StonyLab®

Muffle Furnace

(Model SB-FH-SX4-MFL Series)

Operation Manual

(Please read the instruction carefully before you use the machine)

Contents

1. Introduction

This series of furnaces is designed for elemental analysis in laboratories, mining companies, and research institutes. Additionally, they are used for heat treatments such as annealing and tempering of small steel parts.

2. Main Technical Parameters

Model		SB-FH-SX4-MFL-2-12P-110V
		SB-FH-SX4-MFL-2-12P-220V
		SB-FH-SX4-MFL-7-12P-220V
		SB-FH-SX4-MFL-12-12P-220V
		SB-FH-SX4-MFL-16-12P-380V
Heating Mode		Alloy wire heating on three sides (left, right, and top)
Function	Temp. Range	100°C - 1200°C
	Temp. Resolution	1°C
	Temp. Fluctuation	±1°C
	Time to Reach Max Temp	≤ 30 min
	Chamber Material	Ceramic fiber

Structure	Outer Shell	Cold-rolled steel plate, surface electrostatic spraying; Model 'B' series: embossed stainless steel material			
	Insulation Layer	Ceramic fiber			
	Heater	Alloy heating wire			
	Power Rating	1.5kW	3.0kW	4.5kW	6.0kW
	Exhaust Hole	ϕ30 mm (chimney size 80 x 60 mm)			
Controller	Temp. Control Mode	Fuji 64-segment programmable temperature controller			
	Temp. Setting Mode	Touch button setting			
	Temp. Display Mode	Measuring temp: LED upper row Setting temp: LED lower row			
	Timer	0-9999 min timing function			
	Operation Functions	Fixed-point operation, timed operation, automatic stop			
	Additional Functions	Sensor deviation correction, temperature overshoot self-tuning, internal parameter locking, power-off parameter memory			
	Sensor	High precision K type sensor			
Safety Device		Manual furnace door safety lock, over-temperature audio-visual alarm, door-open power cutoff, over-temperature protection, thermocouple failure alarm			

Specification	Inner Chamber Size (W x L x H)(mm)	120 x 200 x 80	200 x 300 x 120	200 x 300 x 200	250 x 400 x 160
	Exterior Size (W x L x H)(mm)	450 x 685 x 600	530 x 785 x 640	530 x 785 x 720	600 x 895 x 700
	Packing Size (W x L x H)(mm)	580 x 775 x 730	660 x 875 x 770	660 x 875 x 850	730 x 985 x 830
	Internal Volume	2L	7L	12L	16L
	Current Rating (50/60HZ)	AC220V/6.6A	AC220V/13.6A	AC220V/20.4A	AC380V/9.9A
	NW/GW (kg)	33/37	45/50	62/68	77/96
Optional Type		LCD program temperature control device with USD date storage			

3. Characteristics

3.1 The mirror-finish stainless steel furnace mouth retains its color even after prolonged use.

3.2 Double-insulated ceramic chamber ensures stable performance.

3.3 The vacuum-formed polycrystalline mullite fiber furnace chamber provides high-efficiency insulation with 3-sided heating using special alloy wires, ensuring optimal temperature uniformity.

3.4 The precise combination of a high-accuracy micro-computer controller and precision sensor guarantees accurate temperature control.

3.5 The double-shell air insulation and dual ventilation channels ensure excellent airflow with low external temperature rise.

3.6 Multiple safety features, including thermocouple failure detection, door-open power cutoff, over-temperature protection, and audio-visual alarms, ensure the safety of experiments.

3.7 Equipped with imported temperature controllers and high-precision sensors for sensitive response, accurate temperature control, and excellent stability.

3.8 Enhanced exhaust system for improved ashing.

3.9 Split design with detachable circuits for easy maintenance and repair.

3.10 Programmable temperature controllers with multi-stage settings streamline experimental processes and facilitate automatic operation.

4. Installation and Operation

4.1 Unpack the furnace, inspect it thoroughly, and ensure all components are present. Place the furnace on a stable, flat surface, ensuring the controller is protected from vibration.

4.2 Install the power switch on the main power line to control the entire system. For safe operation, both the furnace and controller must be properly grounded.

4.3 Connect the controller to the power line, ensuring the connection is accurate. Then, switch on the power and set the desired temperature on the display. Heating begins when the indicator light turns green. Adjust the power as needed to reach the target temperature, while ensuring that the voltage and current do not exceed the rated capacity.

5. Attentions

	Install external grounding protection to ensure the safety of both the equipment and the experiment, and ensure the power supply meets the machine's requirements.
	This equipment is prohibited from being used in experiments involving flammable, explosive, toxic, or highly corrosive substances.
	Ensure the equipment is installed on a level surface.
	Only professionals are permitted to disassemble and repair this machine.
	Exercise caution with the temperature settings when handling flammable materials.
	Ensure the resin container is dry. If the temperature is accidentally set too high, the container may melt and fall onto the heater, potentially causing a fire.
	Overfilling the sample can cause the lower part of the working chamber to overheat, potentially melting flammable materials and leading to a fire.
	Avoid touching the top of the device, the observation window, or the exhaust port while the machine is in operation to prevent burns from high temperatures.
	**Do not open the door when the temperature exceeds 500°C!**
	**For prolonged use, set the temperature 50°C below the maximum temperature.**
	Refer to the instruction manual prior to operation.

6. Meter operation instruction

6.1 Front Panel Explanation

USER Key

- Press once in PV/SV display (operation screen) to switch between the SV indicator and MV indicator.
- Press and hold in PV/SV display to execute the assigned function (no function is preset from the factory).
- Press once in operation mode, channel selection mode, or setting mode to return to the PV/SV display.

SEL Key

- Press once in operation mode (PV/SV display) to switch to run mode.
- Press and hold in setup mode to switch to channel selection mode.
- Press once in channel selection mode to switch to setting mode.
- Press and hold in setting mode to return to channel selection mode.
- Press once in parameter selection within setting mode to switch to parameter setting status.
- Press once in parameter setting status to confirm and switch back to parameter selection.

< Key

When changing values, use to move the target digit to be adjusted.

