ALTEC®

PC900 Series
Programmable Controller

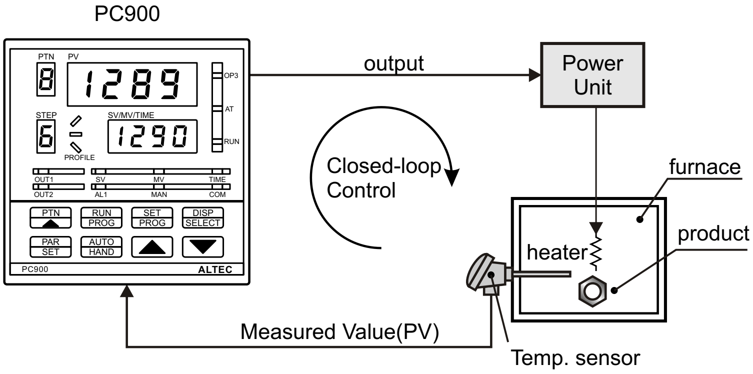
Instruction Manual

Table of Contents

1 Introduction

The PC900 series programmable controller is indented for industrial temperature and process control applications.

Parameters and configuration values are set by use of the front panel keys. The PAR key selects the parameter and the up and down arrows are used to alter their value. The controller can be switched directly from automatic operation to manual by means of AUTO/HAND key.



Without change of the hardware the main process variable input of the instrument can be configured to suit various thermocouples and resistance thermometers,(Pt100). Recalibration is not necessary for this procedure. Signals up to 50mV can be accommodated by using input adapters in the linear input option. Linearisation is scalable within the display range of -999 to 9999, with tenths display resolution.

The controller is also equipped with a ramp to setpoint function. This enables it to automatically adjust the setpoint to give a defined rate of change of process temperature.

2 Features

The Pc900 is a versatile, high stability temperature or process controller, with self-tuning, in 1/4 and 1/8 DIN sizes. It has a modular hardware construction with the option of two control outputs, two alarm relays and a communications module. Two digital input are included as standard. The hardware is configurable for heating, cooling or alarm.

- **Precise control**
  An advanced PID control algorithm gives stable straight-line control of the process. A on-shot tuner is provided to set up the initial PID values and to calculate the overshoot inhibition parameters. On electrically heated loads, power feedback is used to stabilise the output power and hence the controlled temperature against supply voltage fluctuations.
  Dedicated cooling algorithms ensure optimum control of fan, water and oil cooled system.

- **Universal Input**
  A universal input circuit with a advanced analogue to digital convertor samples the input at 8Hz and continuously corrects it for drift. This gives high stability and rapid response to process changes. High noise immunity is achieved by rejection of 50/60Hz pick-up and other sources of noise. Sensor diagnostics are also provided. The input will accept all standard thermocouples, the Pt100 resistance thermometer and linear millivolts, milliamps or DC volts.
  Input filtering from OFF to 999. 9 seconds is included.
- **Easy to Use**
  A simple LED display provides a bright, clear display of the process value and setpoint. Tactile pushbuttons ensure positive operation. Access to other parameter is simple and easy to understand and can be customised to present only those parameters that need to be viewed or adjusted. All other parameters are lock away under password protection.

- **Alarms**
  Up to four process alarms can be combined onto a single output. They can be full scale high or low deviation form setpoint, rate of change or load failure alarms. Alarms messages are flashed on the main display. Alarms can be configured as latching or non-latching and also as blocking type alarms which means that they will become active only after they have first entered a safe state.

- **Digital Communications**
  For communications with a host computer system the instrument can be fitted with either an EIA485 or EIA232 digital interface. This enables the automatic recording of measured values on a printer.

3 Order Code

PC900	/	R	/	R	/	R	/	232	/	Prt
①		②		③		④		⑤		⑥

① Basic Instrument:

PC900	Panel size: W96×H96×D100mm
PC400	Panel size: W96×H48×D100mm
PC410	Panel size: W48×H96×D100mm

②③ Output 1 & Output 2:

0	NONE
R	Relay, 3A/250VAC
L	Logic, 20V/10mA, drive SSR
D	0~10mA, 4~20mA, 0~20mA 0~5V, 1~5V, 0~10V
T1	Triac
T3	3 Triac
Y1	Single-Phase Phase-shift
Y3	Tri-Phase Phase-shift

④ Alarm 1

0	NONE
R	Relay, 3A/250VAC

⑤ Communications

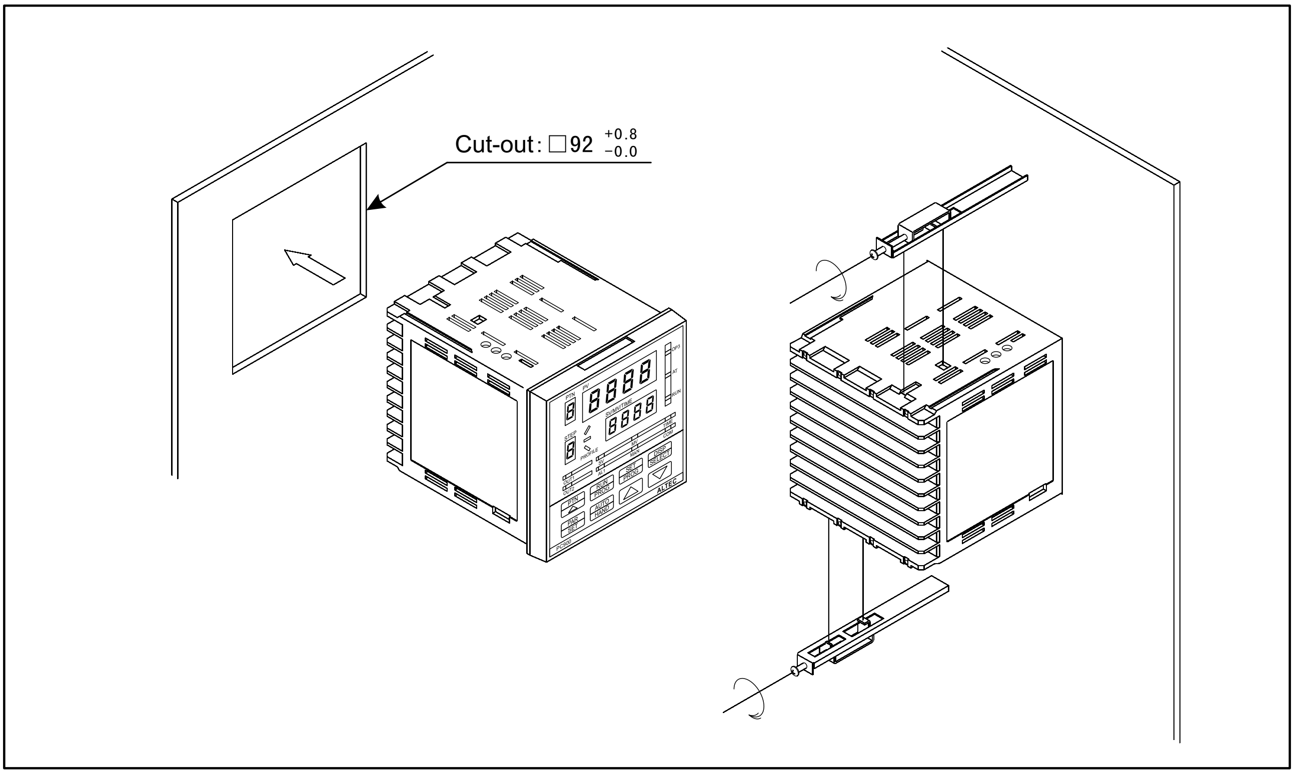
0	NONE
232	RS232(3 wires), comms distance: 12m
422	RS422 (4 lines), comms distance: 1.2km
485	RS485 (2 lines), comms distance: 1.2km

⑥ Special Functions

0	NONE
QP16	16-segment program
Clk	Real time clock
Prt	Record printing
Rem	Remote analog setting
PVT	Process Value Transmission
SVT	Setting Value Transmission

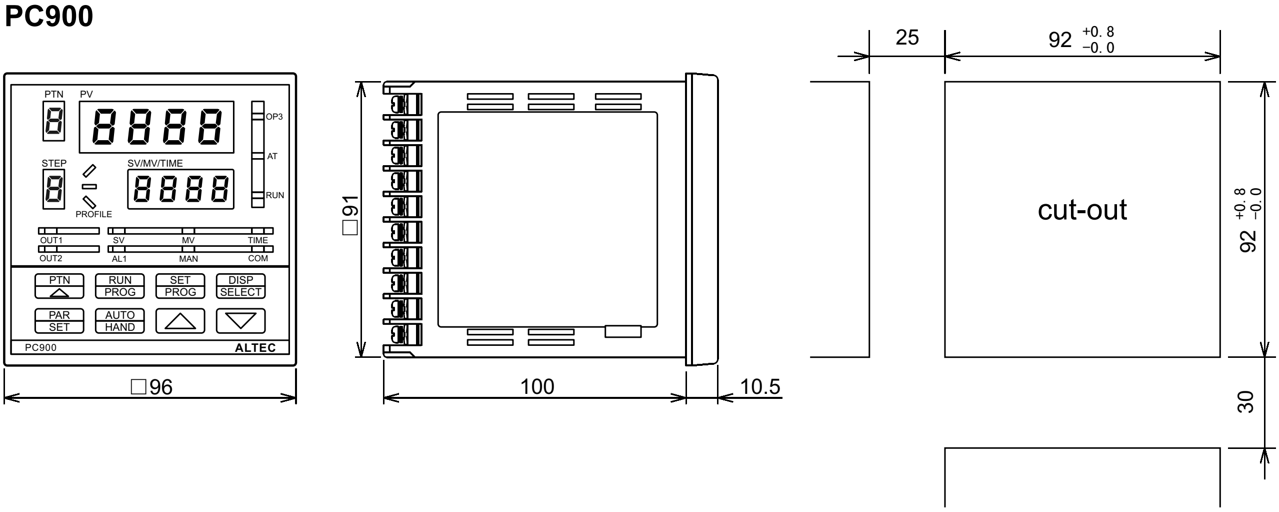
4 Mounting

1. Prepare a square cut-out in the mounting panel to the size shown below. For multiple installation in a control panel, the minimum spacings specified on the drawings must be respected for adequate cooling.
2. Insert the controller through the cut-out.
3. Catch the mounting bracket to the holes top and bottom of the case, and screw to fix.

