T18 Series Sensors (DC Voltage)

Datasheet

- Featuring EZ-BEAM® technology for reliable sensing without the need for adjustments (most models)
- "T" style plastic housing with 18 mm threaded lens mount
- Models available in opposed, retroreflective, diffuse, and fixed-field modes
- Completely epoxy-encapsulated to provide superior durability, even in harsh sensing environments rated to IP69K
- Innovative dual-indicator system for simple sensor performance monitoring
- Advanced diagnostics to warn of marginal sensing conditions or output overload
- 10 to 30 V dc; choose SPDT (complementary) NPN or PNP outputs (150 mA maximum, each)

WARNING: Not To Be Used for Personnel Protection

Never use this device as a sensing device for personnel protection. Doing so could lead to serious injury or death. This device does not include the self-checking redundant circuitry necessary to allow its use in personnel safety applications. A sensor failure or malfunction can cause either an energized or de-energized sensor output condition.

Models

<table>
<thead>
<tr>
<th>Models 1</th>
<th>Sensing Mode</th>
<th>Range</th>
<th>LED</th>
<th>Output</th>
</tr>
</thead>
<tbody>
<tr>
<td>T186E</td>
<td>Opposed</td>
<td>20 m (66 ft)</td>
<td>Infrared, 950 nm</td>
<td>NPN</td>
</tr>
<tr>
<td>T18SN6R</td>
<td>Retroreflective with Gain Control</td>
<td>2 m (79 in)</td>
<td>Visible Red, 680 nm</td>
<td>NPN</td>
</tr>
<tr>
<td>T18SN6L</td>
<td>Polarized Retroreflective</td>
<td>2 m (79 in)</td>
<td>Visible Red, 680 nm</td>
<td>NPN</td>
</tr>
<tr>
<td>T18SP6R</td>
<td>Diffuse with Gain Control</td>
<td>500 mm (20 in)</td>
<td>Infrared, 880 nm</td>
<td>PNP</td>
</tr>
<tr>
<td>T18SP6D</td>
<td>Fixed Field</td>
<td>25 mm (1 in) Cutoff</td>
<td>Infrared, 880 nm</td>
<td>NPN</td>
</tr>
<tr>
<td>T18SN6FF25</td>
<td>Fixed Field</td>
<td>25 mm (1 in) Cutoff</td>
<td>Infrared, 880 nm</td>
<td>NPN</td>
</tr>
<tr>
<td>T18SP6FF25</td>
<td>Fixed Field</td>
<td>50 mm (2 in) Cutoff</td>
<td>Infrared, 880 nm</td>
<td>PNP</td>
</tr>
<tr>
<td>T18SN6FF50</td>
<td>Fixed Field</td>
<td>50 mm (2 in) Cutoff</td>
<td>Infrared, 880 nm</td>
<td>NPN</td>
</tr>
<tr>
<td>T18SP6FF50</td>
<td>Fixed Field</td>
<td>50 mm (2 in) Cutoff</td>
<td>Infrared, 880 nm</td>
<td>PNP</td>
</tr>
<tr>
<td>T18SN6FF100</td>
<td>Fixed Field</td>
<td>100 mm (4 in) Cutoff</td>
<td>Infrared, 880 nm</td>
<td>NPN</td>
</tr>
<tr>
<td>T18SP6FF100</td>
<td>Fixed Field</td>
<td>100 mm (4 in) Cutoff</td>
<td>Infrared, 880 nm</td>
<td>PNP</td>
</tr>
</tbody>
</table>

1 Standard 2 m (6.5 ft) cable models are listed.
2 To order the 9 m (30 ft) cable models, add suffix W/30 (for example, T186E W/30).
3 To order the 4-pin M12/Euro-style QD models, add suffix Q (for example, T186EQ). A model with a QD connector requires a mating cable.
4 Use polarized models when shiny objects will be sensed.
Fixed-Field Mode Overview

T18 Sensors self-contained fixed-field sensors are small, powerful, infrared diffuse mode sensors with far-limit cutoff (a type of background suppression). Their high excess gain and fixed-field technology allow them to detect objects of low reflectivity, while ignoring background surfaces.

