Complies with key safety standards

In Human Machine Interface (HMI) environment, ensuring the safety of operators and machines is given the top priority. Enabling switches, emergency stop switches, light curtains, and other safety products are used to provide safety, and the SafetyOne can monitor and evaluate the safety information from the safety products most effectively.

The SafetyOne satisfies the highest requirements of key safety standards, such as category 4 of EN 954-1, SIL3 of IEC 61508, and performance level e of EN ISO 13849-1. The new safety controller of innovative concept helps you implement applications without requiring any programming. All you need is to select one of the eight logic functions; operation starts simply by connecting safety inputs and output equipment.

The SafetyOne satisfies:
- EN954-1: Category 4
- IEC 61508: SIL3
- ISO 13849-1: Performance level e

The SafetyOne complies with:
- ISO
- IEC
- EN
- ANSI/RIA
- ANSI
- SEMI
- NFPA

Reduces overall cost

Replaces safety modules—simpler and easier wiring

One SafetyOne module can replace more than five safety relay modules (when configuring a partial or entire stop—Logic 7), reducing cost, wiring, and checking.

When using safety relay modules:
- Five safety relay modules
- Ten safety contactors

When using the SafetyOne:
- One SafetyOne
- Four safety contactors

Replaces programmable safety PLC and safety controller—simpler and easier configuring

Safety PLC or Safety Controller + Software (programs, function blocks) = SafetyOne

- Safety PLC
- Tools required for programming
- Creating and debugging a program
- Third-party certification for the program (time and cost)
- Simple design requiring DIP switch selection only
- No tools required
- No programming and debugging required
- No program certification required
The Next Generation Safety Controller (FS1A)

Easy-to-set safety controller requires no programming to configure safety circuits, and meets the highest requirements of key safety standards.

Downsizing

Various functions are packed within a compact safety controller.

Direct connection to various IDEC safety components
The Next Generation Safety Controller
Makes safety circuit configuration easier.

IDECA offers Easy circuit configuration by logic selection — no programming

- World’s first logic-selecting configuration. Eight safety circuit logics are provided.
- The best solution when the system has multiple points requiring complex I/Os, but the use of programmable controller is not desired.

IDECA offers High performance—partial stop/entire stop

- No programming required. Partial Stop—Entire stop is achieved by selecting a logic circuit. All you need is to wire the SafetyOne in the same manner as safety relay modules.
- The best solution when configuring a system without using a safety relay module, or a safety PLC.

IDECA offers Various safety inputs—mechanical contacts and electric components

- The SafetyOne can be connected to a variety of inputs such as emergency stop switches and light curtains.
- The best solution to eliminate the use of safety relay modules for each component.

IDECA offers Safety circuit monitoring—circuit diagnosis with monitor outputs

- Outputs safety I/O status and SafetyOne errors.
- The best solution for the control side to monitor which doors are open, and to see the error status of safety circuits.

IDECA offers Easy connection to interlock switches—solenoid drive output (Spring lock type)

- Solenoid drive output reduces the required I/O points of a PLC.
- The best solution to replace conventional PLCs to control interlock switches.
Compliant with international safety standards

<table>
<thead>
<tr>
<th>Applicable Standards</th>
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</thead>
<tbody>
<tr>
<td>ISO 13849-1, 10218-1</td>
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<tr>
<td>IEC 61508, 62061, 61496-1, 60204-1, 61131-2, 61000-6-2, 61000-6-4</td>
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<td>ANSI/RIA R15.06</td>
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<tr>
<td>UL 508, CSA C22.2 No. 142</td>
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<tr>
<td>ANSI B11.19</td>
</tr>
<tr>
<td>SEMI S2</td>
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<tr>
<td>NFPA 79</td>
</tr>
</tbody>
</table>

The **SafetyOne** satisfies the requirements of SIL3 (IEC 61508), performance level e (ISO 13849-1), and safety category 4 (EN 954-1).

### Muting function

Muting function for a light curtain is provided. Just connect the muting sensor input and the light curtain input to the **SafetyOne**. Relay box and terminals are not necessary. Muting lamp output can also be connected.

Note: When installing light curtains and muting sensors, ensure safety by referring to IEC TS 62046 technical documents.

### Multiple I/Os
- 14 safety inputs (6 for dual inputs)
- 4 safety outputs (2 for dual outputs)
- 2 start inputs
- 10 monitor outputs
- 2 solenoid/muting lamp outputs

### Connector wiring

- Easy connector wiring
- Can be used with:
  - Spring clamp connectors
  - Crimp connectors

### Easy-to-read LED indicators

Errors and I/O statuses can be read easily with digital and LED indicators.

### Off-delay outputs available

8-level selections within 0 to 30 sec.
# Easy circuit configuration by logic switches

A safety circuit for emergency stop switches and interlock switches.

| Logic 1 | General-purpose logic for various apparatus | Page 7 |

A safety circuit for interlock switches, non-contact interlock switches, and emergency stop switches.

| Logic 2 | General-purpose logic for NO/NC contact inputs | Page 8 |

A safety circuit for safety solid state output components such as light curtains, emergency stop switches, interlock switches, and laser scanners.

| Logic 3 | General-purpose logic for apparatus with openings | Page 9 |

A safety circuit for light curtains and muting function.

| Logic 4 | Muting function logic for apparatus with openings | Page 10 |

A safety circuit for two contacts with a long time lag.

| Logic 5 | General-purpose logic for devices for which sync time between contacts cannot be specified | Page 11 |

A safety circuit for mode selection of enabling switches, emergency stop switches, and interlock switches.

| Logic 6 | The logic applicable for selection of active safety input devices | Page 12, 13 |

A safety circuit for partial stop (interlock switches) and entire stop (emergency stop switches).

| Logic 7 | Partial stop 1 logic for various apparatus | Page 14, 15 |

A safety circuit for partial stop (interlock switch A) and entire stop (emergency stop switch or interlock switch B).

| Logic 8 | Partial stop 2 logic for various apparatus | Page 16 |
Logic 1 is used for safeguarding measures of machine tools and robots. It can be used with dual direct-opening components such as emergency stop switches and interlock switches. In this logic, when a safety component is operated, the SafetyOne shuts down the safety output immediately.

### During Operation

- The system is equipped with emergency stop switches and interlock switches.
- The system can operate when:
  - The emergency stop switch is unlatched, AND
  - Guard door is closed (interlock switch contacts are closed)

### System Stop (Safe)

- The system stops when:
  - Emergency stop switch is pressed,
  - OR
  - Guard door is open (interlock switch contacts are open)

  The energized solenoid unlocks the guard door.

### Input Monitor Error Detection Function

All logics have 0.5-sec input monitor error time on the dual channel direct opening inputs. For details, see user’s manual.

Note: Use spring-lock type interlock switch with solenoid. Solenoid lock type cannot be used.
Logic 2

**Normally Open and Normally Closed**

General-purpose logic for NO/NC contact inputs

Logic 2 is used for semiconductor manufacturing systems or food packaging systems which have non-contact interlock switches of NO/NC contacts. In this logic, components with dual NO/NC contacts such as a non-contact interlock switch and a mechanical interlock switch, as well as dual direct-opening components such as emergency stop switch and interlock switches can be used at the same time. When a safety component is operated, the SafetyOne shuts down the safety output.

**Semiconductor Manufacturing System**

**Food Packaging System**

---

**During Operation**

The system is equipped with non-contact interlock switches, emergency stop switches, and an interlock switch.

The system can operate when:
- Emergency stop switch is unlatched, AND
- Guard doors are closed

The system stops when:

- Emergency stop switch is pressed, OR Guard door is open

**System Stop (safe)**

- Monitor output function
  
  In addition to safe solid state output, the SafetyOne is equipped with a monitor output which sends internal error information. For details, see user’s manual.

- Auto manual start and control start
  
  Each logic has the option of setting one of two start inputs. Choose one that conforms to the system risk assessment.
  - Auto manual start to detect input level
  - Control start to detect the input's ON to OFF transition and the time

---

Note 1: Use spring-lock type interlock switch with solenoid. Solenoid-lock type cannot be used.

Note 2: For details about non-contact interlock switches, see user’s manual.
Logic 3 is a general-purpose logic for robots and conveyor lines which have dual solid state outputs of light curtains and safety laser scanners. In addition, dual direct-opening components such as emergency stop switches and interlock switches can be used at the same time.

During Operation
The system is equipped with light curtains, interlock switches, and an emergency stop switch.

The system can operate when:
- Light curtain beams are not interrupted, AND
- Guard doors are closed (interlock switch contacts are closed), AND
- Emergency stop switch is unlatched

System Stop (safe)
The system stops when:
- Light curtain beam is interrupted, OR
- Guard door is open (interlock switch contacts are open), OR
- Emergency stop switch is pressed
- The energized solenoid unlocks the door

Note 1: Use spring-lock type interlock switch with solenoid. Solenoid-lock type cannot be used.
Note 2: Use light curtain with a PNP output.

(09/01/07)
In Logic 4, muting functions are added to the dual solid state output of Logic 3. Dual direct-opening components such as emergency stop switches and interlock switches can be used at the same time.

