# KEYENCE

96M13938

*96M13938-1*

## Safety Laser Scanner
# SZ-V Series
## Instruction Manual

This instruction manual describes handling, operation, and precautionary information for the SZ-V Series Safety Laser Scanner ("SZ-V"). Read this instruction manual thoroughly before operating the SZ-V in order to understand the device features.
Always keep this manual in a safe place for future reference.

Also, ensure that the end user of this product receives this manual.

In this manual, "SZ-V04 type" is used to represent a comprehensive SZ-V unit that uses SZ-VU04 as the display unit; "SZ-V32 type" is used to represent a comprehensive SZ-V unit that uses SZ-VU32 as the display unit; and "SZ-V32N type" is used to represent a comprehensive SZ-V unit that uses SZ-VU32N as the display unit.

This manual is the original instruction manual.

The following symbols represent important messages. Be sure to read these sections carefully.

| ⚠ DANGER | It indicates a hazardous situation which, if not avoided, will result in death or serious injury. |
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| ⚠ WARNING | It indicates a hazardous situation which, if not avoided, could result in death or serious injury. |
| NOTICE | It indicates a situation which, if not avoided, could result in product damage as well as property damage. |

| ▶ Important | It indicates cautions and limitations that must be followed during operation. |
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| ✎ Point | It indicates additional information on proper operation. |
| Reference | It indicates tips for better understanding or useful information. |

## Safety information for SZ-V series
### ■ General precautions

| ⚠ DANGER | • SZ-V is an active opto-electronic protective device responsive to diffuse reflection (AOPDDR). It is a device, whose sensing function is performed by opto-electronic emitting and receiving elements, that detects the diffuse reflection of optical radiations generated within the device by an object present in a protection zone specified in two dimensions.<br>• You must verify that the SZ-V is operating correctly in terms of functionality and performance before the start of machine and the operation of the SZ-V.<br>• KEYENCE does not guarantee the function or performance of the SZ-V if it is used in a manner that differs from the SZ-V specifications contained in this manual or if the SZ-V is modified by the customer.<br>• When using the SZ-V to protect machine operators against a hazard or hazardous zone or when using the SZ-V as a safety component for any purpose, always follow the applicable requirements of the laws, rules, regulations and standards in the country or region where the SZ-V is used. For such regulations, you should directly contact the regulatory agency responsible for occupational safety and health in your country or region.<br>• Depending on the type of machine on which the SZ-V is to be installed, there may be special safety regulations related to the use, installation, maintenance, and operation of the safety component. In such a case, you must fulfill such safety regulations. The responsible personnel must install the SZ-V in strict compliance with such safety regulations.<br>• The responsible personnel must do the training to the assigned personnel for the correct use, installation, maintenance, and operation of the SZ-V.<br>• Maintenance personnel and machine operators must have specialized training for the SZ-V, and they must understand and fulfill the safety regulations in the country or region in which they are using the SZ-V.<br>• If the SZ-V fails to operate, maintenance personnel and machine operators must immediately stop the use of the machine and the SZ-V and report this fact to the responsible personnel.<br>• The SZ-V is designed with the assumption that it would be correctly installed in accordance with the installation procedures described in this manual and correctly operated according to the instructions in this manual. You must perform an appropriate installation of the SZ-V after performing a sufficient risk assessment for the target machine.<br>• Be sure to absolutely confirm that there is nobody in the hazardous zone, before you remove the SZ-V from the machine for replacement or disposal. |
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| ▶ Important | • "Maintenance personnel" refers to personnel who have received appropriate training from the responsible personnel, the responsible personnel can send approved settings to the SZ-V, and are qualified to operate the machine correctly.<br>• "Machine operators" refers to personnel who have received appropriate |
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training from the responsible personnel and are qualified to operate the machine correctly.
• When disposing the SZ-V, always follow the applicable requirements of the laws, rules, regulations and standards in the country or region where the SZ-V is used.
• The SZ-V should be processed as an industrial waste product when being disposed.

### ■ Operators

| ⚠ DANGER | • In order to operate the SZ-V correctly, the responsible personnel, maintenance personnel and machine operators must fulfill all of the procedures described in this manual.<br>• No person other than the responsible personnel, maintenance personnel and machine operators should be allowed to install or test the SZ-V.<br>• When performing electrical wiring, always fulfill the electrical standards and regulations for the country or region in which the SZ-V is used. |
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### ■ Environment of use

| ⚠ DANGER | • Do not use the SZ-V in an environment (temperature, humidity, interfering light, etc.) that does not conform to the specifications contained in this manual.<br>• Do not use a device that emits strong electromagnetic waves near the SZ-V.<br>• The SZ-V is not intended for use as an explosion-proof product. Do not use this product in a hazardous location and/or potentially explosive atmosphere.<br>• Do not use the SZ-V in the presence of substances, such as heavy smoke, particulate matter, or corrosive chemical agents, that may induce deterioration in product quality.<br>• Install the SZ-V in such a way so that no direct or indirect light from inverter-type fluorescent lights (rapid-start type lights, high-frequency operation type lights, etc.) enters the optical window.<br>• Be sure to absolutely confirm that there is nobody in the hazardous zone, before the interlock is released (i.e. the machine system restarts) by the interlock reset mechanism.<br>• Be sure to confirm that there is nobody in the hazardous zone, before the override is activated. |
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### ■ Machine to be installed

| ⚠ DANGER | • The SZ-V has not undergone the model certification examination in accordance with Article 44-2 of the Japanese Industrial Safety and Health Law. The SZ-V, therefore, cannot be used in Japan as a "Safety Device for Press and Shearing machines" as established in Article 42 of that law.<br>• The machine on which the SZ-V is to be installed must be susceptible to an emergency stop at all operating points during its operation cycle. Do not use the SZ-V for machines with irregular stop times.<br>• The SZ-V cannot be used as a PSDI because it does not fulfill the requirements of OSHA 1910.217(h). Refer to OSHA 1910.217 for the PSDI mode.<br>• Do not use the SZ-V to control (stop forward motion, etc.) trains, cars and other transportation vehicles, aircraft, equipment for use in space, medical devices, or nuclear power generation systems.<br>• The SZ-V is designed to protect the people or objects approaching into the specified protection zone against a machine's hazard or hazardous zone. It cannot provide a protection against objects or materials that are expelled from the machine's hazard or hazardous zone, so you must establish additional safety measures such as installing safeguards when there is the possibility of such projectiles. |
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### ■ Installation

| ⚠ DANGER | • SZ-V must be installed in such a way that the screws do not loosen due to vibration and/or shock. The screw loosen may cause the displacement of detection plane and SZ-V cannot make a protection as intended.<br>• Securely tighten mounting brackets and cable connectors used for the installation of the SZ-V in accordance with the torque values specified in this manual.<br>• Do not put the additional housing, such as glass covers or clear polymeric covers, in front of the window of the SZ-V. This may lead to the loss of the detection capability of the SZ-V.<br>• The installation of the SZ-V must ensure the required safety distance in compliance with the requirements of laws, rules, regulations and standards in the country or region in which the SZ-V is installed.<br>• When changing the minimum detectable object size and response time for SZ-V, the safety distance must be recalculated, and the SZ-V must be reinstalled based on the result of recalculation to keep the required safety distance.<br>• The SZ-V must be installed so that the machine operator is able to go into or approach the hazardous zone or hazards only by passing through the protection zone of the SZ-V. Strictly avoid installation that allows the machine operator or a part of the machine operator's body to go into or approach the hazardous zone or hazards without passing through the protection zone of the SZ-V or to remain in a position between the protection zone of the SZ-V and the hazardous zone or hazard.<br>• You must always perform the pre-check tests after installing the SZ-V in accordance with the pre-check test procedures, such as the item specified in this manual, in order to verify that the test pieces can be detected in all of the protection zones.<br>• The interlock reset mechanisms (such as switches) must be installed so that the whole hazardous zone can be checked by the responsible personnel and that operations of the interlock reset mechanisms are not possible within the hazardous zone.<br>• Reference points monitoring function must be applied when the SZ-V is used for the access protection specified in IEC61496-3: 2008 Annex A.12 and A.13 (the application where the angle of the approach exceeds ±30° to the detection plane).<br>• The muting is a function to allow a temporary automatic suspension of the safety function while the SZ-V receives a signal from one or more muting devices (such as sensors or switches). Therefore, additional safety measures are required for the whole machine on which the SZ-V is installed in order to ensure safety while the muting is activated.<br>• The muting devices, the installation of those devices and the procedure to activate the muting must fulfill the conditions specified in this manual and the requirements of the laws, rules, regulations, and standards in the country or region in which the SZ-V and those devices are used.<br>• When you install the muting devices (such as sensors or switches), the |
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following conditions must be fulfilled.

(1) Muting devices must be installed so that the muting cannot be activated if the hazard is still existing during machine cycle.

(2) Muting devices must be installed so that the muting cannot be activated if someone approaches into the protection zone of the SZ-V.

- The muting device must be installed such that only responsible personnel have access to that device to change its installation or orientation. Special tools must be required to ensure that only responsible personnel are capable of installation, orientation or change of muting device.
- Only the responsible personnel may be allowed to install or wire the devices to activate the muting function or override function.
- The customer is fully responsible for complying with the requirements for the muting function and override function. KEYENCE accepts NO responsibility or NO liability for any damage or any injury due to the unauthorized installation, usage, or maintenance, which are not specified in this manual, and/or due to noncompliance with the laws, rules, regulations and standards in the country or region in which the SZ-V is used.
- The installation of muting lamp may be required by the laws, rules, regulations, and standards in the country or region in which the SZ-V is used. It depends on the machine application or the result of your risk assessment. If it is necessary for you to provide the muting lamp, you must fulfill the requirements because you are fully responsible for installing the muting lamp.
- The override is a function to allow a temporary manual suspension of the SZ-V safety functions. Therefore, additional safety measures are required for the whole machine system on which the SZ-V is installed in order to ensure safety while the override is activated.
- The override devices, the installation of those devices, and the procedures to activate the override must fulfill the conditions specified in this manual as well as the requirements of the laws, rules, regulations, and standards in the country or region in which the SZ-V and those devices are used.
- The override devices, which are used for activation of override, must be manual operating devices. When installing the devices to activate the override (override device), those devices must be installed so that the whole hazardous zone can be checked by responsible personnel and so that it is not possible for the device operators to operate those device in the hazardous zone.
- The installation of the indication for override may be required by the laws, rules, regulations and standards in the country or region where the SZ-V is used. It depends on the machine application or the result of your risk assessment. If it is necessary for you to provide the indication for override, you must fulfill the requirements because you are fully responsible for installing the indication for override.
- If the object to be detected moves perpendicular to the detection plane, SZ-V cannot detect the object moving at speed over 1.6m/s, regardless of the encoder setting.

## ■ Circuit design and wiring

**⚠ DANGER**

- Always turn off the power to the SZ-V when performing electrical wiring.
- You must fulfill the electrical standards and regulations in the country or region in which the SZ-V is being used when you perform the electrical wiring.
- To avoid the risk of electric shock, do not connect any of the SZ-V inputs to DC power sources outside of the range of 24 V DC +20% or to any AC power source.
- To avoid the risk of electric shock, be sure that the hazardous voltage must be isolated from all wiring of the SZ-V with the reinforced insulation or double insulation.
- If the power supply for the SZ-V is the converting type, the power supply for the SZ-V must meet the conditions listed below in order to meet the requirements specified in IEC61496-1, UL61496-1, and EN61496-1.
- (a) A rated output voltage of 24 V DC (SELV circuit, Overvoltage Category II) within +20% -30%.
- (b) Double insulation or reinforced insulation between the primary and secondary circuits.
- (c) Output holding time of 20 ms or more.
- (d) A power supply must meet the requirements of the electrical safety and electromagnetic compatibility (EMC) regulations or standards in all countries and/or regions where the SZ-V is used.
- Do not install the electric wiring of the SZ-V together with or in parallel with the high-voltage electrical or power lines.
- For the wiring between SZ-V and a safety-related machine control system, both OSSD 1 and OSSD 2 must be always wired to a safety-related machine control system in order to ensure the safety. Similarly, both OSSD 3 and OSSD 4 must be always wired to a safety-related part of a machine control system if you assign a function for OSSD 3/4. If one OSSD is only wired to a safety-related machine control system, it results in a significant harm to the machine operators, including serious injury or death, due to OSSD malfunction.
- If PNP/NPN selection is set as PNP, do not cause short-circuit between the OSSD and +24V. Otherwise, OSSDs keep staying at the ON-state and it causes a dangerous situation.
- If PNP/NPN selection is set as PNP, be sure to connect the load between the OSSD and 0 V to avoid a dangerous situation. If the load is incorrectly connected between the OSSD and +24V, the logic of OSSD operation will be reversed, and then OSSD will turn to the ON-state when the SZ-V detects an object in the specified protection zone. This is a dangerous situation.
- If PNP/NPN selection is set as NPN, do not cause short-circuit between the OSSD and 0V. Otherwise, OSSDs keep staying at the ON-state and it causes a dangerous situation.
- If PNP/NPN selection is set as NPN, be sure to connect the load between the OSSD and +24V to avoid a dangerous situation. If the load is incorrectly connected between the OSSD and 0 V, the logic of OSSD operation will be reversed, and then OSSD will turn to the ON-state when the SZ-V detects an object in the specified protection zone. This is a dangerous situation.
- In case of wiring, you must fulfill the requirements of Clause 9.4.3 in IEC60204-1 in order to protect against malfunction due to an OSSD earth fault.
- The AUX output is not allowed to be used as a safety output for safety-related control systems. Usage of these functions as safety output could result in the serious injury or death.
- The laser off input is not allowed to be connected to the safety output provided from the safety-related control system.
- The connector cable must have a length less than or equal to the specification in this manual. Usage of connector cables longer than the specified length may cause the improper operation of safety functions and may cause a dangerous situation.

## ■ Inspection and maintenance

**⚠ DANGER**

- You must always perform the pre-check test in accordance with the pre-check test procedures, after maintenance, adjustment or alignment of the target machine or the SZ-V and before the machine startup.
- If the SZ-V does not operate properly when you perform pre-check test in accordance with the pre-check test procedures specified in this manual, do not operate the machine.
- You must periodically examine the machine to verify that all brakes, other stop mechanisms, and control devices operate reliably and correctly in addition to checking the SZ-V.
- The responsible personnel must perform maintenance procedures as specified in this manual at least once every six months to ensure safety to the machine and SZ-V.

# Safety Precautions on Laser Product

This product employs a semiconductor laser for its light source. Follow the instructions mentioned in this manual. Otherwise, injury to the human body (eyes and skin) may result.

**⚠ WARNING**

- Use of controls or adjustments or performance of procedures other than those specified herein may result in hazardous radiation exposure.
- Precautions on Class 1 Laser Product
  - Do not disassemble this product. Laser emission from this product is not automatically stopped when it is disassembled. Turn off the SZ-V before when you replace the window.

# Precautions on Regulations and Standards

## ■ CE Marking

KEYENCE Corporation has confirmed that this product complies with the essential requirements of the applicable EU Directive, based on the following specifications. Be sure to consider the following specifications when using this product in the Member State of European Union.

● **Machinery Directive**

SZ-V is a safety component defined in the EU Machinery Directive Annex V.
The SZ-V complies with the following EN Standards and has been certified by TÜV SÜD Product Service GmbH.

- EN61496-1      Type 3 ESPE
- EN61496-3      Type 3 AOPDDR
- EN61508      SIL2
- EN62061      SIL CL2
- EN ISO13849-1      Category 3, PLd
- EN60825-1      Class 1 Laser Product

● **EMC Directive**

- EN55011      Class A

As Ethernet cable, use a Category 5e or higher STP (Shielded Twisted Pair) cable for connection to the network.

These specifications do not give any guarantee that the end-product with this product incorporated complies with the essential requirements of EMC Directive. The manufacturer of the end-product is solely responsible for the compliance on the end-product itself according to EMC Directive.

## ■ UL Certification and North American Regulations

SZ-V complies with the following UL, CSA, and North American standards and regulations, and has received UL certification and C-UL certification (CCN: NIPM/NIPM7, File No: E322137)

- UL61496-1      Type 3 ESPE
- IEC61496-1      Type 3 ESPE
- IEC61496-3      Type 3 AOPDDR
- UL508
- UL1998
- CAN/CSA 22.2 No.14

SZ-V also complies with the following North American regulations.

- CDRH Part 1040.10 (Laser Notice No.50), Class 1 Laser Product
- FCC Part15 Subpart B, Class A Digital Device
- ICES-003, Class A Digital Apparatus

# Parts List

## ■ SZ-V

● **Standard Models**

These models include the Display unit, scanner head, system memory, and connection cable.

| Type | Model Name | Display Unit Model | Head Model |
|---|---|---|---|
| **Multi-function Set (with camera)** | **SZ-V04X** | SZ-VU04 | SZ-VH1X |
| **Multi-function Set** | **SZ-V04** | SZ-VU04 | SZ-VH1 |
| **Multi-bank Set (with camera)** | **SZ-V32X** | SZ-VU32 | SZ-VH1X |
| **Multi-bank Set** | **SZ-V32** | SZ-VU32 | SZ-VH1 |
| **Network Set (with camera)** | **SZ-V32NX** | SZ-VU32N | SZ-VH1X |
| **Network Set** | **SZ-V32N** | SZ-VU32N | SZ-VH1 |

The system memory and connection cable are the same for all models.
System memory: SZ-VSM      Connection cable: SZ-VS005

● **Separate Models**

**Display unit**

| Type | Display Unit Model Name |
|---|---|
| **Multi-function Type** | SZ-VU04 |
| **Multi-bank Type** | SZ-VU32 |
| **Network Type** | SZ-VU32N |

**Scanner Head**

| Type | Scanner Head Model Name |
|---|---|
| **With camera** | SZ-VH1X |
| **Standard** | SZ-VH1 |

**System Memory**

| Type | Model Name |
|---|---|
| **System Memory** | SZ-VSM |

## ■ Cable

Power cable

| Model name | Length |
|---|---|
| SZ-VP5 | 5m |
| SZ-VP10 | 10m |
| SZ-VP20 | 20m |
| SZ-VP30 | 30m |

Connection cable

| Model name | Length |
|---|---|
| SZ-VS005 | 0.05m |
| SZ-VS5 | 5m |
| SZ-VS10 | 10m |
| SZ-VS20 | 20m |

The SZ-VS005 is bundled with fixing plates (for the standard and multi-bank models) to secure the Display unit and the scanner head.

