

# KSL-1100X High Temperature Muffle Furnace

## [Operation Manual](#)



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Thanks for purchasing MTI's product, please carefully read this manual before using, MTI **has no responsibility** for any damage caused by misuse.

**Note: The specification data in this manual may be different from the real product since MTI keeps upgrading the machine; if any confusion, please visit our website [www.mtixtl.com](http://www.mtixtl.com) for the latest information.**

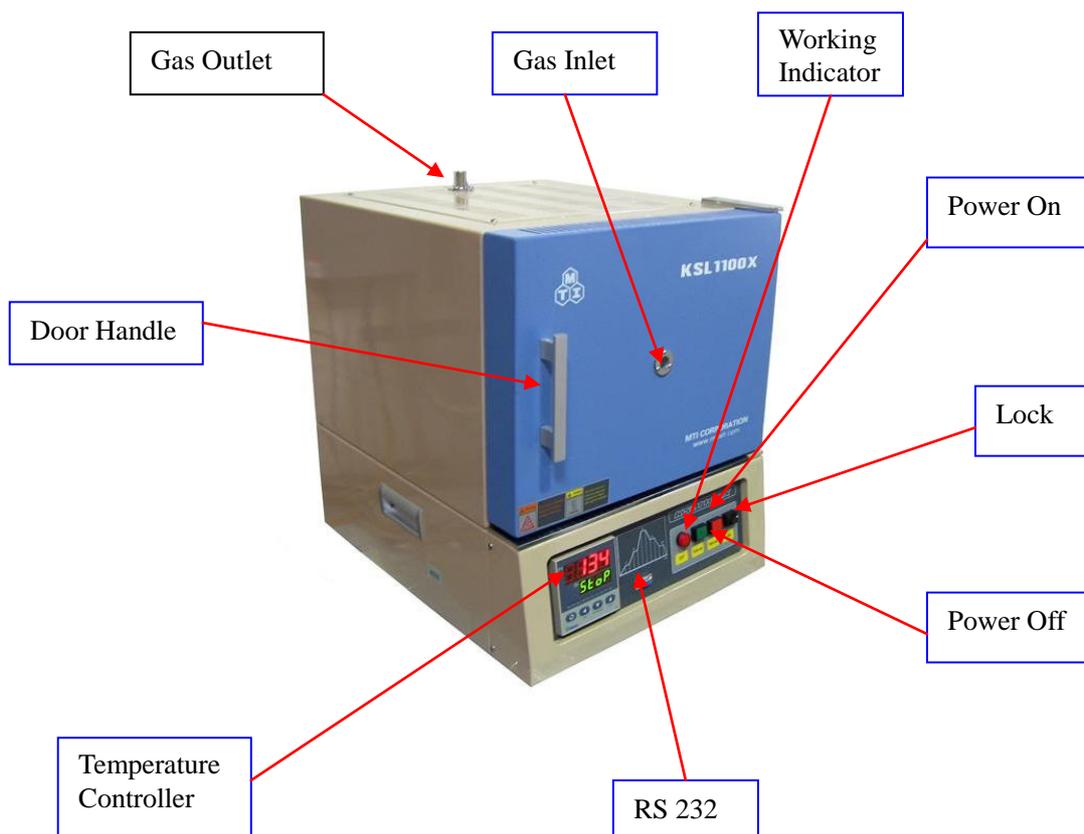
## Product Introduction

- Applications:
  1. Gravimetric analysis
  2. Sintering
  3. Quantitative analysis
  4. Heat treating
  5. Glass preparation
- Maximum energy efficiency is achieved by surrounding the chamber with thermal-efficient alumina fiber ceramic insulation;
- Three sides resistance wire coil for fast and uniform heating;
- Heavy duty double layer structure with cooling fan ensure the lower temperature at outside case;
- 0.5" diameter quartz glass observation window allows user to see inside chamber during heating operation (Optional gas filling port can be added via the window);
- The observation window can be used as gas inlet by inserting an Alumina tube;
- K type thermocouple installed for immediate use;
- Precision temperature controller can provide 30 segments heating and cooling steps with accuracy at +/- 1 oC;
- Vent port installed on the top for gas flow (gas outlet);

Note: For more information of optional product accessories, please search by keyword "EQ-KSL1100X" on [www.mtixtl.com](http://www.mtixtl.com)

## Technical Specifications

### Furnace Structure



## Operating environment

The operating environment information in the following table may be helpful if you plan to safely operate the instrument:

- The construction request a dry, hard and flat surface;
- The instrument shall be kept indoor with nice ventilation and avoided direct sunlight;
- Operating temperature: 50 °C~350 °C;
- Relative humidity (noncondensing): 10%~85%;
- Dust-free.

 **WARNING:** To reduce the possibility of heat-related injuries or of overheating the instrument, do not place the instrument too close to the side wall or obstruct the air vents. Keep the instrument at least 1 meter in distance from the side wall.

