

SCU5 M: Web Guide Controller

Product and User Manual

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INTRODUCTION

This product manual provides information about installation, use and maintenance of SCU5 M web guide controller. The web guide controller includes an operator interface to interact with the web guiding system. For installation of the sensor and web guide please refer to the respective product manuals.

The web guide controller 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 web guiding system is a fully automatic mechatronic system used to accurately align/steer web materials within roll-to-roll machines. The web guide is used at critical locations where accurate alignment of web is necessary. Typical locations include at the unwind section, before process sections, such as before printing, coating, laminating, slitting, and rewind section. Accurate web guiding will improve productivity by enabling high speed transport and manufacturing.

Working Principle

There are three main components to a web guiding system:

1. Web position sensor
2. Web Guide Controller
3. Guide mechanism



Fig. 1: Components of a web guiding system

Web Position Sensor

The web position sensor provides the vision for the control system. The sensor measures the position of the web (edge or a contrasting feature on the web) and sends that information to the controller for corrective action.

Controller

The controller is the brain for the control system. Based on the sensor measurement the controller determines the corrective action necessary to accurately align the web material.

Guide Mechanism

The web guide mechanism is the muscle for the control system. The guide mechanism actuated by a motor physically steers the web to the required position based on the command from the controller.

Web Guide Controller

The web guide controller encloses the electronic hardware for the sensor processing, operator interface and the control algorithm for the web guide/actuator. The control options that are available are shown below.



The most basic controller is the SCU5 MD which has the operator interface integrated within the controller. The option with C(x) includes the industrial ethernet option where both EtherNet/IP (C(E)) and PROFINET (C(P)) are supported. Finally, the controller can also be purchased without the display, in that case the web guide can be controlled through a PLC using the industrial ethernet communication.

General Specifications

Operator Interface	Optional color touchscreen	Output (Voltage)	± 10 V or 0 to 10 V
Languages	Language independent	Output (Current)	0 to 20 mA or 0 to 10 mA
Motor Driver	Microstepping or servo drive	Connectivity	Ethernet/IP, PROFINET
Motor	Linear hybrid stepper	Input Supply	24 V DC
Controller Frequency	50 to 200 Hz	Current	Less than 5 amps

Controller Options

Following table shows the capabilities of the different controller option

Options	SCU5 M	SCU5 MD	SCU5 MC ⁴ D
Input	24 VDC	24 VDC	24 VDC
Application	Web Guiding	Web Guiding	Web Guiding
Operator Interface		YES	YES
Analog output	YES ¹	YES ¹	YES ¹
Voltage output	± 10 V ²	± 10 V ²	± 10 V ²
Current output	0 to 20 mA ³	0 to 20 mA ³	0 to 20 mA ³
Motor Controller	YES	YES	YES
Actuator Included	YES	YES	YES
Current Consumption	< 5 Amps	< 5 Amps	< 5 Amps
Controller Frequency	50 Hz	50 Hz	50 Hz
Industrial Ethernet			YES
Web browser dashboard			YES
Remote Control			YES
Diagnostics/Fault Info			YES
Process two sensors	YES	YES	YES
GO/NO GO	YES ¹	YES ¹	YES ¹
Standalone System	YES	YES	YES ⁵

¹ not a standard option but available upon request

² can be programmed to be ± 10 V or 0 to 10 V or ± 5 V or 0 to 5 V based on application requirement

³ can be programmed to be 0 to 20 mA or 4 to 24 mA or 0 to 10 mA based on application requirement

⁴ the industrial ethernet has two options C(E) for Ethernet/IP and C(P) for PROFINET

⁵ can be made standalone when not connected to a remote controller (PLC) or when set by remote controller (PLC)

Physical Dimensions of SCU5

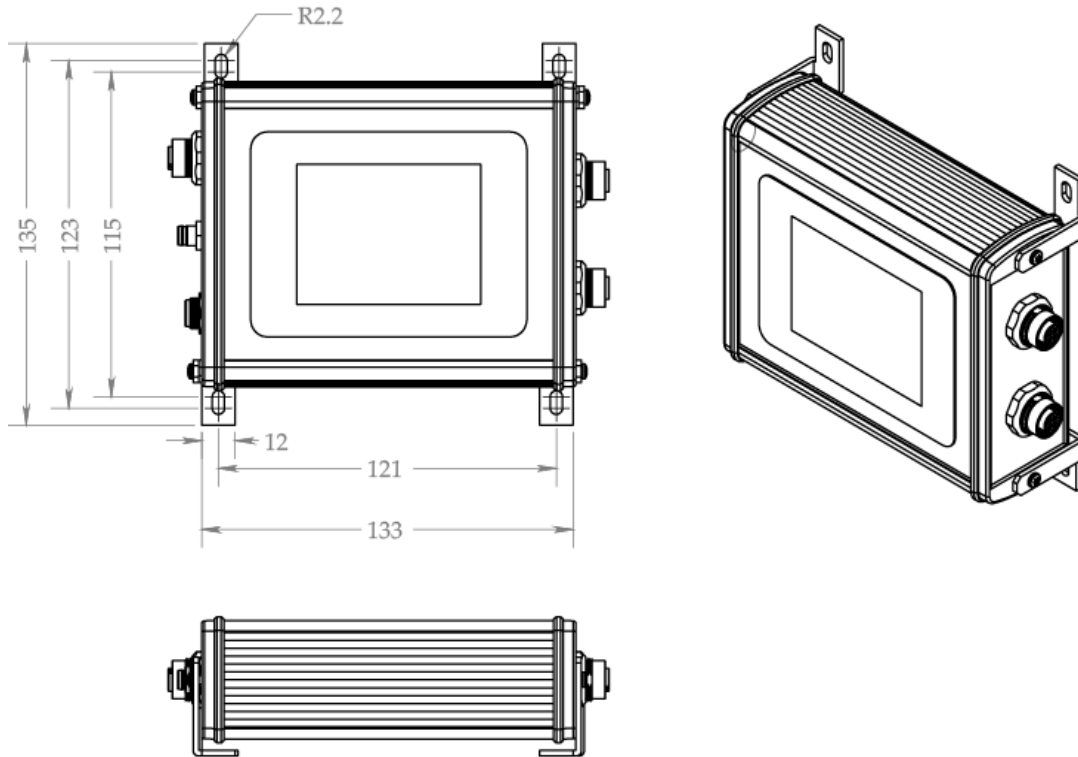


Fig. 3: SCU5 M Controller Physical Dimensions (All dimensions are in mm); Subject to change without notice.

The SCU5 M controller has the following ports available for operation.

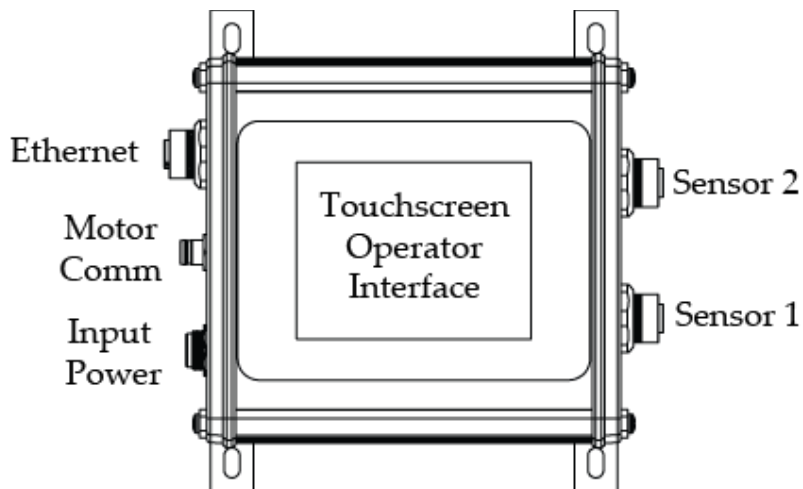


Fig. 4: SCU5 MD Connector Ports

Power Input

The SCU5 M operates under 24 VDC ($\pm 5\%$) power with a maximum current requirement of 5 Amps. The power is supplied through a Switchcraft DC power connector.

