

FS1A-C11S

Safety Controller

SafetyOne

User's manual



IDEC CORPORATION

SAFETY PRECAUTIONS

- Carefully read this user's manual to ensure correct operation before starting installation, wiring, operation, maintenance, and inspection of the SafetyOne.
- In this user's manual, safety precautions are categorized in order of importance Warning and Caution, as follows:

Warning

Warning notices are used to emphasize that improper operation may cause severe personal injury or death.

Caution

Caution notices are used where inattention might cause personal injury or damage to equipment.

Warning

- Do not disassemble, repair, or modify SafetyOne. This will cause impairment of the safe operability of SafetyOne.
- Turn off the power to SafetyOne before starting installation, removing, wiring, maintenance, or inspection. This can cause electrical shocks or fire hazard.
- Before operating SafetyOne, carefully read the instruction sheet and this manual, and ensure that the environment conforms to the requirements of SafetyOne specifications. If SafetyOne is operated in an environment that exceeds the specifications, it causes impairment of the safe operation of SafetyOne.
- The installation, wiring, configuration, and operation of SafetyOne must be performed only by "Safety responsible persons". Safety responsible persons are personal who have requisite qualification authorizing them as being capable of safely carrying out each step including the designing, installation, operation, maintenance, and disposal of SafetyOne. Persons without technical expertise of safety products must not use SafetyOne.
- SafetyOne must be subjected to regular proof test verification that each function of SafetyOne is performing up to the required standard.
- Installation of SafetyOne must be performed according to the instructions found in the instruction sheet and this manual. Improper installation may cause the SafetyOne to fail.
- Do not use the monitor outputs or solenoid/lamp outputs as a safety outputs. When there is a failure in SafetyOne or peripheral devices, Impairment of the safe operation of the system is possible.
- The start switch has to be placed outside the danger zone and in a safe position from which there is good visibility for checking that no person is within the danger zone.
- Do not use the start input and the external device monitor input as a safety input. When there is a failure in SafetyOne or peripheral devices, Impairment of the safe operability of the system is possible.
- Use the SafetyOne in compliance with laws and regulations of the country in which it is being used.
- Use safety inputs and safety outputs in circuit configurations conforming to the application according to the usage, and the safety requirements.

 **Warning**

- Calculate respective safety distances, taking into consideration the response time of the SafetyOne, safety devices to be connected to the SafetyOne, and each other device that forms a part of the system configuration.
- Applicable safety performance is dependent on each system configuration.
- Use a power supply that meets following required specifications:
 - Conforms to the power supply rating of SafetyOne.
 - Complies with the SELV/ PELV circuit specified by EN 50178 or EN60950.
 - Has the functionality or the functional equivalent of the control voltage and current of class 2 circuit, as defined in UL508 or UL1310.
 - Is in compliance with safety laws and regulations relating to electrical safety, EMC, and like under the laws and regulations of the country in which it is being used.
- Ground the V- line (0V DC) for ground diagnosis.
- In the case of a new configuration or modified installation, be sure to perform a check for each input and output function.
- Implement protective measures that personal, other than safety responsible persons operating the SafetyOne, are unable to modify the configuration.
- Separate SafetyOne from devices and wires which are not in accordance with class 2 circuit requirements.

Warning

- Do not connect devices having input and output specifications that do not satisfy the requirements of the SafetyOne.

Refer to the following for information on the requirements of connected devices.

Connected Control Device	Requirements
Emergency stop switch	Device equipped with a direct opening action mechanism conforming to IEC/EN60947-5-5 or indicated in IEC/EN60947-5-1
Interlock switch, limit switch	Device equipped with a direct opening action mechanism indicated in IEC/EN60947-5-1
Interlock switch with lock	Spring lock interlock switch with solenoid
Mode select switch	Device conforming to regulations of the country where used and required categories (for example, switch conforming to IEC/EN60947-1)
Enabling switch	Device conforming to IEC/EN60947-5-8 (or IEC/EN60947-5-1)
Solid state output device	Device conforming to regulations of the country where used (for example, safety light curtain conforming to IEC/EN61496-1) PNP output (See Note 1)
Non-contact interlock switch	IDEC HS7A series, IDEC HS3A serie
Safety relay	Relay equipped with forced guide mechanism or conforming to EN50205
Contactors (electromagnetic switch)	Contactors equipped with forced guide mechanism
Other control devices	Use start switches and other devices that conform to the regulations of the country where used.
Muting sensor	Device conforming to IEC/EN60947-5-2 as shown below -3 wire transmission (dark on) photoelectric switch which has a PNP open collector output. -3 wire (normal open) proximity switch which has a PNP open collector output.
Muting lamp	Incandescent bulb indicator light conforming to IEC/EN60947-1 or IEC/EN60947-5-1 Note 2: It is not possible to detect a disconnection of the muting lamp when using an LED indicator light.
Input device for two-hand control	Device with the structure conforming to ISO13851, and consists of momentary switches conforming to IEC/EN 60947-5-1 with NO/NC contacts.

- Make sure that the end-user thoroughly understands the contents of this user's manual.

Note 1. SafetyOne reads input data at regular intervals. Use a solid state output device that sends output signals of the waveforms shown below. Otherwise the SafetyOne cannot process the input signal correctly.

Applicable solid state output device (Waveform of solid state output)	<p>Pulse output off cycle of 40ms or more and an off time of 1ms or less.</p> <p>Off time: 1ms or less Off cycle: 40ms or more</p>	<p>Pulse output off time of 0.5ms or less.</p> <p>Off time: 0.5ms or less</p>
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The device may not be usable even if the above specifications are satisfied. Be sure to thoroughly confirm operations using the actual device.

 **Caution**

- SafetyOne is designed for installation within an enclosure. Do not install SafetyOne outside an enclosure. Install SafetyOne in enclosure rated IP54 or higher.
- Install SafetyOne in environments described in the catalog, instruction sheet, and user's manual. If SafetyOne is used in places where it is subjected to high temperature, high humidity, condensation, corrosive gases, excessive vibrations, and excessive shocks then electrical shocks, fire hazard, or malfunction may result.
- Environment for using the SafetyOne is "Pollution degree 2". Use SafetyOne in environments of pollution degree 2 (according to IEC/EN60664-1).
- Prevent SafetyOne from falling while moving or transporting otherwise damage or malfunction of the SafetyOne 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 SafetyOne, so that there is adequate distance from the walls, heat generating bodies, and peripherals, taking into consideration space requirements for maintenance and ventilation.
- Install SafetyOne on 35mm DIN rails with BNL6 mounting clips (sold separately) on both sides of SafetyOne.
- Wire the connectors with conforming cables or ferrules.
- Ground FE terminal to assure electromagnetic compatibility.
- Use common 0V DC, if different power supplies are used for SafetyOne and other devices (ex. safety light curtain).
- Wire the inputs and outputs so that they are separated 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 IEC60127 approved fuses on the power line of SafetyOne. (This is required for equipment incorporating SafetyOne that is destined for Europe.)
- When disposing of SafetyOne, handle it under the laws and regulations of the country in which it is disposed.

BEFORE GETTING STARTED

Thank you for your purchase of the IDEC SafetyOne (Type Number FS1A-C11S).

This user's manual describes the specifications, and the procedures for installing and operating the SafetyOne.

Read this manual carefully before using the SafetyOne so that you have an adequate understanding of its functions and performance.

■ About directives and standards

SafetyOne is approved for following directives and standards by TÜV SÜD.

1. EU directives

-Machinery Directive: Directive 2006/42/EC

2. EN standards / IEC standards / ISO standards

IEC/EN 61131-2, IEC 61508 Part1-4, EN ISO 13849-1, IEC/EN 62061, IEC 61326-3-1

SafetyOne is approved for following directives and standards by UL.

1. UL standards

- UL 508

2. CSA standards

- CSA C22.2 No.142

SafetyOne has not undergone the type examination in accordance with Article 44-2 of the Japanese Industrial Safety and Law. SafetyOne, therefore, cannot be used in Japan as a "Safety Device for Press or Shearing machine" as established in Article 42 of that law.

NOTE

- The reproduction, transfer, sale, assignment, or loan of any or a part of this manual is strictly prohibited.
- The contents of this manual are subject to change without notice.
- Thorough measures have been taken in preparing the contents of this manual; however, in the case you find an error or the like, please bring it to the attention of your IDEC sales representative.

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Chapter1 OVERVIEW

This chapter provides an understanding of the SafetyOne. Make efficient use of the SafetyOne by thoroughly familiarizing yourself with its functions.

About the SafetyOne

The FS1A series of SafetyOne™ controllers provides safeguarding measures for various factory automation equipment and systems, including robots, production machinery, semiconductor manufacturing apparatus, food packaging machinery, and printing machinery. You can easily configure the safety circuits by using multiple safety inputs and outputs and selecting the circuit (logic) built into the SafetyOne.

Chapter 1



Features of the SafetyOne

- **You can configure safety circuits without the use of complicated external wiring or special software, thereby greatly reducing the number of developmental man-hours required for product certification and the training time of safety responsible persons.**

- **You can use the DIP switches to select from 24 different types of logic circuits and set the OFF-delay timer value to best match your application.**

The SafetyOne has 16 DIP switches and an ENTER button, which can be used to set the built-in types of logic and the delay timer values for the safety output is OFF.

You can choice logic circuit from integrated 24 types.

You can set the timer value to 0, 0.1, 0.5, 1, 2, 5, 15, or 30 seconds. You can set the stop category to 0 or 1.

- **Conforms to the international safety standards IEC 61508 SIL 3 and EN ISO 13849-1 PL e (Control category 4).**

The SafetyOne can be used for functional safety standard IEC 61508 series and IEC 62061 SIL 1 to 3, which define the safety performance of machinery that uses microprocessors and software, and for performance levels a to e of EN ISO 13849-1 and Control category B to 4 of EN ISO 13849-1, which define safety performance of machinery control systems.

- **You can directly connect an emergency stop switch, interlock switch, light curtain, and other various safety devices.**

The SafetyOne provides dual channel direct opening inputs such as an emergency stop switch or interlock switch; dual channel NO/NC inputs such as a non-contact interlock switch; and dual channel safety inputs such as a safety light curtain or safety laser scanner. These inputs can be enabled by selecting a certain type of logic, thereby enabling various safety devices.

- **The SafetyOne comes with monitor outputs and solenoid/lamp outputs, which can be used as control signals.**

With monitor outputs, you can monitor the status of the SafetyOne, including safety inputs and outputs and error information. When connected to a PLC, the SafetyOne can be used to control all apparatus and the entire system. The SafetyOne is also provided with solenoid/lamp outputs, which can be used to directly control spring lock safety switches with solenoids. In logic4, muting lamps can be connected to solenoid/lamp outputs.

- **Obtain detailed diagnostic information with the LED displays.**

The SafetyOne has two 7-segment LED displays for displaying internal information and 30 LED lights for displaying status. You can use these to display input and output information and to obtain detailed diagnostic information on the status of the SafetyOne.

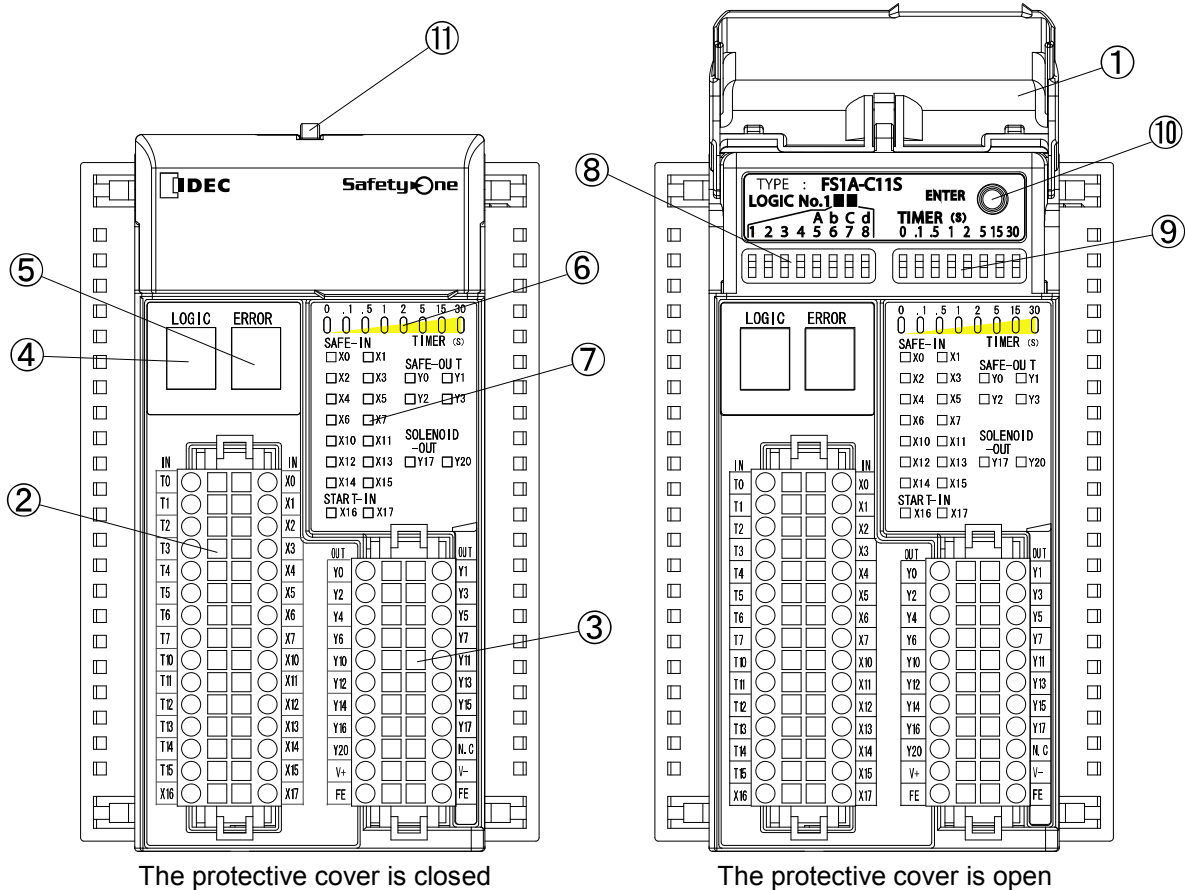
- **Control multiple safety devices (12 safety inputs and 4 safety outputs) by a single unit.**

The SafetyOne has 12 safety inputs and 4 safety outputs, and it can be configured for up to 6 dual channel inputs and 2 dual channel outputs (in case of use as a single channel output, up to 4 outputs)

Chapter 2 PRODUCT SPECIFICATIONS

This chapter describes product specifications of the SafetyOne.

Parts Description



The protective cover is closed

The protective cover is open

1. Protective cover: The cover protects unauthorized changing of configuration switches.
2. Input connector: Spring clamp connector for input devices. (Crimp connector can also be used.)
3. Output connector: Spring clamp connector for output devices and power supply.
(Crimp connector can also be used)
4. Logic LED: The 7-segment green LED indicates the number of logic pattern selected.
5. Error LED: The 7-segment red LED indicates an error in the SafetyOne and peripherals.
6. Timer LED: The eight Timer LEDs indicate the selected timer value.
7. Input/output status LED: The input LEDs indicate the state of inputs.
The output LEDs indicate the state of outputs.
 - SAFE-IN: Status of safe inputs, e.g. X0 ... X15
 - START-IN: Status of start inputs, e.g. X16, 17
 - SAFE-OUT: Status of safe outputs, e.g. Y0 ... Y3
 - SOLENOID-OUT: Status of solenoid outputs, e.g. Y17, 20
8. Logic switch: DIP switch for selecting the internal logic.
9. Timer switch: DIP switch for selecting the OFF-delay time for the safe output.
10. Enter button: button for activation of parameter changes.
11. Locking ring: ring for locking the protective cover

General specifications

Operating conditions	
Operating temperature (Surrounding air temperature)	-10 to +55 °C (no freezing)
Relative operating humidity	10 to 95% (non-condensing)
Storage temperature	-40 to +70 °C (no freezing)
Relative storage humidity	10 to 95% (non-condensing)
Pollution degree	2 (IEC/EN 60664-1)
Degree of protection	IP20 (IEC/EN 60529)
Corrosion immunity	Atmosphere be free from corrosive gas
Altitude	Operation: 0 to 2,000m (0 to 6,565 feet)
	Transportation: 0 to 3,000m (0 to 9,840 feet)
Vibration resistance	Vibration (IEC/EN 60068-2-6): 5 to 8.4 Hz amplitude 3.5 mm, 8.4 to 150 Hz acceleration 9.8 m/s ² (1G), 2 hours per each of XYZ axes Bump (IEC/EN 60068-2-29): Acceleration 98 m/s ² (10G), 16ms duration, 1000 times per each of XYZ axes
Shock resistance	147 m/s ² (15G), 11 ms duration, 3 times per each of XYZ axes (IEC/EN 60068-2-27)
Connector durability	50 times maximum
Operation strength of configuration switches	100 operations maximum (per 1 switch)
Operation strength of enter button	1000 operations maximum
Enclosure material	modified-Poly Phenylene Ether (m-PPE)
Weight	Approximately 330g
Life time	10 years (at 40 °C of operating temperature)
Over voltage category	II
Electrical conditions	
Rated voltage	24V DC
Allowable voltage range	20.4V DC to 28.8V DC
Maximum power consumption	48W (at 24V DC, all inputs and outputs are ON, includes output loads)
Allowable momentary power interruption	10ms minimum (at rated voltage DC)
Reaction time	ON to OFF: 40 ms maximum ^{Note1} : 100ms maximum ^{Note2}
	OFF to ON: 100 ms maximum ^{Note3}
Start-up time ^{Note4}	6s maximum
Dielectric strength	Between live part and FE terminal: 500VAC, 1 minute
	Between enclosure and FE terminal: 500VAC, 1 minute
Insulation resistance	Between live part and FE terminal: 10MΩ minimum (at 500V DC megger)
	Between enclosure and FE terminal: 10MΩ minimum (at 500V DC megger)
Noise immunity (Noise simulator)	DC power terminals: ±1.0 kV, 50 ns to 1 μs
	I/O terminals: ±2.0 kV, 50 ns to 1 μs (with coupling adapter)

Inrush current	25A maximum
Affect of improper power supply connection	Reverse polarity: No operation, no damage
	Improper voltage: Permanent damage may occur

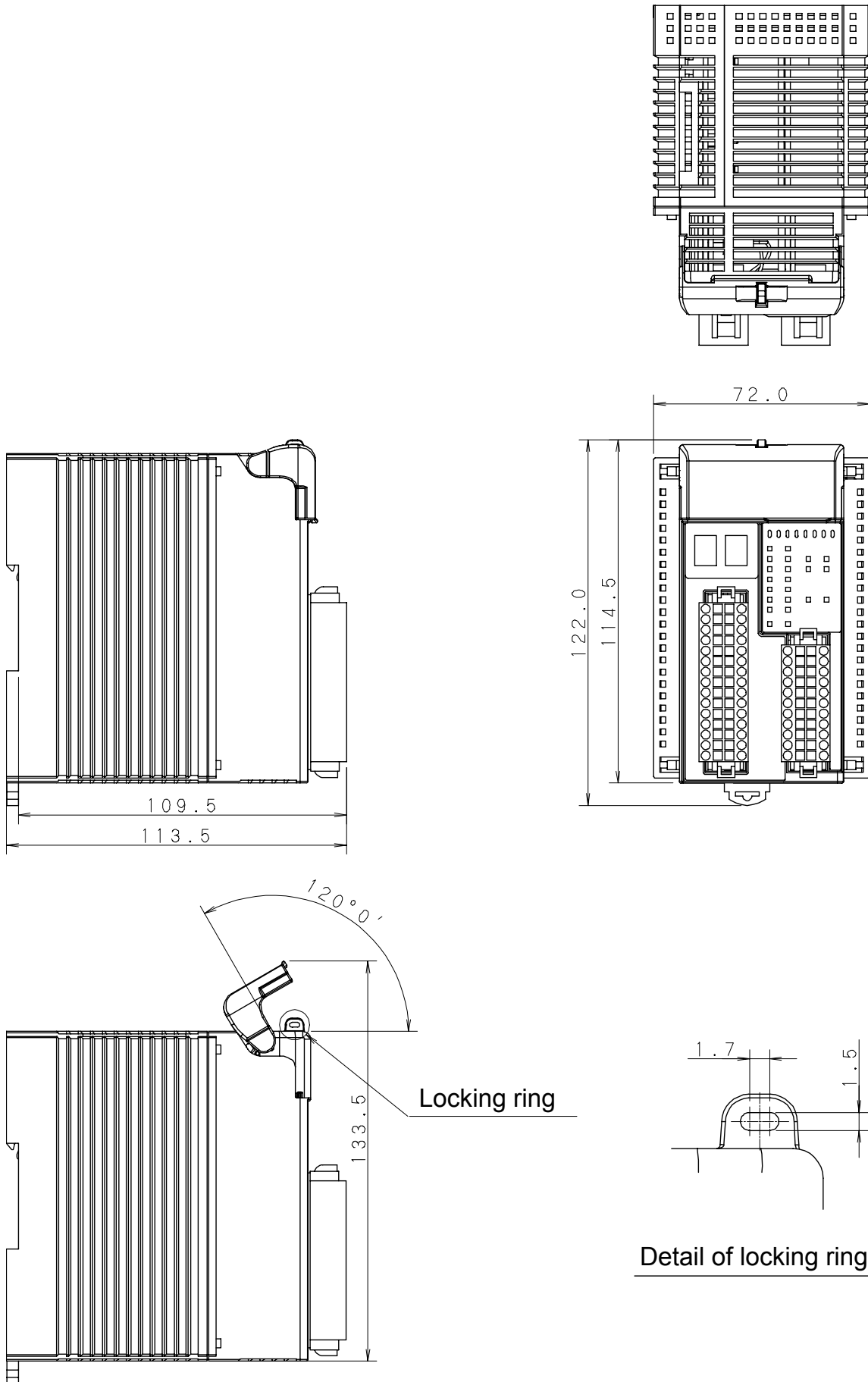
Note1. Time to shut OFF safety outputs after safety inputs are turned OFF or input monitor error is detected (in case of OFF-delay timer is 0s). If the timer value except 0s, add the selected OFF-delay time to this reaction time.

Note2. Time to shut OFF safety outputs after error (except input monitor error) is detected, or configuration change is detected. This reaction time does not depend on OFF-delay timer value.

Note3. Time to turn ON safety outputs after safety inputs are turned ON (in case of auto start). In case of manual start, it means time turn ON safety outputs after start input is turned ON. In case of control start, it means time to turn ON safety outputs after start input transits from ON to OFF.

Note4. Time to change to Run state after power ON.

Dimensions



Applicable standards

Standard	Title
IEC 61508 Part1-7 : 2010	Functional safety of electrical/electronic/programmable electronic safety-related systems
EN ISO 13849-1 : 2008	Safety of machinery -- Safety-related parts of control systems -- Part 1: General principles for design
IEC 62061 : 2005/A1: 2012 EN 62061 : 2005/A1: 2013	Safety of machinery - Functional safety of safety-related electrical, electronic and programmable electronic control systems
IEC 61496-1 : 2012 EN 61496-1 : 2013	Safety of machinery - Electro-sensitive protective equipment - Part 1: General requirements and tests
IEC/EN 61131-2 : 2007	Programmable controllers Part 2: Equipment requirements and tests
IEC/EN 61000-6-2 : 2005	Electromagnetic compatibility (EMC) – Part 6-2: Generic standards – Immunity for industrial environments
IEC 61000-6-4 : 2006/A1:2010 EN 61000-6-4 : 2007/A1:2011	Electromagnetic compatibility (EMC) – Part 6-4: Generic emission standards – Residential, commercial, and light industry
IEC/EN 61326-3-1 : 2008	Electrical equipment for measurement, control and laboratory use - EMC requirements - Part 3-1: Immunity requirements for safety-related systems and for equipment intended to perform safety-related functions (functional safety) - General industrial applications
ISO13851 : 2002	Safety of machinery -- Two-hand control devices -- Functional aspects and design principles
UL 508	Industrial control equipment
CSA C22.2 No.142	Process control equipment

Safety performance

In the case of using safety outputs as dual channel outputs, SafetyOne can be used in a system for control category B to 4 and performance level a to e in accordance with EN ISO13849-1 (2008).

In the case of using safety outputs as single channel outputs, SafetyOne can be used in a system for control category B to 3 and performance level a to d in accordance with EN ISO13849-1 (2008).

Average probability of failure on demand (PFD) and Probability of a dangerous failure per hour (PFH)

- In the case of using safety outputs as dual channel outputs

The following table describes PFD and PFH in the case of dual channel outputs. They are needed for calculation of safety integrity level (SIL) which is applied to a system with SafetyOne. In this case SafetyOne can be used in a system for SIL 1 to 3 in accordance with IEC61508 (2010).

Proof test interval ^{Note}	Average Probability of Failure on Demand (PFD)	Probability of a dangerous Failure per Hour (PFH)
6 months	$< 2.1 \times 10^{-5}$	$< 7.1 \times 10^{-9}$
1 year	$< 3.6 \times 10^{-5}$	
2 years	$< 6.7 \times 10^{-5}$	
5 years	$< 1.6 \times 10^{-4}$ (SIL2)	
10 years	$< 3.2 \times 10^{-4}$ (SIL2)	

In this case SafetyOne can be used in a system for SIL 1 to 3 in accordance with IEC/EN62061 (2005).

Proof test interval ^{Note}	Probability of a dangerous Failure per Hour (PFH)
10 years	$< 1.4 \times 10^{-8}$

- In the case of using safety outputs as single channel outputs

The following table describes PFD and PFH in the case of single channel outputs. They are needed for calculation of safety integrity level (SIL) which is applied to a system with SafetyOne. In this case SafetyOne can be used in a system for SIL 1 to 2 in accordance with IEC61508 (2010).

Proof test interval ^{Note}	Average Probability of Failure on Demand (PFD)	Probability of a dangerous Failure per Hour (PFH)
6 months	$< 4.1 \times 10^{-5}$	$< 1.6 \times 10^{-8}$
1 year	$< 7.5 \times 10^{-5}$	
2 years	$< 1.5 \times 10^{-4}$	
5 years	$< 3.6 \times 10^{-4}$	
10 years	$< 7.0 \times 10^{-4}$	

In this case SafetyOne can be used in a system for SIL 1 to 2 in accordance with IEC/EN62061 (2005).

Proof test interval ^{Note}	Probability of a dangerous Failure per Hour (PFH)
10 years	$< 2.0 \times 10^{-8}$

Note. Refer to Maintenance and Inspection in "APPENDIX" for proof test procedure.

Mean Time To dangerous Failure (MTTF_d) and diagnostic coverage (DC)

- In the case of using safety outputs as dual channel outputs

The following table describes MTTF_d and DC in the case of dual channel outputs. They are needed for the calculation of Performance Level (PL) which is applied to a system with SafetyOne. In this case SafetyOne can be used in a system for PL a to e in accordance with EN ISO13849-1 (2008).

Mean time to dangerous failure (MTTF _d)	Diagnostic Coverage (DC)
100 years	High

- In the case of using safety outputs as single channel outputs

The following table describes MTTF_d and DC in the case of single channel outputs. They are needed for the calculation of Performance Level (PL) which is applied to a system with SafetyOne. In this case SafetyOne can be used in a system for PL a to d in accordance with EN ISO13849-1 (2008).

Mean time to dangerous failure (MTTF _d)	Diagnostic Coverage (DC)
100 years	Medium

Safety input specifications

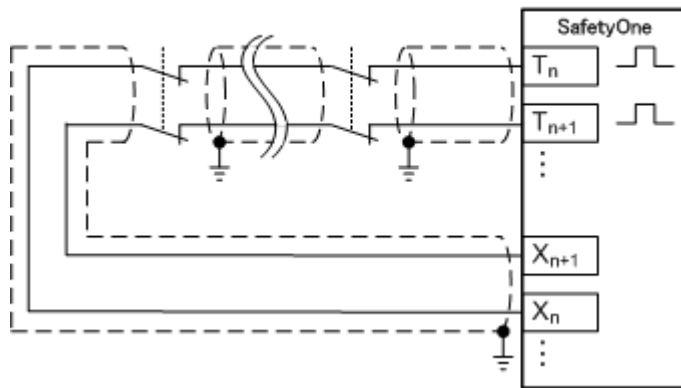
Drive terminal specifications (T0, T1, T2, T3, T4, T5, T6, T7, T10, T11, T12, T13, T14, T15)	
Rated drive voltage	Power supply voltage
Minimum drive voltage	Power supply voltage – 2.0V
Number of drive terminals	14
Maximum drive current	20mA per port (at 28.8V DC) ^{Note1}
Receive terminal specifications (X0, X1, X2, X3, X4, X5, X6, X7, X10, X11, X12, X13, X14, X15)	
Rated input voltage	24V DC
Input ON voltage	15.0V DC to 28.8V DC
Input OFF voltage	Open or 0V DC to 5.0V DC
Number of receive terminals	14
Rated input current	10mA per port (at rated voltage)
Type of input	Sink type input (for PNP output), Type 1 (IEC/EN 61131-2)
Wiring specifications	
Cable length ^{Note2}	100m maximum (total wiring length per 1 input)
Allowable wiring resistance	300Ω maximum

Note1. The drive port generates check pulses in order to diagnose input devices and internal circuits. (Wiring and the diagnostic function are different depending on the logic selected. See “Chapter 5 LOGIC” for details. But the basic function is same.)

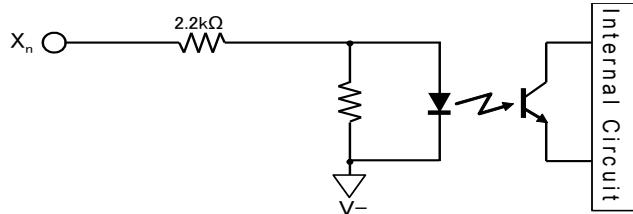
Note2. For cables longer than 30m between SafetyOne and connected devices, or wiring drive terminals and receive terminals separately, use grounded shielded cables to assure electromagnetic compatibility.

Note3. In the common connection of several interlock switches, applicable safety performance depends on result of risk assessment for whole of the safety configuration. Refer to ISO14119 for analysis the connection.

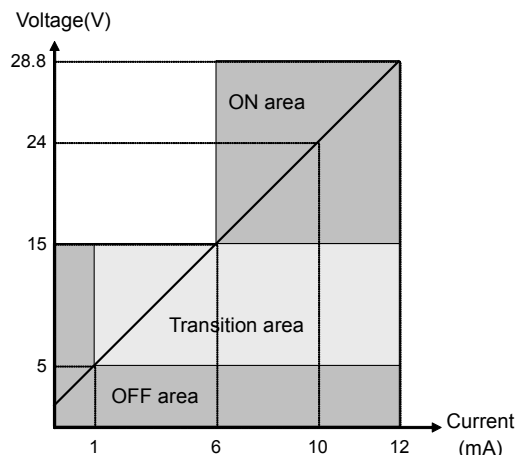
Common connection of several interlock switches



Safety input equivalent circuit



Safety input operating range

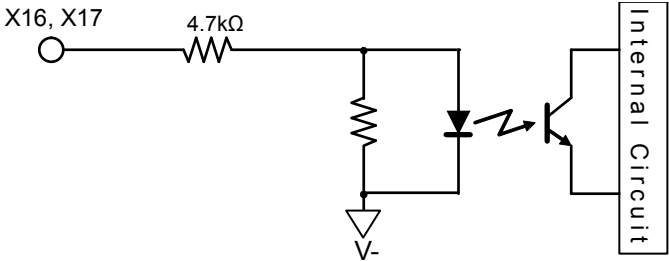


Start input specifications

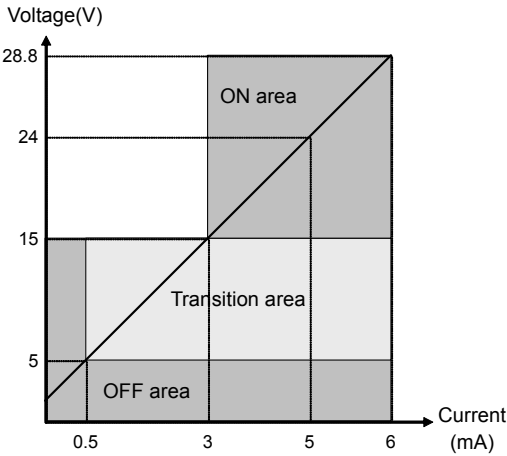
Rated input voltage	24V DC
Input ON voltage	15.0V DC to 28.8V DC
Input OFF voltage	Open or 0V DC to 5.0V DC
Number of start input terminals	2 (X16,17)
Input current	5mA per port (at rated voltage)
Type of input	Sink type input (for PNP output), Type 1 (IEC/EN61131-2)
Cable length ^{Note1}	100m maximum (total wiring length per 1 input)
Allowable wiring resistance	300Ω maximum

Note1. For cables longer than 30m between SafetyOne and connected devices, use grounded shielded cables to assure electromagnetic compatibility.

Start input equivalent circuit



Start input operating range



The specifications of the start inputs changes depending on the Logic selected. See further information in “Chapter 5 LOGIC”. But basic specifications are same.



Do not use start inputs as safety inputs. This may cause the loss of safety functions and possible failure in the SafetyOne or peripherals.

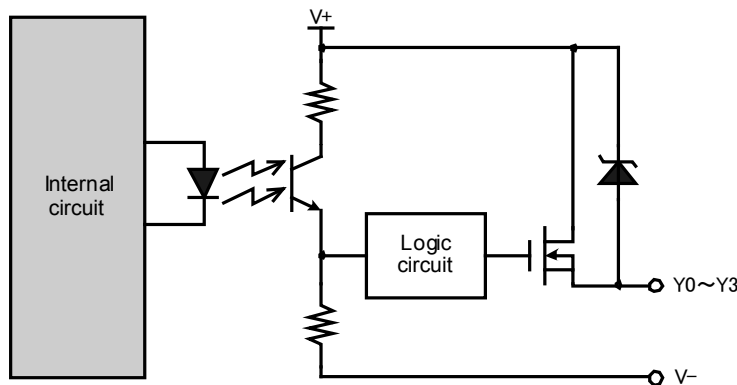
Safety output specifications

Output type		Source output (N channel MOSFET)
Rated output voltage		Power supply voltage
Minimum voltage		Power supply voltage - 2.0V
Number of output terminals		4 (Y0, Y1, Y2, Y3)
Maximum output current	Point	500mA maximum
	total	1A maximum
Leakage current		0.1mA maximum
Allowable inductive Load ^{Note1}		$L / R = 25\text{ms}$
Allowable capacitive load		1 μF maximum
Cable length ^{Note2}		100m maximum (total wiring length per 1 output)

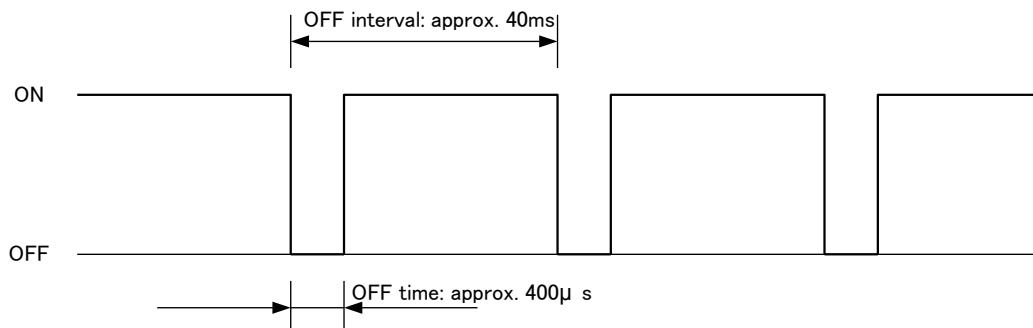
Note1. For protection of output circuits, protection devices such as diodes should be connected to output circuits with inductive loads.

Note2. For cables longer than 30m between SafetyOne and connected devices, use grounded shielded cables to assure electromagnetic compatibility.

Safety output equivalent circuit



Safety outputs of the SafetyOne are semiconductor outputs. For diagnostics of the shut-off function, the SafetyOne generates off-pulses in certain intervals when the outputs are in ON state. The specifications of the safety outputs changes depending on the Logic selected. See further information in “Chapter 5 LOGIC”. But basic specifications are same.



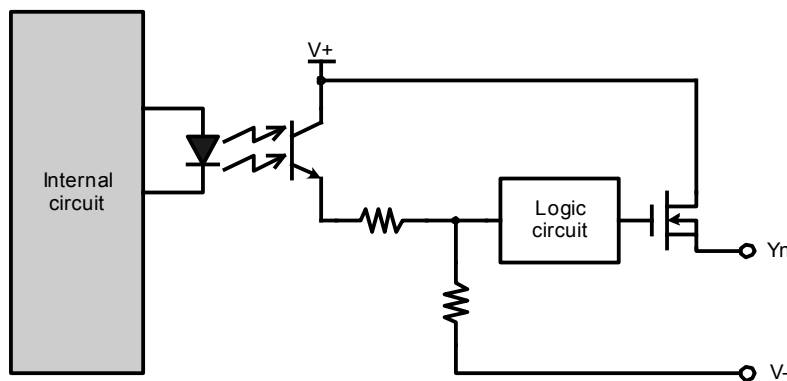
Check the response time of external devices so that they do not correspond to the off pulses. Monitor and solenoid/lamp outputs do not generate off pulses.

Monitor output specifications

Output type		Source output (N channel MOSFET)
Rated output voltage		Power supply voltage
Minimum output voltage		Power supply voltage - 2.0V
Number of outputs		11 (Y4, Y5, Y6, Y7, Y10, Y11, Y12, Y13, Y14, Y15, Y16)
Maximum output current	Point	20mA maximum
	total	220mA maximum
Leakage current		0.1mA maximum
Cable length ^{Note1}		100m maximum (total wiring length per 1output)

Note1. For cables longer than 30m between SafetyOne and connected devices, use grounded shielded cables to assure electromagnetic compatibility.

Monitor output equivalent circuit



The specifications of the monitor outputs change depending on the Logic selected. See further information in “Chapter 5 LOGIC”. But basic specifications are the same.

Warning

Do not use monitor outputs for safety related purposes. This may cause a loss of safety functions in case of failure of the SafetyOne or peripherals.

Caution

Use an IEC60127-approved fuse on the monitor output circuit. (This is required for equipment incorporating SafetyOne that is destined for Europe.)

Ex. Fast-Acting fuse, Amp rating 0.125A, Voltage rating 250V

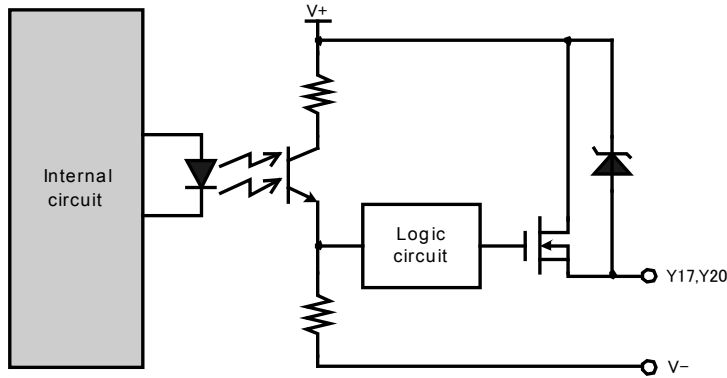
Solenoid/Lamp output specifications

Output type	Source output (N channel MOSFET)	
Rated output voltage	Power supply voltage	
Minimum output voltage	Power supply voltage - 2.0V	
Number of outputs	2 (Y17, Y20)	
Maximum output current	point	500mA maximum
	total	500mA maximum
Leakage current	0.1mA maximum	
Allowable Inductive Load ^{Note1}	L / R = 25ms	
Cable length ^{Note2}	100m maximum (total wiring length per 1 output)	

Note1. For protection of output circuits, protection devices such as diodes should be connected to output circuits with inductive loads.

Note2. For cables longer than 30m between SafetyOne and connected devices, use grounded shielded cables to assure electromagnetic compatibility.

Solenoid/lamp output equivalent circuit



The specifications of the solenoid/lamp outputs changes depending on the Logic selected. See further information in “Chapter 5 Logic”. But basic specifications are the same.

Warning

Do not use solenoid/lamp outputs for safety related purposes. This may cause a loss of safety functions in case of failure of the SafetyOne or peripherals.

Caution

Use an IEC60127-approved fuse on the Solenoid/Lamp output circuit. (This is required for equipment incorporating SafetyOne that is destined for Europe.)

Ex. Time-Lag fuse, Amp rating 2A, Voltage rating 250V

Logic number

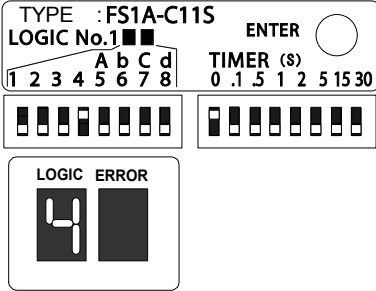
The logic number of the SafetyOne is composed by a 3-digit code as following.

Example 1: LOGIC No.104

The first code "1" indicates the type number "FS1A-C11S".

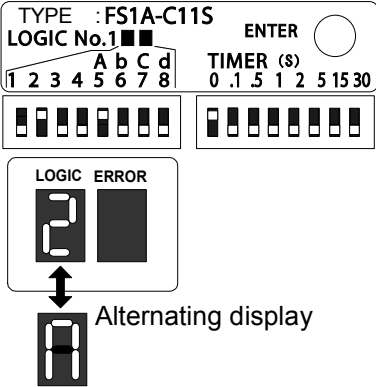
Following 2-digit code "04" indicates the state of the logic switch. The logic LED displays this 2-digit code. But "0" is not displayed.

Ex. 1: Logic 104



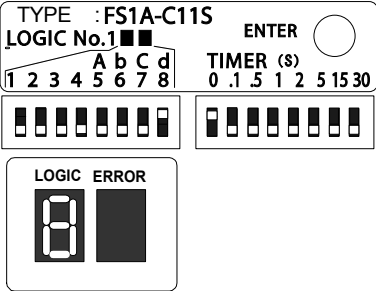
"0" is not displayed.

Ex. 2: Logic 12A



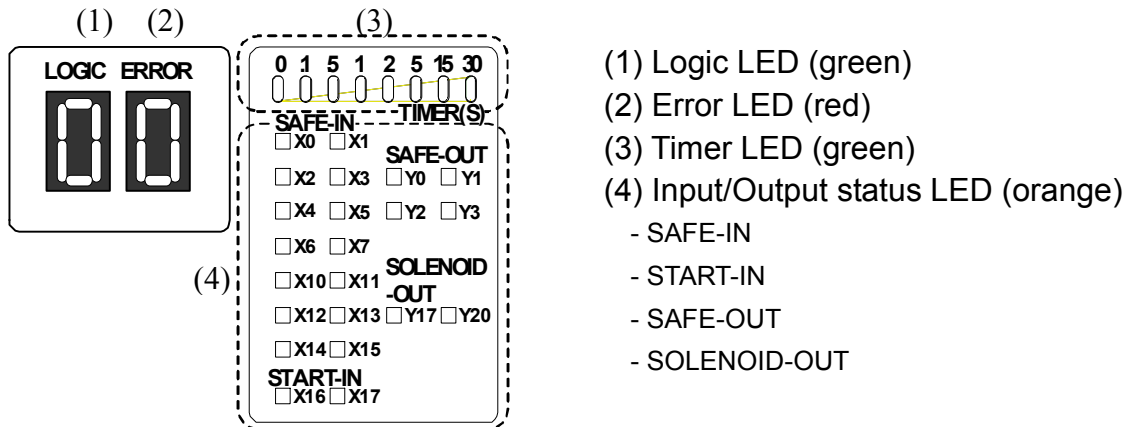
Alternating display

Ex. 3: Logic 108



"0" is not displayed.

Indicators



(1) Logic LED

Indication	Status	Descriptions
"1" ... "8" "A", "b", "C", "d"	ON	The selected logic is in Run or Protection state. (Ex. : In case of logic 14A 4 → A → 4 → A → 4 → ...)
	Blink	The selected logic is in Configuration state. (Ex. : In case of logic 14A 4 → A → OFF → 4 → A → OFF → 4 → A → ...)
"E"	Blink	The selected logic has Configuration error (The logic is not selected or incorrect multiple switches are selected ^{Note1} .)
Random pattern	ON/Blink	Initializing (Initial state)
Blank	OFF	Error (Stop state)

Note1. Proper logic switch configurations are shown below.

-Select one of "1" to "8" switches.

-Select one of "1" to "4" and one of "A", "b", "C", "d" switches.

Other than above selections are incorrect.

(2) Error LED

Indication	Status	Descriptions
"1"	ON	Input monitor error (Protection state)
"2"	ON	Wiring error at safety inputs or error in safety input circuits (Stop state)
"3"	ON	Wiring error at start inputs or error in start input circuits (Stop state)
"4"	ON	Wiring error at safety outputs or error in safety output circuits (Stop state)
"5"	ON	Muting lamp error (disconnection) (Logic 11d only) (Stop state)
"6"	ON	Power supply error or internal power supply circuit error (Stop state)
"7"	ON	Internal error, power supply error or internal power supply circuit error (Stop state)
"9"	ON	EMC disturbance (Stop state)
"C"	ON	Configuration procedure is in progress (Configuration state)
	Blink	Configuration is valid ^{Note1} (Configuration state)
Random	ON/Blink	Initializing (Initial state)
Blank	OFF	Normal operation (Run state)

Note1. Blinks for 1 to 5 seconds after the enter button is pressed. 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.

(3) Timer LED

Indication	Status	Descriptions
0	ON	No OFF-delay (safety outputs shut off immediately)
.1	ON	OFF-delay timer 0.1s
.5	ON	OFF-delay timer 0.5s
1	ON	OFF-delay timer 1s
2	ON	OFF-delay timer 2s
5	ON	OFF-delay timer 5s
15	ON	OFF-delay timer 15s
30	ON	OFF-delay timer 30s
Each LED	Blink	Selected timer value (Configuration state)
Random	ON/Blink	Initializing (Initial state)
Blank	OFF	Timer value is not selected or SafetyOne is in the Stop state

(4) Input LED: SAFE-IN (X0 ... X15), START-IN (X16, X17)

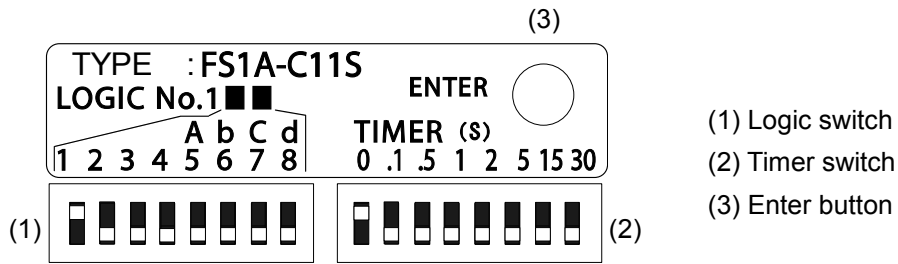
Indication	Status	Descriptions
X0 to X15	ON	Input ON
	OFF	Input OFF, or SafetyOne is in the Stop or Configuration state
	Blink	Input monitor error (Blink input number the error occurred, error number is displayed at Error LED)
X16, X17	ON	Input ON
	OFF	Input OFF, or SafetyOne is in the Stop or Configuration state
	Blink	Input monitor error (Blink input number the error occurred, error number is displayed at Error LED)

Indicators specification of input LEDs are different depending on the selected logic.

(5) Output LED: SAFE-OUT (Y0 ... Y3), SOLENOID-OUT (Y17, Y20)

Indication	Status	Descriptions
Y0 to Y3	ON	Output ON
	OFF	Output OFF, or SafetyOne is in the Stop or Configuration state
	Blink	During OFF-delay timer operation, or output monitor error (Blink output number the error occurred, error number is displayed in Error LED display)
Y17, Y20	ON	Output ON
	OFF	Output OFF, or SafetyOne is in the Stop or Configuration state
	Blink	Output monitor error (Blink output number the error occurred, error number is displayed in Error LED display)

Specification of configuration switches



(1) Logic switch

The logic switch is an 8-digit DIP switch for use in logic configuration. When one of “1” to “8” is selected, or one of “1” to “4” and one of “A”, “b”, “C”, “d” are selected, the corresponding logic in the SafetyOne is activated. See “Chapter 5 Logic” for further information of each logic. The upper position of each digit is the ON state. Other than above selections are not valid.

(2) Timer switch

The timer switch is an 8-digit DIP switch for use in OFF-delay timer value configuration. When one of 8 digits is selected, the delay time at shut-off operation is activated. The upper position of each digit is ON state. Multiple switches must not be selected.

Switch	(Indication)	Descriptions
0	1	No OFF-delay (safety outputs shut OFF immediately)
.1	2	OFF-delay timer 0.1s
.5	3	OFF-delay timer 0.5s
1	4	OFF-delay timer 1s
2	5	OFF-delay timer 2s
5	6	OFF-delay timer 5s
15	7	OFF-delay timer 15s
30	8	OFF-delay timer 30s

(3) Enter button

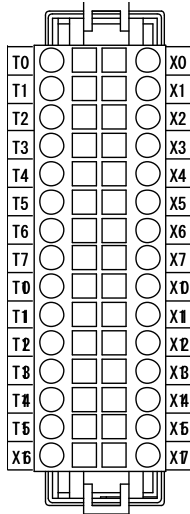
The enter button is used to activate the configuration of logic and timer value. Error LED will blink for 1 to 5 seconds after pressing the enter button. Releasing the button during blinking activates the setting. The blinking LED becomes ON if the button is pressed for more than 5 seconds, and the setting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



For setting the switches and enter button, use the configuration tool supplied with the SafetyOne.

Connector specifications

■ Input connector

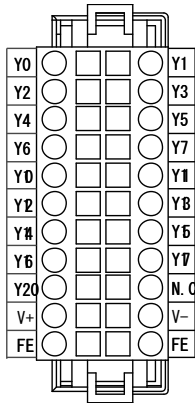


- Connector type:
- Spring clamp connector (30 poles)
FS9Z-CN01 [IDEC]
(Tyco Electronics AMP type Number: 2-1871940-5)
 - Crimp connector (30 poles)^{Note1}
(Tyco Electronics AMP type Number: 2-1871946-5)

Terminal name	Terminal No.	Descriptions	Terminal name	Terminal No.	Descriptions
T0	A1	Safety input drive terminal 0	X0	B1	Safety input receive terminal 0
T1	A2	Safety input drive terminal 1	X1	B2	Safety input receive terminal 1
T2	A3	Safety input drive terminal 2	X2	B3	Safety input receive terminal 2
T3	A4	Safety input drive terminal 3	X3	B4	Safety input receive terminal 3
T4	A5	Safety input drive terminal 4	X4	B5	Safety input receive terminal 4
T5	A6	Safety input drive terminal 5	X5	B6	Safety input receive terminal 5
T6	A7	Safety input drive terminal 6	X6	B7	Safety input receive terminal 6
T7	A8	Safety input drive terminal 7	X7	B8	Safety input receive terminal 7
T10	A9	Safety input drive terminal 10	X10	B9	Safety input receive terminal 10
T11	A10	Safety input drive terminal 11	X11	B10	Safety input receive terminal 11
T12	A11	Safety input drive terminal 12	X12	B11	Safety input receive terminal 12
T13	A12	Safety input drive terminal 13	X13	B12	Safety input receive terminal 13
T14	A13	Safety input drive terminal 14	X14	B13	Safety input receive terminal 14
T15	A14	Safety input drive terminal 15	X15	B14	Safety input receive terminal 15
X16	A15	Start input terminal 16	X17	B15	Start input terminal 17

Note1. For detailed information of Crimp connector, consult Tyco Electronics AMP.

■ Output connector



- Connector type:
- Spring Clamp connector (22 poles)
FS9Z-CN02 [IDEC]
(Tyco Electronics AMP type No.:2-1871940-1)
 - Crimp connector (22 poles)^{Note1}
(Tyco Electronics AMP type No.: 2-1871946-1)

Terminal name	Terminal No.	description	Terminal name	Terminal No.	Description
Y0	A1	Safety output terminal 0	Y1	B1	Safety output terminal 1
Y2	A2	Safety output terminal 2	Y3	B2	Safety output terminal 3
Y4	A3	Monitor output terminal 4	Y5	B3	Monitor output terminal 5
Y6	A4	Monitor output terminal 6	Y7	B4	Monitor output terminal 7
Y10	A5	Monitor output terminal 10	Y11	B5	Monitor output terminal 11
Y12	A6	Monitor output terminal 12	Y13	B6	Monitor output terminal 13
Y14	A7	Monitor output terminal 14	Y15	B7	Monitor output terminal 15
Y16	A8	Monitor output terminal 16	Y17	B8	Solenoid/lamp output terminal 17
Y20	A9	Solenoid/lamp output terminal 20	N.C	B9	No connection terminal
V+	A10	Power supply 24VDC terminal	V-	B10	Power supply 0VDC terminal
FE	A11	Functional Earth terminal	FE	B11	Functional Earth terminal

Note1. For detailed information of the Crimp type connector, consult Tyco Electronics AMP.

Chapter3 INSTALLATION AND WIRING

This chapter describes methods and precautions for installing and wiring the SafetyOne. Before starting installation and wiring, be sure to read “SAFETY PRECAUTIONS” in the beginning of this manual and understand the precautions described under WARNING and CAUTION.

WARNING and CAUTION

Warning

- Turn off power to SafetyOne before starting installation, removing, wiring, maintenance, or inspection. Failure to turn power off may cause electrical shocks or fire hazard.
- Before operating SafetyOne, carefully read the instruction sheet and this manual, and ensure that the environment conforms to the requirements of SafetyOne specifications. If SafetyOne is operated in an environment that exceeds the specifications, it causes impairment of the safe operation of SafetyOne.
- The installation, wiring, configuration, and operation of SafetyOne must be performed only by “Safety responsible personnel”. Safety responsible personnel are personnel who have requisite qualifications as being capable of safely carrying out each step, including designing, installation, operation, maintenance, and disposal of SafetyOne. Personnel without technical expertise of safety personnel must not use SafetyOne.
- Installation of SafetyOne must be performed according to the instructions found in the instruction sheet and this manual. Improper installation may cause the SafetyOne to fail.
- Use a power supply that meets following required specifications:
 - Conforms to the power supply rating of SafetyOne
 - Complies with the SELV/ PELV circuit specified by EN 50178 or EN60950.
 - Has the functionality or the functional equivalent of the control voltage and current of a class 2 circuit, as defined in UL 508 or UL 1310.
 - Is in compliance with safety laws and regulations relating to electrical safety, and EMC, under the laws and regulations of the country in which it is being used.
- Ground the V-line (0V DC) for ground fault diagnosis.
- In the case of a new configuration or modified installation, be sure to perform a check for each input and output function.
- Separate SafetyOne from devices and wires which are not in accordance with class 2 circuit requirements.

Caution

- SafetyOne is designed for installation in an enclosure. Do not install SafetyOne outside an enclosure. Install SafetyOne in enclosure with a rating of IP54 or higher.
- Install SafetyOne in environments described in the catalog, instruction sheet, and user’s manual. If SafetyOne is used in places where it is subjected to high temperature, high humidity, condensation, corrosive gases, excessive vibrations, and excessive shocks, then electrical shocks, fire hazard, or malfunction may result.

INSTALLATION AND WIRING

- Environment for using the SafetyOne is "Pollution degree 2". Use SafetyOne in environments of pollution degree 2 (according to IEC/EN 60664-1).
- Prevent SafetyOne from falling while moving or transporting otherwise damage or malfunction of the SafetyOne 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 SafetyOne, so that there is adequate spacing from walls, heat generating bodies, and peripherals, taking into consideration space requirements for maintenance and ventilation.
- Install SafetyOne on 35mm DIN rails with BNL6 mounting clips (sold separately) on both sides of SafetyOne.
- Perform wiring to the connectors with proper cables or ferrules.
- Ground FE terminal to assure electromagnetic compatibility (EMC)
- Use common 0V DC, if different power supplies are used for SafetyOne and other devices (ex. safety light curtains).
- Install wiring for the inputs and outputs so that it is separated from power lines.

Installation method

■ Installation location and direction

When the SafetyOne is installed in an enclosure, confirm that installation environments meet the product specifications. Using in environments as a described below, (over the product specifications) may cause fire hazard, damage, or malfunction.

- SafetyOne should not be exposed to excessive dust, dirt, salt, vibration or shocks.
- Do not use SafetyOne in an area where corrosive chemicals or flammable gases are present.
- Do not use SafetyOne near induction heat sources.

Mount SafetyOne with enough space from any device as shown at Fig3.1 for maintenance and ventilation. Do not install SafetyOne near, and especially above, any heating device or heat source.

Use SafetyOne in surrounding air temperature, -10 to +55 °C.

Note1. Consider opening and closing of protective cover. (Min. 20mm)

Note2. Consider installation to DIN rail and ventilation characteristic. (Approx. 20mm)

Note3. Consider distance to other devices can be heat source, such as safety relays.
(Approx. 40mm)

Note4. Consider wiring the cables connected to input/output connectors. (Approx. 80mm)

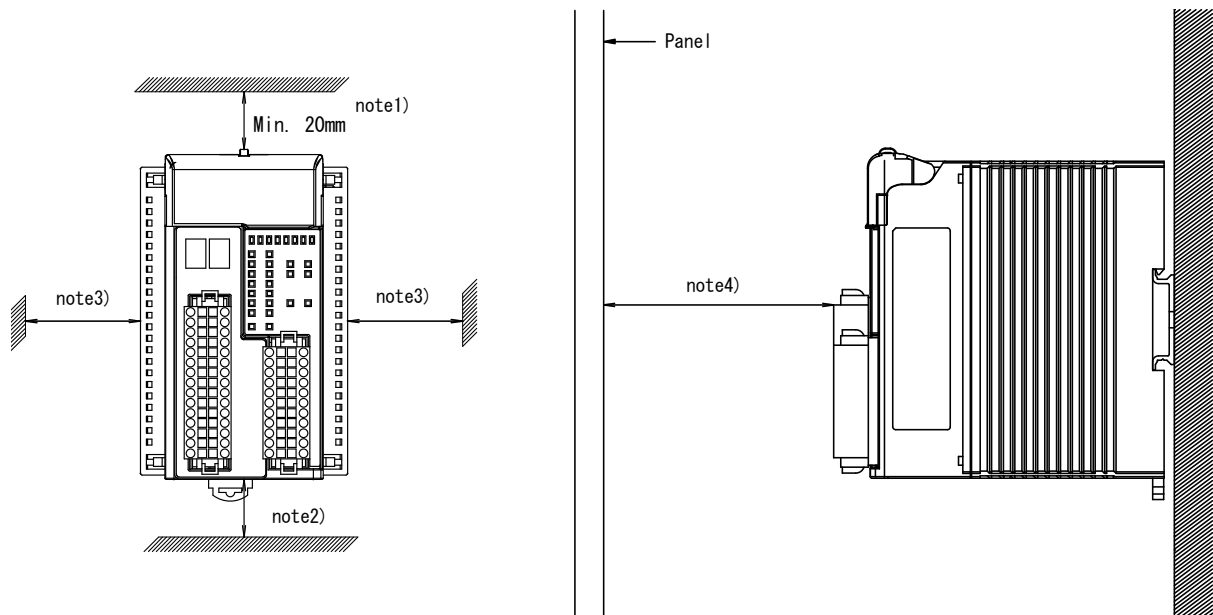


Fig. 3.1 Installation location

Mount SafetyOne on a vertical plane as shown in Fig.3.2.
All other installation directions are not allowed.

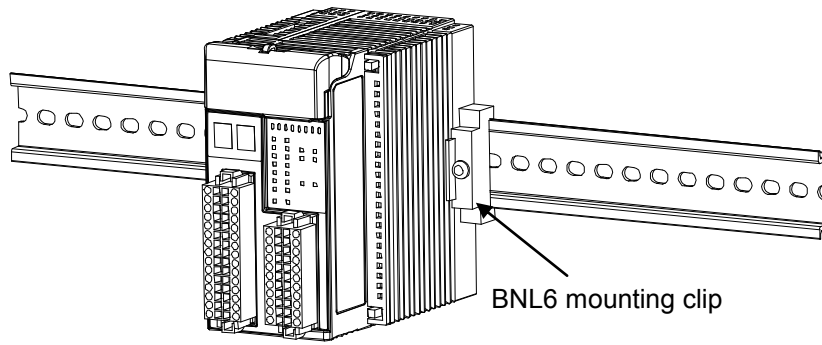


Fig. 3.2 Correct installation direction

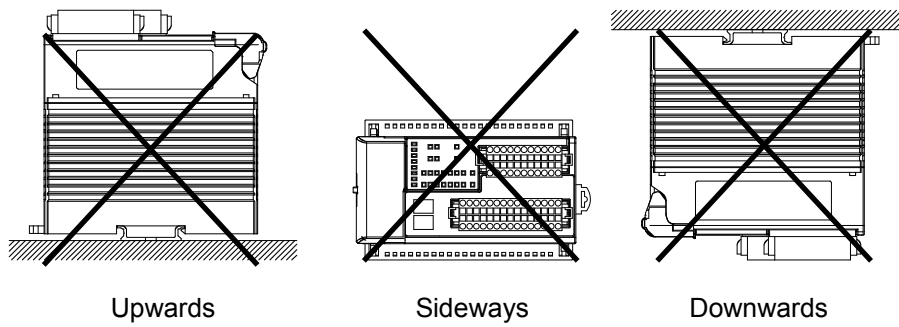


Fig. 3.3 Incorrect installation directions

■ Installing on DIN Rails

Mount and remove SafetyOne on 35mm-wide DIN rails according to the following instructions.
Applicable DIN rail: (for example) BAA1000 (IDEC)

Mounting on DIN rail

1. Fasten DIN rail to a panel using screws.
2. With the top of SafetyOne unit facing up, as shown in Fig. 3.4, insert the groove, on the rear of the unit, and press the unit in the direction of the arrow.
3. Use BNL6 (IDEC) mounting clips (sold separately) on both sides to prevent it from moving sideways.

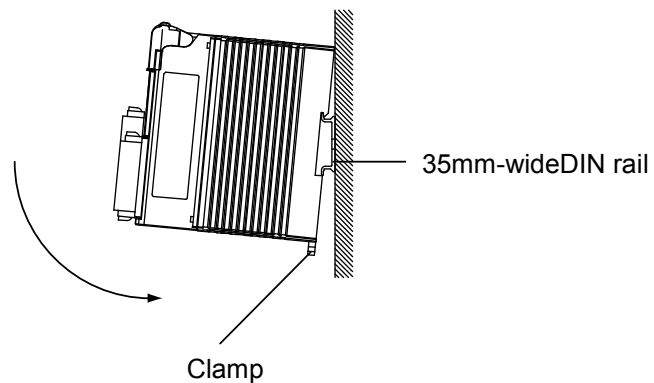


Fig. 3.4 Mounting

Removing from DIN Rail

1. Insert a flat screwdriver into the slot in the clamp.
2. Pull the clamp until you hear a click, as shown in Fig. 3.5.
3. Remove SafetyOne from the bottom.

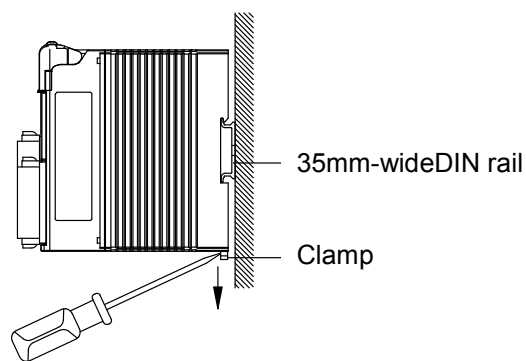


Fig. 3.5 Removing

Wiring method

SafetyOne has two kinds of connectors spring clamp (optional) and crimp.^{Note1}

Note1. For detailed information of Crimp connector, consult Tyco Electronics AMP.

■ Applicable connectors and mounting to SafetyOne

Applicable connectors

Type	No. of pole	Part No.	Remarks
Spring clamp	30	FS9Z-CN01	IDEC (optional)
		2-1871940-5	Tyco Electronics AMP
	22	FS9Z-CN02	IDEC (optional)
		2-1871940-1	Tyco Electronics AMP
Crimp	30	2-1871946-5	Tyco Electronics AMP
	22	2-1871946-1	Tyco Electronics AMP

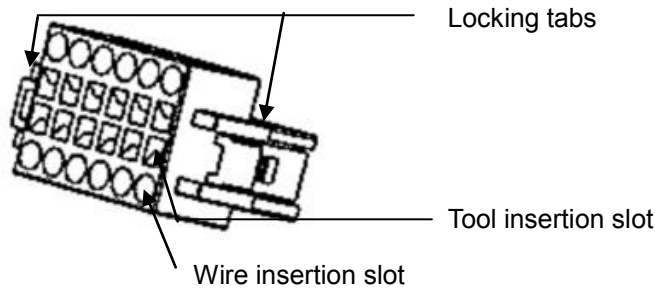


Fig. 3.6 Spring clamp connector (FS9Z-CN0*)

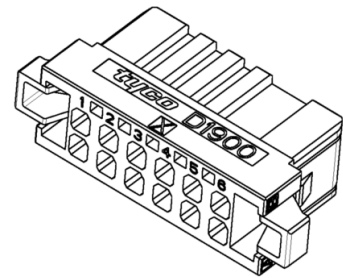


Fig. 3.7 Crimp connector

When mounting a connector to the SafetyOne, be sure to insert the connector straight and completely in until you hear a click or feel it click into position. To remove the connector, press down on the locking tabs completely, and then pull out the connector. If pressing down on the locking tabs is incomplete damage to the connector and wire may occur.

■ Applicable wire and ferrule sizes for spring clamp connector

AWG#18-24 (UL1007 recommended) Stripped length: 7.0 ± 0.3 mm

When using ferrules, specification are shown below.

Long size: 1.02mm (min.) - 1.21mm (max.) ("a" in the figure below)

Short size: 0.95mm (min.) - 1.21mm (max.) ("b" in the figure below)

Applicable wire: AWG#24 (UL1007 recommended)

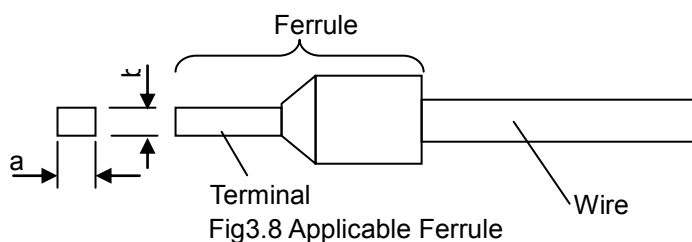


Fig3.8 Applicable Ferrule

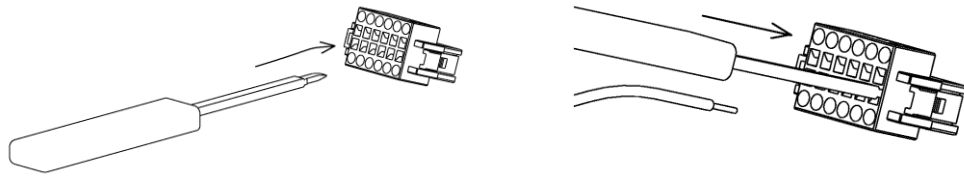
■ Wiring for spring clamp connector

Do not wire the connector while it is connected to the SafetyOne, as this can damage the connector and the SafetyOne.

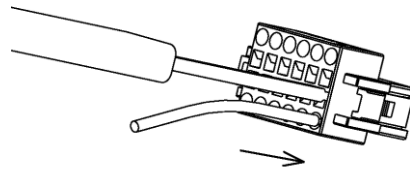
To connect the wire, use a connecting tool (FS9Z-SD01 [IDEC] (Tyco Electronics AMP Type Number: 0-2040798-1) or a commercially-available screwdriver. It is recommended that you use a dedicated connecting tool to prevent any scratches or damage to the connector housing and spring. When rewiring, use wire of the same gauge.

● Wiring with a connecting tool

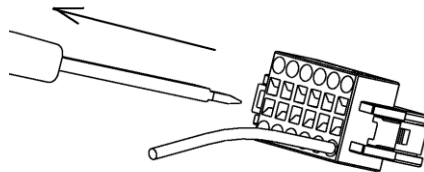
1. Insert the connecting tool into the tool insertion slot on the connector at an angle until the tool comes to a stop.



2. Insert the wire into wire insertion slot. (If there are any loose strands, twist the wire to make it even.)



3. With the wire pressed down, remove the connecting tool to finish. Lightly tug on the wire to check that it is securely connected.



4. To remove the wire, press down the spring with the connecting tool, as if you are connecting the wire, and pull out the wire.

■ Wiring with a commercially-available screwdriver

Use a screwdriver with a tip width that does not exceed 2.4 mm. Be careful when wiring with a screwdriver as this can damage the connector.

1. Insert the screwdriver into the tool insertion slot on the connector at an angle, and press down so as to open the spring. Be careful not to insert the screwdriver with too much force, as this can damage the connector. Do not insert the screwdriver into the wire insertion slot.
2. With the screwdriver inserted, as described in Step 1 above, insert the wire into wire insertion slot. (If there are any loose strands, twist the wire to make it even.)
3. With the wire pressed down, remove the screwdriver to finish. Lightly tug on the wire to check that it is securely connected.
4. To remove the wire, press down the spring with the screwdriver, as if you are connecting the wire, and pull out the wire.

Chapter4 BASIC OPERATIONS

This chapter describes the basic operations of SafetyOne. Make proper use of the SafetyOne by thoroughly familiarizing yourself with basic operations and functions.

Internal states

The SafetyOne operates in five internal states, as shown in Table 4.1.

The LED display and output status for each state are shown in Table 4.2.1 and 4.2.2.

Table 4.1 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. (Refer to "Chapter 5 LOGIC" for details.)
Configuration	A logic or OFF-delay timer value is being configured. Configuration enables the logic and OFF-delay timer value. When completed, the SafetyOne changes to the Run state. (Refer to "Logic configuration" and "Timer configuration" in this chapter for details.)
Protection	An input monitor error has occurred with dual channel input, EDM input, or muting input. When the problem is removed, the SafetyOne changes to Run state. (Refer to "Canceling the Protection state" in this chapter for details.)
Stop	A failure or error has occurred with an external device or internal circuit. When the problem is removed and the power is turned on, Stop state is cleared. (Refer to "Canceling the Stop state" in this chapter for details.)

Table 4.2.1 LED display and output status for each state

(When safety outputs are dual channel outputs)

State	Logic LED	Error LED	Timer LED	Safety output	Solenoid/ lamp output	Monitor output			
				Y0...Y3	Y17,Y20	Y4...Y13	Y14	Y15	Y16
Initial	(1)	(1)	(1)	□OFF	□OFF	□OFF	■ON	■ON	□OFF
Run	Logic #	Blank	Selected Value	(2)	(2)	(2)	□OFF	□OFF	■ON
Configuration	(3)	"C"	(3)	□OFF	□OFF	□OFF	□OFF	■ON	□OFF
Protection	Logic #	"1"	Selected Value	□OFF (6)	□OFF	(4)	□OFF	■ON	□OFF
Stop	Blank	(5)	Blank	□OFF	□OFF	(4)	■ON	■ON Or □OFF	□OFF

Table 4.2.2 LED display and output status for each state

(When safety outputs are single channel outputs)

State	Logic LED	Error LED	Timer LED	Safety output	Monitor output			
				Y0...Y3	Y4...Y13, Y17, Y20	Y14	Y15	Y16
Initial	(1)	(1)	(1)	□OFF	□OFF	■ON	■ON	□OFF
Run	Logic #	Blank	Selected Value	(2)	(2)	□OFF	□OFF	■ON
Configuration	(3)	"C"	(3)	□OFF	□OFF	□OFF	■ON	□OFF
Protection	Logic #	"1"	Selected Value	□OFF (6)	(4)	□OFF	■ON	□OFF
Stop	Blank	(5)	Blank	□OFF	(4)	■ON	■ON Or □OFF	□OFF

BASIC OPERATIONS

- (1) Random display of Initial state.
- (2) Output and LED display of the selected logic.
- (3) Blinking LED display of the selected logic number or the selected timer value.
- (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.
- (5) Error number is displayed.
- (6) Safety output with timer is turned OFF after the preset OFF-delay time.

Refer to “Chapter2 PRODUCT SPECIFICATIONS” for detail information of LED display.



Solenoid/lamp outputs (Y17, Y20) turn ON for 1 second maximum when the state changes to Run state. Take operation of connected components into consideration.

Turning on the power

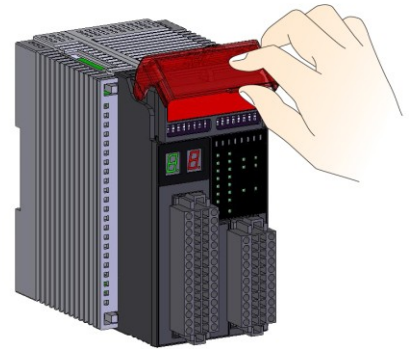
After the SafetyOne is turned on, it transitions to the Initial state and checks internal circuits. SafetyOne changes to the appropriate state (in approximately 6s) according to the result of the internal circuit check. During the Initial state, the LEDs blink to check operation.

Logic switch and timer switch are set Logic: “101” and Timer: “1 (0s)” at the factory. When initially powering up the SafetyOne, thoroughly confirm the configuration and the operation.

Using the protective cover

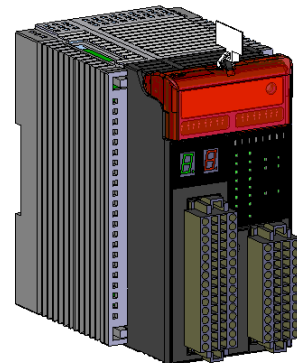
●Opening and closing the protective cover

Place your finger at the bottom right of the protective cover, and open the cover to a position that enables you to view the configuration options. The protective cover can be set at two opened positions (60° or 120°). Be careful not to open the cover beyond 120°, as this causes the cover to separate from the body.



●Locking the protective cover

After configuration of SafetyOne and confirming, close the protective cover. To protect the configuration, it is recommended that the protective cover be locked. Use the attached marking tie or commercially-available wire or a similar equipment to lock the protective cover. In case of using commercially-available wire, use wire that personnel, other than safety responsible persons operating the SafetyOne, are not able to modify. (ex. $\Phi 1.0$ or more metal wire)



Refer to Dimensions in “Chapter 2 PRODUCT SPECIFICATIONS” for Detail of locking hole.

The protective cover and marking tie do not ensure mechanical strength against strong force. The protective cover and marking tie can be broken with the strong force.

Logic configuration

The SafetyOne offers 24 types of logic, and by performing the logic configuration procedure listed below, you can enable the desired logic.

The SafetyOne can transition to the Configuration state from the Run or Protection state.

Configuration operations are disabled in the Initial and Stop states.

Once any logic is configured, it is kept in the SafetyOne even if the power is turned off.

The logic and timer settings can be configured at the same time. Confirm the configuration methods, and configure the logic and timer properly.

The default setting of the logic switch is set to “101” at the factory. When initially powering on the SafetyOne, thoroughly confirm the configuration and the operation.

1. Open the protective cover.

Open the cover to a position that enables you to set the configuration operations.
Refer to "Using the protective cover" for details.

2. Select the logic switch.

Select and operate the logic switch. Select one of “1” to “8” switches, or one of “1” to “4” and one of “A”, “b”, “C”, “d” switches. When operating the logic switch, use the attached configuration tool. When the logic configuration is changed, "C" is displayed in the error LED display and the new number of the logic configuration blinks in the logic LED display.

If any logic switch is not selected or incorrect selection is done, "E" is displayed in the logic LED display.

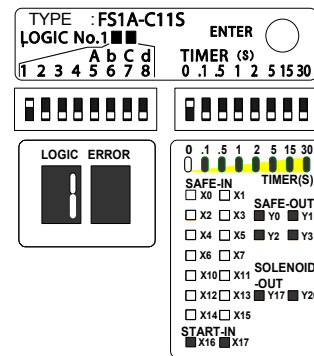


Fig. 4.1 Normally switch configuration and LED indication (Run state)

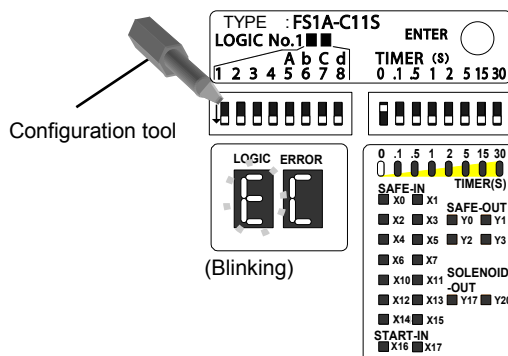


Fig. 4.2 Logic switch is not selected (Configuration state)

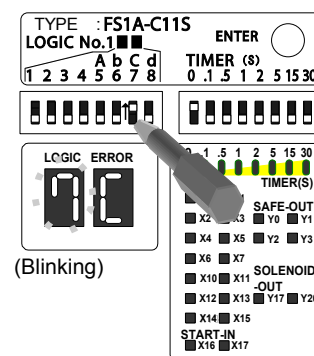


Fig. 4.3 Logic number “107” is selected (Configuration state)

3. Confirm the configuration and press the enter button.

Confirm that the selected logic switch matches the blinking logic LED, and then press the enter button by using configuration tool.

Be sure to confirm that they match. If the switch configuration and display do not match and you press the enter button, unintended logic may be activated.

Press and hold the enter button for 1 to 5s to enable the configuration. "C" blinks in the error LED display while you press the enter button. If you press the enter button for less than 1s or more than 5s, the logic is not activated.

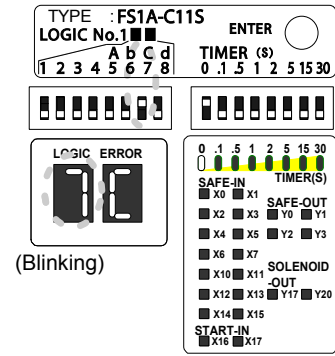


Fig. 4.4 Confirmation of logic switch configuration and LED indication (Configuration state)

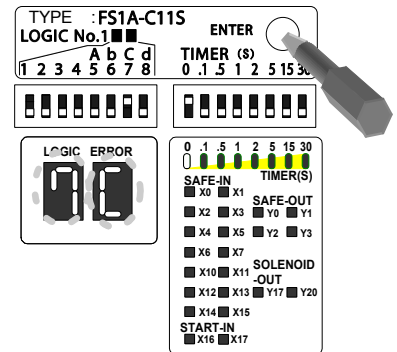


Fig. 4.5 LED indication during enter button is valid (Configuration state)

4. Confirm that the logic is activated.

The logic LED display changes from a blinking display to solid display, the error LED turns off, and the selected logic is activated.

After configuring the logic, be sure to confirm that the selected logic is activated.

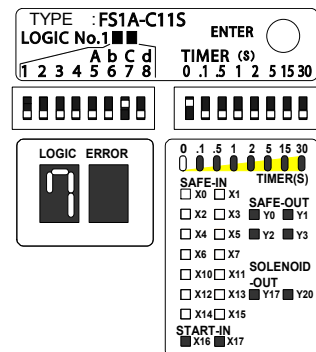


Fig. 4.6 Completion the configuration of Logic "107 "(Run state)

5. Lock the protective cover.

Close the protective cover.

Refer to "Using the protective cover" in this chapter for details. To protect the configuration setting, it is recommended that the protective cover be locked.

Timer configuration

SafetyOne has an OFF-delay timer function that retains safety outputs during the configured time and after that turns OFF the safety outputs. You can use this function to configure stop category "0" or "1". Perform the configuration procedure listed below to configure the OFF-delay timer to one of the following eight settings, using the same procedure as that for configuring the logic:

0, 0.1, 0.5, 1, 2, 5, 15 or 30 s.

Configuration operations are disabled in the Initial and Stop states.

Once any timer value is configured, it is kept in the SafetyOne even if the power is turned off.

Logic and timer settings can be configured at the same time. Confirm the configuration methods, and configure the logic and timer properly.

The timer switch is set at a default value of "1(0s)" at the factory. When initially powering on the SafetyOne, thoroughly confirm the configuration and the operation.

1. Open the protective cover.

Open the cover to a position that enables you to set configuration operations.

Refer to "Using the protective cover" for details.

2. Select the timer switch.

Select and operate a timer switch. When operating a timer switch, use the configuration tool.

When the timer configuration is changed, "C" is displayed in the error LED display and the timer LED light that corresponds to the selected timer configuration switch blinks.

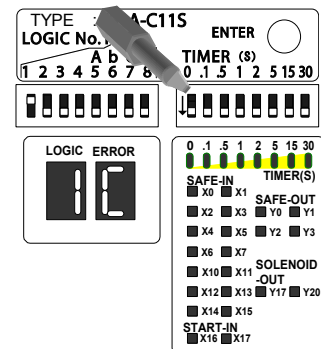


Fig. 4.7 Timer switch is not selected (Configuration state)

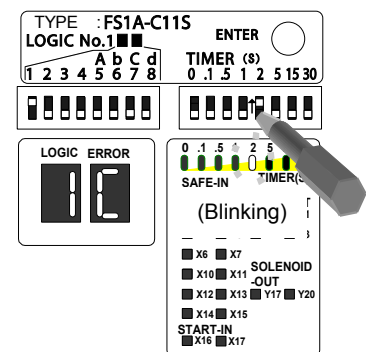


Fig. 4.8 OFF-delay timer value "2s" is selected (Configuration state)

3. Confirm the configuration and press the enter button.

Confirm that the selected timer switch matches the blinking timer LED, and then press the enter button by using the configuration tool.

Be sure to confirm that they match. If the switch configuration and display do not match and you press the enter button, an unintended delay timer may be activated.

Press and hold the enter button for 1 to 5s to activate the configuration. "C" blinks in the error LED display while you press the enter button. If you press the enter button for less than 1s or more than 5s, the timer is not activated.

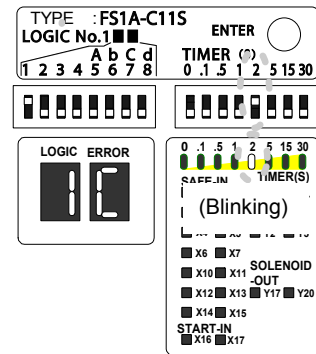


Fig. 4.9 Confirmation of timer switch configuration and LED indication (Configuration state)

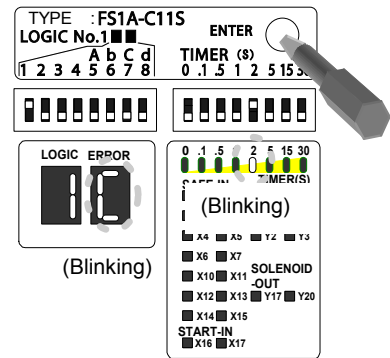


Fig. 4.10 LED indication during enter button is valid (Configuration state)

4. Confirm that the timer is activated.

The timer LED light changes from a blinking display to solid display, the error LED display turns off, and the selected timer value is activated. After configuring the timer, be sure to confirm that the selected timer value is activated.

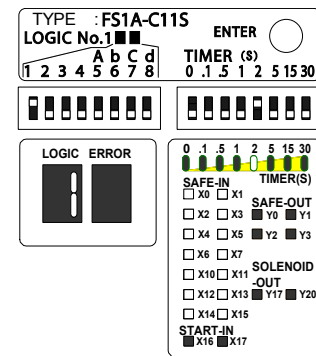


Fig. 4.11 Completion the configuration of OFF-delay timer value "2s" (Run state)

5. Close and lock the protective cover.

Close the protective cover.

Refer to "Using the protective cover" for details.

To protect the configuration setting, it is recommended that the protective cover be locked.

Canceling the Protection state

SafetyOne transitions to the Protection state if a failure is detected in an external device or an error is detected in external wiring, such as when different operations are performed between dual channel inputs or two muting inputs, when the EDM input is OFF while the safety outputs are transitioning from OFF to ON or the EDM input is ON while the safety outputs are transitioning from ON to OFF by output control. In the Protection state, the safety outputs are turned OFF and "1" is displayed in the error LED display. The Protection state can be cancelled by the following methods.

- **Cancellation by the connected control devices**

- In case of an error with the dual channel input, the Protection state is cancelled by turning OFF the appropriate dual channel input. (For example: Press an emergency stop switch or open a guard equipped with an interlock device.) But cancellation is not achieved during OFF-delay operation of safety outputs.
- In case of an error with muting input, the Protection state is cancelled by turning OFF of the appropriate muting input. But cancellation is not achieved during OFF-delay operation of safety outputs.
- In case of an error with mode select input, the Protection state is cancelled by turning OFF 1 of the appropriate 2 inputs. But the cancellation is not achieved during OFF-delay operation of safety outputs.
- In case of an error with the EDM input, the Protection state is cancelled by turning ON the appropriate EDM input. When an EDM input causes an error, the corresponded safety output is not turned ON, but the other safety output can be turned ON and after approximately 1s turned OFF. For the relationship between EDM inputs and safety outputs, refer Table 4.3 shown below.

Table 4.3 EDM inputs and corresponded safety outputs

Safety output types	EDM inputs (External Device Monitor inputs)	Safety outputs
Dual channel outputs	T14-X14	Y0, Y1
	T15-X15	Y2, Y3
Single channel outputs	T12-X12	Y0
	T13-X13	Y1
	T14-X14	Y2
	T15-X15	Y3

- **Cancellation by resetting power to SafetyOne**

The Protection state is cancelled by restarting power to SafetyOne after removing the error factor.

If the error factor that caused the change to the Protection state has been not removed, the unit returns to the Protection state again.

- **Cancellation by transition to Protection state**

By the changing the configuration of a logic or timer switch, the state changes from Protection state to Configuration state.



Turn OFF the power to SafetyOne before inspection and/or connecting of the wires.

Canceling the Stop state

If the SafetyOne detects any wiring errors, abnormalities or internal circuit failure, it changes to the Stop state and locks out operations. The Stop state can be cancelled by the following method.

- **Cancellation by removal of power to SafetyOne**

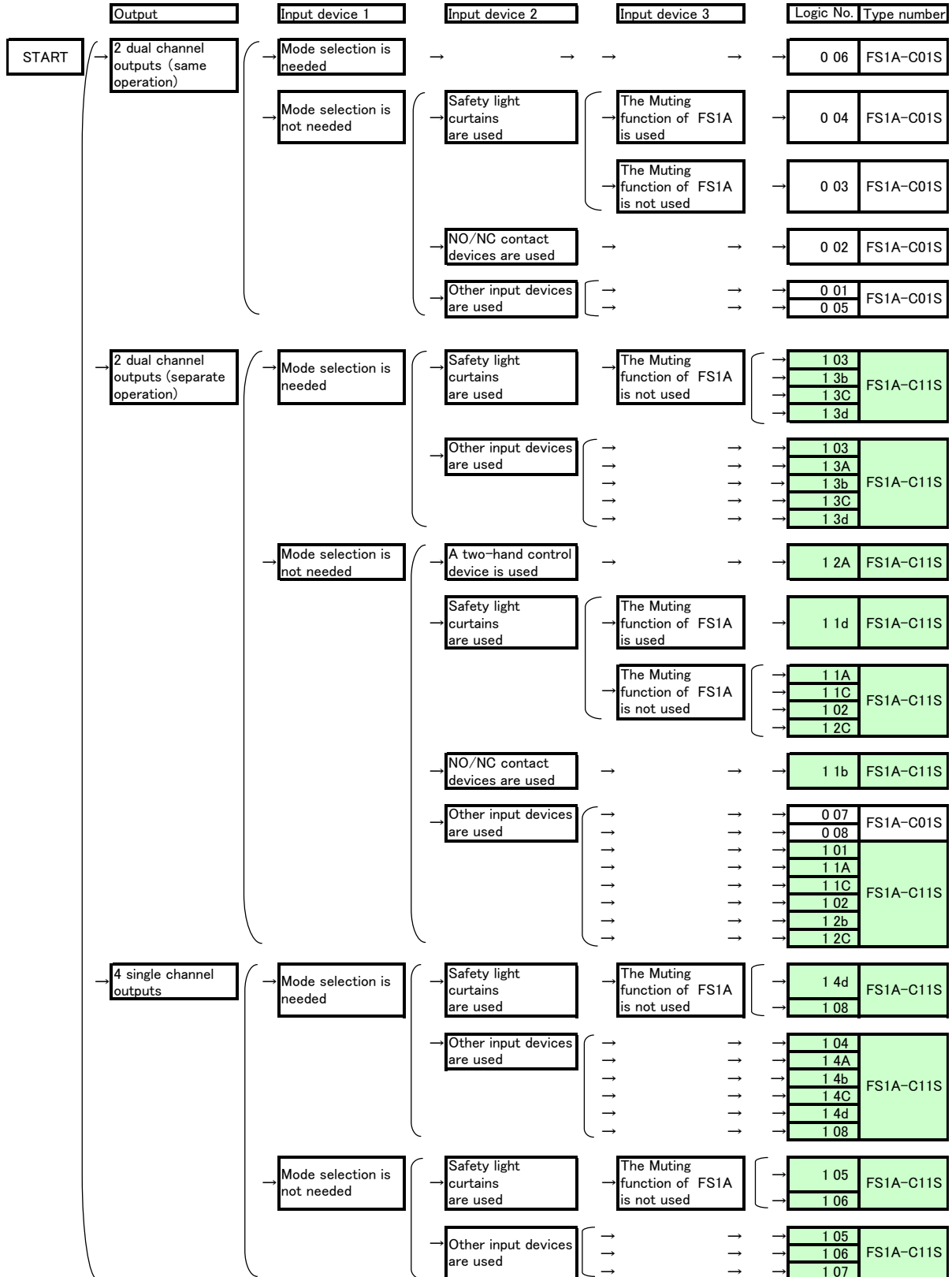
The Stop state is cancelled by restarting power to SafetyOne after removing the error.

Refer "Chapter 6 TROUBLESHOOTING" for information to identify the cause that generated the Protection state or Stop state.

Chapter5 LOGIC

This chapter describes the Logics in the SafetyOne. Make proper use of the SafetyOne by thoroughly familiarizing yourself with the basic operations and function of each Logic.

Logic selection guide

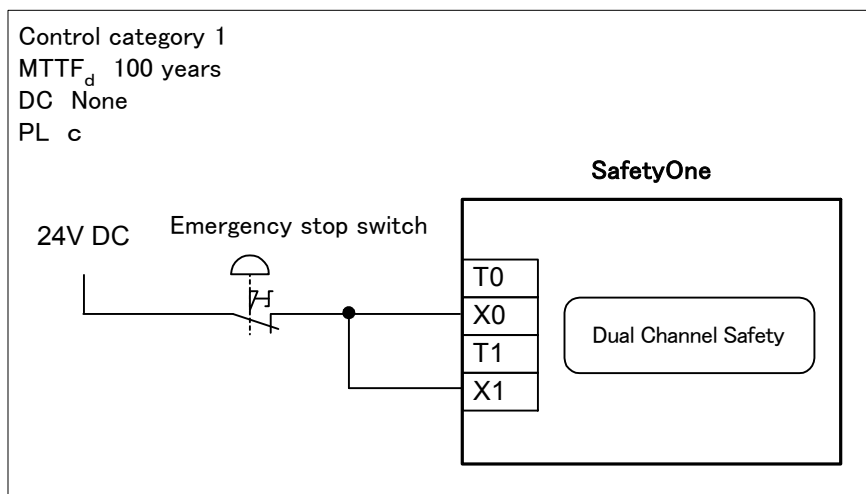
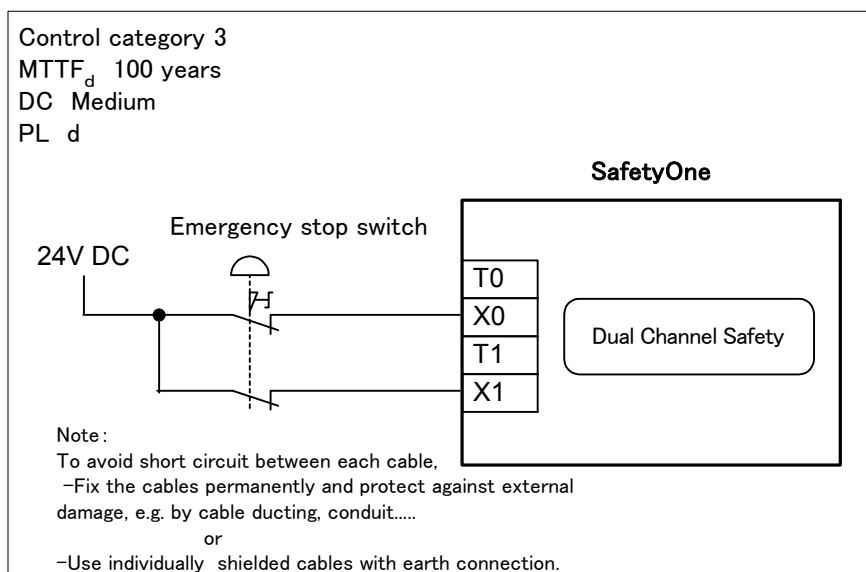
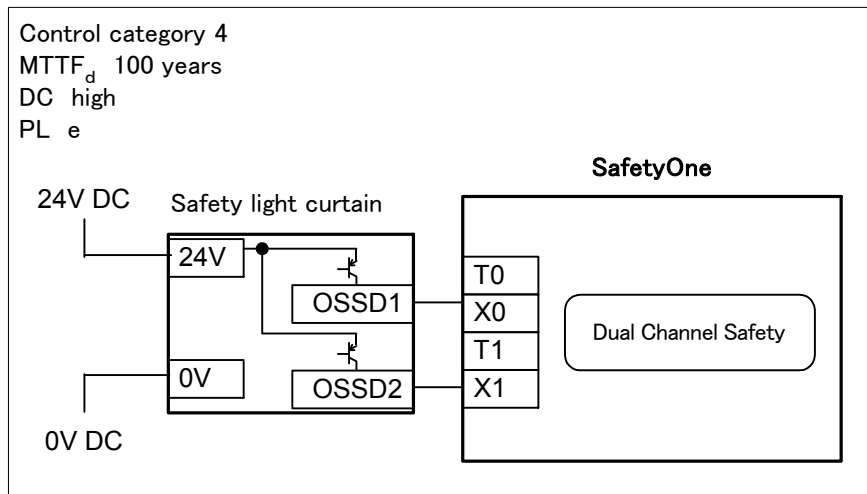


		Logic										
		Logic No.	Interlock switch • Emergency stop switch	Enabling switch	Mode selection	Safety light curtain	Muting function	NO/NC contact device	Two-hand control device	2 dual channel outputs (same operation)	2 dual channel outputs (separate operation)	4 single channel outputs
FS1A-C01S	General-purpose logic for various apparatus	0 01	*						*			
	General-purpose logic for NO/NC contact inputs	0 02	*				*		*			
	General-purpose logic for apparatus with openings	0 03	*			*			*			
	Muting function logic for apparatus with openings	0 04	*			*	*		*			
	General-purpose logic for devices for which synctime between contacts cannot be specified	0 05	*	*					*			
	The logic applicable for selection of active safety input devices	0 06	*	*	*				*			
	Partial stop 1 logic for various apparatus	0 07	*								*	
	Partial stop 2 logic for various apparatus	0 08	*								*	
FS1A-C11S	The logic for various apparatus	1 01	*	*							*	
	The logic for apparatus with openings	1 1A	*			*					*	
	The logic for apparatus with NO/NC contact inputs	1 1b	*				*				*	
	The logic for apparatus with openings	1 1C	*			*					*	
	Muting function logic for apparatus with openings	1 1d	*			*	*				*	
	Partial stop logic for apparatus with openings	1 02	*			*					*	
	The logic for apparatus with a two-hand control device	1 2A	*			*		*			*	
	The logic constructing an OR circuit for various apparatus	1 2b	*	*							*	
	The logic constructing an OR circuit for apparatus with openings	1 2C	*			*					*	
	Partial control logic for apparatus with openings	1 2d	*	*		*					*	
	Partial stop logic applicable for selection of active safety input devices	1 03	*	*	*	*					*	
	The logic applicable for selection of active safety input devices	1 3A	*	*	*						*	
	The logic constructing an OR circuit applicable for selection of active safety input devices	1 3b	*	*	*	*					*	
	Partial stop logic applicable for selection of active safety input devices	1 3C	*	*	*	*					*	
	The logic applicable for selection of active safety input devices	1 3d	*	*	*	*					*	
	Partial stop logic applicable for selection of active safety input devices	1 04	*	*	*						*	
	Partial stop logic applicable for selection of active safety input devices	1 4A	*	*	*						*	
	Partial stop logic applicable for selection of active safety input devices	1 4b	*	*	*						*	
	Partial stop logic applicable for selection of active safety input devices	1 4C	*	*	*						*	
	Partial stop logic applicable for selection of active safety input devices for apparatus with openings	1 4d	*	*	*	*					*	
	Partial stop logic for apparatus with openings	1 05	*			*					*	
	Partial stop logic for apparatus with openings	1 06	*			*					*	
	Partial stop logic for various apparatus	1 07	*								*	
	Partial stop logic applicable for selection of active safety input devices for apparatus with openings	1 08	*	*	*	*					*	

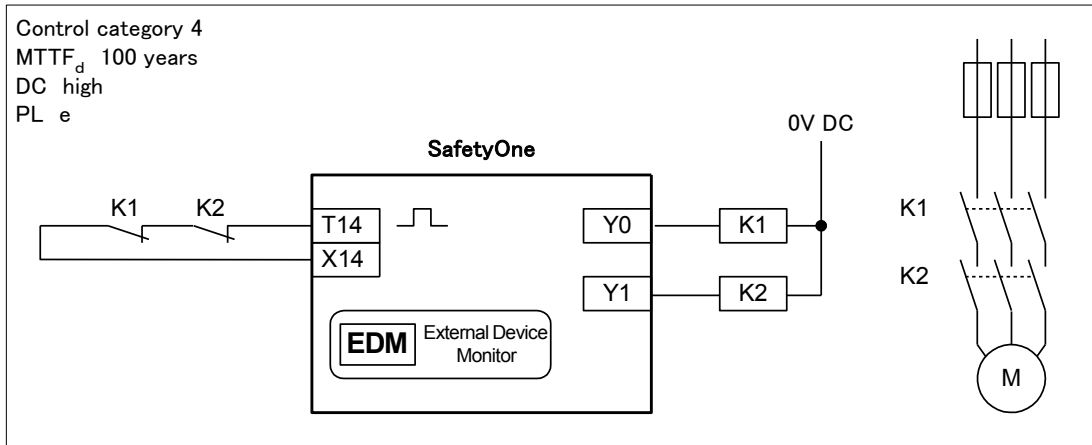
Safety performance on each wiring of inputs and outputs

Applicable safety performance of SafetyOne depends on wiring of the inputs and outputs. Wiring examples and achievable safety performances are shown below.

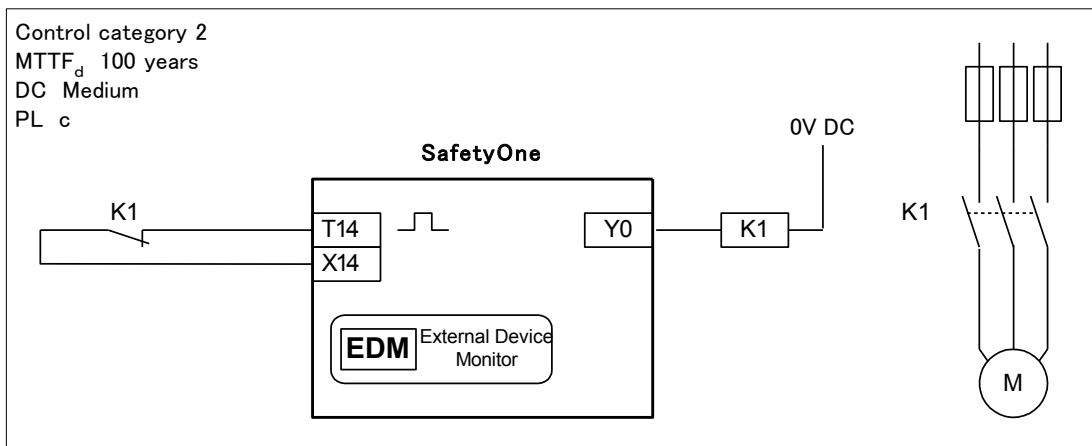
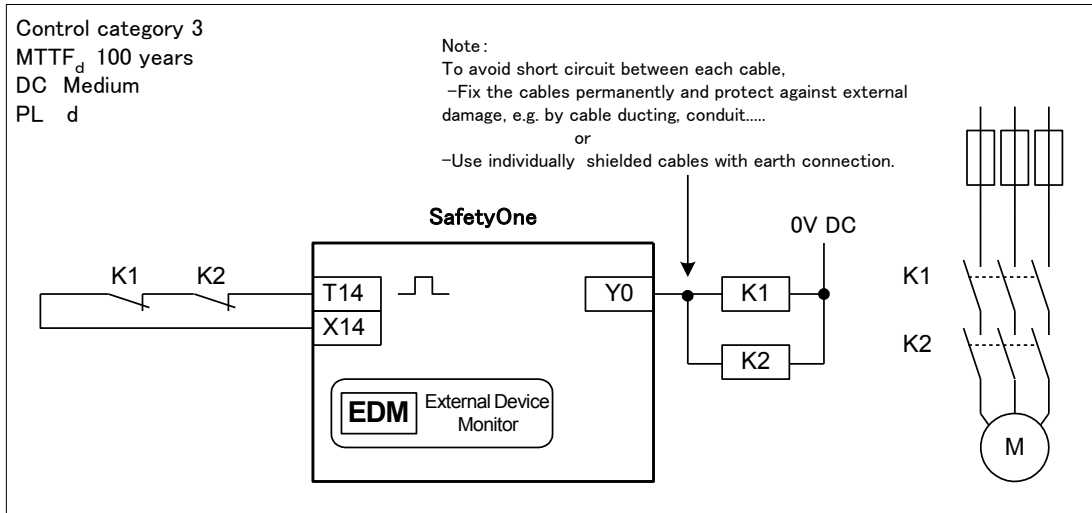
• Wiring example of dual channel safety inputs



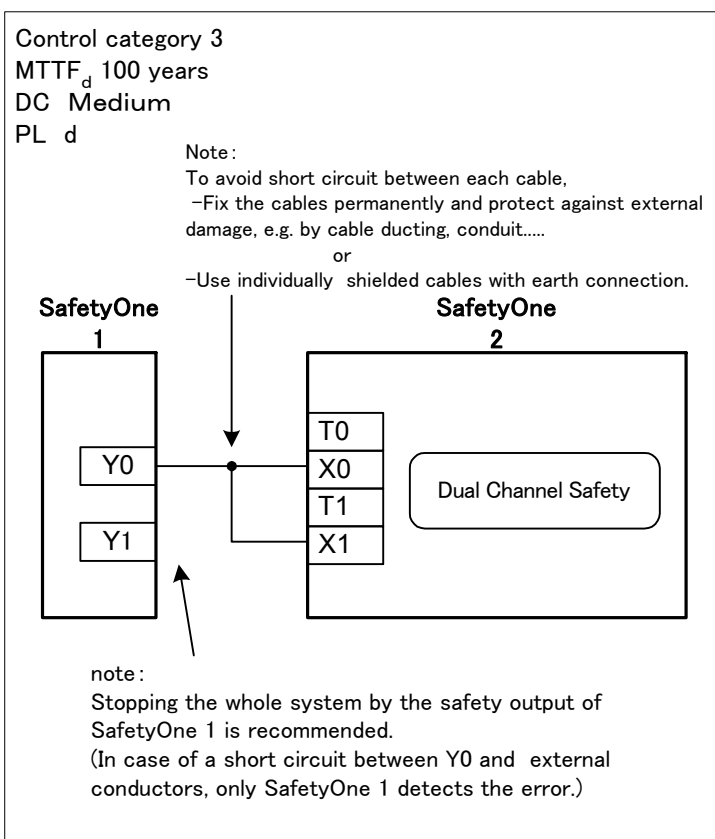
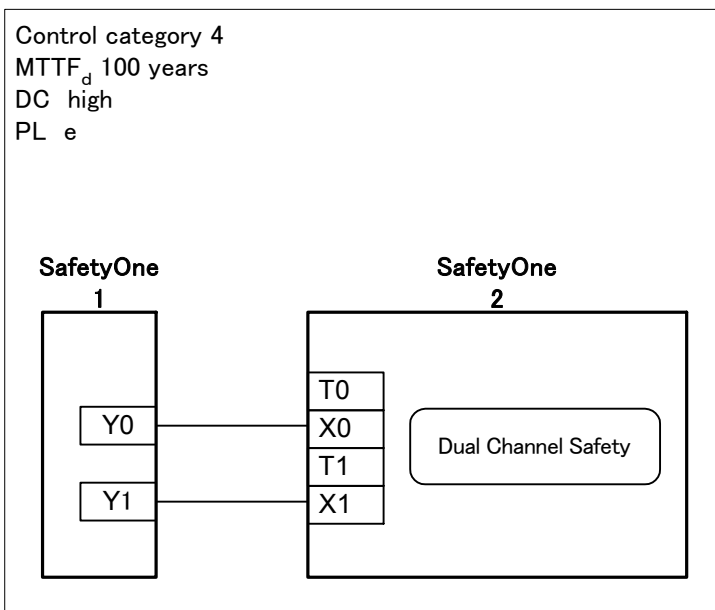
• Wiring example of safety outputs



K : Contactor
 M : Motor



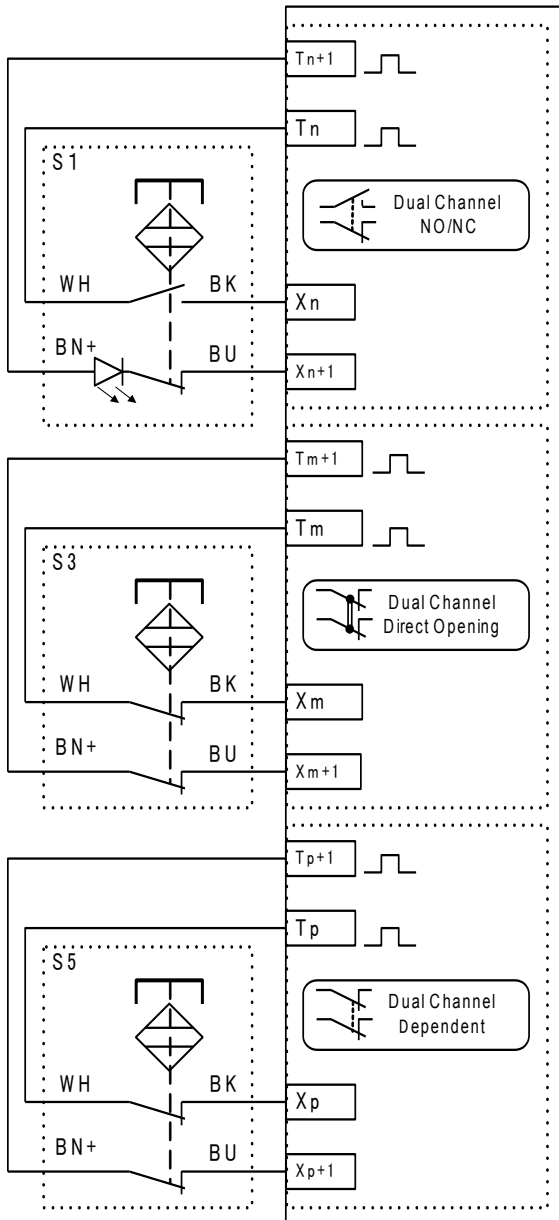
• Wiring example of a SafetyOne and a SafetyOne



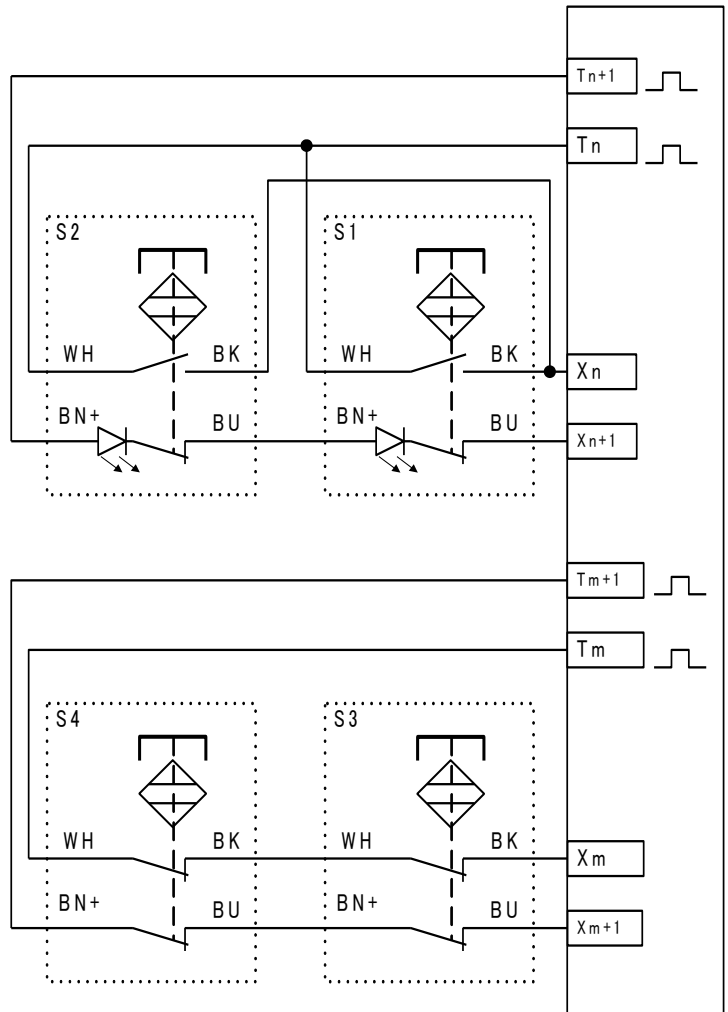
Applicable safety performance depends on the whole system configuration.

Using IDEC non-contact interlock switches HS7A series

- S1, 2 : HS7A-DMC59** (1NO+1NC Contact, with LED / without LED) or
 HS7A-DMP50** (1NO+2NC Contact, with LED / without LED)
 S3, 4, 5 : HS7A-DMC790* (2NO Contact, without LED) or
 HS7A-DMP700* (2NO+1NC Contact, without LED)



Common connection of several non-contact interlock switches ^{note6)}



Note 1) Above illustration shows contact when actuator is present in the sensing area.

Note 2) The HS7A-DMC59** or the HS7A-DMP50** can be connected to the dual channel NO/NC inputs.

Note 3) The HS7A-DMC790* or the HS7A-DMP700* can be connected to the dual channel direct opening inputs or dual channel dependent inputs.

Note 4) In the case of using HS7A-DMC790* or HS7A-DMP700*, safety performance depends on result of risk assessment for whole of the safety configuration.

Note 5) Maximum number of HS7A switches for each safety input is shown below.

HS7A Switch	With out LED	With LED
Dual channel NO/NC input	20	2
Dual channel direct opening input Dual channel dependent input	20	Not applicable

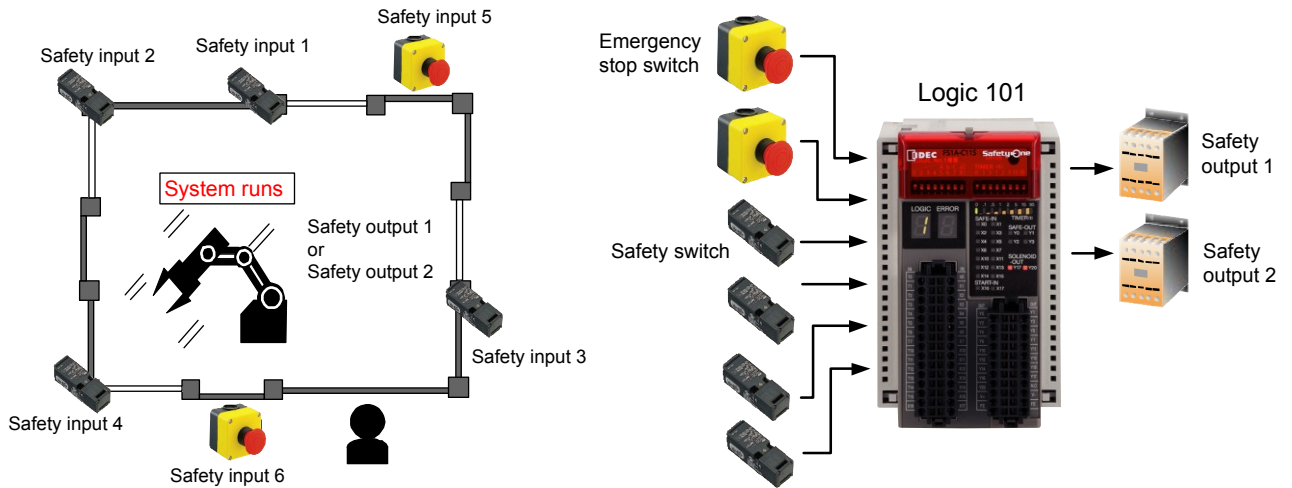
Note 6) In the common connection of several non-contact interlock switches, applicable safety performance depends on result of risk assessment for whole of the safety configuration. Refer to ISO14119 for analysis the connection.

Logic 101: The logic for various apparatus

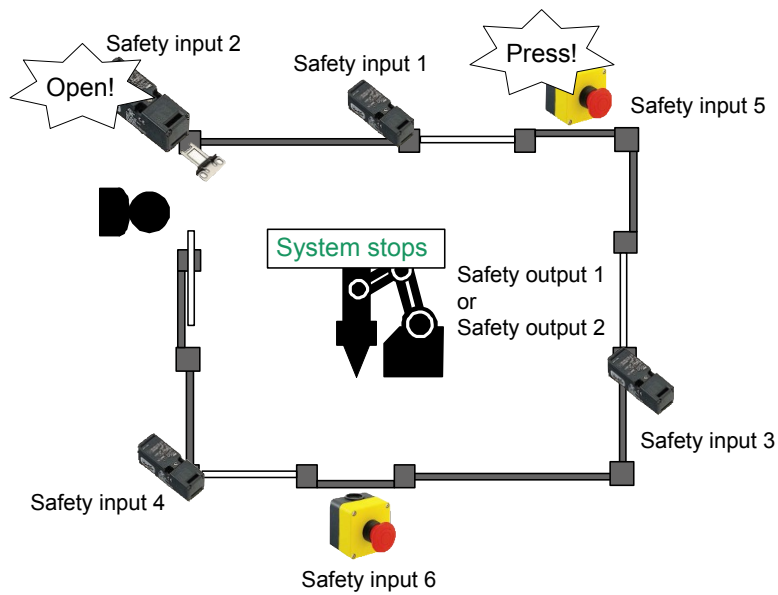
Overview (Logic 101)

This logic is for safety protective measures applicable to production machines and robots. Safety outputs perform as dual channel outputs.

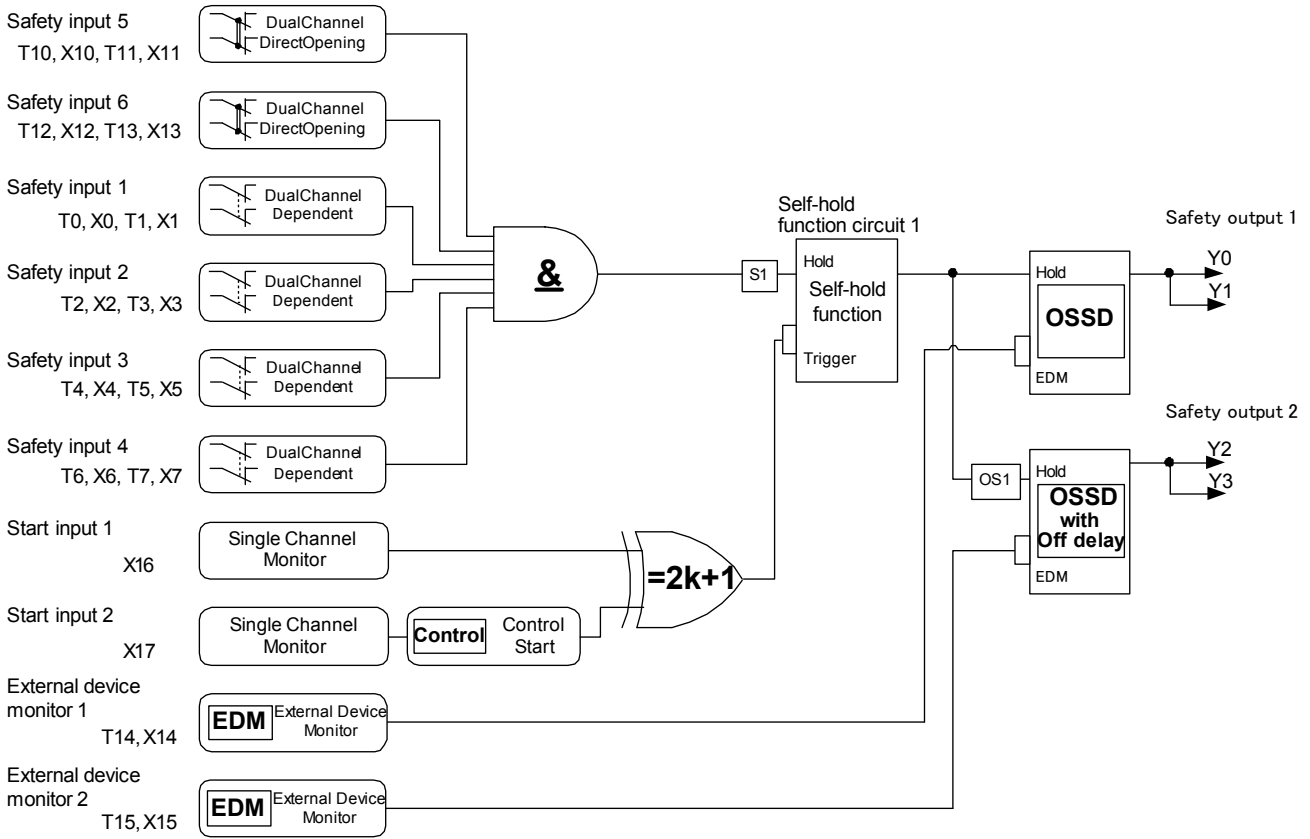
This logic enables the connection of 2 dual channel direct opening inputs and 4 dual channel dependent inputs.



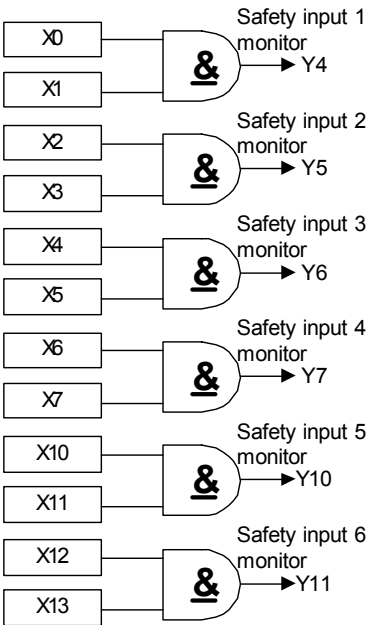
Operation example (Logic 101)



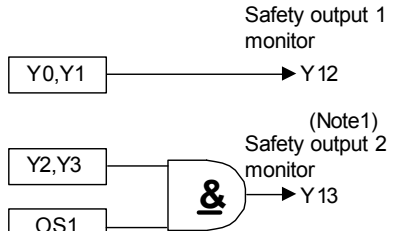
Logic circuit (Logic 101)



● Monitor output for safety input

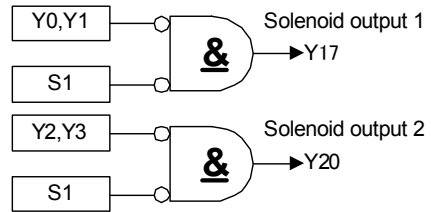


● Monitor output for safety output



Note1:
Safety output 2 monitor turns off immediately independent of OFF-delay time.

● Solenoid output (Note 2)

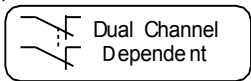


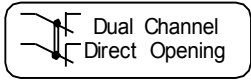
Note2:
In Run state, when the safety outputs are OFF and one or more safety inputs are OFF, the solenoid outputs turn ON.
When all safety inputs are ON, the solenoid outputs turn OFF, even when the start input is OFF.

Functions (Logic 101)

•Safety inputs: X0 to X13 (T0 to T13)

Safety inputs are used to diagnose the status of connected safety devices, such as emergency stop switches, and interlock switches.

Intended inputs (Terminal names)	Function	
Safety input 1 (X0-T0, X1-T1) Safety input 2 (X2-T2, X3-T3) Safety input 3 (X4-T4, X5-T5) Safety input 4 (X6-T6, X7-T7)	Function name	Dual channel dependent input
	Symbol	 Dual Channel Dependent
	Description of operation	This function diagnoses the status of connected safety devices. This function does not diagnose the time interval of status transition between each input of duplicated inputs.
	Detail information	Logic functions (5-313)

Intended inputs (Terminal names)	Function	
Safety input 5 (X10-T10, X11-T11) Safety input 6 (X12-T12, X13-T13)	Function name	Dual channel direct opening input
	Symbol	 Dual Channel Direct Opening
	Description of operation	This function diagnoses the status of connected safety devices. This function diagnoses the time interval of status transition between each input of duplicated inputs (0.5s).
	Detail information	Logic functions (5-311)



For connected control devices, refer to “SAFETY PRECAUTIONS”.

Safety check signals (pulses signals) are sent from the drive terminals (T0 to T13) to diagnose connected safety devices and input circuits. Safety check signals can not be used as a power supply for connected devices.


Note. Solid state outputs, such as safety light curtains, can not be connected.

Note. Use safety inputs as specified combinations, such as receive terminal (Xn) and drive terminal (Tn). If the combinations are incorrect, SafetyOne does not work correctly.

Note. If there are unused safety inputs, connect the unused receive terminals (Xn) to the corresponding drive terminals (Tn). If they are not connected, the SafetyOne does not turn ON the safety outputs.

● **External device monitor inputs: X14 and X15 (T14 and T15)**

External device monitor inputs are used to diagnose the status of devices connected to safety outputs.

Intended inputs (Terminal names)	Target safety outputs (Terminal names)	Function	
External device monitor input 1 (X14-T14)	Safety output 1 (Y0, Y1)	Function name	External device monitor input
External device monitor input 2 (X15-T15)	Safety output 2 (Y2, Y3)	Symbol	
		Description of operation	This function diagnoses the status of devices connected to a target safety output.
		Detail information	Logic Functions (5-326)



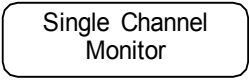
Warning



Safety check signals (pulses signals) are sent from the drive terminals (T14, T15) to diagnose external devices and monitor circuits. Safety check signals can not be used as a power supply for connected devices.

Note. If there are unused safety outputs, connect the intended external device monitor terminals (Xn) to the corresponding drive terminals (Tn). If they are not connected, the SafetyOne detects an input monitor error. As the result, the error LED displays a “1” and the unit changes to the Protection state.

● **Start inputs: X16 and X17**

Start inputs are used to control the start of safety outputs.

