



OptoShield OS3101 Series Installation and Operating Manual



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OS3101 Series

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1 IMPORTANT SAFETY WARNINGS

⚠ WARNING! Read and understand this section prior to installing the OptoShield OS3101 system.

An OptoShield OS3101 system is a general purpose presence sensing device designed to guard personnel working around hazardous machinery.

Whether a specific machine application and OptoShield OS3101 system installation complies with safety regulations depends on the proper application, installation, maintenance and operation of the OS3101 system. These items are the responsibility of the purchaser, installer and employer.

The employer is responsible for the selection and training of personnel to properly install, operate, and maintain the machine and its safeguarding systems. An OS3101 system should only be installed, verified and maintained by a **qualified** person. A qualified person is defined as *“a person or persons who, by possession of a recognized degree or certificate of professional training, or who, by extensive knowledge, training or experience, has successfully demonstrated the ability to solve problems relating to the subject matter and work.”* (ANSI B30.2-1983)

To use an OS3101 system the following requirements must be met:

- The guarded machine **must** be able to stop anywhere in its cycle. Do not use a safety sensor on a press with a full-revolution clutch.
- The guarded machine must not present a hazard from flying parts.
- The guarded machine must have a consistent stopping time and adequate control mechanisms.
- Severe smoke and particulate matter may degrade the efficiency of a safety sensor, causing it to unexpectedly enter a Machine Stop state.
- Use of mirrors in the protection plane must be avoided, as they can hide part of the area to be monitored.
- All applicable governmental and local rules, codes, and regulations must be satisfied. This is the employer's responsibility.
- All safety-related machine control elements must be designed so that an alarm in the control logic or failure of the control circuit does not lead to a failure to danger.
- Additional guarding may be required to prohibit access to dangerous areas not covered by the OS3101 system.
- Perform the STI test procedure at installation and after maintenance, adjustment, repair or modification to the machine controls, tooling, dies or machine, or the OS3101 system.
- Perform only the test and repair procedures outlined in this manual.
- Follow all procedures in this manual for proper operation of the OS3101 system.
- An additional measurement error may need to be added due to reflective backgrounds, refer to Section 11—*Specifications and Additional Information*.

The enforcement of these requirements is beyond the control of STI. The employer has the sole responsibility to follow the preceding requirements and any other procedures, conditions and requirements specific to his machinery.

2 DESCRIPTION OF USE AND FEATURES

2

2.1 THEORY OF OPERATION

The OptoShield OS3101 is an optical safety sensor that uses diffuse reflection of a pulsed laser light to determine the location of objects entering a predefined zone. Internally, a spinning mirror assembly scans an area by sending a pulse of light which reflects off the first object in its path. The distance from the sensor to the object is determined by measuring the time that the light requires to return from the sensed object. This sequence is repeated as the optical assembly rotates so that the entire intended area is scanned.

This method of sensing allows for standard, simple or irregular shapes to be used as the predetermined sensed safety zones. It also allows for the safety zone to be changed if the hazardous area changes. Using diffused reflection of light back to the same sensor that emits it precludes the need for a traditional transmitter/receiver pair.

Within the sensing range of the OS3101, two fields can be defined simultaneously.

- A **Safety Zone** is used to detect personnel or other objects entering an area that has been determined to be a hazard. Upon sensing that the object is within the Safety Zone, the sensor will send a stop signal to the control circuitry of the machine being guarded.
- A **Warning Zone** can be defined to detect objects that are closely approaching the hazardous area of the Safety Zone and can be used to initiate a warning signal for personnel before the actual Safety Zone is encroached.

Applications for the OS3101 included stationary use, such as within a robotic work cell, in front of a press or around other hazardous machinery; as well as mobile applications on automatic guided vehicles (AGV) or transfer carts.

NOTE: *The applications described in this manual are for informational and instructional purposes only, and may not represent actual usage. This publication has been carefully checked for accuracy and is thought to be fully consistent with the product it describes. However, STI does not assume liability for the contents of this publication or the use of any products described herein. STI reserves the right to make changes to the products and/or documentation without further notification.*

2.2 FEATURES

2.2.1 STANDARD FEATURES

- Diagnostic Code Display
- Intrusion Indicators (IIs)
- Three possible operating modes:
 - Automatic Start (with or without delay)
 - Start Interlock
 - Start/Restart Interlock
- Two Safety (PNP) Outputs
- Selective Auxiliary Output (PNP or NPN option configured at factory)
 - Follow mode
 - Alarm mode
- Selective Warning Output (PNP or NPN option configured at factory)
 - Warning Zone mode
 - Weak Signal mode
 - Warning Zone/Weak Signal mode

2.2.2 CONTROL INPUTS

- Reset Input
- ED (MPCE) Monitoring
- External Zone Select

2.2.3 OPTIONAL FEATURES

- DeviceNet

2.2.4 SYSTEM COMPONENTS

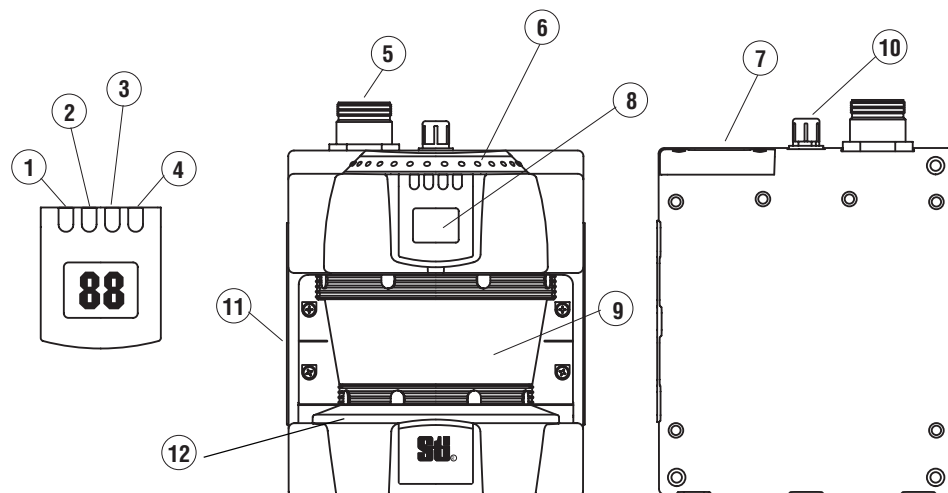


Figure 2-1 System Components

System Components and Indicators		Description
1	Machine Run (green)	Status indicator: green LED will light when no intrusion is detected in the safety zone.
2	Machine Stop (red)	Status indicator: red LED will light when an intrusion is detected in the safety zone.
3	Interlock (yellow)	Status indicator: yellow LED will light (interlock) when an waiting for restart signal.
4	Auxiliary/Warning Zone Output (amber)	Status indicator: amber LED will light when intrusion is detected in warning zone or the aux. output is activated.
5	Power & Controls Connector	A 14-pin mini-type connector is provided for power and control connections.
6	Intrusion Indicators	These LEDs will light when an intrusion is detected in the section, 16 sectors total. Each sector = 11.25°.
7	Serial Port Connector	A DB-9 connector is provided for RS232 interface.
8	Status/Diagnostic Display	Two 7-segment displays are provided for status and diagnostic information.
9	Scan Window	The window where the light is emitted and received.
10	DeviceNet Connector	A 5-pole, M-12, male connector for DeviceNet interface (optional).
11	Scan Plane Indicator	This mark (arrow) indicates the exact location of the scan plane.
12	Dust Ring	Dust detection cover with reflective surface.

Table 2-1 System Components and Indicators

3 SYSTEM OPERATION

3

3.1 OPERATING STATES

The operating condition of an OptoShield OS3101 system is described in terms of states. The following operating states exist for the OS3101 system.

3.1.1 MACHINE RUN

The two scanner safety outputs are in the ON state, the green machine run indicator is lit, and the auxiliary output is in a state consistent with its configuration. The protected machine is allowed to operate. Pressing and releasing the start button has no effect.

3.1.2 MACHINE STOP

The two scanner safety outputs are in the OFF state, the red machine stop indicator is lit, and the auxiliary output is in a state consistent with its configuration. The protected machine is not allowed to operate.

3.1.3 INTERLOCK

The two scanner safety outputs are in the OFF state, the red machine stop indicator and yellow interlock indicator are lit. The auxiliary output is in a state consistent with its configuration. The interlock state does not allow the protected machine to operate until the detection zone is clear of intrusion and the start button is pressed and released.

3.1.4 FAULT

The two scanner safety outputs are in the OFF state, the red machine stop indicator is lit, the yellow interlock indicator is flashing, and the auxiliary output is in the OFF state. The fault state does not allow the protected machine to operate. The primary difference between fault and interlock is that the OS3101 system will remain in the alarm state until the alarm is corrected, regardless of power cycling or an external start button press and release.

Diagnostic Display	OS3101 Status	Optoshield Operating Indicator Status			Safety Outputs
		Machine Run (Green)	Machine Stop (Red)	Aux./Warning Output	
XX**	Machine Run	ON	OFF	Configuration Dependent. See Section 3.3.1.	ON
--	Machine Stop	OFF	ON	Configuration Dependent. See Section 3.3.1.	OFF
01	Interlock	OFF	ON	Configuration Dependent. See Section 3.3.2.	OFF
5X	Fault	OFF	ON	ON (If it is configured for Alarm mode.)	OFF

**See Table 3-5 for more information.

Table 3-1 Operating States

3.2 OPERATING MODES

3.2.1 AUTOMATIC START

In Automatic Start mode, the sensor will power up with its OSSD outputs in the OFF state. It will perform system initialization and self-tests and if no intrusion is detected within the protected zone, enter the Machine Run state. An object entering the protected zone shall cause the sensor to change from Machine Run to Machine Stop within the specified response time, and remain in Machine Stop

for as long as the intrusion remains in the protected zone. Once the protected zone is clear, the sensor will automatically change from Machine Stop to Machine Run with no operator intervention.

Optoshield Modes:Automatic Start				
	Indicator Status		Output Status	
Power UP State	Machine Run (Green)	Machine Stop (Red)	Aux./Warning	Safety
Safety Zone Clear	ON	OFF	Configuration Dependent. See Section 3.3.2.	ON
Safety Zone Infringed	OFF	ON	Configuration Dependent. See Section 3.3.2.	OFF
Warning Zone Clear	ON	OFF	Configuration Dependent. See Section 3.3.2.	
Warning Zone Infringed	ON	OFF	Configuration Dependent. See Section 3.3.2.	

Table 3-2 Automatic Start Mode

3.2.2 **START INTERLOCK**

In Start Interlock mode, the sensor will power up with its OSSD outputs off and perform system initialization and self test. If no fault is detected and the protected zone is clear of intrusion, the sensor enters the Interlock state. If an obstruction is present, the sensor will remain in Machine Stop. When the obstruction is clear of the protection zone, the sensor automatically transitions to Interlock. The sensor's OSSD outputs will remain in the OFF state during power up testing, initialization, and transition to Interlock. The operator must press and release the sensor's Start button before the sensor enters the Machine Run state. Once the sensor is in Machine Run, an object entering the protection zone shall cause the sensor to change from Machine Run to Machine Stop within the specific response time, and remain in Machine Stop for as long as the obstruction remains in the protected zone. Once the protected zone is clear, sensor shall automatically change from Machine Stop to Machine Run, with no operator intervention.

Optoshield Modes:Automatic Start				
	Indicator Status		Output Status	
Power UP State	Machine Run (Green)	Machine Stop (Red)	Aux./Warning	Safety
Safety Zone Clear	OFF	ON	Configuration Dependent. See Section 3.3.2.	OFF
Press Reset w/Safety Zone Clear	ON	OFF	Configuration Dependent. See Section 3.3.2.	ON
Safety Zone Infringed	OFF	ON	Configuration Dependent. See Section 3.3.2.	OFF
Warning Zone Clear	ON	OFF	Configuration Dependent. See Section 3.3.2.	
Warning Zone Infringed	ON	OFF	Configuration Dependent. See Section 3.3.2.	

Table 3-3 Start Interlock

3.2.3 START/RESTART INTERLOCK

In Start/Restart Interlock mode, the sensor shall power up with its OSSD outputs in the Off state and perform system initialization and self test. If no faults are detected and the protected zone is clear of obstructions, the sensor enters the Interlock state. If the protected zone has an intrusion, the sensor remains in Machine Stop. When the intrusion is removed, the sensor OSSD outputs remain in the Off condition during power up testing, initialization, and transition to Interlock. The operator must press and release the sensor's Start button before the sensor enters the Machine Run state. Once sensor is in Machine Run, an object entering the protected zone shall cause the sensor to change from Machine Run to Machine Stop. When the obstruction clears it will automatically change from Machine Stop to Interlock. The operator must press and release the Start button before the sensor enters the Machine Run state.

Optoshield Modes: Start/Restart Interlock				
	Indicator Status		Output Status	
Power UP State	Machine Run (Green)	Machine Stop (Red)	Aux./Warning	Safety
Safety Zone Clear	OFF	ON	Configuration Dependent. See Section 3.3.2.	OFF
Press Reset w/Safety Zone Clear	ON	OFF	Configuration Dependent. See Section 3.3.2.	ON
Safety Zone Infringed	OFF	ON	Configuration Dependent. See Section 3.3.2.	OFF
Safety Zone Clear	ON	OFF	Configuration Dependent. See Section 3.3.2.	ON
Warning Zone Clear	ON	OFF	Configuration Dependent. See Section 3.3.2.	
Warning Zone Infringed	ON	OFF	Configuration Dependent. See Section 3.3.2.	

Table 3-4 Start/Restart Interlock

3.3 PARAMETER CONFIGURATION

The configuration properties consist of two sections Safety-Critical Parameters and Non-Safety Critical parameters.

3.3.1 SAFETY-CRITICAL PARAMETERS

- External Device Monitoring (ED) (MPCE)

ED (MPCE) monitoring is an important safety function. It verifies that the external control elements are responding correctly.

The OS3101 can operate with this feature enabled or disabled. When EDM (MPCE) is enabled, the OS3101 requires that a Normally Closed contact from each Control Element be fed back in for monitoring. If these contacts do not respond as expected the OS3101 will enter a Fault state and turn off the safety outputs.

In the Machine Run state, the OS3101 expects to see the ED (MPCE) input open. In the Machine Stop state, the OS3101 expects to see the ED (MPCE) input closed. The ED (MPCE) inputs must change state within 300 ms of the OptoShield's OSSD safety outputs or a fault will occur.

- Response Time

The response time of the OS3101 is proportional to the number of scans. The safety outputs will not change from on to off until the preset response time has expired. The response time can be set from 80mS to 680mS; each scan is equal to 40mS. The minimum number of scans is two, the maximum is 17. The number of scans may be increased when operating the OS3101 in a dirty environment to avoid nuisance trips caused by floating particulate matter.

⚠ WARNING! A change in the response time requires a recalculation of the safety distance (See Section 6 Stationary Installation and Configuration) and may require the position of the scanner to be relocated. Failure to use the correct safety distance may result in a person entering a hazardous area while the machine, robot, or hazard is still in motion, resulting in severe injury.

- Operating Modes

The OS3101 can be configured to operate in three different modes: Automatic Start, Start Interlock and Start/Restart Interlock.

- Monitoring Zone Setting

Two zone sets can be configured and saved within the OS3101. These zones can then be recalled via the RS232/422 port or by using the external inputs. There are three settings: Zone Set 1, Zone Set 2, or Multiple Zones.

- Status Code Display

The following status codes will appear on the scanner's 7-segment display during machine run state. They are representative of the zone setting and the scanners operating response time. Example: code '24' indicates zone set 2 with a response time of 160mS. Note: Response times longer than 400mS are represented by a Zero.

Active Zone Set	First Digit
Zone Set 1	1
Zone Set 2	2
Union of Zone 1 and 2	U
Response Time (mS)	Second Digit
80mS	2
120mS	3
160mS	4
200mS	5
240mS	6
280mS	7
320mS	8
360mS	9
400mS	0
440mS	0
480mS	0
520mS	0
560mS	0
600mS	0
640mS	0
680mS	0

Table 3-5 Status Code Display

3.3.2 **NON-SAFETY-CRITICAL PARAMETERS**

- **Auxiliary Output Mode**

There are two possible auxiliary output settings: Follow OSSD and Fault Indicate. In Follow OSSD mode, the auxiliary output will follow the state of the safety output. In the Fault Indicate mode, the auxiliary output will only change when the OS3101 enters a Fault state.

- **Warning Output Mode**

The Warning output can be configured to three possible modes: Warning Zone Infringed, Weak Signal and Warning Zone/Weak Signal.

— In Warning Zone Infringed mode, this output reports the status of the Warning Zone.

— In Weak Signal mode, this output reports the detection of a weak signal due to contamination on the window.

— In Warning Zone/Weak Signal mode, this output reports both modes, one at a time.

4 OUTPUTS

4

4.1 **SAFETY OUTPUTS**

⚠ WARNING! *This product is designed for use on a 24 VDC, negative ground (protective earth) electrical system only. Never connect the OptoShield OS3101 to a positive ground (protective earth) system. With a positive ground (protective earth) wiring scheme, certain simultaneous shorts of both safety outputs may not be detected and the guarded machine may not stop resulting in severe operator injury.*

The OS3101 provides two PNP safety outputs, each capable of sourcing 625 mA @ 24VDC. These two outputs can be interfaced directly into a Safety Programmable Logic Controller or may be used to directly energize the machine's primary control element. The safety outputs will turn on and supply up to 625 mA @ 24 VDC when the safety zone is clear and the OS3101 enters a Machine Run state. The OS3101 will turn off its safety outputs and enter a Machine Stop state when it detects an intrusion in the safety zone.

4.2 **AUXILIARY OUTPUT**

The OS3101 has a non-safety auxiliary output, either for PNP (sourcing) or NPN (sinking), max. 100 mA @ 24VDC. This output is factory configured only at time of order. In the field, this output can be configured to operate in two modes. In follow mode it will turn on and off following the status of the safety outputs. In the Fault mode it will turn on only when an internal fault is detected. These operating modes are selected through the set-up software (CFG tool).

4.3 WARNING ZONE/CONTAMINATION OUTPUT

The OS3101 has a non-safety auxiliary output, PNP (sourcing) or NPN (sinking), max. 100 mA @ 24VDC.

In the field this output can be configured to operate in one of three ways:

- Warning Zone Infringed
- Weak Signal Mode
- Both Warning and Zone/Weak Signal.

These modes are selected through the set-up software (CFG tool).

5 APPLICATIONS

5

5.1 APPLYING THE OPTOSHIELD OS3101

The OS3101 may be used for personnel safeguarding. Typical applications include work cell area guarding and collision prevention of AGV (Automated Guided Vehicles).

The applications described in this manual are for informational and instructional purposes only, and may not represent actual usage. This publication has been carefully checked for accuracy and is thought to be fully consistent with the product it describes. However, STI does not assume liability for the contents of this publication or the use of any products described herein. STI reserves the right to make changes to the products and/or documentation without further notification.

5.2 WORK AREA GUARDING

There are many areas in today's manufacturing facilities that require guarding. The OptoShield is ideal for safeguarding hazardous work areas. The flexibility of the OS3101 allows for easy configuration of the scan fields to conform to a variety of work cell shapes. The OS3101 incorporates two zone sets which can be preset and selected via the Set Up software or external hardware inputs, refer to Section 8.10 for more information on this feature. Each Zone Set consists of one Safety Zone and one Warning Zone. *Figure 5-1* shows a single zone set configuration, *Figure 5-3* shows dual zone set configuration.

