

# Autonics Digital Fiber Optic Sensor BF5 SERIES(Dual Display)

M A N U A L



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 machineries(Nuclear power control, medical equipment, vehicle, train, airplane, combustion apparatus, entertainment or safety device etc), it is required to install fail-safe device, or contact us. It may cause a fire, human injury or property loss.
- Do not disassemble the case. Please contact us if it is required. It may cause an electric shock or a fire.

## Caution

- This unit shall not be used outdoors. It might shorten the life cycle of the product or give an electric shock.
- Do not use this unit where inflammable or explosive gas exists. It may cause a fire or an explosion.
- Please observe the rated specifications. It may shorten the life cycle of the product.
- Do not apply over-rated voltage or AC power. 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 an oil-based detergent and use dry towels. It may cause an electric shock or a fire.

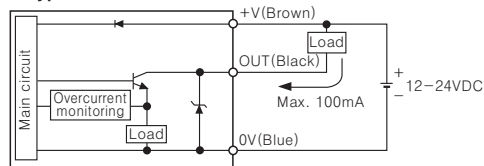
## Front part identification



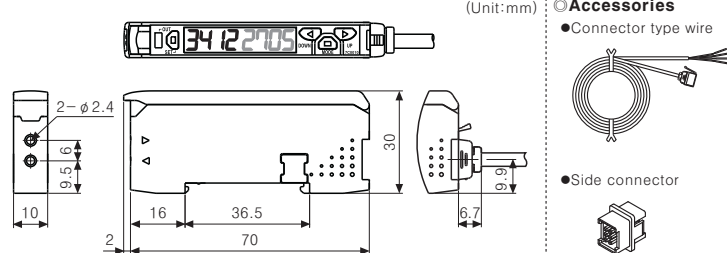
- Control output indicator (Red)**  
Used to indicate control output provided by comparing SV and actual incident light level.
- Sensitivity setting key**  
Used to execute each operation and to set sensing sensitivity.
- PV display part (4 digit, red, 7 segments)**  
Used to indicate incident light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

## I / O Circuit and Terminal Connections

### NPN Open collector type



## Dimensions



\*The above specifications are subject to change without notice.

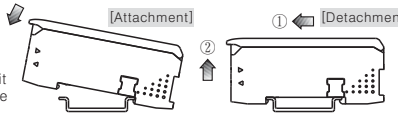
## Specifications

Display type	Dual Display type
Model	BF5R-D1-N
Light source	Red LED(660nm) Pulse modulated light
Power supply	12~24VDC ±10%
Current consumption	Max. 50mA
Control output	NPN Open collector(Sink Current : Max. 100mA, Applied Voltage:Max. 24V, Residual voltage:Max. 1V)
Protection circuit	Reverse polarity protection, Overcurrent protection, Surge absorption
Response time	Ultra Fast:50μs, Fast:150μs, STD:500μs, Long:4 ms
Display	●Incident light level: Red, 4 digit, 7Segment ●SV : Green, 4 digit, 7Segment ●Main output indicator : Red LED
Display function	Incident light level / SV display [4000/10000 resolution], Percentage display, Peak / Bottom value display, Normal / Reversed display
Sensitivity setting	●Auto tuning mode, 1 point teaching ●2 point teaching, Positioning teaching
Mutual interference prevention	Max. 8 unit sets (Automatically set regardless of response time)
initializing	Initializing to factory mode
Power saving	Normal / Power save 1 / Power save 2
Timer	OFF, Off delay, On delay, One shot
Ambient illumination	Incandescent lamp : Max. 3000lx, Sunlight : Max. 11000lx
Ambient temperature	-10 ~ 50°C
Ambient humidity	35% RH ~ 85% RH
Insulation resistance	Min. 20MΩ(at 500VDC mega)
Dielectric strength	1000VAC 50/60Hz for 1 min.
Vibration resistance	1.5 mm amplitude at frequency of 10 to 55Hz in each X, Y, Z direction for 2 hours
Shock	500m/s <sup>2</sup> (Approx. 50G) in X, Y, Z directions for 3 times
Protection	IP40(IEC standard)
Material	ppt
Fiber cable	Min. 2kgf
Tightening torque	Min. 2kgf
Accessories	Connector type wire(φ4, 3P, 2m), Side connector
Unit weight	20g

## Installations

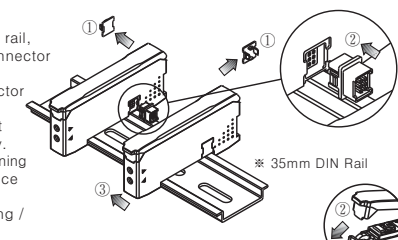
### Amplifier unit Mounting

- Attachment : Hang up the backside holder on DIN rail and press the unit toward the DIN rail.
- Detachment: Slide the back part of the unit and lift up the unit as shown in the figure ① and ②.