## Instrument features

- Power:3500W;
- Operating Voltage: 220V AC±10% Single Phase 50/60 Hz;
- 304 stainless steel chamber;
- Operation Temperature Range: 100~1100°C;
- Maximum Temperature: 1200 °C(The maximum temperature should not be hold more than an hour);
- Stability at 1000 °C: +/- 0.5 °C;
- Uniformity at 1000 °C: +/- 2.0 °C;
- Suggested Normal Heating Rate: ≤ 40°C /min;
- Max. Heating Rate: 50 °C /min;
- Temperature control: 30 segments programmable digital controller with PID function and overheated and overloaded protection;
- Chamber Cubic Capacity: 438 cubic inch , 7.2 Liter;
- Shipping weight (lb): 110 Lbs;
- Overall Dimensions D x H x W (Inch): 25”x 21”x 27”;
- Warranty: One Year limited.

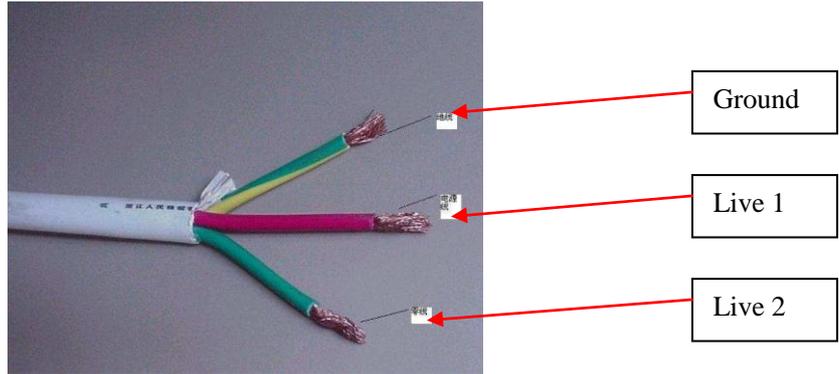
## Operation

**Once you received MTI furnace, please follow these steps to set up the furnace.**

- Open the box; check out if the instruments and the accessories are well kept during the shipping and corresponded with the packing list, if not, please inform us at [info@mtixtl.com](mailto:info@mtixtl.com).
- The instrument shall be kept indoor with nice ventilation;

## Power Connection

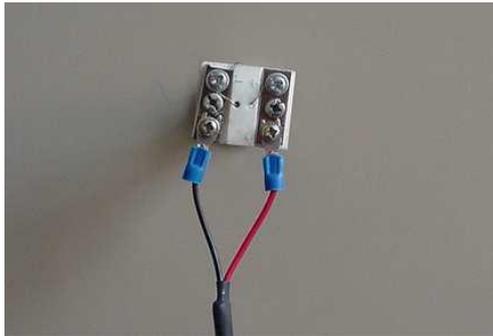
**The furnace uses single phase AC 220V / 3.5 KW power.** Please make sure that power source in your lab is enough to meet this power requirement. The following picture is to show you the three wires, Ground, Live 1, Live 2. **We strongly suggest you contact a professional or licensed electrician to make power connection.** For more information, please refer to the “**Knowledge on AC Power Connection**” in the following section.



## Thermocouple Installation

**Actually, we have ready well installed the thermocouple before shipping, if there is a must to reinstall the thermocouple, please refer to the following steps.**

- Insert thermal couple tube (ceramic tube) in to furnace from backside of furnace, then tighten screw to fix thermal couple's position.
- Connect thermal couple wires to controller. Please make sure that positive and negative polarities are connected correctly (Red to positive; Black to negative; otherwise, controller can not work).



## General Operation

- Place the test sample inside the Chamber (Crucible may be used as material container, please visit: <http://www.mtixtl.com/ceramiccrucibles.aspx>), slightly close the front door.
- Properly connect to the power supply and make sure it is well grounded;
- Power on the instrument by pressing “Run” button and you will see the control panel start to blink.
- Please refer to the following part “**Temperature Controller Instruction**” for how to set the temperature curve.

**NOTE:** Once you finish the set up, we strongly recommend our customer **FIRSTLY** reading the handbook and then following the instructions of attached “QUICK TEST” inside the package to perform a quick test to check the heating condition of the furnace.

**⚠ CAUTION: To reduce the risk of electric shock or damage to your instrument during your quick test, observe these practices:**

- The outer plate of the instrument must be grounded properly, for safety of operation;
- The instrument shall be kept indoor with nice ventilation;
- To reduce potential safety issues, do not place flammable and explosive materials around the instrument;
- No explosion-proof, do not put any flammable and explosive materials into the chamber.

