WARNING . . .
It is the responsibility of the purchaser and user to apply this System in full compliance with all relevant applicable regulations and standards. Refer to the primary manual for a list of applicable standards.

Overview

The Banner PICO-GUARD with Mute Function fiber optic safety system is a diverse-redundant microprocessor-controlled optoelectronic guarding system. Like the base models (without muting function), it consists of a controller, flexible optical fiber, protective sheathing, and fiber optic elements (optical interlock switches, beams, or grids). This document is intended to be used in conjunction with the primary manual, p/n 69761.

The controller features selectable trip or latch output operation. When trip output is selected and the OSSD outputs turn off, the outputs remain disabled until the controller determines the system is safe to turn them back on. When latch output is selected and the OSSD outputs turn off, the outputs remain disabled until the controller reset input has been cycled and the controller determines the system is safe to turn them back on.

The key difference between the model described in this document and the base model (SFCDT-4A1C, described in the primary manual) is that in the ..CM1 model, the USSI inputs have been replaced by four muting device inputs (MS1-MS4). The resulting muting function allows the machine to mute the primary safeguard by monitoring redundant inputs (two or four). This automatically suspends the safeguarding function of a safeguarding device during the non-hazardous portion of the machine cycle.

In this document, the term “muting” refers to the automatic suspension of the safeguarding function of the primary safety device during a non-hazardous portion of the machine cycle. (During the non-hazardous portion of the machine cycle, personnel are not exposed to harm.)
The muting function allows material to be manually or automatically fed into or removed from a machine process, without tripping the primary safeguard. The controller accomplishes this by using diverse-redundant microprocessors that monitor the status of inputs and outputs, so that a single fault will cause the controller to issue a stop command to the machine. The controller, like all Banner safety products, is extensively FMEA (Failure Mode and Effects Analysis) tested to establish an extremely high degree of confidence that no internal component will, even if it does fail, cause a failure to danger. This design philosophy aids machine designers to comply with U.S. control reliability and worldwide standards for the highest level of safety.

### Muting Function Requirements

To mute the primary safeguard appropriately, the design of a muting system must:

1. Identify the non-hazardous portion of the machine cycle,
2. Involve the selection of the proper muting devices, and
3. Include proper mounting and installation of those devices.

The controller can monitor and respond to redundant signals that initiate the mute. The mute then suspends the safeguarding function by ignoring the state of the optical channels; this allows an object or person to pass through the defined area without generating a stop command. (This should not be confused with fixed blanking, floating blanking, or reduced resolution, which are used to disable one or more beams in a safety light screen, resulting in larger minimum object sensitivity.) See Appendix A for example mute timing sequences.

The mute may be triggered by a variety of external devices. This feature provides a variety of options to tailor the System to the requirements of a specific application.

A pair of muting devices must be triggered simultaneously (within 3 seconds of one another). This reduces the chance of common mode failures or defeat.

### Muting Devices

The beginning and end of a mute cycle must be triggered by outputs from a pair of muting devices, depending on the application. Each muting device must have normally open contacts. These contacts must close (conducting) when the muting device is actuated to initiate the mute, and must open (non-conducting) when the muting device is not actuated or in a power-OFF condition.

The controller monitors the muting devices to verify that their outputs turn ON within 3 seconds of each other. If the inputs do not meet this simultaneity requirement, a mute condition can not occur.

**WARNING . . . Muting Limitations**

Muting is allowed only during the non-hazardous portion of the machine cycle.

A muting application must be designed so that no single component failure can prevent the stop command or allow subsequent machine cycles until the failure is corrected.
General Muting Device Requirements
The muting devices (typically sensors or switches) must, at a minimum, comply with the following requirements:

1. There must be a minimum of two independent hard-wired muting devices.
2. The muting devices must have normally open contacts. These contacts must close when the muting device is actuated, and must open (or not conduct) when the muting device is not actuated or in a power OFF condition.
3. The activation of the inputs to the muting function must be from separate sources. These sources must be mounted separately in order to prevent an unsafe muting condition resulting from maladjustment, misalignment, or a single common mode failure. (For example, physical damage to the mounting surface could cause both muting devices to be knocked out of alignment, resulting in false muting input signals.) Only one of these sources may pass through, or be affected by, a programmable logic controller or similar device.
4. The muting devices must be installed so that they can not be easily defeated or bypassed.
5. The muting devices must be mounted so that their physical position and alignment can not be easily changed.
6. It must not be possible for environmental conditions to initiate a mute condition (e.g., extreme airborne contamination).
7. The muting devices must not be set to use any delay or other timing functions (unless such functions are accomplished so that no single component failure prevents the removal of the hazard, subsequent machine cycles are prevented until the failure is corrected, and no hazard is created by extending the muted period).