WARNING: *Supplying more than 24 VDC would damage the controller permanently.*

Switchcraft DC Connector

Sealed Switchcraft L712AS power jack port option is available on the SCU5. 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 SCU5 M controller, the equipment to which the controller is installed must be properly grounded. The metal enclosure surface or the mounting screws may be used to properly ground the controller to the plant earth.

WARNING: *Please use all possible options to safely earth ground the controller. Improper grounding may result in static buildup that can potentially result in malfunction of the controller.*

Sensor Interface

Two sensor ports labeled Sensor 1 and Sensor 2 have industry standard 12-pin M12 connectors to connect the 12-pin connector on the sensor cable. Either sensor ports can be used to connect the sensor(s) and the controller will automatically recognize the connection.

WARNING: *The connectors are key and please do not force the connectors.*

NOTE: *If two sensors are connected the web guide will automatically configure the appropriate guiding mode based on the sensor installation. If both the left and the right edge is seen by the sensor, the center guiding mode will be enabled. If both the sensors see the same edge of the web then an average of the sensor measurement will be used to guide the web.*

WARNING: *Only the sensors and cables provided by Roll-2-Roll Technologies LLC should be connected to the sensor ports. Third-party cables and sensors may damage the controller and will void warranty. Please consult with the factory before adding any patch cords.*

Motor Communication

A 4-pin M8 connector is provided to connect the controller to the actuation system installed on the web guide mechanism. The pre-wired cable with the 4-pin M8 connector from the web guide mechanism should

be connected to the motor communication cable. The motor communication cable carries the power and the communication signals between the SCU5 M controller and the motor driver.

WARNING: Never connect or disconnect the motor communication cable while the SCU5 M controller is powered or connected to a power supply. Always power down the SCU5 M controller during the connection/disconnection of the motor communication cable.

WARNING: Only the cables provided by Roll-2-Roll Technologies LLC should be connected to the motor communication port. Third-party cables and sensors may damage the controller and will void warranty.

Industrial Ethernet Interface

An optional industrial ethernet connection to the web guide controller is available on models with suffix C(E) or C(P). 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 SCU5 M to an ethernet network using RJ45 plug.

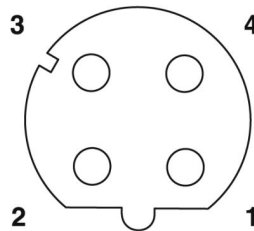


Fig.5: 4- Pin Industrial Ethernet Connector.

A set of input and output registers are available to monitor and control the SCU5 M controller.

SAFETY INSTRUCTIONS

The SCU5 M controller is an electronic device that operates on low voltage (24 V DC). However, it does present a few safety requirements that must be followed in order to assure safe and effective operation of the system.

Instructions for Use

The SCU5 M controller must be properly transported, stored before being installed professionally. The controller should not be installed or commissioned for operation if any visible damage is observed. Only persons who have the necessary qualifications should work on the installation, commissioning, operation, and maintenance of the system.

Notes:

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

Proper Use

The SCU5 M controller is intended for indoor uses only for use in industrial and lab equipment that process materials in web form as they move through a converting or raw material manufacturing process.

Improper Use

- Outdoor use or exposure to direct sunlight is considered improper.
- Any use outside the general 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

- Web, especially plastic webs, when transported over rollers can create significant static voltage potential. This static may discharge to the controller through the sensor cables. The static potential needs to safely discharged by proper grounding of the controller.

OPERATION AND OPERATOR INTERFACE

Main Operator Interface Screen

The web guiding operation is accomplished through the main operator interface on the SCU5 M controller; some models may have remote operator interface. The capacitive touchscreen on the SCU5 MD controller uses a language independent icon based screen that allows ease of operation. Fig. 6 shows an image of the Operator Interface screen:

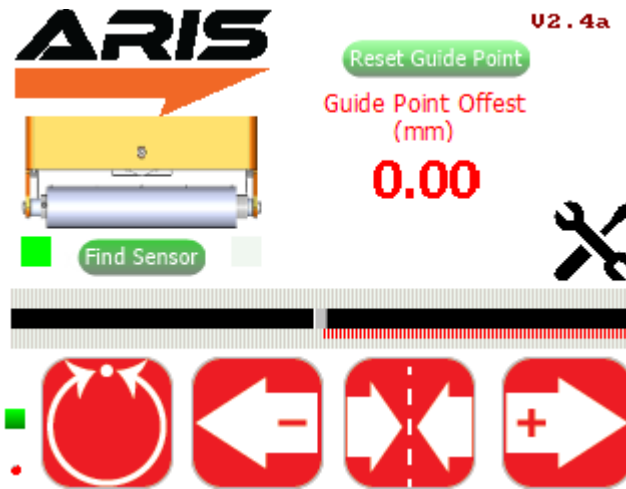


Fig.6: SCU5 MD Operator Interface (Manual Mode)

Never use sharp or pointed tools of any kind to operate the interface. Best practice is to have operators use their fingers to press the different icons. Care must be taken to clean the touch screen surface periodically.

Its icon based design allows for a language independent operation without the need of translation of the screen for setup and operation in different countries.

Automatic/Manual Operation

The web guide controller by the SCU5 M controller can be put into manual or automatic operation by the automatic operation mode by pressing this icon. The guide is in manual operation when the icon is red and is in automatic mode when the icon is green. When the guide is in manual mode and the icon is pressed, the guide will switch to automatic mode. When the guide is in automatic mode and the icon is pressed the guide will be put into manual mode.

- The guide should be placed in manual operation during initial setup of the guide, or during routine maintenance of the production line.



Manual



Automatic

- The guide must be placed in automatic operation when the production line is operational.

WARNING: Changing from one mode to another can result in change in the web guide position causing process upsets. Caution must be exercised when changing the operating mode and should be done by those who completely understand the consequence of this change.

WARNING: No personnel should be manually handling the web guide or the material around the web guide when the guide is in automatic operation. Failure to follow this warning could result in crushing of body parts at pinch points around and within the web guiding system.


WARNING: Care must be taken that only one person is working on the guide when it is in manual operation. Failure to follow this warning could result in crushing of body parts at pinch points around and within the web guiding system.


A few icons on the operator interface are enabled or disabled as the web guide is switched between manual and automatic mode based on the available options in each mode. Fig. 7 shows the operator interface while the web guiding system is in automatic mode. The advanced setup and sensing mode icons are disabled.



Fig. 7: Operator Interface (Automatic Mode)

Servo-Centering Operation

The  Servo-centering off
servo-centering operation roller assembly of the guide.

 Servo-centering on
automatically centers the guide

- During normal operation the icon will be in red.
- Upon pressing the icon, the icon turns green and the guide automatically moves the rollers to a factory preset center position. Once centered the icon returns to red indicating that it has finished the procedure and that servo-centering is off.

The servo center feature allows the guide to be centered quickly to facilitate threading of the web during changeover.

WARNING: Servo centering operation result in change in the web guide position causing process upset. Caution must be exercised when performing this function and should be done by those who completely understand the consequence of this change.

WARNING: Servo centering can be performed only when the web guiding system is in manual mode. Pressing the servo center icon during automatic operation will perform a different function.

WARNING: This is an automatic procedure of the web guiding system. No personnel should be performing manual work on or around the guide during the servo-centering procedure. Failure to follow this warning could result in crushing of body parts at pinch points around and within the web guiding system.

Jog-left/Jog-right Operation



Jog-left OFF



Jog-right OFF



Jog-left ON



Jog-right ON

The Jog-left/Jog-right icons allow the operator to manually move the guide roller assembly to the left or to the right as needed. These operations can be performed only when the web guide is in manual operating mode.

