Analog setting values

To display the following items, press [VIEW] on the setting values screen.

Parameter	Display	Range (Default)	Description
B Analog input selection	ANALOGIN	0123, A123 to AAAA (0123)	Specifies the sensor input (IN0 to IN3) to switch to the signal that is turned ON/OFF between / outside the analog input upper/lower limit values. "0" to "3": sensor input, "A": analog input. **0123:** All for sensor input. **A123:** IN0 for analog input (upper limit: IN0 HIGH, lower limit: IN0 LOW). IN0 input is ignored. **0A2A:** IN1 and IN3 for analog input. **AAAA:** All for analog input."
B Input 0 upper limit value	IN0 HIGH	0 to 9999 (1000)	Specifies the analog input upper limit value when switching the sensor input IN0 to analog input. IN0 is judged as ON when between the specified upper limit value and the lower limit value (IN0 LOW).
B Input 0 lower limit value	IN0 LOW	0 to 9999 (0)	Specifies the analog input lower limit value when switching the sensor input IN0 to analog input.
B Input 1 upper limit value	IN1 HIGH	0 to 9999 (2000)	Specifies the analog input upper limit value when switching the sensor input IN1 to analog input. IN1 is judged as ON when between the specified upper limit value and the lower limit value (IN1 LOW).
B Input 1 lower limit value	IN1 LOW	0 to 9999 (1000)	Specifies the analog input lower limit value when switching the sensor input IN1 to analog input.
B Input 2 upper limit value	IN2 HIGH	0 to 9999 (3000)	Specifies the analog input upper limit value when switching the sensor input IN2 to analog input. IN2 is judged as ON when between the specified upper limit value and the lower limit value (IN2 LOW).
B Input 2 lower limit value	IN2 LOW	0 to 9999 (2000)	Specifies the analog input lower limit value when switching the sensor input IN2 to analog input.
B Input 3 upper limit value	IN3 HIGH	0 to 9999 (4000)	Specifies the analog input upper limit value when switching the sensor input IN3 to analog input. IN3 is judged as ON when between the specified upper limit value and the lower limit value (IN3 LOW).
B Input 3 lower limit value	IN3 LOW	0 to 9999 (3000)	Specifies the analog input lower limit value when switching the sensor input IN3 to analog input.
B Analog input offset	OFFSET	-5000 to 5000 (0)	"Specifies the analog input offset value. Adds the specified value to the input value (full scale 0 to 5000) before span correction. For example, to obtain ""0"" at 4 mA with current input 4-20 mA, the formula is 4×20÷5000=1000 and the offset value is set to -1000. However, the value at 20 mA decreases by 1000, i.e. becomes 4000, therefore adjusting by span correction is recommended (SPAN DIV=4000).
B Analog input preset	PRESET	0 to 9999 (2500)	Specifies so that the analog input value becomes the preset value when any input of IN0 to IN3 rises. When the sensor input turns ON at the reference position determining the object height, the measurement using the relative value to the position is enabled.
B Preset control input selection	PRESETIN	OFF, IN0 to IN3 (OFF)	Specifies the input to start the analog input preset function. Normally select the sensor input switched to analog input in ANALOGIN. Turns OFF when unused. The preset function is cancelled by power on or by switching the bank.
Analog input span (multiplier)	SPAN MUL	0 to 9999 (5000)	Specifies the coefficient (numerator) to be multiplied after deducting the analog input offset value. The multiplied value is the solution of (SPAN MUL÷SPAN DIV).
Analog input span (divisor)	SPAN DIV	0 to 9999 (5000)	Specifies the coefficient (denominator) to be multiplied after deducting the analog input offset value.

B : The setting value changes corresponding to the bank.

Expert setting values

To display the following items, press [UP] and [DOWN] simultaneously for 3 seconds in the standard setting values screen.
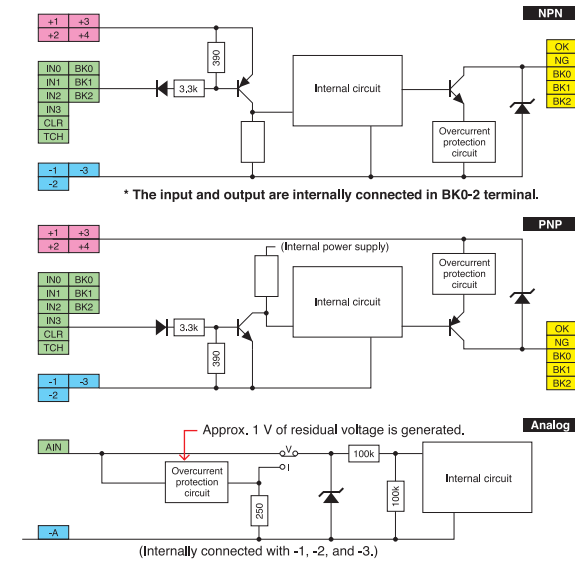
Parameter	Display	Range (Default)	Description
B Clear input	CLEARIN	LEVEL,EDGE (LEVEL)	Switches LEVEL and EDGE of clear input. **LEVEL:** Clears the output OFF/OK counter while the clear input is ON. **EDGE :** Clears the output OFF/OK counter when the clear input rises.
B Allowable object speed (High-speed)	FAST X	1.000 to 84.33 (7.000)	To specify the maximum speed allowable for correct detection, select the value to multiply the setting pattern time by the unit of multiplier. Set it larger when the object speed is faster than the speed at teaching. (If an unnecessarily large value is selected, error detection may occur due to unexpected signal input.)
B Matching mode	MATCHING	NORM, AVRG, ACCL (ACCL)	Selects the mode to compare the ON/OFF patterns. **NORM:** Calculates the concordance rate from the value with the largest time or pattern deviation. Use to detect the only partial deviation. **AVRG:** Averages the total of time and pattern deviation. Use to ignore the slight deviation. **ACCL:** Same as NORM setting. Accepts the gradual change of object moving speed to allow the correct detection while the conveyor speed becomes faster or slower.
B Coincidence influence on the different patterns	PATDIFF	0% to 196% (100%)	When deviation from the registered pattern exists, specifies the rate to reflect it in the coincidence. **0%:** The concordance rate is not lowered even when the ON/OFF patterns are different. **100% :** When the ON/OFF patterns are different, the coincidence is lowered by the same rate as when the pattern width rate is different in 100%. Does not function when the single sensor input only is used.
B Allowable object speed (Low-speed)	SLOW X	1.000 to 84.33 (50.20)	Low-speed version of FAST X setting. Enables to specify the lowest speed allowable for correct detection by the unit of divisor. Set it larger just after the conveyor starts moving or when the conveyor moves slow.
B Tolerable time deviation	TIM GAP	0.0% to 49.6% (0.0%)	Specifies the rate to ignore the time deviation of pattern. When lower than the specified rate against the average time, the time deviation is ignored. Set it higher when the sensor input ON/OFF width of conforming products varies to a certain degree.