Horizontal scan field applications include:

- Robotic work cells
- Material transfer stations
- Metalforming equipment
- Elevators
- Automated production equipment

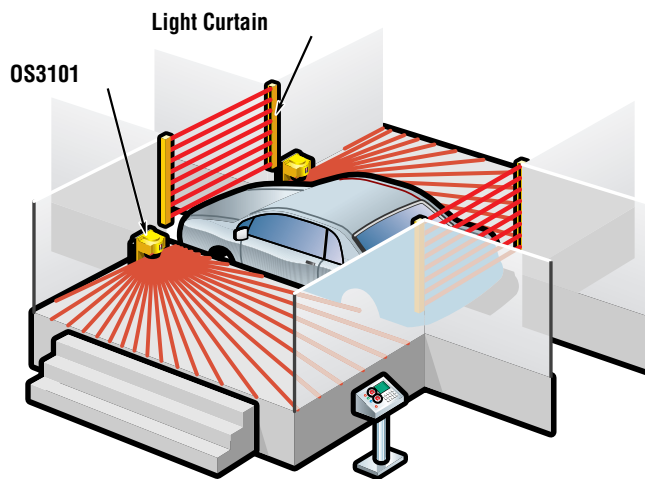


Figure 5-1 OS3101 Automotive Application

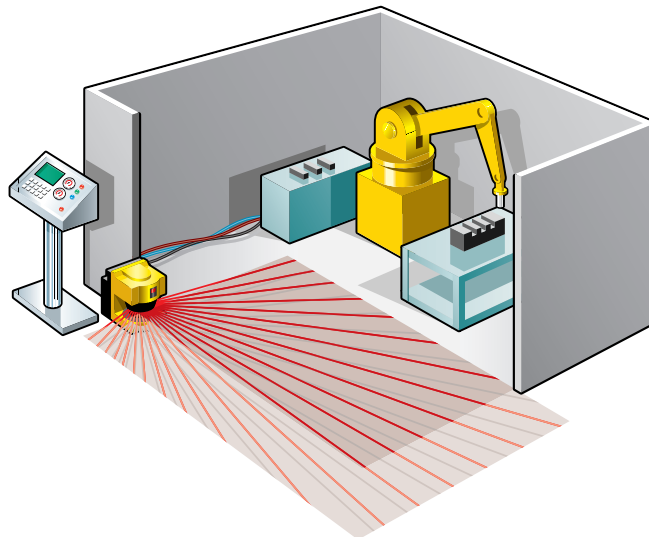


Figure 5-2 Material Transfer Station

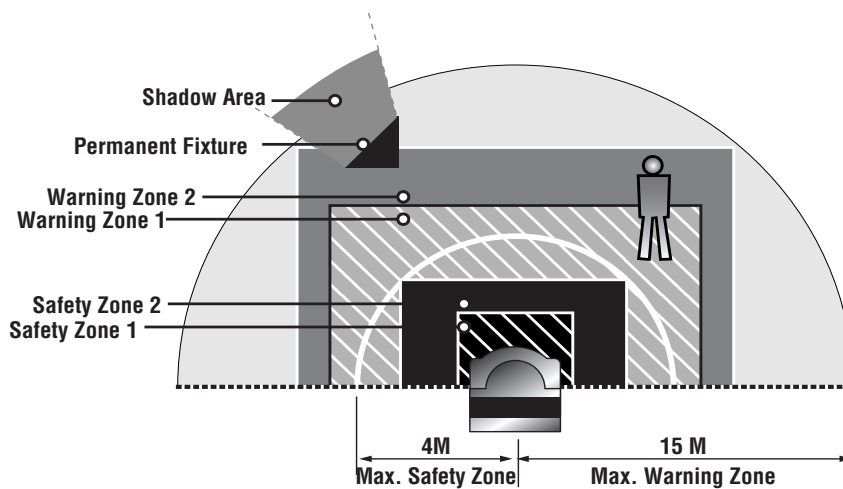


Figure 5-3 Configuration and Ranges of OptoShield

5.3 GUARDING INTERIOR AREAS OF HAZARDOUS EQUIPMENT

On large equipment (i.e. large power press, injection molding) the OS3101 can be used to guard the interior space. If it is possible for the operator to enter the hazardous area the OS3101 can be used as a secondary safety device. This type of equipment would require a safety light curtain as the primary safety device (See Figure 5-4 *Guarding Interior Areas*).

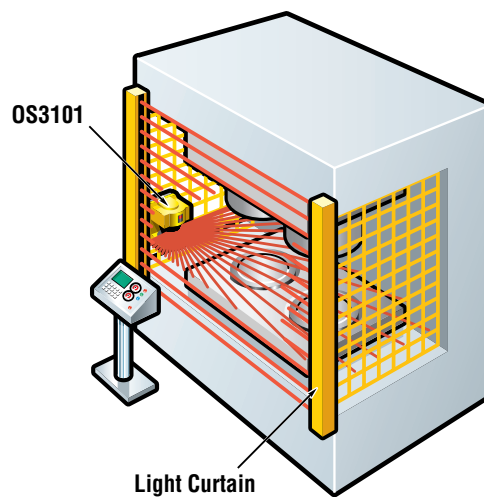


Figure 5-4 Guarding Interior Areas

5.4 APPLYING THE OS3101 ON AUTOMATED GUIDED VEHICLES (AGV)

Unmanned automated vehicles require guarding devices to prevent accidental collisions. The OS3101 will scan the path of the AGV and will reliably stop the vehicle if it detects an object or person. The OS3101 is more adjustable and reliable than conventional pressure bumpers. In addition, the use of the OS3101 allows an AGV to travel at higher speeds than if using conventional bumpers.

The OptoShield OS3101's flexibility allows two types of detection.

5.4.1 WARNING ZONE DETECTION

The warning zone auxiliary output will send a signal to the AGV when the warning zone is infringed. This will trigger the vehicle to slow down, allowing a person to move away from the vehicle path.

5.4.2 SAFETY ZONE DETECTION

The two safety outputs will send an E-stop to the AGV when the safety zone is infringed. This will signal the vehicle to come to a complete stop.

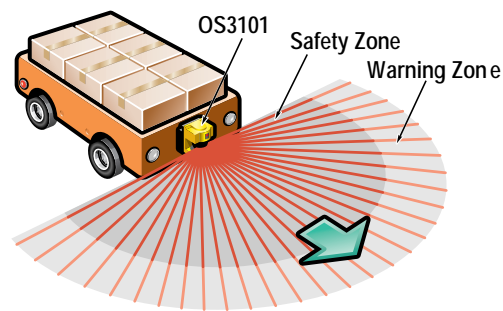


Figure 5-5 AGV Navigation

5.5 MOUNTING CONSIDERATIONS

The following considerations should be taken into account when determining the mounting location for the OptoShield. Although rare, it is possible for ambient light to interfere with normal operation of the sensor. Ambient light interference DOES NOT lead to a loss of safety, it may, however, cause false nuisance stops of the guarded equipment.

Avoid direct exposure to:

- High intensity incandescent light
- Stroboscopic light
- Light from an identical or similar safety scanner
- Infrared light from a safety light curtain.

Some installations may require that the OptoShield be mounted in direct exposure to ambient light. In these situations you must assure that the separation between the scan plane of the OS3101 and the light source be greater than $\pm 8^\circ$.

5.6 CONFIGURING MULTIPLE OS3101 SCANNERS

5.6.1 USE OF SEVERAL SAFETY LASER SCANNERS

The possibility exists that two OS3101 may interfere with each other. To avoid this when using multiple Optoshields in the same location, please review the following mounting recommendations. The scan plane reference location is marked on the sides of the OS3101's front window.

- Adjust the scanners to offset the scanning plane by tilting the OS3101s.
- Adjust the scanners to offset the scanning plane by mounting the OS3101s at different heights.
- Mount the scanners alternating the orientation of the OS3101s by 180°
- Adjust the scanners to different scanning planes and additional sampling scans on the OS3101s
- Install a barrier to block the direct path of possible signal crossing.

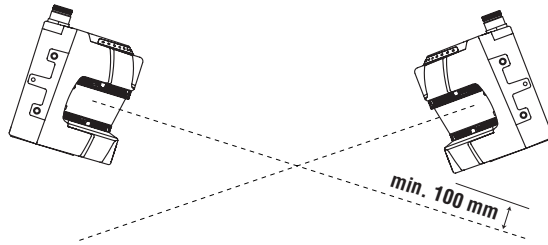


Figure 5-6 Offset Scanning Level by Tilting

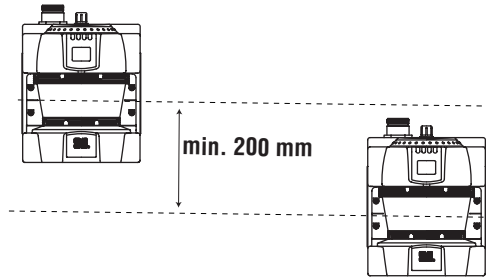


Figure 5-7 Offset Parallel Scanning Levels by Different Installation Height

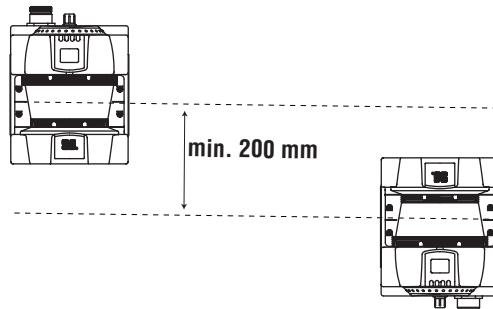


Figure 5-8 Offset Parallel Scanning Levels by Alternate Installation in Upright and Inverted Position.

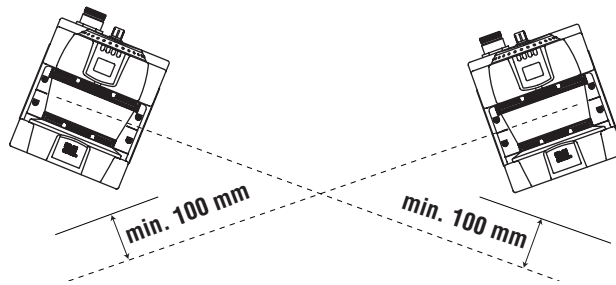


Figure 5-9 Offset Parallel Scanning Levels Plus Additional Sampling Scans

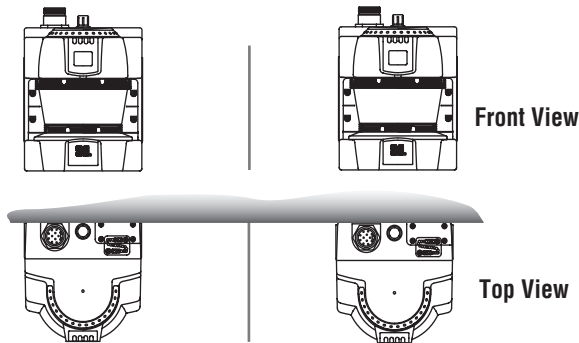


Figure 5-10 Screening Up to Front Edge of the Detection Window

6 STATIONARY INSTALLATION AND CONFIGURATION

6

6.1 INSTALLATION FOR STATIONARY AREA SCANNING

6.1.1 POSITION

The OptoShield OS3101 must always be installed in such a position that the protected zone can cover the danger area being scanned.

Area which cannot be scanned (e.g. behind obstacles) must be secured by taking appropriate additional measures (e.g. barriers).

The reset switch for clearing a Restart Interlock must be positioned in such a way that the entire danger zone is in view and the operating element itself cannot be reached from inside the danger zone.

6.1.2 INSTALLATION HEIGHT (DETECTION LEVEL)

The installation mounting height of the OS3101 is very important, the following considerations should be taken into account to determine the mounting height.

The OS3101 must be mounted in such a way to prevent access to the hazardous area, personnel should not be able to crawl under, stand behind or climb over the protective field.

Always mount the OS3101 so that it is protected from moisture and dirt.

Mount the scanner so that the Status and Intrusion Indicators are visible.

Avoid locations where the OS3101 is exposed to excessive shock and vibration.

According to EN999, for an installation height of >300mm, the possibility of ‘creeping’ under the protective field must be taken into account. On installations where the OS3101 is mounted higher than 300mm, additional guarding may be required. (See Figure 6-1 *Setup for Area Scanning*),

STI offers a mounting stand that allows the OS3101 to be mounted at three different heights. This is very useful when you have multiple scanners guarding an area and the possibility of cross-talk exists. (Refer to Figure 11-6 *Mounting Stand*).

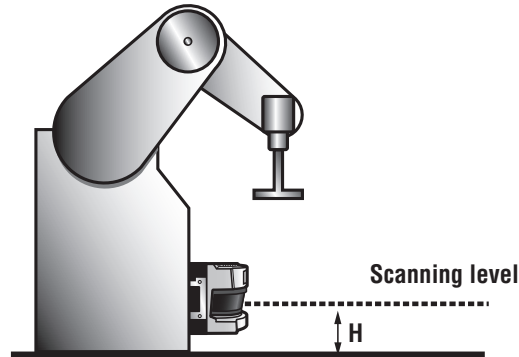


Figure 6-1 *Setup for Area Scanning*

6.1.3 **WHOLE BODY DETECTION (VERTICAL INSTALLATION OF THE AREA SCANNER)**

The versatility of area scanners makes it conceivable for these products to be used in applications other than horizontal installations, such as an overhead vertical installation guarding entry into an area. Vertical guarding applications are usually better protected by light curtains, which offer:

- a selection of different detection capabilities (finger, hand, body)
- a higher safety level (type 4 for a safety light curtain vs type 3 for a area scanner)
- faster response times
- greater operating range
- lower cost

For these reasons, STI recommends the use of safety light curtain devices in vertical sensing applications over area scanners mounted vertically.

Per the IEC 61496-3 international standard, area scanners must reference and monitor the boundaries of the vertical passage limits, such as the entrance or door frame. If the distance between the scanner and the boundaries exceeds 4m, any change in the positioning of the scanner or the boundaries of the detection zone greater than 100mm must be detected. This may be achieved by limiting the width of the references that make-up the boundary. If the detection zone is infringed or if the detection zone side reference boundaries are changed, the scanner should turn off the two OSSD outputs. The OS3101 does not currently employ reference boundary monitoring, and thus is not recommended in vertical applications requiring this international standard.

The two US standards which reference the use of area scanners, ANSI B11.19 -2003 and ANSI/RIA 15.06-1999 do not address the issue of vertical installations. STI does require the user to prevent unauthorized changes in the position of the area scanner and detection zone through administrative (such as a password) and engineering means.

NOTE: The OS3101 does not yet employ the reference monitoring function.

6.2 CONFIGURATION OF AREA SCANNING

When using the OS3101 for area scanning, the mode Start/Restart Interlock should be selected; the regulations applying to the machine must be complied with.

6.2.1 SAFETY DISTANCE (REQUIRED DEPTH OF PROTECTED ZONE)

Always configure the protected zone in such a way that the machine comes to a standstill in the time taken to reach the danger point of the machine after infringing (interrupting) the protection zone. The standard EN 999-1998 must be used to calculate the minimum safety distance; according to EN 999, the minimum safety distance, S, from the danger zone area to the outer edge of the protected zone is calculated as follow:

$$S = (K \times (t_1 + t_2)) + Z + C$$

where:

S = Minimum safety distance in mm measured from the danger area to the outer contour of the protected zone.

K = Movement or approach speed in mm/s (constant K = 1600 mm/s)

Z = Additional safety factors (maximum measurement error), the sum of:

- The scanners maximum measurement error (135mm)
- R = Errors due to highly reflective surfaces, if necessary (See Section 11.2 on page 66).
- T = Delay between in interrupting of the protected zone and standstill of the machine in seconds consisting of the sum of:

t_1 = Response time of the safety device in seconds (adjustable)

t_2 = Rundown time of the machine in seconds (mechanical rundown, reaction time of control system)

C = Safety constant with $C = 1200 \text{ mm} - 0.4 \times H$; where

H = distance of detection level from reference level in mm (H = 500 mm in this example).

$C_{\min} = 1000 \text{ mm}$.

6.2.2 DOCUMENTATION OF CONFIGURATION PARAMETERS

The person responsible for the set-up must record the configuration parameters, print out and sign the report.

- Connect the printer to the PC
- Select the menu "File/Record" in the user software
- The report is printed out
- Sign and date the report and file it in a know place which is always accessible.

6.3 CONFIGURATION EXAMPLE – INSTALLATION OF THE OS3101 ON A MACHINE WITH UNDERCUT

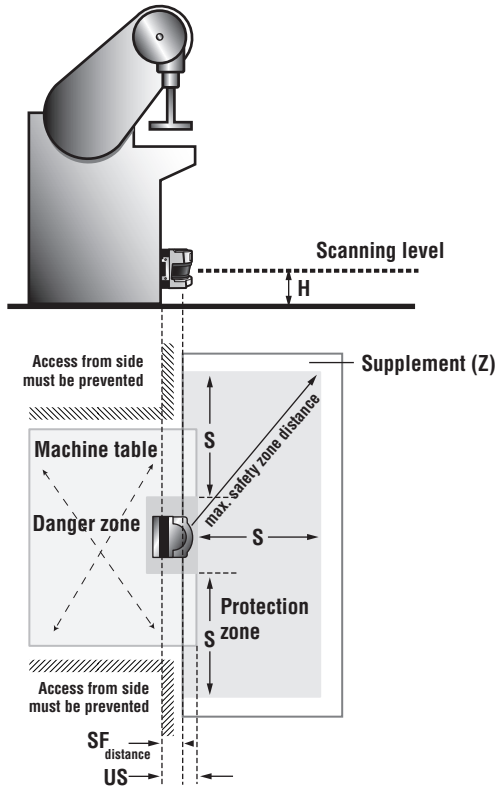


Figure 6-2 Installation on a Machine Table with Undercut

6.3.1 EXAMPLE

S - Safety distance ($S = 1000 \text{ mm}$)

S_{distance} - Protected Zone

K = Movement or approach speed in mm/sec

T = Response time of sensor t_1 , plus machine stop time t_2

D_{max} = Resolution of sensor

C - Safety constant with

$C = 1200 \text{ mm} - 0.4 \times H$,

$C_{\text{min}} = 850 \text{ mm}$

$S = (K \times T) + C$

6.3.2 SPECIFICATION

Danger Zone width = 600 mm

Undercut US = 180 mm

Response time sensor (t_1) with two scans = 80 ms

Total machine stop time (t_2) = 200 ms (includes e.g. response time and rundown of machine)

$$T = t_1 + t_2 = 280 \text{ ms}$$

Installation height, $H = 350 \text{ mm}$ (an addition risk analysis to EN 999 is not necessary for this height)

6.3.3 **CALCULATION OF SAFETY DISTANCE, S**

$$\begin{aligned} S &= (1600 \text{ mm/s} \times T) + (1200 \text{ mm} - 0.4 \times H) \\ &= (1600 \text{ mm/s} \times 280 \text{ ms}) + (1200 \text{ mm} - 0.4 \times 350 \text{ mm}) \\ &= 448 \text{ mm} + 1060 \text{ mm} \\ S &= 1508 \text{ mm} \end{aligned}$$

6.3.4 **CALCULATION OF LENGTH OF PROTECTED ZONE**

The protected zone length SF_{length} is calculated as follow:

$$\begin{aligned} SF_{\text{length}} &= S + US - SF_{\text{distance}} \\ &= 1508 \text{ mm} + 180 \text{ mm} - 91 \text{ mm} \text{ (K = 91mm without optional mounting bracket)} \\ SF_{\text{length}} &= 1597 \text{ mm} \end{aligned}$$

6.3.5 **CALCULATION OF WIDTH OF PROTECTED ZONE**

As the danger zone is symmetrical to the scanner, the width of the protected zone is calculated as follows:

$$\begin{aligned} SF_{\text{width}} &= S + 1/2 \text{ width of danger zone} \\ &= 1508 \text{ mm} + 300 \text{ mm} \\ SF_{\text{width}} &= 1808 \text{ mm} \end{aligned}$$

6.3.6 CALCULATION OF MAXIMUM SAFETY ZONE DISTANCE

The maximum safety zone distance (maximum distance of the protected zone limit from the center of the OS3101) is calculated as follow:

$$\begin{aligned}\text{Max. safety zone distance} &= \sqrt{(\text{SF}_{\text{width}})^2 + (\text{SF}_{\text{length}})^2} \\ &= \sqrt{(1808 \text{ mm})^2 + (1597 \text{ mm})^2}\end{aligned}$$

Maximum safety zone distance = 2412 mm (cannot exceed 4000 mm)

6.3.7 REQUIRED SAFETY FACTORS AND CALCULATION OF CONFIGURATION DATA

The additional safety factors (maximum measurement errors) of the OS3101 must be added to the protective field length ($\text{SF}_{\text{length}}$) and protected width (SF_{width}). The supplemental error Z should be added when the maximum safety zone distance is $> 2\text{m}$.

This yields the following figures for the configuration of a rectangular protected zone when the OS3101 is mounted centrally on the machine. The CFG tool accepts these dimensions in 'cm' only, input the configuration as shown.

Length = 1597 mm (input: 160 cm)

Distance Left = 1808 mm (input: 180 cm)

Distance Right = 1808 mm (input: 180 cm)

Note: Z = Additional safety factors (maximum measurement error), the sum of:

- The scanners maximum measurement error (135mm)
- R = Errors due to highly reflective surfaces, if necessary (See Section 11.2 on page 66).

6.4 CONFIGURATION EXAMPLE – INSTALLATION OF THE OS3101 OPPOSITE A MACHINE TABLE

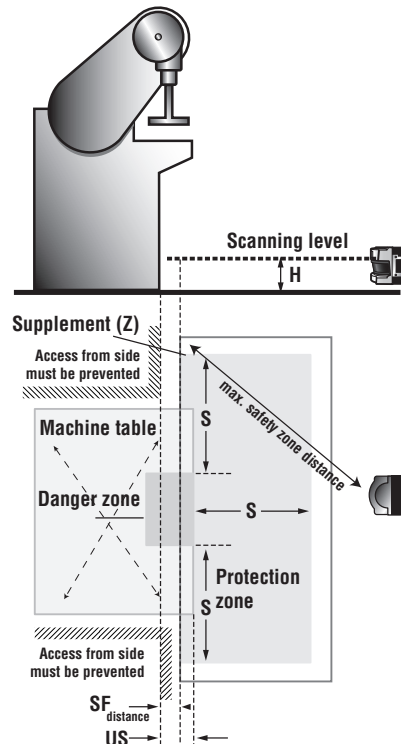


Figure 6-3 Installation Opposite a Machine Table

6.4.1 VARIABLES

S - Safety distance

K = Movement or approach speed in mm/sec (constant K = 1600 mm/s)

T = Response time of sensor t_1 , plus machine stop time t_2

D_{\max} = Resolution of sensor

C - Safety constant with $C = 1200 \text{ mm} - (0.4 \times H)$; $C_{\min} = 850 \text{ mm}$

$S = (K \times T) + C$

H = 500 mm.