- The Jog-left/Jog-right operation icon indicates the operation is off when the icon is red.
- When the operator turns the Jog-left or Jog-right ON by pressing the icon, the guide will start moving to the left or right position. The respective icon will turn green during the Jog operation and will turn back to red when the operation is stopped.

The Jog operation can be stopped at any time by releasing respective icon any time during the jog. If the guide reaches the extreme position, the jog operation will stop automatically. This operation can only be performed when the guide is in manual setting.

WARNING: Jog-Left and Jog-Right operations result in change in the web guide position causing process upset. Caution must be exercised when performing these function and should be done by those who completely understand the consequence of this change.

WARNING: Jog-Left and Jog-Right operation can be performed only when the web guiding system is in manual mode. Pressing the icons during automatic operation will perform a different function.

WARNING: This is a manual procedure of the web guiding system. No personnel should be performing work on or around the guide during the jog procedure. Failure to follow this warning could result in crushing of body parts at pinch points around and within the web guiding system.

Guide Point Adjustment

The guide point of the web guiding system (reference or the desired location of the web with respect to the sensor) is set to 50% of the sensing window of the sensor when shipped from the factory. In this setting the web will be guided to a position exactly in the middle of the sensing window. The guide point can be adjusted to a different location within the sensor range. This setting is absolute irrespective of the sensor position. The current guide point setting is indicated by the guide point indicator as shown in Fig. 8.

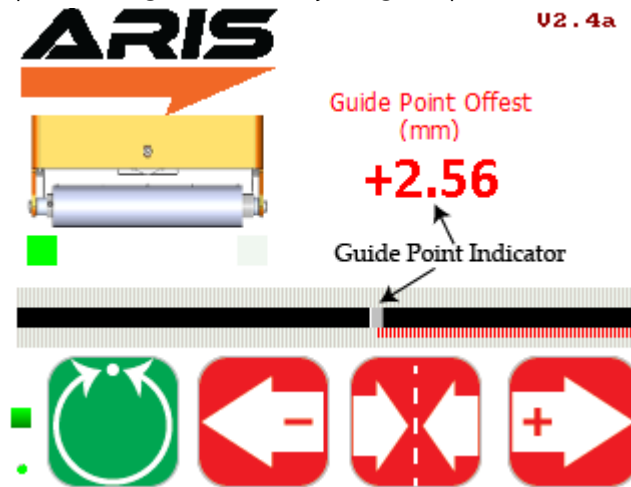


Fig. 8: Guide Point Indicator

The visual guide point indicator is a track bar that provides an easy and quick visual indication of the web edge position with respect to the current guide point. Under normal conditions, the web position should align with the guide point while the web guide is in automatic control mode. A numerical guide point indicator displays the numerical value of the guide point offset on the screen.

The guide point can be adjusted in two ways: fine guide point adjustment for small incremental adjustments and gross guide point adjustment for large step change to the guide point.

Fine Guide Point Adjustment

Fine adjustment to the guide point can only be made when the web guide is in automatic mode. These adjustments enable small incremental changes to the guide through the operator interface to enable operators to move the desired guiding position of the web. The fine adjustment to the guide point can be made by pressing the left (-) or right (+) arrow icons on the operator interface while the web guiding system is in automatic mode. Every single touch of the left or right icon will respectively decrease or increase the guide point by 0.256 mm. This change is immediately displayed by the visual guide point indicator and the numerical guide point indicator. Pressing the middle icon (servo-centering icon) will reset the guide point to 50% or 0 mm guide point offset.

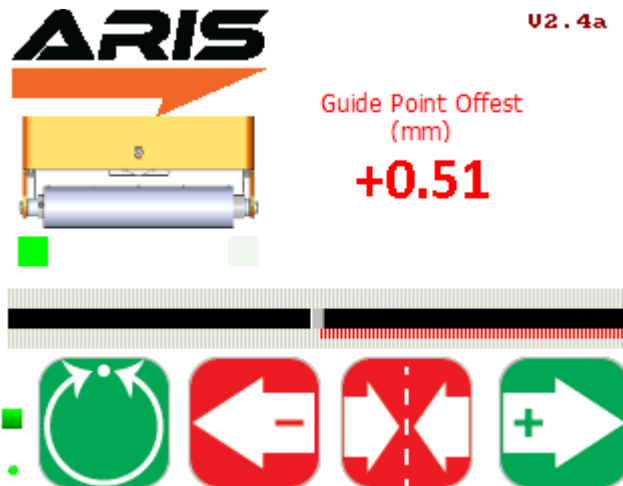


Fig. 9: Fine guide point adjustment

Gross Guide Point Adjustment

The gross guide point adjustment is intended for making a large step change in the guide point, often after a product changeover especially with a web width change. This adjustment can be made by directly sliding the visual guide point indicator track bar to the desired location; the track bar can be moved only when the web guide is in manual mode.

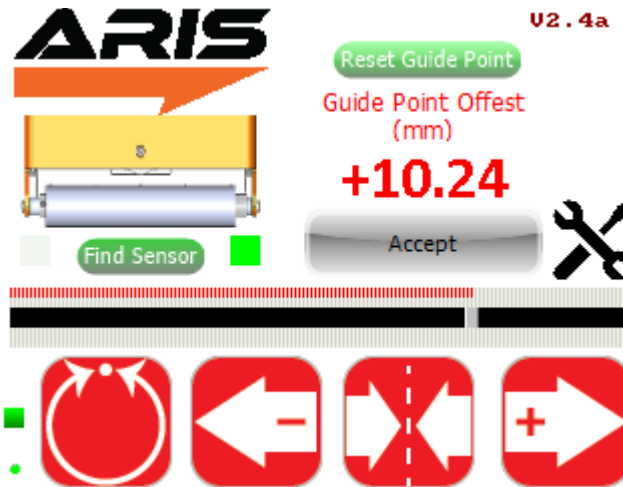


Fig. 10: Gross guide point adjustment

The change in the guide point needs to be confirmed by pressing the “Accept” button that appears whenever the track bar is moved. The confirmation is intended to prevent any accidental changes to the guide point. If the guide point change is not accepted within 10 seconds the change will be disregarded and the previously accepted guide point will be restored.

NOTE: The pressing of the Left (-) or Right (+) during fine guide point adjustment will momentarily change the icon to green as shown in Fig. 14. With the release of the button the icon changes the color back to red.

WARNING: The guide point adjustment operation result in change in the web guide position causing process upset. Caution must be exercised when performing this function and should be done by those who completely understand the consequence of this change.

WARNING: Fine guide point adjustment can be performed only when the web guiding system is in automatic mode. Pressing the Left (-) or Right (+) icons during manual operation will perform the jog operations.

WARNING: Guide point adjustment should be made only if it is necessary and should be carried out by personnel with good knowledge about the consequences of the change. The performance of the guiding system may deteriorate if the guide point is too far away from the desired 50% setting. Some of the changes might have no effect if the web guide is in an extreme position.

Reset Guide Point

The reset guide point is intended to quickly change the guide point to the current web position. The feature is used in applications with frequent web width changes. Instead of manually moving the guide point using the gross or fine guide point adjustment, the guide point can be reset to the current edge position with the press of a button. When in manual mode, pressing the reset guide point button will automatically set the new guide point to the current sensor location as shown in Fig. 11.

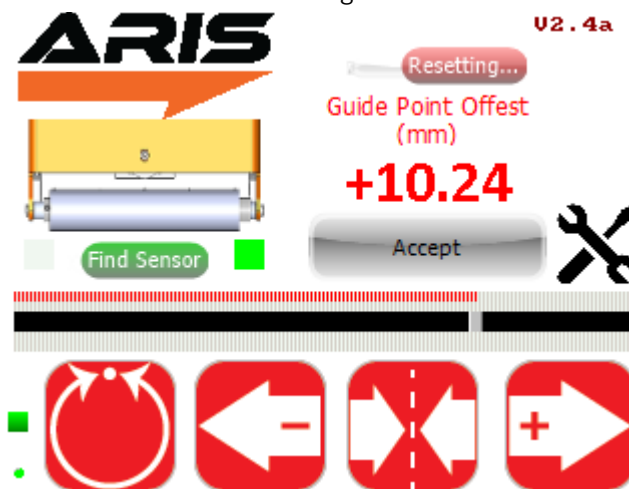


Fig. 11: Guide point reset

The change in the guide point needs to be confirmed by pressing the “Accept” button that appears whenever the reset guide point button is pressed. The confirmation is intended to prevent any accidental changes to the guide point. If the guide point change is not accepted within 10 seconds the change will be disregarded and the previously accepted guide point will be restored.

