



국가표경기관



KS A 9001
ISO 9001



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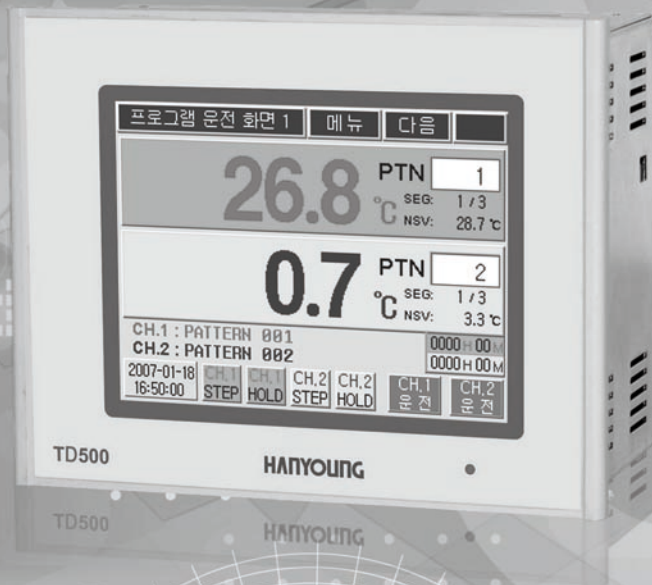
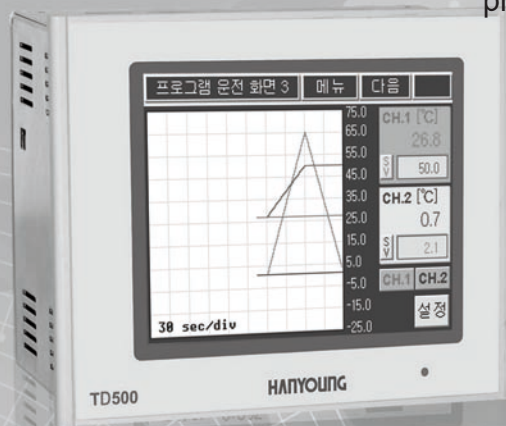
MA0402E080627

TD500

2 Channel Programmable Temperature Controller

MANUAL

We appreciate you for purchasing HanYoung NUX Co.,Ltd product. Before using the product you have purchased, check to make sure that it is exactly what you ordered. Then, please use it following the instructions below.



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CONTENTS

1 BEFORE STARTING	1.1 CHECKING PRODUCT 1.2 SAFETY INFORMATION
2 INSTALLATION INSTRUCTION	2.1 INSTALLATION PLACE AND CAUTION NOTICE 2.2 INSTALLATION METHOD 2.3 SUFFIX CODE 2.4 DIMENSIONS / PANEL CUTOUT AND TERMINAL ARRANGEMENT 2.5 TERMINAL ARRANGEMENT METHOD
3 SETTING AND OPERATION	3.1 INITIAL SCREEN 3.2 BASIC INPUT METHOD 3.3 NAMES OF EACH PART ON THE OPERATING SCREEN 3.4 RUNNING OF FIX-CONTROL 3.5 PROGRAM RUNNING 3.6 GRAPH DISPLAY AND SETTING 3.7 ERROR AND VARIOUS EVENT DISPLAY
4 DISPLAY	4.1 OPERATING SCREEN 4.2 SETTING SCREEN
5 FUNCTION SETTING	5.1 OPERATING METHOD SETTING 5.2 DATE/TIME RESERVATION SETTING 5.3 PROGRAM SETTING
6 SYSTEM SETTING	6.1 SENSOR TYPE SETTING 6.2 CONTROL & TRANSMISSION OUTPUT SETTING 6.3 INNER SIGNAL SETTING 6.4 ALARM SETTING 6.5 P.I.D SETTING 6.6 DIGITAL INPUT (D.I) SETTING 6.7 DIGITAL OUTPUT (D.O) SETTING 6.8 COMMUNICATION SETTING 6.9 OTHER SETTING
7 SPECIFICATION	7.1 INPUT 7.2 OUTPUT 7.3 FUNCTION 7.4 COMMUNICATION 7.5 POWER SUPPLY 7.6 OPERATION ENVIRONMENT 7.6 TRANSPORATION AND STORAGE CONDITIONS

1 Before starting

Thank you for the purchase of HANYOUNG 2 Loop Temperature Controller (Mod:TD500). This manual contains the function of product, install method, caution information and the way of using this controller. So please read this manual before using it. And also please make this manual to be delivered to the final user and to be placed where can be found and seen easily

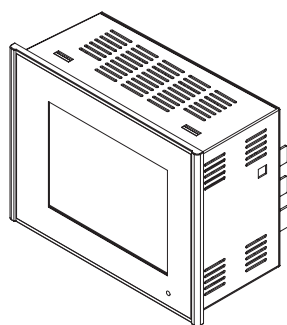
Contents of this user manual can be edited without prior notice for improvement and modification of the product

1.1 Checking product

After purchasing our product, please check if it is correct item you want. Also please check breakage on exterior and omission parts.

If it is a different controller which you want or you find omission parts, please contact our sales office.

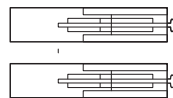
1.1.1 TD500



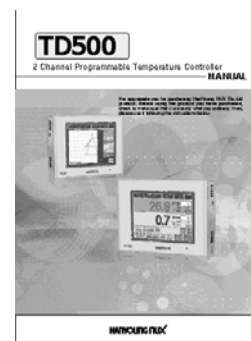
Unit body



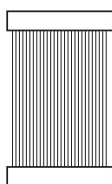
Resistance 250Ω x 2



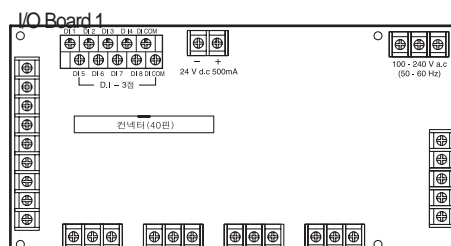
Fixing bracket



Manual



40p cable



1.2 Safety information

1.2.1. Safety notice

- For safety and security of the system that is connected to the product, please read and follow this manual carefully.
- We are not responsible for any damages and safety problems due to disregards of the manual or lack of care of the product.
- Please install any extra safety circuitry or other safety materials outside the product for safety of the program that is connected to the product.
- Do not disassemble, repair or reconstruct the product. It can cause electric shock, fire, and errors.
- Do not give impact to products. It can cause of damage or malfunction.

1.2.2 Quality guarantee

- Unless it is included company's conditions for warrantee, we are not responsible for any warranties or guarantees.
- We are not responsible for any damages and indirect loss of the use or third person due to unpredicted natural disasters.

1.2.3 Quality guarantee conditions of product

- The warranty for this product is valid for 1 year from purchase, and we will fix any breakdowns and faults from proper uses as it is mentioned in this manual for free.
- After the warranty period, repair will be charged according to our standard policies.
- Under following conditions, repair will be charged even during warranty period.
 - Breakdowns due to user's misuses
 - Breakdowns due to natural disasters
 - Breakdowns due to moving the product after installation
 - Breakdowns due to modification of the product
 - Breakdowns due to power troubles
- Please call our customer service for A/S due to breakdowns.

2 Installation method

This is information for installation place and method of TD500 (2 loop temperature controller). So please read it before installation.

2.1 Installation place and caution notice

2.1.1 Installation place

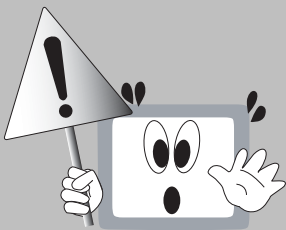
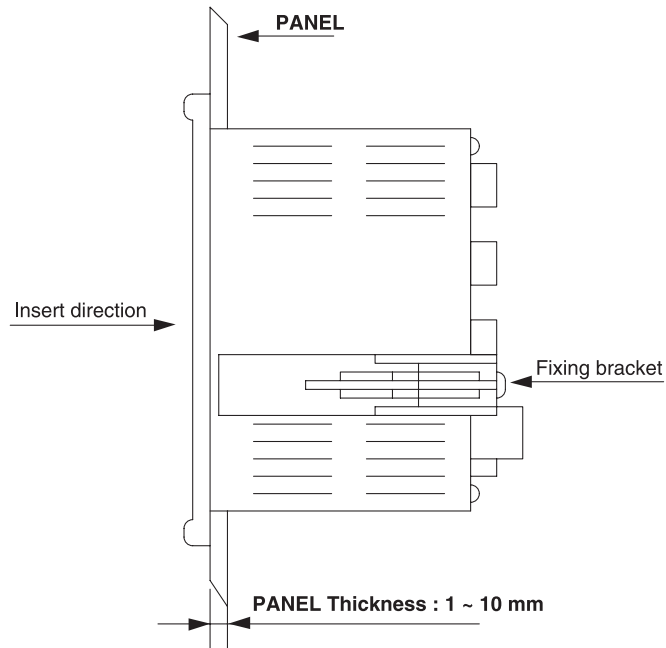
- To avoid electric shock, please use it after installation to panel
- Please avoid installing the product for following places where
 - People can touch terminal unconsciously
 - Directly exposed to the mechanical vibration or impact
 - Exposed to the corrosive gas or combustible gas
 - It is exposed to mechanical shock or vibration
 - Danger of corrosion or combustion of gas exist
 - Temperature changes too frequently
 - Temperature is either too high or too low
 - It is exposed to direct rays
 - It is exposed to electromagnetic waves too much
 - Humid place
 - It has many combustible objects
 - It has dusts and salinity

2.1.2 Caution

- The case of this controller is chrome–zinc plating and Bezel is made by ABS/PC anti–combustion material but please not install it to the inflammable place. Especially please do not put it on the inflammable products.
- Please keep it away from the machine or wires that can be cause of noise. Especially, please have enough warm–up when you operate it under 10°C temperature.
- Please install it on horizontally
- When you wire it, please cut out all of electric power.
- This controller is operating in 100 – 240 V a.c, 50–60 Hz without additional change. If you use other voltage, it may cause of fire and electric shock.
- Do not operate controller with wet hand, it may cause of electric shock.
- Please follow Safety Information to prevent any fire, electric shock and any damage.
- Please follow this manual for install and operation of this controller.
- When you put to earth, please refer to install method. But do not it earth to gas pipes, phone lines and lightning rods
- Please do not turn on power until you install all of parts
- Please do not block ventilating windows. It may cause of break down.
- The grade of over voltage is Catalogue II and using environment is Degree II

2.2 Installation method

- (1) Please use 1mm~10mm thickness of a steel sheet for panel.
- (2) In front of panel, please push into TD500 temperature controller
- (3) Using fixing bracket, please adhere controller to the panel
- (4) If you tighten it up by fixing iron to panel, it can be cause break of case or fixing bracket.



Caution

- To prevent electric shock, please check 'turn off power'
- Before turn on power, please connect over the third class grounding.
- During retransmission, it may cause electric shock so please do not touch terminal.
- Please wire it after turn off main power
- Please contact around 2A fuse to main electronic power line.

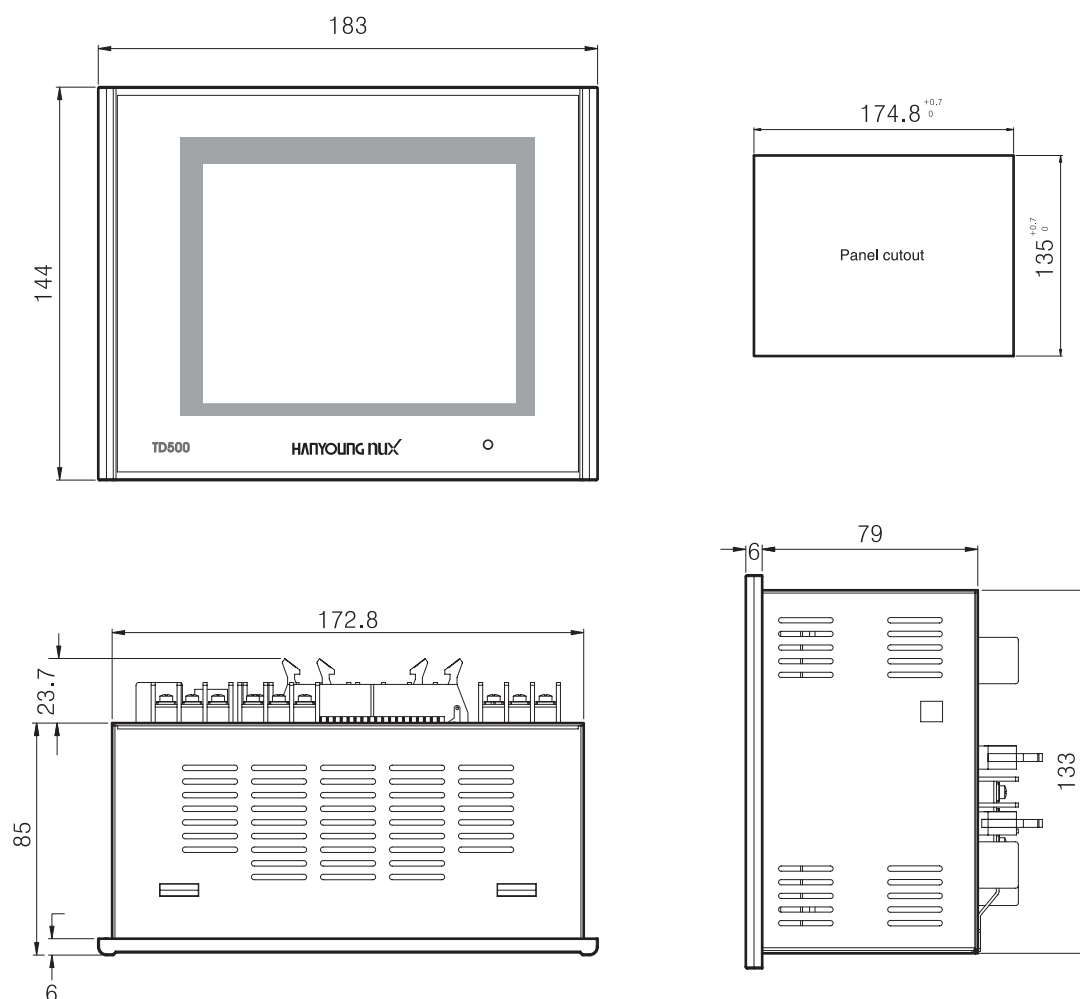
2.3 Suffix Code

MODEL	CODE	DESCRIPTION
TD500	□ □	2 LOOP PROGRAMMABLE TEMPERATURE CONTROLLER
BODY (SEPARA TYPE)	N	NONE
	1	SEPARATE BODY(RS422/485 + USB)
	2	SEPARATE BODY(RS232C + USB)
BODY(UNIT)	3	UNIT BODY(RS422/485 + USB), I/O TERMINAL BUILT-IN
	4	UNIT BODY(RS232C + USB), I/O TERMINAL BUILT-IN
I/O BOARD	N	NO I/O BOARD
	1	SEPARATE TYPE I/O BOARD

2.4 Dimensions / Panel cutout and Terminal arrangement

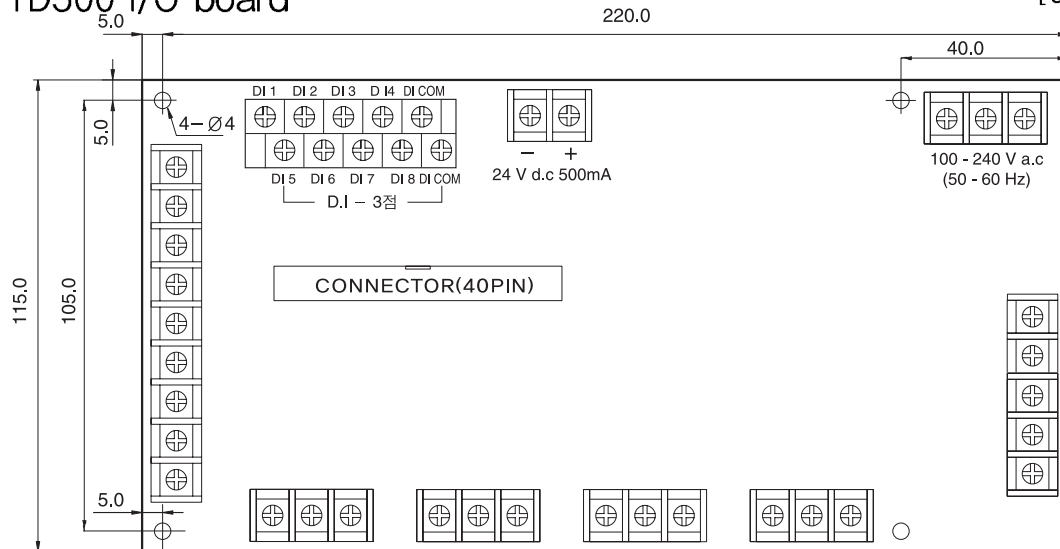
2.4.1. TD500 Unit body

[unit: mm]

