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DIGITEMP Universal Temperature Controller System Operator Manual.

Models: TT-200TTC/P/SSR
TT-200KTC/P/SSR
TT-200RTD/P/SSR

(Models may vary from illustration)

Designed and manufactured by Testronics Pty. Ltd.

1.0 INTRODUCTION.

The Testronics DIGITEMP TT-200TTC/P/SSR, TT-200KTC/P/SSR and TT-200RTD/P/SSR series temperature controllers are a "ready to go" instrument for use in controlling the temperature of many different applications when used with an appropriate heating element and sensing probe.

A standard temperature sensing probe and controlled load/heater output socket are supplied to ensure fast integration into the application/process at hand.

The instrument has a digital programmable PID function controller that is microprocessor based and maintains a high level of accuracy and control over the selected temperature range. It also has an auto tuning feature incorporated to make setup for the specific application easier.

The digital display easily distinguishes between the set temperature (denoted SV) and the current process temperature (denoted PV) by having each displayed simultaneously, one red (SV) and the other green (PV) respectively.

The output is controlled with a solid state relay circuit which provides reliable and reproducible operation over many millions of cycles, unlike their mechanical relay counterparts, saving down time and process losses.

2.0 SPECIFICATIONS.

2.1 Power:

240 VAC ±10% @50Hz
2400 Watts maximum Load Power
Load power illumination when active

2.2 Fuses:

M205 slow blow 240 VAC 10A

2.3 Temperature Probe:

TT-200KTC/P/SSR - K type thermocouple probe, 0 ~ 800°C temperature range
TT-200TTC/P/SSR - T type thermocouple probe, 0 ~ 350°C temperature range
TT-200RTD/P/SSR - RTD/Pt100 3 wire probe, 0 ~ 200°C temperature range

2.4 Load Output:

Solid State Relay output, 10 Amp @ 240 VAC maximum
Standard Australian 3 pin earthed 240 VAC 10 Amp output socket for mating with heating element connections

