FASTUS
Good Thinking, Good Future
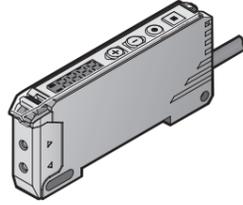
Instruction Manual

Digital Fiber Amplifier

D1RF-T Series

D1RF-T
D1RF-TC

OPTEX FA CO., LTD.

- Thank you for purchasing this Digital Fiber Amplifier D1RF.
- Before using this product, please read this manual carefully to ensure proper use.
- Read this manual thoroughly, and then keep this manual at hand so that it can be used whenever necessary.
- The warranty period of this product is one year after delivery. However, any fault attributable to natural disasters or any other similar disasters or modification or repair will be excluded from the scope of the warranty.

Safety Precautions

Safety precautions for ensuring safe operation of this product are displayed as follows with the following symbols.
Precautions listed here describe important information about safety. Make sure to follow them accordingly.

Safety Symbols

⚠ WARNING	Indicates that any improper operation or handling may result in moderate or minor injury, and in rare cases, serious injury or death. Also indicates a risk of serious property damage.
⚠ CAUTION	Indicates that any improper operation or handling may result in minor injury or property damage.

⚠ WARNING

🚫	Do not disassemble, repair, modify, deform under pressure, or attempt to incinerate this product. Doing so may cause injury or fire.
⚠🔥	This product is not explosion-proof and should not be used around flammable or explosive gases or liquids. Doing so may cause ignition resulting in an explosion or fire.
⚠🔥	Do not use air dusters or any spray that uses flammable gas around the product or on the inside of the product. Doing so may cause ignition resulting in an explosion or fire.
⚠🔥	Do not install this product in any of the following locations. Doing so may cause a fire, damage, or a malfunction. 1. Locations where dust, salt, iron powder, or vapor (steam) is present. 2. Locations subjected to corrosive gases or flammable gases. 3. Locations where oil or chemical splashes may occur. 4. Locations where heavy vibrations or impacts may occur. 5. Locations where the ambient temperature exceeds the rated range. 6. Locations subject to rapid temperature changes (or where condensation occurs). 7. Locations with strong electric or magnetic fields. 8. Outdoor locations or locations subject to direct light.
🚫	This is a class A product. In a domestic environment this product may cause radio interference, in which case the user may be required to take adequate measures.
🚫	This product is not intended for use with nuclear power, railways, aviation, vehicles, medical equipment, food-handling equipment, or any application where particular safety measures are required. Absolutely do not use this product for any of these fields.
🚫	This product cannot be used in applications that directly or indirectly detect human bodies for the purpose of ensuring safety. Do not use this product as a detection device for protecting the human body.
❗	What to do in the event of a malfunction such as smoke being emitted from the product If you detect any malfunction including emission of smoke, abnormal smells or sounds, or the body becoming very hot, immediately stop operating the product and turn off the sensor power. Failure to do so may cause a fire. Repairing the product is dangerous and should in no way be performed by the customer. Contact an Optex FA sales representative for repairs.

⚠ CAUTION

- Make sure to turn the power off before wiring the cable or connecting/disconnecting the connector. Connecting or disconnecting while energized may damage the product or cause electric shock.
- Avoid using the transient state while the power is on (100 ms). Output could become unstable, causing unexpected operation.
- Do not wire with high voltage cables or power lines. Doing so may cause malfunction or damage by induction.
- Do not bend the cable when below the freezing point. This may cause the cable to break.
- Do not drop the product or subject the product to strong impacts. Doing so may damage the product.
- Follow the instructions in this manual or the specified instruction manual when wiring the product or the dedicated controller for the correct wiring method. Incorrect wiring can damage the product or the controller, or cause a malfunction.
- When disconnecting the connector, be careful not to touch the terminals inside the connector, and do not allow foreign objects to enter the connector.
- Install this product as far away as possible from high-voltage equipment, power equipment, equipment that generates large switching surges, inverter motors, welders, or any equipment that can be a source of noise.
- When connecting or disconnecting the cable, make sure to hold it by the connector portion, and do not apply excessive force to the cable.
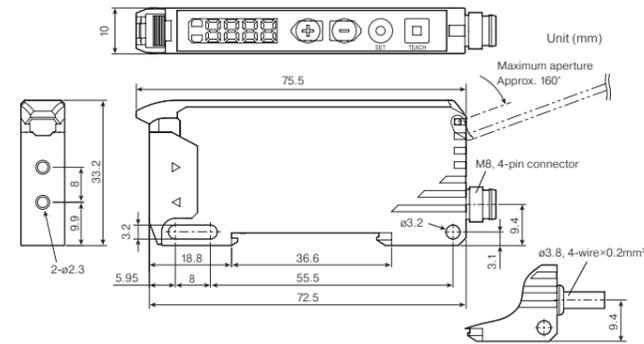
NOTICE