6.4.2 EXAMPLE

Danger Zone width = 600 mm

Undercut $U_c = 180 \text{ mm}$

Response time sensor (t_1) with double scan = 80 ms

Total machine stop time = 200 ms

$T = t_1 + t_2 = 280 \text{ ms}$

Installation height, H = 500 mm (an addition risk analysis not needed per EN 999 for this height).

6.4.3 CALCULATION OF SAFETY DISTANCE, S

$S = (1600 \text{ mm/s} \times T) + (1200 \text{ mm} - 0.4 \times H)$

$= (1600 \text{ mm/s} \times 280 \text{ ms}) + (1200 \text{ mm} - 0.4 \times 500 \text{ mm})$

$= 450 \text{ mm} + 1000 \text{ mm}$

$S = 1450 \text{ mm}$

6.4.4 CALCULATION OF LENGTH OF PROTECTED ZONE

The protected zone is derived from the safety distance, S:

$SF_{\text{length}} = S$

$SF_{\text{length}} = 1450 \text{ mm}$

6.4.5 CALCULATION OF WIDTH OF PROTECTED ZONE

As the danger zone is symmetrical to the scanner, the width of the protected zone is calculated as follows:

$SF_{\text{length}} = S + 1/2 \text{ width of danger zone}$

$= 1450 \text{ mm} + 300 \text{ mm}$

$SF_{\text{width}} = 1750 \text{ mm}$

6.4.6 CALCULATION OF MAXIMUM SAFETY ZONE DISTANCE

When the OS3101 is mounted centrally opposite the machine table, the maximum safety zone distance (maximum distance of the protected zone limit from the center of the OS3101) is calculated as follow:

Max. safety zone distance $= \sqrt{(SF_{\text{width}})^2 + (SF_{\text{length}})^2}$

$= \sqrt{(1750 \text{ mm})^2 + (1450 \text{ mm})^2}$

Maximum safety zone distance = 2,273 mm

6.4.7 REQUIRED SAFETY FACTORS

When the OS3101 is used in such a way that it is not under the guarded machine (opposite or off to the side) then a minimum undercut must be utilized. The depth of the undercut is calculated as follows:

$$US_{\min} = (2 \times \text{max. measuring error}) - d$$

Typically,

$$US_{\min} = (2 \times 135 \text{ mm}) - 62 \text{ mm}$$

$$US_{\min} = 270 \text{ mm} - 62 \text{ mm} = 208 \text{ mm}$$

Considering horizontal use where the smallest object to be sensed is 70 mm then:

$$US_{\min} = 270 \text{ mm} - 70 \text{ mm} = 200 \text{ mm}.$$

This is possible since any person or object in front of the undercut will be detected.

NOTE: The scanner's maximum measurement error is 135 mm.

7 MOBILE INSTALLATION AND CONFIGURATION

7

7.1 APPLYING OS3101 ON AUTOMATED GUIDED VEHICLES (AGV)

When using the OptoShield on mobile applications, such as AGVs, it is important to acknowledge that this is only recommended for private use. AGV vehicles equipped with an OptoShield should only be used on private or company property and not allowed to operate on public streets. The OptoShield must only be used in AGV applications where the vehicle is equipped with an electric motor. In addition to the following guidelines, it is important that you follow the AGV manufacturer's recommendations.

7.1.1 POSITIONING HEIGHT

The OptoShield must be mounted so that it provides a horizontal safety scan plane in the path of the AGV.

The height of the scan plane needs to be placed so that it reliably detects an object 150mm in height. After installation, the entire hazardous area must be tested to verify detection of the 150mm object.

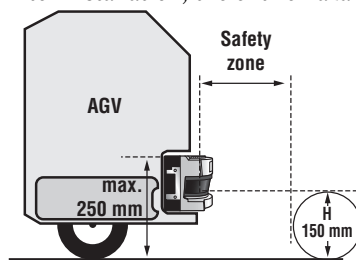


Figure 7-1 Installation on Automatically Guided Vehicle

7.1.2 PROTRUDING FRONT END MOUNTING

When the application requires installation on the vehicles front end, it is necessary to eliminate dead zones. These inactive zones can be minimized by recessed installation of the OptoShield. On vehicles capable of speeds greater than 0.3m/sec within 3 seconds, the dead zone must be ≤ 65 mm. Additional guarding safety measures must be taken, i.e. hard guarding or pressure sensitive bumper.

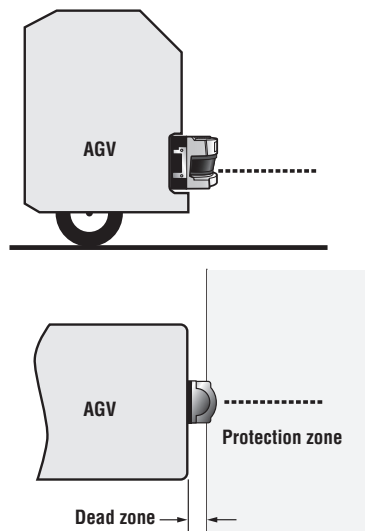


Figure 7-2 Projecting Installation at Front of Vehicle

7.1.3 RECESSED FRONT END MOUNTING

Although a recessed installation reduces the size of the dead zone, in some case this technique creates dead angles. If the Optoshield is mounted too deep within the vehicle, the scanner will not be able to properly scan the hazardous area. These areas are referred to as Dead Angles. On vehicles capable of speeds greater than 0.3 m/sec within 3 seconds, the dead zone must be < 65 mm, additional safety measures must be taken.

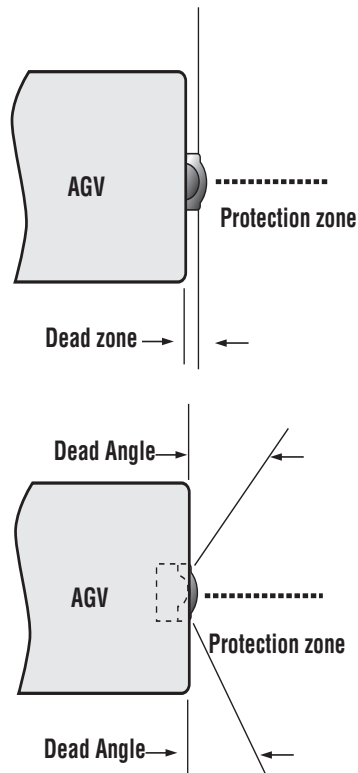


Figure 7-3 Installation with Bodywork of AGV

7.2 CONFIGURATION FOR AUTOMATED GUIDED VEHICLES (AGV)

7.2.1 SAFETY DISTANCE (SAFETY ZONE DEPTH)

For calculating the minimum safety distance for AGV, the standard IEC 61496-3 can be used.

The safety distance, S, for use with an AGV should be calculated using the following formula:

$$S = (V_{\max} \times T) + S_{\text{brake}}$$

S = Minimum safety distance in mm

Vmax = Maximum speed of AGV in mm/s

T = Response time consisting of sum of:

t₁ = Response time of OS3101 in sec.

t₂ = Response time of AGV in sec.

S_{brake} = Braking distance of AGV in mm.

7.2.2 SAFETY ZONE WIDTH FOR AN AGV

- Since a moving AGV can be approached from the side, the safety field must usually be configured wider than the AGV.

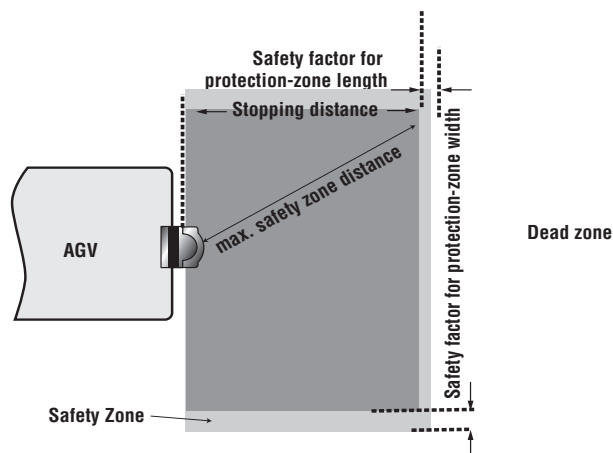


Figure 7-4 Protective Zone of an AGV

7.2.3 SAFETY FACTORS FOR CONFIGURING THE AGV SAFETY ZONE

When configuring the protected zone, add the following safety factors to the minimum safety distance, S.

- Z = Additional safety factors (maximum measurement error), the sum of:
 - The scanners maximum measurement error (135mm)
 - R = Errors due to highly reflective surfaces, if necessary (See Section 11.2 on page 66)
 - Safety Factor for lack of ground clearance; the ground clearance is 90mm so the additional safety factor is 50mm (See Section Figure 7-5 on page 35).
- Safety factor for measuring error caused by intense reflection: if there are retro-reflectors at the scanning level of the OS3101, an additional safety factor is required (see Figure 7-4—*Protective Zone of an AGV*); if possible, remove the retro-reflectors to preclude the addition of this safety factor.
- For AGVs with a clearance of less than 120 mm between chassis and ground, add a safety factor to the minimum safety distance as shown in Figure 7-5—*Safety Factor for Low Ground Clearance*.
- Safe factor for reduction of brake force of the AGV through wear and usage.

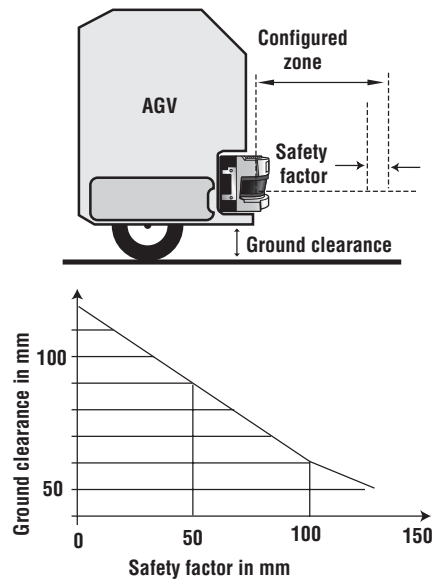


Figure 7-5 Safety Factor for Low Ground Clearance

7.3 EXAMPLE FOR USE ON AN AGV

7.3.1 SPECIFICATIONS

Stopping distance AGV (include brake wear) = 1200 mm

Width of AGV = 1500 mm

Ground clearance (distance chassis-ground) = 90 mm

Installation position = centered.

7.3.2 CALCULATION OF MAXIMUM SAFETY ZONE DISTANCE

Maximum Safety Zone = $\sqrt{(\text{Stopping distance})^2 + (\text{Stopping distance} + (\text{AGV width} / 2))^2}$

$$= \sqrt{(1200\text{mm})^2 + (1200\text{mm} + (1500\text{mm}/2))^2}$$

$$= \sqrt{(1200)^2 + (1950)^2}$$

$$= \sqrt{1440000 + 3802500}$$

$$= \sqrt{5242500}$$

$$= 2290\text{mm}$$

The maximum safety zone distance is 2290mm.

7.3.3 SAFETY FACTORS REQUIRED FOR CALCULATING LENGTH OF SAFETY ZONE

The following safety factors must be added to the length of the safety zone:

Z = Additional safety factors (maximum measurement error), the sum of:

- The scanners maximum measurement error (135mm)
- R = Errors due to highly reflective surfaces, if necessary (See Section 11.2 on page 66).
- Safety factor for lack of ground clearance; the ground clearance is 90mm so the additional safety factor is 50mm. (See "Figure 7-5" on page 35).

7.3.4 ERRORS DUE TO INTERFERENCES BY OTHER SCANNERS

Calculation of Length of Safety Zone

$$\begin{aligned}SF_{\text{length}} &= \text{stopping distance} + \text{factor} \\&= 1200 \text{ mm} + 135 \text{ mm} + 50 \text{ mm} \\SF_{\text{length}} &= 1385 \text{ mm}\end{aligned}$$

7.3.5 CALCULATION OF WIDTH OF SAFETY ZONE

$$\begin{aligned}SF_{\text{width}} &= \text{AGV width}/2 + \text{max. measuring error} + \text{stopping distance} \\&= 750 \text{ mm} + 135 \text{ mm} + 1200 \text{ mm} \\SF_{\text{width}} &= 2085 \text{ mm}\end{aligned}$$

This yields the following values for configuring a rectangular Safety Zone when the OS3101 is mounted centrally on the vehicle. The CFG tool accepts these dimensions in 'cm' only, input the configuration as shown:

Length = 1385 mm (input: 139 cm)

Distance Left = 2085 mm (209 cm)

Distance Right = 2085 mm (209 cm)

7.4 ADDITIONAL EXAMPLE FOR USE ON AN AGV

Stopping distance AGV (include brake wear) = 2400 mm

Width of AGV = 2000 mm

Ground clearance (distance chassis-ground) = 120 mm

Installation position = centered.

7.4.1 CALCULATION OF MAXIMUM SAFETY ZONE DISTANCE

$$\begin{aligned}\text{Max. safety zone distance} &= \sqrt{\text{Stopping distance}^2 + [(\text{AGV width}/2) + \text{stopping distance}]^2} \\&= \sqrt{(2400 \text{ mm})^2 + (3400 \text{ mm})^2} \\ \text{Max. safety zone distance} &= 4162 \text{ mm}\end{aligned}$$

7.4.2 SAFETY FACTORS REQUIRED FOR CALCULATING LENGTH OF SAFETY ZONE

The following safety factors must be added to the length of the Safety Zone:

- Safety factor for maximum Safety Zone error of the OS3101 is 135 mm.
- Safety factor for lack of ground clearance; as the ground clearance is not less than 120 mm, no additional safety factor is needed.

7.4.3 CALCULATION OF LENGTH OF SAFETY ZONE

$$\begin{aligned}SF_{\text{length}} &= \text{stopping distance} + \text{factor} \\&= 2600 \text{ mm} + 135 \text{ mm} \\SF_{\text{length}} &= 2735 \text{ mm}\end{aligned}$$

7.4.4 CALCULATION OF WIDTH OF SAFETY ZONE

$$\begin{aligned}SF_{\text{width}} &= \text{AGV width}/2 + \text{max. measuring error} + \text{stopping distance} \\&= 1100 \text{ mm} + 135 \text{ mm} + 2600 \text{ mm} \\SF_{\text{width}} &= 3835 \text{ mm}\end{aligned}$$

This yields the following values for configuring a rectangular protected zone when the OS3101 is mounted centrally on the vehicle. The CFG tool accepts these dimensions in 'cm' only, input the configuration as shown:

Length = 2735 mm (input: 274 cm)

Distance Left = 3835 mm (384 cm)

Distance Right = 3835 mm (384 cm)

8 GETTING STARTED

8

8.1 BASIC STEPS

The configuration and installation of an OptoShield is a simple process. We have outlined the basic steps needed to get started. Refer to the appropriate section for more information on any of these steps.

- Loading the set-up program on to your computer.

- Connect the scanner to your computer.

- Start the program

- Auto connects
- Connection confirmed

- Log-on

- Select Access Level
- Enter password

- Configuring the safety-related parameters

- EDM (MPCE)
- Response Time
- Operating Mode
- Zone Monitor

- Configuring the non-safety parameters

- Auxiliary Output
- Warning Output

- Select the unit of measure

- Centimeters
- Inches

- Zone Configuration
 - Configure Zone set 1
 - Configure Zone set 2
- Save your Password
- Start the OptoShield

8.2 LOADING THE CFG SETUP PROGRAM

Optoshield setup and configuration requires the use of the CFG tool. Each OS3101 is supplied with a configuration software package. For optimal set-up performance the following computer system hardware requirements are recommended.

- Pentium processor
- Windows 9X, Windows NT, Windows 2000, Windows XP
- 32 MB Ram (5 MB Ram hard drive space available).

8.2.1 CFG INSTALLATION

The installation of the CFG Tool Demo is quick and easy.

- Load the CFG tool CD.
- Run the Setup.exe file
- After installation, the Optoshield CFG Tool icon is available from the your desktop.

8.2.2 THE PASSWORD

Due to the safety nature of the OptoShield, it is required that all users log-in with a password. The password grants the user, the right to view the configuration or the right to change/modify the configuration. The configuration is defined as all the parameters that have been defined to safely guard an application. The OS3101 is shipped with a default password “supeusr” (case sensitive). It is strongly recommended that the password be changed after initial set-up.

There are two user levels:

- Operator Access – The operator can access the OptoShield in a monitor mode. This mode does not require a password as the operator cannot make any changes to the sensor’s parameters.
- Supervisory Access – Supervisors and maintenance personnel may access the OptoShield and perform a variety of functions. They may stop the scanner, transfer and download a new program or modify an existing program.

8.2.3 CHANGING THE PASSWORD

The default password may be changed, allowing maintenance personnel to restrict access to unauthorized persons. To change the password, the user must log-on in the supervisor access level, password “supeusr”.

To change the password:

- Select Change Password
- A screen will appear, it will ask for an authorization password (default password is supeusr)
- Click continue
- Enter the new password and confirm the new password*
- Click OK to change the password
- Then OK the change

Note: The password needs to be at least 5 characters but not more than 7. The password is case-sensitive and must always be entered with the same combination of upper and lower-case letters.

8.2.4 **FORGOT THE PASSWORD?**

In cases where the password was changed and forgotten the encrypted password may be retrieved.

To retrieve the Encrypted Password, the user must log under the Operator access level, no password is needed to access this level.

To retrieve the password:

- Go to the Utilities menu
- Select Read encrypted password
- A screen will appear, displaying the password code
- Write down the password exactly as it appears

Call the STI technical support department at 1/888/510-4357 and they will be able to decode the encrypted word.

8.2.5 **THE CONFIGURATION SCREEN**

The CFG Tool (configuration tool) incorporates easy to understand screens. illustrates the basic layout, Figure 8-2 *The Tool Bar* describes the full functions of the Tool Bar.

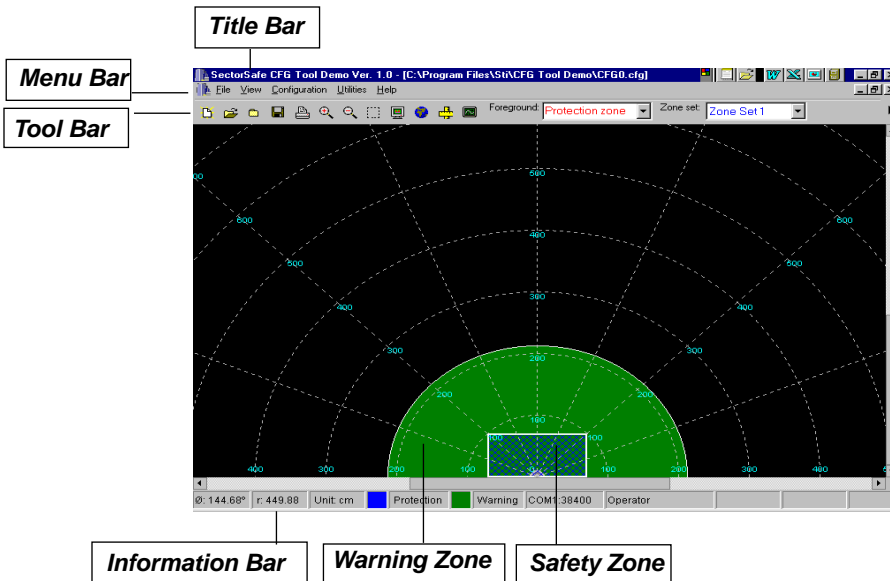


Figure 8-1 Getting to Know the Screen

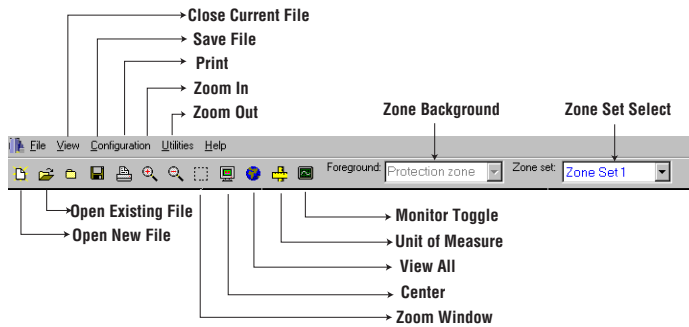


Figure 8-2 The Tool Bar

8.3 START THE CFG PROGRAMMING TOOL

8.3.1 AUTO CONNECT

This is the first step in establishing a communication line with the OptoShield. This Setup Program will automatically select the proper Com Port and Baud Rate.

