Q3X Laser Contrast Sensor Quick Start Guide

Product Description

Laser Expert™ diffuse sensor with bipolar (one PNP and one NPN) output.

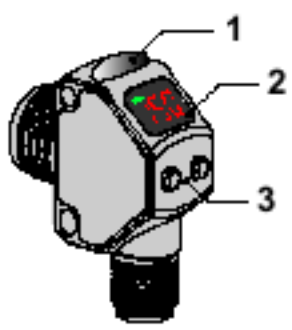
This guide is designed to help you set up and install the Q3X Laser Contrast Sensor. For complete information on programming, performance, troubleshooting, dimensions, and accessories, please refer to the Product Manual at www.bannerengineering.com. Search for part number 181485 to view the Product Manual. Use of this document assumes familiarity with pertinent industry standards and practices.

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.

Features

Sensor Features



1. Output Indicator (Amber)
2. Display
3. Buttons

Display and Indicators

Display in Run Mode

1. Stability Indicator (STB = Green)
2. Active TEACH Indicators
   - DYN = Dynamic TEACH selected (Amber)
   - WND = Symmetric window thresholds are active (Amber)

In Run mode, the 3-digit, 7-segment display provides real time information about signal strength for all models and target position for models with a fixed background suppression distance. The numeric value of 0 to 990 represent the amount of the received light divided by the threshold and represents the excess gain of the sensing event expressed as a percentage of the switch point. This value is called normalized signal strength (NSS). A NSS display range of 999 indicates a saturated received light signal, meaning that low contrast detection is not possible.

In single threshold teach modes (Two-Point Static, Dynamic, Light Set, or Dark Set), the output switches at a displayed value of 100 (excess gain of 1.0).

For models with a specified background suppression distance, CUt indicates that a target is present at a distance beyond the background suppression distance and is being suppressed. In Light Operate mode, the output switches off when CUt displays. For the background suppression models, the sensor's output state when displaying CUt can be controlled using the CtO menu. By default, the sensor treats a target in the background as a dark signal and honors the LO/DO selection.

A displayed value of - - - indicates no light received or a loss of signal.

In Window Set teach mode, the value 100 represents the taught signal strength. The displayed value is the percentage of the received light divided by the taught signal strength. The output switches at displayed values above and below 100 as determined by the user-selected window offset percentage.

Output Indicator

Original Instructions
07-Nov-25

181486
p/n: 181486 Rev. G

- On—Outputs conducting (closed)
- Off—Outputs not conducting (open)

Stability Indicator (STB)

- On—Stable light signal received
- Flashing—Light intensity is within the switching threshold hysteresis band
- Off—No light signal received

Active TEACH Indicators (DYN and WND)

- DYN and WND off—Two-Point Static , Light Set, or Dark Set TEACH mode selected (Two-Point Static TEACH is the default).
- DYN and/or WND flashing—The sensor is in TEACH mode.
- DYN on—Dynamic TEACH mode selected
- WND on—Symmetric Window thresholds are active. The switch points are above and below 100 by the offset percentage

Buttons

Use the sensor buttons (-)(MODE) and (+)(TEACH) to program the sensor. See "Sensor Programming" on page 5 for programming instructions.

(-)(MODE)

- Decrease gain: press and release (-)(MODE), then press and hold (-)(MODE) to rapidly decrease gain
- Enter Setup mode: press and hold (-)(MODE) for longer than 2 seconds
- Navigate the sensor menu: press (-)(MODE)
- Change setting values: press and hold (-)(MODE) to decrease numeric values

(+)(TEACH)

- Increase gain: press and release (+)(TEACH), then press and hold (+)(TEACH) to rapidly increase gain
- Start the currently selected TEACH mode: press and hold (+)(TEACH) for longer than 2 seconds (Two-Point Static TEACH is the default)
- Navigate the sensor menu: press (+)(TEACH)
- Change setting values: press and hold (+)(TEACH) to increase numeric values

(-)(MODE) and (+)(TEACH)

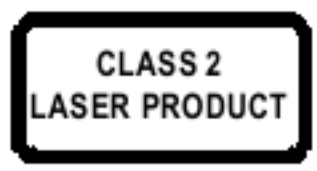
- Select menu items in Setup mode: press (-)(MODE) and (+)(TEACH) simultaneously
- Select and save a parameter and return to Run mode: press (-)(MODE) and (+)(TEACH) simultaneously for longer than 2 seconds

When navigating the menu systems, the menu items loop.

