

KSL-1700X-A4

High Temperature Muffle Furnace

Operational Manual



MTI Corporation

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Thank you for purchasing MTI KSL-1700X-A4 High Temperature Muffle Furnace. To avoid any misuse and damage, please read the operation instruction carefully before operation

1. Introduction

KSL-1700X-A4 is a stand-up high temperature muffle furnace for industry. The furnace consists of high quality alumina fiber brick and MoSi₂ heating elements with maximum energy saving (Max. 9.5KW, 7 KW average at 5 °C /min), and can be used up to 1700 °C. The furnace temperature profile can be set up by 51 segments and run automatically by the 708 type temperature controller. It is excellent for material research, ceramic research labs.

2. Technical Specifications

Name	Unit	Parameter
Power	KW	9.5 (100A air breaker is required)
Voltage	V	AC 208V, 60HZ Single Phase
Max. Temperature	°C	1700
Continuous working temperature	°C	1600
Suggested heating rate	°C/min	<ul style="list-style-type: none"> • 2.5°C /min from RT- 200°C (Cold Start) • <5°C / min from 200-800°C • 5°C / min from 800-1600°C
Temperature accuracy controlled	°C	± 1 °C
Heating element		MoSi ₂
Connection of heating element		Series connection
Thermal Couples		B type Pt-Rh to Pt-Rh
Heat capacity inside chamber	KWH	≤ 80
Dimension of inside chamber	mm	300L x 300W x 400 H
Dimension of outside	mm	650L x 750W x1500 H
Net Weight	Kg	160

3. Instruction of the 708 Intelligent Temperature Controller.

(1) Main Features:

- The 708 temperature controller uses advanced AI intelligent adjustment method, no over shooting, and has auto tune function.
- Both of Input and output employ digital calibration system and insure accurate and stable measurement.
- Measuring accuracy: 0.2% in full scale.
- Alarm function: Up limit and input open circuit.
- 51 segments programmable. Auto and manual operation can be switched without disturbing.
- Power off protection. In the case power off or other disturbing, input data can be saved via smart EPROM IC to ensure continuously running once power resume
- Universal switching power: 85V -264V AC, 50 – 60 Hz
- Power consumption: ≤ 5W

(2) Temperature Controller Connections:

There are 20 connectors in the backside of temperature controller. The connection is shown as Fig 1:

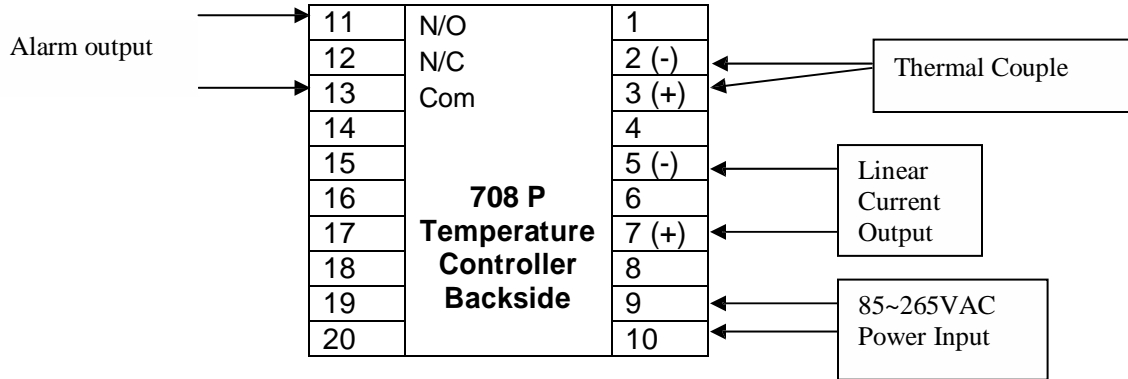






Fig. 1

(3) Indication of Front Panel of Temperature Controller

On Front Panel of Yudian 708 temperature controller, there are several signs and icons such as OUT, AL1, AL2, AUX, PV, SV, , , , and , which indicate the meaning as the Figure 2

