

Autonics Digital Fiber Optic Sensor BF5 SERIES(Dual Display)



Thank you very much for selecting Autonics products.
For your safety, please read the following before using.

Caution for your safety

- Please keep these instructions and review them before using this unit.
- Please observe the cautions that follow.
- Warning** Serious injury may result if instructions are not followed.
- Caution** Product may be damaged, or injury may result if instructions are not followed.
- The following is an explanation of the symbols used in the operation manual.
- Caution: Injury or danger may occur under special conditions.

Warning

- In case of using this unit with machinery(Ex: nuclear power control, medical equipment, ship, vehicle, train, airplane, combustion apparatus, safety device, crime/disaster prevention equipment, etc) which may cause damages to human life or property, it is required to install fail-safe device. It may cause a fire, human injury or damage to property.
- Do not disassemble the case. Please contact us if it is required. It may cause electric shock or a fire.

Caution

- This unit shall not be used outdoors. It might shorten the life cycle of the product or cause electric shock.
- Do not use this unit where inflammable or explosive gas exists. It may cause a fire or explosion.
- Please observe the rated specifications. It may shorten the life cycle of the product.
- Do not use this unit over rated voltage and do not supply AC power to DC power type. It may cause product damage.
- Wire properly after checking the power polarity. It may cause product damage.
- Do not use this unit where severe shock or vibration exists. It may cause product damage.
- In cleaning unit, do not use water or organic solvent. It may cause electric shock or a fire.

Ordering information

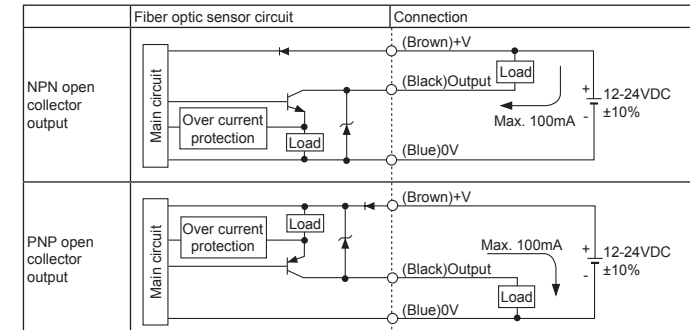
Model	Light source	Display part	Control output
BF5R-D1-N	Red LED	Dual display type	NPN open collector output
BF5R-D1-P	Red LED		PNP open collector output
BF5G-D1-N	Green LED	Dual display type	NPN open collector output
BF5G-D1-P	Green LED		PNP open collector output
BF5B-D1-N	Blue LED	Dual display type	NPN open collector output
BF5B-D1-P	Blue LED		PNP open collector output

Part description



- Control output indicator (Red)**
Used to indicate control output provided by comparing SV and actual incident light level.
- Sensitivity setting key**
Used to execute each operation and to set sensing sensitivity.
- PV display part (4digit, Red, 7-segment)**
Used to indicate incident light level and parameters.
- SV display part (4digit, Green, 7-segment)**
Used to indicate SV and setting data.
- Up/Down key**
Used to indicate control output provided by comparing SV and actual incident light level.
Used to fine-adjust sensitivity
- MODE key**
Used to enter into program mode / data bank mode.
Used to move each parameter.
- Lock lever**
Used to indicate SV and setting data.

Control output circuit diagram and Connections



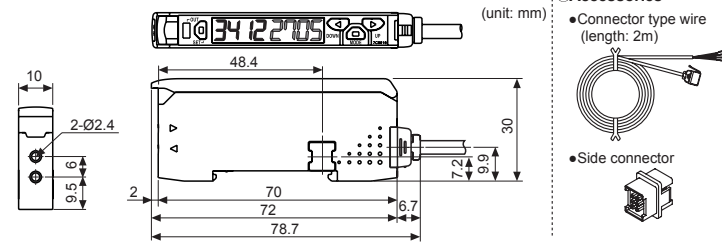
The above specifications are subject to change and some models may be discontinued without notice.

