User's Manual

B42 Board PID Process/Temperature Controller
Warning Symbol ⚠
The Symbol calls attention to an operating procedure, practice, or the like, which, if not correctly performed or adhered to, could result in personal injury or damage to or destruction of part or all of the product and system. Do not proceed beyond a warning symbol until the indicated conditions are fully understood and met.

Use the Manual
• Installers  Read Chapter 1, 2
• System Designer  Read All Chapters
• Expert User  Read Page 15, 16

NOTE:
It is strongly recommended that a process should incorporate a LIMIT CONTROL like L91 which will shut down the equipment at a preset process condition in order to preclude possible damage to products or system.

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

This manual is applicable for the products with software version 22 and later version.

Copyright  a  July 2012, The Brainchild Corporation, all rights reserved. No part of this publication may be reproduced, transmitted, transcribed or stored in a retrieval system, or translated into any language in any form by any means without the written permission of the Brainchild Corporation.
## Contents

<table>
<thead>
<tr>
<th>Chapter 1 Overview</th>
<th>Page No</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-1 General</td>
<td>5</td>
</tr>
<tr>
<td>1-2 Ordering Code</td>
<td>9</td>
</tr>
<tr>
<td>1-3 Programming Port</td>
<td>11</td>
</tr>
<tr>
<td>1-4 Keys and Displays</td>
<td>12</td>
</tr>
<tr>
<td>1-5 Key Operation Flowchart</td>
<td>15</td>
</tr>
<tr>
<td>1-6 Parameter Descriptions</td>
<td>16</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Chapter 2 Installation</th>
<th>Page No</th>
</tr>
</thead>
<tbody>
<tr>
<td>2-1 Unpacking</td>
<td>31</td>
</tr>
<tr>
<td>2-2 Mounting</td>
<td>31</td>
</tr>
<tr>
<td>2-3 Wiring precautions</td>
<td>34</td>
</tr>
<tr>
<td>2-4 Power Wiring</td>
<td>36</td>
</tr>
<tr>
<td>2-5 Sensor Input Wiring</td>
<td>36</td>
</tr>
<tr>
<td>2-6 Control Output Wiring</td>
<td>36</td>
</tr>
<tr>
<td>2-7 Alarm /Event Output Wiring</td>
<td>40</td>
</tr>
<tr>
<td>2-8 Event Input Wiring</td>
<td>41</td>
</tr>
<tr>
<td>2-9 Retransmission Output Wiring</td>
<td>41</td>
</tr>
<tr>
<td>2-10 Data Communication</td>
<td>42</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Chapter 3 Configuration</th>
<th>Page No</th>
</tr>
</thead>
<tbody>
<tr>
<td>3-1 Password</td>
<td>44</td>
</tr>
<tr>
<td>3-2 Signal Input</td>
<td>44</td>
</tr>
<tr>
<td>3-3 Event Input</td>
<td>45</td>
</tr>
<tr>
<td>3-4 Control Outputs</td>
<td>47</td>
</tr>
<tr>
<td>3-5 Alarms</td>
<td>52</td>
</tr>
<tr>
<td>3-6 Configure Home Page</td>
<td>56</td>
</tr>
<tr>
<td>3-7 User Calibration</td>
<td>56</td>
</tr>
<tr>
<td>3-8 Digital Filter</td>
<td>58</td>
</tr>
<tr>
<td>3-9 Failure Transfer</td>
<td>59</td>
</tr>
<tr>
<td>3-10 Auto-tuning</td>
<td>60</td>
</tr>
<tr>
<td>3-11 Manual tuning</td>
<td>61</td>
</tr>
<tr>
<td>3-12 Manual Mode</td>
<td>63</td>
</tr>
<tr>
<td>3-13 Data Communication</td>
<td>63</td>
</tr>
<tr>
<td>3-14 Retransmission</td>
<td>64</td>
</tr>
<tr>
<td>3-15 Output Scaling</td>
<td>65</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Chapter 4 Profiler Operation</th>
<th>Page No</th>
</tr>
</thead>
<tbody>
<tr>
<td>4-1 What is set point profiler</td>
<td>66</td>
</tr>
<tr>
<td>4-2 Segment connection</td>
<td>67</td>
</tr>
<tr>
<td>4-3 Profiler Modes</td>
<td>67</td>
</tr>
<tr>
<td>4-4 Running, holding and aborting a profile</td>
<td>68</td>
</tr>
<tr>
<td>4-5 Viewing and modifying profile progress</td>
<td>69</td>
</tr>
<tr>
<td>4-6 Start</td>
<td>69</td>
</tr>
<tr>
<td>4-7 Holdback</td>
<td>70</td>
</tr>
<tr>
<td>4-8 Power failure</td>
<td>72</td>
</tr>
<tr>
<td>4-9 Configuring the profiler</td>
<td>74</td>
</tr>
<tr>
<td>4-10 Viewing and creating profile</td>
<td>74</td>
</tr>
<tr>
<td>4-11 Event Outputs and PII Selection</td>
<td>78</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Chapter 5 Applications</th>
<th>Page No</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Chapter 6 Specifications</th>
<th>Page No</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Chapter 7 Modbus Communications</th>
<th>Page No</th>
</tr>
</thead>
<tbody>
<tr>
<td>7-1 Functions Supported</td>
<td>8</td>
</tr>
<tr>
<td>7-2 Exception Responses</td>
<td>89</td>
</tr>
<tr>
<td>7-3 Parameter Table</td>
<td>9</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Chapter 8 Manual Calibration</th>
<th>Page No</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Appendix A-1</th>
<th>Page No</th>
</tr>
</thead>
<tbody>
<tr>
<td>Appendix A-2</td>
<td>99</td>
</tr>
</tbody>
</table>
Chapter 1 Overview

1-1 General

The Fuzzy Logic plus PID microprocessor-based profiling controller series, incorporate two bright, easy to read 4-digit LED displays, indicating process value and set point value. The Fuzzy Logic technology enables a process to reach a predetermined set point in the shortest time, with the minimum of overshoot during power-up or external load disturbance.

The unit is powered by 11-26 or 90-250 VDC/VAC supply, incorporating a 2 amp. control relay output as standard. The second output can be used as cooling control, an event output or an alarm. Both outputs can select triac, logic output, linear current or linear voltage to drive external device. The units are fully programmable for PT100 and thermocouple types J, K, T, E, B, R, S, N, L, C, P with no need to modify the unit. The input signal is digitized by using a 18-bit A to D converter. Its fast sampling rate allows the unit to control fast processes.

There are more functions than the heating and cooling control could be configured for the controller outputs, these include: up to three alarm outputs, up to three event outputs and up to two analog retransmission outputs.

Digital communications RS-485 or RS-232 are available as an additional option. These options allow the units to be integrated with supervisory control system and 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, the control loop will minimize the overshoot and undershoot in a shortest time. The following diagram is a comparison of results with and without Fuzzy technology.
The series can be configured as a single set point controller (static mode) or a ramp and dwell profiling controller (profile mode). The profile mode feature allows the user to program up to 9 profiles of up to 64 free-format (ramp, dwell, jump or end) segments each. The total segments available for the product is 288 segments. The profiling controllers contain the following features:

**Flexible Configuration of Program**

There are up to 64 segments can be defined for a profile. Each segment can be configured as a ramp or a dwell (soak) segment or defining a repeat number of cycles at arbitrary location within the profile and finally terminated by an end segment. The user can edit a currently running profile.

**Maximum Capacity of Program**

There are at most 9 profiles can be defined and 288 segments totally available for all profiles. The profiles are divide into three kinds of length. The short length profile contains 16 segments, the medium length profile contains 32 segments while the long length profile contains 64 segments at most.

**Event Input**

The event input feature allows the user to select one of eight functions: enter profile run mode, enter profile hold mode, abort profile mode, enter manual mode, perform failure transfer, enter off mode, advance to the next segment and select second set of PID values.
Programmable Event Outputs
Up to three relays are configurable for event outputs and the state of each output can be defined for each segment and end of profile.

Analog Retransmission
The output 5 and output 4 of the products can be equipped with analog output module. The output can be configured for transmitting the process value as well as set point value.

High Accuracy
The series are manufactured with custom designed ASIC (Application Specific Integrated Circuit) technology which contains a 18-bit A to D converter for high resolution measurement (true 0.1 BF resolution for thermocouple and PT100) 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.

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

Fuzzy Control
The function of Fuzzy control is to adjust PID parameters from time to time in order to make manipulation output value more flexible and adaptive to various processes. The results is to enable a process to reach a predetermined set point in the shortest time, with the minimum of overshoot and undershoot during power-up or external load disturbance.

Digital Communication
The units are equipped with RS-485 or RS-232 interface card to provide digital communication. By using the twisted pair wires there are at most 247 units can be connected together via RS-485 interface to a host computer.
Programming Port

A programming port is used to connect the unit to a hand-held programmer or a PC for quick configuration, also can be connected to an ATE system for automatic testing & calibration.

Auto-tune

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

Lockout Protection

According to actual security requirement, a password is provided to prevent the unit from being changed abnormally.

Bumpless Transfer

Bumpless transfer allows the controller to continue to control by using its previous value as the sensor breaks. Hence, the process can be well controlled temporarily as if the sensor is normal.

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 application where the process value is too unstable to be read.

SEL Function

The units have the flexibility for user to select those parameters which are most significant to him and put these parameters in the home page. There are at most 8 parameters can be selected to allow the user to build his own display sequence.
1-2 Ordering Code

**Power Input**
- 4: 90 - 250 VAC, 47-63 Hz
- 5: 11 - 26 VAC or VDC

**Signal Input**
- 1: Standard Input
  - RTD: PT100 DIN, PT100 JIS
  - Voltage: 0-60mV
- 2: Pulsed voltage to drive SSR, 5V/30mA
- 3: Isolated 4 - 20mA / 0 - 20mA
- 4: Isolated 0 - 5V / 0 - 5V/0 - 10V
- 6: Triac output 1A / 240VAC, SSR
- C: Pulsed voltage to drive SSR, 14V/40mA
- 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 0 - 5V / 0 - 5V/0 - 10V
- 6: Triac output 1A / 240VAC, SSR
- C: Pulsed voltage to drive SSR, 14V/40mA
- 9: Special Order

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

**Output 3**
- 0: None
- 1: Relay rated 2A/240VAC
- 2: Pulsed voltage to drive SSR, 5V/30mA
- 6: Triac output 1A / 240VAC, SSR
- 7: Isolated 20V/25mA transducer power supply
- 8: Isolated 12V/40mA transducer power supply
- A: Isolated 5V/80mA transducer power supply
- C: Pulsed voltage to drive SSR, 14V/40mA
- 9: Special Order

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

**Output 5**
- 0: None
- 3: Retransmit 4 - 20mA / 0 - 20mA
- 4: Retransmit 1 - 5V / 0 - 5V/0 - 10V
- 7: Isolated 20V/25mA transducer power supply
- 8: Isolated 12V/40mA transducer power supply
- A: Isolated 5V/80mA transducer power supply
- D: Isolated RS-485 Interface
- E: Isolated RS-232 Interface

**Display Board and cable**
- 0: None
- 3: Display Board with 300mm connection cable
- 4: Display Board with 1000mm connection cable
**Accessories**

OM94-6 = Isolated 1A / 240VAC Triac Output Module (SSR)
OM94-7 = 14V / 40mA SSR Drive Module
OM98-3 = Isolated 4 - 20 mA / 0 - 20 mA Analog Output Module
OM98-5 = Isolated 0 -10V Analog Output Module
CM94-1 = Isolated RS-485 Interface Module for Output 5
CM94-2 = Isolated RS-232 Interface Module for Output 5
CM94-3 = Isolated 4-20mA/0-20mA Retrans Module for Output 5
CM94-5 = Isolated 0-10V Retrans Module for Output 5
DC94-1 = Isolated 20V/25mA DC Output Power Supply
DC94-2 = Isolated 12V/40mA DC Output Power Supply
DC94-3 = Isolated 5V/80mA DC Output Power Supply
CC94-1 = RS-232 Interface Cable (2M)
CC91-2 = Programming Port Cable
DC21-1 = Isolated 20V/25mA DC Output Power Supply for Output 5
DC21-2 = Isolated 12V/40mA DC Output Power Supply for Output 5
DC21-3 = Isolated 5V/80mA DC Output Power Supply for Output 5
A special connector can be used to touch the programming port which is connected to a PC for automatic configuration, 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 when the unit is used for a normal control purpose.
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 selected parameter.

DOWN KEY : ⬇️
This key is used to decrease the value of selected parameter.

PAGE KEY: ⬇️
This key is used to select desired page of parameters.

REVERSE SCROLL : ⬆️ ⬇️
Press both ⬆️ and ⬇️ keys to jump to the previous parameter.

RESET KEY : ⬆️ ⬇️
Press both ⬆️ and ⬇️ keys to:
1. Revert the display to display the process value.
2. Reset the latching alarm, once the alarm condition is removed.
3. Stop the manual control mode, auto-tuning mode and off mode, then enters the static mode.
4. Clear the message of communication error, holdback time out error and auto-tuning error.
5. To reset new profile start segment to 1.00 after earlier profile is completed when "RUN" and "HLD" LED's are blinking together.

ENTER KEY : Press ⬇️ for 5 seconds to:
1. Enter the selected mode to run.
2. Execute calibration procedure for the low point and high point calibration.
Output Status indicators for output1~output 4

Upper Display, to display process value, menu symbol and error code etc.

Lower Display, to display set point value, parameter value or control output value etc.

On : profile running
Flashing: profile in delayed state

On : profile held
Flashing: profile in holdback state

Running ramp up segment
Running ramp down segment
Running dwell segment
Profile held or in static mode

Both off

4 Buttons for ease of control setup and set point adjustment.

Figure 1.3 Front Panel Description

The unit will display the program code for 2.5 seconds during power up.
The display shows program number 37 with program version 22.
The program no.37.

Figure 1.4 Program code display
1-5 Key Operation Flowchart

Home Page

Mode Page

Profile Page

Home Display

PV
SV

Node (MODE)

Prof (1-9)

run (Profile run mode)
Hold (Profile hold mode)
Start (Static mode)
At (Automatic tuning PID1 mode)
At (Automatic tuning PID2 mode)
Run (Manual mode)
Off (Off mode)

Using [↑]/[↓] key to select desired mode, then

5sec.

Enters the selected mode

PV
H

PV
C

PASS
ASP1
ASP2
ASP3
INPT
UNIT
DP
PB1
TI1
TD1
CYC1
DELAY

PV
RT or RR
P2EV
HB

PV
RT or RR
P2EV
HB

TGSP

DLLT

FSP

SEG
CYCL

SGNO
SGTY

HBB
STSP
RMPU
DLLU
SGNO
SGTY

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

Profile Page

_PROFILEPAGE_
Using ‹ or › key to adjust the offset low value (lower display) until the process value (higher display) is equal to the required value, then

Complete calibration procedure for the low point calibration.