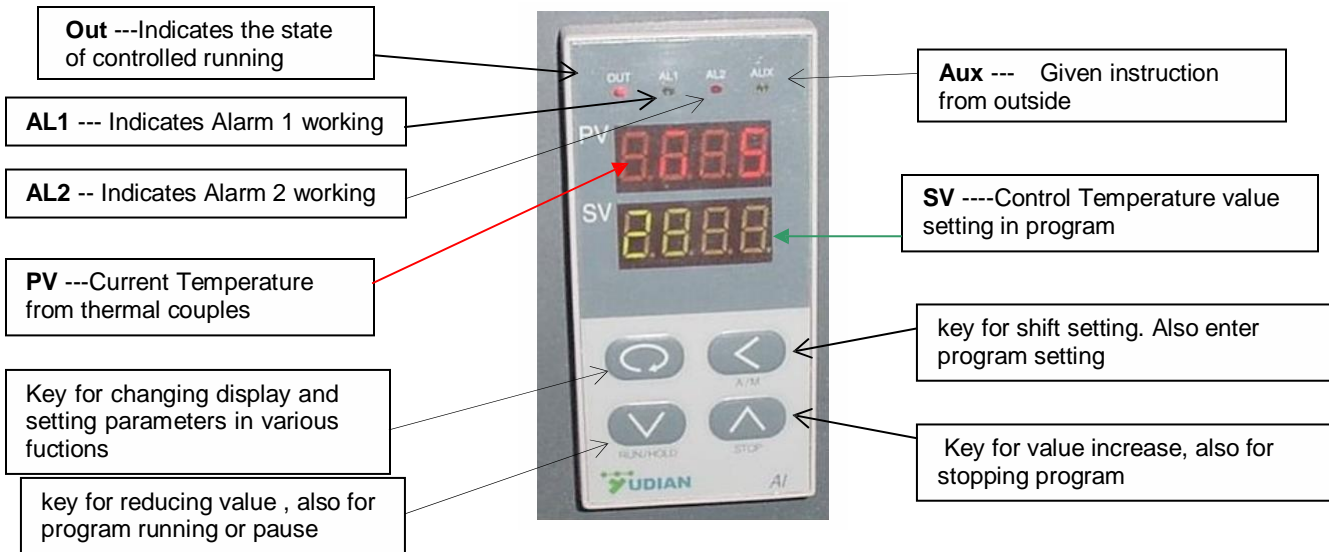


Fig 2

4. Setting Procedure of 708 Temperature Controller

Before running the furnace, you must plug in AC 208-240V, single phase, 60Hz power supply. Install thermal couples at the back of the furnace and make sure connection correctly (blue wire connecting with negative; brown wire connecting with positive, Fig.3)

Then turn lock in clockwise rotation to get temperature controller power on (Fig.4)

After setting program in temperature controller, push "power on" button to make cooling fan running (Fig. 4)



Figure 3



Figure 4

(1) Starting State of Display of Controller Panel


When turning power on, controller display shows the model No (708) of controller, software version first. A few seconds later, controller will display temperature condition. PV shows real temperature, and SV shows setting temperature.

If “SV” flashing, and shows “**Stop**”, it means that control program is at stop state; If “SV” shows “**Hold**”, means that program is at the pause stage.



Figure. 5

(2) Switching Function of Display

Under starting state of temperature display as Fig. 5, e.g. the panel can be switched to program setting function and parameter setting function by touching key: 


Touch  key and hold for one second, PV will show “Step” and SV show Step # (Usually show 1) as Fig. 6



Fig.6



Press  key once again, PV will show the setting time in the step, and SV shows the time that has run in this step.



Fig. 7

Press  key and hold for two seconds under “starting state”, Display will show parameter setting function as Fig 8, (PV shows M5, and SCV shows 289.7)

Please don't change any parameter unless you understand what parameter is. The all parameter has been preset according to our experience. Next chapter will explain how to change “Parameters “ Please be advised that


If no any key touch action on the panel, display will return to “Starting State” automatically. and all revised data will be saved.



Fig.8

(3) Setting Temperature Control Program

In order to set temperature control program, you must switch display panel from “starting state “to Fig. 7 state. (Please follow procedure from Fig. 4 to Fig 7)

Then touch Key  and hold for one second, the Panel enters temperature program setting stage. On the display, (as Fig. 9)
 PV shows first segment for temperature
 SV shows Initial temperature value

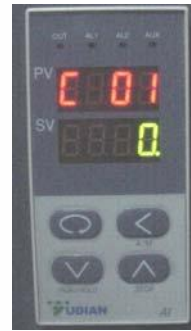


Fig. 9




Then touch Key , program enters holding time (as Fig. 10)




Fig. 10

PV show the segment number for time

SV shows time setting (Minutes) in this segment

By touch key  or , you can increase or decrease the value to be set. Yudian 708 controller allows you to set one temperature profile up to 30 segments

By touch key  and uses key  and  you can get in next segment for temperature or time setting.

During program setting, by touching  and holding for two seconds, you can return to previous setting and make revising.

By touching  key first, then press  key, you can exit program setting mode.

If no key operation for 30 seconds, display exits program setting mode and returns to “starting state”.

(4) Example for Setting Temperature Control Program with 6-segment Profile

For a complicated temperature control profile, we strongly suggest you to make drawing as Fig. 11, then make form as table 1 to list all data in every segment.

Fig. 11 is the temperature profile that we would like to set.

