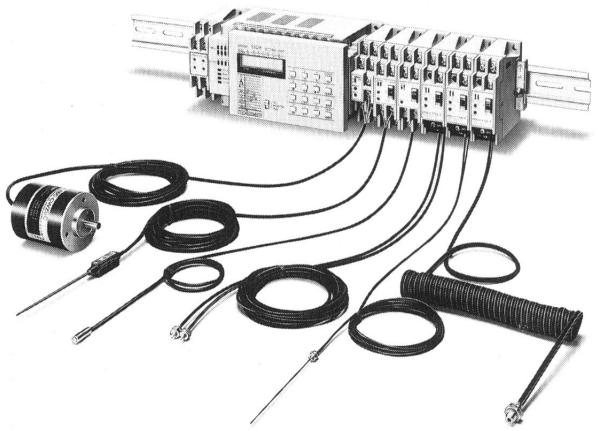
OMRON

Sensor Controller | S3D8

Offers High-speed Logic Control and Complex Detection Capabilities



- Self-contained power supply (12 VDC) eliminates the need for an external sensor power supply.
- Fast input response time (1 ms) enables detection of minute or high-speed objects.
- Teaching function does not require manual programming.
- Effective noise rejection function offers better operation reliability, assuring stable operation regardless of type of input (contact or solid-state input).
- Either contact output or transistor output selectable according to your application.
- Four or eight input points. Slim amplifiers can be track connected without wiring.
- Various program memory chips available (RAM, PROM, and EEPROM).

Ordering Information

Item		S3D8	
Memory		EEPROM	
Connection to exclusive amplifier		Possible	
No. of input points		8	
No. of output points	**Contact**	4 + (4) (see note)	(4) (see note)
	Transistor	(4) (see note)	4 + (4) (see note)
Controller unit		S3D8-CKF-US	S3D8-CCF-US
Output expansion unit	**Contact**	S32-A4K-US	
	Transistor	S32-A4C-US	
Pulse director of rotary encoder		E63-WF5C	
Setting unit		S3D-P	
PROM writer		S32-PM Memory Unit	
PROM		---	

Note: Four output points are added when output expansion unit is connected.

Specifications

■ Ratings

Item			S3D8
Power supply	**Supply voltage**		100 to 240 VAC ±10%, 50/60 Hz
	Power consumption		Approx. 35 VA
	For sensor use	**Supply**	400 mA, 12 VDC ±10%
		Ripple	3% p-p max.
		Short-circuit protection	Provided
Input signal	**ON level**		0 to 3 V; IN1 to 3: 9 mA min., IN4 to 8: 8 mA min.
	OFF level		9 to 12 V; IN1 to 3: 1.5 mA max., IN4 to 8: 2 mA max.
	Current between 0 V and IN terminals and IN terminals		12 mA typ. (20 mA max.)
	Max. applied voltage		30 VDC
	Input impedance		Approx. 1 kΩ
	Input response time	**Contact**	22 ms + chattering time (for stop input and when input is specified by contact input key)
		Transistor	1 ms (up to 60 steps)/2 ms (61 steps or above)
Control output	**Switching capacity**	**Contact**	3 A, 250 VAC (cosϕ = 1), SPST-NO
		Transistor	80 mA, 30 VDC max. ON-state residual voltage: 1 V max. OFF-state leakage current: 0.1 mA max.
	Response time	**Contact**	Input response time + 20 ms max.
		Transistor	Input response time + 1 ms
Protection against momentary power failure			20 ms max.

■ Characteristics

Item	S3D8
Insulation resistance	50 MΩ min. (at 500 VDC) between power supply terminal section and input/output terminal section, and between non-current-carrying metal parts
Dielectric strength	2,000 VAC min. between non-current-carrying and current-carrying parts 1,500 VAC min. between power supply terminal section and input/output terminal section
Noise immunity	Operating power supply: 1,500 V p-p min., pulse width: 100 ns, rise time: 1 ns Input/output: 1,000 V p-p min., pulse width: 100 ns, rise time: 1 ns
Vibration resistance	Destruction/malfunction: 10 to 55 Hz, 0.75-mm double amplitude for 2 hrs each in X, Y, and Z directions
Shock resistance	Destruction/malfunction: 300 m/s^2 (approx. 30G), 3 times each in X, Y, and Z directions
Ambient temperature	Operating: S3D8: –10°C to 55°C S3D-P: 0°C to 40°C
Ambient humidity	Operating: 35% to 85%
Weight	S3D8: approx. 620 g; S3D-P: approx. 100 g

■ Control Functions

Item		S3D8
I/O	**Power supply for sensors**	400 mA, 12 VDC ±10%
	No. of input points	8 (IN1 to 8)
	No. of output points	External: 4+4 (see note 1) (OUT01 to 08) Internal: 8 (OUT09 to 16 (see note2))
	No. of steps	100 (00 to 99)
	Contact input compensation	Input response delay time when contact input key is used: chattering time + 22 ms
Program logic	**Basic logic**	Operations that can be expressed by combinations of AND, OR, differential, one-shot, ON-delay and OFF-delay timers, counter, flip-flop, and operation chart
	Timer functions	One-shot, ON-delay, and OFF-delay
	No. of timers/counters	12 max. (10 when interval check key is used. High-speed counter is excluded).
	Time setting range of timer	0.01 to 999 s
	Timing accuracy	Transistor output: ±0.2% + 2 ms max.; Contact output: ±0.2% + 20 ms max.
	No. of counts that can be preset	1 to 999
	Counter response frequency	400 cps
	High-speed counter	1 reversible counter (response frequency: 3 kHz)
	Shift register	One 8-bit shift register (response speed: 400 Hz)
	Teaching function	Can be used 8 times max.
Self-diagnostic functions		Input interval check, sensor power source short-circuit check, CPU error, memory error, program error, key operation error, excessive timer/counter check, teaching error

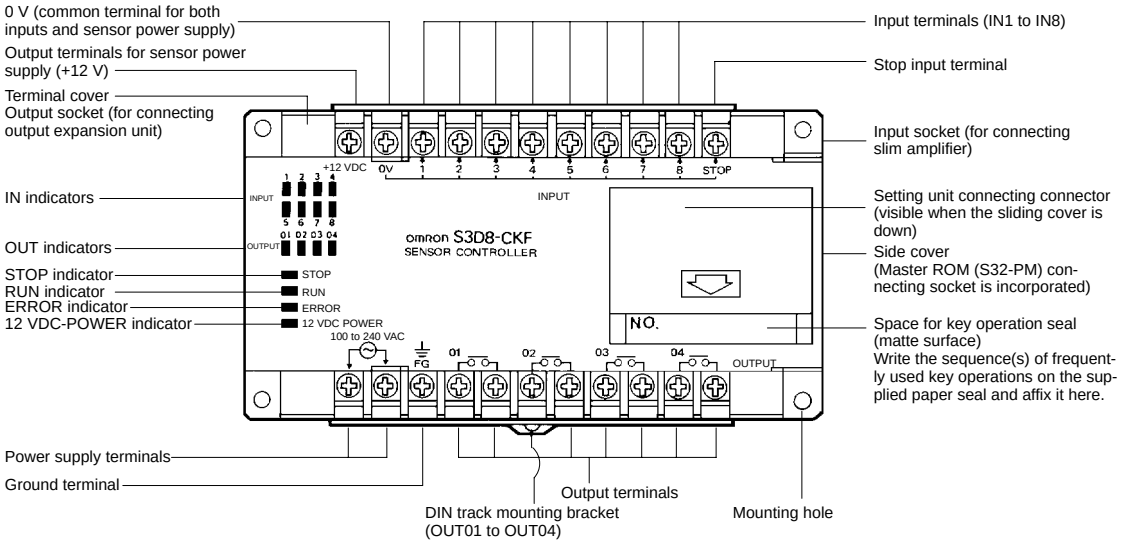
Note: 1. With the external output expansion unit.
2. OUT16 also has a buzzer function.

■ Programming Functions

Item	S3D8
Programming system	Operation chart
Program configuration	Programs are grouped particular to each output point.
Step	Incremented/decremented
Program insertion/deletion	Possible
Program correction	Possible
Internal output monitor	Provided (with S3D-P)
Timer start on power up	Possible
Set time change during operation	Possible
HOLD function	Not provided
Buzzer instruction	Provided
Program copy	Copying function internally provided.

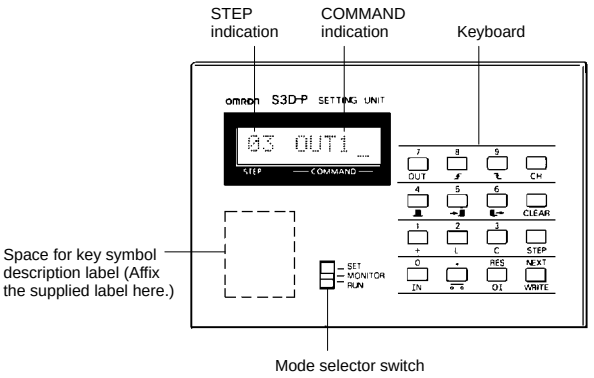
Nomenclature

S3D8-CKF-US
S3D8-CCF-US



Operation

■ Setting Unit (S3D-P)



Caution

The S3D-P setting unit should not be mounted or dismounted when the mode selector switch is in either SET or MONITOR position.

Mode Selector Switch

SET: This mode is used to set functions by operating specific function keys on the keyboard. In this mode, the Sensor Controller performs no operation and all outputs are turned OFF.

MONITOR: This mode is used to check (monitor) the function set by the key operation. In this mode, all outputs are put in the OFF state, but only the OUT indicators are operable, thus allowing operational monitoring of the controller.

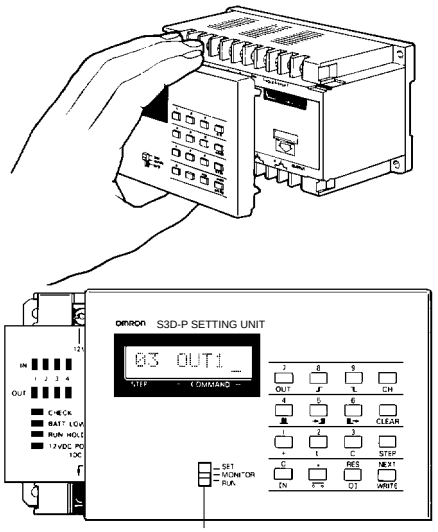
RUN: This mode is used to start operation of the controller. The S3D-P setting unit can be mounted or dismounted while the mode selector switch is set in this position, at which time the controller produces outputs properly.