1. With an OS3101 connected to the computer, click on the “Continue” button

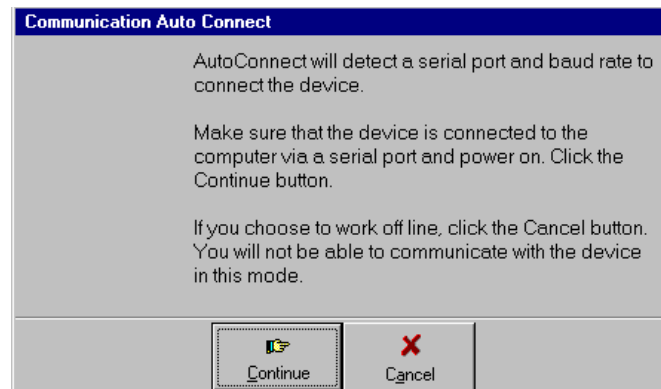


Figure 8-3 Auto Connect

8.3.2 CONNECTION CONFIRMED

A notification screen will appeared. It will notify you of the selected Com Port and Baud Rate.

Click on the ‘continue’ button.



Figure 8-4 Connection Confirmed

8.3.3 SELECTING THE ACCESS LEVEL

The access level needs to be selected and must be followed by a password. The default supervisor password is 'supeusr' (lower case).

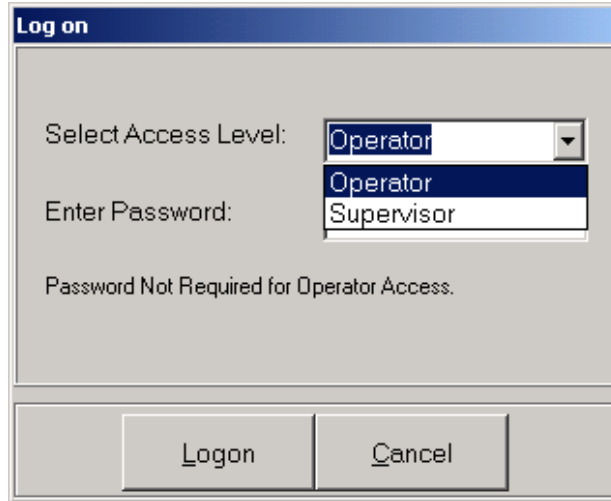


Figure 8-5 Selecting the Access Level

- Select Access Level
- Enter password
- Click on the 'Log on' button

8.3.4 CONFIGURING THE PARAMETERS

You have now successfully logged on. The first step is to define and configure the operating parameters.

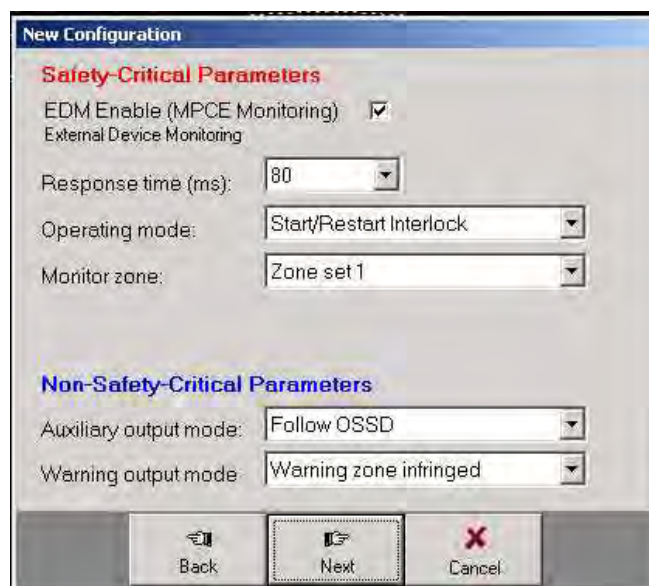


Figure 8-6 Configuring Parameter

- System Parameters

These include both safety-critical and non-safety critical parameters:

- Safety-critical: EDM (MPCE), response time, and monitor (active) zone
- non-safety critical: Auxiliary output and warning output modes

After all the selections are made, press “Next”

- Safety-Related
 - Select EDM (MPCE)
 - Select the Response Time
 - Select the Operating Mode
 - Select the Zone Monitor
- Non-safety-related
 - Auxiliary Output Mode
 - Warning Output Mode

8.4 UNIT OF MEASURE SELECTION

The OS3101 can be configured to measure centimeters or inches.

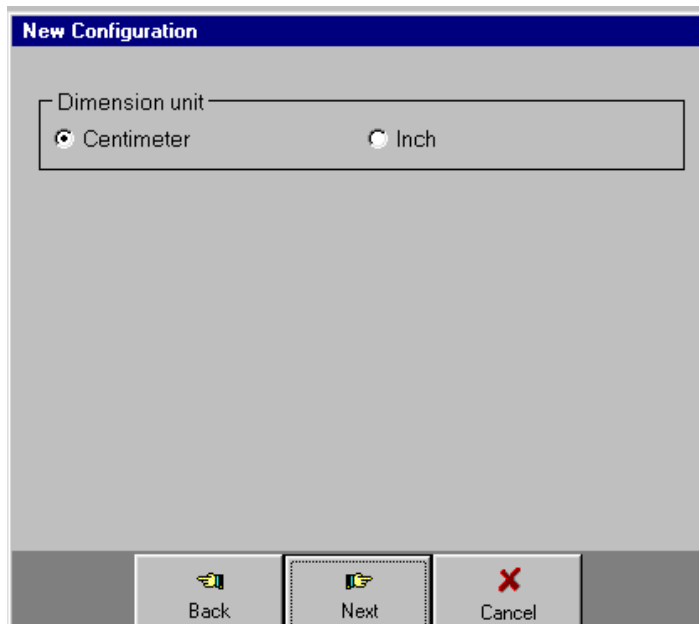


Figure 8-7 Unit of Measure

8.5 ZONE SET SETUP

8.5.1 ZONE SET 1 SETUP

Zone Setup includes both protection safety zone and the warning zone. The shape and size of the zone needs to be determined. In this example (Zone Set 1) we have selected The safety zone to be a semi-circle with a radius of 100 cm. The warning zone is configured as a rectangle with a height of 200 cm and a width of 300 cm. After your specific selections are made, press “Next”.

New Configuration

Zone set 1
Dimension unit: Centimeter

Protection Zone Shape:

Radius:

Min. Range: 9.30 cm (3.66 inch) Max. Range: 400 cm (157.48 inch)

Warning Zone Shape:

Height: Width:

Min. Range: 9.30 cm (3.66 inch) Max. Range: 1500 cm (590.55 inch)

Figure 8-8 Zone Set 1 Setup

This is Zone Set 1, the safety zone to be a semi circle with a radius of 100 cm. The warning zone is the rectangle with a height of 200 cm and a width of 300 cm.

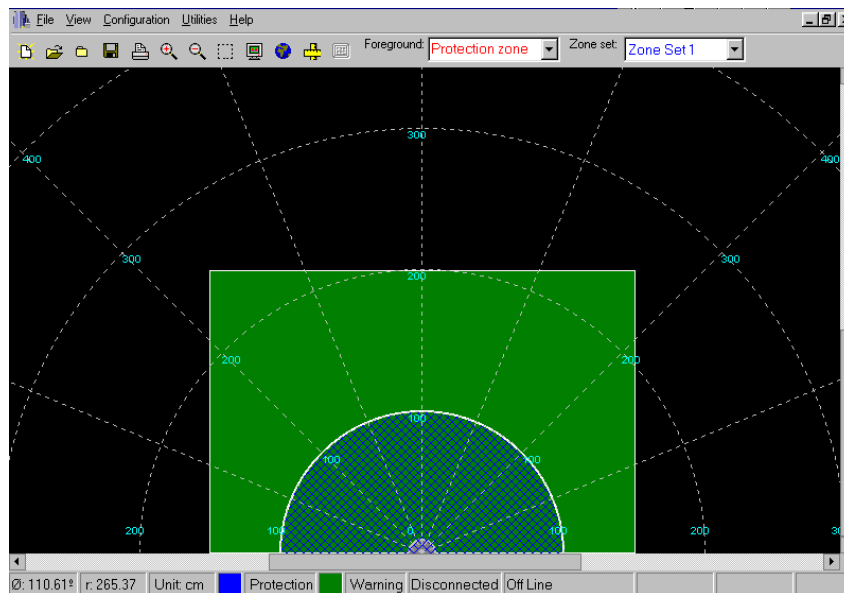


Figure 8-9 Zone Set 1 Screen Display

Note: Section 8.5—*Zone Set Setup* details the configuration of multiple zones. When only one zone is selected in the properties only the selected zone needs to be configured.

8.5.2 ZONE SET 2 SETUP

In this example (Zone Set 2) we have selected safety zone to be a rectangle with a height of 100 cm and a width of 200 cm. The warning zone is configured as a rectangle with a height of 400 cm and a width of 300 cm. After the selections are made, press “Next”.

New Configuration

Zone set 2

Dimension unit: Centimeter

Protection Zone Shape:

Height: Width:

Min. Range: 9.30 cm (3.66 inch) Max. Range: 400 cm (157.48 inch)

Warning Zone Shape:

Height: Width:

Min. Range: 9.30 cm (3.66 inch) Max. Range: 1500 cm (590.55 inch)




 Back  Next  Cancel

Figure 8-10 Zone Set 2 Setup

This is Zone Set 2, the safety zone is the rectangle with a height of 100 cm and a width of 200 cm. The warning zone is the rectangle with a height of 400 cm and a width of 300 cm.

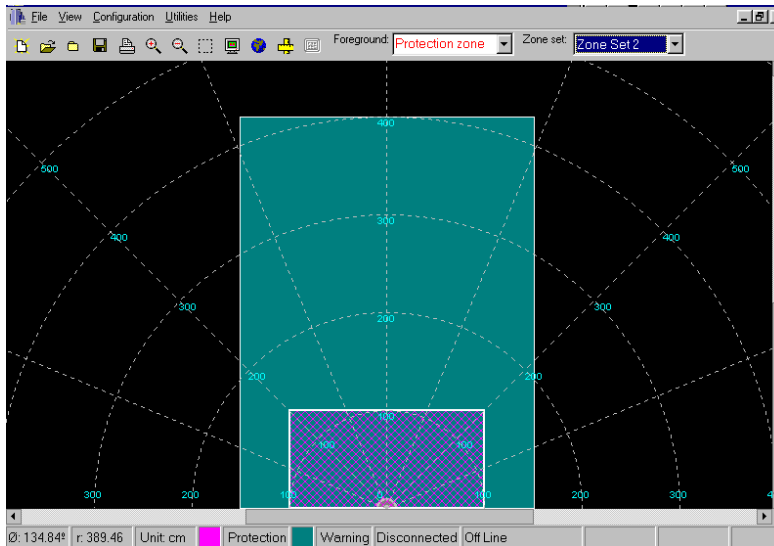


Figure 8-11 Zone Set 2 Screen Display

8.6 EDITING PROPERTIES

The OptoShield's CGF configuration software permits the user to modify the critical and non-critical properties.

The following steps will guide you:

Step 1: Go to the Configuration Heading and select Edit Properties

Step 2: Select the Properties that you intend to change and set them accordingly. The safety-critical properties that you will be able to change include EDM (MPCE), response time, operating mode and monitor zone. The non-safety-critical parameters include auxiliary output mode and warning output mode.

Once you have completed the changes you must send and register the changes. See Section 8.9—*Sending and Registering Changes*.

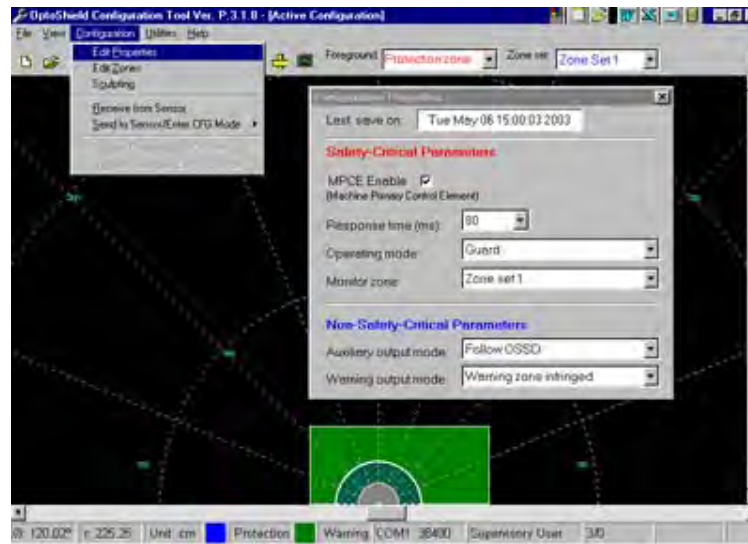


Figure 8-12 Configuration Properties

8.7 EDITING ZONES

The OptoShield's CGF configuration software permits the user to modify the protective zones. The following steps provide guidance on the zone editing process.

Step 1: Go to the Configuration heading and select Edit Zones.

Step 2: Select the zone set and the protection zone that you intend to modify, this shows the warning zone of zone set 1.

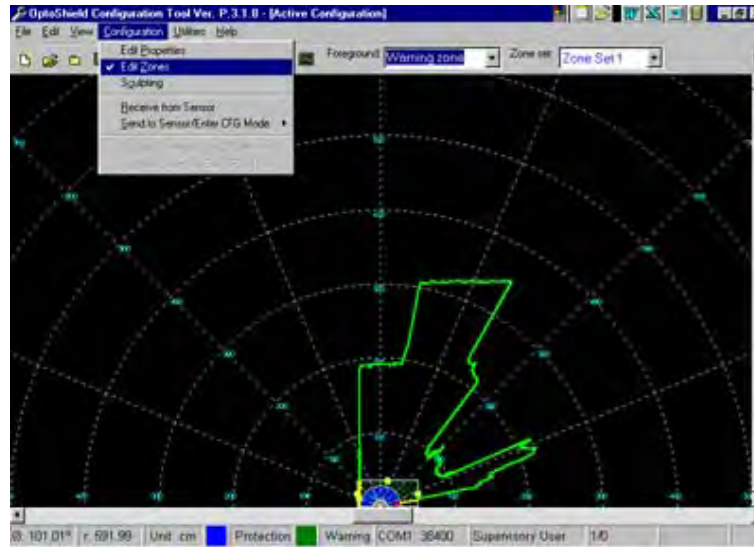


Figure 8-13 Modifying Zone Sets

Step 3: You will notice that drag points will appear on the selected zone. At this time you are permitted to change the zones configuration by clicking and dragging the points.

Once you have completed the changes you must send and register the changes. See Section 8.9—*Sending and Registering Changes*.

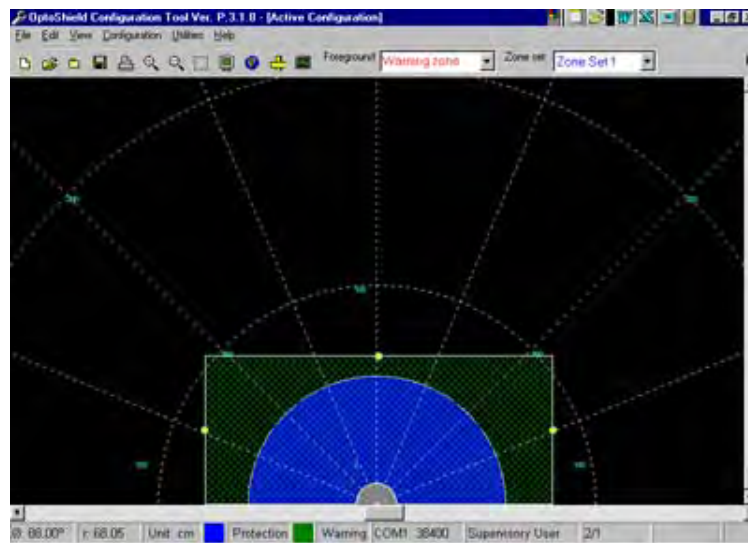


Figure 8-14 Changing the Zone Configuration

8.8 SCULPTING ZONES

The OptoShield's CGF configuration software permits the user to modify the protective zones. The following steps provide guidance on the sculpting editing process.

Step 1: Go to the Configuration Menu and select Sculpting.

Step 2: Select the zone set that you intend to modify, this shows zone set 1. This shows a semi-circle protective zone with a long rectangle warning zone. It also shows the contours of the overall area that the OptoShield is scanning.

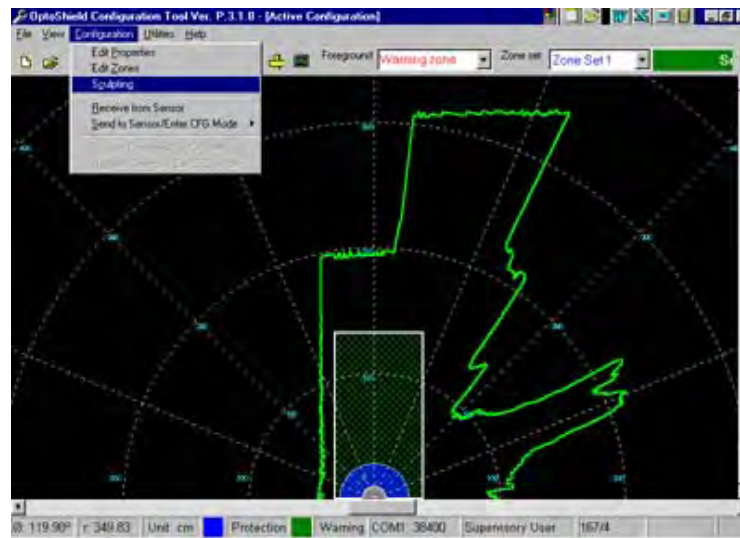


Figure 8-15 Modifying Zone Sets

Step 3: At this time you will be able to accept the scanner's entire vision area as your protective zone, as shown on the previous picture. Or, you may outline a specific protective zone to meet your guarding requirements. Take a piece of cardboard and route it through the perimeter of your predetermined area. The cardboard/object needs to be placed at the same height as the OptoShield's scan plane (the window area).

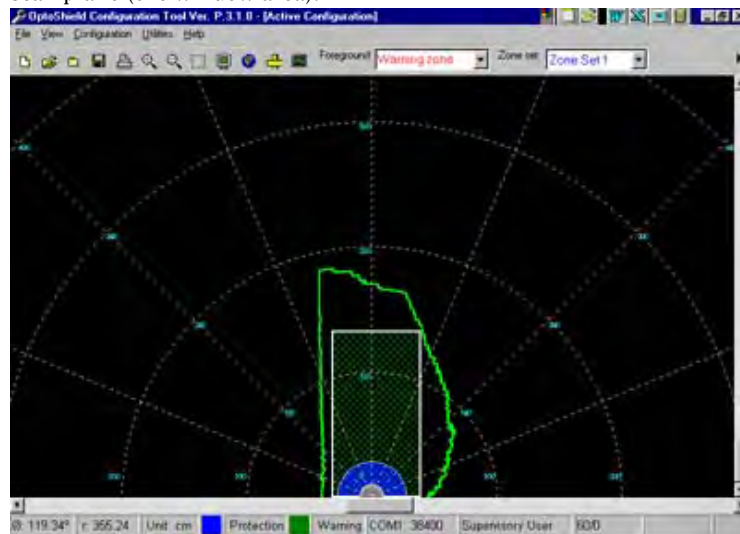


Figure 8-16 Changing the Zone Configuration

Step 4: Once you have sculpted the desired area, go to the configuration menu and select sculpting. The following window will appear, select the desired zone for the sculpted area.

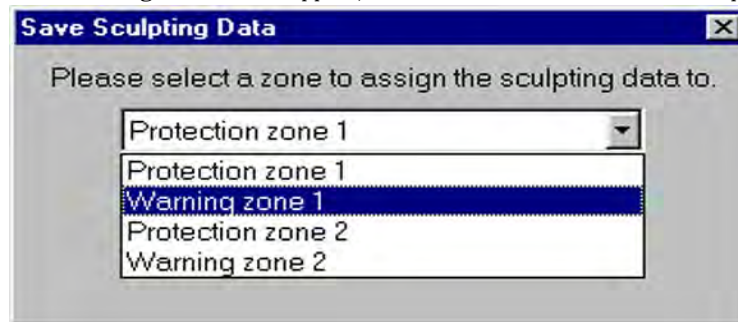


Figure 8-17 Save Sculpting Data

Here we show the new sculpted shape after the data has been sent to the sensor. See Section 8.9—*Sending and Registering Changes*.