# Temperature Controller Instruction

## 708P Temperature Controller

### 1. Specification

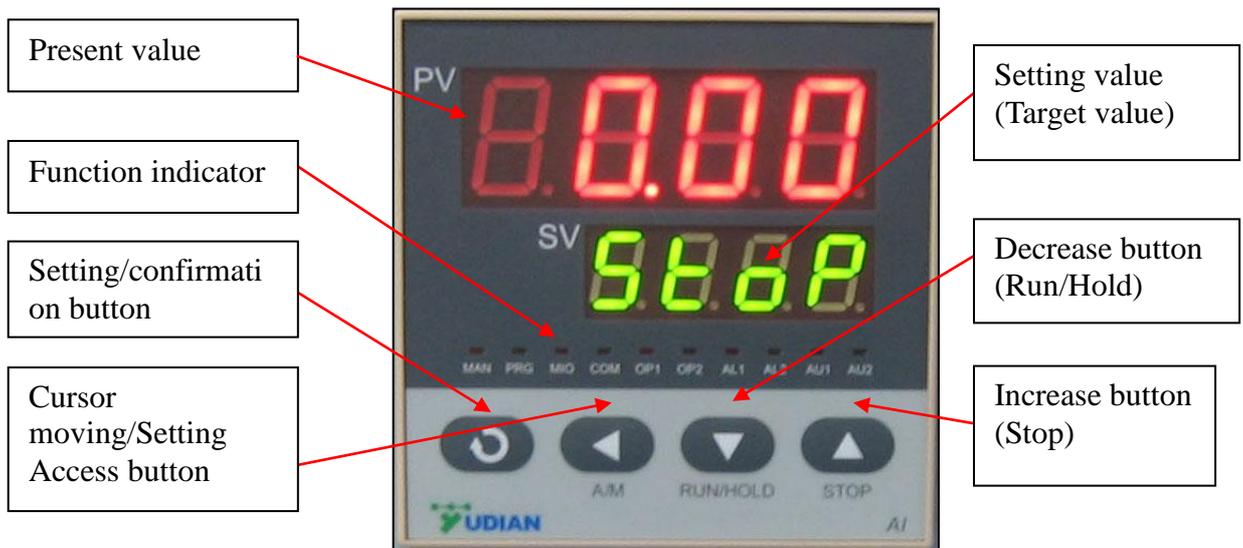
- a. Compatible Thermocouple: K、S、R、E、J、T、N;
- b. Measurement Accuracy: 0.3;
- c. Power Input: Single phase 220V AC ( $\pm 10\%$ ) / 50~60Hz;
- d. Power:  $\leq 5W$ ;
- f. 30 Programmable Segments.

### 2. Structure

MTI have three kinds of temperature controllers but with the same function as below:



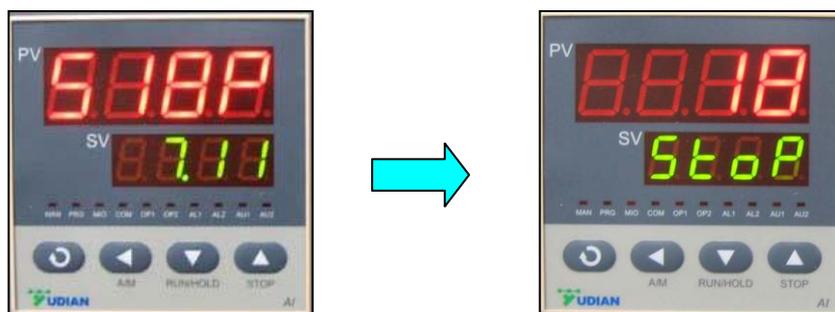
Here we take the first one as default to describe the operation:



## Temperature Controller Setting

### Startup state

When start the device, the meter type and program version will display for a few seconds, and then enter the normal state. Blinking “stop” indicates the program is in stop state.

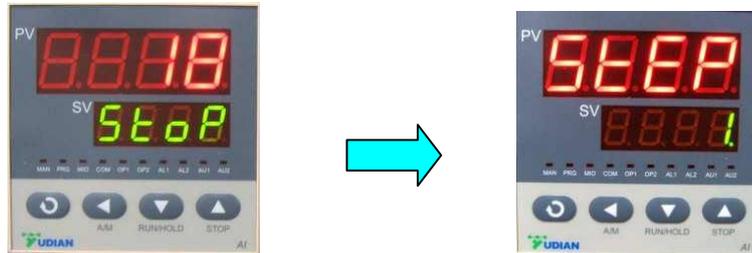


Meter type & Program version

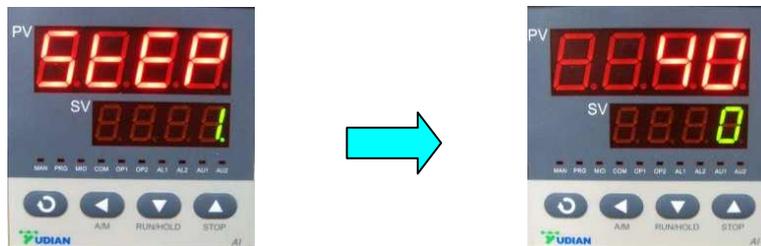
Normal State

## Displaying switch

- In the “normal state” or “program running state”, press “SET” key for 1 second to switch to “executing program segment” (Set executing segment or display the ongoing temperature segment).



