Instruction Manual

SYL-2342-IR PID Temperature Controller

Version 1.0 (Jan 2017)

Caution

- This controller is intended to control equipment under normal operating conditions. If failure or malfunction of the controller may lead to abnormal operating conditions that may result in personal injury or damage to the equipment or other property, devices (limit or safety controls) or systems (alarm or supervisory) intended to warn of or protect against failure or malfunction of the controller must be incorporated into and maintained as part of the control system.
- Installing the rubber gasket supplied will protect the controller front panel from dust and water splash (IP54 rating). Additional protection is needed for higher IP rating.
- This controller carries a 90-day warranty. This warranty is limited to the controller only.

1. Specifications

Input type	**DC voltage**: 0 ~ 20 mV, 0 ~ 100 mV, 0 ~ 5 V, 1 ~ 5 V, 0 ~ 1 V, -100 ~ 100 mV, -20 ~ 20 mV, -5 ~ 5 V, 0.2 ~ 1V. **DC current**: 4 ~ 20 mA.
Input range	Linear input: -1999 ~ +9999 defined by user
Power supply for transducers	12 VDC
Accuracy	± 0.2% or ±1 unit of full input range
Control mode	Fuzzy PID, On-off control
Output mode	Relay contact (NO): 250 VAC / 7 A, 120 V / 10 A, 24 VDC / 10 A
Alarm output	Relay contact (NO): 250 VAC / 1 A, 120 VAC / 3 A, 24 VDC / 3 A
Alarm function	Process high alarm, process low alarm, deviation high alarm, and deviation low alarm
Power supply	85 ~ 260 VAC / 50 ~ 60 Hz
Power consumption	≤ 5 Watt
Ambient temperature	0 ~ 50ºC, 32 ~ 122ºF
Dimension	48 x 48 x 100 mm (W x H x D)
Mounting cutout	45 x 45 mm

2. Terminal Wiring

Model SYL-2342-IR

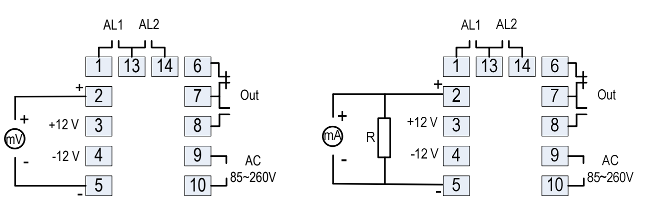

Figure 1. Wiring diagram of transducer with voltage signal (left) and milliamp current signal (right).

2.1 Sensor connection

For voltage signal transducer (see Figure 1, left), the positive voltage signal should be connected to terminal 2, the negative voltage signal should be connected to terminal 5. A 12 VDC power is available between terminal 3 (+12 VDC) and terminal 4 (ground).

For current signal transducer (see Figure 1, right), a resistor should be wired in parallel to the transducer, to convert the current signal to voltage signal. The positive current lead should be connected to terminal 2, and the negative current signal should be connected to terminal 5. A 12 VDC power is available from terminal 3 (+12 VDC) and terminal 4 (ground).

Please note that the ground for the 12 VDC power (terminal 4) and the ground for the signal input (terminal 5) should be isolated. Please **DO NOT** connect terminals 4 and 5 together.

2.2 Power to the controller

The power cables should be connected to terminals 9 and 10. Polarity does not matter. It can be powered by 85 - 260 VAC power source. Neither a transformer nor jumper is needed to wire it up. For the sake of consistency with the wiring example described later, we suggest you connect the hot wire to terminal 9 and neutral to 10.

2.3 Control output connection

The relay output of the controller SYL-2342-IR can be used to turn on a contactor or a solenoid valve. It can drive a small heater directly if the heater draws less than 10 A when connected to 120 VAC power source. For applications needing two control outputs, such as one for heating and another for cooling, relays AL1 or AL2 can be used for the second output with on/off control mode. Please see Section 4 for details.

2.3.1 Connecting the load through a contactor

Assuming the controller is powered by 120 VAC and the contactor has a 120 VAC coil, jump a wire between terminals 8 and 9. Connect terminal 7 to one lead of the coil and terminal 10 to the other lead of the coil. Please see Section 4 for wiring example.

2.3.2 Connecting the heater (or cooler) directly from the internal relay

Assuming the controller and the load (heater or cooler) are powered by the same voltage. Jump a wire from terminal 9 to 8. Connect terminal 7 to the one lead of the load and terminal 10 to the other lead of the load. Please see Section 4 for details.

2.4 For first time users without prior experience with PID controllers, the following notes may prevent you from making common mistakes.

2.4.1 Power to the heater does not flow through terminal 9 and 10 of the controller. The controller consumes less than 2 watts of power. It only provides a control signal to the relay. Therefore, wires in the 18 to 26 gauge range should be used for providing power to terminals 9 and 10. Thicker wires may be more difficult to install.