Class 2 Laser Description and Safety Information

Laser light. Do not stare into the beam.

Complies with 21 CFR 1040.10 and 1040.11 except for deviations pursuant to Laser Notice No. 56, dated May 8, 2019.



CAUTION:

- Never stare directly into the sensor lens.
- Laser light can damage your eyes.
- Avoid placing any mirror-like object in the beam. Never use a mirror as a retroreflective target.

CAUTION:

- Return defective units to the manufacturer.
- Use of controls or adjustments or performance of procedures other than those specified herein may result in hazardous radiation exposure.
- Do not attempt to disassemble this sensor for repair. A defective unit must be returned to the manufacturer.

CAUTION:
- Ne regardez jamais directement la lentille du capteur.
- La lumière laser peut endommager la vision.
- Évitez de placer un objet réfléchissant (de type miroir) dans la trajectoire du faisceau. N'utilisez jamais de miroir comme cible rétro-réfléchissante.

CAUTION:
- Tout dispositif défectueux doit être renvoyé au fabricant.
- L'utilisation de commandes, de réglages ou de procédures autres que celles décrites dans le présent document peut entraîner une exposition dangereuse aux radiations.
- N'essayez pas de démonter ce capteur pour le réparer. Tout dispositif défectueux doit être renvoyé au fabricant.

Class 2 lasers are lasers that emit visible radiation in the wavelength range from 400 nm to 700 nm, where eye protection is normally afforded by aversion responses, including the blink reflex. This reaction may be expected to provide adequate protection under reasonably foreseeable conditions of operation, including the use of optical instruments for intrabeam viewing.

Complies with IEC 60825-1:2014 and EN 60825-1:2014+A11:2021.

Class 2 Laser Safety Notes . Low-power lasers are, by definition, incapable of causing eye injury within the duration of a blink (aversion response) of 0.25 seconds. They also must emit only visible wavelengths (400 nm to 700 nm). Therefore, an ocular hazard may exist only if individuals overcome their natural aversion to bright light and stare directly into the laser beam.

For safe laser use:
- Do not stare at the laser.
- Do not point the laser at a person's eye.
- Mount open laser beam paths either above or below eye level, where practical.
- Terminate the beam emitted by the laser product at the end of its useful path.

IMPORTANT: This laser device is not bore-sighted.

Class 2 Laser Characteristics
Output power: < 0.42 mW
Laser wavelength: 655 nm
Pulse duration: 5 µs

Installation

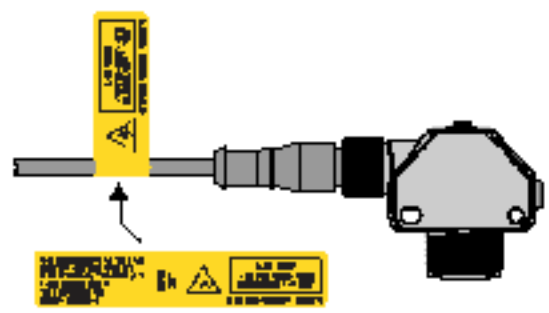
Install the Safety Label

The safety label must be installed on Q3X sensors that are used in the United States.

NOTE: Position the label on the cable in a location that has minimal chemical exposure.

1. Remove the protective cover from the adhesive on the label.
2. Wrap the label around the Q3X cable, as shown.
3. Press the two halves of the label together.

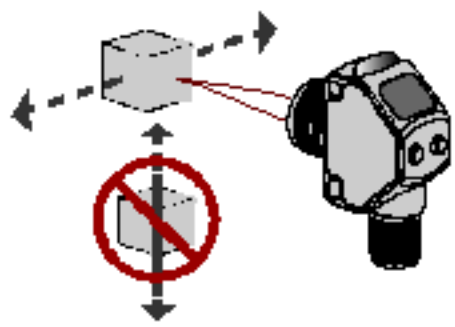
Safety Label Installation



Sensor Orientation

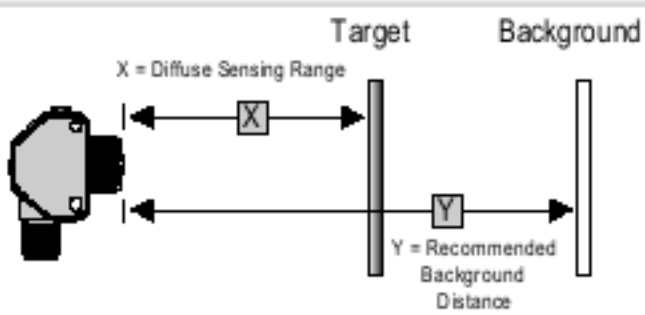
Correct sensor-to-target orientation is important to ensure proper sensing. To ensure reliable detection, orient the sensor as shown in relation to the target to be detected.
For models with background suppression, make sure the intended target is inside of the contrast sensing range and that any background objects are positioned beyond the background suppression distance.