■ Key Operation

Key	Key name	Key	Key name
IN	IN Key: Specifies solid-state output type sensors as input.	CH	Interval Check Key: Sets the range within which the time period of an input signal is checked.
	Contact input Key: Specifies contact output type sensors as input.	C	Counter Key: Sets a count value.
OI	Out/In Key: Specifies an output and to read it or a portion thereof as an input.	C CH	High-speed counter
OUT	OUT Key: Specifies output terminal OUT0 to 8 or OUT01 to 16.	RES	Counter RESET Key: Resets counters.
+	Plus Key: Specifies OR operation.	CLEAR	CLEAR Key: Clears the set parameters on a step-by-step basis. When pressed twice, “END” is displayed, ending the program at the current step.
L	Low Key: Specifies LOW or OFF level.	STEP	STEP Key: Sets step numbers.
	Rise Key: Specifies the leading edge of input signal. Up Key: Increments the time when the set time of a timer is to be changed during operation. Step Back Key: Returns the step by one.	WRITE	WRITE Key: Writes data if the mode selector switch is set to the SET position.
	Fall Key: Specifies the trailing edge of input/output signal. Down Key Decrements the time when the set time of a timer is to be changed during operation.	. , 0 to 9	Numeric Keys: Specifies the set time of timers and input/output terminal numbers.
	One-shot Timer Key: Specifies one-shot time.	NEXT	NEXT Key: Advances step numbers after data has been written by the Write Key.
	ON-delay Timer Key: Specifies the time of an ON-delay timer.	TEACH	TEACHING Key: Used when teaching function is used.
	OFF-delay Timer Key: Specifies the time of an OFF-delay timer.	SFT	SFT Key: Specifies the number of times the shift register is to be shifted.

■ Program Writing

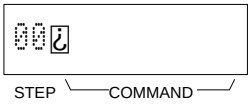
1. Attach the S3D-P setting unit to the Sensor Controller from the front and turn on the power.



2. Slide the mode selector switch to the SET position. If nothing is stored in memory, the following message is displayed.

3. Clear all the steps of the memory with this key sequence:

The display will look like this:



4. Write the program in accordance with the operation chart. For details of programming, refer to page 9.
5. Check whether the key sequence for the program writing was correct. To do this, slide the mode selector switch to the MONITOR position.

If there was no erroneous key operation, the following message is displayed.

6. If the OK message is not displayed, it means that misoperation occurred. The error messages are described on page 7.

Now execute the program.

7. First, slide the mode selector switch to the RUN position.

The following message will then be displayed.

If the RUN message is not displayed, it means an error occurred. The error messages are described on page 7.

8. Turn off the power and remove the setting unit from the Sensor Controller. Then wire the input and output lines.
9. Apply the power to the Sensor Controller to execute the program. Confirm that the 12-VDC-POWER indicator lights upon power application. If the indicator remains dark, it means the power lines of the sensor are short-circuited.

■ Changing Program

Clearing Memory

To erase (clear) all the memory contents, slide the mode selector switch to the SET position and perform this key sequence:

Inserting Program Step

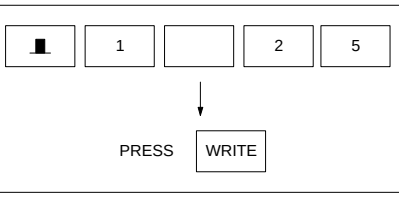
The S3D8 has a function with which new step(s) can be inserted in the existing program. To do this, slide the mode selector switch to the SET position and display the step at which the new program step is to be inserted. Without clearing the program currently displayed, write the new program step. That program step will then be inserted in the existing program. In the following example, a timer instruction is inserted.

(STEP)	(COMMAND)
00	IN1
01	IN2
02	OUT01

1. Display the step number at which the new program step is to be inserted.

(STEP)	(COMMAND)
02	OUT01

2. Write the timer program step.



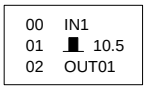
3. The timer instruction has been inserted.

(STEP)	(COMMAND)
00	IN1
01	IN2
02	T 1.52
03	OUT01

Changing Set Time of Timer during Operation

The set time of a timer can be experimentally changed and operation monitored even while the Sensor Controller is operating. Attach the S3D-P setting unit to the Sensor Controller. Then read out the step number at which the timer instruction is stored, using the STEP Key. Use the rise or fall key to increment or decrement the set time of the timer to the desired value. Each time the rise or fall key is pressed, the set time is changed accordingly.

Program Example



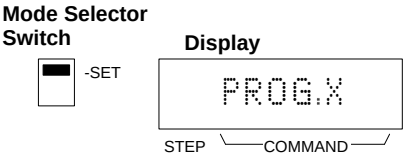
Key operation	Display STEP	Description
Mode selector switch RUN	RUN	The program is being executed.
STEP Key, 0 Key, 1 Key	10.5 01	Read the timer instruction stored in step number 01.
Rise Key	10.6 01	Lengthen the set time of the timer by 0.1 second.
Rise Key	10.7 01	Lengthen the set time by another 0.1 second.
Fall Key	10.6 01	This time, shorten the set time by 0.1 second
Fall Key	10.5 01	Further shorten the set time by 0.1 second.
Fall Key	10.4 01	Again, shorten the set time by 0.1 second.
Mode selector switch SET	IN1 00	Store in memory the time at which the mode selector switch has been moved to the SET position.
Mode selector switch RUN	RUN	Slide the selector switch to the RUN position.

Note: When the set time of a timer has been changed during the RUN operation, slide the mode selector switch of the S3D-P to the SET position; otherwise, the experimentally set time will not be stored in memory. Also, if the stop input is turned on while the set time of a timer is being changed, the new set value is ignored and the time will not be stored in memory.

■ Error Messages

Error Messages

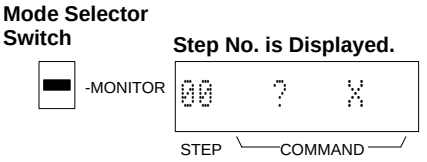
Setting Errors



This message is displayed when:

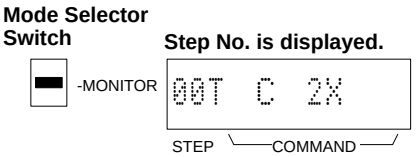
1. Power is supplied, yet no program exists in memory.
2. The setting unit (S3D-P) is attached/detached to/from the Sensor Controller with the mode selector switch set to the SET or MONITOR position.
3. The mode selector switch is moved to the RUN or MONITOR position when nothing is programmed.

Key Operation Error



This message is displayed when an erroneous key operation is performed. The step number displayed along with the error message indicates the step where the error has occurred. Normally, when a wrong key is pressed while data is being set, a buzzer sounds and the step will not advance.

Timer/Counter Excess Error



This message indicates that the number of available timers/counters has been exceeded and that the timer/counter instruction stored in the displayed step is the 12th timer/counter. (The number of timers/counters does not include the high-speed counter. Also note that when the time interval check key is used, the use of two timers is assumed.)

Teaching Error

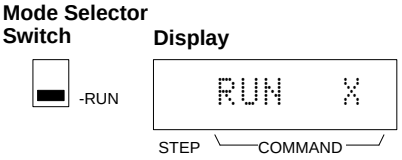
This error message is displayed when:

1. An attempt has been made to “teach” the same input condition twice.
2. An attempt has been made to execute the high-speed counter and teaching function at the same time.

Verify Error

This message indicates that the contents of ROM1 (the internal ROM of the S3D8) and ROM2 (the internal ROM of the S32-PM) are different from each other.

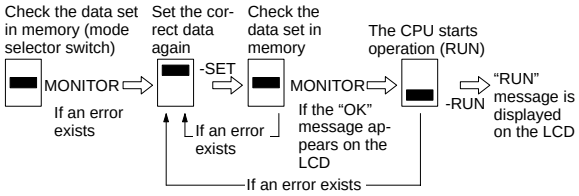
Run Error



This error message indicates that the contents of the memory have been changed while the Sensor Controller is operating. If this happens, check the memory contents. Specify the step number by the STEP Key and read out the data at that step to check it. Afterward, write the same data again in the same step.

Clearing Error Messages

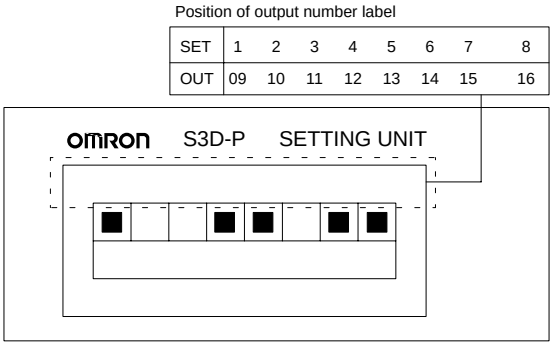
The error messages can all be cleared by returning the mode selector switch to the SET position.



■ Monitor Functions

Internal Output Monitoring

When the OUT and WRITE Keys are pressed with the mode selector switch set to the MONITOR position, up to eight squares appear on the display according to the number of outputs currently turned on. Each corresponds from left to right to output numbers OUT09 to 16 and denotes that the corresponding output is turned on. If an output is turned off, the corresponding square is not displayed.
To facilitate the monitoring of the output statuses, affix the output number label (supplied as an accessory) above the display as shown.



In the above figure, outputs OUT09, OUT12, OUT13, OUT15, and OUT16 are turned on.
Press the CLEAR Key to return the display to the original monitoring status.
Note that output OUT16 is provided with a buzzer function so that the buzzer sounds when this output is turned on.

Shift Register Monitoring

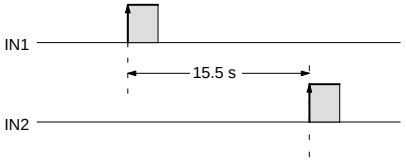
When the SFT and WRITE Keys are pressed with the mode selector switch set to the MONITOR position, the current status of the shift register can be monitored. The status of each of the shift register bits is also indicated by the squares. When a bit of the shift register is logical 1, a square appears at the corresponding position on the display.
Press the CLEAR Key to return the display to the original monitoring status.

Input Time Interval Measuring Function

The time interval between the specified two input signals can be measured and displayed in units of a second when the mode selector switch is moved to the MONITOR position. The displayed time interval is retained until cleared by the CLEAR Key or the WRITE Key is pressed to initiate the next time interval measurement.

Operation

Key operation	Display	
	Step	Command
IN Key, 1 Key, Rise Key, WRITE Key	IN1	Rise Key
IN Key, 2 Key, Rise Key, WRITE Key	IN2	Rise Key
---	Nothing is displayed	
Signals IN1 and IN2 are input.	15.5	



Time interval measuring range: Time display (0.01 to 999.99 s)

When the time interval of the same inputs is to be measured after the time interval has already been measured and monitored once, press the WRITE Key. The Sensor Controller will start measuring the time interval again.

To measure another time interval, press the CLEAR Key. The display will return to the MONITOR message. Then specify the two inputs between which the time interval is to be measured.

The same input can be specified in duplicate. Therefore, time intervals between the risings of two inputs IN1 or between the risings of IN1 and that of any of the next input IN can be measured.

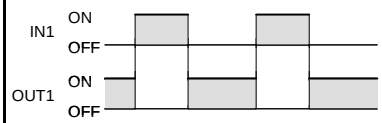
The range of the time interval that can be measured is from 0.01 to 999.99 seconds. If an attempt is made to measure a time interval exceeding 999.99 seconds, a colon is displayed at the most significant digit position (for example: ":18.35").

■ Writing Logic Program

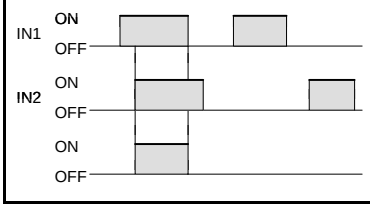
Basic Function

The output number is expressed in two digits in the case of the S3D8. If specifying OUT01, for example, be sure to press the 0 Key and then the 1 Key.

