Detector™

Safety Light Curtains

Technical Reference Guide

DATA INSTRUMENTS

Warning! This is not a User Manual!

This document is not a User Manual. It is a technical reference guide to be used strictly for acquainting you with the technical characteristics of Detector Safety Light Curtains and is not intended to provide the reader with installation or operating instructions. For detailed information on installation, operation, troubleshooting, and the appropriate safety precautions which must be met, you must consult the applicable Detector User Manual which accompanies all Detector shipments.

Detector Safety Light Curtains

Detector Safety Light Curtains (Detector 1 model: 2-box system, and Detector 3 model: 3-box system) protect personnel by signaling the machine to stop if a person's hand (or any other part of the body) gets too close to the hazardous area. Unlike mechanical guards which physically block access to the hazardous area, Detector protects personnel by emitting a field of invisible infrared light in front of the hazard. When this light beam is obstructed, Detector immediately sends a stop signal.

Agency Approvals[1]

All Detectors for 115 Vac are listed by Underwriter's Laboratories to UL 491, *"Power Operated Machine Controls and Systems"*, CSA C22.2-14, *"Industrial Control Equipment — Industrial Products,"* CSA C22.2-0.8 *"Safety Functions Incorporating Electronic Technology"*, and have AMTRI-verified compliance with British Standards BS 6491: Parts 1 & 2, *"Electro-Sensitive Safety Systems Incorporating Photo-electric Sensing Units."* Detector 1 and Detector 3 also comply with OSHA CFR 1910.212 *"General Machine Guarding"* and 1910.217 *"Mechanical Power Presses,"* ANSI[2] B11.1-1988 *"Mechanical Power Presses"*, ANSI B11.19 *"Performance Criteria for Safeguarding;"* ANSI B11.20 *"Manufacturing Systems/Cells,"* and ANSI/RIA 15.06 *"Industrial Robots and Robot Systems."*

Why these approvals

UL 491

Underwriter's Laboratories is the largest independent Nationally Recognized Testing Laboratory (NRTL) in the USA, well-known for creating standards for electrical safety. ANSI/UL 508: 1993, *"Industrial Control Equipment"*, has been accepted as a national standard by ANSI.

Products have been tested and listed by UL under UL 491 since 1975. The Proposed First Edition is based on UL 508 and adds further testing for control reliability; FMEA (Failure Modes and Effects Analysis) to verify that any component under any failure mode does not create an unsafe failure; and environmental stresses, such as EMI/EMF, dust, high temperatures, and shock/ vibrations. The date of final publication is not known. When it is published, Detector may need to be retested if there are any changes to the standard. UL 491 remains as the only US standard for testing the safety of your light curtain.

CSA C22.2-0.8

It is important to ensure that a light curtain is tested for both C22.2-14 and C22.2-0.8. CSA C22.2-14 is roughly equivalent to UL 508, but CSA C22.2-0.8 checks for control reliability and FMEA.

BS 6491

It is one of the very few standards in effect today dedicated only to presence-sensing devices. Every light curtain sold in the UK must be tested for BS6491[3] compliance by an independent laboratory, such as AMTRI. Comprehensive testing includes control reliability and FMEA.

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1 Detector 3 has been submitted for listing to UL491 and CSA C22.2 (-0.8 and -14). It will be submitted for certification to EN50100, upon its approval by the European Community. Adoption of EN50100 will obsolete BS6491.

2 ANSI – American National Standards Institute.

3 Upon British adoption of preliminary EN50100 (may be redesignated as an IEC document), BS6491 will become obsolete.

2-box versus 3-box systems

The Detector 1 (the 2-box system) consists of a transmitter and receiver pair that are not "matched sets." In other words, a transmitter will work with *any same-sized* Detector receiver.

Detector 3 (the 3-box system) includes an additional component — a control box. Detector 3 comes with interchangeable quick-connect cables (in assorted lengths) that easily connect each optic head to the control box. Detector 3 also has the unique capability of allowing you to wire a second set of optic heads to the same control box. Like Detector 1, Detector 3 is not a matched set.

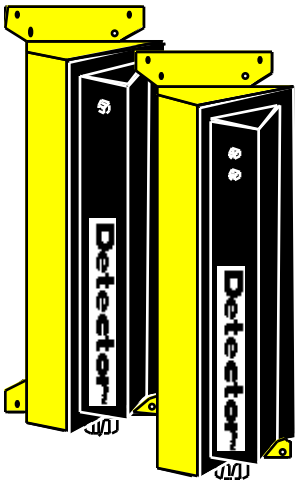


Figure 1a. Detector 1 Safety Light Curtain (2-box system)

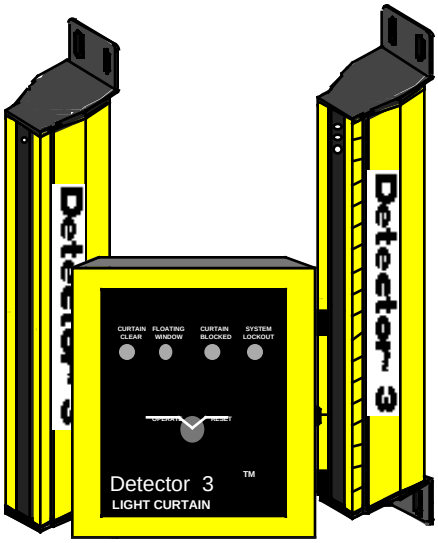


Figure 1b. Detector 3 Safety Light Curtain (3-box system)

Detector and Control Reliability

Detector is control reliable. Control reliability is a term used by the Occupational Safety & Health Administration (OSHA) and the American National Standards Institute (ANSI). Control reliability means that critical components are duplicated so that if one fails, the other will still allow normal operation to stop the machinery. It also means that if a component does fail, the light curtain will detect the failure and send a stop signal. The light curtain will not allow operation until the repairs are made.

Detector has dual, captive-contact relays which operate simultaneously. Even if one of Detector's control relay contacts fails energized (contacts welded closed), the second relay will still de-energize to send the stop signal to the machinery. Detector will detect the failed relay and will not allow machine operation until the relay is replaced. It is unlikely that both relay contacts will fail simultaneously. Detector 3 also has a third captive contact relay— the lockout relay — that is monitored and checked. It can be configured to mimic stop relays.

Excellent protection

Detector provides far better protection than traditional physical guards. Once *properly* installed, it requires little or no adjustment, and eliminates the worry of personnel forgetting to close gates or replace barriers. The invisible light screen automatically signals hazardous motion to stop without getting in the way of normal operation.

Detector has dual components. As a result, it can shut down the machinery even if a component fails. If a failure does occur, Detector's self-checking circuitry auto-matically detects the failure and sends a stop signal to the machinery. These features make Detector more reliable and more convenient to use than other types of machine guarding.

Detector applications

Detector Safety Light Curtains are commonly used on weld lines, filter presses, roll-formers, powdered metal compactors, surface finishing machinery, robotics, injection molders, folder-gluers, automatic assembly equipment, load/unload stations,

packaging/converting equipment, food processing equipment, and other types of machines and equipment used in factory automation.

You cannot see the actual light barrier emitted by Detector. Detector allows access, but will issue a stop command to prevent hazardous motion *before* a person can reach the hazardous area. This makes it ideal for applications requiring frequent, easy access. Detector can also be used when a barrier presents a clearance hazard, even if frequent access is not required.

Detector is easy to maintain

No adjustments or periodic maintenance is required. It continues working silently. You should, however, clean the lens covers every once in a while if your operation is particularly dusty, dirty, or smoky. A heavy build-up of dirt or oil could block a light beam and cause an inadvertent machine shutdown.

Size and scanning range

Detector 1 is available in 12" (30.5 cm), 18" (45.7 cm), 24" (60.9 cm), 36" (91.5 cm), and 48" (121.9 cm) scanning heights.

Detector 3 is available from 6" (30.25 cm) to 72" (182 cm) scanning heights, in 6" increments.

Scanning range for both models is up to 25 ft. (7.6 m), and up to 50 ft. (15.3 m) is optional. The 6" Detector 3 has 8 light beams (or channels). 12" units have 16 channels, with 8 channels added for each additional 6" height.

Sequenced light pulses

Infrared light is not affected by smoke, dirt, and oil found in a typical industrial environment. The transmitter sends light pulses from the LEDs (light emitting diodes) one at a time in succession from top to bottom. The pulses are so fast (ON for 10 microseconds about every 5 milliseconds) that the effect is a continuous light field across the guarded area.

The Detector receiver contains PTs (phototransistors) that detect light from the LEDs. It detects only the light pulse designated for it, by being enabled (powered up) only at the instant that the beam is expected. Each PT must turn on — then off in sequence, or Detector will send a stop command to the machinery.

Because the receiver only accepts *infrared* light pulses of a certain duration in proper sequence, Detector cannot be affected or fooled by other light sources. All continuous light sources and even pulsed light sources are "tuned out." Also, changes in area lighting, flashing strobe lights, or the incidence of "cross talk" will not adversely affect operation.

