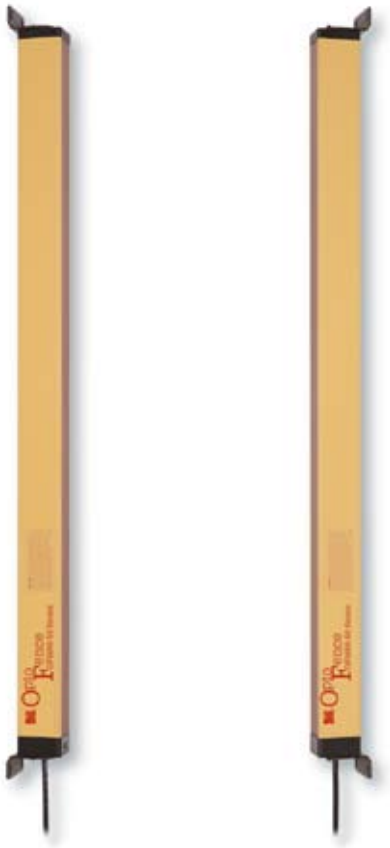

OptoFence®

OF4600-50

- Resolution: 53 mm (2.09 in.)
- Range: 20 m (65 ft.)
- Six protected heights available: 700 mm (27 in.), 1046 mm (41 in.), 1394 mm (55 in.), 1741 mm (69 in.), 2090 mm (82 in.), and 2445 mm (96 in.)
- Compact size — 35 x 50 mm (1.4 x 2 in.)
- Simple "two-box" design — no separate control box required
- No cable required between transmitter and receiver
- Two PNP safety outputs designed to directly switch machine primary control elements
- Individual Beam Indicators
- Available with one NPN or one PNP auxiliary output
- Exact Channel Select
- Floating Blanking
- Choice of operating modes
- MPCE monitoring
- In-line connector cables
- Adjustable mounting brackets

Options

- DeviceNet™ Interface
- MTS (Machine Test Signal)
- Alarm/Follow Mode for auxiliary output
- Versions available for darkroom applications (940 nm) — consult factory
- Muting through RM-3 module

File No. LR90200

Description

An OptoFence OF4600-50 system consists of a transmitter and receiver of equal height. Since the control reliable circuitry is contained in the receiver and transmitter, no separate control box is required.

Despite its compact dimensions, the OF4600-50 comes with a complete feature set. Individual Beam Indicators are included to simplify alignment. When an infrared beam is out of alignment, the corresponding Individual Beam Indicator will glow red.

Two solid-state safety outputs provide 500 mA of current at 24 VDC.

The ability to select the Start/Restart Interlock operating mode means that the OF4600-50 is ideal for perimeter guarding applications.

Exact Channel Select allows the OF4600-50 detection zone to have permanently blocked beams. This is valuable if tooling or other machine parts must permanently obstruct a portion of the zone. Exact Channel Select programming is as easy as pushing a button.

Floating Blanking is useful when process material or parts must transit through the detection zone. Floating Blanking allows up to two beams to be blocked anywhere in the zone.

Machine primary control element monitoring is required for control reliable safety. MPCE

A Go to the Engineering Guide
For in-depth information on safety standards and use.

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monitoring is built into the OF4600-50 rather than being required externally.

In-line connector cables and adjustable mounting brackets allow the OF4600-50 to fit in space-constrained locations and simplify installation.

DeviceNet Option

This optional interface allows an OF4600-50 system to communicate non-safety related data across this popular fieldbus. As the de facto standard for fieldbus communications, DeviceNet is widely employed in the automotive, semiconductor and other industries.

Monitoring of a DeviceNet equipped light curtain provides the process control system with the following non-safety information: manufacturer; product name; operating mode; detection zone status; solid state safety status; signal strength; number of beams installed; number of beams selected; MPCE monitoring enabled/disabled; floating blanking active/inactive; exact channel select active/inactive; blanking pattern for exact channel select; receiver diagnostic codes; error codes and descriptions.

DeviceNet and the OptoFence OF4600-50 provide a powerful automation solution.

MTS Option

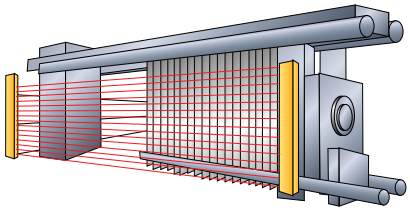
Machine Test Signal (MTS) is an optional feature on the OF4600 series light curtain. MTS allows the machine control system to check for the proper operation of the light curtain safety outputs by simulating a beam blocked state on the transmitter.