∧/∨ Key

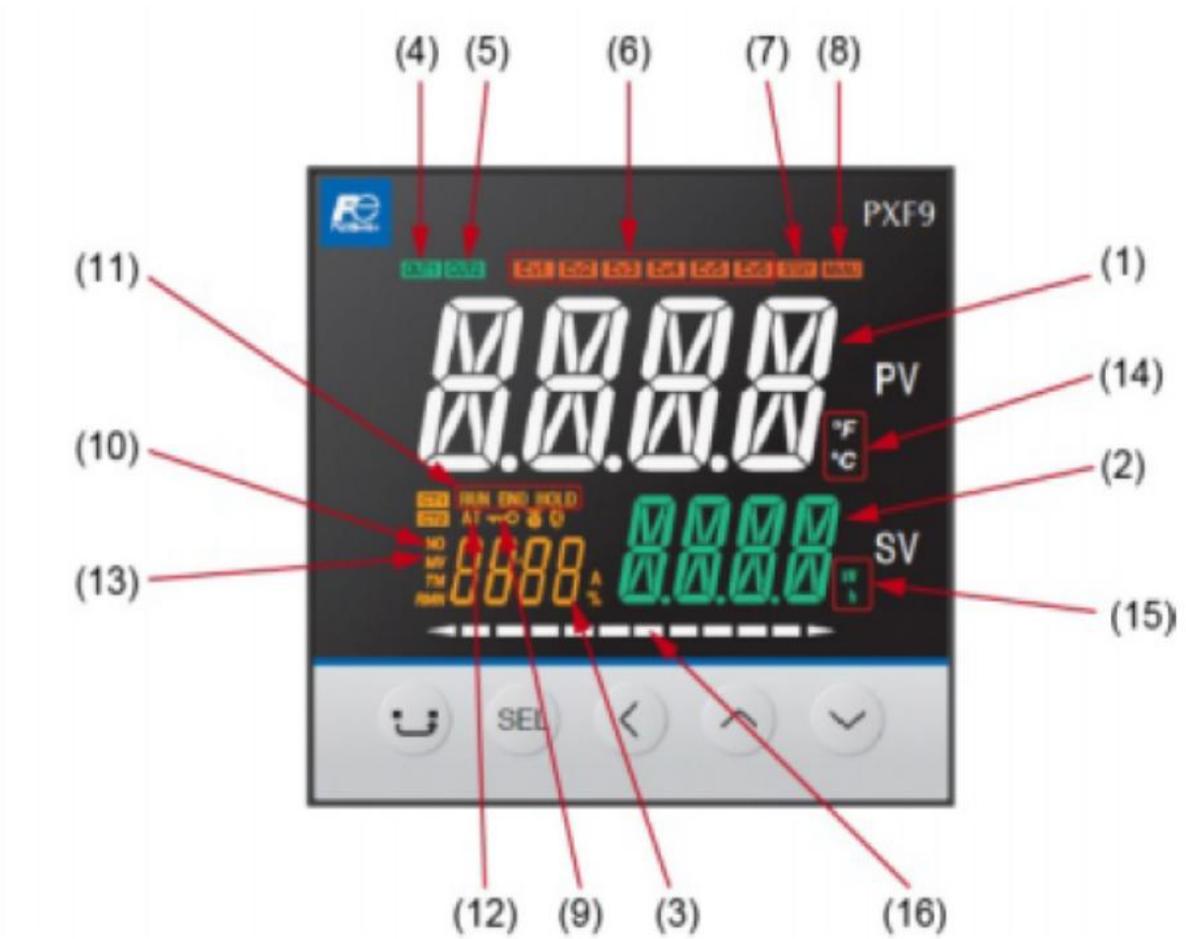
- In PV/SV display, you can modify the SV value.
- In operation, channel selection, and setting modes, it allows modification of parameter indicators.
- In parameter setting mode, it allows modification of parameter values.

USER + ∧ Key

Press and hold in PV/SV display to run the assigned function (the factory preset is set to toggle "Run/Standby").

USER + V Key

Press and hold in PV/SV display to run the assigned function (the factory preset is set to toggle the start/stop of auto-tuning).



(1) Process Value (PV) Display: Shows the process value and parameter name when in parameter setting mode.

(2) Set Point (SV) Display: Displays the set value and the parameter set point during parameter setting.

(3) Screen Number: Displays the screen number during parameter setting.

(4) OUT1 Indicator: Illuminates when control output 1 is active.

(5) OUT2 Indicator: Illuminates when control output 2 is active.

(6) EV1, EV2, EV3 Indicators: Lights up when digital outputs 1 to 3 are active.

(7) STBY Indicator: Illuminates when the system is in standby mode.

(8) MANU Indicator: Lights up during manual mode.

(9) Lock Indicator: Illuminates when the key lock is active.

(10) Number Indicator: Lights up when a screen number is displayed.

(11) RUN/HOLD/END Indicators: Illuminates during ramp/soak operations.

(12) AT Indicator: Lights up during auto-tuning.

(13) MV Indicator: Lights up when MV is displayed in place of SV.