Cross talk may occur when two sets of Detectors are installed on the same or separate machines in close proximity to each other. As a result, the PTs from the first set's transmitter are detected by the LEDs from the second set's receiver, possibly leading to random stops. Although cross talk could generate intermittent shutdowns, it cannot cause a hazardous situation.

If your application requires two sets of Detectors in close proximity of each other, you may need to alternate the sets to avoid the incidence of cross talk between the two sets. See the following illustration.

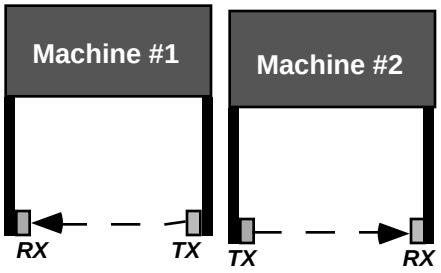


Figure 2. Plan view: avoiding cross talk
Using 2 sets of Detectors and reversing heads

Lensing and Optical Short Circuits

From a safety standpoint, it is assumed that the transmitter's light goes straight to the receiver – defining a "plane of detection." Light can be reflected which is useful for up to 3-sided guarding with mirrors. However it may be disastrous if it were unexpected. An optical short circuit means that the light is reflected off a shiny object (e.g. tooling, reflective paint or surface) before getting to the receiver. See Figures 3a and 3b.

If optical short circuits are expected, the plane of detection is uncertain making proper installation difficult. Light curtains are required to be installed so that hazardous motion stops before a person can reach the hazard. This installation distance from the hazard is called the safety distance which assumes no optical short circuits and a known plane of detection. (Safety distance is discussed later in this guide).

Light curtain "lensing" is described by angle of divergence (transmitter) and angle of acceptance (receiver) specifications. Industry standards and studies have determined that the angle of divergence/ acceptance should be less than ±2°, to prevent optical short circuits.

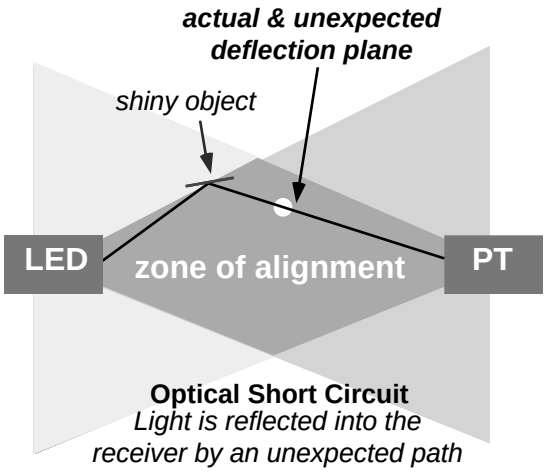


Figure 3a. Unlensed Optics/Optical Short Circuit

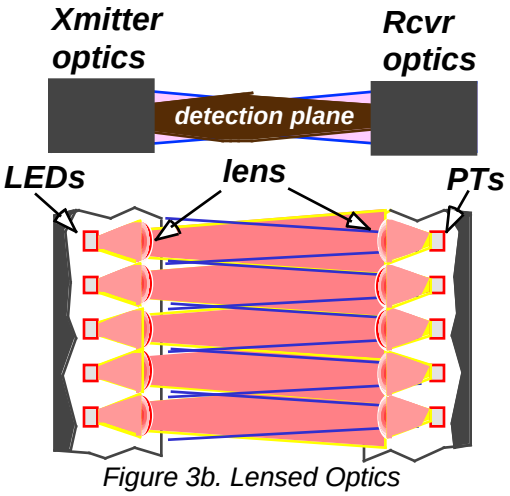


Figure 3b. Lensed Optics

Remember that the PTs are turned on in sequence. Therefore only one PT is looking for its LEDs light at one time.

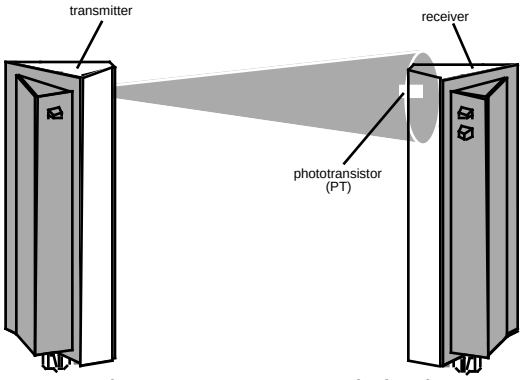


Figure 4a. Detector 1 (2-box)

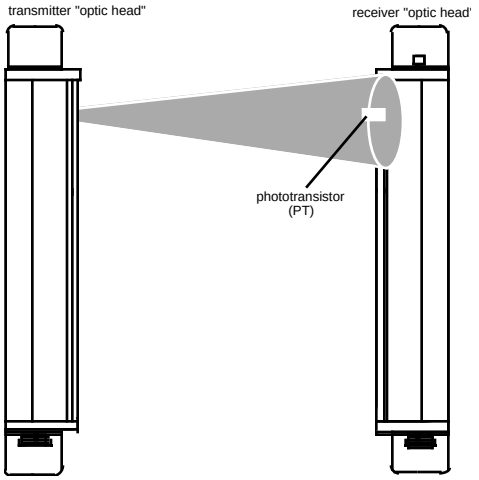


Figure 4b. Detector 3
control box and cables not shown

To optimize alignment and vibration tolerance, it is important to install Detector so that the PT is centered within the light cone of the mating LED.

Detector sends the stop signal

When you block one of the beams, the PT does not get its light when it expects it. No light means no electrical signal from the PT. Without the electrical signal, Detector's control circuitry de-energizes the output relays. With the normally open (NO) outputs[1] , they would change state, going from closed (energized and "green") to open (de-energized and "red"). Any normally closed (NC) outputs would also change state, going from open to closed. Because these relay contacts are connected to the machine's immediate stop circuit, a stop is issued. The response time of Detector 1 from loss of light to relay de-energization is

[1] Detector 1 standard stop outputs are two NO (held closed) relay outputs. One NO held closed and one NC held open are also optionally available.

30 milliseconds (50 ms for 36" and 48"). The response time of Detector 3 is 25 ms to 48" heights (35 ms for 54" through 72").

Indicator lights on Detector

Detectors have indicators on both optic heads. Detector 3 also has indicators on the control box which tell you the operating condition. The following illustrates a portion of Detector's 3's control box showing the indicators.

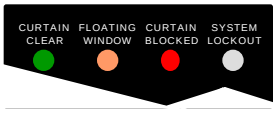


Figure 5. Section of control Box , showing indicators

The receivers on both models have a red indicator and green indicator. The green light (bottom light) means the light curtain is unobstructed (control relay contacts held in the unobstructed/energized state).

The red indicator means the light curtain is obstructed and the machine will not be allowed to operate (control relay contacts held in the obstructed/de-energized state). Detector 1's “red” means the output relays are de-energized, which may also be due to an internal failure. Detector 3’s red and green indicators describe the state of the optics: obstructed or clear. Detector 3's control box indicators describe the state of the output relays. If there is no obstruction and the relays are de-energized, the “system lockout” and “curtain blocked” indicators (found on the control box) illuminate. This may be due to a “lockout” function (latching with a perimeter guard) or an internal failure.

The transmitters of both Detector models have an amber "power on" indicator. When Floating Window is activated, a blinking indicator will illuminate on all Detector receivers and Detector 3's control box. Detector 1's Floating Window indicator is red, while Detector 3's is amber. (optional in Detector 1; standard in Detector 3; see the section "Floating Window" later in this guide).

Blanking Windows

Blanking windows allow you to disable one or more beams of the light curtain in an area where a fixture penetrates the light field Any beam can be blanked on Detector 3. However with Detector 1, all but beam #1 can be blanked.

Blanking allows stationery fixtures to penetrates into Detector's light field. For example, a conveyor or work table, which is required for your operation, protrudes into the light field. A blanking window is installed on the Detector receiver where the fixture penetrates the field. This disables the light beam that would normally detect the fixture. If the light field is obstructed in any area above or below the fixture or “blanked” light beam, the Detector will send a stop signal to the machine.

The blanking window is easy to install. If you are blanking more than one beam, attach the master blanking window first and then connect “slave” windows on top. This increases the blanked area.

Because these blanking windows attach to the receiver, they are clearly visible to personnel — a safety feature.

