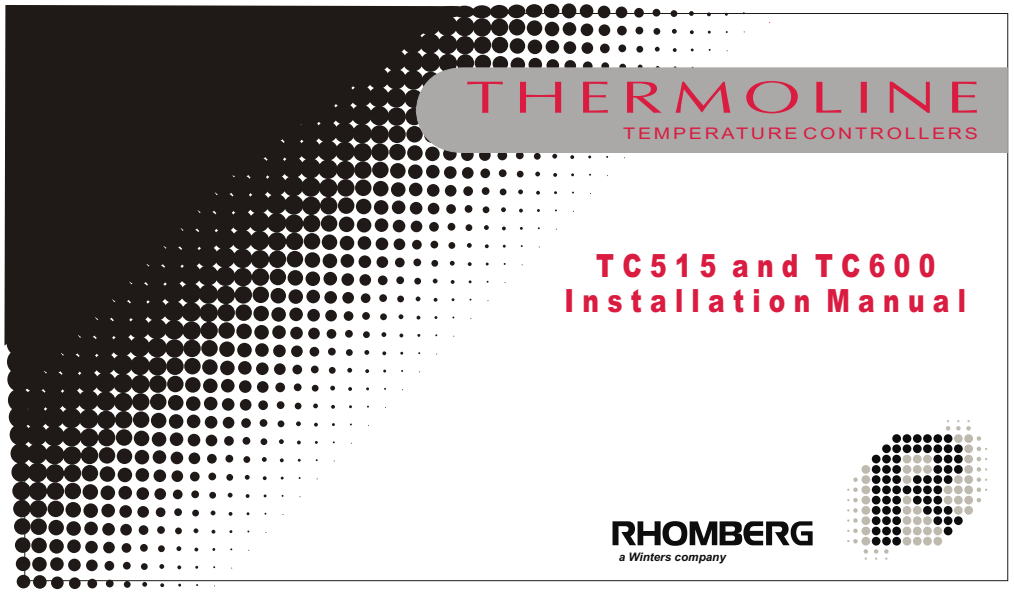

THERMOLINE
TEMPERATURE CONTROLLERS
TC515 and TC600
Installation Manual
RHOMBERG
a Winters company

Guarantee

12 months

Congratulations on the purchase of this new product. Special care with the design, workmanship and choice of materials has been taken to ensure its reliable performance.

Each product is stringently tested before leaving our factory. Therefore, our products are guaranteed for a period of 12 (twelve) months from date of purchase. This guarantee is valid for defects arising from failure during operation under specified conditions. Our company does not accept liability for any consequential damages or losses arising from product malfunction.

Should this product prove to be defective, kindly return it for inspection or repair. For further information, please contact your nearest distributor of Rhomberg products.

RHOMBERG

a Winters company

Contents

Introduction to Temperature Control

The Basics of ON/OFF Control

In this simple form of control, the controller output switches off when the process temperature reaches the setpoint. The process cools until the recovery level is reached and power is reapplied to the process. The resulting process temperature oscillates through this hysteresis band (the band between setpoint and recovery levels) as illustrated in Figure 1.
On/Off Control is ideal for large capacity processes (processes that have slow temperature changes and are insensitive to disturbances) because the hysteresis band can be set very narrow, minimising temperature oscillations.

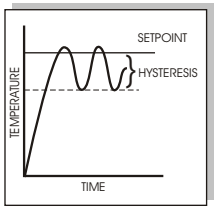


Figure 1 : On/Off Characteristic

Typical Applications:

- *Airconditioning*
- *Oil heaters*
- *Bain Marie catering equipment*

Simple Example:

The thermostat of a household heater uses On/Off control. When the room temperature reaches the setpoint, a switch opens and turns the heater off. The switch remains off until the room temperature drops below the setpoint causing the switch to close, turning the heater on again. The heater is either ON or OFF.

The Basics of Trip & Recovery Control

Trip and Recovery mode facilitates control of two independent setpoints. In heating, each trip point represents the temperature above which the relay is de-energised and the heating mechanism is de-activated. The recovery points represent a temperature below which the relay is re-energised and the heating mechanism is turned on.
This feature can also be used in cooling applications. Each trip point will then represent the temperature below which the relay is de-energised and the cooling mechanism is de-activated. The recovery points represent the temperature above which the relay is re-energised and the cooling mechanism is turned on.
A typical application where two fans are used to control a process is shown in Fig. 2. The first fan is activated at 300 and remains on until the temperature falls below 250 , while the second switches on at 350 and switches off at 280 .

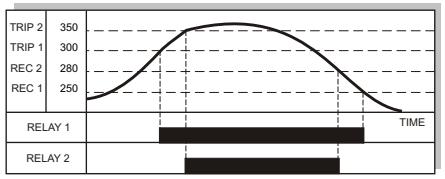


Figure 2 : Trip and Recovery mode used in a cooling application

The Basics of PID Control

In applications where precision control is required, including small capacity processes that react quickly to disturbances, it is necessary to provide a more sophisticated method of temperature regulation than that of ON/OFF control.
For example, ON/OFF control would be ineffective in controlling the temperature of a bathroom shower as the person would be subjected to alternative bursts of HOT and COLD water, neither of which is desirable.
It is necessary to establish a proportion of hot to cold water to maintain the required temperature.

Proportional Control (P)

Proportional control provides added temperature stability by eliminating temperature fluctuations by setting the proportion of power supplied to the process depending on the difference between process and setpoint temperatures.
Unfortunately, the process temperature only settles at the setpoint if the heat source (heater) matches the heat load of the process EXACTLY. Heaters and processes are rarely matched and therefore the process temperature usually settles at a value offset from the setpoint as shown in Figure 3.

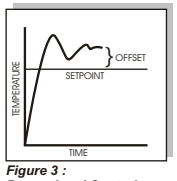


Figure 3 : Proportional Control Characteristic

Proportional and Integral Control (PI)

To compensate for the offset resulting in proportional only control, a second control term known as Integral Action is introduced.
Integral Action eliminates the offset by responding to **duration** of the error signal (through integration) and automatically forcing the process temperature to settle exactly at the setpoint after a period of time. This is achieved by small adjustments in the proportional output.

