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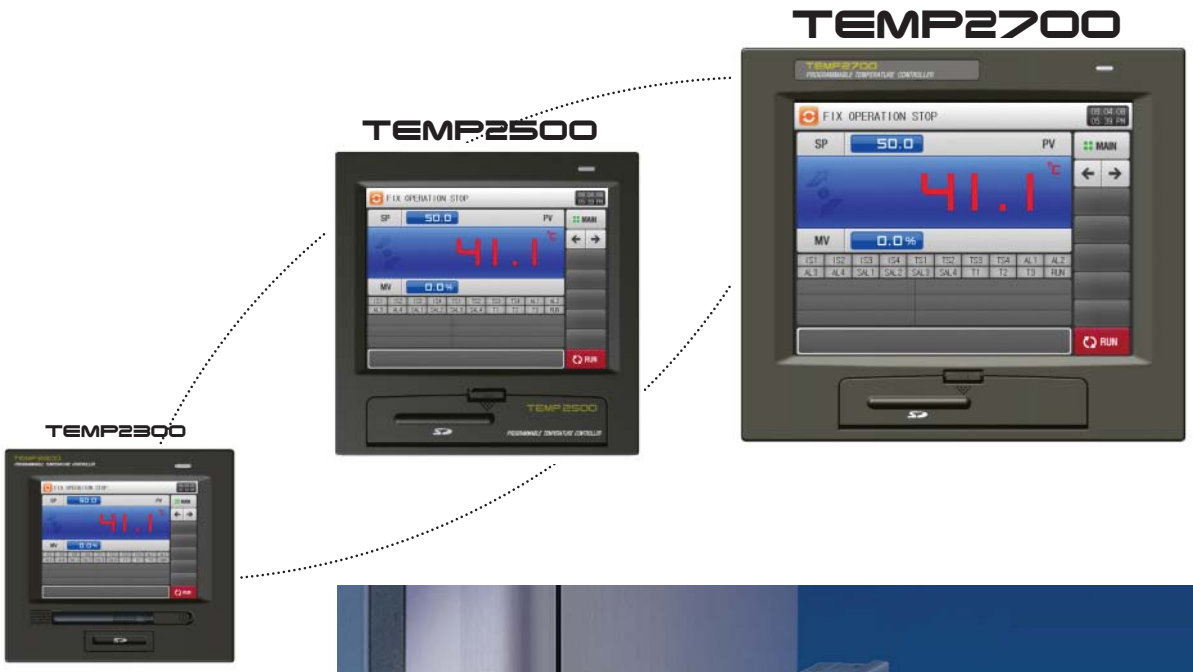
TEMP2000 - SERIES



OPERATION MANUAL

Programmable Controller

※ This manual applies to TEMP2300, TEMP2500 and TEMP2700.
The model stated the manual content is TEMP2500.

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1 Safety Precautions

Thank you for purchasing TEMP2500, programmable controller.
This Operation Manual describes operating procedures of the TEMP2500 controller.

SAFETY SYMBOL MARK

(A) Symbolizes 'Caution' and 'Warnning'. The information with this symbol is especially important for preventing from user injury and protecting the product and system.

(1) Product : This symbol indicates an imminently hazardous situation which if not avoided, will result in serious injury or system damage.
(2) Operating Manual : This symbol indicates potential hazard that may cause personal injury by electrical shock.

(B) Symbolizes 'Protective Earth (PE) Terminal.'

This symbol indicates that the terminal must be connected to the Ground prior to operating.

(C) Symbolizes 'Supplementary Explanation.'

The information with this symbol describes additional explanation for features.

(D) Symbolizes 'Reference.'

☞ This symbol indicates further information and page to refer.

Precautionary Remarks on this Operation Manual

(A) This manual should be passed on the End- User and kept at a suitable place for easy review in time.
(B) Read and understand this Operation Manual carefully before using the product.
(C) This Operation Manual describes functions and features of the product in detail, and SAMWONTECH can not guarantee against over applications would suit a customer's particular purpose which is not described in this manual.
(D) Unauthorized duplication and modification of this Operation Manual are strongly prohibited.
(E) The contents of this manual may be modified without prior notice.
(F) If any errors or omissions in this manual should come to the attention of the user, feel free to contact our sales representatives or our sales office.

Precautions for Safety and Unauthorized Modification

(A) For protecting and ensuring the safety of this product and relevant system, all of the safety instructions and precautions should be well recognized and strictly observed by all users.
(B) SAMWONTECH does not guarantee against damage resulting from unauthorized alteration, misuse, or abuse.
(C) When using additional safety circuit or part such as Noise Filter to protect this product and relevant system, it is strongly required to install that to outside of this product. Additional installation and modification inside of this product are prohibited.
(D) Do not try to disassemble, repair, or modify the product. It may become the cause of a trouble such as malfunction, electric shock, fire.
(E) Contact our sales dept. for part replacement or consumables.
(F) Keep the product away from water inflowing. This may become a critical cause of trouble.
(G) External shock on the product may lead to damage and malfunction.

Limitation of Liability

(A) SAMWONTECH does not guarantee or accept responsibility for this product other than the clauses stated in our warranty policy.
(B) SAMWONTECH assumes no liability to any party for any loss or damage, direct or indirect, caused by the use or any unpredictable defect of the product.

Warranty Policy

(A) Warranty term of this TEMP2500 is one year after delivery to the first purchaser for being free of defects in materials and faulty workmanship under the condition that the product has been applied according to this manual.
(B) The repairing cost will be charged for defective product out of warranty period. This charge will be the actual cost estimated by SAMWONTECH.
(C) Repairing cost may be charged even if within warranty period for following cases.
  (1) Damage due to USER FAULT (Ex.: Product initialization by password loss)
  (2) Damage due to natural disaster (Ex.: fire, flood)
  (3) Damage due to additional removal and re-installation after the first one.
  (4) Damage due to unauthorized disassemble, modification and alternation.
  (5) Damage due to unexpected power failure caused unstable power supply.
  (6) Others
(D) If any A/S is required, feel free to contact our sales office or a representative.

2 Handling overview

▶ This product is Programmable Controller configured with Interactive Touch Screen type, which is designed for user convenience.

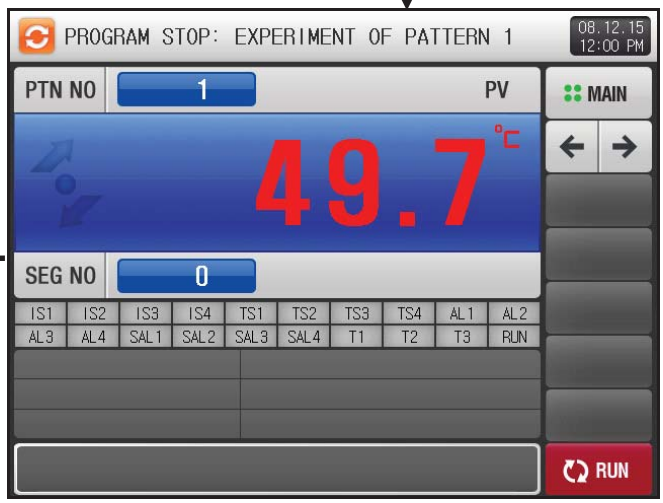
2.1 Initial operation flow

▶ Supplying the power after completing installation correctly, loading screen will appear for loading time then Initial Logo screen will be displayed. The screen will automatically progress to the STOP screen.
☞ It takes around 22 seconds for loading.
▶ Press the MAIN(MAIN) button at the top right hand corner on PROGRAM STOP screen, to move to the MAIN MENU where the general parameter group located.
▶ Initial Logo screen can be changed as user want. Refer to the **[13. INITIAL SETTING]** on **[Installation Manual]** for how to change initial logo.

Loading screen

Initial Logo screen

MAIN MENU screen

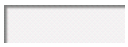
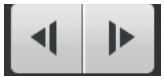


PROGRAM STOP screen

2.2 Setting Buttons

▶ [Table2-1] describes Basic Setting Buttons.