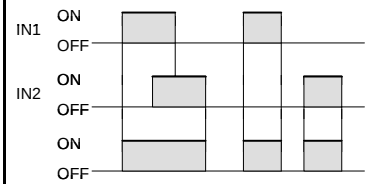
Inversion of Input or Output using the LOW Key

Operation chart	Key operation	Display		Description
		Step	Command	
	IN Key, 1 Key, Low Key, WRITE Key	00	IN1L	Low-level signal of IN1 is output to OUT1.
	OUT Key, 1 Key, WRITE Key	01	OUT1_	
	or			
	IN Key, 1 Key, WRITE Key	00	IN1_	OUT1 is turned to LOW by IN1.
	OUT Key, 1 Key, Low Key, WRITE Key	01	OUT1L	

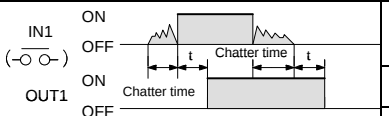
Output of the Overlapped Portion of Two Inputs (AND Operation)

Operation chart	Key operation	Display		Description
		Step	Command	
	IN Key, 1 Key, WRITE Key	00	IN1_	Overlapped portion of IN1 and IN2 is output to OUT1.
	IN Key, 2 Key, WRITE Key	01	IN2_	
	OUT Key, 1 Key, WRITE Key	02	OUT1_	

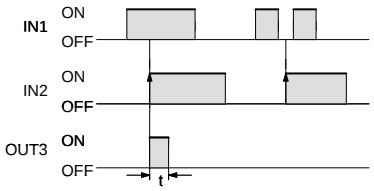
Output of Combined Inputs (OR Operation) using the PLUS Key

Operation chart	Key operation	Display		Description
		Step	Command	
	OUT Key, 1 Key, WRITE Key	00	IN1_	IN1 and IN2 are combined and output to OUT1.
	Plus Key, IN Key, 2 Key, WRITE Key	01	+IN2_	
	OUT Key, 1 Key, WRITE Key	02	OUT1_	
	or			
	IN Key, 1 Key, WRITE Key	00	IN1_	IN1 is output to OUT1 and then IN2 is output to OUT1.
	OUT Key, 1 Key, WRITE Key	01	OUT1_	
	IN Key, 2 Key, WRITE Key	02	IN2_	
	OUT Key, 1 Key, WRITE Key	03	OUT1_	

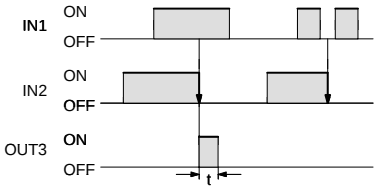
Output of Contact Input using the CONTACT INPUT Key

Operation chart	Key operation	Display		Description
		Step	Command	
 **Note:** t denotes input response time (22 ms).	Contact Input Key, 1 Key, WRITE Key	00	ō ō 1_	Contact input 1 is output to OUT1.
	OUT Key, 1 Key, WRITE Key	01	OUT1_	

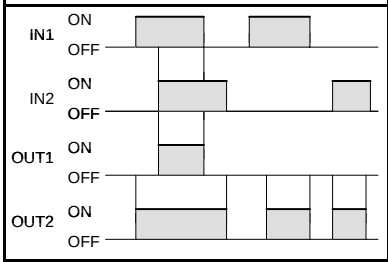
Output of Leading Edge (Differentiation Operation) using the RISE Key (e.g., to Indicate the Leading Edge of IN2)

Operation chart	Key operation	Display		Description
		Step	Command	
 **Note:** t denotes input response time (2 ms).	IN Key, 1 Key, WRITE Key	00	IN1_	A portion of the IN1 overlapping the leading edge of IN2 is output to OUT3.
	IN Key, 2 Key, WRITE Key	01	IN2 ⌐	
	OUT Key, 3 Key, WRITE Key	02	OUT3_	

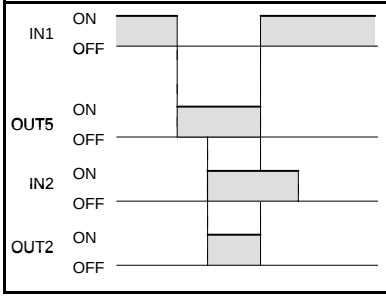
Output of Trailing Edge (Differentiation Operation) using the FALL Key (e.g., to Indicate the Trailing Edge of IN2)

Operation chart	Key operation	Display		Description
		Step	Command	
 **Note:** t denotes input response time (2 ms).	IN Key, 1 Key, WRITE Key	00	IN1_	A portion of IN1 overlapping the trailing edge of IN2 is output to OUT3.
	IN Key, 2 Key, Fall Key, WRITE Key	01	IN2 ¬	
	OUT Key, 3 Key, WRITE Key	02	OUT3_	

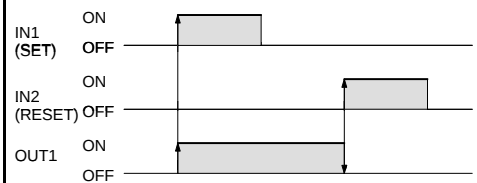
Multiple Outputs by Combination of Inputs (AND Output and OR Output)

Operation chart	Key operation	Display		Description
		Step	Command	
	IN Key, 1 Key, WRITE Key	00	IN1_	Overlapped portion of IN1 and IN2 is output to OUT1.
	IN Key, 2 Key, WRITE Key	01	IN2_	
	OUT Key, 1 Key, WRITE Key	02	OUT1_	
	IN Key, 1 Key, WRITE Key	03	IN1_	IN1 and IN2 are combined and output to OUT2.
	Plus Key, IN Key, 2 Key, WRITE Key	04	+IN2_	
	OUT Key, 1 Key, WRITE Key	05	OUT2	

Connection of OUT to IN Using the OUT/IN Key (e.g., Overlapped Portion of OUT5 and IN2 is Output to OUT2)

Operation chart	Key operation	Display		Description
		Step	Command	
	IN Key, 1 Key, Low Key, WRITE Key	00	IN1L_	OUT5 is read and then its portion overlapping IN2 is output to OUT2.
	OUT Key, 5 Key, WRITE Key	01	OUT5_	
	Out/In Key, 5 Key, WRITE Key	02	OI5_	
	IN Key, 2 Key, WRITE Key	03	IN2_	
	OUT Key, 2 Key, WRITE Key	04	OUT2_	

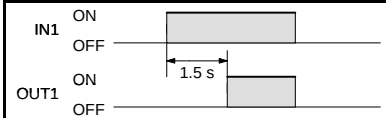
Holding of Output (Flip-flop) Using the RISE Key and FALL Key (e.g., When IN1 is the Set Input and IN2 is the Reset Input)

Operation chart	Key operation	Display		Description
		Step	Command	
	IN Key, 1 Key, Rise Key, WRITE Key	00	IN1 ↑	OUT1 is turned HIGH by the leading edge of IN1 and turned LOW by the leading edge of IN2.
	OUT Key, 1 Key, Rise Key, WRITE Key	01	OUT1 ↑	
	IN Key, 2 Key, Rise Key, WRITE Key	02	IN2 ↑	
	OUT Key, 1 Key, Fall Key, WRITE Key	03	OUT1 ↓	

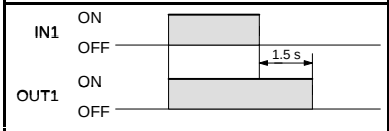
Timer Function

Key to use	Set time	Max. number of timers/conters	Remarks
: ON-delay timer : OFF-delay timer : One-shot timer	0.01 to 999 s	12 (10 when interval check key is used)	1 timer/counter is assigned per input.

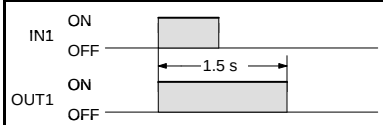
ON-delay Timer Operation Using the ON-DELAY TIMER Key (e.g., Set Time of 1.5 s)

Operation chart	Key operation	Display		Description
		Step	Command	
	IN Key, 1 Key, WRITE Key	00	IN1_	A signal is output to OUT1 for 1.5 s after IN1 has been turned ON.
	ON-delay Timer Key, 1 Key, Point Key, WRITE Key	01	↑ 1.5	
	OUT Key, 1 Key, WRITE Key	02	OUT1_	

OFF-delay Timer Operation Using the OFF-DELAY TIMER Key (e.g., Set Time of 1.5 s)

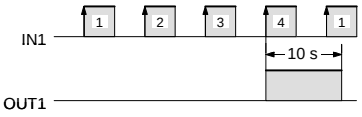
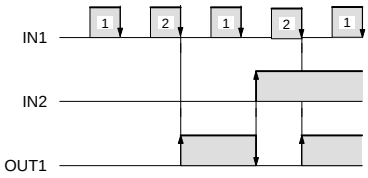
Operation chart	Key operation	Display		Description
		Step	Command	
	IN Key, 1 Key, WRITE Key	00	IN1_	A signal output to OUT1 is prolonged for 1.5 s after IN1 has been turned OFF.
	OFF-delay Timer Key, 1 Key, Point Key, 5 Key, WRITE Key	01	↓ 1.5	
	OUT Key, 1 Key, WRITE Key	02	OUT1_	

One-shot Timer Operation Using the ONE-SHOT TIMER Key (e.g., Set Time of 1.5 s)

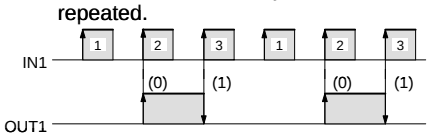
Operation chart	Key operation	Display		Description
		Step	Command	
	IN Key, 1 Key, WRITE Key	00	IN1_	A signal is output to OUT1 for 1.5 s after IN1 has been turned ON.
	One-shot Timer Key, 1 Key, Point Key, 5 Key, WRITE Key	01	▮ 1.5	
	OUT Key, 1 Key, WRITE Key	02	OUT1_	

Counter Function

Key to use	General counter response frequency	Preset count range	No. of timers/counters	High-speed counter	Remarks
C : Presets count value RES : Resets counter C CH : Specifies high-speed counter	400 Hz	001 to 999	12 (10 when the interval check key is used)	One high-speed counter is provided. Preset counter range: 000 to 999 Response frequency: 3 kHz	Per input point

Operation chart	Key operation	Display		Description
		Step	Command	
Ex.1: To count a signal for 10 s at the fourth count 	IN Key, 1 Key, Rise Key, WRITE Key	00	IN1	After counting the leading edge of the fourth pulse in IN1, a signal is output for 10 s to OUT1.
	Counter Key, 0 Key, 4 Key, WRITE Key	01	C 04	
	One-shot Timer Key, 1 Key, 0 Key, WRITE Key	02	10	
	OUT Key, 1 Key, WRITE Key	03	OUT1_	
Ex.2: To output a signal at the second count and reset only the output by IN2 (i.e., counting of the trailing edge of an input pulse) 	IN Key, 1 Key, Fall Key, WRITE Key	00	IN1	After counting the trailing edge of the second pulse of IN1, OUT1 is turned HIGH. It is turned LOW at the leading edge of IN2.
	Counter Key, 0 Key, 2 Key, WRITE Key	01	C 02	
	OUT Key, 1 Key, Rise Key, WRITE Key	02	OUT1	
	IN Key, 2 Key, Rise Key, WRITE Key	03	IN2	
	OUT Key, 1 Key, Fall Key, WRITE Key	04	OUT1	

Note: When resetting a counter, be sure to enter the reset command at the step immediately before the reset itself. Apply as many reset inputs as the number of counters used.