- Press “SET” key again for 1 second to switch to “running time state” (Display the total running time PV xxxx min. and the elapsed time SV xxxx min.)

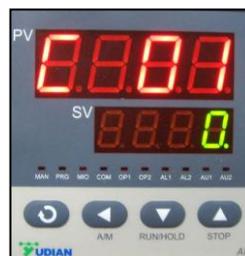


- Press “SET” key again for 1 second to back to “normal state”.

## Temperature Segment Setting example

LTDE programmable smart instrumentation auto-controller allows you to set the temperature profile up to 30 segments. To process this function, follow these steps:

- Power on the furnace, blinking “STOP” on the SV window indicates the Normal State;
- Press “←” once to display “C01” on PV window;
- Set initial temperature to 0 °C by using Keystrokes : “←”, “↑” or “↓”;



- Press “Set” to display “t01” on PV window;



- Set heat-up time (Usually beyond 30 minutes for this segment in case of temperature overshooting) from initial temperature to target temperature by using

- Keystrokes :“←”, “↑” or “↓”;
- Press “Set” to display “C02” on PV window; Set the actual working temperature for the second segment by using Keystrokes :“←”, “↑” or “↓”;



- Press “Set” to display “t02” on PV window; Set heat-up time from initial temperature to target temperature by using Keystrokes :“←”, “↑” or “↓”;
- By pressing “Set”, you can get into the following segments (C03&t03;C04&t04;C05&t05...) for temperature and time setting;
- Press “Set” to display “Cxx” on PV window (xx could be any values among 01~30);
- Press“←”, “↑” or “↓” to set “-121” in the last segment in order to shut down the furnace;



## Illustration of Temperature Segment Setting

Setting Example: Temperature Control Program with 6-segments

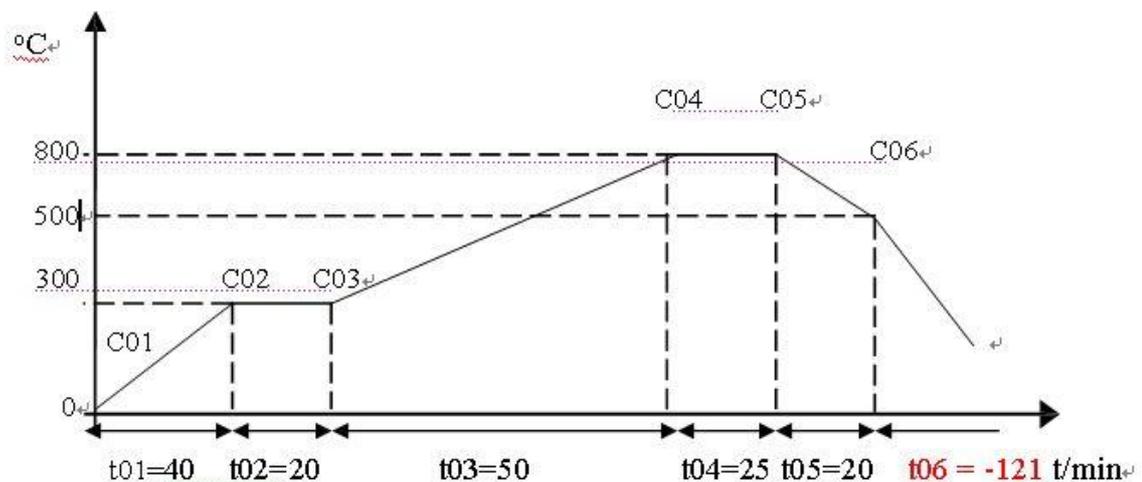


Figure I

According to figure I above, all segments was recorded in the following:

Prompt	Input Data	Description
C01	0	Initial Temperature
T01	40	Heat-up time 40 minutes from 0-300 °C in the first segment
C02	300	Target temperature of the first heat-up stage

T02	20	Keep 20 minutes at 300 °C in the second segment
C03	800	Target temperature of the third stage
T03	50	Heat-up time 50 minutes from 300-800°C in the third segment
C04	800	Target temperature of the fourth stage
T04	25	Keep 25 minutes at 800°C in the fourth segment
C05	500	Target temperature of the fifth cooling stage
T05	20	Cooling time 20 minutes from 800-500°C
C06	500	Beginning temperature of the sixth stage
T06	-121	Program end, Out-put power off. Furnace cooling down naturally. (t06 = -121 is an order to stop running)

## Run the program

- When temperature program set up ready, wait until “STOP” shows on SV window again, then press “↓” and hold for two seconds to display “Run” on SV window;



- Furnace will run automatically segment by segment according to the program setting;
- PV window displays increasing temperature at this moment;
- If you need to hold the furnace at certain temperature **when the program is running**, press “↓” for 2 sec to hold the program and again press it to continue.
- You can stop the program either from running or hold state by pressing “↑” for 2 seconds.