Table 2-1. Basic Set Button

Button Type	Description
	Touch “Set Parameter” part at FIX STOP/RUN Screen, and is used to set desired parameter.
	Touch “Pattern No” part at Program Stop Screen, and is used to set desired Pattern Number by user.
	Button to set target Set Point of humidity, located at the Low left side of OPERATRION screen. Input Keypad will appear
	Button to set general numerical and alphabetical value. Input Keypad will appear.
	Button to set target Set Point of temperature and humidity, and process time for each segment on **[5.1 Program PATTERN]**. Input Keypad will appear.
	Button to select on of several modes or options. (ON / OFF / INACTIVE)
	Button to set whether or not to use each parameter. (ON / OFF / INACTIVE)
	Screen move button to move to the next / previous Screen in the same group.
	Page move button to move to the next / previous Page in the same screen.
	Paragraph move button to move to the next / previous Paragraph by time base in the same page.
	Button to display first / last section of recorded trend data graph on **[6.2 TREND GRAPH view & DATA processing]**.
	Button to move the view point up / down by 1 dot point of recorded trend data graph on **[6.2 TREND GRAPH view & DATA processing]**.

2.3 Input Keypad

▶ When you pressing the [ ] button, the following Input Keypad appears and the required data value can be set by using this Input Keypad.

▶ If the setting value is out of the available range, 'LIMIT ERROR' message will appear with a 'BEEP' sound and input will be rejected.

① Numeric Keypad to input numerical values

② Alpha- Numeric Keypad to input Pattern name or DI error name

☞ For DI ERROR name, refer to the [11.2 DI ERROR NAME] on [Installation Manual].

③ TIME SIGNAL setting Keypad

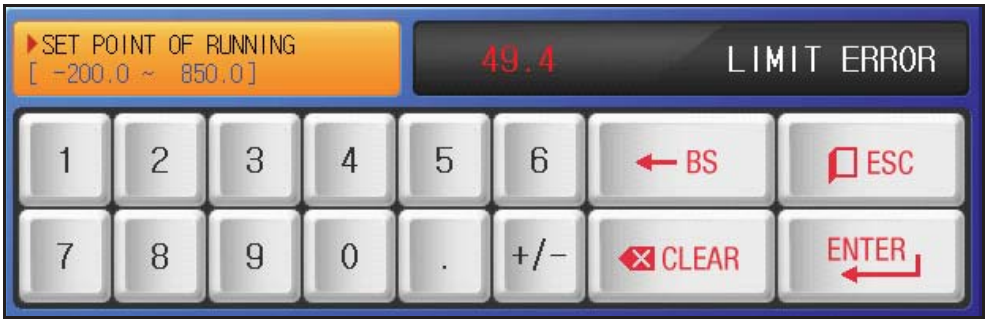
④ Input Key to set Seg Alarm (Segment Alarm)

⑤ Input Key to set Aux. Output

☞ Refer to Aux. Output in **[Control & Transmit Output]** in **[Installation Manual]** for Aux. Output setup.

⑥ User Tag Input Key

⑦ LIMIT ERROR message when out of available rage



NOTE

KEY LOCK Release

▶ Setting operation through Input Keypad can be performed after releasing KEY LOCK function switch ON to OFF.

☞ For further information, refer to **[4. FUNCTION & FIX OPERATION setting]**.

2.3.1 Setting input validity test

▶ TEMP2500 confirms key input process and its validity of value by sound

☞ 'Beep' : indicates key input accessed normally within available range.

☞ 'Three Beeps' : indicates key input denied.

CAUTION

Precautions in Operation

▶ Do not press the setting buttons with a sharp object (ex. pencil). This may lead to damage or malfunction of the touch panel.

2.3.2 Set Point input

- ▶ All Set Points can be set by using above mentioned numeric, alpha-numeric and Time Signal setting Keypad.
- ▶ Numeric Input Keypad will appear with pressing ⌜ ⌟ button to input Set Point.
- ▶ For the TIME SIGNAL setting Keypad, refer to **[5.4 TIME SIGNAL]**.
- ▶ For DI ERROR name, refer to the **[11.2 DI ERROR NAME] on [Installation Manual]**.

▶ Description of Numeric Input Keypad

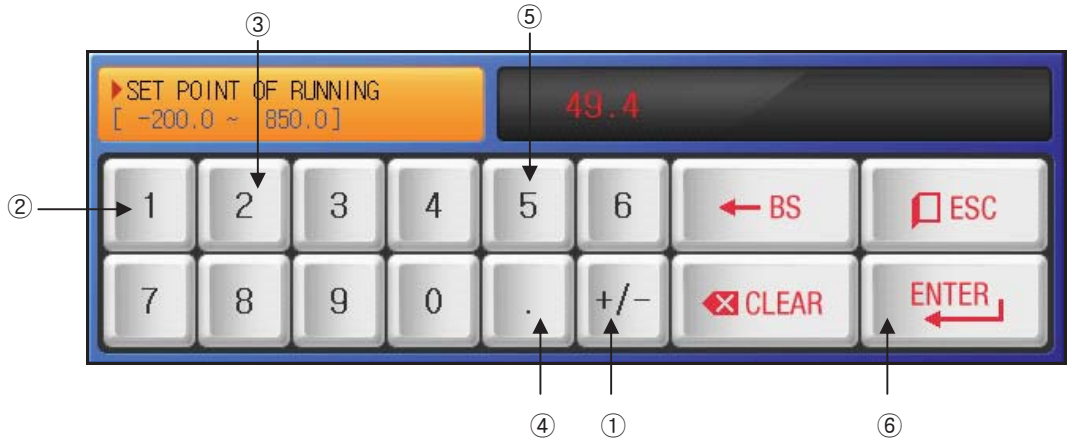
① Displays 'Parameter Name' of Input Keypad.
② Displays available range.
③ Displays new Set Point. If the Set Point is out of range, 'LIMIT ERROR' message will appear.
④ Escape button to cancel and disappear Input Keypad.
⑤ Enter button to accept new set point and disappear Input Keypad.
⑥ Button to input decimal point.
⑦ Button to input negative or positive number. (+/-).
⑧ BackSpace button to delete one numeral of Set Point at a time.
⑨ Clear button to delete the entire Set Point.
⑩ Displays original Set Point.

Ex.) How to input Set Point

▶ The following describes how to change Set Point 49.40 to -12.5.

→ Press the ⌜ ⌟ button to pop up Numeric Input Keypad.

→ Press the numbers by the order (①→②→③→④→⑤). If setting is OK, press ENTER key(⑥).

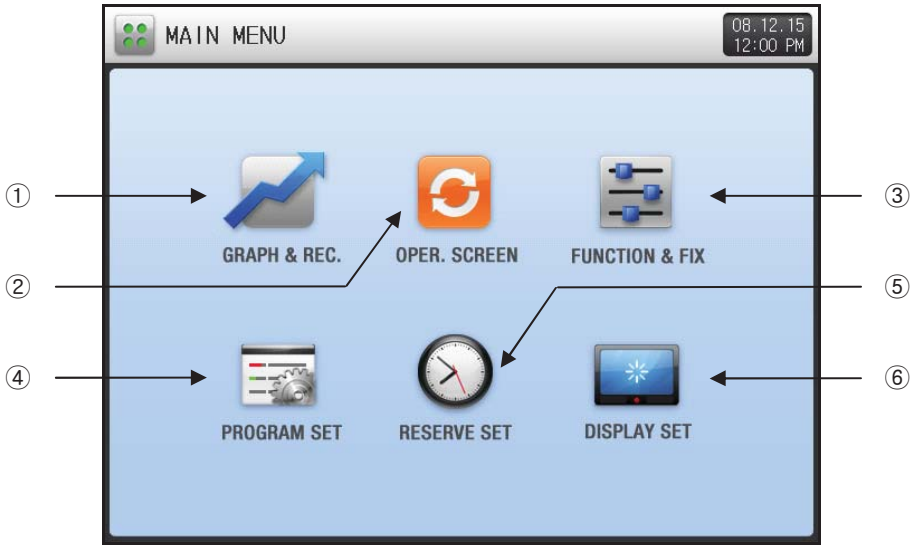


3. OPERATION setting

3.1 MAIN MENU screen

▶ MAIN MENU screen is organized into six sections. This MAIN MENU screen is the central gate way screen to move into Low parameter section

▶ Press the (MAIN) button to move to this MAIN MENU screen.