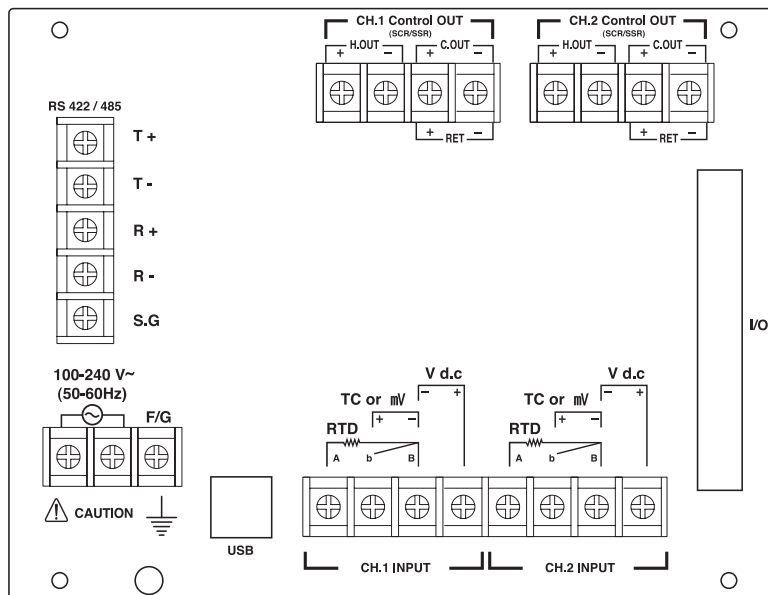


2.4.2 TD500 I/O board

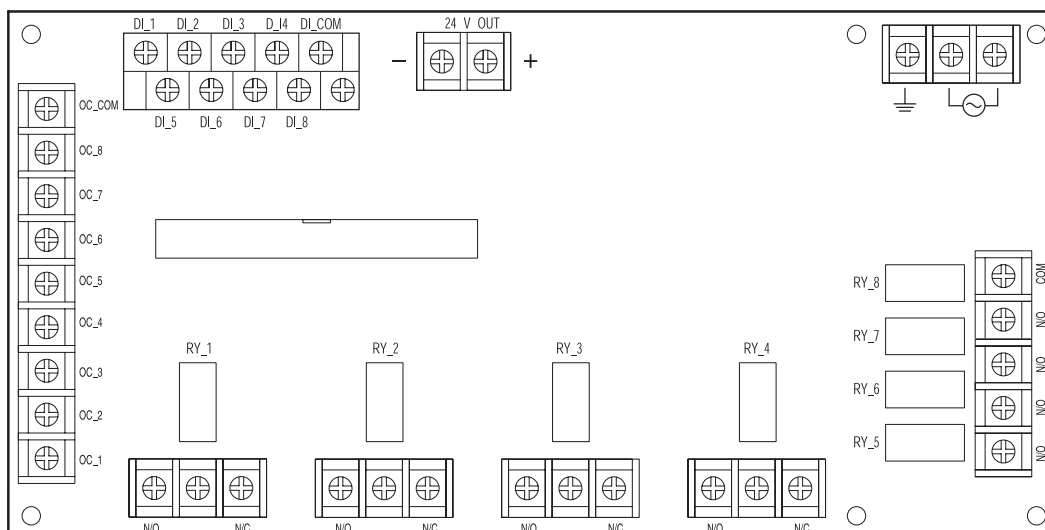
[unit: mm]



2.4.3. TD500 Body terminal arrangement



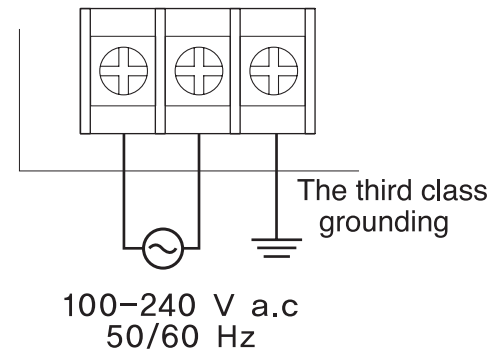
2.4.3. TD500 I/O Board terminal arrangement




2.5 Terminal arrangement method

2.5.1 Power

- Grounding needs over 2mm² wire and at least the third class grounding connection (Grounding resistance below 100Ω). Grounding cable should be within 20meters.

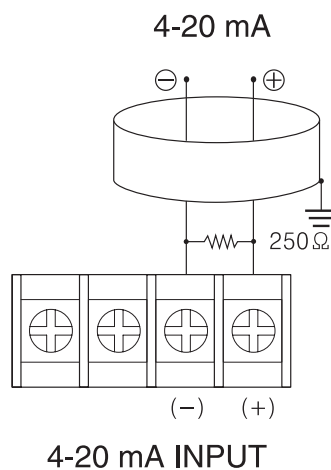
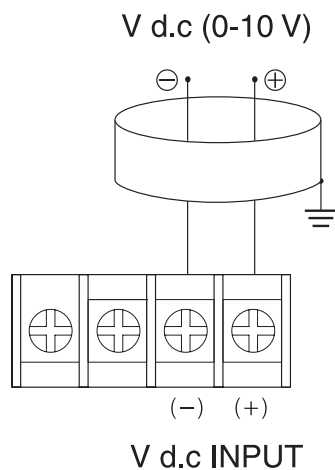
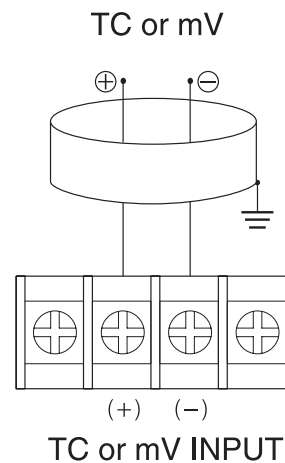
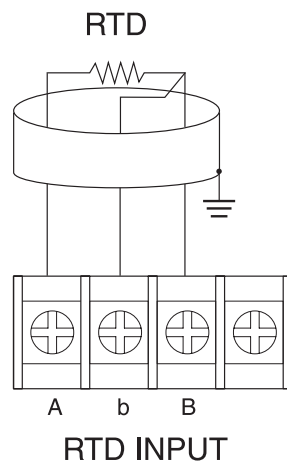


2.5.2 Sensor Input

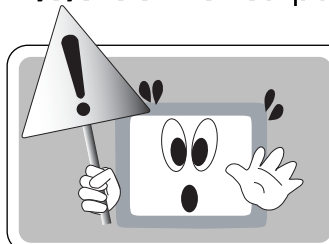


Caution

- Please use input wire with shield. And the shield needs to have 1 point grounding.
- Please leave a space for Sensor line against power line or grounding line.

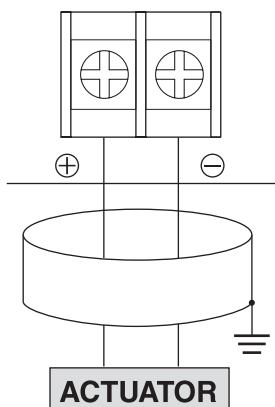


2.5.3 Control output and retransmission arrangement



Caution

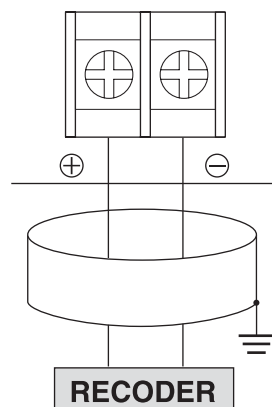
- Please pay attention about output polarity when you wire
- Please use shield line for output line. And shield needs 1 point ground.



CH.1 or CH.2 Control OUT

SCR : 4-20 mA d.c Max. 600 Ω

SSR : 24 V d.c PULSE, Min. 600 Ω

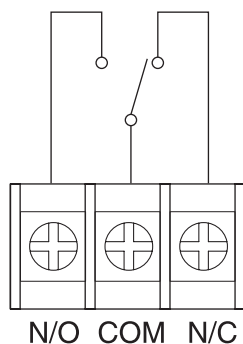


CH.1 or CH.2 RET OUT

4-20 mA d.c Max. 600 Ω

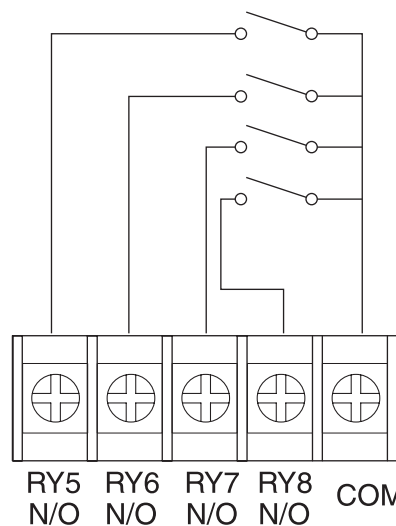
2.5.4 Relay out

RY 1 ~ 4



N/O : 30 V d.c 5 A, 250 V a.c 5 A

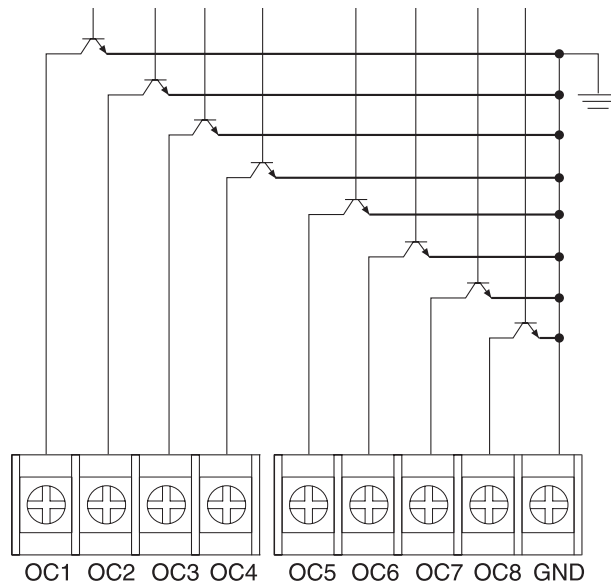
N/C : 30 V d.c 1A, 250 V a.c 5 A



N/O : 30 V d.c 5 A, 250 V a.c 5 A

2.5.5 Transistor (O/C) output

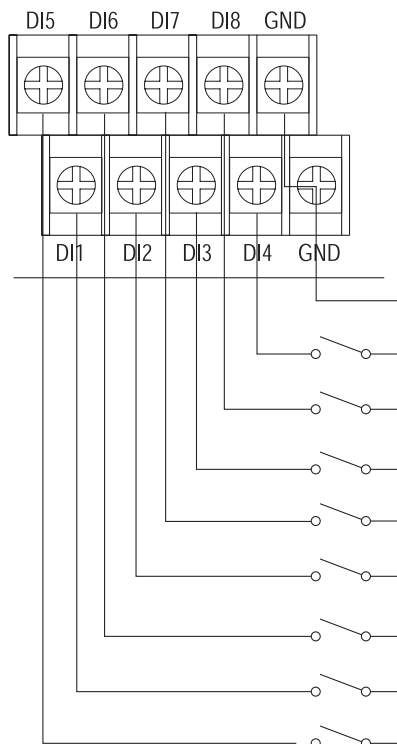
OPEN COLLECTOR (1~8) OUT



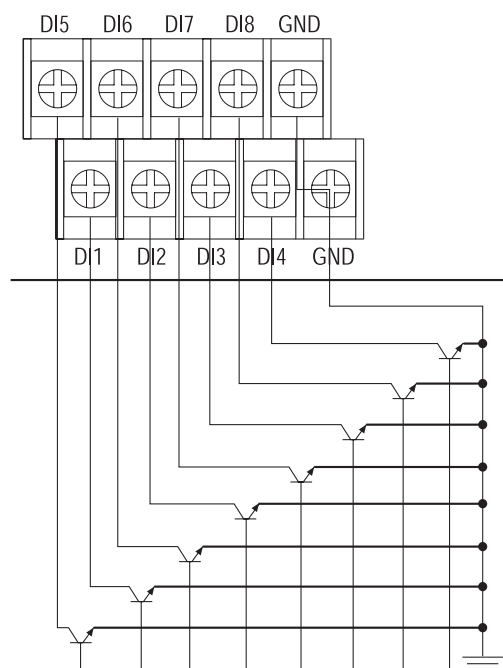
Max. 24 V, 100 mA SINK

2.5.6 Contact input

EXTERNAL CONTACT INPUT(DI 1 ~ 8)



TRANSISTOR INPUT (DI 1 ~ 8)



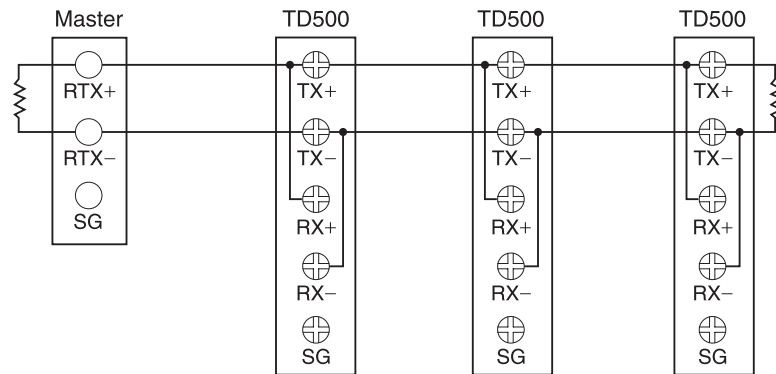
2.5.7 Communication arrangement

- RS422/RS485 arrangement

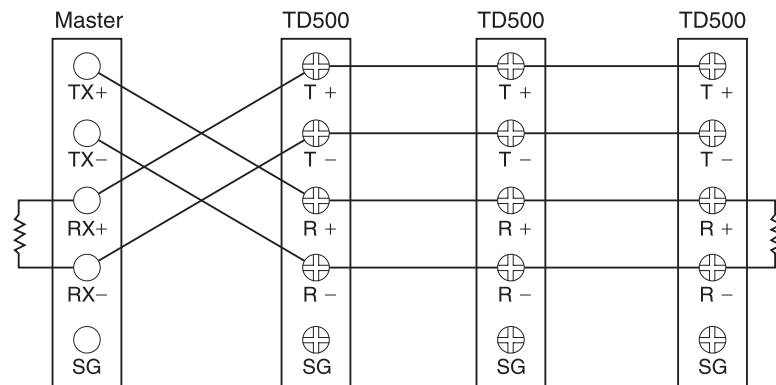
TD500 can contact maximum 256 machines.

Please contact Terminating Resistance ($100 \sim 200 \Omega$ 1/2 W) to the both of ends for communication lines.

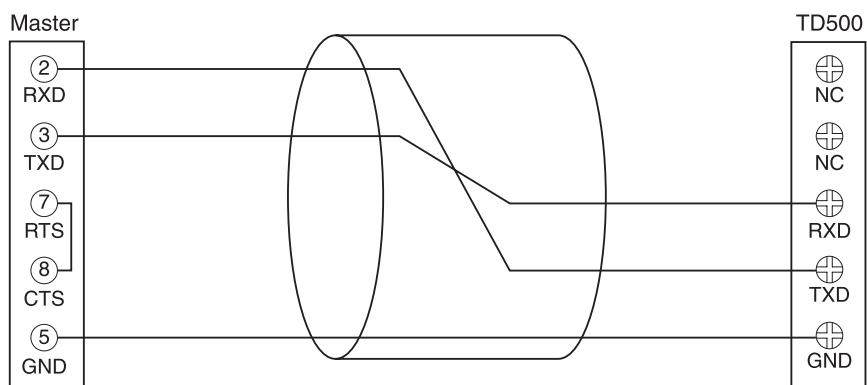
RS485 Connection(2Wires)



RS422 Connection(4Wires)



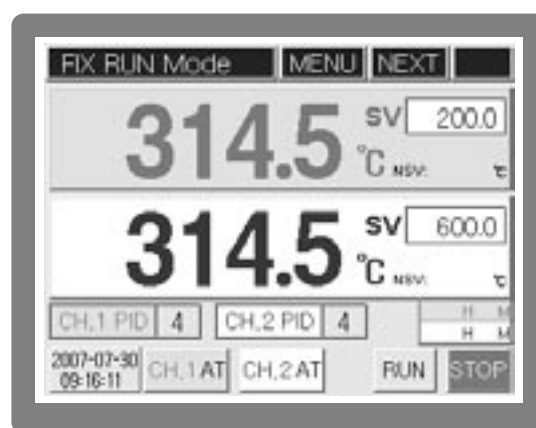
- RS232 arrangement



3 Setting and Operation




3.1 Initial screen

When the power is turned on after installation, the logo screen is indicated for 3 seconds, after which the first operation screen is shown. (Logo screen can be changed by the user through communication functionality.)



3.2 Basic input method

[Table 1]

	Name	Function
	Selection Button	Button selected by the need of the users. When pressed, the button is reversed, and the corresponding operation is selected while the button is being released.
	Activation Input Box	Window to set various settings needed by the users. When pressed, the corresponding range of numbers or characters input window appears, and the needed value is to be pressed.
	Deactivation Input Box	Although it's an input window, depending on the current condition or status, this window is deactivated. When the condition is met, it is converted to an activated input window.

