masibus

User's Manual

AUTO TUNE PID CONTROLLER

TC 5396

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1. INTRODUCTION

Foreword

Thank you for purchasing Auto Tune PID Controller TC5396.
This manual describes the basic functions and operation methods. Please read through this user's manual carefully before using the product.

Notice

The contents of this manual are subject to change without notice as a result of continuous improvements to the instrument's performance and functions.
Every effort has been made to ensure accuracy in the preparation of this manual. Should any errors or omissions come to your attention, however, please inform MASIBUS Sales office or sales representative. Under no circumstances may the contents of this manual, in part or in whole, be transcribed or copied without our permission.

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Checking the Contents of the Package

Unpack the box and check the contents before using the product. If the product is different from which you have ordered, if any parts or accessories are missing, or if the product appears to be damaged, contact your sales representative.

List of Accessories

The product is provided with the following accessories according to the model and suffix codes (see the table below). Check that none of them are missing or damaged.

No	Item name	Part number	Qty	Remarks
1	Mounting Clamps	-	2	

Safety Precautions

The product and the instruction manual describe important information to prevent possible harm to users and damage to the property and to use the product safely.
Understand the following description (signs and symbols), read the text and
Observe Descriptions.

DESCRIPTION OF SIGNS

⚠ WARNING	*This indicates a danger that may result in death or serious injury if not avoided.*
⚠ CAUTION	*This indicates a danger that may result in minor or moderate injury or only a physical damage if not avoided.*

2. SPECIFICATIONS

2.1 PV Input

Input Type	Thermocouple (E, J, K, T, B, R, S), RTD (Pt100), Current, Voltage
Display Range	Refer Table-1
Accuracy	± (0.25% of Full Span + 1 degree) for T/C and RTD input. ± (0.1% of Full Span + 1 count) for Linear input.
ADC Resolution	16 bits
Display Resolution	0.1 / 1 °C
Sampling Rate	5 Samples/Sec
CJC Error	±2.0 °C Max
Sensor open Detection	All inputs except 0-5V, 0-10V
Sensor Burnout current	0.25uA
RTD excitation current	0.16mA (Approx)
NMRR	> 40 dB
CMRR	> 120 dB
Temp-co	< 100ppm/°C
Input Impedance	> 1MΩ (Voltage Input) 250Ω (Current Input)
Max Voltage	20VDC

Input type	Range
E	-200 to 1000°C*
J	-200 to 1200°C*
K	-200 to 1372°C*
T	-200 to 400°C*
B	450 to 1800°C
R	0 to 1768°C
S	0 to 1768°C
PT100 (1°C)	-200 to 850°C*
1-5VDC /0-5VDC /0-10VDC	-1999 to 9999 (Field Scalable)
4-20mA /0-20mA (Ext. 250ohms, 0.1%)	-1999 to 9999 (Field Scalable)

Table-1

*0.1 °C possible for range -1.99.9 to 999.9

2.2 Display & Keys

Process Value	0.8", 7 segment, White LED, 4 digits
Set Value	0.4", 7 segment, Green LED, 4 digits
Manipulated Value	10 segment bar Orange LED
Keys	Enter, A/M, Increase, Decrease
Status LEDs	For Relay, Communication, A/M,Auto tune, SP1, SP2

2.3 Output

Control Type	
Control Type	On/Off, P, PI, Auto tune PID, Valve Position Control (without Feedback)
Manual Offset	±50% of P band
Proportional Band	0.1 to 200.0 %
Integral Time	0(off) to 1000 Sec
Derivative Time	0(off) to 250 Sec
Cycle Time For SSR For Relay	 1 to 60 Sec 10 to 250 Sec (Hyst in on/off mode)

Relay Output (RL1, RL2)	
Function	Control, Alarm
Type	Single Change over Three Terminals (C, NO, NC)
Rating	5A @ 230VAC / 30VDC

Relay Output (RL3, RL4)	
Function	Alarm
Type	Single Change over Three Terminals (C, NO,)
Rating	5A @ 230VAC / 30VDC

SSR Output (Option in lieu of RL1)	
Function	Control
Rating	11 VDC @ 20mA

Analog Output 1-AO1 (Option)	
Function	Control, Retransmission
Current	0-20mA/ 4-20mA @500Ω Max
Voltage	0-5V/ 1-5V/ 0-10V @3 KΩ Min
Output accuracy	±0.25% of span

Analog Output 2-AO2 (Option)	
Function	Retransmission
Current	0-20mA/ 4-20mA @500Ω Max
Voltage	0-5V/ 1-5V/ 0-10V @3 KΩ Min
Output accuracy	±0.25% of span

Communication Output-RS485 (Option)	
Function	Read/Write all Parameters
Protocol	Modbus RTU
Baud Rate	9600, 19200, 38400

Transmitter supply	24V DC (±10%) @26mA (Current limited)

2.4 Power Supply

Standard	85-265VAC/ 100-300VDC
Optional	18-36VDC
Power consumption	<10 VA (Aprrox)

Isolation (Withstanding voltage)

Between primary terminals* and secondary terminals**: At least 1500 V AC for 1 minute
Between primary terminals* and grounding terminal: At least 1500 V AC for 1 minute
Between grounding terminal and secondary terminals**: At least 1500 V AC for 1 minute
Between secondary terminals**: At least 500 V AC for 1 minute
* Primary terminals indicate power terminals and relay output terminals.
** Secondary terminals indicate analog I/O signal and Communication O/P.

Insulation resistance: 20MΩ or more at 500 V DC

2.5 Environmental

TEMPCO	For Input to PV Display < 100ppm. FOR Display to Retransmission and Control output < 100ppm
Humidity	30% to 95% RH (Non-Condensing)
Ambient temperature	0 to 55°C
Storage Temperature	0 to 80°C

2.6 Physical

Mounting Type	Panel
Size H x W x D	100 mm x 100 mm x 55 mm
Front Bezel	100 mm x 100 mm
Panel Cutout	92 mm x 92 mm
Depth Behind The Panel	52 mm
Weight	300g Approx.
Enclosure Material	Front: Polycarbonate, Base: ABS
Enclosure Protection	IP 20
Terminal & Cable Size	Barrier type terminal, cable 2.5 mm^2

Advance Feature

- Input scalability for linear input
- Three years calibration with Auto Zero and Auto Span
- Average Energy Demand parameter as a diagnostic feature

3. PHYSICAL SPECIFICATIONS &MOUNTING DETAILS

Mounting Type	Panel mounting
Size H x W x D	100 mm x 100 mm x 55 mm
Front Bezel	100 mm x 100 mm
Panel Cutout	92 mm x 92 mm
Depth Behind The Panel	52 mm
Weight	300g Approx.
Enclosure Material	Front: Polycarbonate, Base: ABS
Enclosure Protection	IP 20
Terminal & Cable Size	Barrier type terminal, cable 2.5 mm^2