## ■ Others

● **Configuration Software <Safety Device Configurator>**

SZ-V configuration software <SZ-V Configurator> is included in the <Safety Device Configurator>.

The configuration software can be downloaded from the KEYENCE homepage.
http://www.keyence.com
If you are using the machine in an environment where downloading software is not possible via the Internet, contact your nearest KEYENCE office or distributor.

For the details about other optional parts such as mounting brackets or window replacement model, see the "SZ-V Series User's Manual".

## Part Descriptions

SZ-V04 Type, SZ-V32 Type



SZ-V32N Type
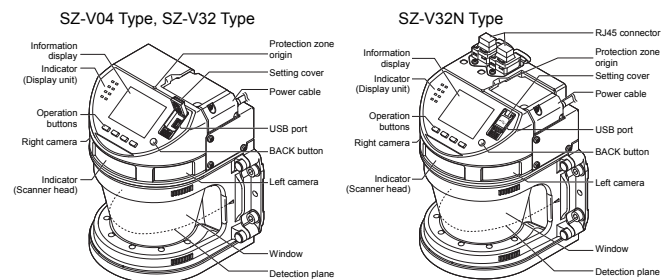


## Protection Zone

When the SZ-V detects an object (someone or something) in the protection zone, the OSSD goes to the OFF-state. The maximum configurable distance varies depending on the operation mode and minimum detectable object size setting.
The protection zone settings are configured in the SZ-V Configurator. For the configuration details, see the "SZ-V Series User's Manual".

**Protection zone (top view)**



**Example of a protection zone**
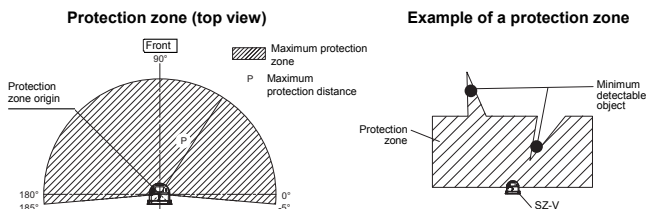


| ⚠ DANGER | • The protection zone must be configured so as to ensure the safety distance, which has been calculated according to the laws, regulations, and standards of the country and region in which the SZ-V is installed.<br>• When either multi-OSSD function or bank switching function is enabled, every protection zone must be configured so as to ensure the safety distance, which has been calculated according to the laws, regulations, and standards of the country and region in which the SZ-V is installed.<br>• SZ-V cannot monitor anything behind the object that the SZ-V detects in the protection zone. (This is a blind area for the SZ-V.) The responsible personnel must perform the risk assessment with taking into account this factor in case of installation of the SZ-V. If necessary, the additional countermeasure must be taken by the responsible personnel.<br>• As shown in the figure above, the detection may not be performed if the whole of minimum detectable object is not included in the protection zone. You must configure the protection zone so as to ensure that the whole of minimum detectable object is included everywhere in that protection zone. |
|---|---|

| Reference | • Set the minimum detectable object size in the SZ-V Configurator.<br>• Even if the object is smaller than the minimum detectable object size, it may be detected; however this is not guaranteed.<br>• Using the multi-OSSD function, allows for the setting of two protection zones individually for one scanner head. |
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## Tips on installation

Note the following items when installing on a machine.

● **Light interference**

Although there is no object in the protection zone, the OSSD might go to the OFF-state if an ambient light source, detailed below, is located at the detection plane, causing the SZ-V to perform a false detection.

• Incandescent lamp
• Sunlight
• Fluorescent light
• Strobe light
• Other infrared light sources (infrared photoelectric sensor, infrared laser, etc.)

In order to avoid this situation, ambient light sources should not be located within ±5° of the detection plane.
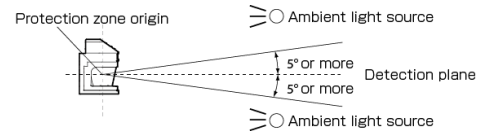


● **Mutual Interference**

The OSSD might go to the OFF-state due to mutual interference if using multiple SZ-V units.

Installations where mutual interference is possible

1. Affected by direct emission



2. Affected by diffuse reflection
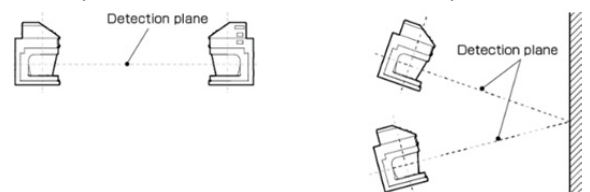


The SZ-V should be installed according to the following countermeasures in order to avoid mutual interference.

1. A shielding plate should be installed like below.
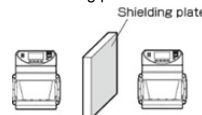


2. The height of installation should be like below.
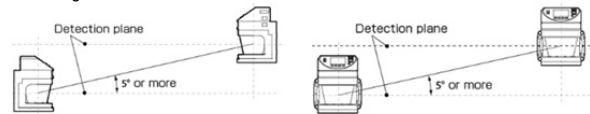


3. The angle of installation should be like below.
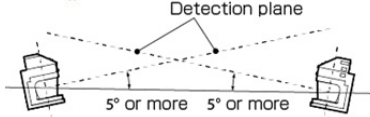


The following countermeasures may be taken to reduce the possibility of the mutual interference.

• Connect multiple scanner heads together.
• Make the protection zone smaller, if possible.
• Make the minimum detectable object size larger, if possible.
• Make the response time longer, if possible.
• Change the scan cycles.

| ⚠ DANGER | • You must calculate the safety distance again in order to reinstall the SZ-V with appropriate safety distance if you want to apply the above countermeasure. |
|---|---|

| Reference | • When adding scanner heads, the scan cycle for each scanner head is automatically allocated and cannot be changed. |
|---|---|

● **Highly reflective backgrounds**
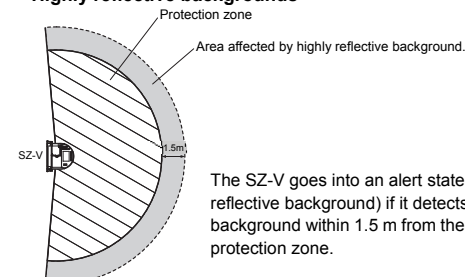


The SZ-V goes into an alert state (alert for a highly reflective background) if it detects a highly reflective background within 1.5 m from the setting range of the protection zone.

| ⚠ DANGER | • If there is a highly reflective background within 1.5 m from the boundary of the protection zone, you must take a countermeasure, such as reducing the reflectance or removing the background itself. If you cannot take the above-mentioned countermeasures, another 200 mm must be added as supplementary necessary distance to the protection zone in case of calculation of the safety distance. |
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| Reference | • Examples of highly reflective backgrounds:<br>• Metallic glossy surfaces, retro-reflective sheets, and retro-reflective plates |
|---|---|

## ● Detection capability in close distance

**Non-detectable zones**

There are non-detectable zones near the SZ-V.

Non-detectable zones when directly attached



X : 777.3 mm
Y : 68.0 mm

| ⚠ DANGER | • Additional countermeasures for protection must be provided if there is a space between the protection zone and the protective structure that the minimum detectable object is not detected by the SZ-V. |
|---|---|

**Zone with the limited detection capability**

SZ-V might not detect an object with low reflectance located at the distance of 93.5mm or less from the protection zone origin. This is the zone with limited detection capability.

Protection zone origin



93.5 mm

| ⚠ DANGER | • In case of installation of the SZ-V, the responsible personnel must perform the risk assessment with taking into account the possibility that an object might go into the zone with limited detection capability. If it is possible, the additional countermeasure must be taken by the responsible personnel. |
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## ● Other

When the reflection from a detection object or the background area is not detected for over 60°, an error will occur and [MI Error] will be displayed.
This function is to prevent people from interfering with the use of objects that emit very little reflection when very close to the SZ-V.

# Safety Distances

The protection zone must be configured so as to ensure the minimum safe distance, which has been calculated according to the laws, regulations, standards of the country and region in which the SZ-V is installed as well as the specification specified in this manual.

## ● Example of area protection (Direction of approach parallel to the protection zone)
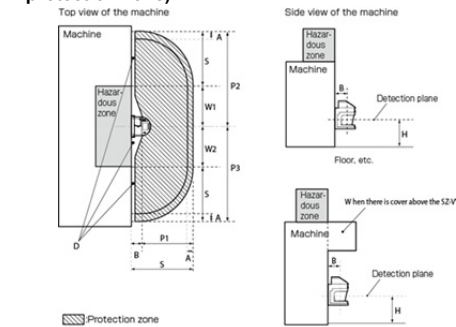


P1, P2, P3 : Protection distances to be configured as the protection zones
W1, W2 : Width of the hazardous area
B: Distance between the edge of the hazardous area and protection zone origin on the SZ-V
D: Unprotected space

**Safety distance calculation according to ISO13855 and IEC61496-3**

$S = K \times T + C + A$

S: Safety distance (mm)
K: Approach speed of the body or parts of the body (mm/s)
T: Overall Response time in second (t1 + t2) (s)
  t1: SZ-V response time (s)
  t2: Max. time required to stop the machine after receiving the OSSD signal from SZ-V (s)
C: 1200 - 0.4 x H (850 mm or higher)
  H: Height of detection plane (protection zone) above the reference plane,
    for example the floor. (mm)   $1000 \geq H \geq 15 \times (d-50)$
  d: SZ-V minimum detectable object size (mm)
A: Additional safety distance (mm)

**Example of safety distance calculation**

K = 1600 mm/s   Approach speed of the body or parts of the body (Constant)
T = t1 + t2 = 0.82 s              Overall response time
  t1 = 0.32 seconds               SZ-V response time (Changeable)
  t2 = 0.5 seconds               Max. time required to stop the machine after receiving the OSSD signal from SZ-V
C = 1200-0.4 x H = 1080 mm

H = 300 mm          Lowest allowable height of detection plane(protection zone).
                    This must be calculated using the following formula.
                    $H \geq 15 \ (d - 50 \ mm)$
d = 70 mm           Minimum detectable object size (Changeable)
A = 100mm           Additional safety distance of SZ-V
B = 68 mm           Distance between the edge of the hazardous area and protection zone origin on the SZ-V
W1 = W2 = 1000m     Width of the hazardous area

**Safety Distances**

$S = K \times T + C + A$
$= 1600 \times 0.82 + 1080 + 100 = 2492$ mm

**Protection distances to be configured as the protection zones**

P1 = S - B = 2424 mm
P2 = S + W1 = 3492 mm
P3 = S + W2 = 3492 mm

| ⚠ DANGER | • The unprotected space (D) between the protection zone and the protective structure must be less than the minimum detectable object size when the SZ-V is installed, in order to prevent the machine operators from approaching into the hazardous area through this space (D). Additional countermeasures for protection must be provided if there is a space (D) between the protection zone and the protective structure that the minimum detectable object is not detected by the SZ-V.<br>• There is a risk of inadvertent undetected access beneath the detection plane (protection zone), if the height "H" of detection plane (protection zone) is greater than 300 mm (200 mm for non-industrial application, for example in the presence of children). The responsible personnel must perform the risk assessment with taking into account this factor in case of installation of the SZ-V. If necessary, the additional countermeasure must be taken by the responsible personnel.<br>• In the protection zone setting, you cannot select the object size of 150 mm when "H" (Height of detection plane) is 1,000 mm or less. You must select the object size of 70 mm or smaller if you want to use SZ-V for area protection (direction of approach is parallel to the protection zone.)<br>• If there is a highly reflective background within 1.5 m from the boundary of the protection zone, another 200 mm must be added as supplementary necessary distance to the P1, P2 and P3 respectively.<br>• We recommend you should have a marking on the floor for indicating the specified protection zone. |
|---|---|

## ● Example of access protection (Direction of approach normal to the protection zone)
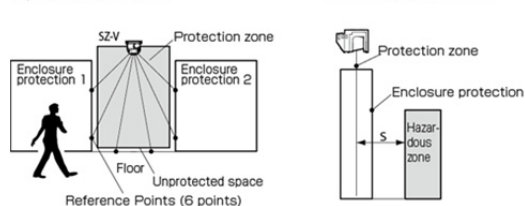


**Safety distance calculation according to ISO13855 and IEC61496-3**

Formula: $S = K \times T + C$

S: Safety distance (mm)
K: Approach speed of the body or parts of the body (mm/s)
T: Overall Response time in second (t1 + t2) (s)
  t1:  SZ-V response time (s)
  t2:  Max. time required to stop the machine after receiving the OSSD signal from SZ-V (s)
C: Additional distance, taking into accounts the intrusion prior to actuation of protective equipment (mm).

**Example of safety distance calculation**

K = 1600 mm/s              Approach speed of the body or parts of the body
T = t1 + t2 = 0.58 s       Overall response time
  t1 = 0.08 seconds        SZ-V response time (Changeable)
  t2 = 0.5 seconds         Max. time required to stop the machine after receiving the OSSD signal from SZ-V
C = 850 mm (Constant)
d = 70 mm          Minimum detectable object size (Changeable)

**Safety Distance**

$S = K \times T + C = 1600 \times 0.58 + 850 = 1778$ mm

| ⚠ DANGER | • Reference point monitoring function must be applied when the SZ-V is used for the access protection specified in IEC61496-3:2008 Annex A.12 and A.13 (the application where the angle of the approach exceeds ±30° to the detection plane). In this case, the tolerance for reference points must be ±100 mm or less and the response time must be 90 ms or less.<br>• The unprotected space between the protection zone and the protective structure must be less than the minimum detectable object size when the SZ-V is installed, in order to prevent the machine operators from approaching into the hazardous area through this space. Additional countermeasures for protection must be provided if there is a space between the protection zone and the protective structure that the minimum detectable object is not detected by the SZ-V.<br>• According to GB 19436.3-2008, "if the maximum distance between the AOPDDR and the reference boundary is greater than 4.0 m, displacement of the detection zone greater than 100 mm shall be detected." In order to comply with this requirement for SZ-V, this may be achieved by limiting the width of the objects of the reference point to ≤200 mm. For the case where the maximum protection distance of the protection zone is over 4.0 m, this limitation must be followed. |
|---|---|

● **Example of installing to an AGV (automated guided vehicle)**
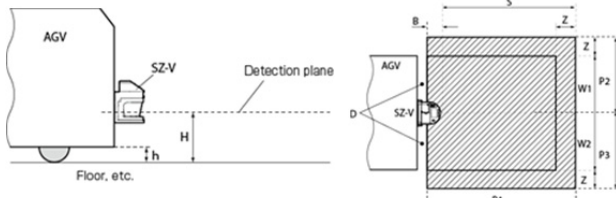


P1, P2, P3 : Protection distances to be configured as the protection zones
W1, W2 : Width of the AGV
B: Distance between the front edge of the SZ-V and protection zone origin on the SZ-V
D: Unprotected space
H: Height of detection plane (protection zone) above the reference plane in millimeters, for example the floor. "H" must be less than 200 mm.

**Safety distance calculation method based on ISO13855 and IEC61496-3**
Formula: $S = V \times T + S_{brake} \times L + Z$

S: Minimum safety distance (mm)
V: Maximum approach speed of the AGV (mm/s)
T: Overall Response time in second $(t_1 + t_2)$(s)
 $t_1$: SZ-V response time (s)
 $t_2$: Max. time that AGV responds after receiving the OSSD signal from SZ-V (s)
$S_{brake}$: Required distance for braking AGV (mm)
L: Safety coefficient for required distance based on the wear of braking
Z: Additional distance $Z_{SZ} + Z_G$ (mm)
 $Z_{SZ}$: Additional safety distance of SZ-V (mm)
 $Z_G$: Supplementary necessary distance, if "h" is not enough. (mm)
 h: Space between the reference plane (floor) and the bottom of AGV. (mm)

If the "h" is not enough ensured, you must take into account the risk that the toe or toe tip is caught between the ground (floor) and the AGV. The relationship between "h" and "$Z_G$" is as follows.
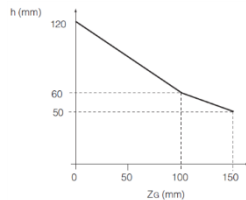


**Example of safety distance calculation**
V = 1500 mm/s
T = $t_1$ + $t_2$ = 0.22 s               Overall response time
 $t_1$ = 0.12 seconds              SZ-V response time (Changeable)
 $t_2$ = 0.1 seconds               Max. time that AGV responds after receiving the OSSD signal from SZ-V
$S_{brake}$ = 1,300 mm             Required distance for braking AGV (mm)
L = 1.1                          Safety coefficient for required distance based on the wear of braking
Z = $Z_{SZ-V}$ + $Z_G$ = 100+100 = 200 mm          Additional distance (mm)
 $Z_{SZ-V}$ = 100mm              Additional safety distance of SZ-V (mm)
 $Z_G$ = 100 mm                 Supplementary necessary distance, if "h" is not enough.
 h = 60 mm                     Space between the reference plane (floor) and the bottom of AGV.
B = 58 mm                      Distance between the front edge of the SZ-V and protection zone origin on the SZ-V (mm)
W1 = W2 = 1,000 mm            Width of AGV (mm)

**Safety Distances**
$S = V \times T + S_{brake} \times L + Z$
= 1500 x 0.22 + 1300 x 1.1 + 200
= 1960mm

**Protection distances to be configured as the protection zones**
P1 = S + B = 2018 mm
P2 = W1 + Z = 1200 mm
P3 = W2 + Z = 1200 mm

| ⚠ DANGER | • Additional countermeasures for protection must be provided if there is a space (D) between the protection zone and the protective structure that the minimum detectable object is not detected by the SZ-V.<br>• There is a risk of inadvertent undetected access beneath the detection plane (protection zone), if the height "H" of detection plane (protection zone) is greater than 200 mm. However, the height "H" should be 150 mm or more in order to detect the object with the height of 150 mm. The responsible personnel must perform the risk assessment with taking into account this factor in case of installation of the SZ-V. If necessary, the additional countermeasure must be taken by the responsible personnel.<br>• If there is a highly reflective background within 1.5 m from the boundary of the protection zone, another 200 mm must be added as supplementary necessary distance to the P1, P2 and P3 respectively. |
|---|---|

# Connecting Units

| Reference | • For the standard models, display unit, scanner head and system memory are connected prior to shipping.<br>• Do not remove the gasket mounted on the connector cable. The IP65 rating cannot be met without this gasket. |
|---|---|

1.  Connect the display unit and scanner head with the connection cable.



M2.6 cross slot screws
Tightening torque : 0.36 N·m
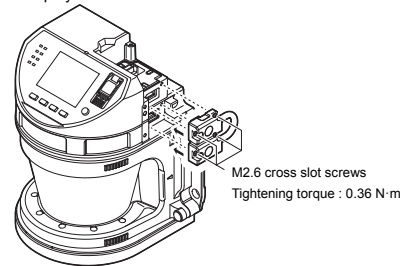
2.  Connect the display unit and system memory.

