Instruction manual

for

DIN rail mounting type indicating controller DCL-33A

To prevent accidents arising from the misuse of this controller, please ensure the operator using it receives this manual.

⚠ Caution

- This instrument should be used according to the specifications described in this manual. If it is not used according to the specifications, it may malfunction or breakdown.
- Be sure to follow the warnings and cautions. Otherwise serious injury or accidents may occur.
- The contents of this instruction manual are subject to change without notice.
- Care has been taken to assure that the contents of this instruction manual are correct, but if there are any doubts, mistakes or questions, please inform our sales department.
- This instrument is designed to be installed in a control panel. If not, measures must be taken to ensure that the operator can not touch power terminals or other high voltage sections.
- Be sure to check that the power is turned off before cleaning this instrument.
- Use a soft and dry cloth when cleaning the instrument. (If paint thinner is used, it might deform or tarnish the unit.)
- As the display section is vulnerable, do not strike or scratch it with a hard object.
- Any unauthorized transfer or copying of this document, in part or in whole, is prohibited.
- SHINKO TECHNOS CO., LTD is not liable for any damages or secondary damages incurred as a result of using this product, including any indirect damages.

1. Model name

1.1 Model name

DCL- 3 3 A - □/□ , □ □ □ □						Series name: DCL-300 (W22.5 x H75 x D100mm)	
Control action	3					PID	
Alarm		A				Selectable by key operation *1	
Control output			R			Relay contact: 1a	
			S			Non-contact voltage (for SSR): 12 V DC	
			A			DC current: 4 to 20mA DC	
Input				M		Multi-range *2	
Supply voltage					1	Supply voltage 24V AC/DC *3	
Option					W (5A)	Heater burnout alarm	CT input rating: 5A
					W (10A)		CT input rating: 10A
					W (20A)		CT input rating: 20A
					W (50A)		CT input rating: 50A
					C5	Serial communication	Based on EIA RS-485

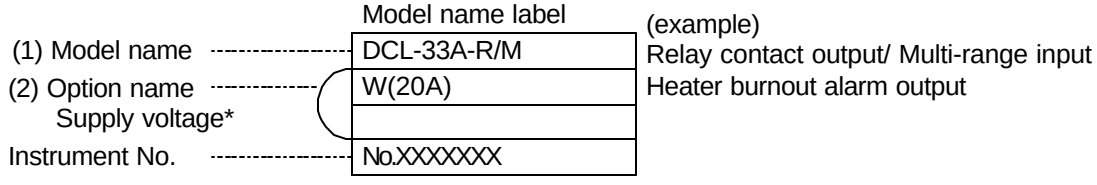
*1: Alarm action (9 types and No alarm) and Energized/Deenergized can be selected by key operation.

*2: Thermocouple, RTD, DC current and DC voltage can be selected by key operation.

*3: Standard supply voltage is 100 to 240V AC. Write down [1] after alphanumeric character only when 24V AC/DC is ordered.

1.1 Model name

Model name labels are put on the right side of the case and the inner assembly.
For Heater burnout alarm output, CT input rating value is written in the bracket ( ).



(Only on internal assembly) *Write 1 only for 24V AC/DC

2. Name and functions of the sections

(1) EVT indicator

A red LED lights up when Event output [Alarm, Loop break alarm or Heater burnout alarm (Option)] is ON.

(2) OUT indicator

A green LED lights up when OUT output is ON.
For current output type, this blinks in 0.25 seconds cycle corresponding to the output manipulated variable .

(3) T/R indicator

A yellow LED blinks while serial communication TX output (Transmission)

(4) AT indicator

A yellow LED blinks while PID auto-tuning is being performed.

(5) PV display

Indicates input value (PV) with a Red LED.

(6) SV display

Indicates setting value (SV) with a Green LED.

(7) Increase key

Increases numeric value.

(8) Decrease key

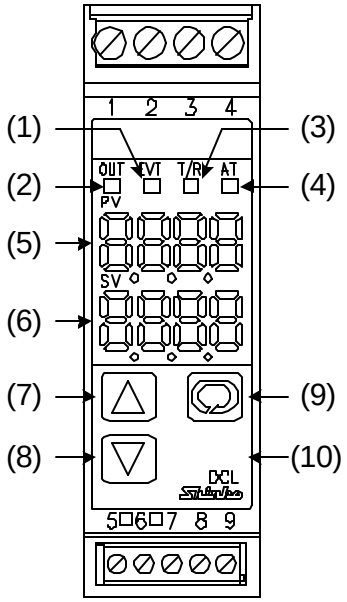
Decreases numeric value.

(9) Mode key

Changes the setting mode or registers the setting value.
(Resisters the setting value by pressing the Mode key.)

(10) Sub-mode key

Calls auxiliary function setting mode 2 in combination with the mode key.



(Fig. 2-1)

> **⚠ Caution**
>
> When setting the specifications and functions of this controller, connect the terminals 1 and 2 for power source first, then set them referring to "5. Setup" before performing "3. Mounting to the control panel" and "4. Wiring".

3. Mounting to the control panel

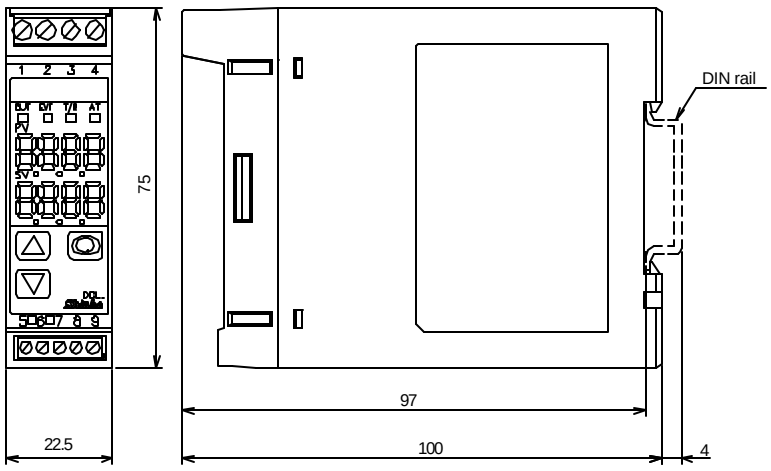
3.1 Site selection

This instrument is intended to be used under the following environmental conditions (IEC61010-1).
: Overvoltage category Ⅱ, Pollution degree 2

Mount the controller in a place with:

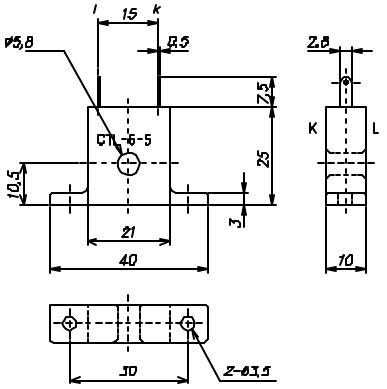
- A minimum of dust, and an absence of corrosive gases
- No flammable, explosive gasses
- Few mechanical vibrations or shocks
- No exposure to direct sunlight, an ambient temperature of 0 to 50℃ (32 to 122℉) without rapid change
- An ambient non-condensing humidity of 35 to 85%RH
- No large capacity electromagnetic switches or cables through which large current is flowing
- No water, oil or chemicals or where the vapors of these substances can come into direct contact with the controller

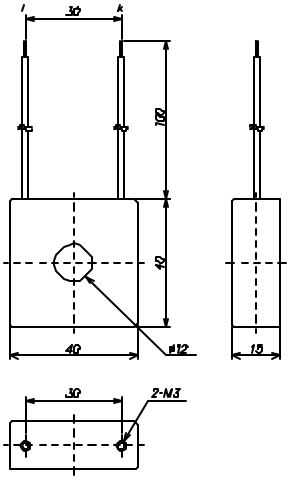
3.2 External dimension



(Fig. 3.2-1)

3.3 CT (Current transformer) external dimension





CTL-6S (for 20A) **CTL-12-S36-10L1 (for 50A)**

(Fig. 3.3-1)

3.4 Mounting to DIN rail

> **⚠ Caution**
>
> **Mount the DIN rail horizontally.**
> **When DIN rail is mounted vertically, be sure to use commercially available fastening plates at the end of DCL-33A series. Mount the DCL-33A seriesto the DIN rail so that the DCL-33A seriesmay be fixed. However, if the DIN rail is mounted horizontally in a position susceptible to vibration or shock, the fastening plates must be used as well.**

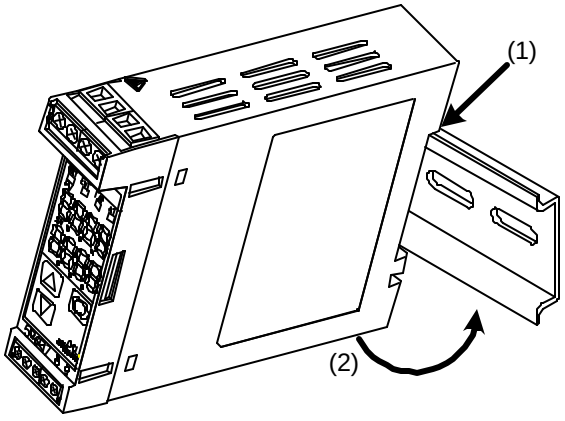
? Recommended fastening plate

Omron corporation	End plate	PEP-M
IDEC corporation	Fastening plate	BNL6P, BNL8P
Matsushita electric works, LTD.	Fastening plate	ATA4806

[1] Hook (1) of the DCL-33A series on the upper side of the DIN rail. (Fig. 3.4-1)

[2] Making (1) part of the DCL-33A series as a support, fit the lower part of the DCL-33A series to the DIN rail.

DCL-33A series will be completely fixed to DIN rail with a "Click" sound. (Fig.3.4-1)



(Fig. 3.4-1)

4. Wiring and connection

⚠ Warning

Turn the power supplied to the instrument OFF before wiring or checking it. Working or touching the terminal with the power switched ON may result in Electric Shock causing severe injury or death.

⚠ Caution

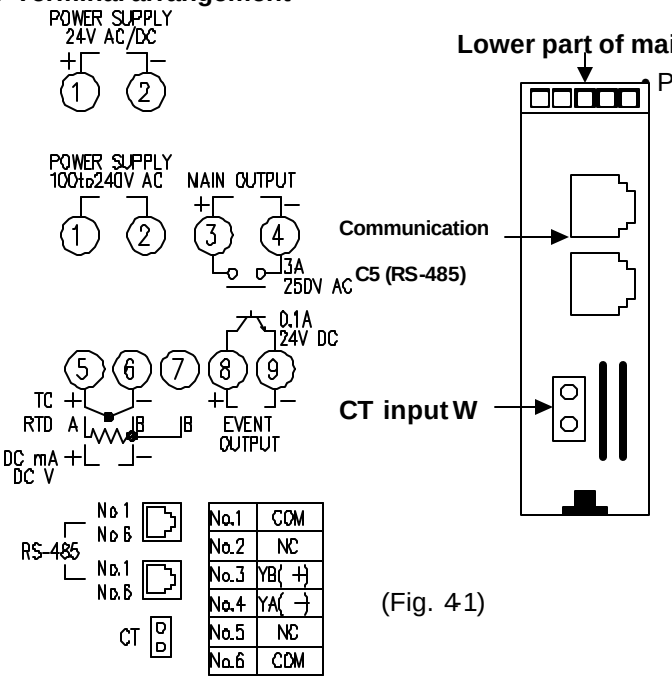
- **Do not leave wire chips into the DCL-33A series when wiring, because they could cause fire, malfunction and trouble.**
- **Insert the connecting cable into the designated connector securely to prevent malfunction, or it may cause malfunction due to imperfect contact.**
- **Connect the AC power wiring to the designated terminal as is written in this instruction manual, or it may burn and damage the DCL-33A series.**
- **Tighten the terminal screw with the specified torque, or damage the terminal screw and deform the case.**
- **Use thermocouple and compensating lead wire that fit sensor input specification of this unit.**
- **Use the 3-wire RTD that fits sensor input specification of this unit.**
- **Do not confuse the polarity when using DC voltage and current inputs in the case 24V DC is used.**
- **Keep input wire (Thermocouple, RTD) away from power source and load wire when wiring.**
- **To prevent the unit from harmful effects of the unexpected level noise, it is recommended that a surge absorber to be installed between the electromagnetic switch coils.**
- **This unit has neither built-in power switch nor fuse. Therfore it is necessary to install them in the circuit near the external unit.**
  (Recommended fuse: Rated voltage 250V AC, Rated current 2A, Fuse type: Time-lag fuse)

? Note

Tighten the terminal screw properly referring to the table below.