Muting Capabilities
PICO-GUARD with Mute provides the capability to use either 4-channel or 2 + 2–channel muting.

• Four-channel muting: Two or four muting devices are used to mute ONE area, defined by all four optical channels.

• Two-plus-two-channel muting: Four muting devices are used to mute TWO areas, one defined by optical channels 1 and 2, and one defined by optical channels 3 and 4. Muting devices 1 and 2 provide muting capability for optical channels 1 and 2. Muting devices 3 and 4 provide muting capability for optical channels 3 and 4.

For either type of muting, optical channels 1 and 3 cannot be disabled. Selection switches are provided to disable optical channels 2 and 4.

Mute Lamp Outputs
Up to two Mute Lamp outputs are available, depending on the muting configuration chosen.

Aux/Mute Lamp Output
If 4-channel muting is configured, the Aux/Mute Lamp output functions as an Aux output. If 2 + 2–channel muting is configured, the Aux/Mute Lamp output functions as a Mute Lamp output for muting devices 3 and 4.
**Mute Lamp Output**
If 4-channel muting is configured, the Mute Lamp output functions as a Mute Lamp output for all muting devices.

If 2 + 2–channel muting is configured, the Mute Lamp output functions as a Mute Lamp output for muting devices 1 and 2.

**Mute Enable**
The Mute Enable input is a non-safety-rated input. When the input is closed, the controller will allow a mute condition to occur; opening this input while the System is muted will have no effect.

Typical uses for Mute Enable include:

- To allow the machine control logic to create a “window” for muting to begin,
- To inhibit muting from occurring, or
- To reduce the chance of unauthorized or unintended bypassing or defeat of the safety system.

**Simultaneity Timer Reset Function**
The Mute Enable input can also be used to reset the simultaneity timer of the mute inputs. If one input is active for longer than three seconds before the second input becomes active, the simultaneity timer will prevent a mute cycle from occurring. This could be due to a normal stoppage of an assembly line that may result in blocking one mute device and the simultaneity time running out.

If the Mute Enable input is cycled (closed-open-closed) while one mute input is active, the simultaneity timer is reset, and if the second mute input becomes active within three seconds, a normal mute cycle begins. The timing requirement for the closed-open-closed is similar to the manual reset function. Initially, the input needs to be active (closed) for longer than 1/4 second, then open for longer than 1/4 second, but not longer than 2 seconds, and then must reclose to reset the simultaneity timer. The function can reset the timer only once per mute cycle (i.e., all mute inputs MS1-MS4 must open before another reset can occur).

**One-Way / Two-Way Muting**
One-way (directional) muting allows the safeguard to be muted only if mute devices are actuated in the order MS1, MS2, (mute initiated), MS3, and MS4. This method allows for a single-direction material flow and reduces the possibility of intentional defeat of the muting devices.

Two-way (non-directional) muting allows the safeguard to be muted any time the actuation of MS1-MS2 or MS3-MS4 meets the 3-second simultaneity requirement. This allows the flow of material from either direction (two-way material flow).

**NOTE:** When using four mute devices (MS1, MS2, MS3 and MS4), in order to extend the mute until the light screen is clear, the object must activate all four of the devices at one time during the mute cycle.
**WARNING . . . Muting Limitations**

Muting is allowed only during the non-hazardous portion of the machine cycle.

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**WARNING . . . User Is Responsible for Safe Application of this Product**

The muting application examples described in this document depict generalized guarding situations. Every guarding application has a unique set of requirements. Extreme care is urged to ensure that all legal requirements are met and that all installation instructions are followed. In addition, any questions regarding safeguarding should be directed to the factory Applications department at the number or addresses listed on the back cover.

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**Figure 1. Typical Application for 2 + 2-Channel Muting**

**Figure 2. Typical Application for 4-Channel Muting**
Muting Application Design

Following are typical applications where muting is used. See Appendix B or call factory Applications (at the number listed on the back cover) for more detailed information.