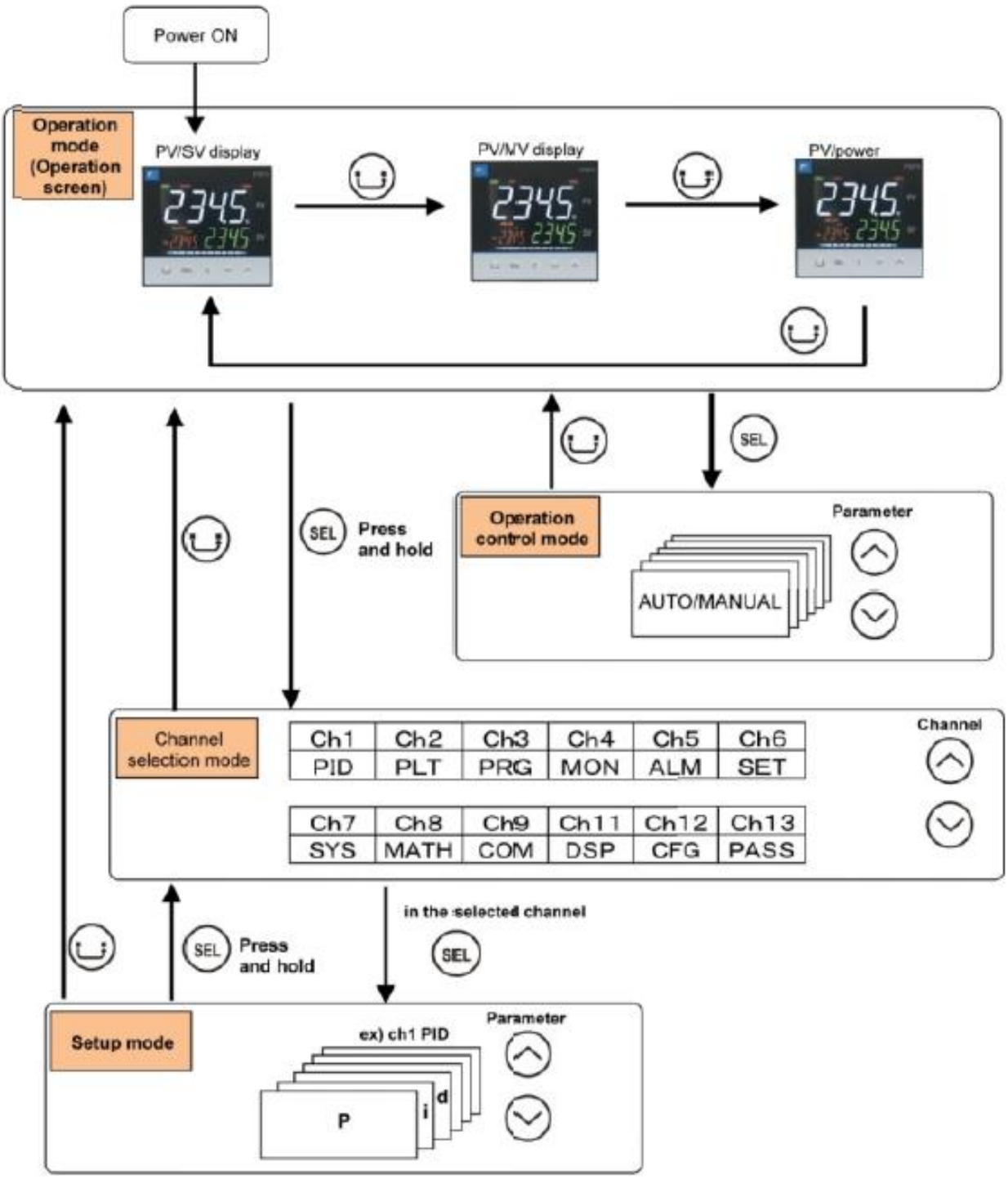
(14) °C/°F Indicator: Displays the temperature unit in use.

(15) A, %, kW/h Indicator: Displays the unit applied to values on the SV display during operation.

(16) Bar Graph: Shows the MV (manipulated variable).

6.2 Basic Operation

The switching between various modes and key operations are shown in the diagram below.



Press the (∧) or (∨) keys to adjust the set value. When the decimal point on the display is flashing, you can use the left arrow key as a shift key to conveniently modify individual digits.

Instrument Self-Tuning: Hold the SEL key for 5 seconds until the display shows "MAN." Press the SEL key 4 more times to display "AT" at the top and "OFF" at the bottom of the screen. Use the

up or down arrows to change "OFF" to "ON, " then press SEL again, followed by the leftmost return key, to start the instrument's self-tuning process. The AT indicator will light up while self-tuning is active and will only turn off once the process is complete. Ensure the power is not interrupted during this process, and if it is, reset the instrument. During self-tuning, the instrument automatically adjusts output power, causing significant temperature fluctuations, so make sure the workspace is empty to avoid damaging samples.

Press SEL to modify the following internal parameters

Parameter			Function	Setting range	Initial value	Remarks
№	Display	Name				
001	MAN	Switchover between auto and manual mode	Switchover between auto and manual modes	oFF (auto) / on(manual)	oFF	This parameter is not displayed in default setting. If you need to change this parameter, change the setting of "Ch11 dSP" so that it appears.
002	StbY	Switchover between RUN and standby	Switchover the operation mode between RUN and standby	oFF(RUN) / on(standby)	oFF	
003	PEM	Local/remote switchover	Switches SV between local/remote.	LoCL (local) / REM (remote)	LoCL	
004	PRoG	Ramp soak control command	Changes ramp soak run states	oFF (stop)rUn (run)hLd (hold)	oFF	Displays End (when ending) or GS (during guaranty soak).
005	AE	Auto-tuning run command	Runs auto-tuning.	oFF (stop/finish)on (normal type)Lo (low PV type)	oFF	
006	LACH	Alarm output latch release command	Cancels the alarm output latch state	oFF / rST (latch resets)	oFF	
007	SVN	SV selection	Chooses the SV No. used for control	LoCL Sv1 Sv2 Sv3 Sv4 Sv5 Sv6 Sv7 di (chooses SV according to DI)	LoCL	"When changing the SV with the front key, do not change the "Svn" parameter via communication. Otherwise, the changed SV may not be stored correctly."
008	PL IM	PID selection	Chooses the PID No. used for control	LoCL (PID ch) Pid 1 (PID group No. 1) Pid 2 (PID group No. 2) Pid 3 (PID group No. 3) Pid 4 (PID group No. 4) Pid 5 (PID group No. 5) Pid 6 (PID group No. 6) Pid 7 (PID group No. 7) di (chooses PID group according to DI)	LoCL	
009	AL 1	ALM1 set value	Sets the alarm value for ALM1.	Absolute value alarm: 0 to 100% FS Deviation alarm: -100 to 100% FS	2.50%FS	
010	A1-L					
011	A1-H					
012	AL2	ALM2 set value	Sets the alarm value for ALM2.	Absolute value alarm: 0 to 100% FS Deviation alarm: -100 to 100% FS	2.50%FS	
013	A2-L					
014	A2-H					
015	AL3	ALM3 set value	Sets the alarm value for ALM3.	Absolute value alarm: 0 to 100% FS Deviation alarm: -100 to 100% FS	2.50%FS	
016	A3-L					
017	A3-H					
018	AL4	ALM4 set value	Sets the alarm value for ALM4.	Absolute value alarm: 0 to 100% FS Deviation alarm: -100 to 100% FS	2.50%FS	
019	A4-L					
020	A4-H					
021	AL5	ALM5 set value	Sets the alarm value for ALM5.	Absolute value alarm: 0 to 100% FS Deviation alarm: -100 to 100% FS	2.50%FS	
022	A5-L					
023	A5-H					
027	WLMd	Electric power calculation command	Switches among on/off/hold of electric power calculation.	oFF (stop calculation) rUn (run calculation) hLd (suspend calculation)	oFF	
028	LoC	Key lock	Sets the key lock to prevent wrong operation	oFF (no lock) ALL (all lock) PArA (All but SV locked)	oFF	