Specifications

Model	BF5R-D1-N	BF5G-D1-N	BF5B-D1-N
NPN open collector output	BF5R-D1-N	BF5G-D1-N	BF5B-D1-N
PNP open collector output	BF5R-D1-P	BF5G-D1-P	BF5B-D1-P
Light source	Red LED(660nm, modulated)	Green LED(530nm, modulated)	Blue LED(470nm, modulated)
Response time	Ultra Fast: 50μs, Fast: 150μs, STD: 500μs, Long: 4ms, Ultra Long: 10ms		
Power supply	12-24VDC ±10%		
Current consumption	Max. 50mA		
Operation mode	Light ON/Dark ON Selectable		
Control output	NPN or PNP open collector output • Load voltage: Max. 24VDC • Load current: Max. 100mA • Residual voltage - NPN Max. 1V, PNP: Max. 3V		
Protection circuit	Reverse power polarity protection, Overcurrent protection, Surge protection		
Display method	• Incident light level: Red, 4digit, 7-segment • SV: Green, 4digit, 7-segment • Main output indicator: Red LED		
Display function	Incident light level / SV display [4,000/10,000 resolution], Percentage display, High/Low peak value display, Normal / Reversed display		
Sensitivity setting	Manual sensitivity setting, Teaching sensitivity setting(Auto-tuning, One-point, Two-point, Positioning)		
Mutual interference prevention	Max. 8 unit sets(Automatically set regardless of response time)		
Initializing	Initializing to factory mode		
Energy saving	Normal / Energy saving 1 / Energy saving 2		
Timer	OFF, OFF Delay, ON Delay, One-shot		
Insulation resistance	Min. 20MΩ(at 500VDC megger)		
Dielectric strength	1,000VAC 50/60Hz for 1min.		
Vibration	1.5 mm amplitude at frequency of 10 to 55Hz(for 1 min.) in each X, Y, Z direction for 2 hours		
Shock	500m/s ² (Approx. 50G) in X, Y, Z directions for 3 times		
Ambient illumination	Incandescent lamp: Max. 3,000lx, Sunlight: Max. 11,000lx(received illumination)		
Ambient temperature	-10 to 50°C, Storage: -20 to 70°C		
Ambient humidity	35 to 85%RH, Storage: 35 to 85% RH		
Protection	IP40(IEC standard)		
Material	Case: PBT, Cover: PC		
Fiber cable tightening torque	Min. 2kgf		
Accessories	Connector type wire(φ4mm, 3-wire, length: 2m)(AWG22, Core diameter: 0.08mm, Number of cores: 60, Insulator diameter: φ1.25mm), Side connector		
Approval	CE		
Weight**	Approx. 138g(approx. 20g)		

*1: The weight is with packaging and the weight in parentheses is only unit weight.
**The temperature or humidity mentioned in Environment indicates a non freezing or condensation environment.

Dimensions

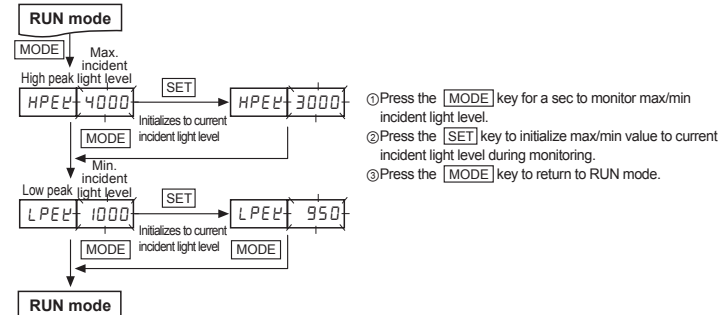


Installations

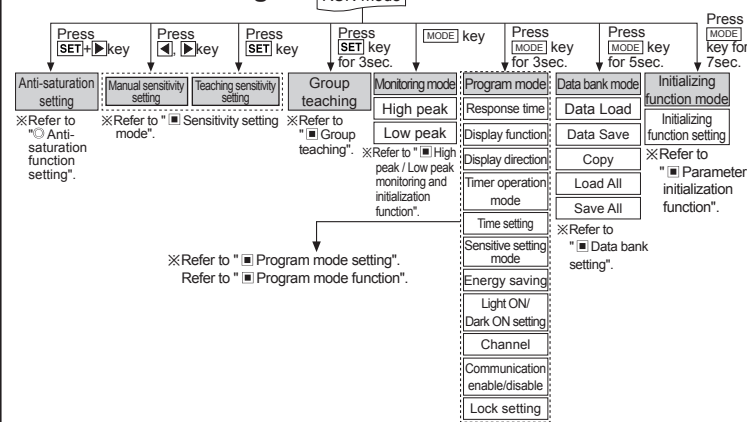
- Amplifier unit mounting**
• Installation: Hang up the backside holder on the DIN rail and press the unit toward the DIN rail.
• Removal: Slide the back part of the unit as the ① figure and lift up the unit as the ② figure.
- Amplifier unit connection**
• Remove the side cover at the connecting side as the figure ① and connect the side connector as the figure ②.
• Be sure that if connecting a side connector with excessive force, it may cause extruded pins.
• After mounting the unit on the DIN rail, push gently both units to fasten each other.
• Make sure that connections between the unit case and connectors correctly.
Improper connection may cause malfunction of channel setting and mutual interference prevention functions.
• Do not supply the power while connecting / disconnecting amplifier units.
- Fiber cable connection**
• Lift up the protective cover to the ① direction and completely lower the lock lever to the direction of the ② direction to release the lock setting.
• Insert the cable to the ③ direction and adhere between the cable and the inside of the amplifier unit. (Insert depth: Approx. 13mm)
• Place up the lock lever to lock the lock setting to the ④ direction and close the protective cover to the ⑤ direction.
- Wire connector connection**
• Insert the connector into the amplifier unit until it clicks into the right position.
• When removing the connector, pull out the connector to the ⑥ direction with pressing the lever downside to the ⑦ direction.