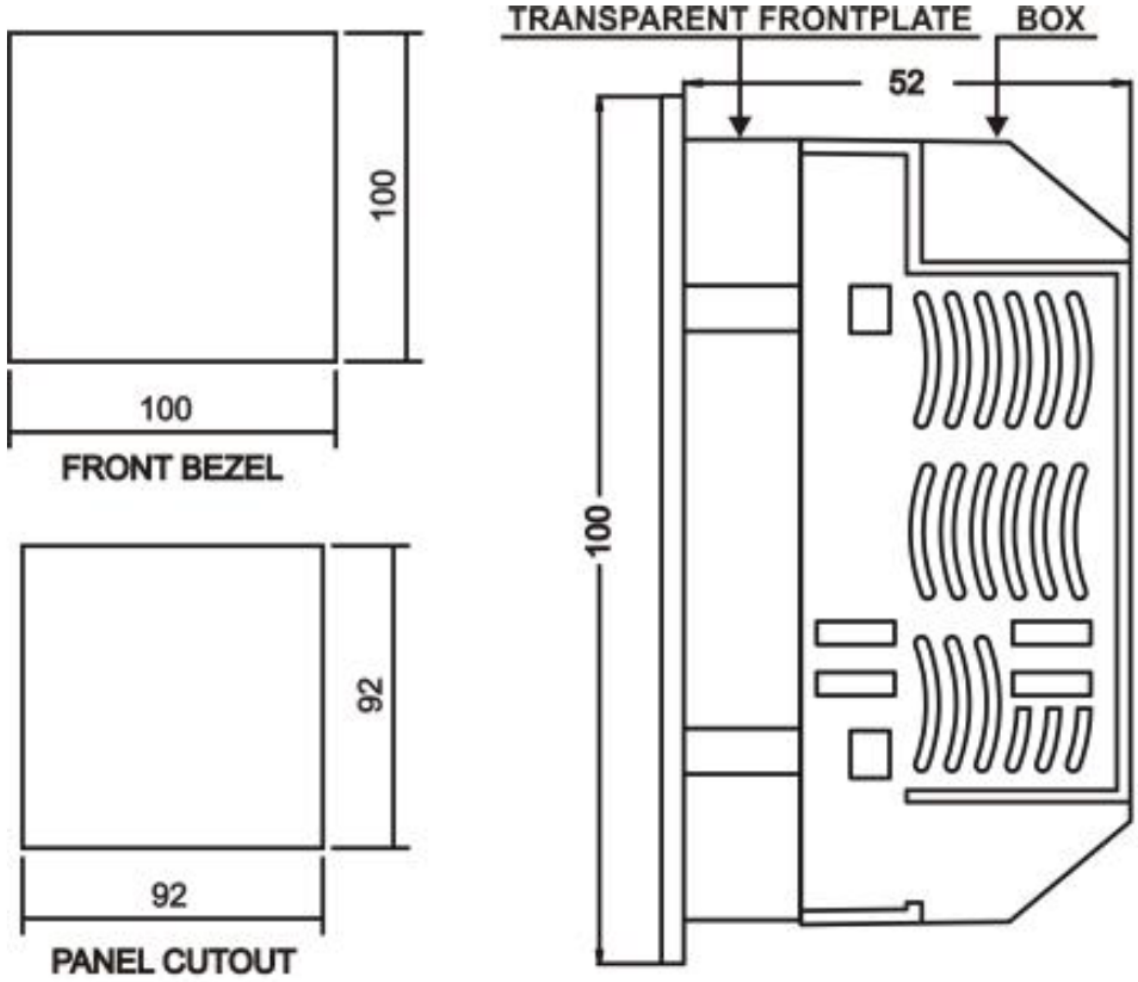


Fig 3.1: Mounting Details

4. TERMINAL CONNECTIONS

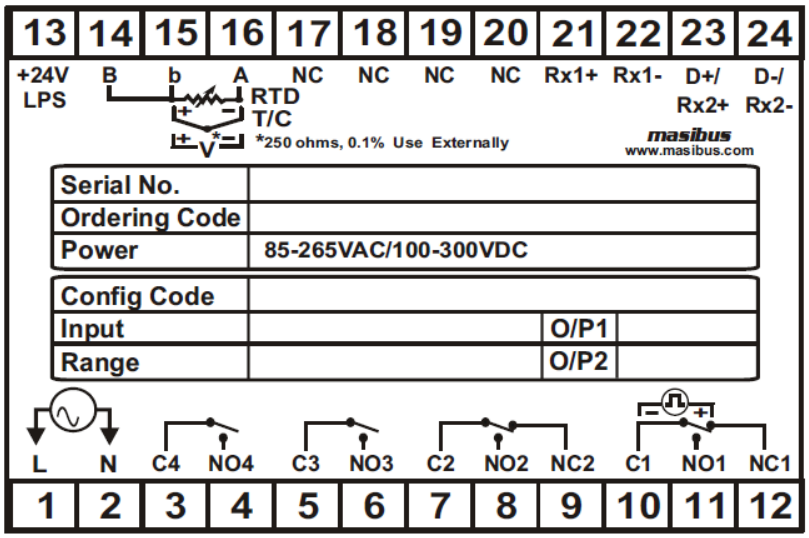


Fig 4.1: Terminal Connection Detail

Terminal No.		Description
1.	L	Power Supply Input
2.	N	
3.	C4	• For Relay-4 potential free Contacts (Use 230V -2A load) • Alarm-4 o/p.
4.	NO4	
5.	C3	• For Relay-3 potential free Contacts (Use 230V -2A load) • Alarm-3 o/p.
6.	NO3	
7.	C2	• For Relay-2 potential free Contacts (Use 230V -2A load) • Alarm-2 o/p. • Reverse Relay, if output type is Motor position control without slide wire feedback
8.	NO2	
9.	NC2	
10.	C1	• For Relay-1 potential free Contacts (Use 230V -2A load) • PID/ On-Off Control o/p. • Alarm-1 o/p, if output type is Linear. • Forward Relay, if output type is Motor position control without slide wire feedback • Terminal 10,11:- SSR Pulse o/p.
11.	NO1	
12.	NC1	
13.	+24V LPS	• +24VDC Loop power supply • Terminal 16 is ground Reference.
14.	B	For RTD Input Only (Three wire Compensation).
15.	b/TC+/V+	For Thermocouple, RTD & Linear Input
16.	A/TC-/V-/LPS-	
17.	NC	Not connected
18.	NC	
19.	NC	
20.	NC	
21.	Rx1+	• For Retransmission-1 output • Linear type Control Output
22.	Rx1-	
23.	D+/ Rx2+	• For Retransmission-2 output • Modbus-RTU Communication Output
24.	D-/ Rx2-	

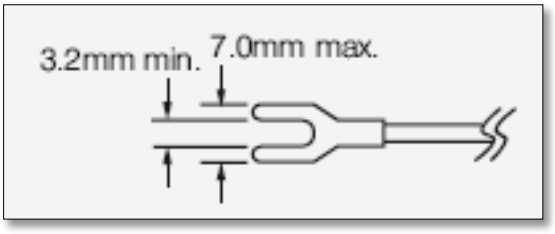


Fig 4.3:Lead Termination Detail

4.1 How to connect wires

Before carrying out wiring, turn off the power to the controller and check that the cables to be connected are not alive because there is a possibility of electric shock.

NOTE:

- ✓ All wiring must confirm to appropriate standards of good practice and local codes and regulations. Wiring must be suitable for Voltage, Current and temperature rating of the system.
- ✓ Provide power from a single-phase instrument power supply. If there is a lot of noise in the power line, insert an insulating transformer into the primary side of the line and use a line filter on the secondary side. Do not place the primary and secondary power cables close to each other.
- ✓ For thermocouple input, use shielded compensating lead wires for wiring. For RTD input, use shielded wires that have low conductor resistance and cause no significant differences in resistance between the three wires.
- ✓ Use repeater after each set of 32 instruments connected in RS-485 Communication.
- ✓ Unused terminals should not be used as jumper points as they may be internally connected, which may cause damage to the unit.
- ✓ Unused control terminals should not be used as jumper points as they may be internally connected, which may cause damage to the unit.
- ✓ Use >250V-1Amp Cable for Power Supply.
- ✓ Supply voltage must be below maximum voltage rating specified on the label.

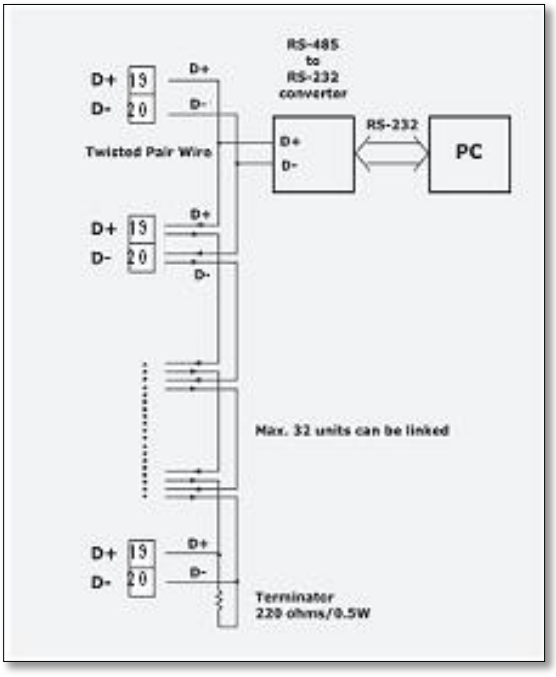


Fig 4.4: RS485 Connection Details

5. FRONT PANEL DETAILS

5.1 Front Panel Description

Name of Part	Symbol	Function
Increase Key		• Increment the Value of any Parameter. • Shows ambient value for T/C Input in RUN mode. • In Manual Mode this key is used to Increment the %Power.
Decrease Key		• Decrement the Value of any Parameter. • Shows %Power value if Device is in Auto Mode in RUN mode. • In Manual Mode this key is used to Decrement the %Power.
Enter Key		• In RUN mode, shows custom display parameters selected from Level-6 menu. • In Sub Menu it can be used to get to the next Parameter. • It is also used to save the parameters to nonvolatile memory, when user setting a proper data by Increment and decrement key for parameter configuration.
Auto/Manual Key		• It works as escape key, if unit is not in RUN mode. • In RUN mode, if pressed for at least 2 sec 1. It is used to switch between Auto to Manual mode and Manual to Auto mode if function key is A/M. 2. Shows remaining soak time when pressed if function key is selected SOKR

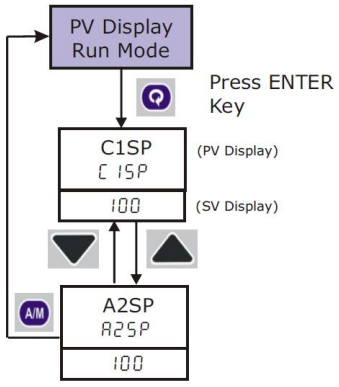
Process Value Display	PV	3. 4 digital 0.8 inch White Display 4. Display process value. 5. Display parameter name when user set parameter. 6. Display error message when an error occurs.
Set Value Display	SV	• 4 digital 0.4 inch GREEN • Display set value. • Display parameter value of parameter in process value field when user set parameter. • Display control output value when in manual mode.
Manipulated Value	MV	• Display control output value in form of Bar scaled in 10 segments bar orange led
Relay-1 Indication	RL1	• ON when Relay-1 is energized & OFF otherwise.
Relay-2 Indication	RL2	• ON when Relay-2 is energized & OFF otherwise.
Relay-3 Indication	RL3	• ON when Relay-3 is energized & OFF otherwise.
Relay-4 Indication	RL4	• ON when Relay-4 is energized & OFF otherwise.
MANUAL Indication	MAN	• ON when unit is in Manual mode. • OFF when unit in Auto Mode.
Auto tune Indication	AT	• Blink when Auto tune Process is on
Control Set point - 1 Indication	SP1	• ON when Set Point 1 is selected. All controller action with respect to SP-1
TX Indication	Tx	• ON when device is transmitting some Data (RS-485).
RX Indication	Rx	• ON when device is receiving some Data (RS-485).

Example:

How to change SET POINT:-

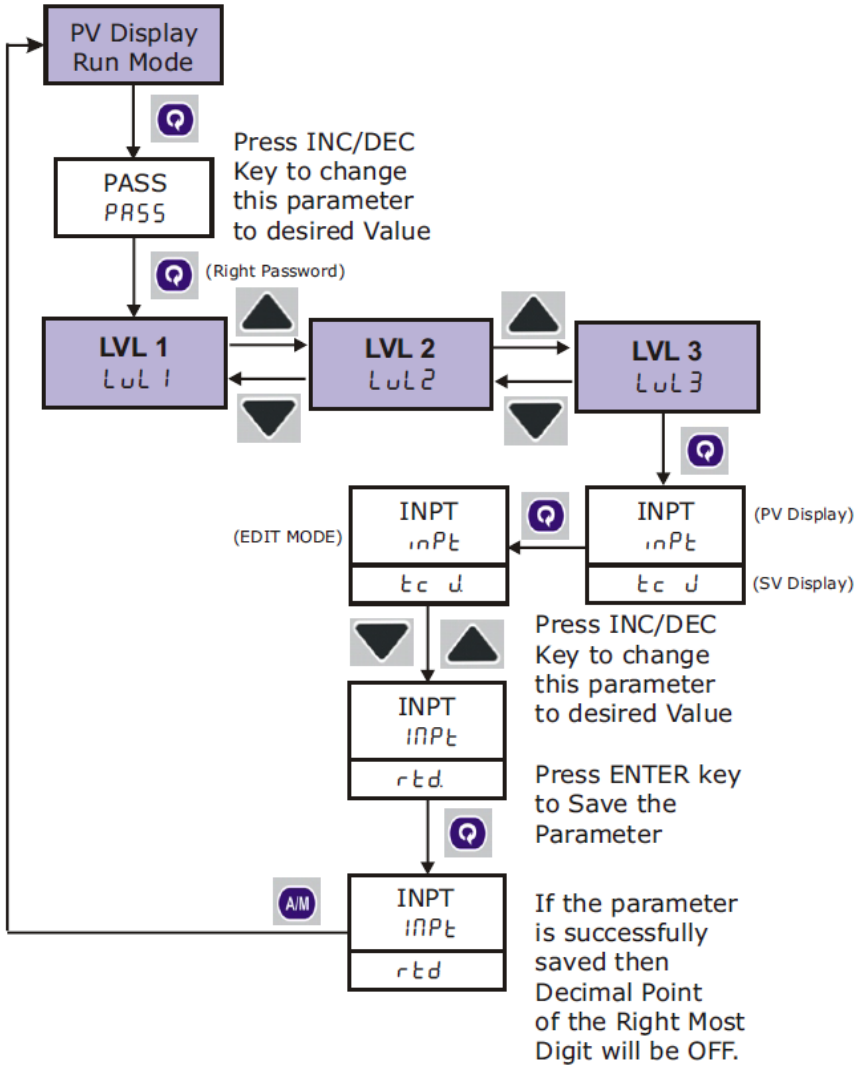
C1SP and A2SP will be shown in operator mode if they are selected in one of the SELECT Display Parameter from LEVEL-6 Menu.

Here "SELECT display 1"(DS1) is set for *"1"(C1SP)* and "SELECT display 2"(DS2)is set for 2 (A2SP).



