PK494-1-OMC
October, 2006

Models ETR-9100, 8100 & 4100
Microprocessor Based
SMARTER LOGIC® Temperature Control

INSTRUCTION MANUAL

Warning Symbol ⚠

This Symbol calls attention to an operating procedure, practice, or the like, which, if not correctly performed or adhered to, could result in personal injury, damage or destruction to part or all of the product and system. Do not proceed beyond a warning symbol until the indicated conditions are fully understood and met.

Using the Manual

- Installer — Read Chapter 1, 2
- System Designer — Read All Chapters

NOTE:

It is strongly recommended that a process incorporates an FM approved LIMIT CONTROL like the ETR-9040 or ETR-3 which will shut down the equipment at a preset process condition in order to preclude any possible damage to individual components or system.

Information in this user's manual is subject to change without notice.

Contents

Chapter 1 Overview

1-1 General Description

The Smarter Logic PID microprocessor-based controller incorporates a bright, easy-to-read 4-digit LED display. The front LED display can be programmed to indicate either the process value or set point value. Smarter Logic technology enables a process to reach a predetermined set point in the shortest possible time, with minimum overshoot during power-up or external load disturbance.

The ETR-9100 is a 1/16 DIN size panel mount controller. The ETR-8100 is a 1/8 DIN size panel mount controller. The ETR-4100 is a 1/4 DIN size panel mount controller.These units are powered by an 11-26 or 90-250 VDC/VAC supply, incorporating a 2 amp control output relay as standard. The second output can be used as cooling control, an alarm or dwell timer. Prior to shipment, both outputs can be independently configured as triac, 5V logic output, linear current or linear voltage to drive an external device. There are six independent programmable alarm modes plus a dwell timer that can be configured for the second output. The units are fully programmable for RTD (PT100) and thermocouple types J, K, T, E, B, R, S, N, L without the need to physically modify the unit. The input signal is digitized by using a 18-bit A to D converter. A fast sampling rate allows the units to control fast processes.

Digital communications RS-485 or RS-232 are available as an additional option. This option allows the units to be integrated with a supervisory control system and/or software.

A programming port is available for automatic configuration, calibration and testing without the need to access the keys on front panel.

By using proprietary Fuzzy modified PID technology(Smarter Logic), the control loop will minimize overshoot and undershoot in the shortest time possible. The following diagram is a comparison of results with and without Fuzzy technology.

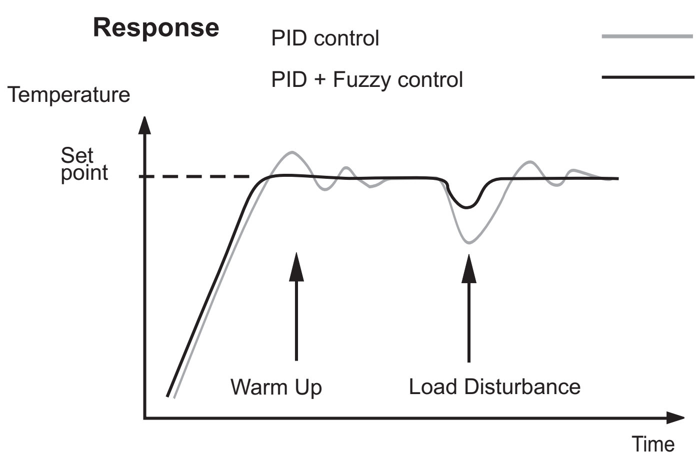


Figure 1.1
Fuzzy Control Advantage

High Accuracy

The ETR-9100, 8100 and 4100 series are manufactured with custom designed ASIC(Application Specific Integrated Circuit) technology which contains an 18-bit A to D converter for high resolution measurement (true 0.1°F resolution for thermocouple and standard Pt100 RTD's) and a 15-bit D to A converter for linear current or voltage control output. The ASIC technology provides improved operating performance, low cost, enhanced reliability and higher density internal storage.

Fast Sampling Rate

The sampling rate of the input A to D converter reaches 5 times/second. This fast sampling rate allows this series to control fast processes.

Smarter Logic Control

The function of Smarter Logic control is to automatically adjust the PID parameters from time to time. These dynamic adjustments are made in order to tune the output value to be more flexible and adaptive to various processes. The result is to enable a process to reach a predetermined set point in the shortest possible time with minimum overshoot and/or undershoot during power-up or external load disturbance.

Digital Communications

The units can be equipped with an RS-485 or RS-232 interface card to provide digital communications. By using shielded twisted pair wire, at most 247 units can be connected together via an RS-485 interface to a host computer. An industry standard Modbus RTU is used for the communication protocol.

Programming Port

A programming port is used to connect the unit to a hand-held programmer or a PC for quick configuration. Additionally, it can be connected to an Automatic Test Equipment (ATE) system for automatic testing & calibration.

Auto-tune

The auto-tune function allows the user to simplify the initial setup for a new system. A clever algorithm is provided to obtain an optimal set of control parameters for the process. The Auto-tune feature can be applied either as the process is warming up (cold start) or as the process is in a steady state (warm start).

Lockout Protection

In order to meet various security requirements, one of four lockout levels can be selected to prevent the unit from being changed without authorization.

Bumpless Transfer

The Bumpless Transfer feature is a unique process protection feature that is employed upon a sensor break condition or input problem. Bumpless transfer allows a controller to continue to proportion it’s output based on previous process and control characteristics. Hence, the process can be temporarily controlled just as if running a closed loop control application, making the severe problem of a Thermocouple error temporarily invisible. Bumpless transfer is not to be used for an extended period time as in open loop control, run-away may occur.

Soft-start Ramp

The ramping function is performed during power up as well as any time the set point is changed. It ramp will control both ramp up and/or ramp down. The process value will reach the set point with a predetermined constant rate.

Digital Filter

A first order low pass filter with a programmable time constant is used to improve the stability of process value. This is particularly useful in certain applications where the process value is too unstable to be read.

Sel Function

The units have the flexibility for a user to select those parameters which are most significant and move these parameters to the front of the display sequence. Up to 8 parameters may be selected to allow the user to build their own display sequence.

1-2 Ordering Code

ETR-4100- ☐ ☐ ☐ ☐ ☐ ☐ ☐
ETR-8100-
ETR-9100-

Power Input

4: 90 - 250 VAC, 50/60 HZ
5: 11 - 26 VAC or VDC
9: Special Order

Signal Input

1: Standard Input
Thermocouple:
J, K, T, E, B, R, S, N, L
RTD: PT100 DIN, PT100 JIS
2: 0 - 60 mV
3: 0 -1 V
4: 0 - 5 V
5: 1 - 5 V
6: 4 - 20 mA
7: 0 - 20 mA
8: 0 - 10 V
9: Special Order

Output 1

0: None
1: Relay rated 2A/240VAC
2: Pulsed voltage to drive SSR, 5V/30mA
3: Isolated 4 - 20mA / 0 - 20mA
4: Isolated 1 - 5V / 0 - 5V
5: Isolated 0 - 10V
6: Triac output 1A / 240VAC,SSR
C: Pulsed voltage to drive SSR, 14V/40mA
9: Special order

Output 2

0: None
1: Form A relay 2A/240VAC
2: Pulsed voltage to drive SSR, 5V / 30mA
3: Isolated 4 - 20mA / 0 - 20mA
4: Isolated 1 - 5V / 0 - 5V
5: Isolated 0 - 10V
6: Triac output, 1A / 240VAC, SSR
7: Isolated 20V/25mA transducer power supply
8: Isolated 12V/40mA transducer power supply
9: Isolated 5V/80mA transducer power supply
C: Pulsed voltage to drive SSR, 14V/40mA
A: Special order

Alarm

0: None
1: Form C relay 2A/240VAC
9: Special order

Communications

0: None
1: RS-485 interface
2: RS-232 interface
3: Retransmit 4-20mA / 0-20mA
4: Retransmit 1-5 V / 0-5V
5: Retransmit 0-10V
9: Special order

Options

0: Panel mount IP50 standard
1: Panel mount IP65 water resistant rubber installed
2: DIN Rail mount with IP50 (for ETR-9100 only)
3: DIN Rail mount with IP65 (for ETR-9100 only)

Related Products

SNA10A = Smart Network Adaptor for third party software, which converts 255 channels of RS-485 or RS-422 to RS-232 Network.

SNA10B = Smart Network Adaptor for ETR-Net software, which converts 255 channels of RS-485 or RS-422 to RS-232 network.

SNA12A = Smart Network Adaptor for programming port to RS-232 interface

ETR-Set = Configuration Software

CC94-1 = RS-232 Interface Cable (2M)

CC91-1 = Programming port cable

1-3 Programming Port

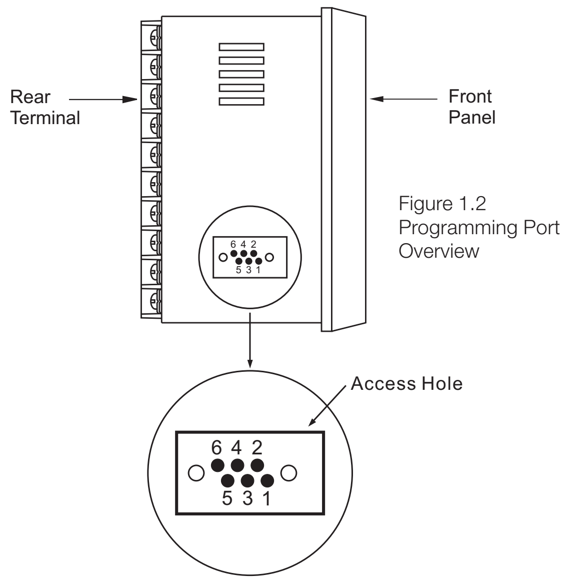


Figure 1.2 Programming Port Overview

A special connector can be used to connect to the programming port which is then connected to a smart network adaptor SNA12A and a PC for automatic configuration. It can also can be connected to an ATE system for automatic calibration and testing.

The programming port is used for off-line automatic setup and testing procedures only. Don't attempt to make any connection to these pins while the unit is powered up and being used for normal control purposes.

1- 4 Keys and Displays

KEYPAD OPERATION

SCROLL KEY: [⟲]
This key is used to select a parameter to be viewed or adjusted.

UP KEY: [▲]
This key is used to increase the value of a selected parameter.

DOWN KEY: [▼]
This key is used to decrease the value of a selected parameter.

RESET KEY: [R]
This key is used to:
1. Revert the controllers display back to the process value (or set point value if DISP is set to SP1).
2. Reset the latching alarm, once the alarm condition is removed.
3. Stop the manual control mode, auto-tuning mode and calibration mode.
4. Clear the message of a communications error or auto-tuning error.
5. Restart the dwell timer when it has timed out.
6. Enter the manual control menu when a failure condition occurs.

ENTER KEY : Press [⟲] for 3 seconds or longer.
Press [⟲] for 3 seconds to:
1. Enter the setup menu. The display will show [SEt] .
2. Enter the manual control mode when the manual control menu, [H - - -] or [C - - -] is displayed.
3. Enter the controller into auto-tuning mode. During auto-tuning mode [A - t] is displayed.
4. Perform calibration to a selected parameter during the calibration procedure. Press [⟲] for 5 seconds to select calibration mode.

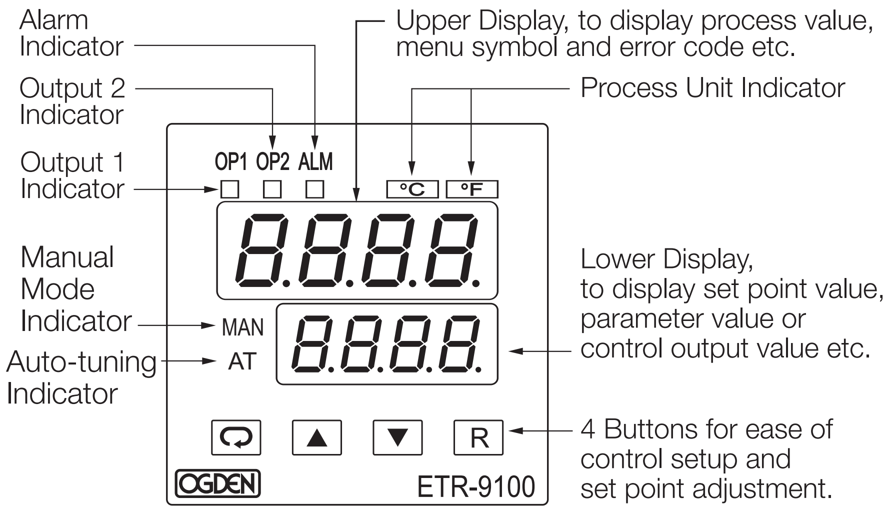
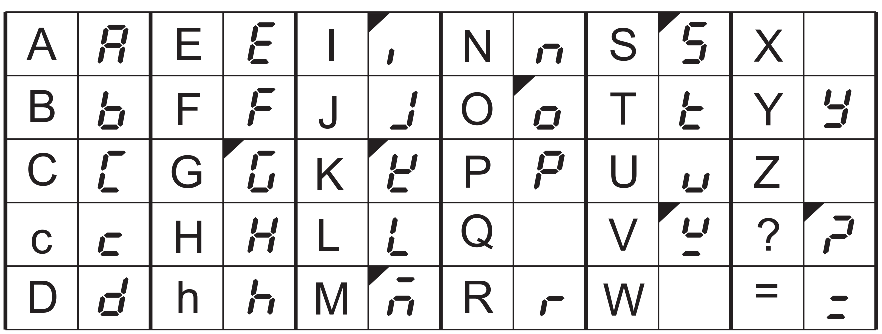
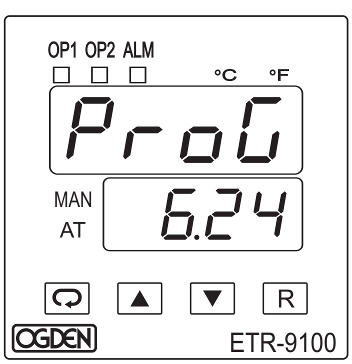


Figure 1.3 Front Panel Description

Table 1.1 Character Legend



◤: Characters Displayed by a Symbol

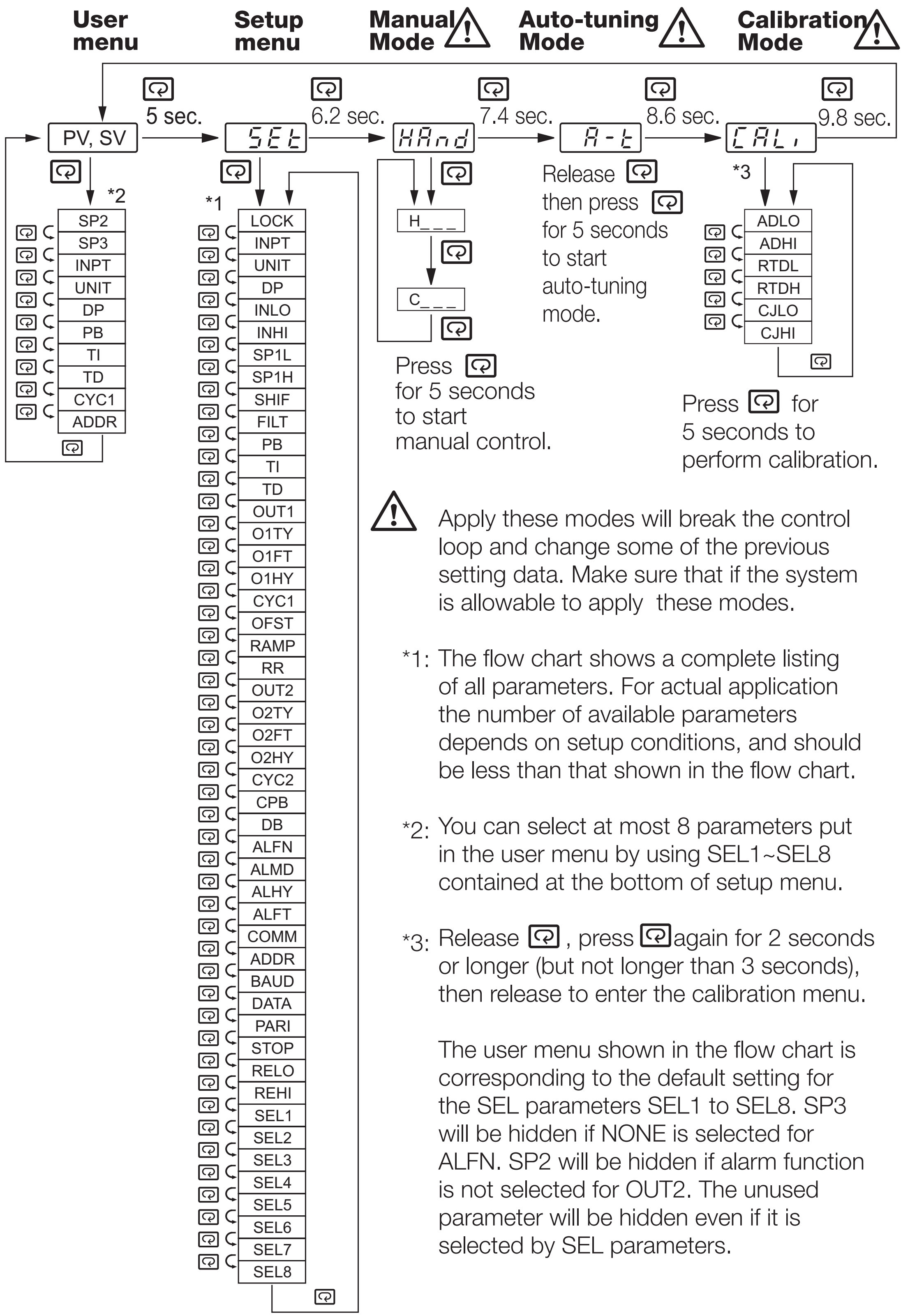


Displays the program code of the product for 2.5 seconds.