- **Entry/Exit Applications.** The muting devices are placed to allow the entry or exit of a pallet or cart of work materials to enter or exit a workstation without tripping the safety light screen, and without allowing the entrance of personnel into the hazardous area.

- **Home or Station Applications.** The muting devices must be placed to mute the safety light screen only when a hazard does not exist or is in another area — so that personnel are not exposed to any hazard.

- **Robot Load/Unload Station Application.** The “Station” muting application uses independent safety light screen circuits, each with its own muting circuit and sensors to protect work locations. When a robot is active in Station A, for example, Station B safety light screen is muted.

- **Turret Table Application.** A “Turret Table” application is similar to the Robot Load/Unload Station muting application, except that any movement of the table ends the mute.

- **Power Press Applications.** The muting devices are placed so that the mute is initiated only during the non-hazardous, opening portion of the cycle (typically the machine upstroke).

**Use of Corner Mirrors with Optical Safety Systems**

Mirrors are typically used with safety light screens and single-/multiple-beam safety systems to guard multiple sides of a hazardous area. If the safety light screen is muted, the safeguarding function is suspended on all sides. It must not be possible for an individual to enter the guarded area without being detected and a stop command issued to the machine control. This supplemental safeguarding is normally provided by an additional device(s) that remains active while the Primary Safeguard is muted. Therefore, mirrors are typically not allowed for muting applications.

**Multiple Presence-Sensing Safety Devices (PSSDs)**

In general, muting multiple distinct sensing fields with one muting device is not recommended. As with the use of corner mirrors (see above), if multiple sensing fields are muted simultaneously, the possibility exists that personnel could move through a muted area or access point to enter the safeguarded area without being detected and a resulting stop command being issued to the machine control.

One appropriate solution is to use one muting device in conjunction with each PSSD at each point of entry/exit. Another method is to use the 2+2 channel feature of the PICO-GUARD with Mute controller, which mutes each access point individually. In this manner, an individual will be detected entering the cell while material is passing through the opposite access point.

**WARNING . . . Guarding Multiple Areas**

DO NOT safeguard multiple areas, with mirrors or multiple sensing fields, if personnel can enter the hazardous area while the System is muted, and not be detected by supplemental safeguarding that will issue a stop command to the machine (see Pass-Through Hazards).
Pass-Through Hazards

A "pass-through hazard" is associated with applications where personnel may pass through a safeguard (at which point the hazard stops or is removed), and then may continue into the hazardous area. Subsequently, their presence is no longer detected, and the safeguard cannot prevent the start or restart of the machine. The related danger is the unexpected start or restart of the machine while personnel are within the hazardous area.

In the use of safety light screens, a pass-through hazard typically results from large separation/safety distances calculated from long stopping times, large minimum object sensitivities, reach over, reach through, or other installation considerations. A pass-through hazard can be generated with as little as 75 mm (3") between the defined area and the machine frame or hard guarding.

Reducing or Eliminating Pass-Through Hazards

Measures must be taken to eliminate or reduce pass-through hazards. One solution is to ensure that personnel are continually sensed while within the hazardous area. This can be accomplished by using supplemental safeguarding, including: safety mats, area scanners, and horizontally mounted safety light screens. While it is recommended to eliminate the pass-through hazard altogether, this may not be possible due to cell or machine layout, machine capabilities, or other application considerations.

An alternate method is to ensure that once the safeguarding device is tripped, it will latch and require a deliberate manual action to reset. This type of supplemental safeguarding relies upon the location of the reset switch as well as safe work practices and procedures to prevent an unexpected start or restart of the guarded machine.

The reset switch or actuating control must be positioned outside the guarded area, and provide the switch operator with a full unobstructed view of the entire guarded area and any associated hazards as the reset is performed. The reset switch or actuating control must not be reachable from within the guarded area and must be protected (through the use of rings or guards) against unauthorized or inadvertent operation. A key-actuated reset switch provides some operator control, as it can be removed by the operator and taken into the guarded area. However, this does not prevent unauthorized or inadvertent resets due to spare keys in the possession of others, or additional personnel entering the safeguarded area unnoticed.