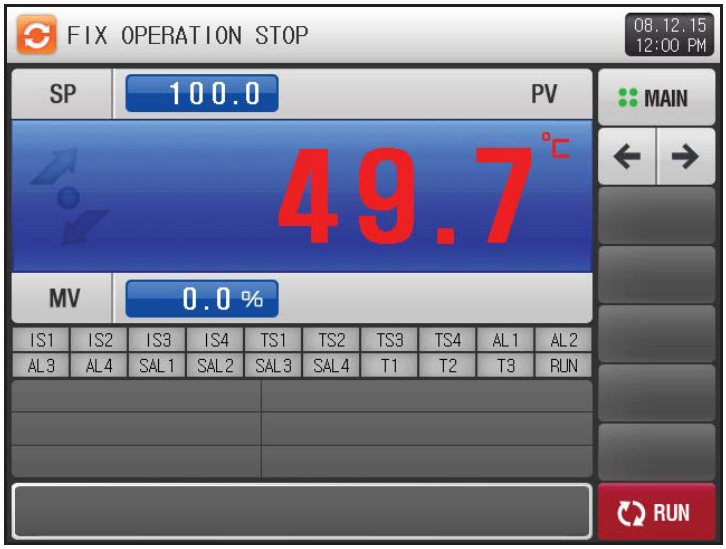
[Figure 3-1] Main Menu Screen

No.	Instructions	Description
①	GRAPH & REC	Section for display recoding data graph and its setting for SD card operation.
②	OPER. SCREEN	Operation status section to start, display and set main operation parameters.
③	FUNCTION & FIX	Function section to set parameters for additional operation function and mode
④	PROGRAM SET	Program setting section organized into 6 groups
⑤	RESERVE SET	Time section to set current time and scheduled operation.
⑥	DISPLAY SET	Move to set Display Brightness Control, PV Font, Buzzer Sound Use/Unuse, Backlight Power Save screen.

3.2 FIX Operation

3.2.1 FIX STOP screen

▶ Under setting 'FIX' operation for 'OPERATION MODE' on **[4. FUNCTION & FIX OPERATION setting]**, when you press [OPER. SCREEN] button on the MAIN MENU screen, this FIX STOP screen will appear.



[Figure 3-2] FIX STOP screen

▶ Input Key is displayed when touch "SET POINT" in the screen to enter set value.

[Figure 3-3] Set Value Input Screen

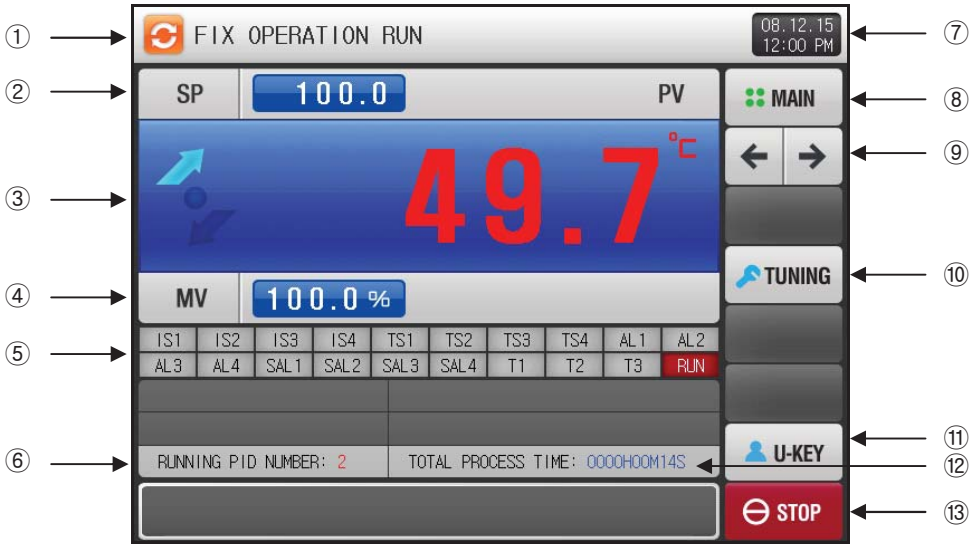
Table 3-1. FIX STOP Screen Parameter

Parameter	Range	Unit	Default
Set Point(SP)	EU(0.0 ~ 100.0%)	EU	EU(0.0%)

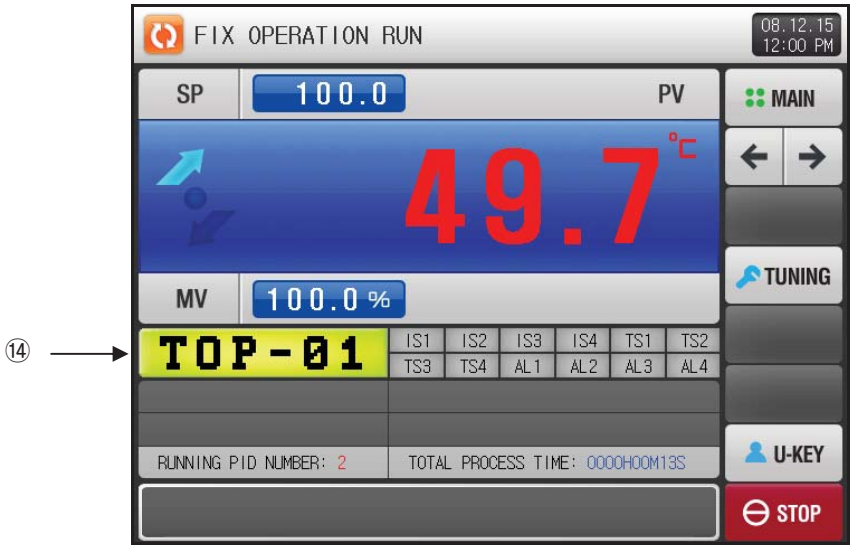
※ EU : Sensor Input Value Range
☞ Refer to **[Engineering Unit]**

3.2.2 The 1st FIX RUN screen

▶ This screen displays Process Value, Set Point, Control Output and Lamp Operation Status.
▶ Set Point Input Key is displayed during operation when touch "SP" part.



[Figure 3-4] The 1st FIX RUN screen-1



[Figure 3-5] The 1st FIX RUN screen-2

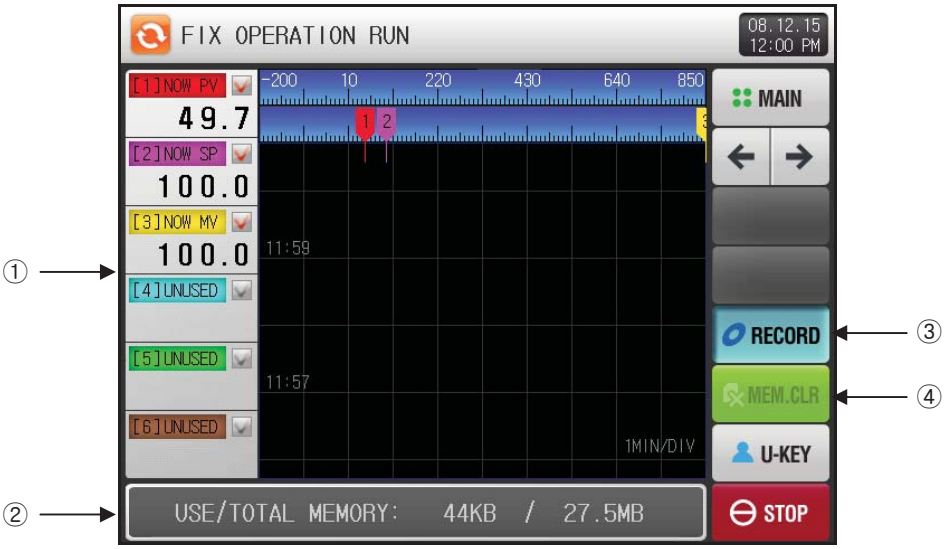
① Indicate current Run Status.
② Indicate current Set Point.
③ Indicate current Process Value.
④ Indicate current Control Output Value.
⑤ Status "ON" is displayed in Red Color, "OFF" is displayed in Dark Gray Color.
☞ Status Lamp can be set at **[SYSTEM INITIAL SET Screen]** in **[Installation Manual]**.
⑥ Indicate PID Group number currently applied.
☞ Able to check applied PID Group at **[PID GROUP]** in **[Installation Manual]**.
⑦ Indicate current Date/Time, and LCD screen turned off when pressing this button.
☞ Red Lamp is turned on when pressing Date/Time button at RUN STOP Screen.
☞ Green Lamp is turned on when pressing Date/Time button at RUN Screen.
⑧ Move to **[Figure 3-1 MAIN MENU]** screen.
☞ Display Keypad to enter Password when set Main Button Restriction.
☞ Refer to **[Figure 4-2]**.

