IDEC

Safetyone
FS1B Series Safety Controller

FS1B series Safety Controller

FS1B-C31S

User's Manual

IDEC CORPORATION

Safety Precautions

- Carefully read this manual to ensure correct operation before starting installation, wiring, operation, maintenance, and inspection of the FS1B-C31S (FS1B).
- In this manual, safety precautions are categorized in order of importance from 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 the FS1B, otherwise the safety performance of the FS1B are impaired.
- Turn off the power to the FS1B before installation, removal, wiring, maintenance, or inspection of the FS1B. Failure to turn power off may cause electrical shocks or fire hazard.
- Before operating the FS1B, read the instruction sheet and the user's manual carefully, and ensure that the environment conforms to the requirements of the FS1B specifications. If the FS1B is operated in an environment that exceeds the specifications, the safety characteristics of the FS1B are impaired.
- The installation, wiring, configuration and operation of the FS1B must be performed by" Safety responsible persons" only. Safety responsible persons are personnel who have necessary qualifications authorizing them to perform designing, installation, operation, maintenance, and disposal of the FS1B. Persons without technical expertise of safety products must not use the FS1B. Also, install the unit in a locked control panel so that no one other than Safety responsible persons can perform wiring or change settings.
- Due to the self-diagnostic function of the FS1B, reconnect the power of the FS1B at appropriate intervals to maintain the safety performance of the FS1B. (At least once every 24 hours)
- Install the FS1B according to the instruction sheet and this manual. Improper installation may cause failure of the FS1B.
- Do not use the monitor outputs or solenoid/lamp outputs as safety outputs. Failure of the FS1B or peripheral components may impair the safety performance of the system.
- To prevent unexpected startup of the system, take safety measures to prevent the hazardous source from operating only with the reset input of FS1B. (for example, provide a start switch, etc.)
- Ensure to install the reset switch outside the hazardous area, from where the operator of the reset switch can confirm that no one is inside the hazardous area, when starting the operation of safety system.
- Do not use the reset inputs and the external device monitor inputs as safety inputs. Failure of the FS1B or peripheral components may impair the safety performance of the system.
- Use the FS1B in compliance with laws and regulations of the country or region where the FS1B is used.
- Use safety inputs and safety outputs in circuit configurations which conform to safety requirements and applications.
- To prevent loss of safety function due to short circuit to other wires, wire properly so that the safety outputs do not touch the other wires accidentally or unintentionally. The wires shall be protected or separated according to the relevant standards (for example, ISO13849-2).
- Calculate the safety distances, while taking into consideration the response time of the FS1B and safety components connected to the FS1B.
- The FS1B is not capable of monitoring the speed of hazardous sources or preventing(detecting)the release of chips from workpieces. If necessary, take additional safety measure in the system to reduce risk.
- When using logic that includes mode select inputs, the operating mode set by the system should be displayed for the operator to verify the operating mode of the system. (for example, the monitor output of the product is taken into the system, information on the system operation mode is processed as a safety parameter, and the result of the setting is displayed on the display.)
- Safety performance is evaluated on a system-wide basis. Please check thoroughly before use.
- Use a power supply that meets the following required specifications completely:
  · Conforms to the power supply rating of the FS1B.
  · Complies with the SELV/ PELV circuit specified by IEC60364-4-41 etc..
  · Has the functionality or the functional equivalent of the control voltage and current of class 2 circuit, as defined in UL508.
  · 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.
- In the case of setting a new configuration or modifying a configuration, check each input and output function.
- Separate the FS1B from equipment and wiring that does not meet the requirements for a class 2 circuit.

⚠️ **CAUTION**

- The FS1B is designed for installation within a control panel. Do not install the FS1B outside a control panel.
- Install the FS1B in a control panel of IP54 or higher.
- Install the FS1B in environments described in the instruction sheet and this manual. If the FS1B is used in places where the FS1B is subjected to high temperature, high humidity, condensation, corrosive gases, excessive vibrations, or excessive shocks, failure such as electrical shocks, fire hazard, or malfunction may result.
- The FS1B is designed for use in pollution degree 2 environment. Use the FS1B in an environment of pollution degree 2.
- Prevent the FS1B from falling while moving or transporting otherwise damage or malfunction of the FS1B may result.
- Prevent metal fragments and pieces of wire from dropping inside the FS1B housing. Put a cover on the FS1B during installation and wiring. Ingress of such fragments and chips may cause fire hazard, damage, or malfunction.
- Install the FS1B so that there is adequate distance from the walls, heat generating components or peripherals, taking into consideration spacing requirements for maintenance and ventilation.
- Install the FS1B on 35mm DIN rails with BNL6 end clips(sold separately)on both sides of the FS1B.
- Use wires of a proper size to meet voltage and current requirements. Use solid wires or ferrules as described in instruction sheet and this manual.
- Use common 0V DC, if different power supplies are used for the FS1B and other components.
- All the input/output signal cables should be installed away from machines power lines and high voltage cables.
- When disposing of the FS1B Series, do so according to the regulations of the country or region.
- Make sure that the end-user thoroughly understands the contents of this manual.

About This Manual

Thank you for purchasing the FS1B Series Safety Controller manufactured by IDEC Corporation.

This document describes the FS1B Series Safety Controller system configuration, specifications, and installation methods, and it provides descriptions of the various functions.

Read this manual to ensure the correct understanding of the entire functions of the FS1B Series Safety Controller.

IDEC Corporation makes the latest product manual PDFs available on our website at no additional cost. Please download the latest product manual PDFs from our website.

Product manuals PDF download page (https://www.idec.com)

❏ Publication History

First edition published in May 2024.

Second edition published in July 2024.

❏ Caution

- All rights in this document belong to IDEC Corporation. It may not be reproduced, reprinted, sold, transferred or rented without our permission.
- The contents of this manual are subject to change without notice.
- Every effort has been made to ensure the content of the product, but if you find any suspicious points or mistakes, please contact the store where you purchased the product or our sales office or branch office.

Regarding Laws and Compatible Standards

This product adheres to the laws and compatible standards of all countries involved, as shown below.

❏ European Laws and Standards

This product complies with the following EU directives.
- Machinery Directive 2006/42/EC
- EMC Directive 2014/30/EU
- RoHS Directive 2011/65/EU

In order to comply with Machine Directive, this product has received the following certifications from TÜV Rheinland based on the international and European standards listed below.
- EN/IEC 61508 Part 1 to 3
- EN ISO 13849-1
- IEC 62061 (as applicable standard for use)

❏ North America Laws and Standards

This product complies with the following UL standards.
- UL 508
- CSA C22.2 No.142

About The Warranty of The Products

(1) Warranty Period

The Products are warranted for 3 years from the date of purchase, or from the date of delivery completion.

(2) Extent of Warranty

IDEC CORPORATION is responsible for failures or defects of the Products during the above warranty period, either a replacement part will be provided or the defective parts of the Products will be repaired free of charge. If such failure or defects should occur, please offer them to the distributor, dealer or IDEC CORPORATION with the materials in which the date of purchase is specified.

* The expenses for installation and construction at the time of repair will not be borne.

(3) Indemnification

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2) The failure or defects of the Products arise from the cause other than the Products; or

3) The Products are improved, modified or altered by the party other than IDEC; or

4) The failure or defects and damages of the Products arise from the usage of the Product in the way that is not intended; or

5) The failure or defects and damages of the Products arise from the cause beyond IDEC's control including, but not limited to, fire, earthquake, flood, lightning, other natural disasters, and acts of God; or

6) The failure or defects and damages of the Products arise from the relocation, transportation or drop after you purchase the Products; or

7) The failure or defects and damages of the Products arise from improper installation; or

8) Maintenance and inspection are not carried out in accordance with instruction.

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The price of the Products will not include the fee for any service such as sending technicians and engineers, IDEC CORPORATION will charge you the fee for the following:

1) Instruction for installment and visiting for test operation, including, but not limited to creating application software and operation tests; and

2) Maintenance and inspection, arrangement and repair; and

3) Technical assistance and technical education; and

4) Product test and inspection based on you request.

Table of Contents

Chapter 1 Overview

This chapter describes the FS1B Series Safety Controller function and system configuration examples.

About the FS1B Series Safety Controllers

The FS1B series provide safeguarding measures for various factory automation equipments and systems, including robots, production machinery, semiconductor manufacturing apparatus, food packaging machinery, and printing machinery. By using multiple safety inputs/outputs and selecting the built-in circuit (logic), safety circuit can be easily constructed.

Features of the FS1B Series Safety Controller

- Safety circuits can be built without complicated external wiring or dedicated software
  Significantly reduces development man-hours and training time for safety responsible persons required for system development and certification by customer.

- Logic and off-delay timer values optimized for various applications can be selected with slide switches
  The built-in logic and the off-delay timer value for safety output off can be set using 2 slide switches and an enter button. Off-delay timer value settings are available for immediate (0s), 0.1s, 0.5s, 1s, 2s, 5s, 15s, and 30s, with selectable stop categories 0 or 1.

- Conforms to the international safety standards IEC 61508 SIL 3 and EN ISO 13849-1 PL e (Category 4)
  The FS1B complies with the Safety Integrity Level (SIL) 1 to 3 of IEC61508 series, and their software, and PL a to e and category 3 and 4 of EN ISO13849-1.

- Switchable input functions allow connection of various safety components
  FS1B is prepared as inputs function and can be used in combination with various safety components, example
  "Dual channel direct opening input" and "Dual channel dependent input" for emergency stop switches or interlock switches, "Dual channel NO/NC input" for non-contact interlock switches, and "Dual channel safety input" for safety light curtain or safety laser scanner. These input functions can be switched by recognizing the wiring status, allowing greater flexibility in logic selection.

- Monitor outputs and solenoid/lamp outputs are provided and can be used as control signals.
  Monitor outputs can be used to monitor the operational status of the product, including safety inputs, safety outputs, and error information. When connected to PLC or other components apparatus and entire system can be monitored. The FS1B has a solenoid outputs that can directly unlock interlock switches with guard locking. Logic is also available to connect muting lamps to the solenoid/lamp outputs.

- Detailed diagnostic information is displayed by LEDs
  The FS1B is equipped with two 7-segment LEDs and 30 status indicator LEDs as a display for internal information, allowing the user to obtain inputs, outputs, and other diagnostic information inside the product from the displayed contents. The input function can be checked by the color of the LED.

- The FS1B 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 the FS1B Series Safety Controller part names and product specifications

Part Names and Functions
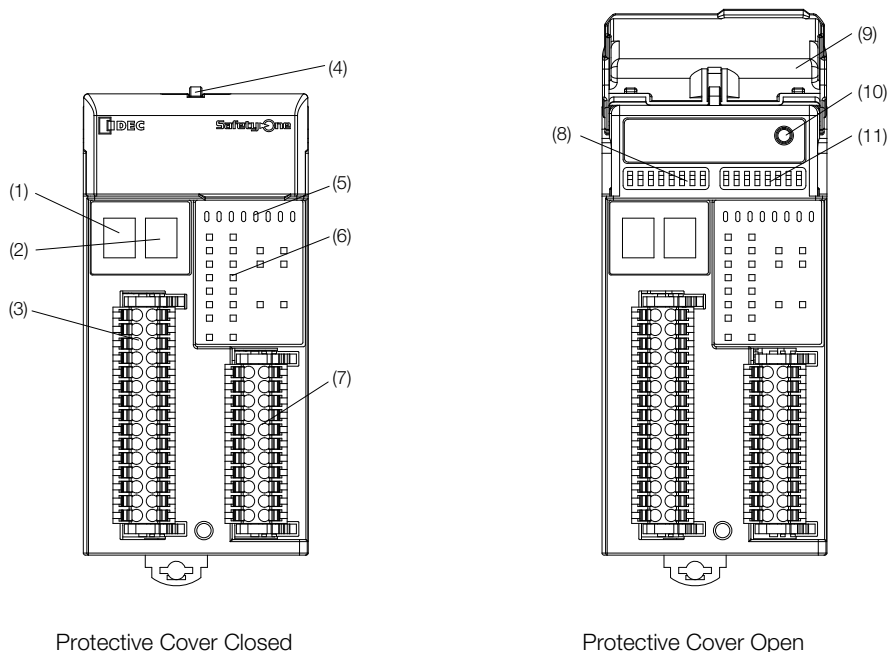
Protective Cover Closed   Protective Cover Open

(1) Logic LED: The 7-segment green LED indicates the number of logic pattern selected.

(2) Error LED: The 7-segment red LED indicates an error in the FS1B and peripherals.

(3) Input connector: Push-in type connector for input components.

(4) Lock hole: Hole for locking the protective cover.

(5) Timer LED: The eight timer LEDs indicate the selected off-delay timer value.

(6) 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, for example, X0 ... X15.

    RESET-IN: Status of reset inputs, for example, X16, X17.

    SAFE-OUT: Status of safe outputs, for example, Y0 ... Y3.

    SOLENOID-OUT: Status of solenoid/lamp outputs, Y17, Y20.

(7) Output connector: Push-in type connector for output components and power supply.

(8) Logic switch: Slide switch for selecting the internal logic.

(9) Protective cover: The cover protects unauthorized changing of configuration switches.

(10) Enter button: The enter button is used to activate the configuration of logic and timer switches.

(11) Timer switch: Slide switch for selecting off-delay time value.

Operating Environment

Operating temperature	-10 to +55°C (no freezing)
Storage temperature	-40 to +70°C (no freezing)
Operating humidity	5 to 95% (with no condensation)
Storage humidity	5 to 95% (with no condensation)
Pollution degree	2 (IEC60664-1)
Degree of protection	IP20 (IEC60529)
Corrosion immunity	Free from corrosive gases
Atmospheric pressure (Altitude)	Operation: 1,013 to 795hPa (0 to 2,000m) Transport: 1,013 to 701hPa (0 to 3,000m)
Installation location	In a control panel of IP54 minimum, indoor use only
Apparatus class	Open type apparatus
Overvoltage category	II
Vibration resistance	5 to 8.4Hz, amplitude 3.5mm 8.4 to 150Hz Acceleration: 10m/s^2, 2hours each on three mutually perpendicular axes (IEC 61131-2)
Shock resistance	150m/s^2, 11ms (3 shocks each on three mutually perpendicular axes) (IEC61131-2)
EMC resistance	IEC61131-2 Zone B
Connector insertion/removal durability	25 operations maximum
Configuration switch durability	100 operations maximum per pole
Enter button durability	1,000 operations maximum
Weight (approx.)	280g
Life time	10 years (at operating temperature 40°C)

Power Supply Specifications

Rated power voltage	24V DC
Allowable voltage range	20.4 to 28.8V DC (including ripple)
Power consumption	No load: 6W maximum (24V DC) Maximum connect load: 48W maximum (24V DC)
Allowable momentary power interruption	1ms minimum (at the rated power voltage)
Dielectric strength	Between internal circuit and housing 1,000V AC, 1minute
Effect of Incorrect Wiring	Reverse polarity: No operation, no damage Improper voltage: Permanent damage may occur Improper wiring: Permanent damage may occur

Time Specifications

Response time	On - > Off	40ms maximum (*1)(*5) Logic No. 32b and No. 32C are 50ms maximum (*1)(*5)
	Off - > On	100ms maximum (*2)
	Mode select	3s maximum (*3)(*5)
Startup time		3s maximum (*4)

*1 The time to shut off safety outputs after inputs are turned off or input monitor error is detected (when off-delay timer is set to 0s).

*2 Auto reset: Time to turn on safety outputs after safe inputs are turned on.

   Manual reset: Time to turn on safety outputs after reset input is turned on.

   Control reset: Time to turn on safety outputs after the reset input is turned off-on-off (maintain on for 0.1 to 5s).

*3 Mode select request occurs (for example, operating the selector switch) until the safety outputs are turned off (when off-delay timer is set to 0s).
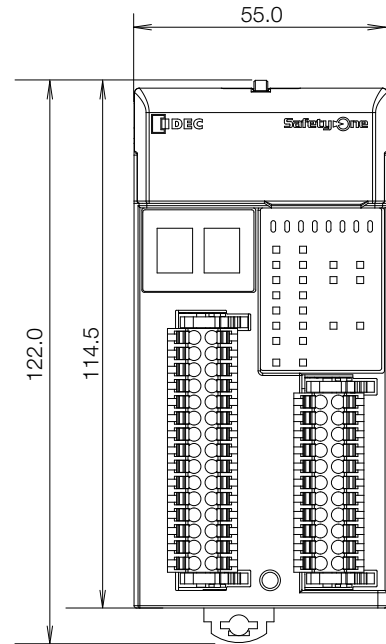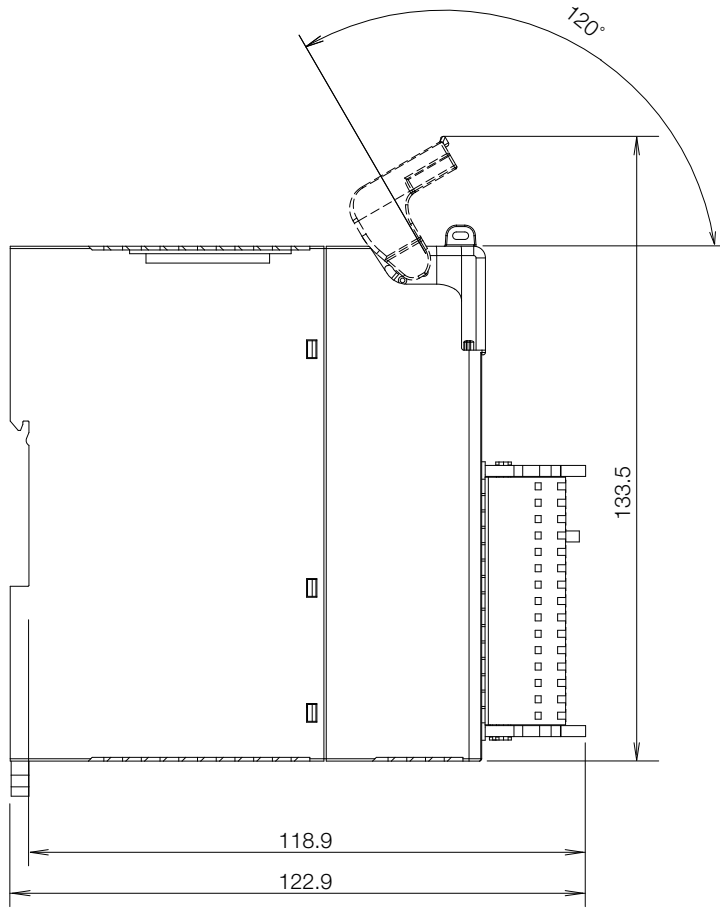
*4 Time to change to Run state after power supply is turned on.

*5 Add the off-delay time to the response time (when off-delay timer is set to other than 0s).

   The maximum value of off-delay time is "off-delay time setting value" × 1.05 + 0.01s.

Dimensions

All dimensions in mm.

120°

133.5

118.9

122.9

55.0

122.0

114.5

Reference Standard

EN ISO 13849-1: 2015	Safety of machinery - Safety-related parts of control systems - Part 1: General principles for design
EN ISO13849-2: 2012	Safety of machinery - Safety-related parts of control systems - Part 2: Validation
EN/IEC 61508-1: 2010	Functional safety of electrical/electronic/programmable electronic safety-related systems - Part 1: General requirements
EN/IEC 61508-2: 2010	Functional safety of electrical/electronic/programmable electronic safety-related systems - Part 2: Requirements for electrical/electronic/programmable electronic safety-related systems
EN/IEC 61508-3: 2010	Functional safety of electrical/electronic/programmable electronic safety-related systems - Part 3: Software requirements
IEC 62061: 2021	Safety of machinery - Functional safety of safety-related control systems
EN 61131-2: 2007	Industrial-process measurement and control - Programmable controllers -Part 2: Equipment requirements and tests
IEC 61131-2: 2017	
EN ISO 13851: 2019	Safety of machinery - Two-hand control devices - Principles for design and selection
EN 61000-6-7: 2015	Electromagnetic compatibility (EMC) - Part 6-7: Generic standards - Immunity requirements for equipment intended to preform functions in a safety-related system (functional safety) in industrial locations Industrial locations
IEC 61000-6-7: 2014	
UL 508	Industrial control equipment
CSA C22.2 No.142	Process control equipment

Safety Performance

• Safety performance based on IEC61508 requirements

Safety outputs	PFDavg (*1)	PFH (*1)	Maximum achievable SIL
Dual channel safety output	$\leq 9.8 \times 10^{-6}$	$\leq 1.3 \times 10^{-10}$	3
Single channel safety output	$\leq 4.0 \times 10^{-5}$	$\leq 6.7 \times 10^{-10}$	2

*1 Proof test interval is 10 years. After this time the FS1B must be replaced.

• Safety performance based on ISO13849-1 requirements

Safety outputs	$MTTF_D$	DCavg	Achievable category	Maximum achievable PL
Dual channel safety output	$\geq$206 years	High	3 and 4	e
Single channel safety output	$\geq$176 years (*3)	Medium	3	d

*2 Mission time is 10 years.
*3 The maximum value per channel is 100 years per ISO 13849-1 requirement.

Safety Input Specifications

Drive terminals	Rated drive voltage	Power supply voltage
	Minimum drive voltage	Power supply voltage - 3V
	Number of drive terminals	14 (T0, T1, T2, T3, T4, T5, T6, T7, T10, T11, T12, T13, T14, T15)
Receive terminals	Rated input voltage	24V DC
	Allowable voltage range	0 to 28.8V DC
	Input on voltage	15 to 28.8V DC
	Input off voltage	Open or 0 to 5V DC
	Number of reset inputs	14 (X0, X1, X2, X3, X4, X5, X6, X7, X10, X11, X12, X13, X14, X15)
	Rated input current	6mA/1 point (at 24V DC)
	Input impedance	4.7kΩ approx.
	Input type	Sink input, Type1 (IEC611311-2)
Wire	Cable length in compliance with electromagnetic immunity	30m maximum (total wire length per input)
	Allowable wire resistance	300Ω maximum

Drive terminals of safety inputs send safety confirmation signals (pulse signals) for the diagnosis of safety components and input circuits.

The operating specifications of the safety input change depending on the selected logic. For details, refer to "Chapter 5 Logic". Basic specifications remain the same.

In the common connection of several interlock switches, applicable safety performance depends on result of risk assessment for whole of the safety configuration. When evaluating the safety performance of a system interlock switches, refer to the relevant standards (such as ISO 14119).

• Safety input (receive terminal) equivalent circuit
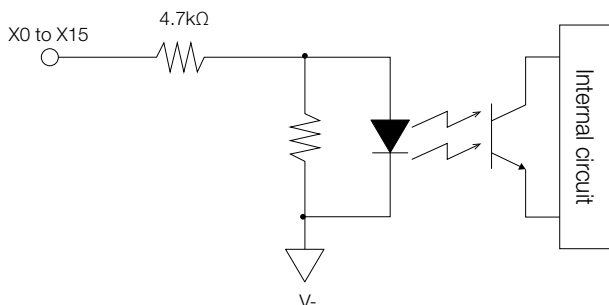
Connection conditions for semiconductor output component

The FS1B reads input signals at regular intervals. Therefore, when connecting semiconductor output components such as safety light curtains or safety laser scanners, use the component that sends output signals of the waveforms shown below. Otherwise the FS1B cannot process the input signal correctly.
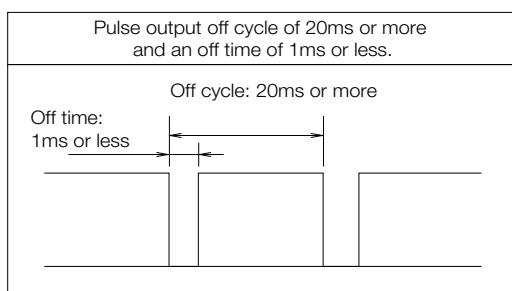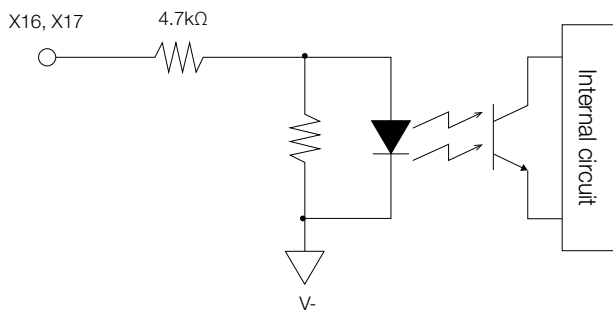

The component may not be usable even if the above specifications are satisfied depending on the operating environment and conditions of use. Be sure to thoroughly confirm operations using the actual component.

Reset Input Specifications

Receive terminals	Rated input voltage	24V DC
	Allowable voltage range	0 to 28.8V DC
	Input on voltage	15 to 28.8V DC
	Input off voltage	Open or 0 to 5V DC
	Rated input current	5mA/1 point (at 24V DC)
	Input impedance	4.7kΩ approx.
	Input type	Sink input, Type1 (EN611311-2)
	Number of reset inputs	2 (X16, X17)
Wire	Cable length in compliance with electromagnetic immunity	30m maximum (total wire length per input)
	Allowable wire resistance	300Ω maximum

The operating specifications of the reset input change depending on the selected logic. For details, refer to "Chapter 5 Logic". Basic specifications remain the same.

• Reset input equivalent circuit

| ⚠ WARNING	• Do not use reset input as a safety input, otherwise the system's safety cannot be assured when the FS1B or safety components fail.
	• To prevent unexpected startup, take safety measures to prevent the hazardous source from operating only with the reset input of FS1B. (for example, provide a start switch)

Safety Output Specifications

Rated output voltage		Power supply voltage
Minimum output on voltage		Power supply voltage - 2V DC
Maximum output off voltage		5V DC
Number of safety output		4 (Y0, Y1, Y2, Y3)
Maximum load current	1 output	500mA maximum
	Total	1A maximum
Leakage current		0.1mA maximum
Output type		Source output
Wire	Cable length in compliance with electromagnetic immunity	30m maximum (total wire length per output)

The operating specifications of the safety output change depending on the selected logic. For details, refer to "Chapter 5 Logic". Basic specifications remain the same.

• Safety output equivalent circuit
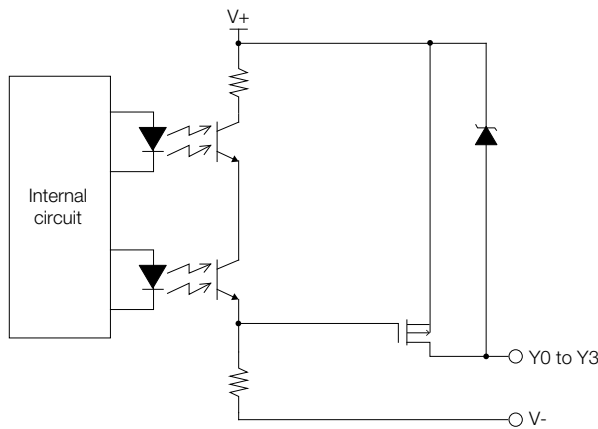
The safety outputs of the FS1B are solid state outputs. When the output is on, off-check signals are generated at regular intervals.

• Off-check pulse waveform of safety outputs
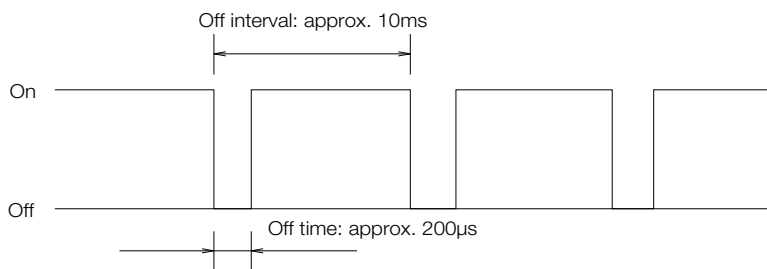
| ⚠	**WARNING**	• To prevent unexpected startup the system due to short circuit to other wires, wire properly so that the safety outputs do not touch the other wires accidentally or unintentionally.

☀	**CAUTION**	• Check the response time of the external components so they do not correspond to the off-pulses.

Monitor Output Specifications

Rated output voltage		Power supply voltage
Minimum output on voltage		Power supply voltage - 2V DC
Leakage current		0.1mA maximum
Maximum load current	1 output	20mA maximum
Output type		Source output
Number of safety output		11 (Y4, Y5, Y6, Y7, Y10, Y11, Y12, Y13, Y14, Y15, Y16)
Wire	Cable length in compliance with electromagnetic immunity	30m maximum (total wire length per output)

The operating specifications of the monitor output change depending on the selected logic. For details, refer to "Chapter 5 Logic". Basic specifications remain the same.
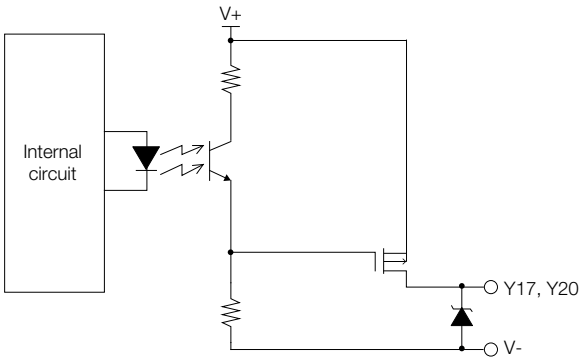
• Monitor output equivalent circuit
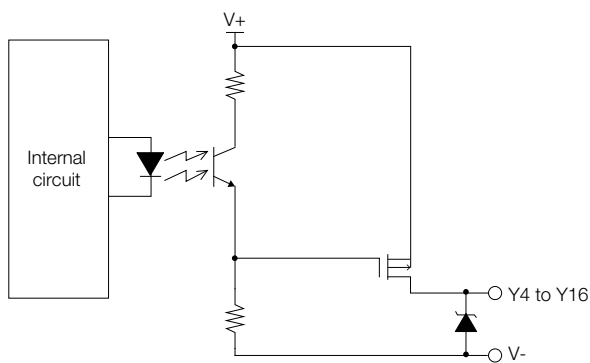
⚠ WARNING	• Do not use monitor outputs as safety outputs, Failure of the FS1B or peripheral components may impair the safety performance of the system.

Solenoid/Lamp Output Specifications

Rated output voltage		Power supply voltage
Minimum output on voltage		Power supply voltage - 2V DC
Leakage current		0.1mA maximum
Maximum load current	1 output	250mA maximum
Output type		Source output
Wire	Cable length in compliance with electromagnetic immunity	30m maximum (total wire length per output)

The selected operating specifications of solenoid/lamp output change depending on the selected logic. For details, refer to "Chapter 5 Logic". Basic specifications remain the same.

• **Solenoid/Lamp output equivalent circuit**

⚠ WARNING	• Do not use solenoid/lamp outputs as safety outputs, Failure of the FS1B or peripheral components may impair the safety performance of the system.

Logic Number

The logic number of the FS1B is composed by a 3-digit code as following.
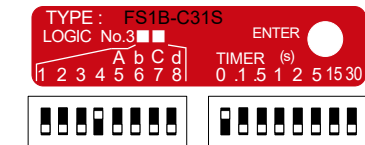
Example 1: Logic No.304

The first code "3" indicates the type number "FS1B-C31S".
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.
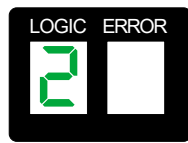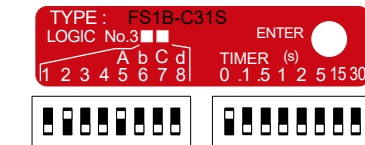
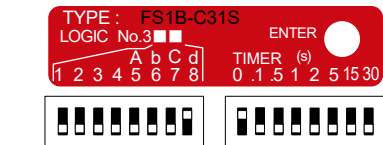Example 1: Logic No.304   Example 2: Logic No.32A   Example 3: Logic No.308

"0" is not displayed   Alternate display   "0" is not displayed

LEDs

(1)	Logic LED (green)
(2)	Error LED (red)
(3)	Timer LED (green)
(4)	Input/Output LED SAFE-IN (red/green/orange) (*1) RESET-IN (green) SAFE-OUT (orange) SOLENOID-OUT (orange)
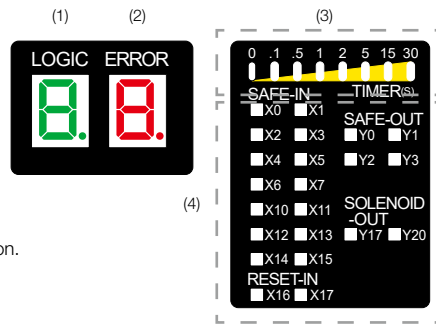
*1 Indication specification of input LEDs are different depending on the selected input function.

(1) Logic LED

LED	Status	Description	State (*1)
1, 2, 3, 4 5, 6, 7, 8, A, b, C, d (*2)	On	Selected Logic number (Example, Logic 34A: 4→A→4→A→4...)	Run state Configuration state Protection state
	Blink	Selected Logic number (Example, Logic 34A: 4→A→off→4→A→off→4...)	Configuration state
E	Blink	The selected Logic has Configuration error (Logic is not selected, or multiple logics are selected)	Configuration state
None	Off	Error	Stop state

*1 For details on state, refer to "Chapter 4 Basic Operation".
*2 When the input function is changed, "." (dot) lights On/Blink in the lower right.

(2) Error LED

LED	Status	Description	State (*1)
1 (*2)	On	Errors that can be removed by turning off the input (Input monitor error)	Protection state
2, 3, 4, 6, 7, 8 (*2)	On	Error requiring power restart to clear	Stop state
C (*3)	On	Configuration procedure is in progress	Configuration state
	Blink	Configuration is valid (*4)	Configuration state
None	Off	Normal operation	Run state

*1 For details on state, refer to "Chapter 4 Basic Operation".
*2 For details on the errors and treatments, refer to "Chapter 6 Troubleshooting".
*3 When the input function is changed, "." (dot) lights On/Blink in the lower right.
*4 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.)

(3) Timer LED

LED	Status	Description	State (*1)
0s	On	No off-delay (safety outputs shut down immediately)	Run state Protection state
.1s	On	Off-delay timer 0.1s	Run state Protection state
.5s	On	Off-delay timer 0.5s	Run state Protection state
1s	On	Off-delay timer 1s	Run state Protection state
2s	On	Off-delay timer 2s	Run state Protection state
15s	On	Off-delay timer 15s	Run state Protection state
30s	On	Off-delay timer 30s	Run state Protection state
Each LED	Blink	Selected off-delay timer value	Configuration state
None	Off	Off-delay timer value is not selected	Configuration state
		Error (*2)	Stop state

*1 For details on state, refer to "Chapter 4 Basic Operation".
*2 For details on the errors and treatments, refer to "Chapter 6 Troubleshooting".

(4) Input/Output LED

• Input LED: SAFE-IN (X0...X15), RESET-IN (X16,X17)

LED	Status	Description	State (*1)
X0...X15 (*2)	On	Input on	Run state
	Off	Input off	Run state
		Error (*3)	Configuration state Stop state
	Blink	An input error occurred at the flashing point. (*3)	Run state Protection state Stop state
X16, X17	On	Input on	Run state
	Off	Input off	Run state
		Error (*3)	Configuration state Stop state
	Blink	An input error occurred at the flashing point. (*3)	Stop state

*1 For details on state, refer to "Chapter 4 Basic Operation".
*2 The LED colors change depending on the selected input functions. For details, refer to "Chapter 4 Basic Operation".
*3 For details on the errors and treatments, refer to "Chapter 6 Troubleshooting".

• Output LEDs: SAFE-OUT (Y0...Y3), SOLENOID-OUT (Y17, Y20)

LED	Status	Description	State (*1)
Y0...Y3	On	Output on	Run state
	Off	Output off	Run state
		Error (*2)	Configuration state Protection state Stop state
	Blink	Off-delay timer operation,	Run state
		An outputs error occurred at the flashing point. (*2)	Stop state
Y17, Y20	On	Output on	Run state
	Off	Output off	Run state
		Error (*2)	Configuration state Protection State Stop state

*1 For more details on states, refer to "Chapter 4 Basic Operation".
*2 For details on the errors and treatments, refer to "Chapter 6 Troubleshooting".

Configuration Switches
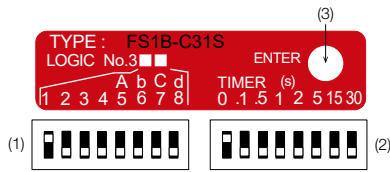
(1) Logic switch

The slide switch for use in logic configuration. When one of 1 to 8 is turned on, or one of 1 to 4 and one of A, b, C, d (5 to 8) are turned on, the corresponding logic in FS1B is activated.

For more details on each logic, refer to "Chapter 5 Logic". The upper position of each digit is the on state.

(2) Timer switch

The slide switch for selecting off-delay time value. When 1 of 8 digits is turned on, the delay time at shut-off operation is activated. The upper position of each digit is the on state.

Timer value	Switch No.	Description
0s	1	No off-delay (Safety outputs shut down immediately)
.1s	2	Off-delay timer 0.1s
.5s	3	Off-delay timer 0.5s
1s	4	Off-delay timer 1s
2s	5	Off-delay timer 2s
5s	6	Off-delay timer 5s
15s	7	Off-delay timer 15s
30s	8	Off-delay timer 30s

(3) Enter button

The enter button is used to confirm the operation specification (logic, timer, input functions) settings. At the Configuration state, when all switches are set properly, pressing this button leads to activation of changed configurations. The configuration is not activated when the switches are not set properly even if the enter button is pressed. Error LED will blink for 1 to 5 seconds after pressing the enter button. Releasing the button during blinking activates the setting.
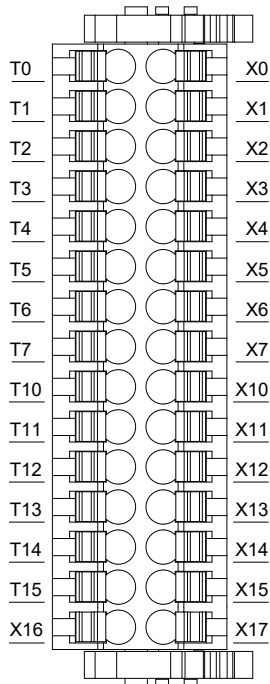
⚠ CAUTION	• When operating enter button, use a precision screwdriver or tool 2mm wide maximum at the tip.

Connector Specifications
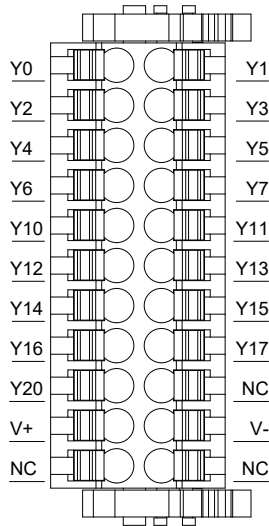
• Input connector

Terminal	Description	Terminal	Description
T0	Safety input drive terminal 0	X0	Safety input receive terminal 0
T1	Safety input drive terminal 1	X1	Safety input receive terminal 1
T2	Safety input drive terminal 2	X2	Safety input receive terminal 2
T3	Safety input drive terminal 3	X3	Safety input receive terminal 3
T4	Safety input drive terminal 4	X4	Safety input receive terminal 4
T5	Safety input drive terminal 5	X5	Safety input receive terminal 5
T6	Safety input drive terminal 6	X6	Safety input receive terminal 6
T7	Safety input drive terminal 7	X7	Safety input receive terminal 7
T10	Safety input drive terminal 10	X10	Safety input receive terminal 10
T11	Safety input drive terminal 11	X11	Safety input receive terminal 11
T12	Safety input drive terminal 12	X12	Safety input receive terminal 12
T13	Safety input drive terminal 13	X13	Safety input receive terminal 13
T14	Safety input drive terminal 14	X14	Safety input receive terminal 14
T15	Safety input drive terminal 15	X15	Safety input receive terminal 15
X16	Reset input terminal 16	X17	Reset input terminal 17

Applicable connector: Push-in (30pins)
FS9Z-CN03 (standard accessories and IDEC optional parts)
B2CF 3.50/30/180LR SN BK BX (Weidmüller)

• **Output connector**

Applicable connector: Push-in (22pins)
FS9Z-CN04 (standard accessories and IDEC optional parts)
B2CF 3.50/22/180LR SN BK BX (Weidmüller)

Terminal	Description	Terminal	Description
Y0	Safety output terminal 0	Y1	Safety output terminal 1
Y2	Safety output terminal 2	Y3	Safety output terminal 3
Y4	Monitor output terminal 4	Y5	Monitor output terminal 5
Y6	Monitor output terminal 6	Y7	Monitor output terminal 7
Y10	Monitor output terminal 10	Y11	Monitor output terminal 11
Y12	Monitor output terminal 12	Y13	Monitor output terminal 13
Y14	Monitor output terminal 14	Y15	Monitor output terminal 15
Y16	Monitor output terminal 16	Y17	Solenoid/lamp output terminal 17
Y20	Solenoid/lamp output terminal 20	NC	Blank terminal
V+	24V DC power terminal	V-	0V DC power terminal
NC	Blank terminal	NC	Blank terminal

Chapter 3 Installation and Wiring

This chapter describes the FS1B Series Safety Controller installation and wiring. Please be sure to fully understand the contents of this manual before handling this product properly.

Installation and Wiring Precautions

⚠ WARNING

- Turn off the power to the FS1B before installation, removal, wiring, maintenance, or inspection of the FS1B.
  Failure to turn power off may cause electrical shocks or fire hazard.
- Before operating the FS1B, read the instruction sheet and the user's manual carefully, and ensure that the environment conforms to the requirements of the FS1B specifications.
  If the FS1B is operated in an environment that exceeds the specifications, the safety characteristics of the FS1B are impaired.
- The installation, wiring, configuration and operation of the FS1B must be performed by "Safety responsible persons" only. Safety responsible persons are personnel who have necessary qualifications authorizing them to perform designing, installation, operation, maintenance, and disposal of the FS1B. Persons without technical expertise of safety products must not use the FS1B. Also, install the unit in a locked control panel so that no one other than Safety responsible persons can perform wiring or change settings.
- Install the FS1B according to the instruction sheet and this manual. Improper installation may cause failure of the FS1B.
- Use a power supply that meets following required specifications:
  - Conforms to the power supply rating of the FS1B.
  - Complies with the SELV/PELV circuit specified by IEC60364-4-41 etc..
  - Has the functionality or the functional equivalent of the control voltage and current of class 2 circuit, as defined in UL508.
  - 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.
- In the case of setting a new configuration or modifying a configuration, check each input and output function.
- Separate the FS1B from equipment and wiring that does not meet the requirements for a class 2 circuit.

⚠ CAUTION

- The FS1B is designed for installation within a control panel. Install the FS1B in a control panel of IP54 or higher.
- Install the FS1B in environments specified in the instruction sheet and this manual. If the FS1B is used in places where the FS1B is subjected to high temperature, high humidity, condensation, corrosive gases, excessive vibrations, or excessive shocks, failure such as electrical shocks, fire hazard, or malfunction may result.
- The FS1B is designed for use in pollution degree 2 environment. Use the FS1B in an environment of pollution degree 2.
- Do not drop the FS1B during transportation, otherwise damage or malfunction may result.
- Prevent metal fragments and pieces of wire from dropping inside the FS1B housing. Put a cover on the FS1B during installation and wiring. Ingress of such fragments and chips may cause fire hazard, damage, or malfunction.
- Install the FS1B so that there is adequate distance from the walls, heat generating components or peripherals, taking into consideration spacing requirements for maintenance and ventilation.
- Install the FS1B on 35mm DIN rails with BNL6 end clips (sold separately) on both sides of the FS1B.
- Use wires of a proper size to meet voltage and current requirements. Use solid wires or ferrules as described in instruction sheet and this manual.
- Use a common 0V DC line when different power supplies are used for the FS1B and other components.
- Separate the input and output wiring from power lines.

Installation

❏ Installation Location and Direction

• The FS1B is designed for installation within a control panel.

• Use the FS1B within the specification values.

• Do not install the FS1B following environments Otherwise, electric shock, fire, or malfunction may occur.
  · Where dust, briny air, iron particles exist or oil fumes.
  · Where the FS1B is subjected to shocks or vibrations.
  · Where corrosive or combustible gases exist.
  · Where condensation occurs.
  · Where the FS1B is directly exposed to water.
  · Where high-voltage lines, high-voltage equipment, power lines, and power equipment.
  · Where large switching surges are generated.
  · Where strong magnetic fields or strong electric fields are generated.

• Install the FS1B vertically as shown in the figure below. For ventilation, provide space around the FS1B, so that sufficient distance is kept from other components, heat source, or panel surface.
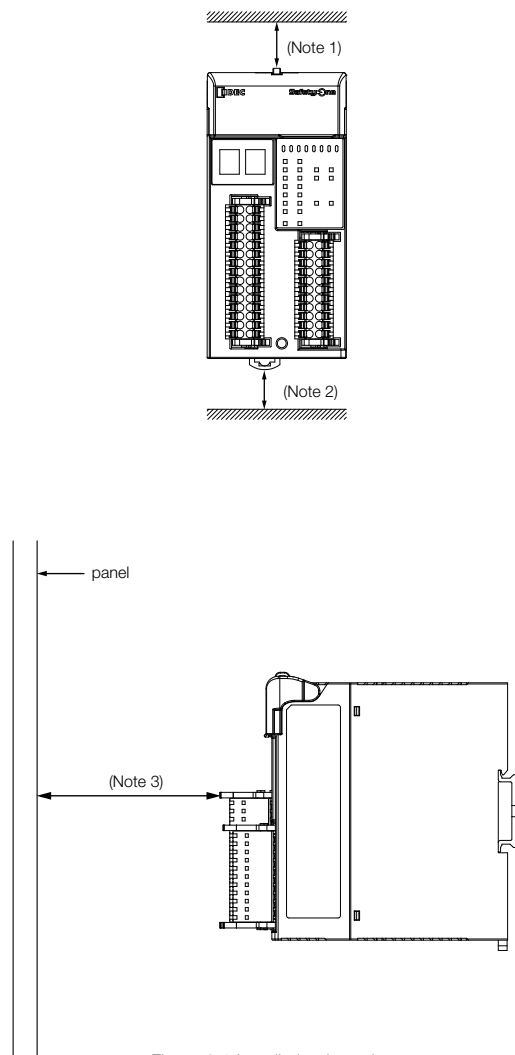
Figure 3.1 Installation Location

Ensure to use the FS1B in the environment of operating temperature -10 to +55°C.

Note 1) For opening/closing of protective cover. (Minimum. 20mm)
Note 2) For installation/removal of the FS1B on the DIN rail, and ventilation. (Approx. 20mm)
Note 3) For wiring of input and output connectors. (Approx. 80mm)

• **Correct installation direction**

BNL6 Mounting clip
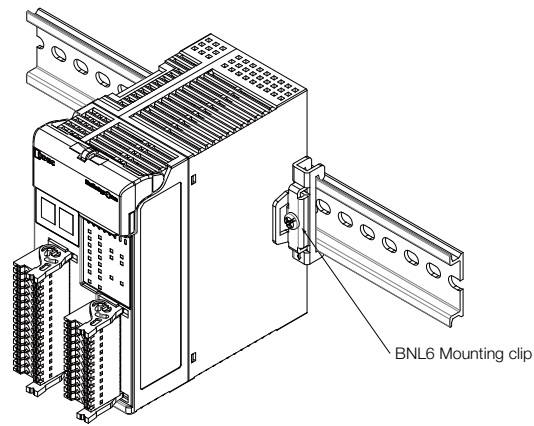
Figure 3.2 Correct Installation Direction

Do not install as shown in Figure 3.3.

Upwards   Sideways   Downwards
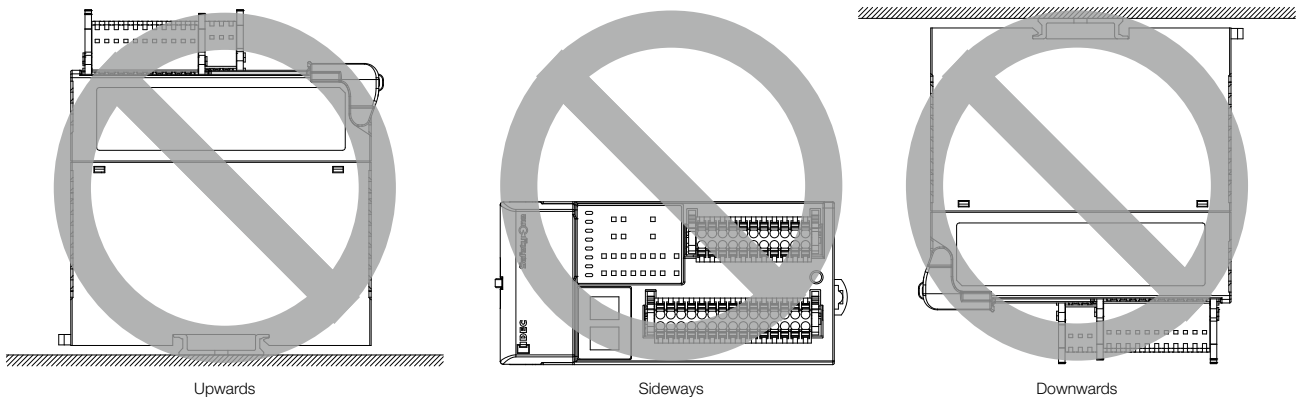
Figure 3.3 Incorrect Installation Directions

❏ Installing on DIN Rails

Use 35mm-wide DIN rails for installing the FS1B. Applicable DIN rails: BAA1000 (IDEC).

• Installing

1. Fasten the DIN rail to a panel using screws.
2. The FS1B is mounted by hooking it onto the DIN rail when the DIN rail hook is raised and pushing it on until it clicks.
3. Use BNL6 end clips on both sides of the FS1B to prevent the module from moving sideways.

35mm-wideDIN rail
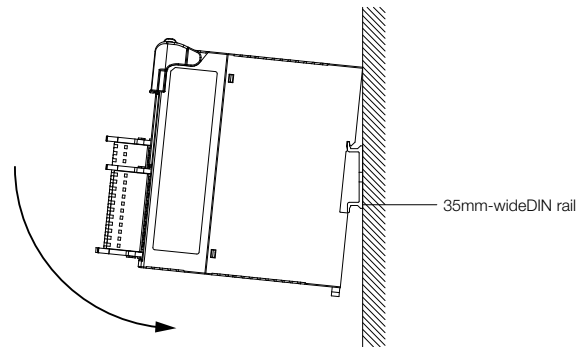
Figure 3.4 Installation

• Removal

1. Lower the FS1B's DIN rail hook with a flat blade screwdriver and lift it up while pulling forward.

35mm-wideDIN rail

Clamp
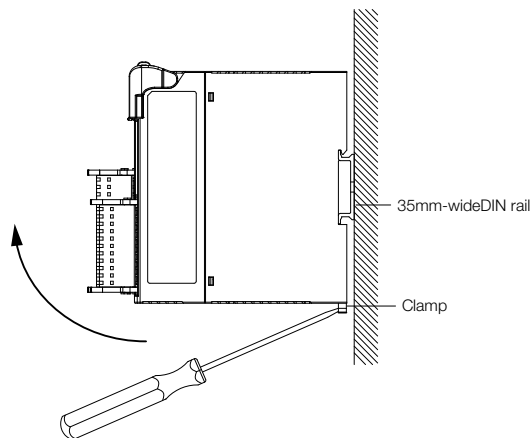
Figure 3.5 Removal

Wiring

❏ Connector Type and Wiring

Type	No. of poles	Part No.	Remarks
Push-in connector with lock and release lever	30	FS9Z-CN03	Accessories, Optional parts
		B2CF 3.50/30/180LR SN BK BX	Weidmüller
	22	FS9Z-CN04	Accessories, Optional parts
		B2CF 3.50/22/180LR SN BK BX	Weidmüller

Push the connector into the FS1B until the latches click. When inserted all the way to the end, there is a crackling sound or sensation (click), and the lock and release lever locks it.

For removal, make sure to press down the lock and release lever completely before removing the connector, otherwise the connector and wires may be damaged.
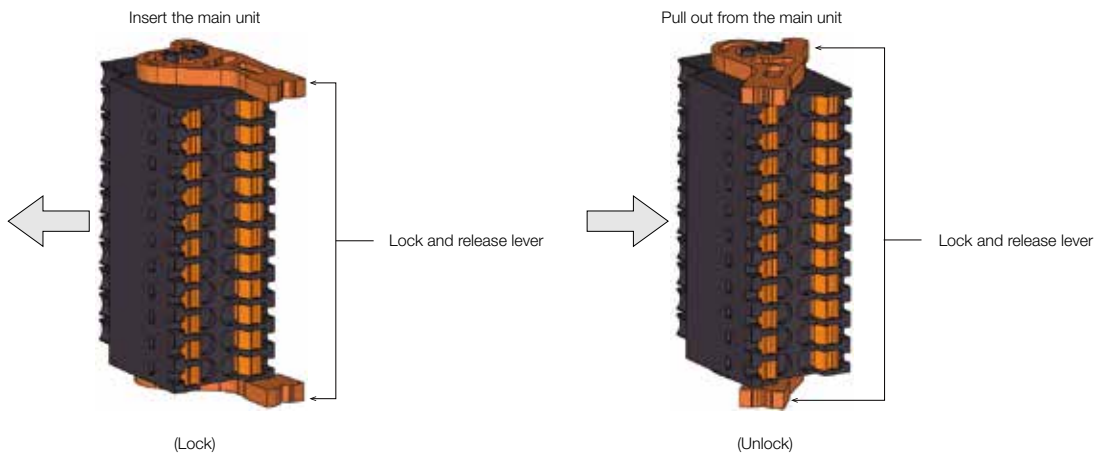
Figure 3.6 Connecting the Connector to the Body

❏ Applicable Wire/Recommended Ferrule

Applicable wires are shown below. Applicable wire Use cables that conform to the applicable standards.

Solid wire: 0.14mm^2 to 1.5mm^2 (AWG 26 to AWG 16) Strip length: 10 ± 0.5mm

Stranded wire: 0.14mm^2 to 1.0mm^2 (AWG 26 to AWG 17)

Use insulating ferrules when using stranded wires. Recommended insulating ferrules are shown below.

Applicable wire		Recommended ferrule (*1)		Ferrule conductor length	Wire strip length
		IDEC	Weidmüller (order number)		
0.14mm^2	AWG26	S3TL-F014-12WC (*2)	H0.14/12 GR SV (9028240000)	8mm	10mm
0.25mm^2	AWG24	S3TL-H025-12WJ	H0.25/12 HBL (9025760000)	8mm	10mm
0.34mm^2	AWG22	S3TL-H034-12WT	H0.34/12 TK (9025770000)	8mm	10mm
0.5mm^2	AWG20	S3TL-H05-16WA	H0.5/16 OR (9025870000)	10mm	12mm
0.75mm^2	AWG18	S3TL-H075-16WW	H0.75/16 W (9025860000)	10mm	12mm
1.0mm^2	AWG17	S3TL-H10-16WY	H1.0/16 GE (9025950000)	10mm	12mm

*1 Recommended Crimping tool: S3TL-CR06D (IDEC), PZ6/5 and PZ 1.5 (Weidmüller).
*2 When using S3TL-F014-12WC (H0.14/12 GR SV), use crimping tool PZ 1.5.

❏ Connecting Wires

• Turn off the power supply before connecting.

Insert the stripping solid wire or the stranded wire with insulating ferrule attached straight in. No tools are required to connect wires.
After wiring, tug lightly to make sure that the wire is properly connected.
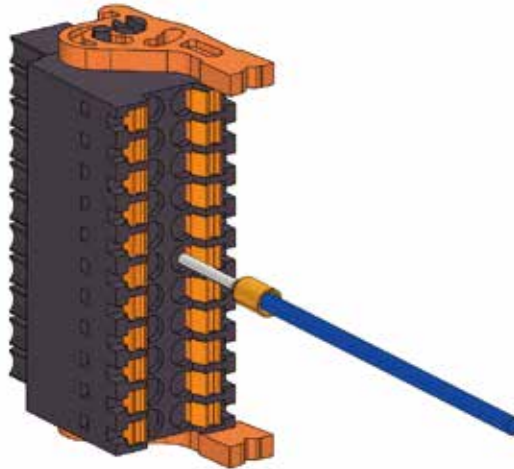
Figure 3.7 Connecting Wires

❏ Removing wires

• Turn off the power supply before removing.

When disconnecting the wire, use a flat screwdriver or similar tool and press the pusher (removal button) with proximately 20N of force. Remove the wire straight out by pressing the pusher.

• Be careful not to damage the push-in terminal.

Operate the pusher with a force of 40N. Do not press excessively. Do not pull out the cable without pressing the pusher.

Pusher
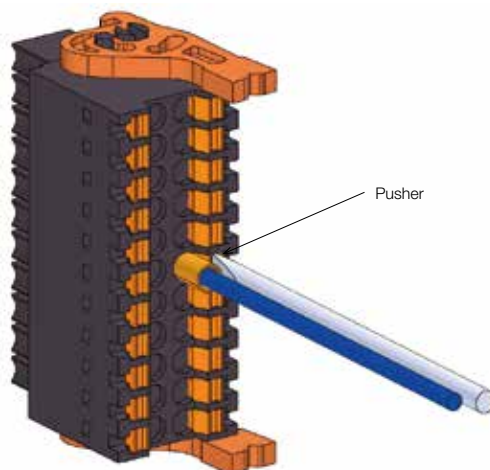
Figure 3.8 Removing Wires

Chapter 4 Basic Operation

This chapter describes the FS1B Series Safety Controller basic operations.

Internal State

The FS1B operates in five internal states, as shown in Table 4.1. For more details on each state, see the sections in this chapter. For more details on logic in Run states, refer to "Chapter 5 Logic".

Table 4.1 State

State	Description
Initial	Initial process is performed immediately after power is supplied to the FS1B. The internal circuits are checked and all LEDs show operation confirmation. (all LEDs on) (maximum 3s)
Run	Normal operation Logic processing continues without failures or wiring errors. (Refer to "Chapter 5 Logic")
Configuration	Logic, off-delay timer value, and input functions are being configured. Configuration enables the desired operation specification. When completed, the FS1B changes to the Run state. (Refer to "Operation Specification Setting" in this chapter)
Protection	An input monitor error has occurred with safety input or EDM input. When the problem is removed, the FS1B changes to Run state. (Refer to "Canceling the Protection State" in this chapter)
Stop	Failure or error has occurred with an external component or internal circuit. When the problem is removed and the power is turned on, Stop state is canceled. (Refer to "Stop State Release" in this chapter)

Turning on the Power

After power on, the FS1B first enter Initial state to check the internal circuits. Based on the results of the internal circuit check, the FS1B move to the appropriate state (within 3s). During the Initial state, each LED displays an operation check (blinking).

The factory default settings for the FS1B is Logic: 301, Timer: 1 (0s: Immediate off). When initially powering up the FS1B, thoroughly confirm the configuration and the operation.

IDEC

Opening and Closing Protective Cover and Locking Protective Cover

❏ Opening and Closing Protective Cover

Place the finger on the lower right corner of the protective cover and open the cover to the position where the setting operation can be performed. The protective cover can be fixed in two opening positions (60° and 120°). Note that the cover is tried to open more than 120°, the cover will come off from the body.

Figure 4.1 Opening and Closing the Protective Cover

❏ Locking the Protective Cover

After configuration of the FS1B and confirming, close the protective cover. To lock the protective cover, use the supplied marking tie or commercially-available wire (for example, Ø1.0 metal wire)
The protective cover do not ensure mechanical strength against strong force. The protection cover can be broken with the strong force.
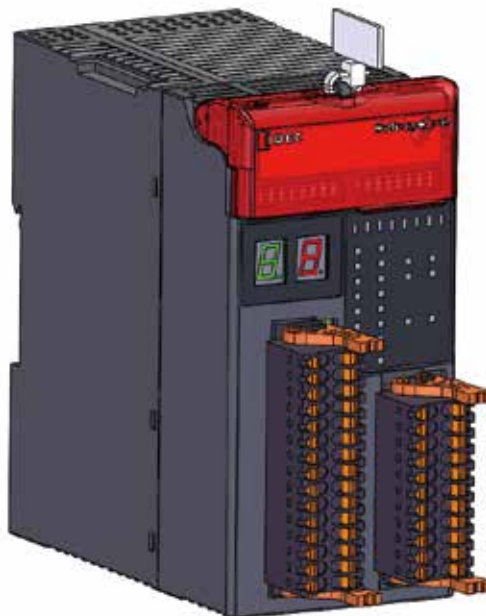
Figure 4.2 Locking the Protective Cover

Operation Specification Setting

The FS1B incorporates 24 logics internally, which can be selected with the Logic switch. Depending on the logic selected, the safety output has the off-delay timer function, and 8 levels of off-delay time can be selected with the timer switch: immediate off (0s), 0.1s, 0.5s, 1s, 2s, 5s, 15s, and 30s. For logic and timer settings, refer to "Changing Logic/Timer Settings" in this chapter.
The FS1B can change some input functions by identifying the wiring status. For operation specification settings including input function changes, refer to "Changing Input Function".

• Note on the setting of the operating specifications
- Use a precision screwdriver or a jig with a tip width of 2mm for operation logic switch, timer switch, enter button.
- When using logic 32A without safety outputs with off-delay timer, select the timer switch: 1 (0s).
- The state does not transition to the Configuration state in the Stop state.
- Once any logic is configured, it is kept in the FS1B even if the power is turned off.

⚠ WARNING	• The factory default settings for the FS1B is logic switch:1and timer switch:1. When initially powering on the FS1B, thoroughly confirm the configuration and the operation. • After the operating specification is finalized, the FS1B shifts to the Run state and starts operation. Before the finalization, throughly confirm the configuration.

❏ Changing Logic/Timer Setting

1. Opening the protective cover
   Open the protective cover to a position that enables you to set the configuration operation. Refer to "Opening and Closing Protective Cover and Locking Protective Cover" in this chapter.

2. Select the logic
   (If the logic setting is not changed, skip to procedure 3.)
   Select the logic to use with the logic switch.
   Select one of 1 to 8, or one of switches 1 to 4 and A, b, C, d (5 to 8), respectively.
   It is possible to write the selected logic number in "No. 3 ☐☐ " on the label.

   The error LED displays "C" and the logic LED blinks the new number of the logic configuration.
   * If the logic switch is not selected, or incorrect switches are selected, the logic LED will blink "E".
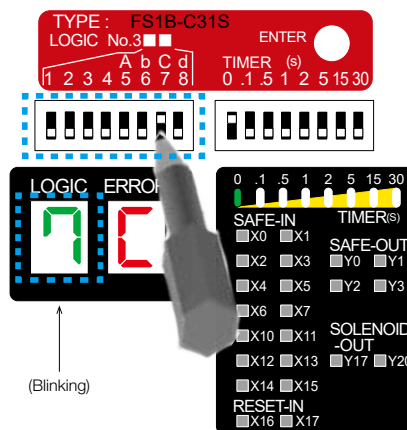
Figure 4.3 Logic "307" Setting State

3. Select the timer
   (If the timer setting is not changed, skip to procedure 4.)
   Select the off-delay timer value with the timer setting switch.

   The error LED displays "C" and the selected timer LED blinks.
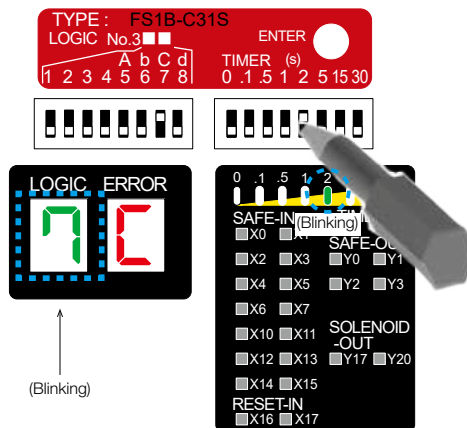
Figure 4.4 Off-delay timer value "2s"

4. Checking and determining the logic/timer

Once verify that the logic number and off-delay timer value are correct on the LED display and that no person is around the hazard (for example, inside the safety guards, etc.), press the enter button for 1s to 5s.

* During 1s to 5s, the error LED blinks with "C".

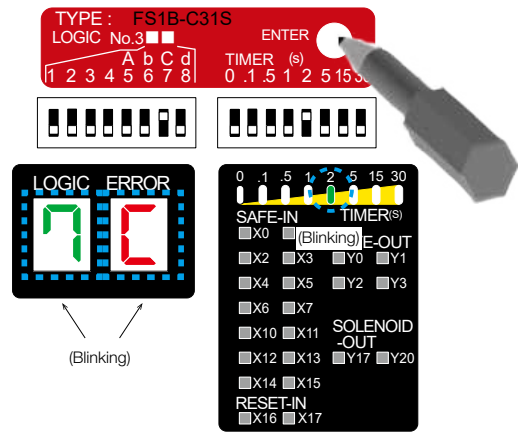* If the enter button is pressed less than 1s or more than 5s, the operation of the enter button is not activated.

Figure 4.5 Pushing in the Enter Button

When the logic LED and timer LED stop blinking and the error LED turns off, the selected logic and off-delay time become valid.
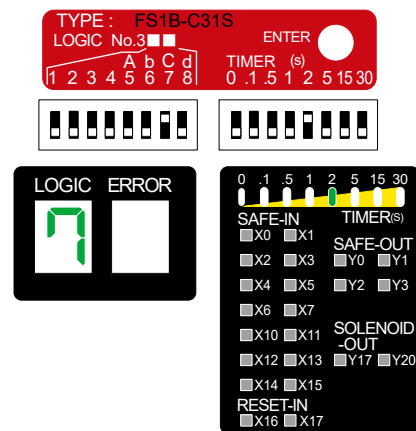
Figure 4.6 Logic 307, Off-delay timer value "2s"

5. Protective cover lock

Close and lock the protective cover. Refer to "Opening and Closing Protective Cover and Locking Protective Cover" in this chapter. Lock the protective cover to protect the configuration settings.

⚠ WARNING	• Install the FS1B in a locked control panel so that no one other than Safety responsible persons can perform wiring or change settings. • To prevent unexpected startup, take safety measures to prevent the hazardous source from operating only with the reset input of FS1B. (for example, provide a start switch)

❏ Changing Input Function

By changing the input function, the safety input components different from the default setting can be connected.

Refer to Table 4.3 for the input functions that can be changed and Table 4.4 for the purpose of each input function and the connection method for changing them. For detailed operation of the input function, refer to Chapter 5 "Logic Function".

* Input function changes must be made after the logic/timer setting.
* Even if only the logic/timer setting is changed after the input function is changed, the input function setting for the logic is retained.
* To return to the initial input function, perform the operation described in "Entering the setting for input function change".

Table4.3 Changeable input functions

Initial input function (LED color)	Optional input functions (LED color)
Dual channel direct opening input (red ■) Dual channel dependent input (red ■)	Dual channel NO/NC input (orange ▨)
	Dual channel safety input II (green ▨)
Dual channel NO/NC input (orange ▨)	Dual channel dependent input (red ■)
	Dual channel safety input II (green ▨)
Dual channel safety input II (green ▨)	Dual channel dependent input (red ■)
	Dual channel NO/NC input (orange ▨)
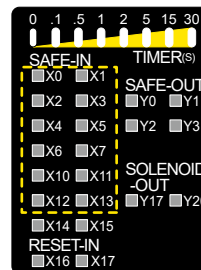
Figure 4.7 LED Representing Input Function

1. Connecting safety components

   Turn off the FS1B and wire the desired input function according to Table 4.4. When using with the initial input function should also be wired.

