QS18E Expert Sensor with IO-Link Product Manual

Original Instructions
p/n: 196872 Rev. H
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ПРОМЭЛЕКТРОНИКА/ sales@prom-elec.com

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Chapter Contents

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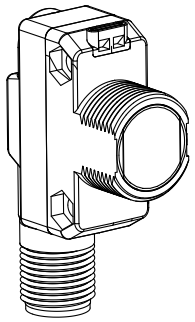
Specifications 5

Chapter 1 Features

Expert Sensor with IO-Link

Expert Opposed-Mode Sensor with IO-Link



- **Self-Contained Models:**
  - IO-Link communication for sensor health monitoring and remote configuration
  - Easy-to-use Expert-style Two-Point Static and Dynamic TEACH methods, plus Window, Light, and Dark SET, using IO-Link, push button or remote input
  - Smart power-control algorithm to maximize performance in low-contrast applications
- **Opposed-Mode Models:**
  - Infrared and visible beam emitter/receiver pairs with a range of 20 m (66 ft)
  - Robust ambient light immunity to prevent unintentional triggering
  - Optical synchronization provides crosstalk avoidance with three frequency channels for side by side sensor mounting
  - Two-Point Static and Dynamic TEACH methods, plus Window, Light, and Dark SET and Opaque mode for reliable long range detection of very dark objects
  - Health data available over IO-Link
- Auto compensation algorithm provides long and reliable operation by compensating for dust build up and ambient temperature changes.
- Fast response speed for high-speed applications
- User-selectable threshold offset percentage to optimize performance for the type of object being detected
- Easy configuration of the sensor by IO-Link, remote input or push button
- Convenient mounting options available for 18 mm barrel or side mount
- Bright indicator LEDs show operating status from 360°
- IP67 rated ABS housing

WARNING:
- **Do not use this device for personnel protection**
- Using this device for personnel protection could result in serious injury or death.
- This device does not include the self-checking redundant circuitry necessary to allow its use in personnel safety applications. A device failure or malfunction can cause either an energized (on) or de-energized (off) output condition.

Models

Polarized retroreflective sensing mode models

Models	Range	Output	Connection
QS18EK6LPQ5	3.5 m (12 ft) (with the use of a BRT-84 reflector)	IO-Link push/pull output and multi-function input/output	150 mm (6 in) PVC cable with a 4-pin M12 quick disconnect (QD)
QS18EK6LPQ7			4-pin M8 QD

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Continued from page 3

Models	Range	Output	Connection
QS18EK6LPQ8			4-pin M12 quick disconnect

Diffuse (infrared) sensing mode models

Models	Range	Output	Connection
QS18EK6DQ5	800 mm (31.5 in) (based on 90% reflectance white test card)	IO-Link push/pull output and multi-function input/output	150 mm (6 in) PVC cable model with a 4-pin M12 QD
QS18EK6DQ7			4-pin M8 QD
QS18EK6DQ8			4-pin M12 QD

Diffuse (visible red) sensing mode models

Models	Range	Output	Connection
QS18EK6DVQ	600 mm (23.6 in) (based on 90% reflectance white test card)	IO-Link push/pull output and multi-function input/output	150 mm (6 in) PVC cable with a 4-pin M8 QD
QS18EK6DVQ5			150 mm (6 in) PVC cable model with a 4-pin M12 QD
QS18EK6DVQ7			4-pin M8 QD
QS18EK6DVQ8			4-pin M12 QD

Convergent sensing mode models

Models	Range	Output	Connection
QS18EK6CV15Q5	16 mm (0.65 in) (based on 90% reflectance white test card)	IO-Link push/pull output and multi-function input/output	150 mm (6 in) PVC cable model with a 4-pin M12 QD
QS18EK6CV15Q7			4-pin M8 QD

Plastic fiber optic mode models

Models	Range	Output	Connection
QS18EK6FPQ	Varies by mode and fiber optics used	IO-Link push/pull output and multi-function input/output	150 mm (6 in) PVC cable with a 4-pin M8 QD
QS18EK6FPQ5			150 mm (6 in) PVC cable model with a 4-pin M12 QD
QS18EK6FPQ7			4-pin M8 QD

Models with a quick disconnect require a mating cordset.

For a list of discontinued models, see Discontinued Models.

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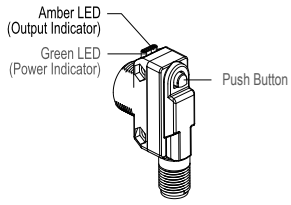
Overview



The Banner QS18E sensor is a high-performance photoelectric sensor with IO-Link and configurable multifunction input/output. For opposed-mode models, the receiver has a configurable multifunction input/output and the emitter has a configurable multifunction input.

Opposed-Mode Emitter

Sensor Condition	Green LED	Amber LED
Power On	ON	OFF
Notification—Push button has been locked out	Flashes four times and returns to solid On after button press	OFF

Self-Contained Models and Opposed-Mode Receivers

Sensor Condition (Run Mode)	Green LED	Amber LED
Output OFF	ON	OFF
Output ON	ON	ON
Self-Contained Models Notification—Sensor needs to be reconfigured for reliable detection ***Opposed-Mode Models*** Notification—Sensor needs to be reconfigured for reliable detection OR The emitter is set to High Power, and the receiver is saturated. Set the emitter to Low Power.	Flashing	ON/OFF
Notification—Push button has been locked out	Flashes four times and returns to solid On after button press	ON/OFF

Opposed-Mode Models: Noise and Crosstalk Immunity

Optical synchronization between the emitter and receiver provides ambient light immunity and crosstalk avoidance not typically available in opposed-mode sensing. The sensor is highly resistant to light detection due to ambient light from high-efficiency light sources or from other light-emitting industrial sensors. In addition, there are three user-selectable frequency channels (A, B, or C) for crosstalk avoidance in side-by-side sensor mounting. The factory default channel is Frequency A.

Specifications

QS18E Self-Contained Models Specifications

Supply Voltage and Current

10 V DC to 30 V DC (10% maximum ripple within specified limits) at 30 mA

Supply Protection Circuitry

Protected against reverse polarity and transient overvoltages

Output Protection Circuitry

Protected against false pulse on power-up and continuous overload or short-circuit of output

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Output Configuration

Channel 1: IO-Link, Push/pull output, configurable PNP or NPN output

Channel 2: Multi-function remote input/output, configurable PNP or NPN

Rating: 50 mA maximum each output at 25 °C

Output Response Time

Momentary delay on power-up, < 0.5 s, output does not conduct during this time

350 microseconds ON & OFF for high speed response time

1 millisecond ON & OFF for standard response time

2 millisecond ON & 1 millisecond OFF for robust response time

Repeatability

140 microseconds for high speed

175 microseconds for standard and robust

IO-Link Interface

Supports Smart Sensor Profile: Yes

Baud Rate: 38400 bps

Process Data Widths: 32 bits In, 8 bits Out

IODD Files: Provides all programming options of push button and remote input wire, plus additional functionality. See the IO-Link Data Reference Guide for more details.

Emitter LED

DV, CV, FP, and LP: Visible red, 625 nm

D models: Infrared, 940 nm

Indicators

Two LEDs (1 green, 1 amber)

Green On: Indicates power applied and sensor ready

Green Flashing: Indicates sensor operating in marginal state, in need of reconfiguration

Amber On: Indicates output conducting

Construction

Housing: ABS

Window: PMMA

Mounting Torque

Nose Mount: 18 mm mounting nut, 20 lbf·in (2.3 N·m)

Side Mount: Two M3 screws, 5 lbf·in (0.6 N·m)

Connections

PVC-jacketed 4-conductor 2 m (6.5 ft) or 9 m (30 ft) unterminated cable, or 4-pin M12 or 4-pin M8 quick-disconnect, either integral or 150 mm (6 in) cable, are available.

