

## Features

No revision without agency approval.

To view or download the latest technical information about this product, including specifications, dimensions, accessories, and wiring, go to [www.bannerengineering.com](http://www.bannerengineering.com).



- Designed for use with approved amplifiers and intrinsically safe barriers in explosive environments
- NAMUR compliant sensor with the rugged design and exceptional optical performance of Q45 series sensors
- Output passes  $\leq 1.2$  mA in the “dark” condition and  $\geq 2.1$  mA in the “light” condition
- Internal multi-turn SENSITIVITY (Gain) control accessible beneath hinged, o-ring sealed top cover
- Models are available with an integral cable or a quick-disconnect connector
- Supply voltage: 5 to 15 V DC

### 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.

## Q45AD9 NAMUR Models

Standard 2 m (6.5 ft) cable models are listed. To order the 9 m (30 ft) cable model, add suffix "W/30" to the cabled model number (Q459E W/30). Models with a QD connector require a mating cable (see Accessories list).

### Opposed Models - Emitter (E) and Receiver (R)

| Models   | Cable        | Performance                                   | Output Type   |
|----------|--------------|---|---|
| Q459E    | 2 m (6.5 ft) | 880 nm, infrared<br>Range: 6 meters (20 feet) | Constant current<br>$\leq 1.2$ mA dark<br>$\geq 2.1$ mA light |
| Q459EQ   | 4-pin M12 QD |   |   |
| Q45AD9R  | 2 m (6.5 ft) |   |   |
| Q45AD9RQ | 4-pin M12 QD |   |   |

## Retroreflective Models

Retroreflective range is specified using one model BRT-3 P retroreflector (3-inch diameter). Actual sensing range may be more or less than specified, depending upon the efficiency and reflective area of the retroreflector(s) in use.

| Non-Polarized Models | Cable        | Performance                               | Output Type   |
|----------------------|--------------|---|---|
| Q45AD9LV             | 2 m (6.5 ft) | 680 nm, visible red<br>Range: 9 m (30 ft) | Constant Current<br>$\leq 1.2$ mA dark<br>$\geq 2.1$ mA light |
| Q45AD9LVQ            | 4-pin M12 QD |   |   |

| Polarized Models | Cable        | Performance                               | Output Type   |
|------------------|--------------|---|---|
| Q45AD9LP         | 2 m (6.5 ft) | 680 nm, visible red<br>Range: 6 m (20 ft) | Constant Current<br>$\leq 1.2$ mA dark<br>$\geq 2.1$ mA light |
| Q45AD9LPQ        | 4-pin M12 QD |   |   |

## Diffuse Models

Performance curves are based on a 90% reflectance white test card.

| Short Range Models | Cable        | Performance                               | Output Type   |
|--------------------|--------------|---|---|
| Q45AD9D            | 2 m (6.5 ft) | 880 nm, infrared<br>Range: 300 mm (12 in) | Constant Current<br>≤ 1.2 mA dark<br>≥ 2.1 mA light |
| Q45AD9DQ           | 4-pin M12 QD |   |   |

| Long Range Models | Cable        | Performance                            | Output Type   |
|-------------------|--------------|--|---|
| Q45AD9DL          | 2 m (6.5 ft) | 880 nm, infrared<br>Range: 1 m (40 in) | Constant Current<br>≤ 1.2 mA dark<br>≥ 2.1 mA light |
| Q45AD9DLQ         | 4-pin M12 QD |  |   |

## Convergent Models

Convergent mode models operate at 680 nm, visible red. Performance curves are based on a 90% reflectance white test card.

| Models     | Cable        | Focus  | Output Type   |
|------------|--------------|--|---|
| Q45AD9CV   | 2 m (6.5 ft) | 38 mm (1.5 in)<br>Spot size at focus: 1.3 mm (0.05 in) | Constant Current<br>≤ 1.2 mA dark<br>≥ 2.1 mA light |
| Q45AD9CVQ  | 4-pin M12 QD |  |   |
| Q45AD9CV4  | 2 m (6.5 ft) | 100 mm (4 in)<br>Spot size at focus: 1.5 mm (0.06 in)  | Constant Current<br>≤ 1.2 mA dark<br>≥ 2.1 mA light |
| Q45AD9CV4Q | 4-pin M12 QD |  |   |

## Plastic Fiber Optic Models

Performance curves are based on a 90% reflectance white test card.

| Models    | Cable        | Performance  | Output Type   |
|-----------|--------------|--|---|
| Q45AD9FP  | 2 m (6.5 ft) | 660 nm, visible red<br>Range: varies by sensing mode and fiber optics used | Constant Current<br>≤ 1.2 mA dark<br>≥ 2.1 mA light |
| Q45AD9FPQ | 4-pin M12 QD |  |   |

## Glass Fiber Optic Models

Performance curves are based on a 90% reflectance white test card.

| Models   | Cable        | Performance   | Output Type   |
|----------|--------------|---|---|
| Q45AD9F  | 2 m (6.5 ft) | 880 nm, infrared<br>Range: varies by sensing mode and fiber optics used | Constant Current<br>≤ 1.2 mA dark<br>≥ 2.1 mA light |
| Q45AD9FQ | 4-pin M12 QD |   |   |

| Models    | Cable        | Performance  | Output Type   |
|-----------|--------------|--|---|
| Q45AD9FV  | 2 m (6.5 ft) | 650 nm, visible red<br>Range: varies by sensing mode and fiber optics used | Constant Current<br>≤ 1.2 mA dark<br>≥ 2.1 mA light |
| Q45AD9FVQ | 4-pin M12 QD |  |   |

## Q45AD9 NAMUR Sensor Overview

The Q45AD9 Series NAMUR Sensor is a rugged, self-contained two-wire sensor designed for use with certified intrinsically safe switching amplifiers and barriers (Approved Apparatus) with intrinsically safe circuits.