Optimal Orientation of Target to Sensor



Sensor-to-Background Position

Q3XBLD Contrast Detection versus Background Suppression

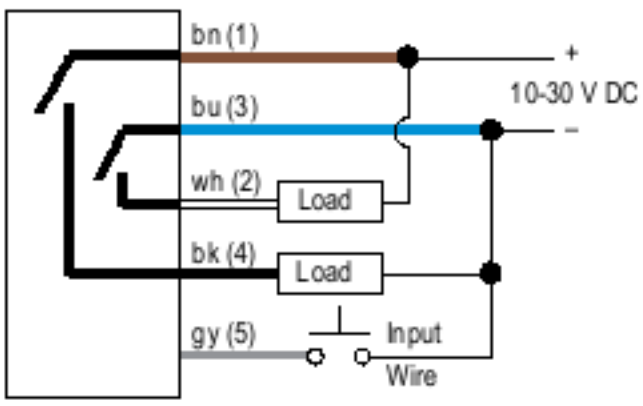


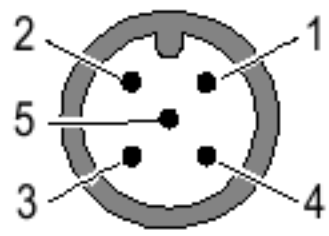
Model Number	X	Y
LD50	50 mm (1.97 in)	60 mm (2.36 in)
LD100	100 mm (3.94 in)	120 mm (4.72 in)
LD150	150 mm (5.91 in)	190 mm (7.48 in)
LD200	200 mm (7.87 in)	280 mm (11.02 in)

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 Diagram





Key
1 = Brown
2 = White
3 = Blue
4 = Black
5 = Gray

NOTE: Open lead wires must be connected to a terminal block.

NOTE: The input wire function is user-selectable; see the Instruction Manual for details. The default for the input wire function is off (disabled).

Sensor Programming

Program the sensor using the buttons on the sensor or the input wire (limited programming options; see the Instruction Manual for details).

In addition to programming the sensor, use the input wire to disable the buttons for security, preventing unauthorized or accidental programming changes. See the Instruction Manual for more information.

Setup Mode

1. Access Setup mode from Run mode by pressing and holding MODE for longer than 2 seconds.
2. Use ⊖ or ⊕ to navigate through the top menu.
3. Select the desired submenu by pressing ⊖ and ⊕ simultaneously.
4. Press ⊖ or ⊕ to view the available options in the submenu.
5. Select a submenu option.
   - Press ⊖ and ⊕ simultaneously to select and save a submenu option and return to the top menu.
   - Press ⊖ and ⊕ simultaneously for longer than 2 seconds to select and save a submenu option and return to Run mode.

NOTE: The current submenu selection is solid, all other selections flash.

To exit Setup mode from the top menu and return to Run mode, navigate to End and press ⊖ and ⊕ simultaneously, or press and hold ⊖ and ⊕ simultaneously for longer than 2 seconds to return to Run mode from anywhere in the top menu.

Basic TEACH Instructions

Use the following instructions to teach the Q3X sensor. The instructions provided on the sensor display vary depending on the type of TEACH mode selected. Two-point TEACH is the default TEACH mode.

1. Press and hold TEACH for longer than 2 seconds to start the selected TEACH mode.
2. Present the target.
3. Press TEACH to teach the target. The target is taught and the sensor waits for the second target, if required by the selected TEACH mode, or returns to Run mode.
   Complete steps 4 and 5 only if prompted by the sensor for the selected TEACH mode:
4. Present the second target.
5. Press TEACH to teach the target. The target is taught and the sensor returns to Run mode.

See the Instruction Manual for detailed instructions and other available TEACH modes.

Manual Adjustments

Manually increase or decrease gain using ⊖ or ⊕.