Table 4.4 Wiring for input functions change

Input functions (LED color)		Purpose and connection
Dual channel direct opening input (red ■)		Input function to connect safety components with redundant contacts, such as emergency stop pushbutton switches or interlock switches, etc. Connect safety components with redundant 2NC contacts. Or short-circuit Tn-Xn and Tn+1-Xn+1 respectively.
Dual channel dependent input (red ■)		Input function to connect safety components with redundant contacts such as interlock switches or enabling switches, etc. Connect safety components with redundant 2NC contacts. Or short-circuit Tn-Xn and Tn+1-Xn+1 respectively.
Dual channel NO/NC input (orange ▨)		Input function to connect safety components with redundant NO/NC contacts, such as non-contact interlock switches or interlock switches, etc. Connect safety components with redundant dual channel NO/NC contacts. Or leave Tn-Xn unconnected and short-circuit Tn+1-Xn+1.
Dual channel safety input II (green ▨)		Input function to connect safety components with redundant semiconductor outputs (PNP outputs) such as safety light curtains or safety laser scanners, etc. Connect safety components with redundant semiconductor outputs(PNP outputs). Or connect 24V DC to Xn and Xn+1.

⚠ **WARNING** • Turn off the power to the FS1B before wiring of the FS1B. Failure to turn power off may cause electrical shocks or fire hazard.

2. Opening the protective cover

   Open the protective cover to a position that enables you to set the configuration operations. Refer to "Opening and Closing Protective Cover and Locking Protective Cover" in this chapter.

3. Entering the setting for input function change

Turn off all logic switch and timer switch, and turn on the power of FS1B.

After the Initial state is completed, the logic LED blinks at "E" and the error LED turns on at "C.".
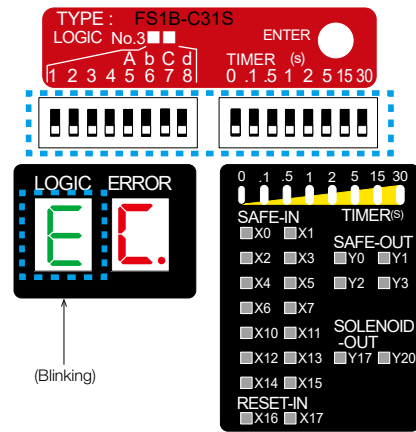

Figure 4.8 Switch Settings and LED Indications for Input Functions Change

4. Select the logic/timer

4-1. Select the logic

Select the logic to be used with logic switch. Select one of 1 to 8, or one of switches 1 to 4 and A, b, C, d (5 to 8), respectively. The error LED displays "C." and the logic LED blinks the selected logic number. It is possible to write the selected logic number in "No. 3 ☐☐ " on the label.

* If the logic switch is not selected, or incorrect switches are selected, the logic LED will blink "E".
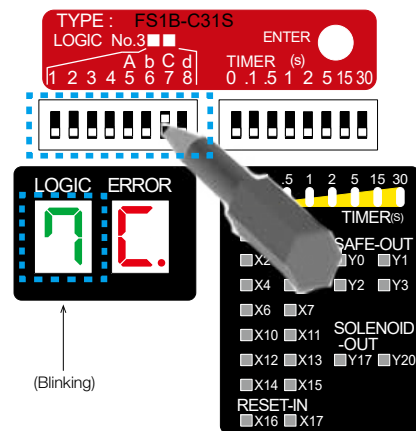
Figure 4.9 Selection State of Logic Number "307"

4-2. Select the timer

Select the off-delay timer value with the timer setting switch.

The selected timer LED blinks.
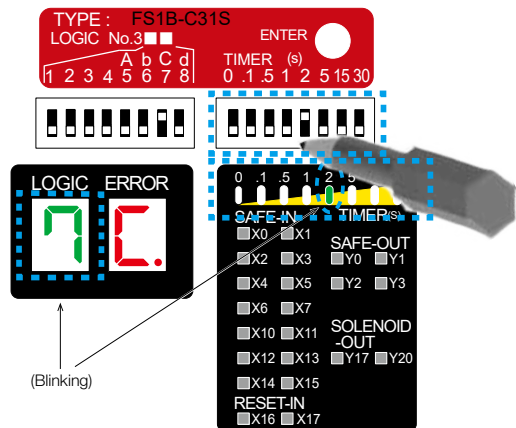
Figure 4.10 Selection State of Off-delay timer value "2s"

4-3. Confirm and determine the logic/timer

Confirm that the logic number and timer value are correct on the blinking LED display, and press and hold the enter button for 1s to 5s.

* During 1s to 5s, the error LED blinks with "C.".
* If the enter button is pressed less than 1s or more than 5s, the operation of the enter button is not activated.
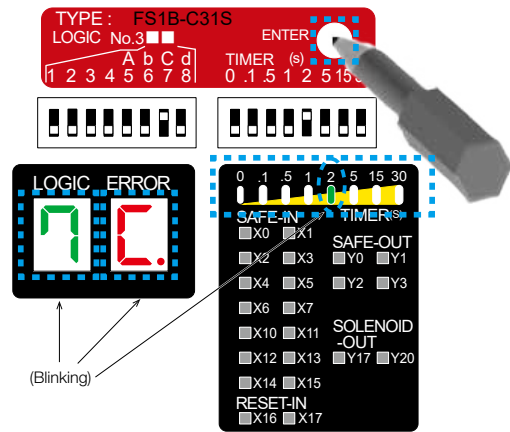

(Blinking)

Figure 4.11 Pressing the Enter Button

The blinking display of the error LED and timer LED changes to solid on. In addition, the logic LED blinks with a "." (dot) added, and the LEDs of the safety inputs whose input function can be changed blink red, green, and orange, in that order.

(Blinking)
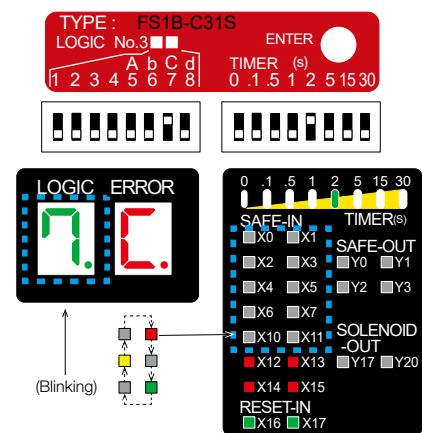
Figure 4.12 Logic "307", Off-delay timer value "2s", Setting Completed

5. Changing input functions

Turn on the wired safety inputs.
(for example, deactivate the emergency stop pushbutton switch, make the light curtain light receiving state, or short-circuit between T* and X*)

The input LEDs of the safety inputs that have been configured turn on in the color of the input function (see Table 4.3).
* Once enabled, input functions cannot be changed. If the function is different from desired configuration to set due to wiring errors or other reason, set it again according to "3. Entering the setting for input function change".

(Blinking)
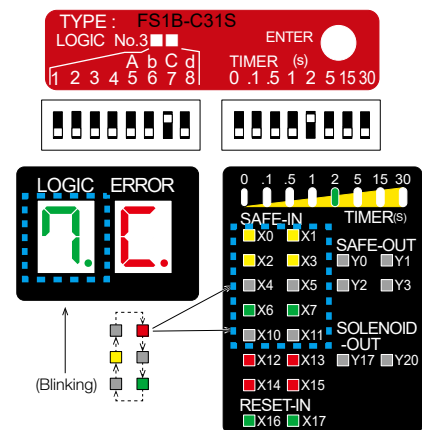
Figure 4.13 LED Status During Input Function Change
(X4, X5 and X10, X11 input functions not yet defined)

When all changeable safety inputs are turned on, the logic LED turns on.

* If all input functions have not been changed from the initial value, the lower right of the logic number "." (dot) will turn off.
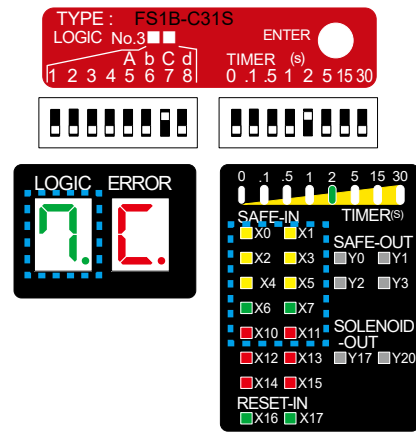
Figure 4.14 LED Status After input Function Change

6. Checking and determining the configuration

Once verify that the logic number, off-delay timer value and input functions are correct on the LED display and that no person is around the hazard (for example, inside the safety guards, etc.), press the enter button for 1s to 5s.

* During 1s to 5s, the error LED blinks with "C.".
* If the enter button is pressed less than 1s or more than 5s, the operation of the enter button is not activated.
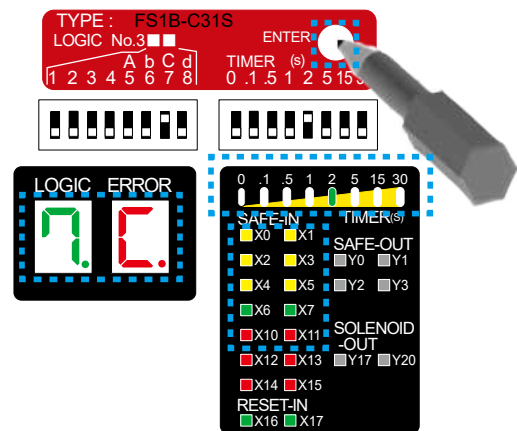
Figure 4.15 Pressing the Enter Button

When the error LED turns off, the selected input functions become valid.
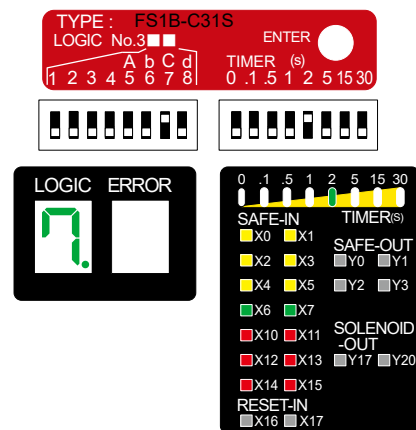
Figure 4.16 Completion State of Input Function Setting

7. Protective cover lock

Close and lock the protective cover. Refer to "Opening and Closing Protective Cover and Locking Protective Cover" in this chapter. Lock the protective cover to protect the configuration settings.

⚠ WARNING	• Install the FS1B in a locked control panel so that no one other than Safety responsible persons can perform wiring or change settings. • To prevent unexpected startup, take safety measures to prevent the hazardous source from operating only with the reset input of FS1B. (for example, provide a start switch)

Canceling the Protection State

If the FS1B detects an external component failure or an external wiring error, such as when an operation different from the specification is performed on the mode select input or when the EDM input is off when the safety output is off, the FS1B will shift to the Protection state. In the Protection state, all of the safety outputs are turned off and "1" is displayed in the error LED. The Protection state can be canceled by the following methods.

❏ Cancellation by the Connected Components
- In case of the error with mode select input, the Protection state is canceled by turning off 1 of the appropriate 2 inputs after removing the error factor. But the Protection state is not canceled during off-delay operation of safety outputs.
- In case of the error with EDM input, the Protection state is canceled by turning on of the appropriate EDM input.

❏ Cancellation by Reconnect of Power to FS1B
The Protection state is canceled by reconnect of power to the FS1B after removing the error factor. If the error factor that caused the change to the Protection state has been not removed, the FS1B returns to the Protection state again.

❏ Cancellation by Transition to Configuration State
By the changing the configuration of a logic or timer switch after removing the error factor, the state changes from Protection state to Configuration state.

⚠	WARNING	• Turn off the power to the FS1B before inspection and/or connecting of the wires.

Canceling the Stop State

If the FS1B detects any wiring errors abnormalities or internal circuit failure, it changes to the Stop state and locks out operations. The Stop state can be canceled by the following method.

❏ Cancellation by Reconnect of Power to FS1B
The Stop state is canceled by reconnect of power to the FS1B after removing the error factor.

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

Chapter 5 Logic

This chapter describes the Logic in the FS1B Series Safety Controller. Make proper use of the FS1B by thoroughly familiarizing yourself with the operations and function of each Logic.

About the logic of FS1B-C31S

Logic No.	Logic	Muting Input	Mode select input	Safety output				Description page
				Y0	Y1	Y2	Y3	
301	AND circuit			Dual channel safety output		Dual channel safety output (with off-delay timer)		44
31A	Circuit including OR functions			Dual channel safety output		Dual channel safety output (with off-delay timer)		49
31b	Circuit including an OR function			Dual channel safety output		Dual channel safety output (with off-delay timer)		55
31C	Circuit including muting functions	✓		Dual channel safety output		Dual channel safety output (with off-delay timer)		60
31d	Circuit including a mode selecting function		✓	Safety output	Safety output (with off-delay timer)	Safety output	Safety output	65
302	Partial stop circuit			Dual channel safety output (with off-delay timer)		Dual channel safety output (with off-delay timer)		72
32A	Circuit including a muting function and a two-hand control input	✓		Dual channel safety output		Dual channel safety output		77
32b	Circuit including OR and XOR functions			Dual channel safety output		Dual channel safety output (with off-delay timer)		82
32C	Circuit including OR and XOR functions			Dual channel safety output		Dual channel safety output (with off-delay timer)		87
32d	Partial stop circuit including a mode selection function		✓	Safety output	Safety output	Safety output (with off-delay timer)	Safety output	93
303	Circuit including a mode selecting function		✓	Dual channel safety output (with off-delay timer)		Dual channel safety output (with off-delay timer)		100
33A	Circuit including a mode selecting function		✓	Dual channel safety output		Dual channel safety output (with off-delay timer)		107
33b	Circuit including a mode selecting function and OR functions		✓	Dual channel safety output		Dual channel safety output (with off-delay timer)		114
33C	Partial stop circuit including a mode select function		✓	Safety output	Safety output (with off-delay timer)	Safety output	Safety output	121
33d	Circuit including two of mode select functions.		✓	Dual channel safety output		Dual channel safety output (with off-delay timer)		128
304	Partial stop circuit including a mode selection function		✓	Safety output	Safety output (with off-delay timer)	Safety output	Safety output	137
34A	Partial stop circuit including a muting function	✓		Safety output	Safety output (with off-delay timer)	Safety output	Safety output (with off-delay timer)	144
34b	Partial stop circuit including a muting function	✓		Safety output	Safety output (with off-delay timer)	Safety output	Safety output (with off-delay timer)	149
34C	Partial stop circuit including a mode select function and OR functions		✓	Safety output	Safety output	Safety output	Safety output (with off-delay timer)	154
34d	Partial stop circuit including an OR function			Safety output	Safety output (with off-delay timer)	Safety output	Safety output (with off-delay timer)	162
305	Partial stop circuit			Safety output	Safety output	Safety output	Safety output (with off-delay timer)	167
306	Partial stop circuit			Safety output	Safety output	Safety output	Safety output (with off-delay timer)	172
307	Partial stop circuit			Safety output	Safety output (with off-delay timer)	Safety output	Safety output (with off-delay timer)	177
308	Partial stop circuit including a mode select function		✓	Safety output	Safety output (with off-delay timer)	Safety output	Safety output (with off-delay timer)	182

❏ Wiring Example of Safety Input and Output

Here is an example of wiring for safety inputs and outputs common to each logic. Safety components to be connected should be selected with due consideration of safety performance and operating conditions.

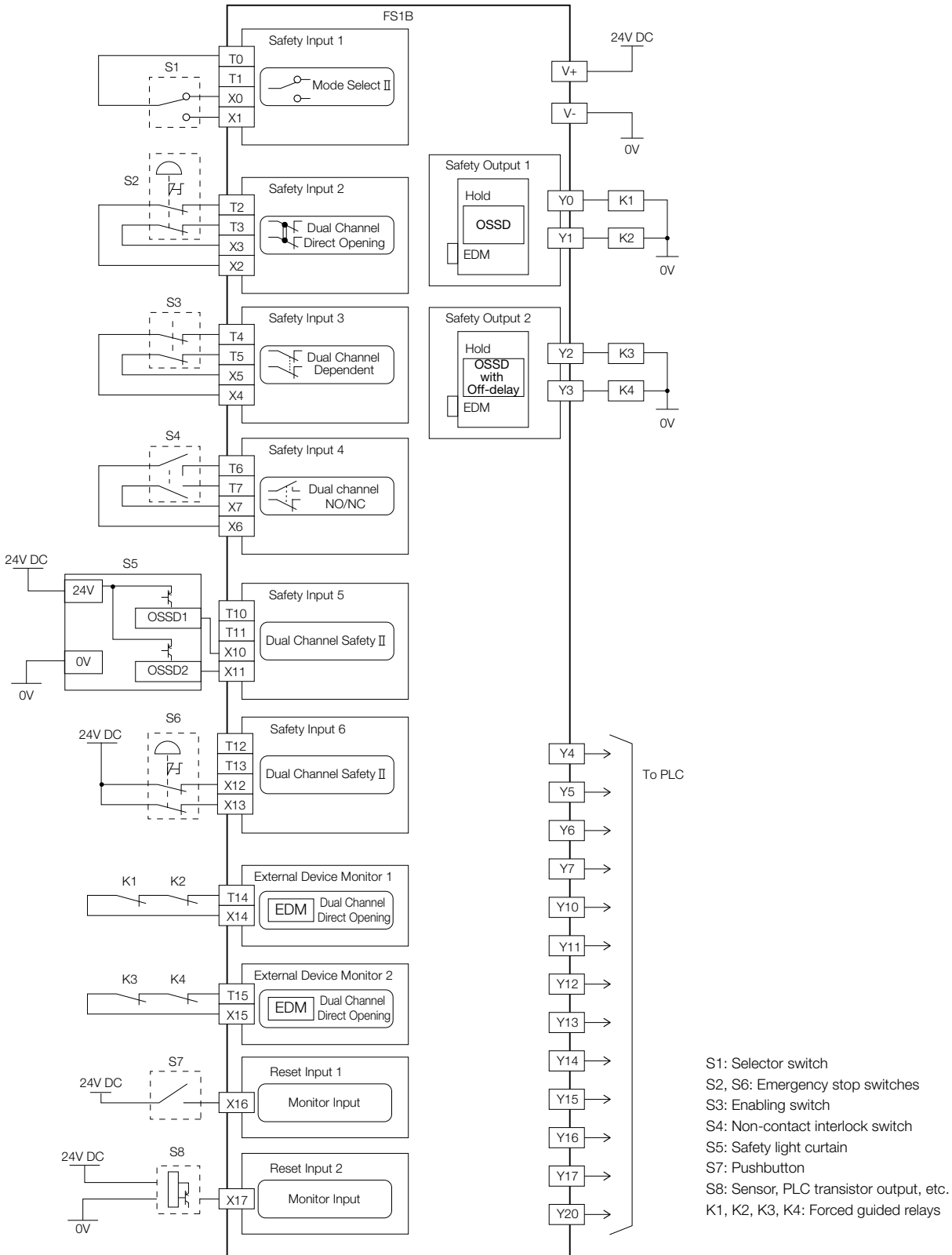| ⚠ WARNING	• Safety performance is evaluated on a system-wide basis. Please check thoroughly the correctness of implementation of safety components in the overall system including wiring, configuration, and located environment, before use.

Figure 5.1 Wiring example (Dual channel safety output)

S1: Selector switch
S2, S6: Emergency stop switches
S3: Enabling switch
S4: Non-contact interlock switch
S5: Safety light curtain
S7: Pushbutton
S8: Sensor, PLC transistor output, etc.
K1, K2, K3, K4: Forced guided relays
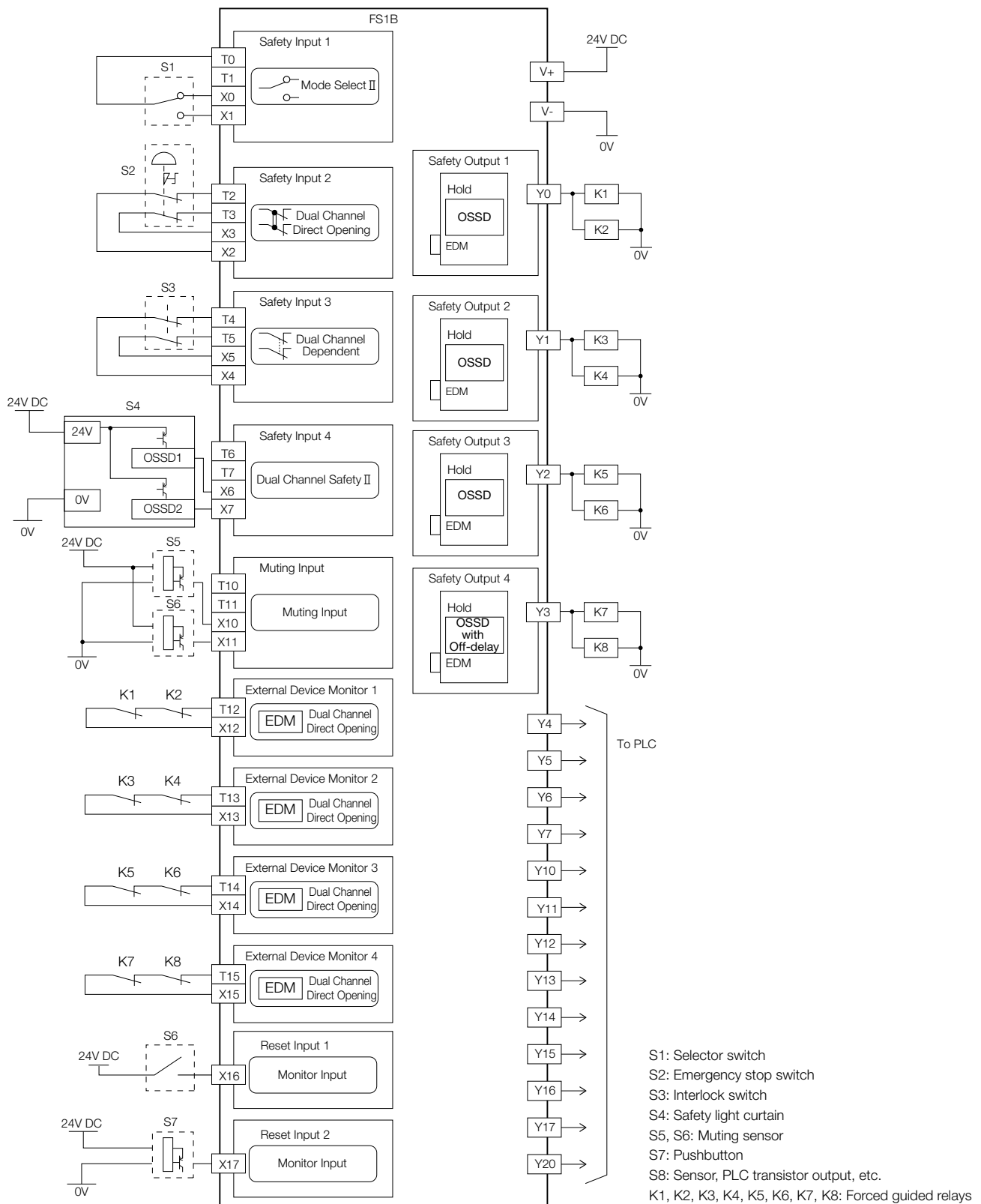
Figure 5.2 Wiring example (Single safety output)

S1: Selector switch
S2: Emergency stop switch
S3: Interlock switch
S4: Safety light curtain
S5, S6: Muting sensor
S7: Pushbutton
S8: Sensor, PLC transistor output, etc.
K1, K2, K3, K4, K5, K6, K7, K8: Forced guided relays

Logic 301: AND Circuit

❏ Logic circuit
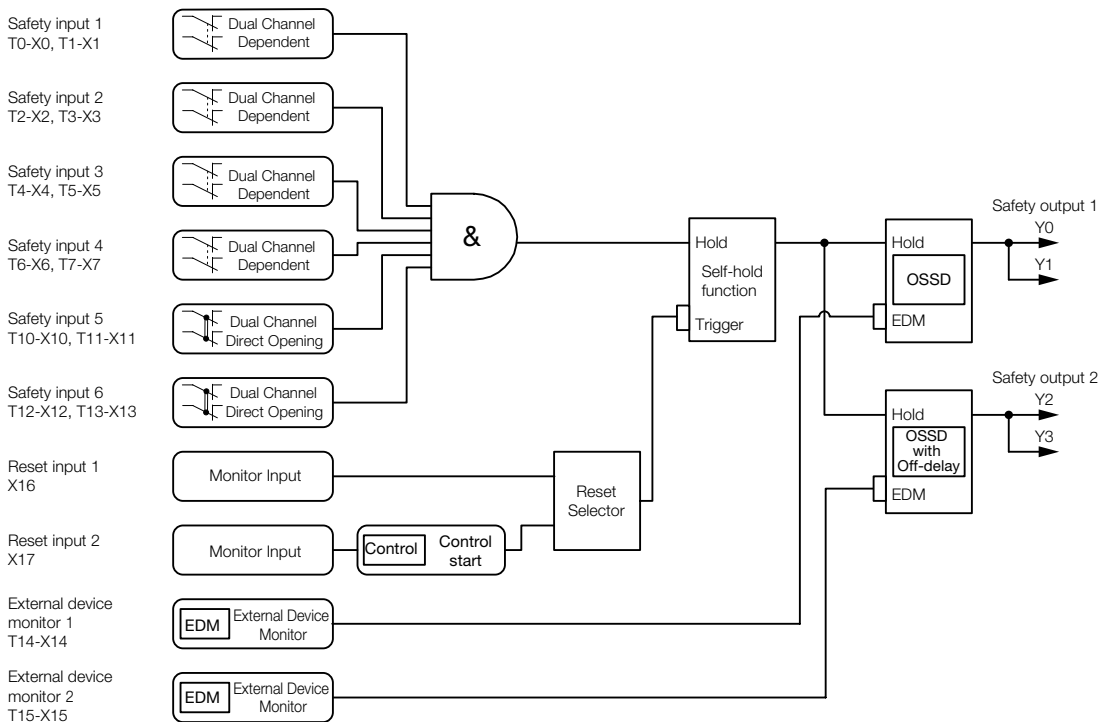
Figure 5.3 Logic circuit (Logic 301)

• Safety inputs

Some safety inputs can be changed input function. The monitor output turns on when the target safety input is on and turns off when the safety input is off.

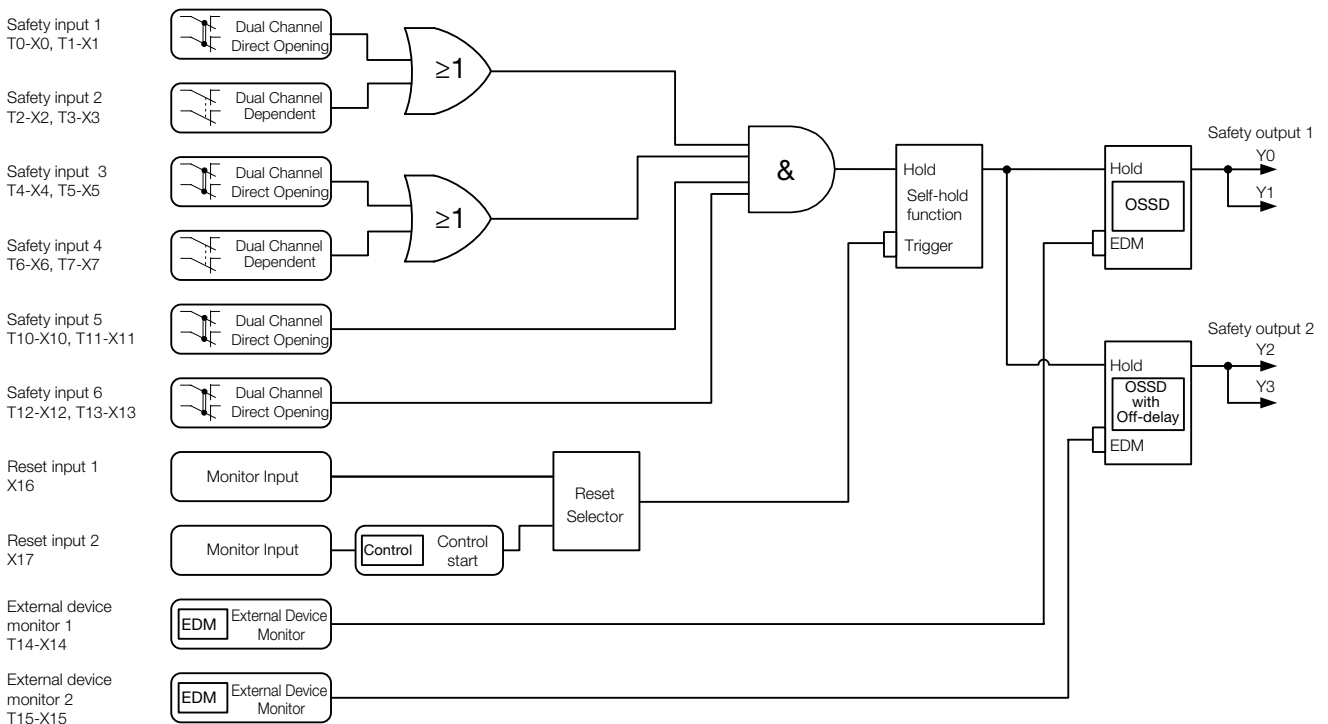|	Initial input function	Optional input functions	Monitor output
Safety input 1 (T0-X0, T1-X1)	Dual channel dependent input	Dual channel NO/NC input Dual channel safety input II	Y4
Safety input 2 (T2-X2, T3-X3)	Dual channel dependent input	Dual channel NO/NC input Dual channel safety input II	Y5
Safety input 3 (T4-X4, T5-X5)	Dual channel dependent input	Dual channel NO/NC input Dual channel safety input II	Y6
Safety input 4 (T6-X6, T7-X7)	Dual channel dependent input	Dual channel NO/NC input Dual channel safety input II	Y7
Safety input 5 (T10-X10, T11-X11)	Dual channel direct opening input	Dual channel NO/NC input Dual channel safety input II	Y10
Safety input 6 (T12-X12, T13-X13)	Dual channel direct opening input	Dual channel NO/NC input Dual channel safety input II	Y11

• Safety outputs

The monitor output turns on when the target safety output is on and turns off when the safety output is off.

The monitor output turns off immediately independent on set off-delay time.

The solenoid output turns on if the safety output is off and any of the safety inputs are off. The solenoid output turns off if the safety input is all on.

	Monitor output	Solenoid output (*1)
Safety output 1 (Y0, Y1)	Y12	Y17
Safety output 2 (Y2, Y3)	Y13	Y20

*1 Solenoid output is turned off outside the Run state.

• **Reset inputs**

Resets inputs are used to reset the safety output.

Reset input 1 (X16)

Reset input 2 (X17)

> • When both X16 and X17 are in the on state, the error LED displays "3" and the system moves to the Stop state. Use only one of them.

> ⚠ **WARNING** | • To prevent unexpected startup of the system, take safety measures to prevent the hazardous source from operating only with the reset input of FS1B. (for example, provide a start switch)

• **External device monitor inputs**

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

External device monitor input 1 (T14-X14): for safety output 1 (Y0, Y1)

External device monitor input 2 (T15-X15): for safety output 2 (Y2, Y3)

• **State monitor outputs**

State monitor outputs output internal state and error status.

	Initial/Configuration	Run	Protection	Stop
State monitor output 1 (Y14)	□Off	□Off	■On	■On
State monitor output 2 (Y15)	□Off	□Off	■On	□Off
State monitor output 3 (Y16)	□Off	■On	□Off	□Off

❏ Wiring example

Figure 5.4 Wiring example (Logic 301)

S1, S2, S3, S4: Interlock switches
S5, S6: Emergency stop switches
S7: Pushbutton
K1, K2, K3, K4: Forced guided relays

❏ Timing chart

Figure 5.5 Timing chart (Logic 301)
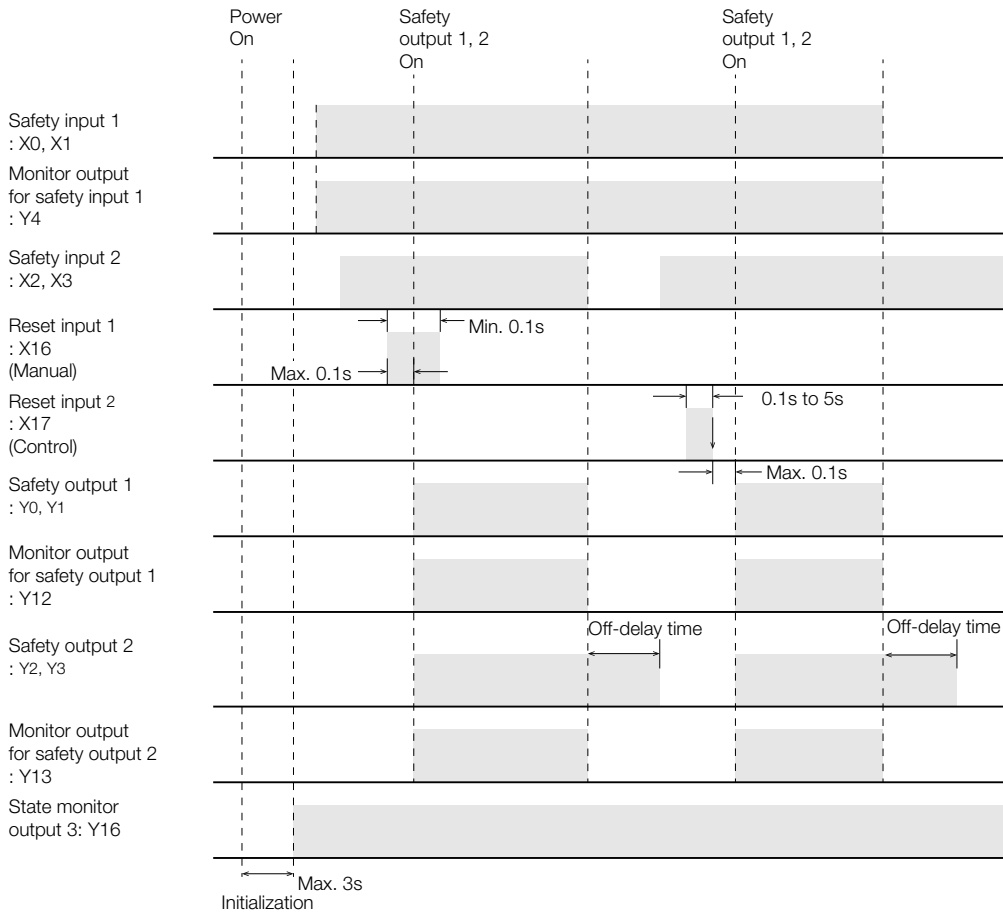
• Safety inputs 3, 4, 5, and 6 are all on in this chart.

❏ Safety system configuration example

This section describes an example of using Logic 301 to implement safety measures for a robotic system.

⚠ WARNING	• The systems in this manual show just examples of intended use application. The user is responsible for safe integration in the overall system. Safety performance must be evaluated on a system-wide basis relevant standards (for example, ISO10218-1 and ISO10218-2), laws and regulations (for example, Machine Directive). • To prevent unexpected startup, take safety measures to prevent the hazardous source from operating only with the reset input of FS1B. (for example, provide a start switch)

• Safety system overview

Safety components to be used

	Safety components to be connected	Input functions
Safety input 1	Interlock switch	Dual channel dependent input
Safety input 2	Interlock switch	Dual channel dependent input
Safety input 3	Interlock switch	Dual channel dependent input
Safety input 4	Interlock switch	Dual channel dependent input
Safety input 5	Emergency stop switch	Dual channel direct opening input
Safety input 6	Emergency stop switch	Dual channel direct opening input

Control object

	Control object
Safety output 1	Robot operation permission
Safety output 2	Robot power

Before starting operation, make sure that the person is not inside the safety guard.

Additional safety measures should be applied as needed. (for example, use padlocks for interlock switches)

The robot system can only operate when the safety guard is closed. Depending on the risk assessment of the entire system, a locking mechanism may be required for the safety guard. (for example, implementation of unlocking after the robot has come to a complete stop)

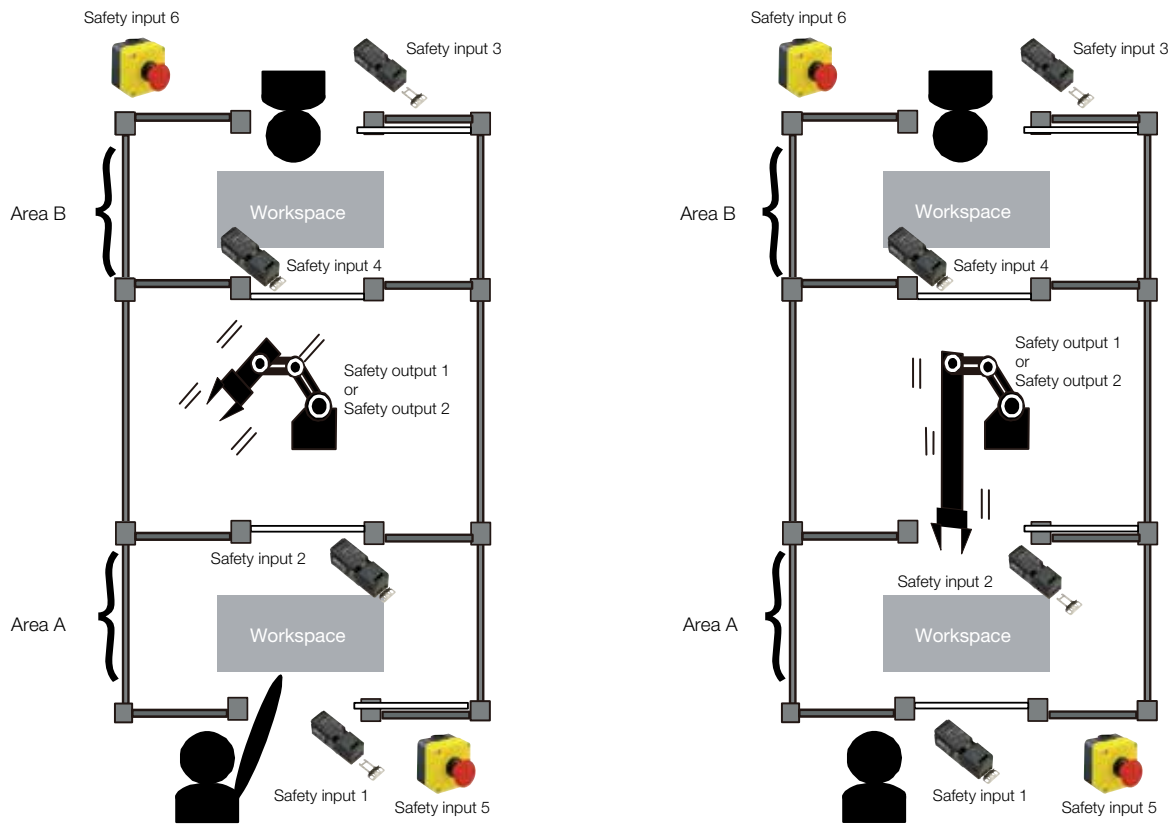Figure 5.6 Safety system configuration example (Logic 301)

⚠ WARNING	• Calculate the safety distances, while taking into consideration the response time of the FS1B and safety components connected to the FS1B.

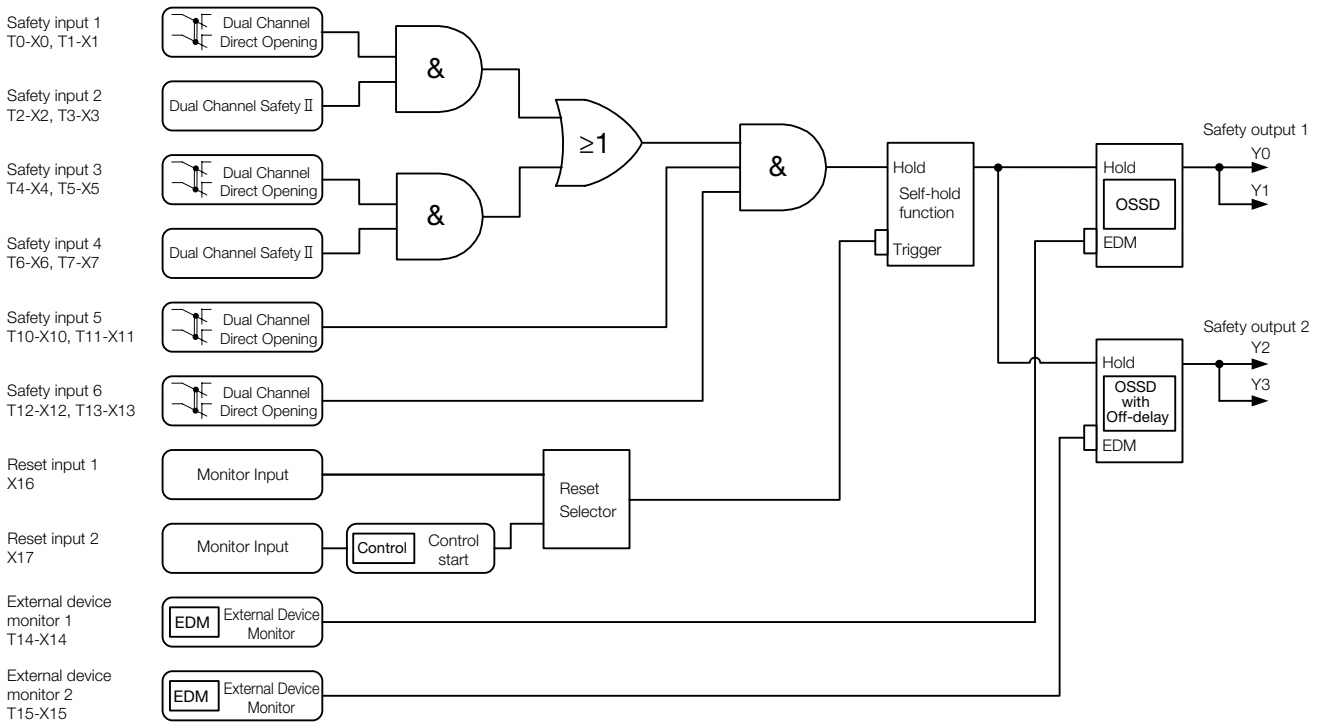## Logic 31A: Circuit including an OR functions

❏ **Logic circuit**

Figure 5.7 Logic circuit (31A)

• **Safety inputs**

Some safety inputs can be changed input function. The monitor output turns on when the target safety input is on and turns off when the safety input is off.

	Initial input function	Optional input functions	Monitor output
Safety input 1 (T0-X0, T1-X1)	Dual channel direct opening input	Dual channel NO/NC input Dual channel safety input II	Y4
Safety input 2 (T2-X2, T3-X3)	Dual channel dependent input	Dual channel NO/NC input Dual channel safety input II	Y5
Safety input 3 (T4-X4, T5-X5)	Dual channel direct opening input	Dual channel NO/NC input Dual channel safety input II	Y6
Safety input 4 (T6-X6, T7-X7)	Dual channel dependent input	Dual channel NO/NC input Dual channel safety input II	Y7
Safety input 5 (T10-X10, T11-X11)	Dual channel direct opening input	Dual channel NO/NC input Dual channel safety input II	Y10
Safety input 6 (T12-X12, T13-X13)	Dual channel direct opening input	Dual channel NO/NC input Dual channel safety input II	Y11

• **Safety outputs**

The monitor output turns on when the target safety output is on and turns off when the safety output is off.

The monitor output turns off immediately independent on set off-delay time.

The solenoid output turns on if the safety output is off and any of the safety inputs are off. When all safety inputs are turned on, the solenoid output is turned off.

	Monitor output	Solenoid output (*1)
Safety output 1 (Y0, Y1)	Y12	Y17
Safety output 2 (Y2, Y3)	Y13	Y20

*1 Solenoid output is turned off outside the Run state.

- **Reset inputs**

  Resets inputs are used to reset the safety output.

  Reset input 1 (X16)

  Reset input 2 (X17)

📝	• When both X16 and X17 are in the on state, the error LED displays "3" and the system moves to the Stop state. Use only one of them.

⚠️	**WARNING**	• To prevent unexpected startup of the system, take safety measures to prevent the hazardous source from operating only with the reset input of FS1B. (for example, provide a start switch)

- **External device monitor inputs**

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

  External device monitor input 1 (T14-X14): for safety output 1 (Y0, Y1)

  External device monitor input 2 (T15-X15): for safety output 2 (Y2, Y3)

- **State monitor outputs**

  State monitor outputs output internal state and error status.

	Initial/Configuration	Run	Protection	Stop
State monitor output 1 (Y14)	☐Off	☐Off	■On	■On
State monitor output 2 (Y15)	☐Off	☐Off	■On	☐Off
State monitor output 3 (Y16)	☐Off	■On	☐Off	☐Off

❏ Wiring example

Figure 5.8 Wiring example (Logic 31A)

S1, S2, S3, S4: Interlock switches
S5, S6: Emergency stop switches
S7: Pushbutton
K1, K2, K3, K4: Forced guided relays

❏ **Timing chart**

Figure 5.9 Timing chart (Logic 31A)
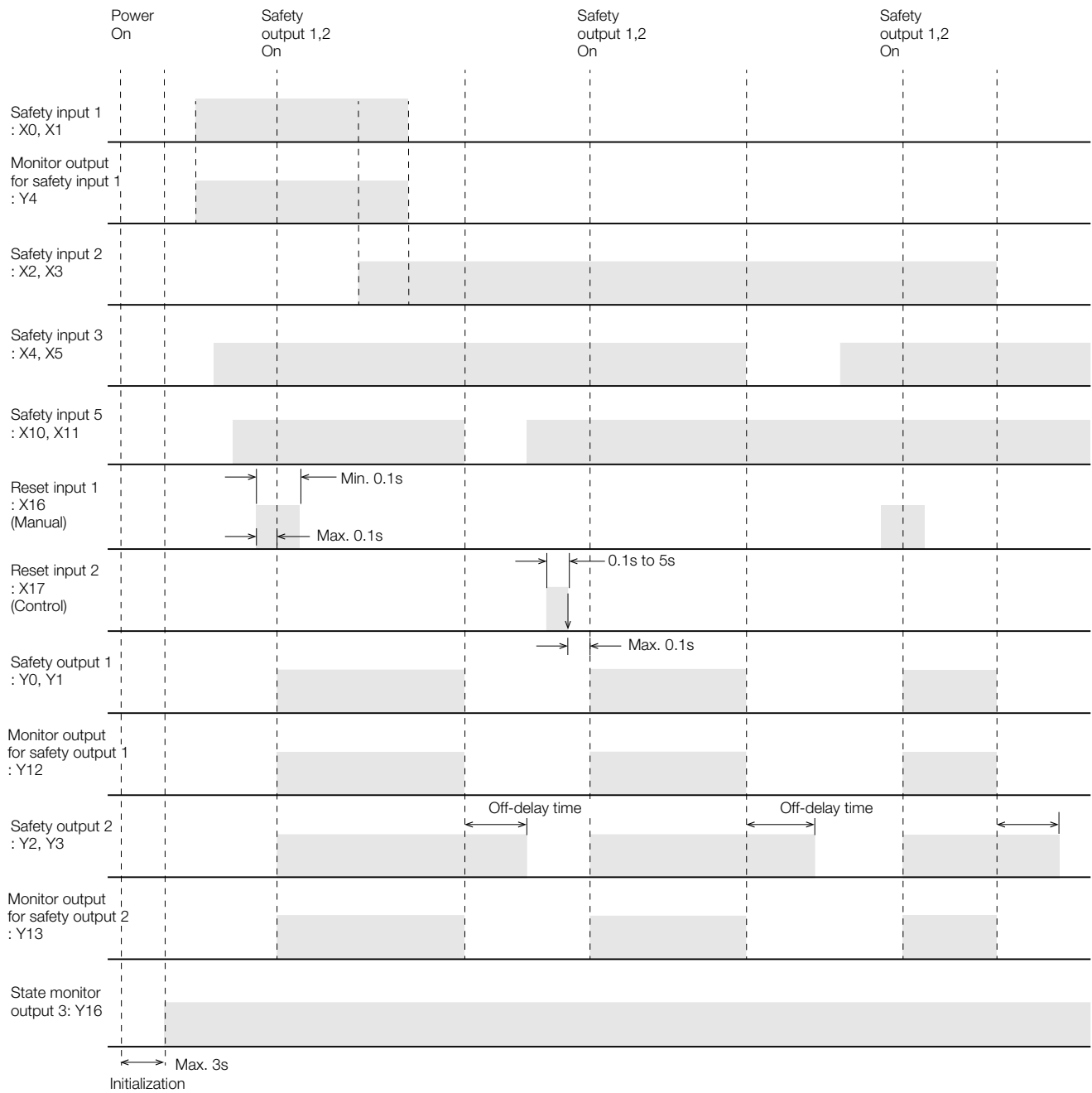
• Safety input 4 is all off and safety input 6 is all on in this chart.

❏ Safety system configuration example

This section describes an example of using Logic 31A to implement safety measures for a robotic system.

⚠ WARNING	• The systems in this manual show just examples of intended use application. The user is responsible for safe integration in the overall system. Safety performance must be evaluated on a system-wide basis relevant standards (for example, ISO10218-1 and ISO10218-2), laws and regulations (for example, Machine Directive). • To prevent unexpected startup, take safety measures to prevent the hazardous source from operating only with the reset input of FS1B. (for example, provide a start switch)

• **Safety system overview**

Safety components to be used

	Safety components to be connected	Input functions
Safety input 1	Interlock switch	Dual channel direct opening input
Safety input 2	Interlock switch	Dual channel dependent input
Safety input 3	Interlock switch	Dual channel direct opening input
Safety input 4	Interlock switch	Dual channel dependent input
Safety input 5	Emergency stop switch	Dual channel direct opening input
Safety input 6	Emergency stop switch	Dual channel direct opening input

Control object

	Control object
Safety output 1	Robot operation permission
Safety output 2	Robot power

Before starting operation, make sure that the person is not inside the safety guard.

Additional safety measures should be applied as needed. (for example, use padlocks for interlock switches.)

The robotic system will only be operational when at least one safety guard in Area A and at least one safety guard in Area B are closed.

Depending on the risk assessment of the entire system, a locking mechanism may be required for the safety guard. (for example, implementation of unlocking after the robot has come to a complete stop.)
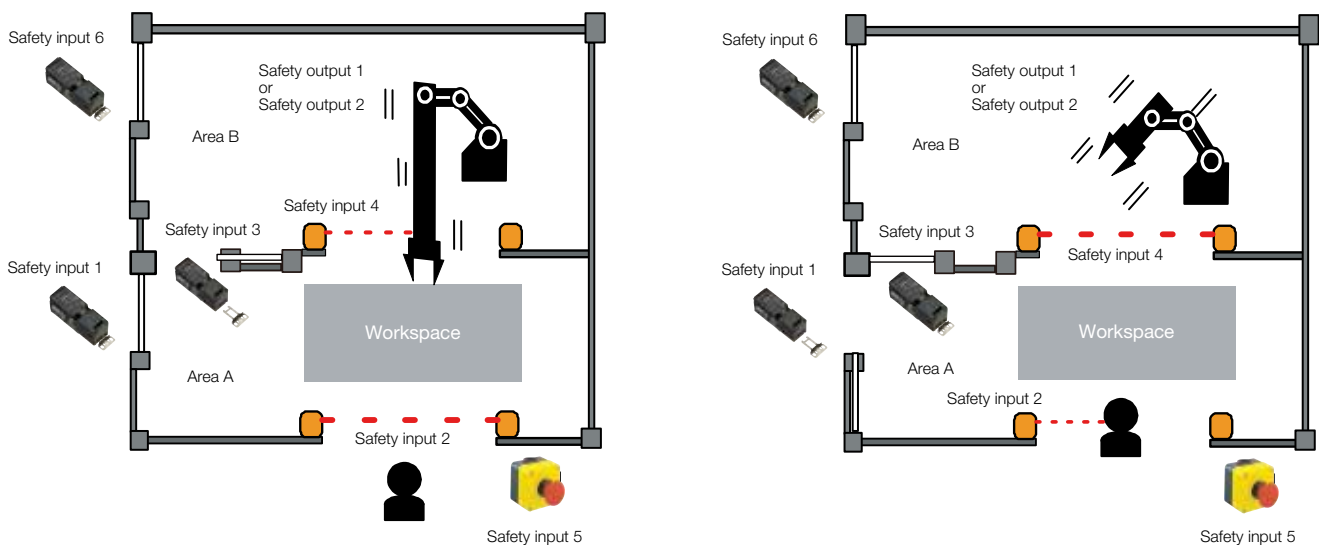

Figure 5.10 Safety system configuration example (Logic 31A)

⚠	WARNING	• Calculate the safety distances, while taking into consideration the response time of the FS1B and safety components connected to the FS1B.

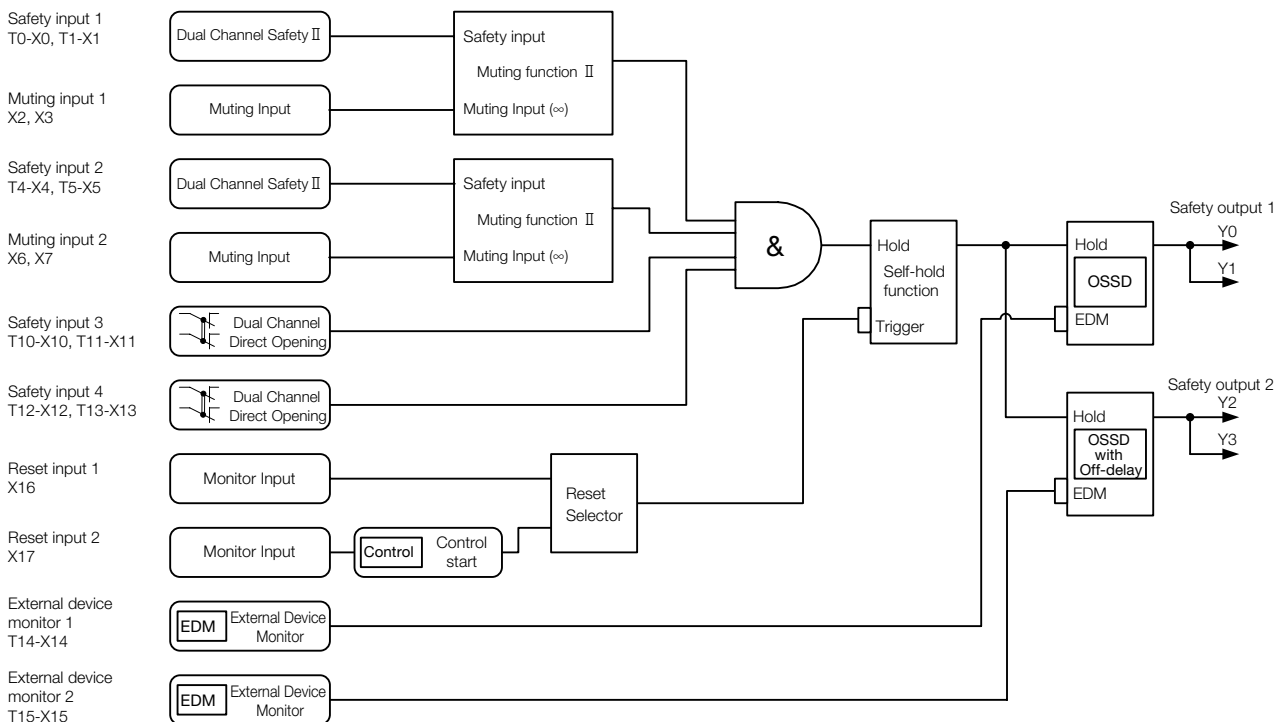## Logic 31b: Circuit including an OR function

❏ Logic circuit

Figure 5.11 Logic circuit (Logic 31b)

• **Safety inputs**

Some safety inputs can be changed input function.

The monitor output turns on when the target safety input is on and turns off when the safety input is off.

	Initial input function	Optional input functions	Monitor output
Safety input 1 (T0-X0, T1-X1)	Dual channel direct opening input	Dual channel NO/NC input Dual channel safety input II	Y4
Safety input 2 (T2-X2, T3-X3)	Dual channel safety input II	Dual channel dependent input Dual channel NO/NC input	Y5
Safety input 3 (T4-X4, T5-X5)	Dual channel direct opening input	Dual channel NO/NC input Dual channel safety input II	Y6
Safety input 4 (T6-X6, T7-X7)	Dual channel safety input II	Dual channel dependent input Dual channel NO/NC input	Y7
Safety input 5 (T10-X10, T11-X11)	Dual channel direct opening input	Dual channel NO/NC input Dual channel safety input II	Y10
Safety input 6 (T12-X12, T13-X13)	Dual channel direct opening input	Dual channel NO/NC input Dual channel safety input II	Y11

• **Safety outputs**

The monitor output turns on when the target safety output is on and turns off when the safety output is off.

The monitor output turns off immediately independent on set off-delay time.

The solenoid output turns on if the safety output is off and one of the safety inputs is off. The solenoid output turns off if the safety input is all on.

	Monitor output	Solenoid output (*1)
Safety output 1 (Y0, Y1)	Y12	Y17
Safety output 2 (Y2, Y3)	Y13	Y20

*1 Solenoid output is turned off outside of the Run state.

- **Reset inputs**

    Resets inputs are used to reset the safety output.

    Reset input 1 (X16)

    Reset input 2 (X17)

	• When both X16 and X17 are in the on state, the error LED displays "3" and the system moves to the Stop state. Use only one of them.

⚠ WARNING	• To prevent unexpected startup of the system, take safety measures to prevent the hazardous source from operating only with the reset input of FS1B. (for example, provide a start switch.)

- **External device monitor inputs**

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

    External device monitor input 1 (T14-X14): for safety output 1 (Y0, Y1)

    External device monitor input 2 (T15-X15): for safety output 2 (Y2, Y3)

- **State monitor outputs**

    State monitor outputs output internal state and error status.

	Initial/Configuration	Run	Protection	Stop
State monitor output 1 (Y14)	☐Off	☐Off	■On	■On
State monitor output 2 (Y15)	☐Off	☐Off	■On	☐Off
State monitor output 3 (Y16)	☐Off	■On	☐Off	☐Off

❏ Wiring example

Figure 5.12 Wiring example (Logic 31b)

S1, S2, S6: Interlock switches
S2, S4: Safety light curtains
S5: Emergency stop switch
S7: Pushbutton
K1, K2, K3, K4: Forced guided relays

❏ Timing chart

Safety input 1 : X0, X1	
Monitor output for safety input 1 : Y4	
Safety input 2 : X2, X3	
Safety input 3 : X4, X5	
Safety input 5 : X10, X11	
Reset input 1 : X16 (Manual)	Min. 0.1s / Max. 0.1s
Reset input 2 : X17 (Control)	0.1s to 5s
Safety output 1 : Y0, Y1	Max. 0.1s
Monitor output for safety output 1 : Y12	
Safety output 2 : Y2, Y3	Off-delay time
Monitor output for safety output 2 : Y13	
State monitor output 3: Y16	

Max. 3s
Initialization

• Safety input 4 and safety input 6 are all on in this chart.

Figure 5.13 Timing chart (Logic 31b)

❏ Safety system configuration example

This section describes an example of using logic 31b to implement safety measures for a robotic system.

⚠ WARNING	• The systems in this manual show just examples of intended use application. The user is responsible for safe integration in the overall system. Safety performance must be evaluated on a system-wide basis relevant standards (for example, ISO10218-1 and ISO10218-2), laws and regulations (for example, Machine Directive). • To prevent unexpected startup, take safety measures to prevent the hazardous source from operating only with the reset input of FS1B. (for example, provide a start switch.)

• Safety system overview

Safety components to be used

	Safety components to be connected	Input functions
Safety input 1	Interlock switch	Dual channel direct opening input
Safety input 2	Safety light curtain	Dual channel safety input II
Safety input 3	Interlock switch	Dual channel direct opening input
Safety input 4	Safety light curtain	Dual channel safety input II
Safety input 5	Emergency stop switch	Dual channel direct opening input
Safety input 6	Interlock switch	Dual channel direct opening input

Control object

	Control object
Safety output 1	Robot operation permission
Safety output 2	Robot power

Before starting operation, make sure that the peson is not inside the safety guard.

The robot can operate in the state where no operator can enter area A (the safety guard in area A is closed and the light curtain is illuminated) or in the state where no operator can enter area B and the robot cannot enter area A (the safety guard in area B is closed and the light curtain is illuminated).

The safety guard in area B is closed and the light curtain is in the light-receiving state. Depending on the risk assessment of the entire system, a locking mechanism may be required for the safety guard. (for example, implementation of unlocking after the robot has come to a complete stop.)

Figure 5.14 Safety system configuration example (Logic 31b)

⚠ WARNING	• Calculate the safety distances, while taking into consideration the response time of the FS1B and safety components connected to the FS1B. • When the person enters area A or area B, protective measure must be taken to prevent the door closing while the person is in the area (for example, using a padlock on the safety input 1 due to prevent restart of robot when the person enters area B).

Logic 31C: Circuit including muting functions

❏ Logic circuit

Figure 5.15 Logic circuit (Logic 31C)

- **Safety inputs**

  Some safety inputs can be changed input function. The monitor output turns on when the target safety input is on and turns off when the safety input is off.

  The muting lamp output turns on in the muting state. The muting state is enabled for the relevant muting ll function when muting input 1 or muting input 2 is turned on while safety output 1 and safety output 2 are on. The muting state is disabled when the muting input is turned off. When the power is turned on or the safety output is turned off while the muting input is on, the muting state is not enabled unless the muting input is turned off once.

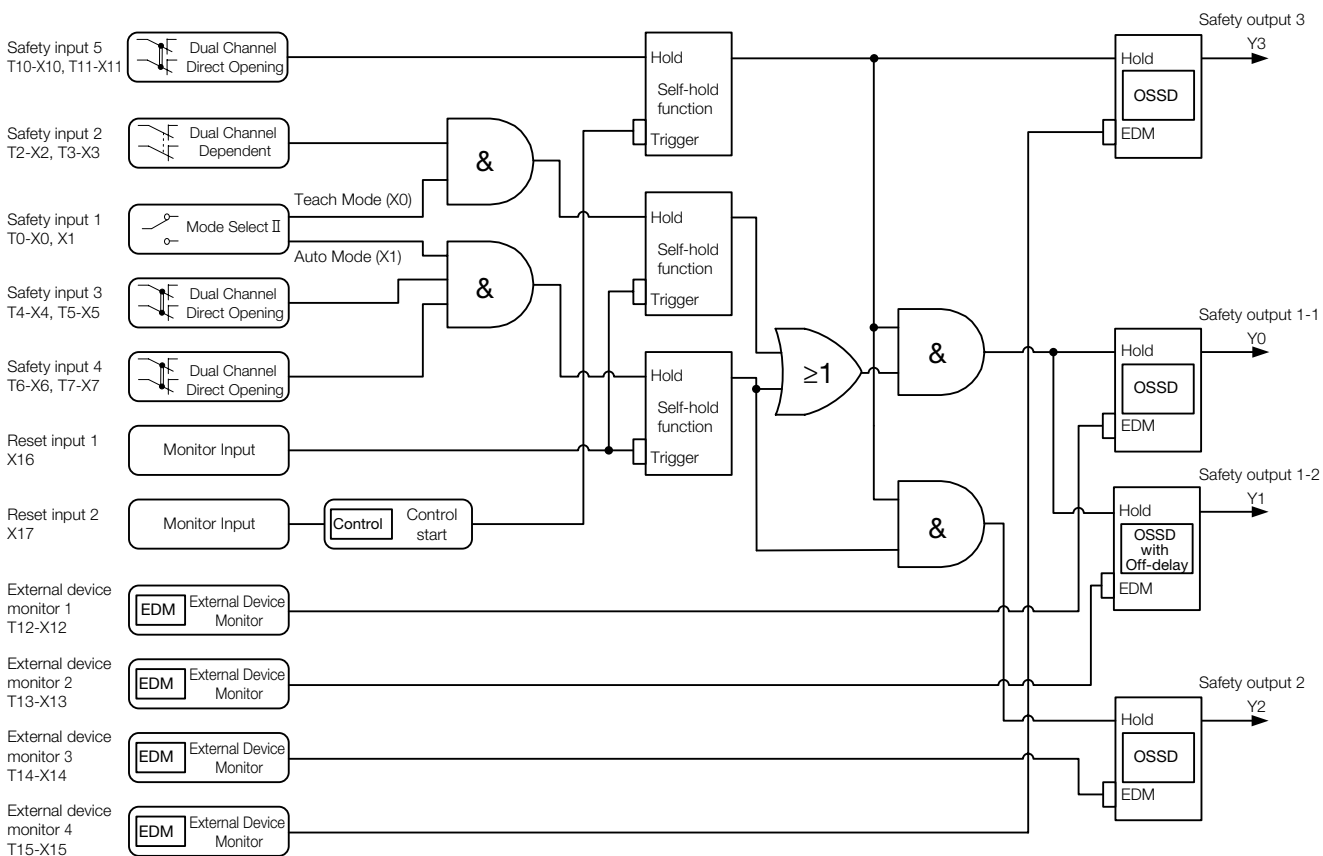|	Initial input function	Optional input functions	Monitor output	Muting lamp output
Safety input 1 (T0-X0, T1-X1)	Dual channel safety input II	Dual channel dependent input Dual channel NO/NC input	Y4	Y17
Muting input 1 (X2, X3)	Muting Input	—	Y5	
Safety input 2 (T4-X4, T5-X5)	Dual channel safety input II	Dual channel dependent input Dual channel NO/NC input	Y6	Y20
Muting input 2 (X6, X7)	Muting Input	—	Y7	
Safety input 3 (T10-X10, T11-X11)	Dual channel direct opening input	Dual channel NO/NC input Dual channel safety input II	Y10	—
Safety input 4 (T12-X12, T13-X13)	Dual channel direct opening input	Dual channel NO/NC input Dual channel safety input II	Y11	—

- **Safety outputs**

  The monitor output turns on when the target safety input is on and turns off when the safety input is off.

  The monitor output turns off immediately independent on set off-delay time.

	Monitor output
Safety output 1 (Y0, Y1)	Y12
Safety output 2 (Y2, Y3)	Y13

- **Reset inputs**

    Resets inputs are used to reset the safety output.

    Reset input 1 (X16)

    Reset input 2 (X17)

[icon]	• When both X16 and X17 are in the on state, the error LED displays "3" and the system moves to the Stop state. Use only one of them.

⚠ WARNING	• To prevent unexpected startup of the system, take safety measures to prevent the hazardous source from operating only with the reset input of FS1B. (for example, provide a start switch.)

- **External device monitor inputs**

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

    External device monitor input 1 (T14-X14): for safety output 1 (Y0, Y1)

    External device monitor input 2 (T15-X15): for safety output 2 (Y2, Y3)

- **State monitor outputs**

    State monitor outputs output internal state and error status.