The Q45AD9 Series NAMUR sensor is designed in accordance with DIN 19234 (IEC/EN 60947-5-6) for operation via two-wire connection to an Approved Apparatus controlled by the variable internal resistance of the sensor.

The sensor varies the impedance across the sensor output, which passes 1 mA or less in the "dark" condition and 2 mA or more in the "light" condition. A highly visible red LED indicator is located beneath a raised transparent dome on top of the sensor.

- SIGNAL—LED lights red when the sensor sees its modulated light source
- POWER (Emitters only)—LED lights red when 5 to 15 V dc power is applied

Multi-turn sensitivity control on top of sensor, beneath a transparent cover, allows precise sensitivity setting (turn clockwise to increase gain).

Models are available with either a 2 m (6.5 ft) or 9 m (30 ft) long attached PVC-covered cable, or a 4-pin M12/Euro-style quick disconnect (QD) connector. Quick disconnect models (with Q in the model number suffix) use MQD9-4.. mating cable (either straight or right angle connector; see "[Accessories](#)" on page 9). Contact Banner Engineering for the availability of sensor models with 9 m (30 ft) long attached cable.

# Installation Instructions

## Q45AD9 Ex/HazLoc Applications

### WARNING:



- **Explosive Atmospheres/Hazardous Locations**
- It is the user's responsibility to ensure that all local, state, and national laws, rules, codes, or regulations relating to the installation and use of this device in any particular application are satisfied. This device must be installed by a Qualified Person<sup>(1)</sup>, in accordance with this document and applicable regulations.

### WARNING:



- **Explosion Hazard**
- Do not disconnect equipment unless the power has been switched off or the area is known to be non-hazardous.

### CAUTION:



- **Electrostatic Discharge (ESD) Special Conditions for Safe Use**
- Parts of the enclosure are non-conducting and can generate an ignition-capable level of ESD.
- Clean the equipment with only a damp cloth.

### General Notes and Conditions for Use:

- See Specifications and Wiring Diagrams for important information concerning entity parameters, permissible locations, electrical connections and certifications.
- In addition to the warning above concerning user responsibility, the installation must comply with the following:
  - All installations must comply with all manufacturer's instructions.
  - U.S. Installations: The relevant requirements of the National Electrical Code® (ANSI/NFPA-70 (NEC®) and when appropriate ANSI/ISA-RP12.06.01 Installation of Intrinsically Safe Systems for Hazardous (Classified) Locations.
  - Canadian Installations: The relevant requirements of the Canadian Electrical Code (CSA C22.1).
  - ATEX and IECEx Installations: The relevant requirements of EN IEC 60079-14 and applicable National regulations.
  - For quick disconnect (QD) models only: Use Banner **MQD9-4##** cordsets (see "[Quick-Disconnect \(QD\) Cables](#)" on page 9), or suitable M12 quick disconnect cordsets with threaded retaining nut (see "[Q45AD9 Specifications](#)" on page 4). The cordset must be securely fastened using the M12x1 QD retaining nut to prevent disconnection. Maximum connector torque: 6 ft-lbs.
- Do not attempt any repairs to this device; it contains no field-replaceable parts or components. Tampering and/or replacement with non-factory components may adversely affect the safe use of the system.
- Approved Apparatus entity parameters must meet the following requirements:
  - $V_{oc}$  or  $V_t \leq V_{max}$
  - $C_a \geq C_i + C_{cable}$
  - $I_{sc}$  or  $I_t \leq I_{max}$
  - $L_a \geq L_i + L_{cable}$
- Sensor Entity Parameters:
  - $V_{max}(U_i) \leq 15$  V dc
  - $I_{max}(I_i) \leq 60$  mA
  - $P_i \leq 225$  mW
  - $C_i = 0.3$   $\mu$ F
  - $L_i = 0$  mH
- Cable Entity Parameters (if unknown):
  - $C_{cable} = 60$  pF/ft
  - $L_{cable} = 0.2$   $\mu$ H/ft
- The ambient operating temperature range of the Sensors is  $-40$  °C to  $+70$  °C ( $-40$  °F to  $+158$  °F).
- For U.S. installations, Class II and III, Division 2 applies only to model numbers ending in a Q suffix.
- For intrinsically safe installations, sensors must be used with certified intrinsically safe switching amplifiers and barriers (Approved Apparatus) with intrinsically safe circuits that limit supply voltage and current in the event of failures.
- Associated Apparatus is not required for installation of the devices within a Division 2 hazardous (classified) location when installed per the National Electrical Code. The maximum voltage for Division 2 installation is 15 V DC. In Division 2 installations (without Associated Apparatus), observe Explosion Hazard warning at the beginning of this section.
- Associated Apparatus is not required for installation of the devices within a Division 2 hazardous (classified) location when installed in, or through the wall of a suitable enclosure with provision for connection of rigid metal conduit per the Canadian Electrical Code, as acceptable to the local inspection authority having jurisdiction. The maximum rating for Division 2 installation is 15V dc, 60 mA. In Division 2 installations (without Associated Apparatus), observe Explosion Hazard warning at the beginning of this section.