2.5 Controller Display Accuracy:

±(0.3% of display value + 1 digit)°C

2.6 Dimensions:

110 (W) x 160 (D) x 55 (H) mm with 2 meter standard IEC mains power lead

2.7 Weight:

1 kg total

3.0 SYSTEM OVERVIEW AND INDEX.

3.1 Front panel:

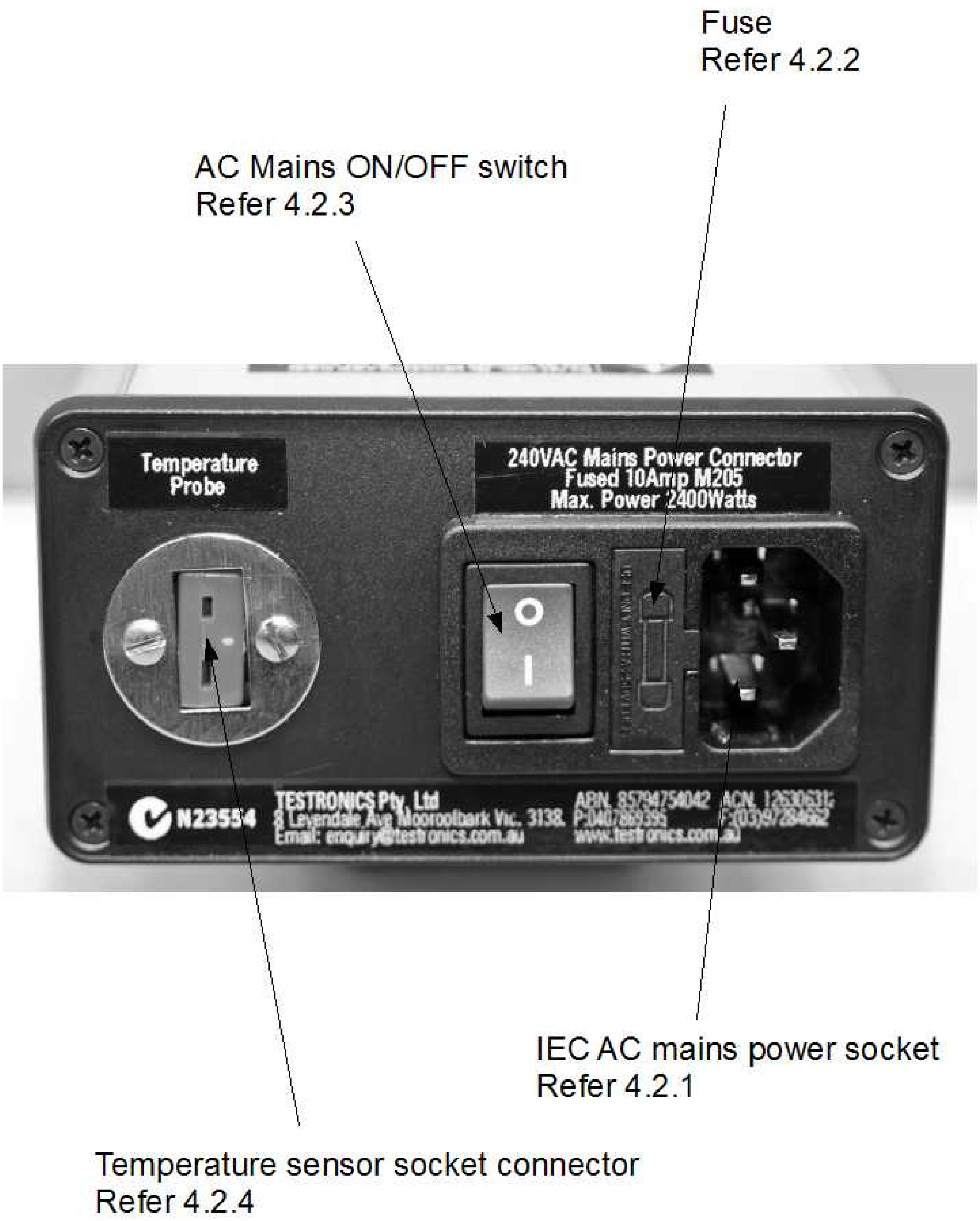
Digital PID temperature controller
Refer 4.1.1

Load/heater active indicator
Refer 4.1.2

Controlled load/heater socket outlet
Refer 4.1.3

(Models may vary from illustration)

3.1 Rear Panel:



(Models may vary from illustration)

4.0 SYSTEM COMPONENT DETAL.

4.1 Front panel components:

4.1.1 Digital PID temperature controller.

The digital PID temperature controller is responsible for sampling the temperature of the sensing element (temperature probe) and optimising the required power supplied to the connected load/heater to maintain better than ±0.5°C regulation.
The PV (process value) green display indicates the actual sensed temperature , the SV (set value) red display indicates the desired set temperature. Both displays are distinguished by their different size and color to aid quick recognition of the action of the controller and the process.
The operator interface consists of four (4) keys at the bottom.
When setting up for a desired set temperature, use is made of all four keys;

1. The "SET" key is momentarily depressed to access changes to the set value.
2. The "◄" key is depressed to select the appropriate digit.
3. The "▲" and/or "▼" keys are used to change the selected digits' value (up or down).
4. The "SET" key is again used to begin control at the newly entered set temperature.

For additional setup condition parameters and controller functions, please refer to the detailed controller configuration guide found in APPENDIX A.

4.1.2 Load/heater active indicator.

This indicator is provided to confirm controlled 240 VAC activity at the load/heater outlet socket. Being connected directly across the load, this indicator provides quick feedback visually of the controllers' actions to regulate the process

4.1.3 Controlled load/heater socket outlet.

This outlet provides controlled AC mains power to the load and/or heater device when connected to this socket. The temperature probe sensor is used to feedback information to the controller which in-turn determines how much power is passed through to the load/heater to meet or maintain the set temperature value.
A solid state relay device is employed between the controller and load/heater outlet, resulting in no mechanical components to wear or break.
The outlet is rated to switch a load/heater rated at a maximum of 2400 Watts, the maximum allowable power of a standard 240 VAC mains outlet.