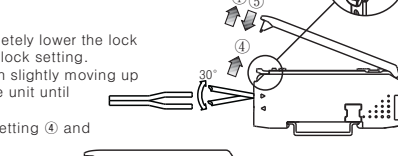
### Amplifier unit connection

- After mounting one amplifier unit on DIN rail, remove the side cover and insert unit connector as shown in the figure ① and ②.
- Connect another unit through the connector as shown in the figure ③.
- Make sure that connections between unit case and connectors have made correctly. Improper connection may cause malfunctioning of channel setting and mutual interference prevention functions.
- Do not supply the power while connecting / disconnecting amplifier units.



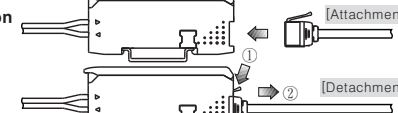
### Fiber cable connection

- Lift up the protective cover ① and completely lower the lock lever to the direction of ② to release the lock setting.
- Insert the cable to the direction of ③ with slightly moving up and down 15°, and gently press into the unit until the cable is completely connected.
- Place up the lock lever to lock the lock setting ④ and close the protective cover ⑤.



### Amplifier unit connector connection

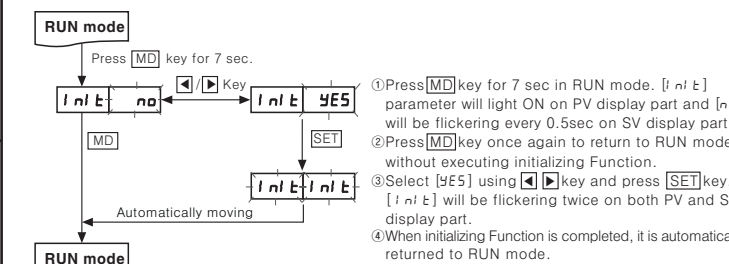
- Insert the connector into the amplifier unit until it clicks into right position.
- When removing the connector, pull out the connector with pressing the lever downside.



## Initializing Function

- A function to initialize all parameters in memory to default value in case the possibility of missetting or misoperation.
- Set lock function [LoCk] to [oFF] to execute Initializing Function.
- High peak value[HPEt] and low peak value[LPEt] shall not be initialized.

### Parameter Initialize FLOW

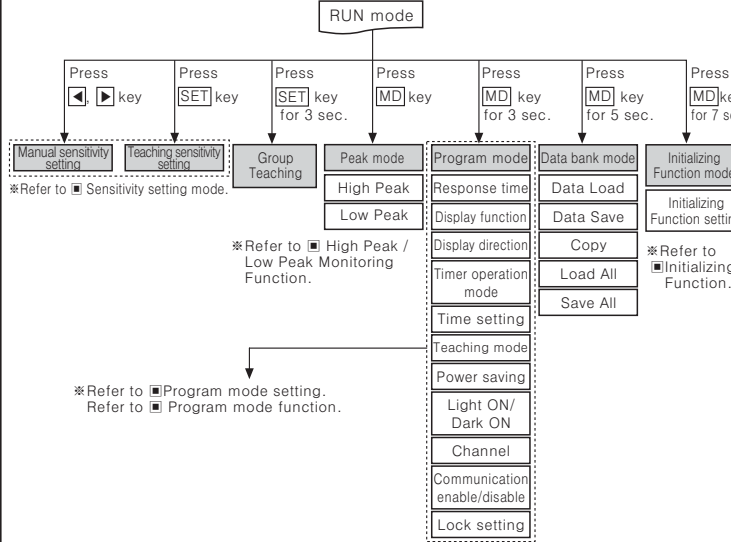


### Initializing Function Parameter Value (Factory mode)

Parameter	Initializing value	Parameter	Initializing value	Parameter	Initializing value
r5Pd	5td	tnod	oFF	Ldon	L-on
d5PF	4000	SEn5	RUt0	Coan	EnR
dlr	l234	ESRu	nor	LoCk	oFF

