

PICK-IQ™ Devices

Instruction Manual



Contents

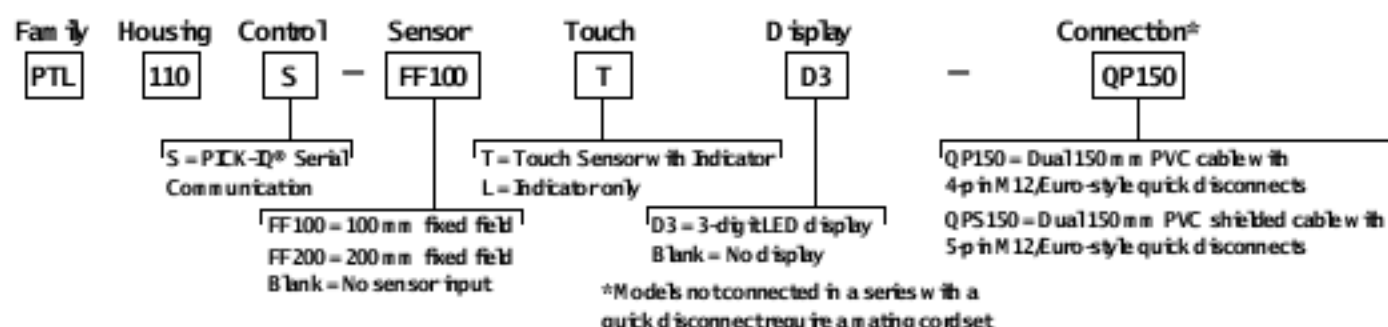
1 Models	3
1.1 PTL110	3
1.2 K50	3
1.3 Overview of PICK-IQ Devices	3
1.3.1 Communications	4
1.3.2 Common ID	4
1.3.3 Timeout	4
2 Configuration Instructions	6
2.1 Operational Modes	6
2.2 Actuator Operation	7
2.3 PTL110 7-Segment Display Operation	8
2.4 Maximum System Size	10
2.5 Set the Device ID	10
3 Installation Instructions	12
3.1 Wiring	12
4 Troubleshooting	13
4.1 Error Codes	13
5 Specifications	14
5.1 PTL110	14
5.2 K50 Devices	15
5.3 Dimensions	16
6 Accessories	17
6.1 Cordsets	17
6.2 Brackets	18
6.2.1 PTL110	18
6.2.2 K50	18
7 Product Support and Maintenance	20
7.1 Contact Us	20
7.2 Banner Engineering Corp. Limited Warranty	20
7.3 FCC Part 15 and CAN ICES-3 (B)/NMB-3(B)	20

1 Models

1.1 PTL110



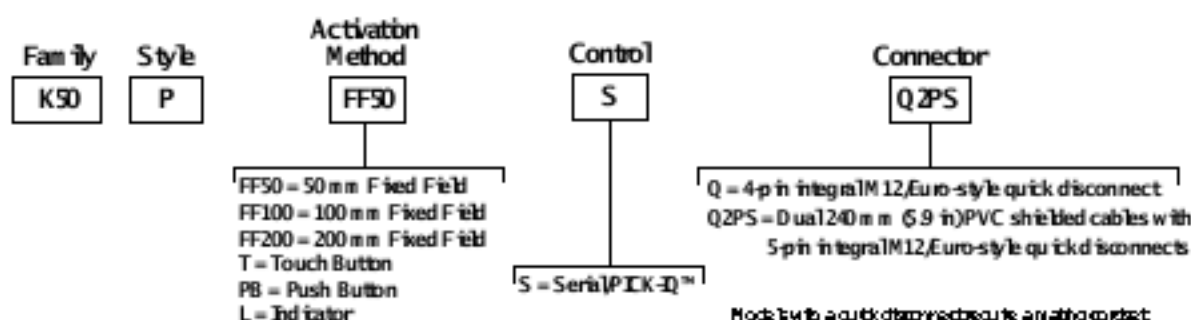
- Optional 3-digit, alphanumeric display
- Optical and touch sensing options



1.2 K50



- Bright, 50 mm diameter dome
- Optical sensor, capacitive touch button, and push button actuation options
- Optical sensor, touch, and indicator models rated IEC IP67 and IP69K per DIN 40050-9; push button models rated IEC IP65



1.3 Overview of PICK-IQ Devices

Indicator and Touch Area

Each PTL110 device contains an indication area. This indicator area is completely customizable with a variety of colors, intensities, and animations. In the touch sensor models, this indicator area has a laser marked logo and is also a touch surface. The touch sensor can be disabled.

Sensor

Optical sensor models contain a Banner fixed field optical sensor for actuation. Three distance models are available, 50 mm (2 in)¹, 100 mm (4 in), and 200 mm (8 in). The optical sensor can be disabled in PTL110 models.

¹ Only available in K50 optical models.

PTL110 Display

Display models contain a 3-digit, 7-segment display with three decimal points. The display is completely customizable and can show numbers as well as a set of letters and symbols. The decimal points can be configured to show various device statuses.

Connectors

Each PTL110 and Q2PS K50 devices have two M12 cables, one male and one female. These devices may be connected directly into each other. Patch cables may also be used. If needed, additional power may be injected into any part of the system.

1.3.1 Communications

These devices are powered by PICK-IQ™, a purpose-built, Modbus RTU compatible serial bus protocol that uses a Common ID to reduce the typical latency that results from polling multiple devices.

The standard Modbus protocol structure does not offer the performance required to operate medium to large sized pick-to-light systems with low latency response times. Adding more devices to a pick-to-light system running standard Modbus protocol eventually makes a pick-to-light system unusable because of the request/response nature of the protocol. The communication latency to and from the master device is too slow.