Models with a quick disconnect require a mating cordset

Operating Conditions

–40 °C to +70 °C (–40 °F to +158 °F)

95% at +50 °C maximum relative humidity (non-condensing)

Environmental Rating

IP67

Application Notes

If the push button does not appear to be responsive, perform the push button enable procedure

Certifications

Banner Engineering BV
Park Lane, Culliganlaan 2F bus 3
1831 Diegem, BELGIUM

Turck Banner LTD Blenheim House
Blenheim Court
Wickford, Essex SS11 8YT
GREAT BRITAIN

Factory Default Settings

Setting	Factory Default
TEACH/SET	D, DV, CV, and FP Models: Two-point Static TEACH LP Models: Light SET
Output Logic	D, DV, CV, and FP Models: Light Operate LP Models: Dark Operate
Output Response Time	Standard
Offset Percentage	30%
Push Button	Unlocked
Auto Compensation	Enabled
OFF Delay	Disabled
Pin 4 Output	IO-Link Enabled Detection Output (Push-pull)
Pin 2 Output	Detection Output: High-speed output when using IO-Link on Pin 4

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

QS18E Opposed Mode Specifications

Supply Voltage and Current

10 V DC to 30 V DC (10% maximum ripple within specified limits) at 30 mA

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Power and Current Consumption, exclusive of load

Normal Run Mode: 1.2W, Current consumption < 50 mA at 24 V DC

Supply Protection Circuitry

Protected against reverse polarity and transient overvoltages

Output Protection Circuitry

Protected against false pulse on power-up and continuous overload or short-circuit of output

Output Configuration

Channel 1: IO-Link, Push/pull output, configurable PNP or NPN output

Channel 2: Multi-function remote input/output, configurable PNP or NPN

Rating: 50 mA maximum each output at 25 °C

Power Up Delay

Momentary delay on power-up, < 1.5 s, output does not conduct during this time

Gain

The gain setting can be changed via IO-Link

Gain values are: **Auto** and the fixed modes **High**, **Mid**, and **Low**

Emitter LED

EV model: Visible red, 625 nm

E models: Infrared, 940 nm

Indicators

Two LEDs (1 green, 1 amber)

Green On: Indicates power applied and sensor ready

Green Flashing: Indicates sensor operating in marginal state, in need of reconfiguration

Amber On: Indicates output conducting

Construction

Housing: ABS

Window: PMMA

Mounting Torque

Nose Mount: 18 mm mounting nut, 20 lbf·in (2.3 N·m)

Side Mount: Two M3 screws, 5 lbf·in (0.6 N·m)

Connections

PVC-jacketed 4-conductor 2 m (6.5 ft) or 9 m (30 ft) unterminated cable; or 4-pin M12 or 4-pin M8 quick-disconnect, either integral or with a 150 mm (6 in) cable, are available.

Models with a quick disconnect require a mating cordset

Emitter Power

High Power is Power 5.

Low Power is Power 0.

The following power levels are available via IO-Link to set intermediate power levels when looking for good contrast control with separation distances > 4 m: Power 5, Power 4, Power 3, Power 2, Power 1, and Power 0

IO-Link Interface

Supports Smart Sensor Profile: Yes

Baud Rate: 38400 bps

Process Data Widths: 32 bits In, 8 bits Out

IODD Files: Provides all programming options of push button and remote input wire, plus additional functionality. See the IO-Link Data Reference Guide (p/n 209308) for more details.

Vibration and Mechanical Shock

All models meet MIL-STD-202G, Method 201A (Vibration: 10 Hz to 60 Hz, 0.06 inch (1.52 mm) double amplitude, 2 hours each along X, Y and Z axes) requirements. Also meets IEC 60947-5-2 (Shock: 30G 11 ms duration, half sine wave) requirements.

Environmental Rating

IP65, IP67

Operating Conditions

–20 °C to +70 °C (–4 °F to +158 °F)

95% at +50 °C maximum relative humidity (non-condensing)

Storage Temperature: –65 °C to +125 °C (-85 °F to 257 °F)

Application Notes

If the push button does not appear to be responsive, perform the push button enable procedure

Response Time and Response Repeatability

When gain = **Auto**, the receiver optimizes the gain during Run mode for the current condition.

When gain = **Fixed**, the receiver optimizes the power for the presented configured condition(s).

Frequency	Gain Mode	Response Time (µs)	Response Repeatability (µs)
High Speed	Fixed	300	140
High Speed	Auto	350	212
A,B,C	Fixed	1000	400
A,B,C	Auto	1100	600

Factory Default Settings—Emitter

Setting	Factory Default
Basic Configuration	Frequency A
Power Setting	High Power
Push Button	Unlocked
Pin 4 Output	IO-Link (Push-pull)
Pin 2 Input	Detection Input: Deactivated
Power	High

Factory Default Settings—Receiver

Setting	Factory Default
Basic Configuration	Frequency A
TEACH/SET	Two-Point Static TEACH
Output Logic	Light Operate
Output Response Time	Standard
Offset Percentage	50%
Push Button	Unlocked
Auto Compensation	Disabled
OFF Delay	Disabled
Pin 4 Output	IO-Link Enabled Detection Output (Push-pull)
Pin 2 Output	Detection Output: High-speed output when using IO-Link on Pin 4
Gain	Auto

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Supply wiring leads < 24 AWG shall not be spliced.

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

FCC Part 15 Class A for Unintentional Radiators

This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

(Part 15.21) Any changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate this equipment.

Industry Canada ICES-003(A)

This device complies with CAN ICES-3 (A)/NMB-3(A). 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.

Cet appareil est conforme à la norme NMB-3(A). Le fonctionnement est soumis aux deux conditions suivantes : (1) ce dispositif ne peut pas occasionner d'interférences, et (2) il doit tolérer toute interférence, y compris celles susceptibles de provoquer un fonctionnement non souhaité du dispositif.

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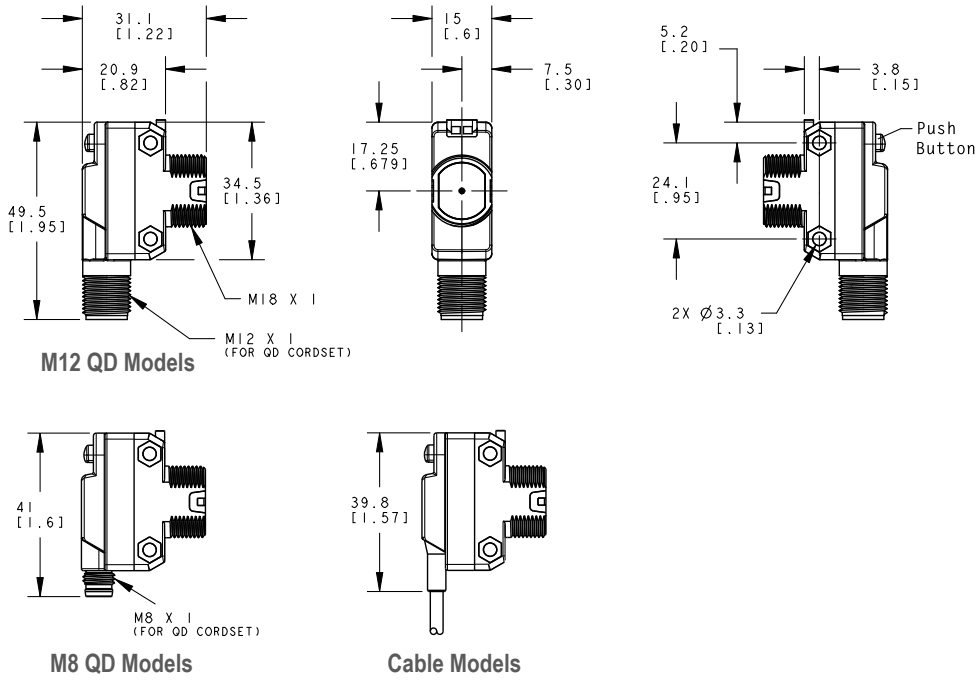
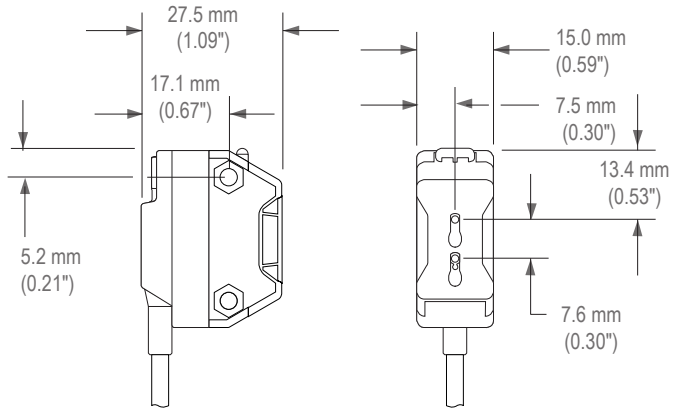
Dimensions



Model Suffix FP



QS18E Performance Curves

Performance using Dark SET, performed in no-light condition.