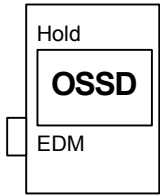
Intended inputs (Terminal names)	Target safety inputs (Terminal names)	Function	
		Start input 1 (X16)	Safety input 1 (X0-T0, X1-T1) Safety input 2 (X2-T2, X3-T3) Safety input 3 (X4-T4, X5-T5) Safety input 4 (X6-T6, X7-T7) Safety input 5 (X10-T10, X11-T11) Safety input 6 (X12-T12, X13-T13)
Symbol			
Description of operation	Safety outputs are started, when all target safety inputs are in the safe state and this function is in the ON state. This function is turned ON by 0.1s or more ON operation.		
Detail information	Logic Functions (5-325)		

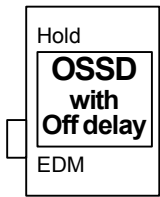
Intended inputs (Terminal names)	Target safety inputs (Terminal names)	Function	
		Start input 2 (X17)	Safety input 1 (X0-T0, X1-T1) Safety input 2 (X2-T2, X3-T3) Safety input 3 (X4-T4, X5-T5) Safety input 4 (X6-T6, X7-T7) Safety input 5 (X10-T10, X11-T11) Safety input 6 (X12-T12, X13-T13)
Symbol	 + 		
Description of operation	Safety outputs are started, when this function becomes ON after all intended safety inputs are in the safe state. This function is turned ON by 0.1s to 5s ON operation.		
Detail information	Logic Functions (5-325, 5-330)		

Note. If both of X16 and X17 are turned ON, the SafetyOne will detect an error. As a result, the error LED displays “3” and the state changes to the Stop state. Use only X16 or X17.

● **Safety outputs: Y0 to Y3**

Safety outputs are used to output safety information processed by SafetyOne.

Intended outputs (Terminal names)	Function	
Safety output 1 (Y0, Y1)	Function name	Safety output without timer
	Symbol	
	Description of operation	This function is a safety output to output safety information processed by SafetyOne. The output is turned OFF immediately by OFF operation (instantaneous OFF output).
	Detail information	Logic Functions (5-332)

Intended outputs (Terminal names)	Function	
Safety output 2 (Y2, Y3)	Function name	Safety output with timer
	Symbol	
	Description of operation	This function is a safety output to output safety information processed by SafetyOne. The output is turned OFF after the preset time of the OFF-delay timer (OFF-delay output).
	Detail information	Logic functions (5-335)

Note. When the SafetyOne changes to Protection state due to input monitor error, safety output without timer (safety output 1) is turned OFF. Safety output with timer (safety output 2) is turned OFF after the preset OFF-delay time.

Note. When the SafetyOne changes to Stop state due to circuit failure or other errors, all safety outputs (safety output 1 and safety output 2) are turned OFF, immediately.

•Safety input monitor outputs: Y4 to Y11

Safety input monitor outputs are used to output the status of safety inputs in SafetyOne.

Intended outputs (Terminal names)	Target safety inputs (Terminal names)	Description of operation
Safety input 1 monitor output (Y4)	Safety input 1 (X0-T0, X1-T1)	When the target safety input is ON, the monitor output is ON. When the target safety input is OFF, the monitor output is OFF.
Safety input 2 monitor output (Y5)	Safety input 2 (X2-T2, X3-T3)	
Safety input 3 monitor output (Y6)	Safety input 3 (X4-T4, X5-T5)	
Safety input 4 monitor output (Y7)	Safety input 4 (X6-T6, X7-T7)	
Safety input 5 monitor output (Y10)	Safety input 5 (X10-T10, X11-T11)	
Safety input 6 monitor output (Y11)	Safety input 6 (X12-T12, X13-T13)	

Note. When the targeted safety input detects an input monitor error, input circuit failure, or EMC the disturbance, corresponding safety input monitor output becomes a pulse output (1Hz). The monitor output is OFF in other errors, Initial state, or Configuration state.

•Safety output monitor outputs: Y12 and Y13

Safety output monitor outputs are used to output status of safety outputs in SafetyOne.

Intended outputs (Terminal names)	Target safety outputs (Terminal names)	Description of operation
Safety output 1 monitor output (Y12)	Safety output 1 (Y0, Y1)	When the target safety output is ON, the monitor output is ON. When the target safety output is OFF, this function is OFF. The monitor output turns OFF immediately, independent of the preset OFF-delay time.
Safety output 2 monitor output (Y13)	Safety output 2 (Y2, Y3)	

Note. When the safety output detects an output circuit failure, the corresponding safety output monitor output becomes a pulse output (1Hz). The monitor output is OFF in other errors, Initial state, or Configuration state.

•State monitor outputs: Y14 to Y16

State monitor outputs are used to output the internal state of SafetyOne.

Intended outputs (Terminal names)	State				
	Initial	Run	Configuration	Protection	Stop
State monitor output 1 (Y14)	■ON	□OFF	□OFF	□OFF	■ON
State monitor output 2 (Y15)	■ON	□OFF	■ON	■ON	■ON or □OFF
State monitor output 3 (Y16)	□OFF	■ON	□OFF	□OFF	□OFF

Refer to “Chapter 4 BASIC OPERATIONS” and to “Chapter 6 TROUBLE SHOOTING” for details of each state.



The monitor outputs are not safety outputs. Do not use these to construct a safety system.

● **Solenoid outputs: Y17 and Y20**

Solenoid outputs are used to control a solenoid in an interlock switch.

Intended outputs (Terminal names)	Description of operation
Solenoid output 1 (Y17)	When safety output 1 is OFF, the solenoid output is ON. When safety Output 1 is ready to turn ON (safety output 1 can be turned ON by operation of the start input), the solenoid output is OFF.
Solenoid output 2 (Y20)	When safety output 2 is OFF, the solenoid output is ON. When safety Output 2 is ready to turn ON (safety output 2 can be turned ON by operation of the start input), the solenoid output is OFF.

 **Warning**

The solenoid outputs are not safety outputs. Do not use these to construct a safety system.

Note. The solenoid outputs are OFF in each state except Run state.

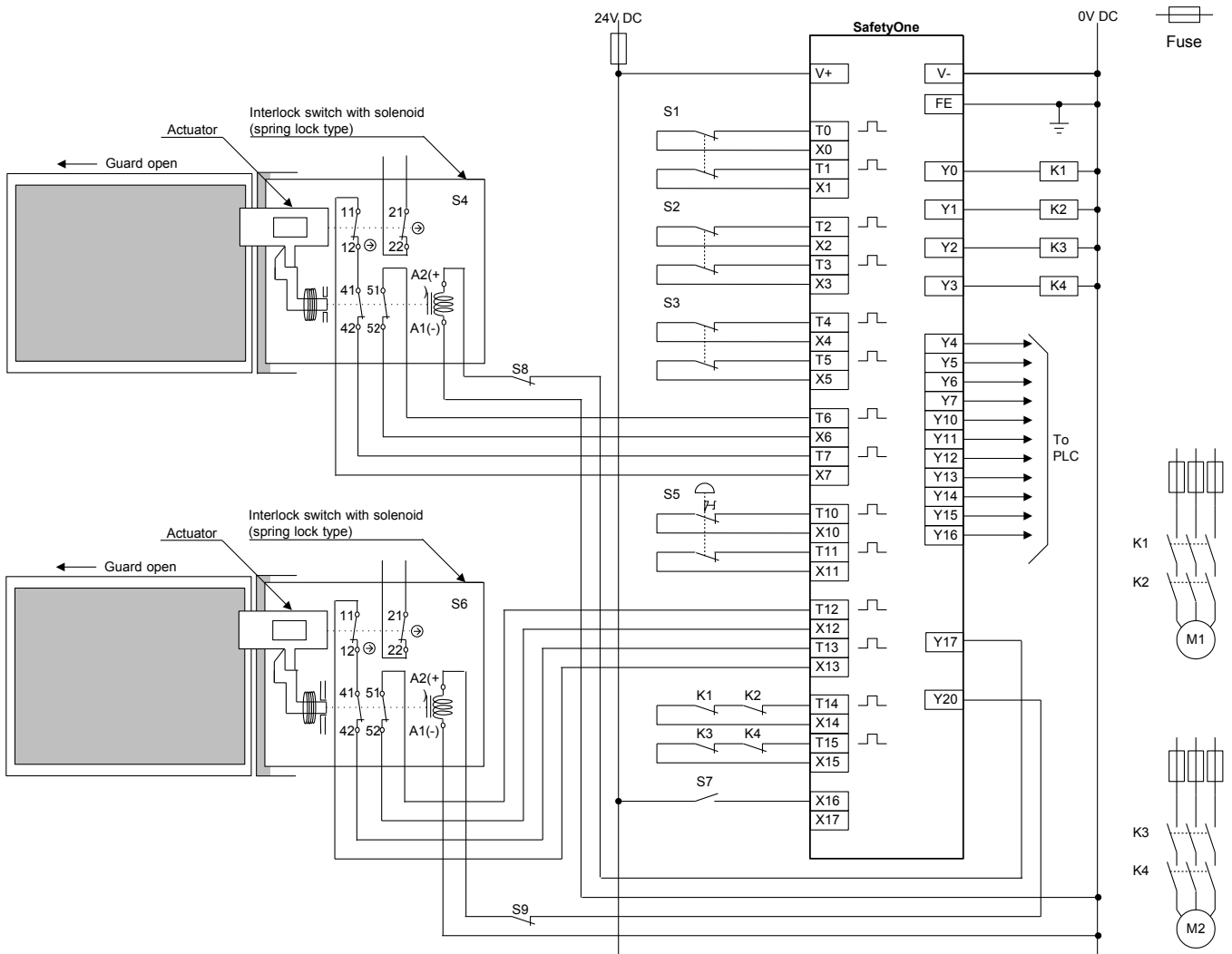
 **Caution**

Refer to "Chapter 2 PRODUCT SPECIFICATIONS" for specifications of each input and output.

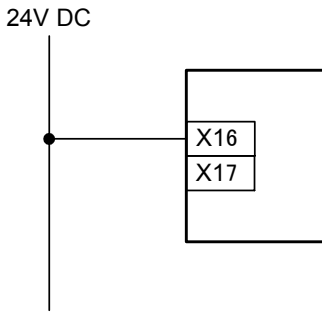
Wiring example (Logic 101)

In the case where 3 interlock switches, 2 interlock switches with solenoid (spring lock type), and 1 emergency stop switch are connected.

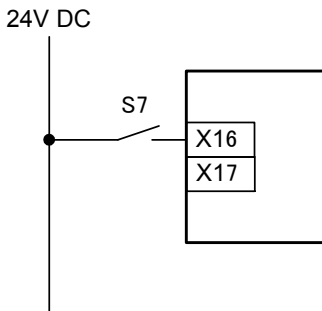
- S1, 2, 3 :Interlock switch
- S4, 6 :Interlock switch with solenoid (spring lock type)
- S5 :Emergency stop switch
- S7 :Start switch
- S8, 9 :Solenoid control switch
(Pressing the solenoid control switches after closing the guard door, contacts 41-42 and 51-52 of S4 and S6 turn on, allowing the SafetyOne to restart.)
- K1 to 4 :Contactor
- M1, 2 :Motor



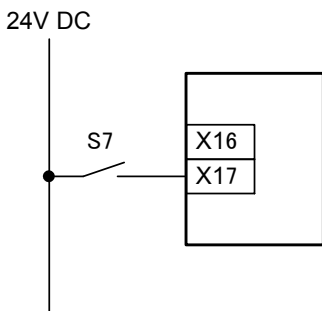
**When not using the start switch
(Auto start)**



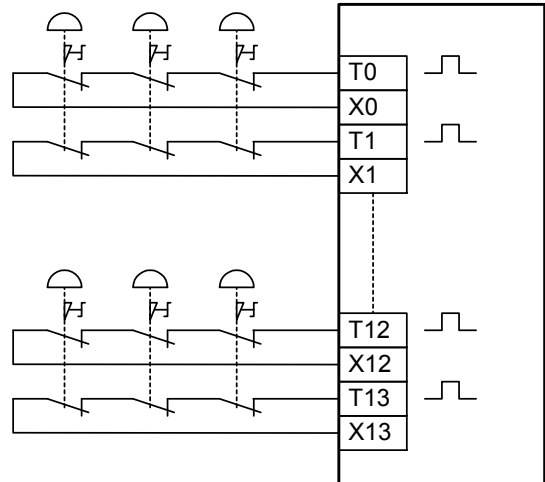
**When not detecting the welding of start switch
(Manual start)**



**When detecting the welding of start switch
(Control start)**



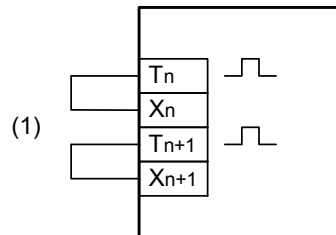
**When connecting multiple emergency
stop switches in series**



NOTE: Safety performance depends on the system configuration.

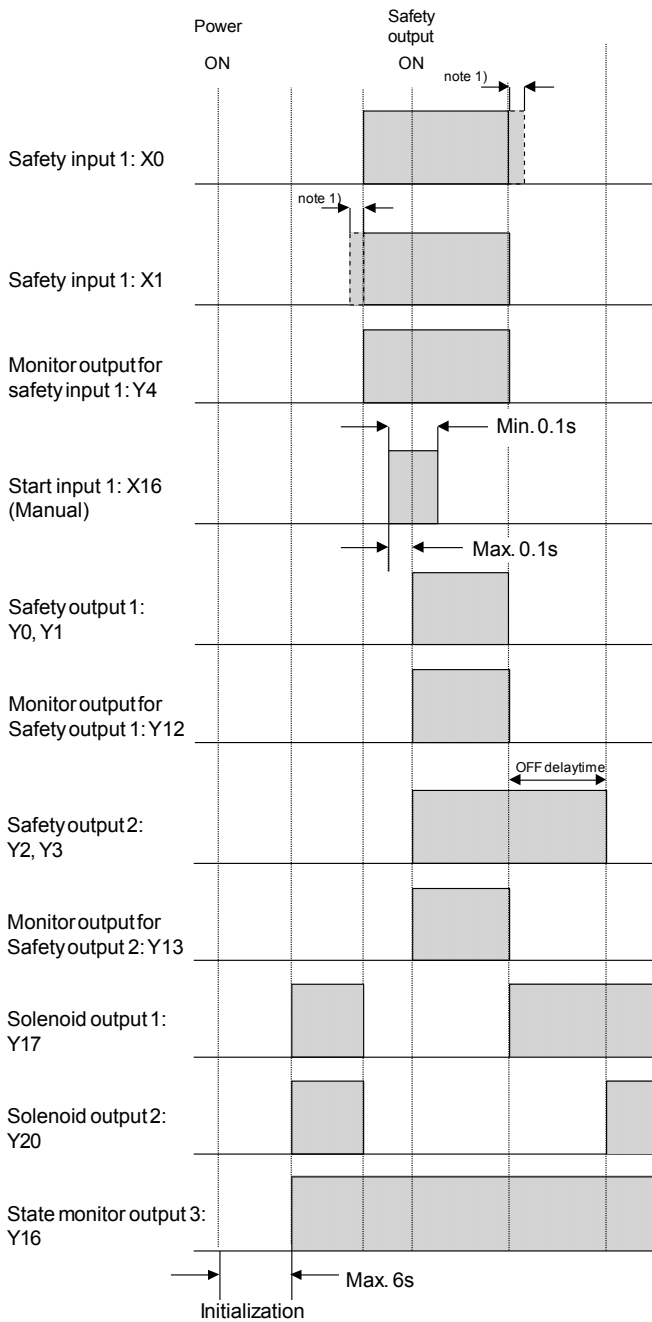
When not using some inputs

- If there are unused safety inputs, connect the unused receive terminals to the corresponding drive terminals. (Refer to (1))



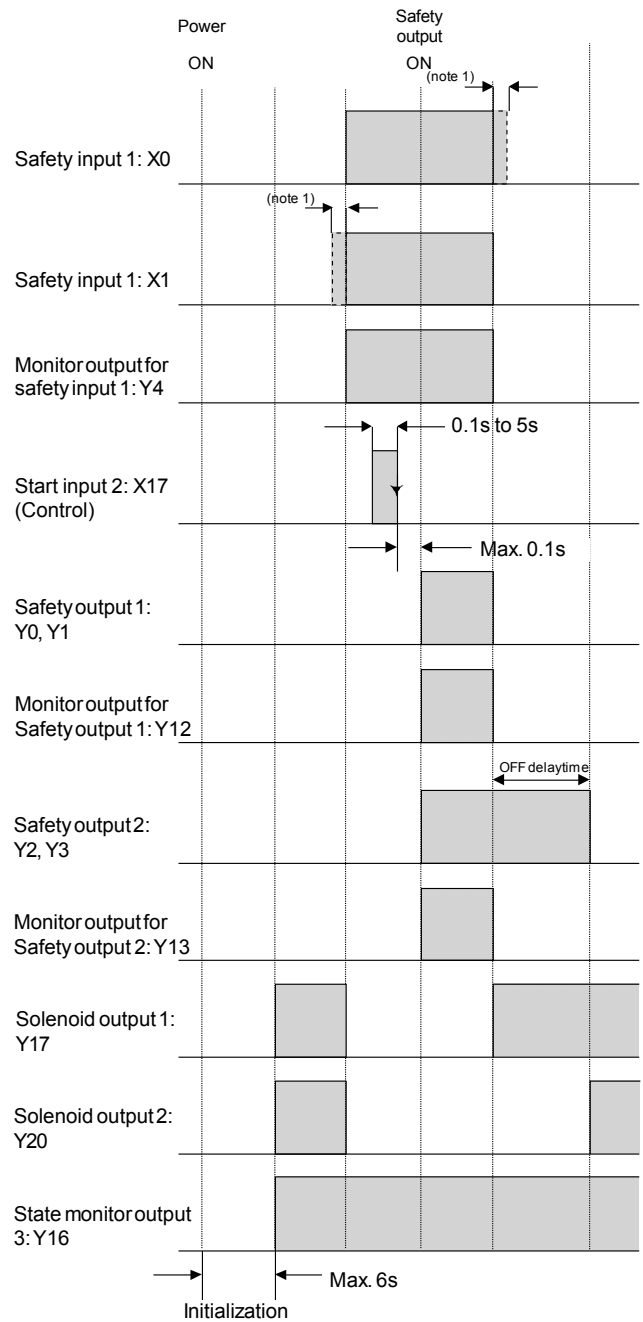
Timing chart (Logic 101)

Example: Manual start input (X16) is used.



(Safety input 2 to 6 are all ON in this chart.)

Example: Control start input (X17) is used.



(Safety input 2 to 6 are all ON in this chart.)

Note 1) Input monitor error detection time is infinity.

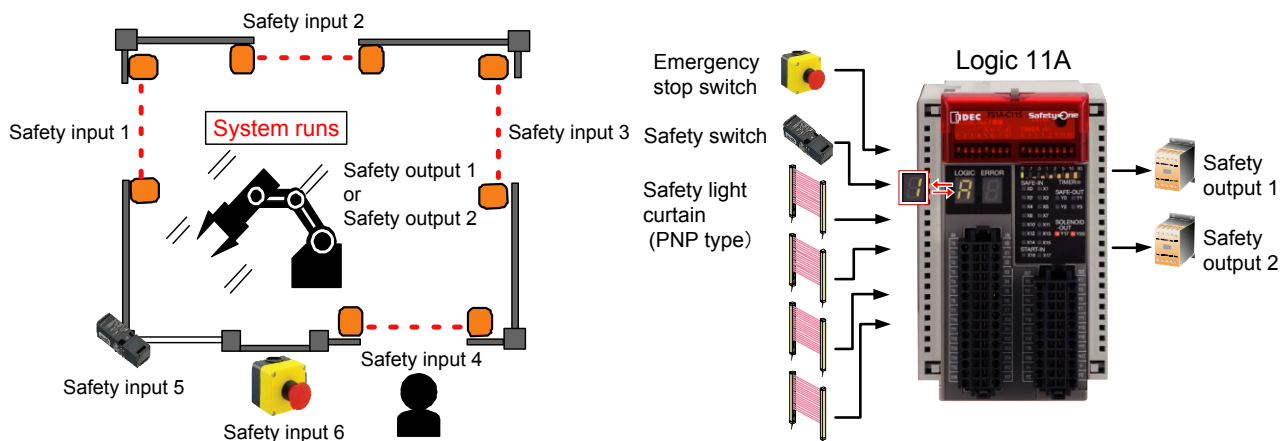
About safety inputs that are not described in this chart, input monitor error detection time is as follows.
 The time of dual channel dependent input (X2 to X7) is infinity.
 The time of dual channel direct opening input (X10 to X13) is 0.5s.
 Refer to the following "Logic functions" for more details.

Logic 11A: The logic for apparatus with openings

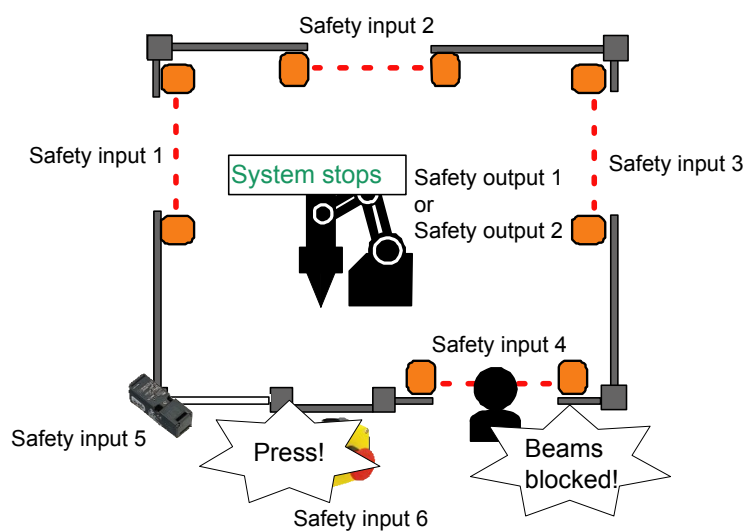
Overview (Logic 11A)

This logic is for using safety devices with dual channel solid state outputs, such as safety light curtains, for safety protective measures of production machinery and robots. Safety outputs perform as dual channel outputs.

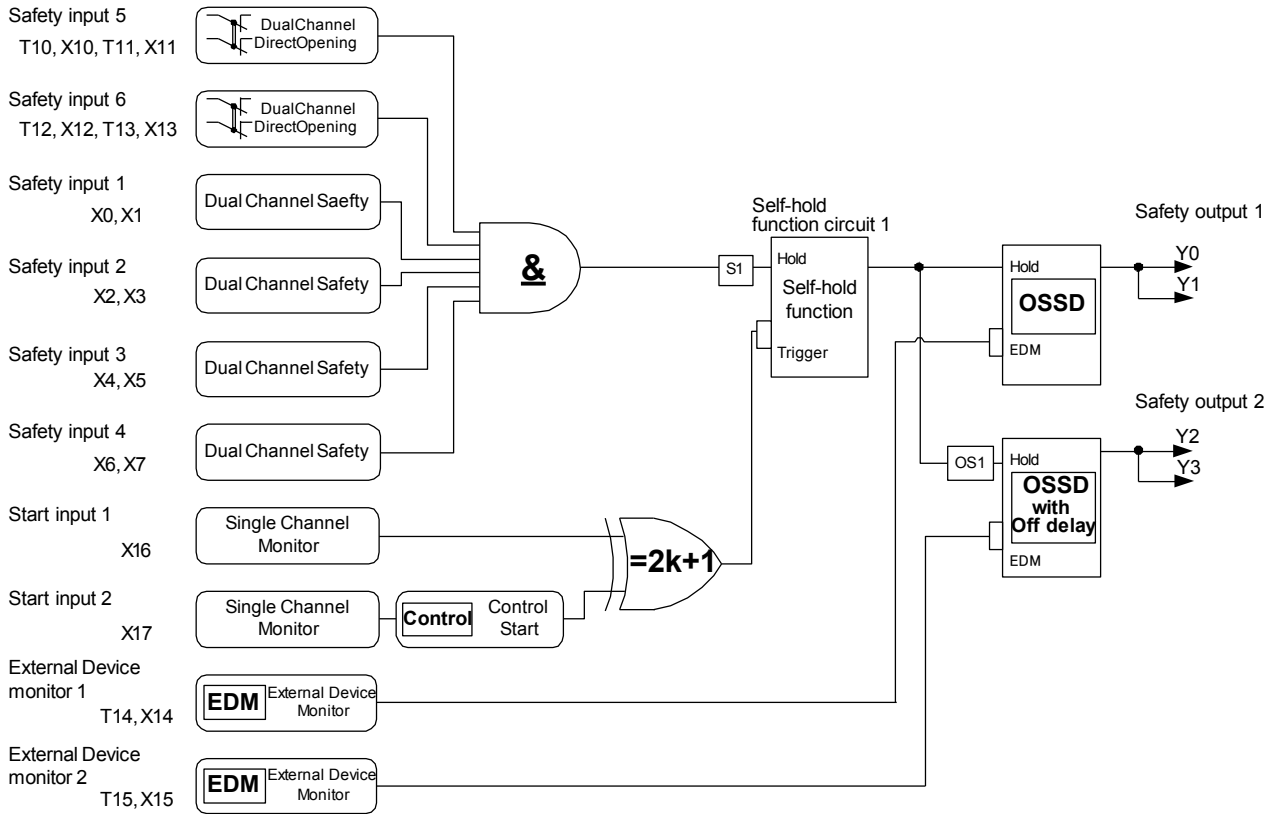
This logic enables the connection of 2 dual channel direct opening inputs and 4 dual channel safety inputs.



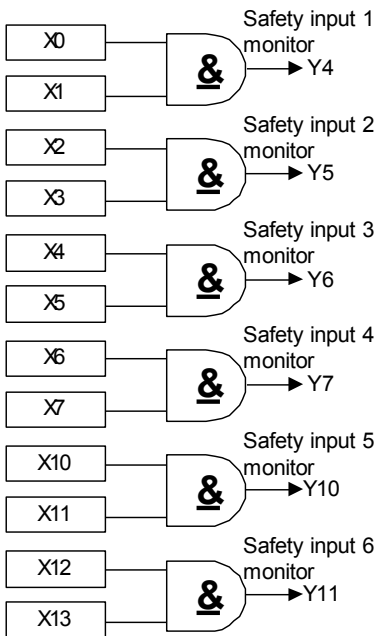
Operation example (Logic 11A)



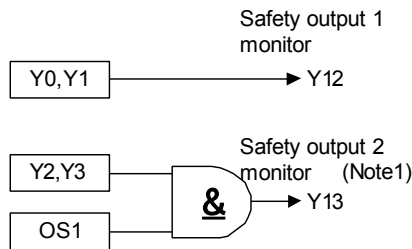
Logic circuit (Logic 11A)



● Monitor output for safety input

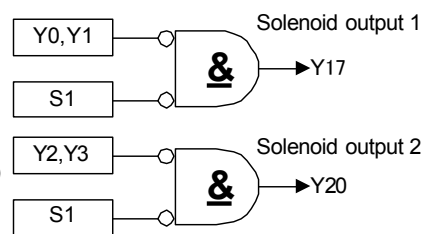


● Monitor output for safety output



Note1:
Safety output 2 monitor turns off immediately independent of OFF-delay time.

(Note2)
● Solenoid output




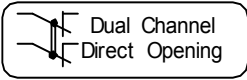
Note2:
In Run state, when the safety outputs are OFF and one or more safety inputs are OFF, the solenoid outputs turn ON.
When all safety inputs are ON, the solenoid outputs turn OFF, even when the start input is OFF.

Functions (Logic 11A)

●Safety inputs: X0 to X13 (T10 to T13)

Safety inputs are used to diagnose the status of connected safety devices, such as emergency stop switches, and interlock switches.

Intended inputs (Terminal names)	Function	
Safety input 1 (X0, X1) Safety input 2 (X2, X3) Safety input 3 (X4, X5) Safety input 4 (X6, X7)	Function name	Dual channel safety input
	Symbol	
	Description of operation	This function diagnoses the status of connected safety devices. This function diagnoses the time interval of status transition between each input of duplicated inputs (0.1s). The function does not use drive terminals (T0 to T7).
	Detail information	Logic functions (5-317)

Intended inputs (Terminal names)	Function	
Safety input 5 (X10-T10, X11-T11) Safety input 6 (X12-T12, X13-T13)	Function name	Dual channel direct opening input
	Symbol	
	Description of operation	This function diagnoses the status of connected safety devices. This function diagnoses the time interval of status transition between each input of duplicated inputs (0.5s).
	Detail information	Logic functions (5-311)



Warning

For connected control devices, refer to “SAFETY PRECAUTIONS”.

Safety check signals (pulses signals) are sent from the drive terminals (T10 to T13) to diagnose connected safety devices and input circuits. Safety check signals can not be used as a power supply for connected devices.

Note. If there are unused safety inputs in safety input 1 through safety input 4, connect the unused receive terminals (Xn) to a 24V DC power supply (V+). If they are not connected, the SafetyOne does not turn ON the safety outputs.


Note. Solid state outputs, such as safety light curtains, can not be connected to safety input 5 and safety input 6.

Note. Use safety input 5 and safety input 6 as specified combinations, such as receive terminal (Xn) and drive terminal (Tn). If the combinations are incorrect, SafetyOne does not work correctly.

Note. If there are unused safety inputs in safety output 5 and safety output 6, connect the unused receive terminals (Xn) to the corresponding drive terminals (Tn). If they are not connected, the SafetyOne does not turn ON the safety outputs.

● **External device monitor inputs: X14 and X15 (T14 and T15)**

External device monitor inputs are used to diagnose the status of devices connected to safety outputs.

Intended inputs (Terminal names)	Target safety outputs (Terminal names)	Function	
External device monitor input 1 (X14-T14)	Safety output 1 (Y0, Y1)	Function name	External device monitor input
External device monitor input 2 (X15-T15)	Safety output 2 (Y2, Y3)	Symbol	
		Description of operation	This function diagnoses the status of devices connected to a target safety output.
		Detail information	Logic functions (5-326)




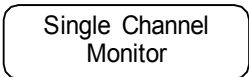

Safety check signals (pulses signals) are sent from the drive terminals (T14, T15) to diagnose external devices and monitor circuits. Safety check signals can not be used as a power supply for connected devices.

Note. If there are unused safety outputs, connect the intended external device monitor terminals (Xn) to the corresponding drive terminals (Tn). If they are not connected, the SafetyOne detects an input monitor error. As the result, the error LED displays a “1” and the unit changes to the Protection state.

● **Start inputs: X16 and X17**

Start inputs are used to control the start of safety outputs.

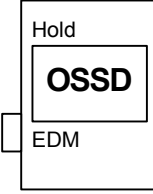
Intended inputs (Terminal names)	Target safety inputs (Terminal names)	Function	
		Start input 1 (X16)	Safety input 1 (X0, X1) Safety input 2 (X2, X3) Safety input 3 (X4, X5) Safety input 4 (X6, X7) Safety input 5 (X10-T10, X11-T11) Safety input 6 (X12-T12, X13-T13)
		Symbol	
		Description of operation	Safety outputs are started, when all target safety inputs are in the safe state and this function is in the ON state. This function is turned ON by 0.1s or more ON operation.
		Detail information	Logic functions (5-325)

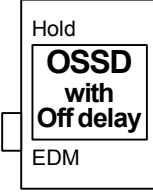
Intended inputs (Terminal names)	Target safety inputs (Terminal names)	Function	
		Start input 2 (X17)	Safety input 1 (X0, X1) Safety input 2 (X2, X3) Safety input 3 (X4, X5) Safety input 4 (X6, X7) Safety input 5 (X10-T10, X11-T11) Safety input 6 (X12-T12, X13-T13)
		Symbol	 + 
		Description of operation	Safety outputs are started, when this function becomes ON after all intended safety inputs are in the safe state. This function is turned ON by 0.1s to 5s ON operation.
		Detail information	Logic functions (5-325, 5-330)

Note. If both of X16 and X17 are turned ON, the SafetyOne will detect an error. As a result, the error LED displays “3” and the state changes to the Stop state. Use only X16 or X17.

● **Safety outputs: Y0 to Y3**

Safety outputs are used to output safety information processed by SafetyOne.

Intended outputs (Terminal names)	Function	
Safety output 1 (Y0, Y1)	Function name	Safety output without timer
	Symbol	
	Description of operation	This function is a safety output to output safety information processed by SafetyOne. The output is turned OFF immediately by OFF operation (instantaneous OFF output).
	Detail information	Logic functions (5-332)

Intended outputs (Terminal names)	Function	
Safety output 2 (Y2, Y3)	Function name	Safety output with timer
	Symbol	
	Description of operation	This function is a safety output to output safety information processed by SafetyOne. The output is turned OFF after the preset time of the OFF-delay timer (OFF-delay output).
	Detail information	Logic functions (5-335)

Note. When the SafetyOne changes to Protection state due to input monitor error, safety output without timer (safety output 1) is turned OFF. Safety output with timer (safety output 2) is turned OFF after the preset OFF-delay time.

Note. When the SafetyOne changes to Stop state due to circuit failure or other errors, all safety outputs (safety output 1 and safety output 2) are turned OFF, immediately.

●Safety input monitor outputs: Y4 to Y11

Safety input monitor outputs are used to output status of safety inputs in SafetyOne.

Intended outputs (Terminal names)	Target safety inputs (Terminal names)	Description of operation
Safety input 1 monitor output (Y4)	Safety input 1 (X0, X1)	When the target safety input is ON, the monitor output is ON. When the target safety input is OFF, the monitor output is OFF.
Safety input 2 monitor output (Y5)	Safety input 2 (X2, X3)	
Safety input 3 monitor output (Y6)	Safety input 3 (X4, X5)	
Safety input 4 monitor output (Y7)	Safety input 4 (X6, X7)	
Safety input 5 monitor output (Y10)	Safety input 5 (X10-T10, X11-T11)	
Safety input 6 monitor output (Y11)	Safety input 6 (X12-T12, X13-T13)	

Note. When the targeted safety input detects an input monitor error, input circuit failure, or EMC the disturbance, corresponding safety input monitor output becomes a pulse output (1Hz). The monitor output is OFF in other errors, Initial state, or Configuration state.

●Safety output monitor outputs: Y12 and Y13

Safety output monitor outputs are used to output status of safety outputs in SafetyOne.

Intended outputs (Terminal names)	Target safety outputs (Terminal names)	Description of operation
Safety output 1 monitor output (Y12)	Safety output 1 (Y0, Y1)	When the target safety output is ON, the monitor output is ON. When the target safety output is OFF, this function is OFF. The monitor output turns OFF immediately, independent of the preset OFF-delay time.
Safety output 2 monitor output (Y13)	Safety output 2 (Y2, Y3)	

Note. When the safety output detects an output circuit failure, the corresponding safety output monitor output becomes a pulse output (1Hz). The monitor output is OFF in other errors, Initial state, or Configuration state.

●State monitor outputs: Y14 to Y16

State monitor outputs are used to output the internal state of SafetyOne.

Intended outputs (Terminal names)	State				
	Initial	Run	Configuration	Protection	Stop
State monitor output 1 (Y14)	■ON	□OFF	□OFF	□OFF	■ON
State monitor output 2 (Y15)	■ON	□OFF	■ON	■ON	■ON or □OFF
State monitor output 3 (Y16)	□OFF	■ON	□OFF	□OFF	□OFF

Refer to “Chapter 4 BASIC OPERATIONS” and to “Chapter 6 TROUBLE SHOOTING” for details of each state.



Warning

The monitor outputs are not safety outputs. Do not use these to construct a safety system.

● **Solenoid outputs: Y17 and Y20**

Solenoid outputs are used to control a solenoid in an interlock switch.

Intended outputs (Terminal names)	Description of operation
Solenoid output 1 (Y17)	When safety output 1 is OFF, the solenoid output is ON. When safety Output 1 is ready to turn ON (safety output 1 can be turned ON by operation of the start input), the solenoid output is OFF.
Solenoid output 2 (Y20)	When safety output 2 is OFF, the solenoid output is ON. When safety Output 2 is ready to turn ON (safety output 2 can be turned ON by operation of the start input), the solenoid output is OFF.

 **Warning**

The solenoid outputs are not safety outputs. Do not use these to construct a safety system.

Note. The solenoid outputs are OFF in each state except Run state.

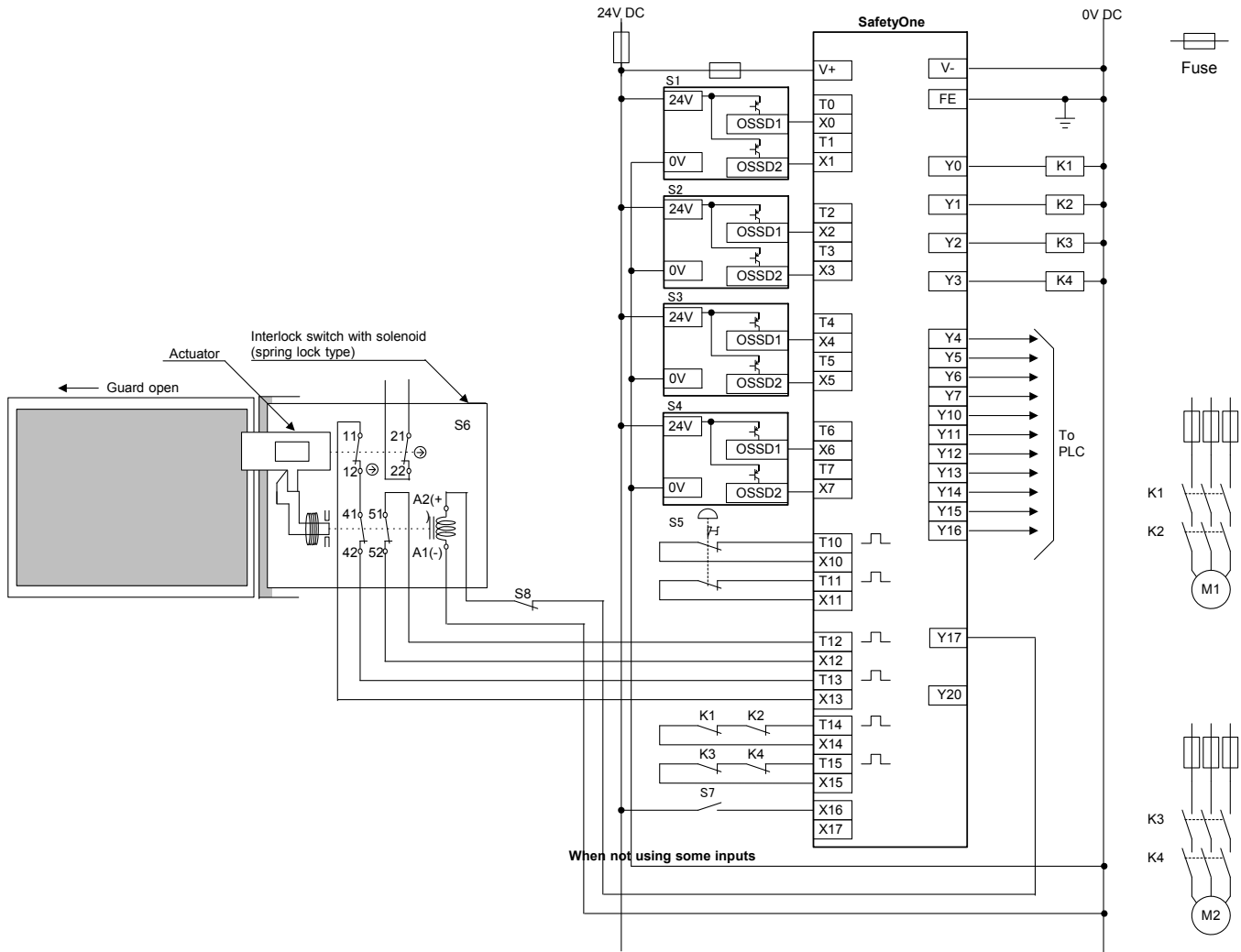
 **Caution**

Refer to "Chapter 2 PRODUCT SPECIFICATIONS" for specifications of each input and output.

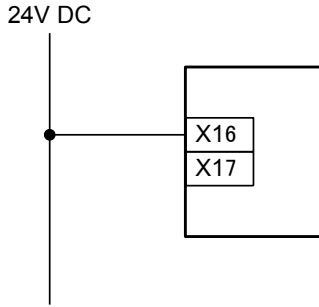
Wiring example (Logic 11A)

In the case where 4 safety light curtains, 1 emergency stop switch, and 1 interlock switch with solenoid (spring lock type) are connected.

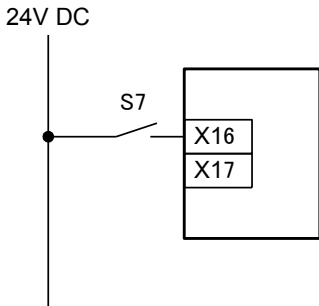
- S1 to 4 : Safety light curtain
- S5 : Emergency stop switch
- S6 : Interlock switch with solenoid (spring lock type)
- S7 : Start switch
- S8 : Solenoid control switch
- (Pressing the solenoid control switches after closing the guard door, contacts 41-42 and 51-52 of S6 turn on, allowing the SafetyOne to restart.)
- K1 to 4 : Contactor
- M1, 2 : Motor



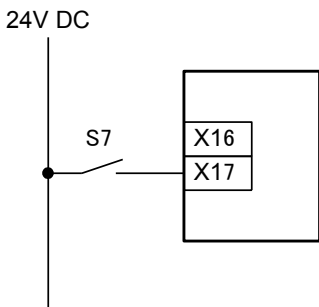
**When not using the start switch
(Auto start)**



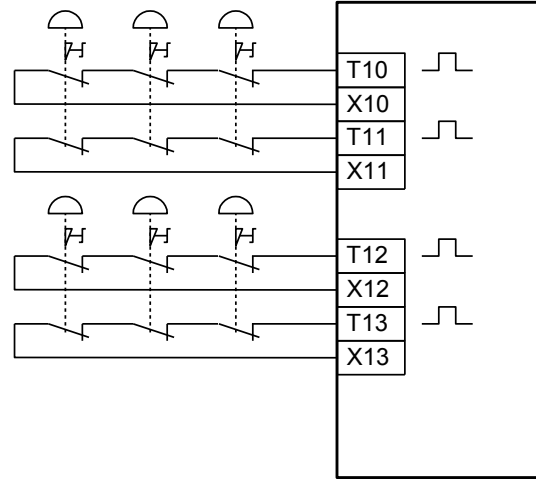
**When not detecting the welding of start switch
(Manual start)**



**When detecting the welding of start switch
(Control start)**



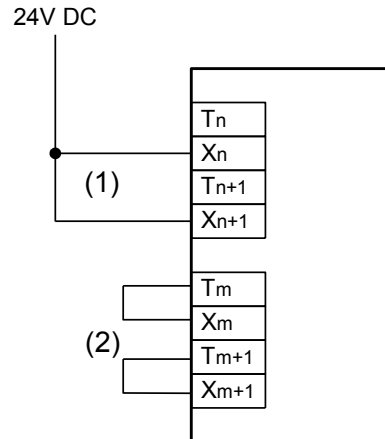
**When connecting multiple emergency stop switches
in series**



NOTE: Safety performance depends on the system configuration.

When not using some inputs

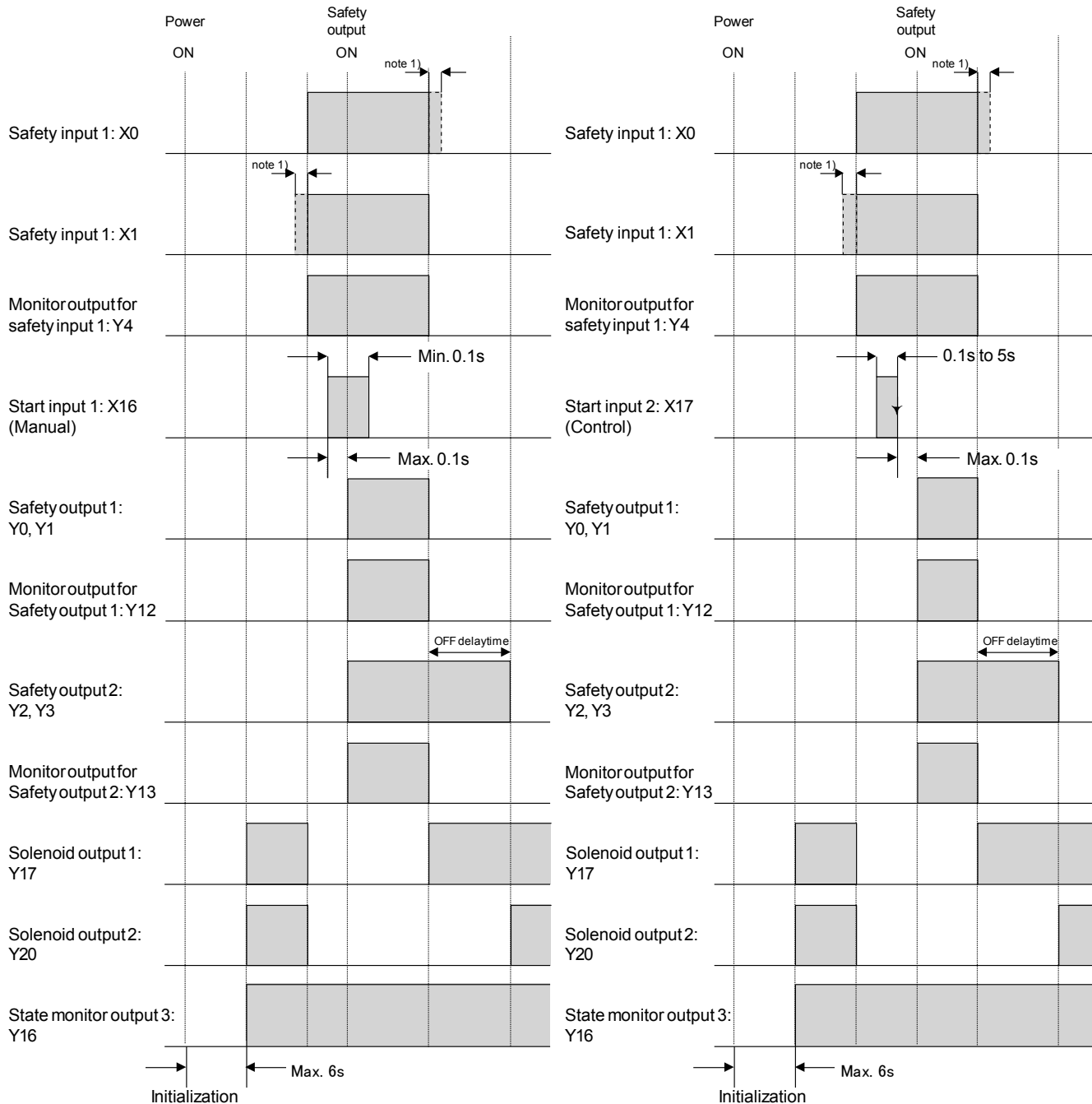
- If there are unused safety inputs in S1 to S4, connect the unused receive terminals to 24V DC power supply (V+). (Refer to (1))
- If there are unused safety inputs in S5 and S6, connect the unused receive terminals to the corresponding drive terminals. (Refer to (2))



Timing chart (Logic 11A)

Example: Manual start input (X16) is used.

Example: Control start input (X17) is used.



(Safety input 2 to 6 are all ON in this chart.)

(Safety input 2 to 6 are all ON in this chart.)

Note 1) Input monitor error detection time is 0.1s.

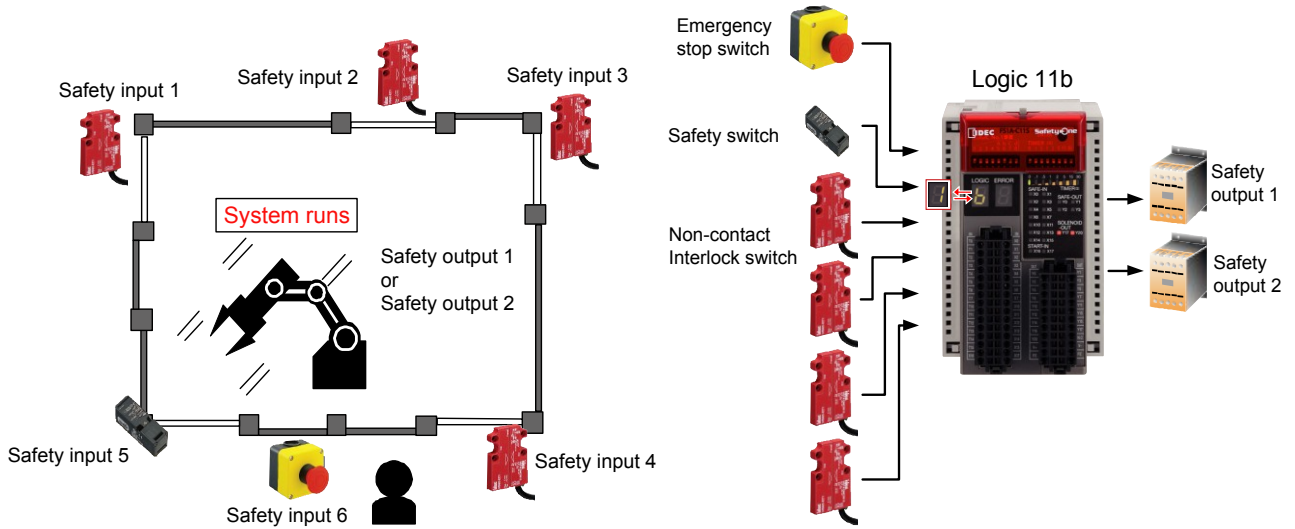
About safety inputs that are not described in this chart, input monitor error detection time is as follows.
 The time of dual channel safety input (X2 to X7) is 0.1s.
 The time of dual channel direct opening input (X10 to X13) is 0.5s.
 Refer to the following "Logic functions" for more details.

Logic 11b: The logic for apparatus with NO/NC contact inputs

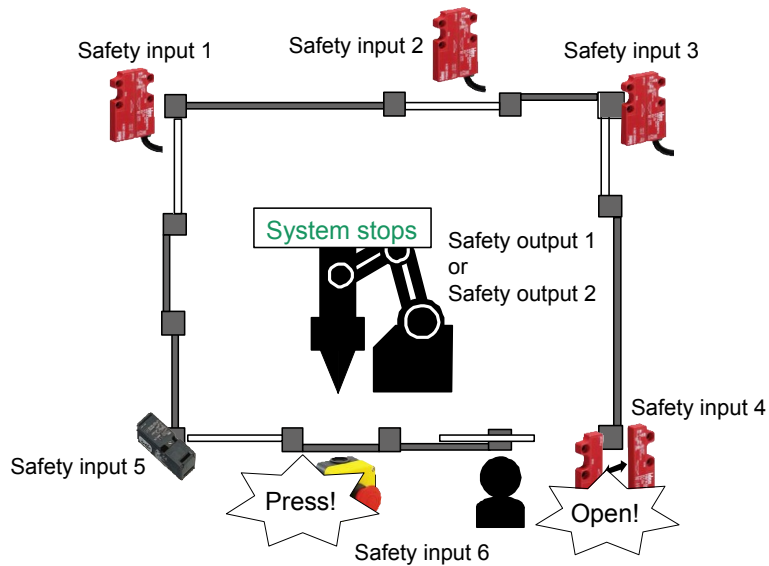
Overview (Logic 11b)

This logic function is for using dual channel NO/NC contact devices as safety protective measures for semiconductor manufacturing machines and food packaging machinery. Safety outputs perform as dual channel outputs.

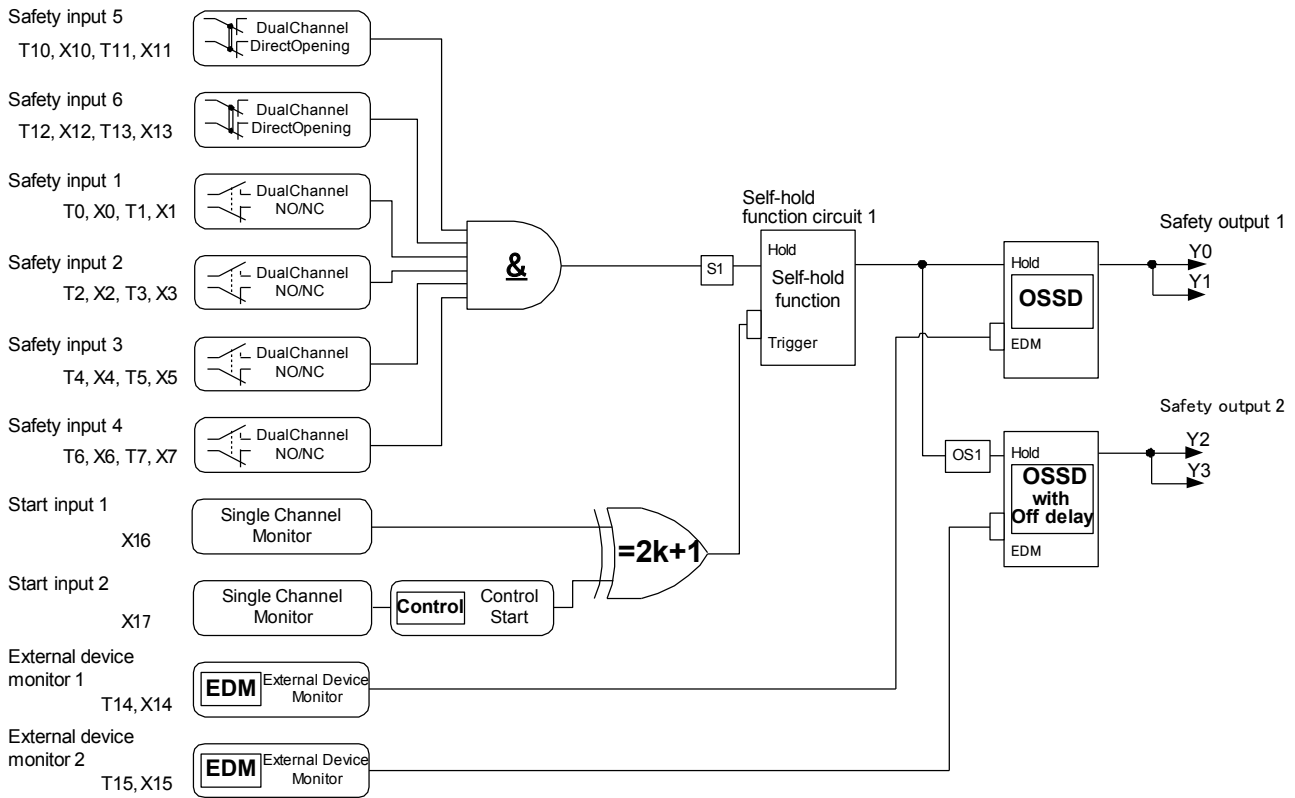
This logic has 2 dual inputs for direct opening inputs and 4 dual channel inputs for NO/NC contact devices.



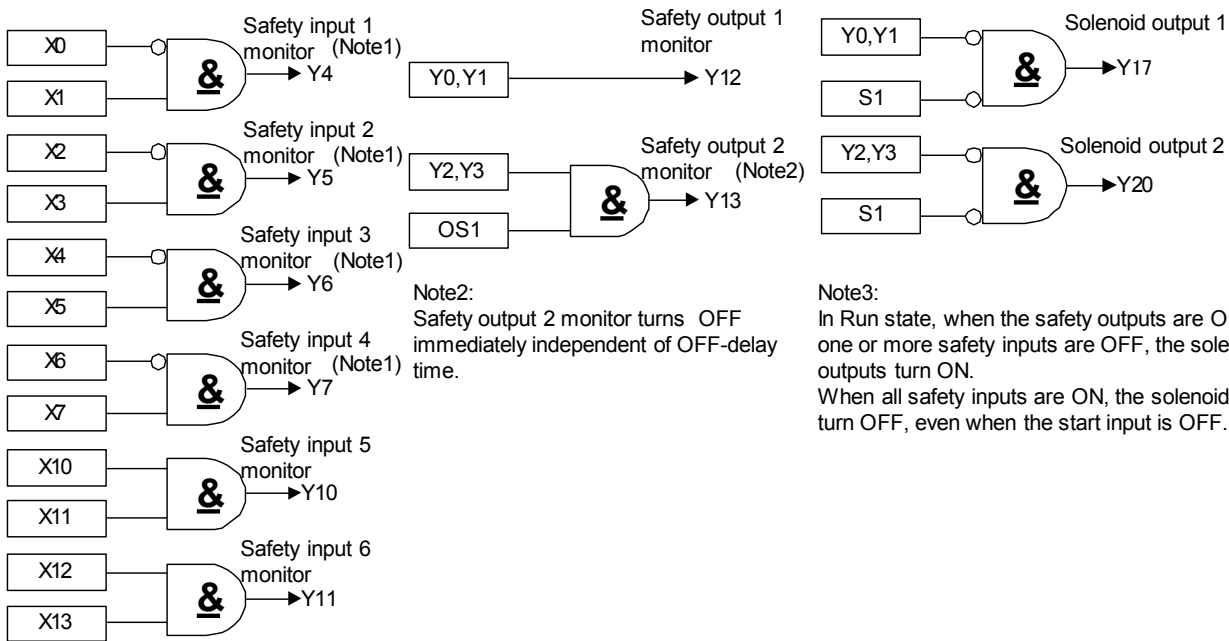
Operation example (Logic 11b)



Logic circuit (Logic 11b)



- Monitor output for safety input
- Monitor output for safety output
- Solenoid output (Note3)



Note1:
When X_n is OFF and X_{n+1} is ON, safety input 1 monitor to safety input 4 monitor turn ON.
(n = 0,2,4,6)

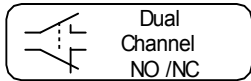
Note2:
Safety output 2 monitor turns OFF immediately independent of OFF-delay time.

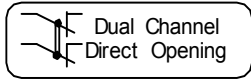
Note3:
In Run state, when the safety outputs are OFF and one or more safety inputs are OFF, the solenoid outputs turn ON.
When all safety inputs are ON, the solenoid outputs turn OFF, even when the start input is OFF.

Functions (Logic 11b)

●Safety inputs: X0 to X13 (T0 to T13)

Safety inputs are used to diagnose the status of connected safety devices, such as emergency stop switches, interlock switches, and non-contact interlock switches.

Intended inputs (Terminal names)	Function	
Safety input 1 (X0-T0, X1-T1) Safety input 2 (X2-T2, X3-T3) Safety input 3 (X4-T4, X5-T5) Safety input 4 (X6-T6, X7-T7)	Function name	Dual channel NO/NC input
	Symbol	
	Description of operation	This function diagnoses the status of connected safety devices. This function diagnoses the time interval of status transition between each input of duplicated inputs (0.5s).
	Detail information	Logic functions (5-315)

Intended inputs (Terminal names)	Function	
Safety input 5 (X10-T10, X11-T11) Safety input 6 (X12-T12, X13-T13)	Function name	Dual channel direct opening input
	Symbol	
	Description of operation	This function diagnoses the status of connected safety devices. This function diagnoses the time interval of status transition between each input of duplicated inputs (0.5s).
	Detail information	Logic functions (5-311)

Warning

For connected control devices, refer to “SAFETY PRECAUTIONS”.

Safety check signals (pulses signals) are sent from the drive terminals (T0 to T13) to diagnose connected safety devices and input circuits. Safety check signals can not be used as a power supply for connected devices.

Note. Solid state outputs, such as safety light curtains, can not be connected to safety inputs.


Note. Use safety inputs as specified combinations, such as receive terminal (Xn) and drive terminal (Tn). If the combinations are incorrect, SafetyOne does not work correctly.

Note. If there are unused safety inputs, connect the unused receive terminals (Xn) to the corresponding drive terminals (Tn) as shown in following table. If they are not connected properly, the SafetyOne does not turn ON the safety outputs.

Unused safety inputs	Terminal names	Connection
Safety input 1	X0-T0	Open
	X1-T1	Short
Safety input 2	X2-T2	Open
	X3-T3	Short
Safety input 3	X4-T4	Open
	X5-T5	Short
Safety input 4	X6-T6	Open
	X7-T7	Short
Safety input 5	X10-T10	Short
	X11-T11	Short
Safety input 6	X12-T12	Short
	X13-T13	Short

● **External device monitor inputs: X14 and X15 (T14 and T15)**

External device monitor inputs are used to diagnose the status of devices connected to safety outputs.

Intended inputs (Terminal names)	Target safety outputs (Terminal names)	Function	
		External device monitor input 1 (X14-T14)	Safety output 1 (Y0, Y1)
External device monitor input 2 (X15-T15)	Safety output 2 (Y2, Y3)	Symbol	
		Description of operation	This function diagnoses the status of devices connected to a target safety output.
		Detail information	Logic functions (5-326)

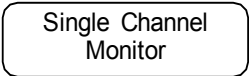


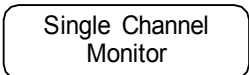

Safety check signals (pulses signals) are sent from the drive terminals (T14, T15) to diagnose external devices and monitor circuits. Safety check signals can not be used as a power supply for connected devices.

Note. If there are unused safety outputs, connect the intended external device monitor terminals (Xn) to the corresponding drive terminals (Tn). If they are not connected, the SafetyOne detects an input monitor error. As the result, the error LED displays a “1” and the unit changes to the Protection state.

● **Start inputs: X16 and X17**

Start inputs are used to control the start of safety outputs.

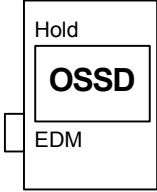
Intended inputs (Terminal names)	Target safety inputs (Terminal names)	Function	
		Start input 1 (X16)	Safety input 1 (X0-T0, X1-T1) Safety input 2 (X2-T2, X3-T3) Safety input 3 (X4-T4, X5-T5) Safety input 4 (X6-T6, X7-T7) Safety input 5 (X10-T10, X11-T11) Safety input 6 (X12-T12, X13-T13)
Symbol			
Description of Operation	Safety outputs are started, when all target safety inputs are in the safe state and this function is in the ON state. This function is turned ON by 0.1s or more ON operation.		
Detail Information	Logic functions (5-325)		

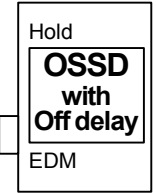
Intended Inputs (Terminal names)	Target safety inputs (Terminal names)	Function	
		Start input 2 (X17)	Safety input 1 (X0-T0, X1-T1) Safety input 2 (X2-T2, X3-T3) Safety input 3 (X4-T4, X5-T5) Safety input 4 (X6-T6, X7-T7) Safety input 5 (X10-T10, X11-T11) Safety input 6 (X12-T12, X13-T13)
Symbol	 + 		
Description of Operation	Safety outputs are started, when this function becomes ON after all intended safety inputs are in the safe state. This function is turned ON by 0.1s to 5s ON operation.		
Detail Information	Logic functions (5-325, 330)		

Note. If both of X16 and X17 are turned ON, the SafetyOne will detect an error. As a result, the error LED displays “3” and the state changes to the Stop state. Use only X16 or X17.

● **Safety outputs: Y0 to Y3**

Safety outputs are used to output safety information processed by SafetyOne.

Intended outputs (Terminal names)	Function	
Safety output 1 (Y0, Y1)	Function name	Safety output without timer
	Symbol	
	Description of operation	This function is a safety output to output safety information processed by SafetyOne. The output is turned OFF immediately by OFF operation (instantaneous OFF output).
	Detail information	Logic functions (5-332)

Intended outputs (Terminal names)	Function	
Safety output 2 (Y2, Y3)	Function name	Safety output with timer
	Symbol	
	Description of operation	This function is a safety output to output the safety information processed by SafetyOne. The output is turned OFF after the preset time of the OFF-delay timer (OFF-delay output).
	Detail information	Logic functions (5-335)

Note. When the SafetyOne changes to Protection state due to input monitor error, safety output without timer (safety output 1) is turned OFF. Safety output with timer (safety output 2) is turned OFF after the preset OFF-delay time.

Note. When the SafetyOne changes to Stop state due to circuit failure or other errors, all safety outputs (safety output 1 and safety output 2) are turned OFF, immediately.

●Safety input monitor outputs: Y4 to Y11

Safety input monitor outputs are used to output the status of safety inputs in SafetyOne.

Intended outputs (Terminal names)	Target safety inputs (Terminal names)	Description of operation
Safety input 1 monitor output (Y4)	Safety input 1 (X0-T0, X1-T1)	When the target safety input is ON, the monitor output is ON. When the target safety input is OFF, the monitor output is OFF.
Safety input 2 monitor output (Y5)	Safety input 2 (X2-T2, X3-T3)	
Safety input 3 monitor output (Y6)	Safety input 3 (X4-T4, X5-T5)	
Safety input 4 monitor output (Y7)	Safety input 4 (X6-T6, X7-T7)	
Safety input 5 monitor output (Y10)	Safety input 5 (X10-T10, X11-T11)	
Safety input 6 Monitor output (Y11)	Safety input 6 (X12-T12, X13-T13)	

Note. When the targeted safety input detects an input monitor error, input circuit failure, or EMC the disturbance, corresponding safety input monitor output becomes a pulse output (1Hz). The monitor output is OFF in other errors, Initial state, or Configuration state.

●Safety output monitor outputs: Y12 and Y13

Safety output monitor outputs are used to output status of safety outputs in SafetyOne.

Intended outputs (Terminal names)	Target safety outputs (Terminal names)	Description of operation
Safety output 1 monitor output (Y12)	Safety output 1 (Y0, Y1)	When the target safety output is ON, the monitor output is ON. When the target safety output is OFF, this function is OFF. The monitor output turns OFF immediately, independent of the preset OFF-delay time.
Safety output 2 monitor output (Y13)	Safety output 2 (Y2, Y3)	

Note. When the safety output detects an output circuit failure, the corresponding safety output monitor output becomes a pulse output (1Hz). The monitor output is OFF in other errors, Initial state, or Configuration state.

●State monitor outputs: Y14 to Y16

State monitor outputs are used to output the internal state of SafetyOne.

Intended output (Terminal names)	State				
	Initial	Run	Configuration	Protection	Stop
State monitor output 1 (Y14)	■ON	□OFF	□OFF	□OFF	■ON
State monitor output 2 (Y15)	■ON	□OFF	■ON	■ON	■ON or □OFF
State monitor output 3 (Y16)	□OFF	■ON	□OFF	□OFF	□OFF

Refer to “Chapter 4 BASIC OPERATIONS” and to “Chapter 6 TROUBLE SHOOTING” for details of each state.



Warning

The monitor outputs are not safety outputs. Do not use these to construct a safety system.

● **Solenoid outputs: Y17 and Y20**

Solenoid outputs are used to control the solenoid in interlock switch with lock.

Intended outputs (Terminal Names)	Description of operation
Solenoid output 1 (Y17)	When safety output 1 is OFF, the solenoid output is ON. When safety Output 1 is ready to turn ON (safety output 1 can be turned ON by operation of the start input), the solenoid output is OFF.
Solenoid output 2 (Y20)	When safety output 2 is OFF, the solenoid output is ON. When safety Output 2 is ready to turn ON (safety output 2 can be turned ON by operation of the start input), the solenoid output is OFF.

 **Warning**

The solenoid outputs are not safety outputs. Do not use these to construct a safety system.

Note. The solenoid outputs are OFF in each state except Run state.

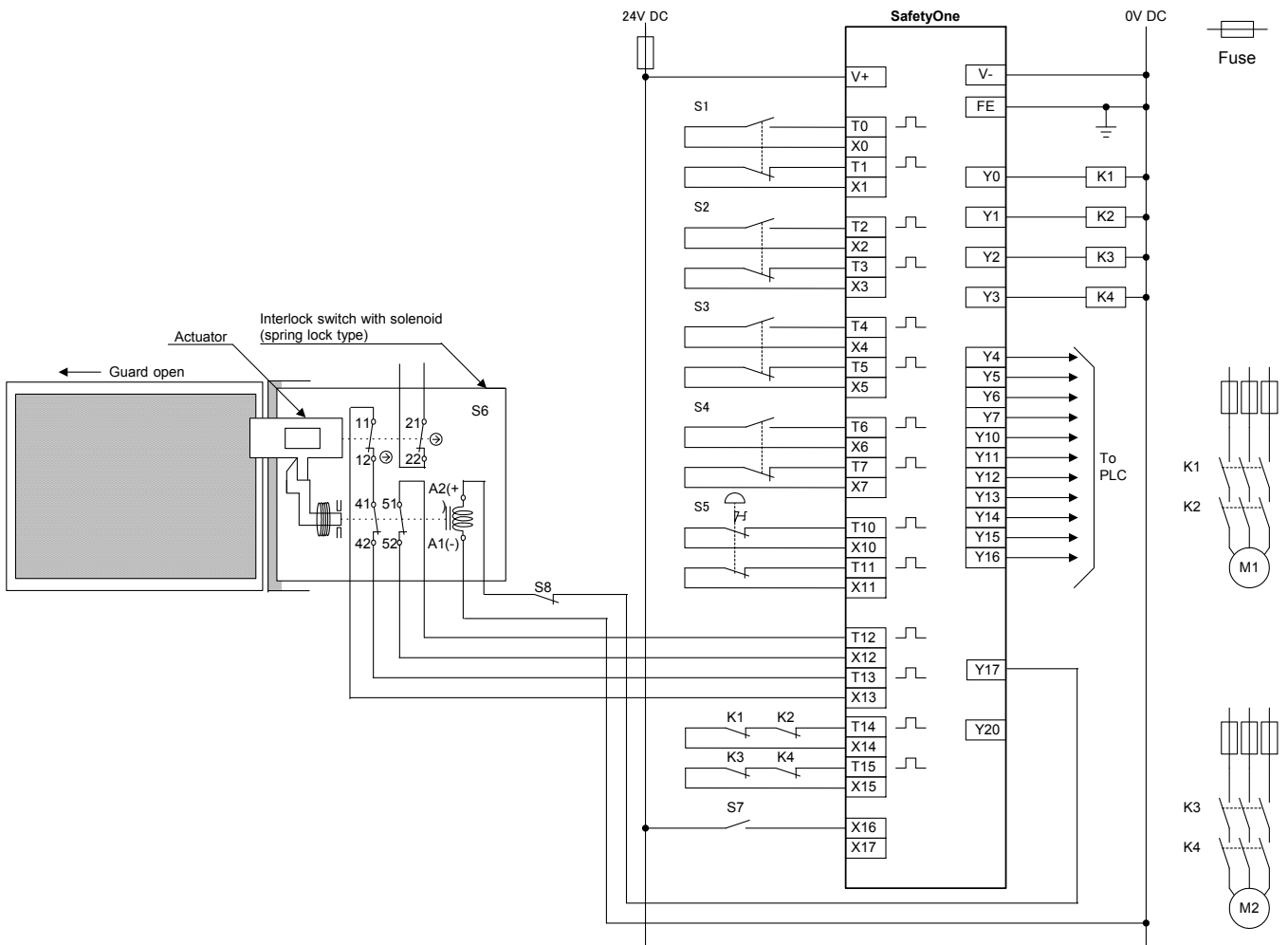
 **Caution**

Refer to "Chapter 2 PRODUCT SPECIFICATIONS" for specifications of each input and output.

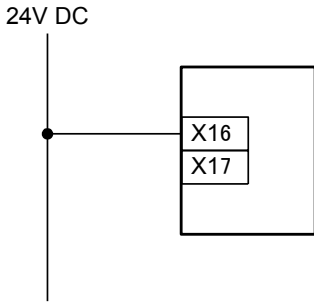
Wiring example (Logic 11b)

In the case where 4 non-contact interlock switches, 1 emergency stop switch, and 1 interlock switch with solenoid (spring lock type) are connected.

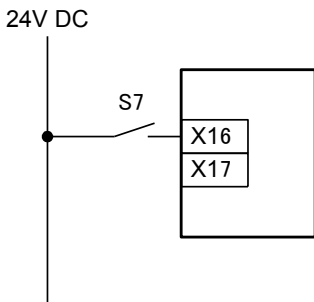
- S1 to 4 : Non-contact interlock switch
- S5 : Emergency stop switch
- S6 : Interlock switch with solenoid (spring lock type)
- S7 : Start switch
- S8 : Solenoid control switch
- (Pressing the solenoid control switches after closing the guard door, contacts 41-42 and 51-52 of S6 turn on, allowing the SafetyOne to restart.)
- K1 to 4 : Contactor
- M1, 2 : Motor



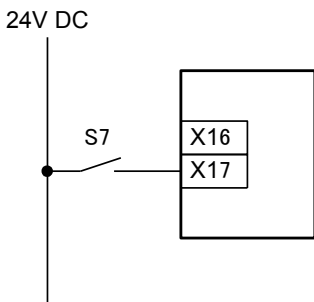
**When not using the start switch
(Auto start)**



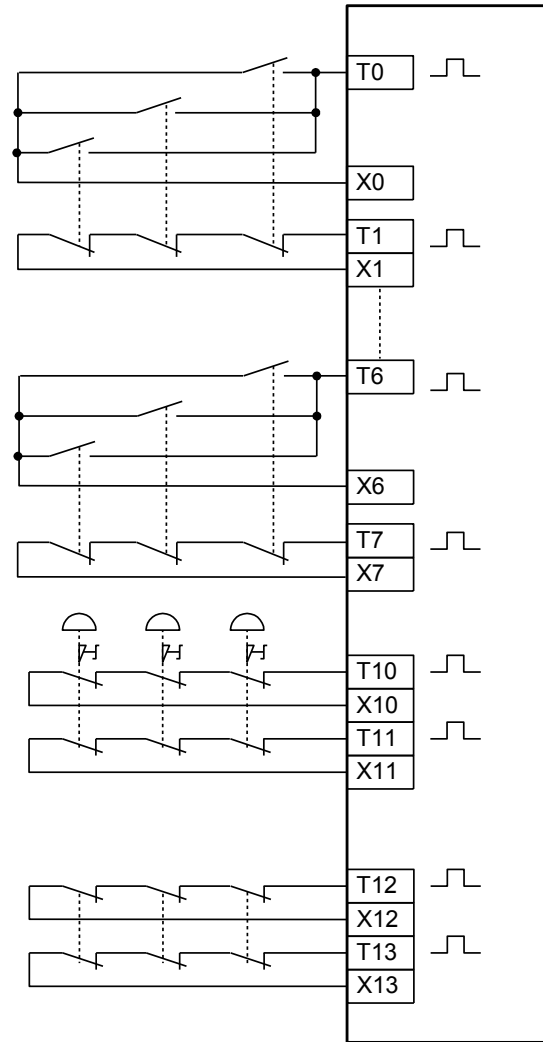
**When not detecting the welding of start switch
(Manual start)**



**When detecting the welding of start switch
(Control start)**



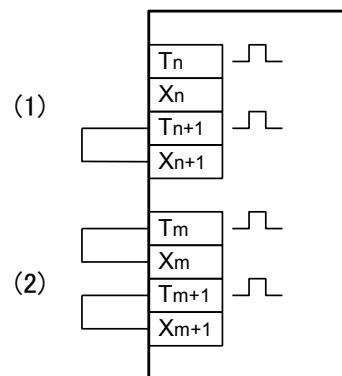
When connecting multiple components in series



NOTE: Safety performance depends on the system configuration.

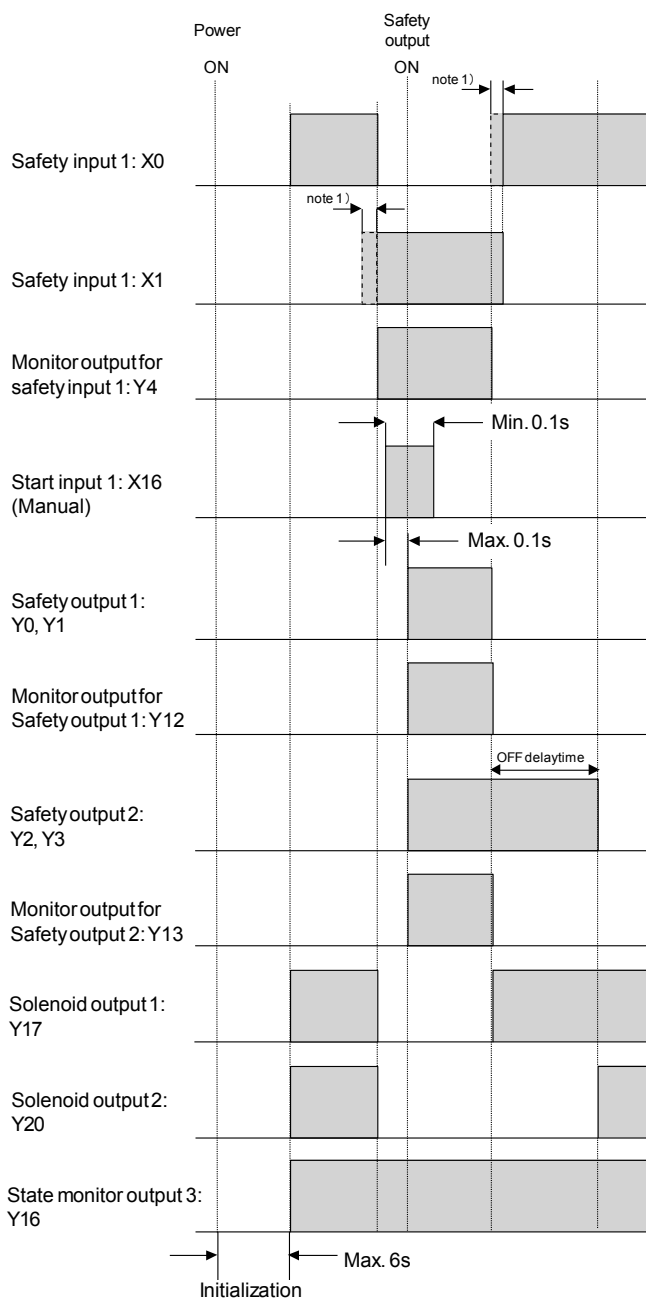
When not using some safety inputs

- If there are unused safety inputs in S1 to S4, open between T_n and X_n and connect X_{n+1} to T_{n+1} . (Refer to (1)) ($n = 0, 2, 4, 6$)
- If there are unused safety inputs in S5 and S6, connect the unused receive terminals to corresponding drive terminals. (Refer to (2))



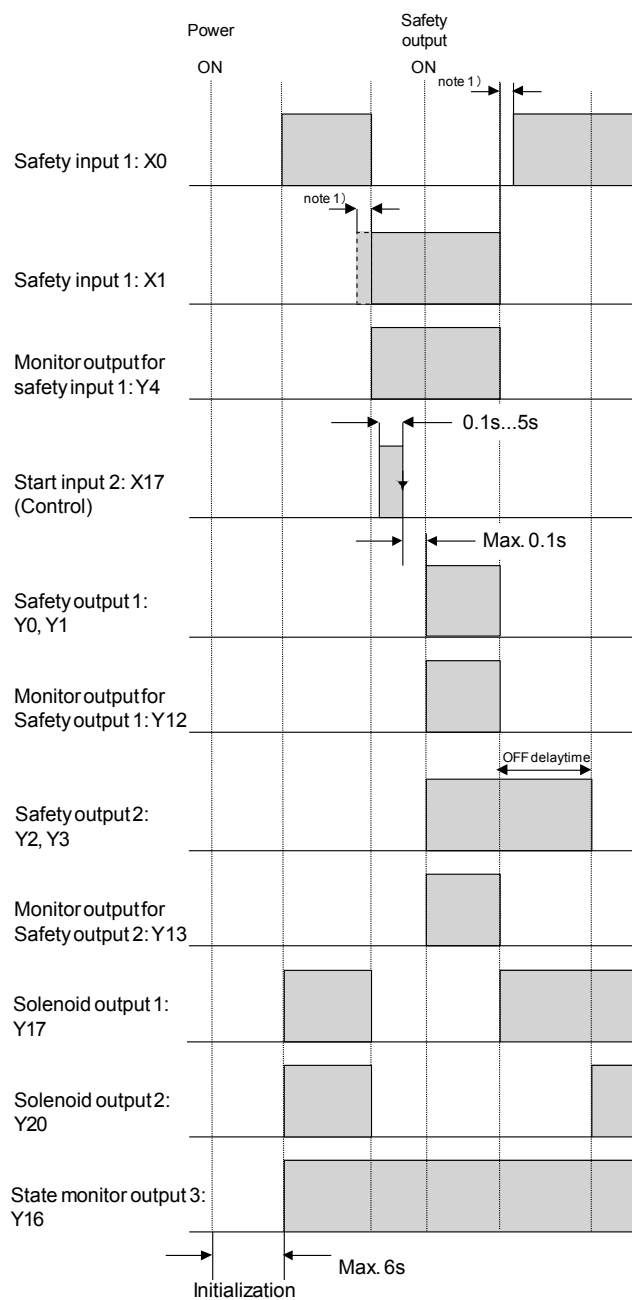
Timing chart (Logic 11b)

Example: Manual start input (X16) is used.



(Safety input 2 to 6 are all ON in this chart.)

Example: Control start input (X17) is used.



(Safety input 2 to 6 are all ON in this chart.)

Note 1) Input monitor error detection time is 0.5s.

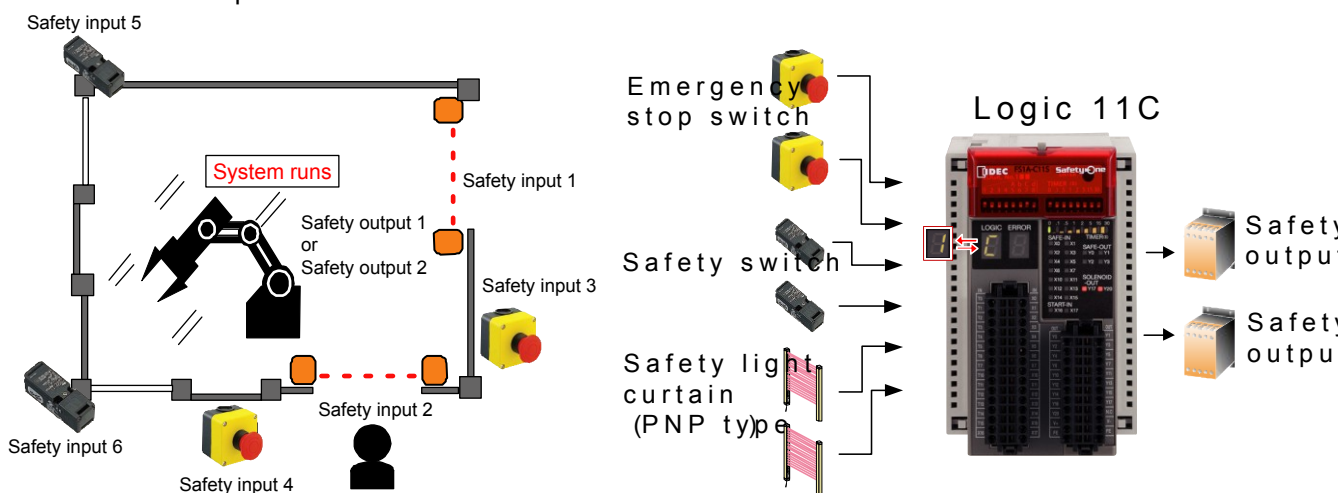
About safety inputs that are not described in this chart, input monitor error detection time is as follows.
 The time of dual channel NO/NC input (X2 to X7) is 0.5s.
 The time of dual channel direct opening input (X10 to X13) is 0.5s.
 Refer to the following "Logic functions" for more details.

Logic 11C: The logic for apparatus with openings

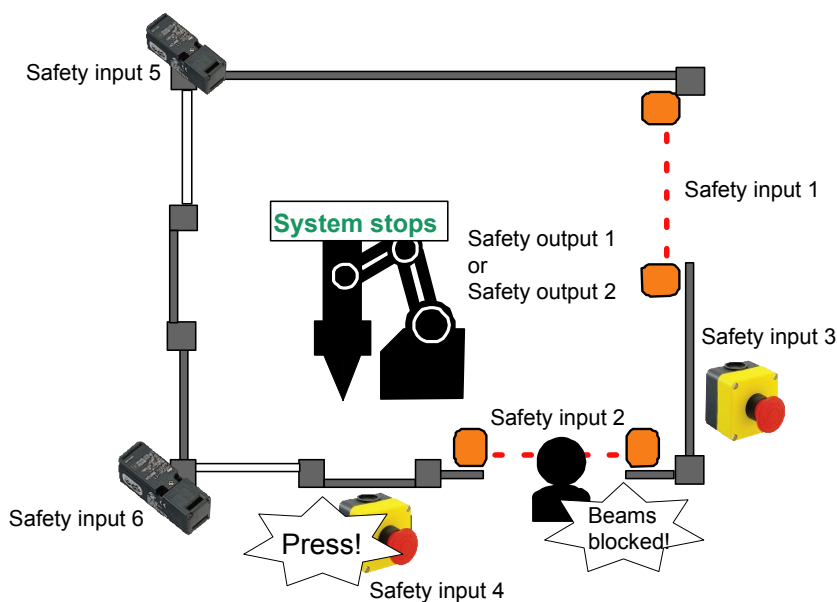
Overview (Logic 11C)

This logic is for using safety devices with dual channel solid state outputs, such as safety light curtains, for safety protective measures of production machinery and robots. Safety outputs perform as dual channel outputs.

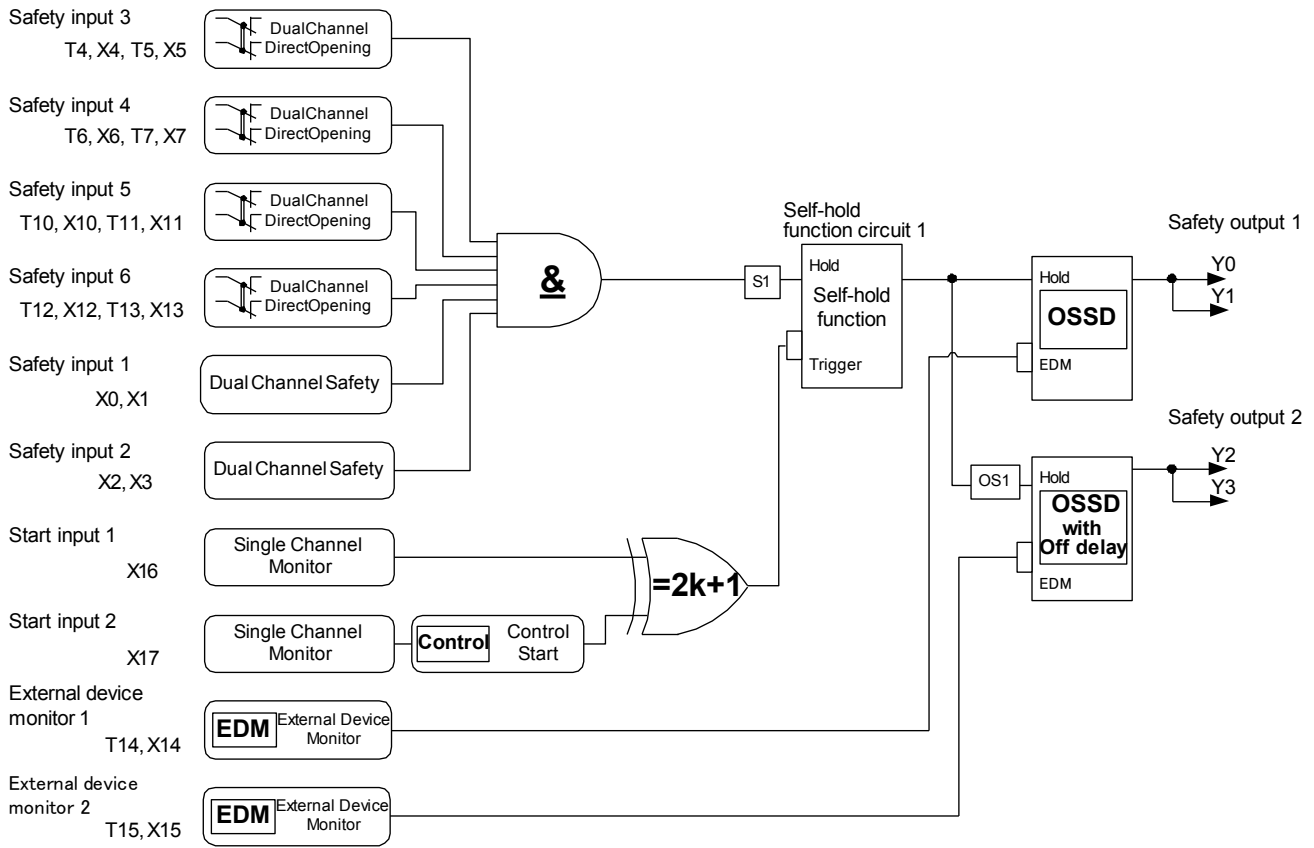
This logic enables the connection of 4 dual channel direct opening inputs and 2 dual channel safety inputs.



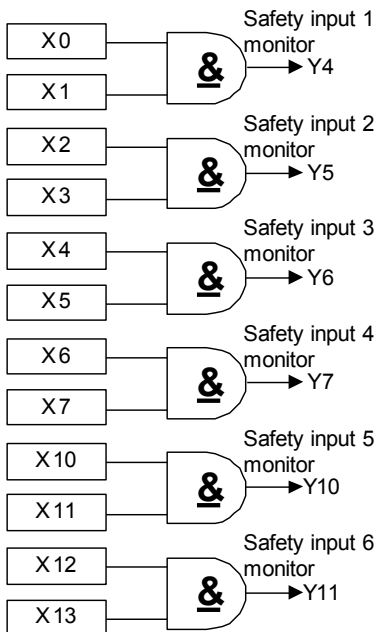
Operation example (Logic 11C)



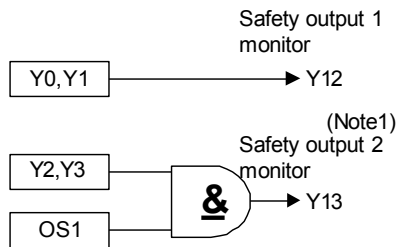
Logic circuit (Logic 11C)



● Monitor output for safety input

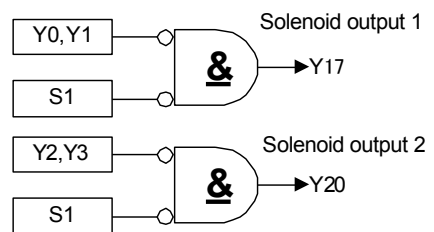


● Monitor output for safety output



Note1:
Safety output 2 monitor turns OFF immediately independent of OFF-delay time.

(Note2)
● Solenoid output




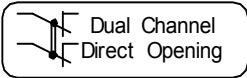
Note2:
In Run state, when the safety outputs are OFF and one or more safety inputs are OFF, the solenoid outputs turn ON.
When all safety inputs are ON, the solenoid outputs turn OFF, even when the start input is OFF.

Functions (Logic 11C)

●Safety inputs: X0 to X13 (T4 to T13)

Safety inputs are used to diagnose the status of connected safety devices, such as emergency stop switches, and interlock switches.

Intended inputs (Terminal names)	Function	
Safety input 1 (X0, X1) Safety input 2 (X2, X3)	Function name	Dual channel safety input
	Symbol	
	Description of operation	This function diagnoses the status of connected safety devices. This function diagnoses the time interval of status transition between each input of duplicated inputs (0.1s). The function does not use drive terminals (T0 to T3).
	Detail information	Logic functions (5-317)

Intended inputs (Terminal names)	Function	
Safety input 3 (X4-T4, X5-T5) Safety input 4 (X6-T6, X7-T7) Safety input 5 (X10-T10, X11-T11) Safety input 6 (X12-T12, X13-T13)	Function name	Dual channel direct opening input
	Symbol	
	Description of operation	This function diagnoses the status of connected safety devices. This function diagnoses the time interval of status transition between each input of duplicated inputs (0.5s).
	Detail information	Logic functions (5-311)



Warning

For connected control devices, refer to “SAFETY PRECAUTIONS”.

Safety check signals (pulses signals) are sent from the drive terminals (T4 to T13) to diagnose connected safety devices and input circuits. Safety check signals can not be used as a power supply for connected devices.

Note. If there are unused safety inputs in safety input 1 and safety input 2, connect the unused receive terminals (Xn) to a 24V DC power supply (V+). If they are not connected, the SafetyOne does not turn ON the safety outputs.


Note. Solid state outputs, such as safety light curtains, can not be connected to safety input 3 to safety input 6.

Note. Use safety input 3 through safety input 6 as specified combinations, such as receive terminal (Xn) and drive terminal (Tn). If the combinations are incorrect, SafetyOne does not work correctly.

Note. If there are unused safety inputs in safety input 3 through safety input 6, connect the unused receive terminals (Xn) to the corresponding drive terminals (Tn). If they are not connected, the SafetyOne does not turn ON the safety outputs.

●External device monitor inputs: X14 and X15 (T14 and T15)

External device monitor inputs are used to diagnose the status of devices connected to safety outputs.

Intended inputs (Terminal names)	Target safety outputs (Terminal names)	Function	
External device monitor input 1 (X14-T14)	Safety output 1 (Y0, Y1)	Function name	External device monitor input
External device monitor input 2 (X15-T15)	Safety output 2 (Y2, Y3)	Symbol	
		Description of operation	This function diagnoses the status of devices connected to a target safety output.
		Detail information	Logic functions (5-326)

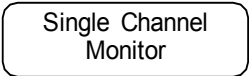


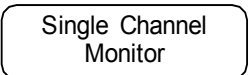

Safety check signals (pulses signals) are sent from the drive terminals (T14, T15) to diagnose external devices and monitor circuits. Safety check signals can not be used as a power supply for connected devices.

Note. If there are unused safety outputs, connect the intended external device monitor terminals (Xn) to the corresponding drive terminals (Tn). If they are not connected, the SafetyOne detects an input monitor error. As the result, the error LED displays a “1” and the unit changes to the Protection state.

● **Start inputs: X16 and X17**

Start inputs are used to control the start of safety outputs.

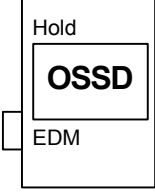
Intended inputs (Terminal names)	Target safety inputs (Terminal names)	Function	
		Start input 1 (X16)	Safety input 1 (X0, X1) Safety input 2 (X2, X3) Safety input 3 (X4-T4, X5-T5) Safety input 4 (X6-T6, X7-T7) Safety input 5 (X10-T10, X11-T11) Safety input 6 (X12-T12, X13-T13)
		Symbol	
		Description of operation	Safety outputs are started, when all target safety inputs are in the safe state and this function is in the ON state. This function is turned ON by 0.1s or more ON operation.
		Detail information	Logic functions (5-325)

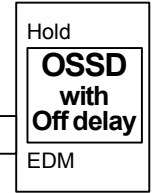
Intended inputs (Terminal names)	Target safety inputs (Terminal names)	Function	
		Start input 2 (X17)	Safety input 1 (X0, X1) Safety input 2 (X2, X3) Safety input 3 (X4-T4, X5-T5) Safety input 4 (X6-T6, X7-T7) Safety input 5 (X10-T10, X11-T11) Safety input 6 (X12-T12, X13-T13)
		Symbol	 + 
		Description of operation	Safety outputs are started, when this function becomes ON after all intended safety inputs are in the safe state. This function is turned ON by 0.1s to 5s ON operation.
		Detail information	Logic functions (5-325, 330)

Note. If both of X16 and X17 are turned ON, the SafetyOne will detect an error. As a result, the error LED displays “3” and the state changes to the Stop state. Use only X16 or X17.

● **Safety outputs: Y0 to Y3**

Safety outputs are used to output safety information processed by SafetyOne.

Intended outputs (Terminal names)	Function	
Safety output 1 (Y0, Y1)	Function name	Safety output without timer
	Symbol	
	Description of operation	This function is a safety output to output safety information processed by SafetyOne. The output is turned OFF immediately by OFF operation (instantaneous OFF output).
	Detail information	Logic functions (5-332)

Intended outputs (Terminal names)	Function	
Safety output 2 (Y2, Y3)	Function name	Safety output with timer
	Symbol	
	Description of operation	This function is a safety output to output safety information processed by SafetyOne. The output is turned OFF after the preset time of the OFF-delay timer (OFF-delay output).
	Detail information	Logic functions (5-335)

Note. When the SafetyOne changes to Protection state due to input monitor error, safety output without timer (safety output 1) is turned OFF. Safety output with timer (safety output 2) is turned OFF after the preset OFF-delay time.

Note. When the SafetyOne changes to the Stop state due to circuit failure or other errors, all safety outputs (safety output 1 and safety output 2) are turned OFF, immediately.

●Safety input monitor outputs: Y4 to Y11

Safety input monitor outputs are used to output the status of safety inputs in SafetyOne.

Intended outputs (Terminal names)	Target safety inputs (Terminal names)	Description of operation
Safety input 1 monitor output (Y4)	Safety input 1 (X0, X1)	When the target safety input is ON, the monitor output is ON. When the target safety input is OFF, the monitor output is OFF.
Safety input 2 monitor output (Y5)	Safety input 2 (X2, X3)	
Safety input 3 monitor output (Y6)	Safety input 3 (X4-T4, X5-T5)	
Safety input 4 monitor output (Y7)	Safety input 4 (X6-T6, X7-T7)	
Safety input 5 monitor output (Y10)	Safety input 5 (X10-T10, X11-T11)	
Safety input 6 monitor output (Y11)	Safety input 6 (X12-T12, X13-T13)	

Note. When the targeted safety input detects an input monitor error, input circuit failure, or EMC the disturbance, corresponding safety input monitor output becomes a pulse output (1Hz). The monitor output is OFF in other errors, Initial state, or Configuration state.

●Safety output monitor outputs: Y12 and Y13

Safety output monitor outputs are used to output status of safety outputs in SafetyOne.

Intended outputs (Terminal names)	Target safety outputs (Terminal names)	Description of operation
Safety output 1 monitor output (Y12)	Safety output 1 (Y0, Y1)	When the target safety output is ON, the monitor output is ON. When the target safety output is OFF, this function is OFF. The monitor output turns OFF immediately, independent of the preset OFF-delay time.
Safety output 2 monitor output (Y13)	Safety output 2 (Y2, Y3)	

Note. When the safety output detects an output circuit failure, the corresponding safety output monitor output becomes a pulse output (1Hz). The monitor output is OFF in other errors, Initial state, or Configuration state.

●State monitor outputs: Y14 to Y16

State monitor outputs are used to output the internal state of SafetyOne.

Intended outputs (Terminal names)	State				
	Initial	Run	Configuration	Protection	Stop
State monitor output 1 (Y14)	■ON	□OFF	□OFF	□OFF	■ON
State monitor output 2 (Y15)	■ON	□OFF	■ON	■ON	■ON or □OFF
State monitor output 3 (Y16)	□OFF	■ON	□OFF	□OFF	□OFF

Refer to “Chapter 4 BASIC OPERATIONS” and to “Chapter 6 TROUBLE SHOOTING” for details of each state.



Warning

The monitor outputs are not safety outputs. Do not use these to construct a safety system.

● **Solenoid outputs: Y17 and Y20**

Solenoid outputs are used to control a solenoid in an interlock switch.

Intended outputs (Terminal names)	Description of operation
Solenoid output 1 (Y17)	When safety output 1 is OFF, the solenoid output is ON. When safety Output 1 is ready to turn ON (safety output 1 can be turned ON by operation of the start input), the solenoid output is OFF.
Solenoid output 2 (Y20)	When safety output 2 is OFF, the solenoid output is ON. When safety Output 2 is ready to turn ON (safety output 2 can be turned ON by operation of the start input), the solenoid output is OFF.

 **Warning**

The solenoid outputs are not safety outputs. Do not use these to construct a safety system.

Note. The solenoid outputs are OFF in each state except Run state.

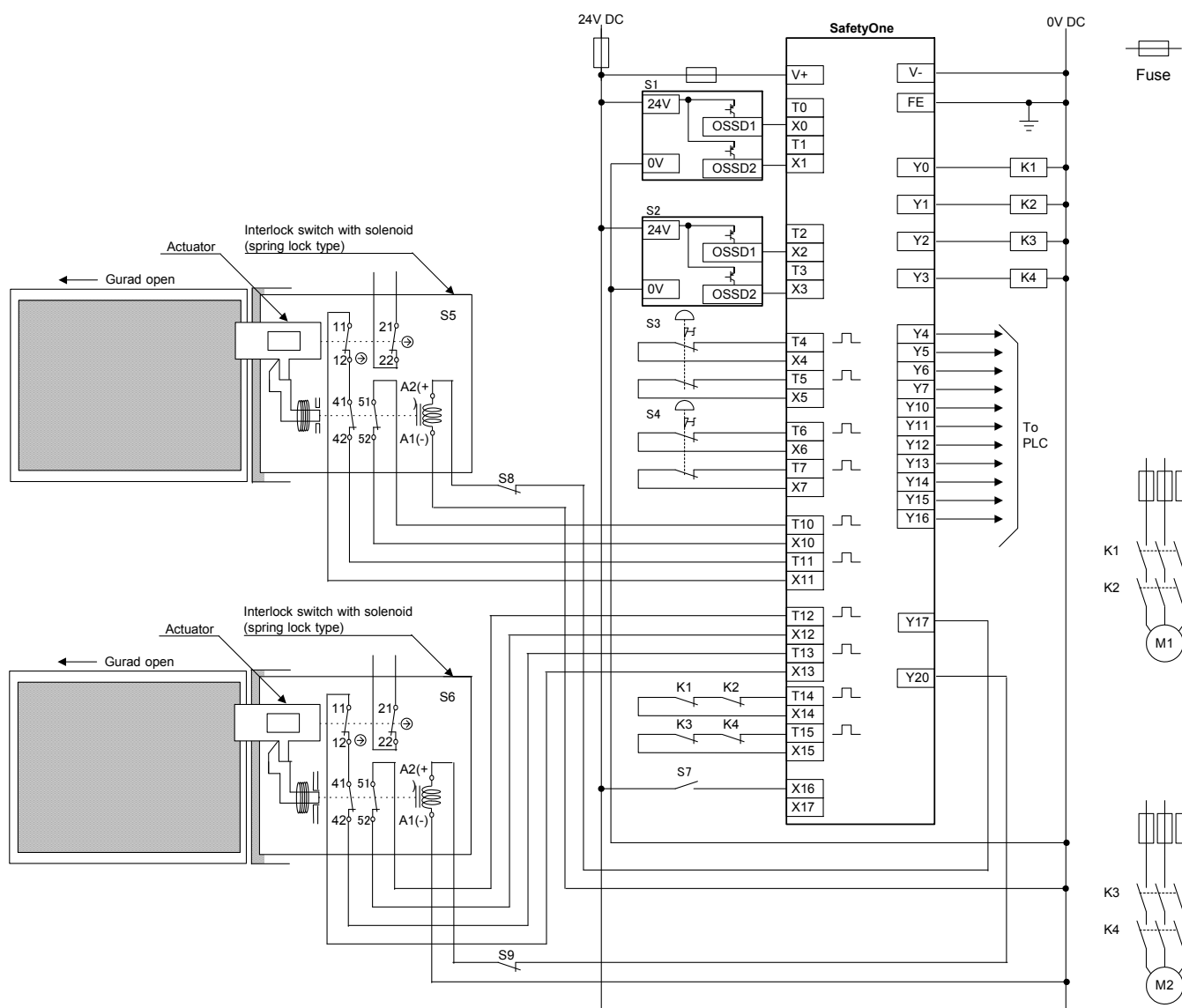
 **Caution**

Refer to "Chapter 2 PRODUCT SPECIFICATIONS" for specifications of each input and output.

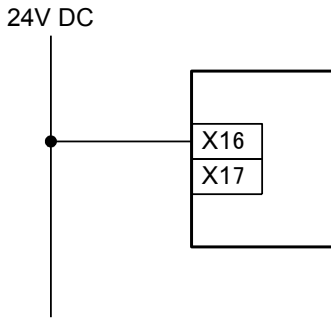
Wiring example (Logic 11C)

In the case where 2 safety light curtains 2 emergency stop switches, and 2 interlock switches with solenoid (spring lock type) are connected.

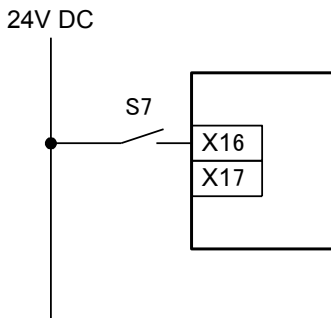
- S1, 2 :Safety light curtain
- S3, 4 :Emergency stop switch
- S5, 6 :Interlock switch with solenoid (spring lock type)
- S7 :Start switch
- S8, 9 :Solenoid control switch
(Pressing the solenoid control switches after closing the guard door, contacts 41-42 and 51-52 of S5 and S6 turn on, allowing the SafetyOne to restart.)
- K1 to 4 :Contactor
- M1, 2 :Motor



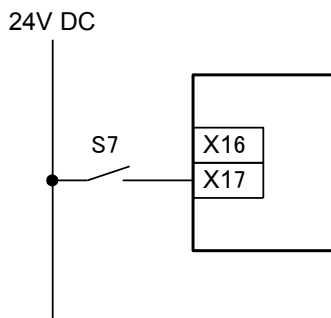
**When not using the start switch
(Auto start)**



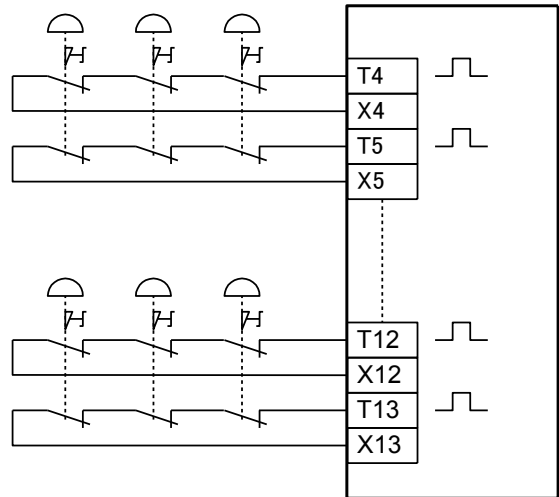
**When not detecting the welding of start switch
(Manual start)**



**When detecting the welding of start switch
(Control start)**



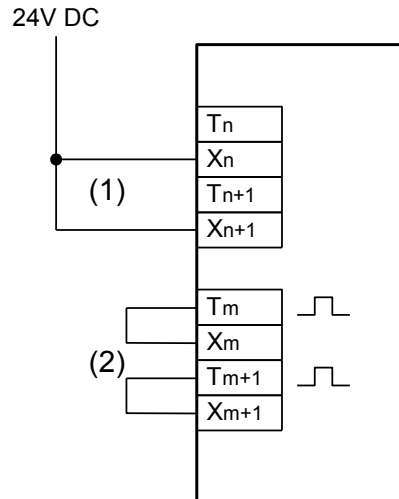
When connecting multiple components in series



NOTE: Safety performance depends on the system configuration.

When not using some safety inputs

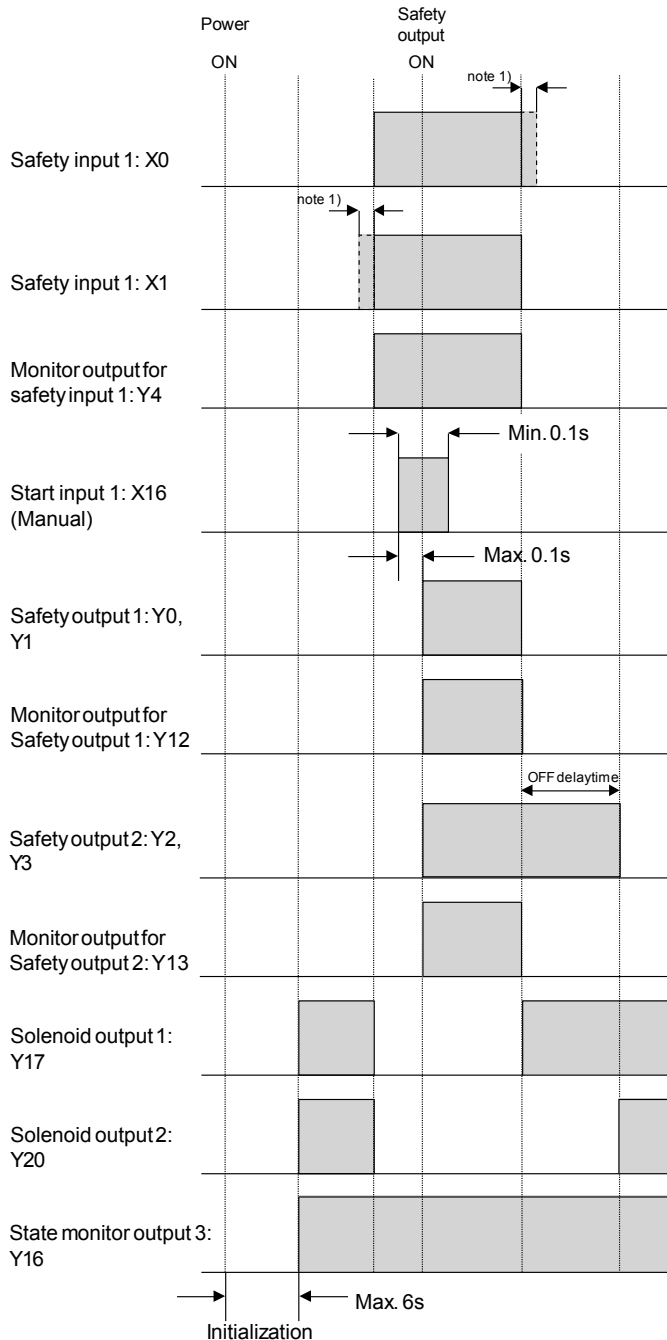
- If there are unused safety inputs in S1 and S2, connect the unused receive terminals to 24V DC power supply (V+). (Refer to (1))
- If there are unused safety inputs in S3 to S6, connect the unused receive terminals to the corresponding drive terminals. (Refer to (2))



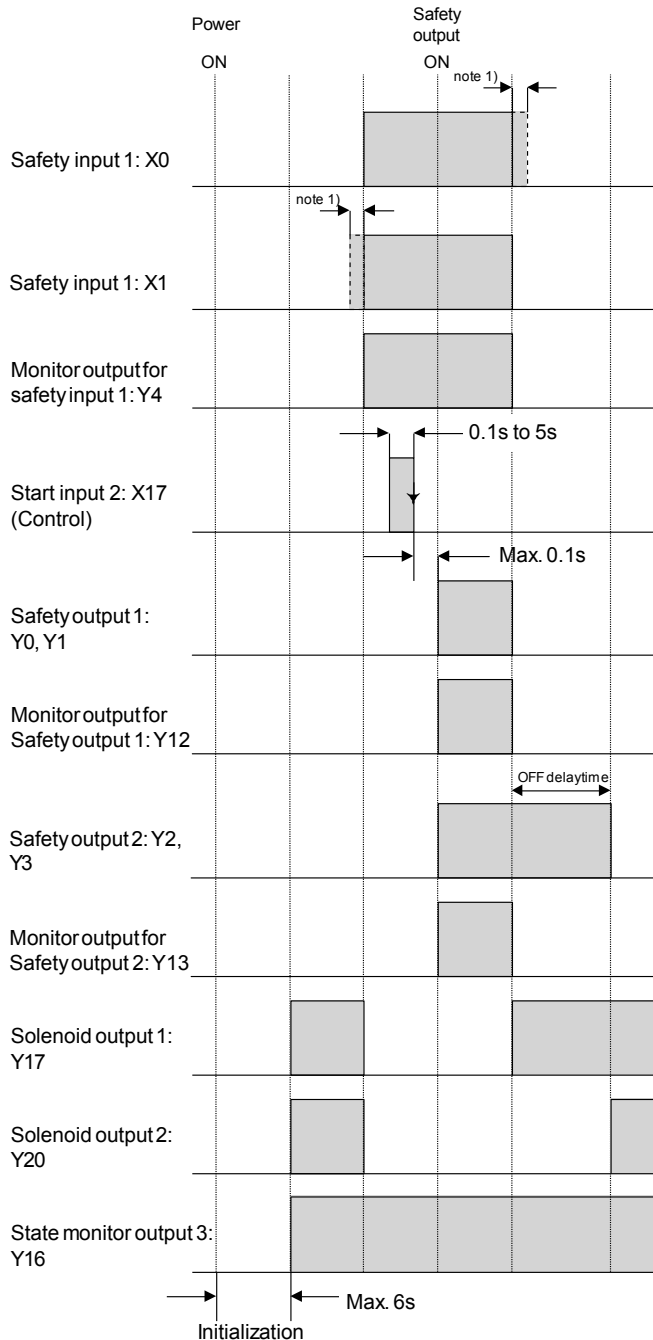
Timing chart (Logic 11C)

Example: Manual start input (X16) is used.

Example: Control start input (X17) is used.



(Safety input 2 to 6 are all ON in this chart.)



(Safety input 2 to 6 are all ON in this chart.)

Note 1) Input monitor error detection time is 0.1s.

About safety inputs that are not described in this chart, input monitor error detection time is as follows.
 The time of dual channel safety input (X2, X3) is 0.1s.
 The time of dual channel direct opening input (X4 to X13) is 0.5s.
 Refer to the following "Logic functions" for more details.

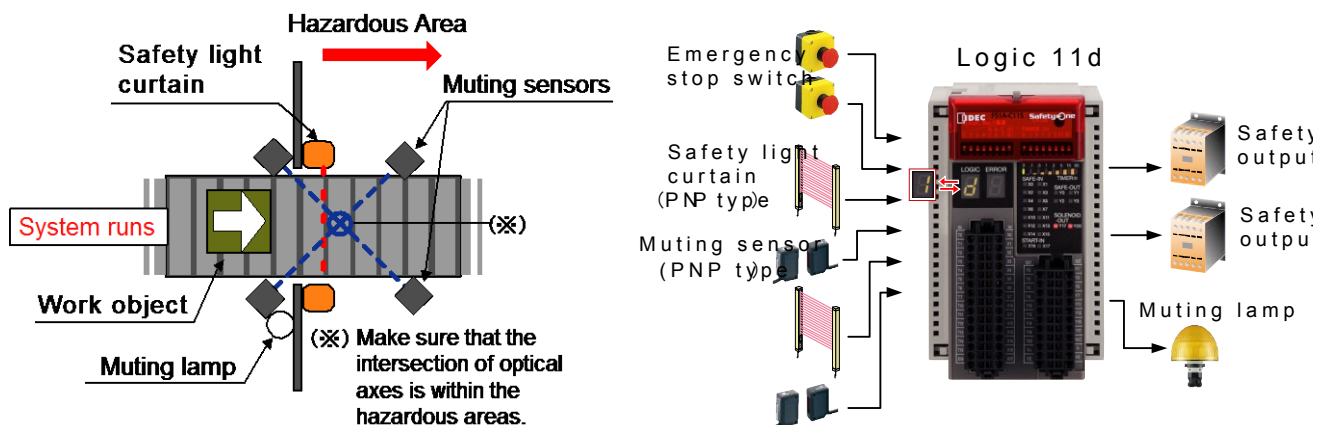
Logic 11d: Muting function logic for apparatus with openings

Overview (Logic 11d)

The logic is for using safety devices with dual channel solid state outputs, such as safety light curtains, and for devices with output muting signals that enable muting functions that temporarily suspend safety functions of safety devices for safety protective measures of robots and conveyor lines.

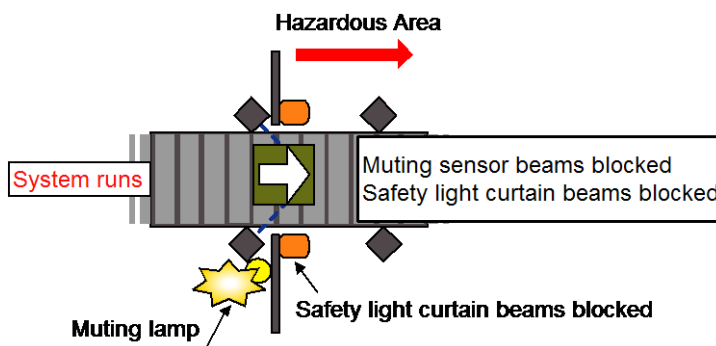
Safety outputs perform as dual channel outputs.

This logic enables the connection of 2 dual channel direct opening inputs and 2 dual channel safety inputs and 2 muting signal output (PNP) devices (Ex. Muting sensor, limit switch).

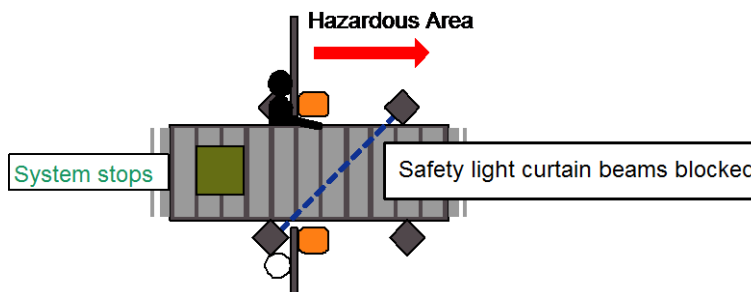


Operation example (Logic 11d)

- Safety input is temporarily suspended

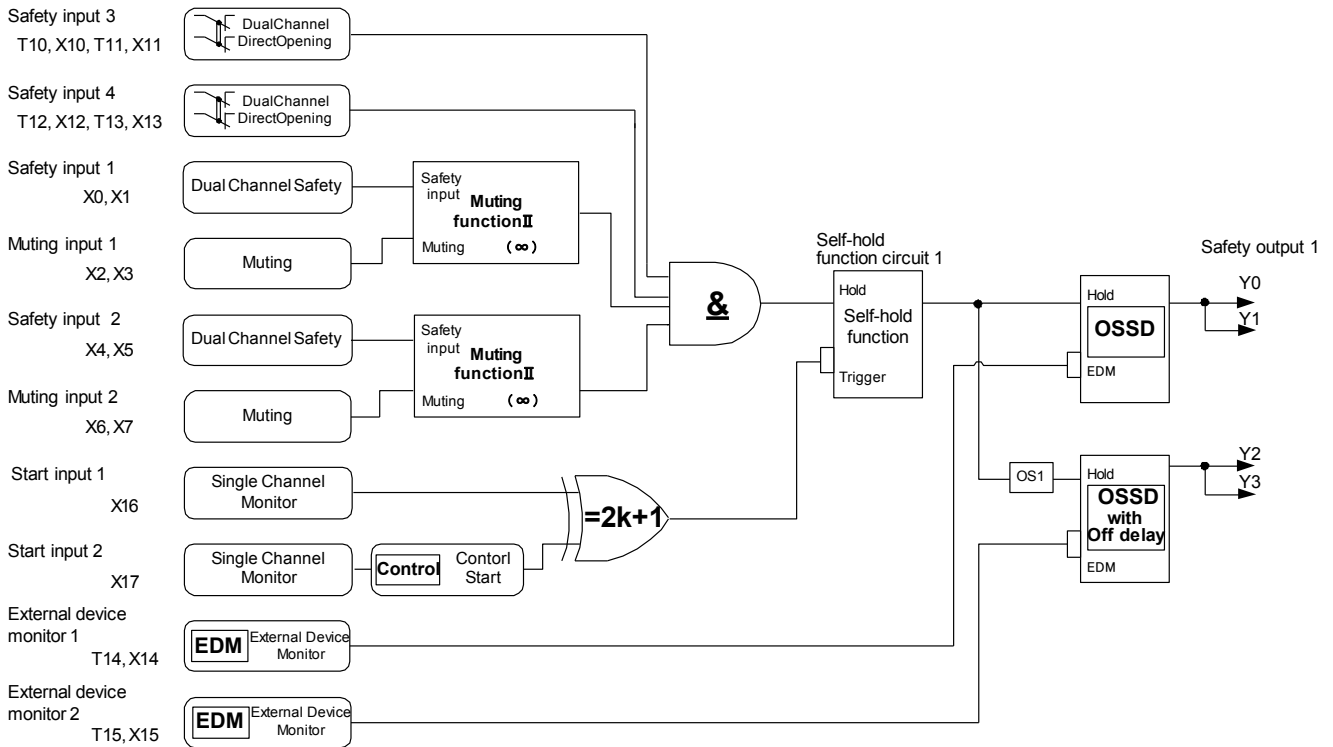


- Safety light curtain beams blocked

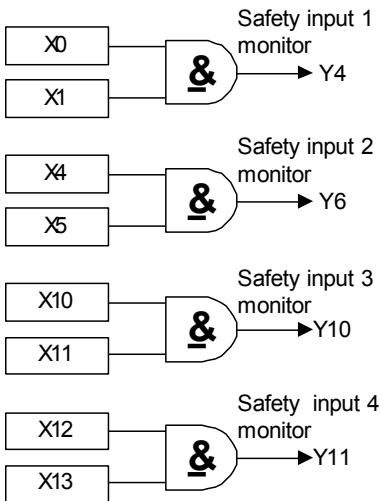


Warning When installing light curtains and muting sensors, ensure safety by referring to referring to IEC TS 62046 technical documents..

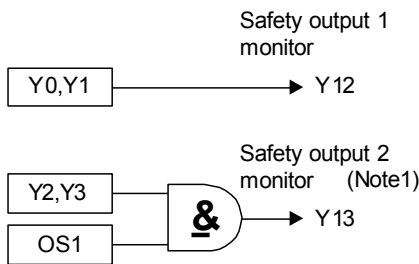
Logic circuit (Logic 11d)



● Monitor output for safety input

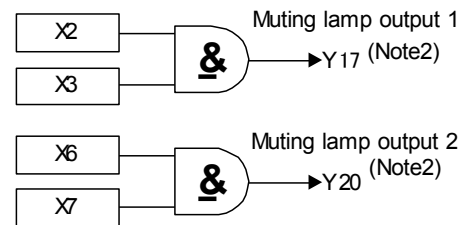


● Monitor output for safety output



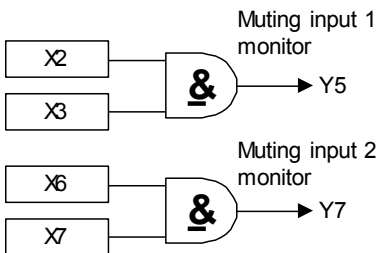
Note1:
Safety output 2 monitor turns OFF immediately independent of OFF-delay time.

● Muting lamp output



Note2:
The muting lamp output turns ON when the safety function of the safety input is temporarily suspended. Even if the muting input is ON when the safety output is OFF, the muting lamp output doesn't turn ON. In case of the SafetyOne is turned ON when the muting input is ON or the safety output turns OFF when the muting input is ON, muting function is not activated without turning off of muting input.


● Monitor output for muting input

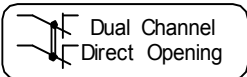


Functions (Logic 11d)

●Safety inputs: X0, X1, X4, X5, and X10 to X13 (T10 to T13)

Safety inputs are used to diagnose the status of connected safety devices, such as emergency stop switches, and interlock switches.

Intended inputs (Terminal names)	Function	
Safety input 1 (X0, X1) Safety input 2 (X4, X5)	Function name	Dual channel safety input
	Symbol	
	Description of operation	This function diagnoses the status of connected safety devices. This function diagnoses the time interval of status transition between each input of duplicated inputs (0.1s). The function does not use drive terminals (T0, T1, T4 and T5).
	Detail information	Logic functions (5-317)

Intended inputs (Terminal names)	Function	
Safety input 3 (X10-T10, X11-T11) Safety input 4 (X12-T12, X13-T13)	Function name	Dual channel direct opening input
	Symbol	
	Description of operation	This function diagnoses the status of connected safety devices. This function diagnoses the time interval of status transition between each input of duplicated inputs (0.5s).
	Detail information	Logic functions (5-311)



Warning

For connected control devices, refer to “SAFETY PRECAUTIONS”.

Safety check signals (pulses signals) are sent from the drive terminals (T10 to T13) to diagnose connected safety devices and input circuits. Safety check signals can not be used as power supply for connected devices.

Note. If there are unused safety inputs in safety input 1 and safety input 2, connect the unused receive terminals (Xn) to a 24V DC power supply (V+). If they are not connected, the SafetyOne does not turn ON the safety outputs.