Press the SEL 5 seconds to modify the follow specification

Ch1 PID (control parameters)

Parameter			Function	Setting range	Initial value	Remarks
№	Display	Name				
050	P	Proportional band (%)	Sets the proportional band of the PID parameter.	0.1 to 999.9%	5.0%	
051	I	Integration time	Sets the integration time of the PID parameter. Setting "0" will turn off integration.	0 to 3200 sec	240 sec	
052	d	Differential time	Sets the differential band of the PID parameter. Setting "0" will turn off differentiation.	0.0 to 999.9 sec	60.0 sec	
053	HYS	ON/OFF control hysteresis	Sets the hysteresis width for the ON/OFF control.	0 to 50%FS	0.25%FS	
054	CooL		Sets the proportional band coefficient for cooling. Setting "0.0" will turn the cooling into an ON/OFF control.	0.0 to 100.0	1.0	
055	db	Dead band (%)	Shifts the cooling proportional band from the set value	-50.0 to 50.0%	0.0%	
056	bAL	Output convergence value (%)	Offset value which is added to the MV output value	-100.0 to 100.0%	0/50 (single/dual)	
057	AR	Anti-reset windup	Sets the range of integration control	0 to 100%FS	100%FS	
058	REV	Normal/reverse operation	Selects single control or dual control. Sets the control action (normal or reverse).	rv-- (heat (reverse)/cool (none)) no-- (heat (normal)/cool (none)) rvno (heat (reverse)/cool (normal)) norv (heat (normal)/cool (reverse)) rvrv (heat (reverse)/cool (reverse)) nono (heat (normal)/cool (normal))	rv--/rvno (single/dual)	[RESET]
059	SVL	SV limit (lower)	Sets the lower limit of SV	0 to 100%FS	0.00%FS	Note 1)
060	SVH	SV limit (upper)	Sets the upper limit of SV	0 to 100%FS	100.00%FS	Note 1)
061	tC1	OUT1 proportion cycle	Sets the proportion cycle of the control output (OUT1) (contacts, SSR drive)	1 to 150 sec	30 (relay) 2 (SSR) 1 (current)	
062	tC2	OUT2 proportion cycle	Sets the proportion cycle of the control output (OUT2) (contacts, SSR drive)	1 to 150 sec	30 (relay) 2 (SSR) 1 (current)	
063	PLC1	OUT1 lower limit	Sets the lower limit of the control output(OUT1)	-5.0 to 105.0%	-5.0%	
064	PHC1	OUT1 upper limit	Sets the upper limit of the control output(OUT1)	-5.0 to 105.0%	105.0%	
065	PLC2	OUT2 lower limit	Sets the lower limit of the control output(OUT2)	-5.0 to 105.0%	-5.0%	
066	PHC2	OUT2 upper limit	Sets the upper limit of the control output(OUT2)	-5.0 to 105.0%	105.0%	
067	PCUt	Type of output limiter	Sets the type of output limiter	0 to 15	0	
073	ALPA	Alpha	Sets 2-degrees of freedom coefficient α	-199.9to 300.0%	40.0%	
074	bEtA	Beta	Sets 2-degrees of freedom coefficient β	0.0 to 999.9%	100.0%	

Note 1: "SVL" and "SVH" must be set so that SvL < Svh. When you change the values for "SVL" and "SVH", check SV 1 ("Sv1 Ch2") through SV 7 ("Sv7 Ch2").

Programmable Temperature Setting Specification

Parameter			Function	Setting range	Initial value	Remarks
№	Display	Name				
200	PtN	Ramp soak operation pattern (Step No.)	Sets which steps to use in the ramp soak operation pattern	0 (uses steps 1 to 8) 1(uses steps 9 to 16) 2(uses steps 17 to 24) 3(uses steps 25 to 32) 4(uses steps 33 to 40) 5(uses steps 41 to 48) 6(uses steps 49 to 56) 7(uses steps 57 to 64) 8(uses steps 0 to 16) 9(uses steps 17 to 32) 10(uses steps 33 to 48) 11(uses steps 49 to 64) 12(uses steps 0 to 32) 13(uses steps 33 to 64) 14(uses steps 0 to 64) di (depending on DI)	14	Note 1)
201	tiMU	Ramp soak time units	Sets the units of the ramp soak time	hh.MM (hour:min) MM.SS (min:sec)	hh.MM	
202	SV-1	Ramp soak 1 seg/SV 1	Sets the SV	0 to 100%FS	0%FS	
203	tM1P	Ramp soak 1 seg ramp time	Sets the ramp time.	00:00 to 99:59 (hour:min/min:sec)	00:00	
204	tM1S	Ramp soak 1 seg soak time	Sets the soak time.	00:00 to 99:59 (hour:min/min:sec)	00:00	
205	SV-2	Ramp soak 2 seg/SV 2	Sets the SV	0 to 100%FS	0%FS	
206	tM2P	Ramp soak 2 seg ramp time	Sets the ramp time.	00:00 to 99:59 (hour:min/min:sec)	00:00	
⋮	⋮	⋮	⋮	⋮	⋮	⋮
389	t63P	Ramp soak 63 seg ramp time	Sets the ramp time.	00:00 to 99:59 (hour:min/min:sec)	00:00	
390	t63S	Ramp soak 63 seg soak time	Sets the soak time.	00:00 to 99:59 (hour:min/min:sec)	00:00	
391	SV64	Ramp soak 64 seg/SV 64	Sets the SV	0 to 100%FS	0%FS	
392	t64P	Ramp soak 64 seg ramp time	Sets the ramp time.	00:00 to 99:59 (hour:min/min:sec)	00:00	
393	t64S	Ramp soak 64 seg soak time	Sets the soak time.	00:00 to 99:59 (hour:min/min:sec)	00:00	
394	Mod	Ramp soak mode	Sets the program operation method	0 to 15	0	
395	GSoN	Guaranty soak ON/OFF	Sets the guaranty soak ON or OFF	oFF (guaranty soak off) on (guaranty soak on)	oFF	
396	GS-L	Guaranty soak band (Lower)	Sets the lower limit of guaranty soak	0 to 50%FS	1.25%FS	
397	GS-H	Guaranty soak band (Upper)	Sets the upper limit of guaranty soak	0 to 50%FS	1.25%FS	
398	PVSt	PV start	Sets whether or not to start ramp soak with PV.	oFF (PV start off) on (PV start on)	oFF	
399	CoNt	Restore mode	Sets how to restart when the controller is restored after a power loss.	rES (Reset) Con (Continue) ini (Restart)	rES	
400	PtNM	Max pattern selection	Sets the maximum pattern number selectable by using the user key.	0 to 14	14	
401	PtMN	Min pattern selection	Sets the minimum pattern number selectable by using the user key.	0 to 14	0	