High peak / Low peak monitoring and initialization function

A function to monitor the high/low peak value of incident light level. The monitored high/low peak value can be initialized.

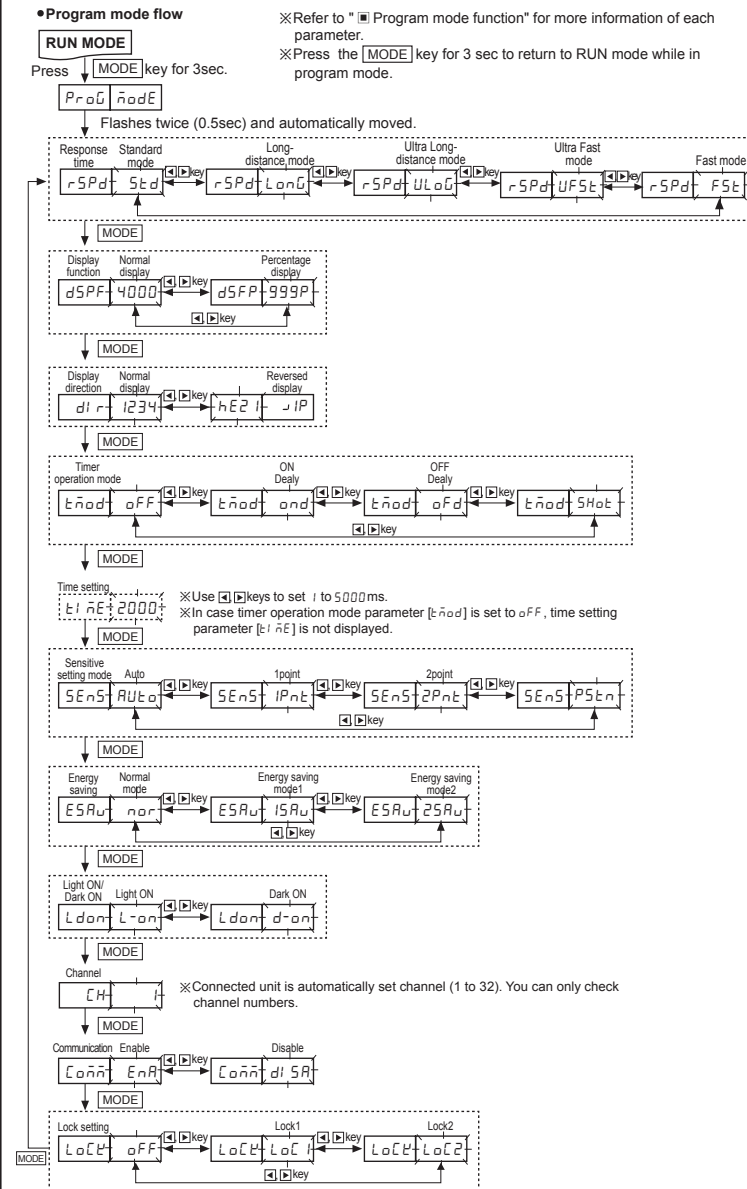


Parameter setting



Program mode setting

- When entering into program mode, the parameter turns ON on the PV display part and the setting value flashes every 0.5 sec on the SV display part. Use the [←], [→] keys to set each setting value.
- Press the [MODE] key one time after setting each parameter to save the setting and enter into next mode.
- If the key lock is set, unlock the key lock before setting parameters.



Program mode function

- Response time setting [rSPd]**
A function to set the response time of control output - 4 response modes selectable.
• Ultra Fast [UF5t]: 50μs • Fast [F5t]: 150μs
• Standard [Std]: 500μs • Long distance [LonG]: 4ms • Ultra Long distance [ULoG]: 10ms
- Display function [dSPF]**
A function to select display mode for incident light level on the PV display part.
• Standard display (4000) / Percentage display (999P)
• Display range of standard mode: 0 to 4000 (0 to 9999, in case of long distance mode)
• Display range of percentage mode: 0P to 999P (Decimal point is not displayed)
- Display direction setting function [dlr]**
A function to reverse the display direction to suit the unit installation location.
• Normal display / Reversed display selectable.
• Reversed display is upside-down(180°) display of normal display.

