Dual Display Fiber Optic Amplifiers

BFN Series

INSTRUCTION MANUAL

TCD250011AD

Autonics

Thank you for choosing our Autonics product.
Be sure to read and fully understand the instruction manual and other manuals before using the product.
For your safety, read and follow the safety precautions, warnings, cautions, and handling instructions listed in the instruction manual, other manuals, and the Autonics website.
Keep this document in a location where it can be easily accessed.

Visit the Autonics website (www.autonics.com or QR code) for the latest information. Manuals, CAD files, certifications, software, etc. are available. The dimensions, specifications, certifications, etc. are subject to change without notice for product improvement. Certain models may be discontinued without notice.

Safety Precautions

- 'Safety Precautions' are provided to ensure safe and proper use of the product and to prevent accidents or hazards. Please make sure to follow them carefully.
- ⚠ symbol indicates a caution, warning of potential hazards under certain conditions.

⚠ Warning Failure to follow instructions may result in serious injury or death.

01. Fail-safe device must be installed when using the product in applications that may cause serious injuries or property loss. (E.g. nuclear control systems, medical equipment, ships, vehicles, railroads, aircraft, combustion devices, safety devices, security systems, disaster prevention devices, etc.)
Failure to do so may result in personal injury, property loss or fire.
02. Do not use or store the product in environments containing flammable, explosive, or corrosive gases, or in places exposed to high humidity, direct sunlight, radiant heat, vibration, shock, or salt.
Failure to do so may result in explosion or fire.
03. When expanding amplifiers, be sure to mount the units on a DIN rail. Securely fix the fiber optic amplifier and communication converter on the DIN rail by attaching end plates on each end. If using third-party end plates, make sure it meets the manufacturer's specification requirements.
Failure to do so may result in fire or product malfunction due to poor contact of the side connectors.
04. The side connectors of the amplifiers on each end or any unused amplifiers must be covered with side connector protective caps.
Failure to do so may result in electric shock or product damage.
05. Do not disassemble, repair, or modify the product without authorization.
Failure to do so may result in fire or injury.
06. Wait at least 3 seconds after applying power before using the product.
07. Do not connect, repair, or inspect the product while connected to a power source.
Failure to do so may result in fire.
08. Check the connection diagram before wiring.
Failure to do so may result in fire or product damage.
09. All unused input/output lines must be individually insulated.
Failure to do so may result in fire or product damage.
10. Installation, configuration, and integration with machine control system must be performed by a qualified supervisory user who is:
- fully familiar with the installation, configuration, operation, and maintenance of the product.
- fully familiar with national and regional standards, regulations, and laws applicable to the type of machine on which the product is installed.
Installation or configuration by personnel other than a supervisory user may result in improper operation or increase the risk of accidents.
11. After installing the product, check that the product's functions and settings are working as intended before the machine is in operation.
Improper configuration of the product may result in personal injury.
12. This product is not a safety sensor and does not comply with any domestic or international safety standards.
Do not use the product in applications where personal injury, loss of life, or property damage may occur.

⚠ Caution Failure to follow instructions may result in injury or product damage.

01. Use the product within its rated specifications and performance limits.
Failure to do so may result in fire or product damage.
02. Use a dry cloth to clean the product. Do not use water or organic solvents.
Failure to do so may result in fire.
03. When the fiber optic unit connection terminal is not in use, prevent dust, debris, or other foreign substances from entering the terminal.
04. Prevent metal, dust, wiring debris, and other foreign material from entering the product.
Failure to do so may result in fire, product malfunction, or product damage.