Note 1: Do not change this parameter during the ramp soak operation. Be sure to set "PRG" = "oFF" before changing the parameter

After configuring the heating program, press the SEL key to adjust the PROG parameter to RUN. The set program will then begin, and once completed, "END" will be displayed on the instrument.

Ch 5 ALM (alarm parameters)

Parameter			Function	Setting range	Initial value	Remarks
№	Display	Name				
470	A1tP	ALM1 alarm type	Set the alarm type for ALM1.	0 to 47	0	Refer to section 11 for the detail.
471	A1HY	ALM1 hysteresis	Sets the hysteresis for alarm output 1 ON/OFF	0 to 50%FS	0.25%FS	
472	dLY1	ALM1 delay	Sets the delay before detecting alarm output 1	0 to 9999 [sec/min]	0	
473	dLU1	ALM1 delay time units	Sets the delay time units for alarm output 1	sec (second)/Min (minute)	sec	
474	AoP1	ALM1 option function	Assigns the optional functions to ALM1 Ones digit: alarm output latch Tens digit: error alarm Hundreds digit: inverted output Thousands digit: hold reset	0000 to 1111	0000	
⋮	⋮	⋮	⋮	⋮	⋮	⋮
490	A5tP	ALM5 alarm type	Set the alarm type for ALM5.	0 to 58	0	Refer to section 11 for the detail.
491	A5HY	ALM5 hysteresis	Sets the hysteresis for alarm output 5 ON/OFF	0 to 50%FS	0.25%FS	
492	dLY5	ALM5 delay	Sets the delay before detecting alarm output 5	0 to 9999[sec/min]	0	
493	dLU5	ALM5 delay time units	Sets the delay time unit for alarm output 5	sec (second)/Min (minute)	sec	
494	AoP5	ALM5 option	Assigns the optional functions to ALM5 Ones digit: alarm output latch Tens digit: error alarm Hundreds digit: inverted output Thousands digit: hold reset	0000 to 1111	0000	
500	Hb1	HB alarm set value	Sets the value to activate the heater burnout alarm.	0.0 to 100.0 (A)	0.0 A	
501	Hb1H	HB alarm hysteresis	Sets an ON/OFF hysteresis for the heater burnout alarm.	0.0 to 100.0 (A)	0.5 A	
502	HS1	Shorted-load alarm set value	Sets the value to activate the shorted load alarm.	0.0 to 100.0 (A)	0.0 A	
503	HS1H	Shorted-load alarm hysteresis	Sets an ON/OFF hysteresis for the shorted heater-load alarm.	0.0 to 100.0 (A)	0.5 A	
508	LbtM	Loop break detection time	Sets the time before detecting a broken loop	0 to 9999 sec	0 (Off)	
509	LbAb	Loop break detector detection range (°C)	Sets the temperature range before detecting a broken loop	0.0 to 100.0%FS	2.50%FS	
511	WHRL	Electricity alarm setpoint	Sets the value for electricity alarm.	0-9999KWh	0	

CH 6 SET (setup parameters)

Parameter			Function	Setting range	Initial value	Remarks
№	Display	Name				
530	PVt	PV input type	Sets the type of input sensor	JPT1: 0.0 to 150.0°C JPT2: 0.0 to 300.0°C JPT3: 0.0 to 500.0°C JPT4: 0.0 to 600.0°C JPT5: -50.0 to 100.0°C JPT6: -100.0 to 200.0°C JPT7: -199.9 to 600.0°C PT1: 0.0 to 150.0°C PT2: 0.0 to 300.0°C PT3: 0.0 to 500.0°C PT4: 0.0 to 600.0°C PT5: -50.0 to 100.0°C PT6: -100.0 to 200.0°C PT7: -199.9 to 600.0°C PT8: -200 to 850°C J1: 0.0 to 400.0°C J2: -20.0 to 400.0°C J3: 0.0 to 800.0°C J4: -100 to 1000°C K1: 0 to 400°C K2: -20.0 to 500.0°C K3: 0.0 to 800.0°C K4: -200 to 1300°C R: 0 to 1700°C B: 0 to 1800°C S: 0 to 1700°C T1: -199.9 to 200.0°C PT2: -199.9 to 400.0°C E1: 0.0 to 740.0°C E2: -150.0 to 740.0°C E3: -200 to 740°C L: -100 to 850°C U1: -199.9 to 400.0°C U2: -200 to 400°C N: -200 to 1300°C W: 0 to 2300°C PL-2: 0 to 1300°C 0-5 V: 0 to 5 V 1-5 V: 1 to 5 V 0-10: 0 to 10 V 2-10: 2 to 10 V MV: 0 to 100 mV 0-20: 0 to 20 mA 4-20: 4 to 20 mA	K1	[RESET] Refer to section 10 for the detail.
531	PVb	PV input lower limit	Sets the lower limit of PV input	-1999 to 9999	0	[RESET]
532	PVF	PV input upper limit	Sets the upper limit of PV input	-1999 to 9999	400	[RESET]
533	PVd	Decimal point position	Sets the decimal point position for the PV/SV	0: No digit after decimal point 1: 1 digit after decimal point 2: 2 digit after decimal point 3: 3 digit after decimal point	0	[RESET]