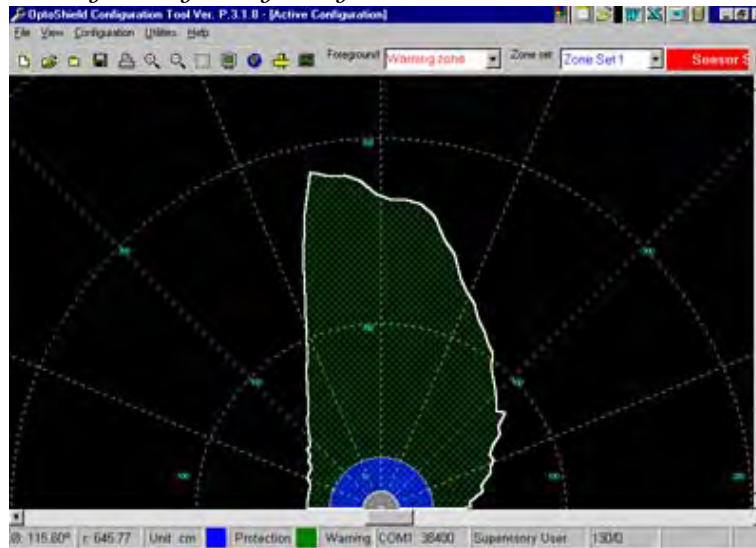


Figure 8-18 OS3101 with New Zone Configuration

8.9 SENDING AND REGISTERING CHANGES

Step 1: When all the zone and property modifications are complete, they must be sent and registered. Go to the Configuration heading and select Send to Sensor/Enter CGF Mode. You may select All changes, Selected changes or Entire Configuration.

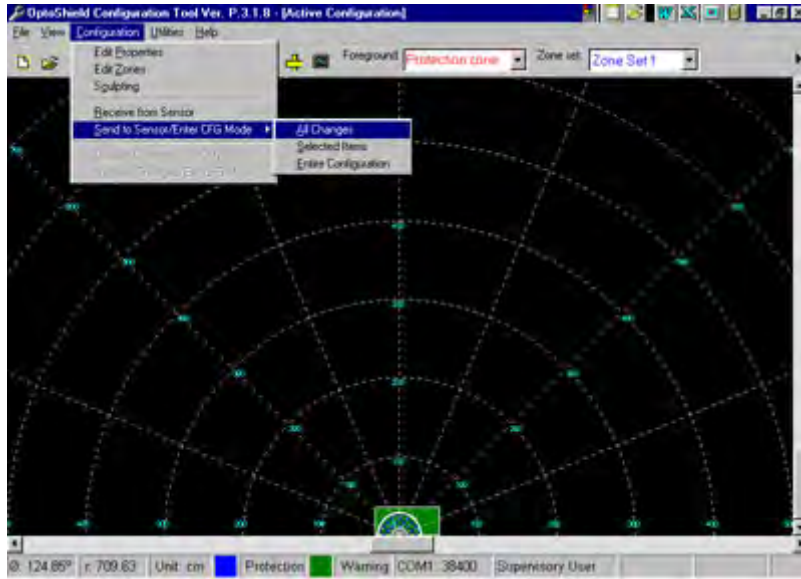


Figure 8-19 Completing Configuration

Step 2: You will be prompted and warned that the operation requested will close the current operating mode, select 'yes'.

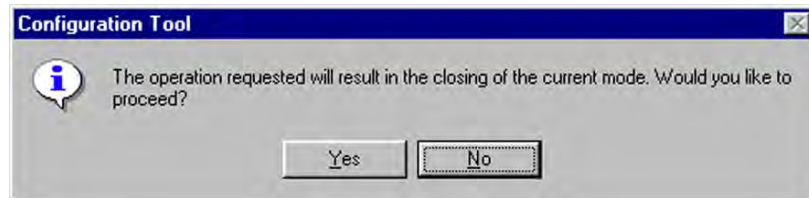


Figure 8-20 Configuration Tool - Entering CGF Mode

Step 3: You will be then warned again, select 'yes'. At this time the OptoShield will exit the Configuration Mode and the machine will come to a stop.

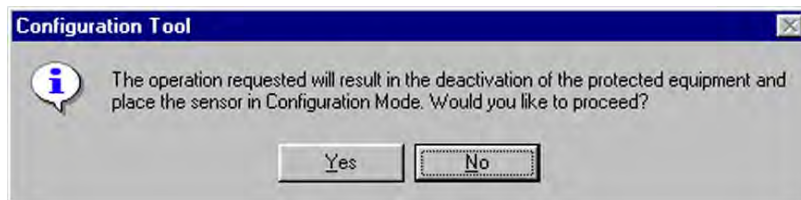


Figure 8-21 Configuration Tool- Enter CGF Mode II

Step 4: You will be prompted and asked to confirm that all the changes are correct, select 'OK'.



Figure 8-22 Configuration Tool - Confirm Changes

Step 5: Go to the Configuration heading and select Register Changes/Exit CGF Mode.

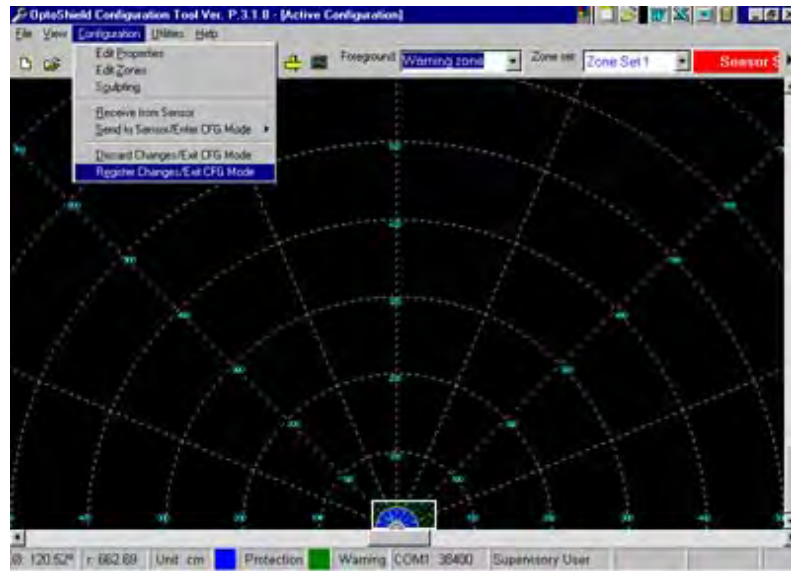


Figure 8-23 Configuration Tool - Register Changes

Step 6: You will be prompted to confirm that you would like to save the configuration, select 'Yes'.

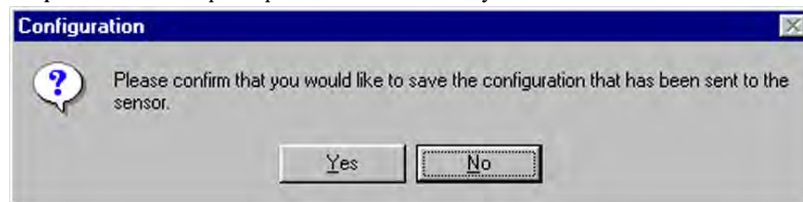


Figure 8-24 Configuration Tool - Save Configuration

Step 9: You will be prompted that all changes were sent, click 'OK'.

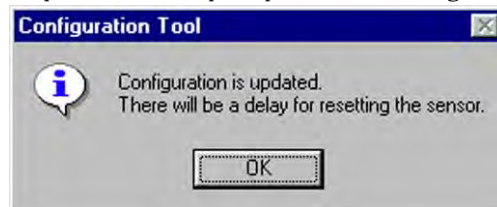


Figure 8-25 Configuration Tool - Configuration Updated

At this time the OS3101 is ready to run and will enter the operating mode to which it is configured.

8.10 ZONE SELECTION

It is possible to define two zone sets and alternate the activation of these sets. This feature gives the user more manufacturing flexibility and faster setup time. The zones can be changed via configuration of the setup software or by two external inputs. To alternate between zones via the setup program, simply select the preferred zone set from the tool bar. An external device for interfacing with the zone select inputs may be used to switch between zone set 1 and zone set 2.

The Zone Select interface inputs consist of three connections: Zone Select 1 (Z1), Zone Select 2 (Z2) and Zone Select Return. In order for a zone selection to be valid, Z1 and Z2 must be in opposite states, as shown in table below.

Z1 Input	Z2 Input	Zone Set
Closed	Open	1
Open	Closed	2
Open	Open	Invalid: Fault after 10 minutes
Closed	Closed	Invalid: Fault after 10 minutes

Table 8-1 Zone Selection

The OptoShield can change from Zone Set 1 to Zone Set 2 within 15 ms after the zone select inputs have been changed. The OS3101 monitors both zone inputs, the maximum time allowed for the inputs (Z1 & Z2) to transition is 10 min. If an invalid state is present, the OS3101 will guard the total accumulated area of both zone sets. If they do not change to a valid state within 10 minutes, the OptoShield will enter a fault state and turn off the OSSD safety outputs.

The 10 minute mark permits the OS3101 to monitor/guard both zone sets simultaneously. Some applications using multiple zones may require a time where it is necessary to guard the combination of the two zone sets.

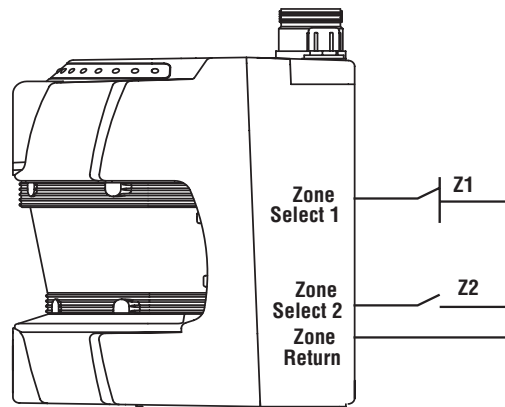


Figure 8-26 Zone Selection

9 SYSTEM CONNECTIONS

9

9.1 INPUT POWER REQUIREMENTS

The OS3101 sensor operates directly from 24 VDC \pm 20%. The operating power to the OptoShield must be supplied from a dedicated power supply. The power supply must meet the requirements of IEC 60204-1 and IEC 61496-1, STI Part Number 40128 or equivalent. The tables below reference the connections on the OptoShield, they are identified by the pin number, input type and input name.

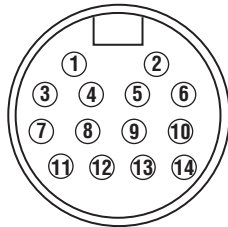


Figure 9-1 Power /Control – 14-Pin Mini-Type Connector

The table below cross-references the Power/Controls connector pin out and to the mating cable conductor color and signal description.

60718-0xxx				
Connector	Pin	Conductor Colors	Type	Signal Name
14-Pin Male Mini-Type Connector	1	Orange/White	Input	Zone Select 1
	2	Orange/Black	Input	Zone Select 2
	3	Gray	Input	Start
	4	Pink	Input	EDM (MPCE)
	5	Black	Input	Zone Return
	6	Violet	–	Not Used
	7	Blue	Output	Auxiliary
	8	Red/Black	Output	Warning Aux.
	9	Red	Output	OSSD B
	10	Yellow	Output	OSSD A
	11	White	Power	+24V
	12	White	Power	+24V
	13	Brown	Power	24V - Ret (0V)
	14	Brown	Power	24V - Ret (0V)

Table 9-1 Power and Input/Output Connections

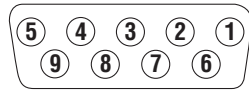


Figure 9-2 Female Shell View of Serial Port DB-9

Connector	Pin	Conductor Colors	Type	Signal Name
RS-232 DB-9	1	Black	Input	RxD+
	2	White	Output	TxD/TxD–
	3	Red	Input	RxD/RxD–
	4	Green	Output	TxD+
	5	Brown	Passive	COMM_GND
	6	Blue	Not Used	Not Used
	7	Yellow	Passive	COMM_SHIELD
	8	Orange	Not Used	Not Used
	9	Purple	Not Used	Not Used
		Braided Shield	Shield P.E.	Shield P.E.

Table 9-2 PC Interface Connections – DB9

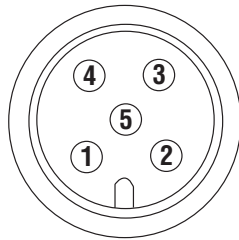


Figure 9-3 DeviceNet M12

Connector	Pin	Type	Signal Name
DeviceNet M-12	1	Passive	CAN_SHIELD
	2	Power	V+
	3	Power	V –
	4	Input/Output	CAN_HIGH
	5	Input/Output	CAN_LOW

Table 9-3 DeviceNet Connections – 5 pole M12

9.2 CONNECTING THE OPTOSHIELD TO A SAFETY MONITORING DEVICE

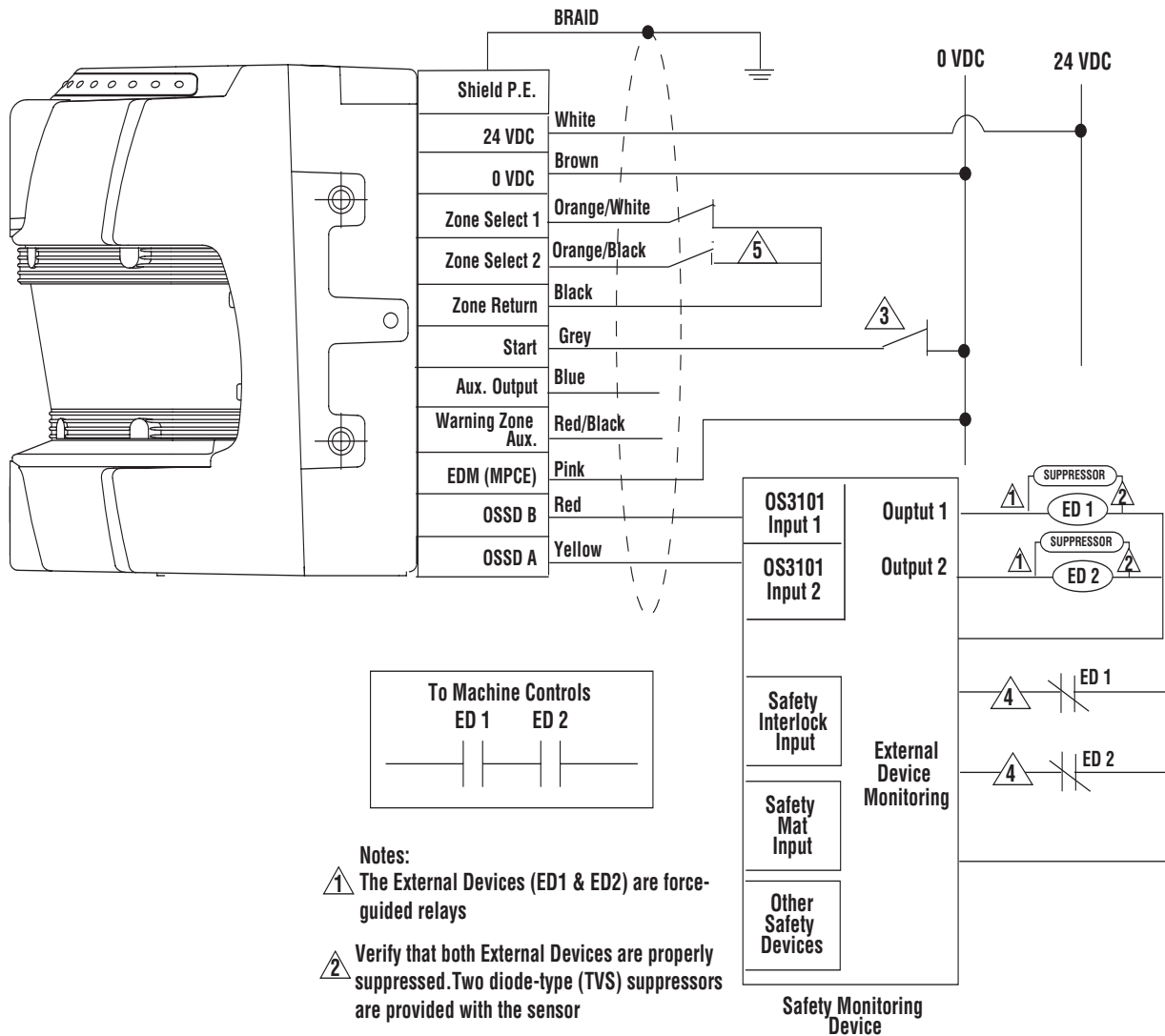


Figure 9-4 Connecting the OptoShield to a Safety Monitoring Device

9.3 CONNECTING THE OPTOSHIELD TO THE RM-1 MODULE

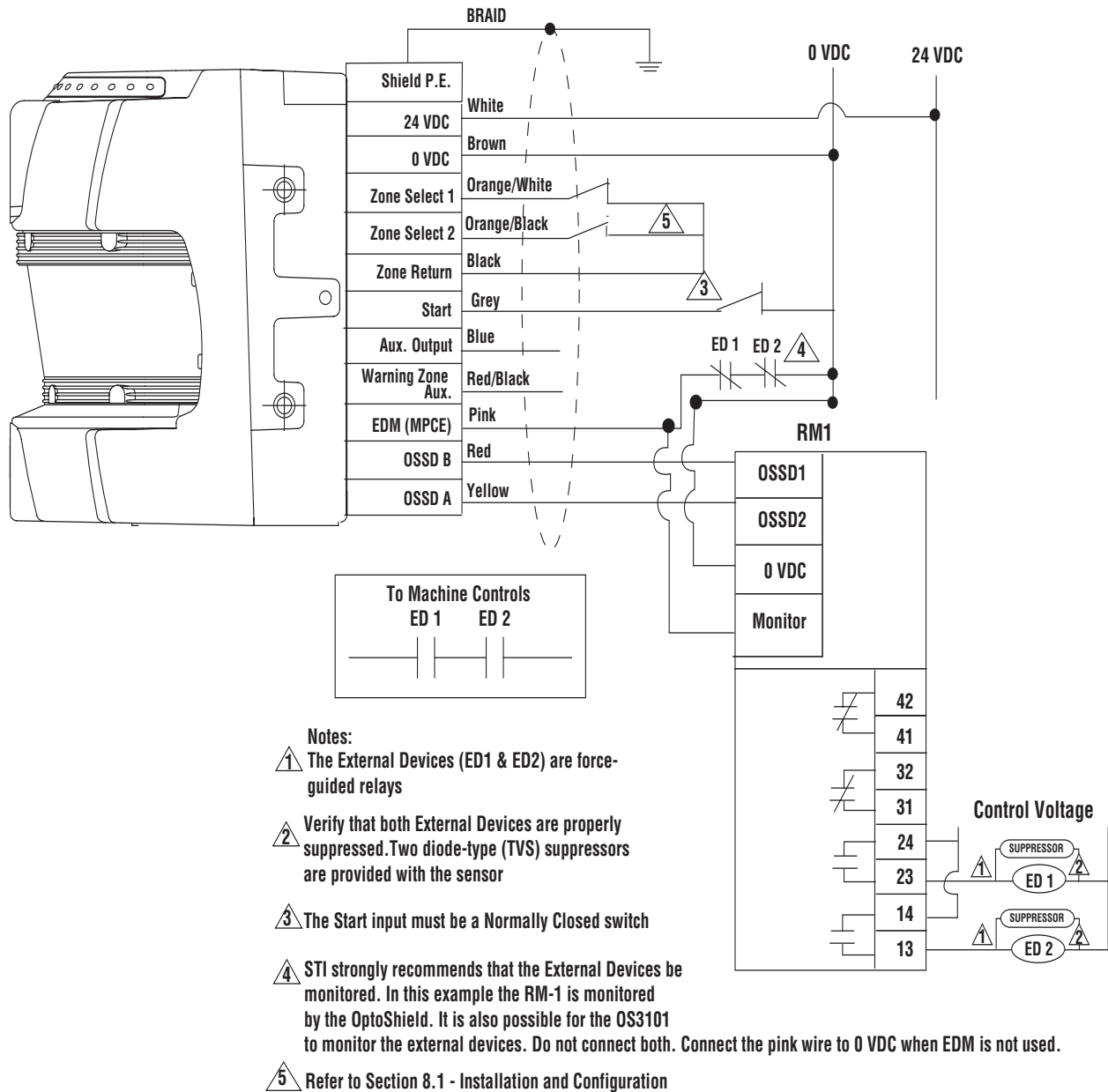
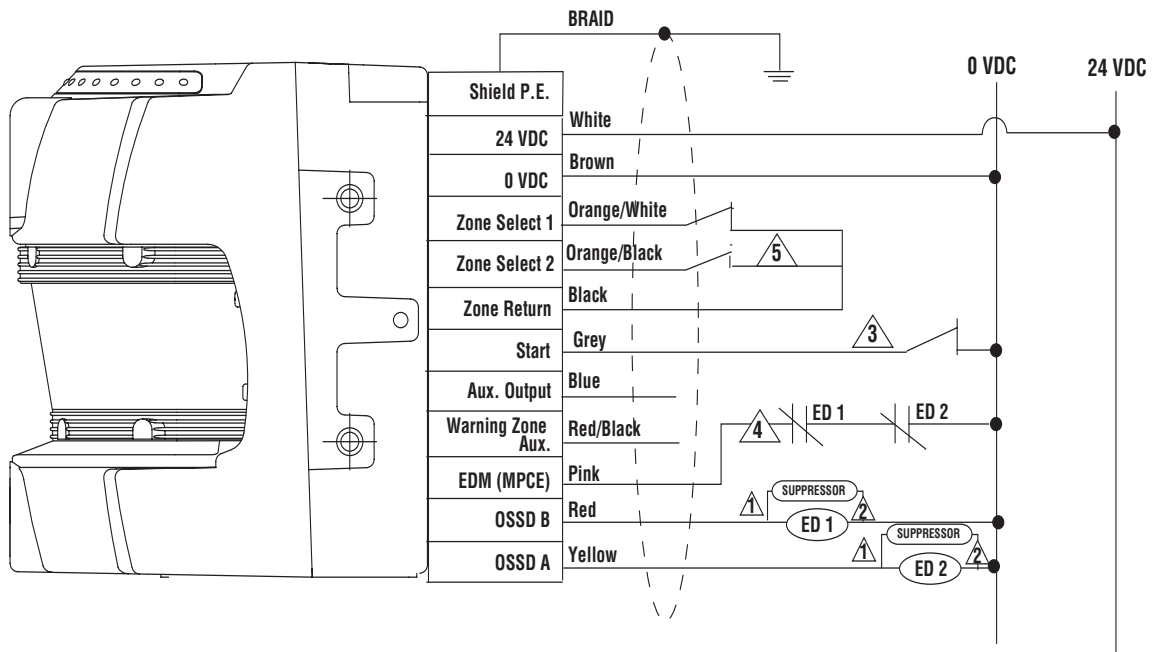