Alarm/Follow Mode Option

The non-safety output can be ordered to have either "alarm" or "follow" functionality. "Alarm" mode means that the non-safety output will be de-energized if the system is behaving normally and energized if the system is in a faulted/interlocked state and will remain this way until the condition is cleared. "Follow" mode mimics the state of the safety solid state safety outputs, meaning they will be active when the system is in the machine run state and inactive when the system is in the machine stopped state.

■ Applications

With a range of 20 m, an OptoFence OF4600-50 system could be used to guard the perimeter of a large filter press. Since there is no separate control box, long cable runs are not required.



Understanding the Standards

A typical application for the OptoSafe OF4600-50 is perimeter guarding around a robotic work cell. The standard which covers this use is the recently revised and approved ANSI/RIA R15.06-1999 *American National Standard for Industrial Robots and Robot Systems – Safety Requirements*. This standard allows the use of safety light curtains and provides the following formula for determining the safe mounting distance of a curtain:

$$D_s = [K \times (T_s + T_c + T_r)] + D_{pf}$$

Where :

D_s = minimum safe distance between safeguarding device and the hazard.

K = speed constant: 63 inches/sec minimum based on the movement being the hand/arm only and the body being stationary.

NOTE: A greater value may be required in specific applications and when a body in motion must also be considered.

T_s = worst stopping time of the machine/equipment.

T_c = worst stopping time of the control system.

T_r = response time of the safeguarding device including its interface.

D_{pf} = maximum travel towards the hazard within the presence sensing safeguarding device's field that may occur before a stop is signaled. Depth penetration factors will change depending on the type of device and application.

Of the factors defined above, the most important, the depth penetration factor (D_{pf}), is based on the minimum object sensitivity of the safety light curtain. Curtains with an object sensitivity greater than 2.5 in. are required to use a D_{pf} of 36 inches where a person must reach through the plane of light. The OptoFence OF4600-50 has a minimum object resolution of 2.0 inches and is allowed to use a D_{pf} equal to 3.4 x (2.0-0.275 in.) or 5.87 in. As you can see, if all the other factors are equal, the OF4600-50 can be mounted closer to the hazardous area than similar curtains with a larger minimum object resolution. This saves money and requires less factory space.

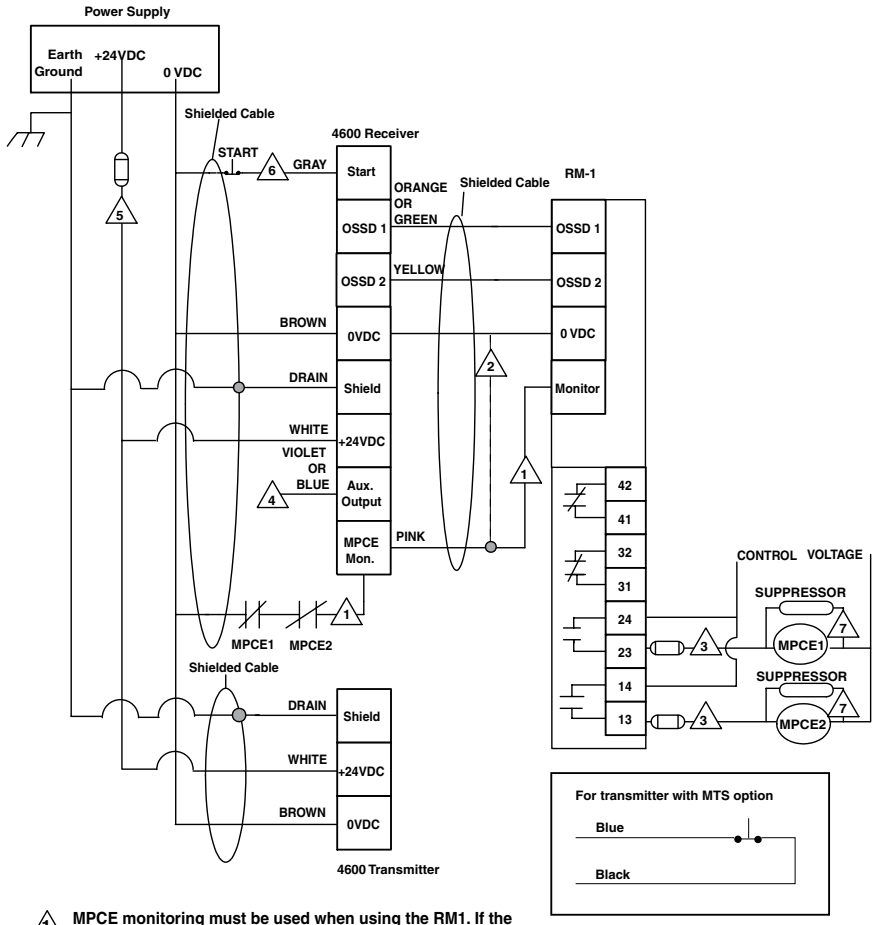
A Go to the Engineering Guide
For in-depth information on safety standards and use.