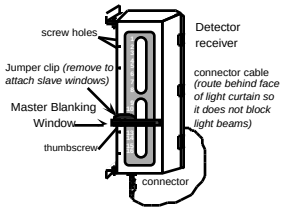


Figure 6a. Detector 1 with blanking window

Detector 3 includes an option for non-consecutive blanking. The Detector 3 Dual Master Adapter (3DMA) easily plugs into the blanking window connector on the top of the receiver and allows you to connect two master blanking windows in a non-contiguous fashion. *Note: The maximum number of beams that can be blanked is 5.*

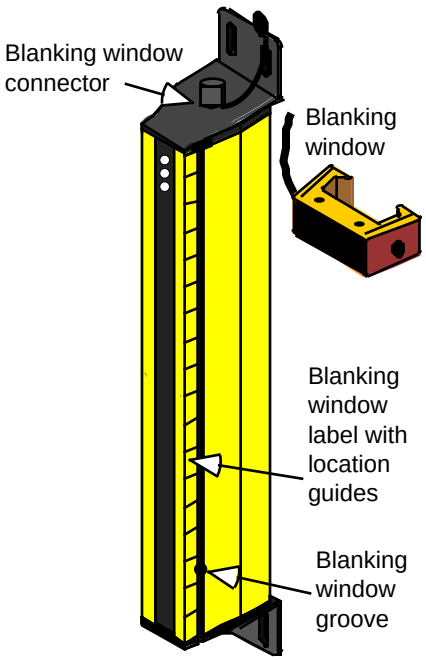


Figure 6b. Detector 3 with blanking window

Floating Window

The floating window provides a means for the random bypass of one beam of the light curtain at a time. It is useful in those applications where material, air ejected parts, or scrap must pass through, or move within the sensing field in a random pattern. In Figure 6, for instance, coil stock obstructs different light beams as the coil unwinds. As long as only one beam is obstructed at a time (no matter which one) Detector allows machinery to operate.

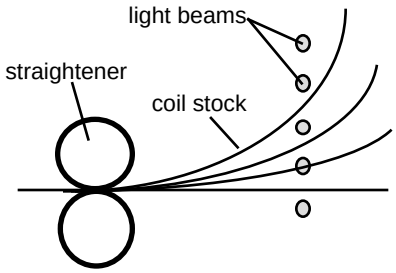


Figure 7. Unwinding coil using Floating window

The floating window may only be used when material or parts will not occupy a space greater than 1 1/8" (4.4 cm) within the sensing field. Larger material would obstruct more than one light beam at a time, which would then result in a stop command.

Floating window is a factory option with Detector 1. A standard feature in Detector 3, floating window must be enabled inside the control box. If your Detector 1 has the floating window option, you will see a keylock switch on the receiver, and an additional, small red indicator located under the large indicators on the receiver will be present. If floating window is enabled inside the Detector 3 control box, the amber floating window indicators on the receiver and on the control box will blink.

OSHA and ANSI requirements

All machine safeguarding devices, including Detector, must be located at the correct safety distance from the pinch point or hazardous area. OSHA regulations govern the mounting of infrared light curtains when used with mechanical power presses (OSHA 1910.217). The OSHA formula should be used as a guide in other applications since at present there is no universally accepted formula for safety distance which governs general machine guarding.

When calculating safety distance, Data Instruments recommends that you use the formula included in ANSI B11.1-1988 and ANSI B11.19-1990. This formula represents a recent consensus on the proper installation of light curtains.

The OSHA safety distance formula

Here is the OSHA safety distance formula as specified in OSHA 1910.217.

63 inches-per-second is the OSHA-recommended hand-speed constant.

$D_s = 63 \times T_s$

D_s is OSHA safety distance in inches

T_s is the stopping time of the machine in seconds, measured at maximum velocity). T_s must include all components that are involved in stopping the machinery, including: response time of the machine control that activates the brake and response time of the light curtain (Detector 1: 30 ms for 12", 18", and 24", 50 ms for 36" and 48" models; and Detector 3: 25 ms for up to 48", 35 ms for 54" through 72"); plus response time of other devices if also involved in stopping the machinery.

The ANSI safety distance formula

$$D_s = 63 \times (T_s + T_c + T_r + T_{bm}) + D_{pf}$$

D_s is the ANSI safety distance in inches. It is similar to OSHA's formula, except that it takes into account more variables, such as response times, stopping performance monitor setting, and depth penetration factor. T_s, T_c, and T_r are the worst case response times of the machine T_s, the control T_c, and the light curtain T_r. Response time for the Detector 1 is 30 ms (50 ms for 36" and 48" models), with Detector 3 at 25 ms (35 ms for 54" - 72").

T_{bm} is additional stopping time of the machine allowed by the stopping performance monitor.

D_{pf} is the depth penetration factor and equals 3.3" (8.4 cm). Depth penetration factor is a measure of how far an object, like a hand, can move through the light curtain before the light curtain reacts. D_{pf} is related to the object sensitivity.

Object sensitivity

Object sensitivity is the smallest diameter object that Detector will detect anywhere in its field. Object sensitivity ***(S)*** for Detector is 1.25" (3.2 cm), with beam centers of 3/4" (1.9 cm). It will detect an object of this diameter anywhere in the sensing field. An object smaller than 1 1/4" diameter could pass through the light field if it traveled in a path directly between the light beams.

European standards discuss object sensitivity as it relates to the type of detection provided. For example, object sensitivity of less than 0.6" (1.5 cm) provides finger detection. Object sensitivities greater than 0.6" and up to 1.3" (~3.3 cm) offer hand detection. Object sensitivities within the hand detection range are equally effective.

Perimeter Guarding

For perimeter safeguarding, there is another consideration — walking speed combined with the hand speed. This is because personnel might be walking while simultaneously reaching into a safeguarded area. Although there is no commonly accepted "walking speed constant" like the "hand constant," you might use ergonomic tables or possibly even 100 inches per second, which is a conservative European "speed constant." For perimeter guarding, the formula would be…

$$D_s = (100) \times (T_s + T_c + T_r + T_{bm}) + D_{pf}$$

Blanking / Floating affects safety distance

If you use a blanking or floating blanking, safety distance is affected because you are changing the sensitivity of the light curtain. A blanking window or floating blanking window blocks one light beam, creating an additional 3/4" (1.9 cm) passageway through the light field where no object will be detected. The minimum size that Detector can sense is an object 1.25" (3.17 cm) in diameter. Anything smaller might fit between two light beams.

The ANSI safety distance formula states that if the object sensitivity increases, the safety distance must also increase. Using blanking windows will require moving the light curtain farther back from the hazardous area (increased D_{pf}). The rule for increasing safety distance is this: *Add 2.6" (6.6 cm) to the safety distance for every window used, up to 2 beams maximum.*

If the blanked area is *entirely* blocked by a fixture such that operator intrusion would be impossible, you do not need to change the safety distance. For instance, you might have a work table that protrudes into the light field but takes up the whole unprotected space between the transmitter and receiver.

If the blanked area is not obstructed physically, the object sensitivity is 2" wide (5.08 cm) (2" = 1 1/4" + 3/4"). The D_{pf} equals 5.9" (15 cm), which is 2.6" more than an unblanked Detector (2.6" = 5.9 - 3.3).

You can blank more than one beam of the light curtain by adding slave windows to the master window. *Always remove* blanking windows when they are no longer required.

Blanking more than two beams can create a large, unprotected passageway through the light curtain. If this passageway is not completely filled by a fixture, the operator would be subject to a particularly dangerous working environment.

Pass-through protection

Another important impact on safety distance is "pass-through protection." To illustrate, consider that you have determined your safety distance to be 12" from the hazardous point of operation — "pinch point." There is a danger that a person could become trapped between the light curtain and the pinch point.

A recommendation would be to install a second set of light curtains mounted *horizontally* between the *vertical* light curtain and the hazard. See the illustration below. If you have Detector 3, two sets of optic heads can be wired to the same control box.

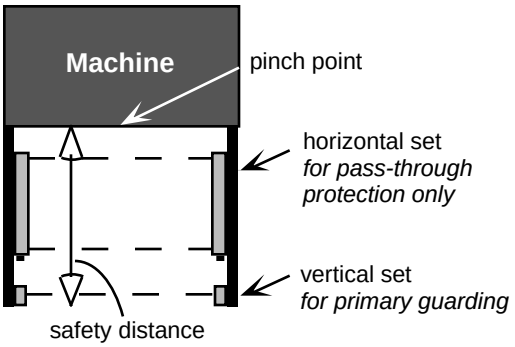


Figure 8. Plan view showing "pass through protection"

The size of the horizontal light curtain should be the minimum length necessary to detect the thinnest operator standing between the vertical light curtain and pinch point. For example, a 6" light curtain located in the center of a 12" safety distance at waist height may be reasonable.

Using Mirrors

Data Instruments has optional mirrors for two- or three-sided guarding with Detector. There are two styles of Data Instruments mirrors: the original "box" style in Figure 9 and the Detector 3 mirror (used with universal mounts[1]), shown in Figure 10. Refer to Tables 2a and 2b for mirror dimensions. Both styles can be used with either Detector.