⑨ Move to next screen from current screen.
⑩ Run or Release AUTO TUNING to current Set Value.
☞ Able to set Tuning Button Yes/No from **[PID GROUP]** in **[Installation Manual]**.
⑪ USER-KEY button.
☞ To remove this U-KEY button from this screen, refer to **[13. INITIAL SETTING]** on **[Installation Manual]**.
☞ For using this U-KEY, set available relay number at 'USER KEY SIGNAL' on **[DO CONFIG]** in **[SYSTEM SETTING]**.
Ex.) Used for Chamber Lamp Output ON/OFF, etc.
☞ If USER KEY has been set, appointed relay will be ON by pressing the (U-KEY) button on FIX / PROGRAM operations screen regardless RUN or STOP state.
⑫ Display FIX RUN PROCESS TIME.
⑬ This is RUN/STOP Button.
⑭ Indicates USER TAG.
☞ Use of USER TAG and Name Set can be made at **[7.1 DISPLAY SET]**.

※ ⑩ Button is not displayed at FIX OPERATION STOP Screen.

3.2.3 The 2nd FIX RUN screen

▶ Left side of screen indicates Process Value, Set Point, Control Output Value.
▶ (☐) Check Box set whether to display Data on the Screen.
▶ Press the (RECORD) button on the right hand side to record trend data established at ① of current program operation, and it starts recording with activating (RECORD) button.
▶ Press the activated (RECORD) button to stop recording, and recorded data will be stored in internal memory as a file. New file will be created by every single turning ON /OFF recording.
▶ All data stored in internal memory will be wiped out by POWER OFF.
☞ Store all important recorded data to SD card before POWER OFF.
☞ Refer to **[6.2 TREND GRAPH view & DATA processing]**.
※ While the data is recording into internal memory, that can not be downloaded to SD card.



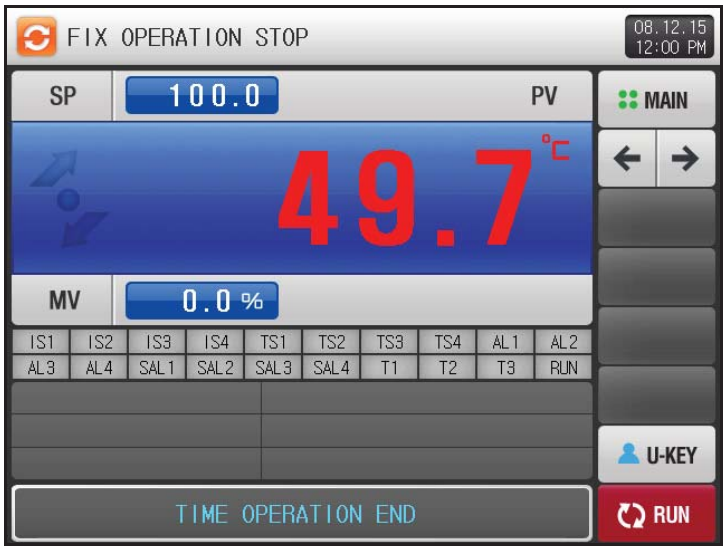
[Figure 3-6] The 2nd FIX RUN Screen

① Indicate current operating Process Value, Set Point and Control Output Value.
② Displays available internal memory volume.
☞ About 25days can be saving on 1 second of sampling time.
③ Button to start recording data selected by check box on the internal memory.
④ Clear button to wipe out all data stored to internal memory.

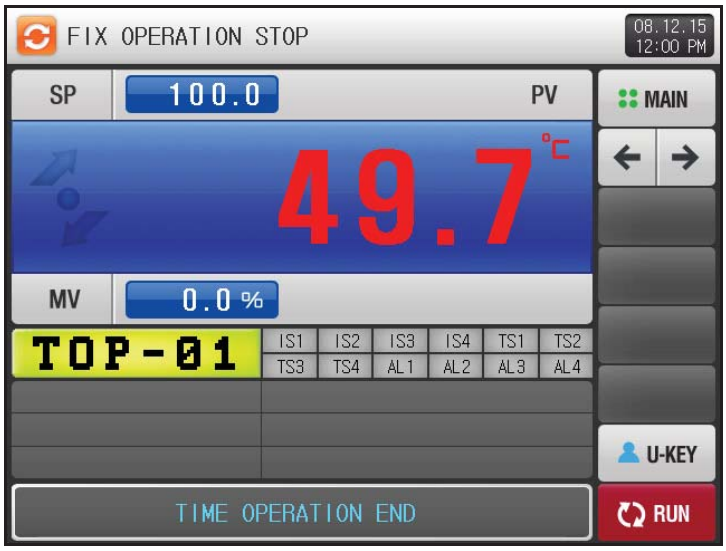
3.2.4 FIX OPERATION STOP Screen

- ▶ Once the operation has completed normally as the time at 'TIME OPERATION' on **[4. FUNCTION & FIX OPERATION setting]**, FIX operation will stop and 'TIME OPERATION END' message appears shown as [Figure 3-7, Figure 3-8]
- ▶ However, this message will not appear if the operation is stopped by force pressing 'STOP' button.
- ▶ That message will disappear with pressing any part of touch screen.

☞ This also applies to PROGRAM STOP



[Figure 3-7] FIX OPERATION STOP Screen-1



[Figure 3-8] FIX OPERATION STOP Screen -2

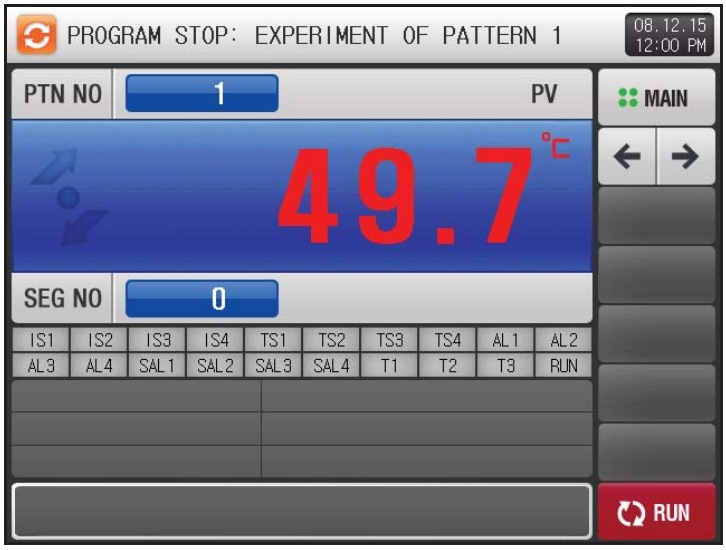
3.3 PROGRAM Operation

3.3.1 PROGRAM STOP screen

▶ Under setting 'PROG' operation at 'OPERATION MODE' on **[4. FUNCTION & FIX OPERATION setting]**, when you press [OPER. SCREEN] section on the MAIN MENU screen, this PROGRAM STOP screen will appear.