	Initial/Configuration	Run	Protection	Stop
State monitor output 1 (Y14)	☐Off	☐Off	■On	■On
State monitor output 2 (Y15)	☐Off	☐Off	■On	☐Off
State monitor output 3 (Y16)	☐Off	■On	☐Off	☐Off

❏ Wiring example

Figure 5.16 Wiring example (Logic 31C)

S1, S4: Safety light curtains
S2, S3, S5, S6: Muting sensors
S7: Emergency stop switch
S8: Interlock switch
S9: Pushbutton
K1, K2, K3, K4: Forced guided relays

❏ Timing chart

Figure 5.17 Timing chart (Logic 31C)
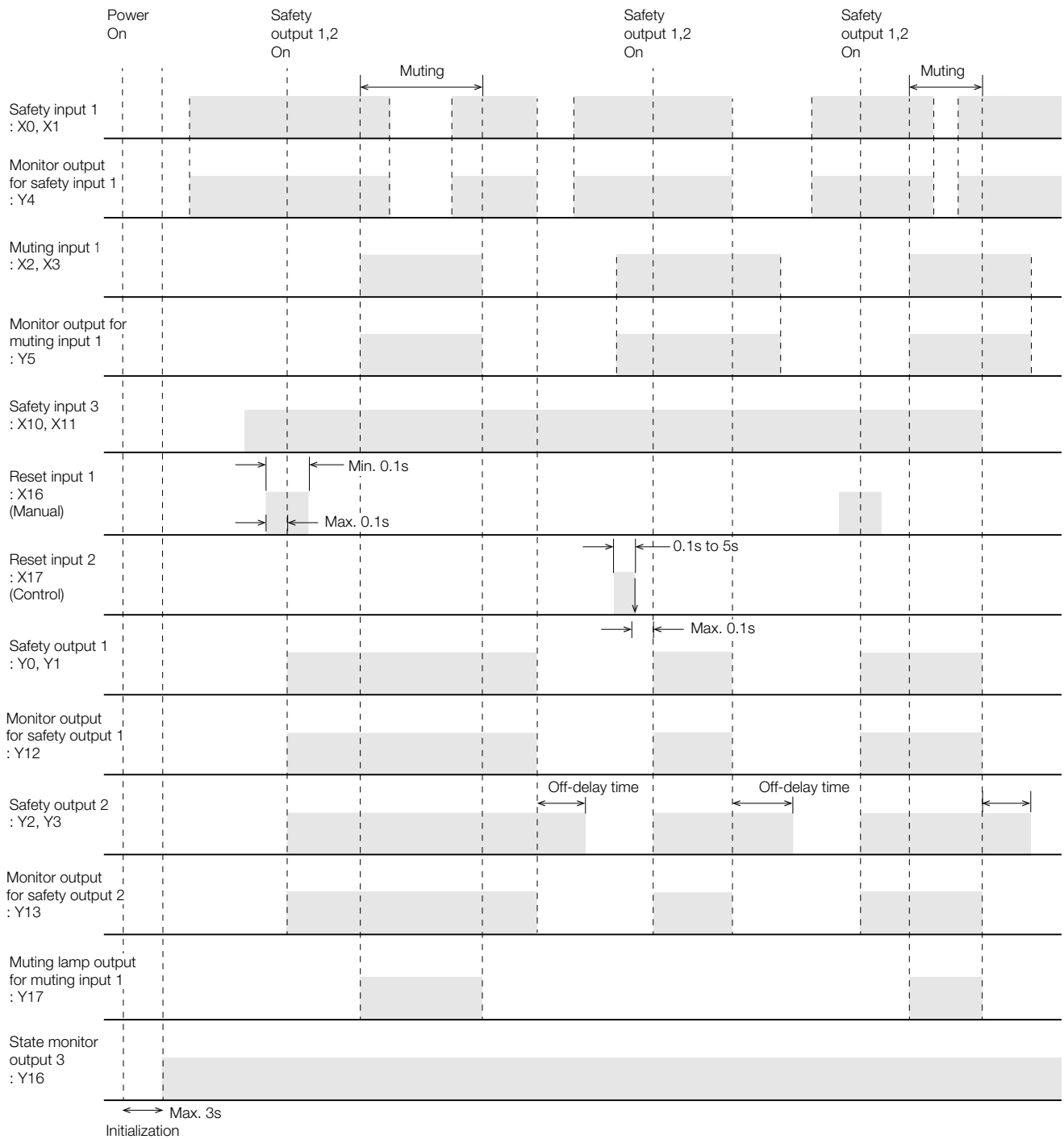
• Muting input 2 is all off, safety input 2 and safety input 4 are all on in this chart.

❑ Safety system configuration example

This section describes an example of using Logic 31C to implement safety measures for a robot system that includes conveyors and other transport devices.

⚠ **WARNING**	• The systems in this manual show just examples of intended use application. The user is responsible for safe integration in the overall system. Safety performance must be evaluated on a system-wide basis relevant standards (for example, ISO10218-1 and ISO10218-2), laws and regulations (for example, Machine Directive).) • To prevent unexpected startup, take safety measures to prevent the hazardous source from operating only with the reset input of FS1B. (for example, provide a start switch.) • Incorrect use of the muting function can lead to accidents. Please familiarize yourself with the muting function and use it correctly in accordance with the relevant standards. (for example, IEC61496-1, etc.) • If the muting function is enabled, the operator must ensure the safety of the protected area in an appropriate measure. (for example, by notifying the surrounding area with a muting lamp.)

• Safety system overview

Safety components to be used

	Safety components to be connected	Input functions
Safety input 1	Safety light curtain	Dual channel safety input II
Muting input 1	Muting Sensor	Muting Input
Safety input 2	Safety light curtain	Dual channel safety input II
Muting input 2	Muting sensor	Muting Input
Safety input 3	Emergency stop switch	Dual channel direct opening input
Safety input 4	Interlock switch	Dual channel direct opening input

Control object

	Control object
Safety output 1	Robot operation permission
Safety output 2	Robot power
Muting lamp output	Muting lamp

Before starting operation, make sure that the person is not inside the safety guard.

Additional safety measures should be applied as needed. (for example, use padlocks for interlock switches.)

The robot system can only be operated when the safety guard is closed and the safety light curtain is in the light receiving state.

The muting sensor detects the cargo carried by the conveyor system and activates the muting function, enabling operation even when the safety light curtains are blocked. When this occurs, the muting lamp illuminates to warn the operator.

Depending on the risk assessment of the entire system, a locking mechanism may be required for the safety guard.

(for example, implementation of unlocking after the robot has come to a complete stop.)
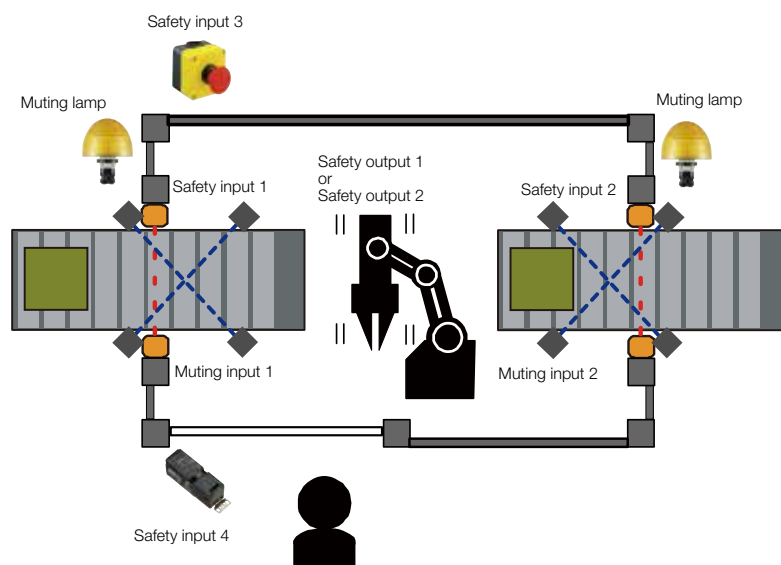
Figure 5.18 Safety system configuration example (Logic 31C)

⚠ **WARNING**	• Calculate the safety distances, while taking into consideration the response time of the FS1B and safety components connected to the FS1B.

Logic 31d: Circuit including a mode selecting function

❏ Logic circuit

Figure 5.19 Logic circuit (Logic 31d)

- **Safety inputs**

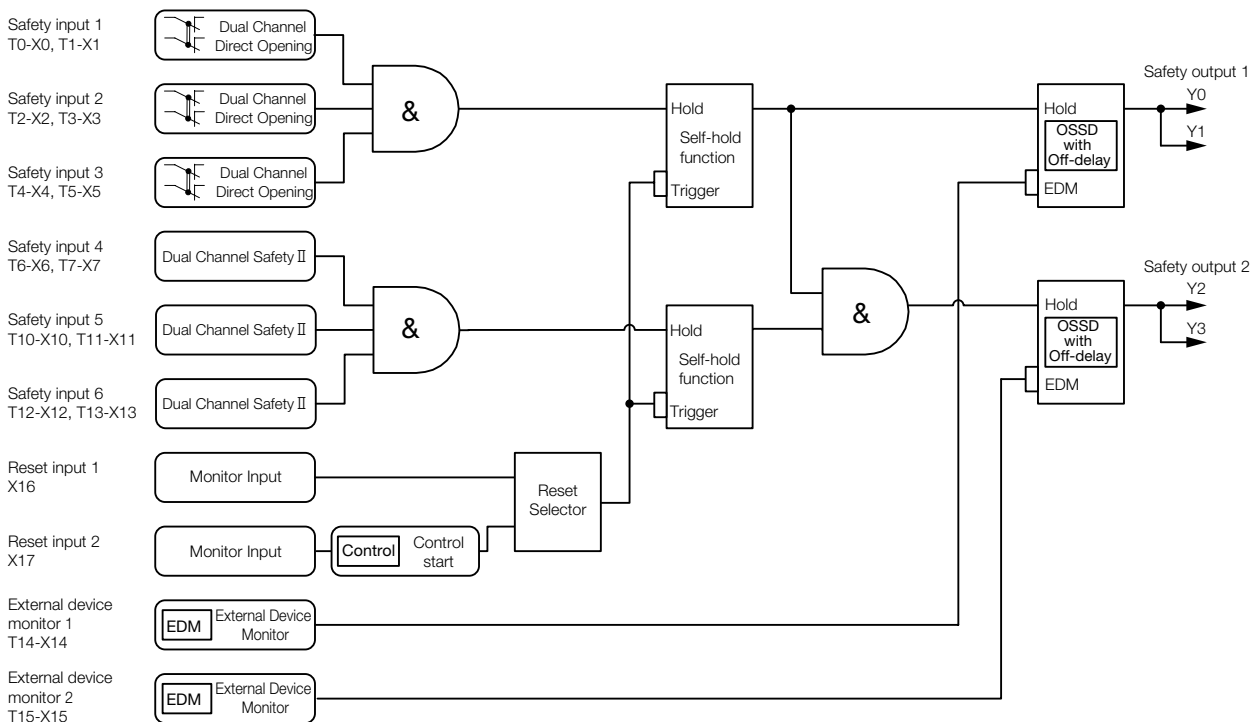 Some safety inputs can be changed input function. The monitor output turns on when the target safety input is on and turns off when the safety input is off.

	Initial input function	Optional input functions	Monitor output
Safety input 1 (T0-X0, X1)	Mode select input II	—	Y4 (On in teach mode (X0))
Safety input 2 (T2-X2, T3-X3)	Dual channel dependent input	Dual channel NO/NC input Dual channel safety input II	Y5
Safety input 3 (T4-X4, T5-X5)	Dual channel direct opening input	Dual channel NO/NC input Dual channel safety input II	Y6
Safety input 4 (T6-X6, T7-X7)	Dual channel direct opening input	Dual channel NO/NC input Dual channel safety input II	Y7
Safety input 5 (T10-X10, T11-X11)	Dual channel direct opening input	Dual channel NO/NC input Dual channel safety input II	Y10

- **Safety outputs**

  The monitor output turns on when the target safety output is on and turns off when the safety output is off.

  The monitor output turns off immediately independent on set off-delay time.

	Monitor output
Safety output 1-1 (Y0)	Y12
Safety output 1-2 (Y1)	Y13
Safety output 2 (Y2)	Y17
Safety output 3 (Y3)	Y20

• Reset inputs

Resets inputs are used to reset the safety output.

Reset input 1 (X16)

Reset input 2 (X17)

⚠ WARNING	• To prevent unexpected startup of the system, take safety measures to prevent the hazardous source from operating only with the reset input of FS1B. (for example, provide a start switch.)

• External device monitor inputs

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

External device monitor input 1 (T12-X12): for safety output 1-1 (Y0)

External device monitor input 2 (T13-X13): for safety output 1-2 (Y1)

External device monitor input 3 (T14-X14): for safety output 2 (Y2)

External device monitor input 4 (T15-X15): for safety output 3 (Y3)

• State monitor outputs

State monitor outputs output internal state and error status.

	Initial/Configuration	Run	Protection	Stop
State monitor output 1 (Y14)	☐Off	☐Off	■On	■On
State monitor output 2 (Y15)	☐Off	☐Off	■On	☐Off
State monitor output 3 (Y16)	☐Off	■On	☐Off	☐Off

❏ Wiring example

Figure 5.20 Wiring example (Logic 31d)

S1: Selector switch
S2: Enabling switch
S4: Interlock switch
S5: Emergency stop switch
S6, S7: Pushbuttons
K1, K2, K3, K4, K5, K6, K7, K8
: Forced guided relays
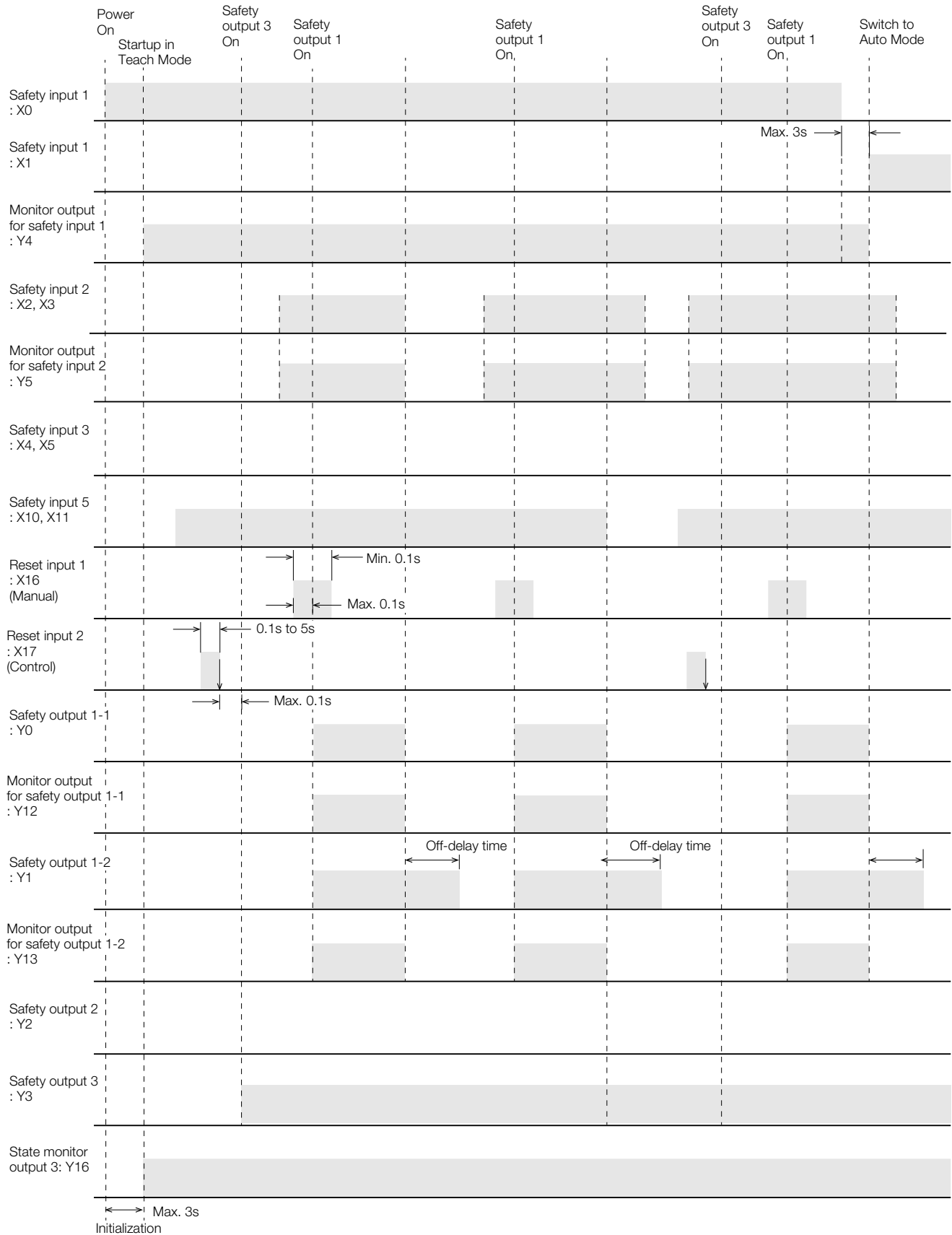
❏ **Timing chart**

• Safety input 4 is all on in this chart.

Figure 5.21 Timing chart (Logic 31d Teach mode)
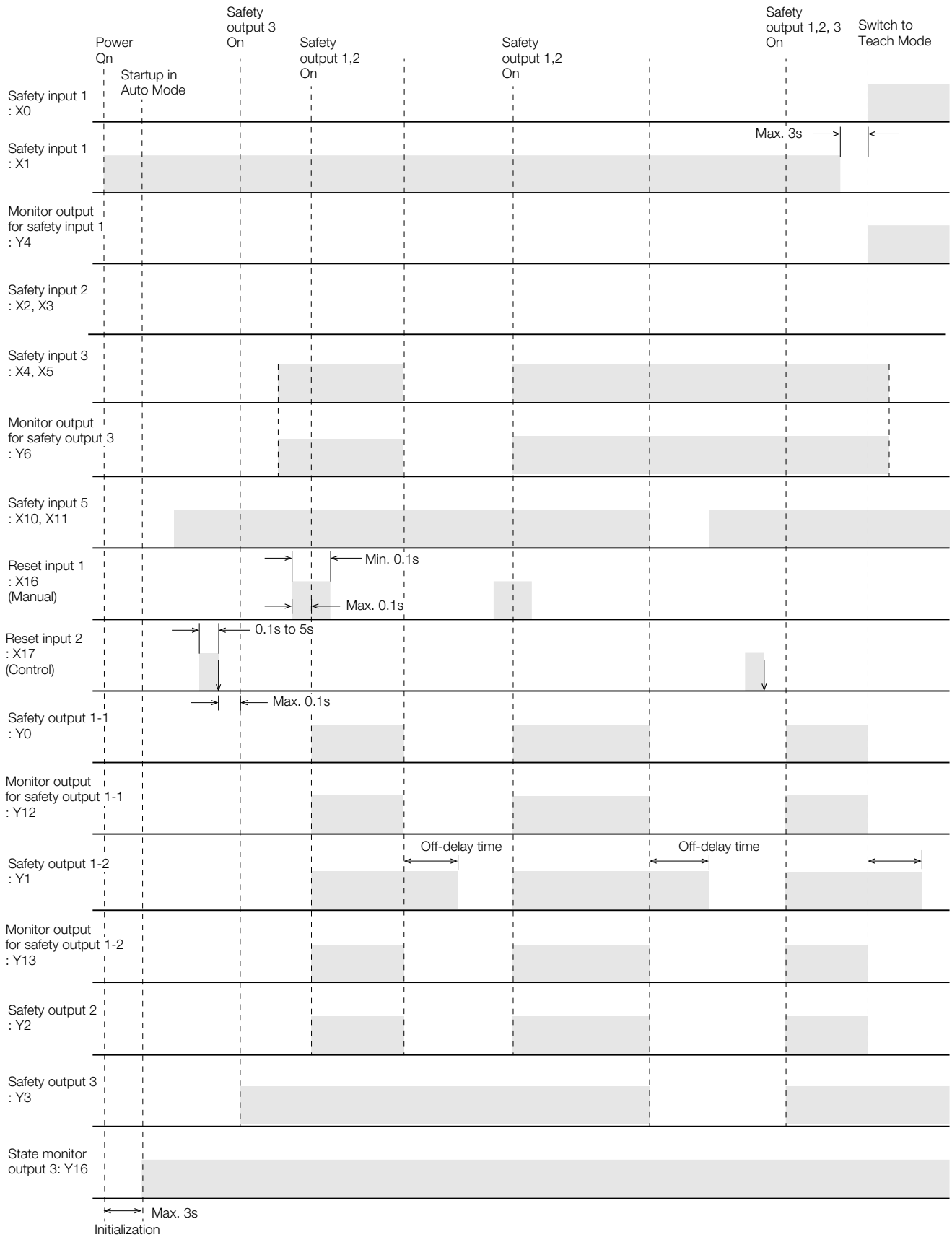
Figure 5.22 Timing chart (Logic 31d Auto mode)

• Safety input 4 is all on in this chart.

❏ Safety system configuration example

This section describes an example of using logic 31d to implement safety measures for machine tools.

⚠️ **WARNING**	• The systems in this manual show just examples of intended use application. The user is responsible for safe integration in the overall system. Safety performance must be evaluated on a system-wide basis relevant standards (for example, ISO16090-1), laws and regulations (for example, Machine Directive). • When using logic that includes a mode select input, the operating mode set by the system should be displayed for the operator to verify the operating mode of the system. (for example, the monitor output of the product is taken into the system, information on the system operation mode is processed as a safety parameter, and the result of the setting is displayed on the display.) • To prevent unexpected startup, take safety measures to prevent the hazardous source from operating only with the reset input of FS1B. (for example, provide a start switch.) • Safety measures in the entire system shall be taken to reduce the as then The FS1B is not capable of monitoring the speed of hazardous source.

• Safety System Overview

Safety components to be used

	Safety components to be connected	Input functions	Active mode
Safety input 1	Selector switch	Mode select input II	—
Safety input 2	Enabling switch	Dual channel dependent input	Teach mode
Safety input 3	Interlock switch	Dual channel direct opening input	Auto mode
Safety input 4	Interlock switch	Dual channel direct opening input	Auto mode
Safety input 5	Emergency stop switch	Dual channel direct opening input	Teach mode Auto mode

Control object

	Control object
Safety output 1-1	Machine tool operating permission
Safety output 1-2	Machine tool power
Safety output 2	Peripherals
Safety output 3	Entire system

- **Teach mode**

  Select the teach mode when teaching the machine tool. The machine tool can be operated only when the enabling switch is set to the operation-allowed state (position 2). At this time, the machine tool must be properly speed-limited so as not to endanger the operator.
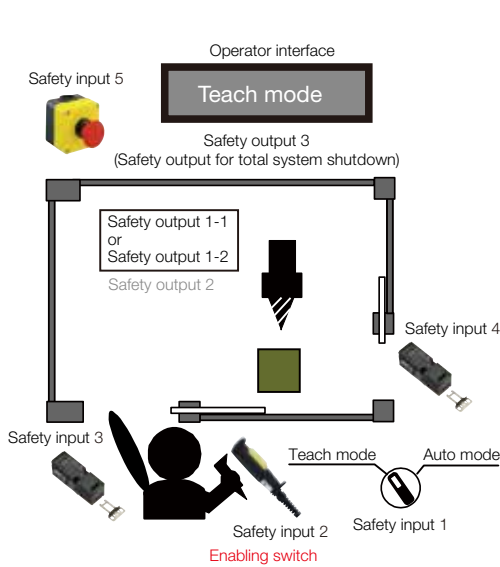
Figure 5.23 Safety system configuration example (Logic 31d Teach mode)
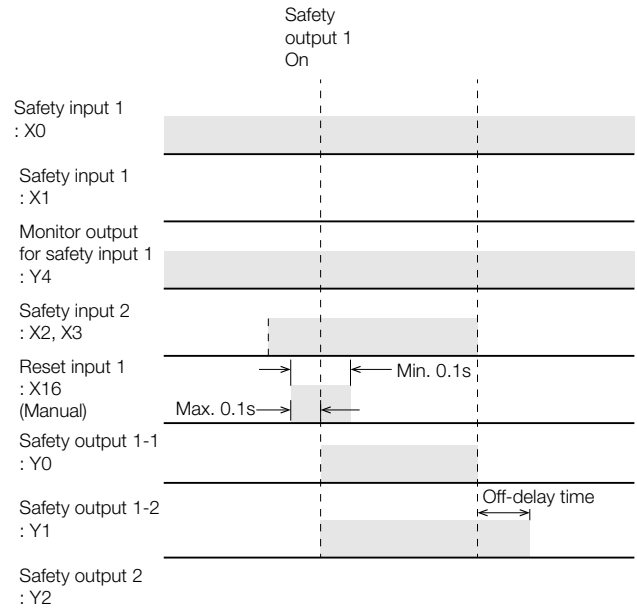
Figure 5.24 Timing chart (Logic 31d Teach mode)

- **Auto mode**

  Select the auto mode when during normal operation of the machine tool.

  Before starting normal operation, make sure that the person is not inside the safety guard. Additional safety measures should be applied as needed. (for example, use padlocks for interlock switches.)

  The machine tool can be operated only when the safety guard is closed. Depending on the risk assessment of the entire system, a locking mechanism may be required for the safety guard. (for example, after the machine tool has come to a complete stop, the unlocking process is performed.)
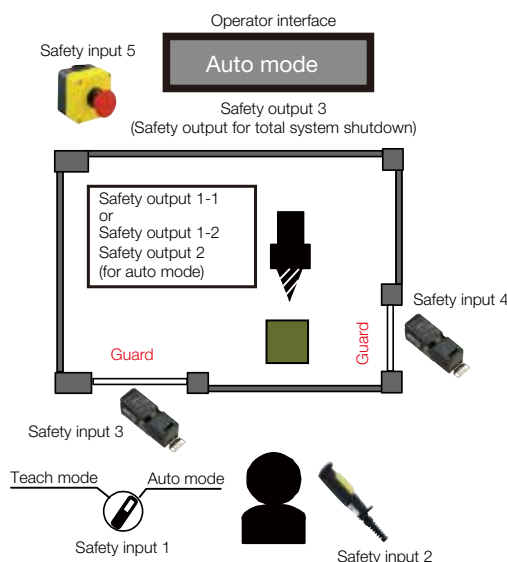
Figure 5.25 Safety system configuration example (Logic 31d Auto mode)
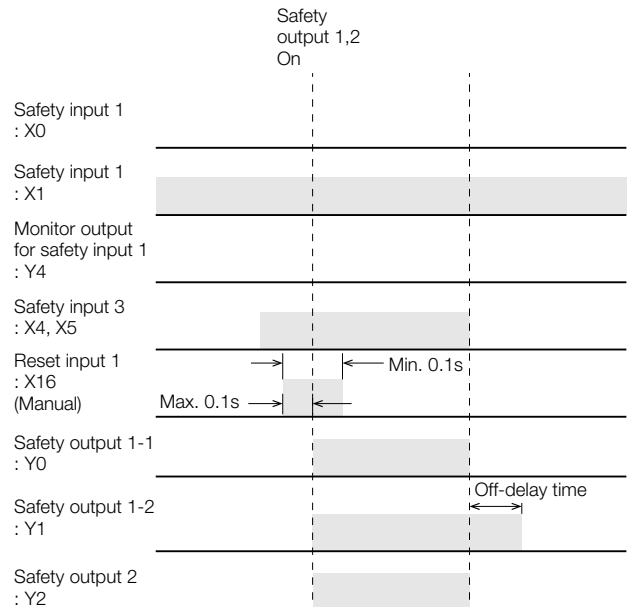
Figure 5.26 Timing chart (Logic 31d Auto mode)

⚠ WARNING	• Calculate the safety distances, while taking into consideration the response time of the FS1B and safety components connected to the FS1B.

Logic 302: Partial stop circuit
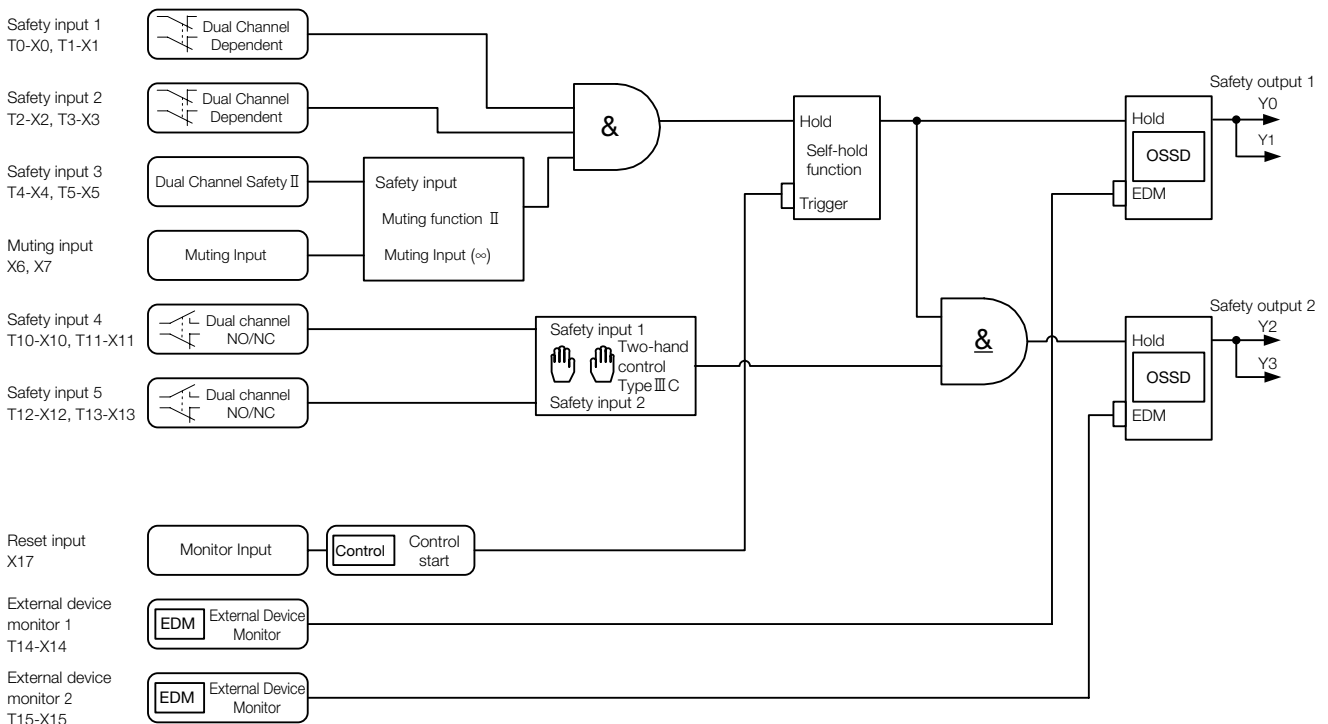
❏ Logic circuit

Figure 5.27 Logic circuit (Logic 302)

• Safety inputs

Some safety inputs can be changed input function. The monitor output turns on when the target safety input is on and turns off when the safety input is off.

	Initial input function	Optional input functions	Monitor output
Safety input 1 (T0-X0, T1-X1)	Dual channel direct opening input	Dual channel NO/NC input Dual channel safety input II	Y4
Safety input 2 (T2-X2, T3-X3)	Dual channel direct opening input	Dual channel NO/NC input Dual channel safety input II	Y5
Safety input 3 (T4-X4, T5-X5)	Dual channel direct opening input	Dual channel NO/NC input Dual channel safety input II	Y6
Safety input 4 (T6-X6, T7-X7)	Dual channel safety input II	Dual channel dependent input Dual channel NO/NC input	Y7
Safety input 5 (T10-X10, T11-X11)	Dual channel safety input II	Dual channel dependent input Dual channel NO/NC input	Y10
Safety input 6 (T12-X12, T13-X13)	Dual channel safety input II	Dual channel dependent input Dual channel NO/NC input	Y11

• Safety outputs

The monitor output turns on when the target safety output is on and turns off when the safety output is off.

The monitor output turns off immediately independent on set off-delay time.

The solenoid output turns on if the safety output is off and any of the safety inputs are off. When all safety inputs are turned on, the solenoid output is turned off.

	Monitor output	Solenoid output (*1)
Safety output 1 (Y0, Y1)	Y12	Y17
Safety output 2 (Y2, Y3)	Y13	Y20

*1 Solenoid output is turned off outside Run state.

- **Reset inputs**

  Resets inputs are used to reset the safety output.

  Reset input 1 (X16)

  Reset input 2 (X17)

> • When both X16 and X17 are turned on, the error LED displays "3" and the device enters the Stop state. Use only one of them.

> **WARNING** • To prevent unexpected startup of the system, take safety measures to prevent the hazardous source from operating only with the reset input of FS1B. (for example, provide a start switch, etc.)

- **External device monitor inputs**

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

  External device monitor input 1 (T14-X14): for safety output 1(Y0, Y1)

  External device monitor input 2 (T15-X15): for safety output 2(Y2, Y3)

- **State monitor outputs**

  State monitor outputs output internal state and error status.

	Initial/Configuration	Run	Protection	Stop
State monitor output 1 (Y14)	□Off	□Off	■On	■On
State monitor output 2 (Y15)	□Off	□Off	■On	□Off
State monitor output 3 (Y16)	□Off	■On	□Off	□Off

❏ Wiring example

S1, S2: Emergency stop switches
S3: Interlock switch
S4, S5, S6: Safety light curtain
S7: Pushbutton
K1, K2, K3, K4: Forced guided relays

Figure 5.28 Wiring example (Logic 302)

❏ Timing chart
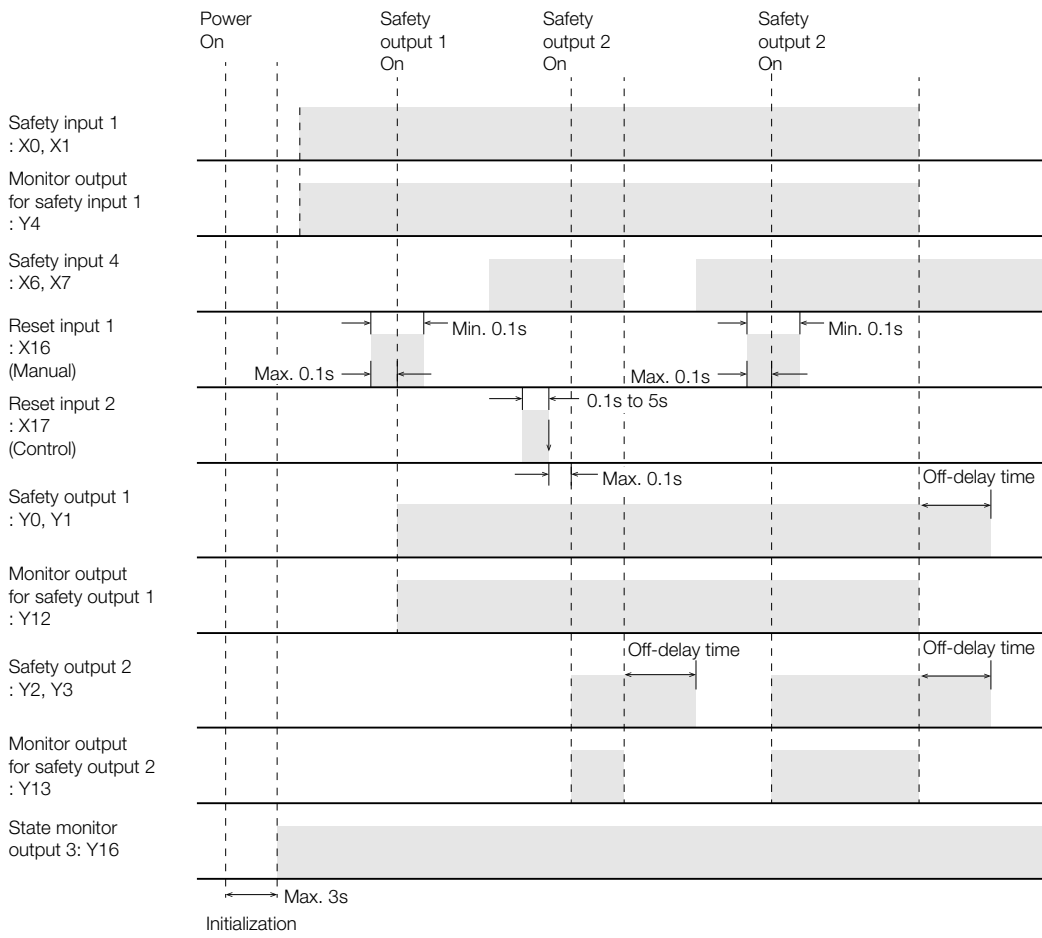
• Safety inputs 2, 3, 5, and 6 are all on in this chart.

Figure 5.29 Wiring example (Logic 302)

❑ Safety system configuration example

This section describes an example of using Logic 302 to implement safety measures for a robotic system.

⚠ WARNING	• The systems in this manual show just examples of intended use application. The user is responsible for safe integration in the overall system. Safety performance must be evaluated on a system-wide basis relevant standards (for example, ISO10218-1 and ISO10218-2), laws and regulations (for example, Machine Directive).) • To prevent unexpected startup, take safety measures to prevent the hazardous source from operating only with the reset input of FS1B. (for example, provide a start switch, etc.)

• Safety system overview

Safety components to be used

	Safety components to be connected	Input functions
Safety input 1	Emergency stop switch	Dual channel direct opening input
Safety input 2	Emergency stop switch	Dual channel direct opening input
Safety input 3	Interlock switch	Dual channel direct opening input
Safety input 4	Safety light curtain	Dual channel safety input II
Safety input 5	Safety light curtain	Dual channel safety input II
Safety input 6	Safety light curtain	Dual channel safety input II

Control object

	Control object
Safety output 1	Entire system
Safety output 2	Robot operation permission

Before starting operation, make sure that the person is not inside the safety guard or near a robot other hazardous source.

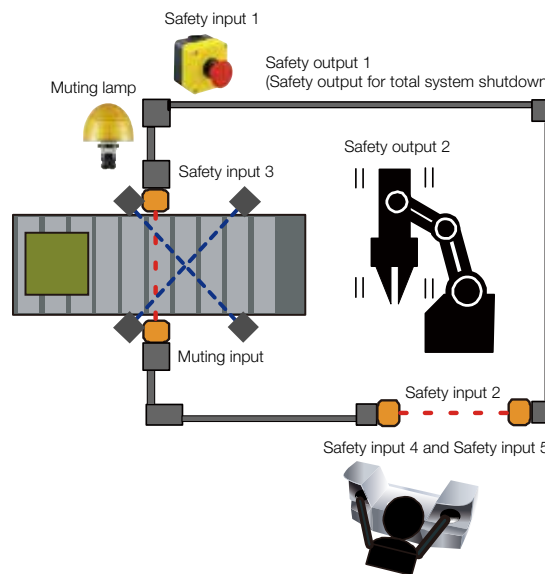The robot system can only operate when the safety guard is closed.
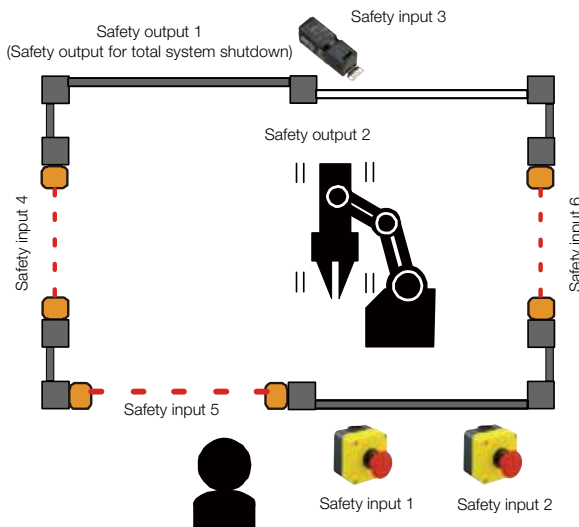
Figure 5.30 Safety system configuration example (Logic 302)

⚠ WARNING	• Calculate the safety distances, while taking into consideration the response time of the FS1B and safety components connected to the FS1B.

Logic 32A: Circuit including muting function and two-hand control input
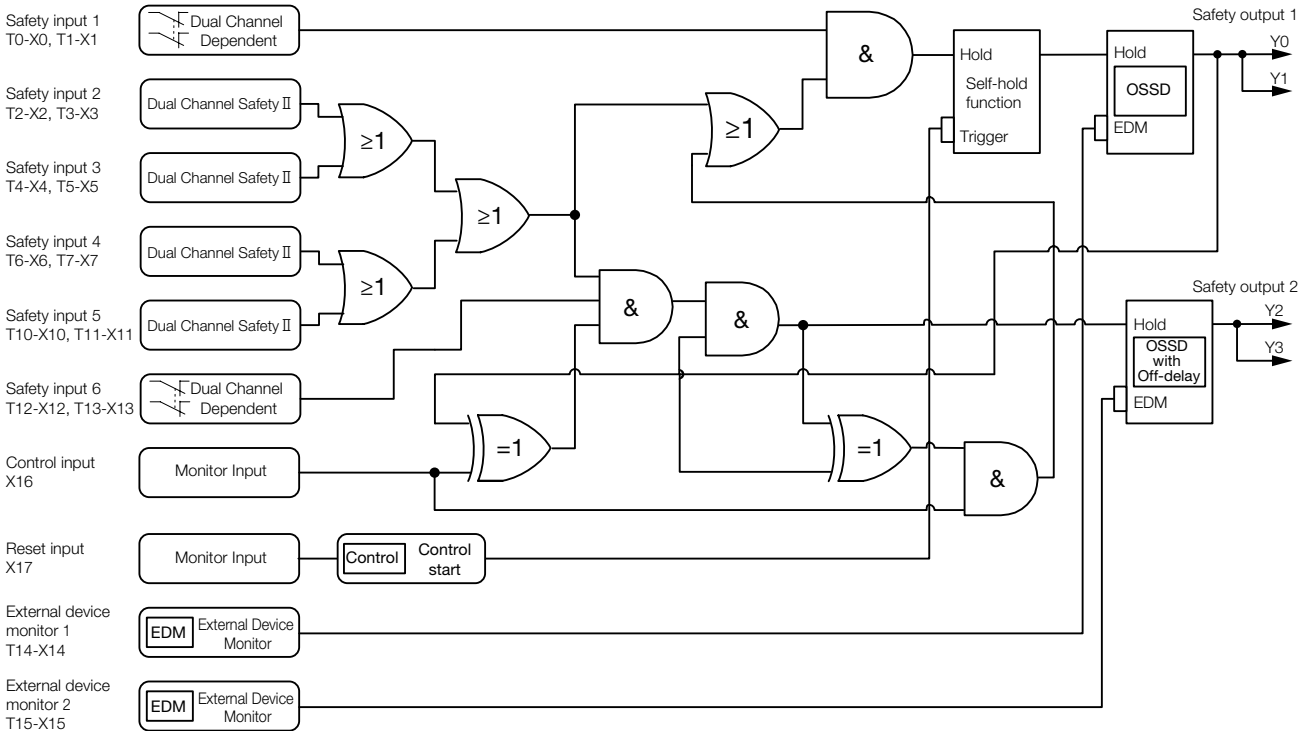
❏ Logic circuit

Figure 5.31 Logic circuit (Logic 32A)

- **Safety inputs**

  Some safety inputs can be changed input function. The monitor output turns on when the target safety input is on and turns off when the safety input is off.

  The muting lamp output turns on in the muting state. The muting state is enabled when muting input is turned on while safety output 1 is on. The muting state is disabled when the muting input is turned off. When the power is turned on or the safety output is turned off while the muting input is on, the muting state is not enabled unless the muting input is turned off once.

  The two-hand control function is turned on when safety input 4 and safety input 5 are turned on at the same time (within 0.5s) while safety output 1 is on. When the power is turned on or the safety output 2 are turned off while safety input 4 and safety input 5 are on, two-hand control function does not turn on unless safety input 4 and safety input 5 are turned off once.

	Initial input function	Optional input functions	Monitor output	Muting lamp output
Safety input 1 (T0-X0, T1-X1)	Dual channel dependent input	Dual channel NO/NC input Dual channel safety input II	Y4	—
Safety input 2 (T2-X2, T3-X3)	Dual channel dependent input	Dual channel NO/NC input Dual channel safety input II	Y5	—
Safety input 3 (T4-X4, T5-X5)	Dual channel safety input II	Dual channel dependent input Dual channel NO/NC input	Y6	Y17
Muting Input (X6, X7)	Muting Input	—	Y7	
Safety input 4 (T10-X10, T11-X11)	Dual channel NO/NC input	Dual channel dependent input Dual channel safety input II	Y10	—
Safety input 5 (T12-X12, T13-X13)	Dual channel NO/NC input	Dual channel dependent input Dual channel safety input II	Y11	—

- **Safety outputs**

  The monitor output turns on when the target safety output is on and turns off when the safety output is off.

	Monitor output
Safety output 1 (Y0, Y1)	Y12
Safety output 2 (Y2, Y3)	Y13

• Reset inputs

Resets inputs are used to reset the safety output.

Reset input 2 (X17)

⚠	WARNING	• To prevent unexpected startup of the system, take safety measures to prevent the hazardous source from operating only with the reset input of FS1B. (for example, provide a start switch, etc.)

• External device monitor inputs

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

External device monitor input 1 (T14-X14): for safety output 1 (Y0, Y1)

External device monitor input 2 (T15-X15): for safety output 2 (Y2, Y3)

• State monitor outputs

State monitor outputs output internal state and error status.

	Initial/Configuration	Run	Protection	Stop
State monitor output 1 (Y14)	☐Off	☐Off	■On	■On
State monitor output 2 (Y15)	☐Off	☐Off	■On	☐Off
State monitor output 3 (Y16)	☐Off	■On	☐Off	☐Off

• Two-hand control monitor output

Two-hand control monitor output is turned on when safety input 4 and safety input 5 are turned on at the same time (within 0.5s).

When the power is turned on while safety input 4 and safety input 5 are on, two-hand control monitor output does not turn on unless safety input 4 and safety input 5 are turned off once.

Two-hand control monitor output (Y20)

❏ **Wiring example**

Figure 5.32 Wiring example (Logic 32A)
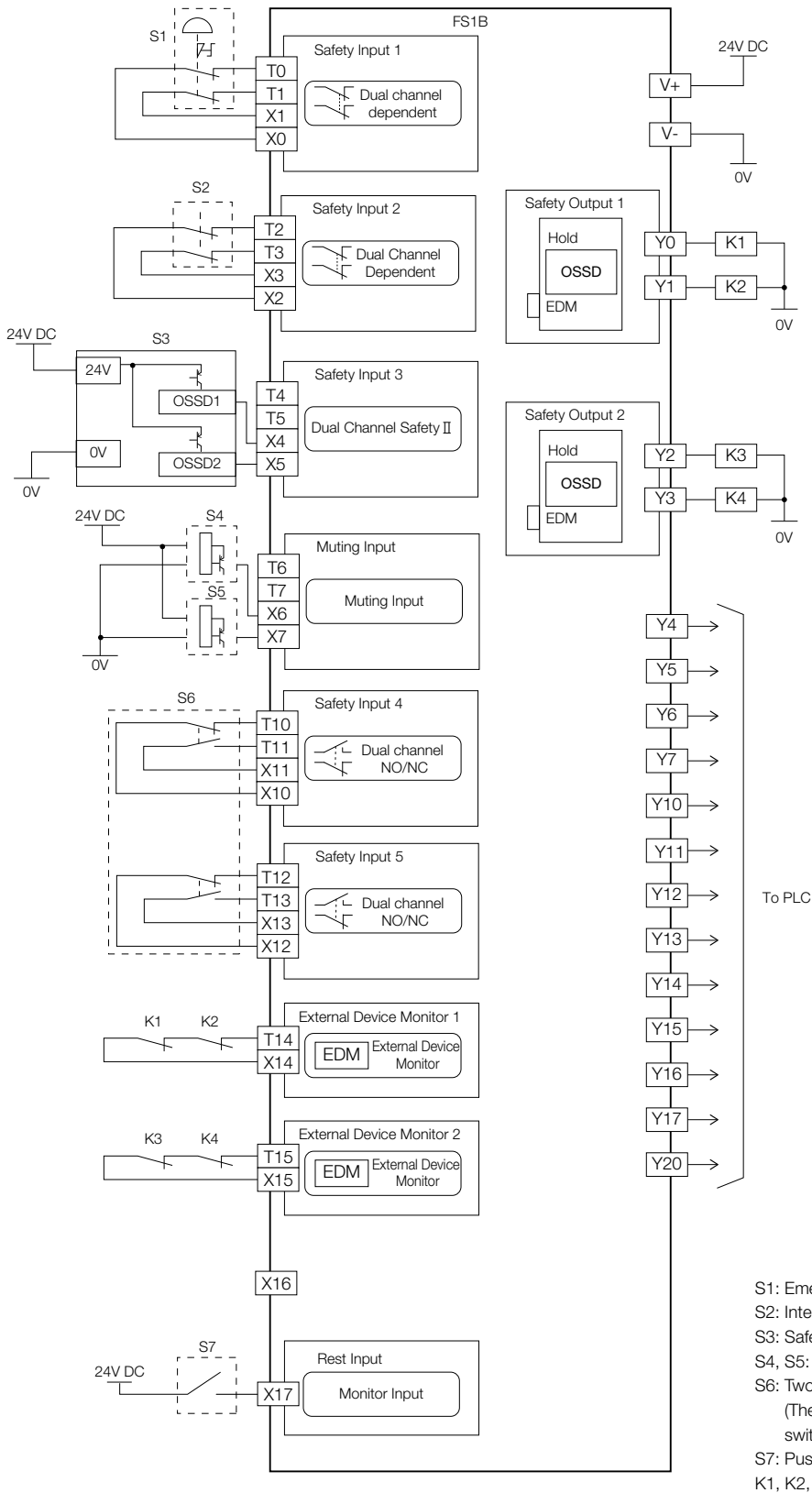
S1: Emergency stop switch
S2: Interlock switch
S3: Safety light curtain
S4, S5: Muting sensors
S6: Two-hand control switch
(The contact state in figure 5.32 is the state in which the switch is not pressed.)
S7: Pushbutton
K1, K2, K3, K4: Forced guided relays
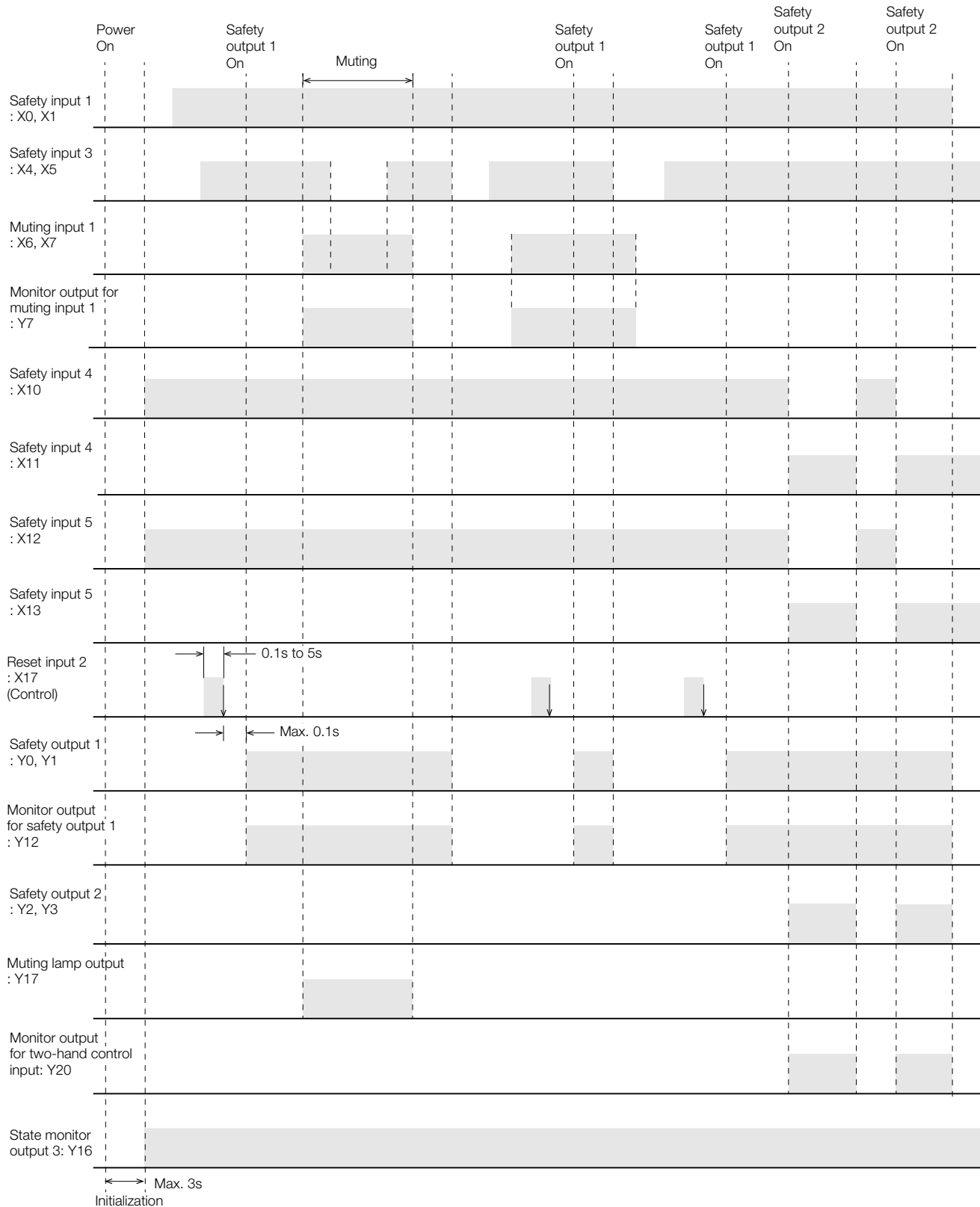
❏ Timing chart

Figure 5.33 Timing chart (Logic 32A)

• Safety input 2 is all on in this chart.

❏ Safety system configuration example

This section describes an example of using Logic 32A to implement safety measures for a press.

⚠	WARNING	• The systems in this manual show just examples of intended use application. The user is responsible for safe integration in the overall system. Safety performance must be evaluated on a system-wide basis relevant standards (for example, ISO13851), laws and regulations (for example, Machine Directive). • To prevent unexpected startup, take safety measures to prevent the hazardous source from operating only with the reset input of FS1B. (for example, provide a start switch, etc.) • Incorrect use of the muting function can lead to accidents. Relevant standards (for example, IEC61496-1, etc.), familiarize yourself with the muting function and use it correctly. • If the muting function is enabled, the operator must ensure the safety of the protected area in appropriate measures. (for example, by notifying the surrounding area with a muting lamp, etc.)

• Safety system overview

Safety components to be used

	Safety components to be connected	Input functions
Safety input 1	Emergency stop switch	Dual channel dependent input
Safety input 2	Safety light curtain	Dual channel safety input II
Safety input 3	Safety light curtain	Dual channel safety input II
Muting input 1	Muting sensor	Muting input
Safety input 4	Two-hand control switch	Dual channel NO/NC input
Safety input 5		Dual channel NO/NC input

Control object

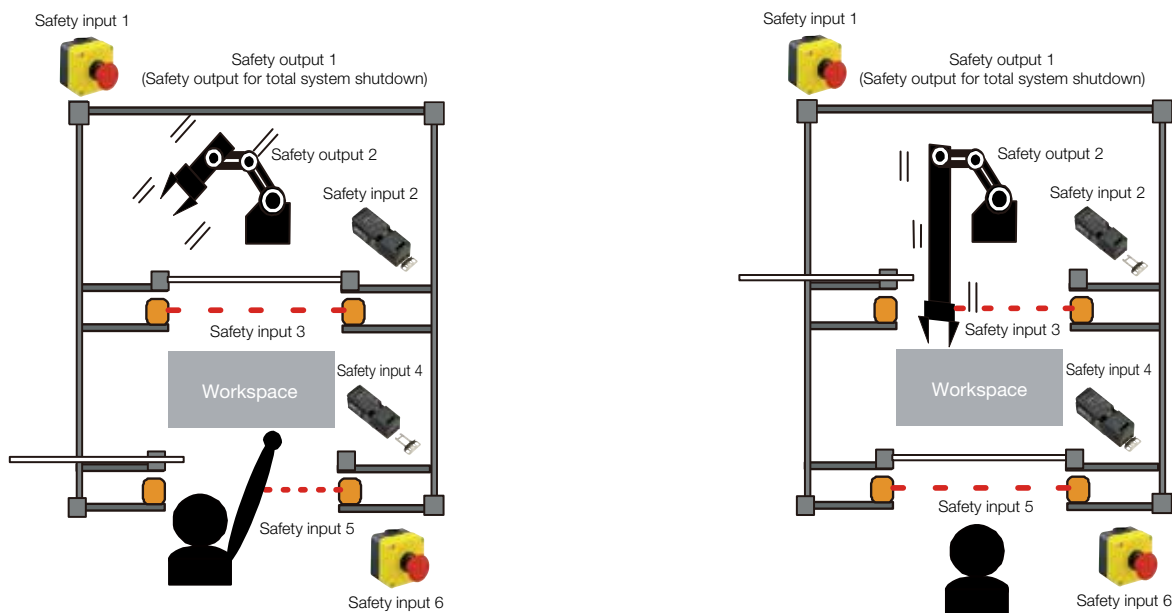|	Control object
Safety output 1	Entire system
Safety output 2	Press action allowed

Figure 5.34 Safety system configuration example (Logic 32A)

⚠	WARNING	• Calculate the safety distances, while taking into consideration the response time of the FS1B and safety components connected to the FS1B.

Logic 32b: Circuit including an OR and a XOR function
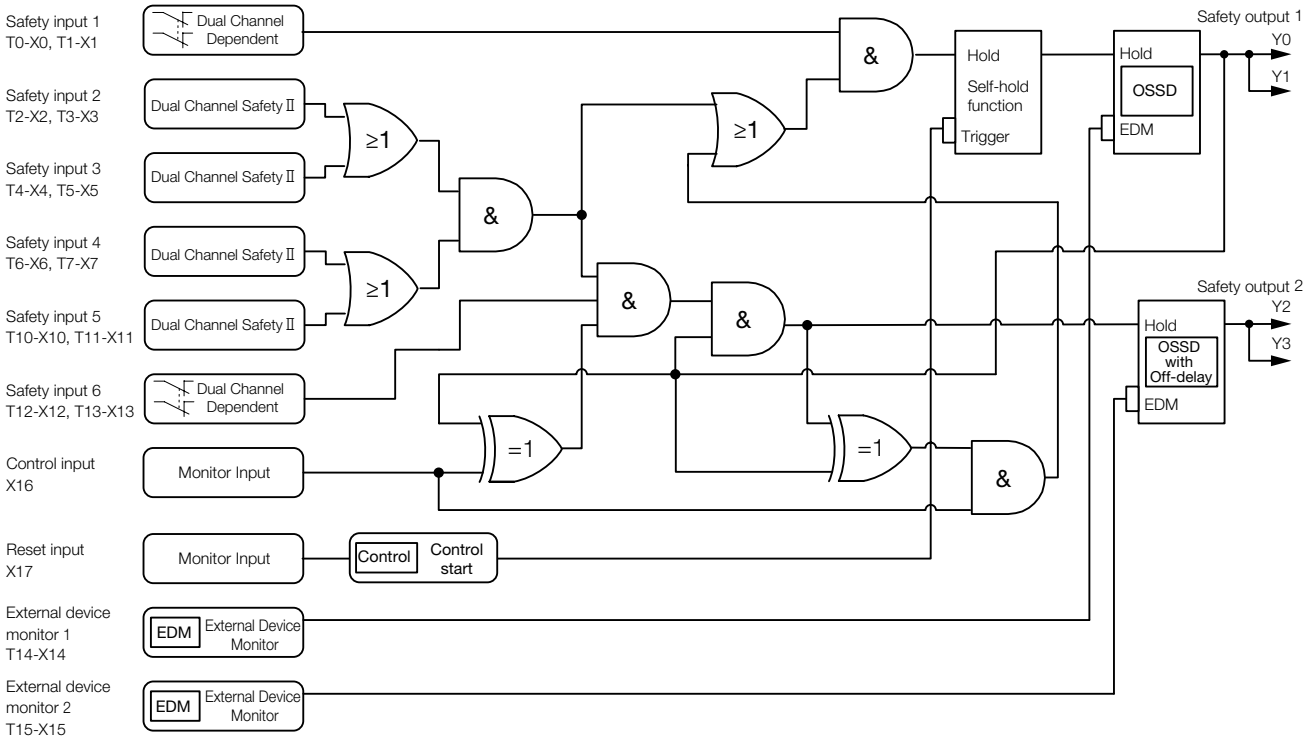
❏ Logic circuit

Figure 5.35 Logic circuit (Logic 32b)

- **Safety inputs**

    Some safety inputs can be changed input function. The monitor output turns on when the target safety input is on and turns off when the safety input is off.

	Initial input function	Optional input functions	Monitor output
Safety input 1 (T0-X0, T1-X1)	Dual channel dependent input	Dual channel NO/NC input Dual channel safety input II	Y4
Safety input 2 (T2-X2, T3-X3)	Dual channel safety input II	Dual channel dependent input Dual channel NO/NC input	Y5
Safety input 3 (T4-X4, T5-X5)	Dual channel safety input II	Dual channel dependent input Dual channel NO/NC input	Y6
Safety input 4 (T6-X6, T7-X7)	Dual channel safety input II	Dual channel dependent input Dual channel NO/NC input	Y7
Safety input 5 (T10-X10, T11-X11)	Dual channel safety input II	Dual channel dependent input Dual channel NO/NC input	Y10
Safety input 6 (T12-X12, T13-X13)	Dual channel dependent input	Dual channel NO/NC input Dual channel safety input II	Y11

- **Safety outputs**

    The monitor output turns on when the target safety input is on and turns off when the safety input is off.

    The monitor output turns off immediately independent on set off-delay time.

	Monitor output
Safety output 1 (Y0, Y1)	Y12
Safety output 2 (Y2, Y3)	Y13

• **Control input**

Control inputs are used to control the safety output.

Control input 1 (X16)

⚠ WARNING	• Control inputs are not safety inputs. Do not use as a safety input since the hazardous source may not stop due to connected equipment or input circuit failure.

• **Reset inputs**

Resets inputs are used to reset the safety output.

Reset input 2 (X17)

⚠ WARNING	• To prevent unexpected startup of the system, take safety measures to prevent the hazardous source from operating only with the reset input of FS1B. (for example, provide a start switch, etc.)

• **External device monitor inputs**

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

External device monitor input 1 (T14-X14): for safety output 1 (Y0, Y1)

External device monitor input 2 (T15-X15): for safety output 2 (Y2, Y3)

• **State monitor outputs**

State monitor outputs output internal state and error status.

	Initial/Configuration	Run	Protection	Stop
State monitor output 1 (Y14)	☐Off	☐Off	■On	■On
State monitor output 2 (Y15)	☐Off	☐Off	■On	☐Off
State monitor output 3 (Y16)	☐Off	■On	☐Off	☐Off

❏ **Wiring example**

Figure 5.36 Wiring example (Logic 32b)

S1, S6: Emergency stop switches
S2, S4: Interlock switches
S3, S5: Safety light curtains
S7, S8: Pushbuttons
K1, K2, K3, K4: Forced guided relays
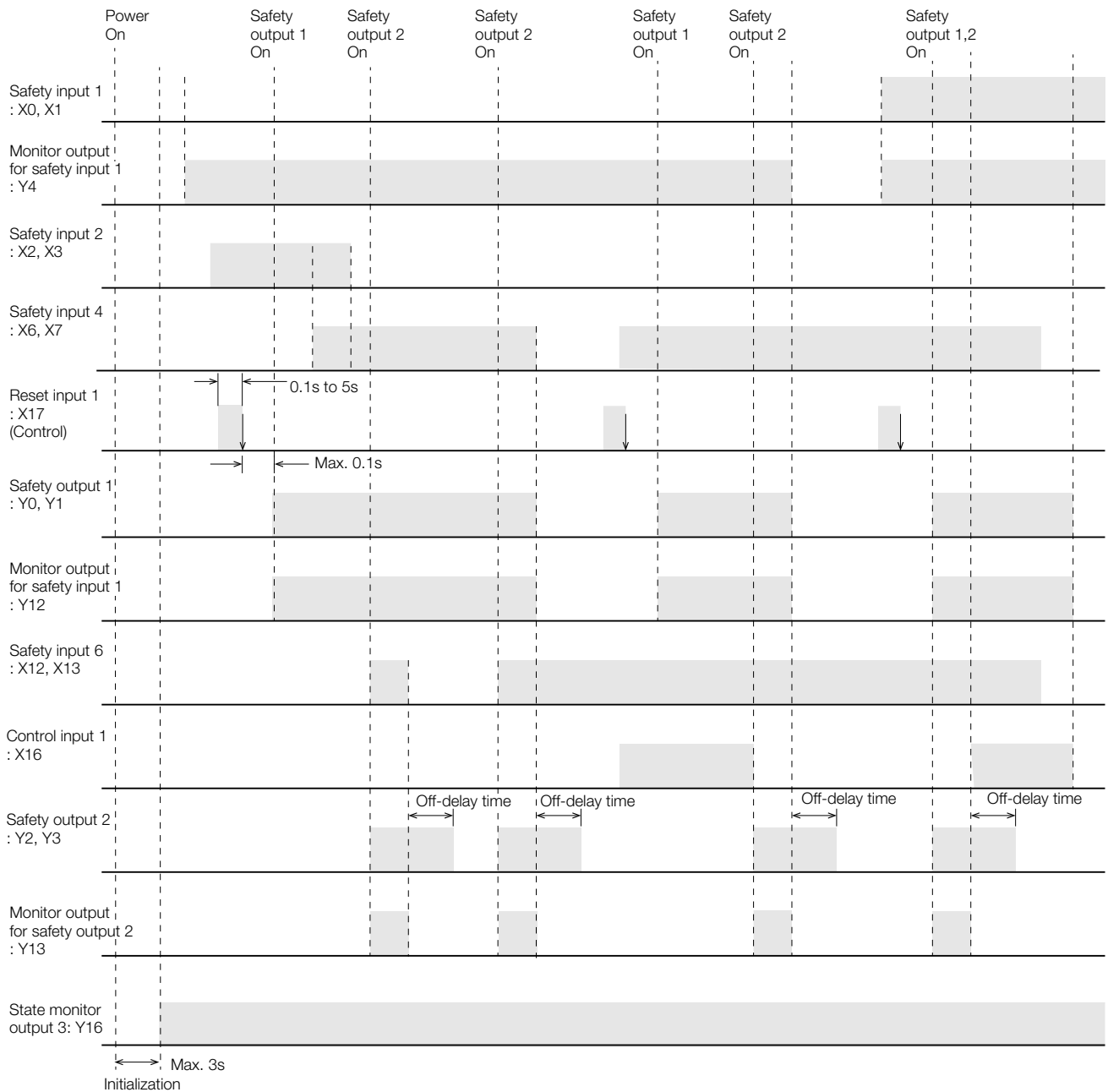
❑ **Timing chart**

Figure 5.37 Timing chart (Logic 32b)

• Safety input 3 and safety input 5 are all on in this chart.