B : The setting value changes corresponding to the bank.

Specifications

Type	TMC-N11	TMC-P11
Supply voltage	12－24V DC ±10%	
Current consumption	Max. 80 mA / 24 V DC	
Input signal	No insulation sink (NPN)	No insulation source (PNP)
Output signal	No insulation NPN Open collector	No insulation PNP Open collector
Sensor input	up to 4	
Teaching/Clear input	1 Teaching input and 1 Clear input	
Bank selection	3 (7 types with binary format)	
Input response time	5 μs - 25.6 ms	
Output response time	Max. 5 μs	
OK/NG output	1 OK output and 1 NG output	
Sorting output	3 (7 types with binary format) Used together with Bank selection input	
Maximum open/close capacity	Max. 100 mA	
Output leakage current	Max. 100 μA	
Output residual voltage	Max. 0.8 V	Max. 1.8 V
Analog resolution	10 bit (1 bit = 6.45 mV / 25.8 μA)	
Accuracy	± 0.2 % of F.S. (F.S. = 6.6 V / 26.4 mA)	
Linearity	± 0.2 % of F.S.	
Input ON voltage	Min. 7.8 V	
Input OFF current	Max. 1.0 mA	
Input current (typical)	7.1 mA / 24 V DC	
Input impedance, Input voltage range	3.3kΩ , 0 - Supply voltage (AIN excluded) 200kΩ , 0 - 6.5 V (AIN voltage input) 250Ω , 0 - 26 mA (AIN current input)	
Temperature drift	± 80 ppm/℃	
Operating temperature	0 - 55℃	
Operating humidity	35 - 85 %/RH	
Storage temperature	-20 - 70℃	
Storage humidity	25 - 95 %/RH	
Anti-vibration	10 - 55 Hz Amplitude 1.5 mm	
Anti-impact	5 G (10 times)	
Housing material	ABS	
Weight	Approx. 130 g	

Input/Output

NPN

* The input and output are internally connected in BK0-2 terminal.

PNP

(Internal power supply)

Analog

Approx. 1 V of residual voltage is generated.

(Internally connected with -1, -2, and -3.)

Dimensions

102.5 / 55 / 28

Front

32.1 / 11.5 / 36.6 / 6.9

Side

7.6 / 46.2

bottom

(mm)

● Specifications and technical information not mentioned here are written in Operation Manual. Or visit our website for getting details.
● All the warnings and cautions to know prior to use are given in Operation Manual.

Terminal arrangement

IN0	IN1	IN2	IN3	AIN	CLR	BK0	BK2	OK	NG
+1	-1	+2	-2	+3	-A	TCH	BK1	-3	+4

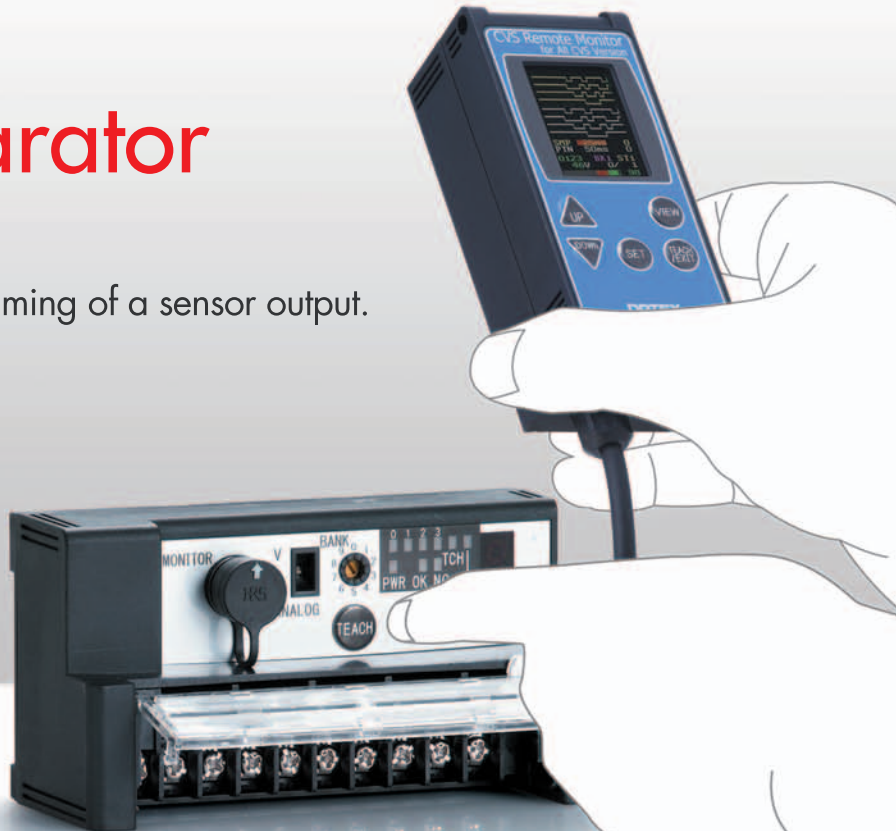| Terminal	Name	Function
IN0	Sensor input 0	The sensor input to detect the object. Connect with the sensor output wires.
IN1	Sensor input 1	
IN2	Sensor input 2	Functions as the preset input of analog input when selected in PRESETIN.
IN3	Sensor input 3	
AIN	Analog input	Analog input + side. Accepts the 0 to 5 V and 0 to 20 mA input.
-A	Analog input common	Analog input - side. Internally connected with -1, -2, and -3 terminals.
CLR	Clear input	The input to turn off the OK/NG output. Use when OFF DLY is set to 0. Output turns off at rising.
TCH	Teaching input	External teaching input. Teaching starts at rising.
BK0	Bank input/output 0	The input to externally switch the bank number. Or the output of the sorted bank number.
BK1	Bank input/output 1	
BK2	Bank input/output 2	Functions as input when SORTING is set to 0.
OK	OK output	The output to turn on when the concordance rate is the OK LEVEL setting value or more.
NG	NG output	The output to turn on when the concordance rate is below the OK LEVEL setting value and is the NG LEVEL setting value or more.
+1	Power supply +	Power supply + side (12 to 24 V DC). All are internally connected and used for sensor power supply.
+2		
+3		
+4		
-1	Power supply -	Power supply - side. All are internally connected and used for sensor power supply.
-2		
-3		