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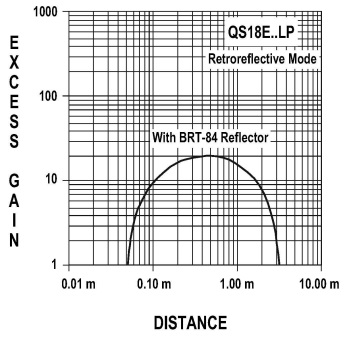
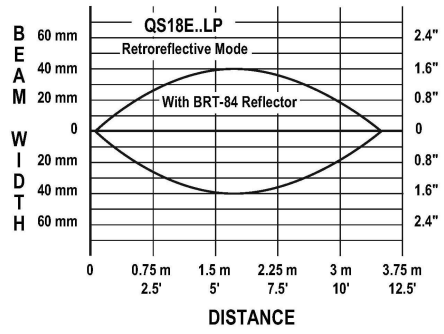
Polarized Retroreflective

Excess Gain

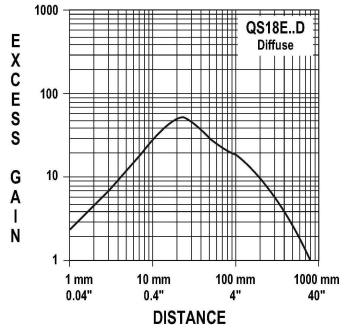


Beam Pattern

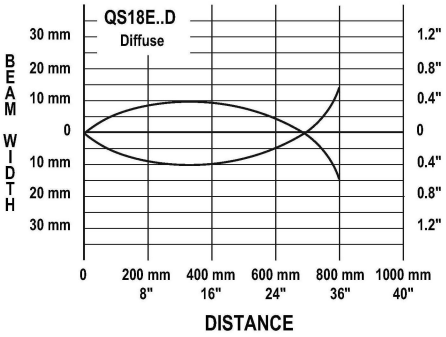


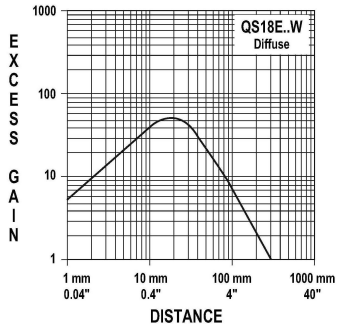
Diffuse (Based on use of 90% reflectance white test card)

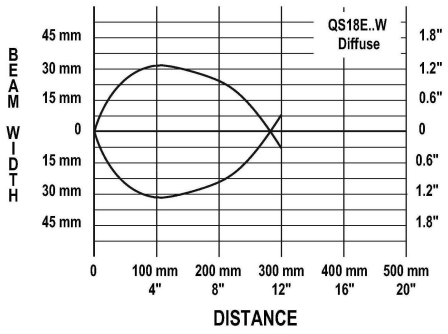
Excess Gain

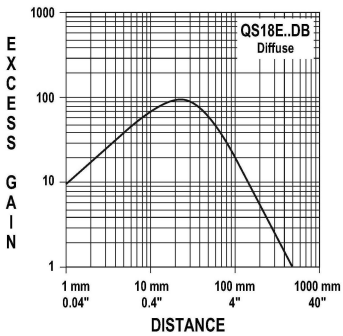


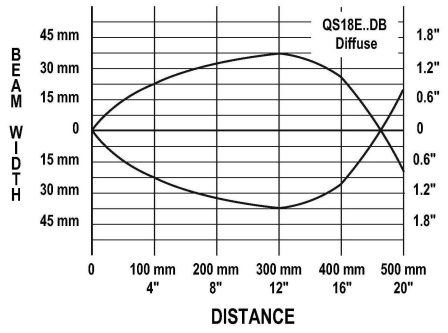
Beam Pattern











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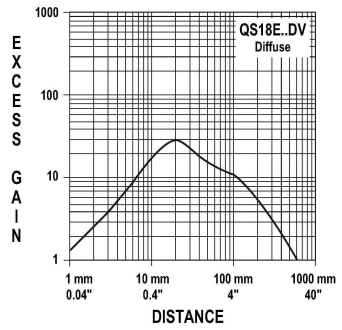
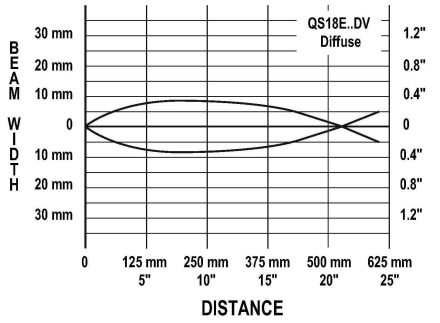
Diffuse (Based on use of 90% reflectance white test card)

Excess Gain

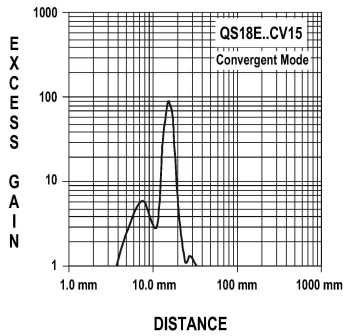


Beam Pattern

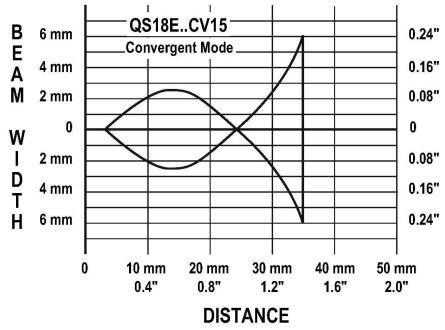


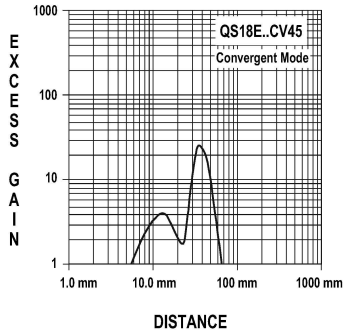
Convergent

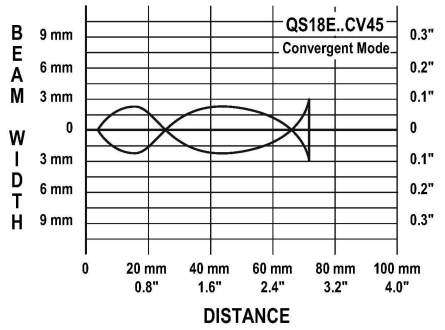
Excess Gain



Beam Pattern







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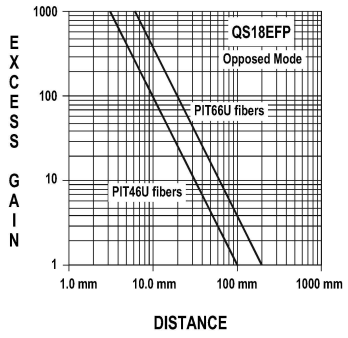
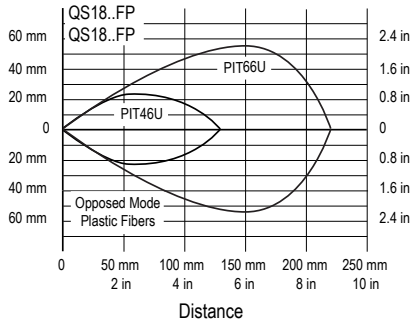
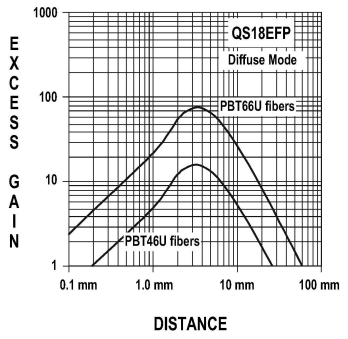
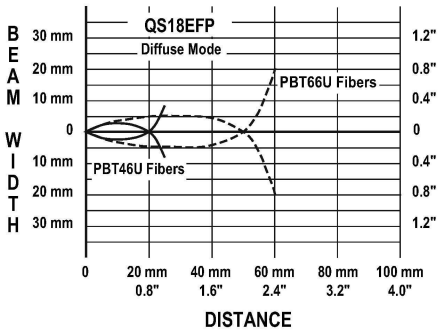
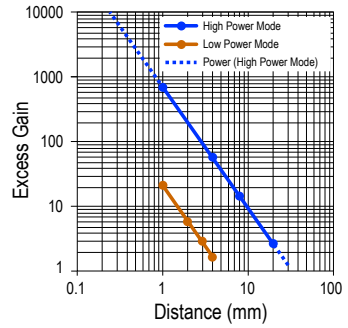
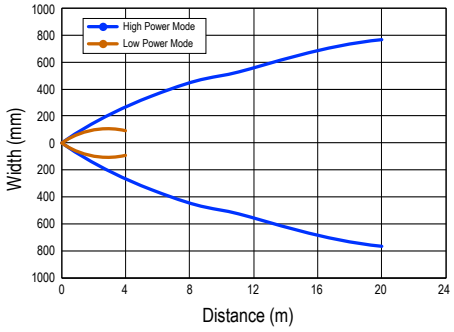
Fiber Optic - Plastic	
Excess Gain	**Beam Pattern**
	