- After carefully considering the intended use, required specifications, and usage conditions, install and use the product within the specified ranges.
- All specifications may be changed without notice.
- When using this product, it is the responsibility of the customer to ensure necessary safety designs in hardware, software, and systems in order to prevent any threat to life, physical health, and property due to product malfunction or failure.
- Do not use this product for the development of weapons of mass destruction, for military use, or for any other military application. Moreover, if this product is to be exported, comply with all applicable export laws and regulations, including the "Foreign Exchange and Foreign Trade Act" and the "Export Administration Regulations," and carry out the necessary procedures pursuant to the provisions therein.
- For more details on conformity to the Restriction of Hazardous Substances Directive for this product, please contact an Optex FA sales representative. Before using this product, fully examine the applicable environmental laws and regulations, and operate the product in conformity to such laws and regulations. Optex FA does not assume any responsibility for damages or losses occurring as a result of noncompliance with applicable laws and regulations.
- Detection characteristics and digital display values may vary depending on the state of the target object and variations among individual products.
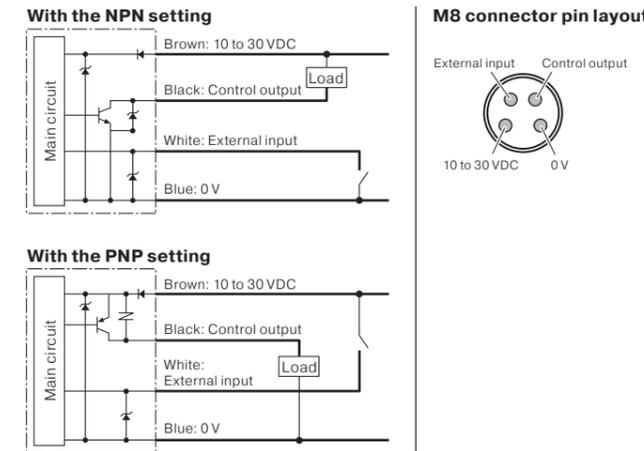
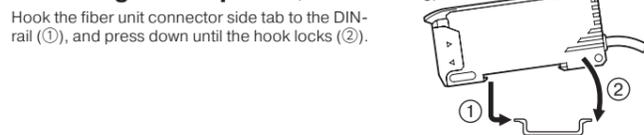# 1. Included Accessories

This instruction manual

2. Dimensions

Unit (mm)

3. I/O Circuit Diagram

With the NPN setting

Brown: 10 to 30 VDC
Black: Control output
Load
White: External input
Blue: 0 V

M8 connector pin layout

External input   Control output
10 to 30 VDC   0 V

With the PNP setting

Brown: 10 to 30 VDC
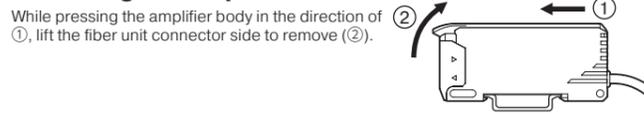Black: Control output
White: External input
Load
Blue: 0 V

4. Mounting

When mounting screws, use M3 screws with a tightening torque of 0.5 N·m or less.

Mounting the amplifier (DIN-rail mounting)

Hook the fiber unit connector side tab to the DIN-rail (①), and press down until the hook locks (②).