Figure 9-5 Connecting the OptoShield to the RM-1 Module

9.4 CONNECTING THE OPTOSHIELD TO TWO FORCE-GUIDED RELAYS



- Notes:**
- ⚠ 1 The External Devices (ED1 & ED2) are force-guided relays
 - ⚠ 2 Verify that both External Devices are properly suppressed. Two diode-type (TVS) suppressors are provided with the sensor
 - ⚠ 3 The Start input must be a Normally Closed switch
 - ⚠ 4 STI strongly recommends that the External Devices be monitored. In this example the External Devices (relays) are monitored by the OptoShield. Connect the pink wire to 0 VDC when EDM is not used.
 - ⚠ 5 Refer to Section 8.1 - Installation and Configuration

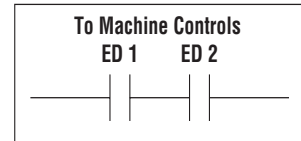


Figure 9-6 Connecting the OptoShield to Two Force-Guided Relays

9.5 CONNECTING THE OPTOSHIELD TO AN RM-2AC

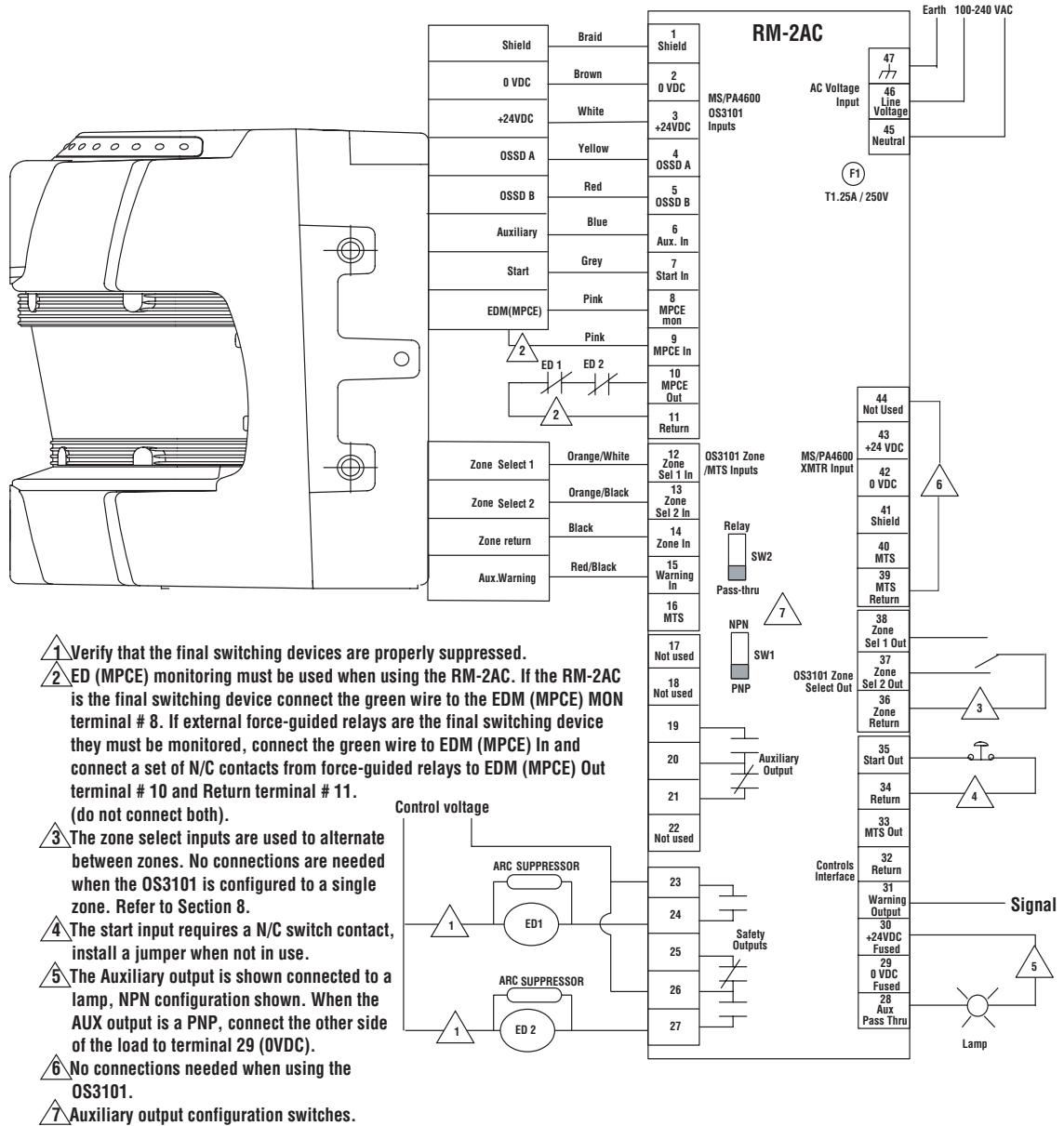


Figure 9-7 Connecting the OptoShield to the RM-2AC

9.6 CHECKOUT AND TEST PROCEDURES

9.6.1 CHECKOUT PROCEDURE

Refer to *Appendix B* for step-by-step instruction and checkout inspection log.

Once the OptoShield has been mounted, configured, and properly connected to the machine control system, qualified personnel must perform the Checkout Procedure detailed in Appendix B. A copy of the checkout results should be kept with the machine's records.

9.6.2 TEST PROCEDURE

Refer to *Appendix C* for step-by-step instruction and test procedure log.

⚠ WARNING! *The tests outlined in this Test Procedure (Appendix C) must be performed at time of installation, according to the employer's regular inspection program and after any maintenance, tooling change, set up, adjustment, or modification to the OS3101 system or the guarded machine. Where a guarded machine is used by multiple operators or shifts, it is suggested that the test procedure be performed at each shift or operation change and also if there is a change in the OS3101 operating mode or defined zone sets. Testing ensures that the laser safety scanner and the machine control system are working properly to stop the machine. Failure to test properly could result in serious injury to personnel.*

With the OS3101 system operating in Automatic Start Mode, verify that the machine stops and is unable to restart while the test object is in the safety zone. When the OptoShield is installed in conjunction with an STI relay module, it is necessary to verify that the module's outputs properly change state. This is accomplished by causing an intentional safety zone intrusion. It is recommended that this be done at least every change of shift or 24 hours of operation.

This Test Procedure must be performed by a *qualified* person. A qualified person is defined as “a person or persons who, by possession of a recognized degree or certificate of professional training, or who, by extensive knowledge, training or experience, has successfully demonstrated the ability to solve problems relating to the subject matter and work.” (ANSI B30.2-1983)

To test the OS3101 system use a test object dimension of 62 mm (2.33 in.) to 80 mm (3.15 in.). (Test object is not supplied with the OptoShield).

9.7 TEST OBJECT INSTRUCTION

To test the OS3101's detection capability, guide the test object along the perimeter of the Safety detection zone as shown in *Figure 9-8*. The hazardous motion of the guarded equipment must stop immediately (within the pre-determined accepted stop times). While in Automatic Start Mode, the OptoShield MUST remain in the machine stop state throughout the entire test.

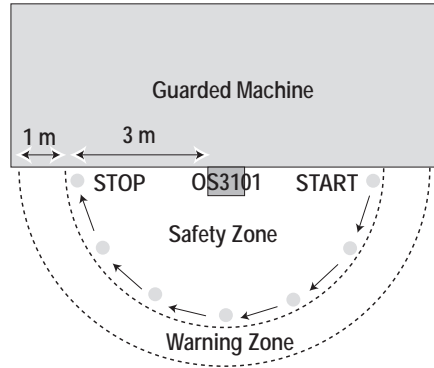


Figure 9-8 Testing the Safety Zone

Verify that all indicators and displays are operating properly and correspond to their defined functions. Inspect the OS3101 housing and the exit window for signs of damage or manipulation.

If the OS3101 is used in a stationary guarding application, ensure that the safety zone(s) are clearly marked on the floor. For mobile applications, make sure that the vehicle stops moving within the limits set in the initial configuration.

If the OS3101 fails any of these tests, lock out the guarded equipment and contact the factory supervisor immediately.

9.8 MINIMUM OBJECT RESOLUTION

The Optoshield OS3101 has a minimum Object Resolution of 62mm. This means that the OS3101 will detect an object 62mm or larger in diameter that is completely within the field of view.

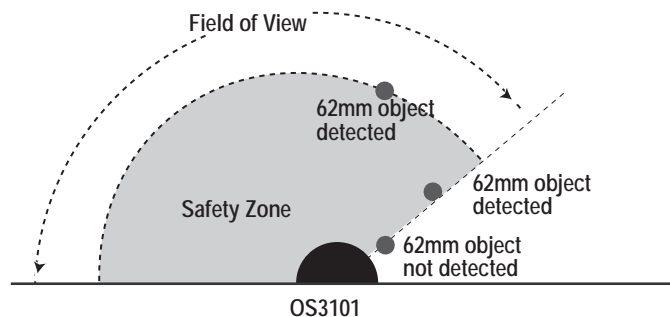


Figure 9-9 Field of View

9.9 SIZE CONSIDERATIONS WHEN CONFIGURING A DETECTION ZONE

Due to the scanner's minimum object resolution criteria, it is possible to configure zones that are not considered valid. These zone configurations may contain a protrusion or intrusion that is narrower than 62mm in width within the field of view. This type of invalid zone configuration can only occur within a distance of 2.6 meters from the scanner.

Narrow protruding areas less than 62mm wide are NOT valid zone perimeters. A scanner configured with such a safety zone would see a presence within this area (if in monitor mode), but would not initiate a machine stop. The following pictures show a possible zone configuration that contains a protrusion that is narrower than 62mm in width, since this protrusion is less than 62mm in width it will not detect a 62mm object.

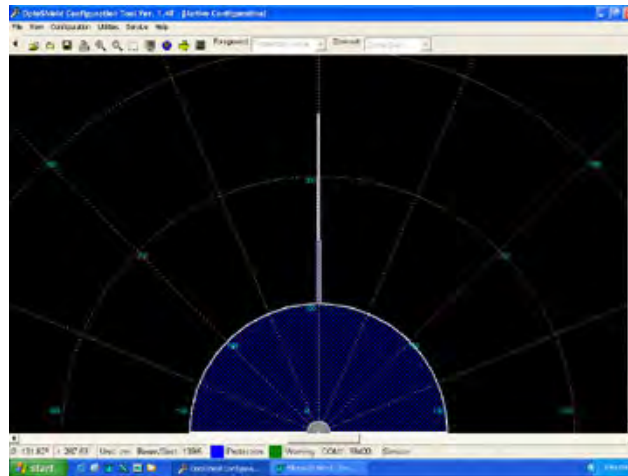


Figure 9-10 Detection Zone with Protrusion

Narrow intruding areas less than 62mm wide are NOT valid zone perimeters. A scanner configured with such a safety zone would see a presence within this area (if in monitor mode), but would not initiate a machine stop. The following pictures show a possible zone configuration that contains an intrusion that is narrower than 62mm in width. In this case the scanner has two fields of view and the object must be entirely in the left or right field of view to be detected, therefore this narrow intrusion of less than 62mm in width is not a valid zone.

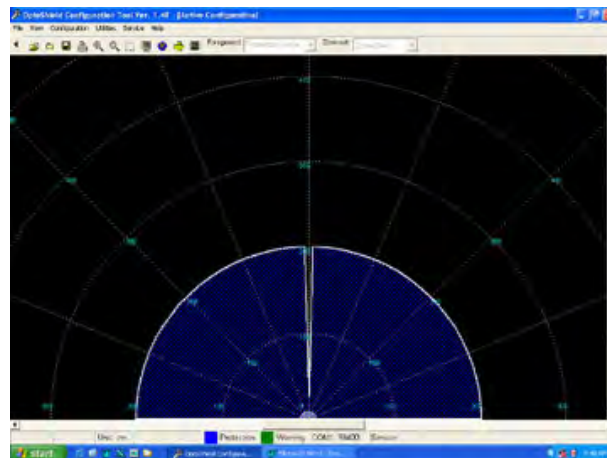


Figure 9-11 Detection Zone with Intrusion

10 TROUBLESHOOTING

10.1 TROUBLE SHOOTING

Here are a few tips that will help you identify and resolve common OS3101 issues.

10.1.1 INTERMITTENT STOP

The scanner will erratically transition from a Machine run (green) state to a Machine stop (red) state. This may happen on a regular basis or very infrequently.

The four reasons are:

- Crosstalk

Crosstalk can occur if two or more scanners are installed in view of each other and at the same height (scan plane) refer to section 5.6 for more information and mounting suggestions.

- Incorrect zone configuration

If the safety zone configuration is set too close to any objects an intermittent stop may occur. Check that the perimeter of the zone is at least 135mm away from the closest physical object. (the measurement error of the scanner is 135mm)

- Bright lights/Lamps

Ambient light or strobe flashes will cause the OS3101 to false stop, see section 5.5 for more information. This is not a safety concern.

- Dust Accumulation on Window

If the intermittent stops occur with an 80 on the display, the window needs to be cleaned.

10.1.2 CONSTANT STOP

- Dirty window

In most cases a dirty/scratched window will give you a status code of 80 indicating that cleaning or replacement is needed. In some cases a dirty/scratchy window may NOT indicate 80. Check the Intrusion Indicators, they will help you determine if the scanner is detecting something.

- Layout change

Verify that the envelope of the guarded area has NOT changed. In some cases something was moved or placed within the zone. Check the Intrusion Indicators, they will help you determine if the scanner is seeing something.

10.1.3 SLOW RESPONSE TO RUN STATE

The same problems mentioned for an intermittent stop crosstalk, incorrect zone configuration and bright lights/lamps could cause a slow response to run state. In all of them the scanner finds some spurious zone violation that prevent it from going green immediately. Check that the perimeter of the zone is at least 135mm away from the closest physical object. (the measurement error of the scanner is 135mm).

10.2 FAULT CONDITION

Check the fault code table

10.2.1 DIAGNOSTIC CODES

The OptoShield has a two-digit numeric display on the front of the scanner indicates status and system fault status. These codes are described in the table below.

Status Codes	Diagnostic Code	Description	Corrective Action
Normal Operation	88	Power Up indication	None required
	--	Normal Operation (machine stop)	None required
	01	Interlock state and waiting for Start input	Press and release Start switch
	02	The unit is in configuration mode	Go to the configuration heading and exit CGF mode
	XX	See Table 10-2	None
Maintenance	80	The unit has detected the accumulation of dust on the window	Clean the window
Fault Codes	Diagnostic Code	Description	Corrective Action
Safety Output (OSSD) Faults	30	General OSSD fault	Check output connections, see manual.
	32	Safety Output A tied to power.	Check output connections, see manual.
	33	Safety Output B tied to power.	Check output connections, see manual.
	34	Safety Output A shorted to Ground	Check output connections, see manual
	35	Safety Output B shorted to Ground	Check output connections, see manual.
EDM (MPCE) Faults	40	General EDM (MPCE) fault	EDM (MPCE) input incorrectly wired, see manual
	41	EDM (MPCE) monitoring signal is in incorrect state before entering the Machine Run state.	Check that EDM (MPCE) input is closed before OSSD activation, see manual
	42	EDM (MPCE) monitoring signal is in incorrect state after entering the Machine Run state	Check that EDM (MPCE) input is open after OSSD activation, see manual
	43	EDM (MPCE) monitoring signal is in incorrect state during power up.	Check that EDM (MPCE) input is closed when power is applied, see manual
Internal Fault	50	Internal fault	Consult factory
	81	The unit has detected a variance in the dust detection circuit.	Clean the window and re-start the unit. If the fault does not clear, consult factory.
	51	Possible crosstalk with other laser scanner	Refer to section 5.5 for proper mounting information.
	52-58	Internal Fault	Consult factory.
	59	The scanner was possibly Jarred or Bumped	Reset scanner by cycling power or pressing the reset button (user supplied). If the fault does not clear, consult factory.
	70	Zone select input fault	Check zone select configuration and input connections

Table 10-1 Diagnostic Code References

- Status Code Display

The following status codes will appear on the scanner's 7-segment display during machine run state. They are representative of the zone setting and the scanners operating response time. Example: code '24' indicates zone set 2 with a response time of 160mS. Note: Response times longer than 400mS are represented by a Zero

Active Zone Set	First Digit
Zone Set 1	1
Zone Set 2	2
Union of Zone 1 and 2	U
Response Time (mS)	Second Digit
80mS	2
120mS	3
160mS	4
200mS	5
240mS	6
280mS	7
320mS	8
360mS	9
400mS	0
440mS	0
480mS	0
520mS	0
560mS	0
600mS	0
640mS	0
680mS	0

Table 10-2 Status Display Code

11 SPECIFICATIONS AND ADDITIONAL INFORMATION

11

11.1 SYSTEM SPECIFICATIONS

Mechanical	
Input Voltage (V_{in})	24 VDC \pm 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. STI part number 40128 or equivalent.
Input Power	20 watts (without load on the outputs)
Response Time	\leq 80 ms (2 scans), add 40 ms with each additional scan (up to 15 additional scans max.)
Light Source (wave length)	laser diode 905 nm
Detection Sets	2
Object Resolution	62 mm @ 4m
Max. Safety Radius	4 m
Max. Warning Radius	15 m
Measurement Angle	180 degree
Angle Resolution	0.36°
Laser Safety	Class 1 per IEC-60825.1 (2001) and CFR 21 1040.10 & 1040.11
Max. Measurement Error	135 mm
Max. Measurement Error w/ reflective backgrounds	See Section 11.2— <i>Reflection Considerations</i> for information.
Outputs	
Safety Outputs Ratings	Two PNP outputs sourcing 625 mA max @ V_{in} (see note 1)
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)
Warning Zone (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)
Inputs	
EDM (MPCE) Monitor	50 mA @ 24 VDC
Start/Restart	20 mA @ 24 VDC
Zone Select 1 & 2	20 mA @ 24 VDC
Status Indicators	
	Machine Run, Machine Stop, Interlock
	Two 7-segment displays for diagnostics
	16 intrusion indicators
Data Interface	
Serial Port	RS232 or RS422; 9.6K, 19.2K, 38.4K Baud Rate and 115.2 K
DeviceNet	For diagnostic data only
Environmental	

Mechanical	
Operating Temperature	0 – 50°C
Storage Temperature	–25 to 70°C
Enclosure Rating	IP65
Relative Humidity	95% max., non condensing
Enclosure	Polyester powder-painted die-cast aluminum
Dimensions	155 x 182 x 156 mm
Vibration	In accordance with IEC 60028-2-6.
Shock	In accordance with IEC 60028-2-29
Weight	4.35 kg.
Max. Cable Limits	
RS232	15 meters
RS422	100 meters
DeviceNet	6 meters
Controls and Outputs	30 meters
Approvals	
Conformities	CE, TUV, UL and CSA
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, auxiliary output and the warning output should not exceed 1.45A. Note 3: Total system current requirement of the OptoShield is 2.3A max. (scanner 850 mA + OSSD1 load + OSSD2 load + auxiliary output load + warning zone output. Specifications are subject to change without notice.	

Table 11-1 OS3101 Specifications

11.2 REFLECTION CONSIDERATIONS

Note: The accuracy of laser scanners, such as the OS3101, can be affected by highly reflective backgrounds. In order to safely consider all sensing errors, this variance must also be taken into consideration during safety zone setup.

The condition occurs due to the short pulsed light that is emitted from the OptoShield and the methods used to determine the distance to the sensed target. This condition only occurs for backgrounds that will reflect large amounts of light back to the sensor such as white and retro-reflective objects. The additional error is required when the following conditions exist:

Retro-reflective background material or object is present in the scanning plane and within **3m** beyond the safety zone, or **white** background material or object is present within **2m** beyond the safety zone.

If any of the conditions listed above apply to your application, an additional error factor should be added to the calculated safety zone size.

Z = Additional safety factors (maximum measurement error), the sum of:

- The scanners maximum measurement error (135mm)
- R = Errors due to highly reflective surfaces, if necessary.