7. Artificial Intelligence Temperature Controller

7.1 Main Features

- Specifically designed for plastic machinery, food processing equipment, packaging machines, and similar applications. It offers ease of use, simple operation, and cost efficiency.
- Features a universal power supply (100-240VAC, 50/60Hz) with selectable °C/°F units.
- Allows flexible selection of input and output types, modular design for quick delivery, and excellent after-sales support.
- Equipped with AT and AI PID intelligent control algorithms.
- Certified with ISO9001, CE, and COC, and compliant with European RoHS standards.

7.2 Operation

7.2.1 Basic Display Status

Upon powering on, the basic display screen appears. The upper window shows the process value (PV), and the lower window displays the set value (SV). If the process value exceeds the measurement range (for example, if the thermocouple fails), the upper window will display "orAL" along with the highest and lowest values. The controller will automatically halt output control at this point.

The front panel includes 6 to 10 LED indicators for functions such as output, first alarm, second alarm, and operational status (OPl, AU1, AU2, RUN).

7.2.2 Time Program Setting

In basic display mode, if the parameter lock "Loc" is not engaged, you can set the setpoint (SV) by pressing ◄, ▼, or ▲. Use the ▼ key to decrease the value, the ▲ key to increase it, and the ◄ key to select the digit you want to modify. Press until "t1" is displayed, and then the time can be set.

7.2.3 Working Control

When the power is on and the controller is in stop mode, press ▼ for 2 seconds until the display shows "run" to start the controller. Press ▲ for 2 seconds until it shows "stop" to halt the controller.

7.2.4 Preparation

If you don't want the timer to start counting while the temperature is still rising, you need to activate the preparation function. When preparation is enabled, the controller will not issue an alarm if it detects an abnormal value (HaAL & LdAL). During this time, the program will pause the timer until the values return to normal.

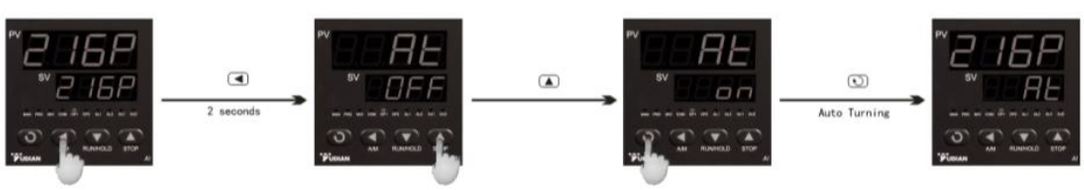
7.2.5 AI Control and Auto-Tuning

When the AI control method is selected, the PID parameters can be obtained by running auto-tuning. In the basic display mode, press the ◄ key for 2 seconds until the "At" parameter appears.

Use the ▲ key to change the "At" value from "OFF" to "ON, " then press the key to initiate the auto-tuning process.

During auto-tuning, the instrument performs on-off control. After 2-3 cycles of on-off actions, the instrument will determine the optimal control parameter values.

To exit auto-tuning, press and hold the ◄ key for about 2 seconds until the "At" parameter reappears. Then, change the "At" value from "ON" back to "OFF, " and press to confirm. This will cancel the auto-tuning process.



Note 1: If the setpoint differs, the parameters obtained from auto-tuning may also vary. It is recommended to set the setpoint to a frequently used or median value before starting the auto-tuning process. Depending on the system, auto-tuning may take anywhere from a few

seconds to several hours.

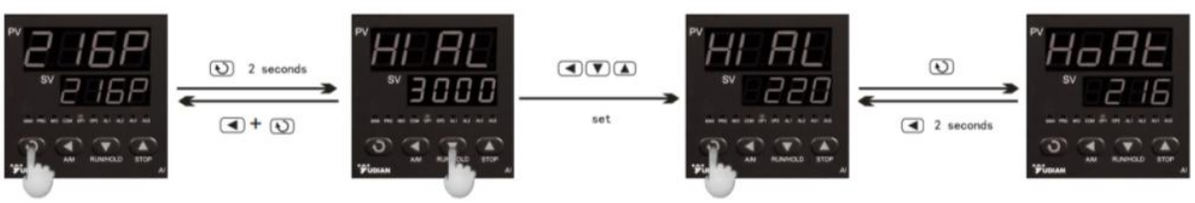
Note 2: The setting of CHYS can affect the auto-tuning results. A lower CHYS value increases accuracy, but setting it too low is not recommended. A CHYS value of 2.0 is recommended.

Note 3: After auto-tuning, the results may initially be unstable, but the system will achieve optimal performance over time.

7.3 Parameter Setting

In the basic display mode, press and hold for about 2 seconds to access the Field Parameter Table. Use ○ to navigate to the next parameter. You can modify a parameter by pressing ◄, ▼, or ▲. To return to the previous parameter, press and hold ◄.

To exit the parameter table, press and hold ◄ (without releasing), then press ○ simultaneously. The instrument will automatically exit the parameter table if no key is pressed within 30 seconds. To access the System Parameter Table, set Loc to 808, then press .