TMC-N11　NPN type
TMC-P11　PNP type

TMC Series
Timing Comparator

A new concept in sensing!
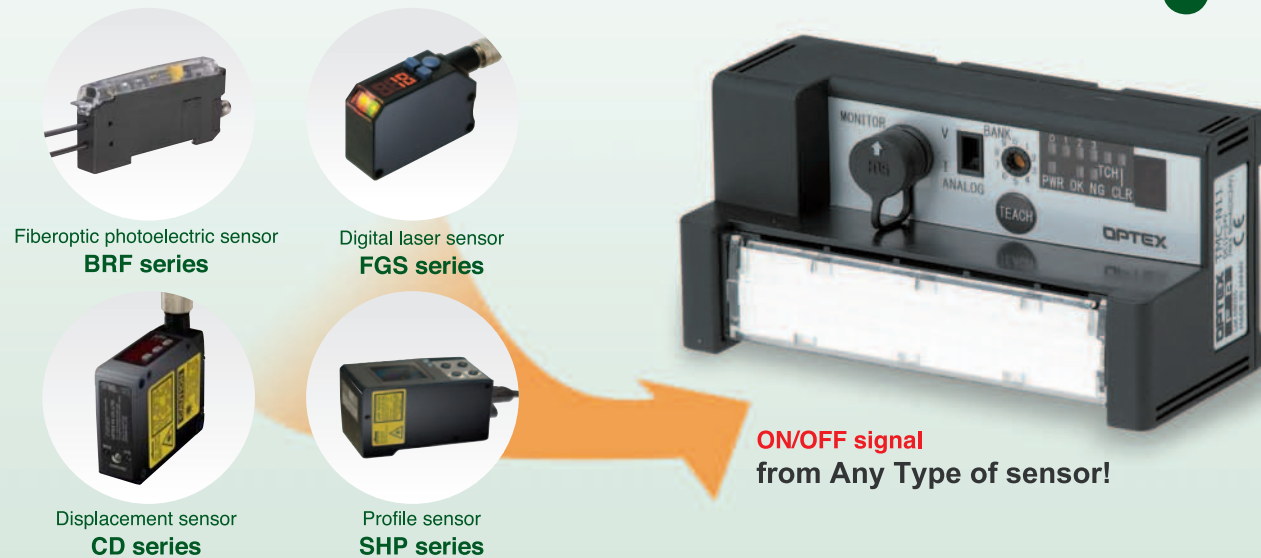Identify an object by monitoring the timing of a sensor output.

http://www.optex-fa.com

What's *TMC Series*
" *Timing comparator* " **?**

Fiberoptic photoelectric sensor
BRF series

Digital laser sensor
FGS series

Displacement sensor
CD series

Profile sensor
SHP series

ON/OFF signal
from Any Type of sensor!
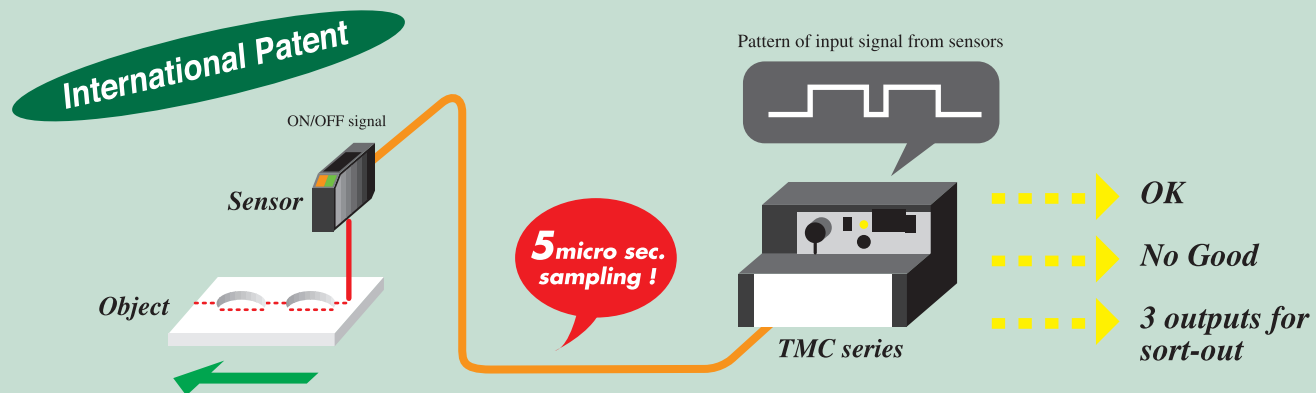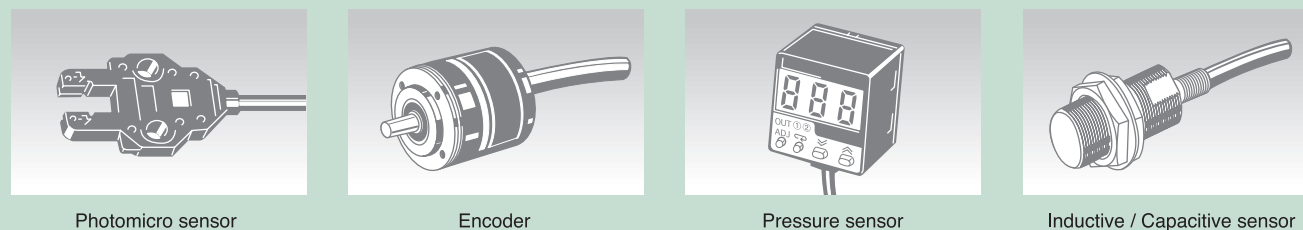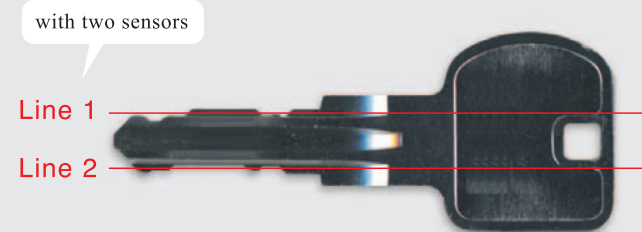
A brand new concept in sensing.