2.4.2 The control relay outputs (for SYL-2342-IR), AL1 and AL2, are "dry" single pole switches. They do not provide power by themselves. If the load of the relay requires a different voltage than that for the controller, another power source will be needed. Please see Section 4 for examples.

2.4.3 For all controller models listed in this manual, the power is controlled by regulating the duration of on time for a fixed period of time. It is not controlled by regulating amplitude of the voltage or current. This is often referred as time proportional control. For example, if the cycle rate is set for 20 seconds, a 60% output means controller will switch on the power for 12 seconds and off for 8 seconds (12/20 = 60%). Almost all high-power control systems use time proportional control because amplitude proportional control is too expensive and inefficient.

3. Front Panel and Operation

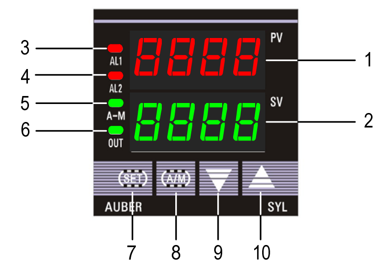

Figure 2. Front panel.

① PV display: Indicates the sensor read out, or process value (PV).
② SV display: Indicates the set value (SV) or output value (%).
③ AL1 indicator: It lights up when AL1 relay is on.
④ AL2 indicator: It lights up when AL2 relay is on.
⑤ A-M indicator: The light indicates that the controller is in manual mode. For the controllers with the Ramp/Soak option, this light indicates that the program is running.
⑥ Output indicator: It is synchronized with control output (terminal 7 and 8), and the power to the load. When it is on, the heater (or cooler) is powered.
⑦ SET key: When it is pressed momentarily, the controller will switch the lower (SV) display between set value and percentage of output. When it is pressed and held for two seconds, the controller will enter the parameter setting mode.
⑧ Automatic/Manual function key (A/M) /Data shift key.
⑨ Decrement key ▼: Decreases numeric value of the setting value.
⑩ Increment key ▲: Increases numeric value of the setting value.

3.1 Display Status

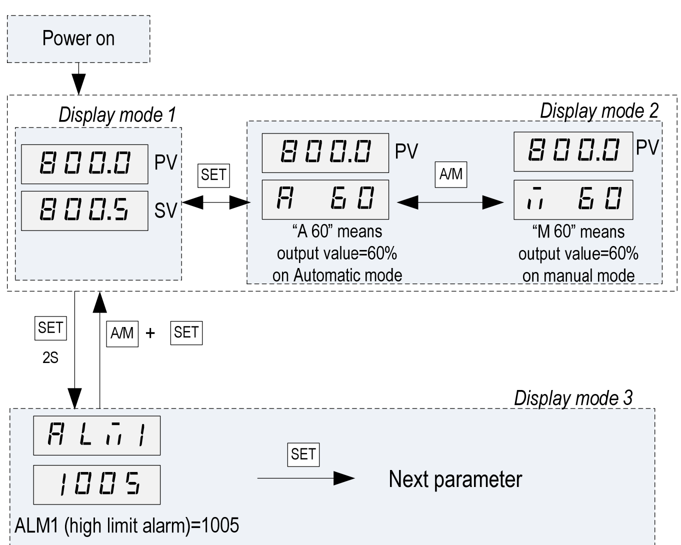

Figure 3. Display modes

3.2 Basic Operation

3.2.1 Change the Set Value (SV)

Press the ▼ or ▲ key once, and then release it. The decimal point on the lower right corner will start to flash. Press the ▼ or ▲ key to change SV until the desired value is displayed. If the change of SV is large, press the A/M key to move the flashing decimal point to the desired digit that needs to be changed. Then press the ▼ or ▲ key to start changing SV from that digit. The decimal point will stop flashing after no key is pressed for 3 seconds. The changed SV will be automatically registered without pressing the SET key.

3.2.2 Switch Display Mode

Press the SET key to change the display mode. The display can be switched between display modes 1 and mode 2.