4.2 Rear panel components:

4.2.1 IEC AC mains power socket.

This industry standard IEC AC mains inlet socket is used in conjunction with a standard AC mains power cord to power the controller and load/heater. The mains cord connects to a 240 VAC 10 Amp GPO mains outlet and then into the IEC mains inlet socket of the controller.

4.2.2 Fuse.

A fuse is provided as a safety measure such that in the unlikely event of load/heater failure, the unit is automatically disconnected from the AC mains power. The fuse can be replaced once the cause of failure is determined.

4.2.3 AC Mains ON/OFF switch.

This When the AC mains power is connected, switching the ON/OFF switch to the ON position connects AC mains power to the digital PID temperature controller from which, following an initialization process, the controller begins the task of achieving and/or maintaining the set temperature.
This switch is also responsible for connecting/disconnecting the AC mains power to the solid state relay and connected load/heater.

4.2.4 Temperature sensor socket connector.

A suitable temperature probe/sensor is connected to this rear panel mounted socket and is used to feedback information to the controller regarding the process temperature. This socket is keyed and mates with the correct plug found at the end opposite to the temperature sensor in only one orientation.
Each digital PID temperature controller is matched internally to the type of sensor chosen at the time of order to ensure maximum control accuracy over the full operating range of the temperature sensor.
Should the temperature sensor short or become open circuit, the controller will detect this as an error condition and halt the process and any attempts to control the load/heater.

5.0 INITIAL INSTALLATION.

5.1 Situate the controller and enclosure in a suitable position near the process to be controlled. Ensure approximately 30 to 40mm clearance around the enclosure.

5.2 Connect/secure the temperature probe at or near the load/heater in a suitable location to provide a positive, quick and accurate response to the heating process.

5.3 Ensure the load/heater is well secured.

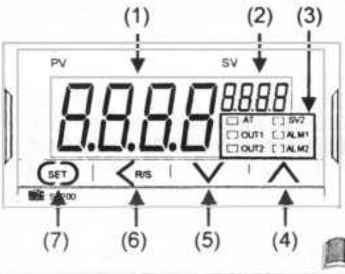
5.4 Connect the AC mains cable and plug into a 240 VAC 10 Amp GPO outlet, then switch ON using the AC mains switch at the GPO and the controller.

5.5 Adjust the "SV" display value to the desired value for the process (i.e would like to heat to 65°C , set SV value to read 65.0°C.)

- Refer to APPENDIX A for further details regarding additional setup parameters that are available to configure the control of your specific process and application.
- Refer to APPENDIX B for an overview of the PID control variables and their actions that are used to optimize the control of your specific process and application.

APPENDIX A.

1. PARTS DESCRIPTION



(1) Measured value (PV) display [Green]
Displays PV or various parameter symbols

(2) Set value (SV) display [Orange]
Displays SV or STEP set value (SV1, SV2)
Displays various parameter set values

(3) Indication lamps
Autotuning (AT) lamp [Green]
Flashes during autotuning activated
(After autotuning is completed AT lamp will become OFF)

Output lamps (OUT1, OUT2) [Green]
OUT1: Lights when output 1 is turned on.
OUT2: Lights when output 2 is turned on.

STEP set value (SV2) lamp [Orange]
Lights when the SV2 of STEP function is selected.