The cutoff distance is fixed. Backgrounds and background objects must always be placed beyond the cutoff distance.

The T18FF compares the reflections of its emitted light beam (E) from an object back to the sensor's two differently aimed detectors, R1 and R2. If the near detector (R1) light signal is stronger than the far detector (R2) light signal (see object A, closer than the cutoff distance), the sensor responds to the object. If the far detector (R2) light signal is stronger than the near detector (R1) light signal (see object B, beyond the cutoff distance), the sensor ignores the object.

The cutoff distance for model T18FF sensors is fixed at 25, 50 or 100 millimeters (1 in, 2 in, or 4 in). Objects lying beyond the cutoff distance usually are ignored, even if they are highly reflective. However, it is possible to falsely detect a background object, under certain conditions (see Background Reflectivity and Placement).

In the drawings and discussion on these pages, the letters E, R1, and R2 identify how the sensor’s three optical elements (Emitter “E”, Near Detector “R1”, and Far Detector “R2”) line up across the face of the sensor. The location of these elements defines the sensing axis (see Figure 2 on page 2). The sensing axis becomes important in certain situations, such as those illustrated in Figure 5 on page 3 and Figure 6 on page 3.

Sensor Setup

Sensing Reliability

As a general rule, the most reliable sensing of an object approaching from the side occurs when the line of approach is parallel to the sensing axis.

For highest sensitivity, position the target object for sensing at or near the point of maximum excess gain. The excess gain curves for these products are shown. Maximum excess gain for the 25 mm models occurs at a lens-to-object distance of about 7 mm; for 50 mm models, at about 10 mm; and for the 100 mm models, at about 20 mm. Sensing at or near this distance will make maximum use of each sensor’s available sensing power. The background must be placed beyond the cutoff distance. (Note that the reflectivity of the background surface also may affect the cutoff distance.) Following these two guidelines will improve sensing reliability.

Background Reflectivity and Placement

Avoid mirror-like backgrounds that produce specular reflections. False sensor response will occur if a background surface reflects the sensor's light more strongly to the near detector, or “sensing” detector (R1), than to the far detector, or “cutoff” detector (R2). The result is a false ON condition (see Figure 3 on page 3). To cure this problem, use a diffusely reflective (matte) background, or angle either the sensor or the background (in any plane) so the background does not reflect light back to the sensor (see Figure 4 on page 3). Position the background as far beyond the cutoff distance as possible.
An object beyond the cutoff distance, either stationary (and when positioned as shown in Figure 5 on page 3), or moving past the face of the sensor in a direction perpendicular to the sensing axis, can cause unwanted triggering of the sensor if more light is reflected to the near detector than to the far detector. The problem is easily remedied by rotating the sensor 90° (Figure 6 on page 3). The object then reflects the R1 and R2 fields equally, resulting in no false triggering. A better solution, if possible, may be to reposition the object or the sensor.

Color Sensitivity

The effects of object reflectivity on cutoff distance, though small, may be important for some applications. It is expected that at any given cutoff setting, the actual cutoff distance for lower reflectance targets will be slightly shorter than for higher reflectance targets (see Performance Curves). This behavior is known as color sensitivity.

For example, an excess gain of 1 for an object that reflects 1/10 as much light as the 90% white card is represented by the horizontal graph line at excess gain = 10. An object of this reflectivity results in a far limit cutoff of approximately 20 mm (0.8 inches), for the 25 mm (1 inch) cutoff model for example; thus 20 mm represents the cutoff for this sensor and target.