The reset of a safeguard must not initiate hazardous motion. Also, before each reset of the safeguard is performed, safe work procedures require that a start-up procedure be followed and that the individual performing the reset verify that the entire hazardous area is clear of all personnel. If any areas cannot be observed from the reset switch location, additional supplemental safeguarding must be used – at a minimum, visual and audible warnings of machine start-up.
Controller Configuration

The controller should be configured before initial checkout and use. Two banks of DIP switches are located under the access cover for the configuration port. To access the DIP switches, open the access cover using the security hex wrench provided (see Figure 4-1 in the primary manual).

Change configuration settings only when the system is OFF.

Because the controller has redundant microprocessors, the two DIP switch banks (Bank A and Bank B) must be set identically. Failure to set Bank A and Bank B identically will result in a lockout condition. Power must be OFF when changing DIP switch settings; changing settings while power is ON will cause a lockout condition. The parameters to be manually configured are shown in Figure 3.

WARNING . . .
Configuration settings are to be made by Qualified Persons only.

WARNING . . .
Avoid Hazardous Installations
Two or four independent position switches (at MS1-MS2 or MS3-MS4) must be properly adjusted or positioned so that they close only after the hazard no longer exists, and open again when the cycle is complete or the hazard is again present. If improperly adjusted or positioned, injury or death could result.

The user has the responsibility to satisfy all local, state, and national laws, rules codes, and regulations relating to the use of safety equipment in any particular application. It is extremely important to be sure that all appropriate agency requirements have been met and that all installation and maintenance instructions contained in the appropriate manuals are followed.

As shown in the following table, the two pairs of switches provide four muting configuration options.

<table>
<thead>
<tr>
<th>Channels</th>
<th>Mute on Power-Up</th>
<th>Muting Direction Enabled</th>
</tr>
</thead>
<tbody>
<tr>
<td>2+2–Channel*</td>
<td>Enabled</td>
<td>N/A</td>
</tr>
<tr>
<td>4-Channel</td>
<td>Disabled</td>
<td>1-Way Muting</td>
</tr>
<tr>
<td>4-Channel</td>
<td>Disabled</td>
<td>2-Way Muting</td>
</tr>
<tr>
<td>4-Channel</td>
<td>Enabled</td>
<td>2-Way Muting</td>
</tr>
</tbody>
</table>

*Default setting

Figure 3. PICO-GUARD with Mute configuration switches

Muting Configuration Selection Switches
The Muting Configuration Selection switches are arranged in redundant pairs; both switches in each pair must be set to identical settings during system operation. The switch settings may be changed while the system is running; however, this will cause a lockout condition, which requires a valid system reset to correct. Similarly, if the switch settings are not redundant during power-up, a lockout condition will occur, requiring a system reset.

As shown in the following table, the two pairs of switches provide four muting configuration options.
Refer to the primary manual for additional information.

**Mute Enable Hookup**

The Machine Interface connector provides connection for the Mute Enable input. Mute Enable gives the user the ability to “frame” or create a “window of opportunity” when a mute can occur. When configured, the Mute Enable input is a contact that must be closed before the safeguard can be muted. After the safeguard is muted, opening of the Mute Enable input has no effect, but it must be re-closed before the safeguard can be muted again.

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(1) See Primary Manual for information on Reset input and hookup.

(2) 2-Channel EDM shown. See Primary Manual for information on EDM input and hookup.

See Primary Manual for information on interfacing of safety stop circuits
## Specifications

Specifications are identical to those listed in the primary manual, except as noted below.

| Status Indicator LEDs | System Status (bi-color Red/Green): overall status of the PICO-GUARD system  
|                       | System Reset (bi-color Yellow/Red): status of the input; indicates system reset needed  
|                       | Channel (4 bi-color Red/Green): each shows the status of one optical channel  
|                       | Muting (4 bi-color Red/Green): status of the muting input  
|                       | Mute Enable (bi-color Yellow/Red): status of the mute enable  
|                       | EDM (bi-color Red/Green): status of the EDM input channels  
|                       | OSSD (bi-color Red/Green): status of the OSSD outputs  
|                       | Config (bi-color Red/Green): status of the system configuration  
| Non-Safety Outputs (Aux/Mute Lamp, Mute Lamp, Fault, Ch1-4) | Solid-state 24V dc (≥ Vin – 1.5V dc), 0.25A max. sourcing non-safety outputs  
| Controls and Adjustments | Redundant switches for Auto/Manual power-up, Trip/Latch output operation and 1- or 2-channel EDM operation.  
|                       | Redundant switches for ON/OFF of two optical channels (2 and 4; channels 1 and 3 are always enabled).  
|                       | Redundant switches for muting configuration.  
| USSI Inputs | Universal Safety Stop Interface (USSI) input is not available on this model.  
| Muting Device Inputs | The muting devices work in pairs (MS1 and MS2, MS3 and MS4) and are required to be “closed” within 3 seconds of each other (simultaneity requirement) to initiate a mute (assuming all other conditions are met). Muting device outputs must be hard contacts (electrical), capable of switching 15 to 30V dc at 10 to 50 mA.  
| Mute Enable Input | When Mute Enable is selected (functional), this input must have +24V dc applied in order to start a mute; opening this input after mute has begun has no effect.  
| Certifications | Approvals in process. Contact the factory for update.  
| Application Notes | Mute Timing Sequences: see Appendix A  
|                       | Typical Muting Applications: see Appendix B  
|                       | Application Standards: see primary manual  

