User's Manual

Models UT351 / UT321 Digital Indicating Controllers with Active Color PV Display User's Manual Installation

NEW GREEN SERIES

IM 05D01D12-01E

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YOKOGAWA
Yokogawa M&C Corporation

This manual describes installation, wiring, and other tasks required to make the controller ready for operation.

Contents

Introduction

Thank you for purchasing the UT351/UT321 digital indicating controllers.
The controller is shipped from the factory with 4 hardcopy user's manuals (A2 and A3 size) and 1 user's manual on CD-ROM. The 4 user's manuals in hardcopy format describe the operating procedures required for basic use. It is recommended that you refer to these user's manuals to understand [1] installation, [2] initial settings, and [3] operating procedures of the controller.
The CD-ROM contains an User's Manual (Reference) with descriptions of various functions and setting ranges that can be set as necessary.
Moreover, the use of an optional parameter setting tool (model: LL100-E10) allows you to easily perform settings and adjustments with a PC.

■ How to Use the Manuals

Purpose	Manual Title	Description	Media
Setup	Installation	Describes the tasks (installation, wiring, and others) required to make the controller ready for operations.	A2-size paper, back and front
Basic operation	Initial Settings	Describes examples of setting PV input types, control output types, and alarm types. Making settings described herein allows you to carry out basic control.	A2-size paper, front
Operating procedures and troubleshooting	Operations	Describes key operation sequences. For operation control through external contact inputs, see the back of Installation User's Manual.	A2-size paper, back
Brief operation and setpoint recording	Parameters	Contains the parameter map used as a guideline for setting parameters and lists of parameters for recording User Settings.	A2-size paper, back and front
Basic operation of Active Color PV Display	Setting / explanation of Active Color PV Display	Describes the setting/explanation of Active Color PV Display.	A3-size paper, back and front
Detailed description of functions	User's Manual (Reference)	Describes functions more advanced than those explained in the 3 hardcopy user's manuals.	CD-ROM

1. Safety Precautions

The following symbol is indicated on the controller to ensure safe use.

CAUTION

This symbol on the controller indicates that the operator must refer to an explanation in the user's manual in order to avoid the risk of injury or death of personnel or damage to the instrument. The manual describes how the operator should exercise special care to avoid electric shock or other dangers that may result in injury or loss of life.

The following symbols are used in the hardcopy user's manuals and in the user's manual supplied on the CD-ROM.

NOTE

Indicates that operating the hardware or software in a particular manner may damage it or result in a system failure.

IMPORTANT

Draws attention to information that is essential for understanding the operation and/or features of the controller.

2. Model and Suffix Codes

Before using the controller, check that the model and suffix codes match your order.

Model	Suffix Code		Description
UT351			Digital indicating controller (provided with retransmission output and 15 V DC loop power supply as standard)
UT321			
Type	-0		Standard type
	-2		Heating/cooling type
	-3		Standard type (with 24 V DC loop power supply)
Optional functions		0	None
		1	With communication, heater burnout alarm
		2	With heater burnout alarm

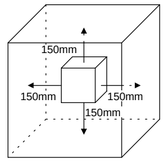
Check that the following items are provided:

- Digital indicating controller (of ordered model): 1
- Brackets (mounting hardware): ..... 1 pair
- Unit label: 1
- User's Manuals: ..... 3 (A2 size)
- User's Manuals "Setting/Explanation of Active Color PV Display": ..... 1 (A3 size)
- User's Manual (Reference) (CD-ROM version): 1

3. How to Install

NOTE

To install the controller, select a location where:
(1) no one may accidentally touch the terminals,
(2) mechanical vibrations are minimal,
(3) corrosive gas is minimal,
(4) temperature can be maintained at about 23°C and the fluctuation is minimal,
(5) no direct radiant heat is present,
(6) no magnetic disturbances are caused,
(7) no wind blows against the terminal board (reference junction compensation element),
(8) no water is splashed,
(9) no flammable materials are around,



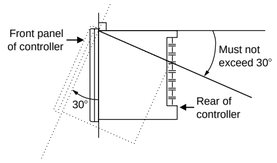
Never place the controller directly on flammable items or equipment.
If the controller has to be installed close to flammable items or equipment, be sure to provide shielding panels all around the controller, at least 150mm away from every side; the panels should be made of either 1.43mm-thick metal-plated steel plates or 1.6mm-thick uncoated steel plates.

NOTE

Never touch the opening at the bottom of the case. It is to be used in the factory at shipping.

● Installation Position

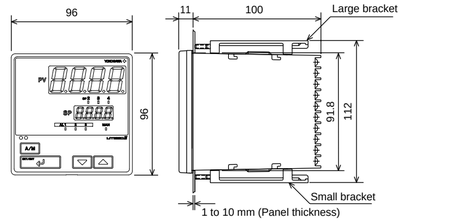
Install the controller at an angle within 30° from horizontal with the front panel facing upward. Do not install it facing downward. The position of right and left sides should be horizontal.



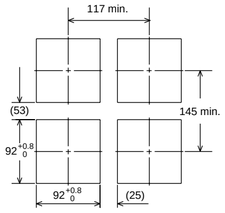
■ External Dimensions and Panel Cutout Dimensions

UT351

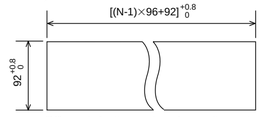
Unit: mm



General installation



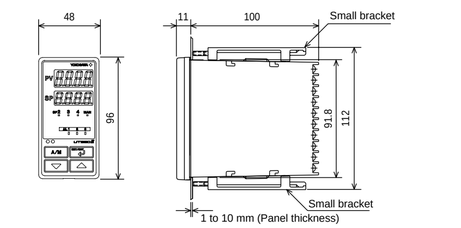
Side-by-side close installation



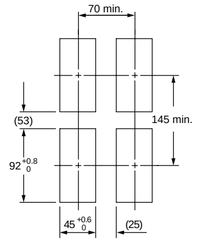
"N" stands for the number of controllers to be installed.
However, the measured value applies if N ≥ 5.

UT321

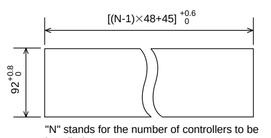
Unit: mm



General installation



Side-by-side close installation

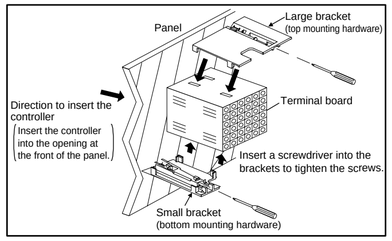


"N" stands for the number of controllers to be installed.
However, the measured value applies if N ≥ 5.

■ How to Install

CAUTION

Turn off the power to the controller before installing it on the panel because there is a possibility of electric shock.



After opening the mounting hole on the panel, follow the procedures below to install the controller:

1. Insert the controller into the opening from the front of the panel so that the terminal board on the rear is at the far side.
2. Set the brackets in place on the top and bottom of the controller as shown in the figure on the left, then tighten the screws of the brackets. Take care not to over-tighten them.

4. How to Connect Wires

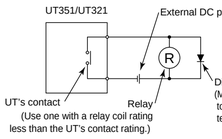
CAUTION

1) Before carrying out wiring, turn off the power to the controller and check that the cables to be connected are not alive with a tester or the like because there is a possibility of electric shock.
2) Wiring must be carried out by personnel who have basic electrical knowledge and practical experience.

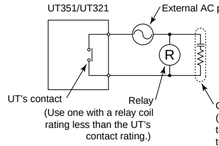
NOTE

1) Provide power from a single-phase instrument power supply. If there is a lot of noise in the power line, insert an insulating transformer into the primary side of the line and use a line filter (recommended part: ZAC2205-00U from TDK) on the secondary side.
As a countermeasures against noise, do not place the primary and secondary power cables close to each other.
2) For thermocouple input, use shielded compensating lead wires for wiring. For RTD input, use shielded wires that have low conductor resistance and cause no significant differences in resistance between the three wires. The cables to be used for wiring, terminal specifications, and recommended parts are as shown below.
3) Control output relays may be replaced. However, because they have a life of 100,000 times that of the resistance load, use auxiliary relays to turn on/off a load.
4) The use of inductance (L) loads such as auxiliary relays, motors and solenoid valves causes malfunction or relay failure; always insert a CR filter for use with alternating current or a diode for use with direct current, as a spark-removal surge suppression circuit, into the line in parallel with the load.
5) When there is possibility of being struck by external lightening surge, use the arrester to protect the instrument.

■ For DC Relay Wiring



■ For AC Relay Wiring

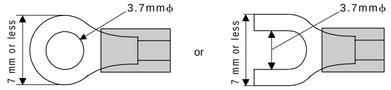


● Cable Specifications and Recommended Cables

Purpose	Name and Manufacturer
Power supply, grounding, relay contact outputs	600 V PVC insulated wires, JIS C 3307, 0.9 to 2.0 mm^2
Thermocouple	Shielded compensating lead wires, JIS C 1610, □x-□-□-□ (See Yokogawa Electric's GS 6B1U1-E.)
RTD	Shielded wires (three conductors), UL2482 (Hitachi Cable)
Other signals	Shielded wires

● Recommended Terminal Lugs

Applicable wire size	Tightening torque
0.3 to 1.65 mm^2	0.8 N·m or less

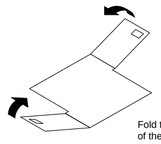


● Terminal Covers (Optional parts)

Target Model	Part Number	Sales Unit
For UT351	T9115YD	1
For UT321	T9115YE	1

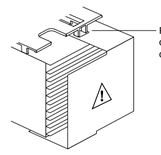
1. Before attaching the terminal cover, bend the side with the groove inward as shown in Fig. A. Be careful not to bend it backwards. This not only marks it harder to attach the cover but will also weaken its hold.

2. Fit the holes on the top and bottom of the terminal cover the projections on the brackets (Fig. B) and lock in place. The figure right shows the attachment of a terminal cover to UT controller.



Fold the cover in the direction of the arrow.

Figure A



Fit the cover hold over the protrusion on the mounting bracket.

Figure B

5. Hardware Specifications

PV Input Signals

- Number of inputs: 1 (terminals ⑪-⑫-⑬)
- Input type: Universal input system. The input type can be selected with the software.
- Sampling period: 250 ms
- Burnout detection: Functions at TC, RTD, standard signal (0.4 to 2 V or 1 to 5 V)
  Upscale, downscale, and off can be specified.
  For standard signal, burnout is determined to have occurred if it is 0.1 V or less.
- Input bias current: 0.05 μA (for TC or RTD b-terminal)
- Measurement current (RTD): About 0.13 mA
- Input resistance: 1 MΩ or more for thermocouple or mV input
  About 1 MΩ for DC voltage input
- Allowable signal source resistance: 250 Ω or less for thermocouple or mV input
  Effects of signal source resistance: 0.1 μV/Ω or less
  2 kΩ or less for DC voltage input
  Effects of signal source resistance: About 0.01%/100 Ω
- Allowable wiring resistance: for RTD input
  Maximum 150 Ω/wire: Conductor resistance between three wires should be equal
  However, 10 Ω/wire for a maximum range of -150.0 to 150.0°C.
  Wire resistance effect: ±0.1°C /10 Ω
- Allowable input voltage: ±10 V DC for thermocouple, mV, or RTD input
  ±20 V DC for DC voltage input
- Noise rejection ratio: 40 dB (50/60 Hz) or more in normal mode
  120 dB (50/60 Hz) or more in common mode
- Reference junction compensation error: ±1.0°C (15 to 35°C)
  ±1.5°C (0 to 15°C, 35 to 50°C)
- Applicable standards: JIS, IEC, DIN (ITS-90) for thermocouples and RTD

Loop Power Supply

Supplies power to a two-wire transmitter.
(15 V DC: terminals ⑭-⑮; 24 V DC: terminals ⑰-⑱)
A resistor (10 to 250 Ω) connected between the controller and transmitter converts a current signal into a voltage signal, which is then read via the PV input terminal.
Supply voltage: 14.5 to 18.0 V DC, max. 21 mA (provided with a protection circuit against a field short-circuit); 21.6 to 28.0 V DC, max. 30 mA (only for models with 24 V DC loop power supply)
When using the 24 V DC loop power supply of the UT321, keep the operating ambient temperature between 0°C and 40°C.

Retransmission Output

Either PV, target setpoint, or control output is output.
Either the retransmission output or the loop power supply can be used with terminals ⑭-⑮.

- Number of outputs: 1 (terminals ⑭-⑮)
- Output signal: 4-20 mA DC
- Load resistance: 600 Ω or less
- Output accuracy: ±0.3% of span under standard operating conditions (23 ±2°C, 55 ±10% RH, power frequency of 50/60 Hz)

Control Output

Universal output system, The output type can be selected with the software.

- Current output (Standard type: terminals ⑯-⑰; Heating side: terminals ⑯-⑰; Cooling side: terminals ⑭-⑮)

Number of outputs	1 or 2 (two for heating/cooling type), switched between a voltage pulse output and current output.
Output signal	4-20 mA DC
Load resistance	600 Ω or less
Output accuracy	± 0.3% of span under standard operating conditions (23 ± 2 °C, 55 ±10% RH, power frequency of 50/60 Hz)

- Voltage pulse output (Standard type: terminals ⑯-⑰; Heating side: terminals ⑯-⑰; Cooling side: terminals ⑭-⑮)

Number of outputs	1 or 2 (two for heating/cooling type), switched between a voltage pulse output and current output.
Output signal	On-voltage = 12 V or more (load resistance: 600 Ω or more) Off-voltage = 0.1 V DC or less
Resolution	10 ms

- Relay contact output (Standard type: terminals ①-②-③; Heating side: terminals ①-②-③; Cooling side: terminals ④-⑦)

Number of outputs	1 or 2 (two for heating/cooling type)
Output signal	Three terminals (NC, NO, and common) / Two terminals
Contact rating	Terminals ①-②-③: 250 V AC or 30 V DC, 3 A (resistance load) Terminals ④-⑦: 240 V AC or 30 V DC, 1A (resistance load)
Resolution	10 ms

Contact Inputs

- Purpose: Selection between target setpoints or Auto/Man modes, or for other purposes
- Number of inputs: 2
- Input type: Non-voltage contact or transistor open collector input
- Input contact rating: 12 V DC, 10 mA or more
- On/off determination: For non-voltage contact input, contact resistance of 1 kΩ or less is determined as "on" and contact resistance of 20 kΩ or more as "off."
  For transistor open collector input, input voltage of 2 V or less is determined as "on" and leakage current must not exceed 100 μA when "off."
- Minimum status detection hold time: About 1 second.