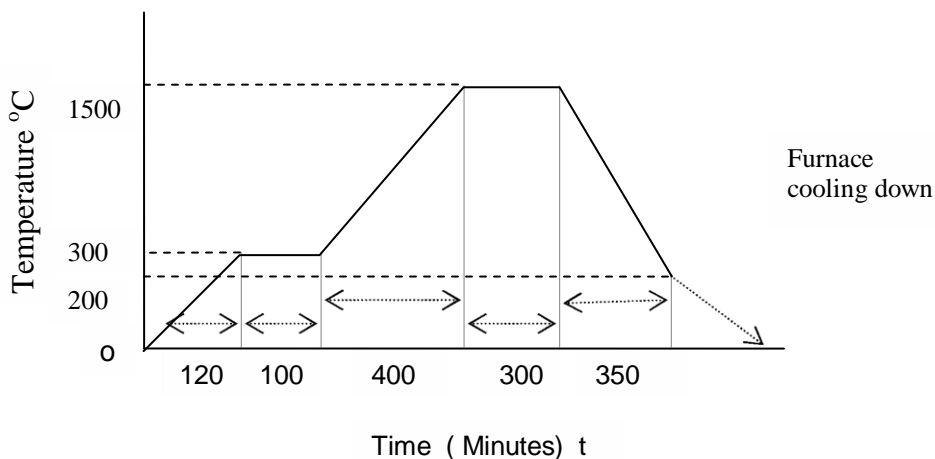






Fig. 11

According to this profile, you shall list all segments in the following

Table 1

Segment #	Symbol in Panel	Data to be In-put	Meaning in the program
1	C 01	0 (°C)	Initial Temperature
2	t 01	120 (min.)	Ramping time from 0 – 300 °C Average Heating rate is 2.5 °C
3	C 02	300 (°C)	Target temperature value to first heating stage (300 °C)
4	t 02	100 (min.)	Holding time at 300 °C stage
5	C 03	300 (°C)	Temperature value at the heating flat
6	t 03	400 (min.)	Second Heating time from 300 -1500 °C Average heating rate is 3 °C /min
7	C 04	1500 (°C)	Target temperature value to peak heating stage (1500 °C)
8	t 04	300 (min.)	Holding time at 1500 °C stage
9	C 05	1500 (°C)	Temperature at peak level
10	t 05	350 (min.)	Cooling time to 200 °C Cooling rate is 3.7 °C /min
11	C 06	200 (°C)	Target temperature to be cooled (500 °C)
12	t 06	-121	Program end, Out-put power off. Furnace cooling down naturally (t 06 = -121 is an order to stop running.

Using 4 keys of , , ,  enter data listed the above table into controller separately , then , you finish one temperature control program finish
Please be noted that “ t xx “ is time value for XX segment. It can be set from 1- 9999 minutes. However, if “ t xx “ is set as the following value , it can be as a special order. These orders only can be used in complicated multi temperature profile program.

If **t xx = 0** : Controller will be paused at xx segment (Hold) .

If **txx = -(1-150)** Negative value is a control order, which let program stop running, or jump to other segment.


If **txx = -(Ax30+B)** , here B value is 1- 30. which indicates program will jump to the segment at B value

When **A=0**, only execute segment jump function.


When **A=1**, program will cut off power delay


When **A=4, B=1**, Program will execute “ stop “ order


(5) Run Temperature Control Program with Furnace

1) When temperature program set up ready, touch key  and hold for two seconds, then display SV will show letter “run”, furnace will run automatically segment by segment according to program step by step.

2) Under furnace running state, “ Out “ indicator ‘s brightness will change based on power out value.

3) If you want the furnace to stop running temporarily, please push key  and hold for two seconds, then display SV will show letter “ Hold”, the furnace enters “pause state “. In the “pause state”, controller will keep furnace temperate at the value when “pause” order was given, but time running is stop.

4) Under the “ Pause “ state, push key  for two seconds, SV display will shows “ run”. And furnace will start running again from the point where is paused.

5) If you want to stop running furnace, whatever under “ pause” or “ running “ state, you can push key  and hold for two seconds, then, SV display shows “ stop” , furnace totally stop running and controller will be in “starting sate”. If you want to run again, the program will start at the beginning step. If furnace temperature still is higher than “C 02”, program will not run until temperature going down to “ C 02”. In order to run faster, you can choose program run from “step 2”, or “step 3”.

(6) Function Parameters Set Up and Revise

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The following function parameters are preset in the temperature controller. They are very important for controlling furnace temperature stably and accurately. Unless you have enough experience, please don't change the preset parameters in the controller.

In order to change the function parameters, follow procedure as below:








- ¾ Press  key and hold for two seconds under "starting state", display will enter parameter setting function
- ¾ Touch  key and hold for one second again, PV display will shows symbol: "M5" (Fig. 12), "P" (Fig. 13), "t" (Fig. 14), "Ctrl" (Fig 15) and "LOC" (Fig.16) respectively.
- ¾ Using  and  key to change the value under different parameter setting.
- ¾ Hold  key for two seconds, setting will go back to previous parameter.
- ¾ Press Key , then push , Display will exist "parameter setting".