Edge Position Indicators

Horizontal bar graph indicators (see Fig. 12) are available on the operator interface to indicate the position of the web as seen by the sensor. Both the edge position as well as the contrast position are indicated.

Depending on the position and orientation of the sensor the bar graphs may increase:

- from left to right for a sensor located on the right side of the web edge
- from right to left for a sensor that is located on the left side of the web edge.

The top web position indicator displays the right edge/contrast position of the web and the bottom web position indicator indicates the left edge/contrast position of the web. When two sensors (one left and one right) are connected or if a wide sensor is connected the edge position indicator may indicate both the left and the right edge of the web.

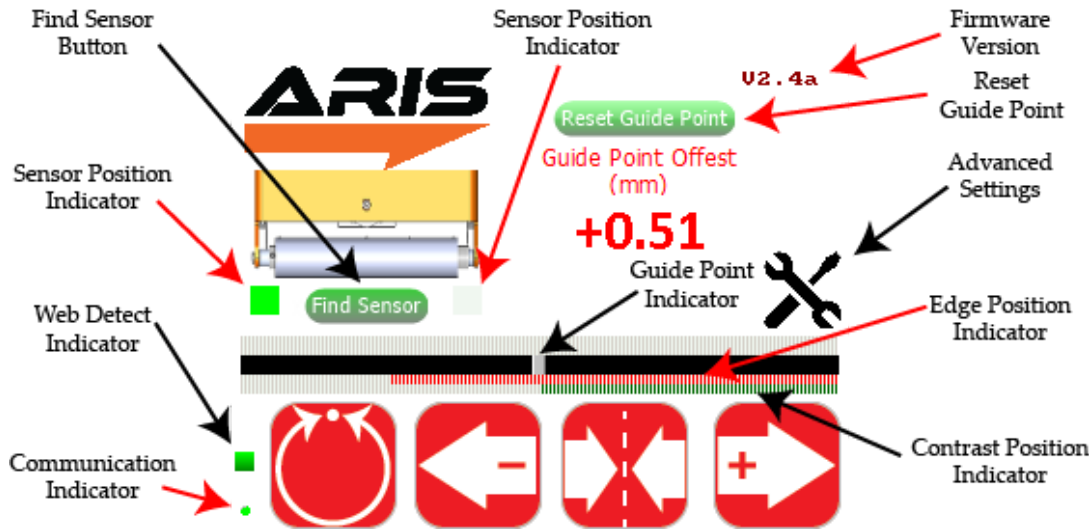


Fig. 12: SCU5 MD Operator Interface

Web Detected Indicator

A small square indicator on the bottom left part of the screen (see Fig. 12) indicates the presence and absence of the web as seen by the sensor.

- Whenever the sensor sees a web or a web edge, the indicator turns green.
- When the web is outside the sensing window the green indication goes off.

This web detect indicator can be used for troubleshooting purposes. If this indicator turns off intermittently while a web is in front of the sensor it may indicate that the sensor is finding it difficult to accurately sense the web. This indicates a low contrast condition for the sensor. Such a condition may occur for optical grade clear webs with low scattering in the infrared spectrum.

Sensor Position Indicator

The position of the sensor is indicated by two square indicators on the display (see Fig. 12) that are located downstream of the web guide picture.

- The indicator turns green to display the position and orientation of the sensor with respect to the guide and the web edge.
- If no sensor is attached to the web guiding system then both the indicators will turn gray.
- If two sensors (one right and one left) are attached to the web guiding system or if a wide sensor with center guiding option is used, both indicators will turn green.
- It is important to ensure that the sensor position indicator accurately indicates the actual position of the sensor with respect to the guide.
- The operator can find the correct position of the sensor by pressing the find sensor button that automatically detects the position of the sensor.

Find Sensor Button

The Find Sensor Button (see Fig. 12) can be used to automatically detect the position and orientation of the sensor with respect to the web guide and the web edge. Once the button is pressed the button will change state (as shown in Fig. 13) until the web edge is found.

- This button should be used whenever the sensor position is changed or when the edge orientation is changed.
- When the edge orientation changes, the bar graph will also change orientation.
- Find sensor button is activated only when the web guiding system is in manual mode.



Fig. 13: Find sensor operation

Communication Indicator

A round indicator at the left bottom of the operator interface (see Fig. 12) indicates the communication between the electronic controller board and the operator interface.

- This indicator is used for troubleshooting purpose.
- During normal operation this indicator will toggle between red and green at about 1 Hz.

Advanced Settings

The SCU5 M controller enables a plug and play guiding system without any need for setup or calibration. However, it may be necessary to adjust a few parameters in rare occasions based on the processing conditions. The advanced setting screen will allow power users and maintenance technicians to adjust parameters to suit their web guiding needs.

Password Screen

To prevent any unintended changes to the settings, password protection can be enabled for power user access. Entering the advanced settings screen without a password will show the power user icon as in Fig. 14 while password protected setting will not show the icon as in Fig. 15.

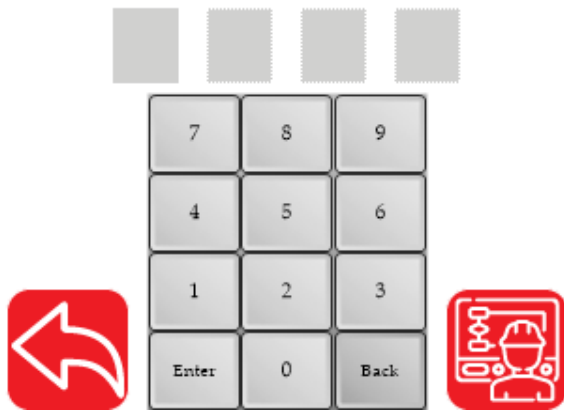


Fig. 14: Power user password disabled

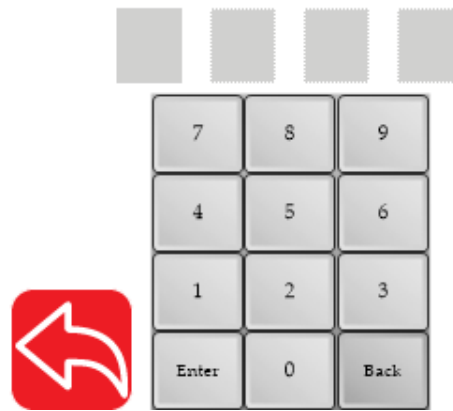


Fig. 15: Power user password enabled

If the power user password is enabled then the appropriate password is necessary to move to the following power user screen. Please contact the factory for the four digit numeric password which can be entered using the touchpad and by pressing "Enter" for authentication.

Power User Screen

Once the password is authenticated the power user icon (as in Fig. 14) will reappear so that the user can proceed to the power user settings screen as shown in Fig. 16.

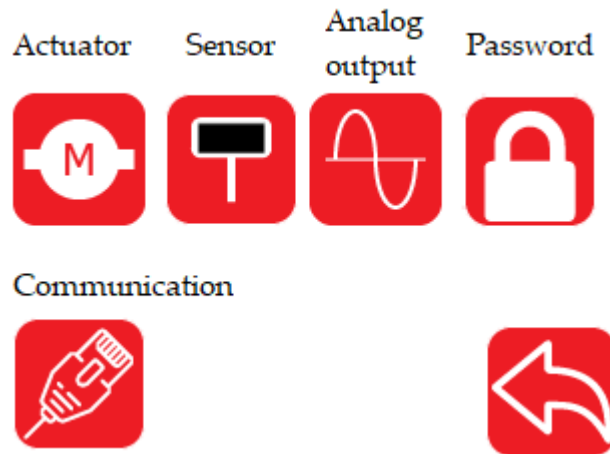


Fig. 16: Power user settings screen

The power user screen has several sub menus including the actuator, sensor, analog output, communication and password protection. Setting for the respective options are available by pressing the respective icons.

