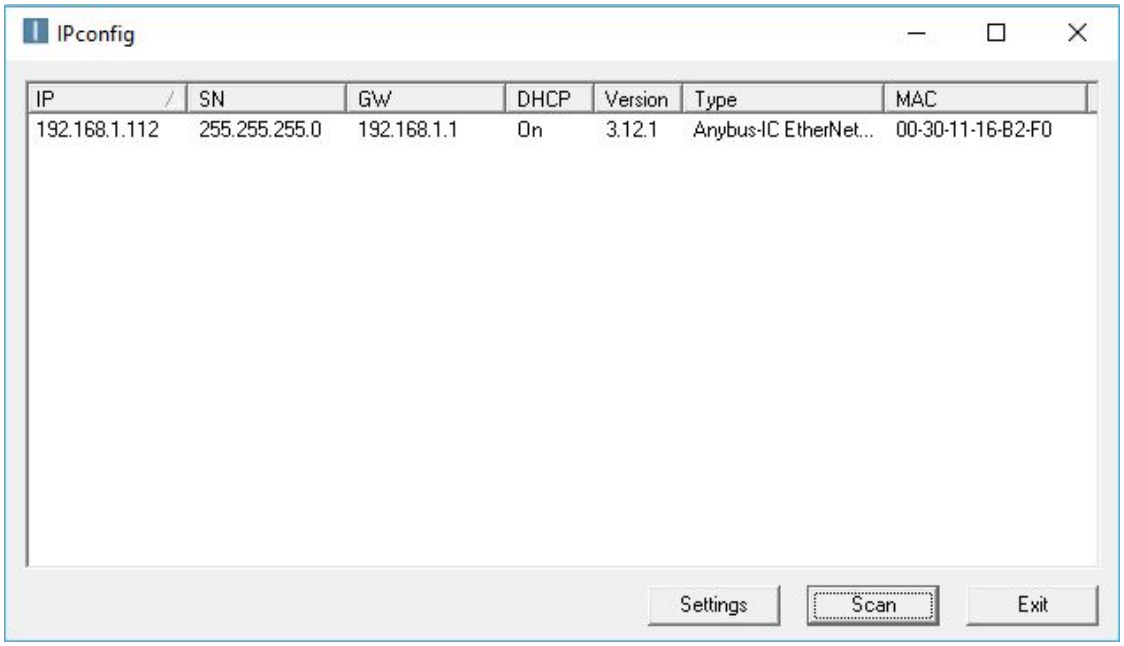
Once the controller is powered ON, the controller will automatically connect to the network. The controller is configured to get the IP address automatically from a DHCP server. Hence the controller should be connected to a network where dynamic IP addresses are issued by a network device such as a router.

A network port scan utility can be used to find the controller. Alternatively the IPConfig utility available in the software section of the HMS Industrial website can be used to scan for the device. The actual device used is **Anybus-IC EtherNet/IP** ORDER CODE**: AB6003.**

Once the utility is installed the program can be run to find the AnyBus IC module on the ARIS SCU5 C(E)/MC(E). The following shows the opening screen of the IPconfig utility.



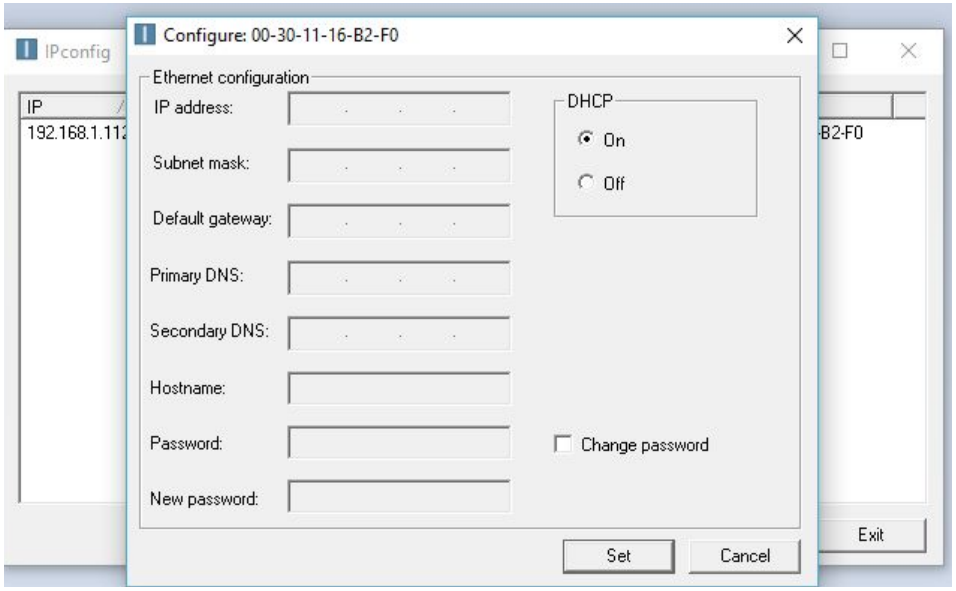
By pressing the scan button all the devices on the network from HMS Industrial network can be found. For example, the utility would find the device and list it as shown below.