Timer function [Timer operation mode: tNoD, Time setting: tNE]

- Used when the external device's response time is too late or when control output time is too short due to small sensing object - 3 modes available.
- Timer OFF [oFF]
- ON Delay [oNd]: A mode in which control output ON time is delayed for a certain period of setting time.
- OFF Delay [oFd]: A mode in which control output OFF time is delayed for a certain period of setting time.
- One-shot [ShoT]: A mode in which control output becomes ON or OFF within a certain period of setting time.
- Time setting [tNE]: 1 to 5000ms

Timing chart



Energy saving function [ESRv]

- A function to save unit's power consumption by reducing power supplying to display parts in case of no setting input within 60sec.
- Selectable from 2 energy saving modes
- Normal mode[nor]: Control output indicator(OUT), PV/SV display parts ON
- Energy saving mode 1[1SRv]: Control output indicator(OUT) and PV display part ON
- Energy saving mode 2[2SRv]: Control output indicator(OUT) ON

Light ON / Dark ON switching function [LdOn]

- A function to set Light ON - control output is ON when incident light level is higher than setting value and Dark ON - control output is ON when incident light level is lower than setting value.

Communication write enable / disable setting function [CoAn]

- A function to set communication write [enable[EnR]] / disable[diSR]] for Slave amplifier units while certain instructions(Load/Save/Copy) or Group teaching is in progress by the Master amplifier unit.

Lock function [LoCt]

- Two types of key lock setting available in order to prevent SV changes due to careless.

Sensitivity setting	oFF	LoC1	LoC2
Data bank mode	●	○	○
Program mode	●	○	○
Parameter initialization	●	○	○

- In case of LoC2 mode, it is required to disable the lock function first to enter into parameter mode.

Amplifier units connection using side connector

- In case multiple amplifier units are connected, supply the power for one unit and the power is also supplied to the other connected units.

Auto channel setting function

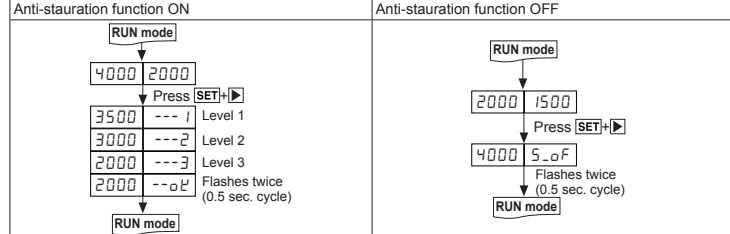
- The channel for each amplifier unit - connected by side connector - is automatically set in a certain direction (→) as soon as power is supplied. Channel number is increasing one by one.
- The automatically set channel can be checked in channel parameter in program mode.
- Channel range : 1 to 32
- Note that the automatically set channel cannot be changed and the channel number of each amplifier unit is not saved in case of power OFF.

Mutual interference prevention function

- A function to set different light receiving time for each amplifier unit in case the adjacent fiber cable is installed in order to prevent mutual interference occurring. (Set automatically when power is turned ON.)
- Mutual interference function is allowed up to maximum 8 amplifier units regardless of the unit model and response time.

Anti-saturation setting function

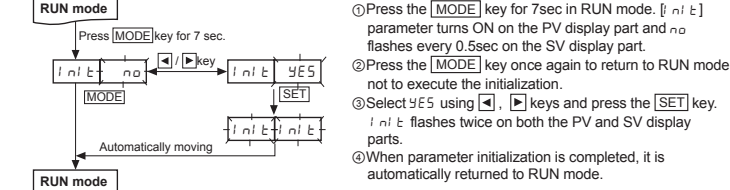
- When the sensing target comes too close and it is saturation status, this function corrects the optimize status.
- Press the [SET] key one time and anti-saturation function operates automatically. There are max. 10 levels.
- Press the [SET] key one time again and anti-saturation function is cleared.
- During anti-saturation, the SV display part displays current level.
- When response mode is ultra fast [UF5t], fast [F5t] or standard [Std] and incident light level is lower than 2200, this function is cleared and this unit returns RUN mode automatically. When response mode is long distance [LonG], ultra long distance [ULoG] and incident light level is lower than 5500, this function is cleared and this unit returns RUN mode automatically.
- This function is not operated when incident light is lower by each mode [UF5t, F5t, Std: 2200, ULoG, LonG: 5500].
- If saturation status is too high and it does not reach the target value, it stops at level 10 and this unit returns RUN mode.
- When anti-saturation function is set, control output operation may be changed.



Parameter initialization function

- A function to initialize all parameters in memory to default value in case the possibility of missetting or misoperation.
- Set lock function [LoCt] to oFF to execute parameter initialization.
- High peak value[HPEL] and low peak value[LPEL] is not initialized.