Using PICK-IQ adds a simple change to the devices that allow the Modbus master controller to run standard Modbus protocol, but achieve the performance required by a medium to large sized pick-to-light system. This change is the addition of a common ID addressing scheme.

1.3.2 Common ID

PICK-IQ devices each have an individual Modbus address called the device ID. PICK-IQ devices also have another address called the common ID.

By adding a common ID, the device responds to an additional address that can be shared among all devices in the system. For example, if a device has a device ID of 5 and a common ID of 195, then the device responds to all messages addressed to ID 5, regardless of actuation status, and messages are addressed to ID 195 when the device is actuated. The addition of this common address functionality allows the overall system to run much faster than a standard polling Modbus network.

When the Modbus master in the system is looking for an actuated device somewhere in the network, it only needs to poll the common ID instead of the entire system. When a device is actuated, it responds to the common ID. Through the common ID, the master can read the unit's device ID stored in register 7940. When polling the common ID, Banner recommends reading a minimum of the device ID register 7940 and the output state register 7941. These registers hold the device ID of the device that was actuated and the status of which sensor was actuated on the device. When reading information from the common ID, only registers 7940 through 7942 are accessible. All other registers should be accessed through the device IDs.

After the device ID of the actuated device is known, use direct communication to the device through its unique device ID.

To prevent the device from responding to the same actuation event, reset the output state register 7941 to 0 by either changing the value directly or by writing to any register 8700 through 8752 before polling the common ID for new actuations. Write these values through the devices' unique device ID and not the common ID. When the value in register 7941 is 0, the device will not respond to the common ID. The addition of this common address functionality allows the overall system to run much faster than a standard polling Modbus network.

Summary of registers:

- 790 Defines the unique device ID
- 791 Defines the output state
- 8700 Defines the device job state
- 8810 Defines the common ID

1.3.3 Timeout

When the system is running in normal operation, the master will experience communication timeouts, which are normal and expected. If no devices have been actuated, there will be no responses in the system. For this reason, it is important to configure your system with adequate communication timeouts.

Set the Modbus Master Timeout Adjustment parameters accurately to ensure all actuation events are captured. Modbus master messages polling the common ID result in a timeout most of the time. Set the master polling speed close to the minimum value allowed by the master. 100 ms is acceptable for a fast system response.

The timeout is because a device only responds to the common ID request when it is actuated. After that event, the value in register 7941 will be non-zero. The register remains non-zero until either the master reverts the value back to 0 (acknowledging the event) or the value times out.

Set the output latch timeout value to a value ten times the system polling speed of the master device. For example, if the master is polling the common ID every 100 ms, set the output latch timeout to 1000 ms. These values can be adjusted depending on the desired system performance.

Output latch timeout is defined in register 8812.

2 onurton Instructions

2.1 Operational Modes

Basic Mode—This operating mode is the most straightforward to configure. In basic mode, the master controls all aspects of the device. The master must communicate all logic functions by defining what the transitions will look like.

Register	Description	Values	
8701	Changes the visual animation of the indicator	0—Indicator is off 1—Indicator is on 2—Indicator flashes flashes with a 50 % duty cycle	3— Indicator strobes with a 20% duty cycle 11–20— Indicator flashes flashes N-10 times (that is, 15 will flash 5 times, then repeat)
8702	Selects the color of the indicator	0 = Off 1 = Red 2 = Green 3 = Yellow 4 = Blue 5 = Magenta 6 = Cyan 7 = White	8 = Amber 9 = Rose 10 = Lime Green 11 = Orange 12 = Sky Blue 13 = Violet 14 = Spring Green

State Mode—State mode requires the configuration of the device to define the visual settings for the four standard pick-to-light logic states, defined below. These settings are embedded inside the device and do not require communication from the master device to change visual states after the device is actuated. This allows the device to respond immediately to any interaction and allows the communication to the master to happen simultaneously.

Register	Description	Values
6300	Enables state mode	0 = Disabled (device will operate in Basic Mode) 1 = Enabled (device will operate in State Mode and use the configurations defined below)
6301 through 6354	Defines visual settings for pick to light states.	Registers 6301 to 6310 define the Waiting State Registers 6312 to 6321 define the Mispick State Registers 6323 to 6332 define the Job State Registers 6334 to 6343 define the Acknowledge State Registers 6345 to 6354 define the Secondary Acknowledge State * Refer to PICK-IQ™ Register Map for descriptions and enumerations of these visual states
8700	Moves a device from the Wait state to the Job state	0 = Wait. Device is waiting and should not be triggered. If the device is triggered it will move to the Mispick state. 1 = Job. Device is active and should be triggered. If the device is triggered it will move to the Acknowledge state.

The job state animation and color may also be modified using registers 8701 and 8702 when in State Mode. Any values written to these registers override the values in registers 6323 and 6324. This allows the device to maintain a common set of Waiting, Acknowledge, and Mispick settings. This functionality allows the on-the-fly customization of the Job animation and color, which can be useful when multiple operators are picking from the same area.

