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EtherNet/IP Connection Parameters

	Assembly Instance	Size	Bit
Input	100	16	16-bit
Output	150	8	16-bit
Configuration	1	0	8-bit

PROFINET Connection Parameters

Ethernet module configuration value based on the PROFINET GSDML file.

Input Module	100	16
Output Module	150	8

NOTE: For PROFINET systems the 16-bit data from the sensor is byte swapped. The register map shown below is how the 16-bit data is stored in the sensor and sent out through the ethernet network. The PROFINET PLC might read the data in little endian format with the least significant byte first. So the 16-bit data from the sensor would need to be byte swapped to read the correct 16-bit value.

Controller Output and PLC Input

#	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 Fault and Status Codes														
1	Sensor 2 Fault and Status Codes														
2	Sensor 1: Left Edge														
3	Sensor 1: Right Edge or Contrast Position														
4	Sensor 1: Coverage														
5	Sensor 2: Left Edge														
6	Sensor 2: Right Edge or Contrast Position														
7	Sensor 2: Coverage														
8	Sensor 1 QF								Sensor 2 QF						
9	Web guide status/fault register														

10	Guide point offset	
11	Motor Speed Percentage	Motor Acceleration Percentage
12	Sensor 1: Thread Count	
13	Sensor 2: Thread Count	
14	Sensor 1: Mean Width or Total Web Width	
15	Sensor 2: Mean Width or Total Web Width	

Sensor status and fault registers

The sensor status/fault register is organized as follows. 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
10-13	1-15	Number of pixels	The number of pixels in the sensor and the corresponding sensor resolution.

			0: 256 WPS 16 (0.0635 mm)
			1: 768 WPS 48 (0.0635 mm)
			2: 1774 WPS 221 (0.125 mm)
			3: 896 WPS 112 (0.127 mm)
			5: 1792 WPS 112 (0.0635 mm)
			6: 1772 WPS 221 (0.127 mm)
			7: 3544 WPS 221 (0.0635 mm)
			8: 3530 WPS 440 (0.127 mm)
14–15	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. 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 1/Sensor 2 Left Edge

If sensing mode is edge, then this register will provide the left edge of the web.

Note: If the sensor orientation is set to the right sensor then this value would be zero.
Note: If the sensor orientation is set to the right sensor or if the sensor mode is contrast, then this value would be meaningless.

Sensor 1/Sensor 2 Right Edge or Contrast

If sensing mode is edge, then this register will provide the right edge of the web. While in contrast mode this register will provide the contrast position. In edge mode this register value is meaningful with either the right sensor or with center sensor.

Note: While in contrast mode if the sensor sees no contrast then this value would equal to the number of pixels in the sensor.

In either sensor orientation (left or right) the measured position increases as the web moves from left to right.

Note: If no sensor bit is set or if no web bit is set then the value in the sensor position output register is meaningless.

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

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.

Note: If a single web (with two edges) is seen by the sensor, then the width of the web can be obtained by taking the difference between right and left edge positions.

Note: If a single web (with two edges) is seen by the sensor, then the centerline of the web can be obtained by taking the average of left and right edge position.

Sensor 1/Sensor 2 Coverage

The sum of individual widths of webs is provided as the coverage value. Individual width is defined as the region between two rising edges on an image captured. When one web with two edges is present, the coverage value will equal the web width. When multiple webs are present, then the coverage value would correspond to the sum of individual widths.

Note: When only one web (with both edges within the sensor field of view) is presented to the sensor the coverage value will be the same as the web width, The coverage value is computed based on edges seen by the controller. Hence, based on the controller settings if multiple contrasting features on the web are seen, then coverage value will not be the same as the web width.

Note: The complement of coverage is the gaps. So if a web is completely covering a sensor's viewing area, then a gap in the web can be detected by seeing a drop in coverage value. Sum of all gaps = Number of Pixels – Coverage.

Note: This measurement is an instantaneous raw measurement for each sensor. Enabling and disabling the filter in the controller will have no effect on the measurement output.

Quality Factor Registers

The quality of the sensor measurement from the two sensors are provided in this register. Higher numbers correspond 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 6 correspond to the 8-bits quality factor from sensor 1 while the eight least significant bits correspond 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. 16-bit signed integer guidepoint offset is provided in this register. When the guide point is changed on the screen or through the remote industrial ethernet interface, this register can be used to verify the change.