Parameter Initialization flow



Parameter value for initialization (Factory default)

Parameter	Factory default	Parameter	Factory default	Parameter	Factory default
rSPd	5t d	tNoD	oFF	LdOn	L-on
dSPF	4000	SEnS	RUt o	CoAn	EnR
dlr	l234	ESRv	nor	LoCt	oFF

SV: 2000, Bank 0 to 2: Initialized

Sensitivity setting mode

There are two methods available for sensitivity setting - manual/teaching sensitivity setting. Select the method most suitable for your application.

Manual sensitivity setting(Fine-adjusting sensitivity)

- This setting is to set the sensitivity manually.
- Used to fine-adjust sensitivity after the teaching sensitivity setting.
- Incident light level is still displayed on the PV display part during setting.



- Press the [4] and [2] key to set the value.
- There is no additional key for completing the setting. If there is no key input for 3sec after completing setting, last set value flashes twice(every 0.5sec) and automatically saved it and returned to RUN mode.

Teaching sensitivity setting(Auto-tuning, One-point, Two-point, Positioning)

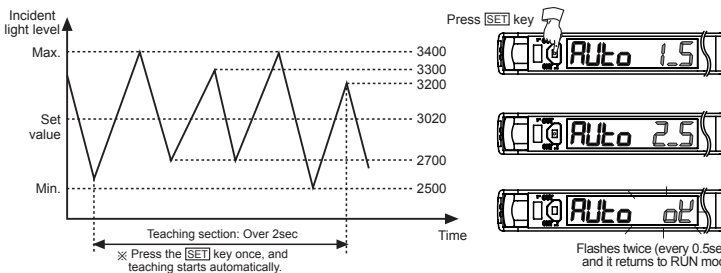
- How to enter into sensitivity setting mode in RUN mode
- Press the [SET] key once in RUN mode and teaching starts. When teaching is complete, it returns RUN mode automatically.
- During teaching, the PV display part displays the set teaching mode parameter and the SV display part displays progressing status.
- Refer to the below for the each teaching sensitivity setting.

1. Auto-tuning teach mode

- Suitable when incident level of sensing object is not stable or when sensing fast moving objects.
- Auto-tune automatically sets the sensitivity using the average value of the incident light level within a certain time period.

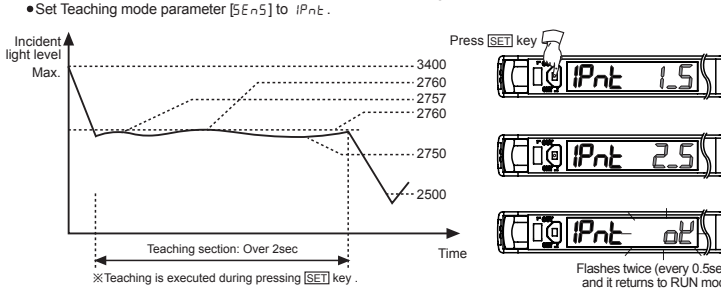
$$\text{Set_value} = \frac{P1+P2+\dots+Pn-1+Pn}{n}$$

- Set Teaching mode parameter [5E n5] to RUt o.



2. One-point teach mode

- One of teaching modes that sets the maximum sensitivity by teaching one sensitivity setting point when setting the SV with no sensing object (Reflective) or when setting the SV with incident light level 0(Through-beam) / Suitable for the applications required little effect of dust or background.
- Set Teaching mode parameter [5E n5] to iP nE.

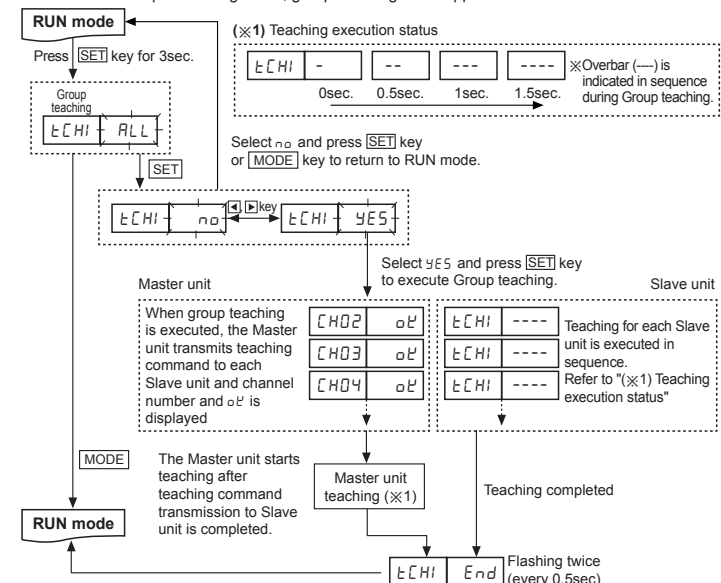


SV range for sensing distance.