Terminal screw	Terminal No.	Torque
M2.6	1 to 4	Max. 0.5N.m
M2.0	5 to 9	Max. 0.25N.m

? Terminal arrangement



(Fig. 4-1)

Lower part of main body

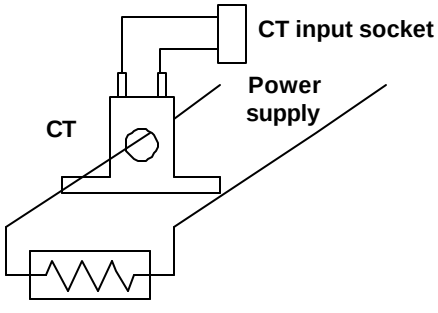
Power supply

- MAIN OUTPUT: Control output
- EVENT OUTPUT: Outputs when Alarm, Loop break alarm or Heater burnout alarm [option] is ON
- RS-485: Serial communication
- TC : Thermocouple
- RTD : Resistance temperature detector
- DC : DC current or DC voltage

• **Option: Heater burnout alarm**

This alarm is not available for detecting current under phase control.

Use the current transformer (CT) provided, and pass a lead wire of the heater circuit into a hole of the CT. When wiring, keep the CT wire away from any AC source or load wires to avoid the external interference.



(Fig. 4-2)

5. Setup

The sensor input character and temperature unit are indicated on the PV display for approx. 3 seconds after the power is turned on, and the input range high limit value is indicated on the SV display. (Table 5-1) (If any other value is set in the scaling high limit value, it is indicated on the SV display.) During this time all outputs and the LED indicators are in OFF status. After that the control starts indicating actual temperature on the PV display and setting value on the SV display.

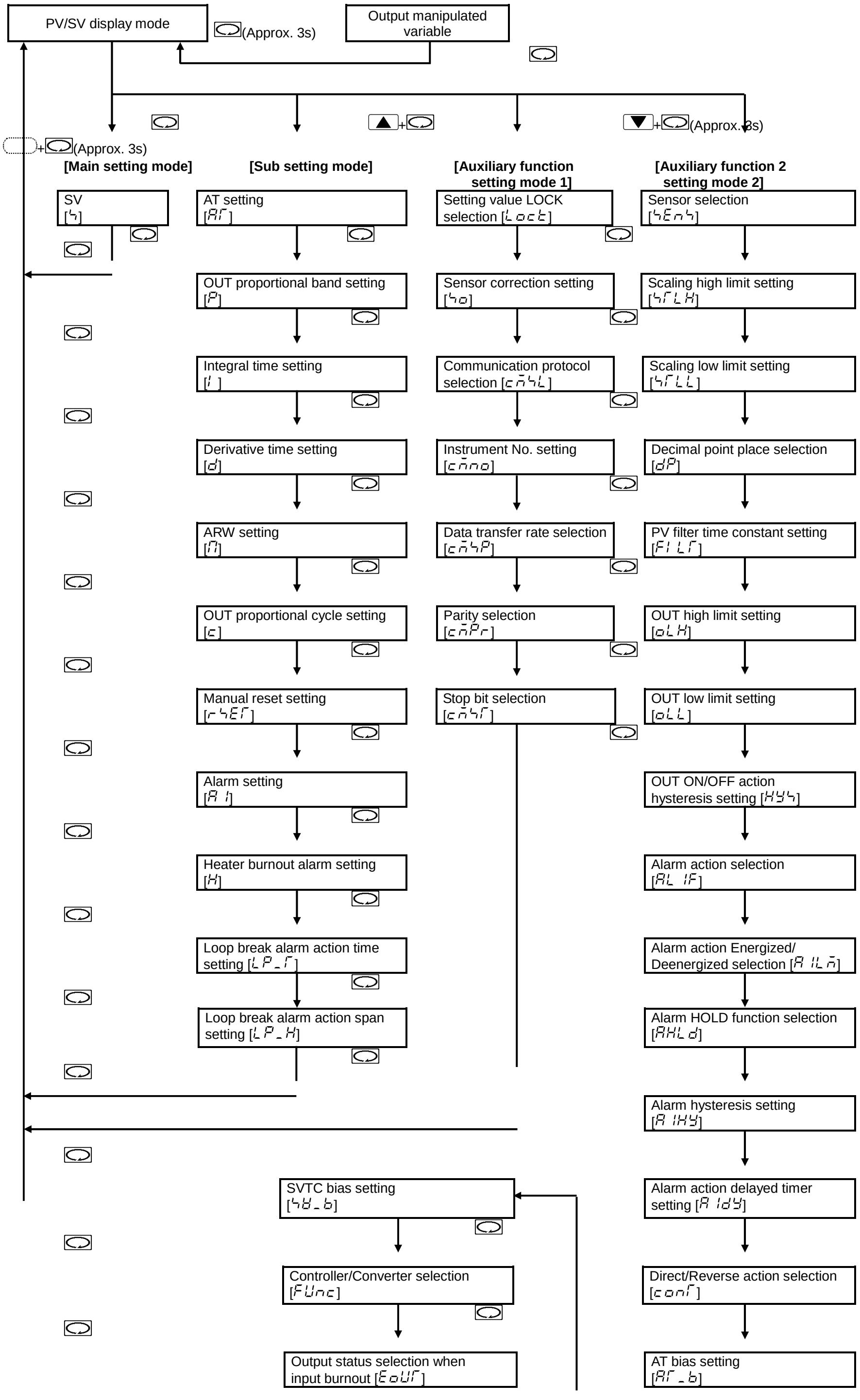
(Table 5-1)

Input	Scale range		Resolution
K	-200 to 1370 ℃	-320 to 2500 ℉	1℃ (℉)
	-199.9 to 400.0℃	-199.9 to 750.0℉	0.1℃ (℉)
J	-200 to1000 ℃	-320 to1800 ℉	1℃ (℉)
R	0 to 1760 ℃	0 to 3200 ℉	1℃ (℉)
S	0 to 1760 ℃	0 to 3200 ℉	1℃ (℉)
B	0 to 1820 ℃	0 to 3300 ℉	1℃ (℉)
E	-200 to 800 ℃	-320 to 1500 ℉	1℃ (℉)
T	-199.9 to 400.0℃	-199.9 to 750.0℉	0.1℃ (℉)
N	-200 to 1300 ℃	-320 to 2300 ℉	1℃ (℉)
PL-Ⅱ	0 to 1390 ℃	0 to 2500 ℉	1℃ (℉)
C (W/Re5-26)	0 to 2315 ℃	0 to 4200 ℉	1℃ (℉)
Pt100	-199.9 to 850.0 ℃	-199.9 to 999.9℉	0.1℃ (℉)
	-200 to 850 ℃	-300 to 1500 ℉	1℃ (℉)
JPt100	-199.9 to 500.0 ℃	-199.9 to 900.0℉	0.1℃ (℉)
	-200 to 500 ℃	-300 to 900 ℉	1℃ (℉)
4 to 20mA DC	-1999 to 9999 *1,*2		1
0 to 20mA DC	-1999 to 9999 *1,*2		1
0 to 1V DC	-1999 to 9999 *1		1
0 to 5V DC	-1999 to 9999 *1		1
1 to 5V DC	-1999 to 9999 *1		1
0 to 10V DC	-1999 to 9999 *1		1

*1: Input range and decimal point place can be changed.

*2: A shunt resistor (50Ω) purchased separately must be connected between the input terminals.

5.1 Setting flow chart



- ▲+: Press the key while the ▲ key is being pressed.
- ▼+(Approx. 3s): Press the key for 3 seconds while the ▼ key is being pressed.
- +(Approx. 3s): Press the key for 3 seconds while the key is being pressed.
- When setting a value or selecting an item in the setting mode, use the ▲ or ▼ key.

Some setting characters are not indicated depending on the specifications.

5.2 Main setting mode

Character	Name, Description, Setting range	Default value
SV	**SV** • Sets the value for controlled object. • Scaling low limit value to scaling high limit value (Decimal point place follows the selection for DC voltage and current inputs)	0℃

5.3 Sub setting mode

Character	Name, Description, Setting range	Default value
AT	**AT setting** • Performs PID auto-tuning. However when PID auto-tuning does not finish after 4 hours, PID auto-tuning is shut down compulsory. • PID auto-tuning cancellation : ---- PID auto-tuning performance: AT	----
P	**OUT proportional band setting** • Sets the proportional band. • The control action becomes ON/OFF when set to 0.0 • Setting range: 0.0 to 110.0%	2.5%
I	**Integral time setting** • Sets the integral time. • Setting the value to 0 disables this function. • This setting item is not indicated for ON/OFF action. • Setting range: 0 to 1000 seconds	200 seconds
d	**Derivative time setting** • Sets the derivative time. • Setting the value to 0 disables this function. • This setting item is not indicated for ON/OFF action. • Setting range: 0 to 300 seconds	50 seconds
rn	**Anti-reset windup setting** • This setting item is indicated only for PID action. • Setting range: 0 to 100%	50%
c	**OUT proportional cycle setting** • Sets the proportional cycle value for the control output (OUT). • This setting item is not indicated for ON/OFF action or DC current output. • Setting range: 1 to 120 seconds	30 seconds or 3 seconds
rSET	**Manual reset setting** • Sets the reset value manually. • This setting item is indicated only for P and PD action. • ±Proportional band converted value (In the case of DC voltage and current inputs, decimal point place follows the selection.)	0.0
A1	**Alarm setting** • Sets the action point for the alarm output. • Setting the value to 0 or 0.0 disables this function. (excluding Process high and Process low alarms) When Loop break alarm and Heater burnout alarm are applied together, the output is common. • This setting item is not indicated when “No alarm” action is selected in [Alarm action selection]. • See (Table 5.3-1). (In the case of DC voltage and DC current inputs, decimal point place follows the selection.)	0℃
H□□□ and □XX.X are indicated in turn.	**Heater burnout alarm setting** • Sets the heater current value for Heater burnout alarm. • Setting the value to 0.0 disables this function. • Self-holding is not available for the alarm output. When alarm and Loop break alarm are applied together, the output is common.	0.0A

	• This setting item is not indicated when Heater burnout alarm is not added. • Rating 5A : 0.0 to 5.0A Rating 20A: 0.0 to 20.0A Rating 10A: 0.0 to10.0A Rating 50A: 0.0 to 50.0A	
LP_T	**Loop break alarm action time setting** • Sets the action time to assess the Loop break alarm. • Setting the value to 0 disables this function. • When alarm and Heater burnout alarm are applied together, the output is common. • Setting range: 0 to 200 minutes	0 minutes
LP_H	**Loop break alarm action span setting** • Sets the action span to assess the Loop break alarm. • Setting the value to 0 disables this function. • When alarm and Heater burnout alarm are applied together, the output is common. • Thermocouple, RTD inputs: 0 to 150℃ (℉) or 0.0 to 150.0℃ (℉) DC voltage and current inputs: 0 to 1500 (Decimal point place follows the selection)	0℃

(Table 5.3-1)

Alarm action type	Setting range
High limit alarm	-(Scaling span) to scaling span
Low limit alarm	-(Scaling span) to scaling span
High/Low limits alarm	0 to scaling span
High/Low limit range alarm	0 to scaling span
Process high alarm	Scaling low limit value to scaling high limit value
Process low alarm	Scaling low limit value to scaling high limit value
High limit alarm with standby	-(Scaling span) to scaling span
Low limit alarm with standby	-(Scaling span) to scaling span
High/Low limits with standby	0 to scaling span

Minimum negative setting value: -199.9 or -1999

Maximum positive setting value: 999.9 or 9999

5.4 Auxiliary function setting mode 1

Character	Name, Description, Setting range	Default value
Lock	**Setting value LOCK selection** • Locks the setting value to prevent setting errors. The setting item to be locked is dependent on the designation. • PID auto-tuning cannot be carried out when Lock1 or Lock2 is selected. Be sure to select LOCK 3 when our programmable controller (with SVTC) is used together. • ---- (Unlock) : All setting values can be changed. Loc 1 (LOCK 1): None of setting values can be changed. Loc2 (LOCK 2): Only main setting mode can be changed. Loc3 (LOCK 3): All setting values can be changed except Controller/Converter function selection. But do not change each setting item of auxiliary function setting mode 2. Changed data reverts to their former value after power is turned off because they are not saved in the non-volatile memory. Lock 3 is suitable when our programmable controller (with SVTC) is used together because it has noting to do with memory life.	Unlock
to	**Sensor correction setting** • Sets the sensor correction value of the sensor. • Thermocouple and RTD inputs: -100.0 to 100.0℃ (℉) DC voltage and current inputs: -1000 to 1000 (Decimal point place follows the selection.)	0.0℃
cmuL	**Communication protocol selection** • Selects communication protocol. • This item is not indicated when [Option: C5] is not added.	Shinko protocol

	• Shinko protocol: nonL , Modbus ASCII mode: nodA Modbus RTU mode: nodr	
cnno	**Instrument number setting** • Sets individual instrument number to each DCL-33A when connecting plural DCL-33As in serial communication. • This item is not indicated when [Option: C5] is not added. • Setting range: 0 to 95	0
cnsP	**Data transfer rate selection** • Selects data transfer rate in conformity with host computer • This item is not indicated when [Option: C5] is not added. • 2400bps: 24, 4800bps: 48, 9600bps: 96, 19200bps: 192	9600bps
cnPr	**Parity selection** • Selects parity. • This item is not indicated when [Option: C5] is not added or when Shinko is selected in Communication protocol selection • None: nonE, Even: EvEn, Odd: odd	Even
cnsT	**Stop bit selection** • Selects stop bit. • This item is not indicated when [Option: C5] is not added or when Shinko is selected in Communication protocol selection • Setting: 1 or 2	1