Contact Outputs

- Purpose: Alarm output, FAIL output, and others
- Number of outputs: 3
- Relay contact rating: 240 V AC/1 A or 30 V DC/1 A ; 1a (COM terminal is common), (FAIL output ; 1b)

Display Specifications

- PV display:
  UT351: 4-digit, 7-segment green or red LED display, character height of 20 mm
  UT321: 4-digit, 7-segment green or red LED display, character height of 12 mm
- Setpoint display: 4-digit, 7-segment red LED display, character height of 9.3 mm (for both UT351 and UT321)
- Status indicating lamps: LEDs

Safety and EMC Standards

- Safety: Compliant with IEC1010-1: 1990 and EN61010-1: 1993+A2:1995
  Approved by CSA1010
  CSA1010 installation category (overvoltage category) : CATII (IEC1010-1)
  Approved by UL508
  (UT321:Application for certification made)
- EMC standards: Complies with EN61326.
  The instrument continues to operate at a measuring accuracy of within ±20% of the range during tests.
  (UT321:To be obtained)

Construction, Installation, and Wiring

- Construction: Only the front panel is dust-proof and drip-proof (protection class IP55)
  For side-by-side close installation the controller loses its dust-proof and drip-proof protection.
- Material: ABS resin and polycarbonate
- Case color: Black
- Weight: About 1 kg or less
- Dimensions:
  UT351 — 96 (W) × 96 (H) × 100 (depth from panel face) mm
  UT321 — 48 (W) × 96 (H) × 100 (depth from panel face) mm
- Installation: Panel-mounting type. With top and bottom mounting hardware (1 each)
- Panel cutout dimensions:
  UT351 — $92^{+0.8}_{0}$ (W) × $92^{+0.8}_{0}$ (H) mm
  UT321 — $45^{+0.6}_{0}$ (W) × $92^{+0.8}_{0}$ (H) mm
- Installation position: Up to 30° upward facing (not designed for facing downward)
- Wiring: M3.5 screw terminals (for signal wiring and power/ground wiring as well)

Power Supply Specifications

- Power supply: Rated voltage of 100 to 240 V AC (±10%), 50/60 Hz
- Power consumption: Max. 20 VA (8.0 W max.)
- Internal fuse rating: 250 V AC, 1.6A time-lag fuse
- Data backup: Non-volatile memory (can be written to up to 100,000 times)
- Withstanding voltage
  - Between primary terminals* and secondary terminals**: At least 1500 V AC for 1 minute (Note)
  - Between primary terminals* and grounding terminal: At least 1500 V AC for 1 minute (Note)
  - Between grounding terminal and secondary terminals**: At least 1500 V AC for 1 minute
  - Between secondary terminals**: At least 500 V AC for 1 minute
  * Primary terminals indicate power terminals and relay output terminals
  ** Secondary terminals indicate analog I/O signal, voltage pulse output, and contact input terminals
  Note: The withstanding voltage is specified as 2300 V AC per minute to provide a margin of safety.
- Insulation resistance: 20 MΩ or more at 500 V DC between power terminals and grounding terminal
- Grounding: Class 3 grounding (grounding resistance of 100 Ω or less)

Signal Isolations

- PV input terminals: Isolated from other input/output terminals. Not isolated from the internal circuit.
- 15 V DC loop power supply terminals: Not isolated from 4-20 mA analog output and voltage pulse control output. Isolated from other input/output terminals and internal circuit.
- 24 V DC loop power supply terminals: Isolated from the 15 V DC loop power supply terminals, 4-20 mA analog output terminals and voltage pulse control output terminals, other I/O terminals and the internal circuitry.
- 4-20 mA analog output terminals (for control output and retransmission): Not isolated between 4-20 mA outputs nor from 15 V DC loop power supply and voltage pulse control output. Isolated from other input/output terminals and internal circuit.
- Voltage pulse control output terminals: Not isolated from 4-20 mA outputs and 15 V DC loop power supply. Isolated from other input/output terminals and internal circuit.
- Relay contact control output terminals: Isolated between contact output terminals and from other input/output terminals and internal circuit.
- Contact input terminals: Not isolated between contact input terminals and from communication terminals. Isolated from other input/output terminals and internal circuit.
- Relay contact alarm output terminals: Not isolated between relay contact alarm outputs. Isolated from other input/output terminals and internal circuit.
- RS-485 communication terminals: Not isolated from contact input terminals. Isolated from other input/output terminals and internal circuit.
- Power terminals: Isolated from other input/output terminals and internal circuit.
- Grounding terminals: Isolated from other input/output terminals and internal circuit.

Environmental Conditions

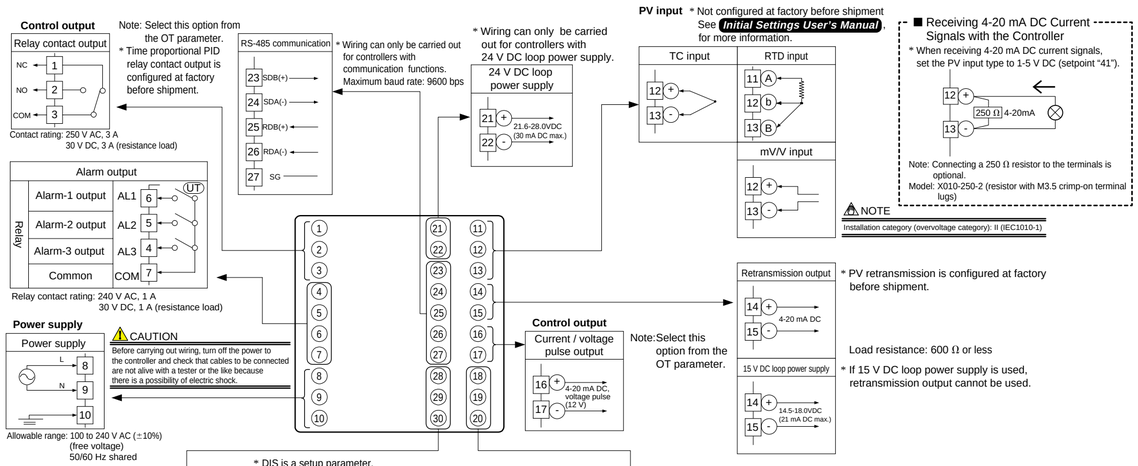
- Normal operating conditions:
  Ambient temperature: 0 to 50°C (40°C or less for side-by-side close installation)
  When using the 24 V DC loop power supply of the UT321, keep the operating ambient temperature between 0°C and 40°C.
  Temperature change rate: 10°C/h or less
  Ambient humidity: 20 to 90% RH (no condensation allowed)
  Magnetic field: 400 A/m or less
  Continuous vibration at 5 to 14 Hz: Full amplitude of 1.2 mm or less
  Continuous vibration at 14 to 150 Hz: 4.9 m/s^2 or less
  Short-period vibration: 14.7 m/s^2, 15 seconds or less
  Shock: 147 m/s^2 or less, 11 ms
  Installation height: Height above sea level of 2000 m or less
  Warm-up time: 30 minutes or more after power on
- Transportation and storage conditions:
  Temperature: -25 to 70°C
  Temperature change rate: 20°C/h or less
  Humidity: 5 to 95% RH (no condensation allowed)
- Effects of changes in operating conditions
  - Effects from changes in ambient temperature:
    - On voltage or thermocouple input, ±1 μV/°C or ±0.01% of F.S./°C, whichever is larger
    - On RTD input, ±0.05°C /°C (ambient temperature) or less
    - On analog output, ±0.05% of F.S./°C or less
  - Effects from power supply fluctuation (within rated voltage range)
    - On analog input, ±1 μV/10 V or ±0.01% of F.S./10 V, whichever is larger
    - On analog output, ±0.05% of F.S./ 10 V or less

6. Terminal Wiring Diagrams

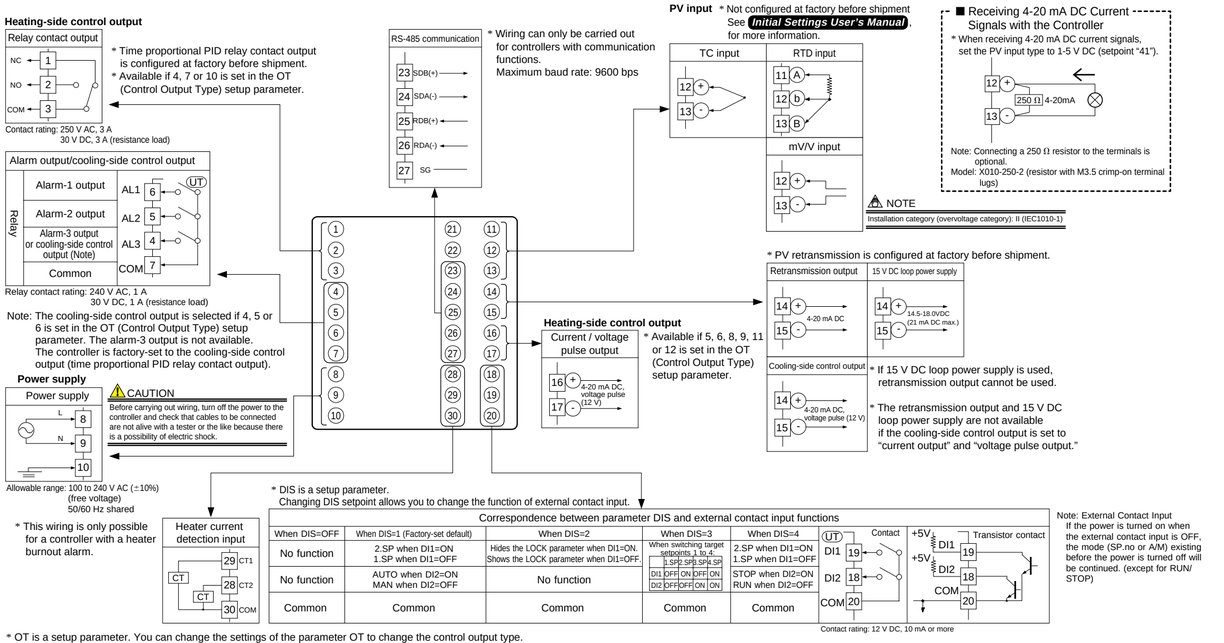
NOTE

Do not use unassigned terminals as relay terminals.

■ UT351 Standard Type (Model UT351-0□ or UT351-3□) or Heating/Cooling type(Model UT351-2□)

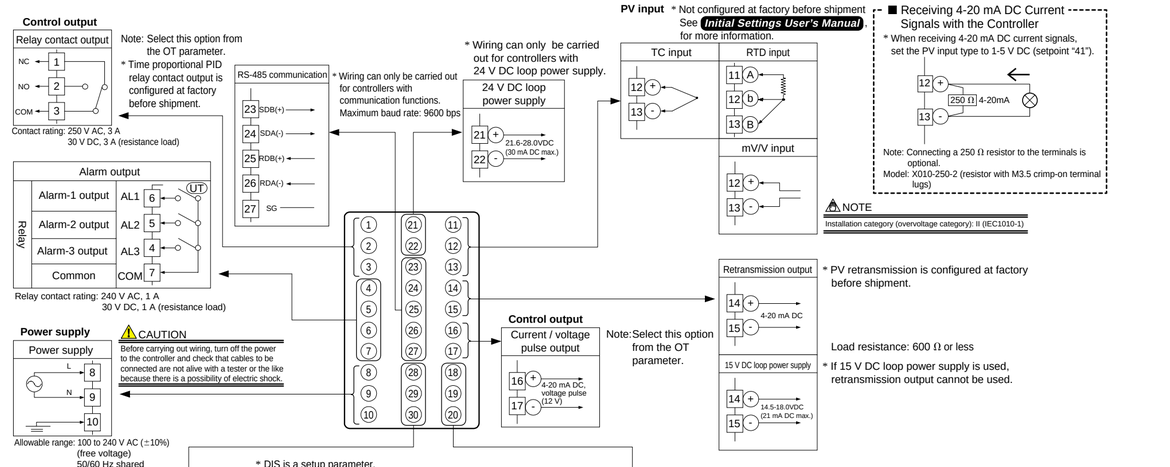


■ UT351 Heating/Cooling Type (Model UT351-2□)

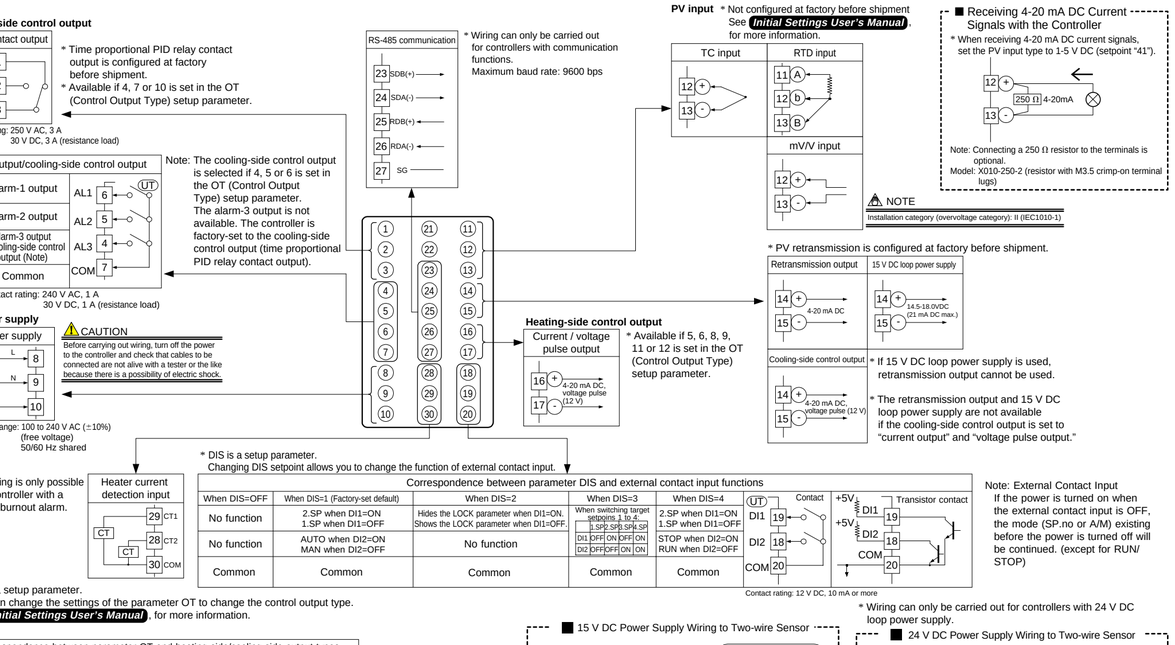


The control output types, "relay output" and "voltage pulse output" shown in the table above refer to those of time proportional control.
To change the type to a relay output for on-off control, select "Relay Terminals" and change the setpoint of the proportional band to "0."

■ UT321 Standard Type (Model UT321-0□ or UT321-3□) or Heating/Cooling type(Model UT321-2□)



■ UT321 Heating/Cooling Type (Model UT321-2□)



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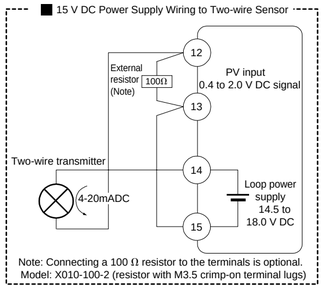
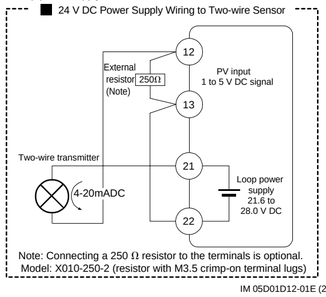
■ 15 V DC Power Supply Wiring to Two-wire Sensor



Note: Connecting a 100 Ω resistor to the terminals is optional.
Model: X010-100-2 (resistor with M3.5 crimp-on terminal lugs)

■ 24 V DC Power Supply Wiring to Two-wire Sensor



Note: Connecting a 250 Ω resistor to the terminals is optional.
Model: X010-250-2 (resistor with M3.5 crimp-on terminal lugs)

* Wiring can only be carried out for controllers with 24 V DC loop power supply.

