

# INSTRUCTION MANUAL

## Digital Fiber Sensor For Leak/Liquid fiber

### FX-301(P)-F

## 1 SPECIFICATIONS

Item	Type	NPN output type	PNP output type
	Model No.	FX-301-F	FX-301P-F
Applicable fiber		FD-F7 series, FT-F9 series	
Supply voltage		12 to 24V DC $\pm$ 10% Ripple P-P 10% or less	
Power consumption		Normal operation: 960mW or less (Current consumption 40mA or less at 24V supply voltage)	
		Eco-operation: 600mW or less (Current consumption 25mA or less at 24V supply voltage)	
Output		NPN open-collector transistor • Maximum sink current: 100mA (Note 1) • Applied voltage: 30V DC or less (between output and 0V) • Residual voltage: 1.5V or less [at 100mA (Note 1) sink current]	PNP open-collector transistor • Maximum source current: 100mA (Note 1) • Applied voltage: 30V DC or less (between output and +V) • Residual voltage: 1.5V or less [at 100mA (Note 1) source current]
	Output operation	When Leak is set (F7 mode): OFF when leak is detected. When Liquid is set (F9 mode): Selectable, either OFF when no liquid is detected (NC) or ON when liquid is detected (NO), with jog switch.	
Short-circuit protection		Incorporated	
Response time		250 $\mu$ s or less (Note 2)	
Display		4 digit red LED display	
Sensitivity setting method		Individual teaching / Collective teaching	
Fine sensitivity adjustment function		Incorporated	
Timer function		Incorporated with delay timer [Effective only when Liquid is set (F9 mode)]	
Ambient temperature		0 to +50°C (If 8 to 16 units are connected together: 0 to +45°C) (No dew condensation or icing allowed), Storage: -20 to +70°C	
Ambient humidity		35 to 85% RH, Storage: 35 to 85% RH	
Emitting element		Red LED (modulated)	
Material		Enclosure: Heat-resistant ABS, Transparent cover: Polycarbonate	
Weight		20 g approx.	

Notes: 1) 50mA if five, or more, amplifiers are connected together.

2) If a leak is detected (Output: OFF) in Leak (F7 mode), since the emission is put in blinking operation, only the response to return to ON gets delayed. (1 sec.)

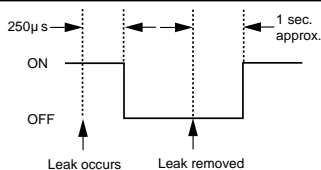
3) The cable for amplifier connection is not supplied as an accessory. Make sure to use the optional quick-connection cables given below.

Main cable (3-core): **CN-73-C1** (cable length 1m), **CN-73-C2** (cable length 2m)

**CN-73-C5** (cable length 5m)

Sub cable (1-core): **CN-71-C1** (cable length 1m), **CN-71-C2** (cable length 2m)

**CN-71-C5** (cable length 5m)



## 2 CAUTIONS

- Make sure to carry out the wiring in the power supply off condition.
- Verify that the supply voltage variation is within the rating.
- Take care that if a voltage exceeding the rated range is applied, or if an AC power supply is directly connected, the sensor may get burnt or damaged.
- In case noise generating equipment (switching regulator, inverter motor, etc.) is used in the vicinity of this product, connect the frame ground (F.G.) terminal of the equipment to an actual ground.
- If power is supplied from a commercial switching regulator, ensure that the frame ground (F.G.) terminal of the power supply is connected to an actual ground.
- Do not use during the initial transient time (0.5 sec.) after the power supply is switched on.
- Make sure to use an isolation transformer for the DC power supply. If an auto-transformer (single winding transformer) is used, this product or the power supply may get damaged.
- In case a surge is generated in the used power supply, connect a surge absorber to the supply and absorb the surge.
- Take care that short-circuit or wrong wiring of the load may burn or damage the sensor.
- Do not run the wires together with high-voltage lines or power lines or put them in the same raceway. This can cause malfunction due to induction.
- Make sure to use the optional quick-connection cable for the connection of the amplifier. Extension up to total 100m is possible with 0.3mm<sup>2</sup>, or more, cable. However, in order to reduce noise, make the wiring as short as possible.
- Take care that the sensor is not directly exposed to fluorescent light from a rapid-starter lamp or a high frequency lighting device, as it may affect the sensing performance.
- This sensor is suitable for indoor use only.
- Avoid dust, dirt, and steam.
- When the fiber head gets dusty or dirty etc. the sensitivity deteriorates. To keep stable detection, wipe the fiber head to remove dust or dirt etc. and carry out sensitivity teaching periodically.
- Take care that the product does not come in direct contact with organic solvents, such as, thinner, etc.
- This sensor cannot be used in an environment containing inflammable or explosive gases.
- Never disassemble or modify the sensor.