Fig.12



Fig.13



Fig.14



Fig.15



Fig.16

Table 2 lists the parameters and their meanings:


Parameter in Display Panel	Range to set	Parameter 's fuction	Preset value in the controller
M5 Maintenance parameter	0 -9999	Adjus temperature difference between set value and real value. the larger M5 value, the longer adjust time, and M5 smaller time is shorter	289.7 (adjust between 200 – 500)
P Speed parameter	1-9999	Adjustment rate in controller. P value increases adjustment faster; decrease, adjustment slower	5 (select between 3-10)
T Delay time parameter	0 - 2000	Control temperature over shooting. t value smaller, temperature overshoot smaller, otherwise overshoot larger.	6 (3-10)
Ctrl Control type	1, 2, 3, 4,	1= Auto tune from front panel 2= Auto tune first, then go to 3 or 4 automatically 3= built-in Auto tune, can not be changed from front panel 4= more accurate auto tune	3
LOC Parameter lock	0 - 9999	Preset in controller. Please never change	0

Again, only in the case that you find temperature controll is not stable during running, the parameters above may be considered to be adjusted.

In the case that you find temperature control is not stable during running, you shall use "**Auto-Tune**" function to achieve the best setting result. The procedure is as the following:

- ¾ Let furnace stay in a temperature that is the most important for you.
- ¾ Set Ctrl value to 2
- ¾ Let display return to "starting state "
- ¾ The front panel of controller will flash with letter "AT", which means controller is in " Auto-Tune" state.
- ¾ After "Auto-Tune", AT letter will disappear and controller will select all M5, P and t value automatically.

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- ¾ You may repeat setting “Auto-tune” 2-3 times to achieve the best result.
- ¾ After Auto-tune, it automatically changes Ctrl to 3.
- ¾ If you want to stop “Auto-tune” in the middle, Hold  key for two seconds, then front panel of controller will stop flashing with letter “AT”, which means controller stop “Auto-Tune” and Ctrl automatically go to 1.
- ¾ Set Ctrl to 3.
- ¾ If temperature is still not stable after Auto-tune, then you may adjust M5, P, and t value manually.

In the special case, furnace can not be run properly due to voltage varies in different area; you may need to adjust some parameters as the Table 3.

Again, the parameters have been preset according to our experience. Please don't adjust the following parameters unless you are very familiar with the function of parameters.

Table 3.

Parameter symbol in PV panel	Value preset in SV Panel	Function	Note
HIAI	1700	Max. Temp limit	
Local	200	Initial Temp limit	Limit output current below 200 °C
dHAL	999.9	Alarm in positive tolerance	
dLAC	999.9	Alarm in negative tolerance	
dF	0.3	Adjustment difference	dF smaller, auto tune has higher accuracy
Ctrl	3	Control type	
M5	389.7	Maintenance parameter	
P	8	Speed parameter	
t	5	Delay time parameter	
Ctrl	1	Output period	Reflect controller's adjustment speed
Sn	6	Thermal couples type	B type T.C
Dlp	0	Position of decimal	
DIL	0	Display valve in Min.	
DIH	1700	Display value in Max.	
Sc	0.0	Main input shift and adjustment	Tolerance between input and sensor
OP1	1	Output type	Select 1 is output from 0 – 10 mA. Please make sure if this value is compatible with controller
OPL	18	Output limit below 200 °C	This value will determine Max. output current when below 200 °C. Please select 16 first. If the output current is too low, please increase the value up to 80. The most suitable value that the current -meter shows is 120 – 140 A in initial heating stage
OPH	100	Output Up limit	Limit Max. output power. Max value is 130. Please set the value as low as possible to avoid damaging heating element
ALP	3	Alarm function	
CF	22	System function selection	82 means limit output current in two stages
Addr	1	Communication address	
bAud	9600	Communication frequency	
dL	1	Input digital filter	dL value larger, measured temperature more

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			stable, but reaction time is slow
run	27	Running condition	
Loc	0	Parameter revising grade	Value "0" will lock the data that has been entered. The value "808" will open lock to allow you to revise all parameters
EP1	M5		
EP2	P		
EP3	t		
EP4	ContrL		
EP5	OP2	After adjusting, set to NoneE	
EP6	OPL	After adjusting, set to NoneE	
EP7	NoneE		
EP8	NoneE		

In order to adjust the parameters above, you need to do as the following:
 From function parameter state of "Loc" as shown in Fig. 16, change "Loc" value from "0" to "808" as shown in Fig. 17



Fig 17



Fig 18



Fig 19

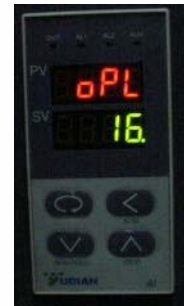





Fig 20



Fig. 21



Fig. 22

Then, you can revise the parameters from "HI AL" (Fig 18) ---- "Sn"(Fig 19) ----- " oPL "(Fig 20) --" oPH" (Fig. 21) by The Key , ,  step by step. After changing the parameter and make sure all parameters are correct, you need to change " LOC" to '0" as shown in Fig. 22. to lock all data entered without change.