Actuator speed percentage

The positioning speed of the actuator as a percentage of maximum speed is provided in most significant bits of register 7. The value ranges between 0 and 100.

Actuator acceleration percentage

The acceleration of the actuator as a percentage of maximum acceleration is provided in the least significant bits of register 7. The value ranges between 0 and 100.

Sensor 1 Thread Count

When multiple webs or strings or threads are viewed by the sensor, the number or the count of threads is provided in the register.

Sensor 2 Thread Count

When multiple webs or strings or threads are viewed by the sensor, the number or the count of threads is provided in the register.

Sensor 1 /Sensor 2 Web Width

When the SCU5 controller is set to provide the width, these registers provide the width output from the controller. Registers 14 and 15 are combined to provide a 32-bit value. The most significant 16-bits are provided in register 14 and the least significant 16-bits are provided in register 15.

Note: The web width measurement provided in this register is in the number of pixels. In order to convert that measurement to engineering units the conversion is as follows: 1 pixel = 0.0635 mm or 1 pixel = 0.0025 in.

Note: The web width measurement output includes the compensation factor that is calculated during the teaching process. For example, when two sensors are used to measure the two edge positions, the width measurement output includes the compensation based on the distance between the two sensors.

Note: The register will have a valid output only after the controller is taught for the nominal web width on the SCU5.

Note: If the filter is enabled the output provided would be the filtered output.

When the SCU5 controller is not set to provide width, then the registers provide the mean widths of the webs seen by each sensor. Register 14 will provide the mean width of the webs seen by sensor 1 and register 15 will provide the mean width of the webs seen by sensor 2.

Note: The mean width is computed by adding all the widths of the webs seen by each sensor and dividing it by thread count. This measurement is an instantaneous raw measurement for each sensor. Enabling and disabling the filter in the controller will have no effect on the measurement output.

Controller Input and PLC Output

#	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	RLC	RBL	Maximum Brightness Limit						Minimum Brightness Limit							
3	S2A	S2BO	Sensor 2 Brightness Override Value						S1A	S1BO	Sensor 1 Brightness Override Value					
4	Guide command register															
5	Guide point offset register															
6	EN	Motor speed percentage register							EN	Motor acceleration percentage register						
7	Reserved for future															

Sensor Command Register

The bits in the command register are organized as follow:

Bit #	Value	Label	Description
0-1	0, 2 or 3	Sensor orientation	0: set sensor orientation to be right sensor 2: set sensor orientation to be left sensor 3: set sensor orientation to be center sensor
2	0/1	Sensing mode	0: set the sensing mode to be edge mode 1: set the sensing mode to be contrast mode
3-5	0-7	Analog mode	0: Analog output is disabled. 1: Analog output is enabled and zero scale voltage/current is output. Note: This mode can be used during calibration while connecting the controller to a third-party controller that requires calibration. During the calibration, this mode can be selected to calibrate for zero scale output. 2: Analog output is enabled and full scale voltage/current is output. Note: This mode can be used during calibration while connecting the controller to a third-party controller that requires calibration. During the calibration, this mode can be selected to calibrate for full scale output. 3: Analog output is enabled and the analog output corresponds to the left edge position. Note: When the sensor is uncovered by the web the zero scale analog value would be output. As the web moves left to cover the web, the analog value would increase and reach the full scale value when the web completely covers the sensor. 4: Analog output is enabled and the right edge position is output. Note: When the sensor is uncovered by the web the zero scale analog value would be output. As the web moves right to cover the web, the analog value would increase and reach the full scale value when the web completely covers the sensor. 5: Analog output is enabled and the center line position is output. The centerline position is the average of the left and the right edge position of the web. Note: If only one edge is seen the output would be the average of the edge position within the window and the extreme position corresponding to the unseen edge. 6: Analog output is enabled and the width of the web is output. The width is computed by taking the difference between the rightmost edge position and the leftmost edge position. The analog output is proportionally scaled based on the sensor range. The ratio of the web width to the sensor range is output through the analog. If two sensors are used then the width would only correspond to the portion of the web that is seen by each sensor. 7: Analog output is enabled and the web coverage is output. The coverage is the percentage of the sensor covered by web(s). This is used when webs can have gaps or voids in them. Unlike width output, which takes the leftmost edge and the rightmost edge, the coverage will not include the gaps/void between the leftmost edge and the rightmost edge.