5.5 Auxiliary function setting mode 2

Character	Name, Description, Setting range	Default value
sEns	**Input type selection** • Selects a sensor type and temperature unit from thermocouple (22 types), RTD (8 types), DC current (2 types) and DC voltage (4 types). • When changing input type from DC voltage input to the others, detach the sensor connected to this unit before changing. Input circuit will break down if input type is change while the sensor is connected.	K (-200 to 1370℃)
	K -200 to 1370 ℃: tC -199.9 to 400.0℃: t.C J -200 to 1000 ℃: JC R 0 to 1760 ℃: rC S 0 to 1760 ℃: sC B 0 to 1820 ℃: bC E -200 to 800 ℃: EC T -199.9 to 400.0℃: T.C N -200 to 1300 ℃: nC PL-Ⅱ 0 to 1390 ℃: PL2C C(W/Re5-26) 0 to 2315 ℃: cC Pt100 -199.9 to 850.0℃: Pt.C JPt100 -199.9 to 500.0℃: JPt.C Pt100 -200 to 850 ℃: PtC JPt100 -200 to 500 ℃: JPtC 4 to 20mA -1999 to 9999 : 420A 0 to 20mA -1999 to 9999 : 020A 0 to 1V -1999 to 9999 : 0 1V 0 to 5V -1999 to 9999 : 0 5V 1 to 5V -1999 to 9999 : 1 5V 0 to 10V -1999 to 9999 : 0 10V	K -320 to 2500 ℉: tF -199.9 to 750.0℉: t.F J -320 to 1800 ℉: JF R 0 to 3200 ℉: rF S 0 to 3200 ℉: sF B 0 to 3300 ℉: bF E -320 to 1500 ℉: EF T -199.9 to 750.0℉: T.F N -320 to 2300 ℉: nF PL-Ⅱ 0 to 2500 ℉: PL2F C (W/Re5-26) 0 to 4200 ℉: cF Pt100 -199.9 to 999.9℉: Pt.F JPt100 -199.9 to 900.0℉: JPt.F Pt100 -300 to 1500 ℉: PtF JPt100 -300 to 900 ℉: JPtF	
sLSH	**Scaling high limit setting** • Sets the scaling high limit value. • Scaling low limit setting value to Input range high limit value (For DC voltage and current inputs, decimal point place follows the selection.)	1370℃
sLSL	**Scaling low limit setting** • Sets the scaling low limit value. • Input range low limit value to scaling high limit setting value	-200℃

	(For DC voltage and current inputs, decimal point place follows the selection.)	
dP	**Decimal point place selection** • Selects the decimal point place. However, when thermocouple or RTD input is selected in the sensor selection, this setting item is not indicated. • No decimal point to 3 digits after decimal point	No decimal point
FILT	**PV filter time constant setting** • Sets the PV filter time constant. If the setting value is too large, it affects control result due to the response delay. • Setting range: 0.0 to 10.0 seconds	0.0 seconds
oLH	**OUT high limit setting** • Sets the OUT high limit value. • This setting item is not indicated when ON/OFF action. • **Setting range: OUT low limit value to 105%** Setting greater than 100% is effective to DC current output type.	100%
oLL	**OUT low limit setting** • Sets the OUT low limit value. • This setting item is not indicated during ON/OFF action. • Setting range: -5% to OUT high limit value Setting less than 0% is effective to DC current output type.	0%
HYS	**OUT ON/OFF action hysteresis setting** • Sets the ON/OFF action hysteresis for the OUT. • This setting item is indicated only for ON/OFF action (P=0). • Thermocouple and RTD inputs: 0.1 to 100.0℃(℉) DC voltage and current inputs : 1 to 1000 (Decimal point place follows the selection)	1.0℃
AL 1F	**Alarm action selection** • Selects an alarm action type. No alarm : ---- High limit alarm : H Low limit alarm : L High/Low limits alarm : HL High/Low limit range alarm : ōId Process high alarm : PH Process low alarm : rPH High limit alarm with standby : H ō Low limit alarm with standby : L ō High/Low limits alarm with standby : HL ō	No alarm
A 1LN	**Alarm action Energized/Deenergized** • Selects the alarm action Energized/Deenergized. • This setting item is not indicated when “No alarm” action is selected in [Alarm action selection]. • Energized : nonL, Deenergized: rEVS	Energized
AHLd	**Alarm HOLD function selection** • Selects whether alarm HOLD function is [Used] or not. If alarm HOLD function is set to [Used], once the alarm functions, alarm output remains until the power is turned off. • This setting item is not indicated when “No alarm” action is selected in [Alarm action selection]. • Alarm HOLD [Not used]: nonE, Alarm HOLD [Used]: HoLd	Alarm HOLD [Not used]
A 1HY	**Alarm hysteresis setting** • Sets the alarm hysteresis. • This setting item is not indicated when “No alarm” action is selected in [Alarm action selection]. • Thermocouple and RTD inputs: 0.1 to 100.0℃(℉) DC voltage and current inputs : 1 to 1000 (Decimal point place follows the selection.)	1.0℃

A1dY	**Alarm action delayed timer setting** • Sets the alarm action delayed time. Alarm output activates when the setting time has passed after the input enters alarm output range. • This setting item is not indicated when “No alarm” action is selected in [Alarm action selection]. • Setting range: 0 to 9999 seconds	0 seconds
conF	**Direct/Reverse selection** • Selects reverse (heating) or direct (cooling) control action. • Reverse (Heating) action : HEAT Direct (Cooling) action : cooL	Reverse (Heating) action
AT_b	**AT bias setting** • Set the PID auto-tuning bias value. • This setting item is not indicated when DC voltage or current input is selected in [Sensor selection] and when action is not PID, either. • Setting range: 0 to 50℃(0 to 100℉) or 0.0 to 50.0℃(0.0 to 100.0℉)	20℃
SV_b	**SVTC bias setting** • Control desired value : Value that was received by SVTC command + SVTC bias value •This setting item is not indicated when [Option: C5] is not added.	0
FUnc	**Controller/ Converter function selection** • Selects controller or converter function. • This setting item is indicated only when the control output is DC current output type. • Controller function: cnTr, Converter function: cnVT	Controller function
EoUT	**Output status selection when input burnout** • Selects whether the OUT output is turned OFF or not when DC input is overscale or underscale. • This setting item is indicated only when DC input and DC current output type. • oFF (output OFF), on (output ON)	Output OFF

Sensor correction function

This corrects the input value from the sensor. When a sensor cannot be set at a location where control is desired, the sensor measuring temperature may deviate from the temperature in the controlled location. When controlling with multiple controllers, the accuracy of the sensors or dispersion of load capacity has influence on the control.

Therefore, sometimes the measured temperature (input value) does not concur with the same setting value. In such case the control can be set at the desired temperature by correcting the input value of the sensors.

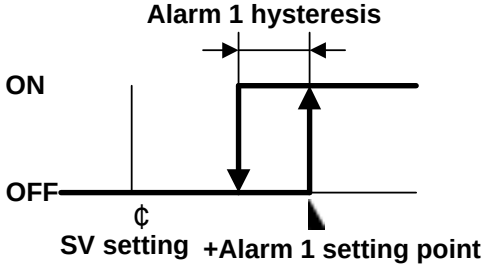
Loop break alarm

The alarm will be activated when the process variable (PV) does not rise as much value as the span or greater within the time it takes to assess the Loop break alarm after the manipulated variable has reached 0% or the output low limit value. When the control action is Direct (Cooling), the alarm acts conversely.

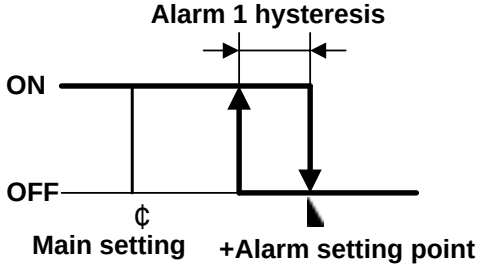
Energized/Deenergized function

[If alarm action Energized is selected]
When the alarm output indicator is lit, the alarm output (between terminal 8 and 9) is conducted (ON).
When the alarm output indicator is unlit, the alarm output is not conducted (OFF).
[If alarm action Deenergized is selected]
When the alarm output indicator is lit, the alarm output (between terminal 8 and 9) is not conducted (OFF).
When the alarm output indicator is unlit, the alarm output is conducted (ON).

High limit alarm (Energized setting)



High limit alarm (Deenergize setting)



(Fig. 5.5-1) (Fig. 5.5-2)

5.6 Control output manipulated variable indication

Name and Description
Control output manipulated variable indication **Press the MODE key for approx. 3 seconds during PV/SV display mode.** Keep pressing the MODE key until the output manipulated variable shows up, though the main setting mode appears during the process. (The control output manipulated variable is indicated on the SV display and the decimal point at the second digit blinks in 0.5 seconds cycle: Pressing the MODE key again, it reverts to the PV/SV display mode.

6. Converter function

⚠ Caution

Since the input/output response of this unit is approx. 1s, input value must be longer than 1 second when converter function is used.

When switching from converter function to controller function, the control parameter and the values set by converter function are held even if the function is switched to the controller function.
So, correct the control parameter and values set by converter function to the value necessary to the controller function after switching to the controller function.

The converter function of this instrument converts each input (Thermocouple, RTD, DC voltage and DC current input) value to “4 to 20mA DC” and outputs using the control parameter of the controller.
When this instrument is used as a converter, follow the process (1) to (7) described below.
When the process (1) to (7) is finished, this instrument can be used as a converter.

(1) Wire and connect this instrument. (Power, Input and Output)
(2) Turn the power of this instrument ON.
(3) Call the “Auxiliary function setting mode 2” by pressing the ⬭ and MODE key at the same time (for approx. 3s).
(4) Select the sensor type from “Sensor selection (SEnS)”.
(5) Set the high limit of the value which is going to be converted during “Scaling high limit setting (SrLH)”.
(6) Set the low limit of the value which is going to be converted during “Scaling low limit setting (SrLH)”.
(7) Select converter (cnvr) from “Controller/ Converter function selection (Func)”.

- **To activate the alarm action by Converter function, set the alarm action to Process alarm action.**

If converter function is selected from “Controller/Converter function selection” in Auxiliary function setting mode 2, the parameter below is automatically set. (Table 6-1)
However, this is applied only to the DC current output type.

(Table 6-1)

Setting item	Setting value	Setting item	Setting value
SV	Scaling low limit	Alarm setting	0
Proportional band	100.0%	Loop break alarm action time	0 seconds
Integral time	0 seconds	Loop break alarm action span	0
Derivative time	0 seconds	Direct/Reverse action selection	Direct action
Manual reset setting	0.0		

7. Running

When mounting and wiring to the control panel (DIN rail) are finished, start the operation following the next procedure.

(1) Turn the power supply to the DCL-33A series ON.
For approx. 3s after power on, character of the sensor type and temperature unit are indicated on the PV display, and the input range high limit value is indicated on the SV display. See (Table 5-1).
(If any other value is set at the scaling high limit value setting, SV display indicates it.)
During this time, all outputs and LED indicators are in their OFF status.
After that PV display indicates actual temperature and SV display indicates the main setting value.

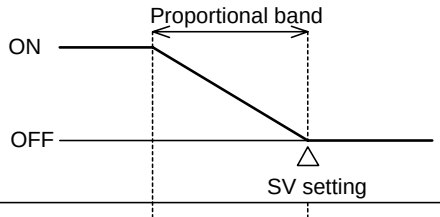
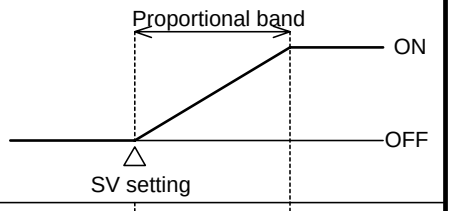
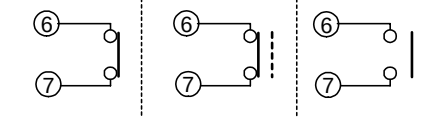
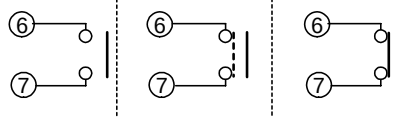
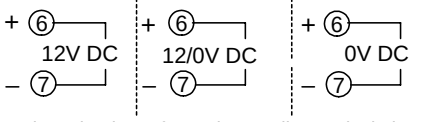
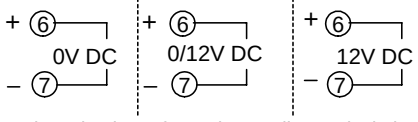
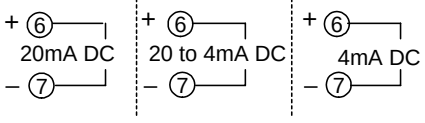
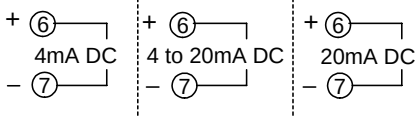
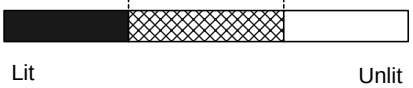
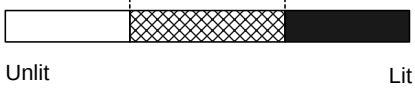
(2) Input the setting value.
Input each setting value referring to “5. Setup”.