**Muting Function Improves Productivity**

With a muting function, the system stops when detecting a human and temporarily defeats the light curtain while work objects are being supplied. This improves the system’s productivity. Muting functions can be used easily by connecting the light curtain, muting sensor, and muting lamp to the SafetyOne (Note). In muting status, the OFF signals of corresponding safety solid state outputs are defeated.

**During Operation (normal operation)**

The system is equipped with light curtains, muting sensors, a muting lamp, and emergency stop switches.

The system can operate when:
- Light curtain beams are not interrupted, AND
- Muting sensor beams are not interrupted, AND
- Muting lamp is connected, AND
- Emergency stop switches are unlatched

**During Operation (muting)**

When muting is activated, the system continues operating even when:
- Light curtain beam is interrupted

The system stops when:
- Emergency stop switch is pressed.

Note 1: Use light curtain with a PNP output.  Note 2: Use muting sensor with 3-wire PNP output.

**System Stop**

(light curtain beam interrupted by other than work object)

The system stops when:
- Muting sensor does not detect an object, AND
- Light curtain beam is interrupted.

Note: Use light curtains, muting sensors, and muting lamps which meet the safety regulations or safety category of the country or regions where the products are used. Otherwise safety cannot be ensured, resulting in possible danger.
Logic 5 is used for providing safeguarding measures of various systems such as machine tools and robots. Because the input error detection time of dual inputs (dual interlock inputs) are set to $\infty$ (infinite), this logic can be used even when there is a long time lag between the two inputs. When a safety component is operated, the SafetyOne shuts down the safety output immediately.

Logic 1 is used when the operations of two contacts (such as emergency stop switch) occur almost at the same time or the time lag can be specified. Higher safety is achieved by specifying the input monitor error detection time. Logic 1, however, cannot be used in applications where the time lag cannot be specified, such as when interlock switches are installed on a guard door. Logic 5 has an infinite monitoring time, therefore it can be used regardless of the location of the interlock switch and the speed to open the guard door.

**System Stop (safe)**

The system stops when:
- Emergency stop switch is pressed, OR
- Guard door is open (interlock switch contact open)
  - (door unlocked by energized solenoid)

Press! OR Open!

Safety contactor/ Safety relay OFF

System stops

Interlock switch with solenoid (spring lock type)

Solenoid output ON

Guard unlocked

Note: Use spring-lock type interlock switch with solenoid. Solenoid-lock type cannot be used.

(09/01/07)
Logic 6 is the mode selection logic used in machine tools, semiconductor manufacturing equipment, and other systems where an active safety component is switched depending on the operation mode. Of dual direct-opening input and dual interlock input, an active input can be selected using the mode selection switch.

Mode Selection Ensures Safety
When the operator works inside a guard door for teaching, checking, and maintenance, an active safety component needs to be switched from interlock component, such as interlock switch installed on the guard door, or an enabling switch of a grip switch and teaching pendant.

Enabling Switch Ensures Safety
An enabling switch enables the manual operation of machines and robots only when the switch is maintained in the predetermined position (position 2). When the operator either releases (position 1) or holds tightly (position 3) the switch, the circuit is shut down. While an emergency stop switch is used to stop a machine’s operation by the operator’s intention, an enabling switch is used to disable machine operation by the operator’s reaction (releasing or holding tightly) to unexpected machine operation.
## FS1A Safety Controller

### Auto Mode (Operation)

**During Operation**
- Automatic operation:
  - The operator is outside the hazardous area
  - Interlock switches are active
  - Enabling device is inactive
  - Emergency stop is active

**System Stop (safe)**
- The system stops (safety output off) when:
  - Emergency stop switch is pressed, OR
  - Interlock switch is operated
  - (the system stops when neither AUTO nor TEACH is selected with the mode selector switch)

### Teach Mode (Maintenance)

**During Operation**
- Manual operation:
  - The operator is inside the hazardous area for teaching or maintenance
  - Interlock switches are inactive
  - Emergency stop is active
  - Enabling device is active

**System Stop (safe)**
- The system stops (safety output off) when:
  - Emergency stop switch is operated, OR
  - Enabling switch is in position 1 or 3
  - (the system stops when neither AUTO nor TEACH is selected with the mode selector switch)

Note: Use spring-lock type interlock switch with solenoid. Solenoid-lock type cannot be used.
Partial stop 1 logic for various apparatus

Logic 7 is used for partial stop of systems such as machine tools, semiconductor manufacturing equipment, and food packaging machines. Four safety outputs can be controlled in two lines.

Partial Stop Improves Productivity

Two-line outputs can be controlled separately for partial stop, improving production efficiency greatly compared to entire stop.

During Operation

The system is equipped with an emergency stop switch and interlock switches. The system is configured so that pressing the emergency stop switch shuts down the entire system, while opening a door (equipped with an interlock switch) shuts down only the corresponding partial system. The other partial system keeps operating.

The entire system can operate when:
\[ \text{The emergency stop switch is unlatched, AND} \]
\[ \text{The guards are closed (interlock switch contacts are closed)} \]

Note: Use spring-lock type interlock switch with solenoid. Solenoid-lock type cannot be used.
Partial System Stop (Hazardous Area A)
The contacts of interlock switch A open, and safety output A turns off.

Guard door A is open

Partial System Stop (Hazardous Area B)
The contacts of interlock switch B open, and safety output B turns off.

Guard door B is open

Entire System Stop (Hazardous Areas A, B)
When the emergency stop switch is pressed, the entire system stops.

Note: Use spring-lock type interlock switch with solenoid. Solenoid-lock type cannot be used.
Partial Stop 2

Partial stop 2 logic for various apparatus

Logic 8 is used for interlocked partial stop of systems such as machine tools, semiconductor manufacturing equipment, and food packaging machines. Four safety outputs can be controlled in two lines.

Partial System Stop (Hazardous Area B)

The contacts of interlock switch B open, and safety output B turns off.

Emergency stop switch is pressed, or guard door A is open

Guard door B is open

Entire System Stop (Hazardous Areas A, B)

Pressing the emergency stop switch or opening the guard A stops the entire system (hazardous areas A and B).

Guard unlocked

Note: Use spring-lock type interlock switch with solenoid. Solenoid-lock type cannot be used.
FS1A Safety Controller

No programming required. Configuration completes by turning on a logic switch only.

- A safety circuit can be configured easily just by selecting a logic from eight pre-programmed logics.
- Partial/entire stop can be achieved just by selecting a logic.
- One SafetyOne module can connect with various inputs such as emergency stop switches and light curtains.
- The status of safety I/Os and the SafetyOne errors can be monitored.
- Solenoid drive output is provided, eliminating the need for PLC.
- IEC 61508 integrity level 3, ISO 13849-1 performance level e, and EN954-1 safety category 4 compliant

**Specifications**

**Operating Environment**

<table>
<thead>
<tr>
<th>Product</th>
<th>Ordering Type No.</th>
<th>Package Quantity</th>
<th>Note</th>
</tr>
</thead>
<tbody>
<tr>
<td>Connector</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>For input</td>
<td>FS9Z-CN01</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>For output</td>
<td>FS9Z-CN02</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Connecting Tool</td>
<td>FS9Z-SD01</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Marked Cable Tie</td>
<td>FS9Z-MT01PN10</td>
<td>10</td>
<td>Used to lock the protection cover of the FS1A.</td>
</tr>
<tr>
<td>DIN Rail</td>
<td>BAA1000PN10</td>
<td>10</td>
<td>Aluminum, 1m 35mm wide</td>
</tr>
<tr>
<td>Mounting Clip</td>
<td>BNL6PN10</td>
<td>10</td>
<td></td>
</tr>
</tbody>
</table>

- For details, see the user’s manual.

**Standard Accessories**

Input connector (FS9Z-CN01) ———— 1 pc
Output connector (FS9Z-CN02) ———— 1 pc
Marked cable tie (FS9Z-MT01) ———— 3 pcs
Setting tool ———— 1 pc
Instruction sheet (B-1088, English) ———— 1 pc
Instruction sheet (B-1087, Japanese) ———— 1 pc

**Optional Parts (sold separately)**

- Electric Characteristics

<table>
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- For details, see the user’s manual.

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</tbody>
</table>

- For details, see the user’s manual.
Safety Input Specifications

• Drive Terminals
  (T0, T1, T2, T3, T4, T5, T6, T7, T10, T11, T12, T13, T14, T15)
  - Rated Drive Voltage: Power supply voltage
  - Minimum Drive Voltage: Power supply voltage – 2.0V
  - Number of Drive Terminals: 14
  - Maximum Drive Current: 20 mA per terminal (28.8V DC) (Note)

Note: Drive terminals of safety inputs send safety confirmation signals (pulse signals) for the diagnosis of safety components and input circuits. (Wiring and diagnosis function change depending on the selected logic. See user’s manual “Chapter 5 Logic.” Basic specifications remain the same.