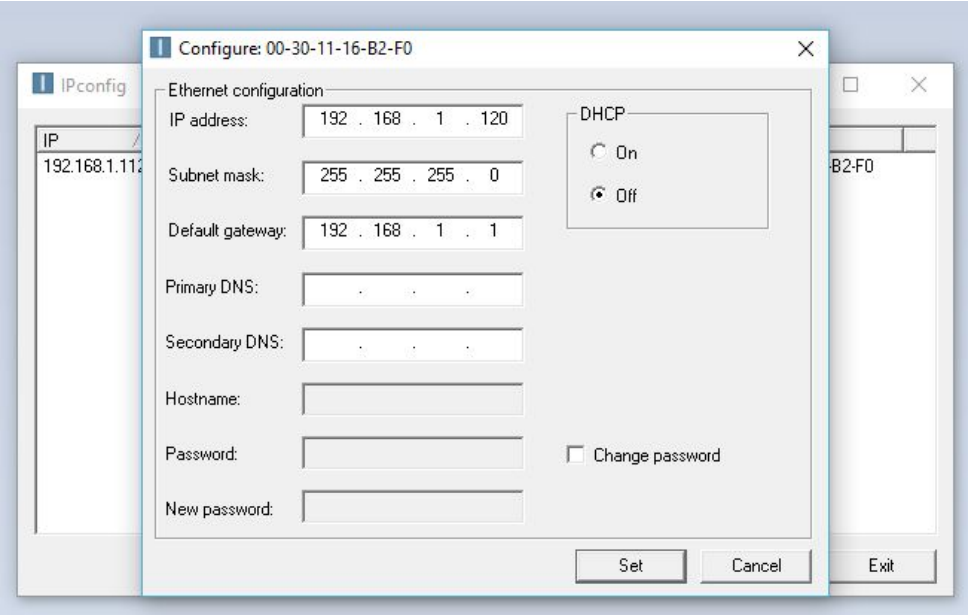


Information such as IP address, DHCP state, Type of module and the MAC address is displayed.

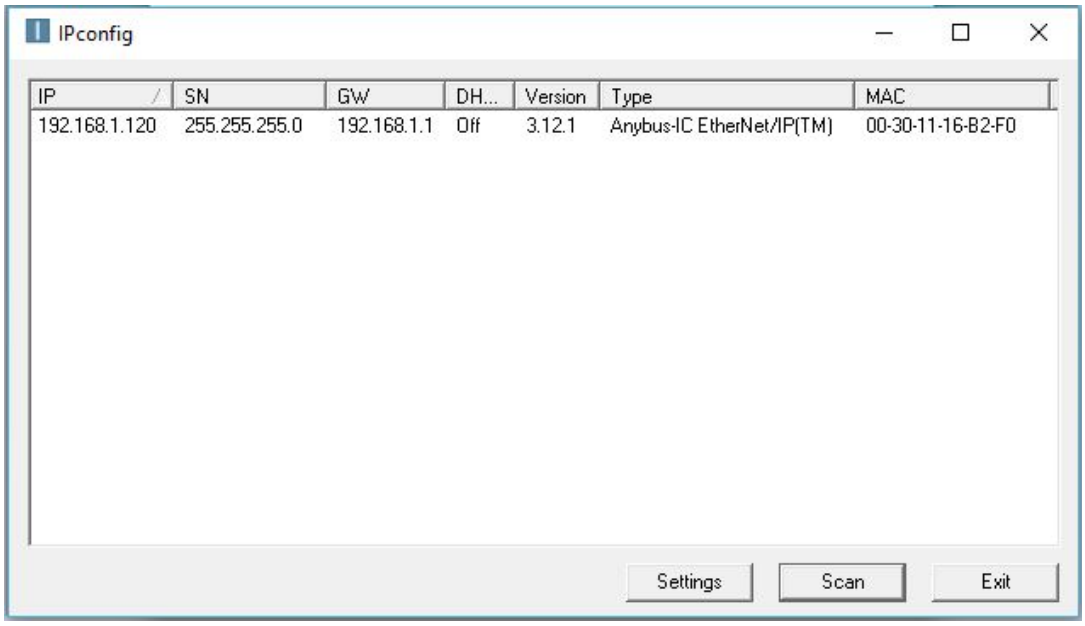
Setting a static IP address for the controller