			Note: There is only one analog output while two sensors can be connected to the controller. Please be aware that enabling the analog output for the sensors would result in unpredictable results. Always disable one sensor while selecting the output of the other sensor. Note: If the sensor orientation is left sensor or right sensor then the analog mode selection value of 3 – 7 will have no effect. The analog output would always correspond to the respective orientation. Note: The analog mode 2 has the highest priority followed by mode 1. If any one of the sensors have these bits enabled then the analog output will always provide the high or low output based on the priority. Always disable one sensor while selecting the output for the other sensor.
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 Auto Switch	0: Enable the auto switch functionality for sensor orientation. Find sensor will work only when this is cleared to zero. 1: Disable auto switch functionality so that the sensor orientation can be forced remotely. This bit must be set to one before bit 0 and bit 1 can be changed.
8-13*	0-64	Minimum contrast	Minimum contrast: Minimum contrast required to accept an edge in contrast mode. Default value is 32.
14*	0/1	Reserved	Reserved for future
15*	0/1	Static Threshold	0: Static thresholding algorithm 1: Dynamic thresholding algorithm

* A previous version of the firmware used all eight bits for contrast. The actual contrast value can only change from 0 – 100 on the display. The latest version would allow remote input between 0 and 63.

Sensor Brightness Command Register

Remote Light Control (RLC)

Bit 15 on register 2 has to be set to 1 to allow remote control of LED brightness to take effect. If this bit is cleared to zero, changing any of the other bits in register 2 and 3 would have any effect on the LED brightness.

Remote Brightness Limit (RBL)

Bit 14 on register 2 allows the user to set brightness limits remotely. In normal operation the brightness of the individual sensors are allowed to vary from 4% to 100%. However, power users can change that limit through ethernet by setting this bit and writing values to the two remaining 7-bit registers.

Maximum and Minimum Brightness Limit

The maximum value for the brightness of the LEDs can be written to bits 13 – 7 while the minimum value can be written to bits 6 to 0.

Note: These maximum and minimum limits are for both the sensors even though the brightness for individual sensors may be different. The upper limit cannot be smaller than the lower limit value.

Note: If bit 15 is not set (or cleared to zero), this will have no effect.

Note: The limit value set through ethernet can change from 0 to 125 while the limit value set from the controller can change from 0 to 100.

Note: The limit will take effect even when the brightness is changed manually as well as if allowed to change automatically.

WARNING: When the ethernet connection is removed or disabled, the limits will be set permanently on to the controller settings. So if the controller would ever be used for standalone operation make sure to rewrite the lower limit to 5 and the upper limit to 125.

Sensor 1/Sensor 2 Automatic Brightness Control (S1A and S2A)

The automatic brightness control can be enabled or disabled by setting and clearing the appropriate bits in register 3. Bit 15 and Bit 7 in register 3 control this functionality. When the bits are set, the brightness is automatically adjusted by the controller and when cleared the brightness is frozen.

Note: If bit 15 in register 2 is not set (or cleared to zero), this will have no effect.

Note: When the automatic brightness control bit is cleared, the actual brightness value would be the last value before the operation. If needed, the user can then remotely adjust the brightness value by writing to the corresponding brightness register for the corresponding sensor after enabling the corresponding brightness override register.

Sensor 1/Sensor 2 Brightness Override (S1BO and S2BO)

Bit 14 and bit 6 of register 3 allows a remote brightness override functionality. When these bits are set, the user can remotely set the brightness by writing a 6-bit value to the corresponding sensor.

Sensor 1/Sensor 2 Brightness Override Value

The brightness of Sensor 1 and Sensor 2 can be changed remotely by writing a value between 0 to 64 in these two 6-bit registers. The corresponding brightness override bit has to be set before these values can be accepted by the controller. This advanced feature is typically used by power users with a really good understanding of the brightness control algorithm.

Note: If automatic brightness control is enabled and a remote brightness value is written, then the automatic brightness control algorithm will use that value as the initial value for its algorithm. The final brightness may or may not settle to the override value. This functionality may be useful for some advanced applications.

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 be at the extremes of the sensing window and will automatically truncate 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 be at the extremes of the sensing window and will automatically truncate if the extreme limit is reached. The extreme limit depends on the sensor resolution and sensor width.
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 functions 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 provide 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 personnel familiar

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).

Actuator speed register

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

Actuator acceleration register

The acceleration 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 being ignored.