5. Installation Procedures

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Please follow the instructions as the below for furnace installation

- ¾ Open shipping package to check if all components are good condition. If find any damage caused by shipping, please report it to MTI Corporation immediately by email at WWW.MTIXTL.COM
- ¾ The furnace must be placed in flat surface to avoid vibration, where must keep from flammable and explosive materials.
- ¾ **The furnace uses AC single phase 220V / 9.5KW power.** Please make sure that power source in your lab is enough to meet this power requirement. You must use a power plug (not included) at > 100A current rating to connect furnace. Fig. 23 (a/b) shows three power lines from the furnace. Please make sure Fire 1 and fire 2 must connect to 240V single phase power line, and ground wire must connect to ground pole at the power.



Fig. 23 a: Three power lines from back of furnace

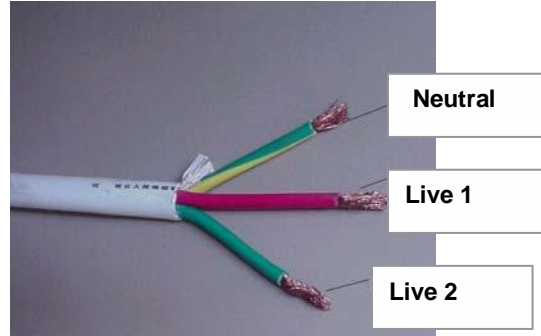


Fig. 23 b: Indication of three power line

- ¾ Please refer to section 10 (**Knowledge for AC power connection**) for how to get 240V single phase power from power panel. We strongly suggest you to contact a professional or licensed electrician to make power connection
- ¾ Please insert thermal couple tube (ceramic tube) in to furnace from backside of furnace, then tighten screw to fix thermal couple's position
- ¾ Connect thermal couple wires to controller. Please make sure that positive and negative polarities are connected correctly (brown to positive; blue to negative. otherwise, controller can not work. Fig. 23).

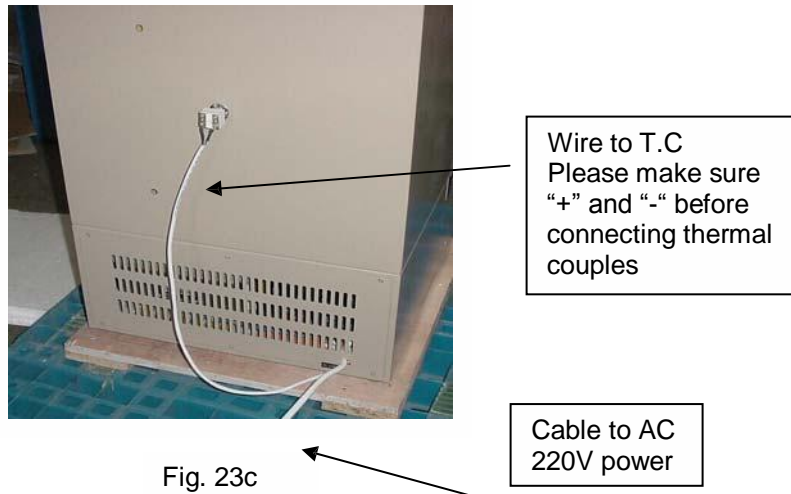


Fig. 23c

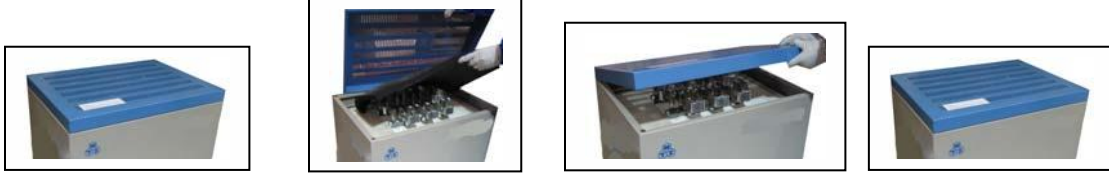
6. Instructions for Quick Start:

MTI always do quality inspection and run a test program before shipping. We strongly recommend customer to do a quick test run after receiving the furnace to ensure no event happens in the shipping period:

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Warning:

Please take out the shock absorption sponge in the top cover board before switch on power!!!



- ¾ Plug in power (Green Power indicator is On)
- ¾ Turn Power switch lock On, (Yudian 708P controller is On)



- ¾ Let 708P control display is at “ starting state “, e.g PV panel shows temperature value , and SV displays “ stop”. If controller is no at the state, touch  key, 708P controller shall be back to “starting state “




- ¾ A preset standard test program is scheduled to run:

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- ¾ Push green “Turn On” power switch button.