SV: 2000, Bank 0~2: Initialized

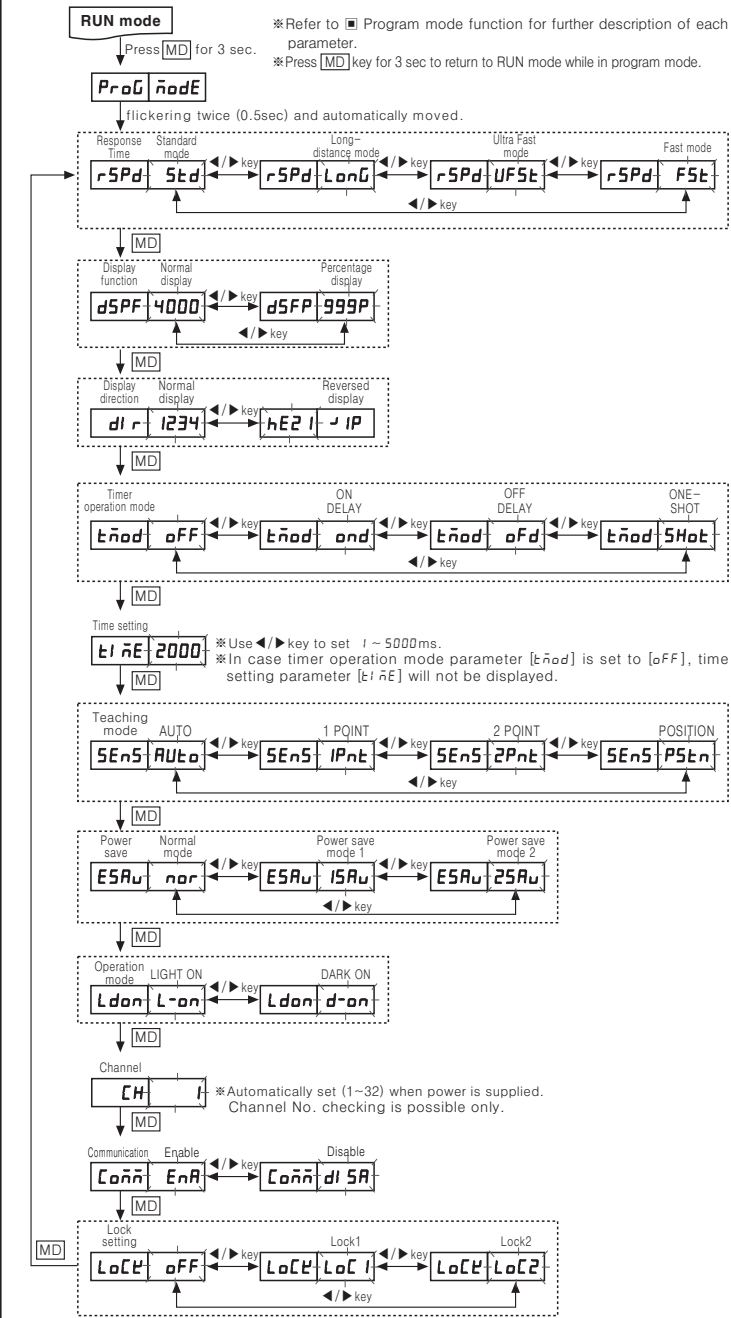
## Parameter Setting



## Program mode setting

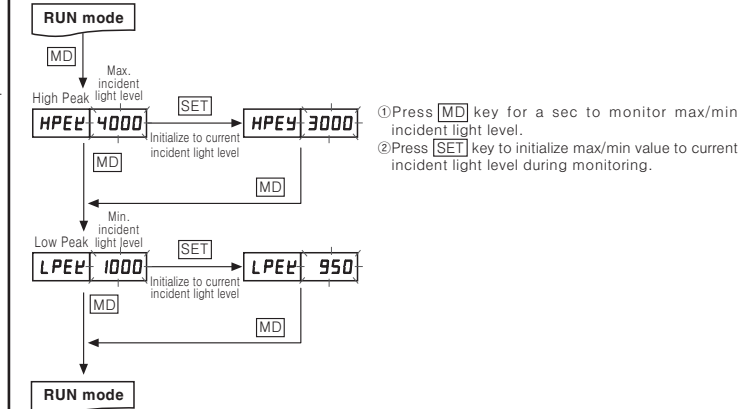
- When entering into program mode, parameters will light ON on PV display part and setting values will be flickering every 0.5 sec on SV display part. Use [↓] key to set each setting value.
- Press [MD] key one time after setting each parameter to save each setting and enter into next mode.
- If the key lock is set (lock1 or lock2), unlock the key lock before setting parameters.