Specifications are identical to those listed in the primary manual, except as noted below.
“System Status” Indicator (bi-color Red/Green): overall status of the PICO-GUARD with Muting system
- Green – Run condition
- Red – Stop or Latch conditions
- Red Flashing – Lockout conditions
- Flashing Burst* (Red or Green) – electrical noise in the system
- Green Flashing – Active mute cycle

“System Reset” Indicator (bi-color Yellow/Red): status of the System Reset input or System Reset needed
- Yellow Double-Flashing – waiting for system reset after power-up
- Yellow Single-Flashing – waiting for system reset after latch condition
- Yellow – input signal is high
- Red Flashing – external fault of the input detected
- OFF – input signal is low or during lockout (except for System Reset faults)
- Red Flashing Burst* – noise on the System Reset input

Optical “Channel” Indicators (bi-color Red/Green): status of the optical channels (one indicator for each optical channel)
- Green – channel is closed (clear)
- Green Double-Flash – channel was interrupted, but is closed again (latch mode only)
- Flickers Green – weak or marginal signal
- Red – channel is open (blocked)
- Red Flashing – channel fault detected
- OFF – channel is disabled or during lockout (except for optical channel faults)
- Flashing Burst* (Red or Green) – noise on the channel

“Muting” Indicators (four bi-color Red/Green): status of the Muting inputs
- Green – an input channel is blocked
- Red Flashing – muting sensor failure detected
- Both Synchronized Red Flashing – fault detected, but the specific input channel cannot be determined
- OFF – an input channel is clear or during lockout (except for muting sensor faults)
- Green Flashing – blocked muting sensor, during a simultaneity condition

“Mute Enable” Indicator (bi-color Yellow/Red): status of the Mute Enable input
- Yellow – input signal is high
- Red Flashing – mute enable fault detected
- OFF – input signal is low or during lockout (except for mute enable faults)
- Red Flashing Burst* – noise on the Mute Enable input

“EDM” Indicators (bi-color Red/Green): status of the EDM inputs (one indicator for each input)
- Green – input signal is high
- Red Flashing – external fault of the input detected
- Both Synchronized Red Flashing – EDM fault detected; specific input cannot be determined
- OFF – input signal is low or during lockout (except for EDM input faults)
- Flashing Burst* (Red or Green) – noise on an EDM input channel

“OSSD” Indicators (bi-color Red/Green): status of each OSSD output (one indicator for each output)
- Green – OSSD is ON
- Red – OSSD is OFF
- Red Flashing – external output fault detected
- Both Synchronized Red Flashing – specific OSSD output fault cannot be determined
- OFF – lockout (except for OSSD output faults)

“Config” Indicator (bi-color Red/Green): status of the system configuration
- Green – configuration switch state is valid
- Red Flashing – configuration switch state is invalid
- OFF – lockout (except for configuration faults)

* A flashing burst is three short consecutive flashes, followed by a pause.