Cautions During Use

- Make sure to follow the instructions in 'Cautions During Use'. Failure to do so may result in unexpected accidents.
- Power input should be supplied from an isolated and limited voltage/current source, or from a Class 2 or SELV power supply.
- When supplying power with an SMPS, ground the F.G. terminal and connect a noise suppression capacitor between the 0 V and F.G. terminals.
- When connecting inductive loads such as DC relays, use a diode, varistor, or similar component to suppress surges.
- To prevent surges and inductive noise, separate the wiring from high-voltage and power lines, and keep wiring lengths as short as possible.
- Do not use the product near devices that generate strong magnetic fields or high-frequency noise.
- To prevent malfunction caused by stray light (sunlight, fluorescent lamps, etc.), use a light shield, slit, or similar measures.
- When detecting at maximum sensitivity, variations in individual characteristics may cause deviations in detection distance.
- Turn off the power before connecting or disconnecting communication converter units to the product. Failure to do so may result in product damage.
- When connecting with the communication converter, connect the power supply only to the communication converter. Do not connect separate power supplies to the communication converter and the fiber optic amplifier.
- When using fiber optic units, please observe the following:
  - Refer to the fiber optic unit manual for the bending radius of the fiber optic cable.
  - Do not apply excessive physical stress such as pulling, compression, bending, or twisting to the fiber optic cable or hood.
  - Do not pull or forcibly move the fiber optic cable.
- When disposing of this product, treat it as industrial waste. For detailed information, refer to the applicable national and regional standards, regulations, and laws.
- This product may be used in the following environmental conditions.
  - Indoors (UL Type 1 Enclosure)
  - Altitude: up to 2,000 m
  - Pollution Degree 3
  - Installation Category II

Software

Download the installation file and the manuals from the Autonics website.

■ atIOLink

atIOLink with purposes for setting, diagnosis, and maintenance of IO-Link device via IODD file is provided as the Port and Device Configuration Tool (PDCT).

- IODD (IO Device Description)

This file contains information such as manufacturer information, process data, diagnostic data, and parameter setting of a sensor using IO-Link communication. By uploading the IODD file to PDCT Software, you can check the setting and communication data according to the user interface.
Download the IODD file from the Autonics website.

Ordering Information

For reference only. The actual product does not support all combinations.
To check all supported models, please refer to the Autonics website.

BFN - ❶ ❷ - ❸ - ❹ - ❺

❶ Display
D: FND display

❷ No. of outputs
No-mark: 1-Output
2: 2-Output

❸ Output type
No-mark: Digital output
A: Digital + Analog output (1 - 5 VDC)

❹ Connection
No-mark: Cable type
C: M8 connector type

❺ IO-Link communication (by model)
No-mark: Not supported (standard)
IL3: IO-Link COM 3 (advanced)

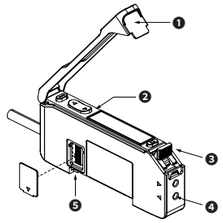
Product Components

- Product × 1
- Instruction manual × 1
- Expansion connector (12-pin) × 1

Sold Separately

- Communication converter: BFNC Series
- Bracket: BK-BFN-A
- M8 connector cable: C□D(H)408-□, C□D(H)4-□EB
- Fiber optic units
- End plate: BK-BFN-B

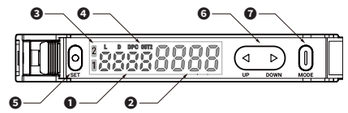
Unit Description



- Cable type shown as reference

❶ Protective cover
❷ Display / operation section
❸ Fiber optic unit locking lever
❹ Fiber optic unit connection terminal
❺ Side connector (+ protective cap)

■ Display / Operation



❶ SV display
Displays the set value for output ON/OFF reference. .

❷ PV display
Displays the current measured value of received light.

❸ Output indicator
Turns on when output 1 or output 2 is activated.

❹ Function indicator
Turns on when function is activated.
(L: Light ON / D: Dark ON / DPC / OUT2)

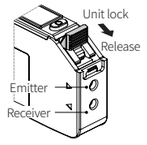
❺ [SET] key
Set sensitivity in run mode based on teaching mode. Supply power while holding to enter installation mode.

❻ [◀] [▶] (UP / DOWN) key
Adjust sensitivity in run mode, or change settings in various modes.

❼ [MODE] key
Press or hold to enter modes, e.g., incident light monitoring, program mode, data bank, and reset settings.