The TMC Series "Timing Comparator" is a Signal Processing Unit that senses not only the ON / OFF signal from a sensor but also memorizes the "timing" of the incoming signals. It can monitor the signals from up to 4 devices. These ON / OFF signals are indicators of the shape. The TMC uses this to identify the shape of the object. This is quite a new way of sorting / identifying. Any sensor that outputs an ON / OFF signal is applicable for use with the TMC Series Timing Comparator. It is possible to not only detect the presence of an object, but to also detect the orientation, shape, etc.

International Patent

ON/OFF signal

Pattern of input signal from sensors

Sensor

Object

5 micro sec. sampling !

TMC series

OK

No Good

3 outputs for sort-out

The TMC works with any type of sensor with an ON / OFF output.

Photomicro sensor

Encoder

Pressure sensor

Inductive / Capacitive sensor

"Timing" is stored and compared like this

with two sensors

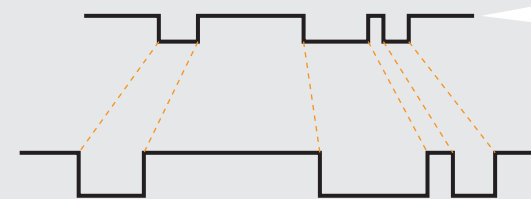Line 1

Line 2

The TMC Timing Comparator memorizes the timing pattern of the incoming signals (sensor outputs). It is possible to monitor a maximum of 4 sensors. Once the pattern of the object has been stored by teaching, the TMC will compare the preset pattern with the incoming signals. The photo at the left shows an example where a key is being checked for the correct orientation. Two sensors are used.

Line speed doesn't matter.

This is an example of the signal from Line 1 above.
This pattern is stored to be used for comparision.

The pattern (timing) is expanded like this at a slower speed, the TMC can automatically adjust for this. There is no difference in the "ratio" of the ON and OFF timing.
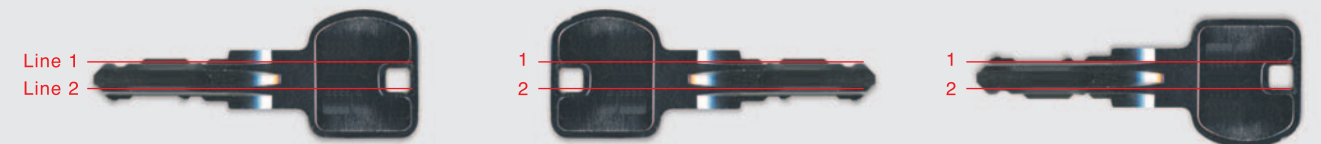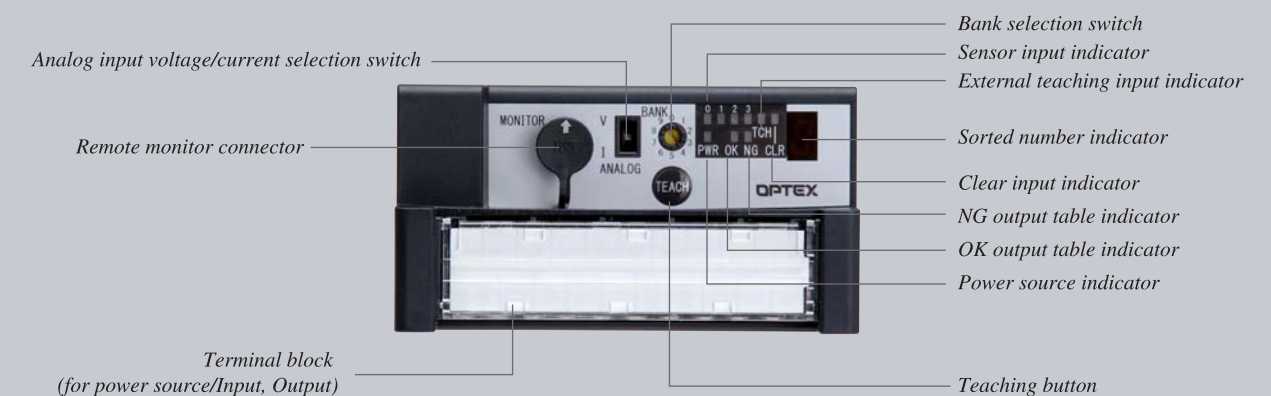
Sampled pattern for Teach-in

Line 1
Line 2

the reference waveform

Line 1
Line 2

Opposite direction

NG

1
2

1
2

Reverse

1
2

NG

1
2

TMC Timing Comparator - Part names

Analog input voltage/current selection switch

Remote monitor connector

Bank selection switch
Sensor input indicator
External teaching input indicator
Sorted number indicator
Clear input indicator
NG output table indicator
OK output table indicator
Power source indicator

Terminal block
(for power source/Input, Output)

Teaching button

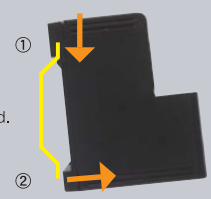**The rear side is to be fixed to the DIN rail.**

How to attach

②
① Hook the lower clip to the DIN rail.
② Press on the top until the upper clip snaps onto the rail.
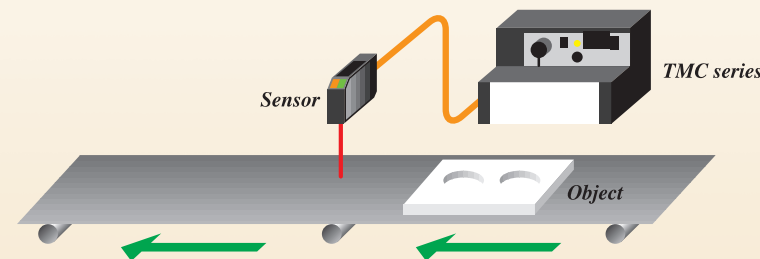①