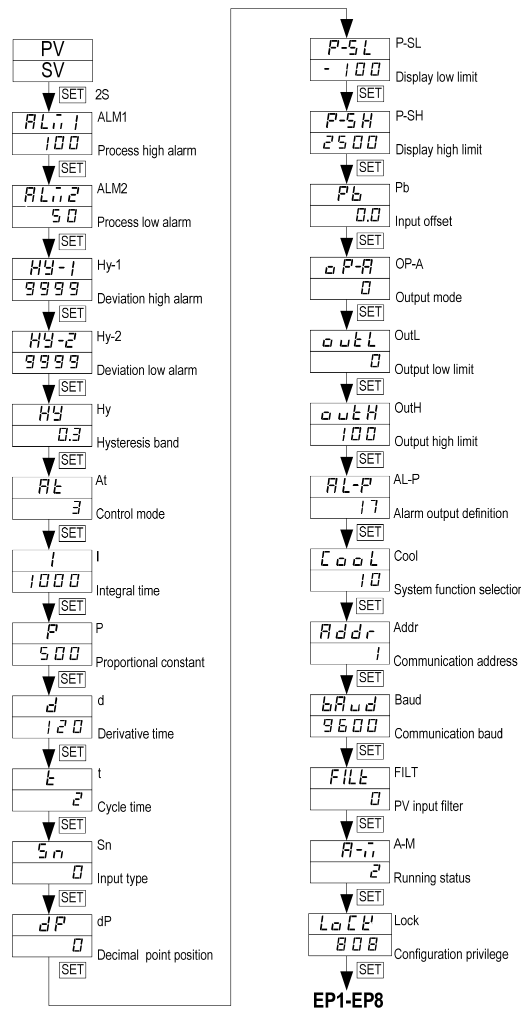

Figure 4. System setup flow chart

3.2.3 Switch Between Manual /Automatic Control Mode

Bumpless switching between PID mode and Manual mode can be performed by pressing the A/M key. The A-M LED will light up when the controller is in Manual mode. In Manual mode, the output amplitude can be increased or decreased by pressing ▲ and ▼ (display mode 2). **Please note that manual control is initially disabled (A-M = 2). To activate the manual control, set A-M = 0 or 1.**

3.2.4 Parameter Setup Mode

When the display mode is 1 or 2, press SET and hold for roughly 2 seconds until the parameter setup menu is displayed (display mode 3). Please refer to 4.3 for how to set the parameters.

3.3 Parameter Setup Flow Chart

While in the parameter setup mode, use ▲ and ▼ to modify a digit and use A/M to select the digit that needs to be modified. Press the A/M and SET key at the same time to exit the parameter setup mode. The instrument will automatically exit if no key is pressed for 10 seconds. Figure 4 is the setup flow chart. Please note the changed parameter will be automatically registered without pressing the SET key. If the controller is locked (see 4.17). Only limited parameters (or no parameters) can be changed.

3.4 Parameter Setting

Table 2. System parameters.

Code	Description	Setting Range	Initial Setting	Remarks
ALM1	Process high alarm	-1999 ~ +9999°C or °F	100	See 4.1.1
ALM2	Process low alarm	-1999 ~ +9999°C or °F	50	
Hy-1	Deviation high alarm	0 ~ +9999°C or °F	9999	
Hy-2	Deviation low alarm	0 ~ +9999°C or °F	9999	
Hy	Hysteresis Band	0 ~ 200°C or °F or 0 ~ 2000 for linear input	0.3	See 4.1.2
At	Auto tuning	0 ~ 3. Set to 1 or 2 to start Auto tuning	3	
I	Integral time	0 ~ 9999	1000	
P	Proportional Constant	1 ~ 9999%	500	
d	Derivative Time	0 ~ 2000	120	
t	Cycle time	2 ~ 125	20 for relays	
Sn	Input type	0 ~ 37	33	See 4.2
dP	Decimal point position	0 ~ 3	0	
P-SL	Display low limit	-1999 ~ +9999°C or °F	0	See 4.3
P-SH	Display high limit	-1999 ~ +9999°C or °F	400	
Pb	Input offset	-1999 ~ +4000 -1999 ~ +9999°C or °F	0.0	
oP-A	Output mode	0 ~ 2	0	
outL	Output low limit	0 ~ 100%	0	
outH	Output high limit	0 ~ 100%	100	
AL-P	Alarm output definition	0 ~ 31	17	See 4.4
CooL	System function selection	0 ~ 15	10	See 4.5
Addr	Communication address	s 0 ~ 20	1	
bAud	Communication baud rate	0 ~ 19200	9600	
FILt	PV input filter	0 ~ 20	0	
A-M	Automatic/Manual status	0. Manual 1. Automatic 2. Manual suppressing	2	
LocK	Configuration privilege	0 ~ 9999	808	See 4.6
EP1-EP8	Field parameter definition	nonE ~ A-M	nonE	See 4.7

For the parameters not mentioned in this manual, please check the manual of SYL-2342.

3.4.1 Alarm parameters

This controller offers four types of alarm, "ALM1", "ALM2", "Hy-1", "Hy-2".

- ALM1: High limit absolute alarm. If the process value is greater than the value specified as "ALM1+Hy" (Hy is the Hysteresis Band), then the alarm will turn on. It will turn off when the process value is less than "ALM1-Hy".
- ALM2: Low limit absolute alarm. If the process value is less than the value specified as "ALM2-Hy", then the alarm will turn on, and the alarm will turn off if the process value is greater than "ALM2+Hy".
- Hy-1: Deviation high alarm. If the temperature is above "SV+Hy-1 +Hy", the alarm will turn on, and the alarm will turn off if the process value is less than "SV+Hy-1 -Hy" (we will discuss the role of Hy in the next section)
- Hy-2: Deviation low alarm. If the temperature is below "SV-Hy-2 -Hy", the alarm will turn on, and the alarm will turn off if the temperature is greater than "SV-Hy-2 +Hy".