Using ‹ or › key to adjust the offset high value (lower display) until the process value (higher display) is equal to the required value, then

Complete calibration procedure for the high point calibration.
## 1-6 Parameter Descriptions

<table>
<thead>
<tr>
<th>Register Address</th>
<th>Parameter Notation</th>
<th>Parameter Description</th>
<th>Range</th>
<th>Default Value</th>
<th>Datatype</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>SP1</td>
<td>Controller (Static mode) Set point value</td>
<td>Low: SPLO High: SPHI</td>
<td>25.0 BC (77.0 BF)</td>
<td>R/W</td>
</tr>
<tr>
<td>1</td>
<td>PFSG P_..</td>
<td>Indicate the current Profile/Segment number</td>
<td>Low: 1.00 High: 9.63</td>
<td>1.00</td>
<td>R/W</td>
</tr>
<tr>
<td>2</td>
<td>TIME TIME</td>
<td>Time remaining for the current segment</td>
<td>Low: 00.00 High: 99.59</td>
<td>—</td>
<td>R/W</td>
</tr>
<tr>
<td>3</td>
<td>CYCL CYCL</td>
<td>cycle remaining for the current profile</td>
<td>Low: 1 High: 9999 10000=infinite</td>
<td>—</td>
<td>R</td>
</tr>
<tr>
<td>4</td>
<td>PASS PASS</td>
<td>Password entry</td>
<td>Low: 0 High: 9999</td>
<td>1</td>
<td>R/W</td>
</tr>
<tr>
<td>5</td>
<td>ASP1 ASP1</td>
<td>Set point for alarm 1</td>
<td>Low: -32768 High: 32767</td>
<td>10.0 BC (18.0 BF)</td>
<td>R/W</td>
</tr>
<tr>
<td>6</td>
<td>ASP2 ASP2</td>
<td>Set point for alarm 2</td>
<td>Low: -32768 High: 32767</td>
<td>10.0 BC (18.0 BF)</td>
<td>R/W</td>
</tr>
<tr>
<td>7</td>
<td>ASP3 ASP3</td>
<td>Set point for alarm 3</td>
<td>Low: -32768 High: 32767</td>
<td>10.0 BC (18.0 BF)</td>
<td>R/W</td>
</tr>
<tr>
<td>8</td>
<td>INPT NPT</td>
<td>Input sensor selection</td>
<td></td>
<td>(T/C=thermocouple)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0 J_EC : J type T/C</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1 E_EC : K type T/C</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2 T_EC : T type T/C</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>3 E_EC : E type T/C</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>4 B_EC : B type T/C</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>5 R_EC : R type T/C</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>6 S_EC : S type T/C</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>7 N_EC : N type T/C</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>8 L_EC : L type T/C</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>9 C_EC : C type T/C</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>10 P_EC : P type T/C</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>11 Pt.dn : PT 100 ohms DIN curve</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>12 Pt.JS : PT 100 ohms JIS curve</td>
<td></td>
</tr>
<tr>
<td>Register Address</td>
<td>Parameter Notation</td>
<td>Parameter Description</td>
<td>Range</td>
<td>Default Value</td>
<td>Data type</td>
</tr>
<tr>
<td>------------------</td>
<td>--------------------</td>
<td>-------------------------------</td>
<td>----------------------------------------------------------------------</td>
<td>---------------</td>
<td>-----------</td>
</tr>
<tr>
<td>8</td>
<td>INPT</td>
<td>Input sensor selection</td>
<td>13 (4-20): 4 - 20 mA linear current input</td>
<td>1 (0)</td>
<td>R/W</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>14 (0-20): 0 - 20 mA linear current input</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>15 (0-60): 0 - 60 mV linear millivolt input</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>16 (0-1): 0 - 1V linear voltage input</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>17 (0-5): 0 - 5V linear voltage input</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>18 (1-5): 1 - 5V linear voltage input</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>19 (0-10): 0 - 10V linear voltage input</td>
<td></td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>UNIT</td>
<td>Input unit selection</td>
<td>0 (\degree C): Degree C unit</td>
<td>0 (1)</td>
<td>R/W</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>1 (\degree F): Degree F unit</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>2 (Process): Process unit</td>
<td></td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>DP</td>
<td>Decimal point selection</td>
<td>0 (n_dp): No decimal point</td>
<td>1</td>
<td>R/W</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>1 (1_dp): 1 decimal digit</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>2 (2_dp): 2 decimal digits</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>3 (3_dp): 3 decimal digits</td>
<td></td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>MODE</td>
<td>Operation mode</td>
<td>0 (run): Profile run mode</td>
<td>0</td>
<td>R/W</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>1 (Hold): Profile hold mode</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>2 (stat): Static mode</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>3 (RT): Automatic tuning PID1 mode</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>4 (RT2): Automatic tuning PID2 mode</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>5 (RM): Manual mode</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>6 (off): Off mode</td>
<td></td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>INLO</td>
<td>Input low scale value</td>
<td>Low: -32768 High: INHI-50</td>
<td>-17.8 LC (0 LF)</td>
<td>R/W</td>
</tr>
<tr>
<td>13</td>
<td>INHI</td>
<td>Input high scale value</td>
<td>Low: INLO+50 High: 32767</td>
<td>93.3 LC (200.0 LF)</td>
<td>R/W</td>
</tr>
<tr>
<td>Register Address</td>
<td>Parameter Notation</td>
<td>Parameter Description</td>
<td>Range</td>
<td>Default Value</td>
<td>Data type</td>
</tr>
<tr>
<td>------------------</td>
<td>--------------------</td>
<td>-----------------------</td>
<td>-------</td>
<td>---------------</td>
<td>-----------</td>
</tr>
<tr>
<td>14</td>
<td>FILT F, L E</td>
<td>Filter damping time constant of PV</td>
<td>0 (0): 0 second time constant, 1 (0.2): 0.2 second time constant, 2 (0.5): 0.5 second time constant, 3 (1): 1 second time constant, 4 (2): 2 seconds time constant, 5 (5): 5 seconds time constant, 6 (10): 10 seconds time constant, 7 (20): 20 seconds time constant, 8 (30): 30 seconds time constant, 9 (60): 60 seconds time constant</td>
<td>2</td>
<td>R/W</td>
</tr>
<tr>
<td>15</td>
<td>EIFN E, F n</td>
<td>Event input function</td>
<td>0 (\text{no e}): No function, 1 (\text{run}): Program run mode, 2 (\text{hold}): Program hold mode, 3 (\text{abort}): Abort profile mode, 4 (\text{man}): Manual mode, 5 (\text{ftr}): Failure Transfer, 6 (\text{off}): Off mode, 7 (\text{pass}): Pass to the next segment, 8 (\text{p2}): Select PB2 TI2 &amp; TD2 for control</td>
<td>0</td>
<td>R/W</td>
</tr>
<tr>
<td>16</td>
<td>SPLO S.P.L o</td>
<td>Low limit of set point value</td>
<td>Low: (-32768), High: SPHI</td>
<td>-17.8 LC (0 LF)</td>
<td>R/W</td>
</tr>
<tr>
<td>17</td>
<td>SPHI S.P.H i</td>
<td>High limit of set point value</td>
<td>Low: SPLO, High: 32767</td>
<td>537.8 LC (1000 LF)</td>
<td>R/W</td>
</tr>
<tr>
<td>18</td>
<td>OUT1 o u t l</td>
<td>Output 1 function</td>
<td>0 (\text{no e}): No function, 1 (\text{hno f}): Heating on-off control, 2 (\text{hpc}): Heating time proportioning control, 3 (\text{hlc}): Heating linear control, 4 (\text{cno f}): Cooling on-off control, 5 (\text{tcp}): Cooling time proportioning control, 6 (\text{clc}): Cooling linear control</td>
<td>3</td>
<td>R/W</td>
</tr>
<tr>
<td>Register Address</td>
<td>Parameter Notation</td>
<td>Parameter Description</td>
<td>Range</td>
<td>Default Value</td>
<td>Data type</td>
</tr>
<tr>
<td>------------------</td>
<td>-------------------</td>
<td>-----------------------</td>
<td>-------</td>
<td>---------------</td>
<td>----------</td>
</tr>
<tr>
<td>19</td>
<td>O1FT</td>
<td>Output 1 failure transfer status</td>
<td>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.</td>
<td>0</td>
<td>R/W</td>
</tr>
<tr>
<td>20</td>
<td>O1HY</td>
<td>Output 1 ON-OFF control hysteresis</td>
<td>Low: 0.1 High: 50.0 °C (90.0°F)</td>
<td>0.1LC (0.2 LF)</td>
<td>R/W</td>
</tr>
<tr>
<td>21</td>
<td>CYC1</td>
<td>Output 1 cycle time</td>
<td>Low: 0.1 High: 90.0 sec.</td>
<td>18.0</td>
<td>R/W</td>
</tr>
<tr>
<td>22</td>
<td>OP1L</td>
<td>Low limit value for output 1</td>
<td>Low: 0 High: 100.0%</td>
<td>0</td>
<td>R/W</td>
</tr>
<tr>
<td>23</td>
<td>OP1H</td>
<td>High limit value for output 1</td>
<td>Low: 0 High: 120.0%</td>
<td>100.0</td>
<td>R/W</td>
</tr>
<tr>
<td>24</td>
<td>PB1</td>
<td>Proportional band value 1</td>
<td>Low: 0 High: 500.0 °C (900.0°F)</td>
<td>10.0 LC (18.0 LF)</td>
<td>R/W</td>
</tr>
<tr>
<td>25</td>
<td>TI1</td>
<td>Integral time value 1</td>
<td>Low: 0 High: 3600 sec</td>
<td>100</td>
<td>R/W</td>
</tr>
<tr>
<td>26</td>
<td>TD1</td>
<td>Derivative time value 1</td>
<td>Low: 0 High: 900.0 sec</td>
<td>25.0</td>
<td>R/W</td>
</tr>
<tr>
<td>27</td>
<td>PB2</td>
<td>Proportional band value 2</td>
<td>Low: 0 High: 500.0 °C (900.0°F)</td>
<td>10.0 LC (18.0 LF)</td>
<td>R/W</td>
</tr>
<tr>
<td>28</td>
<td>TI2</td>
<td>Integral time value 2</td>
<td>Low: 0 High: 3600 sec</td>
<td>100</td>
<td>R/W</td>
</tr>
<tr>
<td>29</td>
<td>TD2</td>
<td>Derivative time value 2</td>
<td>Low: 0 High: 900.0 sec</td>
<td>25.0</td>
<td>R/W</td>
</tr>
<tr>
<td>30</td>
<td>OFST</td>
<td>Offset value for P control (TI=0)</td>
<td>Low: 0.0 High: 100.0%</td>
<td>25.0</td>
<td>R/W</td>
</tr>
<tr>
<td>31</td>
<td></td>
<td>Reserved</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>32</td>
<td></td>
<td>Reserved</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>33</td>
<td>OUT2</td>
<td>Output 2 function</td>
<td>0 ______: No function 1 ______: Cooling time proportioning control 2 ______: Cooling linear control 3 ______: Alarm 1 output 4 ______: Reverse alarm 1 Output 5 ______: Event 1 output 6 ______: DC power supply output</td>
<td>3</td>
<td>R/W</td>
</tr>
</tbody>
</table>