1. From Run mode, press either ⊖ or ⊕ one time. The current signal strength value flashes slowly.
2. Press ⊖ to decrease the sensor's gain or ⊕ to increase the sensor's gain, or press and hold ⊖ or ⊕ to rapidly decrease or increase gain. After 1 second, the normalized signal strength flashes rapidly, the new setting is accepted, and the sensor returns to Run mode.

Locking and Unlocking the Sensor Buttons

Use the lock and unlock feature to prevent unauthorized or accidental programming changes. There are three different settings available:

- uLc —The sensor is unlocked and all settings can be modified (default).
- Loc —The sensor is locked and no changes can be made.
- oLc —The switch point value can be changed by teaching or manual adjustment, but no sensor settings can be changed through the menu.

When in Loc mode, Loc displays when (-)(MODE) or (+)(TEACH) are pressed.

When in oLc mode, Loc displays when (-)(MODE) is pressed and held. To access the manual adjust options, briefly press and release (-)(MODE) or (+)(TEACH). To enter TEACH mode, press the (+)(TEACH) button and hold for longer than 2 seconds.

To enter LOC mode, hold ⊕ and press ⊖ four times. To enter OLC mode, hold ⊕ and press ⊖ seven times. Holding ⊕ and pressing ⊖ four times unlocks the sensor from either lock mode and the sensor displays ULC.

Specifications

Sensing Beam
Visible red Class 2 laser, 655 nm

Supply Voltage (Vcc)
10 V DC to 30 V DC

Power and Current, exclusive of load
Supply Power: < 675 mW
Current consumption: < 28 mA at 24 V DC

Supply Protection Circuitry
Protected against reverse polarity and transient overvoltages

Repeatability
60 µs

Delay at Power Up
1 s

Maximum Torque
Side mounting: 1 N·m (9 in·lbs)
Nose mounting: 10 N·m (88 in·lbs)

Connector
5-pin M12 Integral Connector

Input Wire
Allowable Input Voltage Range: 0 to Vcc
Active Low (internal weak pullup—sinking current): Low State < 2.0 V at 1 mA max.

Output Configuration
Bipolar (1 PNP & 1 NPN) output

Output Rating
Discrete Output: 100 mA maximum (protected against continuous overload and short circuit)
Off-state Leakage Current: < 10 µA
NPN On-state saturation voltage: < 200 mV at 10 mA and < 1.0 V at 100 mA
PNP On-state saturation voltage: < 1 V at 10 mA and < 2.0 V at 100 mA

Ambient Light Immunity
> 5000 lux

Response Speed
User selectable:
- 250—250 microseconds
- 1.5—1 millisecond
- 5.5—5 milliseconds

Operating Conditions
Temperature: –10 °C to +50 °C (+14 °F to +122 °F)
Humidity: 35% to 95% relative humidity

Environmental Rating
IP67 per IEC60529
IP68 per IEC60529
IP69K per ISO 20653 per DIN40050-9

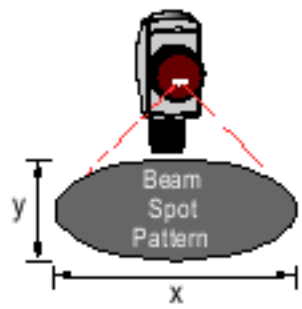
Sensing Range

Sensing Range

Model	Contrast Sensing Range	Background Suppression Distance
Q3XTBLD-Q8	0 to 300 mm (11.81 in)	Not Applicable
Q3XTBLD50-Q8	0 to 50 mm (1.97 in)	60 mm (2.36 in)
Q3XTBLO100-Q8	0 to 100 mm (3.94 in)	120 mm (4.72 in)
Q3XTBLO150-Q8	0 to 150 mm (5.91 in)	190 mm (7.48 in)
Q3XTBLO200-Q8	0 to 200 mm (7.87 in)	280 mm (11.02 in)

Construction
Housing: Nickel-plated zinc die-cast
Side cover: Nickel-plated aluminum
Lens cover: Scratch-resistant PMMA acrylic
Lightpipes and display window: Polysulfone
Adjustment buttons: 316 stainless steel

Beam Spot Size



Models LD, LD100, LD150, LD200

	Distance					
	20 mm	50 mm	100 mm	150 mm	200 mm	300 mm
X	5.9 mm	5.6 mm	5.1 mm	4.6 mm	4.1 mm	3.0 mm
Y	2.3 mm	2.1 mm	1.9 mm	1.6 mm	1.5 mm	1.2 mm