The things you should know about alarms

1) Absolute alarm and deviation alarm

High (or low) limit absolute alarm is set by the specific temperatures that the alarm will be on. Deviation high (or low) alarm is set by how many degrees above (or below) the control target temperature (SV) that the alarm will be on.
Assuming ALM1 = 1000 ºF, Hy-1 = 5 ºF, Hy = 1, SV = 700 ºF. When the probe temperature (PV) is above 706, the deviation alarm will be on. When the temperature is above 1001 ºF, the process high alarm will be on. Later, when SV changes to 600 ºF, the deviation alarm will be changed to 606 but process high alarm will remain the same. Please see 4.5.2 for details.

2) Alarm suppression feature

Sometimes, user may not want the low alarm to be turned on when starting the controller at a temperature below the low alarm setting. The Alarm Suppression feature will suppress the alarm from turning on when the controller is powered up (or SV changes). The alarms can only be activated **after** the PV has reached SV.

This feature is controlled by the B constant of the COOL parameter (see 4.14). The default setting is alarm suppression on. If you use the AL1 or AL2 relay for a control application that needs it to be active as soon as the controller is powered up, you need to turn off the alarm suppression by setting B = 0.

3) Assignment of the relays for the alarms

AL1 and AL2 are the name of the two relays used for alarm output. AL1 is the alarm relay 1 and AL2 is alarm relay 2. Please do not confuse the relays with alarm parameter ALM1 (process high alarm) and ALM2 (process low alarm). AL-P (alarm output definition) is a parameter that allows you to select the relay(s) to be activated when the alarm set condition is met. Please note that deviation alarm cannot trigger alarm relay AL1. You can set all four alarms to activate the one relay (AL1 or AL2), but you can't activate both relays for with just one alarm.

4) Display of the alarm

When AL1 or AL2 relay is activated, the LED on the upper left will light up. If you have multiple alarms assigned to a single relay, you might want to know which alarm activated the relay. This can be done by setting the E constant in the AL-P parameter (see 4.13). When E = 0, the bottom display of the controller will alternately display the SV and the activated alarm parameter.

5) Activate the AL1 and AL2 by time instead of temperature

For the controllers with the ramp and soak function (SYL-2342P and SYL-2352P), AL1 and AL2 can be activated when the process reaches a specific time.

3.4.2 Hysteresis Band "Hy"

The Hysteresis Band parameter Hy is also referred as Dead Band, or Differential. It permits protection of the on/off control from high switching frequency caused by process input fluctuation. Hysteresis Band parameter is used for on/off control, 4-alarm control, as well as the on/off control at auto tuning. For example: (1) When controller is set for on/off heating control mode, the output will turn off when temperature goes above SV + Hy and on again when it drops to below SV - Hy. (2) If the high alarm is set at 800 °F and hysteresis is set for 2 °F, the high alarm will be on at 802 °F (ALM1 + Hy) and off at 798 °F (ALM1 - Hy).

Please note that the cycle time can also affect the action. If the temperature passes the Hy set point right after the start of a cycle, the controller will not respond to the Hy set point until the next cycle. If cycle time is set to 20 seconds, the action can be delay as long as 20 seconds. Users can reduce the cycle time to avoid the delay.

3.4.3 Control mode "At"

At = 0. on/off control. It works like a mechanical thermostat. It is suitable for devices that do not like to be switched at high frequency, such as motor and valves. See 4.5.2 for details.

At = 1. gets the controller ready to start the Auto tuning process by pressing the A/M key.

At = 2. Start auto tuning. It will start automatically after 10 seconds. The function is the same as starting auto tuning from front panel.

At = 3. This configuration is automatically set after auto tuning is done. Auto tuning from the front panel is inhibited to prevent accidental re-starting of the auto tuning process. To start auto tuning again, set At = 1 or At = 2.

3.4.4 Control mode

1) PID control mode

Please note that because this controller uses fuzzy logic enhanced PID control software, the definition of the control constants (P, I and D) are different than that of the traditional proportional, integral, and derivative parameters.

In most cases the fuzzy logic enhanced PID control is very adaptive and may work well without changing the initial PID parameters. If not, users may need to use auto-tune function to let the controller determine the parameters automatically. If the auto tuning results are not satisfactory, you can manually fine-tune the PID constants for improved performance. Or you can try to modify the initial PID values and perform auto tune again. Sometimes the controller will get the better parameters.

The auto-tune can be started in two ways. 1) Set At = 2. It will start automatically after 10 seconds. 2) Set At = 1. Then you can start the auto-tune any time during the normal operation by pressing the A/M key. During auto tuning, the instrument executes on-off control. After 2-3 times on-off action, the microprocessor in the instrument will analyze the period, amplitude, waveform of the oscillation generated by the on-off control, and calculate the optimal control parameter value. The instrument begins to perform accurate artificial intelligence control after auto tuning is finished. If you want to exit from auto tuning mode, press and hold the (A/M) key for about 2 seconds until the blinking of "At" symbol is stopped in the lower display window. Generally, you will need to perform auto tuning once. After the auto tuning is finished. The instrument will set parameter "At" to 3, which will prevent the (A/M) key from triggering auto-tune. This will prevent an accidental repeat of the auto-tuning process.