❏ Safety system configuration example

This section describes an example of using logic 32b to implement safety measures for a robotic system.

⚠ WARNING	• The systems in this manual show just examples of intended use application. The user is responsible for safe integration in the overall system. Safety performance must be evaluated on a system-wide basis relevant standards (for example, ISO10218-1 and ISO10218-2), laws and regulations (for example, Machine Directive). • To prevent unexpected startup, take safety measures to prevent the hazardous source from operating only with the reset input of FS1B. (for example, provide a start switch, etc.)

• Safety system overview

Safety components to be used

	Safety components to be connected	Input functions
Safety input 1	Emergency stop switch	Dual channel dependent input
Safety input 2	Interlock switch	Dual channel safety input II
Safety input 3	Safety light curtain	Dual channel safety input II
Safety input 4	Interlock switch	Dual channel safety input II
Safety input 5	Safety light curtain	Dual channel safety input II
Safety input 6	Emergency stop switch	Dual channel direct opening input

Control object

	Control object
Safety output 1	Entire system
Safety output 2	Robot operation permission

The robot and the operator cannot approach the workbench at the same time. If the operator attempts to approach the workbench while the robot is close to the workbench, the robot will stop.

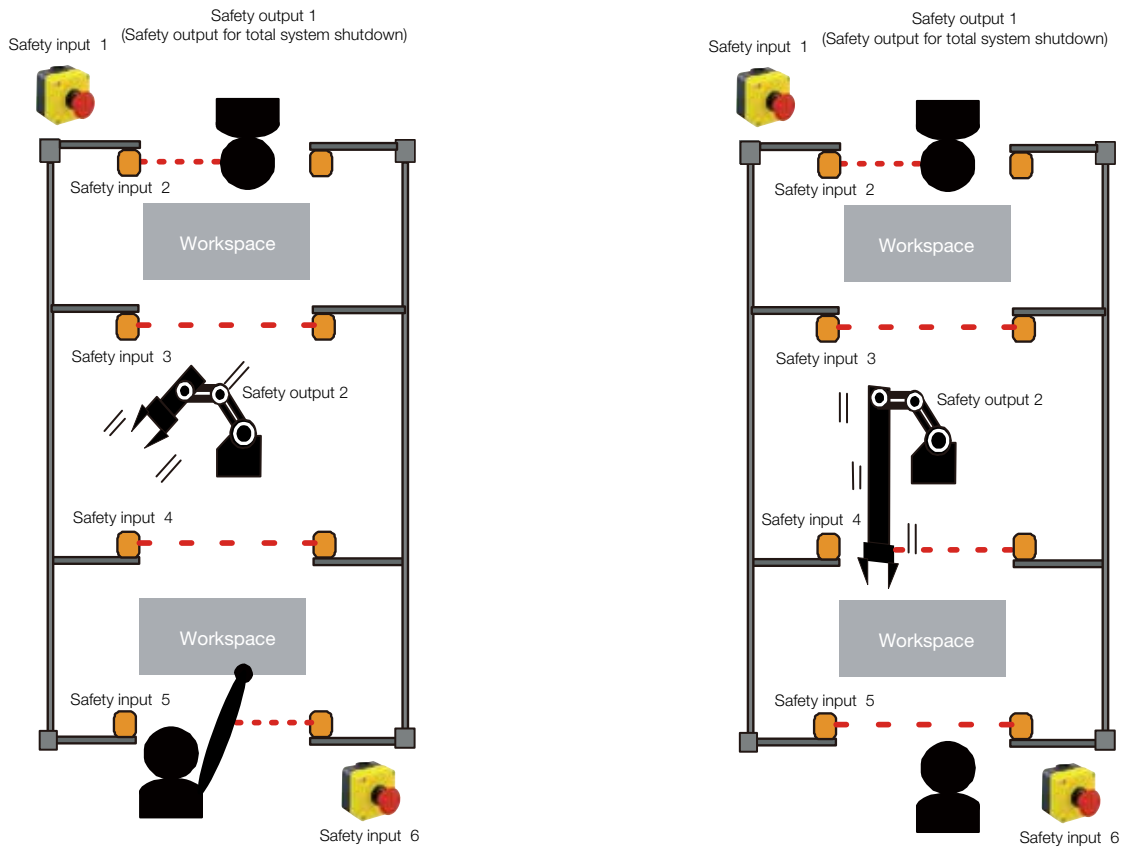Figure 5.38 Safety system configuration example (Logic 32b)

⚠ WARNING	• Calculate the safety distances, while taking into consideration the intrusion speed of the response time of the FS1B and safety components connected to the FS1B.

Logic 32C: Circuit including an OR and a XOR function
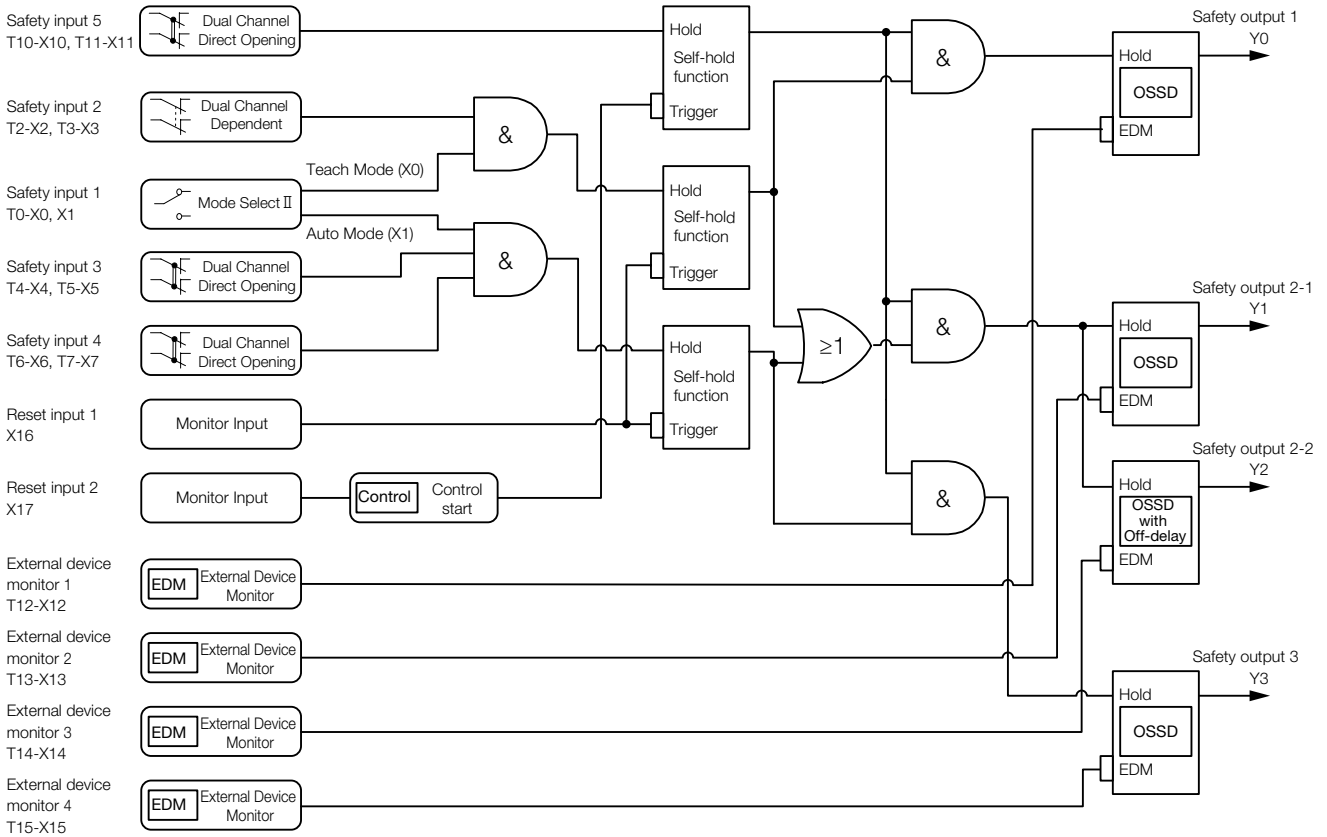
❏ Logic circuit

Figure 5.39 Logic circuit (Logic 32C)

• **Safety inputs**

Some safety inputs can be changed input function. The monitor output turns on when the target safety input is on and turns off when the safety input is off.

	Initial input function	Optional input functions	Monitor output
Safety input 1 (T0-X0, T1-X1)	Dual channel dependent input	Dual channel NO/NC input Dual channel safety input II	Y4
Safety input 2 (T2-X2, T3-X3)	Dual channel safety input II	Dual channel dependent input Dual channel NO/NC input	Y5
Safety input 3 (T4-X4, T5-X5)	Dual channel safety input II	Dual channel dependent input Dual channel NO/NC input	Y6
Safety input 4 (T6-X6, T7-X7)	Dual channel safety input II	Dual channel dependent input Dual channel NO/NC input	Y7
Safety input 5 (T10-X10, T11-X11)	Dual channel safety input II	Dual channel dependent input Dual channel NO/NC input	Y10
Safety input 6 (T12-X12, T13-X13)	Dual channel dependent input	Dual channel NO/NC input Dual channel safety input II	Y11

• **Safety outputs**

The monitor output turns on when the target safety output is on and turns off when the safety output is off.

The monitor output turns off immediately independent on set off-delay time.

	Monitor output
Safety output 1 (Y0, Y1)	Y12
Safety output 2 (Y2, Y3)	Y13

• Control input

Control inputs are used to control the safety output.

Control input (X16)

⚠ **WARNING**	• Control inputs are not safety inputs. Do not use as a safety input since the hazardous source may not stop due to connected equipment or input circuit failure.

• Reset inputs

Resets inputs are used to reset the safety output.

Reset input (X17)

⚠ **WARNING**	• To prevent unexpected startup of the system, take safety measures to prevent the hazardous source from operating only with the reset input of FS1B. (for example, provide a start switch, etc.)

• External device monitor inputs

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

External device monitor input 1 (T14-X14): for safety output 1 (Y0, Y1)

External device monitor input 2 (T15-X15): for safety output 2 (Y2, Y3)

• State monitor outputs

State monitor outputs output internal state and error status.

	Initial/Configuration	Run	Protection	Stop
State monitor output 1 (Y14)	☐Off	☐Off	■On	■On
State monitor output 2 (Y15)	☐Off	☐Off	■On	☐Off
State monitor output 3 (Y16)	☐Off	■On	☐Off	☐Off

❑ **Wiring example**

Figure 5.40 Wiring example (Logic 32C)

S1, S6: Emergency stop switches
S2, S3, S4, S5: Safety light curtains
S7, S8: Pushbuttons
K1, K2, K3, K4: Forced guided relays
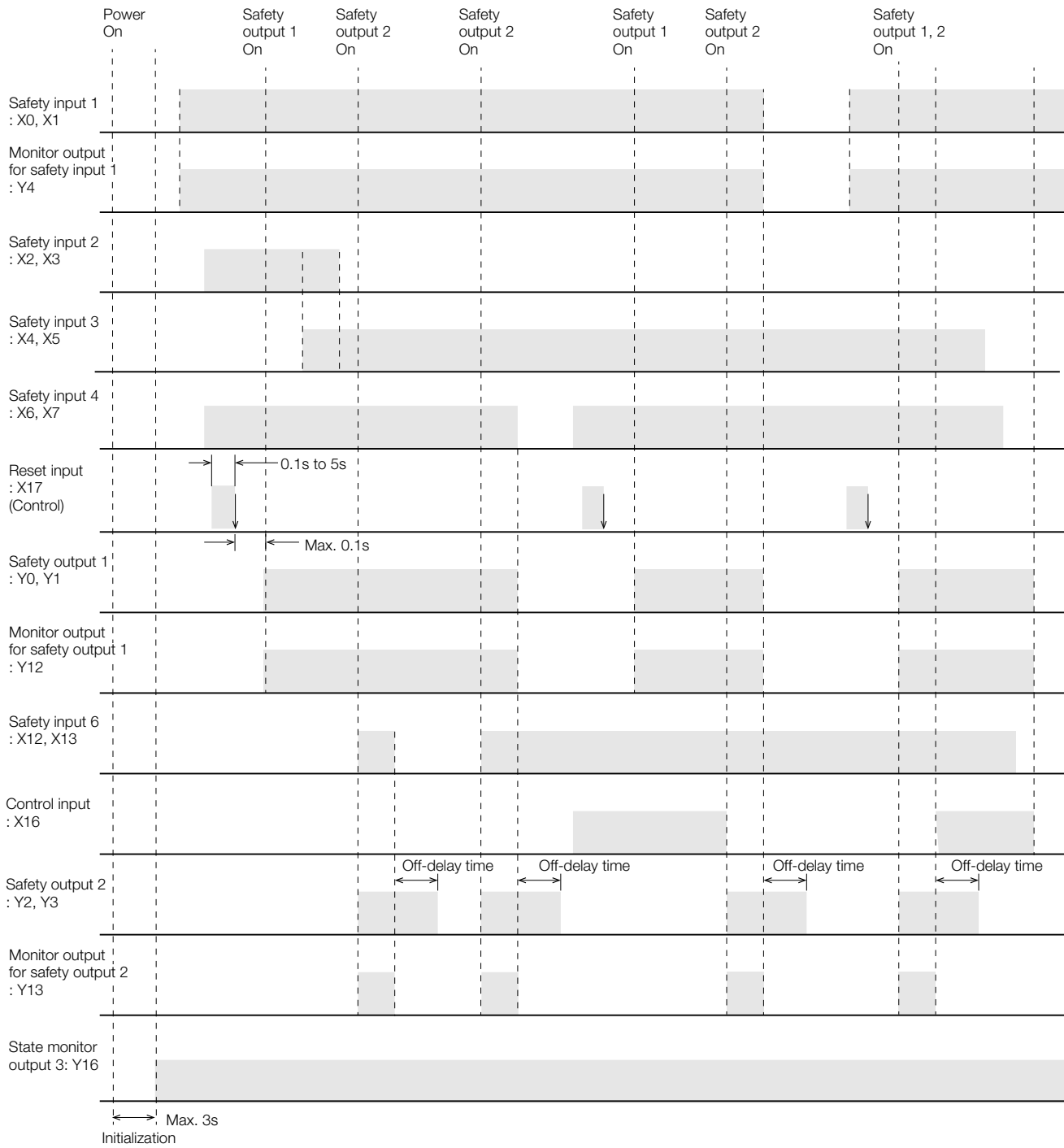
❏ Timing chart

Figure 5.41 Timing chart (Logic 32C)

• Safety input 5 is all on in this chart.

❏ Safety system configuration example

This section describes an example of using logic 32C to implement safety measures for a robotic system.

⚠ WARNING	• The systems in this manual show just examples of intended use application. The user is responsible for safe integration in the overall system. Safety performance must be evaluated on a system-wide basis relevant standards (for example, ISO10218-1 and ISO10218-2), laws and regulations (for example, Machine Directive). • To prevent unexpected startup, take safety measures to prevent the hazardous source from operating only with the reset input of FS1B. (for example, provide a start switch, etc.)

• **Safety system overview**

Safety components to be used

	Safety components to be connected	Input functions
Safety input 1	Emergency stop switch	Dual channel dependent input
Safety input 2	Safety light curtain	Dual channel safety input II
Safety input 3	Safety light curtain	Dual channel safety input II
Safety input 4	Safety light curtain	Dual channel safety input II
Safety input 5	Safety light curtain	Dual channel safety input II
Safety input 6	Emergency stop switch	Dual channel dependent input

Control object

	Control object
Safety output 1	Entire system
Safety output 2	Robot operation permission

The robot and the operator cannot approach the workbench at the same time. If the operator attempts to approach the workbench while the robot is close to the workbench, the robot will stop.

Figure 5.42 Safety system configuration example (Logic 32C)

⚠	WARNING	• Calculate the safety distances, while taking into consideration the intrusion speed of the response time of the FS1B and safety components connected to the FS1B.

Logic 32d: Partial stop circuit including a mode selecting function

❏ Logic circuit

Figure 5.43 Logic circuit (Logic 32d)

• Safety inputs

Some safety inputs can be changed input function. The monitor output turns on when the target safety input is on and turns off when the safety input is off.

	Initial input function	Optional input functions	Monitor output
Safety input 1 (T0-X0, X1)	Mode select input	—	Y4 (On in teach mode (X0))
Safety input 2 (T2-X2, T3-X3)	Dual channel dependent input	Dual channel NO/NC input Dual channel safety input II	Y5
Safety input 3 (T4-X4, T5-X5)	Dual channel direct opening input	Dual channel NO/NC input Dual channel safety input II	Y6
Safety input 4 (T6-X6, T7-X7)	Dual channel direct opening input	Dual channel NO/NC input Dual channel safety input II	Y7
Safety input 5 (T10-X10, T11-X11)	Dual channel direct opening input	Dual channel NO/NC input Dual channel safety input II	Y10

• Safety outputs

The monitor output turns on when the target safety output is on and turns off when the safety output is off.

The monitor output turns off immediately independent on set off-delay time.

	Monitor output
Safety output 1 (Y0)	Y12
Safety output 2-1 (Y1)	Y13
Safety output 2-2 (Y2)	Y17
Safety output 3 (Y3)	Y20

- **Reset inputs**

  Resets inputs are used to reset the safety output.

  Reset input 1 (X16)

  Reset input 2 (X17)

⚠	**WARNING**	• To prevent unexpected startup of the system, take safety measures to prevent the hazardous source from operating only with the reset input of FS1B. (for example, provide a start switch, etc.)

- **External device monitor inputs**

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

  External device monitor input 1 (T12-X12): for safety output 1 (Y0)

  External device monitor input 2 (T13-X13): for safety output 2-1 (Y1)

  External device monitor input 3 (T14-X14): for safety output 2-2 (Y2)

  External device monitor input 4 (T15-X15): for safety output 3 (Y3)

- **State monitor outputs**

  State monitor outputs output internal state and error status.

	Initial/Configuration	Run	Protection	Stop
State monitor output 1 (Y14)	☐Off	☐Off	■On	■On
State monitor output 2 (Y15)	☐Off	☐Off	■On	☐Off
State monitor output 3 (Y16)	☐Off	■On	☐Off	☐Off

❑ Wiring example

Figure 5.44 Wiring example (Logic 32d)

S1: Selector switch
S2: Enabling switch
S4: Interlock switch
S5: Emergency stop switch
S6, S7: Pushbuttons
K1, K2, K3, K4, K5, K6, K7, K8: Forced guided relays
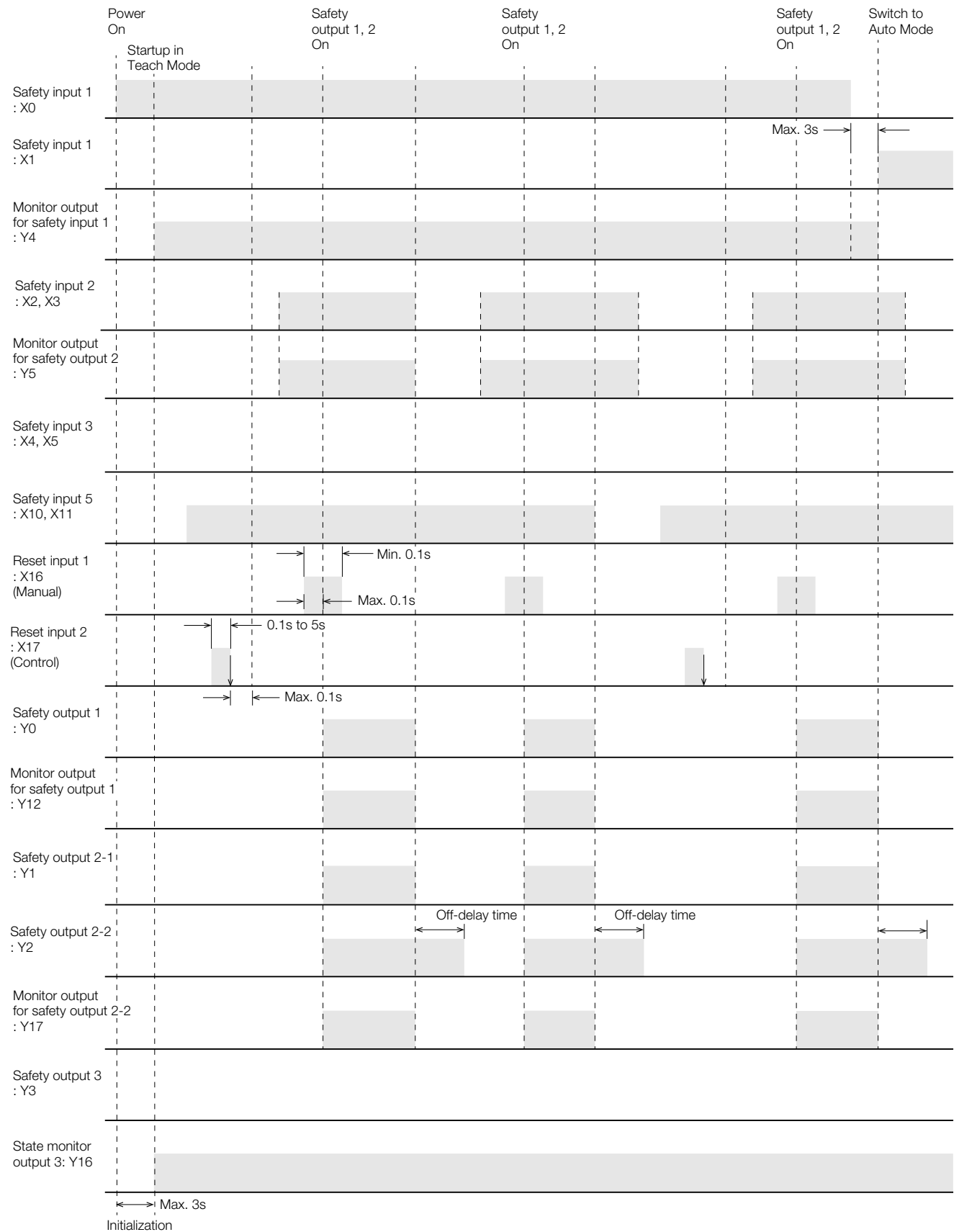
❏ **Timing chart**

• Safety input 4 is all on in this chart.

Figure 5.45 Timing chart (Logic 32d Teach mode)
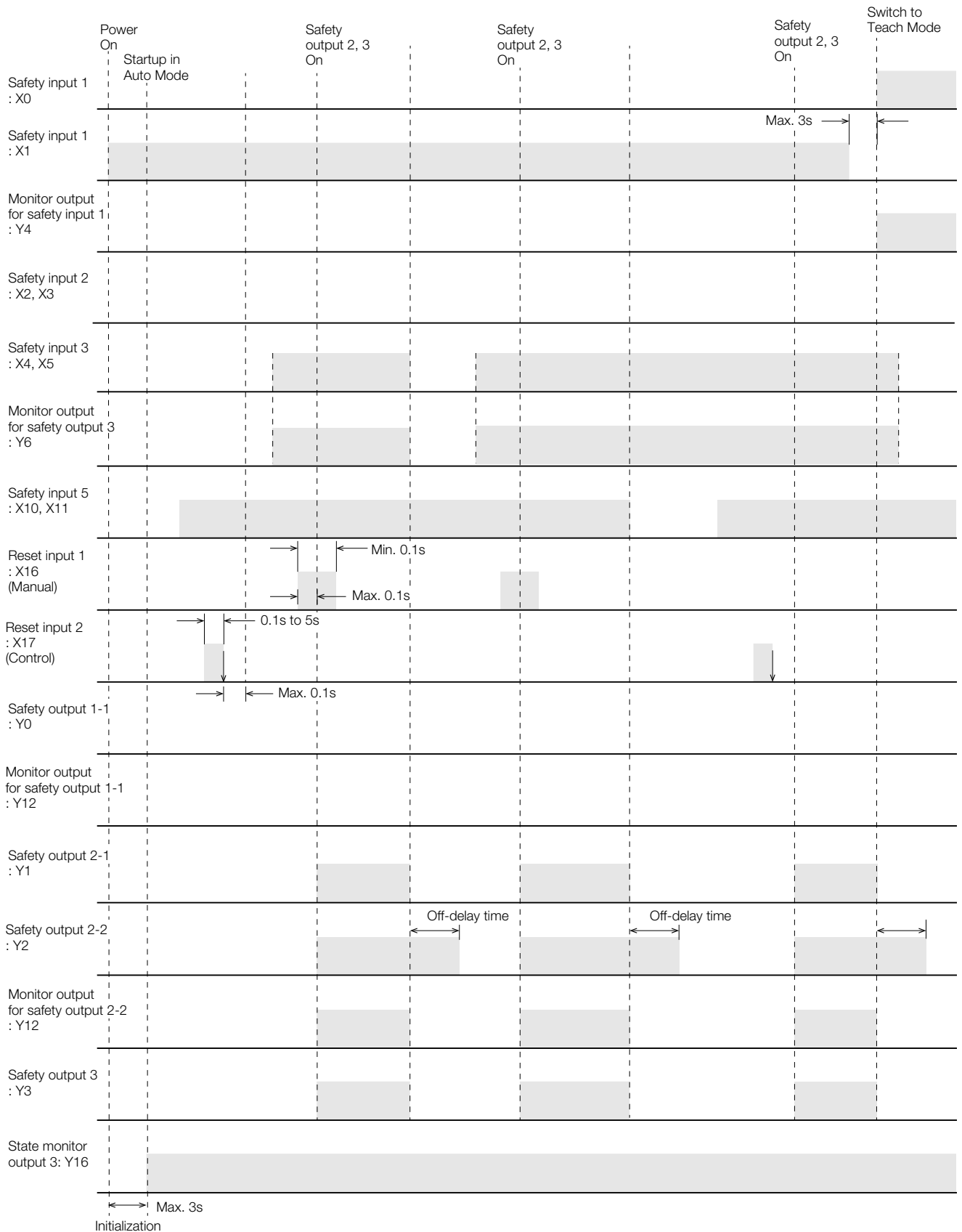
Figure 5.46 Timing chart (Logic 32d Auto mode)

• Safety input 4 is all on in this chart.

❏ Safety system configuration example

This section describes an example of using logic 32d to implement safety measures for machine tools.

⚠ WARNING	• The systems in this manual show just examples of intended use application. The user is responsible for safe integration in the overall system. Safety performance must be evaluated on a system-wide basis relevant standards (for example, ISO16090-1), laws and regulations (for example, Machine Directive). • When using logic that includes a mode select input, the operating mode set by the system should be displayed for the operator to verify the operating mode of the system. (for example, the monitor output of the product is taken into the system, information on the system operation mode is processed as a safety parameter, and the result of the setting is displayed on the display, etc.) • To prevent unexpected startup, take safety measures to prevent the hazardous source from operating only with the reset input of FS1B. (for example, provide a start switch, etc.) • Safety measures in the entire system shall be taken to reduce the as then The FS1B is not capable of monitoring the speed of hazardous source.

• **Safety system overview**

Safety components to be used

	Safety components to be connected	Input functions	Active mode
Safety input 1	Selector switch	Mode select input	—
Safety input 2	Enabling switch	Dual channel dependent input	Teach mode
Safety input 3	Interlock switch	Dual channel direct opening input	Auto mode
Safety input 4	Interlock switch	Dual channel direct opening input	Auto mode
Safety input 5	Emergency stop switch	Dual channel direct opening input	Teach mode Auto mode

Control object

	Control object	Active mode
Safety output 1	Machine tool operating permission	Teach mode
Safety output 2-1	Machine tool operating permission	Teach mode Auto mode
Safety output 2-2	Machine tool power	Teach mode Auto mode
Safety output 3	Machine tool operating permission	Auto mode

- **Teach mode**

  Select the teach mode when teaching the machine tool. The machine tool can be operated only when the enabling switch is set to the operation-allowed state (position 2). At this time, the machine tool must be properly speed-limited so as not to endanger the operator.
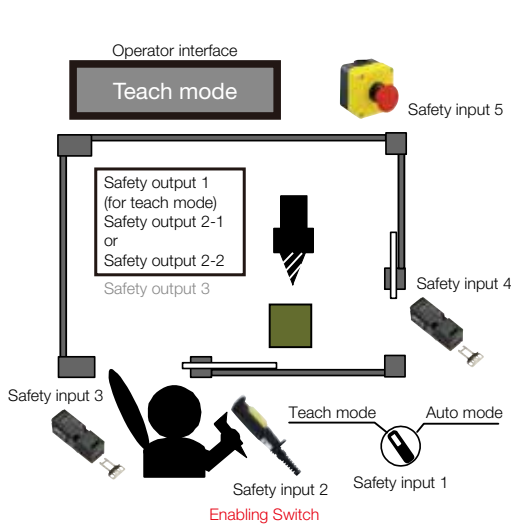
Figure 5.47 Safety system configuration example (Logic 32d Teach mode)
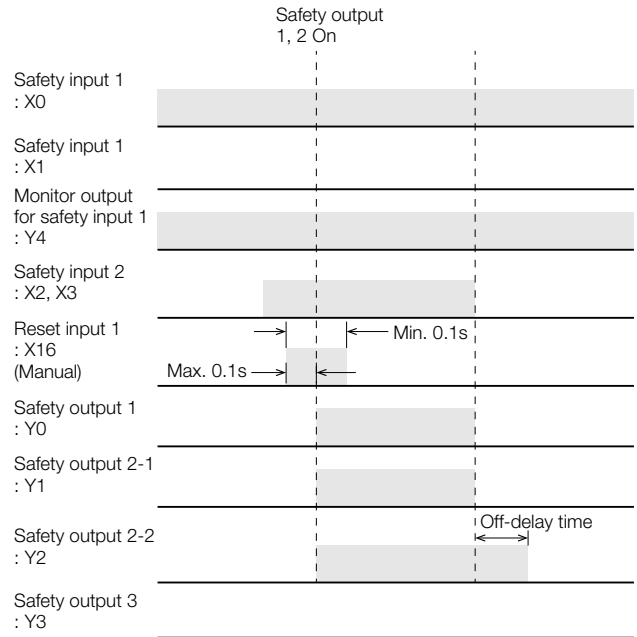
- Safety input 5 is all on and reset input 2 is once on in this chart.

Figure 5.48 Timing chart (Logic 32d Teach mode)

- **Auto mode**

  Select the auto mode when during normal operation of the machine tool. Before starting normal operation, make sure that the person is not inside the safety guard. Additional safety measures should be applied as needed.
  (for example, use padlocks for interlock switches, etc.)
  The machine tool can be operated only when the safety guard is closed. Depending on the risk assessment of the entire system, a locking mechanism may be required for the safety guard. (for example, after the machine tool has come to a complete stop, the unlocking process is performed.)
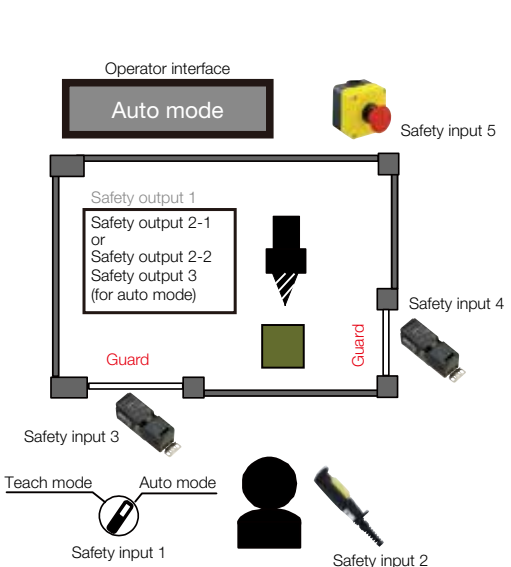
Figure 5.49 Safety system configuration example (Logic 32d Auto mode)
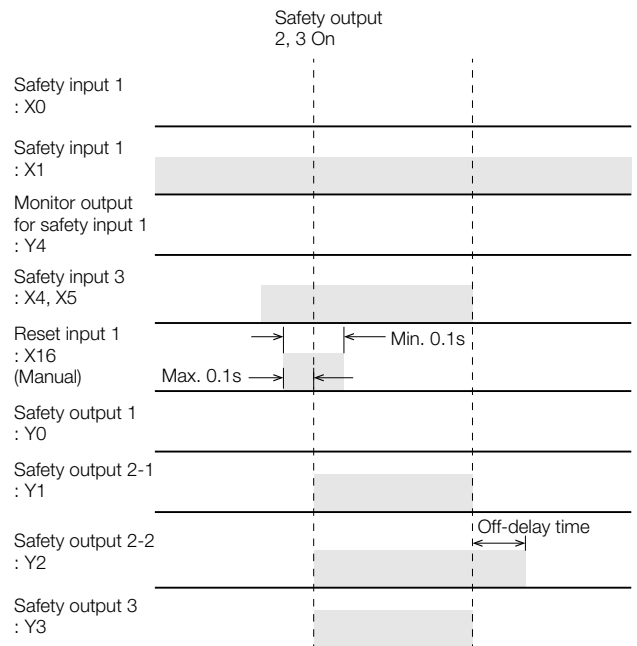
- Safety input 4 and safety input 5 are all on and reset input 2 is once on in this chart.

Figure 5.50 Timing chart (Logic 32d Auto mode)

⚠ WARNING	• Calculate the safety distances, while taking into consideration the intrusion speed of the response time of the FS1B and safety components connected to the FS1B.

Logic 303: Circuit including a mode selecting function
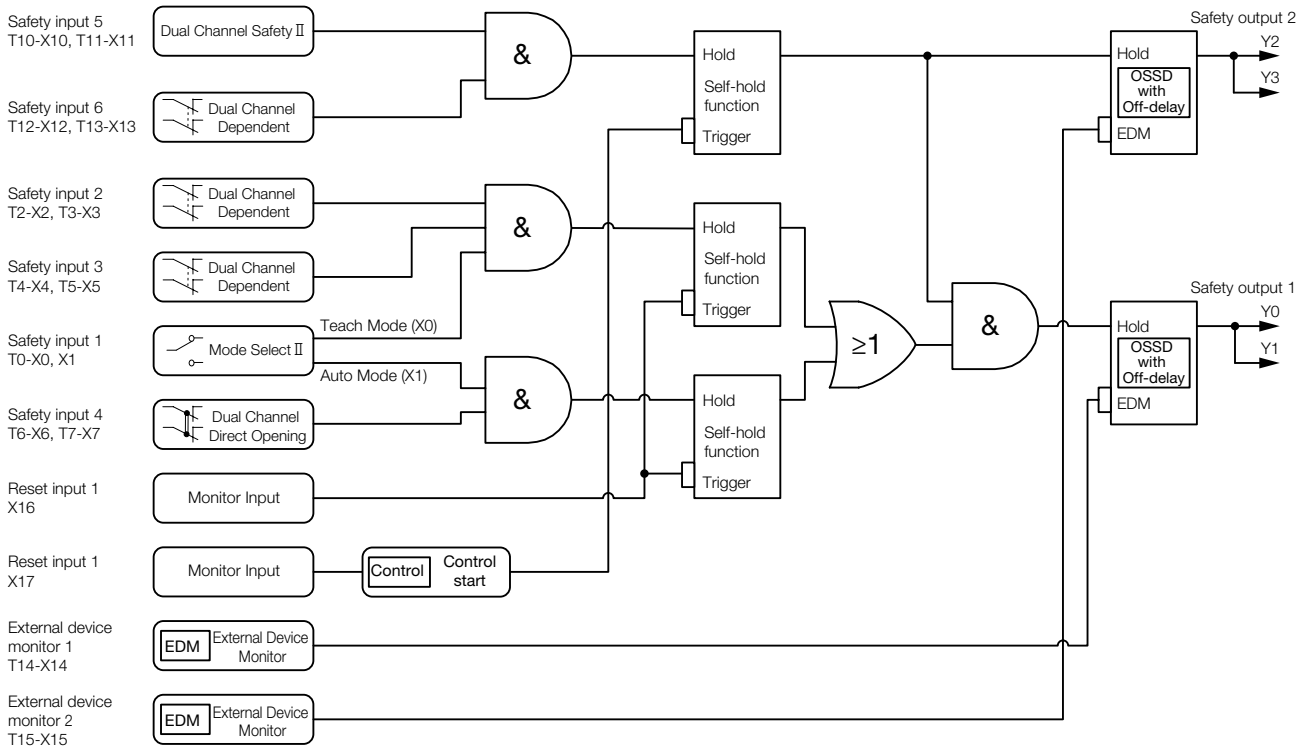
❏ Logic circuit

Figure 5.51 Logic circuit (Logic 303)

- **Safety inputs**

    Some safety inputs can be changed input function. The monitor output turns on when the target safety input is on and turns off when the safety input is off.

	Initial input function	Optional input functions	Monitor output
Safety input 1 (T0-X0, X1)	Mode select input II	—	Y4 (On in teach mode (X0))
Safety input 2 (T2-X2, T3-X3)	Dual channel dependent input	Dual channel NO/NC input Dual channel safety input II	Y5
Safety input 3 (T4-X4, T5-X5)	Dual channel dependent input	Dual channel NO/NC input Dual channel safety input II	Y6
Safety input 4 (T6-X6, T7-X7)	Dual channel direct opening input	Dual channel NO/NC input Dual channel safety input II	Y7
Safety input 5 (T10-X10, T11-X11)	Dual channel safety input II	Dual channel dependent input Dual channel NO/NC input	Y10
Safety input 6 (T12-X12, T13-X13)	Dual channel dependent input	Dual channel NO/NC input Dual channel safety input II	Y11

- **Safety outputs**

    The monitor output turns on when the target safety output is on and turns off when the safety output is off.

    The monitor output turns off immediately independent on set off-delay time.

    The solenoid output turns on if the safety output is off and any of effective safety inputs are off. When all safety inputs are turned on, the solenoid output is turned off. However, in teach mode, Y17 turns on when the safety output turns off regardless of the state of the safety input.

	Monitor output	Solenoid output (*1)
Safety output 1 (Y0, Y1)	Y12	Y17
Safety output 2 (Y2, Y3)	Y13	Y20

*1 Solenoid output is turned off outside of the Run state.

• **Reset inputs**

Resets inputs are used to reset the safety output.

Reset input 1 (X16)

Reset input 2 (X17)

⚠ WARNING	• To prevent unexpected startup of the system, take safety measures to prevent the hazardous source from operating only with the reset input of FS1B. (for example, provide a start switch, etc.)

• **External device monitor inputs**

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

External device monitor input 1 (T14-X14): for safety output 1 (Y0, Y1)

External device monitor input 1 (T15-X15): for safety output 1 (Y2, Y3)

• **State monitor outputs**

State monitor outputs output internal state and error status.

	Initial/Configuration	Run	Protection	Stop
State monitor output 1 (Y14)	☐Off	☐Off	■On	■On
State monitor output 2 (Y15)	☐Off	☐Off	■On	☐Off
State monitor output 3 (Y16)	☐Off	■On	☐Off	☐Off

❏ Wiring example

Figure 5.52 Wiring example (Logic 303)

S1: Selector switch
S2, S3: Enabling switches
S4: Interlock switch
S5, S6: Emergency stop switches
S7, S8: Pushbuttons
K1, K2, K3, K4: Forced guided relays
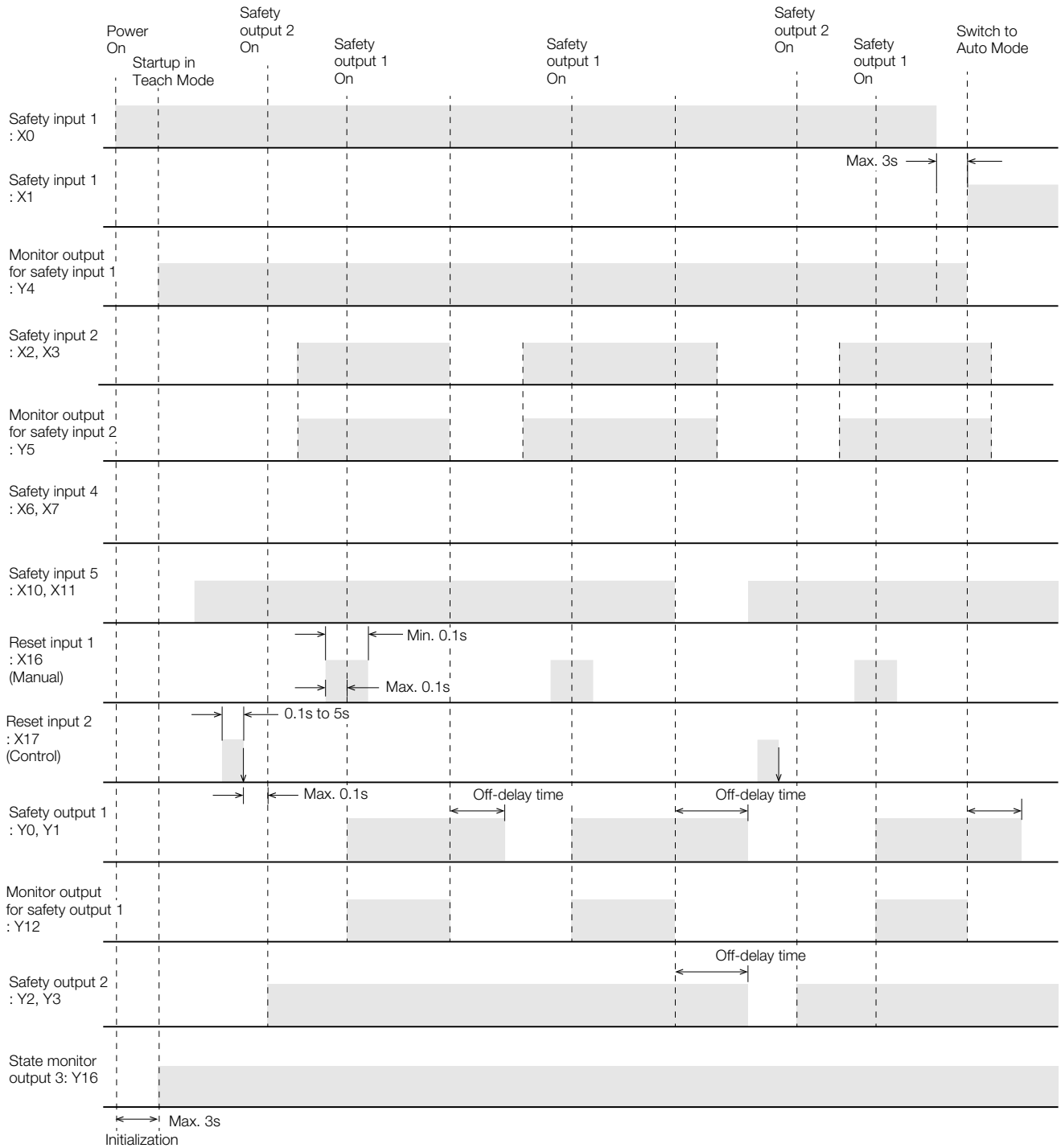
❏ Timing chart

Figure 5.53 Timing chart (Logic 303 Teach mode)
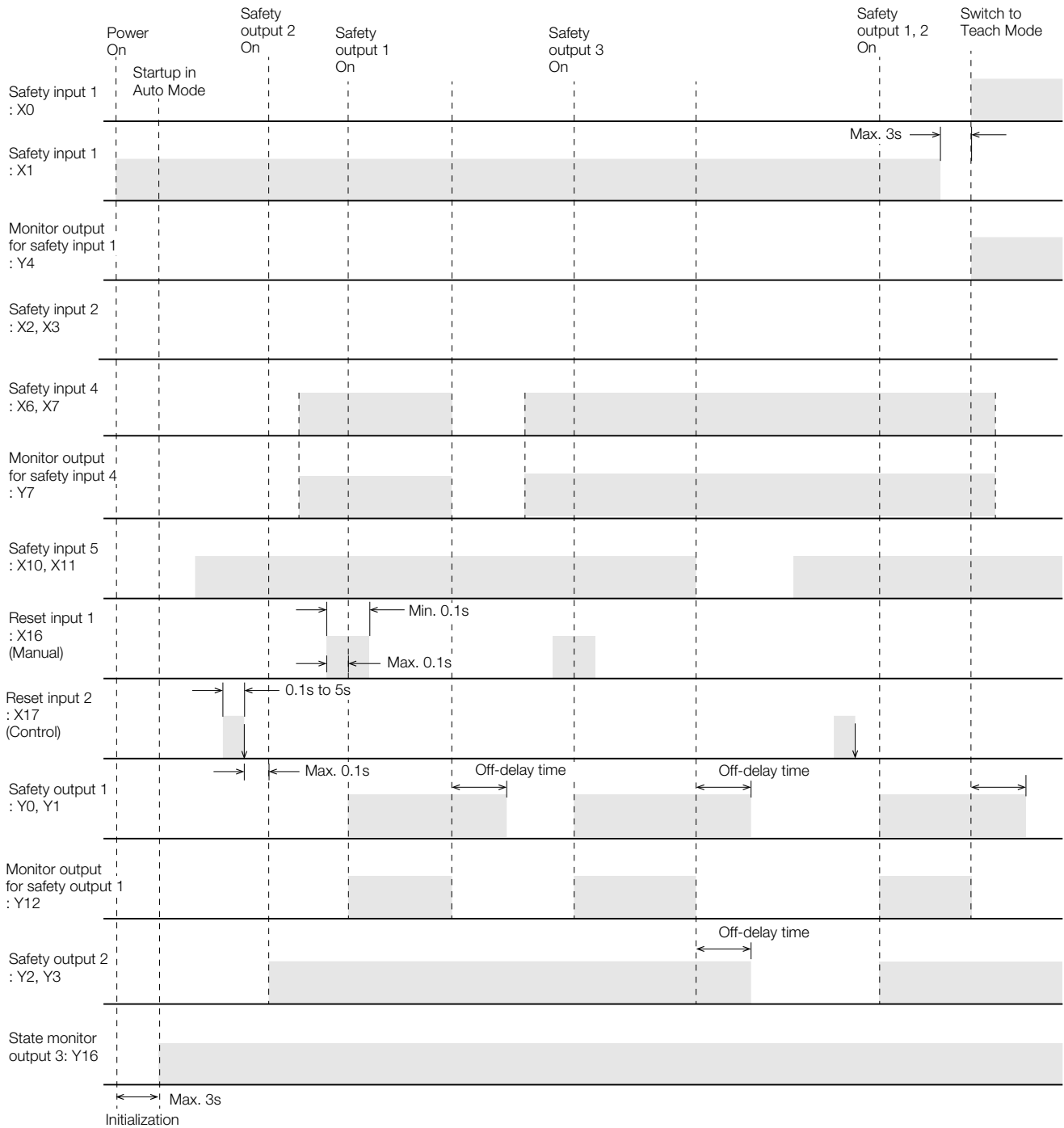
• Safety input 3 and safety input 6 are all on in this chart.

Figure 5.54 Timing chart (Logic 303 Auto mode)

• Safety input 3 and safety input 6 are all on in this chart.

❏ Safety system configuration example

This section describes an example of using logic 303 to implement safety measures for machine tools.

⚠ WARNING	• The systems in this manual show just examples of intended use application. The user is responsible for safe integration in the overall system. Safety performance must be evaluated on a system-wide basis relevant standards (for example, ISO16090-1), laws and regulations (for example, Machine Directive). • When using logic that includes mode select inputs, the operating mode set by the system should be displayed for the operator to verify the operating mode of the system. (for example, the monitor output of the product is taken into the system, information on the system operation mode is processed as a safety parameter, and the result of the setting is displayed on the display, etc.) • To prevent unexpected startup, take safety measures to prevent the hazardous source from operating only with the reset input of FS1B. (for example, provide a start switch, etc.) • Safety measures in the entire system shall be taken to reduce the as then The FS1B is not capable of monitoring the speed of hazardous source.

• **Safety system overview**

Safety components to be used

	Safety components to be connected	Input functions	Active mode
Safety input 1	Selector switch	Mode select input II	—
Safety input 2	Enabling switch	Dual channel dependent input	Teach mode
Safety input 3	Enabling switch	Dual channel dependent input	Teach mode
Safety input 4	Interlock switch	Dual channel direct opening input	Auto mode
Safety input 5	Emergency stop switch	Dual channel dependent input	Teach mode Auto mode
Safety input 6	Emergency stop switch	Dual channel dependent input	Teach mode Auto mode

Control object

	Control object	Active mode
Safety output 1	Machine tool operating permission	Teach mode Auto mode
Safety output 2	Entire system	Teach mode Auto mode

- **Teach mode**

    Select the teach mode when teaching the machine tool. The machine tool can be operated only when the enabling switch is set to the operation-allowed state (position 2). At this time, the machine tool must be properly speed-limited so as not to endanger the operator.

Figure 5.55 Safety system configuration example (Logic 303 Teach mode)
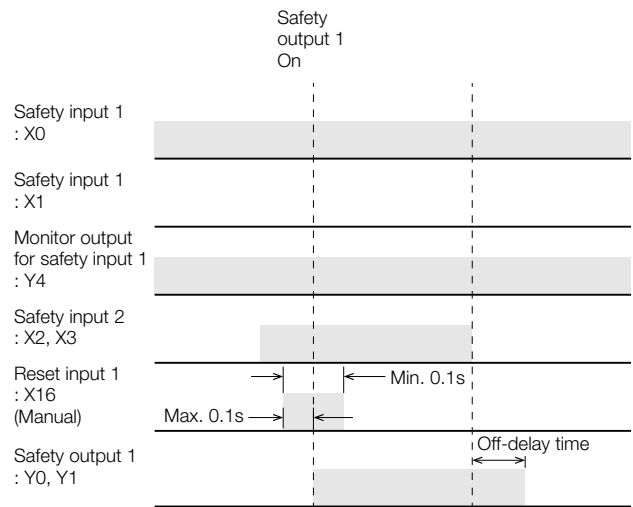
- Safety input 3 and safety output 2 are all on in this chart.

Figure 5.56 Timing chart (Logic 303 Teach mode)

- **Auto mode**

    Select the auto mode when during normal operation of the machine tool. Before starting normal operation, make sure that the person is not inside the safety guard.

    Additional safety measures should be applied as needed. (for example, use padlocks for interlock switches, etc.)

    The machine tool can be operated only when the safety guard is closed. Depending on the risk assessment of the entire system, a locking mechanism may be required for the safety guard. (for example, after the machine tool has come to a complete stop, the unlocking process is performed.)
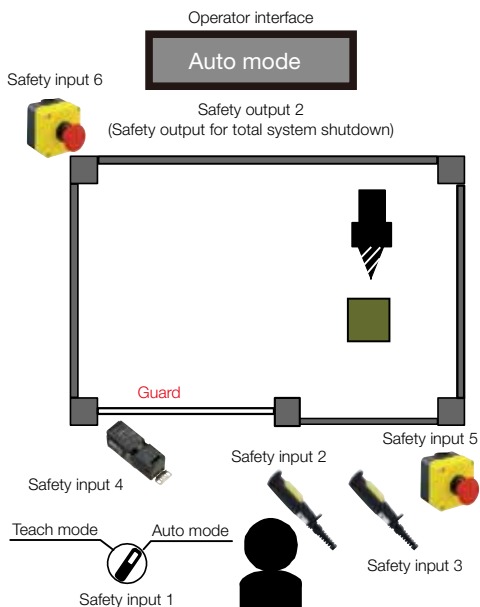
Figure 5.57 Safety system configuration example (Logic 303 Auto mode)
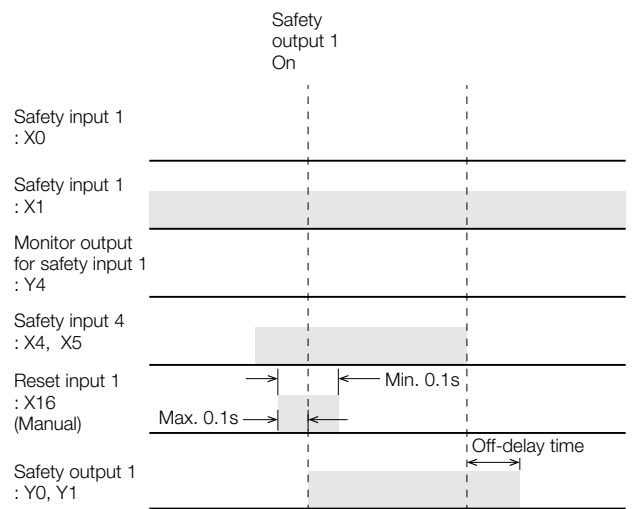
- Safety output 2 is all on in this chart.

Figure 5.58 Timing chart (Logic 303 Auto mode)

⚠	**WARNING**	• Calculate the safety distances, while taking into consideration the response time of the FS1B and safety components connected to the FS1B.

<div style="background:#b01722;color:white;padding:8px;">Logic 33A: Circuit including a mode selecting function</div>
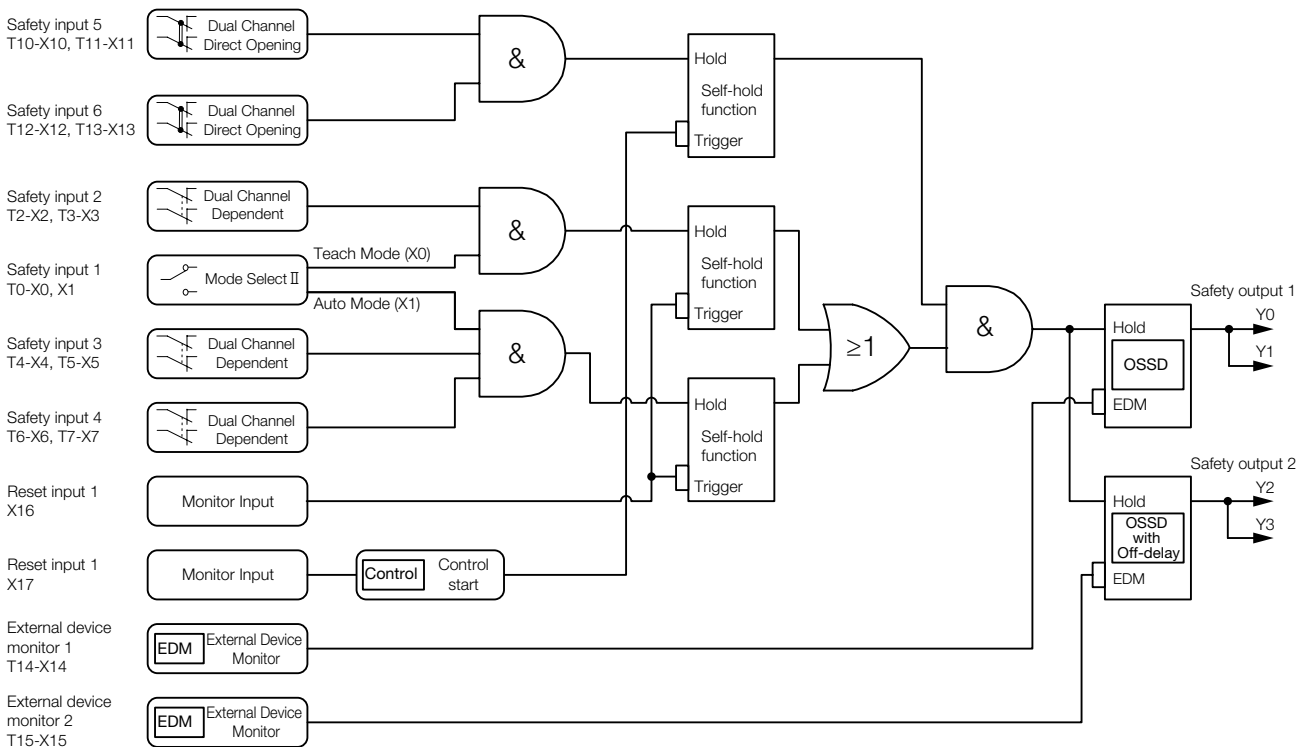
❏ Logic circuit

Figure 5.59 Logic circuit (Logic 33A)

• **Safety inputs**

Some safety inputs can be changed input function. The monitor output turns on when the target safety input is on and turns off when the safety input is off.

	Initial input function	Optional input functions	Monitor output
Safety input 1 (T0-X0, X1)	Mode select input II	—	Y4 (On in teach mode (X0))
Safety input 2 (T2-X2, T3-X3)	Dual channel dependent input	Dual channel NO/NC input Dual channel safety input II	Y5
Safety input 3 (T4-X4, T5-X5)	Dual channel dependent input	Dual channel NO/NC input Dual channel safety input II	Y6
Safety input 4 (T6-X6, T7-X7)	Dual channel dependent input	Dual channel NO/NC input Dual channel safety input II	Y7
Safety input 5 (T10-X10, T11-X11)	Dual channel direct opening input	Dual channel NO/NC input Dual channel safety input II	Y10
Safety input 6 (T12-X12, T13-X13)	Dual channel direct opening input	Dual channel NO/NC input Dual channel safety input II	Y11

• **Safety outputs**

The monitor output turns on when the target safety output is on and turns off when the safety output is off.

The monitor output turns off immediately independent on set off-delay time.

In auto mode, the solenoid output turns on if the safety output is off and any of effective safety inputs are off. When all safety inputs are turned on, the solenoid output is turned off. In teach mode, the solenoid output turns on when the safety output turns off regardless of the state of the safety input.

	Monitor output	Solenoid output (*1)
Safety output 1 (Y0, Y1)	Y12	Y17
Safety output 2 (Y2, Y3)	Y13	Y20

*1 Solenoid output is turned off outside of the Run state.

• **Reset inputs**

Resets inputs are used to reset the safety output.

Reset input 1 (X16)

Reset input 2 (X17)

⚠	**WARNING**	• To prevent unexpected startup of the system, take safety measures to prevent the hazardous source from operating only with the reset input of FS1B. (for example, provide a start switch, etc.)

• **External device monitor inputs**

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

External device monitor input 1 (T14-X14): for safety output 1 (Y0, Y1)

External device monitor input 1 (T15-X15): for safety output 1 (Y2, Y3)

• **State monitor outputs**

State monitor outputs output internal state and error status.

	Initial/Configuration	Run	Protection	Stop
State monitor output 1 (Y14)	☐Off	☐Off	■On	■On
State monitor output 2 (Y15)	☐Off	☐Off	■On	☐Off
State monitor output 3 (Y16)	☐Off	■On	☐Off	☐Off

❏ **Wiring example**

Figure 5.60 Wiring example (Logic 33A)

S1: Selector switch
S2: Enabling switch
S4: Interlock switch
S5, S6: Emergency stop switches
S7, S8: Pushbuttons
K1, K2, K3, K4: Forced guided relays
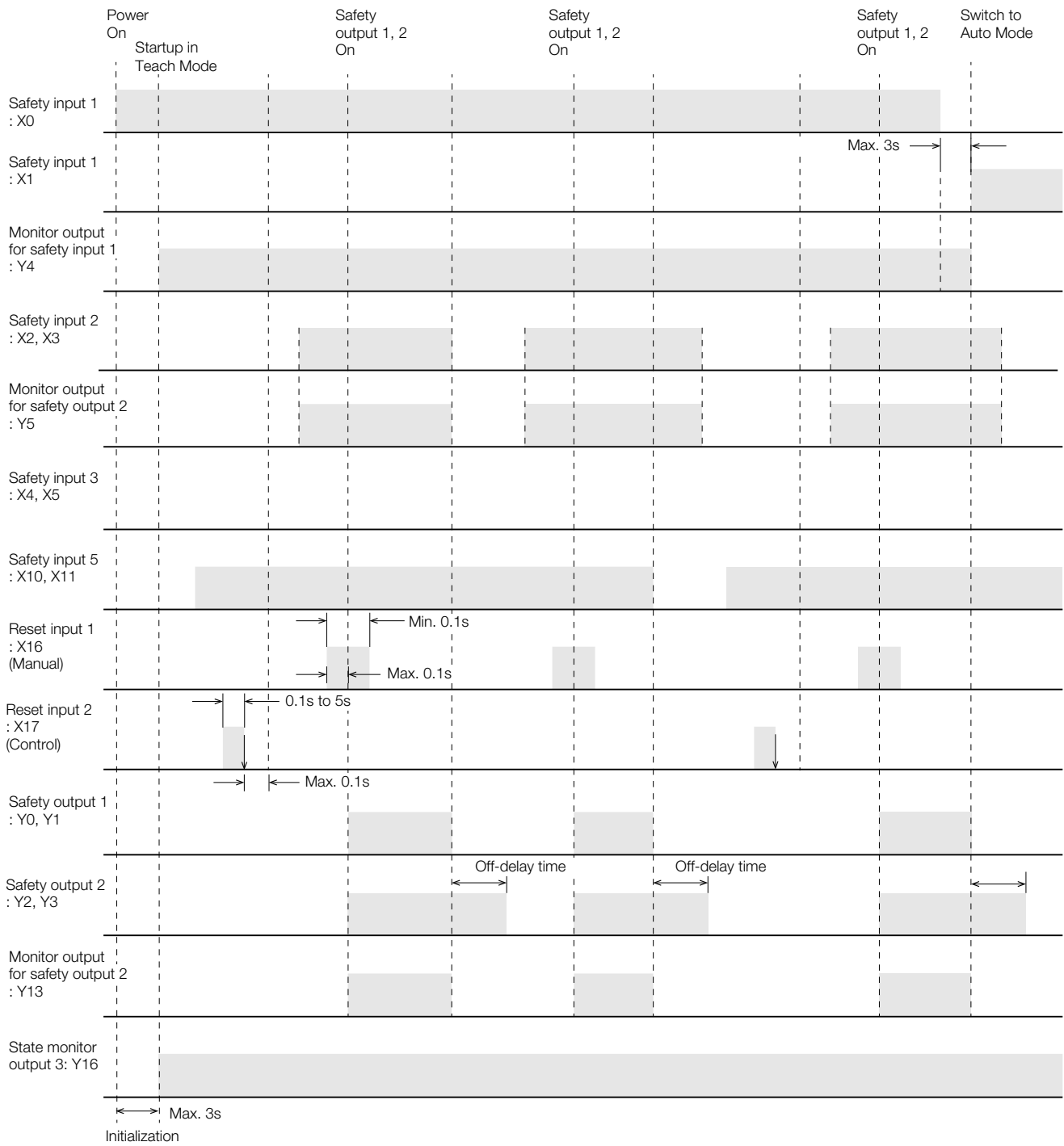
❏ **Timing chart**

Figure 5.61 Timing chart (Logic 33A Teach mode)
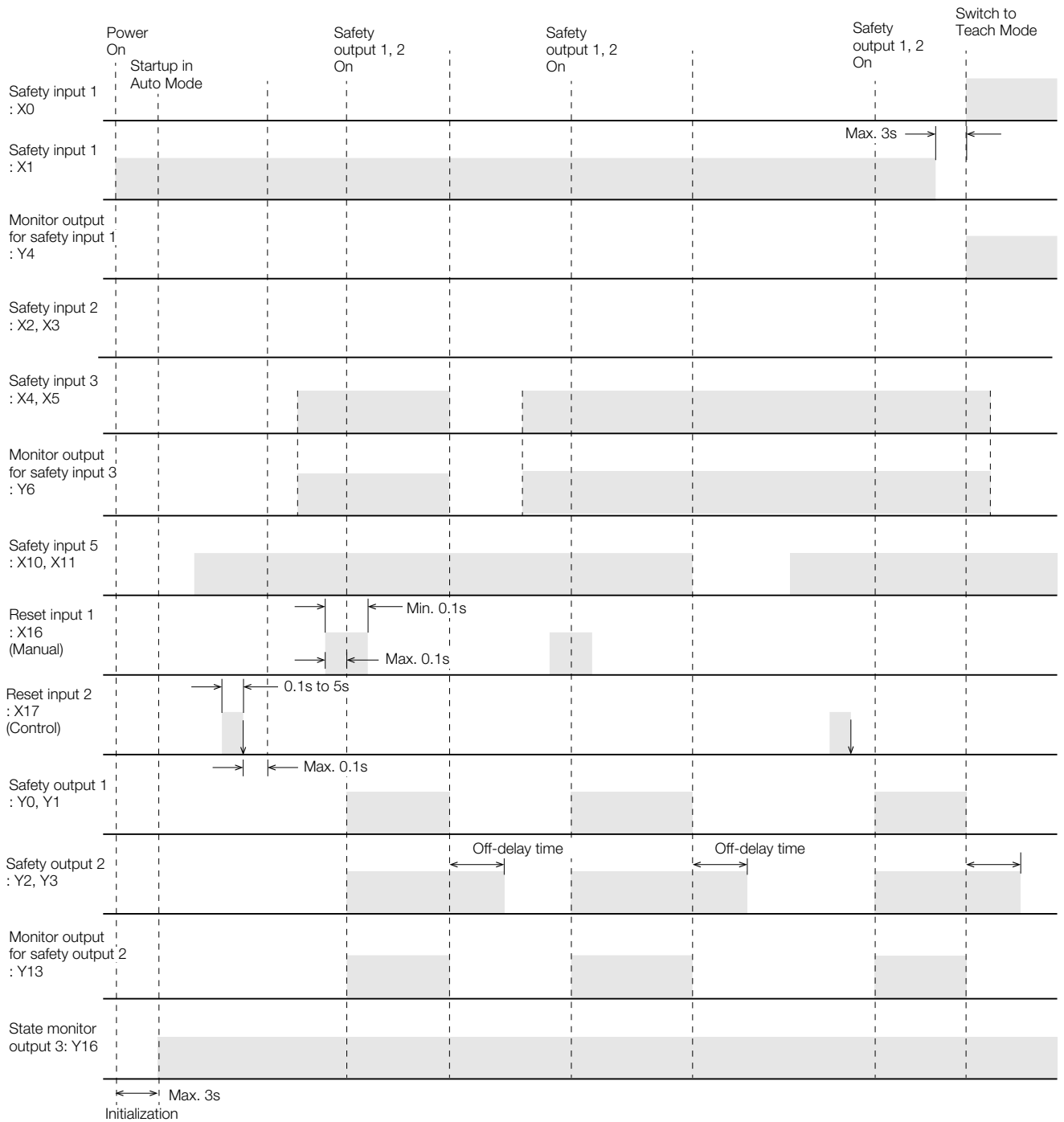
• Safety input 4 and safety input 6 are all on in this chart.

Figure 5.62 Timing chart (Logic 33A Auto mode)

• Safety input 4 and safety input 6 are all on in this chart.

❏ Safety system configuration example

This section describes an example of using Logic 33A to implement safety measures for a robotic system.

⚠ WARNING	• The systems in this manual show just examples of intended use application. The user is responsible for safe integration in the overall system. Safety performance must be evaluated on a system-wide basis relevant standards (for example, ISO10218-1 and ISO10218-2), laws and regulations (for example, Machine Directive). • Display the operation mode set by the system so that the operator can check the operation mode of the robot or robot system. (for example, the monitor output of the product is taken into the system, information on the system operation mode is processed as a safety parameter, and the result of the setting is displayed on the display, etc.) • To prevent unexpected startup, take safety measures to prevent the hazardous source from operating only with the reset input of FS1B. (for example, provide a start switch, etc.) • Safety measures in the entire system shall be taken to reduce the as then The FS1B is not capable of monitoring the speed of hazardous source.