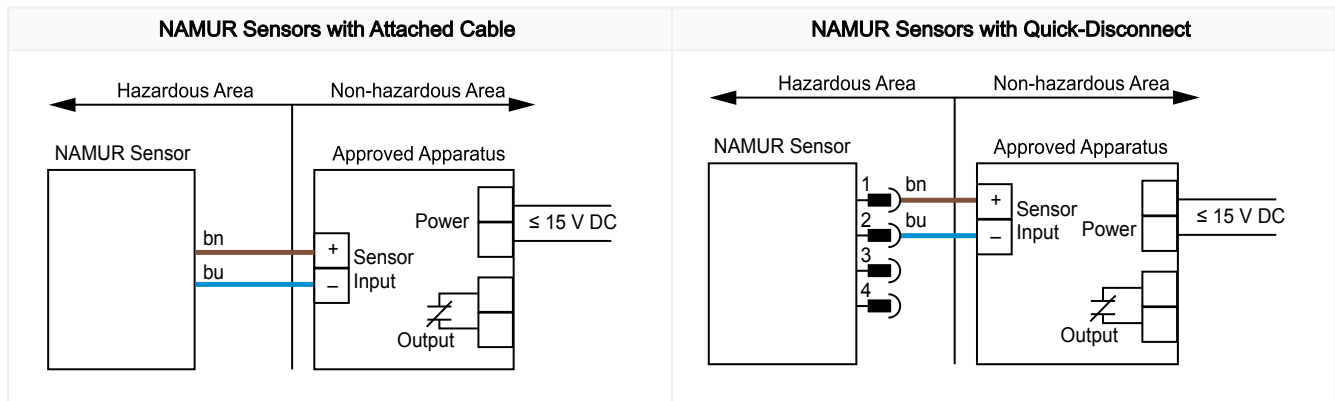
<sup>(1)</sup> A Qualified Person is a person who, by possession of a recognized degree or certificate of professional training, or who, by extensive knowledge, training and experience, has successfully demonstrated the ability to solve problems relating to the subject matter and work.

- Maximum non-hazardous area voltage that the Approved Apparatus (intrinsically safe circuit) is connected to must not exceed 250 V.
- Intrinsic safety ground, if required for the Associated Apparatus, shall be less than 1 ohm.

## Q45AD9 Wiring Connections

Q45AD9 Series NUMAR sensors are intrinsically safe ONLY when used with certified intrinsically safe switching amplifiers and barriers (Approved Apparatus) with intrinsically safe circuits. Banner does not manufacture such devices; however, our applications engineers can refer you to suppliers of certified devices that will interface with Banner sensors.

The user is responsible for proper installation and maintenance of this equipment and must conform with the certification requirements relating to barriers and to maximum allowable capacitance and inductance of the field wiring. If in doubt about these requirements, our applications engineers can refer you to the appropriate authority.



## Hydrocarbon Leak Detectors and Water Leak Detection (FM7745 Approval)

Models: **Q45AD9F(Q)** and **BTxxxSM900** Glass Fiber

Performance is compliant as a Hydrocarbon Leak Detector and as a Water Leak Detector when used with BTxxxSM900 glass fiber optic accessory.

### Application Notes:

- The installation must comply with all installation instructions contained in this document.
- The liquid to be detected must have an index of refraction different from that of air (i.e., typically not clear or colorless).
- The liquid to be detected must be non-viscous (so that it does not cling to the probe tip) for the optical principle of the probe to function correctly.
- The probe must be mounted a minimum of 50 mm (2 in) from a light-colored (e.g., white) or shiny (e.g., stainless steel) background to prevent false proxing in the presence of the fluid.
- The Q45AD9F(Q) gain adjustment must be used to set the excess gain to an acceptable level to ensure that the amount of internal probe reflection will reliably drop below the threshold level when fluid is present.
- When the sensor is configured correctly, the liquid contacting the tip causes the Q45 LED light to scatter into the liquid. This allows sensor to detect the liquid and cause a “dark” condition.
- Scheduled maintenance must include inspecting and cleaning the probe tip to prevent contamination (e.g. dust) from building up on the probe tip. If any damage to the probe tip or the fiber optic cable is found, the damaged item must be immediately replaced.

## Q45AD9 Specifications

### Supply Voltage and Current

5 to 15 V DC; Supply voltage is provided by the amplifier to which the sensor is connected.

### Adjustments

Multi-turn sensitivity control on top of sensor, beneath a transparent o-ring sealed cover, allows precise sensitivity setting (turn clockwise to increase gain).

### Output

Constant current output:  $\leq 1.2$  mA in the “dark” condition and  $\geq 2.1$  mA in the “light” condition

### Output Response Time

Opposed mode receiver: 2 milliseconds on/0.4 milliseconds off. All others 5 milliseconds on/off (does not include amplifier response)

### Construction

Molded thermoplastic polyester housing, o-ring sealed transparent Lexan® top cover, molded acrylic lenses, and stainless steel hardware. Q45s are designed to withstand 1200 psi washdown. The base of cabled models has a 1/2-inch NPS integral internal conduit thread. <sup>(1)</sup>

### Environmental Rating

Banner tested to NEMA 6P, IEC IP67

### Application Note

Special Conditions for Safe Use: Parts of the enclosure are non-conducting and may generate an ignition-capable level of ESD. Cleaning of the equipment must be done only with a damp cloth.

<sup>(1)</sup> Lexan® is a registered trademark of General Electric Co.

**Indicators**

Indicator LEDs are highly visible, located beneath a raised transparent dome on top of the sensor.

POWER (red) LED (emitters only) lights whenever 5 to 15 V DC power is applied

SIGNAL (red) LED lights whenever the sensor sees its modulated light source

**Operating Conditions**

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

Maximum relative humidity: 90% at 50 °C (non-condensing)

**Connections**

PVC-jacketed 2 m (6.5 ft) or 9 m (30 ft) cables, or 4-pin M12 quick-disconnect (QD) fitting are available. QD cables are ordered separately. See "[Quick-Disconnect \(QD\) Cables](#)" on page 9.