### Attention:

- When finish all the segments you need, please end the last segment with -121;



- It is not suggested to modify any parameters during the execution if he or she is not familiar with the furnace operation. If there is a must, please first stop the program.

# Temperature Controller Parameters

## Introduction

Parameter Name	Parameter Function	Setting Range	Unit	Default Setting
M5	Maintain parameter	1—9999	°C or definable unit	
P	Speed	1—9999		
t	Delay time	1—2000	second	
Ctrl	Control type	2, 3		
LOC	Parameter lock	0 or 808		0

Note: Whenever you want to change the parameters that referred below, please firstly change the value of parameter “Loc” to “808” in order to unlock the parameter settings.



## Parameter Function

### Maintain parameter M5:

Like integral time of PID calibration, this parameter is mainly in charge of the integral work during the adjustment process, for instance, the smaller the M5 is set, the stronger the system integral effect is, vice versa. When M5=0, the system will cancel integral and intelligent adjustment, leave only proportion and differential (PD) function.



### Speed parameter P:

Parameter p has nothing to do with integral function. The bigger the p is, the stronger the proportion and differential function are, vice versa.



### Delay time t:

It is defined as the time spent when the heating rate reaches to 63.5% of the maximum value with assumption that there is no heat dissipation. Remember, this parameter affects the three functions such as integral, proportion and differential, the smaller t is, the stronger proportion and integral function are but weaker differential, after all, the system feedback is promoted, vice versa. If  $t \leq 1$ , the differential function will be off.



### Control type CtrlL:

(Do follow the default setting, or the system may be unable to work)

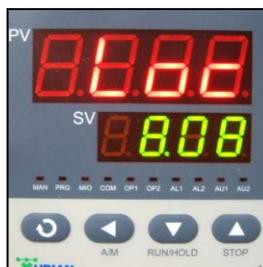
When CtrlL=2, startup auto-tune function, after that, system will go to 3.

When CtrlL=3, adopts advanced AI adjustment, after auto-tune, the system goes to this setting mode, note that in this mode, you can not startup auto-tune function from the panel by holding button, for a protection of repeating auto-tune.



### Parameters lock LOC:

Please set LOC "808" in order to unlock the parameters setting. Otherwise, please keep it as default "0".



### Parameter Setting

- In the "normal state", press "SET" key for 2 seconds, you will see parameter "M5" pops up and press "←", "↑" or "↓" to modify the parameter.
- Press "SET" key for 1 second to go to next parameter and press "←" for 2 seconds to back to preceding parameter.
- Press "←" and then press "SET" key to back up to "normal state". Without any operation on the keys for about 30 minutes, the meter will automatically exit from "parameter setting state".

## Introduction of Default Parameters in the controller

Parameter	Present	Function	Note
<b>HIAL</b>	1250	Max. Temp limit	
<b>LOAL</b>	0	Initial Temp limit	Limit output current below 200 °C
<b>dHAL</b>	999.9	Alarm in positive	
<b>dLAC</b>	999.9	Alarm in negative	
<b>dF</b>	0.3	Adjustment difference	The smaller dF, the higher accuracy auto-tune
<b>Ctrl</b>	3	Control type	
<b>Ctr</b>	1	Output Period	Reflect controller's adjustment Speed
<b>Sn</b>	1	Thermocouple type	S Type Thermal Couple
<b>dIP</b>	0	Position of decimal	
<b>dIL</b>	0	Min. Display value	
<b>dIH</b>	1700	Max. Display value	
<b>Sc</b>	0	Main input shift and adjustment	Tolerance between input and sensor (In order to get a precise result, this may be revised in calibration process).
<b>OP1</b>	1	Output type	1 is output from 1 to 10 mA
<b>OPL</b>		Output lower limit	
<b>OPH</b>		Output upper limit	
<b>ALP</b>	10	Alarm output definition	
<b>CF</b>	16	System function selection	"6" means limit output current at global range
<b>Addr</b>	1	Communication address	
<b>bAud</b>	9600	Baud Rate	
<b>dL</b>	1	Input digital filter	The larger value of dL, the more stable measured temperature will be, but slow down the response rate
<b>run</b>	27	Running Condition	
<b>Loc</b>	0	Parameter Lock	Value '0' will lock data that has been entered. " 808" will open lock to allow you to see and revise all parameters.
<b>EP1</b>	M5		
<b>EP2</b>	P		
<b>EP3</b>	T		
<b>EP4</b>	Ctrl		
<b>EP5</b>	OPL	After adjusting, set to NoneE	

<b>EP6</b>	OPH	After adjusting, set to NoneE	
<b>EP7</b>	NoneE		
<b>EP8</b>	NoneE		

### Auto-tune

In order to get a precise temperature control, customer should pay more attention to the parameters of M5, P and t. Actually, MTI's engineers have already made a strict high temperature pre-heating test (rate: 5°C/min) and fixed on these three parameters according to each furnace' condition before shipping it out. Therefore, we have a confidence of satisfying over 95% customers.