M2.6 cross slot screws
Tightening torque : 0.36 N·m
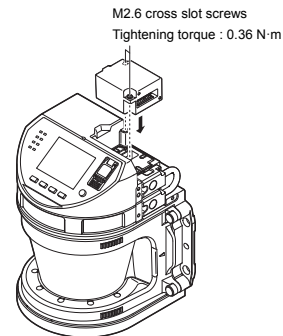


3.  Connect the power cable to the display unit.



M2.6 cross slot screws
Tightening torque : 0.36 N·m
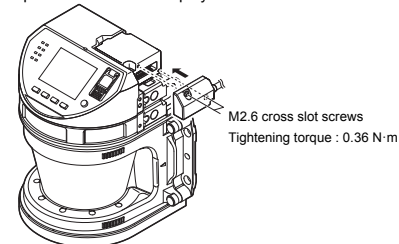
Additional scanner heads require adding additional connection cables
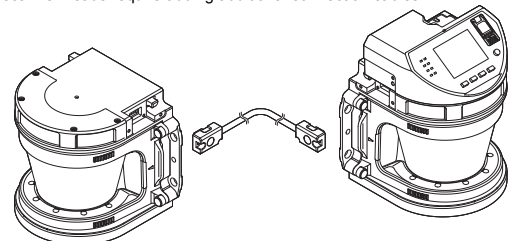


When adding a scanner head to a standard model, remove the metal plate that was attached at the time of shipping and attach the additional connection cable.



M3 cross slot screws

M2.6 cross slot screws
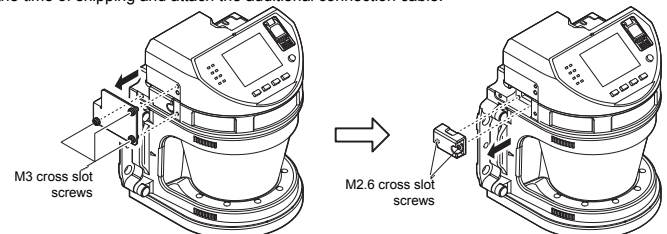
## Mounting

When using an optional mounting bracket, see the "SZ-V Series User's Manual".

### ● Wall mounting (direct mounting)

The four screw holes on the unit can be used for direct mounting. The appropriate screws must be purchased separately.

Recommended screw size: M6 (Thickness of SZ-V mounting part: 4.5mm)
Recommended tightening torque: 5.2N•m
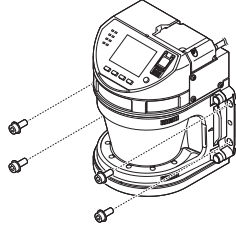


| ⚠ DANGER | • Losing the screw caused by the vibration or shock to the SZ-V must be avoided. It may cause the displacement of detection plane of the SZ-V. |
|---|---|

| Reference | • For more information on the dimensions of SZ-V, see "Dimensions". |
|---|---|

## Power Supply

If the power supply for the SZ-V is the converting type, the power supply for the SZ-V must meet the conditions listed below in order to meet the requirements specified in IEC61496-1, UL61496-1, and EN61496-1.

(a) A rated output voltage of 24 V DC (SELV circuit, Overvoltage Category II) within +20% -30%.
(b) Double insulation or reinforced insulation between the primary and secondary circuits.
(c) Output holding time of 20 ms or more.
(d) A power supply must meet the requirements of the electrical safety and electromagnetic compatibility (EMC) regulations or standards in all countries and/or regions where the SZ-V is used.

| ▶ Important | • If the power supply for the SZ-V is shared with the one for the machine or the other electronic devices, voltage reduction to the SZ-V or noise influence to the SZ-V may occur due to the temporary increasing of the current consumption on the machine or the other electronic devices. Since the SZ-V may go to the error state in such case, the power supply for the SZ-V should only be shared with the one for the load and muting devices. We do not recommend the power supply for the SZ-V is shared with the one for the machine or the other electronic devices. |
|---|---|

## Wire color and assigned function

- Depending on the display unit model and functions used, the cable colors and assigned functions vary.
- The functions assigned to the AUX outputs can be changed in the settings.
- The settings are configured in the SZ-V Configurator. For details on the settings procedure, see the "SZ-V Series User's Manual".

### ■ Wire color and assigned function of SZ-V04 type

| Wire color | Pattern (1) | Pattern (2) | Pattern (3) |
|---|---|---|---|
| Multi-OSSD | Not used | Not used | Not used |
| Bank switching | Not used | Not used | Used (4 banks or less) |
| Muting | Not used | Used | Not used |
| Brown | +24 V | | |
| Blue | 0V | | |
| Black | OSSD 1 | | |
| White | OSSD 2 | | |
| Gray | Not used | | |
| Gray/Black | Not used | | |
| Yellow (Input 1) | Reset input / Laser off input | | |
| Red (Input 2) | EDM input | | |
| Light blue (Input 3) | Not used | Muting input 1 | Bank input A |
| Light blue / Black (Input 4) | Not used | Muting input 2 | Bank input a |
| Yellow / Black (Input 5) | Not used | Override input | Bank input B |
| Red / Black (Input 6) | Not used | Not use | Bank input b |
| Orange | AUX output 1 (State information output 1) | | |
| Orange / Black | AUX output 2 (State information output 2) | | |
| Pink | AUX output 3 | | |
| Pink / Black | AUX output 4 | | |
| Green | AUX output 5 | | |
| Green / Black | AUX output 6 | AUX output 6 (Muting lamp output) | AUX output 6 |

| Wire color | Pattern (4) | Pattern (5) | Pattern (6) |
|---|---|---|---|
| Multi-OSSD | Multi-OSSD | Multi-OSSD | Multi-OSSD |
| Bank switching | Not used | Used (2 banks or less) | Used (4 banks or less, or independent bank switching) |
| Muting | Not used | Not used | Not used |
| Brown | +24 V | | |
| Blue | 0V | | |
| Black | OSSD 1 | | |
| White | OSSD 2 | | |
| Gray | OSSD 3 | | |
| Gray / Black | OSSD 4 | | |
| Yellow (Input 1) | Reset input (1/2) / Laser off input | | Bank input b |
| Red (Input 2) | EDM input (1/2) | | |
| Light blue (Input 3) | Not used | Bank input A | |
| Light blue / Black (Input 4) | Not used | Bank input a | |
| Yellow / Black (Input 5) | Reset input (3/4) | | Bank input B |
| Red / Black (Input 6) | EDM input (3/4) | | |
| Orange | AUX output 1 (State information output 1) | | |
| Orange / Black | AUX output 2 (State information output 2) | | |
| Pink | AUX output 3 | | |
| Pink / Black | AUX output 4 | | |
| Green | AUX output 5 | | |
| Green / Black | AUX output 6 | | |

### ■ Wire color and assigned function of SZ-V32 type

| Wire color | Pattern (1) | Pattern (2) | Pattern (3) | Pattern (4) |
|---|---|---|---|---|
| Bank switching | Not used | Used | Used | Used |
| Bank switching method | | Single or binary | | Encoder |
| Available number of banks | | Single: 8 banks or less Binary: 16 banks or less | Single: 10 banks or less Binary: 32 banks or less | |
| Brown | +24 V | | | |
| Blue | 0V | | | |
| Black | OSSD 1 | | | |
| White | OSSD 2 | | | |
| Gray (AUX1) | AUX output 1 (State information output) | | | |
| Gray / Black (AUX2) | AUX output 2 (State information output) | | | |
| Yellow (Input 1) | Reset input / Laser off input | | | |
| Red (Input 2) | EDM input | | | |
| Light blue (Input 3) | Not used | Bank input A | | |
| Light blue / Black (Input 4) | Not used | Bank input a | | |
| Yellow / Black (Input 5) | Not used | Bank input D | | Encoder input 1A |
| Red / Black (Input 6) | Not used | Bank input d | | Encoder input 2A |
| Orange (Input 7) | Not used | Bank input B | | |
| Orange / Black (Input 8) | Not used | Bank input b | | |
| Pink (Input 9) | Not used | Bank input C | | Encoder input 1B |
| Pink / Black (Input 10) | Not used | Bank input c | | Encoder input 2B |
| Green (AUX3/Input 11) | AUX output 3 | | Bank input E | Encoder input 1A- |
| Green / Black (AUX4/Input 12) | AUX output 4 | | Bank input e | Encoder input 2A- |

### ■ Wire color and assigned function of SZ-V32N type

| Wire color | Pattern (1) | Pattern (2) |
|---|---|---|
| Bank switching | Not used | Not used |
| Muting | Not used | Used |
| Brown | +24 V | |
| Blue | 0V | |
| Black | OSSD 1 | |
| White | OSSD 2 | |
| Gray (AUX1) | AUX output 1 (State information output 1) | |
| Gray / Black (AUX2) | AUX output 2 (State information output 2) | |
| Yellow (Input 1) | Reset input / Laser off input | |
| Red (Input 2) | EDM input | |
| Light blue (Input 3) | Not used | Muting input 1 |
| Light blue / Black (Input 4) | Not used | Muting input 2 |
| Yellow / Black (Input 5) | Not used | Override input |
| Red / Black (Input 6) | Not used | |
| Orange (Input 7) | Not used | |
| Orange / Black (Input 8) | Not used | |
| Pink (Input 9) | Not used | |
| Pink / Black (Input 10) | Not used | |
| Green (AUX3/Input 11) | AUX output 3 | |
| Green / Black (AUX4/Input 12) | AUX output 4 | AUX output 4 (Muting lamp output) |

| Wire color | Pattern (3) | Pattern (4) | Pattern (5) |
|---|---|---|---|
| Bank switching | Used | Used | Used |
| Bank switching method | Single or binary | | Encoder |
| Available number of banks | Single: 8 banks or less<br>Binary: 16 banks or less | Single: 10 banks or less<br>Binary: 32 banks or less | |
| Muting | Not used | Not used | Not used |
| Brown | +24 V | | |
| Blue | 0V | | |
| Black | OSSD 1 | | |
| White | OSSD 2 | | |
| Gray (AUX1) | AUX output 1 (State information output 1) | | |
| Gray / Black (AUX2) | AUX output 2 (State information output 2) | | |
| Yellow (Input 1) | Reset input / Laser off input | | |
| Red (Input 2) | EDM input | | |
| Light blue (Input 3) | Bank input A | | |
| Light blue / Black (Input 4) | Bank input a | | |
| Yellow / Black (Input 5) | Bank input D | | Encoder Input 1A |
| Red / Black (Input 6) | Bank input d | | Encoder Input 2A |
| Orange (Input 7) | Bank input B | | |
| Orange / Black (Input 8) | Bank input b | | |
| Pink (Input 9) | Bank input C | | Encoder Input 1B |
| Pink / Black (Input 10) | Bank input c | | Encoder Input 2B |
| Green (AUX3/Input 11) | AUX output 3 | Bank input E | Encoder Input 1A- |
| Green / Black (AUX4/Input 12) | AUX output 4 | Bank input e | Encoder Input 2A- |

# Examples of wiring

## ■ Wiring example for the SZ-V04 type

PNP Wiring example
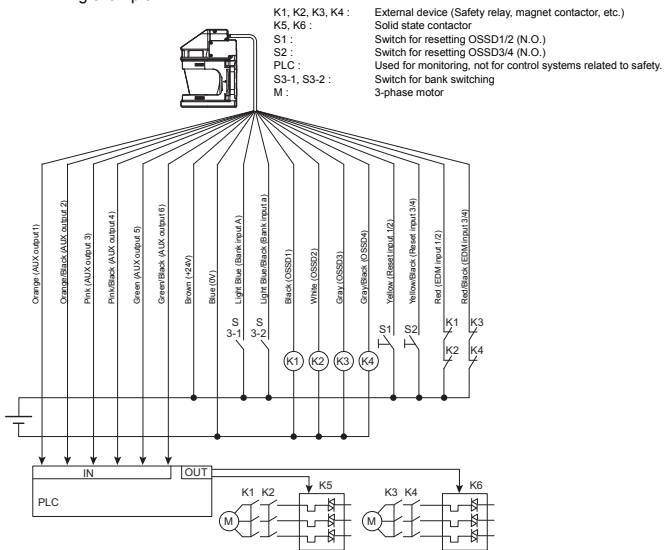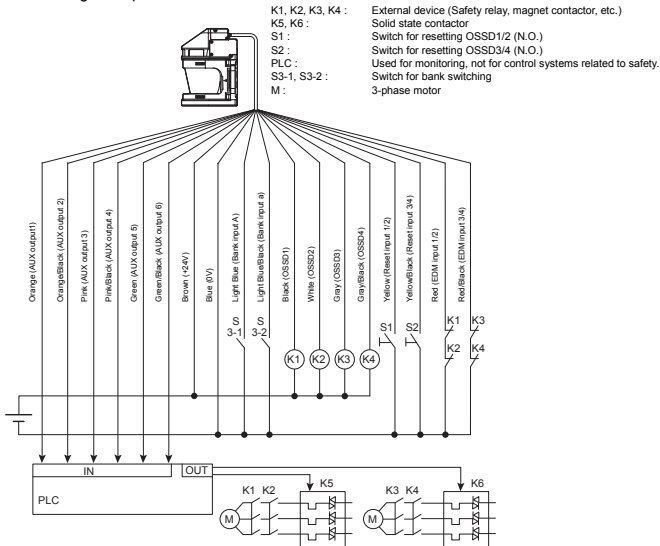


NPN Wiring example



## ■ Wiring example for the SZ-V32 type

PNP Wiring example
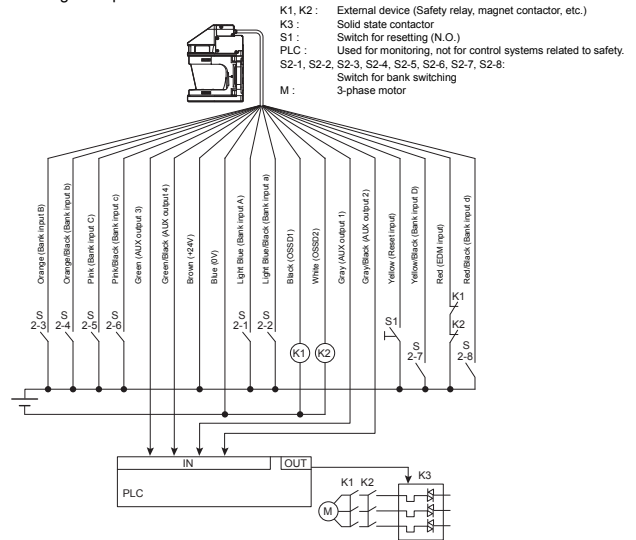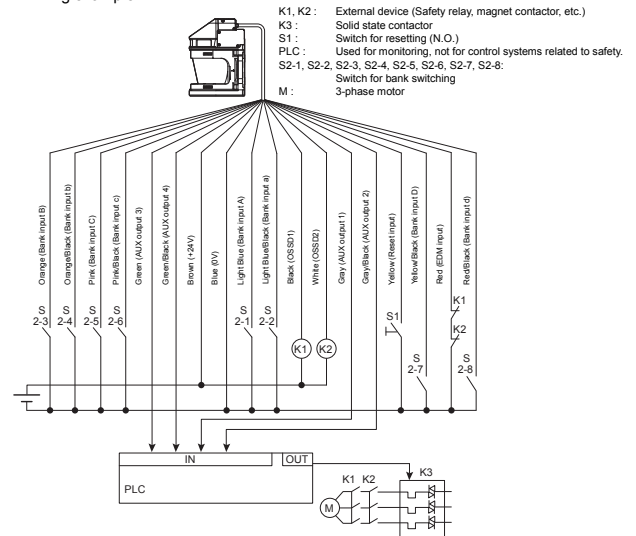


NPN Wiring example



## ■ Wiring example for the SZ-V32N type
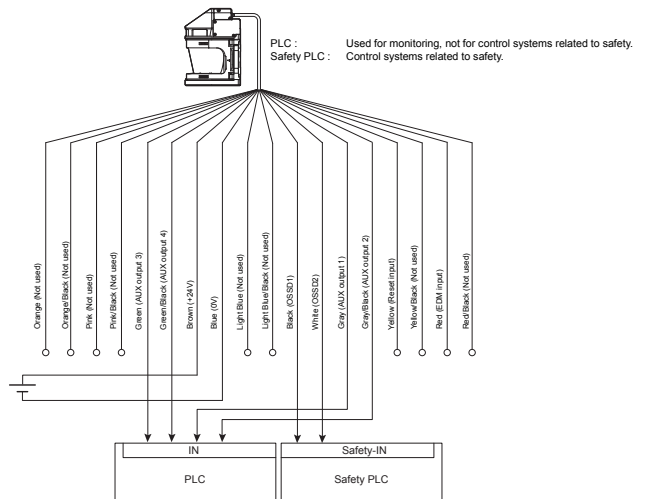
# Input and Output Circuit

## ■ OSSD output circuit (Safety output)

PNP



NPN



## ■ AUX output

PNP/NPN common



## ■ Muting lamp output

NPN
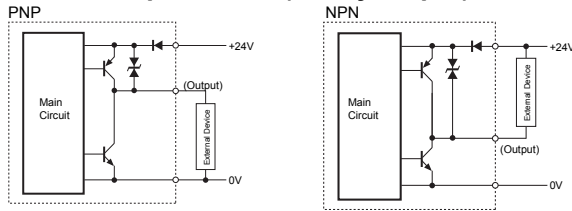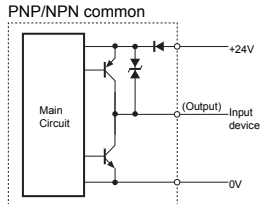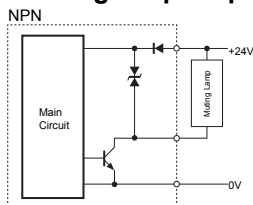


* Muting lamp output will always be a NPN output regardless of the setting of PNP/NPN selection.

