KEYENCE

DUAL DIGITAL FIBER SENSOR

FS-V21/21G/21R(P)/21X

Instruction Manual

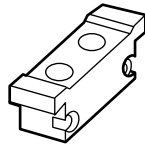## 1. Safety Precautions

> ⚠ **WARNING**
>
> - This product is used to detect targets. Do not apply the product to safety circuits for human protection.
> - This product is not of explosion-proof construction. Do not use the products in places with flammable gas, liquid, or dust.
> - This product is a sensor of DC power supply type. Do not apply AC power. The product may explode or burn if 100 VAC or a higher voltage is applied.

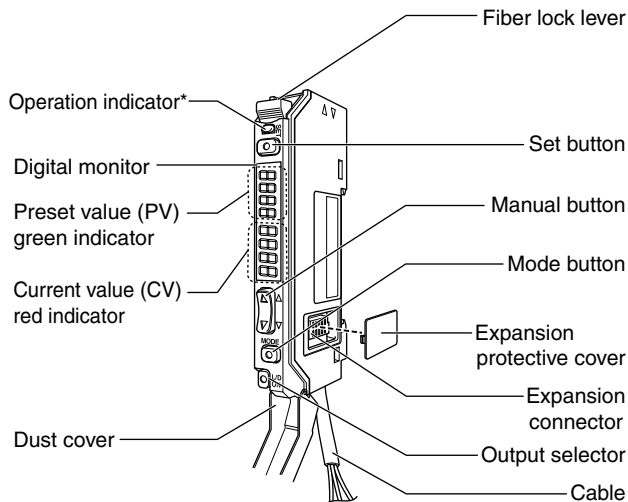Check that all the accessories are ready before use.

- **Accessories**

  Instruction manual (x 1)   Mounting bracket (x 1)

2. Part Names

- Fiber lock lever
- Operation indicator*
- Set button
- Digital monitor
- Preset value (PV) green indicator
- Manual button
- Current value (CV) red indicator
- Mode button
- Expansion protective cover
- Expansion connector
- Dust cover
- Output selector
- Cable

* The operation indicator of the FS-V21X (infrared model) will not be lit.

3. Mounting Unit

● **DIN Track Mounting**
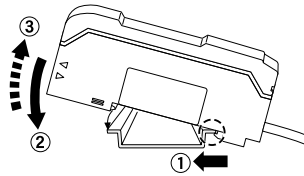
1) As shown in the illustration, engage the claw on the lower side of the unit and the DIN rail, press the unit in the direction shown by arrow ①, and move down the unit in the direction shown by arrow ②.
2) When dismounting the unit, press the unit in the direction shown by arrow ① and move up the unit in the direction shown by arrow ③.

● **Using Mounting Bracket (accessory)**
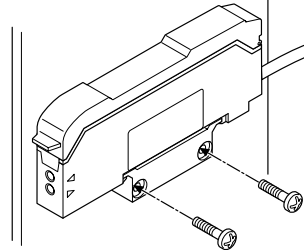
- Attach the unit to the mounting bracket, mount them together, and secure them with two M3 screws as shown in the illustration.

4. Connecting Fiber Unit

Fiber insertion sign
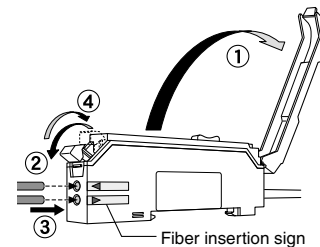
1) Open the dust cover in the direction shown by arrow ①.
2) Move down the fiber lock lever in the direction shown by arrow ②.
3) Insert a fiber unit into the fiber insertion holes to a length of the fiber insertion sign (i.e., approximately 14 mm).
4) Move up and return the fiber lock lever in the direction shown by the arrow ④.

Note: If a thin fiber unit is used, an adapter provided with the thin fiber unit will be required.
Unless the right adapter is connected, the thin fiber unit will not detect targets correctly.