Thank you very much for using SUNX products. Please read this Instruction Manual carefully and thoroughly for the correct and optimum use of this product. Kindly keep this manual in a convenient place for quick reference.

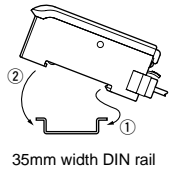


**This product is not a safety sensor. Its use is not intended or designed to protect life and prevent body injury or property damage from dangerous parts of machinery. It is a normal object detection sensor.**

## 3 MOUNTING

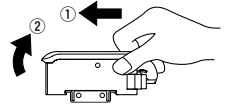
### How to mount the amplifier

- ① Fit the rear part of the mounting section of the amplifier on a 35mm width DIN rail.
- ② Press down the front part of the mounting section of the amplifier on the 35mm width DIN rail.



### How to remove the amplifier

- ① Push the amplifier forward.
  - ② Lift up the front part of the amplifier to remove it.
- Note: Take care that if the front part is lifted up without pushing the amplifier forward, the hook on the rear portion of the mounting section is likely to break.



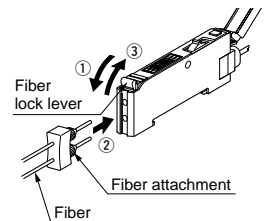
### How to connect the fiber cables

Make sure to fit the fiber attachment (**FX-AT4**), enclosed with the fiber, to the fibers.

Please refer to the instruction manual of the fiber attachment for the fitting method.

- ① Snap the fiber lock lever down.
- ② Insert the fiber cables slowly into the inlets until they stop. (Note 1)
- ③ Return the fiber lock lever to the original position, till it stops.

Note: In case the fiber cables are not inserted to a position where they stop, the sensing becomes unstable.

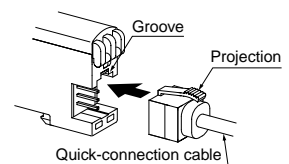


## 4 CONNECTION

Make sure to connect or disconnect the quick-connection cable in the power supply off condition.

### Connection method

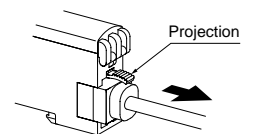
- ① Holding the connector of the quick-connection cable, align its projection with the groove at the top portion of the amplifier connector.
- ② Insert the connector till a click is felt.



### Disconnection method

- ① Pressing the projection at the top of the quick-connection cable connector, pull out the connector.

Note: Take care that if the connector is pulled out without pressing the projection, the projection may break. Do not use a quick-connection cable whose projection has broken. Further, do not pull by holding the cable, as this can cause a cable-break.