• Receive Terminals
  (X0, X1, X2, X3, X4, X5, X6, X7, X10, X11, X12, X13, X14, X15)
  - Rated Input Voltage: 24V DC
  - Input ON Voltage: 15.0 to 28.8V DC
  - Input OFF Voltage: Open or 0 to 5.0V DC
  - Number of Inputs: 14
  - Input Current: 10 mA per terminal (at the rated power voltage)
  - Input Signal: Sink input (for PNP output), Type 1 (IEC61131-2)

• Wire
  - Cable Length (Note): 100 m maximum (total wire length per input)
  - Allowable Wire Resistance: 300Ω maximum

Note: When the wiring between the SafetyOne and the connected component is 30 m or more, use a shielded cable to ensure electromagnetic immunity.

Safety Output Specifications

• Start Input Specifications
  - Rated Input Voltage: 24V DC
  - Input ON Voltage: 15.0 to 28.8V DC
  - Input OFF Voltage: Open or 0V to 5.0V DC
  - Number of Safety Inputs: 14 (Y0, Y1, Y2, Y3)
  - Minimum Output Voltage: Power supply voltage – 2.0V
  - Maximum Output Current: 1 output 500 mA maximum
  - Leakage Current: 1A maximum
  - Allowable Inductive Load (Note 1) L/R = 25 ms
  - Allowable Capacitive Load: 1 μF maximum
  - Cable Length (Note 2): 100 m maximum (total length per output)

Note 1: When connecting an inductive load, connect a protection element such as a diode.
Note 2: When the wiring between the SafetyOne and the connected component is 30 m or more, use a shielded cable to ensure electromagnetic immunity.

• Start Input Internal Circuit
  - Rated Output Voltage: Power supply voltage
  - Minimum Output Voltage: Power supply voltage – 2.0V
  - Number of Safety Outputs: 4 (Y0, Y1, Y2, Y3)
  - Maximum Output Current: 1 output 20 mA maximum
  - Leakage Current: 0.1 mA maximum
  - Allowable Capacitive Load: 1 μF maximum
  - Cable Length (Note 2): 100 m maximum (total length per output)

Note: When the wiring between the SafetyOne and the connected component is 30 m or more, use a shielded cable to ensure electromagnetic immunity.

Monitor Output Specifications

• Start Input Internal Circuit
  - Rated Output Voltage: Power supply voltage
  - Minimum Output Voltage: Power supply voltage – 2.0V
  - Number of Safety Outputs: 4 (Y0, Y1, Y2, Y3)
  - Maximum Output Current: 1 output 20 mA maximum
  - Leakage Current: 0.1 mA maximum
  - Allowable Capacitive Load: 1 μF maximum
  - Cable Length (Note 2): 100 m maximum (total length per output)

Note: When the wiring between the SafetyOne and the connected component is 30 m or more, use a shielded cable to ensure electromagnetic immunity.

• Start Input Operation Range
  - ON Range: 15 to 28.8V DC
  - OFF Range: Open or 0 to 5.0V DC
  - Minimum Output Voltage: Power supply voltage – 2.0V
  - Rated Output Voltage: Power supply voltage

Note: When the wiring between the SafetyOne and the connected component is 30 m or more, use a shielded cable to ensure electromagnetic immunity.

The operating characteristics of the monitor output change depending on the selected logic. For details, see user’s manual “Chapter 5 Logic.” The basic specifications remain the same.

Monitor Output Internal Circuit

The safety outputs of the SafetyOne are solid state outputs. When the output is on, off-check signals are generated at regular intervals. The operating characteristics of the safety output change depending on the selected logic. For details, see user’s manual “Chapter 5 Logic.” The basic specifications remain the same.

Note that off-check signals may cause reaction of some safety components depending on their response speed. Monitor output and solenoid/lamp output do not generate outputs of off-check signals.
Solenoid/Lamp Output Specifications

Output Type: Source output (N channel MOSFET)
Rated Output Voltage: Power supply voltage
Minimum Output Voltage: Power supply voltage – 2.0V
No. of Solenoid/Lamp Outputs: 2 (Y17, Y20)
Maximum Output Current: 500 mA maximum
Total Output Current: 500 mA maximum
Leakage Current: 0.1 mA maximum
Allowable Inductive Load (Note 1): L/R = 25 ms
Cable Length (Note 2): 100m maximum (total length per output)

Note 1: When connecting an inductive load, connect a protection element such as a diode.
Note 2: When connecting an inductive load, connect a protection element such as a diode.

Internal States

State | Description
--- | ---
Initial | Initial processing is performed immediately after power is supplied to the SafetyOne. The internal circuits are checked and the LEDs show operation confirmation (blinking) for 6 seconds (approx.).
Run | The SafetyOne is under normal operation. Logic processing continues without failures or wiring errors.
Configuration | A logic or off-delay timer value is being configured. Configuration enables the logic or off-delay timer value. When completed, the SafetyOne shifts to the Run state.
Protection | An input monitor error has occurred with dual channel input, EDM input, or muting input. When the problem is removed, the SafetyOne shifts to Run state.
Stop | A failure or error occurred with an external device or internal circuit. When the problem is removed and the power is turned on, Stop state is cleared.

LED and Output Status

State | Logic LED | Error LED | Timer LED | Safety Output | Solenoid/Lamp Output | Monitor Output
--- | --- | --- | --- | --- | --- | ---
Initial | (Note 1) | (Note 1) | (Note 1) | OFF | OFF | OFF | OFF | OFF | OFF
Run | Logic #0 Blank Value | (Note 2) | (Note 2) | OFF | OFF | ON | ON | OFF | OFF
Configuration | (Note 3) | 0 | (Note 3) | OFF | OFF | ON | ON | OFF | OFF
Protection | Logic #1 Value | (Note 4) | (Note 4) | OFF | OFF | ON | ON | OFF | OFF
Stop | Blank (Note 5) | Blank | OFF | OFF | ON | ON | OFF | OFF | OFF

Note 1: Random display of initial state.
Note 2: Output and LED display of the selected logic.
Note 3: Blinking LED display of the selected logic number or the selected timer value.
Note 4: Pulsing display of monitor output and output LED corresponding to the input of error. Other LEDs and monitor outputs maintain the display of Run state.
Note 5: Error number is displayed.

Caution
Solenoid/lamp outputs (Y17, Y20) turn on for 1 second maximum when the state shifts to Run state. Take the operation of the connected components into consideration.
**Configuration Switches**

Eight DIP switches are provided for selecting a logic by moving a switch upward. For details, see user’s manual "Chapter 5 Logic." Only one logic switch can be selected.

**Timer Switch**

Eight DIP switches are provided for selecting an off-delay timer value, by moving a switch upward. For details, see user’s manual "Chapter 5 Logic." Only one timer switch can be selected.

**Enter Button**

The enter button is used to activate the configuration of logic and timer switches. Error LED will blink for 1 to 5 seconds after pressing the enter button. Releasing the button during blinking activates the setting. The blinking LED becomes ON if the button is pressed for more than 5 seconds, and the setting becomes invalid even after the button is released. For setting the switches and enter button, use the setting tool supplied with the SafetyOne.

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**Connector Specifications**

**Input Connector**

<table>
<thead>
<tr>
<th>Terminal No.</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>T0</td>
<td>Safety input drive terminal 0</td>
</tr>
<tr>
<td>T1</td>
<td>Safety input drive terminal 1</td>
</tr>
<tr>
<td>T2</td>
<td>Safety input drive terminal 2</td>
</tr>
<tr>
<td>T3</td>
<td>Safety input drive terminal 3</td>
</tr>
<tr>
<td>T4</td>
<td>Safety input drive terminal 4</td>
</tr>
<tr>
<td>T5</td>
<td>Safety input drive terminal 5</td>
</tr>
<tr>
<td>T6</td>
<td>Safety input drive terminal 6</td>
</tr>
<tr>
<td>T7</td>
<td>Safety input drive terminal 7</td>
</tr>
<tr>
<td>T10</td>
<td>Safety input drive terminal 10</td>
</tr>
<tr>
<td>T11</td>
<td>Safety input drive terminal 11</td>
</tr>
<tr>
<td>T12</td>
<td>Safety input drive terminal 12</td>
</tr>
<tr>
<td>T13</td>
<td>Safety input drive terminal 13</td>
</tr>
<tr>
<td>T14</td>
<td>Safety input drive terminal 14</td>
</tr>
<tr>
<td>T15</td>
<td>Safety input drive terminal 15</td>
</tr>
<tr>
<td>T16</td>
<td>Start input terminal 16</td>
</tr>
</tbody>
</table>

**Output Connector**

<table>
<thead>
<tr>
<th>Terminal No.</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Y0</td>
<td>Safety output terminal 0</td>
</tr>
<tr>
<td>Y1</td>
<td>Safety output terminal 1</td>
</tr>
<tr>
<td>Y2</td>
<td>Safety output terminal 2</td>
</tr>
<tr>
<td>Y3</td>
<td>Safety output terminal 3</td>
</tr>
<tr>
<td>Y4</td>
<td>Monitor output terminal 4</td>
</tr>
<tr>
<td>Y5</td>
<td>Monitor output terminal 5</td>
</tr>
<tr>
<td>Y6</td>
<td>Monitor output terminal 6</td>
</tr>
<tr>
<td>Y7</td>
<td>Monitor output terminal 7</td>
</tr>
<tr>
<td>Y10</td>
<td>Monitor output terminal 10</td>
</tr>
<tr>
<td>Y11</td>
<td>Monitor output terminal 11</td>
</tr>
<tr>
<td>Y12</td>
<td>Monitor output terminal 12</td>
</tr>
<tr>
<td>Y13</td>
<td>Monitor output terminal 13</td>
</tr>
<tr>
<td>Y14</td>
<td>Monitor output terminal 14</td>
</tr>
<tr>
<td>Y16</td>
<td>Monitor output terminal 16</td>
</tr>
<tr>
<td>Y20</td>
<td>Monitor output terminal 20</td>
</tr>
<tr>
<td>V+</td>
<td>24V DC power terminal</td>
</tr>
<tr>
<td>FE</td>
<td>Functional ground terminal</td>
</tr>
</tbody>
</table>