Example:

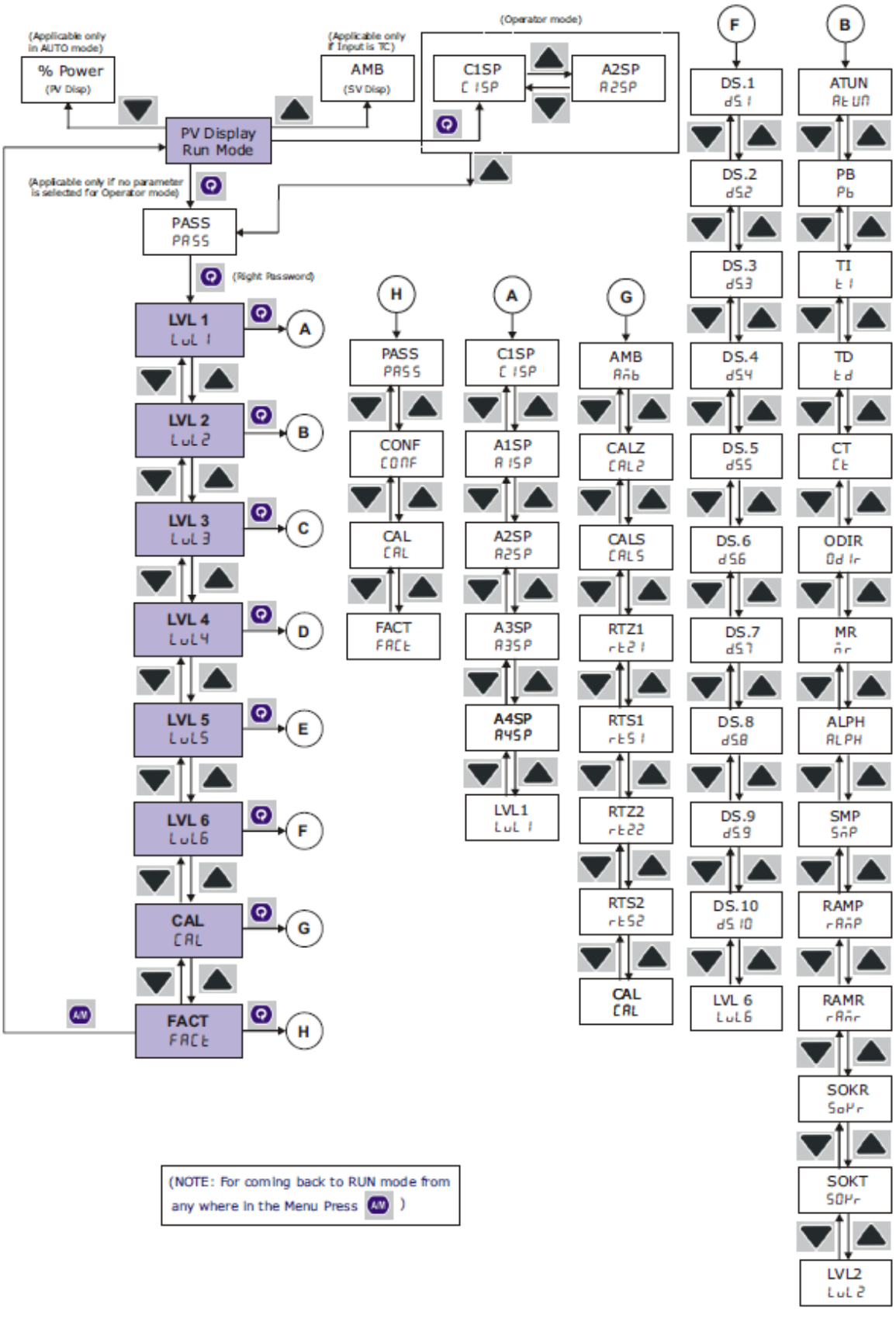
How to change Input Type

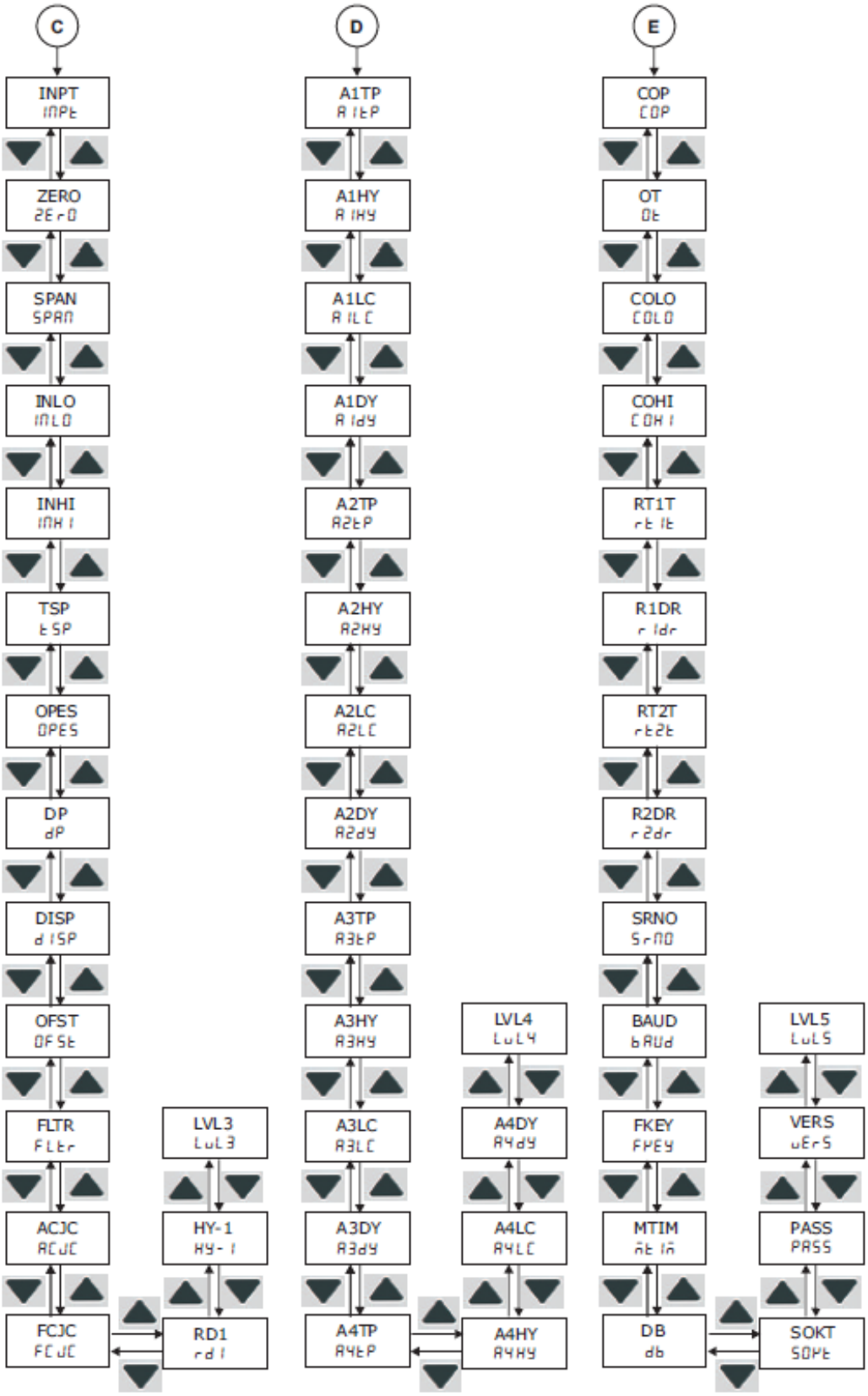


NOTE: ALL other parameters can EDIT according to the above steps.
If one of the SELECT Display Parameter from LEVEL-6 Menu, is register as "0" in "SELECT display". It will be considered as none of parameters are selected for operator mode.

6. MENU LAYOUT

6.1 Menu Layout




C
INPT
ZERO
SPAN
INLO
INHI
TSP
OPES
DP
DISP
OFST
FLTR
ACJC
FCJC
LVL3
HY-1
RD1
D
A1TP
A1HY
A1LC
A1DY
A2TP
A2HY
A2LC
A2DY
A3TP
A3HY
A3LC
A3DY
A4TP
LVL4
A4DY
A4LC
A4HY
E
COP
OT
COLO
COHI
RT1T
R1DR
RT2T
R2DR
SRNO
BAUD
FKEY
MTIM
DB
LVL5
VERS
PASS
SOKT

6.2 RUN Time Indication/Function

Following parameters can view or change during run time.

- Press Decrement key to show percentage power Auto Mode (0.0 to 100.0%)
- For Thermocouple input type, Press Increment key to show ambient temperature.
- During manual mode, Increment key and Decrement Key will use to modify the percentage power.
- TC5396 can be configured as PID or ON-OFF Controller.
- On selection of PID / ON-OFF, only relevant parameters will be displayed in menu.
- Press 

for at least 2 sec to toggle between AUTO & MANUAL mode if function key is A/M.

6.3 LEVEL 1 SET POINT SETTINGS

Set Point Setting:					
Parameter (PV display)		Setting name and description	Default value	Shows only if	Reg. No.
Symbol	Name				
C1SP (C 1SP)	Control Set Point 1	Range Depending on PV sensor type selected	100	-	1
A1SP (A 1SP)	Alarm Set Point 1	Range Depending on PV sensor type selected	100	Output Type is LIN(Linear)	2
A2SP (A2SP)	Alarm Set Point 2	Range Depending on PV sensor type selected	100	-	3
A3SP (A3SP)	Alarm Set Point 3	Range Depending on PV sensor type selected	100		4
A4SP (A4SP)	Alarm Set Point 4	Range Depending on PV sensor type selected	100		5

6.4 LEVEL 2 TUNE MODE

AUTOTUNE PARAMETERS					
Parameter (PV display)		**Setting Name & Description**	**Default Value**	**Show if Only**	**Reg. No.**
Symbol	**Name**				
ATUN (AtUn)	Auto Tune	Start / Stop Auto Tuning Process YES/no 0 : NO (Stop Auto Tuning) 1 : YES (Start Auto Tuning)	NO	Control Type(COP) is PID	6
PB (Pb)	Proportional Band	Adjust Proportional Band 0.1 to 200.0 %	10.0	Control Type(COP) is PID	7
TI (t i)	Integral Time	Adjust Integral Time 0 to 1000	60	Control Type(COP) is PID	8
TD (td)	Derivative Time	Adjust Derivative Time 0 to 250	0	Control Type(COP) is PID	9
CT (Ct)	Cycle Time	Adjust Cycle Time For, SSR o/p: (1 – 60 sec) Relay o/p: (10 – 250 sec)	10		10
O.DIR (o .d ir)	Output Direction	Set Output Direction d ir/rEu 0 : REV (REVERSE) 1 : DIR (Direct)	0 (REV)	Control Type(COP) is PID	11
MR (mr)	Manual Reset	Adjust Manual Reset Value It is used to shift P Band for critical Controlling situations. -50% to 50% of PB EX. If PB = 50, SP = 100, O.DIR = REV MR = 0MR = 25 PV / % POWER: <= 75 / 100 %; 100 / 50 %; >= 125 / 0 % PV / %POWER: <= 100 / 100 %; 125 / 50 %; >= 150 / 0 %	-40.0	Control Type(COP) is PID	12
ALPH (ALPH)	Sampling Rate	Adjust Sampling Rate Its acts like Derivative Factor. It is used to decrease effect of D term in PID output for some critical operating condition 0.01 to 1.00	1.00	Control Type(COP) is PID	13
SMP (SmP)	Sampling Period	Set Sampling Period. 200 /500 / 1 0 : 200 ms 1 : 500 ms 2 : 1 sec	0 (200 ms)	Control Type(COP) is PID	14
RAMP (rAmP)	Ramp Rate type	noneI/m in .r/hr .r 0:none 1:min.r 2:hr.r	None		15
RmpR (rmPr)	Ramp rate value	0.1 to 999.9 Degree per minutes or hour	0.00		16
SOKR (SOHr)	Soak rate	0.00 to 99.59 (Format HH.MM)	0.00		17