Alarm lamps (ALM1, ALM2) [Orange]
ALM1 Lights when alarm 1 is turned on
ALM2 Lights when alarm 2 is turned on

(4) UP key
Increase numerals

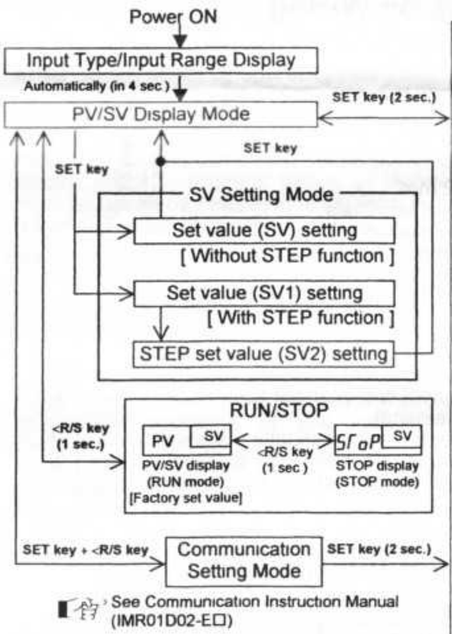
(5) DOWN key
Decrease numerals.

(6) Shift & R/S key
Shift digits when settings are changed
Selects the RUN/STOP function

(7) Set key
Used for parameter calling up and set value registration.

To avoid damage to the instrument, never use a sharp object to press keys.

2. SETTING



See Communication Instruction Manual (IMR01D02-E☐)

This instrument returns to the PV/SV display mode if no key operation is performed for more than one minute

Parameter Setting Mode

LbA — Control loop break alarm (LBA)
Setting range 0 0 to 200 0 min
Factory set value 8 0

Lbd — LBA deadband (LBD)
Setting range 0 to span
Factory set value Temperature input 0 (0 0); Voltage/current inputs 0 0

AL1 — Alarm 1 (ALM1)
Setting range Process alarm, SV alarm: Same as input range; Deviation alarm: -span to +span
Factory set value Temperature input 50 (50 0); Voltage/current inputs 5 0

AL2 — Alarm 2 (ALM2)
Setting range Process alarm, SV alarm: Same as input range; Deviation alarm: -span to +span
Factory set value Temperature input 50 (50 0); Voltage/current inputs 5 0

ATU — Autotuning (AT)
Setting range on AT start or execution; off AT end or cancel
Factory set value off

STU — Self-tuning (ST)
Setting range on Self-tuning ON; off Self-tuning OFF
Factory set value off

P — Heat-side proportional band (P)
Setting range 0 to span (0 or 0 0 ON/OFF action)
Factory set value Temperature input 30 (30 0); Voltage/current inputs 3 0

I — Integral time (I)
Setting range 0 to 3600 sec (0 PD action)
Factory set value 240

d — Derivative time (D)
Setting range 0 to 3600 sec (0 PI action)
Factory set value 60

Ar — Anti-reset windup (ARW)
Setting range 0 to 100 % of heat-side proportional band (0 Integral action OFF)
Factory set value 100

T — Heat-side proportioning cycle time
Setting range 1 to 100 sec
Factory set value Relay contact output 20; Voltage pulse output 2

Pc — Cool-side proportional band
Setting range 1 to 1000 % of heat-side proportional band
Factory set value 100

db — Overlap/Deadband
Setting range -span to +span
Factory set value Temperature input 0 (0 0); Voltage/current inputs 0 0

t — Cool-side proportioning cycle time
Setting range 1 to 100 sec
Factory set value Relay contact output 20; Voltage pulse output 2

Pb — PV bias
Setting range -span to +span
Factory set value Temperature input 0 (0 0); Voltage/current inputs 0 0

dF — Digital filter
Setting range 0 to 100 sec (0 Digital filter OFF)
Factory set value 0

LCK — Set data lock (LCK)
Setting range 0 (Unlock) 1 (Lock)
See Lock Level Table
Factory set value 0000

Set value	Parameter which can be changed
0000	All parameters [Factory set value]
0001	SV Alarms (ALM1 ALM2)
0010	All parameters except for Alarms (ALM1, ALM2)
0100	All parameters except for SV
0011	SV
0101	Alarms (ALM1, ALM2)
0110	All parameters except for SV and Alarms (ALM1 ALM2)
0111	No parameters (All locked)