(3) Turn the load circuit power ON.

Starts control action so as to keep temperature of the controlled object at the main setting value.

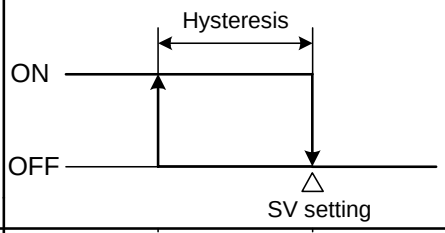
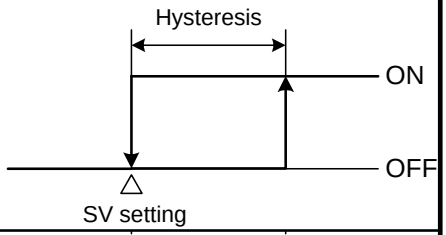
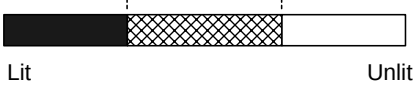
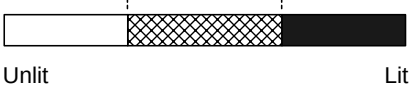
8. Action explanations

8.1 OUT action

	Heating (Reverse) action	Cooling (Direct) action
Control action		
Relay contact output	 Cycle action is performed according to deviation	 Cycle action is performed according to deviation
Non-contact voltage output	 Cycle action is performed according to deviation	 Cycle action is performed according to deviation
DC current output	 Changes continuously according to deviation	 Changes continuously according to deviation
Indicator (OUT) Green		

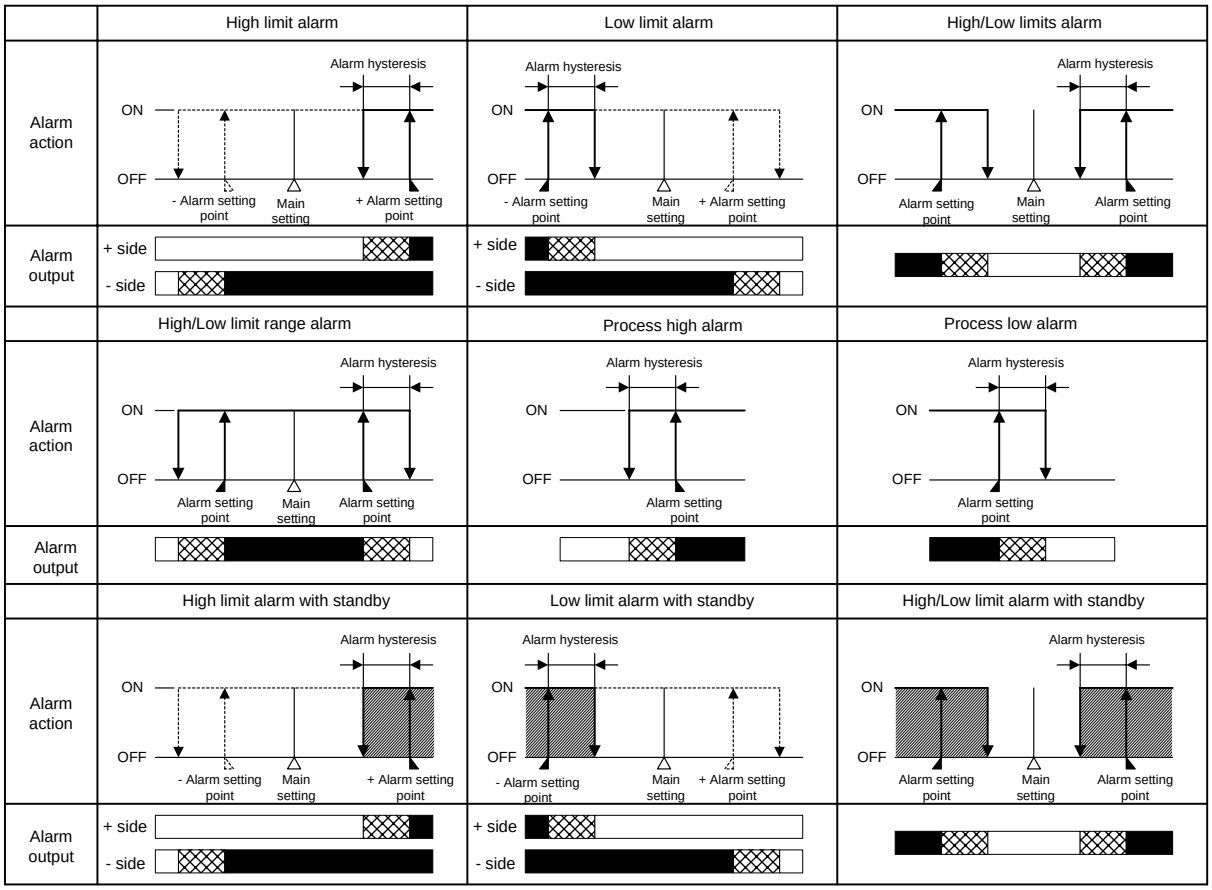
▨ part : Acts ON or OFF.

8.2 OUT ON/OFF action

	Heating (reverse) action	Cooling (direct) action
Control action		
Relay contact output		
Non-contact voltage output		
DC current output		
Indication (OUT) Green		

▨ part: Acts ON or OFF.

8.3 Event (Alarm) action



: Event (EVT) output terminal between 8 and 9 is ON.

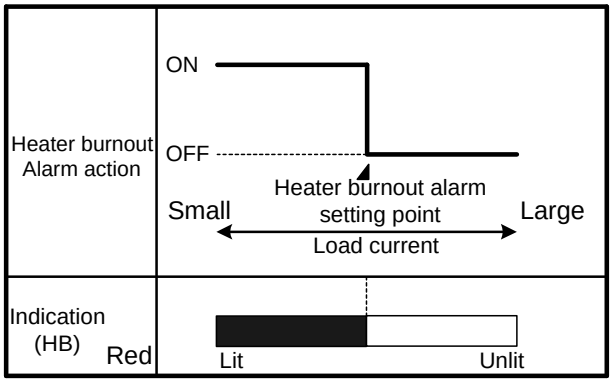
: Event (EVT) output terminal between 8 and 9 is ON or OFF.

: Event (EVT) output terminal between 8 and 9 is OFF.

: Standby functions in this section.

Event (EVT) output indicator lights when between output terminal 8 and 9 is ON, and goes out when between them is OFF.

8.4 EVT (Heater burnout alarm) action



: Event (EVT) output terminal between 8 and 9 is ON

: Event (EVT) output terminal between 8 and 9 is OFF

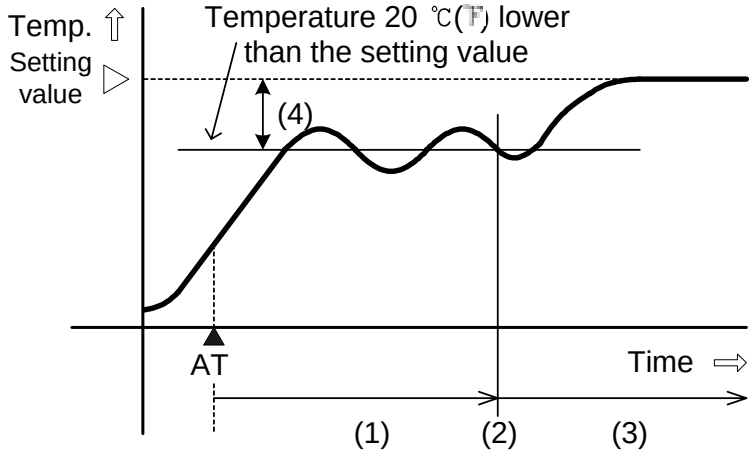
Event (EVT) output indicator lights when output terminal between 8 and 9 is ON, goes out when OFF

9. PID auto-tuning of the DCL-33A Series

In order to decide each P, I, D and ARW a value automatically, this system gives a fluctuation to the controlled object to get an optimal value.
1 of 3 types of fluctuation below are automatically selected.

[When the difference between setting value and processing temperature is large in rising]

When AT bias is set to 20℃(℉), a fluctuation is given at the temperature 20℃(℉) lower than the setting value.

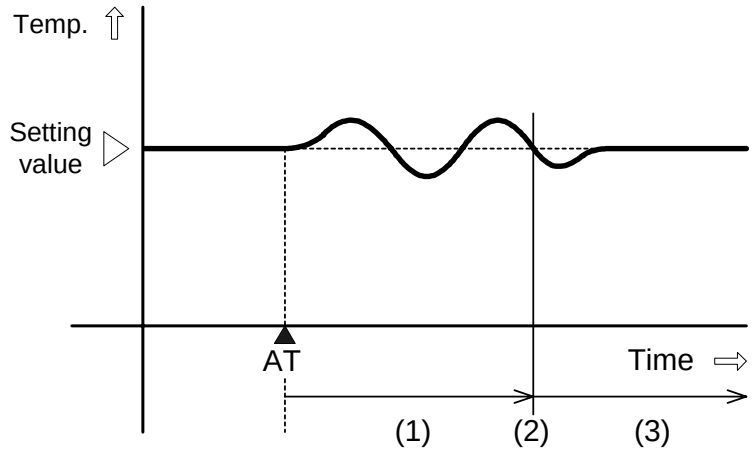


(1): Calculating PID constant
(2): PID contatnt calculated
(3): Controlled by the PID constant set by auto-tuning.
(4): AT bias setting value

▲AT : Auto-tuning starting point

[When control is stable]

A fluctuation is given at the setting value.

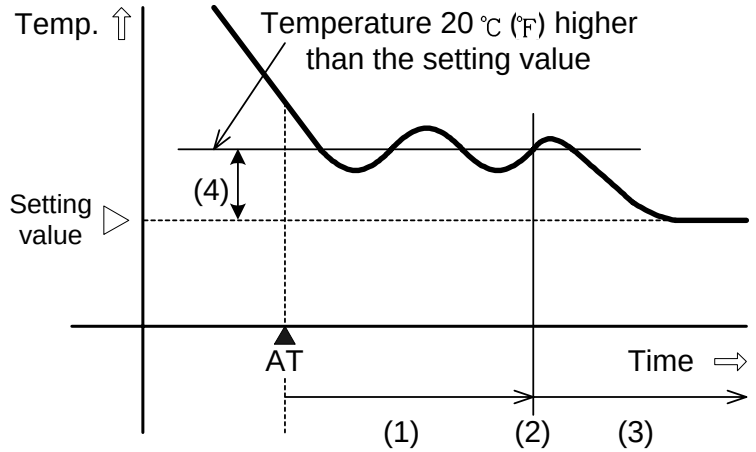


(1): Calculating PID constant
(2): PID constant calculated
(3): Controlled by PID constant set by auto-tuning

▲AT: Auto-tuning starting point

[When the difference between the setting value and processing temperature is large when temperature falls]

When AT bias is set to 20℃(℉), a fluctuation is given at the temperature 20℃(℉) higher than the setting value.