Figure 5. Indicator displays
## Troubleshooting

<table>
<thead>
<tr>
<th>Condition</th>
<th>OSSDs</th>
<th>Controller Mode of Operation</th>
<th>Possible Causes</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Stop Condition</strong></td>
<td>OFF</td>
<td>Start-Up Mode</td>
<td>Power-Up</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Normal Operating Mode</td>
<td>Object blocking optical channel(s)</td>
</tr>
<tr>
<td><strong>Run Condition</strong></td>
<td>ON</td>
<td>Normal Operating Mode (Trip Option Selected)</td>
<td>All optical channels clear</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Normal Operating Mode (Latch Option Selected)</td>
<td>Active mute cycle for the appropriate optical channels</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Normal Operating Mode</td>
<td>All optical channels clear and the System is not latched</td>
</tr>
<tr>
<td></td>
<td></td>
<td>System is latched but object no longer blocking optical channel(s)</td>
<td></td>
</tr>
<tr>
<td><strong>Lockout Condition</strong></td>
<td>OFF</td>
<td>Lockout Mode</td>
<td>Error detected</td>
</tr>
<tr>
<td><strong>Latched Condition</strong></td>
<td>OFF</td>
<td>Normal Operating Mode</td>
<td></td>
</tr>
</tbody>
</table>
Appendix A. Mute Timing Sequences

Muting Sequence with Two Muting Devices
(For example, "X"-pattern Entry/Exit System, see Figure B-1)

DIP Switch Configuration*:
- Manual Reset
- Latch Output

* Both DIP switch banks A and B.

Muting Sequence with Four Muting Devices
(For example, an Entry/Exit System using four photoelectric devices; see Figure B-5)

DIP Switch Configuration*:
- Manual Reset
- Latch Output

* Both DIP switch banks A and B.

NOTE: A mute cycle begins 100 ms after the second mute input becomes active, if all other conditions are met.
Appendix B. Typical Muting Applications

Entry/Exit Applications
The muting devices must be placed to ensure that the points that trigger the mute’s start and end are very close to the safety light screen’s sensing field. This prevents personnel from following, or being pushed by, the object into the hazardous area without interrupting the safety light screen before the mute window opens or at the time the mute window closes.

When two pairs of opposed-mode photoelectrics are used as muting devices, as shown below, the crossing point of the two sensing paths must be on the hazardous side of the safety light screen. The safety light screen will be interrupted before any personnel would be able to block both beams and mute the system. The devices should detect the material and not the pallet or the transport in order to hinder an individual from riding into the hazardous area.

WARNING . . .
- It must not be possible for an individual to block both photoelectric beams (dashed diagonal lines in Figure B-1) and initiate a mute condition. Check the installation to verify that unintentional muting is not possible. The “crossing point” of the photoelectric beams must be located in the hazardous area and not be accessible to personnel (by reaching over, under, through, or around).
- It must not be possible for personnel to walk in front of, behind, or next to the muted object (e.g., the carrier basket) without being detected and stopping the hazardous motion. Supplemental safeguarding must be used to prevent personnel from entering the hazardous area during a mute condition.

WARNING . . .
User is Responsible for Safe Application of this Product
The muting application examples described in Appendix B depict generalized guarding situations. Every guarding application has a unique set of application requirements. Extreme care is urged to ensure that all legal requirements are met and that all installation instructions are followed.
In addition, any questions regarding safeguarding should be directed to the factory applications department at the telephone number or addresses listed on the front cover.

Figure B-1. “X”-Pattern Entry/Exit system using two pairs of opposed-mode photoelectric muting devices

Figure B-2. Horizontal photoelectric muting devices placed at different heights

Figure B-3. Photoelectric muting devices placed diagonally
PICO-GUARD™ with Mute Function, Model SFCDT-4A1CM1

A = (speed of line ft/sec) x 0.1 sec.
B = 3" (or position must hinder personnel following muted object)
C = Length of carrier basket

- Trapping hazards must be avoided and clearance requirements complied with.
- Switch actuators can not be so long that they allow a single person to initiate a muted condition.
- Polarized-retroreflective (with targets mounted on carrier) and inductive proximity sensors could be used in a similar manner, if an individual can not ride into the hazardous area.

One-way (directional) muting can be used in "Exit" applications to reduce the possibility of intentional defeat.

Figure B-4. Entry/exit system using 4 whisker/limit switches as muting devices

A = (speed of line ft/sec) x 0.1 sec.
B = 3" (or position must hinder personnel following muted object)
C = Minimum length of carrier basket
D < (speed of line ft/sec) x 3.0 sec., but beams MS1 and MS2 must be far enough apart to hinder an individual from triggering both sensors.

One-way (directional) muting can be used in "Exit" applications to reduce the possibility of intentional defeat.

Figure B-5. An entry/exit system using four photoelectric sensors as MS1, MS2, MS3, and MS4
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