User's Manual

Models UT351 / UT321 Digital Indicating Controllers with Active Color PV Display User's Manual **Initial Settings**

NEW GREEN SERIES

IM 05D01D12-02E

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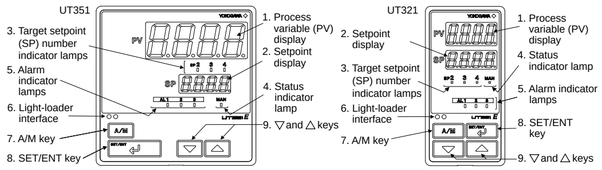
YOKOGAWA
Yokogawa M&C Corporation

This manual describes examples of setting PV input types, control output types, and alarm types. Carrying out settings described herein allows you to perform basic control. Refer to examples of various settings to understand how to set parameters required. Refer to "*1. Parameter Map*" in ***Parameters User's Manual*** for an easy to understand explanation of setting various parameters. If you cannot remember how to carry out an operation during setting, press the SET/ENT key for more than 3 seconds. This brings you to the display (operating display) that appears at power-on.

Contents

1. Names and Functions of Front Panel Parts



	Name of Part	Function
1.	Process variable (PV) display	Displays PV. Displays a parameter symbol when you set a parameter. Displays an error code (in red) if an error occurs.
2.	Setpoint display	Displays the setpoint (SP) or the output value (OUT) during operation. Displays the set value of parameters on the parameter setting display.
3.	Target setpoint (SP) number indicator lamps	When the SP number currently used for operation is 2, 3 or 4, the respective SP No. indicator lamp lighits. When the SP number is 1, the lamp does not light.
4.	Status indicator lamp	Is lit in green during manual operation. MAN: Is lit when in manual mode. Blinks during auto-tuning
5.	Alarm indicator lamps	If any of alarms 1 to 3 occurs, the respective alarm indicator lamp (AL1 to AL3) is lit (in orange).
6.	Light-loader interface	Interface for an adapter cable used when setting and storing parameters from a PC. This requires an optional parameter setting tool.
7.	A/M key (A/M)	Used to switch between the AUTO and MAN modes. Each time you press the key, it switches to the AUTO or MAN mode alternately.
8.	SET/ENT key (SET/ENT)	Used to switch or register a parameter. Pressing the key for more than 3 seconds allows you to switch between the operating display and the menu for operating parameter setting display alternately.
9.	▽and △ keys (▽ △)	Used to change numerical values. On setting displays for various parameters, you can change target setpoints, parameters, and output values (in manual operation). Pressing the ▽ key decreases a numerical value, while pressing the △ key causes it to increase. You can hold down a key to gradually increase the speed of change.

IMPORTANT

The controller automatically returns to the display at the time of power-on (i.e., operating display) if no key is operated for at least one minute.

Although only figures of the UT351 front panel are cited in "*2. Setting PV Input Type (Setting First at Power-on)*," and thereafter, the UT321 is identical to the UT351 in terms of front panel operation.

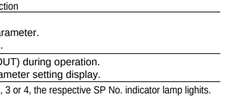
■ Setting of Main Parameters at the Factory before Shipment

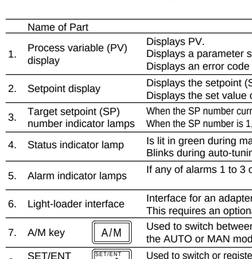
Item	Factory-set defaults for standard type controllers	Factory-set defaults for heating/cooling type controllers
Control output	Time proportional PID relay output (variable)	Heating side: Time proportional PID relay output (variable) Cooling side: Time proportional PID relay output (variable)
Control action	Reverse action (variable)	Not specified
PID parameter	P = 5.0%, I = 240 seconds, D = 60 seconds.	
Alarm output	Alarm-1: PV high limit, Alarm-2: PV low limit, Alarm-3: PV high limit	

2. Setting PV Input Type (Setting First at Power-on)

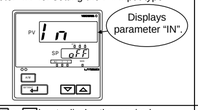
NOTE

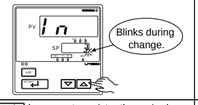
- The controller displays the operating display when the power is turned on. However, if PV input type has not been set, "IN" appears. In this case, first use the △ key to display the input range code to use, then press the SET/ENT key to register it. Then, set the maximum value (RH) and minimum value (RL) of the PV input range (for voltage input, set the maximum value (SH) and minimum value (SL) of the PV input scale).
- The controller is configured to the initial value of each parameter at the factory before shipment.
  First check the initial values shown in "*2. Lists of Parameters*," in ***Parameters User's Manual*** and change parameter values as necessary.

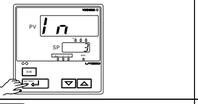
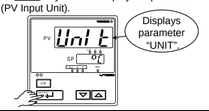


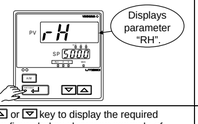


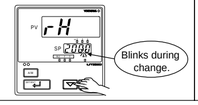
The following operating procedure describes an example of setting the controller to a K-type thermocouple (-199.9°C to 500.0°C) and the measurement range of 0.0°C to 200.0°C.

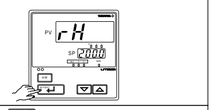
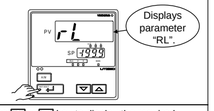
1. Display screen at power-on
   The parameter "IN" for setting the PV input type appears.
   

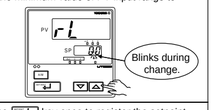
2. Press the △ or ▽ key to display the required setpoint. The figure below is an example of the controller set to a K-type thermocouple (-199.9°C to 500.0°C). See "Instrument Input Range Codes."
   

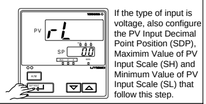
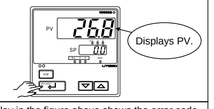
3. Press the SET/ENT key once to register the reqired setpoint.
   
4. Press the SET/ENT key once to display the parameter "UNIT" (PV Input Unit).
   

5. Press the SET/ENT key once to display the parameter "RH" (maximum value of PV input range).
   

6. Press the △ or ▽ key to display the required setpoint. The figure below shows an example of setting the maximum value of PV input range to 200.0°C.
   

7. Press the SET/ENT key once to register the setpoint.
   
8. Press the SET/ENT key once to display the parameter "RL" (minimum value of PV input range).
   

9. Press the △ or ▽ key to display the required setpoint. The figure below shows an example of setting the minimum value of PV input range to 0.0°C.
   

10. Press the SET/ENT key once to register the setpoint.
    
    If the type of input is voltage, also configure the PV Input Decimal Point Position (SDP), Maximim Value of PV Input Scale (SH) and Minimum Value of PV Input Scale (SL) that follow this step.
11. To set the type of control output, see steps 7 and later in "*4. Setting Control Output Type*." To finish settings, press the SET/ENT key for more than 3 seconds. This returns you to the display shown at power-on (figure below).
    

The PV display in the figure above shows the error code for input burnout (b_oUt) if PV input wiring is not yet complete. The error code disappears when you wire the PV input terminals correctly.

■ Instrument Input Range Codes

Select the unit from the UNIT parameter.

Input	Type	Instrument Input Range Code	Instrument Input Range	Measurement Accuracy
Unspecified		OFF	Set the data item PV Input Type "IN" to the OFF option to leave the PV input type undefined.	
Thermocouple	K	1	-200 to 1370°C -300 to 2500°F	±0.1% of instrument range ±1 digit for temperatures equal to or higher than 0°C ±0.2% of instrument range ±1 digit for temperatures below 0°C
		2	-199.9 to 999.9°C 0 to 2300°F	
		3	-199.9 to 500.0°C -199.9 to 999.9°F	
	J	4	-199.9 to 999.9°C -300 to 2300°F	
	T	5	-199.9 to 400.0°C -300 to 750°F	
		6	0.0 to 400.0°C -199.9 to 750.0°F	
	B	7	0 to 1800°C 32 to 3300°F	±0.15% of instrument range ±1 digit for temperatures equal to or higher than 400°C ±5% of instrument range ±1 digit for temperatures below 400°C
	S	8	0 to 1700°C 32 to 3100°F	±0.15% of instrument range ±1 digit
	R	9	0 to 1700°C 32 to 3100°F	
	N	10	-200 to 1300°C -300 to 2400°F	±0.1% of instrument range ±1 digit ±0.25% of instrument range ±1 digit for temperatures below 0°C
	E	11	-199.9 to 999.9°C -300 to 1800°F	±0.1% of instrument range ±1 digit for temperatures equal to or higher than 0°C ±0.2% of instrument range ±1 digit for temperatures below 0°C
	L(DIN)	12	-199.9 to 900.0°C -300 to 1300°F	
	U(DIN)	13	-199.9 to 400.0°C -300 to 750°F	
		14	0.0 to 400.0°C -199.9 to 750.0°F	
	W	15	0 to 2300°C 32 to 4200°F	±0.2% of instrument range ±1 digit
	Platinel 2	16	0 to 1390°C 32 to 2500°F	±0.1% of instrument range ±1 digit
	PR20-40	17	0 to 1900°C 32 to 3400°F	±0.5% of instrument range ±1 digit for temperatures equal to or higher than 800°C No guarantee of accuracy for temperatures below 800°C
	W97Re3-W75Re25	18	0 to 2000°C 32 to 3600°F	±0.2% of instrument range ±1 digit
RTD	JPt100	30	-199.9 to 500.0°C -199.9 to 999.9°F	±0.1% of instrument range ±1 digit (Note1) (Note2)
		31	-150.0 to 150.0°C -199.9 to 300.0°F	±0.2% of instrument range ±1 digit (Note1)
	Pt100	35	-199.9 to 850.0°C -300 to 1560°F	±0.1% of instrument range ±1 digit (Note1) (Note2)
		36	-199.9 to 500.0°C -199.9 to 999.9°F	
		37	-150.0 to 150.0°C -199.9 to 300.0°F	±0.2% of instrument range ±1 digit (Note1)
Standard signal	0.4 to 2 V	40	0.400 to 2.000 V	±0.1% of instrument range ±1 digit The read-out range can be scaled between -1999 and 9999.
	1 to 5 V	41	1.000 to 5.000 V	
DC voltage	0 to 2 V	50	0.000 to 2.000 V	
	0 to 10 V	51	0.00 to 10.00 V	
	-10 to 20 mV	55	-10.00 to 20.00 mV	
	0 to 100 mV	56	0.0 to 100.0 mV	

* Performance in the standard operationg condition (at 23±2°C, 55±10%RH, and 50/60Hz power frequency)
Note1: The accuracy is ±0.3°C of instrument range ±1 digit for a temperature range from 0°C to 100°C.
Note2: The accuracy is ±0.5°C of instrument range ±1 digit for a temperature ranges from -100°C to 0°C and 100°C to 200°C.
* To receive a 4-20 mA DC signal, select a standard signal of 1 to 5 V DC and connect it to a 250Ω resistor. This resistor is optional.
Model: X010-250-2 (resistor with M3.5 crimp-on terminal lugs)

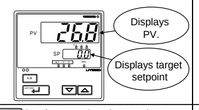
NOTE

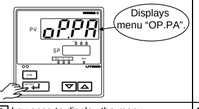
The controller may automatically initialize the registered operating parameter setpoints if any change is made to the data item PV Input Type (IN), Maximum Value of PV Input Range (RH), Minimum Value of PV Input Range (RL), PV Input Decimal Point Position (SDP), Maximum Value of PV Input Scale (SH) or Minimum Value of PV Input Scale (SL). After a change has been made to any of these data items, be sure to verify the registered operating parameter setpoints to ensure that they are correct. If any data item has been changed to its default, set it to a required value.

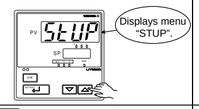
3. Changing PV Input Type

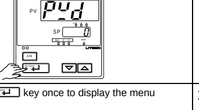
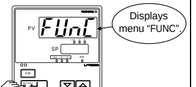
The following operating procedure describes an example of changing the K-type thermocouple (-199.9°C to 500.0°C) to a Pt100 resistance temerature detector (-199.9°C to 500.0°C) and setting the measurement range of 0.0°C to 200.0°C.

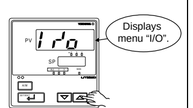
PV input terminal
Thermocouple/mV/V input..... ⑫-⑬
RTD input ..... ⑪-⑫-⑬

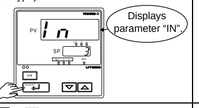
1. Bring the operating display into view (display appears at power on).
   

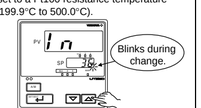
2. Press the SET/ENT key for more than 3 seconds to call up the menu "OP.PA".
   

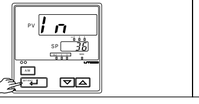
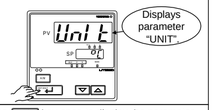
3. Press the △ key once to display the menu "STUP".
   

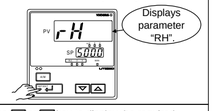
4. Press the SET/ENT key once to display the parameter "PWD".
   
5. Press the SET/ENT key once to display the menu "FUNC".
   

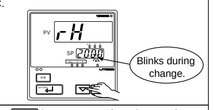
6. Press the △ key once to display the menu "I/O".
   

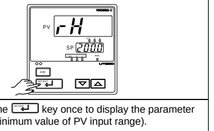
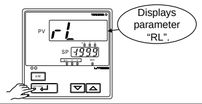
7. Press the SET/ENT key once to display the parameter "IN" (PV input type).
   

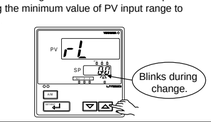
8. Press the △ or ▽ key to display the required setpoint. The figure below is an example of the controller set to a Pt100 resistance temperature detector (-199.9°C to 500.0°C).
   

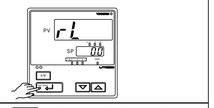
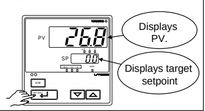
9. Press the SET/ENT key once to register the setpoint.
   
10. Press the SET/ENT key once to display the parameter "UNIT" (PV input unit).
    

11. Press the SET/ENT key once to display the parameter "RH" (maximum value of PV input range).
    

12. Press the △ or ▽ key to display the required setpoint. The figure below shows an example of setting the maximum value of PV input range to 200.0°C.
    

13. Press the SET/ENT key once to register the setpoint.
    
14. Press the SET/ENT key once to display the parameter "RL" (minimum value of PV input range).
    

15. Press the △ or ▽ key to display the required setpoint. The figure below shows an example of setting the minimum value of PV input range to 0.0°C.
    

16. Press the SET/ENT key once to register the setpoint.
    
17. Press the SET/ENT key for more than 3 seconds.
    This returns you to the display shown at power-on (figure below).
    

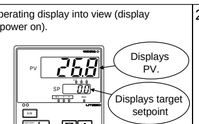
* If the type of input is voltage, also configure the PV Input Decimal Point Position (SDP), Maximim Value of PV Input Scale (SH) and Minimum Value of PV Input Scale (SL) that are displayed after parameter RL.