SOKT (SOPt)	Soak type	Shod/SrSt 0:shod 1:srst	srst		18

6.5 LEVEL 3 CONFIGURATION MODE

CONFIGURATION PARAMETERS

Parameter (PV display)		Setting Name & Description	Default Value	Show if Only	Reg. No.
Symbol	**Name**				
INPT (inPt)	INPUT Type	Set PV Input Type tC E/tC J /tC P /tC t /tC b /tC r /tC S /rtd I0-10 Value | Input Type | Range 0 | TC E | -200 to 1000 °C 1 | TC J | -200 to 1200 °C 2 | TC K | -200 to 1372 °C 3 | TC T | -200 to 400 °C 4 | TC B | 450 to 1800 °C 5 | TC R | 0 to 1768 °C 6 | TC S | 0 to 1768 °C 7 | RTD | -199.9 to 850.0 °C 8 | 0-10 V | -1999 to 9999 ***Use external 250ohms,0.1% for current input**	TC E		19
ZERO (2Ero)	Zero	Automatically change to the Input Lower Range with changing of Input Type (Refer Above Table) Can be set to any value within the Input Range & less the SPAN Value.	-200 (If TC E)		20
SPAN (SPAn)	Span	Automatically change to the Input Higher Range with changing of Input Type (Refer Above Table) Can be set to any value within the Input Range & greater the ZERO Value.	1000 (If TC E)		21
INLO (INLO)	Input low Range	Input low range between 0.0 to 10.0 (It will be always less then INHI)	0.0	Input type is 0-10V	22
INHI (INHI)	Input High Range	Input High range between 0.0 to 10.0 (It will be always greater then INLO)	10.0	Input type is 0-10V	23
TSP1 (tSP I)	Type of Set Point	Set Type of Set Point L-on/H-on 0 : L-ON (Lower ON) 1 : H-ON (Higher ON) Refer ON-OFF Control	0 (L-ON)	Control Type (COP) is ON-OFF.	24
OPES (oPES)	OPEN Sensor Status	Set Control O/P & Retransmission state when Input OPEN condition. doun/UP 0 : DOWN 1 : UP Refer Retransmission Output Table for OPEN /OVER /UNDER Condition & Linear Output Table for OPEN/OVER/ UNDER Condition	1 (UP)		25

DP (dP)	Decimal Point	Set position of Decimal Point on Display. 0 /1 /2 /3 *0 : 0 *1 : 0.0 2 : 0.00 3 : 0.000	1	Input Type is Linear, *if input type is RTD or TC(E,J,K,T)	26
DISP (d iSP)	Display Set Point	Set which Set Point to shown in SV display in RUN mode while device is in Auto Mode C 1SP /A 1SP /A2SP /A3SP /A4SP /SOKr 0 : C1SP (Control Set Point 1) 1 : A1SP (Alarm Set Point 1) 2 : A2SP (Alarm Set Point 2) 3 : A3SP (Alarm Set Point 3) 4 : A4SP (Alarm Set Point 4) 5: SOKR (Remaining Soak Time)	0	Output Type is Linear , only then A1.SP will appear.	27
OFST (oFSt)	offset	Offset Value Input type: RTD/ Thermocouple — range: -100.0°C to +100.0°C Input type: Linear — range: -1000 to +1000	0.0		28
FLTR* (FLtr)	Filter	Enable or Disable Filter for PV Input 0 / 1 / 2 / 3 / 4 / 5	4		29
A.CJC (A .CJC)	Auto Cold Junction Compensation	Select Auto Cold Junction Compensation required or not for TC input Type. no /YES 0 : NO 1 : YES	1 (YES)	Input Type is TC	30
F.CJC (F .CJC)	Fix cold junction Compensation	Set Fix cold junction Compensation value. 0 to 60.0 °C	0.0	Input Type is TC & A.CJC is NO	31
RD1 (rd 1)	Relay Delay (For Relay-1)	Relay Delay is amount of time (in sec), that Relay will wait before getting ON after the ON condition occurs. 1 to 99 sec	1 sec	Control Type (COP) is ON-OFF.	32
HY-1 (HY- 1)	Hysteresis – 1 (For Relay-1)	Hysteresis Value (in °C) for Relay-1 during ON-OFF type Control. 1 to 250 — TC & RTD Input 1 to 250 — Linear Input with DP=0 0.1 to 25.0 — Linear Input with DP=1 0.01 to 2.50 — Linear Input with DP=2 0.001 to 0.250 — Linear Input with DP=3	1	Control Type (COP) is ON-OFF.	33

*The value of FLTR will determine the ability of filtering noise. When a large value is set, the measurement input is stabilized but the response speed is slow. Generally, if great interference exists, then you can increase parameter "FLTR" gradually. When the meter of the instrument is being examined at laboratory, "FLTR" should be set to 0 or 1 to short the response time.

6.6 LEVEL 4 ALARM MODE

ALARM PARAMETERS					
Parameter (PV display)		**Setting Name & Description**	**Default Value**	**Show if Only**	**Reg. No.**
Symbol	**Name**				
A1TP (A 1tP)	Alarm Type – 1	Refer ALARM Type 0 to 15	6 (PVAL)	Output Type is LIN(Linear)	34
A1HY (A 1HY)	Alarm 1 Hysteresis	Set Hysteresis(in °C) for Alarm-1 1 to 250 — TC & RTD Input 0.1 to 25.0 — RTD.1 Input 1 to 250 — Linear Input with DP=0 0.1 to 25.0 — Linear Input with DP=1 0.01 to 2.50 — Linear Input with DP=2 0.001 to 0.250 — Linear Input with DP=3	1	Output Type is LIN(Linear)	35
A1LC (A 1LC)	Alarm 1 Logic	Set Logic for Alarm-1 norñ /FLSF 0 : NORM (Normal) 1 : FLSF (Fail-Safe) Operation diagram of different ALARM Type 0 to 15 for Alarm Logic NORM (Normal). For Fail-Safe Logic Alarm will work completely opposite to Normal behavior. (i.e. for any particular condition when Relay is ON for Normal logic, for that condition relay will OFF for Fail-Safe Logic & vice-versa)	0 (Normal)	Output Type is LIN(Linear)	36
A1DY (A 1dY)	Alarm 1 Delay	Alarm Delay is amount of time (in sec), that Relay-1 will wait before getting ON after the alarm condition occurs. 1 to 99 sec	1	Output Type is LIN(Linear)	37
A2TP (A2tP)	Alarm Type – 2	Refer ALARM Type 0 to 15	6 (PV.A.L.))	Output Type is not VPFN	38
A2HY (A2HY)	Alarm 2 Hysteresis	Set Hysteresis(in °C) for Alarm-2	1	Output Type is not VPFN	39
A2LC (A2LC)	Alarm 2 Logic	Set Logic for Alarm-2 norñ /FLSF 0 : NORM (Normal) 1 : FLSF (Fail-Safe)	0 (Normal)	Output Type is not VPFN	40
A2DY (A2 .dY)	Alarm 2 Delay	Alarm Delay is amount of time (in sec), that Relay-2 will wait before getting ON after the alarm condition occurs. 1 to 99 sec	1	Output Type is not VPFN	41
A3TP (A3tP)	Alarm Type – 3	Refer ALARM Type 0 to 15	6 (PV.A.L.)	Output Type is LIN(Linear)	42
A3HY (A3HY)	Alarm 3 Hysteresis	Set Hysteresis(in °C) for Alarm-3	1	Output Type is LIN(Linear)	43
A3LC (A3LC)	Alarm 3 Logic	Set Logic for Alarm-3 norñ /FLSF 0 : NORM (Normal) 1 : FLSF (Fail-Safe)	0 (Normal)	Output Type is LIN(Linear)	44

A3DY (A3dY)	Alarm 3 Delay	Alarm Delay is amount of time (in sec), that Relay-3 will wait before getting ON after the alarm condition occurs. 1 to 99 sec	1	Output Type is LIN(Linear)	45
A4TP (A4tP)	Alarm Type – 4	Refer ALARM Type 0 to 15	6 (PV.A.L.))	Output Type is not VPFN	46
A4HY (A4HY)	Alarm 4 Hysteresis	Set Hysteresis(in °C) for Alarm-4	1	Output Type is not VPFN	47
A4LC (A4LC)	Alarm 4 Logic	Set Logic for Alarm-4 norñ /FLSF 0 : NORM (Normal) 1 : FLSF (Fail-Safe)	0 (Normal)	Output Type is not VPFN	48
A4DY (A4dY)	Alarm 4 Delay	Alarm Delay is amount of time (in sec), that Relay-4 will wait before getting ON after the alarm condition occurs. 1 to 99 sec	1	Output Type is not VPFN	49

6.7 LEVEL 5 OUTPUT MODE

OUTPUT PARAMETERS					
Parameter (PV display)		**Setting Name & Description**	**Default Value**	**Show if Only**	**Reg. No.**
Symbol	**Name**				
COP (CoP)	Control Output Type	Select Controlling Type for Output P id /ONOF 2 : PID 3: ON-OFF	2 (PID Type)	Control output type is PID	50
OT (ot)	Output Type	Output Type rELY /SSr/L in 0 : RELY (Relay) 1 : SSR (Voltage Pulse Output) 2 : LIN (Linear) 3 : VPFN (Motor position control without slide wire feedback) Device can support RELAY or SSR output once at a time. (Factory Settable) ** Device can support Control output type P Id or onoF .(Factory Settable)	0 (Relay)	**VPFN, LIN and SSR option will not appear if COP(Control Type) is ON-OFF	51
COLO (CoLo)	Control Output Low Limit in %	Control Output Low Limit in %. 0.0 to 100.0 % (It will be always less then CO.HI)	0.0	Control output type is PID	52
COHI (CoH i)	Control Output High Limit in %	Control Output High Limit in %. 0.0 to 100.0 % (It will be always greater then CO.LO)	100.0	Control output type is PID	53

RT1T (rt 1t)	Retransmission 1 Type	Retransmission-1 Output Type This output is according to PV input. Zero & Span acts as Min & Max value of retransmission o/p scale respectively. 0-5u / 1-5u /0- 10u /4-20 /0-20 0 : 0-5V 1 : 1-5V 2 : 0-10V 3 : 4-20mA 4 : 0-20mA Voltage or Current is Jumper Selectable from the Hardware.	3 (4-20mA)		54
R1DR (r 1dr)	Retransmission-1 Direction	Set Direction for the Retransmission Output-1 rEu /d ir 0 : REV (REVERSE) 1 : DIR (DIRECT) EX. If i/p is RTD.1,ZERO=0,SPAN=600, RTR.1=4-20mA& RT.D.1=DIR when PV = 0, RTR o/p = 4mA PV = 300, RTR o/p = 12mA PV = 600, RTR o/p = 20mA RT.D.1=REV when PV = 0, RTR o/p = 20mA PV = 300, RTR o/p = 12mA PV = 600, RTR o/p = 4mA Refer Retransmission Output Table for OPEN /OVER /UNDER Condition	1 (DIRECT)	OT(Output Type) is Relay / SSR	55
RT2T (rt2t)	Retransmission 2 Type	Retransmission-2 Output Type This output is according to PV input. Zero & Span acts as Min & Max value of retransmission o/p scale respectively. 0-5u / 1-5u /0- 10u /4-20 /0-20 0 : 0-5V 1 : 1-5V 2 : 0-10V 3 : 4-20mA 4 : 0-20mA Voltage or Current is Jumper Selectable from the Hardware.	3 (4-20mA)		56
R2DR (r2dr)	Retransmission-2 Direction	Set Direction for the Retransmission Output-2 rEu /d ir 0 : REV (REVERSE) 1 : DIR (DIRECT)	1 (DIRECT)		57
SRNO (Srno)	Serial No.	Unit ID for Modbus-RS485 Communication 1 to 247	1		58
BAUD (bAUd)	Baud Rate	Set Modbus RS485 Communication Baud Rate 9600 / 19 .2K /38 .4K 0 : 9600 (9600 bps) 1 : 19.2K (19200 bps) 2 : 38.4K (38400 bps)	0 (9600)		59
FKEY (FKEY)	Function Key	Select A/M or Soak time A-m/SOKr/nOnE 0 : A-M 1 : SOKR 2 : None	A-m	Control output type is PID	60
MTIM (mt im)	Motor Travel Time	10 to 500 sec	60	Output type is VPFN	61

db (db)	Dead Band	0.1 to 50.0	1.0	Output type is VPFN	62
SOAK* (SOAP)	Soak	Soak StoP / rUn 0: Stop 1: Run	Stop		63
PASS (PASS)	Password	Set Device Password 0 to 9999	1		NA
VERS (uErS)	Version	Shows the Version of the Current Firmware	-		NA

* Last decimal point of PV display "ON", indicates RUN.