Primary Output Logic Tables in State Mode		
Job Input Logic (Register 8700)	Not Actuated	Actuated
Not Active (0)	Wait State	Mispick State
Active (1)	Job State	Acknowledge State

Registers	Animation	Description
6301, 6312, 6323, 6334, 6345	Off	Indicator off

Registers	Animation	Description
	Steady	Color 1 solid on at defined intensity
	Flash	Color 1 flashes at defined speed, intensity and pattern
	Two Color Flash	Color 1 and color 2 flash alternatively at defined speed, intensities and pattern
	Half/Half Top/Bottom	Color 1 is displayed on the top 50% of the indicator and color 2 is displayed on the bottom 50% of the indicator at defined intensities
	Half/Half Left/Right	Color 1 is displayed on the left 50% of the indicator and color 2 is displayed on the right 50% of the indicator at defined intensities
	Half/Half Rotate	Color 1 is displayed on 50% of the indicator and color 2 is displayed on 50% of the indicator while rotating at defined speed, intensities and rotational direction
	Chase	Color 1 is displayed on 25% of the indicator and color 2 is displayed on 75% of the indicator while rotating at defined speed, intensities and rotational direction
	Intensity Sweep	Color 1 repeatedly increases and decreases intensity between 0% and 100% at defined speed

Registers	Pattern	Description
6307, 6318, 6329, 6340, 6351	Normal	Flash with a 50% duty cycle
	Strobe	Strobe with an 20% duty cycle
	3-Pulse	Flash three times, then off, repeat
	SOS	Flash three times quickly, three times slowly, then three times quickly
	Random	Randomized pattern

Registers	State Delays	Description
6309, 6310, 6320, 6321, 6331, 6332, 6342, 6343, 6353, 6354	State On-delay	Defines the amount of time the device waits to move into the next visual state after actuation. State On-Delay defines the operation of the visual state while Input On-Delay (registers 6001 and 6002) defines the operation of output register change. (e.g.) If the device's job input is active and the On-Delay is set to 1000 ms it will remain in the Job state for 1000 ms after the sensor is triggered or the touch surface is touched.
	Job state	Defines the amount of time the device will stay in the visual style of the current pick to light state after actuation before moving to the next state. (e.g.) After a successful pick from the Job state the device will move to the Acknowledge state. If the Acknowledge state Off-Delay is set to 3000 ms the device will remain in the Acknowledge state for 3000 ms before moving to the next visual state. This parameter is useful to show a pick was acknowledged.

2.2 Actuator Operation

In the PTL110, each input method can be defined as primary or secondary. This allows the input methods (touch or optical sensor) to be used together as one or independently of each other. The input in the K50 devices is always defined as Input 1.

Primary Input Operation –

- Input 1—Touch function of PTL110 or K50 input
- Input 2—Optical sensor of PTL110

Input	Register	Description
Input 1	6001	On-delay Defines the time the button must be pushed or the sensor must be actuated to change the output from 0 to 1.
Input 2	6003	For example, if input 1 has an on-delay of 1000 ms, the touch surface must be held for 1000 ms before the output register 7941 changes from 0 to 1.

Output Registers	Register	Description	Values
Output	7941	Holds the latched statuses of the inputs. This register is designed to be cleared by the master upon receipt. If the register is not cleared, the status will be cleared by the timeout (default 1000 ms) defined in register 8812.	0 = None actuated 1 = Primary actuated 2 = Secondary actuated (PTL110 only) 3 = Both actuated (PTL110 only)
Output Status	7942	Holds the real time status of the inputs.	

Secondary Input Operation (PTL110 only)—Enabling one input as the secondary input allows separate use of the other input. For example, use the primary input in a standard pick-to-light application and the secondary input as a call for parts. The secondary input has a different logic table.

Logic table for secondary input		
Job Input Logic	Not Actuated	Actuated
Not Active (0)	Wait State	Secondary Acknowledge State
Active (Non 0)	Job State	

The indicator in the device is fully customizable. A variety of colors, animations, and intensities are available to customize the device for any application or system.

Registers	Description	Values
6200 (in Basic Mode) or 6304, 6305, 6315, 6316, 6326, 6327, 6337, 6338, 6348, and 6349 (in State Mode)	Customize the intensity of the indicator	0 = High 1 = Medium 2 = Low 3 = Off
6202	Customize the sensitivity of the touch button	0—A more deliberate touch is needed to active the touch output. Useful to avoid accidental triggers, such as in areas where water is present. 1—Balanced sensitivity (default setting) 2—A less deliberate touch is need to active the touch output. Useful for faster operation or when operators are wearing gloves.

2.3 PTL110 7-Segment Display Operation

The display in the device is fully customizable, including both the digits and decimal points.

Registers	Description	Values
8703 through 8799	Customizable 3-digit, 7-segment display <ul style="list-style-type: none"> In Primary operation, the values are right justified and null terminated. See Appendix for available characters. Note that upper case and lower case are differentiated and some representations are limited by the nature of the 7-segment display. (ASCII encoded) In Secondary operation, decimals stored in register 8703 and show on the display. (decimal encoded) 	