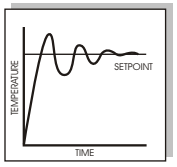


Figure 4 : Proportional and Integral Control Characteristic

The Basics of PID Control (Continued)

Proportional, Integral and Derivative Control (PID)

In many small capacity processes, the controller must respond quickly to large and rapid changes in temperature caused by disturbances. Derivative action provides additional temperature stability by reacting to the **rate** of change of the process temperature.

Simple Example:

An injection moulding machine benefits from PID control. Proportional control ensures that the plastic temperature is stable and does not oscillate. Integral control maintains accuracy by keeping the temperature exactly at the setpoint over long periods. Derivative action forces the temperature back to the setpoint quickly when the cold plastic pellets enter the melting chamber.

Typical Applications:

- *Furnaces*
- *Petrochemical processes*
- *Industrial ovens*
- *Refrigeration control*
- *Jacuzzi control*
- *Injection moulding*

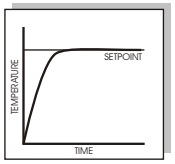


Figure 5 : Proportional, Integral and Derivative Control Characteristic

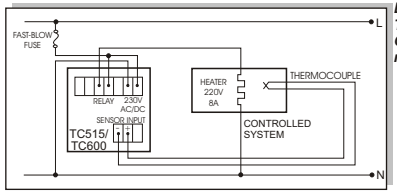
For optimum PID control, the controller parameters (P, I and D values) should be tuned for each temperature process. This can be performed manually or automatically by activating the Autotune function. This facilitates precision control at the setpoint temperature and makes the unit easy to set up.

Anti-Reset Wind-Up

Anti-reset wind-up, sometimes referred to as manual reset, is automatically calculated during the Autotune function but can also be manually set, if required. It is used in conjunction with proportional, integral and derivative terms to speed up the time it takes a process to reach its setpoint temperature while minimising overshoot.
This term represents the percentage power that a proportional only system would require to maintain its setpoint temperature.
Example: A user would set the anti-reset term to 30 for a system requiring 30% power to maintain its setpoint temperature.

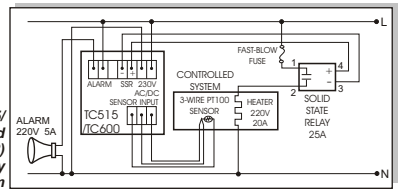
Installation

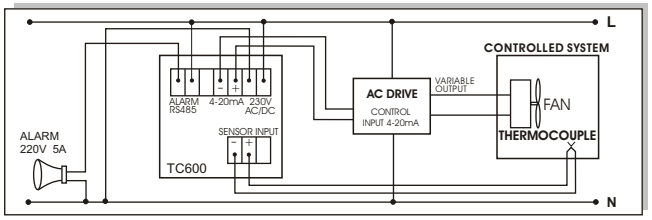
Wiring: Examples on how to connect the TC515 and TC600



Example 1 :TC515/ TC600 with Relay Output, no alarm required.

Example 2: TC515/ TC600 with Solid State Relay (SSR) Output and Relay Output for Alarm





Example 3 : TC600 with Analogue output.

Installation

Connection

Connect the TC515/TC600 to the supply and the temperature sensor to the Temperature Controller unit. Ensure that the correct sensor polarity is observed. [**To prevent noise from entering the sensor input, it is good practice to keep the power and load cables separate from the sensor cable**].

CAUTION: A sensor without screening must be used when the TC515/TC600 has a solid state relay output because there is no isolation between the sensor input and the SSR output.

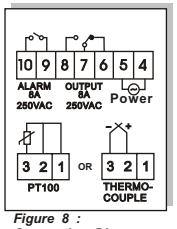


Figure 8 : Connection Diagrams

Panel Cut-out

Cut or punch out a panel cut-out. The ideal panel thickness is between 1 and 7 mm.

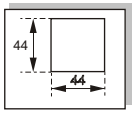


Figure 6 : Panel Cut-out Dimensions (mm)

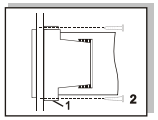
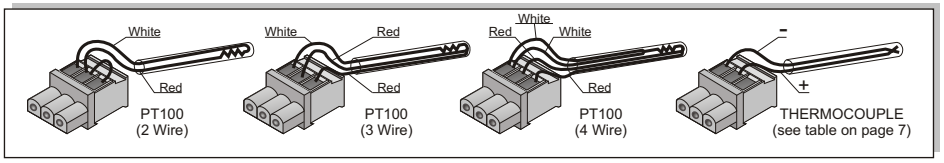


Figure 7 : Mounting Method

Mounting

Insert the TC515/TC600 into the cut-out. Slide the retaining clip (1) over the housing from the rear until the clip presses firmly against the panel. Secure the clip using the screws (2) provided.



The following figure illustrates how the thermocouple or PT100 is connected.

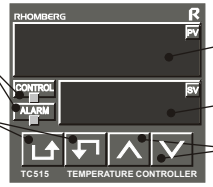
Installation

Thermocouple Reference Table :

	STANDARD									
TYPE	BRITISH BS 1843		AMERICAN ANSI / MCI 96.1		GERMAN DIN 431710-4		FRENCH NFE-18001		DIN IEC 584-3	
E +	BROWN	BROWN	BROWN	PURPLE	BLACK	RED	PURPLE	YELLOW	PURPLE	PURPLE
E -		BLUE		RED		BLACK		PURPLE		WHITE
J +	BLACK	YELLOW	BROWN	WHITE	BLUE	RED	BLACK	YELLOW	BLACK	BLACK
J -		BLUE		RED		BLUE		BLACK		WHITE
K +	RED	BROWN	YELLOW	YELLOW	GREEN	RED	YELLOW	YELLOW	GREEN	GREEN
K -		BLUE		RED		GREEN		PURPLE		WHITE
R +	GREEN	WHITE	GREEN	BLACK	WHITE	RED	GREEN	YELLOW	ORANGE	ORANGE
R -		BLUE		RED		WHITE		GREEN		WHITE
S +	GREEN	WHITE	GREEN	BLACK	WHITE	RED	GREEN	YELLOW	ORANGE	ORANGE
S -		BLUE		RED		WHITE		GREEN		WHITE
T +	BLUE	WHITE	BROWN	BLUE	BROWN	RED	BLUE	YELLOW	BROWN	BROWN
T -		BLUE		RED		BROWN		BLUE		WHITE
B +					GREY	RED				
B -						GREY				
N +	ORANGE	ORANGE	BROWN	ORANGE					PINK	PINK
N -		BLUE		RED						WHITE

Front and Rear Panels

TC515 FRONT PANEL



OUTPUT STATUS INDICATION
CONTROL LED illuminates when control relay is energised.
ALARM LED illuminates when alarm relay is energised.