(1): Calculating PID constacnt
(2): PID constant calculated
(3): Controlled by PID constant set by auto-tuning
(4): AT bias setting value

▲ AT: Auto-tuning starting point

10. Specifications

10.1 Standard specification

Model name : DIN rail mounting indicating controller
Mounting method : DIN rail mounting method
Setting system : Input system using membrane sheet key
Display : PV display: Red LED 4 digits, Character size 7.4 x 4mm (H x W)
SV display: Green LED 4 digits, Character size 7.4 x 4mm (H x W)

Input

Thermocouple : K, J, R, S, E, T, N, PL-Ⅱ, C (W/Re5-26) External resistance: 100Ω or less
For thermocouple B, External resistance, 40Ω or less
RTD : Pt100, JPt100, 3-wire system
Allowable input wire resistance (10Ω or less per wire)
DC current : 0 to 20mA DC, 4 to 20mA, input impedance 50Ω
[Connect 50Ωshunt resistor (sold separately) between input terminal 5 and 6.]
Allowable input current: 50mA or less
DC voltage :

	0 to 1V DC	0 to 5V DC, 1 to 5V DC, 0 to 10V DC
Input impedance	1MΩ or greater	100kΩ or greater
Allowable input voltage	5V or less	15V or less
Allowable signal source resistance	2kΩ or less	100Ω or less

Accuracy (Indicating, Setting)
Thermocouple input: Within ±0.2% of input span ±1 digit or ±2℃(4℉) whichever is greater
R, S input 0 to 200℃(0 to 400℉): Within ±6℃(12℉)
B input 0 to 300℃(0 to 600℉): Accuracy is not guaranteed.
K, J, E, N input less than 0℃ (32℉): Within ±0.4% of input span ±1 digit
RTD input : Within ±0.1% of input span ±1 digit or within ±1℃(2℉) whichever is greater.
DC voltage input : Within ±0.2% of input span ±1 digit
DC current input : Within ±0.2% of input span ±1 digit
Input sampling period : 0.25 seconds

Control

Control action
- PID action (with auto-tuning function)
- PI action: When 0 is set to derivative time
- PD action (with manual reset function): When 0 is set to integral time
- P action (with manual reset function): When 0 is set to derivative and integral time
- ON/OFF action: When 0 is set to proportional band

OUT proportional band: 0.0 to 110.0% (ON/OFF action when set to 0.0)
Integral time : 0 to 1000 seconds (Off when set to 0)
Derivative time : 0 to 300 seconds (Off when set to 0)
OUT proportional cycle: 1 to 120 seconds
ARW : 0 to 100%
Manual reset : ±Proportional band converted value
Output limit : 0 to 100% (DC current output type: -5 to 105%)
(Not available for ON/OFF action)
Hysteresis : Thermocouple and RTD input: 0.1 to 100.0℃(℉)
DC voltage and current inputs: 1 to 1000
(Decimal point place follows the selection)

Control output (OUT)
- Relay contact: 1a Control capacity 3A 250V AC (Resistive load)
1A 250V AC (Inductive load COS ø =0.4)
Electric life 100,000 times
- Non-contact voltage (for SSR drive): 12 V DC Max. 40mA (Short-circuit protected)
- DC current: 4 to 20mA DC, Load resistance: Max. 550Ω
Output accuracy: Within ±0.2% of output span
Resolution : 12000

EVT output

• Alarm output [Common output with Loop break alarm, Heater burnout alarm (option)]

The alarm action point is set by ± deviation to the main setting (excluding Process alarm) and when input exceeds the range in ± deviation setting (excluding Process alarm) to the main setting, alarm (EVT) turns ON or OFF (High/Low limit range alarm), and when Deenergized is selected in Energized/Deenergized selection, alarm (EVT) is activated conversely.

Setting accuracy: The same as indicating accuracy

Action : ON/OFF action

Hysteresis : Thermocouple and RTD input: 0.1 to 100.0℃(℉)

: DC voltage and current input: 1 to 1000

(Decimal point place follows the selection)

Output : Open collector, Control capacity 24V DC 0.1A (Max.)

Alarm output action: One alarm action is selectable from below by front key operation.

High limit, Low limit, High/Low limits, High/Low limit range, Process high, Process low, High limit with standby, Low limit with standby, High/Low limits with standby and No alarm action

Energized/Deenergized: Alarm (EVT) output Energized/Deenergized can be selected.

	Energized	Deenergized
Red (EVT) LED	Lights	Lights
EVT output	ON	OFF

Alarm HOLD function selection: Once the alarm is activated, alarm output is remains until power is turned off.

• Loop break alarm output [Common output with Alarm and Heater burnout alarm (Option)]

Detects heater burnout, sensor burnout, and abnormality at the operation end.

Setting range: Loop break alarm action time setting: 0 to 200 minutes

Loop break alarm action span setting:

Thermocouple and RTD input: 0 to 150℃(℉) or 0.0 to 150.0℃(℉)

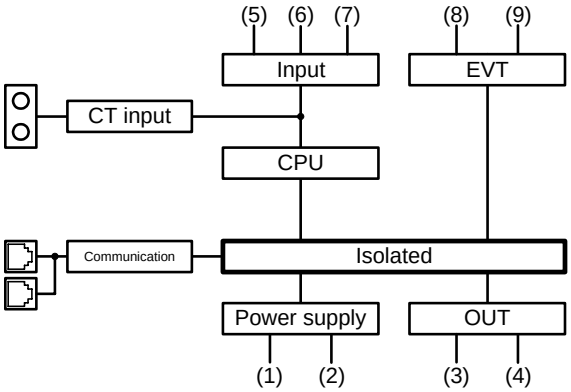
DC voltage and current input : 0 to 1500

(Decimal point place follows the selection.)

Output: Open collector, Control capacity 24V DC 0.1A (Max.)

Converter function : See “6. Converter function”

Isolation • Dielectric strength: Circuit isolation structure



*** When OUT is Non-contact voltage or DC current output, between OUT and Communication is non-isolated.**

Isolation resistance : 10MΩ or greater at 500V DC except the above

Dielectric strength : 1.5kV AC for 1 minute between input terminal and power terminal

1.5kV AC for 1 minute between output terminal and power terminal

Power : 100 to 240V AC 50/60Hz, 24VAC/DC 50/60Hz

Allowable voltage fluctuation 100 to 240V AC : 85 to 264V AC

24V AC/DC : 20 to 28V AC/DC

Power consumption : Approx. 6VA

Ambient temperature: 0 to 50℃

Ambient humidity : 35 to 85%RH (No condensation)

Weight : Approx. 120g

External dimension : 22.5 x 75 x 100mm (W x H x D)

Material : Flame resistant resin (Case)
Color : Light gray (Case)

Attached function:

[Setting value lock]

[Sensor correction]

[Power failure countermeasure]

The setting data is backed up in non-volatile IC memory.

[Self-diagnosis]

The CPU is monitored by a watchdog timer and when any abnormal status is found on the CPU, all outputs are OFF and controller is switched to warm-up status.

[Automatic cold junction temperature compensation] (Only thermocouple input)

Detects the temperature at the connection terminal between thermocouple and instrument and keeps it on the same status at which the reference junction is located at 0℃(32℉).

[Input burnout indication]

Thermocouple, RTD input

If the PV exceeds the Indication range high limit value, the PV display blinks "- - - -", and if the PV exceeds the Indication range low limit value, the PV display blinks "- - - -".

If the PV exceeds the Control range, OUT is turned OFF (for DC current output type, OUT low limit value).

(However, for manual control, it outputs the manipulated variable which has been already set)

Input	Input range	Indication range	Control range
K T	-199.9 to 400.0℃	-199.9 to 450.0℃	-205.0 to 450.0℃
	-199.9 to 750.0℉	-199.9 to 850.0℉	-209.0 to 850.0℉
K	-200 to 1370℃	-250 to 1420℃	-250 to 1420℃
	-320 to 2500℉	-370 to 2550℉	-370 to 2550℉
J	-200 to 1000℃	-250 to 1050℃	-250 to 1050℃
	-320 to 1800℉	-370 to 1850℉	-370 to 1850℉
R S	0 to 1760℃	-50 to 1810℃	-50 to 1810℃
	0 to 3200℉	-50 to 3250℉	-50 to 3250℉
B	0 to 1820℃	-50 to 1870℃	-50 to 1870℃
	0 to 3300℉	-50 to 3350℉	-50 to 3350℉
E	-200 to 800℃	-250 to 850℃	-250 to 850℃
	-320 to 1500℉	-370 to 1550℉	-370 to 1550℉
N	-200 to 1300℃	-250 to 1350℃	-250 to 1350℃
	-320 to 2300℉	-370 to 2350℉	-370 to 2350℉
PL-	0 to 1390℃	-50 to 1440℃	-50 to 1440℃
	0 to 2500℉	-50 to 2550℉	-50 to 2550℉
C(W/Re5-26)	0 to 2315℃	-50 to 2365℃	-50 to 2365℃
	0 to 4200℉	-50 to 4250℉	-50 to 4250℉
Pt100	-199.9 to 850.0℃	-199.9 to 900.0℃	-210.0 to 900.0℃
	-200 to 850℃	-210 to 900℃	-210 to 900℃
	-199.9 to 999.9℉	-199.9 to 999.9℉	-211.0 to 1099.9℉
	-300 to 1500℉	-318 to 1600℉	-318 to 1600℉
JPt100	-199.9 to 500.0℃	-199.9 to 550.0℃	-206.0 to 550.0℃
	-200 to 500℃	-206 to 550℃	-206 to 550℃
	-199.9 to 900.0℉	-199.9 to 999.9℉	-211.0 to 999.9℉
	-300 to 900℉	-312 to 1000℉	-312 to 1000℉

DC current and voltage inputs

If the PV exceeds Indication range high limit value, the PV display blinks "- - - -", and if the PV exceeds the Indication range low limit value, the PV display blinks "- - - -".

Indication range : [Scaling low limit value – Scaling span x 1%] to [Scaling high limit value +Scaling span x 10%]
However, if the PV exceeds the range "–1999 to 9999", the PV display blinks "- - - -" or "- - - -".

Control range : [Scaling low limit value – Scaling span x 1%] to [Scaling high limit value +Scaling span x 10%]

DC input burnout : When DC input is burnt out, PV display blinks "- - - -" for "4 to 20mA DC"

and “1 to 5V DC” inputs, and “ ‾ ‾ ‾ ‾ ” for “0 to 1V DC” input.
For “0 to 20mA DC”, “0 to 5V DC” and “0 to 10V DC” inputs, the PV display indicates the corresponding value for which 0mA or 1V is inputted.

[Burnout]

When the thermocouple or RTD input is burnt out, OUT is turned off and PV display blinks “ ‾ ‾ ‾ ‾ ”.

Accessories included: Instruction manual: 1 copy
Wire harness 3m : 1 piece [When Heater burnout alarm (option) is added]
When Heater burnout alarm (option) is added:
CT (CTL-6S) : 1 piece [When Heater burnout alarm (option) is added]
[Rating 5A, 10A, 20A]
CT (CTL-12-S36-10L1): 1 piece [Rating 50A]

Accessories sold separately: Shunt resistor (50Ω) for DC current input
Terminator (120Ω) for serial communication: RES-T01-120

10.2 Optional specification

Heater burnout alarm (W)

Watches the heater current with CT (Current transformer) and detects the burnout.
When this option is added, it shares common output with alarm output and Loop break alarm.
This option cannot be applied to the current output type.

Rating : 5A [W (5A)], 10A [W (10A)], 20A [W (20A)], 50A [W (50A)] (Must be designated)
Setting range : 5A [W (5A)]: 0.0 to 5.0A (Off when set to 0.0)
10A [W (10A)]: 0.0 to 10.0A (Off when set to 0.0)
20A [W (20A)]: 0.0 to 20.0A (Off when set to 0.0)
50A [W (50A)]: 0.0 to 50.0A (Off when set to 0.0)
Setting accuracy : ±5% of the rated value
Action : ON/OFF action
Output : Open collector
Control capacity 24V DC 0.1A (Max.)

Serial communication (C5)

The following operation is performed from external computer.
(1) Reading and setting of the main setting value, PID and other various setting values
(2) Reading of the input value and action status
(3) Function change

Communication interface : Based on EIA RS-485
Communication method : Half-duplex start-stop synchronous
Data transfer rate : 2400/ 4800/ 9600/ 19200bps (Selectable by key operation)
Parity : Even/ Odd/ None (Selectable by key operation)
Stop bit : 1 or 2 (Selectable by key operation)
Communication protocol : Shinko/ Modbus RTU/ Modbus ASCII (Selectable by key operation)
Number of connectable units : A maximum of 31 units per host computer
Communication error detection : Parity and Checksum
Digital external setting : SV of programmable controller can be transmitted digitally by combining programmable controller (with option SVTC) and the JCS-33A (with option C5)
[Setting value LOCK of the DCL-33A must be set to LOCK 3.]
When data from programmable controller is greater than SV high limit setting or smaller than SV low limit setting, DCL-33A ignores the value and controls the previous value that exceeded SV high limit or low limit.
Control desired value is the value that is added SVTC bias value to the received value by SVTC command.

11. Troubleshooting

If any malfunctions occur, refer to the following items after checking the power supply and wiring.