**However**, the diversity of environment and the distinction in manufacturing for each customer, may seriously affect the operation, so, using auto-tune function to decide these parameters for a perfect result **when the temperature is not stable and the error is large**:

- Run the program and wait until the furnace temperature reaches to 80% of your desired temperature.
- Set the control parameter 'Ctrl' as 2 and then press "←" then "SET" key to switch back to 'Running State'.
- You will see the meter flashes with "AT", it indicates the meter has been in the "auto-tune state". Then, system begins to oscillate 2-3 times and the meter automatically analyzes the furnace' temperature controlling period, amplitude, wave type and coefficient of heat preservation at current temperature segment, finally, yields the three parameters as M5, P and t. Press "←" for 2 seconds to force the meter to stop flashing at any time you want.
- Due to different temperature, the time spent for "auto-tune" may be distinct.

**Note:** that the parameter 'Ctrl' will be set as 3 by the system after "auto-tune", so, if customer need more "auto-tune" operation for the furnace please reset the 'Ctrl' to 2.

\*Actually, "auto-tune" function could produce exact parameters for a general use. For the advanced customer who is familiar with PLC and pursuing perfect accuracy, they can manually modify M5, P and t in terms of experience, MTI would be glad to provide useful information as following:

### Please draw the system response plot, if it is:

- ◆ Short oscillating period, you can decrease P (priority), increase M5 and t.
- ◆ Long oscillating period, you can increase P (priority) as well as M5 and t.
- ◆ No oscillating but offset is large, decrease M5 (priority), increase P.
- ◆ Stable controlling but time-consume is too long, decrease t (priority) as well as M5, increase P.

**Increase (or decrease) one of the three parameters by 30%-50%, if the controlling becomes better**, continue increasing (or decreasing), otherwise, decrease (or increase) it till get the qualified adjustment. **Commonly, M5 posses a priority, if not enough, try P and t.**

## Troubleshooting for typical Problems

### Troubleshooting resources

- Refer to "Quick troubleshooting", the next section in this chapter;

- Visit MTI web site link: [WWW.MTIXTL.COM](http://WWW.MTIXTL.COM) for additional information about the instrument through Help and Support;
- Contact us by tel: 510-525-3070 or email: [info@mtixtl.com](mailto:info@mtixtl.com).

## Quick Troubleshooting

### The furnace is unable to start up

If the furnace can not turn on when you press the power button:

- Be sure the furnace is plugged into an AC outlet with adequate power;
- Fuse in controlling circuit might fail. Check the control circuit and replace the fuse.

### The temperature inside the chamber can't go up

- Temperature may be set too low, adjust the setting value of temperature;
- Thermocouple may be failure, check and replace the thermocouple;
- Temperature controller may be broken, check and replace the thermocouple;

### Real temperature inside the chamber does not match the setting value

- Temperature sensor may be broken, replace the temperature sensor/thermocouple;

### Overheated protection alarm

- Cool furnace down, and find reason why temperature is so high (program setting may be wrong);

### SV show "OraL" alternately

- Thermocouple has open circuit, inspect thermocouple;

### SV show "HIAL" alternately

- Furnace temperature is over upper limit, Please let the furnace naturally cooling down and then check out the reason of over-heating.

## Maintenance and Caution

- In order to prevent the furnace module from splitting, the furnace shall be used after being heated for 1 hour at 120 °C and 2 hours at 300 °C if you firstly apply it or have left it aside for long. Never keep the furnace temperature over rated temperature for avoiding damage on heating element or cover. Do not pour any liquid or melting metal into the module to keep clean inside.
- Set a medium heating rate and small temperature difference between adjacent segments when the furnace is cool. Please make a considerate setting on the heating rate in terms of the character of material sintered.
- Regular check the wire connection and link junction of the heating element.
- Please refer to parameter "M5, P and t" setting if the temperature offset can not be eliminated and the difference between PV and SV goes far at 300 °C.
- Working environment
  - Circumstance temperature: -10~75 °C.
  - Relative humidity:85%
  - Keep from electric dust, explosive and corrosive gas;
  - Keep stable position when working.
- MTI' furnace (**not including tube and heating element**) has one year warranty since it is shipped out. We will give you free maintenance **if there is a quality problem**. For any **misuse and damage**, we will make a charge according to the damage condition if there is a requirement of mending.