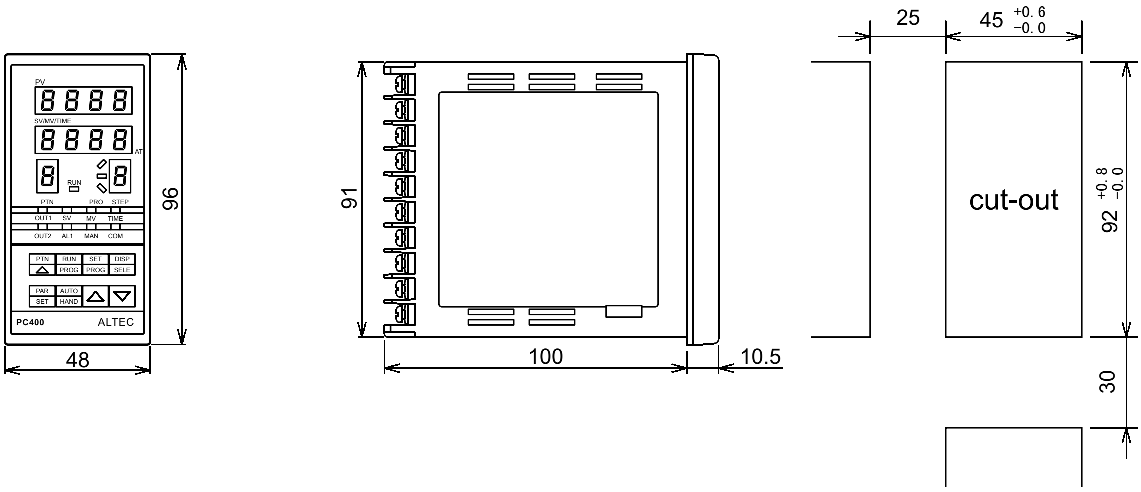


4.1 Dimensions

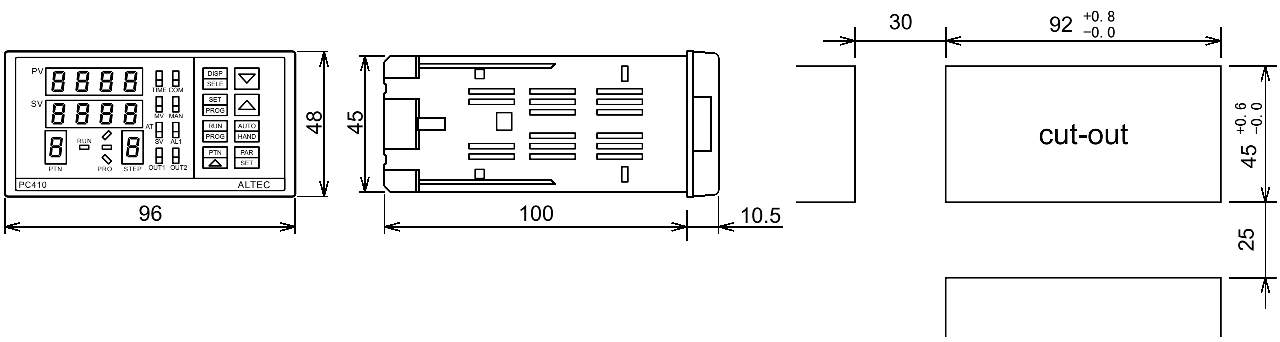
PC900



PC400

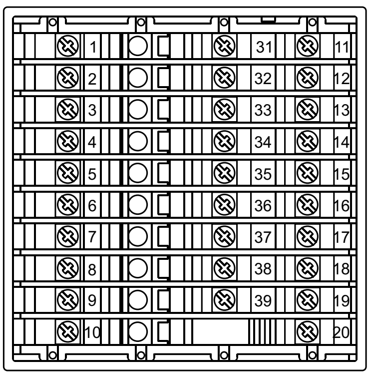


PC410

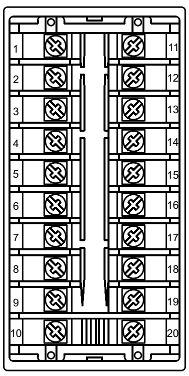


5 Electrical Connection

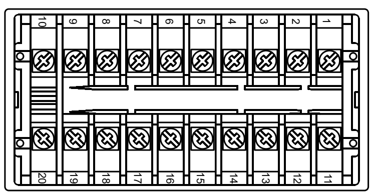
5.1 Rear Terminals Layout



PC900



PC400

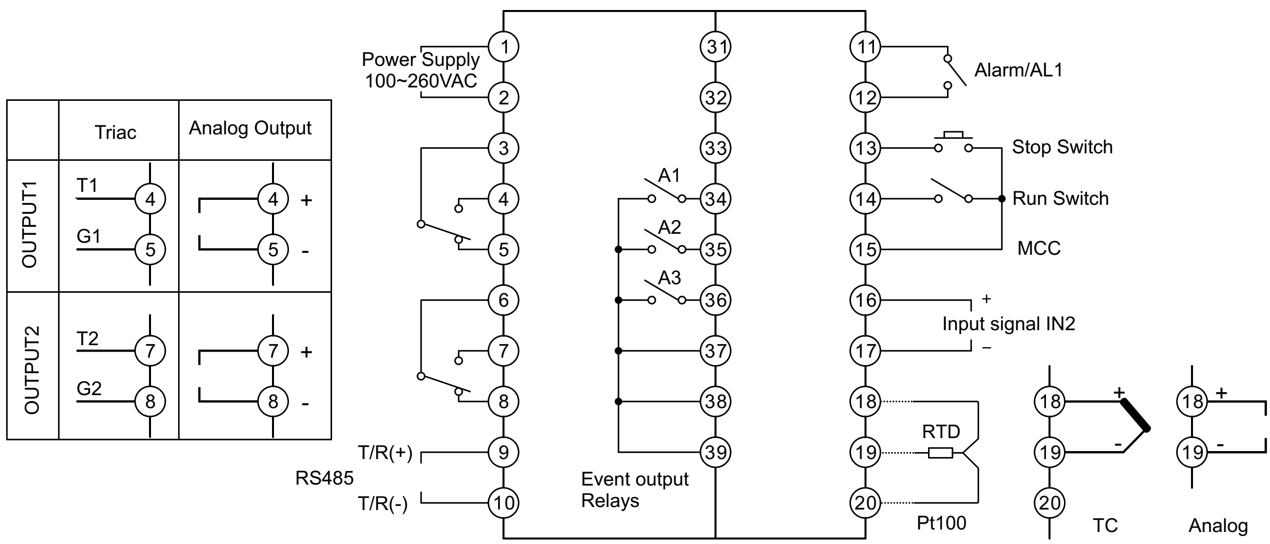


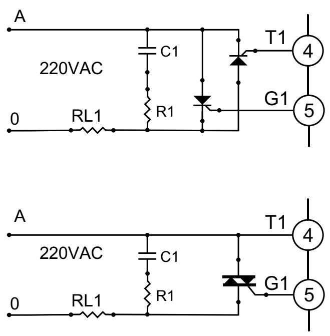
PC410

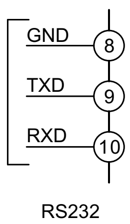
Notice

- ☐ For thermocouples inputs, please connect appropriate compensating cable.
- ☐ For RTD input, the length and gauge of all three wires must be equal.
- ☐ Input wire shall be separated from the power line and load line to avoid electrical noise.
- ☐ The inputs to the controller must be between -10mV to 50mV, voltage signal which **exceed** this range must be attenuated with an appropriately sized input adapter. Current signals are converted to the -10 to 50mV range with a shunt input adapter.
- ☐ If the AC power supply is connected to the I/O terminals or DC supply terminals, the controller will be burned out.

5.2 PC900 Wiring







1). Output1& Output2 can be configured as 0~20mA or 4~20mA output, max load capacity: 750Ω.

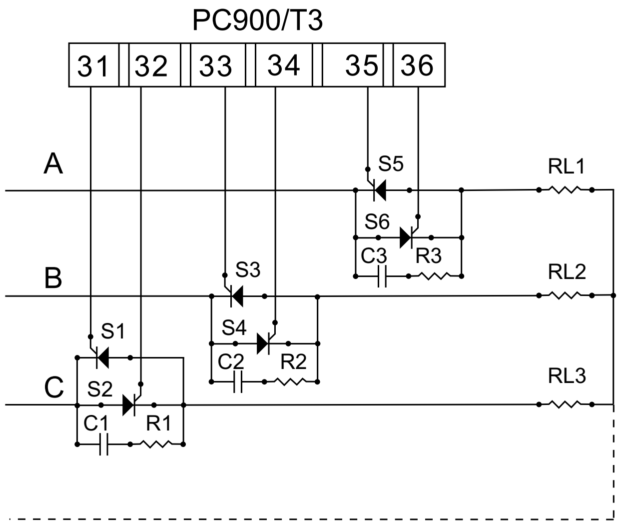
2). Alarm relay(AL1) contact rating: 2A/250VAC.

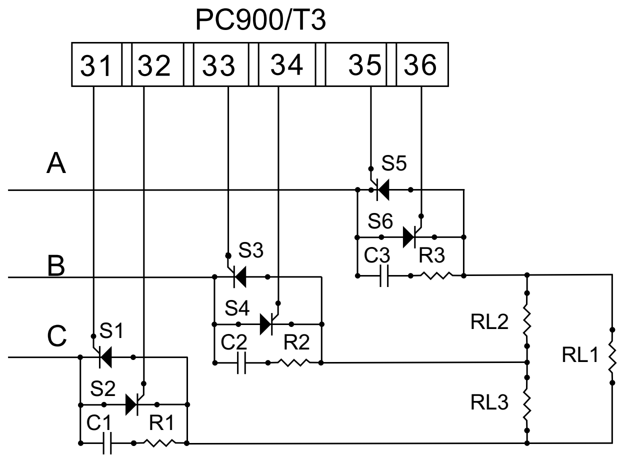
3). Output2 must be relay output(NO) while selecting RS232 communication module.

4). IN2 is auxiliary input, for Remote analog setting or feedback signal inputs.