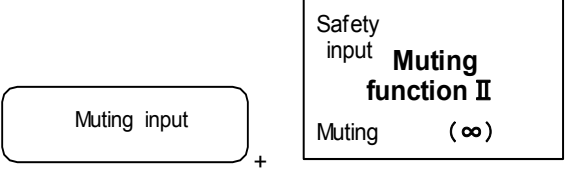
Note. Solid state outputs, such as safety light curtains, can not be connected to safety input 3 and safety input 4.

Note. Use safety input 3 and safety input 4 as specified combinations, such as receive terminal (Xn) and drive terminal (Tn). If the combinations are incorrect, SafetyOne does not work correctly.

Note. If there are unused safety inputs in safety input 3 and safety input 4, connect the unused receive terminals (Xn) to the corresponding drive terminals (Tn). If they are not connected, the SafetyOne does not turn ON the safety outputs.

●Muting inputs: X2, X3, X6, and X7

Muting inputs are used to diagnose the status of muting devices, such as sensors or limit switches.

Intended inputs (Terminal names)	Target safety inputs (Terminal names)	Function	
Muting input 1 (X2, X3)	Safety input 1 (X0, X1)	Function name	Muting input+Muting II
Muting input 2 (X6, X7)	Safety input 2 (X4, X5)	Symbol	
		Description of operation	This function diagnoses the status of connected muting devices. This function diagnoses the time interval of status transition between each input of duplicated inputs (3s). The function does not use a drive terminal (T2, T3, T6, T7).
		Detail information	Logic functions (5-323, 329)




Warning

Muting inputs are not safety inputs. Do not use these to construct a safety system.

The maximum time to suspend the safety function continuously (muting monitor time) is not specified in the SafetyOne. Based on risk assessment, monitor the muting monitor time that is suitable for the safety system, by external circuit or devices.

● **External device monitor inputs: X14 and X15 (T14 and T15)**

External device monitor inputs are used to diagnose the status of devices connected to safety outputs.

Intended inputs (Terminal names)	Target safety outputs (Terminal names)	Function	
External device monitor input 1 (X14-T14)	Safety output 1 (Y0, Y1)	Function name	External device monitor input
External device monitor input 2 (X15-T15)	Safety output 2 (Y2, Y3)	Symbol	
		Description of operation	This function diagnoses the status of devices connected to a target safety output.
		Detail information	Logic functions (5-326)



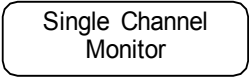
Warning



Safety check signals (pulses signals) are sent from the drive terminals (T14, T15) to diagnose external devices and monitor circuits. Safety checks signal can not be used as a power supply for connected devices.

Note. If there are unused safety outputs, connect the intended external device monitor terminals (Xn) to the corresponding drive terminals (Tn). If they are not connected, the SafetyOne detects an input monitor error. As the result, the error LED displays a “1” and the unit changes to the Protection state.

● **Start inputs: X16 and X17**

Start inputs are used to control the start of safety outputs.

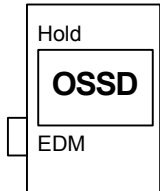
Intended inputs (Terminal names)	Target safety inputs (Terminal names)	Function	
		Function name	Monitor input
Start input 1 (X16)	Safety input 1 (X0, X1) Muting input 1 (X2, X3) Safety input 2 (X4, X5) Muting input 2 (X6, X7) Safety input 3 (X10-T10, X11-T11) Safety input 4 (X12-T12, X13-T13)	Function name	Monitor input
		Symbol	
		Description of operation	Safety outputs are started, when all target safety inputs are in the safe state and this function is in the ON state. This function is turned ON by 0.1s or more ON operation.
		Detail information	Logic functions (5-325)

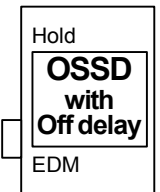
Intended inputs (Terminal names)	Target safety inputs (Terminal names)	Function	
		Function name	Monitor input
Start input 2 (X17)	Safety input 1 (X0, X1) Muting input 1 (X2, X3) Safety input 2 (X4, X5) Muting input 2 (X6, X7) Safety input 3 (X10-T10, X11-T11) Safety input 4 (X12-T12, X13-T13)	Function name	Monitor input + Control start
		Symbol	 + 
		Description of operation	Safety outputs are started, when this function becomes ON after all intended safety inputs are in the safe state. This function is turned ON by 0.1s to 5s ON operation.
		Detail information	Logic functions (5-325, 330)

Note. If both of X16 and X17 are turned ON, the SafetyOne will detect an error. As a result, the error LED displays “3” and the state changes to the Stop state. Use only X16 or X17.

● **Safety outputs: Y0 to Y3**

Safety outputs are used to output safety information processed by SafetyOne.

Intended outputs (Terminal names)	Function	
Safety output 1 (Y0, Y1)	Function name	Safety output without timer
	Symbol	
	Description of operation	This function is a safety output to output safety information processed by SafetyOne. The output is turned OFF immediately by OFF operation (instantaneous OFF output).
	Detail information	Logic functions (5-332)

Intended outputs (Terminal names)	Function	
Safety output 2 (Y2, Y3)	Function name	Safety output with timer
	Symbol	
	Description of operation	This function is a safety output to output safety information processed by SafetyOne. The output is turned OFF after the preset time of the OFF-delay timer (OFF-delay output).
	Detail information	Logic functions (5-335)

Note. When the SafetyOne changes to Protection state due to input monitor error, safety output without timer (safety output 1) is turned OFF. Safety output with timer (safety output 2) is turned OFF after the preset OFF-delay time.

Note. When the SafetyOne changes to Stop state due to circuit failure or other errors, all safety outputs (safety output 1 and safety output 2) are turned OFF, immediately.

● **Safety input monitor outputs: Y4 to Y11**

Safety input monitor outputs are used to output the status of safety inputs in SafetyOne.

Intended outputs (Terminal names)	Target safety inputs and muting inputs (Terminal names)	Description of operation
Safety input 1 monitor output (Y4)	Safety input 1 (X0, X1)	When the target safety input or muting input is ON, the monitor output is ON. When the target input is OFF, the monitor output is OFF.
Muting input 1 monitor output (Y5)	Muting input 1 (X2, X3)	
Safety input 2 monitor output (Y6)	Safety input 2 (X4, X5)	
Muting input 2 monitor output (Y7)	Muting input 2 (X6, X7)	
Safety input 3 monitor output (Y10)	Safety input 3 (X10-T10, X11-T11)	
Safety input 4 monitor output (Y11)	Safety input 4 (X12-T12, X13-T13)	

Note. When the targeted safety input detects an input monitor error, input circuit failure, or EMC the disturbance, corresponding safety input monitor output becomes a pulse output (1Hz). The monitor output is OFF in other errors, Initial state, or Configuration state.

● **Safety output monitor outputs: Y12 and Y13**

Safety output monitor outputs are used to output status of safety outputs in SafetyOne.

Intended outputs (Terminal names)	Target safety outputs (Terminal names)	Description of operation
Safety output 1 monitor output (Y12)	Safety output 1 (Y0, Y1)	When the target safety output is ON, the monitor output is ON. When the target safety output is OFF, this function is OFF. The monitor output turns OFF immediately, independent of the preset OFF-delay time.
Safety output 2 monitor output (Y13)	Safety output 2 (Y2, Y3)	

Note. When the safety output detects an output circuit failure, the corresponding safety output monitor output becomes a pulse output (1Hz). The monitor output is OFF in other errors, Initial state, or Configuration state.

● **State monitor outputs: Y14 to Y16**

State monitor outputs are used to output the internal state of SafetyOne.

Intended outputs (Terminal names)	State				
	Initial	Run	Configuration	Protection	Stop
State monitor output 1 (Y14)	■ON	□OFF	□OFF	□OFF	■ON
State monitor output 2 (Y15)	■ON	□OFF	■ON	■ON	■ON OR □OFF
State monitor output 3 (Y16)	□OFF	■ON	□OFF	□OFF	□OFF

Refer to “Chapter 4 BASIC OPERATIONS” and to “Chapter 6 TROUBLE SHOOTING” for details of each state.



The monitor outputs are not safety outputs. Do not use these to construct a safety system.

●Muting lamp outputs: Y17 and Y20

Muting lamp outputs are used to control muting lamps.

Intended outputs (Terminal names)	Target safety inputs (Terminal names)	Description of operation
Muting lamp output 1 (Y17)	Safety input 1 (X0, X1)	The output is ON, during safety input 1 is muting state by muting input 1.
Muting lamp output 2 (Y20)	Safety input 2 (X4, X5)	The output is ON, during safety input 2 is muting state by muting input 2.

Warning

The muting lamp outputs are not safety outputs. Do not use these to construct a safety system.

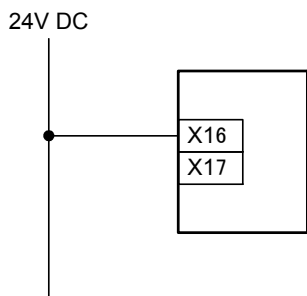
Note. Muting lamp output terminals (Y17 and Y20) detect that muting lamps are disconnected or unconnected. If these failures are detected, the error LED displays "5" and the state changes to the Stop state.

Note. If there is an unused muting lamp output, connect a resistor (10 k Ω , 1/4W) to the unused terminals.

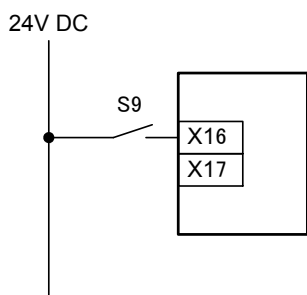
Caution

Refer to "Chapter 2 PRODUCT SPECIFICATIONS" for specifications of each input and output.

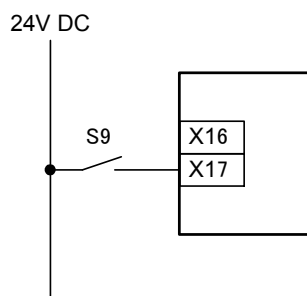
**When not using the start switch
(Auto start)**



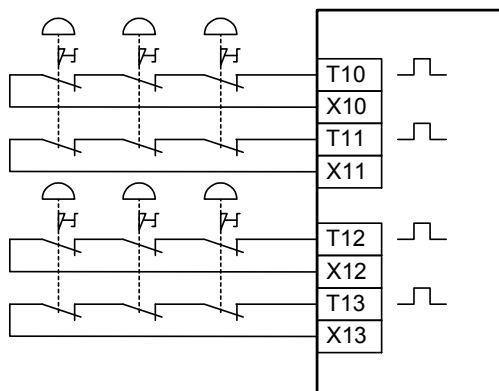
**When not detecting the welding of start switch
(Manual start)**



**When detecting the welding of start switch
(Control start)**



When connecting multiple components in series



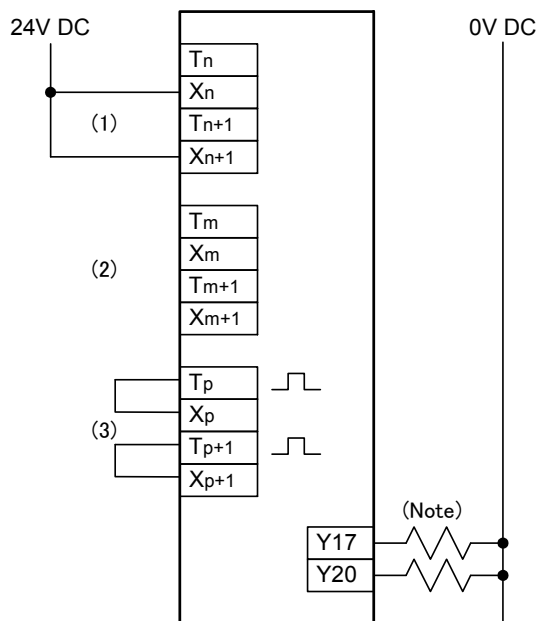
NOTE: Safety performance depends on the system configuration.

When not using some safety inputs

- If there are unused safety inputs in S1 and S4, connect the unused receive terminals to 24V DC power supply (V+). (Refer to (1))
- If there are unused muting inputs in S2, S3, S5 and S6, open between the unused receive terminals and the corresponding drive terminals. (Refer to (2))
- If there are unused safety inputs in S7 and S8, connect the unused receive terminals to the corresponding drive terminals. (Refer to (3))

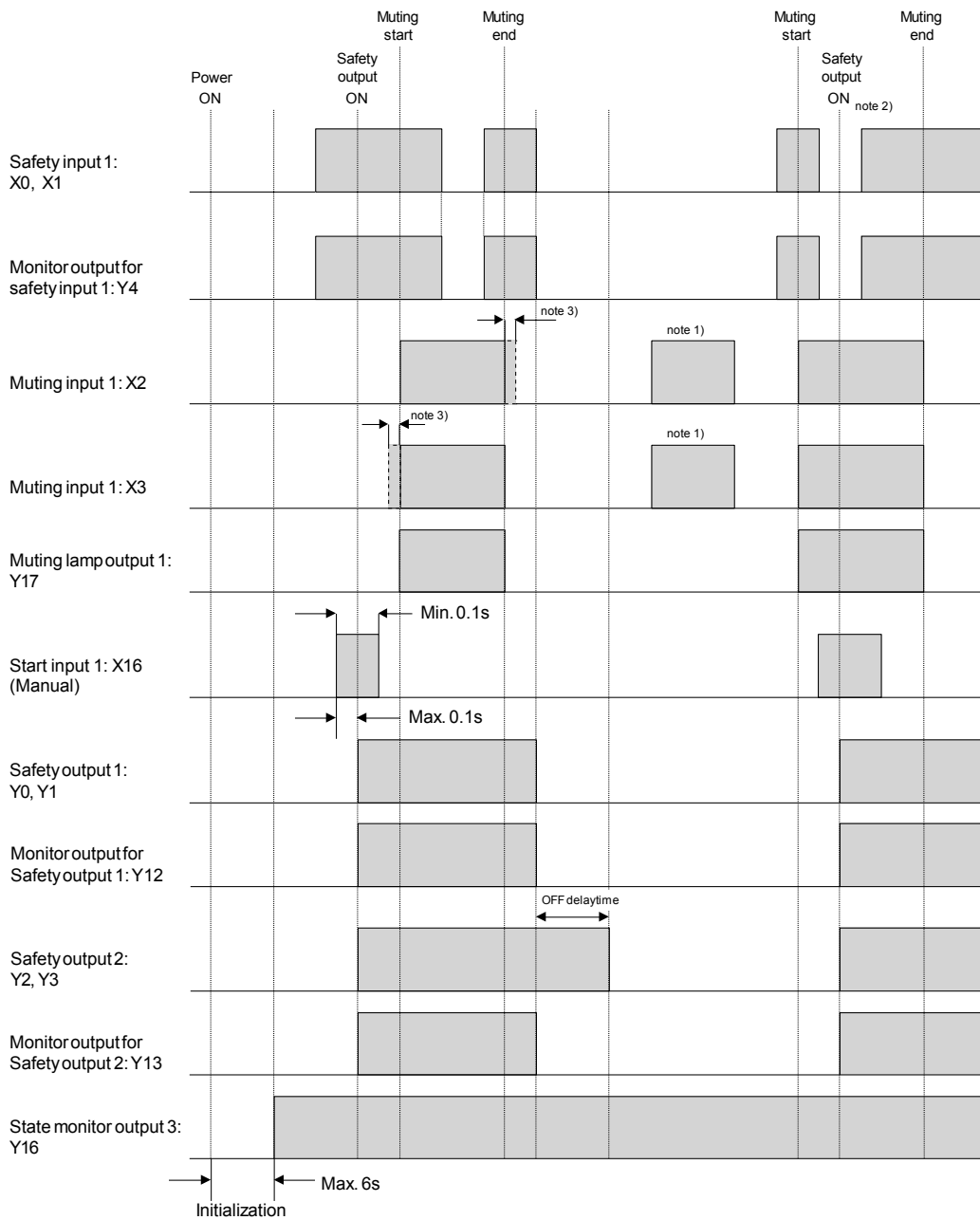
Note: In Logic 11d, the muting lamp output terminals (Y17 and Y20) detect that connected indicator lights are disconnected or unconnected.

When not using the muting function, connect a resistor across these terminals. If no resistor is connected, then the SafetyOne detects any wiring errors and locks out operations.



Timing chart (Logic 11d)

Example: Manual start input (X16) is used.

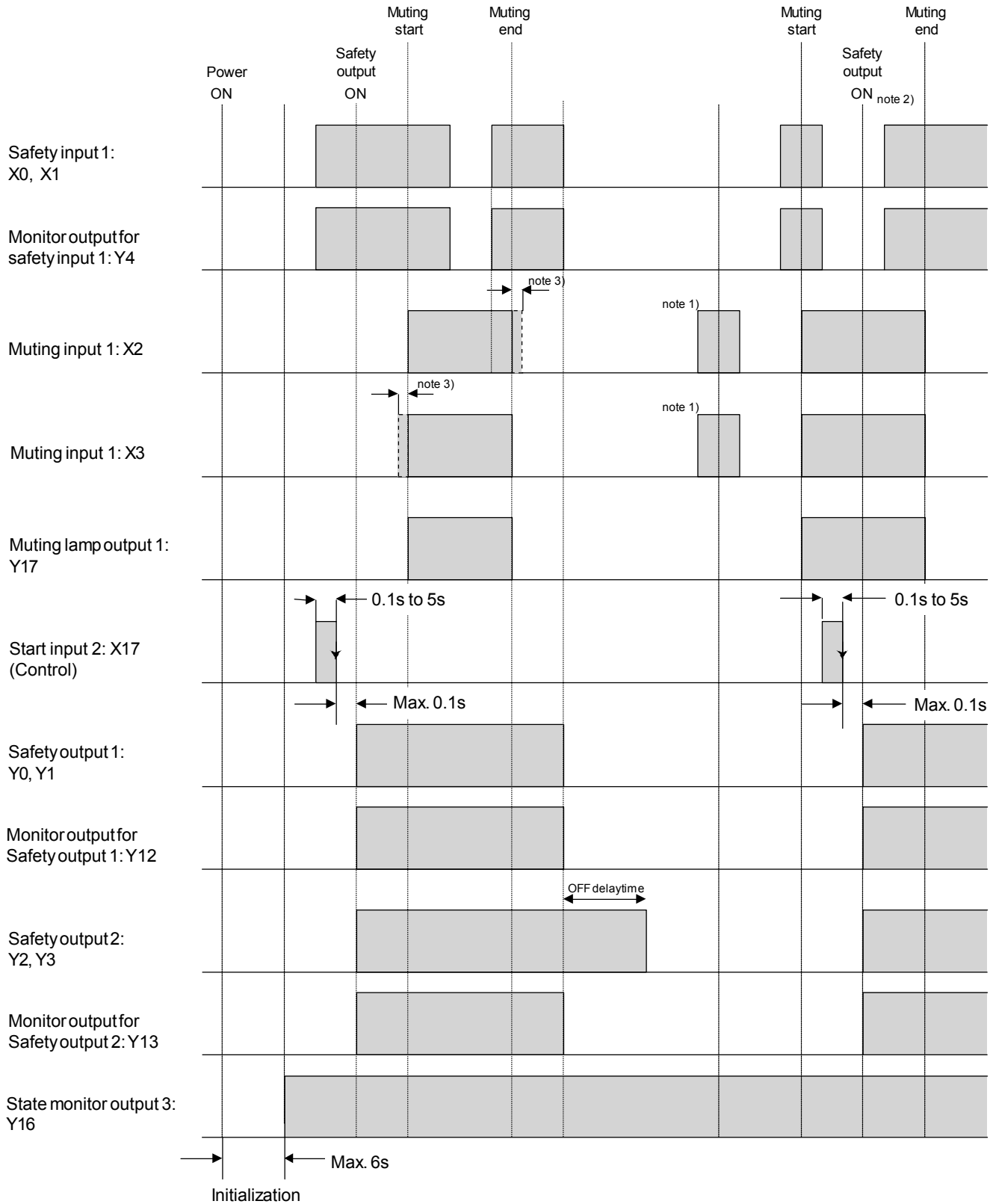


(Safety input 2, 3 and 4 are all ON and muting input 2 is OFF in this chart.)

- Note 1) When “Safety input 1” is turned OFF before “Muting input 1” is turned ON, muting function is not effective and all of “Safety output” are not turned ON. “Safety input 2” and “Muting input 2” is as well.
- Note 2) When “Muting input 1” is turned ON while “Safety input 1” is ON, muting function is effective. In fact all of “Safety output” are turned ON when “Start input” is turned ON. It does not depend on a condition of “Safety input 1” among muting function is effective. “Safety input 2” and “Muting input 2” is as well.
- Note 3) Input monitor error detection time is 3s.

About safety inputs that are not described in this chart, input monitor error detection time is as follows.
 The time of dual channel safety input (X0, X1, X4, and X5) is 0.1s.
 The time of muting input (X6, X7) is 3s.
 The time of dual channel direct opening input (X10 to X13) is 0.5s.
 Refer to the following “Logic functions” for more details.

Example: Control start input (X17) is used.



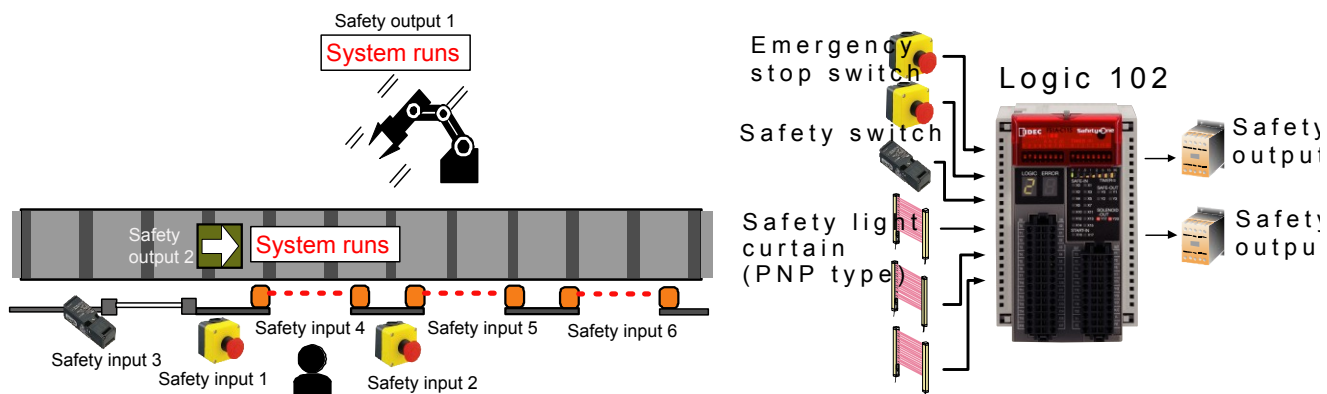
(Safety input 2, 3 and 4 are all ON and muting input 2 is OFF in this chart.)

Logic 102: Partial stop logic for apparatus with openings

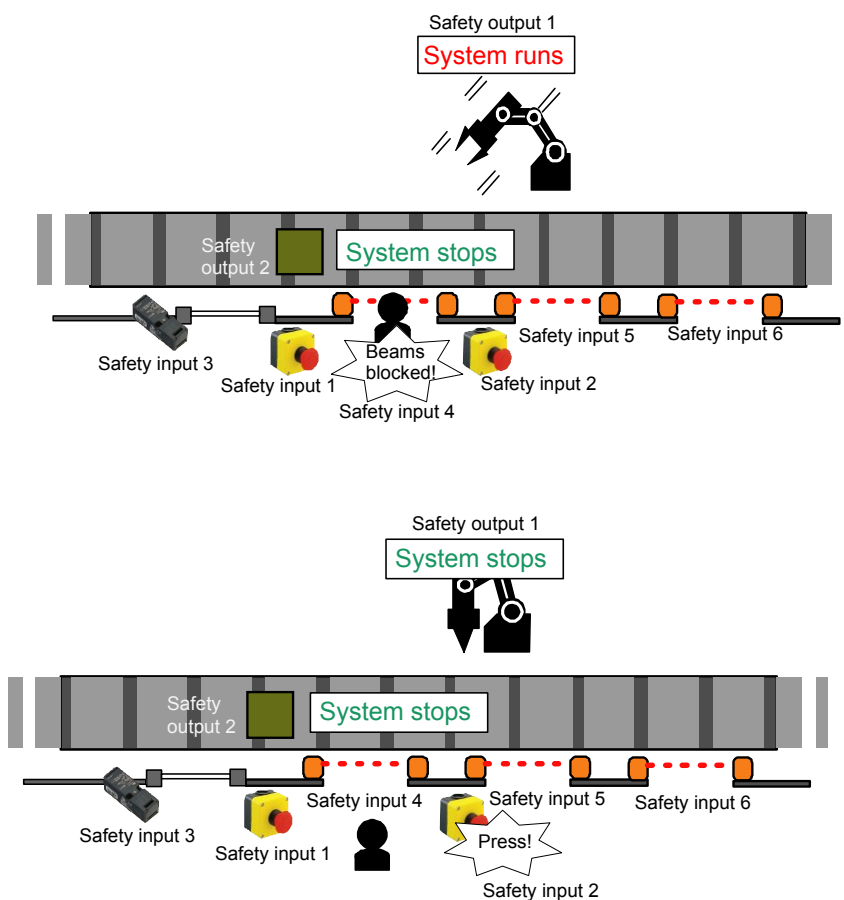
Overview (Logic 102)

This logic is for using safety devices with dual channel solid state outputs, such as safety light curtains, for safety protective measures of production machinery and robots. Safety outputs perform as dual channel outputs.

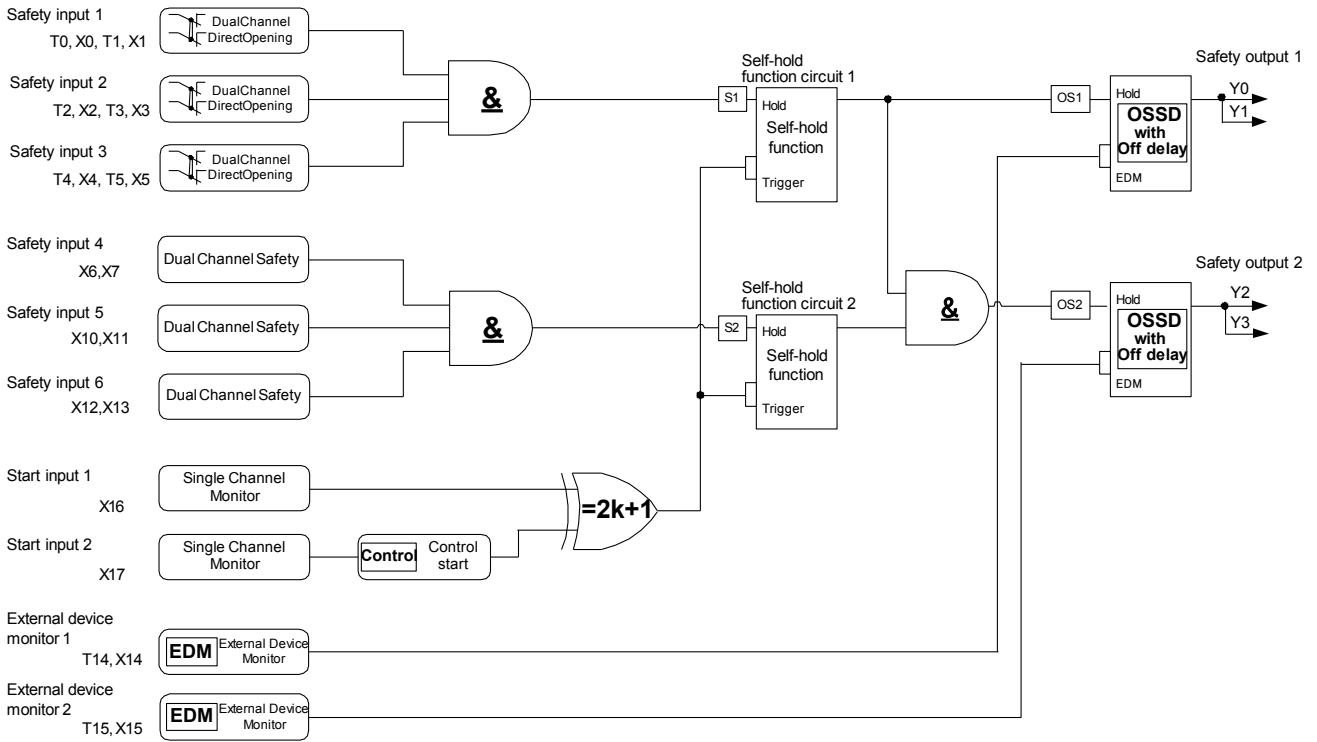
This logic enables the connection of 3 dual channel direct opening inputs and 3 dual channel safety inputs.



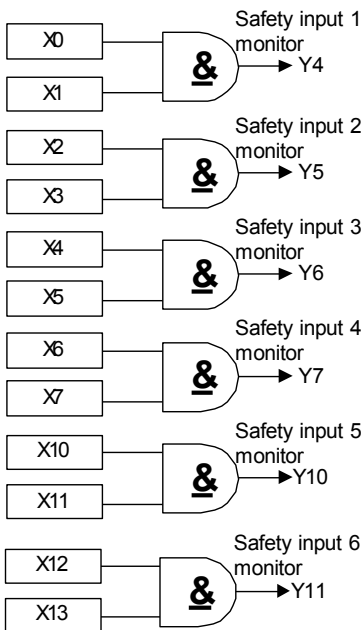
Operation example (Logic 102)



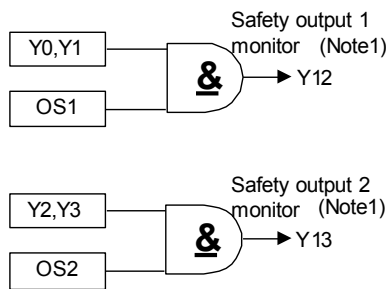
Logic circuit (logic 102)



● Monitor output for safety input

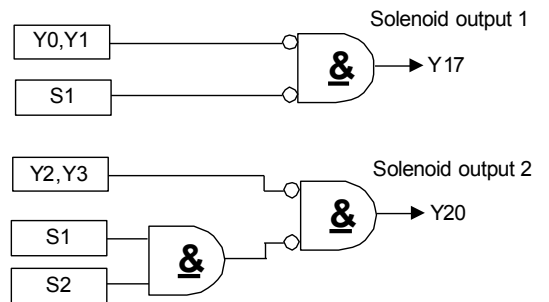


● Monitor output for safety output



Note1:
Safety output 1 monitor and safety output 2 monitor turn OFF immediately independent of OFF-delay time.

● Solenoid output (Note2)

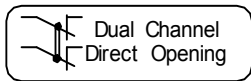



Note2:
In Run state, when the safety outputs are OFF and one or more corresponding safety inputs are OFF, the solenoid outputs turn ON.
When all corresponding safety inputs are ON, the solenoid outputs turn OFF, even when the start input is OFF.

Functions (Logic 102)

●Safety inputs: X0 to X13 (T0 to T5)

Safety inputs are used to diagnose the status of connected safety devices, such as emergency stop switches, and interlock switches.

Intended inputs (Terminal names)	Function	
Safety input 1 (X0-T0, X1-T1) Safety input 2 (X2-T2, X3-T3) Safety input 3 (X4-T4, X5-T5)	Function name	Dual channel direct opening input
	Symbol	
	Description of operation	This function diagnoses the status of connected safety devices. This function diagnoses the time interval of status transition between each input of duplicated inputs (0.5s).
	Detail information	Logic functions (5-311)

Intended inputs (Terminal names)	Function	
Safety input 4 (X6, X7) Safety input 5 (X10, X11) Safety input 6 (X12, X13)	Function name	Dual channel safety input
	Symbol	
	Description of operation	This function diagnoses the status of connected safety devices. This function diagnoses the time interval of status transition between each input of duplicated inputs (0.1s). The function does not use drive terminals (T6 to T13).
	Detail information	Logic functions (5-317)



Warning

For connected control devices, refer to “SAFETY PRECAUTIONS”.

Safety check signals (pulses signals) are sent from the drive terminals (T0 to T5) to diagnose connected safety devices and input circuits. Safety check signals can not be used as a power supply for connected devices.

Note. Solid state outputs, such as safety light curtains, can not be connected to safety input 1 through safety input 3.


Note. Use safety input 1 through safety input 3 as specified combinations, such as receive terminal (X_n) and drive terminal (T_n). If the combinations are incorrect, SafetyOne does not work correctly.

Note. If there are unused safety inputs in safety input 1 through safety input 3, connect the unused receive terminals (X_n) to the corresponding drive terminals (T_n). If they are not connected, the SafetyOne does not turn ON the safety outputs.

Note. If there are unused safety inputs in safety input 4 through safety input 6, connect the unused receive terminals (X_n) to a 24V DC power supply (V+). If they are not connected, the SafetyOne does not turn ON the safety outputs.

●External device monitor inputs: X14 and X15 (T14 and T15)

External device monitor inputs are used to diagnose the status of devices connected to safety outputs.

Intended inputs (Terminal names)	Target safety outputs (Terminal names)	Function	
External device monitor input 1 (X14-T14)	Safety output 1 (Y0, Y1)	Function name	External device monitor input
External device monitor input 2 (X15-T15)	Safety output 2 (Y2, Y3)	Symbol	
		Description of operation	This function diagnoses the status of devices connected to a target safety output.
		Detail information	Logic functions (5-326)



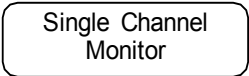
Warning

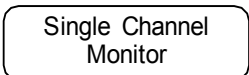

Safety check signals (pulses signals) are sent from the drive terminals (T14, T15) to diagnose external devices and monitor circuits. Safety check signals can not be used as a power supply for connected devices.

Note. If there are unused safety outputs, connect the intended external device monitor terminals (Xn) to the corresponding drive terminals (Tn). If they are not connected, the SafetyOne detects an input monitor error. As the result, the error LED displays a “1” and the unit changes to the Protection state.

● **Start inputs: X16 and X17**

Start inputs are used to control the start of safety outputs.

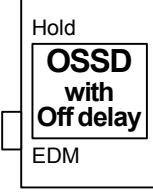
Intended inputs (Terminal names)	Target safety inputs (Terminal names)	Function	
		Start input 1 (X16)	Safety input 1 (X0-T0, X1-T1) Safety input 2 (X2-T2, X3-T3) Safety input 3 (X4-T4, X5-T5) Safety input 4 (X6, X7) Safety input 5 (X10, X11) Safety input 6 (X12, X13)
		Symbol	
		Description of operation	Safety outputs are started, when all target safety inputs are in the safe state and this function is in the ON state. This function is turned ON by 0.1s or more ON operation.
		Detail information	Logic functions (5-325)

Intended inputs (Terminal names)	Target safety inputs (Terminal names)	Function	
		Start input 2 (X17)	Safety input 1 (X0-T0, X1-T1) Safety input 2 (X2-T2, X3-T3) Safety input 3 (X4-T4, X5-T5) Safety input 4 (X6, X7) Safety input 5 (X10, X11) Safety input 6 (X12, X13)
		Symbol	 + 
		Description of operation	Safety outputs are started, when this function becomes ON after all intended safety inputs are in the safe state. This function is turned ON by 0.1s to 5s ON operation.
		Detail information	Logic functions (5-325, 330)

Note. If both of X16 and X17 are turned ON, the SafetyOne will detect an error. As a result, the error LED displays “3” and the state changes to the Stop state. Use only X16 or X17.

● **Safety outputs: Y0 to Y3**

Safety outputs are used to output safety information processed by SafetyOne.

Intended outputs (Terminal names)	Function	
Safety output 1 (Y0, Y1) Safety output 2 (Y2, Y3)	Function name	Safety output with timer
	Symbol	
	Description of operation	This function is a safety output to output safety information processed by SafetyOne. The output is turned OFF after the preset time of the OFF-delay timer (OFF-delay output).
	Detail information	Logic functions (5-335)

Note. When the SafetyOne changes to Protection state due to input monitor error, all safety outputs (safety output 1 and safety output 2) are turned OFF after the preset OFF-delay time.

Note. When the SafetyOne changes to Stop state due to circuit failure or other errors, all safety outputs (safety output 1 and safety output 2) are turned OFF, immediately.

●Safety input monitor outputs: Y4 to Y11

Safety input monitor outputs are used to output the status of safety inputs in SafetyOne.

Intended outputs (Terminal names)	Target safety inputs (Terminal names)	Description of operation
Safety input 1 monitor output (Y4)	Safety input 1 (X0-T0, X1-T1)	When the target safety input is ON, the monitor output is ON. When the target safety input is OFF, the monitor output is OFF.
Safety input 2 monitor output (Y5)	Safety input 2 (X2-T2, X3-T3)	
Safety input 3 monitor output (Y6)	Safety input 3 (X4-T4, X5-T5)	
Safety input 4 monitor output (Y7)	Safety input 4 (X6, X7)	
Safety input 5 monitor output (Y10)	Safety input 5 (X10, X11)	
Safety input 6 monitor output (Y11)	Safety input 6 (X12, X13)	

Note. When the targeted safety input detects an input monitor error, input circuit failure, or EMC the disturbance, corresponding safety input monitor output becomes a pulse output (1Hz). The monitor output is OFF in other errors, Initial state, or Configuration state.

●Safety output monitor outputs: Y12 and Y13

Safety output monitor outputs are used to output status of safety outputs in SafetyOne.

Intended outputs (Terminal names)	Target safety outputs (Terminal names)	Description of operation
Safety output 1 monitor output (Y12)	Safety output 1 (Y0, Y1)	When the target safety output is ON, the monitor output is ON. When the target safety output is OFF, this function is OFF. The monitor output turns OFF immediately, independent of the preset OFF-delay time.
Safety output 2 monitor output (Y13)	Safety output 2 (Y2, Y3)	

Note. When the safety output detects an output circuit failure, the corresponding safety output monitor output becomes a pulse output (1Hz). The monitor output is OFF in other errors, Initial state, or Configuration state.

●State monitor outputs: Y14 to Y16

State monitor outputs are used to output the internal state of SafetyOne.

Intended outputs (Terminal names)	State				
	Initial	Run	Configuration	Protection	Stop
State monitor output 1 (Y14)	■ON	□OFF	□OFF	□OFF	■ON
State monitor output 2 (Y15)	■ON	□OFF	■ON	■ON	■ON or □OFF
State monitor output 3 (Y16)	□OFF	■ON	□OFF	□OFF	□OFF

Refer to “Chapter 4 BASIC OPERATIONS” and to “Chapter 6 TROUBLE SHOOTING” for details of each state.



The monitor outputs are not safety outputs. Do not use these to construct a safety system.

● **Solenoid outputs: Y17 and Y20**

Solenoid outputs are used to control a solenoid in an interlock switch.

Intended outputs (Terminal names)	Description of operation
Solenoid output 1 (Y17)	When safety output 1 is OFF, the solenoid output is ON. When safety Output 1 is ready to turn ON (safety output 1 can be turned ON by operation of the start input), the solenoid output is OFF.
Solenoid output 2 (Y20)	When safety output 2 is OFF, the solenoid output is ON. When safety Output 2 is ready to turn ON (safety output 2 can be turned ON by operation of the start input), the solenoid output is OFF.



Solenoid outputs are not safety outputs. Do not use these to construct a safety system.

Note. The solenoid outputs are OFF in each state except Run state.

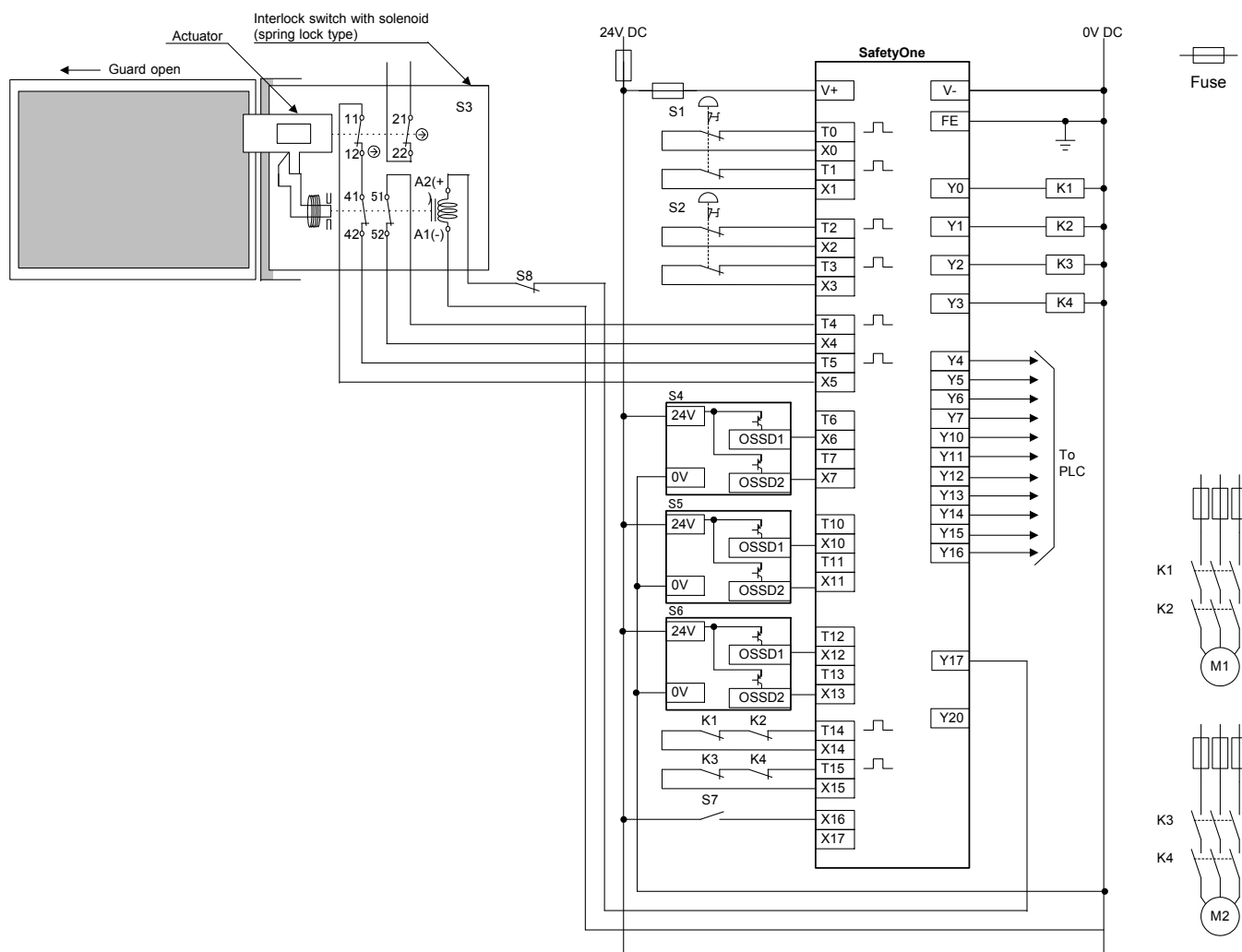


Refer to "Chapter 2 PRODUCT SPECIFICATIONS" for specifications of each input and output.

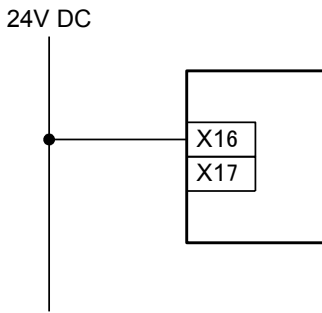
Wiring example (Logic 102)

In the case where 2 emergency stop switches, 1 interlock switch with solenoid (spring lock type), and 3 safety light curtains are connected.

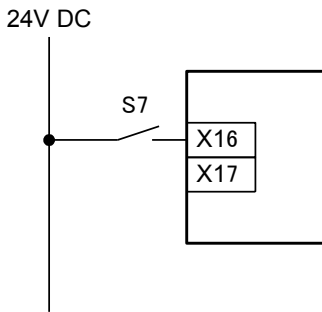
- S1, 2 :Emergency stop switch
- S3 :Interlock switch with solenoid (spring lock type)
- S4, 5, 6 :Safety light curtain
- S7 :Start switch
- S8 :Solenoid control switch
(Pressing the solenoid control switches after closing the guard door, contacts 41-42 and 51-52 of S3 turn on, allowing the SafetyOne to restart.)
- K1 to 4 :Contactor
- M1, 2 :Motor



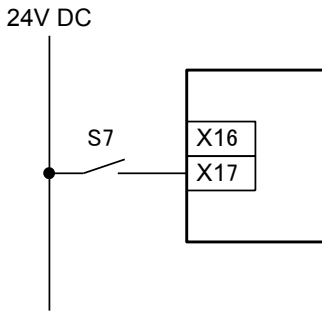
**When not using the start switch
(Auto start)**



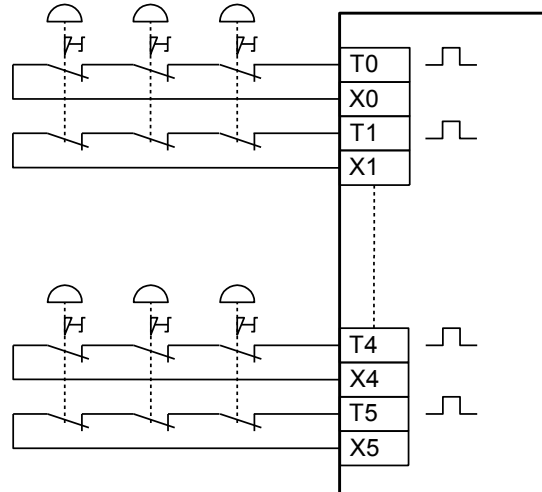
**When not detecting the welding of start switch
(Manual start)**



**When detecting the welding of start switch
(Control start)**



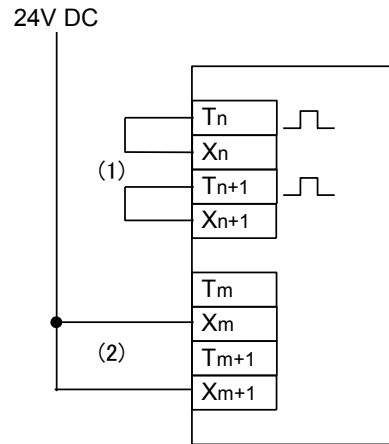
When connecting multiple components in series



NOTE: Safety performance depends on the system onfiguration.

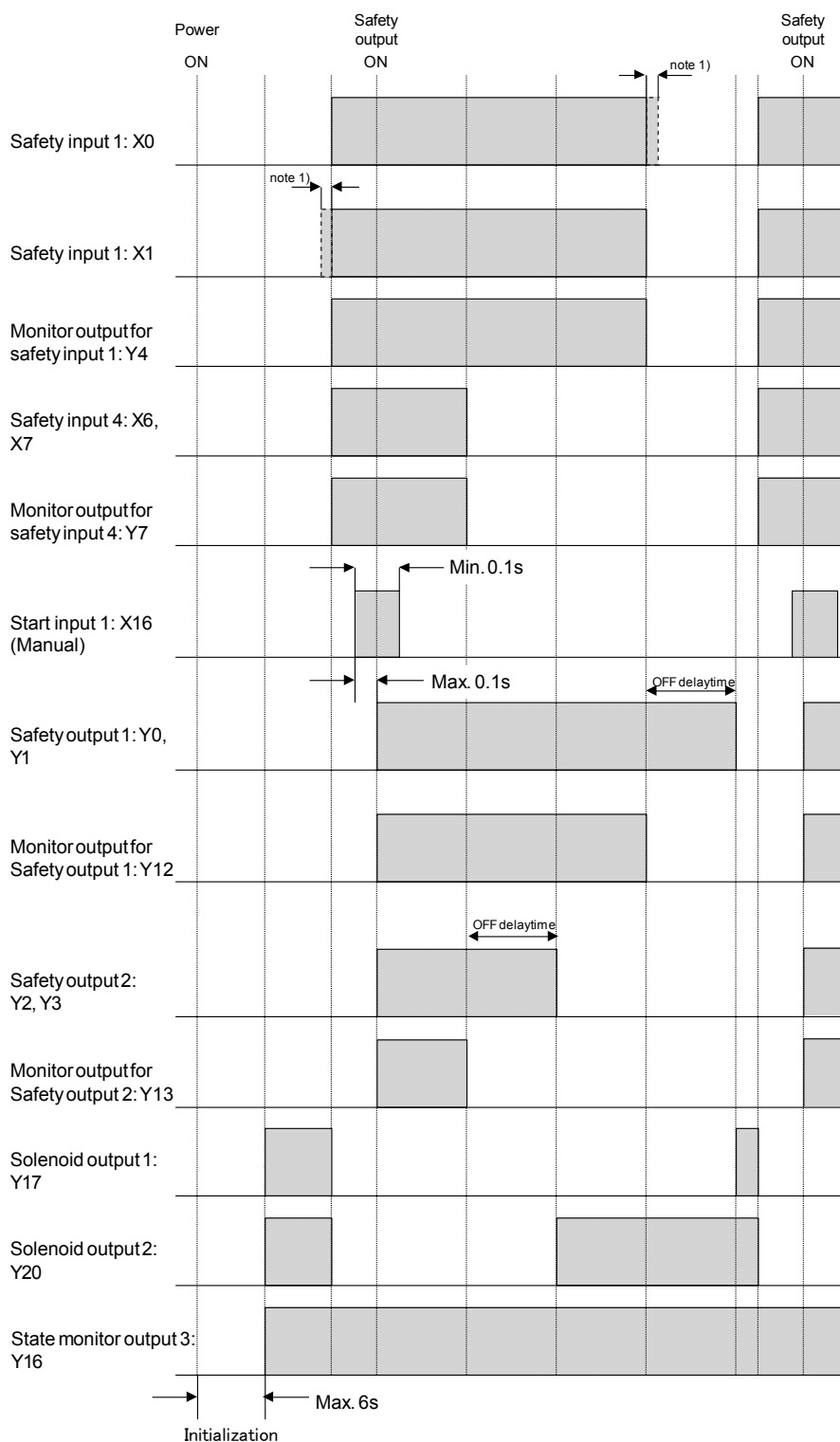
When not using some safety inputs

- If there are unused safety inputs in S1 to S3, connect the unused receive terminals to the corresponding drive terminals. (Refer to (1))
- If there are unused safety inputs in S4 to S6, connect the unused receive terminals to 24V DC power supply (V+). (Refer to (2))



Timing chart (Logic 102)

Example: Manual start input (X16) is used.



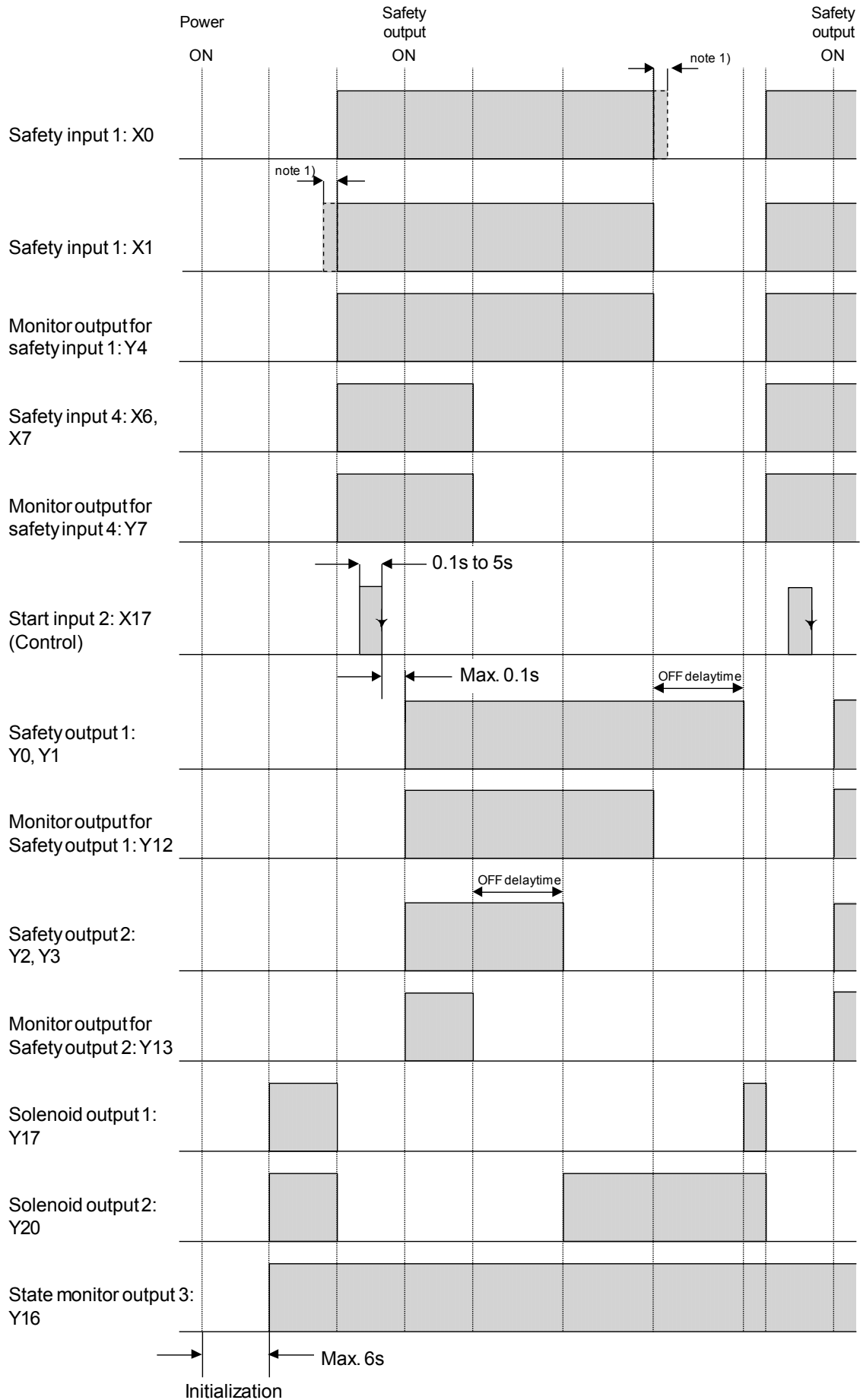
(Safety input 2, 3, 5 and 6 are all ON in this chart.)

Note 1) Input monitor error detection time is 0.5s.

About safety inputs that are not described in this chart, input monitor error detection time is as follows.
 The time of dual channel direct opening input (X2 to X5) is 0.5s.
 The time of dual channel safety input (X6 to X13) is 0.1s.
 Refer to the following "Logic functions" for more details.

LOGIC

Example: Control start input (X17) is used.



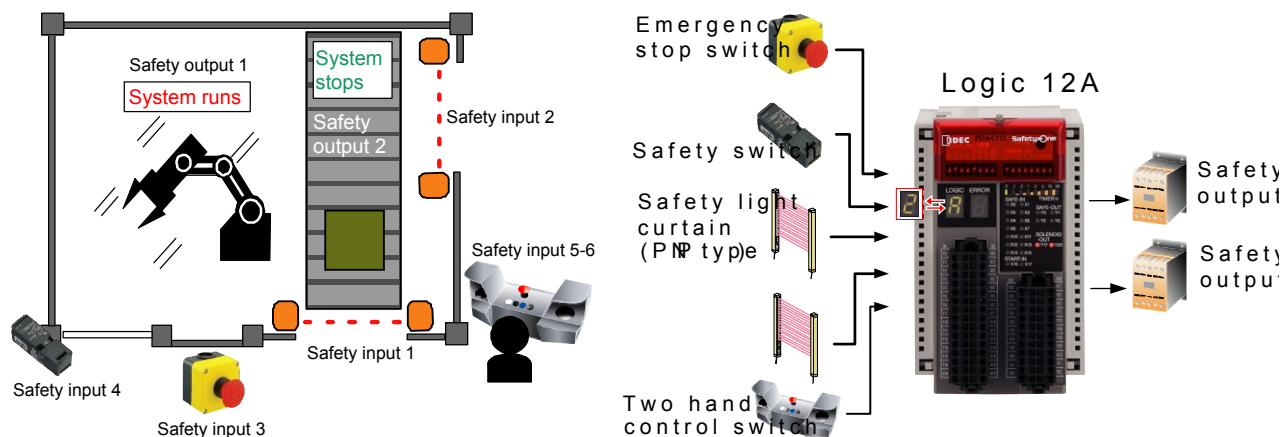
(Safety input 2, 3, 5 and 6 are all ON in this chart.)

Logic 12A: The logic for apparatus with a two-hand control device

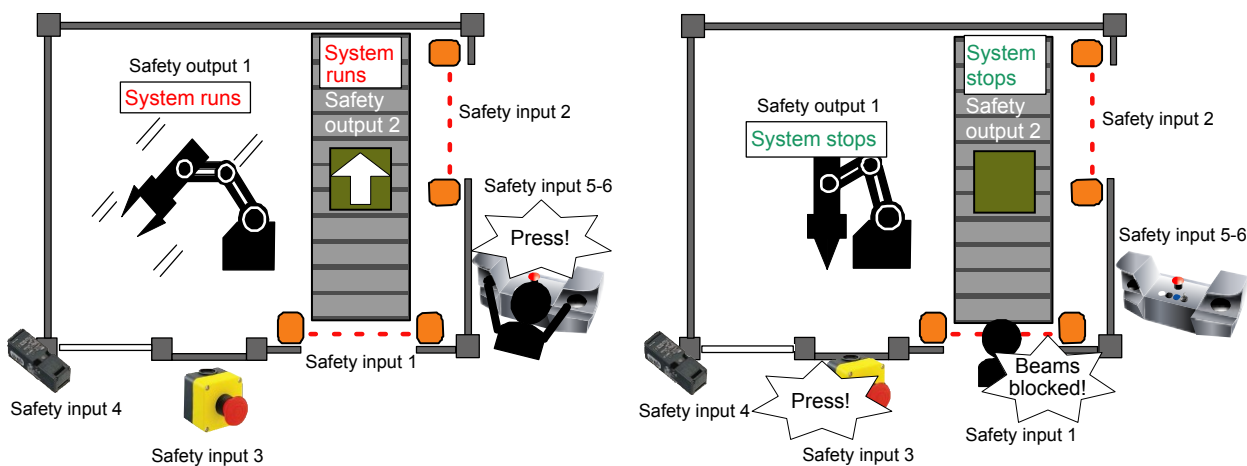
Overview (Logic 12A)

This logic is for using two hand input devices for safety protective measures of production machinery. Safety outputs perform as dual channel outputs.

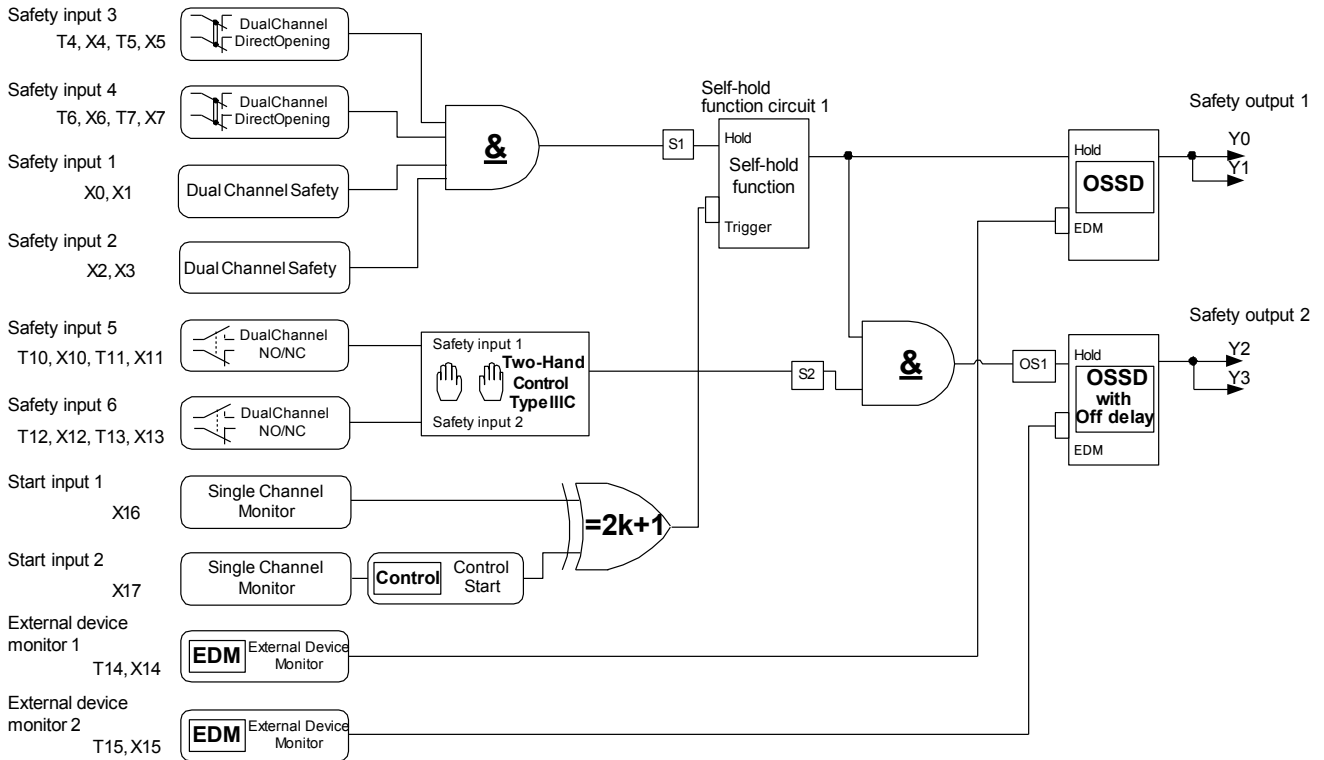
This logic enables the connection of 2 dual channel direct opening inputs, 1 input device for two-hand control (2 dual channel NO/NC inputs), and 2 dual channel safety inputs.



Operation example (Logic 12A)



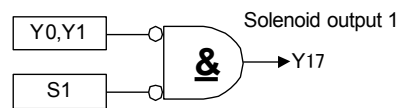
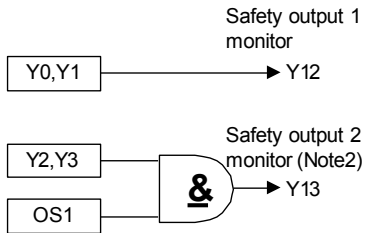
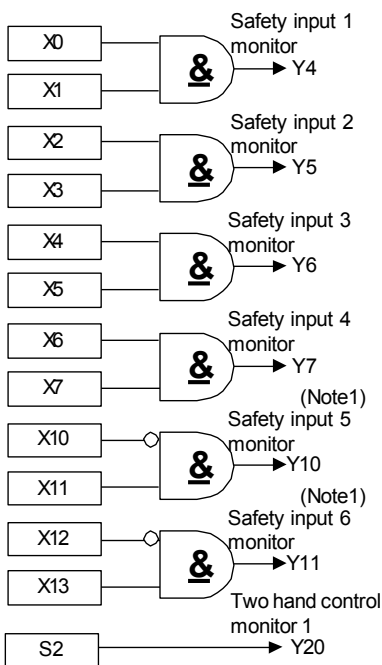
Logic circuit (logic 12A)



● Monitor output for safety input

● Monitor output for safety output

(Note3)
● Solenoid output



Note2:
Safety output 2 monitor turns OFF immediately independent of OFF-delay time.


Note3:
In Run state, when the safety outputs are OFF and one or more corresponding safety inputs are OFF, the solenoid output turns ON.
When all corresponding safety inputs are ON, the solenoid output turns OFF, even when the start input is OFF.

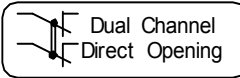
Note1:
When X_n is OFF and X_{n+1} is ON, Safety input 5 monitor and Safety input 6 monitor turn ON.
($n = 10, 12$)

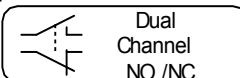
Functions (Logic 12A)

●Safety inputs: X0 to X13 (T4 to T13)

Safety inputs are used to diagnose the status of connected safety devices, such as emergency stop switches, and input devices for two-hand control.

Intended inputs (Terminal names)	Function	
Safety input 1 (X0, X1) Safety input 2 (X2, X3)	Function name	Dual channel safety input
	Symbol	
	Description of operation	This function diagnoses the status of connected safety devices. This function diagnoses the time interval of status transition between each input of duplicated inputs (0.1s). The function does not use drive terminals (T0 to T3).
	Detail information	Logic functions (5-317)

Intended inputs (Terminal names)	Function	
Safety input 3 (X4-T4, X5-T5) Safety input 4 (X6-T6, X7-T7)	Function name	Dual channel direct opening input
	Symbol	
	Description of operation	This function diagnoses the status of connected safety devices. This function diagnoses the time interval of status transition between each input of duplicated inputs (0.5s).
	Detail information	Logic functions (5-311)

Intended inputs (Terminal names)	Function	
Safety input 5 (X10-T10, X11-T11) Safety input 6 (X12-T12, X13-T13)	Function name	Dual channel NO/NC input
	Symbol	
	Description of operation	This function diagnoses the status of connected safety devices. This function diagnoses the time interval of status transition between each input of duplicated inputs (0.5s).
	Detail information	Logic functions (5-315)



For connected control devices, refer to “SAFETY PRECAUTIONS”.

Safety check signals (pulses signals) are sent from the drive terminals (T4 to T13) to diagnose connected safety devices and input circuits. Safety check signals can not be used as a power supply for connected devices.

Note. If there are unused safety inputs in safety input 1 and safety input 2, connect the unused receive terminals (Xn) to a 24V DC power supply (V+). If they are not connected, the SafetyOne does not turn ON the safety outputs.


Note. Solid state outputs, such as safety light curtains, can not be connected to safety input 3 through safety input 6.

Note. Use safety input 3 through safety input 6 as specified combinations, such as receive terminal (Xn) and drive terminal (Tn). If the combinations are incorrect, SafetyOne does not work correctly.

Note. If there are unused safety inputs in safety input 3 and safety input 4, connect the unused receive terminals (Xn) to the corresponding drive terminals (Tn). If they are not connected, the SafetyOne does not turn ON the safety outputs.

●**External device monitor inputs: X14 and X15 (T14 and T15)**

External device monitor inputs are used to diagnose the status of devices connected to safety outputs.

Intended inputs (Terminal names)	Target safety outputs (Terminal names)	Function	
External device monitor input 1 (X14-T14)	Safety output 1 (Y0, Y1)	Function name	External device monitor input
External device monitor input 2 (X15-T15)	Safety output 2 (Y2, Y3)	Symbol	
		Description of operation	This function diagnoses the status of devices connected to a target safety output.
		Detail information	Logic functions (5-326)

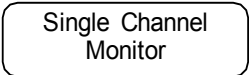




Safety check signals (pulses signals) are sent from the drive terminals (T14, T15) to diagnose external devices and monitor circuits. Safety check signals can not be used as a power supply for connected devices.

Note. If there are unused safety outputs, connect the intended external device monitor terminals (Xn) to the corresponding drive terminals (Tn). If they are not connected, the SafetyOne detects an input monitor error. As the result, the error LED displays a “1” and the unit changes to the Protection state.

● **Start inputs: X16 and X17**

Start inputs are used to control the start of safety outputs.

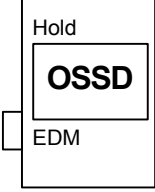
Intended inputs (Terminal names)	Target safety inputs (Terminal names)	Function	
		Start input 1 (X16)	Safety input 1 (X0, X1) Safety input 2 (X2, X3) Safety input 3 (X4-T4, X5-T5) Safety input 4 (X6-T6, X7-T7)
Symbol			
Description of operation	Safety outputs are started, when all target safety inputs are in the safe state and this function is in the ON state. This function is turned ON by 0.1s or more ON operation.		
Detail information	Logic functions (5-325)		

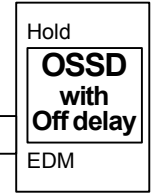
Intended inputs (Terminal names)	Target safety inputs (Terminal names)	Function	
		Start input 2 (X17)	Safety input 1 (X0, X1) Safety input 2 (X2, X3) Safety input 3 (X4-T4, X5-T5) Safety input 4 (X6-T6, X7-T7)
Symbol	 + 		
Description of operation	Safety outputs are started, when this function becomes ON after all intended safety inputs are in the safe state. This function is turned ON by 0.1s to 5s ON operation.		
Detail information	Logic functions (5-325, 330)		

Note. If both of X16 and X17 are turned ON, the SafetyOne will detect an error. As a result, the error LED displays “3” and the state changes to the Stop state. Use only X16 or X17.

● **Safety outputs: Y0 to Y3**

Safety outputs are used to output safety information processed by SafetyOne.

Intended outputs (Terminal names)	Function	
Safety output 1 (Y0, Y1)	Function name	Safety output without timer
	Symbol	
	Description of operation	This function is a safety output to output safety information processed by SafetyOne. The output is turned OFF immediately by OFF operation (instantaneous OFF output).
	Detail information	Logic functions (5-332)

Intended outputs (Terminal names)	Function	
Safety output 2 (Y2, Y3)	Function name	Safety output with timer
	Symbol	
	Description of operation	This function is a safety output to output safety information processed by SafetyOne. The output is turned OFF after the preset time of the OFF-delay timer (OFF-delay output).
	Detail information	Logic functions (5-335)

Note. When the SafetyOne changes to Protection state due to input monitor error, safety output without timer (safety output 1) is turned OFF. Safety output with timer (safety output 2) is turned OFF after the preset OFF-delay time.

Note. When the SafetyOne changes to Stop state due to circuit failure or other errors, all safety outputs (safety output 1 and safety output 2) are turned OFF, immediately.

●Safety input monitor outputs: Y4 to Y11

Safety input monitor outputs are used to output status of safety inputs in SafetyOne.

Intended outputs (Terminal names)	Target safety inputs (Terminal names)	Description of operation
Safety input 1 monitor output (Y4)	Safety input 1 (X0 X1)	When the target safety input is ON, the monitor output is ON. When the target safety input is OFF, the monitor output is OFF.
Safety input 2 monitor output (Y5)	Safety input 2 (X2, X3)	
Safety input 3 monitor output (Y6)	Safety input 3 (X4-T4, X5-T5)	
Safety input 4 monitor output (Y7)	Safety input 4 (X6-T6, X7-T7)	
Safety input 5 monitor output (Y10)	Safety input 5 (X10-T10, X11-T11)	
Safety input 6 monitor output (Y11)	Safety input 6 (X12-T12, X13-T13)	

Note. When the targeted safety input detects an input monitor error, input circuit failure, or EMC the disturbance, corresponding safety input monitor output becomes a pulse output (1Hz). The monitor output is OFF in other errors, Initial state, or Configuration state.

●Two-hand control monitor output: Y20

Two-hand control monitor output is used to output status of the two-hand control function.

Intended outputs (Terminal names)	Description of operation
Two-hand control monitor output (Y20)	When two-hand control function is ON, the monitor output is ON. When this function is OFF, the monitor output is OFF.

●Safety output monitor outputs: Y12 and Y13

Safety output monitor outputs are used to output status of safety outputs in SafetyOne.

Intended outputs (Terminal names)	Target safety outputs (Terminal names)	Description of operation
Safety output 1 monitor output (Y12)	Safety output 1 (Y0, Y1)	When the target safety output is ON, the monitor output is ON. When the target safety output is OFF, this function is OFF. The monitor output turns OFF immediately independent on set OFF-delay time.
Safety output 2 monitor output (Y13)	Safety output 2 (Y2, Y3)	

Note. When the safety output detects an output circuit failure, the corresponding safety output monitor output becomes a pulse output (1Hz). The monitor output is OFF in other errors, Initial state, or Configuration state.

● **State monitor outputs: Y14 to Y16**

State monitor outputs are used to output the internal state of SafetyOne.

Intended outputs (Terminal names)	State				
	Initial	Run	Configuration	Protection	Stop
State monitor output 1 (Y14)	■ON	□OFF	□OFF	□OFF	■ON
State monitor output 2 (Y15)	■ON	□OFF	■ON	■ON	■ON or □OFF
State monitor output 3 (Y16)	□OFF	■ON	□OFF	□OFF	□OFF

Refer to “Chapter 4 BASIC OPERATIONS” and to “Chapter 6 TROUBLE SHOOTING” for details of each state.



Warning

The monitor outputs are not safety outputs. Do not use these to construct a safety system.

● **Solenoid output: Y17**

Solenoid output is used to control a solenoid in an interlock switch.

Intended outputs (Terminal names)	Description of operation
Solenoid output 1 (Y17)	When safety output 1 is OFF, the solenoid output is ON. When safety Output 1 is ready to turn ON (safety output 1 can be turned ON by operation of the start input), the solenoid output is OFF.



Warning

The solenoid output is not safety output. Do not use these to construct a safety system.

Note. The solenoid output is OFF in each state except Run state.



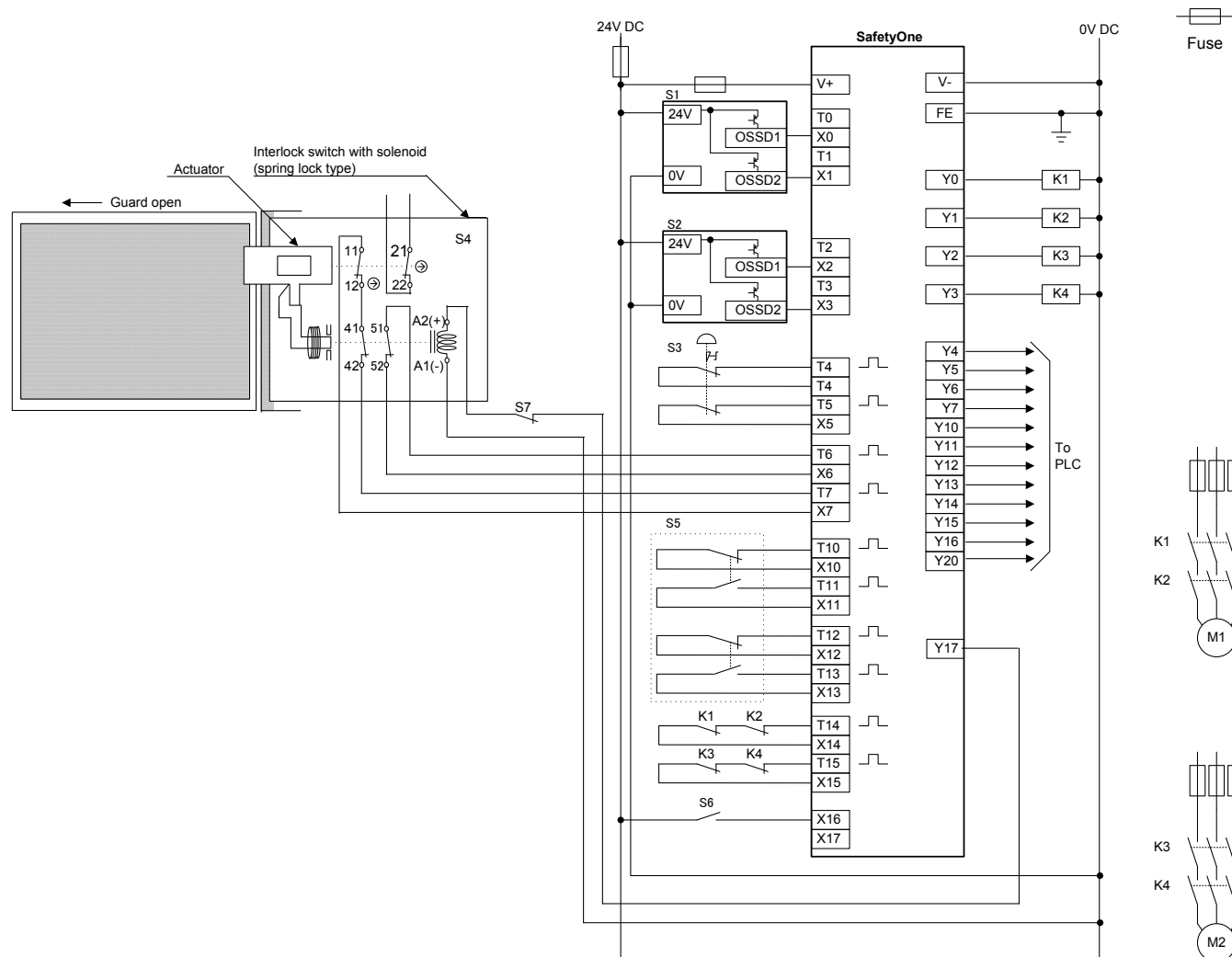
Caution

Refer to "Chapter 2 PRODUCT SPECIFICATIONS" for specifications of each input and output.

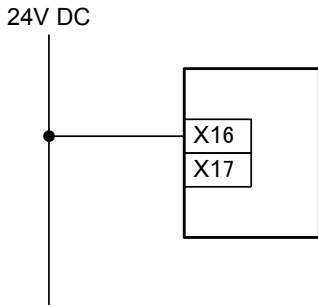
Wiring example (Logic 12A)

In the case where 2 safety light curtains, 1 emergency stop switch, 1 interlock switch with solenoid (spring lock type), and 1 two hand control switch are connected.

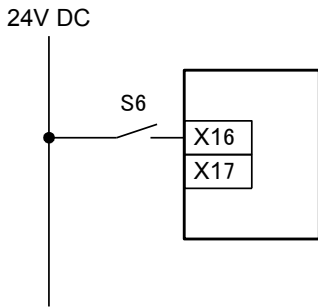
- S1, 2 :Safety light curtain
- S3 :Emergency stop switch
- S4 :Interlock switch with solenoid (spring lock type)
- S5 :Two hand control switch (The figure represents the contacts when the switches are not pushed.)
- S6 :Start switch
- S7 :Solenoid control switch
(Pressing the solenoid control switches after closing the guard door,
contacts 41-42 and 51-52 of S4 turn on, allowing the SafetyOne to restart.)
- K1 to 4 :Contactor
- M1, 2 :Motor



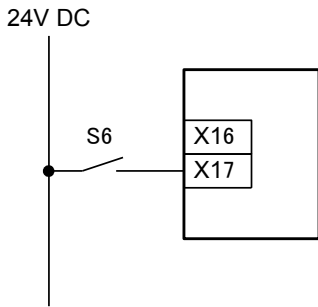
**When not using the start switch
(Auto start)**



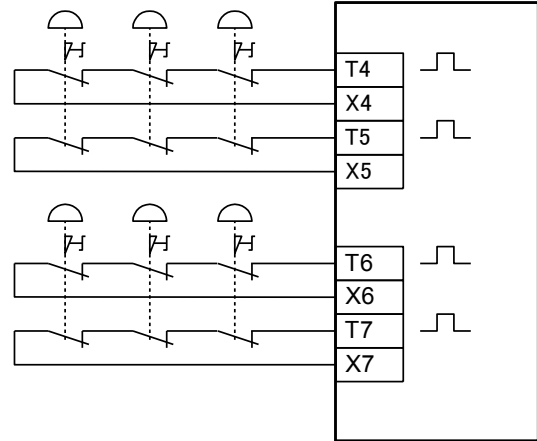
**When not detecting the welding of start switch
(Manual start)**



**When detecting the welding of start switch
(Control start)**



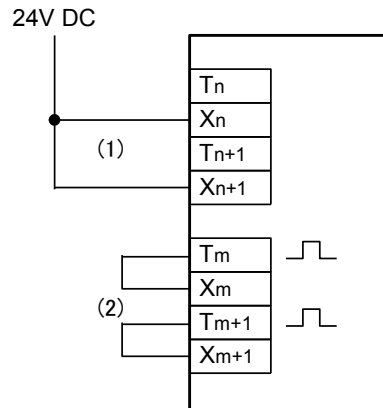
**When connecting multiple emergency stop switches
in series**



NOTE: Safety performance depends on the system configuration.

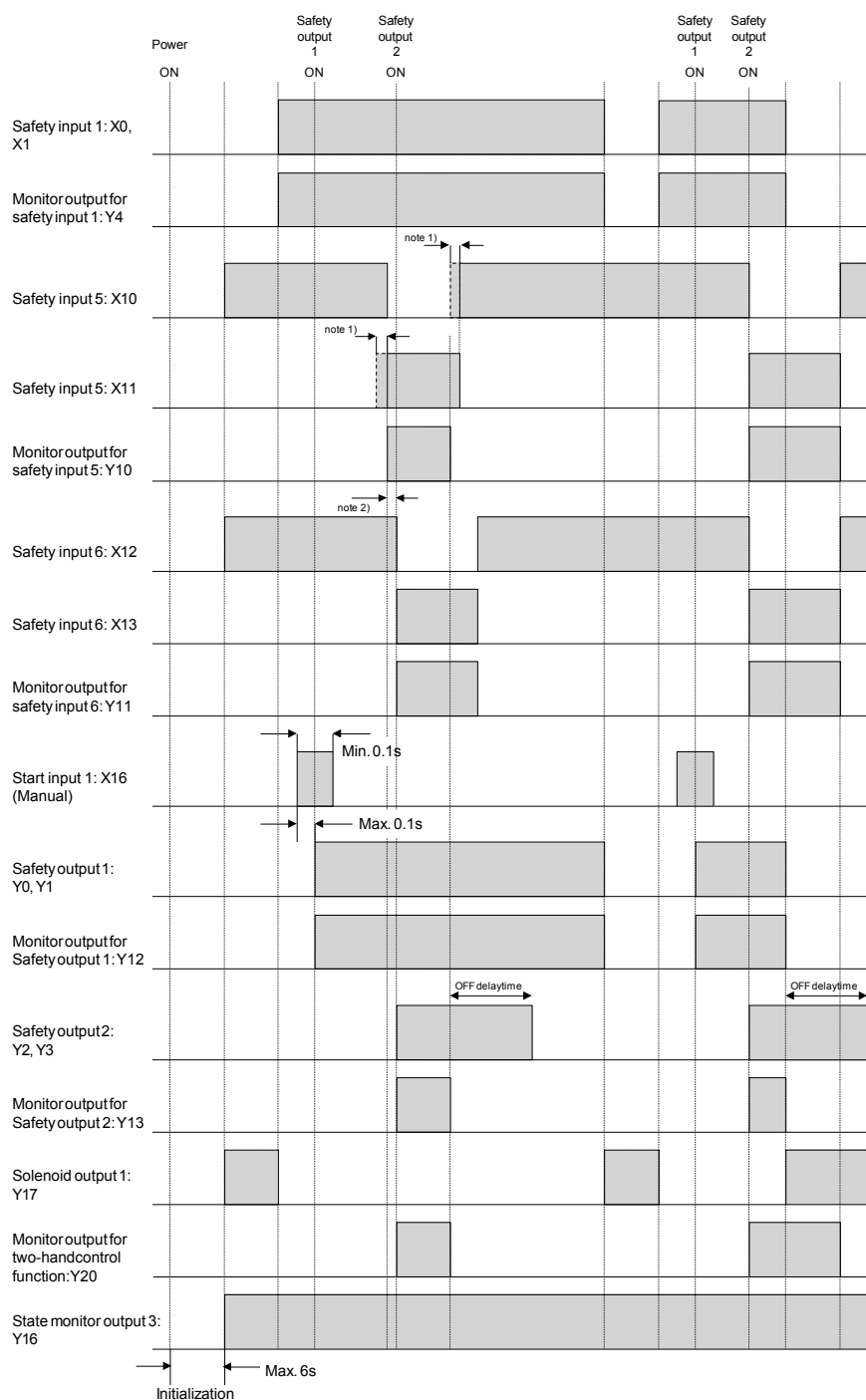
When not using some safety inputs

- If there are unused safety inputs in S1 and S2, connect the unused receive terminals to 24V DC power supply (V+). (Refer to (1))
- If there are unused safety inputs in S3 and S4, connect the unused receive terminals to the corresponding drive terminals. (Refer to (2))



Timing chart (Logic 12A)

Example: Manual start input (X16) is used.



(Safety input 2, 3 and 4 are all ON in this chart.)

Note 1) Input monitor error detection time is 0.5s.

Note 2) "Safety output 2" is not turned ON when time lag between "Safety input 5" and "Safety input 6" for two-hand control function is more than 0.5s. Refer to the following "Logic function" for more details.

About safety inputs that are not described in this chart, input monitor error detection time is as follows.

The time of dual channel safety input (X0 to X3) is 0.1s.

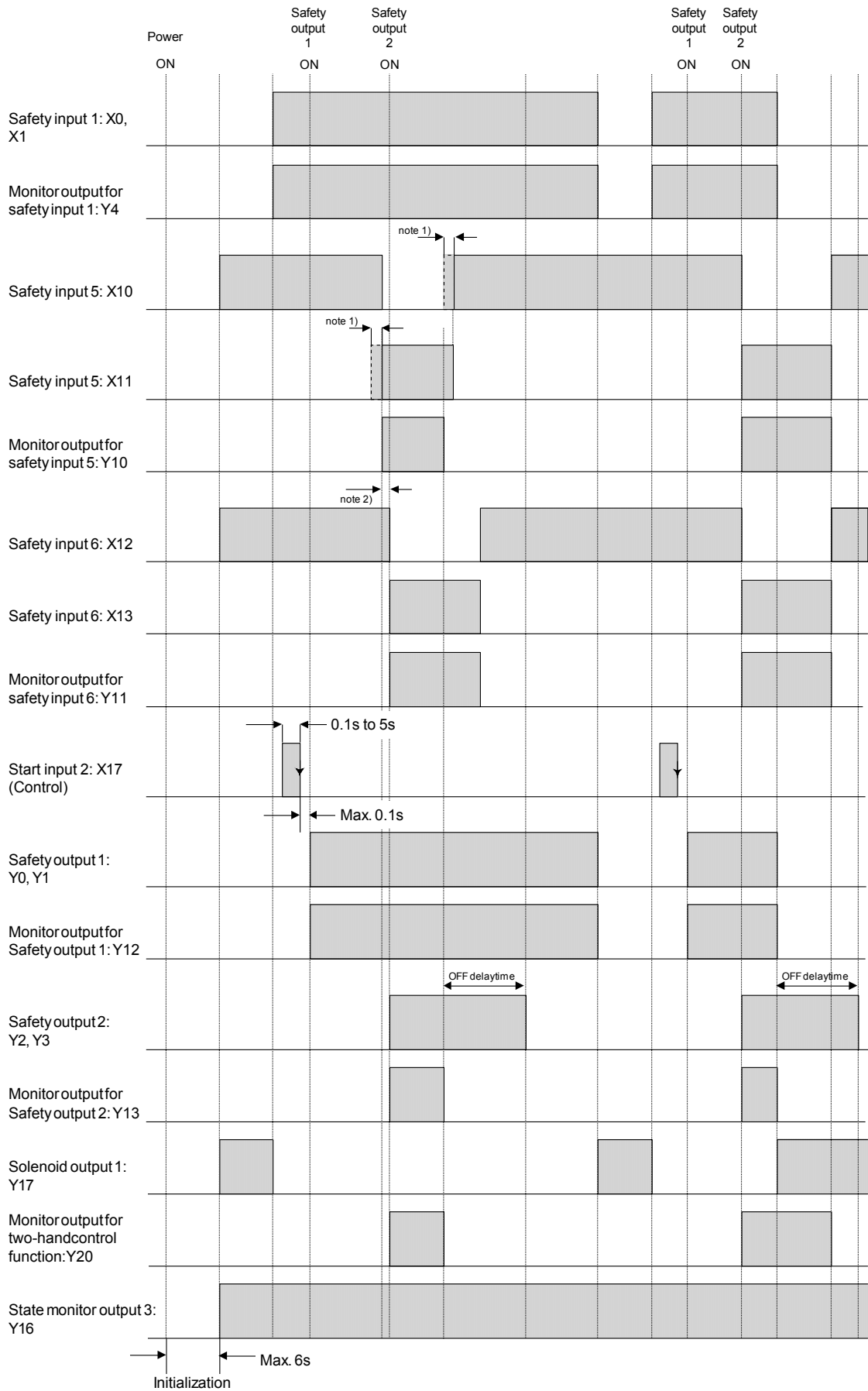
The time of dual channel direct opening input (X4 to X7) is 0.5s.

The time of dual channel NO/NC input (X10 to X13) is 0.5s.

Refer to the following "Logic functions" for more details.

LOGIC

Example: Control start input (X17) is used.



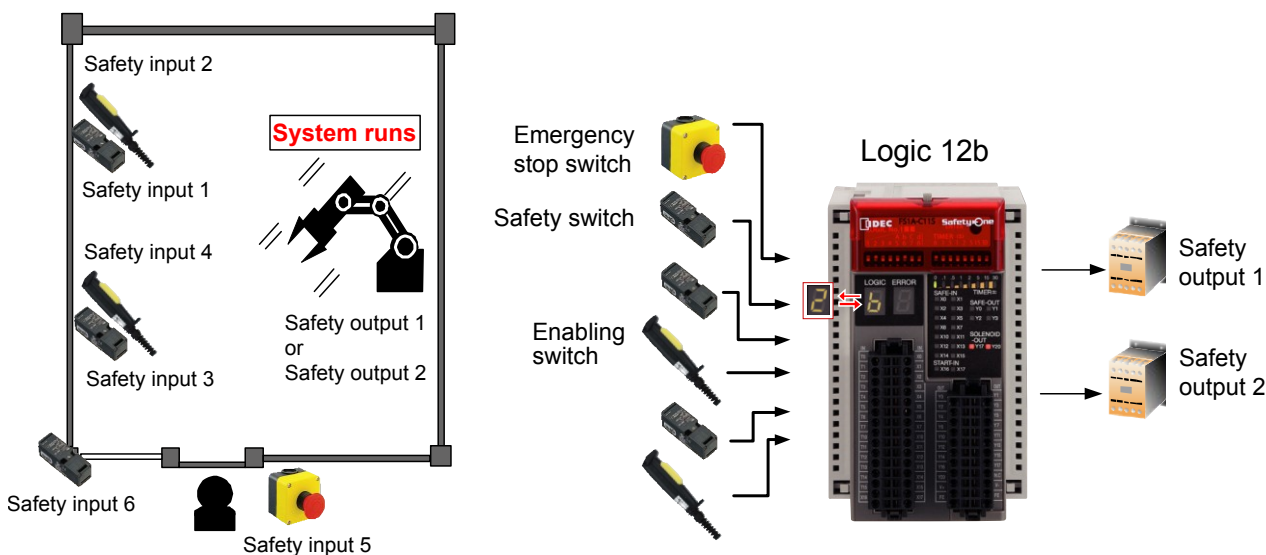
(Safety input 2, 3 and 4 are all ON in this chart.)

Logic 12b: The logic constructing an OR circuit for various apparatus

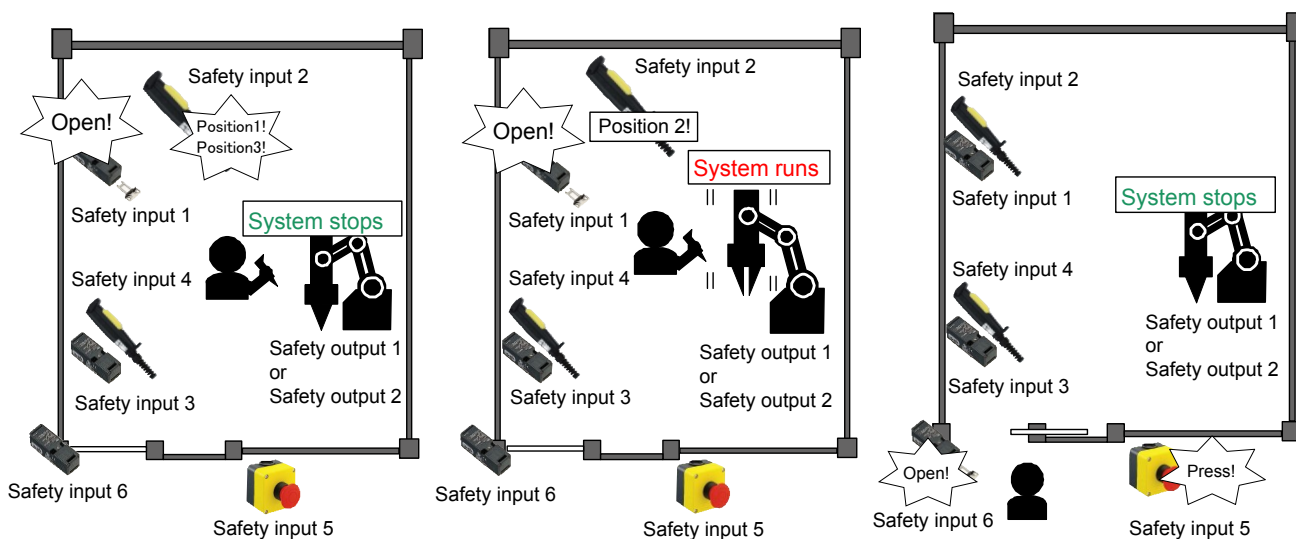
Overview (Logic 12b)

This logic is for constructing an OR circuit of a safety input device for safety protective measures of production machinery, robots.. Safety outputs perform as dual channel outputs.

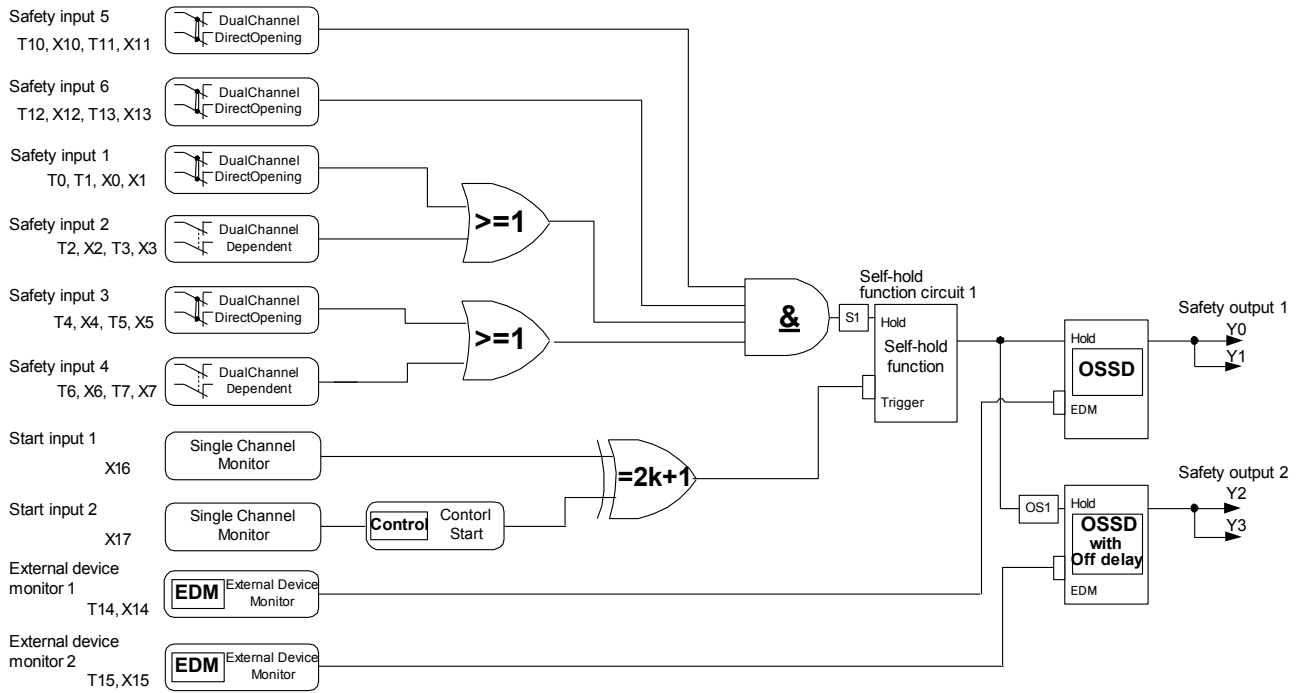
This logic enables the connection of 4 dual channel direct opening inputs, and 2 dual channel dependent inputs.



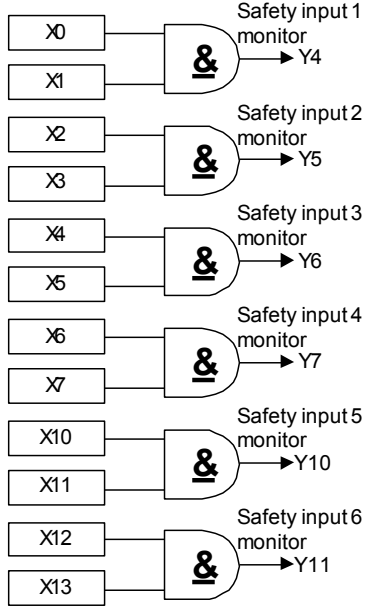
Operation example (Logic 12b)



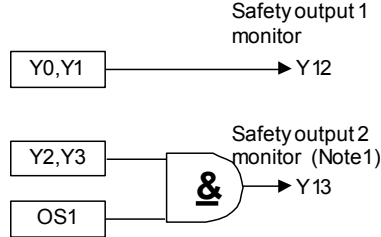
Logic circuit (logic 12b)



● Monitor output for safety input

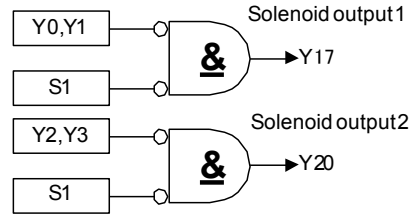


● Monitor output for safety output



Note1:
Safety output 2 monitor turns OFF immediately independent of OFF-delay time.

● Solenoid output

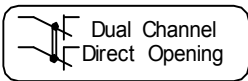


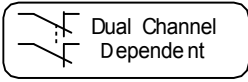
Note2:
In Run state, when the safety outputs are OFF and one or more corresponding safety inputs are OFF, the solenoid outputs turn ON.
When all corresponding safety inputs are ON, the solenoid outputs turn OFF, even when the start input is OFF.

Functions (Logic 12b)

● **Safety inputs: X0 to X13 (T0 to T13)**

Safety inputs are used to diagnose the status of connected safety devices, such as emergency stop switches, and interlock switches.

Intended inputs (Terminal names)	Function	
Safety input 1 (X0-T0, X1-T1) Safety input 3 (X4-T4, X5-T5) Safety input 5 (X10-T10, X11-T11) Safety input 6 (X12-T12, X13-T13)	Function name	Dual channel direct opening input
	Symbol	
	Description of operation	This function diagnoses the status of connected safety devices. This function diagnoses the time interval of status transition between each input of duplicated inputs (0.5s).
	Detail information	Logic functions (5-311)

Intended inputs (Terminal names)	Function	
Safety input 2 (X2-T2, X3-T3) Safety input 4 (X6-T6, X7-T7)	Function name	Dual channel dependent input
	Symbol	
	Description of operation	This function diagnoses the status of connected safety devices. This function does not diagnose the time interval of status transition between each input of duplicated inputs.
	Detail information	Logic functions (5-313)



For connected control devices, refer to “SAFETY PRECAUTIONS”.

Safety check signals (pulses signals) are sent from the drive terminals (T0 to T13) to diagnose connected safety devices and input circuits. Safety check signals can not be used as a power supply for connected devices.

In case of using only safety input 1 or safety input 2, open the unused safety inputs. This is the same for safety input 3 and safety input 4. If unused safety inputs are connected, SafetyOne does not turn OFF by the OFF operation of used safety inputs.

Note. Solid state outputs, such as safety light curtains, can not be connected.

Note. Use safety inputs as specified combinations, such as receive terminal (Xn) and drive terminal (Tn). If the combinations are incorrect, SafetyOne does not work correctly.

Note. When SafetyOne is in Run state or Protection state, input states are monitored in all safety inputs. For example, if input monitor error is detected in safety input 2 although safety input 1 is in ON state, SafetyOne detects error and transits to Protection state.


Note. When both of safety input 1 and safety input 2 are unused, connect one of the unused receive terminal (Xn) to the corresponding drive terminal (Tn) at least. If they are not connected, the SafetyOne does not turn ON the safety outputs.

Note. When both of safety input 3 and safety input 4 are unused, connect one of the unused receive terminal (Xn) to the corresponding drive terminal (Tn) at least. If they are not connected, the SafetyOne does not turn ON the safety outputs.

Note. When safety output 5 or safety output 6 is unused, connect the unused receive terminal (Xn) to the corresponding drive terminal (Tn). If they are not connected, the SafetyOne does not turn ON the safety outputs.

● **External device monitor inputs: X14 and X15 (T14 and T15)**

External device monitor inputs are used to diagnose the status of devices connected to safety outputs.

Intended inputs (Terminal names)	Target safety outputs (Terminal names)	Function	
External device monitor input 1 (X14-T14)	Safety output 1 (Y0, Y1)	Function name	External device monitor input
External device monitor input 2 (X15-T15)	Safety output 2 (Y2, Y3)	Symbol	
		Description of operation	This function diagnoses the status of devices connected to a target safety output.
		Detail information	Logic Functions (5-326)



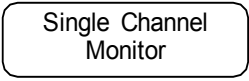
Warning


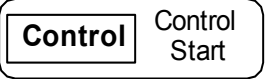
Safety check signals (pulses signals) are sent from the drive terminals (T14, T15) to diagnose external devices and monitor circuits. Safety check signals can not be used as a power supply for connected devices.

Note. If there are unused safety outputs, connect the intended external device monitor terminals (Xn) to the corresponding drive terminals (Tn). If they are not connected, the SafetyOne detects an input monitor error. As the result, the error LED displays a “1” and the unit changes to the Protection state.

● **Start inputs: X16 and X17**

Start inputs are used to control the start of safety outputs.

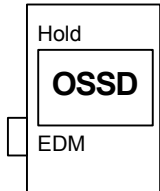
Intended inputs (Terminal names)	Target safety inputs (Terminal names)	Function	
		Start input 1 (X16)	Safety input 1 (X0-T0, X1-T1) Safety input 2 (X2-T2, X3-T3) Safety input 3 (X4-T4, X5-T5) Safety input 4 (X6-T6, X7-T7) Safety input 5 (X10-T10, X11-T11) Safety input 6 (X12-T12, X13-T13)
Symbol			
Description of operation	Safety outputs are started, when all target safety inputs are in the safe state and this function is in the ON state. This function is turned ON by 0.1s or more ON operation.		
Detail information	Logic Functions (5-325)		

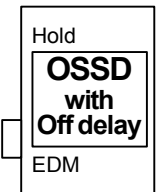
Intended inputs (Terminal names)	Target safety inputs (Terminal names)	Function	
		Start input 2 (X17)	Safety input 1 (X0-T0, X1-T1) Safety input 2 (X2-T2, X3-T3) Safety input 3 (X4-T4, X5-T5) Safety input 4 (X6-T6, X7-T7) Safety input 5 (X10-T10, X11-T11) Safety input 6 (X12-T12, X13-T13)
Symbol	 + 		
Description of operation	Safety outputs are started, when this function becomes ON after all intended safety inputs are in the safe state. This function is turned ON by 0.1s to 5s ON operation.		
Detail information	Logic Functions (5-325, 330)		

Note. If both of X16 and X17 are turned ON, the SafetyOne will detect an error. As a result, the error LED displays “3” and the state changes to the Stop state. Use only X16 or X17.

● **Safety outputs: Y0 to Y3**

Safety outputs are used to output safety information processed by SafetyOne.

Intended outputs (Terminal names)	Function	
Safety output 1 (Y0, Y1)	Function name	Safety output without timer
	Symbol	
	Description of operation	This function is a safety output to output safety information processed by SafetyOne. The output is turned OFF immediately by OFF operation (instantaneous OFF output).
	Detail information	Logic Functions (5-332)

Intended outputs (Terminal names)	Function	
Safety output 2 (Y2, Y3)	Function name	Safety output with timer
	Symbol	
	Description of operation	This function is a safety output to output safety information processed by SafetyOne. The output is turned OFF after the preset time of the OFF-delay timer (OFF-delay output).
	Detail information	Logic functions (5-335)

Note. When the SafetyOne changes to Protection state due to input monitor error, safety output without timer (safety output 1) is turned OFF. Safety output with timer (safety output 2) is turned OFF after the preset OFF-delay time.

Note. When the SafetyOne changes to Stop state due to circuit failure or other errors, all safety outputs (safety output 1 and safety output 2) are turned OFF, immediately.

● **Safety input monitor outputs: Y4 to Y11**

Safety input monitor outputs are used to output the status of safety inputs in SafetyOne.

Intended outputs (Terminal names)	Target safety inputs (Terminal names)	Description of operation
Safety input 1 monitor output (Y4)	Safety input 1 (X0-T0, X1-T1)	When the target safety input is ON, the monitor output is ON. When the target safety input is OFF, the monitor output is OFF.
Safety input 2 monitor output (Y5)	Safety input 2 (X2-T2, X3-T3)	
Safety input 3 monitor output (Y6)	Safety input 3 (X4-T4, X5-T5)	
Safety input 4 monitor output (Y7)	Safety input 4 (X6-T6, X7-T7)	
Safety input 5 monitor output (Y10)	Safety input 5 (X10-T10, X11-T11)	
Safety input 6 monitor output (Y11)	Safety input 6 (X12-T12, X13-T13)	

Note. When the targeted safety input detects an input monitor error, input circuit failure, or EMC the disturbance, corresponding safety input monitor output becomes a pulse output (1Hz). The monitor output is OFF in other errors, Initial state, or Configuration state.

● **Safety output monitor outputs: Y12 and Y13**

Safety output monitor outputs are used to output the status of safety outputs in SafetyOne.

Intended outputs (Terminal names)	Target safety outputs (Terminal names)	Description of operation
Safety output 1 monitor output (Y12)	Safety output 1 (Y0, Y1)	When the target safety output is ON, the monitor output is ON. When the target safety output is OFF, this function is OFF. The monitor output turns OFF immediately, independent of the preset OFF-delay time.
Safety output 2 monitor output (Y13)	Safety output 2 (Y2, Y3)	

Note. When the safety output detects an output circuit failure, the corresponding safety output monitor output becomes a pulse output (1Hz). The monitor output is OFF in other errors, Initial state, or Configuration state.

● **State monitor outputs: Y14 to Y16**

State monitor outputs are used to output the internal state of SafetyOne.

Intended outputs (Terminal names)	State				
	Initial	Run	Configuration	Protection	Stop
State monitor output 1 (Y14)	■ON	□OFF	□OFF	□OFF	■ON
State monitor output 2 (Y15)	■ON	□OFF	■ON	■ON	■ON or □OFF
State monitor output 3 (Y16)	□OFF	■ON	□OFF	□OFF	□OFF

Refer to “Chapter 4 BASIC OPERATIONS” and to “Chapter 6 TROUBLE SHOOTING” for details of each state.



The monitor outputs are not safety outputs. Do not use these to construct a safety system.

● **Solenoid outputs: Y17 and Y20**

Solenoid outputs are used to control a solenoid in an interlock switch.

Intended outputs (Terminal names)	Description of operation
Solenoid output 1 (Y17)	When safety output 1 is OFF, the solenoid output is ON. When safety Output 1 is ready to turn ON (safety output 1 can be turned ON by operation of the start input), the solenoid output is OFF.
Solenoid output 2 (Y20)	When safety output 2 is OFF, the solenoid output is ON. When safety Output 2 is ready to turn ON (safety output 2 can be turned ON by operation of the start input), the solenoid output is OFF.

 **Warning**

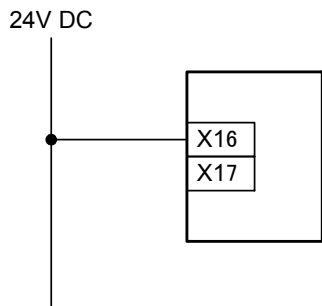
The solenoid outputs are not safety outputs. Do not use these to construct a safety system.

Note. The solenoid outputs are OFF in each state except Run state.

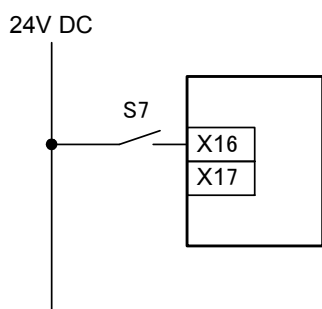
 **Caution**

Refer to "Chapter 2 PRODUCT SPECIFICATIONS" for specifications of each input and output.

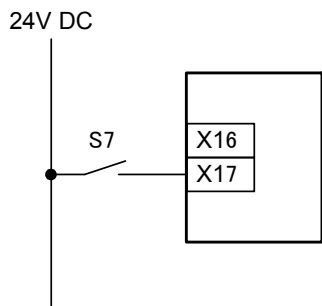
**When not using the start switch
(Auto start)**



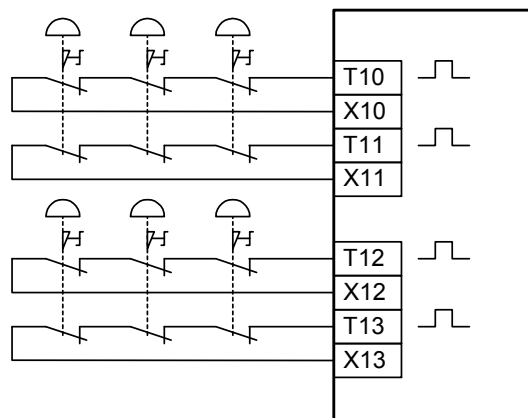
**When not detecting the welding of start switch
(Manual start)**



**When detecting the welding of start switch
(Control start)**



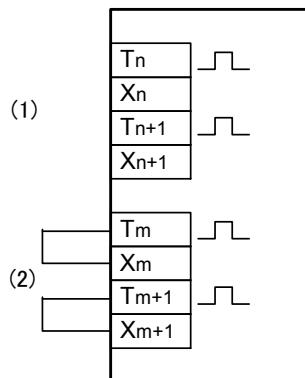
**When connecting multiple emergency stop switches
in series**



NOTE: Safety performance depends on the system configuration.

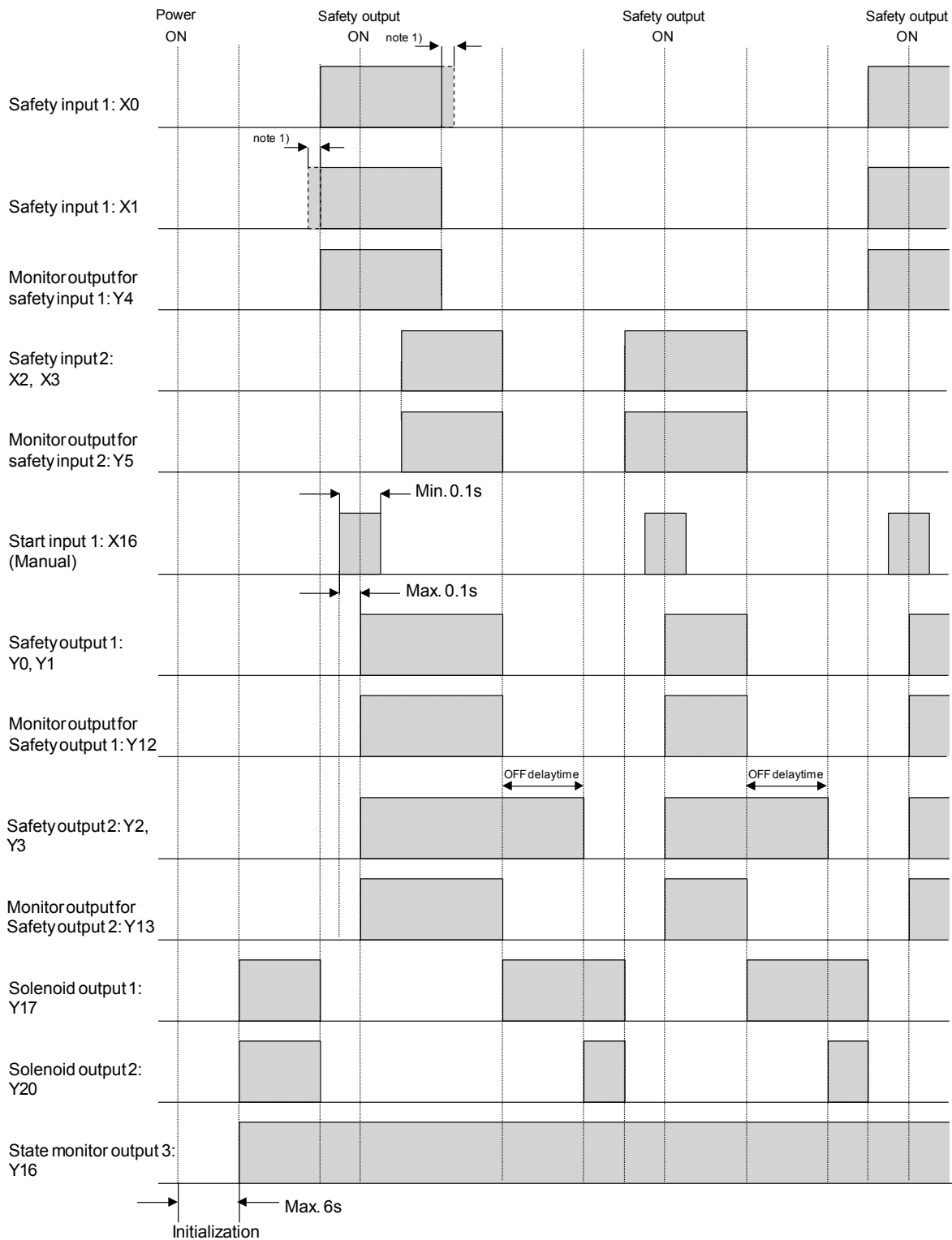
When not using some safety inputs

- In case of use only one of S1 or S2, open the unused safety input. This is same for safety S3 and S4. (Refer to (1))
- In case of unuse both of S1 and S2, connect the receive terminals to corresponding drive terminals. This is same for S3 and S4. (Refer to (2))
- If there are unused safety inputs in S5 and S6, connect the unused the receive terminals to the corresponding drive terminals. (Refer to (2))



Timing chart (Logic 12b)

Example: Manual start input (X16) is used.

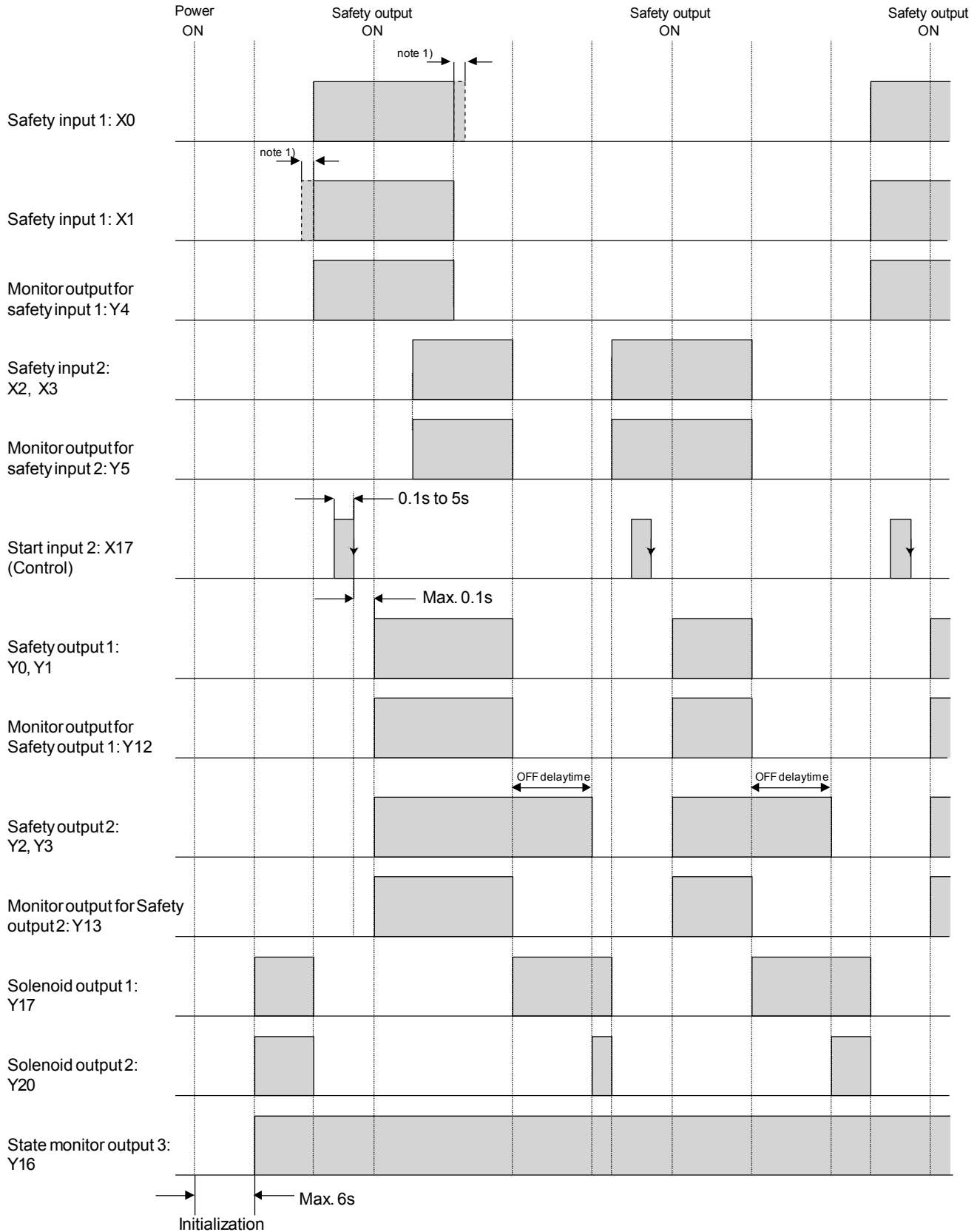


(Either safety input 3 or 4 is ON, and both safety input 5 and 6 are ON in this chart.)

note 1) Input monitor error detection time is 0.5s.

About safety inputs that are not described in this chart, input monitor error detection time is as follows.
 The time of dual channel direct opening input (X4, X5 and X10 to X13) is 0.5s.
 The time of dual channel independent input (X2, X3, X6 and X7) is infinity.
 Refer to the following "Logic functions" for more details.

Example: Control start input (X17) is used.



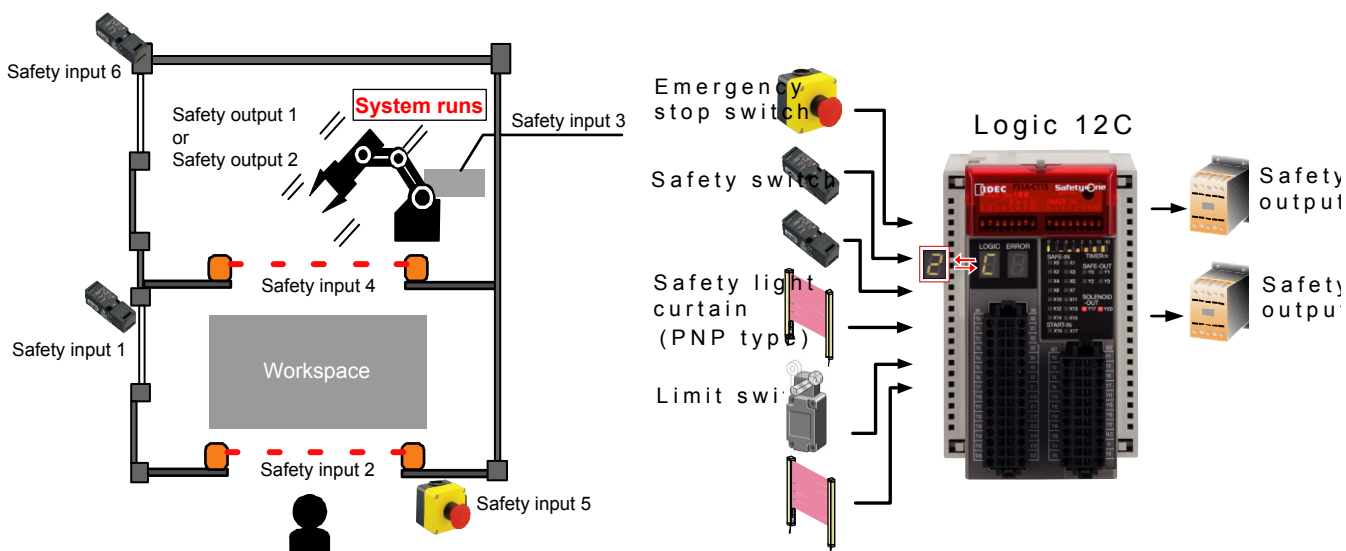
(Either safety input 3 or 4 is ON, and both safety input 5 and 6 are ON in this chart.)

Logic 12C: The logic constructing an OR circuit for apparatus with openings

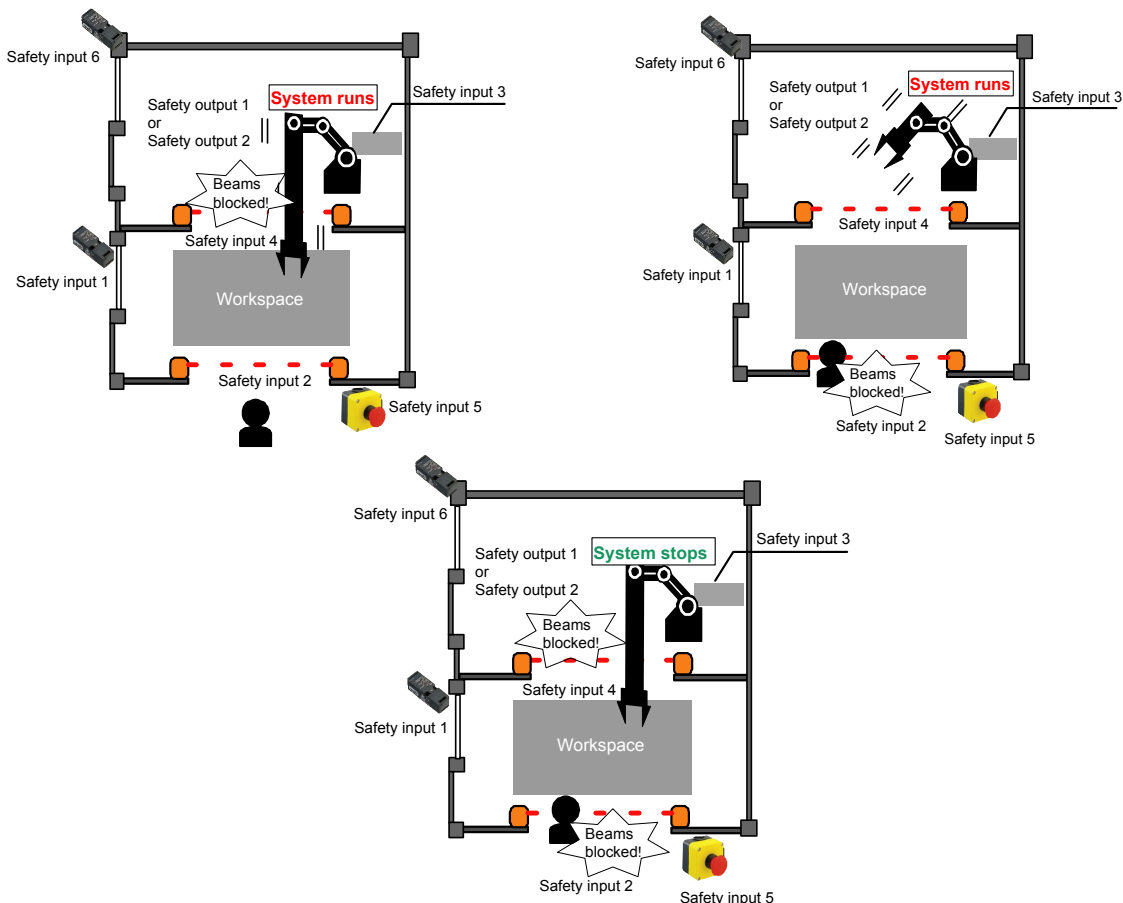
Overview (Logic 12C)

This logic is for constructing an OR circuit of safety devices with dual channel solid state outputs, such as safety light curtains, for safety protective measures of production machinery, robots. Safety outputs perform as dual channel outputs.