11.1 Indication

Phenomenon	Presumed cause and solution
"- - - -" is blinking on the PV display.	• Sensor (Thermocouple, RTD and DC voltage 0 to 1V DC input) is burnt out. **Change the sensor for a new one.** • The lead wire of the sensor (Thermocouple, RTD and DC voltage 0 to 1V DC input) is not securely connected. **Connect it to the terminal properly.**
The indication on the PV display does not change.	• Check if the input signal source for DC voltage (0 to 10V DC) and DC current (0 to 20mA DC) is normal. • Is the lead wire of the sensor DC current (0 to 20mA DC) and DC voltage (0 to 10V DC) securely connected to the terminal? **Connect the sensor lead wire securely to the instrument terminal.**
"- - - -" is blinking on the PV display.	• Check if the input signal source for sensor DC current (4 to 20mA DC) and DC voltage (1 to 5V DC) input is normal. • Is the input signal wire of DC current (4 to 20mA DC) and DC voltage(1 to 5V DC) securely connected to the terminal of this instrument? **Connect the input signal wire securely to the terminal of the instrument.**
The indication on the PV display is abnormal or unstable.	• Is designation of the sensor input correct? **Set the correct sensor input.** • Is the polarity of the sensor input correct? **Wire it correctly.** • Temperature unit (℃/℉) is mistaken. **Set the correct unit.** • AC may be leaking into the input of this controller from thermocouple or the RTD connected to the measured object. **Keep AC from leaking into the input of this controller from thermocouple or RTD of the measured object.**
"Err 1" is indicated on the PV display.	• Internal memory is out of order. **Please contact our sales branch or the shop where you purchased this unit.**

11.2 Key operation

Phenomenon	Presumed cause and solution
• Setting values do not change even if the ▲ or ▼ key is pressed during setting mode	• Mode1 or mode 2 is selected in setting value lock selection. **Cancel the Lock mode.** • PID auto-tuning is performing. **Cancel PID auto-tuning.**
• Unable to set the value above or below scaling high limit or low limit within the input range even if the ▲ or ▼ key is pressed.	• The value of scaling high limit setting or low limit setting in auxiliary function setting mode 2 may be set at the point the value does not change. **Set the proper value.**

• If you have any inquiries, please consult our agency or the shop where you purchased the unit.

SHINKO TECHNOS CO.,LTD.
OVERSEAS DIVISION

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No.DCL31E2 Apr. 2002

Instruction manual

DCL-33A (C5)

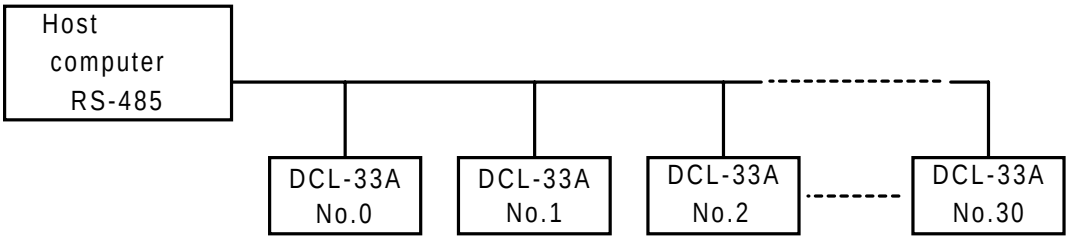
To prevent accidents arising from the misuse of this controller, please ensure the operator using it receives this manual.

⚠ Warning

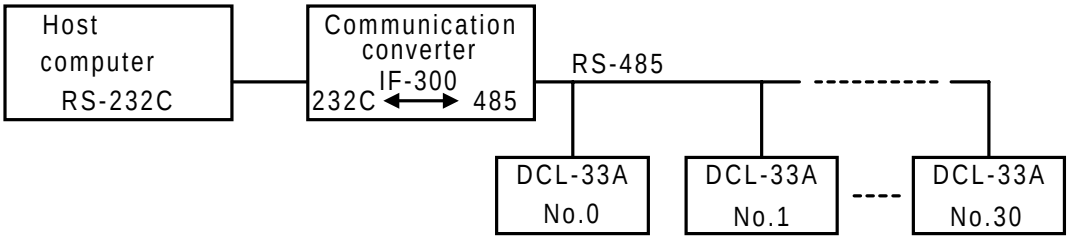
Turn the power supply to the instrument OFF before wiring or checking. Working or touching the terminal with the power switched ON may result in Electric Shock which may cause severe injury or death.

1. System configuration

RS-485 Multi-drop connection communication (Option: C5)



(Fig.1-1)



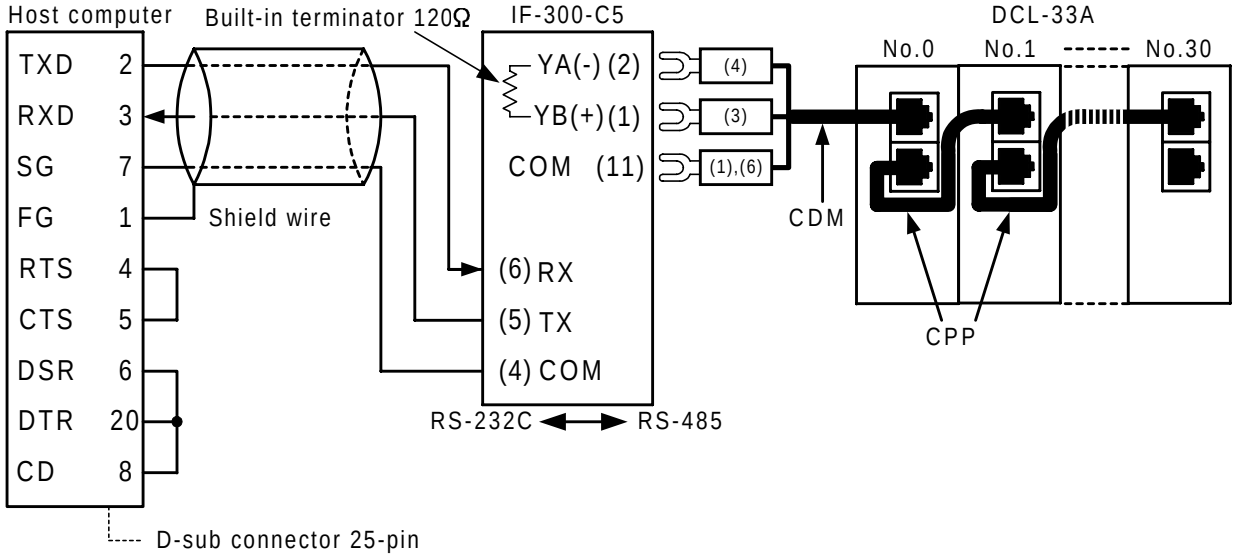
(Fig.1-2)

Wiring connection

When communication converter IF-100-C5 (RS-232C) is used

• Connector: D-sub connector 25-pin

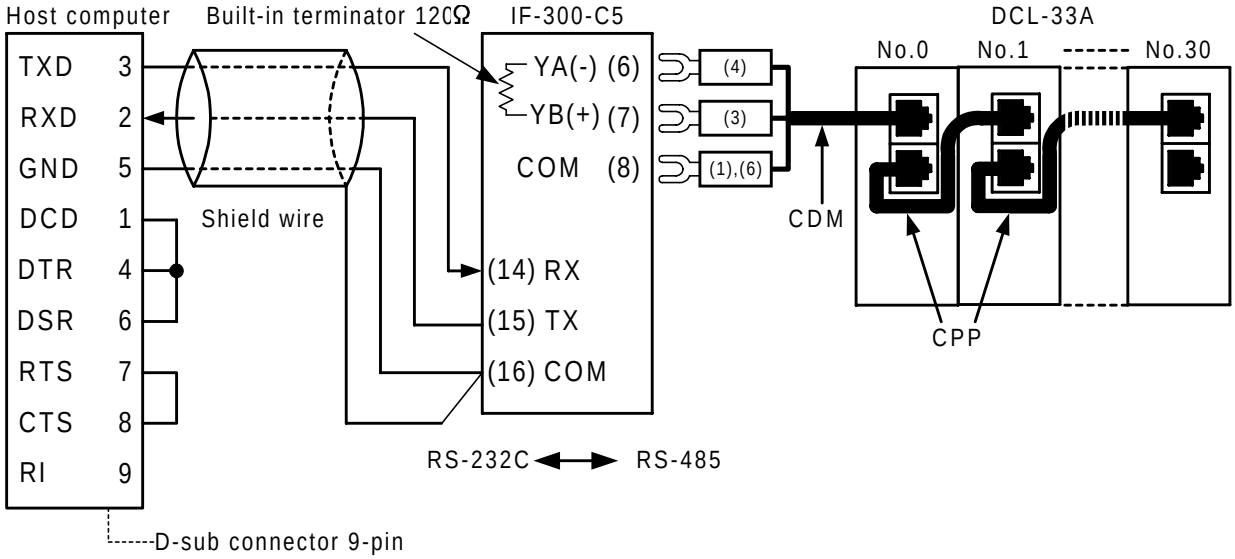
Connection: RS-232C ◄——► RS-485 (Data transfer rate: 2400, 4800, 9600, 19200bps)



(Fig.2-1)

• Connector: D-sub connector 9-pin

Connection: RS-232C ◄——► RS-485 (Data transfer rate: 2400, 4800, 9600, 19200bps)



(Fig.2-2)

Shield wire

Connect only one side of the shield wire to the FG or GND terminal so as not to allow current to flow to the shield section.

If both sides of the shield section are connected to the FG or GND terminal, closed circuit will be made between the shield wire and the ground.

As a result of this, current will run in the shield wire and **the current may cause noise to occur.**

Never fail to ground FG or GND terminal.

Terminator

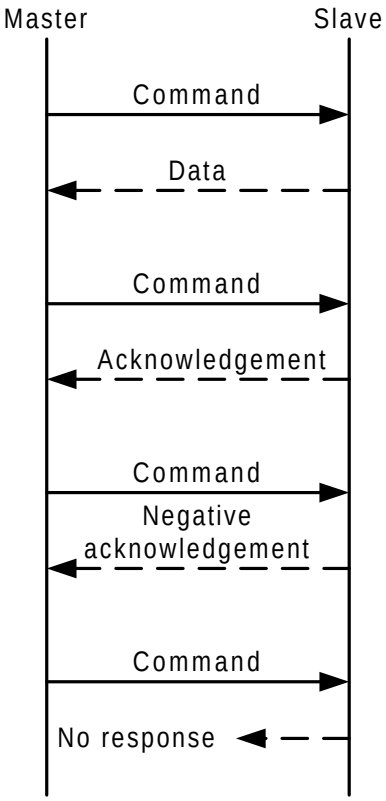
Do not connect terminator onto the communication line, because each DCL-33A has a built-in terminator. **IF-300-C5 (sold separately) is available as a communication converter.**

3. Setting the instruments

- It is necessary to set the instrument number individually to the instruments when plural units are connected in serial communication (Option: C5).
  Select the data transfer rate of DCL-33A in accordance with that of the host computer.
- Refer to the DCL-33A instruction manual as for instrument number setting and transfer rate selection.

4. Communication procedure

Communication starts with command transmission of the host computer (hereafter Master) and ends with the response of the DCL-33A (hereafter Slave).



(Fig.4-1)

- **Response with data**

  When the Master sends reading command, the Slave returns the corresponding setting value or current action status as a response.

- **Acknowledgement**

  When the Master sends setting command, the Slave returns the acknowledgement as a response after the processing is terminated.

- **Negative acknowledgement**

  When the Master sends non-existent command or value out of the setting range, the Slave returns the negative acknowledgement.

- **No response**

  When global address is set or either of framing error and checksum is detected, Slave will not respond to the Master.

Communication timing of the RS-485 (Option: C5)

Slave side;

When a slave starts transmission to RS-485 communication line, the DCL-33A is arranged so as to provide **1 character transmission period or more** of idle status (mark status) before sending the response to ensure the synchronization on the receiving side.
The DCL-33A is arranged so as to disconnect the transmitter from the communication line **within the period of 1 character transmission** after sending the response.

Master side (Notice on making a program);

Set the program so that the host computer can provide a **1 character transmission period or more of idle status** (mark status) before sending the command to ensure the synchronization on the receiving side when the host computer starts the transmission to RS-485 communication line.

Set the program so that the host computer can disconnect the transmitter from the communication line **within the period of 1 character transmission** after sending the command in preparation for reception of the response from the DCL-33A.
To avoid the collision of transmissions between the host computer and the DCL-33A, send the next command after checking that the host computer received the response.

When the host computer communicates with the DCL-33A through the line converter (IF-300-C5), it is not required to manage the transmission timing described above, because the converter takes the timing interpreting the protocol automatically.

5. Shinko protocol

5.1 Command configuration

All commands are written in ASCII. The data (setting value, decimal number) is converted to

Hexadecimal and ASCII are used for the command.
Negative numbers are represented by the 2's complement.

(1) Setting command

Header (02H)	Address	Sub address (20H)	Command type (50H)	Data item	Data	Checksum	Delimitter (03H)
1	1	1	1	4	4	2	1 ← Number of characters

(Fig. 5.1-1)

(2) Reading command

Header (02H)	Address	Sub address (20H)	Command type(20H)	Data item	Checksum	Delimitter (03H)
1	1	1	1	4	2	1 ← Number of characters

(Fig. 5.1-2)

(3) Response with data

Header (06H)	Address	Sub address (20H)	Command type	Data item	Data	Checksum	Delimitter (03H)
1	1	1	1	4	4	2	1 ← Number of characters

(Fig. 5.1-3)

(4) Acknowledgement

Header (06H)	Address	Checksum	Delimitter (03H)
1	1	2	1 ← Number of characters

(Fig. 5.1-4)

(5) Negative acknowledgement

Header (15H)	Address	Error code	Checksum	Delimiter (03H)
1	1	1	2	1 ← Number of characters

(Fig. 5.1-5)

Header : Control code that represents the beginning of the command or response and ASCII is used.
Setting command, Reading command : (02H) fixed
Response with data, Acknowledgement : (06H) fixed
Negative acknowledgement : (15H) fixed

Address : Numbers with which a master discerns slaves.
Instrument number 0 to 94 (20H to 7EH) and **Global address** 95 (7FH)
The numbers are used by giving 20H of bias, because 00H to 1FH are used for control code.
95 (7FH) is called **Global address**, which is used when the same command is sent to all the slaves connected. However, the response is not returned.