5.3 PC900/T3 Wiring(Panel size: 96*96)

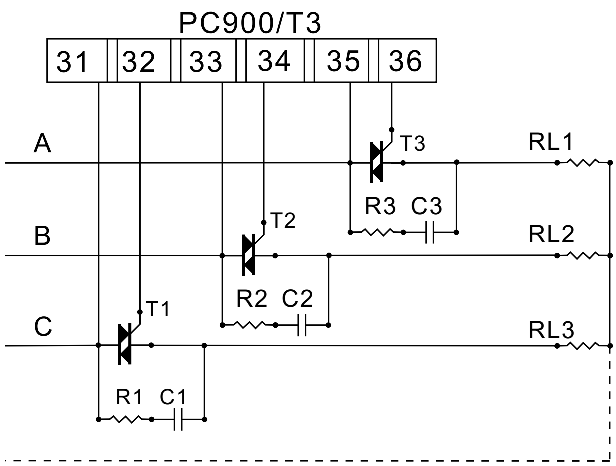
5.3.1 Tri-Phase SCR Wiring

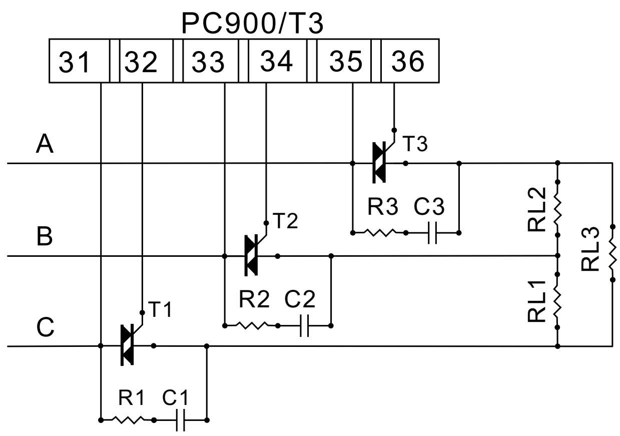




Note: Y-type's neutral wire may be connected or not.

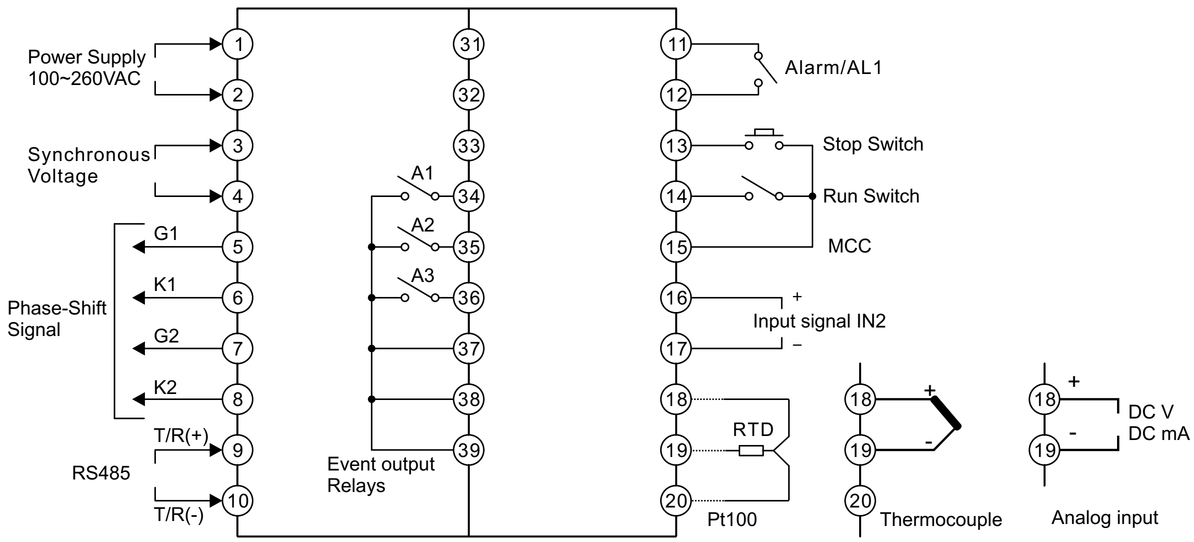
5.3.2 Tri-Phase Triac Wiring



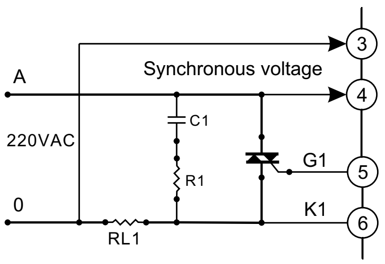


Note: Y-type's neutral wire may be connected or not.

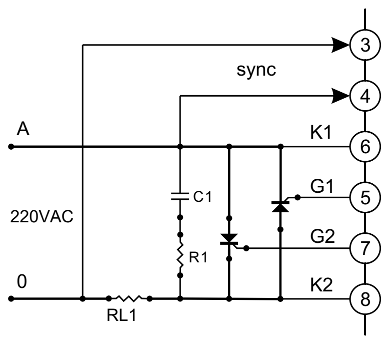
5.4 PC900/Y1 Phase-Shift Wiring



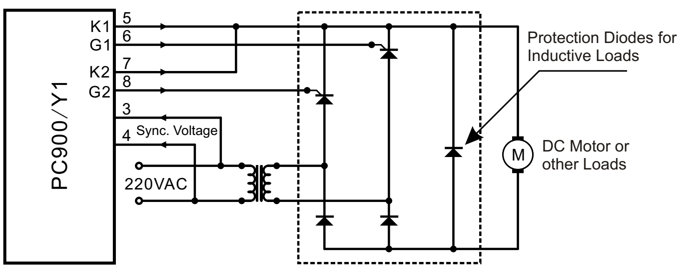
5.4.1 Phase-Shift Triac Wiring



5.4.2 Phase-Shift SCR Wiring

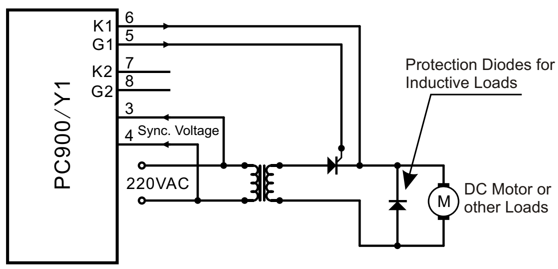


5.4.3 PC900/Y1 Half-Bridge Rectifier

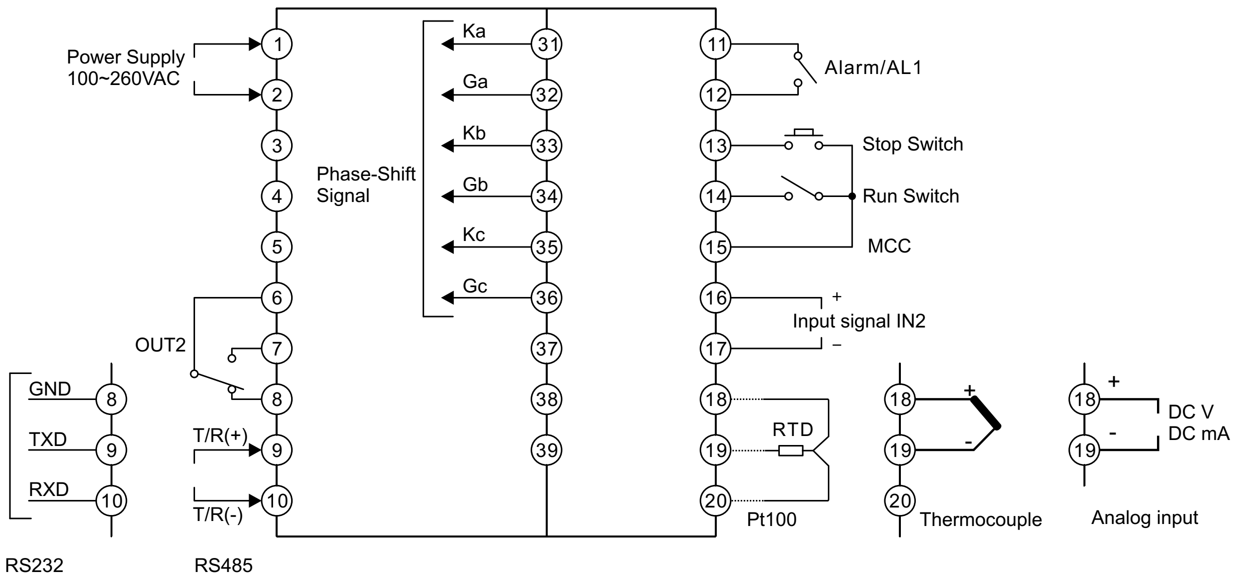


Half-Bridge Rectifier Module

5.4.4 PC900/Y1 Half-Wave Phase-Shift



5.5 PC900/Y3 Wiring

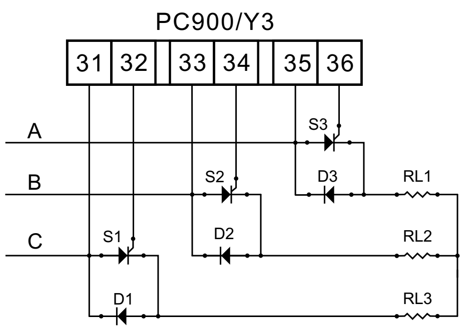


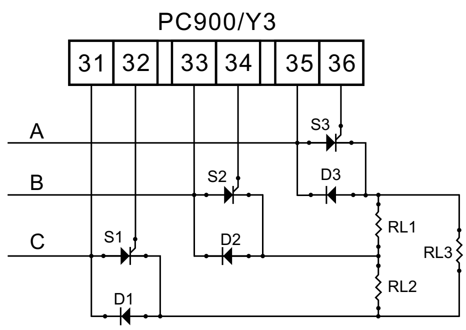
1). Alarm relay(AL1) contact rating: 2A/250VAC.

2). Output2 must be relay output(NO) while selecting RS232 communication module.

3). IN2 is auxiliary input, for Remote analog setting or feedback signal inputs.

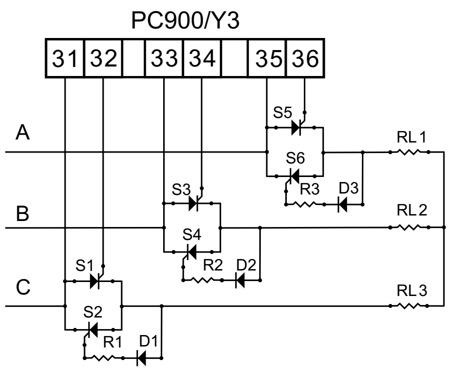
5.5.1 PC900/Y3 SCR-Diode Module Wiring

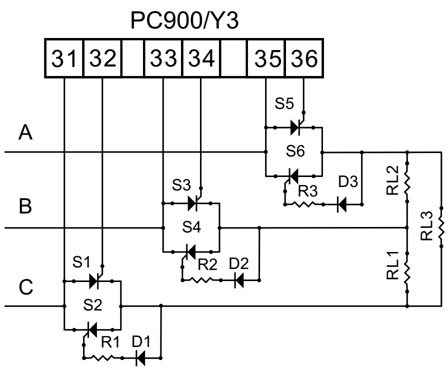




Note: Please add R-C protection for SCR.