Removing the amplifier (DIN-rail mounting)

While pressing the amplifier body in the direction of ①, lift the fiber unit connector side to remove (②).
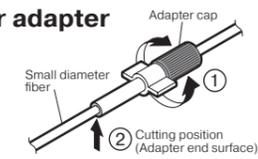

Mounting the fiber unit

Tilt the fiber lock lever (①), and insert the fiber through the insertion opening until it stops (②).
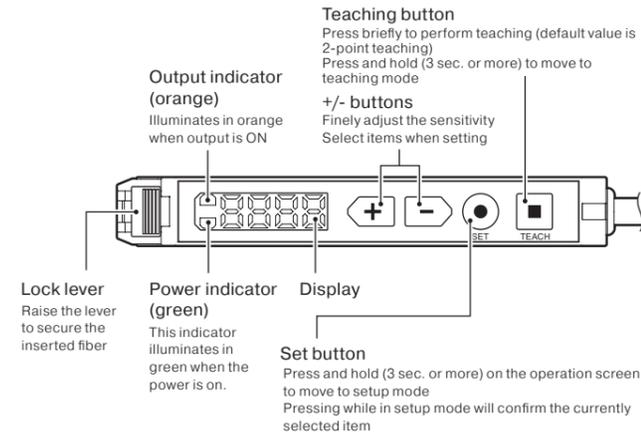Return the fiber lock lever to the stop position (③).

CAUTION
When using a coaxial reflective type fiber, install single-core fiber or fiber containing white wire on the emitting side, and multi-core fiber on the receiving side.

Receiving side
Emitting side

How to use the small diameter adapter

1. With the adapter cap turned all the way to the left, insert the fiber the necessary length and turn the adapter cap to the right to lock it.
2. Cut the unnecessary parts of the fiber with fiber cutters.

Adapter cap
Small diameter fiber
Cutting position (Adapter end surface)

5. Part Names

Teaching button
Press briefly to perform teaching (default value is 2-point teaching)
Press and hold (3 sec. or more) to move to teaching mode

+/- buttons
Finely adjust the sensitivity
Select items when setting

Output indicator (orange)
Illuminates in orange when output is ON

Set button
Press and hold (3 sec. or more) on the operation screen to move to setup mode
Pressing while in setup mode will confirm the currently selected item

Lock lever
Raise the lever to secure the inserted fiber

Power indicator (green)
This indicator illuminates in green when the power is on.
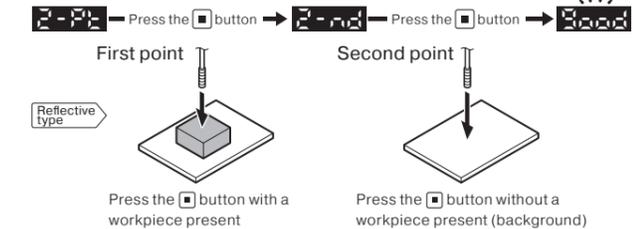
Display

6. Teaching (Sensitivity Setting)

To perform teaching, first press the ■ button for 3 sec. or more, then select teaching with the ＋ ─ button, and confirm with the ■ button.
When teaching is performed, "good" will be displayed before returning to the operation mode.

Detect the presence/absence of workpieces (when teaching is possible in the present/absent state)

Configure teaching when workpieces are present and when they are absent.
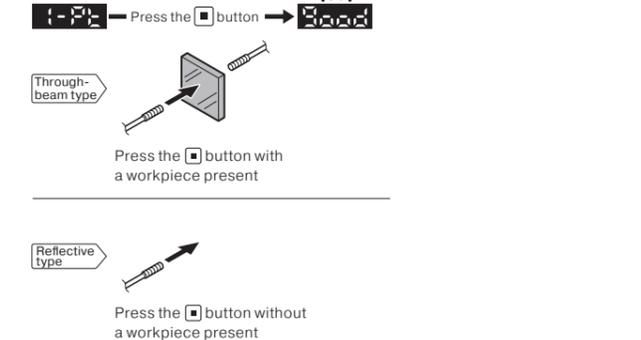The threshold value is set and stored between the first and second points.

● 2-point teaching

2-P1 — Press the ■ button → 2-nd — Press the ■ button → good

First point

Second point

Press the ■ button with a workpiece present

Press the ■ button without a workpiece present (background)

Resistant to dust and dirt

Ideal for long distance detection and detection in severe environments.
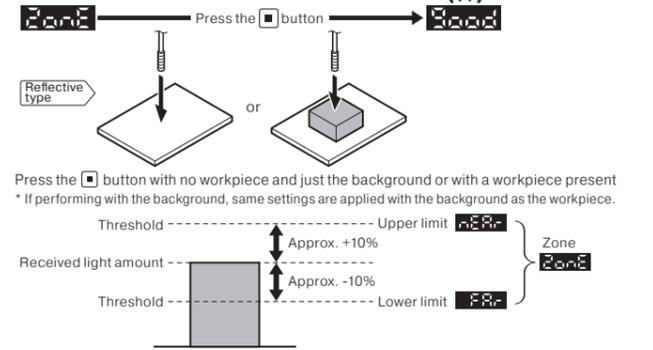The threshold value is set to the minimum value that can be stably detected.