Operation chart	Key operation	Display		Description
		Step	Command	
Ex.3: Ring counter To output a signal at the second count and reset the output at the third count. Then this cycle is repeated. 	Out/In Key, 1 Key, Low Key, WRITE Key	00	OI1 L	When OUT1 is not output, OUT1 is turned HIGH after counting the leading edge of the second pulse of IN1 and OUT1 is turned LOW after counting one leading edge more of IN1 (i.e., leading edge of the third pulse).
	IN Key, 1 Key, Rise Key, WRITE Key	01	*IN1	
	Counter Key, 0 Key, 2 Key, WRITE Key	02	C 02	
	OUT Key, 1 Key, Rise Key, WRITE Key	03	OUT1	
	Out/In Key, 1 Key, WRITE Key	04	OI1	
	IN Key, 1 Key, Rise Key, WRITE Key	05	IN1	
	Counter Key, 0 Key, 1 Key, WRITE Key	06	C 01	
	OUT Key, 1 Key, Fall Key, WRITE Key	07	OUT1	

High-speed Counter

The S3D8 is provided with a high-speed counter whose response frequency is 3 kHz. With this high-speed counter, position control can be performed when a rotary encoder is connected to the Sensor Controller. Both the forward and reverse rotations of the rotary encoder (addition or subtraction of the counter) can be detected by E63-WF5C Pulse Director, which detects the direction of the rotary encoder rotation.

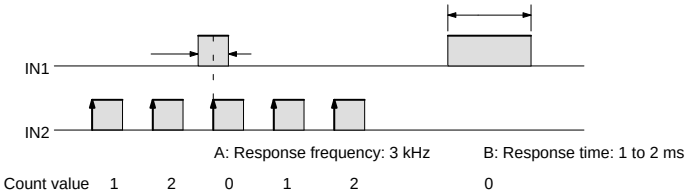
Key to Use

C	CH

Function

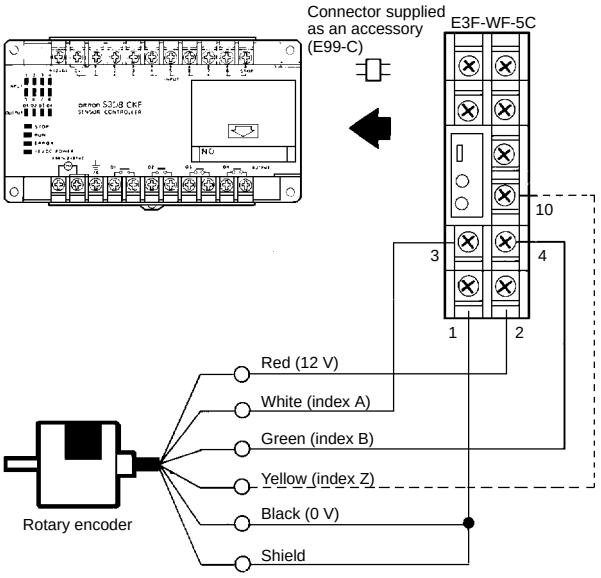
Counting speed	3 K cps
Output	Turns on/off the control output within 1 or 2 ms when the present count value coincides with the preset count value in the program. However, the control output is not produced if its pulse width is programmed as 1 ms or less.
Multiple-stage setting	Any number of stages can be set within the limit of the number of steps.
Set count range	000 to 999 (3-digit ring counter) The count value returns to 000 if incremented from 999.
Up/Down counting	Both up and down counting can be performed. The counter counts down when IN3 is turned on.
Input	The inputs to the high-speed counter are predetermined. IN1: Reset input IN2: Count input IN3: Up/Down input

Note: The reset response speed of the high-speed counter is 3 kHz if the count input (IN2 in the following timing chart) rises when the reset input (IN1) is applied. (“A” in the timing chart.) Where the reset input is applied in this manner, the use of E6A2-CW3C, E6B2-CWZ3C, E6C-CWZ5C, and E6D-CWZ2C Rotary Encoders is recommended. When using an encoder of another make check whether its output pulse width is appropriate for the high-speed counter’s reset input.
When the counter is to be reset independently of the count input, the counter responds to a reset input having a pulse width of 1 or 2 ms.



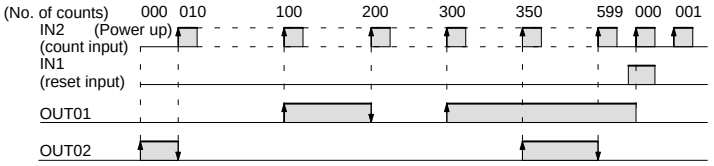
Connections

When a reversible encoder is connected.



Timing Chart

This timing chart assumes the conditions in which IN3 (reversible input) is turned off and thus the Up counting mode is set, and the shaft of the rotary encoder is revolving counterclockwise.



Programming Example

Use the counter key and interval check key to specify the high-speed counter.

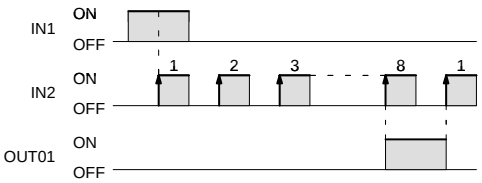
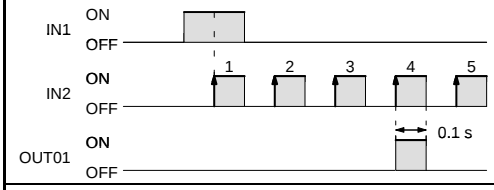
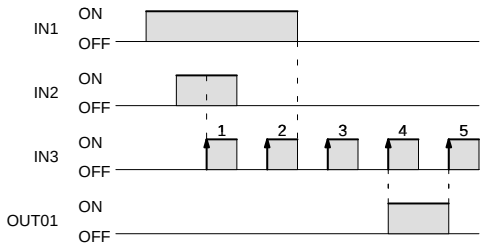
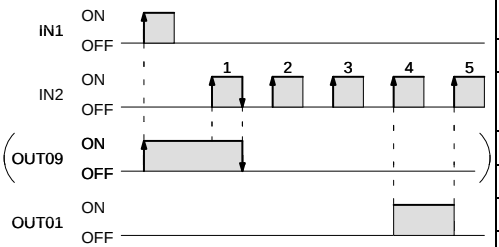
Step	Key Operation	Description
00	IN Key, 2 Key, WRITE Key	IN1
01 (see note 1)	Counter Key, Interval Check Key, 0 Key, 0 Key, 0 Key, WRITE Key	When present count value is “000”, OUT01 rises.
02 (see note 1)	OUT Key, 0 Key, 1 Key, Fall Key, WRITE Key	
03	Counter Key, Interval Check Key, 1 Key, 0 Key, 0 Key, WRITE Key	When present count value is “100”, OUT01 falls.
04	OUT Key, 0 Key, 1 Key, Rise Key, WRITE Key	
05	Counter Key, Interval Check Key, 2 Key, 0 Key, 0 Key, WRITE Key	When present count value is “200”, OUT01 falls.
06	OUT Key, 0 Key, 1 Key, Fall Key, WRITE Key	
07	Counter Key, Interval Check Key, 3 Key, 0 Key, 0 Key, WRITE Key	When present count value is “300”, OUT01 rises.
08	OUT Key, 0 Key, 1 Key, Rise Key, WRITE Key	
09 (see note 2)	Counter Key, Interval Check Key, 9 Key, 9 Key, 9 Key, WRITE Key	When present count value is “999”, OUT01 falls.
10 (see note 2)	OUT Key, 0 Key, 1 Key, Fall Key, WRITE Key	
11 (see note 1)	Counter Key, Interval Check Key, 0 Key, 0 Key, 0 Key, WRITE Key	When present count value is “000”, OUT02 rises.
12 (see note 1)	OUT Key, 0 Key, 2 Key, Rise Key, WRITE Key	
13	Counter Key, Interval Check Key, 0 Key, 1 Key, 0 Key, WRITE Key	When present count value is “010”, OUT02 falls.
14	OUT Key, 0 Key, 2 Key, Fall Key, WRITE Key	
15	Counter Key, Interval Check Key, 3 Key, 5 Key, 0 Key, WRITE Key	When present count value is “350”, OUT02 rises.
16	OUT Key, 0 Key, 2 Key, Rise Key, WRITE Key	
17	Counter Key, Interval Check Key, 5 Key, 9 Key, 9 Key, WRITE Key	When present count value is “599”, OUT02 falls.
18	OUT Key, 0 Key, 2 Key, Fall Key, WRITE Key	

Note: 1. Be sure to specify the output status when the present count value is “000”.

2. When the reset signal (the Z index of the encoder) is input to the IN1 terminal, the reset input takes precedence over the preset count value and the present count value is consequently reset to “000”. In other words, when the Z index of the encoder is used, the count value of the high-speed counter is automatically preset to the maximum resolution (i.e., the number of pulses) of the encoder.

Shift Register Function

The S3D8 is provided with an 8-bit shift register. To use the shift register function, press the SFT Key.

Operation chart	Key		Description
	Step	Key operation	
Ex.1: Output at the eighth shift 	00	IN Key, 1 Key, WRITE Key	IN1 is shifted by IN2 eight times and then output is produced from OUT01.
	01	IN Key, 2 Key, WRITE Key	
	02	SFT Key, 8 Key, WRITE Key	
	03	OUT Key, 0 Key, 1 Key, WRITE Key	
Ex.2: Output at the fourth shift, for 0.1 s. 	00	IN Key, 1 Key, WRITE Key	IN1 is shifted by IN2 four times and then output is produced from OUT01 for 0.1 s.
	01	IN Key, 2 Key, WRITE Key	
	02	SFT Key, 4 Key, WRITE Key	
	03	One-shot Timer Key, 0 Key, Point Key, 1 Key, 0 Key, WRITE Key	
	04	OUT Key, 0 Key, 1 Key, WRITE Key	
Ex.3: ANDed IN1 and IN2 are input and shifted four times 	00	IN Key, 1 Key, WRITE Key	IN1 and IN2 are ANDed and the result is shifted by IN3 four times. The output is produced from OUT01.
	01	IN Key, 2 Key, WRITE Key	
	02	IN Key, 3 Key, WRITE Key	
	03	SFT Key, 4 Key, WRITE Key	
	04	OUT Key, 0 Key, 1 Key, WRITE Key	
Ex.4: Shifting when data input and shift input are not synchronized (output at the fourth shift) 	00	IN Key, 1 Key, Rise Key, WRITE Key	OUT09 (interval output) is raised at rising edge of IN1 and is fallen at falling edge of IN2. OUT09 is shifted by IN2 four times and output is produced from OUT01.
	01	OUT Key, 0 Key, 9 Key, Rise Key, WRITE Key	
	02	IN Key, 2 Key, Fall Key, WRITE Key	
	03	OUT Key, 0 Key, 9 Key, Fall Key, WRITE Key	
	04	Out/In Key, 0 Key, 9 Key, WRITE Key	
	05	IN Key, 2 Key, WRITE Key	
	06	SFT Key, 4 Key, WRITE Key	
	07	OUT Key, 0 Key, 1 Key, WRITE Key	

Note:
1. The instruction programmed in the step before the Shift Key is pressed is used as the shift input and the instruction programmed in the step before the shift input is used as the data input.
2. Since the Sensor Controller is provided with only one shift register, only one output can be specified.
3. The data is shifted at the rising edge of the shift input.
4. When using the shift register, the Rise and Fall Keys cannot be used when specifying the shift input and the output.
5. The response frequency of the shift register is 400 Hz.
6. The data being shifted can be displayed on the LCD of the S3D-P setting unit for monitoring.