Sub address : (20H) fixed

Command type : Code to discern Setting command (50H) and Reading command (20H)

Data item : Data classification for the command object
Composed of hexadecimal 4 digits (Refer to the Communication command table)

Data : The contents of Data (setting value) differ depending on the setting command
Composed of hexadecimal 4 digits (Refer to the Communication command table)

Checksum : 2-character data to detect communication errors

Delimiter : Control code to indicate the end of command (03H) fixed

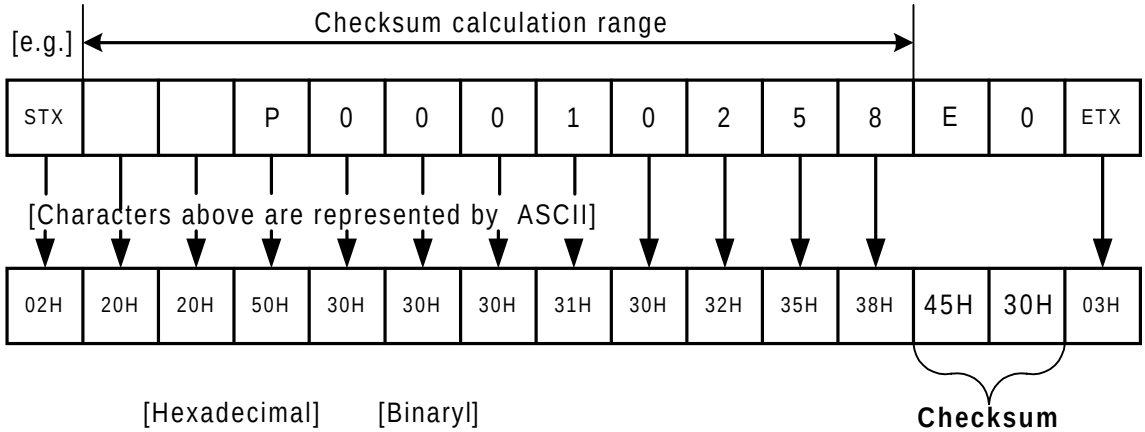
Error code : Indicates error type Composed of hexadecimal 1 digit
0 (30H)-----Unknown error
1 (31H)-----Non-existent command
3 (33H)-----Out of the setting value range
4 (34H)-----Status unable to set (e.g. AT is performing)

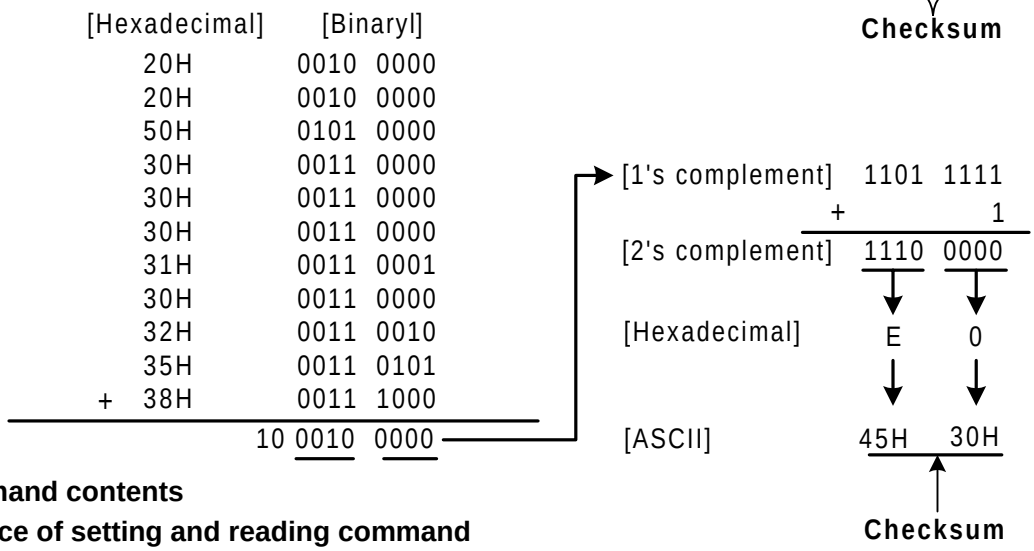
5 (35H)-----In setting mode by key operation

5.2 Checksum calculation

Checksum is used for detecting received command or data errors.
Make a program for the host computer side as well to calculate the checksum of the response data from the slaves so that the communication errors can be checked.
The checksum range is from the address (instrument number) up to the character before the checksum. Adding up all the character codes in the range, obtain 2's complement to the total value, and then describe it in hexadecimal number.
The lower 2-digit of the total value shown by the hexadecimal number is described by ASCII, that is checksum.

- **Checksum calculation example** for setting the Main setting value: 600℃ (0258H) with the Address (instrument number): 0 (20H) is shown as follows.
- 1's complement: Make each bit of binary 0 and 1 reverse.
- 2's complement: Add 1 to 1's complement.





5.3 Command contents

Notice of setting and reading command

- Possible to set the setting value by setting command of the communication function even if the setting value is locked
- Even if the option is not applied, it is possible to set it by the setting command, however, the contents of the command is ineffective.
- The setting value can be extended around 1,000,000 times before the memory expires. If the number of setting times exceeds the limit, it cannot memorize data. So frequent transmission via communication is not recommended.
- When connecting plural DCL-33A, instrument numbers (address) must not be duplicated.
- When sending a command by Global address [95 (7FH)], the same command is sent to all the slaves connected. However, the response is not returned.
- The instrument number and data transfer rate of the DCL-33A cannot be set by communication.

Setting command

• The settable range is the same as the one in the case of key operation.
Refer to the communication command table of this manual as for communication command.
• All commands are written in ASCII.
• The data (setting value) is converted from decimal to a hexadecimal number, and ASCII is used.
Negative numbers are represented by 2's complement. When the data (setting value) has a decimal point, use the whole number as response omitting decimal point.

Reading command

• All commands are written in ASCII.
• The data (setting value) is converted from decimal to hexadecimal number, and ASCII is used.
Negative number is represented by 2's complement. When the data (setting value) has a decimal point, it returns the whole number with the decimal point omitted.

6. Modbus protocol

6.1 Transmission mode

There are 2 transmission modes (ASCII mode and RTU mode) in Modbus protocol.

[ASCII mode]

Hexadecimal (0 to 9, A to F), which is divided to MSB (4-bit) and LSB (4-bit) out of 8-bit binary data in command is transmitted as ASCII characters.

Data structure
Start bit : 1 bit
Data bit : 7 bit
Parity bit : Even/ None/ Odd (Selectable)
Stop bit : 1 bit/ 2 bit (Selectable)
Error detection : LRC (Longitudinal redundancy check)
Data interval : 1 second or less

[RTU mode]

8 bit binary data in command is sent as it is.

Data structure
Start bit : 1 bit
Data bit : 8 bit
Parity bit : Even/ None/ Odd (Selectable)
Stop bit : 1 bit/2 bit (Selectable)
Error detection: CRC-16 (cyclic redundancy check)
Data interval : 3.5 character transmission time or less

6.2 Message configuration

ASCII mode message is configured to start by [: (colon)(3AH)] and end by [CR (carriage return) (0DH) + LF (Line feed)(0AH)]. (Fig. 6.2-1)

(Fig. 6.2-1)

Header (:)	Slave address	Function code	Data	Error check LRC	Delimiter (CR)	Delimiter (LF)

RTU mode is configured to start after idle time processing more than 3.5 character transmission time and end after idle time processing more than 3.5 character transmission time (Fig. 6.2-2)

(Fig. 6.2-2)

3.5 idle characters	Slave address	Function code	Data	Error check LRC	3.5 idle characters

6.3 Slave address

Slave address is set within the range 0 to 95 by the individual instrument number of slave side.
The master identifies slaves by the slave address of the requested message.
The slaves inform the master which slave is responding to the master adding their own slave address to the response message.
(Slave address 0, broadcast address can identify all the slaves. However slaves do not respond.)

6.4 Function code

The function code is the command code what action to take. (Table 6.4-1)

(Table 6.4-1)

Function code	Contents
03 (03H)	Reading setting value and information of slaves
06 (06H)	Setting to slaves

Function code is used as a pointer whether it is a normal response (acknowledgement) or an error

(negative acknowledgement) when the Slave returns responsive message to the Master.
When acknowledgement is returned, original function code is returned with its response.
When negative acknowledgement is returned, MSB of the original function code with 1 is returned.
(For example, when the Master sends request message setting 10H to function code by mistake, Slave returns 90H setting 1 to the MSB, because it is illegal function.)
For negative acknowledgement, abnormal code (Table 6.4-2) below is set to the data of response message and returned to the Maser in order to inform it that what kind of error has occurred.

(Table 6.4-2)

Abnormal code	Contents
1 (01H)	Illegal Function (Non-existent function)
2 (02H)	Illegal data address (Non-existent data address)
3 (03H)	Illegal data value (Value out of the setting range)
17 (11H)	Shinko error code 4 (Unsettable status)
18 (12H)	Shinko error code 5 (During setting by key operation mode, etc)

6.5 Data

Data differs depending on the function code.
A request message from master side is composed of data item, number of data and setting data
A response message is composed of number of bytes, data and abnormal code in negative acknowledgement from slave side. Effective range of data is -32768 to 32767 (8000H to 7FFFH).

6.6 Error check

Error check differs depending on the type of transmission mode.
[ASCII mode]
After calculating LRC (Longitudinal redundancy check) from slave address to data section, calculated 8-bit data is converted to ASCII 2 characters and they are added to the end of data.

How LRC is calculated,

(1) Create a message in RTU mode.
(2) Add the start data (slave address) to the end of data. --X
(3) Complement X (bit reverse). --X
(4) Add 1 (X=X+1)
(5) Add X as an LRC to the end of the message.
(6) Convert the whole data to ASCII characters.

[RTU mode]
After calculating CRC-16 (cyclic redundancy checksum) from slave address to data section, calculated 16-bit data is added to the end of data in the order of LSB and MSB

How CRC is calculated,

In the CRC system, the information to be transmitted is divided by a generating polynomial, the resulting remainder being added to the data. The generation polynomial is as follows.
($X^{16} + X^{15} + X^2 + 1$)
(1) Initialize the CRC-16 data (assumed as X) (FFFFH)
(2) Exclusive logical sum (EX-OR) between data 1 and X ⟶ X
(3) Shift X 1 bit to the right ⟶ X
(4) When a carry is generated, take A001H and EX-OR. If not, go to 5. ⟶ X
(5) Repeat (3) and (4) until shifting 8 times.
(6) EX-OR between the next data and X ⟶ X
(7) Same as (3) to (5).
(8) Repeat up to the last data.
(9) Create a message in the sequence from lower to upper orders of the calculated 16-bit data (X).

6.7 Message example

[ASCII mode]

(1) Reading of the instrument number (address) 1 and SV
- A request message from the master side

Header	Slave address	Function code	Data item	Number of data	Error check LRC	Delimiter
(:)	(01H)	(03H)	(0001H)	(0001H)	(FAH)	(CR ELF)
1	2	2	4	4	2	2 ← Number of characters

(Fig. 6.7-1)

• A response message from slave side in normal status (When SV=100℃)

Header	Slave address	Function code	Number of response bytes	Data	Error check	Delimiter
(:)	(01H)	(03H)	(02H)	(0064H)	(96H)	(CR ELF)
1	2	2	2	4	2	2 ← Number of characters

(Fig. 6.7-2)

• A response message from slave side in abnormal status (When data item is mistaken)

Header	Slave address	Function code	Abnormal code	Error check LRC	Delimiter
(F	(01H)	(83H)	(02H)	(7AH)	(CR EF)
1	2	2	2	2	2 ← Number of characters

(Fig. 6.7-3)

1 is set to the MSB of function code for response message in abnormal status. (83H)
An abnormal code (02H: Illegal data address) is returned as a content of error.

(2) Setting (Address 1, SV=100℃)

• A request message from master side

Header	Slave address	Function code	Data item	Data	Error check LRC	Delimiter
(F)	(01H)	(06H)	(0001H)	(0064H)	(94H)	(CR ELF)
1	2	2	4	4	2	2 ← Number of characters

(Fig. 6.7-4)

• A response message from slave side in normal status

Header	Slave address	Function code	Data item	Data	Error check LRC	Delimiter
(F)	(01H)	(06H)	(0001H)	(0064H)	(94H)	(CR ELF)
1	2	2	4	4	2	2 ← Number of characters

(Fig. 6.7-5)

• A response message from slave side in abnormal status
(When a value out of the setting range is set.)