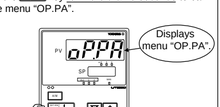
4. Setting Control Output Type

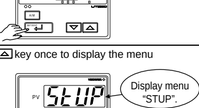
The following operating procedure describes an example of changing time proportional PID relay output (0: factory-set default) to current output (2).

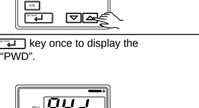
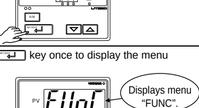
Control output terminal Values in parentheses are setpoints
Time proportional PID relay (0)/on-off(3) output..... ①-②-③
Current (2)/time proportional PID voltage pulse (1) output..... ⑭-⑰

For details on the heating/cooling control output terminals, see "*6. Terminal Wiring Diagrams*" in ***Installation User's Manual***.

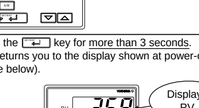
1. Bring the operating display into view (display appears at power on).
   

2. Press the SET/ENT key for more than 3 seconds to call up the menu "OP.PA".
   

3. Press the △ key once to display the menu "STUP".
   

4. Press the SET/ENT key once to display the parameter "PWD".
   
5. Press the SET/ENT key once to display the menu "FUNC".
   

6. Press the SET/ENT key several times to display the parameter "AL1" (alarm-1 type).
   

7. Press the △ or ▽ key to display the required setpoint. The figure below shows an example of setting PV low limit alarm.
   

8. Press the SET/ENT key once to register the setpoint.
   You can take the same steps for alarm-2 type (AL2), and alarm-3 type (AL3) that are displayed after this.
   
9. Press the SET/ENT key for more than 3 seconds.
   This returns you to the display shown at power-on (figure below).

10. When setting an alarm setpoint, see "*4. Setting Alarm Setpoints*" in ***Operations User's Manual***.

5. Changing Alarm Type

The following operating procedure describes an example of changing alarm-1 (factory-set default: PV high limit alarm) to PV low limit alarm.
When you have changed alarm type, the alarm setpoint will be initialized; set the alarm setpoint again.

Alarm output terminals Factory-set defaults
Alarm-1 (terminal numbers ⑧-⑦).....PV input high limit alarm
Alarm-2 (terminal numbers ⑤-⑦).....PV input low limit alarm
Alarm-3 (terminal numbers ④-⑦).....PV input high limit alarm

For details see "List of Alarm Types" in ***Parameters User's Manual***

1. Bring the operating display into view (appears at power-on).

2. Press the SET/ENT key for more than 3 seconds to call up the menu "OP.PA".

3. Press the △ key once to display the menu "STUP".

4. Press the SET/ENT key once to display the parameter "PWD".

5. Press the SET/ENT key once to display the menu "FUNC".

6. Press the SET/ENT key several times to display the parameter "OT" (control output type).

7. Press the △ or ▽ key to display the required setpoint. The figure below shows an example of setting to current output (4 to 20 mA DC).

8. Press the SET/ENT key once to register the setpoint.

9. Press the SET/ENT key for more than 3 seconds.
   This returns you to the display shown at power-on (figure below).

10. Press the SET/ENT key for more than 3 seconds.
    This returns you to the display shown at power-on (figure below).

6. Description of Multiple Setpoints and PID

The UT351/UT321 controllers have a maximum of four target setpoint (SP) parameters and has PID for each of these setpoints. The following shows the correspondence between the target setpoint numbers (SP.NO), target setpoints (SP), and PID parameters.
For example, if you have set "2" to the target setpoint number (SP.NO), the control parameters available are target setpoint (2.SP), proportional band (heating-side proportional band) (2.P), integral time (heating-side integral time) (2.I), derivative time (heating-side derivative time) (2.D), cooling-side proportional band (2.Pc), cooling-side integral time (2.Ic), and cooling-side derivative time (2.Dc).
To use multiple target setpoints, see the table below to check the corresponding parameters.

Target setpoint number (SP.NO)	Target setpoint (SP)	PID parameter					
		Proportional band (heating-side proportional band)	Integral time (heating-side integral time)	Derivative time (heating-side derivative time)	Cooling-side proportional band	Cooling-side integral time	Cooling-side derivative time
SP.NO=1	1.SP	1.P	1.I	1.D	1.Pc	1.Ic	1.Dc
SP.NO=2	2.SP	2.P	2.I	2.D	2.Pc	2.Ic	2.Dc
SP.NO=3	3.SP	3.P	3.I	3.D	3.Pc	3.Ic	3.Dc
SP.NO=4	4.SP	4.P	4.I	4.D	4.Pc	4.Ic	4.Dc

User's Manual

Models UT351 / UT321 Digital Indicating Controllers with Active Color PV Display User's Manual Operations

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YOKOGAWA
Yokogawa M&C Corporation

This manual describes key entries for operating the controller. For operations using external contact inputs, see "*6. Terminal Wiring Diagrams*" in ***Installation User's Manual***. If you cannot remember how to carry out an operation during setting, press the ↵ key for more than 3 seconds. This brings you to the display (operating display) that appears at power-on.

Contents

NOTE

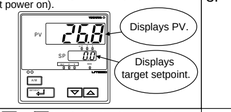
Do not use the instrument generating strong magnetic field such as radio equipment and the like near the controller. This may cause the fluctuation of the PV value.

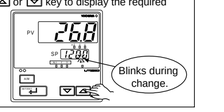
1. Setting Target Setpoint (SP)

The following operating procedure describes an example of setting 120.0 to a target setpoint. In automatic operation, the controller starts control using set target setpoints.

NOTE

When the target setpoint is set through communication, the target setpoint cannot be changed by keystroke.

1. Bring the operating display into view (display appears at power on).


2. Press the ▲ or ▼ key to display the required setpoint.


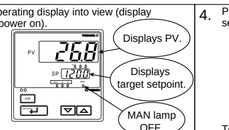
3. Press the ↵ key once to register the setpoint.

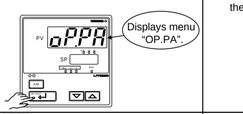

2. Performing/Canceling Auto-tuning

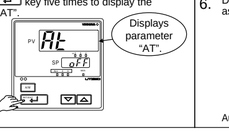
Auto-tuning should be carried out after setting a target setpoint (SP). Make sure the controller is in automatic operation mode (AUTO) and in running state (RUN) before carrying out auto-tuning. See "*7. Switching between AUTO and MAN.*" to change to AUTO and "*6. Switching between RUN and STOP,*" to change to RUN.

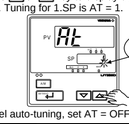
NOTE

When on-off control is being used, auto-tuning cannot be carried out. Moreover, do not perform auto-tuning when contolling any of following processes.
- Control processes with quick response such as flow control or pressure control
- Processes where even temporary output on/off results in inconvenience
- Processes where a large output change at control element results in inconvenience
- Processes where variations in PV may exceed an allowable range, adversely affecting product quality

1. Bring the operating display into view (display appears at power on).


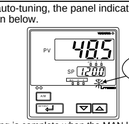
2. Press the ↵ key for more than 3 seconds to call up the menu "OP.PA".


3. Press the ↵ key five times to display the parameter "AT".


4. Press the ▲ or ▼ key to display the required setpoint. Tuning for 1.SP is AT = 1.


To cancel auto-tuning, set AT = OFF.

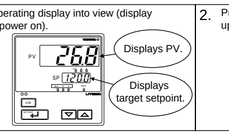
5. Press the ↵ key once to register the setpoint. (This starts auto-tuning.)
If the ↵ key is pressed when AT = OFF, auto-tuning will be cancelled. In this case, PID contains the value existing before auto-tuning.

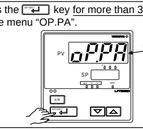

6. During auto-tuning, the panel indications become as shown below.


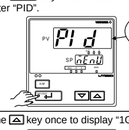
Auto-tuning is complete when the MAN lamp goes off.

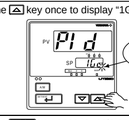
3. Setting PID Manually

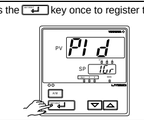
If you know the values to be set or if suitable PID constants cannot be obtained by auto-tuning, follow the procedure below to set values.

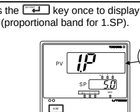
1. Bring the operating display into view (display appears at power on).


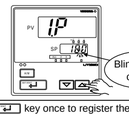
2. Press the ↵ key for more than 3 seconds to call up the menu "OP.PA".


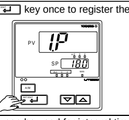
3. Press the ↵ key several times to display the parameter "PID".


4. Press the ▲ key once to display "1Gr."


5. Press the ↵ key once to register the setpoints.


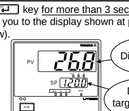
6. Press the ↵ key once to display the parameter "1.P" (proportional band for 1.SP).


7. Press the ▲ or ▼ key to display the required setpoint.


8. Press the ↵ key once to register the setpoint.


The same steps can be used for integral time (1.I) and derivative time (1.D) that are displayed after this.

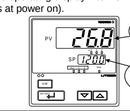
[TIP]
The PID parameter numbers set in step 4. should be set as follows:
In case of PID for 1.SP, PID = 1Gr
In case of PID for 2.SP, PID = 2Gr
In case of PID for 3.SP, PID = 3Gr
In case of PID for 4.SP, PID = 4Gr

9. Press the ↵ key for more than 3 seconds. This returns you to the display shown at power-on (figure below).


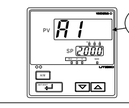
4. Setting Alarm Setpoints

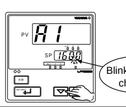
The following operating procedure describes an example of setting 160.0 to alarm-1 setpoint. Check alarm type before setting the alarm setpoint. To change the type of alarm, see "*5. Changing Alarm Type*" in ***Initial Setting User's Manual***.

Alarm output terminals	Factory-set defaults
Alarm-1 (terminal numbers ⑥-⑦)	PV high limit alarm
Alarm-2 (terminal numbers ⑤-⑦)	PV low limit alarm
Alarm-3 (terminal numbers ④-⑦)	PV high limit alarm

1. Bring the operating display into view (display appears at power on).


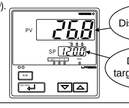
2. Press the ↵ key for more than 3 seconds to call up the menu "OP.PA".


3. Press the ↵ key twice to display the parameter "A1".


4. Press the ▲ or ▼ key to display the required setpoint.


5. Press the ↵ key once to register the setpoint.

Also configure the Alarm-2 Setpoint (A2) and Alarm-3 Setpoint (A3) parameters that follow this step.

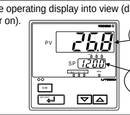
6. Press the ↵ key for more than 3 seconds. This returns you to the display shown at power-on (figure below).


5. Selecting Target Setpoint Numbers (SP.NO)

The following operating procedure describes an example of changing a target setpoint number (SP.NO) from 1 to 2.

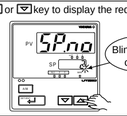
NOTE

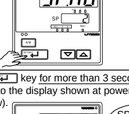
If a target setpoint number has been switched using contact input, when the contact input is on, that number cannot be selected by keystroke.
When using target setpoint ramp setting function, PV tracking works if the target setpoint number is switched.

1. Bring the operating display into view (display appears at power on).


2. Press the ↵ key for more than 3 seconds to call up the menu "OP.PA".


3. Press the ↵ key several times to display the parameter "SP.NO"


4. Press the ▲ or ▼ key to display the required setpoint.


5. Press the ↵ key once to register the setpoint.


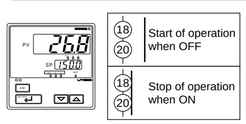
6. Press the ↵ key for more than 3 seconds. This returns you to the display shown at power-on (figure below).


6. Switching between Run and Stop

Switching between the RUN and STOP states can be performed only using external contact input.

NOTE

When the controller is shipped from the factory, it is configured so that switching between the RUN and STOP states cannot be performed. To make the switching possible, configure the DIS setup parameter as "DIS = 4".



When the controller is stopped, input and outputs are as follows:

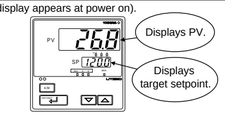
PV input	Displays PV.
Control output	Preset output value (factory-set default: 0%)
Alarm output	ON in the event of an alarm

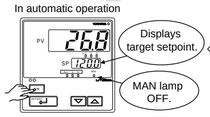
When the controller is stopped, control output display is STOP.

7. Switching between AUTO and MAN

NOTE

If AUTO and MAN have been switched using contact input, when the contact input is ON, switching between AUTO and MAN cannot be achieved by keystroke.

1. Bring the operating display into view (display appears at power on).


2. Each time you press the A/M key on the front panel of the instrument, AUTO and MAN is switched alternately.
In automatic operation


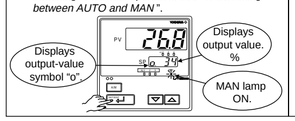
In manual operation

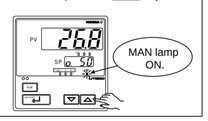

8. Manipulating the Control Output in Manual Operation

NOTE

Control output cannot be changed if the controller is stopped. In this case, the preset output value (setup parameter PO) will be output.

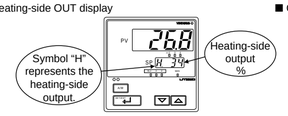
A control output value is linked with a display value changed using the ▼ or ▲ key. Note that the control output changes as displayed without requiring the ↵ key.

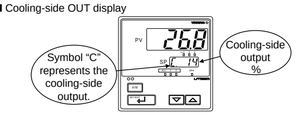
1. Bring manual operating display into view. For switching to manual operation, see "*7. Switching between AUTO and MAN*".


2. Press the ▲ or ▼ key to change a control output value. You don't need to press the ↵ key.


■ Manipulating the Control Output during Heating/Cooling Control

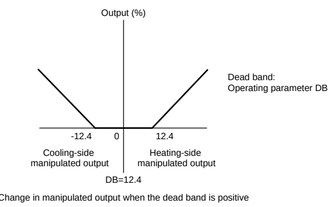
Either of the following two displays appears when the mode is switched to MAN during heating/cooling control.

■ Heating-side OUT display


■ Cooling-side OUT display


● Controller behavior and control output manipulation when the dead band is positive

The following is an example when the DB parameter is set at 12.4%.
If you hold down the ▼ key with the heating-side output under manipulation (i.e., cooling-side output C = 0.0%), the heating-side output (H =) decreases. Consequently, both the heating-side and cooling-side outputs change to 0.0%. If you keep the ▼ key held down longer, you enter the state of manipulating the cooling-side output, and its value begins to increase.
Inversely, if you hold down the ▲ key with the cooling-side output under manipulation (i.e., heating-side output H = 0.0%), the cooling-side output (C =) decreases. Consequently, both the heating-side and cooling-side outputs go to 0.0%. If you keep the ▲ key held down longer, you enter the state of manipulating the heating-side output, and its value begins to increase.

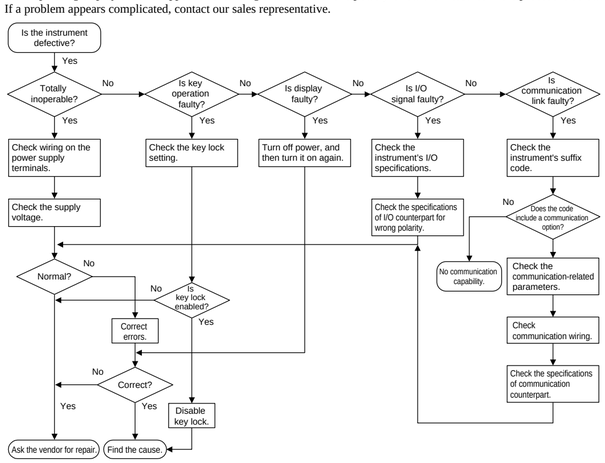


Change in manipulated output when the dead band is positive

9. Troubleshooting

■ Troubleshooting Flow

If the operating display does not appear after turning on the controller's power, follow the measures in the procedure below. If a problem appears complicated, contact our sales representative.