Connecting 4-pin M12 QD Cordsets (see "[Quick-Disconnect \(QD\) Cables](#)" on page 9): Female single-ended Multiconductor cable (at minimum): UL Style 2517, 24 AWG wire, rated ≥ 80 °C; M12 QD connector: per IEC 61076-2-101, must have threaded M12 × 1 retaining nut.

**Certifications**



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1831 Diegem, BELGIUM



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



Exia  
NRTL/C



IEC IECEx FMG 14.0029X  
ATEX FM12ATEX0094X  
FM21UKEX0211X  
FM20US0068X CoC 0003046293 (US)  
FM20CA0032X CoC 0003046293C (CAN)  
CCC 2020012315326173

| Design Standards |   |
|------------------|---|
| ATEX (European)  | EN IEC 60079-0, EN 60079-11   |
| Canada           | CAN/CSA C22.2: No.0-M91, No.142-M1987, No.157-92, No.213-M1987, No.1010.1, E60079-0 and E60079-11 |
| United States    | FM Class 3600, 3610, and 3810; ANSI/ISA 61010-1 (82.02.01), 60079-0 and 60079-11                  |
| IECEx            | IEC 60079-0, IEC 60079-11   |

| Approvals                         |  |
|-----------------------------------|--|
| <b>Q45AD9(a)(b),<br/>Q459E(b)</b> | a = Sensing mode D, DL, F, FP, FV, LV, LP, CV, CV4 or R.<br>b = Connection method Q or blank   |
| ATEX (European)                   | II 1 G Ex ia IIC T5 Ga Ta = -40°C to 70°C - 38343; Entity<br>Entity Parameters: U <sub>i</sub> = 15 V DC, I <sub>i</sub> = 60 mA, P <sub>i</sub> = 225 mW, C <sub>i</sub> = 0.3 µF, L <sub>i</sub> = 0 mH.   |
| Canadian                          | IS / I,II,III / 1 / ABCDEFG / T5 Ta = -40°C to 70°C - 38343; Entity<br>I / 0 / Ex ia / IIC / T5 Ta = -40°C to 70°C - 38343; Entity<br>(Non-incendive) NI / I / 2 / ABCD / T5 Ta = -40°C to 70°C<br>Entity Parameters: V <sub>Max</sub> = 15 V DC, I <sub>Max</sub> = 60 mA, P <sub>i</sub> = 225 mW, C <sub>i</sub> = 0.3 µF, L <sub>i</sub> = 0 mH  |
| United States                     | IS / I,II,III / 1 / ABCDEFG / T5 Ta = -40°C to 70°C - 38343; Entity<br>I / 0 / AEx ia / IIC / T5 / Ga Ta = -40°C to 70°C - 38343; Entity<br>(Non-incendive) NI / I / 2 / ABCD / T5 Ta = -40°C to 70°C<br>S / II,III / 2 / FG* / T5 Ta = -40°C to 70°C<br>*Class II and III, Division 2 applies only to model numbers ending in a Q suffix.<br>Entity Parameters: V <sub>Max</sub> = 15 V DC, I <sub>Max</sub> = 60 mA, P <sub>i</sub> = 225 mW, C <sub>i</sub> = 0.3 µF, L <sub>i</sub> = 0 mH |
| IECEx                             | Ex ia IIC T5 Ga Ta = -40 °C to +70 °C - 35331; Entity<br>Entity Parameters: U <sub>i</sub> = 15 V DC, I <sub>i</sub> = 60 mA, P <sub>i</sub> = 225 mW, C <sub>i</sub> = 0.3 µF, L <sub>i</sub> = 0 mH  |



II 1 G  
Ex ia IIC T5 Ga  
Ta = -40°C to +70°C  
FM12ATEX0094X  
IECEx FMG 14.0029X



FM21UKEX0211X



FM20US0068X  
FM20CA0032X  
CL I/II/III Div 1  
Groups ABCDEFG T5  
CL I Zn 0 AEx ia IIC T5 Ga



15-GA4BO-0492X  
Ex ia IIC T5

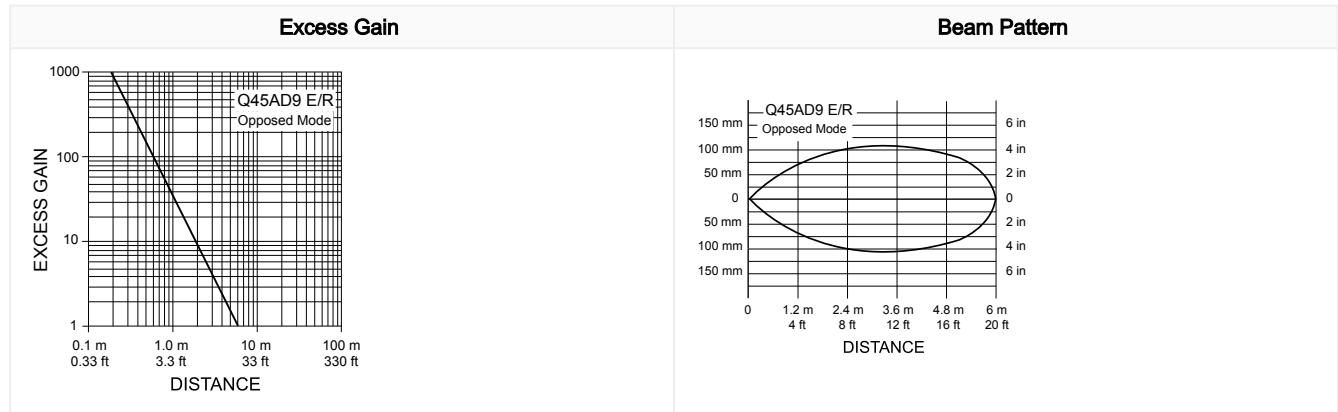
Banner Engineering Corp.  
9714 Tenth Ave. N.  
Mpls, MN 55441 USA