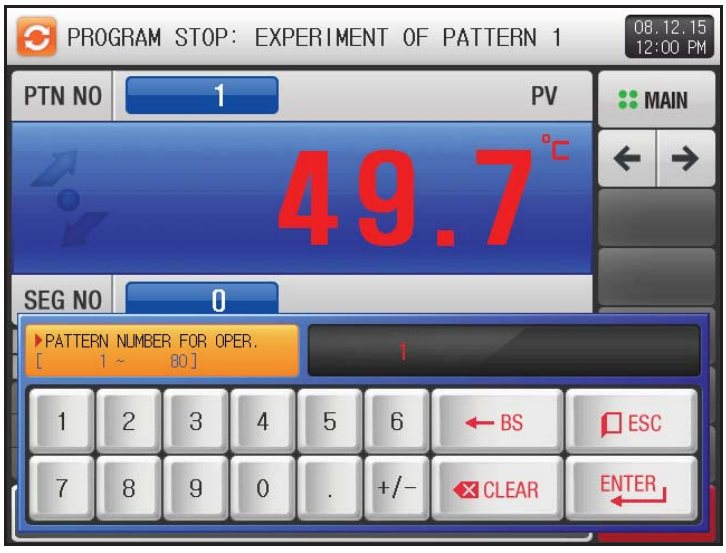
▶ For program settings, refer to **[5. Program PATTERN]**.

▶ Press the RUN(RUN) button on **[Figure 3-9 PROGRAM STOP screen]** to start running operation and move to **[Figure 3-11 The 1st PROGRAM Screen]**.



[Figure 3-9] PROGRAM STOP Screen-1

▶ Input Key is displayed when touching "PATTERN NUMBER FOR OPER" area for pattern number input.



[Figure 3-10] Pattern Number Input Screen

Table 3-2. PROGRAM STOP Screen Parameter

Parameter	Range	Unit	Default
Pattern No.	1~80	ABS	1

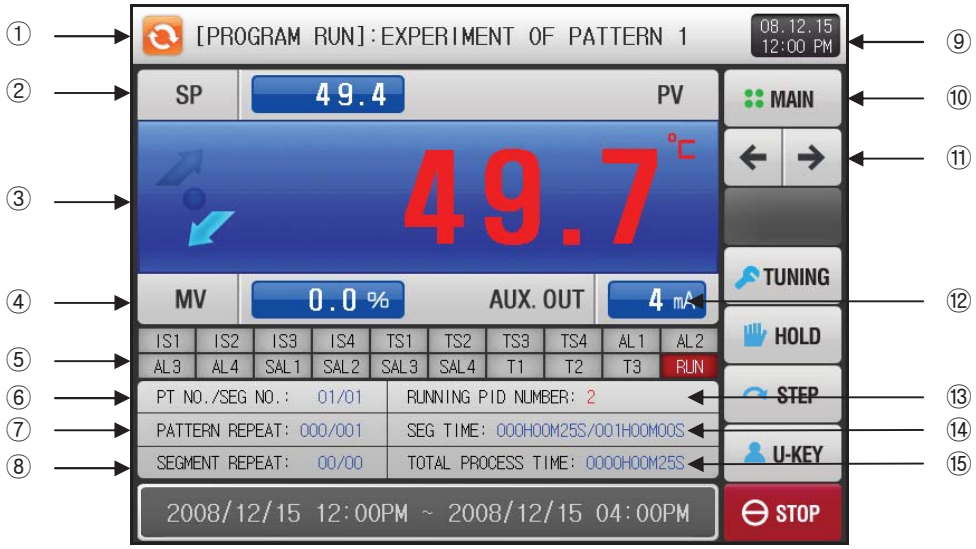
※ Caution for Program Operation

CAUTION

▶ The Operation does not run when the displayed Pattern Number does not include program.
☞ Refer to **[5.1 PATTERN SET]**.

3.3.2 The 1st PROGRAM RUN screen

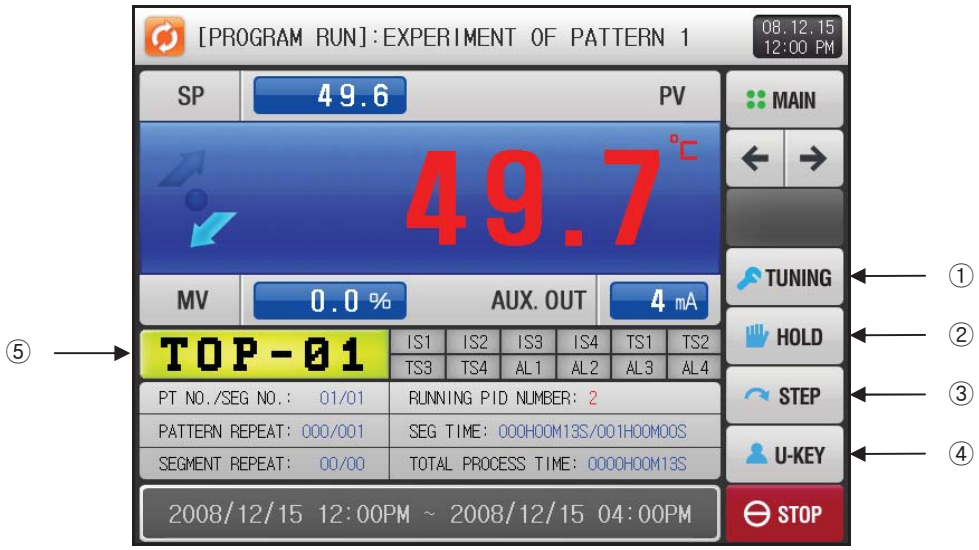
▶ Displays Process Value, Set Point, Control Output and Lamp Operation Status.
▶ It is unable to set Pattern Number during operation.



[Figure 3-11] The 1st PROGRAM RUN screen-1

① Displays current operation status.
② Displays current Segment Set Point.
③ Displays current Process Value.
④ Display current Control Output Value.
⑤ Red status lamp indicates “ON”, and dark gray for “OFF” status.
☞ Status Lamp can be set at **[SYSTEM INITIAL SET Screen]** in **[Installation Manual]**.
⑥ Displays current running Program Pattern number and Segment Number.
⑦ Displays Pattern Repeat status.
☞ [PATTERN REPEAT: 000/000] Former number indicates repeated number, and latter indicates repeat set value.
⑧ Displays Segment Repeat status.
☞ [SEGMENT REPEAT: 00/00] Former number indicates repeated number, and latter indicates repeat set value.
⑨ Displays current Date/Time, and LCD screen disappears when touching this area.
☞ Red Lamp is turned on when pressing Date/Time button at OPERATION STOP Screen.
☞ Green Lamp is turned on when pressing Date/Time button at OPERATION Screen.
⑩ Move to **[Figure 3-1 MAIN MENU]** screen.
☞ Display Keypad to enter Password when set Main Button Restriction.
☞ Refer to **[Figure. 4-2]**
⑪ Move to next screen from current screen.
⑫ Displays current control output value.
☞ Able to select from **[4.1 CONTROL OUTPUT SET]** in **[Installation Manual]**.
☞ AUX Out set can be made from **[5.1 PROGRAM PATTERN]**.
⑬ Displays currently applying PID Group number.
⑭ Displays progress time and set time which is under progress.
☞ [SEG TIME: 000H00M00S/000H00M00S] Former time indicates Segment progress time, and latter indicates Set Time in **[5.1 PROGRAM PATTERN]**.
⑮ Display program run progress time.

▶ Displays Process Value, Set Point, Control Output and Lamp Operation Status.
▶ It is unable to set Pattern Number during operation.