Connecting Fiber Optic Units

⚠
01. If a dedicated adapter is included with the fiber optic unit, attach the adapter before connecting it to the amplifier.
02. For coaxial fiber optic units, connect the single-core cable to the emitter terminal and the multi-core cable to the receiver terminal.
Failure to do so may compromise stable detection performance.



01. Open the protective cover.
02. Push the locking lever forward to release the lock.
03. Insert fiber optic units to the proper emitter/receiver connection terminals.
04. Pull the locking lever back to the lock position to secure the fiber optic units.
05. Close the protective cover.

■ Fiber Optic Unit Adapter

When attaching an adapter, make sure to use the appropriate adapter according to the fiber optic unit cable diameter.

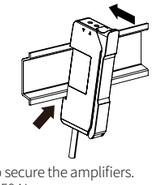
Fiber optic unit cable diameter	Adapter color
Ø 1.0 mm	Black
Ø 1.3 mm	Gray

Installing the Amplifier

■ DIN Rail Installation

Installation
01. Hook the DIN rail holder on the bottom onto the DIN rail.
02. Push the top part towards the DIN rail to lock it in place.

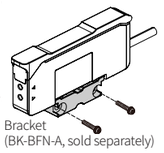
Removal
01. Push the bottom part of the amplifier upward and slightly lift it off the DIN rail.
02. Tilt the amplifier outward to remove it from the DIN rail.



- Install end plates (BK-BFN-B, sold separately) on each end to secure the amplifiers. When installing the screws, tighten with a torque less than 0.59 N•m.

■ Bracket Installation (BK-BFN-A, Sold Separately)

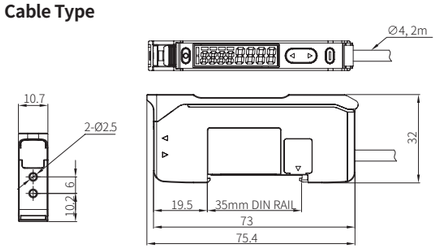
Brackets can be used to install the amplifiers in environments where DIN rail installation is not feasible.
01. Place the bracket at the installation location. The installation surface must be flat with minimal vibration.
02. Tighten M3 screws in the bracket holes and tighten with a torque less than 0.59 N•m to fix it in place. The screws can be inserted from the top of the bracket, or from the side of the bracket as shown in the image.
03. Align the DIN rail holder of the amplifier to the bracket groove and secure it in place.



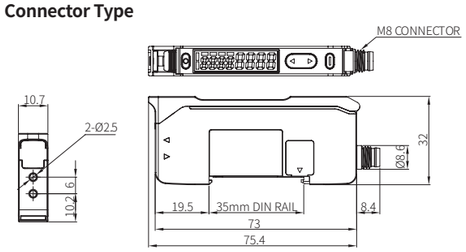
Dimensions

- Unit: mm (Refer to the CAD files from the Autonics website for exact dimensions)

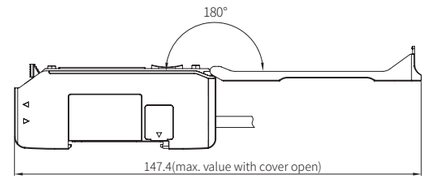
■ Cable Type



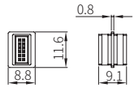
■ Connector Type



- With protective cover wide open (cable type shown)



■ Expansion Connector (12-Pin)

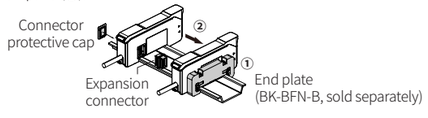


Expanding Amplifiers

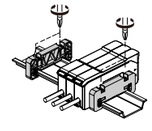
- You can expand multiple amplifiers using the side connectors. (up to 30 units)
- Power supplied to one amplifier will be distributed to all connected amplifiers.
- When power is supplied after connecting the amplifiers, mutual interference prevention function will be activated.