Actuator Setting

The actuator setting screen allows the power user to set the actuator parameters such as stroke length, lead screw pitch, actuator speed, actuator acceleration, the motor polarity and the servo center polarity.

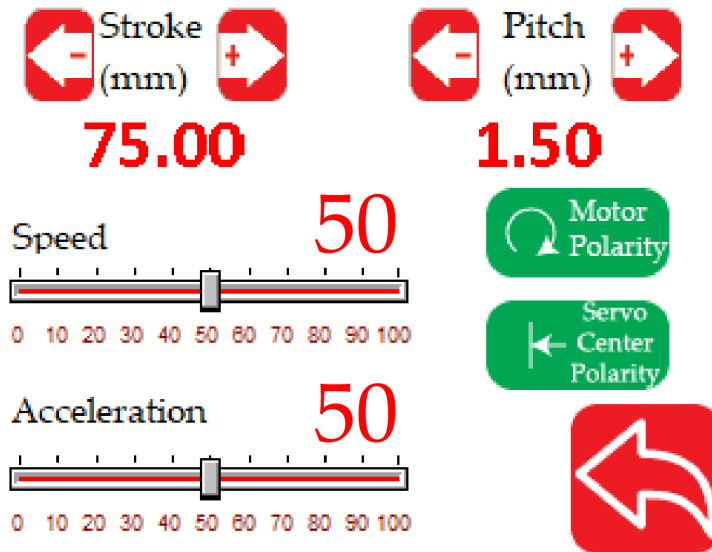


Fig. 17: Actuator settings screen

WARNING: The actuator parameters are typically preset from the factory and should only be changed with consultation with the factory. Except for speed and acceleration all other parameters need not be changed ones the web guide is commissioned for operation.

NOTE: The actuator parameters are intended to be changed by maintenance personnel with sufficient knowledge about the web guide and its performance. Most often these settings are changed during initial commissioning, after an actuator upgrade or replacement and/or with after a retrofit installation.

Stroke

The digital stroke length can be changed in multiples of 5 mm and can be incremented or decremented using the + and - keys. This digital stroke setting is used to keep track of the distance the actuator can move on either side from the servo centered position. Hence from the middle position (servo centered position) the web guide will travel half the stroke length on either side. This stroke length setting prevents the actuator from hitting the mechanical limits and prevent any motor damage in the event that the web guide moves when no web is present.

NOTE: The actuator position is tracked digitally using software and the actuator stops actuating once the digital limits are reached. The digital limit of the actuator may not correspond to the physical limits of the web guide. These digital limits are available to prevent the actuator from hitting the mechanical limits and to avoid any possible motor burnout.

WARNING: Never set the stroke length more than the physical stroke length of the actuator. Setting a stroke length more than the physical stroke available in the actuator may cause actuator damage.

NOTE: The servo center position is used to reset the digital position count whenever the web guide is servo centered.

Pitch

The pitch setting is used to set the lead screw pitch. This setting is pre-set at the factory and should not be changed without the consultation with the factory. The pitch can be incremented in multiples of 0.25 mm.

WARNING: Changing the pitch setting would affect the digital position count of the actuator and hence the effective stroke of the actuator. Setting the pitch higher than the actual pitch would reduce the effective stroke length and vice versa.

WARNING: Never set the pitch to a value that is less than the actual pitch. This can result in the actuator reaching its mechanical limits and possible actuator damage.

Motor Polarity

The motor polarity setting is used to reverse the direction of the actuator. This setting changes the behavior of the actuator both in automatic mode as well as in manual mode. Depending on the sensor installation the motor polarity need to be reversed to make sure that the correction is in the correct direction.

WARNING: If the motor polarity is set incorrectly the web guide will move in the opposite direction of the desired correction when in automatic mode. This is an immediate indication of the incorrect setting.

Servo Center Polarity

The polarity of the servo center can also be changed. This may be necessary if the location of the servo center is changed or if a different type of serov center sensor is used.

WARNING: If the servo polarity is set incorrectly the web guide will move away from the middle position when the servo center button is pressed. This might cause the actuator to hit the mechanical limits and might cause damage to the actuator.

Speed

The actuator speed can be increased or decreased using the slider. The value set indicates the percentage of the maximum and minimum speed setting for the actuator.

WARNING: When the speed is set to 0% the web guide will not respond in the automatic mode.

Acceleration

The actuator acceleration can be increased or decreased using the slider. The value set indicates the percentage of the maximum and minimum acceleration setting for the actuator.

WARNING: When the acceleration is set to 0% the web guide will not respond in the automatic mode.

Sensor Setting

Power users have the ability to change several settings for each sensor to enable advanced capability of the the controller. These setting include the ability to turn on and off the automatic brightness control algorithm, manually set the brightness of sensor(s) LEDs, enable or disable the sensor that is connected to a controller and manually force the position state of the sensor(s).

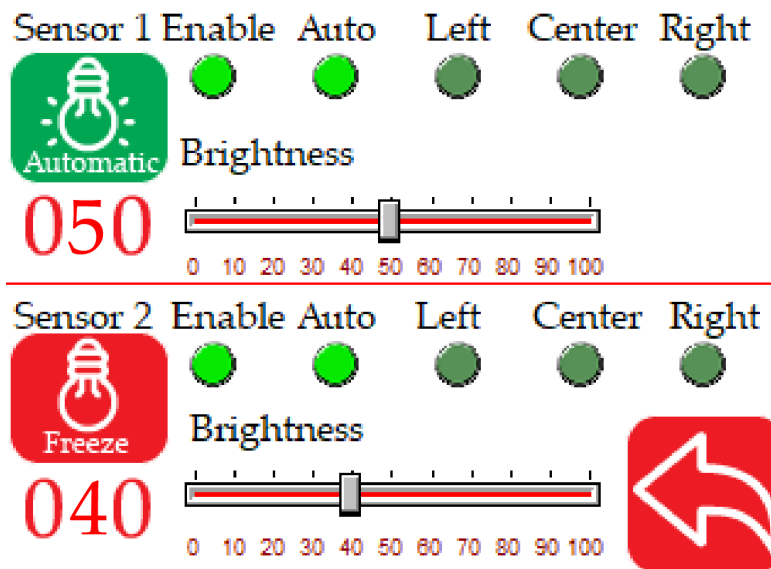


Fig. 18: Sensor settings screen

Automatic Brightness Control

One of the advanced features of the controller is to automatically adjust the brightness of the LEDs in the sensor for background suppression purposes. The default factory setting is to have the automatic brightness control ON. However, the power user has the ability to freeze and manually set the brightness to an arbitrary value depending on their application need. Pressing the brightness icon will toggle the state between Automatic and Freeze.

WARNING: Disabling the automatic control should be performed only for challenging applications where the automatic brightness control is not performing as desired. This operation should be carried out only by those who have very good knowledge about the application and the operation of the web guide controller.

WARNING: Manually setting the brightness too high would disable the background suppression algorithm so this should be carried out only by the power user who is knowledgeable and aware of its consequence.

WARNING: Manually setting the brightness too low may prevent the controller from seeing the web edge. Never set the brightness to zero without consulting the factory about the application.

Brightness Value

The brightness value of the LEDs, either in automatic mode or in frozen mode, is displayed as a two digit integer underneath the brightness control icon. Additionally the horizontal trackbar indicates the value graphically. This trackbar can be used to manually set the brightness value by sliding the trackbar left or right.