How to remove

①
① Press from above.
② The lower clip can be removed.
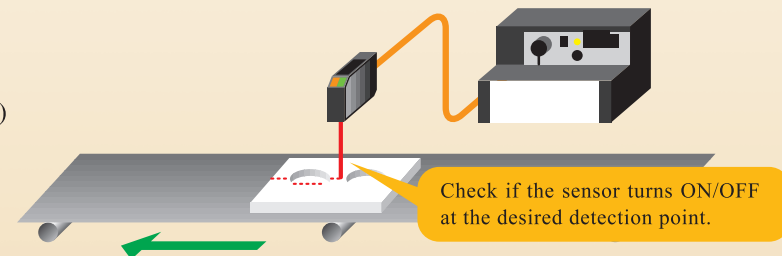②

Easy setup just 3 steps!
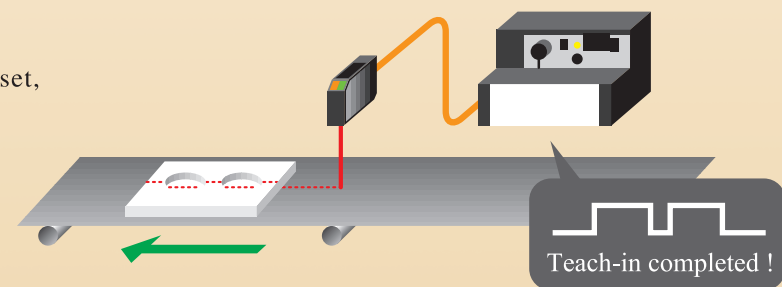
Step 1
Press the teaching button to start.

Sensor
TMC series
Object

Step 2
Scan the object
(maintain a constant speed if possible)

Check if the sensor turns ON/OFF at the desired detection point.

Step 3
Then, after time-out period that is preset, teaching is automatically completed.

Teach-in completed !

Pattern registeration by teaching

When only one item is used:

Teaching is automatically completed after the input stops changing. The time between when the signal stops and the termination (see ★ below) is called "time-out". The duration of time-out is from when the teach-in starts to the 2nd change of the sensor input.

International Patent

Teaching start — Teaching complete
Sensor input
Calculated time-out (★)

Teaching start — Teaching complete
Sensor input
Calculated time-out (★)
The TIMEOUT value is applied in case the value is shorter than the TIMEOUT setting value.
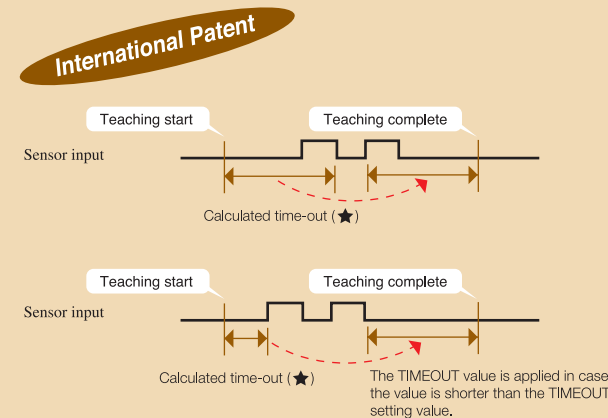
When objects continuously flow:

When objects flow continuously, teaching cannot complete by the time-out due to continuous input changing. In this case, teaching can complete with either of the following conditions:

(1) The time approx. 4 times as long as the time-out setting value has passed.
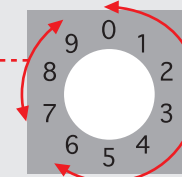(2) The sampled pattern counts 255 or more.

Teaching start — Teaching complete
Sensor input
Approx. 4 times as long as the TIMEOUT setting value (initial value 8 sec.)
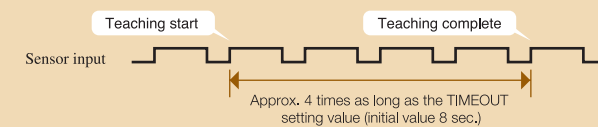
Bank selection table

Parameter BANK	Bank selection switch	BK 0 Terminal	BK 1 Terminal	BK 2 Terminal	Bank Number
0~6	Invalid				0~6
BK0-2 (SWTCH)	0				0
	1				1
	2	Invalid			2
	3				3
	4				4
	5				5
	6				6
7~9		OFF	OFF	OFF	0
		ON	OFF	OFF	1
		OFF	ON	OFF	2
		ON	ON	OFF	3
		OFF	OFF	ON	4
		ON	OFF	ON	5
		OFF	ON	ON	6
		ON	ON	ON	0

* When using BK0-2 terminal switched to output as Bank selection input, the input is regarded as "OFF."

Specified by the setting value.
Specified by the switch.
Specified by the external input.

Setting value SORTING	BK 0 Terminal	BK 1 Terminal	BK 2 Terminal	Selectable bank range
OFF	Input			0~6
2	Output	Input		0,2,4,6
3,4	Output		Input	0,4
5~7	Output			0