⚠
01. Turn off the power before amplifier expansion installation.
02. Do not apply excessive force to the side connector.
Failure to do so may result in damaging or bending the connector pins.
03. Make sure the side connector is tightly and securely connected.
Failure to do so may result in reduced performance or product malfunction.

01. Install the first amplifier on the DIN rail.
02. Install an end plate (BK-BFN-B, sold separately) next to the installed amplifier (①) to prevent the amplifier from moving.
03. Attach an expansion connector (accessory) to the side connector of the expansion amplifier(②).



04. Mount the expansion amplifier on the DIN rail, then push it toward the installed amplifier to connect.
05. Attach the connector protective cap to the last amplifier after expansion is complete.
06. Check that all amplifiers and connectors are tightly and securely connected.
07. Install an end plate next to the final expansion amplifier and tighten with screws with a torque less than 0.59 N•m to fix the position.



Specifications

Type	Advanced		Standard
Model	**BFN-D□-□-IL3**	**BFN-D2-A-□-IL3**	**BFN-D-□**
Display resolution	9999 (SV (Green) / PV (White): 4-digit, 7-segment)		
Communication	BFNC Series compatible, IO-Link		BFNC Series compatible
No. of outputs	1-Output, 2-Output models	2-Output	1-Output
Output	Digital (OUT 1), Digital (OUT 1/2) models	Digital (OUT 1) + Analog (OUT 2)	Digital (OUT 1)
Light source type	Red LED		
Light source wavelength	660 nm		
Operation mode	Light ON, Dark ON (parameter setting)		
Sensitivity setting	Teaching mode (1-point, 2-point, Auto, Area, Rising / Falling edge [01]) / Manual		
Response mode (Response time)	MFST: Mega fast (25 µs) [02] UFST: Ultra fast (50 µs) FST: Fast (150 µs)	STD: Standard (500 µs) LONG: Long (4 ms) ULOG: Ultra long (10 ms) MLOG: Mega long (20 ms) [02]	
Timer	ON Delay, OFF Delay, One Shot, ON/OFF Delay, One Shot ON Delay (parameter setting, time setting range: 1 to 9,999 msec)		
Maximum no. of expansion units	30 units		
Mutual interference prevention	YES (The number of supported units may differ by response mode and mutual interference prevention double settings. [03])		
Certification	IO-Link	IO-Link	
Unit weight (with packaging)	[Cable type] ≈ 74 g (≈ 139 g) [Connector type] ≈ 22 g (≈ 55 g)		

01) Rising / falling edge teaching mode is not supported in MFST/UFST response modes.
02) Only available for advanced type models.
03) Please refer to the user manual for detailed information.

Power supply	10 - 30 VDC⎓ (ripple P-P: ≤ 10%)		
Current consumption		10 VDC⎓	30 VDC⎓
	Normal	≤ 62 mA	≤ 30 mA
	Eco: HALF	≤ 55 mA	≤ 28 mA
	Eco: FULL	≤ 48 mA	≤ 26 mA
Digital output	[Advanced] Push-pull, NPN, PNP output (parameter setting) [Standard] NPN, PNP output (parameter setting)		
Load current	[Advanced: digital 1-output, standard models] ≤ 100 mA, when 4 or more units connected: ≤ 20 mA [Advanced: digital 2-output models] ≤ 50 mA, when 4 or more units connected: ≤ 10 mA each		
Load voltage	≤ 30 VDC⎓		
Residual voltage	NPN: ≤ 2 VDC⎓, PNP: ≤ 2 VDC⎓		
Analog output	[Advanced: digital + analog output models] only [01]		
Voltage output	1 - 5 VDC⎓, ± 5% F.S. (output resistance: 1 kΩ)		
Protection circuit	Reverse power protection circuit, output short overcurrent protection circuit, surge protection circuit		
Insulation resistance	≥ 20 MΩ (500 VDC⎓ megger)		
Dielectric strength	Between charging part and case: 1,000 VAC~ 50/60 Hz for 1 min		
Vibration resistance	1.5 mm double amplitude at frequency 10 to 55 Hz in each X, Y, Z direction for 2 hours		
Shock resistance	500 m/s² (≈ 50 G) in each X, Y, Z direction for 3 times		
Ambient illuminance (receiver)	Sunlight: ≤ 30,000 lx, incandescent lamp: ≤ 20,000 lx		
Ambient temp. [02]	-10 to 50 °C, storage: -20 to 70 °C (no freezing or condensation)		
Ambient humidity	35 to 85% RH, storage: 35 to 85% RH (no freezing or condensation)		
Protection rating	IP50 (IEC standard)		
Connection	Cable type, M8 connector type models		
Cable specifications	Ø 4 mm, 4-wire, 2 m		
Wire specifications	AWG23 (0.08 mm, 60-core), insulator diameter: Ø 1.28 ± 0.05 mm		
Material	Case, cover: PC		