### Program mode Flow



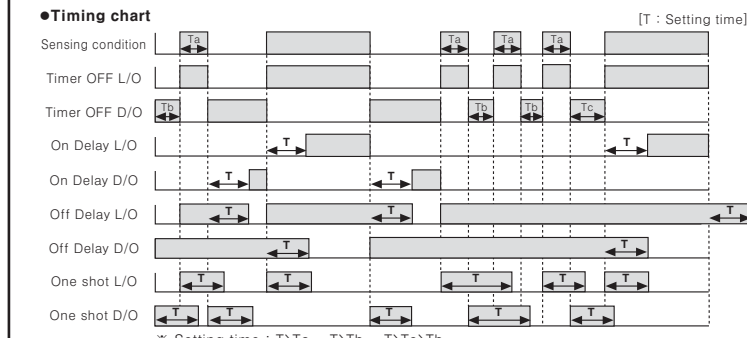
## High Peak / Low Peak Function

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



## Program Mode Function

- Response Time Setting [r5Pd]**  
A function to set the response time of control output - 4 response modes selectable.
  - Ultra Fast(UF5t) mode : 50μs
  - Fast(F5t) mode : 150μs
  - Standard(St-d) mode : 500μs
  - Long distance(LonG) mode : 4 ms
- Display function [d5PF]**  
A function to select incident light level display mode on PV display window : Standard display (4000) / Percentage display (999P)
  - Standard Mode Display Range : 0 - 4000 (0 - 9999, in case of long distance mode)
  - Percentage Mode Display Range : 0P - 999P (No decimal point 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 display of normal display.
- Timer function [Timer operation mode : tnod, Setting time : t r nE]**  
Used when 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.
  - Setting time [t r nE] : 1~5000ms



### Power save function [ESRu]

- A function to save unit's power consumption by reducing power supplying to display parts in case of no setting input within 60 sec.
- Selectable from 2 modes
  - Normal mode[nor] : Main output indicator(OUT), PV/SV display part ON
  - Power save mode 1[ISRu] : Main output indicator(OUT) and PV display part ON
  - Power save mode 2[2SRu] : Main 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 Enable / Disable Setting Function [Coan]

- A function to set Slave amplifier unit's communication [enable(EnR) / disable(dl5R)] while certain instructions (LOAD/SAVE/COPY) or group teaching is in progress by Master amplifier units.

### Setting Key Lock Function [LoCk]

Two types of key lock setting available in order to prevent SV changes due to lack of care.

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

●: Check / Setting both available  
○: Check available  
○: Check / Setting both unavailable

### Amplifier units connection using side connector

- In case multiple amplifier units are connected, the power supply for one unit will feed all 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.
- Auto set channel can be checked in channel parameter in program mode.
- Channel range : 1~32
- Note that auto set channel cannot be changed and the channel No. 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 of adjacent fiber cable installations 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.

## 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-tuning)

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



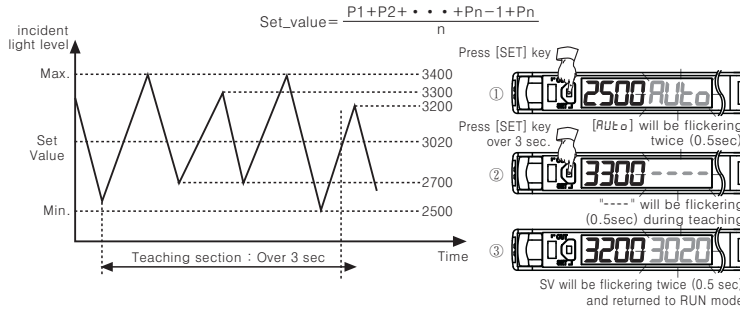
- Press **[▶]** and **[◀]** key to set the value.
- If there is no additional key input for 3 sec after completing setting, last set value will be flickering twice and automatically returned to RUN mode.

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

- How to enter into sensitivity setting mode in RUN mode
- Press SET key once. Then, selected teaching mode parameter will be flickering twice on SV display part.
- Refer to details below for each teaching sensitivity setting.
- Teaching should be executed for over 3 sec.
- If teaching is executed for less than 3 sec, teaching mode parameter will be flickering twice and be on standby to execute teaching.
- Current incident light level is indicated on PV display part while teaching is in the process.
- If incident light level is received under 10 DIGIT while teaching is in the process, it will be automatically returned to RUN mode and previous setting value will be retained.
- If there is no key operation for 60 sec after entering into teaching mode, it will be automatically returned to RUN mode.