Registers	Description	Values																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																											
6209		<table><tr><th>Value</th><th>Character</th><th>Value</th><th>Character</th><th>Value</th><th>Character</th><th>Value</th><th>Character</th></tr><tr><td>0x30</td><td>0</td><td>0x61</td><td>a</td><td>0x6B</td><td>k</td><td>0x75</td><td>u</td></tr><tr><td>0x31</td><td>1</td><td>0x62</td><td>b</td><td>0x6C</td><td>l</td><td>0x76</td><td>v</td></tr><tr><td>0x32</td><td>2</td><td>0x63</td><td>c</td><td>0x6D</td><td>m</td><td>0x77</td><td>w</td></tr><tr><td>0x33</td><td>3</td><td>0x64</td><td>d</td><td>0x6E</td><td>n</td><td>0x78</td><td>x</td></tr><tr><td>0x34</td><td>4</td><td>0x65</td><td>e</td><td>0x6F</td><td>o</td><td>0x79</td><td>y</td></tr><tr><td>0x35</td><td>5</td><td>0x66</td><td>f</td><td>0x70</td><td>p</td><td>0x7A</td><td>z</td></tr><tr><td>0x36</td><td>6</td><td>0x67</td><td>g</td><td>0x71</td><td>q</td><td></td><td></td></tr><tr><td>0x37</td><td>7</td><td>0x68</td><td>h</td><td>0x72</td><td>r</td><td></td><td></td></tr><tr><td>0x38</td><td>8</td><td>0x69</td><td>i</td><td>0x73</td><td>s</td><td></td><td></td></tr><tr><td>0x39</td><td>9</td><td>0x6A</td><td>j</td><td>0x74</td><td>t</td><td></td><td></td></tr><tr><td colspan="8"></td></tr><tr><td colspan="8"></td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td></tr></table>	Value	Character	Value	Character	Value	Character	Value	Character	0x30	0	0x61	a	0x6B	k	0x75	u	0x31	1	0x62	b	0x6C	l	0x76	v	0x32	2	0x63	c	0x6D	m	0x77	w	0x33	3	0x64	d	0x6E	n	0x78	x	0x34	4	0x65	e	0x6F	o	0x79	y	0x35	5	0x66	f	0x70	p	0x7A	z	0x36	6	0x67	g	0x71	q			0x37	7	0x68	h	0x72	r			0x38	8	0x69	i	0x73	s			0x39	9	0x6A	j	0x74	t																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																					
	Value	Character	Value	Character	Value	Character	Value	Character																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																					
	0x30	0	0x61	a	0x6B	k	0x75	u																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																					
	0x31	1	0x62	b	0x6C	l	0x76	v																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																					
	0x32	2	0x63	c	0x6D	m	0x77	w																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																					
	0x33	3	0x64	d	0x6E	n	0x78	x																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																					
	0x34	4	0x65	e	0x6F	o	0x79	y																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																					
	0x35	5	0x66	f	0x70	p	0x7A	z																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																					
	0x36	6	0x67	g	0x71	q																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																							
	0x37	7	0x68	h	0x72	r																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																							
	0x38	8	0x69	i	0x73	s																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																							
	0x39	9	0x6A	j	0x74	t																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																							

2.4 Maximum System Size

The maximum size of the system depends on several factors. Changes to any of these items will affect the maximum number of devices that can be used together in one system.

- **Modbus Master**—Different Modbus masters may place restrictions on the number of devices it can address
- **Power Supply**—The size of the power supply determines how many devices are able to run at one time. Additional power may be injected into the system anywhere.
- **Cable Length**—Total length of cabling, both from the master to the first device and all cabling connecting the devices. The total amount of cable influences the overall voltage available in the system.
- **Devices Status**—The number of devices typically on or active at any given time. The devices draw power at different levels depending on what features are active in the device.

Device Status ²	Average Watts (W)	
	PTL110	K50
Indicator Off, Display Off, Sensor Off	0.21	N/A
Indicator Off, Display Off, Sensor On	0.58	0.67
Indicator On, Display On (123), Sensor Off	0.91	1.32
Indicator On, Display On (123), Sensor On	1.30	
Indicator On, Display On (888), Sensor Off	0.98	1.68
Indicator On, Display On (888), Sensor On	1.35	

System Examples (at 24 V dc)			
Average Watts per Device (W)	Initial Cable Length (m)	Interconnect Cable Length (m)	Maximum Number of Devices ³
0.21	10	0.5	119
0.58	10	0.5	49
1.30	10	0.5	40

2.5 Set the Device ID

The device ID can be set two ways:

- Assign a unique device ID to each device by individually connecting the device and changing the device ID register 6100 (or 7940). This method is consistent with traditional Modbus devices and uses the existing device ID of the device (default ID of 1)
- Write the new device ID to the active device ID register 7940 while the device output register 7941 is active. Output register 7941 is active when the device is actuated.

In this way it is possible to wire a complete system and address multiple devices quickly and easily. The following example is a recommended process to set device ID values through the common ID.

1. Initialize the starting IDs.

Determine the range of device IDs (addresses) to be used. Use a broadcast message to change all device IDs to the last address to be used. The initial device ID addresses do not need to be unique. The common ID address must be different than the addresses being assigned to the devices. If you are using 50 devices in the system, set all device IDs to 50.

2. Poll system for an active state.

Program the Modbus master to continuously poll the Common ID address requesting the active device ID address register 7940 and device output register 7941. Set the Master's polling speed to a time value less than the latched output time out value in register 8812. A polling speed of 100 msec works well in most configurations.

3. Actuate a unique device.

² Display status for K50 devices are not applicable.

³ Additional power may be injected anywhere into the system to overcome the voltage drop.

Manually trigger the active state of the device you wish to assign the unique device ID. Continue to manually trigger the active device until the visual state changes. Changing the physical state of the device must be done intentionally as in step 5.

4. Set a unique device ID.

The device output register 7941 value will be non-zero when the device touch sensor or optical sensor is triggered. During this time the device responds to Modbus commands through the Common ID address. Write the desired device ID value to register 7940 by sending the command to the Common ID device address.

5. Clear the output status and give visual feedback.



- a) Clear the output latch register 7941 by writing directly to the unique device ID that was defined in the previous step.
- b) Write to the unique device ID and change the test mode register 6500 to a value of 1.



Enabling test mode at this time gives visual feedback to the user that the device has been addressed and displays the actual device ID of the unit on the display if present. This has the additional function of disabling state changes to register 7941 to prevent accidentally addressing the device again.

6. For additional addressing, repeat steps 2 through 5, incrementing the assigned unique device ID values to each device.
7. Initialize the system for use. Send a broadcast message to all devices to clear (set to 0) the test mode register.