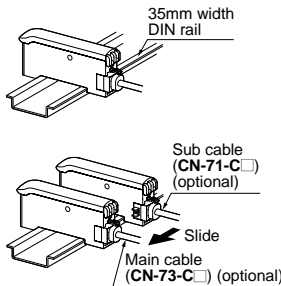


## 5 CASCADING AMPLIFIERS

- Make sure to add or remove the amplifiers in the power supply off condition.
- Make sure to check the allowable ambient temperature, as it depends on the number of amplifiers connected in cascade.
- In case two, or more, amplifiers are connected in cascade, make sure to mount them on a DIN rail.
- When connecting in cascade, mount the amplifiers close to each other, fitting them between the optional end plates (MS-DIN-E) mounted at the two ends.
- Up to maximum 15 amplifiers can be added (total 16 amplifiers connected in cascade.)
- When connecting more than two amplifiers in cascade, use the sub cable (CN-71-C□) as the quick-connection cable for the second amplifier onwards.
- Since the model setting gets changed if collective teaching is done for the amplifiers in Leak setting (F7 mode) and in Liquid setting (F9 mode) mounted in cascade, note that collective teaching should not be done for amplifiers with different model settings mounted in cascade.
- Since the communication function of this sensor and that of the digital fiber sensor FX-301(P)/311(P) is different, if these models are mounted in cascade, do not use the communication function.
- In case of cascading, wait for 10 minutes, or more, to use the teaching function after the power is switched on.

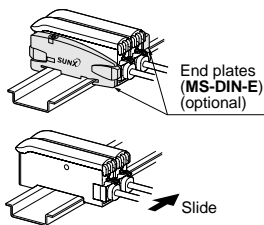
### Cascading method

- 1) Mount the amplifiers, one by one, on the 35mm width DIN rail. (For details, refer to **3 MOUNTING**.)
- 2) Slide the amplifiers next to each other, and connect the quick-connection cables.
- 3) Mount the optional end plates (MS-DIN-E) at both the ends to hold the amplifiers between their flat sides.
- 4) Tighten the screws to fix the end plates (MS-DIN-E).



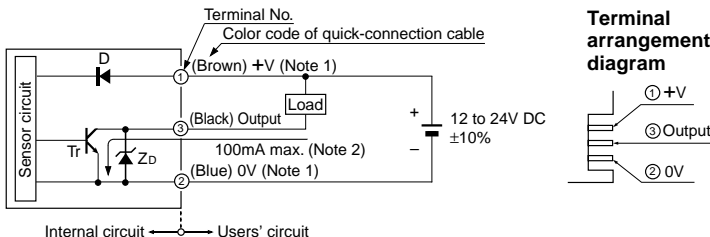
### Dismantling method

- 1) Loosen the screws of the end plates (MS-DIN-E).
- 2) Remove the end plates (MS-DIN-E).
- 3) Slide the amplifiers and remove them one by one. (For details, refer to **3 MOUNTING**.)



## 6 I/O CIRCUIT DIAGRAMS

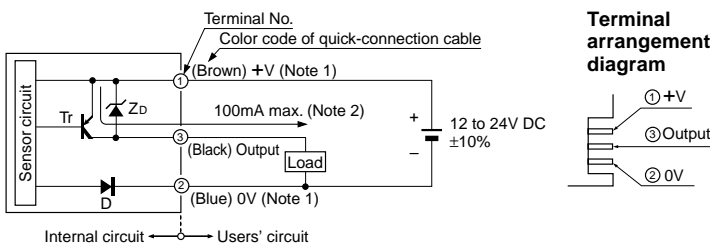
### FX-301-F / NPN output type



- Notes: 1) The quick-connection sub cable does not have +V (brown) and 0V (blue). The power is supplied from the connector of the main cable.  
2) 50mA max. if five, or more, amplifiers are connected together.  
3) Do not use the amplifiers in a series (AND) connection.

Symbols... D : Reverse supply polarity protection diode  
Zd : Surge absorption zener diode  
Tr : NPN output transistor

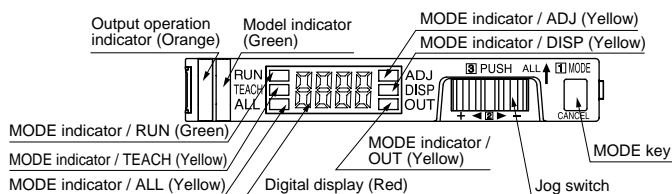
### FX-301P-F / PNP output type



- Notes: 1) The quick-connection sub cable does not have +V (brown) and 0V (blue). The power is supplied from the connector of the main cable.  
2) 50mA max. if five, or more, amplifiers are connected together.  
3) Do not use the amplifiers in a series (AND) connection.