## Make your settings "visible" with monitor unit CVS-M1.

The TMC is able to operate by itself. But for easier operation, connecting the CVS-M1 optional remote monitor is recommended. It is used to modify various settings and to check the waveforms. It can be removed during operation. The description below is for the remote monitor display and its operations.
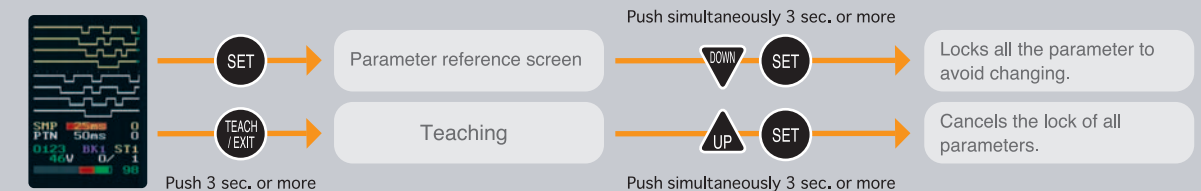
Monitor display
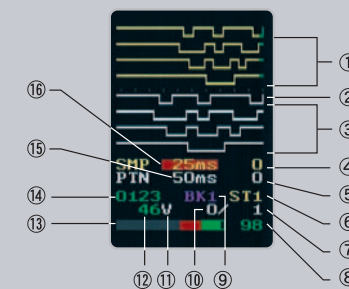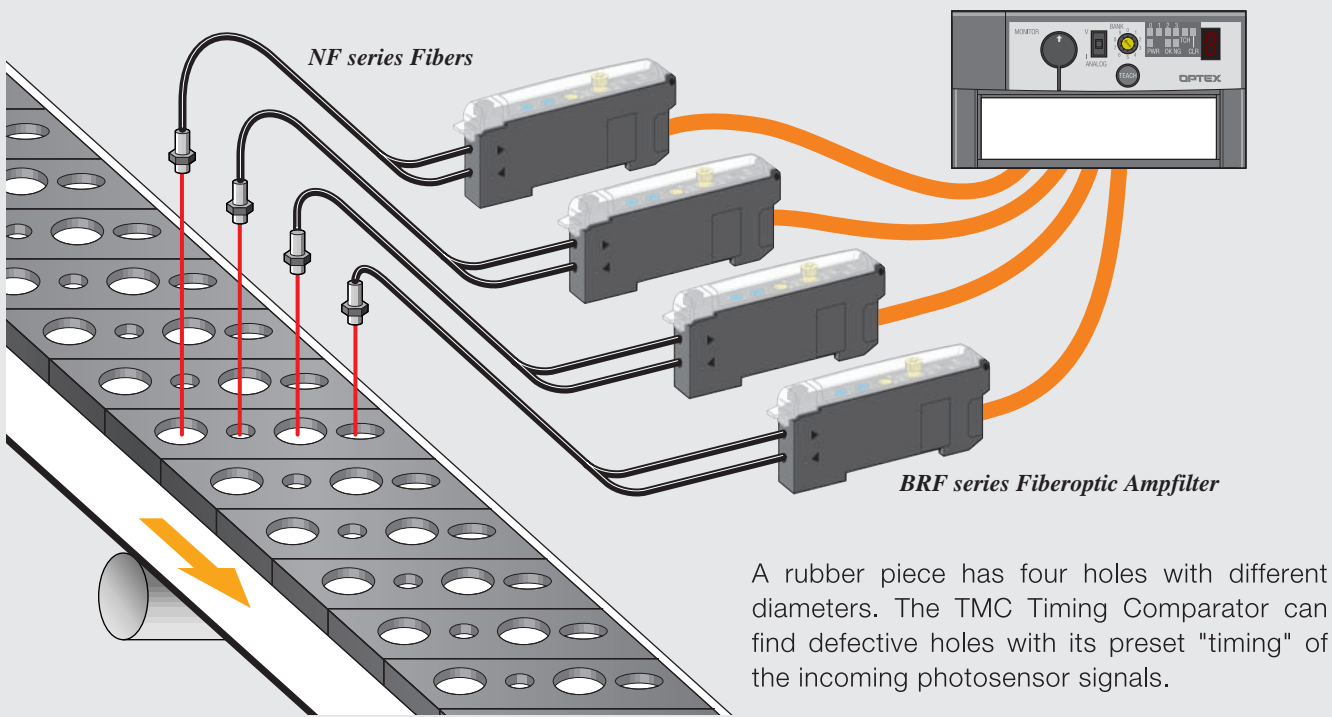
Parameter reference screen
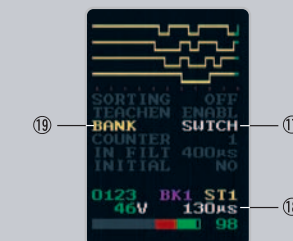
① **Sensor input waveform**
From top to bottom, sensor input 0, 1, 2, and 3. The right side is the new pattern.
Green: OK-judged pattern position
Red: NG-judged pattern position

② **Time axis of waveform**
Clearance between red points is the time displayed on (15) and (16).

③ **Registered pattern waveform**
Displays the waveform teaching has been performed.

④ **Input waveform display starting pattern count**
In displaying the input waveform, starts from the last patterns by specified counts. (0 - 255)

⑤ **Registered waveform display starting pattern count**
In displaying the registered waveform, starts from the last patterns by specified counts. (0 - 251)

⑥ **Sorted result**
Displays the sorted bank number.
(0 - 6: Bank number, -: Without)

⑦ **OK counter setting value**
Displays the COUNTER setting value. Displays A00 when the setting value is 1000.

⑧ **Concordance rate**
Concordance rate when comparing the patterns. (0 - 100)

⑨ **Bank number**
Displays the current bank number. (0 - 6)

⑩ **Actual OK counter value**
Displays the actual OK counter value. (0 -999)

⑪ **Concordance rate bar graph**
Gray: Without object (less than NG LVL)
Red: NG (less than OK LVL)
Green: OK (OK LVL or more)

⑫ **Analog input selection status**
Displays the analog input voltage/current selection switch status.
V: Voltage input I: Current input

⑬ **Analog input value**
Displays the value after offset/span conversion as 0 - 9999.
Displays FFFF when inputting overvoltage.

⑭ **Sensor input ON/OFF status**
0 - 3: Turned ON.
(Number in accordance with IN0 - IN3)
- : Turned OFF.
X : Masked.
(Refer to the setting value MASKING)

⑮ **Registered pattern waveform display time**
Time axis that the registered pattern waveform displays (the time between the red marks).

⑯ **Sensor input waveform display time**
Time axis that the sensor input waveform displays (the time between the red marks).

⑰ **Setting value**
Displays the setting value of menu.

⑱ **Processing time**
Time to detect the concordance rate with the registered pattern.

⑲ **Menu**
Yellow: Common to the all banks
Purple: The setting value switches according to each bank.
Blue: Locked

Operation of monitor display

SET →	Parameter reference screen	DOWN SET → Locks all the parameter to avoid changing.
		Push simultaneously 3 sec. or more
TEACH /EXIT →	Teaching	UP SET → Cancels the lock of all parameters.
Push 3 sec. or more		Push simultaneously 3 sec. or more

Standard Mode

To identify the pattern of holes in a rubber piece.
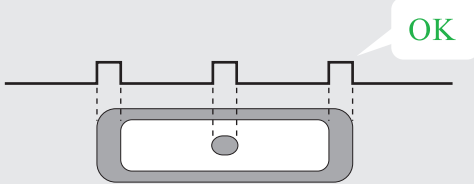
NF series Fibers

BRF series Fiberoptic Ampfilter

A rubber piece has four holes with different diameters. The TMC Timing Comparator can find defective holes with its preset "timing" of the incoming photosensor signals.
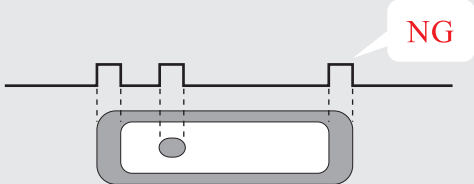
Detection of wrong objects.