01) Analog output is not supported in MFST/UFST response modes.
02) Ambient operating temperature is measured with the unit installed on a metal DIN rail. When installing the unit in an enclosed space, proper ventilation and temperature management is required.

Communication Interface

■ IO-Link

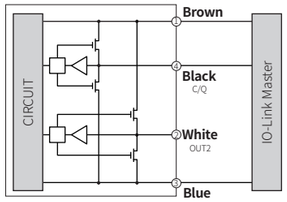
Version	Ver. 1.1.3
Class	Class A
Baud rate	COM3 (230.4 kbps)
Min. cycle time	500 µs
Data length	PD: 4-byte, OD: 1-byte (M-sequence: TYPE_2_V)
Vendor ID	899 (0x383)

Circuit / Wiring Diagram

Load connections differ by output method. Please refer to the diagrams below.

■ [Advanced Model] IO-Link Mode

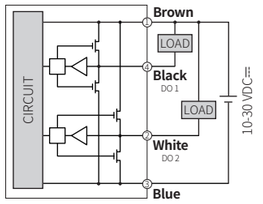
- [Advanced: digital 2-output model] shown as reference.
  The white wire retains OUT 2 output method of the model regardless of IO-Link mode.



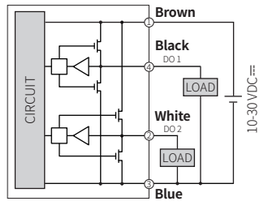
■ [Advanced: Digital 1,2-Output Model]

- [Advanced: digital 2-output model] shown as reference.
  The white wire is not supported in [advanced: digital 1-output model].

NPN setting



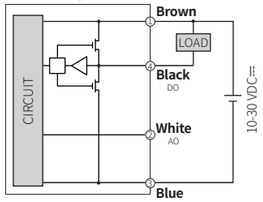
PNP setting



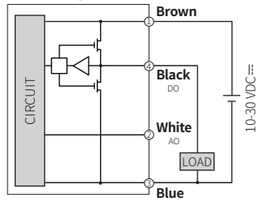
■ [Advanced: Digital + Analog Output Model]

- The black wire: digital output (DO) and white wire: analog output (AO, 1 - 5 VDC⎓) are fixed.

NPN setting

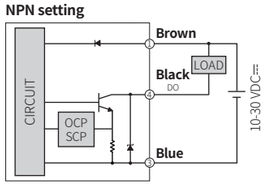


PNP setting

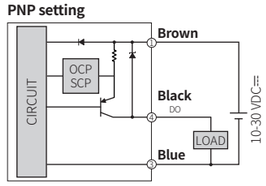


■ [Standard: Digital 1-Output Model]

NPN setting



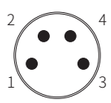
PNP setting



- The white wire is not used in this model. Do not connect the wire.
- OCP (over-current protection), SCP (short-circuit protection)
- If the control output terminal is short-circuited or a current exceeding the rated current is supplied, normal control signals will not be output due to the protection circuit.

Connector Wiring

- For load connections, please refer to the wiring diagram.
- Tighten the connector using the screw thread. (Tightening torque: 0.39 to 0.49 N m)
- In environments with vibration, use PTFE tape around the connector to strengthen the connection.