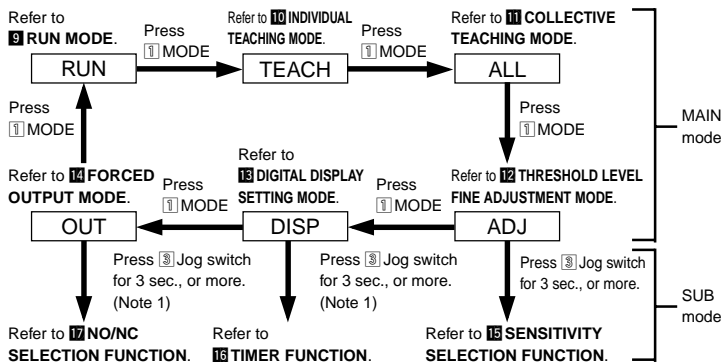
Symbols... D : Reverse supply polarity protection diode  
Zd : Surge absorption zener diode  
Tr : PNP output transistor

## 7 PART DESCRIPTION



## 8 OPERATION PROCEDURE

- When the power supply is switched on, normal condition is displayed [MODE indicator / RUN (green) lights up] and the digital display shows the incident light intensity.
- When MODE key is pressed, the mode changes as per the diagram below. Further, if the jog switch is pressed for 3 sec., or more, in 'ADJ', 'DISP' or 'OUT' condition, SUB mode can be set.



Note 1: In Liquid setting (F9 mode) only.

	Step	Description
MODE key	Press	Used for mode selection or cancellation during setting. (Note 2)
Jog switch	Turn	Used to select each item.
	Press	Used to enter each item.

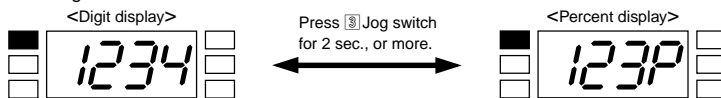
Note 2: When MODE key is pressed for 1 sec., or more, the sensor returns to the RUN mode. (in MAIN mode only)

## 9 RUN MODE

- When MODE indicator / RUN (green) lights up, the display setting or the sensitivity select setting can be checked. Refer to **15 SENSITIVITY SELECTION FUNCTION** for further details of sensitivity select setting.

### How to change to 'percent display'

- When Jog switch is pressed for 2 sec., or more, the display changes as per the diagram below.

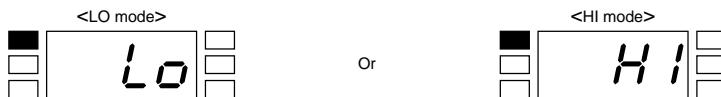


The incident light intensity is displayed within the range 0 to 4,000.

The incident light intensity is displayed in percentage (within 0 to 999) based on the threshold value as the reference.

### How to check the sensitivity state

- If Jog switch is turned to '+' or '-' side, the present sensitivity state can be confirmed. After 2 sec., the display returns to 'digit display' or 'percent display'.



Operating in the low sensitivity mode.

Operating in the high sensitivity mode.

## 10 INDIVIDUAL TEACHING MODE

The sensitivity selection function is set to the automatic sensitivity setting ( $R_{LTC}$ ) at the time of factory shipment. In case sensitivity selection setting is done, make sure to carry out 'teaching' after the sensitivity selection setting. For the sensitivity selection setting, refer to **15 SENSITIVITY SELECTION FUNCTION**.

- When MODE indicator / TEACH (yellow) lights up, threshold value can be set on a single unit.