- ¾ Push Key  on the controller and hold for 2 seconds, SV panel shows “Run”, now furnace is running automatically



Procedure for shut down furnace

- ¾ Push key  to make sure the controller is at “stop” state.
- ¾ Touch Red “ Turn-Off” button, shut down furnace power
- ¾ Turn lock to close position to cut off power to control panel
- ¾ If possible, close power switch from cable.
- ¾ End

7. Maintenance and Cautions

- a) When power on, if you can not hear a sound from cooling fan, please don't continue to operate. You must shut down power to check or replace the cooling fan.

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- b) During furnace running, please don't touch furnace to avoid any high temperature burn.
- c) Before operating the furnace please must place the alumina insulation block (see Fig. 24a and 24b) behind the front door of the furnace for good insulation performance.



Fig. 24a, Alumina insulation block



Fig. 24b, Alumina insulation block behind the door of the furnace

- d) Please don't open the front door of the furnace above 300°C to prevent insulation inside furnace from cracking.
- e) If the furnace is used at first time or not use for long time, please preheat the furnace at 300 °C for at least 2 hours to remove moisture inside to avoid chamber cracking.
- f) MoSi₂ heating element is only suitable for using in air or inert gas environments. Other active gas, such as H₂, Cl₂ and SO₂, will damage heating element.
- g) Please don't use the furnace at 400 – 700 °C temperature range for long time because MoSi₂ heating element will be easy to be oxidized in the temperature range.
- h) MoSi₂ heating element is very brittle. Please pay a great attention during moving and handling. Also, please avoid rapid heating and cooling to avoid the heating element broken. Max. 5 °C/min heating or cooling rate is suggested.
- i) Please check heating element for every three months to see if they are in good connecting condition. If connection get loose, please open case and tighten them properly.
- j) Please always keep inside clean before operation to avoid contamination to your sample.
- k) Furnace must be used under following condition:
Temperature: -10 – 75 °C; Elevate: < 1000 M, Humidity < 85%; Environment: no vibration and conductible dust, explosive, flammable and corrosive gases

How to replace Heating element

- 1) Take of 4 screws on top of furnace, and then open the cover, as Fig 25
- 2) Take off the screw of clip for heating element, as Fig 26
- 3) Take off aluminum plates between connections of heating element, as Fig. 27



Fig. 25



Fig. 26



Fig. 27

- 4) Take off the screws of metal clip for fixing ceramic block, as Fig 28
- 5) Take off the ceramic block between rods of U type heating element, as Fig 29
- 6) Take off the U type heating element which needs to be replaced, as Fig. 30
- 7) Replace a new heating element. Please put ceramic block together with the heating element, and make sure the ceramic block shall fit position as before, as Fig 31.



Fig. 28



Fig. 29



Fig. 30



Fig. 31

8) When tighten the screw of metal clip for heating element, please make sure the bottom of U heating element does not touch the bottom of furnace chamber. Usually the bottom of U element shall rise 5 mm high from the bottom of furnace chamber

9) Then, follow the procedure 4, 3, 2, 1 to tighten screw and finish the exchange of heating element

10) Cautions

- o Please handle the heating element very carefully. Keep it from any impact.
- o When tighten aluminum connecting plates between rod of heating element, please don't over tighten to avoid breaking of the heating element. However, can not be tighten too loose, it will cause higher contact resistibility and temperature rising on the top of furnace.
- o If you find temperature is too high on the top of furnace during heating, please shut down power, re-open the top cover of furnace, tighten further of the screw between heating element rod and aluminum plate
- o For further question, please email to WWW.MTIXTL.COM

MTI Corporation provides one year limited warranty from date that we shipped goods. If you find any defective part caused by manufacturer please feel free to contact us. We will replace defective part and instruct you how to change the part by yourselves during warranty period. However, MTI Corp is not responsible for any damage or consequence damage caused by misuse. After warranty, MTI will continue to provide technical support and spare parts at a reasonable cost. ***(The alumina tube is excluded from the warranty because it is a dissipative material).***

8. Trouble Shooting for typical Problems

Problems	Reason	Solution
Open Power Lock, no power indication	Fuse (4A) in control panel is broken	Check control panel, and replace fuse
Green Power indicator is off, but Red open circuit indicator is On	Fuse in main power circuit is broken	Open the cover of front panel and replace the fuse
No current shows in meter , but has Max. Voltage	Heating element broken	Find broken heating rod, and replace it
Controller display panel SV shows " OraL "	Thermal Couples broken	Replace Thermal couples (B type)
Controller display panel SV shows " HI AL "	Furnace temperature > 1700 °C, Protection from Alarm	Cool furnace down, and find reason why temperature is so high (program setting may be wrong)
Power and heating element are OK, but furnace can't be controlled by program.	Controller or related circuit may be damaged	Replace controller. If not, please inform manufacturer to check what the real problem is
Program running, but furnace can	oPL or oPH value is too low due	Increase "oPL" and "oPH" value

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not be heated, or real temperature is far behind the setting value	to local voltage lower or frequency different	till current meter shows " 120 A – 140 A", and program runs smoothly
During heating below 300 °C, the temperature value (PV) is not stable, and doesn't match with setting program (SV)	It is normal because the furnace comes with a high temperature thermocouple, which is not sensitive at temperature below 300 °C	Don't worry. Let the furnace heat to 300 °C, then thermocouple will function stably with program. If the PV value at 300 °C is still less than that of SV, you may need to increase OPL value a little.