Cable outer dia.	Adapter	Appearance
ø1.3	Adapter A	
ø1.0	Adapter B	

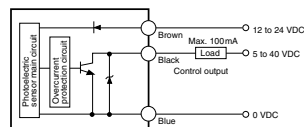- To connect the coaxial reflective type fiber unit to the amplifier, connect the single-core fiber to the transmitter side, and connect the multiple-core fiber to the receiver side.
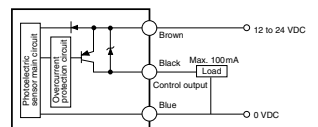

Transmitter
Single-core fiber
Multi-core fiber
Receiver
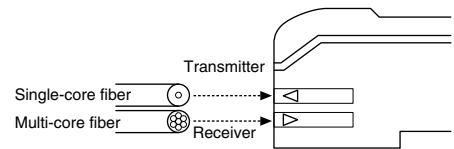
5. I/O Cricuit

Refer to the following I/O circuit diagram when connecting the unit to peripheral devices.

● **FS-V21/21G/21R/21X**   ● **FS-V21RP**

6. Making Sensitivity Settings

● **Full Auto Calibration**

In this mode, the PV will be set to the mean value of the maximum and minimum incident values obtained within a certain period.
Use this mode to detect moving workpieces.

1) Press the set button for a minimum of three seconds while the target workpiece is passing the sensing area of the fiber unit.

   • While the set button is pressed, the sensitivity of the sensor will be set according to the incident values.
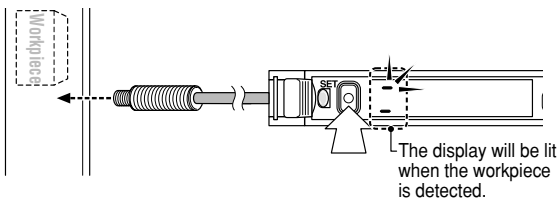
3 s min. — The display will flash when the settings are completed.
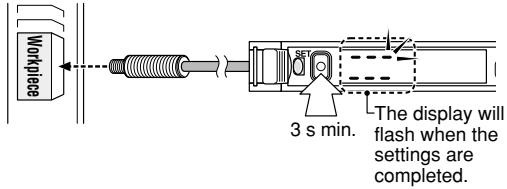
   • When the setting is finished, the digital monitor will display the PV in green.

PV (green) ———— CV (red)
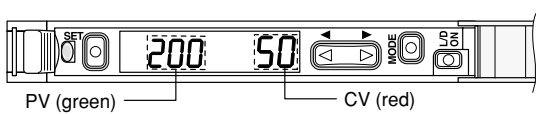
● **Two-point Calibration**

In this mode, the PV used will be the mean value of two sensing values obtained with and without a workpiece.

1) Press the set button for a moment without the workpiece in the sensing area (i.e., in front of the fiber unit).

The display will be lit when the workpiece is detected.

2) Locate the workpiece in the sensing area (i.e., in front of the fiber unit). Then press the set button for a moment.
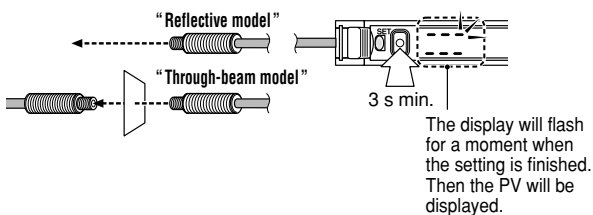
The PV will appear when the settings are completed.
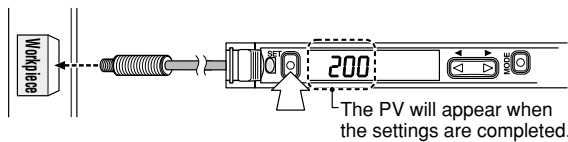
* If there is extremely little difference in sensitivity between the sensing values, the display ---- will flash on completion of tuning.

● **Maximum Sensitivity Setting**

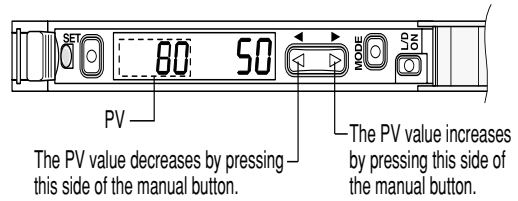If the sensing performance of the sensor drops due to dust or dirt, set the sensitivity of the sensor to maximum.

1) Press the set button without a workpiece if the fiber unit is a reflective model. Press the set button with a workpiece if the fiber unit is a through-beam model. In both cases, press the set button for a minimum of three seconds.

"Reflective model"

"Through-beam model"

3 s min.

The display will flash for a moment when the setting is finished. Then the PV will be displayed.

* If the sensing distance is insufficient, make sensitivity settings in the sensor in two-point tuning mode.