Response Time	Teaching when incident light level is 0	Teaching when incident light level is saturated
UF5t F5t 5td	In case incident light level is 0, set to 10digit.	In case incident light level is saturated, set to 3980digit.
L oG UL oG	In case incident light level is 0, set to 5digit.	In case incident light level is saturated, set to 9980digit.

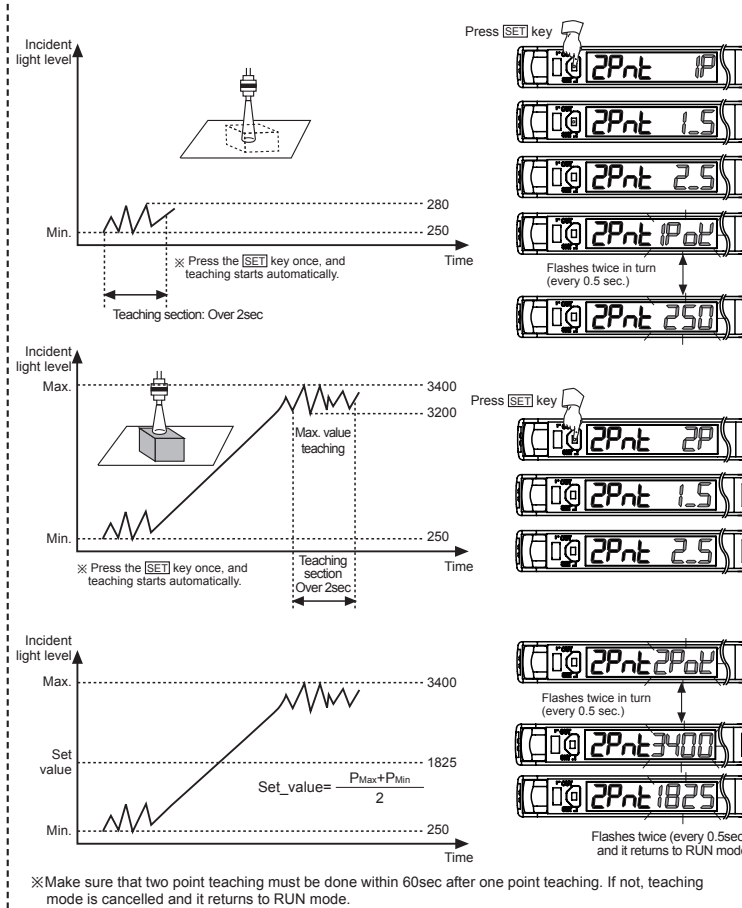
Group teaching

A function to set the sensitivity of Slave amplifier units according to the command of the Master amplifier unit(a certain amplifier unit) in a successive and collective way. In case of two-point setting mode, group teaching is not applicable.



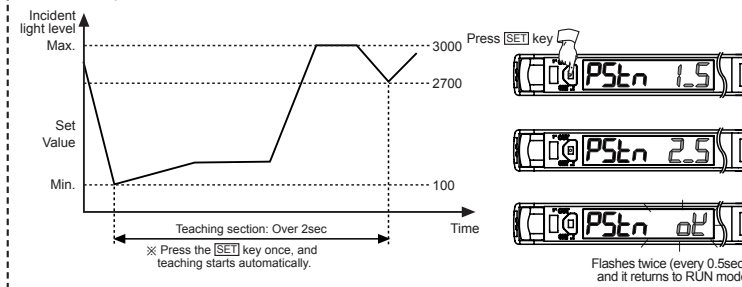
3. Two-point teach mode

- Suitable when incident light level is stable or when sensing object is slow or at stopped position.
- One of teaching modes that sets the sensitivity using the average value of two incident light levels obtained from two point teaching - one point with a sensing object and the other point without a sensing object.
- Set Teaching mode parameter [5E n5] to 2P nE.



4. Positioning teach mode

- One of teaching modes that sets the sensitivity to 90% of max. incident light level when sensing an object with a hole on the surface (Through-beam) or sensing a moving object having curve (Reflective).
- Set teaching mode parameter [5E n5] to P5 t n.



