masibus

AUTO TUNE PID CONTROLLER

SPECIFICATION

Input type	Temp. Range°C	Input type	Temp. Range°C
PT100(0.1°C)	-199.9 to 850.0	B	450 to 1800
PT100	-199 to 850	R	0 to 1768
E	-200 to 1000	S	0 to 1768
J	-200 to 1200	K	-200 to 1372
T	-200 to 400		

Table-1.1

INPUT

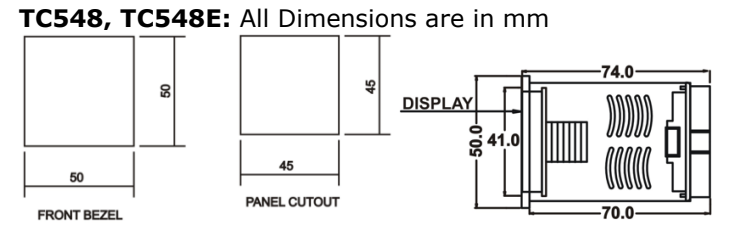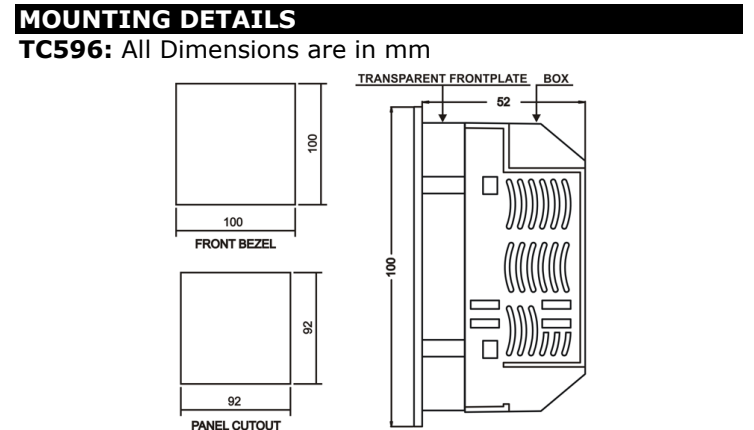|	
Accuracy T/C and RTD:	± (0.25% of Full Span ± 1 count)
Resolution	ADC:16 bits, Display :0.1°C / 1 Count
Sampling Rate	5 Samples/Sec
CJC Error	±3.0 °C Max
Sensor Burnout current	0.25uA
RTD excitation current	0.166mA (Approx)
Allowable wiring resistance for RTD	Maximum 15 ohms/wire (Resistance between three wires should be equal)
NMRR	> 40 dB
CMRR	> 120 dB
Temp-co	< 100ppm/°C
Input Impedance	> 1MΩ
Max Voltage	20VDC

DISPLAY

PV Display	TC596: 0.56" 7-segment Red LED 4-Digit TC548, TC548E: 0.4" 7-segment White LED 4-Digit
SV Display*	TC548E: 0.31" 7-segment Green LED 4-Digit
Status Indication	Individual RED Led for Relay/SSR and Alarm Status
Keys	Enter, Increment, Decrement

* For TC548E

OUTPUT TYPE	Control Mode	Rating	Type
Relay-1	PID/On-Off /Alarm	10A @ 230VAC / 28VDC	Single Change over, Three Terminals (C, NO, NC)
Relay-2	Alarm	5A @ 230VAC / 28VDC	
SSR	PID	11VDC or more / 2VDC or less	Voltage Pulse Output Resolution: -10mSec

Model	TC596	TC548	TC548E
Relay-1	✓	✓	✓
Relay-2	✗	✗	✓
SSR	✓ (in lieu of relay-1)	✓	✓

POWER SUPPLY

Standard	85-265VAC/ 100-300VDC
Power consumption	<3 VA

ENVIRONMENTAL CONDITION

Humidity (Non-Condensing)	30% to 95% RH

Instrument Warm-up Time	Approx. 15 minutes
Ambient Temperature	0 to 55°C
Storage Temperature	0 to 80°C

PHYSICAL

Models	TC596	TC548, TC548E
Front Bezel (in mm)	100 x 100	50 x 50
Panel Cutout (in mm)	92 x 92	45 x 45
Depth Behind the Panel (in mm)	52	70 (Including Terminal)
Weight (Approx.)	160g	110g
Enclosure Material	Lid: PC, Base: ABS	PC
Enclosure Protection	IP20	
Terminal Cable Size	Barrier type terminal, cable 2.5 mm²	

MOUNTING DETAILS

TC596: All Dimensions are in mm

TC548, TC548E: All Dimensions are in mm

WARRANTY

Warranty does not apply to defects resulting from action of the user such as misuse, improper wiring, operation outside of specification, improper maintenance or repair, or unauthorized modification. Masibus is not liable for special, indirect or consequential damages or for loss of profit or for expenses sustained as a result of a device malfunction, incorrect application or adjustment Masibus' total liability is limited to repair or replacement of the product.
The warranty set forth above is inclusive and no other Warranty, whether written or oral, is expressed or implied.