• Safety system overview

Safety components to be used

	Safety components to be connected	Input functions	Active mode
Safety input 1	Selector switch	Mode select input II	—
Safety input 2	Enabling switch	Dual channel dependent input	Teach mode
Safety input 3	Interlock switch	Dual channel dependent input	Auto mode
Safety input 4	Interlock switch	Dual channel dependent input	Auto mode
Safety input 5	Emergency stop switch	Dual channel direct opening input	Teach mode Auto mode
Safety input 6	Emergency stop switch	Dual channel direct opening input	Teach mode Auto mode

Control object

	Control object	Active mode
Safety output 1	Robot operation permission	Teach mode Auto mode
Safety output 2	Robot power	Teach mode Auto mode

• Teach mode

Select the teach mode when teaching the robot. The machine tool can be operated only when the enabling switch is set to the operation-allowed state (position 2). At this time, the machine tool must be properly speed-limited so as not to endanger the operator.

Figure 5.63 Safety system configuration example (Logic 33A Teach mode)

• Safety input 5 and safety input 6 are all on, reset input 2 is once on in this chart.

Figure 5.64 Timing chart (Logic 33A Teach mode)

• Auto mode

Select the auto mode when during normal operation of the robot. Before starting normal operation, make sure that the person is not inside the safety guard. Additional safety measures should be applied as needed. (for example, use padlocks for interlock switches, etc.) The machine tool can be operated only when the safety guard is closed. Depending on the risk assessment of the entire system, a locking mechanism may be required for the safety guard. (for example, after the machine tool has come to a complete stop, the unlocking process is performed.)

Figure 5.65 Safety system configuration example (Logic 33A Auto mode)

• Safety input5and safety input6are all on, reset input 2 is once on in this chart.

Figure 5.66 Timing chart (Logic 33A Auto mode)

⚠ WARNING	• Calculate the safety distances, while taking into consideration the intrusion speed of the response time of the FS1B and safety components connected to the FS1B.

Logic 33b: Circuit including a mode selecting function and an OR function
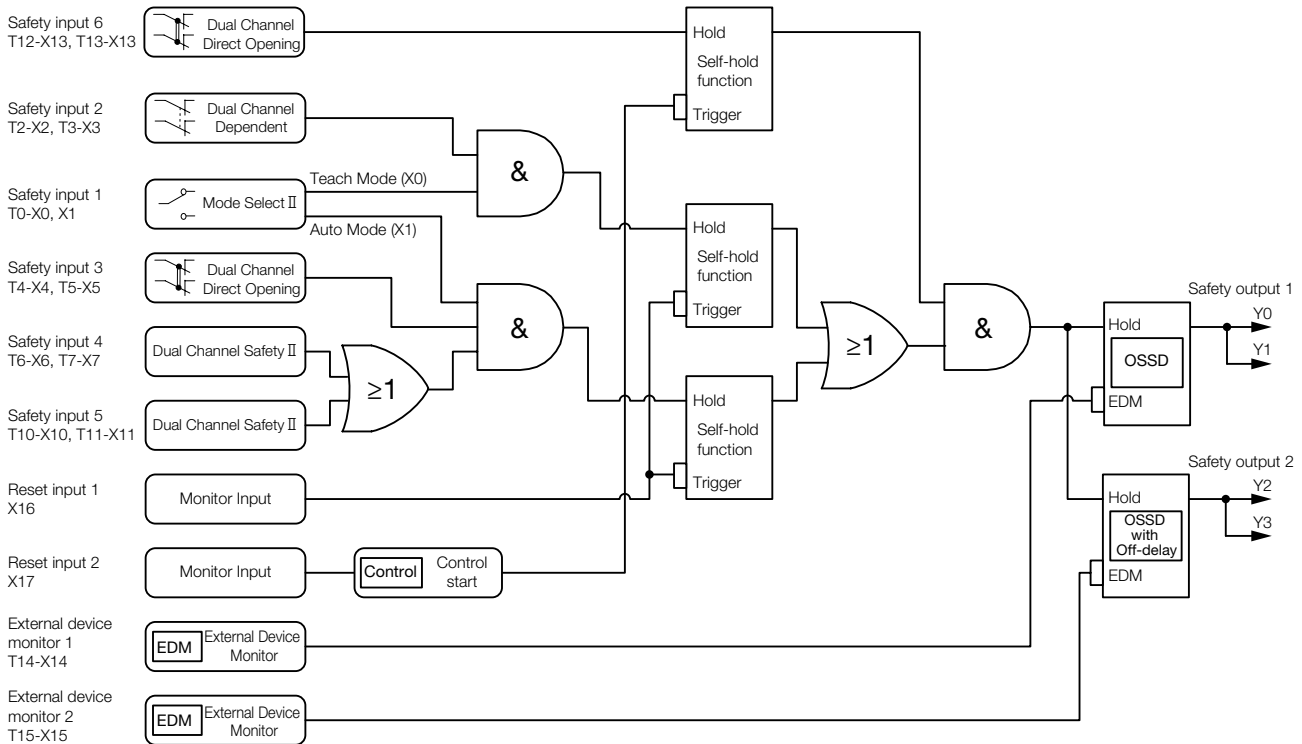
❏ Logic circuit

Figure 5.67 Logic circuit (Logic 33b)

• **Safety inputs**

Some safety inputs can be changed input function. The monitor output turns on when the target safety input is on and turns off when the safety input is off.

	Initial input function	Optional input functions	Monitor output
Safety input 1 (T0-X0, X1)	Mode select input II	—	Y4 (On in teach mode (X0))
Safety input 2 (T2-X2, T3-X3)	Dual channel dependent input	Dual channel NO/NC input Dual channel safety input II	Y5
Safety input 3 (T4-X4, T5-X5)	Dual channel direct opening input	Dual channel NO/NC input Dual channel safety input II	Y6
Safety input 4 (T6-X6, T7-X7)	Dual channel safety input II	Dual channel dependent input Dual channel NO/NC input	Y7
Safety input 5 (T10-X10, T11-X11)	Dual channel safety input II	Dual channel dependent input Dual channel NO/NC input	Y10
Safety input 6 (T12-X12, T13-X13)	Dual channel direct opening input	Dual channel NO/NC input Dual channel safety input II	Y11

• **Safety outputs**

The monitor output turns on when the target safety output is on and turns off when the safety output is off.

The monitor output turns off immediately independent on set off-delay time.

In auto mode, the solenoid output turns on if the safety output is off and any of effective safety inputs are off. When all safety inputs are turned on, the solenoid output is turned off. In teach mode, the solenoid output turns on when the safety output turns off regardless of the state of the safety input.

	Monitor output	Solenoid output (*1)
Safety output 1 (Y0, Y1)	Y12	Y17
Safety output 2 (Y2, Y3)	Y13	Y20

*1 Solenoid output is turned off outside of the Run state.

• **Reset inputs**

Resets inputs are used to reset the safety output.

Reset input 1 (X16)

Reset input 2 (X17)

⚠ WARNING	• To prevent unexpected startup of the system, take safety measures to prevent the hazardous source from operating only with the reset input of FS1B. (for example, provide a start switch, etc.)

• **External device monitor inputs**

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

External device monitor input 1 (T14-X14): for safety output 1 (Y0, Y1)

External device monitor input 1 (T15-X15): for safety output 1 (Y2, Y3)

• **State monitor outputs**

State monitor outputs output internal state and error status.

	Initial/Configuration	Run	Protection	Stop
State monitor output 1 (Y14)	☐Off	☐Off	■On	■On
State monitor output 2 (Y15)	☐Off	☐Off	■On	☐Off
State monitor output 3 (Y16)	☐Off	■On	☐Off	☐Off

❏ **Wiring example**

Figure 5.68 Wiring example (Logic 33b)

S1: Selector switch
S2: Enabling switch
S3: Interlock switch
S4, S5: Safety light curtains
S6: Emergency stop switch
S7, S8: Pushbuttons
K1, K2, K3, K4: Forced guided relays
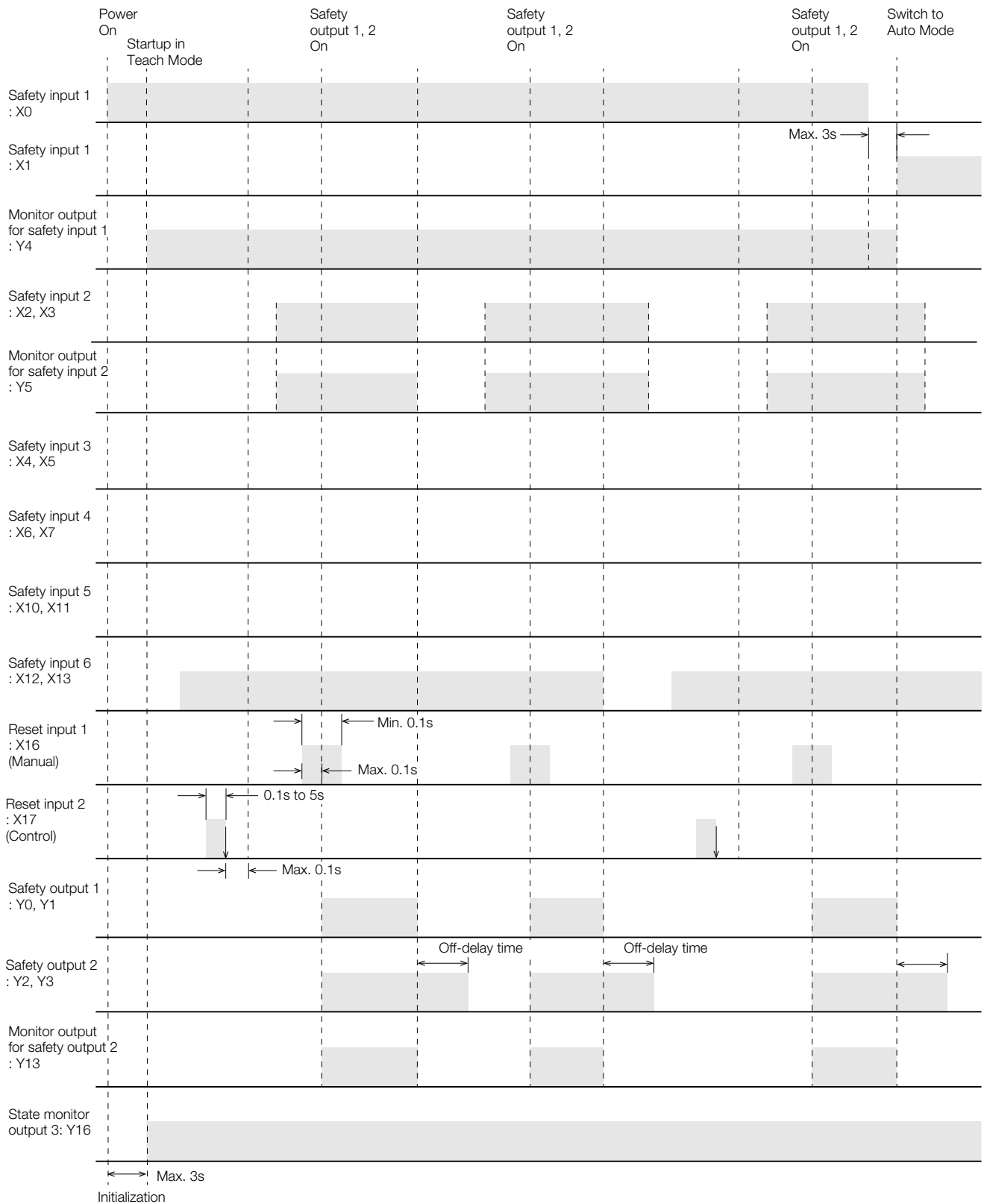
❏ **Timing chart**

Figure 5.69 Timing chart (Logic 33b Teach mode)
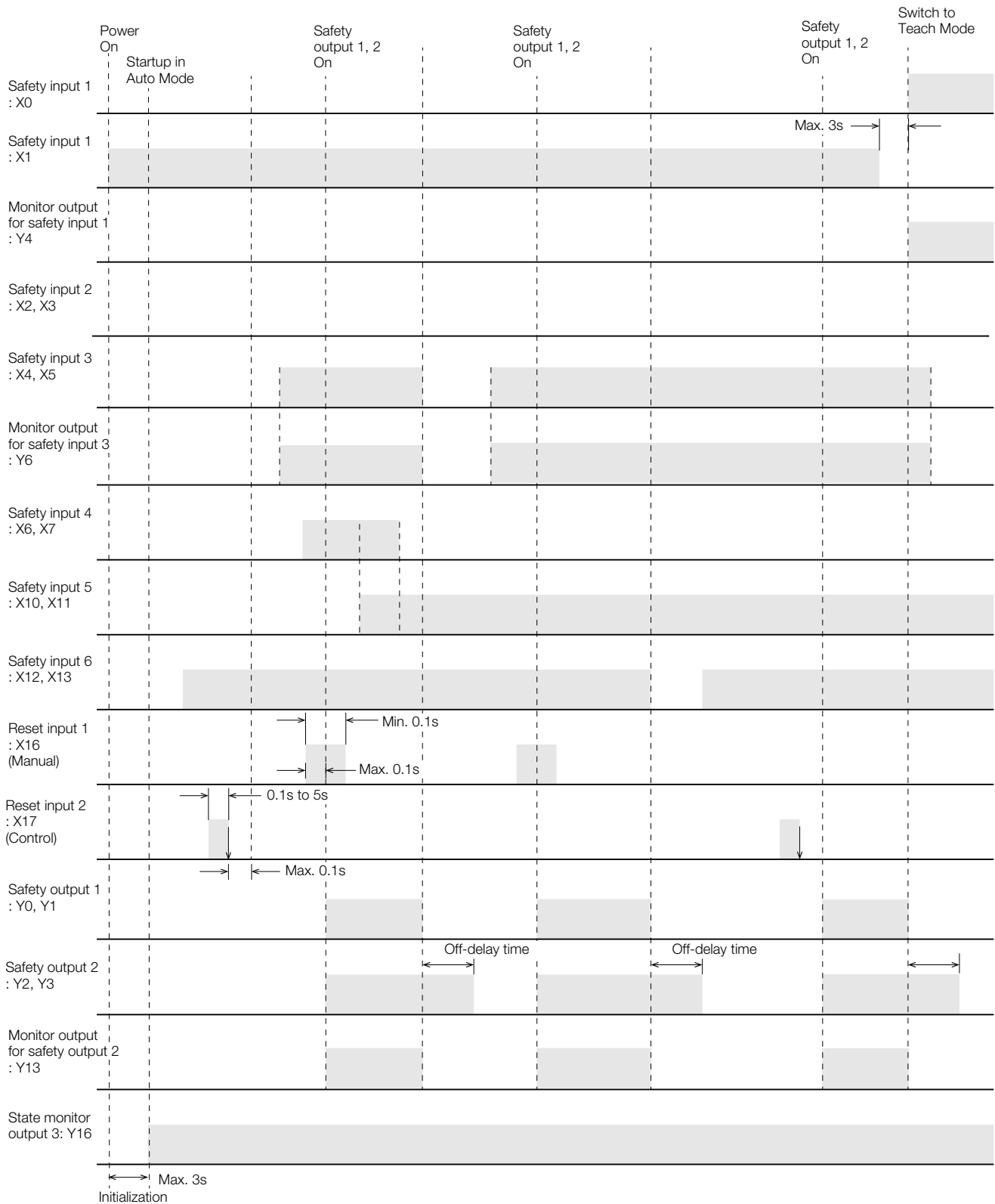
Figure 5.70 Timing chart (Logic 33b Auto mode)

❏ Safety system configuration example

This section describes an example of using logic 33b to implement safety measures for a robotic system.

⚠ WARNING	• The systems in this manual show just examples of intended use application. The user is responsible for safe integration in the overall system. Safety performance must be evaluated on a system-wide basis relevant standards (for example, ISO10218-1 and ISO10218-2), laws and regulations (for example, Machine Directive). • Display the operation mode set by the system so that the operator can check the operation mode of the robot or robot system. (for example, the monitor output of the product is taken into the system, information on the system operation mode is processed as a safety parameter, and the result of the setting is displayed on the display, etc.) • To prevent unexpected startup, take safety measures to prevent the hazardous source from operating only with the reset input of FS1B. (for example, provide a start switch, etc.) • Safety measures in the entire system shall be taken to reduce the as then The FS1B is not capable of monitoring the speed of hazardous source.

• **Safety system overview**

Safety components to be used

	Safety components to be connected	Input functions	Active mode
Safety input 1	Selector switch	Mode select input II	—
Safety input 2	Enabling switch	Dual channel dependent input	Teach mode
Safety input 3	Interlock switch	Dual channel direct opening input	Auto mode
Safety input 4	Safety light curtain	Dual channel safety input II	Auto mode
Safety input 5	Safety light curtain	Dual channel safety input II	Auto mode
Safety input 6	Emergency stop switch	Dual channel direct opening input	Teach mode Auto mode

Control object

	Control object	Active mode
Safety output 1	Robot operation permission	Teach mode Auto mode
Safety output 2	Robot power	Teach mode Auto mode

The robot and the operator cannot approach the workbench at the same time. If the operator attempts to approach the workbench while the robot is close to the workbench, the robot will stop.

⚠ WARNING	• Calculate the safety distances, while taking into consideration the intrusion speed of the response time of the FS1B and safety components connected to the FS1B.

- **Teach mode**

  Select the teach mode when teaching the robot. The machine tool can be operated only when the enabling switch is set to the operation-allowed state (position 2). At this time, the machine tool must be properly speed-limited so as not to endanger the operator. Also, the FS1B will not detect if another person approaches the workbench, so countermeasures such as restricting the robot's operating range are necessary.
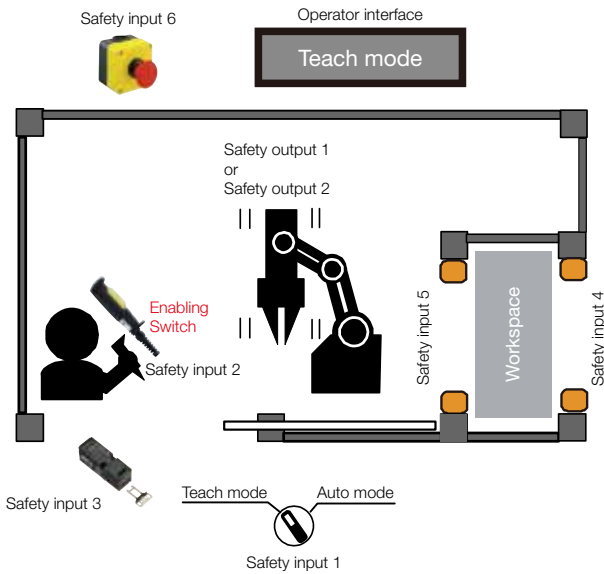
Figure 5.71 Safety system configuration example (Logic 33b Teach mode)
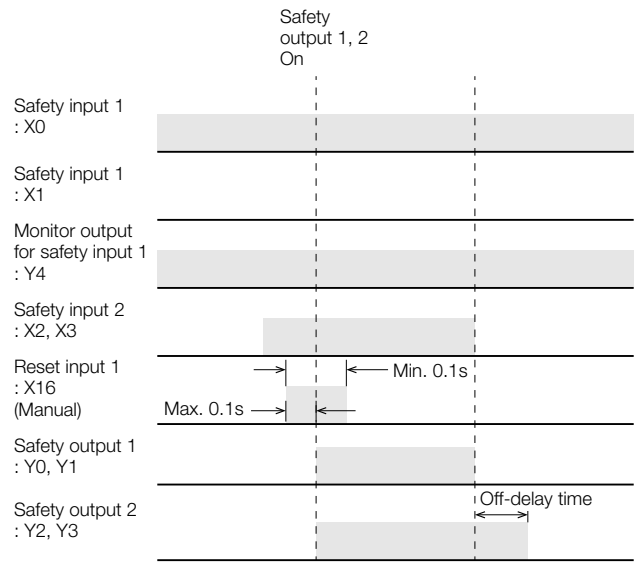
- Safety input 6 is all on and reset input 2 is once on in this chart.

Figure 5.72 Timing chart (Logic 33b Teach mode)

- **Auto mode**

  Select the auto mode when during normal operation of the robot. Before starting normal operation, make sure that the person is not inside the safety guard. Additional safety measures should be applied as needed. (for example, use padlocks for interlock switches, etc.) The machine tool can be operated only when the safety guard is closed. Depending on the risk assessment of the entire system, a locking mechanism may be required for the safety guard. (for example, after the machine tool has come to a complete stop, the unlocking process is performed.) If the operator attempts to approach the workbench while the robot is close to the workbench, the robot will stop.
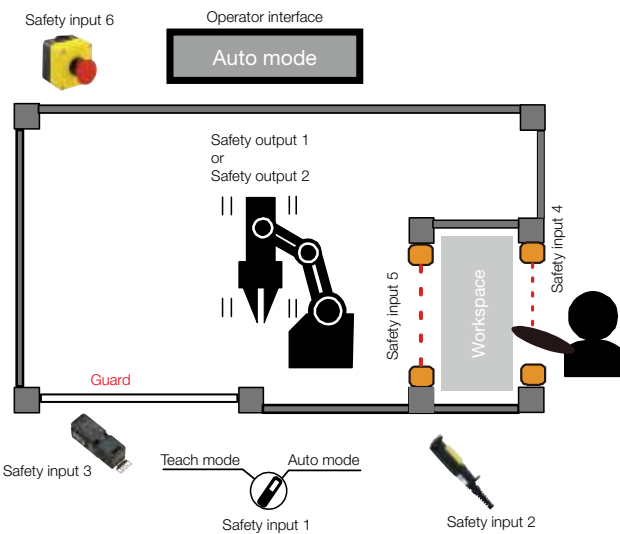
Figure 5.73 Safety system configuration example (Logic 33b Auto mode)
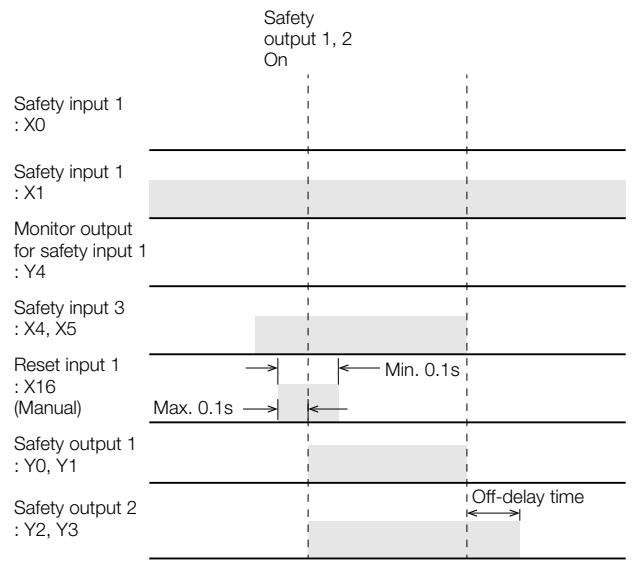
- Safety input 6 is all on and reset input 2 is once on in this chart.

Figure 5.74 Timing chart (Logic 33b Auto mode)

⚠	**WARNING**	- Calculate the safety distances, while taking into consideration the intrusion speed of the response time of the FS1B and safety components connected to the FS1B.

Logic 33C: Partial stop circuit including a mode selecting function
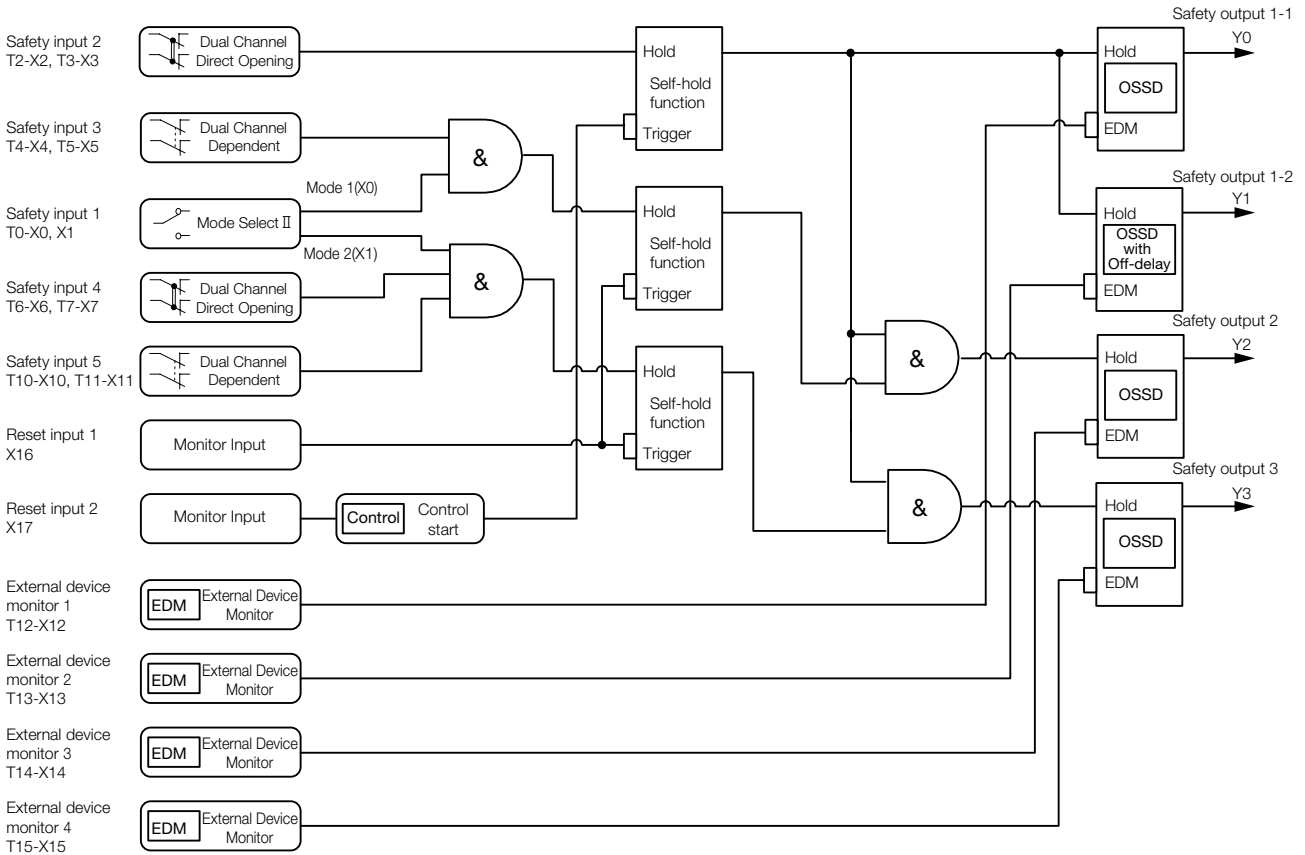
❏ Logic circuit

Figure 5.75 Logic circuit (Logic 33C)

• Safety inputs

Some safety inputs can be changed input function. The monitor output turns on when the target safety input is on and turns off when the safety input is off.

	Initial input function	Optional input functions	Monitor output
Safety input 1 (T0-X0, X1)	Mode select input II	—	Y4 (On in mode 1 (X0) is selected) Y11 (On in mode 2 (X1) is selected)
Safety input 2 (T2-X2, T3-X3)	Dual channel direct opening input	Dual channel NO/NC input Dual channel safety input II	Y5
Safety input 3 (T4-X4, T5-X5)	Dual channel dependent input	Dual channel NO/NC input Dual channel safety input II	Y6
Safety input 4 (T6-X6, T7-X7)	Dual channel direct opening input	Dual channel NO/NC input Dual channel safety input II	Y7
Safety input 5 (T10-X10, T11-X11)	Dual channel dependent input	Dual channel NO/NC input Dual channel safety input II	Y10

• Safety outputs

The monitor output turns on when the target safety output is on and turns off when the safety output is off.

The monitor output turns off immediately independent on set off-delay time.

	Monitor output
Safety output 1-1 (Y0)	Y12
Safety output 1-2 (Y1)	Y13
Safety output 2 (Y2)	Y17
Safety output 3 (Y3)	Y20

- **Reset inputs**

   Resets inputs are used to reset the safety output.

   Reset input 1 (X16)

   Reset input 2 (X17)

⚠ WARNING	• To prevent unexpected startup of the system, take safety measures to prevent the hazardous source from operating only with the reset input of FS1B. (for example, provide a start switch, etc.)

- **External device monitor inputs**

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

   External device monitor input 1 (T12-X12): for safety output 1-1 (Y0)

   External device monitor input 2 (T13-X13): for safety output 1-2 (Y1)

   External device monitor input 3 (T14-X14): for safety output 2 (Y2)

   External device monitor input 4 (T15-X15): for safety output 3 (Y3)

- **State monitor outputs**

   State monitor outputs output internal state and error status.

	Initial/Configuration	Run	Protection	Stop
State monitor output 1 (Y14)	☐Off	☐Off	■On	■On
State monitor output 2 (Y15)	☐Off	☐Off	■On	☐Off
State monitor output 3 (Y16)	☐Off	■On	☐Off	☐Off

❏ **Wiring example**

Figure 5.76 Wiring example (Logic 33C)

S1: Selector switch
S2: Emergency stop switch
S3: Enabling switch
S4, S5: Interlock switches
S6, S7: Pushbuttons
K1, K2, K3, K4, K5, K6, K7, K8: Forced guided relays
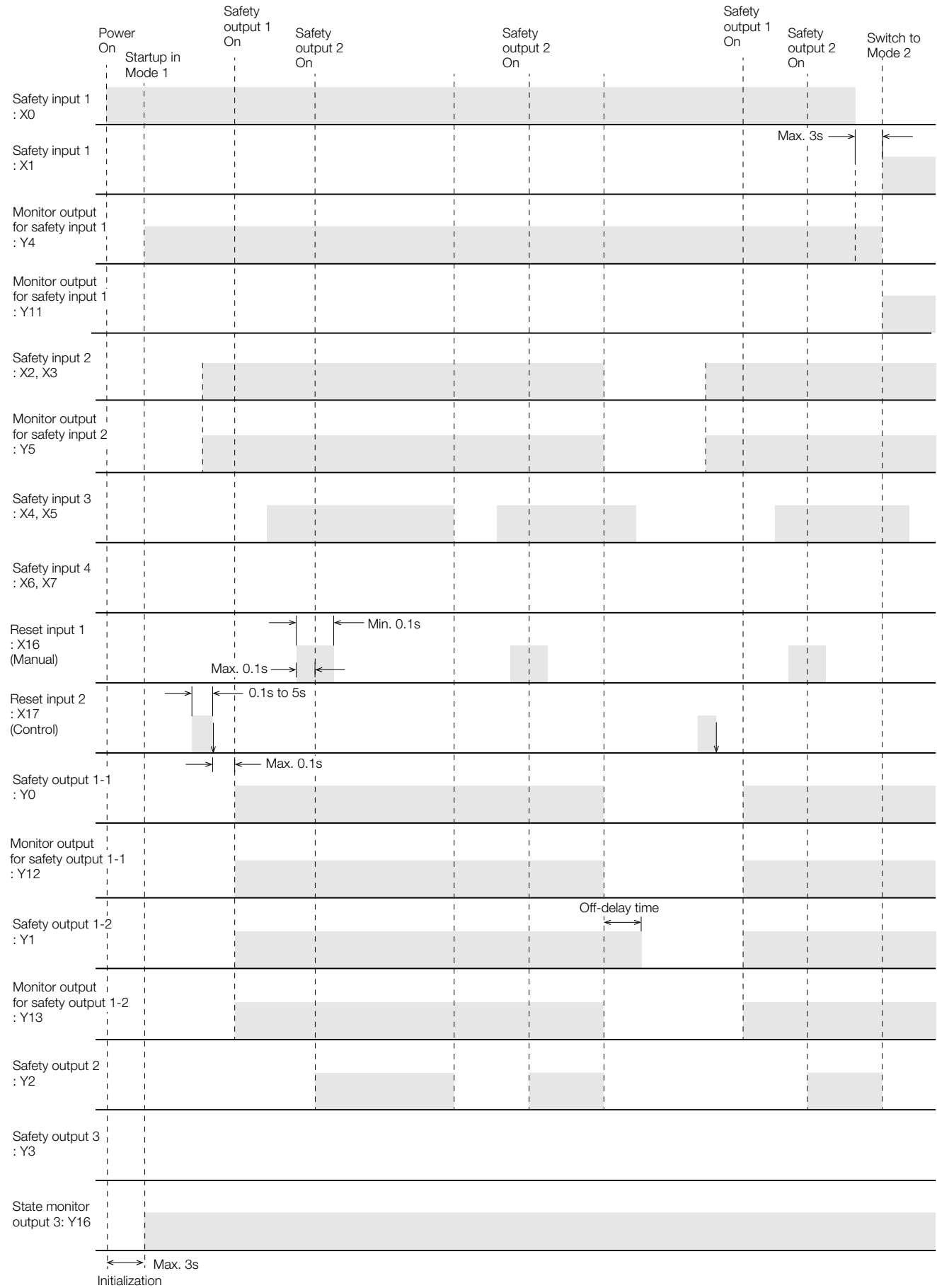
❏ Timing chart

• Safety input 5 is all on in this chart.

Figure 5.77 Timing chart (Logic 33C Mode 1)
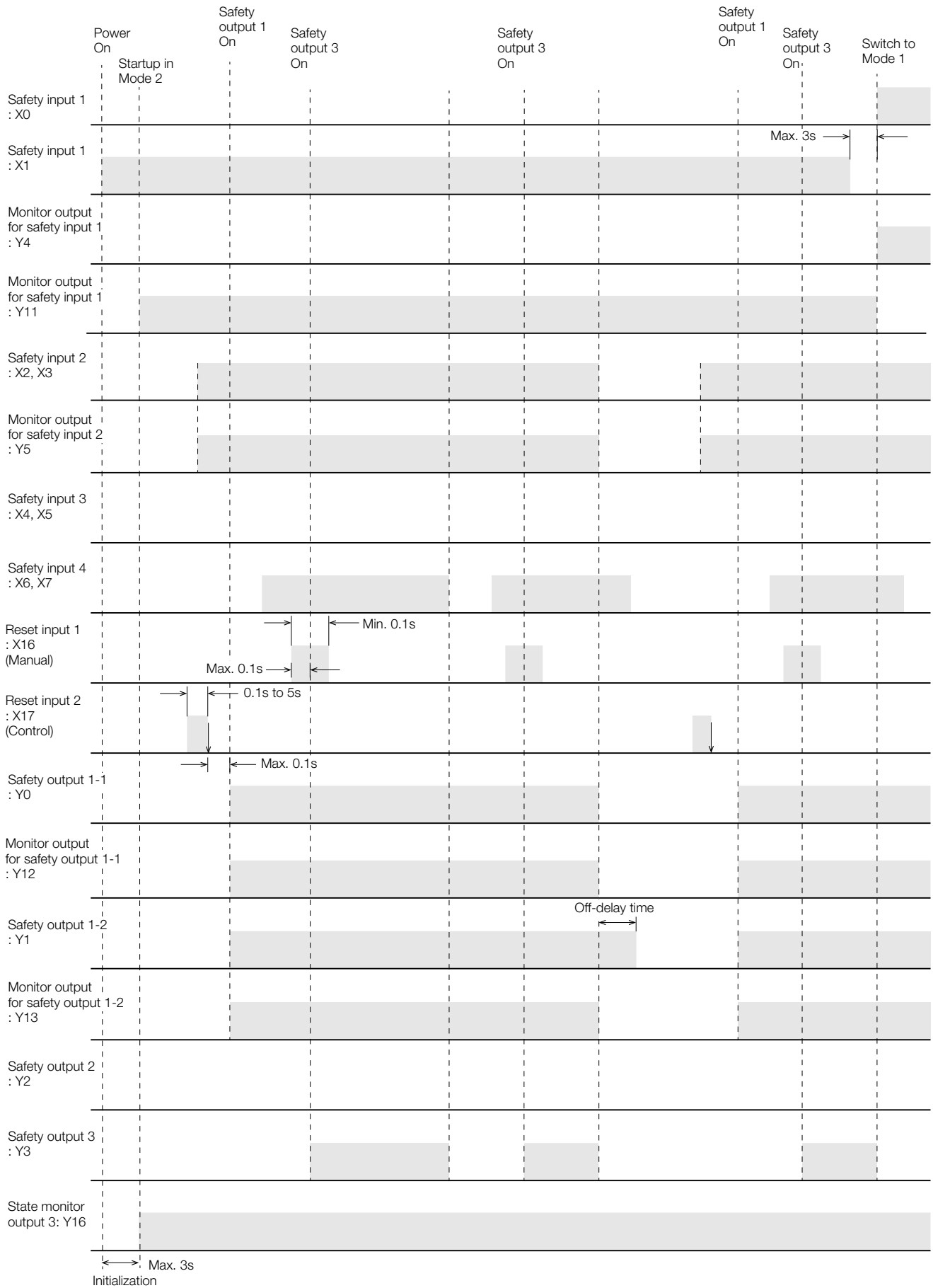
Figure 5.78 Timing chart (Logic 33C Mode 2)

• Safety input 5 is all on in this chart.

❏ Safety system configuration example

This section describes an example of using logic 33C to implement safety measures for machine tools.

⚠ **WARNING**	• The systems in this manual show just examples of intended use application. The user is responsible for safe integration in the overall system. Safety performance must be evaluated on a system-wide basis relevant standards (for example, ISO16090-1), laws and regulations (for example, Machine Directive). • When using logic that includes a mode select input, the operating mode set by the system should be displayed for the operator to verify the operating mode of the system. (for example, the monitor output of the product is taken into the system, information on the system operation mode is processed as a safety parameter, and the result of the setting is displayed on the display, etc.) • To prevent unexpected startup, take safety measures to prevent the hazardous source from operating only with the reset input of FS1B. (for example, provide a start switch, etc.) • Safety measures in the entire system shall be taken to reduce the as then The FS1B is not capable of monitoring the speed of hazardous source.

• Safety system overview

Safety components to be used

	Safety components to be connected	Input functions	Active mode
Safety input 1	Selector Switch	Mode select input II	—
Safety input 2	Emergency stop switch	Dual channel direct opening input	Mode 1 Mode 2
Safety input 3	Enabling switch	Dual channel dependent input	Mode 1
Safety input 4	Interlock switch	Dual channel direct opening input	Mode 2
Safety input 5	Interlock switch	Dual channel dependent input	Mode 2

Control object

	Control object	Active mode
Safety output 1-1	System-wide operating permission	Mode 1 Mode 2
Safety output 1-2	Overall system power	Mode 1 Mode 2
Safety output 2	Machine tool operating permission	Mode 1
Safety output 3	Machine tool operating permission	Mode 2

• **Mode 1**

Select the teach mode when teaching the machine tool. The machine tool can be operated only when the enabling switch is set to the operation-allowed state (position 2). At this time, the machine tool must be properly speed-limited so as not to endanger the operator.
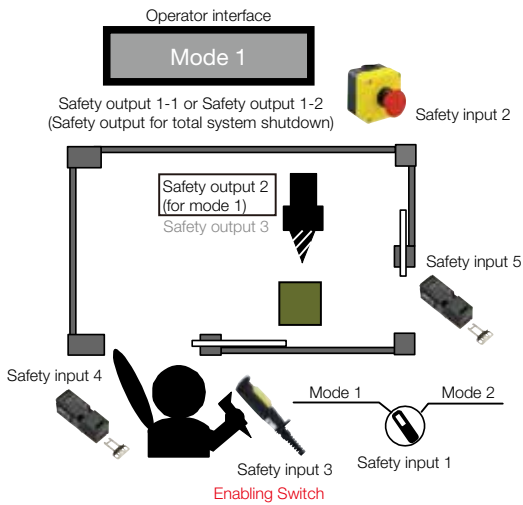
Figure 5.79 Safety system configuration example (Logic 33C Mode 1)
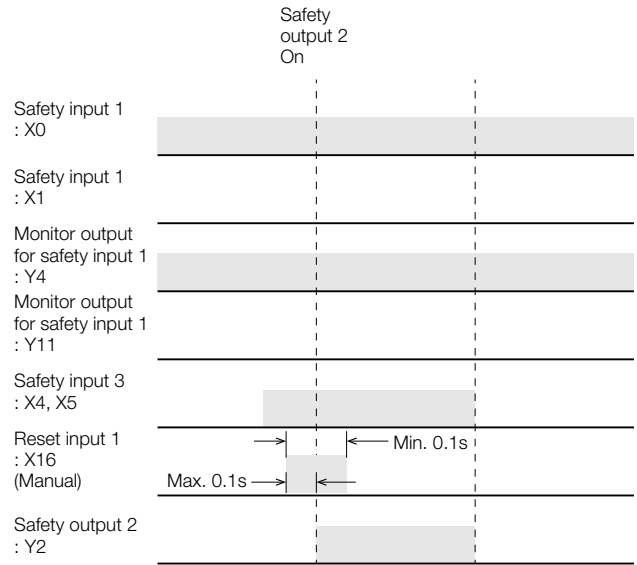
• Safety input 2, safety output 1-1 and safety output 1-2 are all on in this chart.

Figure 5.80 Timing chart (Logic 33C Mode 1)

• **Mode 2**

Select the auto mode when during normal operation of the machine tool. Before starting normal operation, make sure that the person is not inside the safety guard.

Additional safety measures should be applied as needed. (for example, use padlocks for interlock switches, etc.)

The machine tool can be operated only when the safety guard is closed. Depending on the risk assessment of the entire system, a locking mechanism may be required for the safety guard. (for example, after the machine tool has come to a complete stop, the unlocking process is performed.)
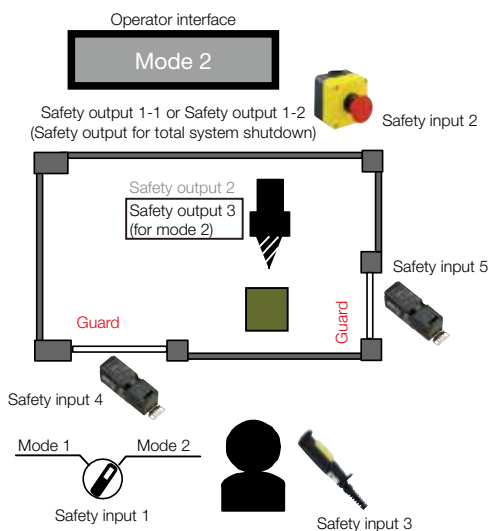
Figure 5.81 Safety system configuration example (Logic 33C Mode 2)
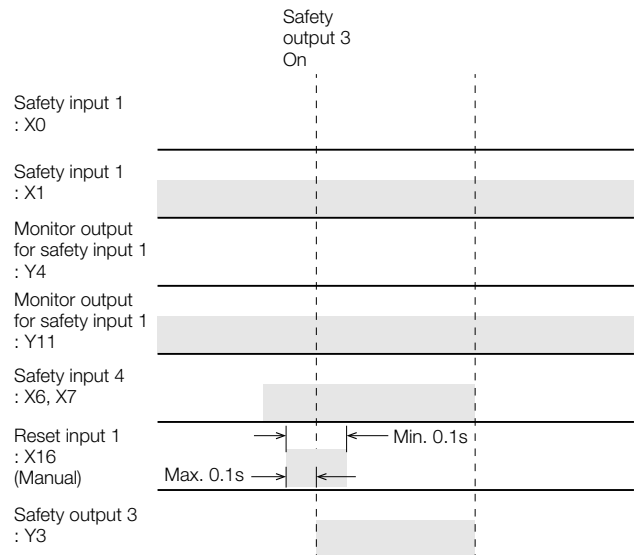
• Safety input 2, safety input 5, safety output 1-1 and safety output 1-2 are all on in this chart.

Figure 5.82 Timing chart (Logic 33C Mode 2)

⚠ WARNING	• Calculate the safety distances, while taking into consideration the intrusion speed of the response time of the FS1B and safety components connected to the FS1B.

Logic 33d: Circuit including two of mode selecting function
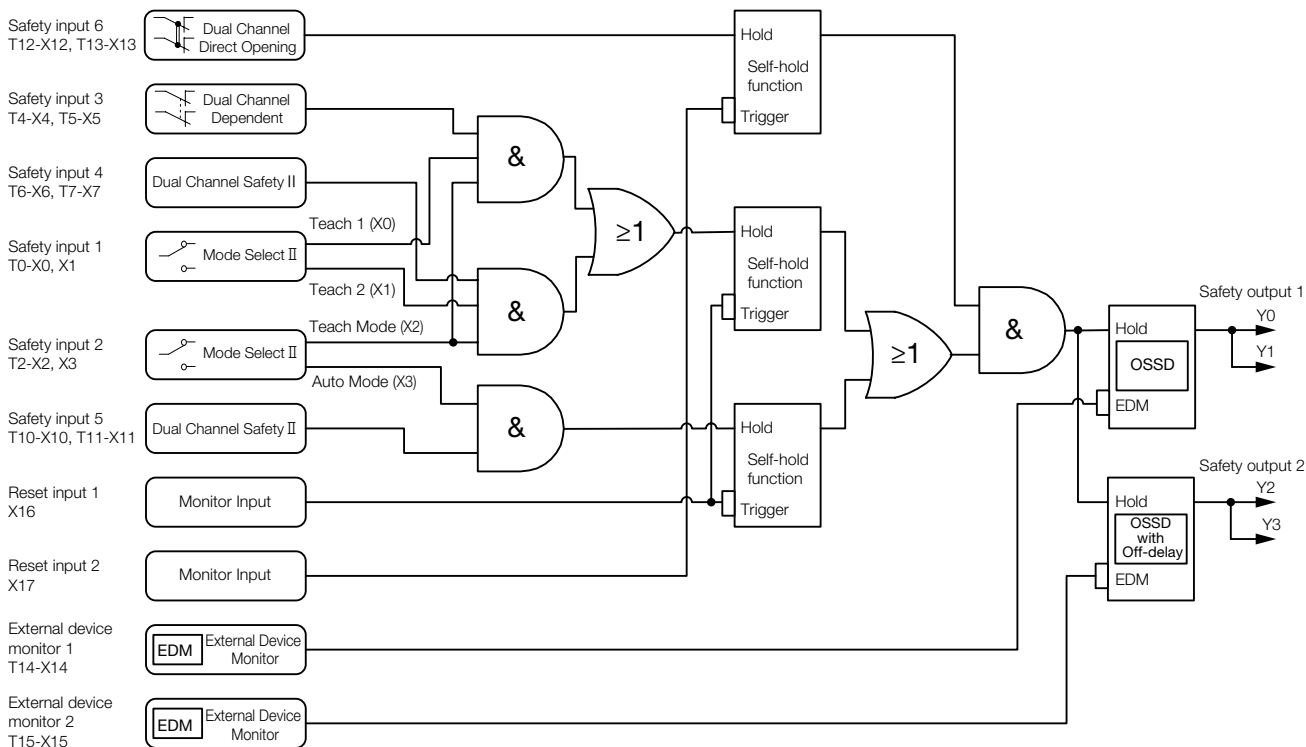
❏ Logic circuit

Figure 5.83 Logic circuit (Logic 33d)

• Safety inputs

Some safety inputs can be changed input function. The monitor output turns on when the target safety input is on and turns off when the safety input is off.

	Initial input function	Optional input functions	Monitor output (* 1)
Safety input 1 (T0-X0, X1)	Mode select input II	—	Y4 (On in Teach 1 (X0)) Y17 (On in teach 1 (X0)) Y20 (On in teach 2 (X1))
Safety input 2 (T2-X2, X3)	Mode select input II	—	Y5 (On in teach mode (X2))
Safety input 3 (T4-X4, T5-X5)	Dual channel dependent input	Dual channel NO/NC input Dual channel safety input II	Y6
Safety input 4 (T6-X6, T7-X7)	Dual channel safety input II	Dual channel dependent input Dual channel NO/NC input	Y7
Safety input 5 (T10-X10, T11-X11)	Dual channel safety input II	Dual channel dependent input Dual channel NO/NC input	Y10
Safety input 6 (T12-X12, T13-X13)	Dual channel direct opening input	Dual channel NO/NC input Dual channel safety input II	Y11

*1 Y4, Y5, Y6, Y7, Y10 and Y11 are turned off in the Initial state, Configuration state and Stop state.
Y17 and Y20 are turned off in the Initial state, Configuration state, Protection state, and Stop state.

• Safety outputs

The monitor output turns on when the target safety output is on and turns off when the safety output is off.
The monitor output turns off immediately independent on set off-delay time.

	Monitor output
Safety output 1 (Y0, Y1)	Y12
Safety output 2 (Y2, Y3)	Y13

- **Reset inputs**

  Resets inputs are used to reset the safety output.

  Reset input 1 (X16)

  Reset input 2 (X17)

⚠ WARNING	• To prevent unexpected startup of the system, take safety measures to prevent the hazardous source from operating only with the reset input of FS1B. (for example, provide a start switch, etc.)

- **External device monitor inputs**

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

  External device monitor input 1 (T14-X14): for safety output 1 (Y0, Y1)

  External device monitor input 1 (T15-X15): for safety output 1 (Y2, Y3)

- **State monitor outputs**

  State monitor outputs output internal state and error status.

	Initial/Configuration	Run	Protection	Stop
State monitor output 1 (Y14)	☐Off	☐Off	■On	■On
State monitor output 2 (Y15)	☐Off	☐Off	■On	☐Off
State monitor output 3 (Y16)	☐Off	■On	☐Off	☐Off

❑ Wiring example

Figure 5.84 Wiring example (Logic 33d)

S1, S2: Selector switches
S3, S4: Enabling switches
S5: Interlock switch
S6: Emergency stop switch
S7, S8: Pushbuttons
K1, K2, K3, K4: Forced guided relays
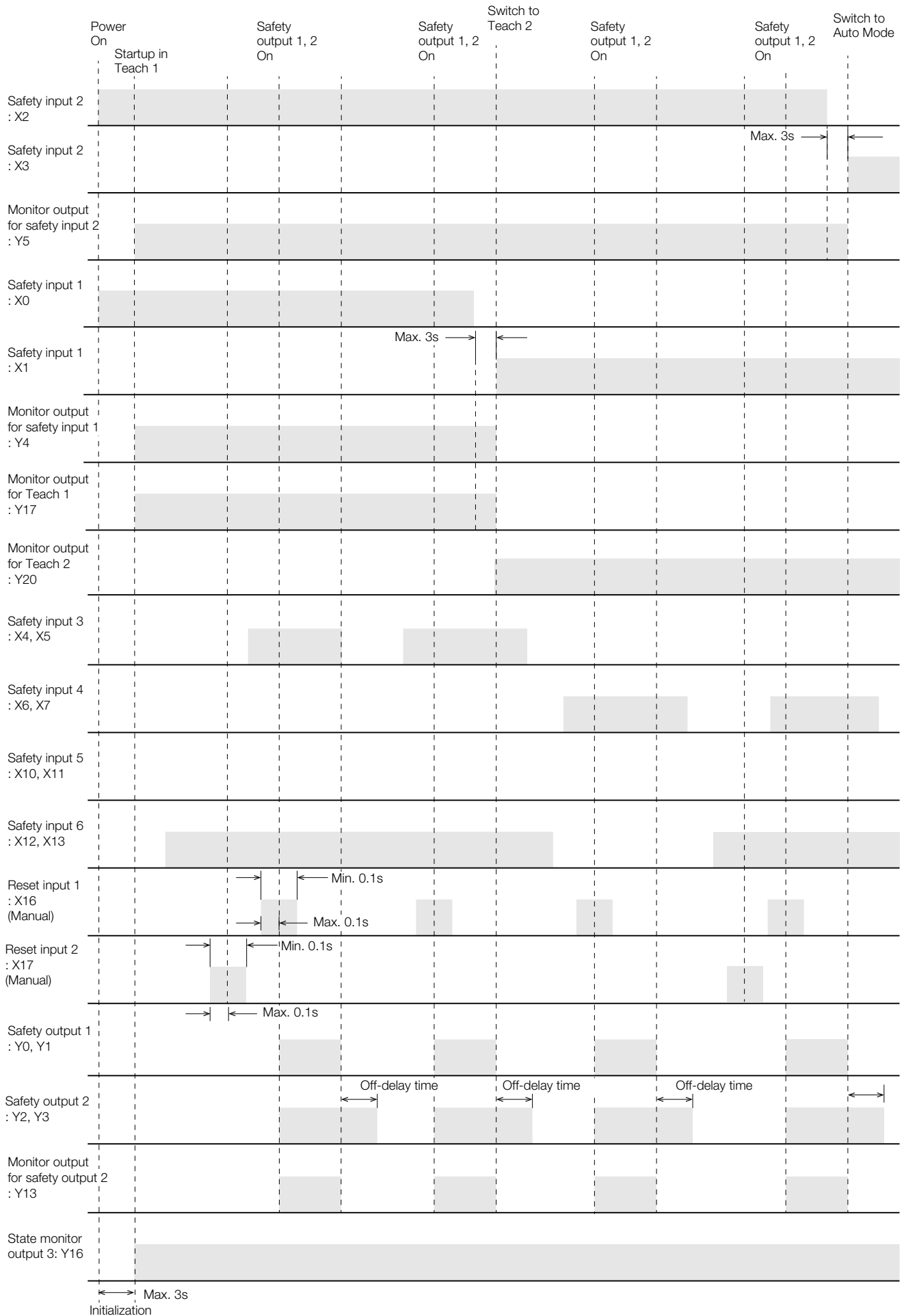
❏ Timing chart

Figure 5.85 Timing chart (Logic 33d Teach mode)
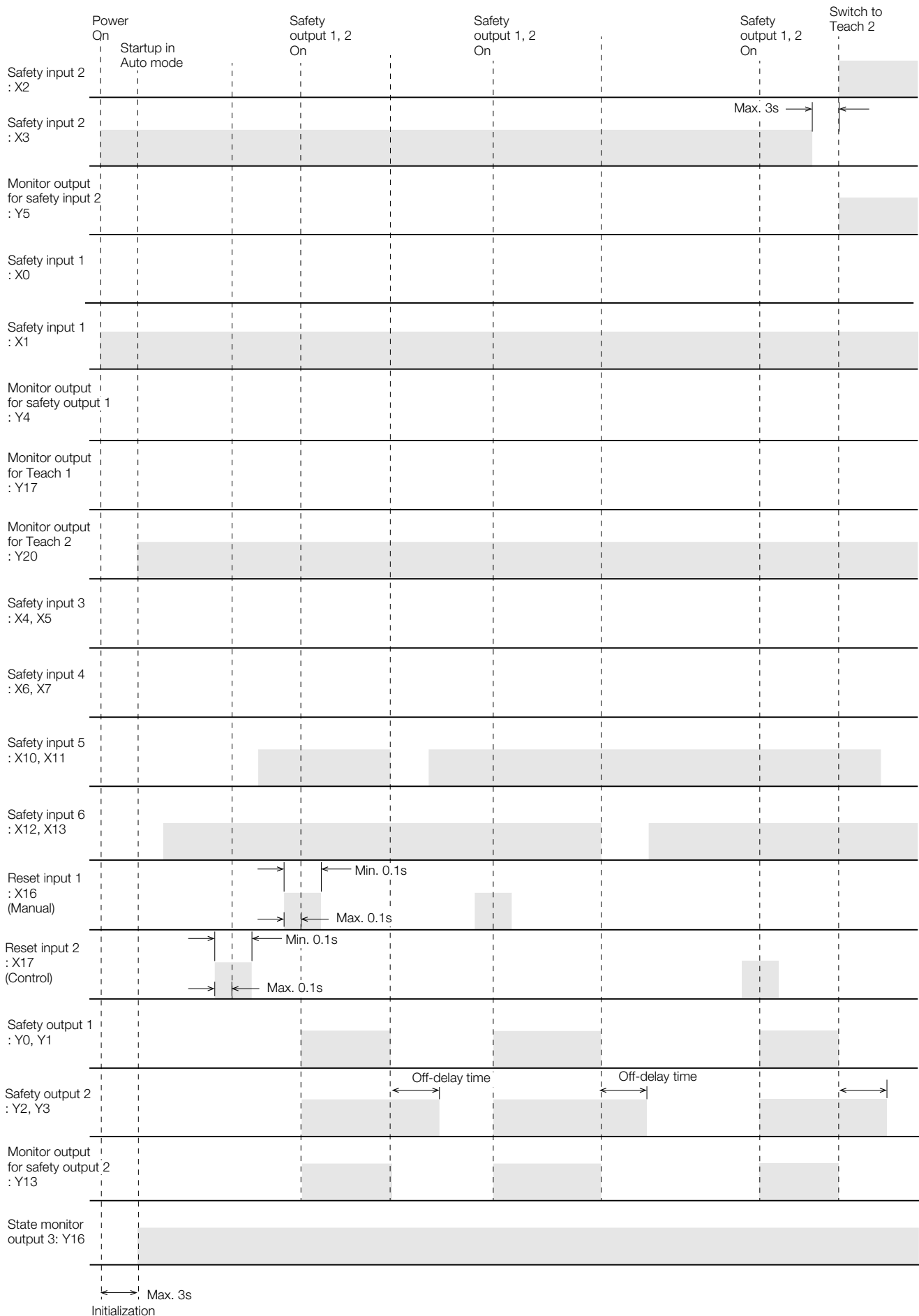
Figure 5.86 Timing chart (Logic 33d Auto mode)

❏ Safety system configuration example

This section describes an example of using logic 33d to implement safety measures for machine tools.

⚠ WARNING	• The systems in this manual show just examples of intended use application. The user is responsible for safe integration in the overall system. Safety performance must be evaluated on a system-wide basis relevant standards (for example, ISO16090-1), laws and regulations (for example, Machine Directive). • When using logic that includes mode select inputs, the operating mode set by the system should be displayed for the operator to verify the operating mode of the system. (for example, the monitor output of the product is taken into the system, information on the system operation mode is processed as a safety parameter, and the result of the setting is displayed on the display, etc.) • To prevent unexpected startup, take safety measures to prevent the hazardous source from operating only with the reset input of FS1B. (for example, provide a start switch, etc.) • Safety measures in the entire system shall be taken to reduce the as then The FS1B is not capable of monitoring the speed of hazardous source.

• Safety system overview

Safety components to be used

	Safety components to be connected	Input functions	Active mode
Safety input 1	Selector switch	Mode select input II	Teach mode
Safety input 2	Selector switch	Mode select input II	—
Safety input 3	Enabling switch	Dual channel dependent input	Teach mode (Teach1)
Safety input 4	Enabling switch	Dual channel dependent input	Teach mode (Teach2)
Safety input 5	Interlock switch	Dual channel safety input II	Auto mode
Safety input 6	Emergency stop switch	Dual channel direct opening input	Teach mode Auto mode

Control object

	Control object	Active mode
Safety output 1	Machine tool operating permission	Teach mode Auto mode
Safety output 2	Machine tool operating permission	Teach mode Auto mode

• **Teach mode**

Select the teach mode when teaching the machine tool. The machine tool can be operated only when the enabling switch is set to the operation-allowed state (position 2). The effective enabling switch depends on the selected position of the selector switch connected to safety input 2. At this time, the machine tool must be properly speed-limited so as not to endanger the operator.
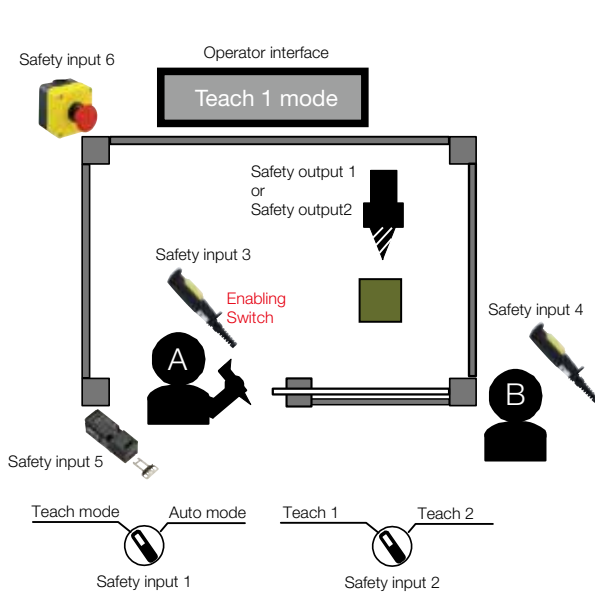
Figure 5.87 Safety system configuration example (Logic 33d Teach 1 mode)
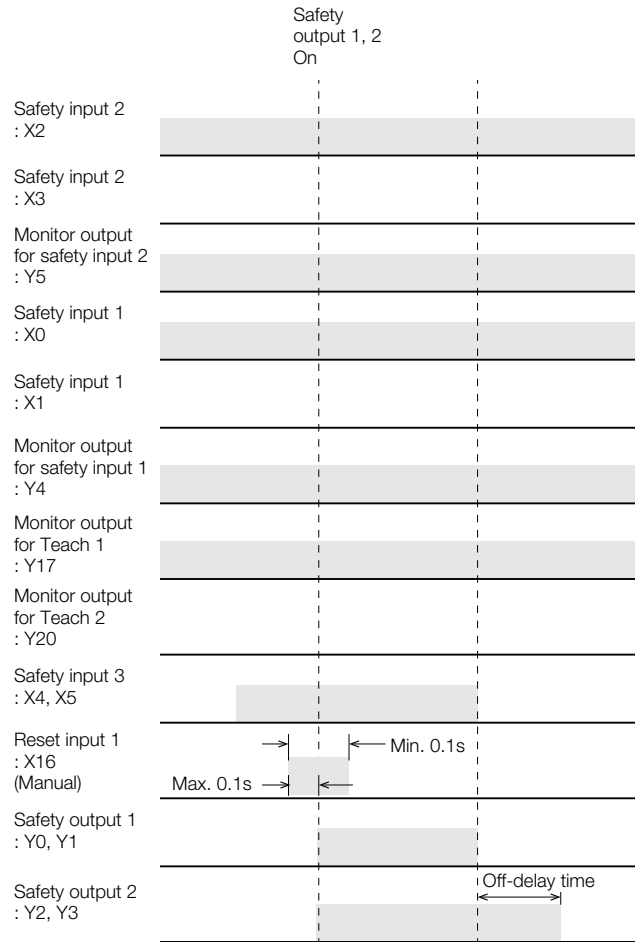
• Safety input 6 and reset input 2 are all on in this chart.

Figure 5.88 Timing chart (Logic 33d Teach 1 mode)
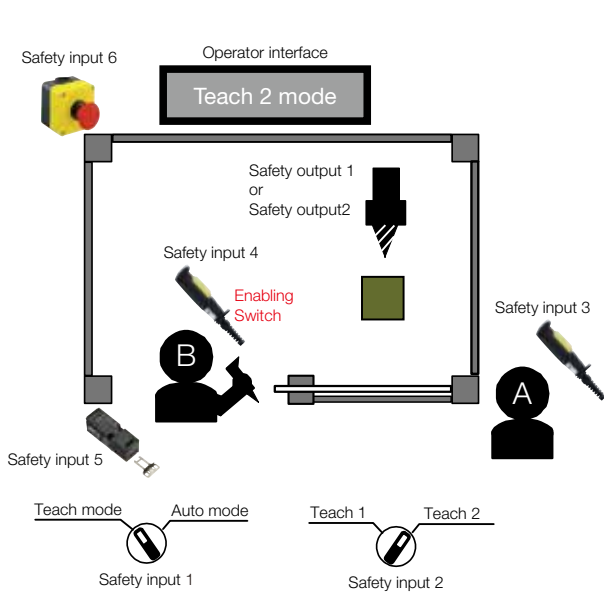
Figure 5.89 Safety system configuration example (Logic 33d Teach 2 mode)
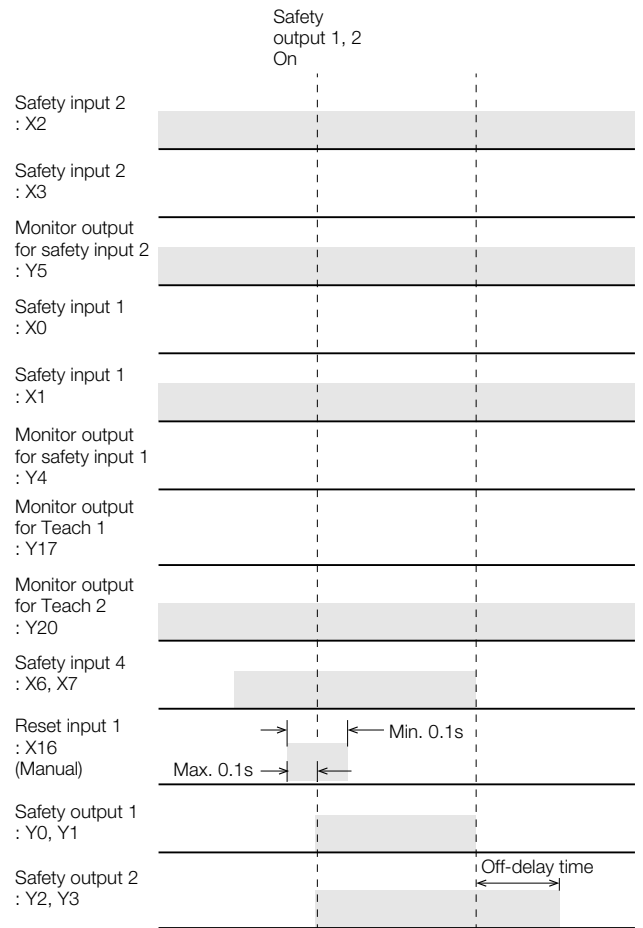
• Safety input 6 and reset input 2 are all on in this chart.

Figure 5.90 Timing chart (Logic 33d Teach 2 mode)

• **Auto mode**

Select the auto mode when during normal operation of the machine tool. Before starting normal operation, make sure that the person is not inside the safety guard.

Additional safety measures should be applied as needed. (for example, use padlocks for interlock switches, etc.)