● 1-point teaching

1-P1 — Press the ■ button → good

Through-beam type

Press the ■ button with a workpiece present

Reflective type

Press the ■ button without a workpiece present

Switching within a fixed range

Ideal for detecting only within a fixed range of received light.
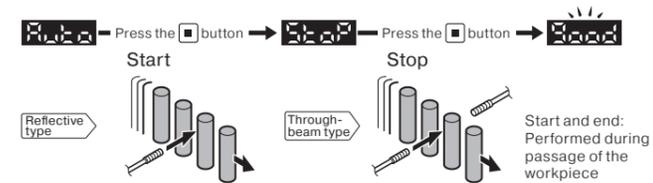The threshold value is set within the range of approx. ±10% the received light amount.

● Zone teaching

ZonE — Press the ■ button → good

Reflective type

or

Press the ■ button with no workpiece and just the background or with a workpiece present
* If performing with the background, same settings are applied with the background as the workpiece.

Threshold --------- Upper limit nEAr   Zone ZonE
Received light amount ---- Approx. +10%
Approx. -10%
Threshold --------- Lower limit FAr

Teaching so the line does not stop

This can be applied when teaching so the line does not stop.
The threshold value is set to between the maximum value and minimum value from start to stop.

● Auto-teaching

Auto — Press the ■ button → StoP — Press the ■ button → good

Start

Stop

Reflective type

Through-beam type

Start and end: Performed during passage of the workpiece

7. Threshold Adjusting Mode

● Normally

Press the ＋ and ─ buttons to adjust the threshold, and press the ◉ button to confirm.
Returns to operation mode after confirming.

Threshold setting range	＿ ～ 8888	4 to 9999 (using digital display)	* Returns to operation mode if there is no operation for 5 seconds

● Selecting zone teaching

[Upper limit setting] Press the ＋ and ─ buttons to select nEAr (upper limit), and press the ◉ button to confirm.
Continue by adjusting the threshold with the ＋ and ─ buttons, and press the ◉ button to confirm.
Returns to operation mode after confirming.

[Lower limit setting] Press the ＋ and ─ buttons to select FAr (lower limit), and press the ◉ button to confirm.
Continue by adjusting the threshold with the ＋ and ─ buttons, and press the ◉ button to confirm.
Returns to operation mode after confirming.

Threshold setting range	＿ ～ 8888	4 to 9999 (using digital display)	* Returns to operation mode if there is no operation for 5 seconds
	＿ ～ 8888	1 to 999% (using percentage display)	

8. Switch to Setup/Teaching Mode

Move to the setup mode

Press the ◉ button for 3 sec. or more to move to setup mode.

3 seconds or more

Move to the teaching mode

Press the ■ button for 3 sec. or more to move to teaching mode.