## ■ Input circuit

PNP



NPN
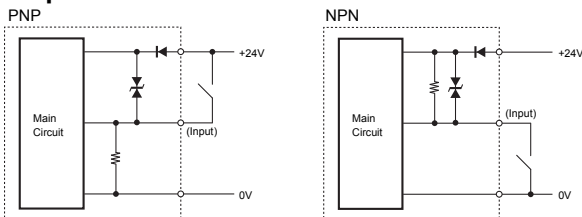


# OSSD

The OSSD is a safety output for the safety-related part of a machine control system. When the SZ-V detects an object (someone or something) in the protection zone, the OSSD goes to the OFF-state.

OSSD 1/2 is a pair of safety outputs that are redundant. Similarly, OSSD 3/4 is also a pair of safety outputs that are redundant.

The SZ-V generates self-diagnosis signals on its internal control circuit to perform diagnostics on the OSSD. These signals periodically force the OSSD into a temporary OFF-state when the OSSD is in the ON-state (when the SZ-V detects no objects in the protection zone).

If the internal control circuit receives a feed-back signal (OFF-signal) based on the self-diagnosis, the SZ-V determines that its OSSD is operating normally. If the OFF-signal is not returned to the internal control circuit, the SZ-V determines that there is a problem with the OSSD or wiring and goes to an error state.

The number of OSSDs available depends on the SZ-V type.

| Type | OSSD 1 | OSSD2 | OSSD3 | OSSD4 |
|---|---|---|---|---|
| SZ-V04 type | ○ | ○ | ○ | ○ |
| SZ-V32 type | ○ | ○ | | |
| SZ-V32N type | ○ | | | |

*For more information about OSSD3/4, see "Multi-OSSD Function".

● OSSD operation

Depending on the state of the SZ-V, the state of the OSSD differs.

| SZ-V State | OSSD state |
|---|---|
| Starting | OFF |
| Normal operation | ON. However, it turns OFF in the following conditions: 1. A person or object is detected in the protection zone(s) by any of the scanner heads[1] 2. A reference point is not detected by one of the scanner heads[1] 3. The laser off input is ON 4. The laser shutdown bank is selected 5. Interlock-reset-ready state 6. Waiting for bank input state 7. During ON-delay |
| Error State | OFF |
| Other states[2] | OFF |

*1 When multi-OSSD is being used, any scanner head that is linked with that OSSD.

*2 Other states refer to any of the following states:
- Waiting for configuration, Transferring settings, Calibrating the window, Clearing system configuration information, Testing AUX output, Changing the password

● Timing chart for self-diagnosis pulse



A : 50 to 250 μs
B : Approx. 60ms
C : Approx. 920ms

| ⚠ DANGER | • For the wiring to a safety-related machine control system, the output of both OSSD 1 and OSSD 2 must be used by the safety-related machine control system in order to create a safety system.<br>• Similarly, the output of both OSSD 3 and OSSD 4 must be used a machine control system if you assign a function to either OSSD 3 or 4.<br>• If one OSSD is only wired to a safety-related machine control system, it will result in a significant harm to the machine operators, including serious injury or death, due to OSSD malfunction. |
|---|---|

| ▶ Important | • The devices connected to the OSSD, such as safety relay or contactor, should not respond to these temporary, self-diagnostic OFF-signals. |
|---|---|

# Operation modes

In the SZ-V, two types of operation modes can be chosen from in accordance with the application.

| Operation mode | Standard Mode (Default Setting) | High Speed Mode |
|---|---|---|
| Advantages | • The maximum protection zone can be large<br>• Not easily affected by suspended matter such as dust | • The response time can be shorter |
| Disadvantages | • The response time is longer | • The maximum protection zone is smaller |

| Reference | • The size of the maximum protection zone differs depending on the minimum detectable object settings as well. |
|---|---|

# Minimum detectable object

The minimum detectable object size can be selected for the SZ-V.
Depending on the minimum detectable object size selected, the maximum configurable distance for the protection zone and warning zone differs.

| Minimum detectable object size (mm) | Operation mode: Standard (Default Setting) | | Operation mode: High Speed | |
|---|---|---|---|---|
| | Maximum protection zone distance (m) | Maximum warning zone distance (m) | Maximum protection zone distance (m) | Maximum warning zone distance (m) |
| φ20 mm | 1.6 m | 21 m | 1.1 m | 15 m |
| φ30 mm | 2.9 m | 23 m | 2.0 m | 18 m |
| φ40 mm | 4.3 m | 24 m | 2.9 m | 20 m |
| φ50 mm | 5.6 m | 25 m | 3.8 m | 21 m |
| φ70 mm | 8.4 m | 26 m | 5.7 m | 23 m |
| φ150 mm | 8.4 m | 26 m | 5.7 m | 23 m |

- This can be configured through the SZ-V Configurator. For details on the settings procedure, see the "SZ-V Series User's Manual".

| ⚠ DANGER | • The necessary safety distance varies depending on the minimum detectable object size. The protection zone must be configured so as to ensure the safety distance, which has been calculated according to the laws, regulations, and standards of the country and region in which the SZ-V is installed.<br>• If you select the minimum detectable object size of 150 mm, "H" (Height of detection plane) exceeds 1,000 mm. You must select the minimum detectable object size of 70 mm or less if you want to configure the area protection (direction of approach parallel to the protection zone.). |
|---|---|

# Response Time and Scan Cycle

The response time of the SZ-V is the time from when an object (someone or something) enters the protection zone, to when the OSSD goes to the OFF-state due to the detection of the object. The response time can be selected by the user.

The response times that can be selected differ based on the following settings:
- "Operation modes", "Scan cycle"

### ● Response time

| Operation mode: Standard Default Setting | | | Operation mode : High-speed | | |
|---|---|---|---|---|---|
| Scan cycle A (Default Setting) | Scan cycle B | Scan cycle C | Scan cycle A | Scan cycle B | Scan cycle C |
| 160 ms | 168 ms | 176 ms | 80 ms | 84 ms | 88 ms |
| 240 ms | 252 ms | 264 ms | 120 ms | 126 ms | 132 ms |
| 320 ms | 336 ms | 352 ms | 160 ms | 168 ms | 176 ms |
| 400 ms | 420 ms | 440 ms | 200 ms | 210 ms | 220 ms |
| 480 ms | 504 ms | 528 ms | 240 ms | 252 ms | 264 ms |
| 560 ms | 588 ms | 616 ms | 280 ms | 294 ms | 308 ms |
| 640 ms | 672 ms | 704 ms | 320 ms | 336 ms | 352 ms |
| 720 ms | 756 ms | 792 ms | 360 ms | 378 ms | 396 ms |
| 800 ms | 840 ms | 880 ms | 400 ms | 420 ms | 440 ms |
| 880 ms | 924 ms | 968 ms | 440 ms | 462 ms | 484 ms |
| 960 ms | 1008 ms | 1056 ms | 480 ms | 504 ms | 528 ms |
| 1040 ms | 1092 ms | 1144 ms | 520 ms | 546 ms | 572 ms |
| 1120 ms | 1176 ms | 1232 ms | 560 ms | 588 ms | 616 ms |
| 1200 ms | 1260 ms | 1320 ms | 600 ms | 630 ms | 660 ms |
| 1280 ms | 1344 ms | 1408 ms | 640 ms | 672 ms | 704 ms |

Shorter response times allow the safety distance to be smaller.
Longer response times decrease the potential for the OSSD to turn OFF due to dust or ambient light.

| ⚠ DANGER | • The necessary safety distance varies depending on the response time you specify. The protection zone must be configured so as to ensure the safety distance, which has been calculated according to the laws, regulations, and standards of the country and region in which the SZ-V is installed.<br>• The response time must be 90 ms or less when the SZ-V is used for the detection for access protection (trip device using whole-body detection with normal approach). The SZ-V may not detect the person in the protection zone if the specified response time is more than 90 ms. |
|---|---|

| Reference | • Only one scan cycle can be set for a scanner head. The protection zone and warning zone response times for a scanner head can only be chosen from the same scan cycle.<br>• Response times can be individually set for the protection zone and warning zone.<br>• When using the multi-OSSD function, response times of Protection Zone A and Protection Zone B can be set individually.<br>• When using two warning zones, response times of Warning Zone A and Warning Zone B can be set individually.<br>• When adding scanner heads, the scan cycle for each scanner head is automatically allocated and cannot be changed. |
|---|---|

# Select PNP or NPN

The input and output circuit polarity can be selected from NPN or PNP.
- Not configured (default), PNP, NPN

| ▶ Important | • You cannot use SZ-V if PNP/NPN selection is not configured. Make sure to select either "PNP" or "NPN". |
|---|---|

# AUX Output

AUX outputs are outputs that can inform the user of the SZ-V operations. The number of available AUX outputs and application functions vary based on the model.

### ● Maximum AUX output count

| | SZ-V04 type | SZ-V32 type | SZ-V32N type |
|---|---|---|---|
| Number of AUX outputs | 6 | 4 | 4 |

Depending on the combination of functions that are used, the number of AUX outputs can vary.

### ● Functions assigned to AUX outputs
For details about each function, see the "SZ-V Series User's Manual".

| | SZ-V04 type | SZ-V32 type | SZ-V32N type |
|---|---|---|---|
| Not used | ○ | ○ | ○ |
| State information output *1 | ○ | ○ | ○ |
| Error output | ○ | ○ | ○ |
| Alert output | ○ | ○ | ○ |
| Error or alert output | ○ | ○ | ○ |
| Muted or override condition output | ○ | -- | ○ |
| Muting lamp output *2 | ○ | -- | ○ |
| OSSD state output | ○ | ○ | ○ |
| Detection in the protection zone output | ○ | ○ | ○ |
| Detection in the warning zone output | ○ | ○ | ○ |
| Interlock-reset-ready output | ○ | ○ | ○ |
| Encoder error output | -- | ○ | ○ |
| Transition to normal operation output | ○ | ○ | ○ |

*1 The state information output uses two outputs: AUX 1 and AUX 2. AUX 3 through 6 cannot be used for the state information output.
*2 For the muting lamp output, the SZ-V04 type uses AUX 6 and the SZ-V32N type uses AUX 4. Any of other AUX outputs cannot be used for the muting lamp output.

| ⚠ DANGER | • The AUX output is not allowed to be used as a safety output for safety-related control systems. |
|---|---|

# Interlock function

Interlock is a function that prevents the OSSD from automatically going into the ON-state from the OFF-state. This prevents the unintended start-up and/or the unintended restart of the machine if the interlock is applied to the SZ-V. It is necessary to perform the reset operation in order for the SZ-V to go back to normal operation from the interlock condition. To use the interlock function, configure the interlock function settings in the SZ-V Configurator and connect a reset switch to the reset input terminal. For details of the setting procedure, see the "SZ-V Series User's Manual".

### ● Interlock
For the interlock function settings, select from the following three variations:

| At start-up | At restart | Notes |
|---|---|---|
| Automatic | Automatic | Default Setting |
| Manual | Automatic | |
| Manual | Manual | |

In this manual, start-up and restart refer to the following.
**Start-up:**
- At start-up (when the power is supplied, after the SZ-V loads and the machine transitions to normal operation),
- When the SZ-V is restored from an error state through a reset operation,
- When configuration is completed with the SZ-V Configurator.

**Restart:**
- When the OSSD goes back to the ON-state from the OFF-state, except for start-up

Here, Automatic and Manual refer to the following operations:
**Automatic:**
The OSSD goes to the ON-state automatically if the SZ-V detects no object in the protection zone at start-up or during restart.
**Manual:**
The OSSD keeps the OFF-state at start-up or during restart (interlock state).

### ● Terminating the interlock state
It is necessary to perform a reset operation when the SZ-V detects no object in the protection zone, in order for the machine to start operation. After the reset operation, the OSSD goes to the ON-state, and then the interlock state is disabled.

| ⚠ DANGER | • Be sure to absolutely confirm that there is nobody in the hazardous zone before the interlock condition is terminated (i.e. the machine system restarts) by the interlock reset mechanism. Failure to follow this warning may result in a significant harm to the machine operators, including serious injury or death.<br>• If you set the interlock function to "Automatic/Automatic", the SZ-V cannot go to the interlock state. You must prevent unintended start-up/restart and ensure the safety with machine control system except for the SZ-V.<br>• Make sure that the reset input does not short-circuit to other inputs or outputs. |
|---|---|

| ⭗ Point | • How to use automatic and manual restart appropriately:<br>• Automatic: This mode is used for machines where nobody can enter or approach the hazardous area by simply passing through the protection zone, or if the safety-related part of the control system other than the SZ-V, such as a safety relay unit, can ensure the safety with other means.<br>• Manual: Unexpected or unintended start-up of the machine or system can/should be prevented. Prevents automatic restart of the machine even if a person or object leaves the SZ-V protection zone. In both cases, the machine can be started with a start switch or the likes after a safety check is complete. |
|---|---|

### ● ON-delay
The time from when the object detected by the SZ-V is removed from the protection zone and when the OSSD goes back to the ON-state. This ON-delay time can be set from 2 seconds to 60 seconds in one second increments (default setting: 2 seconds).
However, if the ON-delay function is not used, the OSSD goes back to the ON-state after passing the response time (OFF to ON).

# EDM Function

The SZ-V can monitor the state of external devices, such as a safety relay or contactors that are connected to the OSSD, in order to detect the failure of the external device. This monitoring function is called the EDM function.
To use the EDM function, wiring between the SZ-V and the N.C. (Normally Closed) contacts of the external device(s) must be performed according to the following diagrams.
The EDM input must be open-circuited if EDM is not applied to the SZ-V. If wiring is incorrectly performed, "Incorrect wiring error" occurs on the SZ-V.

# Bank Switching Function

The number of zones can be set in the SZ-V. The bank switching function is a function that can switch a set of warning and protection zones (Bank) according to external inputs (bank inputs). The bank refers to a combination of protection zone, warning zone and reference points. When multiple scanner heads are used, protection zones, warning zones, and reference points can be set for each scanner head.

## ■ Bank switching methods

The following three bank switching methods are available:
- Switching through wiring inputs (single input)
- Switching through wiring inputs (binary input) (default)
- Switching through rotary encoder inputs (encoder input)

## ■ Number of configurable banks

The maximum number of configurable banks, and the number of protection and warning zones configurable per bank varies depending on the model of display unit that is used and the functions used.

**The maximum number of banks and zones for the SZ-V04 type**

| Functions | Bank switching method | Maximum no. of configurable banks | Per bank | |
|---|---|---|---|---|
| | | | No. of protection zones | No. of warning zones |
| Not used | Single input | 4 | 1 | 2 |
| | Binary input | 4 | 1 | 2 |
| Multi-OSSD (Independent bank switching) | Single input | 2 | 2 | 2 |
| | Binary input | 4 | 2 | 2 |
| | Independent bank switching (single input) | 2 [*1] | 2 [*2] | 2 [*2] |

*1 Two banks are configurable for both OSSD 1/2 and OSSD 3/4.
*2 One protection zone and one warning zone is available for both OSSD 1/2 and OSSD 3/4. "Independent bank switching"

**The maximum number of banks and zones for the SZ-V32 type and SZ-V32N type**

| Bank switching method | Maximum no. of configurable banks | Per bank | |
|---|---|---|---|
| | | No. of protection zones | No. of warning zones |
| Single input | 10 | 1 | 2 |
| Binary input | 32 | 1 | 2 |
| Encoder input | 32 [*1] | 1 | 2 |

*1 A combination of a 4 wiring banks by wire switching (single input) and an 8-velocity range.

Banks can be switched according to the signal combination of bank inputs (ON/OFF state combination). Appropriate protection zones can be selected by configuring the SZ-V to switch the banks corresponding to the hazard and/or hazardous area.

| **⚠ DANGER** | • Someone may be able to approach the hazard and/or hazardous area without passing through the SZ-V protection zone if the bank switching is performed at unintended timing. Therefore, you must perform the risk assessment on your own responsibility, taking into account the bank transition time, in order to establish the appropriate control system for bank switching. |
|---|---|

| Reference | • By designating one bank as the "laser shutdown bank" it is possible to stop the SZ-V laser and control the standby state when this bank is selected. |
|---|---|

## ■ Details on the bank switching methods

### ● Switching through wiring input (single input)

Banks are switched based on the signal state (ON/OFF) of the bank input wires. As shown in the following table, it is possible to switch from bank 0 to bank 9 according to the signal combination of bank inputs (bank input A to E and bank inputs a to e).

| | Bank input | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | A | a | B | b | C | c | D | d | E | e |
| Bank 0 | ON | OFF | OFF | OFF | OFF | OFF | OFF | OFF | OFF | OFF |
| Bank 1 | OFF | ON | OFF | OFF | OFF | OFF | OFF | OFF | OFF | OFF |
| Bank 2 | OFF | OFF | ON | OFF | OFF | OFF | OFF | OFF | OFF | OFF |
| Bank 3 | OFF | OFF | OFF | ON | OFF | OFF | OFF | OFF | OFF | OFF |
| Bank 4 | OFF | OFF | OFF | OFF | ON | OFF | OFF | OFF | OFF | OFF |
| Bank 5 | OFF | OFF | OFF | OFF | OFF | ON | OFF | OFF | OFF | OFF |
| Bank 6 | OFF | OFF | OFF | OFF | OFF | OFF | ON | OFF | OFF | OFF |
| Bank 7 | OFF | OFF | OFF | OFF | OFF | OFF | OFF | ON | OFF | OFF |
| Bank 8 | OFF | OFF | OFF | OFF | OFF | OFF | OFF | OFF | ON | OFF |
| Bank 9 | OFF | OFF | OFF | OFF | OFF | OFF | OFF | OFF | OFF | ON |

| Reference | • When using single input with the SZ-V04 type, the maximum number of configurable banks is 4. Banks 4 to 9 cannot be used.<br>• When using independent bank switching with the SZ-V04 type, the bank switching method differs. To use more than 11 banks with the SZ-V32 type or the SZ-V32N type, single input cannot be used. Binary input switching should be used.<br>• The SZ-V does not start operation if the signal combination of bank inputs is different from the combinations shown above at start-up, because the SZ-V goes to the state of "Waiting for bank input". The SZ-V starts operation automatically if the signal combination of bank inputs is the same as one of the combinations shown above. If the signal combination of bank inputs is different from the combination shown above during normal operation, the SZ-V changes to "Bank input error."<br>• Bank switching must be performed according to the bank transition time specified in the SZ-V Configurator. The SZ-V goes to the error state of "Bank error" if the time does not meet the specified bank transition time.<br>• Individually insulate any bank inputs that are not used. |
|---|---|