	

Opposed-Mode Models Performance Curves

Visible Red—QS18EK6EV/QS18EK6RV	
Excess Gain Curve	**Beam Pattern**
	

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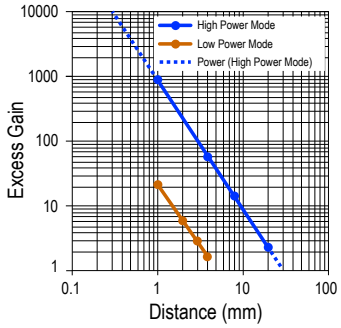
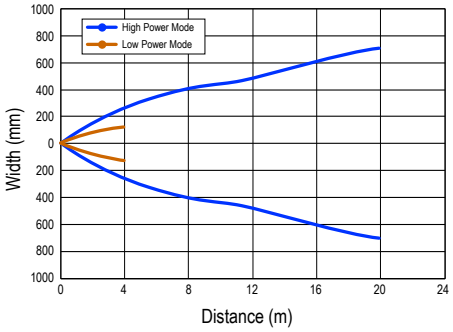
Infrared—QS18EK6E/QS18EK6R

Excess Gain Curve



Beam Pattern



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Mount the Device

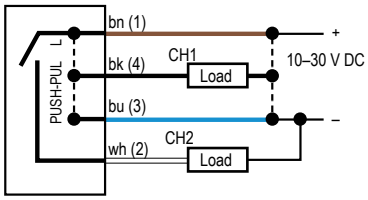
1. If a bracket is needed, mount the device onto the bracket.
2. Mount the device (or the device and the bracket) to the machine or equipment at the desired location. Do not tighten the mounting screws at this time.
3. Check the device alignment.
4. Tighten the mounting screws to secure the device (or the device and the bracket) in the aligned position.

Wiring Diagrams

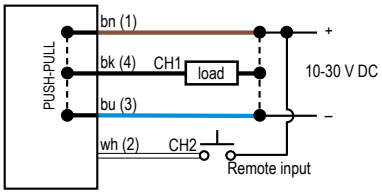
Follow the wiring diagram that is appropriate for your application.

Opposed-Mode Models: The following wiring diagrams apply to the receivers. The wiring diagrams that include remote input apply to the emitters.

Channel 1 = IO-Link, Channel 2 = PNP Output (factory default)



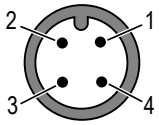
Channel 1 = IO-Link, Channel 2 = PNP Remote Input



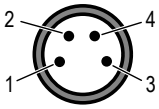
Key

1. Brown
2. White
3. Blue
4. Black[1]

Sensor Pinout M12 Models (Male)



Sensor Pinout M8 Models (Male)



NOTE: NPN/PNP and Remote Input configurations are programmable using IO-Link.

NOTE: Enable the remote input wire function using IO-Link. The default for the remote input wire function is Detection Output.

[1] Opposed-Mode Models: IO-Link only on emitters.

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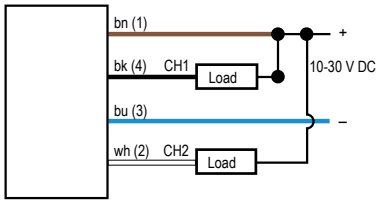
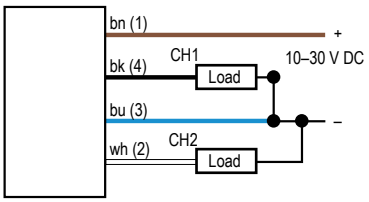
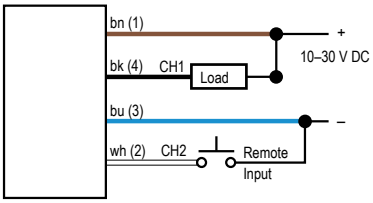
Channel 1 = NPN Output, Channel 2 = NPN Output



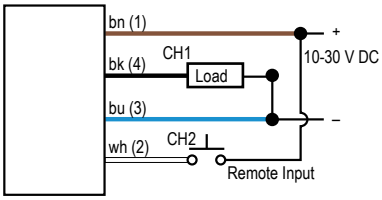
Channel 1 = PNP Output, Channel 2 = PNP Output



Channel 1 = NPN Output, Channel 2 = NPN Remote Input



Channel 1 = PNP Output, Channel 2 = PNP Remote Input



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Chapter 3 Sensor Configuration

Configure the sensor using the TEACH or SET methods to define the sensing limits. Use the setup procedure to enable a 30 ms OFF-delay or to change the Light/Dark Operate setting.

Sensing limit configuration options include:

- Two-Point Static TEACH: One switching threshold, determined by two taught conditions
- Dynamic TEACH: One switching threshold, determined by multiple sampled conditions
- Window SET: A sensing window, centered around a single sensing condition
- Light SET and Dark SET: One switching threshold, offset from a single sensing condition
- Opposed-Mode Models: Opaque Mode: One switching threshold set to maximum excess gain

The sensor's output is disabled during all TEACH and SET procedures, and is enabled upon return to Run mode.

See the Input Flowcharts for configuration information.

- Self-contained models: "Figure: Self-Contained Models Input Flowchart" on page 17
- Opposed-mode emitters: "Figure: Opposed-Mode Models Emitter Input Flowchart" on page 18
- Opposed-mode receivers: "Figure: Opposed-Model Models Receiver Input Flowchart" on page 19

Following any TEACH or SET procedure other than Two-Point Static TEACH, the Output ON condition (Light or Dark Operate setting) remains as it was last configured. To change that setting, or the OFF-delay setting, see the Input Flowchart.

Push Button Configuration. Use the push button to configure the sensor. Click the push button according to the Input Flowchart.

Remote Input Configuration. The remote input wire is disabled by default. Enable the remote input wire using IO-Link. Use the remote input function to configure the sensor remotely. Connect the white wire of the sensor as shown in the wiring diagram. Pulse the remote line according to the Input Flowchart.

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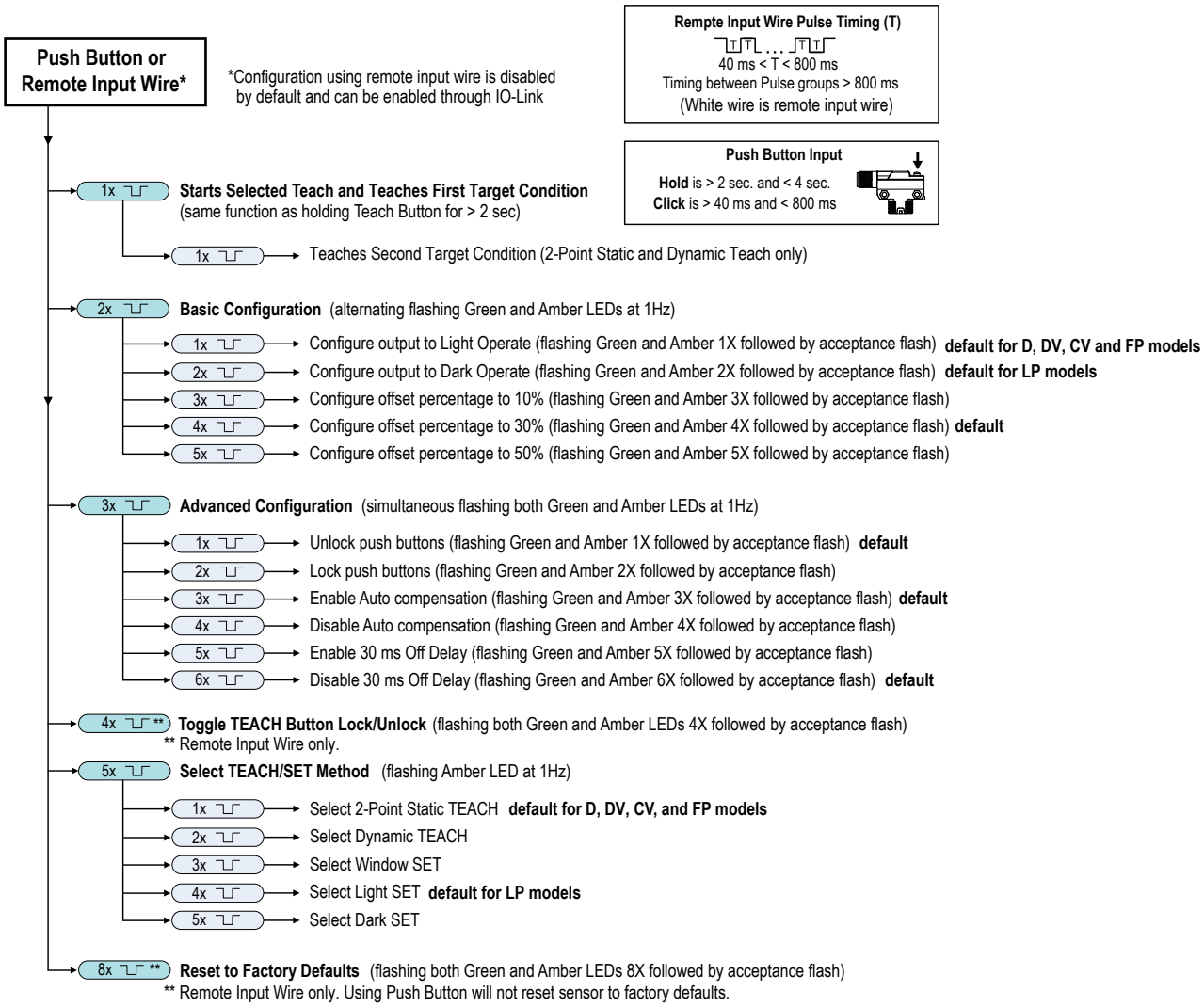
Self-Contained Models Input Flowchart