Step	Display	Description
1	1234	• Insert Leak detection fiber (FD-F7□) or Liquid detection fiber (FT-F9□). • Press MODE key to light up MODE indicator / TEACH (yellow).
2	-F7- -F9-	• Turn the jog switch to '+' or '-' side to set to either Leak (F7) mode (-F7-) or Liquid (F9) mode (-F9-). • In case Liquid (F9) mode (-F9-) is set, the model indicator (Green) lights up.
3	!	• Press Jog switch in no-leak condition with Leak detection fiber (FD-F7□) or no-liquid condition with Liquid detection fiber (FT-F9□). Then, '!' on the display moves from left to right.
4	Good Er-3	• When teaching is accepted, the result of threshold value setting is displayed. In case stable sensing is possible: 'Good' on the display blinks three times. In case stable sensing is not possible: 'Er-3' on the display blinks. (Note 1)
5	1234	• If the teaching result is 'Good', the sensor returns to RUN mode automatically and the incident light intensity is shown on the display. • MODE indicator / RUN (green) lights up. • The setting is complete.

- Notes: 1) For details, refer to **16 ERROR INDICATION**.  
2) The initial setting at the time of factory shipment is Liquid (F9) mode (-F9-).

## 11 COLLECTIVE TEACHING MODE

- When MODE indicator / ALL (yellow) lights up, a threshold value can be collectively set to amplifiers mounted in cascade.

Step	Display	Description
①		<ul style="list-style-type: none"> <li>Insert Leak detection fiber (FD-F7□) or Liquid detection fiber (FT-F9□).</li> <li>Press [1] MODE key to light up MODE indicator / ALL (yellow).</li> </ul>
②		<ul style="list-style-type: none"> <li>Turn [2] the jog switch to the '+' side or '-' side to set to either Leak (F7) mode (-F7-) or Liquid (F9) mode (-F9-).</li> <li>In case Liquid (F9) mode (-F9-) is set, the model indicator (Green) lights up.</li> </ul>
③		<ul style="list-style-type: none"> <li>Press [3] Jog switch in no-leak condition with Leak detection fiber (FD-F7□) fitted or no-liquid condition with Liquid detection fiber fitted (FT-F9□). Then, '0' on the display moves from top left to top right and from bottom right to bottom left (twice).</li> </ul>
④		<ul style="list-style-type: none"> <li>When teaching is accepted, the result of threshold value setting is displayed.</li> <li>In case stable sensing is possible: 'Good' on the display blinks three times.</li> <li>In case stable sensing is not possible: 'Er-3' on the display blinks. (Note 1)</li> </ul>
⑤		<ul style="list-style-type: none"> <li>If the teaching result is 'Good', the sensor returns to RUN mode automatically and the incident light intensity is shown on the display.</li> <li>MODE indicator / RUN (green) lights up.</li> <li>The setting is complete.</li> </ul>

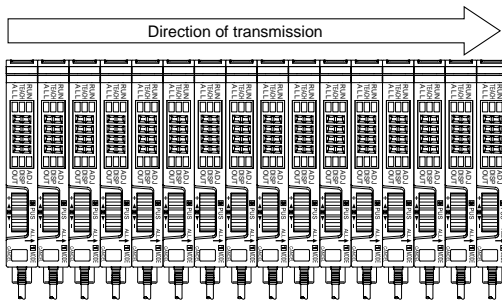
Notes: 1) For details, refer to 13 ERROR INDICATION.

- In collective teaching, only an instruction of the teaching operation is transmitted, the threshold value is not copied. The threshold value taught at the respective amplifier is set.
- When the collective teaching is done, the setting conditions are copied. In case an individual setting condition is desired to be set, set it individually after the collective teaching.

○ : Copied, X : Not copied

Mode	Digit display Percent display	Model setting	Digital display setting	Sensitivity selection function	Timer function	NO/NC selection function
Leak (F7) mode	○	○	○	○	X	X
Liquid (F9) mode	○	○	○	○	○	○

- The collective teaching transmits the information only in the direction of the arrow shown on the amplifier operation panel. The collective teaching is also possible from the middle of the amplifiers mounted in cascade. Check the direction of the transmission before collective teaching is done.



- Since the model setting is also transmitted, do not carry out collective teaching when the amplifiers in Leak (F7) mode (-F7-) and in Liquid mode (F9) mode (-F9-) are mixed in cascade connection.