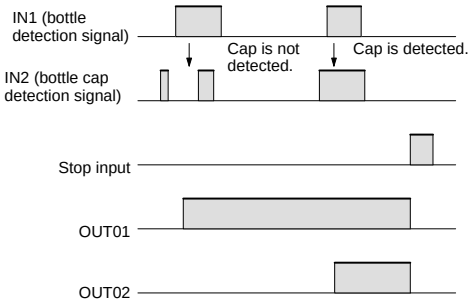
Teach Function

The S3D8 has a function that automatically programs the Sensor Controller's operation through a few key strokes only. When this function is executed with the input devices connected to the Sensor Controller, the Sensor Controller "learns" the conditions on which it is to produce the control output. All you have to do is to specify the output number.
This function can be executed under the following conditions.

- Each input condition is automatically stored in the Sensor Controller's memory at the rising edge of a trigger input signal.
- The number of times this function is used is limited to eight.
- The same input condition (i.e., input signal) cannot be specified in duplicate.
- When the high-speed counter is used, this function cannot be executed.

For example, the following operation is automatically programmed in the Sensor Controller through only six key strokes when this function is executed.

Operation Example

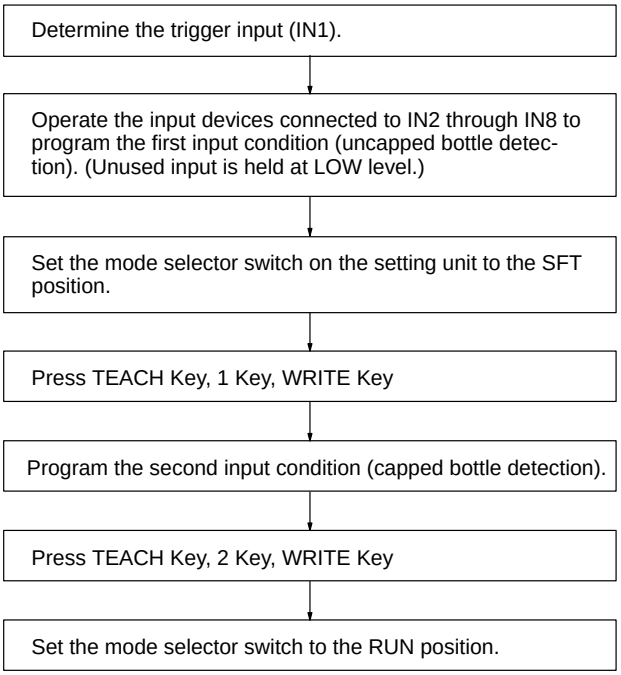


Detection of uncapped bottle		Detection of capped bottle	
Step	**Command**	**Step**	**Command**
00	IN1 ↓	09	IN1 ↓
01	IN2L	10	IN2
02	IN3L	11	IN3L
03	IN4L	12	IN4L
04	IN5L	13	IN5L
05	IN6L	14	IN6L
06	IN7L	15	IN7L
07	IN8L	16	IN8L
08	OUT01	17	OUT02

The above program, which requires 18 steps, can be stored by just pressing six keys, as follows:

TEACH	1	WRITE
TEACH	2	WRITE

The flowchart shows the operation sequence of the Sensor Controller in detail when the TEACHING function is used.



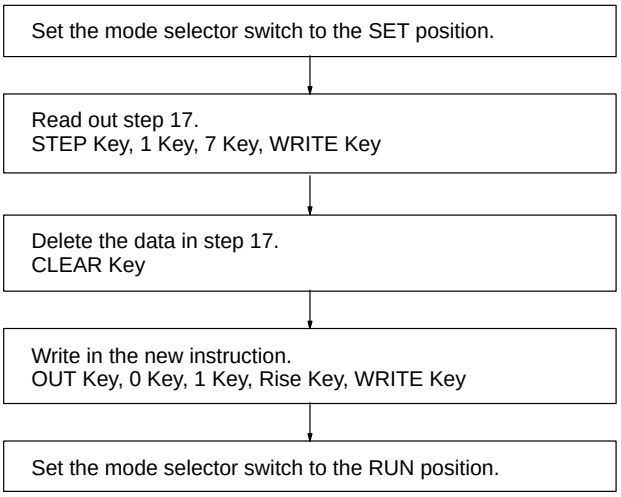
Program Insertion and Deletion

The control output produced by using the teaching function will maintain its ON status. This status can be changed or an additional function, such as the timer function, can be inserted in the program as required by your application.

Example: To reset OUT01 without the stop input and with the capped bottle detected.

- Program the first input condition (the uncapped bottle is detected) and specify OUT01.
- Program the second input condition (the capped bottle is detected) and specify OUT01 (the OUT02 in step 17 is changed to OUT01).
- Turn off OUT01 in step 17.

Operation Sequence



New Operation Chart

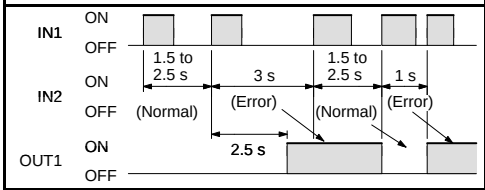
Detection of capped bottle	
Step	**Command**
. . .	. . .
16	IN8L
17	OUT01

Special Functions

Interval Check Function (using CHECK Key)

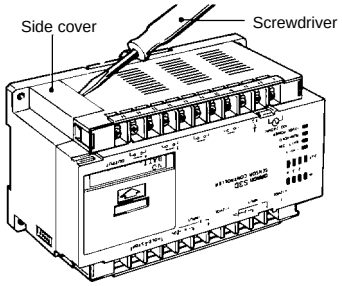
This function generates an output signal when the pulse repetition period of an input signal exceeds a predetermined time range. The function is useful for detecting a defect in products moving on a conveyor at fixed intervals, such as bottles in a bottling machine and wrapping papers in a packaging machine, for system failure detection, and for sensor failure diagnosis.

Example: To output an alarm signal to OUT1 when the repetition period of IN1 is outside the range of 1.5 to 2.5 s.

Operation chart	Key operation	Display		Description
		Step	Command	
	IN Key, 1 Key, WRITE Key	00	IN1	A signal is output to OUT1 when the repetition period of IN1 is outside the range of 1.5 to 2.5 s.
	Interval Check Key, 1 Key, Point Key, 5 Key, WRITE Key	01	CH1.5	
	Interval Check Key, 2 Key, Point Key, 5 Key, WRITE Key	02	CH2.5	
	OUT Key, 1 Key, WRITE Key	03	OUT1	

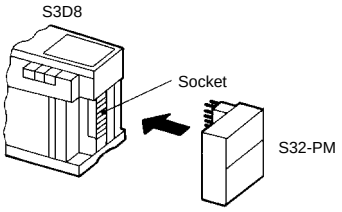
■ Program Copying

The program in the S3D8 memory can be copied to a S32-PM master ROM unit or vice versa. This function is useful when many S3D8s having the same program are used.



Copying Method

Turn off the power to the S3D8. Remove the side cover from the S3D8 to gain access to the socket beneath the cover. Connect the S32-PM to the socket. Attach the setting unit (S3D-P) on the front panel of the S3D8 and then turn on the power to the S3D8.



Program Copy From S3D8 to S32-PM (S3D8: CP1, S32-PM: CP2)

Key operation	Display		Remarks
	Step	Command	
Mode selector switch SET	00		Indicates contents in step 00.
Press STEP Key	---		
Press STEP Key		CP-	
Press Rise Key		CP1-2	
Press WRITE Key		WRITE	Takes about 20 ms to write in memory.
		OK	
	00		Indicates contents in step 00.

Program Copy From S32-PM to S3D8

Key operation	Display		Remarks
	Step	Command	
Mode selector switch SET	00		Indicates contents in step 00.
Press STEP Key	---		
Press STEP Key		CP-	
Press Fall Key		CP1-2	
Press WRITE Key		WRITE	Takes about 20 ms to write in memory.
		OK	
	00		Indicates contents in step 00.

Copied Program Checking

Key operation	Display		Remarks
	Step	Command	
Mode selector switch SET	00		
Press STEP Key			
Press Contact Input Key		VERIFY	
Press WRITE Key		VERIFY	
		OK	The message “OK” indicates that the program has been correctly copied. If the program has not been copied correctly, a buzzer sounds and the message “VERIFY.X” is displayed.

If the message “VERIFY.X” is displayed, redo the copying.

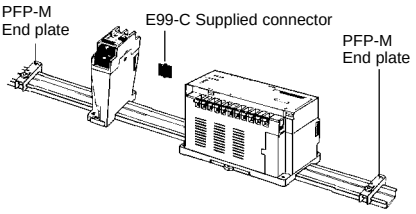
■ Optional Connecting Unit

Output Expansion Unit

Four additional output points can be provided to the S3D8, increasing the number of available output points to eight when S32-A4K/-A4C output expansion unit is connected to the Sensor Controller.

Item	S32-A4K	S32-A4C
Output configuration	Contact	Open collector
No. of output points	4 (OUT05 to OUT8)	
Output switching capacity	SPST-NO (x4), 3 A at 250 VAC ($\cos\phi$ = 1)	80 mA at 30 VDC (x4) ON-time residual voltage: 1 V max. OFF-time leakage current: 0.1 mA max.

Connection

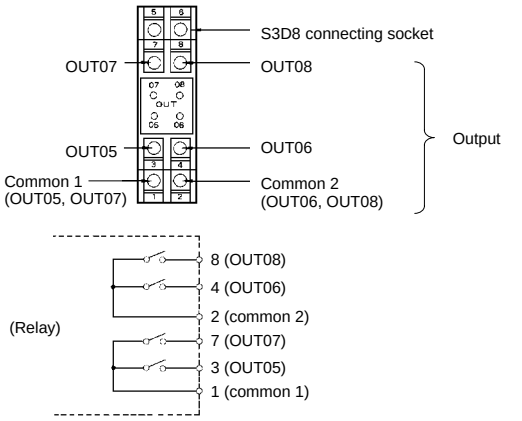


Remove the transparent sticker from the output socket on the left side of the S3D8. A connector is visible. Insert the connector (E99-C) supplied to the S32-A4K/-A4C to this connector. Slide the S32-A4K/-A4C on the DIN track toward the S3D8 and connect it to the Sensor Controller.