[Figure 3-12] The 1st PROGRAM RUN screen-2

① Executes or releases Auto Tuning with current set value.
☞ Able to set On/Off for Tuning Button Display from **[PID Group]** in **[Installation Manual]**.
② Hold On/Off for the current temperature set value
③ Close current progressing segment and forced to move to next segment.
④ USER-KEY button.
☞ To remove this U-KEY button from this screen, refer to **[13. INITIAL SETTING]** on **[Installation Manual]**.
☞ For using this U-KEY, set available relay number at 'USER KEY SIGNAL' on **[DO CONFIG]** group in **[SYSTEM SETTING]**.
Ex.) Used for Chamber Lamp Output ON/OFF, etc.
☞ If USER KEY has been set, appointed relay will be ON by pressing the (U-KEY) button on FIX / PROGRAM operations screen regardless RUN or STOP state.
⑤ Displays User Tag.
☞ User Tag and Name Set can be made at **[7.1 DISPLAY SET]**.

※ ① ~ ③ buttons are not displayed in PROGRAM OPERATION STOP Screen.

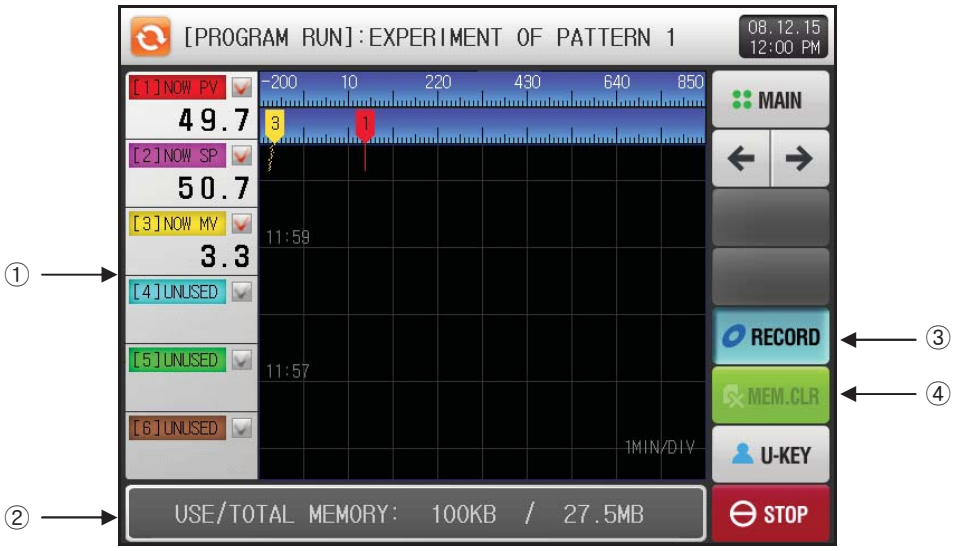
3.3.3 The 2nd PROGRAM RUN Screen

- ▶ Left side of screen indicates Process Value, Set Point, Control Output Value.
- ▶ (☐) Check Box set whether to display Data on the Screen.
- ▶ Press the RECORD(RECORD) button on the right hand side to record trend data established at ① of current program operation, and it starts recording with activating RECORD(RECORD) button.
- ▶ Press the activated RECORD(RECORD) button to stop recording, and recorded data will be stored in internal memory as a file. New file will be created by every single turning ON /OFF recording.
- ▶ All data stored in internal memory will be wiped out by POWER OFF.

☞ Store all important recorded data to SD card before POWER OFF.

☞ Refer to **[6.2 TREND GRAPH view & DATA processing]**.

※ While the data is recording into internal memory, that can not be downloaded to SD card.



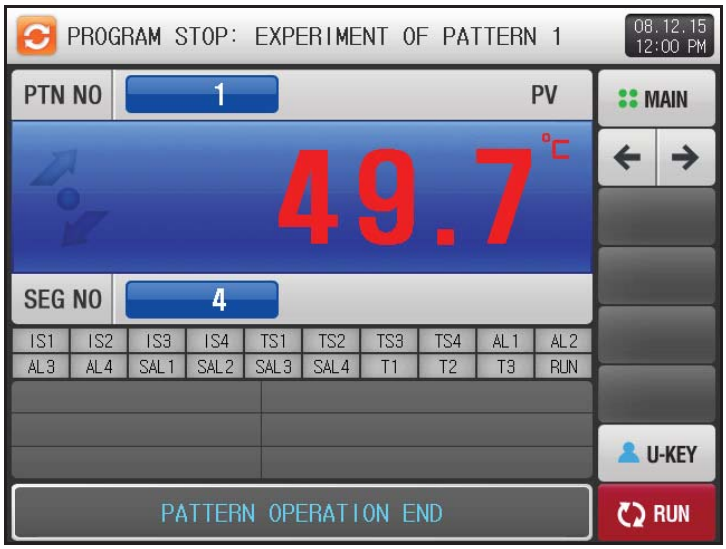
[Figure 3-13] The 2nd PROGRAM RUN Screen

① Indicate current operating Process Value, Set Point and Control Output Value.
② Displays available internal memory volume.
☞ About 25days can be saving on 1 second of sampling time.
③ Button to start recording data selected by check box on the internal memory.
④ Clear button to wipe out all data stored to internal memory.

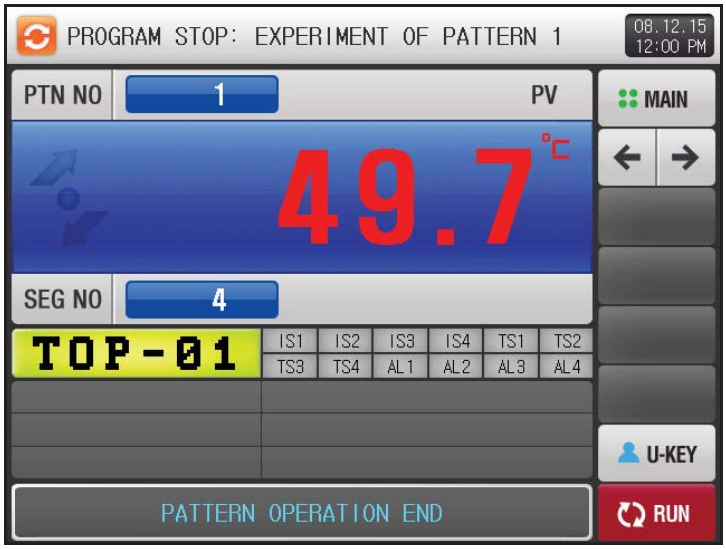
3.3.3 PROGRAM operation STOP Screen

- ▶ Once the operation has completed normally as all setting on processed pattern, PROGRAM operation will stop and 'PATTERM OPERATION END' message appears show as [Figure3-14, Figure3-15].
- ▶ However, this message will not appear if the operation is stopped by force pressing 'STOP' button.
- ▶ That message will disappear with pressing any part of touch screen.

☞ This also applies to FIX STOP



[Figure 3-14] PROGRAM operation STOP Screen-1



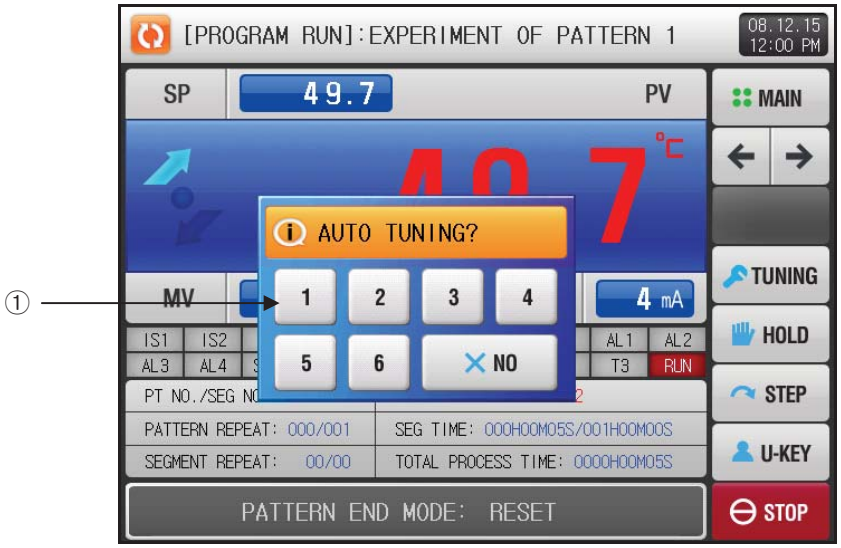
[Figure 3-15] PROGRAM operation STOP Screen-2

3.4 AUTO TUNING screen

▶ Auto Tuning type has two types of Seg PID type and Zone PID type.
▶ Hold and Step key can not be used during Auto Tuning at Program Run.