Double clicking on the desired device listed in the IPConfig window would bring a screen to configure the Static/Dynamic IP address setting as shown below. By selecting the DHCP setting to be off, static IP address can be configured for the device.





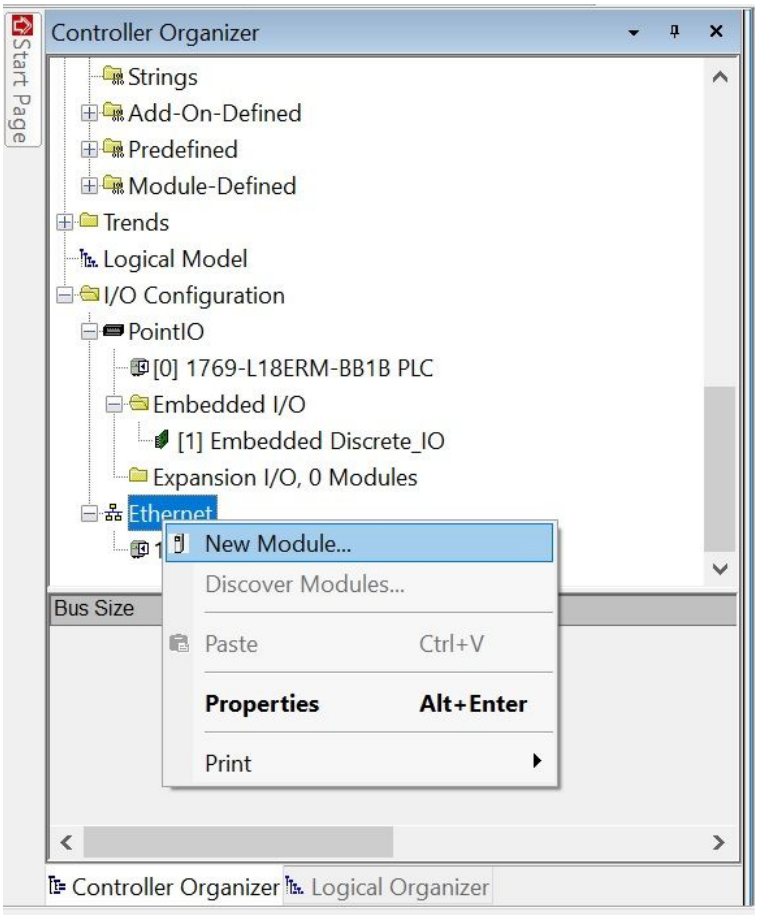
By clicking on the "Set" the static IP address can be set. Once the static IP address is set the IPconfig utility will refresh to show the new configuration. The DHCP setting will be set to "OFF" state and the new IP address will be assigned to the device as shown below.



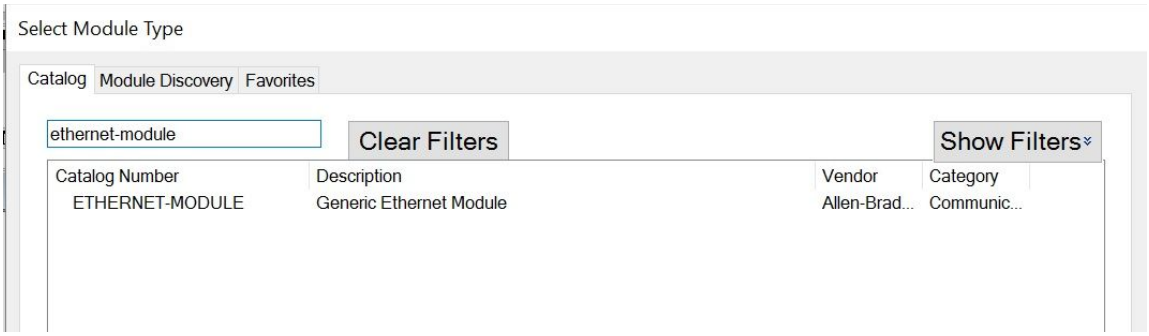
Configuring ARIS SCU5 C(E) in Studio 5000