Field Parameter Table(Press and hold for 2 seconds to access)

Code	Name	Description	Setting Range
HIAL	High Limit Alarm	Alarm on when PV (Process Value) >HA; alarm off when PV<HIA-AHY	0 - 999 °C
LoAL	Lower Limit Alarm	Alarm on when PV(Process Value)<LoA: alarm off when PV>LOA-AHY	0 - 999 °C
HdAL	Deviation High Alarm	Alarm on when PV-SV>HdA: alarm off when PV-SV<HdA-AHY	0 - 999 °C

LdAL	Deviation Low Alarm	Alarm on when PV-SV<LdA: alarm off when PV-SV>HdA-AHY	0 - 999 °C
Loc	Parameter Lock	Loc-0:Allowed to modify parameters and do AT Loc=1:Allowed to modify parameters but cannot AT Loc Parameter Lock Loc-2: Allowed to modify parameters and AT 0~255 Loc=4-255: NOT allowed to modify parameters ecept Loc. Loc-808.Set to 808 and press .allowed modify all parameters.	0 - 255
AHYS	Hysteresis	Avoid wrong frequent alarm caused by wrong value setting	0 - 200
AoP	Alarm Output Assignment	AoP is to define the place of HIALLoALHdAL alarms like $AOP = \frac{0}{LdAL}\ \frac{4}{HdAL}\ \frac{0}{LoAL}\ \frac{3}{HIAL}$ Value 0-4.0 means never alarm, 3 and 4 mean alarm from AU1, AU2.	0 - 444
Srun	Running status	Run, normal running status, PRG light on Stop, stop status, below window shows "stop", PRG light out Hold, keep current status, program stop counting time at this moment	
Act	Dierect/reverse acting function	rE: Reverse acting.Increase in measured variable causes a decrease in the output, such as heating control. dr: Direct acting.Increase in measured variable causes an increase in the output, such as refrigerating control. rEbA: Reverse acting with low limit alarm and deviation low alarm blocking at the beginning of power on. drbA:Direct acting with high limit alarm and deviation high alarm blocking at the beginning of power on.	
P	Proportional band	Proportional band in PID with unit °C/°F. Notes:normally use At to confirm P, I, D and Ctl. But can set known correct value.	1 - 999
I	Time of Integral	Time of integral in PID. No integral effect when I=0 unit is 1 second	0 - 999 Sec
d	Time of Derivative	Time of derivative in PID. No derivative effect when d=0. Display unit is 0.1 second	0 - 999 Sec
Ctl	Control Period	A smaller value improves control precision. For SSR output, the control period is generally set to 0.5 to 3.0	0.5 - 300 Sec

<table>
<tr><td></td><td></td><td>seconds.

For relay output, the control period is typically 15–40 seconds to avoid frequent on-off switching, which can reduce the mechanical relay's lifespan.

It is recommended to set Ctl to about 1/4 to 1/10 of the derivative time.

In on-off control mode, Ctl acts as the restart delay time after an off cycle, providing protection for compressor applications.</td><td></td></tr>
<tr><td>CHYS</td><td>Control

Hysteresis</td><td>CHY is used for on-off control, if PV > SV, output turns off; PV<SV-CHYS, output turns on.</td><td>0 - 200</td></tr>
<tr><td>InP</td><td>Input Specification</td><td><table>
<tr><td>InP</td><td>Input spec</td><td>InP</td><td>Input spec</td></tr>
<tr><td>0</td><td>K</td><td>1</td><td>S</td></tr>
<tr><td>2</td><td>R</td><td>3</td><td>Spare</td></tr>
<tr><td>4</td><td>E</td><td>5</td><td>J</td></tr>
<tr><td>6</td><td>Spare</td><td>7</td><td>N</td></tr>
<tr><td>8-20</td><td>Spare</td><td>21</td><td>Pt100</td></tr>
</table></td><td>0 - 21</td></tr>
<tr><td>dPt</td><td>Resolution</td><td>"0" indicates a display resolution of 1°C or °F, while "0.0" indicates a resolution of 0.1°C or °F.</td><td></td></tr>
<tr><td>Scb</td><td>Input Shift</td><td>Scb is used to make input shift to compensate the error produced by sensor or input signal.

PV_after_compensation= PV_before_compensation + Scb.

Note: normally set it as 0</td><td>-200 - +400°C</td></tr>
<tr><td>FILt</td><td>PV Input Filter</td><td>FILt controls the strength of digital filtering.

A higher FILt setting increases filtering but slows down the data response speed.

If there is significant measurement interference, gradually increase FILt until the fluctuations are reduced to within 2-5 digits.

During calibration, set FILt to 0 or 1 to ensure faster response speed.</td><td>0 - 40</td></tr>
<tr><td>Fru</td><td>Power Frequency and Display Unit</td><td>50C: Indicates a power frequency of 50Hz with maximum interference resistance at this frequency; temperature unit is °C.