Model LD50

	Distance	
	20 mm	50 mm
X	4.8 mm	3.4 mm
Y	2.0 mm	1.4 mm

Vibration
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), with device operating

Shock
MIL-STD-202G, Method 213B, Condition I (100G 6x along X, Y, and Z axes, 18 shocks), with device operating

Storage Temperature
–25 °C to +75 °C (–13 °F to +167 °F)

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

Certifications

Industrial Control Equipment 3TJJ

Class 2 power

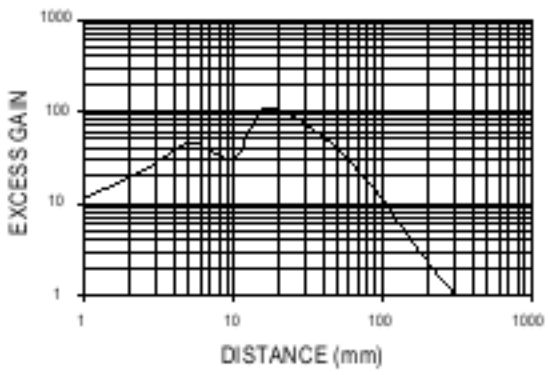
Performance Curves

Performance is based on a 90% reflectance white test card.

NOTE: For high sensitivity, the excess gain increases by a factor of 1.5. For low sensitivity, the excess gain decreases by a factor of 0.75

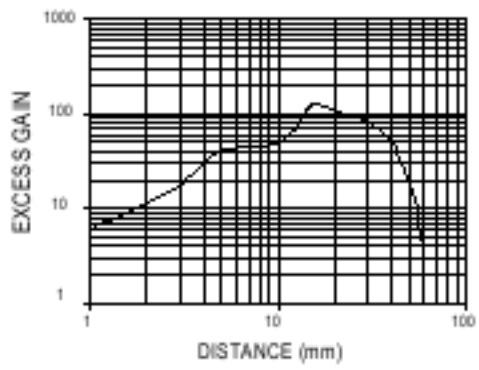
Q3XTBLD Models

Excess Gain for Standard Sensitivity



Q3XTBLD50 Models

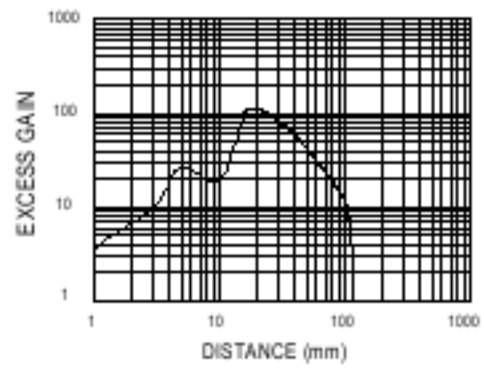
Excess Gain for Standard Sensitivity



For LD50 and LD100 models, the sensing cut-off distance of a 6% reflective black card will be 95% of the sensing cut-off distance of a 90% reflective white card.

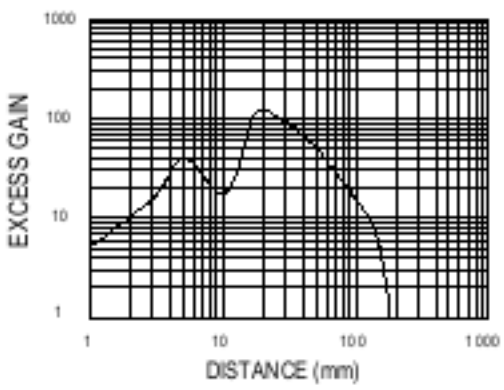
Q3XTBLD100 Models

Excess Gain for Standard Sensitivity



Q3XTBLD150 Models

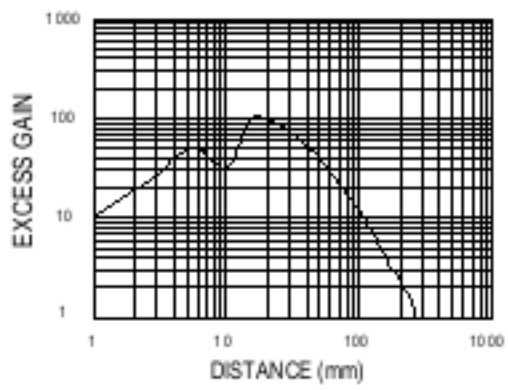
Excess Gain for Standard Sensitivity



For 150 mm models, the sensing cut-off distance for a 6% reflective black card will be 65% of the sensing cut-off distance of a 90% reflective white card.