These excess gain curves were generated using a white test card of 90% reflectance. Objects with reflectivity of less than 90% reflect less light back to the sensor, and thus require proportionately more excess gain in order to be sensed with the same reliability as more reflective objects. When sensing an object of very low reflectivity, it may be especially important to sense it at or near the distance of maximum excess gain.
Specifications

Supply Voltage and Current
- 10 to 30 V dc (10% maximum ripple)
- Supply current (exclusive of load current):
  - Emitter, non-polarized retroreflective, retroreflective, diffuse models: 25 mA
  - Receivers: 20 mA
  - Polarized retroreflective models: 30 mA
  - Fixed-field models: 35 mA

Supply Protection Circuitry
- Protected against reverse polarity and transient voltages

Output Configuration
- SPDT solid-state dc switch; Choose NPN (current sinking) or PNP (current sourcing) models
- Light Operate: N.O. output conducts when sensor sees its own (or the emitter’s) modulated light
- Dark Operate: N.C. output conducts when the sensor sees dark; the N.C. (normally closed) output may be wired as a normally open marginal signal alarm output, depending upon wiring to power supply (U.S. patent 5087838)

Output Rating
- 150 mA maximum (each) in standard wiring. When wired for alarm output, the total load may not exceed 150 mA.
- Off-state leakage current: < 1 microamp at 30 V dc
- ON-state saturation voltage: < 1 V at 10 mA dc; < 1.5 V at 150 mA dc

Output Protection Circuitry
- Protected against false pulse on power-up and continuous overload or short circuit of outputs

Environmental Rating
- Leakproof design rated NEMA 6P and IEC IP67 per IEC 60529
- IP69K per DIN40050 for quick disconnect and cable models when the cables are protected from direct spray

Operating Conditions
- −40 °C to +70 °C (−40 °F to +158 °F)
- 90% at +50 °C maximum relative humidity (non-condensing)

Vibration and Mechanical Shock
- All models meet Mil. Std. 202F requirements. Method 201A (Vibration; frequency 10 Hz to 60 Hz, max., double amplitude 0.06 inch acceleration 10G). Method 213B conditions H&I.
- Shock: 75G with unit operating; 100G for non-operation

Certifications
- CE
- CUS LISTED

Output Response Time
- Opposed mode models: 3 ms ON, 1.5 ms OFF
- Retroreflective, fixed-field, and diffuse mode models: 3 ms ON and OFF
- NOTE: 100 ms delay on power-up; outputs do not conduct during this time.

Repeatability
- Opposed mode models: 375 µs
- Retroreflective, fixed-field, and diffuse mode models: 750 µs
- Repeatability and response are independent of signal strength.

Adjustments
- Non-polarized retroreflective and diffuse models (only) have a single-turn rear-panel sensitivity control (turn clockwise to increase gain)

Indicators
- Two LEDs (green and amber):
  - Green on: power to sensor is on
  - Green flashing: output is overloaded
  - Amber on: N.O. output is conducting
  - Amber flashing: excess gain marginal (1 to 1.5×) in light condition

Construction
- Housing: PBT polyester housing
- Lens: polycarbonate (opposed-mode) or acrylic (other models)

Connections
- 2 m (6.5 ft) integral cable; 9 m (30 ft) integral cable; or 4-pin M12/Euro-style quick-disconnect fitting

Required Overcurrent Protection

<table>
<thead>
<tr>
<th>Supply Wiring (AWG)</th>
<th>Required Overcurrent Protection (Amps)</th>
</tr>
</thead>
<tbody>
<tr>
<td>20</td>
<td>5.0</td>
</tr>
<tr>
<td>22</td>
<td>3.0</td>
</tr>
<tr>
<td>24</td>
<td>2.0</td>
</tr>
<tr>
<td>26</td>
<td>1.0</td>
</tr>
<tr>
<td>28</td>
<td>0.8</td>
</tr>
<tr>
<td>30</td>
<td>0.5</td>
</tr>
</tbody>
</table>

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 http://www.bannerengineering.com.