Enable/Disable Sensor

For certain applications it may be necessary to disable a sensor that is connector to the controller. An example application would be one in which two sensors, located at two positions or locations, are used to control a single web guide or an actuator. However, only one sensor is used at a time for the feedback control. By default both sensor are enabled as part of the default factory settings. Pressing the button would toggle the state between enabling and disabling the sensor. Bright lime green indicates that the sensor is enabled while a dull green indicates that sensor is disabled.

WARNING: Unless the application requires the sensor(s) to be disabled, always leave the sensor(s) enabled with the factory default setting.

Sensor Position/Orientation Setting

Power users also have the ability to force the sensor position/orientation state depending on their application. The states can be one of the following: Auto, Left, Center or Right. When the state is set to Auto the find sensor button on the front screen can be used to automatically detect the sensor position/orientation based on how the web is presented. For certain situations the user may prefer to manually set the state of the sensor to Left, Right or Center.

In edge sensing mode the sensor will look for the web edge scanning from the outside to the inside of the sensor. For a left sensor the scan goes from left to right, while for a right sensor the scan goes from right to left (see Fig. 19). A center sensor state is one in which both the edges of a web is within the field of view of the sensor. The center sensor mode is only available with wide sensor.

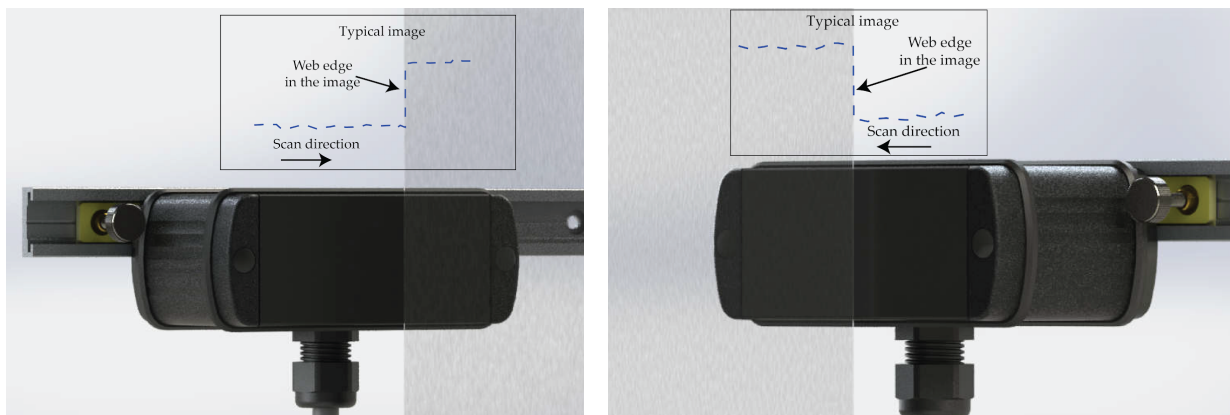


Fig. 19: Left sensor orientation (left) and right sensor orientation (right)

NOTE: The sensor state is always defined based on relative position of the web with respect to the sensor. For example, in the picture on the left above if the sensor is rotated upside down, which the cable gland on the top, then the sensor orientation would change to right sensor.

NOTE: The center state of the sensor can be set only with WPS 221 sensor and not with WPS 48 sensor.

WARNING: If the sensor state is forced to Left, Right or Center, disconnection and reconnection of the sensor will not automatically set the state as in the Auto mode. Everytime the sensor position is changed, with respect to the web, the power user is responsible for ensuring the correct state of the sensor.

Analog Output Setting

This screen is not relevant for web guiding applications. This screen is only relevant for sensing or measuring application with an analog output port. Please refer to the sensor application manual for more information.

Power User Password Setting

This screen allows the power user to enable or disable the password protected power user screen access. Pressing the lock button would toggle the power user password enable/disable option. When the locked icon is displayed, the password for power user will be enabled. And access to the Advanced Setting screen will now prompt for a password to access the power user screen.



Fig. 20: Password protection screen

Communication Setting

For the controller with industrial ethernet, the power user can enable or disable the industrial ethernet communication. The state can be changed by pressing the ON/OFF icon on the screen.

NOTE: The state change from OFF to ON requires a power cycle of the controller to enable and start communication with PLC or other industrial ethernet device.

Communication OFF



Fig. 21: Communication screen

Remote Control and Monitoring

A set of input and output registers are available to monitor and control the web guide controller remotely using industrial ethernet communication such as EtherNet/IP or PROFINET. The remote control and monitoring is available for advanced end users, OEMs and integrators to seamlessly integrate the web guide controller into their existing machine. For more information about these advanced features please consult the factory. It is possible to control/operate the web guide controller without an operator interface and directly using the industrial ethernet connection. The following section describes the advanced settings for the industrial communication.

Output registers

The output registers from the controller provide information about the sensor(s) and the web guide controller. The data include status/fault information, sensor position information and sensor measurement quality information, web guide fault information, motor speed information and the current guide point information. The data from the controller 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 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 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 WPS models.

Model	Resolution	Total Pixel Count
WPS 16	0.0635 mm or 0.0025 in	256
WPS 48	0.0635 mm or 0.0025 in	768
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.

Controller Input Registers

Sensor input registers are control registers that are used to control/configure the parameters of each sensor. One 16-bit command register for each sensor is available for an external device to set the sensor parameters. The input registers are mapped as shown below:

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 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	<p>0: if cleared to zero, the local operator interface have control over the web guide</p> <p>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.</p>
9	0/1	Manual/Auto mode	<p>0: if cleared to zero, the web guide will be placed in the manual mode</p> <p>1: if set to one, the web guide will be placed in the automatic mode</p>
10	0/1	Jog Left or decrease guidepoint	<p>This bit performs two functions based on bit 9.</p> <p>If bit 9 is cleared:</p> <ul style="list-style-type: none"> 0: Stop Jog Left operation 1: Start Jog Left operation <p>Note that this register is a write only register and will not change state if the web guide reaches the extreme position.</p> <p>If bit 9 is set:</p> <ul style="list-style-type: none"> 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. <p>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.</p>
11	0/1	Jog Right or increase guidepoint	<p>This bit performs two functions based on bit 9.</p> <p>If bit 9 is cleared:</p> <ul style="list-style-type: none"> 0: Stop Jog Right operation 1: Start Jog Right operation <p>Note that this register is a write only register and will not change state if the web guide reaches the extreme position.</p> <p>If bit 9 is set:</p> <ul style="list-style-type: none"> 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. <p>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.</p>
12	0/1	Servo Center operation or set guide point	<p>This bit performs two functions based on bit 9.</p> <p>If bit 9 is cleared:</p> <ul style="list-style-type: none"> 0: No effect 1: Start Servo Center operation

			<p>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.</p> <p>If bit 9 is set:</p> <ul style="list-style-type: none"> • 0: will clear the register and has no effect • 1: will set the guide point to be at 50% of the sensing window. <p>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.</p>
13	0/1	Enable arbitrary gross guide point adjustment	<p>This bit allows arbitrary gross adjustment of the guide point offset through the industrial ethernet interface.</p> <p>0: if cleared to zero, gross guide point adjustment is disabled</p> <p>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.</p>
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: Web Guiding System enabled by SCU5 controller 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 = $0.0635 * (\text{the 16-bit guide point offset register})$.

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 SCU5 controller 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 SCU5 MC(x) to an ethernet network using RJ45 plug.