Q3XTBLD200 Models

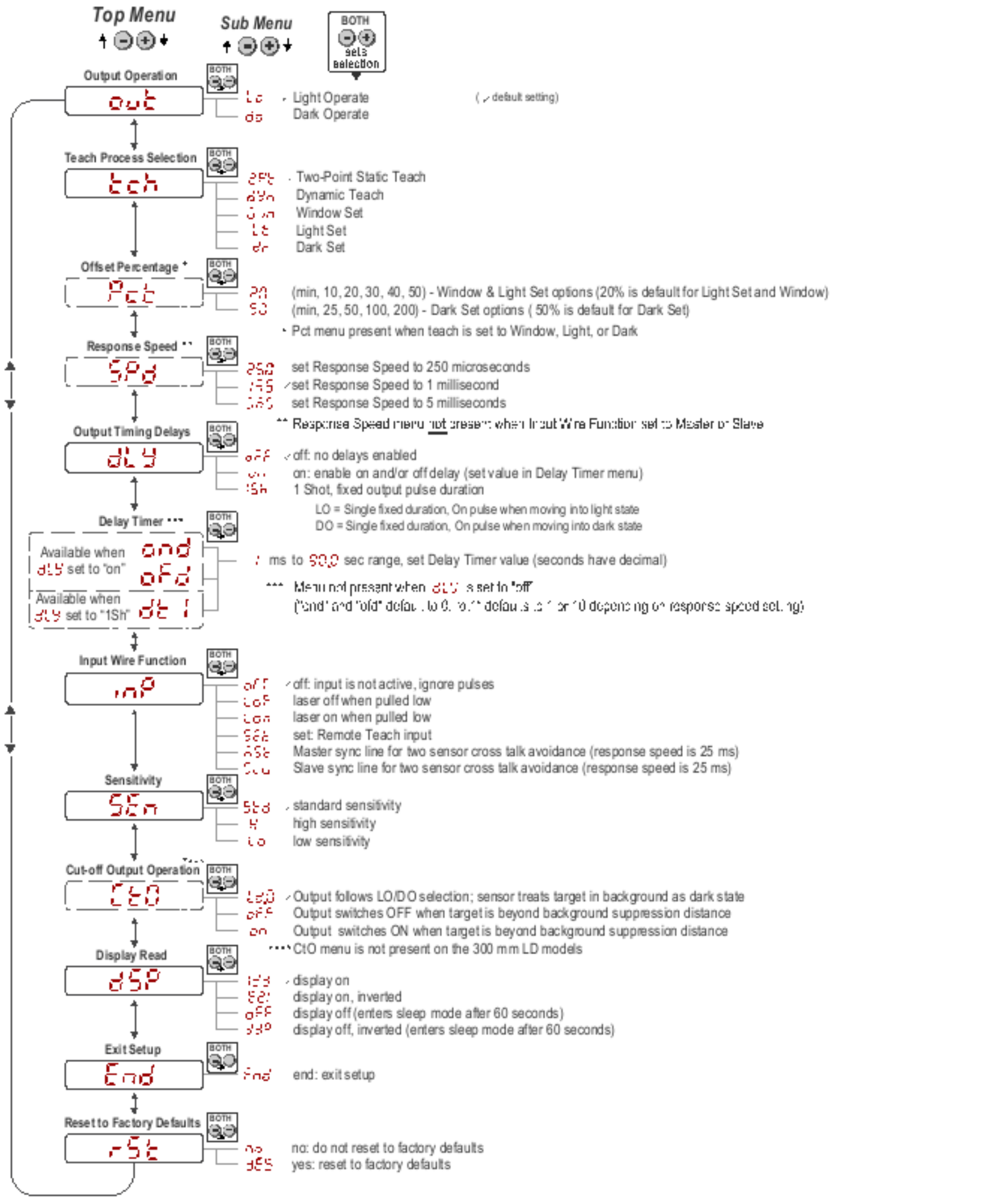
Excess Gain for Standard Sensitivity



For 200 mm models, the sensing cut-off distance for a 6% reflective black card will be 50% of the sensing cut-off distance of a 90% reflective white card.

Sensor Menu Map

Setup Mode Menu Map



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