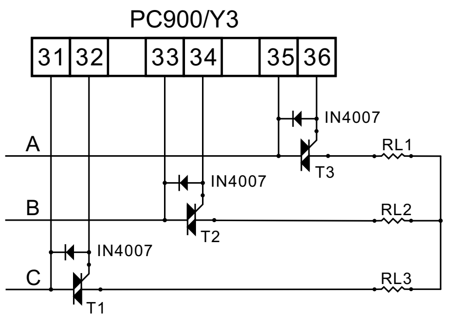
5.5.2 PC900/Y3 SCR Module Wiring

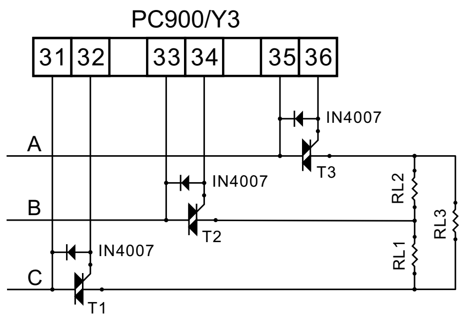




Note: Please add R-C protection for SCR.

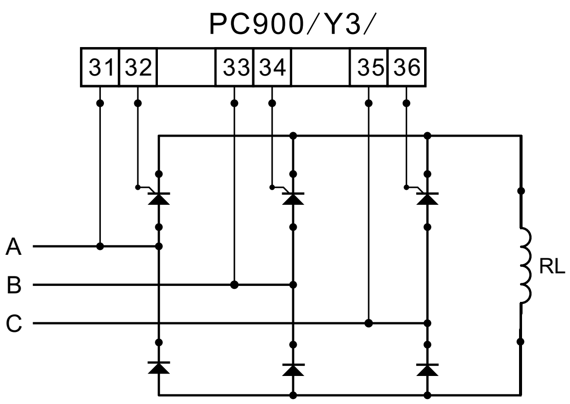
5.5.3 PC900/Y3 Triac Module Wiring





Note: Please add R-C protection for SCR.

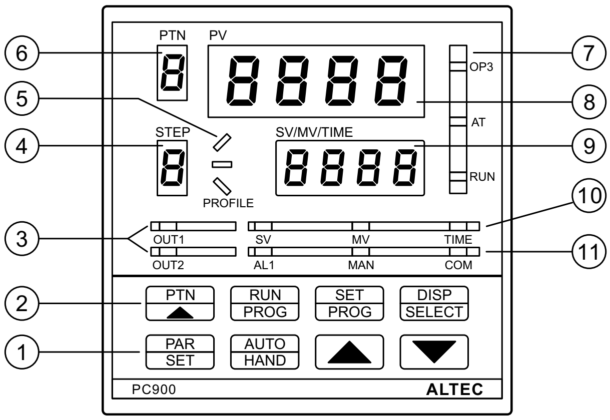
5.5.4 PC900/Y3 Tri-Phase Half-Bridge Rectifier



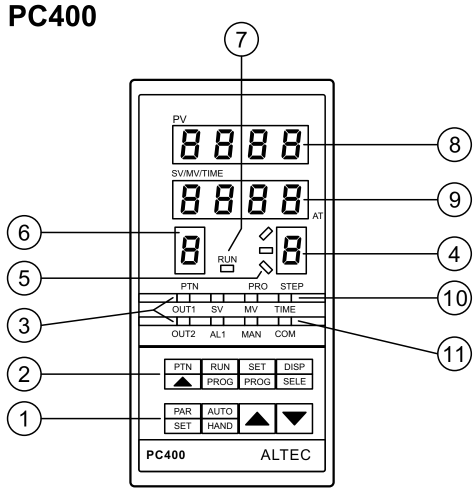
Note: Please add R-C protection for SCR.

6 Operator Interface

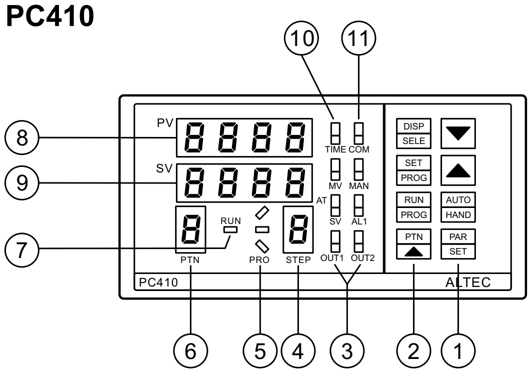
PC900



PC400



PC410



S.N.	Item	Functions
①	PAR SET	Parameters setting key
	AUTO HAND	(Automatic/Manual key) Automatic/Manual operation selection
	▲	(Up key) Increase value
	▼	(Down key) Decrease value

②	PTN ▲	(Pattern key) Selects the program pattern number
	RUN PROG	(Run/Program key) Starts/hold the program, changes the mode from fixed value control to program control
	SET PROG	(Set/Program key) Program parameters setup
	DISP SELECT	(Display/Selection key) Changes the indication on SV/MV/TIME display
③	OUT1	(Output1 indicator) The LED indicator is lit when output1 is 'ON'
	OUT2	(Output2 indicator) The LED indicator is lit when output2 is 'ON'
④	STEP	(Step number display) Indicates the step number of program
⑤	PROFILE	(Program monitor indicator) During program control, '/' is lit when the PV is rising During program control, '-' is lit when the PV is constant During program control, '\' is lit when the PV is falling
⑥	PTN	(Pattern number display) Indicates the pattern number
⑦	OP3	(Output3 indicator) The LED indicator is lit when output3 is 'ON'
	AT	(PID Auto-tuning Indicator) tunE on SV/MV/TIME display flashes during auto-tuning
	RUN	(Program control runing indicator) The LED indicator is lit during program control
⑧	PV Display	(PV Display) Indicates the Process/Measured value
⑨	SV/MV/TIME Display	(SV/MV/TIME display) It indicates the Setting Value(SV), Manipulating Value(MV), or Time(TIME) (The display content can be changed by the 'DISP/SELECT' key)
⑩	SV	(SV Indicator) It is lit when the Setting Value(SV) is being displayed on the lower display
	MV	(MV Indicator) It is lit when the Manipulating Value(MV) is being displayed on the lower display
	TIME	(TIME Indicator) It is lit when the time(TIME) is being displayed on the lower display
⑪	AL1	(Alarm1 output indicator) It is lit when the Alarm1 output is 'ON'
	MAN	(Manual control indicator) It is lit when in manual operation mode
	COM	(Communication indicator) It flashes when the controller is in active communication with a host computer

7 Basic Operations

7.1 Displays & Indicators

There are two LED displays indicate the operating parameters.

The **upper display**(green) indicates the Process Value(PV) when in base condition. On selecting a parameter, the appropriate parameter abbreviation appears.

The **lower display**(red) indicates the Setting Value(SV), Manipulating Value(MV) or the remaining time(TIME) of the running program. The type of contents displayed on the lower display is changed every time the '**DISP SELECT**' key is pressed. The type of contents displayed is indicated by the LED provided on the down side of the lower display. On selecting a parameter, the appropriate parameter value appears here.

When the controller is running in programmer/controller mode(CtrL = Prog), and the indicator '**TIME**' is lit(press the DISP SELECT key to switch), the lower display indicates the remaining time of the running program; when the controller is running as constant temp. controller, the code Cont appears in the lower display.

When the controller is powered on, the upper display indicates the basic model code of the controller, and the lower display indicates the software version of the controller.

3 seconds later, the upper display will indicate process values (PV), and the lower display will indicate set values (SV), or, when the controller is in manual operating mode(indicator '**MAN**' is illuminated), the lower display will indicate the output power.

Both the LED indicators '**OUT1**' and '**OUT2**' indicate the state of the relevant output. The LED is illuminated when the output is 'on'. If output 1 is fitted with analog output, the intensity of the indicator varies with the magnitude of the output level. If the analog output is configured as 4~20mA, the LED glows dimly even with an output level of 0%. If output 2 is configured as an alarm output, the LED '**OUT2**' is illuminated when the alarm is active.

The LED indicator '**AL1**' indicates the status of alarm1, when the alarm is active, the indicator will be lit.
When the controller running in manual mode, the indicator '**MAN**' will be lit.
The indicator '**COM**' will flash when the controller is in active communication with a host computer.

The indicator '**AT**' indicates the status of PID self-tuning, when the controller is in the PID self-tuning process, the led will be lit.

'**OP3**' indicates the status of Output3, or for other purpose in some special versions.

Programmer Indicators:

The displays(**PTN** & **STEP**) and indicators(**PROFILE** & **RUN**) indicates the states of the running programs.

When the controller was configured as programmer mode(CtrL = Prog). The PTN display indicates the program pattern number, the program number which need to be run or modified can be changed with the PTN/▲ key.

When the program is running, the indicator '**RUN**' will be lit, the current running segment number will apear in the **STEP** display. When the SV is rising, indicator '/' will be lit; when the SV is constant, indicator '-' will be lit; when the SV is falling, indicator '\' will be lit.

When the controller was configured as constant temperature controller. The PTN, STEP displays and the PORFILE, RUN indicators will be turned off.

7.2 Operation Keys

There are eight keys on the controller panel.

The **PTN/▲** key, **SET/PROG** key and **RUN/PROG** key are specially for program control related operations:
- **PTN/▲:** Set the program pattern number.
- **SET/PROG:** Set the program parameters.
- **RUN/PROG:** Press this key to run/hold the program.

These keys are inoperative when the controller runs in constant temperature control mode.

The **DISP/SELECT** key is the display selector for the lower display, the type of contents displayed on the lower display is changed every time the '**DISP SELECT**' key is pressed. The type of contents displayed is indicated by the LED provided on the down side of the lower display.

With the **AUTO/HAND** key, the controller can be switched from automatic operating mode to the manual mode. Press the key again returns the controller to automatic mode.

The defined parameter list is scrolled through in sequence using the **PAR/SET** key. By pressing this key, the abbreviation of the next parameter will appear in the upper display. The value associated with this parameter will appear in the lower display. If there is no key operation within 16 seconds, the display returns to the base condition.

With the ▲ and ▼ key, the value of the displayed parameter can be increased/decreased(insofar as modification is permitted). The speed increases/decreases as long as the key is depressed.

7.3 Setpoint Adjusting

During the basic functioning, the Process Value(PV) is shown in the upper display, press DISP/SELECT key until the Setting Value(SV) appears in the lower display.(the indicator 'SV' will be lit)

At this time, the Setting Value can be increase or decrease with the ▲ and ▼ key. Keeping it pressed results in a progressively faster variation. The adjustable range: SP L ~ SP H.