## 12 THRESHOLD VALUE FINE ADJUSTMENT MODE

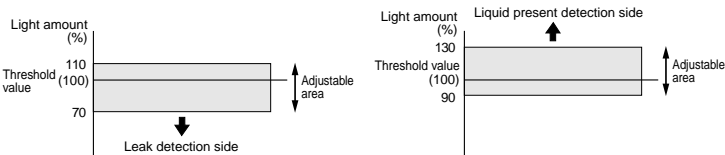
- When MODE indicator / ADJ (yellow) lights up, the set threshold value can be fine adjusted.

Step	Display	Description
①		Press [1] MODE key to light up MODE indicator / ADJ (yellow).
②		<ul style="list-style-type: none"> <li>Turn [2] Jog switch to the '+' side, to increase the threshold value.</li> <li>Turn [2] Jog switch to the '-' side, to decrease the threshold value.</li> </ul>
③		When [3] Jog switch is pressed, the changed threshold value blinks 3 times and is confirmed.
④		<ul style="list-style-type: none"> <li>When [1] MODE key is pressed 3 times, or for 2 sec., or more, the sensor returns to the RUN mode and the incident light intensity is shown in the display.</li> <li>MODE indicator / RUN (green) lights up.</li> <li>The setting is complete.</li> </ul>

Note: The adjustable area is limited as shown below. In order to adjust the threshold the outside the adjustable area, confirm it within the area once and then adjust it again.

Adjustable area in Leak (F7) mode: 70 to 110%

Adjustable area in Liquid (F9) mode: 90 to 130%



## 13 DIGITAL DISPLAY SETTING MODE

- When MODE indicator / DISP (yellow) lights up, the digital display can be switched to the light-up mode, the eco mode or the inverse mode.

Step	Display	Description
①		Press [1] MODE key to light up MODE indicator / DISP (yellow).
②		<ul style="list-style-type: none"> <li>When [2] Jog switch is turned to the '+' side or '-' side, the mode in the digital display changes.</li> <li><i>EcoF</i>: This is the light-up mode in the digital display. The digital display always lights up.</li> <li><i>Econ</i>: This is the eco mode. After confirmation, if key operation has not been done for 8 sec., or more, 'Eco' flashes, and then the digital display is turned off.</li> <li>When a key operation is done after the display is turned off or when the collective teaching is carried out, the digital display lights up.</li> <li><i>turn</i>: This is the inverse mode of the digital display.</li> <li>In the normal display condition, the display changes to the inverse display and in the inverse condition, the display changes to the normal display.</li> </ul>
③		When [3] Jog switch is pressed, the set display blinks 3 times and is confirmed.
④		<ul style="list-style-type: none"> <li>When [1] MODE key is pressed twice or for 1 sec., or more, the sensor returns to RUN mode and the incident light intensity is displayed.</li> <li>MODE indicator / RUN (green) lights up.</li> <li>The setting is complete.</li> </ul>

Note: The initial setting at the time of factory shipment is the light-up mode (EcoF).

## 14 FORCED OUTPUT MODE

- When MODE indicator / OUT (yellow) lights up, the output can be compulsory changed to ON or OFF regardless of the incident light intensity.

Step	Display	Description
①		Press [1] MODE key to light up MODE indicator / DISP (yellow). (Present output state is displayed.)
②		<ul style="list-style-type: none"> <li>When [2] Jog switch is turned to the '+' side or '-' side, the output is compulsory changed to ON or OFF.</li> <li>Since the emitting element of the amplifier blinks, it is possible to check the fiber connected to the amplifier.</li> <li>When the output is compulsory changed to ON, the operation indicator (orange) lights up.</li> </ul>
③		Press [1] MODE key to return the sensor to step ①.
④		<ul style="list-style-type: none"> <li>When [1] MODE key is pressed, the sensor returns to RUN mode and the incident light intensity is displayed.</li> <li>MODE indicator / RUN (green) lights up.</li> <li>The setting is complete.</li> </ul>

## 15 SENSITIVITY SELECTION FUNCION

- If Jog switch is pressed for 3 sec., or more, when MODE indicator / ADJ (yellow) lights up, the sensitivity can be fixed to low sensitivity or high sensitivity, or set to automatic sensitivity.