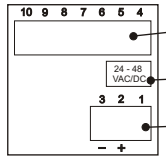
SELECT KEYS
Press to move UP or DOWN the function list. Hold down to scroll quickly.

3 DIGIT (PV) PROCESS TEMPERATURE DISPLAY
Displays process temperature or function name.

3 DIGIT (SV) SETPOINT VALUE DISPLAY
Displays setpoint or function status.

UP/DOWN KEYS
Press to change the SV or change the status of the displayed function. Hold down to scroll quickly.

REAR PANEL



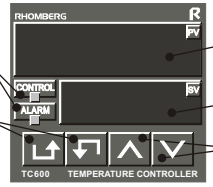
CONTROL/ALARM OUTPUT & POWER SUPPLY

VOLTAGE RATING

SENSOR INPUT

PLEASE NOTE:
The use of sharp objects to change settings will seriously damage the unit. Please use finger tips only.

TC600 FRONT PANEL



OUTPUT STATUS INDICATION
CONTROL LED illuminates when control relay is energised.
ALARM LED illuminates when alarm relay is energised.

SELECT KEYS
Press to move UP or DOWN the function list. Hold down to scroll quickly.

4 DIGIT (PV) PROCESS TEMPERATURE DISPLAY
Displays process temperature or function name.

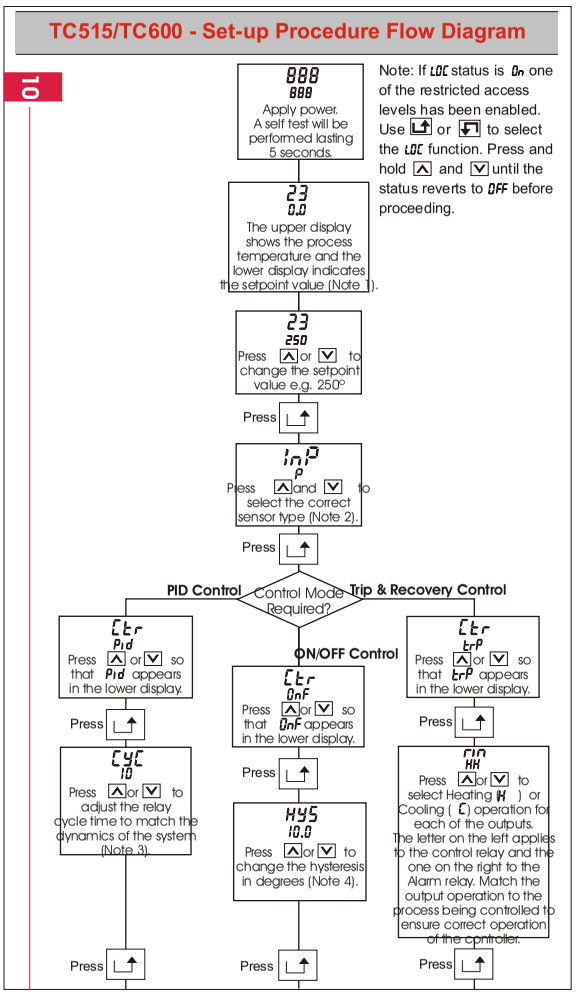
4 DIGIT (SV) SETPOINT VALUE DISPLAY
Displays setpoint or function status.

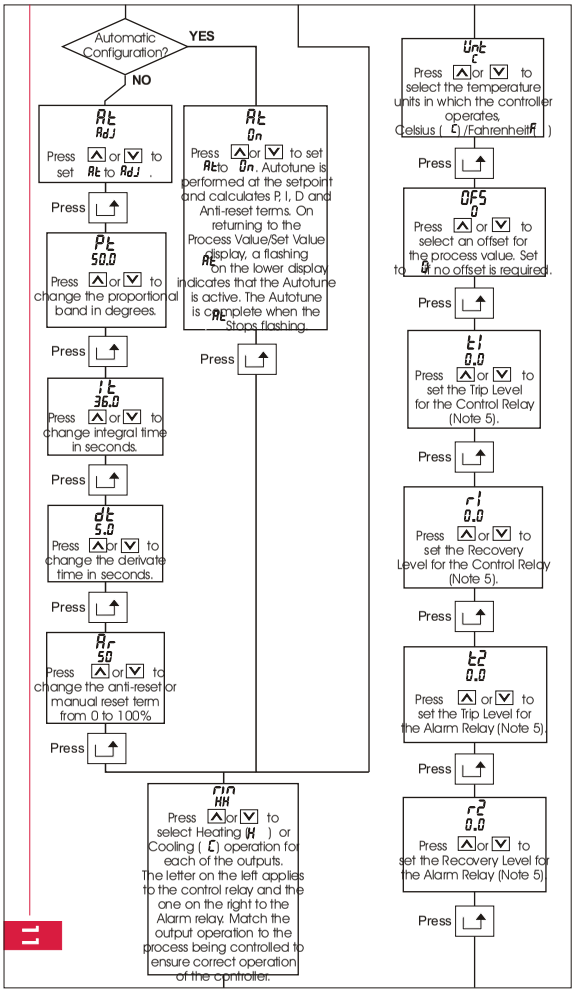
UP/DOWN KEYS
Press to change the SV or change the status of the displayed function. Hold down to scroll quickly.