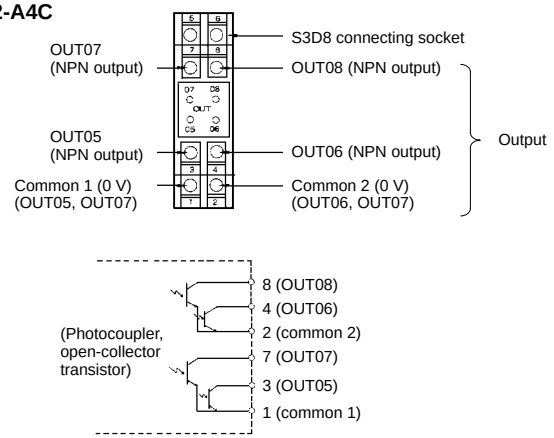
Note:
1. Be sure to secure the output expansion unit and the Sensor Controller with the supplied end plates (PFP-M).
2. Be sure to connect the output expansion unit to the output socket on the left side of the S3D8.
3. Only one output expansion unit can be connected to the Sensor Controller.

Output Stage Circuit Diagram

S32-A4K



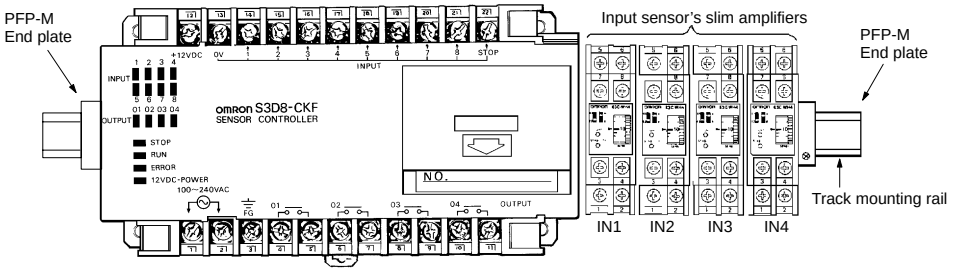
S32-A4C



In both the S32-A4K and S32-A4C, two outputs are connected by one common terminal. When connecting the load or power source, therefore, be sure to connect the correct polarity.

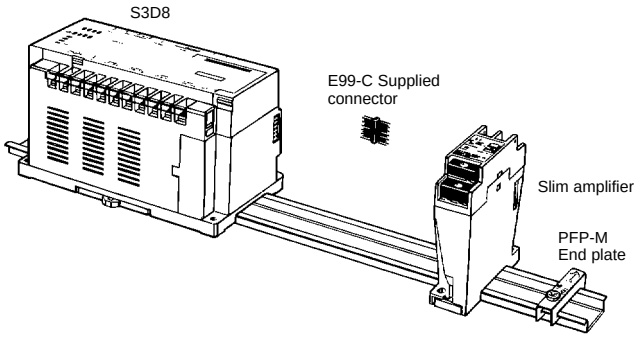
With Amplifier Separated Type Sensors

Mounting



When the slim amplifiers for sensors and the Sensor Controller are mounted on a DIN track, they are automatically connected to IN1, IN2, IN3... starting from the amplifier nearest to the Sensor Controller as shown above.
Since power is applied to the slim amplifiers from the Sensor Controller, if power is also supplied to the externally connected devices, be sure to not to exceed a limit of 120 mA which is calculated as follows.

320 mA – 50 mA x 4 = 120 mA (when four slim amplifiers are connected)



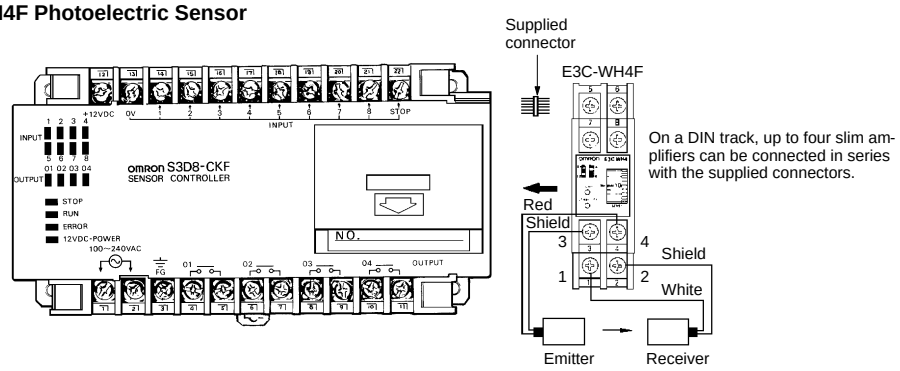
To connect a slim amplifier to the Sensor Controller, slide the amplifier on the DIN track toward the controller and connect it to the controller with the connector supplied with the amplifier (E99-C).

Be sure to secure the slim amplifier farthest from the Sensor Controller with the supplied end plate (PFP-M).

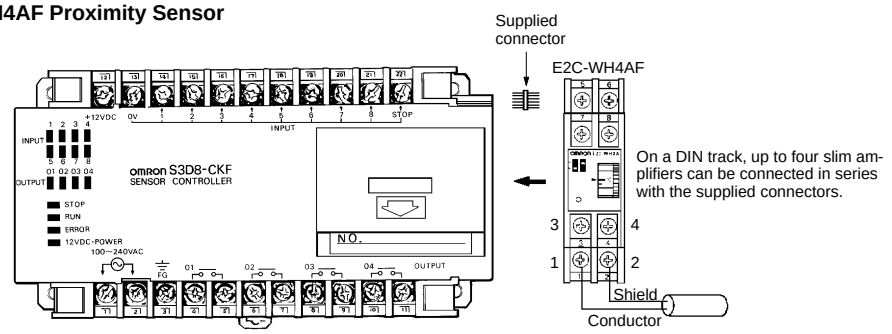
When using plural Sensor Controllers, be sure to secure them with an end plate (PFP-M) between every two controllers and at each end.

Connections

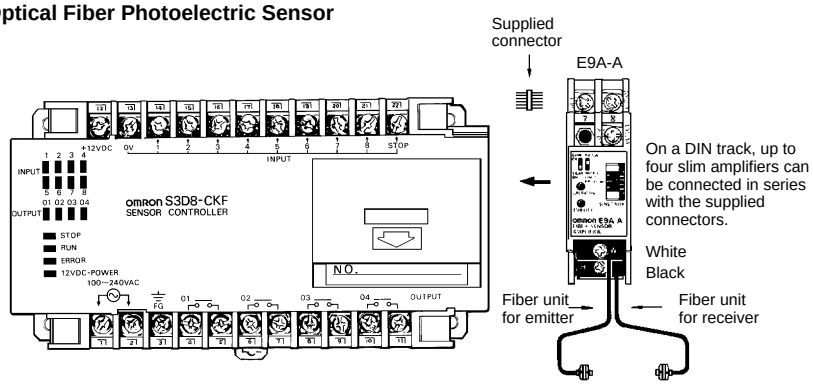
E3C-WH4F Photoelectric Sensor



E2C-WH4AF Proximity Sensor

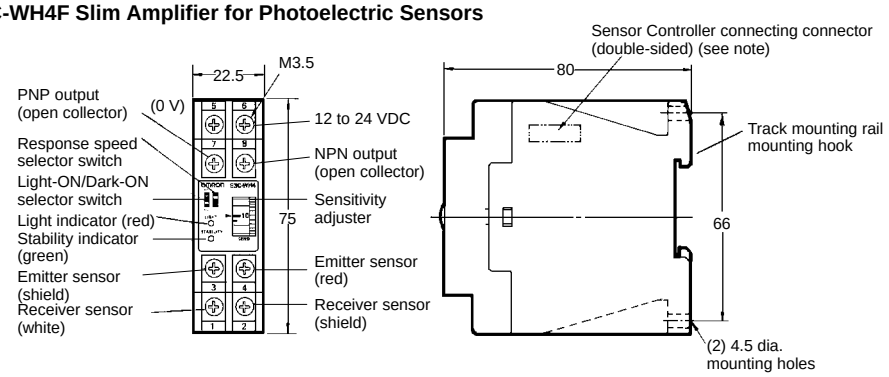


E9A-A Optical Fiber Photoelectric Sensor



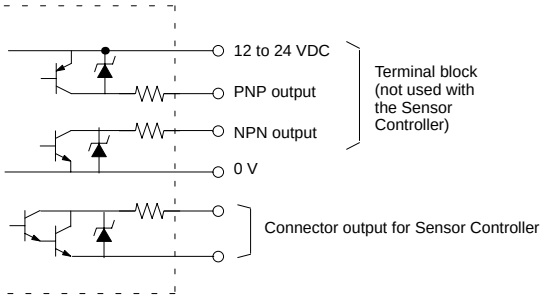
Slim Amplifiers for Various Sensors

E3C-WH4F Slim Amplifier for Photoelectric Sensors



Note: When the amplifier unit is connected to the Sensor Controller with the connector, the unit is automatically applied with power and its output is also automatically connected to the Sensor Controller.

Output Stage Circuit Diagram



Current consumption: 50 mA max.
Response speed: 1 ms max./2 ms max. (selectable)
Output capacity: 100 mA (residual voltage: 2 V max.)

Sensor Models and the Detecting Distances

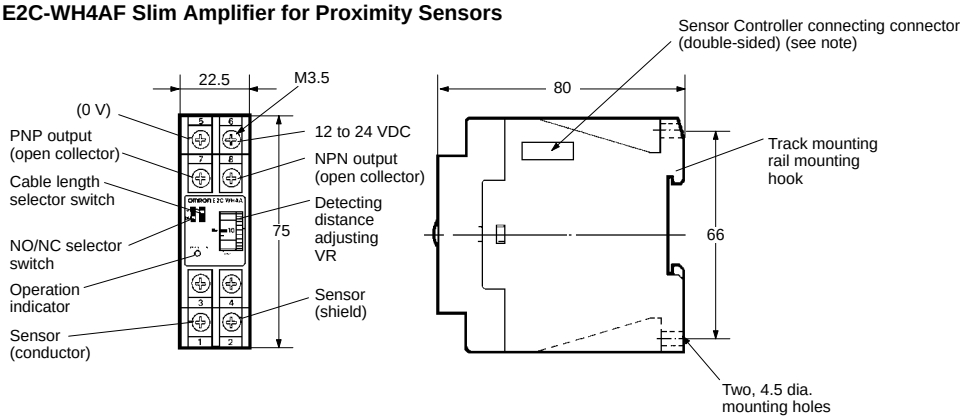
Sensing method		Detecting distance	Models
Through-beam (separate)		10 cm	E3C-S10
		1 m	E3C-1
		2 m	E3C-2
Diffuse reflective	General purpose	10 cm	E3C-DS10
	Mark detection	1±0.2 cm	E3C-VS1G
		3±0.5 cm	E3C-VS3R
Definite reflective		3±0.3 cm	E3C-LS3R

Sensor Models and the Detecting Distances (Optical Fiber Type)

Sensing method	Detecting distance	Housing shape	Models
Through-beam (separate)	5 cm	Square pillar	E3C-S5
		Cylindrical	E3C-S5A
Diffuse reflective	5 mm	Square pillar	E3C-DM5
		Cylindrical	E3C-DM5A
	1 cm	Square pillar	E3C-DS1
		Cylindrical	E3C-DS1A
	2 mm	Square pillar	E3C-DM2R

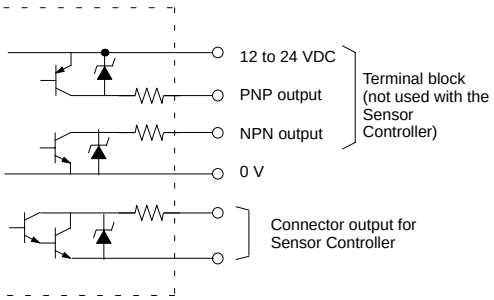
Note: Refer to *E3C Datasheet (E31)* for details.