3 seconds or more

Return to RUN mode

Return to RUN mode without going to "End" by pressing the ■ button in setup mode or the ◉ button in teaching mode for 3 sec. or more.
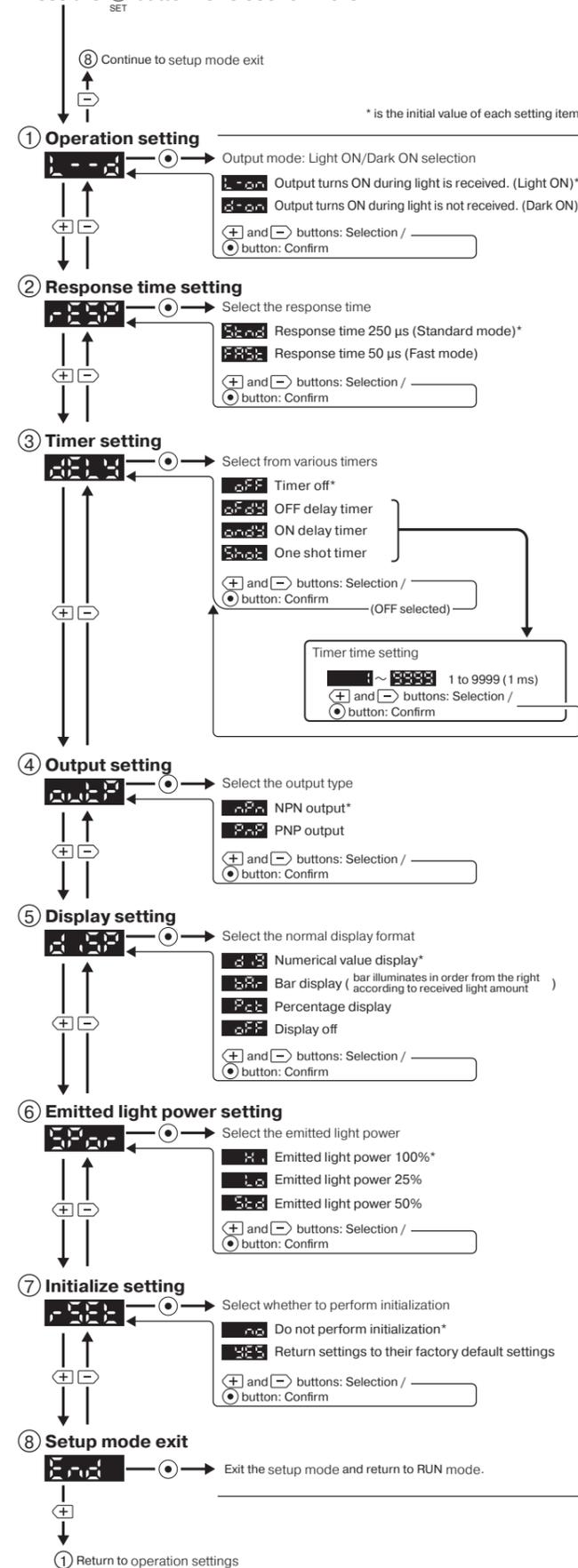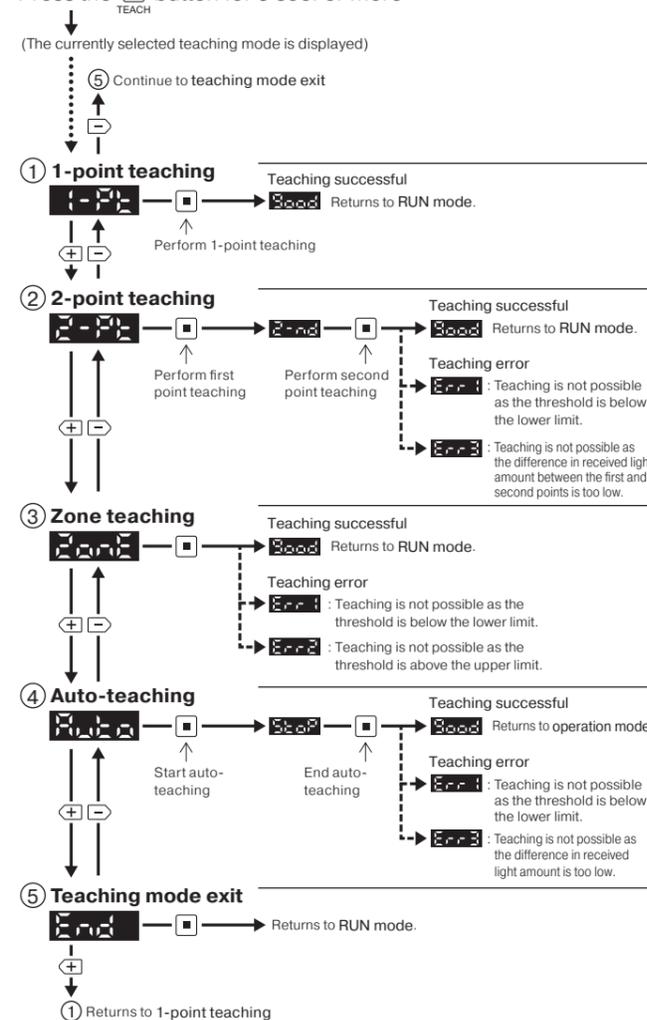
[When in setup mode]