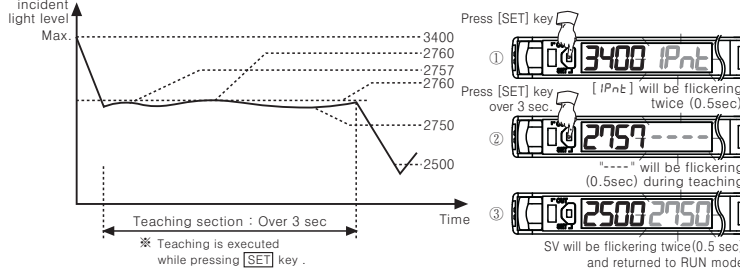
#### Auto-tuning teaching

- In program mode, set Teaching mode parameter [SEn5] to [Aut0].
- Suitable when incident level of sensing object is not stable or when sensing fast moving objects.
- One of teaching modes that sets the sensitivity using average value of incident light level within a certain time period.



#### One-point teaching

- In program mode, set Teaching mode parameter [SEn5] to [IPnt].
- 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.

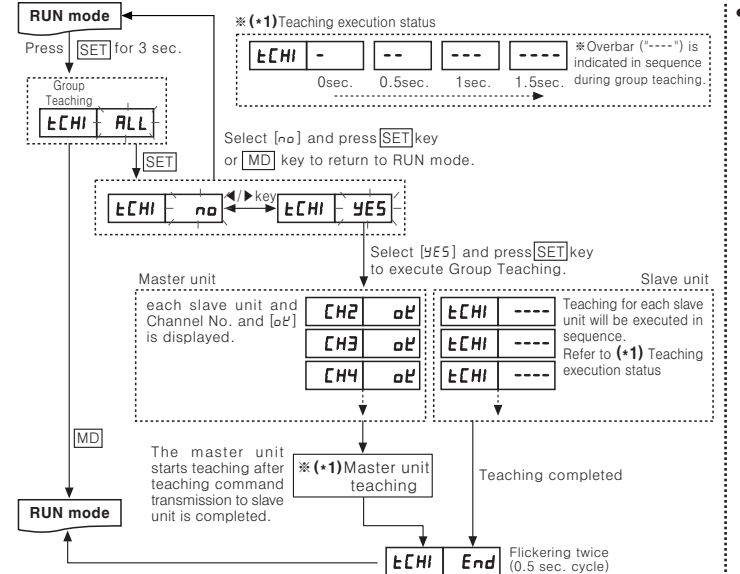


\*SV range for sensing distance.

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 10 digit.	In case incident light level is saturated, set to 3980 digit.
LoG	In case incident light level is 0, set to 5 digit.	In case incident light level is saturated, set to 9980 digit.

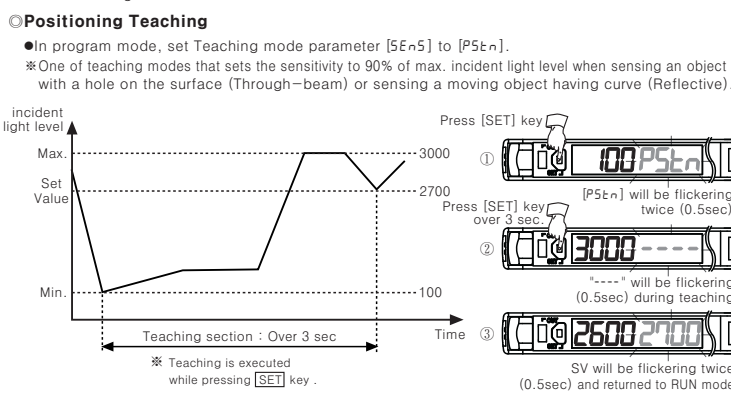
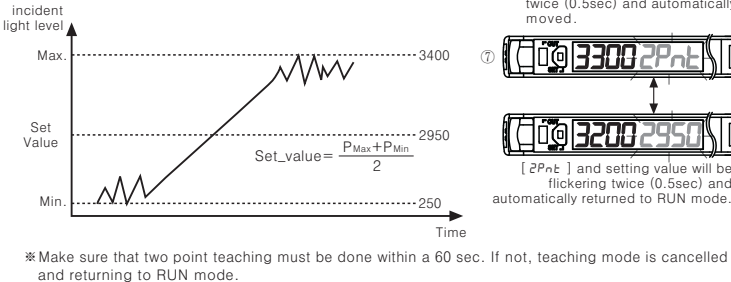
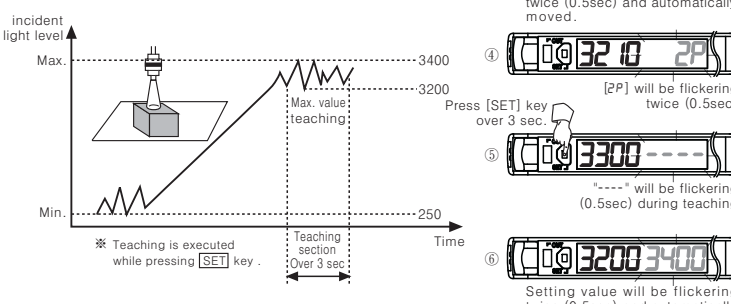
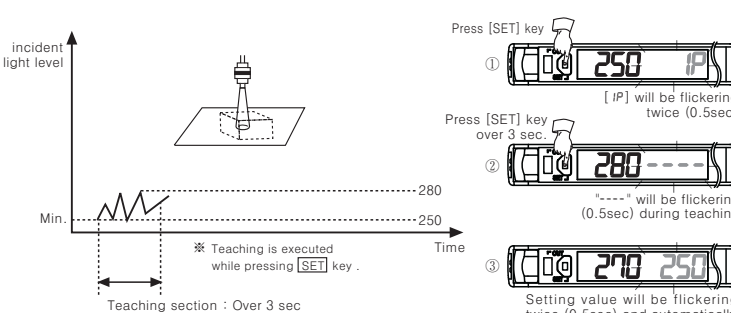
## Group Teaching