The ETR-9100 goes through an initial Power up self test during which it displays the Program code and version of the controller. The left diagram shows program version 6.24 for an ETR-9100.

Figure 1.4
Display at Power-up

1- 5 Menu Overview



Apply these modes will break the control loop and change some of the previous setting data. Make sure that if the system is allowable to apply these modes.

*1: The flow chart shows a complete listing of all parameters. For actual application the number of available parameters depends on setup conditions, and should be less than that shown in the flow chart.

*2: You can select at most 8 parameters put in the user menu by using SEL1~SEL8 contained at the bottom of setup menu.

*3: Release [key], press [key] again for 2 seconds or longer (but not longer than 3 seconds), then release to enter the calibration menu.

The user menu shown in the flow chart is corresponding to the default setting for the SEL parameters SEL1 to SEL8. SP3 will be hidden if NONE is selected for ALFN. SP2 will be hidden if alarm function is not selected for OUT2. The unused parameter will be hidden even if it is selected by SEL parameters.

1-6 Parameter Descriptions

Parameter Notation	Parameter Description	Range	Default Value
SP1	Set point for output 1	Low: SP1L High :SP1H	77.0 °F (25.0 °C)
SP2	Set point for output 2 when output 2 performs alarm function or dwell timer	Low: -19999 High :45536	18.0°F (10.0 °C)
SP3	Set point for alarm or dwell timer output	Low: -19999 High :45536	18.0°F (10.0 °C)
LOCK	Select parameters to be locked	0 nonE : No parameters are locked 1 SEt : Setup data is locked 2 uSEr : Setup and User data is locked Set point is un- locked 3 ALL : All data is locked	0
INPT	Input sensor selection	0 J_tC : J type T/C 1 K_tC : K type T/C 2 t_tC : T type T/C 3 E_tC : E type T/C 4 b_tC : B type T/C 5 r_tC : R type T/C 6 S-tC : S type T/C 7 n_tC : N typeT/C 8 L-tC : L type T/C 9 Pt.dn : PT 100 ohms DIN 10 Pt.JS : PT 100 ohms JIS 11 4-20 : 4 - 20 mA 12 0-20 : 0 - 20 mA 13 0-60 : 0 - 60 mV 14 0-1V : 0 - 1V 15 0-5V : 0 - 5V 16 1-5V : 1 - 5V 17 0-10 : 0 - 10V	1 (0)
UNIT	Input unit selection	0 °C : Degree C unit 1 °F : Degree F unit 2 Pu : Process unit	0 (1)
DP	Decimal point selection	0 no.dP : No decimal point 1 1-dP : 1 decimal digit 2 2-dP : 2 decimal digits 3 3-dP : 3 decimal digits	1
INLO	Input low scale value	Low: -19999 High: 45486	0°F (-17.8 °C)
INHI	Input high scale value	Low: INLO+50 High: 45536	200.0°F (93.3 °C)
SP1L	Low limit of set point value	Low: -19999 High: 45536	0°F (-17.8 °C)
SP1H	High limit of set point value	Low: SP1L High: 45536	1000°F (537.8 °C)
SHIF	PV shift (offset) value	Low: -360.0 °C (-200.0 °C) High: 360.0 °F (200.0 °C)	0.0
FILT	Filter damping time constant of PV (seconds)	0 0 : 0 1 0.2 : 0.2 2 0.5 : 0.5 3 1 : 1 4 2 : 2 5 5 : 5 6 10 : 10 7 20 : 20 8 30 : 30 9 60 : 60	2
PB	Proportional band value	Low: 0 High: 932.0 °F (500.0 °C)	18.0 °F (10.0 °C)
TI	Integral time value	Low: 0 High: 1000 sec	100
TD	Derivative time value	Low: 0 High: 360.0 sec	25.0

Parameter Notation	Parameter Description	Range	Default Value
OUT1	Output 1 function	0 rEUr : Reverse (heating) control 1 dirt : Direct (cooling) control	0
O1TY	Output 1 signal type	0 rELY : Relay 1 SSrd : Solid state relay drive 2 SSr : Solid state relay 3 4-20 : 4-20 mA 4 0-20 : 0 - 20 mA 5 0-1V : 0 - 1V 6 0-5V : 0 - 5V 7 1-5V : 1 - 5V 8 0-10 : 0 - 10V	0
O1FT	Output 1 failure transfer mode	Select BPLS (bumpless transfer) or 0.0 ~ 100.0 % to continue output 1 control function as the unit fails, or select OFF (0) or ON (1) for ON-OFF control.	0
O1HY	Output 1 ON-OFF control hysteresis	Low: 0.1 High: 90.0°F (50.0°C)	0.2 °F (0.1 °C)
CYC1	Output 1 cycle time	Low: 0.1 High: 90.0 sec.	18.0
OFST	Offset value for P control	Low: 0 High: 100.0 %	25.0
RAMP	Ramp function selection	0 nonE : No Function 1 Min.r : Use unit/minute 2 Hr.r : Use unit/hour	0
RR	Ramp rate	Low: 0 High: 900.0 °F (500.0 °C)	0.0
OUT2	Output 2 function	0 nonE : Output 2 No Function 1 tinr : Dwell timer action 2 dE.Hi : Deviation High Alarm 3 dE.Lo : Deviation Low Alarm 4 db.Hi : Deviation out of band Alarm 5 db.Lo : Deviation in band Alarm 6 PV.Hi : Process High Alarm 7 PV.Lo : Process Low Alarm 8 CooL : Cooling PID Function	2
O2TY	Output 2 signal type	0 rELY : Relay output 1 SSrd : Solid state relay drive 2 SSr : Solid state relay 3 4-20 : 4 - 20 mA 4 0-20 : 0 - 20 mA 5 0-1V : 0 - 1V 6 0-5V : 0 - 5V 7 1-5V : 1 - 5V 8 0-10 : 0 - 10V	0
O2FT	Output 2 failure transfer mode	Select BPLS (bumpless transfer) or 0.0 ~ 100.0 % to continue output 2 control function as the unit fails, or select ON (0) or OFF (1) for alarm and dwell timer function.	0
O2HY	Output 2 hysteresis value when output 2 performs alarm function	Low: 0.1 High: 90.0 °F (50.0 °C)	0.2 °F (0.1 °C)
CYC2	Output 2 cycle time	Low: 0.1 High: 90.0 sec.	18.0
CPB	Cooling proportional band value	Low: 50 High: 300 %	100
DB	Heating-cooling dead band (negative value = overlap)	Low: -36.0 High: 36.0 %	0

Parameter Notation	Parameter Description	Range	Default Value
ALFN	Alarm function for alarm output	0 nonE : No alarm function 1 timr : Dwell timer action 2 dE.Hi : Deviation high alarm 3 dE.Lo : Deviation low alarm 4 db.Hi : Deviation band out of band alarm 5 db.Lo : Deviation band in band alarm 6 PV.Hi : Process value high alarm 7 PV.Lo : Process value low alarm	2
ALMD	Alarm operation mode	0 norm : Normal alarm action 1 Ltch : Latching alarm action 2 HoLd : Hold alarm action 3 Lt.Ho : Latching & Hold action	0
ALHY	Hysteresis contol of alarm	Low: 0.1 High: 50.0 °C (90.0 °F)	0.1 °C (0.2 °F)
ALFT	Alarm failure transfer mode	0 on : Alarm output ON as unit fails 1 oFF : Alarm output OFF as unit fails	0
COMM	Communication function	0 nonE : No communication 1 rtu : Modbus RTU mode protocol 2 4-20 :4-20mA retransmission output 3 0-20 :0-20mA retransmission output 4 0-5V :0-5V retransmission output 5 1-5V :1-5V retransmission output 6 0-10 :0-10V retransmission output	1
ADDR	Address assignment of digital communication	Low: 1 High: 255	———
BAUD	Baud rate of digital communication	0 2.4 : 2.4 Kbits/s 1 4.8 : 4.8 Kbits/s 2 9.6 : 9.6 Kbits/s 3 14.4 : 14.4 Kbits/s 4 19.2 : 19.2 Kbits/s 5 28.8 : 28.8 Kbits/s 6 38.4 : 38.4 Kbits/s	2
DATA	Data bit count of digital communication	0 7bit : 7 data bits 1 8bit : 8 data bits	1
PARI	Parity bit of digital communication	0 EVEn : Even parity 1 odd : Odd parity 2 nonE : No parity bit	0
STOP	Stop bit count of digital communication	0 1bit : One stop bit 1 2bit : Two stop bits	0
RELO	Retransmission low scale value	Low: -19999 High: 45536	32.0 °F (0.0 °C)
REHI	Retransmission high scale value	Low: -19999 High: 45536	212.0 °F (100.0 °C)

Parameter Notation	Parameter Description	Range	Default Value
SEL1	Select 1'st parameter for user menu	0 nonE : No parameter selected 1 LocK : LOCK is put ahead 2 inPt : INPT is put ahead 3 unit : UNIT is put ahead 4 dP : DP is put ahead 5 SHiF : SHIF is put ahead 6 Pb : PB is put ahead 7 ti : TI is put ahead 8 td : TD is put ahead 9 o1HY : O1HY is put ahead 10 CYC1 : CYC1 is put ahead 11 oFSt : OFST is put ahead 12 r.r : RR is put ahead 13 o2HY : O2HY is put ahead 14 CYC2 : CYC2 is put ahead 15 C.Pb : CPB is put ahead 16 d.b : DB is put ahead 17 Addr : ADDR is put ahead 18 AL.HY : ALHY is put ahead	2
SEL2	Select 2'nd parameter for user menu	Same as SEL1	3
SEL3	Select 3'rd parameter for user menu	Same as SEL1	4
SEL4	Select 4'th parameter for user menu	Same as SEL1	6
SEL5	Select 5'th parameter for user menu	Same as SEL1	7
SEL6	Select 6'th parameter for user menu	Same as SEL1	8
SEL7	Select 7'th parameter for user menu	Same as SEL1	10
SEL8	Select 8'th parameter for user menu	Same as SEL1	17

Chapter 2 Installation

⚠ Dangerous voltages capable of causing death are sometimes present in this instrument. Before installation or beginning any cleaning or troubleshooting procedures the power to all equipment must be switched off and isolated. Units suspected of being faulty must be disconnected and removed to a properly equipped workshop for testing and repair. Component replacement and internal adjustments must be made by a qualified maintenance person only.

⚠ This instrument is protected throughout by Double Insulation ▣ To minimize the possibility of fire or shock hazards, do not expose this instrument to rain or excessive moisture.

⚠ Do not use this instrument in areas under hazardous conditions such as excessive shock, vibration, dirt, moisture, corrosive gases or oil. The ambient temperature of the areas should not exceed the maximum rating specified in Chapter 6.

⚠ Remove stains from this instrument using a soft, dry cloth. In order to avoid deformation or discoloration, do not use harsh chemicals, volatile solvent such as thinner or strong detergents to clean the instrument.

2-1 Unpacking

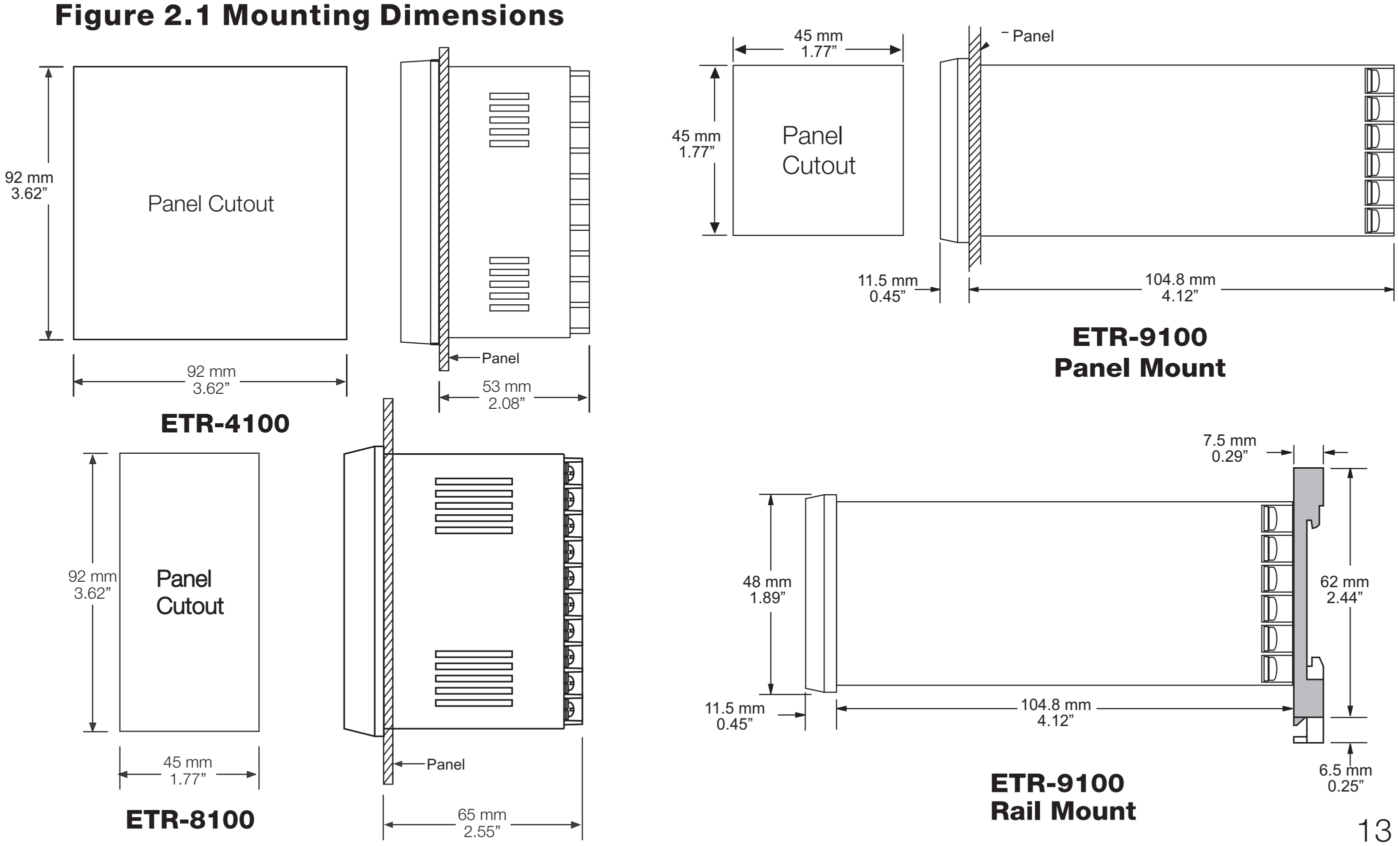
Upon receipt of the shipment remove the unit from the carton and inspect the unit for shipping damage.
If any damage due to transit , report and claim with the carrier. Write down the model number, serial number, and date code for future reference when corresponding with our service center.The serial number (S/N) and date code (D/C) are labeled on the box and the housing of control.