### ● Switching through wiring input (binary input)

Banks are switched based on the signal state (ON/OFF) of the bank input wires. As shown in the following table, it is possible to switch from bank 0 to bank 31 according to the signal combination of bank inputs (bank inputs A to E and bank inputs a to e).

| | Bank input | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | A | B | C | D | E | a | b | c | d | e |
| Bank 0 | OFF | OFF | OFF | OFF | OFF | ON | ON | ON | ON | ON |
| Bank 1 | ON | OFF | OFF | OFF | OFF | OFF | ON | ON | ON | ON |
| Bank 2 | OFF | ON | OFF | OFF | OFF | ON | OFF | ON | ON | ON |
| Bank 3 | ON | ON | OFF | OFF | OFF | OFF | OFF | ON | ON | ON |
| Bank 4 | OFF | OFF | ON | OFF | OFF | ON | ON | OFF | ON | ON |
| Bank 5 | ON | OFF | ON | OFF | OFF | OFF | ON | OFF | ON | ON |
| Bank 6 | OFF | ON | ON | OFF | OFF | ON | OFF | OFF | ON | ON |
| Bank 7 | ON | ON | ON | OFF | OFF | OFF | OFF | OFF | ON | ON |
| Bank 8 | OFF | OFF | OFF | ON | OFF | ON | ON | ON | OFF | ON |
| Bank 9 | ON | OFF | OFF | ON | OFF | OFF | ON | ON | OFF | ON |
| Bank 10 | OFF | ON | OFF | ON | OFF | ON | OFF | ON | OFF | ON |
| Bank 11 | ON | ON | OFF | ON | OFF | OFF | OFF | ON | OFF | ON |
| Bank 12 | OFF | OFF | ON | ON | OFF | ON | ON | OFF | OFF | ON |
| Bank 13 | ON | OFF | ON | ON | OFF | OFF | ON | OFF | OFF | ON |
| Bank 14 | OFF | ON | ON | ON | OFF | ON | OFF | OFF | OFF | ON |
| Bank 15 | ON | ON | ON | ON | OFF | OFF | OFF | OFF | OFF | ON |
| Bank 16 | OFF | OFF | OFF | OFF | ON | ON | ON | ON | ON | OFF |
| Bank 17 | ON | OFF | OFF | OFF | ON | OFF | ON | ON | ON | OFF |
| Bank 18 | OFF | ON | OFF | OFF | ON | ON | OFF | ON | ON | OFF |
| Bank 19 | ON | ON | OFF | OFF | ON | OFF | OFF | ON | ON | OFF |
| Bank 20 | OFF | OFF | ON | OFF | ON | ON | ON | OFF | ON | OFF |
| Bank 21 | ON | OFF | ON | OFF | ON | OFF | ON | OFF | ON | OFF |
| Bank 22 | OFF | ON | ON | OFF | ON | ON | OFF | OFF | ON | OFF |
| Bank 23 | ON | ON | ON | OFF | ON | OFF | OFF | OFF | ON | OFF |
| Bank 24 | OFF | OFF | OFF | ON | ON | ON | ON | ON | OFF | OFF |
| Bank 25 | ON | OFF | OFF | ON | ON | OFF | ON | ON | OFF | OFF |
| Bank 26 | OFF | ON | OFF | ON | ON | ON | OFF | ON | OFF | OFF |
| Bank 27 | ON | ON | OFF | ON | ON | OFF | OFF | ON | OFF | OFF |
| Bank 28 | OFF | OFF | ON | ON | ON | ON | ON | OFF | OFF | OFF |
| Bank 29 | ON | OFF | ON | ON | ON | OFF | ON | OFF | OFF | OFF |
| Bank 30 | OFF | ON | ON | ON | ON | ON | OFF | OFF | OFF | OFF |
| Bank 31 | ON | ON | ON | ON | ON | OFF | OFF | OFF | OFF | OFF |

| Reference | • Bank No. is represented with binary code consisting of the signal combination of bank inputs A, B, C, D, and E. For bank inputs a, b, c, d, and e, these are inverted signals from bank inputs A, B, C, D, and E.<br>• The SZ-V does not start operation if the signal combination of bank inputs is different from the combinations shown above at start-up, because the SZ-V goes to a state of "Waiting for bank input". The SZ-V starts operation automatically if the signal combination of bank inputs is the same as one of the combinations shown above. If the signal combination of bank inputs is different from the combination shown above during normal operation, the SZ-V changes to "Bank input error."<br>• Bank switching must be performed according to the bank transition time was specified through the SZ-V Configurator. The SZ-V goes to the error state of "Bank error" if the time does not meet the specified bank transition time.<br>• When using binary inputs with the SZ-V04 type, the maximum number of configurable banks is 4. Banks 4 to 31 cannot be used.<br>• If the total number of banks is 16 or less (that is, when bank 0 to bank 15 are enabled), the SZ-V does not check the state of bank input E and bank input e because they are not related to bank switching.<br>• If the total number of banks is 8 or less (that is, when bank 0 to bank 7 are enabled), the SZ-V does not check the state of bank input D/E and bank input d/e because they are not related to bank switching.<br>• If the total number of banks is 4 or less (that is, when bank 0 to bank 3 are enabled), the SZ-V does not check the state of bank input C, D, E and bank input c, d, e because they are not related to bank switching.<br>• If the total number of banks is 2 or less (that is, when bank 0 to bank 1 are enabled), the SZ-V does not check the state of bank input B, C, D, E and bank input b, c, d, e because they are not related to bank switching.<br>• Individually insulate any bank inputs that are not used. |
|---|---|

## ■ Switching through rotary encoder input (encoder input)

This is a function that is available when encoders are connected to the SZ-V. Zones can be switched in accordance with speed information received from two independent encoders. The velocity range (velocity bank) is configurable in 8 stages.
By combining wiring inputs (single input), it is possible to switch between up to 4 wiring banks. With combination of 8 velocity banks and 4 wiring banks, it is possible to switch between maximum 32 banks.

Encoders must meet the following conditions:
- Power voltage of DC 24 V
- A rotary encoder that has A and B phase, as well as an A- output (A phase inverse output)
- Complimentary output
- Maximum pulse frequency: 100 kHz

The ranges of setting parameters are shown below. It can be selected in accordance with the type of encoder that is used and the application:

| | |
|---|---|
| Encoder Velocity Setting (Number of pulses per 1mm of AGV travel) | • 5 to 100 (pulses/mm) • Default:  5 (pulses/mm) |
| Allowable Variation | • 0 to 45 % • Default: 25% |
| Maximum Variation Time | • 10 s • 30 s (default) • 1 min |

For details on each setting, see the "SZ-V Series User's Manual".

Reference
- When the velocity of the two encoders is not the same, the higher velocity is used as the determined velocity.
- It is possible to receive an output for an encoder error.
- For the SZ-V04 type, encoder input switching cannot be selected.
- If the bank switching function is used on the SZ-V32N type, the muting function cannot be used.
- During normal operation, the SZ-V results in an error if one of the following conditions is met.
  1. The encoder velocity exceeds the set velocity range.
  2. An input is received that exceeds the maximum pulse frequency (100 kHz).
  3. The velocity difference between the two encoders is more than the allowable variation and exceeds the maximum variation time.
  4. The encoder velocity is zero and one of the following mismatches is detected:
     a. Encoder input 1A and 1A- mismatch
     b. Encoder input 2A and 2A- mismatch
- Two encoders are assumed to rotate towards same direction, when AGV is moving. In the case of applications where the direction of two encoders is opposite, SZ-V cannot recognize the encoder pulses properly.

**Number of pulses per 1mm of AGV travel**
Calculation method
$P = p/(r \times D_{AGV} \times \pi)$

P: Number of pulses per 1mm move of AGV [pulses/mm]
p: Number of pulses per one rotation of encoder [pulses]
r: Number of AGV tire rotations per one rotation of encoder
$D_{AGV}$: Diameter of AGV tire [mm]

**Calculation example**
When using a friction wheel attached to an encoder.
$D_f$: Diameter of friction wheel [mm]
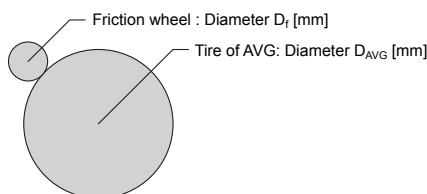


Friction wheel : Diameter $D_f$ [mm]
Tire of AVG: Diameter $D_{AVG}$ [mm]
Floor, etc.

| | |
|---|---|
| P = 1000 [pulses] | Number of pulses per one rotation of encoder |
| $D_{AGV}$ = 450 [mm] | Diameter of AGV tire |
| $D_f$ = 54 [mm] | Diameter of friction wheel |
| r = Df/DAGV = 54/450 = 0.12 | Number of AGV tire rotation per one rotation of encoder |

**Number of pulses per 1mm move of AGV**
$P = p/(r \times D_{AGV} \times \pi) = 1000/(0.12 \times 450 \times \pi) = 5.9$ [pulses/mm]

⚠ DANGER
- If the object to be detected moves perpendicular to the detection plane, SZ-V cannot detect the object moving at speed over 1.6m/s, regardless of the encoder setting.

## Bank Sequence Monitoring Function

The SZ-V can monitor the sequence of bank switching so that the OSSD goes to the OFF-state due to an error state if the SZ-V detects a signal combination of bank inputs in an unexpected sequence. This prevents machine operation with an unintended protection zone selected through the use of the bank sequence monitoring.
For each bank, 3 bank numbers can be assigned to follow. The SZ-V goes to the error state of "Bank sequence error" if the bank number indicated by the signal combination of bank inputs is different from the specified bank number that is to be followed under the bank sequence monitoring function.

KEYENCE Corporation strongly recommends enabling the bank sequence monitoring function to specify the proper bank sequence for the machine application.

This can be configured through the SZ-V Configurator. For details on the settings procedure, see the "SZ-V Series User's Manual".

## Multi-OSSD Function

When using the multi-OSSD function, it is possible to set two independent protection zones for one scanner head.
The two protection zones are called Protection Zone A and Protection Zone B. OSSD 1/2 goes to the OFF-state if the SZ-V detects an object in protection zone A. OSSD 3/4 goes to the OFF-state if the SZ-V detects an object in protection zone B.

When adding more scanner heads, it is possible to assign each scanner head a protection zone for OSSD 1/2 and OSSD 3/4.

⚠ DANGER
- If you control two hazard sources independently, you must fully consider the SZ-V installation position and orientation. If there is unprotected space where the operator can approach into the hazardous area, you must take additional countermeasure against the hazard.

Reference
- Even when using the multi-OSSD function, maximum number of warning zones is two.
- To switch the protection zone for OSSD 1/2 (Protection Zone A) and the protection zone for OSSD 3/4 (Protection Zone B) at different times, use the independent bank switching function.

### ● Independent bank switching

The independent bank switching function can be used in combination with the bank switching function.
Normally when the bank switching function is used, the protection zone for OSSD 1/2 (Protection Zone A) and the protection zone for OSSD 3/4 (Protection Zone B) switch at the same time. However, if the independent bank switching function is used, Protection Zone A and Protection Zone B can be switched at different times.

| OSSD 1/2 Protection zone A | OSSD 3/4 Protection zone B | Bank input | | | |
|---|---|---|---|---|---|
| | | A | a | B | b |
| Bank 0 | --- | ON | OFF | -- | -- |
| Bank 1 | --- | OFF | ON | -- | -- |
| --- | Bank 0 | -- | -- | ON | OFF |
| --- | Bank 1 | -- | -- | OFF | ON |

Reference
- Certain functions cannot be used at the same as the independent bank switching function. For details, see the "SZ-V Series User's Manual".

## Temporarily Disabling the Safety Function

The SZ-V04 type and the SZ-V32N type have a function that can temporarily disable the safety function when specific conditions are met. While the specific signals, which fulfill that condition, are activated, the OSSD keeps the ON-state even if the SZ-V detects something or someone in the protection zone, or if the SZ-V detects a change of position monitored through the reference points monitoring function.

⚠ DANGER
- The conditions, SZ-V settings, peripheral devices, and the installation of those devices in order to disable the SZ-V safety function must fulfill the conditions specified in this manual as well as the requirements of the laws, rules, regulations, and standards in the country or region in which the SZ-V and those devices are used.

Reference
- The state of suspension of safety function can be checked through the muting indicator and AUX output signal. The configuration of AUX outputs is necessary to check the state of suspension through AUX output signals.
- Certain functions cannot be used if the muting function is used. For details, see the "SZ-V Series User's Manual".

## ■ Muting function

A muting zone can be configured anywhere in the protection zone. The SZ-V goes to the muted condition when the conditions for initiation of muting are fulfilled. The OSSD keeps the ON-state even if the SZ-V detects an object in the muting zone.
(Even if the conditions for initiation of muting are fulfilled, the OSSD goes to the OFF-state when the SZ-V detects an object in the protection zone where the muting zone is not configured.)
For example, it is not necessary to stop the machine when an AGV enters the hazardous area by configuring the muting zone in the protection zone where the AGV would pass through.
The muting input terminals on the SZ-V must be connected to muting devices to use the muting function.

### ● Restrictions on the muting device
- Output must be N.O. (normally open)
- Must be a contact output or PNP/NPN output which corresponds to the settings selected in the selection of PNP or NPN.
- Do not use one muting device with multiple outputs in place of two or more muting devices (always one output for one device).
- If the muting device has a timer function that can adjust the output timing, do not use that function.

### ● Conditions for initiation of muting
Muted condition is initiated if all of the following conditions are met.
1. Muting inputs go to the ON-state within the specified sequence and within the specified time between them.
2. The SZ-V detects no objects in the protection zone.
3. The OSSD is in the ON-state.

### ● Conditions for termination of muting
The muted condition is terminated if one of the following conditions is met:
1. Either of muting inputs go to the OFF-state for more than 0.015 sec.
2. The SZ-V goes into an error state.
3. The laser off input goes to the ON-state (Operation Check Function).
4. The power supply is interrupted.
5. The maximum muting period of time has passed.

### ● Configuring muting conditions
The ranges of setting parameters are shown below. It can be selected in accordance with the type of encoder that is used and the application:

| Sequence of muting inputs | • Muting input 1 to Muting input 2 fixed (default)<br>• Muting input 2 to Muting input 1 fixed<br>• Not specified |
|---|---|
| Time period between muting inputs | • 0.04 to 3.0 s (default)<br>• 0.04 to 5.0 s<br>• 0.04 to 10.0 s<br>• 0.04 to (not specified) |
| Maximum muting period of time | • 1 min<br>• 5 min (Default)<br>• 10 min<br>• Not specified |

| ⚠ DANGER | • The responsible personnel must perform the risk assessment based on the machine application in order to appropriately determine the risk if "Not specified" is selected for the maximum muting period of time. Moreover, based on this result, enact additional safeguards if necessary. |
|---|---|

| ✎ Point | • Consider the potential danger due to the muting sensor unexpectedly failing. Also, note the following when "Not specified" is selected for both the maximum muting period and time between muting inputs.<br>  • If the time between muting inputs exceeds 3 seconds, the muting state will be terminated approximately 5 minutes later. (If the time between muting inputs is within 3 seconds, the muting state continues and is unlimited as per the settings.) |
|---|---|

| Reference | • Upon start up, the SZ-V starts from the muting terminated state regardless of the muting input state. The SZ-V is unable to power on into a muted state. |
|---|---|

## ■ Override function

With the safety function temporarily disabled by the muting function, the OSSD goes to the OFF-state if that suspension is interrupted for any reason. If this occurs while an object is still in the protection zone, then the machine remains stopped because the muting function cannot initiate again since the SZ-V detects an object in the protection zone.
The override is a helpful function suitable for such a situation. The SZ-V goes to the override condition when the conditions for initiation of override are met. When override is activated, an object in the protection zone can be easily removed.
All of the scanner heads and protection zones go into the override state when this function is activated and the safety function is disabled. (It is not possible to suspend the safety function for only a part of the protection zone or to disable just one scanner head.)

### ● Conditions for initiation of override
Override is initiated when the reset input[*] goes to the ON-state within 0.04 to 1 sec. after the override input goes to the ON-state, and if all of the following conditions are met:
1. The SZ-V is not in an error state.
2. At least one scanner head detects an object in the protection zone.
3. The OSSD is in the OFF-state. (Including interlock condition)
4. Either muting input or both muting inputs are in the ON-state.

*If the operation check function with laser off input is used, the laser off input must go in the ON-state instead of the reset input for the initiation of override.

### ● Conditions for termination of override
The override condition is terminated if one of the following conditions is met:
1. All muting inputs go to the OFF-state.
2. Either override input or reset input goes to the OFF-state.
3. The SZ-V goes into an error state.
4. Maximum override period of time has passed.

### ● Configuring override conditions
The ranges of setting parameters are shown below. It can be selected in accordance with the type of encoder that is used and the application:

| Maximum override period of time | 1 min (default), 5 min, 10 min |
|---|---|

## Reference Points Monitoring Function

Reference points monitoring is a safety-related function where the SZ-V monitors the position change of a structure (such as protective guarding or a door) located at a specified reference point. Similar to when the SZ-V detects an object in the protection zone, the OSSD goes to the OFF-state if the position of the structure (such as protective guarding or door) varies exceeding the specified tolerance.

| ⚠ DANGER | • Reference points monitoring function must be applied when the SZ-V is used for the access protection specified in IEC61496-3:2008 Annex A.12 and A.13 (the application where the angle of the approach exceeds ±30° to the detection plane). In this case, the tolerance for reference points must be ±100 mm or less and the response time must be 90 ms or less. Additional countermeasures for protection must be provided if there is a space between the protection zone and the protective structure that the minimum detectable object is not detected by the SZ-V. |
|---|---|

| Reference | • Maximum of 15 reference points can be set.<br>• When using bank switching function, maximum of 15 reference points can be set for protection zone of each bank.<br>• When the multi-OSSD function is used, a maximum of 15 points can be set in each protection zone.<br>• The OSSD turning OFF because an object or person was detected in the protection zone, or the reference points monitor function turning OFF the OSSD can be distinguished with the SZ-V display and the detection history.<br>• The reference points monitoring function stops while the safety function is temporarily disabled. |
|---|---|

## Other functions

For more information about "Warning Zone", "Operation check function", "Mutual Interference Reduction Function", "Power Saving Mode", "Camera Blur Function", "System Memory", "Detection History" and "Configuration Code (CRC)", see the "SZ-V Series User's Manual".