● **Manual Calibration**

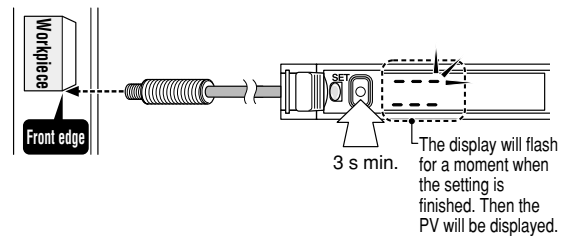In this mode, make manual PV settings.

PV —

The PV value decreases by pressing this side of the manual button.

The PV value increases by pressing this side of the manual button.

● **Positioning Calibration**

In this mode, a workpiece will be detected when the front edge of the workpiece has reached a preset position.

1) Press the set button for a moment without the workpiece in the sensing area (i.e., in front of the fiber unit).

The display will be lit when the workpiece is detected.
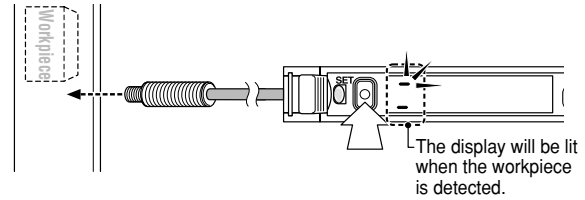
2) Locate the front edge of the workpiece in the sensing area. Then press the set button for a minimum of three seconds.

3 s min.

Workpiece
Front edge

The display will flash for a moment when the setting is finished. Then the PV will be displayed.

7. Selecting Output

Either light-ON mode or dark-ON mode is selectable.

Press the output selector. ①

The display indicates that the sensor is in dark-ON mode. The CV will be displayed if no buttons are operated for approximately five seconds.

Press the manual button ② within five seconds after pressing the output selector ①.
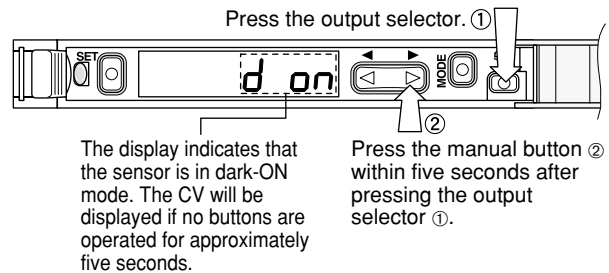
• Take the same steps to set the sensor to light-ON mode again.

8. User-friendly Functions

● **Access Mode Selection**

Two modes are available to the display of values and menu items.

EASY	Only basic functions are displayed.
FULL	All available functions are displayed.

Press 3 s min.

Select

EASY	EASY
FuLL	FULL

Completion of selection

Press 3 s min.
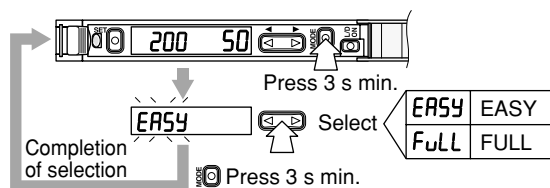
• The mode is set to EASY before shipping.

● Display Selection (Access Mode: EASY)

PV CV

`50  12`

↓ **MODE** Press

`24P  12` → **MODE** Press → `L on F inE`

Excess gain / CV   Output status / Power mode status

↑ **MODE** Press
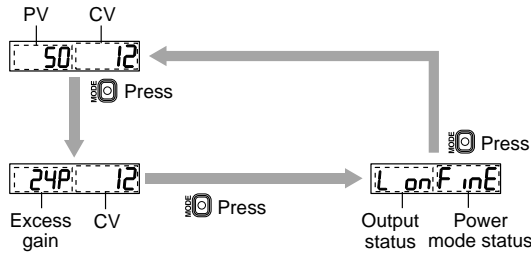
- The CV is displayed in percent based on the PV.

- The current value will be displayed if no keys are operated for approximately 30 s.
- If the timer function is set, the output status with power mode and the timer mode with set time will be displayed alternately.