All models, except T186E are UL approved.
T18 Series Sensors (DC Voltage)

Dimensions

<table>
<thead>
<tr>
<th>Cabled Models</th>
<th>QD Models</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jam Nut (Supplied)</td>
<td>ø 30.0 mm (1.18&quot;)</td>
</tr>
<tr>
<td>M18 x 1 Thread</td>
<td>ø 30.0 mm (1.18&quot;)</td>
</tr>
<tr>
<td>ø 15 mm (0.59&quot;)</td>
<td>ø 15 mm (0.59&quot;)</td>
</tr>
<tr>
<td>Green LED Power Indicator</td>
<td>Yellow LED Output Indicator</td>
</tr>
<tr>
<td>Single-turn Sensitivity (Gain) Control (D and L Models)</td>
<td></td>
</tr>
</tbody>
</table>

Performance Curves

<table>
<thead>
<tr>
<th>Excess Gain</th>
<th>Beam Pattern</th>
<th>Excess Gain</th>
<th>Beam Pattern</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Opposed Models</strong></td>
<td></td>
<td><strong>Retroreflective Models</strong></td>
<td></td>
</tr>
<tr>
<td><img src="image" alt="Graph" /></td>
<td><img src="image" alt="Graph" /></td>
<td><img src="image" alt="Graph" /></td>
<td><img src="image" alt="Graph" /></td>
</tr>
<tr>
<td><strong>Polarized Retroreflective</strong></td>
<td></td>
<td><strong>Diffuse (500 mm)</strong></td>
<td></td>
</tr>
<tr>
<td><img src="image" alt="Graph" /></td>
<td><img src="image" alt="Graph" /></td>
<td><img src="image" alt="Graph" /></td>
<td></td>
</tr>
</tbody>
</table>

For the polarized retroreflective and retroreflective models, the performance is based on a model BRT-3 retroreflector (3 in diameter). The actual sensing range may be more or less than specified, depending on the efficiency and reflective area of the retroreflector used.

For the diffuse models, the performance is based on a 90% reflectance white test card.
For the fixed field models, the performance is based on a 90% reflectance white test card. Focus and spot sizes are typical.

### Wiring Diagrams

<table>
<thead>
<tr>
<th>Cabled Emitters</th>
<th>QD Emitters</th>
<th>Key</th>
</tr>
</thead>
</table>
| ![Cabled Emitters Diagram](image1) | ![QD Emitters Diagram](image2) | 1. Brown  
2. White  
3. Blue  
4. Black |

Wiring for the quick disconnect (QD) models is functionally identical.

### Accessories

#### 4-Pin Threaded M12/Euro-Style Cordsets

<table>
<thead>
<tr>
<th>Model</th>
<th>Length (ft)</th>
<th>Style</th>
<th>Dimensions</th>
<th>Pinout (Female)</th>
</tr>
</thead>
</table>
| MQDC-406  | 1.83        | Straight |            | 1 = Brown  
2 = White  
3 = Blue  
4 = Black |
| MQDC-415  | 4.57        |        |            |                 |
| MQDC-430  | 9.14        |        |            |                 |
| MQDC-450  | 15.2        |        |            |                 |
### 4-Pin Threaded M12/Euro-Style Cordsets

<table>
<thead>
<tr>
<th>Model</th>
<th>Length</th>
<th>Style</th>
<th>Dimensions</th>
<th>Pinout (Female)</th>
</tr>
</thead>
<tbody>
<tr>
<td>MQDC-406RA</td>
<td>1.83 m (6 ft)</td>
<td></td>
<td>32 Typ. [1.26&quot;]</td>
<td>M12 x 1</td>
</tr>
<tr>
<td>MQDC-415RA</td>
<td>4.57 m (15 ft)</td>
<td>Right-Angle</td>
<td>30 Typ. [1.18&quot;]</td>
<td>ø 14.5 [0.57&quot;]</td>
</tr>
<tr>
<td>MQDC-430RA</td>
<td>9.14 m (30 ft)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MQDC-450RA</td>
<td>15.2 m (50 ft)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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