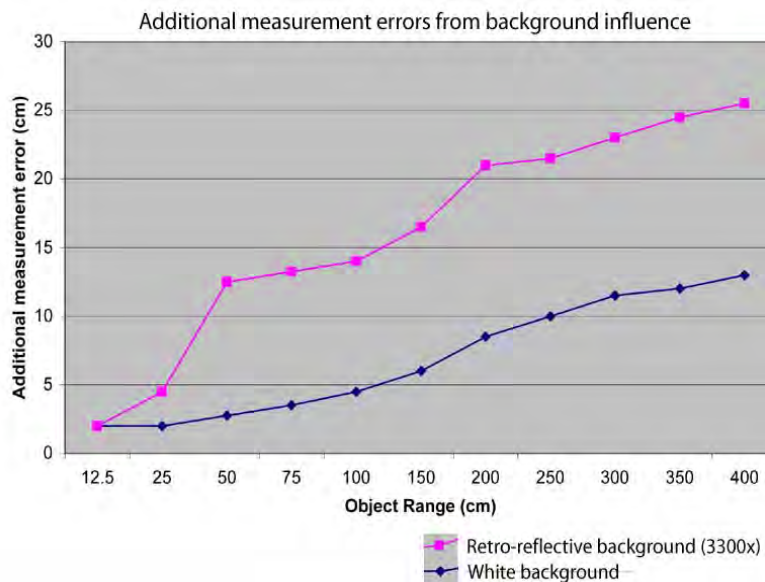


Figure 11-1 Additional Measurement Errors

11.3 DIMENSIONAL DRAWINGS (MM)

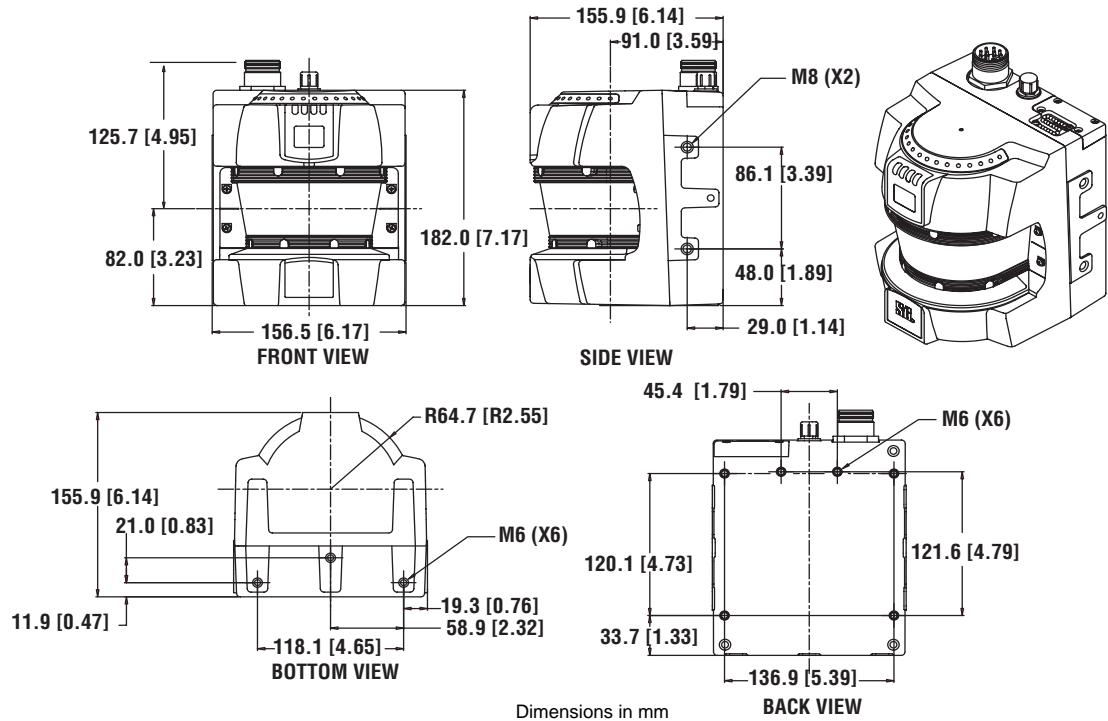


Figure 11-2 OptoShield Dimensional Drawing

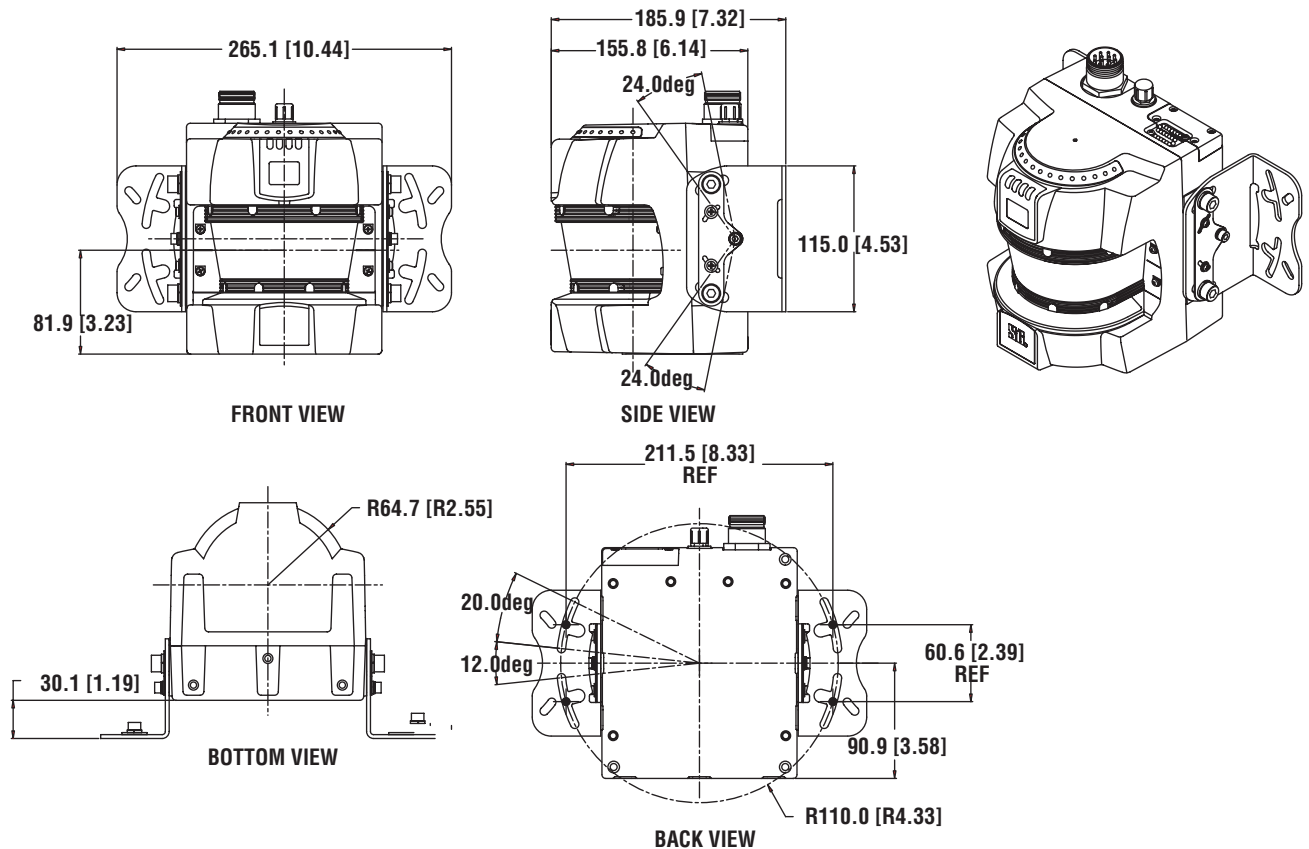


Figure 11-3 OptoShield with Outward Mounting Brackets

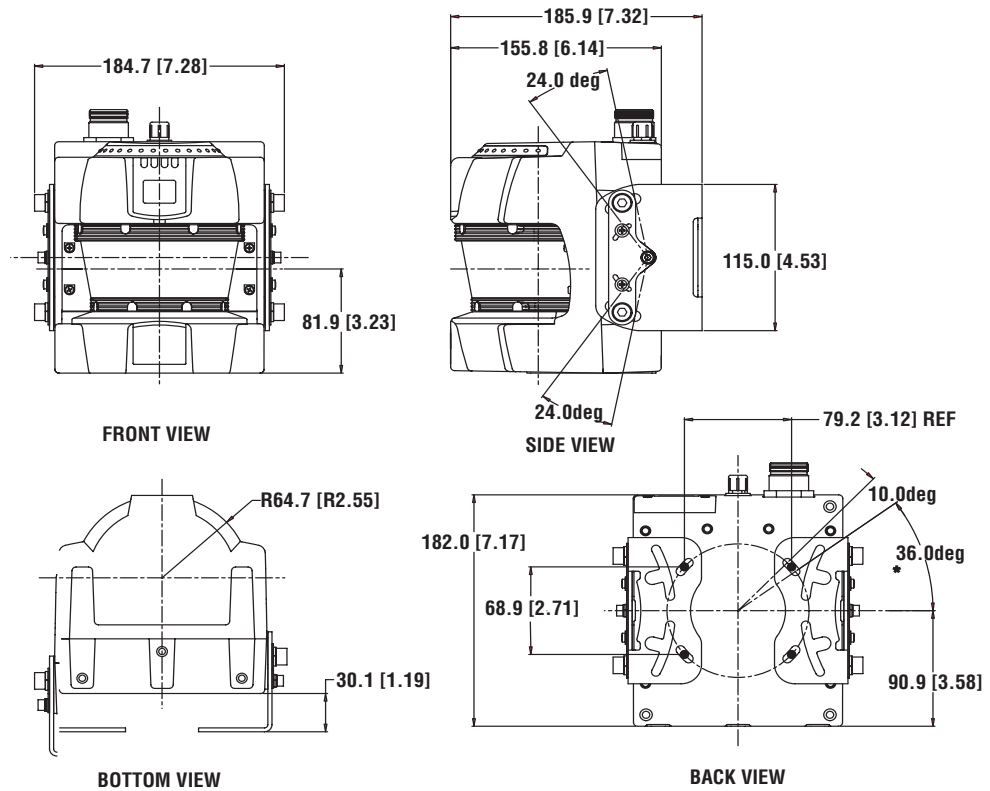


Figure 11-4 OptoShield with Inward Mounting Brackets

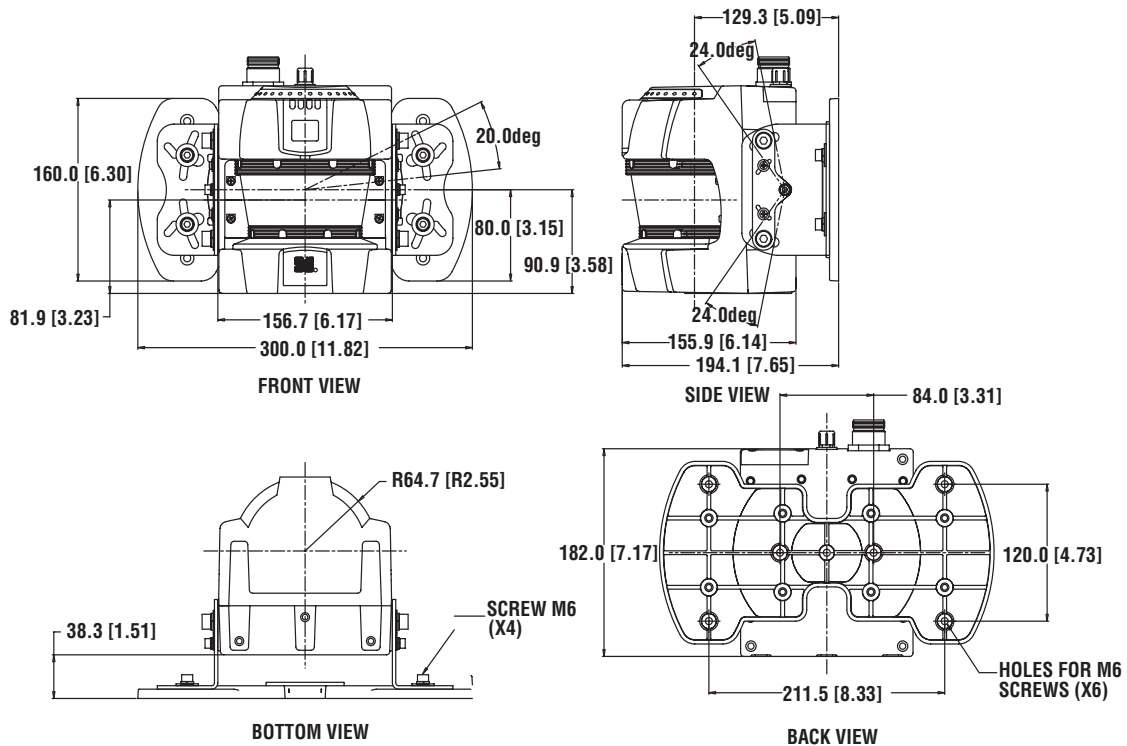


Figure 11-5 OptoShield with Bracket Kit and Mounting Plate

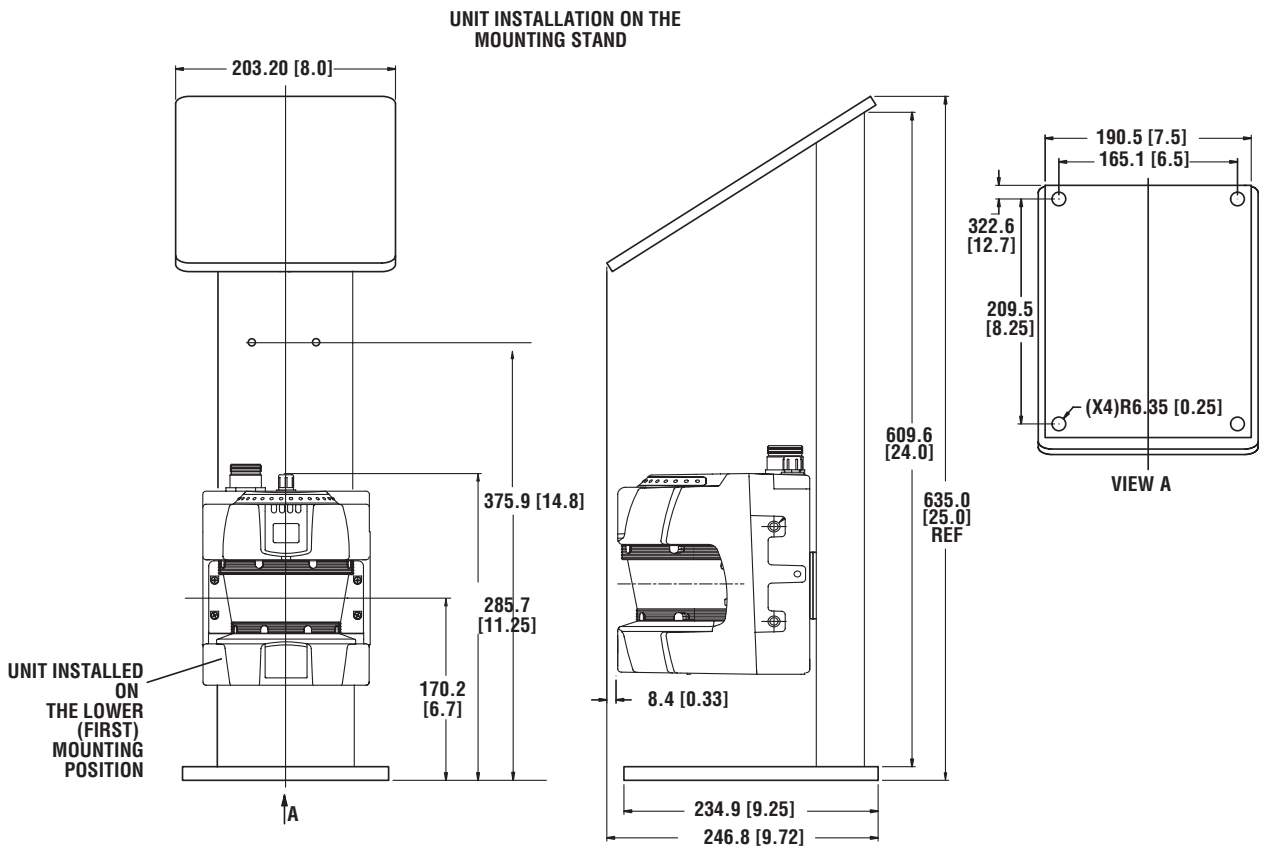


Figure 11-6 Mounting Stand

12 GLOSSARY AND OTHER INFORMATION

12

12.1 GLOSSARY

- Auxiliary Output

This is a non-safety output. It may be configured to follow the OSSD Safety Outputs or to indicate a fault condition.

- Auto Connect

Feature of the Configuration Tool (CFG). It establishes the serial communication between the sensor and the computer. It automatically selects the serial port and baud rate on the computer to which the OptoShield is connected. Supported baud rates: 9.6 K, 19.2 K and 38.4 K; serial ports: COM1 through COM8.

- Baud Rate (bits per second)

The speed at which your computer can transmit and receive information. The Optoshield can transmit in four baud rates: 9.6 K, 19.2 K, and 38.4 K.

- Edit Zones

When enabled the edit zones mode will allow the current configurations of the protection and warning zones to be modified. The zones are graphically displayed for editing. This feature can only be used with an access log-on level of supervisory user or higher.

- External Device Monitoring (ED) a.k.a. (MPCE)

That electrically powered element which directly controls the machine's normal operating motion in such a way that it is last (in time) to operate when motion is initiated or arrested. Redundant machine control circuits must have two external device monitoring (EDM (MPCE)). The monitoring of the machine external control devices is an important part of a safety system installation and is referred to as EDM.

- Monitoring Mode

In this mode, the continuously measured data from scanner is displayed on the screen in real time.

- Monitoring Zone

The Monitoring Zone command selects the zone set to be monitored. There are three selections for this property zone set 1, zone set 2, or multiple zones. Each zone set consists of a protection zone and a warning zone.

- MPCE (See External Devices)

- Safety-critical Settings

These are the settings that configure the safe installation of the OptoShield. Example: EDM (MPCE), response time and operating mode.

- Non-Safety Critical Settings

These are settings that are not related to the safe installation of the Optoshield. Example: auxiliary output, warning output and warning zone.

- OSSD

Output Signal Switching Device, this term is used when referring to the safety outputs of the sensor.

- Protection Zone

A user-defined protection area originating from the sensor and extending radially to the protection boundary. The range of the Protection Zone is a radius of 93mm to 4000mm. Within the zone, the sensor performs accident-prevention functions. This zone is a safety-critical property.

- Response Time

The maximum time between the actuation of the sensor function and the switching of the safety output of the Optoshield. The response time ranges from 80 ms (2 scans) to 680 ms (17 scan), in increments of 40 ms.

- Warning Zone

The user-defined warning area originating from the sensor and extending radially to the zone boundary. The range of the Warning Zone is a radius of 93 mm to 15 m. This zone allows a large scanning area than the Protection Zone and can be used to activate a warning function. This zone is a non-safety-critical property.

12.2 COMMANDS

- Discard Change/Exit CFG Mode command

Instructs the Optoshield to discard all the changes that have been received since the last update. In addition, the sensor then exits the CFG (configuration) Mode and reset itself.

- Edit Properties command

Enables the user to edit the existing operating properties. The properties are divided into two categories, safety critical and non-safety critical. The user must have the supervisory access or higher to make any changes.

- Receive from Sensor

This command retrieves and displays the current operating setting and zone configurations from the OS3101.

- Register Changes/Exit CFG Mode

This command saves the changes in the Optoshield's settings since the last update. The sensor then exits the CFG (configuration) Mode.

- Sculpting Command

Allows the user to specify the protection and warning zone based on the sensor's measurements of the distance to a physical boundary. This physical boundary may either be part of a static monitoring region, or an object (e.g., test piece) manually placed at the desired radius by the user. Selecting the Sculpting command instructs the sensor to send the measured profiles to the host. On each angular direction, the range will be the minimum between the current measured range and the transmitted range in the previous scan. The CFG Tool subtracts a stand-off distance of 135cm from the received profile of any protection zone before it is graphically displayed for the user. The user can shape the contour of the zone by encroaching into the scanned area at the appropriate points. Once the user is satisfied with the displayed zone, the CFG Tool will allow the user to stop Sculpting (select the command again) which will cause the sensor to cease sending profiles. At that point the user will be allowed to edit the last received profile and/or to assign it to one of the Protection or Warning zones in the displayed configuration.

- Send to Sensor/Enter CFG Mode command

This command places the sensor in Configuration Mode and sends the displayed configuration's properties to the sensor. The user logon must be supervisory use.

There are three options available:

- All Changes - to send all properties that have been changed since the last update.
- Send Selected Items - user selects the properties to be sent.
- Entire Configuration - to send the completed configuration to the sensor.