6.8 LEVEL 6 CUSTOM DISPLAY

Select the 'SELECT display' parameter, and then enter register number (Reg. No.) to accompanying that Parameter. The registered parameter can be accessed in operator mode by pressing ***ENTER*** key.

Note: The registered no of all parameters can be found from the Last column of Menu Description of all LEVEL.

For example, By registering "19" for Input type (**INPT**) to DS.1, **INPT** parameter can be appear first in operator mode. It is editable. By registering "0" in "SELECT display" will be considered as none of parameters are selected for operator mode.

CUSTOM DISPLAY PARAMETERS			
Parameter (PV display)		**Setting Name & Description**	**Default Value**
Symbol	**Name**		
DS.1 (dS .1)	SELECT display 1	0 to 63 (0 = None) Can be set within 0 to 63.	1
DS.2 (dS .2)	SELECT display 2		2
DS.3 (dS .3)	SELECT display 3		0
DS.4 (dS .4)	SELECT display 4		0
DS.5 (dS .5)	SELECT display 5		0
DS.6 (dS .6)	SELECT display 6		0
DS.7 (dS .7)	SELECT display 7		0
DS.8 (dS .8)	SELECT display 8		0
DS.9 (dS .9)	SELECT display 9		0
DS.10 (dS .10)	SELECT display 10		0

6.9 CALIBRATION MODE

CALIBRATION PARAMETERS				
Parameter (PV display)		Setting Name & Description	Default Value	Show if Only
Symbol	Name			
AMB (Amb)	Ambient	Ambient Adjustment	-	Input is TC
CALZ (CAL2)	Calibration Zero	Calibration Zero for PV Input (SV Display : PV)	-	
CALS (CALS)	Calibration Span	Calibration Span for PV Input (SV Display : PV)	-	
RTZ1 (rt2 1)	Retransmission-1 ZERO	Calibration Zero for Retransmission Output-1 (SV Display : If voltage:-0.000 If Current:-4.000)	-	
RTS1 (rtS 1)	Retransmission-1 SPAN	Calibration Span for Retransmission Output-1 (SV Display : If voltage:-8.000 If Current:-20.00)	-	
RTZ2 (rt22)	Retransmission-2 ZERO	Calibration Zero for Retransmission Output 2 (SV Display : If voltage:-0.000 If Current:-4.000)	-	
RTS2 (rtS2)	Retransmission-2 SPAN	Calibration Span for Retransmission Output-2 (SV Display : If voltage:-8.000 If Current:-20.00)	-	

NOTE:-

- The retransmission output type is jumper selectable. Thus if current type or voltage type output, will be decided by the position of the jumper.
- **The Linear type control output will depend on the type of Retransmission-1 output selection**. If Retransmission-1 type output is 4-20mA, then the linear output will function respectively.
- No need to feed input while calibrating Rx. o/p. just make the value in calibration mode equal to the displayed value.

6.10 FACTORY RESET MODE

FACTORY RESET PARAMETERS			
Parameter (PV display)		Setting Name & Description	Default Value
Symbol	Name		
PASS (PASS)	Password	Password protection	5396
CONF (CONF)	Configuration parameter	Only Configuration parameters set to default value no /YES	NO
CAL (CAL)	Cal Parameter	Only calibration set to default value no /YES	NO

7. CONTROL FUNCTION

7.1 ON/OFF Control

ON/OFF Controller is the simplest form of temperature control device. The output from the device is either on or off, with no middle state. An on-off controller will switch the output only when the temperature crosses the setpoint. For heating control, the output is on when the temperature is below the set point, and off above set point.

Since the temperature crosses the set point to change the output stage, the process temperature will be cycling continually, going from below set point to above, and back below. In cases where this cycling occurs rapidly, and to prevent contactors and valves from getting damaged, an on-off differential, or "hysteresis," is added to the controller operations. On-Off hysteresis prevents the output from "chattering" or making fast, continual switches if the cycling above and below the set point occurs very rapidly.

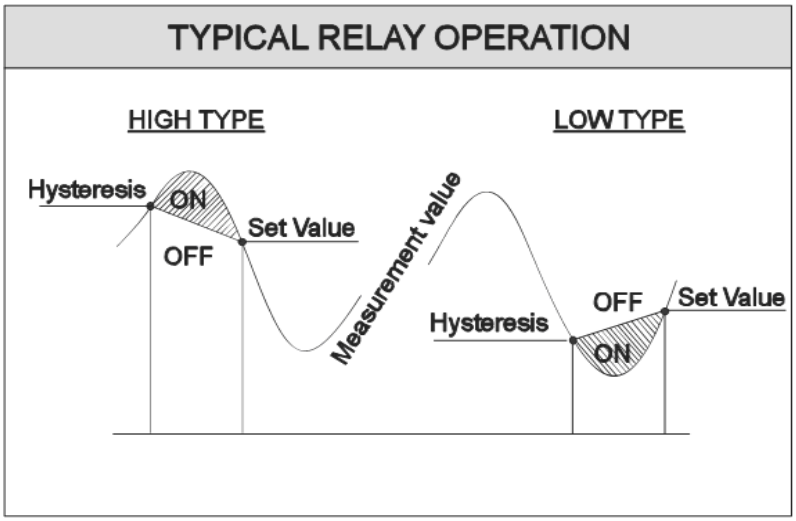


Figure 7.1: Typical Relay operation

High type (H-ON):
For High type of set value, once process value reaches up to set point + Hysteresis value, relay will be ON after few seconds (as per relay delay) and it will be ON until process value goes down to Set point.

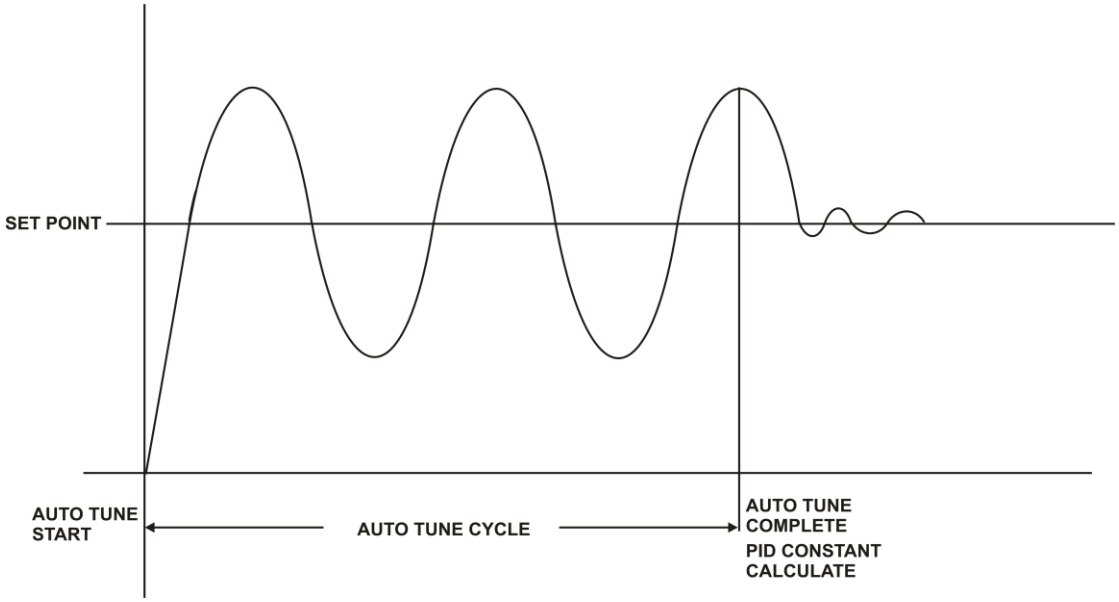
Low type (L-ON):
For Low type of set value, once process value reaches down to set point – Hysteresis value relay will be ON after nearly few seconds (as per relay delay) and it will be ON until process value goes up toward Set point.

NOTE:-

- **TC5396 has both ON-OFF & PID Controlling for Relay-1. And Relay-2, Relay-3, Relay-4 is used for Alarm output. If ON-OFF controlling is required for Relay-1, COP (Control Type) must be selected as ON-OFF.**
- **When PB,TI,TD term is '0' and auto tune is set 'no', and unit is not in manual mode, then control output will work as on-off controller else it will work as PID controller.**

7.2 PID Control

AUTO TUNE FUNCTION:



Auto Tuning:

The Auto tuning process is performed at set point. Temperature will oscillate around the set point during tuning process. Set a set point to a lower value if overshooting around the normal process value is likely to cause damage. To start the auto tuning process, set the desired set point, select the parameter A.TUN in LEVEL-2 menu and set it to YES.

During Auto tuning "AT" LED will remain ON.

After auto tune procedure is completed, "AT" LED will be OFF and controller will revert back to the PID control by using the new calculated PID values. The PID values obtained are stored in the nonvolatile memory.

Control Parameter:-

Proportional BAND:

Proportional action is the action which the control output varies in proportion to the deviation between the setting value and the processing temperature. If the proportional band is narrowed, even if the output changes by a slight variation of the processing temperature, better control results can be obtained as the offset decreases. However, if when the proportional band is narrowed too much, even slight disturbances may cause variation in the processing temperature, and control action changes to ON/OFF action and the so called hunting phenomenon occurs. Therefore, when the processing temperature comes to a balanced position near the setting value and a constant temperature is maintained, the most suitable value is selected by gradually narrowing the proportional band while observing the control results.

Integral Time:

Integral action is used to eliminate offset. When the integral time is shortened, the returning speed to the setting point is quickened. However, the cycle of oscillation is also quickened and the control becomes unstable.

Derivative Time:

Derivative action is used to restore the change in the processing temperature according to the rate of change. It reduces the amplitude of overshoot and undershoots width. If the derivative time is shortened, restoring value becomes small, and if the derivative time is made longer, an excessive returning phenomenon may occur and the control system may be oscillated.