**Notice: MTI never suggest you put any noxious, explosive or flammable gas into the tube.**

## Knowledge on AC Power Connection

For power connection, you must follow your local law and let a licensed electrician do it. **MTI Corporation is not responsible for any damage caused by wrong power connection.**

Extra power connection knowledge is not only for you to get a better application of the product, but also for your safety.

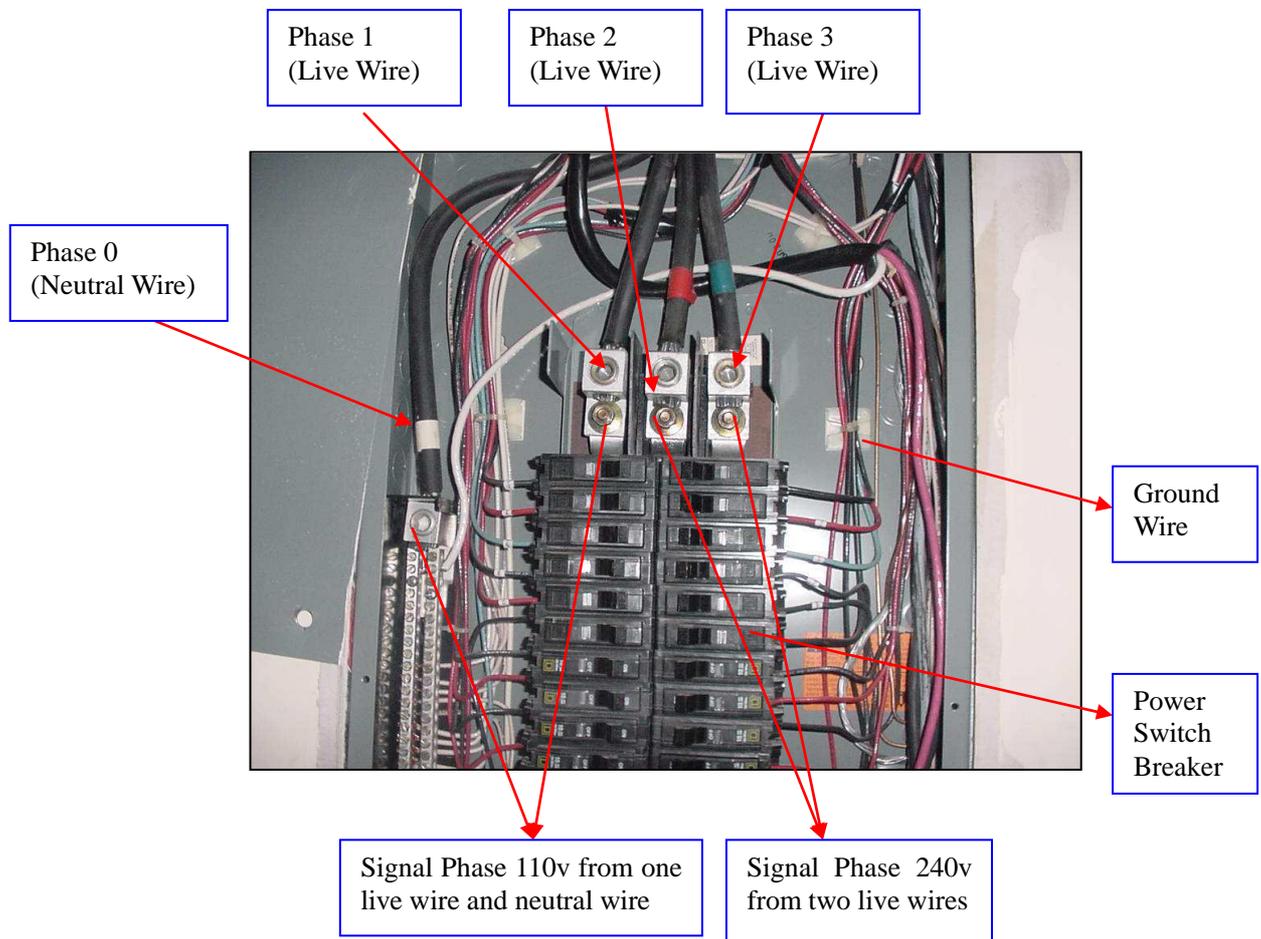
**If your country uses 220V power, you have no problem.**