Applicable connector

<table>
<thead>
<tr>
<th>Spring clamp (22-pin)</th>
</tr>
</thead>
<tbody>
<tr>
<td>FS9Z-CN02 (IDEC)</td>
</tr>
<tr>
<td>2-1871940-1 (Tyco Electronics)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Spring clamp (30-pin)</th>
</tr>
</thead>
<tbody>
<tr>
<td>FS9Z-CN01 (IDEC)</td>
</tr>
<tr>
<td>2-1871940-5 (Tyco Electronics)</td>
</tr>
</tbody>
</table>

**Switch No.**

<table>
<thead>
<tr>
<th>Switch No.</th>
<th>Timer Value</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0</td>
<td>No off-delay (safety outputs shut down immediately)</td>
</tr>
<tr>
<td>2</td>
<td>.1</td>
<td>Off-delay timer 0.1s</td>
</tr>
<tr>
<td>3</td>
<td>.5</td>
<td>Off-delay timer 0.5s</td>
</tr>
<tr>
<td>4</td>
<td>1</td>
<td>Off-delay timer 1s</td>
</tr>
<tr>
<td>5</td>
<td>2</td>
<td>Off-delay timer 2s</td>
</tr>
<tr>
<td>6</td>
<td>5</td>
<td>Off-delay timer 5s</td>
</tr>
<tr>
<td>7</td>
<td>15</td>
<td>Off-delay timer 15s</td>
</tr>
<tr>
<td>8</td>
<td>30</td>
<td>Off-delay timer 30s</td>
</tr>
</tbody>
</table>

Note: For the specifications of crimp connector, contact Tyco Electronics.
FS1A Safety Controller

Logic 1

- **Monitor Output for Safety Input**
  - X0
  - X1
  - X2
  - X3
  - X4
  - X5
  - X6
  - X7
  - X10
  - X11
  - X12
  - X13

- **Monitor Output for Safety Output**
  - Y0, Y1
  - Y2, Y3
  - Y4
  - Y5
  - Y6
  - Y7
  - Y10
  - Y11
  - Y12
  - Y13
  - Y17
  - Y20

- **Solenoid Output (Note 2)**
  - Y0, Y1
  - Y2
  - Y17
  - Y20

Note 1: Safety output 1 monitor and safety output 2 monitor turn off immediately independent of off-delay time.

Note 2: In Run state, the solenoid output turns on when the safety output is off and one or more corresponding safety inputs are off. When all corresponding safety inputs are on, the solenoid outputs are turned off even when the start input is off.
• Logic 1 Wiring Example

When using four emergency stop switches and two spring-lock type interlock switches with solenoid

S1 to S4: Emergency stop switch
S5, S6: Interlock switch with solenoid (spring lock type)
S7: Start switch
K1 to K4: Safety contactor
M1, M2: Motor
S8, S9: Solenoid control switch

(Pressing the solenoid control switches after closing the guard door, contacts 41-42 and 51-52 of S5 and S6 turn on, allowing the SafetyOne to restart.)

Safety components used in this system
Emergency stop switch: XA1E, XW1E, XN1E, HA1B, HA1E, HW1B, HW1E
Interlock switch with solenoid (spring lock type): HS6E
Non-contact safety switch (2NO type): HS7A
Interlock switch: HS6B, HS5B

Guard open
Guard open

Actuator
Actuator

Spring lock type
Spring lock type

Interlock switch with solenoid
Interlock switch with solenoid

When not using the start switch (auto start)

When not detecting the welding of start switch (manual start)

When detecting the welding of start switch (control start)

When connecting multiple emergency stop switches in series

When not using some inputs

Note:
Safety performance depends on the system configuration.

24V DC
24V DC
24V DC
24V DC
24V DC
0V DC

22
### Logic 1 Time Chart

#### When using manual start input X16

<table>
<thead>
<tr>
<th>Power ON</th>
<th>Safety Output ON</th>
<th>Off-delay Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>Safety Input (X0)</td>
<td>Note</td>
<td></td>
</tr>
<tr>
<td>Safety Input (X1)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Monitor Output for X0, X1 (Y4)</td>
<td></td>
<td>0.1s minimum</td>
</tr>
<tr>
<td>Manual Start Input (X16)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Safety Output (Y0, Y1, Y2, Y3)</td>
<td></td>
<td>0.1s maximum</td>
</tr>
<tr>
<td>Safety Output Monitor (Y12, Y13)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Solenoid Output (Y17, Y20)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>RUN Monitor (Y16)</td>
<td></td>
<td>Initializing 6s maximum</td>
</tr>
</tbody>
</table>

Note: When the input time difference at the dual channel safety inputs is 0.5s or more, the input monitor error is detected.

#### When using control start input X17

<table>
<thead>
<tr>
<th>Power ON</th>
<th>Safety Output ON</th>
<th>Off-delay Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>Safety Input (X0)</td>
<td>Note</td>
<td></td>
</tr>
<tr>
<td>Safety Input (X1)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Monitor Output for X0, X1 (Y4)</td>
<td></td>
<td>0.1s minimum</td>
</tr>
<tr>
<td>Manual Start Input (X17)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Safety Output (Y0, Y1, Y2, Y3)</td>
<td></td>
<td>0.1s maximum</td>
</tr>
<tr>
<td>Safety Output Monitor (Y12, Y13)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Solenoid Output (Y17, Y20)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>RUN Monitor (Y16)</td>
<td></td>
<td>Initializing 6s maximum</td>
</tr>
</tbody>
</table>

(Safety inputs X2 to X13 are ON in this chart)
• **Monitor Output for Safety Input**

  - X0  
  - X1  
  - X2  
  - X3  
  - X4  
  - X5  
  - X6  
  - X7  
  - X10  
  - X11  
  - X12  
  - X13  

Note 1: When Xn is off and Xn+1 is on, safety input monitor 1 to 4 turn on.  
(n = 0, 2, 4, 6)

• **Monitor Output for Safety Output**

  - Y0, Y1  
  - OS1  
  - Y2, Y3  
  - OS1

Note 2: Safety output 1 monitor and safety output 2 monitor turn off immediately independent of off-delay time.

• **Solenoid Output**  
  
  - Y0, Y1  
  - S1  
  - Y2, Y3  
  - S1

Note 3: In Run status, the solenoid output turns on when the safety output is off and one or more corresponding safety inputs are off. When all corresponding safety inputs are on, the solenoid output is turned off even when the start input is off.
### Logic 2 Wiring Example

When connecting four non-contact interlock switches, an emergency stop switch, and a spring-lock type interlock switch with solenoid

- **S1 to S4**: Non-contact interlock switch
- **S5**: Emergency stop switch
- **S6**: Interlock switch with solenoid (spring lock type)
- **S7**: Start switch
- **K1 to K4**: Safety contactor
- **M1, M2**: Motor
- **S8**: Solenoid control switch

(Pressing the solenoid control switch after closing the guard door, contacts 41-42 and 51-52 of S6 turn on, allowing the SafetyOne to restart.)

**Safety components used in this system**

- Emergency stop switch: XA1E, XW1E, XN1E, HA1B, HA1E, HW1B, HW1E
- Interlock switch with solenoid (spring lock type): HS6E, HS5E
- Non-contact safety switch (1NC+1NO type): HS7A
- Interlock switch: HS6B, HS5B

**Note: Safety performance depends on the system configuration.**
• Logic 2 Time Chart

When using manual start input X16

<table>
<thead>
<tr>
<th>Power ON</th>
<th>Safety Input (X0)</th>
<th>Safety Output ON</th>
<th>Off-delay Time</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>(Note)</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Safety Input (X1)</th>
<th>Safety Output (Y0, Y1, Y2, Y3)</th>
<th>Safety Output Monitor (Y12, Y13)</th>
<th>Solenoid Output (Y17, Y20)</th>
<th>RUN Monitor (Y16)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.1s minimum</td>
<td>0.1s maximum</td>
<td>Initializing</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note: When the input time difference at the dual channel safety inputs is 0.5s or more, an input monitor error is detected.