Pin	Color	Function	
		Advanced	Standard
①	Brown	L+	VCC
②	White	[Digital 1-output model] - [Digital 2-output model] Digital OUT 2 (DO 2) [Digital+analog output model] Analog OUT (AO)	-
③	Blue	L-	GND
④	Black	C/Q	OUT

Entering Settings

- Directions to enter each settings from run mode.
- Please refer to the dedicated section of the user manual for details on each settings.

Settings	Method	Description
Sensitivity settings	[SET] key for 0.5 secs or more	Set the sensitivity based on teaching mode. - Press for (0.5 sec): teach for set amount of time - Press for (≥ 0.5 sec): teach for duration of hold
Manual sensitivity settings	[◀ / ▶] key for over 0.5 secs	Fine tune the sensitivity manually after initial setting.
Anti-saturation function	[SET + ▶] keys for over 0.5 secs	Enable or disable anti-saturation function.
Zero shift function	[◀ + MODE] keys for over 0.5 secs	Enable or disable zero shift function.
Select digital output	[◀ + ▶] keys for over 2 secs	[Digital 2-output model] Select OUT1 or OUT2. Selection is synchronized with settings from program mode P-2 digital output selection.
Incident light level monitoring	[MODE] key for 0.5 secs	Displays max value, min value, or output count.
Program mode	[MODE] key for over 2 secs	Enter program mode.
Data bank	[MODE] key for over 5 secs	Set or execute data bank.
Reset settings	[MODE] key for over 7 secs	Reset to default settings.

Manual Sensitivity Setting

Adjust the sensitivity manually after setting the sensitivity based on teaching mode.
Press the [◀ / ▶] (UP / DOWN) keys during run mode to fine tune the sensitivity.
Press [MODE] key for 0.5 secs and the set value will flash twice and return to run mode.

- The supported min/max values differ depending on settings from program mode P-2-A Teaching mode and P-9 Hysteresis.

Hysteresis	Setting Range	
	1/2-Point, Auto, Area [01] Teaching	Rising / Falling Edge Teaching
LOW	10 to 9,980	150 to 9,999
MID	50 to 9,950	
HIGH	100 to 9,900	

01) Press the [MODE] key to switch between SV_H / SV_L and set sensitivity.

Incident Light Level Monitoring

Press the [MODE] key for 0.5 seconds in run mode to check incident light level value.
- [MODE] key: display next value / [SET] key: reset current display value

Display		Operation
SV	PV	
Run mode		Press the [MODE] key for 0.5 secs in run mode.
HPEK	5200	Displays the high peak (max.) value from measured data.
LPEK	200	Displays the low peak (min.) value from measured data.
Cnt	99	Displays output count. (Range: 0 to 9,999, then restarts from 0) Counts the number of times output changes from OFF → ON.
Run mode		Press the [MODE] key for 0.5 secs to return to run mode.

Reset to Default Settings

Reset SV1/SV2 and program mode settings to default settings.
Press the [MODE] key for over 7 seconds to enter reset settings menu.

Display		Operation
SV	PV	
Run mode		Press the [MODE] key for over 7 secs in run mode.
Init	nodE	SV display: INIT, PV display: MODE will flash twice.
Init	no	Press the [◀ / ▶] keys to select reset option (YES / NO). Press the [MODE] key to execute selection.
Init	Init	SV display: INIT, PV display: INIT will flash twice. The settings have been reset to default settings.
Run mode		Returns to run mode automatically.

Error Display

Display		Error	Troubleshooting
SV	PV		
PUEr	Err	Exceeds rated power supply range	Check the power supply voltage and adjust it to the specified rated range.
CH	Err	Unstable side expansion connection	Check the connections by referring to the 'Expanding Amplifiers' section.
o1oC	Err	Overcurrent in digital 1 output circuit	Remove the overload condition to eliminate the overcurrent.
o2oC	Err	Overcurrent in digital 2 output circuit	

Program Mode

- Press the [MODE] key for over 2 seconds from run mode to enter program mode.
  SV display: PROG, PV display: MODE will flash twice, then enter into settings.
- [MODE] key: save and move to next item / [SET] key: save and move to previous item
  [◀ / ▶] keys: change value / [MODE] key over 3 secs: save and return to run mode
  When idle for 120 seconds, the settings will be saved and return to run mode.
- Certain parameters may be enabled or disabled depending on the model or other parameter settings. Refer to the description on each item for details.
- Please refer to the dedicated section of the user manual for details on each settings.