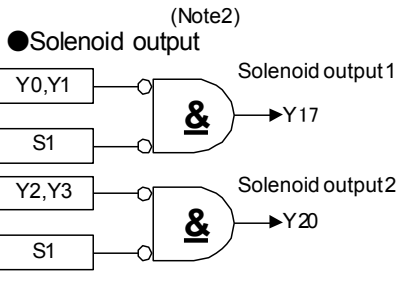
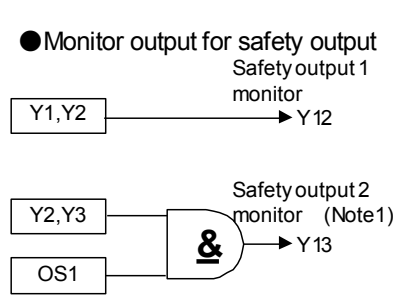
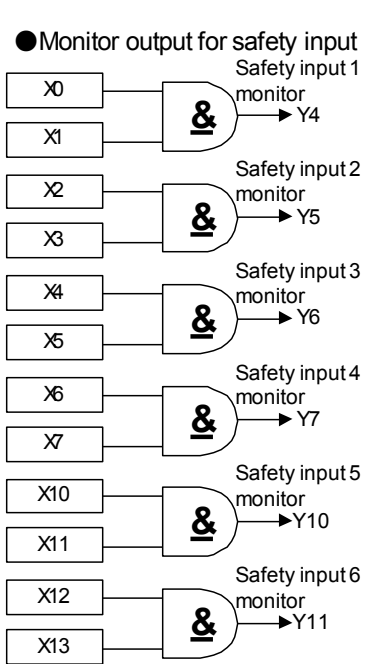
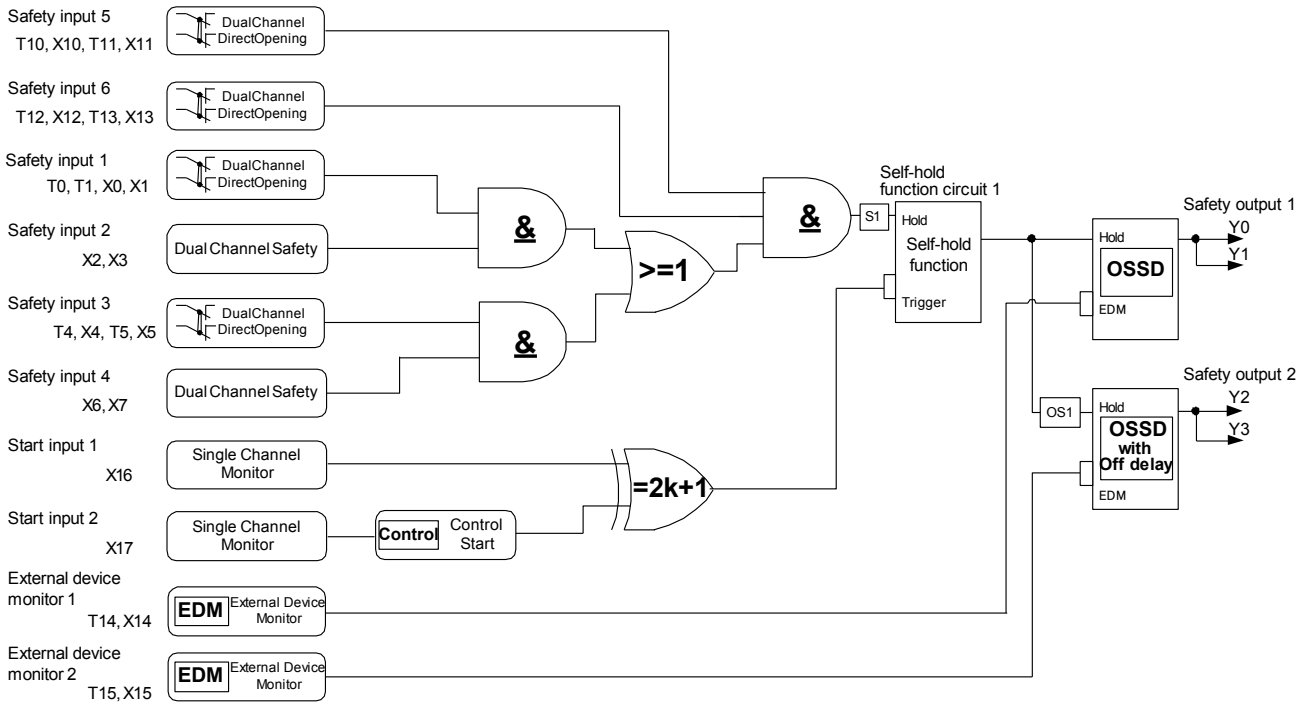
This logic enables the connection of 4 dual channel direct opening inputs, and 2 dual channel safety inputs.



Operation example (Logic 12C)



Logic circuit (logic 12C)



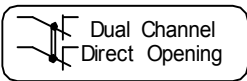
Note1:
Safety output 2 monitor turns OFF immediately independent of OFF-delay time.


Note2:
In Run state, when the safety outputs are OFF and one or more corresponding safety inputs are OFF, the solenoid outputs turn ON.
When all corresponding safety inputs are ON, the solenoid outputs turn OFF, even when the start input is OFF.

Functions (Logic 12C)

●**Safety inputs: X0 to X13 (T0, T1, T4, T5, and T10 to T13)**

Safety inputs are used to diagnose the status of connected safety devices, such as emergency stop switches.

Intended inputs (Terminal names)	Function	
Safety input 1 (X0-T0, X1-T1) Safety input 3 (X4-T4, X5-T5) Safety input 5 (X10-T10, X11-T11) Safety input 6 (X12-T12, X13-T13)	Function name	Dual channel direct opening input
	Symbol	
	Description of operation	This function diagnoses the status of connected safety devices. This function diagnoses the time interval of status transition between each input of duplicated inputs (0.5s).
	Detail information	Logic functions (5-311)

Intended inputs (Terminal names)	Function	
Safety input 2 (X2, X3) Safety input 4 (X6, X7)	Function name	Dual channel safety input
	Symbol	
	Description of operation	This function diagnoses the status of connected safety devices. This function diagnoses the time interval of status transition between each input of duplicated inputs (0.1s). The function does not use drive terminals (T2, T3, T6 and T7).
	Detail information	Logic functions (5-317)



For connected control devices, refer to “SAFETY PRECAUTIONS”.

Safety check signals (pulses signals) are sent from the drive terminals (T0, T1, T4, T5 and T10 to T13) to diagnose connected safety devices and input circuits. Safety check signals can not be used as a power supply for connected devices.

Note. Solid state outputs, such as safety light curtains, can not be connected to safety input 1, safety input 3, safety input 5, and safety input 6.

Note. Use safety input 1, safety input 3, safety input 5, and safety input 6 as specified combinations, such as receive terminal (Xn) and drive terminal (Tn). If the combinations are incorrect, SafetyOne does not work correctly.


Note. When SafetyOne is in Run state or Protection state, input states are monitored in all safety inputs. For example, if input monitor error is detected in safety input 2 or safety input 3 although safety input 1 and safety input 2 are in ON state, SafetyOne detects error and transits to Protection state.

Note. If using only safety input 1 of safety input 1 and safety input 2, connect the unused receive terminals (X2 and X3) to a 24V DC power supply (V+). If using only safety input 2, connect the unused receive terminals (X0 and X1) to the corresponded drive terminals (T0 and T1). If using only safety input 3 of safety input 3 and safety input 4, connect the unused receive terminals (X6 and X7) to a 24V DC power supply (V+). If using only safety input 4, connect the unused receive terminals (X4 and X5) to the corresponding drive terminals (T4 and T5). If they are not connected, the SafetyOne does not turn ON the safety outputs.

Note. When safety output 5 or safety output 6 is unused, connect the unused receive terminal (Xn) to the corresponding drive terminal (Tn). If they are not connected, the SafetyOne does not turn ON the safety outputs.

● **External device monitor inputs: X14 and X15 (T14 and T15)**

External device monitor inputs are used to diagnose the status of devices connected to safety outputs.

Intended inputs (Terminal names)	Target safety outputs (Terminal names)	Function	
External device monitor input 1 (X14-T14)	Safety output 1 (Y0, Y1)	Function name	External device monitor input
External device monitor input 2 (X15-T15)	Safety output 2 (Y2, Y3)	Symbol	
		Description of operation	This function diagnoses the status of devices connected to a target safety output.
		Detail information	Logic functions (5-326)



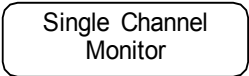
Warning

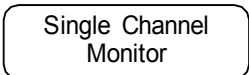

Safety check signals (pulses signals) are sent from the drive terminals (T14, T15) to diagnose external devices and monitor circuits. Safety check signals can not be used as a power supply for connected devices.

Note. If there are unused safety outputs, connect the intended external device monitor terminals (Xn) to the corresponding drive terminals (Tn). If they are not connected, the SafetyOne detects an input monitor error. As the result, the error LED displays a “1” and the unit changes to the Protection state.

● **Start inputs: X16 and X17**

Start inputs are used to control the start of safety outputs.

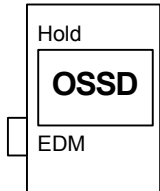
Intended inputs (Terminal names)	Target safety inputs (Terminal names)	Function	
		Start input 1 (X16)	Safety input 1 (X0-T0, X1-T1) Safety input 2 (X2, X3) Safety input 3 (X4-T4, X5-T5) Safety input 4 (X6, X7) Safety input 5 (X10-T10, X11-T11) Safety input 6 (X12-T12, X13-T13)
Symbol			
Description of operation	Safety outputs are started, when all target safety inputs are in the safe state and this function is in the ON state. This function is turned ON by 0.1s or more ON operation.		
Detail information	Logic functions (5-325)		

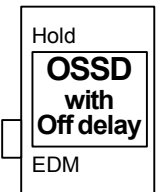
Intended inputs (Terminal names)	Target safety inputs (Terminal names)	Function	
		Start input 2 (X17)	Safety input 1 (X0-T0, X1-T1) Safety input 2 (X2, X3) Safety input 3 (X4-T4, X5-T5) Safety input 4 (X6, X7) Safety input 5 (X10-T10, X11-T11) Safety input 6 (X12-T12, X13-T13)
Symbol	 + 		
Description of operation	Safety outputs are started, when this function becomes ON after all intended safety inputs are in the safe state. This function is turned ON by 0.1s to 5s ON operation.		
Detail information	Logic functions (5-325, 330)		

Note. If both of X16 and X17 are turned ON, the SafetyOne will detect an error. As a result, the error LED displays “3” and the state changes to the Stop state. Use only X16 or X17.

● **Safety outputs: Y0 to Y3**

Safety outputs are used to output safety information processed by SafetyOne.

Intended outputs (Terminal names)	Function	
Safety output 1 (Y0, Y1)	Function name	Safety output without timer
	Symbol	
	Description of operation	This function is a safety output to output safety information processed by SafetyOne. The output is turned OFF immediately by OFF operation (instantaneous OFF output).
	Detail information	Logic functions (5-332)

Intended outputs (Terminal names)	Function	
Safety output 2 (Y2, Y3)	Function name	Safety output with timer
	Symbol	
	Description of operation	This function is a safety output to output safety information processed by SafetyOne. The output is turned OFF after the preset time of the OFF-delay timer (OFF-delay output).
	Detail information	Logic functions (5-335)

Note. When the SafetyOne changes to Protection state due to input monitor error, safety output without timer (safety output 1) is turned OFF. Safety output with timer (safety output 2) is turned OFF after the preset OFF-delay time.

Note. When the SafetyOne changes to Stop state due to circuit failure or other errors, all safety outputs (safety output 1 and safety output 2) are turned OFF, immediately.

•Safety input monitor outputs: Y4 to Y11

Safety input monitor outputs are used to output the status of safety inputs in SafetyOne.

Intended outputs (Terminal names)	Target safety inputs (Terminal names)	Description of operation
Safety input 1 monitor output (Y4)	Safety input 1 (X0-T0, X1-T1)	When the target safety input is ON, the monitor output is ON. When the target safety input is OFF, the monitor output is OFF.
Safety input 2 monitor output (Y5)	Safety input 2 (X2, X3)	
Safety input 3 monitor output (Y6)	Safety input 3 (X4-T4, X5-T5)	
Safety input 4 monitor output (Y7)	Safety input 4 (X6, X7)	
Safety input 5 monitor output (Y10)	Safety input 5 (X10-T10, X11-T11)	
Safety input 6 monitor output (Y11)	Safety input 6 (X12-T12, X13-T13)	

Note. When the targeted safety input detects an input monitor error, input circuit failure, or EMC the disturbance, corresponding safety input monitor output becomes a pulse output (1Hz). The monitor output is OFF in other errors, Initial state, or Configuration state.

•Safety output monitor outputs: Y12 and Y13

Safety output monitor outputs are used to output the status of safety outputs in SafetyOne.

Intended outputs (Terminal names)	Target safety outputs (Terminal names)	Description of operation
Safety output 1 monitor output (Y12)	Safety output 1 (Y0, Y1)	When the target safety output is ON, the monitor output is ON. When the target safety output is OFF, this function is OFF. The monitor output turns OFF immediately, independent of the preset OFF-delay time.
Safety output 2 monitor output (Y13)	Safety output 2 (Y2, Y3)	

Note. When the safety output detects an output circuit failure, the corresponding safety output monitor output becomes a pulse output (1Hz). The monitor output is OFF in other errors, Initial state, or Configuration state.

•State monitor outputs: Y14 to Y16

State monitor outputs are used to output the internal state of SafetyOne.

Intended outputs (Terminal names)	State				
	Initial	Run	Configuration	Protection	Stop
State monitor output 1 (Y14)	■ON	□OFF	□OFF	□OFF	■ON
State monitor output 2 (Y15)	■ON	□OFF	■ON	■ON	■ON or □OFF
State monitor output 3 (Y16)	□OFF	■ON	□OFF	□OFF	□OFF

Refer to “Chapter 4 BASIC OPERATIONS” and to “Chapter 6 TROUBLE SHOOTING” for details of each state.



The monitor outputs are not safety outputs. Do not use these to construct a safety system.

● **Solenoid outputs: Y17 and Y20**

Solenoid outputs are used to control a solenoid in an interlock switch.

Intended outputs (Terminal names)	Description of operation
Solenoid output 1 (Y17)	When safety output 1 is OFF, the solenoid output is ON. When safety Output 1 is ready to turn ON (safety output 1 can be turned ON by operation of the start input), the solenoid output is OFF.
Solenoid output 2 (Y20)	When safety output 2 is OFF, the solenoid output is ON. When safety Output 2 is ready to turn ON (safety output 2 can be turned ON by operation of the start input), the solenoid output is OFF.

 **Warning**

The solenoid outputs are not safety output. Do not use these to construct a safety system.

Note. The solenoid outputs are OFF in each state except Run state.

 **Caution**

Refer to "Chapter 2 PRODUCT SPECIFICATIONS" for specifications of each input and output.

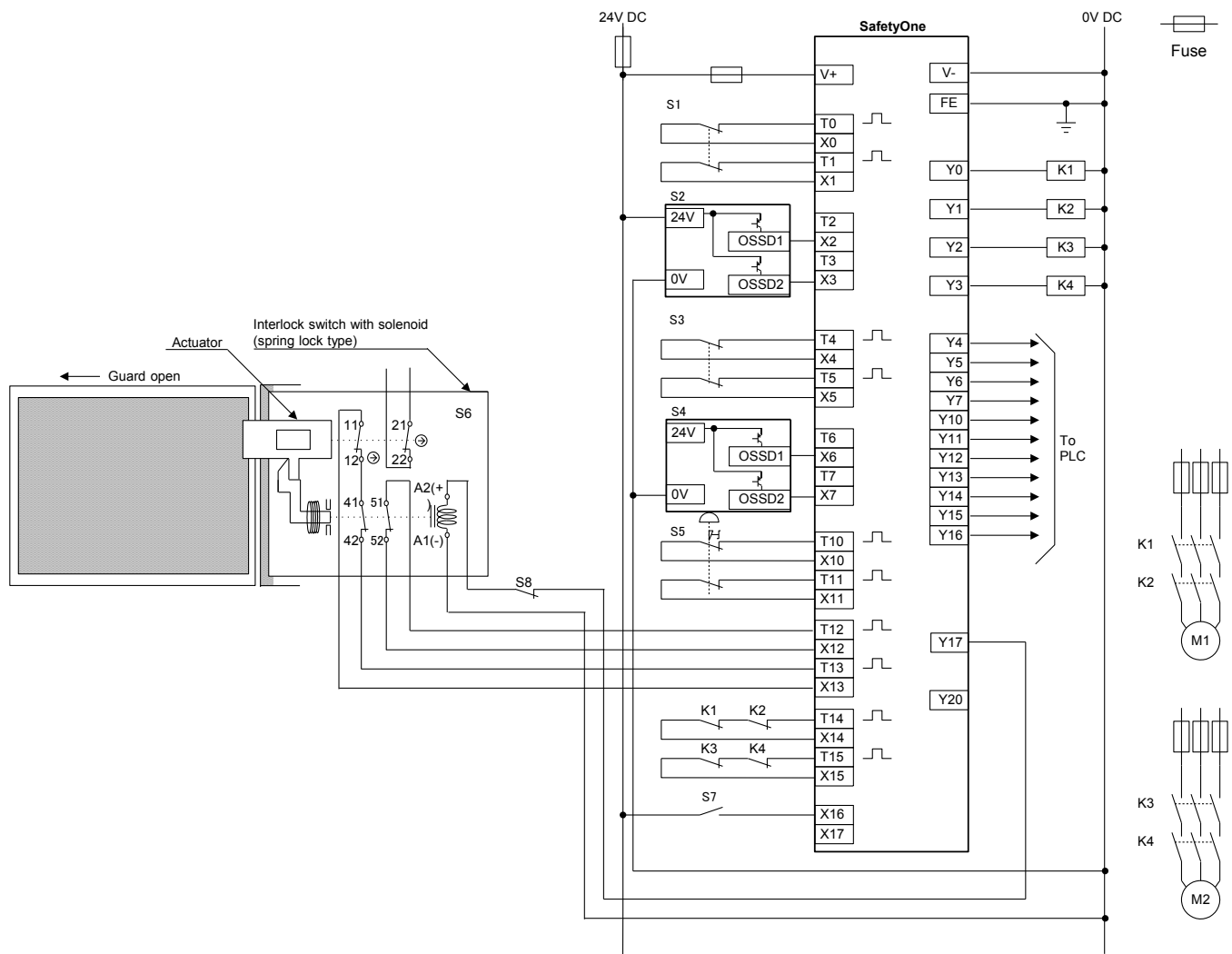
Wiring example (Logic 12C)

In the case where 1 limit switch, 2 safety light curtains, 1 interlock switch, 1 emergency stop switch, and 1 interlock switch with solenoid (spring lock type) are connected.

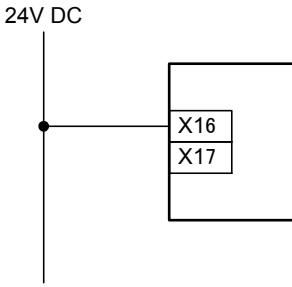
- S1 :Limit switch
- S2, 4 :Safety light curtain
- S3 :Interlock switch
- S5 :Emergency stop switch
- S6 :Interlock switch with solenoid (spring lock type)
- S7 :Start switch
- S8 :Solenoid control switch

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

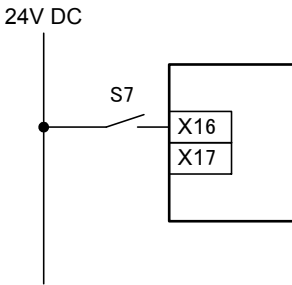
- K1 to 4 :Contactor
- M1, 2 :Motor



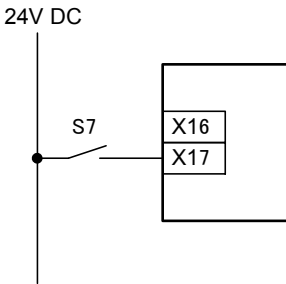
**When not using the start switch
(Auto start)**



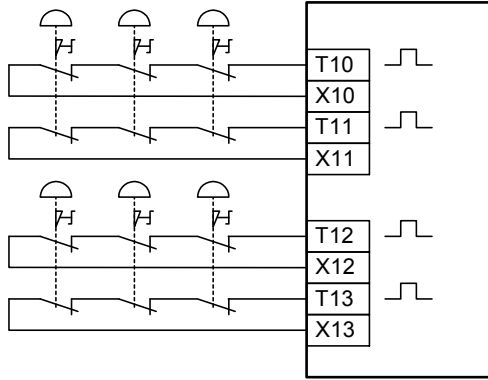
**When not detecting the welding of start switch
(Manual start)**



**When detecting the welding of start switch
(Control start)**



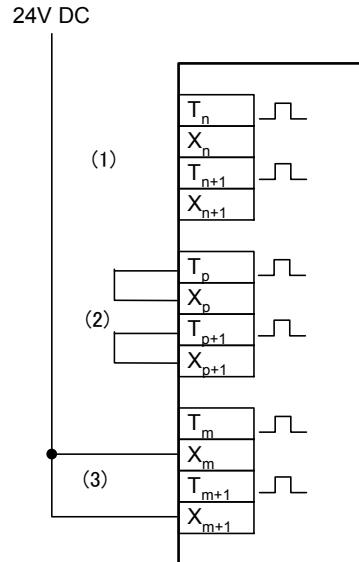
**When connecting multiple emergency stop switches
in series**



NOTE: Safety performance depends on the system configuration.

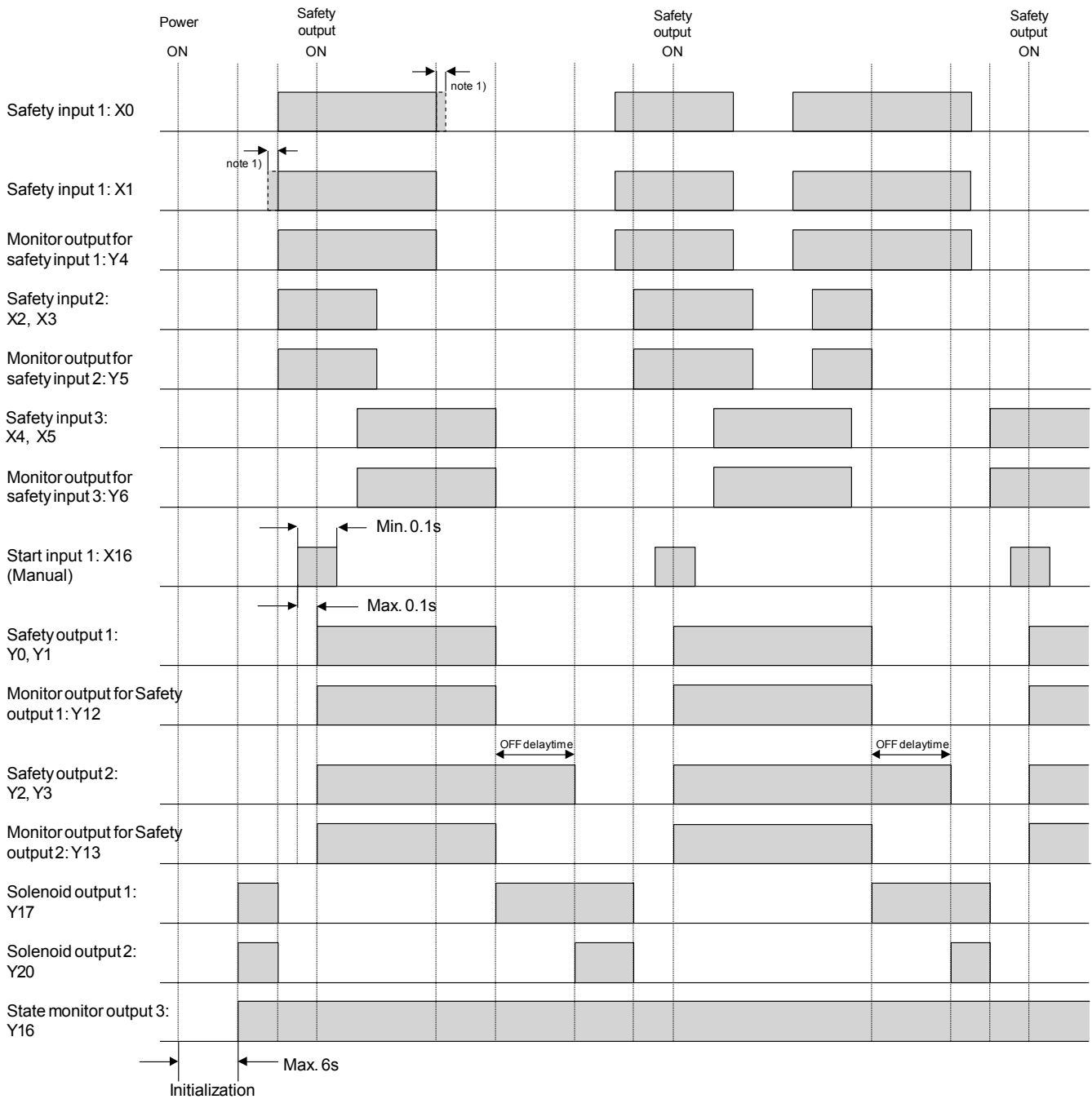
When not using some inputs

- If unused both of S1 and S2, open between the receive terminals and drive terminals. This is same for S3 and S4. (Refer to (1))
- If use only S1 of S1 and S2, connect the unused receive terminals to 24V DC power supply (V+). (Refer to (3))
- If use only S2 of S1 and S2, connect the unused receive terminals to corresponded drive terminals. (Refer to (2))
- If use only S3 of S3 and S4, connect the unused receive terminal to 24V DC power supply (V+). (Refer to (3))
- If use only S4 of S3 and S4, connect the unused receive terminals to corresponded drive terminals. (Refer to (2))
- If there are unused safety inputs in S5 and S6, connect the unused receive terminals to the corresponded drive terminals. (Refer to (2))



Timing chart (Logic 12C)

Example: Manual start input (X16) is used.



(Safety input 4, 5 and 6 are all ON in this chart.)

Note 1) Input monitor error detection time is 0.5s.

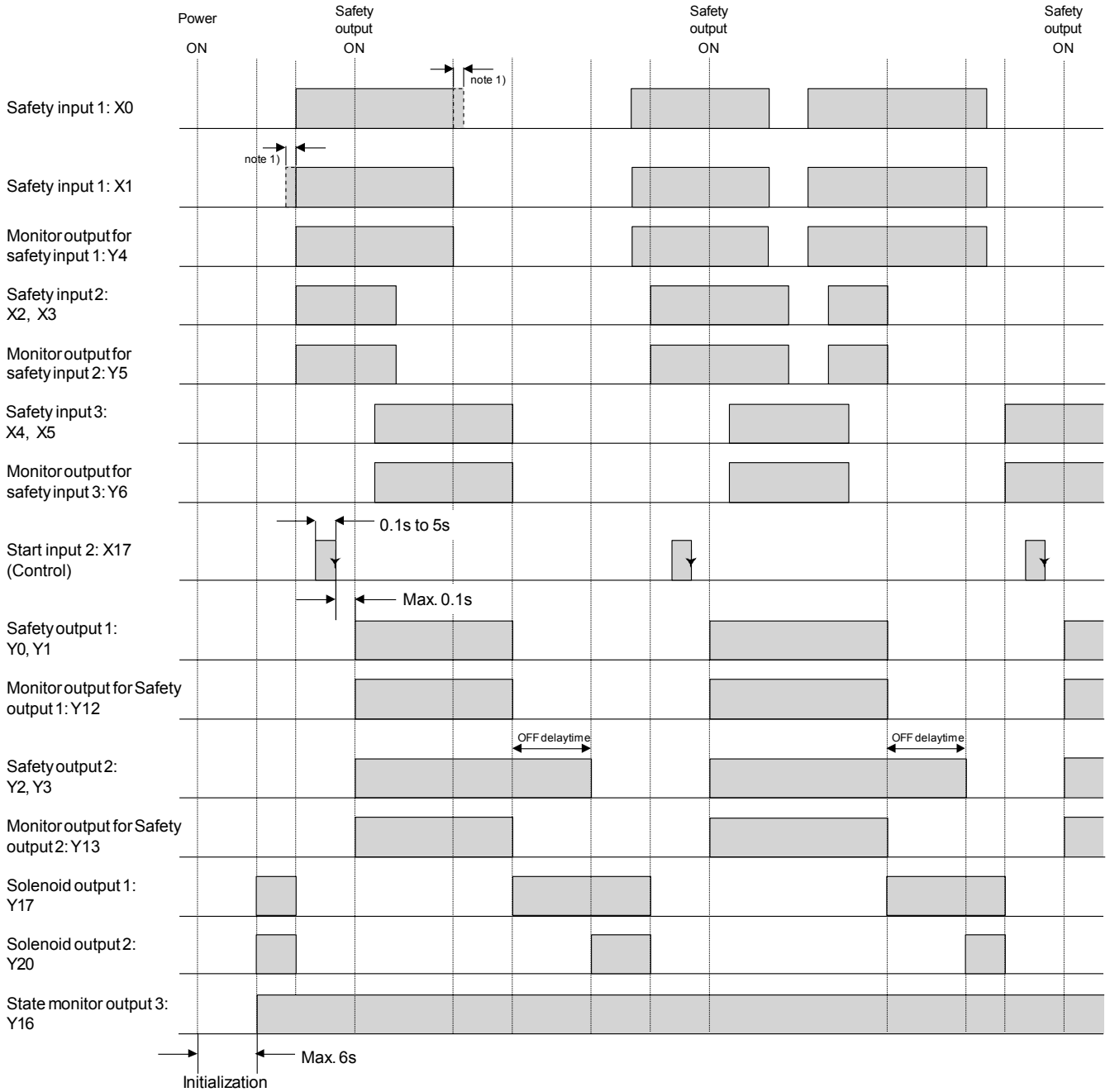
About safety inputs that are not described in this chart, input monitor error detection time is as follows.

The time of dual channel direct opening input (X4, X5 and X10 to X13) is 0.5s.

The time of dual channel safety input (X2, X3, X6 and X7) is 0.1s.

Refer to the following "Logic functions" for more details.

Example: Control start input (X17) is used.



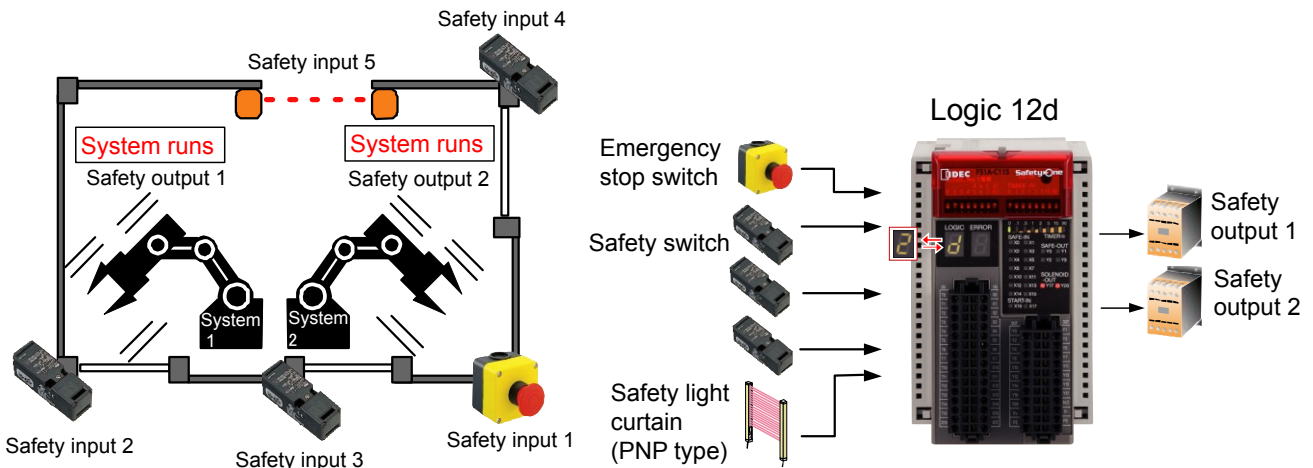
(Safety input 4, 5 and 6 are all ON in this chart.)

Logic 12d: Partial control logic for apparatus with openings

Overview (Logic 12d)

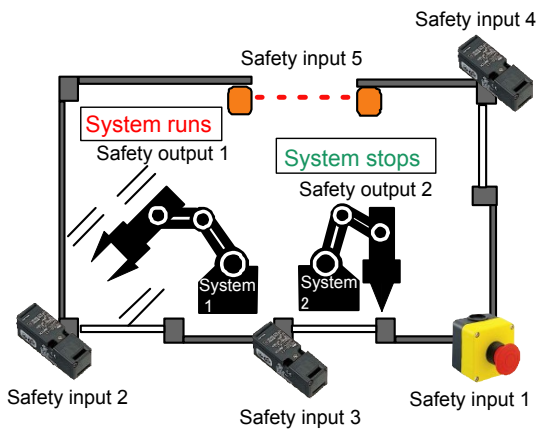
This logic is for constructing partial control of safety devices with dual channel solid state outputs, such as safety light curtains, for safety protective measures of production machinery, robots. Safety outputs perform as dual channel outputs.

This logic enables the connection of 1 dual channel direct opening inputs, and 1 dual channel safety inputs, 3 dual channel dependent inputs.

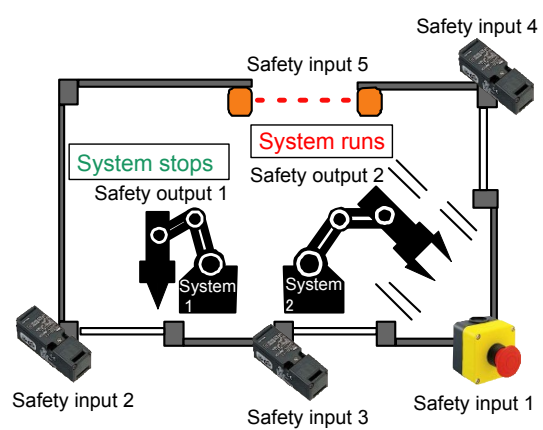


Operation example (Logic 12d)

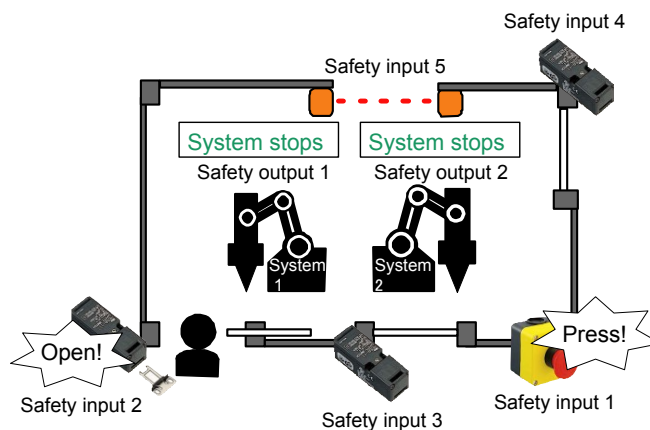
●Control input 1 is ON



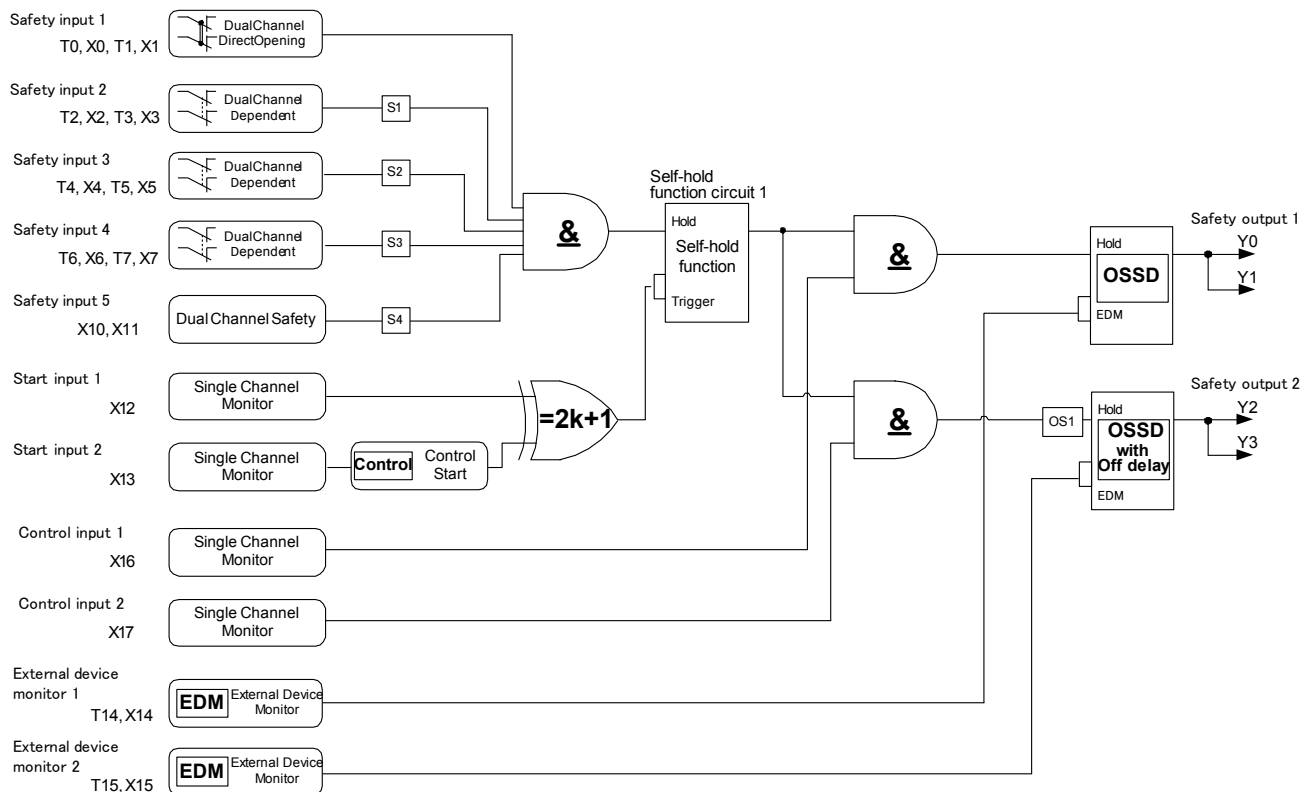
●Control input 2 is ON



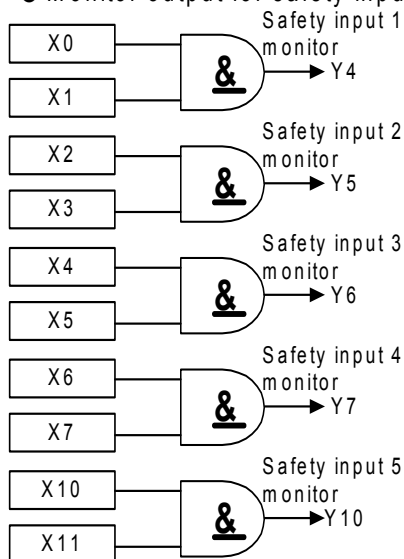
●Entire system stop



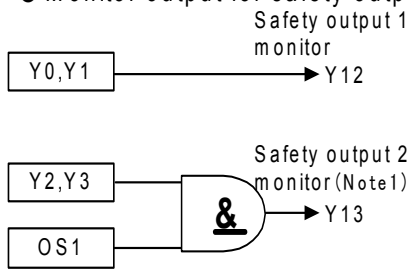
Logic circuit (logic 12d)



● Monitor output for safety input

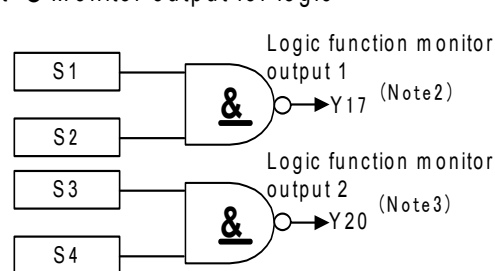


● Monitor output for safety output



Note 1:
Safety output 2 monitor turns OFF immediately independent of OFF-delay time.

● Monitor output for logic



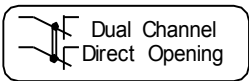
Note 2:
When both safety input 2 and 3 are ON, Logic function monitor output 1 turns OFF. When either safety input 2 or 3 is OFF, Logic function monitor output 1 turns ON.

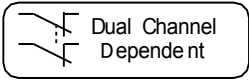
Note 3:
When both safety input 4 and 5 are ON, Logic function monitor output 2 turns OFF. When either safety input 4 or 5 is OFF, Logic function monitor output 2 turns ON.


Functions (Logic 12d)

●**Safety inputs: X0 to X11 (T0 to T7)**

Safety inputs are used to diagnose the status of connected safety devices, such as emergency stop switches, and interlock switches.

Intended inputs (Terminal names)	Function	
Safety input 1 (X0-T0, X1-T1)	Function name	Dual channel direct opening input
	Symbol	 Dual Channel Direct Opening
	Description of operation	This function diagnoses the status of connected safety devices. This function diagnoses the time interval of status transition between each input of duplicated inputs (0.5s).
	Detail information	Logic functions (5-311)

Intended inputs (Terminal names)	Function	
Safety input 2 (X2-T2, X3-T3) Safety input 3 (X4-T4, X5-T5) Safety input 4 (X6-T6, X7-T7)	Function name	Dual channel dependent input
	Symbol	 Dual Channel Dependent
	Description of operation	This function diagnoses the status of connected safety devices. This function does not diagnose the time interval of status transition between each input of duplicated inputs.
	Detail information	Logic functions (5-313)

Intended inputs (Terminal names)	Function	
Safety input 5 (X10, X11)	Function name	Dual channel safety input
	Symbol	 Dual Channel Safety
	Description of operation	This function diagnoses the status of connected safety devices. This function diagnoses the time interval of status transition between each input of duplicated inputs (0.1s). The function does not use drive terminals (T10, T11).
	Detail information	Logic functions (5-317)



For connected control devices, refer to “SAFETY PRECAUTIONS”.

Safety check signals (pulses signals) are sent from the drive terminals (T0 to T7) to diagnose connected safety devices and input circuits. Safety check signals can not be used as a power supply for connected devices.

Note. Solid state outputs, such as safety light curtains, can not be connected to safety input 1 through safety input 4.


Note. Use safety input 1 through safety input 4 as specified combinations, such as receive terminal (Xn) and drive terminal (Tn). If the combinations are incorrect, SafetyOne does not work correctly.

Note. If there are unused safety inputs in safety input 1 through safety input 4, connect the unused receive terminals (Xn) to the corresponding drive terminals (Tn). If they are not connected, the SafetyOne does not turn ON the safety outputs.

Note. If safety input 5 is not used, connect the receive terminal (X10 and X11) to a 24V DC power supply (V+). If they are not connected, the SafetyOne does not turn ON the safety outputs.

●External device monitor inputs: X14 and X15 (T14 and T15)

External device monitor inputs are used to diagnose the status of devices connected to safety outputs.

Intended inputs (Terminal names)	Target safety outputs (Terminal names)	Function	
External device monitor input 1 (X14-T14)	Safety output 1 (Y0, Y1)	Function name	External device monitor input
External device monitor input 2 (X15-T15)	Safety output 2 (Y2, Y3)	Symbol	
		Description of operation	This function diagnoses the status of devices connected to a target safety output.
		Detail information	Logic functions (5-326)

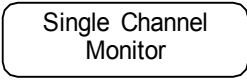




Safety check signals (pulses signals) are sent from the drive terminals (T14, T15) to diagnose external devices and monitor circuits. Safety check signals can not be used as a power supply for connected devices.

Note. If there are unused safety outputs, connect the intended external device monitor terminals (Xn) to the corresponding drive terminals (Tn). If they are not connected, the SafetyOne detects an input monitor error. As the result, the error LED displays a “1” and the unit changes to the Protection state.

●**Start inputs: X12 and X13**

Start inputs are used to control the start of safety outputs.


Intended inputs (Terminal names)	Target safety inputs (Terminal names)	Function	
		Start input 1 (X12)	Safety input 1 (X0-T0, X1-T1) Safety input 2 (X2-T2, X3-T3) Safety input 3 (X4-T4, X5-T5) Safety input 4 (X6-T6, X7-T7) Safety input 5 (X10, X11)
		Symbol	
		Description of operation	Safety outputs are started, when all target safety inputs are in the safe state and this function is in the ON state. This function is turned ON by 0.1s or more ON operation.
		Detail information	Logic functions (5-325)

Intended inputs (Terminal names)	Target safety inputs (Terminal names)	Function	
		Start input 2 (X13)	Safety input 1 (X0-T0, X1-T1) Safety input 2 (X2-T2, X3-T3) Safety input 3 (X4-T4, X5-T5) Safety input 4 (X6-T6, X7-T7) Safety input 5 (X10, X11)
		Symbol	 + 
		Description of operation	Safety outputs are started, when this function becomes ON after all intended safety inputs are in the safe state. This function is turned ON by 0.1s to 5s ON operation.
		Detail information	Logic functions (5-325, 320)

Note. If both of X12 and X13 are turned ON, the SafetyOne will detect an error. As a result, the error LED displays “3” and the state changes to the Stop state. Use only X12 or X13.

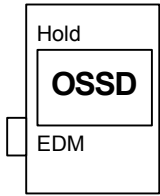
●**Control inputs: X16 and X17**

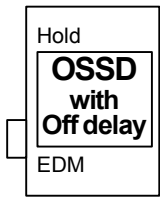
Control inputs are used to control of safety outputs.

Intended inputs (Terminal names)	Target safety outputs (Terminal names)	Function	
		Control input 1 (X16)	Safety output 1 (Y0, Y1)
		Symbol	
Control input 2 (X17)	Safety output 2 (Y2, Y3)	Description of operation	Target safety outputs are controlled by these control inputs.
		Detail information	Logic functions (5-325)

● **Safety outputs: Y0 to Y3**

Safety outputs are used to output safety information processed by SafetyOne.

Intended outputs (Terminal names)	Function	
Safety output 1 (Y0, Y1)	Function name	Safety output without timer
	Symbol	
	Description of operation	This function is a safety output to output safety information processed by SafetyOne. The output is turned OFF immediately by OFF operation (instantaneous OFF output).
	Detail information	Logic functions (5-332)

Intended outputs (Terminal names)	Function	
Safety output 2 (Y2, Y3)	Function name	Safety output with timer
	Symbol	
	Description of operation	This function is a safety output to output safety information processed by SafetyOne. The output is turned OFF after the preset time of the OFF-delay timer (OFF-delay output).
	Detail information	Logic functions (5-335)

Note. When the SafetyOne changes to Protection state due to input monitor error, safety output without timer (safety output 1) is turned OFF. Safety output with timer (safety output 2) is turned OFF after the preset OFF-delay time.

Note. When the SafetyOne changes to Stop state due to circuit failure or other errors, all safety outputs (safety output 1 and safety output 2) are turned OFF, immediately.

•Safety input monitor outputs: Y4 to Y10

Safety input monitor outputs are used to output status of safety inputs in SafetyOne.

Intended outputs (Terminal names)	Target safety inputs (Terminal names)	Description of operation
Safety input 1 monitor output (Y4)	Safety input 1 (X0-T0, X1-T1)	When the target safety input is ON, the monitor output is ON. When the target safety input is OFF, the monitor output is OFF.
Safety input 2 monitor output (Y5)	Safety input 2 (X2-T2, X3-T3)	
Safety input 3 monitor output (Y6)	Safety input 3 (X4-T4, X5-T5)	
Safety input 4 monitor output (Y7)	Safety input 4 (X6-T6, X7-T7)	
Safety input 5 monitor output (Y10)	Safety input 5 (X10, X11)	

Note. When the targeted safety input detects an input monitor error, input circuit failure, or EMC the disturbance, corresponding safety input monitor output becomes a pulse output (1Hz). The monitor output is OFF in other errors, Initial state, or Configuration state.

•Logic function monitor outputs: Y17 and Y20

Logic function monitor outputs are used to monitor the state of internal logic function.

Intended outputs (Terminal names)	Description of operation
Logic function monitor output 1 (Y17)	When both safety input 2 and 3 are ON, the monitor output is OFF. When either safety input 2 or 3 is OFF, the monitor output is ON.
Logic function monitor output 2 (Y20)	When both safety input 4 and 5 are ON, the monitor output is OFF. When either safety input 4 or 5 is OFF, the monitor output is ON.

Note. The Logic function monitor output is OFF in errors, Initial state, or Configuration state.

•Safety output monitor outputs: Y12 and Y13

Safety output monitor outputs are used to output the status of safety outputs in SafetyOne.

Intended outputs (Terminal names)	Target safety outputs (Terminal names)	Description of operation
Safety output 1 monitor output (Y12)	Safety output 1 (Y0, Y1)	When the target safety output is ON, the monitor output is ON. When the target safety output is OFF, this function is OFF. The monitor output turns OFF immediately independent on set OFF-delay time.
Safety output 2 monitor output (Y13)	Safety output 2 (Y2, Y3)	

Note. When the safety output detects an output circuit failure, the corresponding safety output monitor output becomes a pulse output (1Hz). The monitor output is OFF in other errors, Initial state, or Configuration state.



The monitor outputs are not safety outputs. Do not use these to construct a safety system.

● **State monitor outputs: Y14 to Y16**

State monitor outputs are used to output the internal state of SafetyOne.

Intended outputs (Terminal names)	State				
	Initial	Run	Configuration	Protection	Stop
State monitor output 1 (Y14)	■ON	□OFF	□OFF	□OFF	■ON
State monitor output 2 (Y15)	■ON	□OFF	■ON	■ON	■ON or □OFF
State monitor output 3 (Y16)	□OFF	■ON	□OFF	□OFF	□OFF

Refer to "Chapter 4 BASIC OPERATIONS" and to "Chapter 6 TROUBLE SHOOTING" for details of each state.



Warning

The monitor outputs are not safety outputs. Do not use these to construct a safety system.



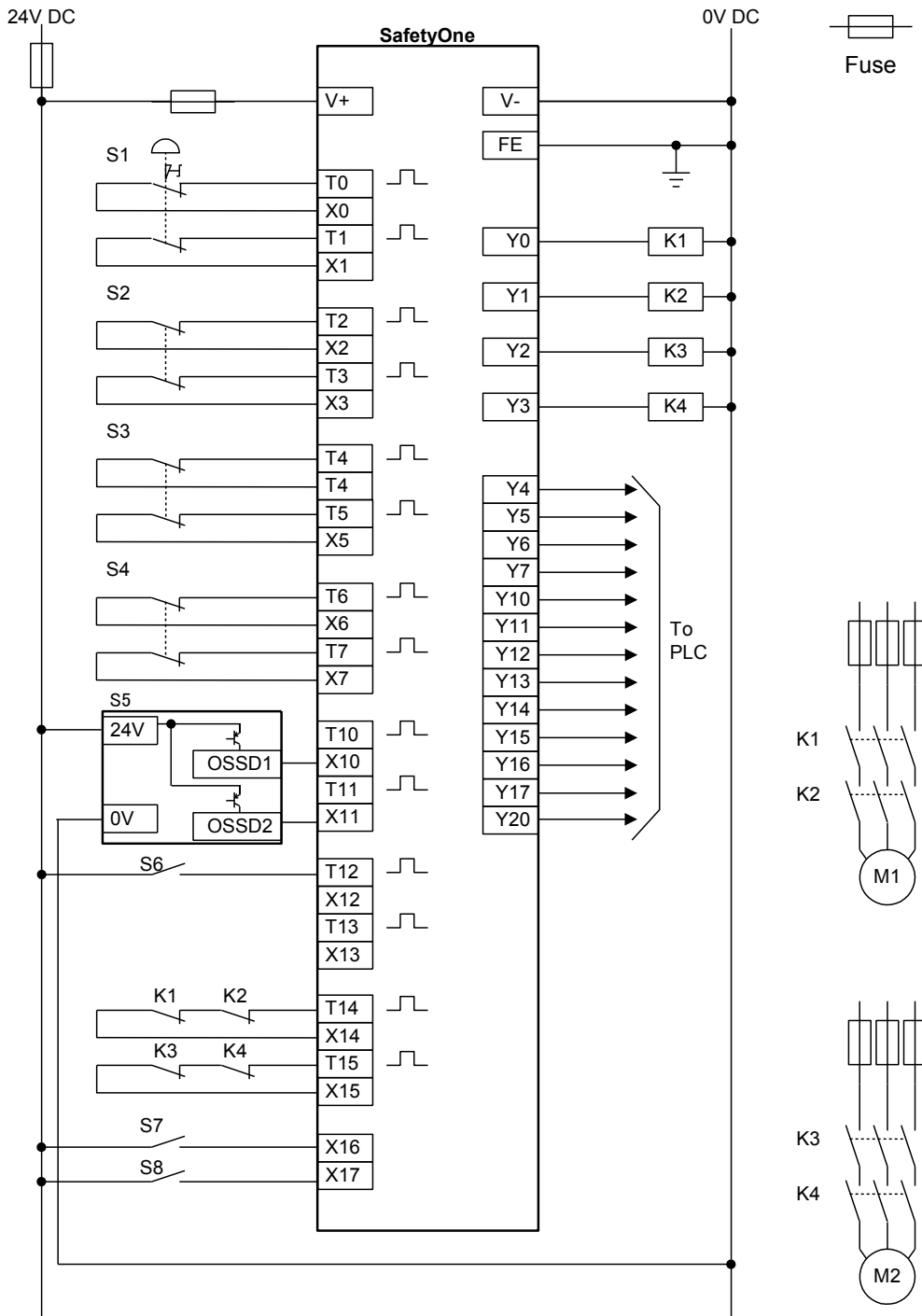
Caution

Refer to "Chapter 2 PRODUCT SPECIFICATIONS" for specifications of each input and output.

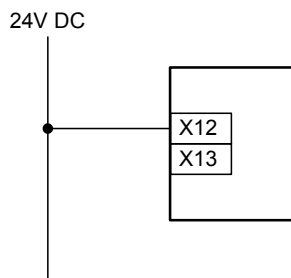
Wiring example (Logic 12d)

In the case where 1 emergency stop switch, 3 interlock switches, and 1 safety light curtain are connected.

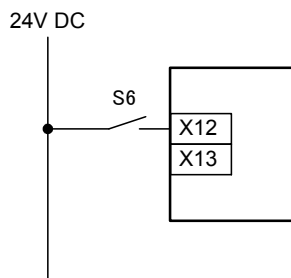
- S1 :Emergency stop switch
- S2, 3, 4 :Interlock switch
- S5 :Safety light curtain
- S6 :Start switch
- S7, 8 :Control input switch
- K1 to 4 :Contactor
- M1, 2 :Motor



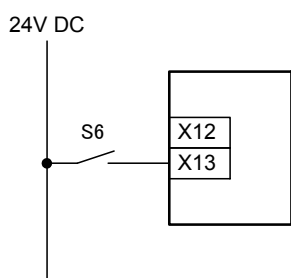
**When not using the start switch
(Auto start)**



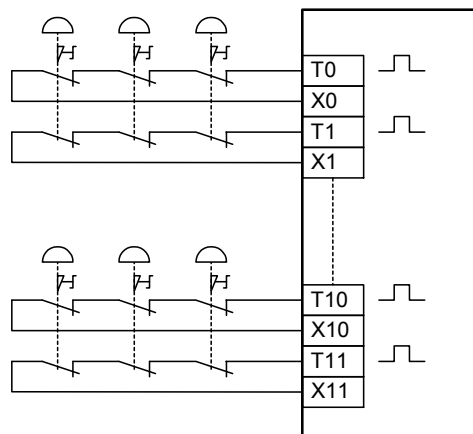
**When not detecting the welding of start switch
(Manual start)**



**When detecting the welding of start switch
(Control start)**



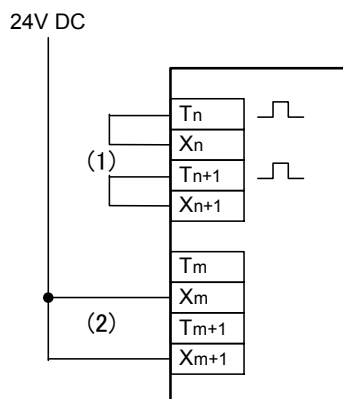
**When connecting multiple emergency stop switches
in series**



NOTE: Safety performance depends on the system configuration.

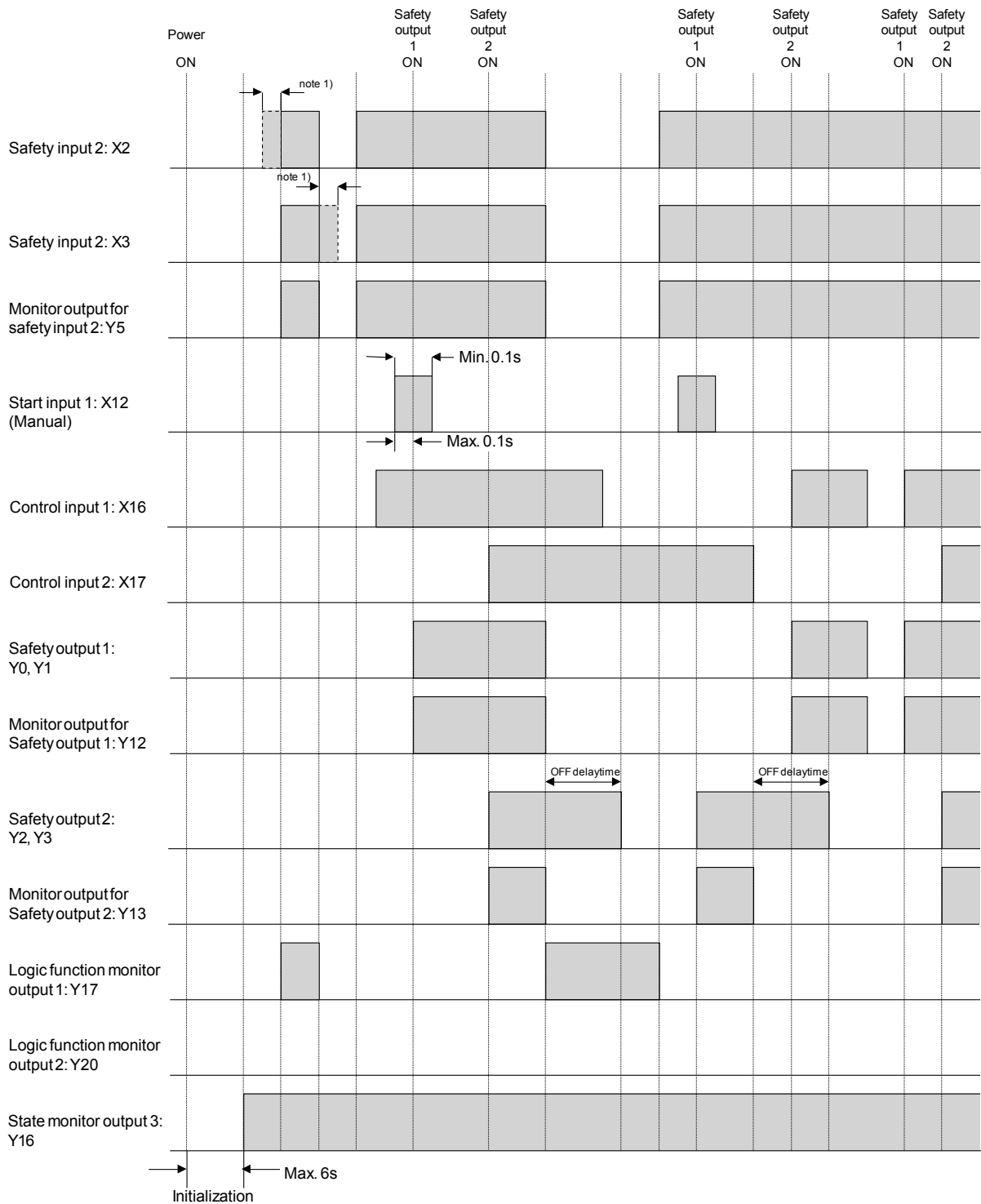
When not using some inputs

- If there are unused safety inputs in S1 to S4, connect the unused receive terminals to the corresponding drive terminals. (Refer to (1))
- If S5 is not used, connect the receive terminal to 24V DC power supply (V+). (Refer to (2))



Timing chart (Logic 12d)

Example: Manual start input (X12) is used.

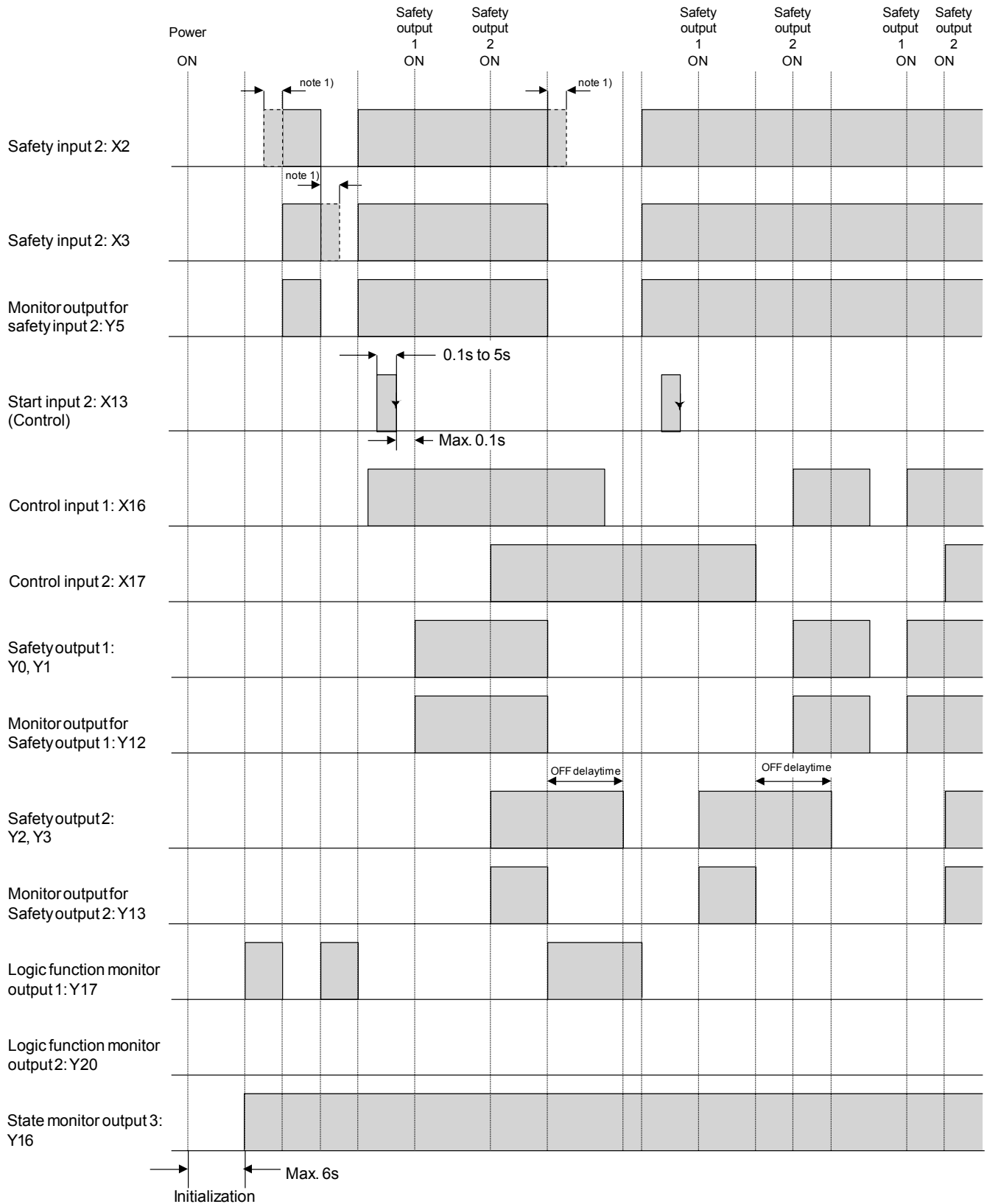


(Safety input 1, 3, 4 and 5 are all ON in this chart.)

Note 1) Input monitor error detection time is infinity.

About safety inputs that are not described in this chart, input monitor error detection time is as follows.
 The time of dual channel direct opening input (X0, X1) is 0,5s.
 The time of dual channel dependent input (X4 to X7) is infinity.
 The time of dual channel safety input (X10, X11) is 0,1s.
 Refer to the following "Logic functions" for more details.

Example: Control start input (X13) is used.



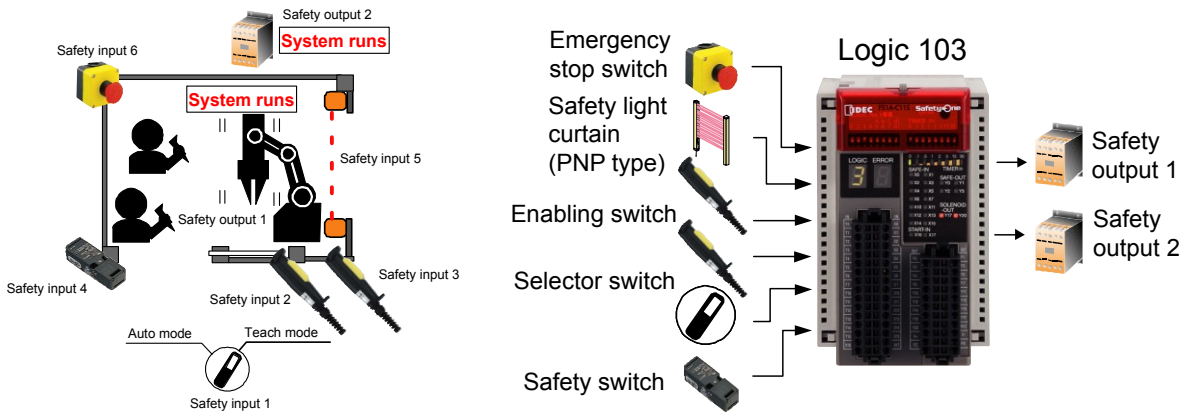
(Safety input 1, 3, 4 and 5 are all ON in this chart.)

Logic 103: Partial stop logic applicable for selection of active safety input devices

Overview (Logic 103)

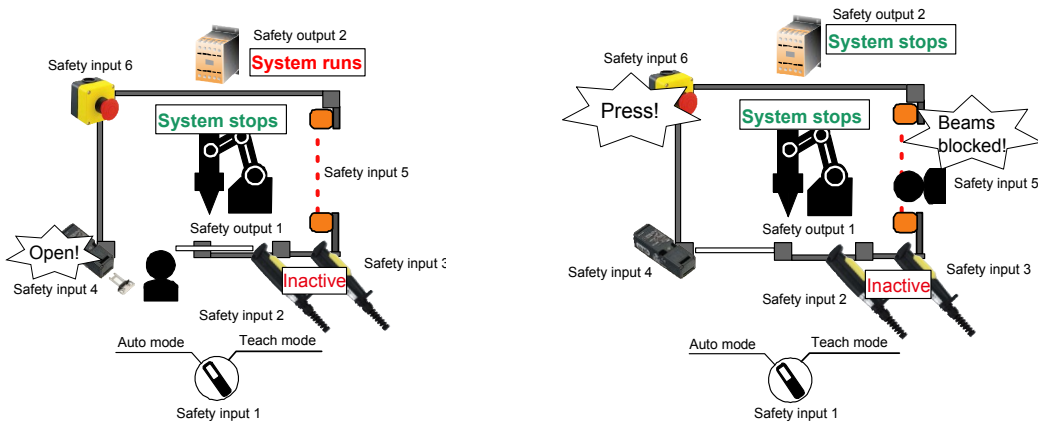
For production machines, robots, and the like, a hazard is generally isolated by a protective door (guard); however, when performing teaching or maintenance, the machine is operated in the condition that a person is in the danger zone. For such a situation, this logic described is applicable to the mode selection between Teach mode (maintenance mode) and Auto mode (operating mode). Safety outputs perform as dual channel outputs.

This logic enables the connection of 1 dual channel direct opening input, 1 mode select input, 3 dual channel dependent inputs, and 1 dual channel safety input.

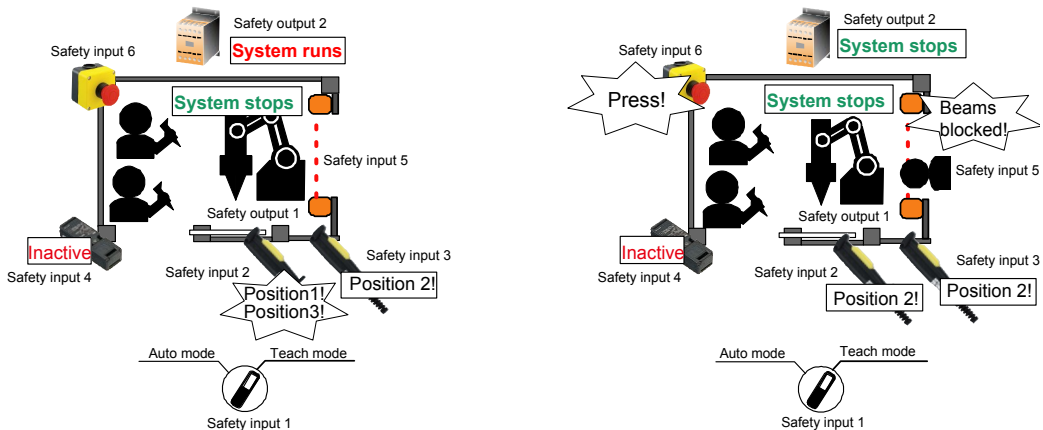


Operation example (Logic 103)

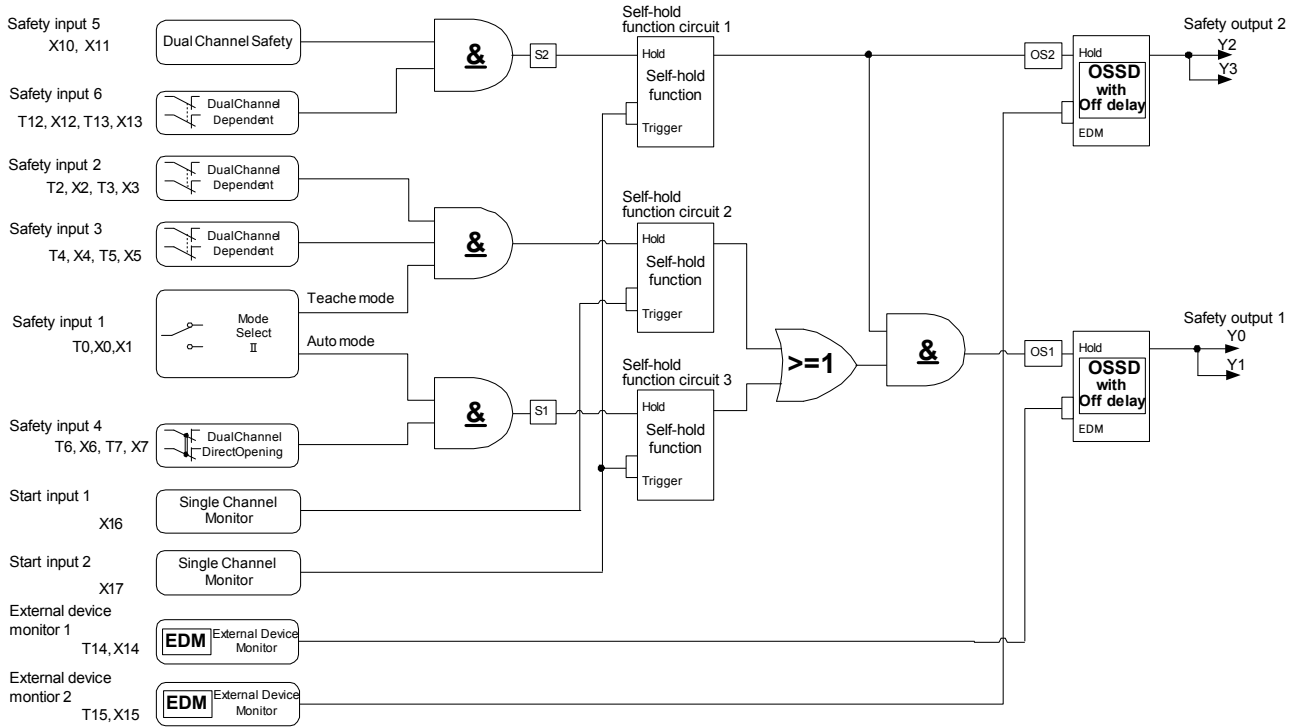
•Auto mode



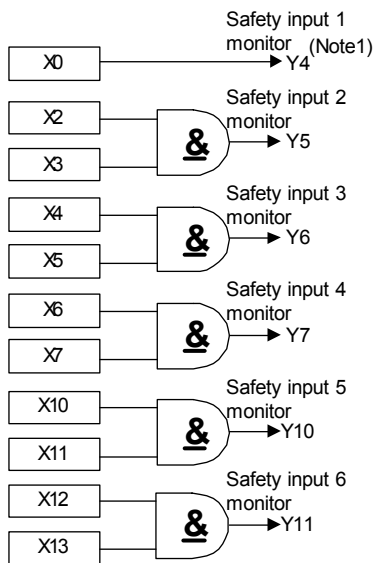
•Teach mode



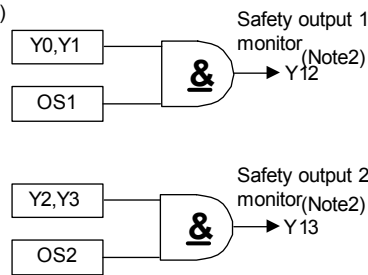
Logic circuit (Logic 103)



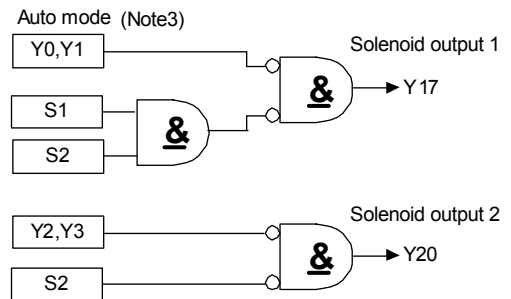
- Monitor output for safety input
- Monitor output for safety output
- Solenoid output



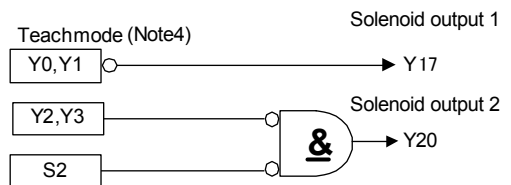
Note1:
When safety input 1 is set to Auto mode, the monitor for safety input 1 turns OFF.



Note2:
Safety output 1 monitor and safety output 2 monitor turn OFF immediately independent of OFF-delay time.



Note3:
Auto mode:
In Run state, when the safety outputs are OFF and one or more corresponding safety inputs are OFF, the solenoid outputs turn ON.
When all corresponding safety inputs are ON, the solenoid outputs turn OFF even when the start input is OFF.

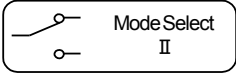


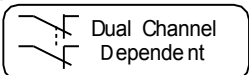
Note4:
Teach mode:
In Run state, when the safety outputs are OFF, the solenoid output 1 turns ON.

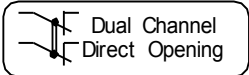
Functions (Logic 103)

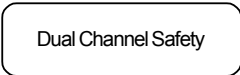
•Safety inputs: X0 to X13 (T0, T2 to T7, T12, T13)

Safety inputs are used to diagnose the status of connected safety devices, such as emergency stop switches, interlock switches, and mode select switches.

Intended inputs (Terminal names)	Function	
Safety input 1 (X0/X1-T0)	Function name	Mode select input II
	Symbol	
	Description of operation	This function is for connecting devices with a mode selector function, such as mode selector switch. When the switching of inputs is performed within 3s, this function output is kept at previous state. This function diagnoses time interval of status transition between each input (0.5s).
	Detail information	Logic functions (5-321)

Intended inputs (Terminal names)	Function	
Safety input 2 (X2-T2, X3-T3) Safety input 3 (X4-T4, X5-T5) Safety input 6 (X12-T12, X13-T13)	Function name	Dual channel dependent input
	Symbol	
	Description of operation	This function diagnoses the status of connected safety devices. This function does not diagnose the time interval of status transition between each input of duplicated inputs.
	Detail information	Logic functions (5-313)

Intended inputs (Terminal names)	Function	
Safety input 4 (X6-T6, X7-T7)	Function name	Dual channel direct opening input
	Symbol	
	Description of operation	This function diagnoses the status of connected safety devices. This function diagnoses the time interval of status transition between each input of duplicated inputs (0.5s).
	Detail information	Logic functions (5-311)

Intended inputs (Terminal names)	Function	
Safety input 5 (X10, X11)	Function name	Dual channel safety input
	Symbol	
	Description of operation	This function diagnoses the status of connected safety devices. This function diagnoses the time interval of status transition between each input of duplicated inputs (0.1s). The function does not use drive terminals (T10, T11).
	Detail information	Logic functions (5-317)


Warning

For connected control devices, refer to “SAFETY PRECAUTIONS”.

Safety check signals (pulses signals) are sent from the drive terminals (T0, T2 to T7, T12, T13) to diagnose connected safety devices and input circuits. Safety check signals can not be used as a power supply for connected devices.

Note. Solid state outputs, such as safety light curtains, can not be connected to safety input 1 through safety input 4, and safety input 6.

Note. Use safety input 1 through safety input 4, and safety input 6 as specified combinations, such as receive terminal (Xn) and drive terminal (Tn). If the combinations are incorrect, SafetyOne does not work correctly.


Note. When SafetyOne is in Run state or Protection state, input states are monitored in all safety inputs. For example, if input monitor error is detected in safety input 2 or safety input 3 although AUTO mode is selected, SafetyOne detects error and transits to Protection state.

Note. If there are unused safety inputs in safety input 2 through safety input 4 and safety input 6, connect the unused receive terminals (Xn) to the corresponding drive terminals (Tn). If they are not connected, the SafetyOne does not turn ON the safety outputs.

Note. If safety input 5 is not used, connect the receive terminals (X10 and X11) to a 24V DC power supply (V+). If they are not connected, the SafetyOne does not turn ON the safety outputs.

●External device monitor inputs: X14 and X15 (T14 and T15)

External device monitor inputs are used to diagnose status of the devices connected to safety outputs.

Intended inputs (Terminal names)	Target safety outputs (Terminal names)	Function	
External device monitor input 1 (X14-T14)	Safety output 1 (Y0, Y1)	Function name	External device monitor input
External device monitor input 2 (X15-T15)	Safety output 2 (Y2, Y3)	Symbol	
		Description of operation	This function diagnoses the status of devices connected to a target safety output.
		Detail information	Logic functions (5-326)

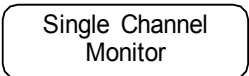


Safety check signals (pulses signals) are sent from the drive terminals (T14, T15) to diagnose external devices and monitor circuits. Safety check signals can not be used as a power supply for connected devices.

Note. If there are unused safety outputs, connect the intended external device monitor terminals (Xn) to the corresponding drive terminals (Tn). If they are not connected, the SafetyOne detects an input monitor error. As the result, the error LED displays a “1” and the unit changes to the Protection state.

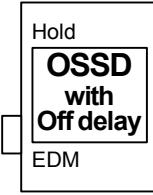
●Start inputs: X16 and X17

Start inputs are used to control the start of safety outputs.

Intended inputs (Terminal names)	Target safety inputs (Terminal names)	Function	
Start input 1 (X16)	Safety input 1 (X0-T0: TEACH) Safety input 2 (X2-T2, X3-T3) Safety input 3 (X4-T4, X5-T5)	Function name	Monitor input
		Symbol	
Start input 2 (X17)	Safety input 1 (X1-T0: AUTO) Safety input 4 (X6-T6, X7-T7) Safety input 5 (X10, X11) Safety input 6 (X12-T12, X13-T13)	Description of operation	Safety outputs are started, when all target safety inputs are in the safe state and this function is in the ON state. This function is turned ON by 0.1s or more ON operation.
		Detail information	Logic functions (5-325)

●Safety outputs: Y0 to Y3

Safety outputs are used to output safety information processed by SafetyOne.

Intended outputs (Terminal names)	Function	
Safety output 1 (Y0, Y1) Safety output 2 (Y2, Y3)	Function name	Safety output with timer
	Symbol	
	Description of operation	This function is a safety output to output safety information processed by SafetyOne. The output is turned OFF after the preset time of the OFF-delay timer (OFF-delay output).
	Detail information	Logic functions (5-335)

Note. When the SafetyOne changes to Protection state due to input monitor error, all safety outputs (safety output 1 and safety output 2) are turned OFF after the preset OFF-delay time.

Note. When the SafetyOne changes to Stop state due to circuit failure or other errors, all safety outputs (safety output 1 and safety output 2) are turned OFF, immediately.

Note. Set time of safety output with timer is active independent of the selected mode.

●Safety input monitor outputs: Y4 to Y11

Safety input monitor outputs are used to output the status of safety inputs in SafetyOne.

Intended outputs (Terminal names)	Target safety inputs (Terminal names)	Description of operation
Safety input 1 monitor output (Y4)	Safety input 1 (X0-T0: TEACH)	When TEACH mode (X0) is selected, the monitor output is ON. When TEACH mode is not selected, the monitor output is OFF. When the target safety input is ON, the monitor output is ON. When the target safety input is OFF, the monitor output is OFF.
Safety input 2 monitor output (Y5)	Safety input 2 (X2-T2, X3-T3)	
Safety input 3 monitor output (Y6)	Safety input 3 (X4-T4, X5-T5)	
Safety input 4 monitor output (Y7)	Safety input 4 (X6-T6, X7-T7)	
Safety input 5 monitor output (Y10)	Safety input 5 (X10, X11)	
Safety input 6 monitor output (Y11)	Safety input 6 (X12-T12, T13-X13)	

Note. When the targeted safety input detects an input monitor error, input circuit failure or EMC the disturbance, corresponding safety input monitor output becomes a pulse output (1Hz). The monitor output is OFF in other errors, Initial state, or Configuration state.

● **Safety output monitor outputs: Y12 and Y13**

Safety output monitor outputs are used to output the status of safety outputs in SafetyOne.

Intended outputs (Terminal names)	Target safety outputs (Terminal names)	Description of operation
Safety output 1 monitor output (Y12)	Safety output 1 (Y0, Y1)	When the target safety output is ON, the monitor output is ON. When the target safety output is OFF, this function is OFF. The monitor output turns OFF immediately, independent of the preset OFF-delay time.
Safety output 2 monitor output (Y13)	Safety output 2 (Y2, Y3)	

Note. When the safety output detects an output circuit failure, corresponding safety output monitor output becomes a pulse outputs (1Hz). The monitor output is OFF in other errors, Initial state, or Configuration state.

● **State monitor outputs: Y14 to Y16**

State monitor outputs are used to output the internal state of SafetyOne.

Intended outputs (Terminal names)	State				
	Initial	Run	Configuration	Protection	Stop
State monitor output 1 (Y14)	■ON	□OFF	□OFF	□OFF	■ON
State monitor output 2 (Y15)	■ON	□OFF	■ON	■ON	■ON OR □OFF
State monitor output 3 (Y16)	□OFF	■ON	□OFF	□OFF	□OFF

Refer to “Chapter 4 BASIC OPERATIONS” and to “Chapter 6 TROUBLE SHOOTING” for details of each state.



The monitor outputs are not safety outputs. Do not use these to construct a safety system.

● **Solenoid outputs: Y17 and Y20**

Solenoid outputs are used to control a solenoid in an interlock switch. The operations of solenoid output 1 are different by the selected mode.

Intended outputs (Terminal names)	Description of operation	
Solenoid output 1 (Y17)	AUTO mode	When safety output 1 is OFF, the solenoid output is ON. When safety Output 1 is ready to turn ON (safety output 1 can be turned ON by operation of the start input), the solenoid output is OFF.
	TEACH mode	When safety output 1 is OFF, the solenoid output is ON. When safety Output 1 is ON, the solenoid output is OFF.
Solenoid output 2 (Y20)	When safety output 2 is OFF, the solenoid output is ON. When safety Output 2 is ready to turn ON (safety output 2 can be turned ON by operation of the start input), the solenoid output is OFF.	



Warning

The solenoid outputs are not safety output. Do not use these to construct a safety system.

Note. The solenoid outputs are OFF in each state except Run state.



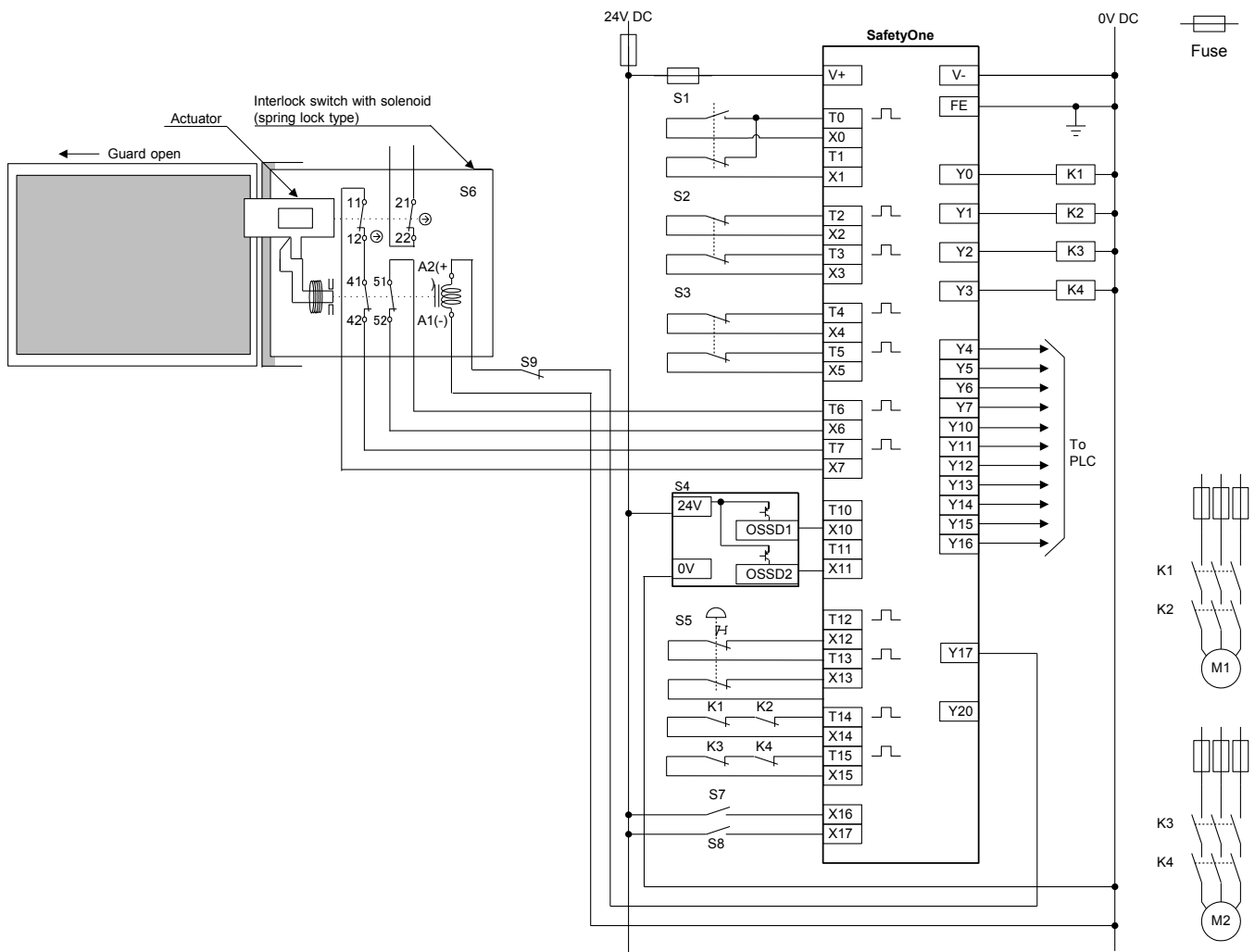
Caution

Refer to "Chapter 2 PRODUCT SPECIFICATIONS" for specifications of each input and output.

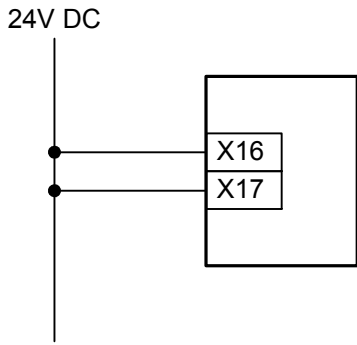
Wiring example (Logic 103)

In the case where 1 selector switch, 2 enabling switches, 1 safety light curtain, 1 emergency stop switch, and 1 interlock switch with solenoid (spring lock type) are connected.

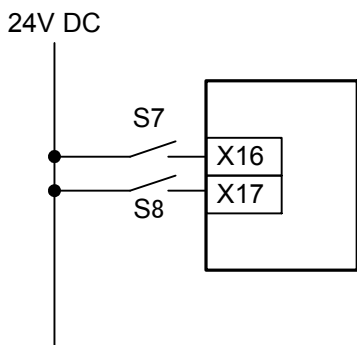
- S1 :Selector switch
 - S2, 3 :Enabling switch
 - S4 :Safety light curtain
 - S5 :Emergency stop switch
 - S6 :Interlock switch with solenoid (spring lock type)
 - S7, 8 :Start switch
 - S9 :Solenoid control switch
- (Pressing the solenoid control switches after closing the guard door, contacts 41-42 and 51-52 of S6 turn on, allowing the SafetyOne to restart.)
- K1 to 4 :Contactor
 - M1, 2 :Motor



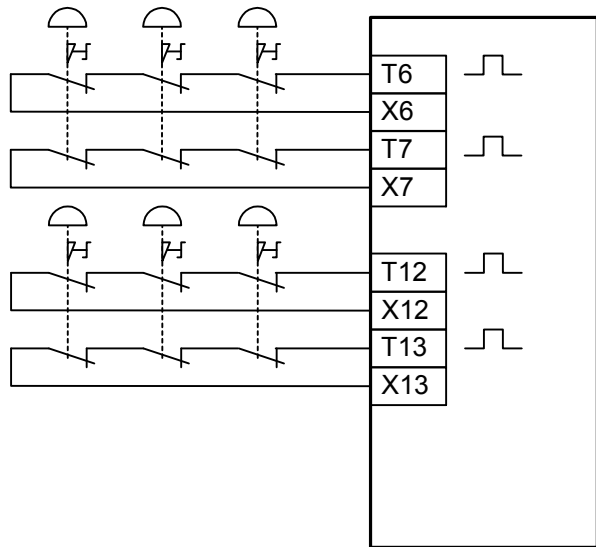
**When not using the start switch
(Auto start)**



**When using the start switch
(Manual start)**



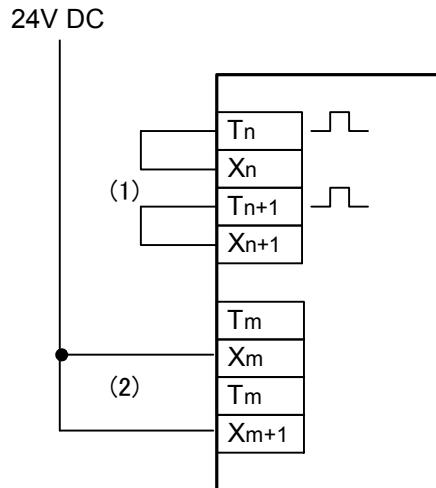
**When connecting multiple emergency stop switches
in series**



NOTE: Safety performance depends on the system configuration.

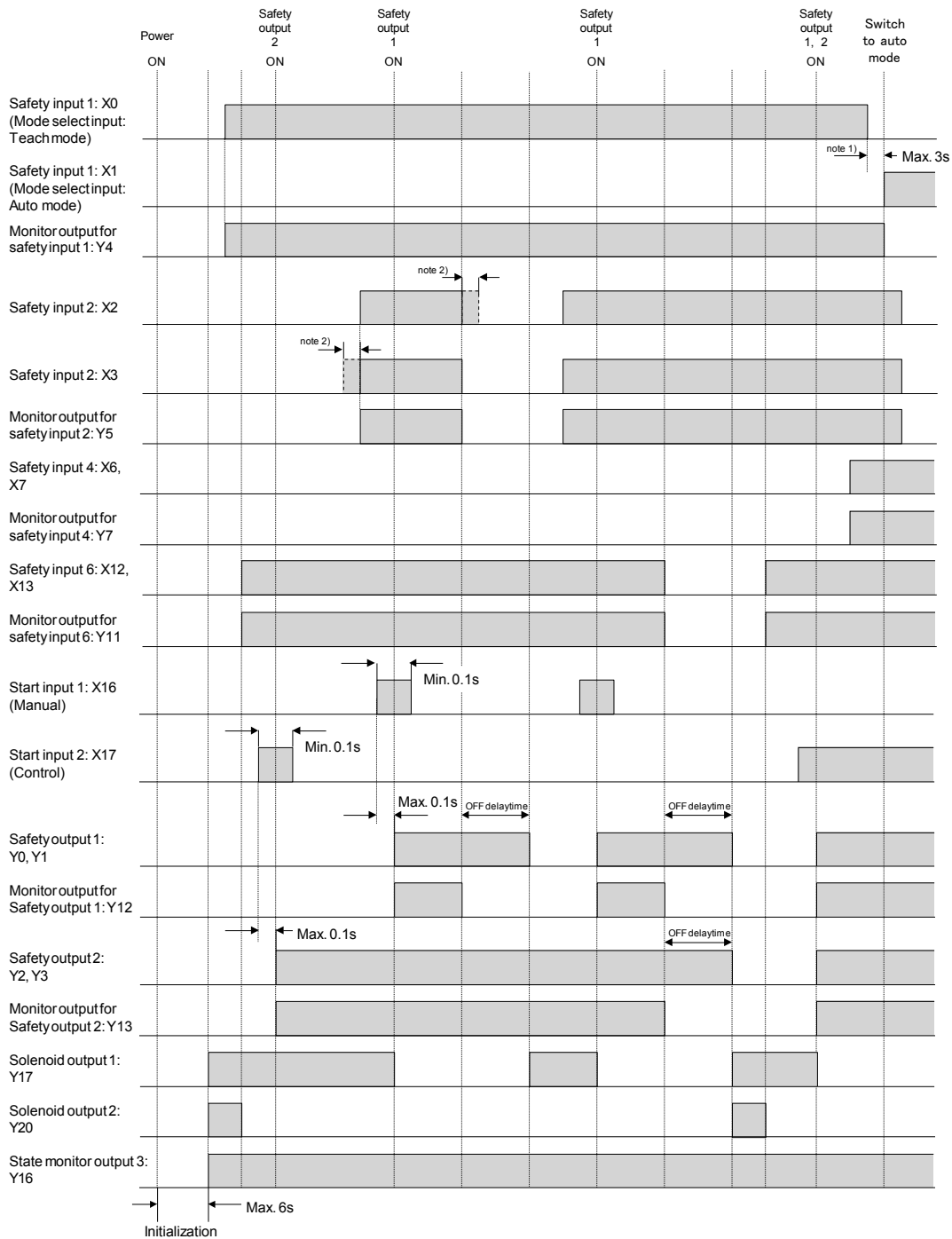
When not using some inputs

- If there are unused safety inputs in S3 and S4 and S6, connect the unused receive terminals to the corresponding drive terminals. (Refer to (1)).
- If S5 is not used, connect the receive terminal to 24V DC power supply (V+). (Refer to (2))



Timing chart (Logic 103)

Example: Teach mode



(Both safety input 3 and 5 are ON in this chart.)

Note 1) When "Safety input 1(mode select input)" is switched to another mode within 3s, "Safety output 1" is kept ON. "Safety output 2" is unrelated to mode select input.

Note 2) Input monitor error detection time is infinity.

About safety inputs that are not described in this chart, input monitor error detection time is as follows.

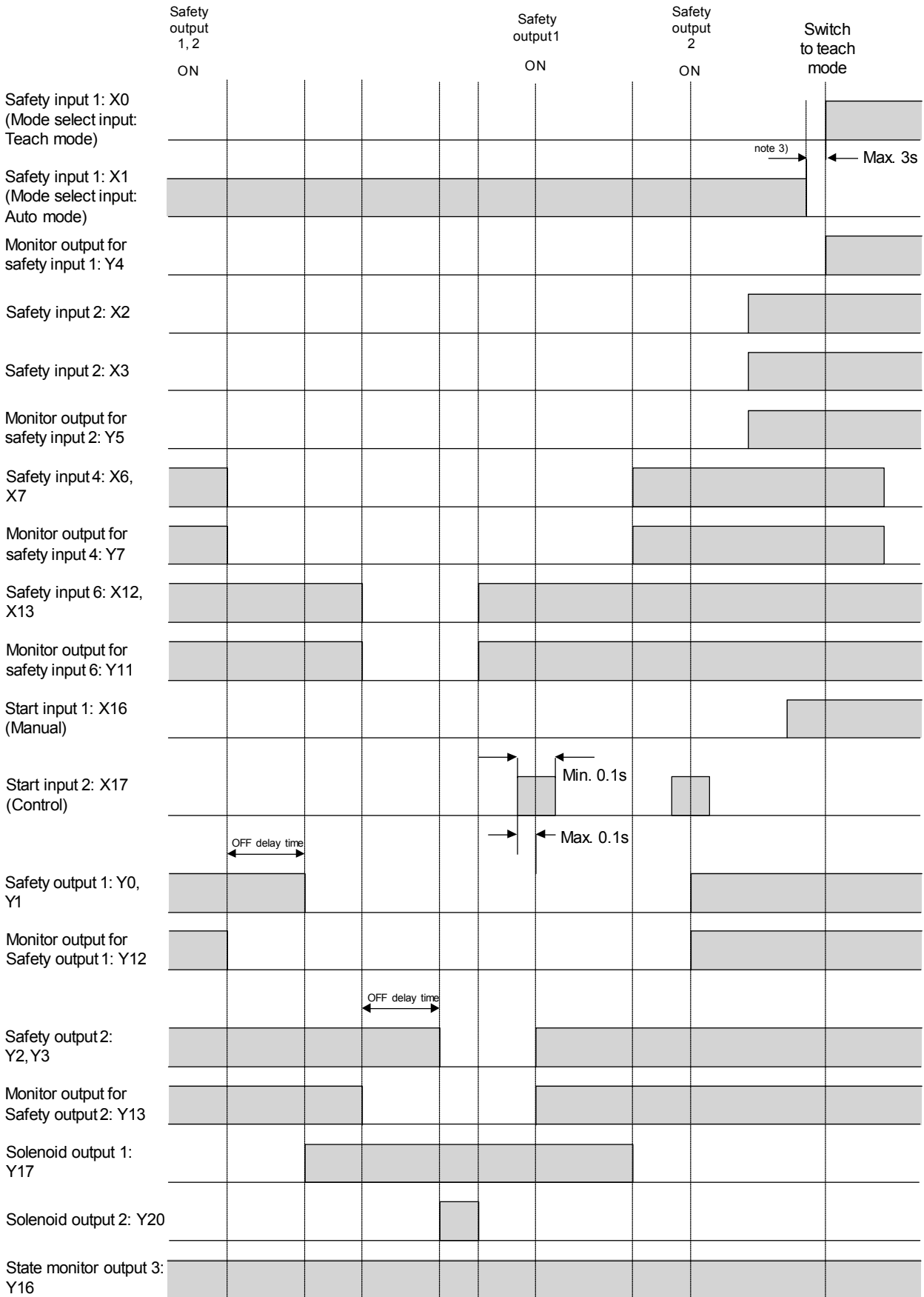
The time of dual channel dependent input (X4, X5, X12 and X13) is infinity.

The time of dual channel direct opening input (X6, X7) is 0.5s.

The time of dual channel safety input (X10, X11) is 0.1s.

Refer to the following "Logic functions" for more details.

Example: Auto mode



(Both safety input 3 and 5 are ON in this chart.)

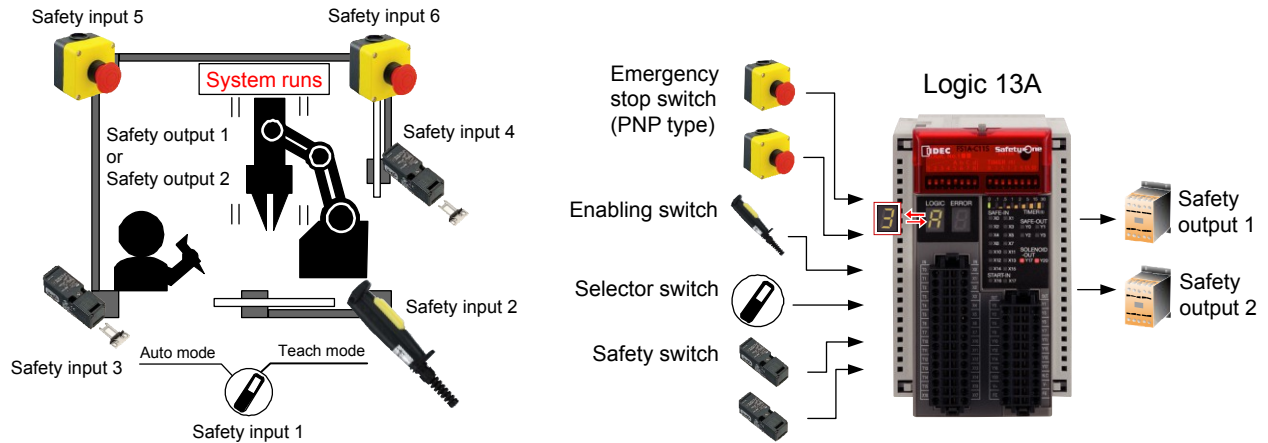
Note 3) When “Safety input 1 (mode select input)” is switched to another mode within 3s, “Safety output 1” is kept ON. “Safety output 2” is unrelated to mode select input.

Logic 13A: The logic applicable for selection of active safety input devices

Overview (Logic 13A)

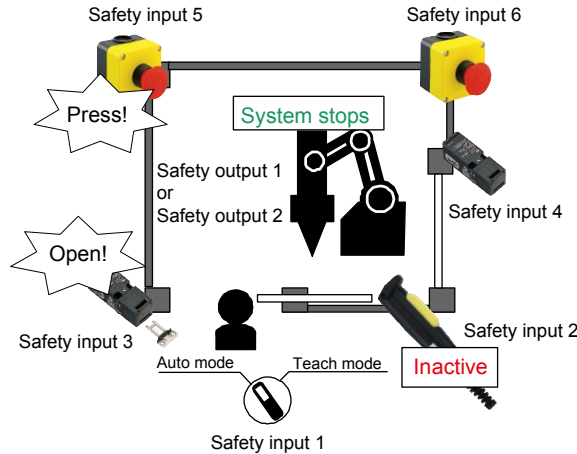
For production machines, robots, and the like, a hazard is generally isolated by a protective door (guard); however, when performing teaching or maintenance, the machine is operated in the condition that a person is in the danger zone. For such a situation, this logic described is applicable to the mode selection between Teach mode (maintenance mode) and Auto mode (operating mode). Safety outputs perform as dual channel outputs.

This logic enables the connection of 2 dual channel direct opening inputs, 1 mode select input, and 3 dual channel dependent inputs.

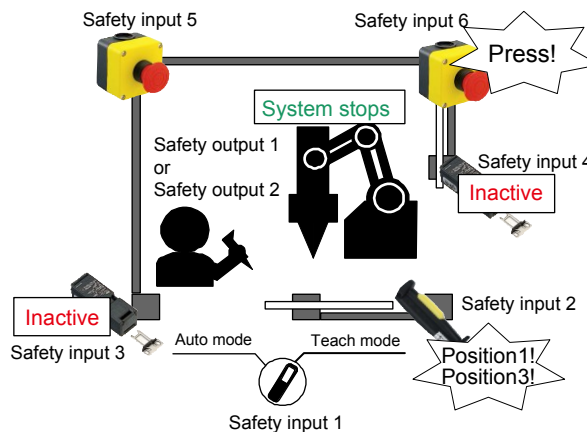


Operation example (Logic 13A)

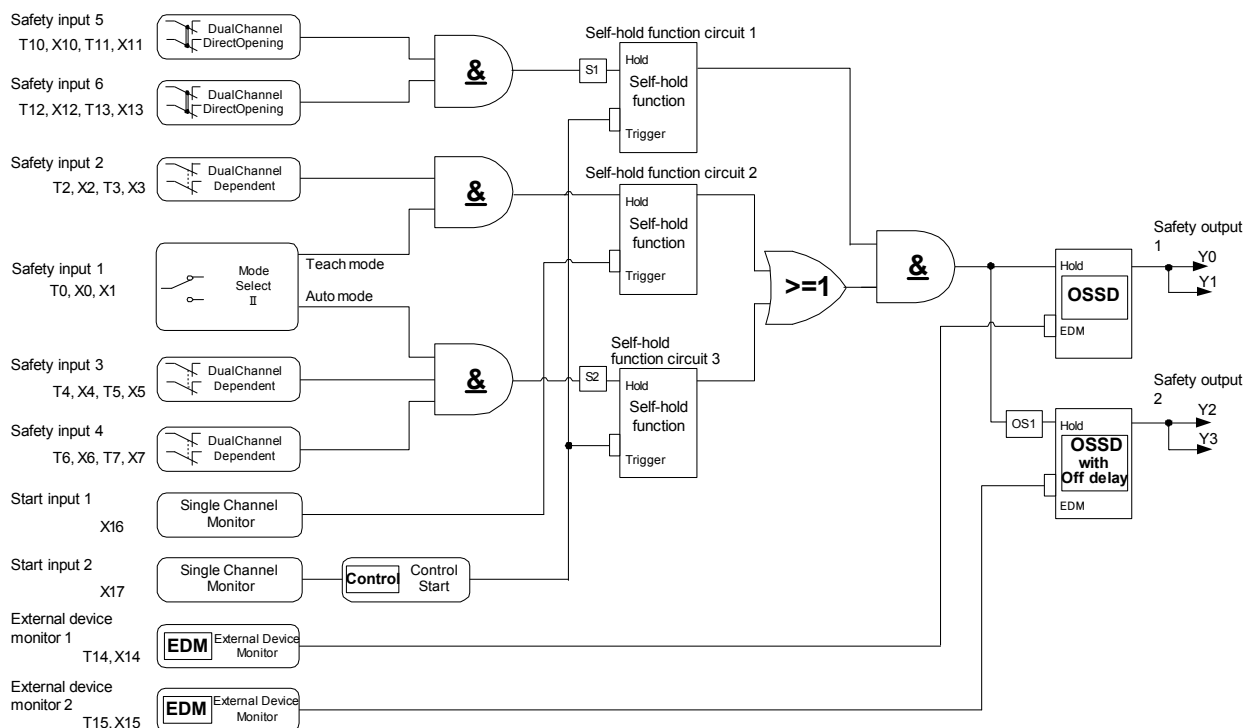
•Auto mode



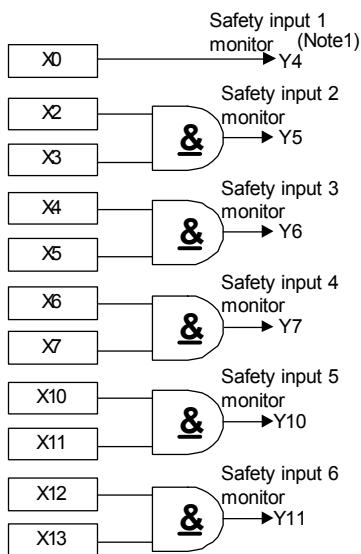
•Teach mode



Logic circuit (Logic 13A)

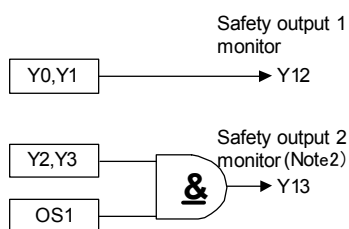


● Monitor output for safety input



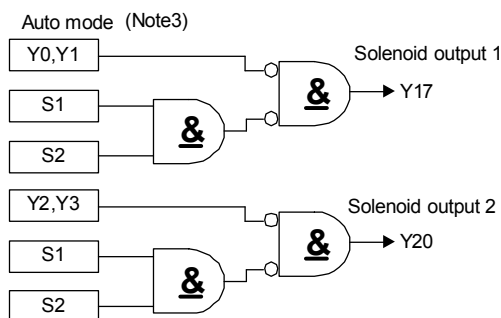
Note1:
When safety input 1 is Auto mode, the monitor for safety input 1 is turned OFF.

● Monitor output for safety output



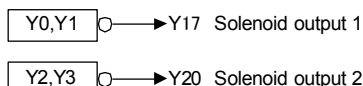
Note2:
Safety output 2 monitor turns OFF immediately independent of OFF-delay time.

● Solenoid output



Note3:
Auto mode:
In Run state, when the safety outputs are OFF and one or more corresponding safety inputs are OFF, the solenoid outputs turn ON.
When all corresponding safety inputs are ON, the solenoid outputs turn OFF even when the start input is OFF.

Teachmode (Note4)

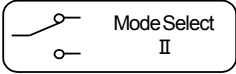


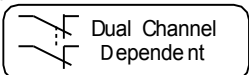
Note4:
Teach mode:
In Run state, when the safety outputs are OFF, the solenoid outputs are turned ON.

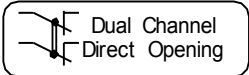
Functions (Logic 13A)

•Safety inputs: X0 to X13 (T0, T2 to T13)

Safety inputs are used to diagnose the status of connected safety devices, such as emergency stop switches, interlock switches, and mode select switches.

Intended inputs (Terminal names)	Function	
Safety input 1 (X0/X1-T0)	Function name	Mode select input II
	Symbol	
	Description of operation	This function is for connecting devices with a mode selector function, such as mode selector switch. When the switching of inputs is performed within 3s, this function output is kept at previous state. This function diagnoses time interval of status transition between each input (0.5s).
	Detail information	Logic functions (5-321)

Intended inputs (Terminal names)	Function	
Safety input 2 (X2-T2, X3-T3) Safety input 3 (X4-T4, X5-T5) Safety input 4 (X6-T6, X7-T7)	Function name	Dual channel dependent input
	Symbol	
	Description of operation	This function diagnoses the status of connected safety devices. This function does not diagnose the time interval of status transition between each input of duplicated inputs.
	Detail information	Logic functions (5-313)

Intended inputs (Terminal names)	Function	
Safety input 5 (X10-T10, X11-T11) Safety input 6 (X12-T12, X13-T13)	Function name	Dual channel direct opening input
	Symbol	
	Description of operation	This function diagnoses the status of connected safety devices. This function diagnoses the time interval of status transition between each input of duplicated inputs (0.5s).
	Detail information	Logic functions (5-311)



For connected control devices, refer to “SAFETY PRECAUTIONS”.

Safety check signals (pulses signals) are sent from the drive terminals (T0, T2 to T13) to diagnose connected safety devices and input circuits. Safety check signals can not be used as a power supply for connected devices.

Note. Solid state outputs, such as safety light curtains, can not be connected to safety inputs.


Note. Use safety inputs as specified combinations, such as receive terminal (Xn) and drive terminal (Tn). If the combinations are incorrect, SafetyOne does not work correctly.

Note. When SafetyOne is in Run state or Protection state, input states are monitored in all safety inputs. For example, if input monitor error is detected in safety input 2 although AUTO mode is selected, SafetyOne detects error and transits to Protection state.

Note. If there are unused safety inputs in safety input 2 through safety input 6, connect the unused receive terminals (Xn) to the corresponding drive terminals (Tn). If they are not connected, the SafetyOne does not turn ON the safety outputs.

●External device monitor inputs: X14 and X15 (T14 and T15)

External device monitor inputs are used to diagnose status of the devices connected to safety outputs.

Intended inputs (Terminal names)	Target safety outputs (Terminal names)	Function	
External device monitor input 1 (X14-T14)	Safety output 1 (Y0, Y1)	Function name	External device monitor input
External device monitor input 2 (X15-T15)	Safety output 2 (Y2, Y3)	Symbol	
		Description of operation	This function diagnoses the status of devices connected to a target safety output.
		Detail information	Logic functions (5-326)

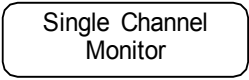


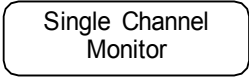
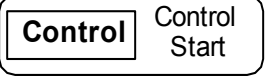
Safety check signals (pulses signals) are sent from the drive terminals (T14, T15) to diagnose external devices and monitor circuits. Safety check signals can not be used as a power supply for connected devices.

Note. If there are unused safety outputs, connect the intended external device monitor terminals (Xn) to the corresponding drive terminals (Tn). If they are not connected, the SafetyOne detects an input monitor error. As the result, the error LED displays a “1” and the unit changes to the Protection state.

●Start inputs: X16 and X17

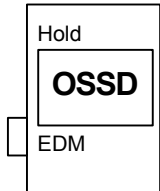
Start inputs are used to control the start of safety outputs.

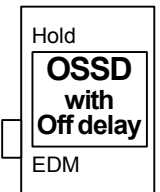
Intended inputs (Terminal names)	Target safety inputs (Terminal names)	Function	
		Start input 1 (X16)	Safety input 1 (X0-T0: TEACH) Safety input 2 (X2-T2, X3-T3)
Symbol			
Description of operation	Safety outputs are started, when all target safety inputs are in the safe state and this function is in the ON state. This function is turned ON by 0.1s or more ON operation.		
Detail information	Logic functions (5-325)		

Intended inputs (Terminal names)	Target safety inputs (Terminal names)	Function	
		Start input 2 (X17)	Safety input 1 (X1-T0: AUTO) Safety input 3 (X4-T4, X5-T5) Safety input 4 (X6-T6, X7-T7) Safety input 5 (X10-T10, X11-T11) Safety input 6 (X12-T12, X13-T13)
Symbol	 + 		
Description of operation	Safety outputs are started, when this function becomes ON after all intended safety inputs are in the safe state. This function is turned ON by 0.1s to 5s ON operation.		
Detail information	Logic functions (5-325, 330)		

● **Safety outputs: Y0 to Y3**

Safety outputs are used to output safety information processed by SafetyOne.

Intended outputs (Terminal names)	Function	
Safety output 1 (Y0, Y1)	Function name	Safety output without timer
	Symbol	
	Description of operation	This function is a safety output to output safety information processed by SafetyOne. The output is turned OFF immediately by OFF operation (instantaneous OFF output).
	Detail information	Logic functions (5-332)

Intended outputs (Terminal names)	Function	
Safety output 2 (Y2, Y3)	Function name	Safety output with timer
	Symbol	
	Description of operation	This function is a safety output to output safety information processed by SafetyOne. The output is turned OFF after the preset time of the OFF-delay timer (OFF-delay output).
	Detail information	Logic functions (5-335)

Note. When the SafetyOne changes to Protection state due to input monitor error, safety output without timer (safety output 1) is turned OFF. Safety output with timer (safety output 2) is turned OFF after the preset OFF-delay time.

Note. When the SafetyOne changes to Stop state due to circuit failure or other errors, all safety outputs (safety output 1 and safety output 2) are turned OFF, immediately.

Note. Set time of safety output with timer is active independent of the selected mode.

Safety input monitor outputs: Y4 to Y11

Safety input monitor outputs are used to output the status of safety inputs in SafetyOne.

Intended outputs (Terminal names)	Target safety inputs (Terminal names)	Description of operation
Safety input 1 monitor output (Y4)	Safety input 1 (X0-T0: TEACH)	When TEACH mode (X0) is selected, the monitor output is ON. When TEACH mode is not selected, the monitor output is OFF. When the target safety input is ON, the monitor output is ON. When the target safety input is OFF, the monitor output is OFF.
Safety input 2 monitor output (Y5)	Safety input 2 (X2-T2, X3-T3)	
Safety input 3 monitor output (Y6)	Safety input 3 (X4-T4, X5-T5)	
Safety input 4 monitor output (Y7)	Safety input 4 (X6-T6, X7-T7)	
Safety input 5 monitor output (Y10)	Safety input 5 (X10-T10, X11-T11)	
Safety input 6 monitor output (Y11)	Safety input 6 (X12-T12, T13-X13)	

Note. When the targeted safety input detects an input monitor error, input circuit failure or EMC the disturbance, corresponding safety input monitor output becomes a pulse output (1Hz). The monitor output is OFF in other errors, Initial state, or Configuration state.

•Safety output monitor outputs: Y12 and Y13

Safety output monitor outputs are used to output the status of safety outputs in SafetyOne.

Intended outputs (Terminal names)	Target safety outputs (Terminal names)	Description of operation
Safety output 1 monitor output (Y12)	Safety output 1 (Y0, Y1)	When the target safety output is ON, the monitor output is ON. When the target safety output is OFF, this function is OFF. The monitor output turns OFF immediately, independent of the preset OFF-delay time.
Safety output 2 monitor output (Y13)	Safety output 2 (Y2, Y3)	

Note. When the safety output detects an output circuit failure, corresponding safety output monitor output becomes a pulse output (1Hz). The monitor output is OFF in other errors, Initial state, or Configuration state.

●State monitor outputs: Y14 to Y16

State monitor outputs are used to output the internal state of SafetyOne.

Intended outputs (Terminal names)	State				
	Initial	Run	Configuration	Protection	Stop
State monitor output 1 (Y14)	■ON	□OFF	□OFF	□OFF	■ON
State monitor output 2 (Y15)	■ON	□OFF	■ON	■ON	■ON or □OFF
State monitor output 3 (Y16)	□OFF	■ON	□OFF	□OFF	□OFF

Refer to “Chapter 4 BASIC OPERATIONS” and to “Chapter 6 TROUBLE SHOOTING” for details of each state.



Warning

The monitor outputs are not safety outputs. Do not use these to construct a safety system.

●Solenoid outputs: Y17 and Y20

Solenoid outputs are used to control a solenoid in an interlock switch. The operations of solenoid outputs are different by the selected mode.

Intended outputs (Terminal names)	Description of operation	
	Solenoid output 1 (Y17)	AUTO mode
TEACH mode		When safety output 1 is OFF, the solenoid output is ON. When safety output 1 is ON, the solenoid output is OFF.
Solenoid output 2 (Y20)	AUTO mode	When safety output 2 is OFF, the solenoid output is ON. When safety Output 2 is ready to turn ON (safety output 2 can be turned ON by operation of the start input), the solenoid output is OFF.
	TEACH mode	When safety output 2 is OFF, the solenoid output is ON. When safety output 2 is ON, the solenoid output is OFF.



Warning

the solenoid outputs are not safety output. Do not use these to construct a safety system.

Note. The solenoid outputs are OFF in each state except Run state.



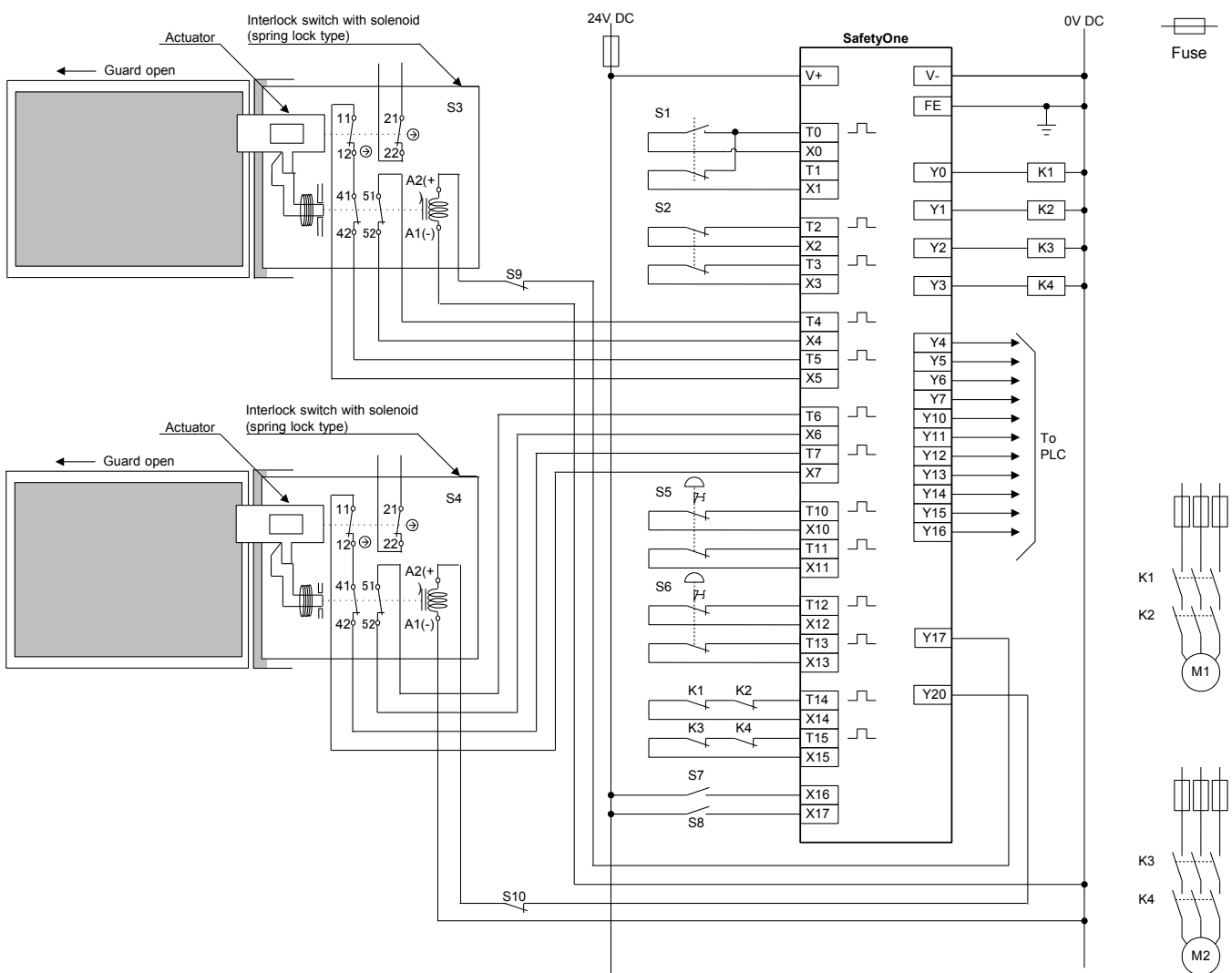
Caution

Refer to "Chapter 2 PRODUCT SPECIFICATIONS" for specifications of each input and output.

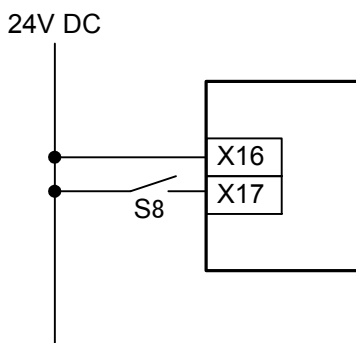
Wiring example (Logic 13A)

In the case where 1 selector switch, 1 enabling switch, 1 interlock switch with solenoid (spring lock type), and 2 emergency stop switches are connected.