The outside shape is OK, but the position, the number or the size of the inner pins is incorrect. In the past you may have been using an expensive vision system for this type of workpiece. These can be complicated to setup and use.

The TMC Timing Comparator offers a simple and easy solution in a totally new concept. It features simple setup and easy processing at a much lower cost than vision systems.
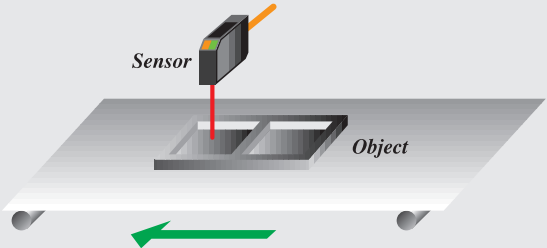
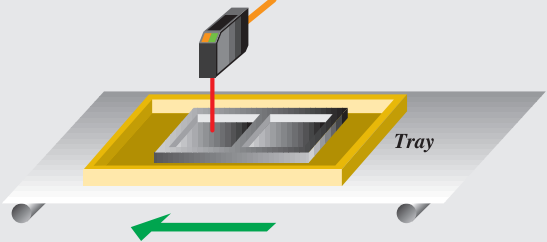**For teach-in and sensing, the object must move but not necessarily in a constant speed.**

(1) Inspection on conveyor

Sensor

Object

(2) Inspection when the index table is moving

Tray

(3) Inspection by moving the sensor

Cylinder

Teaching waveform

OK

Incorrect position of hole.
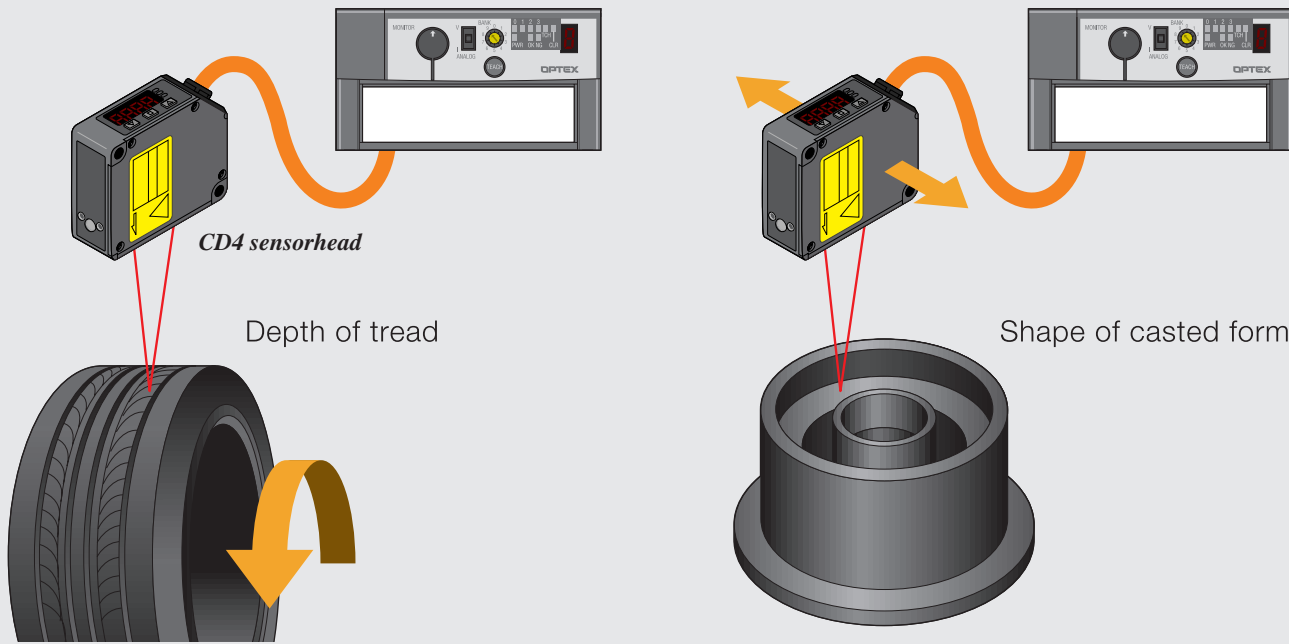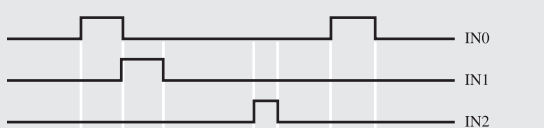
NG
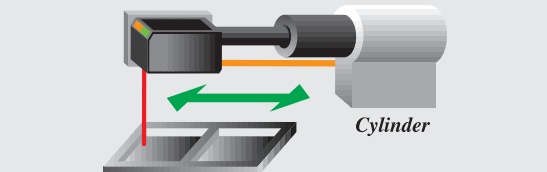
Analog Mode

With the CD3 and CD4 Displacement Sensors you are able to identify between good and bad products by monitoring the analog signal. The TMC Timing Comparator can support one analog device.

CD4 sensorhead
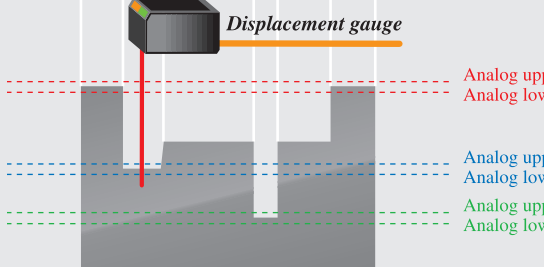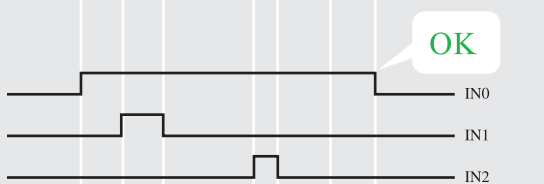
Depth of tread

Shape of casted form

Teach-in is easy for Analogue mode, too.