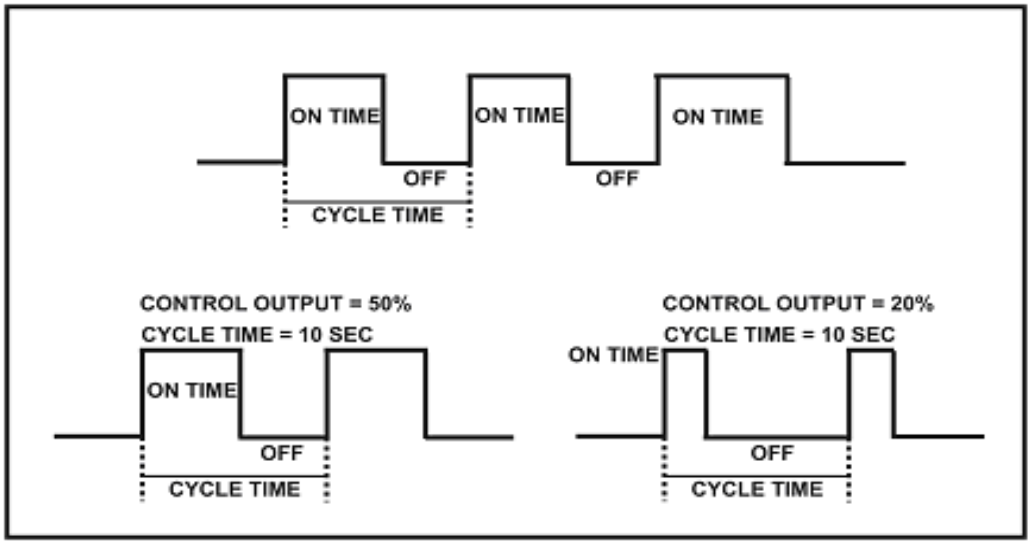
Manual Reset:

Virtually no process requires precisely 50% output on single output controls or 0% output on two output controls. Because of this many older control designs incorporated an adjustment called manual reset (also called offset on some controls). This adjustment allows the user to redefine the output requirement at the set point. A proportioning control without manual reset or Integral time (defined above) will settle out somewhere within the proportioning band but likely not on the set point.
Some controls use manual reset (as a digital user programmable value), this allows the user to preprogram the approximate output requirement at the set point to allow for quicker settling at set point when Automatic reset (Integral time) set to zero. Range for the manual reset is -50.0% to +50.0% of proportional band for TC5396.

Cycle Time:

The Cycle time for output is the time where the output is on for percentage of that time and off for a percentage of that time, creating a portioning effect. The cycle time is only used where PI, PD or PID control action is used. The shorter the cycle time, the higher the proportionate resolution is, and better is the control.

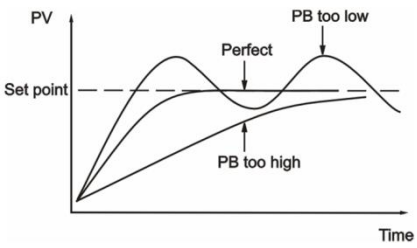
For Relay output: Set to 10 to 300 seconds or more
For SSR output: Set to 1 to 60 seconds or more



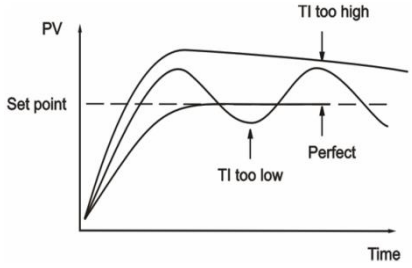
BASIC PID TUNING PROCEDURE:

ADJUSTMENT SEQUENCE	SYMPTOM	SOLUTION
Proportional Band	Slow Response	Decrease PB
	Overshoot or Oscillation	Increase PB
Integral Time	Slow Response	Decrease TI
	Instability or Oscillation	Increase TI
Derivative Time	Slow Response or Oscillation	Decrease TD
	High Overshoot or Instability	Increase TD

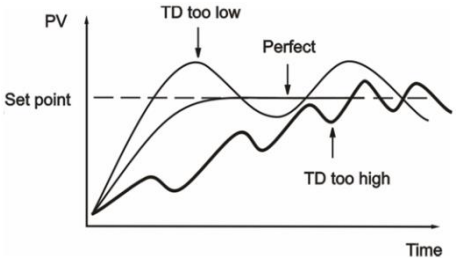
P ACTION: -



I Action: -



D Action: -



Control output Selection:

"COP"	"OT"	Terminal 10,11,12	Terminal 7,8,9	Terminal 5,6	Terminal 3,4	Terminal 21, 22	Terminal 23, 24
PID	Relay	USE FOR CONTROL ACTION	ALARM2	ALARM3	ALARM4	AO output	AO Output/ Communication
	SSR	USE FOR CONTROL ACTION	ALARM2	ALARM3	ALARM4	AO output	AO Output/ Communication
	Linear	ALARM1	ALARM2	ALARM3	ALARM4	USE FOR CONTROL ACTION	AO Output/ Communication
	VPFN	Forward Relay	Revers Relay	ALARM3	ALARM4	AO output	AO Output/ Communication
ON-OFF Action	Relay	USE FOR CONTROL ON-OFF ACTION	ALARM2	ALARM3	ALARM4	AO output	AO Output/ Communication

NOTE:-At a time either Relay or SSR is provided (factory set)
For Terminal 23,24 only one type of output is available.
(AO Output or Communication)(Factory Settable)

7.3 Ramp and Soak *Function*

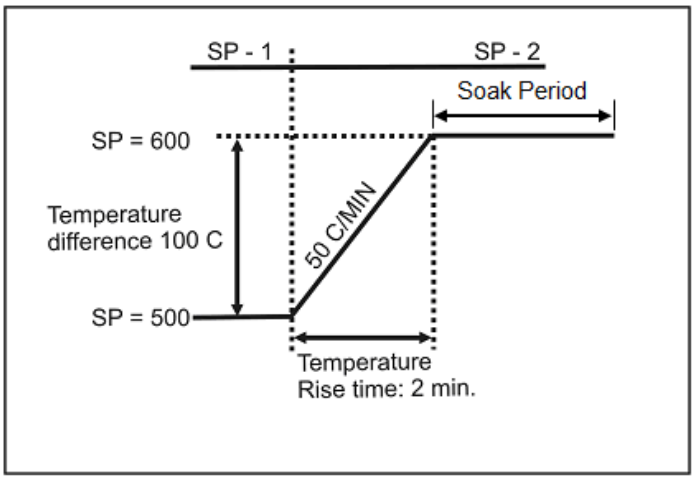
This function is used to stop the sudden change of set point. The ramp function is performed in following conditions. The target set point is changed. Target set point number is changed. (**For example:** Switching from SP-1 to SP-2). The power is turned ON or the controller is recovered from power failure. A change is made from manual mode to auto mode.
When the Soak is in RUN mode and the process value crosses the set point value for the first instant, a "soak period" begins.
Indication of "SOAK" in RUN mode: Decimal point of last digit of PV display is "ON"

The ramp function will be performed when ramp unit parameter is selected as n Inr (minute rate) or Hrr (hour rate). The ramp rate can be programmed by setting the parameter rAPr.
The Soak rate is programmed by setting SoPr . Soak time will be performed according to Shod and SrSt . When the soak type is Shod it will not reset the soak rate when the

power is down and when the Soak type is SrSt it will reset the soak rate when the power is down.

The ramp and Soak function will be cancelled in following conditions.

- A change is made from Auto mode to manual mode.
- Sensor Failure occurs.
- Auto tuning function is activated.

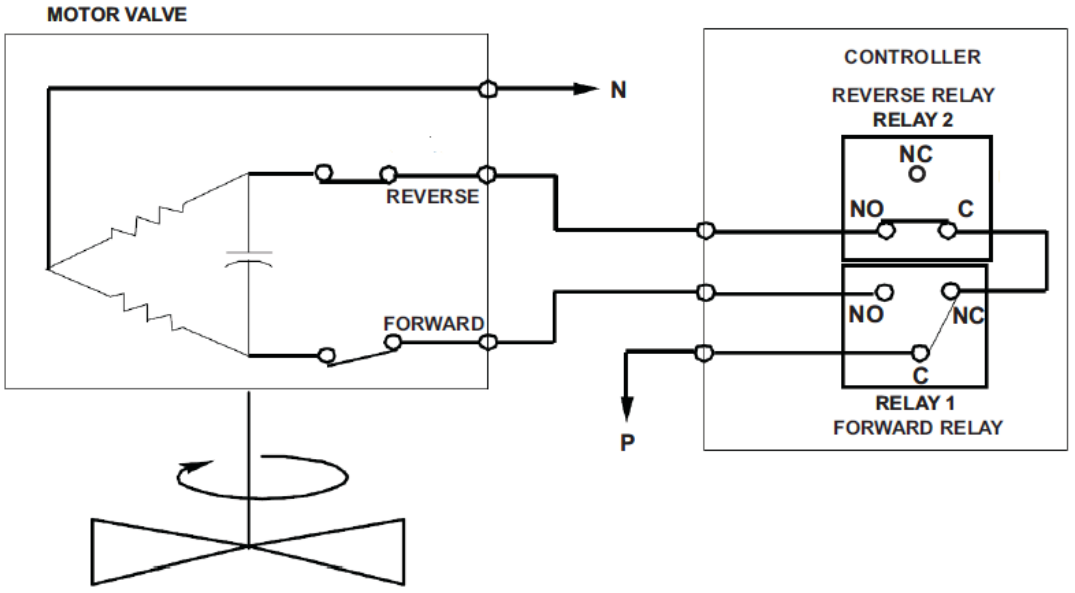


7.4 Motor Positon Control without slide wire feedback:

In Motor Positon Control without slide wire feedback control, user has to set the operating time required for a valve to change from the fully closed position to the fully open position. With the preset operating time, the controller controls the valve by estimating the position. There is no need for feedback input wiring.

When in manual operation you can directly manipulate the controller's output terminals. Pressing Increment key sends the valve into opening motion while pressing the Decrement key sends it to closing motion.

The figure below shows a schematic representation of Motor Positon Control without slide wire feedback control.



8. ALARM OUTPUT

For all Alarm outputs there are five settings. (As shown in configuration mode Menu)

- Set Value (in run mode)
- Type
- Hysteresis(Dead band)
- Direction (Normal/Fail safe)
- Delay

SET VALUE: Alarm set point

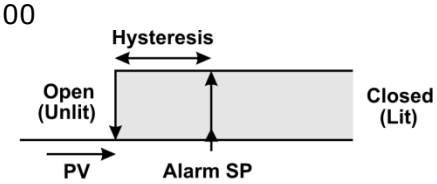
8.1 ALARM TYPES

Various alarm operations are shown in the reference figure.

ALARM TYPE NO	Display message	ALARM TYPE	Note
0	nonE	None	NO operation available
1	PudH	Deviation High alarm	Ref figure 3
2	PudL	Deviation Low alarm	Ref figure 4
3	Pudr	Deviation High & Low range alarm	Ref figure 5
4	Pudb	Deviation High & Low Band alarm	Ref figure 6
5	PuAH	Absolute value High alarm	Ref figure 1
6	PuAL	Absolute value Low alarm	Ref figure 2
7	SPAH	Absolute value set point high alarm	Ref figure 7
8	SPAL	Absolute value set point low alarm	Ref figure 8
9	PSdH	Deviation High alarm with standby	Same as figure 3
10	PSdL	Deviation Low alarm with standby	Same as figure 4
11	PSdr	Deviation High & Low range alarm with standby	Same as figure 5
12	PSdb	Deviation High & Low limit alarm with standby	Same as figure 6
13	PSAH	Absolute value High alarm with standby	Same as figure 1
14	PSAL	Absolute value Low alarm with standby	Same as figure 2
15	Pu-E	PV error(OPEN/OVER/UNDER)	Note 1

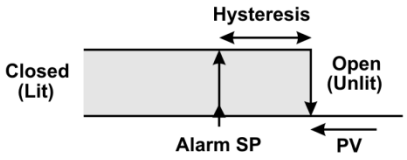
NOTE-1:

The fault diagnosis output turns on in case of input burnout (PV) failure.