Header	Slave address	Function code	Abnormal code	Error check LRC	Delimiter
(F	(01H)	(86H)	(03H)	(76H)	(CR EF)
,P	2	2	2	2	2 ← Number of characters

(Fig. 6.7-6)

1 is set to the MSB of function code for response message in abnormal status. (86H)
An abnormal code (03H: A value out of the setting range) is returned as a content of error.

[RTU mode]

(3) Reading (Address1, SV)

• Request message from the master side

3.5 idle character	Slave address	Function code	Data item	Number of data	Error check LRC	3.5 idle character
	(01H)	(03H)	(0001H)	(0001H)	(D5CAH)	
	1	1	2	2	2 ← Number of characters	

(Fig. 6.7-7)

• Response message of slave side in normal status (When SV=100℃)

3.5 idle character	Slave address	Function code	Number of response bytes	Data	Error check CRC	3.5 idle character
	(01H)	(03H)	(02H)	(0064H)	(B9AFH)	
	1	1	1	2	2 ← Number of characters	

(Fig. 6.7-8)

• Response message of slave in abnormal status (When data item is mistaken)

3.5 idle character	Slave address	Function code	Abnormal code	Error check CRC	3.5 idle character
	(01H)	(83H)	(02H)	(COF1H)	
	1	1	1	2 ← Number of characters	

(Fig. 6.7-9)

1 is set to the MSB of function code for response message in abnormal status. (83H)
An abnormal code (02H: Illegal data address) is returned as a content of error.

(4) Setting (Address 1, SV=100℃)

• Request message from master side

3.5 idle character	Slave address (01H)	Function code (06H)	Data item (0001H)	Data (0064H)	Error check CRC (D9E1H)	3.5 idle character
	1	1	2	2	2 ←	Number of characters

(Fig. 6.7-10)

• Response message of slave in normal status

3.5 idle character	Slave address (01H)	Function code (06H)	Data item (0001H)	Data (0064H)	Error check CRC (D9E1H)	3.5 idle character
	1	1	2	2	2 ←	Number of characters

(Fig. 6.7-11)

• Response message in abnormal status (When a value out of the setting range is set)

3.5 idle character	Slave address (01H)	Function code (86H)	Abnormal code (03H)	Error check CRC (0261H)	3.5 idle character
	1	1	1	2 ←	Number of characters

(Fig. 6.7-12)

1 is set to the MSB of function code for response message in abnormal status. (86H)
An abnormal code (03H: A value out of the setting range) is returned as an content of error.

7. Communication command table

When the data (setting value) has a decimal point, remove the decimal point and represent it as a whole number, then describe the whole number in hexadecimal number.

Shinko standard command type	Modbus function code	Data item	Data
20H/50H	03H/06H	0001H: SV	Setting value
20H/50H	03H/06H	0002H: Not used	
20H/50H	03H/06H	0003H: AT setting	0: Cancel 1: Perform
20H/50H	03H/06H	0004H: OUT proportional band setting	Setting value
20H/50H	03H/06H	0005H: Not used	
20H/50H	03H/06H	0006H: Integral time setting	Setting value
20H/50H	03H/06H	0007H: Derivative time setting	Setting value
20H/50H	03H/06H	0008H: OUT proportional cycle setting	Setting value
20H/50H	03H/06H	0009H: Not used	
20H/50H	03H/06H	000AH: Manual reset setting	Setting value
20H/50H	03H/06H	000BH: Alarm setting	Setting value
20H/50H	03H/06H	000CH: Not used	
⋮	⋮	⋮	
20H/50H	03H/06H	000EH: Not used	
20H/50H	03H/06H	000FH: Heater burnout alarm setting	Setting value
20H/50H	03H/06H	0010H: Loop break alarm time setting	Setting value
20H/50H	03H/06H	0011H: Loop break alarm span setting	Setting value
20H/50H	03H/06H	0012H: Setting value lock selection (*1)	0: Unlock 2: Lock 2 1: Lock 1 3: Lock 3
20H/50H	03H/06H	0013H: Not used	
20H/50H	03H/06H	0014H: Not used	
20H/50H	03H/06H	0015H: Sensor correction value setting	Setting value

20H/50H	03H/06H	0016H: Not used	
20H/50H	03H/06H	0017H: Not used	
20H/50H	03H/06H	0018H: Scaling high limit setting	Setting value
20H/50H	03H/06H	0019H: Scaling low limit setting	Setting value
20H/50H	03H/06H	001AH: Decimal point place selection	0: XXXX (No decimal point) 1: XXX.X(1 digit after decimal point) 2: XX.XX(2 digit after decimal point) 3: X.XXX(3 digit after decimal point))
20H/50H	03H/06H	001BH: PV filter time constant setting	Setting value
20H/50H	03H/06H	001CH: OUT high limit setting	Setting value
20H/50H	03H/06H	001DH: OUT low limit setting	Setting value
20H/50H	03H/06H	001EH: OUT ON/OFF action hysteresis setting	Setting value
20H/50H	03H/06H	001FH: Not used	
⋮	⋮	⋮	
20H/50H	03H/06H	0022H: Not used	
20H/50H	03H/06H	0023H: Alarm action type selection (*2)	0: No alarm action 1: High limit alarm 2: Low limit alarm 3: High/Low limits alarm 4: High/Low limit range alarm 5: Process high alarm 6: Process low alarm 7: High limit alarm w/standby 8: Low limit alarm w/standby 9: High/Low limits alarm w/standby
20H/50H	03H/06H	0024H: Not used	
20H/50H	03H/06H	0025H: Alarm action hysteresis setting	Setting value
20H/50H	03H/06H	0026H: Not used	
20H/50H	03H/06H	0027H: Not used	
20H/50H	03H/06H	0028H: Not used	
20H/50H	03H/06H	0029H: Alarm action delayed timer setting	Setting value
20H/50H	03H/06H	002AH: Not used	
⋮	⋮	⋮	
20H/50H	03H/06H	003FH: Not used	
20H/50H	03H/06H	0040H: Alarm action Energized/Deenergized	0: Energized 1: Deenergized
20H/50H	03H/06H	0041H: Not used	
20H/50H	03H/06H	0042H: Alarm HOLD function selection	0: Not HOLD 1: HOLD
20H/50H	03H/06H	0043H: Not used	

20H/50H	03H/06H	0044H: Input type selection	0: K [-200 to 1370℃] 1: K [-199.9 to 400.0℃] 2: J [-200 to 1000℃] 3: R [0 to 1760℃] 4: S [0 to 1760℃] 5: B [0 to 1820℃] 6: E [-200 to 800℃] 7: T [-199.9 to 400.0℃] 8: N [-200 to 1300℃] 9: PL-Ⅱ [0 to 1390℃] 10: C (W/Re5-26) [0 to 2315℃] 11: Pt100 [-199.9 to 850.0℃] 12: JPt100 [-199.9 to 500.0℃] 13: Pt100 [-200 to 850℃] 14: JPt100 [-200 to 500℃] 15: K [-320 to 2500℉] 16: K [-199.9 to 750.0℉] 17: J [-320 to 1800℉] 18: R [0 to 3200℉] 19: S [0 to 3200℉] 20: B [0 to 3300℉] 21: E [-320 to 1500℉] 22: T [-199.9 to 750.0℉] 23: N [-320 to 2300℉] 24: PL-Ⅱ [0 to 2500℉] 25: C (W/Re5-26) [0 to 4200℉] 26: Pt100 [-199.9 to 999.9℉] 27: JPt100 [-199.9 to 900.0℉] 28: Pt100 [-300 to 1500℉] 29: JPt100 [-300 to 900℉] 30: 4 to 20mA DC[-1999 to 9999] 31: 0 to 20mA DC[-1999 to 9999] 32: 0 to 1V DC [-1999 to 9999] 33: 0 to 5V DC [-1999 to 9999] 34: 1 to 5V DC [-1999 to 9999] 35: 0 to 10V DC [-1999 to 9999]
20H/50H	03H/06H	0045H: Direct/Reverse action selection	0: Heating (Reverse action) 1: Cooling (Direct action)
20H/50H	03H/06H	0046H: Not used	
20H/50H	03H/06H	0047H: AT bias setting	Setting value
20H/50H	03H/06H	0048H: ARW (anti reset windup) setting	Setting value
20H/50H	03H/06H	006FH: Key LOCK selection	0: Key enabled 1: LOCK
50H	06H	0070H: Key operation change flag clearing	0: No action 1: All clearing
20H	03H	0080H: PV (input) value reading	Present PV (input) value
20H	03H	0081H: MV (control output manipulated variable) reading	Present MV (control output manipulated variable) reading
20H	03H	0082H: Not used	
20H	03H	0083H: Not used	
20H	03H	0084H: Not used	
20H	03H	0085H: OUT status reading	0000 0000 0000 0000 2^{15} to 2^{0} 2^0 digit: OUT 0: OFF 1: ON 2^1 digit: Not used (Always 0) 2^2 digit: Alarm output 0: OFF 1: ON 2^3 digit: Not used (Always 0) 2^4 digit: Not used (Always 0) 2^5 digit: Not used (Always 0) 2^6 digit: Heater burnout alarm output

			0: OFF 1: ON (When sensor burnout, 0: OFF) 2^7 digit: Loop break alarm output 0: OFF 1: ON 2^8 digit: Overscale 0: OFF 1: ON 2^9 digit: Underscale 0: OFF 1: ON 2^{10} digit: Not used (Always 0) 2^{11} digit: AT is active 0: OFF 1: ON 2^{12} digit: Not used (Always 0) 2^{13} digit: Converter function 0: Controller 1: Converter 2^{14} digit: Not used (Always 0) 2^{15} digit: Key operation change 0: No 1: Yes
20H	03H	0086H: Not used	
20H	03H	0087H: Not used	
20H	03H	00A0H: Not used	
20H	03H	00A1H: Instrument info reading	0000 0000 0000 0000 2^{15} to 2^0 2^0 digit: Not used (Always 0) 2^1 digit: Not used (Always 0) 2^2 digit: Alarm function 0: No 1: Yes 2^3 digit: Not used (Always 0) 2^4 digit: Not used (Always 0) 2^5 digit: Not used (Always 0) 2^6 digit: Heater burnout alarm 0: No 1: Yes 2^7 digit: Loop break alarm 0: No 1: Yes 2^8 to 2^{15} digit: Not used(Always 0)

(*1) When Lock 3 is designated, the setting data is not saved in the memory.
This is why the setting value reverts to the one before Lock 3 when power is turned OFF.

(*2) When alarm action type is changed, the alarm setting values reverts to the one when this instrument is shipped and alarm output status is initialized too.

*** Notice**

When data setting is changed by key operation at the front panel of the instrument, the data that is related to the changed item is also changed automatically as shown the example 1 below. However, when the data setting is changed by communication function, the related data does not change as shown the example 2 below. (Only the changed data changes.)

(Example 1) Main setting value high limit: 1370℃
Main setting value : 1000℃

When the main setting value high limit is changed to 800℃ by key operation at the front panel of the instrument.

Both main setting value high limit and main setting value are changed to 800℃

(Example 2) Main setting value high limit: 1370℃
Main setting value : 1000℃

When the main setting value high limit is changed to 800℃ by communication function

Main setting value high limit is 800℃ but main setting value keeps the same temperature (1000℃)

8. Specifications

Communication	: Half-duplex
Data transfer rate	: 9600bps (2400, 4800, 9600, 19200bps) Selectable by key operation
Synchronous system	: Start-stop synchronous
Code form	: ASCII
Error correction	: Command request repeat system
Error detection	: Parity check, Checksum
Data format	Start bit: 1 Data bit: 7 Parity : Even Stop bit: 1

9. Troubleshooting

If any malfunction occurs, refer to the following items after checking the power supply to the host computer and the DCL-33A.

• Phenomenon: If it is unable to communicate,

Check the following
The connection or wiring of communication is not securely done.
Burnout or imperfect contact on the communication cable and the connector.
Data transfer rate of the DCL-33A coincides with that of the host computer.
Whether the data bit, parity and stop bit of the host computer accord with those of the DCL-33A.
The instrument number of the DCL-33A coincides with that of the command.
The instrument numbers are duplicated in multiple DCL-33A.
When communicating by RS-485 (option: C5) without IF-300-C5 (communication converter), make sure that the program is proper for the transmission timing.

• Phenomenon: Though it is able to communicate, 'NAK' is responded.

Check the following
The command code is surely existent or not.
Whether the setting command exceeds the setting range or not.
In the case of the situation being unable to set (such as AT of DCL-33A performing)
Whether the operation mode is under the setting mode by the key operation

• If you have any inquiries, please consult our agency or the shop where you purchased the unit.

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