2-2 Mounting

Make a panel cutout as per dimensions shown in Figure 2.1.

Take the mounting clamp away and insert the controller into the panel cutout. Install the mounting clamp back.

Figure 2.1 Mounting Dimensions



2 - 3 Wiring Precautions

* Before wiring, verify the label for correct model number and options. Switch off the power while checking.

* Care must be taken to ensure that the maximum voltage rating specified on the label is not exceeded.

* It is recommended that the power of these units be protected by fuses or circuit breakers rated at the lowest value possible.

* All units should be installed inside a suitably grounded metal enclosure to prevent live parts from contact with human hands and metal tools.

* All wiring must conform to appropriate standards of good practice and local codes and regulations. Wiring must be suitable for voltage, current, and temperature rating of the system.

* Beware not to overtighten the terminal screws. The torque should not exceed 1 N-m (8.9 Lb-in or 10.2 KgF-cm).

* Unused control terminals should not be used as jumper points as they may be internally connected, causing damage to the unit.

* Verify that the ratings of the output devices and the inputs as specified in Chapter 6 are not exceeded.

* Except the thermocouple wiring, all wiring should use stranded copper conductor with a maximum gauge of 18 AWG.

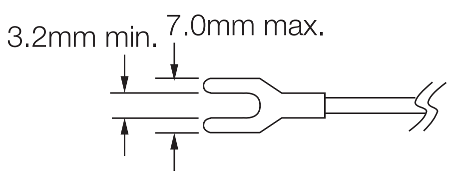


Figure 2.2 Lead Termination for ETR-4100 and ETR-8100

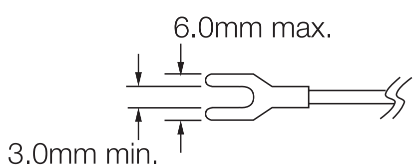


Figure 2.3 Lead Termination for ETR-9100

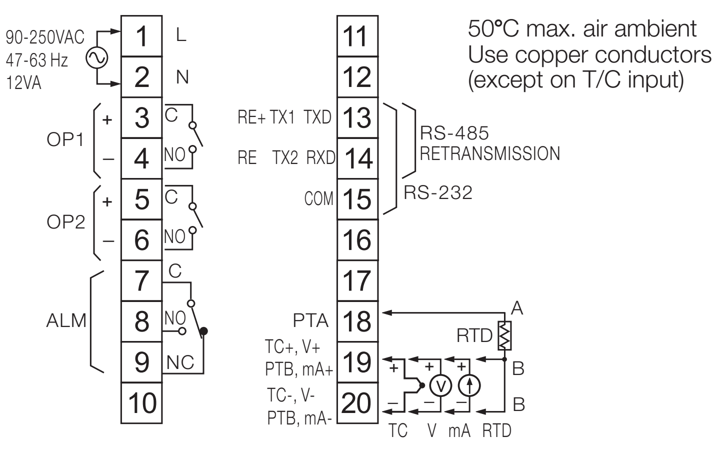


Figure 2.4 Rear Terminal Connection for ETR-4100 and ETR-8100

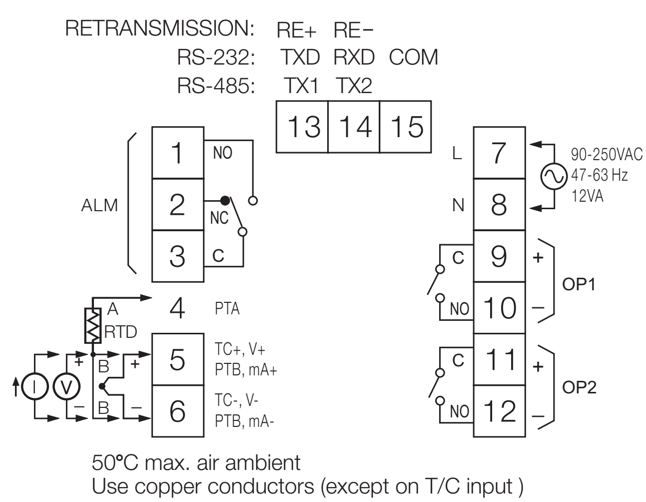


Figure 2.5
Rear Terminal Connection for ETR-9100

2-4 Power Wiring

The controller is designed to operate at 11-26 VAC / VDC or 90-250 VAC. Check that the installation voltage corresponds with the power rating indicated on the product label before connecting power to the controller. Near the controller, a fuse and a switch rated at 2A/250VAC should be equipped, as shown in the following diagram.,

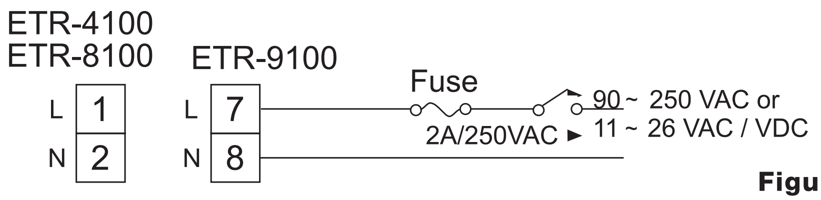


Figure 2.6 Power Supply Connections

⚠ This equipment is designed for installation in an enclosure which provides adequate protection against electric shock. The enclosure must be connected to earth ground.

Local requirements regarding electrical installation should be rigidly observed. Consideration should be given to prevent unauthorized access to the power terminals.

2-5 Sensor Installation Guidelines

Proper sensor installation can eliminate many problems in a control system. The probe should be placed so that it can detect any temperature change with minimal thermal lag. In a process that requires fairly constant heat output, the probe should be placed close to the heater. In a process where the heat demand is variable, the probe should be close to the work area. Some experiments with probe location are often required to find this optimum position.

In a liquid process, addition of a stirrer will help to eliminate thermal lag. Since the thermocouple is basically a point measuring device, placing more than one thermocouple in parallel can provide an average temperature readout and produce better results in most air heated processes.

Proper sensor type is also a very important factor to obtain precise measurements. The sensor must have the correct temperature range to meet the process requirements. In special processes the sensor might need to have different requirements such as leak-proof, anti-vibration, antiseptic, etc.

Standard sensor limits of error are ±4 degrees F (± 2 degrees C) or 0.75% of sensed temperature (half that for special) plus drift caused by improper protection or an over-temperature occurrence. This error is far greater than controller error and cannot be corrected on the sensor except by proper selection and replacement.