IMPORTANT

Take note of the parameter settings when asking the vendor for repair.

■ Errors at Power On

The following table shows errors that may be detected by the fault diagnosis function when the power is turned on.

Error indication (on PV display unit)	Description of error	PV	Control output	Alarm output	Retransmission output	Communi-cation	Remedy
E000 (E000)	Faulty RAM	None	0% or less or OFF	OFF	0% or less	Stopped	Faulty Contact us for repair.
E001 (E001)	Faulty ROM						
E002 (E002)	System data error	0%			0%	Normal action	
PV decimal point blinks.	Faulty calibration value	Normal action (out of accuracy)	Normal action (out of accuracy)	Normal action (out of accuracy)	Normal action (out of accuracy)		
E400 (E400)	Parameter error	0%	Preset value output	OFF	0%		Check and set the parameters, as they have been set to the limited values.

■ Possible Errors during Operation

The following shows possible errors occurring during operations.

Error indication (on PV display unit)	Description of error	PV	Control output	Alarm output	Retransmis-sion output	Commu-nication	Remedy
Displays "RJC" and PV alternately	RJC error	Measured with RJC=OFF	Normal action	Normal action	Normal action	Normal action	Faulty Contact us for repair.
PV value blinks.	EEPROM error	Normal action	Normal action	Normal action	Normal action	Normal action	
E300 (E300)	A/DC error	105%	Preset value output	Normal action	Normal action	Normal action	
bOUt (B.OUT)	PV burnout error	Dependent on the BSL parameter Up-scale: 105% Down-scale: -5%	Preset value output	Normal action	Normal action	Normal action	Check wires and sensor.
oVr (OVER) or -oVr (-OVER)	Excessive PV Out of -5 to 105%	-5% or 105%	Normal action	Normal action	Normal action	Normal action	Check process.
E200 (E200)	Auto-tuning failure (Time-out)	Normal action	Normal action	Normal action	Normal action	Normal action	Check process. Press any key to erase error indication.
SP decimal point blinks. (on setpoint display unit)	Faulty communi-cation line	Normal action	Normal action	Normal action	Normal action	Normal action	Check wires and communication parameters, and make resetting. Recovery at normal receipt
All indications off	Runaway (due to defective power or noise)	None	0% or less or OFF	OFF	0% or less	Stopped	Faulty if power off/on does not reset start the unit. Contact us for repair.
All indications off	Power off	None	0%	OFF	0%	Stopped	Check for abnormal power.

■ If a Power Failure Occurs during Operation

● Momentary power failures shorter than 20 ms

The controller is not affected at all and continues normal operation.

● Power failures of 20 ms or longer

- The alarm function of the controller continues to work normally. (Alarms with the stand-by feature temporarily return to their stand-by state, however.)
- Setting parameters that have already been configured retain their settings.
- Auto-tuning is cancelled.
- After recovery from a power failure, control action resumes in the same mode as the one before the occurrence of the power failure. The control output begins with the preset output value.

■ Troubleshooting When the Controller Fails to Operate Correctly

If your control tasks are not successful, check the preset parameters and controller wiring before concluding the controller to be defective. The following show some examples of troubleshooting you should refer to in order to avoid the possibility of other problems.

● The controller does not show the correct measured input (PV).

- The UT351/UT321 controllers have a universal input.
  The type of PV input can be set/changed using the parameter "IN". At this point, the controller must be wired correctly according to the selected type of PV input. Check the wiring first if the controller fails to show the correct PV. To do this, refer to ***Initial Settings User's Manual***.
  With the parameters "RH", "RL", "SDP", "SH" and "SL", it is possible to scale the input signal and change its number of decimal places. Also check that these parameters are configured correctly.

● The controller does not provide any control output or the control output does not change at all.

- The UT351/UT321 controllers have a universal output.
  The type of control output can be set/changed using the parameter "OT".
  At this point, the controller must be wired correctly according to the selected type of control output. Check the wiring first if the controller provides no control output. To do this, refer to "*6. Terminal Wiring Diagrams*," in ***Installation User's Manual***.
  With the parameters "OH" and "OL", it is possible to set/change the high and low limits of control output. The control output may not change at all, however, because of restrictions on these parameters. Also check the restrictions on these parameters.
- The control output can only be changed when the controller is in the MAN mode.
  If the MAN lamp is off (i.e., the controller is in the AUTO mode), you cannot change the control output using key operation.

● The control output does not change soon after the target setpoint SP has been changed.

- If this happens, check the setpoint of the parameter "C.MD". In cases where fixed-point control is selected as the PID control mode (C.MD = 1), tracking based on the I-term works to prevent the control output from changing suddenly even if the target setpoint SP is varied.
  The control output therefore may appear to be working incorrectly at first; however it gradually adapts itself to the new target setpoint.

User's Manual

Models UT351 / UT321 Digital Indicating Controllers with Active Color PV Display User's Manual Parameters

NEW GREEN SERIES

IM 05D01D02-03E

3rd Edition: Apr. 1, 2003

YOKOGAWA ◆
Yokogawa M&C Corporation

This manual contains a parameter map as a guideline for setting parameters, and lists of parameters for recording User Settings.

Contents

1. Basic Key Operation Sequence and Parameter Map

Basic Key Operation Sequence

1. Setting display can be switched (moved) using the ↵ key.
2. A numerical value is changed by
   (1) Using the ▽ or △ key to change a displayed value (decimal point blinking) and
   (2) Pressing the ↵ key to register it.
3. Pressing the ↵ key on an operating display (for more than 3 seconds) brings you to the operating parameter setting display.
4. Pressing the ↵ key on the operating parameter setting display (for more than 3 seconds) returns you to the operating display.
5. Pressing the ↵ key on the setup parameter setting display (for more than 3 seconds) returns you to the operating display.
   You cannot return to the operating parameter setting display from the setup parameter setting display.

If you become unsure of key operation during parameter setting, hold down the ↵ key for more than 3 seconds. This returns you to the display at power-on (i.e., operating display).

Power on → Display? IN = OFF (No / Yes)

Determine PV input type first. Settings herein are described in "2. Setting PV Input Type (Setting First at Power-on)", in Initial Settings User's Manual.

Display example (PV: In, SP: oFF) → Display example (PV: In, SP: 0) → Blinks during change. → Display example (PV: In, SP: 5)

1. Use the ▽ or △ key to set a numerical value. See Instrument Input Range Codes in Initial Settings User's Manual.
2. Press the ↵ key to register the value.

After PV input type (IN), input/output parameters such as PV input unit (UNIT), maximum value of PV input range (RH), and minimum value of PV input range (RL) will be displayed.

Operating Display

SP display (PV: 26.8, SP: 12.00) — Target Setpoint — key — Output-value symbol "o" — OUT display (PV: 26.8, o: 5.0) — Output value %

Operating Display for Heating/Cooling Control

SP display (PV: 26.8, SP: 12.00) — key — Heating-side output-value symbol "H" — Heating-side output display (PV: 26.8, H: 3.0) — Heating-side output %

SP display (PV: 26.8, SP: 12.00) — key — Cooling-side output-value symbol "C" — Cooling-side output display (PV: 26.8, C: 1.0) — Cooling-side output %

NOTE

Changing the registered value of a setup parameter may cause the registered value of an operating parameter to be initialized automatically. Thus, when you have changed a setup parameter, always check that the registered value of the operating parameter is appropriate. If it is initialized to default, reset it to the required value.

Operating Parameter Setting Display

key — Press this key for more than 3 seconds to move to the operating parameter setting display.

Menu → oPPA

LL	LL communication interface selection
A1	Alarm-1 setpoint
A2	Alarm-2 setpoint
A3	Alarm-3 setpoint (Not displayed when OT parameter set to 4 to 6.)
AT	Auto-tuning (Displayed in automatic operation)
SC	SUPER function
SP.no	Target setpoint number selection
PId	PID parameter display number
FL	PV input filter
bS	PV input bias
UPr	Setpoint ramp-up rate
dnr	Setpoint ramp-down rate
oH	Output high limit/heating-side output high limit
oL	Output low limit/cooling-side output high limit
H	ON/OFF control hysteresis/ heating-side/cooling-side ON/OFF control hysteresis (Displayed for ON/OFF control)
dr	Direct/reverse action switching
PCCH	High limit for PV color change (Displayed when PCMD (PV color mode parameter) = 6 to 9)
PCCL	Low limit for PV color change
Hb1	Heater burnout current setpoint 1
Hb2	Heater burnout current setpoint 2
HC1	Heater burnout current measurement 1
HC2	Heater burnout current measurement 2
orb	ON/OFF rate detection band (The setpoints of the ORB, ORH and ORL parameters are only effective when a sensor grounding alarm is used.)
orH	ON/OFF rate high limit (The OR parameter represents the moving average (for 5 cycle times) of the control output and is not a setpoint.)
orL	ON/OFF rate low limit
or	ON/OFF rate
1SP	Target setpoint-1
2SP	Target setpoint-2
3SP	Target setpoint-3
4SP	Target setpoint-4

FL is displayed if you press the ↵ key when PID = MENU.

Pressing the ↵ key when PID = 1Gr causes PID for 1.SP to appear.

1P	Proportional band / heating-side proportional band
1I	Integral time / heating-side integral time
1d	Derivative time / heating-side derivative time
1MR	Manual reset
1Pc	Cooling-side proportional band
1Ic	Cooling-side integral time
1dc	Cooling-side derivative time
1db	Dead band
1rP	Zone PID reference point-1

Pressing the ↵ key when PID = 2Gr causes PID for 2.SP to appear.

2P	Proportional band / heating-side proportional band
2I	Integral time / heating-side integral time
2d	Derivative time / heating-side derivative time
2MR	Manual reset
2Pc	Cooling-side proportional band
2Ic	Cooling-side integral time
2dc	Cooling-side derivative time
2db	Dead band
2rP	Zone PID reference point-1

Pressing the ↵ key when PID = 3Gr causes PID for 3.SP to appear.

3P	Proportional band / heating-side proportional band
3I	Integral time / heating-side integral time
3d	Derivative time / heating-side derivative time
3MR	Manual reset
3Pc	Cooling-side proportional band
3Ic	Cooling-side integral time
3dc	Cooling-side derivative time
3db	Dead band
3rP	Zone PID reference point-1

Pressing the ↵ key when PID = 4Gr causes PID for 4.SP to appear.

4P	Proportional band / heating-side proportional band
4I	Integral time / heating-side integral time
4d	Derivative time / heating-side derivative time
4MR	Manual reset
4Pc	Cooling-side proportional band
4Ic	Cooling-side integral time
4dc	Cooling-side derivative time
4db	Dead band
rdW	Zone PID reference point-1

(Not displayed for ON/OFF control; Displayed when integral time is OFF; Displayed for heating/cooling control; Displayed for heating/cooling control; Displayed when parameter ZON=ON)

To switch the parameter display, press the ↵ key.

Description of Operating Parameter Menu Display: Displays the operating parameter menu symbol "oP.PA". (oPPA) — Nothing appears.

Description of Operating Parameter Setting Display: Displays a parameter symbol. (A1) — Displays a setpoint. (500)

Setup Parameter Setting Display

key — Press this key for more than 3 seconds to move to the operating display.

Menu → SEtUP → key → PWd Password input (No password is required when PWD = 0.) → key → B

When shipped from the factory, this parameter appears first after power-on.

Controll function related: FUnC (or △ key)

SPH	Target setpoint limiter upper limit
SPL	Target setpoint limiter lower limit
PCmd	PV color mode
AL1	Alarm-1 type
AL2	Alarm-2 type
AL3	Alarm-3 type (Not displayed when OT parameter set to 4 to 6.)
HY1	Alarm-1 hysteresis
HY2	Alarm- 2 hysteresis
HY3	Alarm- 3 hysteresis
dY1	Alarm-1 delay timer
dY2	Alarm- 2 delay timer
dY3	Alarm- 3 delay timer
Ct	Control output cycle time / heating-side control output cycle time
Ctc	Cooling-side control output cycle time (Displayed for heating /cooling control)
Po	Preset output / heating-side preset output
Poc	Cooling-side preset output (Displayed for heating /cooling control)
Cmd	PID control mode
Zon	Zone PID selection
Ar	Anti-reset windup
tmU	Ramp-rate time unit
PSL	Protocol selection (Displayed only for controllers with communication functions)
bPS	Baud rate
Pri	Parity
StP	Stop bit
dLn	Data length
Adr	Address
rPt	Minimum response time
tESt	(This parameter is not to be set.)

Input/output related: Iro (or △ key)

In	PV input type (PV INPUT terminals)
Unit	PV input unit
rH	Maximum value of PV input range
rL	Minimum value of PV input range
SdP	PV input decimal point position (displayed at voltage input)
SH	Maximum value of PV input scale (displayed at voltage input)
SL	Minimum value of PV input scale (displayed at voltage input)
rJC	Presence/absence of PV input reference junction compensation
ErJC	External RJC setpoint (displayed when IN=TC)
bSL	Selection of PV input burnout action
ot	Control output type
rEt	Retransmission output type
rtH	Maximum value of retransmission output scale
rtL	Minimum value of retransmission output scale
diS	DI function selection
CS1	SELECT display-1 registration
CS2	SELECT display-2 registration
CS3	SELECT display-3 registration
CS4	SELECT display-4 registration
LoCK	Key lock
PWd	Password setting

Description of Setup Parameter Menu Display: Displays a menu such as "FUNC" or "I/O". (FUnC) — Nothing appears.

Description of Setup Parameter Setting Display: Displays a parameter symbol. (SPH) — Displays a setpoint. (2000)

List of Alarm Types

The table below shows the alarm types and alarm actions.
In the table, codes 1 to 10 are not provided with stand-by actions, while codes 11 to 20 are provided with stand-by actions.