3 Installation Instructions

3.1 Wiring

Wiring for the PTL110S QP and K50 Q Models				
4-pin M12/Euro-style Male	4-pin M12/Euro-style Female	Pin	Wire Color	Connection
		1	brown	10 V DC to 30 V DC
		3	blue	DC common
		4	black	RS-485 (-)
		2	white	RS-485 (+)

Wiring for the PTL110 QPS and K50 Q2PS Models				
5-pin M12/Euro-style Male	5-pin M12/Euro-style Female	Pin	Wire Color	Connection
		1	brown	10 V DC to 30 V DC
		3	blue	DC common
		4	black	RS-485 (-)
		2	white	RS-485 (+)
		5	gray	Shield

4 Troubleshooting

4.1 Error Codes

Problem	Display		Solution
	7-Segment	Indicator	
Intermittent communication	N/A	N/A	Try slowing the baud rate.
Hardware error	Err	3-pulse 1 s long red	Return to factory
Startup self check error	Test Error	Strobes red	Return to factory

5 ptons

5.1 PTL110

Supply and Voltage Current

10 V dc to 30 V dc, UL Listed class 2 power supply
1.65 Watts max. power draw

Maximum Current

155 mA at 10 V dc
60 mA at 24 V dc
55 mA at 30 V dc
Current measurements assume indicator is on at high intensity, display is on, and sensor module is active. Typical device current will be dependent on its configuration.

Construction

Housing: ABS
Indicator: Polycarbonate
Lens: Acrylic

Optical Sensor Emitter LED

Infrared 870 nm

Connections

Integral PVC cable with quick disconnect, length varies depending on model

Environmental Rating

IEC IP54

Certifications



Operating Conditions

-40 °C to +50 °C (-40 °F to +122 °F)
90% at +50 °C maximum relative humidity (non-condensing)

Required Overcurrent Protection



WARNING: Electrical connections must be made by **qualified** personnel in accordance with local and national electrical codes and regulations.

Overcurrent protection is required to be provided by end product application per the supplied table.
Overcurrent protection may be provided with external fusing or via Current Limiting, Class 2 Power Supply.
Supply wiring leads < 24 AWG shall not be spliced.
For additional product support, go to www.bannerengineering.com.

Supply Wiring (AWG)	Required Overcurrent Protection (Amps)
20	5.0
22	3.0
24	2.0
26	1.0
28	0.8
30	0.5

5.2 K50 Devices

Supply Voltage

10 V DC to 30 V DC

Supply Current

210 mA maximum current at 10 V DC

Touch Models: 55 mA typical at 24 V DC

Optical Models: 70 mA typical at 24 V DC

Push Button/Indicator Models: 55 mA typical at 24 V DC

Supply Protection Circuitry

Protected against reverse polarity and transient voltages

Touch Dwell Time

If touch dwells for longer than 60 seconds, the output will revert to the untouched state

Touch Response Time

Input Response: 5 ms minimum

Touch Response: 300 ms maximum (Standard Sensitivity touch response)

Optical Sensor Emitter LED

Infrared 870 nm

Operating Conditions

-40 °C to +50 °C (-40 °F to +122 °F)

Humidity: 90% at +50 °C maximum relative humidity (non-condensing)

Storage: -40 °C to +70 °C (-40 °F to +158 °F)

Environmental Rating

Touch, Indicator, and Optical Models: IEC IP67, IP69K per DIN 40050-9⁴

Push Button Models: IEC IP65

Mounting

M30 x 1.5 threaded base, maximum torque 4.5 N·m (40 in·lb)

Construction

Base, Dome, and Nut: Polycarbonate

Push Button: Thermoplastic

Vibration and Mechanical Shock

Meets IEC 60068-2-6 requirements (Vibration: 10 Hz to 55 Hz, 1.0 mm amplitude, 5 minutes sweep, 30 minutes dwell)

Meets IEC 60068-2-27 requirements (Shock: 30G 11 ms duration, half sine wave)

Connections

Integral 4-pin M12/Euro-style quick disconnect or dual 240 mm (9.4 in), shielded PVC cables with 5-pin M12/Euro-style quick disconnects, depending on model

Models with a quick disconnect require a mating cordset

Certifications



Default Indicator Characteristics

Color	Dominant Wavelength (nm) or Color Temperature (CCT)	Color Coordinates ⁵		Lumen Output (Typical at 25 °C)	
		x	y	Touch Button Models ⁶	Indicator Models
Green	522	0.154	0.700	16.5	23
Red	620	0.689	0.309	8.3	7.2
Yellow	576	0.477	0.493	23.8	18
Blue	466	0.140	0.054	4.6	5.2
White	5700K	0.328	0.337	25.1	21.7
Cyan	493	0.170	0.340	18.4	26.2
Magenta	—	0.379	0.172	11.1	9.3
Amber	589	0.556	0.420	15.7	13
Rose	—	0.515	0.220	9.1	7.9
Lime Green	562	0.388	0.561	21.4	27.9
Sky Blue	486	0.155	0.247	19.5	28
Orange	599	0.616	0.370	12.1	10.2
Violet	—	0.217	0.089	9.7	10.7
Spring Green	508	0.177	0.536	17	24.1

Required Overcurrent Protection



WARNING: Electrical connections must be made by **qualified** personnel in accordance with local and national electrical codes and regulations.

Overcurrent protection is required to be provided by end product application per the supplied table.

Overcurrent protection may be provided with external fusing or via Current Limiting, Class 2 Power Supply.

Supply wiring leads < 24 AWG shall not be spliced.

For additional product support, go to www.bannerengineering.com.