2-6 Sensor Input Wiring

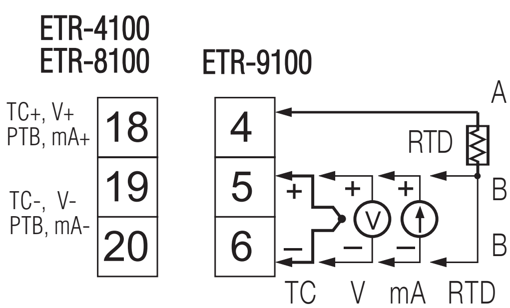


Figure 2.7 Sensor Input Wiring

2-7 Control Output Wiring

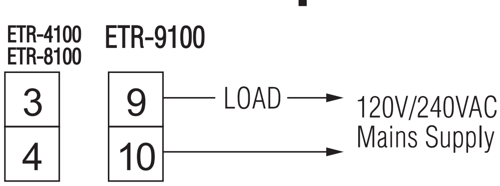


Figure 2. 8
Output 1 Relay or Triac (SSR) to Drive Load

2-7 Control Output Wiring

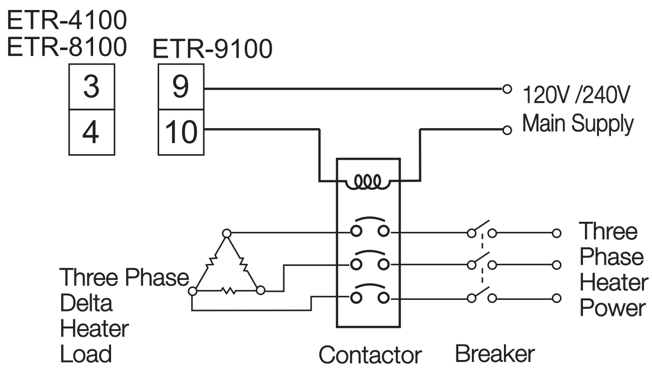


Figure 2.9
Output 1 Relay or Triac (SSR) to Drive Contactor

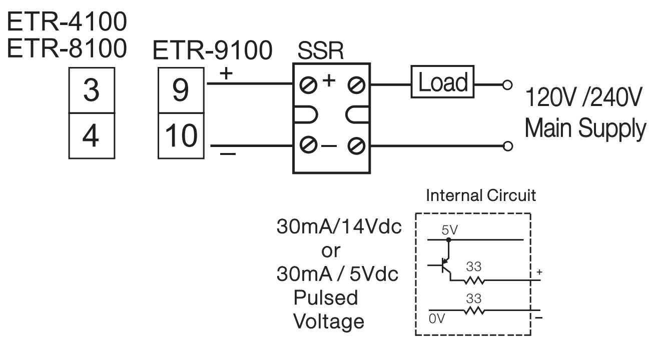


Figure 2.10
Output 1 Pulsed Voltage to Drive SSR

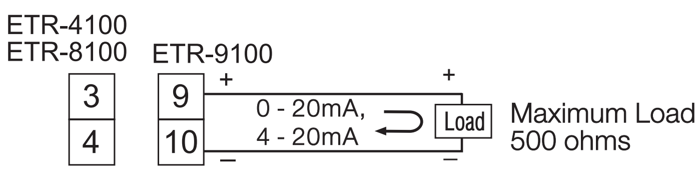


Figure 2.11
Output 1 Linear Current

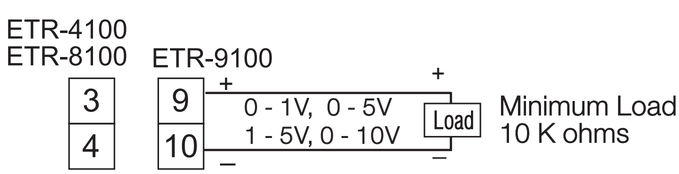


Figure 2.12
Output 1 Linear Voltage

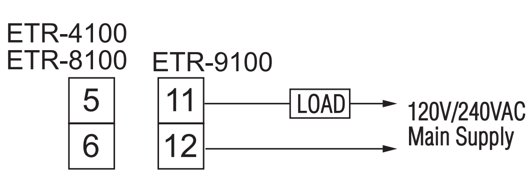


Figure 2.13
Output 2 Relay or Triac (SSR) to Drive Load

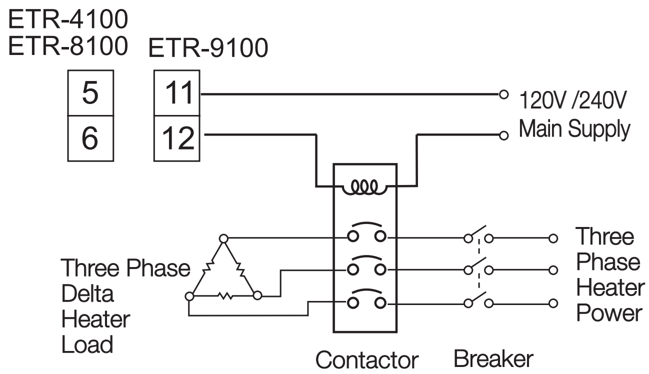


Figure 2.14
Output 2 Relay or Triac (SSR) to Drive Contactor

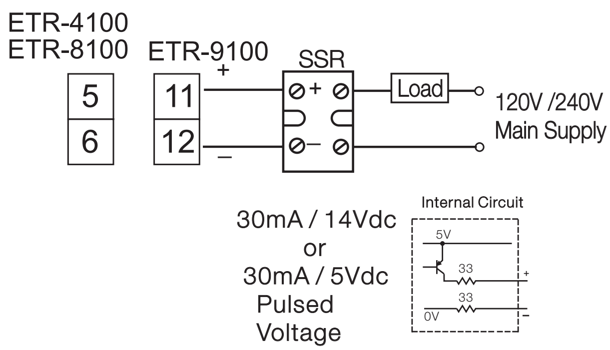


Figure 2.15
Output 2 Pulsed Voltage to Drive SSR

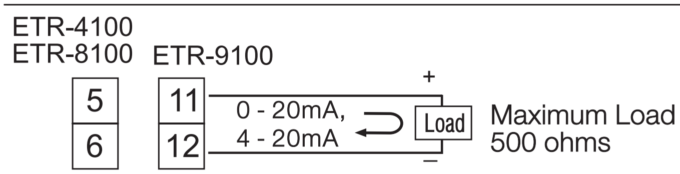


Figure 2.16
Output 2 Linear Current

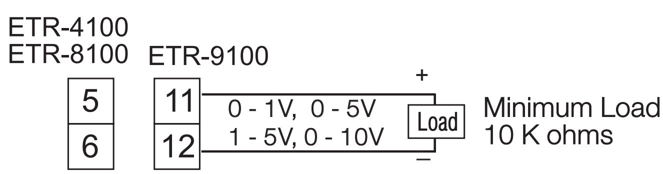


Figure 2.17
Output 2 Linear Voltage

2-8 Alarm Wiring

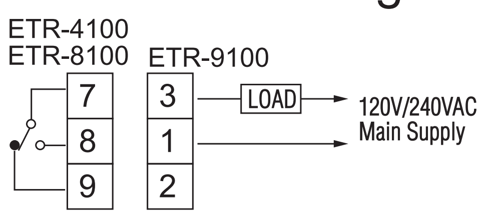


Figure 2.18
Alarm Output to Drive Load

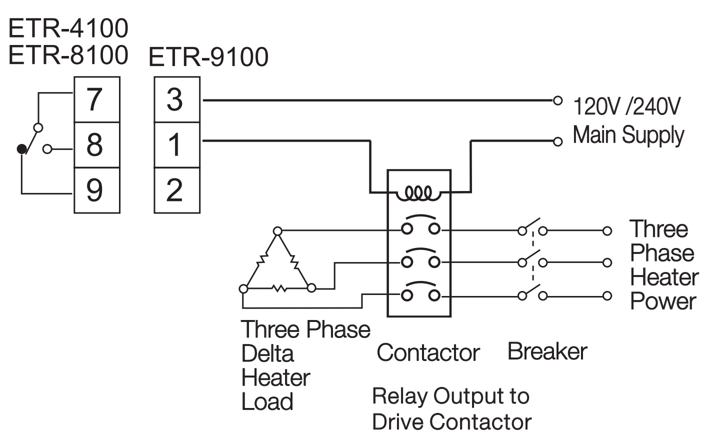


Figure 2.19
Alarm Output to Drive Contactor

2-9 Data Communication

RS-485

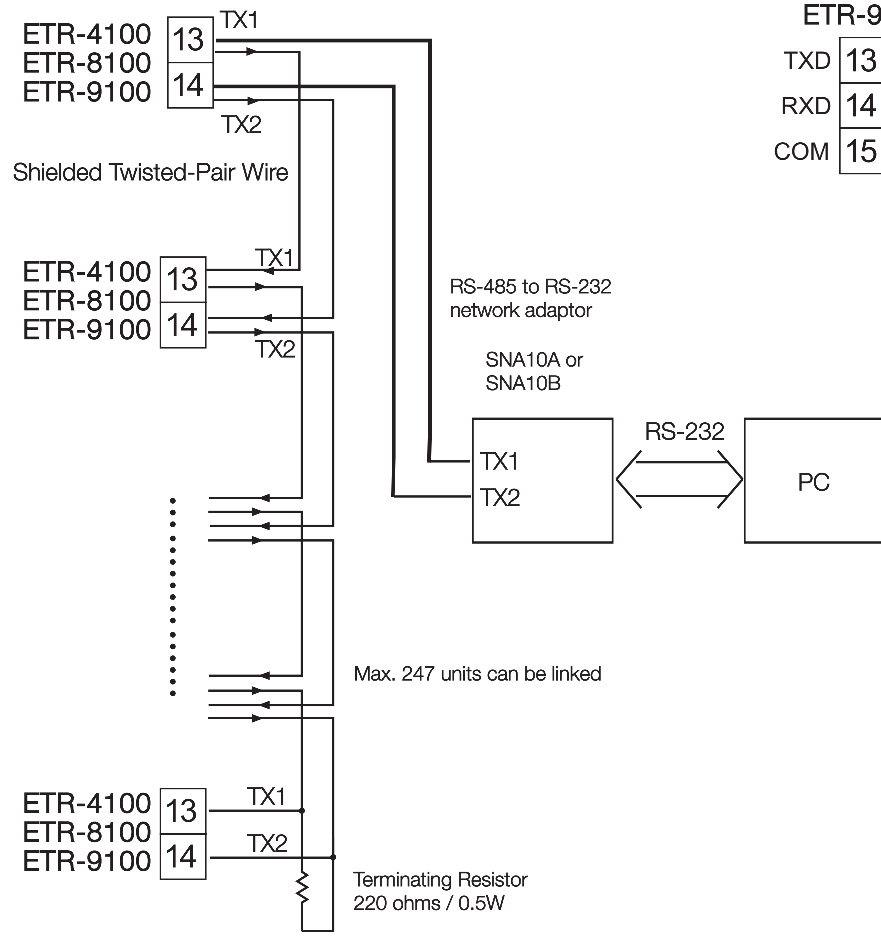


Figure 2.21 RS-485 Wiring

RS-232

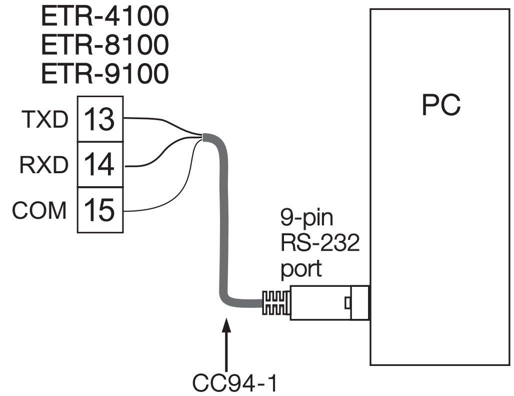


Figure 2.22
RS-232 Wiring

Using RS-232 communications as shown in fig. 2.2, a special cable CC-94-1 should be used. The other option is to configure a 9-pin serial cable as in fig. 2-23.

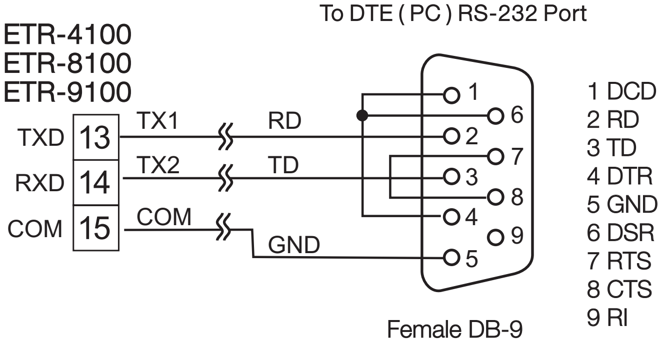


Figure 2.23
Configuration of RS-232 Cable

Chapter 3 Programming

Press [↻] for 3 seconds and release to enter setup menu. Press [↻] to select the desired parameter. The display indicates the parameter symbol. Press [▲] or [▼] to view or adjust the value of the selected parameter.

3-1 Lockout

Four security levels can be selected using the LOCK parameter.

If **NONE** is selected for LOCK, then all parameters are unlocked.
If **SET** is selected for LOCK, then all setup menu parameters are locked.
If **USER** is selected for LOCK, then all setup and user parameters (refer to **section 1-5**) except set point are locked.
If **ALL** is selected for LOCK, then all parameters are locked to prevent any changes.

3-2 Signal Input

INPT: Selects the sensor or signal type for signal input.
  Range: (thermocouple) J, K, T, E, B, R, S, N, L
    (RTD) PT.DN, PT.JS
    (linear) 4-20mA, 0-20mA, 0-60mV, 0-1V, 0-5V, 1-5V, 0-10
UNIT: Selects the process unit
  Range: °C, °F, PU (process unit). If the unit is neither °C nor °F, then select PU.
DP: Selects the resolution of process value.
  Range: (for T/C and RTD) NO.DP, 1-DP
    (for linear) NO.DP, 1-DP, 2-DP, 3-DP
INLO: Selects the low scale value for the linear type input.
INHI : Selects the high scale value for the linear type input.

How to use INLO and INHI:

If 4 - 20 mA is selected for INPT, let SL specifies the input signal low (ie. 4 mA), SH specifies the input signal high (ie. 20 mA), S specifies the current input signal value, the conversion curve of the process value is shown as follows:

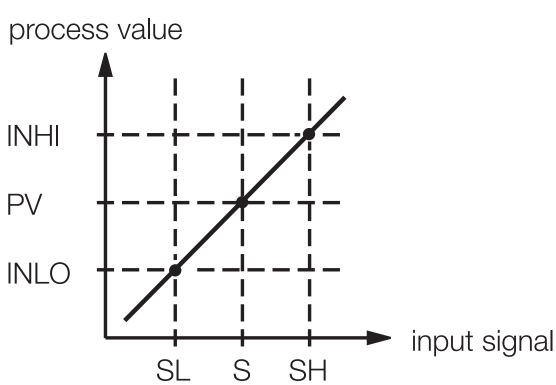


Figure 3.1
Conversion Curve for
Linear Type Process Value

Example : A 4-20 mA current loop pressure transducer with range 0 - 15 kg/cm² is connected to input, then perform the following setup :

Formula : PV = INLO +-(INH $\frac{S \ \ SL}{SH \ \ SL}$ INLO)
INPT = 4 - 20 INLO = 0.00
INHI = 15.00 DP = 2-DP
Of course, you may select other values for DP to alter the resolution.

3-3 Control Outputs

There are 4 kinds of control modes that can be configured, as shown in **Table 3.1**

Table 3.1 Heat-Cool Control Setup Value

Control Modes	OUT1	OUT2	O1HY	O2HY	CPB	DB
Heat only	REVR	×	☆	×	×	×
Cool only	DIRT	×	☆	×	×	×
Heat: PID Cool: ON-OFF	REVR	DE.HI	×	○	×	×
Heat: PID Cool: PID	REVR	COOL	×	×	○	○

× : Don't care ○ :Adjust to met process requirements ☆:Required if ON-OFF control is configured

Heat Only ON-OFF Control : Select REVR for OUT1, Set PB to 0, O1HY is used to adjust dead band for ON-OFF control, The output 1 hysteresis (O1HY) is enabled in case of PB = 0 . The heat only on-off control function is shown in the following diagram :

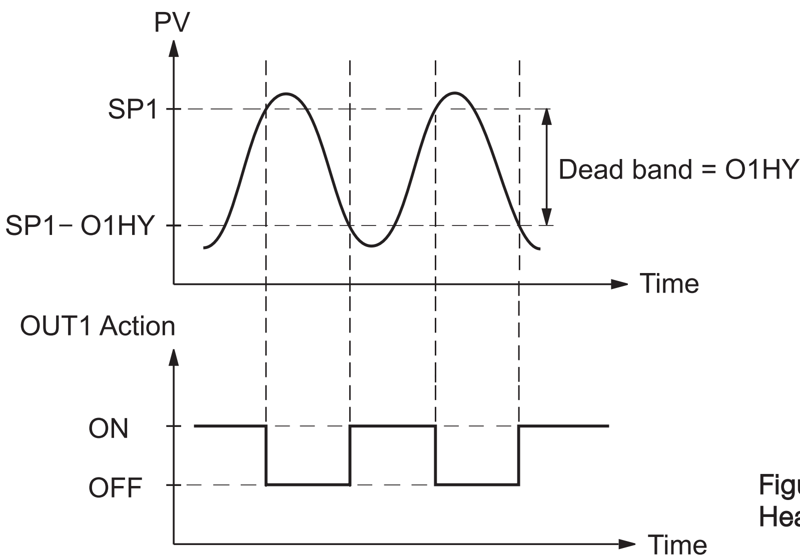


Figure 3.2
Heat Only ON-OFF Control

The ON-OFF control may introduce excessive process oscillation even if hysteresis is minimized. If ON-OFF control is set (ie. PB = 0), TI, TD, CYC1, OFST, CYC2, CPB, DB will be hidden and have no function to the system. The auto-tuning mode and bumpless transfer will be disabled too.

Heat only, P (or PD) control: Select REVR for OUT1, set TI to 0, OFST is used to adjust the control offset (manual reset). **O1HY is hidden** if PB is not equal to 0. **OFST Function:** OFST is measured by % with range 0 - 100.0%. In the steady state (ie. process has been stabilized) if the process value is lower than the set point by a definite value, for example 5°C, while 20°C is used for PB, that is 25% lower, then increase OFST 25%, and vice versa. After adjusting the OFST value, the process value will be varied and eventually, coincide with the set point. Using the P control (TI set to 0), the auto-tuning is disabled. Refer to section 3-12 " manual tuning " for the adjustment of PB and TD. Manual reset (adjust OFST)is not practical because the load may change from time to time and often need to adjust OFST repeatedly. PID control setup can avoid this situation.

Heat only PID control : Selecting REVR for OUT1, PB and TI should not be zero. Operate auto-tuning for the new process, or set PB, TI and TD with historical values. See section 3-11 for auto-tuning operation. If the control result is still unsatisfactory, then use manual tuning to improve the control . See section 3-12 for manual tuning. The unit contains a **sophisticated PID and Fuzzy algorithm** to achieve **minimal overshoot and a fast response** to the process if it is properly tuned.

Cool only control: ON-OFF control, P (PD) control and PID control can be used for cooling control. Set OUT1 to DIRT (direct action). The other functions for cool only ON-OFF control, cool only P (PD) control and cool only PID control are the same as the descriptions for heat only control, except that the output variable (and action) for the cool control is inverse to the heat control.

> **NOTE:** ON-OFF control may result in excessive overshoot and undershoot problems in the process. The P (or PD) control will result in a deviation of process value from the set point. It is recommended to use PID control for the Heat-Cool control to produce a stable and zero offset process value.

Other Setup Required:

Cycle Time: CYC1, CYC2, O1FT, O2FT O1TY & O2TY parameters are set in accordance with the types of OUT1 & OUT2 installed. CYC1 & CYC2 are selected according to the output 1 type (O1TY) & output 2 type (O2TY) Generally, if SSRD or SSR is used for O1TY, select 0.5 ~ 2 sec. for CYC1; if relay is used for O1TY, select 10 ~ 20 sec; and if linear output is used, CYC1 is ignored. Similar settings are applied for CYC2 selection.

You can use the **auto-tuning** program for a new process or directly set the appropriate values for PB, TI & TD according to the historical records for the repeated systems. If the control behavior is still inadequate, then use **manual tuning** to improve the control. See **section 3-12** for manual tuning.

CPB Programming: The cooling proportional band is measured by % of PB with range 50~300. Initially set 100% for CPB and examine the cooling effect. If cooling action should be enhanced then decrease CPB, if cooling action is too strong then increase CPB. The value of CPB is related to PB and its value remains unchanged throughout the auto-tuning procedures. Adjustment of CPB is related to the cooling media used. For air used as a cooling media, adjust CPB to 100(%). For oil is used as a cooling media, adjust CPB to 125(%). For water used as cooling media, adjust CPB to 250(%).

DB Programming: Adjustment of DB is dependent on the system requirements. If more positive value of DB (greater dead band between heating and cooling) is used, an unwanted cooling action can be avoided but an excessive overshoot over the set point will occur. If more negative value of DB (greater overlap) is used, an excessive overshoot over the set point can be minimized but an unwanted cooling action will occur. It is adjustable in the range -36.0% to 36.0 % of PB. A negative DB value shows an overlap area over which both outputs are active. A positive DB value shows a dead band area over which neither output is active.

Output 2 ON-OFF Control (Alarm function): The output 2 can also be configured as alarm function. There are 6 kinds of alarm functions can be selected for output 2, these are: **DE.HI** (deviation high alarm), **DE.LO** (deviation low alarm), **DB.HI** (deviation band out of band alarm), **DB.LO** (deviation band in band alarm), **PV.HI** (process high alarm) and **PV.LO** (process low alarm). Refer to **Figure 3.3** and **Figure 3.4** for the description of deviation alarm and process alarm with normal alarm mode.

3-4 Alarm

There are 6 types of alarm functions and one dwell timer can be selected, and four kinds of alarm modes (ALMD) are available for each alarm function (ALFN). Besides the alarm output, the output 2 can also be configured as another alarm. But output 2 only provides 4 kinds of alarm functions and only normal alarm mode is available for this alarm.

ALARM FUNCTIONS:

A process alarm sets two absolute trigger levels. When the process is higher than SP2, a process high alarm (PV.HI) occurs, and the alarm is off as the process is lower than SP2-O2HY. When the process is lower than SP2, a process low alarm (PV.LO) occurs and the alarm is off as the process is higher than SP2+O2HY. A process alarm is independent of set point.

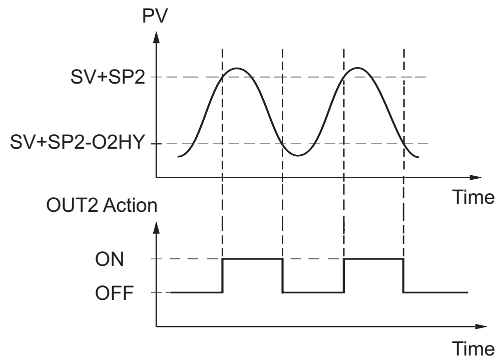


Figure 3.3 Output 2 Deviation High Alarm

A deviation alarm alerts the user when the process deviates too far from set point. When the process is higher than SV+SP2, a deviation high alarm (DE.HI) occurs and the alarm is off as the process is lower than SV+SP2-O2HY. When the process is lower than SV+SP2, a deviation low alarm (DE.LO) occurs and the alarm is off as the process is higher than SV+SP2+O2HY. Trigger level of deviation alarm is moving with set point.