When the controller was configured as programmer mode(CtrL = Prog), during the program running, the setting value can't be modified.

7.4 Automatic/Manual Operating Modes

The controller can run in two different operating modes: close-loop(Automatic) mode & open-loop(Manua)l mode.

In automatic mode(close-loop), the output of the controller is determined by the control algorithm. In the base condition, the process value and the setpoint appear on the LED display. The setpoint is modified by the ▲ and ▼ keys.

If the controller is switched to manual mode, the output level is operator-adjustable by means of the ▲and ▼ keys, control is then open-loop. In the base condition, the process value and the output level appear on the LED display. Illumination of the 'MAN' indicator indicates manual mode.

In the manual mode, the max output level is limited by the 'Max Output Power' parameter(Code: H PL).

Changeover in two modes is through the AUTO/HAND key(if not locked out).
The changeover is controlled by the 'Auto/manual Enable' parameter(code: A H):
If A H = Auto, changeover locked out;
If A H = HAnd, changeover possible.

7.5 Modifying the Operation Parameter

When the controller is in the PV displaying status, press **PAR/SET** key and hold about 3 seconds, reveals the first parameter. Press **PAR/SET** once again, the next enabled parameter and its current value appears. The parameter value can either be modified with the ▲ and ▼ key, or left unmodified.

If the last parameter is displayed or there's no key operation within 16 seconds, the menu times out automatically.

7.5.1 Operation Parameter List

S.N.	Mnemonic	Parameter	Adjustable Range	Comments
1	C F	Display units	Display only	Celsius or Fahrenheit(Read only)
2	prog	Programmer/controller status(display & selection)	IdLE run HoLd	Program halted Program running Program hold
3	SP	Setpoint in closed loop	SP L~SP H	
4	tunE	Active Self-Tune	OFF on	Stop PID self-tune Start PID self-tune
5	AL 1	Alarm 1	Measurement range	
6	AL2	Alarm 2	Measurement range	Appears if OP2 = AL02
7	HYS1	AL1 Hysteresis	1~300°C	*Optional Appears if HYS = on
8	HYS2	AL2 Hysteresis	1~300°C	
9	ProP	Proportional Band	1~2000°C	Becomes hysteresis if CtrL is configured as On.OF
10	Int.t	Integral Time	OFF; 1 ~ 8000s	Disappears if CtrL=On.OF
11	dEr.t	Derivative Time	OFF; 1 ~ 999s	
12	rEL.c	Relative Cool Coefficient	0.1 ~ 10.0	Appears during heat/cool
13	db	Dead Band	0.1 ~ 10.0	
14	H c.t	Heat Cycle Time	0.1 ~ 240.0s	Disappears if CtrL = On.OF
15	C c.t	Cool Cycle Time	0.1 ~ 240.0s	Appears during heat/cool
16	Hi A	Current High Limit	1~9999A	*Optional
17	Loc	Configuration Password	0 ~ 9999	Set to 808 to enter the configuration menu

7.5.2 Comments on Operation Parameters

1. Proportional Band(ProP)
This is the band of error within which the power output is proportional to the error. Error values outside this band give 100% or 0% power output.
If the proportional band is too narrow it will give control resembling on/off control with continuous oscillation. Wide proportional bands give stable but sluggish control with an offset in the steady-state condition.

2. Integral Time(Int.t)
This term provides automatic compensation for long term control offsets. It is the time taken for the output to change by one proportional band width for a constant error equal to the proportional band. Typically this must be set to a value longer than the response time of the process being controlled.

3. Derivative Time(dEr.t)
This term provides anticipation and fast recovery from disturbances. It can be taken as the 'look ahead' period of the controller. It is typically set to a time approximately one sixth of the integral time.

4.Relative Cool Coefficient(rEL.c)
This parameter indicates the relationship between the heating and cooling performance of the controlled equipment. By this means, a special proportional band is defined for the cool channel, which is calculated from the value for the heat channel and the factor set in rEL.c. The parameter is set according to the ratio:
rEL.c = heat performance:cool performance
Therefore the heating/cooling effectiveness values of the controlled equipment must be know or deduced. The parameter must be correctly set without fail before activating self-tuning, as tuning relies on this value of calculating the control parameters.

5.Cycle time(H c.t, C c.t)
The cycle time of the switching outputs(H c.t and C c.t) should be set high value(e.g.20 seconds) if contactors are used, and to low values(e.g. 1 second for logic output) if thyristors are used.

8 Software Configuration

The controller must be configured properly in order to perform the correct control function.

How to enter software configuration menu:
1) Press PAR/SET key and hold for 3 seconds to enter the first level menu(i.e. operation parameter list);
2) Press PAR/SET key to scroll the parameter to Loc and set its value to 808(the initial password);
3) Press PAR/SET key, the first parameter appears on the upper display, at the same time the lower display will display the value of this parameter. The values can be modified by pressing keys ▲ and ▼. After modification, press the PAR/SET key, the next parameter appears, at the same time, the modified data has been saved in the memory.

If the last parameter is displayed or there is no key operation within 16 seconds, the menu times out automatically.

After configuration, set the configuration password(code Loc) to data other than 808 in order to protect the parameter values from being inadvertent modification.

8.1 Configuration Parameter List

S.N.	Mnemonic	Parameter	Adjustable Range	Comments
1	SP H	Setpoint High Limit	Measurement range	always > SP L
2	SP L	Setpoint Low Limit	Measurement range	always < SP H
3	H PL	Max output power	0.0~100.0	
4	SnbP	Sensor Break Power	0.0~100.0	
5	OFSt	Input/calibration offset	-19.99~99.99	
6	C F	°C/°F unit selection	C Centigrade F Fahrenheit	Affects all temperature dependent parameters
7	Sn	Input Signal	Jtc CAtc Etc rtc Stc btc ttc rtd .rtd cu .cu Lin .Lin PrE .PrE	J thermocouple K thermocouple E thermocouple R thermocouple S thermocouple B thermocouple T thermocouple Pt100 Pt100(0.1 prec) Cu50 Cu50(0.1 prec) Linear input Linear input (0.1 prec) Linear resistance signal Linear resistance signal (0.1 prec)
8	Addr	Instrument Address	0.0~9.9	
9	bAud	Baud Rate	600 1200 2400 4800 9600 19.2	

Configuration Parameter List(Continued)

S.N.	Mnemonic	Parameter	Adjustable Range	Comments
10	CtrL	Control Algorithm	On.OF P i d r SP prog	ON/OFF Regulation PID Regulation(Proportional Integral Derivative) PID with ramp to SP PID programer/controller
11	SPrr	Ramp to setpoint	0.01~99.99 units/min	Only appears if CtrL = r SP (°C/min)
12	OP1	Output 1(main)	tP 0-20 4-20	Time-proportioned 0~20mA output 4~20mA output
13	OP2	Output 2(cooling)	OFF FAn O i l H2O 0.05 ALO2 on	Off Fan cooling, linear Oil cooling, linear Water cooling, non-linear Compressor refrigeration 2nd alarm output On
14	ALo1	Alarm 1	on OFF H i AL LoAL HdA LdA dAo ndAo Pout	On Off Full-scale high alarm Full-scale low alarm High-deviation alarm low-deviation alarm outside deviation band alarm Inside deviation band alarm Alarm when program halt
15	ALo2	Alarm 2 Appears only if OP2 is configured as ALO2		
16	A H	Auto/manual Enable	Auto HAnd	Changeover locked out Changeover possible
17	Pb d	Proportional Band Display	C-F L i n Pct	°C or °F Linear input units Percentage
18	PH-L	Proportional Band Scale Factor	10~1500°C	Parameter appears only if Pb d = Pct
19	Prt	Unit of program running time	m i n SEc	Minute Second (Appears only if CtrL = prog)
20	P-PH	Program output Power High limitation	on OFF	Enabled Disabled
21	orAt	**O**utput changing **rate** limit	OFF 0.1~9.9	Disabled small leads slow change rate (Active for continuous outputs)
22	t Ao	No-Alarm on Start-up	OFF on	Disabled Enabled
23	HYS	Alarm Hysteresis	OFF on	Enable Disable
24	Act	Control Action	rEu d i r	Reverse Action Direct Action
25	F i L	Input Filter	0.01~99.99	Appears only when input are linear input(Sn is configured as L i n or .L i n, PrE or .PrE)
26	Proc	Process scaling (straight line equation)	P 1 P2	1st Scaling point 2nd Scaling point

8.2 Comments on Configuration Parameters

Pre-Configuration, Parameter Setting
A large number of parameters are installation-dependent, and as such only need setting once before commissioning. This setting should take place before connecting the instrument to the plant.

Warning: Never configure the instrument while it is controlling a process.

1). Input Signal - Sn

The parameter Sn should be set to the correct sensor type the controller connected, otherwise the display of PV will be incorrect.

2). Outputs - OP1 & OP2

The value for OP1(output 1) and OP2(output 2) must be set according to the output modules:

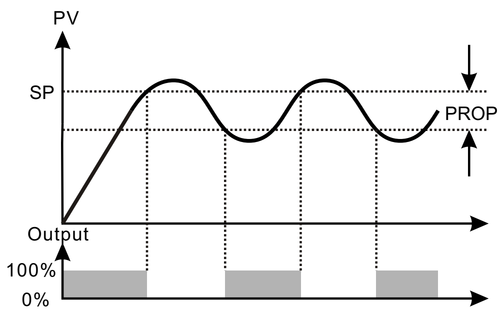
Time proportioned output

This applies to relay, logic or triac outputs(i.e. ON/OFF devices) and PID control. The percentage 'on' time of the device over a period is proportional to the power demand of the PID. Appropriate cycle times can be selected to suit the type of output device and the process response time.

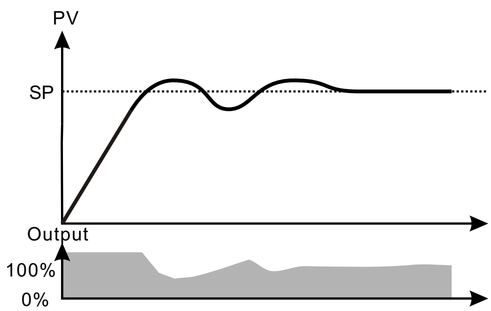
Analogue output

Where continuously variable control is required. DC volts or current are available. 4 to 20 mA is a standard output. Other standard outputs are 0 to 5V, o to 10V, 1 to 5V, 0 to 20mA.