SAFETY/WARNING PRECAUSTIONS

To ensure that the device can be operated safely and all functions can be used, please read these instructions carefully.
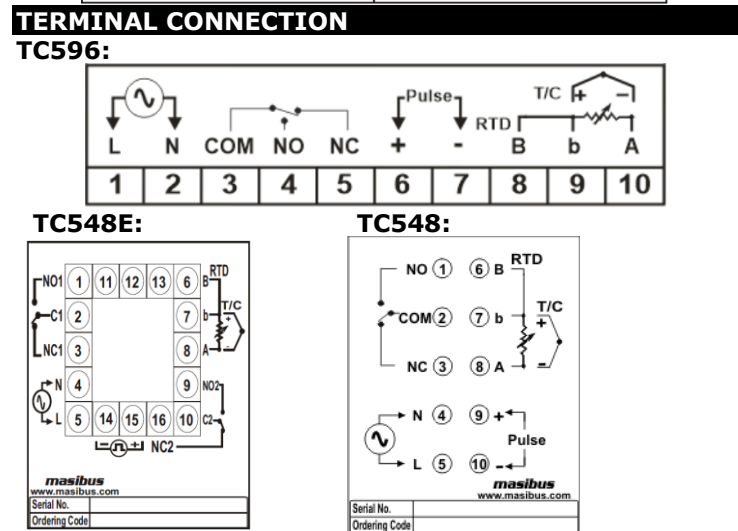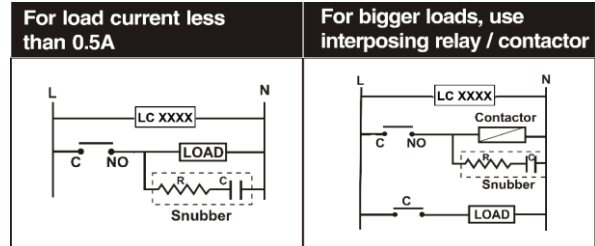Installation and Start-up must be carried out by qualified personnel only. The relevant county-specific regulations must also be observed.
Before start-up it is particularly important to ensure:
• Terminal wiring: check that all cables are correctly connected according to the connection diagram
• All 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. Unused control terminals should not be used as jumper points as they may be internally connected, which may cause damage to the unit.

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.

For load current less than 0.5A	For bigger loads, use interposing relay / contactor

TERMINAL CONNECTION

TC596:

TC548E:

TC548:

FRONT KEYS DESCRIPTION

Functions	Key press
To enter into Set-point mode	Press 🔘 key to entering into Set-point mode. Set-point is changed by using ▼ or ▲ Keys. Then Press 🔘 Key to Store the Set-point.
To enter into lock mode	Press ▲ & ▼ Keys for 3 seconds to enter into Lock mode.
To enter in to run mode	Press ▲ & ▼ Keys to enter into Run mode from menu mode.

FRONT PANEL DESCRIPTION

Symbol	Function
▲	In run mode Press Increment key to view ambient temperature. In run mode press Increment key for 3 seconds to entering into conf mode. In Menu mode it increments the value of any parameters.
▼	In run mode Press Decrement key to view average energy. In run mode press Decrement key for 3 seconds to entering into tune mode. In Menu mode it decrements the value of any parameters.
🔘	In run mode Press enter key to entering in to set-point mode. In menu mode it stores the value of parameters. TC548E: In run mode press enter key for 3 seconds to view remaining soak time.
PV	Display Process Value. Display parameter name when user set parameter.
R1,R2,R3	ON when Relay is energized & OFF otherwise.