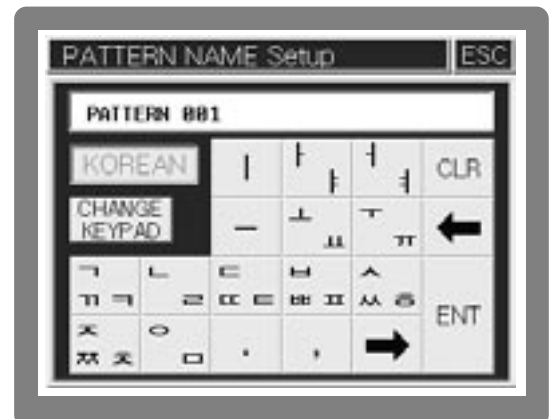
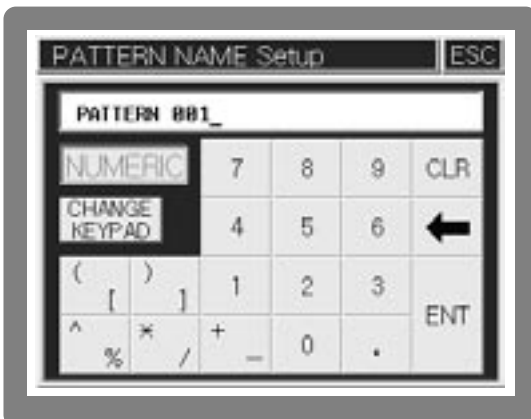
3.2.1 Numerical Input Window

Positive and real numbers can be inputted at the basic number input window. On the top left, the 'input area' and 'max/min value' are indicated, and the current input value is indicated on the number board's indication box. The input number is inputted when the **ENT** button is pressed, and if **ESC** is pressed beforehand, the current input is cancelled.

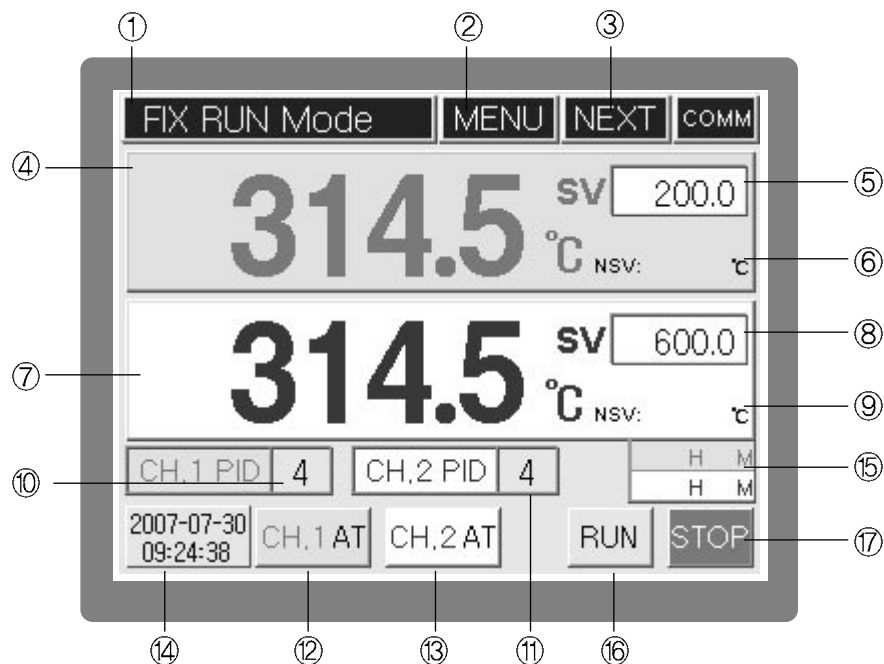


3.2.2 Character Input Window (Korean/English/Numeric Character)

Character input is possible. It is shown when setting the pattern name, contact input (D.I) name and etc. Korean/English/Numeric Character conversion is possible by using the keyboard conversion button.

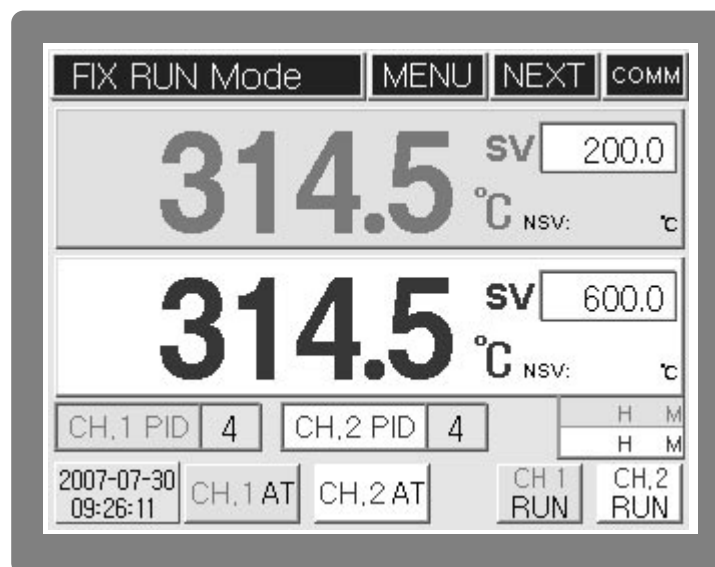


3.3 Name of operation screen

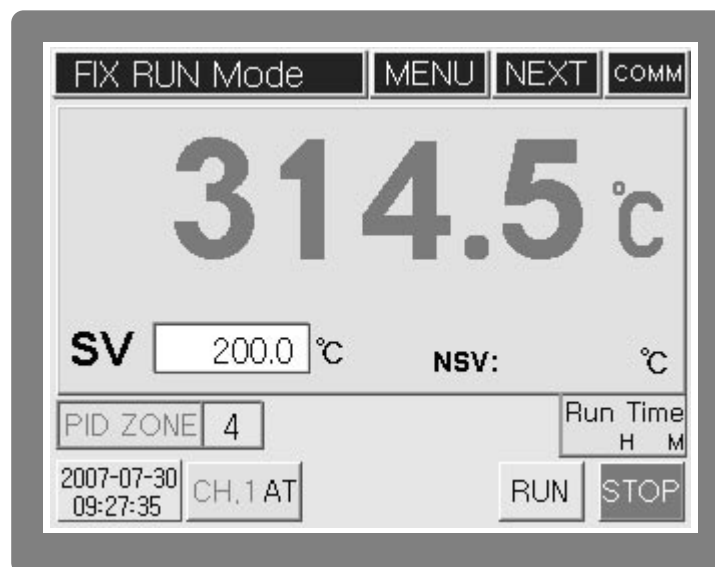


(1st Screen for Fixed Control Operation, 2 channel simultaneous operation mode)

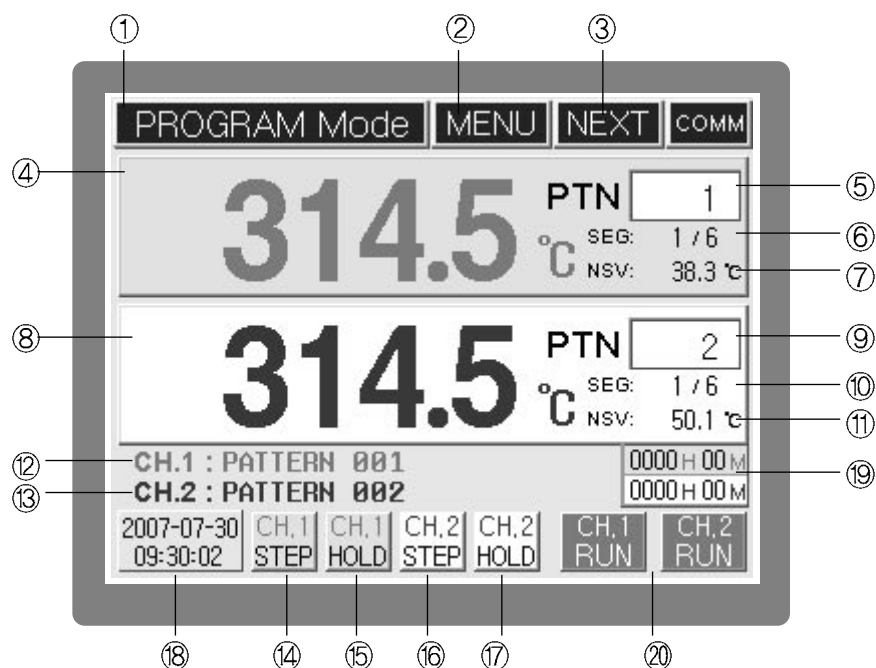
1. Current screen information
2. Menu button for function setting
3. Conversion button to next screen
4. CH.1 Process Value(PV) display
5. CH.1 Target Set Value(TSV) input box
6. CH.1 Current target set value display
7. CH.2 Process Value(PV) display
8. CH.2 Target Set Value(TSV) input box
9. CH.2 Current target set value display
10. CH.1 PID zone input box
11. CH.2 PID zone input box
12. CH.1 AT button
13. CH.2 A.T button
14. Current Date / Time display
15. Operation progress time
16. Operation Start button
17. Operation Stop button



(1st Screen for Fixed Control Operation, 2 channel separate operation mode)

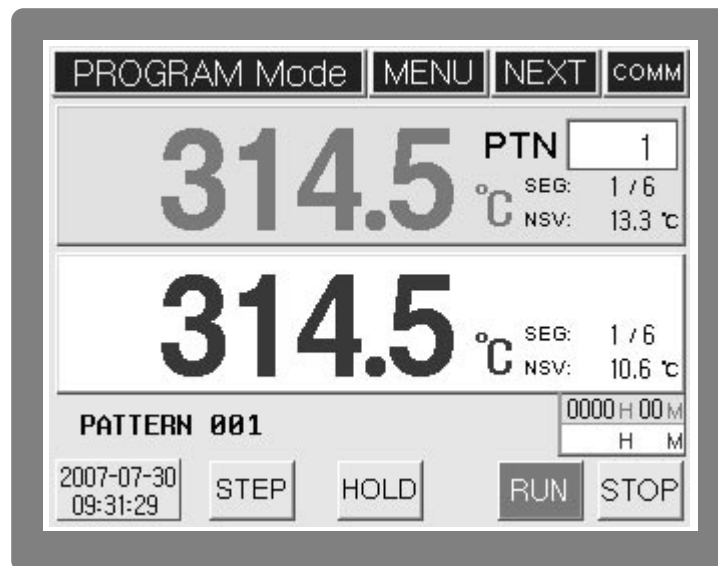


(1st Screen for Fixed Control Operation, 1 channel operation mode)

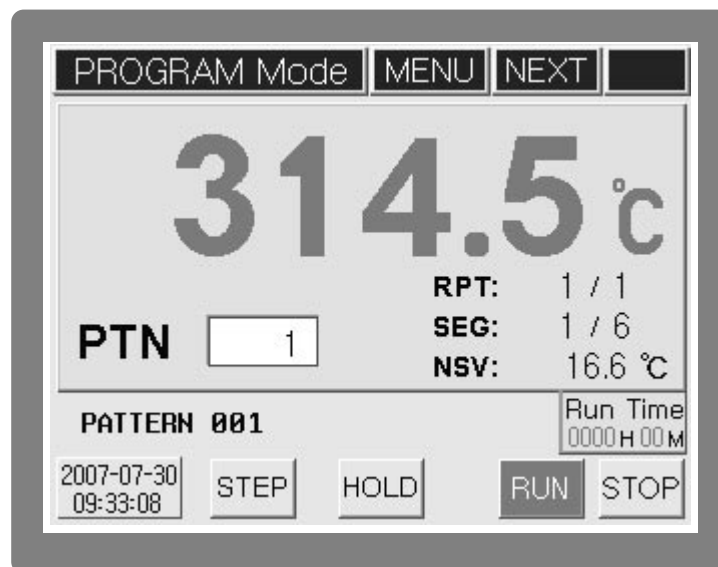


(1st Screen for Program Operation, 2 channel separate operation mode)

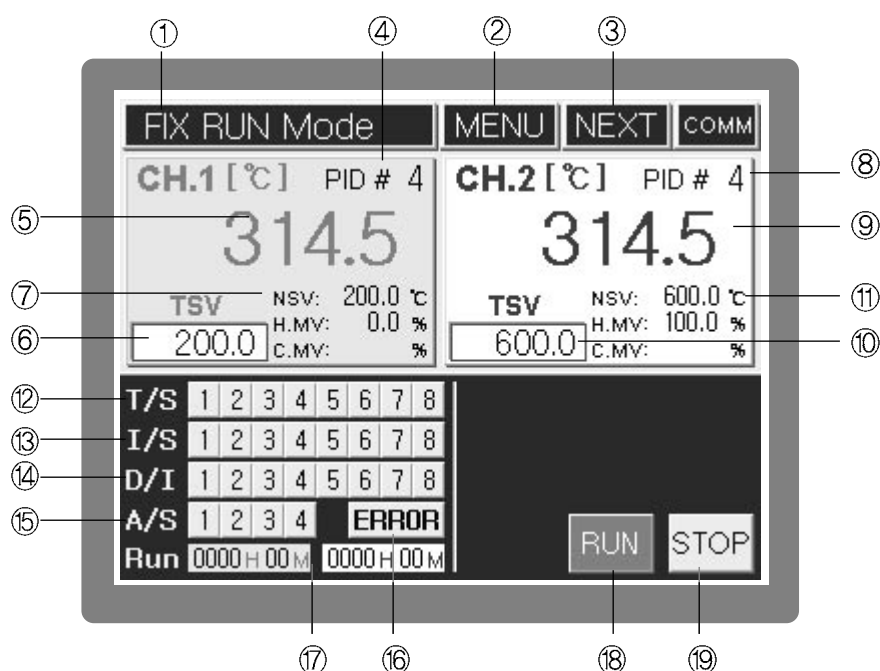
1. Current screen information
2. Menu button for function setting
3. Conversion button to next screen (Move to 2nd operation screen)
4. CH.1 Process Value(PV) display
5. CH.1 Operation Pattern input box
6. CH.1 Operation Pattern Segment information (Current segment number / Total segment number of pattern)
7. CH.1 Current target set value display
8. CH.2 Process Value(PV) display
9. CH.2 Operation Pattern input box
10. CH.1 Operation Pattern Segment information (Current segment number / Total segment number of pattern)
11. CH.2 Current target set value display
12. CH.1 Operation pattern name
13. CH.2 Operation pattern name
14. CH.1 Step button
15. CH.1 Hold button
16. CH.2 Step button
17. CH.2 Hold button
18. Current Date / Time display
19. Operation progress time
20. CH.1, CH.2 Operation button



(1st Screen for Program Operation, 2 channel simultaneous operation mode)

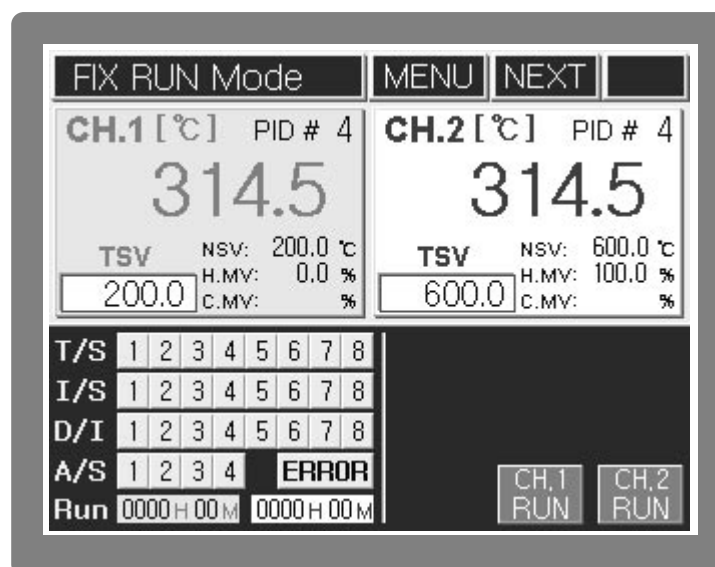


(1st Screen for Program Operation, 1 channel operation mode)

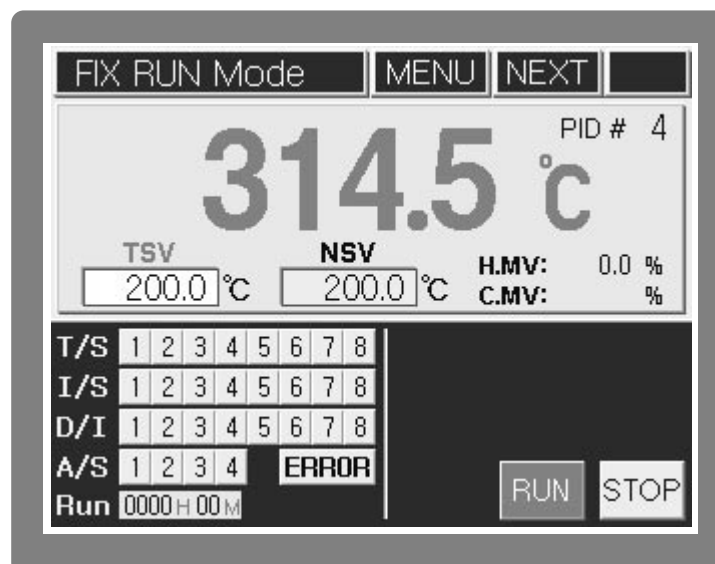


(2nd Screen for Fixed Control Operation, 2 channel simultaneous operation mode)