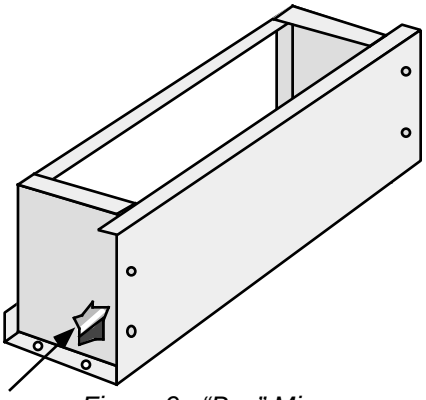


Figure 9. "Box" Mirror
Cut-away shows mirror surface

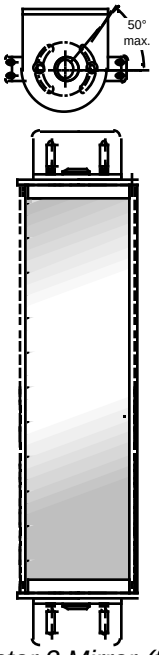


Figure 10. Detector 3 Mirror (front & top view)

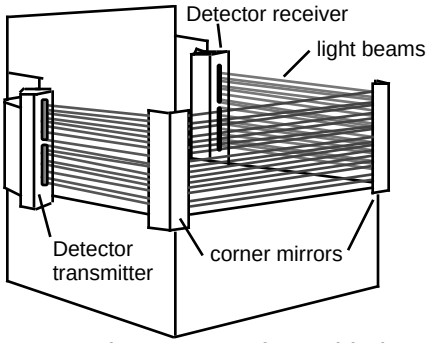


Figure 11. Using Detector for 3-sided guarding

In the above illustration, Detector's transmitter and receiver are aimed at the mirrors. The light beam is reflected from the transmitter by the mirrors to the receiver. This method could be used on any type of machinery where two- or three-sided guarding is required.

[1] Universal mounts are located at the top and bottom of each Detector 3 optic head, and are held in place by mounting screws. They can be rotated ±30° to facilitate installation and alignment. See the Detector 3 user manual for installation information.

You do not have to arrange Detector and mirrors in a rectangle as shown. You can adjust the mirrors to reflect light from the Detector transmitter at positions other than right angles. Detector aligns in the same way whether you are using mirrors or not. Even though the transmitter and receiver will not be pointed at each other, the units and the mirrors must be mounted in line with each other so each PT in the receiver can detect the light beam coming from its opposite LED.

When using mirrors, the scanning range is reduced by 10% per mirror. If you use two mirrors, the maximum extended range unit is 40 ft. (50 feet minus 10 feet).

It is important to note that the use of mirrors not only decreases the scanning range, but also decreases the alignment and vibration tolerance. That is why no more than two mirrors should be used.

Wiring the Detector 1

The transmitter and receiver are wired independently to a 115 Vac 50-60 Hz single phase power source, and the output circuit[1] from the Detector 1 receiver (see Figure 12) unit is wired to the machine's stop circuit.

Note: A specially-modified Detector 1 can be used with 220 Vac, 50 Hz.

Please refer to the specifications in this guide and specific installation instructions in the Detector 1 User Manual.

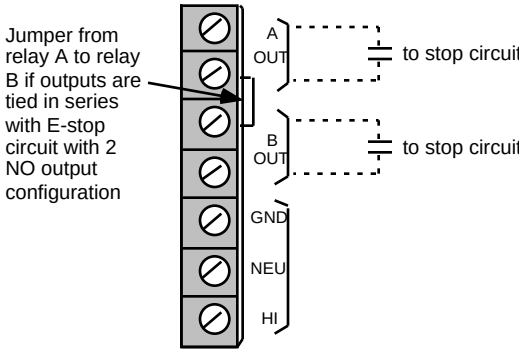


Figure 12. Detector 1 Receiver wiring

Wiring the Detector 3

You can easily connect the Detector 3 optic heads to the control box using interchangeable quick-connect cables. The control box can be wired either to a 115 Vac or 230 Vac power source. A convenient voltage selector switch is located on Detector 3's control circuit board.

The machine interconnections are all completed inside the Detector 3 control box. For instance, if you use two NO stop outputs and connect to a relay-based stop circuit or single string immediate stop circuit, first tie the outputs in series so that you only have one set of wires to connect to your control. If you use one NO / one NC stop outputs and connect to a relay-based stop circuit or a single immediate stop string, exercise great caution. With this configuration, the NC output's logic must be inverted to connect to the stop circuit. The inverting logic *must* also be control reliable.

Please refer to the specifications in this guide and specific installation instructions in the Detector 3 User Manual.

Wiring Detectors to a PLC

When wiring Detector Light Curtains to a Programmable Logic Controller (PLC) or other type of microprocessor-based control, two (or more) independent logic systems should be used to control the machine's stop circuit. *Data Instruments does not provide specific step-by-step instructions for connecting Detectors to PLC's.* This is because of the variety of PLC's and the various programming techniques used.

To ensure maximum safety, you must wire and program the PLC so that it can detect an internal component failure and immediately stop the machine. Both outputs from Detector's control relays must be connected separately. Next, you must create a program that will check and compare each input signal from the Detector relays independently. The program should stop the machine immediately if the inputs or their checks disagree. Also, with Detector relays wired separately to the PLC, if one of Detector's control relay contacts were to be weld closed preventing the stop signal to be

[1] See "Detector sends the stop signal" in this guide for relay operation information about standard N/O outputs and optional one NO, one NC outputs.

sent to the PLC, the other relay would still open to send the stop signal. If you do not connect Detector to the PLC properly and a component in the PLC fails, the PLC may incorrectly read the Detector signals. Then even though Detector signals a stop, the PLC does not stop the machine. This situation must not occur.

Remote testing of PLC input modules

Detector's “Remote Interrupt” (machine test) capability can be used to test your PLC's input modules, adding another level of safety to your operation (provided with Detectors 1 and 3). Before starting the machine, the PLC can momentarily interrupt the transmitter's function and watch the redundant output relays open, and then resume the transmitter's normal operation and watch the relays close (see Figure 13a for Detector 1 and Figure 13b for Detector 3). If the input modules do not respond properly and simultaneously, the PLC can inhibit the machine from further operation until the PLC inputs have been checked out.

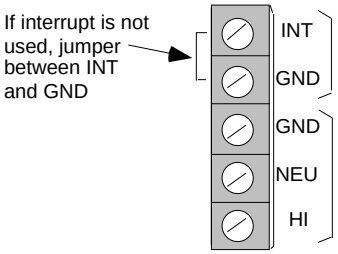


Figure 13a. Detector 1 transmitter terminal

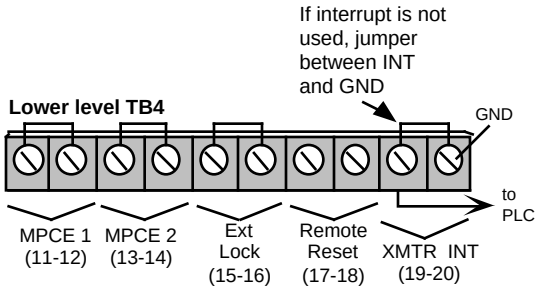


Figure 13b. Detector 3 terminal TB4 (lower)

Optional wiring for Detector 3

There are various optional features available with Detector 3. These include wiring for remote reset, indicator outputs, MPCE monitor input (MPCE stands for "Machine Primary Control Element"), and external lockout input. *Carefully review the user manual to ensure proper installation.*

Remote reset

The remote reset feature allows you to reset Detector 3 from a remote location. It is strongly recommended that you install a keylock switch similar to the one on the Detector control box to ensure security.

Indicator outputs

You can wire all 4 indicator outputs to *customer-supplied* solid-state relays. These indicator outputs are NOT control reliable and must not be used to protect personnel from a hazard. They, however, can be used as a convenience to interface automation or enable remote indicators. These outputs (open collectors to ground), allow you to remotely view Detector 3's operating status by mimicking the indicators at the Detector control box.

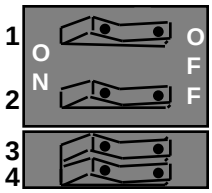
MPCE monitor inputs

With Detector 3, you can monitor the performance of your relays via the MPCE monitor inputs if you wire the Detector stop circuits to interfacing relays (instead of in series with the machine's immediate stop circuit or with control reliable safety relays). MPCE monitoring is recommended if you use a NC output from Detector 3's stop outputs. Here, the NC logic must be inverted at the machine control and must be control reliable, requiring careful consideration.

External lockout input

Detector 3 allows you to lockout the machine by opening a remote contact. A lockout condition cannot be reset at the Detector 3 control until the remote contact is closed.

Detector 3 optional settings



(factory settings at "off")

Figure 14. Detector 3 switch settings

Detector 3 includes optional settings that can be made inside the control box (see Figure 14).

1. OFF: When Detector 3 is powered up, the machine cannot be operated until Detector 3 has been reset.

   ON: Disables this feature.

2. ON: This setting creates a lockout condition if one or more light beams has been obstructed. Detector 3 does not reset to green automatically even if the obstruction has been removed. To resume operation, correct the condition and reset Detector 3. This feature is useful in perimeter guarding applications.

3. ON: This enables floating window option. See "Floating Window" earlier in this guide.

4. ON: Here, the lockout relay can be used to "mimic" the output relays. This feature is useful for turning a remote indicator on or for status input to a PLC.

Weld Shields

Weld shields are made of hard-coated acrylic (1.7" wide, 0.125" thick). Figure 15 shows the weld shields on Detector 1 (left) and Detector 3 (right).