3.4.1 Auto Tuning (Seg)

▶ Seg PID type auto tunes based on current set point, and the tuning value is stored to “PID No” which is set by Auto Tuning Parameter.
▶ Current set point becomes Auto Tuning Set Point during Auto Tuning execution.
☞ Segment is held during Program Run.
▶ When Auto Tuning is completed, it runs with current Set Point.
☞ Segment progresses during Program Run.



[Figure 3-16] The 1st PROGRAM RUN screen

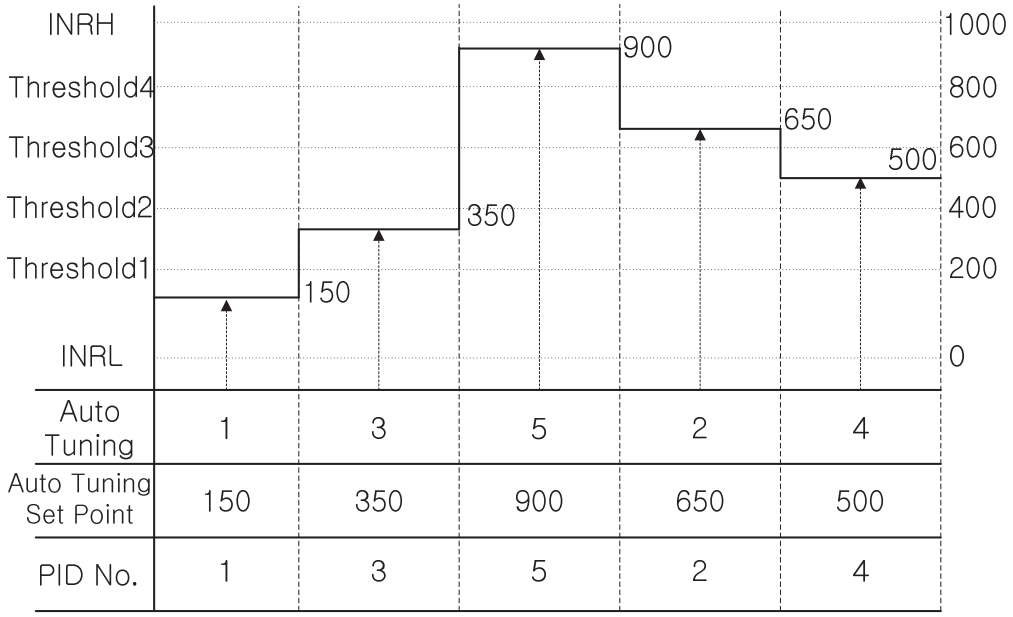
① Able to set PID No.
☞ Store the tuning value to selected number when Auto Tuning is completed.

Table 3-3 Auto Tuning (Seg) Parameter

Parameter	Range	Unit	Default
Auto Tuning	OFF, 1 ~ 6	ABS	OFF

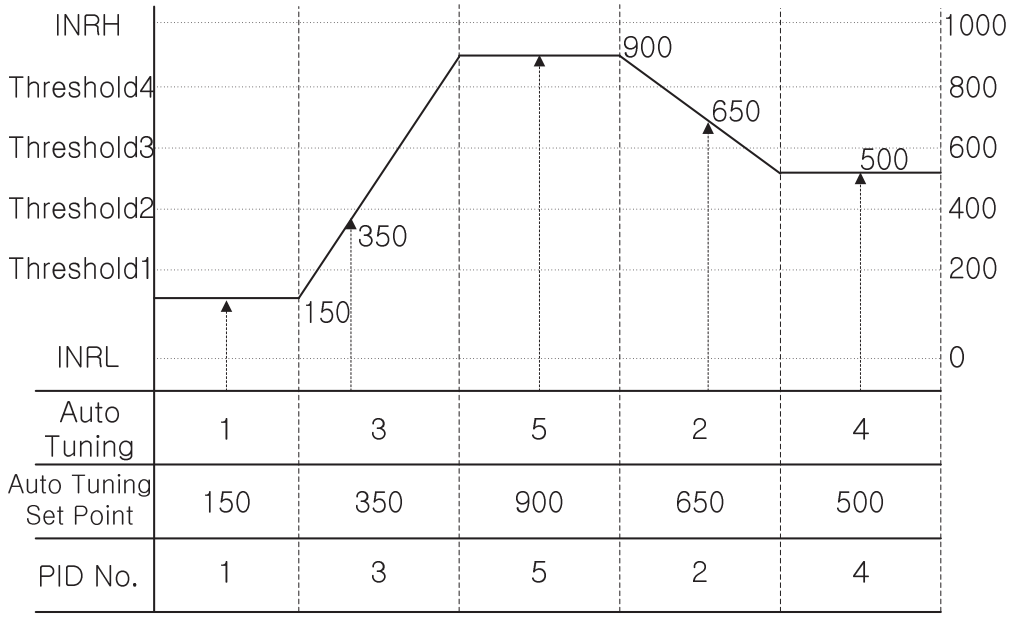
▶ FIX and PROGRAM: AUTO TUNING(SEG)

☞ INRH, INRL : Indicates input sensor range.
☞ Threshold 1 ~4: Indicates threshold value of PID No.
☞ Auto Tuning : Indicates PID No selected for Auto Tuning.
☞ Auto Tuning Set Point: Indicates currently running Set Point.



Auto Tuning	1	3	5	2	4
Auto Tuning Set Point	150	350	900	650	500
PID No.	1	3	5	2	4

FIX OPERATION: AUTO TUNING (SEG)

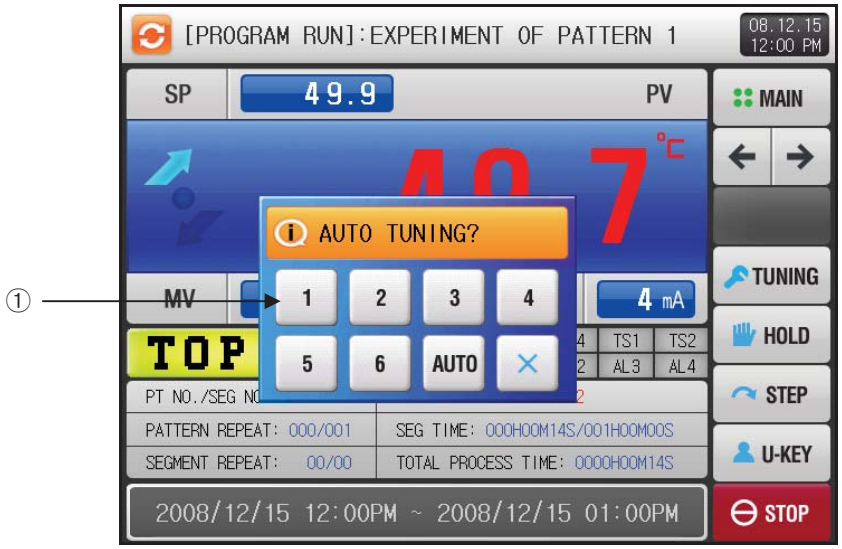


Auto Tuning	1	3	5	2	4
Auto Tuning Set Point	150	350	900	650	500
PID No.	1	3	5	2	4

PROGRAM OPERATION: AUTO TUNING (SEG)

3.4.2 AUTO TUNING (ZONE)

▶ Tuning is performed with the center value as target of PID group threshold value which is set at Auto Tuning Parameter, and the tuning value is stored to selected PID No.
▶ Current set point becomes Auto Tuning Set Point during Auto Tuning execution.
☞ Segment is held during Program Run.
▶ When Auto Tuning is completed, current Set Point is changed to Set Point prior to Auto Tuning.
☞ Segment progresses during Program Run.
▶ When it is forced to stop during Auto Tuning, Tuning Value will be stored into PID No.
☞ Tuning Value will not be stored on power outage during Auto Tuning, too.