Adding an ethernet module

Open the Studio 5000 project for the PLC that needs to be connected to the ARIS SCU5 C(E)/MC(E). Locate the Ethernet module in the I/O configuration of the controller organizer. Select the Ethernet module and right click to add a new module:

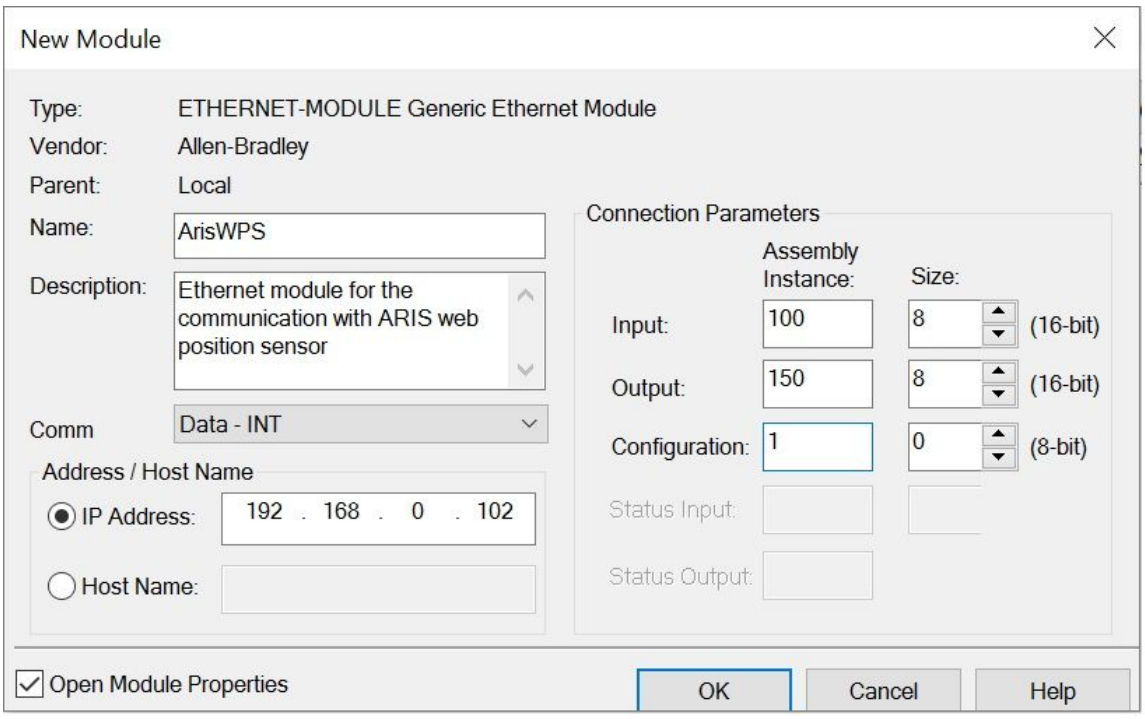


In the search box type “ethernet-module”, to add a generic ethernet module.