(1) Proportional constant "P"

Please note the P constant is not defined as Proportional Band as in the traditional model. Its unit is not in degrees. A larger P value results in stronger and quicker action, which is the opposite of the traditional proportional band value. It also functions in the entire control range rather than a limited band.
If you are controlling a very fast response system (>1°F/second) that fuzzy logic is not quick enough to adjust, set P = 1 will change the controller to the traditional PID system with a moderate gain for the P.

(2) Integral time "I"

Integral action is used to eliminate offset. Larger values lead to slower action. Increase the integral time when temperature fluctuates regularly (system oscillating). Decrease it if the controller is taking too long to eliminate the temperature offset. When I = 0, the system becomes a PD controller.

(3) Derivative time "D"

Derivative action can be used to minimize the temperature over-shoot by responding to its rate of change. The larger the number, the faster the action.

2) On/off control mode

It is necessary for inductive loads such as motors, compressors, or solenoid valves that do not like to take pulsed power. It works like a mechanical thermostat. When the temperature passes hysteresis band (Hy), the heater (or cooler) will be turned off. When the temperature drops back to below the hysteresis band, the heater will turn on again.

To use the on/off mode, set At = 0. Then, set the Hy to the desired range based on control precision requirements. Smaller Hy values result in tighter temperature control, but also cause the on/off action to occur more frequently.

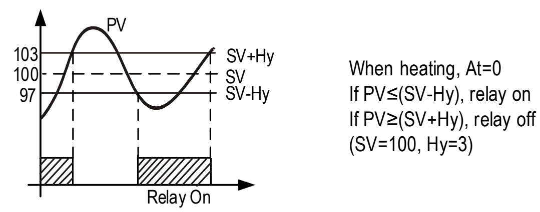

Figure 5. On/off control mode.

3) Manual mode

Manual mode allows the user to control the output as a percentage of the total heater power. It is like a dial on a stove. The output is independent of the temperature sensor reading. One application example is controlling the strength of boiling during beer brewing. You can use the manual mode to control the boiling so that it will not boil over to make a mess. The manual mode can be switched from PID mode but not from on/off mode. This controller offers a "bumpless" switch from the PID to manual mode. If the controller outputs 75% of power at PID mode, the controller will stay at 75% when it is switched to the manual mode, until it is adjusted manually. See Figure 3 for how to switch the display mode. The Manual control is initially disabled (A-M = 2). **To activate manual control, please make sure At = 3 (section 4.4.3) and A-M = 0 or 1 (section 4.16).** If you are currently in ON/OFF mode (At = 0), you will not be able to use manual mode.

4) Auto-tune

The auto-tune can be started in two ways. 1) Set At = 2. It will start automatically after 10 seconds. 2) Set At = 1. Then you can start the auto-tune any time during the normal operation by pressing the A/M key. When auto-tuning starts, the lower window will flash between "At" and the current set temperature.

During auto tuning, the instrument executes on/off control at the current set temperature. After 2 ~ 3 times on/off action, the microprocessor in the instrument will analyze the period, amplitude, waveform of the oscillation generated by the on/off control, and calculate the optimal value for the P, I, and D.

When auto-tune is finished, the lower window will stop flashing "At"; only the set temperature will be shown in the lower window. Controller will resume running the program. Generally, you will only need to perform auto tuning once. After the auto tuning is finished, controller will set parameter "At" to 3, which will prevent the (A/M) key from triggering auto-tune. This will prevent an accidental repeat of the auto-tuning process.

The auto-tuning process can also be manually stopped by holding the A/M key 2 seconds. Hold the A/M key too long may bring the controller into the programming mode. If the auto-tune is manually stopped, controller will not change "At" to 3. P, I, and D will not be changed either. User can start the auto-tune again by holding A/M key for 2 seconds.

3.4.5 Cycle time "t"

It is the time period (in seconds) that the controller uses to calculate its output. For example, when t = 20, if the controller decides output should be 10%, the heater will be on 2 second and off 18 seconds for every 20 seconds. For relay or contactor output, it should be set longer to prevent contacts from wearing out too soon. Normally it is set to 20~40 seconds.

3.4.6 Input selection code for "Sn"

Please see Table 3 for the acceptable sensor type and its range.

Table 3. Code for sensor input type (Sn) and sensor input range.