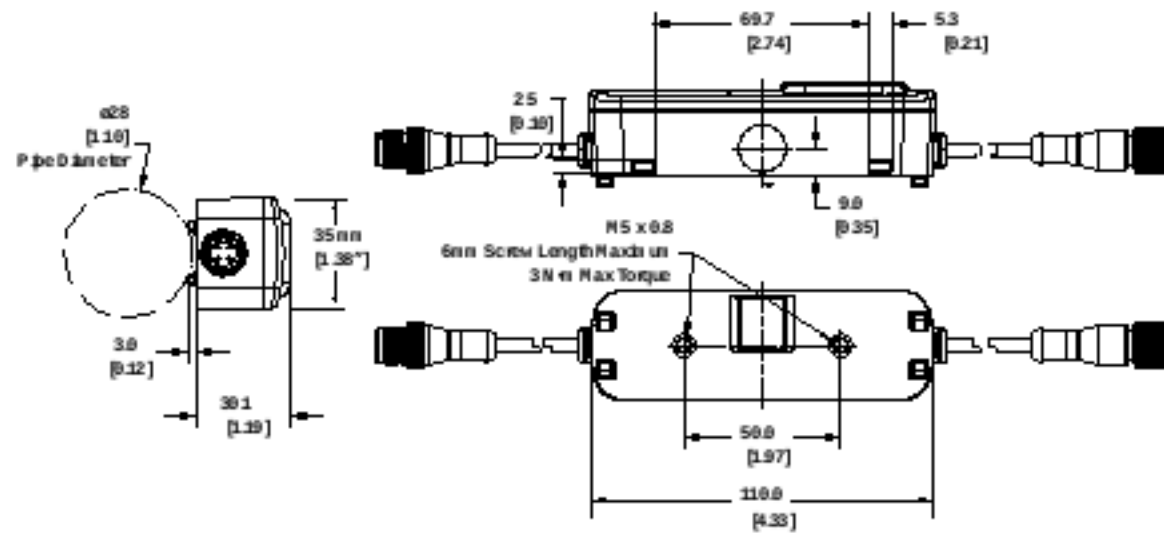
Supply Wiring (AWG)	Required Overcurrent Protection (Amps)
20	5.0
22	3.0
24	2.0
26	1.0
28	0.8
30	0.5

⁴ Q2PS models must be installed to protect the cable and cable entrance from high-pressure spray to meet IP69K.

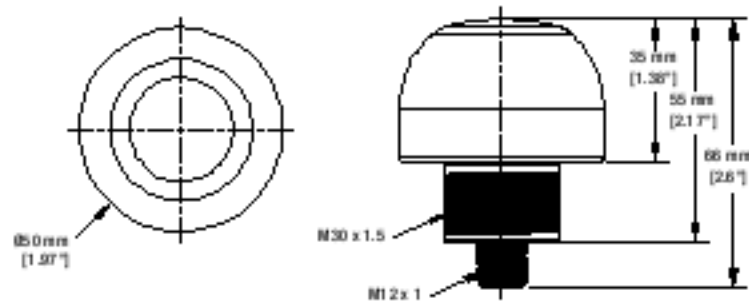
⁵ Refer to the CIE 1931 (x,y) Chromaticity Diagram to show equivalent color with indicated color coordinates. Actual coordinates may differ ± 5%.

⁶ Values shown apply to touch dome models only. Lumen output for optical sensor models is 14% lower and push button models is 10% lower.

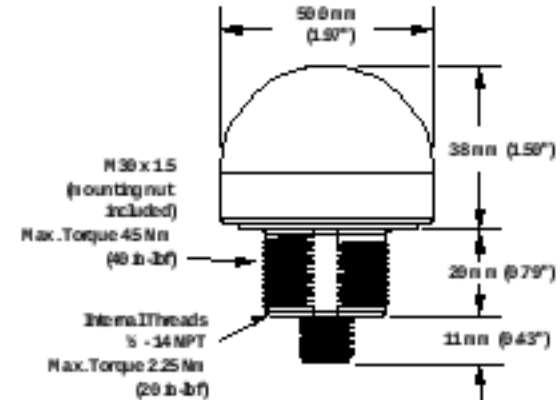
5.3 Dimensions



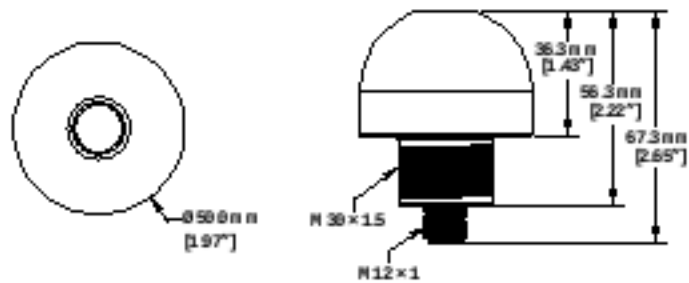
Touch Button



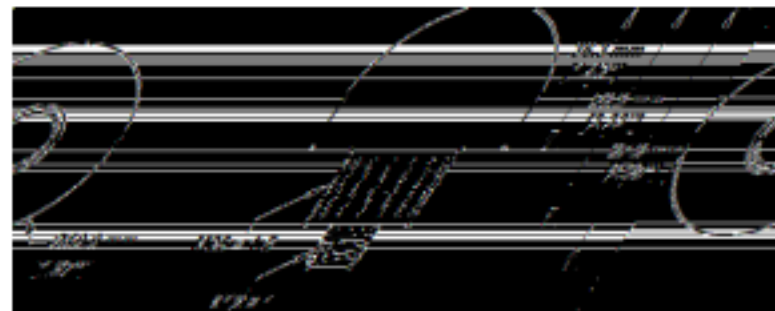
Indicator



Push Button



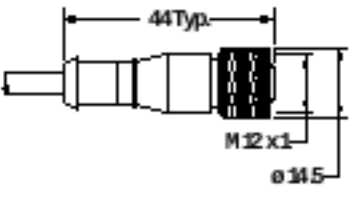

Optical Sensor

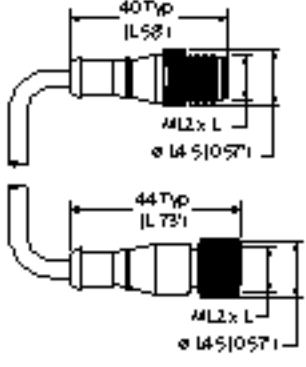




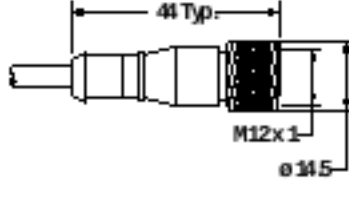

6 Accessories

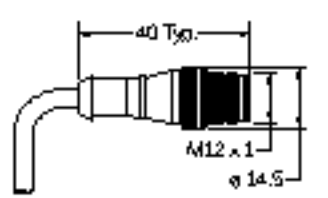
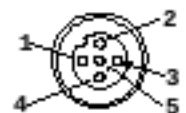
6.1 Cordsets

Use single-ended cordsets between the power source and the quick disconnect connection of the first device in a chain.
Use double-ended cordsets between devices in a chain.