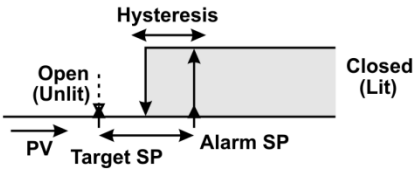
Absolute Value High Alarm

Figure: 1



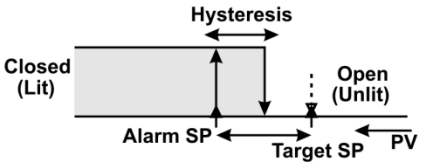
Absolute Value Low Alarm

Figure: 2



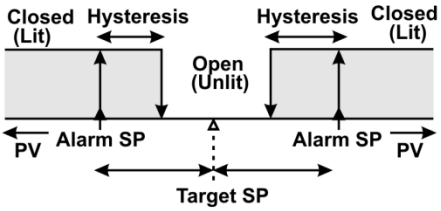
Deviation High Alarm

Figure: 3



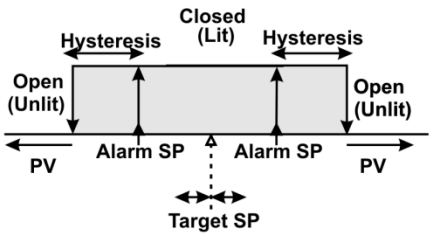
Deviation Low Alarm

Figure: 4



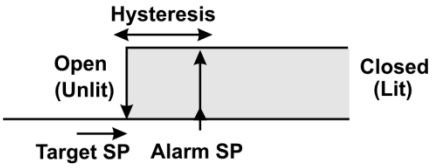
Deviation High/Low Range Alarm

Figure: 5



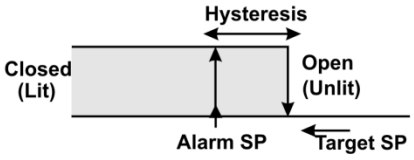
Deviation High/Low Band Alarm

Figure: 6



Absolute Value
Set Point High Alarm

Figure: 7



Absolute Value
Set Point Low Alarm

Figure: 8

NOTE:-

- LIT = LED on, UNLIT = LED off
- Up arrow indicate Alarm will ON from this value.
- Down arrow indicate Alarm will OFF from this value.

Hysteresis (Dead band): Hysteresis (Dead band) application is shown in the figure.

Direction:
All the figures here are shown considering the setting is direct (Normal). If the settings are reversing (Fail Safe), the relays will behave exactly the opposite. However, it's worth mentioning that the relays will be in off (de-energized state on Power on / reset condition). They will energize only after approximate 5 seconds. When alarm type none is selected, ALRAM relay status depends on Direction.

Delay:
A time delay can be provided for the actual output. The relay will operate after the set delay time.

Standby operation:

For alarm types, 9 to 14, the relay action happens only after the PV has crossed the SP after power on.

Example:-

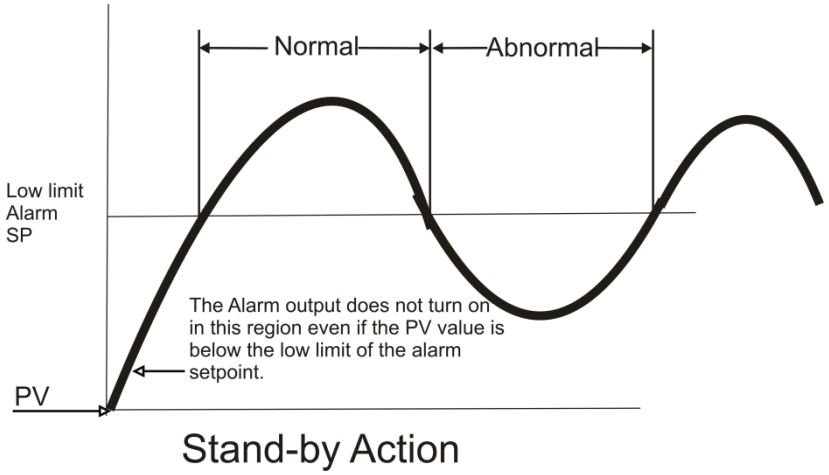


FIGURE 8.1. ALARM OUTPUT DIAGRAM

9. CALIBRATION PROCEDURE

9.1 Procedure for CAL-zero and CAL-span

The instrument is factory calibrated for the specified range, but due to long term drift of components, re-calibration may be necessary in some cases. For calibrating the instrument a reliable source is required. This source should be at least ten times accurate compared to the range of the instrument.

The unit can be calibrated without opening it and without trim pots.

For Entering into the Calibration Mode, Please refer Menu Layout.
After applying appropriate Input from the calibrator source, press 'INCREMENT' OR 'DECREMENT KEY' to bring the actual process value on display.

Example:-
At zero calibration reading expected on the display is 100 and it shows 107, adjust the process value to 100 by using 'DECREMENT KEY'. Now press 'SET' to store the calibration parameter in non-volatile memory. Similarly one can calibrate Ambient, SPAN and retransmission parameters.

For calibrating i/p, both zero and span are calibrated. Here **one-shot calibration** technique is used, i.e. the zero and span are calibrated once. Individual zero or span can also be calibrated; first calibrate zero and then span. While calibrating thermocouple type input, first calibrate the ambient (if required) and then continue with the span calibration of the same.

9.2 Procedure for RET-zero and RET-span

For calibrating the retransmission output, both retransmission zero and retransmission span has to be calibrated. At a time there can be either one or two retransmission output available. If only one retransmission is used, then calibrate **RTZ1** (retransmission 1 zero) and **RTS1** (retransmission 1 span)and if there are two retransmission outputs available, then calibrate **RTZ2** (retransmission 2 zero)and **RTS2** (retransmission 2 span) for second retransmission. No need to feed input while calibrating retransmission o/p.it is like calibrating using digital trim pot. Only look at the output, display value has no significance with output generated.

Example:-
At retransmission zero calibration, expected output is 4.00mA and it gives 4.153mA. Then adjust the output value to 4.153 by using 'INCREMENT KEY'. Now press 'SET1' to store the calibration parameter in non-volatile memory. Similarly one can calibrate retransmission span.

10. COMMUNICATION PROTOCOL–MODBUS RTU

10.1 Introduction

The unit can be connected in RS-485 communication data link either in multi drop or repeat mode. Each unit must have unique Serial Number. Entire range of addresses (1 to 247) may be used. Before starting any communication, choose a baud rate compatible to the host computer. The serial protocol used is MODBUS RTU.

Function Code for Modbus

CODE	NAME	Function
01	Read coil status	Use to read Relay and Digital output status
03	Read Holding registers	Use to read programmable registers
04	Read input registers	Use to read PV, Control op etc
06	Preset Single register	Use to write programmable register

The error checking field contains a 16-bit value implemented as two eight-bit bytes. The error check value is the result of a Cyclical Redundancy Check (CRC) calculation performed on the message contents.

10.2 Parameter Address Details

Sr. No.	Parameters	Absolute Address	Type	Access Type
1	PROCESS VALUE	30001	Int	Read Only
2	POWER IN PERCENTAGE	30002	Int	Read Only
3	AUTOTUNE STATUS	30003	Int	Read Only
4	AMBIENT	30004	Int	Read Only
5	SSR STATUS	30005	Int	Read Only
6	RELAY-1 STATUS	30006	Int	Read Only
7	RELAY-2 STATUS	30007	Int	Read Only
8	RELAY-3 STATUS	30008	Int	Read Only
9	RELAY-4 STATUS	30009	Int	Read Only

NOTE: Process Value (PV) Error Conditions Value

OPEN : 32767
UNDER : 32765
OVER : 32766

Sr. No.	Parameters	Absolute Address	Type	Access Type
1	Control set point	40001	Int	R + W
2	Alarm set point 1	40002	Int	R + W
3	Alarm set point 2	40003	Int	R + W
4	Alarm set point 3	40004	Int	R + W
5	Alarm set point 4	40005	Int	R + W

6	Auto/Manual	40006	Int	R + W
7	% POWER	40007	Int	R + W
8	Proportional band	40008	Int	R + W
9	Integral time	40009	Int	R + W
10	Derivative time	40010	Int	R + W
11	Cycle time	40011	Int	R + W
12	Output Direction	40012	Int	R + W
13	Manual reset	40013	Int	R + W
14	Sampling rate	40014	Int	R + W
15	Sampling period	40015	Int	R + W
16	Ramp – type	40016	Int	R + W
17	Ramp – rate	40017	Int	R + W
18	Soak - rate	40018	Int	R + W
19	Soak type	40019	Int	R + W
20	Input Type	40020	Int	R + W
21	Zero	40021	Int	R + W
22	Span	40022	Int	R + W
23	Input Low Limit	40023	Int	R + W
24	Input High Limit	40024	Int	R + W
25	SET Type-1	40025	Int	R + W
26	Open Sensor Status	40026	Int	R + W
27	Decimal Point	40027	Int	R + W
28	Display set point	40028	Int	R + W
29	offset	40029	Int	R + W
30	Filter	40030	Int	R + W
31	Auto CJC Status	40031	Int	R + W
32	Fixed CJC value	40032	Int	R + W
33	Relay Delay -1	40033	Int	R + W
34	Hysteresis 1	40034	Int	R + W
35	Alarm-1 Type	40035	Int	R + W
36	Alarm-1 hysteresis	40036	Int	R + W
37	Alarm-1 logic	40037	Int	R + W
38	Alarm-1 delay	40038	Int	R + W
39	Alarm-2 Type	40039	Int	R + W
40	Alarm-2 hysteresis	40040	Int	R + W
41	Alarm-2 logic	40041	Int	R + W
42	Alarm-2 delay	40042	Int	R + W
43	Alarm-3 Type	40043	Int	R + W
44	Alarm-3 hysteresis	40044	Int	R + W
45	Alarm-3 logic	40045	Int	R + W
46	Alarm-3 delay	40046	Int	R + W
47	Alarm-4 Type	40047	Int	R + W
48	Alarm-4 hysteresis	40048	Int	R + W
49	Alarm-4 logic	40049	Int	R + W
50	Alarm-4 delay	40050	Int	R + W

51	Control output type	40051	Int	R + W
52	Control type	40052	Int	R + W
53	Control Output Low Limit	40053	Int	R + W
54	Control Output High Limit	40054	Int	R + W
55	Retransmission o/p Type -1	40055	Int	R + W
56	Retransmission o/p direction – 1	40056	Int	R + W
57	Retransmission o/p Type -2	40057	Int	R + W
58	Retransmission o/p direction – 2	40058	Int	R + W
59	Serial Number	40059	Int	R + W
60	Baud Rate	40060	Int	R + W
61	Function Key	40061	Int	R + W
62	Motor Travel time	40062	Int	R + W
63	Dead Band	40063	Int	R + W
64	Soak (Run/Stop)	40064	Int	R + W
65	Pass word	40065	Int	R + W
66	Version	40066	Int	R

10.3 Exceptional Response

TABLE– 8

CODE	MEANING
01	Function code Invalid. It must be 01, 05, 03 or 06.The function code received in the query is not allowable action for the slave.
02	Illegal address value. The data address received in the query is not an allowable address for the salve.
03	Illegal data value. A value contained in the query data field is not an allowable value for the salve.
06	When Master device write some parameters to Slave device, If slave device busy then it will send 06 code to indicate slave device is busy.