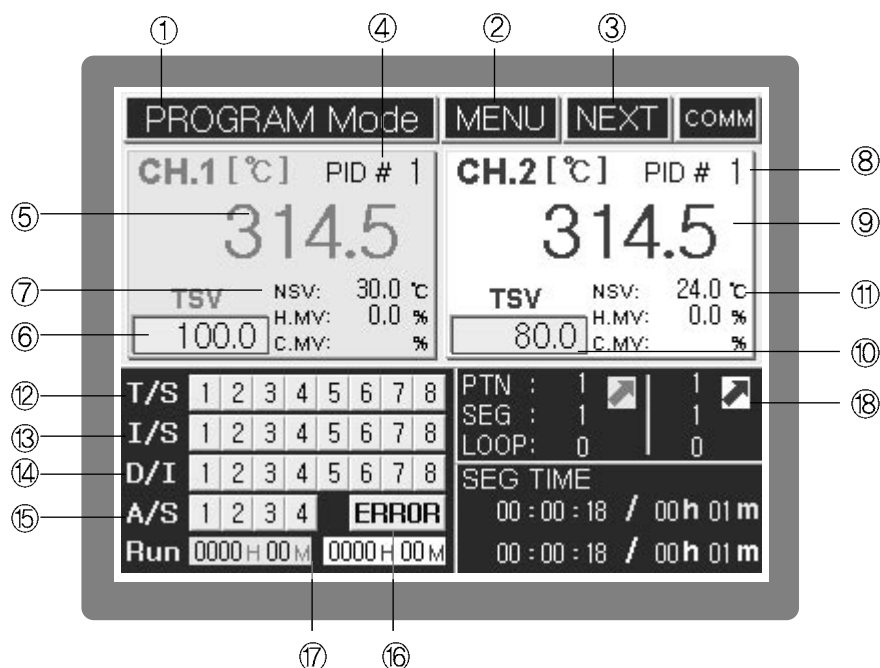
1. Current screen information
2. Menu button for function setting
3. Conversion button to next screen (Move to 3rd operation screen)
4. CH.1 P. I. D zone display
5. CH.1 Process Value(PV) display
6. CH.1 Target Set Value(TSV) input box
7. CH.1 Current target set value display and Control output value (H.MV, C.MV)
8. CH.2 P. I. D zone display
9. CH.2 Process Value(PV) display
10. CH.2 Target Set Value(TSV) input box
11. CH.2 Current target set value display and Control output value (H.MV, C.MV)
12. Time signal status display
13. Inner signal status display
14. Contact input status display
15. Alarm status display
16. Error status display / Confirmation button
17. Operation progress time display
18. Operation Start button
19. Operation Stop button



(2nd Screen for Fixed Control Operation, 2 channel separate operation mode)

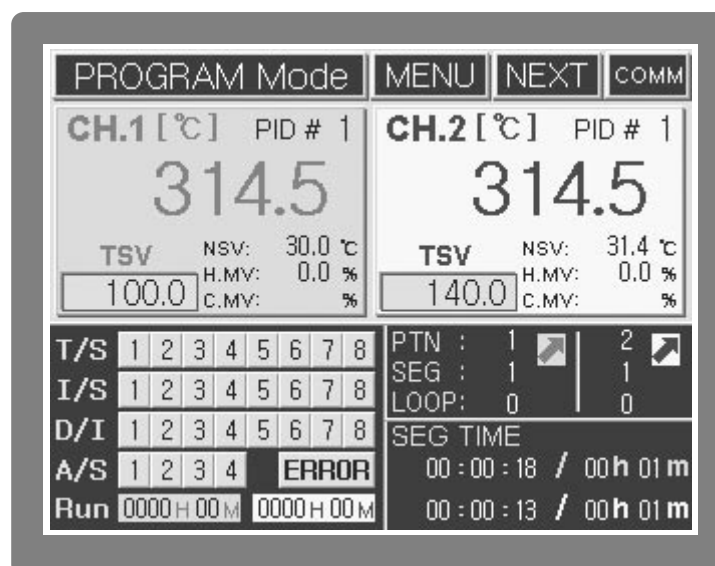


(2nd Screen for Fixed Control Operation, 1 channel operation mode)

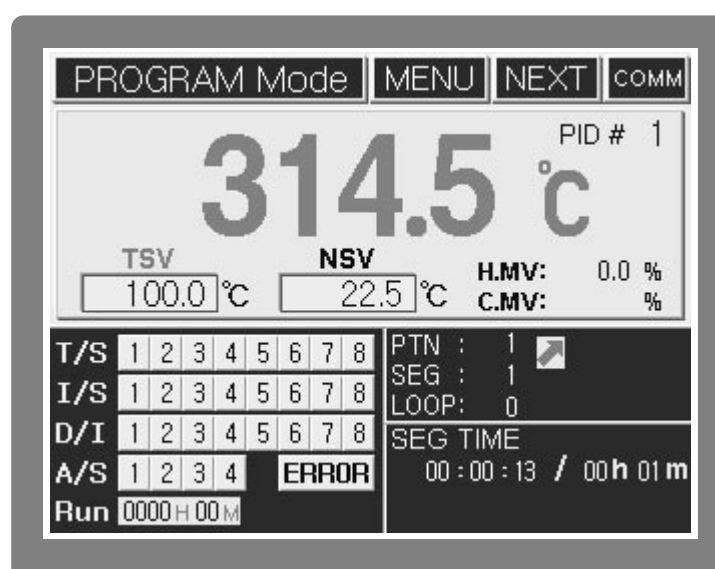


(2nd Screen for Program Operation, 2 channel simultaneous operation mode)

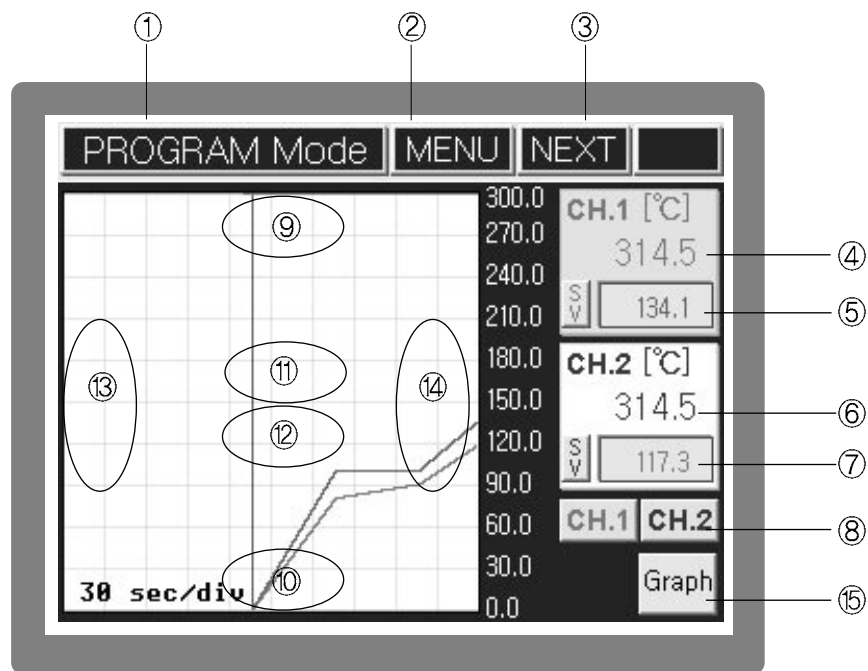
1. Current screen information
2. Menu button for function setting
3. Conversion button to next screen (Move to 3rd operation screen)
4. CH.1 P. I. D zone display
5. CH.1 Process Value(PV) display
6. CH.1 Target Set Value(TSV) display
7. CH.1 Current target set value display and Control output value (H.MV, C.MV)
8. CH.2 P. I. D zone display
9. CH.2 Process Value(PV) display
10. CH.2 Target Set Value(TSV) display
11. CH.2 Current target set value display and Control output value (H.MV, C.MV)
12. Time signal status display
13. Inner signal status display
14. Contact input status display
15. Alarm status display
16. Error status display / Confirmation button
17. Operation progress time display
18. Program operation status display for each channel



(2nd Screen for Program Operation, 2 channel separate operation mode)

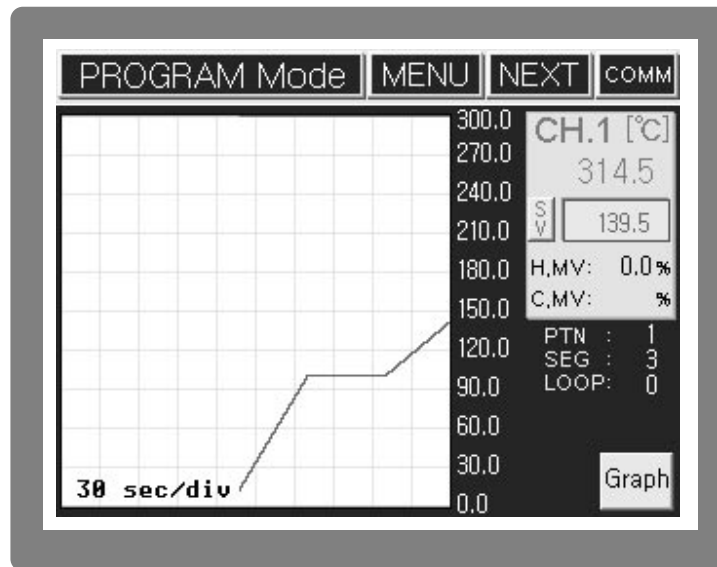


(2nd Screen for Program Operation, 1 channel operation mode)



(3rd Screen for Program Operation, 2 channels operation mode)

1. Current screen information
2. Menu button for function setting
3. Conversion button to next screen (Move to 1st operation screen)
4. CH.1 Process Value(PV) display
5. CH.1 Target Set Value(TSV) display
6. CH.2 Process Value(PV) display
7. CH.2 Target Set Value(TSV) display
8. Channel selection button
9. Hidden button for lifting screen
10. Hidden button for descending screen
11. Hidden button for magnifying screen
12. Hidden button for reducing screen
13. Hidden button for descending screen
14. Hidden button for increasing time axis
16. Button for moving to graph setting menu

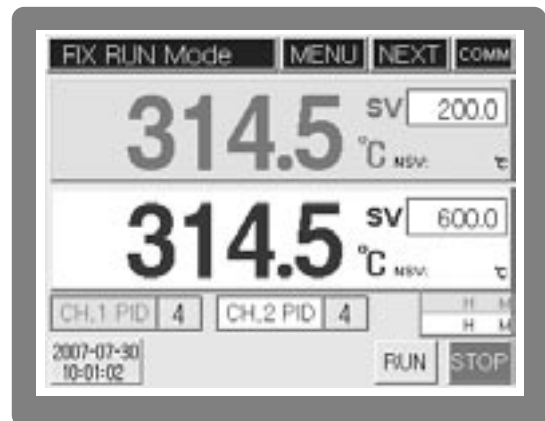


(3rd Screen for Program Operation, 1 channels operation mode)

3.4 Fixed Control Operation

Fixed Control Operation controls the temperature at certain set value (SV).

3.4.1 Select Fixed Control Operation



(1st Fixed Control Operation Screen)

- Start Operation: After inputting the set value (SV) for each channel at Fixed Control Operation Screen, when [RUN] is pressed, the operation commences after verification. LED light flashes to indicate that it's in operation at this time. (At the operation mode of each channel, the RUN button is in toggle form).
- Stop Operation: When [STOP] button is pressed during operation, the operation stops after verification.

When selecting the Fixed Control or the program, pressing the [MENU] button (in stop mode) displays the screen for function setup menu.

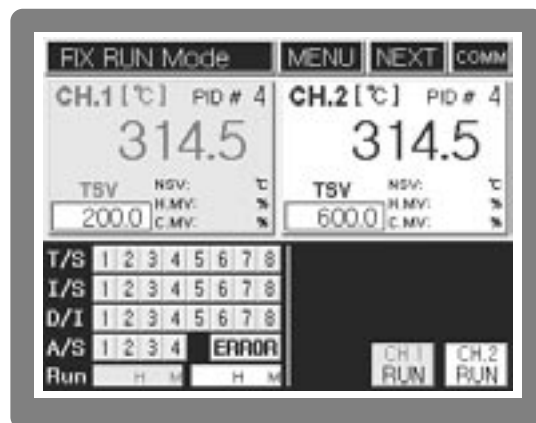
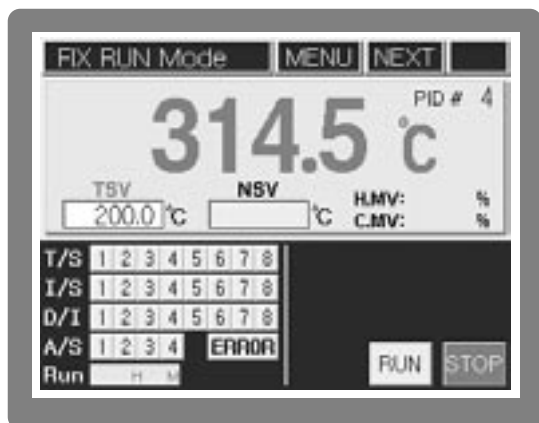
Press [RUN SETTIN] button on this screen to move to RUN SETUP1 screen, then make selection in RUN METHOD.

During fixed control operation, if the set value (SV) is altered, the applied PID GAIN is automatically adjusted according to the set value. At automatic selection setting, if a certain PID GAIN value needs to be used, after setting the PID ZONE selection to manual, input the PID ZONE numbers directly.

(When setting up this product for the first time, the PID GAIN must be set for each zone, and in order to do this, the auto tuning procedure must be performed. At this time, the PID menu must be set, for A/T button to appear on the screen. Also, the auto tuning is possible only at fixed control operation mode. When auto tuning is finished for each zone, it is advisable to make adjustment, so A/T button is not displayed on the operation screen).

3.4.2 screen 2 for Fixed Control Operation

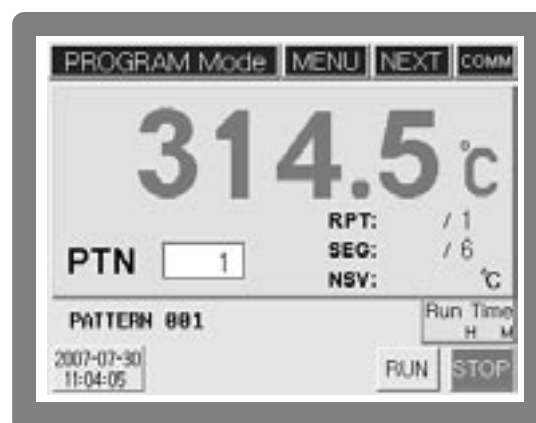
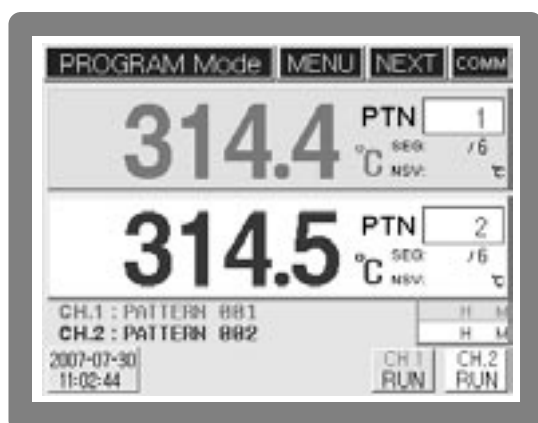
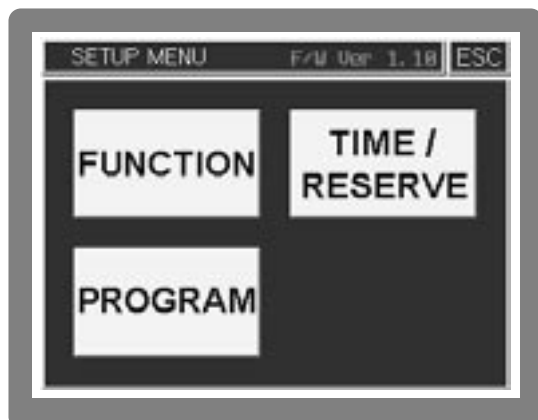
The status for each signal is shown on screen 2 of fixed control operation.