Note: Reconfiguration is required before a new TEACH/SET method takes effect.

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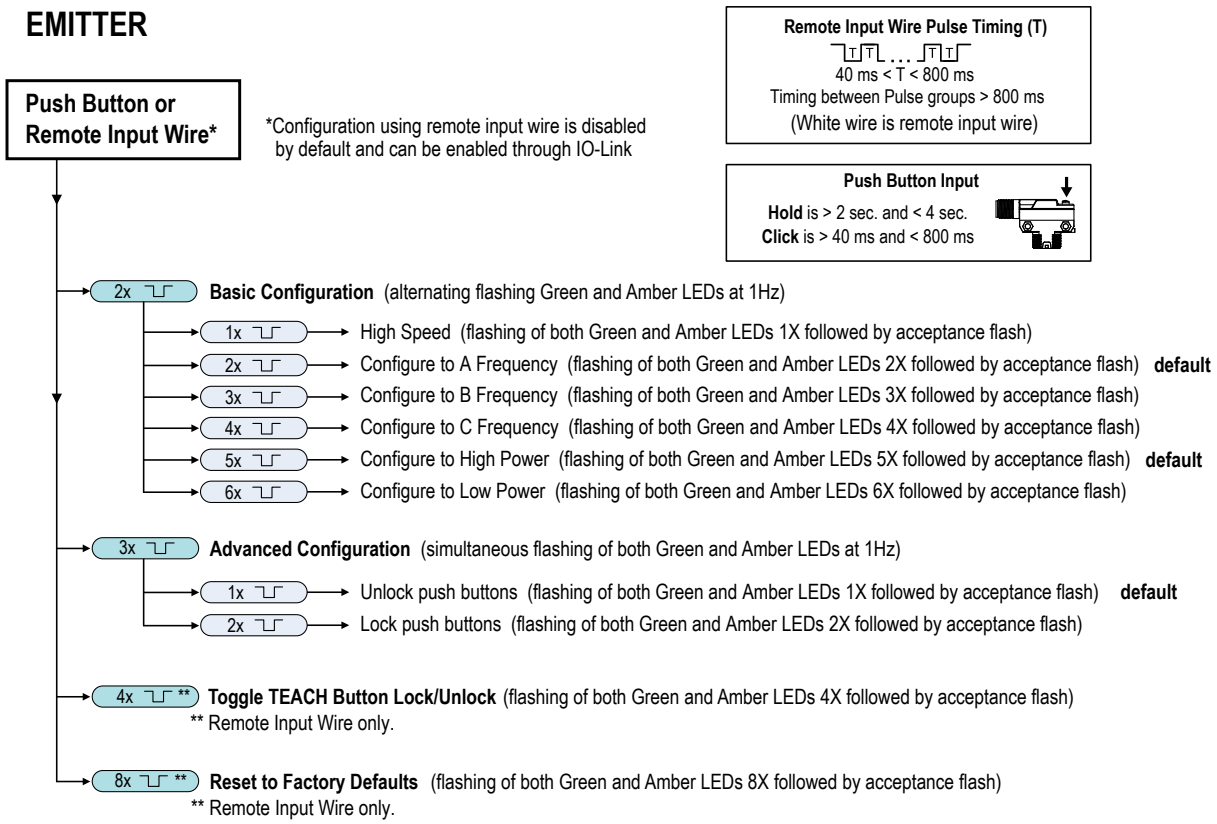
Opposed-Mode Models Emitter Input Flowchart



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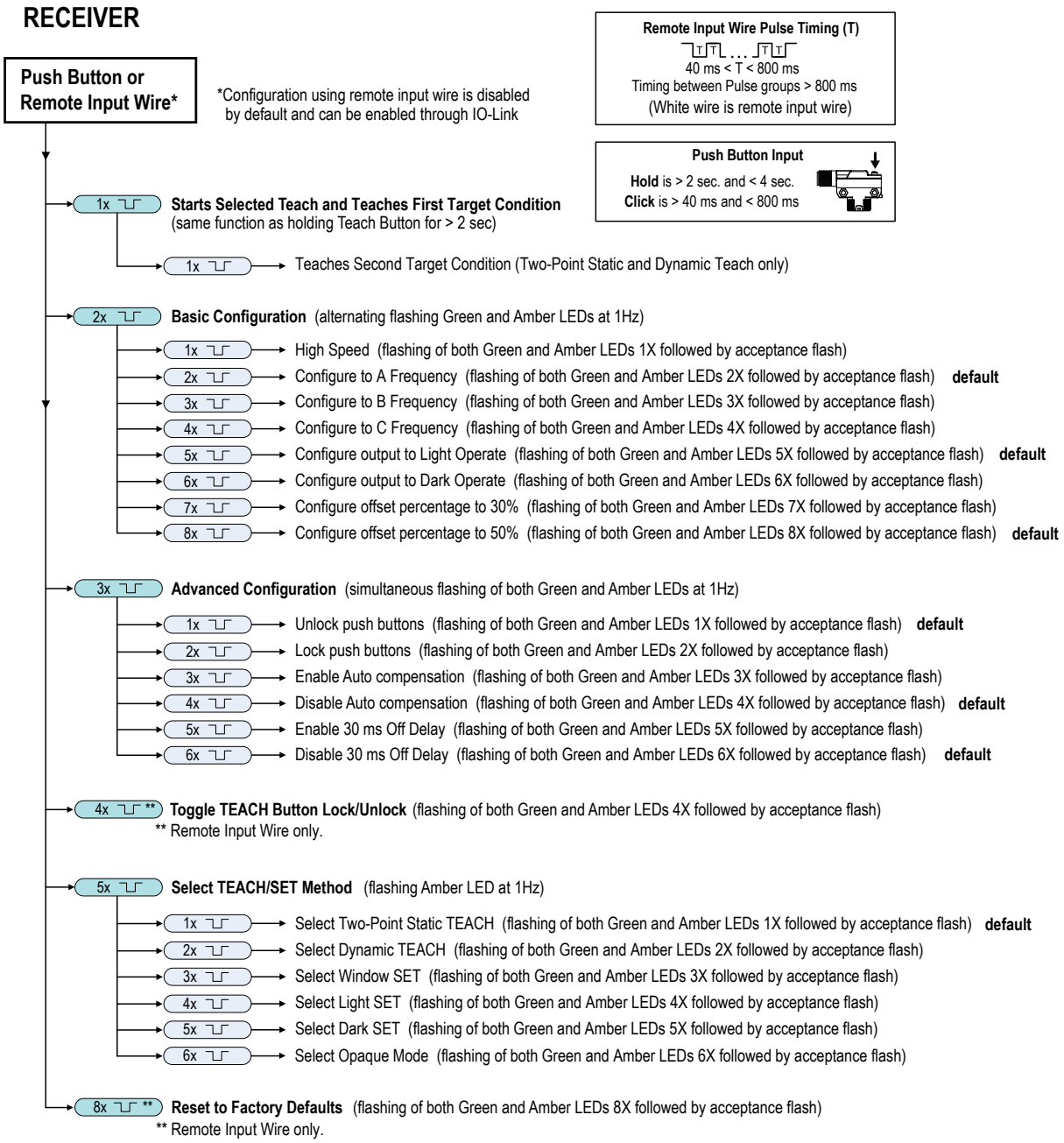
Opposed-Model Models Receiver Input Flowchart



IO-Link Interface

IO-Link® [2]is a point-to-point communication link between a master device and sensor. Use IO-Link to parameterize sensors and transmit process data automatically.