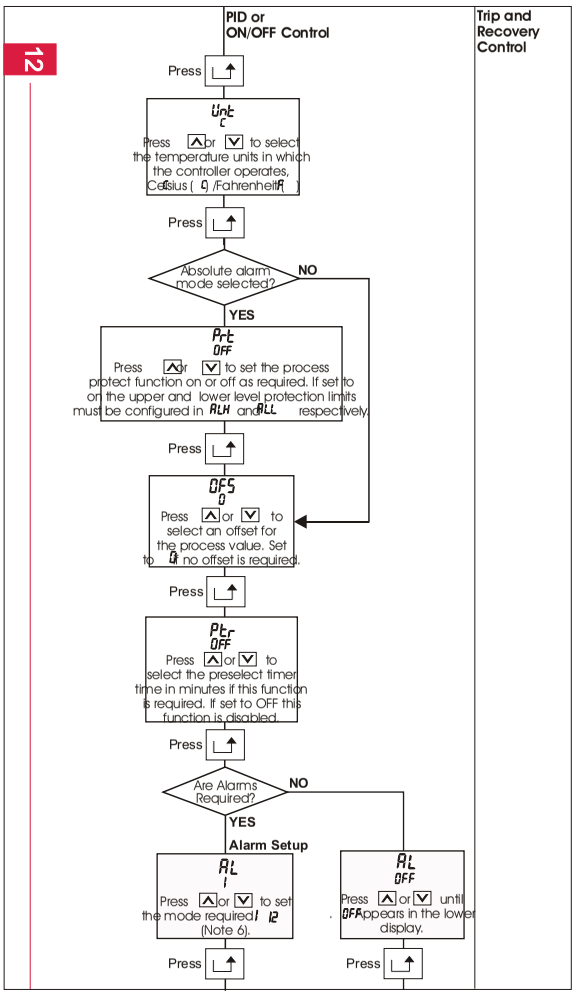
TC515/TC600 -Key Features

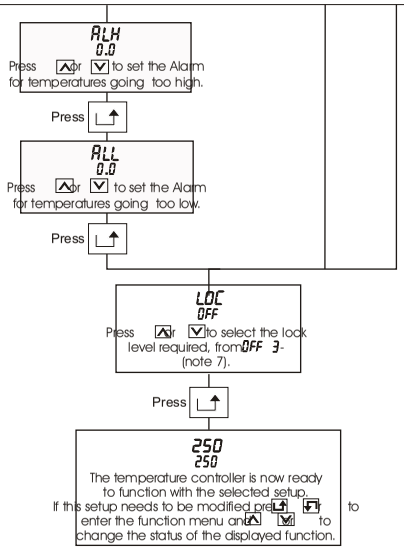
- ❒ Simultaneous display of process and setpoint temperatures, TC515 - 3 digits, TC600 - 4 digits.
- ❒ Autotune PID control with programmable P,I,D and anti-reset windup terms.
- ❒ On/Off control with programmable hysteresis.
- ❒ Two independently programmable trip and recovery levels with separate outputs.
- ❒ Two programmable alarm levels configurable in 12 modes with a single output.
- ❒ Control/Alarm output options, 8A relay or solid state relay drive.
- ❒ Analogue control output options (TC600 only), 0-20mA, 4-20mA, 0-5V or 0-10V.
- ❒ Programmable to accept 9 sensor types.
- ❒ Programmable control for cooling or heating applications.
- ❒ Programmable operation in degrees Celsius or degrees Fahrenheit.
- ❒ Process protect facility to prevent changing the setpoint outside the alarm limits.
- ❒ Programmable process temperature offset to cancel the effects of temperature gradients within the process.
- ❒ A 16 hour preselect timer for batch processing.
- ❒ A programme lock which may be set according to the access level required.

TC515/TC600 - Set-up Procedure Flow Diagram




Automatic Configuration?
YES
NO
At
AdJ
Press ▲ or ▼ to set At to AdJ .
Press
Pb
50.0
Press ▲ or ▼ to change the proportional band in degrees.
Press
It
36.0
Press ▲ or ▼ to change integral time in seconds.
Press
dt
5.0
Press ▲ or ▼ to change the derivate time in seconds.
Press
Ar
50
Press ▲ or ▼ to change the anti-reset or manual reset term from 0 to 100%
Press
At
On
Press ▲ or ▼ to set At to On. Autotune is performed at the setpoint and calculates P, I, D and Anti-reset terms. On returning to the Process Value/Set Value display, a flashing AE On the lower display indicates that the Autotune is active. The Autotune is complete when the AE Stops flashing.
Press
rin
HH
Press ▲ or ▼ to select Heating (H) or Cooling (C) operation for each of the outputs. The letter on the left applies to the control relay and the one on the right to the Alarm relay. Match the output operation to the process being controlled to ensure correct operation of the controller.
Unit
C
Press ▲ or ▼ to select the temperature units in which the controller operates, Celsius (C) /Fahrenheit (F)
Press
OFS
0
Press ▲ or ▼ to select an offset for the process value. Set to 0 if no offset is required.
Press
t1
0.0
Press ▲ or ▼ to set the Trip Level for the Control Relay (Note 5).
Press
r1
0.0
Press ▲ or ▼ to set the Recovery Level for the Control Relay (Note 5).
Press
t2
0.0
Press ▲ or ▼ to set the Trip Level for the Alarm Relay (Note 5).
Press
r2
0.0
Press ▲ or ▼ to set the Recovery Level for the Alarm Relay (Note 5)
Press


PID or
ON/OFF Control
Trip and
Recovery
Control
Press
Unit
C
Press or to select the temperature units in which the controller operates, Celsius (C) /Fahrenheit F)
Press
Absolute alarm mode selected?
NO
YES
Prt
OFF
Press or to set the process protect function on or off as required. If set to on the upper and lower level protection limits must be configured in RLH and RLL respectively.
Press
OFS
0
Press or to select an offset for the process value. Set to 0 if no offset is required.
Press
Ptr
OFF
Press or to select the preselect timer time in minutes if this function is required. If set to OFF this function is disabled.
Press
Are Alarms Required?
NO
YES
Alarm Setup
AL
1
Press or to set the mode required 1 12 (Note 6).
Press
AL
OFF
Press or until OFF appears in the lower display.
Press



Note 1:
If the desired functionality differs from the factory default settings shown on pages 14 - 17, an error message may appear. Complete this set-up procedure to configure the unit correctly.

Note 2: Thermocouple Table

STATUS	P	E	J	H	r	S	t	b	n
SENSOR TYPE	PT100	E	J	K	R	S	T	B	N
	RTD	THERMOCOUPLES							

Note 3:
Adjust the relay cycle time to <10 sec for a system with fast dynamics and >10 sec for a slow system.
Not adjustable or visible on a TC600 with analogue control options ordered.