Sn code	Input device	Display range
28	0 ~ 20 mV	Set by P-SL and P-SH.
29	0 ~ 100 mV	
30	0 ~ 60 mV	
31	0 ~ 1 V	
32	0.2 ~ 1 V 4 - 20 mA (w/ 50 Ω Resistor)	
33	1~5 V 4 ~ 20 mA (w/ 250 Ω Resistor)	
34	0 ~ 5 V	
35	-20 ~ +20 mV	
36	-100 ~ +100 mV	
37	-5 V ~ +5 V	

3.4.7 Decimal point setting "dP"

The parameter "dP" defines how many digits after the decimal point will be displayed. For Linear input (voltage, current, or resistance input, Sn = 28 ~ 37) For other linear input signals, dP can be set to from 0 to 3. Please see Table 4 for its value the corresponding resolution.

Table 4. dP parameter setting.

dP Value	0	1	2	3
Display format	0000	000.0	00.00	0.000

3.4.8 Limiting the control range, "P-SH" and "P-SL"

For linear input signals, "P-SH" and "P-SL" are used for scaling the display. "P-SL" is the value to be displayed when the signal is at its low limit of the linear input. "P-SH" is the value to be displayed when the signal is at its high limit of the linear input. For example, for 0-5V signal, "P-SL" corresponds to the value when signal is 0V, and "P-SH" corresponds to the value when signal is 5V. If you have a pressure transducer that its 0V output represents -18 PSI, and 5V output represents 168 psi, then set P-SL = -18 and P-SH = 168 will convert the voltage signal to pressure value in PSI and display it on the PV window on the controller. In the real world, some of the pressure transducer manufactures only offer the signal in 0.5 V to 4.5 V range. In that case, user needs to extrapolate the signal range to get the corresponding value at 0 V and 5 V assuming it is linear.

3.4.9 Input offset "Pb"

Input offset Pb is used to add an offset value to compensate the sensor error or simply to shift the reading. For example, if the controller displays 2ºC when probe is in ice/water mixture, setting Pb = -2, will make the shift the temperature reading to 0ºC.

3.4.10 Output definition "OP-A"

This parameter is not used for this model. It should not be changed.

3.4.11 Output range limits "OUTL" and "OUTH"

OUTL and OUTH allow you set the output range low and high limit.

OUTL is a useful feature for a system that needs to have a minimum amount of power as long as the controller is powered. e.g. If OUTL = 20, the controller will maintain a minimum of 20% power output even when input sensor failed.

OUTH can be used when you have an overpowered heater to control a small subject. e.g. If you set the OUTH = 50, the 5000 W heater will be used as 2500 W heater (50%) even when the PID wants to send 100% output.

3.4.12 Alarm output definition "AL-P"

Parameter "AL-P" may be configured in the range of 0 to 31. It is used to define which alarms ("ALM1", "ALM2", "Hy-1" and "Hy-2") is output to AL1 or AL2. Its function is determined by the following formula:

AL-P = AX1 + BX2 + CX4 + DX8 + EX16

If A = 0, then AL2 is activated when Process high alarm occurs.
If A = 1, then AL1 is activated when Process high alarm occurs.
If B = 0, then AL2 is activated when Process low alarm occurs.
If B = 1, then AL1 is activated when Process low alarm occurs.
If C = 0, then AL2 is activated when Deviation high alarm occurs.
If C = 1, then AL1 is activated when Deviation high alarm occurs.
If D = 0, then AL2 is activated when Deviation low alarm occurs.
If D = 1, then AL1 is activated when Deviation low alarm occurs.
If E = 0, then alarm types, such as "ALM1" and "ALM2" will be displayed alternatively in the lower display window when the alarms are on. This makes it easier to determine which alarms are on.
If E = 1, the alarm will not be displayed in the lower display window (except for "orAL"). Generally, this setting is used when the alarm output is used for control purposes.

For example, in order to activate AL1 when a Process high alarm occurs, trigger AL2 by a Process low alarm, Deviation high alarm, or Deviation low alarm, and not show the alarm type in the lower display window, set A = 1, B = 0, C = 0, D = 0, and E = 1. Parameter "AL-P" should be configured to:

AL-P = 1X1 + 0X2 + 0X4 + 0X8 + 1X16 = 17 **(this is the factory default setting)**

Note: Unlike controllers that can be set to only one alarm type (either absolute or deviation but not both at same time), this controller allows both alarm types to function simultaneously. If you only want one alarm type to function, set the other alarm type parameters to maximum or minimum (ALM1, Hy-1 and Hy-2 to 9999, ALM2 to –1999) to stop its function.

3.4.13 "COOL" for Celsius, Fahrenheit, Heating, and Cooling Selection

Parameter "COOL" is used to set the display unit, heating or cooling, and alarm suppression. Its value is determined by the following formula:

COOL = AX1 + BX2 + CX8

A = 0, reverse action control mode for heating control.
A = 1, direct action control mode for cooling control.
B = 0, without alarm suppressing when turned on or when set point changes.
B = 1, alarm suppressing at power up or set point changes.
C = 0, display unit in ºC.
C = 1, display unit in ºF.
The factory setting is A = 0, B = 1, C = 1 (heating, with alarm suppression, display in Fahrenheit). Therefore,
COOL = 0X1 + 1X2 + 1X8 = 10

To change from Fahrenheit to Celsius display, set COOL = 2.