3). Control Algorithm - CtrL



ON/OFF Control



PID Control

Four different control algorithms can be configured:
● ON/OFF controller(heat only, no cool)
The instrument functions as a two-state controller with a controller switch point (heat output only). ProP becomes hysteresis if CtrL is configured as On.OF

● PID controller with immediate setpoint modification
The PID control algorithm includes self-tuning and special parameters for optimal start-up.
The setpoint can be freely modified between the configured limits(see parameter list), when the actual value is indicated in the upper display and the setpoint in the lower display.

By turning off I and D as appropriate it is possible to configure these controllers as PD, PI, or P only. P or PD control is typically used for situations where straight line control is required but offsets during steady-state are tolerable. PI control gives offset free steady-state control and PID gives tight control with little or no overshoot when well tuned.

● **PID controller with ramp-to-setpoint**
This function is configured in the parameter CtrL by selecting r SP. Excessive thermal shock to sensitive loads is prevented by bumpless start-up to the required setpoint. The ramp-to-setpoint is independently activated by powering up the controller or by modifying the setpoint. The instantaneous control setpoint is modified by adjustable ramping. It begins with the original process value and ends with the adjusted target setpoint. The ramp rate is selectable by the SPrr parameter in units/min.

During ramp-to-setpoint, the process value is indicated in the upper display and the target setpoint in the lower. The **RUN** indicator is lit until the target setpoint has been reached. In order to view the instantaneous setpoint, the **PAR/SET** key must be pressed once. The **RUN** indicator flashes during display of the instantaneous setpoint.

With the Hb(holdback) parameter the maximum allowable deviation between the process value and the instantaneous setpoint can be defined. If the deviation exceeds Hb, ramping is halted and the **RUN** indicator flashes. The function of hold back is further explained below.

If the ramp rate or the target setpoint is modified during ramp-to-setpoint, this modification directly affects active ramping.

● **PID programmer/controller with multi-segments**
If CtrL = Prog, the controller was configured as a programmer/controller.
See section 12 "Programmer/Controller" for details.

4). Proportional Band - Pb d, PH-L

With the Pb d parameter, one can select whether the proportional band should be displayed in units or in percentage. If the percentage setting is chosen, the range is determined using the PH-L parameter, to which the percentage data refers. The value should be equal to the measurement range of the instrument.

5). Control Action - Act

A reverse acting controller(parameter rEu) will reduce its output demand as the process variable increases. rEu should be selected for temperature control loops with the heat output.

A direct acting controller(parameter di r) will increase its output demand as its process variable increases. di r should be selected for temperature control loops with the cool output.

6). No-Alarm on Start-up - t Ao

When the controller starts up or after the modification of setting value, even alarm condition occurs, the alarm will be not active. The alarm will act only when the controller runs in the normal condition and the alarm condition occurs again.

- For reverse control(Act=rEu), the function is enabled for "Full-scale low alarm" and "Low-deviation alarm".
- For direct control(Act=di r), the function is enabled for "Full-scale high alarm" and " High-deviation alarm".

7). Alarms Modes - ALo1, ALo2

Two alarms outputs may be installed in the controller. Six different modes of alarm can be setup with these alarm outputs by configuration:

(1) Full-scale high alarm(HiAL) Alarm operates above an absolute level.

(2) Full-scale low alarm(LoAL) Alarm operates below an absolute level.

(3) High-deviation alarm(HdA) Alarm operates above a defined band above the control level.

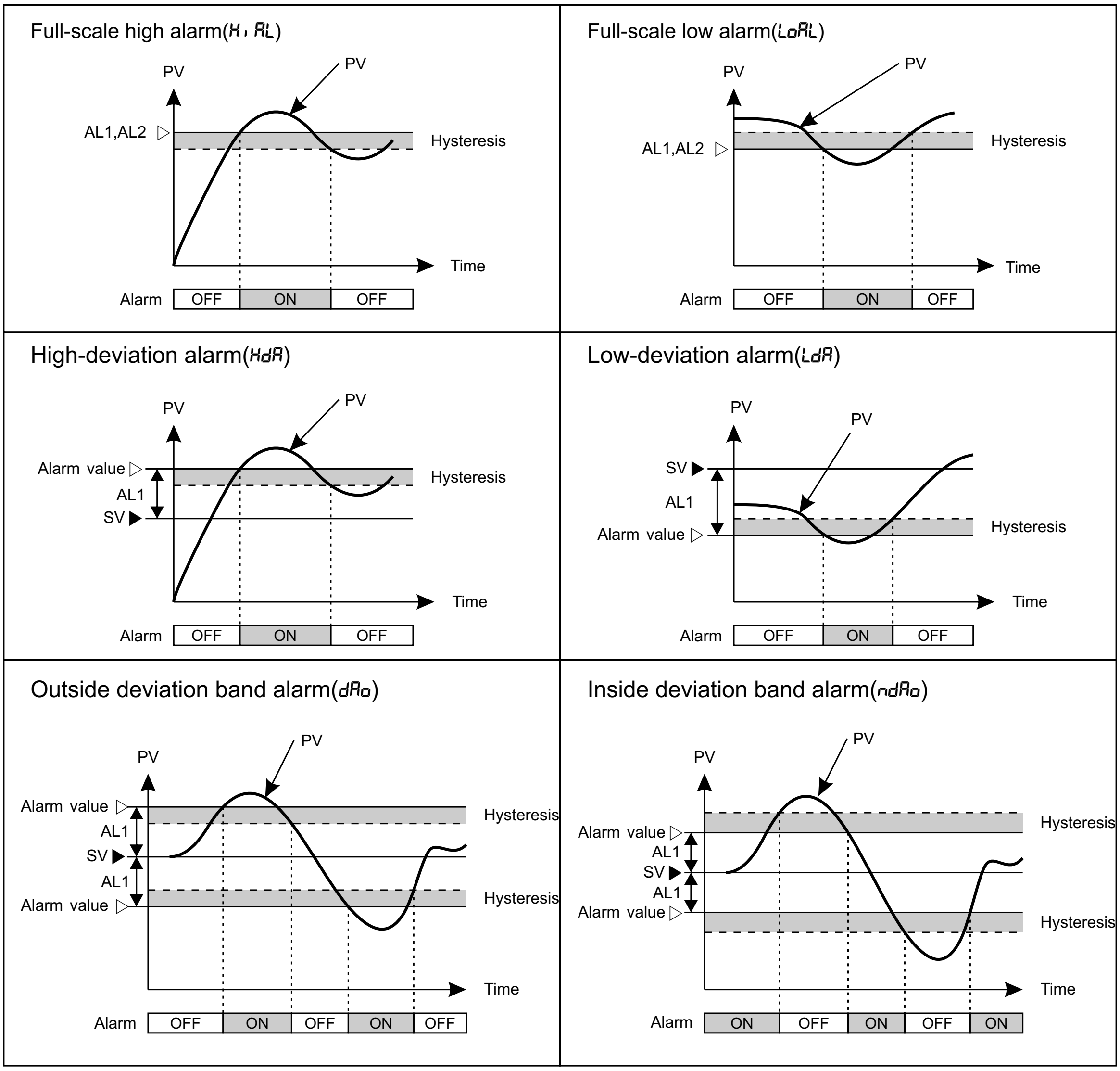
(4) Low-deviation alarm(LdA) Alarm operates below a defined band below the control level.

(5) Outside deviation band alarm(dAo)
Alarm operates outside a defined band around the control level.

(6) Inside deviation band alarm(ndAo)
Alarm operates inside a defined band around the control level.

8). Alarm Hysteresis - HYS1, HYS2

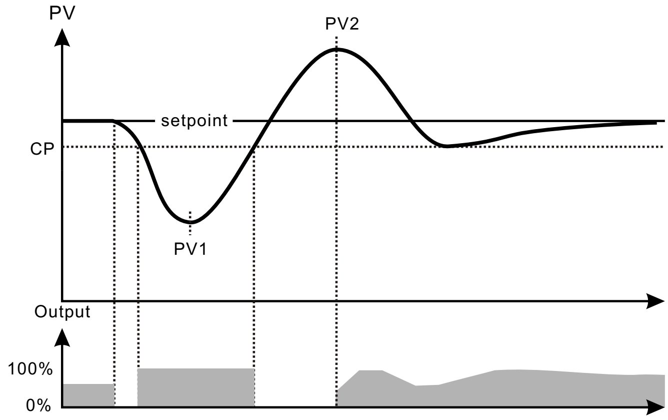
The alarm hysteresis is HYS1 and HYS2. Hysteresis is used to provide a definite indication of the alarm condition and to prevent alarm relay chatter.



9 PID Self-Tuning

9.1 Self-Tuning – General

PC900 series programmable controllers have in-built self-tuning as a standard feature, which can be activated by the user on demand. According to a special procedure, the instrument examines the process reaction curve and calculates by means of a complex computer algorithm the optimum control parameter, using the data measured during the procedure. The parameters thereby obtained after successful tuning are automatically set into the instrument. Control parameters can be adapted in this way at any time for new or modified process reaction curves. It is not necessary to pre-adjust the control parameters before tuning, this is an important advantage over customary procedure.



Self-tuning from setpoint – heating process

Note: The adjustment procedures used here apply thermal shocks; in sensitive systems damage can occur. The adjustment procedure relies on correct configuration of the controller for the process and can only work correctly if there pre-conditions are met.

A self-tune procedure from setpoint is performed if, on activating self-tuning, the measured value and the setpoint are approximately equal, e.g. when the process reaction curve has converged. This procedure can be used for post-runing the curve in the finalised control set-up.

Self-tuning calculate the following control parameters:

- ProP Proportional band
- Int.t Integral time constant
- dEr.t Derivative time constant

9.2 Self-Tuning – Operation

In order to achieve optimal control results, the actual value should be broadly stable before the start. The algorithm functions even if the actual value is unstable but it evaluates this change as part of the process reaction curve.

During the course of the operation, the indicator AT will be lit. During this periods, do not change any of the instrument parameters. The tuning operation is finished when the indicator AT no longer lights. The user can abort self-tuning at any time by setting the parameter tunE to OFF.

9.3 Self-Tuning – Activation

Self-tuning can be activated under the following conditions:
- Operator level(not in configuration level)
- Automatic operating(closed loop)
- PID control algorithm(PId, rSP, or Prog)

In the following circumstances, self-tuning is halted or overridden:
1. Tuning is halted when the controller is switched over from automatic to manual. It automatically begins afresh when switched back to closed-loop(if not switched off in between times).

2. In a power outage the process is interrupted. If automatic tuning is configured to take place on application of mains power, tuning re-starts when the power supply returns.

3. If the programmer/controller is executing a program, tuning cannot be activated during a ramp. The program must be reset beforehand(IdLE) or halted(HoLd).

4. If the instrument is configured as a PID controller with ramped setpoint(rSP), the tuning procedure overrides the start-up ramp.