Banner Eng. Europe  
Park Ln., Culliganlann 2F  
Diegem BE 1831

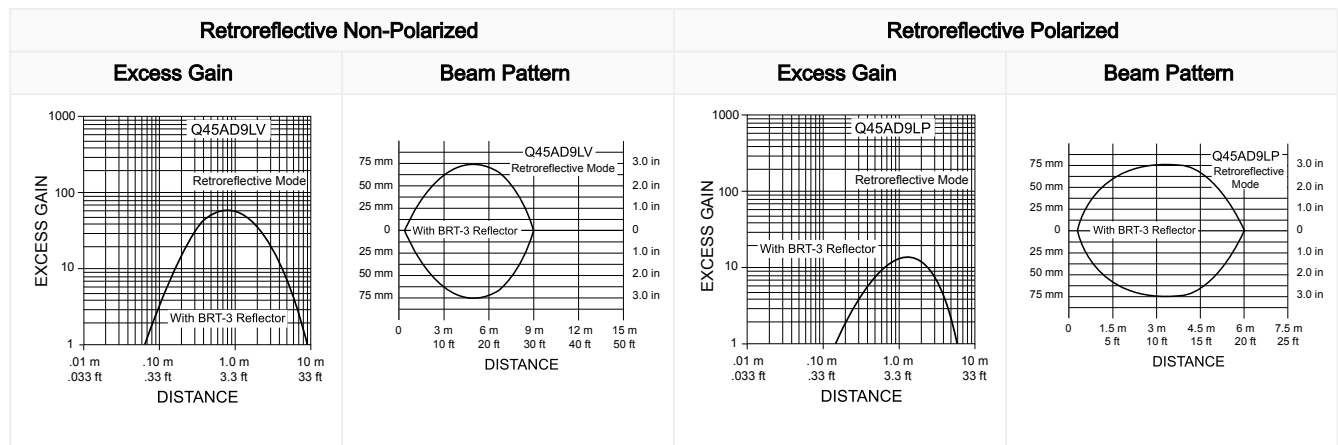
INSTALL PER CONTROL  
DRAWING # 38343

# Performance Curves

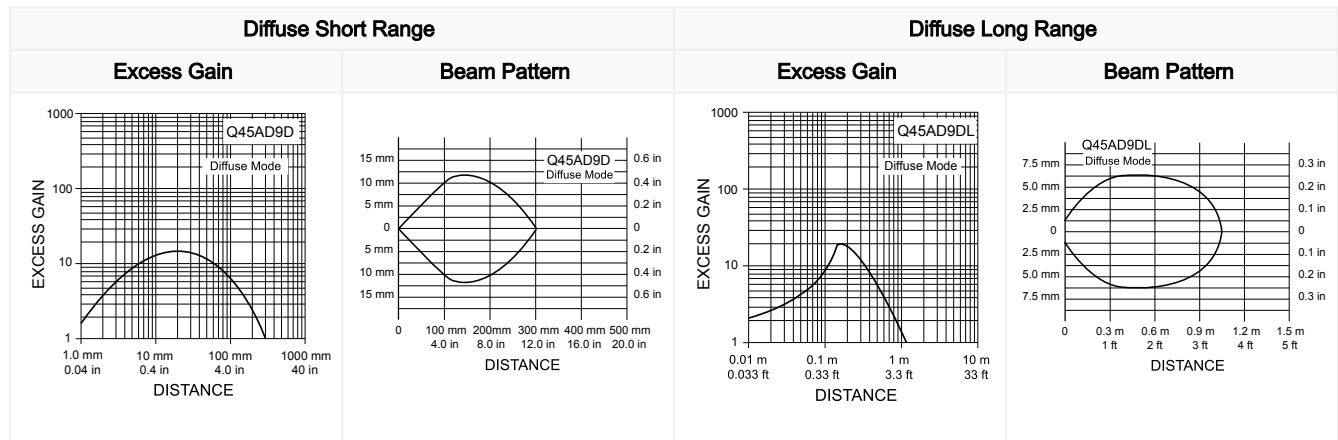
## Opposed mode sensors



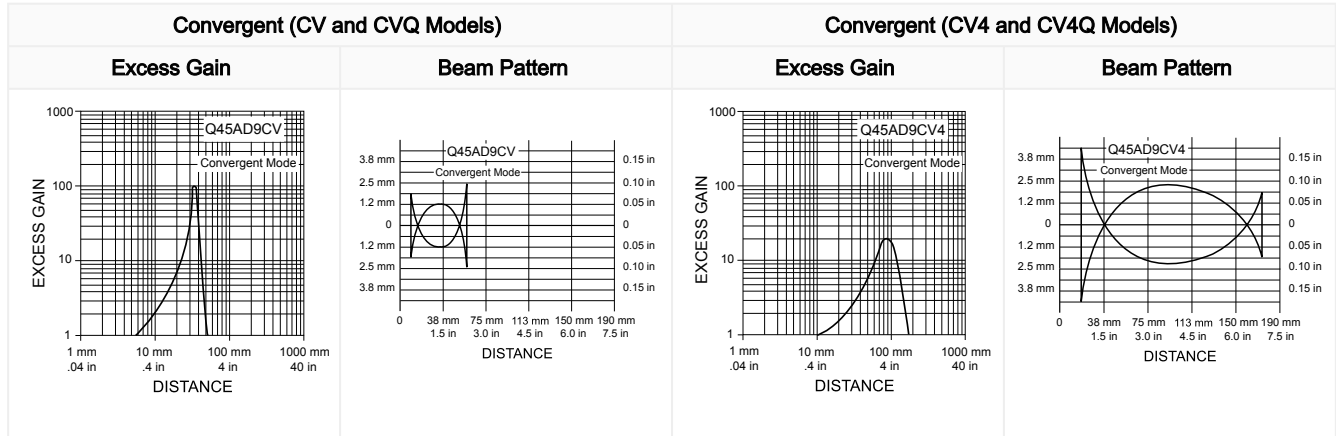
## Retroreflective mode sensors



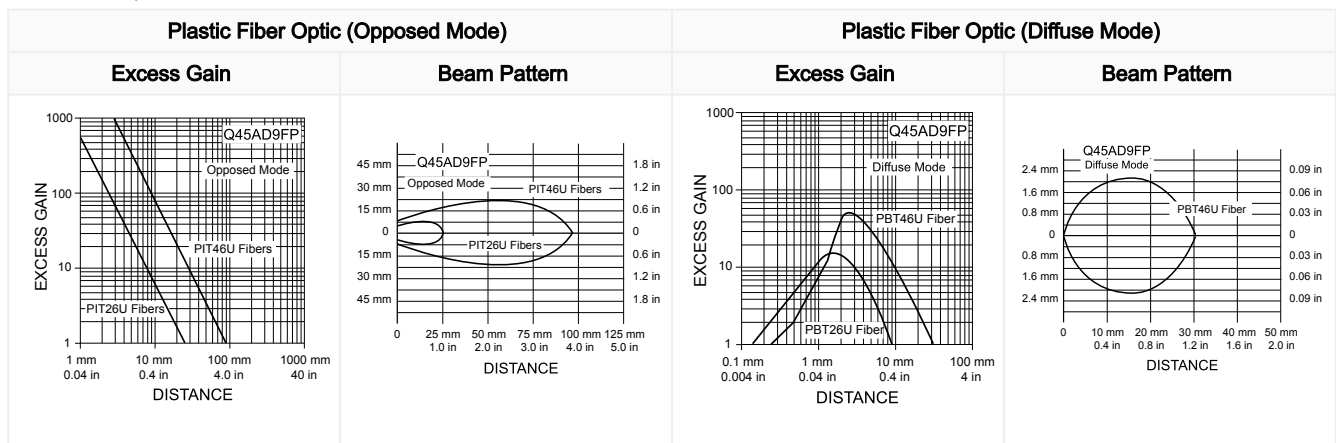
## Diffuse mode sensors



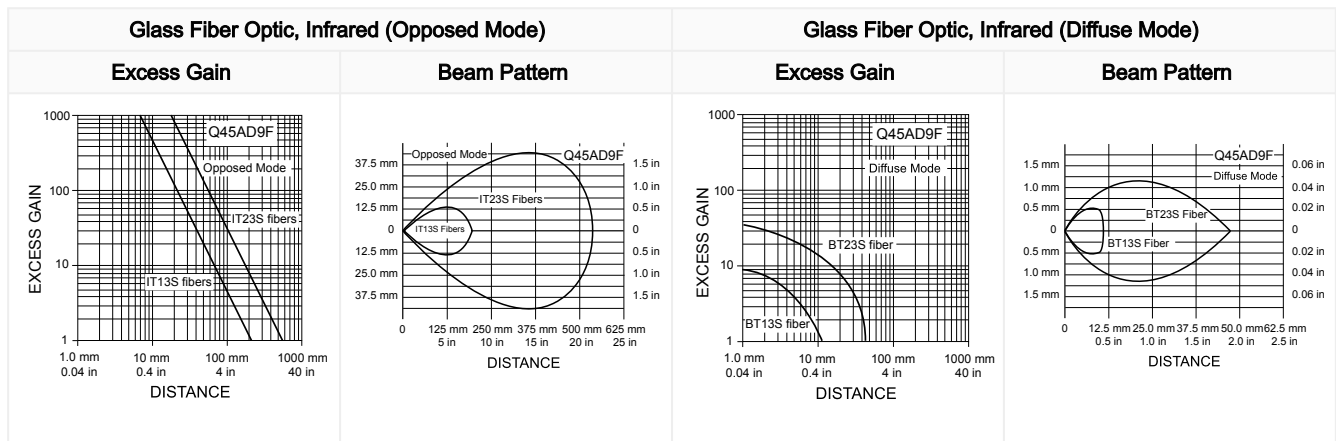
Convergent mode sensors

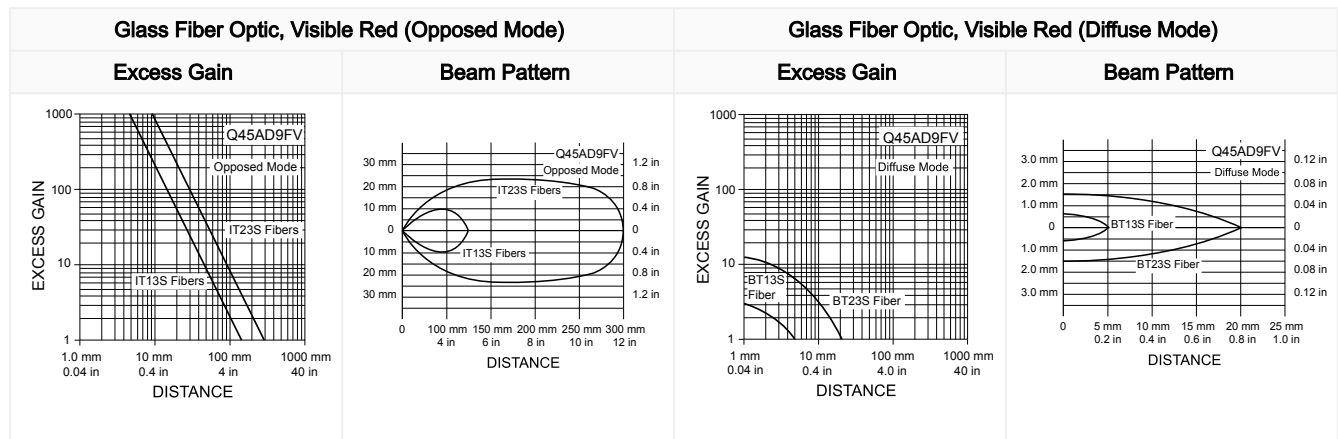


Plastic fiber optic sensors



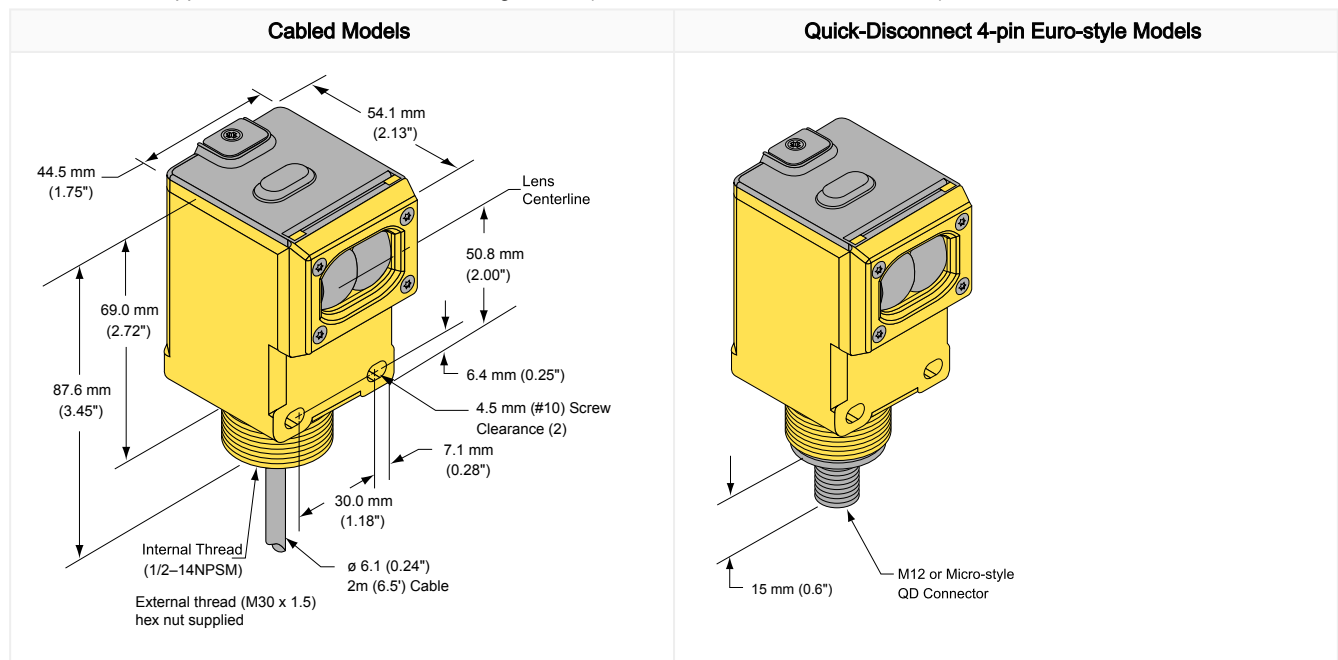
Glass fiber optic sensors





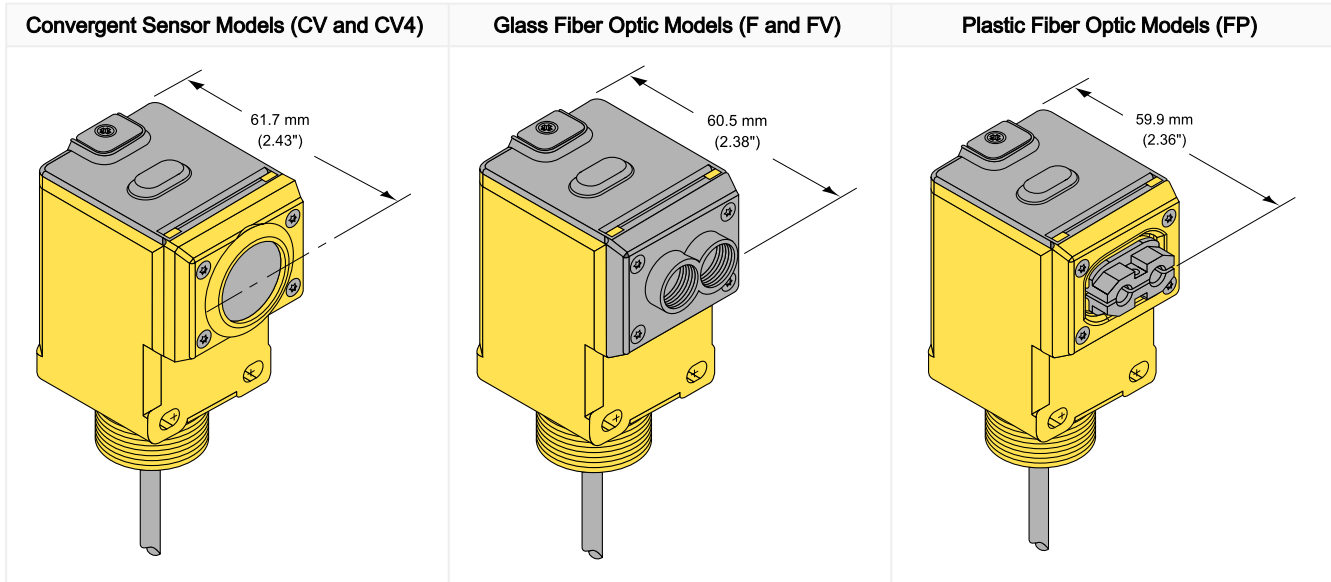
## Dimensions

NAMUR Series Opposed, Retro, and Diffuse Sensing Modes (Model Suffix E, R, D, DL, LP, and LV)



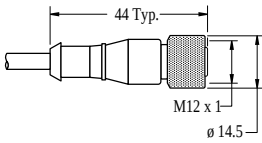
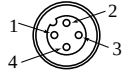
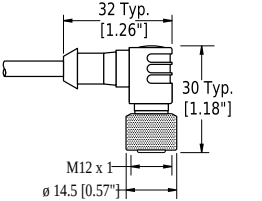
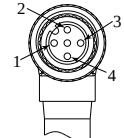


Other models



## Accessories

### Quick-Disconnect (QD) Cables

| 4-Pin Threaded M12 Cordsets (for use with NAMUR sensors)—Single Ended |               |             |   |   |                       |