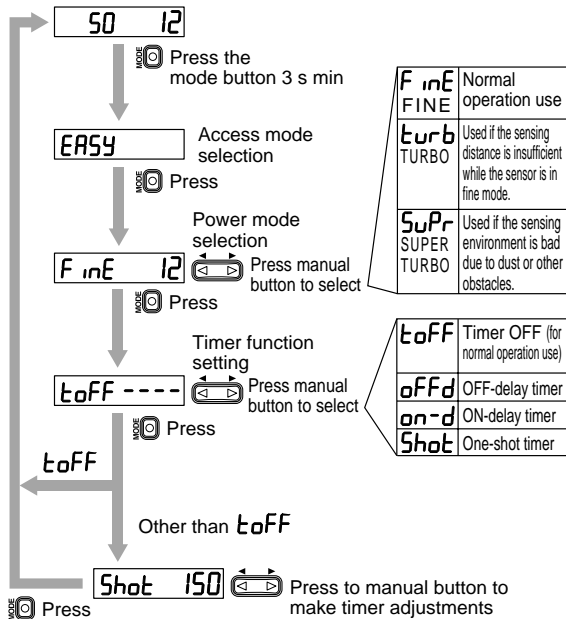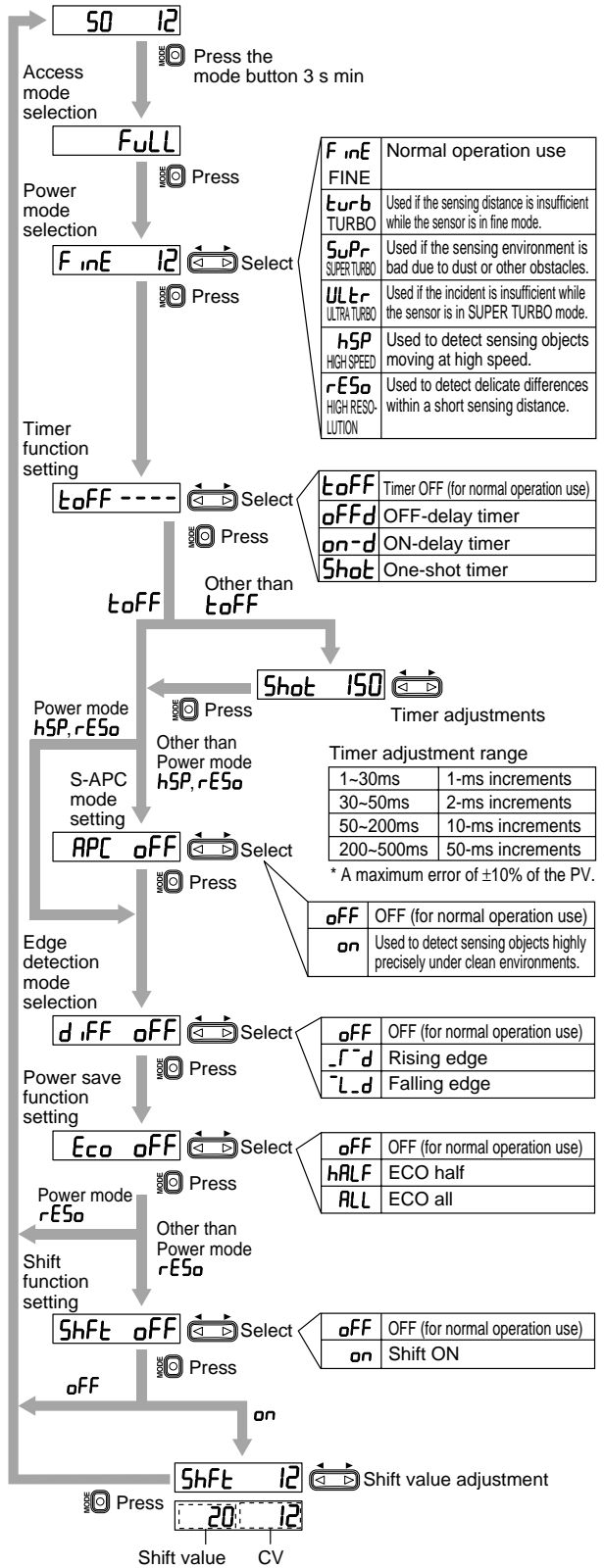## ● Display Selection (Access Mode: FULL)

PV CV

`50  12`

↓ **MODE** Press

`L on F inE`
Output status / Power mode status

↑ **MODE** Press

Excess gain / CV

`24P  12`

↓ **MODE** Press

`HoLd`
`200P  12P`
Peak excess gain / Bottom excess gain

↑ **MODE** Press

`llllllll  115`
LED bar indicator / CV

→ **MODE** Press → `HoLd` / `200  12`
Peak value / Bottom value

● Menu Selection (Access Mode: EASY)

`50  12`

↓ **MODE** Press the mode button 3 s min

`EASY` Access mode selection

↓ **MODE** Press

`F inE  12` Power mode selection — Press manual button to select

F inE FINE	Normal operation use
turb TURBO	Used if the sensing distance is insufficient while the sensor is in fine mode.
SuPr SUPER TURBO	Used if the sensing environment is bad due to dust or other obstacles.