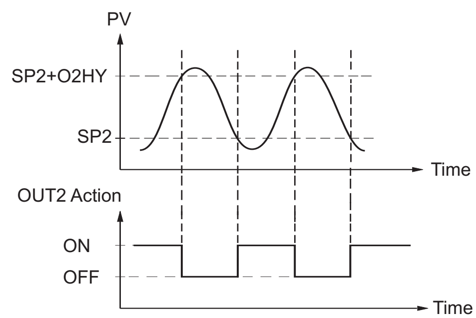


Figure 3.4 Output 2 Process Low Alarm

A deviation band alarm presets two trigger levels relative to the set point. The two trigger levels are SV+SP2 and SV - SP2 for alarm. When the process is higher than (SV+SP2) or lower than (SV - SP2), a deviation band high alarm (DB.HI) occurs. When the process is within the trigger levels, a deviation band low alarm (DB.LO) occurs.

Note: In the above descriptions; SV denotes the current set point value for control which is different from SP1 as the ramp function is performed.

There are four types of alarm modes available for each alarm function.These are: Normal alarm, Latching alarm, Holding alarm and Latching/Holding alarm. They are described as follows:

ALARM MODES:

Normal Alarm: ALMD = NORM
When a normal alarm is selected, the alarm output is de-energized in the non-alarm condition and energized in an alarm condition.

Latching Alarm: ALMD = LTCH
If a latching alarm is selected, once the alarm output is energized, it will remain unchanged even if the alarm condition is cleared. The latching alarm is reset when the RESET key is pressed, once the alarm condition is removed.

Holding Alarm: ALMD = HOLD
A holding alarm prevents or inhibits an alarm from kicking on during initial controller power up. The alarm is enabled only when the process reaches the set point

Latching / Holding Alarm: ALMD = LT.HO
A latching / holding alarm performs both holding and latching function. The latching alarm is reset when the RESET key is pressed, once the alarm condition is removed.

Alarm Failure Transfer is activated as the unit enters **failure mode**. Alarm will go on if **ON** is set for **ALFT** and go off if **OFF** is set for **ALFT**. The unit will enter failure mode when sensor break occurs or if the A-D converter of the unit fails.

SEL1~SEL8 : Selects the parameter for view and change in the user menu.
Range : LOCK, INPT, UNIT, DP, SHIF, PB, TI, TD, O1HY, CYC1, OFST, RR, O2HY, CYC2, CPB, DB, ADDR, ALHY

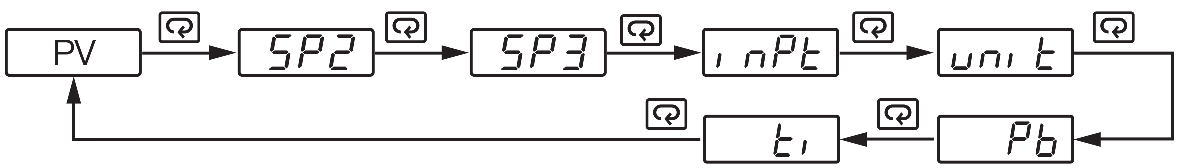
When using the up-down key to select the parameters, you may not obtain all of the above parameters. The number of visible parameters is dependent on the setup condition. The hidden parameters for the specific application are also deleted from the SEL selection.

3-5 Configure User Menu (SEL)

The units give you the flexibility to select those parameters which are most significant and move these parameters to the front of the display sequence.

Example :

OUT2 selects DE.LO PB= 100.0 SEL1 selects INPT
SEL2 selects UNIT SEL3 selects PB SEL4 selects TI
SEL5~SEL8 selects NONE Now, the upper display scrolling becomes:



3 - 6 Ramp

The ramping function is performed during power up as well as any time the set point is changed. Choose MINR (units per minute) or HRR (units per hour) for RAMP, the unit will perform the ramping function. The ramp rate is programmed by adjusting RR. The ramping function is disabled as soon as failure mode, manual control mode, the auto-tuning mode or the calibration mode is entered.

Example without Dwell Timer

Select MINR for RAMP, select °C for UNIT, select 1-DP for DP, Set RR= 10.0. SV is set to 200°C initially, and changed to 100°C 30 minutes after power up. The starting temperature is 30°C. After power up, the process runs like the curve shown below:

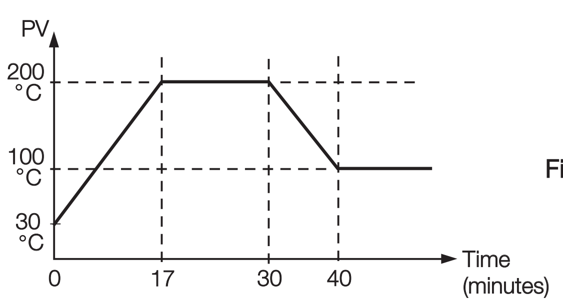


Figure 3.5 RAMP Function

Note: When the ramp function is used, the display will show the current ramping value. However it will revert to the set point value as soon as the up or down key is touched for adjustment. The ramping value is initiated to process value either as power up or RR and /or set point are changed. Setting RR to zero disables the ramp function.

3-7 Dwell Timer

Output 2 can be configured as dwell timer by selecting TIMR for OUT2. As the dwell timer is configured, the parameter SP2 is used for dwell time adjustment. The dwell time is measured in minutes, ranging from 0.1 to 4553.6 minutes. Once the process reaches the set point, the dwell timer starts to count down until zero (time out). The timer relay will remain unchanged until time out. The dwell timer operation is shown as in fig. 3.6. After time out, the dwell timer will be restarted by pressing the RESET key. The timer stops to count during the manual control mode, failure mode, calibration period and auto-tuning period.

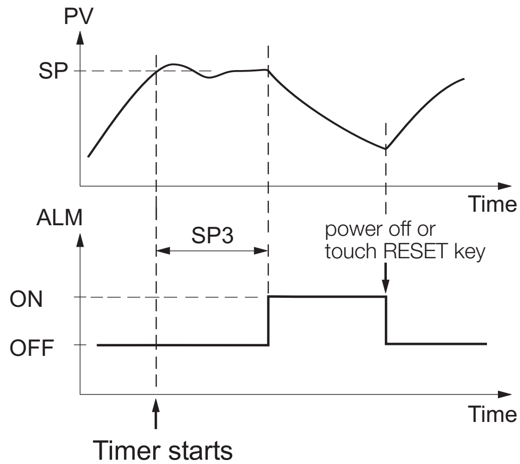


Figure 3.6
Dwell Timer Function

If output 2 is configured as dwell timer, ALHY and ALMD will be hidden.

3 - 8 PV Shift

In certain applications it is desirable to shift the controller display value from its actual value. This can be easily accomplished by using the PV shift function.

The SHIF function will alter PV only.

Here is an example. A process is equipped with a heater, a sensor and a subject to be warmed up. Due to the design and position of the components in the system, the sensor cannot be placed any closer to the part. Thermal gradient (temperature differential) is common in any thermal system when heat is transferred from one point to another. If the difference between the sensor and the subject is 35°C, and the desired temperature at the subject to be heated is 200°C, the controlling value or the temperature at the sensor should be 235°C. You should input -35 °C as to subtract 35°C from the actual process display. This in turn will cause the controller to energize the load and bring the process display up to the set point value.

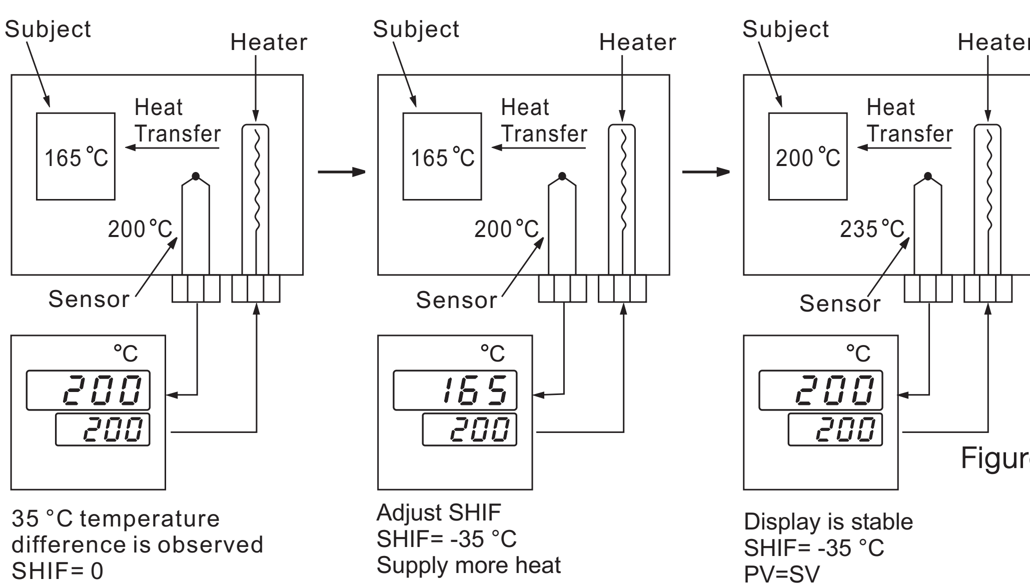


Figure 3.7 PV Shift Application

3- 9 Digital Filter

In certain applications, the process value is too unstable to be read. To improve this, a programmable low pass filter incorporated in the controller can be used. This is a first order filter, with the time constant specified by FILT parameter. The default value of FILT is 0.5 sec. before shipping. Adjust FILT to change the time constant from 0 to 60 seconds. 0 seconds represents no filter is applied to the input signal. The filter is characterized by the following diagram.

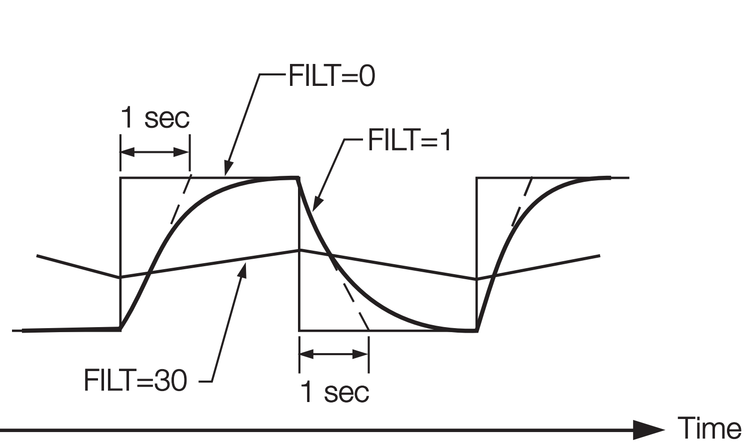


Figure 3.8
Filter Characteristics

Note:

The Filter is available only for PV, and is performed for the displayed value only. The controller is designed to use an unfiltered signal for control even if a Filter is applied. A lagged (filtered) signal, if used for control, may produce an unstable process.

3 -10 Failure Transfer

The controller will enter failure mode as one of the following conditions occurs:

1. SBER occurs due to the input sensor break or input current below 1mA, if 4-20 mA is selected or input voltage below 0.25V if 1-5 V is selected.
2. ADER occurs due to the A-D converter of the controller failing.

The output 1 and output 2 will perform the failure transfer function as the controller enters failure mode.

Output 1 Failure Transfer, if activated, will perform:

1. If output 1 is configured as proportional control (PB=∅), and BPLS is selected for O1FT, then output 1 will perform bumpless transfer. Thereafter the previous control output value (MV1) will be used for controlling output 1.
2. If output 1 is configured as proportional control (PB=∅), and a value of 0 to 100.0 % is set for O1FT, then output 1 will perform failure transfer. Thereafter the value of O1FT will be used for controlling output 1.
3. If output 1 is configured as ON-OFF control (PB=0), then output 1 will transfer to off state if OFF is set for O1FT and transfer to on state if ON is set for O1FT.

Output 2 Failure Transfer, if activated, will perform:

1. If OUT2 is configured as COOL, and BPLS is selected for O2FT, then output 2 will perform bumpless transfer. Thereafter the previous averaging value of MV2 will be used for controlling output 2.
2. If OUT2 is configured as COOL, and a value of 0 to 100.0% is set for O2FT, then output 2 will perform failure transfer. Thereafter the value of O2FT will be used for controlling output 2.
3. If OUT2 is configured as alarm function, and OFF is set for O2FT, then output 2 will transfer to off state, otherwise, output 2 will transfer to on state if ON is set for O2FT.

Alarm Failure Transfer is activated as the controller enters failure mode. Thereafter the alarm will transfer to the ON or OFF state which is determined by the set value of ALFT.

3 -11 Auto-tuning

⚠ The auto-tuning process is performed at set point.
The process will oscillate around the set point during the tuning process. Set a set point to a lower value if overshooting beyond the normal process value set point is likely to cause damage.

The auto-tuning is applied in the following cases:

* Initial setup for a new process
* When set point is changed substantially from the previous auto- tuning value
* When control result is unsatisfactory

Operation:

1. The system has been installed normally.
2. Set the correct values for the setup menu of the unit. Don not use a zero value for PB and TI , otherwise, the auto-tuning program will be disabled. The LOCK parameter should be set at NONE.
3. Set the set point to a normal operating value or a lower value if overshooting beyond the normal process value is likely to cause damage.
4. Press [⟲] several times until [A-t] appears on the display.
5. Press [⟲] for at least 3 seconds. The display will begin to flash and the auto-tuning procedure will begin.

NOTE :

The ramping function, if used, will be disabled once auto-tuning is initiated.

The auto-tuning mode is disabled as soon as either failure mode or manual control mode occurs.

Procedures:

The auto-tuning can be applied either as the process is warming up (Cold Start) or as the process has been in steady state (Warm Start).

After the auto-tuning procedure is complete, the AT indicator will cease to flash and the unit will revert to PID control by using its new PID values. The PID values obtained are stored in the nonvolatile memory.

[AtEr] Auto-Tuning Error

If auto-tuning fails, an ATER message will appear on the display if:

- PB exceeds 9000 (9000 PU, 900.0°F or 500.0°C).
- or TI exceeds 1000 seconds.
- or set point is changed during auto-tuning procedure.

Solutions to [AtEr]

1. Try auto-tuning once again.
2. Do not change the set point value during auto-tuning procedure.
3. Do not set zero value for PB and TI.
4. Use manual tuning instead of auto-tuning. (See section 3-12).
5. Touch RESET key ([▲] or [▼]) to reset [AtEr] message.

3 - 12 Manual Tuning

In certain applications (very few) using auto-tuning to tune a process may be inadequate for the control requirement. Manual tuning is the option in such cases..

If the control performance by using auto- tuning is still unsatisfactory, the following rules can be applied for further adjustment of PID values :

ADJUSTMENT SEQUENCE	SYMPTOM	SOLUTION
(1) Proportional Band (PB)	Slow Response	Decrease PB
	High overshoot or Oscillations	Increase PB
(2) Integral Time (TI)	Slow Response	Decrease TI
	Instability or Oscillations	Increase TI
(3) Derivative Time (TD)	Slow Response or Oscillations	Decrease TD
	High Overshoot	Increase TD

Table 3.2 PID Adjustment Guide

Operation:

To enable manual control, set the LOCK parameter to NONE, press [↻] several times, then [H _ _ _] (Heating output) or [C _ _ _] (Cooling output) will appear on the display. Press [↻] for 3 seconds. The display will begin to flash. The controller will enter the manual control mode. [H _ _ _] indicates output control variable for output 1, and [C _ _ _] indicates control variable for output 2. Use the up-down key to adjust the percentage values for the heating or cooling output.

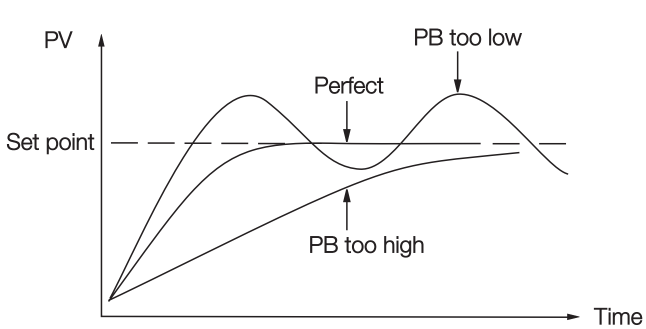
The controller will perform open loop control as long as it stays in manual control mode.