For the latest IO-Link protocol and specifications, see www.io-link.com.

Each IO-Link device has an IODD (IO Device Description) file that contains information about the manufacturer, article number, functionality etc. This information can be easily read and processed by the user. Each device can be unambiguously identified via the IODD as well as via an internal device ID. Download the QS18E's IO-Link IODD package from Banner Engineering's website at www.bannerengineering.com.

[2] IO-Link® is a registered trademark of PROFIBUS Nutzerorganisation e.V.

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IODD package part numbers:

- Self-contained models: 199851
- Opposed-mode emitter: 209310
- Opposed-mode receiver: 209311

Banner has also developed Add On Instruction (AOI) files to simplify ease-of-use between the QS18E, multiple third-party vendors' IO-Link masters, and the Logix Designer software package for Rockwell Automation PLCs. Three types of AOI files for Rockwell Allen-Bradley PLCs are listed below. These files and more information can be found at www.bannerengineering.com.

Process Data AOIs—These files can be used alone, without the need for any other IO-Link AOIs. The job of a Process Data AOI is to intelligently parse out the Process Data word(s) in separate pieces of information. All that is required to make use of this AOI is an EtherNet/IP connection to the IO-Link Master and knowledge of where the Process Data registers are located for each port.

Parameter Data AOIs—These files require the use of an associated IO-Link Master AOI. The job of a Parameter Data AOI, when working in conjunction with the IO-Link Master AOI, is to provide quasi-realtime read/write access to all IO-Link parameter data in the sensor. Each Parameter Data AOI is specific to a given sensor or device.

IO-Link Master AOIs—These files require the use of one or more associated Parameter Data AOIs. The job of an IO-Link Master AOI is to translate the desired IO-Link read/write requests, made by the Parameter Data AOI, into the format a specific IO-Link Master requires. Each IO-Link Master AOI is customized for a given brand of IO-Link Master.

Add and configure the relevant Banner IO-Link Master AOI in your ladder logic program first; then add and configure Banner IO-Link Device AOIs as desired, linking them to the Master AOI as shown in the relevant AOI documentation.

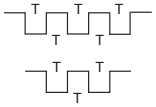
Banner has also developed Function Blocks to simplify ease-of-use between the QS18E, multiple third-party vendors' IO-Link masters, and the Siemens TIA Portal software package for Siemens PLCs. Two types of Function Blocks files for TIA Portal are listed below. The files and more information can be found at www.bannerengineering.com.

Process Data Function Blocks—These files can be used alone, without the need for any other IO-Link Function Blocks. A Process Data Function Block intelligently parses out the Process Data byte(s) in separate pieces of information. To make use of this Function Block, a Profinet connection to the Io-Link Master and knowledge of where the Process Data registers are located for each port is required.

Parameter Data Function Blocks—These files require the Siemens TIA Portal Function Block IO_Link_Device. This is available from the Siemens website. A Parameter Function Block provides quasi-realtime read/write access to all IO-Link parameter data in the sensor. Each Parameter Function Block is specific to a given sensor.

Push Button Enable/Disable

The push button can be disabled to prevent unauthorized adjustment. Perform the appropriate procedure below to enable or disable the feature.

Action	Method		Result
Push Button—Disable	**Push Button:** From Run mode, click the button three times, then click two times to disable the button.		Green and amber LEDs flash two times in unison followed by acceptance flash.
	Remote: From Run mode, pulse the remote three time, then pulse two times to disable the button.		
Push Button—Enable	**Push Button:** From Run mode, click the button three times then click one time to enable the button.		Green and amber LEDs flash once in union followed by acceptance flash.

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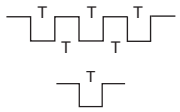
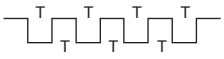
Action	Method		Result
	Remote: From Run mode, pulse the remote three time, then pulse one time to enable the button.		
Push Button—Disable/ Enable Toggle	**Remote:** From Run mode, pulse the remote line four times.		Sensor toggles between enable/ disable settings and returns to Run mode. Green and amber LEDs flash four times in unison followed by acceptance flash.

Select TEACH/SET Method

Self-Contained Models: To select Light SET, Dark SET, Window SET, Two-Point Static TEACH, or Dynamic TEACH, follow these steps.

Opposed-Mode Models: When using the receiver to select Light SET, Dark SET, Window SET, Two-Point Static TEACH, Dynamic TEACH, or Opaque mode, follow these steps.

1. Initiate select TEACH/SET Method.

Method	Action	Result
Push Button	Click the button five times	The green LED turns off and the amber LED flashes at 1 Hz.
Remote Input	Pulse the remote input line five times	

2. Select TEACH/SET Method.

Method	TEACH/SET Method	Action	Result
Push Button	Two-Point Static TEACH	Click the button one time	The selected TEACH/ SET method is enabled.
	Dynamic TEACH	Click the button two times	
	Window SET	Click the button three times	
	Light SET	Click the button four times	
	Dark SET	Click the button five times	
	Opposed-Mode Models: Opaque Mode	Click the button six times	
IO-Link	Two-Point Static TEACH	Set BDC1 Mode using IO-Link	
	Dynamic TEACH		
	Window SET		
	Light SET		
	Dark SET		
	Opposed-Mode Models: Opaque Mode		
Remote Input	Two-Point Static TEACH	Pulse the remote line one time	
	Dynamic TEACH	Pulse the remote line two times	
	Window SET	Pulse the remote line three times	

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Method	TEACH/SET Method	Action	Result
	Light SET	Pulse the remote line four times	
	Dark SET	Pulse the remote line five times	
	Opposed-Mode Models: Opaque Mode	Pulse the remote line six times	

Configure TEACH/SET

Self-Contained Models: By default, the sensor TEACH/SET method is Two-Point Static TEACH. To perform a TEACH/SET, use the following procedures for your preferred method.

Opposed-Mode Models: By default, the receiver TEACH/SET method is Two-Point Static TEACH. To perform a TEACH/SET, use the following procedures for your preferred method.

Push Button

Action		Result
Two-Point Static TEACH	1. Present the output ON target condition. 2. Press and hold the button for longer than 2 seconds to enter TEACH mode and configure the output ON light level. 3. Present the output OFF target condition. 4. Click the button once to configure the output OFF light level and return to Run mode.	**Accepted** 1. The amber LED indicator is off and the green indicator LED flashes three times. 2. The green and amber LED indicators flash six times rapidly in unison (acceptance flash). 3. The sensor returns to Run mode with valid thresholds. **Invalid Teach Condition** 1. The green and amber indicator LEDs flash two times in unison. 2. The green and amber LED Indicators flash six times rapidly in unison (acceptance flash). 3. The sensor returns to Run Mode with coerced thresholds.
Dynamic TEACH	1. Press and hold the Push Button for greater than 2 seconds to start the Dynamic TEACH process. 2. Run the target application to configure the ON and OFF conditions. 3. Click the Push Button once to stop the Dynamic TEACH process and return to Run mode.	
Window SET	1. Present the target condition. 2. Press and hold the button for greater than 2 seconds to configure the target condition and return to Run mode.	
Light SET		
Dark SET		
Opposed-Mode Models: Opaque Mode		

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IO-Link

Action		Result
Two-Point Static TEACH	1. Present the output ON target condition. 2. Send SP1 Two Value Teach TP1 command using IO-Link to enter TEACH mode and learn the output ON light level. 3. Present the output OFF target condition. 4. Send the SP1 Two Value Teach TP2 command using IO-Link to configure the output OFF light level and return to Run mode.	**Accepted** 1. The amber LED indicator is off and the green indicator LED flashes three times. 2. The green and amber LED indicators flash six times rapidly in unison (acceptance flash). 3. The sensor returns to Run mode with valid thresholds. **Invalid Teach Condition** 1. The green and amber indicator LEDs flash two times in unison. 2. The green and amber LED Indicators flash six times rapidly in unison (acceptance flash). 3. The sensor returns to Run Mode with coerced thresholds.
Dynamic TEACH	1. Send SP1 Dynamic Teach Start command using IO-Link to start the Dynamic TEACH process. 2. Run the target application to configure the ON and OFF conditions. 3. Send SP1 Dynamic Teach Stop command using IO-Link to stop the Dynamic TEACH process and return to Run mode.	
Window SET Light SET Dark SET Opposed-Mode Models: Opaque Mode	1. Present the target condition. 2. Send the SP1 Single Value Teach command using IO-Link to configure the target condition and return to Run mode.	