When using control start input X17

<table>
<thead>
<tr>
<th>Power ON</th>
<th>Safety Input (X0)</th>
<th>Safety Output ON</th>
<th>Off-delay Time</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>(Note)</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Safety Input (X1)</th>
<th>Safety Output (Y0, Y1, Y2, Y3)</th>
<th>Safety Output Monitor (Y12, Y13)</th>
<th>Solenoid Output (Y17, Y20)</th>
<th>RUN Monitor (Y16)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.1s minimum</td>
<td>0.1s maximum</td>
<td>Initializing</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

(Safety inputs X2, X4, X6 are OFF and X3, X5, X7, X10, X11, X12, X13 are ON in this chart.)
### Logic 3

- **Safety Input 1**
  - (X0, X1)
  - Dual Channel Solid State

- **Safety Input 2**
  - (X2, X3)
  - Dual Channel Solid State

- **Safety Input 3**
  - (T4, X4, T5, X5)
  - Dual Channel Direct Opening

- **Safety Input 4**
  - (T6, X6, T7, X7)
  - Dual Channel Direct Opening

- **Safety Input 5**
  - (T10, X10, T11, X11)
  - Dual Channel Direct Opening

- **Safety Input 6**
  - (T12, X12, T13, X13)
  - Dual Channel Direct Opening

- **Start Input 1**
  - (X16)
  - Single Channel Monitor

- **Start Input 2**
  - (X17)
  - Single Channel Monitor

- **External Device Monitor 1**
  - (T14, X14)

- **External Device Monitor 2**
  - (T15, X15)

---

#### Monitor Output for Safety Input

- Safety Input 1 Monitor
  - Y4

- Safety Input 2 Monitor
  - Y5

- Safety Input 3 Monitor
  - Y6

- Safety Input 4 Monitor
  - Y7

- Safety Input 5 Monitor
  - Y10

- Safety Input 6 Monitor
  - Y11

---

#### Monitor Output for Safety Output

- Safety Output 1 Monitor (Note 1)
  - Y0, Y1

- Safety Output 2 Monitor (Note 1)
  - Y2, Y3

- Safety Output 1 Monitor
  - Y0

- Safety Output 2 Monitor
  - Y2

Note 1: Safety output 1 monitor and safety output 2 monitor turn off immediately independent of off-delay time.

---

#### Solenoid Output (Note 2)

- Y0, Y1
- S1
- Y2, Y3
- S1

Y17

Y20

Note 2:
- Auto mode
  - In Run status, the solenoid output turns on when the safety output is off and one or more corresponding safety inputs are off.
  - When all corresponding safety inputs are on, the solenoid output is turned off even when the start input is off.

---

(09/01/07)

Courtesy of Steven Engineering, Inc.-230 Ryan Way, South San Francisco, CA 94080-6370-Main Office: (650) 588-9200-Outside Local Area: (800) 258-9200-www.stevenengineering.com
• Logic 3 Wiring Example

When wiring two light curtains (PNP), two emergency stop switches, and two interlock switches with solenoid (spring lock type)

S1, S2: Light curtain (PNP type)
S3, S4: Emergency stop switch
S5, S6: Interlock switch with solenoid (spring lock type)
S7: Start switch
K1 to K4: Safety contactor
M1, M2: Motor
S8, S9: Solenoid control switch

Safety components used in this system
Emergency stop switch: XA1E, XW1E, XN1E, HA1B, HA1E, HW1B, HW1E
Interlock switch with solenoid (spring lock type): HS6E
Light curtain (PNP type): SE4B
Non-contact safety switch (2NO type): HS7A
Interlock switch: HS6B, HS5B

S1 and S2: SE4B light curtain

When using IDEC’s SE4B light curtain for S1 and S2

S1: SE4B light curtain
Emitter Receiver
TEST/START switch (external device)

(white) TEST/START
(brown) 24V DC
(gray) OSSD1
(pink) OSSD2
(yellow) EDM

Emitter Receiver
S2: SE4B light curtain

(white) TEST/START
(brown) 24V DC
(gray) OSSD1
(pink) OSSD2
(yellow) EDM

Test/Start switch

When not using the start switch (auto start)
When not detecting the welding of start switch (manual start)
When detecting the welding of start switch (control start)

When connecting multiple emergency stop switches in series

Note:
Safety performance depends on the system configuration.

24V DC
0V DC

Fuse

24V DC
0V DC

SafetyOne

When using two light curtains (PNP), two emergency stop switches, and two interlock switches with solenoid (spring lock type)
• Logic 3 Time Chart

When using manual start input X16

- Safety Input (X0)
- Safety Input (X1)
- Monitor Output for X0, X1 (Y4)
- Manual Start Input (X16)
- Safety Output (Y0, Y1, Y2, Y3)
- Safety Output Monitor (Y12, Y13)
- Solenoid Output (Y17, Y20)
- RUN Monitor (Y16)

Power ON

Safety Output ON

Off-delay Time

(09/01/07)

 Initializing

6s maximum

0.1s minimum

0.1s maximum

(Note)

Note: When the input time difference at the dual channel solid state inputs (X0-X1 and X2-X3) is 0.1s or more, the input monitor error is detected. When the input time difference at the dual channel direct opening inputs (X4-X5, X6-X7, X12-X13) is 0.5s or more, the input monitor error is detected.

When using control start input X17

- Safety Input (X0)
- Safety Input (X1)
- Monitor Output for X0, X1 (Y4)
- Manual Start Input (X17)
- Safety Output (Y0, Y1, Y2, Y3)
- Safety Output Monitor (Y12, Y13)
- Solenoid Output (Y17, Y20)
- RUN Monitor (Y16)

Power ON

Safety Output ON

Off-delay Time

(09/01/07)

 Initializing

6s maximum

0.1s minimum

0.1s maximum

(Note)

(Safety inputs X2 to X13 are ON in this chart.)
Logic 4

- **Safety Input 1 Monitor** (X0, X1)
- **Safety Input 2 Monitor** (X4, X5)
- **Safety Input 3 Monitor** (X10, X11)
- **Safety Input 4 Monitor** (X12, X13)

- **Muting Input 1 Monitor** (X2, X3)
- **Muting Input 2 Monitor** (X6, X7)

- **Safety Output 1 Monitor**
- **Safety Output 2 Monitor**

- **External Device Monitor 1** (T14, X14)
- **External Device Monitor 2** (T15, X15)

- **Safety Output 1** (Y0)
- **Safety Output 2** (Y2)
- **Muting Lamp Output** (Note 2)

Note 1: Safety output 1 monitor and safety output 2 monitor turn off immediately independent of off-delay time.

Note 2: The muting lamp output is turned on when the safety function of the safety input is temporarily suppressed. Even if the muting input is on, the muting lamp output is not turned on when the muting watch time is exceeded or the corresponding safety input (muting input 1: safety input 1) is off.
Logic 4 Wiring Example

When connecting two light curtains (PNP), four muting sensors (PNP), one emergency stop switch, and one interlock switch

Safety components used in this system

- Emergency stop switch: XA1E, XW1E, XN1E, HA1B, HA1E, HW1B, HW1E
- Interlock switch with solenoid (spring lock type): HS6E, HS5E, HS1E
- Light curtain (PNP type): SE4B
- Muting sensor (PNP type): SA1E
- Muting lamp: HW1P-5Q7
- Selector switch
- Non-contact safety switch (2NO type): HS7A
- Interlock switch: HS6B, HS5B

Note: In logic 4, wire disconnection or non-connection of the lamp connected to the muting lamp output terminals (Y17, Y20) is detected. When not using the muting function, connect resistors to these terminals. When resistors are not connected, the SafetyOne detects errors and locks out the circuit.
• Logic 4 Time Chart

When using manual start input X16

Power ON

Safety Input (X0)

Safety Input (X1)

Muting Input (X2)

Muting Input (X3)

Monitor Output for X0, X1 (Y4)

Muting Lamp Output (Y17, Y20)

Manual Start Input (X16)

Safety Output (Y0, Y1, Y2, Y3)

Safety Output Monitor (Y12, Y13)

RUN Monitor (Y16)

Initializing

(Safety inputs X4, X5, X10 to X13 are ON, and muting inputs X6 and X7 are off in this chart.)

When using control start input X17

Power ON

Safety Input (X0)

Safety Input (X1)

Muting Input (X2)

Muting Input (X3)

Monitor Output for X0, X1 (Y4)

Muting Lamp Output (Y17, Y20)

Manual Start Input (X17)

Safety Output (Y0, Y1, Y2, Y3)

Safety Output Monitor (Y12, Y13)

RUN Monitor (Y16)

Initializing

(Safety inputs X4, X5, X10 to X13 are ON, and muting inputs X6 and X7 are off in this chart.)
**Logic 5**

- **Safety Input 1** (T0, X0, T1, X1)  
- **Safety Input 2** (T2, X2, T3, X3)  
- **Safety Input 3** (T4, X4, T5, X5)  
- **Safety Input 4** (T6, X6, T7, X7)  
- **Safety Input 5** (T10, X10, T11, X11)  
- **Safety Input 6** (T12, X12, T13, X13)  

- **Start Input 1** (X16)  
- **Start Input 2** (X17)  

- **External Device Monitor 1** (T14, X14)  
- **External Device Monitor 2** (T15, X15)  

- **Safety Output 1 Monitor** and **Safety Output 2 Monitor** (Note 1)

- **Solenoid Output** (Note 2)

**Monitor Output for Safety Input**

- X0 → Y1  
- X1 → Y1  
- X2 → Y1  
- X3 → Y1  
- X4 → Y1  
- X5 → Y1  
- X6 → Y1  
- X7 → Y1  
- X10 → Y1  
- X11 → Y1  
- X12 → Y1  
- X13 → Y1

**Monitor Output for Safety Output**

- Y0, Y1 → Y1  
- OS1 → Y1  
- Y2, Y3 → Y1  
- OS1 → Y1

**Solenoid Output** (Note 2)

- Y0, Y1 → Y17  
- Y2, Y3 → Y17  
- S1 → Y17

Note 1: Safety output 1 monitor and safety output 2 monitor turn off immediately independent of off-delay time.