PARAMETER SETTINGS

Display	Name	Description	Default Value	Shows only if
C1.SP (C1.sp)	Control Set Point 1	Range Depending on PV sensor type selected	100	-
A1.SP (A1.SP)	Alarm Set Point 1	Range Depending on PV sensor type selected	100	TC548E, SSR is selected in OT.
A2.SP (A2.SP)	Alarm Set Point 2	Range Depending on PV sensor type selected	100	TC548E
SSTR* (SStr)	SOAK run/stop	Run/ Stop button for SOAK.	stop	TC548E

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

tUnE mode

Display	Name	Description	Default Value	Shows only if
A.TUN (A.tUn)	Auto Tune	Auto Tuning Process yes / no	NO	COP is PID
PB (Pb)	Proportional Band	0 to 9999(B,R,S,RTD 1 deg⁰C) or 0.0 to 999.9 (E,J,K,T,RTD 0.1 deg⁰C)	160.0	COP is PID
TI (t i)	Integral Time	0 to 1000	175	COP is PID
TD (td)	Derivative Time	0 to 180	40	COP is PID
CT (Ct)	Cycle Time	Adjust Cycle Time 1 – 300 sec	10	COP is PID
MR (mr)	Manual Reset	To Prevent Overshoot (-50% to +50%) of PB	-40%	COP is PID
TIL (t iL)	Integral Inihibit Low	0 to 100	100	COP is PID
O.DIR (o .d ir)	Output Direction	Reverse/Direct	0 (REV)	COP is PID
RAMP (rAMP)	Ramp Rate Type	None/minutes/hours	NONE	TC548E
RMPR (rMPr)	Ramp rate Value	0.1 to 999.9 Degree per minute or hour	0.1	TC548E
SOKR (Sokr)	Soak Rate	0 to 99.59 [HH.MM]hour and minute	0.00	TC548E
SOKT (Sokt)	Soak Type	Reset/Hold	RESET	TC548E

ConF mode

Display	Name	Description	Default Value	Shows only if
INPT (inPt)	INPUT Type	As per table 1.1	TC E	
ZERO (ZEro)	Zero	Any value within the Input Range & less the SPAN Value.	-200	If TC E
SPAN (SPAn)	Span	Any value within the Input Range & greater the ZERO Value.	1000	If TC E
DP (dP)	Decimal Point	1/ 0.1	1	
*FLTR (FLtr)	Filter	Filter for PV Input(0 to 5)	3	
OFST (OFSt)	Offset	Offset to be added in PV value -100.0 to 100.0	0	
OPES (oPES)	OPEN Sensor Status	Set Control O/P when Input OPEN condition. DOWN /UP	UP	
OT (ot)	Output Type	Relay/SSR rELY / SSr	Relay	TC548, TC548E Model
COP (CoP)	Control Output	PID/ONOF P id / onoF	PID Type	OT is Relay

	Type			
TSP (tSP)	Type of Set Point	L-ON / H-ON Lower ON Higher ON	L-ON	Control Type (COP) is ON-OFF
HY (HY)	Hysteresis	Hysteresis Value (in °C) for Relay during ON-OFF type Control. 1 to 250	1	Control Type (COP) is ON-OFF
RD1 (rd1)	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	TC548, TC548E Model
DISP (d iSP)	Display Set Point	Set which Set Point to shown in SV display in RUN mode while device is in Auto Mode C1.SP, A2.SP Tsok (Remaining Soak time)	0	TC548, TC548E Model
CO.LO (Co.Lo)	Control Output Low	Control Output Low Limit in %. 0.0 to 100.0 % (CO.LO < CO.HI)	0.0	TC548, TC548E Model
CO.HI (Co.H i)	Control Output High	Control Output High Limit in %. 0.0 to 100.0 %	100.0	TC548, TC548E Model
A1TP (A ItP)	Alarm Type – 1	Refer ALARM Type Table 0 to 15	6 (PV.A.L)	
A1HY (A IHY)	Alarm 1 Hysteresis	Set Hysteresis (in °C) for Alarm-1	1	
A1LC (A ILC)	Alarm 1 Logic	Set Logic for Alarm-1 0: NORM (Normal) 1: FLSF (Fail-Safe)	0 (Normal)	TC548, TC548E, SSR is selected in OT.
A1DY (A I .dY)	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	
A2TP (A2tP)	Alarm Type – 2	Refer ALARM Type Table 0 to 15	6 (PV.A.L)	TC548E Model
A2HY (A2HY)	Alarm 2 Hysteresis	Set Hysteresis (in °C) for Alarm-2	1	TC548E Model
A2LC (A2LC)	Alarm 2 Logic	Set Logic for Alarm-2 0: NORM (Normal) 1: FLSF (Fail-Safe)	0 (Normal)	TC548E Model
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	TC548E Model
A.CJC (A .CJC)	ACJC	Auto Cold Junction Compensa-tion NO / YES	YES	Input Type is TC.
F.CJC (F .CJC)	Fix cold junction Compensa-tion	0 to 60.0 °C	0.0	Input Type is TC & A.CJC is NO.
PASS (PASS)	Password	Password protection for calibration mode & factory default	1	
VERS (uErS)	Version	Shows the Version of the Current Firmware	-	

*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. "FLTR" should be set to 0 or 1 to short the response time.