■ Using Solid-state Outputs

Extreme versatility is a feature of the solid-state outputs from the OptoFence OF4600-50. These outputs can be connected to an Omron STI RM-series relay module, a safety monitoring and control device, or in many cases, directly to the primary control element of the guarded machine.

Connecting Via an RM-1 Module

The Omron STI RM-1 module provides force-guided relay outputs for machine control. OSSD (safety) outputs 1 and 2 are connected to the RM-1 and provide the power necessary to energize its relays.



1. MPCE monitoring must be used when using the RM1. If the RM1 is the Final Switching Device connect the Pink wire to the MONITOR terminal of the RM1. If force-guided control relays are used as Final Switching Devices they must be monitored, connect the Pink wire though N/C contacts to 0 VDC. (Do not connect both.)

2. For testing prior to installation, the user may select MPCE OFF(default factory setting). In this case the MPCE line (pink wire) must be connected to the system 0 VDC line.

3. User supplied over current protection, 6 A max.

4. Auxilary Output connect to PLC (optional)

5. User-supplied fuse.

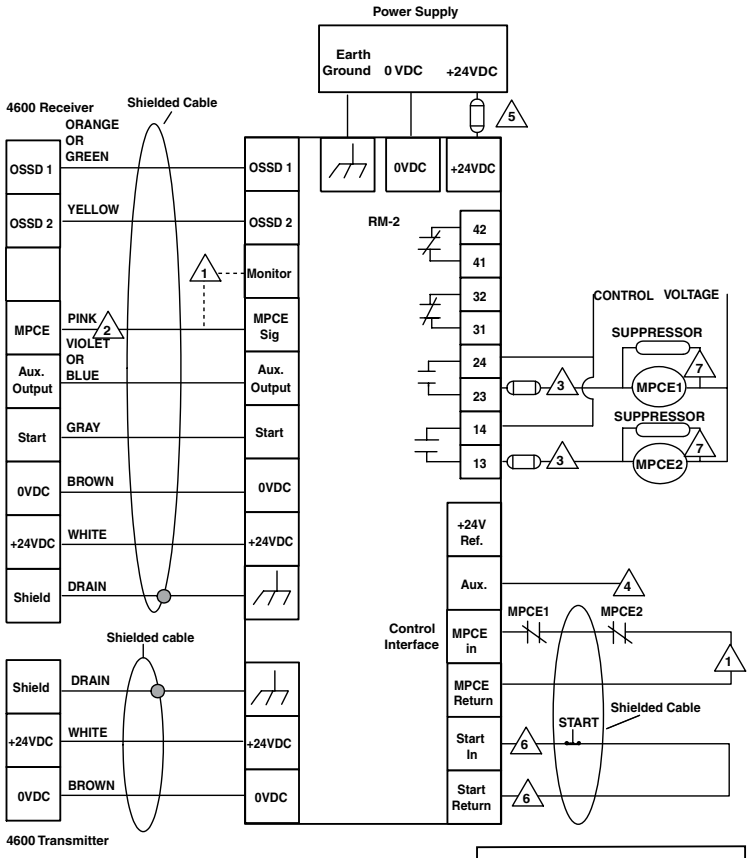
6. If remote start is not used, connect the start line (grey wire) to 0 VDC.

7. Verify that the final switching devices are properly suppresed.

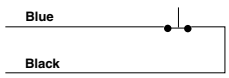
■ *Using Solid-state Outputs (continued)*

Connecting Via an RM-2 Module

The Omron STI RM-2 module provides force-guided relay outputs for machine control as well as a convenient location to terminate all outputs and inputs from the OF4600-50.