E2C-WH4AF Slim Amplifier for Proximity Sensors



Note: When the amplifier unit is connected to the Sensor Controller with the connector, the unit is automatically applied with power and its output is also automatically connected to the Sensor Controller.

Output Stage Circuit Diagram



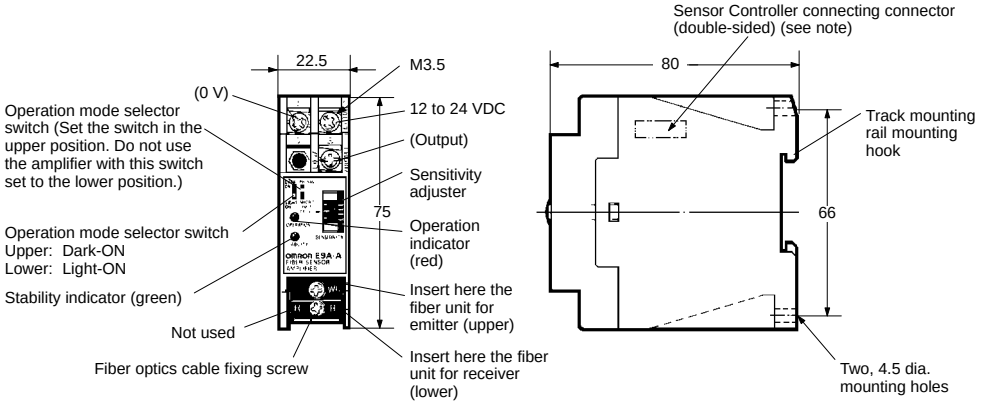
Current consumption: 25 mA max.
Sensor cable length: 3 m/5 m (selectable)
Output capacity: 200 mA (residual voltage: 1.5 V max.)

Sensor Models and the Detecting Distances

Sensing method	Detecting distance	OD	Models
Sealed	0.8 mm	3.5 dia.	E2C-CR8A
	1 mm	M5	E2C-X1A
	1 mm	5.4 dia.	E2C-C1A
	1.5 mm	M8	E2C-X1R5A
	2 mm	M12	E2C-X2A
	5 mm	M18	E2C-X5A
	10 mm	M30	E2C-X10A
Non-sealed	20 mm	40 dia.	E2C-C20MA

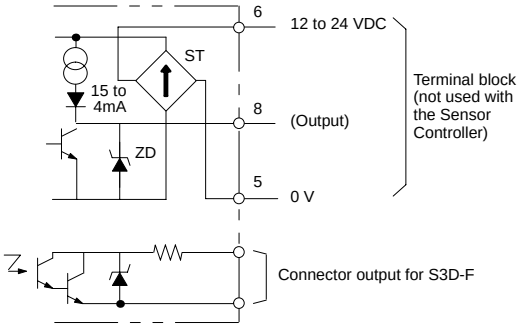
Note: Refer to *Sensors Group Catalog (X042)* for details.

E9A-A Slim Amplifier for Optical Fiber Sensors



Note: When the amplifier unit is connected to the Sensor Controller with the connector, the unit is automatically applied with power and its output is also automatically connected to the Sensor Controller.

Output Stage Circuit Diagram



Current consumption: 50 mA max.
Response speed: 1 ms (fixed)
Output capacity: 80 mA (residual voltage: 1.2 V)

Typical Fiber Units Models and the Detecting Distances

Material of fiber unit	Sensing method	Fiber unit	Length of fiber unit	Detecting distance	Models
Plastic (polyethylene sheath)	Through-beam (separate)	M3	2 m (free cut)	12 cm	E32-TC200A (see note 1)
	Diffuse reflective	Coaxial		5 cm	E32-CC200 (see note 1)
	Through-beam	With stainless steel tube		12 cm	E32-TC200B (see note 1)
	Diffuse reflective			5 cm	E32-DC200B (see note 1)
	Through-beam	Coiled		10 cm (60 cm)	E32-TC200C
	Diffuse reflective		2 m (fully extended)	1.5 cm	E32-DC200C
	Through-beam	With stainless steel tube		10 cm	E32-TC200D
	Diffuse reflective			1.5 cm	E32-DC200D

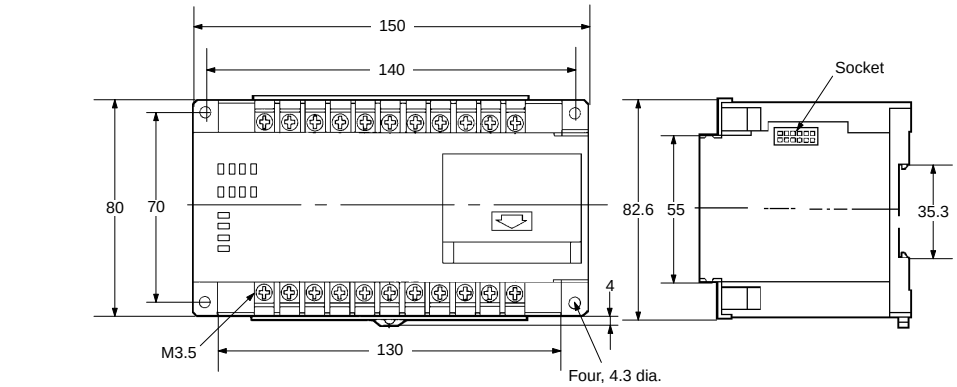
Material of fiber unit	Sensing method	Fiber unit	Length of fiber unit	Detecting distance	Models
Plastic (polyethylene sheath)	Through-beam (separate)	Fine fiber unit	2 m (free cut)	3.5 cm	E32-TC200E
	Diffuse reflective			1.2 cm	E32-DC200E
	Through-beam	Fine fiber unit with stainless steel tube		3.5 cm	E32-TC200F
	Diffuse reflective			1.2 cm	E32-DC200F
	Through-beam	Standard		12 cm (1 m)	E32-TC200 (see note 1)
	Diffuse reflective			5 cm	E32-DC200 (see note 1)

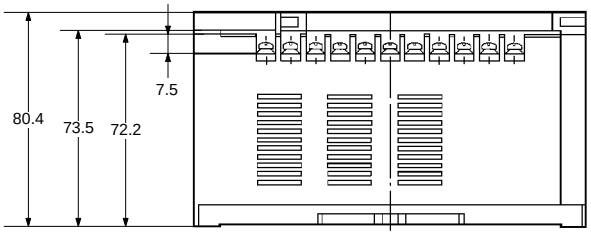
Note: 1. The fiber unit can be cut to the desired length using the cutting tool (E39-F4) supplied as an accessory.
2. The figure in parentheses denotes the detecting distance when E39-F1 lens attachment is added.
3. For details, refer to E9A-A slim amplifier for Optical Fiber Sensor.

Dimensions

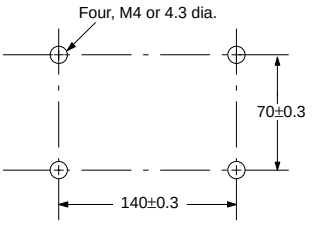
Note: All units are in millimeters unless otherwise indicated.

S3D8 Sensor Controller



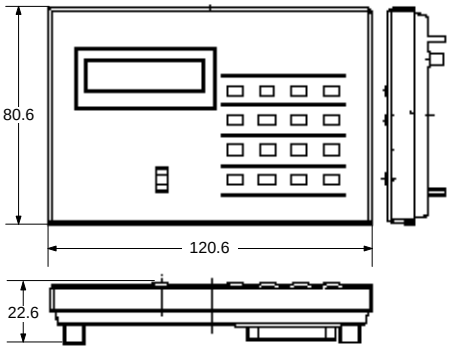


Mounting Hole Dimensions for Direct Mounting

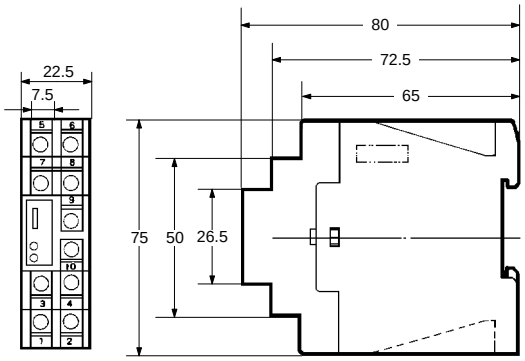


Note: Mounting on a DIN track is also possible.

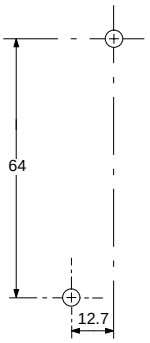
S3D-P Setting Unit



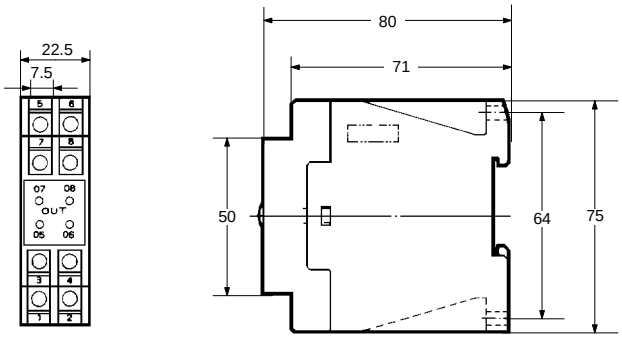
E63-WF5C



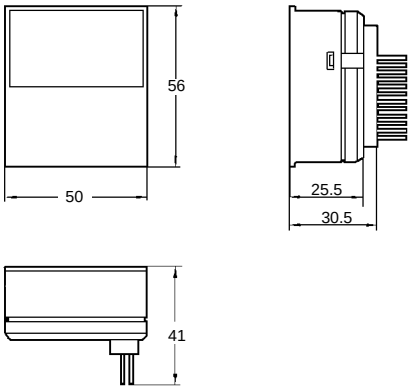
Mounting Holes



S32-A4K/S32-A4C

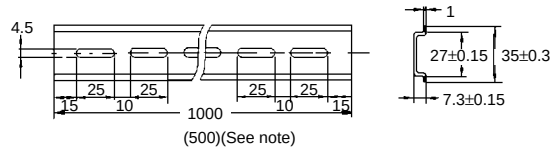


S32-PM Master ROM Unit



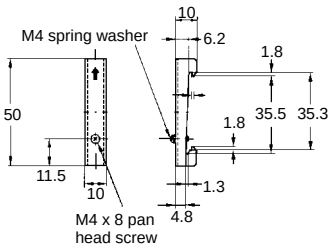
When placing your order for the Sensor Controller, also specify the desired accessories for track mounting.