Detector 1 weld shields can be installed on each transmitter and receiver. There are weld shield guides at every 12" on each "weld shield ready" Detector 1 optic head, along with easy slide-through tracks.

Weld shields are also available for Detector 3. There are screw holes at the top, bottom, and sides of each Detector 3 optic head. These are used to fasten the weld shields in place. Weld shields can be easily field-installed to any existing Detector 3. Detector 3 blanking windows can slide outside the weld shield.

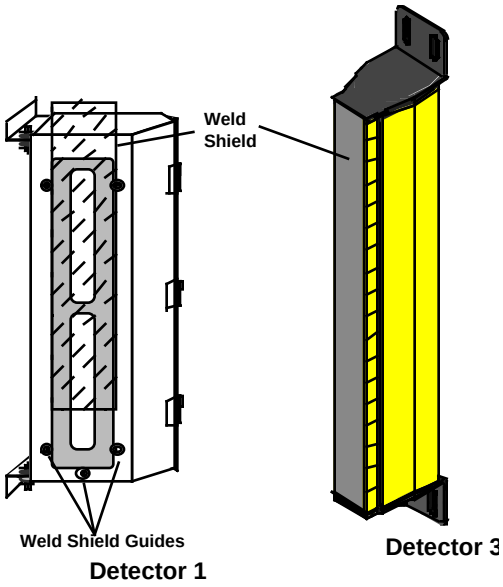


Figure 15. Detector Weld shields

Warning! This is not a User Manual!

This document is not a User Manual. It is a technical reference guide to be used strictly for acquainting you with the technical characteristics of Detector Safety Light Curtains and is not intended to provide the reader with installation or operating instructions. For detailed information on installation, operation, troubleshooting, and the appropriate safety precautions which must be met, you must consult the applicable Detector User Manual which accompanies all Detector shipments.

Table 1a. Detector 1 dimensions (receiver represented) with 1 blanking window installed

Model	Dimensions xx.xx inches (xx.xx centimeters)								Recommended Bolt Size *	
	A		B		C		D		Inner	Outer
12 (30)	13.87	(35.23)	14.64	(37.19)	15.70	(39.88)	16.50	(41.91)	1/4–20	5/16-18
18 (45)	19.87	(50.47)	20.64	(52.43)	21.70	(55.12)	22.50	(57.15)	1/4–20	5/16-18
24 (61)	25.87	(65.71)	26.64	(67.66)	27.70	(70.36)	28.50	(72.39)		5/16-18
36 (91)	37.87	(96.18)	38.64	(98.15)	39.70	(100.84)	40.50	(102.87)		5/16-18
48 (122)	49.87	(126.7)	50.64	(128.6)	51.70	(131.30)	52.50	(133.40)		5/16-18

** Inner or outer mounting holes can be used for 12" and 18" units*

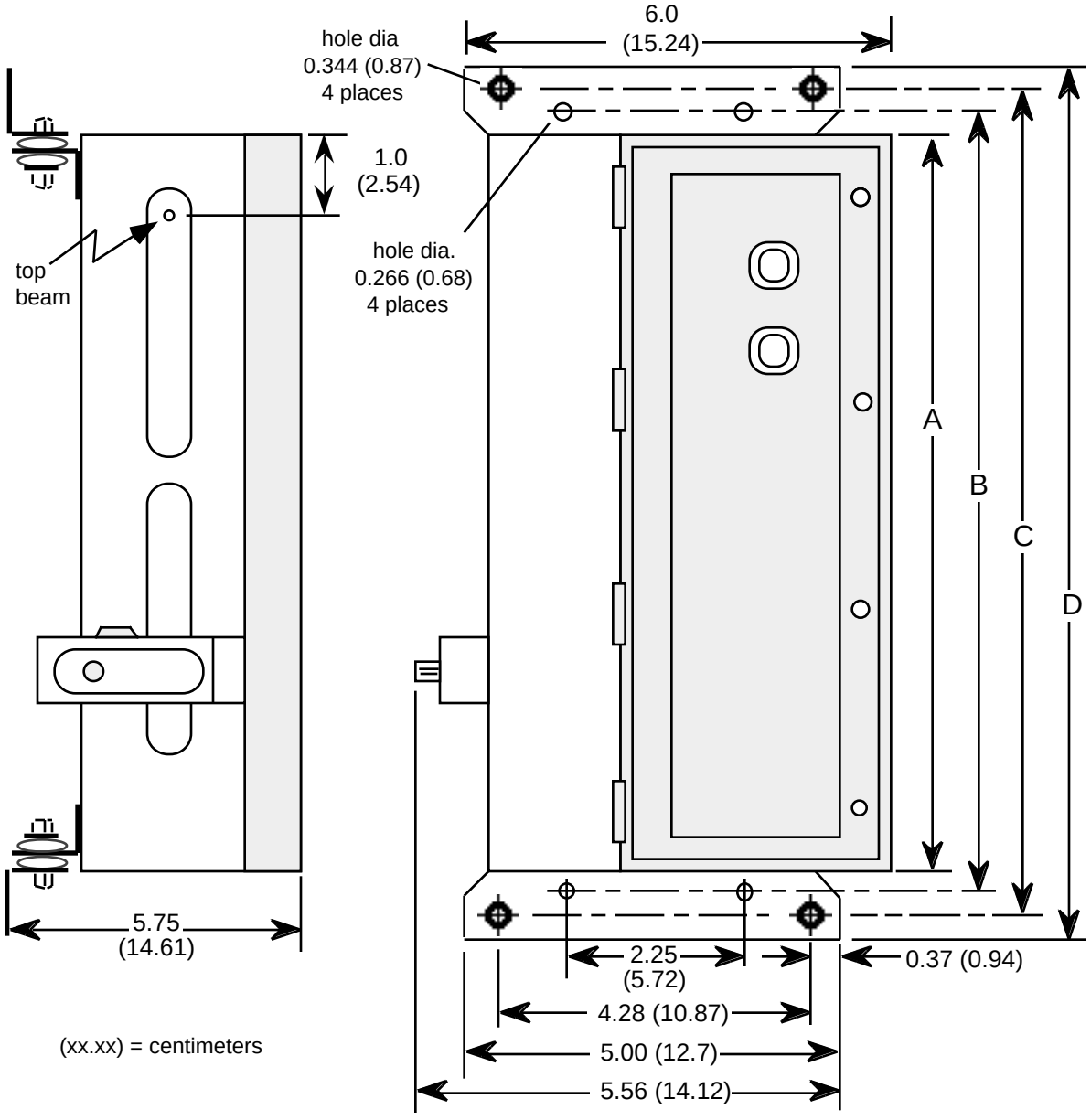
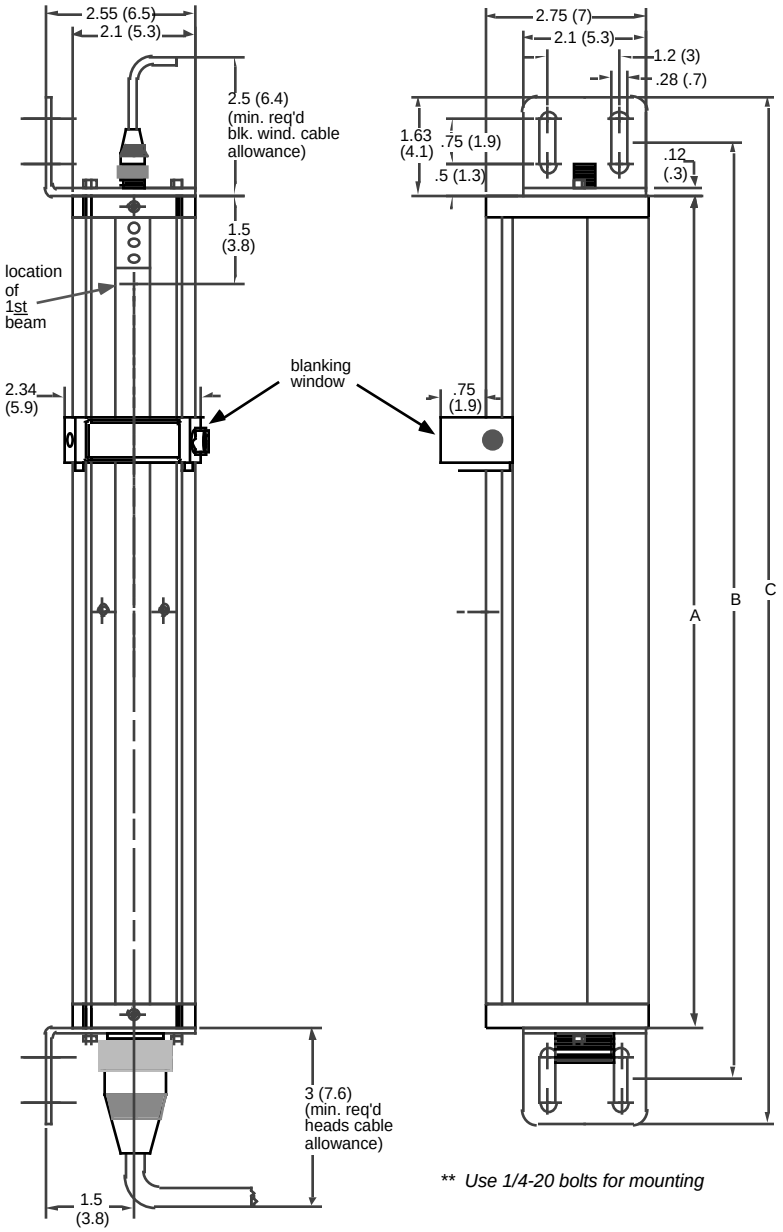