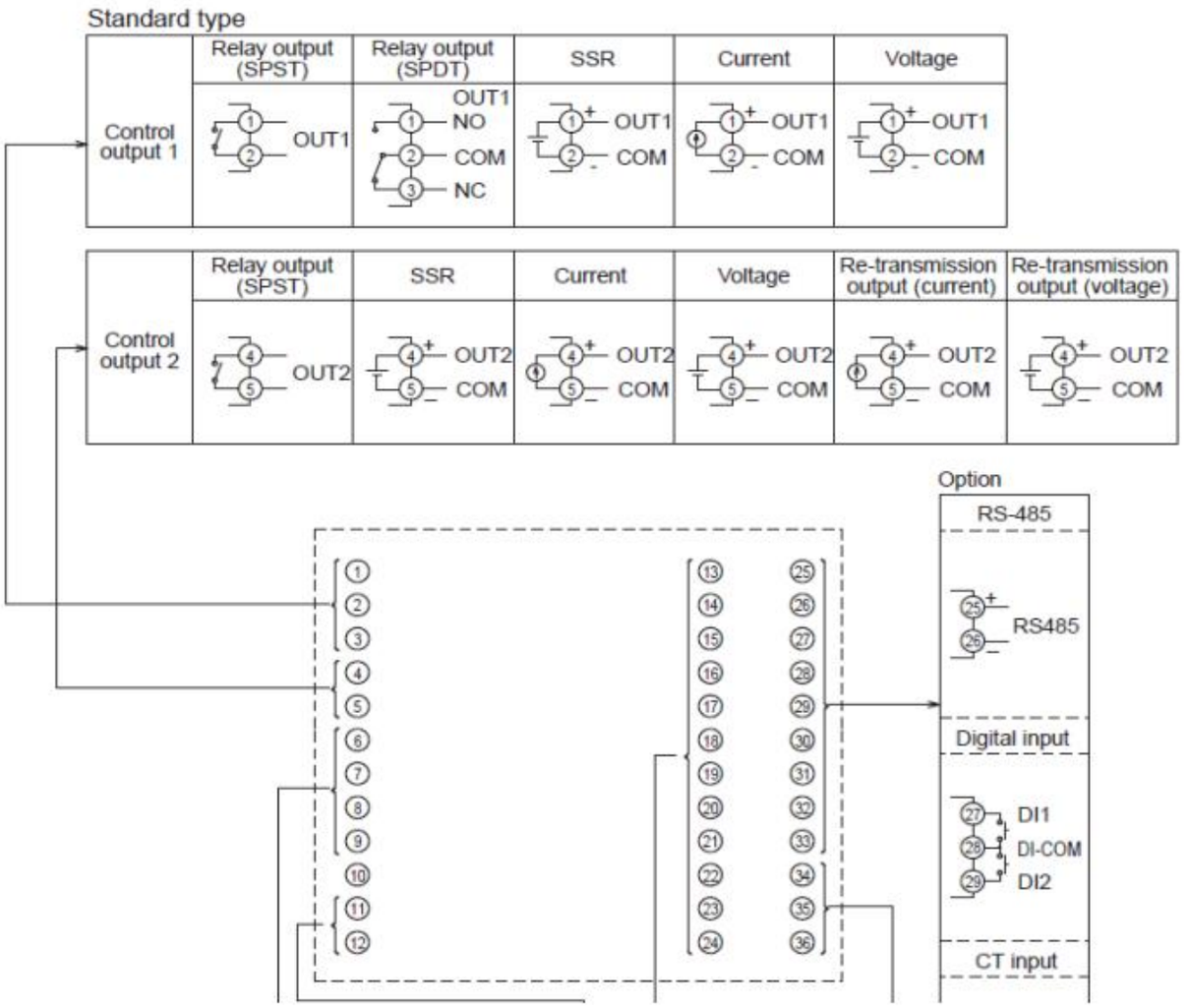
50F: Indicates a power frequency of 50Hz with maximum interference resistance at this frequency; temperature unit is °F.

60C: Indicates a power frequency of 60Hz with maximum interference resistance at this frequency; temperature unit is °C.

60F: Indicates a power frequency of 60Hz with maximum interference resistance at this frequency; temperature unit is °F.</td><td></td></tr>
<tr><td>OPH</td><td>Output Highest Limit</td><td>When PV<OEF, max limit 100%</td><td>0 -100%</td></tr>
<tr><td>OEF</td><td>OPH Valid Range</td><td>When PV<OEF, OUTP output highest limit is OPH,</td><td>-999 - +3200</td></tr>
</table>

		When PV>OEF, no limit, 100% output Note: if you want to avoid too quick temperature raising, and temperature is lower than 150°C, only 30% is allowed for heating power, then you can set: OEF=150.0 °C, OPH=30%	
AF	Senior Function Code	The AF parameter is used to select advanced functions, calculated as follows: AF = A×1 + B×2 + E×16 + G×64 A = 0: HdAL and LdAL are deviation alarms. A = 1: HdAL and LdAL are absolute value alarms, allowing the instrument to have 2 channels of absolute upper and lower limit alarms. B = 0: Alarm and hysteresis for on-off control are single-sided. B = 1: Hysteresis is double-sided. E = 0: HIAL and LOAL are absolute upper and lower limit alarms. E = 1: HIAL and LOAL change to deviation upper and lower limit alarms, providing 4 channels of deviation alarms. G = 0: An increase in the measured value due to sensor disconnection allows for upper limit alarms (the upper limit alarm should be set lower than the signal range upper limit). G = 1: An increase in the measured value due to sensor disconnection does not allow for upper limit alarms. Note that in this mode, even normal upper limit alarms (HIAL) will be delayed by approximately 30 seconds before activation.	0 - 255
SPL	Lower Limit of SV	Minimum value of SV	-999 - +3000
SPH	Upper Limit of SV	Maximum value that SV allowed to be. When SPH=400, the SV range will 0 - 400°C.	-999 - +3000
SPr	Limit of Temperature Rising Speed	If SPr is enabled, when the program starts, if the measured value is lower than the setpoint, the temperature will first increase to the initial setpoint at the rate defined by SPr. During this rate-limited heating phase, the RUN light will flash.	0 - 3200 °C/m
PonP	Auto Running When Power On	Cont, controller stop work StoP, when power on, it's in stop status. Run1, continue working dASt, if now alarm, then work, if alarm, stop working HoLd, (only for AI-518P), if accident short of electricity, stop work.	
EP1~EP8	Senior Function Code	Can set 1-8 field parameter. If not need or less than 8, can set it as nonE.	

8. Wiring Diagram



9. Fault Analysis

Phenomena	Causation	Treatment Method
No Power	1. No Power Supply 2. Switch broken 3. Wire short or fuse broken	1. Check the power or change the plug socket 2. Change the switch 3. Check the wire or change the fuse

SX4	HHHH	1. Thermocouple disconnection. 2. Break in the platinum resistance input at terminal A. 3. Measured value exceeds 10% above the maximum range.	1. Check if the thermocouple wiring is loose; if so, reconnect the wires properly. 2. If the wiring is not loose, replace the thermocouple.
Buzzer Sounds or Over-Temperature Indicator Light is On		The furnace temperature exceeds the set limit, triggering the instrument's protection mode.	Once the temperature drops to a safe level, the instrument will automatically return to normal operation (check for the cause of the overheating) or adjust the limit temperature.
The power supply is functioning normally, but the furnace is not operating.		The instrument parameters were incorrectly modified.	Adjust the parameters to the correct settings.
The power supply is normal, but the furnace is unable to heat up.		1. Control circuit is damaged. 2. Heating element is disconnected.	Reach out to us for assistance with repairs.