5. Self-tuning can be activated with two different parameters, the tuning setpoint can be adjusted for about one minute after the start.

6. With the parameter tunE, the user can trigger an immediate tune. The parameter values on and OFF serve to activated and display the tuning procedure.

10 Sensor Break

A sensor break and likewise an input error occurs when the input is open circuit or the measured value at the input over or under-ranges the linearisation span of the instrument. If the input is open circuit or the measured value is over-range, the annunciation Snb appears on the upper display. In an under-range condition(reversed polarity or wrong thermocouple connection) the annunciation ur appears. In both cases, the flashing '**MAN'** beacon indicates that the output level is set at the value defined by the parameter SnbP.

If a sensor break is detected at the input of the instrument, one of the output levels defined by the user(SnbP Parameter) is given on the output. The control loop is therefore open. The SnbP parameter can be adjusted for heat control in the range 0 to 100% and for heat/cool control in the range -99.9 to 100%.

Once failure eliminated, the controller will return to automatic control mode.

11 Linear Signal Input

To measure physical quantities such as pressure, humidity, tension, weight, voltage and current, these physical quantities must be converted into analog voltage signals before inputting to instrument.

For linear signal inputs, set the parameter Sn to value Lin or .Lin.

The input to the controller must be between -10~50mV, voltage signal which **exceed** this range must be attenuated with an appropriately sized input adapter. Current signals are converted to the -10~50mV range with a shunt input adapter.

e.g.

Input	Adapter
4 to 20 mA	Ri=2.5Ω
0 to 10 V	Ri=1k/200kΩ

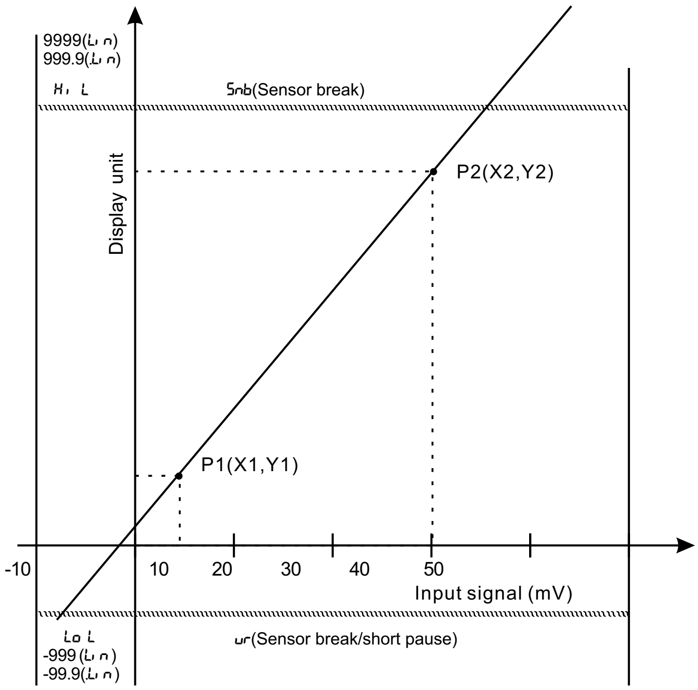
11.1 Setup and Configuration

- Set the parameter Sn to Lin or .Lin;

- Set HiL to the point desired to be the sensor overrange point or the sensor upper break point(in display units). If the input signal causes the display value to exceed this threshold, the controller enters the sensor break condition.

- Set LoL to the point desired to be the sensor underrange point or the sensor lower break point(in display units). If the input signal cause the display value fall below this threshold, the controller enters the sensor break condition.

- Set parameter FiL to appropriate value, the bigger is the FiL, the more stable it is, but the response will be slower.



Principle:

Two points define a straight line.

The scaling procedure maps input signals to specific display values.

The figure left clearly illustrates the principle.

11.2 Scaling Procedure

The following two examples are used to describe the checking and programming procedures: input 4~20 mA, so that the corresponding display of the Pc900 is 50~2500, and the check steps are as follows:

Connect a resistor of 2.5Ω at the input terminal, so that the input signal is within the range of 0 to 50mV. Connect the controller to some form signal generator which can reproduce the sensor output, or to the sensor itself if the sensor can be induced to supply various signal levels.

P1:

STEP	BUTTON OPERATION	DISPLAY
1	Connect source(from signal generator or sensor to input terminals before proceeding.) Apply a signal equal to 4mA for the first point(P1)	
2	Press **PAR/SET** key until Proc appears in the upper display	Proc ----
3	Press ▲ key, P1 appears in the lower display	Proc P1
4	Press **PAR/SET** key, the number in the lower display will be the value(after adjustment) assigned to the injected input signal	P1 150
5	Press ▲ or ▼ key to adjust the number in the lower display until it corresponds to the value represented by the injected signal(4mA)	P1 50
6	Press **PAR/SET** key	50 no
7	Press ▲ key to affirm	50 YES
8	Press **PAR/SET** key, P1 appears in the upper and lower display at the same time	P1 P1
9	5 seconds later, the scaling of the 1st point is completed	Proc ----

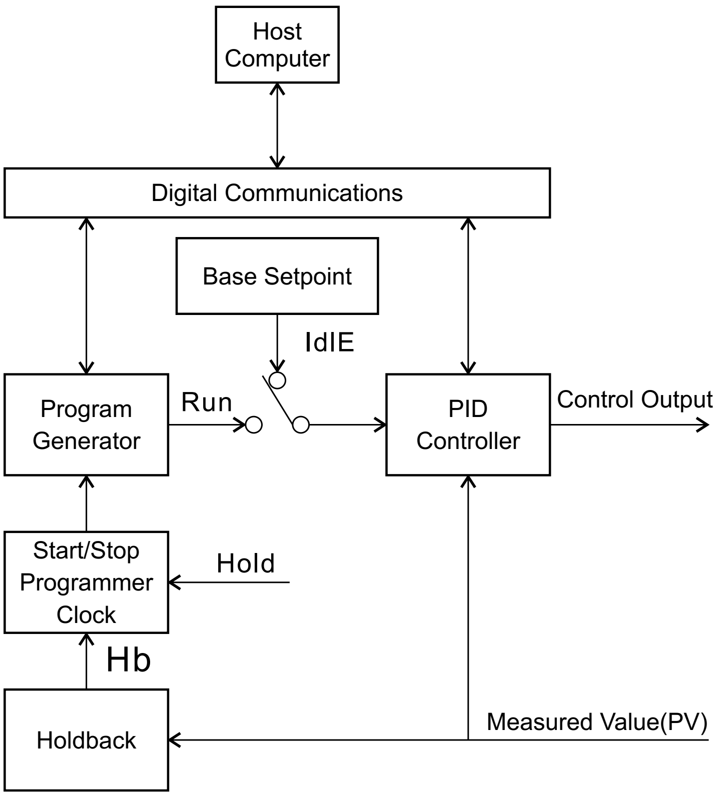
P2:

STEP	BUTTON OPERATION	DISPLAY
1	Apply a signal equal to 20mA for the second point(P2)	
2	Press **PAR/SET** key until Proc appears in the upper display	Proc ----
3	Press ▲ key until P2 appears in the lower display	Proc P2
4	Press **PAR/SET** key again: The number in the lower display will be the value(after adjustment) assigned to the injected input signal	P2 1500
5	Press ▲ or ▼ key to adjust the number in the lower display until it corresponds to the value represented by the injected signal(20mA)	P2 2500
6	Press **PAR/SET** key	2500 no
7	Press ▲ key to affirm	2500 YES
8	Press **PAR/SET** key, P2 appears in the upper and lower display at the same time	P2 P2
9	5 seconds later, the scaling of the 2nd point is completed	Proc ----

12 Programmer/Controller

12.1 General Description

PC900 series programmable controller contains an in-built setpoint generator in addition to the controller function. This setpoint generator can produce a temperature/time profile with 16 segments. When the program is running, the current setpoint from the setpoint generator is fed to the control algorithm. The current setpoint is continuously shown on the lower display.



The sixteen segments are defined in the order: Ramp 1, Dwell period 1, Ramp 2, Dwell period 2..., and are executed in succession.

● **Ramp**
A ramp consists of a slope(linear gradient) and a target setpoint. The control setpoint increases or decreases at a linear ramp rate from the actual measured value until a specified target setpoint is reached. The relative positions of the actual measured value and the target setpoint determine whether the slope of the ramp is positive or negative. Parameters r1, r2, r3... express the ramping rate in unites per minute(0.01~99.99), parameters L1, L2, L3... the appropriate target setpoint in display units.

● **Dwell period**
In a Dwell period, the target setpoint, which has been attained, remains unchanged for a fixed period. All the dwell periods are defined by their duration in minutes with parameters d1, d2, d3...(0~9999). When the program is running, these parameter display the time remaining in the active dwell period. If the parameter equals zero, the dwell period is skipped.

12.2 Program Parameters Setting

First, parameter CtrL must be configured as ProG.

When the controller runs in the PV displaying status:
1). Select the target program pattern number with the **PTN/▲** key.

2). press **SET/PROG** key, the first program parameter appears in the upper display. The value associated with this parameter will be shown in the lower display.

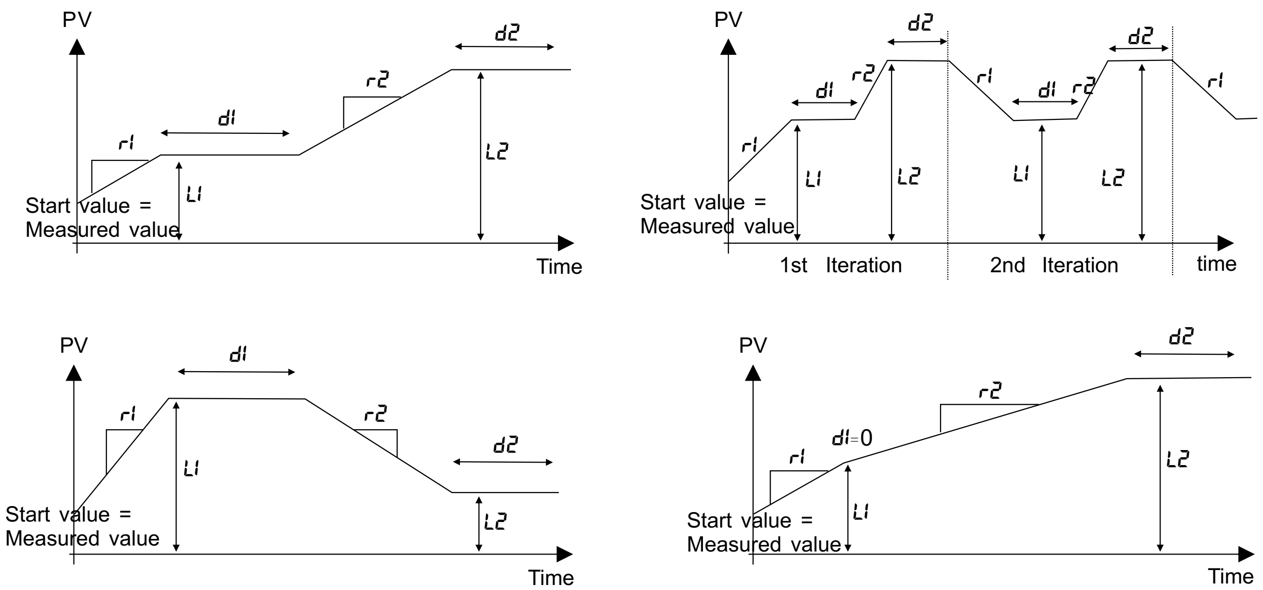
3). Use ▲ and ▼ key to modify the value.