Note 2: In Run status, the solenoid output turns on when the safety output is off and one or more corresponding safety inputs are off. When all corresponding safety inputs are on, the solenoid output is turned off even when the start input is off.
**Logic 5 Wiring Example**

When connecting two emergency stop switches, two interlock switches, and two interlock switches with solenoid (spring lock type)

- S1, S2: Emergency stop switch
- S3, S4: Interlock switch
- S5, S6: Interlock switch with solenoid (spring lock type)
- S7: Start switch
- K1 to K4: Safety contactor
- M1, M2: Motor
- S8, S9: Solenoid control switch

Safety components used in this system

- Emergency stop switch: XA1E, XW1E, XN1E, HA1B, HA1E, HW1B, HW1E
- Interlock switch with solenoid (spring lock type): HS6E
- Non-contact safety switch (2NO): HS7A
- Interlock switch: HS6B, HS5B

**Diagram**

When not using the start switch (auto start) 24V DC

When not detecting the welding of start switch (manual start) 24V DC

When detecting the welding of start switch (control start) 24V DC

When connecting multiple emergency stop switches in series

When not using some safety inputs

Note:
Safety performance depends on the system configuration.
• Logic 5 Time Chart

When using manual start input X16

- **Power ON**
- **Safety Input (X0)**
- **Safety Input (X1)**
- **Monitor Output for X0, X1 (Y4)**
- **Manual Start Input (X16)**
- **Safety Output (Y0, Y1, Y2, Y3)**
- **Safety Output Monitor (Y12, Y13)**
- **Solenoid Output (Y17, Y20)**
- **RUN Monitor (Y16)**

**Initializing**

**Note:** The detection time of input monitor error is infinite.

**Off-delay Time:**
- 0.1s minimum
- 0.1s maximum
- 6s maximum

When using control start input X17

- **Power ON**
- **Safety Input (X0)**
- **Safety Input (X1)**
- **Monitor Output for X0, X1 (Y4)**
- **Manual Start Input (X17)**
- **Safety Output (Y0, Y1, Y2, Y3)**
- **Safety Output Monitor (Y12, Y13)**
- **Solenoid Output (Y17, Y20)**
- **RUN Monitor (Y16)**

**Initializing**

**Off-delay Time:**
- 0.1s minimum
- 0.1s maximum
- 6s maximum

(Safety inputs X2 to X13 are ON in this chart.)
Logic 6

**Monitor Output for Safety Input** (Note 1)

- **Safety Input 1** (T0, X0, X1)
- **Safety Input 2** (T2, X2, T3, X3)
- **Safety Input 3** (T4, X4, T5, X5)
- **Safety Input 4** (T6, X6, T7, X7)
- **Safety Input 5** (T10, X10, T11, X11)
- **Safety Input 6** (T12, X12, T13, X13)

**Monitor Output for Safety Output** (Note 2)

- **Safety Output 1 Monitor** Y1
- **Safety Output 2 Monitor** Y3

Note 2: Safety output 1 monitor and safety output 2 monitor turn off immediately independent of off-delay time.

**Solenoid Output**

**Auto Mode** (Note 3)

- **Safety Output 1** Y0
- **Safety Output 2** Y2

Note 3:
- **Auto mode** In Run state, the solenoid output turns on when the safety output is off and one or more corresponding safety inputs are off. When all corresponding safety inputs (except safety input 2) are on, the solenoid output is turned off even when the start input is off.

**Teach Mode** (Note 4)

- **Safety Output 1** Y0
- **Safety Output 2** Y2

Note 4:
- **Teach mode** In Run state, the solenoid output turns on when the safety output is off.

---

Note 1: Safety output 1 monitor is turned off when safety input 1 is set to auto mode.
**Logic 6 Wiring Example**

When connecting an enabling switch (2-contact), a selector switch, two emergency stop switches, and two interlock switches with solenoid (spring lock type)

- **S1**: Selector switch
- **S2**: Enabling switch
- **S3, S4**: Interlock switch with solenoid (spring lock type)
- **S5, S6**: Emergency stop switch
- **S7, S8**: Start switch
- **K1 to K4**: Safety contactor
- **M1, M2**: Motor
- **S9, S10**: Solenoid control switch

(Pressing the solenoid control switch after closing the guard door, contacts 41-42 and 51-52 of S3 and S4 turn on, allowing the SafetyOne to restart.)

**Safety components used in this system**

- Emergency stop switch: XA1E, XW1E, XN1E, HA1B, HA1E, HW1B, HW1E
- Interlock switch with solenoid (spring lock type): HS6E
- Selector switch: HE1B, HE2B, HE3B, HE5B, HE1G
- Non-contact safety switch (2NO type): HS7A
- Interlock switch: HS6B, HS5B

**When not using the start switch in teach mode (auto start)**

- 24V DC
- X15
- X17

**When not detecting the welding of start switch in teach mode (manual start)**

- 24V DC
- S7
- S8
- X15
- X17

**When connecting multiple emergency stop switches in series**

**When not using some safety inputs**

Note: Safety performance depends on the system configuration.
### Logic 6 Time Chart

#### Teach Mode

<table>
<thead>
<tr>
<th>Event</th>
<th>Power ON</th>
<th>Safety Output ON</th>
<th>Off-delay Time</th>
<th>Safety Output ON</th>
<th>Off-delay Time</th>
<th>Safety Output ON</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mode Select Input (X0)</td>
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<tr>
<td>Mode Select Input (X1)</td>
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<tr>
<td>Monitor Output for X0, X1 (Y4)</td>
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<tr>
<td>Safety Input (X2)</td>
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<tr>
<td>Safety Input (X3)</td>
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<tr>
<td>Monitor Output for X2, X3 (Y5)</td>
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<tr>
<td>Safety Input (X10, X11)</td>
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<tr>
<td>Monitor Output for X10, X11 (Y10)</td>
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<tr>
<td>Manual Start Input (X16)</td>
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<tr>
<td>Control Start Input (X17)</td>
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<tr>
<td>Safety Output (Y0, Y1, Y2, Y3)</td>
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<tr>
<td>Safety Output Monitor (Y12, Y13)</td>
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<tr>
<td>Solenoid Output (Y17, Y20)</td>
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<tr>
<td>RUN Monitor (Y16)</td>
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</tr>
</tbody>
</table>

Initiating 6s max.  

(Safety inputs X4 to X7, X12, and X13 are on in this chart.)

**Note 1:** The detection time of input monitor error is infinite at dual channel dependent inputs (X2-X3). When the input time difference at the dual channel direct opening inputs (X4-X5, X6-X7, X10-X11, and X12-X13) is 0.5s or more, input monitor error is detected.

**Note 2:** The above chart shows an example when the control start input (X17) is turned on before turning on the manual start input (X16).

### Auto Mode

<table>
<thead>
<tr>
<th>Event</th>
<th>Power ON</th>
<th>Safety Output ON</th>
<th>Off-delay Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mode Select Input (X0)</td>
<td></td>
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</tr>
<tr>
<td>Mode Select Input (X1)</td>
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<td></td>
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<tr>
<td>Monitor Output for X0, X1 (Y4)</td>
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<tr>
<td>Safety Input (X2)</td>
<td></td>
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<tr>
<td>Safety Input (X3)</td>
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</tr>
<tr>
<td>Monitor Output for X2, X3 (Y5)</td>
<td></td>
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</tr>
<tr>
<td>Safety Input (X10, X11)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Monitor Output for X10, X11 (Y10)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Control Start Input (X17)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Safety Output (Y0, Y1, Y2, Y3)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Safety Output Monitor (Y12, Y13)</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Solenoid Output (Y17, Y20)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>RUN Monitor (Y16)</td>
<td></td>
<td></td>
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</tr>
</tbody>
</table>

Initiating 6s max.  

(Safety inputs X6 to X13 are on in this chart.)

**Note:** When the input time difference is 0.5s or more, input monitor error is detected.
**Logic 7**

- **Safety Input 1** (T0, X0, T1, X1)
- **Safety Input 2** (T2, X2, T3, X3)
- **Safety Input 3** (T4, X4, T5, X5)
- **Safety Input 4** (T6, X6, T7, X7)
- **Safety Input 5** (T10, X10, T11, X11)

**Start Input 1** (X12)
**Start Input 2** (X13)
**Start Input 3** (X16)
**Start Input 4** (X17)

**External Device Monitor 1** (T14, X14)
**External Device Monitor 2** (T15, X15)

**Monitor Output for Safety Input**
- X0
- X1
- X2
- X3
- X4
- X5
- X6
- X7
- X10
- X11

**Monitor Output for Safety Output**
- Y0, Y1
- Y2, Y3
- Y4
- Y5
- Y6
- Y7
- Y0
- Y1
- Y2
- Y3
- Y4
- Y5
- Y6
- Y7

**Solenoid Output** (Note 2)
- Y0, Y1
- Y2, Y3
- Y0
- Y1
- Y2
- Y3

Note 1: Safety output 1 monitor and safety output 2 monitor turn off immediately independent of off-delay time.