Return to first parameter setting item

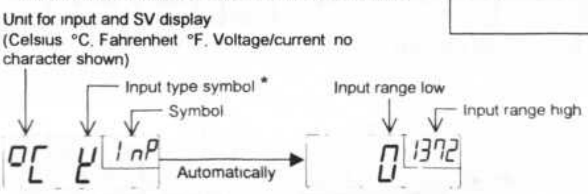
Some parameter symbols may not be displayed depending on the specification

The setting range is from 1999 to +9999 regardless of the position of the decimal point

■ Input type and Input Range Display

When the instrument is powered on, it immediately confirms the input type and input range

Example
When sensor type of input is K thermocouple



* Input Type Symbol Table

Symbol															
	Thermocouple (TC)												RTD		Voltage (Current)
Input type	K	J	R	S	B	E	T	N	PL II	W5Re/W26Re	U	L	JPt 100	Pt 100	

■ PV/SV Display Mode

The controller will display the measured value (PV) and the set value (SV)

- If the STEP function is provided, the SV display will show the set value (SV1) or STEP set value (SV2) depending on whether the contact input is opened or closed
- The controller can be switched to RUN or STOP mode

■ SV Setting Mode

The blinking digit on the SV display indicates which digit can be set

Setting range Within input range
Factory set value Temperature input 0 (0 0) °C [°F], Voltage/current inputs 0 0 %

If the STEP function is provided, the following parameter symbols are displayed on the PV

Set value (SV1) SH1 STEP set value (SV2) SH2

3. OPERATIONS

3.1 Operating Precautions

(1) All mounting and wiring must be completed before the power is turned on
(2) The settings for the SV and all parameters should be appropriate for the controlled object.
(3) A power supply switch is not furnished with this instrument It is ready to operate as soon as the power is turned on.
[Factory set value: RUN (operation start)]

Connect the input signal wiring and turn the power on. If the input signal wiring is not complete prior to turning the power on, the instrument determines that burnout has occurred.

A power failure of 20 ms or less will not affect the control action When a power failure of more than 20 ms occurs, the instrument assumes that the power has been turned off When power returns, the controller will retain the conditions that existed prior to shut down.

The alarm hold action is activated when the power is turned on or the SV is changed, including an SV change made with the STEP function.

3.2 RUN/STOP

RUN/STOP can be selected by contact input (option) other than the key operation In addition, at STOP the key operation and contact state are displayed on the PV display Relationships between key operation, RUN/STOP and the characters to indicate the STOP state are shown in the following.

		RUN/STOP with Contact Input [1]	
		RUN (Contact closed)	STOP (Contact open)
RUN/STOP with Key Operation	RUN	RUN	STOP
		STOP is not displayed	dSTP (dSTP) [2]
	STOP	STOP	STOP
		KSTP (KSTP) [2]	SToP (SToP) [2]

[1] Contact input: Terminal No.10, 12
[2] Characters in parentheses are those shown on the PV display
dSTP Only contact input is in the STOP mode
KSTP · Only key operation is in the STOP mode
SToP · Both key operation and contact input are in the STOP mode

Conditions when changed to STOP mode
- Control, Alarm Control OFF, Alarm OFF
- Output: OUT1 output OFF (OPEN), OUT2 output OFF (OPEN)
- Autotuning (AT) AT canceled (The PID constants are not updated)

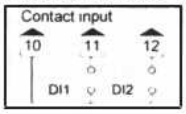
■ RUN/STOP transfer by key operation

1. Press the <R/S key for 1 second in PV/SV display mode.
2. The mode is changed to STOP from RUN. The PV display shows the characters of showing the relevant STOP state.

Also when changing from STOP to RUN, press the <R/S key for 1 second while in the PV/SV display mode

■ RUN/STOP transfer by contact input

RUN/STOP can be selected according to the open or closed state of the terminal numbers 10 to 12.



Terminal No	RUN	STOP
10 - 12	Contact closed	Contact open

3.3 Set Data Lock (LCK)

The set data lock restricts parameter setting changes by key operation. This function prevents the operator from making errors during operation

Set value	Parameters which can be changed
0000	All parameters [Factory set value]
0001	SV, Alarms (ALM1, ALM2)
0010	All parameters except for Alarms (ALM1, ALM2)
0100	All parameters except for SV
0011	SV
0101	Alarms (ALM1, ALM2)
0110	All parameters except for SV and Alarms (ALM1, ALM2)
0111	No parameters (All locked)

Set Data Lock can be changed in both RUN and STOP mode.