4). Press the **PAR/SET** key, the next parameter appears. At the same time, the modification has been saved in the memory. Use ▲ and ▼ key to modify the value.

Repeat this procedure till all the parameters are set. Or if there is no key operation within 16 seconds, the menu times out automatically.

Program Parameter List(These parameters appear only if CtrL = ProG**)**

S.N.	Mnemonic	Parameter	Adjustable Range	Comments
1	Lc	Program Loop Counter	1~200, cont(continuous)	
2	r1	Ramp Rate 1	End; StEP; 0.01~99.99 units/(min, sec)	
3	L1	Target Setpoint 1	SPL ~ SPH	
4	d1	Dwell Time 1	0 ~ 9999 min	
5	r2	Ramp Rate 2	End; StEP; 0.01~99.99 units/(min, sec)	
6	L2	Target Setpoint 2	SPL ~ SPH	
7	d2	Dwell Time 2	0 ~ 9999 min	
...	...	...	...	...
8	PL1	ramp 1 and dwell 1 output power limit	0.0~100%	Appears only if “Program output Power High limitation” function is enabled.(P-PH = on)
9	PL2	ramp 2 and dwell 2 output power limit	0.0~100%	
...	...	...	...	...
10	P.End	Program ending action	OFF SP 0.Pr 1.Pr ...	Stop output Constant temp. control, setpoint=SP Run 0# program Run 1# program ...
11	OPt1	event output during program running		Optional
...	...	...	...	...
12	Hb	Holdback(band)	1~9999°C	



Program Examples

Comments on Program Parameters

● **Ramp Rate 1 – r1**

If r1 = End, the program will be ended when the program runs to the slope;
If r1 = StEP, the program will skip this slope, and directly goto the next dwell period.

● **Target Setpoint 1 – L1**

The target value to which the setpoint ramps when the programmer has been placed into run. Note that the adjustment range of this level is bound by the setpoint limit parameter SP L and SP H.

● **Dwell Time 1 - d1**

The value of this parameter indicates the time remaining in the dwell segment if the value is viewed while the program is currently in this particular dwell segment. The segment is skipped if d1 is set to zero minutes.

● **Program Loop Counter - LC**

This parameter determines the number of iterations of the program. Note that when a program is running, the value indicates will select the number of iterations remaining including the current iteration before the programmer reverts to IdLE.

● **Holdback Band – Hb**

For detail, see the next page "Programmer States".

12.3 Programmer States

The programmer/controller can be placed in three different states: IdLE, run and HoLd. The state is determined by the parameter Prog. An additional, non-selectable state is holdback(Hb).

● **Idle State – IdLE**
If the programmer/controller has been placed in the IdLE state, it operates as a simple controller with the setpoint shown on the lower display. An entered program is not executed. The controller will return to IdLE state at the end of the program.

● **Run State – run**
In the run state, the program has been started and is executing. When started from the IdLE state, the program is always launched from the beginning, at the end of the program it returns to IdLE. The current running segment is displayed in the **STEP** display. A program which is running may be reset by selecting IdLE(parameter Prog).

● **Hold State – HoLd**
A program which is running(run) is halted by selecting HoLd(parameter Prog). The program generator stops the program on the current setpoint, and the program timer will be stopped. From the HoLd state, the program can be continued(run) or reset(IdLE).

● **Holdback State – Hb**
The holdback state(Hb)is a special case of HoLd. It is activated of its own accord by the programmer/controller and cannot be selected by the user. The Hb parameter allows the user to set the difference tolerated between the current setpoint and the actual value while the program is running. If this difference is exceeded, the program generator halts itself in order for the process value to catch up with the program setpoint. In a dwell period the time-base is halted. If the difference between setpoint and actual value is again smaller than Hb, the program is continued.

To switch off holdback, set the parameter to a very high value.

12.4 Program Control Methods

The state of the programmer can be modified in three ways. All of the three have the same priority and the last action from any of them is acted upon:

1). Via the front panel keys, by choosing the parameter Prog and selecting the parameter value(IdLE, run or HoLd). Note that the rear terminals 14 & 15 must be bridged during this time, otherwise the controller will immediately enter HoLd state when the program starts. If the programmer/controller is placed from IdLE into HoLd via the front panel keys, the program is both started and then immediately halted.

2). Via the rear terminal 14 & 15 as shown in the wiring diagram. When the controller is in run or HoLd state, short circuit terminals 14 and 15. If terminals 14 and 14 are already shorted, first disconnect them, then short again, so that the controller enters the run state.
When the controller is in run state, disconnect terminals 14 & 15, the controller will enter the HoLd state.
When the controller is in run state, press the “STOP” switch(terminals 14 & 15), the controller will enter the IdLE state.

3). Via digital communications, by modifying the status word, see communications protocol for ALTEC AL808 series controller. The communication protocol and communication test software can be downloaded from our wetsite(http://www.altec.cc).

12.5 Annunciators

The LED indicator **RUN** indicates the current state of the programmer/controller:

● LED on ---> running(run)

● LED off ---> stop (IdLE)

● LED flashes ---> Hold (HoLd) or Holdback (Hb)

Note: The indicator RUN will be lit at the slope when CtrL is configured as r SP.

Display of running program segments:
When the controller is in run, Hb or HoLd state, the current segment number of the running program will appears in the **STEP** display.
During program running,

'/' is lit when the SV is rising.
'-' is lit when the SV is constant.
'\' is lit when the SV is falling.

Display of remaining time:
When the controller is in run, Hb or HoLd state, press the **DISP**/**SELECT** key until the indicator '**TIME**' is lit. The value displayed in the lower display is the remaining time of the segment's running instead of the total running time of the segment.

Display of setting value:
When the controller is in run, Hb or HoLd state, the values displayed in the lower display are the setting values (SV) which is running instead of setpoint (SP), while the values displayed under the SP parameter code are setpoint (SP).

When the controller is in the IdLE state, the lower display will display the setpoint (SP), the value can by modified with the ▲ and ▼ key.

12.6 Changing Program Parameter

The program pattern number **PTN** can't be changed when the controller is in run and HoLd state.

● In the run state, the parameters specific to the program, Lc, r1, L1, d1, r2, L2 and d2..., can't be modified. A modification is possible to the other parameter, the modification is permanent.

● In the HoLd state, the parameters specific to the program, Lc, r1, L1, d1, r2, L2, d2..., can be modified, the modification is, however, not permanent and is valid only for the current iteration of the program. A modification is possible to the other parameter, the modification is permanent.

● In the IdLE state, all the parameters can be modified, the modification is permanent.

12.7 Program Recovery Following Loss of Power

All the parameters are stored in non-volatile memory. When power is lost, the current point in the program is also stored in the memory. When power is restored, the programmer/controller resumes the program in the appropriate segment at the point reached at the moment of interruption, as soon as the process value re-enters the holdback band.

12.7 Program Output Power Limitation

In furnaces which use MoSi2 bar, Molybdenum filament, tungsten filament as heating elements, the cold-resistance of the heater is very small.

If the controller runs in the automatic mode and there is no power limitation to the output, the heater even the furnace may be burned out.

If the “program output power limitation” function is enabled(P-PH=on), the parameters PL1, PL2, PL3... will appear in the program parameter list. Set them to appropriate value for the furnaces.

12.8 Ending a Program & Program linking

At the end of a program, the controller will act according to the related parameter(code: P.End):
1) P.End = OFF, the controller will turn off the outputs, finish the program.

2) P.End = SP, when the program is over, the controller will perform as a constant temp. controller, the setting value is SP. The value of SP appears in the lower display, the value can be modified with the ▲ and ▼ key.

3) P.End = 0. Pr, 1. Pr, 2. Pr, 3. Pr..., when the program is over, the controller will jump to corresponding program and start to run it. Thus, several programs can be connected as one program.

Technical Data

Accuracy	±0.2%+1 digit
Sample Rate	125 ms
Input	Thermocouple: J, K, E, R, S, T and B RTD: Pt100 and Cu50 Linear Input: 0~20mA, 4~20mA, -10.0~50.0mV, 0~10V
Output	Relay(NO, max. 250VAC, 3A) Logic(20V/10mA), drive SSR Triac Analog: 0~10mA, 4~20mA, 0~20mA, or 0~5V, 1~5V, and 0~10V
Alarm	Relay(NO, max. 250VAC, 3A) Modes: upper and lower limit alarm, deviation alarm
Program	10*16-segments programs Cycle: 1~200 times or continuous
Control Algorithm	ON/OFF PID and PID self-tuning
Communications	RS232, RS422, RS485
Power Supply	Voltage Range: 85~264VAC; 45/60Hz
Environment	Temperature: 0~50°C, Humidity: ≤85%

Measurement Range

Code	Input	Measurement Range(°C)	Measurement Range(°F)
J tc	J thermocouple	-135~1000	-211~1832
CAtc	K thermocouple	-255~1395	-427~2543
E tc	E thermocouple	-99~749	-427~1380
r tc	R thermocouple	-50~1767	-58~3213
S tc	S thermocouple	-50~1767	-58~3213
b tc	B thermocouple	-50~1967	-58~3313
t tc	T thermocouple	-260~400	-436~752
rtd	Pt100	-100~1000	-100~1000
.rtd	Pt100(1/10' prec)	-99.9~999.9	-99.9~999.9
Cu	Cu50	-50~150	-50~150
.Cu	Cu50(1/10' prec)	-49.99~149.9	-49.9~149.9
Lin	Linear input	-1999~9999	-1999~9999
.Lin	Linear input(1/10' prec)	-199.9~999.9	-199.9~999.9
PrE	Linear resistance	-1999~9999	-1999~9999
.PrE	Linear resistance	-199.9~999.9	-199.9~999.9