Table 1b. Detector 3 optic heads dimensions (refer to chart below)



receiver shown above with 1 blanking window installed

Size	A	B	C
6 (15)	7.75 (19.7)	9.5 (24.1)	11 (27.9)
12 (30)	13.75 (34.9)	15.5 (39.4)	17 (43.2)
18 (45)	19.75 (50.2)	21.5 (54.6)	23 (58.4)
24 (61)	25.75 (65.4)	27.5 (69.9)	29 (73.7)
30 (76)	31.75 (80.6)	33.5 (85.1)	35 (88.9)
36 (91)	37.75 (95.9)	39.5 (100.3)	41 (104.1)
42 (106)	43.75 (111.1)	45.5 (115.6)	47 (119.4)
48 (122)	49.75 (126.4)	51.5 (130.8)	53 (134.6)
54 (137)	55.75 (141.6)	57.5 (146.1)	59 (149.9)
60 (152)	61.75 (156.8)	63.5 (161.3)	65 (165.1)
66 (167)	67.75 (172.1)	69.5 (176.5)	71 (180.3)
72 (183)	73.75 (187.3)	75.5 (191.8)	77 (195.6)

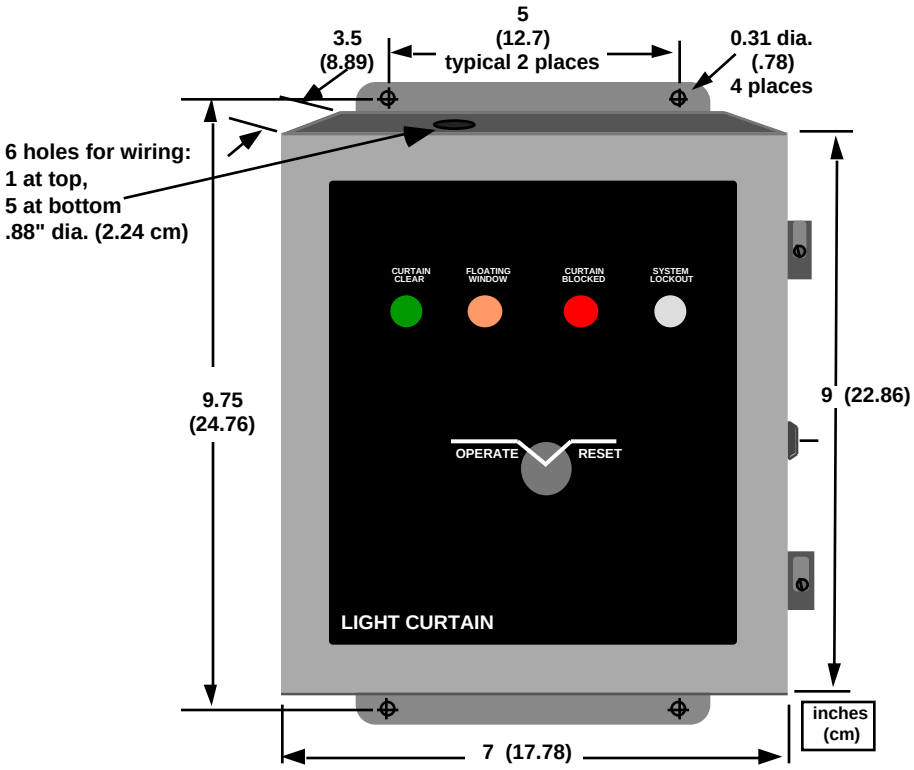


Figure 16. Detector 3 Control Box mounting dimensions

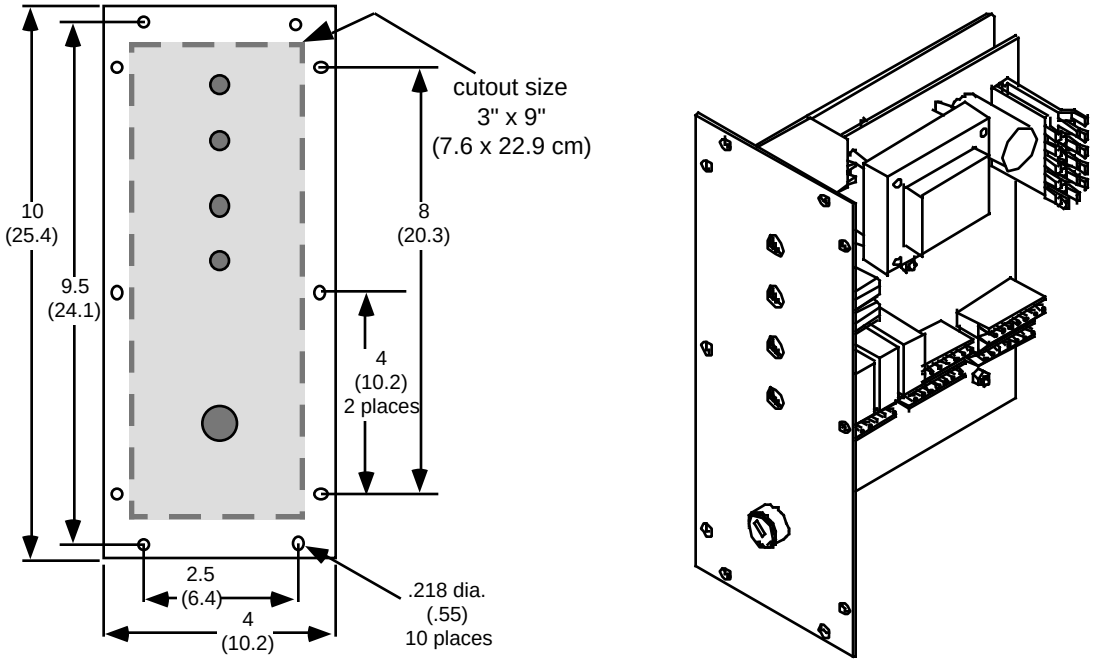
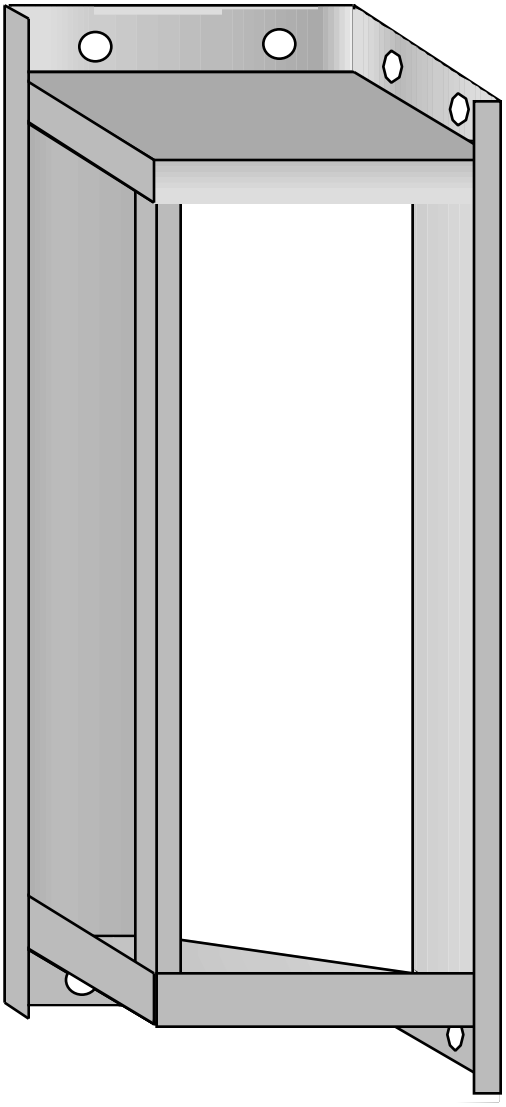


Figure 17. Detector 3 Panel Mount Control dimensions (left) and illustration (right)
Note: Allow 8" depth clearance.