UM0B421A 19
<table>
<thead>
<tr>
<th>Register Address</th>
<th>Parameter Notation</th>
<th>Parameter Description</th>
<th>Range</th>
<th>Default Value</th>
<th>Data Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>34</td>
<td>O2FT</td>
<td>Output 2 failure transfer status</td>
<td>Select BPLS (bumpless transfer) or 0.0 ~ 100.0% to continue output 2 control function as the unit fails, or select OFF (0) or ON (1) for alarm or event output.</td>
<td>0</td>
<td>R/W</td>
</tr>
<tr>
<td>35</td>
<td>CYC2</td>
<td>Output 2 cycle time</td>
<td>Low: 0.1 High: 90.0 sec.</td>
<td>18.0</td>
<td>R/W</td>
</tr>
<tr>
<td>36</td>
<td>CPB</td>
<td>Cooling proportional band value</td>
<td>Low: 50 High: 300%</td>
<td>100</td>
<td>R/W</td>
</tr>
<tr>
<td>37</td>
<td>DB</td>
<td>Heating-cooling dead band (negative value= overlap)</td>
<td>Low: -36.0 High: 36.0%</td>
<td>0</td>
<td>R/W</td>
</tr>
<tr>
<td>38</td>
<td>OP2L</td>
<td>Low limit value for output 2</td>
<td>Low: 0 High: 100.0%</td>
<td>0</td>
<td>R/W</td>
</tr>
<tr>
<td>39</td>
<td>OP2H</td>
<td>High limit value for output 2</td>
<td>Low: 0 High: 120.0%</td>
<td>100.0</td>
<td>R/W</td>
</tr>
<tr>
<td>40</td>
<td></td>
<td>Reserved</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>41</td>
<td></td>
<td>Reserved</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>42</td>
<td>OUT3</td>
<td>Output 3 function</td>
<td>0: No function 1: Alarm 2 output 2: Reverse alarm 2 output 3: Event 2 output 4: DC power supply output</td>
<td>3</td>
<td>R/W</td>
</tr>
<tr>
<td>43</td>
<td>O3FT</td>
<td>Output 3 failure transfer status</td>
<td>0: Output 3 OFF as unit fails 1: Output 3 ON as unit fails</td>
<td>0</td>
<td>R/W</td>
</tr>
<tr>
<td>44</td>
<td>OUT4</td>
<td>Output 4 function</td>
<td>0: No function 1: Alarm 3 output 2: Reverse alarm 3 output 3: Event 3 output 4: Retransmit process value 5: Retransmit set point value 6: DC power supply output</td>
<td>3</td>
<td>R/W</td>
</tr>
<tr>
<td>Register Address</td>
<td>Parameter Notation</td>
<td>Parameter Description</td>
<td>Range</td>
<td>Default Value</td>
<td>Data Type</td>
</tr>
<tr>
<td>------------------</td>
<td>--------------------</td>
<td>-----------------------</td>
<td>-------</td>
<td>---------------</td>
<td>-----------</td>
</tr>
</tbody>
</table>
| 45               | O4FT               | Output 4 failure transfer status | 0 **off**: Output 4 OFF as unit fails  
1 **on**: Output 4 ON as unit fails | 0 | R/W |
| 46               | OP4L               | Low limit value for output 4 | Low: 0  
High: 100.0 % | 0 | R/W |
| 47               | OP4H               | High limit value for output 4 | Low: 0  
High: 120.0 % | 100.0 | R/W |
| 48               | REL4               | Retransmission low scale value for output 4 | Low: -32768  
High: 32767 | 0.0 BC (32.0BF) | R/W |
| 49               | REH4               | Retransmission high scale value for output 4 | Low: -32768  
High: 32767 | 10 0.0 BC (212.0BF) | R/W |
| 50               | Reserved           |                         |       |               |           |
| 51               | OUT5               | Output 5 function | 0 **none**: No function  
1 **Comm**: Communication port  
2 **ESP**: Retransmit process value  
3 **ESP**: Retransmit set point value  
4 **DCPS**: DC power supply output | 0 | R/W |
| 52               | OP5L               | Low limit value for output 5 | Low: 0  
High: 100.0 % | 0 | R/W |
| 53               | OP5H               | High limit value for output 5 | Low: 0  
High: 120.0 % | 100.0 | R/W |
| 54               | REL5               | Retransmission low scale value for output 5 | Low: -32768  
High: 32767 | 0.0 BC (32.0BF) | R/W |
| 55               | REH5               | Retransmission high scale value for output 5 | Low: -32768  
High: 32767 | 10 0.0 BC (212.0BF) | R/W |
| 56               | ADDR               | Address assignment of digital communication | Low: 1  
High: 247 | 1 | R/W |
<table>
<thead>
<tr>
<th>Register Address</th>
<th>Parameter Notation</th>
<th>Parameter Description</th>
<th>Range</th>
<th>Default Value</th>
<th>Data type</th>
</tr>
</thead>
<tbody>
<tr>
<td>57</td>
<td>BAUD</td>
<td>Baud rate of digital communication</td>
<td>0 2.4 Kbits/s baud rate, 1 4.8 Kbits/s baud rate, 2 9.6 Kbits/s baud rate, 3 14.4 Kbits/s baud rate, 4 19.2 Kbits/s baud rate, 5 28.8 Kbits/s baud rate, 6 38.4 Kbits/s baud rate</td>
<td>2</td>
<td>R/W</td>
</tr>
<tr>
<td>58</td>
<td>PARI</td>
<td>Parity bit of digital communication</td>
<td>0 Even, 1 Odd, 2 None</td>
<td>0</td>
<td>R/W</td>
</tr>
<tr>
<td>59</td>
<td>ALF1</td>
<td>Alarm 1 function</td>
<td>0 Process high, 1 Process low, 2 Deviation high, 3 Deviation low, 4 Deviation band high/low, 5 End of profile, 6 Hold mode, 7 Static mode</td>
<td>2</td>
<td>R/W</td>
</tr>
<tr>
<td>60</td>
<td>A1MD</td>
<td>Alarm 1 operation mode</td>
<td>0 Normal, 1 Latching, 2 Hold, 3 Latching &amp; Hold</td>
<td>0</td>
<td>R/W</td>
</tr>
<tr>
<td>61</td>
<td>A1HY</td>
<td>Hysteresis control for alarm 1</td>
<td>Low: 0.1, High: 50.0 LC (90.0 LF)</td>
<td>0.1 LC (0.2 LF)</td>
<td>R/W</td>
</tr>
<tr>
<td>Register Address</td>
<td>Parameter Notation</td>
<td>Parameter Description</td>
<td>Range</td>
<td>Default Value</td>
<td>Data type</td>
</tr>
<tr>
<td>-----------------</td>
<td>--------------------</td>
<td>-----------------------</td>
<td>-------</td>
<td>--------------</td>
<td>-----------</td>
</tr>
<tr>
<td>62</td>
<td>ALF2</td>
<td>Alarm 2 function</td>
<td></td>
<td>2</td>
<td>R/W</td>
</tr>
<tr>
<td>63</td>
<td>A2MD</td>
<td>Alarm 2 operation mode</td>
<td></td>
<td>0</td>
<td>R/W</td>
</tr>
<tr>
<td>64</td>
<td>A2HY</td>
<td>Hysteresis control for alarm 2</td>
<td>Low: 0.1 High: 50.0 LC (90.0 LF)</td>
<td>0.1 LC (0.2 LF)</td>
<td>R/W</td>
</tr>
<tr>
<td>65</td>
<td></td>
<td>Reserved</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>66</td>
<td>ALF3</td>
<td>Alarm 3 function</td>
<td></td>
<td>2</td>
<td>R/W</td>
</tr>
<tr>
<td>67</td>
<td>A3MD</td>
<td>Alarm 3 operation mode</td>
<td></td>
<td>0</td>
<td>R/W</td>
</tr>
<tr>
<td>Register Address</td>
<td>Parameter Notation</td>
<td>Parameter Description</td>
<td>Range</td>
<td>Default Value</td>
<td>Data type</td>
</tr>
<tr>
<td>------------------</td>
<td>-------------------</td>
<td>-----------------------</td>
<td>-------</td>
<td>--------------</td>
<td>----------</td>
</tr>
<tr>
<td>68</td>
<td>A3HY</td>
<td>Hysteresis control for alarm 3</td>
<td>Low: 0.1 High: 50.0 LC (90.0 LF)</td>
<td>0.1 LC (0.2 LF)</td>
<td>R/W</td>
</tr>
<tr>
<td>69</td>
<td>Reserved</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>70</td>
<td>SEL1</td>
<td>Select 1st parameter for home page</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>71</td>
<td>SEL2</td>
<td>Select 2nd parameter for home page</td>
<td>Same as SEL1</td>
<td>0</td>
<td>R/W</td>
</tr>
<tr>
<td>72</td>
<td>SEL3</td>
<td>Select 3rd parameter for home page</td>
<td>Same as SEL1</td>
<td>0</td>
<td>R/W</td>
</tr>
<tr>
<td>Register Address</td>
<td>Parameter Notation</td>
<td>Parameter Description</td>
<td>Range</td>
<td>Default Value</td>
<td>Data type</td>
</tr>
<tr>
<td>------------------</td>
<td>-------------------</td>
<td>-----------------------</td>
<td>-------</td>
<td>---------------</td>
<td>-----------</td>
</tr>
<tr>
<td>73</td>
<td>SEL4</td>
<td>Select 4'th parameter for home page</td>
<td>Same as SEL1</td>
<td>0</td>
<td>R/W</td>
</tr>
<tr>
<td>74</td>
<td>SEL5</td>
<td>Select 5'th parameter for home page</td>
<td>Same as SEL1</td>
<td>0</td>
<td>R/W</td>
</tr>
<tr>
<td>75</td>
<td>SEL6</td>
<td>Select 6'th parameter for home page</td>
<td>Same as SEL1</td>
<td>0</td>
<td>R/W</td>
</tr>
<tr>
<td>76</td>
<td>SEL7</td>
<td>Select 7'th parameter for home page</td>
<td>Same as SEL1</td>
<td>0</td>
<td>R/W</td>
</tr>
<tr>
<td>77</td>
<td>SEL8</td>
<td>Select 8'th parameter for home page</td>
<td>Same as SEL1</td>
<td>0</td>
<td>R/W</td>
</tr>
<tr>
<td>78</td>
<td>CODE</td>
<td>Security code for parameter protection</td>
<td>Low: 0  High: 9999  0=unprotected 1000= home page unprotected</td>
<td>0</td>
<td>R/W</td>
</tr>
<tr>
<td>79</td>
<td></td>
<td>Reserved</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>80</td>
<td>STAR</td>
<td>Set point value at start of each profile</td>
<td>0 $P_V$: Current process value PV  1 $S_P _1$: Controller set point value SP1  2 $S_T _S_P$: Start set point value STSP</td>
<td>0</td>
<td>R/W</td>
</tr>
<tr>
<td>81</td>
<td>END</td>
<td>Set point value at end of each profile</td>
<td>0 $F_S_P$: Final set point value for each program  1 $S_P _1$: Controller set point value  2 $\alpha F$: All outputs go to off except end of profile relay</td>
<td>0</td>
<td>R/W</td>
</tr>
<tr>
<td>82</td>
<td>DLAY</td>
<td>Delay time (hours/minutes) between profile initiation and profile start</td>
<td>Low : 0.00  High : 99.59</td>
<td>0</td>
<td>R/W</td>
</tr>
<tr>
<td>Register Address</td>
<td>Parameter Notation</td>
<td>Parameter Description</td>
<td>Range</td>
<td>Default Value</td>
<td>Data type</td>
</tr>
<tr>
<td>------------------</td>
<td>-------------------</td>
<td>-----------------------</td>
<td>-------</td>
<td>---------------</td>
<td>-----------</td>
</tr>
</tbody>
</table>
| 83               | PFR P.F.r         | Power fail recovery   | 0 \textit{cont} : Continue profile from the last set point value  
1 \textit{PV} : Start to run from PV  
2 \textit{SP} : Static mode, SP1  
3 \textit{OFF} : OFF mode | 2 | R/W |
| 84               | HBT H.b.t         | Holdback wait time    | Low : 0.00  High : 99.59 (hour.minute)  
0.00= \textit{Inf} : infinite | 1.00 | R/W |
| 85               |                   | Reserved              |       |               |           |
| 86               | PROF P.rof        | Profile number selected for view | Low: 1  High: 9 | 1 | R/W |
| 87               | HBBBD H.b.b.d     | Holdback band         | Low: 1  High: 555 LC (999LF) | — | R/W |
| 88               | STSP S.t.s.p      | Start set point value | Low : SPLO  High : SPHI | — | R/W |
| 89               | RMPU r.n.P.u      | Unit for ramp segment | 0 \textit{HH\texttt{\textendash}m} : Hours. Minutes  
1 \textit{SS} : Minutes. Seconds  
2 \textit{IN} : units per minute  
3 \textit{HR} : units per hour | — | R/W |
| 90               | DLLU d.l.L.u      | Unit for dwell segment | 0 \textit{HH\texttt{\textendash}m} : Hours. Minutes  
1 \textit{SS} : Minutes. Seconds | — | R/W |
| 91               | SGNO S.g.n.o      | Segment number        | Low : 0  High:15(PROF=1~4)  
31(PROF=5~7)  
63(PROF=8,9) | — | R/W |
| 92               | SGTY S.g.t.y      | Segment type for the selected segment number | 0 \textit{Ramp}  
1 \textit{DlL} : Dwell  
2 \textit{JnP} : Jump  
3 \textit{End} : End | 3 | R/W |
<p>| 93               | TGSP t.G.s.p      | Target set point for ramp segment | Low : SPLO  High : SPHI | — | R/W |</p>
<table>
<thead>
<tr>
<th>Register Address</th>
<th>Parameter Notation</th>
<th>Parameter Description</th>
<th>Range</th>
<th>Default Value</th>
<th>Data Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>94</td>
<td>RTRR</td>
<td>Time duration or Ramp rate for ramp segment</td>
<td>Low: 0 High: 5999</td>
<td>—</td>
<td>R/W</td>
</tr>
<tr>
<td>95</td>
<td>P2EV</td>
<td>States assignment of PID selection and event outputs for ramp, and dwell segment.</td>
<td>Four-bit binary number ( 0=inactive 1=active )</td>
<td>—</td>
<td>R/W</td>
</tr>
<tr>
<td>96</td>
<td>HBTY</td>
<td>Holdback type</td>
<td>0. <em>FF</em>: Holdback disabled 1. <em>L_0</em>: Deviation low holdback 2. <em>H_1</em>: Deviation high holdback 3. <em>bRn_d</em>: Deviation band holdback</td>
<td>—</td>
<td>R/W</td>
</tr>
<tr>
<td>97</td>
<td>DLLT</td>
<td>Duration time for dwell segment</td>
<td>Low: 0 High: 99.59</td>
<td>—</td>
<td>R/W</td>
</tr>
<tr>
<td>98</td>
<td>SEG</td>
<td>Target segment number for the jump segment</td>
<td>Low: 0 High:15(PROF=1<del>4) 31(PROF=5</del>7) 63(PROF=8,9)</td>
<td>—</td>
<td>R/W</td>
</tr>
<tr>
<td>99</td>
<td>CYCL</td>
<td>Repeat number of cycles for the jump and end segment</td>
<td>Low: 1 High: 9999 10000 <em>nF</em> : infinite</td>
<td>—</td>
<td>R/W</td>
</tr>
<tr>
<td>100</td>
<td>FSP</td>
<td>Final set point for the end segment</td>
<td>Low: SPLO High: SPHI</td>
<td>—</td>
<td>R/W</td>
</tr>
<tr>
<td>101</td>
<td>OFSTL</td>
<td>Offset value for low point calibration</td>
<td>Low: -1999 high: 1999</td>
<td>0</td>
<td>R/W</td>
</tr>
<tr>
<td>102</td>
<td>OFSTH</td>
<td>Offset value for high point calibration</td>
<td>Low: -1999 high: 1999</td>
<td>0</td>
<td>R/W</td>
</tr>
<tr>
<td>103</td>
<td>ADLO</td>
<td>mV calibration low coefficient</td>
<td>Low: -1999 high: 1999</td>
<td>—</td>
<td>R/W</td>
</tr>
<tr>
<td>104</td>
<td>ADHI</td>
<td>mV calibration high coefficient</td>
<td>Low: -1999 high: 1999</td>
<td>—</td>
<td>R/W</td>
</tr>
<tr>
<td>Register Address</td>
<td>Parameter Notation</td>
<td>Parameter Description</td>
<td>Range</td>
<td>Default Value</td>
<td>Data type</td>
</tr>
<tr>
<td>------------------</td>
<td>--------------------</td>
<td>---------------------------------------------------</td>
<td>--------------------</td>
<td>---------------</td>
<td>-----------</td>
</tr>
<tr>
<td>105</td>
<td>RTDL</td>
<td>RTD calibration low coefficient</td>
<td>Low: -1999 high: 1999</td>
<td>—</td>
<td>R/W</td>
</tr>
<tr>
<td>106</td>
<td>RTDH</td>
<td>RTD calibration high coefficient</td>
<td>Low: -1999 high: 1999</td>
<td>—</td>
<td>R/W</td>
</tr>
<tr>
<td>107</td>
<td>CJLO</td>
<td>Cold junction calibration low coefficient</td>
<td>Low: -5.00 high: 40.00</td>
<td>—</td>
<td>R/W</td>
</tr>
<tr>
<td>108</td>
<td>CJHI</td>
<td>Cold junction calibration high coefficient</td>
<td>Low: -1999 high: 1999</td>
<td>—</td>
<td>R/W</td>
</tr>
<tr>
<td>109</td>
<td>DATE</td>
<td>Date code</td>
<td>Low: 0 High: 3719 (9C31)</td>
<td>—</td>
<td>R/W</td>
</tr>
<tr>
<td>110</td>
<td>SRNO</td>
<td>Serial number</td>
<td>Low: 0 High: 9999</td>
<td>—</td>
<td>R/W</td>
</tr>
<tr>
<td>111</td>
<td></td>
<td>Reserved</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>112</td>
<td>BPL1</td>
<td>Bumpless transfer value of MV1</td>
<td>Low: 0 High: 100.00</td>
<td>—</td>
<td>R</td>
</tr>
<tr>
<td>113</td>
<td>BPL2</td>
<td>Bumpless transfer value of MV2</td>
<td>Low: 0 High: 100.00</td>
<td>—</td>
<td>R</td>
</tr>
<tr>
<td>114</td>
<td>CJCL</td>
<td>Sense voltage during cold junction calibration low</td>
<td>Low: 0 High: 7552</td>
<td>—</td>
<td>R</td>
</tr>
<tr>
<td>115</td>
<td>CALO</td>
<td>Input signal value during low point calibration</td>
<td>Low: -32768 High: 32767</td>
<td>0</td>
<td>R</td>
</tr>
<tr>
<td>116</td>
<td>CAHI</td>
<td>Input signal value during high point calibration</td>
<td>Low: -32768 High: 32767</td>
<td>1000</td>
<td>R</td>
</tr>
<tr>
<td>117</td>
<td>CAIN</td>
<td>Input sensor calibrated</td>
<td>Low: 0 High: 20</td>
<td>20</td>
<td>R</td>
</tr>
<tr>
<td>118</td>
<td></td>
<td>Reserved</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>119</td>
<td></td>
<td>Reserved</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>120</td>
<td></td>
<td>Reserved</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>121</td>
<td></td>
<td>Reserved</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>122</td>
<td></td>
<td>Reserved</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Register Address</td>
<td>Parameter Notation</td>
<td>Parameter Description</td>
<td>Range</td>
<td>Default Value</td>
<td>Data type</td>
</tr>
<tr>
<td>------------------</td>
<td>--------------------</td>
<td>----------------------------------------</td>
<td>--------------------</td>
<td>---------------</td>
<td>-----------</td>
</tr>
<tr>
<td>123</td>
<td>Reserved</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>124</td>
<td>Reserved</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>125</td>
<td>Reserved</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>126</td>
<td>Reserved</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>127</td>
<td>MAEO</td>
<td>Manual event output</td>
<td>Low: 000 High: 111</td>
<td>—</td>
<td>R/W</td>
</tr>
<tr>
<td>128</td>
<td>PV</td>
<td>Process value</td>
<td>Low: -32768 High: 32767</td>
<td>—</td>
<td>R</td>
</tr>
<tr>
<td>129</td>
<td>SV</td>
<td>Set point value for control</td>
<td>Low: SPLO High: SPHI</td>
<td>—</td>
<td>R</td>
</tr>
<tr>
<td>130</td>
<td>MV1</td>
<td>Output 1 percentage value (Heating)</td>
<td>Low: 0.00 High: 100.00</td>
<td>—</td>
<td>*1</td>
</tr>
<tr>
<td>131</td>
<td>MV2</td>
<td>Output 2 percentage value (Cooling)</td>
<td>Low: 0.00 High: 100.00</td>
<td>—</td>
<td>*1</td>
</tr>
</tbody>
</table>
| 132              | STAT               | Mode and operation status word          | Bit 0 = Profile run mode  
Bit 1 = Profile hold mode  
Bit 2 = Static mode  
Bit 3 = Automatic tuning mode  
Bit 4 = Manual mode  
Bit 5 = Off mode  
Bit 6 = Failure mode  
Bit 7 = Profile running up  
Bit 8 = Profile running down  
Bit 9 = Profile soaking  
Bit 10 = Alarm 1 active  
Bit 11 = Alarm 2 active  
Bit 12 = Alarm 3 active  
Bit 13 = Event 1 on  
Bit 14 = Event 2 on  
Bit 15 = Event 3 on | —             | R         |
<p>| 133              | EROR               | Error Code                              | Low: 0 High: 40    | —             | R         |
| 134              | PFSG               | Current profile and segment running     | Low: 1.00 High: 9.63 | —             | R         |
| 135              | TNSG               | Total number of segments                | Low: 1 High: 64    | —             | R         |
| 136              | TTSG               | Total time for segment running          | Low: 0 High: 99.59 | —             | R         |</p>
<table>
<thead>
<tr>
<th>Register Address</th>
<th>Parameter Notation</th>
<th>Parameter Description</th>
<th>Range</th>
<th>Default Value</th>
<th>Data Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>137</td>
<td>SPSG</td>
<td>Set point for current segment</td>
<td>Low: SPLO High: SPHI</td>
<td>—</td>
<td>R</td>
</tr>
<tr>
<td>138</td>
<td>TIME</td>
<td>Time remaining for the current segment</td>
<td>Low: 00.00 High: 99.59</td>
<td>—</td>
<td>R</td>
</tr>
<tr>
<td>139</td>
<td>CYCL</td>
<td>Cycle remaining for the current loop</td>
<td>Low: 1 High: 9999 Low: 10000= infinite</td>
<td>—</td>
<td>R</td>
</tr>
<tr>
<td>140</td>
<td>PROG</td>
<td>Program and version code of the product</td>
<td>Low: -32768 High: 32767</td>
<td>—</td>
<td>R</td>
</tr>
<tr>
<td>141</td>
<td>HBTR</td>
<td>Holdback time remaining for the current segment</td>
<td>Low: 0 High: 99.59</td>
<td>—</td>
<td>R</td>
</tr>
<tr>
<td>142</td>
<td>CMND</td>
<td>Command code</td>
<td>Low: -32768 High: 32767</td>
<td>—</td>
<td>R/W</td>
</tr>
<tr>
<td>143</td>
<td>JOB</td>
<td>Job code</td>
<td>Low: -32768 High: 32767</td>
<td>—</td>
<td>R/W</td>
</tr>
</tbody>
</table>