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



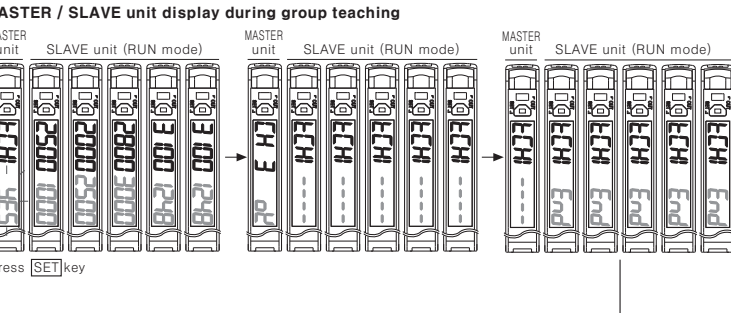
### Two-point teaching

- In program mode, set Teaching mode parameter [SEn5] to [2Pnt].
- 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 intermediate 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.



### Positioning Teaching

- In program mode, set Teaching mode parameter [SEn5] to [P5tn].
- 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).



- Channel No. is indicated on PV display part and [aE] is indicated on SV display part for MASTER unit while group teaching is operating.
- [tCHI] is indicated on PV display part and "-----" is flickering every 0.5 sec for SLAVE unit while group teaching is executed. When group teaching is completed, setting value will be flickering twice and [tCHI] and [End] will be indicated on both PV and SV display part for Slave units. Then, it will be automatically returned to RUN mode.
- The master unit starts teaching after teaching command transmission to slave unit is completed. When teaching is completed, setting value will be flickering twice and [tCHI] and [End] will be indicated on both PV and SV display part. Then, it will be automatically returned to RUN mode.

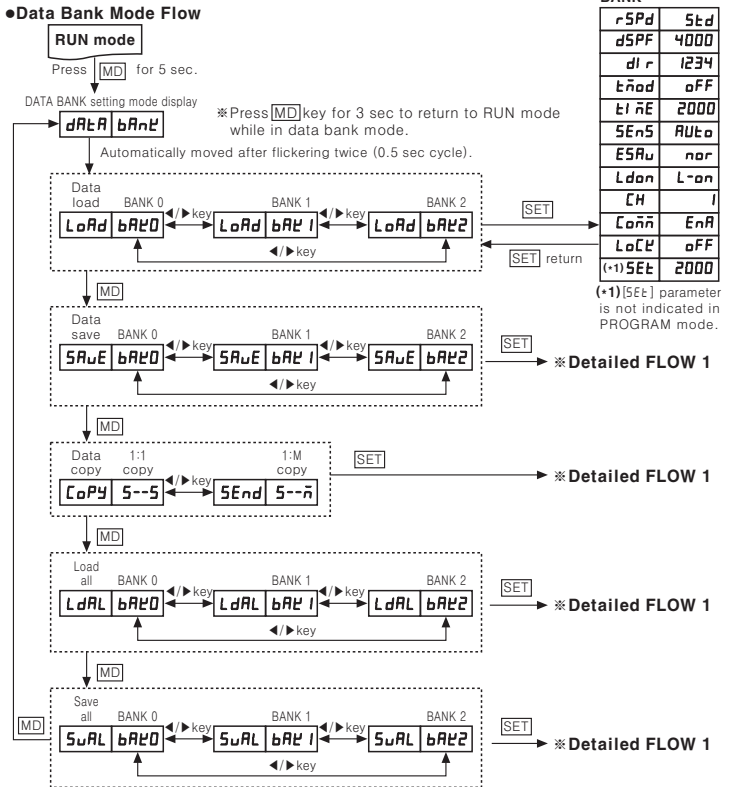
## Data Bank Setting

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.