For transmitter with MTS option

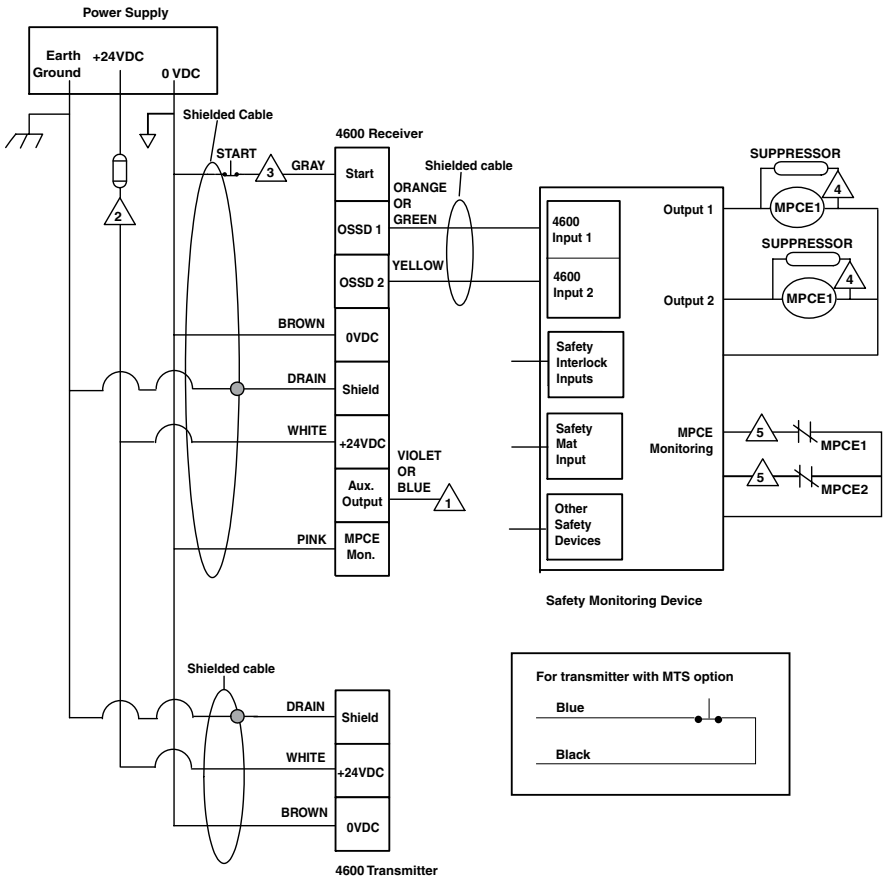


1. MPCE monitoring must be used when using the RM2. If the RM2 is the Final Switching Device connect the Pink wire to the MONITOR terminal of the RM2. If force-guided control relays are used as Final Switching Devices connect the Pink wire to the MPCE Sig. terminal. Then connect a set of N.C. contacts from MPCE1 and MPCE2 to the MPCE in and MPCE return terminals. (Do not connect both.)
2. For testing prior to installation, the user may select MPCE OFF (default factory setting). In this case the MPCE line (pink wire) must be connected to the system 0 VDC line.
3. User-supplied over current protection, 6 A max.
4. Auxilary output-connect to PLC (optional).
5. User-supplied fuse.
6. If remote start is not used, install a jumper across the Start connections at the Control Interface terminals.
7. Verify that the final switching devices are properly suppressed.

A Go to the Engineering Guide
For in-depth information on safety standards and use.

Connecting to a Safety Monitoring Device

The wiring from the OF4600-50 to the machine control circuit must be control reliable. Safety devices, such as the OF4600-50 should not depend on a PLC to stop a guarded machine. However, safety related monitoring devices are now available. Note that all safety inputs are directed to the monitoring device which also performs the MPCE monitoring function.