*1 Read only unless in manual control mode.
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. Don’t use harsh chemicals, volatile solvent such as thinner or strong detergents to clean the instrument in order to avoid deformation or discoloration.

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 panel cutout to dimension shown in Figure 2.1. Take both mounting clamps away and insert the controller into panel cutout. Install the mounting clamps back. Gently tighten the screws in the clamp till the controller front panels is fitted snugly in the cutout.
Figure 2.1 Dimension of Control Board
Figure 2.2 Dimension of Display Board
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 maximum voltage rating specified on the label are not exceeded.

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

* All units should be installed inside a suitably grounded metal enclosure to prevent live parts being accessible from 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 over-tighten the terminal screws. The torque should not exceed 1 N-m (8.9 Lb-in or 10.2KgF-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 maximum gauge 18 AWG.

---

**Figure 2.3 Lead Termination**

2.0mm
0.08" max.

4.5 ~ 7.0 mm
0.18" ~ 0.27"
Figure 2.4 Terminal Connection
2 - 4 Power Wiring

![Diagram of Power Supply Connections]

Figure 2.6 Power Supply Connections

2-5 Sensor Input Wiring

![Diagram of Sensor Input Wiring]

Figure 2.7 Sensor Input Wiring

2-6 Control Output Wiring

![Diagram of Control Output Wiring]

Figure 2.8 Output 1 Relay or Triac (SSR) to Drive Load
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

![Diagram of a relay or triac (SSR) driving a contactor with three phase delta heater load and no fuse breaker.]

Figure 2.15  
Output 2 Pulsed Voltage to Drive SSR

![Diagram showing the internal circuit of a SSR with 30mA/5V pulsed voltage.]

Figure 2.16  
Output 2 Linear Current

![Diagram illustrating the maximum load of 500 ohms for 0-20mA and 4-20mA linear current.]

UM0B421A 39
2-7 Alarm / Event Output Wiring

Figure 2.17 Output 2 Linear Voltage

Figure 2.18 Alarm / Event output wiring

Figure 2.19 Alarm Output to Drive Contactor
2-8 Event Input Wiring

2-9 Retransmission Output Wiring

Minimum Load
10K ohms for voltage
Maximum Load
500 ohm for current
2-10 Data Communication

Max. 247 units can be linked

Terminator 220 ohms / 0.5W

Figure 2.22 RS-485 Wiring
If you use a conventional 9-pin RS-232 cable instead of CC94-2, the cable must be modified according to the following circuit diagram.

**Figure 2.23**
RS-232 Wiring

**Figure 2.24**
Configuration of RS-232 Cable
Chapter 3  Configuration

The parameters stored in Home page can be obtained by pressing scroll key \( \mathbb{A} \). The parameters stored in Configuration page are obtained by pressing page key \( \mathbb{D} \) 2 times until the display shows \( PrOF \), then press page key \( \mathbb{D} \) for at least 5 seconds and release to show \( C_{onF} \) - the Configuration page, then press scroll key to get the configuration parameter. The upper display indicates the parameter symbol, and the lower display indicates the selected value of parameter.

3-1 Password

There are two parameters which specify the data security function, these are PASS (password) and CODE (security code).

<table>
<thead>
<tr>
<th>Value of CODE</th>
<th>Value of PASS</th>
<th>Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Any value</td>
<td>All parameters are changeable</td>
</tr>
<tr>
<td>=1000</td>
<td></td>
<td>All parameters are changeable</td>
</tr>
<tr>
<td>≠1000</td>
<td></td>
<td>Only Home page parameters are changeable</td>
</tr>
<tr>
<td>Others</td>
<td>=CODE</td>
<td>All parameters are changeable</td>
</tr>
<tr>
<td></td>
<td>≠CODE</td>
<td>All parameters are not changeable</td>
</tr>
</tbody>
</table>

Table 3.1 Password operation

3-2 Signal Input

**INPT:** Selects the sensor type or signal type for signal input.

- **Range:** (thermocouple) J_TC, K_TC, T_TC, E_TC, B_TC, R_TC, S_TC, N_TC, L_TC, C_TC, P_TC.
- (RTD) PT.DN, PT.JS
- (linear) 4-20, 0-20, 0-60, 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 selects 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:

Formula: \( PV = \text{INLO} + (\text{INHI} - \text{INLO}) \frac{S - \text{SL}}{\text{SH} - \text{SL}} \)

Example: A 4-20 mA current loop pressure transducer with range 0 - 15 kg/cm\(^2\) is connected to input, then perform the following setup:

- \( \text{INPT} = 4 - 20 \)
- \( \text{INLO} = 0.00 \)
- \( \text{INHI} = 15.00 \)
- \( \text{DP} = 2 - \text{DP} \)

Of course, you may select other value for DP to alter the resolution.

3-3 Event Input

The Event input accepts a digital type signal via momentary and close contacts. The types of signal:

1. relay or switch contacts, 
2. open collector pull low and 
3. TTL logic level, can be used to switch the event input. one of eight functions can be chosen by using \( E\), \( F\) (EIFN) contained in configuration page.

0 NONE: Event input no function

1 RUN: Applicable when unit is in static mode or Off mode
   Requires only momentary type input
   Event input close: unit will enter run mode
2 **HOLD**: Applicable when unit is running  
   Event input close: Hold the profile  
   Event input open: Run profile again. Resume from the  
   segment where it hold earlier

3 **ABOT**: Applies when unit is in run mode  
   Requires only momentary type input  
   Event input close: Unit will abort the current running profile  
   and enter static mode.

4 **MAN**: Applies when unit is in static mode or run mode  
   Event input close: Outputs performs bumpless transfer  
   Event input open: Unit will perform normal PID operation

5 **FTRA**: Applies when unit is in static mode or run mode  
   Event input close: Performs failure transfer function  
   Event input open: Unit will perform normal PID operation

6 **OFF**: Applies when unit is in static mode or run mode  
   Event input close: All outputs/alarm turn off, profile stops  
   running  
   Event input open: If running, profile resumes where it was put  
   into off condition, outputs/alarms active again as per  
   configuration

7 **PASS**: Applies when unit is run mode  
   Requires only momentary type input to pass to next segment  
   Event input close: Profile will move ahead by 1 segment

8 **PID2**: Applies when unit is in static mode or run mode  
   If chosen, close the event input pins the PB2, TI2 and TD2 will  
   replace PB1, TI1 and TD1 for control.
3-4 Control Outputs

There are five types of control modes can be configured as shown in Table 3.2.

<table>
<thead>
<tr>
<th>Control Modes</th>
<th>OUT1</th>
<th>OUT2</th>
<th>O1HY</th>
<th>A1HY</th>
<th>CPB</th>
<th>DB</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heat only</td>
<td>$H_{on}F$</td>
<td>$H_{PEC}$</td>
<td>$H_{Lin}$</td>
<td>$\times$</td>
<td>$\star$</td>
<td>$\times$</td>
</tr>
<tr>
<td>Cool only</td>
<td>$C_{on}F$</td>
<td>$C_{PEC}$</td>
<td>$C_{Lin}$</td>
<td>$\times$</td>
<td>$\star$</td>
<td>$\times$</td>
</tr>
<tr>
<td>Heat: ON-OFF</td>
<td>$H_{on}F$</td>
<td>$AL_I$</td>
<td>$\bigcirc$</td>
<td>$\bigcirc$</td>
<td>$\times$</td>
<td>$\times$</td>
</tr>
<tr>
<td>Cool: ON-OFF</td>
<td>$H_{PEC}$</td>
<td>$AL_I$</td>
<td>$\times$</td>
<td>$\bigcirc$</td>
<td>$\times$</td>
<td>$\times$</td>
</tr>
<tr>
<td>Heat: PID</td>
<td>$HEPC$</td>
<td>$CL_I$</td>
<td>$\times$</td>
<td>$\times$</td>
<td>$\bigcirc$</td>
<td>$\bigcirc$</td>
</tr>
<tr>
<td>Cool: PID</td>
<td>$HEPC$</td>
<td>$CL_I$</td>
<td>$\times$</td>
<td>$\times$</td>
<td>$\bigcirc$</td>
<td>$\bigcirc$</td>
</tr>
</tbody>
</table>

$\star$: Required to adjust if ON-OFF control is configured.

$\bigcirc$: Adjust to meet process requirements

$\times$: Don't care

Table 3.2 Heat-Cool control configuration value

**Heat Only ON-OFF Control**: Select $H_{on}F$ for OUT1 and O1HY is used for adjusting the dead band of ON-OFF control. The heat only on-off control function is shown in the following diagram.
The ON-OFF control may introduce excessive process oscillation even if hysteresis is minimized to the smallest. If ON-OFF control is set, PB1, TI1, TD1, PB2, TI2, TD2, CYC1, CYC2, OFST, CPB and 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 \( H \cdot E \cdot P \cdot C \) or \( H \cdot L \cdot n \) for OUT1 and set TI1 and TI2 to ZERO, OFST is used to adjust the control offset (manual reset). O1HY is hidden. **OFST Function:** OFST is measured by % with range 0 - 100.0%. In the steady state (i.e., the process has been stabilized) if the process value is lower than the set point by a definite value, say 5°C, while 20°C is used for proportional band, that is lower than set point by 25%, then increase OFST value by 25% will compensate the process offset situation. After adjusting OFST to a correct value, the process value will move to coincide with set point. The auto-tuning mode is disabled for P or PD control. Refer to section 3-11 for manual tuning. P or PD control is not perfect because the load may change from time to time and you need to adjust OFST often. The PID control can avoid this defect.
**Heat only PID control**: Set $H \in \mathbb{P}$ or $H \in \mathbb{L}$ for OUT1 and non-zero value of proportional band and integral time. Perform auto-tuning to the new process, or set correct values for PB1, TI1 and TD1. If the control result is still unsatisfactory, then perform manual tuning to improve the control. See section 3-11 for manual tuning. The unit contains a very clever PID and fuzzy algorithm to achieve a very small overshoot and very quick response to the process if it is tuned properly.

**Cool only control**: ON-OFF control, $P$ (or $PD$) control and PID control can be selected for cool only control through Output 1. Set OUT1 to $ConF$, $\mathbb{L} \in \mathbb{P}$ or $\mathbb{L} \in \mathbb{L}$, the other functions for cool only ON-OFF control, cool only $P$ ($PD$) control and cool only PID control are same as descriptions for heat only control except that the output variable (and action) for the cool control is inverse to the heat control.