Note 4:
- ❒ For heating processes, the hysteresis trip level is below the setpoint temperature.
- ❒ For cooling processes, the hysteresis trip level is above the setpoint temperature.

Note 5:
- ❒ The recovery level is always below trip level for a heating process and above trip level for a cooling process.
- ❒ The second Trip and Recovery levels control the alarm relay. Thus, setting of alarms is not possible in the Trip and Recovery control mode.

Note 6: Alarm Modes

STATUS				indicates alarm activated
No Stand-by		With Stand-by		
ABSOLUTE	DEVIATION	ABSOLUTE	DEVIATION	
1	4	7	10	SV ALH
2	5	8	11	ALL ALH
3	6	9	12	ALL

Note 7: Keypad lock levels

STATUS	ACCESS
OFF	All functions
1	SV, ALH, ALL, t1, r1, t2, r2 and LOC only
2	SV and LOC only
3	LOC only

TC515/TC600 - Function Description Table

DISPLAY	FUNCTION	STATUS OPTIONS	FACTORY SETTINGS	SCOPE	NOTES
InP	INPUT TYPE	STATUS: P, E, J, H, r, S, t, b, n INPUT SENSOR: PT100 E J K R S T B N RTD THERMOCOUPLES	P (PT100)	Available in all control modes.	See page 18 for a more detailed description.
Ctr	CONTROL MODE	STATUS / DESCRIPTION / APPLICATIONS P.id / PID Control / Precision Control OnF / ON/OFF Control / Non-critical Applications trP / Trip & Recovery Control / Applications requiring 2 fully configurable relay outputs	OnF (On/Off)	Available in all control modes.	See page 18 for a more detailed description.
HYS	ON/OFF HYSTERESIS	STATUS: ON/OFF hysteresis in degrees LIMITS: 0 - 99.9°	10.0 (10°)	Available in On/Off control mode only.	See page 18 for a more detailed description.
CYC	PID RELAY CYCLE TIME	STATUS: PID Relay Cycle time in seconds LIMITS: 1 - 240 sec	10 (10 seconds)	Available in PID control mode with non-analogue control option only.	See page 19 for a more detailed description.
At	PID AUTOTUNE	STATUS / PID AUTOTUNE OFF Disabled On Enabled Adj Manual adjustment	OFF	Available in PID control mode only.	See page 19 for a more detailed description.

TC515/TC600 - Function Description Table

DISPLAY	FUNCTION	STATUS OPTIONS	FACTORY SETTINGS	SCOPE	NOTES
Pt	PROPORTIONAL TERM	STATUS: Proportional band in degrees; LIMITS: 0.5° - 999°; AUTOTUNE CONFIGURED: YES	50.0 (50°)	Available in PID control mode only.	See page 19 for a more detailed description.
it	INTEGRAL TERM	STATUS: Integral time in seconds; LIMITS: 0 - 999 secs; AUTOTUNE CONFIGURED: YES	36.0 (36 seconds)	Available in PID control mode only.	See page 20 for a more detailed description.
dt	DERIVATIVE TERM	STATUS: Derivative time in seconds; LIMITS: 0 - 999 secs; AUTOTUNE CONFIGURED: YES	5.0 (5 seconds)	Available in PID control mode only.	See page 20 for a more detailed description.
Ar	ANTI-RESET WINDUP	STATUS: Anti-reset windup as a percentage of full power; LIMITS: 0 - 100%; AUTOTUNE CONFIGURED: YES	50 (50%)	Available in PID control mode only.	See page 20 for a more detailed description.
rin	RELAY INVERSION	HH: Heating / Heating; CH: Cooling / Heating; HC: Heating / Cooling; CC: Cooling / Cooling (STATUS / CONTROL RELAY / ALARM RELAY)	HH (Heating / Heating)	Available in all control modes.	See page 21 for a more detailed description.
Unt	TEMPERATURE UNITS	C: In degrees - Celsius; F: In degrees - Fahrenheit (STATUS / ALL TEMPERATURE VALUES)	C (°C)	Available in all control modes.	See page 21 for a more detailed description.

TC515/TC600 - Function Description Table

DISPLAY	FUNCTION	STATUS OPTIONS	FACTORY SETTINGS	SCOPE	NOTES
PrE	PROCESS PROTECT	STATUS: PROCESS PROTECT OFF: Disabled On: Enabled	OFF (Disabled)	Available in PID and ON/OFF control modes only.	See page 21 for a more detailed description.
OFS	PROCESS OFFSET	STATUS: PROCESS OFFSET 0: Disabled TC515 -99° - 999° / TC600 -273° - 2000°: Offset in degrees	0 (No Offset)	Available in all control modes.	See page 22 for a more detailed description.
PtR	PRESELECT TIMER	STATUS: TIMER STATUS 0: Disabled 1 - 999: Preselected Time in minutes	0 (Disabled)	Available in PID and ON/OFF control modes only.	See page 22 for a more detailed description.
t1	TRIP 1	STATUS: Control Relay Trip Point in degrees LIMITS: TC515 -99° - 999° / TC600 -273° - 2000°	0.0 (0°)	Available in Trip & Recovery control mode only.	See page 23 for a more detailed description.
r1	RECOVERY 1	STATUS: Control Relay Recovery Point in degrees LIMITS: TC515 -99° - 999° / TC600 -273° - 2000°	0.0 (0°)	Available in Trip & recovery control mode only.	See page 23 for a more detailed description.
t2	TRIP 2	STATUS: Alarm Relay Trip Point in degrees LIMITS: TC515 -99° - 999° / TC600 -273° - 2000°	0.0 (0°)	Available in Trip & Recovery control mode only.	See page 23 for a more detailed description.