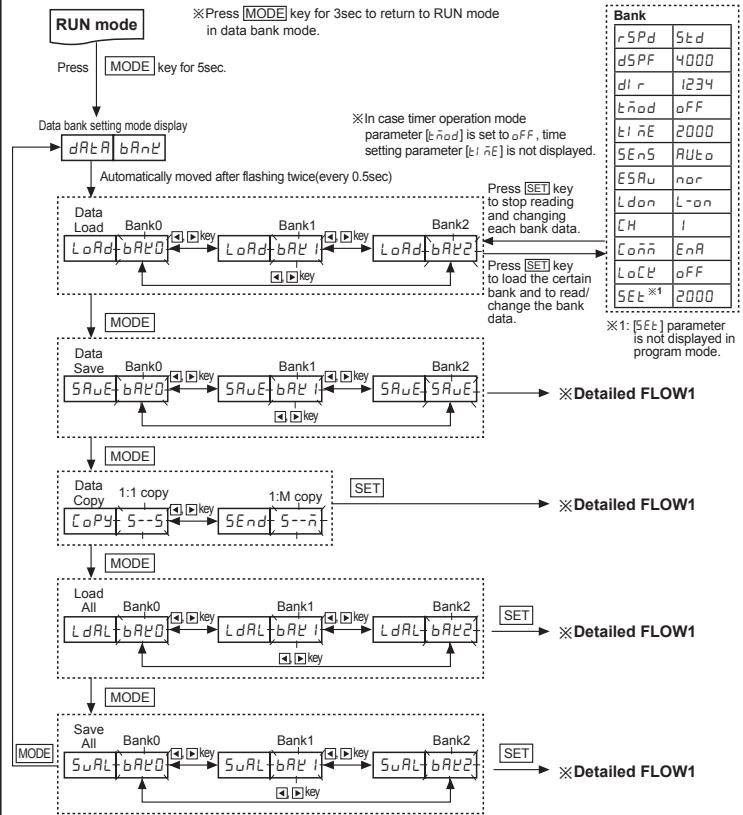
Data bank setting

A function to save settings for group amplifier units in each data bank by using Master unit's command or by adjusting one amplifier unit's setting and to load required data bank when it is necessary without resetting for each unit's parameters and setting values.

- Load[dRL]: Loads one of the preset databanks[bRL0, 1, 2] and applies it to the amplifier unit. Detailed bank parameters can be read and changed.
- Save[5RuE]: Saves one amplifier unit settings in one of the databanks[bRL0, 1, 2].
- Copy[CoPy]: Copies the currently loaded bank by Master's instructions to the other amplifier unit (1:1) or the whole amplifier units (1:M)
- Load All[dRL]: Selects one databank by Master's instructions loads it to entire group units.
- Save All[5uRL]: Selects one databank by Master's instructions and saves it in entire group units.

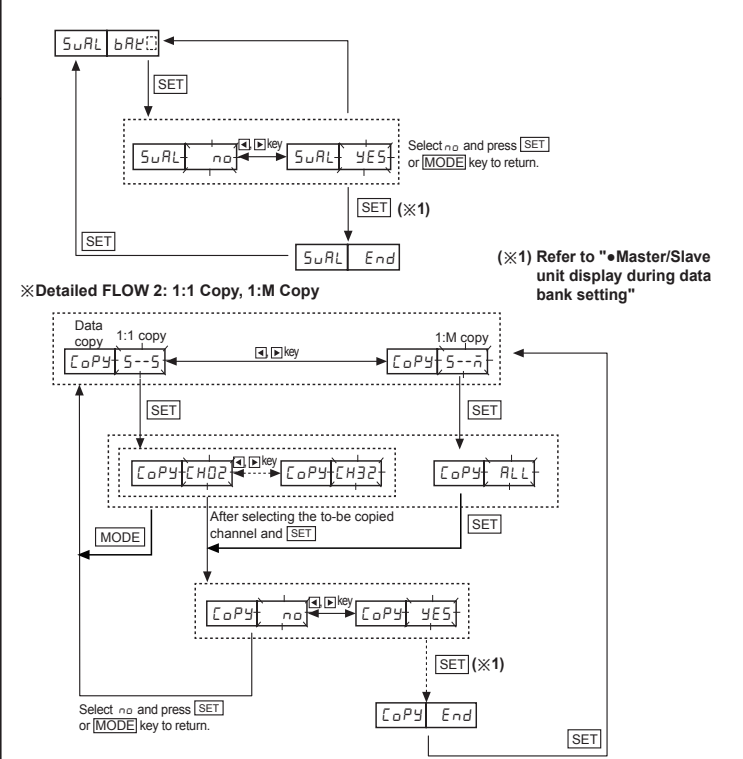
- For BF5-D1, three data banks are available ([bRL0], [bRL1] and [bRL2]) so that three different sensing object information can be saved. Each Bank can be read and changed. It allows users to detect three different sensing objects with one amplifier unit without resetting each parameter.
- Data bank function can be executed only if all amplifier units are in RUN mode.
- Copy/Load All/Save All functions are available only if multiple amplifier units are connected.
- If lock function is set (LoCk /LoCk) on amplifier units or if the Slave unit commanded bank Load and Save by the connected amplifier unit is disable to communication write, the command is not executed.