**Heat - Cool control**: Three types of combination for heat-cool control are available as shown in table 3.1. The case 1~case 3 in Fig 3.3 show the heat PID and cool PID operation. The case 4 show the heat PID and cool ON-OFF operation.
Figure 3.3 Heat - cool Control

Case 2

Case 3

Case 4

Output Power (%)

Output 1

Output 2

PB1 or PB2

CPB

Process value

DB positive

DB=0

SV

Output 2 OFF

Output 2 ON

Output 1

Output 1

Output 2

Output 1

Output 2

OUT2=ALM1

ALF1 = dE.H

ASP1 = A1HY

Figure 3.3 Heat - cool Control
**DB Configuration**: Adjustment of DB is dependent on the system requirements. If more positive value of DB (greater dead band) 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

**NOTE**: The ON-OFF control may result excessive overshoot and undershoot problems in the process. The P (or PD) control will result in a deviation 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 configuration required**: CYC1, CYC2, O1FT and O2FT

CYC1 is adjusted according to the type of output device. Generally, select 0.5~2 sec. for CYC1 if solid state relay drive or solid relay is installed for output1, 10~20 sec. if relay is installed for output1 and CYC1 is ignored if linear output is selected. Similar condition is applied for CYC2 selection.

See section 3-9 for O1FT and O2FT adjustment.
3-5 Alarms

The unit can be configured up to three alarm outputs at OUT2, OUT3 and OUT4. There are 9 types of alarm functions can be selected, and 4 kinds of alarm modes are available for each alarm function.

- **P.H:** A process high alarm is independent of set point. When the process is higher than the alarm value, a process high alarm occurs, and the alarm is off as the process value is lower than alarm value - (minus) alarm hysteresis. Fig. 3.4 shows the process high alarm operation.

![Figure 3.4 Process high alarm 1 operation](image)

- **P.L:** A Process low alarm is independent of set point. When the process is lower than the alarm value, a process low alarm occurs, and the alarm is off as the process value is higher than alarm value + alarm hysteresis. Fig. 3.5 shows the process low alarm operation.

![Figure 3.5 Process low alarm 1 operation](image)
**dE.H:** A deviation high alarm alerts the operator when the process deviates too high from set point value. When the process is higher than SV+ASP1, a deviation high alarm occurs and the alarm is off as the process is lower than SV+ASP1-A1HY. Figure 3.6 shows the deviation high alarm operation.

![Figure 3.6 Deviation high alarm 1 operation](image)

**dE.L:** A deviation low alarm alerts the operator when the process deviates too low from set point value. When the process is lower than SV+ASP1 (ASP1 is negative value), a deviation low alarm occurs, and the alarm is off as the process is higher than SV+ASP1+A1HY. Figure 3.7 shows the deviation low alarm operation.

![Figure 3.7 Deviation low alarm 1 operation](image)
A deviation band high/low alarm presets two trigger levels relative to set point value. The two trigger levels are SV+ASP1 and SV-ASP1 for alarm. When the process is higher than SV+ASP1 or lower than SV-ASP1, a deviation band alarm occurs. When the process is within the trigger levels SV+ASP1-A1HY and SV-ASP1+A1HY (where ASP1 must be positive value). Figure 3.8 shows the deviation band alarm 1 operation.

**Figure 3.8 Deviation band alarm 1 operation**

The above description is based on alarm 1 which is selected for output 2, the operations of alarm 2 and alarm 3 are same as alarm 1. In the above description SV denotes the current set point value for control which is different from SP1 as the profile mode is performed.
The alarm modes (A1MD, A2MD and A3MD) are set by using a three bit of binary number.

<table>
<thead>
<tr>
<th>alarm mode value</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>normal</td>
<td>A direct acting <strong>normal</strong> alarm output is off as the non-alarm condition and on as an alarm condition. The output state is inverted as a reverse alarm output is selected for OUT2, OUT3 or OUT4.</td>
</tr>
<tr>
<td>latching</td>
<td>A direct acting <strong>latching</strong> alarm output is on as an alarm condition and it will remain unchanged even if the alarm condition is cleared. The output state is inverted as a reverse alarm output is selected for OUT2, OUT3 or OUT4.</td>
</tr>
<tr>
<td>holding</td>
<td>A direct acting <strong>holding</strong> alarm output is off even if an alarm condition may occur on power up. This will prevail until the alarm condition returns to the &quot;inactive&quot; condition, thereafter the alarm will operate normally. The output state is inverted as a reverse alarm output is selected for OUT2, OUT3 or OUT4.</td>
</tr>
<tr>
<td>latching holding</td>
<td>A direct acting <strong>latching</strong> and <strong>holding</strong> alarm performs both holding and latching alarm functions. The output state is inverted as a reverse alarm output is selected for OUT2, OUT3 or OUT4.</td>
</tr>
</tbody>
</table>

**Table 3.3 Alarm mode description**

The latching alarm output is off when both ▲ and ▼ keys are pressed, once the alarm condition is removed.
3-6 Configure Home Page

The conventional controllers are designed with a fixed parameter scrolling. This unit has the flexibility for you to select those parameters which are most useful to you and put these parameters in the home page. Hence, you can have a custom home page.

There are up to eight parameters can be selected for home page, these are : SEL1~SEL8 in the configuration page.

There are 19 parameters can be selected for SEL1~SEL8, these are: INPT, UNIT, DP, PB1, TI1, TD1, PB2, TI2, TD2, OFST, O1HY, CYC1, CYC2, CPB, DB, A1HY, A2HY, A3HY, ADDR.

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 configuration condition. The hidden parameters for a specific application are also deleted from the values of SEL1~SEL8 parameters.

3-7 User Calibration

Each unit is calibrated in the factory before shipment. You still can modify the calibration conditions after shipment.

Purpose of user calibration
The basic calibration of the unit is highly stable and set for life. User calibration allows you to offset the permanent factory calibration to either:

1. Calibrate the unit to meet your reference standard.
2. Match the calibration of the unit to that of a particular transducer or sensor input.
3. Calibrate the unit to suit the characteristics of a particular installation.
4. Remove long term drift in the factory set calibration.

There are two parameters: offset low value OFSTL and offset high value OFSTH which are adjusted to correct the error of process value.

See section 1-5 for key operation flowchart, press key until low calibration page is obtained. Send the low signal to the input of unit, then press key. If the process value (the upper display) is different from the input signal, then you can use and keys to change the OFSTL value (the lower display) until the process value is equal to the value you want. Then press and hold key for 5 seconds. The low point calibration is finished. The similar procedure is applied to high point calibration.
The two points construct a straight line. For the reason of accuracy it is best to calibrate with the two points as far as possible. After user calibration is complete, the input type will be stored in the memory. If the input type is changed, a calibration error will occur and an error code \text{EAE} is displayed.
In certain application 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 time constant specified by \texttt{FILT} parameter. The default value of \texttt{FILT} is 0.5 sec. before shipping. Adjust \texttt{FILT} to change the time constant from 0 to 60 seconds. 0 second represents no filter is applied to the input signal. The filter is characterized by

\textbf{Note}

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

\textbf{Figure 3.10 Filter Characteristics}

\begin{figure}[h]
\centering
\includegraphics[width=\textwidth]{filter_characteristics.png}
\caption{Filter Characteristics}
\end{figure}
3 -9 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 fails.

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 (ie. HTPC, CTPC, HLIN, or CLIN selected for OUT1, ), and BPLS is selected for O1FT, then output 1 will perform bumpless transfer. Thereafter the previous averaging value of MV1 will be used for controlling output 1.
2. If output 1 is configured as proportional control, 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 (ie. HONF or CONF is selected for OUT1), 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 CTPC or CLIN, 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 CTPC or CLIN, 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.

**OUT3 and OUT4 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 O3FT or O4FT.
3-10 Auto-tuning

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

The auto-tuning is applied in cases of:
* Initial setup for a new process
* The set point is changed substantially from the previous auto-tuning value
* The control result is unsatisfactory

Operation:
1. Set the correct values for the configuration page. Nonzero value for PB and TI should be set. Set a correct password for the unit.
2. Set EIFN = PID2 if a second set of PID is required to be tuned.
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. Then enters the A-T mode. The upper display will begin to flash and the auto-tuning procedure for PID1 is beginning.
4. If the system needs to use a second set of PID values, then after the first auto-tuning is complete, close the event input of the unit and repeat the step 3 to the second set of PID values.

NOTE:
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 procedures are completed, the upper display will cease to flash and the unit revert to PID control by using its new PID values. The PID values obtained are stored in the nonvolatile memory.
Auto-Tuning Error

If auto-tuning fails an ATER message will appear on the upper display in cases of:

- If PB exceeds 9000 (9000 PU, 900.0 F or 500.0 C).
- or if TI exceeds 3600 seconds.
- or if set point is changed during auto-tuning procedure.

Solutions to ATER

1. Try auto-tuning once again.
2. Don't change set point value during auto-tuning procedure.
3. Don't set zero value for PB and TI.
4. Use manual tuning instead of auto-tuning. (See section 3-12).
5. Touch ▲ and ▼ key to reset ATER message.

3 - 11 Manual Tuning

In certain applications (very few) using auto-tuning to tune a process may be inadequate for the control requirement, then you can try manual tuning.

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

<table>
<thead>
<tr>
<th>ADJUSTMENT SEQUENCE</th>
<th>SYMPTOM</th>
<th>SOLUTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1) Proportional Band (PB)</td>
<td>Slow Response</td>
<td>Decrease PB</td>
</tr>
<tr>
<td></td>
<td>High overshoot or Oscillations</td>
<td>Increase PB</td>
</tr>
<tr>
<td>(2) Integral Time (TI)</td>
<td>Slow Response</td>
<td>Decrease TI</td>
</tr>
<tr>
<td></td>
<td>Instability or Oscillations</td>
<td>Increase TI</td>
</tr>
<tr>
<td>(3) Derivative Time (TD)</td>
<td>Slow Response or Oscillations</td>
<td>Decrease TD</td>
</tr>
<tr>
<td></td>
<td>High Overshoot</td>
<td>Increase TD</td>
</tr>
</tbody>
</table>

Table 3.4 PID Adjustment Guide

Figure 3.11 shows the effects of PID adjustment on process response.
Figure 3.11 Effects of PID Adjustment
3 - 12 Manual Mode

Operation:
To enable manual control the password PASS should be set with a value equal to CODE (except CODE=0 ). Press key to get \( \text{mode select} \), then use \( \text{Man} \) keys to obtain \( \text{Man} \). Then press key for 5 seconds, the unit now enters the manual mode. The upper display will begin to flash and the lower display will show \( \text{man} \) or \( \text{man} \). \( \text{man} \) indicates control percentage value for heating output and \( \text{man} \) indicates control percentage value for cooling output. Now you can use up and down key to adjust the percentage values for the heating or cooling output. The controller performs open loop control as long as it stays in manual mode.

Exit Manaul Made
To press both \( \text{up} \) and \( \text{down} \) keys, the controller will revert to static mode and show home display.

3 - 13 Data Communication
The controllers support \( \text{RTU} \) mode of \( \text{Modbus} \) protocol for the data communication. Other protocols are not available for the series.

Two types of interface are available for Data Communication. These are \( \text{RS-485} \) and \( \text{RS-232} \) 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.

Using a PC for data communication is the most economic 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. But there is no need to be sad. Many RS-485 units (up to 247 units) can be connected to one RS-232 port, therefore a PC with 4 comm ports can communicate with 988 units. It is quite economic.
Setup
Enters the configuration page.
Select COMM for OUT4 or OUT5. Set unequal addresses for those units which are connected to the same port.
Set the Baud Rate (BAUD), and Parity Bit (PARI) such that these values are conform to 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 2-10.

3 - 14 Retransmission
The profiler can output (retransmit) process value or set point value via its retransmission terminals RE+ and RE- provided that the retransmission option is ordered. To accomplish this you can select $r_{EPV}$ (REPV) or $r_{ESP}$ (RESP) for OUT4 or OUT5. The following parameters should be configured for retransmission:

OP4L : Low limit value for output 4
OP4H : High limit value for output 4
REL4 : Retransmission low scale value for output 4
REH4 : Retransmission high scale value for output 4
OP5L : Low limit value for output 5
OP5H : High limit value for output 5
REL5 : Retransmission low scale value for output 5
REH5 : Retransmission high scale value for output 5

Example: If you want to output 4 mA for PV at 0°C and 20mA for PV at 1000°C via output 5, then you should set the following parameters:

\[
\text{OUT5} = r_{EPV} \\
\text{OP5L} = 20.0 \% , \text{since 20\% of a 0-20mA output module equipped will output 4 mA (20\% of 20mA span).}
\]

OP5H = 100.0 (%) \\
REL5 = 0°C \\
REH5 = 1000°C
3 - 15 Output Scaling

The output scaling can be applied to the cases of linear output (case 1 in Fig. 3.12) and retransmission (case 2 in Fig. 3.12). The Out.L in Fig. 3.12 may be 0 mA, 0V, 1V or 4mA, and out.H may be 20mA, 5V or 10V according the output module installed.

Case 1

MV1 or MV2

Case 2

Retransmission PV or SV

Figure 3.12 Output scaling function
Chapter 4 Profiler Operation

4-1 What is set point profiler

Many applications need to vary temperature or process value with time. Such applications need a controller which varies a set point as a function of time. The process controller B42 can do this. The set point is varied by using a set point profiler. The profile is stored as a series of "ramp" and "dwell" segments, as shown below.

![Set point profile](image)

**Figure 4.1 Set point profile**

In each segment you can define the state of up to 3 event outputs which can drive either relay, logic or triac outputs, depending on the modules installed.

A profile is executed either once, repeated a set number of times or repeated continuously. If repeated a set number of times, then the number of cycles must be specified as part of the profile.