TC515/TC600 - Function Description Table

DISPLAY	FUNCTION	STATUS OPTIONS	FACTORY SETTINGS	SCOPE	NOTES
r2	RECOVERY 2	STATUS: Alarm Relay Recovery Point in degrees LIMITS: TC515 -99° - 999° TC600 -273° - 2000°	0.0 (0°)	Available in Trip & Recovery control mode only.	See page 23 for a more detailed description.
AL	ALARM MODE	STATUS (No Stand-by: ABSOLUTE, DEVIATION; With Stand-by: ABSOLUTE, DEVIATION): 1, 4, 7, 10 / 2, 5, 8, 11 / 3, 6, 9, 12 indicates alarm activated 	OFF (Alarm disabled)	Available in PID & ON/OFF control modes only.	See page 24 for a more detailed description.
ALH	ALARM HIGH	STATUS: Upper Alarm level in degrees LIMITS: TC515 -99° - 999° TC600 -273° - 2000°	0.0 (0°)	Available in PID & ON/OFF control modes only.	See page 25 for a more detailed description.
ALL	ALARM LOW	STATUS: Lower Alarm level in degrees LIMITS: TC515 -99° - 999° TC600 -273° - 2000°	0.0 (0°)	Available in PID & ON/OFF control modes only.	See page 25 for a more detailed description.
LOC	KEYPAD LOCK	STATUS / ACCESS: OFF — All functions 1 — SV, ALH, ALL, t1, r1, t2, r2 and LOC only 2 — SV and LOC only 3 — LOC only	OFF (Full access)	Available in all control modes.	See page 25 for a more detailed description.

InP INPUT TYPE

- Set InP to select the correct input sensor type, P (PT100), E, J, H (K), r, S, t, b or n .
  Note: If the input type and the sensor connected do not match, the process value will be inaccurate or an error code may be displayed.

Ctr CONTROL MODE

The control mode determines whether or not many of the other functions in the menu are visible. Only functions relevant to the currently selected control mode will appear when scrolling through the controller's menu.

- Set Ctr to Pid for PID control. This control mode should be used where precise control is required. When selected for the first time the Autotune function should be activated (See At).
- Set Ctr to OnF for ON/OFF control. This control mode should be used for non critical applications.
- Set Ctr to trP for Trip and Recovery Control. This control mode should be used when control with two independent trip and recovery levels, each with its own output, is required.
  Note: With trip and recovery control selected, trP will appear in the lower (SV) display while the process temperature is being displayed. The four set values t1, r1, t2 and r2 must be configured in their respective functions. The alarm output becomes the second control output and as a result all alarm levels will be ignored.

HYS HYSTERESIS

The HYS value represents the ON/OFF control hysteresis in degrees and is only used when the control mode is set to ON/OFF. It can be adjusted from 0º to 99,9º, defining the recovery point for ON/OFF control. ON/OFF control takes place in the hysteresis band between the setpoint and the recovery point, sometimes referred to as the deadband.

CYC PID RELAY CYCLE TIME

The CYC value represents the PID relay cycle time in seconds and is only used when the control mode is set to PID. It can be adjusted from 1 to 240 seconds. The faster the process the smaller the cycle time will have to be for the controller to maintain control. For best results this value should be set as low as can be tolerated by the load and switching device.
Note: CYC is not visible or adjustable on a TC600 with one of the analogue control options ordered.

AT PID AUTOTUNE

- Set AT to On to start the Autotune function.
  While the Autotune function is active, AT will flash on the lower (SV) display while the process temperature is being displayed. The Autotune function calculates P,I,D and Anti-reset terms by cycling the process 3 times. The time it takes to complete an Autotune will therefore depend on the speed of the process.
  Once completed AT will automatically return to OFF. The controller will revert to PID control using the new P,I,D and Anti-reset terms. These terms are also saved for future use whenever PID control is selected.
- Set AT to OFF to abort the Autotune function and revert to PID control with previously saved P,I,D and Anti-reset terms.
- Set AT to AdJ to manually adjust the PID parameters (see Pt, It, dt and Ar).

Pt PID CONTROL - PROPORTIONAL BAND

The Pt value represents the PID control proportional band term in degrees. It is only used during PID control and only visible with AT set to AdJ. It is automatically set by the Autotune function but it can also be manually adjusted between 0.5º to 999º. See tip on setting P, I and D terms.

It PID CONTROL -INTEGRAL TIME

The It value represents the PID control Integral time term in seconds. It is only used during PID control and only visible with At set to Adj. It is automatically set by the Autotune function but it can also be manually adjusted between 0 and 999 seconds. See tip for setting P, I and D terms.

dt PID CONTROL -DERIVATIVE TIME

The dt value represents the PID control Derivative time term in seconds. It is only used during PID control and only visible with At set to Adj. It is automatically set by the Autotune function but it can also be manually adjusted between 0 and 999 seconds. See tip on setting P, I and D terms.

TIP: Setting of P, I and D terms.

Reduce the proportional band to get a fast enough rise time, increase the derivative time until the overshoot is reduced to an acceptable level, and then adjust the integral time (if necessary) to eliminate the steady state error. Make small incremental changes rather than large changes and if the system becomes unstable activate the Autotune function to let the controller recalculate the values.

Ar ANTI-RESET WIND-UP

The Ar value represents the percentage of full power that a proportional only system would require to maintain its setpoint. It is only used during PID control and only visible with At set to Adj. It is automatically set by the Autotune function but it can also be manually adjusted between 0 and 100%.

Example: Set the anti-rest term to 30 for a system requiring 30% power to maintain its setpoint temperature.

rIn RELAY INVERSION

Each of the outputs (control and alarm) can be configured to be either ON or OFF when the process value is compared to the set value. In a heating process for example the output should be on when the process value is much lower than the set value. For a cooling process the reverse is true.
The rIn function allows the state of the output relays to be individually configured, ensuring fail safe control of either heating (H) or cooling (C) applications.
The relay inversion status is represented by two letters, the one on the left applies to the control relay and the one on the right to the alarm relay.

Unt TEMPERATURE UNITS

- Set Unt to configure the temperature units in which the controller operates, Celsius (C) or Fahrenheit (H).
  Note: The units selected apply to all temperature related controller settings i.e. All parameters that are in degrees.

Prt PROCESS PROTECTION

This unique feature offers added safety to critical processes. It is only available in PID and ON/OFF Control Modes and when one of the absolute alarm modes is selected (see AL).

- Set Prt to On to prevent the operator from adjusting the set point value (SV) outside the alarm limits set in ALH and ALL
- Set Prt to OFF to allow unrestricted adjustment of the set point value (SV).