IP Address

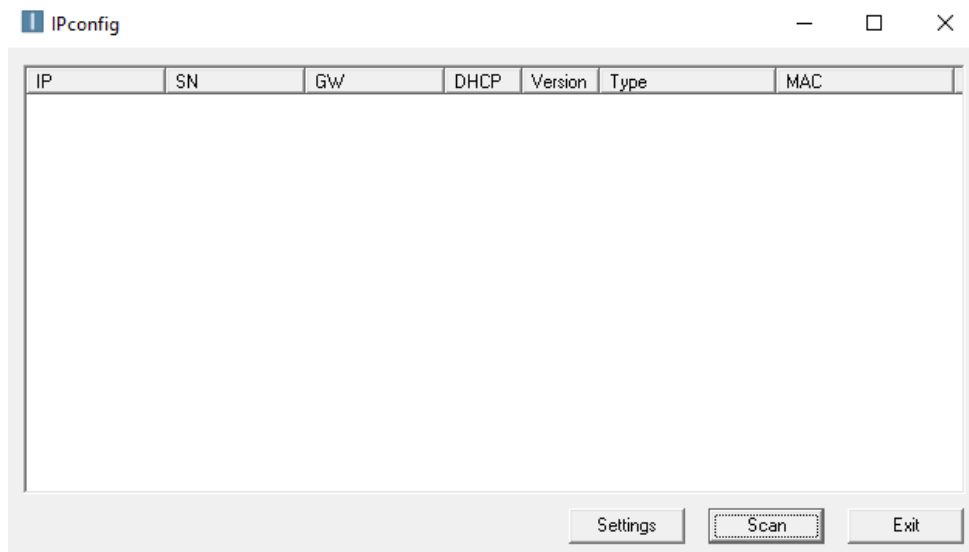
The SCU5 MC(x) is configured to automatically acquire an IP address from a DHCP router or a server. As soon as the controller is connected to a network, an IP address is automatically assigned to the device. Before starting the configuration procedure find the IP address of the controller on the network.

Finding the IP Address

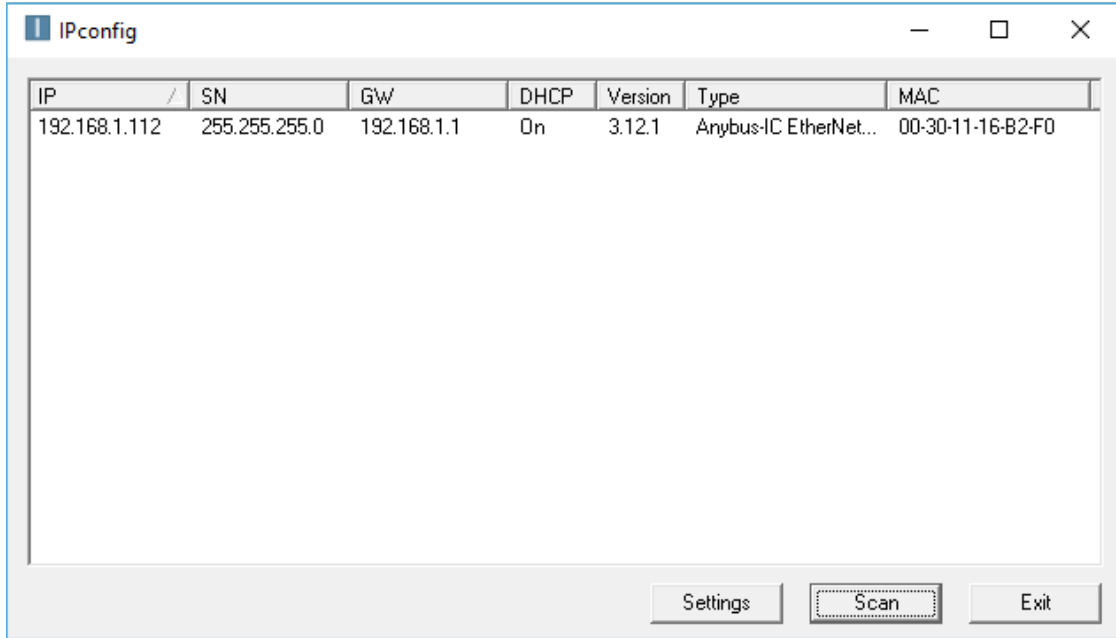
Once the controller is powered ON, the controller will automatically connect to the network. The controller is configured to get the IP address automatically from a DHCP server. Hence the controller should be connected to a network where dynamic IP addresses are issued by a network device such as a router.

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.

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



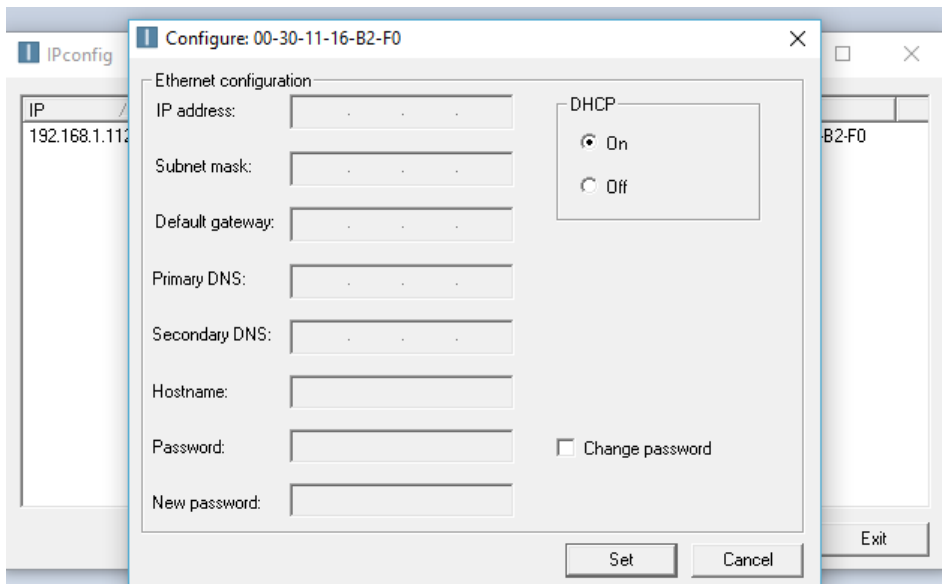
By pressing the scan button all the devices on the network from HMS Industrial network can be found. For example, the utility would find the device and list it as shown below.

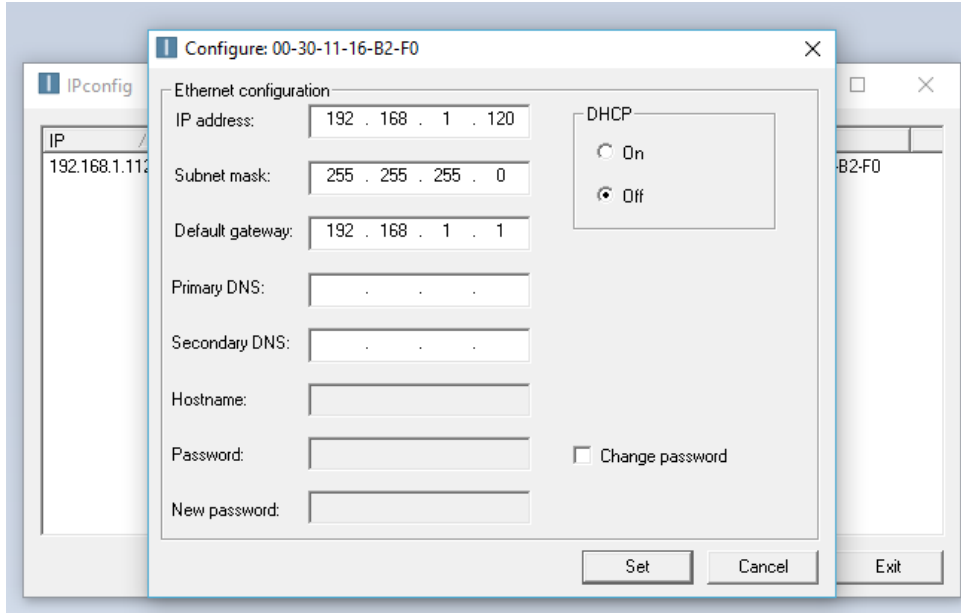


Information such as IP address, DHCP state, Type of module and the MAC address is displayed.