There are four types of segment:

<table>
<thead>
<tr>
<th>Segment</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ramp</td>
<td>The set point ramp linearly, from its current value to a new value, either at a rate (ramp rate), or in a set time ramp time. You must specify the ramp rate or the ramp time and the target set point when creating or modifying a profile.</td>
</tr>
<tr>
<td>Dwell</td>
<td>The set point remains constant for a specified period.</td>
</tr>
<tr>
<td>Jump</td>
<td>It is often necessary to jump backward and run the loop a set number of cycles.</td>
</tr>
<tr>
<td>End</td>
<td>The profile either ends in this segment or repeats a set number of cycles. The profile stops after the repeated cycles are finished.</td>
</tr>
</tbody>
</table>

Table 4.1 Segment types
4-2 Segment connection
Four kinds of combination are allowable for connecting segments, these are:

Ramp-Ramp:

Ramp-Dwell:

Dwell-Ramp:

Dwell-Dwell:

4-3 Profiler Modes
The profiler has eight operating modes:

<table>
<thead>
<tr>
<th>Mode</th>
<th>Description</th>
<th>Indication</th>
</tr>
</thead>
<tbody>
<tr>
<td>Run</td>
<td>In run mode, the profiler varies the set point according to the stored profile values.</td>
<td>RUN light on</td>
</tr>
<tr>
<td>Hold</td>
<td>In hold mode, the profile is frozen at its current point. In this state you can make temporary changes to any profile parameter (for example, a target set point, a dwell time or the time remaining in the current segment). Such changes will only remain effective until the profile is reset and run again, when they will be overwritten by the stored profile values.</td>
<td>HLD light on</td>
</tr>
<tr>
<td>Mode</td>
<td>Description</td>
<td>Indication</td>
</tr>
<tr>
<td>--------</td>
<td>-----------------------------------------------------------------------------</td>
<td>-------------------------------------</td>
</tr>
<tr>
<td>Holdback</td>
<td>Holdback indicates that the process value is lagging the set point by more than a preset amount (holdback band HBBBD) and that the profile is in HOLD, waiting for the process to catch up.</td>
<td>HLD light flashes</td>
</tr>
<tr>
<td>Static</td>
<td>In static mode, the profiler is inactive and the controller act as a standard controller, with the set point determined by the value set in the lower display.</td>
<td>Both RUN and HLD light are off</td>
</tr>
<tr>
<td>A-T</td>
<td>In automatic tuning mode, the profiler is inactive and the controller executes automatic tuning function at its static mode set point.</td>
<td>Both RUN and HLD light are off. Upper display flashes.</td>
</tr>
<tr>
<td>MAN</td>
<td>In manual mode, the profiler is inactive and the heating and cooling output values can be adjusted at the lower display by up-down keys.</td>
<td>Both RUN and HLD light are off. Upper display flashes. Lower display shows ( H _ _ _ ) or ( L _ _ _ )</td>
</tr>
<tr>
<td>OFF</td>
<td>In off mode, the profiler is inactive and all the outputs are disabled. That is all the control outputs, alarms and event outputs are off.</td>
<td>Both RUN and HLD light are off. Upper display shows OFF and flashes.</td>
</tr>
<tr>
<td>End</td>
<td>The profile is complete.</td>
<td>Both RUN and HLD lights flash.</td>
</tr>
</tbody>
</table>

**Table 4.2 Profiler Modes**

**4-4 Running, holding and aborting a profile**

Press page key until mode page is obtained. The upper display will show \( \text{ModE} \) and the lower display is the values for mode selection. By using up/down key until \( \text{run} \) is obtained. Press page key for 5 seconds then the profiler enters RUN mode. If \( \text{HoLd} \) is obtained, pressing the page key for 5 seconds will enter HOLD mode.
The operator may abort (i.e. terminate) the current profile by holding page key for more than 5 seconds during the lower display shows STARE. When the program is aborted, the profiler is inactive and enters static mode. At the same time both the RUN light and HLD light are off.

If "RUN" and "HLD" LED's are blinking simultaneously, it indicates the end of previous running profile, it requires to Reset profile controller by pressing UP and DOWN keys together to take Profile start segment, PFSG = 1.00. Select the profile and segment by pressing Enter Key. P 1.00 indicates profile 1 and segment 00 is selected.

Please refer to section 1-5 for key operation.

4-5 Viewing and modifying profile progress

Three parameters: PFSG, TIME, CYCL which indicate the status of profile progress. The operator can easily view these parameters: the current profile and segment number, the time remaining for the current segment and the cycle remaining for the current profile on the home page.

When profile is running, if is required to jump to another segment, then it requires holding of current profile, go to current segment PSEG by pressing "Enter" button, then use "Up" and "Down" buttons to modify the segment and then run the profile again.

When profile is running, if it is required to change dwell time or ramp rate of current segment, then it requires holding of current profile, press "Enter" button, twice to go to "TIME" and then modify the value and then run the profile again.

When profile is running, if it is required to modify next segment data, no need to hold the current profile, modifications can be done directly from the configuration

4-6 Start

The parameter "St Ar" in the configuration is used to specify the start point for the profile.
There are three values for the starting point, these are
PV: Process value (default value )
SP1: controller set point value
STSP: start set point value
The normal method is to start from the process value, because this will produce a smooth and bumpless start to the process. However, if you want to guarantee the time period of the first segment, you should set SP1 or STSP for the start point
4-7 Holdback

As the set point ramps up or down (or dwells), the measured value may lag behind or deviate from the set point by an undesirable amount. "Holdback" is available to freeze the profile at its current state, should this occur. The action of Holdback is the same as a deviation alarm. It can be enabled or disabled. Holdback has three parameters: \textbf{HBT}\textsuperscript{2} holdback wait time, \textbf{HBBD}\textsuperscript{2} holdback band and \textbf{HBTY}\textsuperscript{2} holdback type. If the error from the set point exceeds the set holdback band (HBBD), then the holdback feature, if enabled, will automatically freeze the profile at its current point and flash the HLD light. At the same time, the holdback timer begins to count. When the value of holdback timer exceeds the value of holdback wait time HBT, the profiler will no longer be freezed and jump to its next segment, at the same time an error code \textit{HbEr} will be displayed. When the error comes within the holdback band (HBBD), the program will resume normal running. There are four different Holdback types. The choice of type is made by setting HBTY parameter when creating a profile, and may be one of the following:

\begin{itemize}
  \item \textit{OFF} - Disables Holdback - no action is taken.
  \item \textit{Lo} - Deviation Low Holdback holds the profile back when the process value deviates below the set point by more than the holdback band (HBBD).
  \item \textit{Hi} - Deviation high holdback holds the profile back when the process value deviates above the set point by more than the holdback band (HBBD).
  \item \textit{brnd} - Deviation Band Holdback is a combination of the two. It holds the profile back when the process value deviates either above or below the set point by more than the holdback band (HBBD).
\end{itemize}

HBT is a global parameter which is common to all profiles. HBBD is a parameter which apply to a specific profile. HBTY is a parameter which apply to a segment in a specific profile.
Holdback on dwell

Profile held if HBTY set to Hi or BAND

Profile held if HBTY set to Lo or BAND

Holdback on positive ramp

Profile held if HBTY set to Hi or BAND

Profile held if HBTY set to Lo or BAND

Holdback on negative ramp

Profile held if HBTY set to Hi or BAND

Profile held if HBTY set to Lo or BAND

Figure 4.2 Holdback operation
4-8 Power failure

If power is lost and then restored, while a profile is running, the behavior of the profile is determined by the setting of the parameter " PFR " power fail recovery in profile configuration. This can have one of 4 settings - \texttt{cont}, \texttt{PU}, \texttt{SP} and \texttt{off}. If \texttt{cont} is selected, then when power is restored the profile continues from where it was interrupted when power was lost. The parameters such as set point value ( \texttt{SV} ), time remaining ( \texttt{TIME} ) and cycle remaining ( \texttt{CYCL} ) will be restored to their power-down values. For application that need to bring the process value to the set point value as soon as possible, this is the best choice. The two diagrams below illustrate the respective responses, Fig. 4.3 if power fails during a dwell segment and Fig. 4.4 if it fails during a ramp segment.

\begin{figure}[h]
\centering
\includegraphics[width=\textwidth]{figure4.3.png}
\caption{Recovery from profile at dwell segment}
\end{figure}

\begin{figure}[h]
\centering
\includegraphics[width=\textwidth]{figure4.4.png}
\caption{Recovery from profile at ramp segment}
\end{figure}
If $PV$ is selected, then when power is restored the set point starts at the current process value, and then runs to the target set point of the active segment. This choice provides a smoother recovery. The two diagrams below illustrate the respective responses, Fig. 4.5 if power fails during a dwell segment and Fig. 4.6 if it fails during a ramp segment.

**Figure 4.5 Recovery from PV at dwell segment**

**Figure 4.6 Recovery from PV at ramp segment**

If $SP1$ is selected, then when power is restored the profiler is disabled and it enters static mode, and SP1 is selected for control set point. If $OFF$ is selected, then when power is restored the profiler is disabled and it enters OFF mode, all the control outputs as well as alarms and events are off.
4-9 Configuring the profiler
when first installing a profiler you should check that the configuration conforms to your requirement.

The following parameters are common to all profiles:

**Global Data**
- STAR : set point value at start of profile
- END : set point value at end of profile
- DLAY : Delay time before profile start
- PFR : Power fail recovery
- HBT : Holdback wait time

The following parameters are used for a specific profile:

**Profile Data**
- PROF : Profile number selected for view
- HBBD : Holdback band
- STSP : Start set point value
- RMPU : Unit for ramp segment
- DLLU : Unit for dwell segment

The following parameters which apply to each segment in a specific profile:

**Segment Data**
- SGNO : Segment number
- SGTY : Segment type
- TGSP : Target set point
- RTRR : Ramp time or ramp rate
- P2EV : PID selection and event output states
- HBTY : Holdback type
- DLLT : Dwell time
- SEG : Target segment number for jump segment
- CYCL : Repeat number of cycle
- FSP : Final set point for the end segment

4-10 Viewing and creating a profile
Refer to section 1-5 for key operation. Press page key to obtain configuration page. After completing the configuration of all the parameters including those parameters which are common to all profiles, you can proceed to the profile page to create a profile. To create a specific profile you need to set the profile number at first, then set HBBD, STSP, RMPU, DLLU and SGNO for this profile.
The next parameter is segment type (SGTY). There are four different segment types, these are:

- Ramp to a new set point at a set rate or in a set time (RAMP)
- Dwell for a set time (DLL)
- Jump to a specified segment in the same profile (JUMP)
- Make this segment the end of the profile (END)

The parameters that follow SGTY (segment type) depend on the type of segment selected as shown in the table below. The function of each parameter follows the table.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>0 RAMP</th>
<th>1 DLL</th>
<th>2 JUMP</th>
<th>3 END</th>
</tr>
</thead>
<tbody>
<tr>
<td>TGSP</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>RTRR</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>P2EV</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>HBTY</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>DLLT</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SEG</td>
<td></td>
<td>✓</td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>CYCL</td>
<td></td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>FSP</td>
<td></td>
<td></td>
<td></td>
<td>✓</td>
</tr>
</tbody>
</table>

Table 4.3 Parameters that follow segment type

Suppose that you need a profiler to control a process. The response of the profiler must be same as the figure shown below.
In order to meet the response of profiling curve example, you can make a series of setting of parameters as follow:

**Global Data**
- **STAR** = STSP
- **END** = OFF
- **DLAY** = 0
- **PFR** = PV
- **HBT** = 1.00

**Profile Data**
- **PROF** = 1
- **HBBBD** = 50
- **STSP** = 25.0
- **RMPU** = HH.MM
- **DLLU** = HH.MM

**Segment Data**

**Segment 0**
- **SGNO** = 0
- **SGTY** = RAMP
- **TGSP** = 150.0
- **RTRR** = 15
- **P2EV** = 0000
- **HBTY** = 1

**Segment 1**
- **SGNO** = 1
- **SGTY** = DLL
- **P2EV** = 0000
- **HBTY** = 3
- **DLLT** = 20

Figure 4.7 Profiling curve example
4-11 Event Outputs and PID Selection

The event outputs and PID selection are defined by parameter P2EV in the segment data and parameters OUT2, OUT3 and OUT4. There are up to 3 event outputs can be configured. The register 95 shown in section 1-6 describes how to define event status and select PID values.

There are two sets of PID parameters stored in the memory. If the unit is in RUN or HOLD mode, the PID sets are selected by the most significant bit of parameter P2EV. If the unit is in STAT mode (static or controller mode), the PID sets are selected by event input function EIFN. If the unit is in A-T mode, then PB1, TI1, TD1 are selected. If the unit is in AT2 mode, then PB2, TI2 and TD2 are selected.

There is a parameter MAEO which allows you to manually turn the output on and off when parameter OUT1, OUT2 or OUT3 is configured as event output. It is a four-bit binary number, 0 = inactive, 1 = active, the USB is to turn on/off the Event 1, the second bit is to turn on/off the Event 2 and the 3rd bit is to turn on/off the Event 3. This parameter MAEO can be accessed either via communication port or via front key switch and MAEO can be viewed in home page by selecting it in one of SEL1 through SEL8. The parameter MAEO will be not active in the profile mode or off mode, and will be active in static, manual and auto turn modes.
Chapter 5 Applications

A heat treatment oven need to vary temperature as a function of time. Because the process requires a rapid increase of temperature as it is heated and a rapid decrease of temperature as it is cooled. In order to achieve a rapid increase of temperature, an additional heater is turned on at higher range of temperature. A cooling fan is turned on to accelerate the cooling rate as the temperature falls fast. An alarm is required to announce the operator as the procedure is finished. Since the condition is changing when an additional heater is turned on, the PID control parameter should be different from the case of single heater. A B42 process controller is perfectly to meet the above requirements. The system diagram is shown below:

![System Diagram](image-url)
The output 1 is used to drive the main heater, the output 2 is used to drive the cooling fan, the output 3 is used for end of profile relay and the output 4 is used to drive the auxiliary heater.

![Temperature profile of the Heat Treatment Oven](image)

**Figure 5.2 Temperature profile of the Heat Treatment Oven**

The temperature profile is shown as Fig. 5.2. To achieve this profile, the profiler is configured by the following setting:

### Global Data

- STAR = PV
- END = OFF
- DLAY = 0
- PFR = CONT
- HBT = 0.05

### Profile Data

- PROF = 1
- HBBD = 50
- RMPU = HH.MM
- DLLU = HH.MM

### Segment Data

- SGNO = 1
- SGTY = RAMP
- TGSP = 400.0
- RTRR = 25
- P2EV = 0000
- HBTY = 1

### Controller Configuration Data

- ALF2 = ENDP
- A2MD = 0000
- INPT = K_TC
- OUT1 = HTPC
- O1FT = BPLS
- UNIT = LC
- DP = 1_DP
- CYC1 = 18.0

**Auto-tuning** is performed at 400 LC for PID1 and 1000LC for PID2.

Global Data

<table>
<thead>
<tr>
<th>Setting</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>STAR</td>
<td>PV</td>
</tr>
<tr>
<td>END</td>
<td>OFF</td>
</tr>
<tr>
<td>DLAY</td>
<td>0</td>
</tr>
<tr>
<td>PFR</td>
<td>CONT</td>
</tr>
<tr>
<td>HBT</td>
<td>0.05</td>
</tr>
</tbody>
</table>

Profile Data

<table>
<thead>
<tr>
<th>Setting</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>PROF</td>
<td>1</td>
</tr>
<tr>
<td>HBBD</td>
<td>50</td>
</tr>
<tr>
<td>RMPU</td>
<td>HH.MM</td>
</tr>
<tr>
<td>DLLU</td>
<td>HH.MM</td>
</tr>
</tbody>
</table>

Segment Data

<table>
<thead>
<tr>
<th>Setting</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>SGNO</td>
<td>1</td>
</tr>
<tr>
<td>SGTY</td>
<td>RAMP</td>
</tr>
<tr>
<td>TGSP</td>
<td>400.0</td>
</tr>
<tr>
<td>RTRR</td>
<td>25</td>
</tr>
<tr>
<td>P2EV</td>
<td>0000</td>
</tr>
<tr>
<td>HBTY</td>
<td>1</td>
</tr>
</tbody>
</table>

Controller Configuration Data

<table>
<thead>
<tr>
<th>Setting</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>ALF2</td>
<td>ENDP</td>
</tr>
<tr>
<td>A2MD</td>
<td>0000</td>
</tr>
<tr>
<td>INPT</td>
<td>K_TC</td>
</tr>
<tr>
<td>OUT1</td>
<td>HTPC</td>
</tr>
<tr>
<td>O1FT</td>
<td>BPLS</td>
</tr>
<tr>
<td>UNIT</td>
<td>LC</td>
</tr>
<tr>
<td>DP</td>
<td>1_DP</td>
</tr>
<tr>
<td>CYC1</td>
<td>18.0</td>
</tr>
</tbody>
</table>