3 seconds or more

[When in teaching mode]

3 seconds or more

9. Menu List

Setup mode

Press the ⊙ button for 3 sec. or more
SET

⑧ Continue to setup mode exit

* is the initial value of each setting item

① Operation setting

`L-d` → ⊙ → Output mode: Light ON/Dark ON selection

`L-on` Output turns ON during light is received. (Light ON)*
`d-on` Output turns ON during light is not received. (Dark ON)

⊕ and ⊖ buttons: Selection /
⊙ button: Confirm

② Response time setting

`rESP` → ⊙ → Select the response time

`Stnd` Response time 250 µs (Standard mode)*
`FASt` Response time 50 µs (Fast mode)

⊕ and ⊖ buttons: Selection /
⊙ button: Confirm

③ Timer setting

`dELY` → ⊙ → Select from various timers

`oFF` Timer off*
`oFdY` OFF delay timer
`ondY` ON delay timer
`Shot` One shot timer

⊕ and ⊖ buttons: Selection /
⊙ button: Confirm

(OFF selected)

Timer time setting

`1` ~ `9999` 1 to 9999 (1 ms)
⊕ and ⊖ buttons: Selection /
⊙ button: Confirm

④ Output setting

`outP` → ⊙ → Select the output type

`nPn` NPN output*
`PnP` PNP output

⊕ and ⊖ buttons: Selection /
⊙ button: Confirm

⑤ Display setting

`dISP` → ⊙ → Select the normal display format

`d.d` Numerical value display*
`bAr` Bar display (bar illuminates in order from the right according to received light amount)
`Pct` Percentage display
`oFF` Display off

⊕ and ⊖ buttons: Selection /
⊙ button: Confirm

⑥ Emitted light power setting

`PPor` → ⊙ → Select the emitted light power

`H` Emitted light power 100%*
`Lo` Emitted light power 25%
`Std` Emitted light power 50%

⊕ and ⊖ buttons: Selection /
⊙ button: Confirm

⑦ Initialize setting

`rESt` → ⊙ → Select whether to perform initialization

`no` Do not perform initialization*
`YES` Return settings to their factory default settings

⊕ and ⊖ buttons: Selection /
⊙ button: Confirm

⑧ Setup mode exit

`End` → ⊙ → Exit the setup mode and return to RUN mode.

⊕

① Return to operation settings

Teaching mode

Press the ■ button for 3 sec. or more
TEACH

(The currently selected teaching mode is displayed)

⑤ Continue to teaching mode exit

① 1-point teaching

`1-Pt` — ■ → Teaching successful
`Good` Returns to RUN mode.

Perform 1-point teaching

② 2-point teaching

`2-Pt` — ■ → `2-nd` — ■ → Teaching successful
`Good` Returns to RUN mode.

Perform first point teaching   Perform second point teaching

Teaching error
`Err1` : Teaching is not possible as the threshold is below the lower limit.
`Err3` : Teaching is not possible as the difference in received light amount between the first and second points is too low.

③ Zone teaching

`Zone` — ■ → Teaching successful
`Good` Returns to RUN mode.

Teaching error
`Err1` : Teaching is not possible as the threshold is below the lower limit.
`Err2` : Teaching is not possible as the threshold is above the upper limit.

④ Auto-teaching

`Auto` — ■ → `StoP` — ■ → Teaching successful
`Good` Returns to operation mode.

Start auto-teaching   End auto-teaching

Teaching error
`Err1` : Teaching is not possible as the threshold is below the lower limit.
`Err3` : Teaching is not possible as the difference in received light amount is too low.

⑤ Teaching mode exit

`End` — ■ → Returns to RUN mode.

⊕

① Returns to 1-point teaching

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10. Convenient Functions

Initialize settings

All settings are returned to their factory default settings.
1. Press the ⊙ button for 3 sec. or more to enter setup mode.
2. Press the ⊖ button twice to display `rESt`, and confirm with the ⊙ button.
3. Display `YES` with the ⊕ ⊖ button, and perform initialization with the ⊙ button.
4. Press the ■ button for 3 sec. or more to return to normal mode.

* "Output setting" is not changed even if initialization is performed.