LocP Mode : To lock/Unlock

L.CON (L .CON)	The conf menu parameters			
L.TUN (L .tUN)	the tune menu parameters			
L.SC1 (L .SC1)	the Control Set point	LocP/ UnLocP	Unlock	
L.SA1 (L .SA1)	the Alarm -1 set point			TC548, TC548E, OT is SSR
L.SA2 (L .SA2)	the Alarm -2 set point			TC548E
L.Str (L .Str)	the Run/ Stop button for SOAK.			TC548E

CONTROL FUNCTION

ON/OFF Control (For L-ON Mode): The relay is 'ON' up to the set temperature and cuts 'OFF' above the set temperature. As the temperature of the system drops, the relay is switched 'ON' at a temperature slightly lower than the set point.
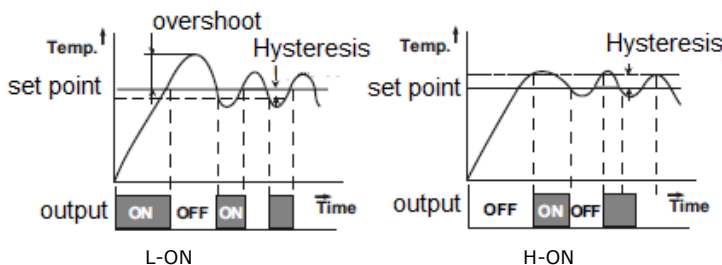
Figure 1.1: Typical Relay operation

HYSTERESIS: The difference between the temperatures at which relay switches 'ON' and at which the relay switches 'OFF' is the hysteresis or dead band.

PID Control

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 TUNE menu and set it to YES. During auto tuning lower display (SV) will flash "AT" message. After auto tune procedure is completed, the message will be removed 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.

AUTO TUNE FUNCTION:
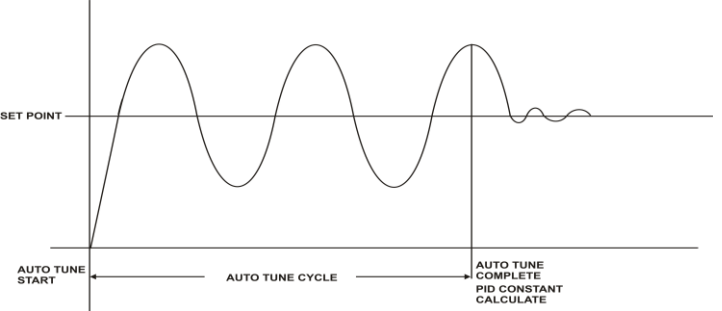
Manual Reset: After some time, the process temperature settles at some point and there is a difference between the set temperature & the controlled temperature. This difference can be removed by setting the manual reset value equal & opposite to the offset. Range for the manual reset is -50.0% to +50.0% of proportional band.

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
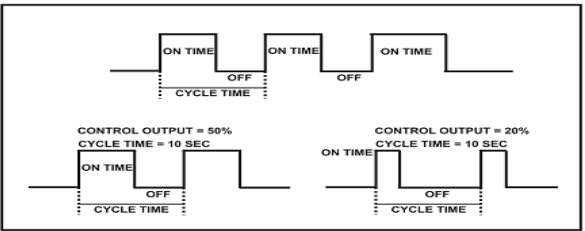
USER GUIDE

PV bias for input correction: PV bias is used for normal operation. This function can be used for adjustment to compensate for differences in measurement reading.

Settable Digital Filter: 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 IIR filter with time constant.

Filter Effects:

Input PV   Filtering for 2 sec   Filtering for 10 sec
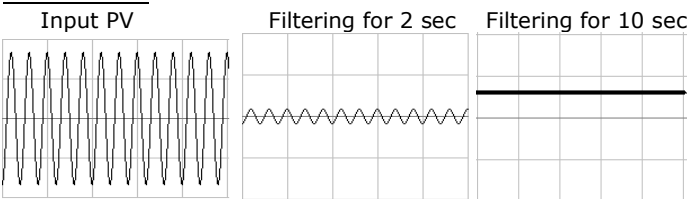
Settable manual reset to prevent overshoot: Virtually no process requires precisely 50% output on single output controls or 0% output on two output controls. Because of this many older control designs incorporated an adjustment called manual reset (also called offset on some controls). This adjustment allows the user to redefine the output requirement at the set point. A proportioning control without manual reset or Integral time 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 pre-program the approximate output requirement at the set point to allow for quicker settling at set point when Automatic reset (Integral time) set to zero.
For PI and PID control, set MR to prevent overshoot
Range for the manual reset is -50% to +50% of Proportional band.