**Note:**

Auto-tuning is performed at 400 LC for PID1 and 1000LC for PID2.
Chapter 6 Specifications

Power

- 90– 250 VAC, 47– 63 Hz, 12VA, 5W maximum
- 11– 26 VAC / VDC, 12VA, 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: A1.5uV/ C for all inputs except
  mA input
  A3.0uV/ 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

Burn-out Current: 200 nA

Common Mode Rejection Ratio ( CMRR ): 120dB
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:

<table>
<thead>
<tr>
<th>Type</th>
<th>Range</th>
<th>Accuracy @ 25 °C</th>
<th>Input Impedance</th>
</tr>
</thead>
<tbody>
<tr>
<td>J</td>
<td>-120°C–1000°C ( -184°F–1832°F )</td>
<td>+/-2 C</td>
<td>2.2 MΩ</td>
</tr>
<tr>
<td>K</td>
<td>-200°C–1370°C ( -328°F–2498°F )</td>
<td>+/-2 C</td>
<td>2.2 MΩ</td>
</tr>
<tr>
<td>T</td>
<td>-250°C–400°C ( -418°F–752°F )</td>
<td>+/-2 C</td>
<td>2.2 MΩ</td>
</tr>
<tr>
<td>E</td>
<td>-100°C–900°C ( -148°F–1652°F )</td>
<td>+/-2 C</td>
<td>2.2 MΩ</td>
</tr>
<tr>
<td>B</td>
<td>0°C–1800°C ( 32 BF–3272 F )</td>
<td>+/-2 C</td>
<td>2.2 MΩ</td>
</tr>
<tr>
<td>R</td>
<td>0°C–1767.8°C ( 32 BF–3214 F )</td>
<td>+/-2 C</td>
<td>2.2 MΩ</td>
</tr>
<tr>
<td>S</td>
<td>0°C–1767.8°C ( 32 BF–3214 F )</td>
<td>+/-2 C</td>
<td>2.2 MΩ</td>
</tr>
<tr>
<td>N</td>
<td>-250°C–1300°C ( -418°F–2372°F )</td>
<td>+/-2 C</td>
<td>2.2 MΩ</td>
</tr>
<tr>
<td>L</td>
<td>-200°C–900°C ( -328°F–1652°F )</td>
<td>+/-2 C</td>
<td>2.2 MΩ</td>
</tr>
<tr>
<td>C</td>
<td>0°C–2315°C ( 32 F–4199 F )</td>
<td>+/-2 C</td>
<td>2.2 MΩ</td>
</tr>
<tr>
<td>P</td>
<td>0°C–1395°C ( 32 F–2543 F )</td>
<td>+/-2 C</td>
<td>2.2 MΩ</td>
</tr>
<tr>
<td>PT100 (DIN)</td>
<td>-210°C–700°C ( -346°F–1292°F )</td>
<td>+/-0.4 C</td>
<td>1.3 KΩ</td>
</tr>
<tr>
<td>PT100 (JIS)</td>
<td>-200°C–600°C ( -328°F–1112°F )</td>
<td>+/-0.4 C</td>
<td>1.3 KΩ</td>
</tr>
<tr>
<td>mV</td>
<td>-8mV–70mV</td>
<td>+/-0.05 %</td>
<td>2.2 MΩ</td>
</tr>
<tr>
<td>mA</td>
<td>-3mA–27mA</td>
<td>+/-0.05 %</td>
<td>70.5Ω</td>
</tr>
<tr>
<td>V</td>
<td>-1.3V–11.5V</td>
<td>+/-0.05 %</td>
<td>650 KΩ</td>
</tr>
</tbody>
</table>
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**

<table>
<thead>
<tr>
<th>Type</th>
<th>Zero Tolerance</th>
<th>Span Tolerance</th>
<th>Load Capacity</th>
</tr>
</thead>
<tbody>
<tr>
<td>4~20 mA</td>
<td>3.6~4 mA</td>
<td>20~21 mA</td>
<td>500Ω max.</td>
</tr>
<tr>
<td>0~20 mA</td>
<td>0 mA</td>
<td>20~21 mA</td>
<td>500Ω max.</td>
</tr>
<tr>
<td>0 ~ 5 V</td>
<td>0 V</td>
<td>5 ~ 5.25 V</td>
<td>10 KΩ min.</td>
</tr>
<tr>
<td>1 ~ 5 V</td>
<td>0.9 ~ 1 V</td>
<td>5 ~ 5.25 V</td>
<td>10 KΩ min.</td>
</tr>
<tr>
<td>0 ~ 10 V</td>
<td>0 V</td>
<td>10 ~10.5 V</td>
<td>10 KΩ min.</td>
</tr>
</tbody>
</table>

**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)

<table>
<thead>
<tr>
<th>Type</th>
<th>Tolerance</th>
<th>Max. Output Current</th>
<th>Ripple Voltage</th>
<th>Isolation Barrier</th>
</tr>
</thead>
<tbody>
<tr>
<td>20 V</td>
<td>±1 V</td>
<td>25 mA</td>
<td>0.2 Vp-p</td>
<td>500 VAC</td>
</tr>
<tr>
<td>12 V</td>
<td>±0.6 V</td>
<td>40 mA</td>
<td>0.1 Vp-p</td>
<td>500 VAC</td>
</tr>
<tr>
<td>5 V</td>
<td>±0.25 V</td>
<td>80 mA</td>
<td>0.05 Vp-p</td>
<td>500 VAC</td>
</tr>
</tbody>
</table>

**Alarm**

- **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,
- **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
- **Parity Bit**: None, Even or Odd
- **Communication Buffer**: 256 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**

- **Dual 4-digit LED Displays**
- **Keypad**: 4 keys
- **Programming Port**: For automatic setup, calibration and testing
- **Communication Port**: RS-232 and RS-485

**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

**Output Settling Time**: 0.1 sec. (stable to 99.9 %)
**Isolation Breakdown Voltage**: 1000 VAC min.
**Integral Linearity Error**: +/-0.005 % of span
**Temperature Effect**: +/-0.0025 % of span/°C
**Saturation Low**: 0 mA (or 0 V)
**Saturation High**: 22.2 mA (or 5.55V, 11.1V min.)
**Linear Output Range**: 0-22.2mA(0-20mA or 4-20mA)
  - 0-5.55V (0 - 5V, 1 - 5V)
  - 0 - 11.1 V (0 - 10V)
Profiler

Number of profiles: 9
Number of Segment per profile
  Profile 1, 2, 3, 4: 16
  Profile 5, 6, 7: 32
  Profile 8, 9: 64
Event Outputs: 3

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/s² for 2 hours
Shock Resistance: 200 m/s² (20 g)

Approval Standards

Safety: UL61010C-1
  CSA C22.2 No.24-93
  EN61010-1 (IEC1010-1)
EMC: EN61326
Chapter 7 Modbus Communications

This chapter specifies the Modbus Communications protocol as RS-232 or RS-485 interface module is installed. Only RTU mode is supported. Data is transmitted as eight-bit binary bytes with 1 start bit, 1 stop bit and optional parity checking (None, Even or Odd). Baud rate may be set to 2400, 4800, 9600, 14400, 19200, 28800 and 38400.

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

<table>
<thead>
<tr>
<th>Query (from master)</th>
<th>Response (from slave)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Slave address (1-247)</td>
<td></td>
</tr>
<tr>
<td>Function code (3)</td>
<td></td>
</tr>
<tr>
<td>Starting address of register Hi (0)</td>
<td>Byte count</td>
</tr>
<tr>
<td>Starting address of register Lo (0-117, 128-143)</td>
<td>Data 1 Hi</td>
</tr>
<tr>
<td>No. of words Hi (0)</td>
<td>Data 1 Lo</td>
</tr>
<tr>
<td>No. of words Lo (1-118)</td>
<td>Data 2 Hi</td>
</tr>
<tr>
<td>CRC16 Hi</td>
<td>Data 2 Lo</td>
</tr>
<tr>
<td>CRC16 Lo</td>
<td></td>
</tr>
</tbody>
</table>

Function 06: Preset single Register

<table>
<thead>
<tr>
<th>Query (from master)</th>
<th>Response (from slave)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Slave address (1-247)</td>
<td></td>
</tr>
<tr>
<td>Function code (6)</td>
<td></td>
</tr>
<tr>
<td>Register address Hi (0)</td>
<td></td>
</tr>
<tr>
<td>Register address Lo (0-117, 128-143)</td>
<td></td>
</tr>
<tr>
<td>Data Hi</td>
<td></td>
</tr>
<tr>
<td>Data Lo</td>
<td></td>
</tr>
<tr>
<td>CRC16 Hi</td>
<td></td>
</tr>
<tr>
<td>CRC16 Lo</td>
<td></td>
</tr>
</tbody>
</table>
Function 16: Preset Multiple Registers

**Query** (from master)

Slave address (1-247)
Function code (16)
Starting address of register Hi (0)
Starting address of register Lo (0-117, 128-143)

No. of words Hi (0)
No. of words Lo (1-118)
Byte count (2-236)
Data 1 Hi
Data 1 Lo
Data 2 Hi
Data 2 Lo

**Response** (from slave)

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:

<table>
<thead>
<tr>
<th>Exception Code</th>
<th>Name</th>
<th>Cause</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Bad function code</td>
<td>Function code is not supported by the controller</td>
</tr>
<tr>
<td>2</td>
<td>Illegal data address</td>
<td>Register address out of range</td>
</tr>
<tr>
<td>3</td>
<td>Illegal data value</td>
<td>Data value out of range or attempt to write a read-only or protected data</td>
</tr>
</tbody>
</table>

Table 7.1 Exception Code Table

7-3 Parameter Table

You can refer to section 1-6 for the parameter description. The register address for each parameter is shown in the first column of the table. The register 133 for EROR is the error code. The error code description is shown in Table A.1.
The register 140 for PROG is the program code of the product. The program code is 37.xx for P41 and B42 where xx denotes the software version number. For example, PROG = 37.22 means that the process controller is P41 or B42 with software version 22.
7-4 Number System

The values stored in registers are based on 2's complement format. The relation between the value of number in register and its actual value is shown as following table.

<table>
<thead>
<tr>
<th>Number in register</th>
<th>Actual value</th>
</tr>
</thead>
<tbody>
<tr>
<td>65535</td>
<td>-1</td>
</tr>
<tr>
<td>65534</td>
<td>-2</td>
</tr>
<tr>
<td>50000</td>
<td>-15536</td>
</tr>
<tr>
<td>32769</td>
<td>-32767</td>
</tr>
<tr>
<td>32768</td>
<td>-32768</td>
</tr>
<tr>
<td>32767</td>
<td>32767</td>
</tr>
<tr>
<td>10000</td>
<td>10000</td>
</tr>
<tr>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

Table 7.2 Number Conversion Table

7-5 Communication Example

Example 1: Read the real time data (register 128~141)

Query

<table>
<thead>
<tr>
<th>Addr.</th>
<th>Func.</th>
<th>03</th>
<th>00</th>
<th>0x80</th>
<th>00</th>
<th>0x0E</th>
<th>Hi</th>
<th>Lo</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Example 2: Read segment 2 data of profile 3

Query

<table>
<thead>
<tr>
<th>Addr.</th>
<th>Func.</th>
<th>06</th>
<th>00</th>
<th>0x56</th>
<th>00</th>
<th>03</th>
<th>Hi</th>
<th>Lo</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 7.2 Number Conversion Table
Example 3: Perform reset function

Example 4: Enter auto-tuning mode

Example 5: Enter manual mode

Example 6: Modify the Calibration coefficient
Preset the CMND register with 26668 before attempting to change the calibration coefficient.
Example 7: Start from segment 4 to run profile 3

<table>
<thead>
<tr>
<th>Addr.</th>
<th>Func.</th>
<th>Register Addr.</th>
<th>Data Hi / Lo</th>
<th>CRC16</th>
</tr>
</thead>
<tbody>
<tr>
<td>06</td>
<td>00</td>
<td>0x0B</td>
<td>00</td>
<td>00</td>
</tr>
</tbody>
</table>

Query

Example 8: Hold the current profile

<table>
<thead>
<tr>
<th>Addr.</th>
<th>Func.</th>
<th>Register Addr.</th>
<th>Data Hi / Lo</th>
<th>CRC16</th>
</tr>
</thead>
<tbody>
<tr>
<td>06</td>
<td>00</td>
<td>0x0B</td>
<td>00</td>
<td>01</td>
</tr>
</tbody>
</table>

Query

Example 9: Create the profile which is specified in example of Fig. 4.7

<table>
<thead>
<tr>
<th>Addr.</th>
<th>Func.</th>
<th>Starting Addr.</th>
<th>No. of words</th>
<th>Bytes</th>
<th>STAR = 2</th>
<th>END = 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>0x10</td>
<td>00</td>
<td>0x50</td>
<td>00</td>
<td>05</td>
<td>0x0A</td>
<td>00</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Addr.</th>
<th>Func.</th>
<th>Starting Addr.</th>
<th>No. of words</th>
<th>Bytes</th>
<th>STAR = 2</th>
<th>END = 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>00</td>
<td>00</td>
<td>00</td>
<td>01</td>
<td>00</td>
<td>0x64</td>
<td>Hi</td>
</tr>
</tbody>
</table>

DLAY = 0  PFR = 1  HBT = 1.00  CRC16

Query

<table>
<thead>
<tr>
<th>Addr.</th>
<th>Func.</th>
<th>Starting Addr.</th>
<th>No. of words</th>
<th>Bytes</th>
<th>PROF = 1</th>
</tr>
</thead>
<tbody>
<tr>
<td>0x10</td>
<td>00</td>
<td>0x56</td>
<td>00</td>
<td>05</td>
<td>0x0A</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Addr.</th>
<th>Func.</th>
<th>Starting Addr.</th>
<th>No. of words</th>
<th>Bytes</th>
<th>PROF = 1</th>
</tr>
</thead>
<tbody>
<tr>
<td>00</td>
<td>0x32</td>
<td>00</td>
<td>0xFA</td>
<td>00</td>
<td>00</td>
</tr>
</tbody>
</table>