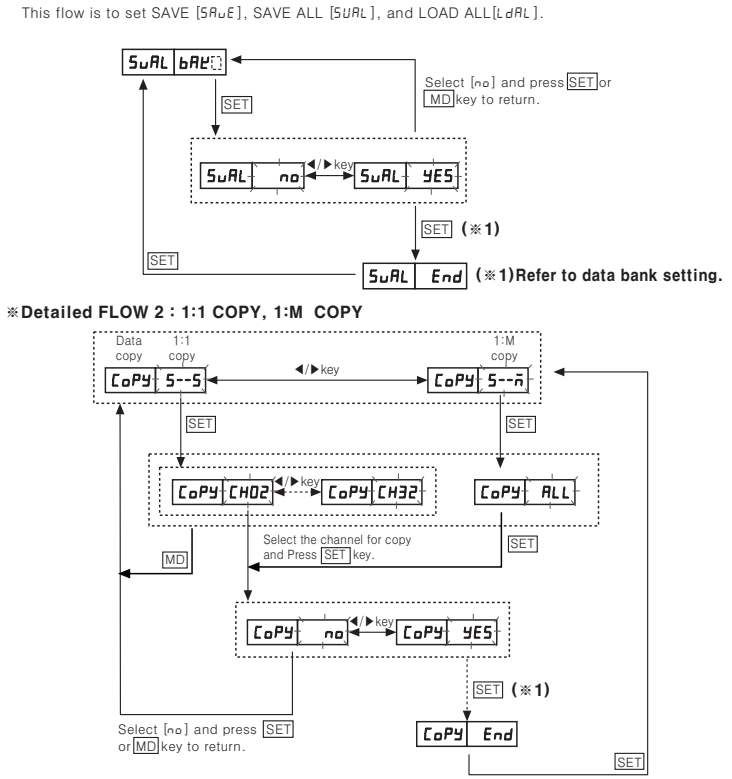
- LOAD [LoRd] : Load preset databank (bAnE0, 1, 2) and apply it to the amplifier unit.
  - Detailed bank parameters can be read and changed.
- SAVE [SAvE] : Save one amplifier unit settings in one of databank (bAnE0, 1, 2).
- COPY [CoPy] : Select one databank according to MASTER's instructions and copy it in another unit (1:1) or entire group units (1:N).
- LOAD ALL [LdRl] : Select one databank according to MASTER's instructions load it to entire group units.
- SAVE ALL [SvRL] : Select one databank according to MASTER's instructions and save it in entire group units.

Up to 3 databanks are available [bAnE0, 1, 2] and each bank can be read and changed. It allows users to detect three different sensing objects using one amplifier unit without resetting each parameter.

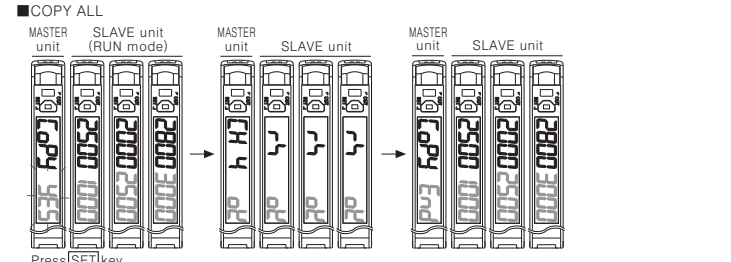
**Data bank function can be executed only if all amplifier units are in RUN mode.**  
**COPY/LOAD ALL/SAVE ALL functions are applicable only if multiple amplifier units are connected.**  
**If lock function is set (LOC1 / LOC2) on amplifier units or if the SLAVE unit is set to communication disable (di5R), LOAD and SAVE command for the unit will not be executed.**



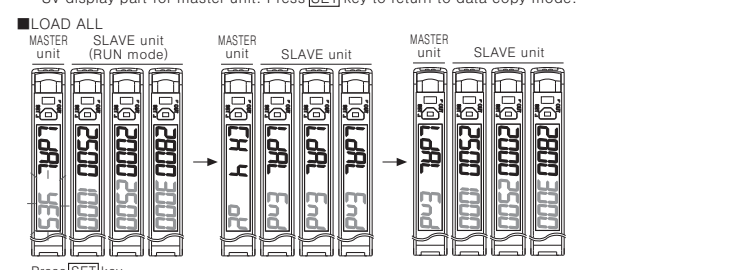
**Detailed FLOW 1 : DATA SAVE, SAVE ALL, LOAD ALL**  
 This flow is to set SAVE [SAvE], SAVE ALL [SvRL], and LOAD ALL [LdRl].