3.5 Program Control Operation

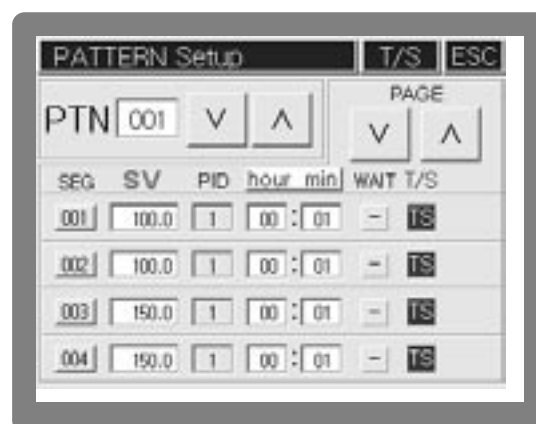
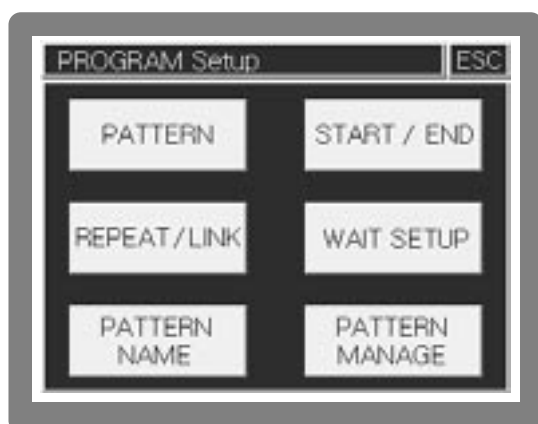
The program control operation is the operation that changes the intended value (SV) with time and achieving the wanted pattern of operation. The user pre-programs the wanted operation pattern, and when running, the pattern number is selected, and starts to run at program mode.

3.5.1 Select Program Control Operation



In order to run on program control, press [MENU] on the operation screen (while stopped) to enter the MENU screen. Then press [RUN MODE] to enter the operation selection screen, and select the operation to [PROGRAM].

3.5.2 Program Setup



PATTERN Setup [T/S] [ESC]

PTN [001] [V] [^] PAGE [V] [^]

SEG	SV	PID	hour	min	WAIT	T/S
001	100.0	1	00	01	-	TS
002	100.0	1	00	01	-	TS
003	150.0	1	00	01	-	TS
004	150.0	1	00	01	-	TS

PATTERN Setup [T/S] [ESC]

PTN [001] [V] [^] PAGE [V] [^]

SEG	SV	PID	hour	min	Time Signal
001	100.0	1	00	01	1 2 3 4 5 6 7 8
002	100.0	1	00	01	1 2 3 4 5 6 7 8
003	150.0	1	00	01	1 2 3 4 5 6 7 8
004	150.0	1	00	01	1 2 3 4 5 6 7 8

(When setting operation mode or 1 channel usage mode for each channel)

PATTERN Setup [T/S] [ESC]

PTN [001] [V] [^] PAGE [V] [^]

SEG	SV 1	SV 2	hour	min	WAIT	T/S
001	100.0	00.0	00	01	-	TS
002	100.0	90.0	00	01	-	TS
003	150.0	130.0	00	01	-	TS
004	150.0	140.0	00	01	-	TS

PATTERN Setup [T/S] [ESC]

PTN [001] [V] [^] PAGE [V] [^]

SEG	SV 1	SV 2	hour	min	Time Signal
001	100.0	00.0	00	01	1 2 3 4 5 6 7 8
002	100.0	90.0	00	01	1 2 3 4 5 6 7 8
003	150.0	130.0	00	01	1 2 3 4 5 6 7 8
004	150.0	140.0	00	01	1 2 3 4 5 6 7 8

(When setting simultaneous operation mode for each channel)

PATTERN Repeat/Link Setup [ESC]

PTN [001] [V] [^] REPEAT [001] LINK PTN [---]

LOOP	Start SEG	End SEG	REPEAT
01	001	002	002
02	003	004	010
03			
04			

PAGE [V] [^]

WAIT Setup [ESC]

PTN [001] [V] [^]

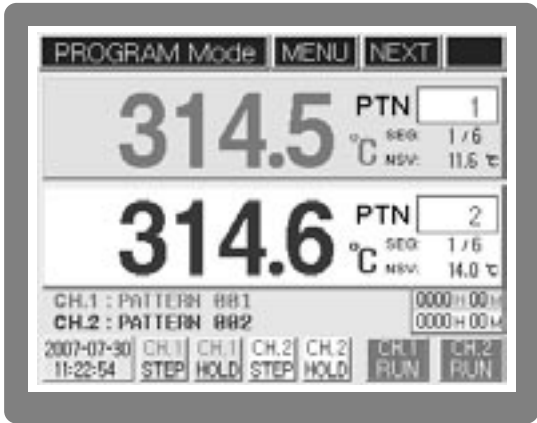
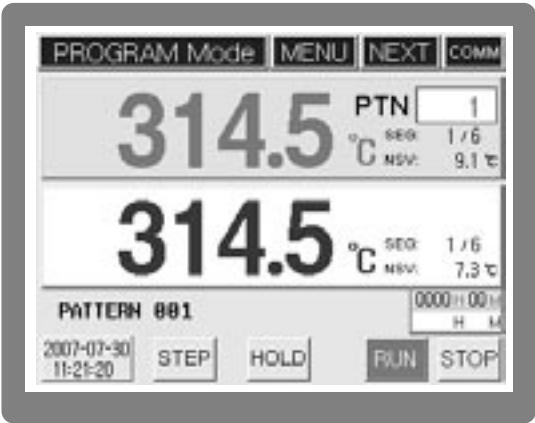
WAIT RANGE \pm [1.0] [°C]

MAX WAIT TIME -- hour -- min

Press [PATTERN SETUP] button at program setup menu to move to program pattern setup screen. Pattern consists of 'segments'. With each segment, various specific settings are carried out. The maximum number of segments for each pattern is limited to 100, and the maximum number of loops contained in one pattern is limited to 20. (These limits can be extended by pattern repeats and repeated operation).

The start of the operation in program mode starts from the PV at the time of the start (when PV2 is set). If wanting to start at particular SV, set the start mode to SSV, input the start value, then run. PV1 is the start fore mostly with slope. That is the number 1 segment time can decrease, based on the slope between the SSV and the number 1 intended segment value.

The program mode operation is carried out from number 1 segment in order. When the end segment is set, after corresponding segment is executed, it is forced to exit. The exit mode for program operation can be selected with the RST or the HOLD.

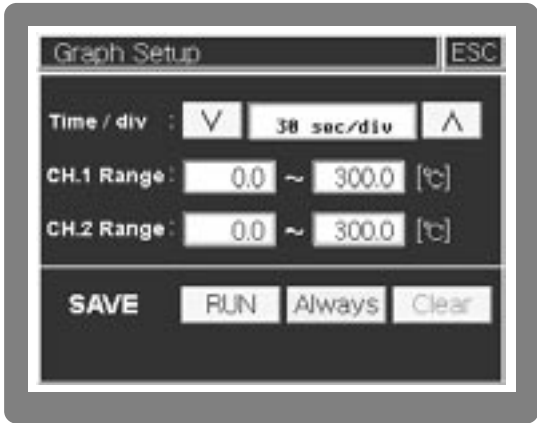
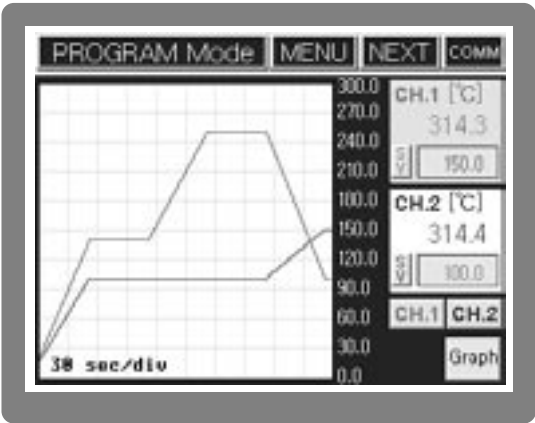


When the program controlled operation starts, the **STEP** **HOLD** buttons are indicated as the above figure, and it controls the segment processing for each channel.

	Function
STEP	Stop the current segment processing and move onto the next segment. If in wait/hold status, cancels the corresponding operation, and move one to the next segment.
HOLD	Stop the segment processing (time stop) and maintain the current status.

3.6 Graph indication and Setup

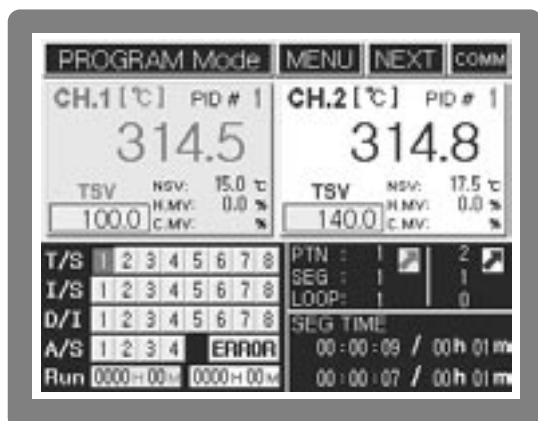
The graph indicator screen displays the intended value (SV) and measured value (PV) on graph. The X-axis is the time and the Y-axis is the temperature range.



Press [SETUP] button on the bottom right hand corner on the screen for specific setup of the graph.

3.7 Errors and Indicators for Various Events

The program and fixed control operation screen 2 indicates the specific operation status.

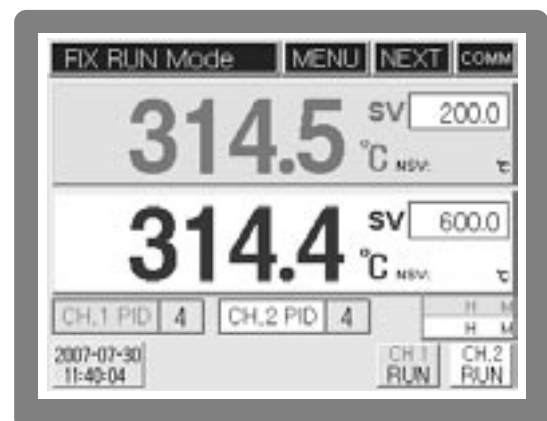
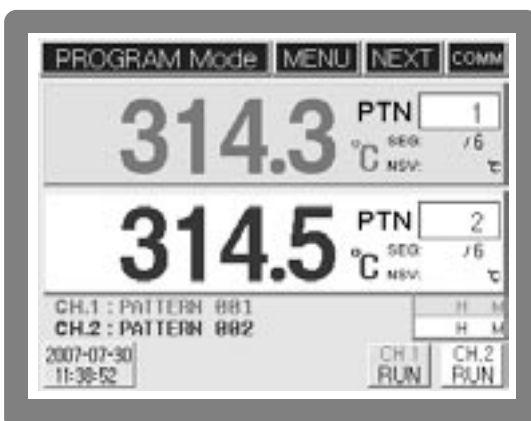
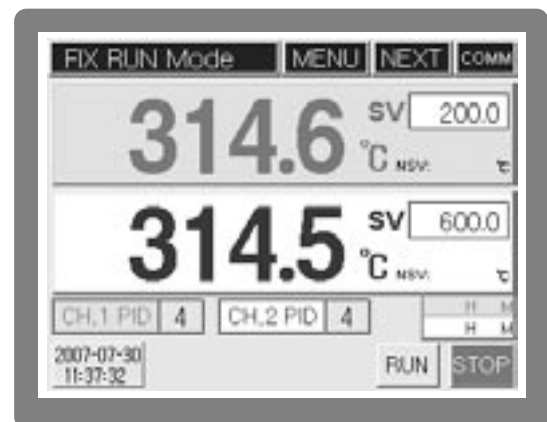
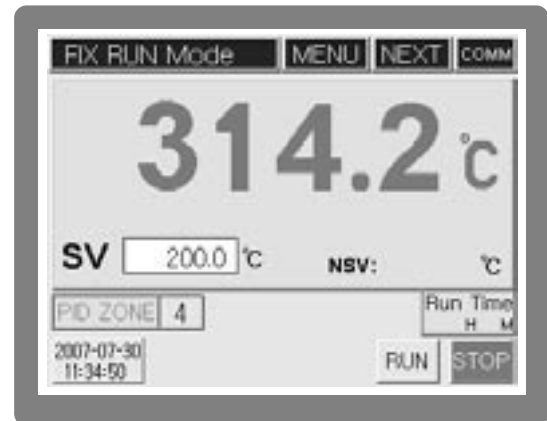
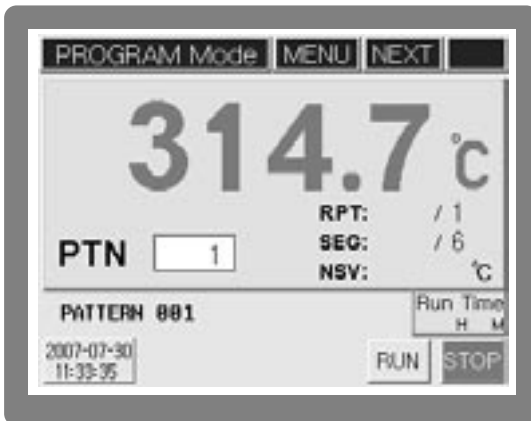


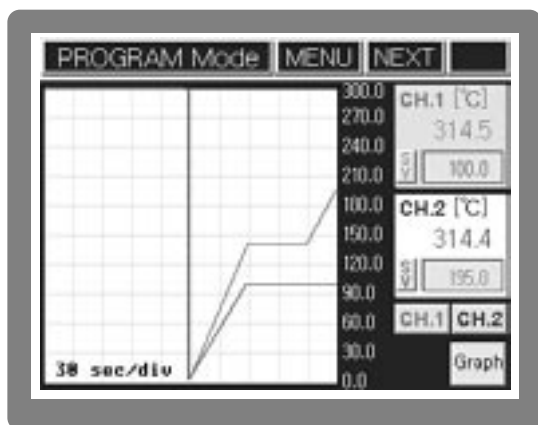
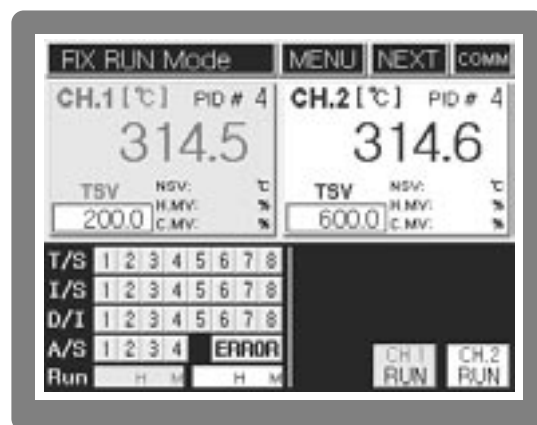
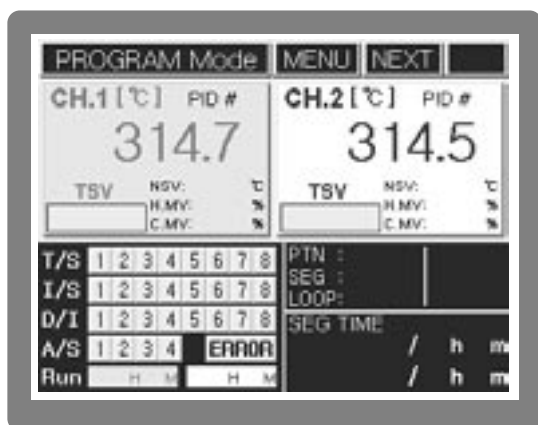
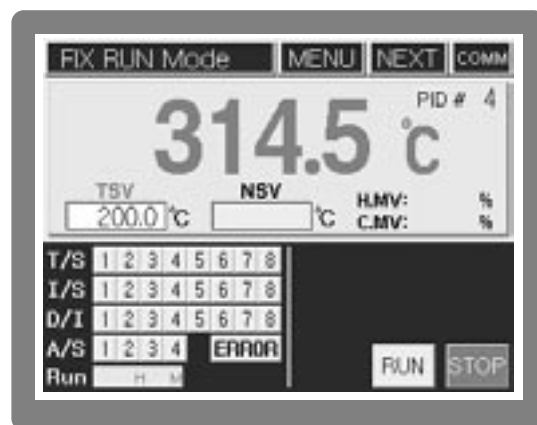
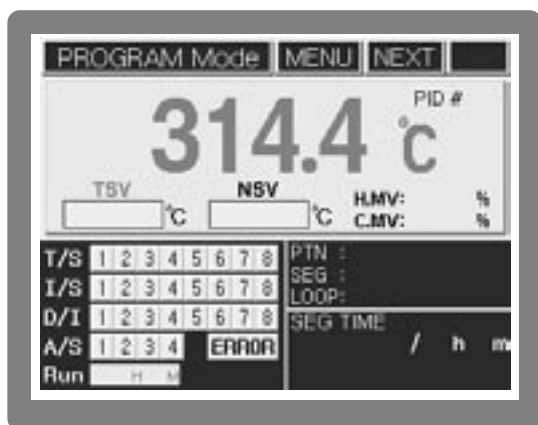
The error caused by sensor disconnection or through input (D/I) on external connection point, can be checked by pressing the [ERROR] button on the bottom of the operation screen 2 (in case of errors, automatically goes to this screen). Operations start/end, power input and other events can be also checked. (Up to 40 events are automatically stored).

4 Screen Layouts

The whole screen layout is composed of two parts, the Operation screen and the setup screen.