Remote Input

Action		Result
Two-Point Static TEACH	1. Present the output ON target condition. 2. Pulse the remote line once to enter TEACH mode and configure the output ON light level. 3. Present the output OFF target condition. 4. Pulse the remote line again to configure the output OFF light level and return to Run mode.	**Accepted** 1. The amber LED indicator is off and the green indicator LED flashes three times. 2. The green and amber LED indicators flash six times rapidly in unison (acceptance flash). 3. The sensor returns to Run mode with valid thresholds. **Invalid Teach Condition** 1. The green and amber indicator LEDs flash two times in unison. 2. The green and amber LED Indicators flash six times rapidly in unison (acceptance flash). 3. The sensor returns to Run Mode with coerced thresholds.
Dynamic TEACH	1. Pulse the remote line once to start the Dynamic TEACH process. 2. Run the target application to configure the ON and OFF conditions. 3. Pulse the remote line again to stop the Dynamic TEACH process and return to Run mode.	

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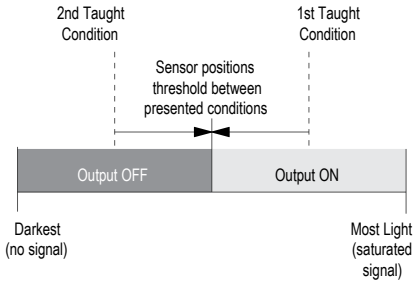
Action		Result
Window SET	1. Present the target condition. 2. Pulse the remote line once to configure the target condition and return to Run mode.	
Light SET		
Dark SET		
Opposed-Mode Models: Opaque Mode		

TEACH/SET

Two-Point Static TEACH

- Two-Point Static TEACH locates a single switching threshold (switchpoint) centered between the two taught conditions, with the Output ON condition on one side, and the Output OFF condition on the other.
- During Two-Point Static TEACH, the first condition taught is the ON condition. Output ON and OFF conditions may be reversed by switching the TEACH order or by changing the Light/Dark Operate setting.
- Two-Point Static TEACH is recommended for applications where two conditions can be presented individually.

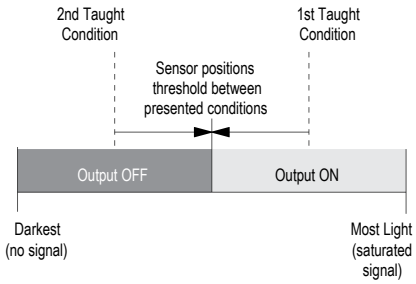
Two-Point Static TEACH



Dynamic TEACH

- Dynamic TEACH locates a single switching threshold (switchpoint) centered between the two taught conditions, with the Output ON condition on one side, and the Output OFF condition on the other.
- During Dynamic TEACH, the Output ON state (Light or Dark Operate setting) remains as it was last configured. Self-Contained Models: Output ON and OFF conditions may be reversed by switching the TEACH order or by changing the Light/Dark Operate setting.
- Dynamic TEACH is recommended for applications where a machine or process may not be stopped for configuration.

Dynamic TEACH



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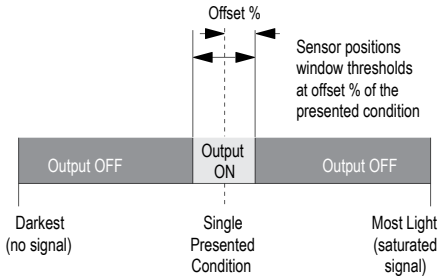
Window SET

- In Window SET, the single ON condition window extends above and below the presented condition by the user selectable offset percentage :
  - Self-contained models: 30% default
  - Opposed-mode models: 50% default
- Output ON and OFF conditions may be reversed by changing the Light/Dark Operate setting.
- Lighter or darker conditions outside of the window cause the output to change state.
- Window SET is recommended for applications where the target to be sensed may not always appear in the same place, or when other unwanted signals may appear.

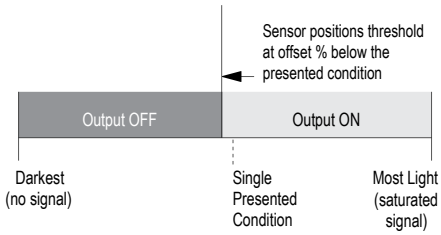
Window SET



Light SET

- Light SET sets a threshold below the presented condition by the user-selectable offset percentage:
  - Self-contained models: 30% default
  - Opposed-mode models: 50% default
- Any condition darker than the threshold causes the output to change state.
- In Light Operate mode, the presented condition is the Output ON condition. In Dark Operate mode, the presented condition is the Output OFF condition. Reverse the Output ON and OFF conditions by changing the Light / Dark Operate setting.
- Light SET is recommended for applications where only one condition is known, for example a stable light background with varying darker targets, or in retroreflective applications.

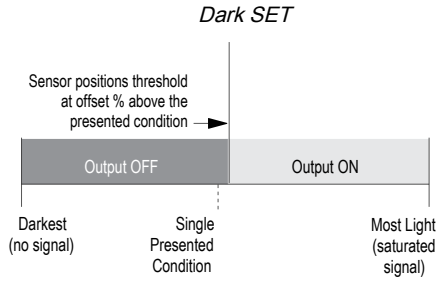
Light SET



Dark SET

- Dark SET sets a threshold above the presented condition by the user-selectable offset percentage
  - Self-contained models: 30% default
  - Opposed-mode models: 50% default
- Any condition lighter than the threshold causes the output to change state.
- In Light Operate mode, the presented condition is the Output OFF condition. In Dark Operate mode, the presented condition is the Output ON condition. Reverse the Output ON and OFF conditions by changing the Light / Dark Operate setting.
- Dark SET is recommended for applications where only one condition is known, for example a stable dark background with varying lighter targets, or when maximum excess gain is required.

Dark SET



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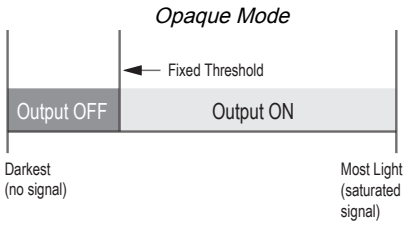
Opposed-Mode Models: Opaque Mode

Opaque mode is recommended for long-range detection of opaque (light-blocking) targets. When Opaque mode is used, the sensor operates at maximum sensing range regardless of the taught condition.



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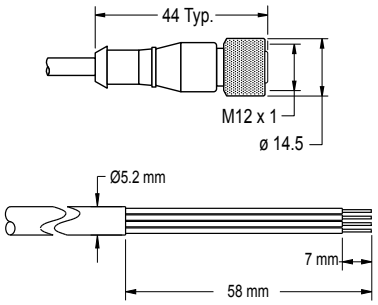
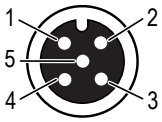
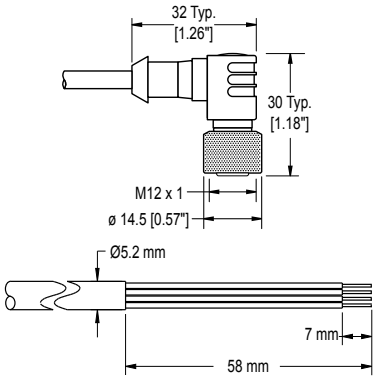
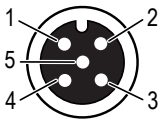
Chapter 4 Accessories

Cordsets

Use the M12 cordsets with the QS18 models with an M12 quick disconnect connector. Use the M8 cordsets with the QS18 models with an M8 QD.