|---|---------------|-------------|---|---|-----------------------|
| Model   | Length        | Style       | Dimensions  | Pinout (Female)   |                       |
| <b>MQD9-406</b>   | 2 m (6.56 ft) | Straight    |  |  | 1 = Brown<br>2 = Blue |
| <b>MQD9-415</b>   | 5 m (16.4 ft) |             |   |   |                       |
| <b>MQD9-430</b>   | 9 m (29.5 ft) |             |   |   |                       |
| <b>MQD9-406RA</b>   | 2 m (6.56 ft) | Right-Angle |  |  |                       |
| <b>MQD9-415RA</b>   | 5 m (16.4 ft) |             |   |   |                       |
| <b>MQD9-430RA</b>   | 9 m (29.5 ft) |             |   |   |                       |

### Q45AD9 Replacement Lenses

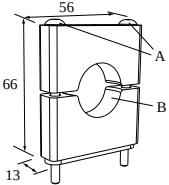
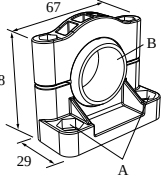
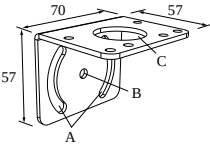
| Replacement Lens Assemblies |   |
|-----------------------------|---|
| Models                      | Description                                 |
| UC-45L                      | Replacement lens for E, R, DL and LV models |
| UC-45LP                     | Replacement lens for LP                     |