The machine tool can be operated only when the safety guard is closed. Depending on the risk assessment of the entire system, a locking mechanism may be required for the safety guard. (for example, after the machine tool has come to a complete stop, the unlocking process is performed.)
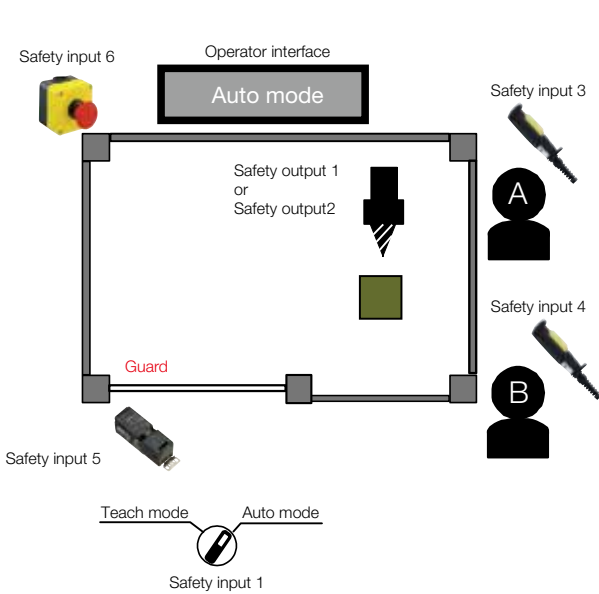
Figure 5.91 Safety system configuration example (Logic 33d Auto mode)
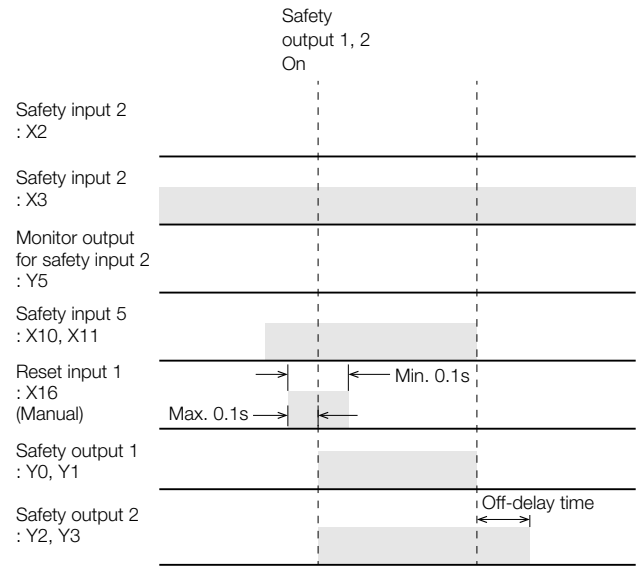
Figure 5.92 Timing chart (Logic 33d Auto mode)

• Safety input 6 and reset input 2 are all on in this chart.

⚠	**WARNING**	• Calculate the safety distances, while taking into consideration the intrusion speed of the response time of the FS1B and safety components connected to the FS1B.

Logic 304: Partial stop circuit including a mode select function
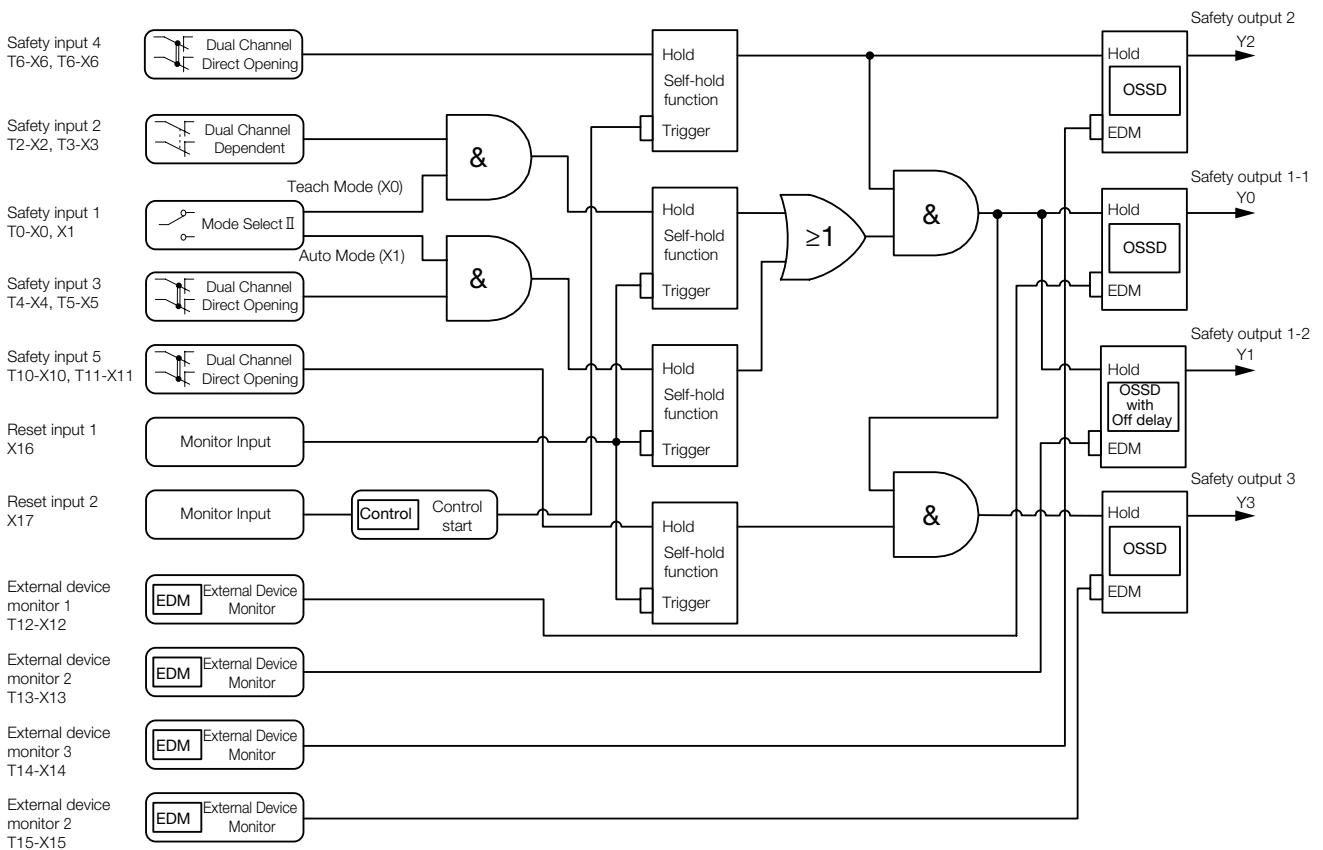
❏ Logic circuit

Figure 5.93 Logic circuit (Logic 304)

- **Safety inputs**

    Some safety inputs can be changed input function. The monitor output turns on when the target safety input is on and turns off when the safety input is off.

	Initial input function	Optional input functions	Monitor output
Safety input 1 (T0-X0, X1)	Mode select input II	—	Y4 (On in teach mode (X0))
Safety input 2 (T2-X2, T3-X3)	Dual channel dependent input	Dual channel NO/NC input Dual channel safety input II	Y5
Safety input 3 (T4-X4, T5-X5)	Dual channel direct opening input	Dual channel NO/NC input Dual channel safety input II	Y6
Safety input 4 (T6-X6, T7-X7)	Dual channel direct opening input	Dual channel NO/NC input Dual channel safety input II	Y7
Safety input 5 (T10-X10, T11-X11)	Dual channel direct opening input	Dual channel NO/NC input Dual channel safety input II	Y10

- **Safety outputs**

    The monitor output turns on when the target safety output is on and turns off when the safety output is off.

    The monitor output turns off immediately independent on set off-delay time.

	Monitor output
Safety output 1-1 (Y0)	Y12
Safety output 1-2 (Y1)	Y13
Safety output 2 (Y2)	Y17
Safety output 3 (Y3)	Y20

- **Reset inputs**

  Resets inputs are used to reset the safety output.

  Reset input 1 (X16)

  Reset input 2 (X17)

⚠	**WARNING**	• To prevent unexpected startup of the system, take safety measures to prevent the hazardous source from operating only with the reset input of FS1B. (for example, provide a start switch, etc.)

- **External device monitor inputs**

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

  External device monitor input 1 (T12-X12): for safety output 1-1 (Y0)

  External device monitor input 2 (T13-X13): for safety output 1-2 (Y1)

  External device monitor input 3 (T14-X14): for safety output 2 (Y2)

  External device monitor input 4 (T15-X15): for safety output 3 (Y3)

- **State monitor outputs**

  State monitor outputs output internal state and error status.

	Initial/Configuration	Run	Protection	Stop
State monitor output 1 (Y14)	☐Off	☐Off	■On	■On
State monitor output 2 (Y15)	☐Off	☐Off	■On	☐Off
State monitor output 3 (Y16)	☐Off	■On	☐Off	☐Off

❑ **Wiring example**

Figure 5.94 Wiring example (Logic 304)

S1: Selector switch
S2: Enabling switch
S3, S5: Interlock switch
S4: Emergency stop switch
S6, S7: Pushbuttons
K1, K2, K3, K4, K5, K6, K7, K8: Forced guided relays
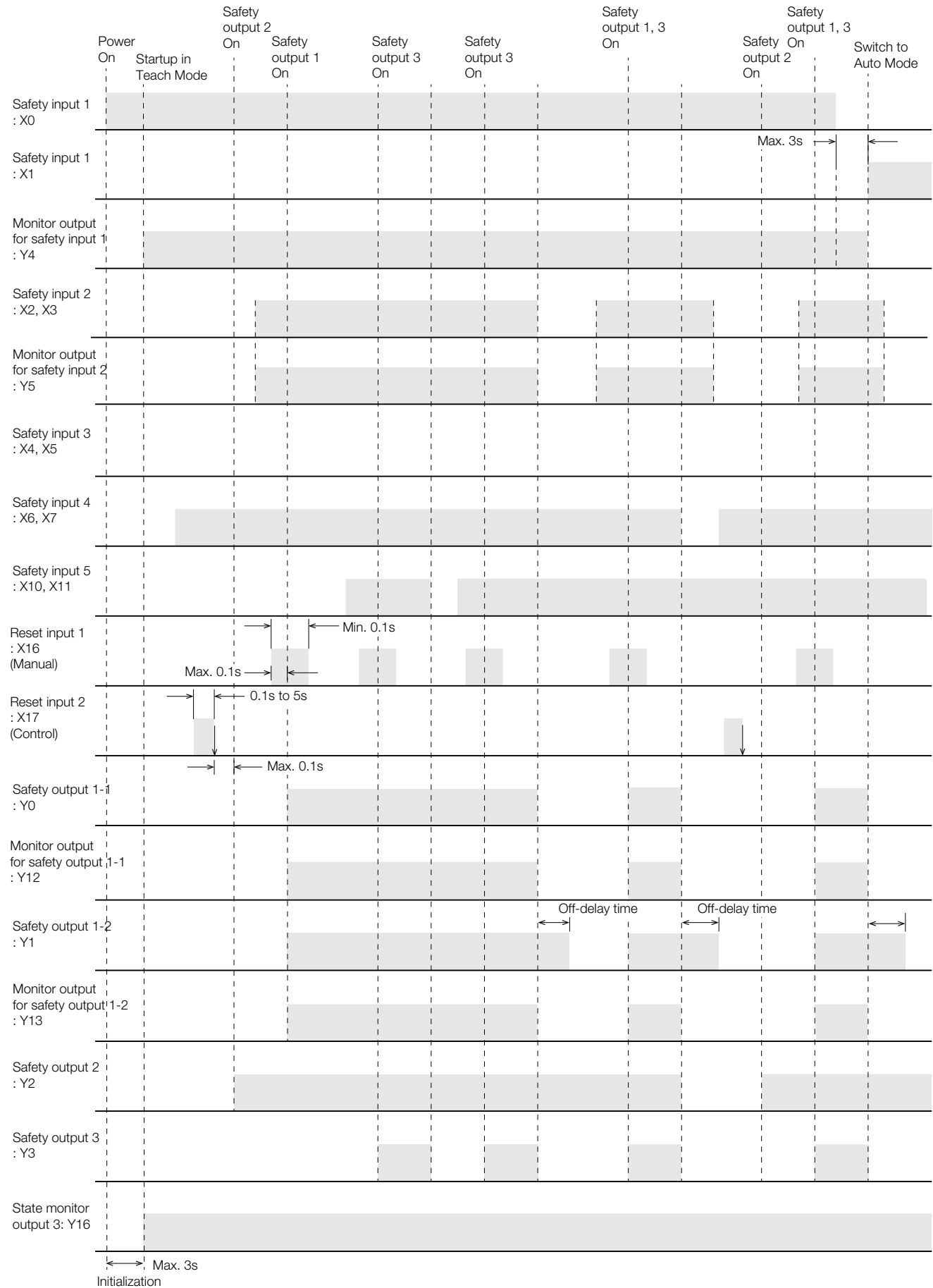
❏ **Timing chart**

Figure 5.95 Timing chart (Logic 304 Teach mode)
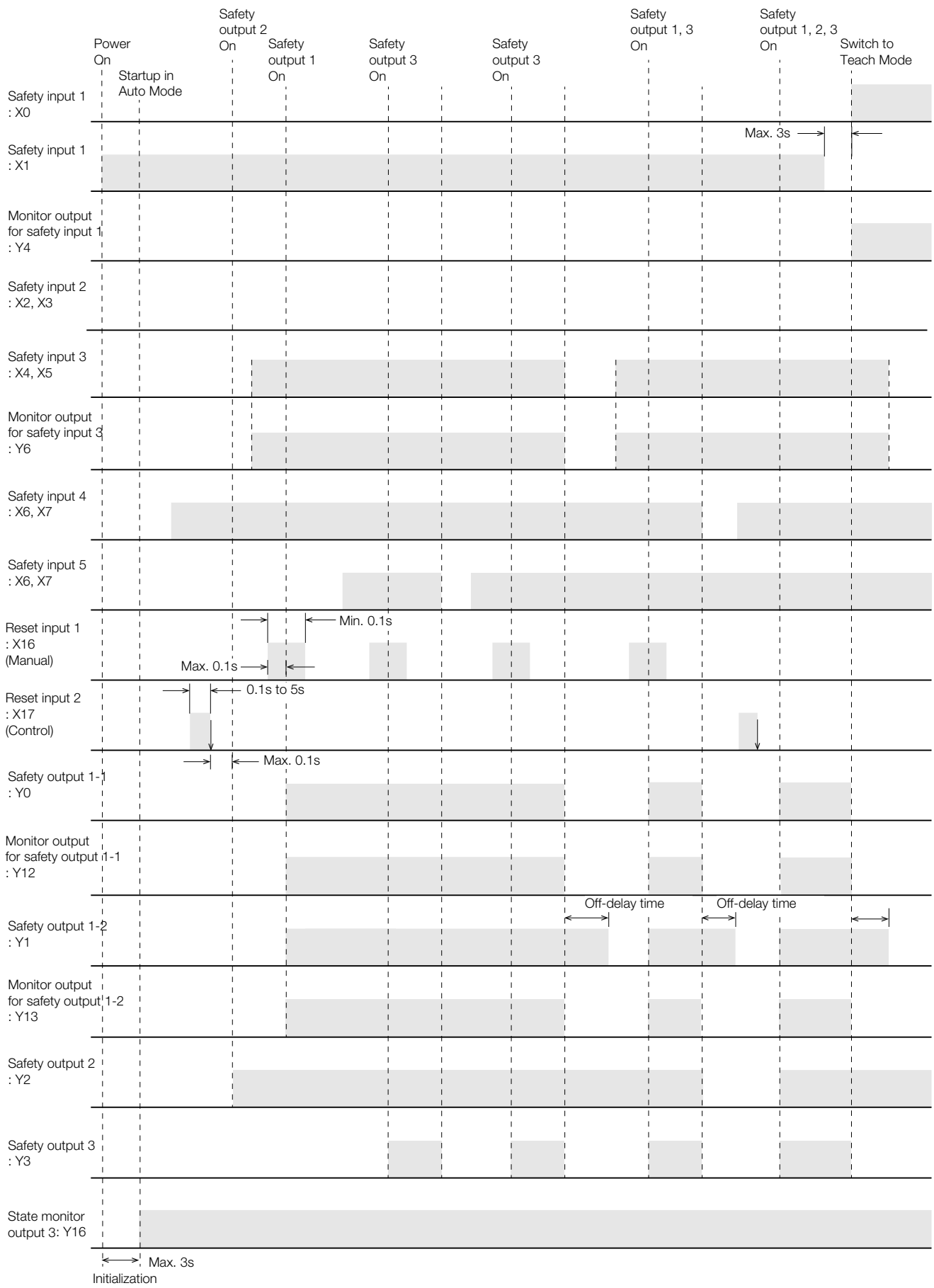
Figure 5.97 Timing chart (Logic 304 Auto mode)

❏ Safety system configuration example

This section describes an example of using logic 304 to implement safety measures for machine tools.

⚠ WARNING	• The systems in this manual show just examples of intended use application. The user is responsible for safe integration in the overall system. Safety performance must be evaluated on a system-wide basis relevant standards (for example, ISO16090-1), laws and regulations (for example, Machine Directive). • When using logic that includes a mode select input, the operating mode set by the system should be displayed for the operator to verify the operating mode of the system. (for example, the monitor output of the product is taken into the system, information on the system operation mode is processed as a safety parameter, and the result of the setting is displayed on the display, etc.) • To prevent unexpected startup, take safety measures to prevent the hazardous source from operating only with the reset input of FS1B. (for example, provide a start switch, etc.) • Safety measures in the entire system shall be taken to reduce the as then The FS1B is not capable of monitoring the speed of hazardous source.

• **Safety System Overview**

Safety components to be used

	Safety components to be connected	Input functions	Active mode
Safety input 1	Selector Switch	Mode select input II	—
Safety input 2	Enabling switch	Dual channel dependent input	Teach mode
Safety input 3	Interlock switch	Dual channel direct opening input	Auto mode
Safety input 4	Emergency stop switch	Dual channel direct opening input	Teach mode Auto mode
Safety input 5	Interlock switch	Dual channel direct opening input	Teach mode Auto mode

Control object

	Control object	Active mode
Safety output 1-1	Machine tool operating permission	Teach mode Auto mode
Safety output 1-2	Machine tool power	Teach mode Auto mode
Safety output 2	Entire system	Teach mode Auto mode
Safety output 3	Conveyor	Teach mode Auto mode

- **Teach mode**

  Select the teach mode when teaching the machine tool. The machine tool can be operated only when the enabling switch is set to the operation-allowed state (position 2). At this time, the machine tool must be properly speed-limited so as not to endanger the operator.

- Safety output 2 is all on in this chart.
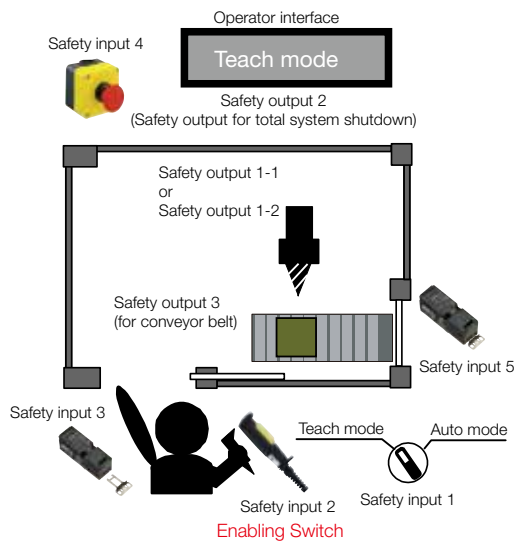
Figure 5.98 Safety system configuration example (Logic 304 Teach mode)
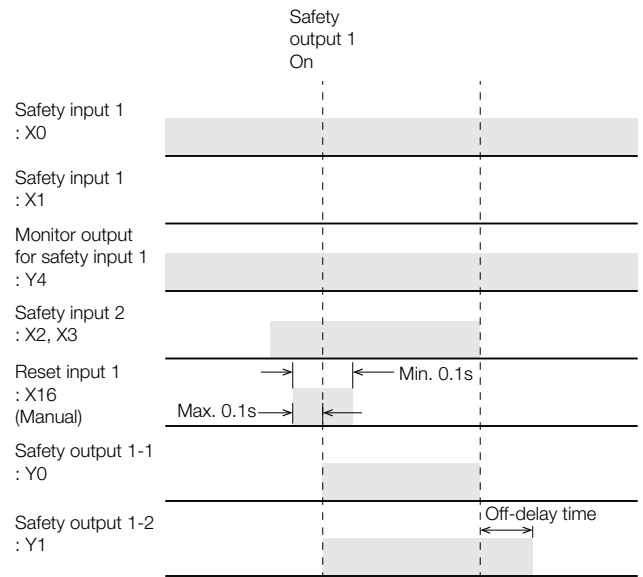
Figure 5.99 Timing chart (Logic 304 Teach mode)

- **Auto mode**

  Select the auto mode when during normal operation of the machine tool. Before starting normal operation, make sure that the operator is not inside the safety guard.

  Additional safety measures should be applied as needed. (for example, use padlocks for interlock switches, etc.)

  The machine tool can be operated only when the safety guard is closed. Depending on the risk assessment of the entire system, a locking mechanism may be required for the safety guard. (for example, after the machine tool has come to a complete stop, the unlocking process is performed.)

- Safety output 2 is all on in this chart.
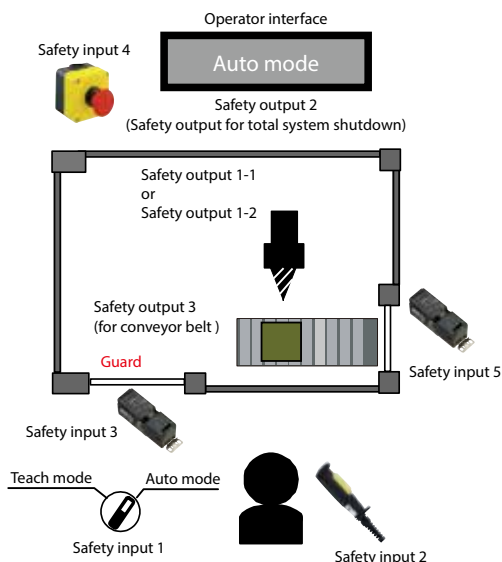
Figure 5.100 Safety system configuration example (Logic 304 Auto mode)

Figure 5.101 Timing chart (Logic 304 Auto mode)

⚠ WARNING	• Calculate the safety distances, while taking into consideration the intrusion speed of the response time of the FS1B and safety components connected to the FS1B.
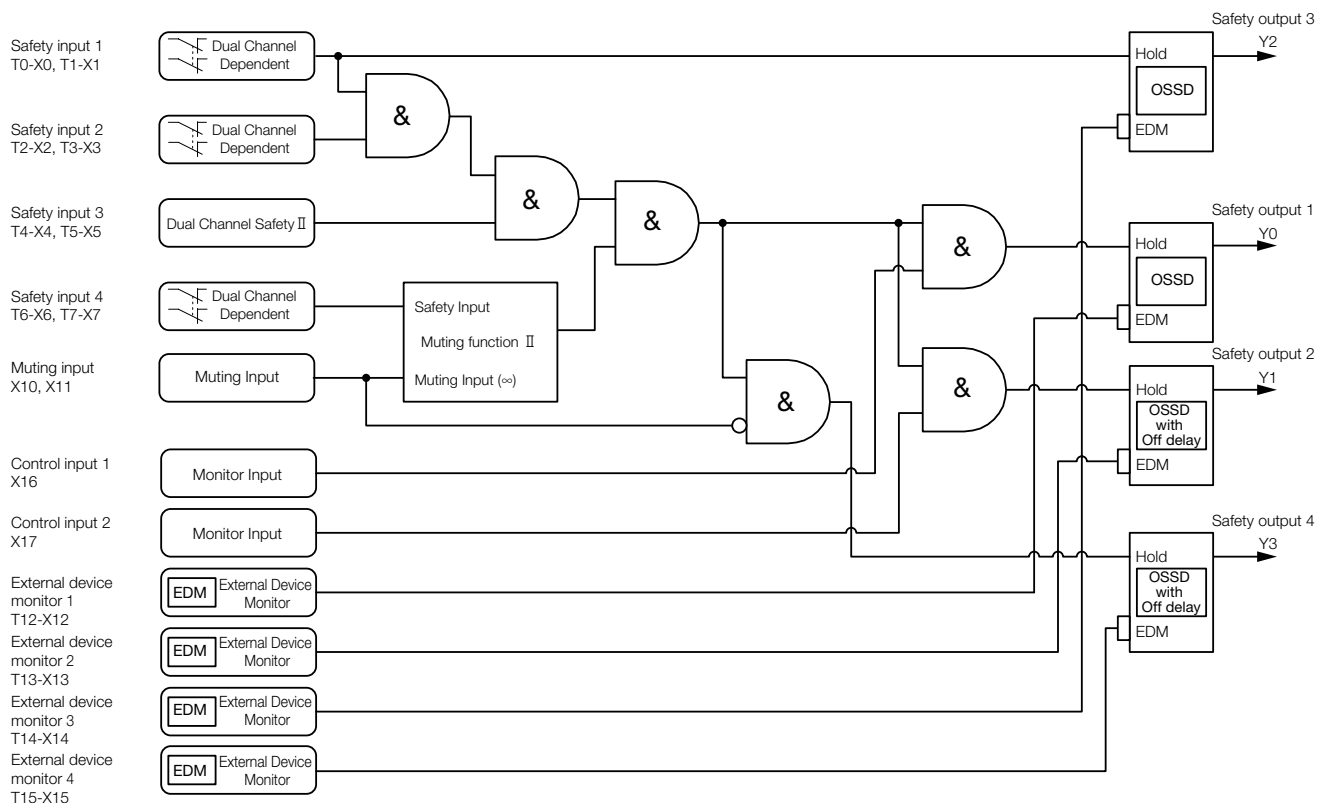
❏ **Logic circuit**

Figure 5.102 Logic circuit (Logic 34A)

● **Safety inputs**

Some safety inputs can be changed input function. The monitor output turns on when the target safety input is on and turns off when the safety input is off.

The muting lamp output turns on in the muting state. The muting state is enabled when muting input is turned on while safety output 1 and safety output 2 are on. The muting state is disabled when the muting input is turned off. When the power is turned on or the safety output is turned off while the muting input is on, the muting state is not enabled unless the muting input is turned off once.

	Initial input function	Optional input functions	Monitor output	Muting lamp output
Safety input 1 (T0-X0, T1-X1)	Dual channel dependent input	Dual channel NO/NC input Dual channel safety input II	Y4	—
Safety input 2 (T2-X2, T3-X3)	Dual channel dependent input	Dual channel NO/NC input Dual channel safety input II	Y5	—
Safety input 3 (T4-X4, T5-X5)	Dual channel safety input II	Dual channel dependent input Dual channel NO/NC input	Y6	—
Safety input 4 (T6-X6, T7-X7)	Dual channel dependent input	Dual channel NO/NC input Dual channel safety input II	Y7	Y17
Muting input (X10, X11)	Muting Input	—	Y10	

- **Safety outputs**

   The monitor output turns on when the target safety output is on and turns off when the safety output is off. The monitor output turns off immediately independent on set off-delay time.

	Monitor output
Safety output 1 (Y0)	Y12
Safety output 2 (Y1)	Y13
Safety output 3 (Y2)	—
Safety output 4 (Y3)	Y20

- **Control input**

   Control inputs are used to control the safety output.

   Control input 1 (X16)

   Control input 2 (X17)

> ⚠️ **WARNING** • Control inputs are not safety inputs. Do not use as a safety input since the hazardous source may not stop due to connected equipment or input circuit failure.

- **External device monitor inputs**

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

   External device monitor input 1 (T12-X12): for safety output 1 (Y0)

   External device monitor input 2 (T13-X13): for safety output 2 (Y1)

   External device monitor input 3 (T14-X14): for safety output 3 (Y2)

   External device monitor input 4 (T15-X15): for safety output 4 (Y3)

- **State monitor outputs**

   State monitor outputs output internal state, alert and error status.

	Initial/ Configuration	Run	Run (Alert detection)	Protection	Stop	Stop (External power supply voltage error detection)
State monitor output 1 (Y14)	☐Off	☐Off	☐Off	☐Off	■On	■On
State monitor output 2 (Y15)	☐Off	☐Off	■On	■On	☐Off	■On
State monitor output 3 (Y16)	☐Off	■On	☐Off	☐Off	☐Off	☐Off

❏ Wiring example

Figure 5.103 Wiring example (Logic 34A)
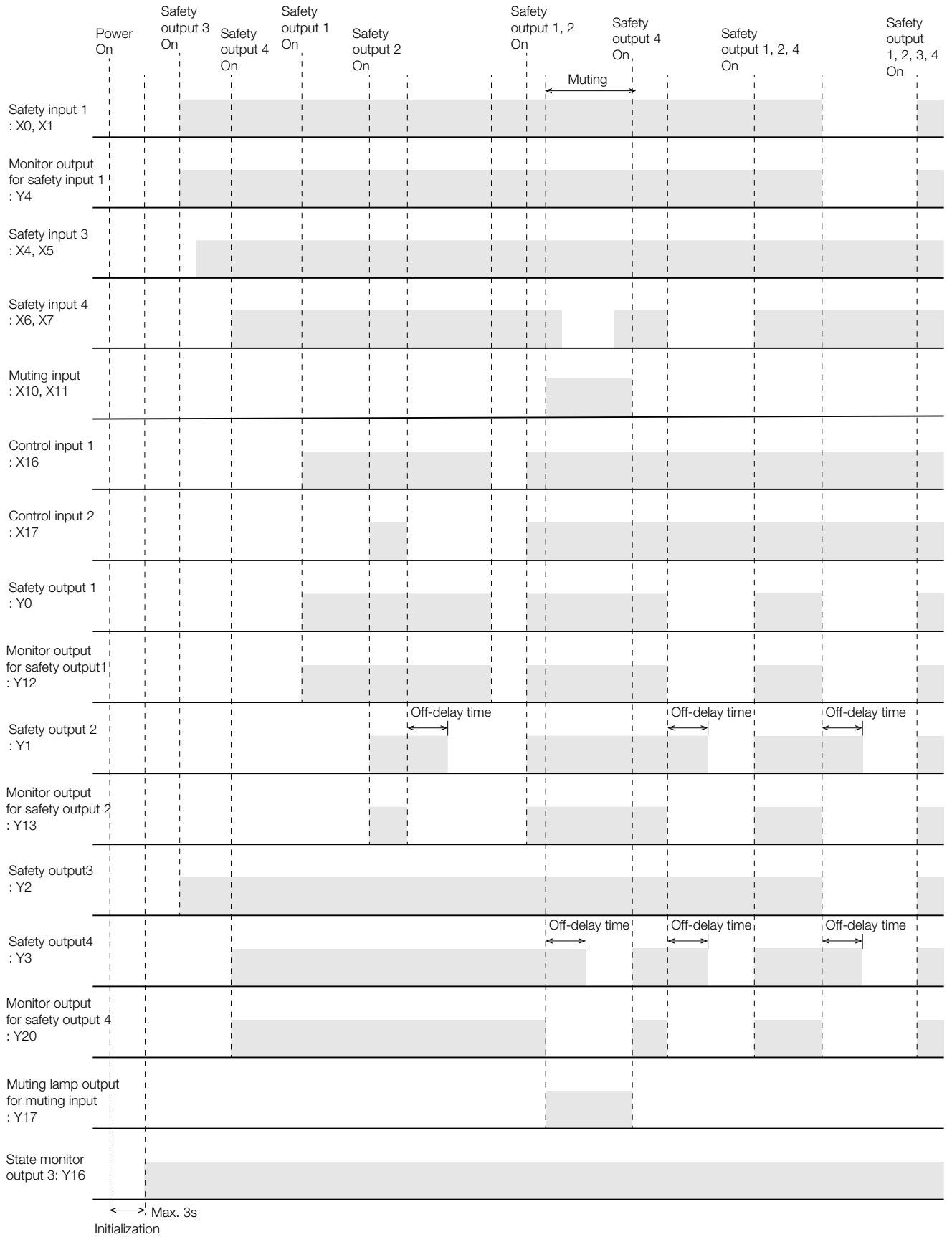
❏ **Timing chart**

Figure 5.104 Timing chart (Logic 34A)

- Safety input 2 is all on in this chart.

❏ Safety system configuration example

This section describes an example of using Logic 34A to implement safety measures for a robotic system.

⚠ WARNING	• The systems in this manual show just examples of intended use application. The user is responsible for safe integration in the overall system. Safety performance must be evaluated on a system-wide basis relevant standards (for example, ISO10218-1 and ISO10218-2), laws and regulations (for example, Machine Directive). • To prevent unexpected startup, take safety measures to prevent the hazardous source from operating only with the reset input of FS1B. (for example, provide a start switch, etc.) • Incorrect use of the muting function can lead to accidents. Relevant standards (for example, IEC61496-1, etc.), familiarize yourself with the muting function and use it correctly. • If the muting function is enabled, the operator must ensure the safety of the protected area in appropriate measures (for example, by notifying the surrounding area with a muting lamp, etc.).

• **Safety System Overview**

Safety components to be used

	Safety components to be connected	Input functions
Safety input 1	Emergency stop switch	Dual channel dependent input
Safety input 2	Interlock switch	Dual channel dependent input
Safety input 3	Interlock switch	Dual channel safety input II
Safety input 4	Safety light curtain	Dual channel safety input II
Muting Input	Muting Sensor	Muting Input

Control object

	Control object
Safety output 1	Peripheral system power supply
Safety output 2	Robot operation permission
Safety output 3	Entire system
Safety output 4	Conveyor

Before starting operation, make sure that the operator is not inside the safety guard. Additional safety measures should be applied as needed. (for example, use padlocks for interlock switches, etc.)

The robot system can only operate when the operator cannot enter the safety guard (when the safety guard is closed and the safety light curtain is illuminated). Depending on the risk assessment of the entire system, a locking mechanism may be required for the safety guard. (for example, implementation of unlocking after the robot has come to a complete stop)
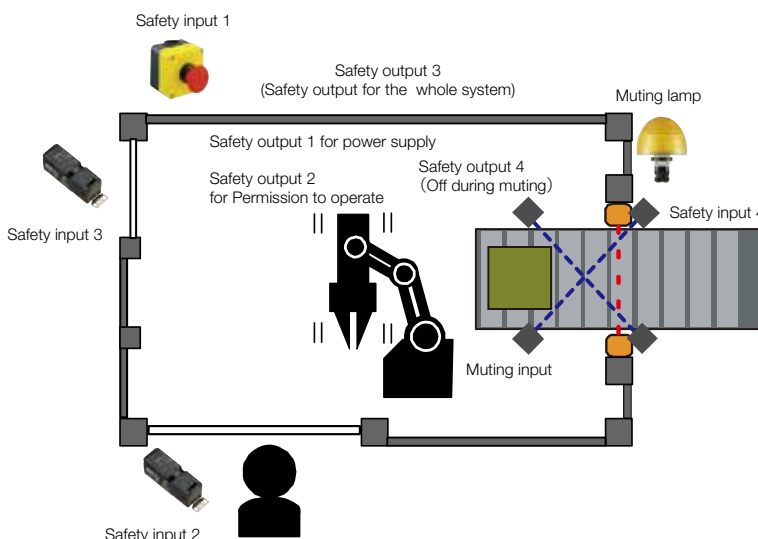
Figure 5.105 Safety system configuration example (Logic 34A)

⚠ WARNING	• Calculate the safety distances, while taking into consideration the intrusion speed of the response time of the FS1B and safety components connected to the FS1B.

Logic 34b: Partial stop circuit including a muting function

❏ Logic circuit
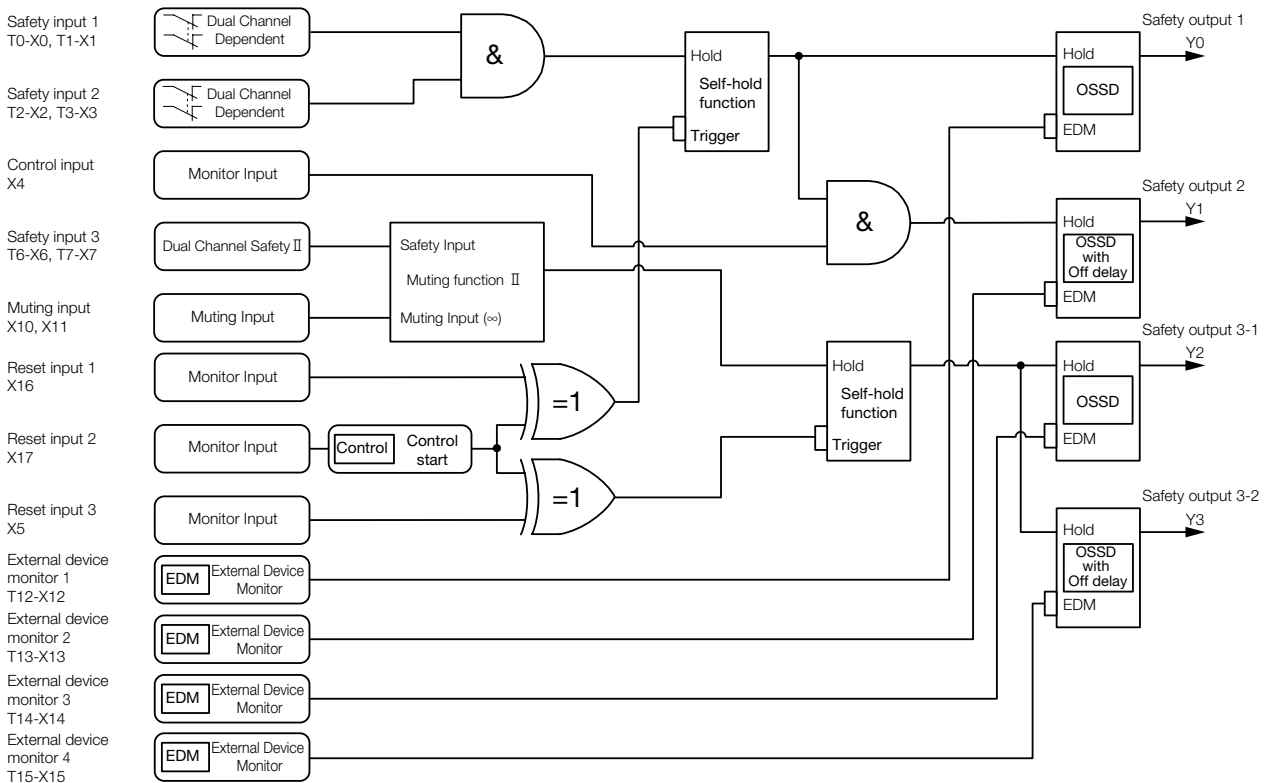
Figure 5.106 Logic circuit (Logic 34b)

- **Safety inputs**

  Some safety inputs can be changed input function. The monitor output turns on when the target safety input is on and turns off when the safety input is off.

  The muting lamp output turns on in the muting state. The muting state is enabled when muting input is turned on while safety output 3-1 and safety output 3-2 are on. The muting state is disabled when the muting input is turned off. When the power is turned on or the safety output is turned off while the muting input is on, the muting state is not enabled unless the muting input is turned off once.

	Initial input function	Optional input functions	Monitor output	Muting lamp output
Safety input 1 (T0-X0, T1-X1)	Dual channel dependent input	Dual channel NO/NC input Dual channel safety input II	Y4	—
Safety input 2 (T2-X2, T3-X3)	Dual channel dependent input	Dual channel NO/NC input Dual channel safety input II	Y5	—
Safety input 3 (T6-X6, T7-X7)	Dual channel safety input II	Dual channel dependent input Dual channel NO/NC input	Y7	Y20
Muting Input (X10, X11)	Muting Input	—	Y10	

- **Safety outputs**

  The monitor output turns on when the target safety output is on and turns off when the safety output is off. The monitor output turns off immediately independent on set off-delay time.

	Monitor output
Safety output 1 (Y0)	Y12
Safety output 2 (Y1)	Y13
Safety output 3-1 (Y2)	Y17
Safety output 3-2 (Y3)	—

• **Control input**

Control inputs are used to control the safety output.

Control input 1(X4)

⚠ WARNING	• Control inputs are not safety inputs. Do not use as a safety input since the hazardous source may not stop due to connected equipment or input circuit failure.

• **Reset inputs**

Resets inputs are used to reset the safety output.

Reset input 1 (X16)

Reset input 2 (X17)

Reset input 3 (X5)

⚠ WARNING	• To prevent unexpected startup of the system, take safety measures to prevent the hazardous source from operating only with the reset input of FS1B. (for example, provide a start switch, etc.)

• **External device monitor inputs**

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

External device monitor input 1 (T12-X12): for safety output 1 (Y0)

External device monitor input 2 (T13-X13): for safety output 2 (Y1)

External device monitor input 3 (T14-X14): for safety output 3-1 (Y2)

External device monitor input 4 (T15-X15): for safety output 3-2 (Y3)

• **State monitor outputs**

State monitor outputs output internal state and error status.

	Initial/Configuration	Run	Run (Alert detection)	Protection	Stop	Stop (External power supply voltage error detection)
State monitor output 1 (Y14)	☐Off	☐Off	☐Off	☐Off	■On	■On
State monitor output 2 (Y15)	☐Off	☐Off	■On	■On	☐Off	■On
State monitor output 3 (Y16)	☐Off	■On	☐Off	☐Off	☐Off	☐Off

❑ Wiring example

S1: Emergency stop switch
S2: Interlock switch
S3, S4, S8, S9: Pushbuttons
S5: Safety light curtain
S6, S7: Muting sensors
K1, K2, K3, K4, K5, K6, K7, K8: Forced guided relays

Figure 5.107 Wiring example (Logic 34b)
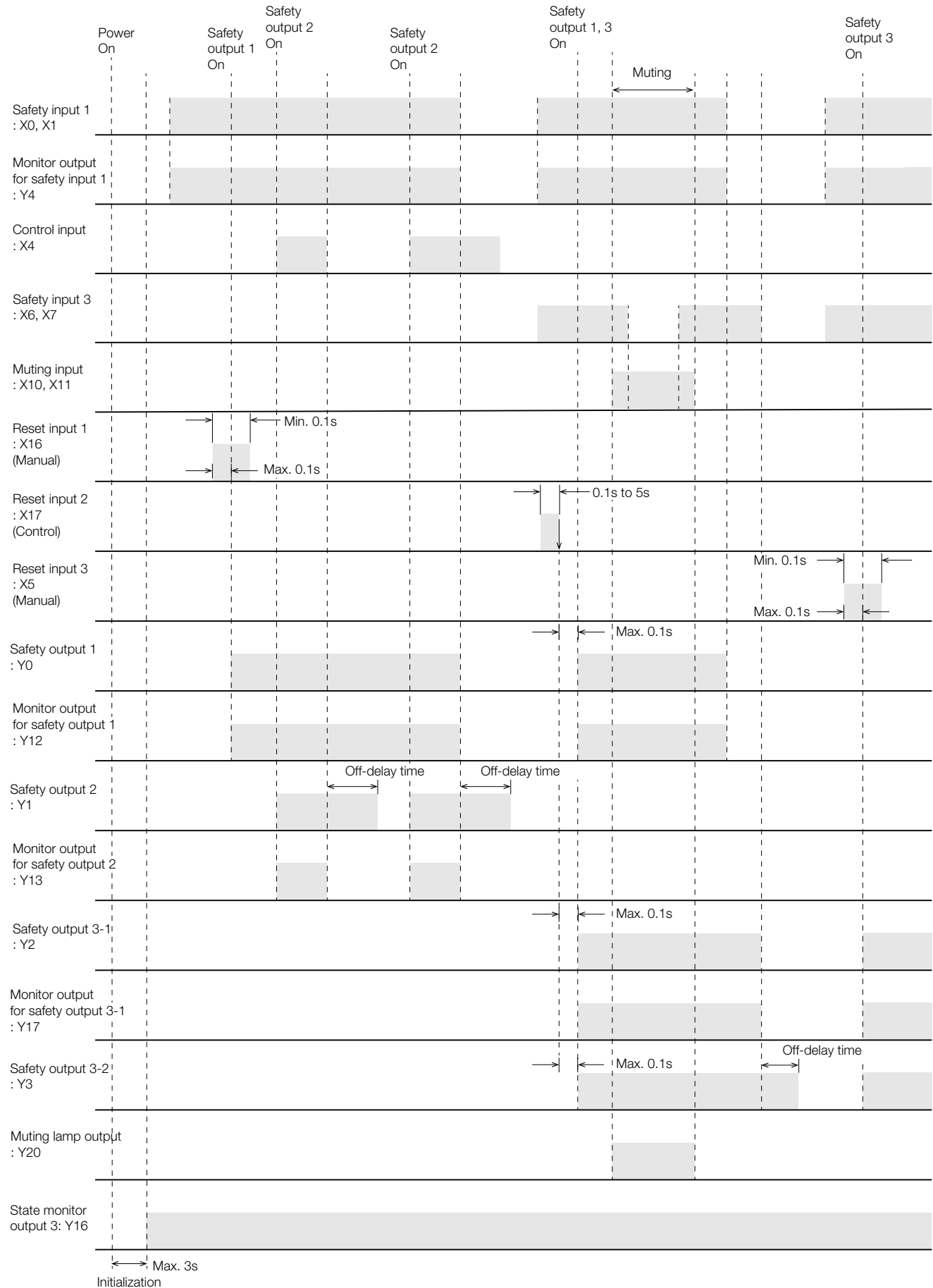
❏ Timing chart

Figure 5.108 Timing chart (Logic 34b)

• Safety input 2 is all on in this chart.

❏ Safety system configuration example

This section describes an example of using logic 34b to implement safety measures for a robotic system.

⚠ WARNING	• The systems in this manual show just examples of intended use application. The user is responsible for safe integration in the overall system. Safety performance must be evaluated on a system-wide basis relevant standards (for example, ISO10218-1 and ISO10218-2), laws and regulations (for example, Machine Directive). • To prevent unexpected startup, take safety measures to prevent the hazardous source from operating only with the reset input of FS1B. (for example, provide a start switch, etc.) • Incorrect use of the muting function can lead to accidents. Relevant standards (for example, IEC61496-1, etc.), familiarize yourself with the muting function and use it correctly. • If the muting function is enabled, the operator must ensure the safety of the protected area in appropriate measures. (for example, by notifying the surrounding area with a muting lamp, etc.)

• Safety System Overview

Safety components to be used

	Safety components to be connected	Input functions
Safety input 1	Emergency stop switch	Dual channel dependent input
Safety input 2	Interlock switch	Dual channel dependent input
Safety input 3	Safety light curtain	Dual channel safety input II
Muting Input	Muting Sensor	Muting Input

Control object

	Control object
Safety output 1	Entire system
Safety output 2	Entire system
Safety output 3-1	Robot operation permission
Safety output 3-2	Robot power

Before starting operation, make sure that the operator is not inside the safety guard. Additional safety measures should be applied as needed. (for example, use padlocks for interlock switches, etc.)

The robot system can only operate when the operator cannot enter the safety guard. (Safety guard is closed and the safety light curtain is illuminated) Depending on the risk assessment of the entire system, a locking mechanism may be required for the safety guard. (for example, implementation of unlocking after the robot has come to a complete stop.)
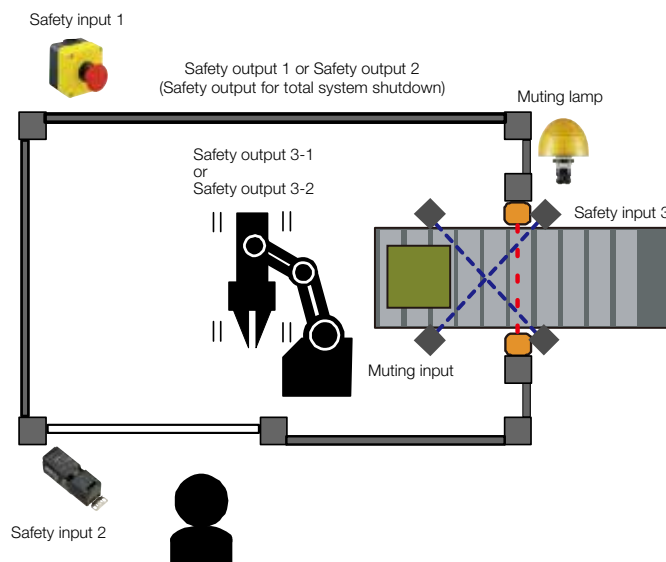
Figure 5.109 Safety system configuration example (Logic 34b)

⚠ WARNING	• Calculate the safety distances, while taking into consideration the intrusion speed of the response time of the FS1B and safety components connected to the FS1B.

Logic 34C: Partial stop circuit including a mode selecting function and an OR function
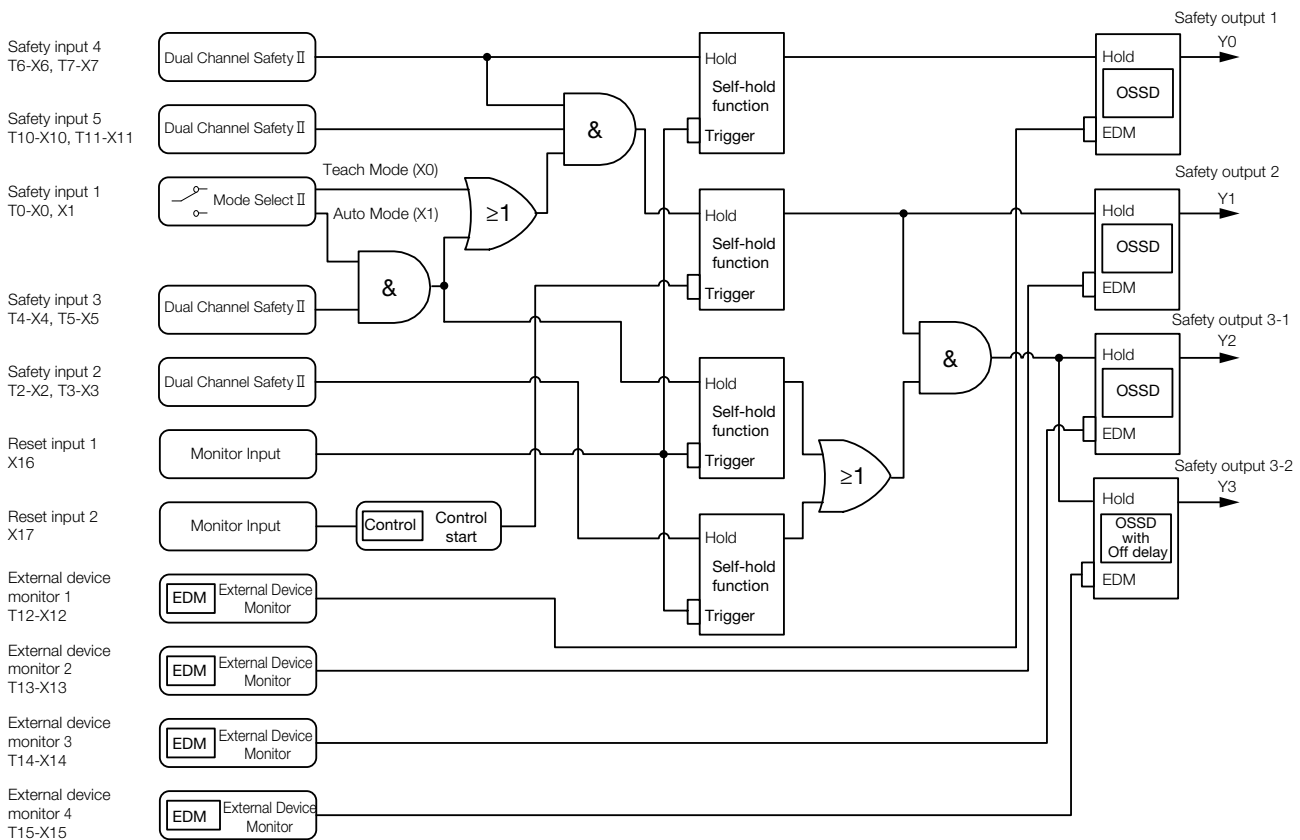
❏ Logic circuit

Figure 5.110 Logic circuit (Logic 34C)

- **Safety inputs**

  Some safety inputs can be changed input function. The monitor output turns on when the target safety input is on and turns off when the safety input is off.

	Initial input function	Optional input functions	Monitor output
Safety input 1 (T0-X0, X1)	Mode select input II	—	Y4 (On in teach mode (X0)) Y11 (On in auto mode (X1))
Safety input 2 (T2-X2, T3-X3)	Dual channel safety input II	Dual channel dependent input Dual channel NO/NC input	Y5
Safety input 3 (T4-X4, T5-X5)	Dual channel safety input II	Dual channel dependent input Dual channel NO/NC input	Y6
Safety input 4 (T6-X6, T7-X7)	Dual channel safety input II	Dual channel dependent input Dual channel NO/NC input	Y7
Safety input 5 (T10-X10, T11-X11)	Dual channel safety input II	Dual channel dependent input Dual channel NO/NC input	Y10

- **Safety outputs**

  The monitor output turns on when the target safety output is on and turns off when the safety output is off. The monitor output turns off immediately independent on set off-delay time.

	Monitor output
Safety output 1 (Y0)	Y12
Safety output 2 (Y1)	Y13
Safety output 3-1 (Y2)	Y17
Safety output 3-2 (Y3)	Y20

- **Reset inputs**

  Resets inputs are used to reset the safety output.

  Reset input 1 (X16)

  Reset input 2 (X17)

⚠	WARNING	• To prevent unexpected startup of the system, take safety measures to prevent the hazardous source from operating only with the reset input of FS1B. (for example, provide a start switch, etc.)

- **External device monitor inputs**

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

  External device monitor input 1 (T12-X12): for safety output 1 (Y0)

  External device monitor input 2 (T13-X13): for safety output 2 (Y1)

  External device monitor input 3 (T14-X14): for safety output 3-1 (Y2)

  External device monitor input 4 (T15-X15): for safety output 3-2 (Y3)

- **State monitor outputs**

  State monitor outputs output internal state and error status.

	Initial/Configuration	Run	Protection	Stop	Stop (External power supply voltage error detection)
State monitor output 1 (Y14)	□Off	□Off	□Off	■On	■On
State monitor output 2 (Y15)	□Off	□Off	■On	□Off	■On
State monitor output 3 (Y16)	□Off	■On	□Off	□Off	□Off

❏ **Wiring example**
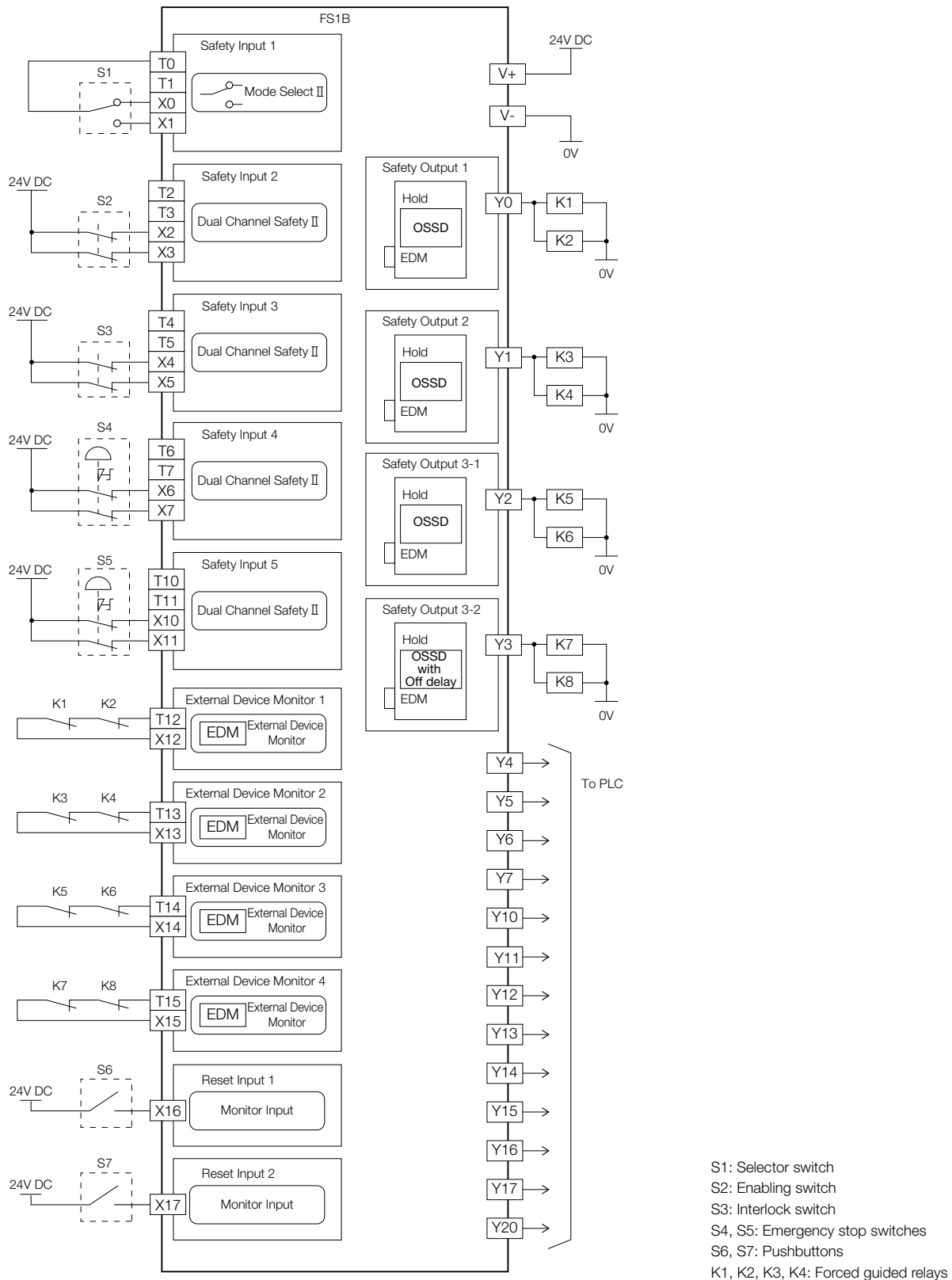
Figure 5.111 Wiring example (Logic 34C)

S1: Selector switch
S2: Enabling switch
S3: Interlock switch
S4, S5: Emergency stop switches
S6, S7: Pushbuttons
K1, K2, K3, K4: Forced guided relays
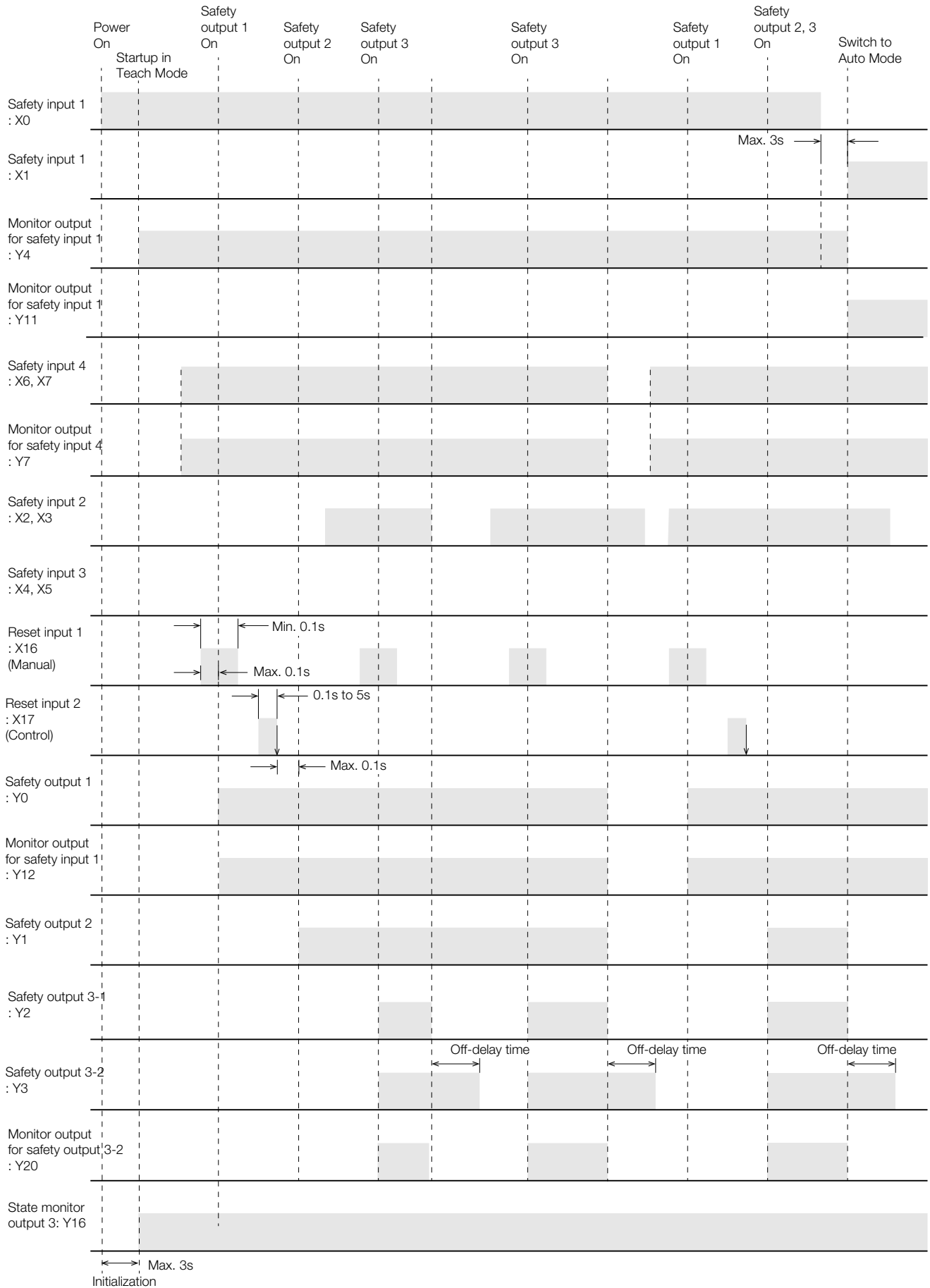
❏ **Timing chart**

Figure 5.112 Timing chart (Logic 34C Teach mode)
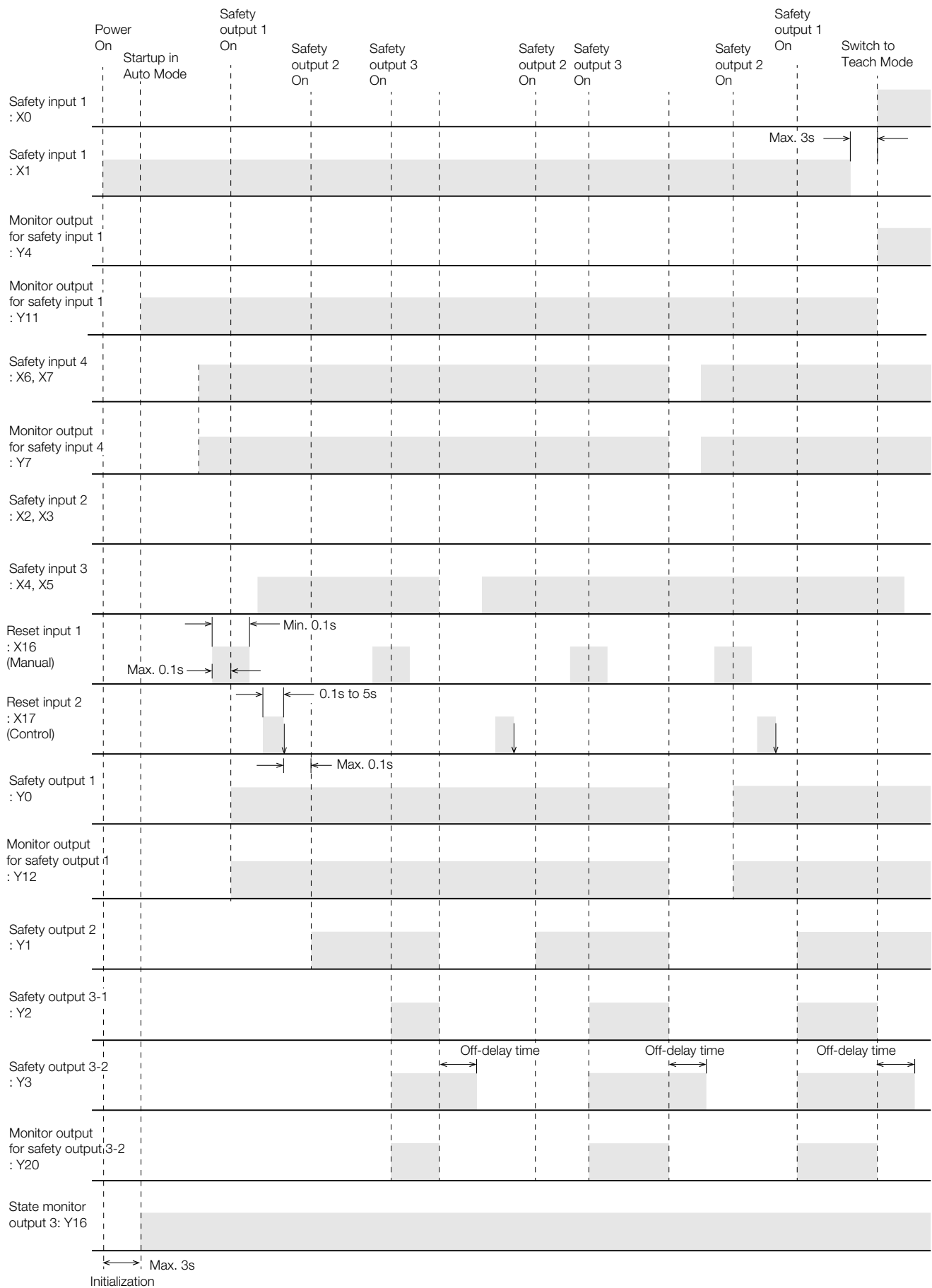
• Safety input 5 is all on in this chart.

Figure 5.113 Timing chart (Logic 34C Auto mode)

• Safety input 5 is all on in this chart.

❏ Safety system configuration example

This section describes an example of using logic 34C to implement safety measures for a robotic system.

⚠ WARNING	• The systems in this manual show just examples of intended use application. The user is responsible for safe integration in the overall system. Safety performance must be evaluated on a system-wide basis relevant standards (for example, ISO10218-1 and ISO10218-2), laws and regulations (for example, Machine Directive). • When using logic that includes a mode select input, the operating mode set by the system should be displayed for the operator to verify the operating mode of the system. (for example, the monitor output of the product is taken into the system, information on the system operation mode is processed as a safety parameter, and the result of the setting is displayed on the display, etc.) • To prevent unexpected startup, take safety measures to prevent the hazardous source from operating only with the reset input of FS1B. (for example, provide a start switch, etc.) • Safety measures in the entire system shall be taken to reduce the as then The FS1B is not capable of monitoring the speed of hazardous source.