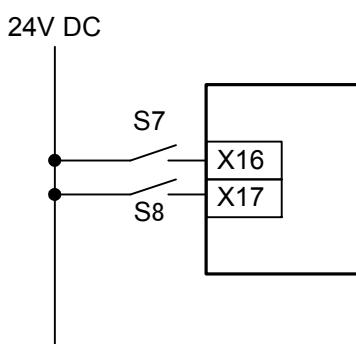
- S1 :Selector switch
- S2 :Enabling switch
- S3, 4 :Interlock switch with solenoid (spring lock type)
- S5, 6 :Emergency stop switch
- S7, 8 :Start switch
- S9, 10 :Solenoid control switch
(Pressing the solenoid control switches after closing the guard door,
contacts 41-42 and 51-52 of S3 and S4 turn on, allowing the SafetyOne to restart.)
- K1 to 4 :Contactor
- M1, 2 :Motor



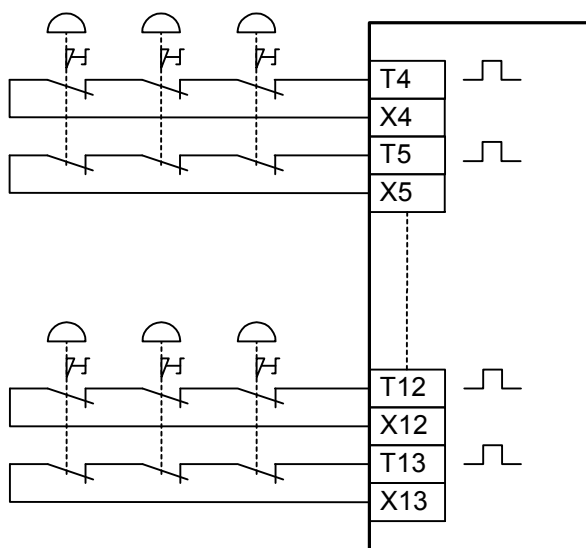
**When not using the start switch S7
(Auto start)**



**When using the start switch S7
(Manual start)**



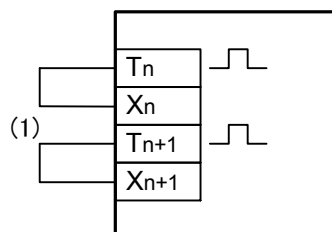
**When connecting multiple emergency stop switches
in series**



NOTE: Safety performance depends on the system configuration.

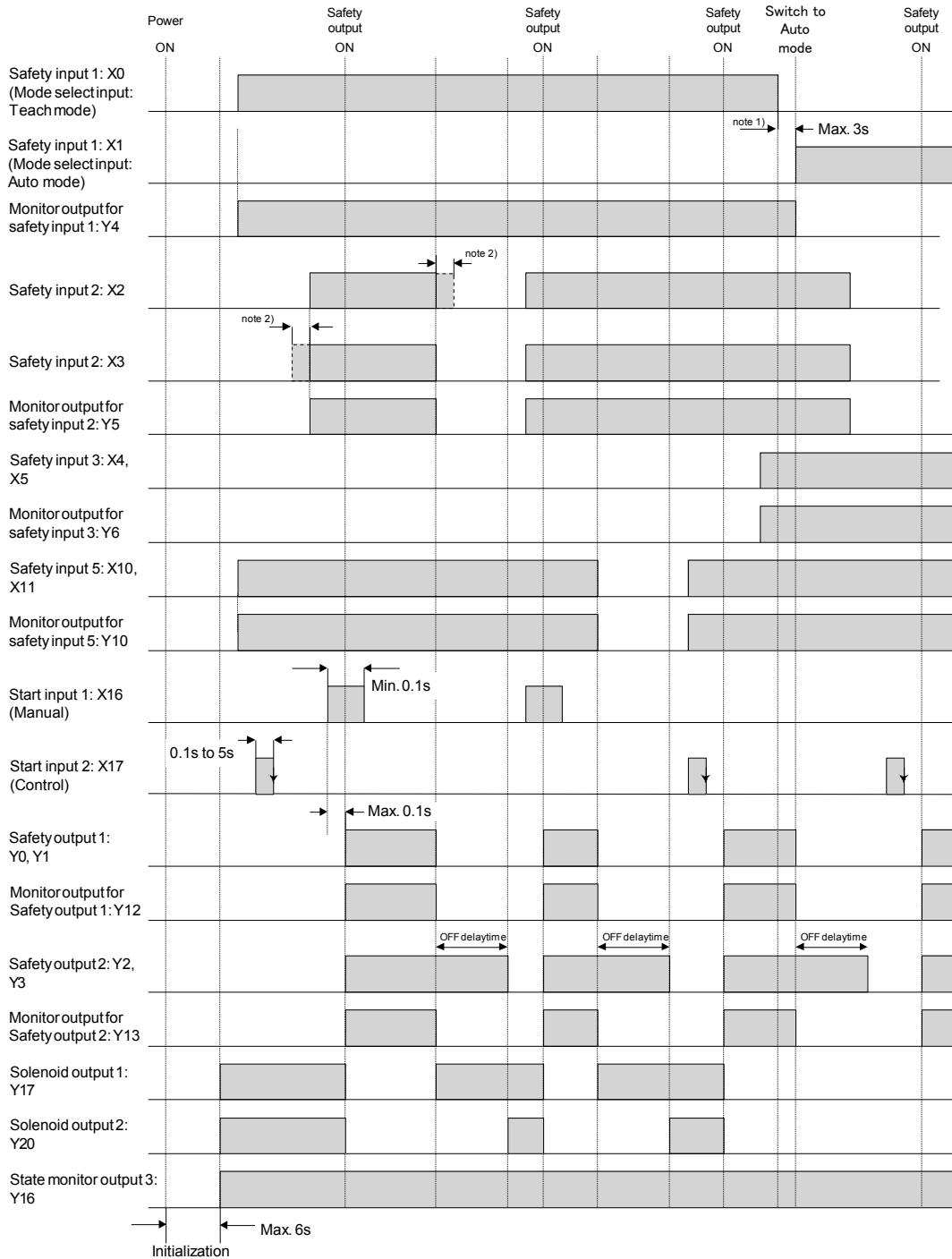
When not using some safety inputs

• If there are unused safety inputs in S3 to S6, connect the unused receive terminals to the corresponding drive terminals. (Refer to (1))



Timing chart (Logic 13A)

Example: Teach mode



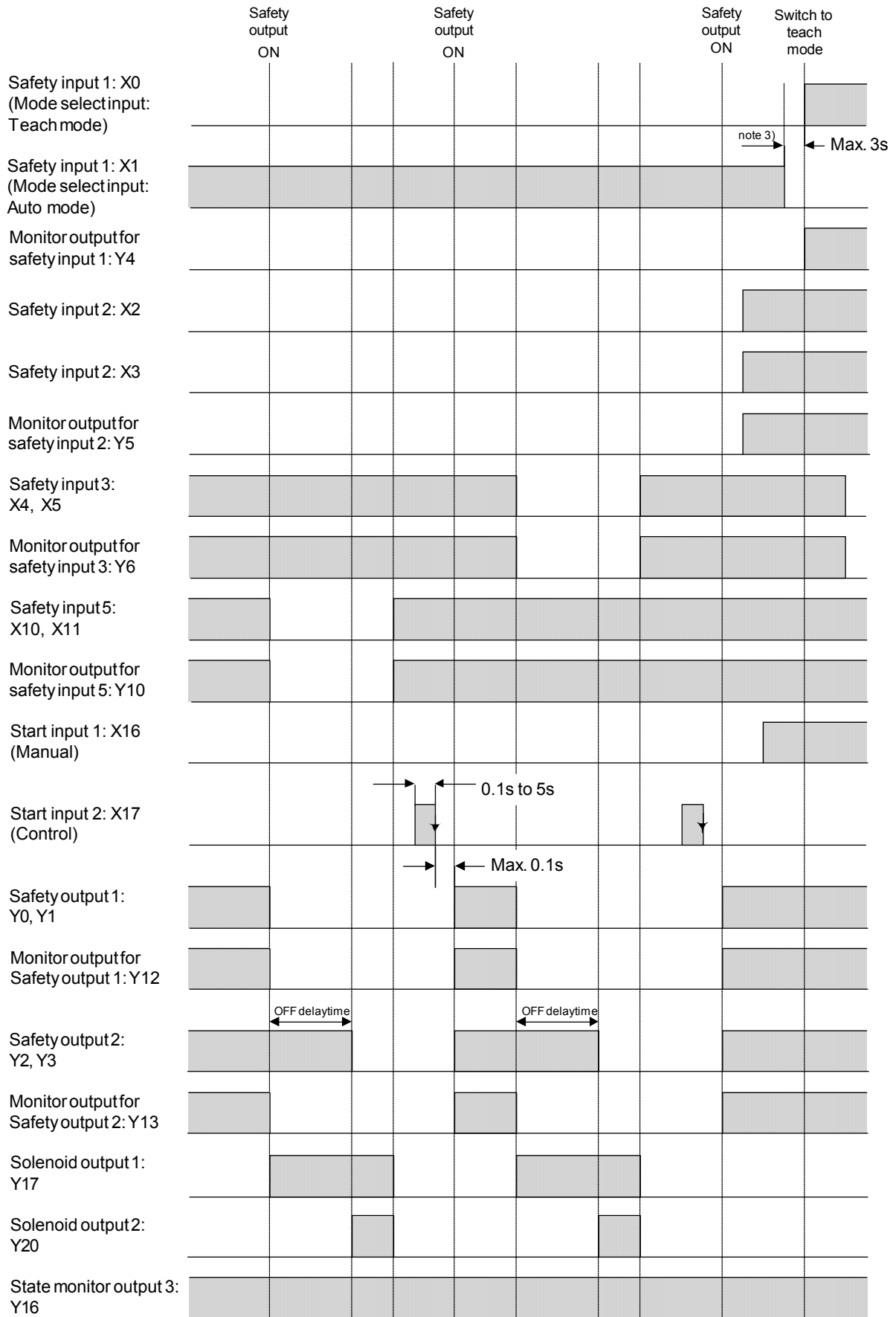
(Both safety input 4 and 6 are ON in this chart.)

Note 1) When Safety input 1 (mode select input) is switched to Auto mode from Teach mode, all of Safety output are kept ON for 3s maximum till X1 is turned ON after X0 is turned OFF. All of Safety output are turned OFF at the same time as X1 is turned ON.

Note 2) Input monitor error detection time is infinity.

About safety inputs that are not described in this chart, input monitor error detection time is as follows.
 The time of dual channel dependent input (X4 to X7) is infinity.
 The time of dual channel direct opening input (X10 to X13) is 0.5s.
 Refer to the following "Logic functions" for more details.

Example: Auto mode



(Both safety input 4 and 6 are ON in this chart.)

Note 3) When Safety input 1 (mode select input) is switched to another mode within 3s, all of Safety output are kept ON.

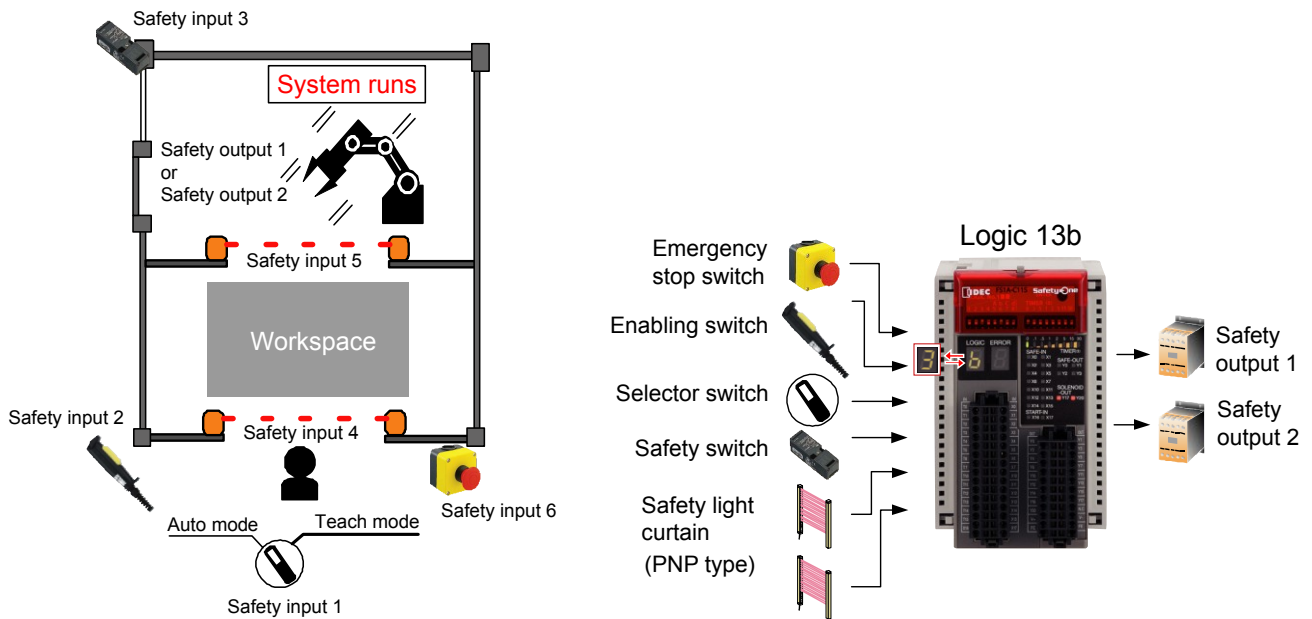
Logic 13b: The logic constructing an OR circuit applicable for selection of active safety input devices

Overview (Logic 13b)

For production machines, robots, and the like, a hazard is generally isolated by a protective door (guard); however, when performing teaching or maintenance, the machine is operated in the condition that a person is in the danger zone. For such a situation, this logic described is applicable to the mode selection between Teach mode (maintenance mode) and Auto mode (operating mode). Safety outputs perform as dual channel outputs.

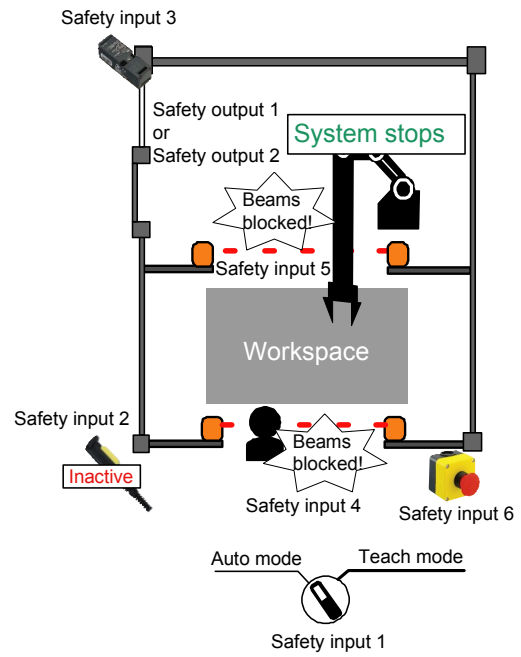
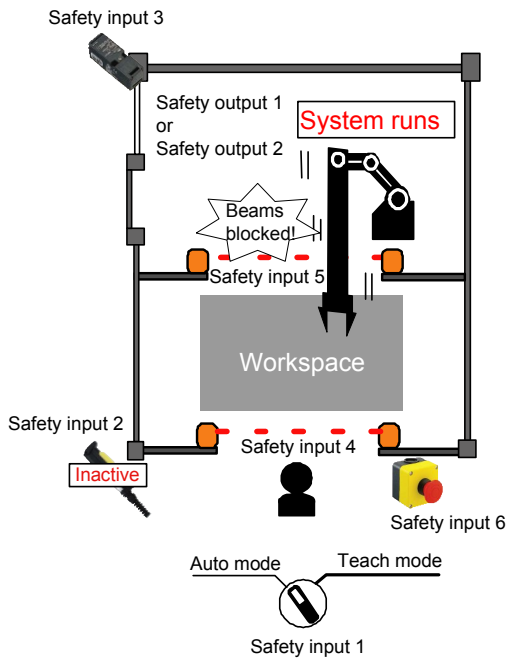
This logic enables constructing an OR circuit in Auto mode (operating mode).

This logic enables the connection of 2 dual channel direct opening inputs, 1 mode select input, 1 dual channel dependent input, 2 dual channel safety inputs.

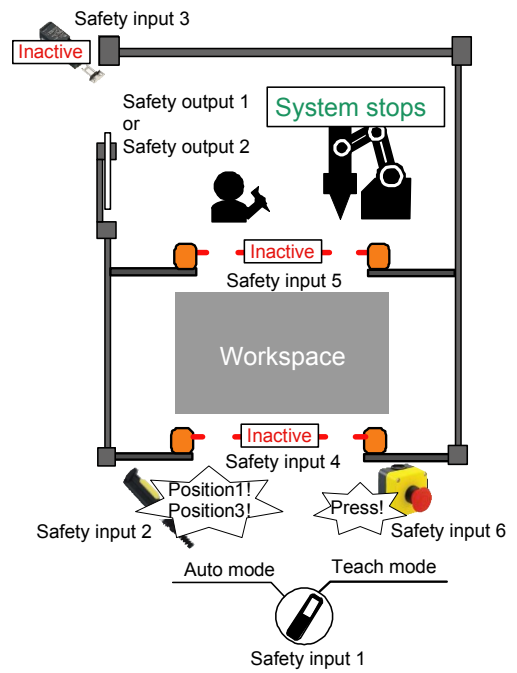
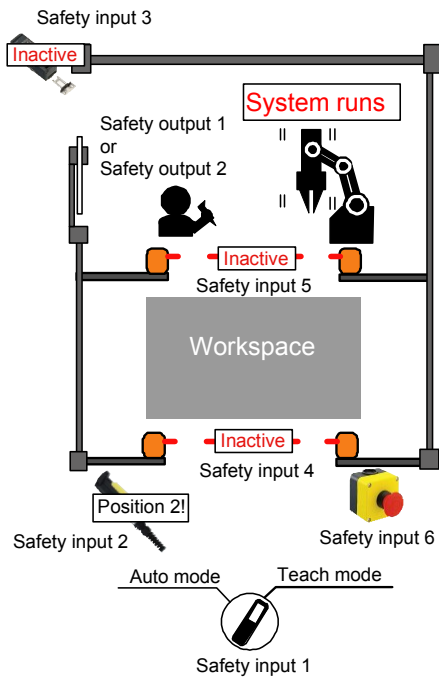


Operation example (Logic 13b)

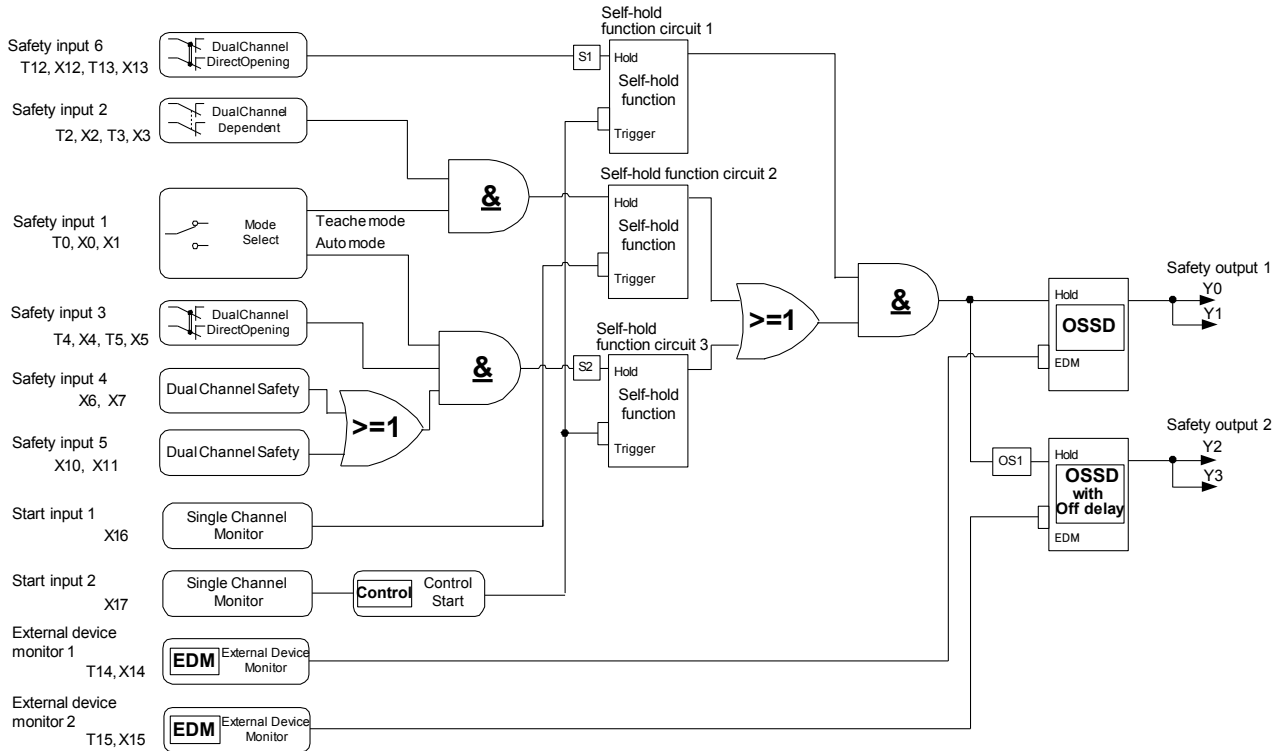
•Auto mode



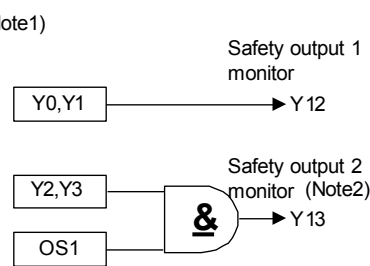
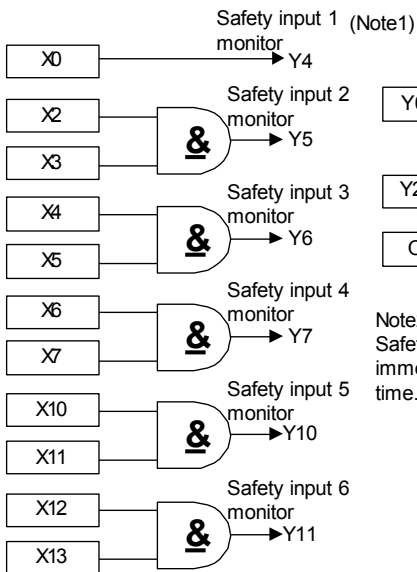
•Teach mode



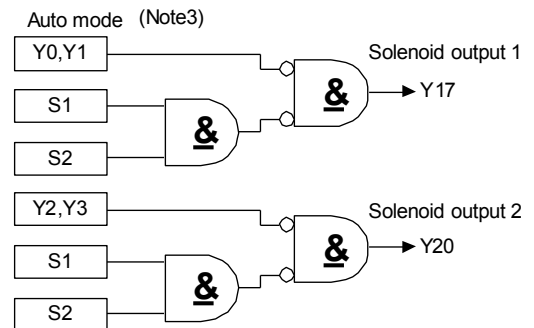
Logic circuit (Logic 13b)



● Monitor output for safety input ● Monitor output for safety output ● Solenoid output

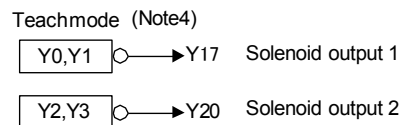


Note2:
Safety output 2 monitor turns OFF immediately independent of OFF-delay time.



Note3:
Auto mode:
In Run state, when the safety outputs are OFF and one or more corresponding safety inputs are OFF, the solenoid outputs turn ON.
When all corresponding safety inputs are ON, the solenoid outputs turn OFF even when the start input is OFF.

Note1:
When safety input 1 is Auto mode, the monitor for safety input 1 is turned OFF.

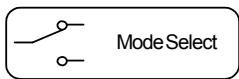


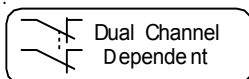
Note4:
Teachmode:
In Run state, when the safety outputs are OFF, the solenoid outputs turn ON.

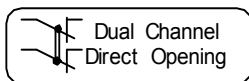
Functions (Logic 13b)

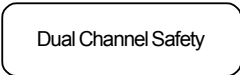
●**Safety inputs: X0 to X13 (T0, T2 to T5, T12, T13)**

Safety inputs are used to diagnose the status of connected safety devices, such as emergency stop switches, interlock switches, and mode select switches.

Intended inputs (Terminal names)	Function	
Safety input 1 (X0/X1-T0)	Function name	Mode select input
	Symbol	
	Description of operation	This function is for connecting devices with a mode selector function, such as mode selector switch. This function diagnoses time interval of status transition between each input (0.5s).
	Detail information	Logic functions (5-319)

Intended inputs (Terminal names)	Function	
Safety input 2 (X2-T2, X3-T3)	Function name	Dual channel dependent input
	Symbol	
	Description of operation	This function diagnoses the status of connected safety devices. This function does not diagnose the time interval of status transition between each input of duplicated inputs.
	Detail information	Logic functions (5-313)

Intended inputs (Terminal names)	Function	
Safety input 3 (X4-T4, X5-T5) Safety input 6 (X12-T12, X13-T13)	Function name	Dual channel direct opening input
	Symbol	
	Description of operation	This function diagnoses the status of connected safety devices. This function diagnoses the time interval of status transition between each input of duplicated inputs (0.5s).
	Detail information	Logic functions (5-311)

Intended inputs (Terminal names)	Function	
Safety input 4 (X6,X7) Safety input 5 (X10, X11)	Function name	Dual channel safety input
	Symbol	
	Description of operation	This function diagnoses the status of connected safety devices. This function diagnoses the time interval of status transition between each input of duplicated inputs (0.1s). The function does not use drive terminals (T6, T7, T10 and T11).
	Detail information	Logic functions (5-317)

 **Warning**

For connected control devices, refer to “SAFETY PRECAUTIONS”.

Safety check signals (pulses signals) are sent from the drive terminals (T0, T2 to T5, T12, T13) to diagnose connected safety devices and input circuits. Safety check signals can not be used as a power supply for connected devices.

In case of using only one of safety input 4 or safety input 5, open the unused safety inputs. If the unused safety input is connected to a 24 VDC power supply (V+), SafetyOne does not turns OFF by the OFF operation of used safety input.

Note. Solid state outputs, such as safety light curtains, can not be connected to safety input 1 through Safety input 3, and safety input 6.


Note. Use safety input 1 through safety input 3, and safety input 6, as specified combinations, such as receive terminal (Xn) and drive terminal (Tn). If the combinations are incorrect, SafetyOne does not work correctly.

Note. When SafetyOne is in Run state or Protection state, input states are monitored in all safety inputs. For example, if input monitor error is detected in safety input 2 although AUTO mode is selected, SafetyOne detects error and transits to Protection state.

Note. If there are unused safety inputs in safety input 2, safety input 3, or safety input 6, connect the unused receive terminals (Xn) to the corresponding drive terminals (Tn). If they are not connected, the SafetyOne does not turn ON the safety outputs.

● **External device monitor inputs: X14 and X15 (T14 and T15)**

External device monitor inputs are used to diagnose status of the devices connected to safety outputs.

Intended inputs (Terminal names)	Target safety outputs (Terminal names)	Function	
External device monitor input 1 (X14-T14)	Safety output 1 (Y0, Y1)	Function name	External device monitor input
External device monitor input 2 (X15-T15)	Safety output 2 (Y2, Y3)	Symbol	
		Description of operation	This function diagnoses the status of devices connected to a target safety output.
		Detail information	Logic functions (5-326)



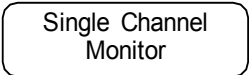
Warning



Safety check signals (pulses signals) are sent from the drive terminals (T14, T15) to diagnose external devices and monitor circuits. Safety check signals can not be used as a power supply for connected devices.

Note. If there are unused safety outputs, connect the intended external device monitor terminals (Xn) to the corresponding drive terminals (Tn). If they are not connected, the SafetyOne detects an input monitor error. As the result, the error LED displays a “1” and the unit changes to the Protection state.

●Start inputs: X16 and X17

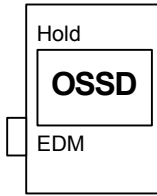
Start inputs are used to control the start of safety outputs.

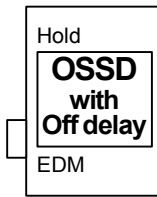
Intended inputs (Terminal names)	Target safety inputs (Terminal names)	Function	
		Start input 1 (X16)	Safety input 1 (X0-T0: TEACH) Safety input 2 (X2-T2, X3-T3)
Symbol			
Description of operation	Safety outputs are started, when all target safety inputs are in the safe state and this function is in the ON state. This function is turned ON by 0.1s or more ON operation.		
Detail information	Logic functions (5-325)		

Intended inputs (Terminal names)	Target safety inputs (Terminal names)	Function	
		Start input 2 (X17)	Safety input 1 (X1-T0: AUTO) Safety input 3 (X4-T4, X5-T5) Safety input 4 (X6, X7) Safety input 5 (X10, X11) Safety input 6 (X12-T12, X13-T13)
Symbol	 + 		
Description of operation	Safety outputs are started, when this function becomes ON after all intended safety inputs are in the safe state. This function is turned ON by 0.1s to 5s ON operation.		
Detail information	Logic functions (5-325, 330)		

● **Safety outputs: Y0 to Y3**

Safety outputs are used to output safety information processed by SafetyOne.

Intended outputs (Terminal names)	Function	
Safety output 1 (Y0, Y1)	Function name	Safety output without timer
	Symbol	
	Description of operation	This function is a safety output to output safety information processed by SafetyOne. The output is turned OFF immediately by OFF operation (instantaneous OFF output).
	Detail information	Logic functions (5-332)

Intended outputs (Terminal names)	Function	
Safety output 2 (Y2, Y3)	Function name	Safety output with timer
	Symbol	
	Description of operation	This function is a safety output to output safety information processed by SafetyOne. The output is turned OFF after the preset time of the OFF-delay timer (OFF-delay output).
	Detail information	Logic functions (5-335)

Note. When the SafetyOne changes to Protection state due to input monitor error, safety output without timer (safety output 1) is turned OFF. Safety output with timer (safety output 2) is turned OFF after the preset OFF-delay time.

Note. When the SafetyOne changes to Stop state due to circuit failure or other errors, all safety outputs (safety output 1 and safety output 2) are turned OFF, immediately.

Note. Set time of safety output with timer is active independent of the selected mode.

Safety input monitor outputs: Y4 to Y11

Safety input monitor outputs are used to output the status of safety inputs in SafetyOne.

Intended outputs (Terminal names)	Target safety inputs (Terminal names)	Description of operation
Safety input 1 monitor output (Y4)	Safety input 1 (X0-T0: TEACH)	When TEACH mode (X0) is selected, the monitor output is ON. When TEACH mode is not selected, the monitor output is OFF. When the target safety input is ON, the monitor output is ON. When the target safety input is OFF, the monitor output is OFF.
Safety input 2 monitor output (Y5)	Safety input 2 (X2-T2, X3-T3)	
Safety input 3 monitor output (Y6)	Safety input 3 (X4-T4, X5-T5)	
Safety input 4 monitor output (Y7)	Safety input 4 (X6, X7)	
Safety input 5 monitor output (Y10)	Safety input 5 (X10, X11)	
Safety input 6 monitor output (Y11)	Safety input 6 (X12-T12, X13-T13)	

Note. When the targeted safety input detects an input monitor error, input circuit failure or EMC the disturbance, corresponding safety input monitor output becomes a pulse output (1Hz). The monitor output is OFF in other errors, Initial state, or Configuration state.

•Safety output monitor outputs: Y12 and Y13

Safety output monitor outputs are used to output status of safety outputs in SafetyOne.

Intended outputs (Terminal names)	Target safety outputs (Terminal names)	Description of operation
Safety output 1 monitor output (Y12)	Safety output 1 (Y0, Y1)	When the target safety output is ON, the monitor output is ON. When the target safety output is OFF, this function is OFF. The monitor output turns OFF immediately, independent of the preset OFF-delay time.
Safety output 2 monitor output (Y13)	Safety output 2 (Y2, Y3)	

Note. When the safety output detects an output circuit failure, corresponding safety output monitor output becomes a pulse output (1Hz). The monitor output is OFF in other errors, Initial state, or Configuration state.

●State monitor outputs: Y14 to Y16

State monitor outputs are used to output the internal state of SafetyOne.

Intended outputs (Terminal names)	State				
	Initial	Run	Configuration	Protection	Stop
State monitor output 1 (Y14)	■ON	□OFF	□OFF	□OFF	■ON
State monitor output 2 (Y15)	■ON	□OFF	■ON	■ON	■ON or □OFF
State monitor output 3 (Y16)	□OFF	■ON	□OFF	□OFF	□OFF

Refer to “Chapter 4 BASIC OPERATIONS” and to “Chapter 6 TROUBLE SHOOTING” for details of each state.



Warning

The monitor outputs are not safety outputs. Do not use these to construct a safety system.

●Solenoid outputs: Y17 and Y20

Solenoid outputs are used to control a solenoid in an interlock switch. The operations of solenoid outputs are different by the selected mode.

Intended outputs (Terminal names)	Description of operation	
	Solenoid output 1 (Y17)	AUTO mode
TEACH mode		When safety output 1 is OFF, the solenoid output is ON. When safety output 1 is ON, the solenoid output is OFF.
Solenoid output 2 (Y20)	AUTO mode	When safety output 2 is OFF, the solenoid output is ON. When safety Output 2 is ready to turn ON (safety output 2 can be turned ON by operation of the start input), the solenoid output is OFF.
	TEACH mode	When safety output 2 is OFF, the solenoid output is ON. When safety output 2 is ON, the solenoid output is OFF.



Warning

The solenoid outputs are not safety output. Do not use these to construct a safety system.

Note. The solenoid output is OFF in each state except Run state.



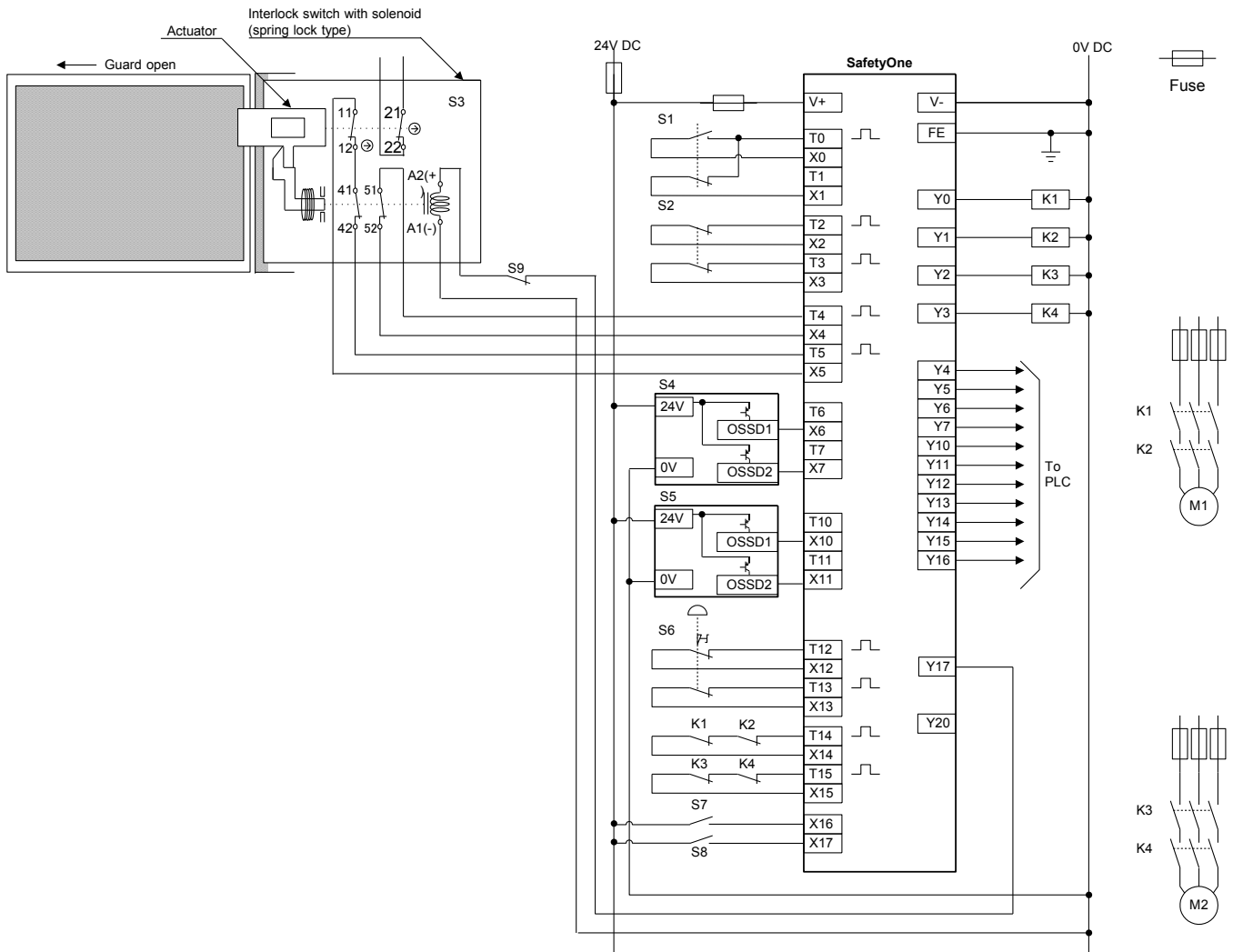
Caution

Refer to "Chapter 2 PRODUCT SPECIFICATIONS" for specifications of each input and output.

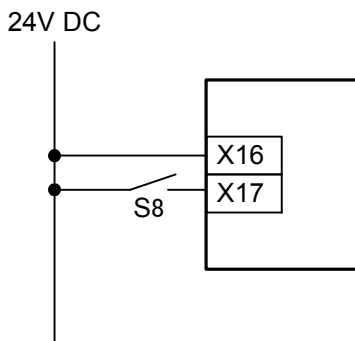
Wiring example (Logic 13b)

In the case where 1 selector switch, 1 enabling switch, 1 interlock switch with solenoid (spring lock type), 2 safety light curtains, and 1 emergency stop switch are connected.

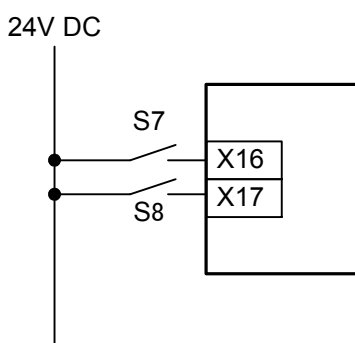
- S1 :Selector switch
 - S2 :Enabling switch
 - S3 :Interlock switch with solenoid (spring lock type)
 - S4, 5 :Safety light curtain
 - S6 :Emergency stop switch
 - S7, 8 :Start switch
 - S9 :Solenoid control switch
- (Pressing the solenoid control switches after closing the guard door, contacts 41-42 and 51-52 of S3 turn on, allowing the SafetyOne to restart.)
- K1 to 4 :Contactor
 - M1, 2 :Motor



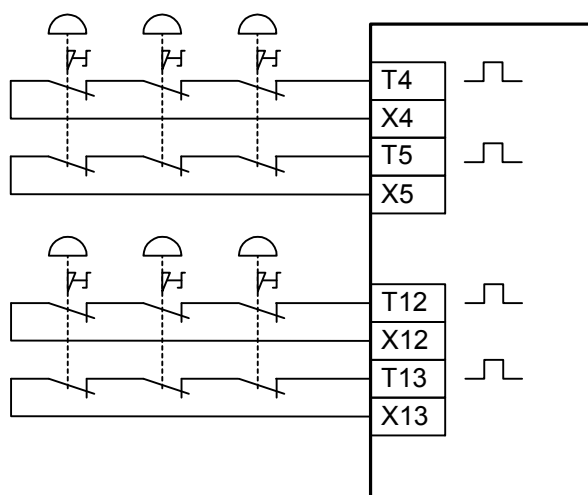
**When not using the start switch S7
(Auto start)**



**When using the start switch S7
(Manual start)**



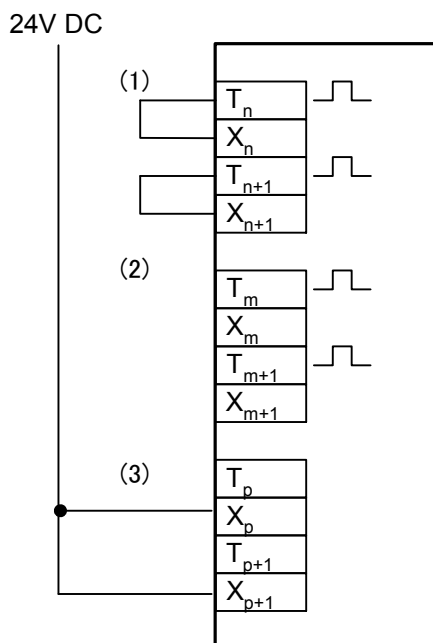
**When connecting multiple emergency stop switches
in series**



NOTE: Safety performance depends on the system configuration.

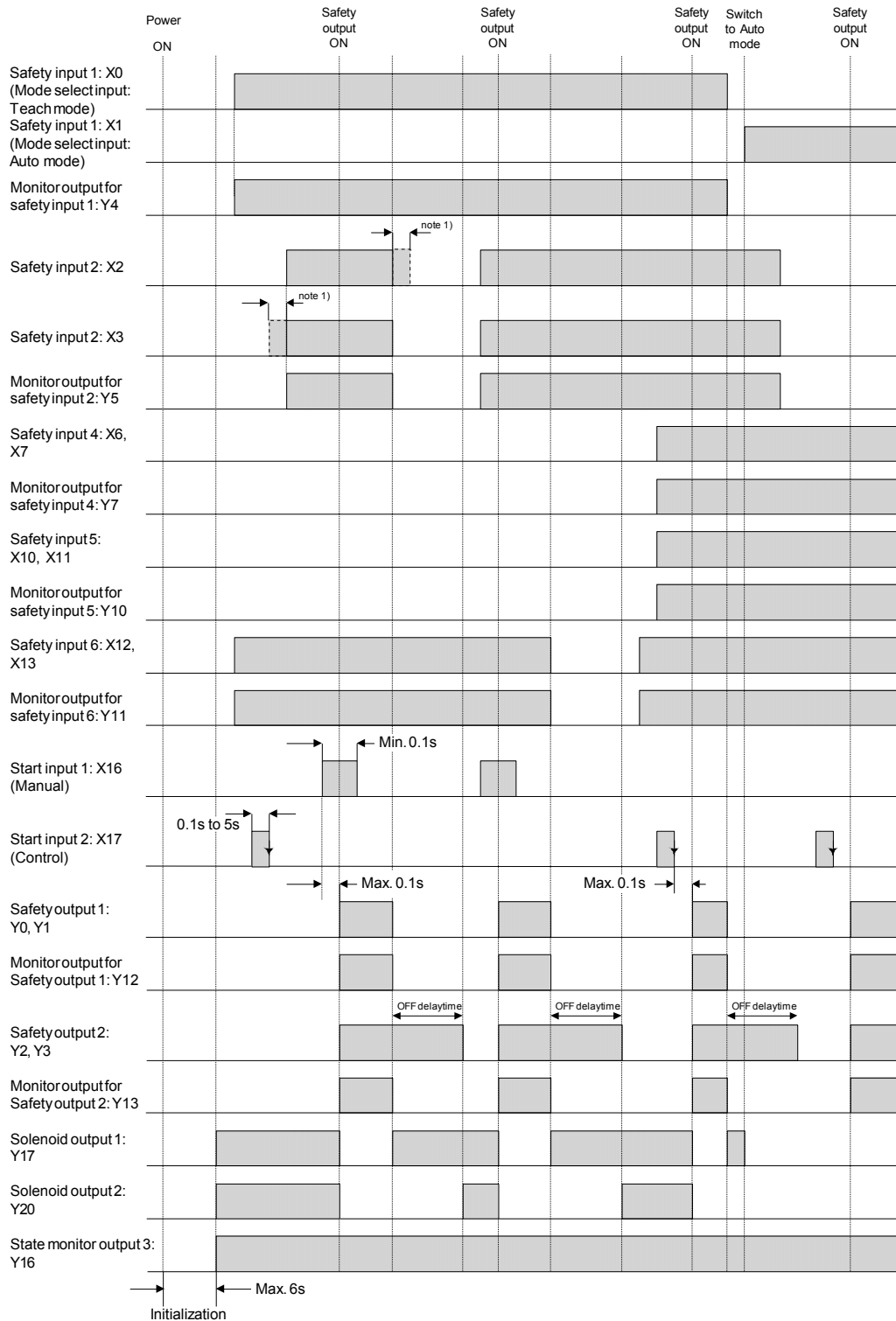
When not using some safety inputs

- If there are unused safety inputs in S3 and S6, connect the unused receive terminals to the corresponded drive terminals. (Refer to (1))
- If use only one of S4 and S5, open between the unused receive terminals and drive terminals. (Refer to (2))
- If unuse both of S4 and S5, connect the receive rminals to DC power supply 24V DC. (Refer to (3))



Timing chart (Logic 13b)

Example: Teach mode

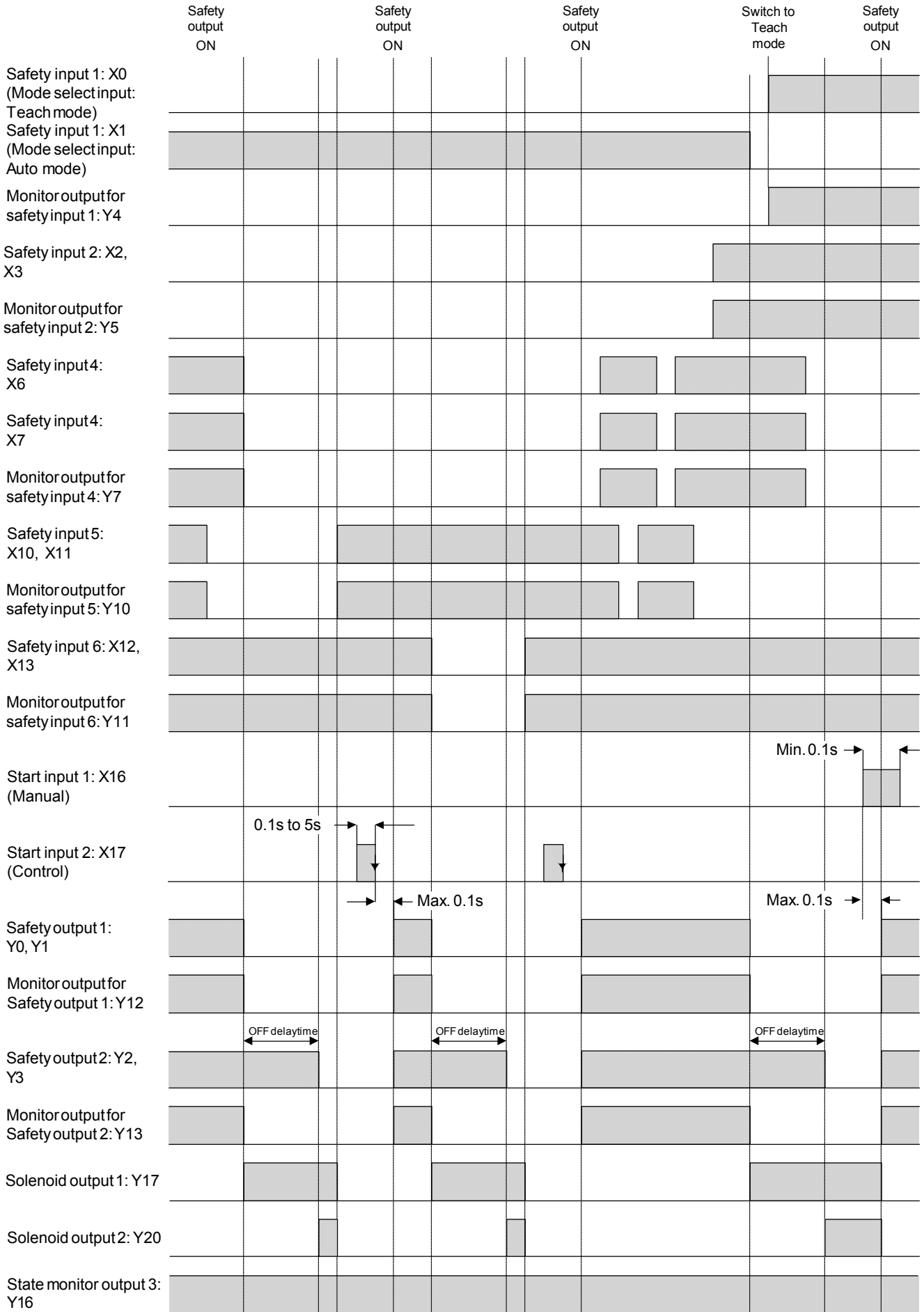


(Safety input 3 is ON in this chart.)

Note 1) Input monitor error detection time is infinity.

About safety inputs that are not described in this chart, input monitor error detection time is as follows.
 The time of dual channel direct opening input (X4, X5, X12 and X13) is 0.5.
 The time of dual channel safety input (X6 to X11) is 0.1s.
 Refer to the following "Logic functions" for more details.

Example: Auto mode



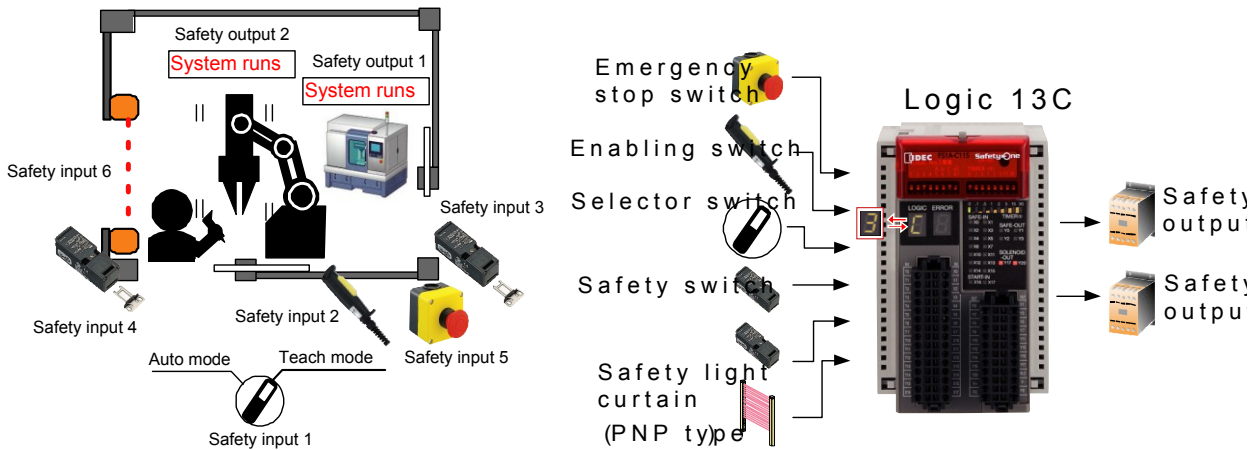
(Safety input 3 is ON in this chart.)

Logic 13C: Partial stop logic applicable for selection of active safety input devices

Overview (Logic 13C)

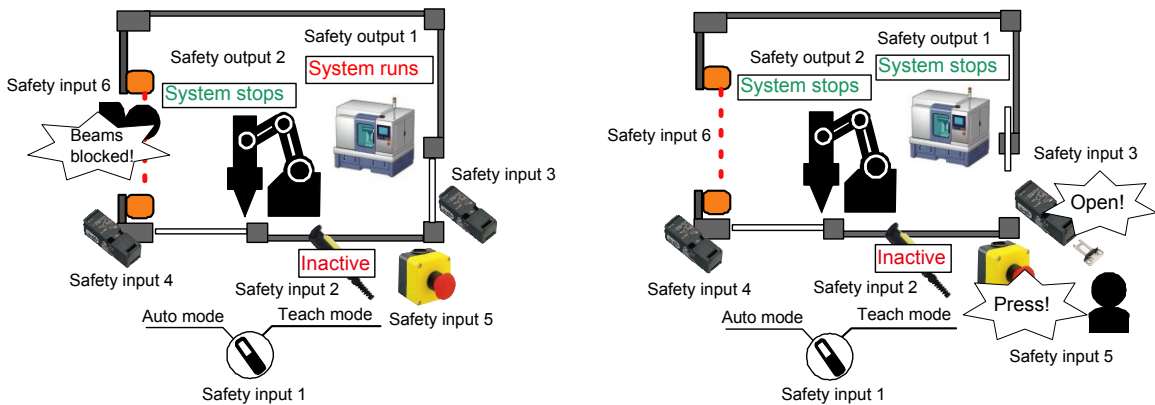
For production machines, robots, and the like, a hazard is generally isolated by a protective door (guard); however, when performing teaching or maintenance, the machine is operated in the condition that a person is in the danger zone. For such a situation, this logic described is applicable to the mode selection between Teach mode (maintenance mode) and Auto mode (operating mode). Safety outputs perform as dual channel safety outputs.

This logic enables the connection of 3 dual channel direct opening inputs, 1 mode select input, 1 dual channel dependent input, 1 dual channel safety input.

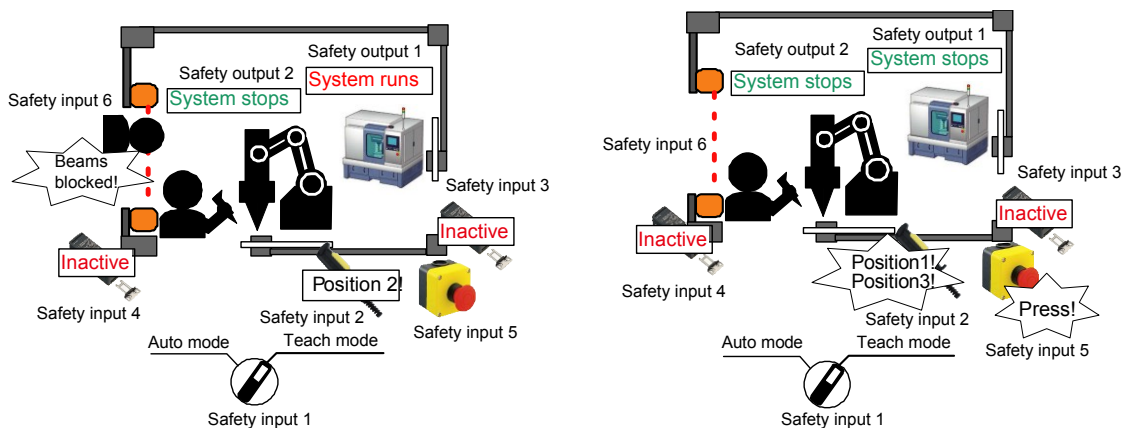


Operation example (Logic 13C)

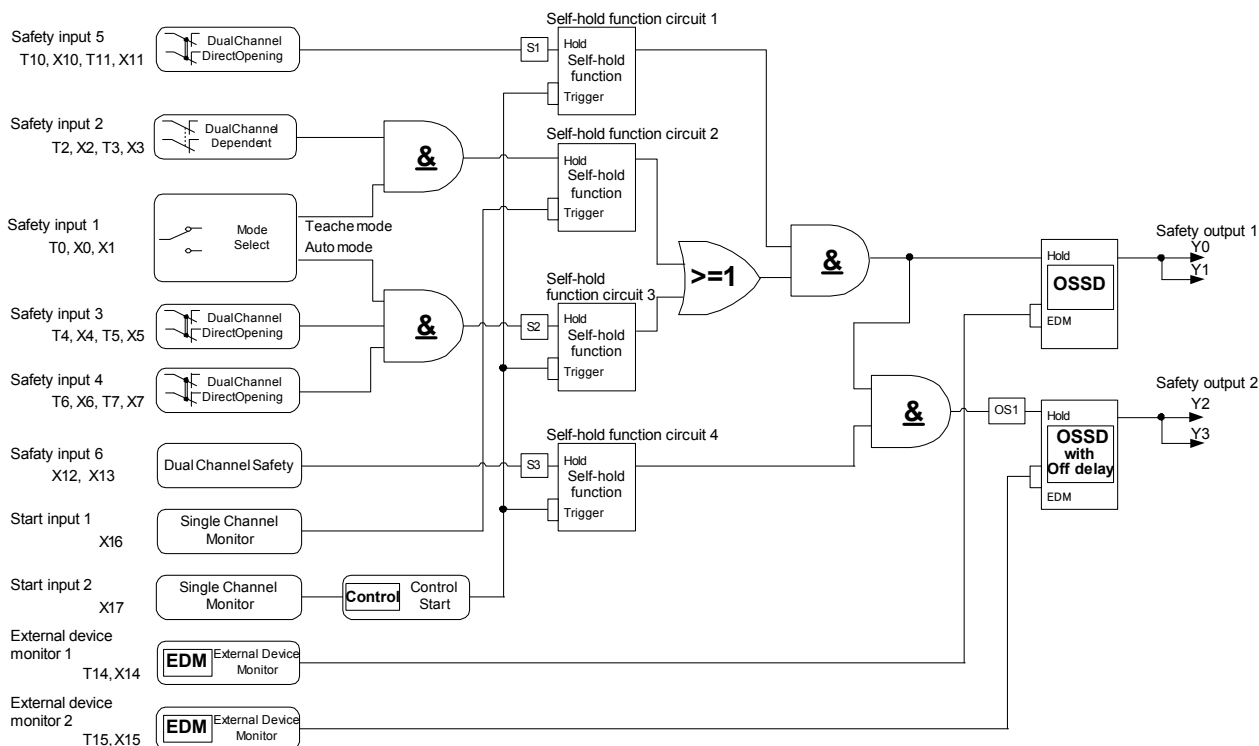
•Auto mode



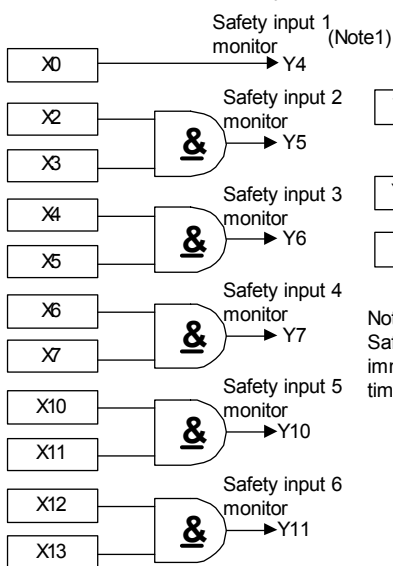
•Teach mode



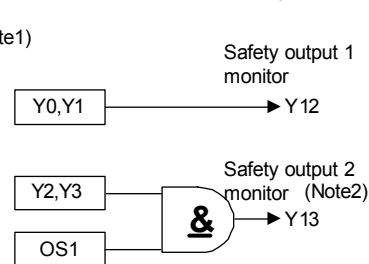
Logic circuit (Logic 13C)



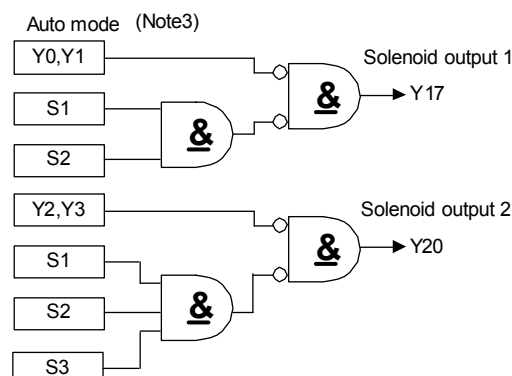
Monitor output for safety input
 Monitor output for safety output
 Solenoid output



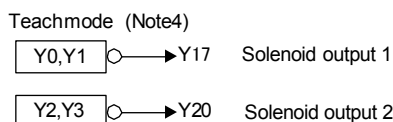
Note1:
When safety input 1 is Auto mode, the monitor for safety input 1 is turned OFF.



Note2:
Safety output 2 monitor turns OFF immediately independent of OFF-delay time.



Note3:
Auto mode:
In Run state, when the safety outputs are OFF and one or more corresponding safety inputs are OFF, the solenoid outputs turn ON.
When all corresponding safety inputs are ON, the solenoid outputs turn OFF even when the start input is OFF.

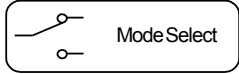


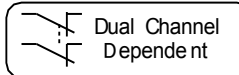
Note4:
Teach mode:
In Run state, when the safety outputs are OFF, the solenoid outputs turn ON.

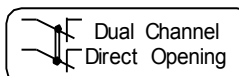
Functions (Logic 13C)

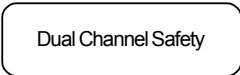
●**Safety inputs: X0 to X13 (T0, T2 to T11)**

Safety inputs are used to diagnose the status of connected safety devices, such as emergency stop switches, interlock switches, and mode select switches.

Intended inputs (Terminal names)	Function	
Safety input 1 (X0/X1-T0)	Function name	Mode select input
	Symbol	
	Description of operation	This function is for connecting devices with a mode selector function, such as mode selector switch. This function diagnoses time interval of status transition between each input (0.5s)
	Detail information	Logic functions (5-319)

Intended inputs (Terminal names)	Function	
Safety input 2 (X2-T2, X3-T3)	Function name	Dual channel dependent input
	Symbol	
	Description of operation	This function diagnoses the status of connected safety devices. This function does not diagnose the time interval of status transition between each input of duplicated inputs.
	Detail information	Logic functions (5-313)

Intended inputs (Terminal names)	Function	
Safety input 3 (X4-T4, X5-T5) Safety input 4 (X6-T6, X7-T7) Safety input 5 (X10-T10, X11-T11)	Function name	Dual channel direct opening input
	Symbol	
	Description of operation	This function diagnoses the status of connected safety devices. This function diagnoses the time interval of status transition between each input of duplicated inputs (0.5s).
	Detail information	Logic functions (5-311)

Intended inputs (Terminal names)	Function	
Safety input 6 (X12, X13)	Function name	Dual channel safety input
	Symbol	
	Description of operation	This function diagnoses the status of connected safety devices. This function diagnoses the time interval of status transition between each input of duplicated inputs (0.1s). The function does not use drive terminals (T12, T13).
	Detail information	Logic functions (5-317)

**Warning**

For connected control devices, refer to “SAFETY PRECAUTIONS”.

Safety check signals (pulses signals) are sent from the drive terminals (T0, T2 to T11) to diagnose connected safety devices and input circuits. Safety check signals can not be used as a power supply for connected devices.

Note. Solid state outputs, such as safety light curtains, can not be connected to safety input 1 through Safety input 5.

Note. Use safety input 1 through Safety input 5, as specified combinations, such as receive terminal (Xn) and drive terminal (Tn). If the combinations are incorrect, SafetyOne does not work correctly.


Note. When SafetyOne is in Run state or Protection state, input states are monitored in all safety inputs. For example, if input monitor error is detected in safety input 2 although AUTO mode is selected, SafetyOne detects error and transits to Protection state.

Note. If there are unused safety inputs in safety input 2 through safety input 5, connect the unused receive terminals (Xn) to the corresponding drive terminals (Tn). If they are not connected, the SafetyOne does not turn ON the safety outputs.

Note. If safety input 6 is not used, connect the receive terminals (X12 and X13) to a 24V DC power supply (V+). If they are not connected, the SafetyOne does not turn ON the safety outputs.

●External device monitor inputs: X14 and X15 (T14 and T15)

External device monitor inputs are used to diagnose status of the devices connected to safety outputs.

Intended inputs (Terminal names)	Target safety outputs (Terminal names)	Function	
External device monitor input 1 (X14-T14)	Safety output 1 (Y0, Y1)	Function name	External device monitor input
External device monitor input 2 (X15-T15)	Safety output 2 (Y2, Y3)	Symbol	
		Description of operation	This function diagnoses the status of devices connected to a target safety output.
		Detail information	Logic functions (5-326)

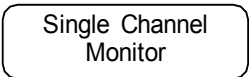



Safety check signals (pulses signals) are sent from the drive terminals (T14, T15) to diagnose external devices and monitor circuits. Safety check signals can not be used as a power supply for connected devices.

Note. If there are unused safety outputs, connect the intended external device monitor terminals (Xn) to the corresponding drive terminals (Tn). If they are not connected, the SafetyOne detects an input monitor error. As the result, the error LED displays a “1” and the unit changes to the Protection state.

● **Start inputs: X16 and X17**

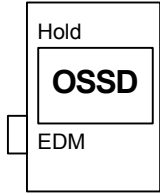
Start inputs are used to control the start of safety outputs.

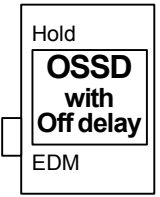
Intended inputs (Terminal names)	Target safety inputs (Terminal names)	Function	
		Start input 1 (X16)	Safety input 1 (X0-T0: TEACH) Safety input 2 (X2-T2, X3-T3)
Symbol			
Description of operation	Safety outputs are started, when all target safety inputs are in the safe state and this function is in the ON state. This function is turned ON by 0.1s or more ON operation.		
Detail information	Logic functions (5-325)		

Intended inputs (Terminal names)	Target safety inputs (Terminal names)	Function	
		Start input 2 (X17)	Safety input 1 (X1-T0: AUTO) Safety input 3 (X4-T4, X5-T5) Safety input 4 (X6-T6, X7-T7) Safety input 5 (X10-T10, X11-T11) Safety input 6 (X12, X13)
Symbol			
Description of operation	Safety outputs are started, when this function becomes ON after all intended safety inputs are in the safe state. This function is turned ON by 0.1s to 5s ON operation.		
Detail information	Logic functions (5-325, 330)		

● **Safety outputs: Y0 to Y3**

Safety outputs are used to output safety information processed by SafetyOne.

Intended outputs (Terminal names)	Function	
Safety output 1 (Y0, Y1)	Function name	Safety output without timer
	Symbol	
	Description of operation	This function is a safety output to output safety information processed by SafetyOne. The output is turned OFF immediately by OFF operation (instantaneous OFF output).
	Detail information	Logic functions (5-332)

Intended outputs (Terminal names)	Function	
Safety output 2 (Y2, Y3)	Function name	Safety output with timer
	Symbol	
	Description of operation	This function is a safety output to output safety information processed by SafetyOne. The output is turned OFF after the preset time of the OFF-delay timer (OFF-delay output).
	Detail information	Logic functions (5-335)

Note. When the SafetyOne changes to Protection state due to input monitor error, safety output without timer (safety output 1) is turned OFF. Safety output with timer (safety output 2) is turned OFF after the preset OFF-delay time.

Note. When the SafetyOne changes to Stop state due to circuit failure or other errors, all safety outputs (safety output 1 and safety output 2) are turned OFF, immediately.

Note. Set time of safety output with timer is active independent of the selected mode.

Safety input monitor outputs: Y4 to Y11

Safety input monitor outputs are used to output the status of safety inputs in SafetyOne.

Intended outputs (Terminal names)	Target safety inputs (Terminal names)	Description of operation
Safety input 1 monitor output (Y4)	Safety input 1 (X0-T0: TEACH)	When TEACH mode (X0) is selected, the monitor output is ON. When TEACH mode is not selected, the monitor output is OFF. When the target safety input is ON, the monitor output is ON. When the target safety input is OFF, the monitor output is OFF.
Safety input 2 monitor output (Y5)	Safety input 2 (X2-T2, X3-T3)	
Safety input 3 monitor output (Y6)	Safety input 3 (X4-T4, X5-T5)	
Safety input 4 monitor output (Y7)	Safety input 4 (X6-T6, X7-T7)	
Safety input 5 monitor output (Y10)	Safety input 5 (X10-T10, X11-T11)	
Safety input 6 monitor output (Y11)	Safety input 6 (X12, X13)	

Note. When the targeted safety input detects an input monitor error, input circuit failure or EMC the disturbance, corresponding safety input monitor output becomes a pulse output (1Hz). The monitor output is OFF in other errors, Initial state, or Configuration state.

•Safety output monitor outputs: Y12 and Y13

Safety output monitor outputs are used to output the status of safety outputs in SafetyOne.

Intended outputs (Terminal names)	Target safety outputs (Terminal names)	Description of operation
Safety output 1 monitor output (Y12)	Safety output 1 (Y0, Y1)	When the target safety output is ON, the monitor output is ON. When the target safety output is OFF, this function is OFF. The monitor output turns OFF immediately, independent of the preset OFF-delay time.
Safety output 2 monitor output (Y13)	Safety output 2 (Y2, Y3)	

Note. When the safety output detects an output circuit failure, corresponding safety output monitor output becomes a pulse output (1Hz). The monitor output is OFF in other errors, Initial state, or Configuration state.

● **State monitor outputs: Y14 to Y16**

State monitor outputs are used to output the internal state of SafetyOne.

Intended outputs (Terminal names)	State				
	Initial	Run	Configuration	Protection	Stop
State monitor output 1 (Y14)	■ON	□OFF	□OFF	□OFF	■ON
State monitor output 2 (Y15)	■ON	□OFF	■ON	■ON	■ON or □OFF
State monitor output 3 (Y16)	□OFF	■ON	□OFF	□OFF	□OFF

Refer to “Chapter 4 BASIC OPERATIONS” and to “Chapter 6 TROUBLE SHOOTING” for details of each state.



Warning

The monitor outputs are not safety outputs. Do not use these to construct a safety system.

● **Solenoid outputs: Y17 and Y20**

Solenoid outputs are used to control a solenoid in an interlock switch. The operations of solenoid outputs are different by the selected mode.

Intended outputs (Terminal names)	Description of operation	
	Solenoid output 1 (Y17)	AUTO mode
TEACH mode		When safety output 1 is OFF, the solenoid output is ON. When safety output 1 is ON, the solenoid output is OFF.
Solenoid output 2 (Y20)	AUTO mode	When safety output 2 is OFF, the solenoid output is ON. When safety Output 2 is ready to turn ON (safety output 2 can be turned ON by operation of the start input), the solenoid output is OFF.
	TEACH mode	When safety output 2 is OFF, the solenoid output is ON. When safety output 2 is ON, the solenoid output is OFF.



Warning

The solenoid outputs are not safety output. Do not use these to construct a safety system.

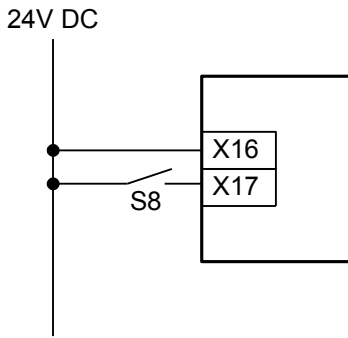
Note. The solenoid output is OFF in each state except Run state.



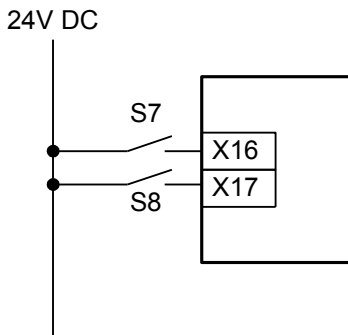
Caution

Refer to "Chapter 2 PRODUCT SPECIFICATIONS" for specifications of each input and output.

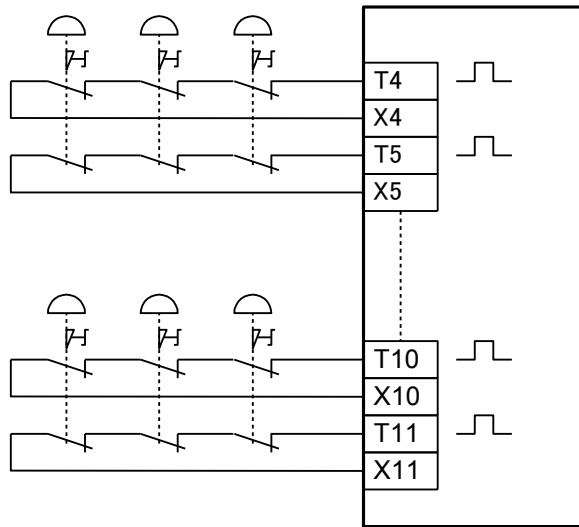
**When not using the start switch S7
(Auto start)**



**When using the start switch S7
(Manual start)**



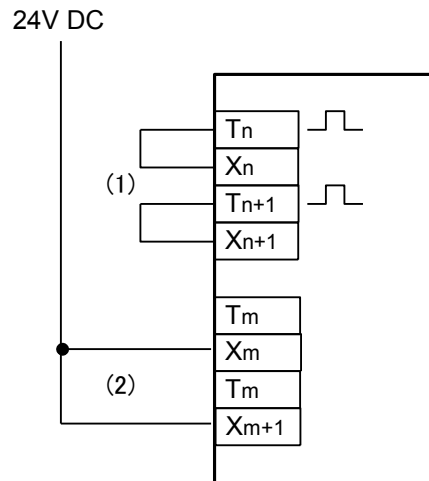
**When connecting multiple emergency stop switches
in series**



NOTE: Safety performance depends on the system configuration.

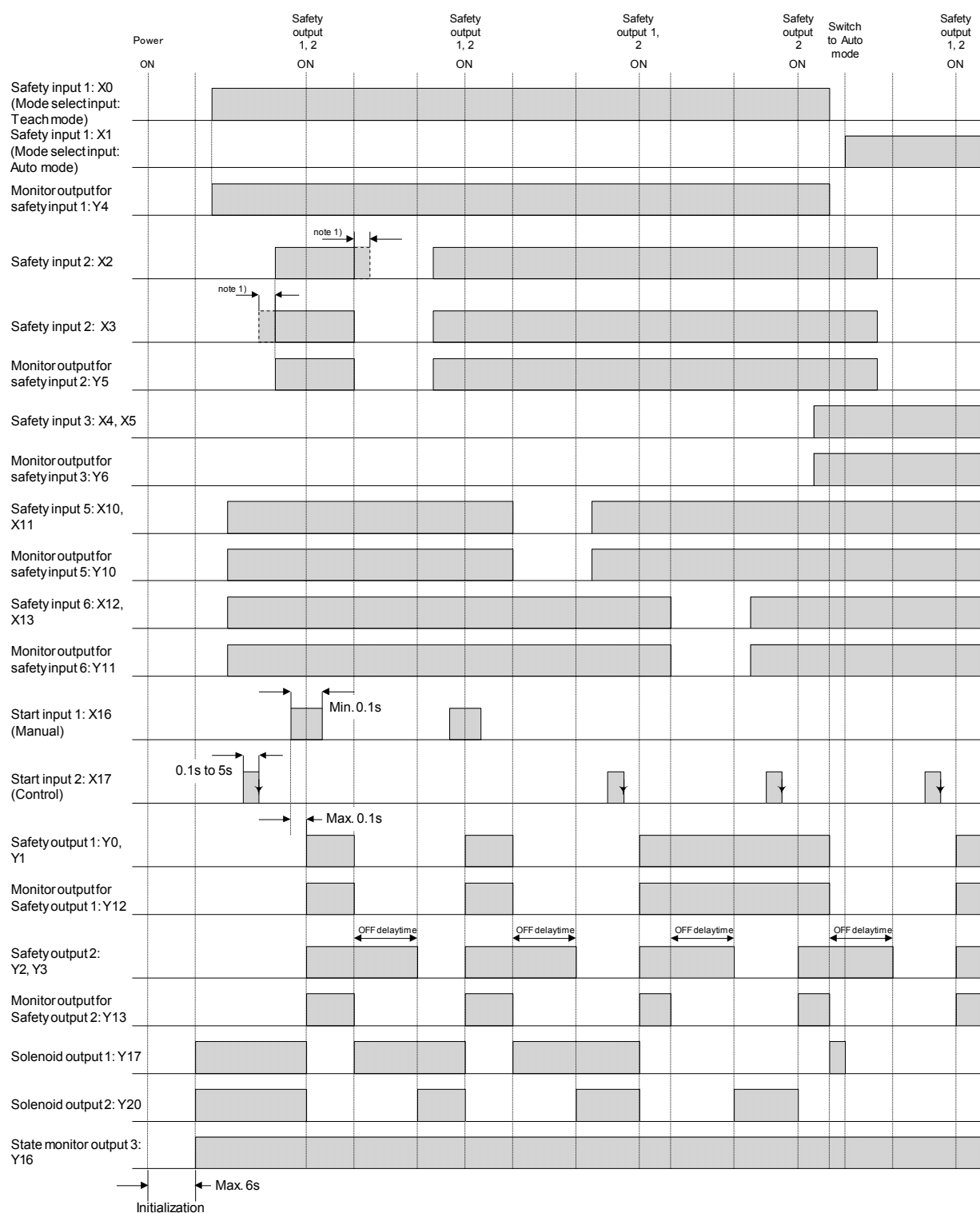
When not using some safety inputs

- If there are unused safety inputs in S3 to S5, connect the unused receive terminals to the corresponding drive terminals. (Refer to (1))
- If S6 is not used, connect the receive terminal to 24V DC power supply (V+). (Refer to (2))



Timing chart (Logic 13C)

Example: Teach mode



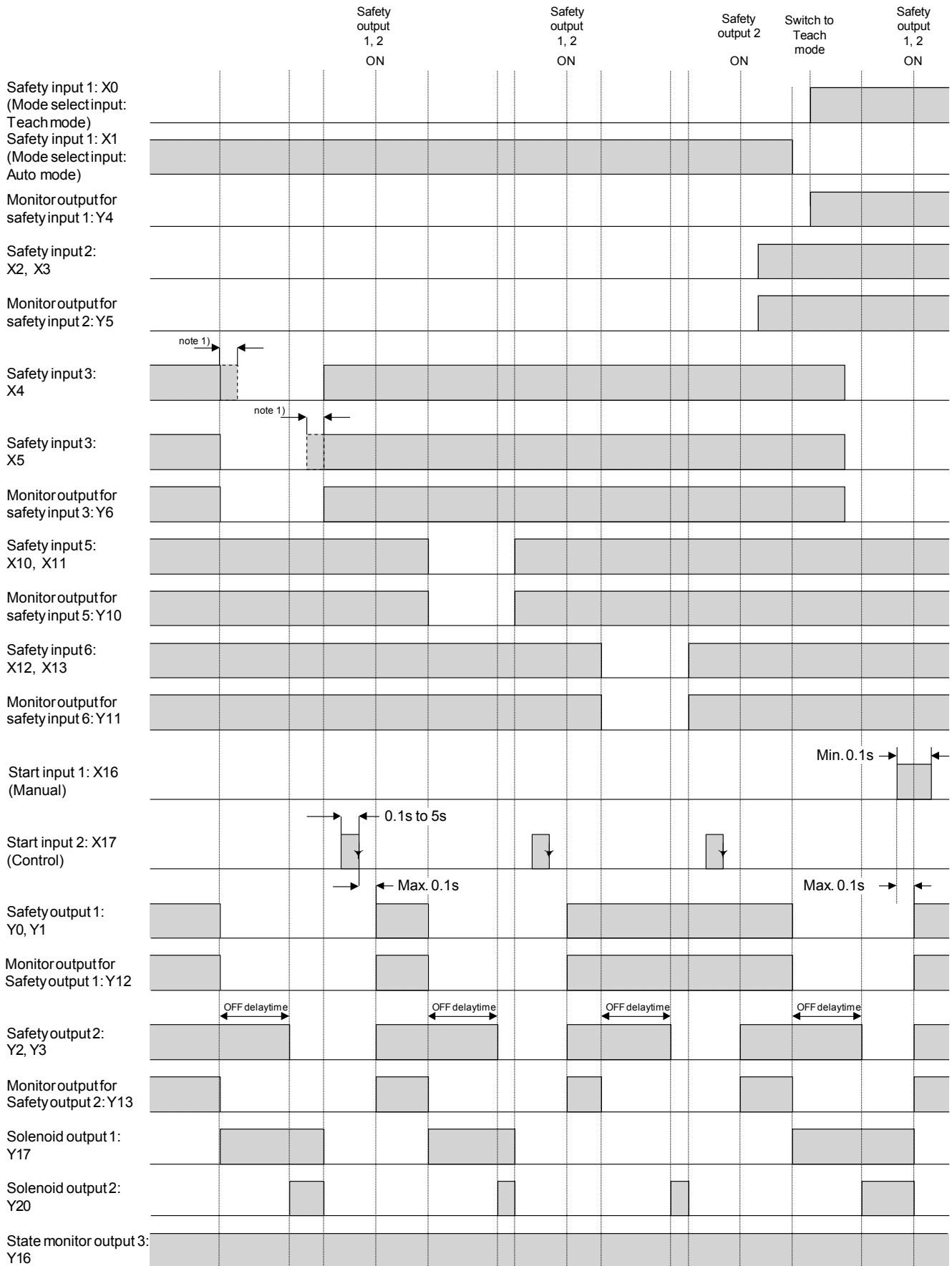
(Safety input 4 is ON in this chart.)

Note 1) Input monitor error detection time is infinity.

About safety inputs that are not described in this chart, input monitor error detection time is as follows.
 The time of dual channel direct opening input (X4 and X11) is 0.5.
 The time of dual channel safety input (X12, X13) is 0.1s.
 Refer to the following "Logic functions" for more details.

LOGIC

Example: Auto mode

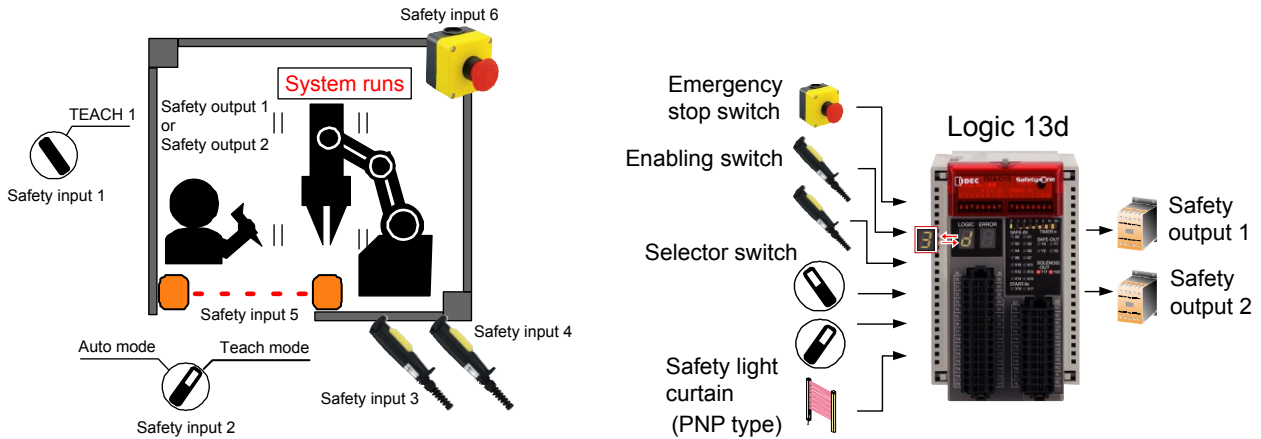


(Safety input 4 is ON in this chart.)

Logic 13d: The logic applicable for selection of active safety input devices

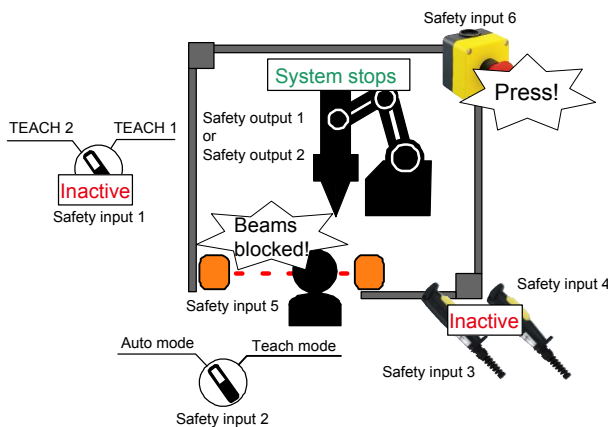
Overview (Logic 13d)

For production machines, robots, and the like, a hazard is generally isolated by a protective door (guard), however, when performing teaching or maintenance, the machine is operated in the condition that a person is in the danger zone. For such a situation, this logic described is applicable to the mode selection between Teach mode (maintenance mode) and Auto mode (operating mode). Furthermore, the mode can be selected as “TEACH 1” and “TEACH 2” in Teach mode (maintenance mode). Safety outputs perform as dual channel outputs. This logic enables the connection of 1 dual channel direct opening inputs, 2 mode select inputs, 2 dual channel dependent inputs, 1 dual channel safety input.

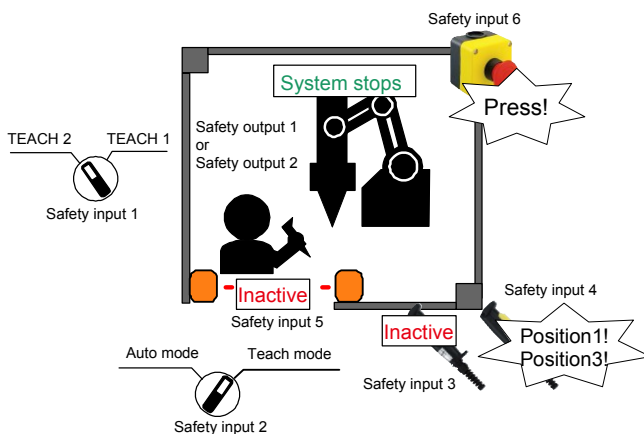


Operation example (Logic 13d)

●Auto mode

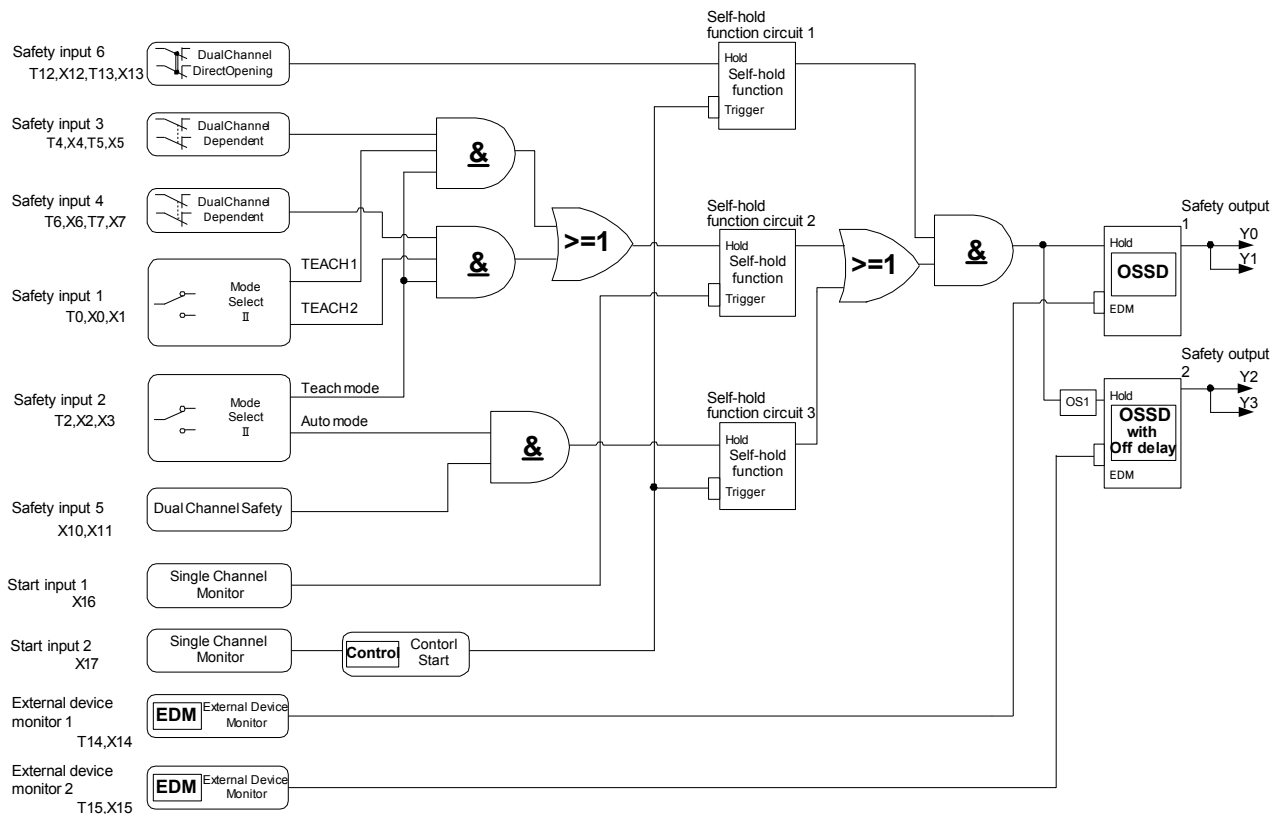


●Teach mode (TEACH 2 (X1) is selected)

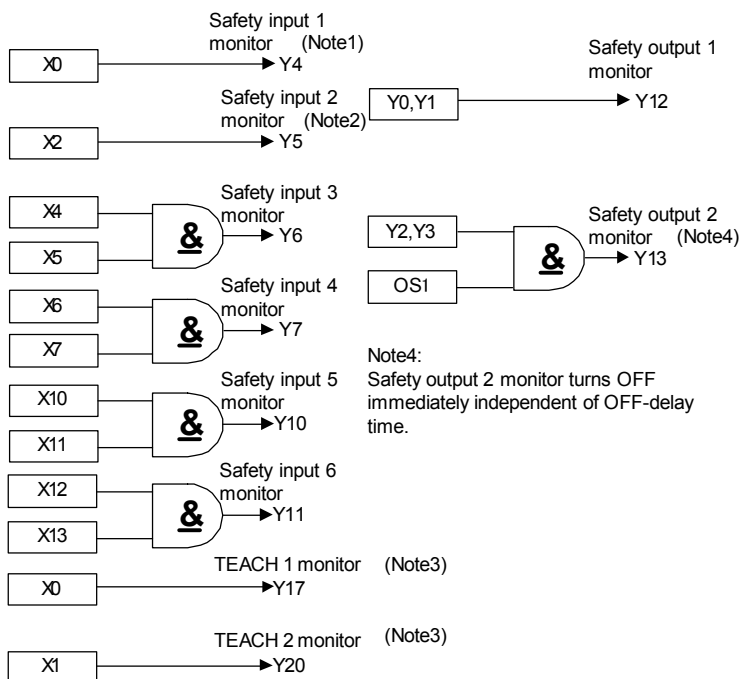


Note. When safety input 1 is TEACH 1, safety input 3 is active and safety input 4 is inactive in Teach mode.

Logic circuit (Logic 13d)



● Monitor output for safety input ● Monitor output for safety output



Note1:
When safety input 1 is THACH 2,
the safety input 1 monitor is turned OFF.

Note2:
When safety input 2 is Auto mode,
the safety input 2 monitor is turned OFF.

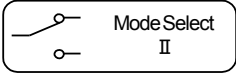
Note3:
Each state exception of Run state,
TEACH 1 monitor and TEACH 2 monitor are turned OFF.

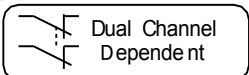
Note4:
Safety output 2 monitor turns OFF
immediately independent of OFF-delay
time.

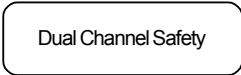
Functions (Logic 13d)

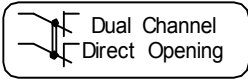
●**Safety inputs: X0 to X13 (T0, T2, T4 to T7, T12, T13)**

Safety inputs are used to diagnose the status of connected safety devices, such as emergency stop switches, interlock switches, and mode select switches.

Intended inputs (Terminal names)	Function	
Safety input 1 (X0/X1-T0) Safety input 2 (X2/X3-T2)	Function name	Mode select input II
	Symbol	
	Description of operation	This function is for connecting devices with a mode selector function, such as mode selector switch. When the switching of inputs is performed within 3s, this function output is kept at previous state. This function diagnoses time interval of status transition between each input (0.5s).
	Detail information	Logic functions (5-321)

Intended inputs (Terminal names)	Function	
Safety input 3 (X4-T4, X5-T5) Safety input 4 (X6-T6, X7-T7)	Function name	Dual channel dependent input
	Symbol	
	Description of operation	This function diagnoses the status of connected safety devices. This function does not diagnose the time interval of status transition between each input of duplicated inputs.
	Detail information	Logic functions (5-313)

Intended inputs (Terminal names)	Function	
Safety input 5 (X10, X11)	Function name	Dual channel safety input
	Symbol	
	Description of operation	This function diagnoses the status of connected safety devices. This function diagnoses the time interval of status transition between each input of duplicated inputs (0.1s). The function does not use drive terminals (T10, T11).
	Detail information	Logic functions (5-317)

Intended inputs (Terminal names)	Function	
Safety input 6 (X12-T12, X13-T13)	Function name	Dual channel direct opening input
	Symbol	
	Description of operation	This function diagnoses the status of connected safety devices. This function diagnoses the time interval of status transition between each input of duplicated inputs (0.5s).
	Detail information	Logic functions (5-311)

 **Warning**

For connected control devices, refer to “SAFETY PRECAUTIONS”.

Safety check signals (pulses signals) are sent from the drive terminals (T0, T2, T4 to T7, T12, T13) to diagnose connected safety devices and input circuits. Safety check signals can not be used as a power supply for connected devices.

Note. Solid state outputs, such as safety light curtains, can not be connected to safety input 1 through Safety input 4, and safety input 6.

Note. Use safety input 1 through safety input 4, and safety input 6, as specified combinations, such as receive terminal (Xn) and drive terminal (Tn). If the combinations are incorrect, SafetyOne does not work correctly.


Note. When SafetyOne is in Run state or Protection state, input states are monitored in all safety inputs. For example, if input monitor error is detected in safety input 3 or safety input 4 although AUTO mode is selected, SafetyOne detects error and transits to Protection state.

Note. If there are unused safety inputs in safety input 3, safety input 4 or safety input 6, connect the unused receive terminals (Xn) to the corresponding drive terminals (Tn). If they are not connected, the SafetyOne does not turn ON the safety outputs.

Note. If safety input 5 is not used, connect the receive terminals (X10 and X11) to a 24V DC power supply (V+). If they are not connected, the SafetyOne does not turn ON the safety outputs.

●External device monitor inputs: X14 and X15 (T14 and T15)

External device monitor inputs are used to diagnose status of the devices connected to safety outputs.

Intended inputs (Terminal names)	Target safety outputs (Terminal names)	Function	
External device monitor input 1 (X14-T14)	Safety output 1 (Y0, Y1)	Function name	External device monitor input
External device monitor input 2 (X15-T15)	Safety output 2 (Y2, Y3)	Symbol	
		Description of operation	This function diagnoses the status of devices connected to a target safety output.
		Detail information	Logic functions (5-326)

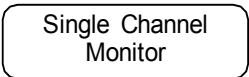



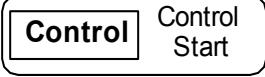
Safety check signals (pulses signals) are sent from the drive terminals (T14, T15) to diagnose external devices and monitor circuits. Safety check signals can not be used as a power supply for connected devices.

Note. If there are unused safety outputs, connect the intended external device monitor terminals (Xn) to the corresponding drive terminals (Tn). If they are not connected, the SafetyOne detects an input monitor error. As the result, the error LED displays a “1” and the unit changes to the Protection state.

● **Start inputs: X16 and X17**

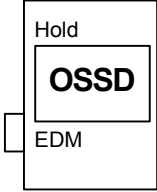
Start inputs are used to control the start of safety outputs.

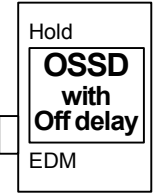
Intended inputs (Terminal names)	Target safety inputs (Terminal names)	Function	
		Start input 1 (X16)	Safety input 1 (X0/X1-T0) Safety input 2 (X2-T2: TEACH) Safety input 3 (X4-T4, X5-T5) Safety input 4 (X6-T6, X7-T7)
		Symbol	
		Description of operation	Safety outputs are started, when all target safety inputs are in the safe state and this function is in the ON state. This function is turned ON by 0.1s or more ON operation.
		Detail information	Logic functions (5-325)

Intended inputs (Terminal names)	Target safety inputs (Terminal names)	Function	
		Start input 2 (X17)	Safety input 2 (X3-T2: AUTO) Safety input 5 (X10, X11) Safety input 6 (X12-T12, X13-T13)
		Symbol	 + 
		Description of operation	Safety outputs are started, when this function becomes ON after all intended safety inputs are in the safe state. This function is turned ON by 0.1s to 5s ON operation.
		Detail information	Logic functions (5-325, 330)

● **Safety outputs: Y0 to Y3**

Safety outputs are used to output safety information processed by SafetyOne.

Intended outputs (Terminal names)	Function	
Safety output 1 (Y0, Y1)	Function name	Safety output without timer
	Symbol	
	Description of operation	This function is a safety output to output safety information processed by SafetyOne. The output is turned OFF immediately by OFF operation (instantaneous OFF output).
	Detail information	Logic functions (5-332)

Intended outputs (Terminal names)	Function	
Safety output 2 (Y2, Y3)	Function name	Safety output with timer
	Symbol	
	Description of operation	This function is a safety output to output safety information processed by SafetyOne. The output is turned OFF after the preset time of the OFF-delay timer (OFF-delay output).
	Detail information	Logic functions (5-335)

Note. When the SafetyOne changes to Protection state due to input monitor error, safety output without timer (safety output 1) is turned OFF. Safety output with timer (safety output 2) is turned OFF after the preset OFF-delay time.

Note. When the SafetyOne changes to Stop state due to circuit failure or other errors, all safety outputs (safety output 1 and safety output 2) are turned OFF, immediately.

Note. Set time of safety output with timer is active independent of the selected mode.

Safety input monitor outputs: Y4 to Y11

Safety input monitor outputs are used to output the status of safety inputs in SafetyOne.

Intended outputs (Terminal names)	Target safety inputs (Terminal names)	Description of operation
Safety input 1 monitor output (Y4)	Safety input 1 (X0-T0: TEACH 1)	When TEACH 1(X0) is selected, the monitor output is ON. When TEACH 1 is not selected, the monitor output is OFF.
Safety input 2 monitor output (Y5)	Safety input 2 (X2-T2: TEACH mode)	When TEACH mode (X2) is selected, the monitor output is ON. When TEACH mode is not selected, the monitor output is OFF.
Safety input 3 monitor output (Y6)	Safety input 3 (X4-T4, X5-T5)	When the target safety input is ON, the monitor output is ON. When the target safety input is OFF, the monitor output is OFF.
Safety input 4 monitor output (Y7)	Safety input 4 (X6-T6, X7-T7)	
Safety input 5 monitor output (Y10)	Safety input 5 (X10, X11)	
Safety input 6 monitor output (Y11)	Safety input 6 (X12-T12, X13-T13)	

Note. When the targeted safety input detects an input monitor error, input circuit failure or EMC the disturbance, corresponding safety input monitor output becomes a pulse output (1Hz). The monitor output is OFF in other errors, Initial state, or Configuration state.

•Safety output monitor outputs: Y12 and Y13

Safety output monitor outputs are used to output the status of safety outputs in SafetyOne.

Intended outputs (Terminal names)	Target safety outputs (Terminal names)	Description of operation
Safety output 1 monitor output (Y12)	Safety output 1 (Y0, Y1)	When the target safety output is ON, the monitor output is ON. When the target safety output is OFF, this function is OFF. The monitor output turns OFF immediately, independent of the preset OFF-delay time.
Safety output 2 monitor output (Y13)	Safety output 2 (Y2, Y3)	

Note. When the safety output detects an output circuit failure, corresponding safety output monitor output becomes a pulse output (1Hz). The monitor output is OFF in other errors, Initial state, or Configuration state.

● **State monitor outputs: Y14 to Y16**

State monitor outputs are used to output the internal state of SafetyOne.

Intended outputs (Terminal names)	State				
	Initial	Run	Configuration	Protection	Stop
State monitor output 1 (Y14)	■ON	□OFF	□OFF	□OFF	■ON
State monitor output 2 (Y15)	■ON	□OFF	■ON	■ON	■ON or □OFF
State monitor output 3 (Y16)	□OFF	■ON	□OFF	□OFF	□OFF

Refer to “Chapter 4 BASIC OPERATIONS” and to “Chapter 6 TROUBLE SHOOTING” for details of each state.



Warning

The monitor outputs are not safety outputs. Do not use these to construct a safety system.

● **TEACH monitor outputs: Y17 and Y20**

TEACH monitor outputs are used to monitor which of TEACH 1 and TEACH 2 is selected in TEACH mode.

Intended outputs (Terminal names)	Target safety inputs (Terminal names)	Description of operation
TEACH 1 monitor output 1 (Y17)	Safety input 1 (X0-T0: TEACH 1)	When TEACH 1 (X0) is selected, the monitor output is ON. When TEACH 1 is not selected, the monitor output is OFF.
TEACH 2 monitor output 2 (Y20)	Safety input 1 (X1-T0: TEACH 2)	When TEACH 2 (X1) is selected, the monitor output is ON. When TEACH 2 is not selected, the monitor output is OFF.



Warning

The monitor outputs are not safety output. Do not use these to construct a safety system.



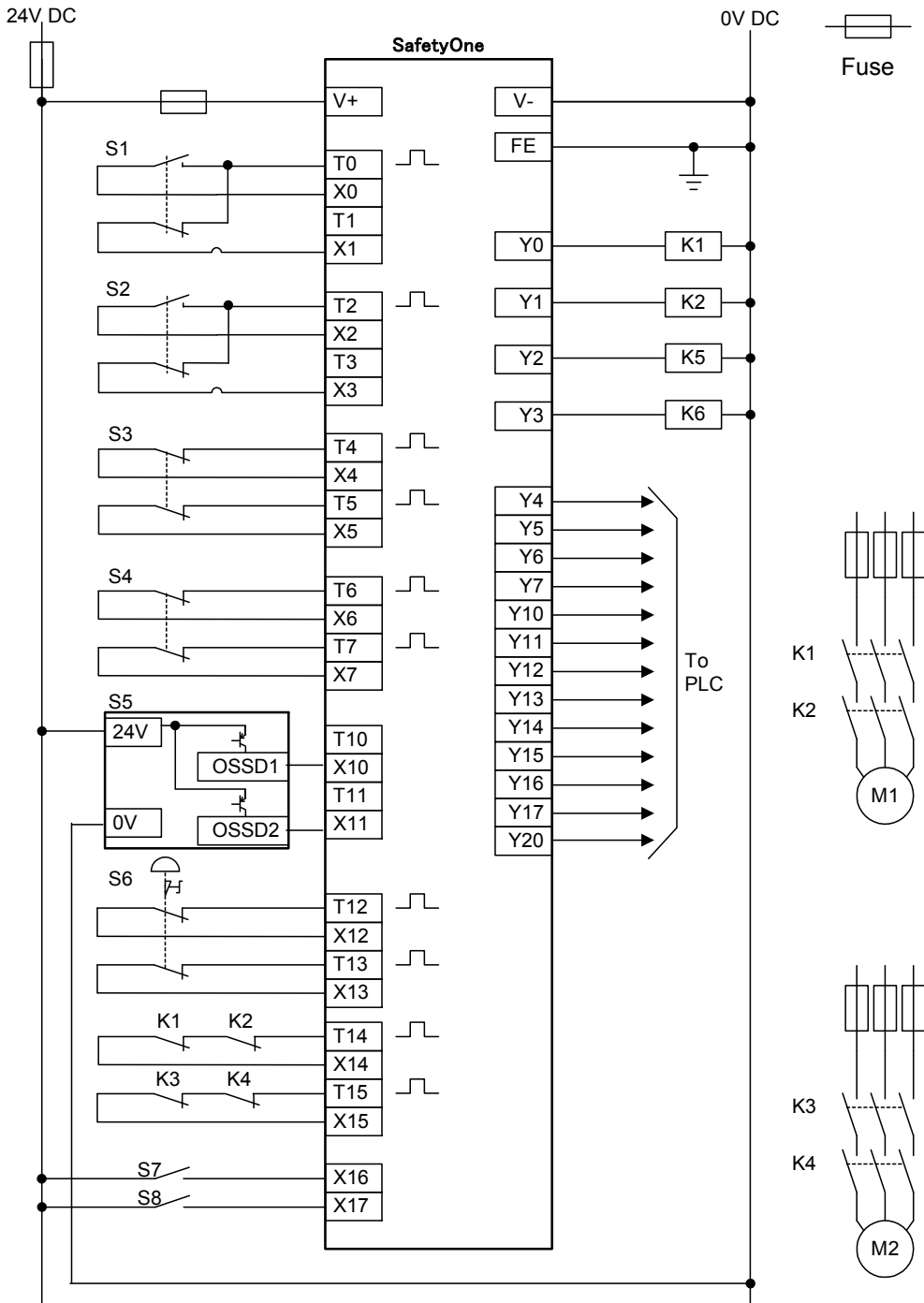
Caution

Refer to "Chapter 2 PRODUCT SPECIFICATIONS" for specifications of each input and output.

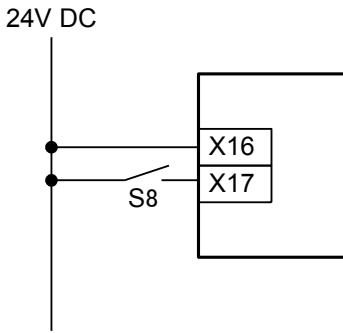
Wiring example (Logic 13d)

In the case where 2 selector switches, 2 enabling switches, 1 safety light curtains, and 1 emergency stop switch are connected.

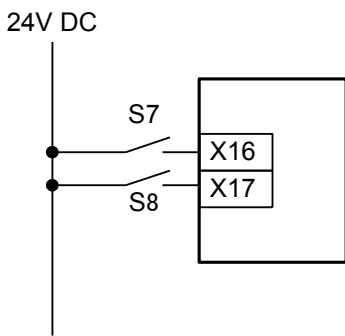
- S1, 2 :Selector switch
- S3, 4 :Enabling switch
- S5 :Safety light curtain
- S6 :Emergency stop switch
- S7, 8 :Start switch
- K1 to 4 :Contactor
- M1, 2 :Motor



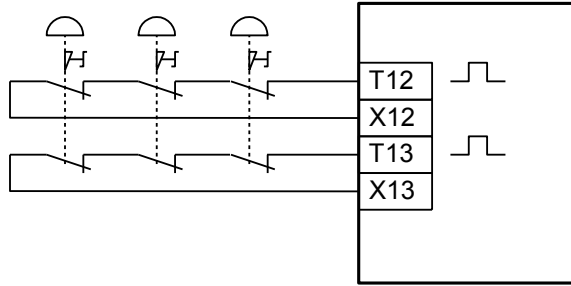
**When not using the start switch S7
(Auto start)**



**When using the start switch S7
(Manual start)**



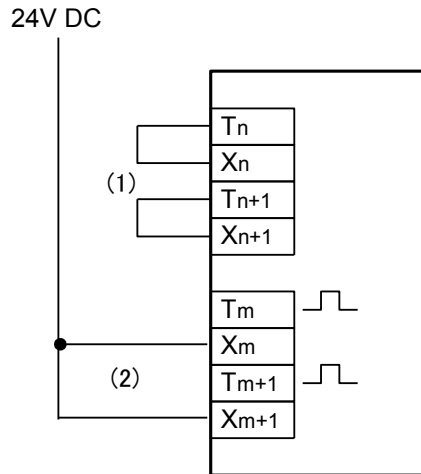
When connecting multiple emergency stop switches in series



NOTE: Safety performance depends on the system configuration.

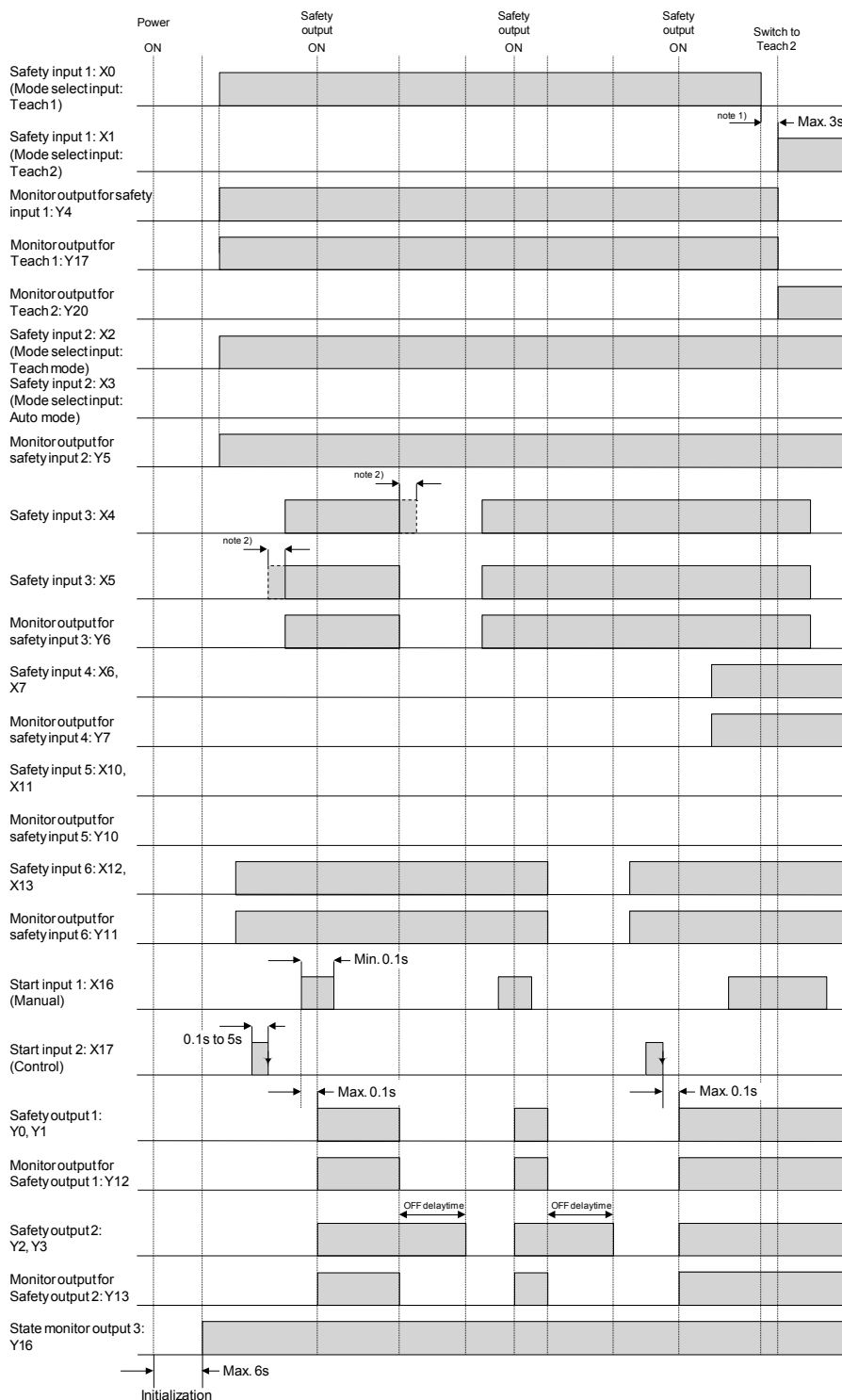
When not using some safety inputs

- If there are unused safety inputs in S3, S4, or S6, connect the unused receive terminals to the corresponding drive terminals. (Refer to (1))
- If S5 is not used, connect the receive terminal to 24V DC power supply (V+). (Refer to (2))



Timing chart (Logic 13d)

Example: TEACH 1



Note 1) When “Safety input 1 (mode select input)” is switched to another mode within 3s, all of “Safety output” are kept ON.

Note 2) Input monitor error detection time is infinity.

About safety inputs that are not described in this chart, input monitor error detection time is as follows.

The time of dual channel dependent input (X6, X7) is infinity.

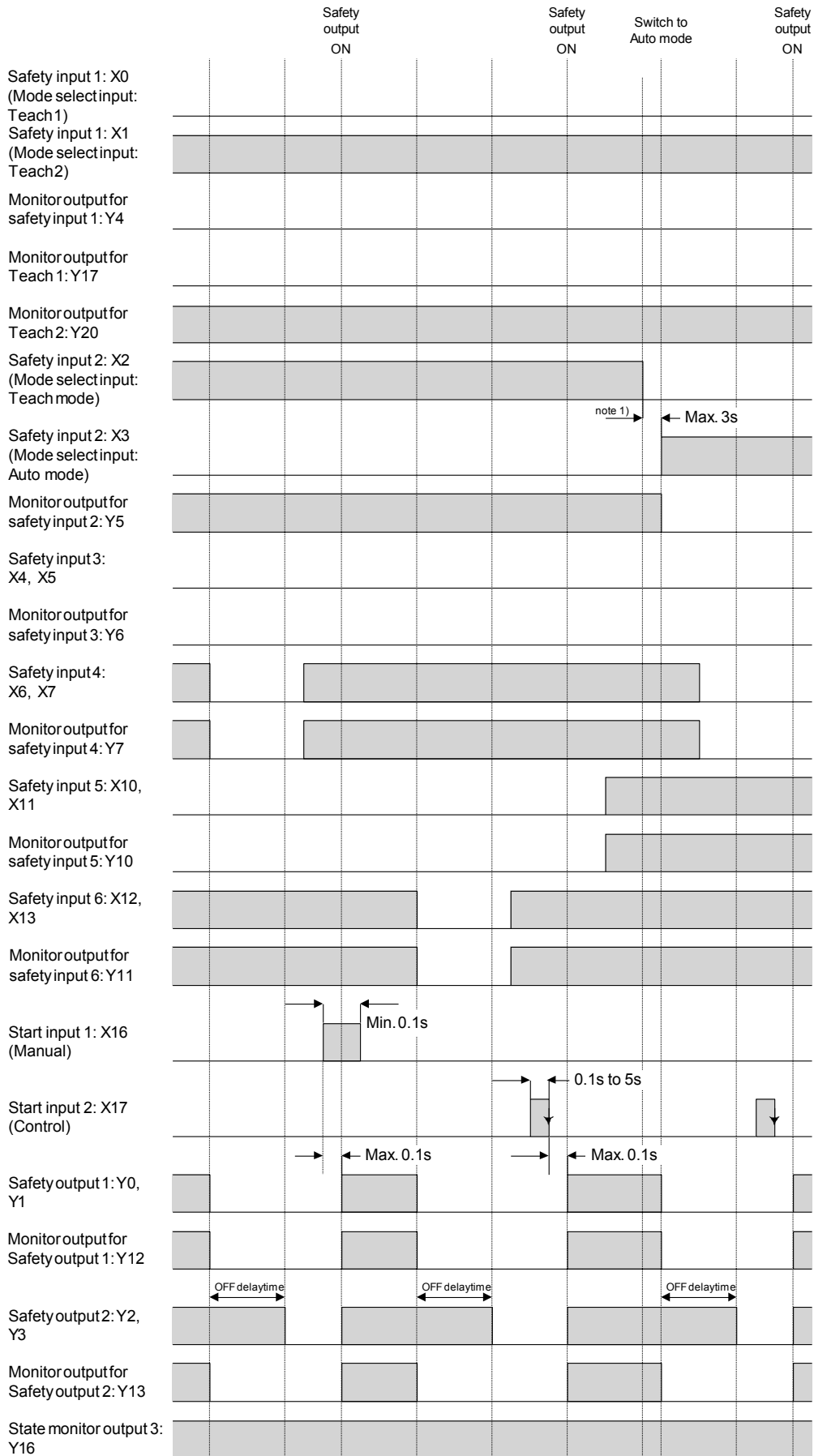
The time of dual channel safety input (X10, X11) is 0.1s.

The time of dual channel direct opening input (X12, X13) is 0.5s.

Refer to the following “Logic functions” for more details.

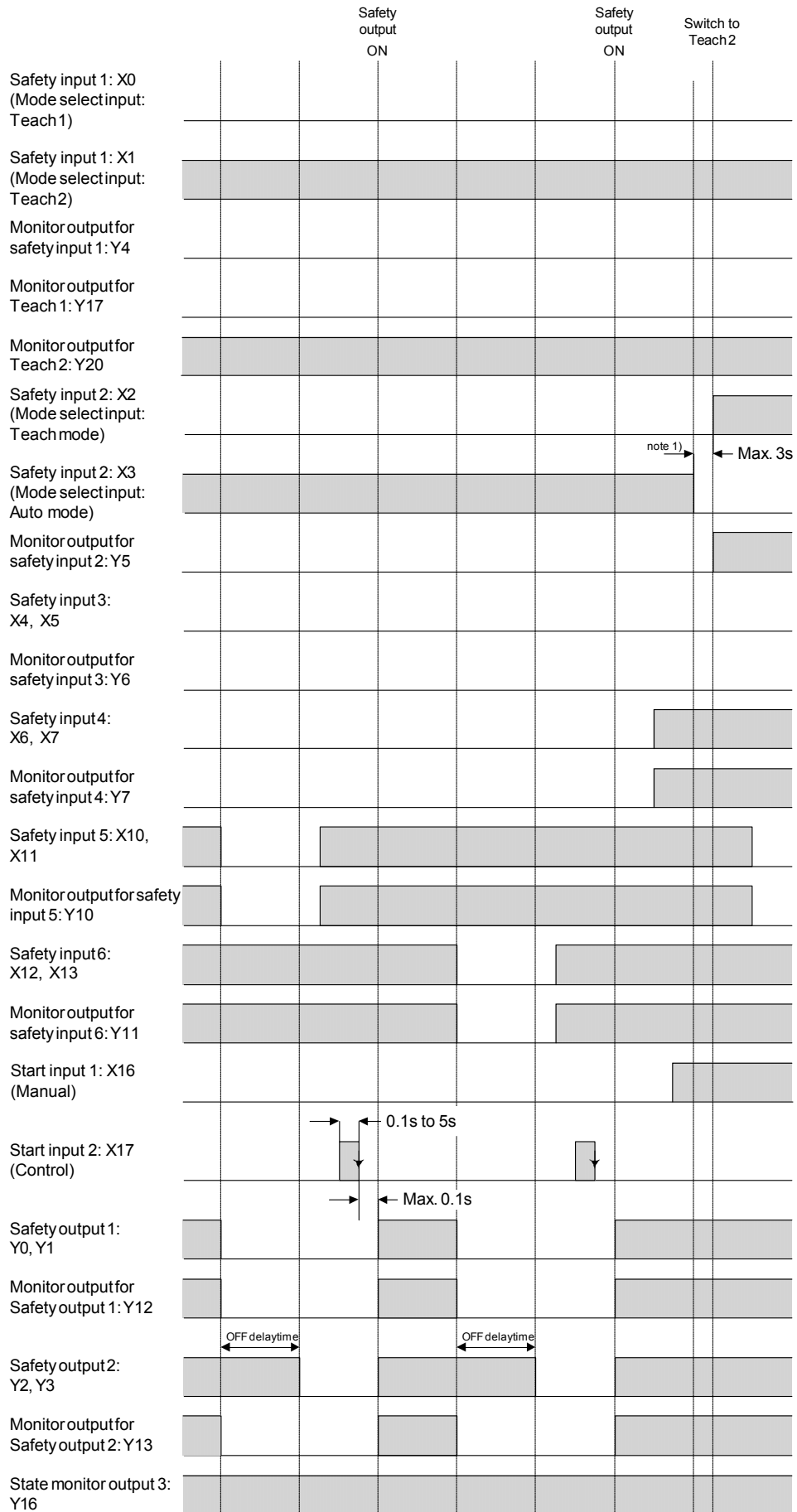
LOGIC

Example: TEACH 2



Note 1) When “Safety input 2 (mode select input)” is switched to Auto mode from Teach mode, all of “Safety output” are kept ON for 3s maximum till X3 is turned ON after X2 is turned OFF. All of “Safety output” are turned OFF at the same time as X3 is turned ON.

Example: Auto mode



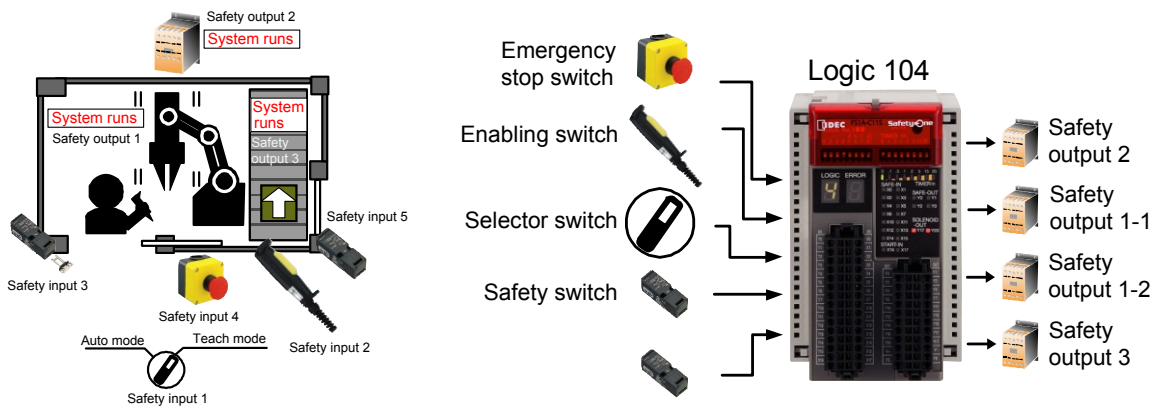
Note 1) When "Safety input 2 (mode select input)" is switched to another mode within 3s, all of "Safety output" are kept ON.

Logic 104: Partial stop logic applicable for selection of active safety input devices

Overview (Logic 104)

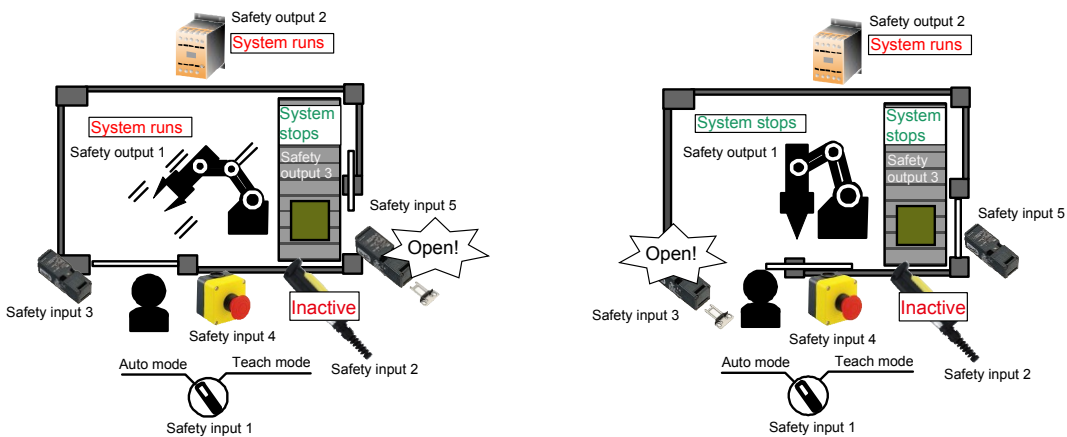
For production machines, robots, and the like, a hazard is generally isolated by a protective door (guard), however, when performing teaching or maintenance, the machine is operated in the condition that a person is in the danger zone. For such a situation, this logic described is applicable to the mode selection between Teach mode (maintenance mode) and Auto mode (operating mode). Safety outputs perform as single channel outputs.

This logic enables the connection of 3 dual channel direct opening inputs, 1 mode select input, and 1 dual channel dependent input.