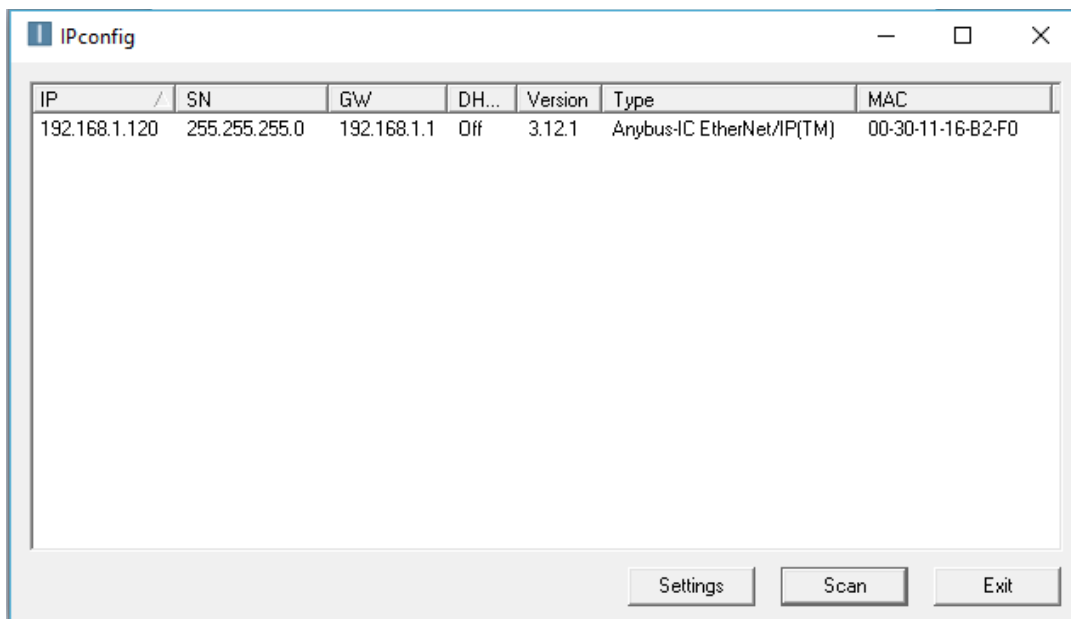
Setting a static IP address for the controller

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.



COMMISSIONING

A properly installed web guide requires correct threading of the web over the guide rollers and initial positioning of the sensor based on the desired position of the web to provide optimum performance. Once the material is threaded over the guide rollers and the sensor has been properly positioned, all the operator has to do is to press the automatic operation icon on the operator interface. Please refer to the respective sensor and web guide manual for proper installation of the web guiding system.

The following section describes the steps and conditions required for automatic operation with a SCU5 M web guide controller.

Edge Guiding Application

1. Power ON the system
2. Automatic/Manual operation set to “Manual” (Automatic/Manual icon pressed to red)
3. Jog the guide to left extreme and then to right extreme to correct for any transportation related guide roller assembly movements.
4. Press the Servo-Center button to center the guide rollers.
5. Thread the material over the rollers. The material wrapped over the rollers must be at a 90 degree angle both at the entry and exit of the guide rollers.
6. Verify that the material is aligned in the desired position with respect to the upstream and downstream position of the web. Place web under normal operation tension.
7. Adjust sensor position on the desired edge of the web. Then manually position the sensor so that the edge of the web is at the middle of the sensing window. This can be done by observing the web edge position indicator on the display. When the bar is in the middle position then the web edge is in the middle of the sensing window.
8. If the sensor position indicator and the actual position of the sensor are different then press the “Find Sensor” button on the operator interface so that the controller automatically find the correct orientation of the edge sensor. In order for this function to work the web edge needs to be in the middle of the sensing window.
9. Tighten the sensor thumbscrews or the brake on the sensor to secure the sensor position on the sensor rail.
10. Press the Automatic/Manual operation icon to “Automatic” (Automatic/Manual icon pressed to green).
11. The guide will automatically adjust the position of the web material to guide it to the correct position.

Center Guiding Application

For center guiding application follow the same steps for each sensor before enabling the automatic guiding mode.

Standard Operating Procedure

The standard operating procedure for the web guide controller involves the following steps.

1. During startup or changing, servo center the web guide to its home/middle position.
2. Thread the web at the desired location on the web guide rollers.
3. If the guide point is offset is not needed then reset the guide point offset to zero.
4. For edge guiding applications, position the sensor such that the web aligns with the guide point location on the screen.
5. If manual positioning of the sensor is not desired, use the reset guide point operation to digitally move the guide point to the current web position. This is mostly applicable with wide sensors when the new location of the web is still within the sensing window of the sensor.
6. If web is guided to the center line position, reset the guide point to the current location of the web while ensuring that both the edges are seen by the sensors.
7. Set the web guide in automatic mode.
8. If during operation fine adjustments to the guide point are needed, then use the fine guide point adjustment procedure to make the necessary changes while the web guide is in automatic mode. The effect of the guide point adjustment will be seen only when the web is moving.
9. Once the line is stopped for changeover or production stoppage, set the web guide to manual mode and if needed servo center the web guide to its home/middle position.

General Maintenance

There is no general maintenance required for the web guide controller. Please refer to the respective sensor and web guide manual for maintenance information.

TROUBLESHOOTING

Problem	Probable Cause	Action
Sensor indicator does not light up and the sensor does not find the web.	Background or faulty sensor cable or connection.	<ul style="list-style-type: none"> * Ensure that the background in the field of view of the sensor is dark. Any bright surfaces may reduce the contrast levels and can prevent automatic find sensor operations. * Ensure that the sensor cable is properly connected. Disconnect the cable and reconnect it and use the find sensor button procedure. * If that does not fix the problem try a different sensor head. * If that does not fix the problem please call support.
The touch screen does not work and the communication indicator is not blinking.	Communication between the electronic hardware and the operator interface is lost.	<ul style="list-style-type: none"> * Power cycle the controller to see if the communication is reestablished. * If that does not fix the problem, please call support.
The web guide is not moving in automatic mode.	Faulty cable or connection. or Software soft stop reached.	<ul style="list-style-type: none"> * Check the sensor cables and connection to ensure that the sensor sees the web. * If the sensor works properly, then try to manually jog the web guide away from the center position. The web guide will stop jogging when the software soft stop is reached. While jogging, the actuator may produce a noise because of the hard stop. It is normal. Once the software stops jogging, push the automatic button again. * If that does not fix the problem, please call support.

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.

Roll-2-Roll Technologies LLC
1110 S Innovation Way Dr
Stillwater, OK 74074
Website: <https://www.r2r-tech.com>

Technical Support Phone: +1 (888) 290-3215 - ext 3
General Support Phone: +1 (888) 290-3125 - ext 1

Technical Support Email: engineering@r2r-tech.com
General Support Email: 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	Changes
1.0	Sep 2015	Initial Release Version
1.1	Feb 2016	Comprehensive revision and new sections added: safety instructions, mounting dimensions, troubleshooting, specifications.
2.0	Jun 2016	Updated documentation for SCU V4 Rev D hardware, firmware and OI.
2.2	Dec 2016	Updated documentation for firmware updates and usability changes
2.4	Jun 2017	Updated documentation for firmware updates and operator interface changes
2.6	Nov 2018	Updated documentation for firmware updates and operator interface changes

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 Rev B	May 2017	Smaller form factor board
SCU5 Rev C	Nov 2017	Robustness 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 V4 Rev D
2.2b	Dec 2016	Ethernet/IP implicit messaging, edge detection algorithm updates
2.4a	Jun 2017	Changes to guide point adjustment and Ethernet/IP registers
2.5	Apr 2018	Minor bug fixes, enabled password protected screen
2.6	Nov 2018	Provided more access to internal settings of the controller for power users.



Roll-2-Roll Technologies LLC

1110 S Innovation Way Dr

Stillwater, OK 74074

www.r2r-tech.com

info@r2r-tech.com

+1-(888)-290-3215