9. Knowledge on AC Power Connection

KSL-1700X-A4 tube furnace use single phase 220- 240V AC power and need 100A current capability.

For power connection, you must follow your local law and let a licensed electrician to do it. MTI Corporation is not responsible for any damage caused by wrong power connection. However, you need to know the knowledge on the power connection.

If your country uses 220V house power, you have no problem.

Just make sure your power plug can take 100A above current, and connect furnace two wires to 30A rate plug, and make good connection for ground wire, then you can run furnace.

If your country uses 220V house power, you may need a 240V single phase AC power line.

You need asking your electrician to make single phase 240V power line, similar to you set up a 240V electric washer/dryer in your home. You may need to know the follow knowledge:

Three phases (240V) AC power panel box usually is located in every laboratory and inside wires are shown in following Fig. 32.

In order to get single phase 240V, two power lines come from two of fire wires, as indicated in Fig. 32. Of course, a 240V switch breaker must be needed to get 240 V single phase from fire line (breaker is available from Home Depot)

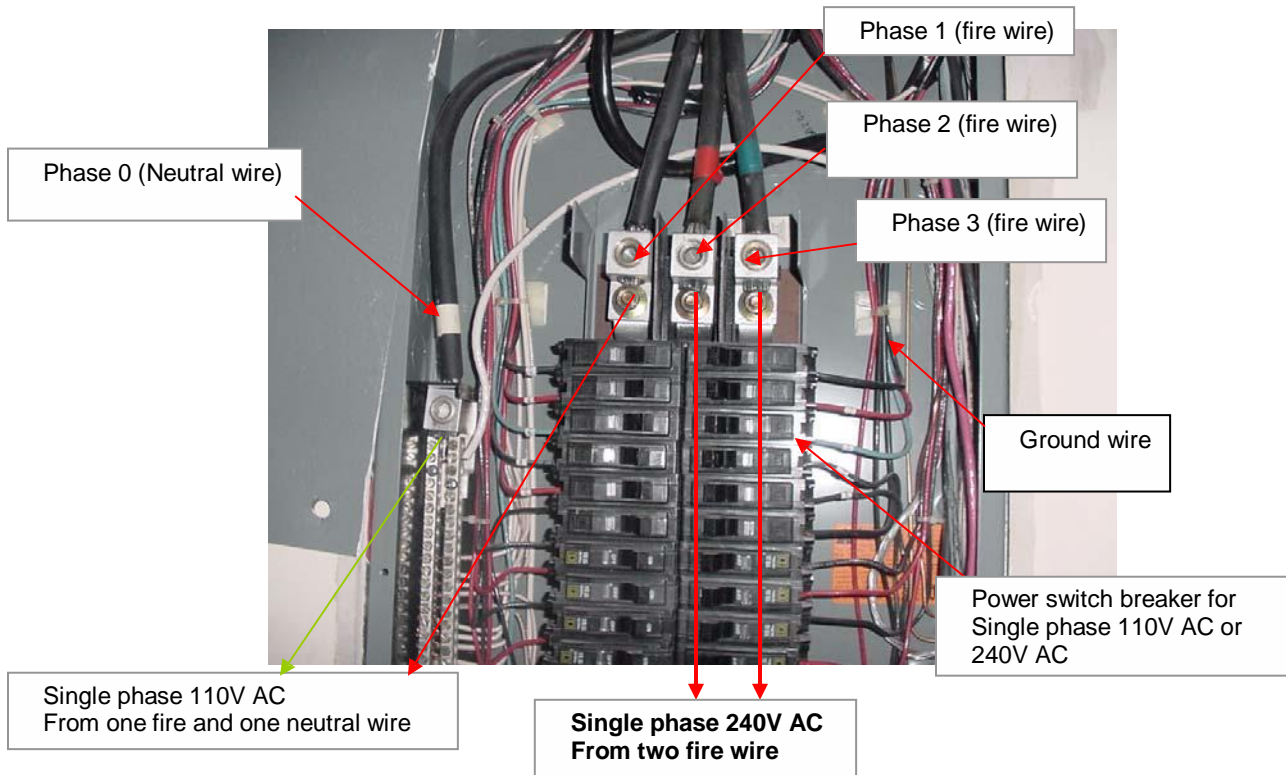


Fig. 32: Typical three phases AC power box in USA.