Prevent misoperation (key lock)

Disable key operation to prevent misoperation, etc.
While in normal mode, press the ⊕ ⊖ buttons simultaneously for 3 sec. or more. Key lock is canceled by performing the same operation.

When locked `Loc`

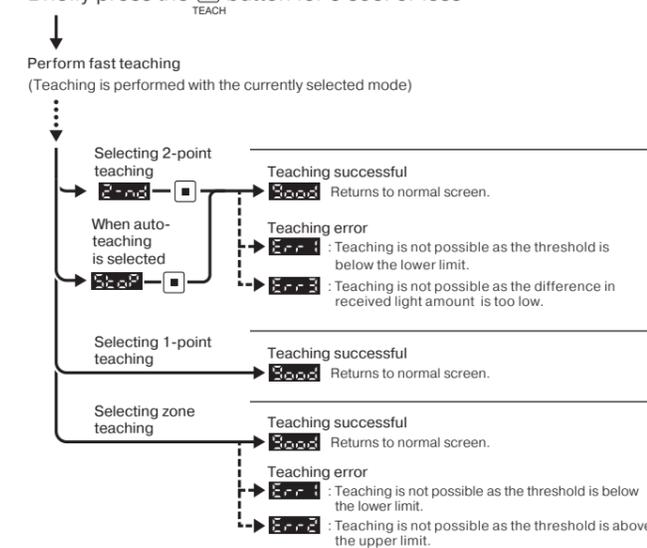When unlocked `unLc`   Press simultaneously (3 sec. or more)
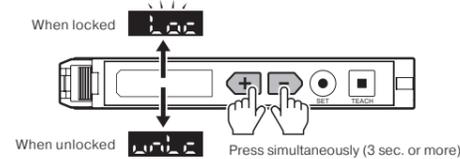
Display received light amount percentage

Sets the display as a percentage.
1. Press the ⊙ button for 3 sec. or more to enter setup mode.
2. Press the ⊕ button four times to display `dISP`, and confirm with the ⊙ button.
3. Display `Pct` with the ⊕ ⊖ button, and set the percentage display with the ⊙ button.
4. Press the ■ button for 3 sec. or more to return to normal mode.

On the spot teaching (fast teaching)

Briefly press the ■ button for 3 sec. or less
TEACH

Perform fast teaching
(Teaching is performed with the currently selected mode)

Selecting 2-point teaching
`2-nd` — ■ → Teaching successful
`Good` Returns to normal screen.

When auto-teaching is selected
`StoP` — ■ →

Teaching error
`Err1` : Teaching is not possible as the threshold is below the lower limit.
`Err3` : Teaching is not possible as the difference in received light amount is too low.

Selecting 1-point teaching
→ Teaching successful
`Good` Returns to normal screen.

Selecting zone teaching
→ Teaching successful
`Good` Returns to normal screen.

Teaching error
`Err1` : Teaching is not possible as the threshold is below the lower limit.
`Err2` : Teaching is not possible as the threshold is above the upper limit.

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11. Details on External Teaching

When using external input for teaching, the teaching method can be selected according to input time.
The conditions under which external input is turned ON differs depending on the output settings.
- With the NPN setting: ON at 0 V (blue) and short circuit
- With the PNP setting: ON at 10 V to 30 V (brown) and short circuit
* External teaching is cancelled if 8 sec. or more have passed with external input ON.
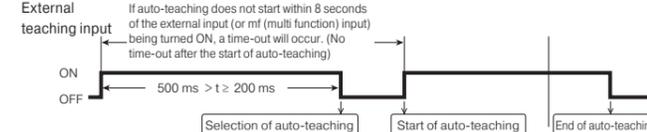
1-point teaching

- The received light amount is sampled when external input is turned ON.
- If external input turns OFF within 10 ms to 100 ms after it is turned ON, 1-point teaching is performed.

External teaching input
ON / OFF
8 s > t
100 ms > t ≥ 10 ms
Obtain received light amount   Perform 1-point teaching
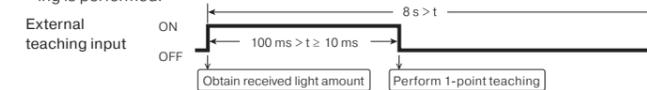
Zone teaching

- The received light amount is sampled when external input is turned ON.
- If external input turns OFF within 100 ms to 200 ms after it is turned ON, zone teaching is performed.