Note 2: In Run state, the solenoid output turns on when the safety output is off and one or more corresponding safety inputs are off. When all corresponding safety inputs are on, the solenoid output is turned off even when the start input is off.
• Logic 7 Wiring Example

When connecting three emergency stop switches and two interlock switches with solenoid (spring lock type)

| S1, S2, S4: Emergency stop switch |
| S3, S5: Interlock switch with solenoid (spring lock type) |
| S6, S7, S8: Start switch |
| K1 to K4: Safety contactor |
| M1, M2: Motor |
| S9, S10: Solenoid control switch |

(Pressing the solenoid control switches after closing the guard door, contacts 41-42 and 51-52 of S3 and S5 turn on, allowing the SafetyOne to restart.)

Safety components used in this system

Emergency stop switch: XA1E, XW1E, XN1E, HA1B, HA1E, HW1B, HW1E
Interlock switch with solenoid (spring lock type): HS6E
Non-contact safety switch (2NO type): HS7A
Interlock switch: HS6B, HS5B

K1 to K4: Safety contactor
M1, M2: Motor
S9, S10: Solenoid control switch

Note:
Safety performance depends on the system configuration.
• Logic 7 Time Chart

When not detecting the welding of start switch on partial stop (manual start input X13 is used)

When detecting the welding of start switch on partial stop (control start input X16 and X17 used)

Note 1: When the input time difference at the dual channel safety inputs is 0.5s or more, input monitor error is detected.
Note 2: When the control start input (X12) is turned on before turning on the manual start input (X13).

(X4, X5, X10, and X11 are on in this chart.)

(X4, X5, X10, and X11 are on in this chart.)
Logic 8

Safety Input 1 (T0, X0, T1, X1)
Safety Input 2 (T2, X2, T3, X3)
Safety Input 3 (T4, X4, T5, X5)
Safety Input 4 (T6, X6, T7, X7)
Safety Input 5 (T10, X10, T11, X11)
Start Input 1 (X12)
Start Input 2 (X13)
Start Input 3 (X16)
Start Input 4 (X17)
External Device Monitor 1 (T14, X14)
External Device Monitor 2 (T15, X15)

• Monitor Output for Safety Input
  X0 → Y4
  X1 → Y5
  X2 → Y6
  X3 → Y7
  X4 → Y8
  X5 → Y9
  X6 → Y10
  X7 → Y11
  X10 → Y12
  X11 → Y13

• Monitor Output for Safety Output
  Safety Input 1 Monitor (Note 1)
  Safety Output 1 Monitor (Note 1)

• Solenoid Output (Note 2)
  Y0, Y1 → Y14
  S1 → Y15
  Y2, Y3 → Y16
  S2 → Y17
  S3 → Y18

Note 1: Safety output 1 monitor and safety output 2 monitor turn off immediately independent of off-delay time.

Note 2: In Run status, the solenoid output turns on when the safety output is off and one or more corresponding safety inputs are off. When all corresponding safety inputs are on, the solenoid output is turned off even when the start input is off.
• Logic 8 Wiring Example

When wiring three emergency stop switches and two interlock switches with solenoid (spring lock type)

S1, S2, S4: Emergency stop switch
S3, S5: Interlock switch with solenoid (spring lock type)
S6, S7, S8: Start switch
K1 to K4: Safety contactor
M1, M2: Motor
S9, S10: Solenoid control switch

(Pressing the solenoid control switches after closing the guard door, contacts 41-42 and 51-52 of S3 and S5 turn on, allowing the SafetyOne to restart.)

Safety components used in this system
Emergency stop switch: XA1E, XW1E, XN1E, HA1B, HA1E, HW1B, HW1E
Interlock switch with solenoid (spring lock type): HS6E
Non-contact safety switch (2NO type): HS7A
Interlock switch: HS6B, HS5B

K1 to K4: Safety contactor
M1, M2: Motor
S9, S10: Solenoid control switch

Safety performance depends on the system configuration.

Note:
When connecting multiple emergency stop switches in series
When not using some safety inputs
### Logic 8 Time Chart

#### When not detecting the welding of start switch on partial stop (manual start input X13 is used)

| Time Event | Safety Input (X0) | Safety Input (X1) | Monitor Output for X0, X1 (Y4) | Safety Input (X2) | Safety Input (X3) | Monitor Output for X2, X3 (Y5) | Safety Input (X6) | Safety Input (X7) | Monitor Output for X6, X7 (Y7) | Control Start Input (X12) | Manual Start Input (X13) | Safety Output 1 (Y0, Y1) | Safety Output Monitor (Y12) | Solenoid Output (Y17) | Safety Output 2 (Y2, Y3) | Safety Output Monitor (Y13) | Solenoid Output (Y20) | Run Monitor (Y16) |
|------------|-------------------|-------------------|-------------------------------|-------------------|-------------------|-------------------------------|-------------------|-------------------|-------------------------------|----------------------------|-------------------|---------------------------|-----------------------------|----------------|----------------|-----------------------------|----------------|----------------|-----------------------------|
| Power ON   |                   |                   |                               |                   |                   |                               |                   |                   |                               |                           |                   |                           |                             |               |               |                             |               |               |                             |
| Safety Output 1 ON |               |                   |                               |                   |                   |                               |                   |                   |                               |                           |                   |                           |                             |               |               |                             |               |               |                             |
| Off-delay Time |               |                   |                               |                   |                   |                               |                   |                   |                               |                           |                   |                           |                             |               |               |                             |               |               |                             |
| Safety Output All ON |               |                   |                               |                   |                   |                               |                   |                   |                               |                           |                   |                           |                             |               |               |                             |               |               |                             |
| Off-delay Time |               |                   |                               |                   |                   |                               |                   |                   |                               |                           |                   |                           |                             |               |               |                             |               |               |                             |
| Safety Output 2 ON |               |                   |                               |                   |                   |                               |                   |                   |                               |                           |                   |                           |                             |               |               |                             |               |               |                             |

**Note 1:** When the input time difference at the dual channel safety input is 0.5s or more, input monitor error is detected.

**Note 2:** When the control start input (X12) is turned on before turning on the manual start input (X13).

#### When detecting the welding of start switch on partial stop (control start inputs X16 and X17 are used)

<table>
<thead>
<tr>
<th>Time Event</th>
<th>Safety Input (X0)</th>
<th>Safety Input (X1)</th>
<th>Monitor Output for X0, X1 (Y4)</th>
<th>Safety Input (X2)</th>
<th>Safety Input (X3)</th>
<th>Monitor Output for X2, X3 (Y5)</th>
<th>Safety Input (X6)</th>
<th>Safety Input (X7)</th>
<th>Monitor Output for X6, X7 (Y7)</th>
<th>Control Start Input (X12)</th>
<th>Control Start Input (X16)</th>
<th>Control Start Input (X17)</th>
<th>Safety Output 1 (Y0, Y1)</th>
<th>Safety Output Monitor (Y12)</th>
<th>Solenoid Output (Y17)</th>
<th>Safety Output 2 (Y2, Y3)</th>
<th>Safety Output Monitor (Y13)</th>
<th>Solenoid Output (Y20)</th>
<th>Run Monitor (Y16)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Power ON</td>
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<tr>
<td>Safety Output 1 ON</td>
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<td>Off-delay Time</td>
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<tr>
<td>Safety Output All ON</td>
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<td>Off-delay Time</td>
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</tbody>
</table>

**Note 1:** When the input time difference at the dual channel safety input is 0.5s or more, input monitor error is detected.