## Authorization Level and Settings

Three types of authorization levels are available in the SZ-V Configurator. User capabilities differ depending on the authorization level setting.

| Authorization level names | Overview |
|---|---|
| Responsible personnel | Can perform all operations |
| Maintenance personnel | In addition to machine operator authorization level, the following operations are possible:<br>• Transfer the settings approved by the responsible personnel<br>• Window calibration<br>• Clear system configuration information |
| Machine operator (User yet to log in) | Only the following operations are possible<br>• Retrieve settings<br>• Monitor operations<br>• Check detection history |

By default, valid authorization level setting is either responsible personnel or machine operator only. Maintenance personnel authorization level is disabled by default. Only the responsible personnel can change the validity of maintenance personnel authorization level, or change the password of maintenance personnel.

| ▶ Important | • The configuration for safety-related functions and the others cannot be performed without the password. You must strictly keep the password. |
|---|---|

| Reference | • Maintenance personnel can transfer only settings that have been approved by the responsible personnel.<br>• If the maintenance personnel modifies settings, those settings cannot be transferred, even if the settings have been approved by the responsible personnel.<br>• If the responsible personnel saves the approved setting into a file, maintenance personnel can open the saved file and transfer the setting. However if maintenance personnel modifies the settings, the setting cannot be transferred. |
|---|---|

# How to read the indicators

## ■ Display unit indicators
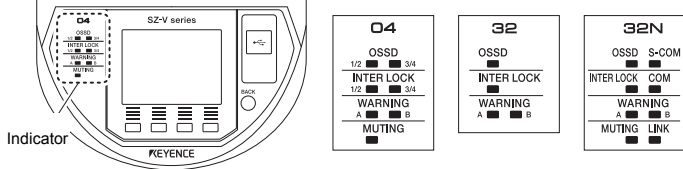


| | SZ-V04 type | SZ-V32 type | SZ-V32N type |
|---|---|---|---|
| 1 | OSSD 1/2 indicator | OSSD indicator | OSSD indicator |
| 2 | OSSD 3/4 indicator | None | Always OFF |
| 3 | Interlock 1/2 indicator | Interlock indicator | Interlock indicator |
| 4 | Interlock 3/4 indicator | None | COM indicator |
| 5 | Warning zone indicator A | Warning zone indicator A | Warning zone indicator A |
| 6 | Warning zone indicator B | Warning zone indicator B | Warning zone indicator B |
| 7 | Muting indicator | None | Muting indicator |
| 8 | None | None | Link indicator |

**OSSD indicator**

| Light color | Status | Details |
|---|---|---|
| Green | ON | OSSD 1/2 (3/4) is in the ON-state |
| Red | ON | OSSD 1/2 (3/4) is in the OFF-state |
| | Flashing | Error State |
| -- | OFF | Power OFF state |

**Interlock indicator**

| Light color | Status | Details |
|---|---|---|
| Yellow | ON | OSSD 1/2 (3/4) is in the interlock state |
| | Flashing | OSSD 1/2 (3/4) is in the interlock-reset-ready state |
| -- | OFF | Other states |

**Warning zone indicator A (B)**

| Light color | Status | Details |
|---|---|---|
| Orange | ON | Object or person detected in Warning Zone A (B) |
| -- | OFF | Other states |

**Muting indicator**

| Light color | Status | Details |
|---|---|---|
| Orange | Flashing | The SZ-V is currently in a muted or override state |
| -- | OFF | Other states |

**COM indicator**

| Light color | Status | Details |
|---|---|---|
| Yellow | ON | EtherNet/IP or UDP data communication is established |
| -- | OFF | Other states |

**Link indicator**

| Light color | Status | Details |
|---|---|---|
| Orange | ON | EtherNet communication is established |
| | Flashing | Transmitting data |
| | Flashing slowly | Connected to the SZ-V Configurator |
| -- | OFF | Other states |

## ■ Scanner Head Indicators
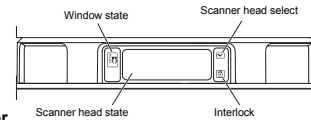


**Window state indicator**

| Light color | Status | Details |
|---|---|---|
| Orange | ON | This scanner head is in a window alert state or a window error state |
| -- | OFF | Other states |

**Scanner head state indicator**

| Light color | Status | Details |
|---|---|---|
| Green | ON | The protection zone or warning zone for this scanner head is in a non-detection state |
| | Flashing slowly | • In Simulation mode, the simulation zone is in a non-detection state.<br>• While dynamic drawing, the zone being edited is in an object non-detection state. |
| Orange | ON | The protection zone for this scanner head is in a non-detection state but the warning zone is in a detection state |
| | Flashing | Muted or override condition |
| | Flashing slowly | While dynamic drawing, the dynamic drawing sheet is in a detection state. |
| Red | ON | The protection zone for this scanner head is in a detection state |
| | Flashing | Error State |
| | Flashing slowly | • In Simulation mode, the simulation zone is in a detection state.<br>• While dynamic drawing, the zone being edited is in an object detection state. |
| -- | OFF | • Power is OFF<br>• During start-up<br>• Setting from SZ-V Configurator<br>• No operation for more than 30 seconds in Power Saving Mode. |

**Scanner head selection indicator**

| Light color | Status | Details |
|---|---|---|
| Orange | ON | • When checking the operation of this scanner head from the SZ-V Configurator or when checking the settings<br>• When monitor view or camera view of this scanner head is displayed on the display unit. |
| -- | OFF | Other states |

**Interlock indicator**

| Light color | Status | Details |
|---|---|---|
| Yellow | ON | Interlock condition |
| | Flashing | Interlock-reset-ready |
| -- | OFF | Other states |

# Models

● **Set model**
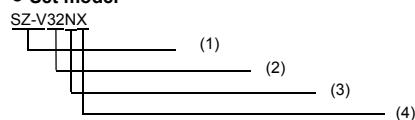
SZ-V32NX



| (1) | Basic designation | | |
|---|---|---|---|
| (2) | Number of banks | 04: | 4 Banks |
| | | 32: | 32 Banks |
| (3) | Network | blank: | Without network connection capability |
| | | N: | With network connection capability |
| (4) | Camera | blank: | Without camera |
| | | X: | With Camera |

● **Display unit model**
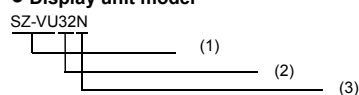
SZ-VU32N



| (1) | Basic designation | | |
|---|---|---|---|
| (2) | Number of banks | 04: | 4 Banks |
| | | 32: | 32 Banks |
| (3) | Network | blank: | Without network connection capability |
| | | N: | With network connection capability |

● **Scanner head model**

SZ-VH1X
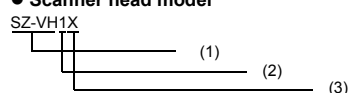


| (1) | Basic designation | | |
|---|---|---|---|
| (2) | Scanner head model number | | |
| (3) | Camera | blank: | Without camera |
| | | X: | With Camera |

# Specifications

| Model Name | | | SZ-V04(X) | SZ-V32(X) | SZ-V32N(X) |
|---|---|---|---|---|---|
| Type | | | Multi-function Type | Multi-bank Type | Network Type |
| Detection capability | Minimum detectable object size | | Diameter 20, 30, 40, 50, 70, 150 mm (depends on the setting) | | |
| | | | Reflectance 1.8 % min., Speed 1.6 m/s max. *1 | | |
| | Detectable angle | | 190° (- 5° to 185° ) | | |
| | Response time (ON to OFF) *2 | Standard Mode *3 | Scan Cycle A | 160ms (2scans) to 1280ms (16scans) | | |
| | | | Scan Cycle B | 168ms (2scans) to 1344ms (16scans) | | |
| | | | Scan Cycle C | 176ms (2scans) to 1408ms (16scans) | | |
| | | High Speed Mode *3 | Scan Cycle A | 80ms (2scans) to 640ms (16scans) | | |
| | | | Scan Cycle B | 84ms (2scans) to 672ms (16scans) | | |
| | | | Scan Cycle C | 88ms (2scans) to 704ms (16scans) | | |
| | Response time (OFF to ON) | | Response time (ON to OFF) + 150 ms | | |
| | Protection zone | Minimum detectable object size: 70 / 150 mm | 8.4m (Standard Mode) 5.7m (High Speed Mode) | | |
| | | Minimum detectable object size: 50 mm | 5.6m (Standard Mode) 3.8m (High Speed Mode) | | |
| | | Minimum detectable object size: 40 mm | 4.3m (Standard Mode) 2.9m (High Speed Mode) | | |
| | | Minimum detectable object size: 30 mm | 2.9m (Standard Mode) 2.0m (High Speed Mode) | | |
| | | Minimum detectable object size: 20 mm | 1.6m (Standard Mode) 1.1m (High Speed Mode) | | |
| | Warning zone | Minimum detectable object size: 70 / 150 mm | 26m (Standard Mode) 23m (High Speed Mode) *4 | | |
| | | Minimum detectable object size: 50 mm | 25m (Standard Mode) 21m (High Speed Mode) *4 | | |
| | | Minimum detectable object size: 40 mm | 24m (Standard Mode) 20m (High Speed Mode) *4 | | |
| | | Minimum detectable object size: 30 mm | 23m (Standard Mode) 18m (High Speed Mode) *4 | | |
| | | Minimum detectable object size: 20 mm | 21m (Standard Mode) 15m (High Speed Mode) *4 | | |
| | Additional safety distance | | 100mm*5 | | |
| | Maximum measurement distance | | 60m*6 | | |
| Maximum number of banks | | | Max 4 banks | Max 32 banks | Max 32 banks |
| Multiple scanner heads | | | Max 3 | | |
| Monitor camera | | | Monitor area: over 190° (-5° to 185°) *7 | | |
| Display | | | QVGA 2.2inch color LCD | | |
| Light source | Type, wavelength | | Infrared laser diode, 905 nm | | |
| | Laser Class | IEC | Class1 IEC/EN60825-1 | | |
| | | FDA | Class1 FDA 21CFR 1040.10, 1040.11 (Laser Notice No.50) *8 | | |
| | | JIS | Class1 JIS C6802 | | |
| Rating | Power voltage | | 24 V DC ±10 % (Ripple P-P 10 % or less): When using a converter power supply | | |
| | | | 24 V DC +20 %/-30 %: When using a battery | | |
| | Power consumption | | 11.8W (without load) 55.0W (with load) *9 | 11.8W (without load) 55.0W (with load) *9 | 13.4W (without load) 50.8W (with load) *9 |
| Control Output (OSSD) | Output | | Transistor outputs (NPN or PNP is selected by the dedicated PC software) | | |
| | Number of outputs | | 4 outputs | 2 outputs | 2 outputs |
| | Max. load current | | 500mA *10 | | |
| | Residual voltage (during ON) | | Max. 2.5 V (with a cable length of 5 m) | | |
| | OFF-state voltage | | Max. 2.0 V (with a cable length of 5 m) | | |
| | Leakage current | | Max. 1 mA *11 | | |
| | Max. capacitive load | | 2.2 µF (with a load resistance of 100Ω) | | |
| | Load wiring resistance | | Max. 2.5Ω | | |
| Input | PNP | | ON-voltage: 10 to 30 V | | |
| | | | OFF-voltage: Open or 0 to 3 V | | |
| | | | Short-circuit current: Approx. 2.5 mA (Approx. 10 mA for EDM) | | |
| | NPN | | ON-voltage: 0 to 3 V | | |
| | | | OFF-voltage: Open or 10 V to Power voltage | | |
| | | | Short-circuit current: Approx. 2.5 mA (Approx. 10 mA for EDM) | | |
| Non safety related output (AUX output) | Output type | | Transistor outputs. (NPN or PNP is selected by the dedicated PC software) | | |
| | Number of outputs | | 6 outputs | 4 outputs | 4 outputs |
| | Max. load current | | Max. 50 mA | | |
| | Residual voltage (during ON) | | Max. 2.5 V (with a cable length of 5 m) | | |
| | Muting lamp | | Incandescent lamp (24 VDC, 1 to 5.5 W) or LED lamp (load current :10 to 230 mA) can be connected | - | Incandescent lamp (24 VDC, 1 to 5.5 W) or LED lamp (load current :10 to 230 mA) can be connected |
| Interface | USB | | USB2.0 | | |
| | Ethernet | Standard | - | - | IEEE802.3u (100BASE-TX) |
| | | Transmission rate | - | - | 100Mbps |
| | | Cable | - | - | STP(Shielded Twisted Pair) cable or UTP(Unshielded Twisted Pair) cable. Category 5 or higher. |
| | | Connector | - | - | RJ45 (IP65) 2 ports |
| Network function | | | - | - | EtherNet/IP UDP |
| Environmental resistance | Enclosure protection | | IP65 (IEC60529) | | |
| | Operating ambient temperature | | -10 to +50 °C (No freezing) | | |
| | Storage ambient temperature | | -25 to +60 °C (No freezing) | | |
| | Operating relative humidity | | 35% to 85 %RH (No condensation) | | |
| | Storage relative humidity | | 35 % to 95 % RH | | |
| | Surrounding light | | incandescent lamp: 1500 lx or less *12 | | |
| | Vibration | | 10 to 55 Hz, 0.7 mm compound amplitude, 20 sweeps each in X, Y, and Z directions | | |
| | Shock | | 100 m/s2 (Approx. 10 G) 16 ms pulse, in X, Y, Z directions 1,000 times each axis | | |
| Material | Scanner head | Main unit case | Magnesium | | |
| | | Window | Polycarbonate, PEI | | |
| | | Indicator part | Aluminum, PES | | |
| | Display unit | case | Magnesium, PPS, Polycarbonate | | |
| | System memory | case | Aluminum, PPE | | |
| Cable length | Power and I/O cable | | 30m or less *13 | | |
| | Between scanner head and display unit | | 20m or less *14 | | |
| | Ethernet cable | | - | - | 100m or less *15 |
| Approved standards | EMC | EMS | IEC61496-1, EN61496-1, UL61496-1 (Type 3 ESPE) | | |
| | | EMI | EN55011 ClassA, FCC Part15B ClassA, ICES-003 ClassA | | |
| | Safety | | IEC61496-1, EN61496-1, UL61496-1 (Type 3 ESPE) IEC61496-3, EN61496-3 (Type 3 AOPDDR) IEC61508, EN61508, IEC62061, EN62061 (SIL2 / SILCL2) EN ISO13849-1 : 2015 (PLd, Category3) UL508, UL1998 CSA C22.2 No.14, CSA C22.2 No.0.8 | | |

*1 If the object to be detected moves perpendicular to the detection plane, SZ-V cannot detect the object moving at speed over 1.6m/s, regardless of the encoder setting.
*2 When using the SZ-V with series connected scanner heads, the first scanner head is scan cycle A, the second scanner head is scan cycle B, and the third scanner head is scan cycle C.
*3 The response time, protection zone, and warning zone is determined by the operation mode.
*4 20% or more reflectance is necessary for the minimum detectable object in the warning zone.
*5 If there is a highly reflective background within 1.5 m from the boundary of the protection zone, 200 mm must be added as supplementary necessary distance to the protection zone when calculating the safety distance.
*6 Even when using the network data output, the maximum measured output distance is 60 m.
*7 Only applicable for a type with a camera.
*8 The laser classification for FDA (CDRH) is implemented based on IEC60825-1 in accordance with the requirements of Laser Notice No.50.
*9 When using the SZ-V with series connected scanner heads, it is necessary to add 9.4W per scanner head. Also, power consumption may temporarily be higher (maximum 3.6W). Power consumption will be within the specification after SZ-V moves to normal operation.
*10 For the SZ-V04 type and the SZ-V32 type, the load current calculation of the OSSD output and AUX output is 1.5 A or less when using one scanner head, 1.0 A or less when using two scanner heads, and 0.5 A or less when using three scanner heads. For the SZ-V32N type, the load current calculation of the OSSD output and AUX output is 1.2 A or less when using one scanner head, 0.8 A or less when using two scanner heads, and 0.3 A or less when using three scanner heads.
*11 Includes when the power is OFF.
*12 An ambient light source should not be located within ±5° of the detection plane.
*13 10 m or less when supplying power from a battery.
*14 When supplying power from a battery, the length of each connection cable should be 10 m or less when using two scanner heads, and 5 m or less when using three scanner heads.
*15 Distance between SZ-V and Ethernet switch

# IEC61508-related parameters

| T1 (proof test interval) | 20 years |
|---|---|
| Hardware fault tolerance | 1 |
| Type of element | B |
| Malfunction response time | Within the response time |
| Safe state | OSSD OFF state |

## ■ PFH$_D$ (dangerous failure rate per hour)

No. of scanner heads: When there is 1 scanner head

| Display unit model | OSSD1/2 | OSSD3/4 |
|---|---|---|
| SZ-VU04 | 7.98×10$^{-9}$ | 7.98×10$^{-9}$ |
| SZ-VU32 | 8.02×10$^{-9}$ | |
| SZ-VU32N | 8.02×10$^{-9}$ | |

For PFH$_D$ with 2 or more scanner heads, see the "SZ-V Series User's Manual".
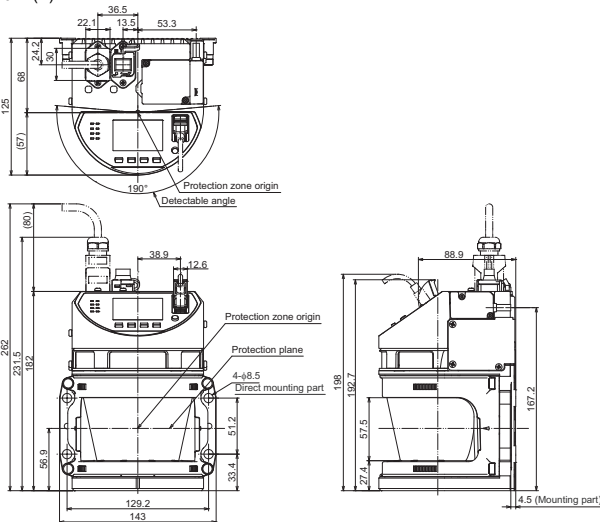
# EtherNet/IP$^{TM}$ Specifications

| Compatible functions | Cyclic communication |
|---|---|
| | Compatible with UCMM and Class 3 messaging (Explicit messaging) |
| Number of connections | 16 |
| RPI (Transmission cycle) | 0.5 to 10,000ms (0.5ms unit) |
| Tolerable communication bandwidth for cyclic communication | 3,000pps |
| Conformance Test | Conform to CT12 |

# Dimensions

SZ-V04(X) / SZ-V32(X)
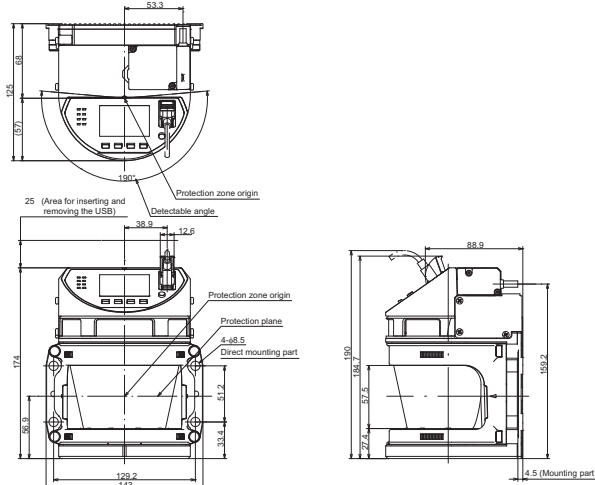


SZ-V32N(X)



# Troubleshooting

The following table shows the messages on the display unit's display, the state of the SZ-V, and an explanation.