Use the analog output of the CD3 or CD4 Displacement sensors to sort products. For example, sorting tires by measuring the depth of tread.
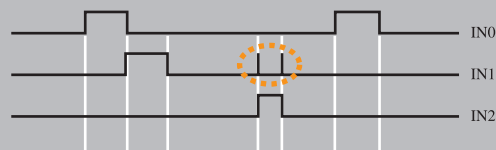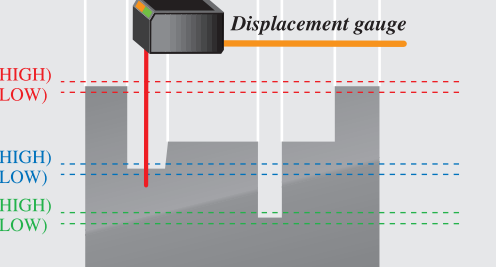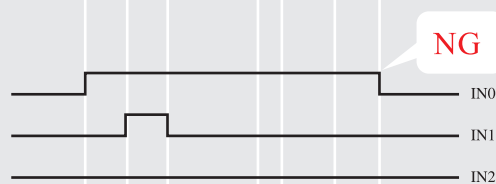
By comparing the stored patterns against the CD3 or CD4 Displacement sensor output it is possible to identify the product.

IN0
IN1
IN2

Teaching waveform

IN0
IN1
IN2

Sample waveform (good)

OK

IN0
IN1
IN2

Displacement gauge

Analog upper limit value 0 (IN0 HIGH)
Analog lower limit value 0 (IN0 LOW)

Analog upper limit value 1 (IN1 HIGH)
Analog lower limit value 1 (IN1 LOW)

Analog upper limit value 2 (IN2 HIGH)
Analog lower limit value 2 (IN2 LOW)

Process depth is insufficient (incorrect)

NG

IN0
IN1
IN2

Displacement gauge

Standard setting values

To lock the settings
To lock all the settings, press [DOWN] and [SET] simultaneously for 3 seconds on the monitor display. (The settings turns to blue.)
To cancel the lock of all the settings, press [UP] and [SET] simultaneously for 3 seconds on the monitor display.

	Parameter	Display	Range (Default)	Description
	Bank selection	BANK	No.0 to No.6, EXTIN (EXTIN)	Specifies the bank number. No.0 to No.6: Switches to any of bank "0" to "6". EXTIN: Selects the bank number by the bank input (BK0 to 2) or the bank selection switch."
B	OK counter setting value	COUNTER	1 to 256 (1)	Selects the count value of OK counter. When OK counter reaches the setting value or more, OK output is turned ON and OK counter is cleared. If the OK counter is below the setting value, OK output is not turned ON. In NG judgment, however, NG output is turned ON.
B	Input ON/OFF selection	IN ENBL	ALL, X123 to XXX1 (ALL)	Selects ON/OFF of the sensor input (IN0 to 3). ALL: All inputs are activated. X123 : IN0 is deactivated. 0X23 : IN1 is deactivated. In the same way, "X" shows the deactivated input and the numeral shows the activated input. When the sensor input signal used for other bank interferes the concerned sensor input, deactivate the interfering input to avoid malfunction.
B	Filter time to eliminate input noise	INFILT	0μs to 25.6ms (400μs)	Selects the filter time to eliminate the chattering and noise of sensor input. Selectable value: 0μs, 12μs, 25μs, 50μs, 100μs, 200μs, 400μs, 800μs, 1.6ms, 3.2ms, 6.4ms, 12.8ms, 25.6ms.
	Initialization, Lock of settings	INTIALZ	----, INIT (----)	Initializes the setting values. ---- : No initialization INIT: Enter this setting to initialize all the settings. (The display disappears and restart after approximately a second.)
B	NG output level	NG LVL	0 to 100 (60)	Selects the lower limit value to turn ON NG output. Set the half value of the concordance rate, that was obtained at the defect object detection. When not using NG output, set the value more than OK LEVEL setting to avoid turning it ON.
B	OK output level	OK LVL	0 to 100 (80)	Selects the lower limit value to turn ON OK output. Set the intermediate value satisfying the following conditions: below the concordance rate obtained at the conforming object detection, and equal to or more than the concordance rate obtained at the defect object detection.
	Output holding, OFF delay time	OFF DLY	HOLD, CONT, 0.01ms to 5.00s (CONT)	Selects the output holding function and OFF delay time of OK/NG/Bank output. HOLD: Holds the output when turned ON. CLR input turns the output OFF. If NG judgment occurs during OK output, the output switches to NG output. (The opposite pattern does not occur.) When using the handshake protocol with the receiving PLC, use this setting to hold NG output and release it by external switch. CONT: Holds the output when turned ON, and switches to the updated judgment output when NG judgment occurs during OK output ON or when OK judgment occurs during NG output ON. 0.01ms to 5.00s: Specifies OFF delay time. Select so that the receiving PLC can surely pick up the output (Normally twice as long as the PLC cycle time).
	ON delay time	ON DLY	0.00ms to 5.00s (0.00ms)	Selects the ON delay time of OK/NG/Bank output. 0.00ms to 5.00s: Specifies ON delay time. For example, when NG output shall accidentally occur during receiving the sampled data, set the ON delay time longer to avoid the error output.
B	Sorting number	SORTING	OFF, 2 to 7 (OFF)	Compares the multiple bank patterns sequentially, and outputs the bank number of the highest concordance rate. The processing time becomes longer as the number of sorted banks increases. OFF: Sorting function is deactivated. (Compares the selected bank pattern only.) 2: Includes the next bank pattern and compares the two bank patterns in total. For example, when "1" is set for bank "1," the patterns of bank "1" and "2" are compared. For the number over bank "7," the setting is ignored. 3 to 7: As the setting "2," compares the successive banks. (When "3" is selected, three banks in total, and when "7," seven banks in total.) Use the sorting function to switch the process according to object type on the production line that contains multiple-type products simultaneously. * To use the sorting function, ensure that the banks have the same sensor input status (ON/OFF) at teaching completion.
	Number of patterns to complete teaching	TCH PAT	1 to 250 (250)	Completes the teaching when the number of times of the sensor input change (= the number of patterns) reaches the setting value. Use when the specified time-out (TIMEOUT) cannot be secured between the objects placed too close.
	Teaching ON/OFF selection	TEACHEN	ENABL, PRHBT(ENABL)	ENABL: Teaching ON PRHBT: Teaching OFF (including external teaching)"
	Time-out to complete teaching	TIMEOUT	2ms to 90.0s (2.5s)	Specifies the time to complete the teaching. Teaching is completed when the sensor input status does not change for the specified time. Set it longer when the change of sensor input is very slow. When the objects flow uninterruptedly during teaching, set it to the shortest or set the number of patterns in TCH PAT.

B : The setting value changes corresponding to the bank.