Table 2a. Detector “Box-style” mirror dimensions

Model	Dimensions xx.xx inches (xx.xx centimeters)						
	A	B	C	D	E dia	F	G
12 (30)	16.44 (41.76)	17.44 (44.30)	4.25 (10.76)	0.5 (1.3)	0.250 (0.64)	2.25 (5.72)	0.94 (2.29)
18 (45)	22.44 (57.00)	23.44 (59.54)	4.25 (10.76)	0.5 (1.3)	0.250 (0.64)	2.25 (5.72)	0.94 (2.29)
24 (61)	28.44 (72.24)	29.44 (74.78)	4.25 (10.76)	0.5 (1.3)	0.250 (0.64)	2.25 (5.72)	0.94 (2.29)
36 (91)	42.88 (108.9)	44.00 (111.76)	6.00 (15.24)	0.55 (1.4)	0.312 (0.79)	4.00 (10.16)	1.00 (2.54)
48 (122)	54.88 (139.4)	56.00 (142.2)	6.00 (15.24)	0.55 (1.4)	0.312 (0.79)	4.00 (10.16)	1.00 (2.54)



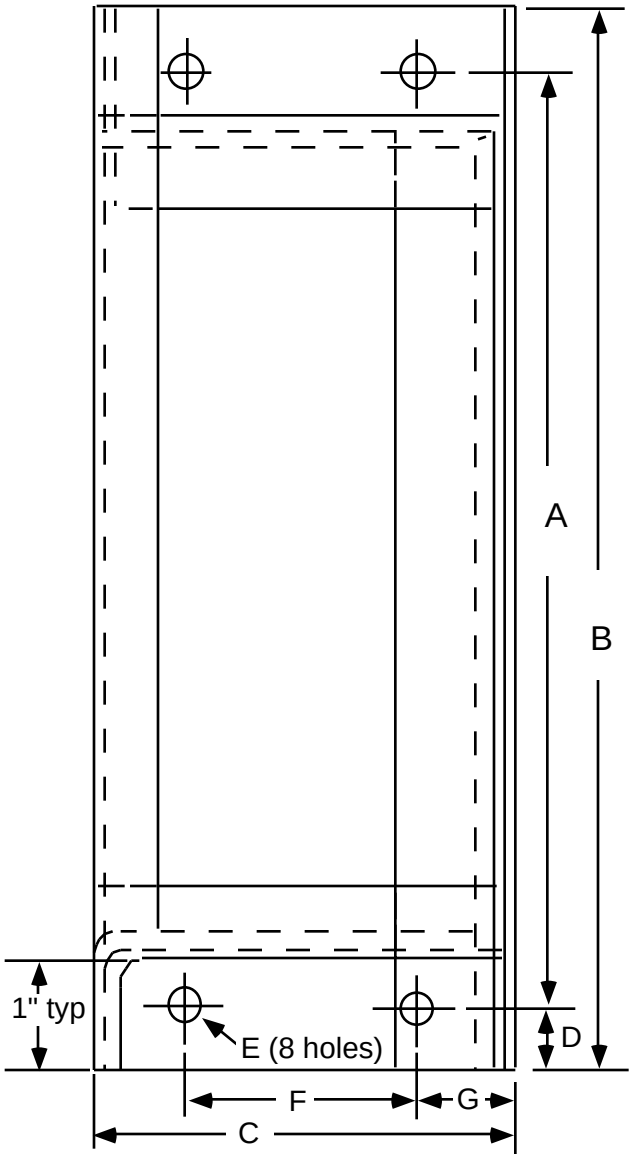
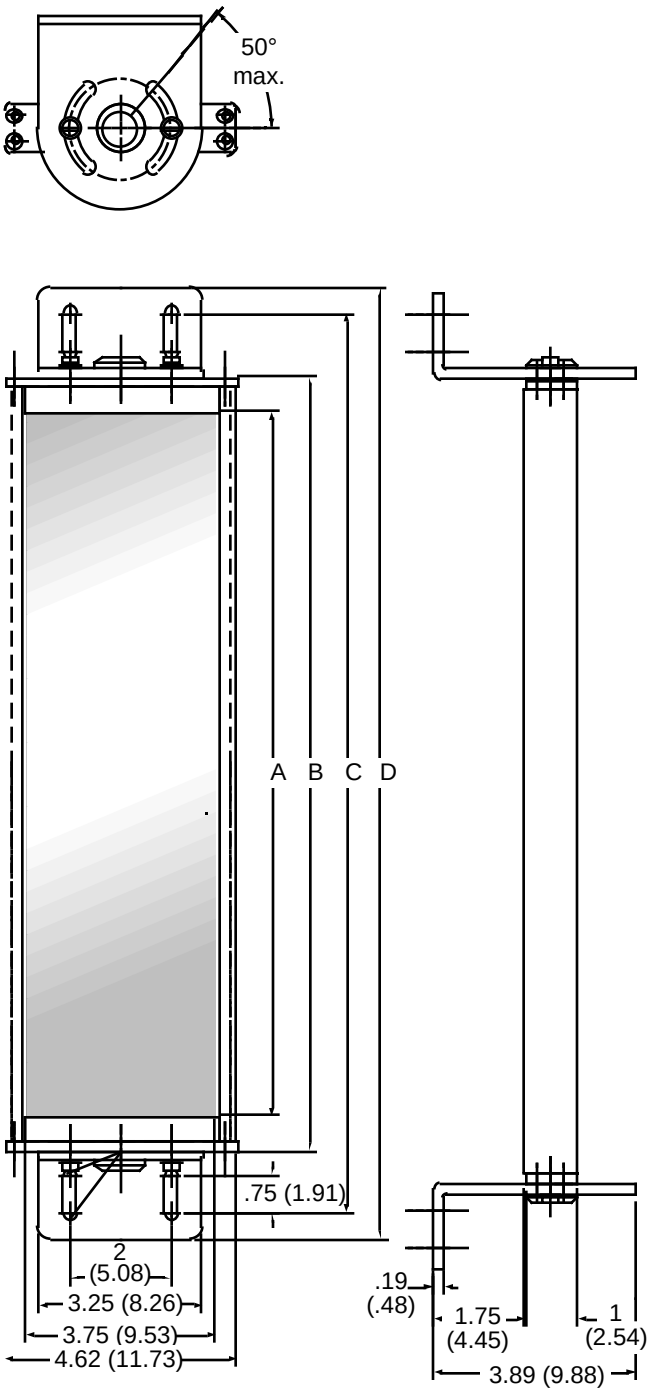


Illustration of Mirror Assembly, not to scale

Table 2b. Detector 3 mirror dimensions



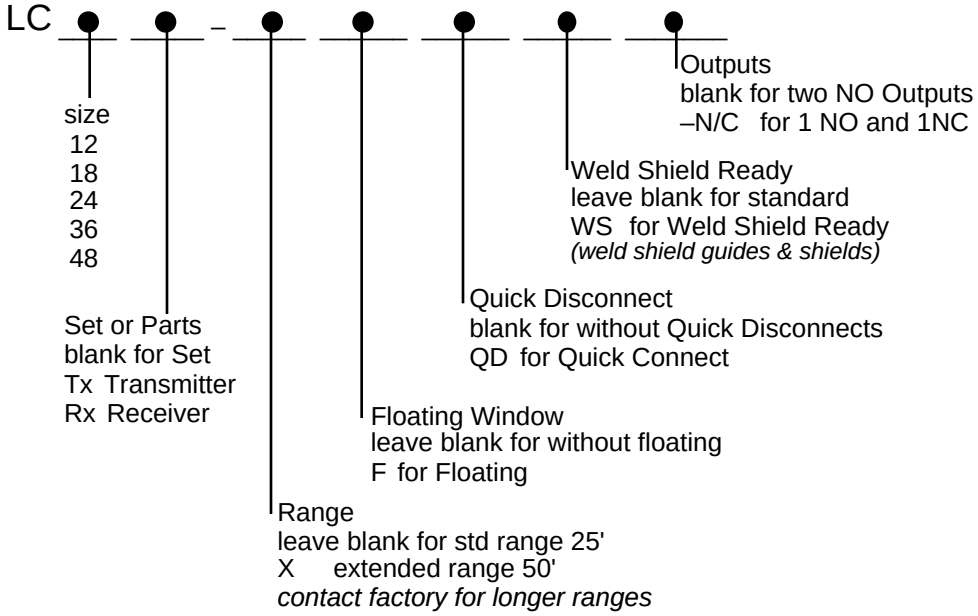
Model	A	B	C	D
6 in.	8	9.38	11.88	12.64
12 in.	14	15.38	17.88	18.64
18 in.	20	21.38	23.88	24.64
24 in.	26	27.38	29.88	30.64
30 in.	32	33.38	35.88	36.64
36 in.	38	39.38	41.88	42.64
42 in.	44	45.38	47.88	48.64
48 in.	50	51.38	53.88	54.64
54 in.	56	57.38	59.88	60.64
60 in.	62	63.38	65.88	66.64
66 in.	68	69.38	71.88	72.64
72 in.	74	75.38	77.88	78.64