OFS PROCESS OFFSET

In applications where the temperature sensor is situated some distance from the heat source of a process, a consistent temperature difference may exist between actual and displayed temperatures.

- Set OFS to the difference between the required temperature and the displayed temperature.

  The process is then controlled to the new displayed temperature, taking the process offset into account.

  Example: If a temperature of 240º is displayed when the actual temperature is 250º, a process offset of +10º is entered so that 250º is displayed.

Ptr PRESELSECT TIMER

This timer function is ideal for batch processing applications. It is only available in PID and ON/OFF Control modes. Once activated it will allow the process to reach the setpoint temperature , maintain this temperature for the preselect time period, then deactivate the control relay, shutting the process down (see figure 9).

- Set Ptr to the preselect time (in minutes) that the process must remain on once the . setpoint has been reached. This value can be adjusted up to 999 minutes (16 hours 39 minutes). The timer only starts once the process temperature reaches the setpoint temperature. Once the controller is timing, Ptr will flash in the lower (SV) display. When the time has elapsed and the process has been shut down the lower display will show Ptr and the upper display will flash OFF.
- The process can be re-triggered by pressing any one of the select keys or by cycling power to the controller.
- Set Ptr to 0 to disable this function.

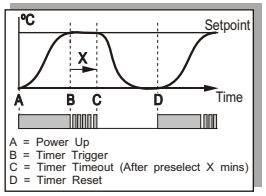


Figure 9 : Timer Operation

t1 TRIP POINT FOR THE CONTROL RELAY

The t1 value represents the trip point in degrees for the control relay when the Control Mode is set to Trip and Recovery (see Ctr). It can be adjusted from -99º to 999º (TC515) or from -273º to 2000º (TC600).

r1 RECOVERY POINT FOR THE CONTROL RELAY

The r1 value represents the recovery point in degrees for the control relay when the Control Mode is set to Trip and Recovery (see Ctr). It can be adjusted from -99º to 999º (TC515) or from -273º to 2000º (TC600).

t2 TRIP POINT FOR THE ALARM RELAY

The t2 value represents the trip point in degrees for the alarm relay when the Control Mode is set to Trip and Recovery (see Ctr). It can be adjusted from -99º to 999º (TC515) or from -273º to 2000º (TC600).

r2 RECOVERY POINT FOR THE ALARM RELAY

The r2 value represents the recovery point in degrees for the alarm relay when the Control Mode is set to Trip and Recovery (see Ctr). It can be adjusted from -99º to 999º (TC515) or from -273º to 2000º (TC600).

AL ALARM MODE

Alarms are only available in the PID and ON/OFF control modes (see Ctr).

Absolute alarm modes

When any of the ABSOLUTE ALARM MODES are selected(Status 1, 2, 3, 7, 8, 9) the alarm levels ALH and ALL represent absolute temperatures above and/or below which the alarm activates.

EXAMPLE:

If AL=1 (HIGHABSOLUTE ALARM)is selectedwith ALH at 50°, thenthe alarm will be activated at 50° irrespective of the SV.

Deviation alarm modes

When any of the DEVIATION ALARM MODES are selected (Status 4, 5, 6, 10, 11, 12) the alarm levels ALH and ALL represent deviations above and below the setpoint temperature. A process temperature falling outside of these limits triggers the alarm.

EXAMPLE:

If AL= 4 (HIGH DEVIATION ALARM) is selected with ALH at 50° and SV = 150°, the alarm will be activated at 200°.

Alarm modes with stand-by

When any of the STAND-BY ALARM MODES are selected (Status 7 to 12) the ALARM levels are disabled after power-up until the process temperature reaches the setpoint. Hereafter the alarm is activated whenever the temperature exceeds and/or falls below the corresponding ALARM level.

Without STAND-BY selected (Status 1 to 6) all alarm levels are available immediately after power up.

ALH HIGH LEVEL ALARM

The ALH value represents the high alarm level in degrees. It is the temperature above which the alarm activates if enabled in alarm mode (see AL status 1,2,4,5,7,8,10 or 11). It also acts as the upper limit that the set value can be set to if the process protect function is enabled (see Pr-t). It can be adjusted from -99º to 999º (TC515) or from -273º to 2000º (TC600).

ALL LOW LEVEL ALARM

The ALL value represents the low alarm level in degrees. It is the temperature below which the alarm activates if enabled in alarm mode (see AL status 2,3,5,6,8,9,11 or 12). It also acts as the lower limit that the set value can be set to if the process protect function is enabled (see Pr-t). It can be adjusted from -99º to 999º (TC515) or from -273º to 2000º (TC600).

LOC KEYPAD LOCK

- Set LOC to OFF to allow full access to all functions
- Set LOC to 1 to only allow access to Setpoint Temperature(SV), ALH, ALL, t1, r1, t2, r2 and LOC.
- Set LOC to 2 to only allow access to Setpoint Temperature(SV) and LOC.
- Set LOC to 3 to only allow access to LOC.

With any one of the restricted levels selected (LOC status 1,2 or 3) the lock status will be indicated as LOC On.
To remove the lock restriction, select the LOC function. Press and hold the Up and Down keys simultaneously until LOC, OFF is displayed. The controller will now allow full access to all functions.

TC515/TC600 - Error Messages

Message	Condition	Remedy
Err 1	Measured temperature is below sensor's specified minimum	Select more appropriate sensor type.
	Controller input failure	Factory Repair
Err 2	Measured temperature is above sensor's specified maximium	Select more appropriate sensor type.
	Sensor cable open circuit (burn out)	Replace sensor
	Sensor incorrectly connected	Check connections
	Controller Input failure	Factory Repair
Err 3	Ambient temperature >50°C	Reduce the Controllers operating temperature
	Cold junction failure	Factory repair

TC515 - Specifications

Controller Specifications:

Setting Accuracy	± 1%
Linearisation Accuracy	± 0.3%
Cold Junction Tracking	0.05°C per °C
Sampling Period	70ms
Control Method	PID, On/Off or Trip & Recovery
PID Relay Cycle Period	1 - 240secs
On/Off Control Hysteresis	0 - 99.9°
Proportional Band	50°
Integral Time	36s
Derivative Time	5s
Timer Range	1 - 999 minutes
Timer Accuracy	0.1% of preset time
Timer Resolution	1 minute