External teaching input
ON / OFF
200 ms > t ≥ 100 ms
Obtain received light amount   Perform zone teaching
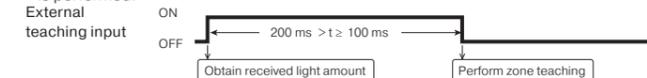
Auto-teaching

If the external input (or mf (multi function) input) is turned ON and then turned OFF within 200 ms to 500 ms, auto-teaching will be selected.
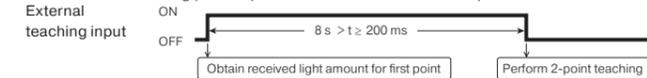- After selecting auto-teaching, auto-teaching will start when the external input (or mf (multi function) input) is turned on.
- Auto-teaching will end when the external input (or mf (multi function) input) is turned OFF.

External teaching input
If auto-teaching does not start within 8 seconds of the external input (or mf (multi function) input) being turned ON, a time-out will occur. (No time-out after the start of auto-teaching)
ON / OFF
500 ms > t ≥ 200 ms
Selection of auto-teaching   Start of auto-teaching   End of auto-teaching

2-point teaching

If external input turns OFF more than 200 ms after it is turned ON, 2-point teaching is performed.
- The first teaching point is performed when the external input is turned ON.
- The second teaching point is performed when the external input is turned OFF.

External teaching input
ON / OFF
8 s > t ≥ 200 ms
Obtain received light amount for first point   Perform 2-point teaching

Minimum pulse period

Since there is an input filter time, set the minimum ON/OFF time to 10 ms or more.

10 ms or more   10 ms or more

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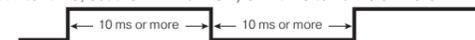
12. Specifications

Item		D1RF-T / D1RF-TC
Light source		Red LED
Supply voltage		10 to 30 VDC (including 10% ripple)
Current consumption (power)		40 mA max.
Response time	Standard	250 µs
	Fast	50 µs
Control output		NPN/PNP switched by setting, Open collector, 30 V/100 mA, Residual voltage 1.8 V max.
External input		External teaching
Initialization time		100 ms
Sensitivity adjustment		Teaching, fine tuning with +/- buttons
Output mode		Light ON / Dark ON selectable
Indicators		Output indicator: Orange, Power indicator: Green
Digital display		7-segment, 4-digit display Received light amount / Threshold / Set value
Protection circuit		Reverse connection protection, Overcurrent protection, 30 V max.
Cross talk prevention		Max. 2 units
Degree of protection		IP66
Operating temperature/ humidity		-25 to +55°C / 35 to 85% (no freezing or condensation)*
Storage temperature/ humidity		-40 to +70°C / 35 to 95% (no freezing or condensation)
Ambient illuminance		Sunlight: 10,000 lx or less, Incandescent light: 3,000 lx or less
Vibration resistance		10 to 55 Hz; Double amplitude 1.5 mm; 2 hours in each of the X, Y, and Z directions
Shock resistance		50 G (500 m/s²), 3 times in each of the X, Y, and Z directions
Mounting		Machine screw: M3 × 2, Rail: 35 mm DIN-rail
Connection type		Cable type: 4-wire 2 m cable, Connector type: M8, 4-pin
Connection		1/Brown: 10 to 30 VDC, 2/White: External input, 3/Blue: 0 V, 4/Black: Control output
Material		Housing, cover: Polycarbonate (PC)
Outer dimensions		10 × 33.2 × 75.5 (mm)
Included accessory(ies)		Instruction manual
Options		Mounting bracket
Applicable regulation(s)	EMC	EMC Directive (2014/30/EU)
	Environment	RoHS Directive (2011/65/EU), China RoHS (MIIT Order No.32)
Applicable standard(s)		EN 60947-5-2
NRTL certification		UL Recognized Component Proximity Switch Certified for US and Canada

*: Up to 16 closely mounted units

Model naming rules

D1RF-TC

Common   C: Connector type / No symbol: Cable type

NOTE: This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions:
(1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

- Support for the China RoHS directive
For details on the support for the China RoHS (the Administrative Measure on the Control of Pollution Caused by Electronic Information Products), see the following website.
http://www.optex-fa.com/rohs_cn/

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http://www.optex-fa.com