4.1 Operation Screen



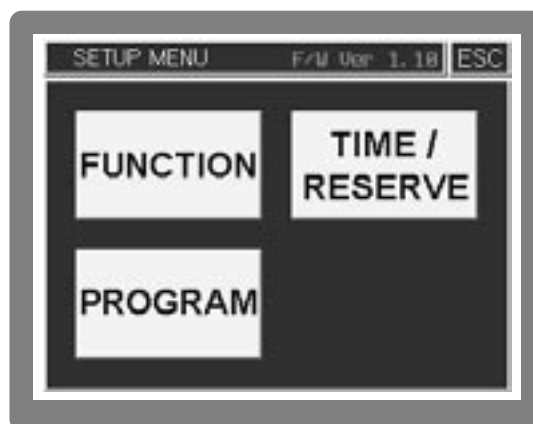
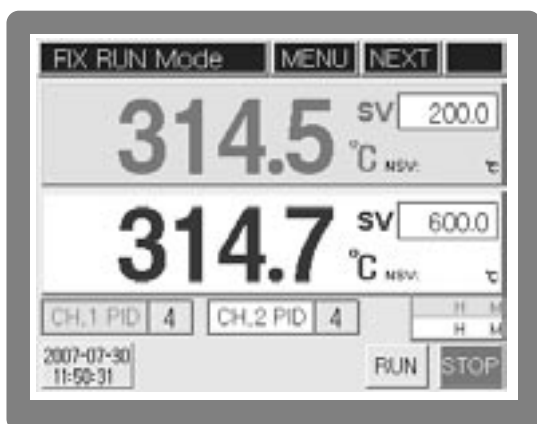


When powered up, the logo screen is displayed momentarily, and then the operation screen 1 is displayed.

When the [SETUP] button at the right hand bottom of the fixed control or the program operation screen 3 is pressed, the graph setup screen appears. (The graph time axis values, temperature range and the data storage location etc are setup here).

4.2 Setup Screen

When the [MENU] button on the operation screen (at fixed control, and program 1, 2, 3) is pressed, the setup menu screen is displayed.

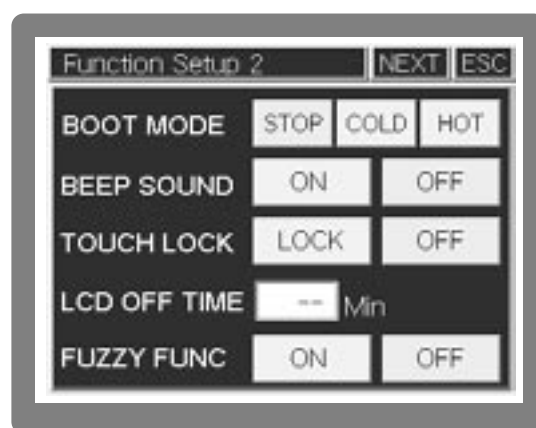
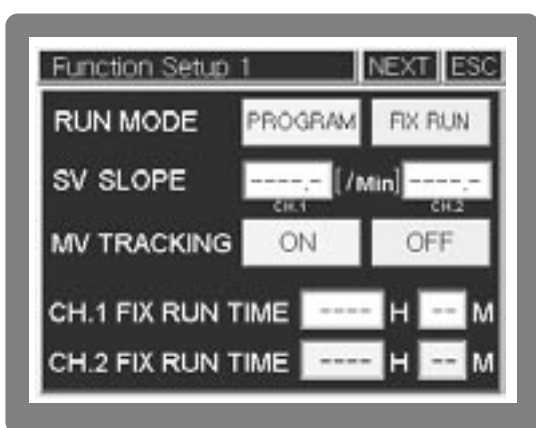


5 Function Setup

Pressing [MENU] button on the operation screen gets into setup menu where various parameters can be set.

5.1 Operation Setup

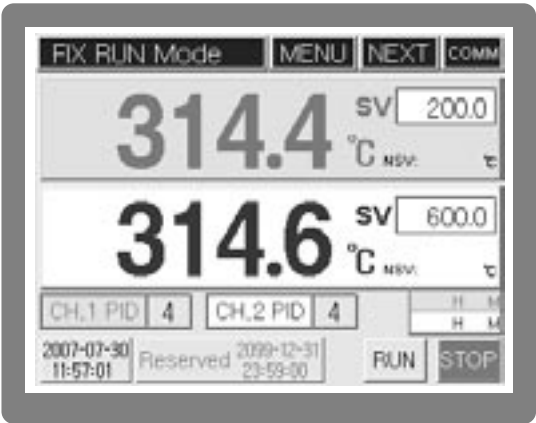
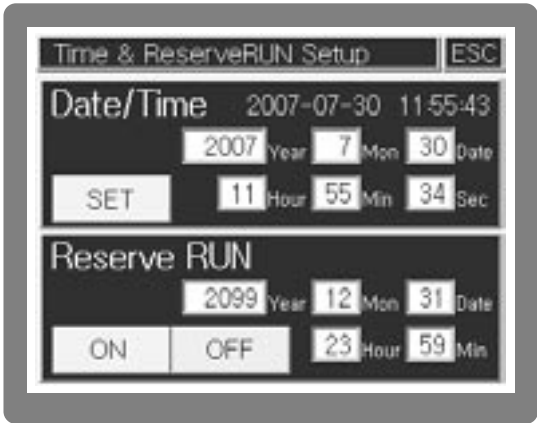
When [OPERATION SETUP] button is pressed on the function setup screen, the operation setup screen is displayed.



- Operation Type: Program control or fixed control
- Limit SV change rate: used to prevent rapid SV changes during fixed control operation.
- Limit MV change rate: Setup when concerned about problems caused by rapid changes in controlled output. When it is set, the output rate is limited to 10% per second (5% per 0.5 sec).
- Fixed operation time: if this time is set, when the time expires during fixed control operation, the operation stops automatically.
- Power-out Handling: If power goes down and recovers, the type of operation is set.
STOP → Operation stopped state, COLD → Control from beginning,
HOT → control from the stopped point
- Buzzer Setup: Touch sound, ON/OFF
- Touch Input Lock: When set, only [MENU] and [NEXT] respond. Prevents mistakes.
- Automatic Screen Power Down: To preserve lifespan of LCD and BACK LIGHT, when there are no inputs for certain period of time, the screen powers down automatically.
{Does not affect the operation}
- Purging: Suppresses over shoot. {Time taken to reach the intended value delays}

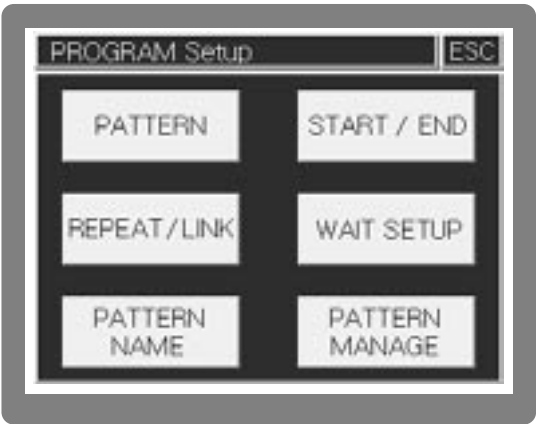
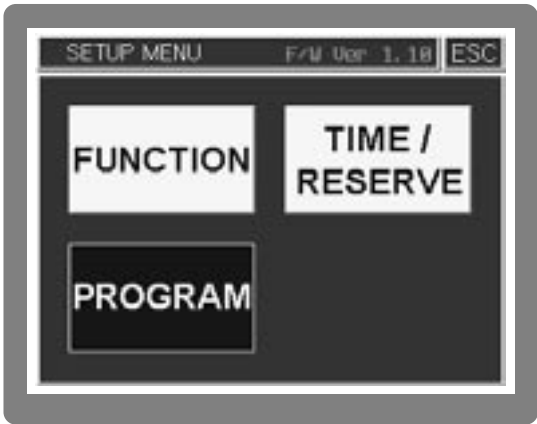
5.2 Time/ Timer Setup

Setup system date and time. When the timer is set for operation, the [TIMER SET] light comes on (this light goes off during operation). If stopped when the timer is activated at the set time, the operation automatically starts. (This does not mean it does self-power. Power must be on).



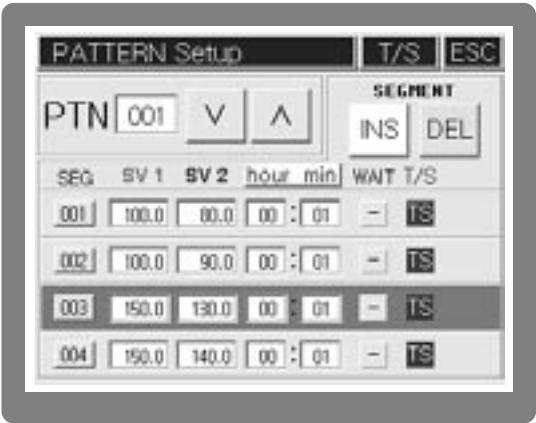
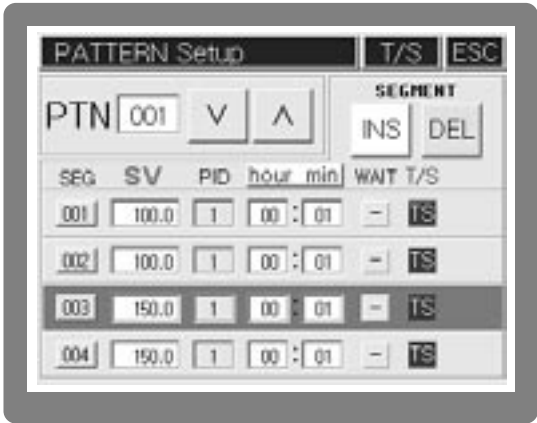
5.3 Program Setup

Press [PROGRAM] button on the setup menu screen to enter program setup screen.



5.3.1 Pattern Setup

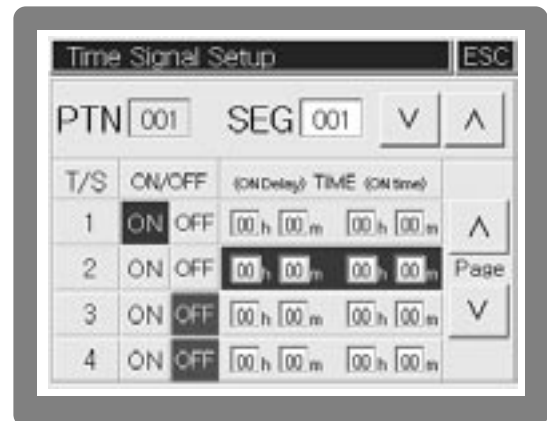
Press [PATTERN SETUP] button on the program setup screen to enter the detailed segment setup screen (segments compose the pattern). The program control is performed in accordance to the content and the order of segment settings made here.



{Independent operation for each channel
or 1 channel operation mode}

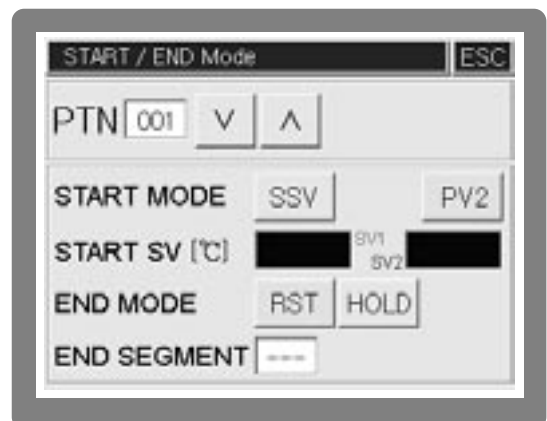
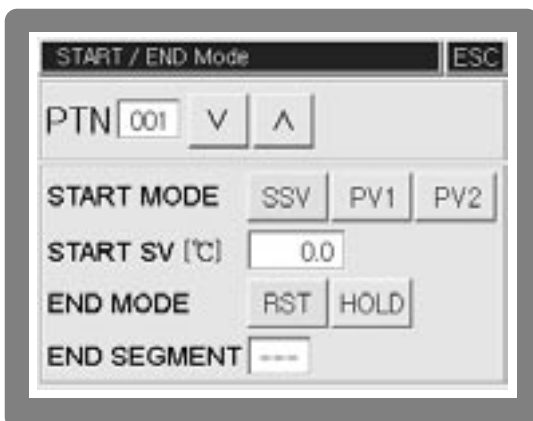
{Simultaneous operation of the channels}

- Additional segments are generated when empty space is pressed.
- To insert/delete segments, press segment number, it activates the segment and allows insert/delete.
- Press [T/S] button to display time signal setting in detail for each segment.
- Press WAIT box for each segment to activate/deactivate the standby.
- Press T/S box for each segment to enter the time signal setup screen for the corresponding segment.



- The operation mode of the time signal is divided to 'segment ON/OFF mode' and the 'time operated mode'. Total of 8 time signals can be set.

5.3.2 Start/Exit Setup



- Start Mode: SSM (start set value),
PV1 (Start the directed value, take priority on the slope level),
PV2 (Start the directed value, take priority on time)
- Start SV: Setup value when starting in PV1 or SSV
- Exit Mode: RST (when program is terminated, stop running), HOLD (when program is terminated, switch to 'hold' status automatically).
- Exit Segment: Segment number that will operate at last. (if 0, operate until the end of the segment of the corresponding pattern).

5.3.3 Repeat Pattern/Connection Setup

Press [REPEAT/CONNECT] button on the program setup screen to enter the REPEAT/CONNECT setup screen.

LOOP	Start SEG	End SEG	REPEAT
01	001	002	002
02	003	004	010
03			
04			

- Pattern Repeat: Setup number of pattern repeats. Default: 1
- Connect Pattern: Number for the pattern for connection. (If 0, no connect operation)

Basically, although the program executes the segments in the corresponding pattern sequentially, at times the particular segments are set in the pattern repeatedly. At these times, if the part-repeat functionality is used, the program input can be minimized. The part-repeat loop in the pattern can be set at maximum, 20. If part repeat is not set, the segments inputted in the patterns are sequentially executed, and if the loop is set, then the execution starts at segment 1, until the segment number for the first loop is encountered, the loop is executed. Afterwards, when the last loop is complete, the program is executed from the next segment number until the last segment of the pattern.

5.3.4 Standby Mode Setup

Press [STANDBY MODE] in the program setup screen to enter the standby setup screen.

WAIT RANGE ± 1.0 [°C]

MAX WAIT TIME --- hour --- min

In the case where 'standby' is activated for each segments of corresponding pattern, the range for which 'standby' is to be applied and the maximum time for 'standby' is setup.

When the 'standby' mode is activated, check whether PV had come into the 'standby' range at the time of segment change, and if the 'standby' range is not entered, it'll wait until the maximum time for 'standby' is expired. When the maximum 'standby' time is expired, it goes over to the next segment by force. (When 0 is set, 'standby' without time limit).

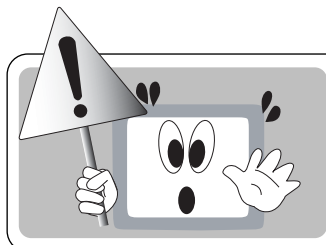
5.3.5 Pattern name setting

PTN	
001	PATTERN 001
002	PATTERN 002
003	PATTERN 003
004	PATTERN 004
005	PATTERN 005

5.3.6 Pattern management

PTN/SEG Management		ESC
SOURCE		TARGET
Pattern No. 001	PTN.COPY →	Pattern No. 001
↑ Pattern Clear		
Segment No. 001 - 006	SEG.COPY →	Segment No. 001 - 006

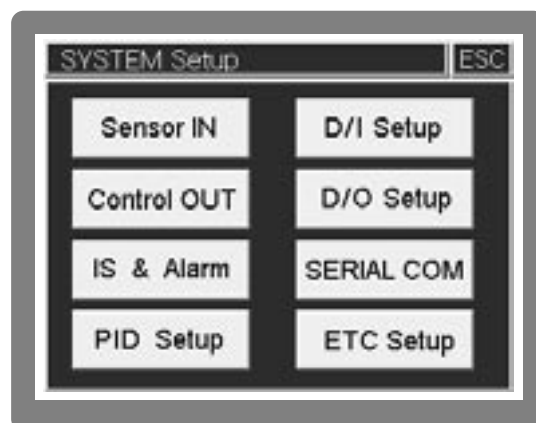
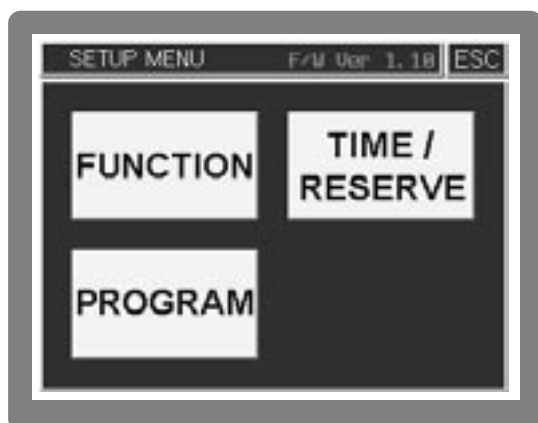
6 System Setup



CAUTION

Care must be taken when changing system setup. System setup is pre-set by the system installer, it is the basic condition of this instrument.