Configuring the module parameters

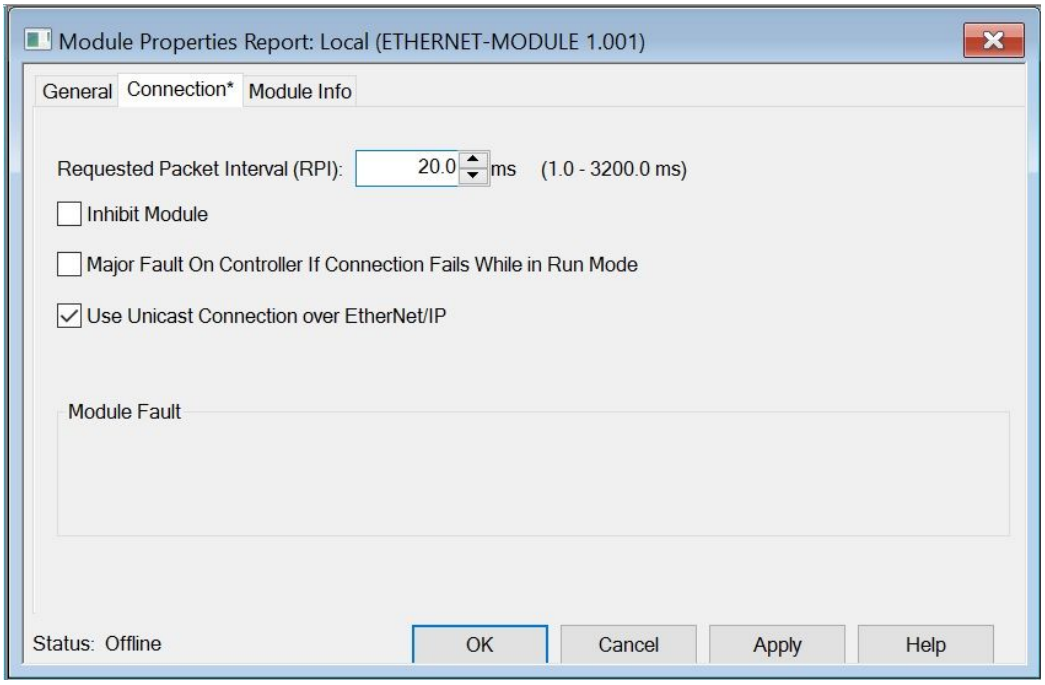
Once selected a property box will pop-up. In the property box, the name and description fields can be chosen arbitrarily. The communication data format MUST be changed to Data-INT in the drop down menu. The IP address MUST match the IP address of the sensor on the network. The connection parameters MUST match the one shown on the image below:



In the connection parameters choose the input assembly instance to start at 100 with a size of 8 (16-bit), output to start at 150 with a size of 8 (16-bit) and the configuration to 1 with a size of 0. Check "Open Module Properties" and press OK.

Configuring communication options

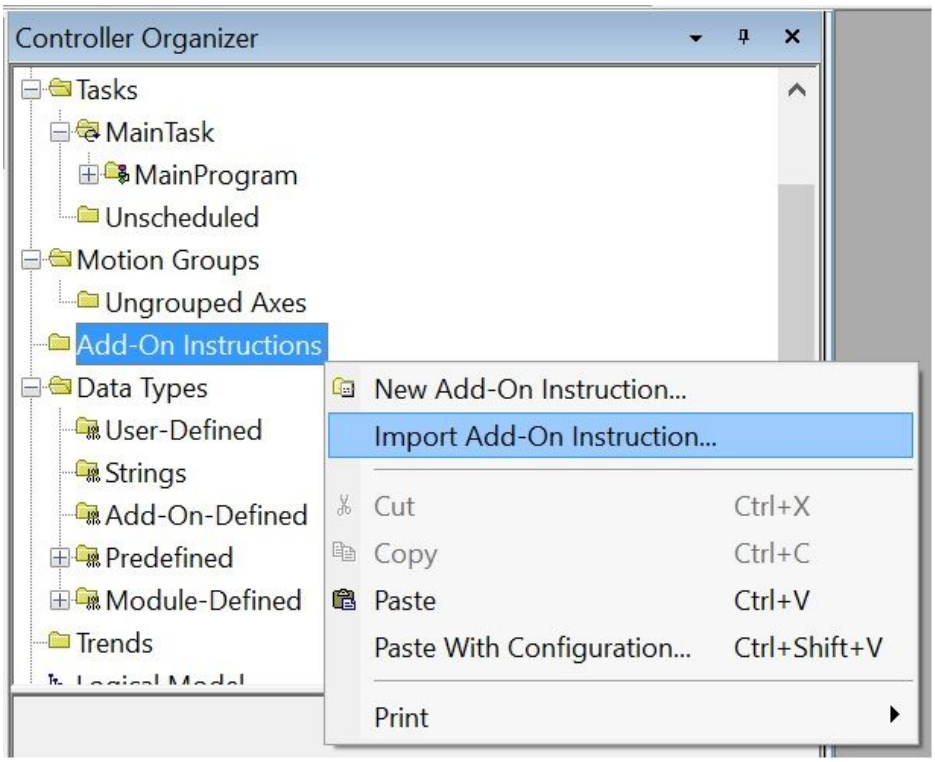
The next step involves the communication option configuration. The RPI sets the frequency at which the data is exchanged, lower RPI would imply an higher network load and vice versa. The sensor update the data every 20ms, therefore any RPI lower than that would not result in any extra meaningful data. Set the RPI to be 20 ms.