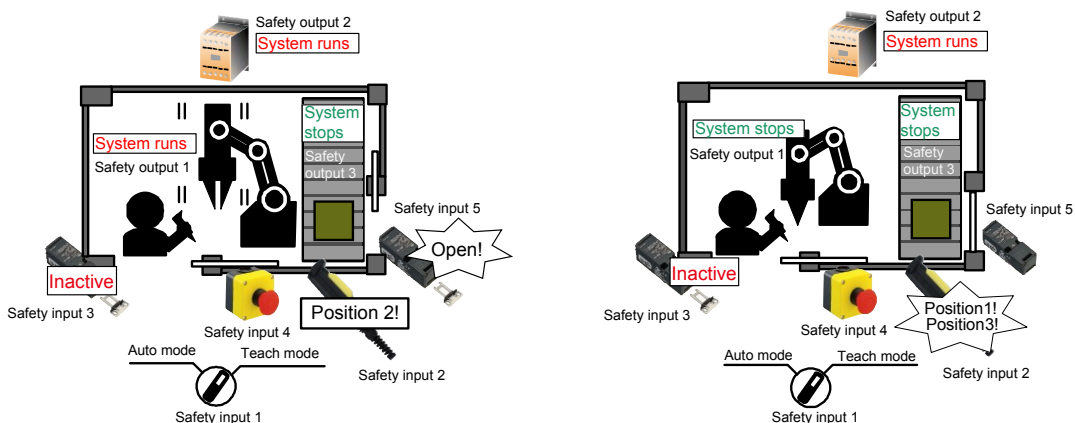


Operation example (Logic 104)

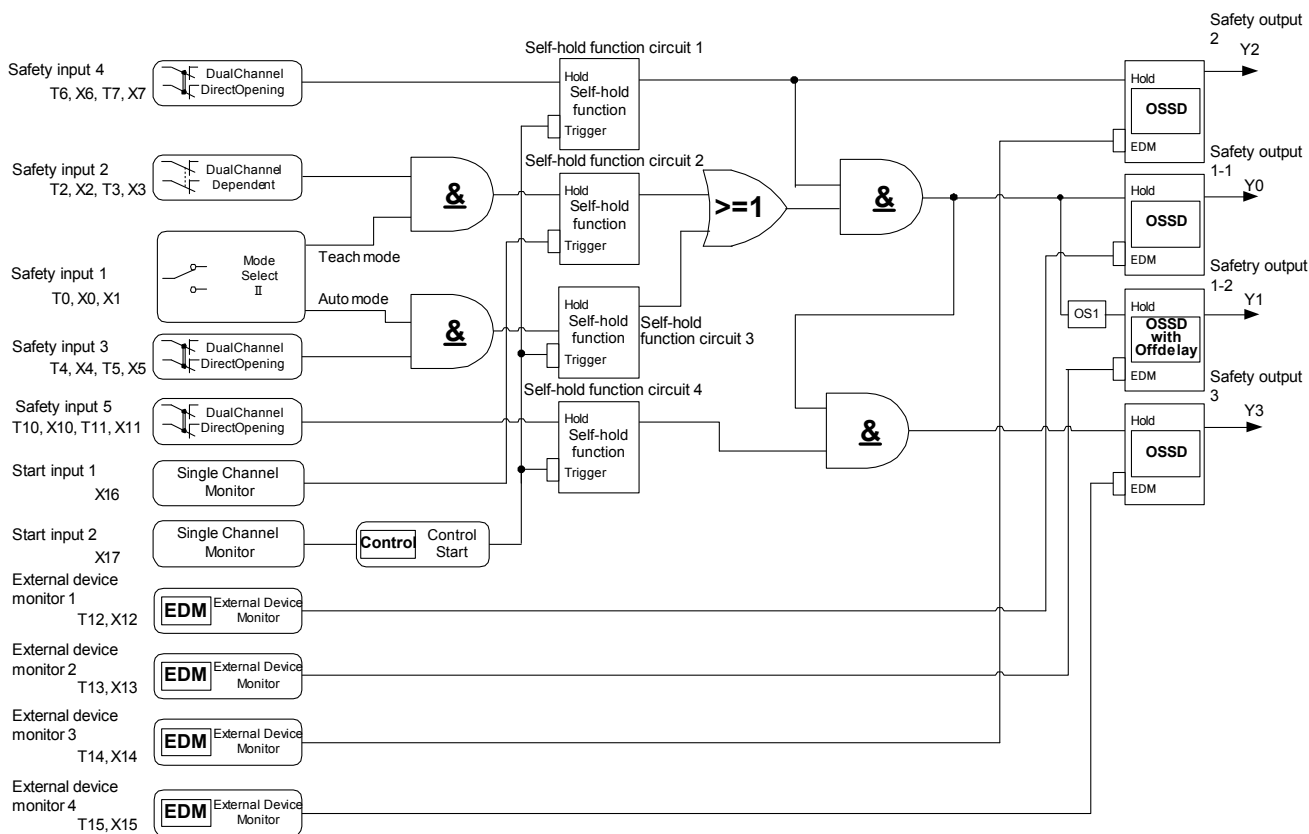
•Auto mode



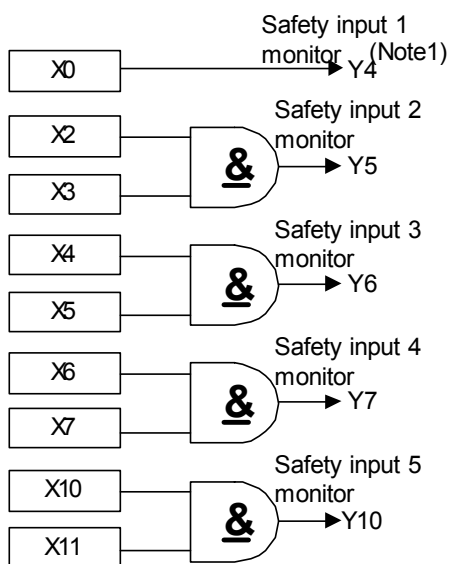
•Teach mode



Logic circuit (Logic 104)

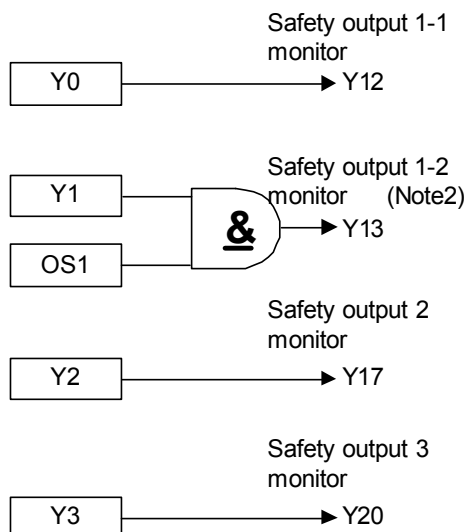


● Monitor output for safety input



Note1:
When safety input 1 is set to Auto mode, safety output 1 monitor turns OFF.

● Monitor output for safety output

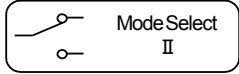


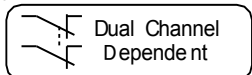
Note2:
Safety output 1-2 monitor turns OFF immediately independent of OFF-delay time.

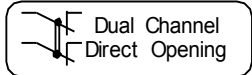
Function (Logic 104)

●**Safety inputs: X0 to X11 (T0, T2 to T11)**

Safety inputs are used to diagnose the status of connected safety devices, such as emergency stop switches, interlock switches, and mode select switches.

Intended inputs (Terminal names)	Function	
Safety input 1 (X0/X1-T0)	Function name	Mode select input II
	Symbol	
	Description of operation	This function is for connecting devices with a mode selector function, such as mode selector switch. When the switching of inputs is performed within 3s, this function output is kept at previous state. This function diagnoses time interval of status transition between each input (0.5s).
	Detail information	Logic functions (5-321)

Intended inputs (Terminal names)	Function	
Safety input 2 (X2-T2, X3-T3)	Function name	Dual channel dependent input
	Symbol	
	Description of operation	This function diagnoses the status of connected safety devices. This function does not diagnose the time interval of status transition between each input of duplicated inputs.
	Detail information	Logic functions (5-313)

Intended inputs (Terminal names)	Function	
Safety input 3 (X4-T4, X5-T5) Safety input 4 (X6-T6, X7-T7) Safety input 5 (X10-T10, X11-T11)	Function name	Dual channel direct opening input
	Symbol	
	Description of operation	This function diagnoses the status of connected safety devices. This function diagnoses the time interval of status transition between each input of duplicated inputs (0.5s).
	Detail information	Logic functions (5-311)



For connected control devices, refer to “SAFETY PRECAUTIONS”.

Safety check signals (pulses signals) are sent from the drive terminals (T0, T2 to T11) to diagnose connected safety devices and input circuits. Safety check signals can not be used as a power supply for connected devices.

Note. Solid state outputs, such as safety light curtains, can not be connected to safety inputs.


Note. Use safety inputs, as specified combinations, such as receive terminal (Xn) and drive terminal (Tn). If the combinations are incorrect, SafetyOne does not work correctly.

Note. When SafetyOne is in Run state or Protection state, input states are monitored in all safety inputs. For example, if input monitor error is detected in safety input 2 although AUTO mode is selected, SafetyOne detects error and transits to Protection state.

Note. If there are unused safety inputs in safety input 2 through safety input 5, connect the unused receive terminals (Xn) to the corresponding drive terminals (Tn). If they are not connected, the SafetyOne does not turn ON the safety outputs.

● External device monitor inputs: X12 to X15 (T12 to T15)

External device monitor inputs are used to diagnose status of the devices connected to safety outputs.

Intended inputs (Terminal names)	Target safety outputs (Terminal names)	Function	
External device monitor input 1 (X12-T12)	Safety output 1-1 (Y0)	Function name	External device monitor input
External device monitor input 2 (X13-T13)	Safety output 1-2 (Y1)	Symbol	
External device monitor input 3 (X14-T14)	Safety output 2 (Y2)	Description of operation	This function diagnoses the status of devices connected to a target safety output.
External device monitor input 4 (X15-T15)	Safety output 3 (Y3)	Detail information	Logic functions (5-326)

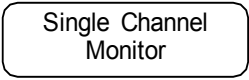


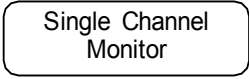
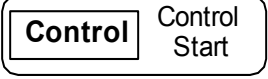
Safety check signals (pulses signals) are sent from the drive terminals (T12 to T15) to diagnose external devices and monitor circuits. Safety check signals can not be used as a power supply for connected devices.

Note. If there are unused safety outputs, connect the intended external device monitor terminals (Xn) to the corresponding drive terminals (Tn). If they are not connected, the SafetyOne detects an input monitor error. As the result, the error LED displays a “1” and the unit changes to the Protection state.

● **Start inputs: X16 and X17**

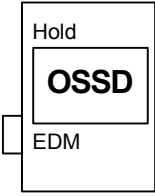
Start inputs are used to control the start of safety outputs.

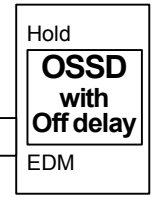
Intended inputs (Terminal names)	Target safety inputs (Terminal names)	Function	
		Start input 1 (X16)	Safety input 1 (X0-T0: TEACH) Safety input 2 (X2-T2, X3-T3)
		Symbol	
		Description of operation	Safety outputs are started, when all target safety inputs are in the safe state and this function is in the ON state. This function is turned ON by 0.1s or more ON operation.
		Detail information	Logic functions (5-325)

Intended inputs (Terminal names)	Target safety inputs (Terminal names)	Function	
		Start input 2 (X17)	Safety input 1 (X1-T0: AUTO) Safety input 3 (X4-T4, X5-T5) Safety input 4 (X6-T6, X7-T7) Safety input 5 (X10-T10, X11-T11)
		Symbol	 + 
		Description of operation	Safety outputs are started, when this function becomes ON after all intended safety inputs are in the safe state. This function is turned ON by 0.1s to 5s ON operation.
		Detail information	Logic functions (5-325, 330)

● **Safety outputs: Y0 to Y3**

Safety outputs are used to output safety information processed by SafetyOne.

Intended outputs (Terminal names)	Function	
Safety output 1-1 (Y0) Safety output 2 (Y2) Safety output 3 (Y3)	Function name	Safety output without timer
	Symbol	
	Description of operation	This function is a safety output to output safety information processed by SafetyOne. The output is turned OFF immediately by OFF operation (instantaneous OFF output).
	Detail information	Logic functions (5-332)

Intended outputs (Terminal names)	Function	
Safety output 1-2 (Y1)	Function name	Safety output with timer
	Symbol	
	Description of operation	This function is a safety output to output safety information processed by SafetyOne. The output is turned OFF after the preset time of the OFF-delay timer (OFF-delay output).
	Detail information	Logic functions (5-335)

Note. When the SafetyOne changes to Protection state due to input monitor error, safety output without timer (safety output 1-1, safety output 2, and safety output 3) is turned OFF. Safety output with timer (safety output 1-2) is turned OFF after the preset OFF-delay time.

Note. When the SafetyOne changes to Stop state due to circuit failure or other errors, all safety outputs (safety output 1-1, safety output 1-2, safety output 2, and safety output 3) are turned OFF, immediately.

Note. Set time of safety output with timer is active independent of the selected mode.

Safety input monitor outputs: Y4 to Y10

Safety input monitor outputs are used to output the status of safety inputs in SafetyOne.

Intended outputs (Terminal names)	Target safety inputs (Terminal names)	Description of operation
Safety input 1 monitor output (Y4)	Safety input 1 (X0-T0: TEACH)	When TEACH mode (X0) is selected, the monitor output is ON. When TEACH mode is not selected, the monitor output is OFF. When the target safety input is ON, the monitor output is ON. When the target safety input is OFF, the monitor output is OFF.
Safety input 2 monitor output (Y5)	Safety input 2 (X2-T2, X3-T3)	
Safety input 3 monitor output (Y6)	Safety input 3 (X4-T4, X5-T5)	
Safety input 4 monitor output (Y7)	Safety input 4 (X6-T6, X7-T7)	
Safety input 5 monitor output (Y10)	Safety input 5 (X10-T10, X11-T11)	

Note. When the targeted safety input detects an input monitor error, input circuit failure or EMC the disturbance, corresponding safety input monitor output becomes a pulse output (1Hz). The monitor output is OFF in other errors, Initial state, or Configuration state.

•Safety output monitor outputs: Y12, Y13, Y17, and Y20

Safety output monitor outputs are used to output the status of safety outputs in SafetyOne.

Intended outputs (Terminal names)	Target safety outputs (Terminal names)	Description of operation
Safety output 1-1 monitor output (Y12)	Safety output 1-1 (Y0)	When the target safety output is ON, the monitor output is ON. When the target safety output is OFF, this function is OFF. The monitor output turns OFF immediately, independent of the preset OFF-delay time.
Safety output 1-2 monitor output (Y13)	Safety output 1-2 (Y1)	
Safety output 2 monitor output (Y17)	Safety output 2 (Y2)	
Safety output 3 monitor output (Y20)	Safety output 3 (Y3)	

Note. When the safety output detects an output circuit failure, corresponding safety output monitor output becomes a pulse output (1Hz). The monitor output is OFF in other errors, Initial state, or Configuration state.

● **State monitor outputs: Y14 to Y16**

State monitor outputs are used to output the internal state of SafetyOne.

Intended outputs (Terminal names)	State				
	Initial	Run	Configuration	Protection	Stop
State monitor output 1 (Y14)	■ON	□OFF	□OFF	□OFF	■ON
State monitor output 2 (Y15)	■ON	□OFF	■ON	■ON	■ON or □OFF
State monitor output 3 (Y16)	□OFF	■ON	□OFF	□OFF	□OFF

Refer to "Chapter 4 BASIC OPERATIONS" and to "Chapter 6 TROUBLE SHOOTING" for details of each state.



Warning

The monitor outputs are not safety outputs. Do not use these to construct a safety system.



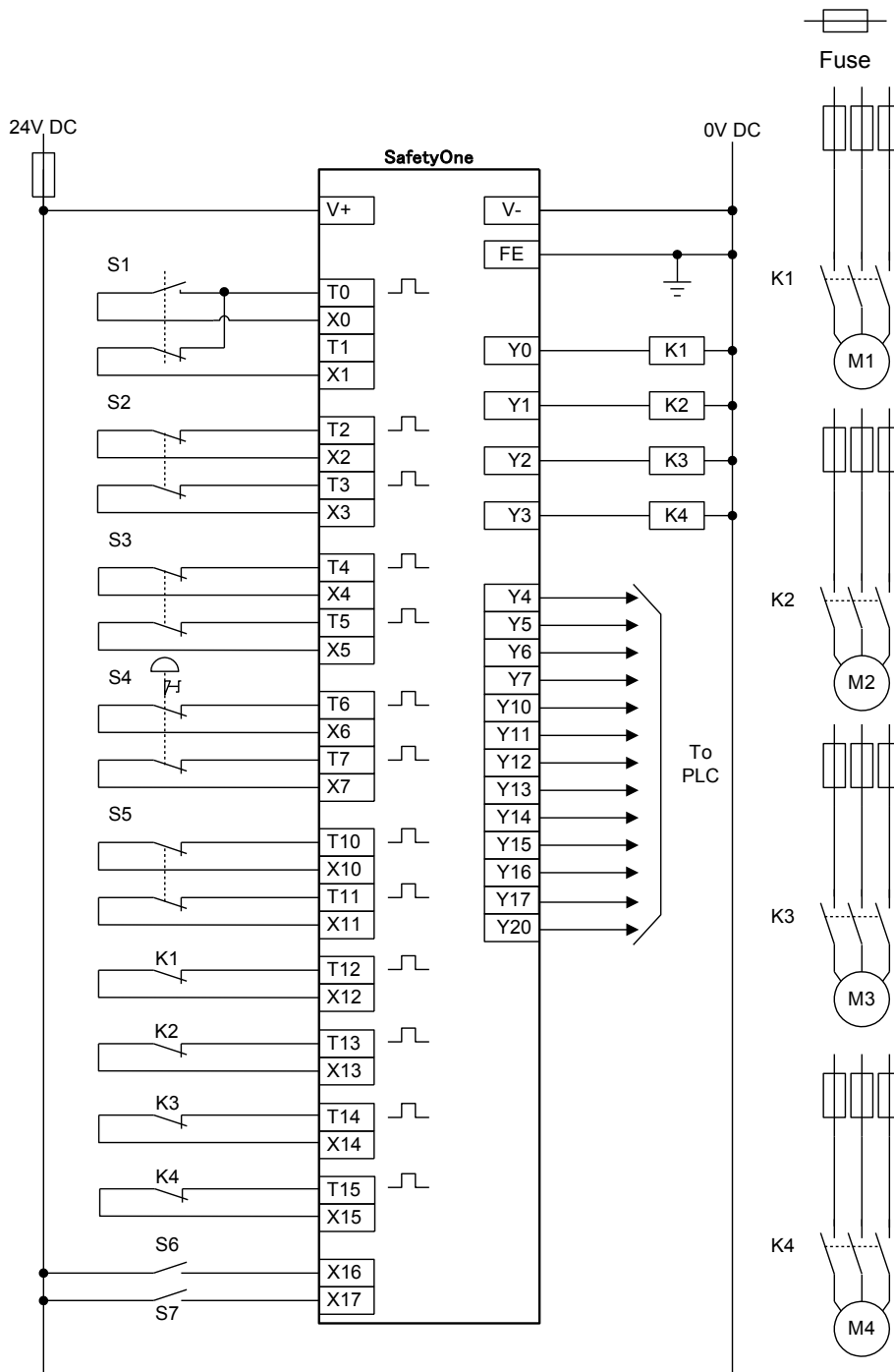
Caution

Refer to "Chapter 2 PRODUCT SPECIFICATIONS" for specifications of each input and output.

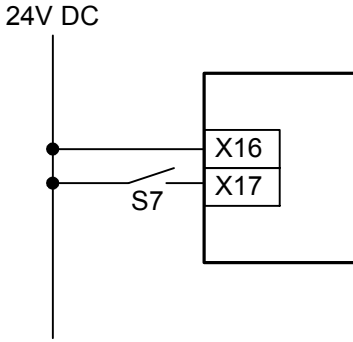
Wiring example (Logic 104)

In the case where 1 selector switch, 1 enabling switch, 2 interlock switches, and 1 emergency stop switch are connected.

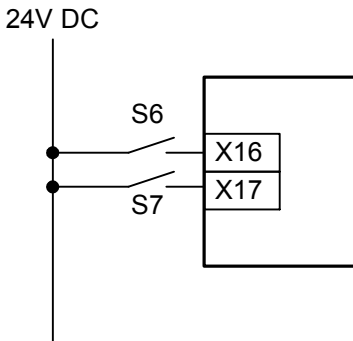
- S1 : Selector switch
- S2 : Enabling switch
- S3, 5 : Interlock switch
- S4 : Emergency stop switch
- S6, 7 : Start switch
- K1 to 4 : Contactor
- M1 to 4 : Motor



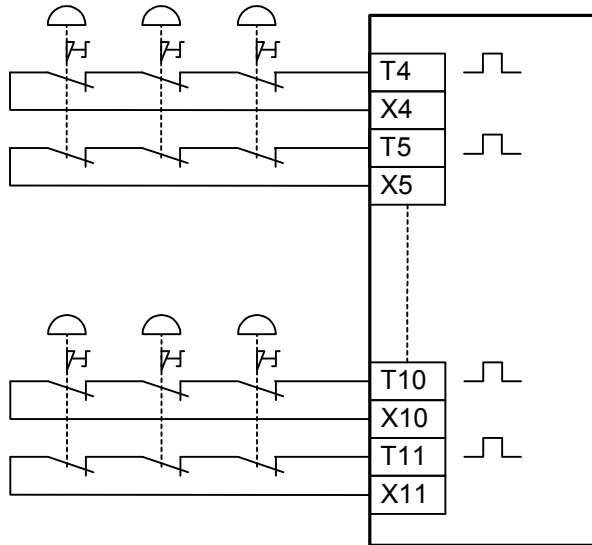
**When not using the start switch S6
(Auto start)**



**When using the start switch S6
(Manual start)**



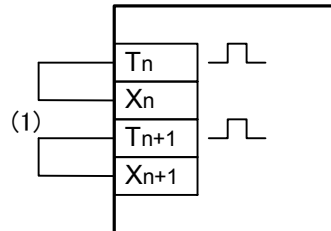
**When connecting multiple emergency stop switches
in series**



NOTE: Safety performance depends on the system configuration.

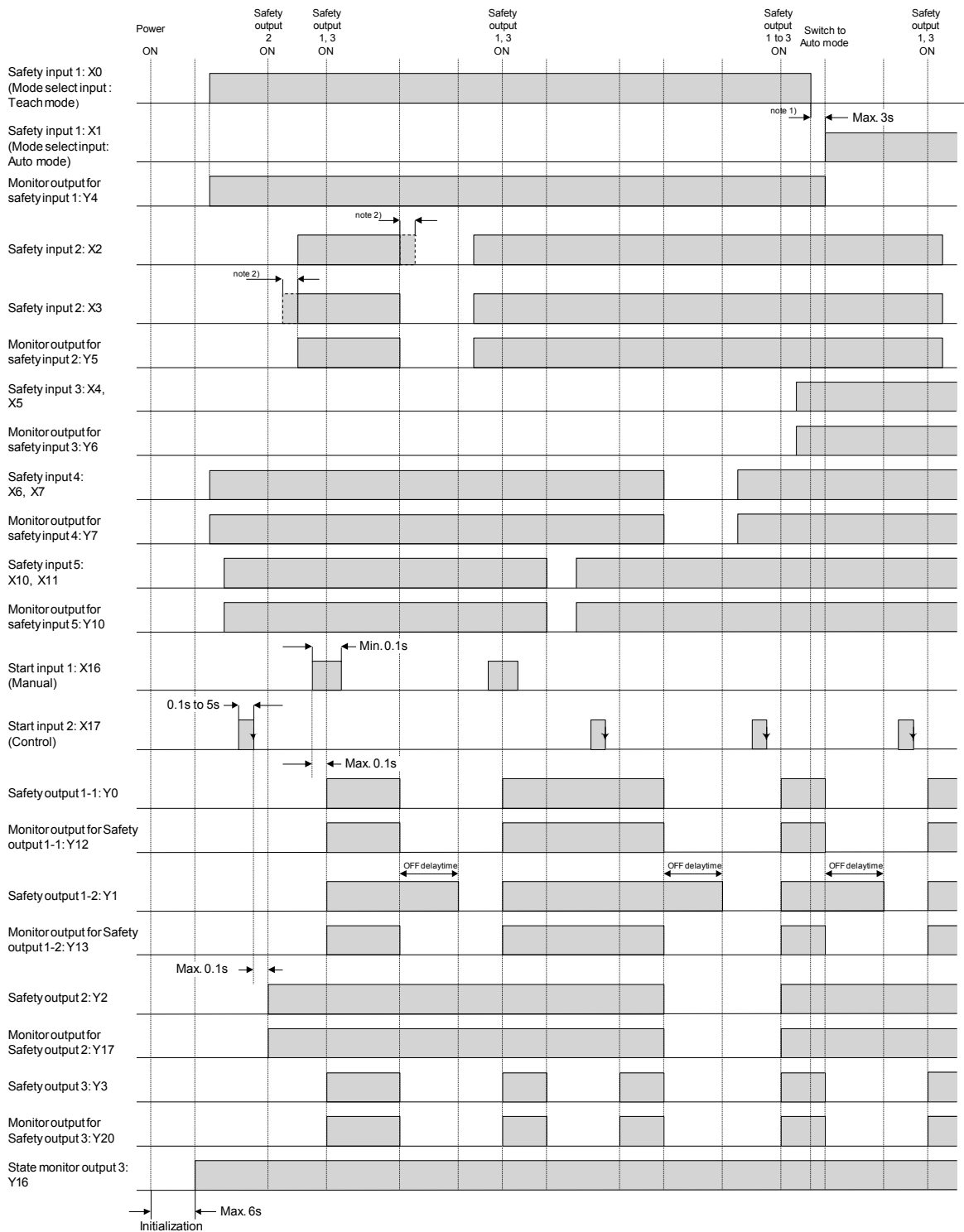
When not using some safety inputs

- If there are unused safety inputs, connect the unused receive terminals to the corresponding drive terminals. (Refer to (1))



Timing chart (Logic 104)

Example: Teach mode



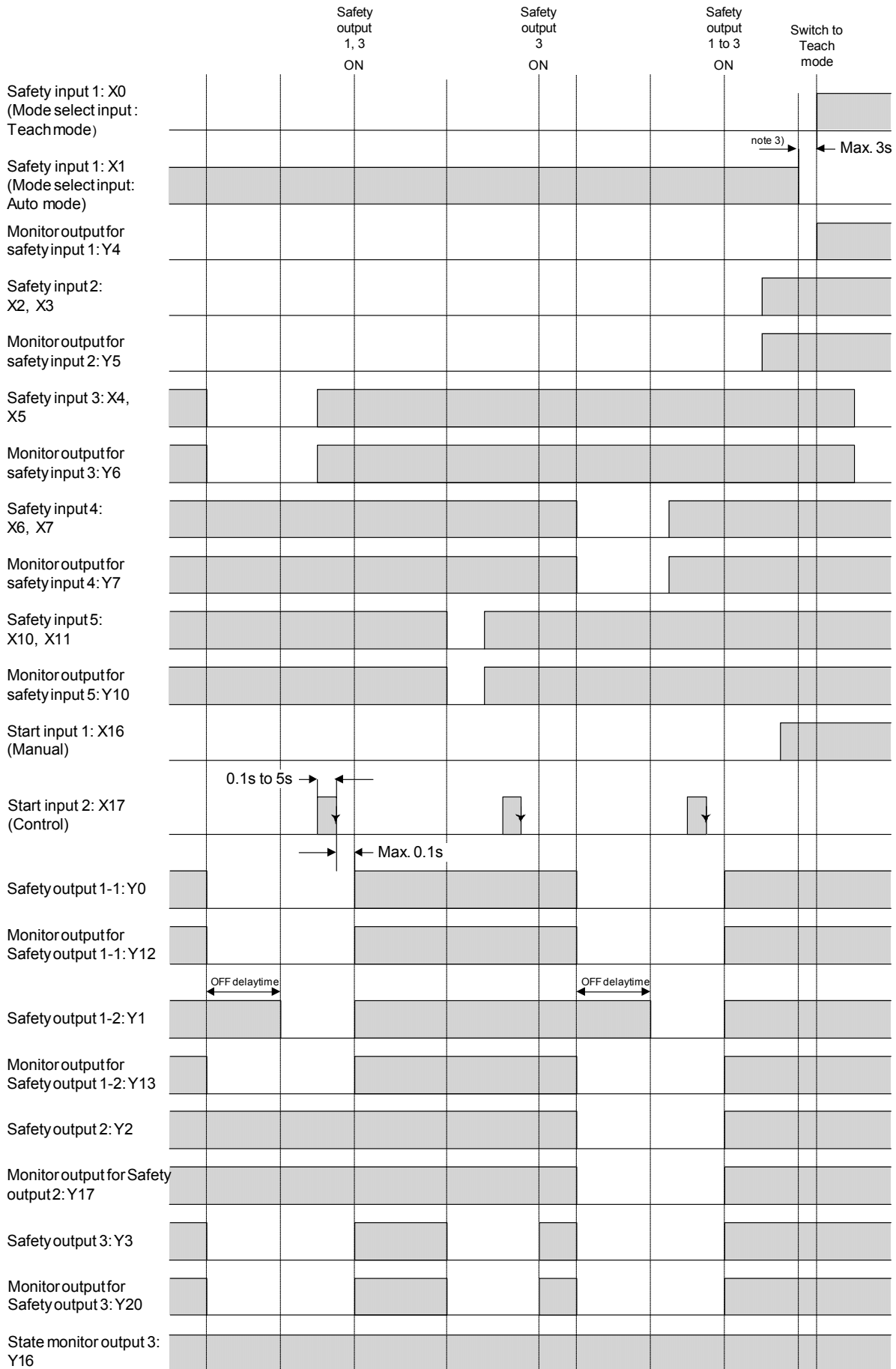
Note 1) When “Safety input 1 (mode select input)” is switched to Auto mode from Teach mode, “Safety output 1 and 3” are kept ON for 3s maximum till X1 is turned ON after X0 is turned OFF. “Safety output 1 and 3” are turned OFF at the same time as X1 is turned ON.

“Safety output 2” is unrelated to mode select input.

Note 2) Input monitor error detection time is infinity.

About safety inputs that are not described in this chart, input monitor error detection time is as follows.
 The time of dual channel direct opening input (X4 to X11) is 0.5s.
 Refer to the following “Logic functions” for more details.

Example: Auto mode



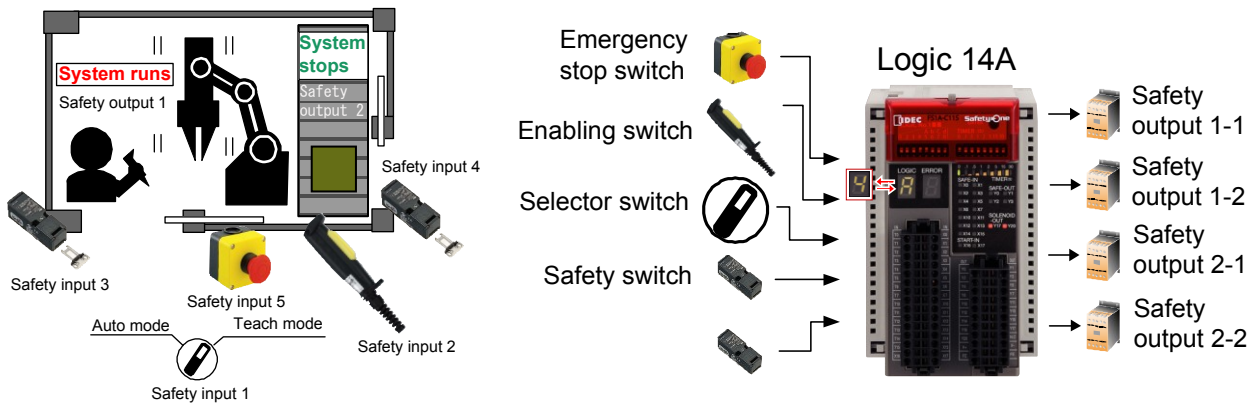
Note 3) When “Safety input 1 (mode select input)” is switched to another mode within 3s, all of “Safety output” are kept ON.

Logic 14A: Partial stop logic applicable for selection of active safety input devices

Overview (Logic 14A)

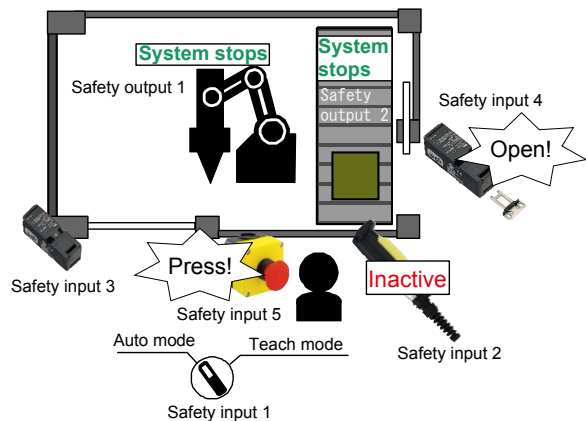
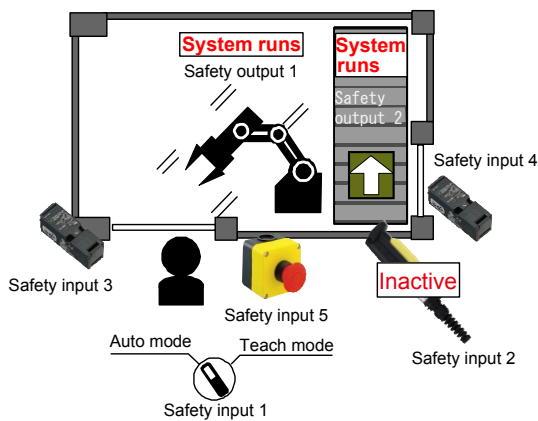
For production machines, robots, and the like, a hazard is generally isolated by a protective door (guard), however, when performing teaching or maintenance, the machine is operated in the condition that a person is in the danger zone. For such a situation, this logic described is applicable to the mode selection between Teach mode (maintenance mode) and Auto mode (operating mode). Safety outputs perform as single channel outputs.

This logic enables the connection of 3 dual channel direct opening inputs, 1 mode select input, and 1 dual channel dependent input.

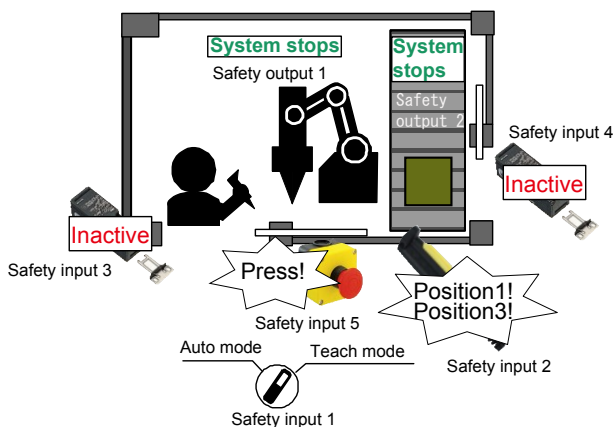


Operation example (Logic 14A)

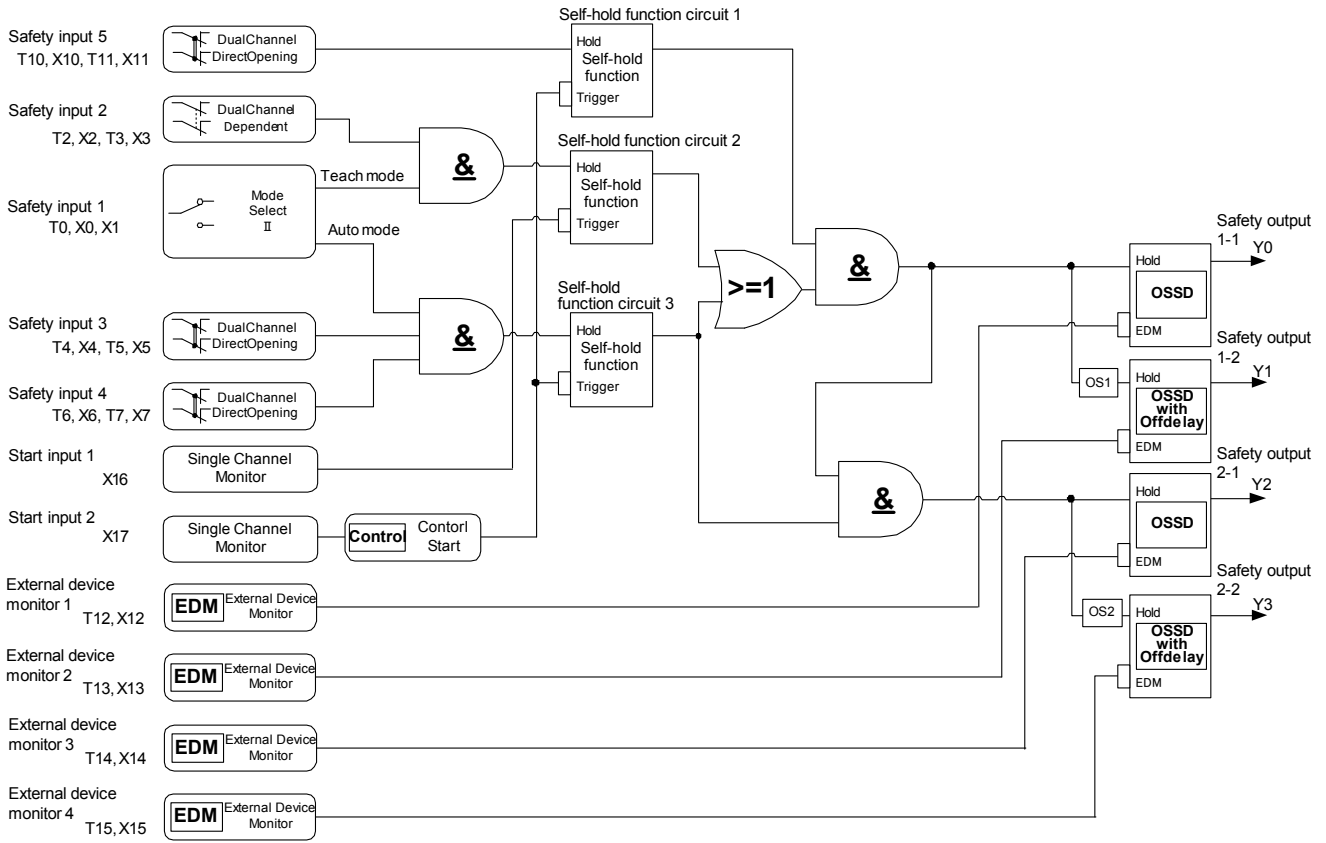
•Auto mode



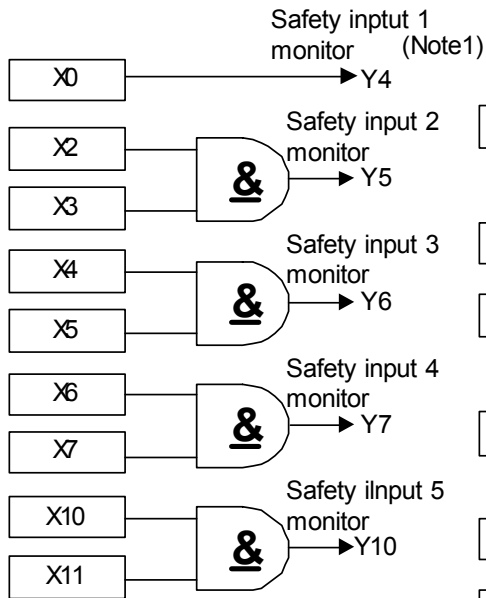
•Teach mode



Logic circuit (Logic 14A)

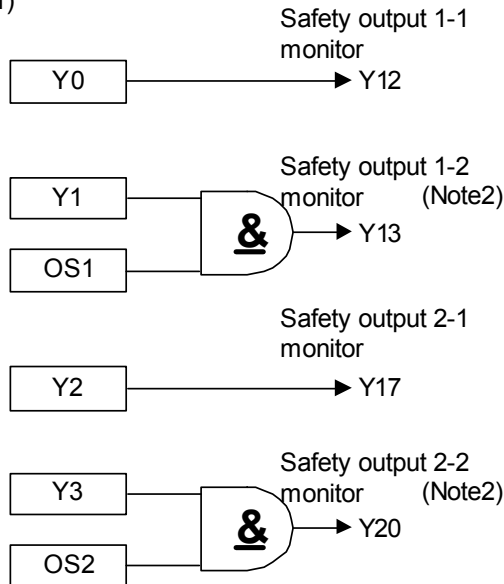


● Monitor output for safety input



Note1:
When safety input 1 is set to Auto mode, safety input 1 monitor turns OFF.

● Monitor output for safety output

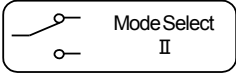


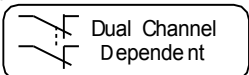
Note2:
Safety output 1-2 and safety output 2-2 turn OFF immediately independent of OFF-delay time.

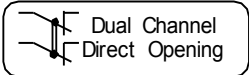
Function (Logic 14A)

●**Safety inputs: X0 to X11 (T0, T2 to T11)**

Safety inputs are used to diagnose the status of connected safety devices, such as emergency stop switches, interlock switches, and mode select switches.

Intended inputs (Terminal names)	Function	
Safety input 1 (X0/X1-T0)	Function name	Mode select input II
	Symbol	
	Description of operation	This function is for connecting devices with a mode selector function, such as mode selector switch. When the switching of inputs is performed within 3s, this function output is kept at previous state. This function diagnoses time interval of status transition between each input (0.5s).
	Detail information	Logic functions (5-321)

Intended inputs (Terminal names)	Function	
Safety input 2 (X2-T2, X3-T3)	Function name	Dual channel dependent input
	Symbol	
	Description of operation	This function diagnoses the status of connected safety devices. This function does not diagnose the time interval of status transition between each input of duplicated inputs.
	Detail information	Logic functions (5-313)

Intended inputs (Terminal names)	Function	
Safety input 3 (X4-T4, X5-T5) Safety input 4 (X6-T6, X7-T7) Safety input 5 (X10-T10, X11-T11)	Function name	Dual channel direct opening input
	Symbol	
	Description of operation	This function diagnoses the status of connected safety devices. This function diagnoses the time interval of status transition between each input of duplicated inputs (0.5s).
	Detail information	Logic functions (5-311)



For connected control devices, refer to “SAFETY PRECAUTIONS”.

Safety check signals (pulses signals) are sent from the drive terminals (T0, T2 to T11) to diagnose connected safety devices and input circuits. Safety check signals can not be used as a power supply for connected devices.

Note. Solid state outputs, such as safety light curtains, can not be connected to safety inputs.


Note. Use safety inputs, as specified combinations, such as receive terminal (Xn) and drive terminal (Tn). If the combinations are incorrect, SafetyOne does not work correctly.

Note. When SafetyOne is in Run state or Protection state, input states are monitored in all safety inputs. For example, if input monitor error is detected in safety input 2 although AUTO mode is selected, SafetyOne detects error and transits to Protection state.

Note. If there are unused safety inputs in safety input 2 through safety input 5, connect the unused receive terminals (Xn) to the corresponding drive terminals (Tn). If they are not connected, the SafetyOne does not turn ON the safety outputs.

● External device monitor inputs: X12 to X15 (T12 to T15)

External device monitor inputs are used to diagnose status of the devices connected to safety outputs.

Intended inputs (Terminal names)	Target safety outputs (Terminal names)	Function	
External device monitor input 1 (X12-T12)	Safety output 1-1 (Y0)	Function name	External device monitor input
External device monitor input 2 (X13-T13)	Safety output 1-2 (Y1)	Symbol	
External device monitor input 3 (X14-T14)	Safety output 2-1 (Y2)	Description of operation	This function diagnoses the status of devices connected to a target safety output.
External device monitor input 4 (X15-T15)	Safety output 2-2 (Y3)	Detail information	Logic functions (5-326)

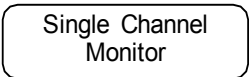


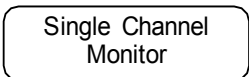

Safety check signals (pulses signals) are sent from the drive terminals (T12 to T15) to diagnose external devices and monitor circuits. Safety check signals can not be used as a power supply for connected devices.

Note. If there are unused safety outputs, connect the intended external device monitor terminals (Xn) to the corresponding drive terminals (Tn). If they are not connected, the SafetyOne detects an input monitor error. As the result, the error LED displays a “1” and the unit changes to the Protection state.

●Start inputs: X16 and X17

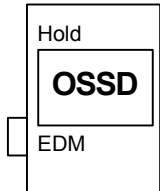
Start inputs are used to control the start of safety outputs.

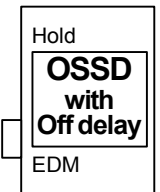
Intended inputs (Terminal names)	Target safety inputs (Terminal names)	Function	
		Start input 1 (X16)	Safety input 1 (X0-T0: TEACH) Safety input 2 (X2-T2, X3-T3)
Symbol			
Description of operation	Safety outputs are started, when all target safety inputs are in the safe state and this function is in the ON state. This function is turned ON by 0.1s or more ON operation.		
Detail information	Logic functions (5-325)		

Intended inputs (Terminal names)	Target safety inputs (Terminal names)	Function	
		Start input 2 (X17)	Safety input 1 (X1-T0: AUTO) Safety input 3 (X4-T4, X5-T5) Safety input 4 (X6-T6, X7-T7) Safety input 5 (X10-T10, X11-T11)
Symbol	 + 		
Description of operation	Safety outputs are started, when this function becomes ON after all intended safety inputs are in the safe state. This function is turned ON by 0.1s to 5s ON operation.		
Detail information	Logic functions (5-325, 330)		

● **Safety outputs: Y0 to Y3**

Safety outputs are used to output safety information processed by SafetyOne.

Intended outputs (Terminal names)	Function	
Safety output 1-1 (Y0) Safety output 2-1 (Y2)	Function name	Safety output without timer
	Symbol	
	Description of operation	This function is a safety output to output safety information processed by SafetyOne. The output is turned OFF immediately by OFF operation (instantaneous OFF output).
	Detail information	Logic functions (5-332)

Intended outputs (Terminal names)	Function	
Safety output 1-2 (Y1) Safety output 2-2 (Y3)	Function name	Safety output with timer
	Symbol	
	Description of operation	This function is a safety output to output safety information processed by SafetyOne. The output is turned OFF after the preset time of the OFF-delay timer (OFF-delay output).
	Detail information	Logic functions (5-335)

Note. When the SafetyOne changes to Protection state due to input monitor error, safety output without timer (safety output 1-1 and safety output 2-1) is turned OFF. Safety output with timer (safety output 1-2 and safety output 2-2) is turned OFF after the preset OFF-delay time.

Note. When the SafetyOne changes to Stop state due to circuit failure or other errors, all safety outputs (safety output 1-1, safety output 1-2, safety output 2-1, and safety output 2-2) are turned OFF, immediately.

Note. Set time of safety output with timer is active independent of the selected mode.

Safety input monitor outputs: Y4 to Y10

Safety input monitor outputs are used to output the status of safety inputs in SafetyOne.

Intended outputs (Terminal names)	Target safety inputs (Terminal names)	Description of operation
Safety input 1 monitor output (Y4)	Safety input 1 (X0-T0: TEACT)	When TEACH mode (X0) is selected, the monitor output is ON. When TEACH mode is not selected, the monitor output is OFF. When the target safety input is ON, the monitor output is ON. When the target safety input is OFF, the monitor output is OFF.
Safety input 2 monitor output (Y5)	Safety input 2 (X2-T2, X3-T3)	
Safety input 3 monitor output (Y6)	Safety input 3 (X4-T4, X5-T5)	
Safety input 4 monitor output (Y7)	Safety input 4 (X6-T6, X7-T7)	
Safety input 5 monitor output (Y10)	Safety input 5 (X10-T10, X11-T11)	

Note. When the targeted safety input detects an input monitor error, input circuit failure or EMC the disturbance, corresponding safety input monitor output becomes a pulse output (1Hz). The monitor output is OFF in other errors, Initial state, or Configuration state.

•Safety output monitor outputs: Y12, Y13, Y17, and Y20

Safety output monitor outputs are used to output the status of safety outputs in SafetyOne.

Intended outputs (Terminal names)	Target safety outputs (Terminal names)	Description of operation
Safety output 1-1 monitor output (Y12)	Safety output 1-1 (Y0)	When the target safety output is ON, the monitor output is ON. When the target safety output is OFF, the function is OFF. The monitor output turns OFF immediately independent on set OFF-delay time.
Safety output 1-2 monitor output (Y13)	Safety output 1-2 (Y1)	
Safety output 2-1 monitor output (Y17)	Safety output 2-1 (Y2)	
Safety output 2-2 monitor output (Y20)	Safety output 2-2 (Y3)	

Note. When the safety output detects an output circuit failure, corresponding safety output monitor output becomes a pulse output (1Hz). The monitor output is OFF in other errors, Initial state, or Configuration state.

● **State monitor outputs: Y14 to Y16**

State monitor outputs are used to output the internal state of SafetyOne.

Intended outputs (Terminal names)	State				
	Initial	Run	Configuration	Protection	Stop
State monitor output 1 (Y14)	■ON	□OFF	□OFF	□OFF	■ON
State monitor output 2 (Y15)	■ON	□OFF	■ON	■ON	■ON or □OFF
State monitor output 3 (Y16)	□OFF	■ON	□OFF	□OFF	□OFF

Refer to "Chapter 4 BASIC OPERATIONS" and to "Chapter 6 TROUBLE SHOOTING" for details of each state.



Warning

The monitor outputs are not safety outputs. Do not use these to construct a safety system.



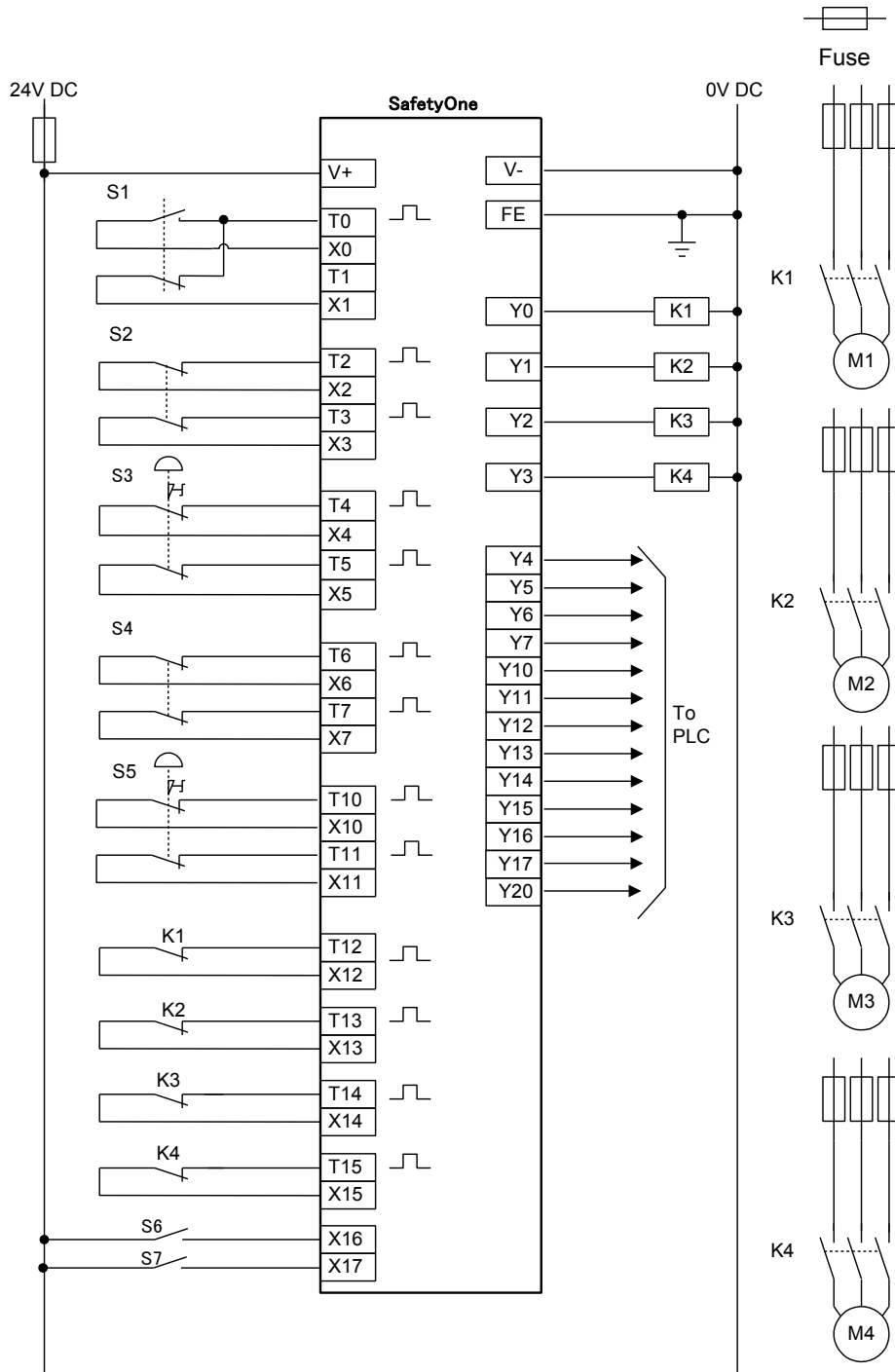
Caution

Refer to "Chapter 2 PRODUCT SPECIFICATIONS" for specifications of each input and output.

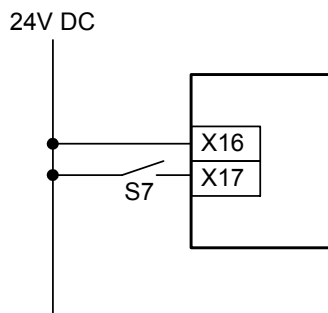
Wiring example (Logic 14A)

In the case where 1 selector switch, 1 enabling switch, 2 emergency stop switches, and 1 interlock switch are connected.

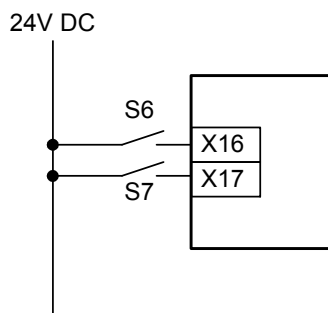
- S1 : Selector switch
- S2 : Enabling switch
- S3, 5 : Emergency stop switch
- S4 : Interlock switch
- S6, 7 : Start switch
- K1 to 4 : Contactor
- M1 to 4 : Motor



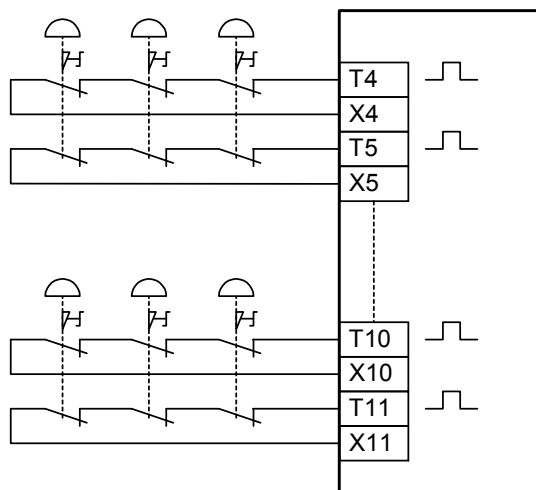
**When not using the start switch S6
(Auto start)**



**When using the start switch S6
(Manual start)**



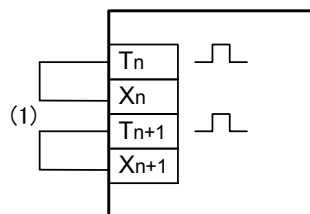
**When connecting multiple emergency stop switches
in series**



NOTE: Safety performance depends on the system configuration.

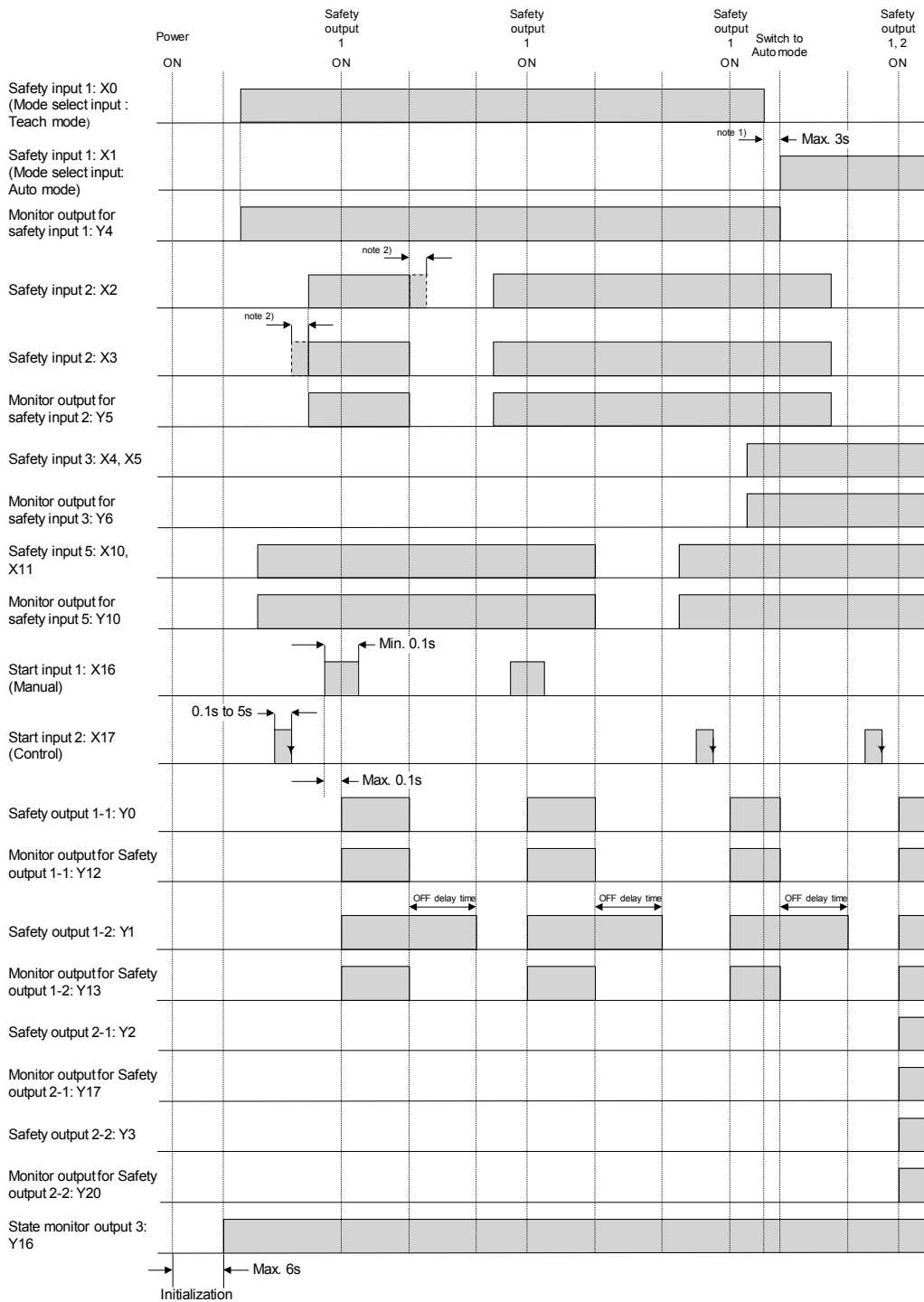
When not using some safety inputs

• If there are unused safety inputs, connect the unused receive terminals to the corresponding drive terminals.
(Refer to (1))



Timing chart (Logic 14A)

Example: Teach mode



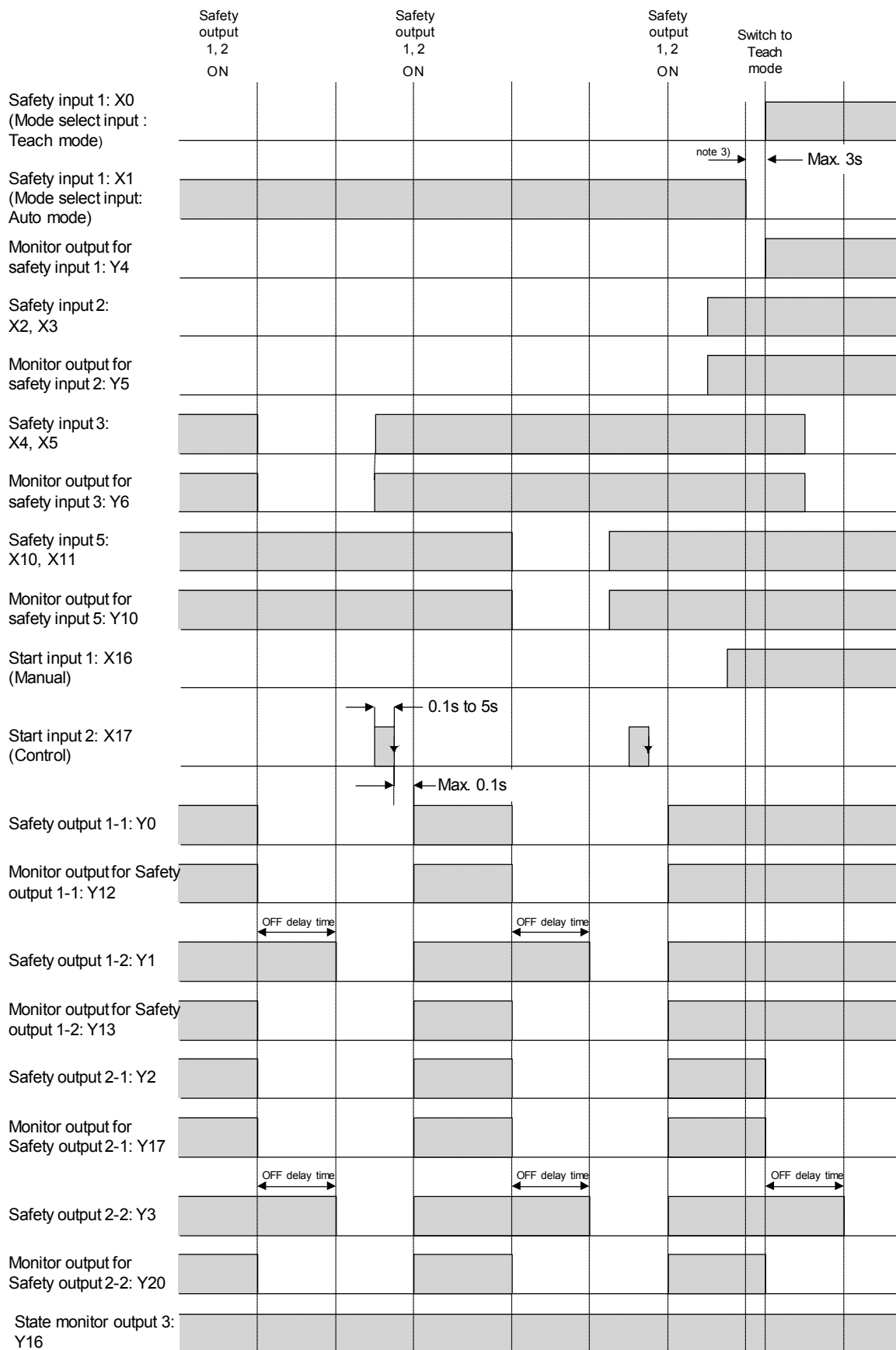
(Safety input 4 is ON in this chart.)

Note 1) When "Safety input 1 (mode select input)" is switched to Auto mode from Teach mode, all of "Safety output" are kept ON for 3s maximum till X1 is turned ON after X0 is turned OFF. All of Safety output are turned OFF at the same time as X1 is turned ON.

Note 2) Input monitor error detection time is infinity.

About safety inputs that are not described in this chart, input monitor error detection time is as follows. The time of dual channel direct opening input (X4 to X11) is 0.5s. Refer to the following "Logic functions" for more details.

Example: Auto mode



(Safety input 4 is ON in this chart.)

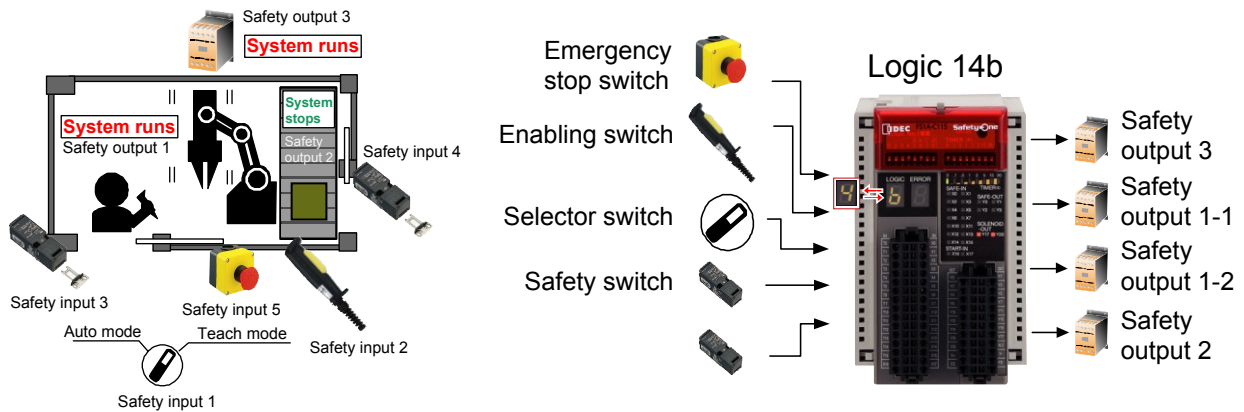
Note 3) When Safety input 1 (mode select input) is switched to another mode within 3s, Safety output 1 is kept ON. Safety output 2 is unrelated to mode select input.

Logic 14b: Partial stop logic applicable for selection of active safety input devices

Overview (Logic 14b)

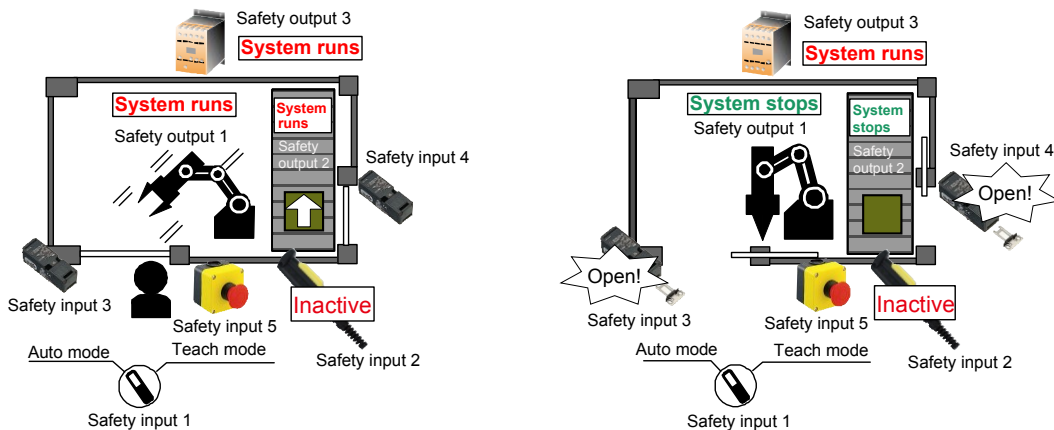
For production machines, robots, and the like, a hazard is generally isolated by a protective door (guard), however, when performing teaching or maintenance, the machine is operated in the condition that a person is in the danger zone. For such a situation, this logic described is applicable to the mode selection between Teach mode (maintenance mode) and Auto mode (operating mode). Safety outputs perform as single channel outputs.

This logic enables the connection of 3 dual channel direct opening inputs, 1 mode select input, and 1 dual channel dependent input.

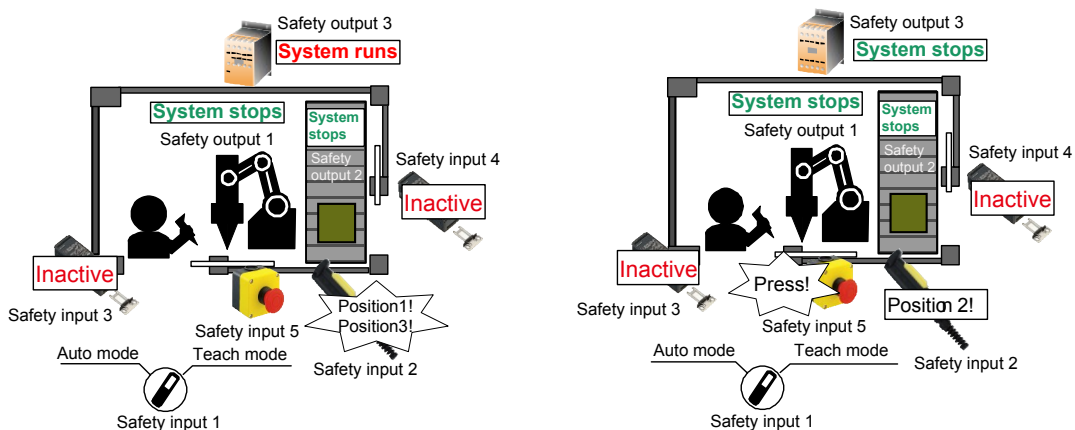


Operation example (Logic 14b)

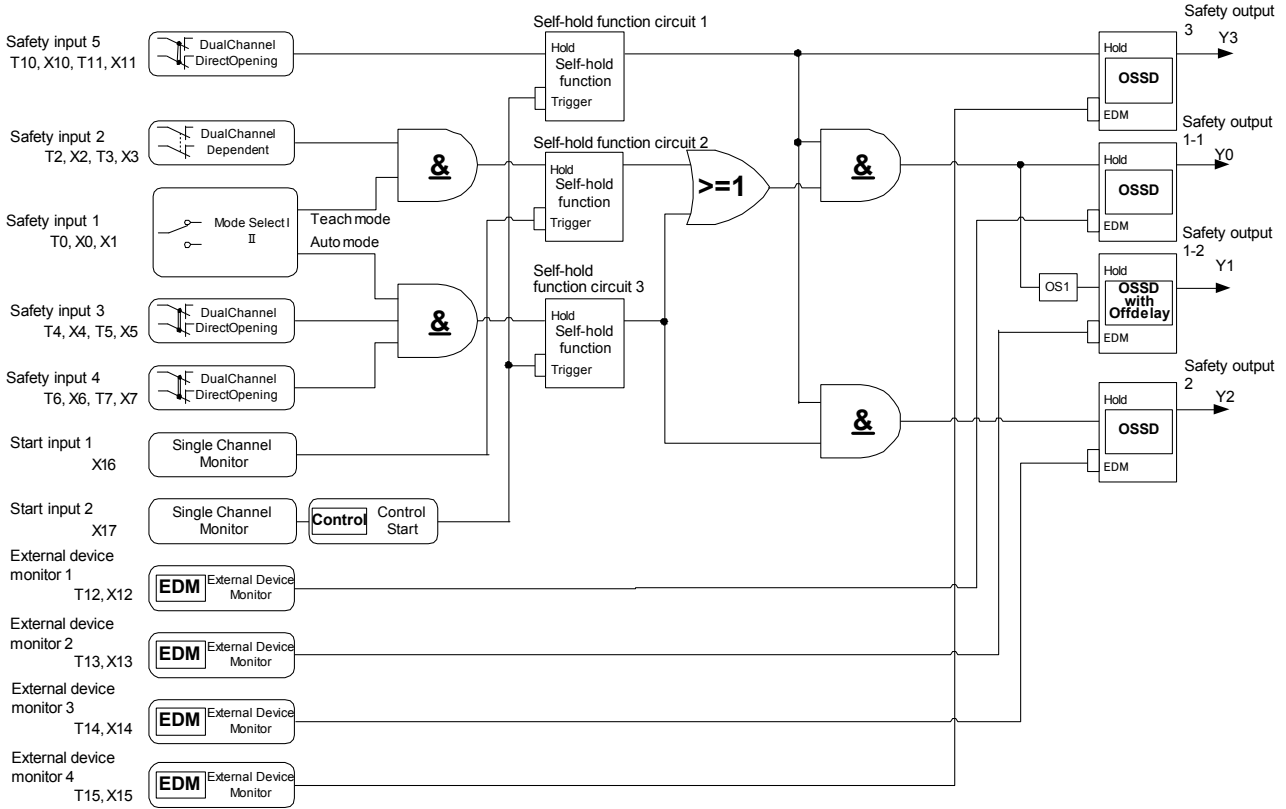
•Auto mode



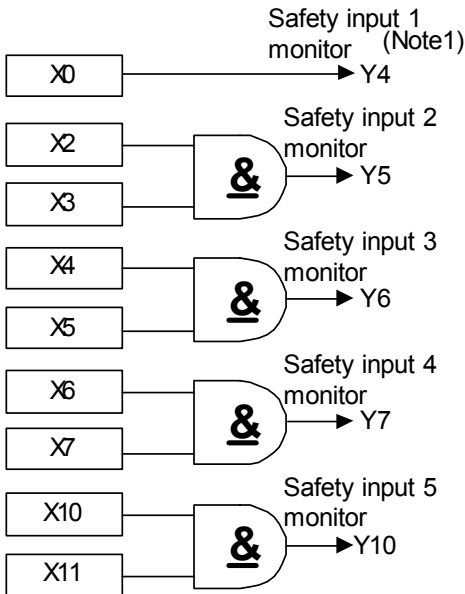
•Teach mode



Logic circuit (Logic 14b)

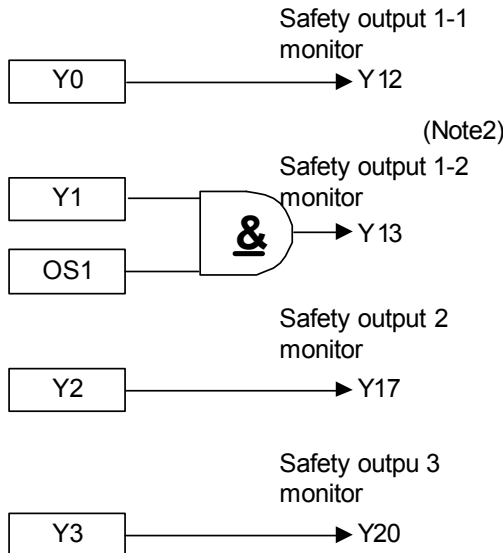


● Monitor output for safety input



Note1:
When safety input 1 is set to Auto mode, safety input 1 monitor turns OFF.

● Monitor output for safety output

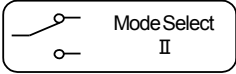


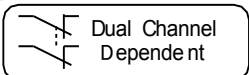
Note2:
Safety output 1-2 monitor turns OFF immediately independent of OFF-delay time.

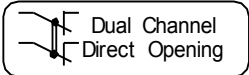
Function (Logic 14b)

●**Safety inputs: X0 to X11 (T0, T2 to T11)**

Safety inputs are used to diagnose the status of connected safety devices, such as emergency stop switches, interlock switches, and mode select switches.

Intended inputs (Terminal names)	Function	
Safety input 1 (X0/X1-T0)	Function name	Mode select input II
	Symbol	
	Description of operation	This function is for connecting devices with a mode selector function, such as mode selector switch. When the switching of inputs is performed within 3s, this function output is kept at previous state. This function diagnoses time interval of status transition between each input (0.5s).
	Detail information	Logic functions (5-321)

Intended inputs (Terminal names)	Function	
Safety input 2 (X2-T2, X3-T3)	Function name	Dual channel dependent input
	Symbol	
	Description of operation	This function diagnoses the status of connected safety devices. This function does not diagnose the time interval of status transition between each input of duplicated inputs.
	Detail information	Logic functions (5-313)

Intended inputs (Terminal names)	Function	
Safety input 3 (X4-T4, X5-T5) Safety input 4 (X6-T6, X7-T7) Safety input 5 (X10-T10, X11-T11)	Function name	Dual channel direct opening input
	Symbol	
	Description of operation	This function diagnoses the status of connected safety devices. This function diagnoses the time interval of status transition between each input of duplicated inputs (0.5s).
	Detail information	Logic functions (5-311)



For connected control devices, refer to “SAFETY PRECAUTIONS”.

Safety check signals (pulses signals) are sent from the drive terminals (T0, T2 to T11) to diagnose connected safety devices and input circuits. Safety check signals can not be used as a power supply for connected devices.

Note. Solid state outputs, such as safety light curtains, can not be connected to safety inputs.


Note. Use safety inputs, as specified combinations, such as receive terminal (Xn) and drive terminal (Tn). If the combinations are incorrect, SafetyOne does not work correctly.

Note. When SafetyOne is in Run state or Protection state, input states are monitored in all safety inputs. For example, if input monitor error is detected in safety input 2 although AUTO mode is selected, SafetyOne detects error and transits to Protection state.

Note. If there are unused safety inputs in safety input 2 through safety input 5, connect the unused receive terminals (Xn) to the corresponding drive terminals (Tn). If they are not connected, the SafetyOne does not turn ON the safety outputs.

● External device monitor inputs: X12 to X15 (T12 to T15)

External device monitor inputs are used to diagnose status of the devices connected to safety outputs.

Intended inputs (Terminal names)	Target safety outputs (Terminal names)	Function	
External device monitor input 1 (X12-T12)	Safety output 1-1 (Y0)	Function name	External device monitor input
External device monitor input 2 (X13-T13)	Safety output 1-2 (Y1)	Symbol	
External device monitor input 3 (X14-T14)	Safety output 2 (Y2)	Description of operation	This function diagnoses the status of devices connected to a target safety output.
External device monitor input 4 (X15-T15)	Safety output 3 (Y3)	Detail information	Logic functions (5-326)

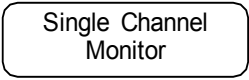


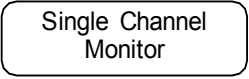
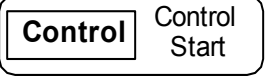
Safety check signals (pulses signals) are sent from the drive terminals (T12 to T15) to diagnose external devices and monitor circuits. Safety check signals can not be used as a power supply for connected devices.

Note. If there are unused safety outputs, connect the intended external device monitor terminals (Xn) to the corresponding drive terminals (Tn). If they are not connected, the SafetyOne detects an input monitor error. As the result, the error LED displays a “1” and the unit changes to the Protection state.

● **Start inputs: X16 and X17**

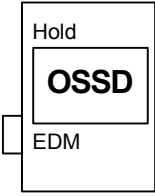
Start inputs are used to control the start of safety outputs.

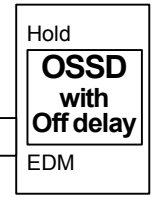
Intended inputs (Terminal names)	Target safety inputs (Terminal names)	Function	
		Start input 1 (X16)	Safety input 1 (X0-T0: TEACH) Safety input 2 (X2-T2, X3-T3)
		Symbol	
		Description of operation	Safety outputs are started, when all target safety inputs are in the safe state and this function is in the ON state. This function is turned ON by 0.1s or more ON operation.
		Detail information	Logic functions (5-325)

Intended inputs (Terminal names)	Target safety inputs (Terminal names)	Function	
		Start input 2 (X17)	Safety input 1 (X1-T0: AUTO) Safety input 3 (X4-T4, X5-T5) Safety input 4 (X6-T6, X7-T7) Safety input 5 (X10-T10, X11-T11)
		Symbol	 + 
		Description of operation	Safety outputs are started, when this function becomes ON after all intended safety inputs are in the safe state. This function is turned ON by 0.1s to 5s ON operation.
		Detail information	Logic functions (5-325, 330)

● **Safety outputs: Y0 to Y3**

Safety outputs are used to output safety information processed by SafetyOne.

Intended outputs (Terminal names)	Function	
Safety output 1-1 (Y0) Safety output 2 (Y2) Safety output 3 (Y3)	Function name	Safety output without timer
	Symbol	
	Description of operation	This function is a safety output to output safety information processed by SafetyOne. The output is turned OFF immediately by OFF operation (instantaneous OFF output).
	Detail information	Logic functions (5-332)

Intended outputs (Terminal names)	Function	
Safety output 1-2 (Y1)	Function name	Safety output with timer
	Symbol	
	Description of operation	This function is a safety output to output safety information processed by SafetyOne. The output is turned OFF after the preset time of the OFF-delay timer (OFF-delay output).
	Detail information	Logic functions (5-335)

Note. When the SafetyOne changes to Protection state due to input monitor error, safety output without timer (safety output 1-1 and safety output 2-1) is turned OFF. Safety output with timer (safety output 1-2 and safety output 2-2) is turned OFF after the preset OFF-delay time.

Note. When the SafetyOne changes to Stop state due to circuit failure or other errors, all safety outputs (safety output 1-1, safety output 1-2, safety output 2-1, and safety output 2-2) are turned OFF, immediately.

Note. Set time of safety output with timer is active independent of the selected mode.

Safety input monitor outputs: Y4 to Y10

Safety input monitor outputs are used to output the status of safety inputs in SafetyOne.

Intended outputs (Terminal names)	Target safety inputs (Terminal names)	Description of operation
Safety input 1 monitor output (Y4)	Safety input 1 (X0-T0: TEACH)	When TEACH mode (X0) is selected, the monitor output is ON. When TEACH mode is not selected, the monitor output is OFF. When the target safety input is ON, the monitor output is ON. When the target safety input is OFF, the monitor output is OFF.
Safety input 2 monitor output (Y5)	Safety input 2 (X2-T2, X3-T3)	
Safety input 3 monitor output (Y6)	Safety input 3 (X4-T4, X5-T5)	
Safety input 4 monitor output (Y7)	Safety input 4 (X6-T6, X7-T7)	
Safety input 5 monitor output (Y10)	Safety input 5 (X10-T10, X11-T11)	

Note. When the targeted safety input detects an input monitor error, input circuit failure or EMC the disturbance, corresponding safety input monitor output becomes a pulse output (1Hz). The monitor output is OFF in other errors, Initial state, or Configuration state.

•Safety output monitor outputs: Y12, Y13, Y17, and Y20

Safety output monitor outputs are used to output the status of safety outputs in SafetyOne.

Intended outputs (Terminal names)	Target safety outputs (Terminal names)	Description of operation
Safety output 1-1 monitor output (Y12)	Safety output 1-1 (Y0)	When the target safety output is ON, the monitor output is ON. When the target safety output is OFF, this function is OFF. The monitor output turns OFF immediately, independent of the preset OFF-delay time.
Safety output 1-2 monitor output (Y13)	Safety output 1-2 (Y1)	
Safety output 2 monitor output (Y17)	Safety output 2 (Y2)	
Safety output 3 monitor output (Y20)	Safety output 3 (Y3)	

Note. When the safety output detects an output circuit failure, corresponding safety output monitor output becomes a pulse output (1Hz). The monitor output is OFF in other errors, Initial state, or Configuration state.

● **State monitor outputs: Y14 to Y16**

State monitor outputs are used to output the internal state of SafetyOne.

Intended outputs (Terminal names)	State				
	Initial	Run	Configuration	Protection	Stop
State monitor output 1 (Y14)	■ON	□OFF	□OFF	□OFF	■ON
State monitor output 2 (Y15)	■ON	□OFF	■ON	■ON	■ON or □OFF
State monitor output 3 (Y16)	□OFF	■ON	□OFF	□OFF	□OFF

Refer to "Chapter 4 BASIC OPERATIONS" and to "Chapter 6 TROUBLE SHOOTING" for details of each state.



Warning

The monitor outputs are not safety outputs. Do not use these to construct a safety system.



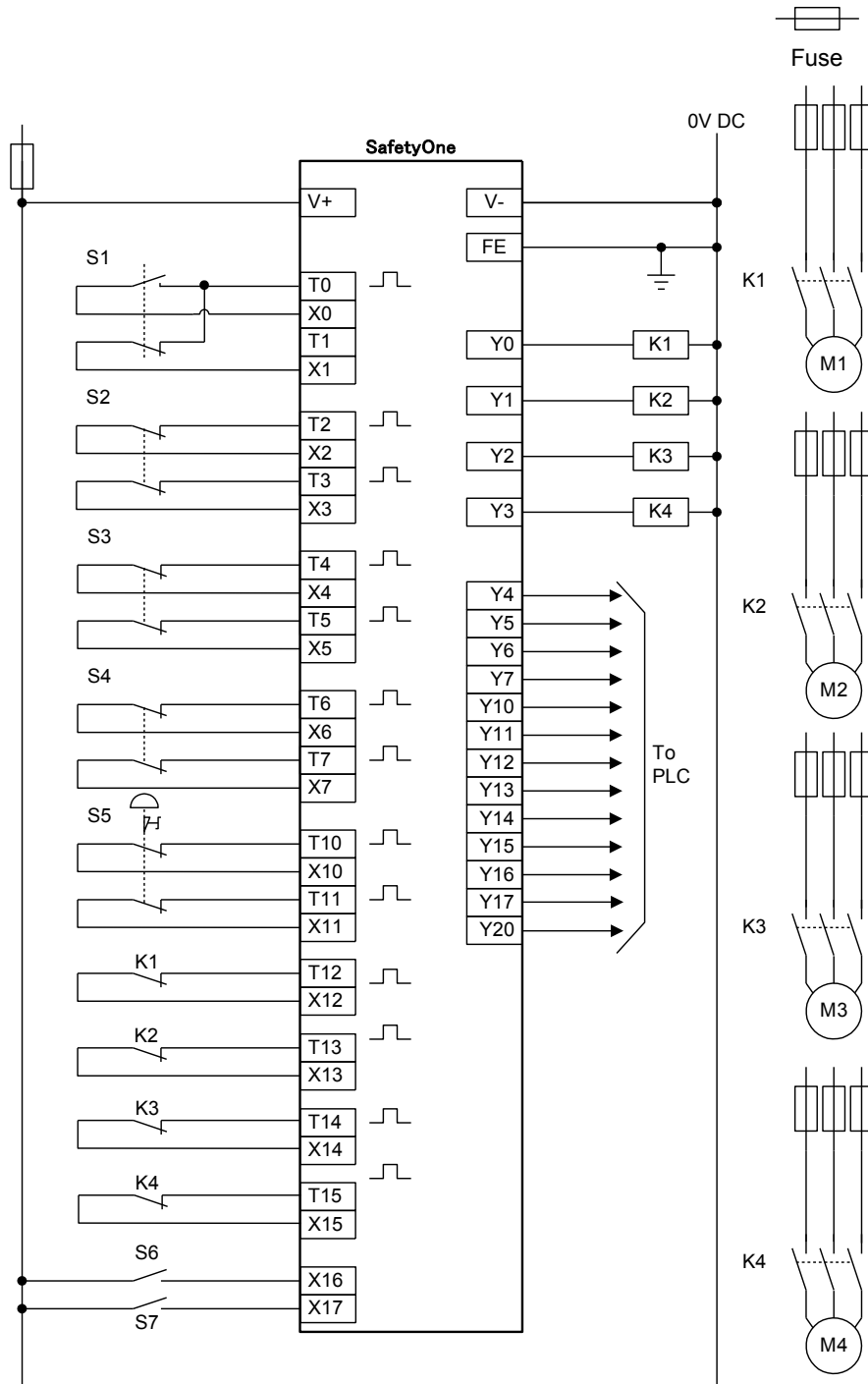
Caution

Refer to "Chapter 2 PRODUCT SPECIFICATIONS" for specifications of each input and output.

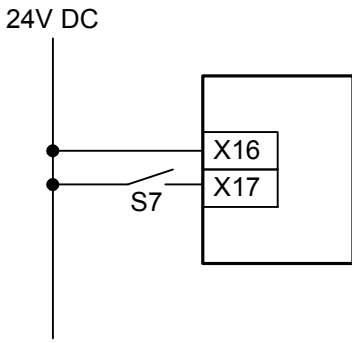
Wiring example (Logic 14b)

In the case where 1 selector switch, 1 enabling switch, 2 interlock switches, and 1 emergency stop switch are connected.

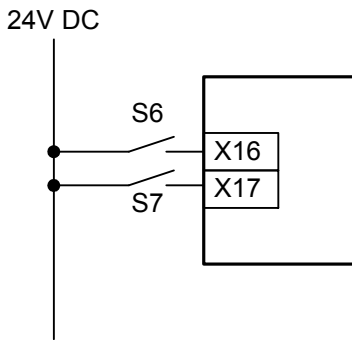
- S1 :Selector switch
- S2 :Enabling switch
- S3, 4 :Interlock switch
- S5 :Emergency stop switch
- S6, 7 :Start switch
- K1 to 4 :Contactor
- M1 to 4 :Motor



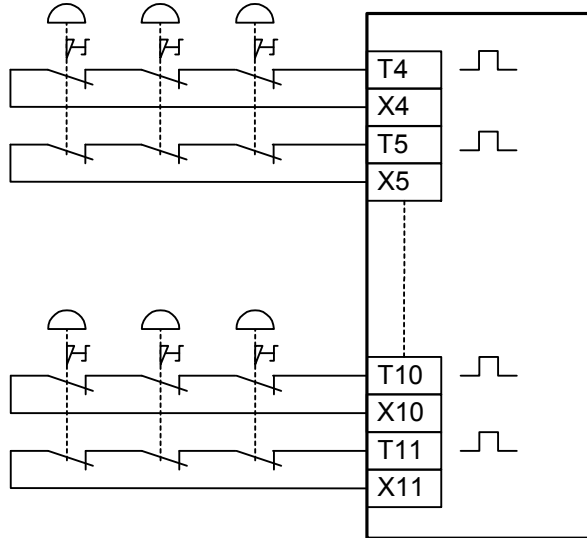
**When not using the start switch S6
(Auto start)**



**When using the start switch S6
(Manual start)**



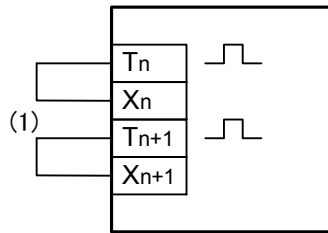
**When connecting multiple emergency stop switches
in series**



NOTE: Safety performance depends on the system configuration.

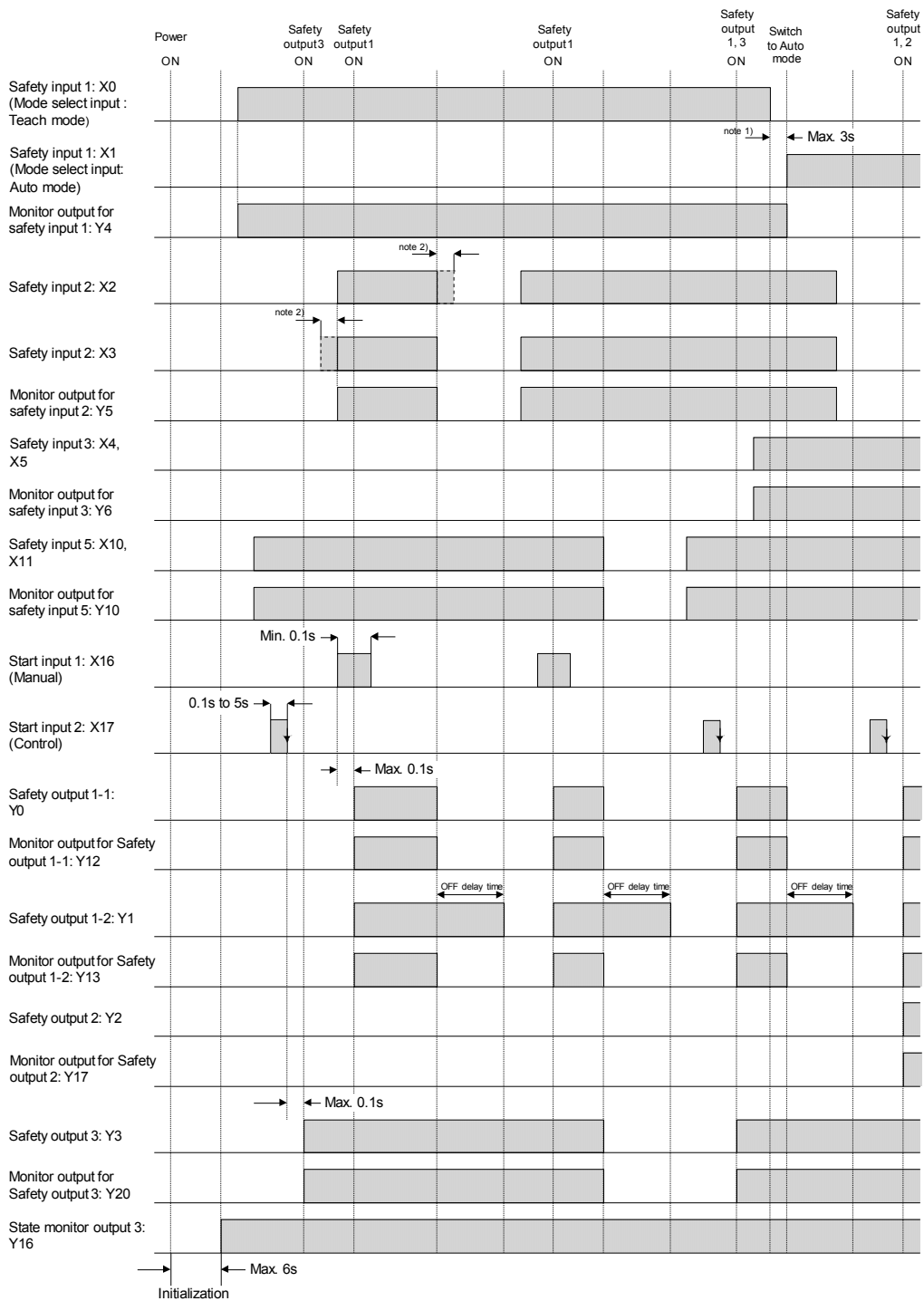
When not using some safety inputs

• If there are unused safety inputs, connect the unused receive terminals to the corresponding drive terminals.
(Refer to (1))



Timing chart (Logic 14b)

Example: Teach mode



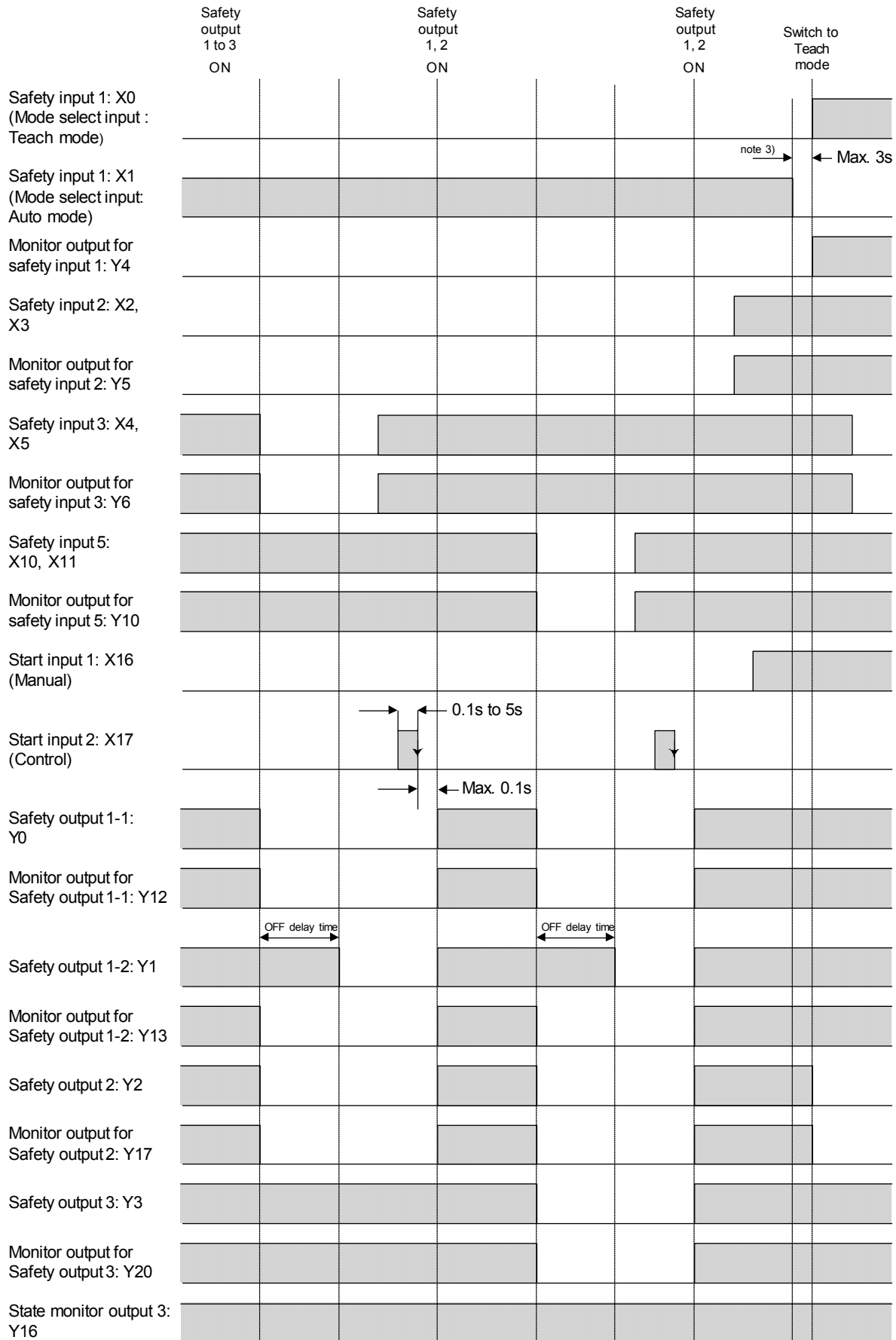
(Safety input 4 is ON in this chart.)

Note 1) When Safety input 1 (mode select input) is switched to Auto mode from Teach mode, Safety output 1 is kept ON for 3s maximum till X1 is turned ON after X0 is turned OFF. Safety output 1 is turned OFF at the same time as X1 is turned ON. Safety output 3 is unrelated to mode select input.

Note 2) Input monitor error detection time is infinity.

About safety inputs that are not described in this chart, input monitor error detection time is as follows. The time of dual channel direct opening input (X4 to X11) is 0.5s. Refer to the following "Logic functions" for more details.

Example: Auto mode



(Safety input 4 is ON in this chart.)

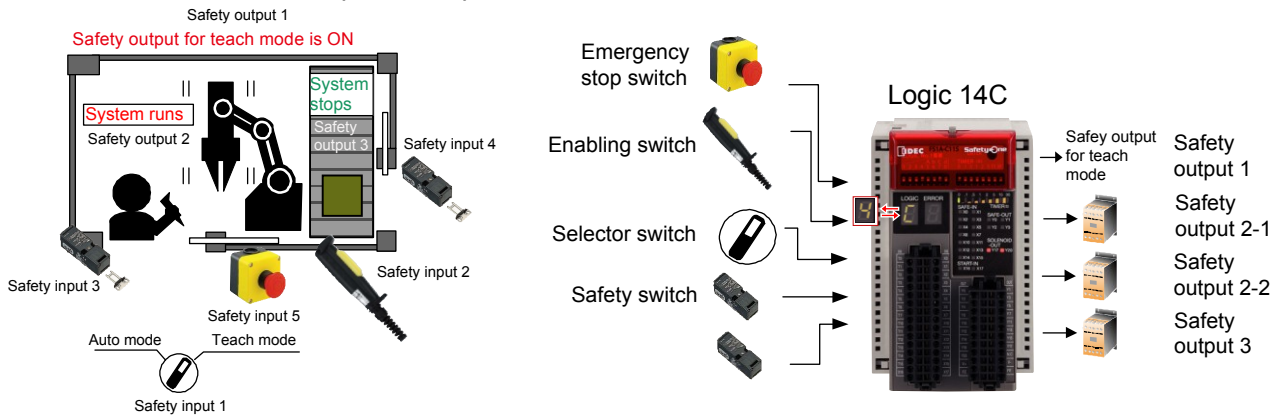
Note 3) When Safety input 1 (mode select input) is switched to another mode within 3s, Safety output 1 is kept ON.

Logic 14C: Partial stop logic applicable for selection of active safety input devices

Overview (Logic 14C)

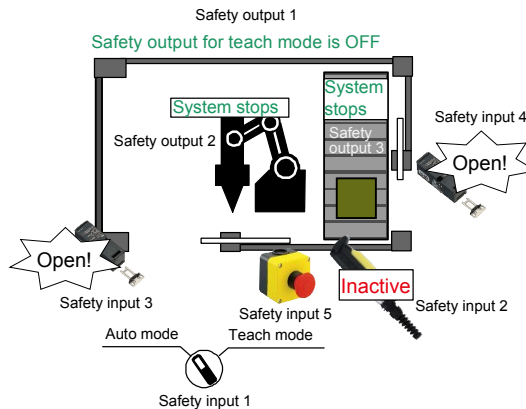
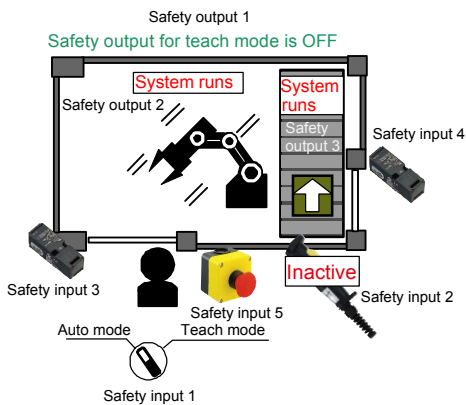
For production machines, robots, and the like, a hazard is generally isolated by a protective door (guard), however, when performing teaching or maintenance, the machine is operated in the condition that a person is in the danger zone. For such a situation, this logic described is applicable to the mode selection between Teach mode (maintenance mode) and Auto mode (operating mode). Safety outputs perform as single channel outputs.

This logic enables the connection of 3 dual channel direct opening inputs, 1 mode select input, and 1 dual channel dependent input.

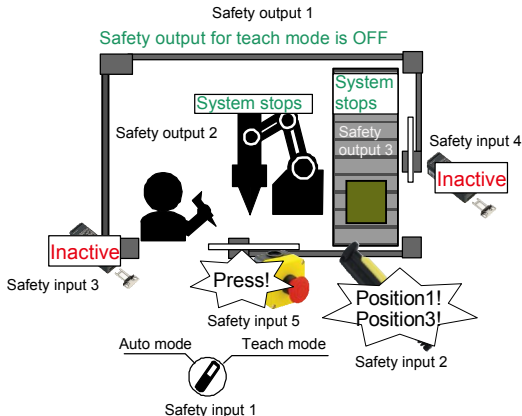


Operation example (Logic 14C)

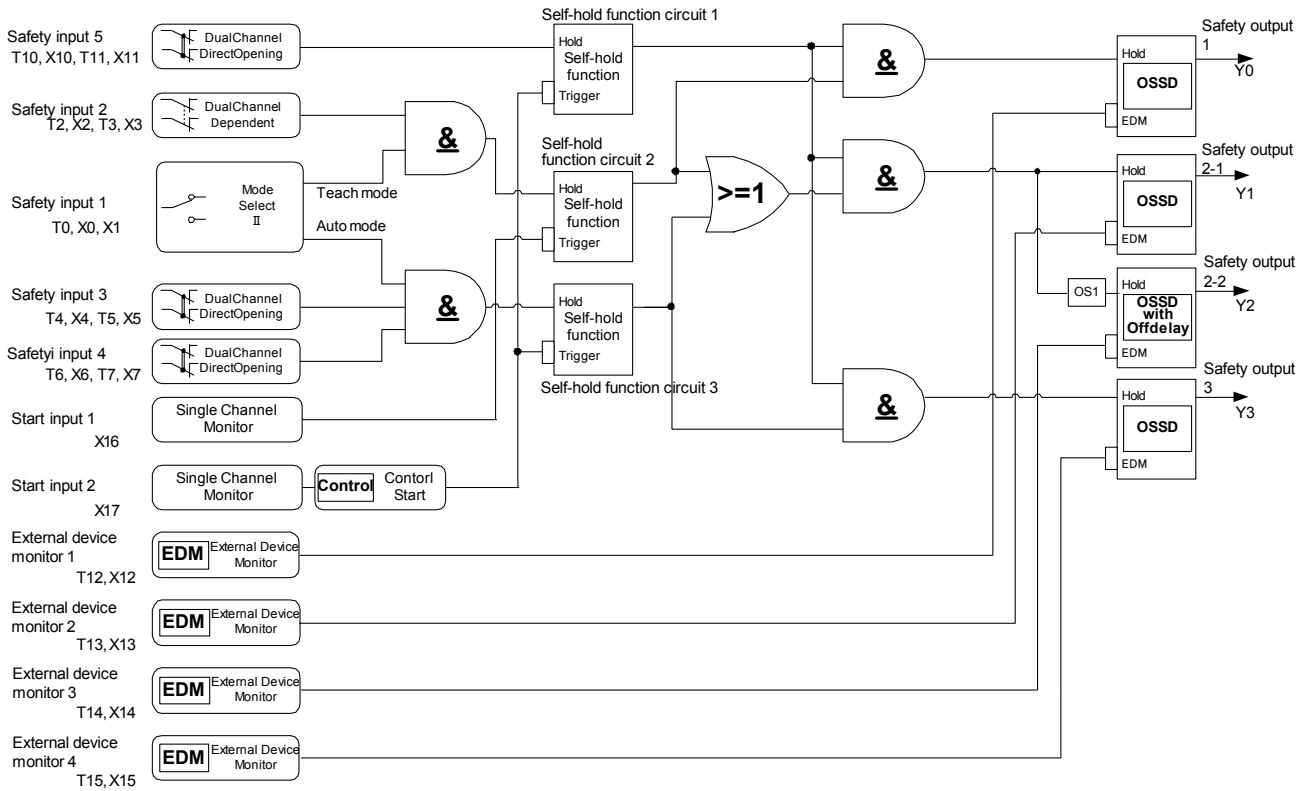
•Auto mode



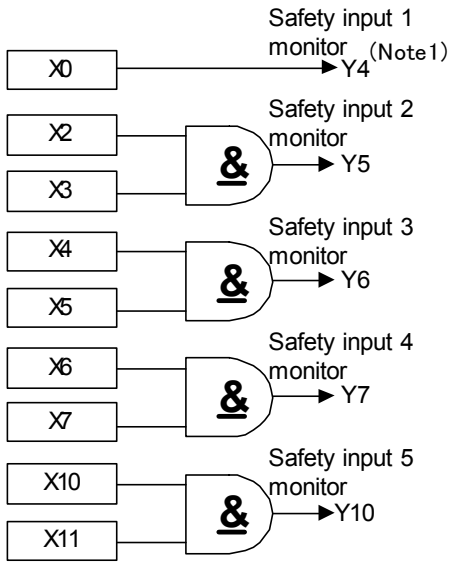
•Teach mode



Logic circuit (Logic 14C)

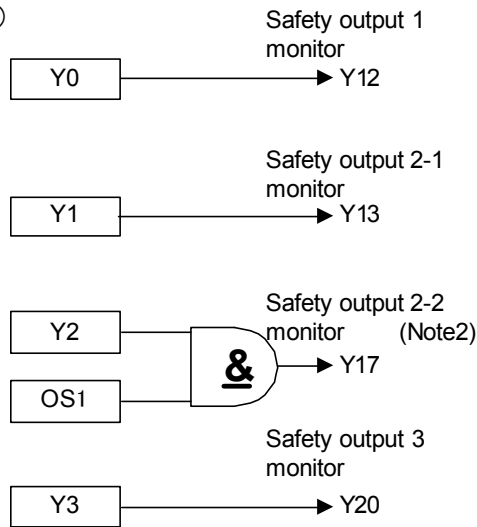


● Monitor output for safety input



Note1:
When safety input 1 is set to Auto mode, safety input 1 monitor turns OFF.

● Monitor output for safety output

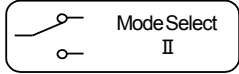


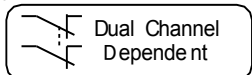
Note2:
Safety output 2-2 monitor turns OFF immediately independent of OFF-delay time.

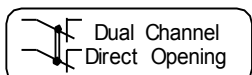
Function (Logic 14C)

●**Safety inputs: X0 to X11 (T0, T2 to T11)**

Safety inputs are used to diagnose the status of connected safety devices, such as emergency stop switches, interlock switches, and mode select switches.

Intended inputs (Terminal names)	Function	
Safety input 1 (X0/X1-T0)	Function name	Mode select input II
	Symbol	
	Description of operation	This function is for connecting devices with a mode selector function, such as mode selector switch. When the switching of inputs is performed within 3s, this function output is kept at previous state. This function diagnoses time interval of status transition between each input (0.5s).
	Detail information	Logic functions (5-321)

Intended inputs (Terminal names)	Function	
Safety input 2 (X2-T2, X3-T3)	Function name	Dual channel dependent input
	Symbol	
	Description of operation	This function diagnoses the status of connected safety devices. This function does not diagnose the time interval of status transition between each input of duplicated inputs.
	Detail information	Logic functions (5-313)

Intended inputs (Terminal names)	Function	
Safety input 3 (X4-T4, X5-T5) Safety input 4 (X6-T6, X7-T7) Safety input 5 (X10-T10, X11-T11)	Function name	Dual channel direct opening input
	Symbol	
	Description of operation	This function diagnoses the status of connected safety devices. This function diagnoses the time interval of status transition between each input of duplicated inputs (0.5s).
	Detail information	Logic functions (5-311)



For connected control devices, refer to “SAFETY PRECAUTIONS”.

Safety check signals (pulses signals) are sent from the drive terminals (T0, T2 to T11) to diagnose connected safety devices and input circuits. Safety check signals can not be used as a power supply for connected devices.

Note. Solid state outputs, such as safety light curtains, can not be connected to safety inputs.


Note. Use safety inputs, as specified combinations, such as receive terminal (Xn) and drive terminal (Tn). If the combinations are incorrect, SafetyOne does not work correctly.

Note. When SafetyOne is in Run state or Protection state, input states are monitored in all safety inputs. For example, if input monitor error is detected in safety input 2 although AUTO mode is selected, SafetyOne detects error and transits to Protection state.

Note. If there are unused safety inputs in safety input 2 through safety input 5, connect the unused receive terminals (Xn) to the corresponding drive terminals (Tn). If they are not connected, the SafetyOne does not turn ON the safety outputs.

●External device monitor inputs: X12 to X15 (T12 to T15)

External device monitor inputs are used to diagnose status of the devices connected to safety outputs.

Intended inputs (Terminal names)	Target safety outputs (Terminal names)	Function	
External device monitor input 1 (X12-T12)	Safety output 1 (Y0)	Function name	External device monitor input
External device monitor input 2 (X13-T13)	Safety output 2-1 (Y1)	Symbol	
External device monitor input 3 (X14-T14)	Safety output 2-2 (Y2)	Description of operation	This function diagnoses the status of devices connected to a target safety output.
External device monitor input 4 (X15-T15)	Safety output 3 (Y3)	Detail information	Logic functions (5-326)

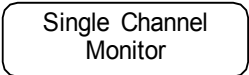




Safety check signals (pulses signals) are sent from the drive terminals (T12 to T15) to diagnose external devices and monitor circuits. Safety check signals can not be used as a power supply for connected devices.

Note. If there are unused safety outputs, connect the intended external device monitor terminals (Xn) to the corresponding drive terminals (Tn). If they are not connected, the SafetyOne detects an input monitor error. As the result, the error LED displays a “1” and the unit changes to the Protection state.

●Start inputs: X16 and X17

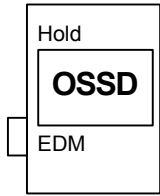
Start inputs are used to control the start of safety outputs.

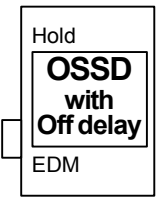
Intended inputs (Terminal names)	Target safety inputs (Terminal names)	Function	
		Start input 1 (X16)	Safety input 1 (X0-T0: TEACH) Safety input 2 (X2-T2, X3-T3)
Symbol			
Description of operation	Safety outputs are started, when all target safety inputs are in the safe state and this function is in the ON state. This function is turned ON by 0.1s or more ON operation.		
Detail information	Logic functions (5-325)		

Intended inputs (Terminal names)	Target safety inputs (Terminal names)	Function	
		Start input 2 (X17)	Safety input 1 (X1-T0: AUTO) Safety input 3 (X4-T4, X5-T5) Safety input 4 (X6-T6, X7-T7) Safety input 5 (X10-T10, X11-T11)
Symbol	 + 		
Description of operation	Safety outputs are started, when this function becomes ON after all intended safety inputs are in the safe state. This function is turned ON by 0.1s to 5s ON operation.		
Detail information	Logic functions (5-325, 330)		

● **Safety outputs: Y0 to Y3**

Safety outputs are used to output safety information processed by SafetyOne.

Intended outputs (Terminal names)	Function	
Safety output 1 (Y0) Safety output 2-1 (Y1) Safety output 3 (Y3)	Function name	Safety output without timer
	Symbol	
	Description of operation	This function is a safety output to output safety information processed by SafetyOne. The output is turned OFF immediately by OFF operation (instantaneous OFF output).
	Detail information	Logic functions (5-332)

Intended outputs (Terminal names)	Function	
Safety output 2-2 (Y2)	Function name	Safety output with timer
	Symbol	
	Description of operation	This function is a safety output to output safety information processed by SafetyOne. The output is turned OFF after the preset time of the OFF-delay timer (OFF-delay output).
	Detail information	Logic functions (5-335)

Note. When the SafetyOne changes to Protection state due to input monitor error, safety outputs without timer (safety output 1, safety output 2-1, and safety output3) are turned OFF. Safety outputs with timer (safety output 2-2) are turned OFF after the preset OFF-delay time.

Note. When the SafetyOne changes to Stop state due to circuit failure or other errors, all safety outputs (safety output 1, safety output 2-1, safety output 2-2, and safety output 3) are turned OFF, immediately.

Note. Set time of safety output with timer is active independent of the selected mode.

● **Safety input monitor outputs: Y4 to Y10**

Safety input monitor outputs are used to output the status of safety inputs in SafetyOne.

Intended outputs (Terminal names)	Target safety inputs (Terminal names)	Description of operation
Safety input 1 monitor output (Y4)	Safety input 1 (X0-T0: TEACH)	When TEACH 1(X0) is selected, the monitor output is ON. When TEACH 1 is not selected, the monitor output is OFF. When the target safety input is ON, the monitor output is ON. When the target safety input is OFF, the monitor output is OFF.
Safety input 2 monitor output (Y5)	Safety input 2 (X2-T2, X3-T3)	
Safety input 3 monitor output (Y6)	Safety input 3 (X4-T4, X5-T5)	
Safety input 4 monitor output (Y7)	Safety input 4 (X6-T6, X7-T7)	
Safety input 5 monitor output (Y10)	Safety input 5 (X10-T10, X11-T11)	

Note. When the targeted safety input detects an input monitor error, input circuit failure, or EMC the disturbance, corresponding safety input monitor output becomes a pulse output (1Hz). The monitor output is OFF in other errors, Initial state, or Configuration state.

● **Safety output monitor outputs: Y12, Y13, Y17, and Y20**

Safety output monitor outputs are used to output the status of safety outputs in SafetyOne.

Intended outputs (Terminal names)	Target safety outputs (Terminal names)	Description of operation
Safety output 1 monitor output (Y12)	Safety output 1 (Y0)	When the target safety output is ON, the monitor output is ON. When the target safety output is OFF, this function is OFF. The monitor output turns OFF immediately, independent of the preset OFF-delay time.
Safety output 2-1 monitor output (Y13)	Safety output 2-1 (Y1)	
Safety output 2-2 monitor output (Y17)	Safety output 2-2 (Y2)	
Safety output 3 monitor output (Y20)	Safety output 3 (Y3)	

Note. When the safety output detects an output circuit failure, the corresponding safety output monitor output becomes a pulse output (1Hz). The monitor output is OFF in other errors, Initial state, or Configuration state.

● **State monitor outputs: Y14 to Y16**

State monitor outputs are used to output the internal state of SafetyOne.

Intended outputs (Terminal names)	State				
	Initial	Run	Configuration	Protection	Stop
State monitor output 1 (Y14)	■ON	□OFF	□OFF	□OFF	■ON
State monitor output 2 (Y15)	■ON	□OFF	■ON	■ON	■ON or □OFF
State monitor output 3 (Y16)	□OFF	■ON	□OFF	□OFF	□OFF

Refer to "Chapter 4 BASIC OPERATIONS" and to "Chapter 6 TROUBLE SHOOTING" for details of each state.



Warning

The monitor outputs are not safety outputs. Do not use these to construct a safety system.



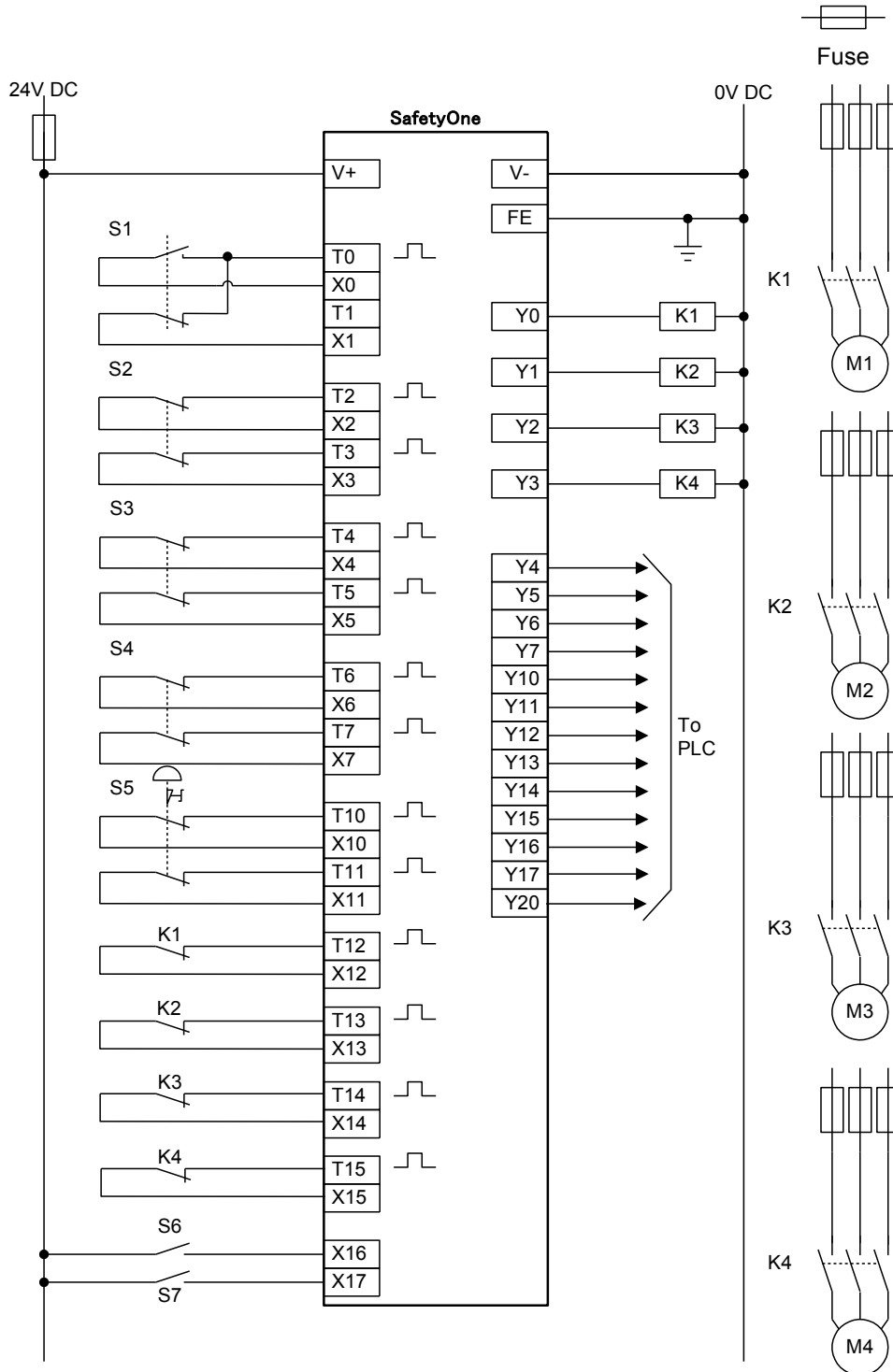
Caution

Refer to "Chapter 2 PRODUCT SPECIFICATIONS" for specifications of each input and output.

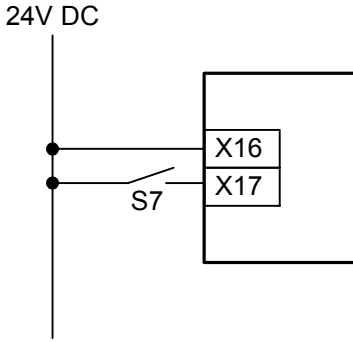
Wiring example (Logic 14C)

In the case where 1 selector switch, 2 enabling switches, 2 interlock switches, and 1 emergency stop switch are connected.

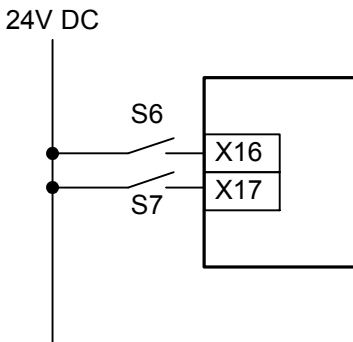
- S1 : Selector switch
- S2 : Enabling switch
- S3, 4 : Interlock switch
- S5 : Emergency stop switch
- S6, 7 : Start switch
- K1 to 4 : Contactor
- M1 to 4 : Motor



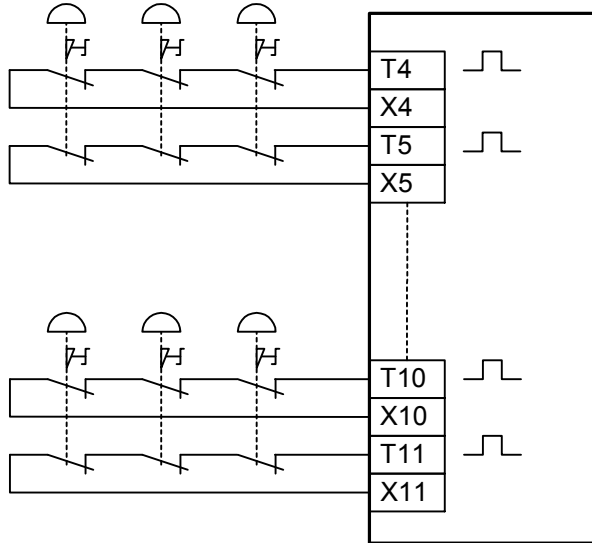
**When not using the start switch S6
(Auto start)**



**When using the start switch S6
(Manual start)**



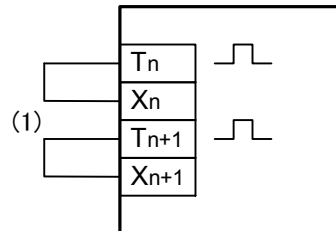
**When connecting multiple emergency stop switches
in series**



NOTE: Safety performance depends on the system configuration.