• Safety System Overview

Safety components to be used

	Safety components to be connected	Input functions	Active mode
Safety input 1	Selector Switch	Mode select input II	—
Safety input 2	Enabling switch	Dual channel safety input II	Teach mode Auto mode
Safety input 3	Interlock switch	Dual channel safety input II	Auto mode
Safety input 4	Emergency stop switch	Dual channel safety input II	Teach mode Auto mode
Safety input 5	Emergency stop switch	Dual channel safety input II	Teach mode Auto mode

Control object

	Control object	Active mode
Safety output 1	Entire system	Teach mode Auto mode
Safety output 2	Power	
Safety output 3-1	Robot operation permission	
Safety output 3-2		

• **Teach mode**

Select the teach mode when teaching the robot. The robot can be operated only when the enabling switch is set to the operation-allowed state (position 2). At this time, the robot must be properly speed-limited so as not to endanger the operator.
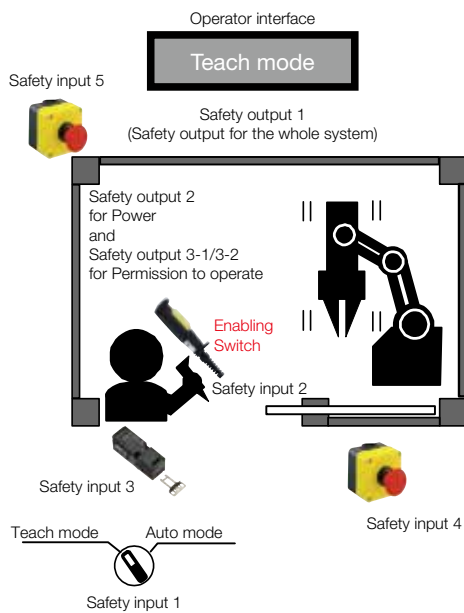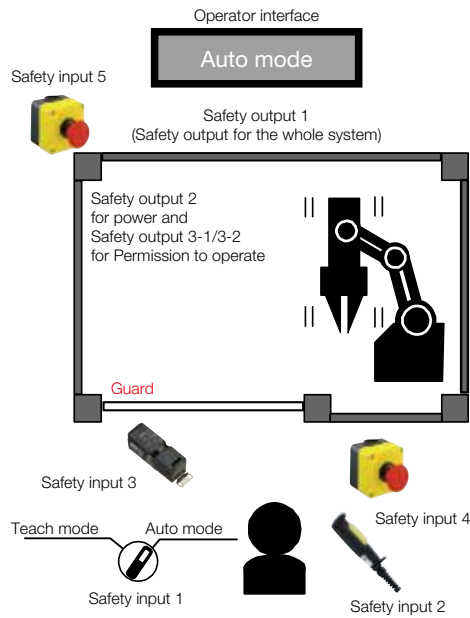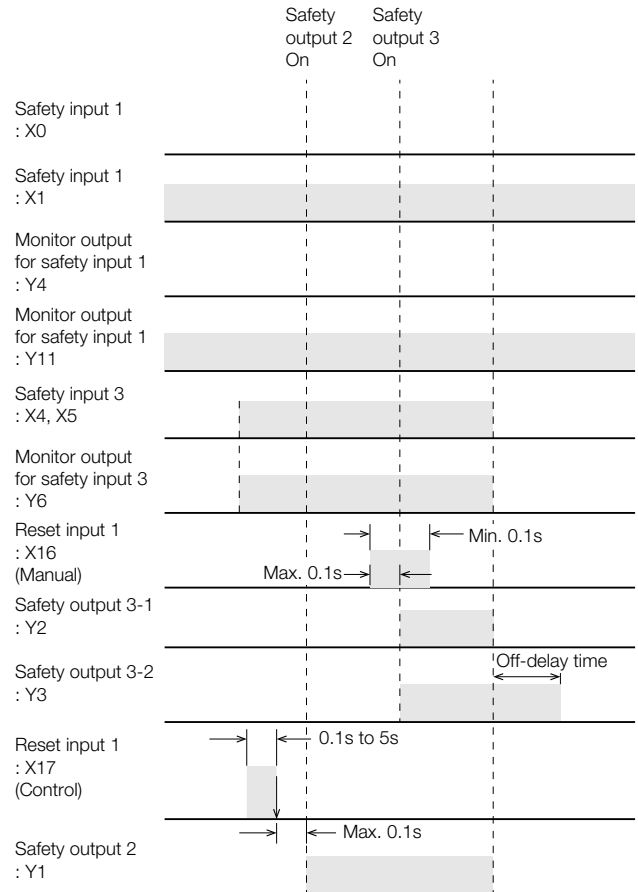

Figure 5.114 Safety system configuration example (Logic 34C)
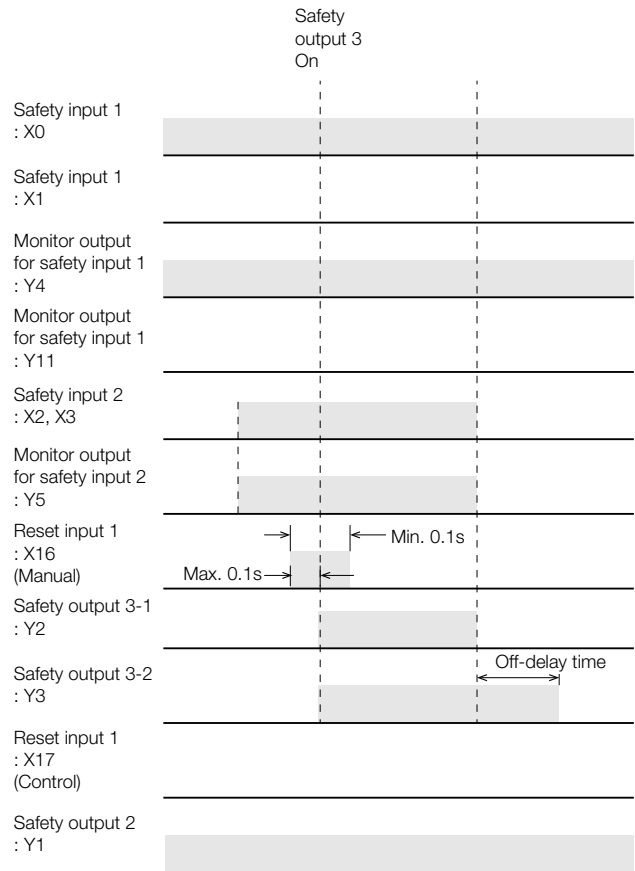
• Safety input 4 and safety input 5 are all on and safety output 1 is all on in this chart.

Figure 5.115 Timing chart (Logic 34C Teach mode)

⚠	WARNING	• Safety measures in the entire system shall be taken to reduce the as then The FS1B is not capable of monitoring the speed of hazardous source.

• **Auto mode**

Select the auto mode when during normal operation of the robot system. Before starting normal operation, make sure that the operator is not inside the safety guard.

Additional safety measures should be applied as needed. (for example, use padlocks for interlock switches, etc.)

The robot system can only operate when the safety guard is closed. Depending on the risk assessment of the entire system, a locking mechanism may be required for the safety guard. (for example, implementation of unlocking after the robot has come to a complete stop)

Figure 5.116 Safety system configuration example (Logic 34C Auto mode)

• Safety input 4 and safety input 5 are all on and safety output 1 is all on in this chart.

Figure 5.117 Timing chart (Logic 34C Auto mode)

⚠	**WARNING**	• Calculate the safety distances, while taking into consideration the response time of the FS1B and safety components connected to the FS1B.

Logic 34d: Partial stop circuit including an OR function
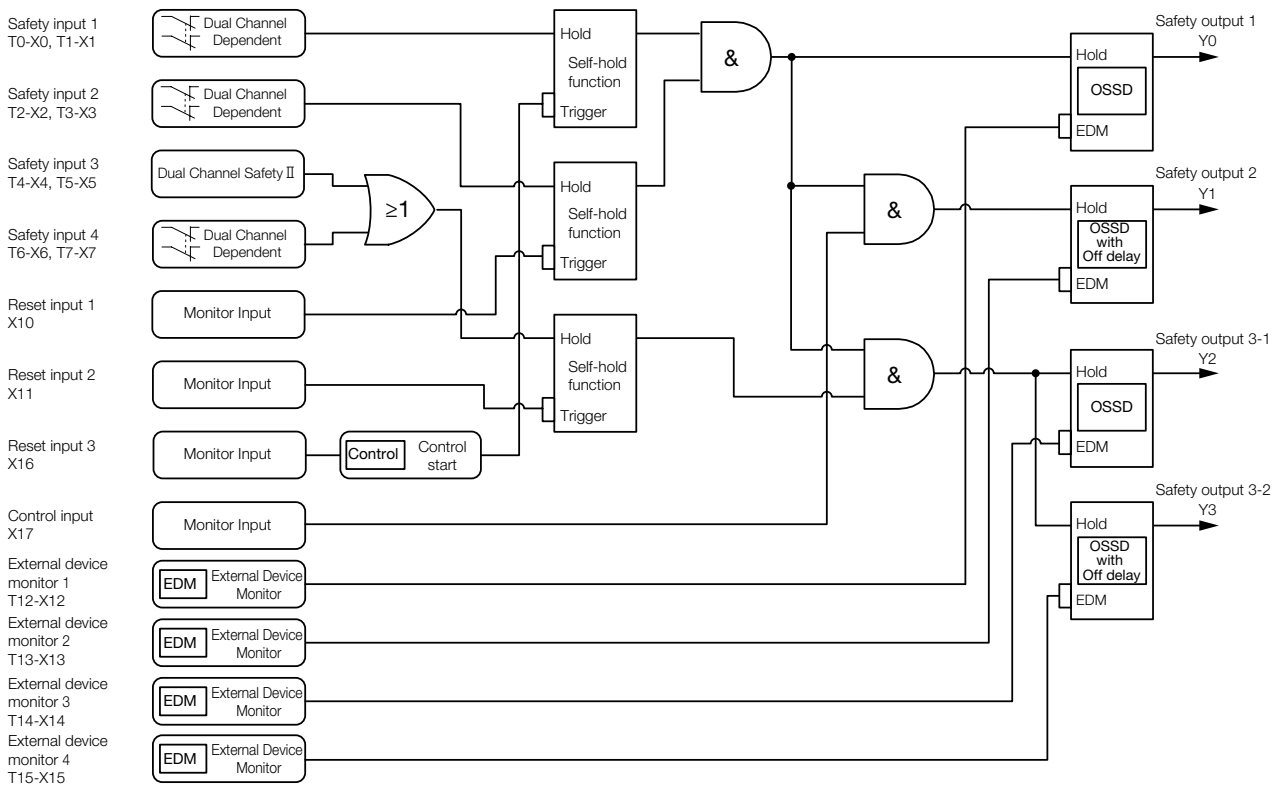
❏ Logic circuit

Figure 5.118 Logic circuit (Logic 34d)

• Safety inputs

Some safety inputs can be changed input function. The monitor output turns on when the target safety input is on and turns off when the safety input is off.

	Initial input function	Optional input functions	Monitor output
Safety input 1 (T0-X0, T1-X1)	Dual channel dependent input	Dual channel NO/NC input Dual channel safety input II	Y4
Safety input 2 (T2-X2, T3-X3)	Dual channel dependent input	Dual channel NO/NC input Dual channel safety input II	Y5
Safety input 3 (T4-X4, T5-X5)	Dual channel safety input II	Dual channel dependent input Dual channel NO/NC input	Y6
Safety input 4 (T6-X6, T7-X7)	Dual channel dependent input	Dual channel NO/NC input Dual channel safety input II	Y7

- **Safety outputs**

The monitor output turns on when the target safety output is on and turns off when the safety output is off.

The monitor output turns off immediately independent on set off-delay time.

	Monitor output
Safety output 1 (Y0)	Y12
Safety output 2 (Y1)	Y13
Safety output 3-1 (Y2)	Y17
Safety output 3-2 (Y3)	Y20

- **Control input**

Control inputs are used to control the safety output.

Control input 1 (X17)

⚠ **WARNING**	• Control inputs are not safety inputs. Do not use as a safety input since the hazardous source may not stop due to connected equipment or input circuit failure.

- **Reset inputs**

Resets inputs are used to reset the safety output.

Reset input 1 (X10)

Reset input 2 (X11)

Reset input 3 (X16)

⚠ **WARNING**	• To prevent unexpected startup of the system, take safety measures to prevent the hazardous source from operating only with the reset input of FS1B. (for example, provide a start switch, etc.)

- **External device monitor inputs**

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

External device monitor input 1 (T12-X12): for safety output 1 (Y0)

External device monitor input 2 (T13-X13): for safety output 2 (Y1)

External device monitor input 3 (T14-X14): for safety output 3-1 (Y2)

External device monitor input 4 (T15-X15): for safety output 3-2 (Y3)

- **State monitor outputs**

State monitor outputs output internal state and error status.

	Initial/ Configuration	Run	Run (Alert detection)	Protection	Stop	Stop (External power supply voltage error detection)
State monitor output 1 (Y14)	☐Off	☐Off	☐Off	☐Off	■On	■On
State monitor output 2 (Y15)	☐Off	☐Off	■On	■On	☐Off	■On
State monitor output 3 (Y16)	☐Off	■On	☐Off	☐Off	☐Off	☐Off

❏ **Wiring example**

Figure 5.119 Wiring example (Logic 34d)

S1: Emergency stop switch
S2, S4: Interlock switches
S3: Safety light curtain
S5, S6, S7, S8: Pushbuttons
K1, K2, K3, K4, K5, K6, K7, K8: Forced guided relays
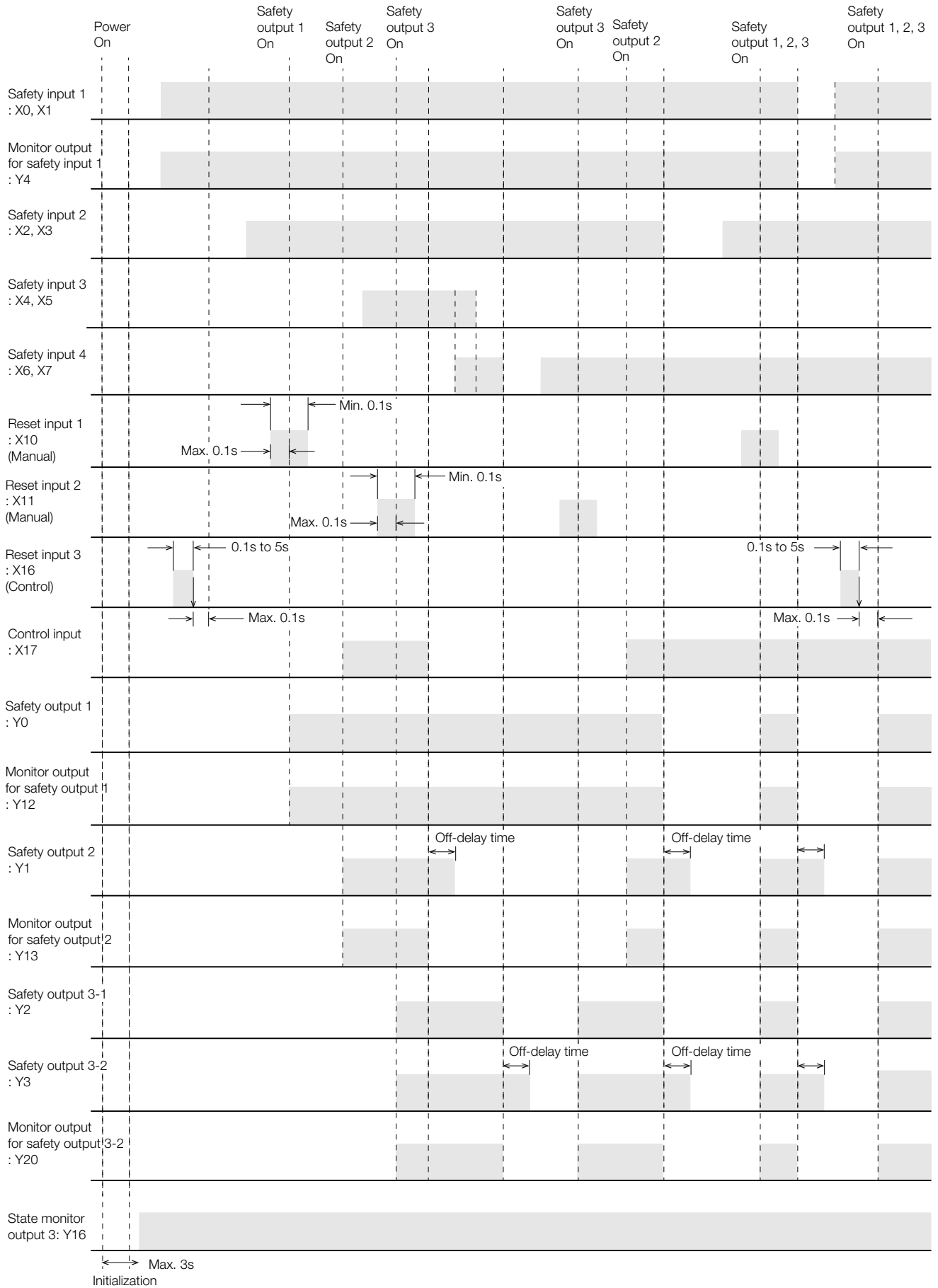
❏ Timing chart

Figure 5.120 Timing chart (Logic 34d)

❏ Safety system configuration example

This section describes an example of using logic 34d to implement safety measures for a robotic system.

⚠️ WARNING	• The systems in this manual show just examples of intended use application. The user is responsible for safe integration in the overall system. Safety performance must be evaluated on a system-wide basis relevant standards (for example, ISO10218-1 and ISO10218-2), laws and regulations (for example, Machine Directive). • To prevent unexpected startup, take safety measures to prevent the hazardous source from operating only with the reset input of FS1B. (for example, provide a start switch, etc.)

• Safety System Overview

Safety components to be used

	Safety components to be connected	Input functions
Safety input 1	Emergency stop switch	Dual channel dependent input
Safety input 2	Interlock switch	Dual channel dependent input
Safety input 3	Safety light curtain	Dual channel safety input II
Safety input 4	Interlock switch	Dual channel dependent input

Control object

	Control object
Safety output 1	Entire system
Safety output 2	Power
Safety output 3	Robot operation permission
Safety output 4	Robot operation permission

Before starting operation, make sure that the operator is not inside the safety guard.

Additional safety measures should be applied as needed. (for example, use padlocks for interlock switches, etc.)

The operator can only approach the workbench when the robot is not approaching the workbench (and the safety light curtain is illuminated).

The robot can only approach the workbench when the operator cannot approach the workbench(and the door is closed).

Depending on the risk assessment of the entire system, a locking mechanism may be required for the safety guard. (for example, implementation of unlocking after the robot has come to a complete stop.)
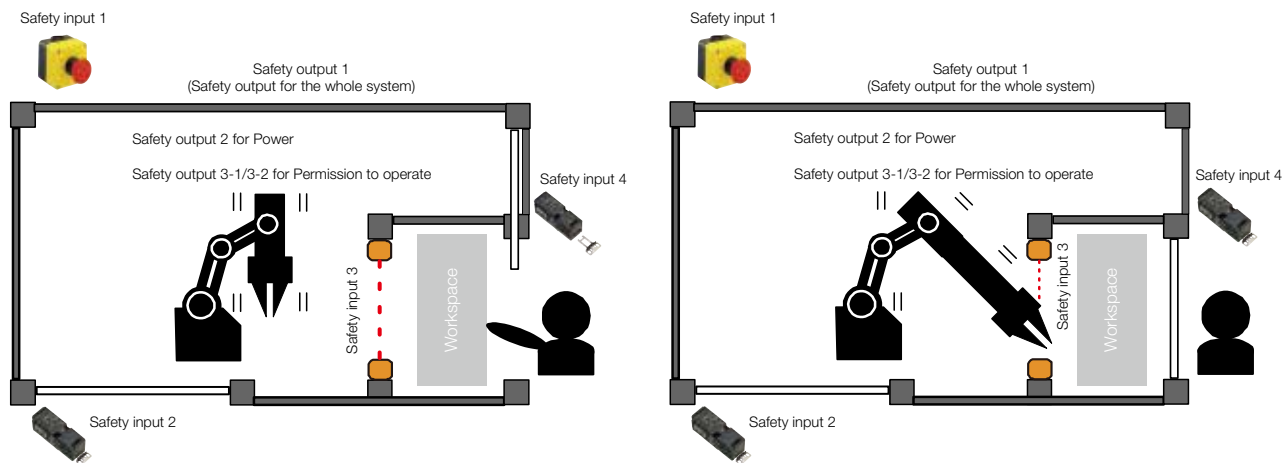
Figure 5.121 Safety system configuration example (Logic 34d)

⚠️ WARNING	• Calculate the safety distances, while taking into consideration the response time of the FS1B and safety components connected to the FS1B. • The FS1B is not capable of detecting abnormalities in robot operation. Appropriately limit the operating range so that the robot cannot approach the workbench while the operator is able to approach the workbench.

Logic 305: Partial stop circuit
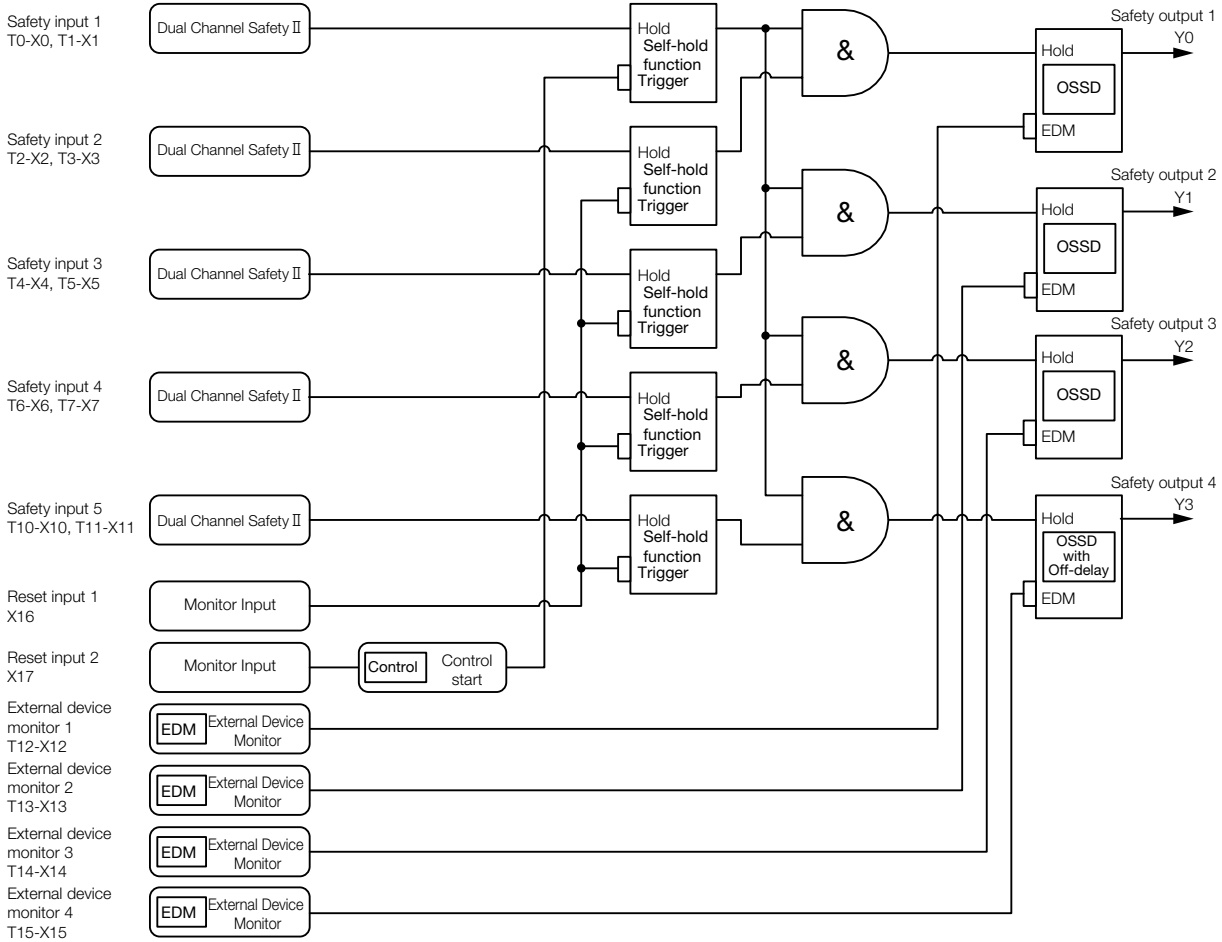
❑ Logic circuit

Figure 5.122 Logic circuit (Logic 305)

• **Safety inputs**

Some safety inputs can be changed input function. The monitor output turns on when the target safety input is on and turns off when the safety input is off.

	Initial input function	Optional input functions	Monitor output
Safety input 1 (T0-X0, T1-X1)	Dual channel safety input II	Dual channel dependent input Dual channel NO/NC input	Y4
Safety input 2 (T2-X2, T3-X3)	Dual channel safety input II	Dual channel dependent input Dual channel NO/NC input	Y5
Safety input 3 (T4-X4, T5-X5)	Dual channel safety input II	Dual channel dependent input Dual channel NO/NC input	Y6
Safety input 4 (T6-X6, T7-X7)	Dual channel safety input II	Dual channel dependent input Dual channel NO/NC input	Y7
Safety input 5 (T10-X10, T11-X11)	Dual channel safety input II	Dual channel dependent input Dual channel NO/NC input	Y10

- **Safety outputs**

The monitor output turns on when the target safety output is on and turns off when the safety output is off. The monitor output turns off immediately independent on set off-delay time.

	Monitor output
Safety output 1 (Y0)	Y12
Safety output 2 (Y1)	Y13
Safety output 3 (Y2)	Y17
Safety output 4 (Y3)	Y20

- **Reset inputs**

Resets inputs are used to reset the safety output.

Reset input 1 (X16)

Reset input 2 (X17)

⚠ WARNING	• To prevent unexpected startup of the system, take safety measures to prevent the hazardous source from operating only with the reset input of FS1B. (for example, provide a start switch, etc.)

- **External device monitor inputs**

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

External device monitor input 1 (T12-X12): for safety output 1 (Y0)

External device monitor input 2 (T13-X13): for safety output 2 (Y1)

External device monitor input 3 (T14-X14): for safety output 3 (Y2)

External device monitor input 4 (T15-X15): for safety output 4 (Y3)

- **State monitor outputs**

State monitor outputs output internal state and error status.

Internal state	Initial/Configuration	Run	Protection	Stop
State monitor output 1 (Y14)	☐Off	☐Off	■On	■On
State monitor output 2 (Y15)	☐Off	☐Off	■On	☐Off
State monitor output 3 (Y16)	☐Off	■On	☐Off	☐Off

❏ Wiring example

Figure 5.123 Wiring example (Logic 305)

S1: Emergency stop switch
S2, S3, S4, S5: Safety light curtains
S6, S7: Pushbuttons
K1, K2, K3, K4, K5, K6, K7, K8: Forced guided relays
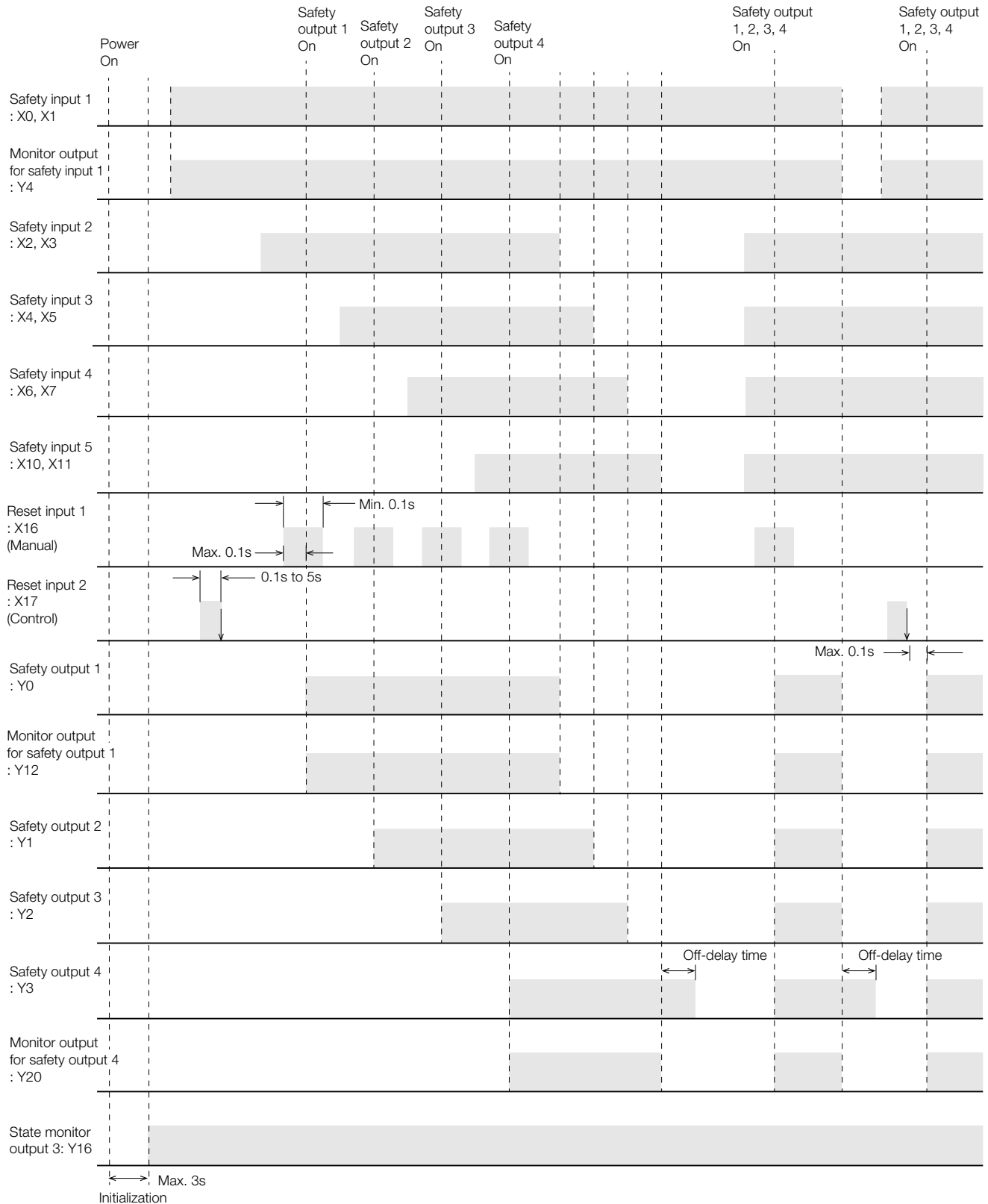
❏ **Timing chart**

Figure 5.124 Timing chart (Logic 305)

❏ Safety system configuration example

This section describes an example of using Logic 305 to implement safety measures for a robotic system.

⚠ WARNING	• The systems in this manual show just examples of intended use application. The user is responsible for safe integration in the overall system. Safety performance must be evaluated on a system-wide basis relevant standards (for example, ISO10218-1 and ISO10218-2), laws and regulations (for example, Machine Directive).) • To prevent unexpected startup, take safety measures to prevent the hazardous source from operating only with the reset input of FS1B. (for example, provide a start switch, etc.)

• Safety System Overview

Safety components to be used

	Safety components to be connected	Input functions
Safety input 1	Emergency stop switch	Dual channel safety input II
Safety input 2	Safety light curtain	Dual channel safety input II
Safety input 3	Safety light curtain	Dual channel safety input II
Safety input 4	Safety light curtain	Dual channel safety input II
Safety input 5	Safety light curtain	Dual channel safety input II

Control object

	Control object
Safety output 1	Robot operation permission
Safety output 2	Robot operation permission
Safety output 3	Robot operation permission
Safety output 4	Robot operation permission

The corresponding robot can only be operated when the operator is not allowed to approach the hazardous source (and the safety light curtain is light receiving state).
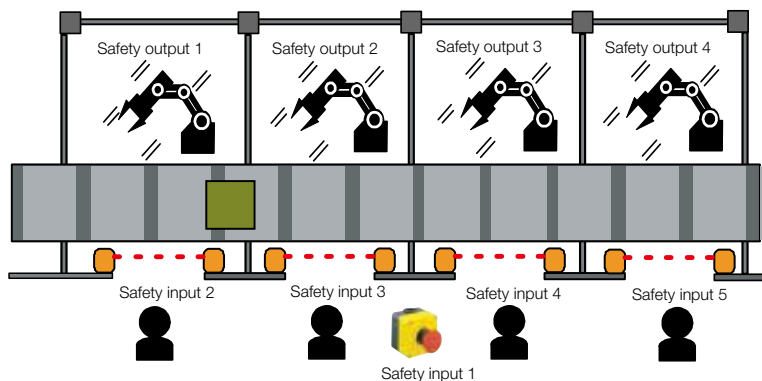
Figure 5.125 Safety system configuration example (Logic 305)

⚠ WARNING	• Calculate the safety distances, while taking into consideration the intrusion speed of the response time of the FS1B and safety components connected to the FS1B.

Logic 306: Partial stop circuit

❏ Logic circuit
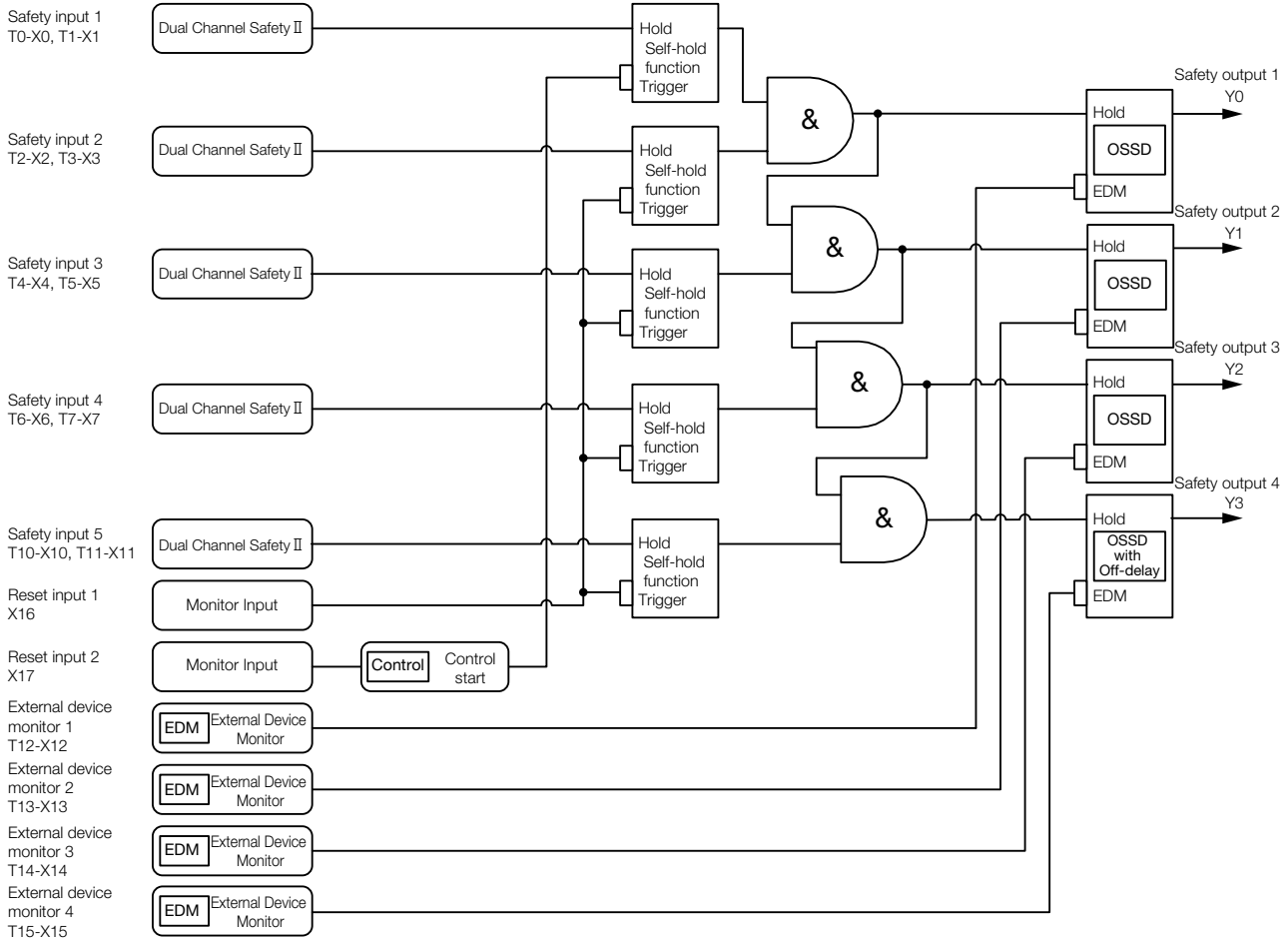
Figure 5.126 Safety system configuration example (Logic 306)

- **Safety inputs**

    Some safety inputs can be changed input function. The monitor output turns on when the target safety input is on and turns off when the safety input is off.

	Initial input function	Optional input functions	Monitor output
Safety input 1 (T0-X0, T1-X1)	Dual channel safety input II	Dual channel dependent input Dual channel NO/NC input	Y4
Safety input 2 (T2-X2, T3-X3)	Dual channel safety input II	Dual channel dependent input Dual channel NO/NC input	Y5
Safety input 3 (T4-X4, T5-X5)	Dual channel safety input II	Dual channel dependent input Dual channel NO/NC input	Y6
Safety input 4 (T6-X6, T7-X7)	Dual channel safety input II	Dual channel dependent input Dual channel NO/NC input	Y7
Safety input 5 (T10-X10, T11-X11)	Dual channel safety input II	Dual channel dependent input Dual channel NO/NC input	Y10

• **Safety outputs**

The monitor output turns on when the target safety output is on and turns off when the safety output is off. The monitor output turns off immediately independent on set off-delay time.

	Monitor output
Safety output 1 (Y0)	Y12
Safety output 2 (Y1)	Y13
Safety output 3 (Y2)	Y17
Safety output 4 (Y3)	Y20

• **Reset inputs**

Resets inputs are used to reset the safety output.

Reset input 1 (X16)

Reset input 2 (X17)

⚠ WARNING	• To prevent unexpected startup of the system, take safety measures to prevent the hazardous source from operating only with the reset input of FS1B. (for example, provide a start switch, etc.)

• **External device monitor inputs**

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

External device monitor input 1 (T12-X12): for safety output 1 (Y0)

External device monitor input 2 (T13-X13): for safety output 2 (Y1)

External device monitor input 3 (T14-X14): for safety output 3 (Y2)

External device monitor input 4 (T15-X15): for safety output 4 (Y3)

• **State monitor outputs**

State monitor outputs output internal state, alerts and error status.

Internal state	Initial/Configuration	Run	Protection	Stop
State monitor output 1 (Y14)	☐Off	☐Off	■On	■On
State monitor output 2 (Y15)	☐Off	☐Off	■On	☐Off
State monitor output 3 (Y16)	☐Off	■On	☐Off	☐Off

❏ Wiring example

Figure 5.127 Wiring example (Logic 306)

S1: Emergency stop switch
S2, S3, S4, S5: Safety light curtains
S6, S7: Pushbuttons
K1, K2, K3, K4, K5, K6, K7, K8: Forced guided relays
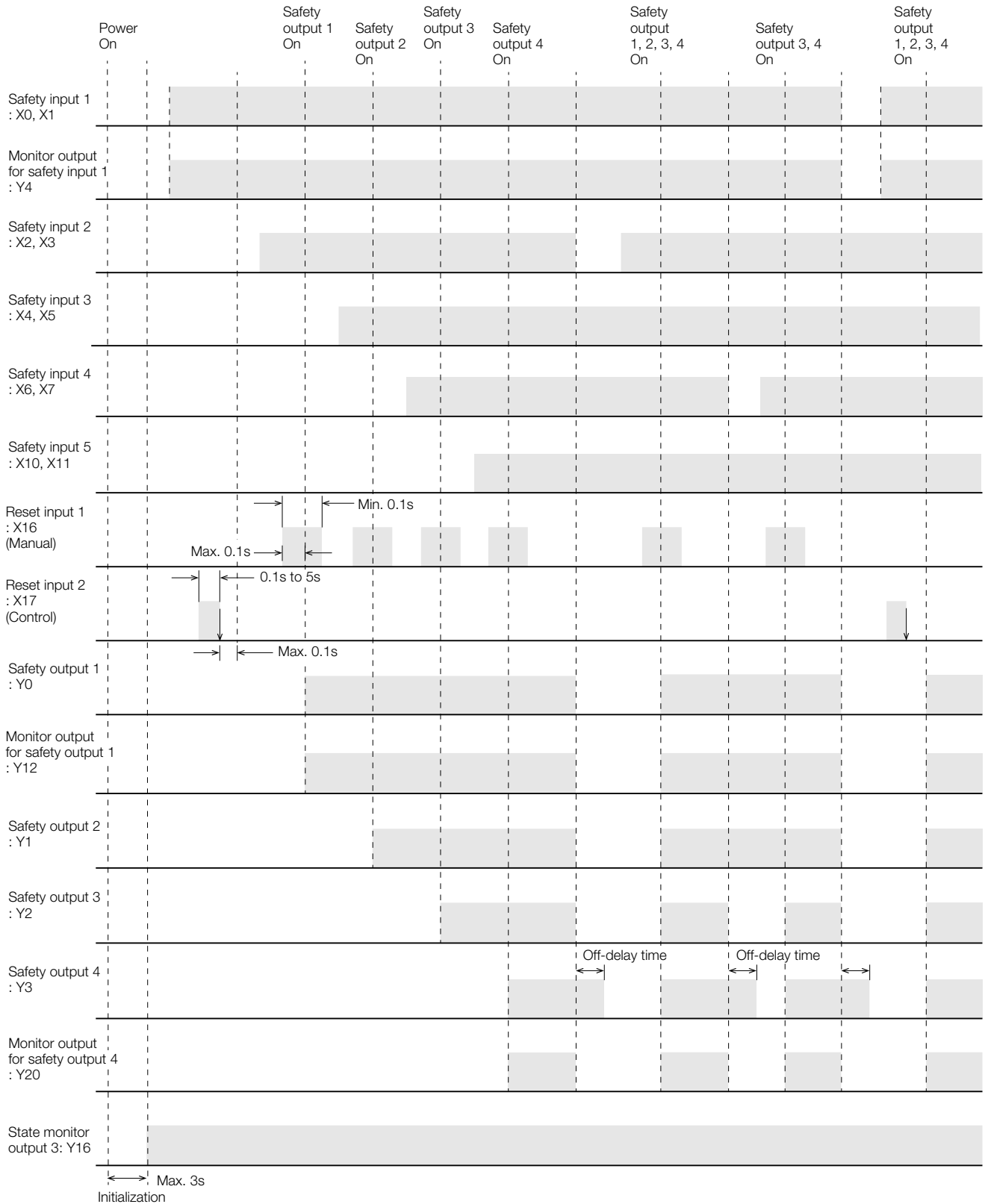
❏ **Timing chart**

Figure 5.128 Timing chart (Logic 306)

❏ Safety system configuration example

This section describes an example of using Logic 306 to implement safety measures for a robotic system.

⚠ WARNING	• The systems in this manual show just examples of intended use application. The user is responsible for safe integration in the overall system. Safety performance must be evaluated on a system-wide basis relevant standards (for example, ISO10218-1 and ISO10218-2), laws and regulations (for example, Machine Directive). • To prevent unexpected startup, take safety measures to prevent the hazardous source from operating only with the reset input of FS1B. (for example, provide a start switch, etc.)

• Safety System Overview

Safety components to be used

	Safety components to be connected	Input functions
Safety input 1	Emergency stop switch	Dual channel safety input II
Safety input 2	Safety light curtain	Dual channel safety input II
Safety input 3	Safety light curtain	Dual channel safety input II
Safety input 4	Safety light curtain	Dual channel safety input II
Safety input 5	Safety light curtain	Dual channel safety input II

Control object

	Control object
Safety output 1	Robot operation permission
Safety output 2	Robot operation permission
Safety output 3	Robot operation permission
Safety output 4	Robot operation permission

The corresponding robot can only operate when the corresponding safety light curtain and the front (on the left side of the figure below) safety light curtain are in the light receiving state.
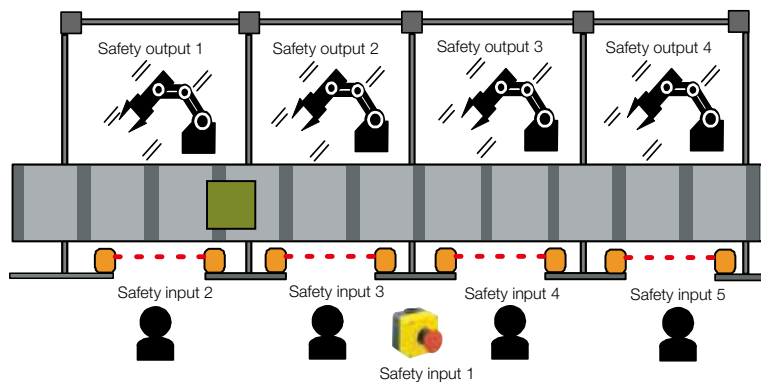
Figure 5.129 Safety system configuration example (Logic 306)

⚠ WARNING	• Calculate the safety distances, while taking into consideration the response time of the FS1B and safety components connected to the FS1B.

Logic 307: Partial stop circuit
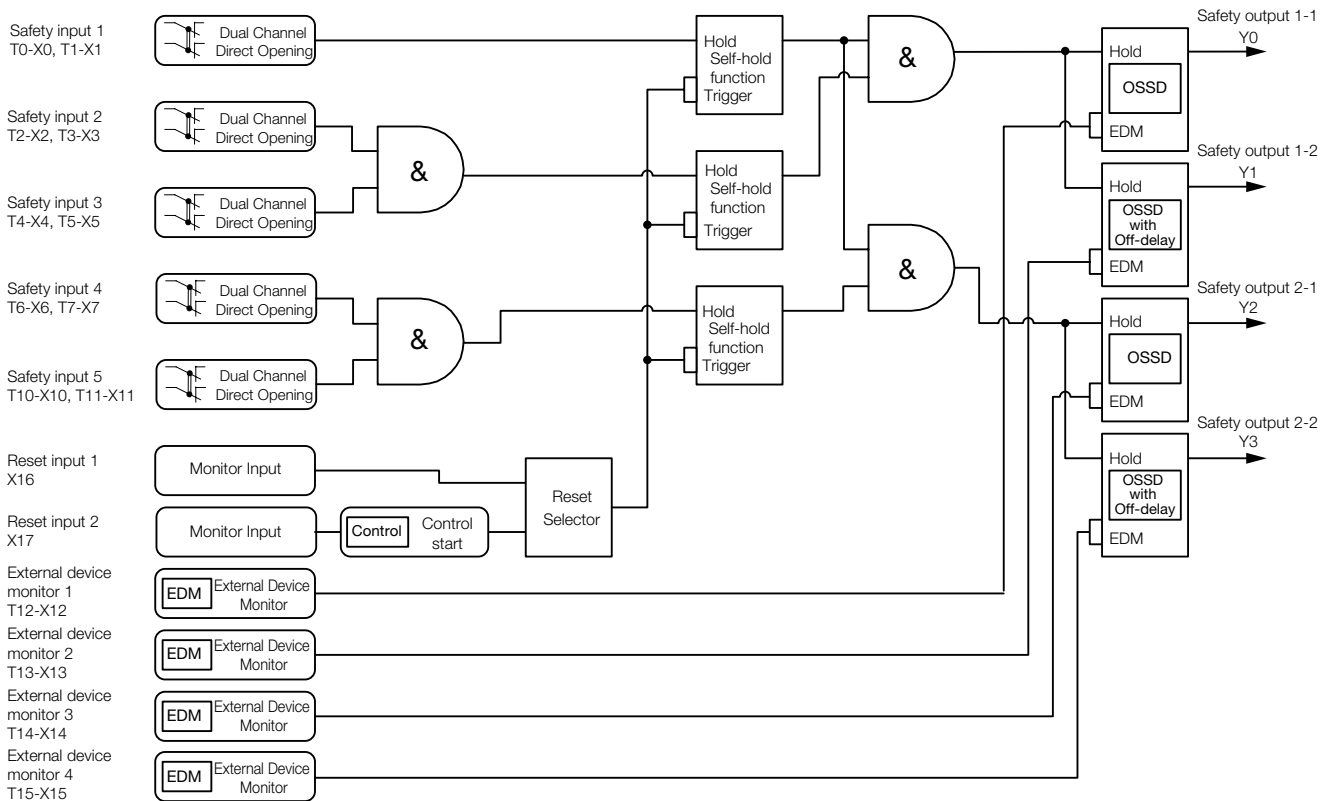
❏ Logic circuit

Figure 5.130. Logic circuit (Logic 307)

• Safety inputs

Some safety inputs can be changed input function. The monitor output turns on when the target safety input is on and turns off when the safety input is off.

	Initial input function	Optional input functions	Monitor output
Safety input 1 (T0-X0, T1-X1)	Dual channel direct opening input	Dual channel NO/NC input Dual channel safety input II	Y4
Safety input 2 (T2-X2, T3-X3)	Dual channel direct opening input	Dual channel NO/NC input Dual channel safety input II	Y5
Safety input 3 (T4-X4, T5-X5)	Dual channel direct opening input	Dual channel NO/NC input Dual channel safety input II	Y6
Safety input 4 (T6-X6, T7-X7)	Dual channel direct opening input	Dual channel NO/NC input Dual channel safety input II	Y7
Safety input 5 (T10-X10, T11-X11)	Dual channel direct opening input	Dual channel NO/NC input Dual channel safety input II	Y10

• Safety outputs

The monitor output turns on when the target safety output is on and turns off when the safety output is off. The monitor output turns off immediately independent on set off-delay time.

	Monitor output
Safety output 1-1 (Y0)	Y12
Safety output 1-2 (Y1)	Y13
Safety output 2-1 (Y2)	Y17
Safety output 2-2 (Y3)	Y20

• Reset inputs

Resets inputs are used to reset the safety output.

Reset input 1 (X16)

Reset input 2 (X17)

	• When both X16 and X17 are turned on, the error LED indicates "3" and the device enters the Stop state. Use only one of them.

	WARNING	• To prevent unexpected startup of the system, take safety measures to prevent the hazardous source from operating only with the reset input of FS1B. (for example, provide a start switch, etc.)

• External device monitor inputs

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

External device monitor input 1 (T12-X12): for safety output 1-1 (Y0)

External device monitor input 2 (T13-X13): for safety output 1-2 (Y1)

External device monitor input 3 (T14-X14): for safety output 2-1 (Y2)

External device monitor input 4 (T15-X15): for safety output 2-2 (Y3)

• State monitor outputs

State monitor outputs output internal state and error status.

Internal state	Initial/Configuration	Run	Protection	Stop
State monitor output 1 (Y14)	☐Off	☐Off	■On	■On
State monitor output 2 (Y15)	☐Off	☐Off	■On	☐Off
State monitor output 3 (Y16)	☐Off	■On	☐Off	☐Off

❏ **Wiring example**

Figure 5.131 Wiring example (Logic 307)
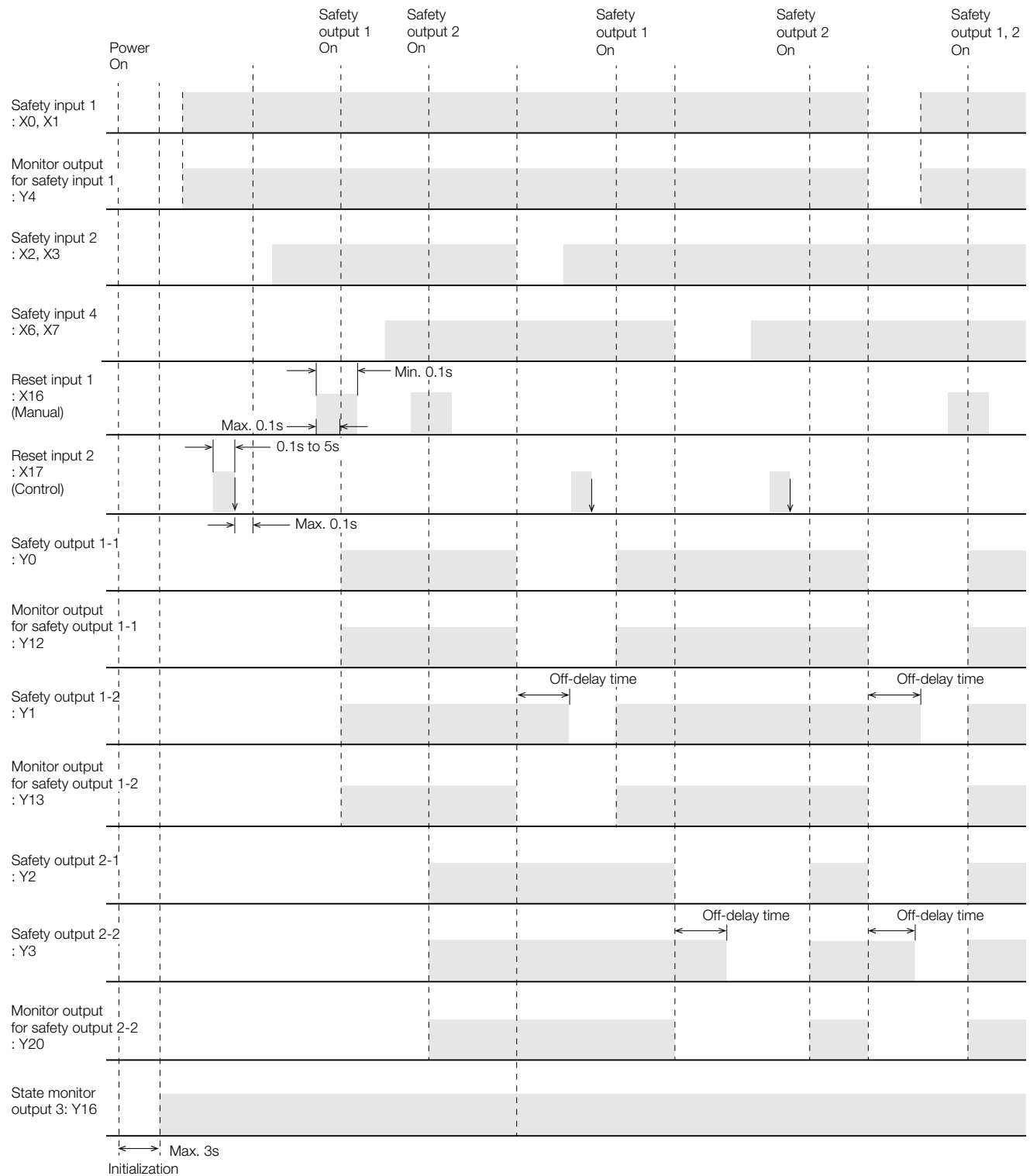
❏ Timing chart

Figure 5.132 Timing chart (Logic 307)

- Safety input 3 and safety input 5 are all on in this chart.

❑ Safety system configuration example

This section describes an example of using Logic 307 to implement safety measures for a robotic system.

⚠ **WARNING**	• The systems in this manual show just examples of intended use application. The user is responsible for safe integration in the overall system. Safety performance must be evaluated on a system-wide basis relevant standards (for example, ISO10218-1 and ISO10218-2), laws and regulations (for example, Machine Directive). • To prevent unexpected startup, take safety measures to prevent the hazardous source from operating only with the reset input of FS1B. (for example, provide a start switch, etc.)

• Safety System Overview

Safety components to be used

	Safety components to be connected	Input functions
Safety input 1	Emergency stop switch	Dual channel direct opening input
Safety input 2	Interlock switch	Dual channel direct opening input
Safety input 3	Interlock switch	Dual channel direct opening input
Safety input 4	Interlock switch	Dual channel direct opening input
Safety input 5	Interlock switch	Dual channel direct opening input

Control object

	Control object
Safety output 1-1	Robot operation permission
Safety output 1-2	Robot power
Safety output 2-1	Robot operation permission
Safety output 2-2	Robot power

Before starting operation, make sure that the operator is not inside the safety guard.

Additional safety measures should be applied as needed. (for example, use padlocks for interlock switches, etc.)

The corresponding robot can operate only when the corresponding safety door is closed.
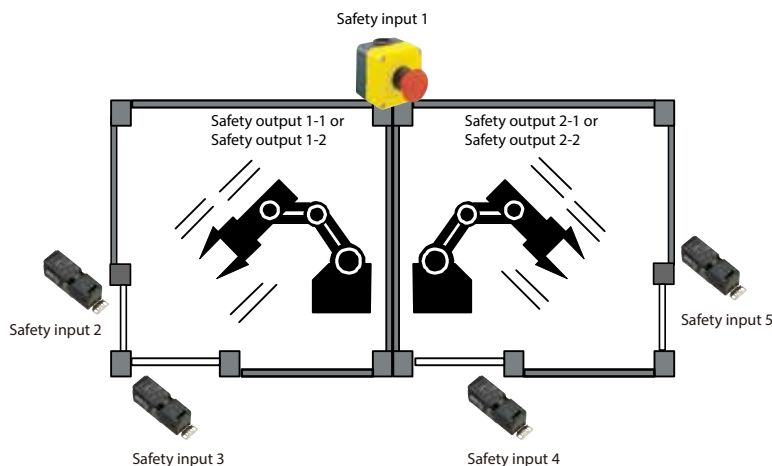
Figure 5.133 Safety system configuration example (Logic 307)

⚠ **WARNING**	• Calculate the safety distances, while taking into consideration the response time of the FS1B and safety components connected to the FS1B.

Logic 308: Partial stop circuit including a mode select function
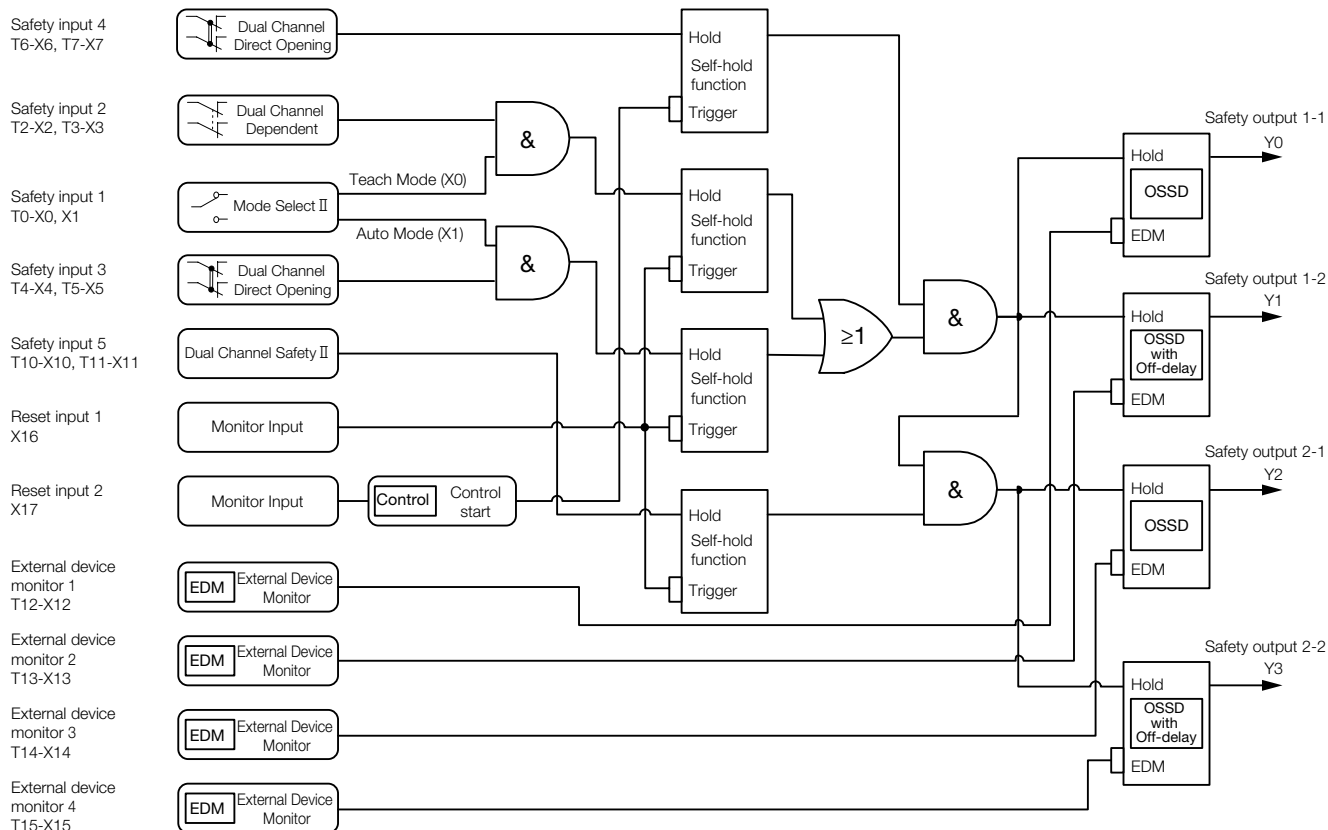
❑ Logic circuit

Figure 5.134 Logic circuit (Logic 308)

- **Safety inputs**

  Some safety inputs can be changed input function. The monitor output turns on when the target safety input is on and turns off when the safety input is off.

	Initial input function	Optional input functions	Monitor output
Safety input 1 (T0-X0, X1)	Mode select input II	—	Y4 (On in teach mode (X0))
Safety input 2 (T2-X2, T3-X3)	Dual channel dependent input	Dual channel NO/NC input Dual channel safety input II	Y5
Safety input 3 (T4-X4, T5-X5)	Dual channel direct opening input	Dual channel NO/NC input Dual channel safety input II	Y6
Safety input 4 (T6-X6, T7-X7)	Dual channel direct opening input	Dual channel NO/NC input Dual channel safety input II	Y7
Safety input 5 (T10-X10, T11-X11)	Dual channel safety input II	Dual channel dependent input Dual channel NO/NC input	Y10

• **Safety outputs**

The monitor output turns on when the target safety output is on and turns off when the safety output is off. The monitor output turns off immediately independent on set off-delay time.

	Monitor output
Safety output 1-1 (Y0)	Y12
Safety output 1-2 (Y1)	Y13
Safety output 2-1 (Y2)	Y17
Safety output 2-2 (Y3)	Y20

• **Reset inputs**

Resets inputs are used to reset the safety output.

Reset input 1 (X16)

Reset input 2 (X17)

⚠ WARNING	• To prevent unexpected startup of the system, take safety measures to prevent the hazardous source from operating only with the reset input of FS1B. (for example, provide a start switch, etc.)

• **External device monitor inputs**

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

External device monitor input 1 (T12-X12): for safety output 1-1 (Y0)

External device monitor input 2 (T13-X13): for safety output 1-2 (Y1)

External device monitor input 3 (T14-X14): for safety output 2-1 (Y2)

External device monitor input 4 (T15-X15): for safety output 2-2 (Y3)

• **State monitor outputs**

State monitor outputs output internal state and error status.

	Initial/Configuration	Run	Protection	Stop
State monitor output 1 (Y14)	☐Off	☐Off	■On	■On
State monitor output 2 (Y15)	☐Off	☐Off	■On	☐Off
State monitor output 3 (Y16)	☐Off	■On	☐Off	☐Off

❏ Wiring example

Figure 5.135 Wiring example (Logic 308)

S1: Selector switch
S2: Enabling switch
S3, S5: Interlock switch
S4: Emergency stop switch
S6, S7: Pushbuttons
K1, K2, K3, K4, K5, K6, K7, K8: Forced guided relays
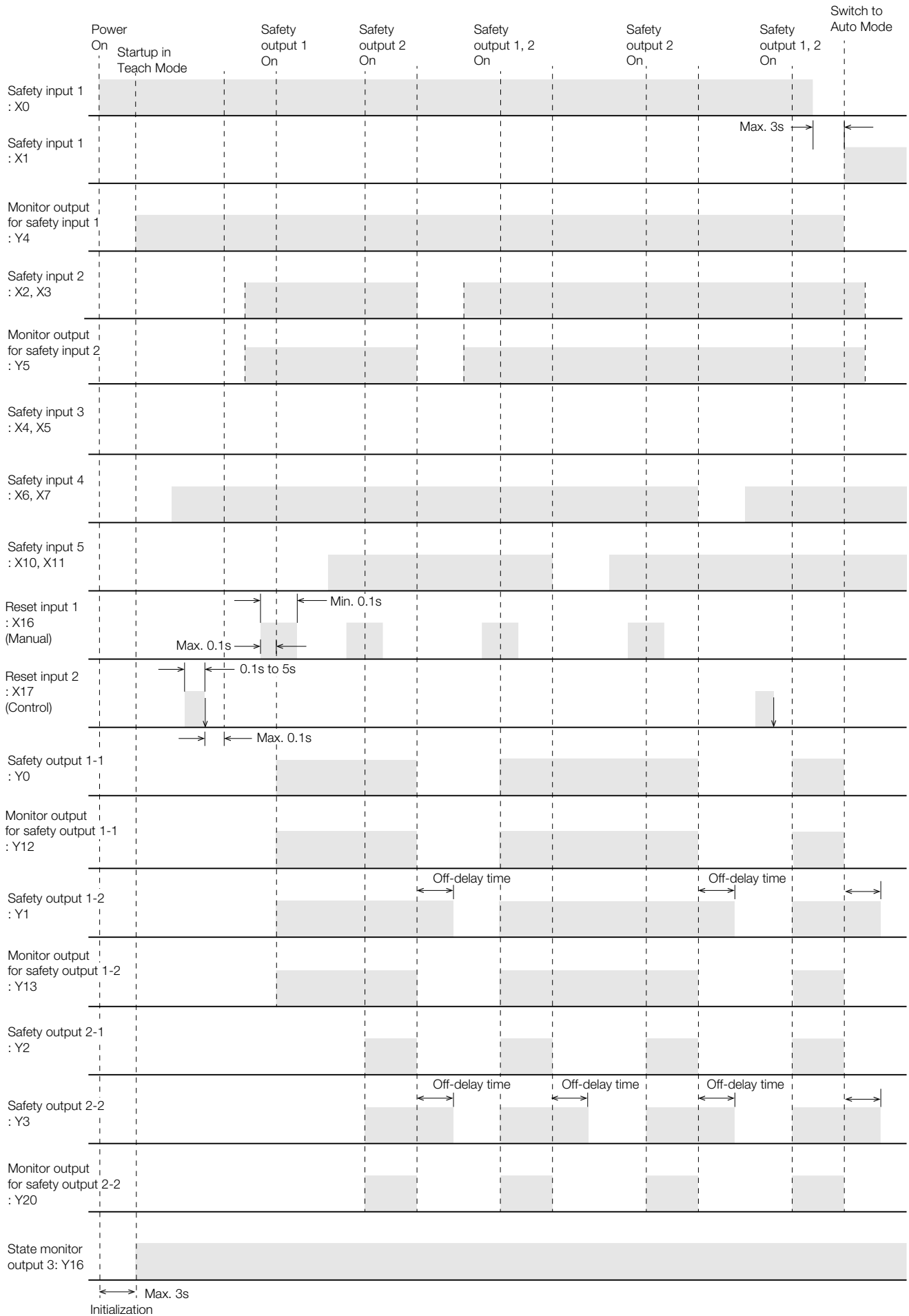
❏ Timing chart

Figure 5.136 Timing chart (Logic 308 Teach mode)
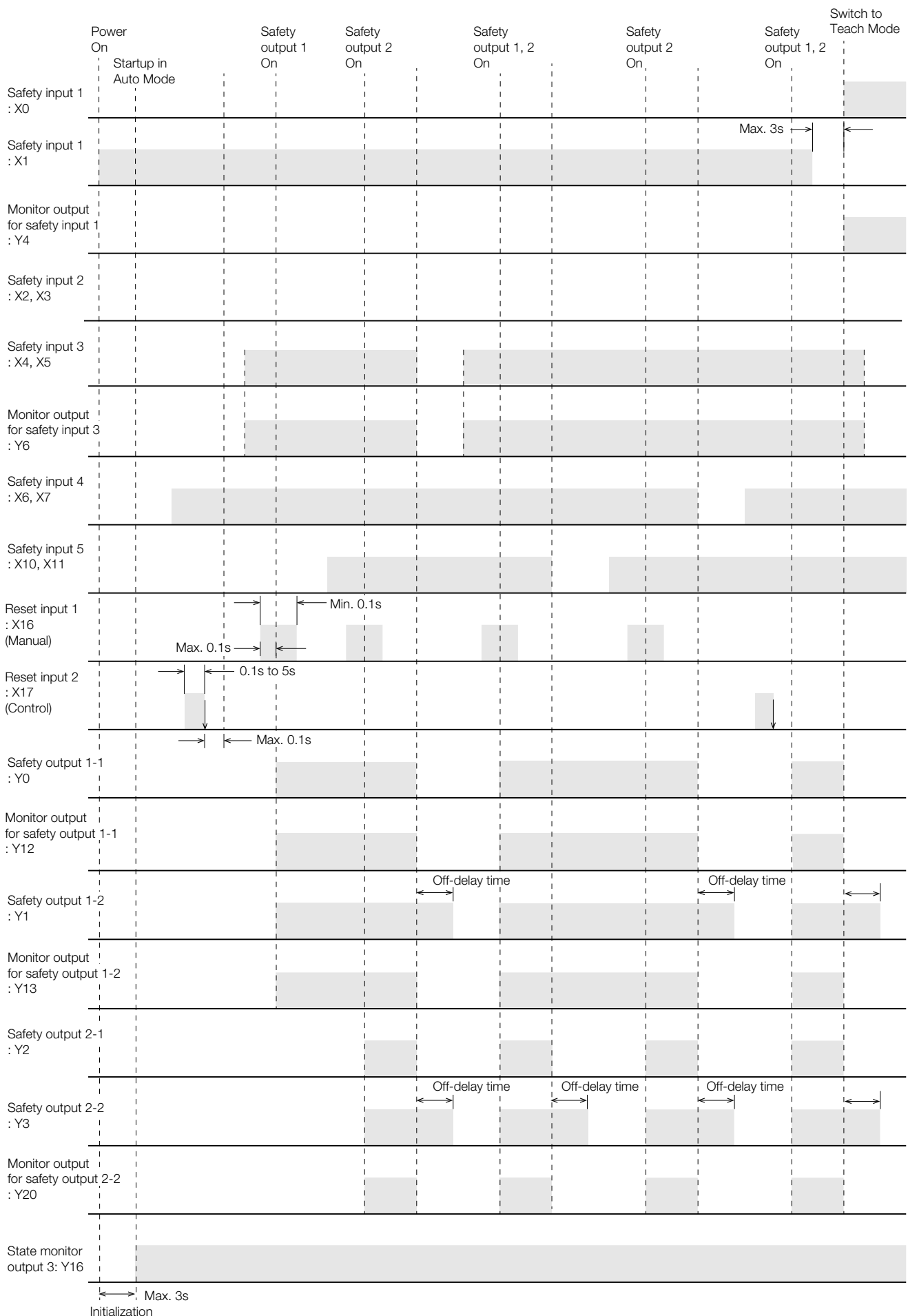
Figure 5.137 Timing chart (Logic 308 Auto mode)

❏ Safety system configuration example

This section describes an example of using logic 308 to implement safety measures for machine tools.