Exit Manual Control

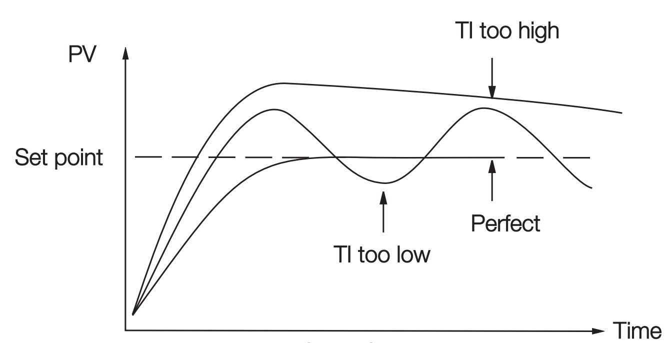
Press the [R] keys and the controller will revert to normal display mode.

3 -13 Manual Control

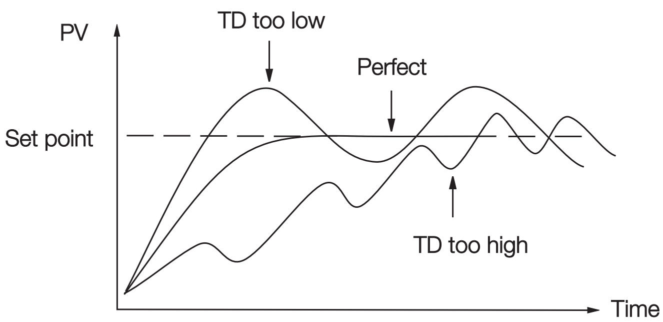
Figure 3.9 shows the effects of PID adjustment on process response.



P action



I action



D action

Figure 3.9 Continued
Effects of PID Adjustment

3-14 Data Communication

The controllers support RTU mode of Modbus protocol for the data communication. Other protocols are not available for this series.

Two types of interfaces are available for Data Communication. These are RS-485 and RS-232 interface. Since RS-485 uses a differential architecture to drive and sense signal instead of a single-ended architecture which is used for RS-232, RS-485 is less sensitive to the noise and suitable for a longer distance communication. RS-485 can communicate without error over 1 km distance while RS-232 is not recommended for a distance over 20 meters.

Using a PC for data communication is the most economical way. The signal is transmitted and received through the PC communication Port (generally RS-232). Since a standard PC can't support RS-485 port, a network adaptor (such as SNA10A, SNA10B) has to be used to convert RS-485 to RS-232 for a PC if RS-485 is required for the data communication. Many RS-485 units (up to 247 units) can be connected to one RS-232 port, therefore a PC outfitted with 4 comm ports can communicate with up to 988 units. Communications encompass a large scope of applications from single point interface through hundreds of controls to historical trending through endless zones. ETR communications provide for a very powerful and economic solution.

Setup

Enter the setup menu.
Select RTU for COMM. Set individual addresses for each unit which is connected to the same port.
Set the Baud Rate (BAUD), Data Bit (DATA), Parity Bit (PARI) and Stop Bit (STOP) such that these values are in accordance with PC setup conditions.

If you use a conventional 9-pin RS-232 cable instead of CC94-1, the cable should be modified for proper operation of RS-232 communication according to Section 2-9.

Please see Chapter 7 for more detailed information.

3 -15 PV Retransmission

The controller can output (retransmit) process value via its retransmission terminals RE+ and RE- provided that the retransmission option is ordered. A correct signal type should be selected for COMM parameter to meet the retransmission option installed. RELO and REHI are adjusted to specify the low scale and high scale values of retransmission.

Chapter 4 Applications

4-1 Heat Only Control with Dwell Timer

An oven is designed to dry products at 150 degrees C for 30 minutes and then stay unpowered until the next batch is ready for baking. An ETR-8100 equipped with a dwell timer is used for this purpose. A single phase system diagram is shown as follows :

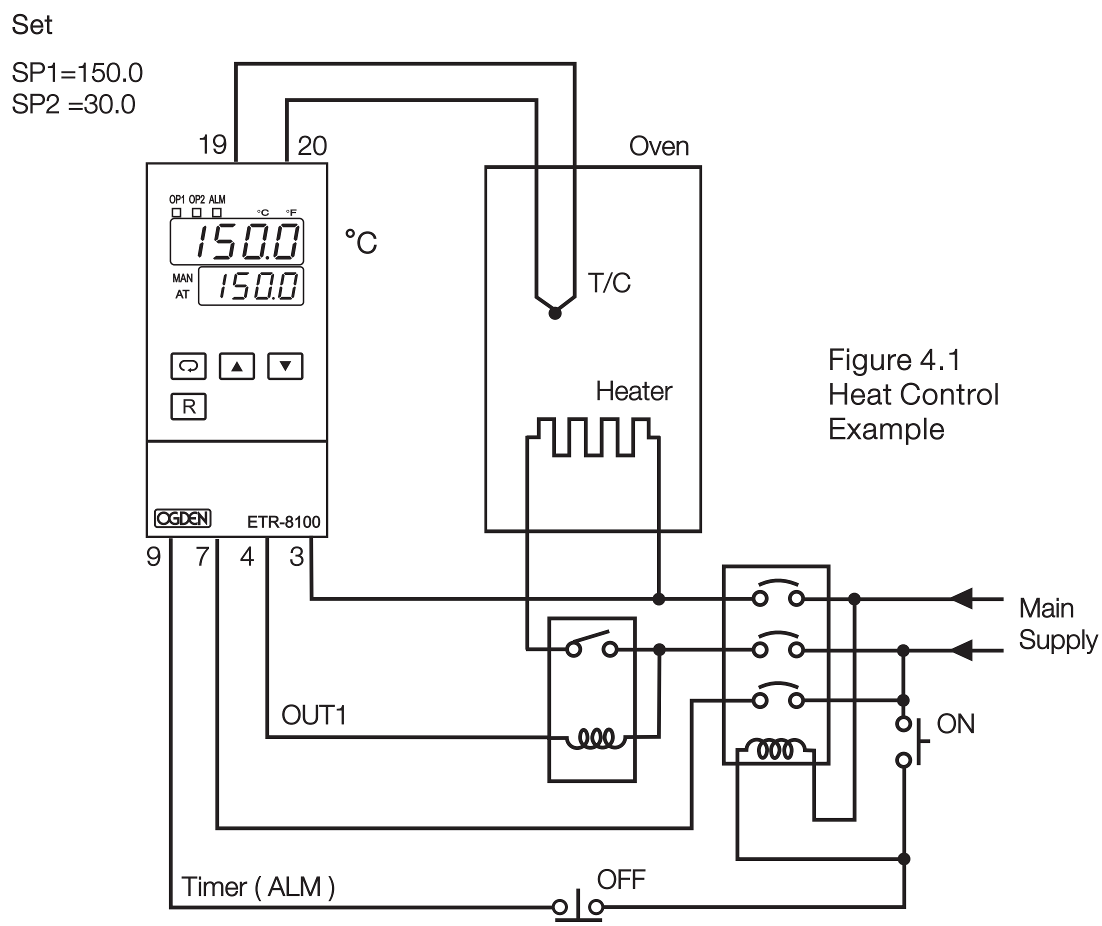


Figure 4.1
Heat Control
Example

To achieve this function set the following parameters in the setup menu.

INPT=K_TC	UNIT= °C	DP=1_DP
OUT1=REVR	O1TY=RELY	CYC1=18.0
O1FT=BPLS	OUT2=TIMR	O2FT=ON

Auto-Tuning is performed at 150 °C for this new oven.

4-2 Cool Only Control

An ETR-8100 is used to control the temperature of a refrigerator below 0°C. The temperature is lower than the ambient, therefore a cooling action is required. Select DIRT for OUT1. Since output 1 is used to drive a magnetic contactor, O1TY should be set to RELY. A small temperature oscillation is tolerable, hence use ON-OFF control to reduce wear and tear on the mechanical parts and resulting over-all cost. To achieve ON-OFF control, the PB is set to zero and O1HY is set at 0.1°C.

Setup Summary:

INPT=PT.DN
UNIT= °C
DP=1-DP
OUT1=DIRT
O1TY=RELY

User Menu:

PB = 0 (°C)
O1HY=0.1 (°C)

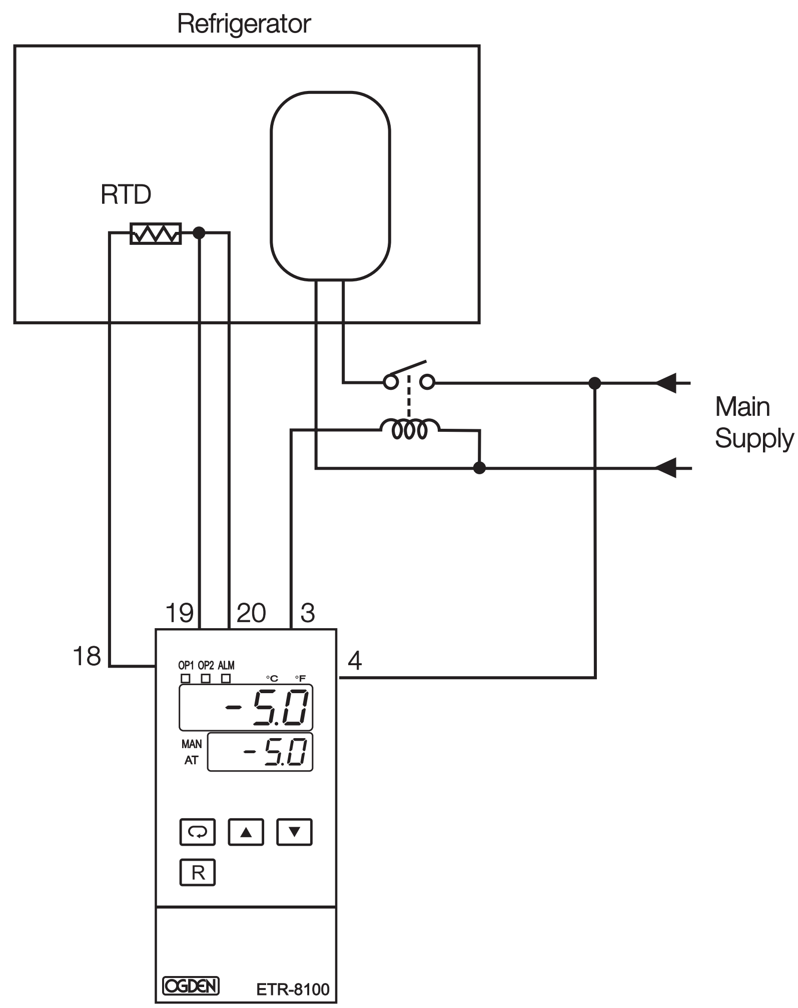


Figure 4.2 Cooling Control Example

4-3 Heat-Cool Control

An injection mold is required to be controlled at 120 °C to ensure a consistent quality for the parts. An oil pipe is buried in the mold. Since plastics are injected at higher temperatures (e.g. 250 °C), the circulation oil needs to be cooled as its temperature rises. Here is an example:

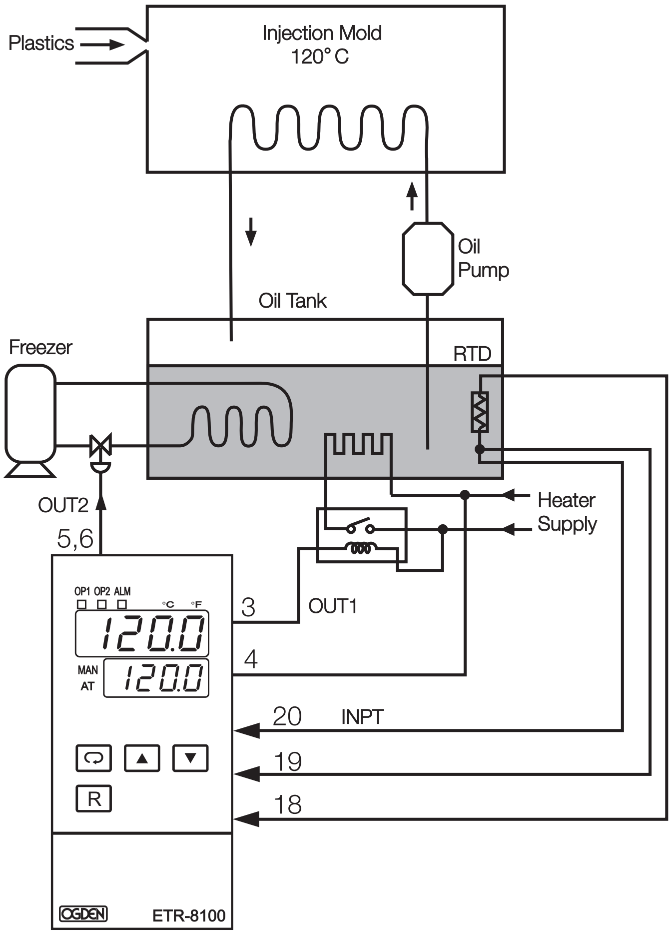


Figure 4.3
Heat-Cool Control Example

The PID Heat-Cool is used for the above example. In order to achieve this, set the following parameters in the Setup Menu:

INPT=PT.DN
UNIT= °C
DP= 1-DP
OUT1=REVR
O1TY=RELY
CYC1=18.0 (sec)
O1FT=BPLS
OUT2=COOL
O2TY=4-20
O2FT=BPLS

Adjust SV at 120.0°C , CPB at 125 (%) and DB at -4.0 (%).

Apply Auto-tuning at 120 °C for a new system to get an optimal PID values. See Section 3-11.

Adjustment of CPB is related to the cooling media used. If water is used as cooling media instead of oil, the CPB is set at 250 (%). If air is used as cooling media instead of oil, the CPB is set at 100 (%).
Adjustment of DB is dependent on the system requirements. More positive value of DB will prevent unwanted cooling action, but will increase the temperature overshoot, while more negative value of DB will achieve less temperature overshoot, but will increase unwanted cooling action.

Chapter 5 Calibration

⚠ Do not proceed through this section unless there is a definite need to re-calibrate the controller. Otherwise, all previous calibration data will be lost. Do not attempt recalibration unless you have appropriate calibration equipment. If calibration data is lost, you will need to return the controller to your supplier who may charge you a service fee to re-calibrate the controller.

⚠ Entering calibration mode will break the control loop. Make sure that if the system is allowable to apply calibration mode.

Equipment needed before calibration:

(1) A high accuracy calibrator maintained at NIST standards (Fluke 5520A Calibrator recommended) with following functions:
0 - 100 mV millivolt source with ±0.005 % accuracy
0 - 10 V voltage source with ±0.005 % accuracy
0 - 20 mA current source with ±0.005 % accuracy
0 - 300 ohm resistant source with ±0.005 % accuracy
(2) A test chamber providing 25 °C - 50 °C temperature range
(3) A switching network (SWU16K, optional for automatic calibration)
(4) A calibration fixture equipped with programming units (optional for automatic calibration)
(5) A PC installed with calibration software ETR -Net and Smart Network Adaptor SNA10B (optional for automatic calibration)

Since the controller needs 30 minutes to warm up aunit before calibration, calibrating the unit one by one is quite inefficient. An automatic calibration system for numerous quantities is available upon request.

Manual Calibration

* Perform step 1 to enter calibration mode.

Step 1. Set the Lock parameter to the unlocked condition (LOCK=NONE).
Press and hold the scroll key until [CALI] appears on the display, then release the scroll key.
Press the scroll key for 2 seconds then release, the display will show [AdLo] and the unit enters calibration mode .