Input Specifications:

Operating Temperature		Sensor Type								
		PT100	E	J	K	R	S	T	B	N
Upper Limit	°C	800	950	750	999	999	999	380	999	999
	°F	999	999	999	999	999	999	716	999	999
Lower Limit	°C	-99	-99	-99	-99	-40	-40	-99	50	-99
	°F	-99	-99	-99	-99	-40	-40	-99	122	-99

EMC protection rating

Radiated Susceptibility	IEC 801-3, Class 3
Radiated Emission	CISPR11, Class B
Conducted Susceptibility	IEC 255-22-1, Class II
Conducted Emission	CISPR11, Class B

Control Output Options:

Relay	250V AC, 8A, SPDT
SSR Drive	8-28V DC at 10mA

Alarm Output Options:

Relay	250V AC, 8A, SPST (N.O)
SSR Drive	8-28V DC at 10mA

General Specifications:

Operating Temperature	0 - 50°C
Humidity	5-85% non-condensing
Storage Temperature	-20°C to 70°C
Protection Class (Front Panel)	IP54
Protection Class (Rear)	IP30
Connection	Plug-connector
Weight	250g
Standards	CE Mark
Creepage Distance	VDE 0110 (Group C 250V) IEC 664/664A/DE 0435

Power Supply:

Power Supply	21 - 53V AC/DC 85 - 265V AC/DC
Power Consumption	Less than 3VA

Display Specifications:

PV Display Type	3 x 10mm red
SV Display Type	3 x 7mm green
Resolution (PV, SV)	1°C (SV 0,1° from -9,9° - 99,9°)
Temperature Display Range	-99 to 999°C

TC600 - Specifications

Controller Specifications:

Setting Accuracy	± 1%
Linearisation Accuracy	± 0.3%
Cold Junction Tracking	0.05°C per °C
Sampling Period	70ms
Control Method	PID, On/Off or Trip & Recover
PID Relay Cycle Period	1 - 240secs
On/Off Control Hysteresis	0 - 99.9°
Proportional Band	50°
Integral Time	36s
Derivative Time	5s
Timer Range	1 - 999 minutes
Timer Accuracy	0.1% of preset time
Timer Resolution	1 minute

EMC protection rating

Radiated Susceptibility	IEC 801-3, Class 3
Radiated Emission	CISPR11, Class B
Conducted Susceptibility	**IEC 255-22-1, Class II**
Conducted Emission	CISPR11, Class B

Control Output Options:

Relay	250V AC, 8A, SPDT
SSR Drive	8-28V DC at 10mA
Analogue	0 - 20mA
Analogue	4 - 20mA
Analogue	0 - 5V at 10mA
Analogue	0 - 10V at 10mA

Alarm Output Options:

Relay	**250V AC, 8A, SPST (N.O)**
SSR Drive	8-28V DC at 10mA

General Specifications:

Operating Temperature	0 - 50°C
Humidity	5-85% non-condensing
Storage Temperature	-20°C to 70°C
Protection Class (Front Panel)	IP54
Protection Class (Rear)	IP30
Connection	Plug-connector
Weight	250g
Standards	CE Mark
Creepage Distance	VDE 0110 (Group C 250V) IEC 664/664A/DE 0435

Power Supply:

Power Supply	21 - 53V AC/DC 85 - 265V AC/DC
Power Consumption	Less than 3VA

Input Specifications:

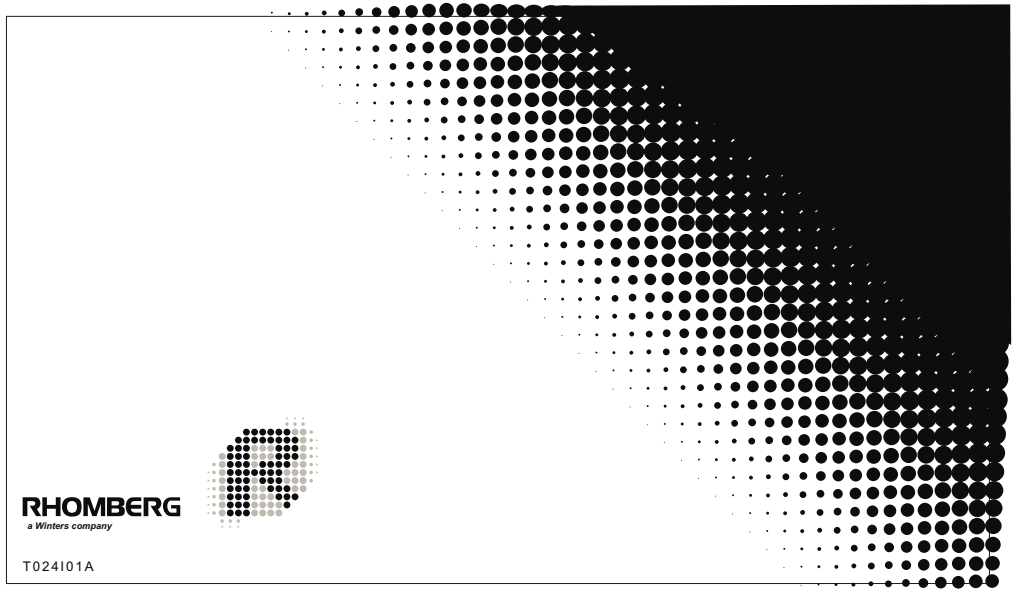
Operating Temperature		Sensor Type								
		PT100	E	J	K	R	S	T	B	N
Upper Limit	°C	800	950	750	1250	1450	1450	380	1700	1300
	°F	1472	1742	1382	2282	2642	2642	716	3092	2372
Lower Limit	°C	-200	-200	-99	-200	-40	-40	-200	50	-270
	°F	-328	-328	-146	-328	-40	-40	-328	122	-454

Display Specifications:

PV Display Type	4 x 10mm red
SV Display Type	4 x 7mm green
Resolution (PV, SV)	1°C (0,1° from -9,9° - 99,9°)
Temperature Display Range	-270° to 2000°C

Notes

RHOMBERG
a Winters company



T024I01A