↓ **MODE** Press

`toFF ----` Timer function setting — Press manual button to select

toFF	Timer OFF (for normal operation use)
oFFd	OFF-delay timer
on-d	ON-delay timer
Shot	One-shot timer

↓ **MODE** Press

`toFF`

Other than `toFF`

`Shot  150` Press to manual button to make timer adjustments

MODE Press

* For timer values, refer to the corresponding table under FULL mode.

● Menu Selection (Access Mode: FULL)

`50  12` Access mode selection

↓ **MODE** Press the mode button 3 s min

`FuLL` Power mode selection

↓ **MODE** Press

`F inE  12` Select

F inE FINE	Normal operation use
turb TURBO	Used if the sensing distance is insufficient while the sensor is in fine mode.
SuPr SUPER TURBO	Used if the sensing environment is bad due to dust or other obstacles.
ULtr ULTRA TURBO	Used if the incident is insufficient while the sensor is in SUPER TURBO mode.
hSP HIGH SPEED	Used to detect sensing objects moving at high speed.
rESo HIGH RESOLUTION	Used to detect delicate differences within a short sensing distance.

↓ **MODE** Press — Timer function setting

`toFF ----` Select

toFF	Timer OFF (for normal operation use)
oFFd	OFF-delay timer
on-d	ON-delay timer
Shot	One-shot timer

`toFF` → Other than `toFF`

`Shot  150` Timer adjustments

↓ **MODE** Press

Timer adjustment range

1~30ms	1-ms increments
30~50ms	2-ms increments
50~200ms	10-ms increments
200~500ms	50-ms increments

* A maximum error of ±10% of the PV.

Power mode `hSP,rESo` → S-APC mode setting

Other than Power mode `hSP,rESo`

`APC  oFF` Select

oFF	OFF (for normal operation use)
on	Used to detect sensing objects highly precisely under clean environments.

↓ **MODE** Press — Edge detection mode selection

`d iFF  oFF` Select

oFF	OFF (for normal operation use)
_r_d	Rising edge
⁻L_d	Falling edge

↓ **MODE** Press — Power save function setting

`Eco  oFF` Select

oFF	OFF (for normal operation use)
hALF	ECO half
ALL	ECO all

↓ **MODE** Press

Power mode `rESo` → Shift function setting

Other than Power mode `rESo`

`ShFt  oFF` Select

oFF	OFF (for normal operation use)
on	Shift ON

↓ **MODE** Press

`oFF` → / `on` →

`ShFt  12` Shift value adjustment

`20  12`
Shift value / CV

MODE Press

Sensitivity Settings in Edge Detection Mode
The sensitivity of the sensor will be set to maximum by pressing the **MODE** while the sensor is in edge detection mode. Make fine sensitivity adjustments by pressing the manual button.

Note: • Press the mode button (**MODE**) for a minimum of three seconds to return to the display of the CV from any menu selection stage. To return to the previous display, press the mode button (**MODE**) first, and press the left side of the manual button.
- When the power mode is set to HIGH RESOLUTION, the S-APC mode will be always turned ON.
- When the power mode is set to HIGH SPEED, the S-APC mode will be always turned ON in the case of the R model, or otherwise the S-APC mode will be always turned OFF.

9. Key Lock

The key lock function disables the operation of all keys.

Press the manual button for three seconds while pressing the mode button.
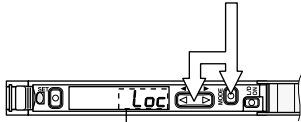
Indicates that the keys are locked.

• Take the same step to unlock the keys.

10. Mode Settings before Shipping (Initialization)

The following factory settings are made before shipping.

Access mode	EASY	`EASY`
Power mode	FINE	`F inE`
Timer function	OFF	`toFF`
Output selection	Light-ON	`L on`

* Returning to factory settings: Press the SET button for a minimum of five seconds while pressing the button.