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You need a three holes female wall plug with > 100A current rating to connect with two fire lines and one ground wire. Then connect three lines from furnace to the male plug as indicated in Fig 33.

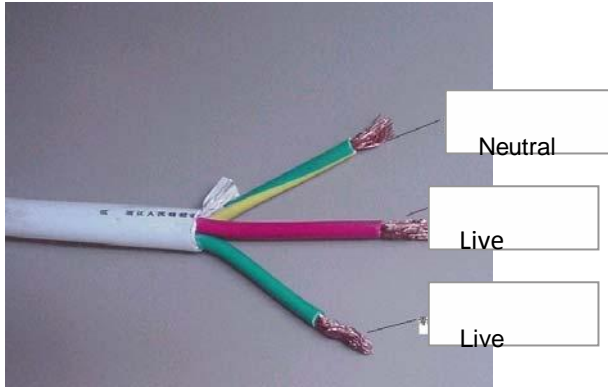


Fig. 33: Three lines from furnace (labeled)

However, there is two phase 240 V AC power panel box in house sometime (two fire lines and one neutral), as shown in Fig 34.
In order to get single phase 240V AC power, you need to get power line from two fire line, as indicated Fig. 34

Again, the above information is just for basic knowledge only; please contract a licensed electrician for real applications.

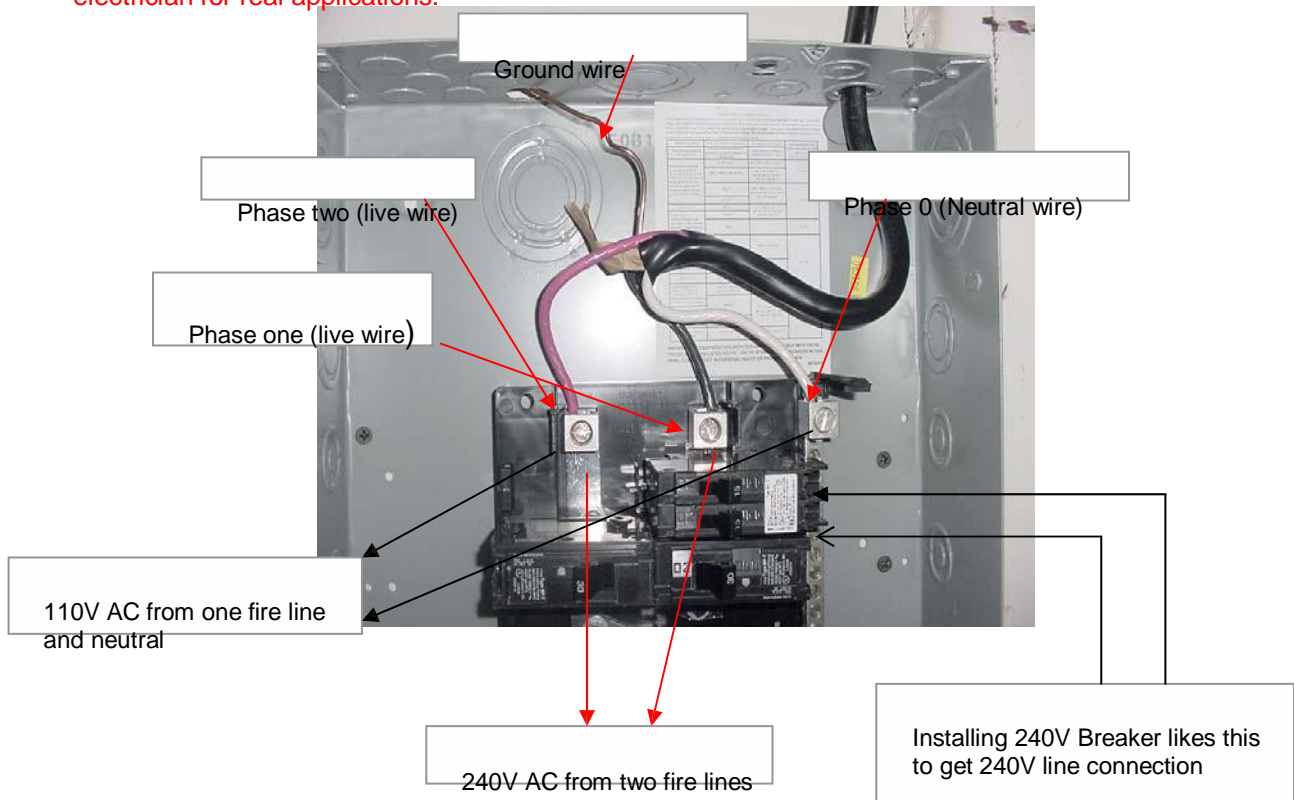


Fig. 34: Typical two phases AC power box in USA.