Note:

1. **Refer Menu Mode Description Table the value & Range of each Parameter.**

   EX: Input Type (Applicable Range: 0 to 8):

Input Type	Value
E-tc	0
J-tc	1
K-tc	2
T-tc	3
B-tc	4
R-tc	5
S-tc	6
RTD	7
0 – 10V	8

11. APPENDIX

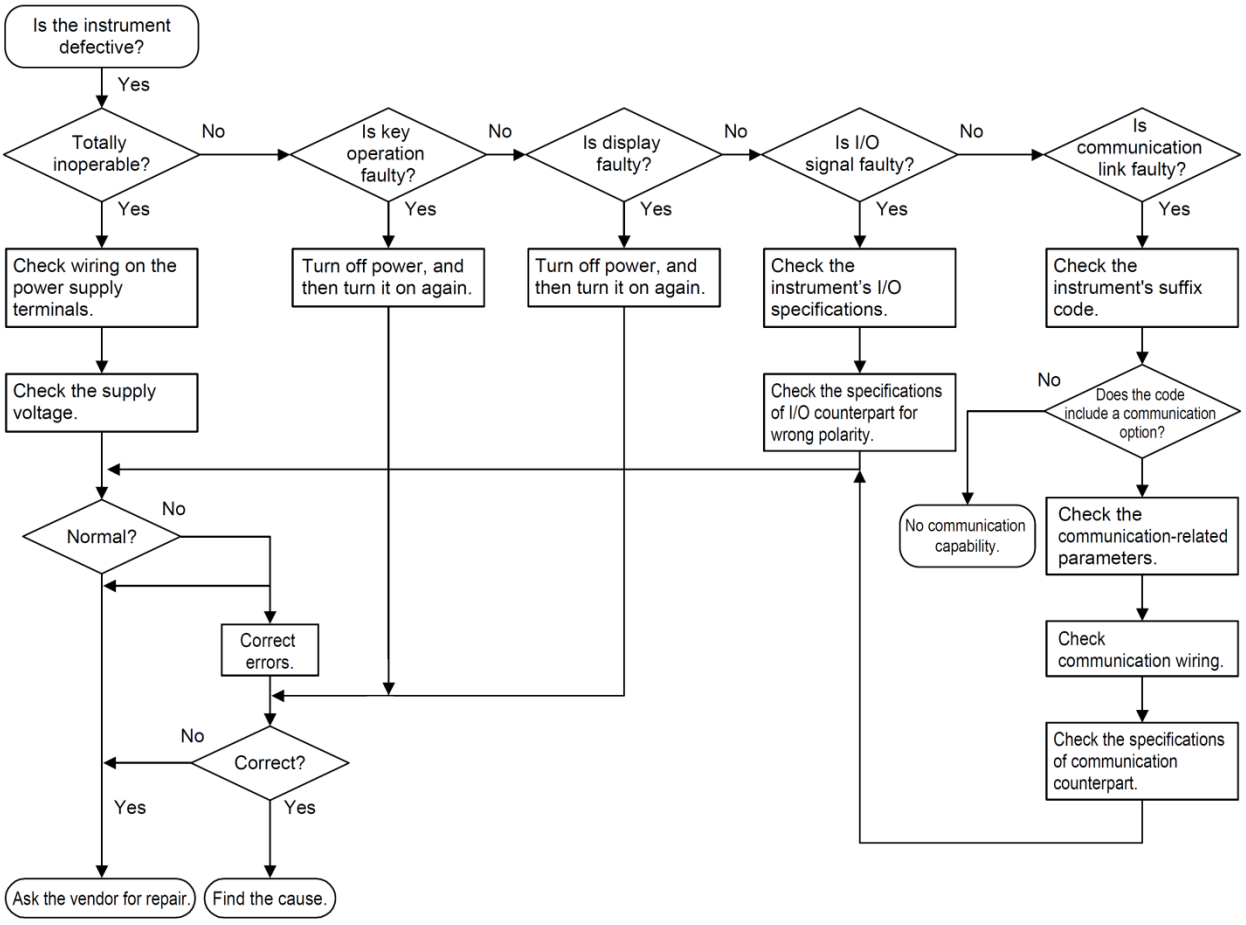
11.1 Troubleshooting

If the operating display does not appear after turning on the controller's power, follow the measures in the procedure below.

If a problem appears complicated, contact our sales representative.

IMPORTANT

Take note of the parameter settings when asking the vendor for repair.



11.2 ON-OFF LOGIC

Relay type	PV	Relay	LED
Hi-On	PV > SP	On	On
	PV < SP	Off	Off
Open sensor	Up scale	On	On
	Down scale	Off	Off
Low-On	PV > SP	Off	Off
	PV < SP	On	On
Open sensor	Up scale	Off	Off
	Down scale	On	On

11.3 Retransmission Output Table for OPEN /OVER /UNDER Condition

RETRASMISSION	VARIABLE	SCALE	ACTION	OPEN	OVER	UNDER
4-20mA	PV	UP	DIR	20.8	20.8	3.2
	PV	DOWN	REV	3.2	3.2	20.8
	PV	UP	REV	20.8	3.2	20.8
	PV	DOWN	DIR	3.2	20.8	3.2
1-5V	PV	UP	DIR	5.2V	5.2V	0.8V
	PV	DOWN	REV	0.8V	0.8V	5.2V
	PV	UP	REV	5.2V	0.8V	5.2V
	PV	DOWN	DIR	0.8V	5.2V	0.8V

NOTE: -

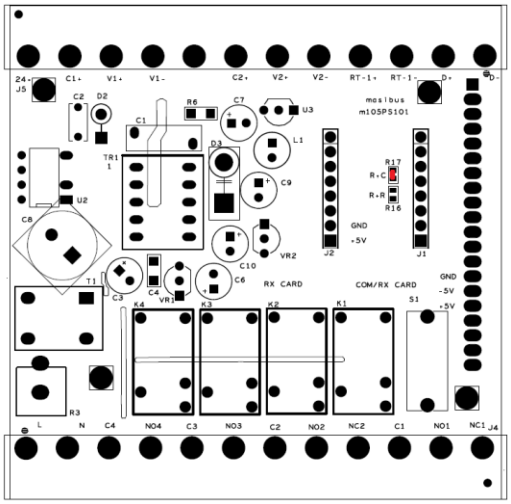
1. OPEN/UNDER/OVER condition is applicable to all input types except 0-5v / 0-20mA.

11.4 Linear Output Table for OPEN/OVER/ UNDER Condition

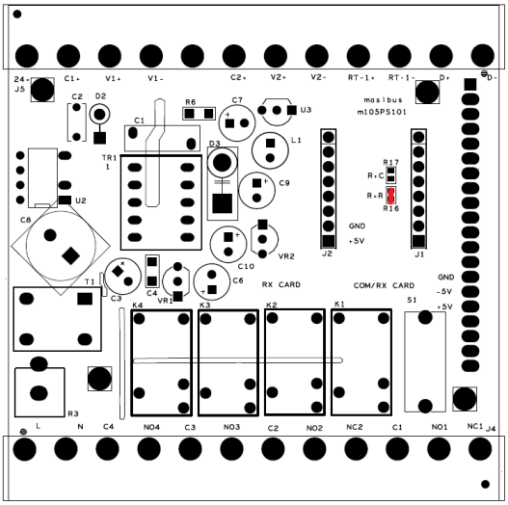
CONTROL OP	Process Scale	Output Direction (O.DIR)	DISPLAY INDICATION		
			OPEN	OVER	UNDER
4-20mamp	UP	DIR	20.0	20.0	4.0
Current	DOWN	REV	4.0	4.0	20.0
	UP	REV	20.0	4.0	20.0
	DOWN	DIR	4.0	20.0	4.0
SSR	UP	DIR	ON	ON	OFF
Pulse Output	DOWN	REV	OFF	OFF	ON
	UP	REV	ON	OFF	ON
	DOWN	DIR	OFF	ON	OFF
RELAY	UP	DIR	ON	ON	OFF
	DOWN	REV	OFF	OFF	ON
	UP	REV	ON	OFF	ON
	DOWN	DIR	OFF	ON	OFF

11.5 Jumper Settings for Addon Card Selection & Retransmission Output Type

- TC5396 comes with different Variants differing by various Output option available.
- There are Two Addon Card Slots available on PCB of PSI Card. The Right Most Slot is fixed for Retransmission (Analog) Output. And the other Left Slot can be used for either Retransmission or RS-485 Communication Card by appropriate Jumper setting shown in below figure.



Jumper setting for RS485

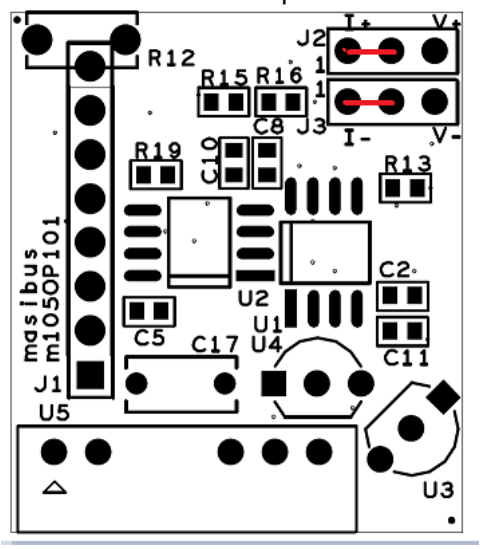


Jumper setting for Retransmission

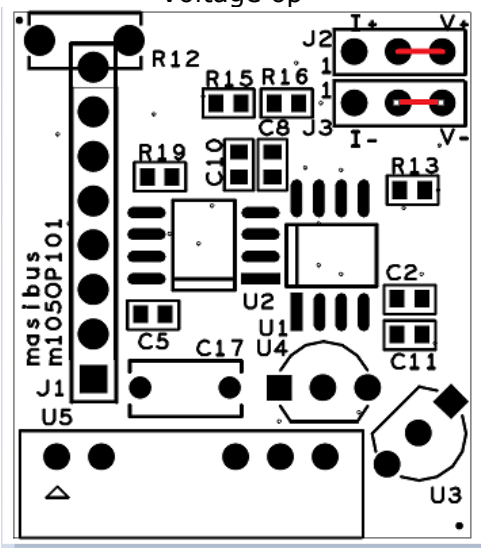
- 0E (SMD 0603) Resistor is used for shorting the Jumper.

- There are mainly Two types of Retransmission Output is available:
- Voltage (0-10VDC, 0-5VDC, 1-5VDC)
- Current (4-20mADC, 0-20mADC)
- This can be Settable by changing the Position of Shorting Link Jumpers on Retransmission Addon Card shown in below figure.
- **Jumper Setting for Retransmission card:**

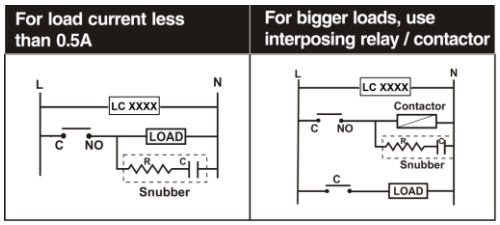
  - Current op



  Voltage op



11.6 Load connection



Electrical precautions during use

Electrical noise generated by switching of inductive loads can create momentary disruption, erratic display, and latch up, data loss or permanent damage to the instrument. Use of snubber circuits across loads as shown above, is recommended.