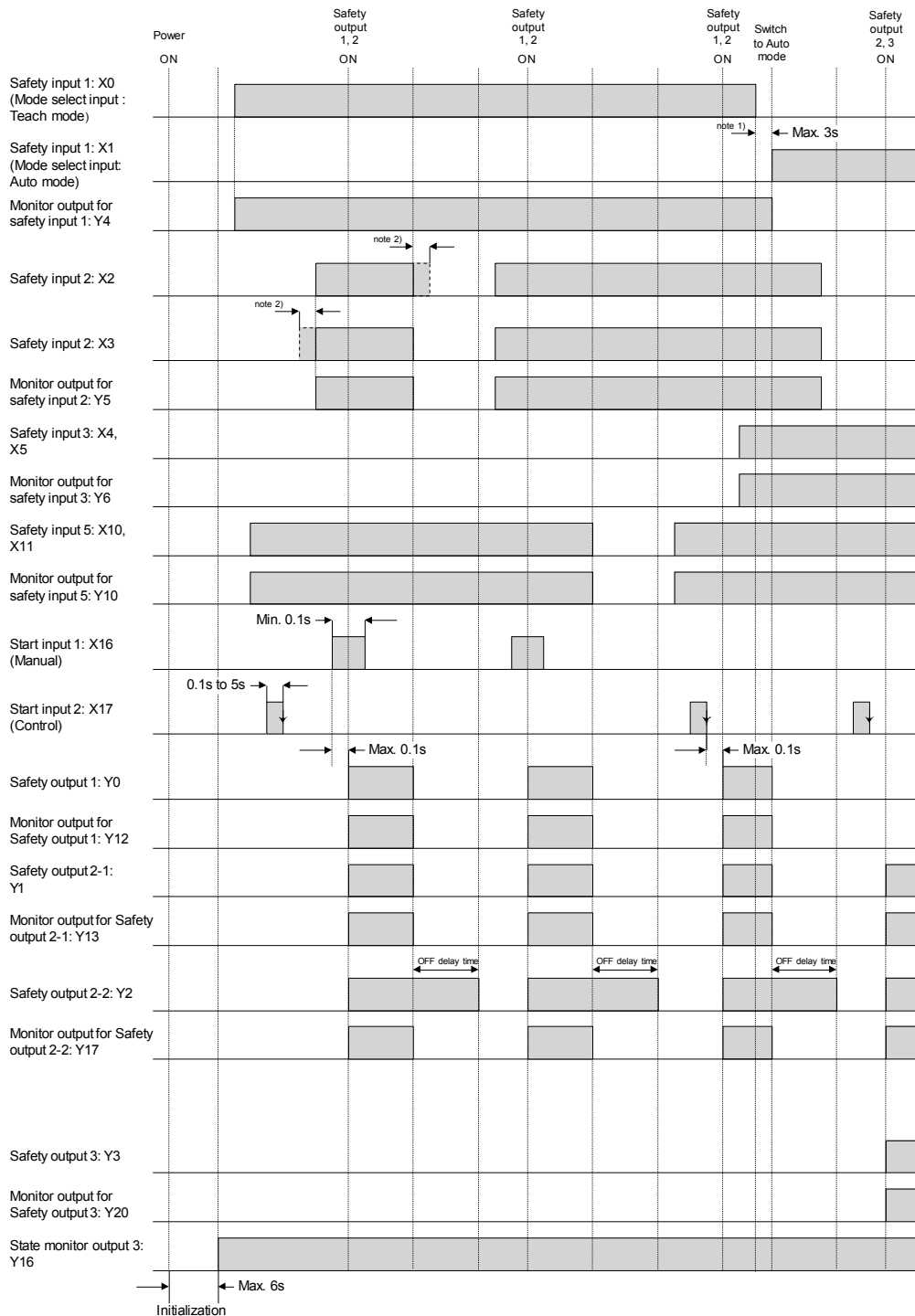
When not using some safety inputs

- If there are unused safety inputs, connect the unused receive terminals to the corresponding drive terminals. (Refer to (1))



Timing chart (Logic 14C)

Example: Teach mode



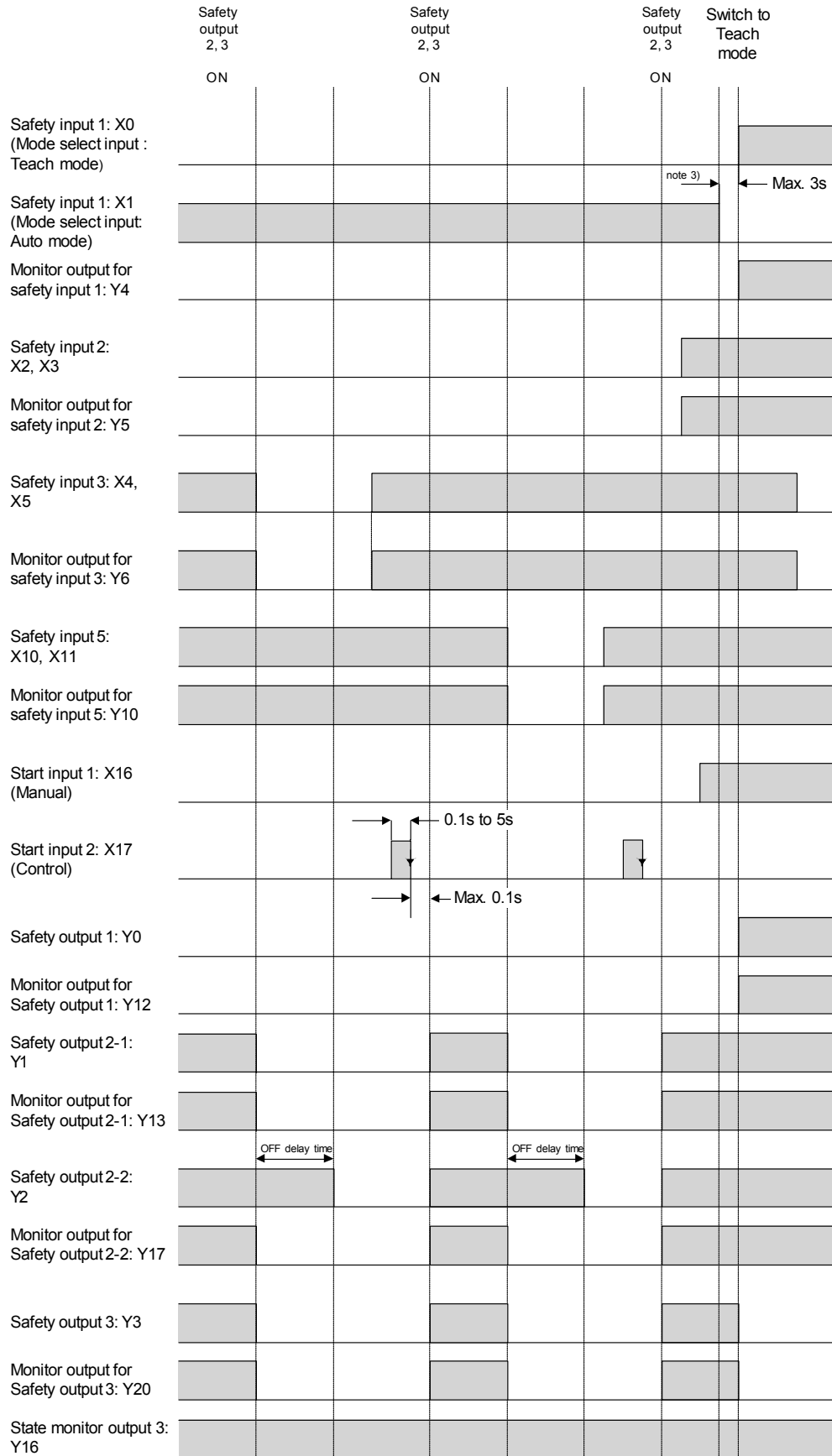
(Safety input 4 is ON in this chart.)

Note 1) When Safety input 1 (mode select input) is switched to Auto mode from Teach mode, Safety output 1 and Safety output 2 are kept ON for 3s maximum till X1 is turned ON after X0 is turned OFF. Safety output 1 and Safety output 2 are turned OFF at the same time as X1 is turned ON.

Note 2) Input monitor error detection time is infinity.

About safety inputs that are not described in this chart, input monitor error detection time is as follows. The time of dual channel direct opening input (X4 to X11) is 0.5s. Refer to the following "Logic functions" for more details.

Example: Auto mode



(Safety input 4 is ON in this chart.)

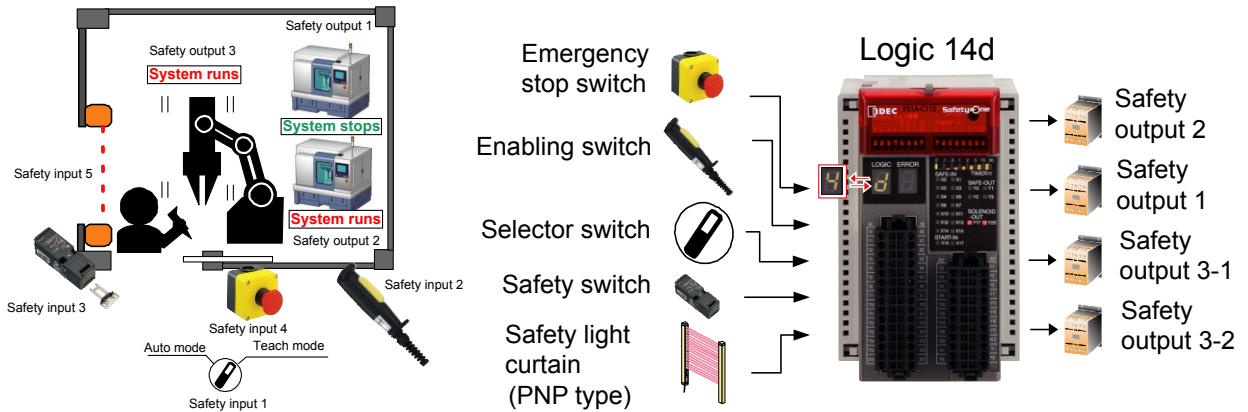
Note 3) When Safety input 1 (mode select input) is switched to another mode within 3s, Safety output 2 is kept ON.

Logic 14d: Partial stop logic applicable for selection of active safety input devices for apparatus with openings

Overview (Logic 14d)

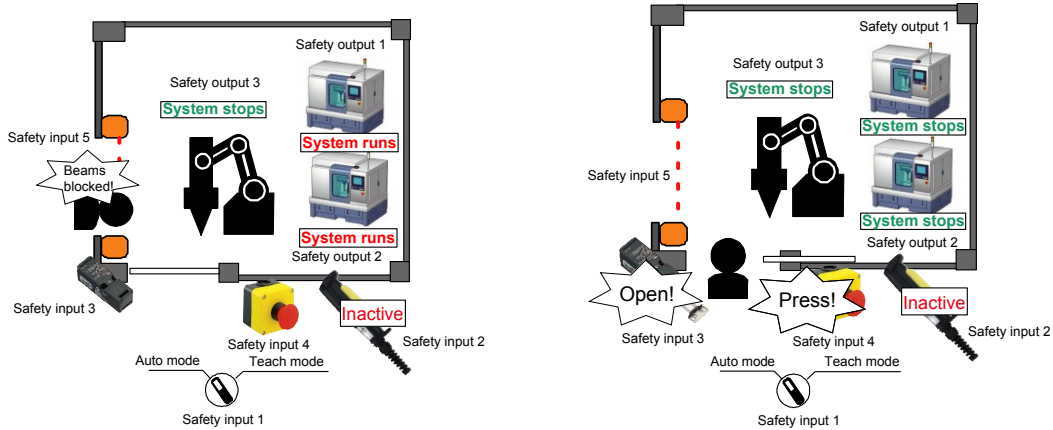
For production machines, robots, and the like, a hazard is generally isolated by a protective door (guard), however, when performing teaching or maintenance, the machine is operated in the condition that a person is in the danger zone. For such a situation, this logic described is applicable to the mode selection between Teach mode (maintenance mode) and Auto mode (operating mode). Safety outputs perform as single channel outputs.

This logic enables the connection of 2 dual channel direct opening inputs, 1 mode select input, 1 dual channel dependent input, and 1 dual channel safety input.

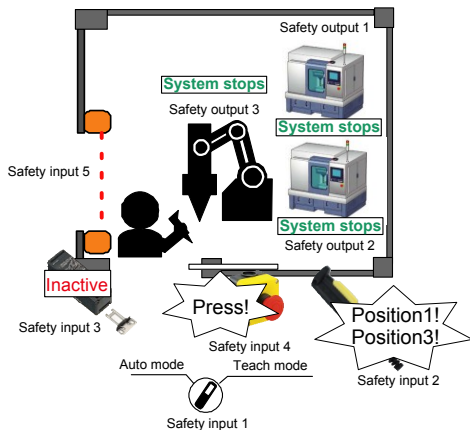


Operation example (Logic 14d)

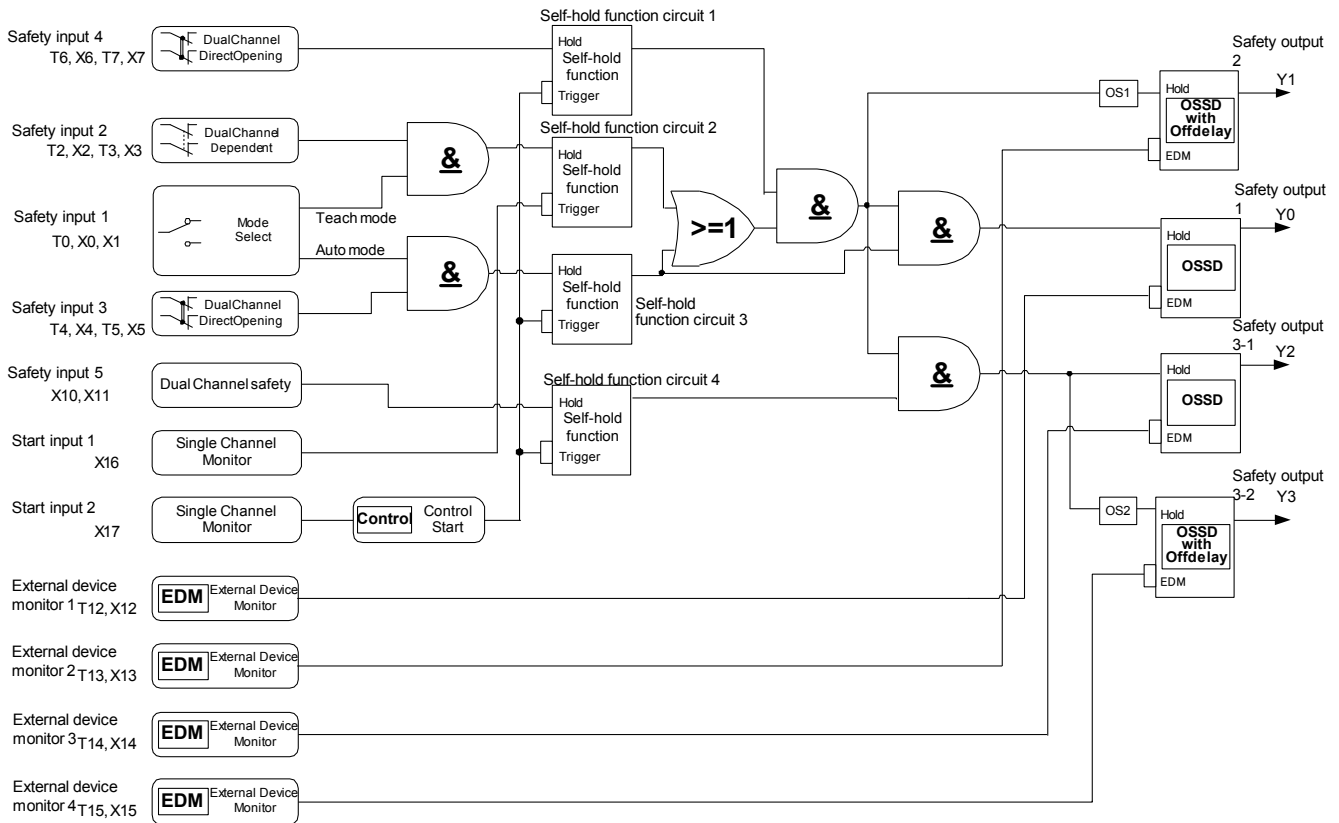
•Auto mode



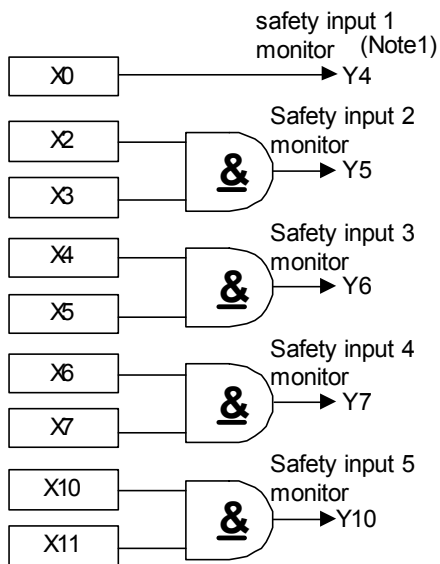
•Teach mode



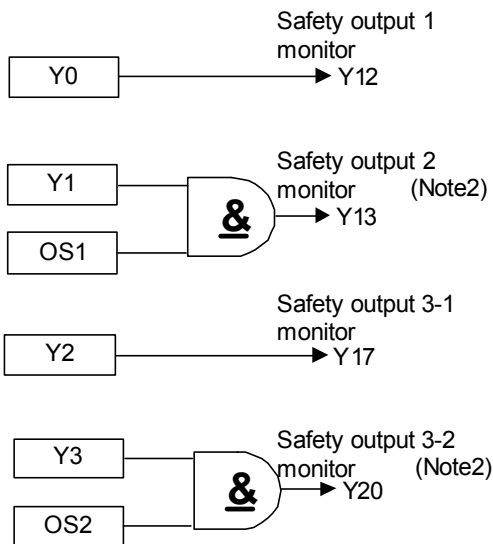
Logic circuit (Logic 14d)



● Monitor output for safety input



● Monitor output for safety output



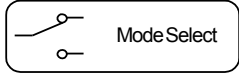
Note1:
When safety input 1 is set to Auto mode, safety input 1 monitor turns OFF.

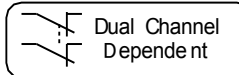
Note2:
Safety output 2 monitor and safety output 3-2 monitor turn OFF immediately independent of OFF-delay time.

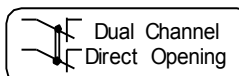
Function (Logic 14d)

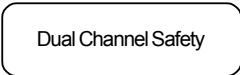
●**Safety inputs: X0 to X11 (T0, T2 to T7)**

Safety inputs are used to diagnose the status of connected safety devices, such as emergency stop switches, interlock switches, and mode select switches.

Intended inputs (Terminal names)	Function	
Safety input 1 (X0/X1-T0)	Function name	Mode select input
	Symbol	
	Description of operation	This function is for connecting devices with a mode selector function, such as mode selector switch. This function diagnoses time interval of status transition between each input (0.5s).
	Detail information	Logic functions (5-319)

Intended inputs (Terminal names)	Function	
Safety input 2 (X2-T2, X3-T3)	Function name	Dual channel dependent input
	Symbol	
	Description of operation	This function diagnoses the status of connected safety devices. This function does not diagnose the time interval of status transition between each input of duplicated inputs.
	Detail information	Logic functions (5-313)

Intended inputs (Terminal names)	Function	
Safety input 3 (X4-T4, X5-T5) Safety input 4 (X6-T6, X7-T7)	Function name	Dual channel direct opening input
	Symbol	
	Description of operation	This function diagnoses the status of connected safety devices. This function diagnoses the time interval of status transition between each input of duplicated inputs (0.5s).
	Detail information	Logic functions (5-311)

Intended inputs (Terminal names)	Function	
Safety input 5 (X10, X11)	Function name	Dual channel safety input
	Symbol	
	Description of operation	This function diagnoses the status of connected safety devices. This function diagnoses the time interval of status transition between each input of duplicated inputs (0.1s). The function does not use drive terminals (T10 and T11).
	Detail information	Logic functions (5-317)


Warning

For connected control devices, refer to “SAFETY PRECAUTIONS”.

Safety check signals (pulses signals) are sent from the drive terminals (T0, T2 to T7) to diagnose connected safety devices and input circuits. Safety check signals can not be used as a power supply for connected devices.

Note. Solid state outputs, such as safety light curtains, can not be connected to safety input1 through safety input 4.

Note. Use safety input 1 through safety input 4, as specified combinations, such as receive terminal (Xn) and drive terminal (Tn). If the combinations are incorrect, SafetyOne does not work correctly.


Note. When SafetyOne is in Run state or Protection state, input states are monitored in all safety inputs. For example, if input monitor error is detected in safety input 2 although AUTO mode is selected, SafetyOne detects error and transits to Protection state.

Note. If there are unused safety inputs in safety input 2 through safety input 4, connect the unused receive terminals (Xn) to the corresponding drive terminals (Tn). If they are not connected, the SafetyOne does not turn ON the safety outputs.

Note. If safety input 5 is not used, connect the receive terminals (X10 and X11) to a 24V DC power supply (V+). If they are not connected, the SafetyOne does not turn ON the safety outputs.

● **External device monitor inputs: X12 to X15 (T12 to T15)**

External device monitor inputs are used to diagnose status of the devices connected to safety outputs.

Intended inputs (Terminal names)	Target safety outputs (Terminal names)	Function	
External device monitor input 1 (X12-T12)	Safety output 1 (Y0)	Function name	External device monitor input
External device monitor input 2 (X13-T13)	Safety output 2 (Y1)	Symbol	
External device monitor input 3 (X14-T14)	Safety output 3-1 (Y2)	Description of operation	This function diagnoses the status of devices connected to a target safety output.
External device monitor input 4 (X15-T15)	Safety output 3-2 (Y3)	Detail information	Logic functions (5-326)



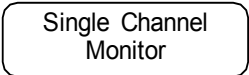
Warning



Safety check signals (pulses signals) are sent from the drive terminals (T12 to T15) to diagnose external devices and monitor circuits. Safety check signals can not be used as a power supply for connected devices.

Note. If there are unused safety outputs, connect the intended external device monitor terminals (Xn) to the corresponding drive terminals (Tn). If they are not connected, the SafetyOne detects an input monitor error. As the result, the error LED displays a “1” and the unit changes to the Protection state.

● **Start inputs: X16 and X17**

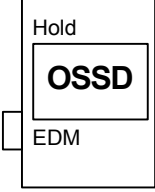
Start inputs are used to control the start of safety outputs.

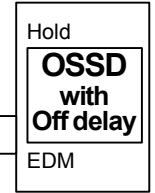
Intended inputs (Terminal names)	Target safety inputs (Terminal names)	Function	
		Start input 1 (X16)	Safety input 1 (X0-T0: TEACH) Safety input 2 (X2-T2, X3-T3)
		Symbol	
		Description of operation	Safety outputs are started, when all target safety inputs are in the safe state and this function is in the ON state. This function is turned ON by 0.1s or more ON operation.
		Detail information	Logic functions (5-325)

Intended inputs (Terminal names)	Target safety inputs (Terminal names)	Function	
		Start input 2 (X17)	Safety input 1 (X1-T0: AUTO) Safety input 3 (X4-T4, X5-T5) Safety input 4 (X6-T6, X7-T7) Safety input 5 (X10, X11)
		Symbol	 + 
		Description of operation	Safety outputs are started, when this function becomes ON after all intended safety inputs are in the safe state. This function is turned ON by 0.1s to 5s ON operation.
		Detail information	Logic functions (5-325, 330)

● **Safety outputs: Y0 to Y3**

Safety outputs are used to output safety information processed by SafetyOne.

Intended outputs (Terminal names)	Function	
Safety output 1 (Y0) Safety output 3-1 (Y2)	Function name	Safety output without timer
	Symbol	
	Description of operation	This function is a safety output to output safety information processed by SafetyOne. The output is turned OFF immediately by OFF operation (instantaneous OFF output).
	Detail information	Logic functions (5-332)

Intended outputs (Terminal names)	Function	
Safety output 2 (Y1) Safety output 3-2 (Y3)	Function name	Safety output with timer
	Symbol	
	Description of operation	This function is a safety output to output safety information processed by SafetyOne. The output is turned OFF after the preset time of the OFF-delay timer (OFF-delay output).
	Detail information	Logic functions (5-335)

Note. When the SafetyOne changes to Protection state due to input monitor error, safety outputs without timer (safety output 1 and safety output 3-1) are turned OFF. Safety outputs with timer (safety output 2 and safety output 3-2) are turned OFF after the preset OFF-delay time.

Note. When the SafetyOne changes to Stop state due to circuit failure or other errors, all safety outputs (safety output 1, safety output 2, safety output 3-1, and safety output 3-2) are turned OFF, immediately.

Note. Set time of safety output with timer is active independent of the selected mode.

● **Safety input monitor outputs: Y4 to Y10**

Safety input monitor outputs are used to output the status of safety inputs in SafetyOne.

Intended outputs (Terminal names)	Target safety inputs (Terminal names)	Description of operation
Safety input 1 monitor output (Y4)	Safety input 1 (X0-T0: TEACH)	When TEACH mode (X0) is selected, the monitor output is ON. When TEACH mode is not selected, the monitor output is OFF. When the target safety input is ON, the monitor output is ON. When the target safety input is OFF, the monitor output is OFF.
Safety input 2 monitor output (Y5)	Safety input 2 (X2-T2, X3-T3)	
Safety input 3 monitor output (Y6)	Safety input 3 (X4-T4, X5-T5)	
Safety input 4 monitor output (Y7)	Safety input 4 (X6-T6, X7-T7)	
Safety input 5 monitor output (Y10)	Safety input 5 (X10, X11)	

Note. When the targeted safety input detects an input monitor error, input circuit failure, or EMC the disturbance, corresponding safety input monitor output becomes a pulse output (1Hz). The monitor output is OFF in other errors, Initial state, or Configuration state.

● **Safety output monitor outputs: Y12, Y13, Y17, and Y20**

Safety output monitor outputs are used to output status of safety outputs in SafetyOne.

Intended outputs (Terminal names)	Target safety outputs (Terminal names)	Description of operation
Safety output 1 monitor output (Y12)	Safety output 1 (Y0)	When the target safety output is ON, the monitor output is ON. When the target safety output is OFF, this function is OFF. The monitor output turns OFF immediately, independent of the preset OFF-delay time.
Safety output 2 monitor output (Y13)	Safety output 2 (Y1)	
Safety output 3-1 monitor output (Y17)	Safety output 3-1 (Y2)	
Safety output 3-2 monitor output (Y20)	Safety output 3-2 (Y3)	

Note. When the safety output detects an output circuit failure, corresponding safety output monitor output becomes a pulse outputs (1Hz). The monitor output is OFF in other errors, Initial state, or Configuration state.

● **State monitor outputs: Y14 to Y16**

State monitor outputs are used to output the internal state of SafetyOne.

Intended outputs (Terminal names)	State				
	Initial	Run	Configuration	Protection	Stop
State monitor output 1 (Y14)	■ON	□OFF	□OFF	□OFF	■ON
State monitor output 2 (Y15)	■ON	□OFF	■ON	■ON	■ON or □OFF
State monitor output 3 (Y16)	□OFF	■ON	□OFF	□OFF	□OFF

Refer to “Chapter 4 BASIC OPERATIONS” and to “Chapter 6 TROUBLE SHOOTING” for details of each state.



The monitor outputs are not safety outputs. Do not use these to construct a safety system.

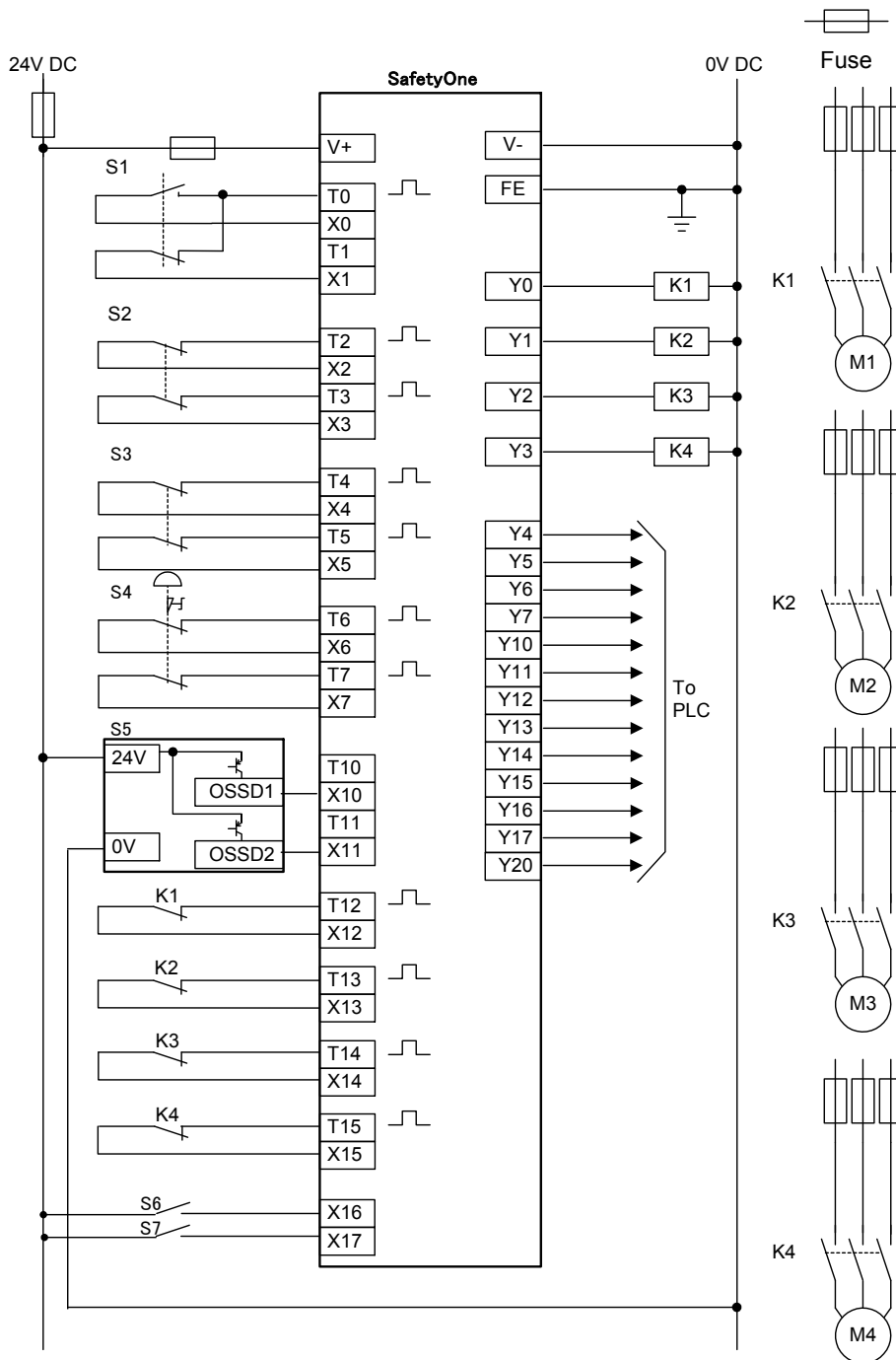


Refer to "Chapter 2 PRODUCT SPECIFICATIONS" for specifications of each input and output.

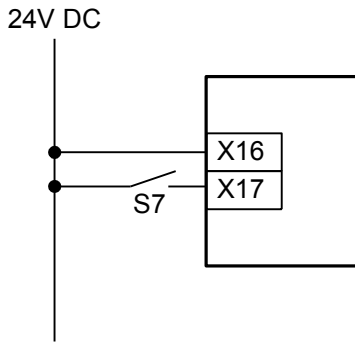
Wiring example (Logic 14d)

In the case where 1 selector switch, 1 enabling switch, 1 interlock switch, 1 emergency stop switch, and 1 safety light curtain are connected.

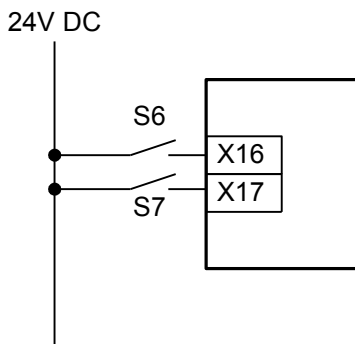
- S1 :Selector switch
- S2 :Enabling switch
- S3 :Interlock switch
- S4 :Emergency stop switch
- S5 :Safety light curtain
- S6, 7 :Start switch
- K1 to 4 :Contactor
- M1 to 4 :Motor



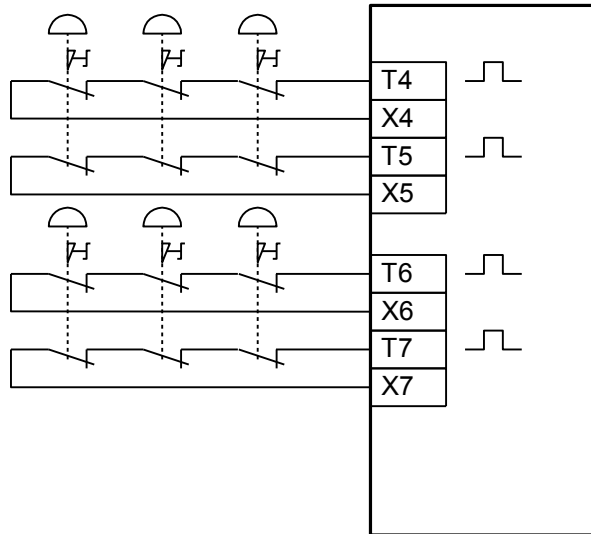
**When not using the start S6
(Auto start)**



**When using the start switch S6
(Manual start)**



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

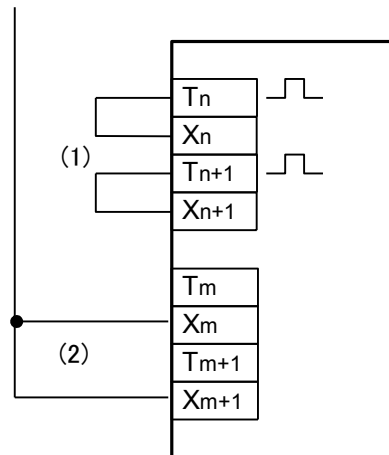


NOTE: Safety performance depends on the system configuration.

When not using some safety inputs

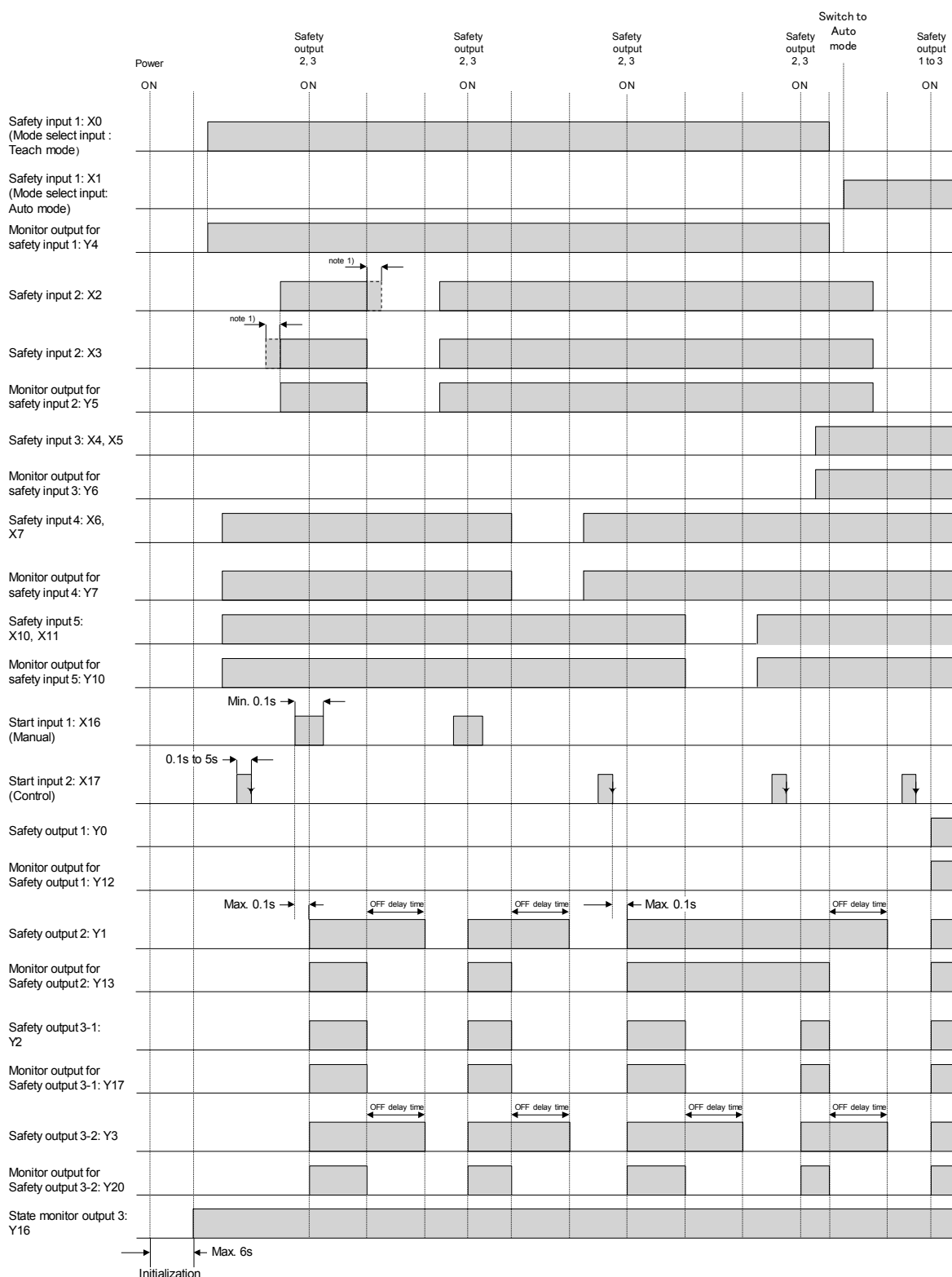
- If there are unused safety inputs in S3 and S4, connect the unused receive terminals to the corresponding drive terminals. (Refer to (1))
- If S5 is not used, connect the receive terminal to 24V DC power supply (V+). (Refer to (2))

24V DC



Timing chart (Logic 14d)

Example: Teach mode

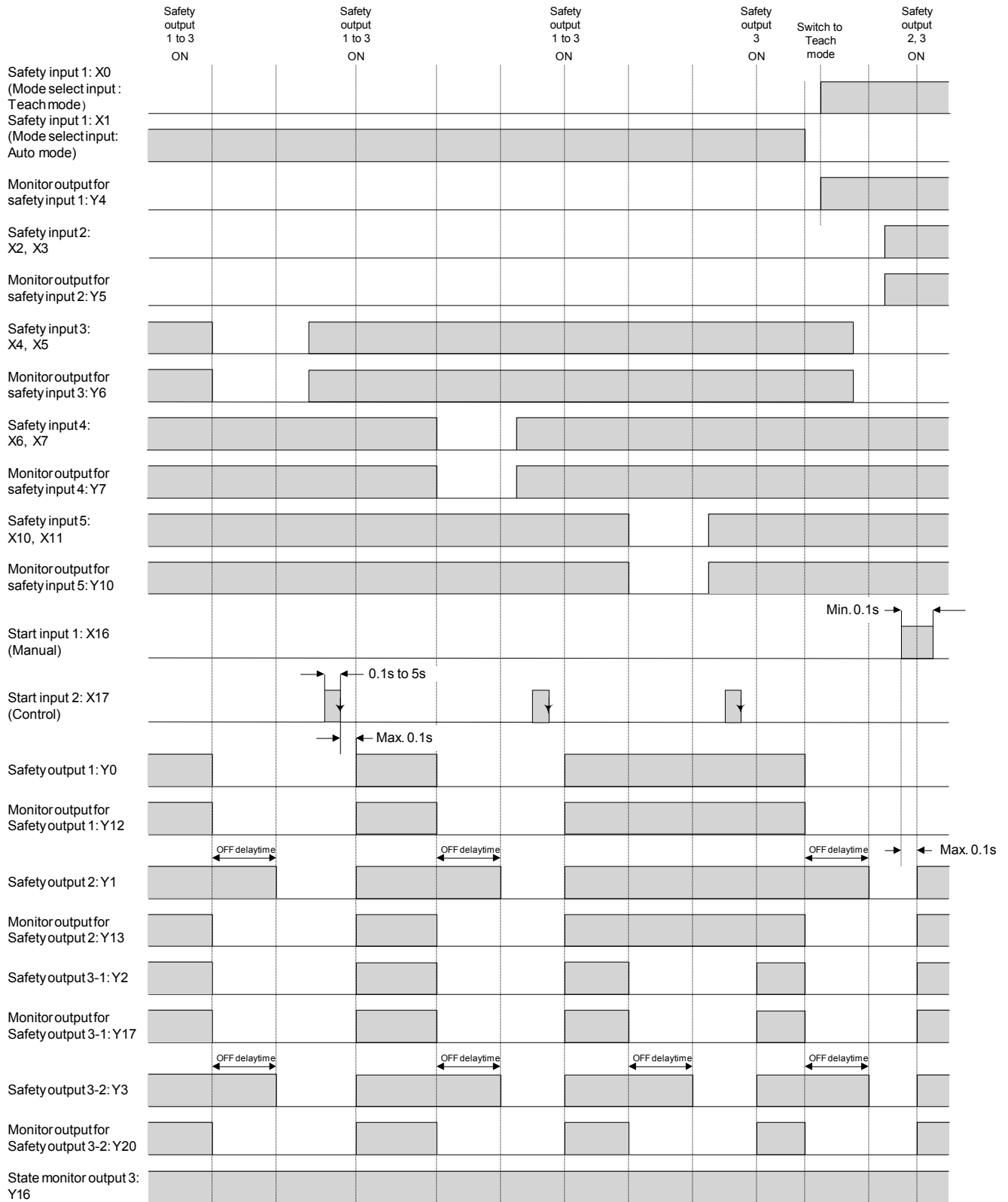


Note 1) Input monitor error detection time is infinity.

About safety inputs that are not described in this chart, input monitor error detection time is as follows.
 The time of dual channel direct opening input (X4 to X7) is 0.5s.
 The time of dual channel safety input (X10, X11) is 0.1s.
 Refer to the following “Logic functions” for more details.

LOGIC

Example: Auto mode

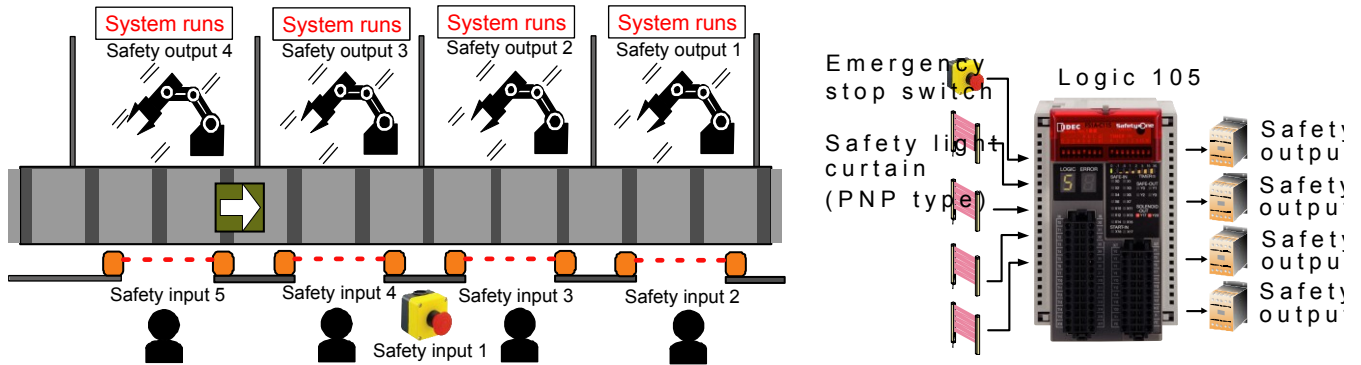


Logic 105: Partial stop logic for apparatus with openings

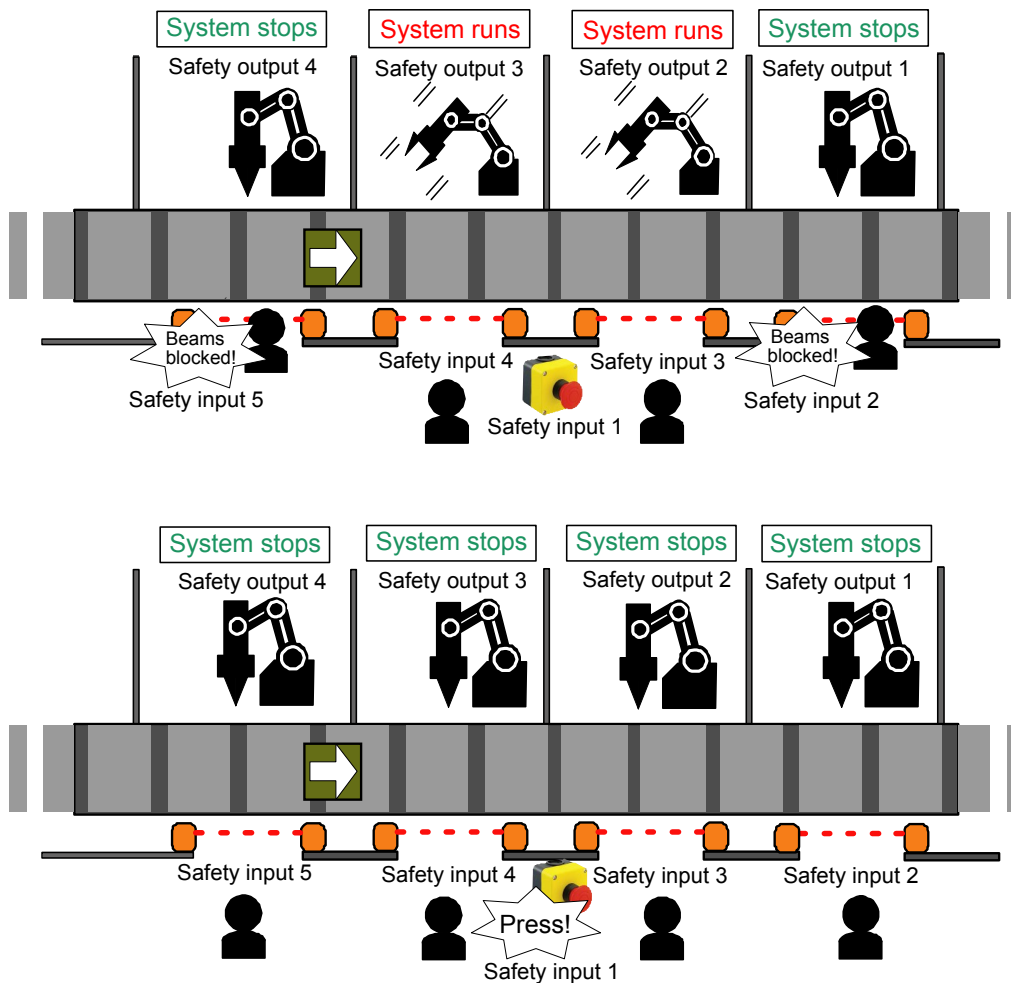
Overview (Logic 105)

This logic is for using safety devices with dual channel solid state outputs, such as safety light curtains, for safety protective measures of production machinery and robots. Safety outputs perform as single channel outputs.

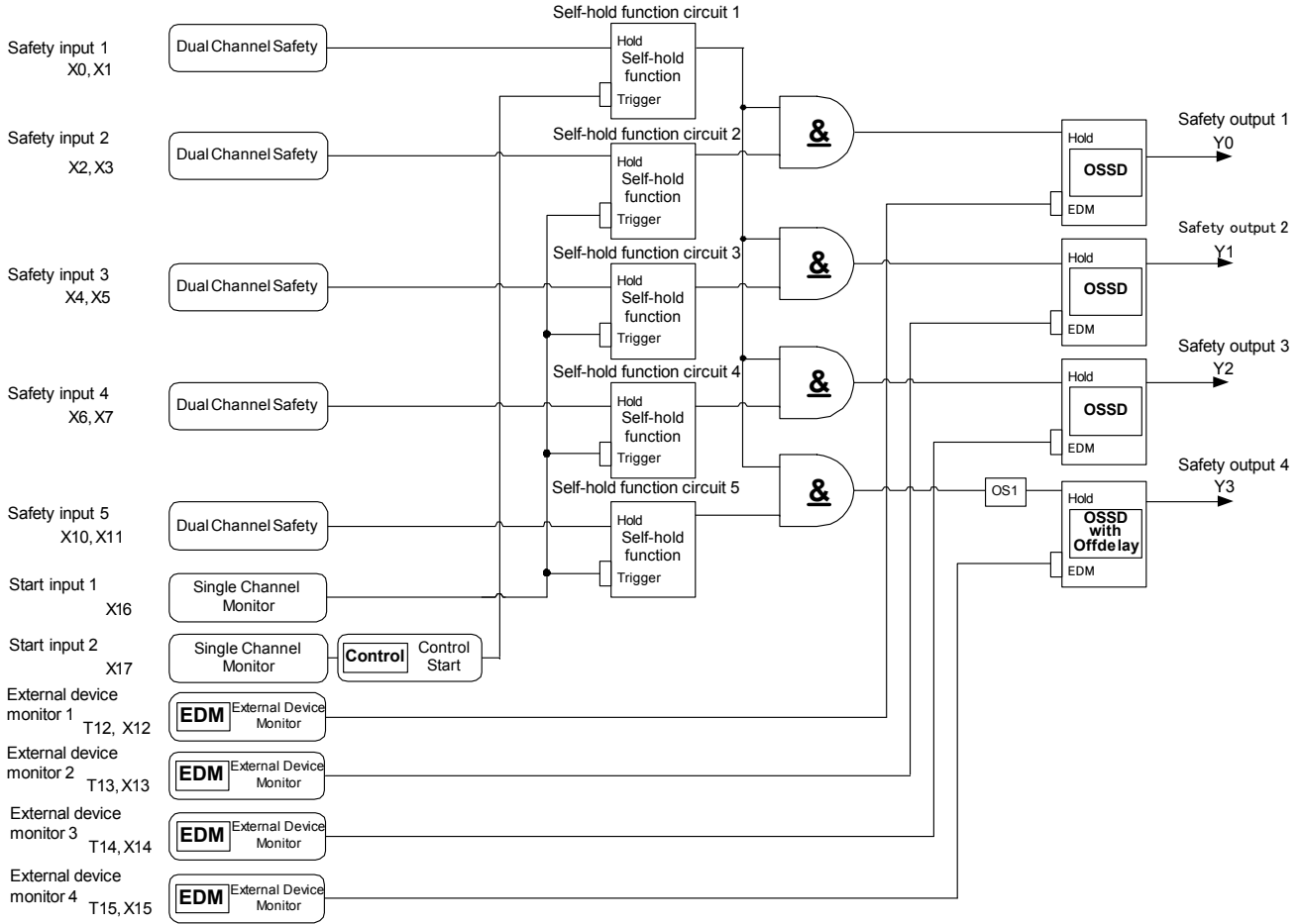
This logic enables the connection of 5 dual channel safety inputs.



Operation example (Logic 105)

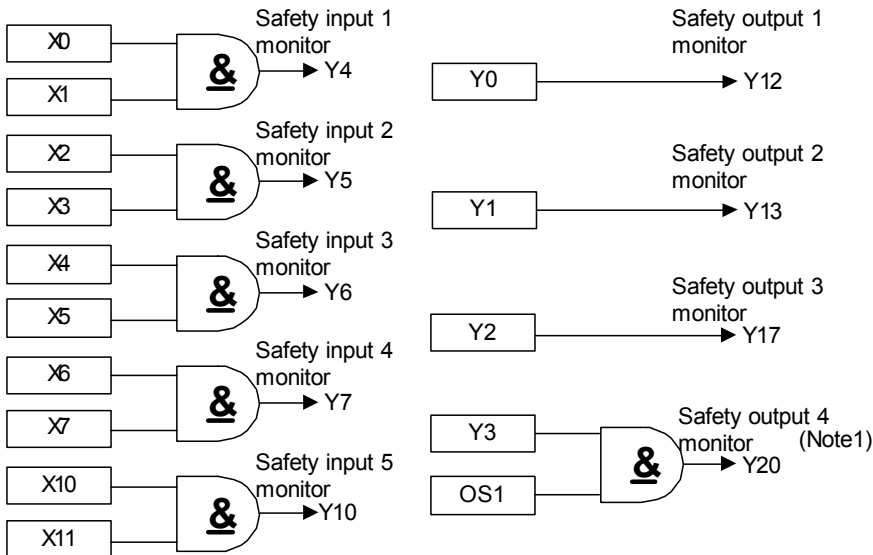


Logic circuit (Logic 105)



● Monitor output for safety input

● Monitor output for safety output




Note1:
Safety output 4 monitor turns OFF immediately independent of OFF-delay time.

Functions (Logic 105)

●Safety inputs: X0 to X11

Safety inputs are used to diagnose the status of connected safety devices, such as emergency stop switches, and interlock switches.

Intended inputs (Terminal names)	Function	
Safety input 1 (X0, X1) Safety input 2 (X2, X3) Safety input 3 (X4, X5) Safety input 4 (X6, X7) Safety input 5 (X10, X11)	Function name	Dual channel safety input
	Symbol	
	Description of operation	This function diagnoses the status of connected safety devices. This function diagnoses the time interval of status transition between each input of duplicated inputs (0.1s). The function does not use drive terminals (T0 to T11).
	Detail information	Logic functions (5-317)




For connected control devices, refer to “SAFETY PRECAUTIONS”.

Note. If safety inputs are not used, connect the receive terminals to a 24V DC power supply (V+). If they are not connected, the SafetyOne does not turn ON the safety outputs.

● **External device monitor inputs: X12 to X15 (T12 to T15)**

External device monitor inputs are used to diagnose the status of devices connected to safety outputs.

Intended inputs (Terminal names)	Target safety outputs (Terminal names)	Function	
External device monitor input 1 (X12-T12)	Safety output 1 (Y0)	Function name	External device monitor input
External device monitor input 2 (X13-T13)	Safety output 2 (Y1)	Symbol	
External device monitor input 3 (X14-T14)	Safety output 3 (Y2)	Description of operation	This function diagnoses the status of devices connected to a target safety output.
External device monitor input 4 (X15-T15)	Safety output 4 (Y3)	Detail information	Logic functions (5-326)



Safety check signals (pulses signals) are sent from the drive terminals (T12 to T15) to diagnose external devices and monitor circuits. Safety check signals can not be used as a power supply for connected devices.

Note. If there are unused safety outputs, connect the intended external device monitor terminals (Xn) to the corresponding drive terminals (Tn). If they are not connected, the SafetyOne detects an input monitor error. As the result, the error LED displays a “1” and the unit changes to the Protection state.

●Start inputs: X16 and X17

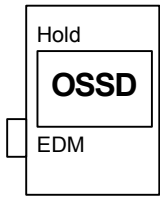
Start inputs are used to control the start of safety outputs.

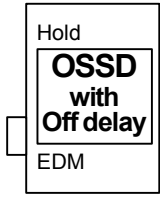
Intended inputs (Terminal names)	Target safety inputs (Terminal names)	Function	
		Start input 1 (X16)	Safety input 2 (X2, X3) Safety input 3 (X4, X5) Safety input 4 (X6, X7) Safety input 5 (X10, X11)
Symbol			
Description of operation	Safety outputs are started, when all target safety inputs are in the safe state and this function is in the ON state. This function is turned ON by 0.1s or more ON operation.		
Detail information	Logic functions (5-325)		

Intended inputs (Terminal names)	Target safety inputs (Terminal names)	Function	
		Start input 2 (X17)	Safety input 1 (X0, X1)
Symbol			
Description of operation	Safety outputs are started, when this function becomes ON after all intended safety inputs are in the safe state. This function is turned ON by 0.1s to 5s ON operation.		
Detail information	Logic functions (5-325, 330)		

● **Safety outputs: Y0 to Y3**

Safety outputs are used to output safety information processed by SafetyOne.

Intended outputs (Terminal names)	Function	
Safety output 1 (Y0) Safety output 2 (Y1) Safety output 3 (Y2)	Function name	Safety output without timer
	Symbol	
	Description of operation	This function is a safety output to output safety information processed by SafetyOne. The output is turned OFF immediately by OFF operation (instantaneous OFF output).
	Detail information	Logic functions (5-332)

Intended outputs (Terminal names)	Function	
Safety output 4 (Y3)	Function name	Safety output with timer
	Symbol	
	Description of operation	This function is a safety output to output safety information processed by SafetyOne. The output is turned OFF after the preset time of the OFF-delay timer (OFF-delay output).
	Detail information	Logic functions (5-335)

Note. When the SafetyOne changes to Protection state due to input monitor error, safety output without timer (safety output 1 through safety output 3) is turned OFF. Safety output with timer (safety output 4) is turned OFF after the preset OFF-delay time.

Note. When the SafetyOne changes to Stop state due to circuit failure or other errors, all safety outputs (safety output 1 through safety output 4) are turned OFF, immediately.

•Safety input monitor outputs: Y4 to Y10

Safety input monitor outputs are used to output the status of safety inputs in SafetyOne.

Intended outputs (Terminal names)	Target safety inputs (Terminal names)	Description of operation
Safety input 1 monitor output (Y4)	Safety input 1 (X0, X1)	When the target safety input is ON, the monitor output is ON. When the target safety input is OFF, the monitor output is OFF.
Safety input 2 monitor output (Y5)	Safety input 2 (X2, X3)	
Safety input 3 monitor output (Y6)	Safety input 3 (X4, X5)	
Safety input 4 monitor output (Y7)	Safety input 4 (X6, X7)	
Safety input 5 monitor output (Y10)	Safety input 5 (X10, X11)	

Note. When the targeted safety input detects an input monitor error, input circuit failure, or EMC the disturbance, corresponding safety input monitor output becomes a pulse output (1Hz). The monitor output is OFF in other errors, Initial state, or Configuration state.

•Safety output monitor outputs: Y12, Y13, Y17, and Y20

Safety output monitor outputs are used to output status of safety outputs in SafetyOne.

Intended outputs (Terminal names)	Target safety outputs (Terminal names)	Description of operation
Safety output 1 monitor output (Y12)	Safety output 1 (Y0)	When the target safety output is ON, the monitor output is ON. When the target safety output is OFF, this function is OFF. The monitor output turns OFF immediately, independent of the preset OFF-delay time.
Safety output 2 monitor output (Y13)	Safety output 2 (Y1)	
Safety output 3 monitor output (Y17)	Safety output 3 (Y2)	
Safety output 4 monitor output (Y20)	Safety output 4 (Y3)	

Note. When the safety output detects an output circuit failure, the corresponding safety output monitor output becomes a pulse output (1Hz). The monitor output is OFF in other errors, Initial state, or Configuration state.

● **State monitor outputs: Y14 to Y16**

State monitor outputs are used to output the internal state of SafetyOne.

Intended outputs (Terminal names)	State				
	Initial	Run	Configuration	Protection	Stop
State monitor output 1 (Y14)	■ON	□OFF	□OFF	□OFF	■ON
State monitor output 2 (Y15)	■ON	□OFF	■ON	■ON	■ON Or □OFF
State monitor output 3 (Y16)	□OFF	■ON	□OFF	□OFF	□OFF

Refer to “Chapter 4 BASIC OPERATIONS” and to “Chapter 6 TROUBLE SHOOTING” for details of each state.



Warning

The monitor outputs are not safety outputs. Do not use these to construct a safety system.



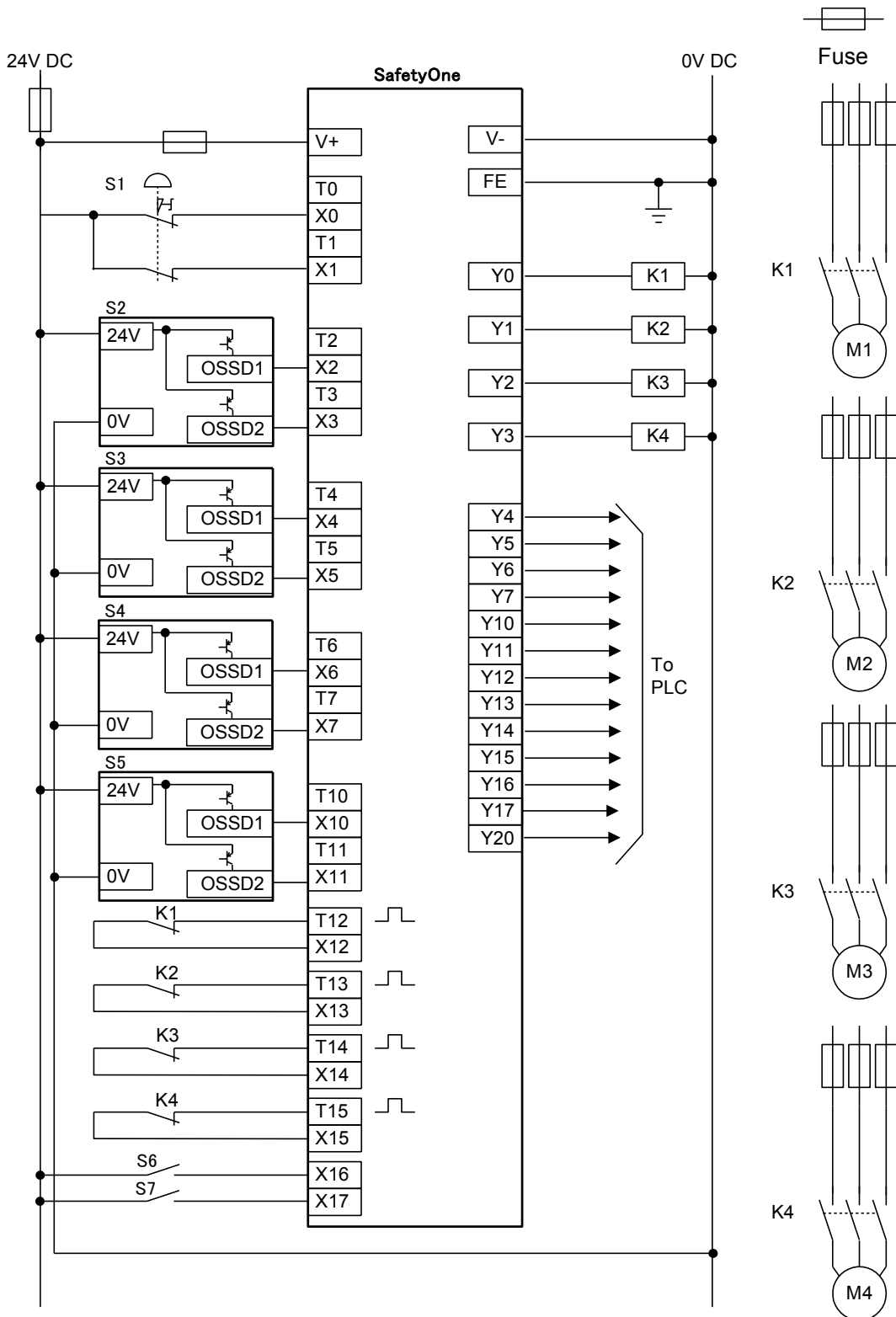
Caution

Refer to "Chapter 2 PRODUCT SPECIFICATIONS" for specifications of each input and output.

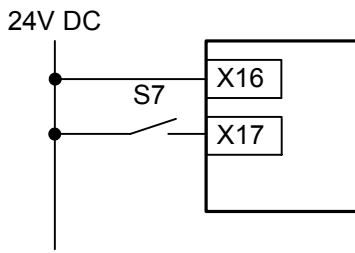
Wiring example (Logic 105)

In the case where 1 emergency stop switch and 4 safety light curtains are connected.

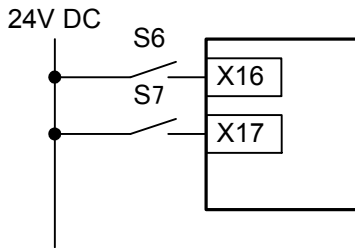
- S1 :Emergency stop switch
- S2 to 5 :Safety light curtain
- S6, 7 :Start switch
- K1 to 4 :Contactor
- M1 to 4 :Motor



**When not using the start switch S6
(Auto start)**

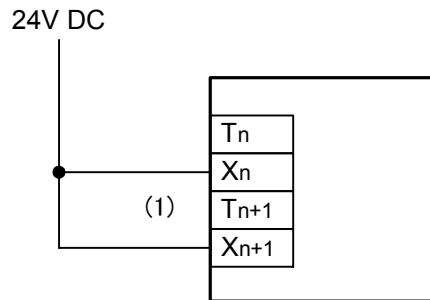


When not using some safety inputs

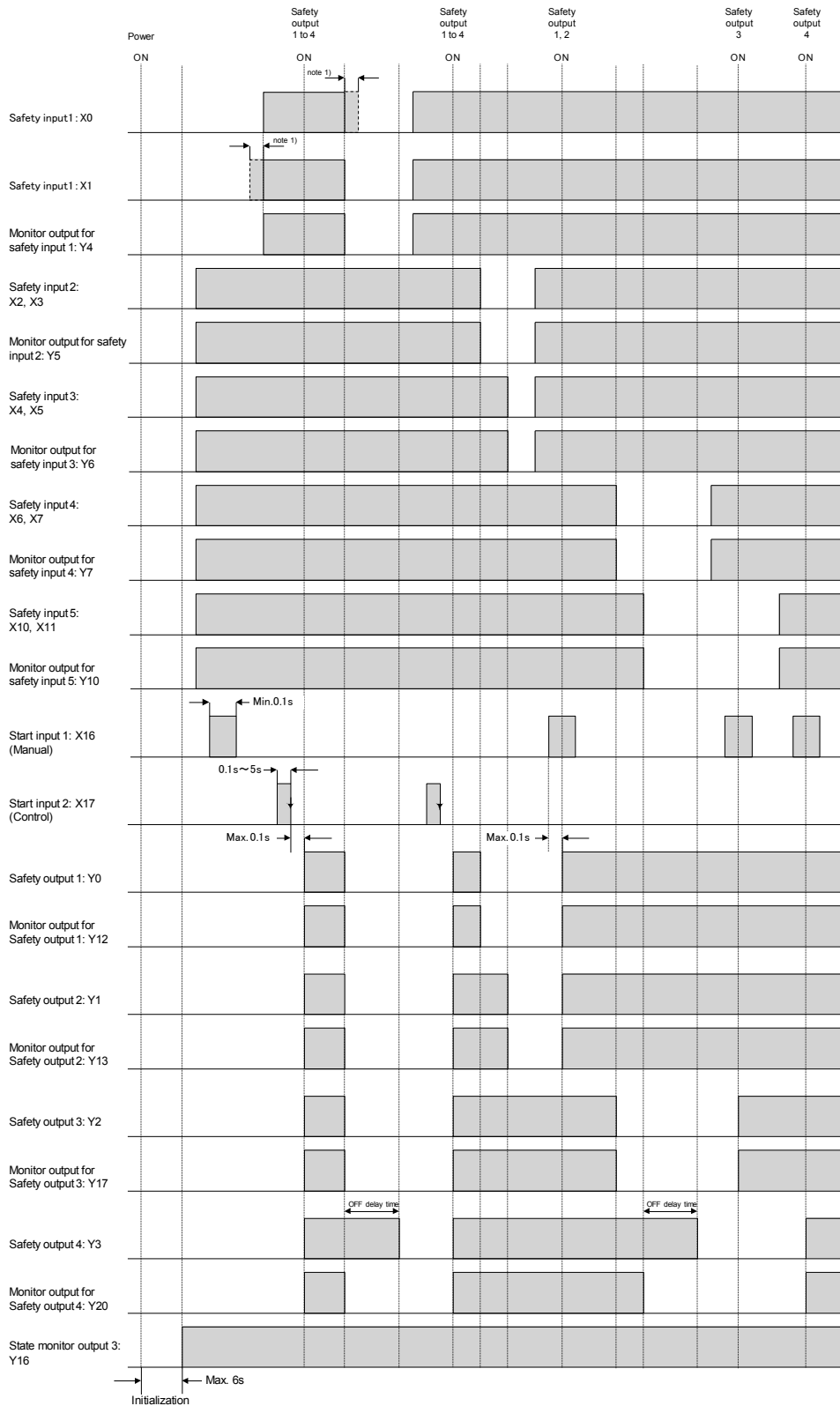


**When using the start switch S6
(Manual start)**

- If safety inputs are not used, connect the receive terminal to 24V DC power supply (V+). (Refer to (1))



Timing chart (Logic 105)



Note 1) Input monitor error detection time is 0.1s.

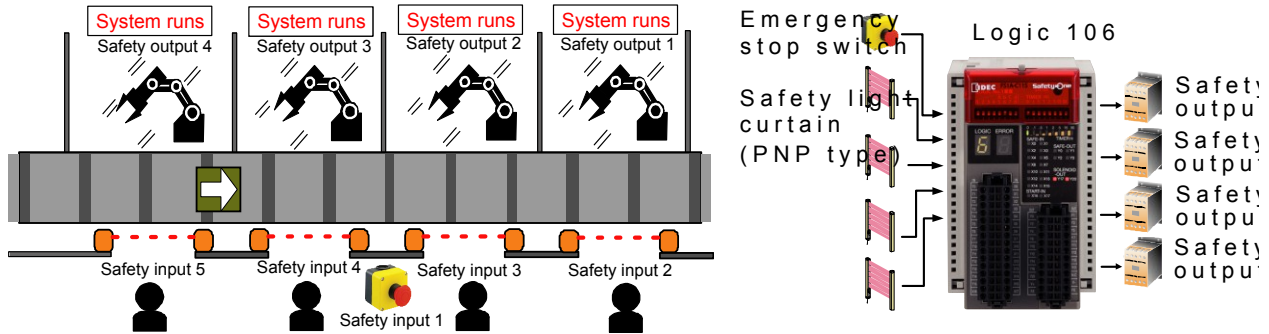
About safety inputs that are not described in this chart, input monitor error detection time is as follows. The time of dual channel safety input (X2 to X11) is 0.1s. Refer to the following “Logic functions” for more details.

Logic 106: Partial stop logic for apparatus with openings

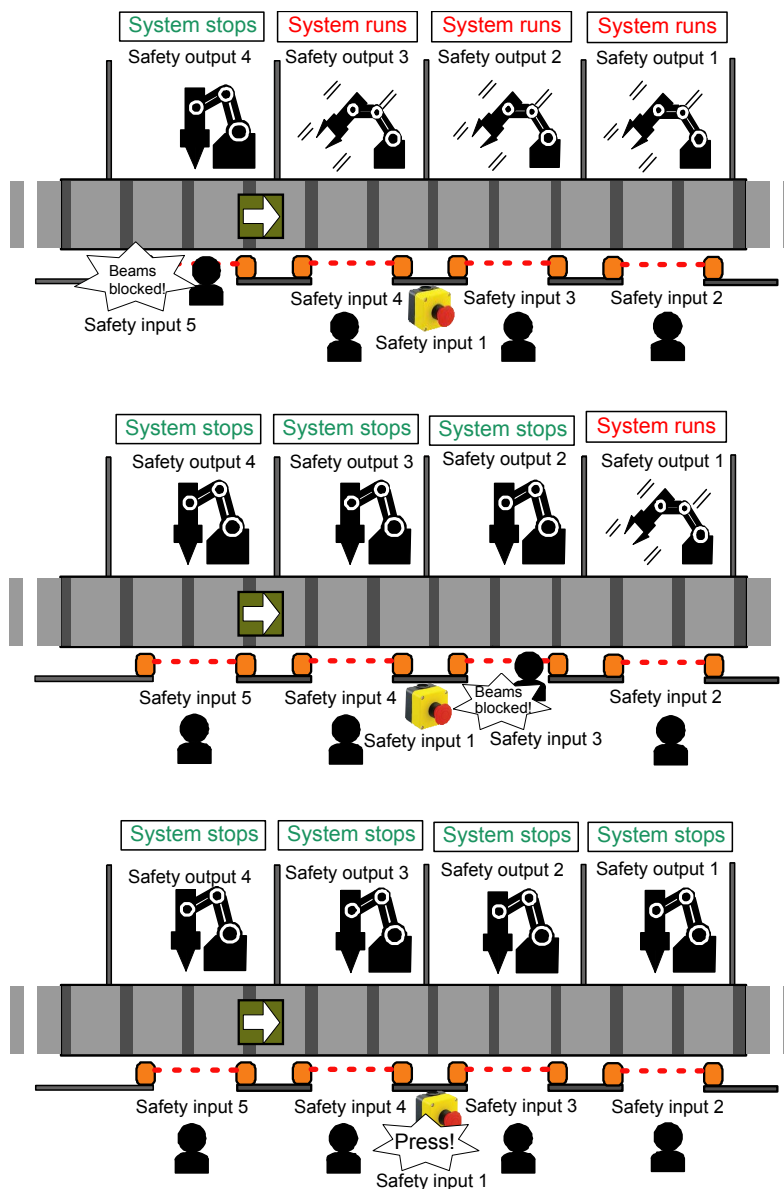
Overview (Logic 106)

This logic is for using safety devices with dual channel solid state outputs, such as safety light curtains, for safety protective measures of production machinery and robots. Safety outputs perform as single channel outputs.

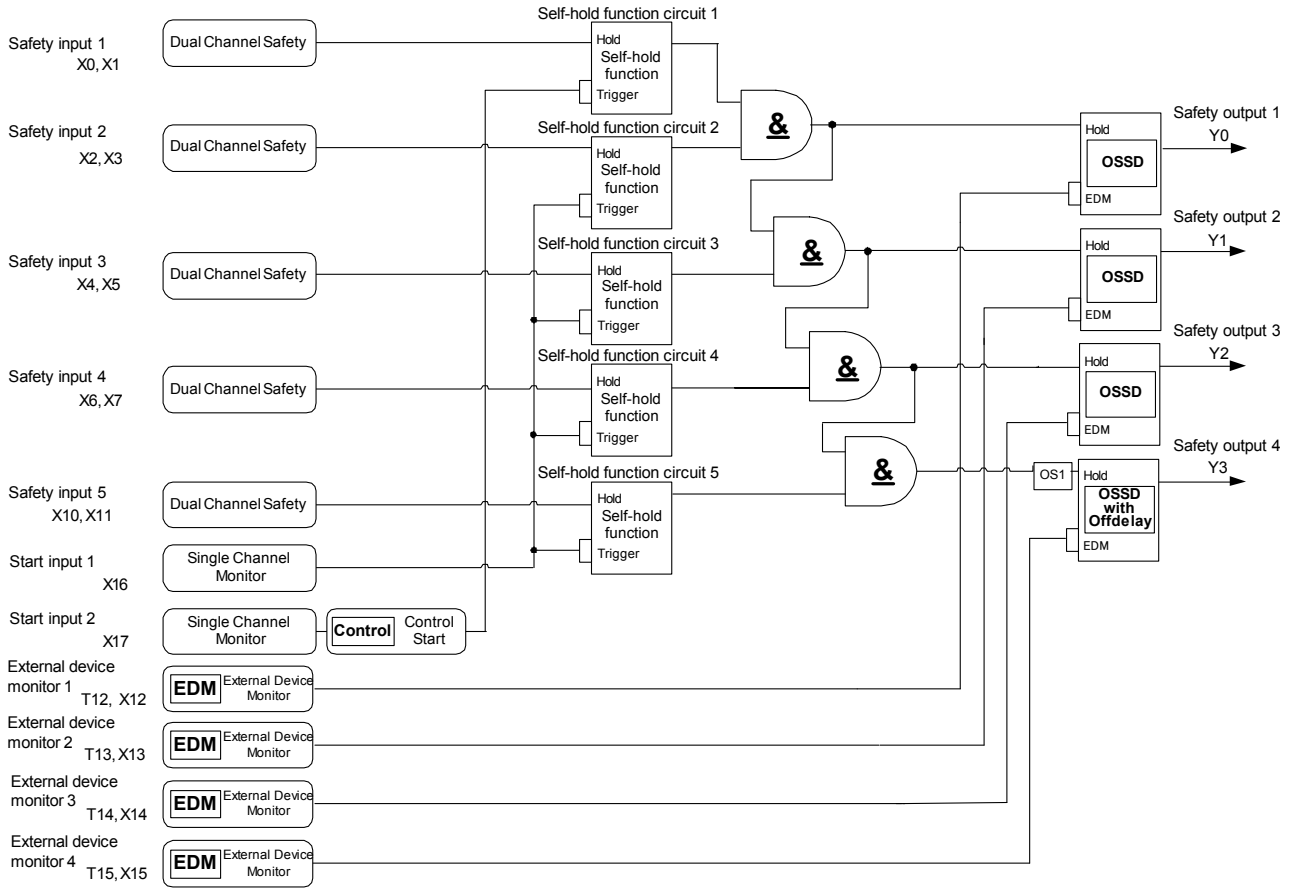
This logic enables the connection of 5 dual channel safety inputs.



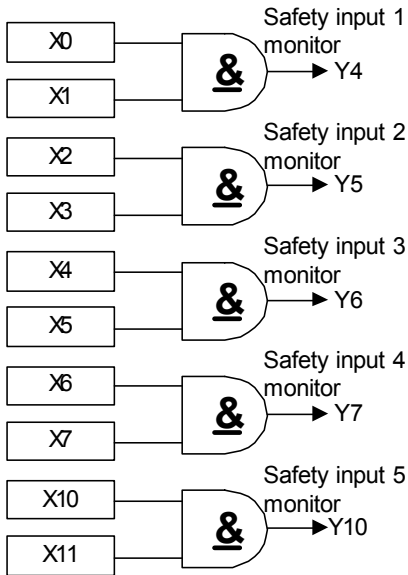
Operation example (Logic 106)



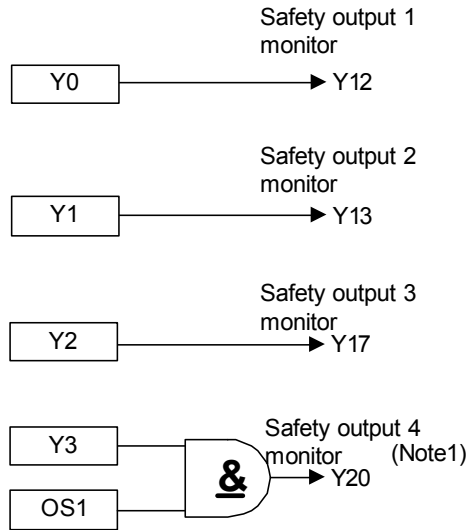
Logic circuit (Logic 106)



● Monitor output for safety input



● Monitor output for safety output




Note1:
Safety output 4 monitor turns OFF immediately independent of OFF-delay time.

Functions (Logic 106)

●Safety inputs: X0 to X11

Safety inputs are used to diagnose the status of connected safety devices, such as emergency stop switches, and interlock switches.

Intended inputs (Terminal names)	Function	
Safety input 1 (X0, X1) Safety input 2 (X2, X3) Safety input 3 (X4, X5) Safety input 4 (X6, X7) Safety input 5 (X10, X11)	Function name	Dual channel safety input
	Symbol	
	Description of operation	This function diagnoses the status of connected safety devices. This function diagnoses the time interval of status transition between each input of duplicated inputs (0.1s). The function does not use drive terminals (T0 to T11).
	Detail information	Logic functions (5-317)




For connected control devices, refer to “SAFETY PRECAUTIONS”.

Note. If safety inputs are not used, connect the receive terminals to a 24V DC power supply (V+). If they are not connected, the SafetyOne does not turn ON the safety outputs.

● **External device monitor inputs: X12 to X15 (T12 to T15)**

External device monitor inputs are used to diagnose the status of devices connected to safety outputs.

Intended inputs (Terminal names)	Target safety outputs (Terminal names)	Function	
External device monitor input 1 (X12-T12)	Safety output 1 (Y0)	Function name	External device monitor input
External device monitor input 2 (X13-T13)	Safety output 2 (Y1)	Symbol	
External device monitor input 3 (X14-T14)	Safety output 3 (Y2)	Description of operation	This function diagnoses the status of devices connected to a target safety output.
External device monitor input 4 (X15-T15)	Safety output 4 (Y3)	Detail information	Logic functions (5-326)






Safety check signals (pulses signals) are sent from the drive terminals (T12 to T15) to diagnose external devices and monitor circuits. Safety check signals can not be used as a power supply for connected devices.

Note. If there are unused safety outputs, connect the intended external device monitor terminals (Xn) to the corresponding drive terminals (Tn). If they are not connected, the SafetyOne detects an input monitor error. As the result, the error LED displays a “1” and the unit changes to the Protection state.

●Start inputs: X16 and X17

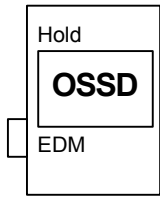
Start inputs are used to control the start of safety outputs.

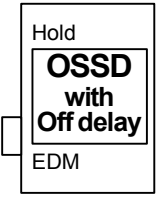
Intended inputs (Terminal names)	Target safety inputs (Terminal names)	Function	
		Start input 1 (X16)	Safety input 2 (X2, X3) Safety input 3 (X4, X5) Safety input 4 (X6, X7) Safety input 5 (X10, X11)
Symbol			
Description of operation	Safety outputs are started, when all target safety inputs are in the safe state and this function is in the ON state. This function is turned ON by 0.1s or more ON operation.		
Detail information	Logic functions (5-325)		

Intended inputs (Terminal names)	Target safety inputs (Terminal names)	Function	
		Start input 2 (X17)	Safety input 1 (X0, X1)
Symbol	 + 		
Description of operation	Safety outputs are started, when this function becomes ON after all intended safety inputs are in the safe state. This function is turned ON by 0.1s to 5s ON operation.		
Detail information	Logic functions (5-325, 330)		

● **Safety outputs: Y0 to Y3**

Safety outputs are used to output safety information processed by SafetyOne.

Intended outputs (Terminal names)	Function	
Safety output 1 (Y0) Safety output 2 (Y1) Safety output 3 (Y2)	Function name	Safety output without timer
	Symbol	
	Description of operation	This function is a safety output to output safety information processed by SafetyOne. The output is turned OFF immediately by OFF operation (instantaneous OFF output).
	Detail information	Logic functions (5-332)

Intended outputs (Terminal names)	Function	
Safety output 4 (Y3)	Function name	Safety output with timer
	Symbol	
	Description of operation	This function is a safety output to output safety information processed by SafetyOne. The output is turned OFF after the preset time of the OFF-delay timer (OFF-delay output).
	Detail information	Logic functions (5-335)

Note. When the SafetyOne changes to Protection state due to input monitor error, safety output without timer (safety output 1 through safety output 3) is turned OFF. Safety output with timer (safety output 4) is turned OFF after the preset OFF-delay time.

Note. When the SafetyOne changes to Stop state due to circuit failure or other errors, all safety outputs (safety output 1 through safety output 4) are turned OFF, immediately.

● **Safety input monitor outputs: Y4 to Y10**

Safety input monitor outputs are used to output the status of safety inputs in SafetyOne.

Intended outputs (Terminal names)	Target safety inputs (Terminal names)	Description of operation
Safety input 1 monitor output (Y4)	Safety input 1 (X0, X1)	When the target safety input is ON, the monitor output is ON. When the target safety input is OFF, the monitor output is OFF.
Safety input 2 monitor output (Y5)	Safety input 2 (X2, X3)	
Safety input 3 monitor output (Y6)	Safety input 3 (X4, X5)	
Safety input 4 monitor output (Y7)	Safety input 4 (X6, X7)	
Safety input 5 monitor output (Y10)	Safety input 5 (X10, X11)	

Note. When the targeted safety input detects an input monitor error, input circuit failure, or EMC the disturbance, corresponding safety input monitor output becomes a pulse output (1Hz). The monitor output is OFF in other errors, Initial state, or Configuration state.

● **Safety output monitor outputs: Y12, Y13, Y17, and Y20**

Safety output monitor outputs are used to output status of safety outputs in SafetyOne.

Intended outputs (Terminal names)	Target safety outputs (Terminal names)	Description of operation
Safety output 1 monitor output (Y12)	Safety output 1 (Y0)	When the target safety output is ON, the monitor output is ON. When the target safety output is OFF, this function is OFF. The monitor output turns OFF immediately, independent of the preset OFF-delay time.
Safety output 2 monitor output (Y13)	Safety output 2 (Y1)	
Safety output 3 monitor output (Y17)	Safety output 3 (Y2)	
Safety output 4 monitor output (Y20)	Safety output 4 (Y3)	

Note. When the safety output detects an output circuit failure, the corresponding safety output monitor output becomes a pulse output (1Hz). The monitor output is OFF in other errors, Initial state, or Configuration state.

● **State monitor outputs: Y14 to Y16**

State monitor outputs are used to output the internal state of SafetyOne.

Intended outputs (Terminal names)	State				
	Initial	Run	Configuration	Protection	Stop
State monitor output 1 (Y14)	■ON	□OFF	□OFF	□OFF	■ON
State monitor output 2 (Y15)	■ON	□OFF	■ON	■ON	■ON Or □OFF
State monitor output 3 (Y16)	□OFF	■ON	□OFF	□OFF	□OFF

Refer to “Chapter 4 BASIC OPERATIONS” and to “Chapter 6 TROUBLE SHOOTING” for details of each state.



Warning

The monitor outputs are not safety outputs. Do not use these to construct a safety system.



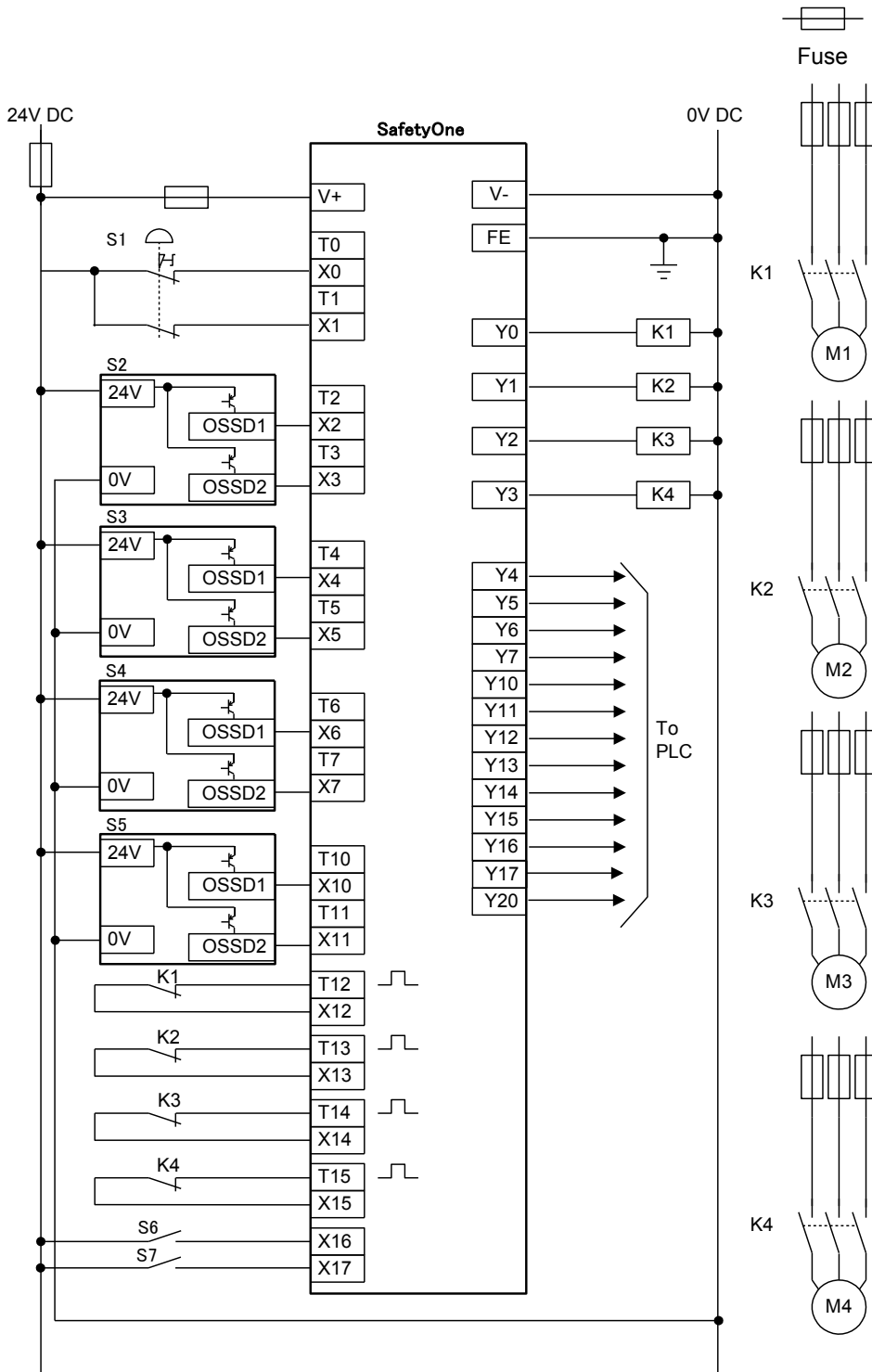
Caution

Refer to "Chapter 2 PRODUCT SPECIFICATIONS" for specifications of each input and output.

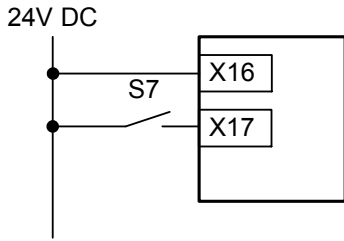
Wiring example (Logic 106)

In the case where 1 emergency stop switch and 4 safety light curtains are connected.

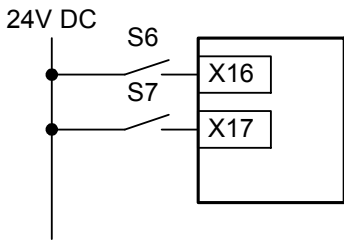
- S1 :Emergency stop switch
- S2 to 5 :Safety light curtain
- S6, 7 :Start switch
- K1 to 4 :Contactor
- M1 to 4 :Motor



**When not using the start switch S6
(Auto start)**

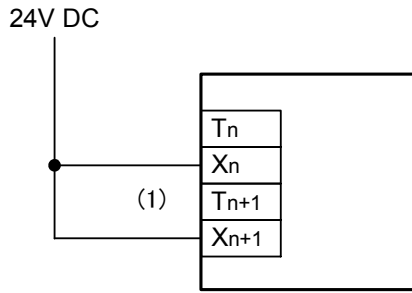


**When using the start switch S6
(Manual start)**

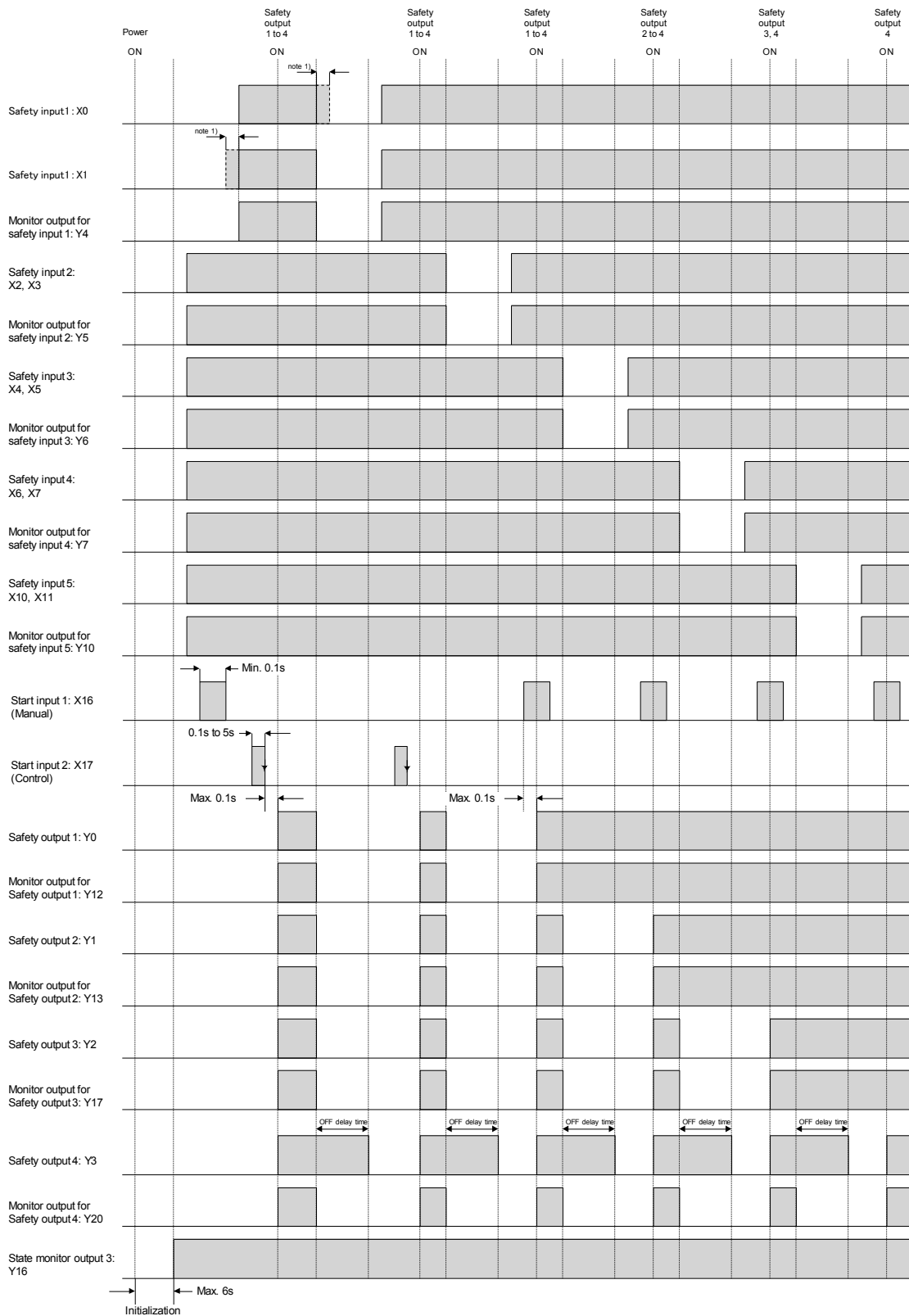


When not using some safety inputs

• If safety inputs are not used, connect the receive terminal to 24V DC power supply (V+). (Refer to (1))



Timing chart (Logic 106)



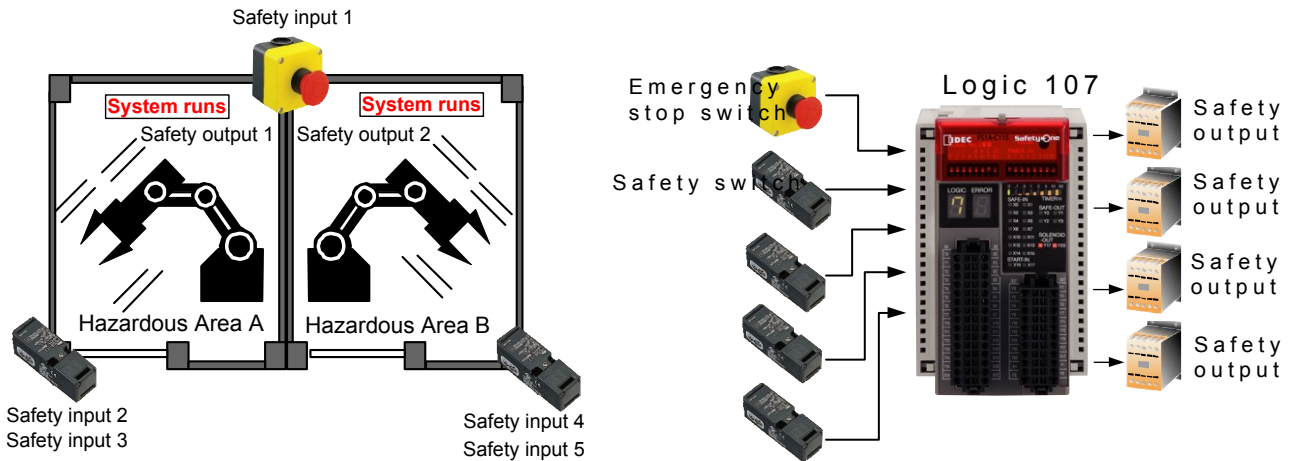
Note 1) Input monitor error detection time is 0.1s.

About safety inputs that are not described in this chart, input monitor error detection time is as follows.
 The time of dual channel safety input (X2 to X11) is 0.1s.
 Refer to the following "Logic functions" for more details.

Logic 107: Partial stop logic for various apparatus

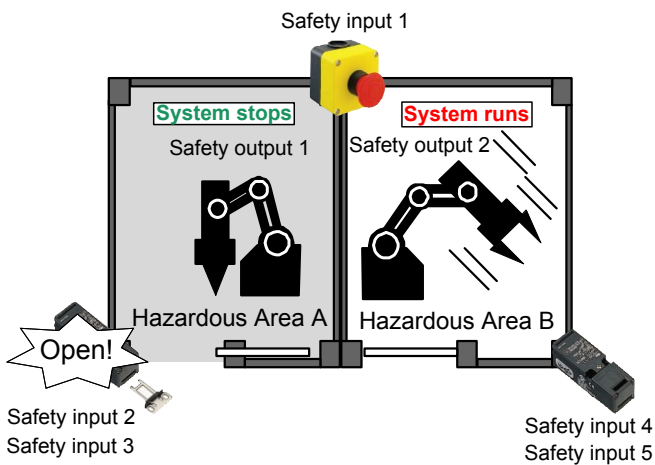
Overview (Logic 107)

This logic is for safety protective measures applicable to production machines and robots. Safety outputs perform as single channel outputs.
 This logic enables the connection of 5 dual channel direct opening inputs.

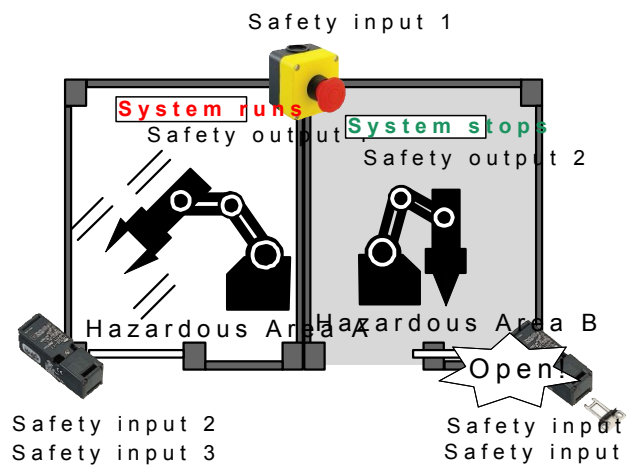


Operation example (Logic 107)

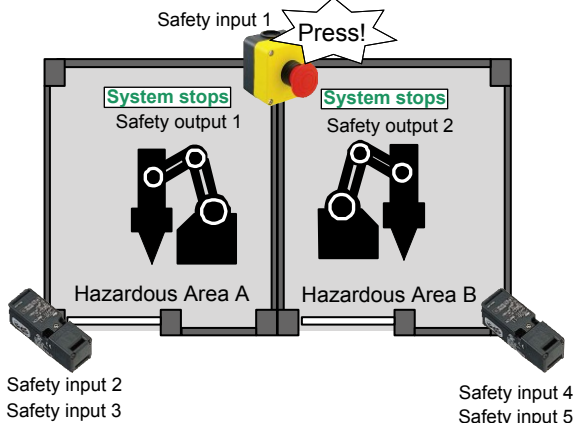
• Partial system stop <Hazardous Area A>



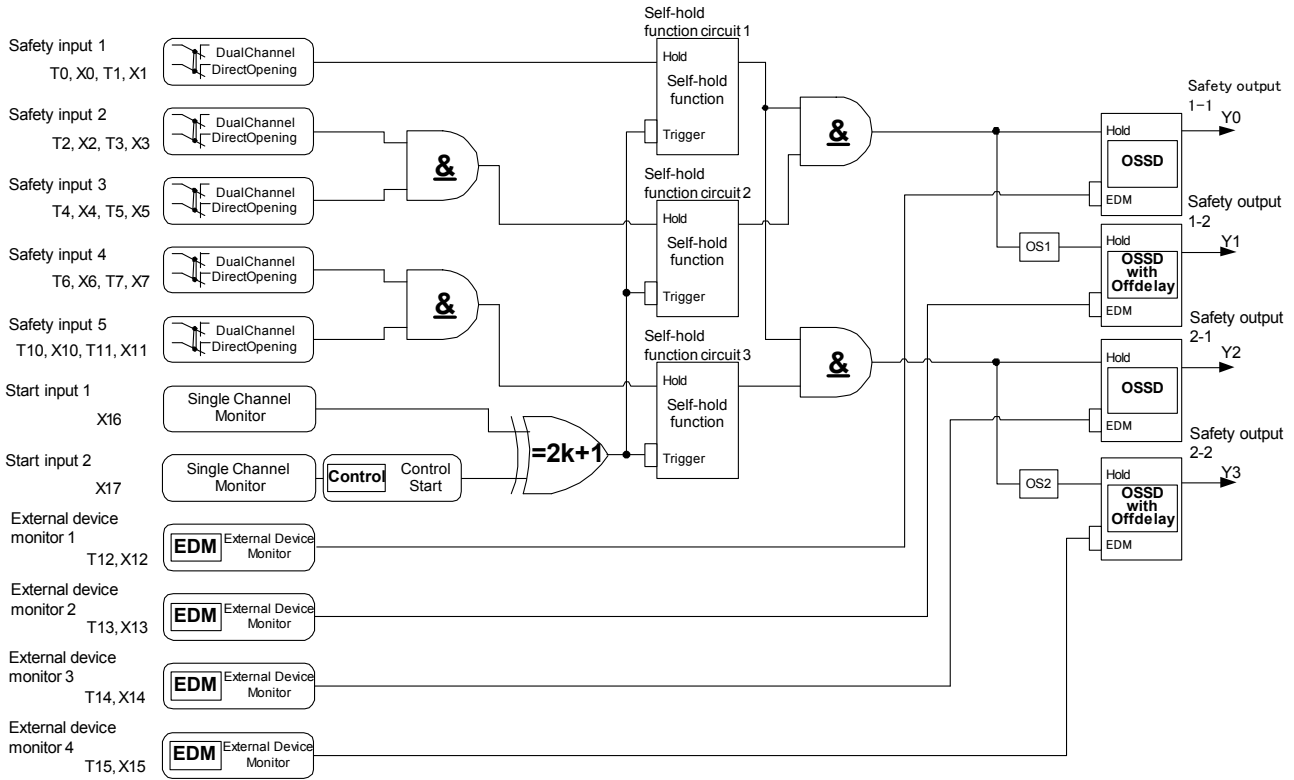
• Partial system stop <Hazardous Area B>



• Entire system stops <Hazardous Area A, B>

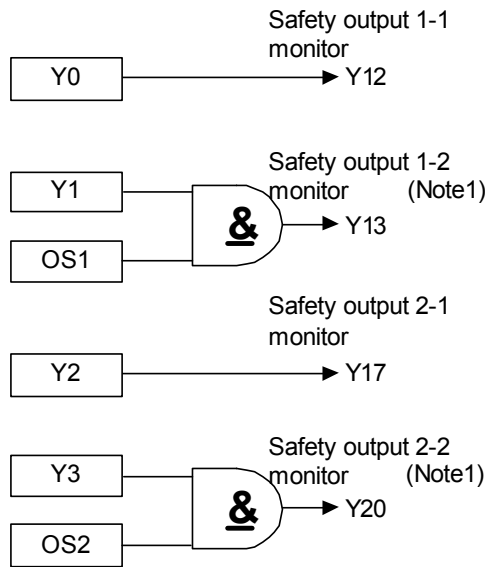
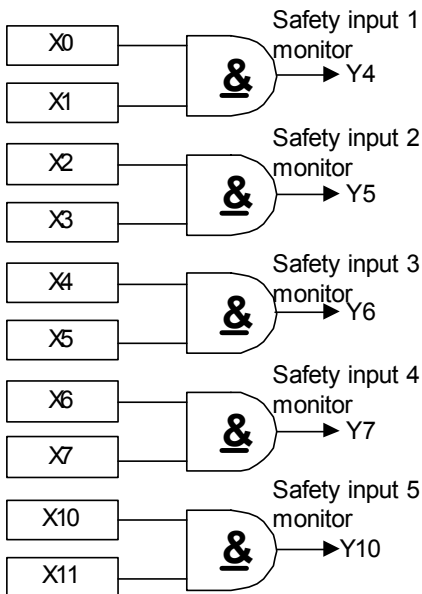


Logic circuit (Logic107)



● Monitor output for safety input

● Monitor output for safety output

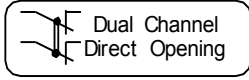


Note1:
Safety output 1-2 monitor and safety output 2-2 monitor turn OFF immediately independent of OFF-delay time.

Functions (Logic 107)

●Safety inputs: X0 to X11 (T0 to T11)

Safety inputs are used to diagnose the status of connected safety devices, such as emergency stop switches, and interlock switches.

Intended inputs (Terminal names)	Function	
Safety input 1 (X0-T0, X1-T1) Safety input 2 (X2-T2, X3-T3) Safety input 3 (X4-T4, X5-T5) Safety input 4 (X6-T6, X7-T7) Safety input 5 (X10-T10, X11-T11)	Function name	Dual channel direct opening input
	Symbol	
	Description of operation	This function diagnoses the status of connected safety devices. This function diagnoses the time interval of status transition between each input of duplicated inputs (0.5s).
	Detail information	Logic functions (5-311)



For connected control devices, refer to “SAFETY PRECAUTIONS”.

Safety check signals (pulses signals) are sent from the drive terminals (T0 to T11) to diagnose connected safety devices and input circuits. Safety check signals can not be used as a power supply for connected devices.


Note. Solid state outputs, such as safety light curtains, can not be connected to safety inputs.

Note. Use safety inputs as specified combinations, such as receive terminal (Xn) and drive terminal (Tn). If the combinations are incorrect, SafetyOne does not work correctly.

Note. If there are unused safety inputs, connect the unused receive terminals (Xn) to the corresponding drive terminals (Tn). If they are not connected, the SafetyOne does not turn ON the safety outputs.

● **External device monitor inputs: X12 to X15 (T12 to T15)**

External device monitor inputs are used to diagnose the status of devices connected to safety outputs.

Intended inputs (Terminal names)	Target safety outputs (Terminal names)	Function	
		Function name	
External device monitor input 1 (X12-T12)	Safety output 1-1 (Y0)	Function name	External device monitor input
External device monitor input 2 (X13-T13)	Safety output 1-2 (Y1)	Symbol	
External device monitor input 3 (X14-T14)	Safety output 2-1 (Y2)	Description of operation	This function diagnoses the status of devices connected to a target safety output.
External device monitor input 4 (X15-T15)	Safety output 2-2 (Y3)	Detail information	Logic functions (5-326)



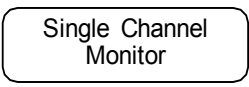
Warning

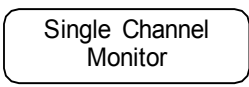
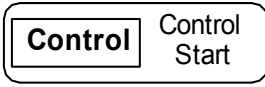
Safety check signals (pulses signals) are sent from the drive terminals (T12 to T15) to diagnose external devices and monitor circuits. Safety check signals can not be used as a power supply for connected devices.

Note. If there are unused safety outputs, connect the intended external device monitor terminals (Xn) to the corresponding drive terminals (Tn). If they are not connected, the SafetyOne detects an input monitor error. As the result, the error LED displays a “1” and the unit changes to the Protection state.

● **Start inputs: X16 and X17**

Start inputs are used to control the start of safety outputs.

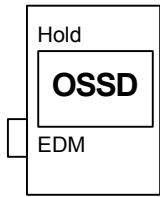
Intended inputs (Terminal names)	Target safety inputs (Terminal names)	Function	
		Start input 1 (X16)	Safety input 1 (X0-T0, X1-T1) Safety input 2 (X2-T2, X3-T3) Safety input 3 (X4-T4, X5-T5) Safety input 4 (X6-T6, X7-T7) Safety input 5 (X10-T10, X11-T11)
Symbol			
Description of operation	Safety outputs are started, when all target safety inputs are in the safe state and this function is in the ON state. This function is turned ON by 0.1s or more ON operation.		
Detail information	Logic functions (5-325)		

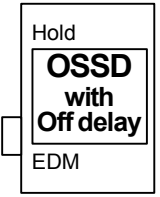
Intended inputs (Terminal names)	Target safety inputs (Terminal names)	Function	
		Start input 2 (X17)	Safety input 1 (X0-T0, X1-T1) Safety input 2 (X2-T2, X3-T3) Safety input 3 (X4-T4, X5-T5) Safety input 4 (X6-T6, X7-T7) Safety input 5 (X10-T10, X11-T11)
Symbol	 + 		
Description of operation	Safety outputs are started, when this function becomes ON after all intended safety inputs are in the safe state. This function is turned ON by 0.1s to 5s ON operation.		
Detail information	Logic functions (5-325, 330)		

Note. If both of X16 and X17 are turned ON, the SafetyOne will detect an error. As a result, the error LED displays “3” and the state changes to the Stop state. Use only X16 or X17.

● **Safety outputs: Y0 to Y3**

Safety outputs are used to output safety information processed by SafetyOne.

Intended outputs (Terminal names)	Function	
Safety output 1-1 (Y0) Safety output 2-1 (Y2)	Function name	Safety output without timer
	Symbol	
	Description of operation	This function is a safety output to output safety information processed by SafetyOne. The output is turned OFF immediately by OFF operation (instantaneous OFF output).
	Detail information	Logic functions (5-332)

Intended outputs (Terminal names)	Function	
Safety output 1-2 (Y1) Safety output 2-2 (Y3)	Function name	Safety output with timer
	Symbol	
	Description of operation	This function is a safety output to output safety information processed by SafetyOne. The output is turned OFF after the preset time of the OFF-delay timer (OFF-delay output).
	Detail information	Logic functions (5-335)

Note. When the SafetyOne changes to Protection state due to input monitor error, safety output without timer (safety output 1-1 and safety output 2-1) is turned OFF. Safety output with timer (safety output 1-2 and safety output 2-2) is turned OFF after the preset OFF-delay time.

Note. When the SafetyOne changes to Stop state due to circuit failure or other errors, all safety outputs (safety output 1-1, safety output 1-2, safety output 2-1, and safety output 2-2) are turned OFF, immediately.

● **Safety input monitor outputs: Y4 to Y10**

Safety input monitor outputs are used to output the status of safety inputs in SafetyOne.

Intended outputs (Terminal names)	Target safety inputs (Terminal names)	Description of operation
Safety input 1 monitor output (Y4)	Safety input 1 (X0-T0, X1-T1)	When the target safety input is ON, the monitor output is ON. When the target safety input is OFF, the monitor output is OFF.
Safety input 2 monitor output (Y5)	Safety input 2 (X2-T2, X3-T3)	
Safety input 3 monitor output (Y6)	Safety input 3 (X4-T4, X5-T5)	
Safety input 4 monitor output (Y7)	Safety input 4 (X6-T6, X7-T7)	
Safety input 5 monitor output (Y10)	Safety input 5 (X10-T10, X11-T11)	

Note. When the targeted safety input detects an input monitor error, input circuit failure, or EMC the disturbance, corresponding safety input monitor output becomes a pulse output (1Hz). The monitor output is OFF in other errors, Initial state, or Configuration state.

● **Safety output monitor outputs: Y12, Y13, Y17, and Y20**

Safety output monitor outputs are used to output status of safety outputs in SafetyOne.

Intended outputs (Terminal names)	Target safety outputs (Terminal names)	Description of operation
Safety output 1-1 monitor output (Y12)	Safety output 1-1 (Y0)	When the target safety output is ON, the monitor output is ON. When the target safety output is OFF, this function is OFF. The monitor output turns OFF immediately, independent of the preset OFF-delay time.
Safety output 1-2 monitor output (Y13)	Safety output 1-2 (Y1)	
Safety output 2-1 monitor output (Y17)	Safety output 2-1 (Y2)	
Safety output 2-2 monitor output (Y20)	Safety output 2-2 (Y3)	

Note. When the safety output detects an output circuit failure, the corresponding safety output monitor output becomes a pulse output (1Hz). The monitor output is OFF in other errors, Initial state, or Configuration state.

● **State monitor outputs: Y14 to Y16**

State monitor outputs are used to output the internal state of SafetyOne.

Intended outputs (Terminal names)	State				
	Initial	Run	Configuration	Protection	Stop
State monitor output 1 (Y14)	■ON	□OFF	□OFF	□OFF	■ON
State monitor output 2 (Y15)	■ON	□OFF	■ON	■ON	■ON Or □OFF
State monitor output 3 (Y16)	□OFF	■ON	□OFF	□OFF	□OFF

Refer to “Chapter 4 BASIC OPERATIONS” and to “Chapter 6 TROUBLE SHOOTING” for details of each state.



Warning

The monitor outputs are not safety outputs. Do not use these to construct a safety system.



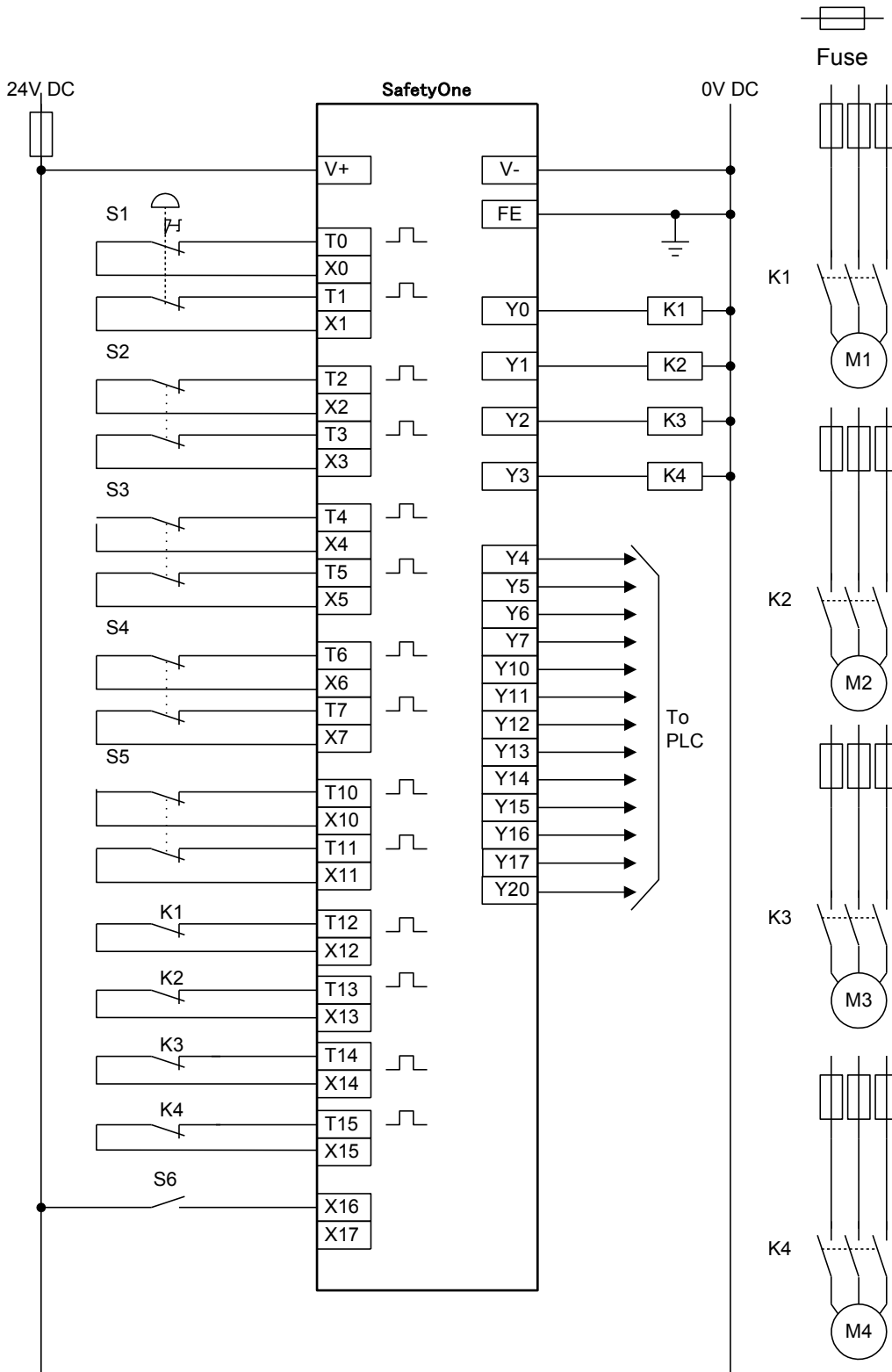
Caution

Refer to "Chapter 2 PRODUCT SPECIFICATIONS" for specifications of each input and output.

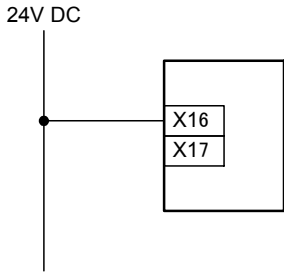
Wiring example (Logic 107)

In the case where 1 emergency stop switch and 4 interlock switches are connected.

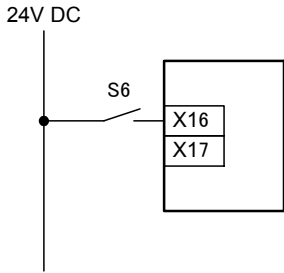
- S1 :Emergency stop switch
- S2 to 5 :Interlock switch
- S6 :Start switch
- K1 to 4 :Contactor
- M1 to 4 :Motor



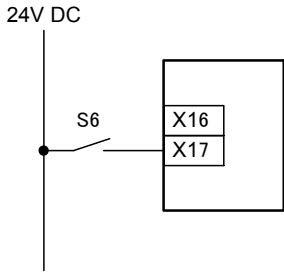
**When not using the start switch
(Auto start)**



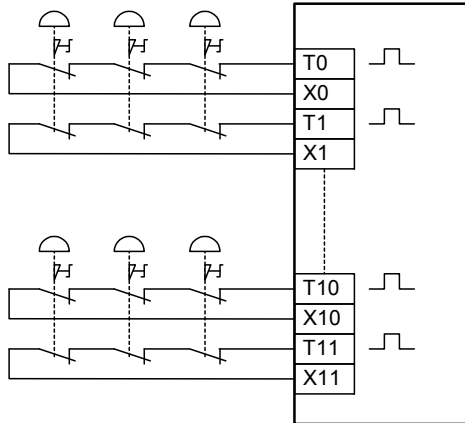
**When not detecting the welding of start switch
(Manual start)**



**When detecting the welding of start switch
(Control start)**



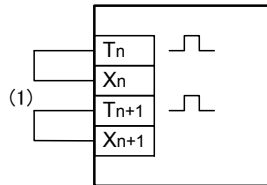
**When connecting multiple emergency stop switches
in series**



NOTE: Safety performance depends on the system configuration.

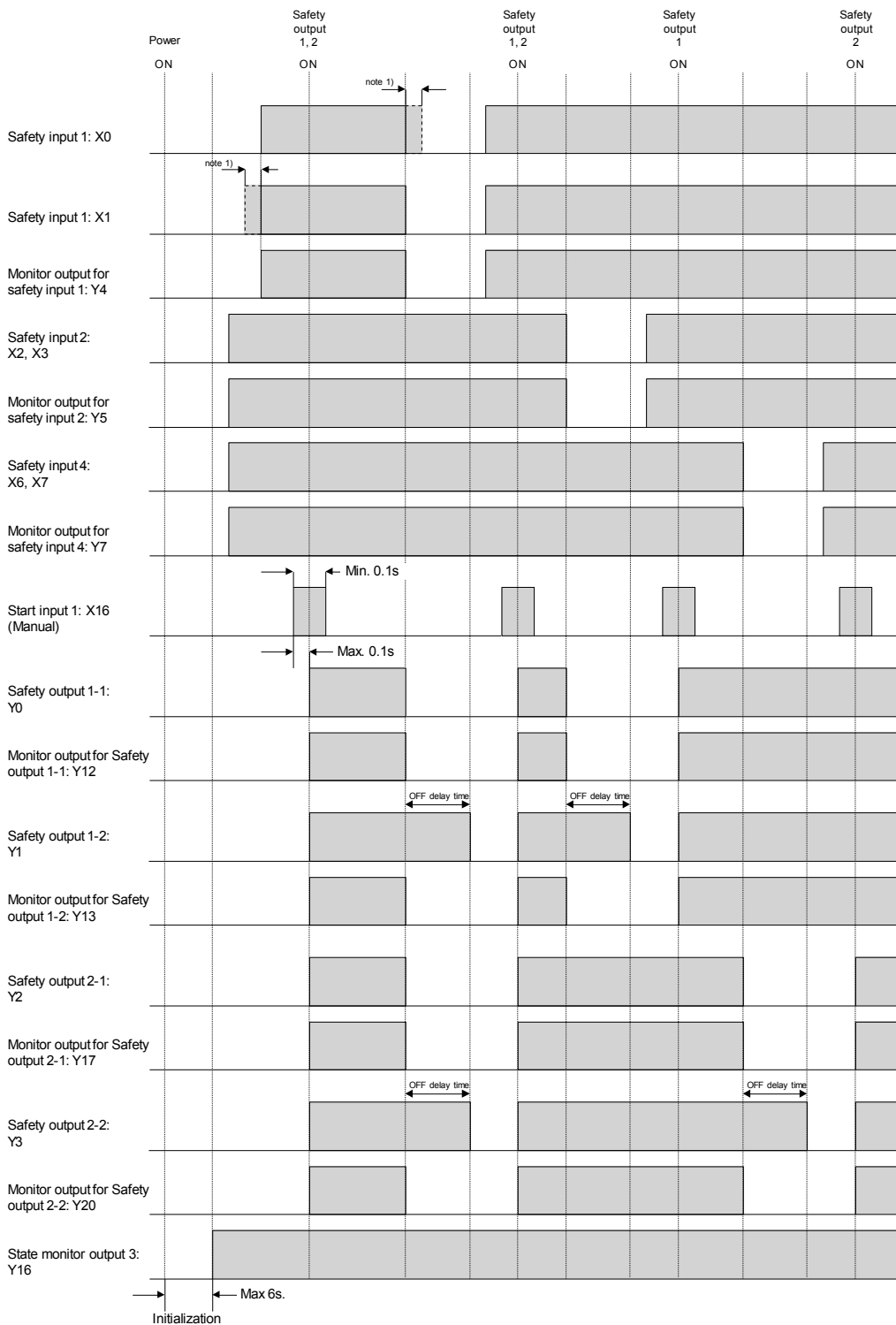
When not using some inputs

• If there are unused safety inputs, connect the unused receive terminals to the corresponding drive terminals.
(Refer to (1))



Timing chart (Logic 107)

Example: Manual start input (X16) is used.

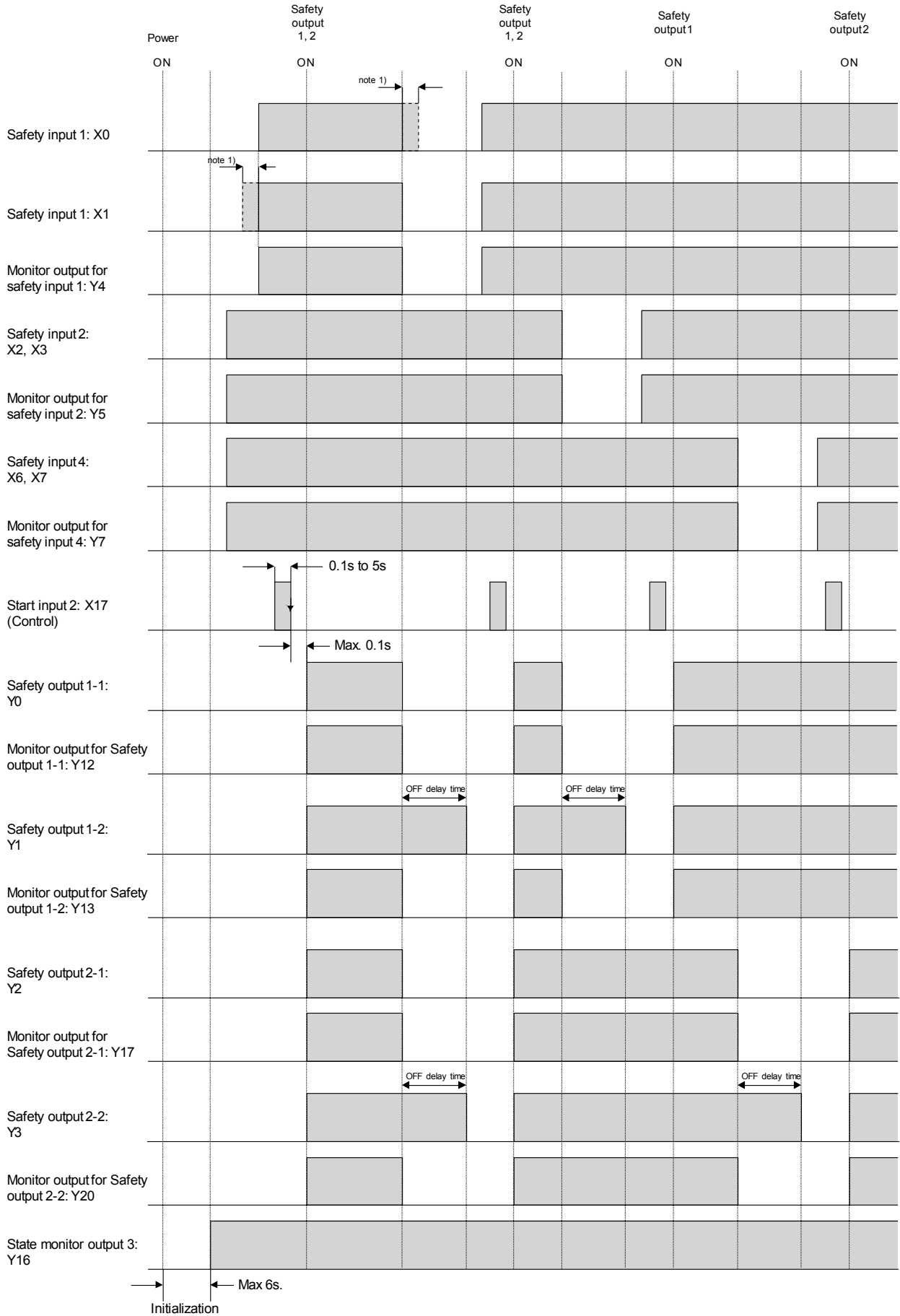


(Both safety input 3 and 5 are ON in this chart.)