PFP-100N/PFP-50N Mounting Tracks (Meets DIN EN50 022)

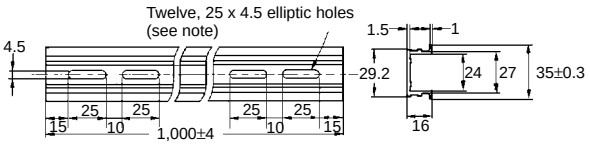


Note: This dimension applies to PFP-50N.

PFP-M End Plate

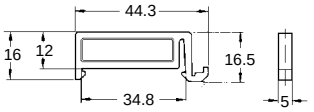


PFP-100N/PFP-50N Mounting Tracks (Meets DIN EN50 022)



Note: A total of twelve 25 x 4.5 elliptic holes are provided with six holes cut from each rail end at a pitch of 10 mm.

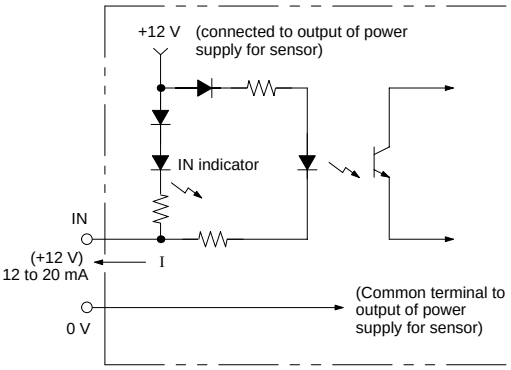
PFP-S Spacer



Installation

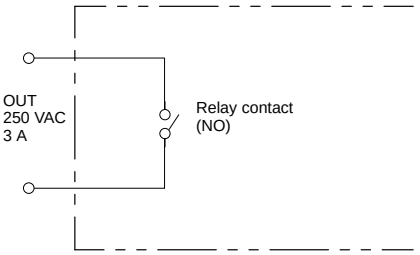
■ I/O Circuit

Input Circuit

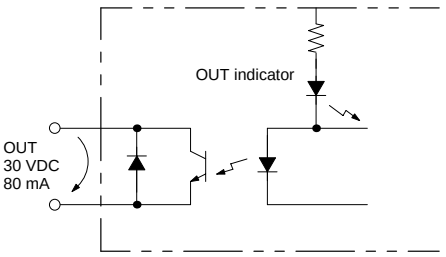


Output Circuit

Contact Output



Transistor Output



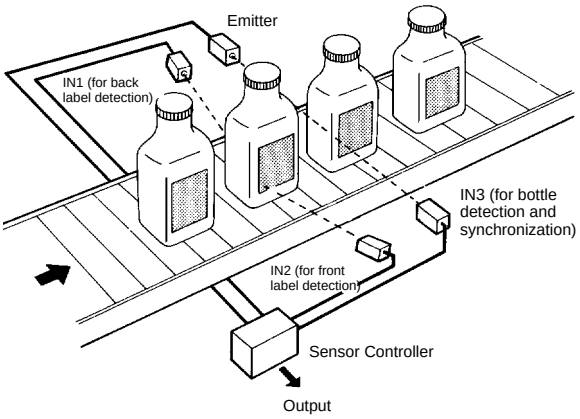
Application Examples

Bottling Machine

Label Detection

Three sensors are used to detect the front and back labels of a bottle approaching on a conveyor. When no label is discovered a defect signal is output for a predetermined period from the Sensor Controller.

Sensors used: Photoelectric sensors
IN1: Reflective model (Light-ON mode: model with suffix E1 in model number)
IN2:
IN3: Through-beam model (Dark-ON mode: model with suffix E2 in model number)



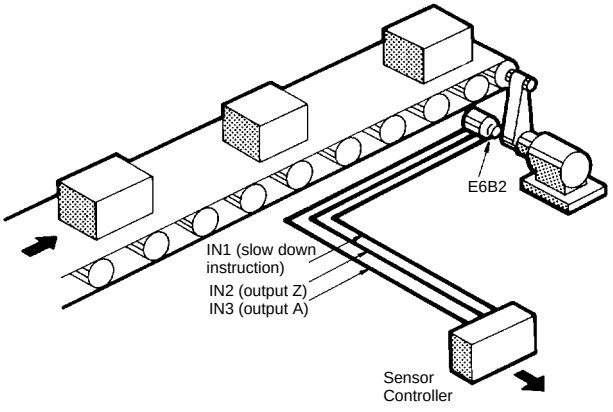
Note: Sensors IN1 and IN2 must be installed obliquely to the bottle surfaces to avoid reflections.

Metal Processing Machine

Stopping Conveyor at a Predetermined Position

E6B2 Incremental Encoder with zero index function is used to stop the conveyor at a predetermined position. The rotary encoder employed in this application measures 40 mm in diameter and offers a resolution of 600 pulses/revolution. The shaft of the E6B2 is coupled with that of the motor.

Sensors used: Relay and rotary encoders
IN1: Relay (MY4)
IN2: Rotary encoder (E6B2's output Z)
IN3: Rotary encoder (E6B2's output A)

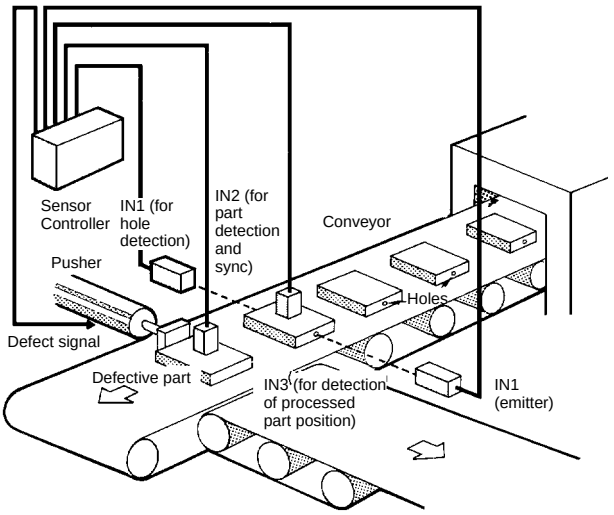


Machine Tool

Detection of Defective Pressed Parts

Three sensors are used to detect the presence or absence of a hole in each pressed metal part on the conveyor and to remove the defective part (without hole) from the process line. A Photoelectric sensor is used to detect the presence of a hole and a pusher is used to remove the defective part.

Sensors used: Proximity and Photoelectric Sensors
IN1: Through-beam Photoelectric Sensor (Dark-ON mode: model with suffix E2 in model number)
IN2: TL-X Proximity Sensor
IN3: TL-X Proximity Sensor

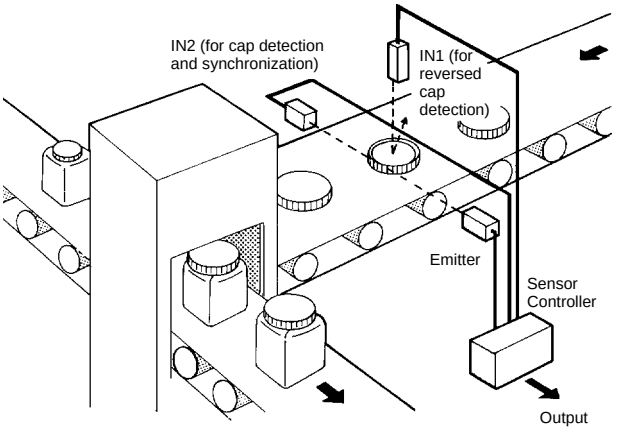


Food Processing Machine

Reversed Cap Detection

When a reversed cap is detected among the caps on the conveyor feeding the automatic capping machine, a defect signal is output for a predetermined period.

Sensors used: Photoelectric Sensors
IN1: Definite reflective models (Light-ON mode: model with suffix E1 in model number)
IN2: Through-beam models (Dark-ON mode: model with suffix E2 in model number)

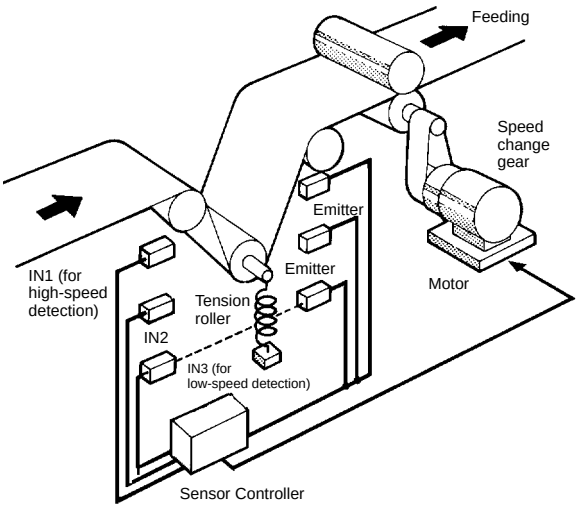


Textile Machine

Detection of Feeding Speed of Tape, Paper, or Cloth

Uneven, insufficient, or excessive feeding speed of paper tape, rolled paper, or cloth can be detected and corrected using sensors. A change in the feeding speed of materials is detectable from the tension roller position in feeding which varies according to the feeding speed.

Sensors used: Photoelectric Sensors
IN1: } Through-beam model
IN2: } (Dark-ON mode: model with suffix E2
IN3: } in model number)

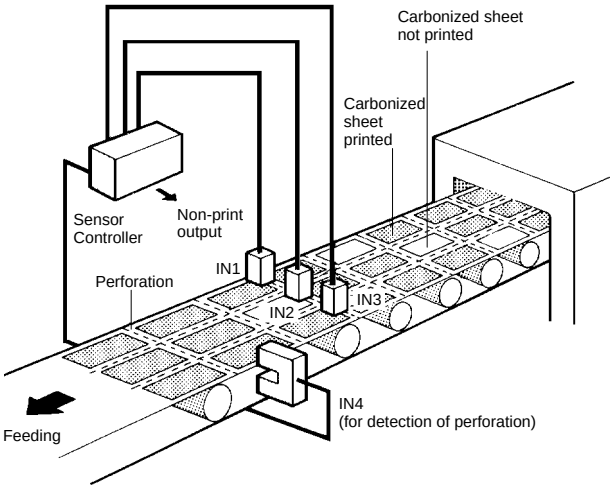


Printing Press

Detection of Missing Print

In the carbonizing and printing process, any carbonized sheet that has print missing is detected and a defect signal is output for a predetermined period.

Sensors used: Photoelectric Sensors
IN1: } Definite reflective model
IN2: } (Light-ON mode: model with suffix E1 in model
IN3: } number)
IN4: Through-beam model (Light-ON mode: model with suffix E1 in model number)



ALL DIMENSIONS SHOWN ARE IN MILLIMETERS.
To convert millimeters into inches, multiply by 0.03937. To convert grams into ounces, multiply by 0.03527.

Cat. No. Q32-E1-3 **In the interest of product improvement, specifications are subject to change without notice.**

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