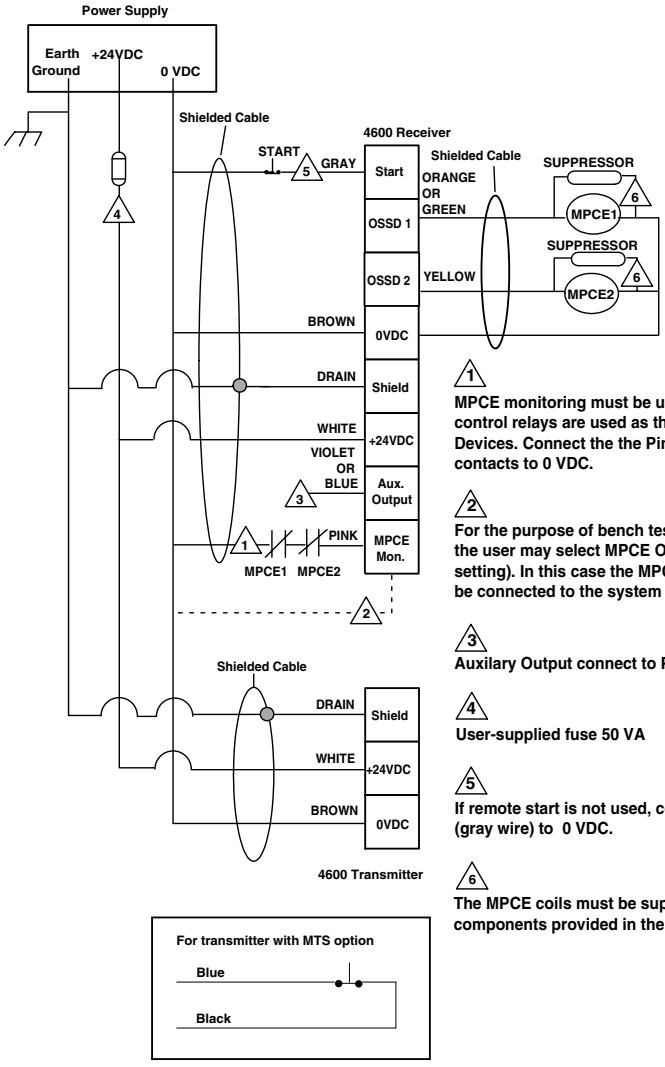


1. Auxilary Output connect to PLC (optional)
2. User-supplied fuse.
3. If remote start is not used, connect the start line (grey wire) to 0 VDC.
4. Verify that the final switching devices are properly suppressed.
5. The Safety Monitoring Device must monitor the MPCE's Normally Closed Contacts.

■ *Using Solid-state Outputs (continued)*

Connecting Via Two Force-Guided Relays

FGR series relays provides force-guided outputs for machine control.



1 **MPCE monitoring must be used when force-guided control relays are used as the Final Switching Devices. Connect the the Pink wire though N/C contacts to 0 VDC.**

2 **For the purpose of bench testing prior to installation, the user may select MPCE OFF (default factory setting). In this case the MPCE line (pink wire) must be connected to the system 0 VDC line.**

3 **Auxilary Output connect to PLC (optional)**

4 **User-supplied fuse 50 VA**

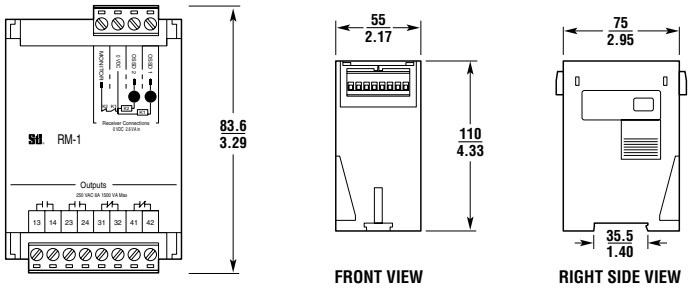
5 **If remote start is not used, connect the start line (gray wire) to 0 VDC.**

6 **The MPCE coils must be suppressed with the components provided in the documentation kit.**

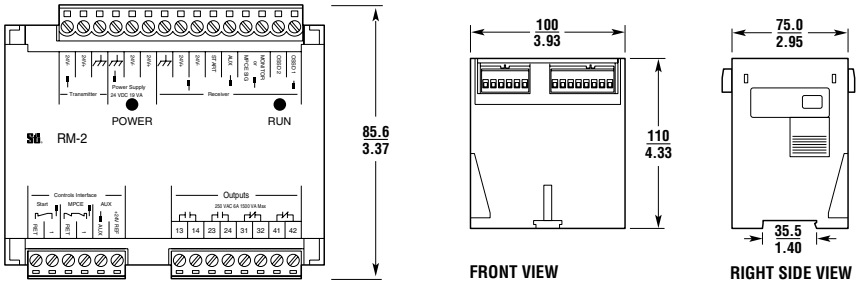
A Go to the Engineering Guide
For in-depth information on safety standards and use.

■ Module Dimensions—mm/in.