11. Hints On Correct Use

• To extend the cable length, use a cable with at least a 0.3 mm^2 cross-section area. Limit the length of cable extension to no more than 100 m. (To connect several units, contact Keyence for further information.)
• Do not wire the amplifier line along with power lines or high-tension lines, or otherwise the sensor may malfunction or receive damage due to noise.
• When using a commercially available switching regulator, ground the frame ground terminal and ground terminal.
• Do not use the FS series outdoors, or in a place where extraneous light can enter the light receiving surface directly.
• Due to the individual dispersion of characteristics and the difference in fiber unit model, the maximum sensing distance or displayed value of all the units are not the same.
• If the sensor is used in S-APC mode for a long time, the LED indicators will be imposed with a heavy load. In that case, the sensor will be automatically set to ACC mode where the current consumption of the sensor for light emission will be constant, and "END APC" will be displayed. The sensor can be continuously used in this case. Replace the sensor, however, if highly precise detection is required.

12. Specifications

Model	FS-V21*1	FS-V21G	FS-V21R (P)	FS-V21X*1
Light source	Red LED	Greed LED	4-element red LED	Infrared (950 nm)
Response time	250µs (FINE)/500µs (TURBO)/1ms (SUPER TURBO)/ 4ms (ULTRA TURBO)/500µs (HIGH RESOLUTION)/ 50µs (HIGH SPEED)			
Display shift function	Max. ±1999 (variable)			
Timer function	Timer OFF, OFF-delay timer, ON-delay timer, and one-shot timer (1 to 500 ms)			
Control output	NPN open collector with 100 mA max at 40 V with a max*2, Residual voltage of 1 V.			

Rating	Supply voltage	DC12-24V ±10% with a maximum ripple (peak to peak) of 10%		

	Current consumption	Model	Mode	S-APC mode OFF	S-APC mode turned ON or when the HIGH SPEED mode is selected.
		Other than R model	Normal	580 mW	720 mW
			ECO half	480 mW	600 mW
			ECO all	430 mW	550 mW
		R model	Normal	650 mW	720 mW
			ECO half	530 mW	600 mW
			ECO all	480 mW	550 mW

Environment resistance	Ambient illumination	Incandescent lamp: 20,000 ℓx max. Sunlight: 30,000 ℓx max.
	Ambient temperature	-10°C to 55°C (No freezing)
	Relative humidity	35% to 85% RH (No condensation)
	Vibration	10 to 55 Hz, 1.5-mm double amplitude, each in X, Y, and Z directions for two hours
	Shock resistance	500 m/s^2 Three times each in X, Y, and Z directions
Housing material		Unit and cover are both polycarbonate made
Size		W 9 mm x L70 mm x H 30 mm
Weight		Approximately 80 g (including 2-m cable)

*1. The model is sold only in Japan. Consult your KEYENCE representative if the model is required outside Japan.
*2. The maximum current will be 20 mA in the case of expansion.

13. List of Digital Display Items

`200 50` Preset value/Current value display	`oFFd 150` Timer function setting (OFF-delay timer)
`d on` Output selection (Dark ON)	`on-d 150` Timer function setting (ON-delay timer)
`L on` Output selection (Light-ON)	`Shot 150` Timer function setting (One-shot timer)
`EASY` Access mode selection (EASY)	`APC oFF` S-APC mode setting (S-APC OFF)
`FuLL` Access mode selection (FULL)	`APC on` S-APC mode setting (S-APC ON)
`24P 12` Excess gain display	`d iFF oFF` Edge detection mode (OFF)
`ıılıⁱⁱⁱ 115` LED bar display	`d iFF _ſ⁻d` Edge detection mode (Rising edge)
`HoLd` Hold display	`d iFF ⁻L_d` Edge detection mode (Falling edge)
`F inE 50` Power mode selection (FINE)	`Eco oFF` ECO mode setting (ECO mode OFF)
`turb 100` Power mode selection (TURBO)	`Eco hALF` ECO mode setting (ECO half)
`SuPr 200` Power mode selection (SUPER TURBO)	`Eco ALL` ECO mode setting (ECO all)
`ULtr 800` Power mode selection (ULTRA TURBO)	`ShFt oFF` Shift function setting (Shift OFF)
`hSP 100` Power mode selection (HIGH SPEED)	`ShFt on` Shift function setting (Shift ON)
`rESo 100` Power mode selection (HIGH RESOLUTION)	`Loc` Key lock setting
`toFF ----` Timer function setting (Timer OFF)	`unL` Key unlock
`End APC` Forecast maintenance warning (END APC)	