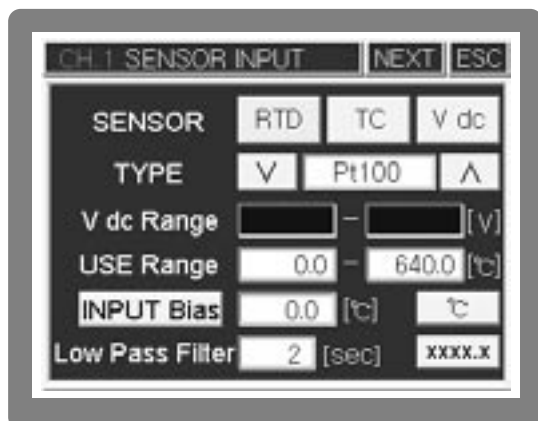
Press [MENU] on operation screen, and menu screen is displayed. Press <Function Setup> at the top on the text. It performs the password verification process and the setup menu is displayed



6.1 Sensor Input Setup

This product (TD500) supports variety of input types. Therefore, in order to use this instrument, the input setting must be performed. (Set by the system installer).

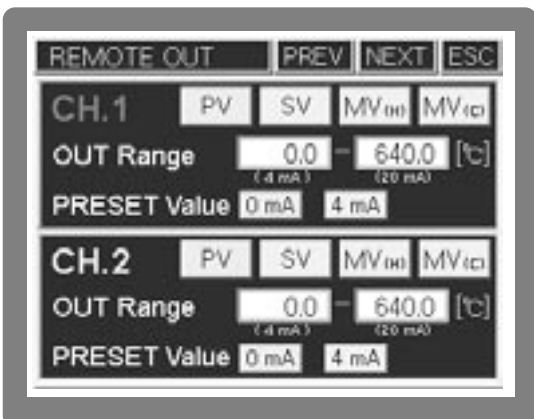
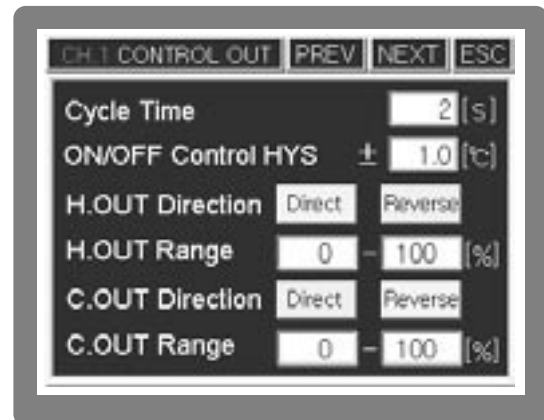
Press [SENSOR INPUT SETUP] button in system setup screen to enter sensor input setup screen.



- Sensor type: Select signal input type.
- Specific type: Select specific type for each input type.
- V dc input range: When inputting voltage signal, setup affective range that will be used.(Restrict to 0-10V ranges)
- Usage Range: Setup temperature range, used during signal input.
(SV setup is restricted)

- Input Compensation: When the product is shipped, it is adjusted to precision with error margin within 0.1%. However, in case of imprecision during simultaneous use with other instruments, the input temperature can be increased/decreased by force within the range of $\pm 100\text{ }^{\circ}\text{C}$.
- Filter Setup: If severe noise is present in the sensor signal system, and measured values are inconsistent, then suitable filtering time should be set. (Higher this value, the prompt control become difficult).

6.2 Control/Transmission Setup

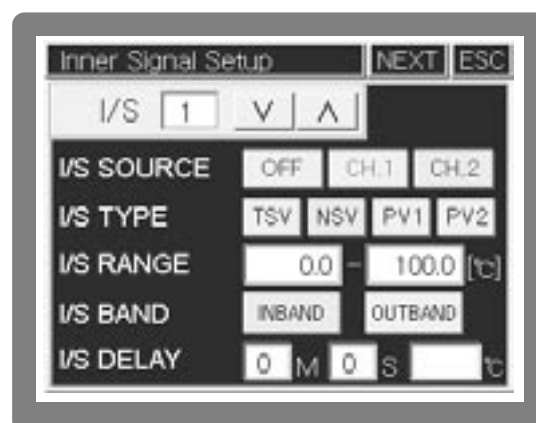
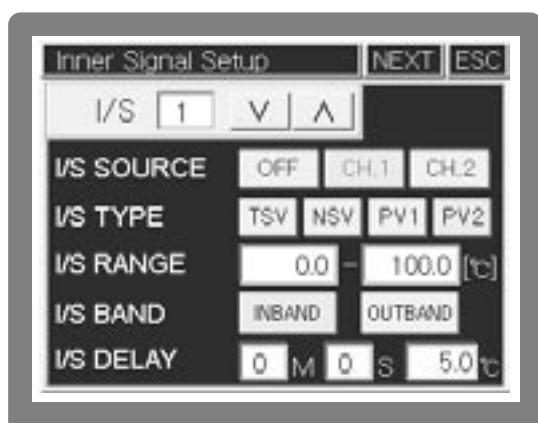


- Control Mode: Heating control, heating/cooling control selection
- Control output type: SCR, SSR, RELAY Selection. (When relay is selected, relay number selection box is activated).
- Anti Reset Wind-up: Range setup to prevent overloading. (Setup in P-BAND Percentage)
- Output Frequency: If control output type is SSR or RELAY (PID Control), PID control will be carried out in time ratio. Setup output frequency at this time. (Shorter the frequency, control performance is better, but can stress relay etc. Recommend SSR usage)
- ON/OFF Control Irresponsiveness: At ON/OFF control, setup output switch Irresponsiveness. If irresponsiveness is high, the control performance degrades, low irresponsiveness stresses the relay etc through frequent ON/OFF switching, and therefore a suitable value must be set. (If PID GAIN P-BAND value is 0, it operates in ON/OFF control mode).

- Heated Side Output Direction: Setup basic output direction. The heating side is by default, opposite direction, the cooling side is by default, right direction. If heat control is done by cooler etc, it could be necessary to change the output direction.
- Heated Side Output Range: Setup the limit for minimum output, maximum range. (The control output is automatically scaled to this range)
- Cooling side output direction: Opposite to the heated side output.
- Cooling side output range: Setup the limit for minimum output, maximum range. (The control output is automatically scaled to this range)
- Transmission Output Type: Setup transmission type for each channel.
(PV, SV, H.MV, C.M.V)
- Temperature Output Range for Transmission Output: When outputting 4–20mA of power, setup corresponding temperature range.
- Sensor Disconnection Output Setting: Setup transmission output value when sensor is disconnected. {Select 0mA or 4 mA}.
- Fix Power Output: When the product is shipped, the power output of 4–20 mA is set with precision, however, in case of imprecision during simultaneous use with other instruments, the power output can adjusted within the range of $\pm 5\%$.

6.3 Inner Signal Setup

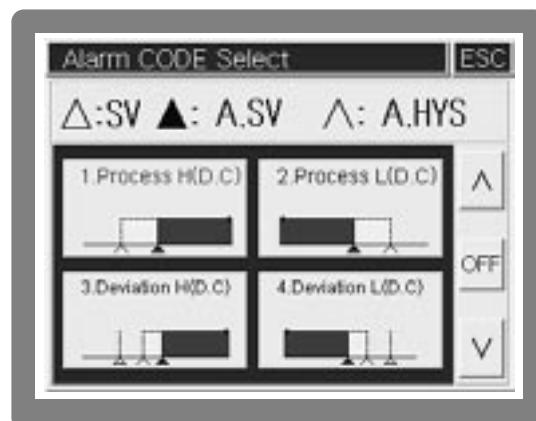
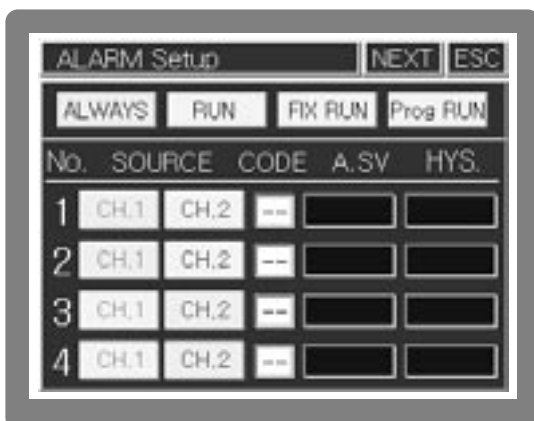
Time signal is used when certain signal generation is desired in relation to time during program mode operation. In contrast, inner signal is used when output signal accordance with the PV and SV values during operation, is desired. Mostly, in constant temperature and humidity, it is used mainly to control cooler, according to the range setting.



- Target I/S Setup: Select I/S signal originator.
- I/S type setup: Select I/S signal source.
- I/S operation range: Select range for signal generation
- I/S range direction: Select inclusive range and exclusive range.
- I/S Delay Time: Set I/S signal generation delay. If PV2 is the source, irresponsiveness value at I/S signal OFF. (Prevents frequent ON/OFF in coolers etc).

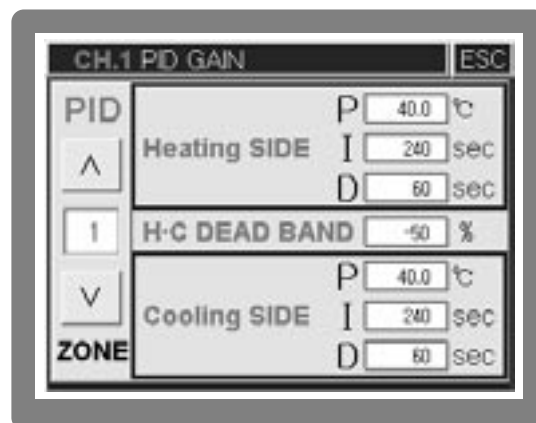
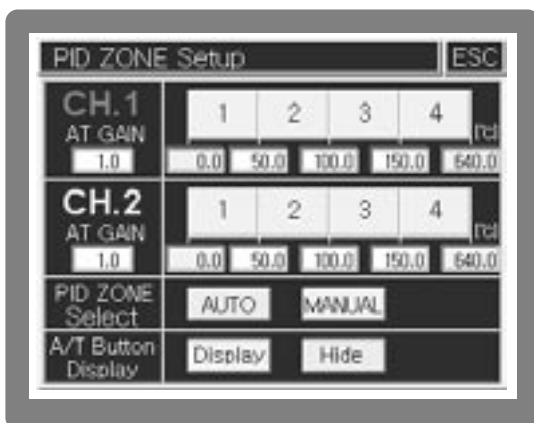
6.4 Alarm Setup

Press [VS, ALARM SETUP] button on the system setup menu, and press [NEXT] button. Then the alarm setup screen is displayed.



- Select inspect on alarm condition: Select either always inspect or inspect during operation.
- Select alarm occurrence source: Select sources that trigger alarm.
- Select alarm code: Press box to display the screen for selecting alarm code (1-20).
- Alarm SV: Setup alarm setting. (Absolute or varied)
- Alarm irresponsiveness: Setup irresponsive alarm setting. Alarm OFF.

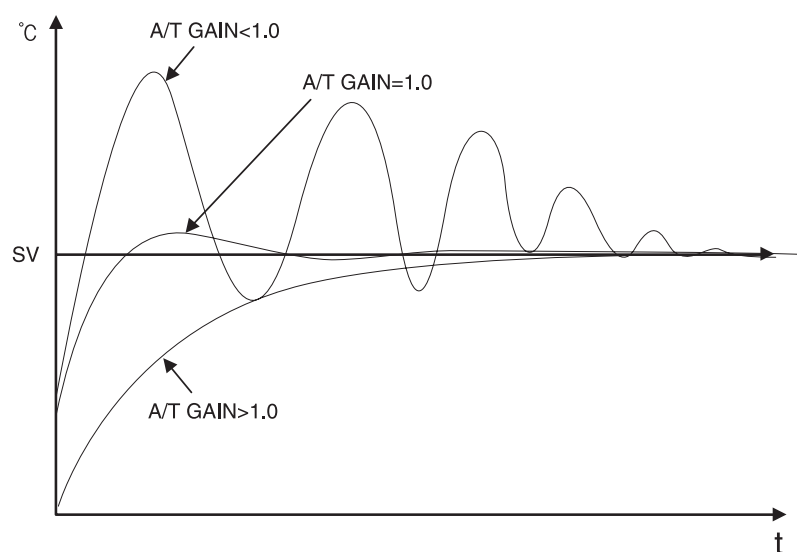
6.5 PID Setup



The PID GAIN for this instrument is divided into 4 areas for each channel. For each area, setup limit is 3, so the optimal PID GAIN can be applied for control. (Is able to select either automatic or manual). PID GAIN of each area has setup values of P-BAND, I-TIME, and D-TIME. When controlling heating/cooling, the cooling side attains the above values separately. Also, when controlling heating/cooling in the setting DEAD BAND, more precise control is possible. When installing the system, divide the areas that will be in used, and perform auto tuning based on the mid point of each area.

The indication of A/T button is installed only during initial installation. When tuning is complete, to prevent end user errors, it is not displayed on the operation screen. Recommend auto select even for PD ZONE.

- P-BAND: If compared ratio is large, the control output for deviation is small, therefore the time taken to reach the set value is delayed. If compared ratio is narrow, then the control output is large, so the set value is reached faster, but the overshoot increases.
- I-TIME: Shows the integral time. Cannot prevent generation of deviation only by ratio control. To remedy this, the deviation is reduced by integral operation. If integral time is too long, the reflected ratio gets too small, and if integral time is short, the hunting generation increases.
- D-TIME: Shows the integral time. This is counter action against rapid change. Adjusts in accordance to the rate of change. Greater the differential time, stronger the adjustments.
- DEAD BAND: During heating/cooling control, setup the size of the output on the intersection of heating side and the cooling side. In order to improve controllability, it is recommended to setup so the heating and cooling are slightly overlapped. (Minus)
- A/T GAIN: When controlling using PD GAN value that is auto tuned, according to the user's preference (whether faster following is wanted, or slight overshoot is wanted in place of speed), adjust reflection ratio for differential/integral time. If less than 1, then response gets faster but overshoot increases and hunting gets worse. If greater than 1, the response is slower, but the overshoot and hunting reduces.



Change of control characteristic depend on A/T GAIN (PV)

6.6 Inputs at Point of Contact (D/I) Setup

8 point of contact input are provided, when error occurs, by default, operation stops. Also, each point of contact input has RUN/STOP and STEP, and HOLD functionalities, and each input can set operation stop, delay time.

D/I ACTION Setup						NEXT	ESC
No.	ACT	WAIT	No.	ACT	WAIT		
D/I 1	NO	- S	D/I 5	NO	- S		
D/I 2	NO	- S	D/I 6	NO	- S		
D/I 3	NO	- S	D/I 7	NO	- S		
D/I 4	NO	- S	D/I 8	NO	- S		
ERROR Input Active						RUN	Always

D/I ACTION Setup						NEXT	ESC
No.	ACT	WAIT	No.	ACT	WAIT		
D/I 1	RST	0 S	D/I 5	RST	0 S		
D/I 2	RST	0 S	D/I 6	RST	0 S		
D/I 3	RST	0 S	D/I 7	RST	0 S		
D/I 4	RST	0 S	D/I 8	RST	0 S		
ERROR Input Active						RUN	Always

D/I ACTION Setup						NEXT	ESC
No.	ACT	WAIT	No.	ACT	WAIT		
D/I 1	RUN	- S	D/I 5	STEP	- S		
D/I 2	RST	0 S	D/I 6	HOLD	- S		
D/I 3	RST	0 S	D/I 7	HOLD ON	- S		
D/I 4	RST	0 S	D/I 8	HOLD OFF	- S		
ERROR Input Active						RUN	Always

D/I ACTION Setup						NEXT	ESC
No.	ACT	WAIT	No.	ACT	WAIT		
D/I 1	CH.1 RUN	- S	D/I 5	CH.1 STEP	- S		
D/I 2	CH.2 RUN	- S	D/I 6	CH.1 HOLD	- S		
D/I 3	CH.1 RST	0 S	D/I 7	CH.2 STEP	- S		
D/I 4	CH.2 RST	0 S	D/I 8	CH.2 HOLD	- S		
ERROR Input Active						RUN	Always

D/I NAME Setup		NEXT	ESC
D/I 1	D/I_1 ERROR		
D/I 2	D/I_2 ERROR		
D/I 3	D/I_3 ERROR		
D/I 4	D/I_4 ERROR		
D/I 5	D/I_5 ERROR		
D/I 6	D/I_6 ERROR		
D/I 7	D/I_7 ERROR		
D/I 8	D/I_8 ERROR		

- The signal direction of RUN/STOP operation can be setup.
- The name of D/I should be set intuitively.
- To prevent incorrect operation stop due to noise, able to set time for operation stop grace period.

6.7 Point of Contact Output (D/O) Setup

Setup for point of contact output is the setup for real relay or the transistor output for various signals in the system. Only the signals assigned here are outputted through the terminal. The point of contact assignment can overlap (except for certain special cases), therefore, care must be taken for input.