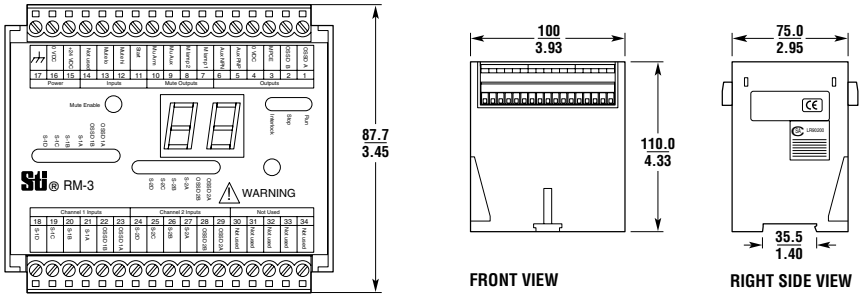
RM-1



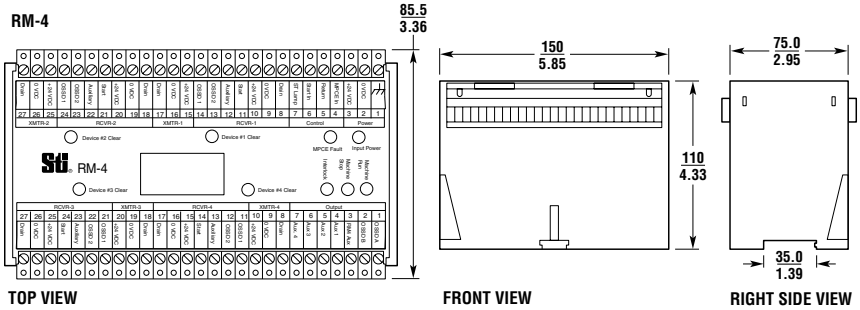
RM-2



RM-3



RM-4



■ Available Modules

The following relay modules are available to extend the function of the OF4600-50 series:

RM-1: Provides force-guided safety relay outputs using input from OF4600-50 system. Receives required 24 VDC power direct from OF4600-50 solid-state safety outputs. DIN rail mount. Removable terminal blocks.

RM-2: Provides a single location to terminate all inputs and outputs to OF4600-50 system. Also provides force-guided safety relay outputs using input from OF4600-50 system. Requires external 24 VDC power supply which also provides power to the OF4600-50. DIN rail mount. Removable terminal blocks.

RM-3: Provides muting, the temporary automatic suspension of the safety function, for up to two safety light curtains. Requires external 24 VDC power supply. It has DIN-rail mount and removable terminal blocks.

RM-4: Up to four OF4600-50 systems can be connected to the RM-4. It provides two PNP safety outputs and one user selectable NPN or PNP non-safety, auxiliary output. Additionally, connections are provided for the auxiliary output of each safety device. It requires external 24 VDC power supply which also provides power to the OF4600-50.

In addition to the above modules, the **RM-X**, **RM2-AC** and **RM2-AC-IP** are also compatible with the OF4600-50.

For information on Resource Modules, see page D138

■ Specifications for Transmitter and Receiver

Performance
Protected Heights: 698, 1046, 1393, 1741, 2090 and 2437 mm (27.5, 41.2, 54.9, 68.6, 82.3 and 95.9 in.)
Operating Range
OF4600-50SR: 0.3 to 9 m (1 to 30 ft.)
OF4600-50LR: 0.3 to 20 m (1 to 65 ft.)
Resolution: 53 mm (2.09 in.). Use of Exact Channel Select and/or Floating Blanking will increase this value.
Response Time (varies by protected height): see chart at right
Input Voltage (V_{in}): 24 VDC ± 20%
Input Power: 14 watts (without load on the outputs)
Safety Output Ratings: Two PNP outputs sourcing 500 mA max @ V_{in} (see note 1). Short circuit protected.
Auxiliary (Non-Safety) Output Ratings: One NPN output sinking 100 mA max @ V_{in} or one PNP output sourcing 100 mA @ V_{in} (see notes 1 and 2)
Power Supply: 24 VDC ± 20%. The rating depends on the current requirements of the loads attached to the outputs (see note 3). The power supply must meet the requirements of IEC 60204-1 and 61496-1. Omron STI part number 42992 or equivalent.
MPCE Monitoring Circuit: 50 mA steady state @ 24 VDC
Start/Restart Input: N.C. or N.O. momentary contact (20 mA consumption)
Effective Aperture Angle: ±2.5° maximum, transmitter and receiver at operating range greater than 3 m (9.8 ft.).
Light Source: GaAlAs Light Emitting Diode, 850 nm
Indicator
Transmitter: power applied
Receiver: machine run, machine stop, interlock/fault; channel select/floating blanking, individual beam
Mechanical
Enclosure: Polyurethane powder-painted aluminum
Cable Length: Cables are available in 10, 15, 30 and 50 m lengths
Cable Connections
Receiver: 8-pin
Transmitter: 3-pin standard, 5-pin with MTS
Environmental
Protection Rating: IP65; NEMA 4, 12
Operating Temperature: 0 to 55°C (32 to 131°F)
Relative Humidity: 95% maximum, non-condensing
Vibration: 5-60 Hz maximum on all three axes
Shock: 10 g for 0.016 seconds, 1,000 shocks for each axes on two axes
Conformity/Approvals
Conforming to Standards: ANSI/RIA R15.06-1999, ANSI B11.19-2003, OSHA 1910.217(c), OSHA 1910.212
Other Approvals: All OF4600 systems have been EC type examined to the requirements of IEC 61496-1, -2 for a Type 4 ESPE. UL listed.

Specifications are subject to change without notice.