**If your country uses 110V power, you may need a 208~240V single phase AC power line.**

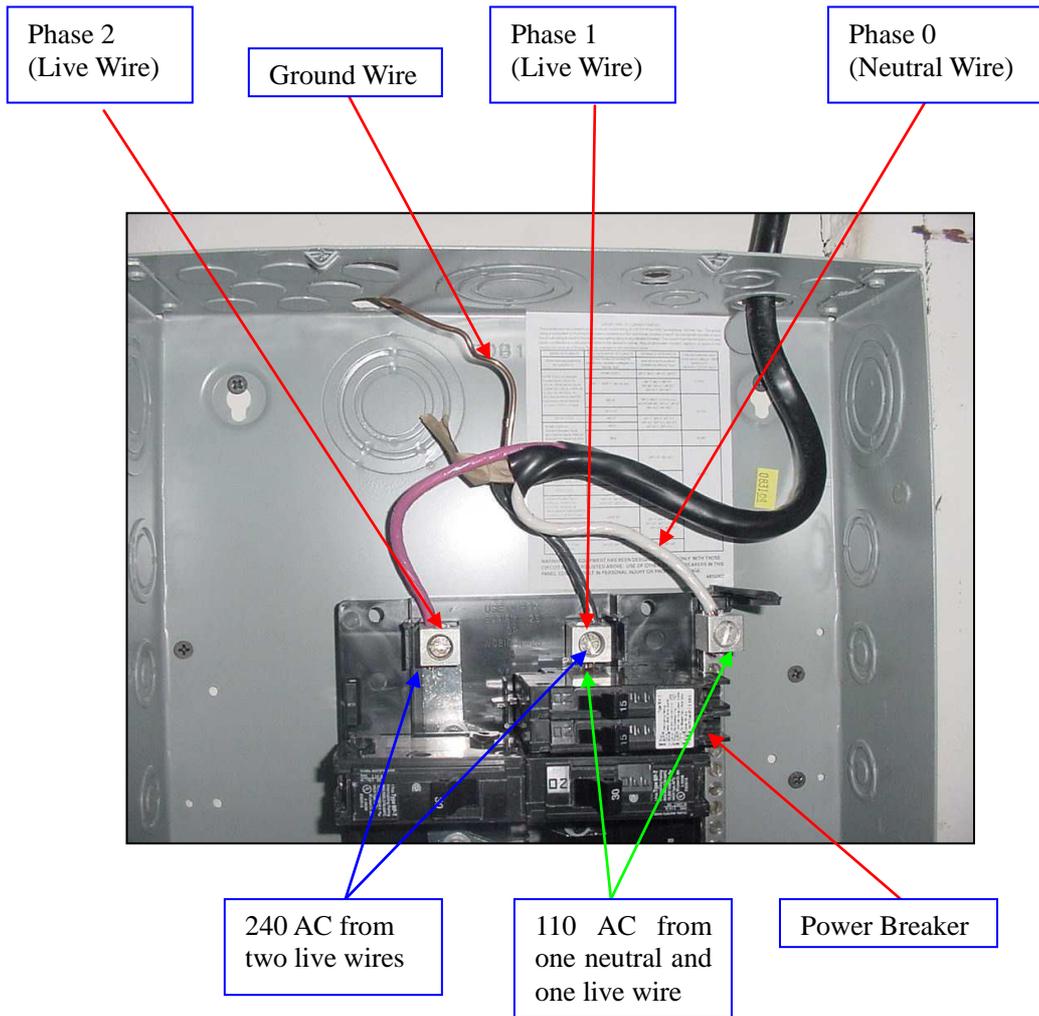
Ask your electrician to make single phase 240V power line, similar to you set up a 240V electric washer/dryer in your home. Please prepare the following knowledge:

**Three phases (240V) AC power panel box** usually is located in the laboratory and inside wires are shown below.

**In order to get single phase 240V**, two power lines come from two live wires, Of course, a 240V switch breaker must be installed.

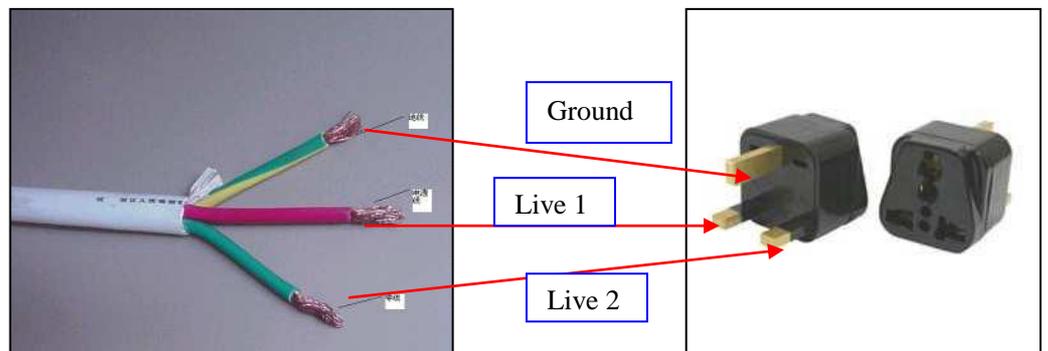


**Typical Three Phases AC Power in US**



## Typical Two Phases AC Power in US

Connect the power cable of the furnace to a male plug and the two single phase wires to female and then connect them for easy and safe use:



**Again, the above information is just for basic knowledge only; please contract a licensed electrician to do the connection!!!**