Step	Display	Description
①		Press [1] MODE key to light up MODE indicator / ADJ (yellow).
②		<ul style="list-style-type: none"> <li>Press [3] Jog switch for 3 sec. or more. (The sensor goes into the sensitivity setting condition.)</li> <li>MODE indicator / RUN (green) blinks.</li> </ul>
③		<ul style="list-style-type: none"> <li>When [2] Jog switch is turned to the '+' side or '-' side, the display and MODE indicator / RUN (green) blinks, and the sensitivity can be selected.</li> <li><i>Auto</i>: Automatic sensitivity setting</li> <li>After selecting the automatic sensitivity, the optimum sensitivity is set by carrying out teaching.</li> <li><i>Lo</i>: Low sensitivity setting</li> <li><i>Hi</i>: High sensitivity setting</li> </ul>
④		When [3] Jog switch is pressed, the setting display blinks 3 times and is confirmed.
⑤		<ul style="list-style-type: none"> <li>MODE indicator / TEACH (green) lights up and '-F7-' or '-F9-' is displayed.</li> <li>After sensitivity selection, carry out the teaching.</li> <li>For the setting method of teaching, refer to 10 INDIVIDUAL TEACHING MODE.</li> </ul>

Note: The initial setting at the time of factory shipment is the automatic sensitivity setting (Auto).

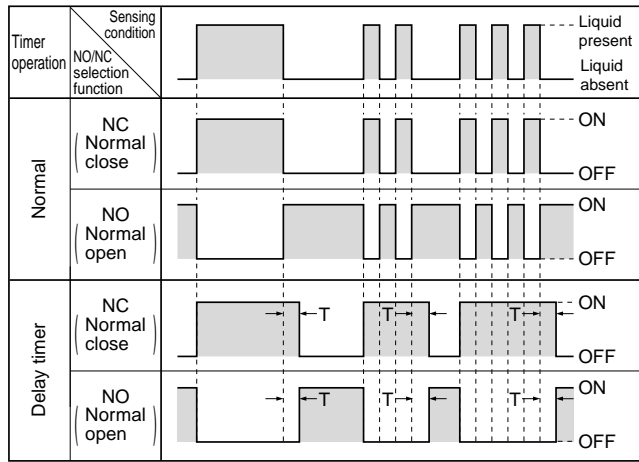
## 16 TIMER FUNCTION [Liquid (F9) mode only]

- The timer setting can be done by pressing the jog switch for 3 sec., or more, when Liquid (F9) mode (-F9-) has been set and MODE indicator / DISP (yellow) lights up. In case of Leak (F7) mode (-F7-), the display does not change to the timer function.

For the selection method of Leak (F7) mode / Liquid (F9) mode, refer to **10 INDIVIDUAL TEACHING MODE** or **11 COLLECTIVE TEACHING MODE**.

- This product incorporates a delay timer which reduces the effect of air bubbles, etc.

### <Time chart>



Timer period: T=10ms, 100ms, 1,000ms

Step	Display	Description
①		Confirm if the sensor is in Liquid (F9) mode (-F9-) in <b>10 INDIVIDUAL TEACHING MODE</b> or <b>11 COLLECTIVE TEACHING MODE</b> .
②		Press <b>1</b> MODE key to light up MODE indicator / DISP (yellow).
③		Press <b>3</b> Jog switch for 3 sec., or more. (The sensor goes into the timer setting condition.) MODE indicator / RUN (green) blinks.
④		When <b>2</b> Jog switch is turned to the '+' side or '-' side, the display and MODE indicator / RUN (green) blinks, and the timer period can be chosen. non : Without timer 10 : 10ms timer 100 : 100ms timer 1000 : 1,000ms timer
⑤		When <b>3</b> Jog switch is pressed, setting display blinks 3 times and is confirmed.
⑥		The sensor returns to step ②.
⑦		When <b>1</b> MODE key is pressed twice or for 1 sec., or more, the sensor returns to RUN mode and the incident light intensity is displayed. MODE indicator / RUN (green) lights up. The setting is complete.