4-Pin Threaded M12/Euro-Style Cordsets — Single Ended				
Model	Length	Style	Dimensions	Pinout (Female)
MQDC-406	1.83 m (6 ft)	Straight		 <p>1 = Brown 2 = White 3 = Blue 4 = Black</p>
MQDC-415	4.57 m (15 ft)			
MQDC-430	9.14 m (30 ft)			
MQDC-450	15.2 m (50 ft)			

4-Pin Threaded M12/Euro-Style Cordsets — Double Ended				
Model	Length	Style	Dimensions	Pinout
MQDEC-401SS	0.31 m (1 ft)	Male Straight/ Female Straight		Female
MQDEC-403SS	0.91 m (3 ft)			
MQDEC-406SS	1.83 m (6 ft)			Male
MQDEC-412SS	3.66 m (12 ft)			
MQDEC-420SS	6.10 m (20 ft)			1 = Brown 2 = White 3 = Blue 4 = Black
MQDEC-430SS	9.14 m (30 ft)			
MQDEC-450SS	15.2 m (50 ft)			

5-Pin M12/Euro-Style Shielded Cordsets				
Model	Length	Style	Dimensions	Pinout (Female)
MQDC-STP-501	0.31 m (1 ft)	Straight		 <p>1 = Brown 2 = White 3 = Blue 4 = Black 5 = Shield</p>
MQDC-STP-501	0.91 m (3 ft)			
MQDC-STP-506	1.83 m (6 ft)			
MQDC-STP-515	4.6 m (15 ft)			
MQDC-STP-530	9.1 m (30 ft)			

5-Pin Threaded M12/Euro-Style Shielded Cordsets— Double Ended				
Model	Length	Style	Dimensions	Pinout (Female)
MQDEC-STP-501SS	0.31 m (1 ft)	Male Straight/ Female Straight		 <p>1 = Brown 2 = White 3 = Blue 4 = Black 5 = Shield</p>
MQDEC-STP-503SS	0.91 m (3 ft)			
MQDEC-STP-506SS	1.83 m (6 ft)			
MQDEC-STP-515SS	4.57 m (15 ft)			
MQDEC-STP-530SS	9.14 m (30 ft)			
MQDEC-STP-550SS	15.2 m (50 ft)			

6.2 Brackets

6.2.1 PTL110

Use different brackets for mounting to various surfaces.

LMBPTL110C

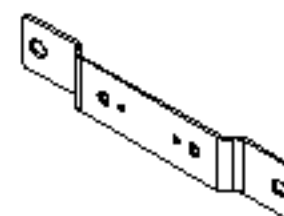
- For 28 mm tubular racking
- Toolless mount to racking

Hole center spacing: 50 mm



LMBPTL110F

- Flat mount
- For slotted extrusion and T-rail mounting
- 150 mm x 25 mm



LMBPTL110A45

- Angle mount
- For slotted extrusion and T-rail mounting
- 143 mm x 19 mm with a 30 mm depth



ACC-CAP Euro-10

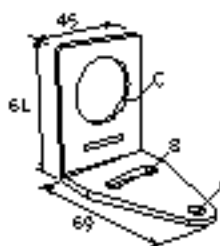
- 10 Caps
- Seal and protect exposed, unterminated cascade quick disconnect connectors



6.2.2 K50

SMB30A

- Right-angle bracket with curved slot for versatile orientation
- Clearance for M6 (¼ in) hardware
- Mounting hole for 30 mm sensor
- 12-ga. stainless steel

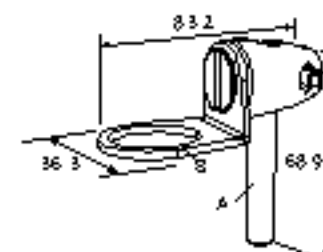


Hole center spacing: A to B=40

Hole size: A=Ø 6.3, B= 27.1 x 6.3, C=Ø 30.5

SMB30FA

- Swivel bracket with tilt and pan movement for precise adjustment
- Mounting hole for 30 mm sensor
- 12-ga. 304 stainless steel
- Easy sensor mounting to extrude rail T-slot
- Metric and inch size bolt available



Bolt thread: SMB30FA, A= 3/8 - 16 x 2 in; SMB30FAM10, A= M10 - 1.5 x 50

Hole size: B= Ø 30.1

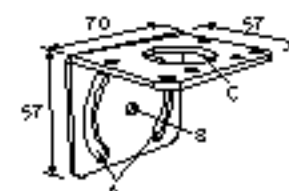
SMB30FVK

- V-clamp, 1/2" bracket and fasteners for mounting to pipe or extensions
- Clamp accommodates 28 mm dia. tubing or 1 in. square extrusions
- 30 mm hole for mounting sensors


Hole size: A = ϕ 31

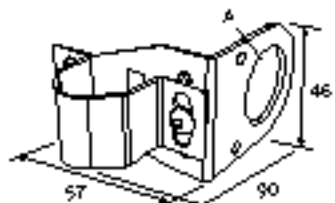
SMB30MM

- 12-ga. stainless steel bracket with curved mounting slots for versatile orientation
- Clearance for M6 (1/4 in) hardware
- Mounting hole for 30 mm sensor