3.4.14 Input digital filter "FILt"

If measurement input fluctuates due to noise, then a digital filter can be used to smooth the input. "FILt" may be configured in the range of 0 to 20. Stronger filtering increases the stability of the readout display, but causes more delay in the response to change in temperature. FILt = 0 disables the filter.

3.4.15 Manual and Automatic Mode Selection "A-M"

Parameter A-M is for selecting automatic or manual control mode.
A-M = 0, manual control mode
A-M = 1, automatic control mode (either PID or on/off control)
A-M = 2, automatic control mode, in this state manual operation is prohibited
This parameter functions differently for controllers with the ramp/soak function (see supplemental manual for details).

3.4.16 Lock up the settings, field parameter "EP" and parameter "LocK"

To prevent the operator from changing the settings by accident, you can lock the parameter settings after initial setup. You can select which parameter can be viewed or changed by assigning one of the field parameters to it. Up to 8 parameters can be assigned into field parameter EP1-EP8. The field parameter can be set to any parameter listed in Table 2, except parameter EP itself. When LocK is set to 0, 1, 2, and so on, only parameters or setting values of program defined in an EP can be displayed. This function can speed up parameter modification and prevent critical parameters (like input, output parameters) from being modified.

If the number of field parameters is less than 8, then define the first unused parameter as none. For example, if only ALM1 and ALM2 need to be modified by field operators, the parameter EP can be set as following:
LocK = 0, EP1 = ALM1, EP2 = ALM2, EP3 = nonE.

In this case, the controller will ignore the field parameters from EP4 to EP8. If field parameters are not needed after the instrument is initially adjusted, simply set EP1 to nonE.

Lock code 0, 1 and 2 will give the operator limited privileges to change some of the parameters that can be viewed. Table 5 shows the privileges associated with each lock code.

Table 5. LocK parameter.

LocK value	SV Adjustment	EP1-8 Adjustment	Other parameters
0	Yes	Yes	Locked
1	Yes	No	Locked
2	No	Yes	Locked
3 and up	No	No	Locked
808			Unlocked

Note: to limit the control temperature range instead of completely locking it, please refer to section 4.9.

4. Wiring Examples

4.1 Control a small load directly with the build-in relay.

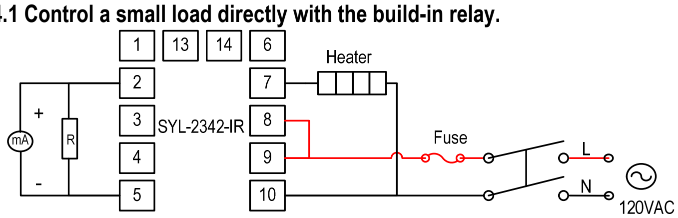

Figure 6. SYL-2342 or SYL-2342P control the heater directly by the internal relay of the controller. The heater must consume less current than the internal relay's maximum rating (7A at 240VAC and 10A at 120VAC).

4.2 Control a load via an external contactor.

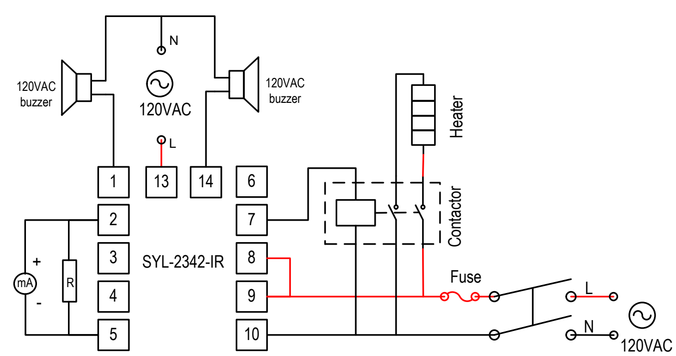

Figure 7. Wire a SYL-2342-IR with an external contactor to control a heating element. This is a typical wiring for oven or kiln.

Using the external contactor allows users to control higher power loads than the internal relay can handle. It is also easy to service. If the contacts of the relay wear out, it is more economical to replace them than to repair the controller. In this example, we assume the coil voltage of the contactor is the same as the voltage of the controller power supply. The voltage of power supply for alarm is 120 VAC. **Note: You don't have to wire or set the alarm to control the temperature. It is just to show how the alarm can be wired.**

4.3 Controlling a 24 VAC valve.

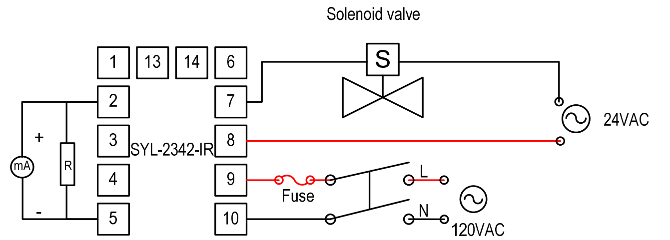

Figure 8. Wire a SYL-2342-IR with a solenoid valve. This is a typical wiring set up for a 24 V gas valve, hot water valve, or a contactor with 24 V coil voltage.