**Note 2:** When the control start input (X12) is turned on before turning on the manual start input (X13).
### Logic Functions

<table>
<thead>
<tr>
<th>Type</th>
<th>Function</th>
<th>Symbol</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Input Function</td>
<td>Dual channel direct opening input</td>
<td>![Dual Channel Direct Opening]</td>
<td>For connecting safety components with dual channel direct opening action mechanism, such as emergency stop switches and interlock switches.</td>
</tr>
<tr>
<td></td>
<td>Dual channel dependent input</td>
<td>![Dual Channel Dependent]</td>
<td>For connecting safety components with dual channel dependent action mechanism, such as enabling switches.</td>
</tr>
<tr>
<td></td>
<td>Dual channel NO/NC Input</td>
<td>![Dual Channel NO/NC]</td>
<td>For connecting safety components with dual channel NO/NC mechanism, such as non-contact interlock switches.</td>
</tr>
<tr>
<td></td>
<td>Dual channel solid state input</td>
<td>![Dual Channel Solid Stat]</td>
<td>For connecting safety components with dual channel solid state output (PNP output), such as light curtains or safety laser scanners.</td>
</tr>
<tr>
<td></td>
<td>Mode select input</td>
<td>![Mode Selector Switch]</td>
<td>For connecting components with mode select function, such as mode selector switches.</td>
</tr>
<tr>
<td></td>
<td>Muting input</td>
<td>![Muting Input]</td>
<td>For connecting components such as muting sensors and limit switches.</td>
</tr>
<tr>
<td></td>
<td>Monitor input</td>
<td>![Single Channel Monitor]</td>
<td>For connecting switches or sensors for start input.</td>
</tr>
<tr>
<td></td>
<td>External device monitor input</td>
<td>![External Device Monitor]</td>
<td>For monitoring external devices controlled by the SafetyOne. External devices are diagnosed for errors by connecting a NC contact, such as contactor or safety relay.</td>
</tr>
</tbody>
</table>

| Logic Operation Function      | AND function                          | ![AND]                     | Logical multiplication (AND) of multiple inputs.                             |
|                               | OR function                           | ![OR]                      | Logical addition (OR) of multiple inputs.                                   |
|                               | XOR function                          | ![XOR]                     | Exclusive logical addition (XOR) of multiple inputs.                        |
|                               | Self-hold function                    | ![Self-hold]               | Self-holding of input.                                                      |
|                               | Muting function                       | ![Muting]                  | Adds muting function to the connected safety components.                   |
|                               | Control start                         | ![Control]                 | Adds operation confirmation function to the connected start input devices.  |

| Output Function               | Safety output with timer              | ![Safety Output With Timer] | For controlling the safety output.                                           |

(09/01/07)
Dimensions

Operating Instructions

Installation Location
When installing the SafetyOne in an enclosure such as a control panel, make sure that the operating condition satisfies the specifications of the SafetyOne. Do not use the SafetyOne in an environment described below, or where the operating conditions exceed the limit of the SafetyOne. Otherwise electric shock, fire hazard, damage, or malfunction will be caused.

- Near inductive device or heat source
- Where excessive dust, dirt, salt, or iron powder is present
- Where the SafetyOne is exposed to vibration or shock

For maintenance and ventilation, provide space around the SafetyOne as shown in the figure below, so that sufficient distance is kept from other components, heat source, or panel surface.

Installing on DIN Rails
Use 35mm-wide DIN rails for installing the SafetyOne. Applicable DIN rails: BAA1000 (IDEC)

Installing
1. Fasten the DIN rail to a panel using screws firmly.
2. Pull out the clamp from the SafetyOne module, and put the groove of the module on the DIN rail. Press the module towards the DIN rail and push in the clamp as shown below.
3. Use BNL6 end clips on both sides of the SafetyOne module to prevent from moving sideways.

Removal
1. Insert the tip of a flat screwdriver into the latch.
2. Pull down the latch until the latch clicks.
3. Pull out the SafetyOne lightly, and remove from the DIN rail.

Direction
Install the SafetyOne vertically as shown in Figure 1. Do not install in other directions (Figure 2).
Wiring

For wiring the SafetyOne, spring clamp (supplied with the SafetyOne) or crimp connector can be used. For crimp type connector, contact Tyco Electronics AMP.

Push the connector into the SafetyOne until the latches click. For removal, make sure to press down the latches completely before removing the connector, otherwise the connector and wires may be damaged.

Applicable Wire and Ferrule Size

(spring clamp type)

AWG#18 to 24 (recommended wire: UL1007)
Strip length 7.0 ±0.3mm.

When using a ferrule for wiring, select a ferrule which satisfies the terminal specifications shown below.

<table>
<thead>
<tr>
<th>Terminal Wire</th>
<th>Ferrule</th>
</tr>
</thead>
<tbody>
<tr>
<td>a: 1.02 to 1.21 mm</td>
<td>b: 0.95 to 1.21 mm</td>
</tr>
</tbody>
</table>

Applicable wire: AWG#24 (recommended: UL1007)

Wiring to Spring Clamp Connector

When wiring to a connector, make sure that the connector is removed from the SafetyOne, otherwise the connector and the SafetyOne may be damaged. For wiring, use the connecting tool FS9Z-SD01. When rewiring, use the wire of the same type and size.

1. Insert the connecting tool completely into the tool slot in the connector at an angle.
2. Insert a wire into the wire slot. When using a stranded wire, twist the wire beforehand so that the wire does not become loose.
3. While the wire is inserted, remove the connecting tool. Wiring is completed. Pull the wire lightly to confirm whether it is clamped securely.
4. To remove the wire, press down the spring using the connecting tool and pull out the wire.

Using a Screwdriver

When using a screwdriver for wiring, use a screwdriver of 2.4mm wide maximum at the tip. Pay extra attention when using a screwdriver, so that the connector is not damaged.

1. Insert the screwdriver into the tool slot on the connector at an angle, and press down so as to pry open the spring. Do not apply excessive force when inserting the screwdriver, otherwise the connector will be damaged. Do not insert the screwdriver into the wire slot.
2. While the screwdriver is inserted, insert a wire into the wire slot. When using a stranded wire, twist the wire beforehand so that the wire does not become loose.
3. While the wire is inserted remove the screwdriver. Wiring is completed. Pull the wire lightly to confirm whether it is clamped securely.
4. To remove the wire, press down the spring using the screwdriver and pull out the wire.

Safety Precautions

1. Do not disassemble, repair, or modify the SafetyOne, otherwise the safety characteristics of the SafetyOne are impaired. Turn off the power to the SafetyOne before installation, removing, wiring, maintenance, or inspection of the SafetyOne. Failure to do so may cause electrical shocks or fire hazard.
2. Before operating the SafetyOne, read the instruction sheet and the user’s manual carefully, and ensure that the environment conforms to the requirements of the SafetyOne specifications. If the SafetyOne is operated in an environment that exceeds the specifications of the SafetyOne, the safety characteristics of the SafetyOne are impaired.
3. The installation, wiring, configuration, and operation of the SafetyOne must be performed by safety experts only. Safety experts are personnel who have necessary qualifications authorizing them to perform designing, installation, operation, maintenance, and disposal of the SafetyOne. Persons without technical expertise must not use the SafetyOne.
4. The SafetyOne must be subjected to a regular test which proves that all functions of the SafetyOne satisfy the required standard.
5. Perform daily operation check on the SafetyOne.
6. Install the SafetyOne according to the instruction sheet and the user’s manual. Improper installation may cause failure of the SafetyOne.
7. Do not use the monitor outputs or solenoid/lamp outputs as safety outputs, otherwise the system safety is impaired in case the SafetyOne or connected components fail.
8. Do not use the start input and the external device monitor input as safety inputs, otherwise the system safety is impaired in case the SafetyOne or connected components fail.
9. Use the SafetyOne in compliance with laws and regulations of the country or region where the SafetyOne is used.
10. Use safety inputs and safety outputs in circuit configurations which conform to safety requirements and applications.
11. Calculate the respective safety distances, while taking into consideration the response time of the SafetyOne and safety components connected to the SafetyOne.
12. Separate the SafetyOne from components and wires which do not satisfy Class 2 circuit requirements.
13. Safety performance differs depending on system configurations.
14. Use a power supply that meets the following required specifications completely:
   - Complies with the power supply rating of the SafetyOne.
   - The primary and secondary circuits are separated by double insulation or reinforced insulation.
   - Has the functionality equivalent of the control voltage and current of Class 2 circuit specified by UL508 or UL1310.
   - Complies with safety laws or regulations relating to electrical safety or EMC of the country where the SafetyOne is used.
15. Ground the V–line (0V DC) for ground diagnosis.
16. After setting a new configuration or modifying a configuration, check each input and output function.
17. Implement protective measure so that personal other than safety responsible persons operating the SafetyOne do not modify the configuration.
18. The SafetyOne is designed for installation within an enclosure. Do not install the SafetyOne outside an enclosure. Install the SafetyOne in enclosure of IP54 or higher protection.
19. Install the SafetyOne in environments specified in the catalog, instruction sheet, and user’s manual. If the SafetyOne is used in places where the SafetyOne is subjected to high temperature, high humidity, condensation, corrosive gases, excessive vibra-
Safety Precautions

- Ground the FE terminal to assure electromagnetic compatibility.
- Use a common 0V DC line when different power supplies are used for the SafetyOne and other components (ex. light curtain).
- Separate the input and output wiring from power lines.
- When overcurrent flows into output terminals, the protective function turns off the output. However, when overcurrent status lasts long, internal protective elements will fuse. To protect the internal elements, insert fuses of double the rated value to each terminal.
- Use the fuse compliant with IEC60127 requirements on the power line of the SafetyOne. (Required for equipment incorporating the SafetyOne for the use in Europe.)
- When disposing of the SafetyOne, do so according to the regulations of the country or region.
- Do not drop the SafetyOne during transportation, otherwise damage or malfunction may result.
- Prevent metal fragments and pieces of wire from dropping inside the SafetyOne housing. Put a cover on the SafetyOne during installation and wiring. Ingress of such fragments and chips may cause fire hazard, damage or malfunction.
- Install the SafetyOne so that there is adequate distance from the walls, heat generating devices or peripherals, taking into consideration spacing requirements for maintenance and ventilation.

Specifications and other descriptions in this catalog are subject to change without notice.