Alarm type	Alarm action ("Open/close" shows status of relay contact, and "lit" and "unlit" shows status of lamp)	Alarm type code: Contact closes if alarm occurs	Alarm type code: Contact opens if alarm occurs
No alarm		OFF	
PV high limit	Hysteresis; Open (unlit) / Closed (lit); PV; Alarm setpoint	1 / 11	
PV low limit	Hysteresis; Closed (lit) / Open (unlit); Alarm setpoint; PV	2 / 12	
Deviation high limit	Hysteresis; Open (unlit) / Closed (lit); PV; Deviation setpoint; Target SP	3 / 13	
Deviation low limit	Hysteresis; Closed (lit) / Open (unlit); Deviation setpoint; PV; Target SP	4 / 14	
De-energized on deviation high limit alarm	Hysteresis; Closed (unlit) / Open (lit); PV; Deviation setpoint; Target SP	/	5 / 15
Fault diagnosis output (Note 1)	Fault diagnosis output	21	
FAIL output (Note 2)	The controller stops when in a FAIL state. The control output is set to "OFF" or "0%" and alarm output is set to "OFF".	/	22
Sensor grounding alarm	Sensor grounding alarm	23	/
SP high limit	Hysteresis; Open (unlit) / Closed (lit); SP; Alarm setpoint	28	/
SP low limit	Hysteresis; Closed (lit) / Open (unlit); Alarm setpoint; SP	29	/
De-energized on deviation low limit alarm	Hysteresis; Open (lit) / Closed (unlit); Deviation setpoint; PV; Target SP	/	6 / 16
Deviation high and low limits	Hysteresis; Closed (lit) / Open (unlit) / Closed (lit); Deviation setpoint; PV; Target SP	7 / 17	
Deviation within high and low limits	Hysteresis; Open (unlit) / Closed (lit); Deviation setpoint; PV; Target SP	8 / 18	
De-energized on PV high limit	Hysteresis; Closed (unlit) / Open (lit); PV; Alarm setpoint	/	9 / 19
De-energized on PV low limit	Hysteresis; Open (lit) / Closed (unlit); Alarm setpoint; PV	/	10 / 20
Heater burnout alarm 1	Heater burnout alarms 1 and 2	24	/
Heater burnout alarm 2	Heater burnout alarms 1 and 2	/	25
Output high limit	Hysteresis; Open (unlit) / Closed (lit); Output value; Alarm setpoint	30	/
Output low limit	Hysteresis; Closed (lit) / Open (unlit); Alarm setpoint; Output value	31	/

Stand-by Action

It is effective in the following cases where;
- the power is turned on
- the target setpoint is changed
- the target setpoint number is switched (however, except for remote setpoint)

°C; Treated as normal; Normal; Abnormal; The alarm output turns on. (Low limit of alarm setpoint); The alarm output does not turn on in this region even if the PV value is below the low limit of the alarm setpoint. (Power-on → Time)

Note 1: The fault diagnosis output turns on in case of input burnout, A/D converter failure, or reference junction compensation (RJC) failure. The control output in case of input burnout or A/D converter failure is set to the value of the PO (Preset Output Value) setup parameter. In case of RJC failure, the controller continues control under the condition of "RJC = OFF".

Note 2: The FAIL output is on during normal operation and turns off in case of failure.

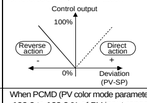
Instrument Input Range Codes

Input	Type	Instrument Input Range Code	Instrument Input Range	
Unspecified		OFF	Set the data item PV Input Type "IN" to the OFF option to leave the PV input type undefined.	
Thermocouple	K	1	-200 to 1370°C	-300 to 2500°F
		2	-199.9 to 999.9°C	0 to 2300°F
		3	-199.9 to 500.0°C	-199.9 to 999.9°F
	J	4	-199.9 to 999.9°C	-300 to 2300°F
	T	5	-199.9 to 400.0°C	-300 to 750°F
		6	0.0 to 400.0°C	-199.9 to 750.0°F
	B	7	0 to 1800°C	32 to 3300°F
	S	8	0 to 1700°C	32 to 3100°F
	R	9	0 to 1700°C	32 to 3100°F
	N	10	-200 to 1300°C	-300 to 2400°F
	E	11	-199.9 to 999.9°C	-300 to 1800°F
	L(DIN)	12	-199.9 to 900.0°C	-300 to 1300°F
	U(DIN)	13	-199.9 to 400.0°C	-300 to 750°F
		14	0.0 to 400.0°C	-199.9 to 750.0°F
	W	15	0 to 2300°C	32 to 4200°F
	Platinel 2	16	0 to 1390°C	32 to 2500°F
	PR20-40	17	0 to 1900°C	32 to 3400°F
	W97Re3-W75Re25	18	0 to 2000°C	32 to 3600°F
RTD	JPt100	30	-199.9 to 500.0°C	-199.9 to 999.9°F
		31	-150.0 to 150.0°C	-199.9 to 300.0°F
	Pt100	35	-199.9 to 640.0°C	-300 to 1560°F
		36	-199.9 to 500.0°C	-199.9 to 999.9°F
		37	-150.0 to 150.0°C	-199.9 to 300.0°F
Standard signal	0.4 to 2 V	40	0.400 to 2.000V	
	1 to 5 V	41	1.000 to 5.000V	
DC voltage	0 to 2 V	50	0.000 to 2.000V	
	0 to 10 V	51	0.00 to 10.00V	
	-10 to 20 mV	55	-10.00 to 20.00mV	
	0 to 100 mV	56	0.0 to 100.0mV	

2. Lists of Parameters

* Parameters relating to PV or setpoints should all be set in real numbers. For example, use temperature values to define target setpoints and alarm setpoints for temperature input.

■ Operating Parameters

Parameter Symbol	Name of Parameter	Setting Range and Description	Initial Value	User Setting	Target Item in CD-ROM
LL (LL)	LL communication interface selection	OFF: Communication is carried out via the RS485 communication terminals. ON: Communication is carried out via the light-loader adapter.	with communication : OFF without communication : ON		—
A1 (A1)	Alarm 1-setpoint	PV alarm / SP alarm: -100.0 to 100.0% of PV input range Deviation alarm: -100.0 to 100.0% of PV input range span Output alarm : -5.0 to 105.0% An alarm common to the 1.SP to 4.SP parameters.	PV high limit/SP high limit alarm: 100.0% of PV input range Deviation alarm: 0.0% of PV input range span Other PV/SP low limit alarm: 0.0% of PV input range Output high limit alarm: 100.0% Output low limit alarm: 0.0%		—
A2 (A2)	Alarm 2-setpoint				—
A3 (A3)	Alarm 3-setpoint				—
AT (AT)	Auto-tuning	OFF: No auto-tuning 1: Auto-tuning for 1.SP 2: Auto-tuning for 2.SP 3: Auto-tuning for 3.SP 4: Auto-tuning for 4.SP AUTO: Performs auto-tuning to all groups 1 to 4.	OFF		—
SC (SC)	"Super" function	OFF: Disable 1: Overshoot suppressing function Suppresses overshoots generated by abrupt changes in the target setpoint or by disturbances. 2: Hunting suppressing function (Stable mode) Suitable to stabilize the state of control when the load varies greatly, or the target setpoint is changed. Enables to answer the wider characteristic changes compared with Response mode. 3: Hunting suppressing function (Response mode) Enables quick follow-up and short converging time of PV for the changed target setpoint. Note: Use "SUPER" function (SC) 2 or 3 in PID control or PI control. "SUPER" function 2 or 3 is not available in the following control: 1) ON/OFF control 2) P control (control for proportional band only) 3) PD control (control for proportional band and derivative item only) 4) Heating/cooling control Do not use hunting suppressing function when control processes with response such as flow or pressure control.	OFF		Ref.2.1(5) Ref.2.1(6)
SP.no (SP.NO)	Target setpoint number selection	0: Uses target setpoint via communication 1: Selects target setpoint 1 (1.SP). 2: Selects target setpoint 2 (2.SP). 3: Selects target setpoint 3 (3.SP). 4: Selects target setpoint 4 (4.SP).	1		Ref.4.1(1)
PId (PID)	PID parameter display number	MENU: Move to FL parameter display 1Gr to 4Gr: Display of each PID parameter	MENU		
FL (FL)	PV input filter	OFF, 1 to 120 second. Used when the PV input fluctuates.	OFF		Ref.1.1(1)
bS (BS)	PV input bias	-100.0% to 100.0% of PV input range span Used to correct the PV input range.	0.0% of PV input range span		
UPr (UPR)	Setpoint ramp-up-rate	OFF 0.0% + 1 digit of PV input range span to 100.0% of PV input range span Set ramp-up-rate or ramp-down-rate per hour or minute. Sets unit in ramp-rate-time unit (TMU).	OFF		Ref.4.1(4)
dnr (DNR)	Setpoint ramp-down-rate		OFF		
oH (OH)	Output high limit Heating-side output high limit (in heating/cooling control)	-5.0 to 105.0% Heating-side limiter in heating/cooling control: 0.0 to 105.0% (OL < OH)	100% Heating/cooling control: 100.0%		Ref.2.1(3)
oL (OL)	Output low limit Cooling-side output high limit (in heating/cooling control)	-5.0 to 105.0% Cooling-side limiter in heating/cooling control: 0.0 to 105.0% (OL < OH)	0.0% Heating/cooling control: 100.0%		
H (H)	ON/OFF control hysteresis Heating-side/cooling-side ON/OFF control hysteresis (in heating/cooling control)	In ON/OFF control: 0.0 to 100.0% of PV input range span In heating/cooling control: 0.0 to 10.0%	ON/OFF control: 0.5% of PV input range span Heating/cooling control: 0.5%		—
dr (DR)	Direct/reverse action switching	0: reverse action, 1: direct action 	0		Ref.2.1(1)
PCCH (PCCH)	High limit for PV color change	When PCMD (PV color mode parameter) = 6 or 7: -100.0 to 100.0 % of PV input range When PCMD (PV color mode parameter) = 8 or 9: -100.0 to 100.0 % of PV input range span	When PCMD = 6 or 7 : PCCH = 100.0%, When PCMD = 8 or 9 : PCCH and PCCL = 1.0 %		—
PCCL (PCCL)	Low limit for PV color change				
Hb1 (HB1)	Heater burnout current setpoint 1	OFF, or 1 to 50 A	OFF		Ref.3.3(5)
Hb2 (HB2)	Heater burnout current setpoint 2				
HC1 (HC1)	Heater burnout current measurement 1	These are not setpoints.	The current value of the heater burnout detector is shown on the display of the HC1 or HC2 parameter.		
HC2 (HC2)	Heater burnout current measurement 2				
orb (ORB)	ON/OFF rate detection band	0.0 to 100.0% of PV input range span	1.0% of PV input range span		Ref.3.3(4)
orH (ORH)	ON/OFF rate high limit	ORL + 1 digit to 105.0%	100.0%		
orL (ORL)	ON/OFF rate low limit	-5.0% to ORH - 1 digit	0.0%		
or (OR)	ON/OFF rate	This is not a setpoint.	The moving average (for 5 cycle times) of the control output is shown.		
1SP (1.SP)	Target setpoint-1	0.0 to 100.0% of PV input range However, between target setpoint limiter lower limit (SPL) and upper limit (SPH).	0.0% of PV input range		Ref.4.1(1)
2SP (2.SP)	Target setpoint-2				
3SP (3.SP)	Target setpoint-3				
4SP (4.SP)	Target setpoint-4				

● PID-related Parameters

The following parameters are displayed when "1Gr" is set to PID parameter display number (PID). In this case, the corresponding target setpoint is 1.SP (target setpoint-1).
To set PID corresponding to target setpoint 2 to 4, set "2Gr", "3Gr", or "4Gr" to PID. The relevant parameters will then be displayed.

Parameter Symbol	Name of Parameter	Setting Range and Description	Initial Value	User Setting	Target Item in CD-ROM
1P (1.P)	Proportional band/Heating-side proportional band (in heating/cooling control)	0.1 to 999.9% In heating/cooling control: 0.0 to 999.9% (heating-side ON/OFF control applies when 0.0)	5.0%		Ref.4.1(1)
1I (1.I)	Integral time Heating-side integral time (in heating/cooling control)	OFF, 1 to 6000 second	240 second		
1d (1.D)	Derivative time Heating-side derivative time (in heating/cooling control)	OFF, 1 to 6000 second	60 second		
1mr (1.MR)	Manual reset	-5.0 to 105.0% (enabled when integral time "1.I" is OFF) The manual reset value equals the output value when PV = SP is true. For example, if the manual reset value is 50%, the output value is 50% when PV = SP becomes true.	50.0%		
1Pc (1.Pc)	Cooling-side proportional band	0.0 to 999.9% (Cooling-side ON/OFF control applies when 0.0)	5.0%		
1Ic (1.Ic)	Cooling-side integral time	OFF, 1 to 6000 second	240 second		
1dc (1.Dc)	Cooling-side derivative time	OFF, 1 to 6000 second	60 second		
1db (1.DB)	Deadband	-100.0 to 50.0% In heating/cooling control, a reagion where both of the heating- and cooling-side outputs are presented, or none of them is presented, can be set.	3.0%		Ref.4.1(1)
1rP (1.RP)	Zone PID reference point-1	0.0 to 100.0% of PV input range. Note that 1.RP ≤ 2.RP.	100% value of PV input range		

Refer to the table below for recording setpoints when two sets or more of PID parameters are used.

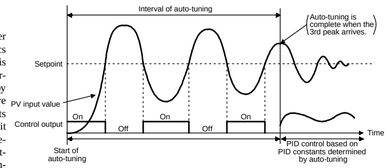
Parameter	n=2	n=3	n=4
n.P			
n.I			
n.D			
n.MR			
n.Pc			
n.Ic			
n.Dc			
n.DB			
n.RP		None	None

rdV (RDV)	Reference deviation	OFF, 0.0 to100.0% of PV input range span Used to select PID constants according to a deviation from the setpoint. The 4th group of PID constants is used when the controller fails to keep track of the deviation.	OFF		Ref.4.1(1)

* The "User Setting" column in the table below is provided for the customer to record setpoints.
* The "Target Item in CD-ROM" column in the table below provides references from User's Manual (Reference) (CD-ROM Version) which describes items in more detail and items that are not contained in this manual.

■ Auto-tuning

Auto-tuning is a function with which the controller automatically measures the process characteristics to automatically set the optimum PID constants. This function does not work when the controller is performing on-off control. The UT351/UT321 employ the "Limit Cycle Method." As shown in the figure on the right, the controller temporarily changes its control output in a step-waveform manner. Then, it calculates the optimum proportional band (P), integral time (I) and derivative time (D) from the resulting response to set them in their respective parameters. If the Output High Limit (OH) and Output Low Limit (OL) parameters are already configured, the control output turns on and off only between the output's high and low limits during auto-tuning.



● Auto-tuning Using Zone PID (see "■ PID Switching (Zone PID)" later in this manual)

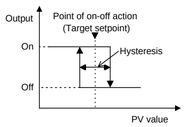
Setting of AT Parameter	Auto-tuned Setpoint	Remarks
OFF	-	Auto-tuning is turned off (disabled).
1	The setpoints when auto-tuning is started	Determines the values of 1.P, 1.I and 1.D parameters by auto-tuning.
2		Determines the values of 2.P, 2.I and 2.D parameters by auto-tuning.
3		Determines the values of 3.P, 3.I and 3.D parameters by auto-tuning.
4		Determines the values of 4.P, 4.I and 4.D parameters by auto-tuning.
AUTO	Median value of each zone width	Determines the values of all PID parameters in use by auto-tuning.

The AT parameter settings numbered 1 to 4 in the table above are dependent on how many zones have been set. For example, if you have set two zones, you can use AT parameter settings 1 and 2. Likewise, if you have set three zones, you can use AT parameter settings 1, 2 and 3.

■ Hysteresis (for Target Setpoints (On-Off Control) and Alarm Setpoints)

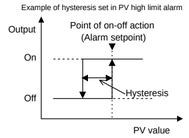
Hysteresis can be set in on-off control setpoints and alarm setpoints as well. With the hysteresis settings, it is possible to prevent relays from chattering.