* Perform step 2 to calibrate Zero of A to D converter and step 3 to calibrate gain of A to D converter.

Step 2. Short the thermocouple inpt terminals , then press scroll key for at least 3 seconds. The display will blink a moment and a new value is obtained. Otherwise, if the display didn't blink or if the obtained value is equal to -199.9 or 199.9, then the calibration fails.

Step 3. Press scroll key until the display shows [AdHi]. Send a 60mV signal to the thermocouple input terminals in correct polarity . Press scroll key for at least 3 seconds . The display will blink a moment and a new value is obtained . Otherwise , if the display didn't blink or if the obtained value is equal to -199.9 or 199.9, then the calibration fails.

* Perform both steps 4 and 5 to calibrate RTD function (if required) for input.

Step 4. Press scroll key until the display shows [rtd.L]. Send a 100 ohms signal to the RTD input terminals according to the connection shown below:

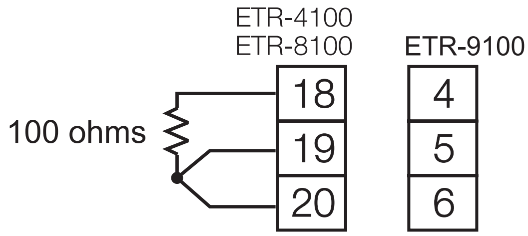


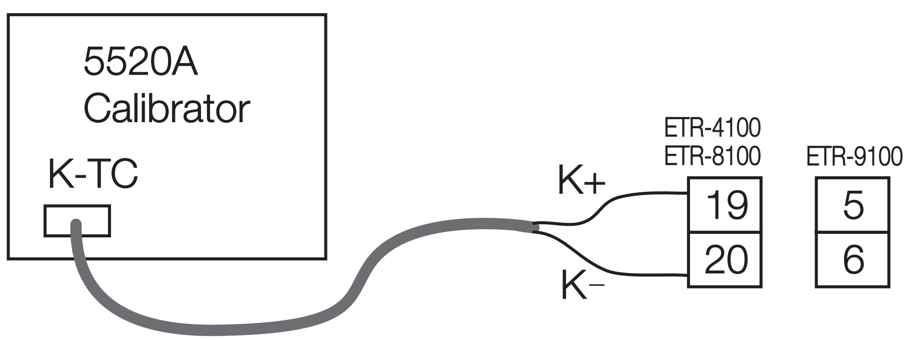
Figure 5.1 RTD Calibration

Press scroll key for at least 3 seconds. The display will blink a moment, otherwise the calibration fails.

Step 5. Press scroll key and the display will show [rtd.H]. Change the ohm's value to 300 ohms .Press scroll key for at least 3 seconds. The display will blink a moment and two values are obtained for RTDH and RTDL (step 4). Otherwise, if the display didn't blink or if any value obtained for RTDH and RTDL is equal to -199.9 or 199.9 , then the calibration fails.

* Perform step 6 to calibrate offset of cold junction compensation, if required.

Step 6. Setup the equipments according to the following diagram for calibrating the cold junction compensation. Note that a K type thermocouple must be used.



Stay at least 20 minutes in still-air room
room temperature 25 ± 3 °C

Figure 5.2
Cold Junction Calibration Setup

The 5520A calibrator is configured as K type thermocouple output with internal compensation. Send a 0.00°C signal to the unit under calibration.

The unit under calibration is powered in a still-air room with temperature 25±3 °C. Stay at least 20 minutes for warming up. Perform step 1 stated above, then press scroll key until the display shows [CJ.Lo]. Press up/down key to obtain 40.00. Press scroll key for at least 3 seconds. The display will blink a moment and a new value is obtained. Otherwise, if the display didn't blink or if the obtained value is equal to -5.00 or 40.00, then the calibration fails.

* Perform step 7 to calibrate gain of cold junction compensation, if required.

Step 7. Setup the equipments like step 6. The unit under calibration is powered in a still-air room with temperature 50 ±3°C. Wait at least 20 minutes for warming up . The calibrator source is set at 0.00°C with internal compensation mode.

Perform step 1 stated earlier, then press scroll key until the display shows CJ.Hi. Press scroll key for at least 3 seconds. The display will blink a moment and a new value is obtained. Otherwise , if the display didn't blink or if the obtained value is equal to -199.9 or 199.9, then the calibration fails.

This setup is performed in a high temperature chamber, hence it is recommended to use a computer to perform the procedures.

* Input modification and recalibration procedures for a linear voltage or a linear current input:

1. Remove R60(3.3K) and install two 1/4 W resistors RA and RB on the control board with the recommended values specified in the following table.

The low temperature coefficient resistors should be used for RA and RB.

Input Function	RA	RB	R60
T/C, RTD, 0~60mV	X	X	3.3K
0 ~ 1 V	61.9K	3.92K	X
0 ~ 5V, 1 ~ 5V	324K	3.92K	X
0 ~ 10 V	649K	3.92K	X
0~20mA, 4~20mA	39Ω	3.01Ω	X

2. Perform Step 1 and Step 2 to calibrate the linear input zero.

3. Perform Step 3 but send a span signal to the input terminals instead of 60mV. The span signal is 1V for 0~1V input, 5V for 0~5V or 1~5V input, 10V for 0~10V input and 20mA for 0~20mA or 4~20mA input.

* Final step

Step 8. Set the LOCK value to your desired function.

Chapter 6 Specifications

Power

90 ~ 250 VAC, 47 ~ 63 Hz, 10VA, 5W maximum
11 ~ 26 VAC / VDC, 10VA, 5W maximum

Input

Resolution: 18 bits
Sampling Rate: 5 times / second
Maximum Rating: -2 VDC minimum, 12 VDC maximum (1 minute for mA input)
Temperature Effect: ±1.5uV/ °C for all inputs except mA input
±3.0uV/ °C for mA input
Sensor Lead Resistance Effect:
T/C: 0.2uV/ohm
3-wire RTD: 2.6 °C/ohm of resistance difference of two leads
2-wire RTD: 2.6 °C/ohm of resistance sum of two leads 200 nA
Common Mode Rejection Ratio (CMRR): 120dB

Burn-out Current :

Normal Mode Rejection Ratio (NMRR): 55dB

Sensor Break Detection:

Sensor open for TC, RTD and mV inputs,
Sensor short for RTD input
below 1 mA for 4-20 mA input,
below 0.25V for 1 - 5 V input,
unavailable for other inputs.

Sensor Break Responding Time :

Within 4 seconds for TC, RTD and mV inputs, 0.1 second for 4-20 mA and 1 - 5 V inputs.

Characteristics:

Type	Range	Accuracy @ 25 VC	Input Impedance
J	-120°C~1000°C (-184°F~1832°F)	±2°C	2.2 MΩ
K	-200°C~1370°C (-328°F~2498°F)	±2°C	2.2 MΩ
T	-250°C~400°C (-418°F~752°F)	±2°C	2.2 MΩ
E	-100°C~900°C (-148°F~1652°F)	±2°C	2.2 MΩ
B	0°C~1800°C (32°F~3272°F)	(±200°C~1800°C)	2.2 MΩ
R	0°C~1767.8°C (32°F~3214°F)	±2°C	2.2 MΩ
S	0°C~1767.8°C (32°F~3214°F)	±2°C	2.2 MΩ
N	-250°C~1300°C (-418°F~2372°F)	±2°C	2.2 MΩ
L	-200°C~90°C (-328°F~1652°F)	±2°C	2.2 MΩ
PT100 (DIN)	-210°C~700°C (-346°F~1292°F)	±0.4°C	1.3 KΩ
PT100 (JIS)	-200°C~600°C (-328°F~1112°F)	±0.4°C	1.3 KΩ
mV	-8mV~70mV	±0.05%	1.3 KΩ
mA	-3mA~27mA	±0.05%	70.5Ω
V	-1.3V~11.5V	±0.05%	650 KΩ

Output 1 / Output 2

Relay Rating: 2A/240 VAC, life cycles 200,000 for resistive load
Pulsed Voltage: Source Voltage 5V, current limiting resistance 66. Ω

Linear Output Characteristics

Type	Zero Tolerance	Span Tolerance	Load Capacity
4~20 mA	3.6~4 mA	20~21 mA	500Ω max.
0~20 mA	0 mA	20~21 mA	500Ω max.
0 ~ 5 V	0 V	5 ~ 5.25 V	10 KΩ min.
1 ~ 5 V	0.9 ~ 1 V	5 ~ 5.25 V	10 KΩ min.
0 ~ 10 V	0 V	10 ~10.5 V	10 KΩ min.

Linear Output

Resolution: 15 bits

Output Regulation: 0.02% for full load change
Output Settling Time: 0.1 sec. (Stable to 99.9%)
Isolation Breakdown Voltage: 1000 VAC
Temperature Effect: ±0.01% of SPAN / °C

Triac (SSR) Output

Rating: 1A / 240 VAC
Inrush Current: 20A for 1 cycle
Min. Load Current: 50 mA rms
Max. Off-state Leakage: 3 mA rms
Max. On-state Voltage: 1.5 V rms
Insulation Resistance: 1000 Mohms min. at 500 VDC
Dielectric Strength: 2500 VAC for 1 minute

DC Voltage Supply Characteristics (Installed at Output 2)

Type	Tolerance	Max. Output Current	Ripple Voltage	Isolation Barrier
20 V	±1 V	25 mA	0.2 Vp-p	500 VAC
12 V	±0.6 V	40 mA	0.1 Vp-p	500 VAC
5 V	±0.25 V	80 mA	0.05 Vp-p	500 VAC

Alarm Relay: Form C Rating
2A/240VAC, Life cycles 200,000 for resistive load
Alarm Functions: Dwell timer,
Deviation High / Low Alarm,
Deviation Band High / Low Alarm,
PV High / Low Alarm,
PID cooling control
Alarm Mode: Normal, Latching, Hold, Latching / Hold.
Dwell Timer: 0.1 - 4553.6 minutes

Data Communication

Interface: RS-232 (1 unit), RS-485 (up to 247 units)
Protocol: Modbus Protocol RTU mode
Address: 1 - 247
Baud Rate: 2.4 ~ 38.4 Kbits/sec
Data Bits: 7 or 8 bits
Parity Bit: None, Even or Odd
Stop Bit: 1 or 2 bits
Communication Buffer: 160 bytes

Analog Retransmission

Output Signal: 4-20 mA, 0-20 mA, 0 - 5V, 1 - 5V, 0 - 10V
Resolution: 15 bits
Accuracy: ±0.05% of span ±0.0025%/°C
Load Resistance:
0 - 500 ohms (for current output)
10 K ohms minimum (for voltage output)
Output Regulation: 0.01% for full load change

User Interface

Single 4-digit LED Display
Keypad: 3 keys
Programming Port: For automatic setup, calibration and testing
Communication Port: Connection to PC for supervisory control

Control Mode

Output 1: Reverse (heating) or direct (cooling) action
Output 2: PID cooling control, cooling P band 50~300% of PB, dead band -36.0 ~ 36.0 % of PB
ON-OFF: 0.1 - 90.0 (°F) hysteresis control (P band = 0)
P or PD: 0 - 100.0 % offset adjustment
PID: Fuzzy logic modified
Proportional band 0.1 ~ 900.0°F.
Integral time 0 - 1000 seconds
Derivative time 0 - 360.0 seconds
Cycle Time: 0.1 - 90.0 seconds
Manual Control: Heat (MV1) and Cool (MV2)
Auto-tuning: Cold start and warm start
Failure Mode: Auto-transfer to manual mode while sensor break or A-D converter damage
Ramping Control: 0 - 900.0°F/minute or 0 - 900.0°F/hour ramp rate

Digital Filter

Function: First order
Time Constant: 0, 0.2, 0.5, 1, 2, 5, 10, 20, 30, 60 seconds programmable

Environmental & Physical

Operating Temperature : -10 °C to 50 °C
Storage Temperature : -40 °C to 60 °C
Humidity : 0 to 90 % RH (non-condensing)
Altitude: 2000m maximum
Pollution: Degree 2
Insulation Resistance : 20 Mohms min. (at 500 VDC)
Dielectric Strength : 2000 VAC, 50/60 Hz for 1 minute
Vibration Resistance : 10 - 55 Hz, 10 m/s^2 for 2 hours
Shock Resistance : 200 m/s^2 (20 g)
Moldings : Flame retardant polycarbonate
Dimensions :
ETR-4100-----96mm(W) X 96mm(H) X 65mm(D),
53 mm depth behind panel
ETR-8100-----48mm(W) X 96mm(H) X 80mm(D),
65 mm depth behind panel
ETR-9100-----48mm(W) X 48mm(H) X 116mm(D),
105 mm depth behind panel
Weight : ETR-4100----- 250 grams
ETR-8100----- 210 grams
ETR-9100----- 150 grams

Approval Standards

Safety: UL61010C-1, EN61010-1 (IEC1010-1)
Protective Class:
IP65 for panel with additional option
IP50 for panel without additional option
IP20 for terminals and housing with protective cover.
All indoor use.

EMC: CE En61326

Chapter 7 Modbus Communications

7-1 Functions Supported

Only function 03, 06 and 16 are available for this series of controllers. The message formats for each function are described as follows:

Function 03: Read Holding Registers

Query (from master)	Response (from slave)
Slave address (0-255)	←
Function code (3)	←
Starting address of register Hi (0)	Byte count
Starting address of register Lo (0-79)	Data 1 Hi
No. of words Hi (0)	Data 1 Lo
No. of words Lo (1-79)	Data 2 Hi
CRC16 Hi	Data 2 Lo
CRC16 Lo	⋮
	CRC16 Hi
	CRC16 Lo

Function 06: Preset single Register

Query (from master)	Response (from slave)
Slave address (0-255)	←
Function code (6)	←
Register address Hi (0)	←
Register address Lo (0-79, 128-131)	←
Data Hi	←
Data Lo	←
CRC16 Hi	←
CRC16 Lo	←

Function 16: Preset Multiple Registers

Query (from master)	Response (from slave)
Slave address (0-255)	←
Function code (16)	←
Starting address of register Hi (0)	←
Starting address of register Lo (0-79, 128-131)	←
No. of words Hi (0)	←
No. of words Lo (1-79)	←
Byte count (2-158)	CRC16 Hi
Data 1 Hi	CRC16 Lo
Data 1 Lo	
Data 2 Hi	
Data 2 Lo	
⋮	
CRC16 Hi	
CRC16 Lo	

7-2 Exception Responses

If the controller receives a message which contains a corrupted character (parity check error, framing error etc.), or if the CRC16 check fails, the controller ignores the message. However, if the controller receives a syntactically correct message which contains an illegal value, it will send an exception response, consisting of five bytes as follows:

slave address +offset function code + exception code + CRC16 Hi + CRC16 Lo

Where the offset function code is obtained by adding the function code with 128 (ie. function 3 becomes H'83), and the exception code is equal to the value contained in the following table:

Exception Code	Name	Cause
1	Bad function code	Function code is not supported by the controller
2	Illegal data address	Register address out of range
3	Illegal data value	Data value out of range or attempt to write a read-only or protected data