12.3 SPARE PARTS

Model	Description:
OS3101-2-PN-0P	Optoshield with RS232 serial port, PNP auxiliary output
OS3101-2-PN-RV-0P	Optoshield with RS232 serial port, PNP auxiliary output, Device net
Cables	
OS3101-10PT	Power cable – 10 meters long
OS3101-20PT	Power cable – 20 meters long
OS3101-30PT	Power cable – 30 meters long
RS2-C4	Serial port cable 4 meter (for temporary use only)
RS2-C2	Serial port cable 2 meter (for temporary use only)
RV-6	Device net cable 6 meter (20 ft.)
Mounting Hardware	
OS3101-BKT	Mounting bracket kit
OS31-BPT	Mounting back plate
OS31-MT	Mounting Stand
Resource Modules	
RM-1	RM-1 resource module
RM-X	RM-X resource module
RM2-AC	RM2-AC resource module
Accessories	
OS3101-WIN-KT	Window w/ gasket replacement kit
OS31-CLN-KT	Window cleaning kit, Anti-static cleaner
USB-RS2	USB to Serial adapter
OS3101-INST	OS3101 Installation and Operating Manual
OS31-CFG	OS3101 Configuration Tool CD
OS3101-DST-KT	Dust Ring w/gasket replacement kit

12.4 WARRANTY

STI warrants its products to be free from defects of material and workmanship and will, without charge, replace or repair any equipment found defective upon inspection at its factory, provided the equipment has been returned, transportation prepaid, within one year from the date of installation and not to exceed 18 months from date of factory shipment.

The foregoing warranty is in lieu of and excludes all other warranties not expressly set forth herein, whether expressed or implied by operation of law or otherwise including but not limited to any implied warranties of merchantability or fitness for a particular purpose. No representation or warranty, express or implied, made by any sales representative, distributor, or other agent or representative of STI which is not specifically set forth herein shall be binding upon STI. STI shall not be liable for any incidental or consequential damages, losses or expenses directly or indirectly arising from the sale, handling, improper application or use of the goods or from any other cause relating thereto and STI's liability hereunder, in any case, is expressly limited to repair or replacement (at STI's option) of goods.

Warranty is specifically at the factory or an STI authorized service location. Any on site service will be provided at the sole expense of the Purchaser at standard field service rates.

All associated equipment must be protected by properly rated electronic/electrical protection devices. STI shall not be liable for any damage due to improper engineering or installation by the purchaser or third parties. Proper installation, operation and maintenance of the product becomes the responsibility of the user upon receipt of the product.

12.5 PATENTS

Elements of the electronics and optics essential to meet the specifications and performance standards of STI controls are covered by one or more of the following U.S. Patent Numbers: 6,665,621; 6,753,776; 6,493,653; 6,587,811.

12.6 TRADEMARKS

OptoShield is a trademark of Scientific Technologies, Inc.; STI® is the registered trademark of Scientific Technologies Inc.

12.7 REPAIRS

STI offers product repair service at our factory. If you need repairs made to any STI product contact our Service Department.

12.8 DOCUMENTATION CRITERIA

This publication has been carefully checked for accuracy and is believed to be fully consistent with the products it describes. However, STI does not assume liability for the contents of this publication, the examples used within, or the use of any product described herein. STI reserves the right to make changes to products and/or documentation without further notification.

13 WINDOW AND DUST-RING REPLACEMENT PROCEDURE

13.1 Window Kit

Window Kit model: OS31-WIN-KT

Kit contents:

- Qty. 1– Molded window
- Qty. 1– Molded gasket
- Qty. 4– fastening screws (M3 X 6)
- Qty. 4–flat washers

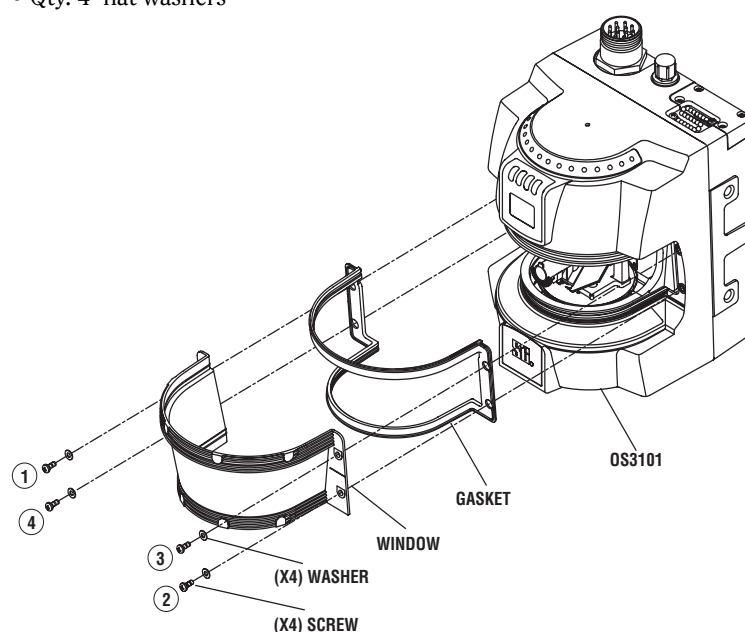


Figure 13-1 Window Replacement

Window replacement can be accomplished without factory support. This procedure will guide maintenance personnel in safely and efficiently replacing the window with minimal downtime.

1. Take precautions to prevent dirt, dust or debris from entering the internal space of the OS3101. It is recommended that this be done on a clean workstation as contaminants may degrade the performance of the OptoShield.
2. Remove power from the OS3101. It will be necessary to dismount the OptoShield from the guarded equipment.
3. Remove the serial and power connection cables.
4. Using a clean cotton cloth, gently wipe off any dirt or dust from the front of the unit that may inadvertently enter the internal space of the OS3101 while the window is removed. (Do not use standard compressed shop air to blow off dust from inside the unit)
5. Remove the four retaining screws on the sides of the window.

6. Remove the existing window by using a small flat head screwdriver to gently pry up the window's edge. (close to the screw fastening location).
7. Remove the existing gasket and install the new gasket. To remove air-born particles from the inside of the unit only use low pressure compressed air that is suitable for optics and sensitive electronics.
8. Install the new window, care should be taken to assure that the inside of the window is clean and free of fingerprints and to obtain a snug fit of the window to the window sealing area.
9. Replace the four retaining screws in an alternating pattern, see Figure 13-1—*Window Replacement*. It is recommended that the retaining screws be tightened to a torque of 60 in-oz. (42 newton/cm.). Caution: excess pressure on the edges of the exit window may result in cracking of the material.
10. Recalibrate the OptoShield to the new window, see window calibration procedure.

Note: If the exit window is damaged to a point where the housing's IP rating integrity is compromised, it is highly suggested to replace the window as soon as possible to reduce the probability for internal contamination. It is also advisable to take precautions to prevent dirt, dust or debris to enter the internal space of the OS3101

13.2 Dust Ring Replacement Procedure

Dust-Ring Kit model: OS3101-DST-KT (Kit contents):

- Qty. 1– Molded dust ring
- Qty. 1– Molded gasket
- Qty. 2 – Fastening screws (M3 X 6)
- Qty. 2 – Flat washers
- Qty. 1– STI logo label

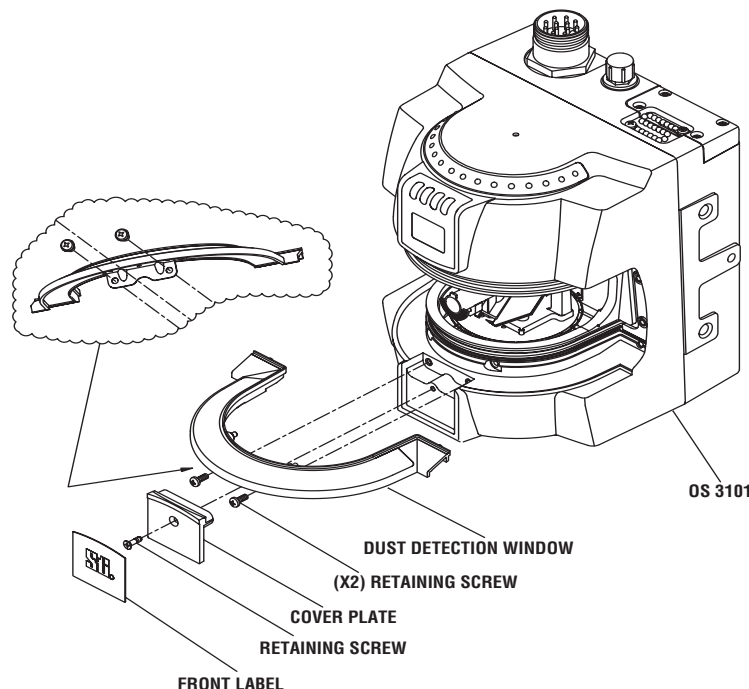


Figure 13-2 Dust-Ring Replacement

Dust Ring replacement can be accomplished without factory support. This procedure will guide maintenance personnel in safely and efficiently replacing the Dust Ring with minimal downtime.

1. Take precautions to prevent dirt, dust or debris from entering the internal space of the Dust Ring reflective area. It is recommended that this be done on a clean workstation as contaminants may degrade the performance of the OptoShield.
2. Remove power from the OS3101. It will be necessary to dismount the OptoShield from the guarded equipment.
3. Remove the serial and power connection cables.
4. Using a clean cotton cloth, gently wipe off any dirt or dust from the front of the unit that may inadvertently enter the internal space of the OS3101 while the Dust ring is removed. (Do not use standard compressed shop air to blow off dust from inside the unit)
5. Remove the front STI logo label.
6. Remove the one retaining screw and remove the cover plate.
7. Remove the two retaining screws from the dust ring.
8. Remove the existing dust ring by using a small flat head screwdriver to gently pry up the dust ring. (close to the screw fastening location).
9. Remove the existing gasket and install the new gasket. To remove air-born particles from the inside of the reflective area only use low pressure compressed air that is suitable for optics and sensitive electronics.
10. Install the new dust ring, care should be taken to assure that the inside of the dust ring and reflector is clean and free of fingerprints and to obtain a snug fit of the dust ring to the ring sealing area.
11. Replace the two retaining screws, see Figure 13-2—Dust Ring Replacement. It is recommended that the retaining screws be tightened to a torque of 60 in-oz. (42 newton/cm.). Caution: excess pressure on the edges of the ring may result in cracking of the material.
12. Recalibrate the OptoShield to the new dust ring, see window calibration procedure.

Note: If the dust ring is damaged to a point where the housing's IP rating integrity is compromised, it is highly suggested to replace the ring as soon as possible to reduce the probability for internal contamination.

13.3 Window and Dust-Ring calibration procedure

The OS3101 requires that it be recalibrated every time the window or dust ring is replaced. The calibration process may only be performed by a qualified person possessing the Supervisor password.

The calibration process requires the use of a computer and the OS3101 configuration tool.

To calibrate the unit follow these steps:

- Go to the Utilities menu
- Select Window Calibration
- A warning will advise that the operation requested will result in the deactivation of the protected equipment and place the scanner in configuration mode, would you like to proceed?
- Click, Yes
- The calibration process will start, this will take about 15 seconds.

If the measured values are acceptable, the following message will appear:

- Calibration value is valid, would you like to save the data?
- Click Yes
- Confirm that you would like to save the configuration to the scanner
- Configuration is updated, there will be a delay in resetting the scanner.

If the measured values are not acceptable, the following message will appear:

- Calibration value is lower than the minimum, data will be discarded.
- Click O.K.
- All changes were discarded, there will be a delay in resetting the scanner.
- Click O.K.

Check the following:

- Verify that the window is clean and free of fingerprints on both sides.

Note: If the exit window is damaged to a point where the housing's IP rating integrity is compromised, it is highly suggested to replace the window as soon as possible to reduce the probability for internal contamination. It is also advisable to take precautions to prevent dirt, dust or debris to enter the internal space of the OS3101.

13.4 OS3101 MAINTENANCE

The OS3101 will require periodic cleaning of the window. The interval of the cleanings will depend on the environment in which the scanner is used. It is recommended that the window be cleaned using a common glass/plastic cleaner. The window should be sprayed and wiped down with a soft cloth. STI offers a cleaning kit OS31-CLN-KT.....

APPENDIX A —DEVICE NET OPERATING INSTRUCTIONS

⚠ WARNING! *DeviceNet is not a safety-rated system and is only used to provide status information. Never use information provided by DeviceNet to control a machine.*

A.1 INTRODUCTION

The OS3101 system is available with DeviceNet which allows communication of non-safety, monitoring and diagnostic information across the DeviceNet Bus.

A.2 FEATURES

- Connects to network using simple micro-style connectors
- The following information is available on DeviceNet:

A.2.1 SYSTEM IDENTIFICATION

- Manufacturer, Product Name, Product Serial Number

A.2.2 SYSTEM STATUS

- Operating Mode
- Detection zone
- Safety Outputs
- Signal Strength

A.2.3 SYSTEM SETTINGS

- Operating Mode/Automatic Start/Start interlock
- EDM (MPCE) Monitoring Enabled/Disabled

A.2.4 DIAGNOSTIC INFORMATION

- OS3101 Diagnostic Codes
- Signal Strength
- Error Code
- Error Description
- Device Serial Number

An Electronic Data Sheet (EDS) is supplied with each segment to assist in device configuration.

Table A-1 Specifications for OS 3100 System with DeviceNet

DeviceNet Power	24 VDC, 50 mA - Supplied by deviceNet BUS Network
DeviceNet Configuration	Vendor Code: 405 (Scientific Technologies Inc.) Device Type: 150 (Safety Laser Scanner AOPDDR) Product Code: 10 (OS3101 system) Connection Type Supported: Explicit Messages, Poll, Strobe, Change of State MAC ID: 0-63 (network confirmed, 63 is dealarm) Baud Rate Supported: 125K, 250K, 500K (network configured, 125K is default) EDS File Name: 3100.eds Bit Map Icon File Name: 3100.bmp, 3100.ICO EDS and Bitmap files supplied on 3-1/2" disk
Poll, Bit Strobe and COS I/O Assembly Instances	3100 device I/O assemblies consist of: —Poll and Bit Strobe: Product specific input assembly containing operating mode detection zone status, safety output status and Remote Start input status. —COS: Product specific input assembly containing operating mode.

Table A-2 OS3101 Status Information Sent in Response to Bit Strobe Commands

Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0	Fault	Warning Zone Intrusion	Weak Signal	EDM (MPCE) Monitor Enabled	Detection Zone Intrusion (see note 4)	Machine Stop	Machine Run	Interlock
1	Warning Output Wa. Zone	Warning Output Weak Signal	Detect. Zone Set	Multizone Select Enable (see note 3)	Restart Interlock Mode	Start Interlock Mode	Auto Start Mode	Auxiliary Output
2	Leftmost beam / Blocked sectors 1 - 8							
3	Blocked sectors 9 - 16 / Rightmost beam							
4	Fault Code (see note 2)							
5	Reserved for future use				Response Time (see note 1)			
6	Reserve for future use							
7	Reserved for future use							

Table A-3 I/O Status Information Sent in Response to COS (Change of State) Commands

Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0	Fault	Warning Zone Intrusion	Weak Signal	EDM (MPCE) Monitor Enabled	Detection Zone Intrusion	Machine Stop	Machine Run	Interlock

- Note 1

Response Time	(Byte 5, bits 0-3)
80mS	0
120mS	1
160mS	2
200mS	3
240mS	4
280mS	5
320mS	6
360mS	7
400mS	8
440mS	9
480mS	10
520mS	11
560mS	12
600mS	13
640mS	14
680mS	15

- Note 2

Fault Code	(Byte 4, bits 0-7)
30	1
32	2
33	3
34	4
35	5
40	6
41	7
42	8
43	9
50	10
60	11
70	12
80	13
90	14

- Note 3

Multi-Zone Select Enable	(Byte 1, bits 4)
Zone 1	0
Zone 2	1
both	2

- Note 4

Detection Zone Intrusion	(Byte 0, bits 3)
Alarm Mode	0
Follow Mode	1

A.3 DEVICENET CONNECTIONS

Connections for DeviceNet communications are made at the OS3101 system receiver. Pin assignments for the five-pin DeviceNet connector are given in *Table A-1*.

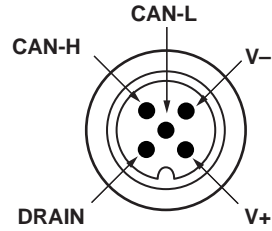


Figure A-1 DeviceNet Pin Assignment

APPENDIX B —CHECKOUT PROCEDURE LOG

The following checkout procedure must be performed by qualified personnel during OS3101 system installation and at least every three months or more frequently depending on machine usage and company guidelines.

Machine Identification: _____ Date: _____

Technician Signature: _____

Item	Condition	Comments
1. Verify that the guarded machine is compatible for use with the OS3101 system. See <i>Section 1 – Important Safety Warning</i> for further information.	<input type="checkbox"/> Pass <input type="checkbox"/> Failed	
2. Verify that the maximum safety zone distance configuration of the OS3101 system is equal to or greater than the calculated Safety Zone from the danger point. For further information, See <i>Section 6.2.1 – Safety Distance</i>	<input type="checkbox"/> Pass <input type="checkbox"/> Failed	
3. Determine that all access to the danger points not protected by the OptoShield system are guarded by other means, such as gates, fencing or other approved methods. Verify that all additional guarding devices are installed and operating properly.	<input type="checkbox"/> Pass <input type="checkbox"/> Failed	
4. Make sure the operator is not able to stand between the OptoShield system safety zone and the machine danger point. Verify that the scanner can only be reset from a position outside and within view of the hazardous machine area.	<input type="checkbox"/> Pass <input type="checkbox"/> Failed	
5. Inspect the electrical connections between the guarded machine's control system and the OS3101. Verify connections are properly wired to the machine such that a stop signal from the OS3101 system results in an immediate halt of the machine's cycle. See <i>Section 9 – System Connections</i> .	<input type="checkbox"/> Pass <input type="checkbox"/> Failed	
6. If the EDM/MPCE monitoring feature is not used, proceed to step 7. To test the EDM/MPCE feature, verify that the feature has been enabled. Turn the machine power on. Cycle the machine. Place a temporary jumper wire between the EDM/MPCE connections. The OS3101 should enter an fault condition. Remove the temporary jumper. Press and release the start button. See <i>Section 9 – System Connections</i> .	<input type="checkbox"/> Pass <input type="checkbox"/> Failed	
7. Record the test results in the machine's log and perform the Test Procedure.	<input type="checkbox"/> Pass <input type="checkbox"/> Failed	

APPENDIX C —TEST PROCEDURE LOG

The following test procedure must be performed by qualified personnel during initial OS3101 system installation and after any maintenance, adjustments or modifications to the OptoShield or it's guarded machine, and according to the employer's regular inspection programs. Testing ensures that the OptoShield system and machine control system work together to properly stop the machine. Failure to properly test the equipment could result in serious injury to personnel.

Machine Identification: _____ Date: _____

Technician Signature: _____

Item	Condition	Comments
1. Disable the guarded machine. Apply power to the OS3101 system.	<input type="checkbox"/> Pass <input type="checkbox"/> Failed	
2. Visually inspect the machine to ensure that access to the danger point is only through the OptoShield's safety detection zone. If not, additional guarding, including mechanical barriers may be required. Verify that all additional guarding devices and barriers are installed and operating properly.	<input type="checkbox"/> Pass <input type="checkbox"/> Failed	
3. Verify that the maximum safety zone distance of the OS3101 system is equal to or greater than the calculated safety zone distance from the danger point. (See <i>Section 6 – Safe Mounting Distance</i> for stationary and mobile installation. Ensure that the operator is not able to stand between the safety zone and the danger zone.	<input type="checkbox"/> Pass <input type="checkbox"/> Failed	
4. Check for signs of external damage to the OptoShield system, the machine and the electrical cables and wiring. If damage is found, lock out the machine and report to the supervisor.	<input type="checkbox"/> Pass <input type="checkbox"/> Failed	
5. Intrude into the OptoShield's safety zone with the proper size test object. Move the test object inside the perimeter of the safety zone. At least one intrusion indicator must be lit while the test object is anywhere in the detection zone. If in Automatic Start mode, verify that the red machine stop status LED is lit. If in Start/Restart Interlock mode, verify that the red machine stop and yellow interlock lights are on. Press and release start button before proceeding to step 6.	<input type="checkbox"/> Pass <input type="checkbox"/> Failed	
6. Start the machine. While the machine is in motion, intrude into the safety zone with the test object. The machine should stop immediately. Never insert the test object into the dangerous parts of the machine. With the machine at rest, interrupt the detection zone with the test object. Verify that the machine will not start with the test object in the detection zone.	<input type="checkbox"/> Pass <input type="checkbox"/> Failed	
7. Verify that the machine braking system is working properly. If the machine does not stop fast enough, adjust the braking system or increase the safety zone distance from the detection zone to the danger point.	<input type="checkbox"/> Pass <input type="checkbox"/> Failed	
8. If the safety devices or the machine fails any of these tests, do not run the machine. Immediately tag or lock out the machine to prevent its use and notify the supervisor.	<input type="checkbox"/> Pass <input type="checkbox"/> Failed	