[Figure 3-17] The 1st PROGRAM RUN screen

① Tuning value is stored to the selected number when Auto Tuning is completed.
☞ Number in the box indicates PID number.
☞ Tuning Value is stored from1 ~ 6 sequentially when selecting Auto.

Table 3-4 Auto Tuning (Zone) Parameter

Parameter	Range	Unit	Default
Auto Tuning	OFF, 1 ~ 6, Auto	ABS	OFF

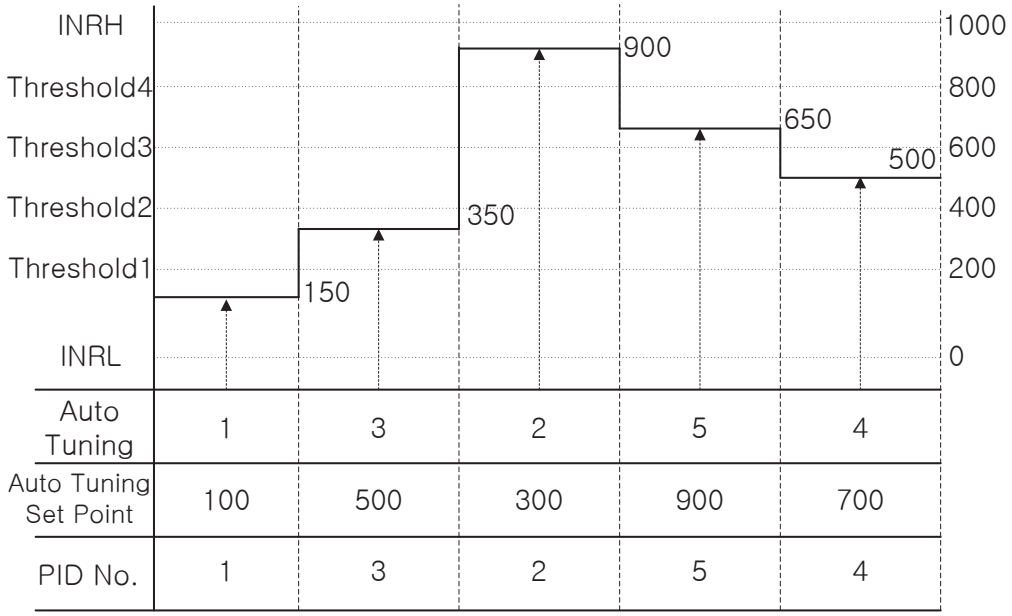
CAUTION

Caution for Auto Tuning (Zone Type)

▶ When it is forced to stop during Auto Tuning, nothing will be stored into PID No.
▶ Nothing will be stored on power outage, too.

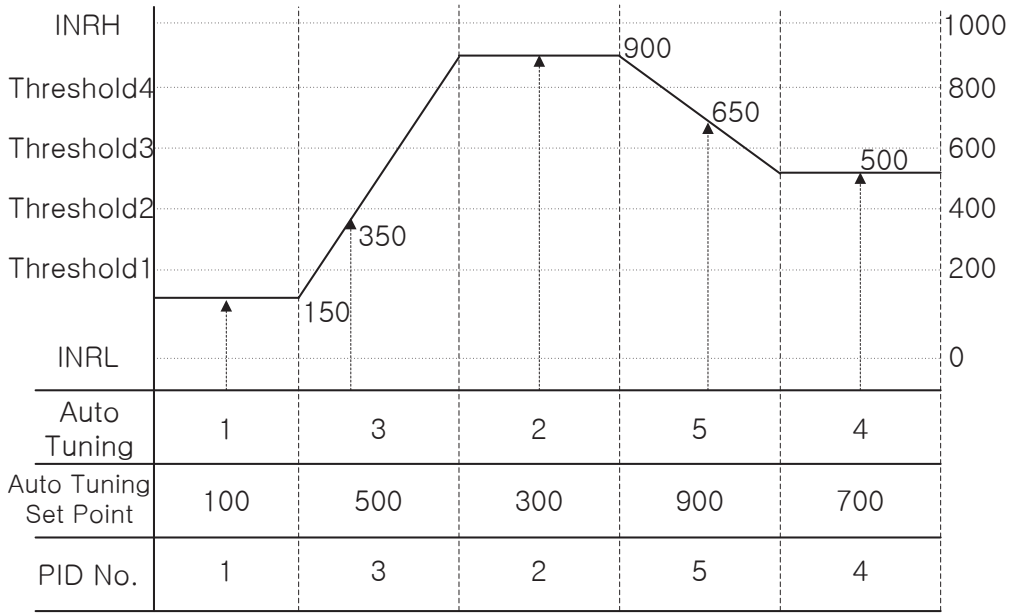
▶ FIX and PROGRAM: AUTO TUNING (Zone)

☞ INRH, INRL : Indicates input sensor range.
☞ Threshold 1 ~4: Indicates threshold value of PID No.
☞ Auto Tuning : Indicates PID No selected for Auto Tuning.
☞ Auto Tuning Set Point: Indicates currently running Set Point.



Auto Tuning	1	3	2	5	4
Auto Tuning Set Point	100	500	300	900	700
PID No.	1	3	2	5	4

FIX OPERATION: AUTO TUNING



Auto Tuning	1	3	2	5	4
Auto Tuning Set Point	100	500	300	900	700
PID No.	1	3	2	5	4

PROGRAM OPERATION: AUTO TUNING (Zone)

▶ Following is the Tuning Point Calculation method in Zone Type.

① Tuning Point : 1
☞ Execute PID1 Segment Auto Tuning.
– PID1 Auto Tuning Set Point = $INRL + \frac{Threshold\ 1 - INRL}{2}$

② Tuning Point : 2
☞ Execute PID2 Segment Auto Tuning.
– PID2 Auto Tuning Set Point = $Threshold\ 1 + \frac{Threshold\ 2 - Threshold\ 1}{2}$

③ Tuning Point : 3
☞ Execute PID3 Segment Auto Tuning.
– PID3 Auto Tuning Set Point = $Threshold\ 2 + \frac{Threshold\ 3 - Threshold\ 2}{2}$

④ Tuning Point : 4
☞ Execute PID4 Segment Auto Tuning.
– PID4 Auto Tuning Set Point = $Threshold\ 3 + \frac{Threshold\ 4 - Threshold\ 3}{2}$

⑤ Tuning Point : 5
☞ Execute PID5 Segment Auto Tuning.
– PID5 Auto Tuning Set Point = $Threshold\ 4 + \frac{INRH - Threshold\ 4}{2}$

⑥ Tuning Point : 6
☞ Execute PID6 Segment Auto Tuning.
- PID6 Auto Tuning Set Point = $INRL + \frac{INRH - INRL}{2}$

⑦ Tuning Point: Auto
☞ Execute Auto Tuning for PID1 ~ 6 Segment sequentially.
☞ Store Auto Tuning value to PID1 ~ 6 Segments.
– PID1 Auto Tuning Set Point = $INRL + \frac{Threshold\ 1 - INRL}{2}$

– PID2 Auto Tuning Set Point = $Threshold\ 1 + \frac{Threshold\ 2 - Threshold\ 1}{2}$

– PID3 Auto Tuning Set Point = $Threshold\ 2 + \frac{Threshold\ 3 - Threshold\ 2}{2}$

– PID4 Auto Tuning Set Point = $Threshold\ 3 + \frac{Threshold\ 4 - Threshold\ 3}{2}$

– PID5 Auto Tuning Set Point = $Threshold\ 4 + \frac{INRH - Threshold\ 4}{2}$

- PID6 Auto Tuning Set Point = $INRL + \frac{INRH - INRL}{2}$