Click “Apply” to add the module.

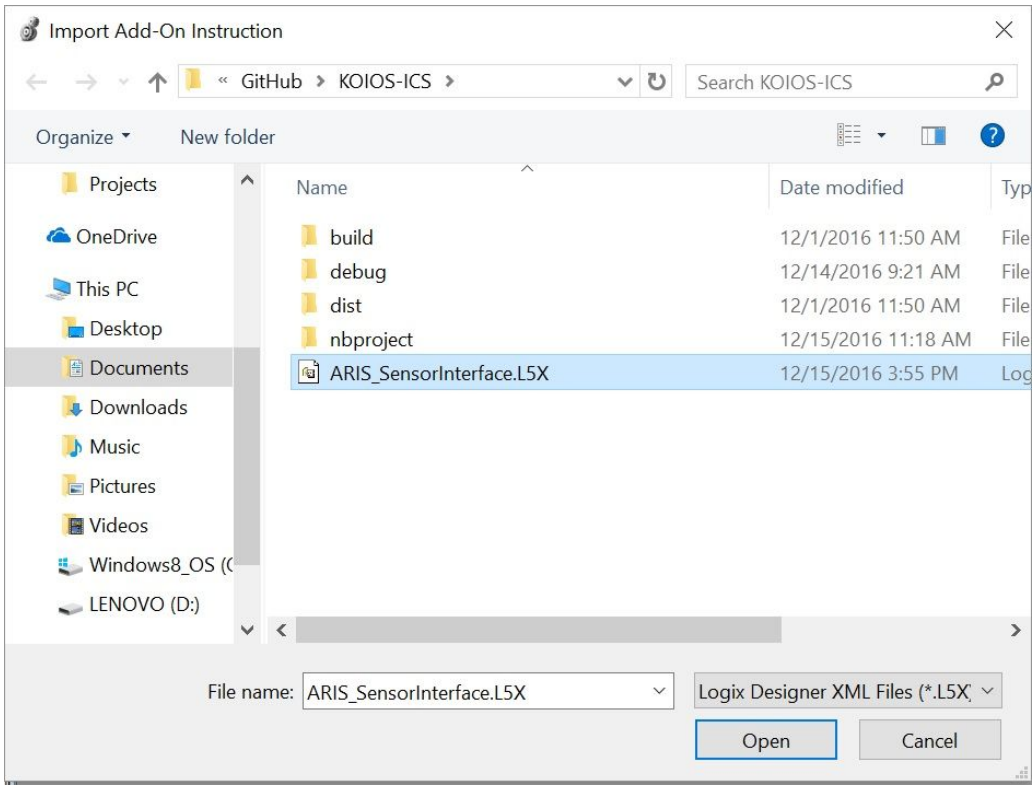
Importing Add-On-Instruction

Roll-2-Roll Technologies provides an Add-On-Instruction (AOI) to easily interface the sensor as well as the web guide. To import the AOI: select the Add-On Instruction in the controller organizer, right click and select import Add-On Instruction:

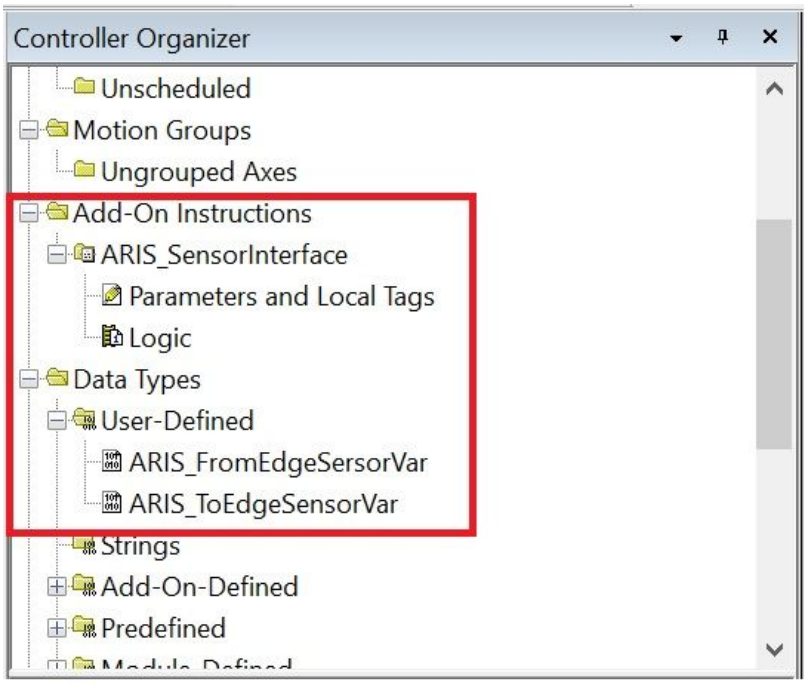


For example, importing the AOI for sensor is shown in the following.

Select the ARIS_SensorInterface.L5X file provided by Roll-2-Roll Technologies.

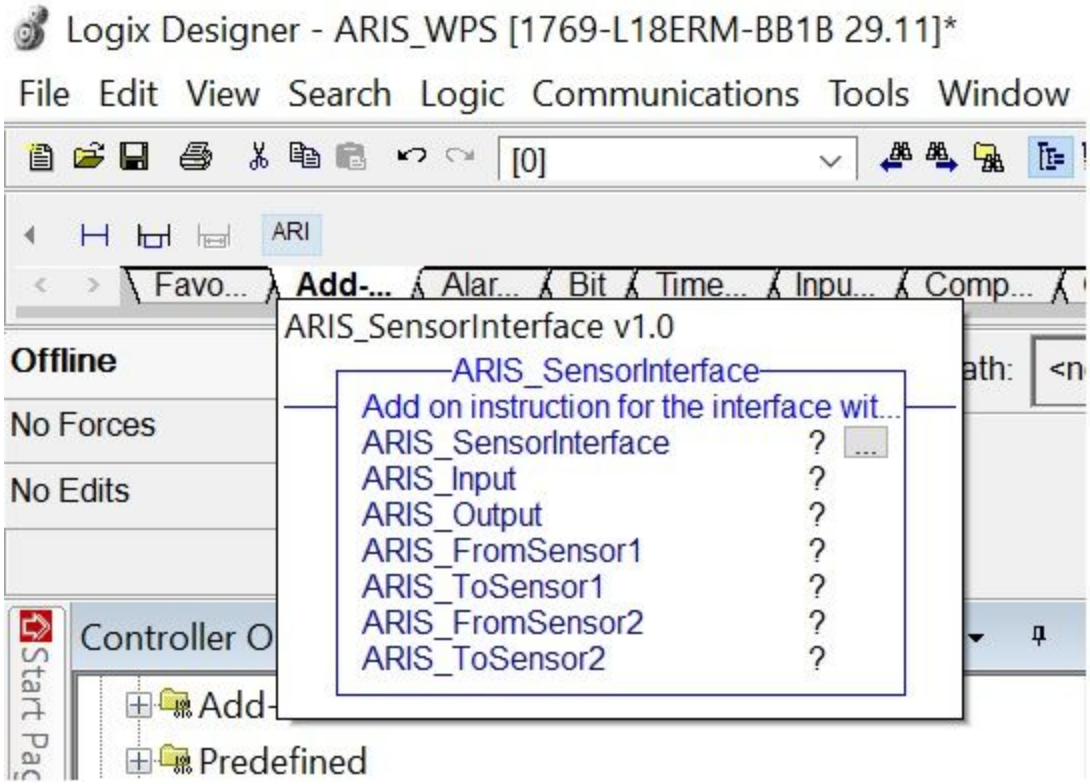


Once imported the AOI logic and user defined variables will appear in the controller organizer:

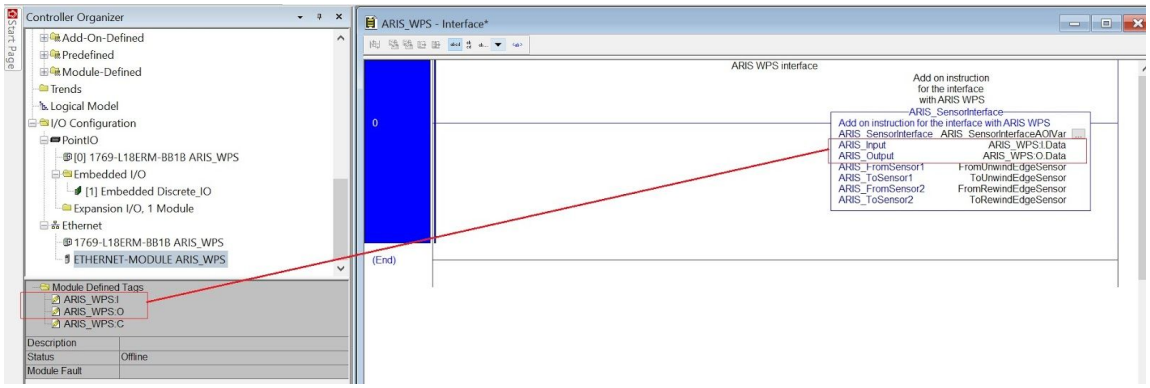


Using SCU5 C(E) Add-On Instruction

Once imported, ARIS AOI will appear in the Add-on tab from which it can be added to the project.



Once dropped in a rung simply fill the variables in the AOI. ***Note: the ARIS_Input and ARIS_Output variable MUST match the variable of the ARIS Ethernet module.*** All other variable can be named arbitrarily. In this example the ARIS_Input is mapped to ARIS_WPS:I.Data and ARIS_Output is mapped to ARIS_WPS:O.Data.



Sensor variables

ARIS SCU5 C(E) sensor variables are defined to make the integration of the sensor easy for the user without having to worry about the mapping and decoding the input and output registers. There are two types of variables: ARIS_FromWebEdgeSensorVar and ARIS_ToWebEdgeSensorVar. The first one contains all the data coming from the sensor, the second all the data that can be sent to the ARIS SCU5 C(E) to control the sensor. The sensor related data coming from the controller is read from the sensor output registers. The image below shows an instance of the ARIS_FromWebEdgeSensorVar variable with all the available fields. In this instance FromRewindEdgeSensor is the name of the variable of type ARIS_FromWebEdgeSensorVar. The PLC program can uses these variables to monitor the status/fault as well as obtain the measurement information from the sensor.

FromRewindEdgeSensor	{...}	{..}		ARIS_Fro...
FromRewindEdgeSensor.NoSensor	0		Decimal	BOOL
FromRewindEdgeSensor.LowContrast	0		Decimal	BOOL
FromRewindEdgeSensor.NoWeb	0		Decimal	BOOL
FromRewindEdgeSensor.WorngOrie...	0		Decimal	BOOL
FromRewindEdgeSensor.Flutter	0		Decimal	BOOL
FromRewindEdgeSensor.LeftSensor	0		Decimal	BOOL
FromRewindEdgeSensor.RightSensor	0		Decimal	BOOL
FromRewindEdgeSensor.NumberOfP...	0		Decimal	INT
FromRewindEdgeSensor.SensorMode	0		Decimal	INT
FromRewindEdgeSensor.EdgePixel	0		Decimal	DINT
FromRewindEdgeSensor.Edge_mm	0.0		Float	REAL
FromRewindEdgeSensor.QualityFactor	0		Decimal	INT

The image below shows an instance of the ARIS_ToWebEdgeSensorVar which can be used in the PLC program to control/command the sensor through the ARIS SCU5 C(E).

ToRewindEdgeSensor	{...}	{..}		ARIS_ToE...
ToRewindEdgeSensor.ForceRightSe...	0		Decimal	BOOL
ToRewindEdgeSensor.ForceLeftSen...	0		Decimal	BOOL
ToRewindEdgeSensor.FindSensor	0		Decimal	BOOL
ToRewindEdgeSensor.AutoSwitchOff	0		Decimal	BOOL
ToRewindEdgeSensor.SensorMode	0		Decimal	INT
ToRewindEdgeSensor.OutputDis	0		Decimal	BOOL

REVISION HISTORY

Document Revision

Version	Date	Author	Description
1.0	Dec 2016	CB	Initial version
2.0	June 2017	AS	Updated the document for firmware version 2.4a

Hardware Revision

Version	Date	Description
SCU V4 Rev D	July 2016	Added industrial ethernet option
SCU5	May 2017	Updated hardware with smaller form factor

Firmware Revision

Version	Date	Description
2.2b	Dec 2016	Ethernet/IP implicit messaging capabilities
2.4a	May 2017	Added gross guide point adjustment and motor speed adjustment

Roll-2-Roll Technologies LLC
1110 S Innovation Way Dr
Stillwater, OK 74074
https://r2r.tech
experts@r2r.tech
+1-(888)-290-3215