Note: The initial setting at the time of factory shipment is the without timer (non) condition.

## 17 NO/NC SELECTION FUNCTION [Liquid (F9) mode only]

- The NO/NC selection can be done by pressing the jog switch for 3 sec., or more, when Liquid (F9) mode (-F9-) has been set and MODE indicator / DISP (yellow) lights up. In case of Leak (F7) mode (-F7-), the display does not change to NO/NC selection function.

For the selection method of Leak (F7) mode / Liquid (F9) mode, refer to **10 INDIVIDUAL TEACHING MODE** or **11 COLLECTIVE TEACHING MODE**.

Step	Display	Description
①		Confirm if the sensor is in Liquid (F9) mode (-F9-) in <b>10 INDIVIDUAL TEACHING MODE</b> or <b>11 COLLECTIVE TEACHING MODE</b> .
②		Press <b>1</b> MODE key to light up MODE indicator / OUT (yellow).
③		Press <b>3</b> Jog switch for 3 sec., or more. (The sensor goes into the NO/NC setting condition.) MODE indicator / RUN (green) blinks.
④		When <b>2</b> Jog switch is turned to the '+' side or '-' side, the display and MODE indicator / RUN (green) blinks, and NO/NC can be chosen. nc : Normal close (OFF in liquid absent condition.) no : Normal open (OFF in liquid present condition.)
⑤		When <b>3</b> Jog switch is pressed, setting display blinks 3 times and is confirmed.
⑥		The sensor returns to the step ②.
⑦		When <b>1</b> MODE key is pressed, the sensor returns to RUN mode and the incident light intensity is displayed. MODE indicator / RUN (green) lights up. The setting is complete.

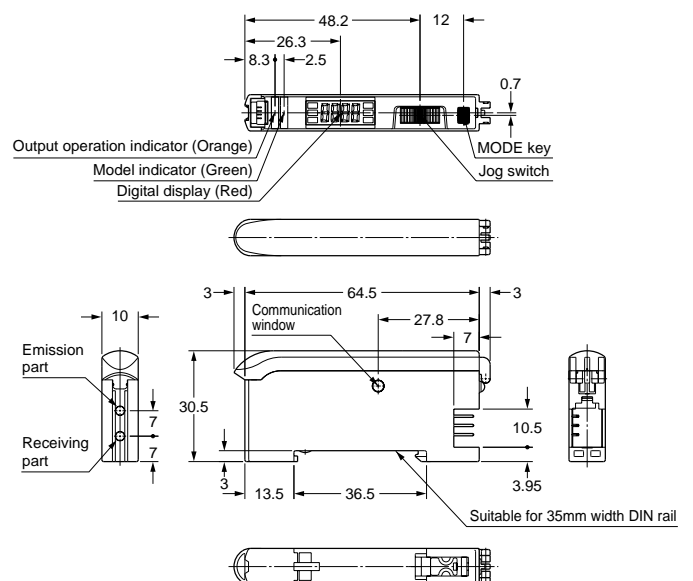
Note: The initial setting at the time of factory shipment is the normal close (nc) setting.

## 18 ERROR INDICATION

- When an error is displayed, remedy as follows.

Error indication	Cause	Remedy
	Excessive current flows due to a short-circuit.	Switch off the power supply and check the load.
	The teaching is abnormal.	Check the installation condition of the fiber, or whether the fiber has come out, and then do teaching again. Press <b>1</b> MODE key to cancel 'Er-3'. After the cancellation, the sensor operates at the set value conditions before the error. However, in case the sensitivity selection function has been set to the automatic sensitivity setting (Auto), the sensor operates at optimum sensitivity.
	The communication is abnormal.	Check if the amplifiers mounted in cascade are disconnected. After the confirmation, do the teaching again.

## 19 DIMENSIONS



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