Response Time

Protected Height (mm/in.)	No. of Beams	Response Time (seconds)
698/27.5	16	<0.014
1046/41.2	24	<0.016
1393/54.9	32	<0.017
1741/68.6	40	<0.021
2090/82.3	48	<0.025
2437/95.9	56	<0.025

Note 1: Voltage available at the outputs is equal to V_{in} - 2.0 VDC.

Note 2: Total current required by the two solid-state outputs and the aux. output should not exceed 1.1 A.

Note 3: Total system current requirement is the sum of the transmitter 285 mA and receiver 1.4 A max. (Receiver 300 mA + OSSD1 load + OSSD2 load + Aux. output load)

A Go to the Engineering Guide
For in-depth information on safety standards and use.

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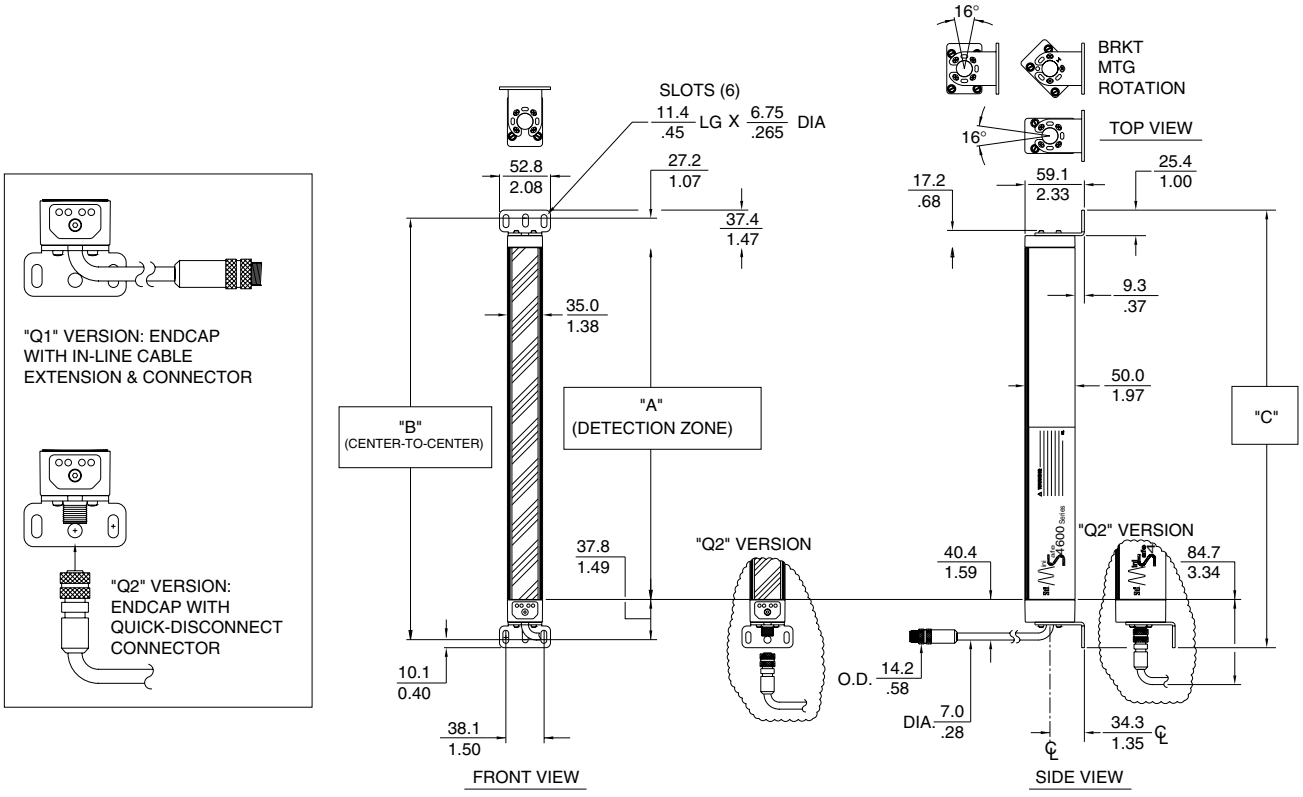
■ OF4600-50 Dimensions—mm/in.