● When hysteresis is set in a target setpoint



● When hysteresis is set in an alarm setpoint

Example of hysteresis set in PV high limit alarm

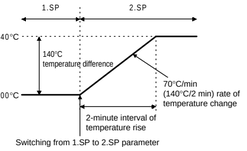


■ Target Setpoint Ramp Setting Function

Use this function to prevent the target setpoint from changing suddenly. The ramp setting function works when:

[1] the target setpoint is changed (example: change in "1.SP" from 100°C to 150°C);
[2] the target setpoint number is switched (example: switch from "1.SP" to "3.SP");
[3] the power is turned on or the controller is recovered from power failure;
[4] a change is made from manual operation to automatic operation; or
[5] a change is made from the STOP state to the RUN state.

If the target setpoint before switching is smaller than the target setpoint after switching, the controller operates according to the settings of the Setpoint Ramp UP (UPR) and Ramp Time Unit (TMU) parameters. If the target setpoint before switching is greater than the target setpoint after switching, the controller operates according to the settings of the Setpoint Ramp Down (DNR) and Ramp Time Unit (TMU) parameters. The figure on the right shows an example when the Target Setpoint Number (SP.NO) parameter is switched. The 1.SP and 2.SP parameters are set to 500°C and 640°C, respectively. Thus, there is a temperature difference of 140°C between the 1.SP and 2.SP parameters. This example shows how the temperature is changed by as much as this temperature difference over a period of two minutes. In this example, the UPR parameter is 70°C and the TMU parameter is 1 minute.



Switching from 1.SP to 2.SP parameter

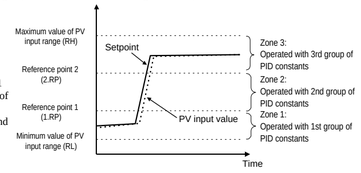
NOTE

When using target setpoint ramp setting function, PV tracking works in case of the above conditions [2] to [5].

■ PID Switching (Zone PID)

Using a zone PID, you can automatically switch between groups of PID constants according to the temperature zone. You can set a maximum of three temperature zones.

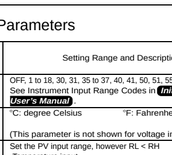
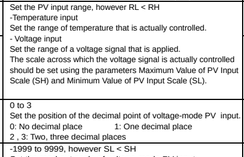
Setting Method:
[1] Set the Zone PID Selection (ZON) parameter to "ON".
[2] Define a reference point.
When using two zones, define only reference point 1 (1.RP) between the minimum and maximum values of the PV input range.
When using three zones, define reference points 1 and 2 (1.RP and 2.RP) in the same way as noted above.



Note: Set the maximum and minimum values, as close as possible to those of the actual range to be controlled, in the Maximum Value of PV Input Range (RH) and Minimum Value of PV Input Range (RL) parameters. Otherwise, the controller may fail to determine the optimum values when auto-tuning is carried out.

■ Setup Parameters

● Control Function-related Parameters

Parameter Symbol	Name of Parameter	Setting Range and Description	Initial Value	User Setting	Target Item in CD-ROM
SPH (SPH)	Target setpoint limiter upper limit	0.0 to 100.0% of PV input range where, SPL < SPH Places a limit on the range within which the target setpoint is changed.	100.0% of PV input range		
SPL (SPL)	Target setpoint limiter lower limit		0.0% of PV input range		
PCmd (PCMD)	PV color mode	0: Fixed in green 1: Fixed in red 2: Link to alarm 1 (Alarm OFF:green, Alarm ON:red) 3: Link to alarm 1 (Alarm OFF:red, Alarm ON:green) 4: Link to alarm 1 and 2 (Alarm OFF:green, Alarm ON:red) 5: Link to alarm 1 and 2 (Alarm ON:red, Alarm OFF:green) 6: PV limit (Within PV range:green, Out of PV range:red) 7: PV limit (Within PV range:red, Out of PV range:green) 8: SP deviation (Within deviation:green, Out of deviation:red) 9: SP deviation (Within deviation:red, Out of deviation:green)	1		
AL1 (AL1)	Alarm-1 type	OFF, 1 to 25, 28 to 31 1: PV high limit (energized, no stand-by action) 2: PV low limit (energized, no stand-by action) 3: Deviation high limit (energized, no stand-by action) 4: Deviation low limit (energized, no stand-by action) 5: Deviation high limit (de-energized, no stand-by action) 6: Deviation low limit (de-energized, no stand-by action) These Alarm Type parameters are common to the parameters 1.SP to 4.SP. See List of Alarm Types on the back for other alarm types.	1		Ref.3.3(4)
AL2 (AL2)	Alarm-2 type		2		
AL3 (AL3)	Alarm-3 type		1		
HY1 (HY1)	Alarm-1 hysteresis	0.0 to 100.0% of PV input range span Output alarm: 0.0 to 100.0% 	0.5% of PV input range span Output alarm: 0.5%		Ref.3.3(2)
HY2 (HY2)	Alarm-2 hysteresis				
HY3 (HY3)	Alarm-3 hysteresis				
dY1 (DY1)	Alarm-1 delay timer	An alarm is output when the delay timer expires after the alarm setpoint is reached. 0.00 to 99.59 (min, sec.) (enabled when alarm-1 type AL1 is 1 to 20 or 28 to 31) 	0.00		
dY2 (DY2)	Alarm-2 delay timer	0.00 to 99.59 (min, sec.) (enabled when alarm-2 type AL2 is 1 to 20 or 28 to 31)			
dY3 (DY3)	Alarm-3 delay timer	0.00 to 99.59 (min, sec.) (enabled when alarm-3 type AL3 is 1 to 20 or 28 to 31)			
Ct (CT)	Control output cycle time Heating-side control output cycle time (in heating/cooling control)	1 to 1000 second	30 second		Ref.3.3(4)
Ctc (CTc)	Cooling-side control output cycle time	1 to 1000 second	30 second		
Po (PO)	Preset output/Heating-side preset output (in heating/cooling control)	-5.0 to 105.0% In heating/cooling control: Heating side 0.0 to 105.0% In Stop mode, fixed control output can be generated.	0.0%		Ref.2.1(8)
Poc (POc)	Cooling-side preset output	0.0 to 105.0% In Stop mode, cooling-side fixed control output can be generated.	0.0%		
Cmd (C.MD)	PID control mode	0: Standard PID control (with output bump at SP change) 1: Fixed point control (without output bump at SP change) Choose fixed point control when controlling pressure or flow rate.	0		Ref.2.1(2)
Zon (ZON)	Zone PID selection	OFF: SP selection ON: Zone PID	ON		Ref.4.1(2)
Ar (AR)	Anti-reset windup (Excess integration prevention)	AUTO (0), 50.0 to 200.0% Used when the control output travels up to 100% or down to 0% and stays at this point. The larger SP, the sooner PID computation (integral computation) stops.	AUTO		Ref.2.1(4)
tmU (TMU)	Ramp-rate time unit setting	0: hour, 1: minute Time unit of setpoint ramp-up (UPR) and setpoint ramp-down (DNR)	0		Ref.4.1(4)
P.SL (P.SL)	Protocol selection	0: PC link communication 1: PC link communication (with sum check) 2: Ladder communication 3: Coordinated master station 4: Coordinated slave station 7: MODBUS (ASCII) 8: MODBUS (RTU) 10: Coordinated slave station (loop-1 mode) 11: Coordinated slave station (loop-2 mode)	0		communi-cation function
bPS (BPS)	Baud rate	0: 600, 1: 1200, 2: 2400, 3: 4800, 4: 9600 (bps)	4		
Pri (PRI)	Parity	0: None 1: Even 2: Odd	1		
StP (STP)	Stop bit	1, 2	1		
dLn (DLN)	Data length	7, 8: Fixed at 7, when the P.SL parameter is set to MODBUS (ASCII). Fixed at 8, when the P.SL parameter is set to MODBUS (RTU) or Ladder Communication.	8		
Adr (ADR)	Address	1 to 99 However, the maximum number of stations connectable is 31.	1		
rPt (RP.T)	Minimum response time	0 to 10 (× 10 ms)	0		
tESt (TEST)		If this parameter symbol appears, press the SET/ENT key to return to the FUNC menu. Caution: Do not change the setpoint of the TEST parameter, otherwise the controller will be disabled.			

● Input-/Output-related Parameters

Parameter Symbol	Name of Parameter	Setting Range and Description	Initial Value	User Setting	Target Item in CD-ROM
In (IN)	PV input type (PV INPUT terminals) ①-②-③terminals	OFF, 1 to 18, 30, 31, 35 to 37, 40, 41, 50, 51, 55, 56 See Instrument Input Range Codes in ***Initial Settings User's Manual***	OFF		—
Unit (UNIT)	PV input unit	°C: degree Celsius °F: Fahrenheit (This parameter is not shown for voltage input.)	°C		—
rH (RH)	Max. value of PV input range	Set the PV input range, however rH < rL ·Temperature input Set the range of temperature that is actually controlled. ·Voltage input Set the range of a voltage signal that is applied. The scale across which the voltage signal is actually controlled should be set using the parameters Maximum Value of PV Input Scale (SH) and Minimum Value of PV Input Scale (SL).	Max. value of instrument input range		—
rL (RL)	Min. value of PV input range		Min. value of instrument input range		—
SdP (SDP)	PV input decimal point position (displayed at voltage input)	0 to 3 Set the position of the decimal point of voltage-mode PV input. 0: No decimal place 1: One decimal place 2 , 3: Two, three decimal places	1		—
SH (SH)	Max. value of PV input scale (displayed at voltage input)	-1999 to 9999, however SL < SH Set the read-out scale of voltage-mode PV input.	100.0		—
SL (SL)	Min. value of PV input scale (displayed at voltage input)		0.0		—
rJC (RJC)	Presence/absence of PV input reference junction compensation	OFF, ON	ON		—
ErJC (ERJC)	External RJC setpoint	-50.0 to 50.0 °C -58.0 to 122.0 °F	0.0 °C 32.0 °F		—
bSL (BSL)	Selection of PV input burnout action	OFF 1: Up scale 2: Down scale	1		—
ot (OT)	Control output type	0 Time proportional PID relay contact output (terminals①-②-③) 1 Time proportional PID voltage pulse output (terminals⑭-⑰) 2 Current output (terminals⑭-⑰) 3 ON/OFF control relay contact output (terminals①-②-③)	0		—

Continued

ot (OT)	Control output type	The following 4 to 12 are displayed only for heating/ cooling type controllers. 4 Heating-side relay output (terminals ①-②-③), cooling-side relay output (terminals ④-⑦) 5 Heating-side pulse output (terminals ⑭-⑰), cooling-side relay output (terminals ④-⑦) 6 Heating-side current output (terminals ⑭-⑰), cooling-side relay output (terminals ④-⑦) 7 Heating-side relay output (terminals ①-②-③), cooling-side pulse output (terminals ⑭-⑮) 8 Heating-side pulse output (terminals ⑭-⑰), cooling-side pulse output (terminals ⑭-⑮) 9 Heating-side current output (terminals ⑭-⑰), cooling-side pulse output (terminals ⑭-⑮) 10 Heating-side relay output (terminals ①-②-③), cooling-side current output (terminals ⑭-⑮) 11 Heating-side pulse output (terminals ⑭-⑰), cooling-side current output (terminals ⑭-⑮) 12 Heating-side current output (terminals ⑭-⑰), cooling-side current output (terminals ⑭-⑮)	Heating/cooling type: 4		—
rEt (RET)	Retransmission output type	1: PV, 2: SP, 3: OUT, 4: Loop power supply for sensor (15 V) In position proportional control, a valve opening signal (0 to 100%) is transmitted if setpoint "3" is selected. In heating/cooling control, an output value before allocation to heating and cooling control (0 to 100%) is transmitted if setpoint "3" is selected (0 to 50%: Cooling-side output; 50 to 100%: Heating-side output).	1		Ref.2.2(1)
rtH (RTH)	Max. value of retransmission output scale	RET=1, 2: RTL + 1 digit to 100.0% of PV input range RET=3: RTL + 1 digit to 100.0%	100.0% of PV input range		
rtL (RTL)	Min. value of retransmission output scale	RET=1, 2: 0.0% of PV input range to RTH - 1 digit RET=3: 0.0% to RTH - 1 digit	0.0% of PV input range		
dIS (DIS)	DI function selection	OFF Disables the external contact input. 1 DI1: 2.SP (on)/1.SP (off), DI2: AUTO (on)/MAN (off) 2 DI1: Hides (on)/shows (off) the LOCK setup parameter. DI2: Unused. 3 See the table below. 4 DI1: 2.SP (on)/1.SP (off), DI2: STOP (on)/RUN (off)	1		Ref.3.1(1)

○ SP Selection when DIS = 3 is set

	DI1	DI2
1.SP	OFF	OFF
2.SP	ON	OFF
3.SP	OFF	ON
4.SP	ON	ON

CS1 (C.S1)	SELECT display-1 registration	OFF, 201 to 1015 Select the desired parameter from among the operating and setup parameters, then register the number (D register No.) accompanying that parameter. For example, registering "231" for C.S1 allows you to change alarm-1 setpoint in operating display. Numbers for registering operating display: Alarm-1 setpoint: 231 Alarm-2 setpoint: 232 Alarm-3 setpoint: 233 Above numbers are alarm setpoint parameters for target setpoint-1 (1.SP). See User's Manual (Reference) (CD-ROM).	OFF		Ref.6.1(1)
CS2 (C.S2)	SELECT display-2 registration				
CS3 (C.S3)	SELECT display-3 registration				
CS4 (C.S4)	SELECT display-4 registration				
LocK (LOCK)	Key lock	OFF: No key lock 1: Change to any parameter prohibited Prohibits any operating parameter or setup parameter from being changed. The setpoint of the LOCK parameter itself can be changed, however. 2: Change to and display of operating parameters prohibited Turns off the display for setting operating parameters, thus prohibiting any change to the parameter settings. (Hold down the SET/ENT key for more than 3 seconds to show the password check display.) 3: Disables the A/M key on the instrument's front panel.	OFF		Ref.7.1(2)
Pwd (PWD)	Password setting	0: Password not set 1 to 9999	0		Ref.7.1(1)

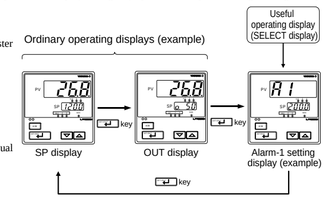
■ Useful Operating Displays (SELECT Display)

Registering frequently changed parameters in the SELECT display after ordinary operating displays will allow you to change settings easily. A maximum of four displays can be registered.

Setting method:
Set the parameter numbers (D register numbers) you wish to register for setup parameters C.S1 to C.S4.

Alarm parameter for target setpoint-1	Registration number
Alarm-1 setpoint parameter	231
Alarm-2 setpoint parameter	232
Alarm-3 setpoint parameter	233

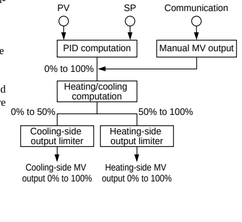
For any registration number other than those above, see User's Manual (Reference) (CD-ROM version).



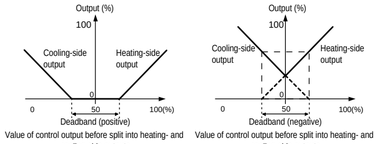
■ Heating/Cooling Control (for a Heating/Cooling Controller Only)

In heating/cooling control, the controller outputs the result of computation after splitting it into heating-purpose and cooling-purpose signals. In addition, the controller can perform PID control or on-off control on the heating and cooling sides separately. When performing on-off control, set the proportional band to "0".
The controller splits the result of computation (0 to 100%) into heating-side and cooling-side signals, as described below.