D/O Setup 1				PREV	NEXT	ESC
Relay		O/C		Relay		O/C
I/S 1	<input type="checkbox"/>	<input type="checkbox"/>	I/S 5	<input type="checkbox"/>	<input type="checkbox"/>	
I/S 2	<input type="checkbox"/>	<input type="checkbox"/>	I/S 6	<input type="checkbox"/>	<input type="checkbox"/>	
I/S 3	<input type="checkbox"/>	<input type="checkbox"/>	I/S 7	<input type="checkbox"/>	<input type="checkbox"/>	
I/S 4	<input type="checkbox"/>	<input type="checkbox"/>	I/S 8	<input type="checkbox"/>	<input type="checkbox"/>	

D/O Setup 2				PREV	NEXT	ESC
Relay		O/C		Relay		O/C
T/S 1	<input type="checkbox"/>	<input type="checkbox"/>	T/S 5	<input type="checkbox"/>	<input type="checkbox"/>	
T/S 2	<input type="checkbox"/>	<input type="checkbox"/>	T/S 6	<input type="checkbox"/>	<input type="checkbox"/>	
T/S 3	<input type="checkbox"/>	<input type="checkbox"/>	T/S 7	<input type="checkbox"/>	<input type="checkbox"/>	
T/S 4	<input type="checkbox"/>	<input type="checkbox"/>	T/S 8	<input type="checkbox"/>	<input type="checkbox"/>	

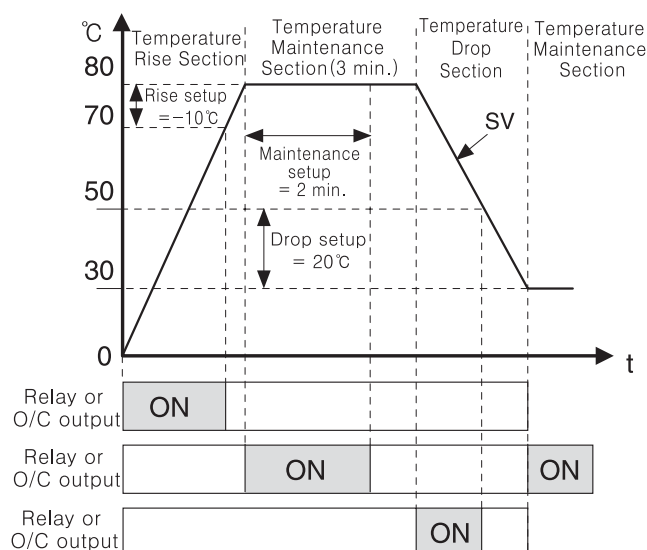
D/O Setup 3				PREV	NEXT	ESC
Relay		O/C		Relay		O/C
Alarm 1	<input type="checkbox"/>	<input type="checkbox"/>				
Alarm 2	<input type="checkbox"/>	<input type="checkbox"/>				
Alarm 3	<input type="checkbox"/>	<input type="checkbox"/>				
Alarm 4	<input type="checkbox"/>	<input type="checkbox"/>				

D/O Setup 4				PREV	NEXT	ESC
Relay		O/C		Relay		O/C
CH.1 SEN	<input type="checkbox"/>	<input type="checkbox"/>	CH.2 SEN	<input type="checkbox"/>	<input type="checkbox"/>	
BURN	<input type="checkbox"/>	<input type="checkbox"/>	BURN	<input type="checkbox"/>	<input type="checkbox"/>	
CH.1 RUN	<input type="checkbox"/>	<input type="checkbox"/>	CH.2 RUN	<input type="checkbox"/>	<input type="checkbox"/>	
CH.1 WAIT	<input type="checkbox"/>	<input type="checkbox"/>	CH.2 WAIT	<input type="checkbox"/>	<input type="checkbox"/>	
CH.1 HOLD	<input type="checkbox"/>	<input type="checkbox"/>	CH.2 HOLD	<input type="checkbox"/>	<input type="checkbox"/>	

D/O Setup 5				PREV	NEXT	ESC
	Relay	O/C	Value			
CH.1 UP	<input type="checkbox"/>	<input type="checkbox"/>	<input type="text"/> [°C]			
CH.1 SOAK	<input type="checkbox"/>	<input type="checkbox"/>	<input type="text"/> M			
CH.1 DOWN	<input type="checkbox"/>	<input type="checkbox"/>	<input type="text"/> [°C]			
CH.2 UP	<input type="checkbox"/>	<input type="checkbox"/>	<input type="text"/> [°C]			
CH.2 SOAK	<input type="checkbox"/>	<input type="checkbox"/>	<input type="text"/> M			
CH.2 DOWN	<input type="checkbox"/>	<input type="checkbox"/>	<input type="text"/> [°C]			

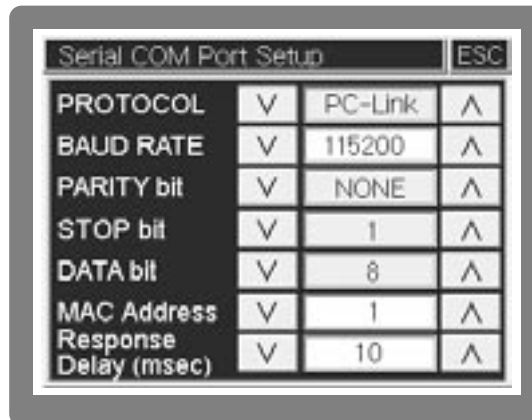
D/O Setup 6				PREV	NEXT	ESC
	Relay	O/C	Time			
D/I ERROR	<input type="checkbox"/>	<input type="checkbox"/>	<input type="text"/> S			
CH.1 PROG.END	<input type="checkbox"/>	<input type="checkbox"/>	<input type="text"/> S			
CH.2 PROG.END	<input type="checkbox"/>	<input type="checkbox"/>	<input type="text"/> S			
AND Signal 1 (I/S_1 & I/S_x)	<input type="checkbox"/>	<input type="checkbox"/>	I/S_ <input type="text"/>			
AND Signal 2 (I/S_2 & I/S_x)	<input type="checkbox"/>	<input type="checkbox"/>	I/S_ <input type="text"/>			

- I/S 1~8: Inner Signal Output Setup (Select from Relay 1~8, O/C 1~8)
- T/S 1~8: Time Signal Output Setup (Select from Relay 1~8, O/C 1~8)
- Alarm 1~4: System Alarm Output Setup (Select from Relay 1~8, O/C 1~8)
- CH1 & CH2 Sensor Disconnection: Output Setup during Sensor Disconnection (Select from Relay 1~8, O/C 1~8)
- CH1 & CH2 Operation: Output Setup for signal during operation (Select from Relay 1~8, O/C 1~8)
- CH1 & CH2 Standby: Output Setup for signal during standby mode (Select from Relay 1~8, O/C 1~8)
- CH1 & CH2 Hold: Output Setup for signal during hold mode (Select from Relay 1~8, O/C 1~8)
- CH1 & CH2 Rise Section : Output Setup for signal when inclining (Select from Relay 1~8, O/C 1~8) Select range for output signal (\pm °C)
- CH1 & CH2 Maintenance Section : Output Setup for signal for maintaining section (Select from Relay 1~8, O/C 1~8) Setup time for signal output (minutes).
- CH1 & CH2 Drop Section : Output Setup for signal when declining (Select from Relay 1~8, O/C 1~8) Select range for output signal (\pm °C)
- D/I Error: Setup output for D/O error input (Select from Relay 1~8, O/C 1~8). Setup maximum time to maintain output. (Second) (When set with maximum, maintain D/O even when there is touch input).
- CH1 & CH2 Stop program execution: Output Setup for when program execution is stopped (Select from Relay 1~8, O/C 1~8) Setup maximum time to maintain output. (Second).
- Composite Signal 1: Output composite signal 1 (Select from Relay 1~8, O/C 1~8) Used in composite conditions for I/S number setup cooler operation checked by I/S_1 and AND condition has lower SV by certain amount and lower PV by certain amount.
- Composite Signal 2: Output composite signal 1 (Select from Relay 1~8, O/C 1~8) Setup I/S number that will be checked by I/S_2 and AND condition.



(Example of Rise/Maintenance/Drop signal output)

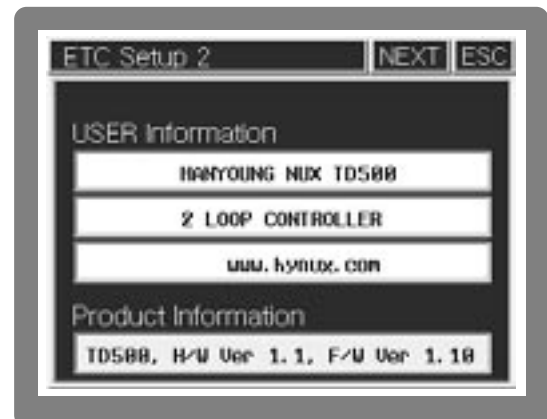
6.8 Communication Setup



Communication Setup screen is for setting up communication parameters when communicating with instruments that supports interfaces to the PC or other serial devices. Up/down arrows are used to change the values. The response delay setup (0 ~ 250 msec) with local device number (1~255) can be set by directly selecting the box. When communicating in 2-wire with RS422/485 model, the product terminal T+ is connected with R+, T- with R-.

The SG pin of the terminal is used when communication performance deteriorates due to the problem of potential difference. As for response delay, it is used when a converter is used that automatically controls the communication from the other device by using timing delay. It is a functionality that waits few msec to prevent data crash. (When 2-wire communication is used).

6.9 Other Setup



- Displayed Language: Select language for the menus. (Currently provides Korean and English)
- Setup for usage of each channel: Select channels that are used.
Control→ use control actions
Observe→ indicate only the instructed value (no control actions)
Not used→ the channel is not used (when channel 2 is disabled, the operation screen changes to single channel mode).
- Setup password: Password setup for authority to change system setup.
- Setup for simultaneous control mode for each channel, or separate control mode: When 2 channels are used, setup for simultaneous operation of channels.

7 Specification

7.1 Input Specification

Input (2 channels)	Pt100 (IEC751)	-200 ~ 640 °C, ± 0.1 % of F.S
	TC_K	-200 ~ 1370 °C, ± 0.1 % of F.S
	TC_J	-200 ~ 1200 °C, ± 0.1 % of F.S
	TC_E	-200 ~ 1000 °C, ± 0.1 % of F.S
	TC_T	-200 ~ 400 °C, ± 0.1 % of F.S
	TC_R	0 ~ 1700 °C, ± 0.15 % of F.S
	TC_S	0 ~ 1700 °C, ± 0.15 % of F.S
	mV	0 ~ 100 mV or -10 ~ 20 mV (-999.9 ~ 9999.9), ± 0.1 % of F.S
	V d.c	0 - 10 V (Signal Input Range setup is available, -999.9 ~ 9999.9), $\pm 0.1\%$ of F.S
	4 - 20 mA	Use 250 Ω external resistance, V d.c Use after setup of V d.c 1 - 5 V
Input Resolution		24 bit
Accuracy of indication		0.1 °C
Sampling cycle		Each channel 500 msec
Input Resistance		More than 1 M Ω
Maximum allowable resistance of line		Less than 50 Ω / Line (Resistance of lines is a same condition)
RJC		± 1.5 °C

7.2 Output Specification

Control Output	(SCR)	4 - 20 mA d.c(Resistive load : less than 600 Ω) Output Resolution : 16bit Accuracy of Output : $\pm 0.1\%$ of F.S Output Ripple : 0.2% of F.S
	(SSR)	24 V d.c Pulse (Resistive load : More than 600 Ω) Min. Pulse Range : 10ms Cycle Time : Available to select 1 - 1000s
	Relay Output	External Relay by using internal relay or TR output(Max.24V,100mA) Kind of Internal Relay : N/O \rightarrow 250 V a.c 5 A / 30 V d.c 5 A N/C \rightarrow 250 V a.c 2 A / 30 V d.c 1 A
Transmission Output (4 - 20 mA)		Available to select PV/SV/H.MV/C.MV of each channel Output Accuracy : $\pm 0.1\%$ of F.S In case of heating/cooling control, if control output of heating is SCR or SSR, this channel can not use transmission output.
Transmission Output Period of output renewal		Each channel 500 ms

7.3 Functions

Screen	5.7 Inch Color LCD and Interface with Touch Panel
Pattern	Max 100 , Available to operate each channel's pattern
Segment	Max 2,400 (Max 100 per segment)
Waiting Mode	Setup per pattern and setup of using or not using per segment
Repetition&Connection	Available to use Pattern Repetition and Section Repeat Loop Setup(Max. 20) Free connecting operation among patterns is available
PID Group	Each channel 4 Zones, Selectable between manual or automatic
Control Method	Heating control or Heating/Cooling control in each channel. PID or ON/OFF control
Auto Tuning	Optimal PID GAIN is automatically calculated according to Set Value. It could be operated by each channel
Proportional Band	0.0 ~1000.0°C (If "0" = On/Off control, Not "0" = PID control)
Integral Time	0 ~ 6000 sec ("0" = No Integral Calculation)
Differential Time	0 ~ 6000 sec ("0" = No Differential Calculation)
ON/OFF control	Available to select Dead zone 0.1~1000.0°C
Event Log	Max 40 Event Logs could be saved depend on various situations
LCD protection	Back light will be off according to designated time of not using touch panel
Password	Password is available to prevent other people from changing system setup
Protection of Over-Integral and Differential	ARW Zone setup(50~200% of proportional band)
Fuzzy Function	Control overshoot
RAMP	Available to select SV changing ratio in case of fixing operation
Restrict MV changing ratio	Function to control sudden change of MV
Alarm Setup	4 points, High, Low, Deviation etc. 20 kinds
Inner Signal	8 points, object, range and delayed time setup are available
Time Signal	8 points when program mode operation
Graph Function	PV, SV of each channel could be display by graph
Fixing Operation Hour	Available to set fixing operation hour up
Reservation Operation Function	Available to use reservation operation time by using built in timer.
User Logo Display	User logo could be shown for 3 sec after power on. Download through communication port
Screen Capture	Upload is available through communication port
Language	Korean and English
Contact Input	RUN/STOP, STEP, HOLD and Error Input(Stop operation, Delayed\ setup is available)
Contact Output	Output of various signals
Storage in Power Failure	Setup and operation information is saved in inner Flash Memory of
Return from Power Failure	NVRAM STOP/COLD/HOT could be returned in case of power failure

7.4 Communication

Applied Standard	EIA-RS232C, EIA-RS422/485, USB	
Max.Connection Number	RS232 RS422/485	1 : 1 1 : 256
Communication Method	RS232 RS422/485	Full Duplex 4 wired Half Duplex, 2 wired Half Duplex
Synchronous Method	RS232 RS422/485	asynchronous
Communication Distance	RS232 RS422/485	Within approximately 10 m Within approximately 1.2 Km
Communication Speed	RS232 RS422/485	2400 ~ 115200
Length of Data	RS232 RS422/485	8 bits
Parity Bit	RS232 RS422/485	NONE
Stop Bit	RS232 RS422/485	1 bit(s)
Communication Protocol	RS232 RS422/485	PCLINK + CHECK SUM
Delayed Response Time	RS232 RS422/485	1 + (0 ~ 250)ms

7.5 Ratings

Rated Voltage	100 – 240 V a.c, Variable Voltage Ratio : $\pm 10\%$	
Frequency	50 / 60 Hz	
Power Consumption	Main Body : Max 16W, I/O Board : Max 20W	
절연저항	Between 1st & 2nd Terminal 1st/2nd and Earth Terminal	More than 20 M Ω /500 V d.c
내전압	Between 1st & 2nd Terminal 1st/2nd and Earth Terminal	2500 V a.c, 50/60 Hz, 1 min.
전원출력	24 V d.c, 500 mA Max.	

7.6 Operation Surroundings

Installation	Continuous Vibration	Vibration Wide : Below 1.2 mm(5 – 14 Hz)
	Short time Vibration	Below 4.9 $\mu\text{m/s}^2$ (4 – 150 Hz)
	Shock	Below 14.7 $\mu\text{m/s}^2$ 15 sec(Each 3 directions)
		Below 147 $\mu\text{m/s}^2$ 11 msec (Each 6 directions, 3 times)
Normal Operation Condition	Surrounding Temperature	0 ~ 50 °C
	Surrounding Humidity	20 ~ 90 % R.H (No Condensation)
	Magnetic Effect	Less than 400 AT/m
	Preheating	More than 10분
Effect of surrounding temperature	Voltage/TC Input	$\pm 1 \mu\text{V} / ^\circ\text{C}$ or $\pm 0.01 \% \text{ of F.S} / ^\circ\text{C}$
	RTD Input	Less than $\pm 0.05 ^\circ\text{C} / ^\circ\text{C}$
	Analog Output	Less than $\pm 0.05 \% \text{ of F.S} / ^\circ\text{C}$

7.7 Condition of Transport and Storage

Temperature	-25 ~ 70 °C
Humidity	5 ~ 95 % R.H (No condensation)
Shock	Less than 1M when dropping the packed product