Note 1) Input monitor error detection time is 0.5s.

About safety inputs that are not described in this chart, input monitor error detection time is as follows. The time of dual channel direct opening input (X2 to X11) is 0.5s. Refer to the following “Logic functions” for more details.

Example: Control start input (X17) is used.



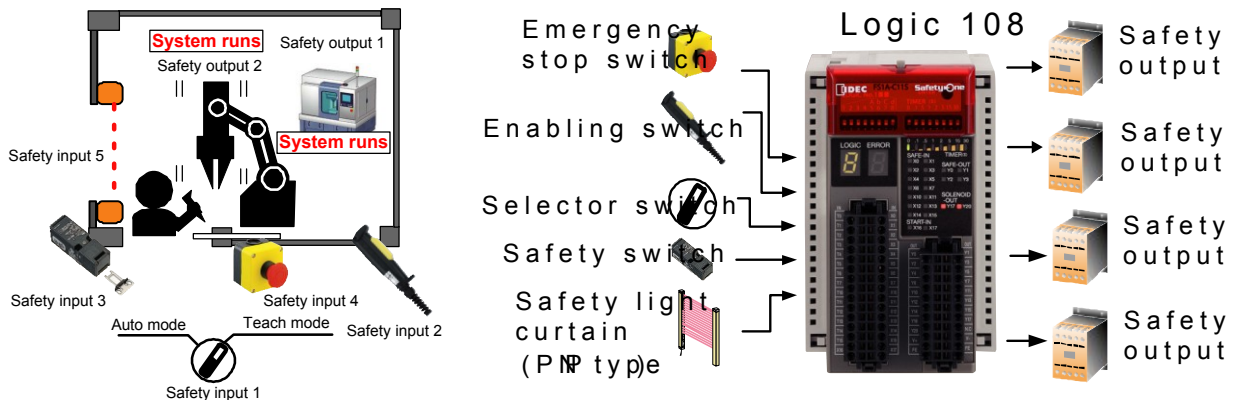
(Both safety input 3 and 5 are ON in this chart.)

Logic 108: Partial stop logic applicable for selection of active safety input devices in apparatus with openings

Overview (Logic 108)

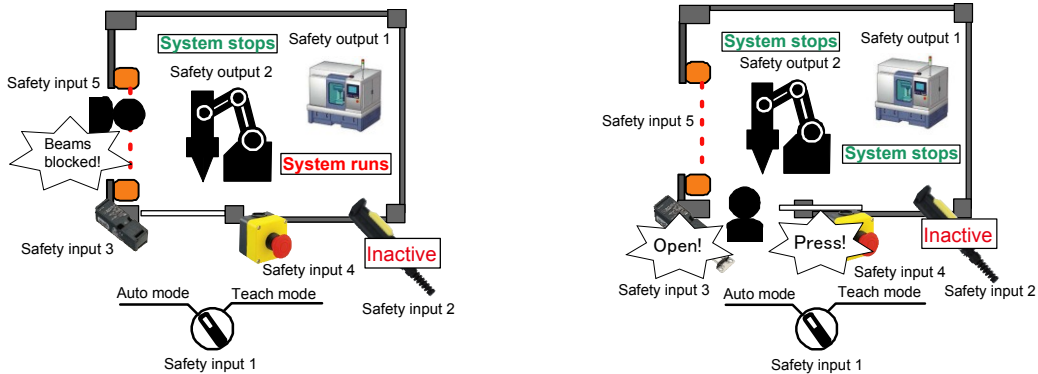
For production machines, robots, and the like, a hazard is generally isolated by a protective door (guard), however, when performing teaching or maintenance, the machine is operated in the condition that a person is in the danger zone. For such a situation, the logic described is applicable to the mode selection between teach mode (maintenance mode) and the auto mode (operating mode). Safety outputs perform as single channel outputs.

This logic enables the connection of 2 dual channel direct opening inputs, 1 mode select input, 1 dual channel dependent input, and 1 dual channel safety input.

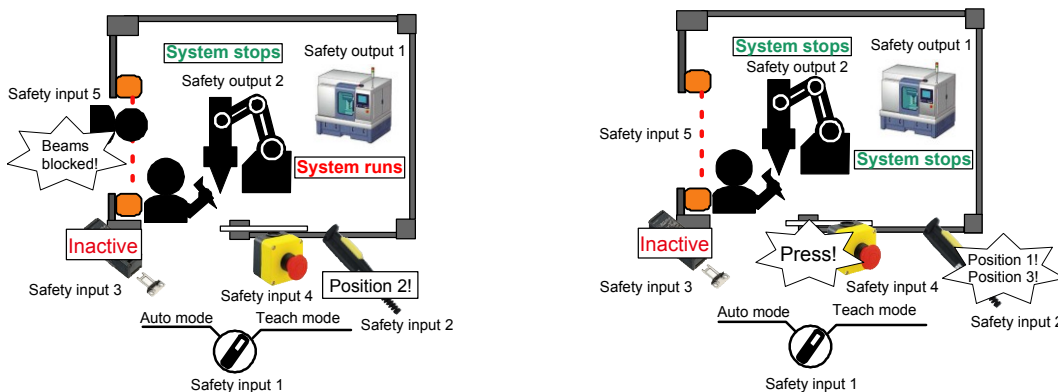


Operation example (Logic 108)

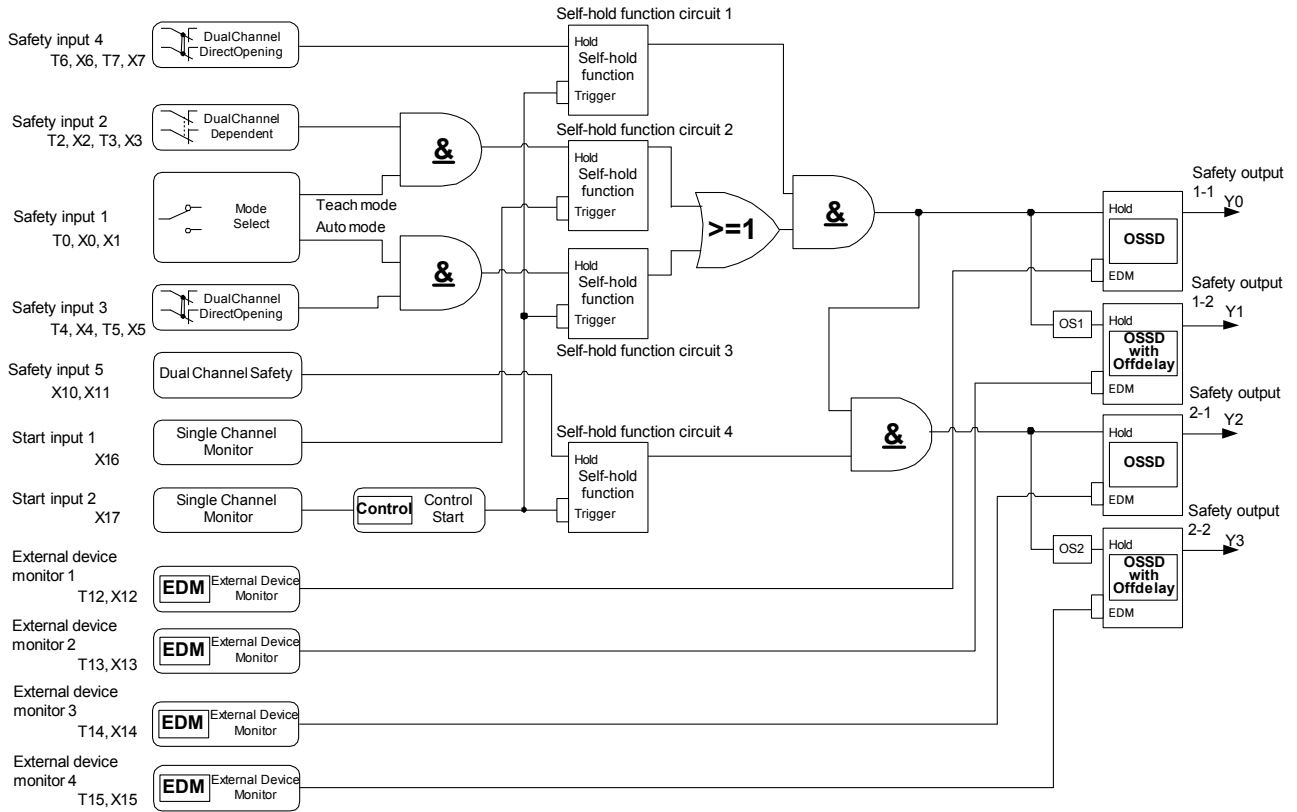
•Auto mode



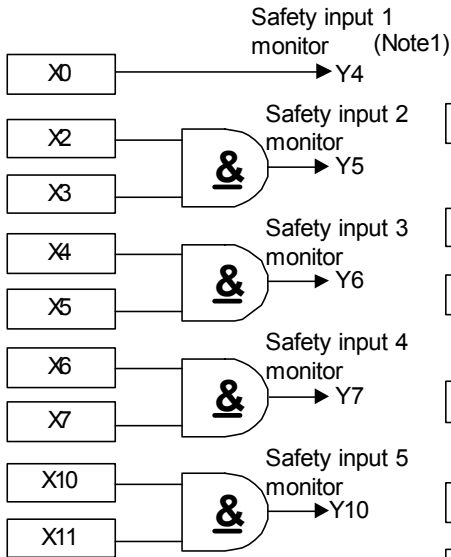
•Teach mode



Logic circuit (Logic 108)

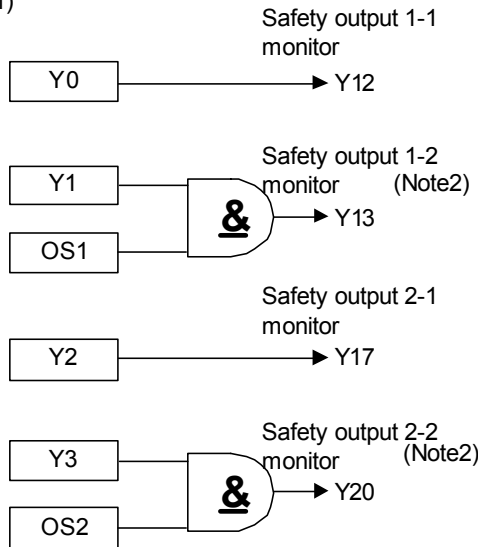


● Monitor output for safety input



Note1:
When safety input 1 is set to Auto mode, Safety input 1 monitor turns OFF.

● Monitor output for safety output

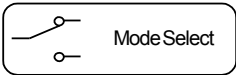


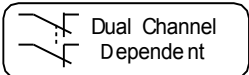
Note2:
Safety output monitor 1-2 and safety output 2-1 monitor turn OFF immediately independent of OFF-delay time.

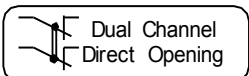
Functions (Logic 108)


● **Safety inputs: X0 to X11 (T0, T2 to T7)**

Safety inputs are used to diagnose the status of connected safety devices, such as emergency stop switches, interlock switches, and mode select switches.

Intended inputs (Terminal names)	Function	
Safety input 1 (X0/X1-T0)	Function name	Mode select input
	Symbol	
	Description of operation	This function is for connecting devices with a mode selector function, such as mode selector switch. This function diagnoses time interval of status transition between each input (0.5s).
	Detail information	Logic functions (5-319)

Intended inputs (Terminal names)	Function	
Safety input 2 (X2-T2, X3-T3)	Function name	Dual channel dependent input
	Symbol	
	Description of operation	This function diagnoses the status of connected safety devices. This function does not diagnose the time interval of status transition between each input of duplicated inputs.
	Detail information	Logic functions (5-313)

Intended inputs (Terminal names)	Function	
Safety input 3 (X4-T4, X5-T5) Safety input 4 (X6-T6, X7-T7)	Function name	Dual channel direct opening input
	Symbol	
	Description of operation	This function diagnoses the status of connected safety devices. This function diagnoses the time interval of status transition between each input of duplicated inputs (0.5s).
	Detail information	Logic functions (5-311)

Intended inputs (Terminal names)	Function	
Safety input 5 (X10, X11)	Function name	Dual channel safety input
	Symbol	
	Description of operation	This function diagnoses the status of connected safety devices. This function diagnoses the time interval of status transition between each input of duplicated inputs (0.1s). The function does not use drive terminals (T10, T11).
	Detail information	Logic functions (5-317)

 **Warning**

For connected control devices, refer to “SAFETY PRECAUTIONS”.

Safety check signals (pulses signals) are sent from the drive terminals (T0, T2 to T7) to diagnose connected safety devices and input circuits. Safety check signals can not be used as a power supply for connected devices.

Note. Solid state outputs, such as safety light curtains, can not be connected to safety input 1 through safety input 4.

Note. Use safety input 1 through safety input 4, as specified combinations, such as receive terminal (Xn) and drive terminal (Tn). If the combinations are incorrect, SafetyOne does not work correctly.


Note. When SafetyOne is in Run state or Protection state, input states are monitored in all safety inputs. For example, if input monitor error is detected in safety input 2 although AUTO mode is selected, SafetyOne detects error and transits to Protection state.

Note. If there are unused safety inputs in safety input 2 through safety input 4, connect the unused receive terminals (Xn) to the corresponding drive terminals (Tn). If they are not connected, the SafetyOne does not turn ON the safety outputs.

Note. If safety input 5 is not used, connect the receive terminals (X10 and X11) to a 24V DC power supply (V+). If they are not connected, the SafetyOne does not turn ON the safety outputs.

● **External device monitor inputs: X12 to X15 (T12 to T15)**

External device monitor inputs are used to diagnose status of the devices connected to safety outputs.

Intended inputs (Terminal names)	Target safety outputs (Terminal names)	Function	
External device monitor input 1 (X12-T12)	Safety output 1-1 (Y0)	Function name	External device monitor input
External device monitor input 2 (X13-T13)	Safety output 1-2 (Y1)	Symbol	
External device monitor input 3 (X14-T14)	Safety output 2-1 (Y2)	Description of operation	This function diagnoses the status of devices connected to a target safety output.
External device monitor input 4 (X15-T15)	Safety output 2-2 (Y3)	Detail information	Logic functions (5-326)






Safety check signals (pulses signals) are sent from the drive terminals (T12 to T15) to diagnose external devices and monitor circuits. Safety check signals can not be used as a power supply for connected devices.

Note. If there are unused safety outputs, connect the intended external device monitor terminals (Xn) to the corresponding drive terminals (Tn). If they are not connected, the SafetyOne detects an input monitor error. As the result, the error LED displays a “1” and the unit changes to the Protection state.

●Start inputs: X16 and X17

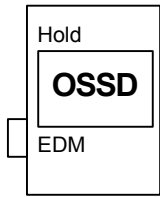
Start inputs are used to control the start of safety outputs.

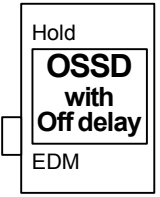
Intended inputs (Terminal names)	Target safety inputs (Terminal names)	Function	
		Start input 1 (X16)	Safety input 1 (X0-T0: TEACH) Safety input 2 (X2-T2, X3-T3)
		Symbol	
		Description of operation	Safety outputs are started, when all target safety inputs are in the safe state and this function is in the ON state. This function is turned ON by 0.1s or more ON operation.
		Detail information	Logic functions (5-325)

Intended inputs (Terminal names)	Target safety inputs (Terminal names)	Function	
		Start input 2 (X17)	Safety input 1 (X1-T0: AUTO) Safety input 3 (X4-T4, X5-T5) Safety input 4 (X6-T6, X7-T7) Safety input 5 (X10, X11)
		Symbol	 + 
		Description of operation	Safety outputs are started, when this function becomes ON after all intended safety inputs are in the safe state. This function is turned ON by 0.1s to 5s ON operation.
		Detail information	Logic functions (5-325, 330)

● **Safety outputs: Y0 to Y3**

Safety outputs are used to output safety information processed by SafetyOne.

Intended outputs (Terminal names)	Function	
Safety output 1-1 (Y0) Safety output 2-1 (Y2)	Function name	Safety output without timer
	Symbol	
	Description of operation	This function is a safety output to output safety information processed by SafetyOne. The output is turned OFF immediately by OFF operation (instantaneous OFF output).
	Detail information	Logic functions (5-332)

Intended outputs (Terminal names)	Function	
Safety output 1-2 (Y1) Safety output 2-2 (Y3)	Function name	Safety output with timer
	Symbol	
	Description of operation	This function is a safety output to output safety information processed by SafetyOne. The output is turned OFF after the preset time of the OFF-delay timer (OFF-delay output).
	Detail information	Logic functions (5-335)

Note. When the SafetyOne changes to Protection state due to input monitor error, safety outputs without timer (safety output 1-1 and safety output 2-1) are turned OFF. Safety outputs with timer (safety output 1-2 and safety output 2-2) are turned OFF after the preset OFF-delay time.

Note. When the SafetyOne changes to Stop state due to circuit failure or other errors, all safety outputs (safety output 1-1, safety output 1-2, safety output 2-1, and safety output 2-2) are turned OFF, immediately.

Note. Set time of safety output with timer is active independent of the selected mode.

● **Safety input monitor outputs: Y4 to Y10**

Safety input monitor outputs are used to output the status of safety inputs in SafetyOne.

Intended outputs (Terminal names)	Target safety inputs (Terminal names)	Description of operation
Safety input 1 monitor output (Y4)	Safety input 1 (X0-T0: TEACH)	When TEACH mode (X0) is selected, the monitor output is ON. When TEACH mode is not selected, the monitor output is OFF. When the target safety input is ON, the monitor output is ON. When the target safety input is OFF, the monitor output is OFF.
Safety input 2 monitor output (Y5)	Safety input 2 (X2-T2, X3-T3)	
Safety input 3 monitor output (Y6)	Safety input 3 (X4-T4, X5-T5)	
Safety input 4 monitor output (Y7)	Safety input 4 (X6-T6, X7-T7)	
Safety input 5 monitor output (Y10)	Safety input 5 (X10, X11)	

Note. When the targeted safety input detects an input monitor error, input circuit failure, or EMC the disturbance, corresponding safety input monitor output becomes a pulse output (1Hz). The monitor output is OFF in other errors, Initial state, or Configuration state.

● **Safety output monitor outputs: Y12, Y13, Y17, and Y20**

Safety output monitor outputs are used to output status of safety outputs in SafetyOne.

Intended outputs (Terminal names)	Target safety outputs (Terminal names)	Description of operation
Safety output 1-1 monitor output (Y12)	Safety output 1-1 (Y0)	When the target safety output is ON, the monitor output is ON. When the target safety output is OFF, this function is OFF. The monitor output turns OFF immediately, independent of the preset OFF-delay time.
Safety output 1-2 monitor output (Y13)	Safety output 1-2 (Y1)	
Safety output 2-1 monitor output (Y17)	Safety output 2-1 (Y2)	
Safety output 2-2 monitor output (Y20)	Safety output 2-2 (Y3)	

Note. When the safety output detects an output circuit failure, corresponding safety output monitor output becomes a pulse outputs (1Hz). The monitor output is OFF in other errors, Initial state, or Configuration state.

● **State monitor outputs: Y14 to Y16**

State monitor outputs are used to output the internal state of SafetyOne.

Intended outputs (Terminal names)	State				
	Initial	Run	Configuration	Protection	Stop
State monitor output 1 (Y14)	■ON	□OFF	□OFF	□OFF	■ON
State monitor output 2 (Y15)	■ON	□OFF	■ON	■ON	■ON or □OFF
State monitor output 3 (Y16)	□OFF	■ON	□OFF	□OFF	□OFF

Refer to “Chapter 4 BASIC OPERATIONS” and to “Chapter 6 TROUBLE SHOOTING” for details of each state.



Warning

The monitor outputs are not safety outputs. Do not use these to construct a safety system.



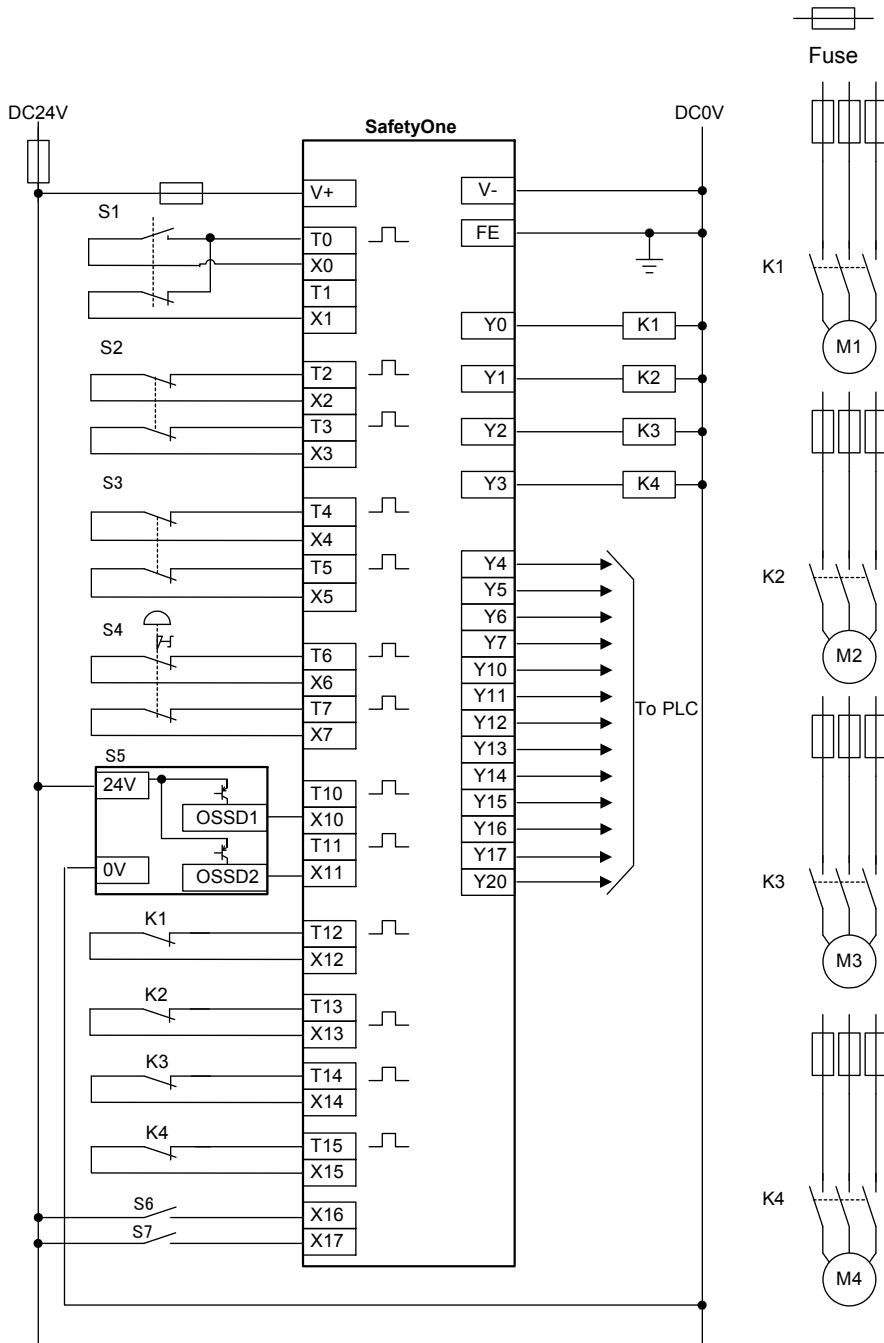
Caution

Refer to "Chapter 2 PRODUCT SPECIFICATIONS" for specifications of each input and output.

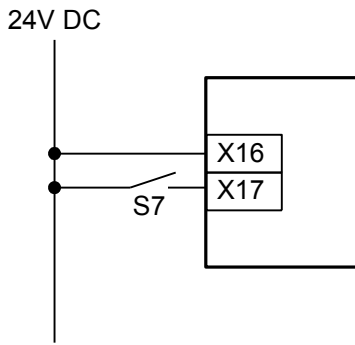
Wiring example (Logic108)

In the case where 1 selector switch, 1 enabling switch, 1 interlock switch, 1 emergency stop switch, and 1 safety light curtain are connected.

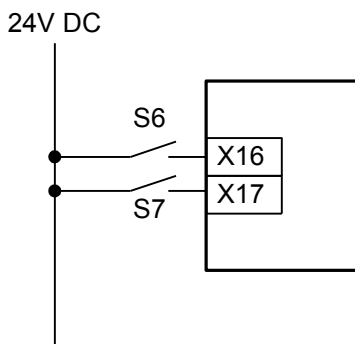
- S1 :Selector switch
- S2 :Enabling switch
- S3 :Interlock switch
- S4 :Emergency stop switch
- S5 :Safety light curtain
- S6, 7 :Start switch
- K1 to 4 :Contactor
- M1 to 4 :Motor



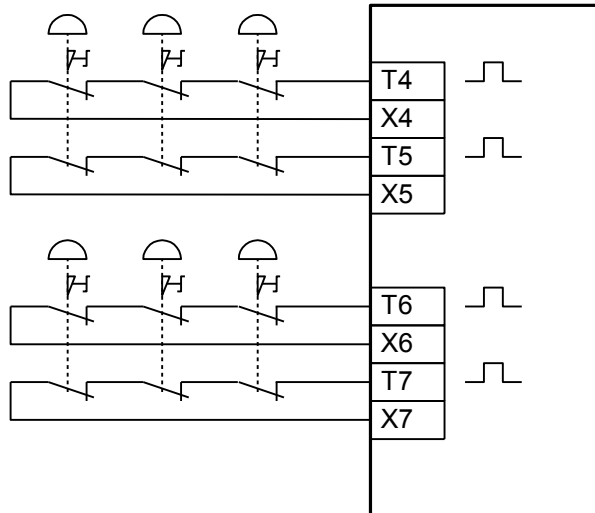
**When not using the start switch S6
(Auto start)**



**When using the start switch S6
(Manual start)**



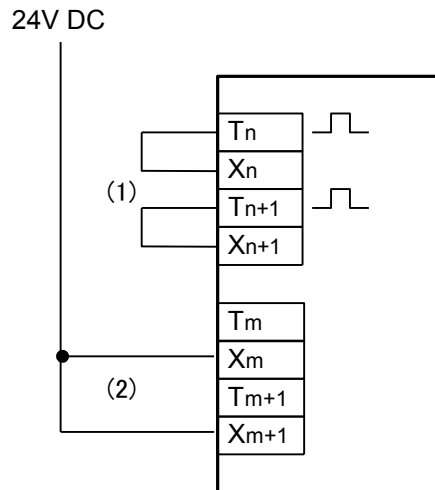
**When connecting multiple emergency stop switches
in series**



NOTE: Safety performance depends on the system configuration.

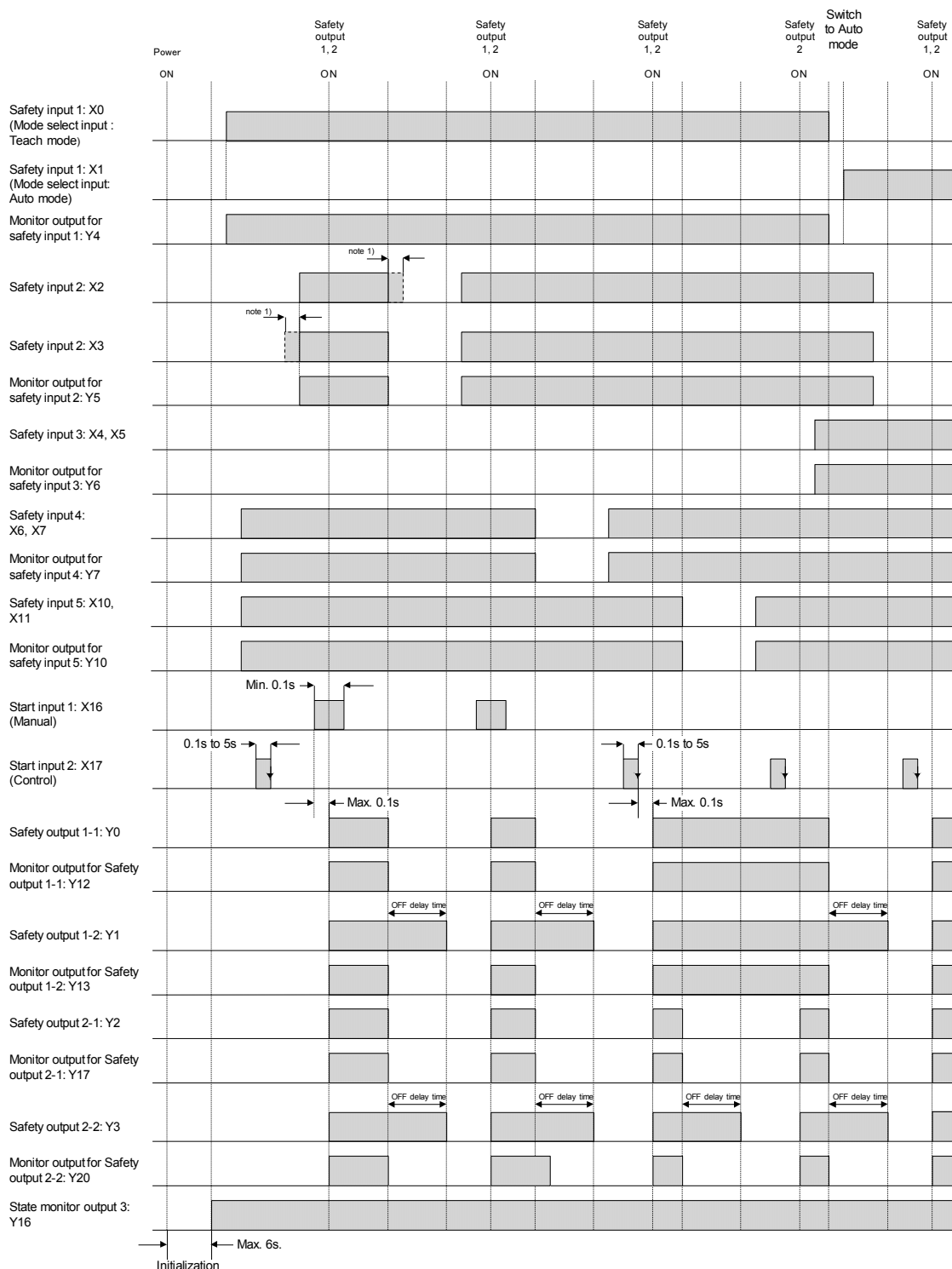
When not using some safety inputs

- If there are unused safety inputs in S3 and S4, connect the unused receive terminals to the corresponding drive terminals. (Refer to (1))
- If S5 is not used, connect the receive terminal to 24V DC power supply (V+). (Refer to (2))



Timing chart (Logic 108)

Example: Teach mode

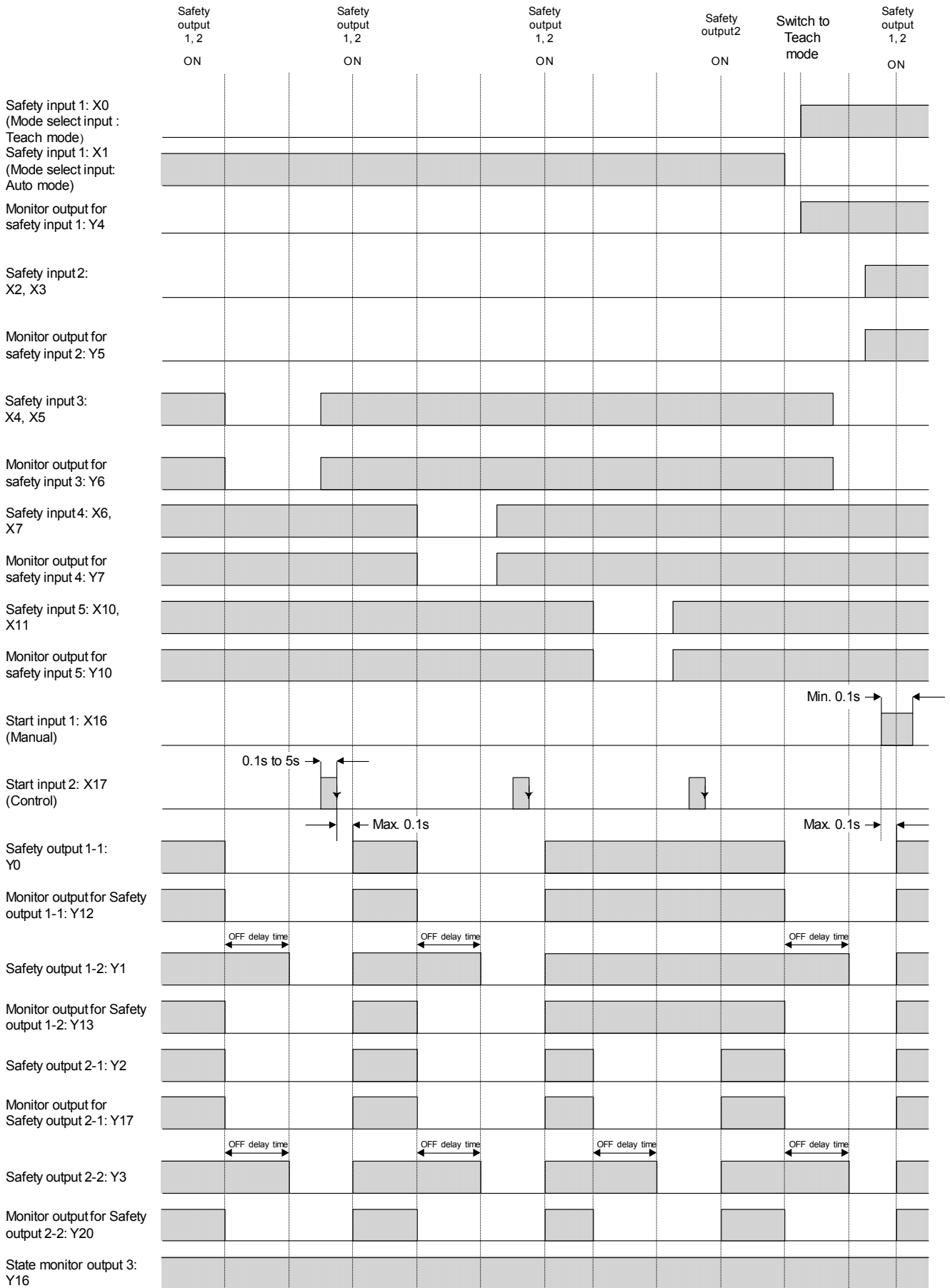


Note 1) Input monitor error detection time is infinity.

About safety inputs that are not described in this chart, input monitor error detection time is as follows.
 The time of dual channel direct opening input (X4 to X7) is 0.5s.
 The time of dual channel safety input (X10, X11) is 0.1s.
 Refer to the following "Logic functions" for more details.

LOGIC

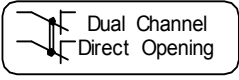
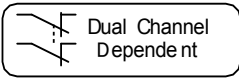
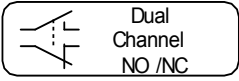
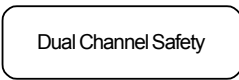
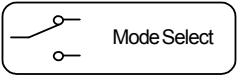
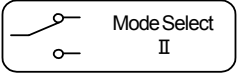
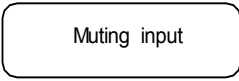
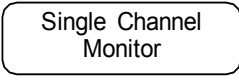

Example: Auto mode

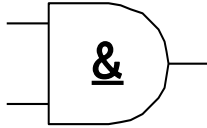
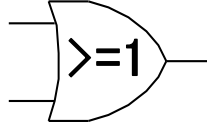
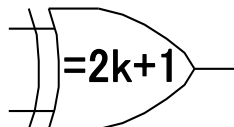
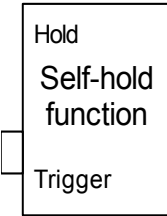
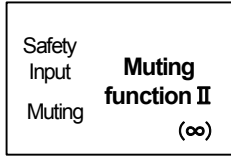
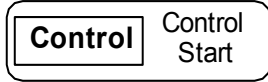
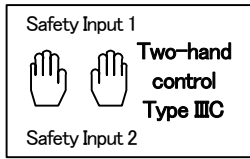
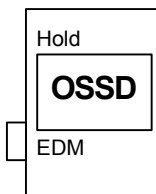
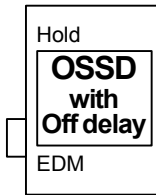


Logic functions

This section describes the functions of each logic circuit. The logic functions are separated into input, logic operation, and output functions in Table 5-1. Select the appropriate logic after understanding its functionality.

Table 5-1 List of logic functions

Type	Function	Symbol	Description	Reference page
Input function	Dual channel direct opening input		This function is for connecting safety devices with dual channel direct opening action mechanisms, such as emergency stop switches or interlock switches.	5-311
	Dual channel dependent input		This function is for connecting safety devices with dual channel dependent action mechanisms, such as enabling switches.	5-313
	Dual channel NO/NC input		This function is for connecting a safety device with a dual channel NO/NC mechanism, such as a non-contact interlock switch.	5-315
	Dual channel safety input		This function is for connecting safety devices with dual channel solid state outputs (PNP output), such as safety light curtains, safety laser scanners, or safety devices with dual channel contacts, such as emergency stop switches.	5-317
	Mode select input		This function is for connecting devices with a mode selector function, such as a mode selector switch.	5-319
	Mode select input II		This function is for connecting devices with a mode selector function, such as mode selector switch. In case of switching if the input is performed within 3s, the function output is kept at the previous state.	5-321
	Muting input		This function is for connecting a sensor or any other input device to perform muting.	5-323
	Monitor input		This function is for connecting a switch or sensor for use as a start input.	5-325
	External device monitor input		This function is for monitoring external devices controlled by the SafetyOne. External devices are diagnosed for errors by connecting a NC contact, such as a contactor or safety relay.	5-326

Type	Function	Symbol	Description	Reference page
Logic operation function	AND		This function means logical (AND) of multiple inputs.	5-327
	OR		This function means logical (OR) of multiple inputs.	5-327
	XOR		This function means exclusive logical (XOR) of multiple inputs.	5-328
	Self-hold		This function means self-holding of an input.	5-328
	Muting II		This function adds a muting function to connected safety devices. (∞) means the limit of muting time is undefined.	5-329
	Control start		This function adds an operation confirmation function to the connected start input devices.	5-330
	Two-hand control		This function means two-hand control function. This function is applicable as Type IIIC according to ISO13851.	5-331
Output function	Safety output		This function is for controlling the safety output.	5-332
	Safety output with timer		This function is for controlling the safety output with an OFF delay timer.	5-335

Input functions

Dual channel direct opening input

This function is for connecting safety devices with dual channel direct opening action mechanisms, such as an emergency stop switch or an interlock switch. As shown in Fig. 5-1, this function is comprised of a dual channel input receive circuit (X_n, X_{n+1}), drive circuit (T_n, T_{n+1}), and function output (I_n).

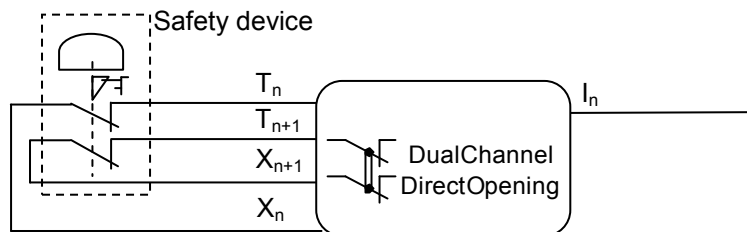


Fig. 5-1 Circuit for dual channel direct opening input functions

Connects to

Safety devices with direct opening mechanisms, such as emergency stop switches or interlock switches.

Note. This cannot be connected to a safety light curtain or other safety solid state outputs.

Description of operation

The operation timing is described in Fig. 5-2.

- I When safety check signals from 2 drive circuits are supplied to 2 receiving circuits, the output is turned ON. (Ex. Emergency stop switch is released, the guard is closed.)
- II When safety check signal to either of the receiving circuits is turned OFF, the output is turned OFF. (Ex. Emergency stop switch is released, the guard is opened.)
- III If safety check signals are not correctly supplied to the receiving circuits, due to an error in the safety device or input circuit, the output is turned OFF immediately. Status of any detected error is reflected by the error LED, input LEDs and monitor output. (Ex. Fault in emergency stop switch or interlock switch, or wiring error.)

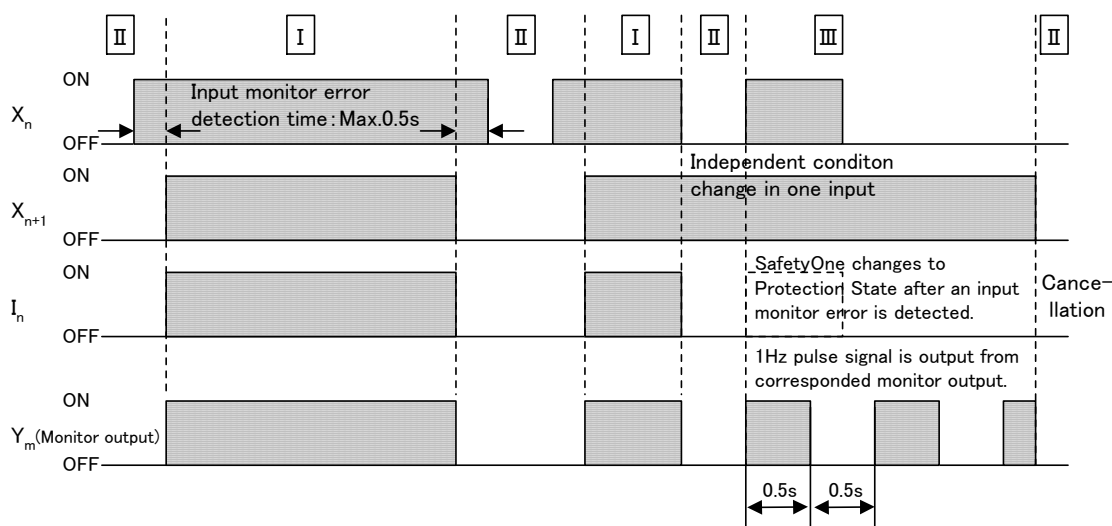


Fig. 5-2 Operation timing of a dual channel direct opening input function

Error detection function

Input monitoring and grounding detection

When an error is detected between dual channel inputs, the SafetyOne changes to the Protection state and displays "1" on the error LED display. The conditions to be detected as input errors are shown below.

- When the input monitor error detection time (0.5s) is exceeded during 2 input conditions or do not match (namely ON/OFF or OFF/ON).
- When there is an independent condition change at 1 of the inputs.
- When the ON state input circuit has been grounded.

The input LEDs blink and the monitor output (Y_m) outputs pulses (1Hz), to notify the operator of the corresponding input. See Fig. 5-2.

Short circuit

When an input error, such as a short circuit, or circuit failure, is detected, the SafetyOne changes to the Stop state and displays "2" on the error LED display.

The input LEDs blink and the monitor output (Y_m) outputs pulses (1Hz), to notify the operator of the corresponding input.

Noise detection filter

The SafetyOne is tested according to IEC/EN 61000-6-2, however in the case when the SafetyOne is used in an environment with severe noise, the SafetyOne changes to the Stop state and displays "9" on the error LED display.



Safety check signals (pulses signals) are transmitted from the drive circuits (T_n) to diagnose connected safety devices and input circuits. Safety check signals can not be used as a power for connected devices.

Dual channel dependent input

This function is for connecting safety devices with dual channel dependent action mechanisms, such as an enabling switch. As shown in Fig. 5-3, this function is comprised of a dual channel input receive circuit (X_n, X_{n+1}), a drive circuit (T_n, T_{n+1}), and a functional output (I_n). The difference from dual channel direct opening input, is that the dependency of the 2 inputs is monitored with the dual channel dependent input function, but the dependent time is infinite.

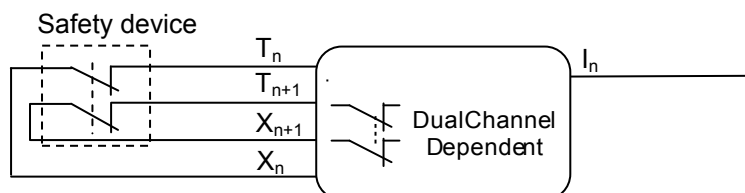


Fig. 5-3 Circuit for dual channel dependent input function

Connects to

Safety devices with a direct opening mechanism, such as emergency stop switches or interlock switches.

Safety devices with a contact dependent mechanism, such as an enabling switch.

Note. This cannot be connected to a safety light curtain or any other safety solid state outputs.

Description of operation

The operation timing is described in Fig. 5-4.

- ❑ When safety check signals from 2 drive circuits are correctly supplied to 2 input receiving circuits, the output is turned ON. (Ex. Guard is closed.)
- ❑❑ When the safety check signal to either of the receiving circuits is turned OFF, the output is turned OFF. (Ex. Guard is opened.)
- ❑❑❑ If safety check signals are not supplied correctly to the receiving circuits, due to an error in the safety device or input circuit, the output is turned OFF immediately. Status of a detected error is displayed by the error LED, input LEDs and monitoring output. (Ex. Fault in Interlock switch or wiring error)

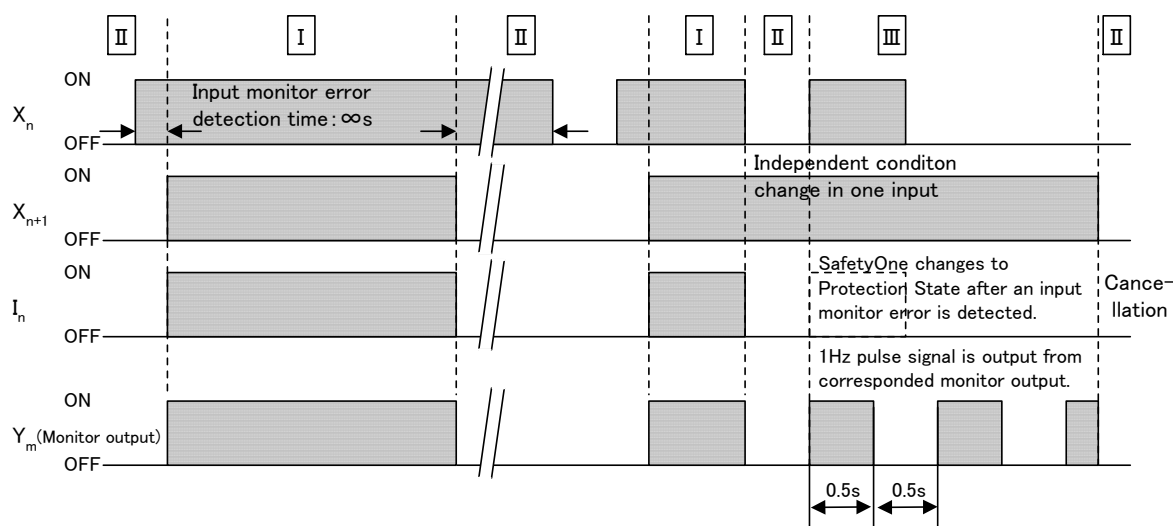


Fig. 5-4 Operation timing of a dual channel dependent input function

Error detection function

Input monitoring

When an error is detected between dual channel inputs, the SafetyOne changes to the Protection state and displays "1" on the error LED display. The condition to be detected as an input error is shown below.

- When there is an independent condition change of 1 of the inputs

The input LEDs blink and the monitoring output (Y_m) outputs pulses (1 Hz), to notify the operator of the corresponding input. See Fig. 5-4.

Note. The dependency of the 2 inputs is monitored with the dual channel dependent input function, but the dependent time is infinite.

Short circuit

When an input error, such as a short circuit or circuit failure, is detected, the SafetyOne changes to the Stop state and displays "2" on the error LED display.

The input LEDs blink and the monitoring output (Y_m) outputs pulses (1 Hz), to notify the operator of the corresponding input.

Noise detection filter

The SafetyOne is tested according to IEC/EN 61000-6-2, however in the case when the SafetyOne is used in an environment with severe noise, the SafetyOne changes to the Stop state and displays "9" on the error LED display.



Safety check signals (pulses signals) are supplied from the drive circuits (T_n) to diagnose connected safety devices and input circuits. Safety check signals can not be used as a power for connected devices.

Dual channel NO/NC input

This function is for connecting safety devices with dual channel NO/NC mechanisms, such as a non-contact interlock switch or an interlock switch. As shown in Fig. 5-5, this function is comprised of a dual channel input receiving circuit (X_n, X_{n+1}), a drive circuit (T_n, T_{n+1}), and a functional output (I_n). Because safety devices comprised of NO and NC contacts are connected, during normal operation, 1 of the dual channel inputs is ON while the other is OFF.

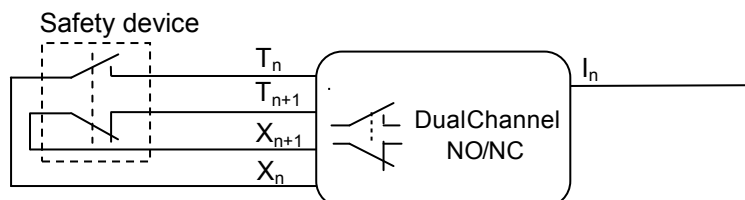


Fig. 5-5 Circuit for dual channel NO/NC input function

Connects to

Safety devices with NO/NC contacts, such as non-contact interlock switches or interlock switches.

Note. This cannot be connected to a safety light curtain or any other safety solid state output.

Description of operation

The operation timing is described in Fig. 5-6.

- I When a safety check signal from 1 of the 2 drive circuits (T_{n+1}) is supplied to the corresponding receiving circuit (X_{n+1}) and the other receiving circuit (X_n) is OFF, the output is turned ON. (Ex. Guard is closed.)
- II When a safety check signal from 1 of the 2 drive circuits (T_n) is supplied to the corresponding receiving circuit (X_n), and the other receiving circuit (X_{n+1}) is OFF, the output is turned OFF. (Ex. Guard is opened.)
- III If safety check signals are not supplied correctly to the receiving circuits, due to an error in the safety device or input circuit, the output is turned OFF immediately. Status of any detected error is displayed on the error LED, input LEDs and monitoring output. (Ex. Fault in the non-contact Interlock switch or wiring error)

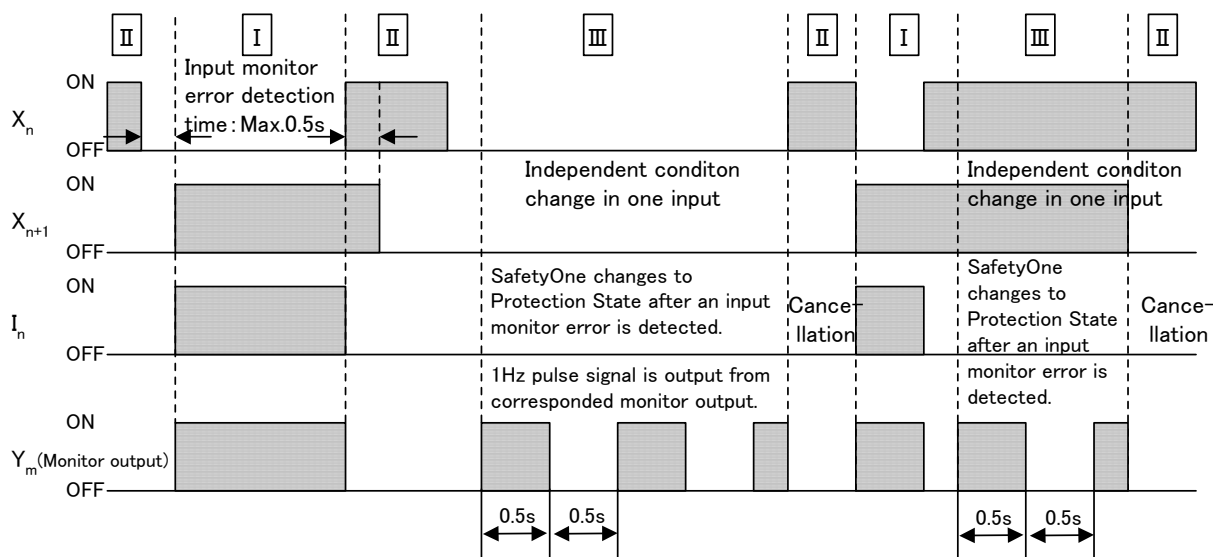


Fig. 5-6 Operation timing of a dual channel NO/NC input function

Error detection function

Input monitoring and grounding detection

When an error is detected between the dual channel inputs, the SafetyOne changes to the Protection state and displays "1" on the error LED display. The conditions to be detected as input errors are shown below.

- When an input monitoring error detection time (0.5 s) is exceeded during the 2 input conditions are the same condition (namely ON/ON or OFF/OFF).
- When there is an independent condition change of 1 of the inputs.
- When the ON state input circuit has been grounded.

The input LEDs blink and the monitoring output (Y_m) sends pulses (1Hz), to notify the operator of the corresponding input. See Fig. 5-6.

Short circuit

When an input error, such as short circuit or circuit failure, is detected, the SafetyOne changes to the Stop state and displays "2" on the error LED display.

The input LEDs blink and the monitoring output (Y_m) sends pulses (1Hz), to notify the operator of the corresponding input.

Noise detection filter

The SafetyOne is tested according to IEC/EN 61000-6-2, however in the case when the SafetyOne is used in an environment with severe noise, the SafetyOne changes to the Stop state and displays "9" on the error LED display.

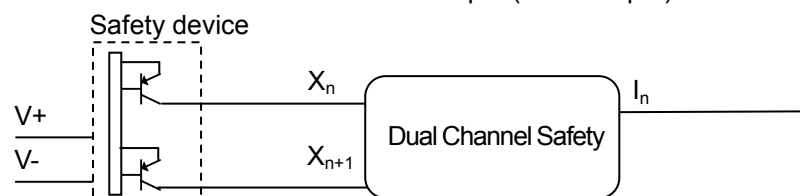


Safety check signals (pulses signals) are supplied from the drive circuits (T_n) to diagnose connected safety devices and input circuits. Safety check signals can not be used as a power for connected devices.

Dual channel safety input

This function is for connecting a safety device with a dual channel solid state output (PNP output), such as a safety light curtain or a safety laser scanner, or a safety device with contacts such as an emergency stop switch or an interlock switch. As shown in Fig. 5-7, this function is comprised of a dual channel receive circuit (X_n , X_{n+1}) and a functional output (I_n). Use safety devices with diagnostic functions or prevent the short circuit of an input circuit, because the drive circuit is not used for this function.

-For safety device with dual channel solid state output (PNP out put)



-For safety device with contacts

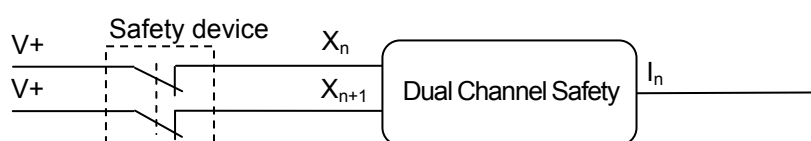


Fig. 5-7 Circuit for dual channel safety input function

Connects to

Safety devices with dual channel solid state outputs (PNP output), such as a safety light curtains or a safety laser scanners, and safety devices with contacts such as emergency stop switches or interlock switches.



Safety performance depends on used safety devices when connecting mechanical contact devices, such as emergency stop switches or interlock switches.

Note. Solid state output devices with sink outputs (NPN output) cannot be connected.

Description of operation

The operation timing is described in Fig. 5-8.

- I When the dual channel safety check signals from the safety device are correctly supplied to the 2 input receiving circuits, the output is turned ON. (Ex. Safety light curtain is not shaded.)
- II When the safety check signal to either of the receiving circuits is turned OFF, the output is turned OFF immediately. (Ex. Safety light curtain is shaded.)
- III If safety check signals are not supplied correctly to the input receiving circuits, due to an error in the safety device or input circuit, the output is turned OFF immediately. Status of the detected error is displayed by the error LED, input LEDs and monitor output. (Ex. Fault in the light curtain or wiring error)

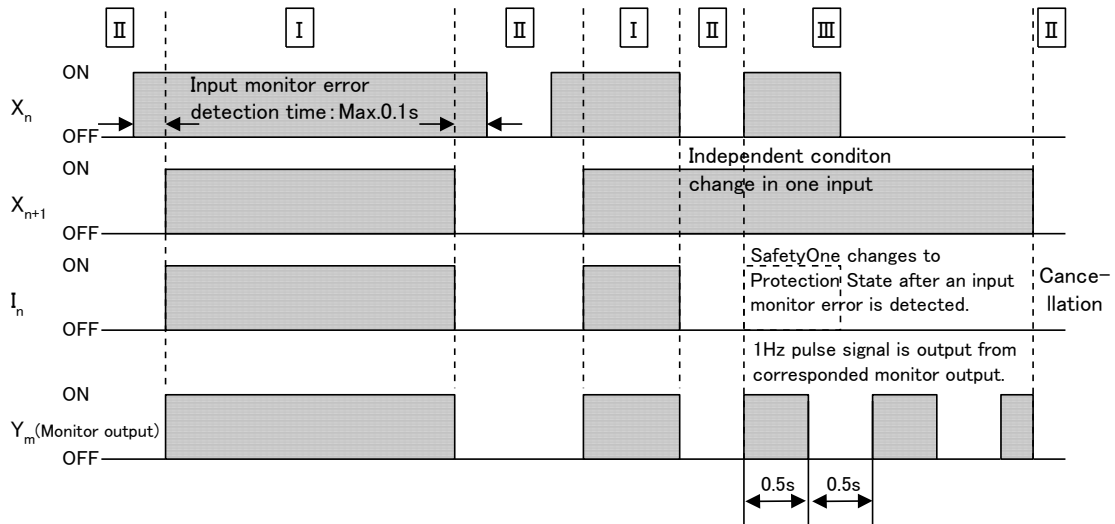


Fig. 5-8 Operation timing of a dual channel safety input function

Error detection function

Input monitoring and grounding detection

When an error is detected between the dual channel inputs, the SafetyOne changes to the Protection state and displays "1" on the error LED display. The conditions to be detected as input errors are shown below.

- When an input monitoring error detection time (0.1s) is exceeded during the 2 input conditions and they do not match (namely ON/OFF or OFF/ON).
- When there is an independent condition change of 1 of the inputs.
- The input circuit of the ON state has gone to ground.

The input LEDs blink and the monitor output (Y_m) supplies pulses (1Hz), to notify the operator of the corresponding input. See Fig. 5-8.

Noise detection filter

The SafetyOne is tested according to IEC/EN 61000-6-2, however in the case when the SafetyOne is used in an environment with severe noise, the SafetyOne changes to the Stop state and displays "9" on the error LED display.

Note. Drive circuit corresponding to the dual channel safety input (T_n, T_{n+1}) is always OFF.

Mode select input

This function is for connecting devices with a mode select function, such as a selector switch. As shown in Fig. 5-9, this function is comprised of 2 input receiving circuits (X_n , X_{n+1}), 1 drive circuit (T_n), and a functional output (TEACH, AUTO).

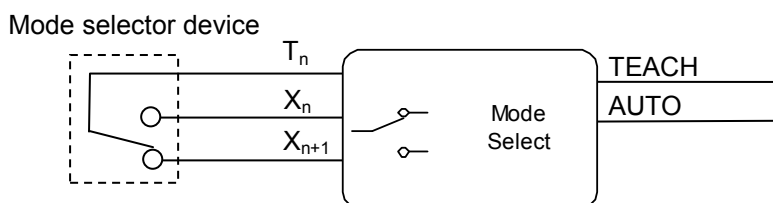


Fig. 5-9 Circuit for mode select input function

Connects to

Mode selecting device such as a selector switch or a rotary switch

Note: This cannot be connected to a safety light curtain or any other safety solid state output.

Description of operation

The operation timing is described in Fig. 5-10.

- I-1** When a safety check signal from the drive circuit (T_n) is supplied to 1 of the receiving circuits (X_{n+1}), and the other receiving circuit (X_n) is OFF, the output “AUTO” is turned ON.
- I-2** When a safety check signal from the drive circuit (T_n) is supplied to 1 of the receiving circuits (X_n), and the other receive circuit (X_{n+1}) is OFF, the output “TEACH” is turned ON.
- II-1** When both receiving circuits are OFF, both of outputs “TEACH” and “AUTO” are turned OFF. (Ex. The selector switch is in the intermediate position.)
- II-2** When both receiving circuits are ON, both of outputs “TEACH” and “AUTO” are turned OFF. And if the input monitoring error detection time (0.5s) is exceeded during the time both receiving circuits are ON, an input monitoring error is detected.
- III** If safety check signals are not supplied correctly to the receiving circuits due to an error in the selected mode device or input circuit, the output is turned OFF immediately. Status of the error is displayed by the error LED, input LEDs, and the monitoring output. (Ex. Fault in selector switch or wiring error)

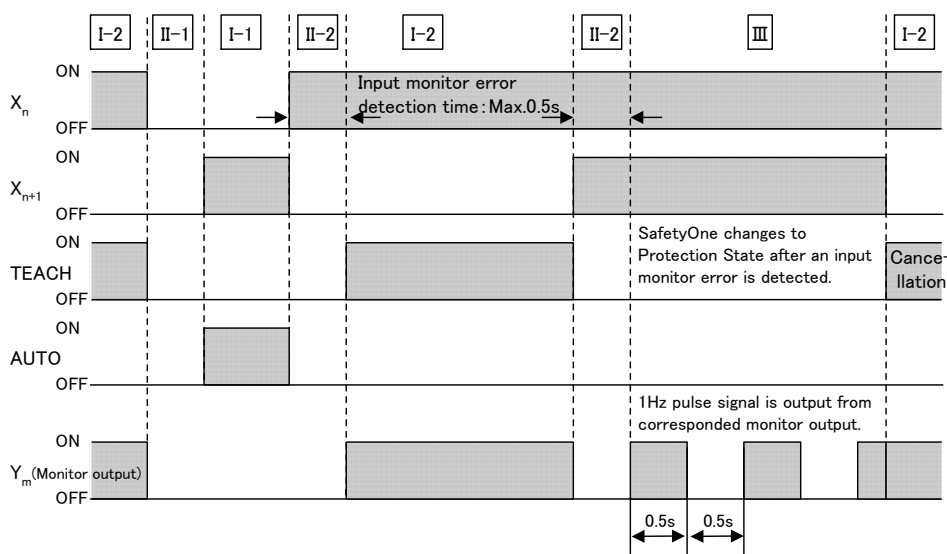


Fig. 5-10 Operation timing of a mode select input function

Error detection function

Input monitoring

When an error is detected at the inputs, the SafetyOne changes to the Protection state and displays "1" on the error LED display. The condition to be detected as an input error is shown below.

- When an input monitoring error detection time (0.5s) is exceeded while both of the 2 input conditions are ON.

The input LEDs blink and the monitor output (Y_m) outputs pulses (1Hz), to notify the operator of the corresponding input. See Fig. 5-10.

Short circuit detection

When an input error, such as a short circuit, or a circuit failure, is detected, the SafetyOne changes to the Stop state and display "2" on the error LED display.

The input LEDs blink and the monitor output (Y_m) outputs pulses (1Hz), to notify the operator of the corresponding input.

Noise detection filter

The SafetyOne is tested according to IEC/EN 61000-6-2, however in the case when the SafetyOne is used in an environment with severe noise, the SafetyOne changes to the Stop state and displays "9" on the error LED display.



Safety check signals (pulses signals) are supplied from the drive circuits (T_n) to diagnose connected safety devices and input circuits. Safety check signals can not be used as a power for connected devices.

Note. Drive circuit " T_{n+1} " is always OFF.

Mode select input II

This function is for connecting devices with a mode select function, such as a selector switch. In case of switching the input is performed within 3 s, the function output is kept at previous state. As shown in Fig. 5-11, this function is comprised of 2 input receiving circuits (X_n , X_{n+1}), 1 drive circuit (T_n), and functional output (TEACH, AUTO).

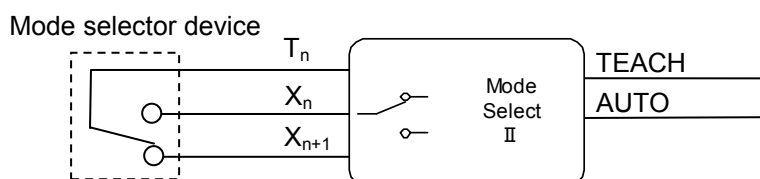


Fig. 5-11 Circuit for mode select input II function

Connects to

Mode selecting device such as a selector switch or a rotary switch

Note. This cannot be connected to a safety light curtain or any other safety solid state output.

Description of operation

The operation timing is described in Fig. 5-12.

- I-1** When a safety check signal from the drive circuit (T_n) is supplied to 1 of the receiving circuits (X_{n+1}), and the other receiving circuit (X_n) is OFF, the output “AUTO” is turned ON. The output “AUTO” is kept ON state within input switching time (3s: the time from receiving circuit (X_{n+1}) is turned OFF to receiving circuit (X_n) is turned ON).
- I-2** When a safety check signal from the drive circuit (T_n) is supplied to 1 of the receiving circuits (X_n), and the other receive circuit (X_{n+1}) is OFF, the output “TEACH” is turned ON. The output “TEACH” is kept ON state within input switching time (3s: the time from receiving circuit (X_n) is turned OFF to receiving circuit (X_{n+1}) is turned ON).
- II-1** When both receiving circuits are OFF over the input switching time (3s), both of outputs “TEACH” and “AUTO” are turned OFF. (Ex. The selector switch is in the intermediate position.)
- II-2** When both receiving circuits are ON, both of outputs “TEACH” and “AUTO” are turned OFF. And if the input monitoring error detection time (0.5s) is exceeded during the time both receiving circuits are ON, an input monitoring error is detected.
- III** If safety check signals are not supplied correctly to the receiving circuits due to an error in the selected mode device or input circuit, the output is turned OFF immediately. Status of the error is displayed by the error LED, input LEDs, and the monitoring output. (Ex. Fault in selector switch or wiring error)

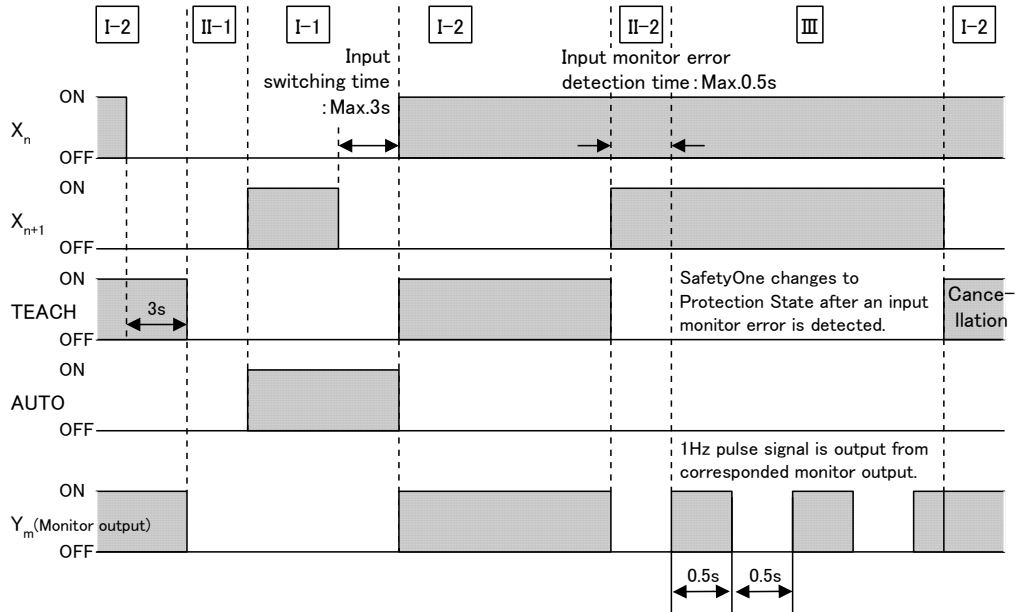


Fig. 5-12 Operation timing of a mode select input II function

Error detection function

Input monitoring

When an error is detected at the inputs, the SafetyOne changes to the Protection state and displays "1" on the error LED display. The condition to be detected as an input error is shown below.

- When an input monitoring error detection time (0.5s) is exceeded while both of the 2 input conditions are ON.

The input LEDs blink and the monitor output (Y_m) outputs pulses (1Hz), to notify the operator of the corresponding input. See Fig. 5-12.

Short circuit detection

When an input error, such as a short circuit, or a circuit failure, is detected, the SafetyOne changes to the Stop state and display "2" on the error LED display.

The input LEDs blink and the monitor output (Y_m) outputs pulses (1Hz), to notify the operator of the corresponding input.

Noise detection filter

The SafetyOne is tested according to IEC/EN 61000-6-2, however in the case when the SafetyOne is used in an environment with severe noise, the SafetyOne changes to the Stop state and displays "9" on the error LED display.



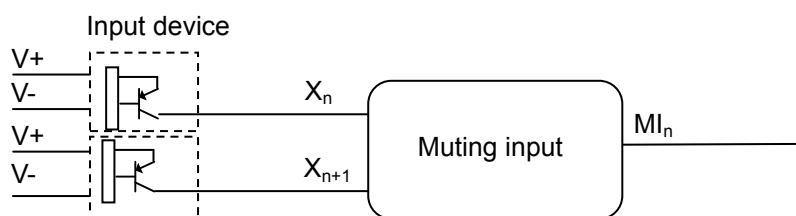
Safety check signals (pulses signals) are supplied from the drive circuits (T_n) to diagnose connected safety devices and input circuits. Safety check signals can not be used as a power for connected devices.

Note. Drive circuit " T_{n+1} " is always OFF.

Muting input

This function is for connecting a muting sensor with a solid state output (PNP output) or a mechanical contact device such as a limit switch. As shown in Fig. 5-13, this function is comprised of 2 input receiving circuits (X_n) and one functional output (MI_n).

- For muting sensors with a solid state output (PNP)



- For a mechanical contact device

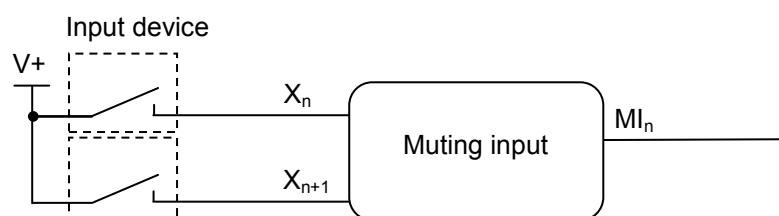


Fig. 5-13 Circuit for muting input function

Connects to

Through-beam dark ON photoelectric switches with 3-wire PNP open collector outputs
Normally open proximity sensors with 3-wire PNP open collector output



Warning

Do not use the muting input as a safety input.

Description of operation

The operation timing is described in Fig. 5-14.

- I When the 2 output signals from the muting input devices, such as muting sensor, are correctly connected to the 2 receiving circuits, the output is turned ON. (Ex. Sensor detects objects.)
- II When the input signal to either of receiving circuits is turned OFF, the output is turned OFF. (Ex. Sensor object detection is canceled.)
- III If safety check signals are not correctly supplied to the receiving circuit due to an error in the sensor device or input circuit, the output is turned OFF immediately. Status of the detected error is displayed by the error LED, input LEDs, and monitoring output. (Ex. Fault in sensor or wiring error)

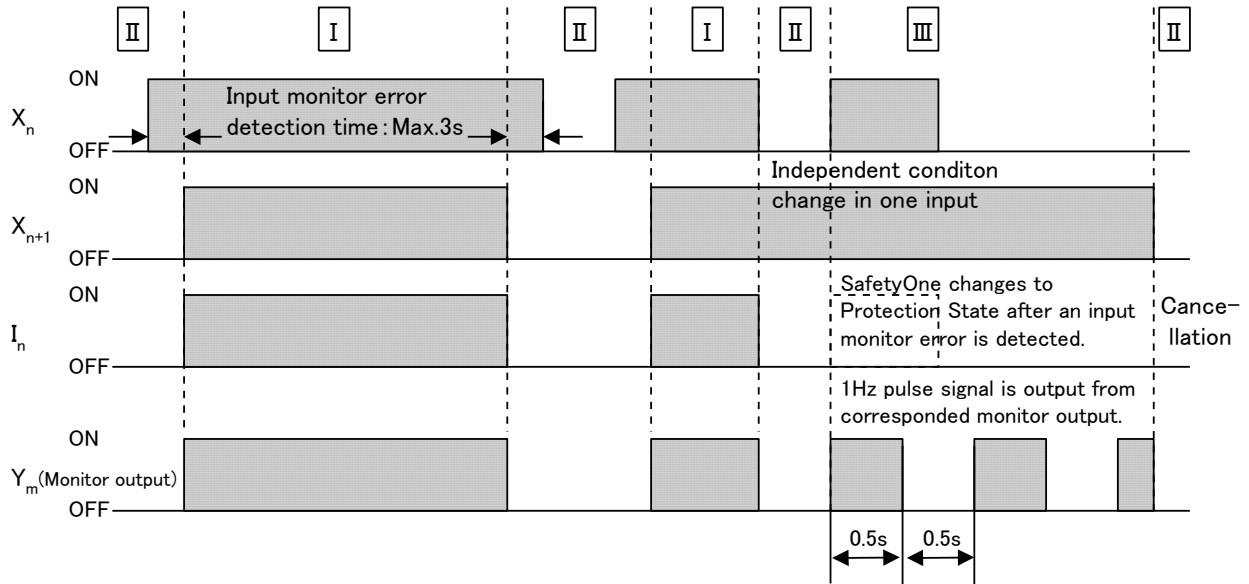


Fig. 5-14 Operation timing of the muting input function

Error detection function

Input monitoring and grounding detection

When an error is detected at the inputs, the SafetyOne changes to the Protection state and displays "1" on the error LED display. The conditions to be detected as an input error are shown below.

- When the input monitor error detection time (3s) is exceeded during the 2 input conditions and they do not match (namely ON/OFF or OFF/ON).
- When there is an independent condition change of the 1 of the input.
- When the ON state of the input goes to the ground state.

The input LEDs blink and the monitoring output (Y_m) send pulses (1Hz), to notify the operator of the corresponding input. See Fig. 5-14

Noise detection filter

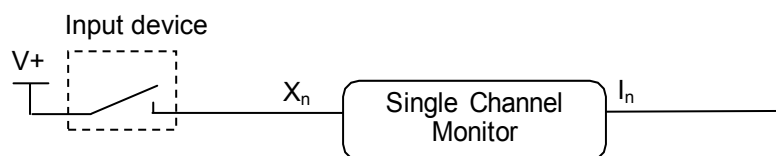
The SafetyOne is tested according to IEC/EN 61000-6-2, however in the case when the SafetyOne is used in an environment with severe noise, the SafetyOne changes to the Stop state and displays "9" on the error LED display.

Note. Drive circuit corresponding to muting input (T_n, T_{n+1}) is always OFF.

Monitor input

This function is for connecting a switch (mechanical contact device) or sensor with a solid state output (PNP output) as a start input. As shown in Fig. 5-15, this function is comprised of 1 receiving circuit (X_n) and 1 functional output (I_n).

- For mechanical contact device



- For input device with solid state output (PNP)

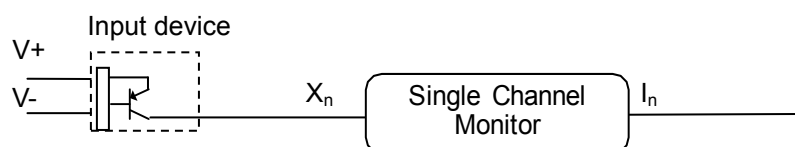


Fig. 5-15 Circuit for monitor input function

Connects to

Input device such as a mechanical contact switch, a photoelectric switch, or a proximity switch

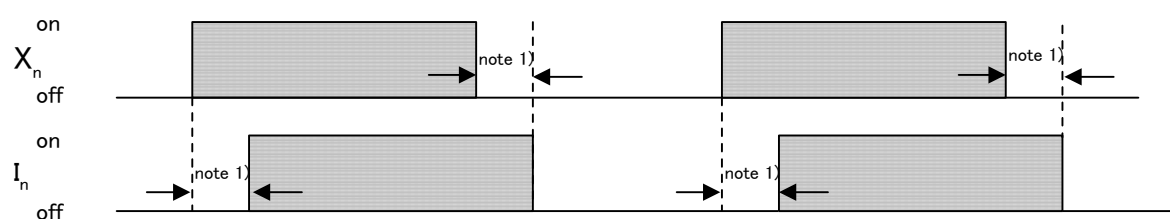


Do not use the monitor input as a safety input. When there is a failure in the SafetyOne or peripheral devices, the safety system will not function properly as intended.

Description of operation

Operation timing is described in Fig. 5-16.

When the output signals from the start input device are correctly supplied to the receiving circuit, the output (I_n) turns ON.



note 1) This time is part of the Reaction time which is shown at "Electrical conditions" in General specifications.

Fig. 5-16 Operation timing of the monitor input

Error detection function

Noise detection filter

The SafetyOne is tested according to IEC/EN 61000-6-2, however in the case when the SafetyOne is used in an environment with severe noise, the SafetyOne changes to the Stop state and displays "9" on the error LED display.

External device monitoring input

This function is for monitoring external devices controlled by the SafetyOne. External devices can be diagnosed for errors by connecting a NC contact, such as a contactor or a safety relay. As shown in Fig. 5-17, this function is comprised of an input receiving circuit (X_n), drive circuit (T_n), and functional output.

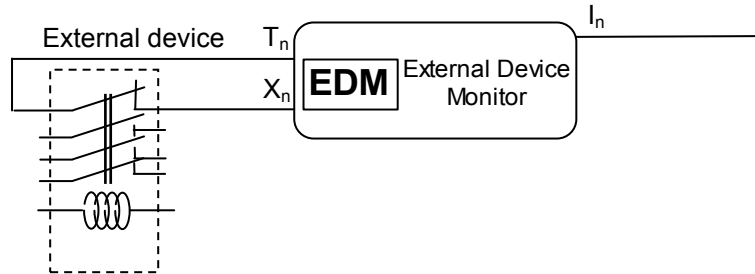


Fig. 5-17 Circuit for external device monitor input function

Connects to

NC contact on devices such as a contactor, safety relay, or other devices equipped with forced guided mechanisms

Note. Solid state output devices cannot be connected.

Description of operation

- I When a safety check signal from the drive circuit is supplied correctly to the receiving circuit, the output is turned ON. (Ex. External device is turned OFF.)
- II When safety check signal input to the receiving circuit is turned OFF, the output is turned OFF. (Ex. External device is turned ON.)
- III If the safety check signal is not supplied correctly to the receiving circuit due to an error in an external device or input circuit, the output is turned OFF immediately. Status of the detected error is displayed on error LED, input LED, and monitor output. (Ex. Fault in external device or wiring error)

Error detection function

Noise detection filter

The SafetyOne is tested according to IEC/EN 61000-6-2, however in the case when the SafetyOne is used in an environment with severe noise, the SafetyOne changes to the Stop state and displays "9" on the error LED display.

Note. Refer to "Safety output without timer" or "Safety output with timer" for details of EDM input monitoring.

LOGIC FUNCTION

AND

As shown in Fig. 5-18 and 5-19, this function reflects the results of a logic (AND) function processing for multiple inputs (I_n) in the function output (O_n).

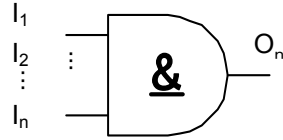


Fig. 5-18 AND function circuit

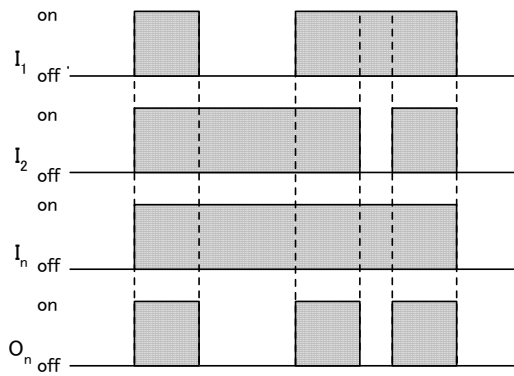


Fig. 5-19 Operation timing of the AND function

OR

As shown in Fig. 5-20 and 5-21, this function reflects the results of a logic (OR) function processing for multiple inputs (I_n) in the function output (O_n).

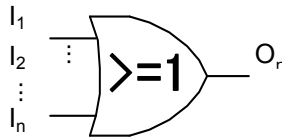


Fig. 5-20 OR function circuit

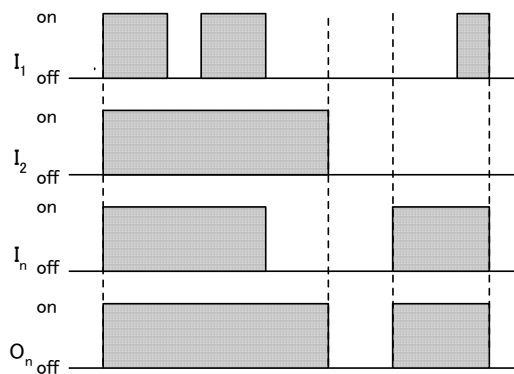


Fig. 5-21 Operation timing of the OR function

XOR

As shown in Fig. 5-22 and 5-23, this function reflects the results of an exclusive logic (XOR) function processing for multiple inputs (I_n) in the function output (O_n).

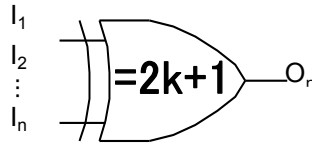


Fig. 5-22 XOR function circuit

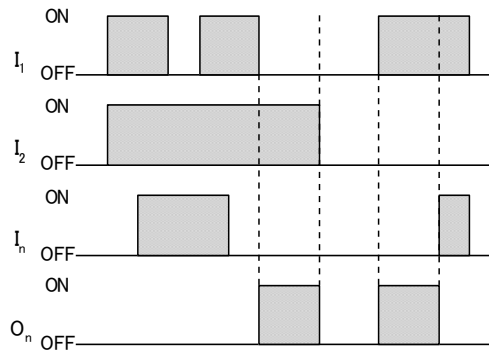


Fig. 5-23 Operation timing of XOR function

Self-hold

As shown in Fig. 5-24 and 5-25, this function is comprised of a hold input (IH_n), a trigger input (IT_n), and a functional output (O_n), and reflects the results of self-holding processing by the hold input and trigger input in the output.

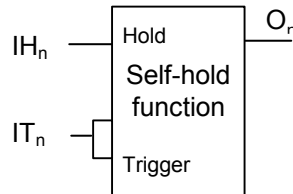


Fig. 5-24 Self-holding function circuit

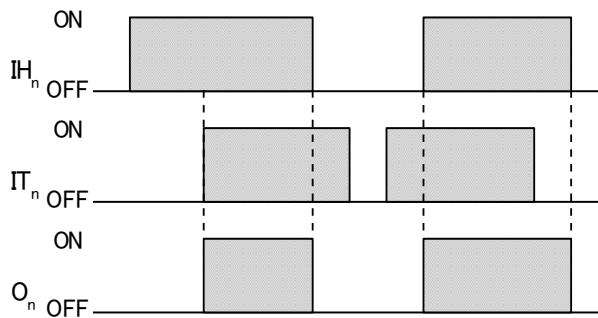


Fig. 5-25 Operation timing of the self-holding function

Note. When the SafetyOne changes to the Configuration, Protection, or Stop state, the self-holding function is canceled.

Muting II

This function adds muting to connected safety devices.

As shown in Fig. 5-26, this function is comprised of a safety input (I_n), a muting input (IM_n), and a functional output (O_n). The output of the muting input function is connected to the muting input (IM_n).

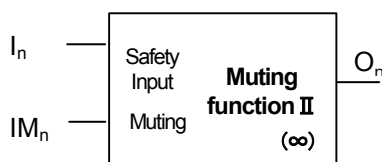


Fig. 5-26 Muting II function circuit

Description of operation

The timing is described in Fig. 5-27.

- ▮ When the muting input is turned ON while the safety input is ON, the OFF status of the safety input is suspended, and the output remains ON.
- ▮▮ When the muting input is turned OFF, muting is canceled and the ON/OFF status of the safety input is shown by the output.
- ▮▮▮ If muting is not used under the correct conditions, the muting function is disabled and the ON/OFF status of the safety input is shown by the output.

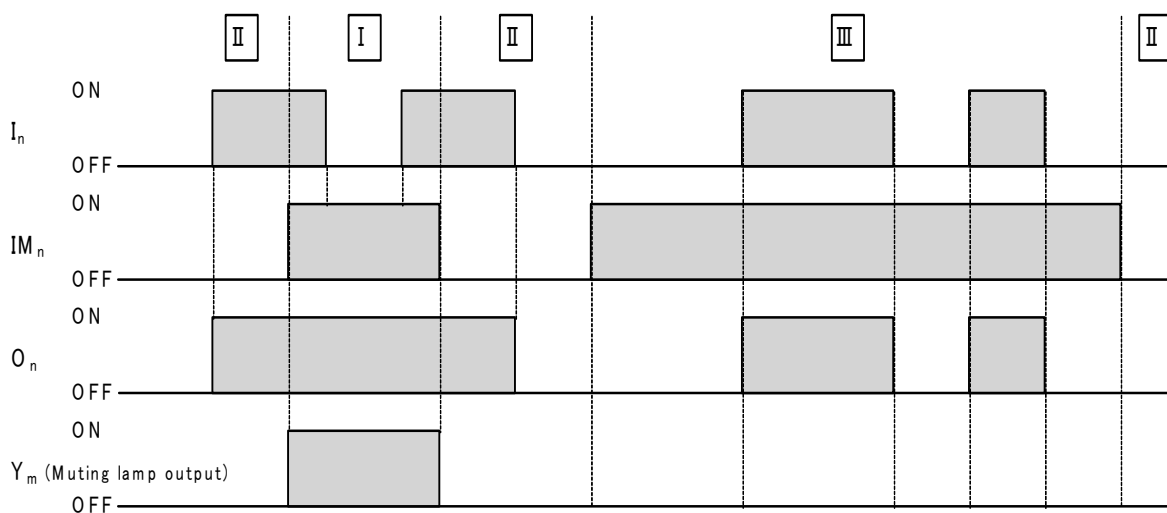


Fig. 5-27 Operation timing of the muting function

Error detection function

Muting monitor

When the following condition is satisfied, the SafetyOne disables the muting function.

- When the safety device to be muted is OFF

When the muting input is turned ON while the safety input to be muted is OFF, the muting function is disabled.

Note. lamp outputs (Y17, Y20) have diagnostic functions of wire breaking or no connection of an indicator in logic 11d. When wire breaking or no connection of an indicator, the SafetyOne changes to the Stop state and displays "5" in the error LED display.

Control start

This function confirms operation of the connected start input device. As shown in Fig.5-28, this function is comprised of a functional input (I_n) and a functional output (O_n).

The start input (I_n) ON operation is monitored to determine whether it is performed within the designated control time (0.1 s to 5 s).



Fig. 5-28 Control start function circuit

Description of operation

The operation timing is described in Fig. 5-29.

- ▣ If the input turns ON within the designated control time (0.1 s to 5 s), the output turns ON until the connected self-holding function or another trigger input turns ON. (The function output turns OFF after the other trigger input turns ON.)
- ▣ If the input does not turn ON within the designated control time (0.1 s to 5 s) (If the function input turns on before 0.1 s or after 5 s), the output does not turn ON.

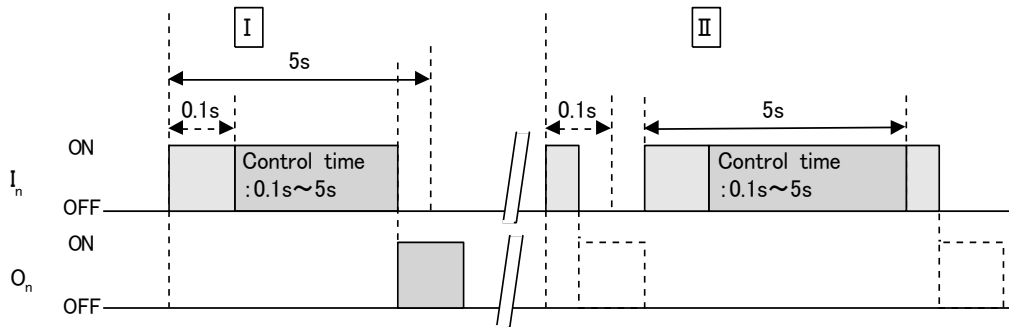


Fig. 5-29 Operation timing of the control start function

Two hand control

This function adds a two hand control function to the connected the safety device. As shown in Fig.5-30, this function is comprised of 2 safety inputs (I_n , I_{n+1}) and a functional output (O_n). The function outputs of dual channel NO/NC output are connected to safety inputs (I_n , I_{n+1}) of this function.

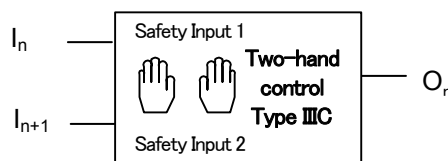


Fig. 5-30 Two hand control function circuit

Description of operation

The operation timing is described in Fig. 5-31.

II If the both of safety inputs turn ON, function output turns ON.

III If the one of safety outputs turns, function output turns OFF.

(1) The input status of both of safety inputs are different over the input monitoring error detection time (0.5s), function output kept at OFF state.

(2) The one of inputs change the state independently on another input, function output kept at OFF state.

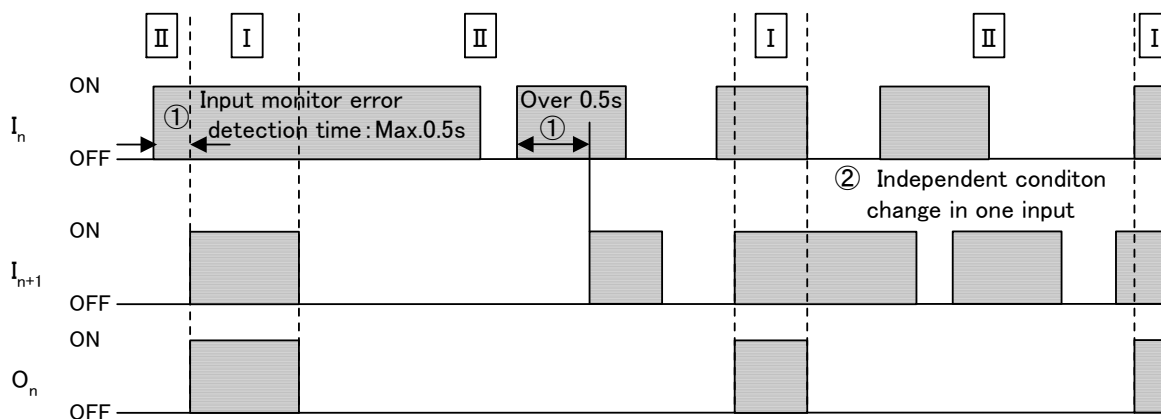


Fig. 5-31 Operation timing of the two hand control function

Output function

Safety output (without timer)

This function is for controlling the safety output without OFF delay timer.

As shown in Fig. 5-32, this function is comprised of a hold input (O_n), an EDM input (I_n), and a safety output (Y_n). The function output of this external device monitoring input function is connected to the EDM input (I_n).

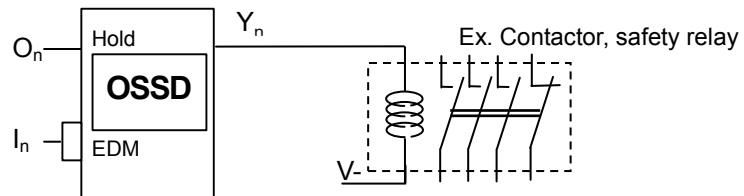


Fig. 5-32 Safety output function circuit

Connects to

Equipment with force guided mechanisms, such as, contactors, safety relays.

Input of safety PLC, or other safety controllers.

Description of operation

The operation timing is described in Fig. 5-33 and 5-34.

- I When hold input is turned ON, the safety output is turned ON after confirmation that the EDM input is ON.
- II When hold input is turned OFF, the safety output is turned OFF.
- III If the EDM input is not applied correctly (ON state of EDM input is not detected during EDM monitoring time (1s) after hold input is turned ON, ON state of EDM input is not detected during EDM monitoring time (1s) after safety output turns OFF, or ON state of EDM input is not detected during EDM monitoring time (1s) after EDM input turns OFF due to the error during safety output is OFF state), the SafetyOne changes to the Protection state, and indicates "1" on the error LED without turning ON the safety output. (See Fig. 5-34.)

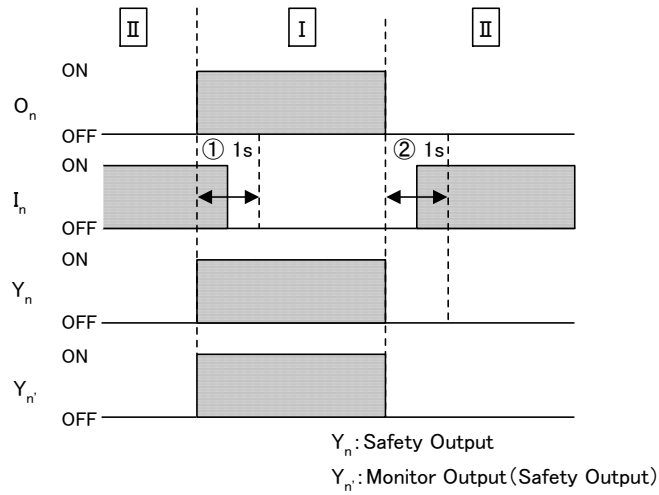


Fig.5-33 Operation timing of the safety output with timer function

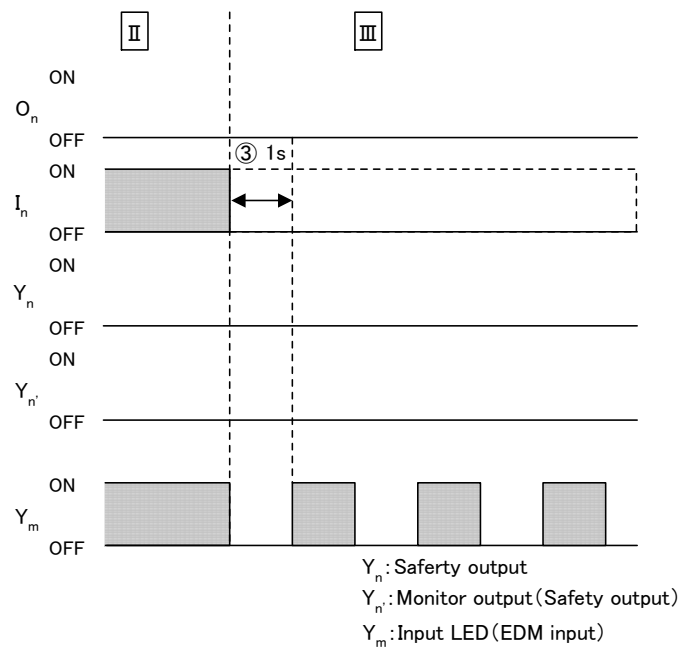
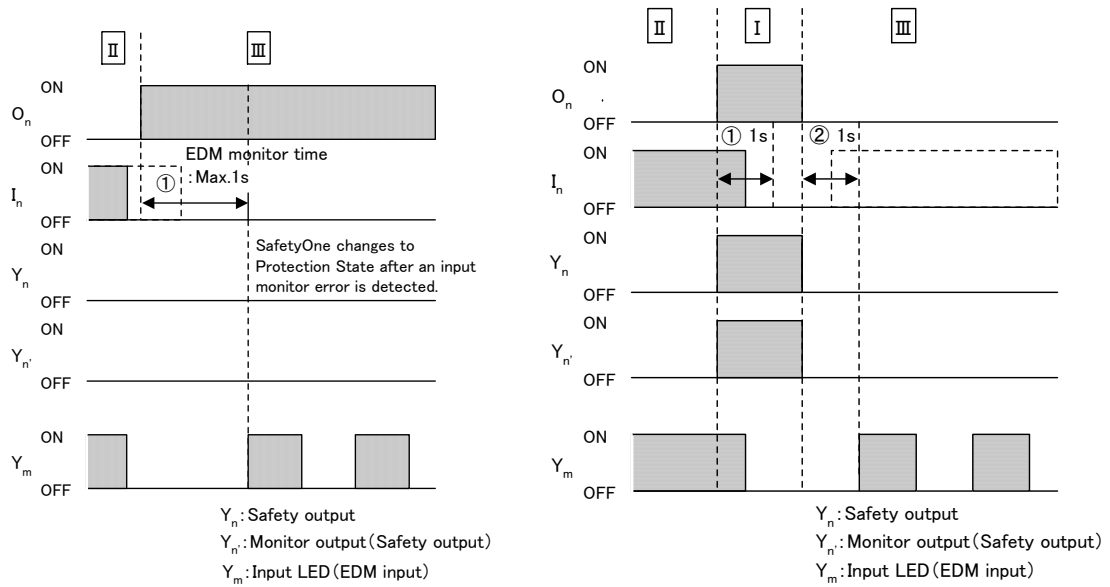


Fig. 5-34 Operation timing when EDM input error occurs

Error detection function

EDM input monitoring

When the following condition is satisfied, the SafetyOne changes to the Protection state and displays "1" in the error LED display.

- (1) When the EDM input does not turn ON within the EDM monitoring time (1 s) after the hold input turns ON.
- (2) When the EDM input does not turn ON within the EDM monitoring time (1s) after safety output turns OFF.
- (3) When the EDM input does not turn ON within the EDM monitoring time (1s) after EDM input turns OFF during safety output is OFF state.

The input LEDs (Y_m) blink transmits pulses, to notify the operator of the corresponding EDM input (I_n).

Short circuit and grounding detection

When an output error, such as short circuit, grounding or circuit failure, is detected, the SafetyOne changes to the Stop state and displays "4" on the error LED display.

The output LEDs blink and the monitor output outputs pulses (1Hz), to notify the operator of the corresponding output.

Note. OFF check signals are outputted at a fixed interval while the safety output is ON for checking the OFF function of the output circuit. Refer to "Chapter 2 PRODUCT SPECIFICATION" for details.

Safety output with timer

This function is for controlling the safety output with OFF delay timer.

As shown in Fig. 5-35, this function is comprised of a hold input (O_n), an EDM input (I_n), and a safety output (Y_n). The function output of this external device monitoring input function is connected to the EDM input (I_n).

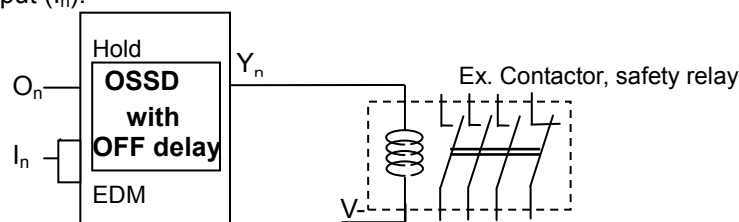


Fig. 5-35 Safety output with timer function circuit

Connects to

Equipment with force guided mechanisms, such as, contactors, safety relays.

Input of safety PLC, or other safety controllers.

Description of operation

The operation timing is described in Fig. 5-36 and 5-37.

- I When hold input is turned ON, the safety output is turned ON after confirmation that the EDM input is ON.
- II When hold input is turned OFF, the safety output is turned OFF.
- III When the OFF-delay timer is set, after the hold input is turned OFF, the safety output is turned OFF after the set time of the OFF-delay timer. However, the monitor outputs for safety outputs are turned OFF immediately after the hold input is turned OFF regardless of the set time of the OFF-delay timer.
- IV If the EDM input is not applied correctly (ON state of EDM input is not detected during EDM monitoring time (1s) after hold input is turned ON, ON state of EDM input is not detected during EDM monitoring time (1s) after safety output turns OFF, or ON state of EDM input is not detected during EDM monitoring time (1s) after EDM input turns OFF due to the error during safety output is OFF state), the SafetyOne changes to the Protection state, and indicates "1" on the error LED without turning ON the safety output. (See Fig. 5-37.)

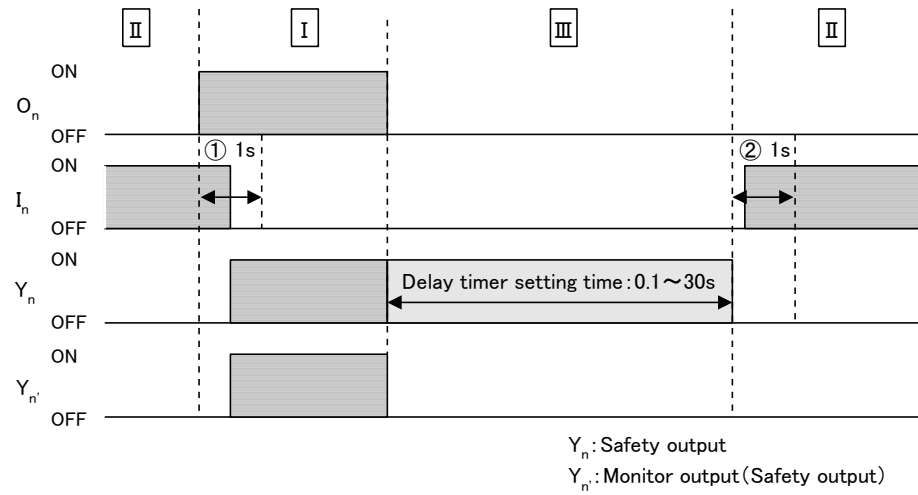


Fig.5-36 Operation timing of the safety output with timer function

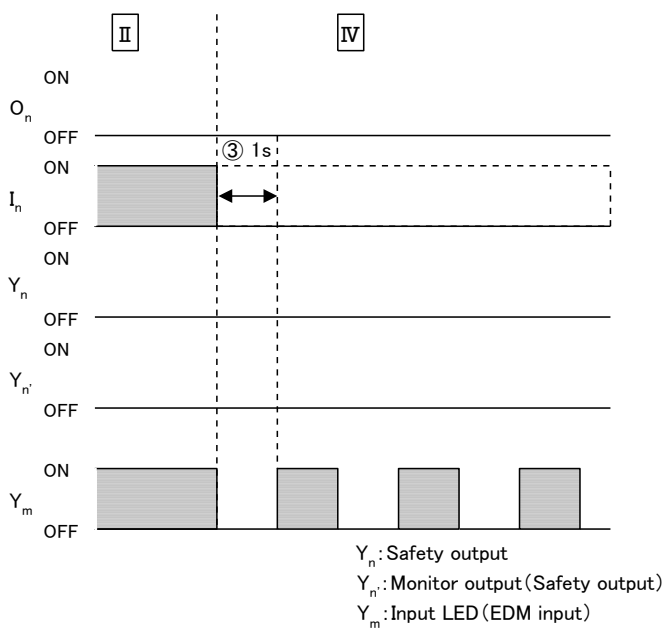
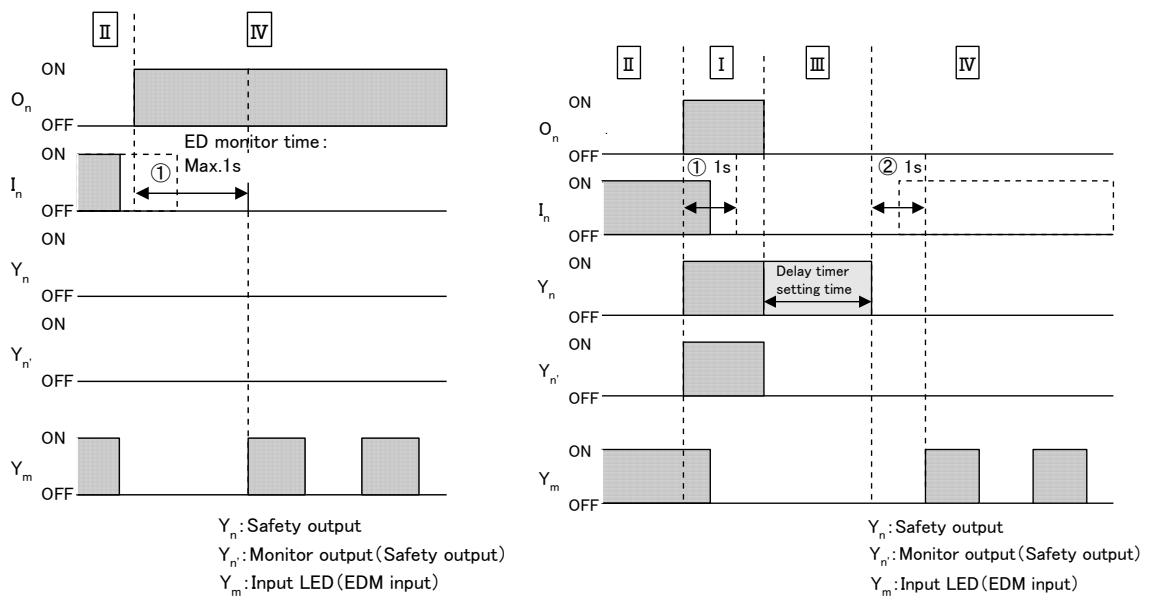


Fig. 5-37 Operation timing when EDM input error occurs

Error detection function

EDM input monitoring

When the following condition is satisfied, the SafetyOne changes to the Protection state and displays "1" in the error LED display.

- (1) When the EDM input does not turn ON within the EDM monitoring time (1 s) after the hold input turns ON.
- (2) When the EDM input does not turn ON within the EDM monitoring time (1s) after safety output turns OFF.
- (3) When the EDM input does not turn ON within the EDM monitoring time (1s) after EDM input turns OFF during safety output is OFF state.

The input LEDs (Y_m) blink transmits pulses, to notify the operator of the corresponding EDM input (I_n).

Short circuit and grounding detection

When an output error, such as short circuit, grounding or circuit failure, is detected, the SafetyOne changes to the Stop state and displays "4" on the error LED display.

The output LEDs blink and the monitor output outputs pulses (1Hz), to notify the operator of the corresponding output.

Note. OFF check signals are outputted at a fixed interval while the safety output is ON for checking the OFF function of the output circuit. Refer to "Chapter 2 PRODUCT SPECIFICATION" for details.

Chapter6 TROUBLE SHOOTING

This chapter describes how to determine the cause of a failure or error that occurs with the SafetyOne or connected device, and the measures to take to solve the problem.

Error descriptions and troubleshooting

The SafetyOne uses advanced diagnostic functions to detect any problems within the SafetyOne and its peripheral devices, thereby ensuring safety performance of the entire system. You can obtain information about a detected failure or error by using the error LED display, input LEDs, and monitor outputs.

Error information from error LED display and monitor outputs

Error LED	Monitor output			Description	Cause	Possible solution
	Y14	Y15	Y16			
-	OFF	OFF	ON	Normal operation	-	-
1	OFF	ON	OFF	Input monitor error	1. Fault in the dual channel input 2. Fault in the muting input 3. Both inputs of the mode selector inputs are ON 4. EDM input is OFF	1. Check the corresponding dual channel input device and wiring. 2. Check the corresponding muting input device and wiring. 3. Check the mode selecting device and wiring. 4. Check the corresponding external device and wiring.
2	ON	OFF	OFF	Fault in safety input wiring or safety input circuit	1. Broken or shorted safety input wiring 2. Fault in safety input device	1. Check safety input wiring. 2. Check operation the safety input device.
3	ON	OFF	OFF	Fault in start input wiring or start input circuit	1. Shorted start input wiring 2. Fault in start input device	1. Check start input wiring. 2. Check operation of the start input device.
4	ON	OFF	OFF	Fault in safety output wiring or safety output circuit	1. Shorted safety output wiring 2. Fault in safety output device	1. Check safety output wiring. 2. Check operation of safety output device.

TROUBLE SHOOTING

5	ON	OFF	OFF	Muting lamp error (broken wire) (For logic 11d only)	1. Broken wire of muting lamp wiring 2. Broken wire of Muting lamp	1. Check functionality and wiring of the muting lamp. 2. Check the operation of the muting lamp.
6	ON	ON	OFF	Fault in power supply or internal power supply circuit	1. The voltage of the power supply to SafetyOne is not within the allowable range.	1. Check voltage of power supply to the SafetyOne.
7	ON	ON	OFF	Fault in power supply or internal power supply circuit	1. The voltage of power supply to SafetyOne is not within the allowable range.	1. Check voltage of power supply to SafetyOne.
7	ON	OFF	OFF	Internal circuit error	1. Internal failure of the SafetyOne	1. Replace the SafetyOne.
9	ON	OFF	OFF	Noise filter error	1. Noise influences to the SafetyOne or input/output line.	1. Check noise in surrounding environment.
C	OFF	ON	OFF	Changing to the Configuration state	-	-

The state of the input LEDs and monitoring output varies depending upon the logic selected. Refer to "Chapter 4 BASIC OPERATIONS" and to "Chapter 5 LOGIC" for details.

APPENDIX

Minimum Distance

The minimum distance is the distance required to minimize the risk of contact with the hazard in the danger zone.

Be sure to maintain a sufficient minimum distance while taking into consideration the stopping time of the entire system, including the reaction time of the SafetyOne and the reaction time of any connected devices. If sufficient minimum distance is not maintained, the machinery may not be able to come to the sudden stop before a person meets a hazard, resulting in death or serious injury.

Calculating the minimum distance when connecting a safety light curtain

■ For ISO 13855-2002

You must take the following 5 points into consideration when determining the minimum distance.

1. Reaction time of the safety light curtain and SafetyOne
(The time it takes for the safety outputs of the SafetyOne are turned OFF after the safety light curtain is shaded)
2. Stopping time of the machinery
(The time it takes for dangerous machinery operation to come to the stop after the safety outputs of the SafetyOne are turned OFF)
3. Size of the minimum detectable object of the safety light curtain
4. Speed of the detected object entering the danger zone
5. Height of the maximum allowable optical axis of the safety light curtain

Parameters

S: Minimum distance (mm)

K: Speed of the detected object, arm or leg entering the danger zone (mm/s)

Tc: t_1+t_2

$$\left(\begin{array}{l} t_1: \text{Reaction time of the SafetyOne (s)} \\ t_2: \text{Preset OFF-delay time of the SafetyOne (s)} \end{array} \right)$$

T1: Reaction time of the safety light curtain (s)

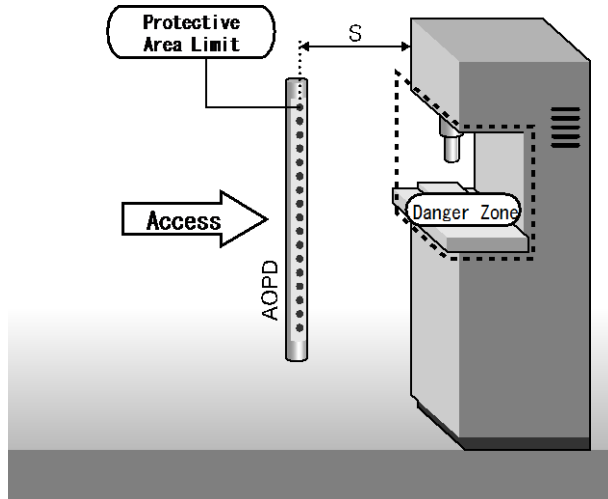
T2: Maximum time from when the safety output of SafetyOne is turned OFF to when the hazard is stopped (s)

C: Additional distance calculated from the minimum detectable object of the safety light curtain (mm)

H: Height of the maximum allowable optical axis of the safety light curtain

β : Angle of the ground surface and the safety light curtain to the direction of entry

Example in which the direction of entry is perpendicular to the safety light curtain



- When the size of the minimum detected object is 40 (mm) or smaller

Use the following formula to calculate the minimum distance.

$$S = K \times (T_c + T_1 + T_2) + C$$

$$T_c = t_1 + t_2$$

If using the SafetyOne and a safety light curtain, the following parameters are used for the above formula.

$$K = 2000 \text{ (mm/s)}$$

$$t_1 = 0.04 \text{ (s)}$$

$$t_2 = 0 \text{ (s)}, 0.1 \text{ (s)}, 0.5 \text{ (s)}, 1 \text{ (s)}, 2 \text{ (s)}, 5 \text{ (s)}, 15 \text{ (s)}, 30 \text{ (s)}$$

T1 (s) (Check the specifications of the safety light curtain)

T2 (s) (Check the maximum time from when the safety output of the SafetyOne is turned OFF when the hazard is stopped)

$$C = 8 \times (\text{Size of the minimum detectable object of the safety light curtain } d \text{ (mm)} - 14 \text{ (mm)})$$

Under the above conditions, when the minimum distance (S) is less than 100 (mm), it becomes 100 (mm).

When the minimum distance (S) is greater than 500 (mm), calculate again with K = 1600 (mm/s).

When the result of the recalculation with K = 1600 (mm/s) is less than 500 (mm), it becomes 500 (mm).

- When the size of the minimum detected object is greater than 40 (mm)

Use the following formula to calculate the minimum distance.

$$S = K \times (T_c + T_1 + T_2) + C$$

$$T_c = t_1 + t_2$$

$$K = 1600 \text{ (mm/s)}$$

$$t_1 = 0.04 \text{ (s)}$$

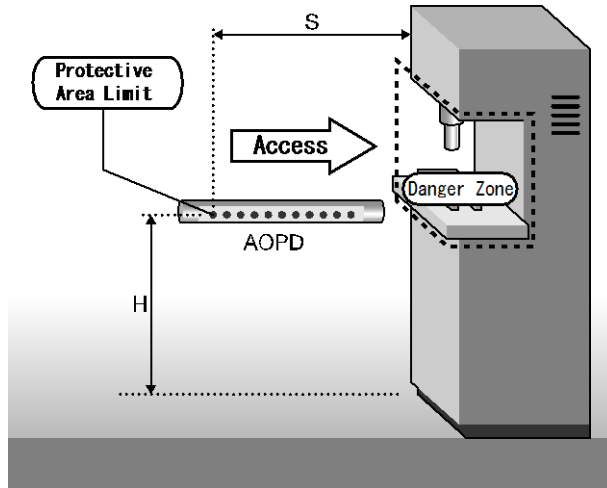
$$t_2 = 0 \text{ (s)}, 0.1 \text{ (s)}, 0.5 \text{ (s)}, 1 \text{ (s)}, 2 \text{ (s)}, 5 \text{ (s)}, 15 \text{ (s)}, 30 \text{ (s)}$$

T1 (s) (Check the specifications of the safety light curtain.)

T2 (s) (Check the maximum time from when the safety output of the SafetyOne is turned OFF when the hazard is stopped)

$$C = 850 \text{ (mm)}$$

Example in which the direction of entry is horizontal to the safety light curtain



Use the following formula to calculate the minimum distance (distance to the farthest optical axis).

$$S = K \times (T_c + T_1 + T_2) + C$$

$$T_c = t_1 + t_2$$

$$C = (1200 - 0.4 \times H)$$

$$K = 1600 \text{ (mm/s)}$$

$$t_1 = 0.04 \text{ (s)}$$

$$t_2 = 0 \text{ (s)}, 0.1 \text{ (s)}, 0.5 \text{ (s)}, 1 \text{ (s)}, 2 \text{ (s)}, 5 \text{ (s)}, 15 \text{ (s)}, 30 \text{ (s)}$$

T_1 (s) (Check the specifications of the safety light curtain.)

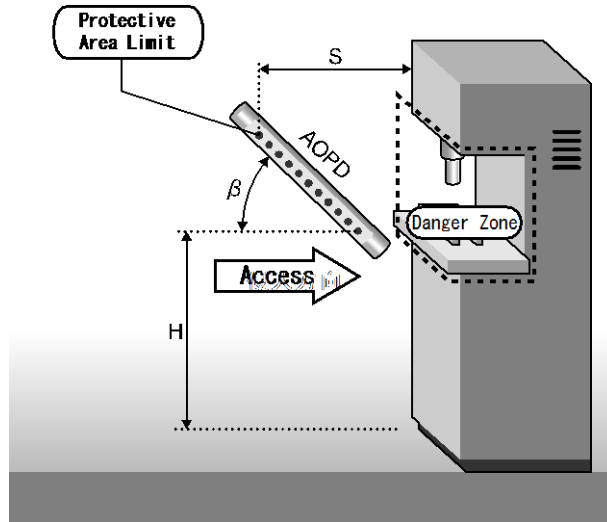
T_2 (s) (Check the maximum time from when the safety output of the SafetyOne is turned OFF when the hazard is stopped)

$$C = (1200 - 0.4 \times \text{Height of the optical axis } H \text{ (mm)}) \quad (\text{However, } C \geq 850 \text{ (mm)})$$

The height of the maximum allowable optical axis (H) must be within a range of $15 (d - 50 \text{ (mm)}) \leq H \leq 1000 \text{ (mm)}$.

Futhermore, when the valus of H calculated using $H \geq 15 (d - 50)$ is $H \geq 300 \text{ (mm)}$, there is an unexpected proximity risk in where objects can not be detected below the detection zone. This must be taken into consideration for a risk assessment.

Example in which the direction of entry is at an angle to the safety light curtain



The angle of entry is set within a range of $5^\circ \leq \beta \leq 85^\circ$.

At $\beta > 30^\circ$, the direction of entry is calculated as being perpendicular.

At $\beta < 30^\circ$, the direction of entry is calculated as being horizontal.

The minimum distance is the distance to the farthest optical axis, and the height of the optical axis is calculated using ≤ 1000 (mm)

The height of the lowest optical axis is calculated using $H \geq 15 (d - 50)$ (mm).

■ **For ANSI B11.19**

Use the following formula to calculate the minimum distance.

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

$$T_r = t_1 + t_2 + T_1$$

Parameters

S: Minimum distance (mm)

K: Speed of the detected object or arm or leg entering the danger zone (mm/s)

(However, the speed of entry K is not defined by ANSI B11.19.
 Take into consideration various factors such as the physical ability of the operator.
 The OSHA recommended value is $K = 63 \text{ (inch/s)} \cong 1600 \text{ (mm/s)}$)

T_s: Machinery stopping time (s) as calculated from the last control elements (air valves, etc.) to come to a stop

T_c: Maximum reaction time (s) of the machine control circuit required for operating the machine brake

T_r: $t_1 + t_2 + T_1$ (s)

(t₁: Reaction time of the SafetyOne (s)
 t₂: Preset OFF-delay time of the SafetyOne (s)
 T₁: Reaction time of the safety light curtain (s))

T_{bm}: Additional stop time allowed by the brake monitor (s)

(If the machinery is equipped with a brake monitor, the following formula applies.
 $T_{bm} = T_a - (T_s + T_c)$
 T_a: Brake monitor set time (s)
 (If the machinery is not equipped with brake monitor, it is recommended that 20% or more of (T_s+T_c) become an additional stop time.))

D_{pf}: Additional distance calculated from the minimum detected object of the safety light curtain (mm)

($D_{pf} = 3.4 \times (d - 0.275) \text{ (inch)}$
 $= 3.4 \times (d - 7) \text{ (mm)}$
 However, D_{pf} cannot be 0 or less.)

In case of using the SafetyOne and a safety light curtain, the following parameter is used for the above formula.

$K = 63 \text{ (inch/s)} \cong 1600 \text{ (mm/s)}$

T_r = $t_1 + t_2 + T_1$ (s)

(t₁ = 0.04 (s)
 t₂ = 0 (s), 0.1 (s), 0.5 (s), 1 (s), 2 (s), 5 (s), 15 (s), 30 (s)
 T₁ (s) (Check the specifications of the safety light curtain.))

Maintenance and Inspection



To ensure safety, use the SafetyOne after performing inspections described below and confirming that the entire safety system incorporating the SafetyOne is operating normally.

The following checklist contains only the minimum items for use of the SafetyOne. Depending on the machinery on which the SafetyOne is installed and the regulations that apply in the country or region where the SafetyOne is used, additional inspection items may be required.

Note. Record and store inspection results.

Note. Perform inspections with a clear understanding of the operations of the SafetyOne and the machine on which it is used.

Daily inspection

Before beginning operations, check the following items.

Inspection items	Check
Check that the power supply of the SafetyOne is OFF.	
Check that the power supply of the machine being controlled by the safety output of the SafetyOne is OFF.	
Before turning ON the power supply of the SafetyOne, make sure that no person is in the danger zone.	
Check that there is no damage on the input devices and wiring.	
Operate the connected safety devices, and check that they are operating normally.(Ex. Press the emergency stop switch, shade the light curtain)	

Periodic inspection

Every testing interval and after changing the settings of the machinery, check the following items.

Inspection items	Check
Check that unintended changes are not introduced into the safety system.	
Check that the safety system incorporating the SafetyOne operates as expected.	
Check that the SafetyOne is installed securely. Check that the DIN rail hooks has not come off and that the DIN rails and end clip screws are not loose.	
Check that the connectors and the wiring are not loose.	
Check that the protective cover is on the SafetyOne to prevent changes to the logic or OFF-delay timer setting by anyone other than the safety responsible person.	

Type number

Item	Type number
Module	FS1A-C11S

Accessories

Item	Type number	Quantity
Input connector	FS9Z-CN01	1
Output connector	FS9Z-CN02	1
Configuration tool	-----	1
Marking tie	FS9Z-MT01	3
Instruction sheet (English/Japanese)	B-1216 / B-1217	1 for each

Options (sold separately)

Item	Type number	Quantity
Input connector	FS9Z-CN01	1
Output connector	FS9Z-CN02	1
Marking tie	FS9Z-MT01PN10	10
Connecting tool	FS9Z-SD01	1

DECLARATION OF CONFORMITY

We, IDEC CORPORATION
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declare under our sole responsibility that the product:

Description: Safety Controller
Series Name: FS1A
Model No.: FS1A-C11S

to which this declaration relates is in conformity with the EC Directive on the following standard(s) or other normative document(s). In case of alteration of the product, not agreed upon by us, this declaration will lose its validity.

Applicable EC Directive: Machinery Directive (2006/42/EC)
EC Directive of Electromagnetic Compatibility (2004/108/EC)

Applicable Standard(s) : EN ISO 13849-1:2008
IEC 61131-2:2007 / EN 61131-2:2007
IEC 62061:2005A1:2012 / EN 62061:2005/A1:2013
IEC 61000-6-2:2005 / EN 61000-6-2:2005
IEC 61000-6-4:2006A1:2010 / EN 61000-6-4:2007/A1:2011

Reference Standard(s) : IEC 61508:2010 Part 1 to 4
IEC 61326-3-1:2008 / EN 61326-3-1:2008

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FS1A-C11S SafetyOne User's manual (Original instructions)

- B-1218(3)
 - December, 2014
 - 2-6-64 Nishi-Miyahara, Yodogawa-ku, Osaka, 532-0004 Japan
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