7-3 Parameter Table

Register Address	Parameter Notation	Parameter	Scale Low	Scale High	Notes
0	SP1	Set point 1	*4	*4	R/W
1	SP2	Set point 2	*7	*7	R/W
2	SP3	Set point 3	*6	*6	R/W
3	LOCK	Lock code	0	65535	R/W
4	INPT	Input sensor selection	0	65535	R/W
5	UNIT	Measuring unit	0	65535	R/W
6	DP	Decimal point position	0	65535	R/W
7	INLO	Low scale value for linear input	*4	*4	R/W
8	INHI	High scale value for linear input	*4	*4	R/W
9	SP1L	Low limit of SP1	*4	*4	R/W
10	SP1H	High limit of SP1	*4	*4	R/W
11	SHIF	PV shift value	*4	*4	R/W
12	FILT	Filter time constant	0	65535	R/W
13	DISP	Display form (for C21)	0	65535	R/W
14	PB	P (proportional) band	*5	*5	R/W
15	TI	Integral time	0	65535	R/W
16	TD	Derivative time	0.0	6553.5	R/W
17	OUT1	Output 1 function	0	65535	R/W
18	O1TY	Output 1 signal type	0	65535	R/W
19	O1FT	Output 1 failure transfer	-1999.9	4553.6	R/W
20	O1HY	Output 1 ON-OFF hysteresis	*5	*5	R/W
21	CYC1	Output 1 cycle time	0.0	6553.5	R/W
22	OFST	Offset value for P control	0.0	6553.5	R/W
23	RAMP	Ramp function	0	65535	R/W
24	RR	Ramp rate	*5	*5	R/W
25	OUT2	Output 2 function	0	65535	R/W
26	RELO	Retransmission low scale value	*4	*4	R/W
27	O2TY	Output 2 signal type	0	65535	R/W
28	O2FT	Output 2 failure transfer	-1999.9	4553.6	R/W
29	O2HY	Output 2 ON-OFF hysteresis	*5	*5	R/W

Register Address	Parameter Notation	Parameter	Scale Low	Scale High	Notes
30	CYC2	Output 2 cycle time	0.0	6553.5	R/W
31	CPB	Cooling P band	0	65535	R/W
32	DB	Heating-cooling dead band	-1999.9	4553.6	R/W
33	ALFN	Alarm function	0	65535	R/W
34	REHI	Retransmission high scale value	*4	*4	R/W
35	ALMD	Alarm opertion mode	0	65535	R/W
36	ALHY	Alarm hysteresis	*5	*5	R/W
37	ALFT	Alarm failure transfer	0	65535	R/W
38	COMM	Communication function	0	65535	R/W
39	ADDR	Address	0	65535	R/W
40	BAUD	Baud rate	0	65535	R/W
41	DATA	Data bit count	0	65535	R/W
42	PARI	Parity bit	0	65535	R/W
43	STOP	Stop bit count	0	65535	R/W
44	SEL1	Selection 1	0	65535	R/W
45	SEL2	Selection 2	0	65535	R/W
46	SEL3	Selection 3	0	65535	R/W
47	SEL4	Selection 4	0	65535	R/W
48	SEL5	Selection 5	0	65535	R/W
49	SEL6	Selection 6	0	65535	R/W
50	SEL7	Selection 7	0	65535	R/W
51	SEL8	Selection 8	0	65535	R/W
52	ADLO	mV calibration low coefficient	-1999.9	4553.6	R/W
53	ADHI	mV calibration high coefficient	-1999.9	4553.6	R/W
54	RTDL	RTD calibration low coefficient	-1999.9	4553.6	R/W
55	RTDH	RTD calibration high coefficient	-1999.9	4553.6	R/W
56	CJLO	Cold junction calibration low coefficient	-199.99	455.36	R/W
57	CJHI	Cold junction calibration high coefficient	-1999.9	4553.6	R/W
58	DATE	Date Code	0	65535	R/W
59	SRNO	Serial Number	0	65535	R/W
60	HOUR	Working hours of the controller	0	65535	R/W

Register Address	Parameter Notation	Parameter	Scale Low	Scale High	Notes
61	BPL1	Bumpless transfer of OP1	0.00	655.35	R
62	BPL2	Bumpless transfer of OP2	0.00	655.35	R
63	CJCL	Cold junction signal low	0.000	65.535	R
64, 128	PV	Process value	*4	*4	R
65, 129	SV	Current set point value	*4	*4	R
66 130	MV1	OP1 control output value	0.00	655.35	Read only, unless in manual control
67 131	MV2	OP2 control output value	0.00	655.35	Read only, unless in manual control
68	TIMER	Remaining time of dwell timer	-1999.9	4553.6	R
69	EROR	Error code *1	0	65535	R
70	MODE	Operation mode & alarm status *2	0	65535	R
71, 140	PROG	Program code *3	0.00	655.35	R
72	CMND	Command code	0	65535	R/W
73	JOB1	Job code	0	65535	R/W
74	JOB2	Job code	0	65535	R/W
75	JOB3	Job code	0	65535	R/W
76	CJCT	Cold Junction Temperature	-199.99	455.36	R
77		Reserved	0	65535	R
78		Reserved	0	65535	R
79		Reserved	0	65535	R

*1: The error code is show in the first column of Table A.1.

*2: Definition for the value of MODE register

H'000X = Normal mode
H'010X = Calibration mode
H'020X = Auto-tuning mode
H'030X = Manual control mode
H'040X = Failure mode

H'0X00 = Alarm status is off
H'0x01 = Alarm status is on

The alarm status is shown in MV2 instead of MODE for models C21 and C91.

*3: The PROG Code is defined in the following table:

Model No.	ETR-9100	ETR-8100	ETR-4100	C21	C91
PROG Code	6.XX	11.XX	12.XX	33.XX	34.XX

Where XX denotes the software version number. For example: PROG=34.18 means that the controller is C91 with software version 18.

*4: The scale high/low values are defined in the following table for SP1, INLO, INHI, SP1L, SP1H, SHIF, PV, SV, RELO and REHI:

Conditions	Non-linear input	Linear input DP = 0	Linear input DP = 1	Linear input DP = 2	Linear input DP = 3
Scale low	-1999.9	-19999	-1999.9	-199.99	-19.999
Scale high	4553.6	45536	4553.6	455.36	45.536

*5: The scale high/low values are defined in the following table for PB, O1HY, RR, O2HY and ALHY:

Conditions	Non-linear input	Linear input DP = 0	Linear input DP = 1	Linear input DP = 2	Linear input DP = 3
Scale low	0.0	0	0.0	0.00	0.000
Scale high	6553.5	65535	6553.5	655.35	65.535

*6: The scale high/low values are defined in the following table for Sp3:

Conditions	ALFN=1 (TIMR)	Non-linear input	Linear input DP = 0	Linear input DP = 1	Linear input DP = 2	Linear input DP = 3
Scale low	-1999.9	-1999.9	-19999	-1999.9	-199.99	-19.999
Scale high	4553.6	4553.6	45536	4553.6	455.36	45.536

*7: The scale high/low values are defined in the following table for SP2:
For C21 and C91.

Conditions	OUT2=1 (TIMR)	Non-linear input	Linear input DP = 0	Linear input DP = 1	Linear input DP = 2	Linear input DP = 3
Scale low	-1999.9	-1999.9	-19999	-1999.9	-199.99	-19.999
Scale high	4553.6	4553.6	45536	4553.6	455.36	45.536

For ETR-9100, ETR-8100 and ETR-4100

Conditions	Non-linear input	Linear input DP = 0	Linear input DP = 1	Linear input DP = 2	Linear input DP = 3
Scale low	-1999.9	-19999	-1999.9	-199.99	-19.999
Scale high	4553.6	45536	4553.6	455.36	45.536

7-4 Data Conversion

The word data are regarded as unsigned (positive) data in the Modbus message. However, the actual value of the parameter may be negative value with decimal point. The high/low scale values for each parameter are used for the purpose of such conversion.

Let M = Value of Modbus message
A = Actual value of the parameter
SL = Scale low value of the parameter
SH = Scale high value of the parameter

The conversion formulas are as follows:

$$M = \frac{65535}{SH-SL} \cdot (A - SL)$$

$$A = \frac{SH-SL}{65535} \cdot M + SL$$

7-5 Communication Examples :

Example 1: Down load the default values via the programming port

The programming port can perform Modbus communications regardless of the incorrect setup values of address, baud, parity, stop bit etc. It is especially useful during the first time configuration for the controller. The host must be set with 9600 baud rate, 8 data bits, even parity and 1 stop bit.

The Modbus message frame with hexadecimal values is shown as follows:

01	10	00	00	00	34	68	4F	19	4E	83	4E	83
Addr.	Func.	Starting Addr.		No. of words		Bytes	SP1=25.0		SP2=10.0		SP3=10.0	

00	00	00	01	00	00	00	01	4D	6D	51	C4
LOCK=0		INPT=1		UNIT=0		DP=1		INLO=-17.8		INHI=93.3	

4D	6D	63	21	4E	1F	00	02	00	00	00	64
SP1L=-17.8		SP1H=537.8		SHIF=0.0		FILT=2		DISP=0		PB=10.0	

00	64	00	FA	00	00	00	00	4E	1F	00	01
TI=100		TD=25.0		OUT1=0		O1TY=0		O1FT=0		O1HY=0.1	

00	B4	00	FA	00	00	00	00	00	02	4E	1F
CYC1=18.0		OFST=25.0		RAMP=0		RR=0.0		OUT2=2		RELO=0.0	

00	00	4E	1F	00	01	00	B4	00	64	4E	1F
O2TY=0		O2FT=0		O2HY=0.1		CYC2=18.0		CPB=100		DB=0	

00	02	52	07	00	00	00	01	00	00	00	01
ALFN=2		REHI=100.0		ALMD=0		ALHY=0.1		ALFT=0		COMM=1	

00	01	00	02	00	01	00	00	00	00	00	02
ADDR=1		BAUD=2		DATA=1		PARI=0		STOP=0		SEL1=2	

00	03	00	04	00	06	00	07	00	08	00	0A
SEL2=3		SEL3=4		SEL4=6		SEL5=7		SEL6=8		SEL7=10	

00	11	Hi	Lo
SEL8=17		CRC16	

Example 2: Read PV, SV, MV1 and Mv2.

Send the following message to the controller via the COMM port or programming port:

	03	00	H'40 H'80	00	04	Hi	Lo
Addr.	Func.	Starting Addr.		No. of words		CRC16	

Example 3: Perform Reset Function (same effect as pressing R key)

Query

	06	00	H'48	H'68	H'25	Hi	Lo
Addr.	Func.	Register Addr.		Data Hi/Lo		CRC16	

Example 4: Enter Auto-tuning Mode

Query

	06	00	H'48	H'68	H'28	Hi	Lo
Addr.	Func.	Register Addr.		Data Hi/Lo		CRC16	

Example 5: Enter Manual Control Mode

Query

	06	00	H'48	H'68	H'27	Hi	Lo
Addr.	Func.	Register Addr.		Data Hi/Lo		CRC16	

Example 6: Read All Parameters

Query

	03	00	00	00	H'50	Hi	Lo
Addr.	Func.	Starting Addr.		No. of words		CRC16	

Example 7: Modify the Calibration Coefficient

Preset the CMND register with 26669 before attempting to change the calibration coefficient.

	06	00	H'48	H'68	H'2D	Hi	Lo
Addr.	Func.	Register Addr.		Data Hi / Lo		CRC16	

Table A.1 Error Codes and Corrective Actions

Error Code	Display Symbol	Error Description	Corrective Action
4	Er04	Illegal setup values been used: Before COOL is used for OUT2, DIRT (cooling action) has already been used for OUT1, or PID mode is not used for OUT1 (that is PB = 0, and / or TI = 0)	Check and correct setup values of OUT2, PB, TI and OUT1. IF OUT2 is required for cooling control, the control should use PID mode (PB ≠ 0, TI ≠ 0) and OUT1 should use reverse mode (heating action), otherwise, don't use OUT2 for cooling control.
10	Er 10	Communication error: bad function code	Correct the communication software to meet the protocol requirements.
11	Er 11	Communication error: register address out of range	Don't issue an over-range register address to the slave.
14	Er 14	Communication error: attempt to write a read-only data or a protected data	Don't write a read-only data or a protected data to the slave.
15	Er 15	Communication error: write a value which is out of range to a register	Don't write an over-range data to the slave register.
26	AtEr	Fail to perform auto-tuning function	1.The PID values obtained after auto-tuning procedure are out of range. Retry auto-tuning. 2.Don't change set point value during auto-tuning procedure. 3.Use manual tuning instead of auto-tuning. 4. Don't set a zero value for PB. 5. Don’t set a zero value for TI. 6. Touch RESET key
29	EEPE	EEPROM can't be written correctly	Return to factory for repair.
30	CJEr	Cold junction compensation for thermocouple malfunction	Return to factory for repair.
39	SbEr	Input sensor break, or input current below 1 mA if 4-20 mA is selected, or input voltage below 0.25V if 1 - 5V is selected	Replace input sensor.
40	AdEr	A to D converter or related component(s) malfunction	Return to factory for repair.

A.2 WARRANTY AND LIMITATION OF REMEDY AND LIABILITY

Chromalox warrants only that the Products and parts manufactured by Chromalox, when shipped, and the work performed by Chromalox when performed, will meet all applicable specification and other specific product and work requirements (including those of performance), if any, and will be free from defects in material and workmanship under normal conditions of use. All claims for defective or nonconforming (both hereinafter called defective) Products, parts or work under this warranty must be made in writing immediately upon discovery, and in any event, within one (1) year from delivery, provided, however all claims for defective Products and parts must be made in writing no later than eighteen (18) months after shipment by Chromalox. Defective and nonconforming items must be held for Chromalox’s inspections and returned to the original f.o.b. point upon request. THE FOREGOING IS EXPRESSLY IN LIEU OF ALL OTHER WARRANTIES WHATSOEVER, EXPRESS, IMPLIED AND STATUTORY, INCLUDING, WITHOUT LIMITATION, THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE.

Notwithstanding the provisions of this WARRANTY AND LIMITATION Clause, it is specifically understood that Products and parts not manufactured and work not performed by Chromalox are warranted only to the extent and in the manner that the same are warranted to Chromalox by Chromalox’s vendors, and then only to the extent that Chromalox is reasonably able to enforce such warranty, it being understood Chromalox shall have no obligation to initiate litigation unless Buyer undertakes to pay all cost and expenses therefor, including but not limited to attorney’s fees, and indemnifies Chromalox against any liability to Chromalox’s vendors arising out of such litigation.

Upon Buyer’s submission of a claim as provided above and its substantiation, Chromalox shall at its option either (i) repair or replace its Products, parts or work at the original f.o.b. point of delivery or (ii) refund an equitable portion of the purchase price.

THE FOREGOING IS CHROMALOX’S ONLY OBLIGATION AND BUYER’S EXCLUSIVE REMEDY FOR BREACH OF WARRANTY, AND IS BUYER’S EXCLUSIVE REMEDY AGAINST CHROMALOX FOR ALL CLAIMS ARISING HEREUNDER OR RELATING HERETO WHETHER SUCH CLAIMS ARE BASED ON BREACH OF CONTRACT, TORT (INCLUDING NEGLIGENCE AND STRICT LIABILITY) OR OTHER THEORIES, BUYER’S FAILURE TO SUBMIT A CLAIM AS PROVIDED ABOVE SHALL SPECIFICALLY WAIVE ALL CLAIMS FOR DAMAGES OR OTHER RELIEF, INCLUDING BUT NOT LIMITED TO CLAIMS BASED ON LATENT DEFECTS. IN NO EVENT SHALL BUYER BE ENTITLED TO INCIDENTAL OR CONSEQUENTIAL DAMAGES AND BUYER SHALL HOLD CHROMALOX HARMLESS THEREFROM. ANY ACTION BY BUYER ARISING HEREUNDER OR RELATING HERETO, WHETHER BASED ON BREACH OF CONTRACT, TORT (INCLUDING NEGLIGENCE AND STRICT LIABILITY) OR OTHER THEORIES, MUST BE COMMENCED WITHIN ONE (1) YEAR AFTER THE DATE OF SHIPMENT OR IT SHALL BE BARRED.

RETURNS

No product returns may be accepted without a completed Return Material Authorization (RMA) form.

103 Gamma Drive
Pittsburgh,PA 15238
(412) 967-3906 • Fax: (412) 967-3930
www.ogdenmfg.com

Specifications subject to change without notice.

Printed in U.S.A. 9/2006