| UC-45D                      | Replacement lens for D                      |
| UC-45F                      | Replacement lens for F and FV               |
| UC-45FP                     | Replacement lens for FP                     |
| UC-45C                      | Replacement lens for CV                     |
| UC-45C4                     | Replacement lens for CV4                    |

Continued on page 10

Continued from page 9

| Replacement Lens Assemblies                       |             |
|---|-------------|
| Models  | Description |
| Q45 Series lens assemblies are field-replaceable. |             |

## Q45AD9 Brackets

|   |   |
|---|---|
| <p><b>SMB30C</b></p> <ul style="list-style-type: none"> <li>• 30 mm split clamp, black PBT bracket</li> <li>• Stainless steel mounting hardware included</li> <li>• Mounting hole for 30 mm sensor</li> </ul>   |    |
| <p><b>Hole center spacing:</b> A=∅ 45<br/> <b>Hole size:</b> B=∅ 27.2</p>   |   |
| <p><b>SMB30SC</b></p> <ul style="list-style-type: none"> <li>• Swivel bracket with 30 mm mounting hole for sensor</li> <li>• Black reinforced thermoplastic polyester</li> <li>• Stainless steel mounting and swivel locking hardware included</li> </ul> |    |
| <p><b>Hole center spacing:</b> A=∅ 50.8<br/> <b>Hole size:</b> A=∅ 7.0, B=∅ 30.0</p>  |   |
| <p><b>SMB30MM</b></p> <ul style="list-style-type: none"> <li>• 12-ga. stainless steel bracket with curved mounting slots for versatile orientation</li> <li>• Clearance for M6 (¼ in) hardware</li> <li>• Mounting hole for 30 mm sensor</li> </ul>       |  |
| <p><b>Hole center spacing:</b> A = 51, A to B = 25.4<br/> <b>Hole size:</b> A = 42.6 x 7, B = ∅ 6.4, C = ∅ 30.1</p>   |   |
| <p><b>SMB30UR</b></p> <ul style="list-style-type: none"> <li>• 2-piece universal swivel bracket for limit-switch style sensors</li> <li>• 300 series stainless steel</li> <li>• Stainless steel swivel locking hardware included</li> </ul>               |   |
| <p><b>Hole center spacing:</b> A to B=31.8, B to C=19.0, A to C=50.8, D=50.8<br/> <b>Hole size:</b> C=6.9x32, D=73.0x6.9</p>  |   |

## Repairs and Translations

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Original Instructions

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