DIMENSIONS: mm (+\-.3) / INCHES (+\-.01)

A = DETECTION ZONE

B = A + 65.0 / 2.56

C = A + 85.4 / 3.36

OptoFence OF4600-50 Dimensions

	OF46-X-700-50 OF46-R-700-50	OF46-X-1045-50 OF46-R-1045-50	OF46-X-1390-50 OF46-R-1390-50	OF46-X-1745-50 OF46-R-1745-50	OF46-X-2095-50 OF46-R-2095-50	OF46-X-2445-50 OF46-R-2445-50
A mm/in.	698/27.5	1046/41.2	1393/54.9	1741/68.6	2090/82.3	2437/95.9
B mm/in.	763/30.0	1111/43.7	1460/57.5	1807/71.1	2155/84.8	2507/98.5
C mm/in.	783/30.8	1131/44.5	1479/58.2	1827/71.9	2175/85.6	2423/99.5
System Shipping Weight						
kg/lb.	6.6/14	8.2/18	9.6/21	11.4/25	12.8/28	14.6/32

■ Ordering

To order a OptoFence OF4600-50 system, simply fill in the fields in the model number sequence given below. Each field is numbered and information on completing a specific field can be found in the sections which follow.

___ - ___ - ___ - ___X - ___R - ___ - ___ - ___ - ___ - ___ - ___
❶ ❷ ❸ ❹ ❹ ❺ ❻ ❼ ❽ ❾ ❿

❶ Information required. Represents the system operating range. *For applications where the transmitter and receiver will be mounted less than 9 m (29.5 ft.) apart, please select the SR version.*

Designator	Description
OF46-50SR	0.3 to 9 m (1 to 30 ft.)
OF46-50LR	0.3 to 20 m (1 to 65 ft.)

❷ Information required. Represents the coverage height of the detection zone. Designators are described below:

Designator	Coverage Height
700	698 mm (27.5 in.)
1045	1046 mm (41.2 in.)
1390	1393 mm (54.9 in.)
1745	1741 mm (68.6 in.)
2095	2090 mm (82.3 in.)
2445	2437 mm (95.9 in.)

❸ Information required. Represents the connector type for transmitter and receiver.

Designator	Description
Q1	In-line cable with QD connector (pig tail)
Q2	QD connector

❹ Information required. Represents transmitter (X) and receiver (R) cable length. Cables can be shortened in the field.

Designator	Description
10	10 m (33 ft.)
15	15 m (49 ft.)
30	30 m (99 ft.)
50	50 m (164 ft.)

❺ Information required. Represents the start/restart input type.

Designator	Description
NC	Normally closed
NO	Normally open

❻ Information required. Represents the Auxiliary output configuration. Designators are described below.

Designator	Description
FN	NPN outputs follow solid-state safety outputs
FP	PNP outputs follow solid-state safety outputs
AN	NPN outputs operate only in Alarm status
AP	PNP outputs operate only in Alarm status

❼ Information optional. Indicate if you would like the optional MTS (machine test signal) on transmitter.

Designator	Description
M	Include MTS
(Blank)	No MTS

❽ Information optional. Indicate if you would like the optional DeviceNet interface.

Designator	Description
RV	DeviceNet Installed
(Blank)	No DeviceNet

❾ Information optional. Indicate if you would like the optional DeviceNet cable.

Designator	Description
D	6 m (19 ft.) DeviceNet Cable
(Blank)	No DeviceNet Cable

❿ Information optional. Indicate optional RM resource module.

Designator	Description
RM1	Include RM-1 Resource Module
RM2	Include RM-2 Resource Module
RM2A	Include RM-2AC Resource Module
RM2AP	Include RM-2AC-IP Resource Module, IP65
RM3	Include RM-3 Resource Module
RM4	Include RM-4 Resource Module
RMX	Include RM-X Resource Module
(Blank)	Do not include Resource Module

For information on Resource Modules, see page D138

For information on safety light curtain accessories, see page D184

A Go to the Engineering Guide
For in-depth information on safety standards and use.

Safety Standards and Precautions

All models of the OptoFence OF4600-50 meet ANSI/RIA R15.06-1999 and ANSI B11.19-2003. When used with mechanical power presses, OSHA industrial safety standards apply as stated in 1910.217(c). For other applications, the machine guarding requirements found in section 1910.212 apply. The OptoFence OF4600-50 series meets ANSI control reliability requirements for point-of-operation presence sensing devices.

OptoFence OF4600-50 systems have been EC type examined to the requirements of IEC 61496-1, -2 for a Type 4 ESPE.

The OptoFence OF4600-50 should only be used on machinery that can consistently and immediately stop anywhere in its cycle or stroke. Never use a OptoFence OF4600-50 on a full revolution clutched power press or machine. If the light curtain does not protect all access to the point of operation, the unprotected access must be guarded by other appropriate devices such as mechanical guards.

The purchaser, installer and employer have the responsibility to meet all local, state and federal government laws, rules, codes or regulations relating to the proper use, installation, operation and maintenance of this control and the guarded machine. See the Installation and Operation Manual for additional information.

All application examples described are for illustration purposes only. Actual installations will differ from those indicated.