Parameter		Display		Setting Range	Support Conditions
		SV	PV (default)		
P-1	Response mode [01]	rSPS	Std	MFST*: Mega fast (25 µs) [02] UFST: Ultra fast (50 µs) [02] FST: Fast (150 µs) STD: Standard (500 µs) LONG: Long (4 ms) ULOG: Ultra long (10 ms) MLOG*: Mega long (20 ms)	*Advanced model
P-2	Select digital output	SEL	oUt1	[Digital 2-output model] OUT1: Digital output 1 OUT2: Digital output 2 • Set parameters for (P-2-A to E) based on selected output.	
P-2-A	Teaching mode	SEnS	2Pnt	2PNT: 2-Point 1PNT: 1-Point AUTO: Auto AREA*: Area RISI**: Rising edge FALI**: Falling edge	*P-2 digital output: OUT1 **P-1 response mode: not MFST, P-2 digital output: OUT1, P-7 DPC: OFF
P-2-B	Operation mode	Ldon	L-on	L-ON: Light ON D-ON: Dark ON	
P-2-C	Output type	tYPE	nPn	NPN: NPN PNP: PNP P-P*: Push-pull	*Advanced model (IO-Link)
P-2-D	Timer	tmod	oFF	OFF: Disabled OND: ON Delay OFD: OFF Delay SHOT: One Shot ONOF: ON/OFF Delay SH-O: One Shot ON Delay	P-1 response mode: not MFST
P-2-E	Timer value	tIME	5	1 to 9,999 msec	P-1 response mode: not MFST P-2-D timer: not OFF
P-3	Analog output direction	ALoD	ASEn	[Digital + analog output model] ASEN: Ascend DSEN: Descend	
P-4	Enable zero shift	ZEro	----	DO: Enable zero shift CANC: Disable zero shift	P-6 Preset: OFF
P-5	Enable anti-saturation	SAtU	----	DO: Enable anti-saturation CANC: Disable anti-saturation	
P-6	Preset	PrSt	oFF	OFF: Disabled ON: Enabled • Set to ON before teaching. Incident light level is displayed as a percentage of preset value. (%=P)	P-7 DPC: OFF
P-7	DPC (Dynamic Power Control)	dPC	oFF	OFF: Disabled ON: Enabled	P-1 response mode: not MFST
P-8	Mutual interference prevention double	IntF	Std	STD: Standard DBLE*: Double (double the no. of mutual interference prevention units and response speed)	*P-1 response mode: not MFST, UFST
P-9	Hysteresis	HYS	LoY	LOW, MID, HIGH • Set hysteresis where incident light fluctuates widely to increase output stability and accuracy. Output may malfunction when set to LOW.	
P-10	Display direction	dir	1234	1234: Standard 4321: Inverted	
P-11	Power-saving mode	ECo	oFF	OFF: Disabled HALF: When there is no key input for 1 min, only the output indicator and PV display are left ON. FULL: When there is no key input for 1 min, only the output indicator is left ON. • Set to lower current consumption.	
P-12	Disable communication	Comm	EnA	ENA: Run communication commands from master device. DISA: Blocks communication commands from master device. (only P-12/13 settings allowed)	
P-13	Lock	LoCK	oFF	OFF: Disabled LOC1: Only sensitivity and program mode check allowed LOC2: Only sensitivity check allowed	

01) When changed, sensitivity is reset, zero shift/anti-saturation are disabled, and P-6-Preset/P-7 DPC are turned OFF.
02) In digital + analog output models, analog output is not supported in MFST, UFST modes.

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