## ■ Display during normal operation

| Display state | Details | Countermeasures |
|---|---|---|
| Normal Operation | The SZ-V is under normal operation. The OSSD is ON. | None. |
| | The SZ-V is under normal operation. The OSSD is ON. The bank switching function is used and Bank 1 to 31 is selected. | |
| | The SZ-V is under normal operation. Scanner head 1 protection zone is in detection state | None. If the OSSD goes to the OFF-state when nothing is present in the protection zone, see "Troubleshooting the OSSD operation" |
| | The SZ-V is under normal operation. Scanner head 2 protection zone is in detection state | |
| | The SZ-V is under normal operation. Scanner head 3 protection zone is in detection state | |
| Normal Operation ON Delay | The on-delay function is operating, OSSD is OFF. | "ON-delay" |
| Interlock | The interlock function is operating, OSSD is OFF. The SZ-V has detected a person or an object in the protection zone. | Terminate the interlock function by returning the SZ-V to a state in which it does not detect an object in the protection zone, and then perform reset operation using the reset input. "Terminating the interlock state" |
| Interlock Reset Ready | The interlock function is operating, OSSD is OFF. Perform the reset operation to restart | Terminate the interlock function by performing the reset operation using reset input. |

| | the SZ-V because the conditions for disabling the interlock are met. | "Terminating the interlock state" |
|---|---|---|
| Interlock Reset Ready 1/2 | The interlock function is operating, OSSD 1/2 is OFF. Engage reset input 1/2 to restart the SZ-V because the conditions for terminating the interlock are met. | |
| Interlock Reset Ready 3/4 | The interlock function is operating, OSSD 3/4 is OFF. Engage reset input 3/4 to restart the SZ-V because the conditions for terminating the interlock are met. | |
| Normal Operation Laser Shutdown | The laser shutdown bank is selected. | Switch to a bank other than the laser shutdown bank. |
| | Laser off input is ON. | "Operation Check Function" For details, see the "SZ-V Series User's Manual". |
| Ref. Point Undetected | One of the scanner heads does not detect a reference point(s), OSSD is OFF. | Ensure that the scanner head detects the reference points. "Reference Points Monitoring Function" |
| Muting | Muted condition. The safety function has been temporarily disabled and OSSD is ON. | "Muting function" |
| Override | Override condition. The safety function has been temporarily disabled and OSSD is ON. | "Override function" |
| Waiting for Bank Input | Waiting for bank input state. A bank has not been selected, OSSD is OFF. | Check that the bank input is correct. "Bank Switching Function" |
| History Saving | The detection history is being saved. The next detection history will not be saved until saving of the detection history is complete. | The SZ-V returns to the Normal Operation screen once the detection history has been saved. Videos take about 30 seconds to save. |
| History Saving Suspended | In preparation of saving the detection history. The next detection history will not be saved until preparation is done. | The SZ-V returns to the Normal Operation screen once the preparation is done. |
| PC Connection | The SZ-V is under normal operation. Communicating with SZ Configurator. | If the connection with SZ Configurator is terminated, the SZ-V returns to the Normal Operation screen. |
| | Operations, such as transferring settings from the SZ Configurator are being performed. OSSD is fixed to OFF. | Once the operations from the SZ Configurator are complete and the connection is terminated, the SZ-V returns to the Normal Operation screen. |

## ■ Display during alert state

| Display state | Details | Countermeasures |
|---|---|---|
| AUX Over Current | Alert: AUX Overcurrent The SZ-V detects an overcurrent on the AUX output. The AUX output enters the OFF-state after the SZ-V detects this alert. (The check pulse is intermittently output.) The OSSD continues normal operation. | Check the wiring between the AUX outputs and the loads, and whether the loads are broken or not. Also check the current on AUX outputs. "Specifications" |
| Conflict IP Address | Alert: IP address duplication The SZ-V IP address is duplicated by another device. | Reconfigure the IP address. For details, see the "SZ-V Series User's Manual". |
| Window Pollution (Head1) | Window alert The window of scanner head 1 may be polluted or damaged. | The OSSD may go to the OFF-state if the situation is left as it is. Clean the window in accordance with "Cleaning the Window" |
| Window Pollution (Head 2) | Window alert The window of scanner head 2 may be polluted or damaged. | |
| Window Pollution (Head 3) | Window alert The window of scanner head 3 may be polluted or damaged. | |
| Light Interference (Head1) | Light interference alert Scanner head 1 is experiencing light interference, such as from an incandescent lamp, fluorescent lamp, stroboscopic light, or photoelectric sensor. There may also be mutual interference between SZ-Vs. | While the SZ-V is operating normally, the OSSD may go to the OFF-state unintentionally. Take countermeasures in accordance with "Light interference" and "Mutual Interference". |
| Light Interference (Head 2) | Light interference alert Scanner head 2 experiencing light interference, such as from an incandescent lamp, fluorescent lamp, stroboscopic light, or photoelectric sensor. There may also be mutual interference between SZ-Vs. | |
| Light Interference (Head 3) | Light interference alert Scanner head 3 experiencing light interference, such as from an incandescent lamp, fluorescent lamp, stroboscopic light, or photoelectric sensor. There may also be mutual interference between SZ-Vs. | |
| High Reflection (Head 1) | Alert: Highly-reflective background There is a highly-reflective background behind the specified protection zone of scanner head 1, which may impact the detection capability. | Highly reflective backgrounds must not be positioned within 1.5 m from the boundary of the protection zone. (The background itself must be removed or the reflectance must be reduced). Unless the above-mentioned countermeasures are taken, 200 mm must be added as supplementary necessary distance to the protection zone during the calculation of the safety distance. "Highly reflective background" |
| High Reflection (Head 2) | Alert: Highly-reflective background There is a highly-reflective background behind the specified protection zone of scanner head 2, which may impact the detection capability. | |
| High Reflection (Head 3) | Alert: Highly-reflective background There is a highly- reflective background behind the specified protection zone of scanner head 3, which may impact the detection capability. | |
| Muting lamp open | Muting Lamp Alert (Disconnection) There is a problem where the muting lamp is connected to the muting lamp output. (The muting lamp is disconnected or it is broken.) | Please check the following: • If the muting lamp output is correctly connected to the muting lamp • If the muting lamp is broken • If the rating/specification of the |

| | | |
|---|---|---|
| Muting lamp Over current | Muting Lamp Alert (Overcurrent) The muting lamp connected to the muting lamp output has an overcurrent exceeding the rated current. | muting lamp is within the range of the muting lamp output |
| Camera (Head 1) | Camera error An error has occurred with the camera area of scanner head 1. | Turn the power of the SZ-V off and then on again. If turning the power back on does not resolve the error, replace the scanner head. |
| Camera (Head 2) | Camera error An error has occurred with the camera area of scanner head 2. | |
| Camera (Head 3) | Camera error An error has occurred with the camera area of scanner head 3. | |
| History Store | Detection History Error The detection history cannot be retrieved correctly. | Transfer the settings again. If that does not resolve the error, replace the display unit. |
| History Store (Head1) | Detection history error The detection history for scanner head 1 cannot be retrieved correctly. | Transfer the settings again. If that does not resolve the error, replace the scanner head. |
| History Store (Head 2) | Detection history error The detection history for scanner head 2 cannot be retrieved correctly. | |
| History Store (Head 3) | Detection history error The detection history for scanner head 3 cannot be retrieved correctly. | |

## ■ Display during an error state

| Display state | Details | Countermeasures |
|---|---|---|
| Window Error (Head1) | • The window of scanner head 1 may be polluted or scratched. • The window of scanner head 1 may be broken. | Clean the window in accordance with "Cleaning the Window". If the error continues after cleaning, replace the window in accordance with " Replacing the Window. |
| Window Error (Head 2) | • The window of scanner head 2 may be polluted or scratched. • The window of scanner head 2 may be broken. | |
| Window Error (Head 3) | • The window of scanner head 3 may be polluted or scratched. • The window of scanner head 3 may be broken. | |
| MI Error (Head 1) | MI error (man-made interference error) • A structure with extremely low reflectance is located close to the SZ-V. • The SZ-V does not detect any diffuse reflection from the object to be detected or the structure outside the protection zone. The SZ-V generates an error if it does not detect anything over 60 degrees. | • Remove the structure with low reflectance close to the SZ-V. • Position a structure outside the protection zone so that the SZ-V detects diffuse reflection from the structure. |
| MI Error (Head 2) | | |
| MI Error (Head 3) | | |
| OSSD 1 Error | OSSD error • The OSSD is short-circuited. Alternatively, the wiring is wrong. • The OSSD experienced a surge in voltage due to an inductive load. • The OSSD is being affected by an EMC environment. • The OSSD is broken. | • Check the wiring for the OSSD. "Examples of wiring" • Use a load with a surge absorber function, or apply surge protection to the load. • Check the surrounding wiring and EMC environment. • Replace the display unit. |
| OSSD 2 Error | | |
| OSSD 3 Error | | |
| OSSD 4 Error | | |
| OSSD 1 Overcurrent Error | OSSD 1 Overcurrent Error Overcurrent occurs on OSSD 1. | Check the wiring between OSSD 1 and the load, and whether the load is broken or not. "Examples of wiring" |
| OSSD 2 Overcurrent Error | OSSD 2 Overcurrent Error Overcurrent occurs on OSSD 2. | Check the wiring between OSSD 2 and the load, and whether the load is broken or not. "Examples of wiring" |
| OSSD 3 Overcurrent Error | OSSD 3 Overcurrent Error Overcurrent occurs on OSSD 3. | Check the wiring between OSSD 3 and the load, and whether the load is broken or not. "Examples of wiring" |
| OSSD 4 Overcurrent Error | OSSD 4 Overcurrent Error Overcurrent occurs on OSSD 4. | Check the wiring between OSSD 4 and the load, and whether the load is broken or not. "Examples of wiring" |
| Output Over Current Error | Output Over Current Error (in total) Total amount of current on each output exceeds the specification. | Check the wiring between each output and the load, and whether the load is broken or not. "Wiring" Check if the total amount of current is within the specification. "Specifications" |
| Muting Lamp Open Error | Muting Lamp Error (Disconnection) There is a problem where the muting lamp is connected to the muting lamp output. (The muting lamp is disconnected or it is broken.) | Please check the following: • If the muting lamp output is correctly connected to the muting lamp • If the muting lamp is broken • If the rating/specification of the muting lamp is within the range of the muting lamp output. |
| Muting Lamp Over Current Error | Muting Lamp Error (Overcurrent) The muting lamp connected to the muting lamp output has an overcurrent exceeding the rated current. | |
| EDM (OSSD 1/2) Error | EDM error • EDM input is not connected to the external device correctly. • The external device connected to the OSSD is broken. | • Check the EDM input wiring. "EDM Function", "Examples of wiring" • Check the external device and replace if it is broken. |
| EDM (OSSD 3/4) Error | | |
| BANK Input Error | Bank Input Error • The signal combination of bank inputs does not meet the specification. • The bank switching was not performed during the specified bank transition time. | • Check the wiring of the bank inputs. • Confirm that bank switching is performed during the specified bank transition time. |
| BANK Sequence Error | Bank Sequence Error The bank switching was not performed according to the specified bank sequence. | Check the bank sequence and the configuration of bank sequence monitoring. "Bank Sequence Monitoring Function" |
| Encoder Velocity Error | Encoder velocity error The encoder velocity exceeds the set velocity range. | Ensure that the encoder velocity does not exceed the velocity range. |
| Encoder Pulse Frequency Error (Ch.1) | Encoder Pulse Frequency Error (Ch.1) The input of Encoder Input 1 exceeds the maximum pulse frequency (100 kHz). | Ensure that the output from the encoder does not exceed the maximum pulse frequency. |

| Display state | Details | Countermeasures |
|---|---|---|
| Encoder Pulse Frequency Error (Ch.2) | Encoder Pulse Frequency Error (Ch.2) The input of Encoder Input 2 exceeds the maximum pulse frequency (100 kHz). | |
| Encoder Ch.1/Ch.2 Error | Encoder Mismatch Error • The difference in velocity between the two encoders exceeds the specified tolerance. • Two encoders are rotating in opposite direction. • The wiring for the encoder input is not correct. | • Ensure that the difference in velocity between the two encoders does not exceed the tolerance range. • Make two encoders rotate in the same direction. • Check the encoder input wiring. "Examples of wiring" |
| Encoder Connection Error (Ch.1) | Encoder Input Error (Ch.1) Wiring of encoder input 1 is incorrect. | Check the encoder input wiring. "Examples of wiring" |
| Encoder Connection Error (Ch.2) | Encoder Input Error (Ch.2) Wiring of encoder input 2 is incorrect. | |
| Head Communication Error | Communication Error • The connection cable is not correctly connected or the wires are damaged. • The connected cable is being affected by an EMC environment. • The power voltage is temporarily or continuously falling. | • Check the cable connection. • Check the wiring and the surrounding EMC environment. • Replace the power source, increase the power capacity, or prepare a SZ-V-dedicated power source. |
| Incorrect Wiring (input2) Error | Unused Wiring Error (Input 2) Input 2 is set as unused but is not in an open circuit. | If Input 2 is set to unused, make an open circuit on Input 2 with insulation. |
| Incorrect Wiring (input6) Error | Unused Wiring Error (Input 6) Input 6 is set as unused but is not in an open circuit. | If Input 6 is set to unused, make an open circuit on Input 6 with insulation. |
| System Memory Error (Type) | Configuration Error (Type) The display unit type does not match the settings in the system memory. | Check the display unit type. |
| System Memory Error (Head) | Configuration Error (Head) The number of scanner heads does not match the settings in the system memory. | Check the number of scanner heads. |
| System Memory Error (Data) | System Memory Error (Data) • The system memory data is not correct or is corrupt. • The system memory data cannot be retrieved. | • Transfer the data to the system memory again. • Check the wiring and the surrounding EMC environment. |
| System Config. Error (Display unit) | System Configuration Error (Display unit) The Display unit is paired to another system memory. | Transfer new settings from the SZ Configurator again, or delete the system configuration information. For details of clearing system configuration information, see the "SZ-V Series User's Manual". |
| System Config. Error (Head1) | System Configuration Error (Head 1) Scanner head 1 is paired to another system memory. | |
| System Config. Error (Head2) | System Configuration Error (Head 2) Scanner head 2 is paired to another system memory. | |
| System Config. Error (Head3) | System Configuration Error (Head 3) Scanner head 3 is paired to another system memory. | |
| Window Calibration Error (Head1) | Window Calibration Error • Window calibration did not execute correctly. • The SZ-V is broken. | • Execute window calibration again. For details of window calibration, see the "SZ-V Series User's Manual". • Replace the SZ-V. |
| Window Calibration Error (Head2) | | |
| Window Calibration Error (Head3) | | |
| System Error | System Error • The SZ-V is being affected by an EMC environment. • The SZ-V has experienced strong vibration or shock. • The power was disconnected during configuration. • The SZ-V is broken. | • Check the wiring and the surrounding EMC environment. • Install the SZ-V so as not to have the vibration and/or shock exceeding the specification. • Perform the configuration again. • Replace the SZ-V. |

## ■ Other states

| Display state | Details | Countermeasures |
|---|---|---|
| (Nothing is displayed) | The power is OFF or the voltage is insufficient. | Ensure that the voltage is within the rated range. Check the wiring. "Examples of wiring" |
| | The SZ-V is in "Power Saving Mode". | Turn power saving mode off. |
| | The SZ-V may be broken. | Replace the Display unit. |
| SZ-V Series Start Up | This is the start screen displayed after the power is turned on. | In approximately 8 seconds, the screen will transition to normal operation. |
| Waiting for Configuration | • The SZ-V is not configured. • The settings are not approved yet. | • Transfer the settings. • Approve the settings. |

## ■ Troubleshooting the OSSD operation

| Situation | Details | Countermeasures |
|---|---|---|
| The OSSD goes to the OFF-state when nothing is present in the protection zone. | Light interference may be occurring. | Take countermeasures according to the description in "Light interference" Check the status of light interference through the SZ-V Configurator. |
| | Mutual interference due to another SZ-V may be occurring. | Take countermeasures according to the description in "Mutual Interference". |
| | The SZ-V may detect the floor or the surrounding (background) because the SZ-V is installed with some inclination. | Adjust the SZ-V installation angle and position it so that the SZ-V does not detect the floor or the surroundings (background). |
| | The background is close to the boundary of the specified protection zone. | The SZ-V detects the surroundings (background). Move it away from the specified protection zone. |

| | If the surroundings are highly reflective backgrounds, take into account the additional safety distance. |
|---|---|
| The position of the SZ-V or the surroundings (background) has been changed. | Restore the position of the SZ-V or the surroundings (background). Perform the configuration on the protection zone again. |
| The structure for the reference points is not present or is not located within the specified tolerance. | Check the position of the structure on the reference points and the tolerance. Change the configuration on the reference points, if necessary. |
| Laser shutdown function is activated. | Either turn OFF the laser OFF input, or switch to a different bank from laser shutdown bank. |
| The SZ-V has pollution on the window. | Clean the window according to "Cleaning the Window" |
| The SZ-V detects particles in the air, such as dust, spatter or moisture. | Take countermeasures so that the particles in the air do not go into the protection zone. |