⚠ WARNING	• The systems in this manual show just examples of intended use application. The user is responsible for safe integration in the overall system. Safety performance must be evaluated on a system-wide basis relevant standards (for example, ISO16090-1), laws and regulations (for example, Machine Directive). • When using logic that includes a mode select input, the operating mode set by the system should be displayed for the operator to verify the operating mode of the system. (for example, the monitor output of the product is taken into the system, information on the system operation mode is processed as a safety parameter, and the result of the setting is displayed on the display, etc.) • To prevent unexpected startup, take safety measures to prevent the hazardous source from operating only with the reset input of FS1B. (for example, provide a start switch, etc.) • Safety measures in the entire system shall be taken to reduce the as then The FS1B is not capable of monitoring the speed of hazardous source.

• Safety System Overview

Safety components to be used

	Safety components to be connected	Input functions	Active mode
Safety input 1	Selector switch	Mode select input II	—
Safety input 2	Enabling switch	Dual channel dependent input	Teach mode
Safety input 3	Interlock switch	Dual channel direct opening input	Auto mode
Safety input 4	Emergency stop switch	Dual channel direct opening input	Teach mode Auto mode
Safety input 5	Interlock switch	Dual channel safety input II	Teach mode Auto mode

Control object

	Control object	Active mode
Safety output 1-1	Machine tool operating permission	Teach mode Auto mode
Safety output 1-2	Machine tool power	Teach mode Auto mode
Safety output 2-1	Conveyor	Teach mode Auto mode
Safety output 2-2	Conveyor	Teach mode Auto mode

• Teach mode

Select the teach mode when teaching the machine tool. The machine tool can be operated only when the enabling switch is set to the operation-allowed state (position 2). At this time, the machine tool must be properly speed-limited so as not to endanger the operator.
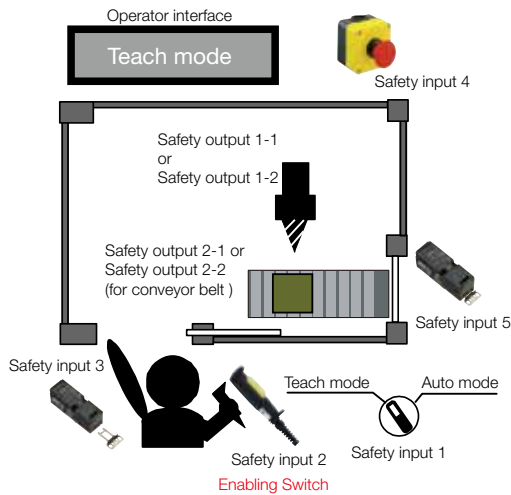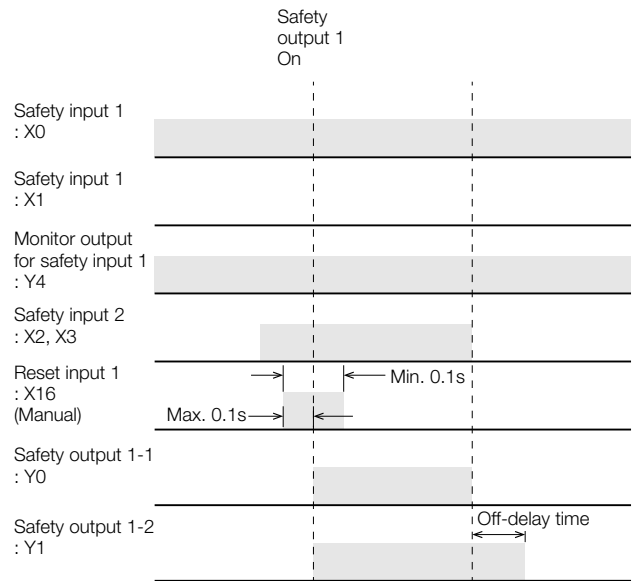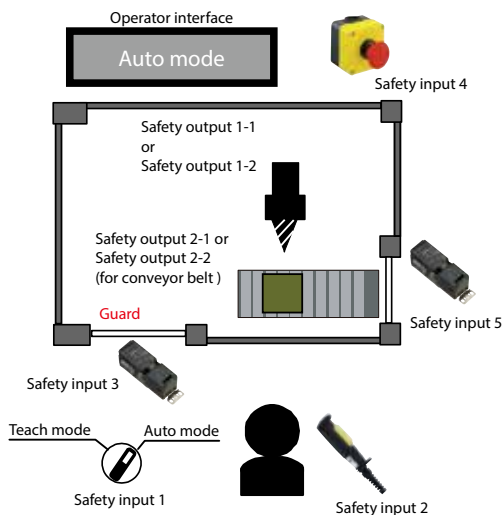

Figure 5.138 Safety system configuration example (Logic 308 Teach mode)

• Safety input 4 is all on, reset input 2 is once on in this chart.

Figure 5.139 Timing chart (Logic 308 Teach mode)

• Auto mode

Select the auto mode when during normal operation of the machine tool. Before starting normal operation, make sure that the operator is not inside the safety guard.

Additional safety measures should be applied as needed. (for example, use padlocks for interlock switches, etc.)

The machine tool can be operated only when the safety guard is closed. Depending on the risk assessment of the entire system, a locking mechanism may be required for the safety guard. (for example, after the machine tool has come to a complete stop, the unlocking process is performed.)

Figure 5.140 Safety system configuration example (Logic 308 Auto mode)
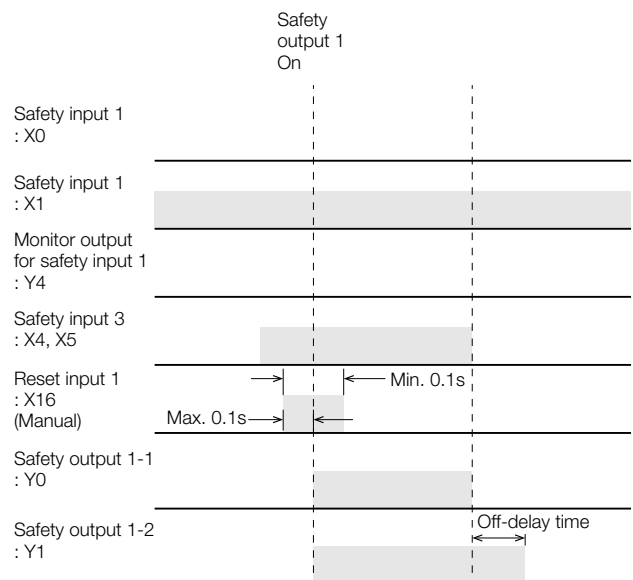
• Safety input 4 is all on, reset input 2 is once on in this chart.

Figure 5.141 Timing chart (Logic 308 Auto mode)

⚠ WARNING	• Calculate the safety distances, while taking into consideration the response time of the FS1B and safety components connected to the FS1B.

❏ Logic functions

This section describes the functions of logic circuit. Each logic function is classified into input functions listed in Table 5.1, Logic operation function and output functions in Table 5.2.
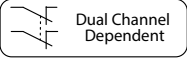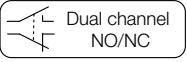
Table 5.1 Input functions
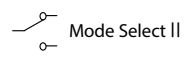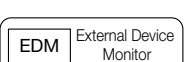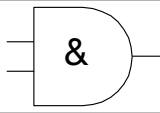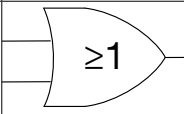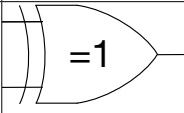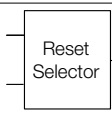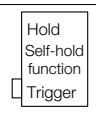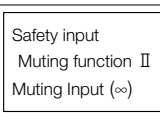
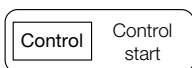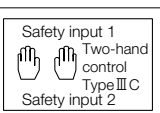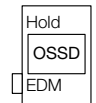| Function	LED color	Symbol	Description	Optional input functions	Description page
Dual channel direct opening input	Red	Dual Channel Direct Opening	For connecting safety components with redundant contacts, such as emergency stop switches or interlock switches etc. If there is a time lag between opening and closing of the contacts, an alert condition occurs. (Monitoring time 0.5s)	Dual channel safety input II Dual channel NO/NC input	191
Dual channel dependent input	Red	Dual Channel Dependent	For connecting safety components with redundant contacts such as enabling switches etc. Time difference between opening and closing of contacts does not result in an alert condition.	Dual channel safety input II Dual channel NO/NC input	193
Dual channel safety input II	Green	Dual Channel Safety II	For connecting safety components with redundant semiconductor outputs (PNP outputs) such as safety light curtains and safety laser scanners.	Dual channel dependent input Dual channel NO/NC input	195
Dual channel NO/NC input	Orange	Dual channel NO/NC	For connecting safety components with redundant NO/NC contacts, such as non-contact safety switches or interlock switches etc.	Dual channel dependent input Dual channel safety input II	197
Mode select input II	Orange	Mode Select II	For connecting selector switches or other mode selection components.	—	199
Muting Input	Green	Muting Input	For connecting muting sensors such as photoelectric switches.	—	201
Monitor input	Green	Monitor Input	For connecting components for control input and reset input such as sensors and switches.	—	203
External device monitor input	Red	EDM External Device Monitor	For monitoring external components controlled by the FS1B, such as forced-guided relays and safety contactors. Connects NC contacts of external components connected to the safety outputs to diagnose abnormalities in external components.	—	204

Table 5.2 Other functions

Function		Symbol	Description	Description page
Logic operation function	AND	**&**	Logical multiplication (AND) of multiple inputs.	205
	OR	**≥1**	Logical addition (OR) of multiple inputs.	205
	XOR II	**=1**	Exclusive logical addition (XOR) of multiple inputs.	206
	Reset selector	Reset Selector	This function ensures that the connected input (reset input) does not go to the on state at the same time.	206
	Self-hold	Hold Self-hold function Trigger	Self-holding of input.	207
	Muting II	Safety input Muting function II Muting Input (∞)	For muting function to the connected safety components.	208
	Control Start	Control Control start	For operation check function to the connected reset input components.	209
	Two-hand control	Safety input 1 Two-hand control Type III C Safety input 2	For two-handed operation input. Type III C (ISO 13851) is supported.	210
Safety output function	Safety output (without off-delay timer)	Hold OSSD EDM	For controlling the safety output. Turns off the safety outputs immediately after the input is turned off.	211
	Safety output (with off-delay timer)	Hold OSSD with Off-delay EDM	This function is used to control the safety output. After the input is turned off, the safety output is turned off after the time set by the timer switch has elapsed.	212

❏ Input functions

● Dual channel direct opening input

For connecting safety components with redundant contacts, such as emergency stop switches or interlock switches etc. When the safety check signal output from the drive circuits (Tn, Tn+1) is input to the corresponding receive circuits (Xn, Xn+1), each turns on, and when the two of receive circuits turn both on simultaneously (within 0.5s), the function output (In) turns on.
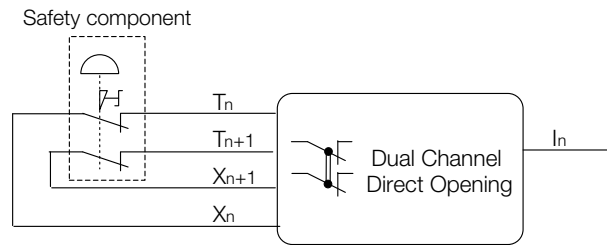
Function output (In) is on

Figure 5.142 Dual channel direct opening input function circuit

Connects to

Emergency stop switches or interlock switches, etc.

> • Safety light curtains, safety laser scanners, and other semiconductor output components cannot be connected.

Description of operation

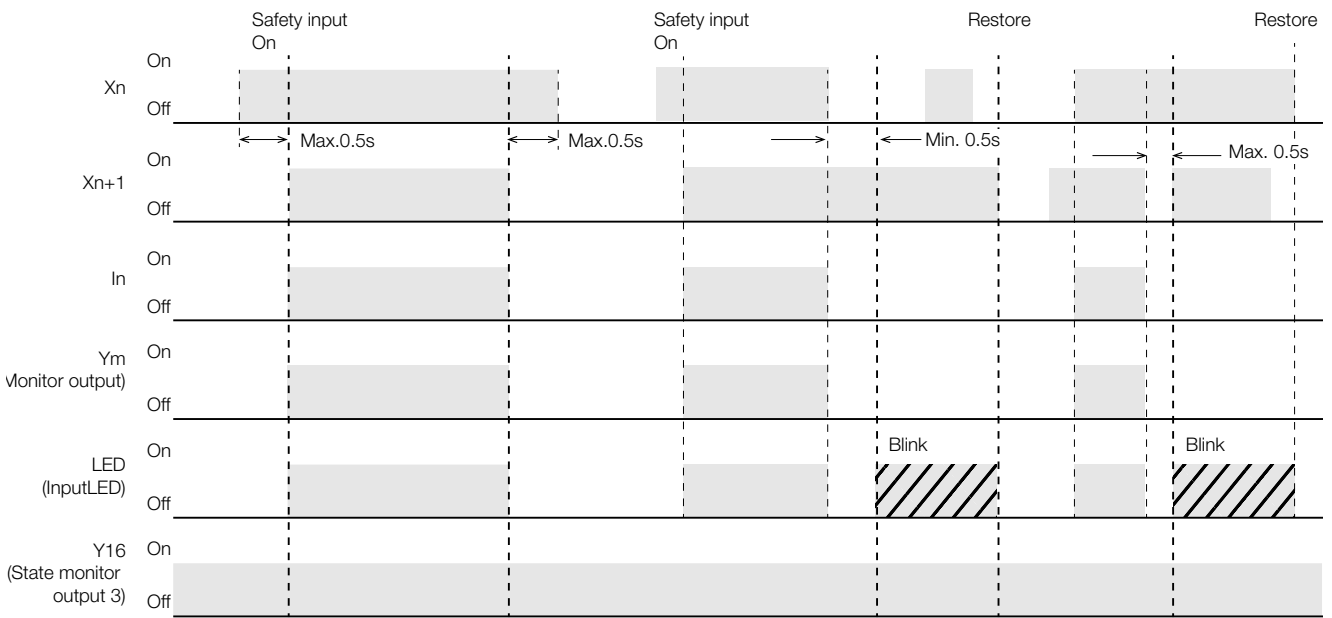The operation timing is described in figure 5.143.

Figure 5.143 Operation timing of dual channel direct opening input function

- The function output turns on when the connected safety component is turned on and the safety check signals output by the two drive circuits are correctly input to the two receive circuits at the same time. (within 0.5s)

- When the connected safety component is turned off and one of the two receive circuits is turned off, the function output is turned off.

- Due to the operation of the safety component, if the safety check signal is not input to the two receive circuits within a certain period of time, an alert condition will occur, the input LED will blink, and the function output will not turn on.

- If only one receive circuit (Xn+1 in the figure 5.143) is turned off while two of receive circuits (Xn, Xn+1) are on fault in safety component or input circuit (welding of contacts, short circuit in wiring or input circuit error, etc.) and then turned on again, even if the time is less than 0.5s, an alert condition will occur and the input LED will blink. The function output is not turned on at that time.

- The alert state can be canceled by checking that there are no abnormalities in the safety component or wiring, and then turning the safety component to the off state. The function output is then turned on when the safety component is turned on.

⚠ WARNING	• Drive terminals of safety inputs send safety check signals (pulse signals) for the diagnosis of safety components and input circuits. Safety check signals cannot be used as a power for connected components.

• Dual channel dependent input

For connecting safety components with redundant contacts such as interlock switches or enabling switches etc. When the safety check signals output from the drive circuits (Tn, Tn+1) are input to the corresponding receive circuits (Xn, Xn+1), each is turned on, and when the two of receive circuits are turned on, the function output (In) is turned on.
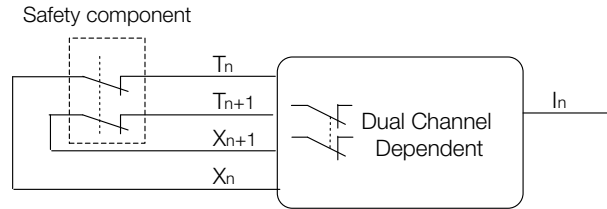
Function output (In) is on

Figure 5.144 Dual channel dependent input function circuit

Connects to

Interlock switches or enabling switches, etc.

> • Safety light curtains, safety laser scanners, and other semiconductor output components cannot be connected.

Description of operation

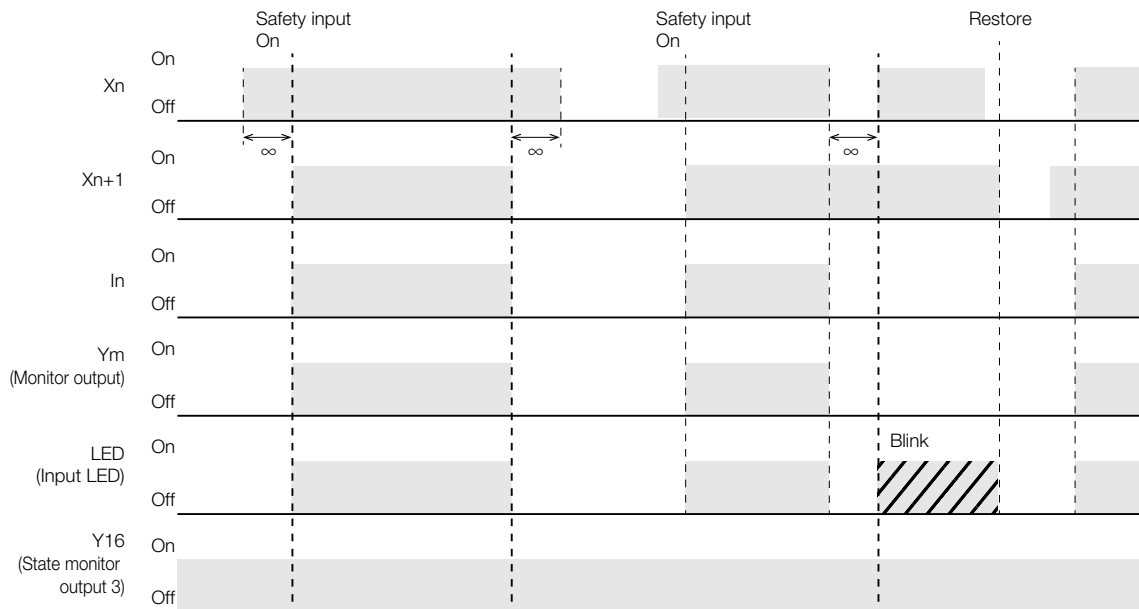The operation timing is described in figure 5.145.

Figure 5.145 Operation timing of dual channel dependent input function

- The function output (In) is turned on when the connected safety component is turned on and the safety check signal output from the two drive circuits (Tn, Tn+1) is correctly input to the two receive circuits (Xn, Xn+1).

- When the connected safety component is turned off and one of the two receive circuits (Xn, Xn+1) is turned off, the function output (In) is turned off.

- If only one receive circuit (Xn+1 in the figure) is turned off while the two of receive circuits (Xn, Xn+1) are on fault in safety component or input circuit(welding of contacts, short circuit in wiring or input circuit error, etc.) and then turned on again, an alert condition will occur and the input LED will blink. At that time, the function output is not turned on.

- The alert state can be canceled by checking that there are no abnormalities in the safety component or wiring, and then turning the safety component to the off state. The function output is then turned on when the safety component is turned on.

⚠ WARNING	• Drive terminals of safety inputs send safety check signals (pulse signals) for the diagnosis of safety components and input circuits. Safety check signals cannot be used as a power for connected components.

• Dual channel safety input II

This function for connecting safety components with redundant semiconductor outputs (PNP outputs) such as safety light curtains and safety laser scanners. When the OSSD (DC24V) is input to the receive circuit, the receive circuit (Xn, Xn+1) turn on respectively. When the two receive circuits turn on, the function output (In) turns on.

In the case of safety light curtains and safety laser scanners, the drive circuit is not used because the circuit is monitored by the safety components. If interlock switches or enabling switches are connected, an anomaly between inputs cannot be detected.

· For safety components with redundant semiconductor outputs (PNP outputs)
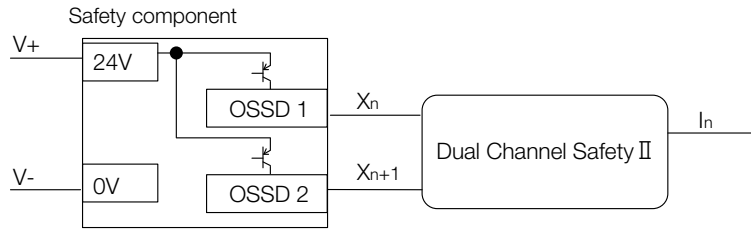
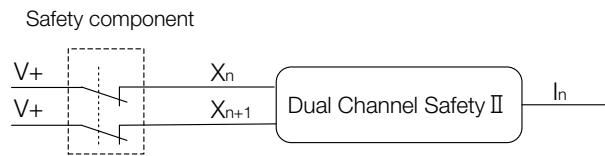**· For a mechanical contact component**

Function output (In) is on

Figure 5.146 Dual channel safety input II function circuit

Connects to

Safety light curtains, safety laser scanners, interlock switches, etc.

⚠ WARNING	• A short circuit in the wiring connected to the receive circuit (Xn, Xn+1) cannot be detected. Connect the safety components that can detect a short circuit, or the wires shall be protected or separated according to the relevant standards (for example, ISO13849-2).

💥 CAUTION	• Semiconductor output components with sink output (NPN output) cannot be connected.

Description of operation

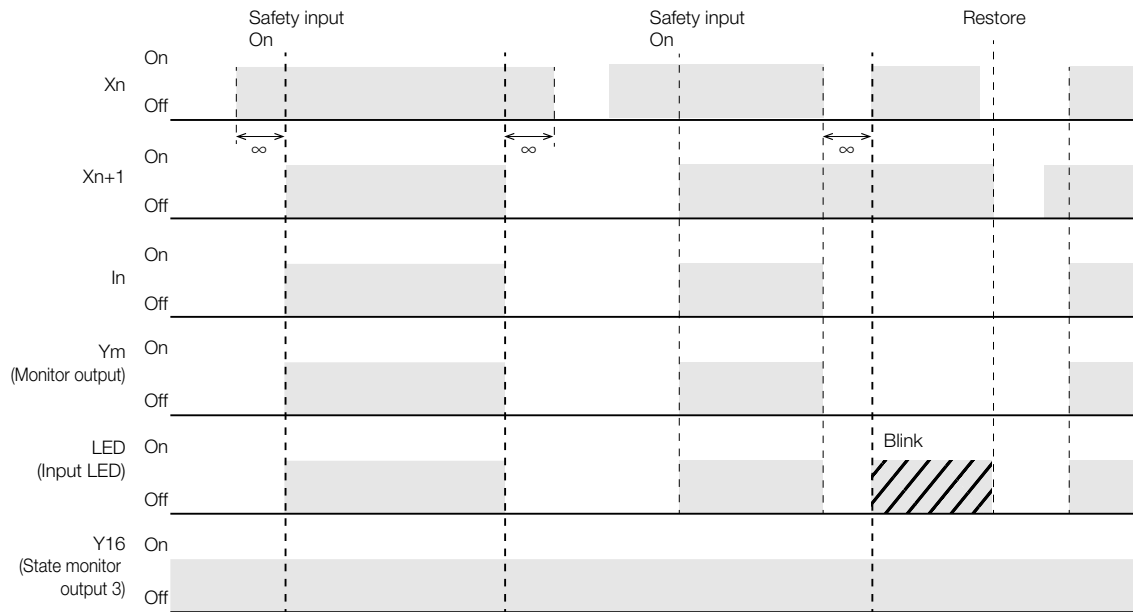The operation timing is described in figure 5.147.

Figure. 5.147 Operation timing of dual channel safety input II function

- The function output (In) is turned on when the connected safety component is turned on (for example, safety light curtain is not blocked, safety laser scanner does not detect the operator) and the output safety check signal is correctly input to the two receive circuits (Xn, Xn+1).

- The output of the connected safety component is in an off state (safety light curtains are blocked, safety laser scanner detects a person, etc.)

- If only one receive circuit (Xn+1 in the figure 5.147) is turned off while the two of receive circuits are on fault in safety component or input circuit (welding of contacts, short circuit in wiring or input circuit error, etc.) and then turned on again, an alert condition will occur and the input LED will blink. The function output is not turned on at that time.

- After confirming that there is no abnormality in the safety component or wiring, the alert state is canceled and restored when the output of the safety component is turned off. The function output is then turned on when the safety component is turned on.

• Dual channel NO/NC input

Input function for connecting safety components with redundant NO/NC contacts, such as non-contact safety switches or interlock switches etc. When the signal output from the drive circuit (Tn, Tn+1) is input to the corresponding receive circuit (Xn, Xn+1). When the even side receive circuit (Xn) is off and the odd side receive circuit (Xn+1) is on function output (In) turns on.
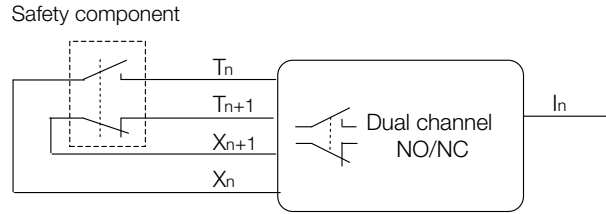
Function output (In) is on

Figure 5.148 Dual channel NO/NC input function circuit

Connects to

Non-contact safety switches or interlock switches, etc.

> • Safety light curtains, safety laser scanners, and other semiconductor output components cannot be connected.

Description of operation

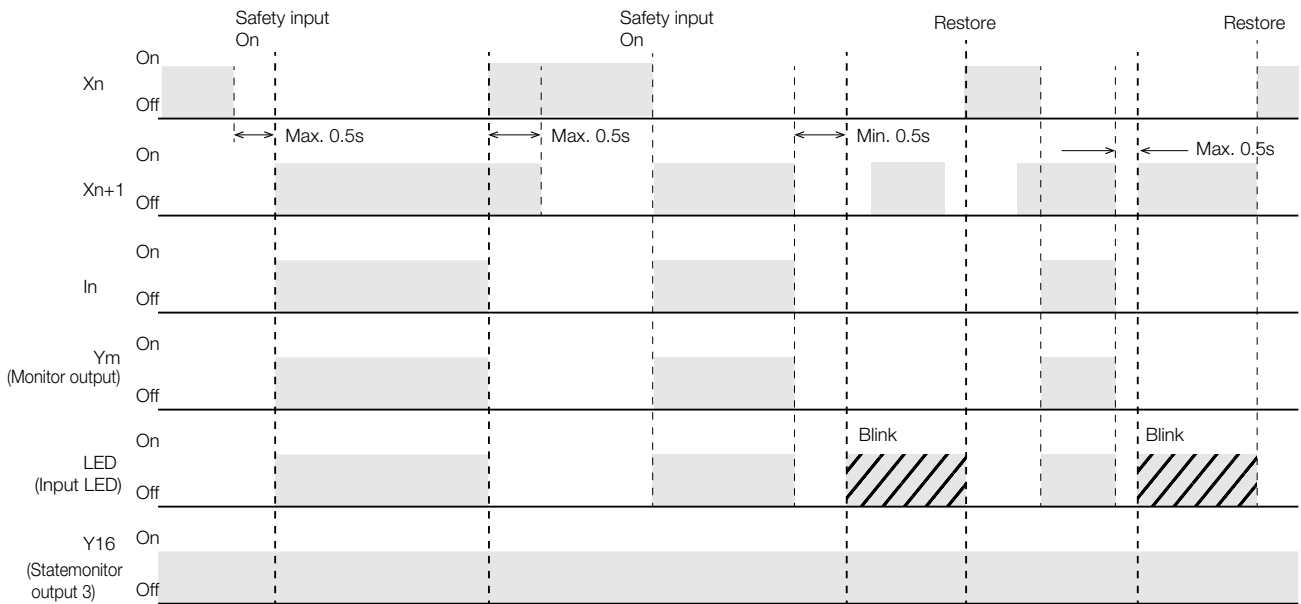The operation timing is described in figure 5.149.

Figure 5.149 Operation timing of dual channel NO/NC input function

- The function output (In) turns on when the output of the connected safety component is turned on (for example, a safety guard with a non-contact safety switch installed is closed etc.) and the safety check signal output by the odd-side drive circuit (Tn+1) is correctly input to the odd-side receive circuit (Xn+1) and the even-side receiver circuit (Xn) is turned off.

- The function output (In) is turned off when the connected safety component is turned off (for example, a safety guard with a non-contact safety switch installed is opened etc.), the safety check signal output by the even-side drive circuit (Tn) is correctly input to the even-side receive circuit (Xn) and the odd-side receiver circuit (Xn+1) is turned off.

- If the safety check signals of the two receive circuits remain on (or off) for a certain period of time (0.5s) due to the operation of safety components, an alert condition will occur, the input LED will blink, and the function output will not turn on.

- If only one receive circuit (Xn+1 in the figure) changes state and returns to the original state while the function output is on fault in safety component or input circuit (welding of contacts, short circuit in wiring or input circuit error, etc.), even if the time is less than 0.5s, an alert condition will occur and the input LED will blink. The function output is not turned on at that time.

- After confirming that there are no abnormalities in the safety component or wiring, the alert state is canceled and restored when the safety component is turned off. The function output is then turned on when the safety component is turned on.

⚠	WARNING	• Drive terminals of safety inputs send safety check signals (pulse signals) for the diagnosis of safety components and input circuits. Safety check signals cannot be used as a power for connected components.

● Mode select input II

Input function for connecting safety components with redundant NO/NC contacts, such as non-contact safety switches or interlock switches etc.

When the safety check signal output from the drive circuit (Tn) is input to the even side receive circuit (Xn), one function output (teach (mode 1)) is turned on, and when input to the odd side receive circuit (Xn+1), the other function output (auto (mode 2)) is turned on.
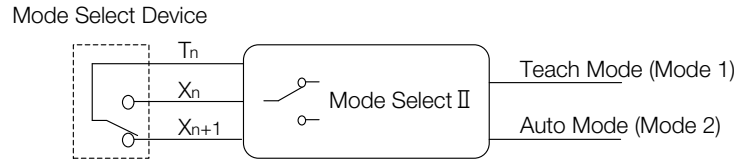
Auto (mode 2) is selected

Figure 5.150 Mode select input II function circuit

Connects to

Selector switches, etc.

> • Semiconductor output components cannot be connected.

Description of operation

The operation timing is described in figure 5.151.

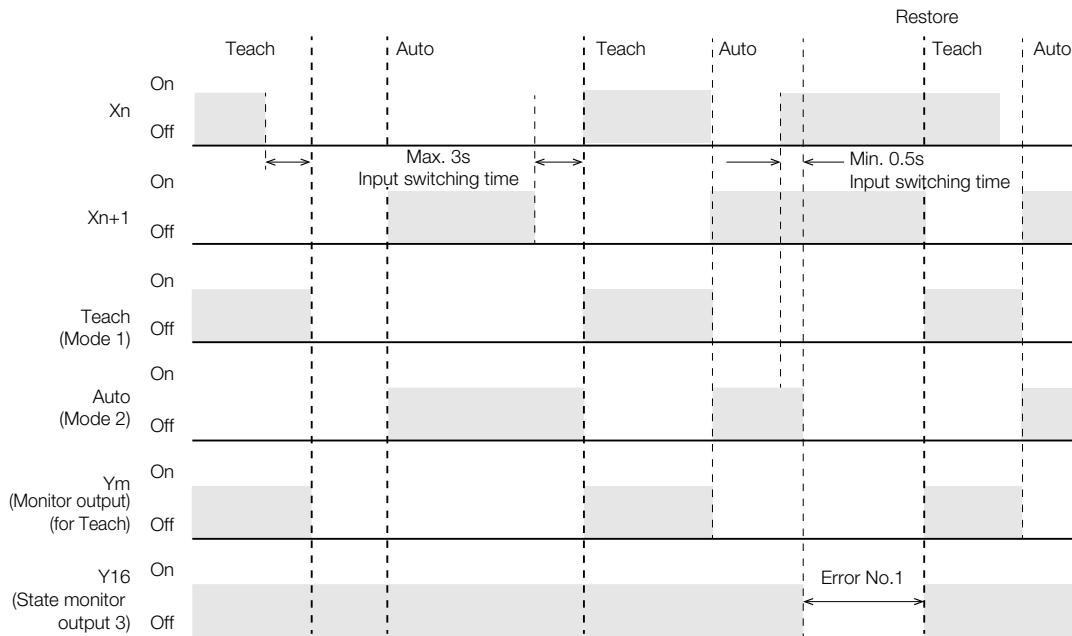Figure 5.151 Operation timing of mode select input II

- When the safety check signal output by the drive circuit (Tn) is correctly input to the even side receive circuit (Xn) and the odd side receive circuit (Xn+1) turns off, the function output (teach (mode 1)) turns on. If the time between the even side receive circuit (Xn) turns off and the odd side receive circuit (Xn+1) turns on is within the input switching time (3s), the function output (teach (mode 1)) remains on.

- When the safety check signal output by the drive circuit (Tn) is correctly input to the odd side receive circuit (Xn+1) and the even side receive circuit (Xn) is turned off, the function output(auto (mode 2)) is turn on. If the time between the odd receive circuit (Xn+1) turns off and the even receive circuit (Xn) turns on is within the input switching time (3s), the function output (auto (mode 2)) remains on.

- If the two of receive circuits are both off beyond the input switching time (3s), function outputs are turned both off. (selector switch in the middle position, etc.)

- Due to an input circuit error (short circuit in wiring etc.), if the two of receive circuits remain both on for a certain period of time (0.5s), outputs are turned off. At this time, an input monitor error occurs, and the FS1B enters Protection state, and the error LED displays "1".

- When the input circuit error is resolved and only one of the receive circuits is turned on, the input monitor error condition is released. After that, the FS1B enters the operation mode and the corresponding function outputs are turned on.

| ⚠ WARNING	• The even side drive circuit (Tn) outputs a safety check signal (pulse signal) for the diagnosis of safety component and input circuits. Safety check signals cannot be used as a power for connected components.

📖✏	• Odd side drive circuit (Tn+1) is all off.

● **Muting input**

This function connects contact components such as photoelectric switches and limit switches with semiconductor outputs (PNP outputs). When the component output (DC24V) is input to the receive circuits (Xn, Xn+1) at the same time (within 3s), each turns on, and when the two of receive circuits turn on, the function output (IMn) turns on.

· **For muting sensors with semiconductor output (PNP)**
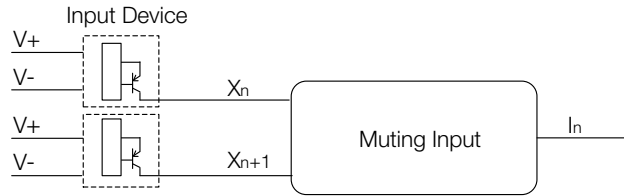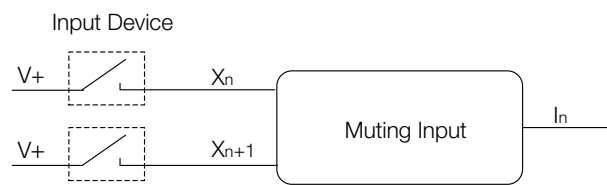

· **For a mechanical contact component**

Figure 5.152 Muting input function circuit

Connects to

Photoelectric switches, proximity switches and limit switches etc.

⚠	**WARNING**	• Do not use muting input as a safety input.

💥	**CAUTION**	• Semiconductor output components with sink output (NPN output) cannot be connected.

Description of operation
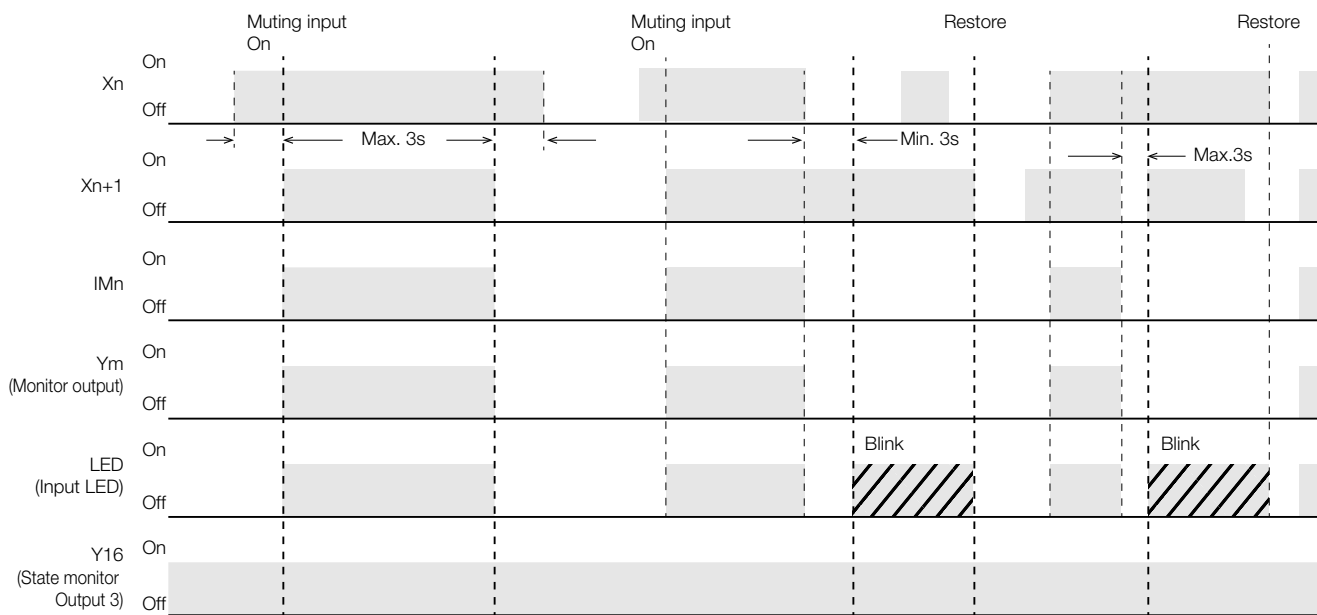
The operation timing is described in figure 5.153.

Figure 5.153 Operation timing of muting input

- The function output(IMn)turns on when the output signal from the connected component is correctly input to the two of receive circuits (Xn, Xn+1) at the same time (within 3s).

- When one of the two receive circuits is turned off, the function output (IMn) is turned off.

- If the output signals of the two receive circuits (Xn, Xn+1) do not reach the same state within a certain period of time (3s) due to the operation of the safety component, an alert condition will occur, the input LED will blink and the function output (IMn) will not turn on.

- Due to an abnormality in the safety component or input circuit (welding of contacts, short circuit or disconnection wiring, etc.), the two of receive circuits are both on and one receive circuit (Xn+1 in figure 5.153) returns to its original state, even if the time is less than 3s, an alert condition will occur and the input LED will blink. The function output is not turned on at that time.

- The alert state can be canceled by checking that there are no abnormalities in the safety component or wiring, and then turning the safety component to the off state. The function output is then turned on when the safety component is turned on.
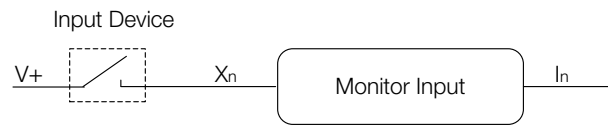
- The drive circuit (Tn, Tn+1) corresponding to the muting input is all off.

• Monitor Input

This function connects a switch (contact component) or a sensor with semiconductor output (PNP output) for reset input or control input. As shown in figure 5.154, this function consists of one receive circuit (Xn) and one function output (In).

· For a mechanical contact component

Input Device

$$V+ \quad\text{———}\quad X_n \quad \boxed{\text{Monitor Input}} \quad I_n$$

· For sensors with semiconductor output (PNP)

Input Device

$$\begin{array}{l} V+ \\ V- \end{array} \quad X_n \quad \boxed{\text{Monitor Input}} \quad I_n$$
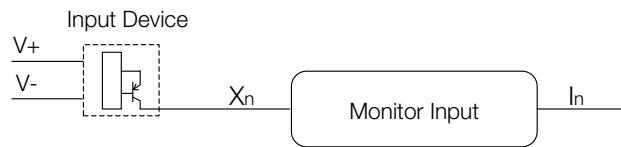
Figure 5.154 Monitor input function circuit

Connects to

Contact switches, photoelectric switches and proximity switches, etc.

⚠ WARNING	• Do not use monitor input as a safety input. Failure of the FS1B or peripheral components may impair the safety performance of the system.

• External device monitor inputs

Function for monitoring external components connected to the safety outputs.

Connect NC contacts such as forced guided relays and contactors for diagnosis. As shown in figure 5.155 function consists of a receive circuit (Xn), a drive circuit (Tn) and a function output (ln).
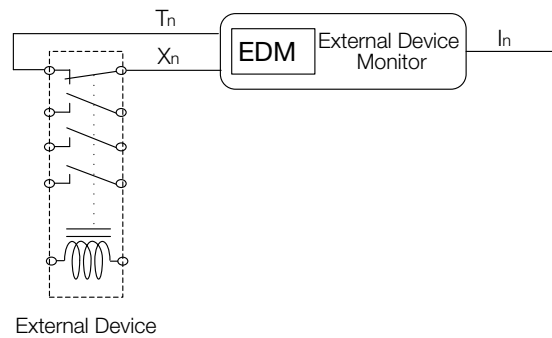

External Device

Figure 5.155 External device monitor input function circuit

Connects to

NC contacts such as forced guided relays and safety contactors with mirror contacts.

⚠ WARNING	• Semiconductor output components cannot be connected.

❏ Logical operation function

• AND function

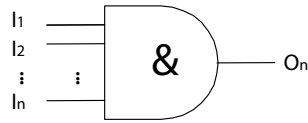Logical multiplication (AND) of multiple inputs.
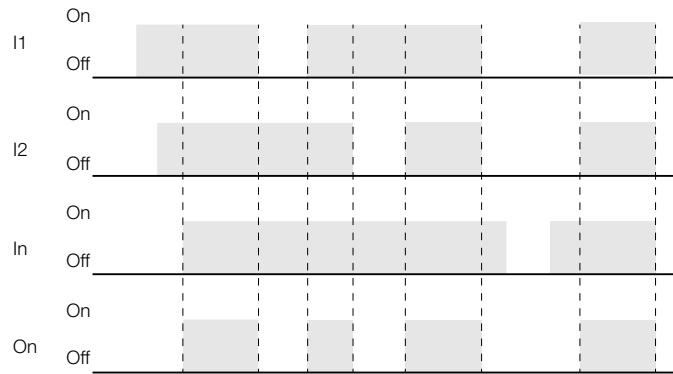

Figure 5.156 AND function circuit

Figure 5.157 Operation timing of AND function

• OR function
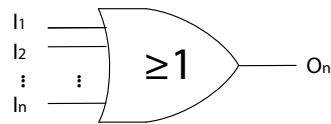
Logical addition (OR) of multiple inputs.
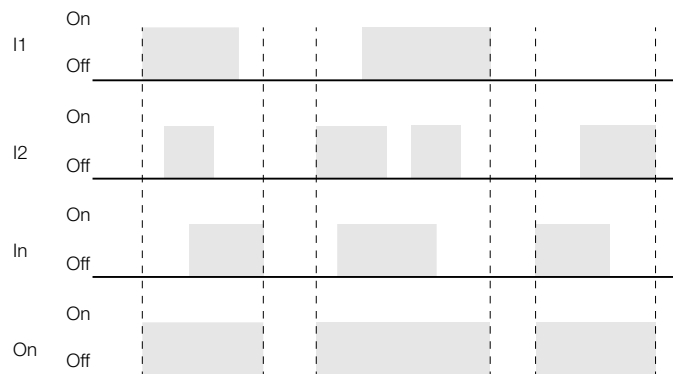

Figure 5.158 OR function circuit

Figure 5.159 Operation timing of OR function

• XOR II function

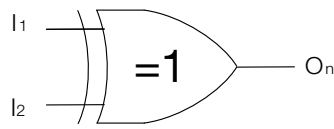Exclusive logical addition (XOR) of multiple inputs.
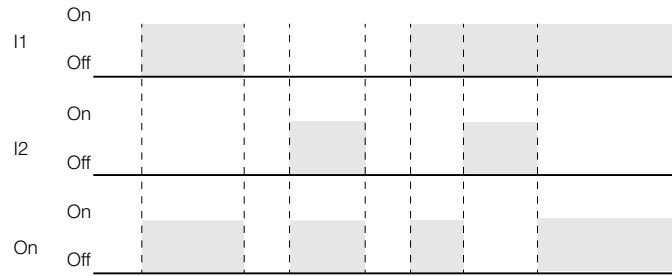

Figure 5.160 XOR II function circuit

Figure 5.161 Operation timing of XOR II function

• Reset selector function

This function ensures that the connected input (reset input) does not go to the on state at the same time.

If the two of inputs are turned both on at the same time, an error is detected and the FS1B enters Stop state.
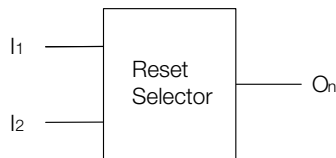

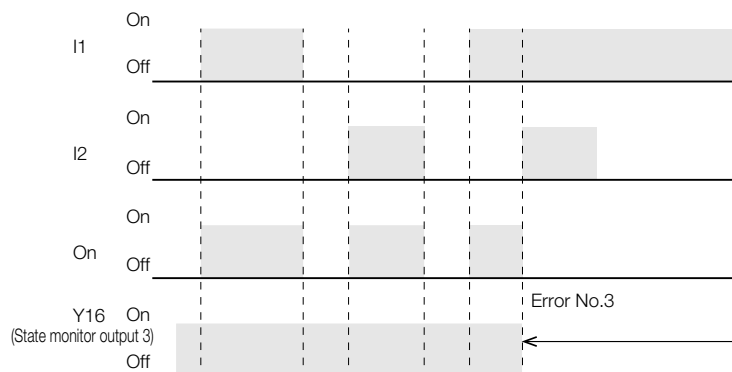Figure 5.162 Reset selector function circuit

Figure 5.163 Operation timing of reset selector function

• **Self-hold function**

Self-holding of input. When the trigger input (ITn) is turned on while the hold input (IHn) is on, the function output On) is turned on; when the hold input is turned off, the function output is turned off regardless of the trigger input status.
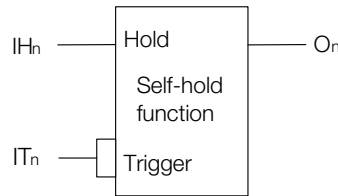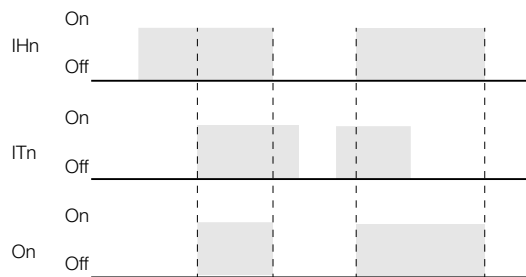

Figure 5.164 Self-hold function circuit

Figure 5.165 Operation timing of self-hold function

• Muting II function

This function adds a muting function to safety components connected to the safety input.

Figure 5.166 Muting II function circuit

Description of operation

The operation timing is described in figure 5.167.
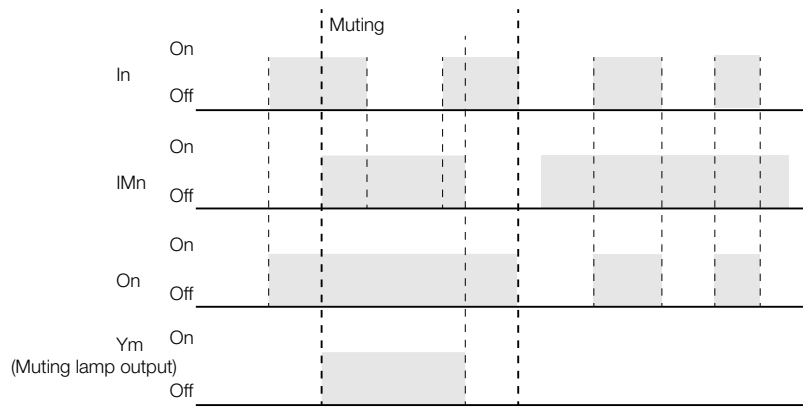
Figure 5.167 Operation timing of muting II function

- The muting input (IMn) turns on when the safety input (In) is on, thus maintaining the on state of the function output (On) regardless of the state of the safety input.

- Turning off the muting input disables the muting function and the state of the safety input is reflected in the function output.

- If muting is not used under the correct conditions, the muting function is disabled and the state of the safety input is reflected in the function output.

• Control start

This function checks the operation of the connected component for reset input.

As shown in figure 5.168, this function consists of one function input (In) and one function output (On). This function monitors whether the on time of the function input (In) is within the control time (0.1s to 5s).

In ———— [Control | Control start] ———— On
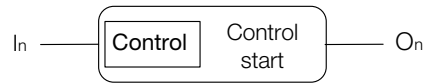
Figure 5.168 Control start function circuit

Description of operation

The operation timing is described in figure 5.169.
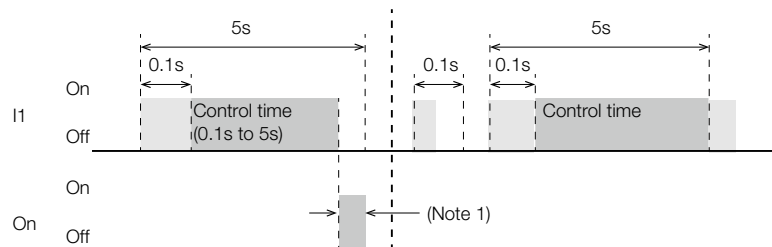
Note 1: This time represents one cycle of a cyclically executed program.

Figure 5.169 Operation timing of control start function

• When the on time of the function input satisfies the control time (0.1s to 5s), the function output is temporarily turned on.

• If the on time of the function input does not satisfy the control time (0.1s to 5s) (on time less than 0.1s or greater than 5s), the function output will not turn on.

• **Two-hand control function**

This function adds a two-hand operation input function to safety components connected to the safety input.

As shown in figure 5.170, this function consists of two safety inputs (In, In+1) and a function output (On).
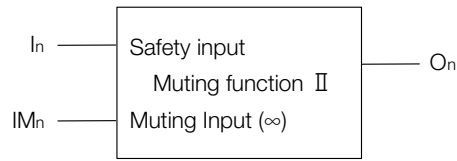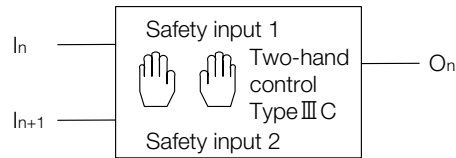

Figure 5.170 Two-hand control function circuit

Description of operation

The operation timing is described in figure 5.171.
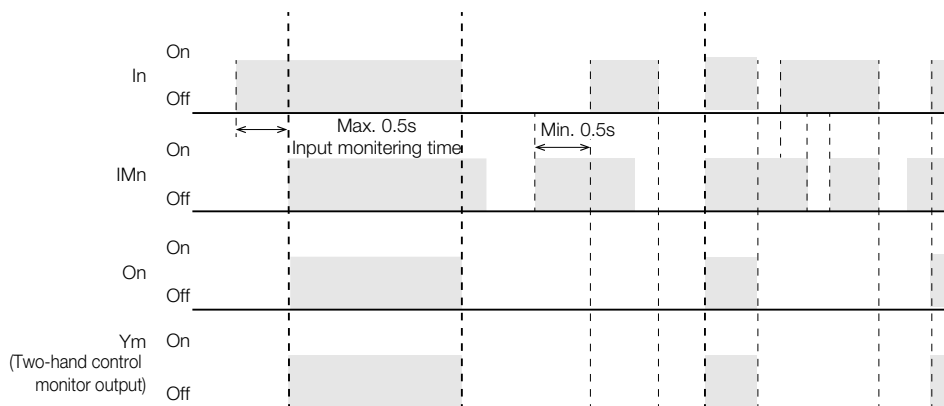
Figure 5.171 Operation timing of two-hand control function

• When two safety inputs (In, In+1) are turned on at the same time (within 0.5s), the function output (On) is turned on.

• When either of the two safety inputs is turned off, the function output is turned off.

• If the two input states exceed the input monitoring time (0.5s) in different states, the output of the function remains off.

• If an independent change of state occurs on one input, the output of the function does not turn on, but remains off.

❏ Output function

• Safety outputs function

This function is used to control the safety output. As shown in figure 5.172, this function consists of a hold input (On), an EDM input (In) and a safety output (Yn). The function output of the external device monitor input function is connected to the EDM input (In).

Figure 5.172 Safety output function circuit

Connects to

Components with forced guided mechanisms and mirror contacts such as safety relays and contactors
Inputs to safety controllers and safety PLCs, etc.

Description of operation

The operation timing is described in figure 5.173.
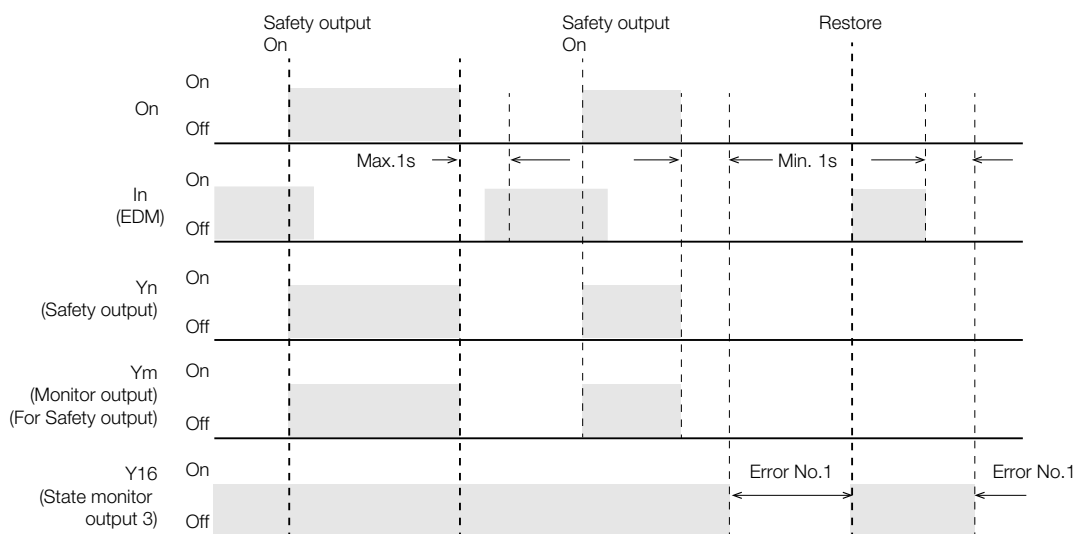
Figure 5.173 Operation timing of safety output function

• When the hold input (On) is turned on, the EDM input (In) is verified to be on and the safety output (Yn) is turned on.

• When the hold input is turned off, the safety output is turned off.

• If the EDM input is not correctly input due to an input circuit error (the EDM input cannot be confirmed to be on within the EDM monitoring time (1s) after the safety output is turned off), the function will shift to Protective state without turning on the safety output and the error LED will display "1". The error is canceled and restored when the safety output is off and the EDM input is on.

• If the safety outputs are in the off state and the EDM input cannot be confirmed to be on for more than the EDM monitoring time, the FS1B will enter Protection state and the error LED will display "1".

• **Safety output with timer**

This function to control the safety output with off-delay timer. As shown in figure 5.174, this function consists of a hold input (On), an EDM input (In) and a safety output (Yn). The function output of the external device monitor input function is connected to the EDM input (In).
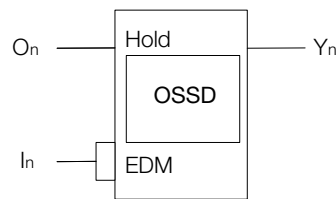

Figure 5.174 Safety output with timer function circuit

Connects to

Components with forced guided mechanisms and mirror contacts such as safety relays and contactors

Inputs to safety controllers and safety PLCs, etc.

Description of operation
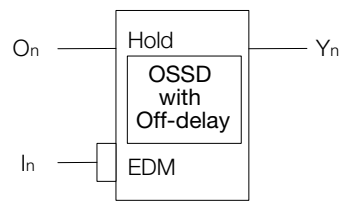
The operation timing is described in figure 5.175.
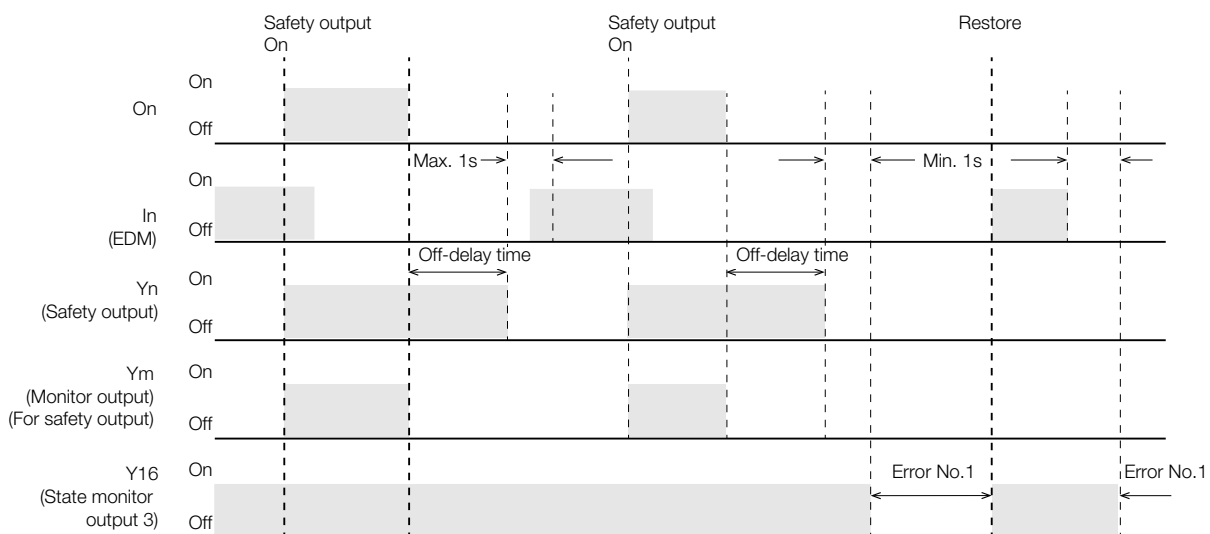
Figure 5.175 Operation timing of safety output with timer function

• Hold input (On) turns on, EDM input (In) turns on, and safety output (Yn) turns on.

• When the hold input is turned off, the safety output is turned off. When the off-delay timer is set, the safety output turns off after the hold input is turned off and after the time set for the off-delay timer. However, the monitor output for safety output is turned off immediately after the hold input is turned off, regardless of the off-delay timer setting time.

• If the EDM input is not correctly input due to an input circuit error (the EDM input cannot be confirmed to be on within the EDM monitoring time (1s) after the safety output is turned off), the function will shift to Protective state without turning on the safety output and the error LED will display "1". The error is canceled and restored when the safety output is off and the EDM input is on.

• If the safety output is off and the EDM input is not confirmed to be on for more than 1s, the FS1B will enter Protection state and the error LED will display "1".

Chapter 6 Troubleshooting

This chapter describes what to do when the FS1B safety controller detects an error. The FS1B safety controller operates differently depending on the type of error detected.

Error

If the FS1B safety controller detects a serious malfunction, it enters an error state. Depending on the type of error, the FS1B transitions to the protection or stop state and turns off all safety outputs. In case of an error related to input or output, the corresponding input LED and output LED blink. Check the error LED, monitor output, and take action according to Table 6.1.

Table 6.1 Error descriptions and troubleshooting

Error LED	Monitor output			Description (state)	Cause	Possible solution
	Y14	Y15	Y16			
1	■On (Note 1)	■On	□Off	Input monitor error (Protection state)	1. The two of mode select inputs are both on for 0.5s or longer.	1. Check that there are no problems with the component and wiring connected to the corresponding input.
					2. Safety output is off and EDM input is off for more than 1s.	2. Check that there are no problems with the component and wiring connected to the corresponding input.
2	■On	□Off	□Off	Fault in safety input wiring or connected component (Stop state)	1. Short circuit in wiring.	1. Check that there are no problems with the wiring and turn the power back on.
					2. Failure of connected component.	2. Check the operation of the component connected to the relevant input, and if there are no problems, turn the power back on.
3	■On	□Off	□Off	Fault in reset input wiring or connected component (Stop state)	1. Short circuit in wiring.	1. Check that there are no problems with the wiring and turn the power back on.
					2. Failure of connected component.	2. Check the operation of the component connected to the relevant input, and if there are no problems, turn the power back on.
4	■On	□Off	□Off	Fault in safety output wiring or connected component (Stop state)	1. Short circuit in wiring.	1. Check that there are no problems with the wiring and turn the power back on.
					2. Failure of connected component.	2. Check the operation of the component connected to the relevant input, and if there are no problems, turn the power back on.
6	■On	□Off (Note 2)	□Off	Fault in power supply (Stop state)	1. The voltage of power supply to FS1B is not within the allowable range.	1. Check that there is no problem with the connected power supply and turn the power back on.
7	■On	□Off	□Off	Internal circuit error (Stop state)	1. Failure of the FS1B.	1. Replace the FS1B.
8	■On	□Off	□Off	Abnormality when changing input function (Stop state)	1. Operation of the logic setting switch or timer setting switch during input function change.	1. After shutting off the power, set the operation specifications according to "Chapter 4 Basic specification setting change input functions".

Note 1: Monitor outputs are turned off in logic 34A, 34b, 34C, and 34d.
Note 2: Monitor outputs are turned on in logic 34A, 34b, 34C, and 34d.

> • If the above measures do not resolve the problem, contact our technical support.

Alert

An alert condition may occur when an error related to safety components connected to the safety inputs or input circuits is detected. In the alert state, the corresponding input LED blinks and the output of the input function is not turned on. The method of canceling the alert differs depending on the type of input function, so follow the instructions for each input function.

❏ **Input Functions to be Detected Alerts**

Dual channel direct opening input (191 Page)
Dual channel dependent input (193 Page)
Dual channel safety input II (195 Page)
Dual channel NO/NC input (197 Page)
Muting input (201 Page)

Chapter 7 Maintenance and Inspection

⚠️ **WARNING**

- To ensure safety, use the FS1B after performing inspections described below and confirming that the entire safety system incorporating the FS1B is operating normally. Record and store inspection results.
- Perform inspections with a clear understanding of the operations of the FS1B and the machine on which it is used.
- To prevent loss of safety function due to short circuit to other wires, wire properly so that the safety outputs do not touch the other wires accidentally or unintentionally. The wires shall be protected or separated according to the relevant standards (for example, ISO13849-2).
- In case of using the input function that can not detect a short circuit in the wiring connected to the receive circuit, use the safety components that can detect a short circuit, or wire properly so that the wires do not touch accidentally or unintentionally.
- The following checklist contains only the minimum items for use of the FS1B. Depending on the machinery on which the FS1B is installed and the regulations that apply in the country or region where the FS1B is used, additional inspection items may be required.
- Due to the self-diagnostic function of the FS1B, reconnect the power of the FS1B at appropriate intervals to maintain the safety performance of the FS1B. (At least once every 24 hours.)

❏ **Daily Inspection**

Before beginning operations, inspect the safety system the following procedure.

Inspection procedure
1. Check that the power supply of the FS1B is off.
2. Check that the power supply of the machine being controlled by the safety output of the FS1B is off.
3. Check that there is no damage on the input devices and wirings.
4. Make sure no person is in the danger zone and turn on the FS1B and connected devices.
5. Operate the connected safety components, and check that all of safety functions are operating normally.

❏ **Inspections to be Performed After Changes to the FS1B and/or Safety System Settings**

The following inspection items should be checked when any changes are made to the product and safety system settings, including installation or wiring.

Inspection items
Check that unintended changes are not implemented into the safety system.
Check that the safety system incorporating the FS1B operates as expected.
Check that the FS1B 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 covered and locked on the FS1B to prevent changes to the logic or off-delay timer setting by anyone other than the safety responsible person.