Data bank mode flow



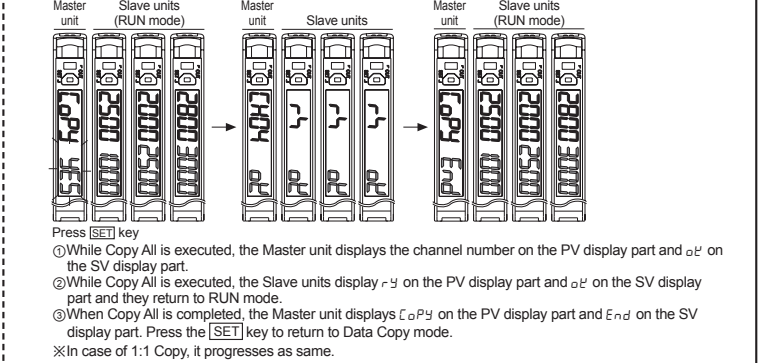
Detailed FLOW 1: Data Save, Save All, Load All

This flow is to set Save [5RuE], Save All [SUAL], and Load All[dRL].

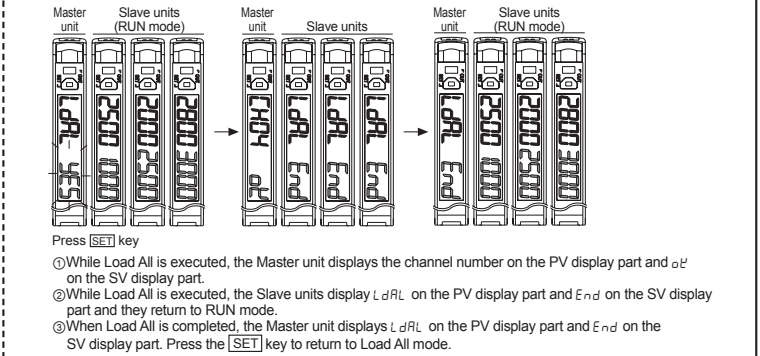


Master / Slave unit display during data bank setting

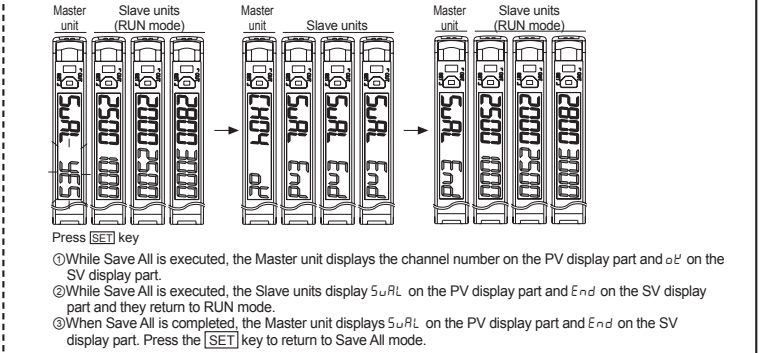
Copy All



Load All



Save All



If communication write enable / disable parameter [Co n] for the Slave unit is set to disable dL 5R while Save All, Load All or Copy is executed, the master unit displays channel number on the PV display part and dL 5R on the SV display part.

Error code

Error code	Cause	Troubleshooting
E r r	In case overcurrent inflow occurs into the output circuit.	Remove the overcurrent due to the overload.
E r b	In case the slave is failed to execute the Master's instructions due to unstable communication line connection during Copy All/Load All/Save All/Group teaching.	Check the amplifier units' connection again. Check the circuit and the hardware around the side connector.

Caution for using

- When using switching power supply as the source of supplying power, Frame Ground (F.G.) terminal shall be grounded and a condenser for removing noise shall be installed between OV and F.G. terminal.
 - Avoid using the unit where there is severe dust and corrosion, or it may cause malfunction.
 - Do not start operating during initial power supplying time(3sec.).
 - In case moving the unit from cold outside to a indoor room, start operating after removing moisture.
 - When wiring the amplifier with high voltage line, power line in a same conduit, it may cause malfunction or mechanical problem. Please wire it separately or use different conduit.
 - Do not use the unit outdoor or anywhere exposed to direct extraneous light.
- In case of max. sensitivity setting, there might exist slight sensing distance difference due to each feature deviation.
- Please keep the above precautions to avoid malfunction and damages.

Major products

- Photoelectric sensors
- Fiber optic sensors
- Door sensors
- Door side sensors
- Area sensors
- Proximity sensors
- Pressure sensors
- Rotary encoders
- Connectors/Sockets
- Switching mode power supplies
- Control switches/Lamps/Buzzers
- I/O Terminal Blocks & Cables
- Stepper motors/drivers/motion controllers
- Graphic/Logic panels
- Field network devices
- Laser marking system(Fiber, CO₂, Nd:YAG)
- Laser welding/soldering system
- Temperature controllers
- Temperature/Humidity transducers
- SSR/Power controllers
- Counters
- Timers
- Panel meters
- Tachometer/Pulse(Rate)meters
- Display units
- Sensor controllers

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