Hole center spacing: A = 51, A to B = 25.4
Hole size: A = 42.6 x 7, B = ϕ 6.4, C = ϕ 30.1

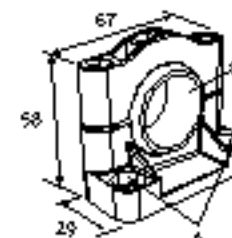
SMB30RAVK

- V-clamp, right-angle bracket and fasteners for mounting sensors to pipe or extrusion
- Clamp accommodates 28 mm dia. tubing or 1 in. square extrusions
- 30 mm hole for mounting sensors


Hole size: A = ϕ 30.5

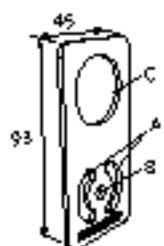
SMB30SC

- Swivel bracket with 30 mm mounting hole for sensor
- Black reinforced thermoplastic polyester
- Stainless steel mounting and swivel locking hardware included


Hole center spacing: A= ϕ 50.8
Hole size: A= ϕ 7.0, B= ϕ 30.0

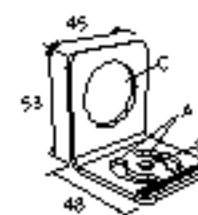
SMBAMS30P

- Flat SMBAMS series bracket
- 30 mm hole for mounting sensors
- Articulation slots for 90°+ rotation
- 12-ga. 300 series stainless steel


Hole center spacing: A=26.0, A to B=13.0
Hole size: A=26.8 x 7.0, B= ϕ 6.5, C= ϕ 31.0

SMBAMS30RA

- Right-angle SMBAMS series bracket
- 30 mm hole for mounting sensors
- Articulation slots for 90°+ rotation
- 12-ga. (2.6 mm) cold-rolled steel


Hole center spacing: A=26.0, A to B=13.0
Hole size: A=26.8 x 7.0, B= ϕ 6.5, C= ϕ 31.0

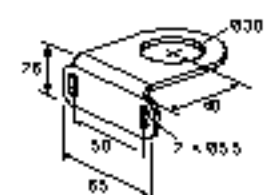
TC-K50-CL

- Touch cover

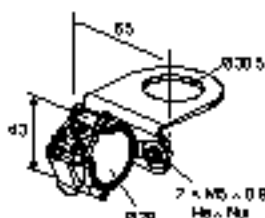

Diameter: A = 67 mm
Height: B = 42.5 mm

LMB30LP

- Low profile
- 30 mm mounting hole
- 300 series stainless steel


LMB30LPC

- For 28 mm tubular racking
- LMB30LP attached to clamp bracket
- Toolless mount to racking
- 30 mm mounting hole



7 Product Support and Maintenance

7.1 Contact Us

Banner Engineering Corp. headquarters is located at:

9714 Tenth Avenue North
Minneapolis, MN 55441, USA
Phone: + 1 888 373 6767

For worldwide locations and local representatives, visit www.bannerengineering.com.

7.2 Banner Engineering Corp. Limited Warranty

Banner Engineering Corp. warrants its products to be free from defects in material and workmanship for one year following the date of shipment. Banner Engineering Corp. will repair or replace, free of charge, any product of its manufacture which, at the time it is returned to the factory, is found to have been defective during the warranty period. This warranty does not cover damage or liability for misuse, abuse, or the improper application or installation of the Banner product.

THIS LIMITED WARRANTY IS EXCLUSIVE AND IN LIEU OF ALL OTHER WARRANTIES WHETHER EXPRESS OR IMPLIED (INCLUDING, WITHOUT LIMITATION, ANY WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE), AND WHETHER ARISING UNDER COURSE OF PERFORMANCE, COURSE OF DEALING OR TRADE USAGE.

This Warranty is exclusive and limited to repair or, at the discretion of Banner Engineering Corp., replacement. IN NO EVENT SHALL BANNER ENGINEERING CORP. BE LIABLE TO BUYER OR ANY OTHER PERSON OR ENTITY FOR ANY EXTRA COSTS, EXPENSES, LOSSES, LOSS OF PROFITS, OR ANY INCIDENTAL, CONSEQUENTIAL OR SPECIAL DAMAGES RESULTING FROM ANY PRODUCT DEFECT OR FROM THE USE OR INABILITY TO USE THE PRODUCT, WHETHER ARISING IN CONTRACT OR WARRANTY, STATUTE, TORT, STRICT LIABILITY, NEGLIGENCE, OR OTHERWISE.

Banner Engineering Corp. reserves the right to change, modify or improve the design of the product without assuming any obligations or liabilities relating to any product previously manufactured by Banner Engineering Corp. Any misuse, abuse, or improper application or installation of this product or use of the product for personal protection applications when the product is **designed** as not intended for such purposes will void the product warranty. Any **modifications** to this product without prior express approval by Banner Engineering Corp. will void the product warranties. All **specifications** published in this document are subject to change; Banner reserves the right to modify product **specifications** or update documentation at any time. **specifications** and product information in English supersede that which is provided in any other language. For the most recent version of any documentation, refer to: www.bannerengineering.com.

For patent information, see www.bannerengineering.com/patents.

7.3 FCC Part 15 and CAN ICES-3 (B)/NMB-3(B)

This device complies with part 15 of the FCC Rules and CAN ICES-3 (B)/NMB-3(B). Operation is subject to the following two conditions:

1. This device may not cause harmful interference, and
2. This device must accept any interference received, including interference that may cause undesired operation.

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules and CAN ICES-3 (B)/NMB-3(B). These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the manufacturer.