4-pin Single-Ended M12 Female Cordsets (datasheet p/n 235937)				
Model	**Length**	**Dimensions (mm)**	**Pinout (Female)**	
BC-M12F4-22-1	1 m (3.28 ft)			1 = Brown 2 = White 3 = Blue 4 = Black 5 = Unused c UL us LISTED
BC-M12F4-22-2	2 m (6.56 ft)			
BC-M12F4-22-5	5 m (16.4 ft)			
BC-M12F4-22-8	8 m (26.25 ft)			
BC-M12F4-22-10	10 m (30.81 ft)			
BC-M12F4-22-15	15 m (49.2 ft)			
BC-M12F4-22-20	20 m (65.61 ft)			
BC-M12F4-22-25	25 m (82.02 ft)			
BC-M12F4-22-30	30 m (98.42 ft)			

4-pin Single-Ended M12 Female Right-Angle Cordsets (datasheet p/n 235937)				
Model	**Length**	**Dimensions (mm)**	**Pinout (Female)**	
BC-M12F4A-22-1	1 m (3.28 ft)			1 = Brown 2 = White 3 = Blue 4 = Black 5 = Unused c UL us LISTED
BC-M12F4A-22-2	2 m (6.56 ft)			
BC-M12F4A-22-5	5 m (16.4 ft)			
BC-M12F4A-22-8	8 m (26.25 ft)			
BC-M12F4A-22-10	10 m (30.81 ft)			
BC-M12F4A-22-15	15 m (49.2 ft)			

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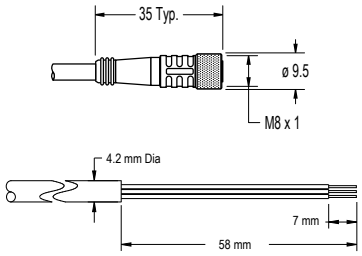
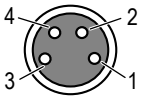
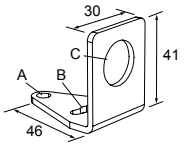
4-pin Single-Ended M8 Female Cordsets (datasheet p/n 236623)				
Model	**Length**	**Dimensions (mm)**	**Pinout (Female)**	
BC-M8F4-24-0.5	0.5 m (1.64 ft)			1 = Brown 2 = White 3 = Blue 4 = Black c UL us LISTED
BC-M8F4-24-1	1 m (3.28 ft)			
BC-M8F4-24-2	2 m (6.56 ft)			
BC-M8F4-24-5	5 m (16.4 ft)			
BC-M8F4-24-8	8 m (26.25 ft)			
BC-M8F4-24-10	10 m (30.81 ft)			

Brackets

SMB18A

- Right-angle mounting bracket with a curved slot for versatile orientation
- 12-ga. stainless steel
- 18 mm sensor mounting hole
- Clearance for M4 (#8) hardware
- CAD Files: DXF, PDF, IGS, STP

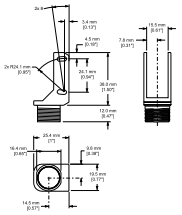
Hole center spacing: A to B = 24.2
Hole size: A = ø 4.6, B = 17.0 × 4.6, C = ø 18.5



SMBQS18Y

- Die-cast bracket for 18 mm holes
- Includes metal hex nut and lock washer
- Allows ± 8° for cabled sensors
- CAD Files: DXF, PDF, IGS, STP

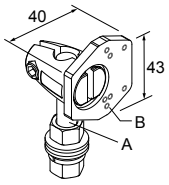
Hole size: A = ø 15.3



SMBQ4X..

- Swivel bracket with tilt and pan movement for precision adjustment
- Easy sensor mounting to extruded rail T-slots
- Metric and inch size bolts are available
- Side mounting of some sensors with the 3 mm screws included with the sensor
- SMBQ4XFA CAD Files: DXF, PDF, IGS, STP
- SMBQ4XFAM10 CAD Files: DXF, PDF, IGS, STP

B = 7 × M3 × 0.5
Bolt thread (A): 3/8 - 16 × 2¼ in for SMBQ4XFA; M10 - 1.5 × 50 for SMBQ4XFAM10; n/a; no bolt included. Mounts directly to 12 mm (½ in) rods for SMBQ4XFMA1



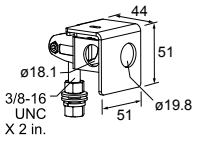
SMB18AFA..

- Protective, swivel bracket with tilt and pan movement for precision adjustment
- Easy sensor mounting to extruded rail T-slots
- Metric and inch size bolts available
- Mounting hole for 18 mm sensors

Hole size: B = ø 18.1

Bolt Thread (A):

SMB18AFA = 3/8 - 16 × 2 in
CAD Files: DXF, PDF, IGS, STP
SMB18AFAM10 = M10 - 1.5 × 50
CAD Files: IGS, STP



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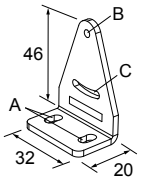
SMB312S

- Stainless steel 2-axis, side-mount bracket
- CAD Files: DXF, PDF, IGS, STP

A = 4.3 × 7.5, B = diam. 3, C = 3 × 15.3



Retroreflectors

For use with self-contained LP models.

BRT-51X51BM

- Square, acrylic target
- Reflectivity Factor: 1.5
- Temperature: –20 °C to +50 °C (–4 °F to +122 °F)
- Micro-prism geometry
- Optional brackets are available
- Reflector size: 51 mm × 51 mm
- Approximate size: 51 mm × 61 mm × 6.2 mm
- Two 4.6 mm diameter slots for mounting
- CAD Files: DXF, PDF, IGS, STP



BRT-60X40C and **BRT-60X40CM** (Microprism)

- Rectangular, acrylic target
- Reflectivity Factor: 1.4
- Temperature: –20 °C to +60 °C (–4 °F to +140 °F)
- Optional brackets are available
- Approximate size: 40 mm × 60 mm
- **BRT-60X40C** CAD Files: DXF, PDF, IGS, STP
- **BRT-60X40CM** CAD Files: DXF, PDF, IGS, STP



BRT-92X92C

- Square, acrylic target
- Reflectivity Factor: 3.0
- Temperature: –20 °C to +60 °C (–4 °F to +140 °F)
- Optional brackets are available
- Reflector size: 92 mm × 92 mm
- Approximate size: 100 mm × 100 mm × 9 mm
- Two 3.5 mm diameter mounting holes
- CAD Files: DXF, PDF, IGS, STP



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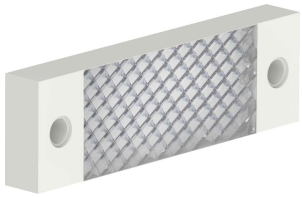
BRT-40X19A

- Rectangular, acrylic target
- Reflectivity Factor: 1.3
- Temperature: –20 °C to +60 °C (–4 °F to +140 °F)
- Reflector size: 18 mm × 40 mm
- Approximate size: 18 mm × 60 mm × 7.3 mm
- Two 4 mm diameter mounting holes, 50 mm centers
- CAD Files: DXF, PDF, IGS, STP



BRT-84

- Round, acrylic target
- Reflectivity Factor: 1.4
- Temperature: –20 °C to +60 °C (–4 °F to +140 °F)
- Optional brackets are available
- Size: 84 mm diameter
- Mounting Hole: 4.5 mm diameter
- CAD files: DXF, PDF, IGS, STP



2-inch retroreflective tape, 2.5 m (100 in)

Model	Reflectivity Factor	Maximum Temperature	Size
BRT-THG-2-100	0.7	+60 °C (+140 °F)	50 mm (2 in) wide, 2.5 m (100 in) long

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Chapter 5 Product Support and Maintenance

Discontinued Models

The following models are no longer available for order but are still covered by the information in this document.

Models	Sensing Mode	Connection
QS18EK6LPQ	Polarized retroreflective	150 mm (6 in) PVC cable model with a 4-pin M8 quick disconnect model
QS18EK6DQ	Diffuse (infrared)	150 mm (6 in) PVC cable with a 4-pin M8 QD
QS18EK6CV15Q	Convergent	150 mm (6 in) PVC cable with a 4-pin M8 QD
QS18EK6CV15Q8	Convergent (16 mm range)	4-pin M12 QD
QS18EK6CV45Q	Convergent (43 mm range)	150 mm (6 in) PVC cable with a 4-pin M8 QD
QS18EK6CV45Q5		150 mm (6 in) PVC cable model with a 4-pin M12 QD
QS18EK6CV45Q7		4-pin M8 QD
QS18EK6CV45Q8		4-pin M12 QD
QS18EK6FPQ8	Plastic fiber option	4-pin M12 QD

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