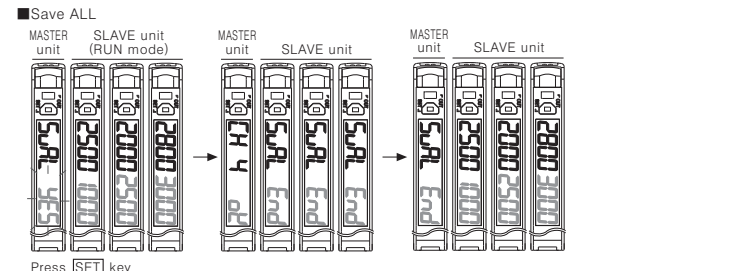
### MASTER / SLAVE unit display during data bank setting



- Channel No. is indicated on PV display part and [aE] is indicated on SV display part for master unit while COPY is executed.
- [rN] is indicated on PV display part and [aE] is indicated on SV display part for slave units while COPY is executed. Then, it is returned to RUN mode.
- When COPY is completed, [CoPy] is indicated on PV display part and [End] is indicated on SV display part for master unit. Press [SET] key to return to data copy mode.



- Channel No. is indicated on PV display part and [aE] is indicated on SV display part for master unit while LOAD ALL is executed.
- [LdRl] is indicated on PV display part and [End] is indicated on SV display part for slave units while LOAD ALL is executed. Then, it is returned to RUN mode.
- When LOAD ALL is completed, [LdRl] is indicated on PV display part and [End] is indicated on SV display part for master unit. Press [SET] key to return to Load All mode.



- Channel No. is indicated on PV display part and [aE] is indicated on SV display part for master unit while SAVE ALL is executed.
- [SvRL] is indicated on PV display part and [End] is indicated on SV display part for slave units while SAVE ALL is executed. Then, it is returned to RUN mode.
- When SAVE ALL is completed, [SvRL] is indicated on PV display part and [End] is indicated on SV display part for master unit. Press [SET] key to return to Save All mode.

If communication enable / disable parameter [CoRn] for SLAVE unit is set to communication disable while SAVE ALL, LOAD ALL or COPY is executed, Master unit displays Channel No. on PV display part and [di5R] on SV display part.

## Error code

Error code	Cause	Countermeasure
Err-L	In case incident light level is below the min. range when teaching.	Increase the incident light level above min. range.
Err	In case overcurrent inflow occurs into output circuit.	Remove overcurrent due to overload.
Err-b	<ul style="list-style-type: none"> <li>In case Slave is failed to execute Master's instructions due to unstable communication line connection during Group Copy / Load / Save / Teaching.</li> <li>In case other communication errors occur</li> </ul>	<ul style="list-style-type: none"> <li>Check amplifier unit's connection again.</li> <li>Check circuit and hardware around side connector.</li> </ul>

## Caution for using

- In case power is supplied from switching power supply, ensure that the frame ground (F·G) terminal of the power supply is connected to an actual ground and connect a condenser for noise removal between OV and F·G terminal.
  - Avoid using the unit where dust exists or corrosion causing environments. It may cause product malfunction.
  - Do not start operating during initial power supplying time (3 sec.).
  - In case moving the unit from cold outside to a indoor room, start operating after removing moisture.
  - Do not wire high voltage / power source line and unit together. It may cause product damage or malfunction due to noise.
  - 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

- Proximity sensors
- Area sensors
- Door/Door side sensors
- Counters
- Rotary encoders
- Power controllers
- Panel meters
- Temperature controllers
- Temperature/Pulse(Rate) meters
- Temperature/Humidity transducers
- Switching power supplies
- Stepping motors/drivers/motion controllers
- Field network devices
- Laser marking system(CO<sub>2</sub>, Nd:YAG)
- Laser welding/soldering system

- Photoelectric sensors
- Fiber optic sensors
- Pressure sensors
- Timers
- Display units
- Sensor controllers
- Graphic/Logic panels

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