Integral Inhibit: The Value of Integral Inhibit is in a percentage of PB.
To accurate control a process at some defined set point we use PID control. But some of the processes, overshoot can occur during controlling. To overcome this type of issue we can use Integral Inhibit parameter in such type of process to control overshoot.
By use of integral inhibit "I" term (Integral constant) function is limited in specific region of Proportional band (PB).
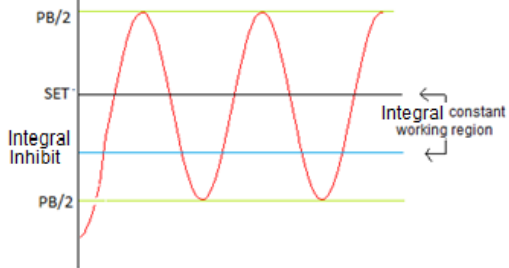
ALARM OUTPUT
Alarm Types:
Various alarm operations are shown in the reference figure.

	Display message	ALARM TYPE		Display message	ALARM TYPE
1	none	None	9	SP.A.L	Absolute value set point low alarm
2	Pv.d.H	Deviation High alarm	10	P.S.d.H	Deviation High alarm with standby
3	Pv.d.l	Deviation Low alarm	11	P.S.d.L	Deviation Low alarm with standby
4	Pv.d.r	Deviation High & Low range alarm	12	P.S.d.r	Deviation High & Low range alarm with standby
5	Pv.d.b	Deviation High & Low Band alarm	13	P.S.d.b	Deviation High & Low limit alarm with standby
6	Pv.a.H	Absolute value High alarm	14	P.S.A.H	Absolute value High alarm with standby
7	Pv.A.L	Absolute value Low alarm	15	P.S.A.L	Absolute value Low alarm with standby
8	SP.A.H	Absolute value set point high alarm	16	PV.-E.	PV error (OPEN/OVER/ UNDER)

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
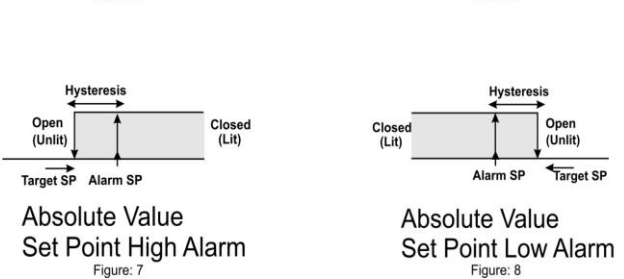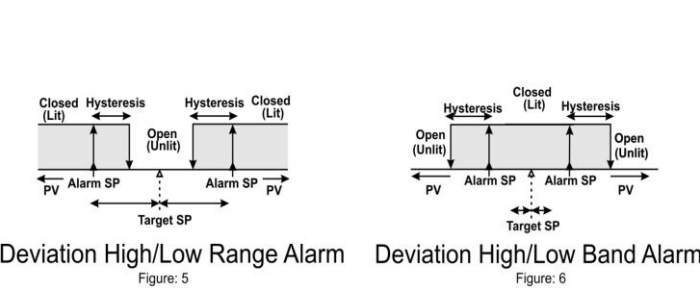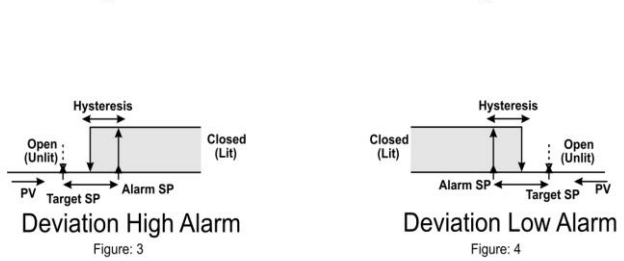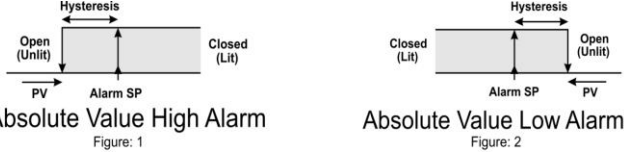
NOTE: -
LIT = LED on, UNLIT = LED off
Up arrow indicate Alarm will ON from this value.
Down arrow indicate Alarm will OFF from this value.
Standby operation:
For alarm types, 9 to 14, the relay action happens only after the PV has crossed the SP after power on.