- 0% to 50% of the computation result is presented as a 0% to 100% cooling-side output.
- 50% to 100% of the computation result is presented as a 0% to 100% heating-side output.



Heating/cooling control provides two methods in which either none of the heating- and cooling-side outputs are presented or both of the heating- and cooling-side outputs are presented, as shown in the following figures.



Value of control output before split into heating- and cooling-side outputs

Value of control output before split into heating- and cooling-side outputs

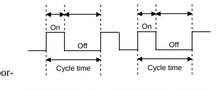
Precautions in Heating/Cooling Control

- Keep the ratio of the heating-side proportional band (P) to the cooling-side proportional band (Pc) equal to or below 5.
- If neither the heating side nor the cooling side is performing on-off control, setting the integral time (I or Ic) of one side to "0" results in the Integral Time parameters of both sides being set to "OFF", irrespective of the integral time setting of the other side.

■ Cycle Time

A cycle time can only be set if the type of control output is time proportional PID relay output or time proportional voltage pulse output.

A cycle time refers to one period consisting of on- and off-state time lengths. The ratio of the on-state time to the off-state time differs according to the value of the control output. The figure on the right shows on-to-off time ratios of the control output when the cycle time is set to 10 seconds. Setting a shorter cycle time allows the controller to perform elaborate control at short time intervals. This significantly reduces the on- and off-state times, however it shortens the service life of a relay.



Relay's Behavior when Cycle Time = 10 sec

For 20% of Control Output	For 50% of Control Output	For 80% of Control Output
10 sec	10 sec	10 sec
On-state duration: 2 sec Off-state duration: 8 sec	On-state duration: 5 sec Off-state duration: 5 sec	On-state duration: 8 sec Off-state duration: 2 sec

User's Manual

IM 05D01D12-04E

Models UT351 / UT321 Digital Indicating Controllers with Active Color PV Display User's Manual Setting/Explanation of Active Color PV Dislay

NEW GREEN SERIES

This manual describes the PV display color changing function "Active Color PV Display."

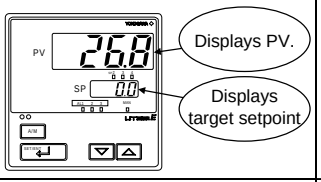
Carry out setings according to the following procedures after referring to "Functions of Active Color PV Display" on the back of this manual. Use "Parameter Map" of Parameters User's Manual to understand the required parameters. If you cannot remember how to carry out an operation during setting, press the [SET/ENT] key for more than 3 seconds. This brings you to the display (operating display) that appears at power-on. The UT321 is identical to the UT351 in items of front panel operation.

■ Setting the PV display color changing function "Active Color PV Display"

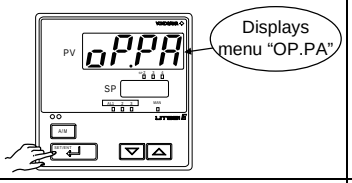
The following operating procedure describes an example of changing PV color mode (factory-set default: Fixed in red mode) to Link to alarm 1 mode.

Parameter Symbol	Name of Parameter	Setting Range	Initial Value
PCnd (PCMD)	PV color mode	0 : Fixed in green 1 : Fixed in red 2 : Link to alarm 1 (Alarm OFF:green, Alarm ON: red) 3 : Link to alarm 1 (Alarm OFF:red, Alarm ON:green) 4 : Link to alarm 1 and 2 (Alarm OFF:green, Alarm ON:red) 5 : Link to alarm 1 and 2 (Alarm OFF:red, Alarm ON:green) 6 : PV limit (Within PV range:green, Out of range:red) 7 : PV limit (Within PV range:red, Out of range:green) 8 : SP deviation (Within deviation:green, Out of deiviation:red) 9 : SP deviation (Within deviation:red, Out of deviation:green)	1

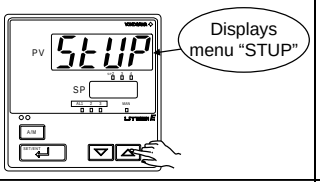
(1) Bring the operating display into view (appears at power on).



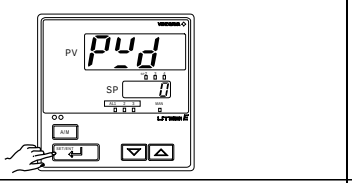
(2) Press the [SET/ENT] key for more than 3 seconds to call up the menu "OP.PA."



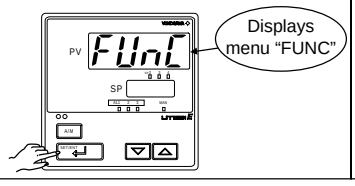
(3) Press the [▲] key once to display the menu "STUP."



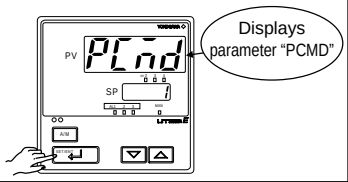
(4) Press the [SET/ENT] key once to display the parameter "PWD."



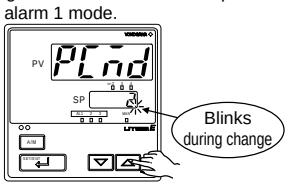
(5) Press the [SET/ENT] key once to display the menu "FUNC."



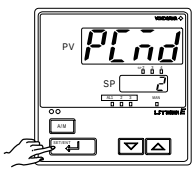
(6) Press the [SET/ENT] key several times to display the menu "PCMD" (PV color mode).



(7) Press the [▲] key or [▼] key to display the required setpoint. The figure below shows an example of setting Link to alarm 1 mode.

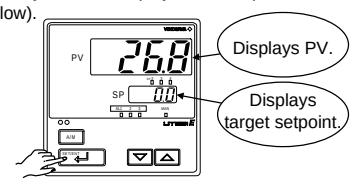


(8) Press the [SET/ENT] key once to register the setpoint.



If PCMD = 6, 7, 8 or 9, also set the relating paraemters PCCH (High limit for PV color change) and PCCL (Low limit for PC color change).

(9) Press the [SET/ENT] key for more than 3 seconds. This returns you to the display shown at power-on (figure blow).

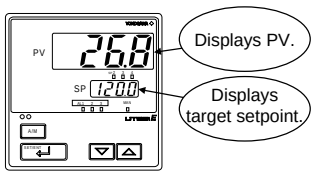


■ Setting the High Limit and Low limit for PV Color change

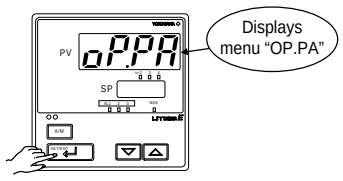
The following operating procedure describes an example of changing PV display color by linking to PV. Set High limit and Low limit for PV color change. Setting for both of High limit and Low limit is required.

Parameter Symbol	Name of Parameter	Setting Range	Initial Value
PCCH (PCCH)	High limit for PV color change	When PCMC (PV color mode parameter) = 6 or 7: -100.0 to 100.0 % of PV input range. When PCMC (PV color mode parameter) = 8 or 9: -100.0 to 100.0 % of PV input range span.	When PCMD = 6 or 7: PCCH:100.0 %, PCCL:0.0 % When PCMD = 8 or 9: PCCH and PCCL:1.0 %
PCCL (PCCL)	Low limit for PV color change		

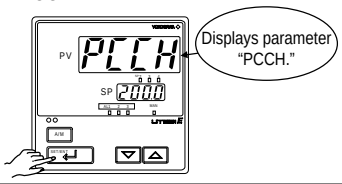
(1) Bring the operating display into view (appears at power-on).



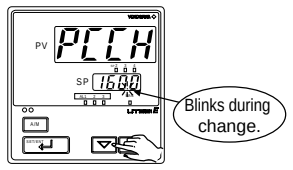
(2) Press the [SET/ENT] key for more than 3 seconds to call up the menu "OP.PA."



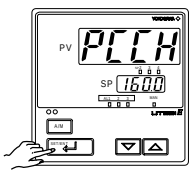
(3) Press the [SET/ENT] key several times to display the parameter "PCCH."



(4) Press the [▲] key or [▼] key to display the required setpoint.

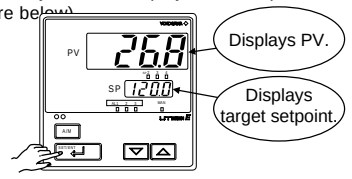


(5) Press the [SET/ENT] key once to register the setpoint.



PCCL (Low limit for PV color change parameter) that is displayed after this can be

(6) Press the [SET/ENT] key for more than 3 seconds. This returns you to the display shown at power-on (figure below).

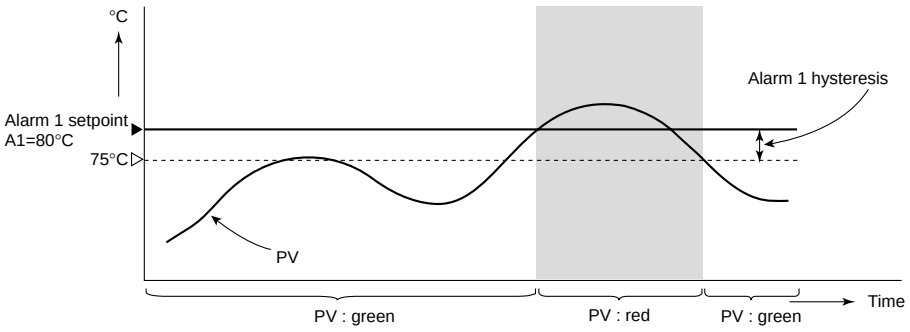


■ Functions of Active Color PV Display

This part describes the functions of “Active Color PV Display.” PV display color is changed by the following four actions.
PV display is selectable from red-to-green or green-to-red changing action, or fixed color.
Link to alarm 1 mode (when PCMD = 2, 3) (Setting example-1)
Link to alarm 1 and 2 mode (when PCMD = 4, 5) is the same. When either of the alarms occurs, the display color is changed.
SP deviaton mode (when PCMD = 8, 9) (Setting example-2)
PV limit mode (when PCMD = 6, 7) (Setting example-3)
Fixed color mode (when PCMD = 0, 1) (Setting example-4)

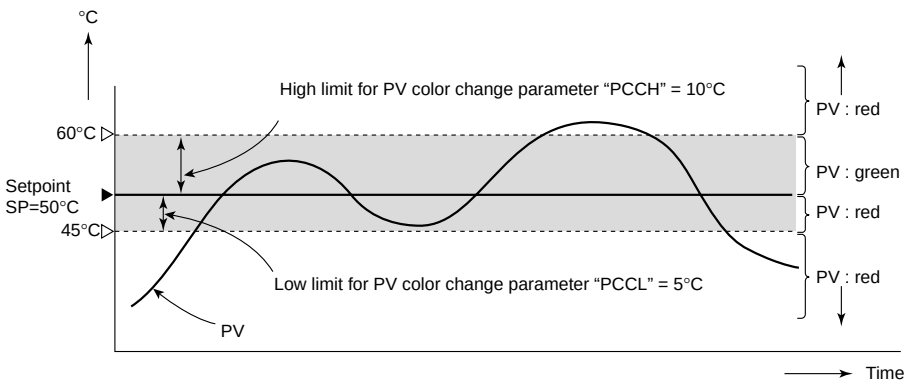
Setting Example-1 : Link to Alarm

Works linked to alarm 1.
Set “PV high limit alarm” for alarm 1 type, and “80°C” for alarm 1 setpoint.
If PCMD (PV color mode parameter) = 2, PV display color is changed from green to red when PV input value exceeds alarm 1 setpoint.
The red-to-green changing action is selectable.
Setting parameters
PCMD (PV color mode parameter) = 2
AL1 (Alarm 1 type parameter) = 1
A1 (Alarm 1 setpoint parameter) = 80°C
HY1 (Alarm 1 hysteresis parameter) = 5°C



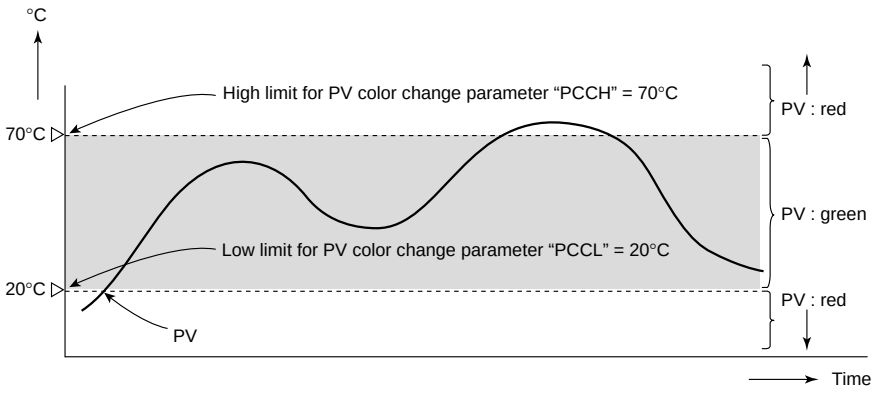
Setting Example-2 : Change by Deviation

Set high limit deviation band “10°C” for PCCH, and low limit deviation band “5°C” for PCCL against current setpoint “50°C.”
PV display color is changed from green to red when PV input value is out of the deviation.
The red-to-green changing action is selectable.
Setting parameters
PCMD (PV color mode parameter) = 8
PCCH (High limit for PV color change parameter) = 10°C
PCCL (Low limit for PV color change parameter) = 5°C
Hyesteresis fixed to 0.25% is inserted where PV display color is changed.
In the example blow, where changed from red to green.



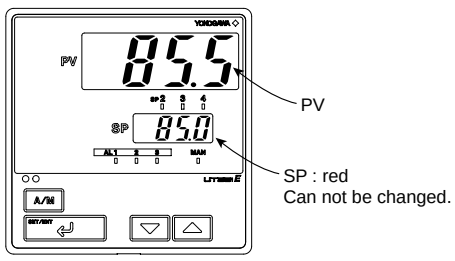
Setting Example-3 : Link to PV

Set high limit “70°C” for PCCH, and low limit “20°C” for PCCL.
PV display color is changed from green to red when PV input value is out of the range.
The red-to-green changing action is selectable.
Setting parameters
PCMD (PV color mode parameter) = 6
PCCH (High limit for PV color change parameter) = 70°C
PCCL (Low limit for PV color change parameter) = 20°C
Hysteresis fixed to 0.25% is inserted where PV display color is changed.
In the example blow, where changed from red to green.



Setting Example-4 : Fixed in Red or Green

Set the PV display color or Fixed in green mode, Setting of Fixed to red mode is also possible.
Setting parameter
PCMD (PV color mode parameter) = 0



■ External RJC

External RJC is not a compensation function built in a controller but a compensation function working outside the controller.

External RJC is used when input is thermocouple, and RJC=OFF.

Using External RJC makes the accuracy of RJC higher and shortens the compensating wire.

Parameter Symbol	Name of Parameter	Setting Range	Initial Value
ErJC (ERJC)	External RJC setpoint	-50.0 to 50.0°C, -58.0 to 122.0°F For thermocouple input, temperature compensation value outside the controller can be set. Available only when RJC=OFF.	0.0°C 32.0°F