Table 3. Detector Safety Light Curtain Specifications

Specifications	**Detector 1** *(2-box system)*	**Detector 3** *(3-box system)*
Scanning Heights:	12", 18", 24", 36", 48" (30.5, 45.7, 61, 91.5, 122 cm)	12 models 6" to 72" in 6" increments (15.3 to 183 cm in 15.3 cm incr.)
Scanning Range:	Standard: Up to 25 feet (7.6 m) Extended: Up to 50 feet (15.3 m)	
Interchangeability	Transmitter and receivers are not matched sets: a transmitter can be used with any same size receiver within the Detector 1 series and also within the Detector 3 series	
Beams & Object Sens:.	3/4" (1.9 cm) beam centers and 1-1/4" (3.2 cm) object sensitivity	
Angle of Divergence/Acceptance	less than ±2°	
Blanking/Floating	External Blanking Windows required, Optional 1 beam Floating	External Blanking Windows required, 1 beam Floating capability
Response Time:	30 mSec max - 12" to 24" 50 mSec max. - 36" to 48"	25 mSec max. - 6" to 48" 35 mSec max. - 54" to 72"
OUTPUTS:	2 “captive contact” stop relays	3 “captive contact” relays (stop & lockout) & 4 solid state indicator outputs
Stop Circuit / Lockout	2 mech relays, std: 2 NO contacts or opt with 1NO and 1NC output contacts	3 mech relays with NO or NC contacts available on all three relays
	4A @ 240 VAC or DC resistive max	4A @ 240 VAC or DC resistive max
Indicator outputs	Not applicable	4 - open collector NPN, opto-isolated can switch 70V load @ 2mA max *(not control reliable)*
INPUTS:		
Power	110 - 120 Vac, 50-60 Hz; 7 watts, transmitter; 12 watts, receiver (220 Vac available as option)	110 - 120 Vac or 220-240 Vac (DC available) 50 - 60 Hz, 24 watts max
Transmitter/Receiver Sets	One set per system, with no wiring between the transmitter and receiver	Two sets (any height) can be connected to the same control box
MPCE Monitor Input	Not applicable	Closure to ground ON voltage 2V @ 2 mA
Remote Interrupt Input	Closure to ground ON voltage 2V @ 2 mA	Closure to ground ON voltage 2V @ 2 mA
Remote Lockout Input	Not applicable	Closure to ground ON voltage 2V @ 2 mA
Remote Reset Input	Not applicable	Closure to ground ON voltage 2V @ 2 mA
INDICATORS:	Transmitter: Amber (power) Receiver: Green (clear), Red (obstruct) and flashing Red (Floating On)	Transmitter: Amber (power) Rec: Green, Red, & flashing Amber (Floating On) Control Box: Green, Red, Yellow (lock-out), flashing Amber (Floating) Control box also includes internal indicators for power and 1 or 2 set designation
CONSTRUCTION		
Transmitter and Receiver	18 gauge welded steel	Extruded aluminum 0.12" (3 mm) wall min
Control Box	Not applicable	Lockable, 18 gauge welded steel with keylock
Cables	Not applicable	5', 15', 30', 50', & 100' (1.5, 4.5, 9, 15, 30 m) w/ connector at the optic head
ENVIRONMENTAL		
Transmitter and Receiver	NEMA 4 hosedown, IP65	NEMA 4, IP65; Optional explosion-proof encl
Control Box	Not applicable	NEMA 2/IP52. Optional NEMA 4/IP65; Optional Explosion-proof enclosure Optional w/ 4 quick connects for optic head cables
Cables	Not applicable	NEMA 4 Connector at heads. Oil resistant PVC cable std; Opt 30' SJOOW cable with NEMA 4 connectors at both ends
Weight	Heads: 12"- 8 lbs (3.6 kg), 18"- 11 lbs (5 kg), 24"- 13 lbs (5.9 kg), 36"- 19 lbs (8.6); 48" - 23 lbs (10.4 kg)	Heads: 6" = 1.4 lbs (.64 kg), Add 0.9 lbs (.4 kg) for every additional 6 inch Control Box = 9 lbs (4 kg)
Operating Temperature	-4° to +122°F (-20 to 50C)	

Warranty	2 years

Table 4a. Detector 1 (2-box) Safety Light Curtain Model Numbers



Examples[1, 2, 3, 4, 5]

Height	Standard – 25' Scanning Range	Extended Range – 50' Scanning
12"	LC12 (*no floating)*	LC12–X (*no floating)*
12"	LC12–F (*with floating)*	LC12–XF (*with floating)*

Table 5. Detector 1 (2-box) Accessories Model Numbers

Blanking Windows standard	DBWM DBWM36 DBWS	Master for 12" 18", or 24" Master for 36" or 48" Slave for any size
Blanking windows, for "Weld Shield Ready" units	DBWM/WS DBWM36/WS	Master for 12" 18", or 24" Master for 36" or 48"
	DBWS/WS	Slave for any size
Mirrors	M12 , M18 , M24 , M36, and M48	12", 18", 24", 36", 48"
Spares kits	SP-1 SP-2	For 12", 18", or 24" For 36" or 48"
Weld shield, for "Weld Shield Ready" units	12WS, 18WS, 24WS, 36WS, 48WS	Replacements for 12",18", 24", 36", and 48"
User manual	UM-1	For all Detector 1 models

[1] The Detector 1 Light Curtain model numbers are for a set (transmitter and receiver) with two NO outputs.

[2] For 1NO and 1NC outputs, add suffix "–1NC" to the end of "LC" part number as shown above.

[3] For "weld shield ready" Detector 1 units, add suffix "WS" to the end of "LC" part number as shown above.

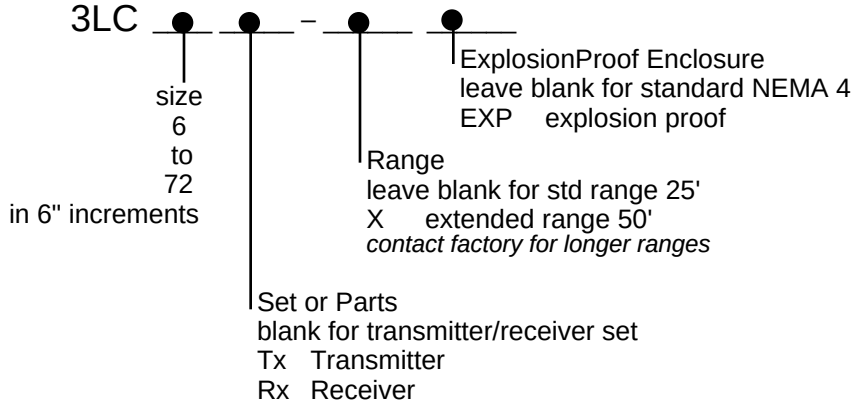
[4] For "Quick Disconnect" Detectors, add suffix "QD" to the end of "LC" part number as shown above. See Table 3 Specifications for connector information. UL and CSA approvals pending.

[5] For Floating Window capability, add suffix "F".

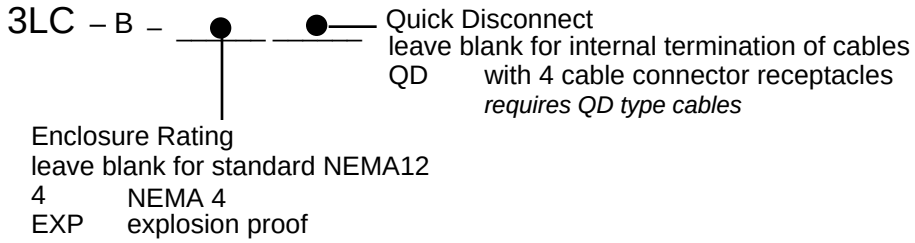
Table 4b. Detector 3 Safety Light Curtain Model Numbers

A Detector 3 system requires a set of optic heads (2 sets maximum per system), a control box, and two cables (1 for each transmitter and 1 for each receiver). Order each item separately.

For the Optics Heads:



For the Control Box:



For the Panel Mount Control: 3LC-PM

For the Cables:

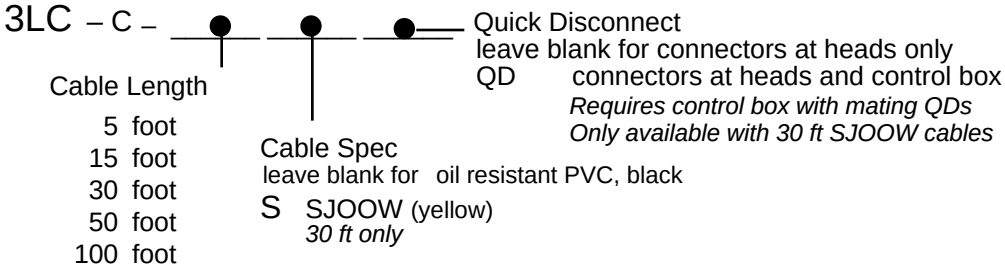


Table 5b. Detector 3 Accessories Model Numbers

Blanking Windows	3DBWM*	Master (multiple cable lengths available, contact factory)
	3DMA	Dual Master Adapter for non-contiguous blanked beams
	3DBWS*	Slave for any size
Mirrors	3M06 thru 3M72	6" thru 72" Detector 3 mirrors
Weld Shield	3WS06 through 3WS72	Clear acrylic shields
Weld Filter	3WF06 through 3WF72	Dark acrylic filter that decreases transmission of weld flash and infrared light (reduces range by 40%)
User manual	UM-3	For all model Detector 3s

* Maximum number of beams that can be blanked is 5.