HBBD = 5.0  STSP = 25.0  RMPU = 0  DLLU = 0  CRC16
<table>
<thead>
<tr>
<th>Addr. Func.</th>
<th>Starting Addr.</th>
<th>No. of words</th>
<th>Bytes</th>
<th>SGNO</th>
<th>SGTY</th>
</tr>
</thead>
<tbody>
<tr>
<td>0x05 0xDC</td>
<td>0x0F 0x00</td>
<td>0x00 0x00</td>
<td>0x01</td>
<td>Hi</td>
<td>Lo</td>
</tr>
<tr>
<td>TGSP = 150.0</td>
<td>RTRR = 15</td>
<td>P2EV = 0</td>
<td>HBTY = 1</td>
<td>CRC16</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Addr. Func.</th>
<th>Starting Addr.</th>
<th>No. of words</th>
<th>Bytes</th>
<th>SGNO</th>
<th>SGTY</th>
</tr>
</thead>
<tbody>
<tr>
<td>0x06 0x0C</td>
<td>0x00 0x00</td>
<td>0x01 0x01</td>
<td>Hi</td>
<td>Lo</td>
<td></td>
</tr>
<tr>
<td>TGSP = 250.0</td>
<td>RTRR = 20</td>
<td>P2EV = 0</td>
<td>HBTY = 1</td>
<td>CRC16</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Addr. Func.</th>
<th>Starting Addr.</th>
<th>No. of words</th>
<th>Bytes</th>
<th>SGNO</th>
<th>SGTY</th>
</tr>
</thead>
<tbody>
<tr>
<td>0x09 0xC4</td>
<td>0x14 0x00</td>
<td>0x01 0x01</td>
<td>Hi</td>
<td>Lo</td>
<td></td>
</tr>
<tr>
<td>TGSP = 250.0</td>
<td>RTRR = 20</td>
<td>P2EV = 0</td>
<td>HBTY = 1</td>
<td>CRC16</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Addr. Func.</th>
<th>Starting Addr.</th>
<th>No. of words</th>
<th>Bytes</th>
<th>SGNO</th>
<th>SGTY</th>
</tr>
</thead>
<tbody>
<tr>
<td>0x0A 0x00</td>
<td>0x03 0x03</td>
<td>0x01 0x01</td>
<td>Hi</td>
<td>Lo</td>
<td></td>
</tr>
<tr>
<td>P2EV=10</td>
<td>DLLT=20</td>
<td>HBTY=1</td>
<td>CRC16</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Addr. Func.</th>
<th>Starting Addr.</th>
<th>No. of words</th>
<th>Bytes</th>
<th>SGNO</th>
<th>SGTY</th>
</tr>
</thead>
<tbody>
<tr>
<td>0x0B 0xC4</td>
<td>0x14 0x00</td>
<td>0x01 0x01</td>
<td>Hi</td>
<td>Lo</td>
<td></td>
</tr>
<tr>
<td>P2EV=10</td>
<td>DLLT=20</td>
<td>HBTY=1</td>
<td>CRC16</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
## Query

<table>
<thead>
<tr>
<th>Addr. Func.</th>
<th>Starting Addr.</th>
<th>No. of words</th>
<th>Bytes</th>
<th>SGNO</th>
<th>SGTY</th>
</tr>
</thead>
<tbody>
<tr>
<td>0x10 0x0</td>
<td>0x5B 0x0</td>
<td>0x06</td>
<td>0xOC</td>
<td>0x04</td>
<td>0x00</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>BytesStarting Addr.</th>
<th>StartingAddr</th>
<th>No. of words</th>
<th>Bytes</th>
<th>SGNO</th>
<th>SGTY</th>
</tr>
</thead>
<tbody>
<tr>
<td>0x05 0xDC</td>
<td>0x19 0x0</td>
<td>0x01</td>
<td>0x02</td>
<td>Hi</td>
<td>Lo</td>
</tr>
</tbody>
</table>

- **TGSP = 150.0**
- **RTRR = 25**
- **P2EV = 1**
- **HBTY = 2**
- **CRC16**

## Query

<table>
<thead>
<tr>
<th>Addr. Func.</th>
<th>Starting Addr.</th>
<th>No. of words</th>
<th>Bytes</th>
<th>SGNO</th>
<th>SGTY</th>
</tr>
</thead>
<tbody>
<tr>
<td>0x10 0x0</td>
<td>0x5B 0x0</td>
<td>0x02</td>
<td>0x04</td>
<td>0x05</td>
<td>0x02</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>BytesStarting Addr.</th>
<th>StartingAddr</th>
<th>No. of words</th>
<th>Bytes</th>
<th>SGNO</th>
<th>SGTY</th>
<th>CRC16</th>
</tr>
</thead>
<tbody>
<tr>
<td>0x02 0x62</td>
<td>0x02</td>
<td>0x04</td>
<td>0x01</td>
<td>0x02</td>
<td>Hi</td>
<td>Lo</td>
</tr>
</tbody>
</table>

- **SEG = 2**
- **CYCL = 2**
- **CRC16**

## Query

<table>
<thead>
<tr>
<th>Addr. Func.</th>
<th>Starting Addr.</th>
<th>No. of words</th>
<th>Bytes</th>
<th>SGNO</th>
<th>SGTY</th>
</tr>
</thead>
<tbody>
<tr>
<td>0x10 0x0</td>
<td>0x5B 0x0</td>
<td>0x02</td>
<td>0x04</td>
<td>0x06</td>
<td>0x01</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>BytesStarting Addr.</th>
<th>StartingAddr</th>
<th>No. of words</th>
<th>Bytes</th>
<th>SGNO</th>
<th>SGTY</th>
<th>CRC16</th>
</tr>
</thead>
<tbody>
<tr>
<td>0x02 0x64</td>
<td>0x02</td>
<td>0x04</td>
<td>0x03</td>
<td>0x06</td>
<td>0x00</td>
<td>0x03</td>
</tr>
</tbody>
</table>

- **P2EV = 0**
- **HBTY = 3**
- **DLLT = 24**
- **CRC16**

## Query

<table>
<thead>
<tr>
<th>Addr. Func.</th>
<th>Starting Addr.</th>
<th>No. of words</th>
<th>Bytes</th>
<th>SGNO</th>
<th>SGTY</th>
<th>TGSP</th>
</tr>
</thead>
<tbody>
<tr>
<td>0x10 0x0</td>
<td>0x5B 0x0</td>
<td>0x06</td>
<td>0xOC</td>
<td>0x07</td>
<td>0x00</td>
<td>0x00</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>BytesStarting Addr.</th>
<th>StartingAddr</th>
<th>No. of words</th>
<th>Bytes</th>
<th>SGNO</th>
<th>SGTY</th>
<th>TGSP</th>
</tr>
</thead>
<tbody>
<tr>
<td>0x00 0x1E</td>
<td>0x0A</td>
<td>0x00</td>
<td>0x01</td>
<td>Hi</td>
<td>Lo</td>
<td></td>
</tr>
</tbody>
</table>

- **RTRR = 30**
- **P2EV = 10**
- **HBTY = 1**
- **CRC16**

## Query

<table>
<thead>
<tr>
<th>Addr. Func.</th>
<th>Starting Addr.</th>
<th>No. of words</th>
<th>Bytes</th>
<th>SGNO</th>
<th>SGTY</th>
</tr>
</thead>
<tbody>
<tr>
<td>0x10 0x0</td>
<td>0x5B 0x0</td>
<td>0x02</td>
<td>0x04</td>
<td>0x08</td>
<td>0x00</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>BytesStarting Addr.</th>
<th>StartingAddr</th>
<th>No. of words</th>
<th>Bytes</th>
<th>SGNO</th>
<th>SGTY</th>
<th>CRC16</th>
</tr>
</thead>
<tbody>
<tr>
<td>0x02 0x64</td>
<td>0x02</td>
<td>0x04</td>
<td>0x06</td>
<td>0x00</td>
<td>0x03</td>
<td>0x00</td>
</tr>
</tbody>
</table>

- **P2EV = 8**
- **SGTY = 1**
- **CRC16**

## Notes

- **UM0B421A**
<table>
<thead>
<tr>
<th>Addr. Func.</th>
<th>Starting Addr.</th>
<th>No. of words</th>
<th>Bytes</th>
<th>P2EV</th>
<th>HBTY</th>
<th>DLLT</th>
<th>CRC16</th>
</tr>
</thead>
<tbody>
<tr>
<td>0x10 00 0x5F 00 03</td>
<td>0x06 0x0A 00 03 00 0x1E</td>
<td>Hi Lo</td>
<td>Bytes</td>
<td>P2EV=10</td>
<td>HBTY=3</td>
<td>DLLT=30</td>
<td>CRC16</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Addr. Func.</th>
<th>Starting Addr.</th>
<th>No. of words</th>
<th>Bytes</th>
<th>SGNO</th>
<th>SGTY</th>
<th>TGSP</th>
</tr>
</thead>
<tbody>
<tr>
<td>0x10 00 0x5B 00 06 0xOC 00 0x09 00 00 0x11 0x94</td>
<td>0x03 06 0x0A 0300</td>
<td>No. of words</td>
<td>Bytes</td>
<td>SGNO=9</td>
<td>SGTY=0</td>
<td>TGSP=450.0</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Addr. Func.</th>
<th>Starting Addr.</th>
<th>No. of words</th>
<th>Bytes</th>
<th>P2EV</th>
<th>HBTY</th>
<th>CRC16</th>
</tr>
</thead>
<tbody>
<tr>
<td>0x00 0x1E 00 0x0B 00 02</td>
<td>Hi Lo</td>
<td>RTRR=30</td>
<td>P2EV=11</td>
<td>HBTY = 2</td>
<td>CRC16</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Addr. Func.</th>
<th>Starting Addr.</th>
<th>No. of words</th>
<th>Bytes</th>
<th>SGNO</th>
<th>SGTY</th>
<th>CRC16</th>
</tr>
</thead>
<tbody>
<tr>
<td>0x10 00 0x5B 00 02 04 00 0x0A 00 01</td>
<td>Hi Lo</td>
<td>No. of words</td>
<td>Bytes</td>
<td>SGNO=10</td>
<td>SGTY=1</td>
<td>CRC16</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Addr. Func.</th>
<th>Starting Addr.</th>
<th>No. of words</th>
<th>Bytes</th>
<th>P2EV</th>
<th>HBTY</th>
<th>DLLT</th>
<th>CRC16</th>
</tr>
</thead>
<tbody>
<tr>
<td>0x10 00 0x5F 00 03</td>
<td>0x06 0x0A 00 03 00 0x14</td>
<td>Hi Lo</td>
<td>Bytes</td>
<td>P2EV=10</td>
<td>HBTY=3</td>
<td>DLLT=20</td>
<td>CRC16</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Addr. Func.</th>
<th>Starting Addr.</th>
<th>No. of words</th>
<th>Bytes</th>
<th>SGNO</th>
<th>SGTY</th>
<th>CRC16</th>
</tr>
</thead>
<tbody>
<tr>
<td>0x10 00 0x5B 00 06 0xOC 00 0x0B 00 00</td>
<td>0x03 0xE8 00 0x0B</td>
<td>00 01 00 02</td>
<td>Hi Lo</td>
<td>SGNO =11</td>
<td>SGTY = 0</td>
<td>CRC16</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Addr. Func.</th>
<th>Starting Addr.</th>
<th>No. of words</th>
<th>Bytes</th>
<th>SGNO</th>
<th>SGTY</th>
<th>CRC16</th>
</tr>
</thead>
<tbody>
<tr>
<td>0x10 00 0x5B 00 02 04 00 0x0C 00 03</td>
<td>Hi Lo</td>
<td>No. of words</td>
<td>Bytes</td>
<td>SGNO=12</td>
<td>SGTY=3</td>
<td>CRC16</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Addr. Func.</th>
<th>Starting Addr.</th>
<th>No. of words</th>
<th>Bytes</th>
<th>CYCL</th>
<th>FSP</th>
<th>CRC16</th>
</tr>
</thead>
<tbody>
<tr>
<td>0x10 00 0x63 00 02</td>
<td>04 00 02 0x03 0xE8</td>
<td>Hi Lo</td>
<td>Bytes</td>
<td>CYCL=2</td>
<td>FSP=100.0</td>
<td>CRC16</td>
</tr>
</tbody>
</table>
Chapter 8 Manual 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.

Equipments needed before calibration:
(1) A high accuracy calibrator (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

The calibration procedures described in the following section are a step by step manual procedures.
Manual Calibration Procedures

Step 1. Press the page key then release for 2 times until the Prof appears on the display. Press the page key for at least 5 seconds then release the display will show Conf. Press the page key for at least 5 seconds then release, the display will show Calo.

Step 2. Press the scroll key for at least 5 seconds then release, the display will show RdLo and the unit enters calibration mode. Send a 0.0 mV signal to the thermocouple input terminals. Press scroll key for at least 5 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 -1999 or 1999, then the calibration fails.

Step 3. Press the scroll key then release, the display will show AdHi. Send a 60 mV signal to the thermocouple input terminals in correct polarity. Press scroll key for at least 5 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 -1999 or 1999, then the calibration fails.

Step 4. Press the scroll key then release, the display will show rtdl. Send a 100 ohms signal with 3-wire to the RTD input terminals. Press scroll key for at least 5 seconds. The display will blink a moment. Otherwise if the display didn’t blink, then the calibration fails.

Step 5. Press the scroll key then release, the display will show rtdh. Change the ohm’s value to 300ohms. Press scroll key for at least 5 seconds. The display will blink a moment and two values are obtained for rtdl and rtdh. Otherwise if the display didn’t blink or if any value obtained for rtdl and rtdh is equal to -1999 or 1999, then the calibration fails.

Step 6. Connect a K type thermocouple to the thermocouple input terminals. Press the scroll key then release, the display will show CJo. Apply up/down key until value 0.00 is obtained. The unit under calibration is powered in a still-air room with temperature 25 C. Stay at least 20 minutes for warming up. Send a 0.0 C signal to the thermocouple input terminals. Apply up/down key until 0.00 is obtained. Press scroll key for at least 5 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.

Step 7. Return to the static mode by pressing up and down key at a time then release.
<table>
<thead>
<tr>
<th>Error Code</th>
<th>Display Symbol</th>
<th>Error Description</th>
<th>Corrective Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>Er04</td>
<td>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)</td>
<td>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.</td>
</tr>
<tr>
<td>10</td>
<td>Er10</td>
<td>Communication error: bad function code</td>
<td>Correct the communication software to meet the protocol requirements.</td>
</tr>
<tr>
<td>11</td>
<td>Er11</td>
<td>Communication error: register address out of range</td>
<td>Don’t issue an over-range register address to the slave.</td>
</tr>
<tr>
<td>14</td>
<td>Er14</td>
<td>Communication error: attempt to write a read-only data or a protected data</td>
<td>Don’t write a read-only data or a protected data to the slave.</td>
</tr>
<tr>
<td>15</td>
<td>Er15</td>
<td>Communication error: write a value which is out of range to a register</td>
<td>Don’t write an over-range data to the slave register.</td>
</tr>
<tr>
<td>25</td>
<td>HbeEr</td>
<td>Holdback time out</td>
<td>Evaluate validity of the PID values</td>
</tr>
</tbody>
</table>
| 26         | AteEr          | 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.  
4. Don’t set a zero value for PB.  
5. Don’t set a zero value for TI.  
6. Touch RESET key |
| 27         | CaeEr          | You have selected an input type which was not calibrated                           | Calibrate the new input type or change input type to the calibrated one.           |
| 29         | Eepe           | EEPROM can’t be written correctly                                                  | Return to factory for repair.                                                      |
| 30         | CjeEr          | Cold junction compensation for thermocouple malfunction                            | Return to factory for repair.                                                      |
| 39         | SbeEr          | 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         | AdeEr          | A to D converter or related component(s) malfunction                               | Return to factory for repair.                                                      |