## ■ Troubleshooting Concerning Connection with the SZ-V Configurator

| Situation | Details | Countermeasure |
|---|---|---|
| Cannot communicate with the SZ-V. (Cannot log-in.) | The power is not supplied to the SZ. | Supply power to the SZ. |
| | For a USB connection | |
| | The USB cable is not connected to the SZ-V, or is disconnected. | Check the USB cable and USB port on the computer. |
| | The USB driver is not installed on the computer. | Double-click the "DPInst" file to execute it. Installation of the USB driver starts. The "DPInst" file is in the folder where the SZ-V Configurator is installed. (C:\Program Files\KEYENCE\SZ-V Configurator\Driver\) |
| | In cases where NPN is selected in PNP/NPN Select, the SZ-V with positive grounding is connected to the PC with negative grounding is connected through a USB cable. | Before connecting the SZ-V and computer with a USB cable, either the SZ-V or the computer should not be grounded. The brown wire needs to be grounded in order to start normal operation. |
| | For Ethernet connection (for the SZ-V32N type only) | |
| | The Ethernet cable is not connected to the SZ-V, or is disconnected. | Check the Ethernet cable and the Ethernet port on the computer. |
| | The SZ-V network is not correctly configured. | Check the SZ-V network settings. |
| | Which SZ-V to communicate with is not selected. | Select the SZ-V to communicate with through the SZ-V Configurator. |
| Cannot transfer the configuration. | The model specified in the SZ-V Configurator mismatches the actual SZ-V model. | Check the SZ-V model in "Properties" on the Settings tab. If the SZ-V model does not match, create new settings. |
| | Configured number of scanner heads is different from the actually connected number of scanner heads. | Check the number of connected scanner heads. |
| | All configurations are not completed. | Check that all settings have been configured |
| | The specified protection zone or warning zone is configured beyond the specification. | Check the configuration of the protection zone, warning zone, and minimum detectable object size. |
| | You do not have the authorization level to transfer settings. | If transferring settings that have not been approved, log in as the responsible personnel. If transferring settings that have been approved, log in as the responsible personnel or maintenance personnel. |
| | The power is not supplied to the SZ-V. | Supply power to the SZ-V. |
| Cannot perform the monitoring on the SZ-V. | The settings in the software do not match the settings in the SZ-V. | Match the settings between the SZ-V Configurator and the SZ-V before starting monitoring. Run the settings on the SZ-V Configurator and to monitor the SZ-V operation, transfer the settings to the SZ-V. On the other hand, retrieve the configuration in the SZ-V to monitor the SZ-V operation according to the current configuration in the SZ-V. In this case, all settings in the SZ-V Configurator are deleted. Save the file as required. |
| | The configuration is not completed. | Start monitoring after transferring the configuration to the SZ-V. |

# Inspection and Maintenance

## ■ Precaution During Inspection

| ⚠ DANGER | • Do not use the machine on which the SZ-V is installed if the SZ-V does not operate according to any of the inspection items as listed below. |
|---|---|

Performance of maintenance and inspections are critical factors that you must take into account in your risk assessment. When you perform the risk assessment on your machine application, you must take performance of maintenance and inspections into account.
In addition, it is a responsibility for the responsible personnel to train the machine operators regarding inspection and maintenance of the machine and the SZ-V.
When you mount the SZ-V onto a device, perform the following inspection.
Note that the following inspection items comprise only a bare minimum inspection. KEYENCE Corporation strongly recommends including the necessary checking items into this checklist based on the judgment of the responsible personnel since additional criteria may be necessary depending on both the machine to which the SZ-V is installed and the laws, rules, regulations and standards in the country or region in which the SZ-V is used/installed.
You must keep the inspection result along with the machine log.

## ■ Initial inspection

When the installation of the SZ-V is completed, the responsible personnel must verify the operation of the SZ-V in accordance with the checklist shown below.

(1) Pre-check for installation conditions
• The SZ-V is installed without loose fixture screws, in accordance with the specification of tightening torque in this manual.
• The machine under SZ-V control can stop running when the OSSD is in the OFF-state.
• The SZ-V is installed so that the machine operator cannot go into or approach the hazardous area or hazards without passing through the protection zone of the SZ-V.
• The SZ-V is installed so that the machine operator cannot go into or approach the hazardous area or hazards without passing through any of the protection zone of the SZ-V belonging to the bank switching function.
• The interlock reset mechanism is installed so that it cannot be operated if there are any personnel within the hazardous area.
• The device to activate the override is installed so that it cannot be operated if there are any personnel within the hazardous area.
• Safety distance is ensured, which has been calculated according to the laws, regulations, and standards of the country and region in which the SZ-V is installed. "Safety Distances"
• The SZ-V is installed at a location free from light interference, for example an incandescent lamp and a halogen lamp. "Tips on installation"
• When two or more SZ-V are installed nearby, the countermeasures against mutual interference are taken based on the description of "Tips on installation"
• The muting devices fulfill the conditions specified in this manual and the requirements of the laws, rules, regulations and standards in the country or region in which the SZ-V and those devices are used. "Muting function"
• The devices used to activate the override fulfill the conditions specified in this manual and the requirements of the laws, rules, regulations and standards in the country or region in which the SZ-V and those devices are used. "Override function"
• The reference points monitoring function is enabled for access protection. Additionally, two or more reference points are set on one structure so as to ensure the detection of its position change. "Reference Points Monitoring Function"

(2) Pre-check for wiring
• The SZ-V power supply is 24 V DC, fulfilling the conditions for the power supply as specified in this manual. "Power Supply"
• For the wiring between the SZ-V and a safety-related part of a machine control system, both OSSD 1 and OSSD 2 is wired to a safety-related part of a machine control system. Similarly, both OSSD 3 and OSSD 4 is also wired to a safety-related part of a machine control system if you assign a function for OSSD 3/4.
• The polarity of the power supply is not reversed.
• If you selected PNP for selection of PNP or NPN, the OSSD is +24 V and not short-circuited.
• If you selected PNP for selection of PNP or NPN, the load is connected between the OSSD and 0 V.
• If you selected NPN for selection of PNP or NPN, the OSSD is 0V and not short-circuited.
• If you selected NPN for selection of PNP or NPN, the load is connected between the OSSD and +24V.
• All of the AUX outputs are not used as a safety output for safety-related part of a control system.
• There is no damage to the cable insulation. Additionally, the protection against the disconnection or short-circuit of cable, which might be caused by crushing or being caught in a machine, is taken into account.
• Any non-safety related functions described in this manual should not be used as a safety related machine control.

(3) Pre-check test while the machine is stopped
You should do the following pre-check test with the test piece in order to make sure the operation of the SZ-V while the machine is stopped. In this case, you should supply the power only to the SZ-V.
The test piece should match the minimum detectable object size you chose.

• The OSSD indicator lights in red when the test piece is present in the specified protection zone. This test must be performed for the whole specified protection zone. If the bank switching function is applied to the SZ-V, this test must be performed for the whole and every specified protection zone. If the muting function is applied to a part of the protection zone, this test must be performed during muted condition for the whole specified protection zone, except for muting zone.
• The OSSD indicator lights in red when the SZ-V detects the test piece at the intended detection plane (height) while the test piece vertical to the detection plane moves in the protection zone. This test must be performed for the whole specified protection zone.
• The OSSD indicator lights in red due to an error caused by the open-circuit of the EDM input while the test piece is present in the protection zone. This is only applicable if the EDM function is applied.
• The OSSD indicator lights in green when the SZ-V starts normal operation after power on (when "SZ-V Start Up" is changed to "Normal Operation" on the information display) and

detects no object in the protection zone with "Automatic/Automatic" for the configuration of start/restart mode.
- The OSSD indicator continues to light in red and the interlock indicator lights in yellow, when the SZ-V starts normal operation after power on (when "SZ-V Start Up" is changed to "Normal Operation" on the information display) with either "Manual/Manual" or "Manual/Automatic" for the configuration of start/restart mode. Continuously, the OSSD indicator lights in green and the interlock indicator lights off in the event of reset operation, if the SZ-V detects no object in the protection zone at that time.
- The OSSD indicator lights in red and the interlock indicator lights in yellow when the SZ-V detects the test piece in the protection zone with "Manual/Manual" for the configuration of start/restart mode. Continuously, the OSSD indicator continues to light in red and the interlock indicator flashes in yellow when the test piece is removed from the protection zone.
- The OSSD indicator lights in green after the specified delay time has been passed if the ON-delay function is applied to the SZ-V.
- The SZ-V does not go to the muted condition even if the muting inputs are activated in accordance with the specified sequence and time difference, when the SZ-V detects an object in the protection zone other than muting zone. This is only applicable if the muting function is applied.
- The SZ-V does not go to the muted condition if the muting inputs are activated with different sequence from the specified one. The SZ-V does not also go to the muted condition if the muting inputs are activated exceeding the specified time difference. These are only applicable if the muting function is applied.
- The muted condition is terminated if the specified muting period of time has been passed. This is only applicable if the muting function is applied.
- The override condition is terminated if the specified override period of time has been passed. This is only applicable if the override function is applied.
- The protection zone can be switched according to the signal combination of bank inputs in case of bank switching function.
- "Bank sequence error" occurs if the protection zone is switched according to the unspecified sequence. This is only applicable if the bank sequence monitoring function is applied.
- If there is an unprotected space between the protection zone and the protective structure, test piece is always detected by the SZ-V when it goes through that space. This is only applicable if the SZ-V is used for the access protection (the application where the angle of the approach exceeds ±30° to the detection plane).
- The OSSD indicator lights in red when the protective structure moves exceeding the tolerance of reference point. This is only applicable if the SZ-V is used for the access protection (the application where the angle of the approach exceeds ±30° to the detection plane).

(4) Pre-check test while the machine operates
The purpose of this pre-check test is to make sure that the machine (hazards) stops its operation. This test must be performed after you ensure that there is nobody in the hazardous zone.

- Machine (hazard) stops its operation if the test piece is present in the specified protection zone. If the bank switching function is applied to the SZ-V, this test must be performed for the specified protection zone for each bank.
- The machine (hazard) still stops its operation as long as the test piece is present in the specified protection zone. If the bank switching function is applied to the SZ-V, this test must be performed for the specified protection zone for each bank.
- The machine (hazard) stops its operation when the power for the SZ-V is disconnected.
- The machine (hazard) stops its operation when the interlock indicator lights in yellow.
- The response time for overall safety-related control system (from the intrusion of test piece in the protection zone to the machine stop) is less than overall response time (T) used for the calculation of safety distance.

## ■ Daily inspection
The daily inspection for the SZ-V operation and the machine operation should be performed based on the following check items.

(1) Pre-check for installation conditions
- The SZ-V is installed so that the machine operator cannot go into or approach the hazardous area or hazards without passing through the protection zone of the SZ-V.
- The SZ-V is installed so that the machine operator cannot go into or approach the hazardous area or hazards without passing through any of the protection zone of the SZ-V belonging to the bank switching function.
- The SZ-V is installed at a location free from light interference, for example an incandescent lamp and a halogen lamp.
- There is no damage to the cable insulation. Additionally, the protection against the disconnection or short-circuit of cable, which might be caused by crushing or being caught in a machine, is taken into account.

(2) Pre-check test while the machine is stopped
You should do the following pre-check test with the test piece in order to make sure the operation of the SZ-V while the machine is stopped. In this case, you should supply the power only to the SZ-V.
The test piece should match the minimum detectable object size you chose.

- The OSSD indicator lights in red when the test piece is present in the specified protection zone. This test must be performed for the whole specified protection zone. If the bank switching function is applied to the SZ-V, this test must be performed for the whole and every specified protection zone. If the muting function is applied to a part of the protection zone, this test must be performed during muted condition for the whole specified protection zone, except for muting zone.
- The OSSD indicator lights in red when the SZ-V detects the test piece at the intended detection plane (height) while the test piece vertical to the detection plane moves in the protection zone. This test must be performed for the whole specified protection zone.
- The OSSD indicator lights in green when the SZ-V starts normal operation after power on (when "SZ-V Start Up" is changed to "Normal Operation" on the information display) and detects no object in the protection zone with "Automatic/Automatic" for the configuration of start/restart mode.
- The OSSD indicator continues to light in red and the interlock indicator lights in yellow, when the SZ-V starts normal operation after power on (when "SZ-V Start Up" is changed to "Normal Operation" on the information display) with either "Manual/Manual" or "Manual/Automatic" for the configuration of start/restart mode. Continuously, the OSSD

indicator lights in green and the interlock indicator lights off in the event of reset operation, if the SZ-V detects no object in the protection zone at that time.
- The OSSD indicator lights in red and the interlock indicator lights in yellow when the SZ-V detects the test piece in the protection zone with "Manual/Manual" for the configuration of start/restart mode. Continuously, the OSSD indicator continues to light in red and the interlock indicator lights off when the test piece is removed from the protection zone.
- The OSSD indicator lights in green after the specified delay time has been passed if the ON-delay function is applied to the SZ-V.
- The SZ-V does not go to the muted condition even if the muting inputs are activated in accordance with the specified sequence and time difference, when the SZ-V detects an object in the protection zone other than muting zone. This is only applicable if the muting function is applied.
- The SZ-V does not go to the muted condition if the muting inputs are activated with different sequence from the specified one. The SZ-V does not also go to the muted condition if the muting inputs are activated exceeding the specified time difference. These are only applicable if the muting function is applied.
- The protection zone can be switched according to the signal combination of bank inputs in case of bank switching function.
- If there is an unprotected space between the protection zone and the protective structure, test piece is always detected by the SZ-V when it goes through that space. This is only applicable if the SZ-V is used for the access protection (the application where the angle of the approach exceeds ±30° to the detection plane).
- The OSSD indicator lights in red when the protective structure moves exceeding the tolerance of reference point. This is only applicable if the SZ-V is used for the access protection (the application where the angle of the approach exceeds ±30° to the detection plane).

(3) Pre-check test while the machine operates
The purpose of this pre-check test is to make sure that the machine (hazards) stops its operation. This test must be performed after you ensure that there is nobody in the hazardous zone.

- Machine (hazard) stops its operation if the test piece is present in the specified protection zone. If the bank switching function is applied to the SZ-V, this test must be performed for the specified protection zone for each bank.
- The machine (hazard) still stops its operation as long as the test piece is present in the specified protection zone. If the bank switching function is applied to the SZ-V, this test must be performed for the specified protection zone for each bank.
- The machine (hazard) stops its operation when the power for the SZ-V is disconnected.
- The machine (hazard) stops its operation when the interlock indicator lights in yellow.
- The response time for overall safety-related control system (from the intrusion of test piece in the protection zone to the machine stop) is less than overall response time (T) used for the calculation of safety distance.

## ■ Regular (Periodical) inspection
The responsible personnel must perform a regular inspection at least once every six months. Additionally, you should perform the regular inspection if you make any change to the configuration on the SZ-V and on the machine on which the SZ-V is installed.
Regular (periodical) inspection items include the following, in addition to "Daily inspection".

(1) Additional inspection items
- The SZ-V is installed without losing the screws for fixture, in accordance with the specification of tightening torque in this manual.
- The screw on the connector cable is fastened tightly to the SZ-V.
- The SZ-V does not have any change on its position. (Safety distance is ensured. The detection plane has also not changed.)
- All wires are correctly connected to external device, and the connection is securely performed.
- There is sufficient life left in terms of how many times the safety relay has been opened and closed.
- There is no damage to the SZ-V that may impair the performance of its protective IP65 structure.
- The surface of the window is not dirty or damaged.
- The OSSD indicator lights in red due to an error caused by the open-circuit of the EDM input while the test piece is present in the protection zone. This is only applicable if the EDM function is applied.
- The muted condition is terminated if the specified muting period of time has been passed. This is only applicable if the muting function is applied.
- The override condition is terminated if the specified override period of time has been passed. This is only applicable if the override function is applied.
- "Bank sequence error" occurs if the protection zone is switched according to the unspecified sequence. This is only applicable if the bank sequence monitoring function is applied.

## Cleaning the Window
The SZ-V window is a critical part of the detection system. Clean the window whenever there is dust or pollution on it.
Wipe off the pollution in the area indicated by the diagonal lines with a soft cloth moistened with a mild detergent that will not corrode polycarbonate.

| NOTICE | • OSSD might go to the OFF-state if the window has a scratch, because the SZ-V falsely detects that scratch as the object approaching into the protection zone. Be sure to not scratch the window during cleaning.<br>• Be careful of static electricity while cleaning due to the collection of dust. You should use a cloth that that does not easily generate static electricity when rubbed on polycarbonate. |
| --- | --- |

| Reference | • Detection capability might decrease due to the attenuation of light if the window has pollution. The OSSD goes to the OFF-state before the pollution on the window leads to loss of detection capability because the SZ-V has a function to monitor the pollution on the window. Furthermore, the OSSD might go to the OFF-state if the window has pollution because the SZ-V detects that pollution as an object approaching into the protection zone. Be sure to keep the window clean to avoid unnecessary OFF-state of OSSD. |
| --- | --- |

## Replacing the Window

The SZ-V window is a critical part of the detection system. If the window becomes extremely dirty or is scratched, replace it.
For the details of the replacement procedure, see the "SZ-V Series User's Manual".

| | |
|---|---|
| **⚠ DANGER** | • No person other than the responsible personnel or maintenance personnel is allowed to replace the SZ-V window.<br>• Always turn off the power to the SZ-V when replacing the window.<br>• After replacing the window, always perform window calibration. If you do no perform the window calibration, the SZ-V will not work properly.<br>• Perform window calibration in an environment with ambient temperature of 5 to 35 °C and with no dust or dirt on the window. |
| *NOTICE* | • Do not touch the lens part inside the window. If you touch the lens part inside of the housing, you may break the SZ-V. |
| ▶ Important | • Replace the window in an environment with no dust or dirt, and replace it as quickly as possible.<br>• Make sure that the replacement window is not dirty or scratched, and has never been used. Also be sure not to dirty or scratch the new window when you install it.<br>• When replacing the window, do not leave the SZ-V with the window removed.<br>• Make sure that dust or dirt does not enter the inside of the window.<br>• If you do not follow the procedure, you may lose the IP65 rating. |

## Replacing the Display unit

By using the system memory, the same settings can be maintained, even if replacing the Display unit. It is not necessary to transfer the settings from the SZ-V Configurator.
For details on the replacement procedure, see the "SZ-V Series User's Manual".

## Revision history

| Revision history | Edition number | Revision details |
|---|---|---|
| May 2016 | First edition | |
| July 2016 | First (a) edition | |

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