4.4 Use one controller for both cooling and heating control.

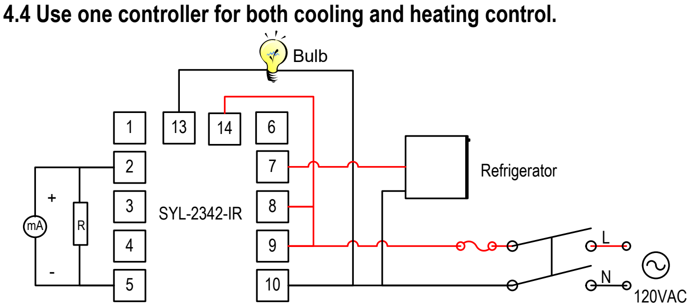

Figure 9. Connect both heating and cooling devices to SYL-2342-IR.

The refrigerator is driven by the internal relay of the controller directly. **Please note that the internal relay output (terminals 7 and 8) is not powered by itself.** A power supply **must** be used to drive the external relay. The refrigerator must consume less current than the internal relay's maximum rating (7 A at 240 VAC and 10 A at 120 VAC). The bulb (less than 100 - 300 W) is for heating. The example is setup to have the heater to turn on when temperature drops to below 60°F and turns off at 64°F. The refrigerator will turn on when temperature is above 69°F and turn off at 65°F.

Parameter settings on the controller
1) Hy = 3.0. Set both hysteresis band for heater and cooler to 3 degrees.
2) COOL = 9. Set the controller to cooling mode, no alarm suppression, Fahrenheit temperature unit display.
3) AT = 0. Set the controller main output to on/off control mode for refrigerator compressor control
4) ALM2 = 62. Set the low limit alarm to 62 °F. Heater will be on at 60 °F (ALM2-Hy) and off at 64 °F (ALM2+Hy)
5) SV = 67. Refrigerator will be on at 69 °F (SV + Hy) and off at 65 °F (SV - Hy).

4.5 Control a load via an external contactor in a 240 V system.

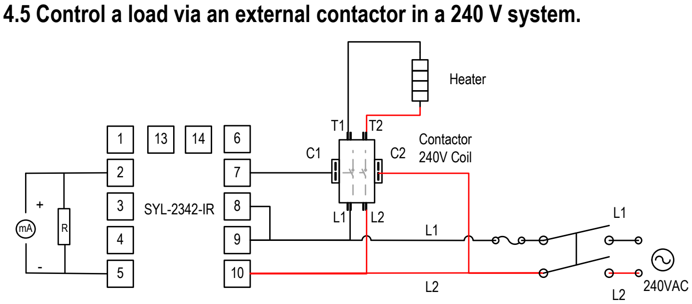

Figure 11. Control a heater in a 240 V system.

4.6 Wiring infrared temperature sensor OS136-1-mA to the SYL-2342-IR controller.

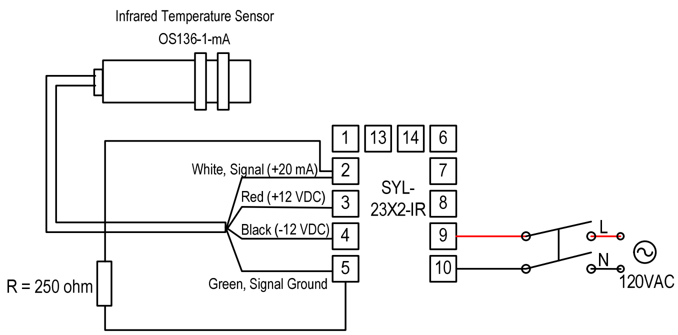

Figure 12. Wire an OS136-1-mA non-contact infrared sensor to SYL-2342-IR controller.

The OS136-1-mA sensor has 4 leads. The red and black leads are for 12 VDC power, they should be connected to terminal 3 and 4 respectively. The white and green leads are for signal output from the IR sensor. The white lead should be connected to terminal 2 and the green lead should be connected to terminal 5.

A 250 ohm resistor should be connected in parallel with the signal leads to the controller on terminal 2 and 5. This resistor converts the 4 ~ 20 mA signal to 1 ~ 5 VDC signal which can be accepted by the controller.

On the controller, the sensor input type Sn should be set to 33 for reading 1 ~ 5 VDC signal. The P-SL and P-SH should be set accordingly to match the sensor's temperature range. To read temperature in Celsius, please set P-SL = -18 and P-SH = 204; to read temperature in Fahrenheit, set P-SL = 0 and P-SH = 400.

(End)

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