Parameters protected by Set Data Lock function are still displayed for monitoring

3.4 Autotuning (AT)

Autotuning (AT) automatically measures, calculates and sets the optimum PID and LBA constants. The following conditions are necessary to carry out autotuning and the conditions which will cause the autotuning to stop.

Caution for using the Autotuning (AT)
When a temperature change (UP and/or Down) is 1 °C or less per minute during Autotuning, Autotuning may be cancelled before calculating PID values. In that case, adjust the PID values manually. It is possible to happen when the set value is around the ambient temperature or is close to the maximum temperature achieved by the load.

■ Requirements for AT start

Start the autotuning when all following conditions are satisfied:
- Prior to starting the AT function, end all the parameter settings other than PID and LBA.
- Confirm the LCK function has not been engaged.

When the autotuning is finished, the controller will automatically returns to PID control.

■ Requirements for AT cancellation

The autotuning is canceled if any of the following conditions exist.
- When the set value (SV1, SV2) is changed.
- When the power is turned off
- When the PV bias value is changed.
- When the RUN/STOP mode is changed to the STOP mode
- When the PV becomes abnormal due to burnout.
- When the AT does not end in 9 hours after autotuning started.
- When power failure longer than 20 ms occurs.

If the AT is canceled, the controller immediately changes to PID control. The PID values will be the same as before AT was activated.

When AT is completed, the controller immediately changes to PID control If the control system does not allow the AT cycling process, set each PID constant manually to meet the needs of the application.

3.5 Self-tuning (ST)

The ST function is used to automatically calculate and set adaptive PID constants anytime the power is turned on, the SV is changed or the controller detects unstable control conditions.

The ST function should be turned off when the controlled system is affected by rippling that occurs due to periodic external disturbances.

The power to the controlled system must be turned on before the power to the instrument is turned on or SV is changed. This is required when ST function is on.

To activate the ST function, the following parameters must not be set to zero: P≠0, I≠0, D≠0, ARW≠0.

When heat/cool PID action is selected, the ST function cannot be activated

When the AT function is activated, the ST function can not be turned on

When the ST function is activated, the PID and ARW settings can be monitored, but not changed

4. ERROR DISPLAYS

■ Error display

Display	Description	Solution
Err Err 128	The error codes are shown in the SV display When two or more errors occur simultaneously, the error code numbers are totaled and displayed as one number	Turn off the power once If an error occurs after the power is turned on again, please contact RKC sales office or the agent

■ Overscale and Underscale

Display	Description	Solution
Measured value (PV) is flashing	PV is outside of input range	⚠ **WARNING** To prevent electric shock, always turn off the power before replacing the sensor Check the sensor or input lead.
oooo flashing oooo 200	Overscale - PV is above the high input display range limit	
uuuu flashing uuuu 200	Underscale - PV is below the low input display range limit	

5. INPUT RANGE TABLE

●TC/RTD

Type	Range	Code		Range	Code		Range	Code	
K	0 to 200 °C 0 to 800 °C 0 to 1372 °C 0 0 to 800 0 °C 0 to 450 °C 0 0 to 600 0 °C 0 to 1600 °F 20 to 70 °F	K	01 04 07 10 17 37 A2 A9	0 to 400 °C 0 to 1000 °C 199 9 to +300 0 °C 0 to 100 °C 0 to 500 °C 199 9 to +800 0 °C 0 to 2502 °F 199 9 to +999 9 °F	K	02 05 08 13 20 38 A3 B2	0 to 600 °C 0 to 1200 °C 0 0 to 400 0 °C 0 to 300 °C 0 0 to 200 0 °C 0 to 800 °F 0 0 to 800 0 °F	K	03 06 09 14 29 A1 A4
J	0 to 200 °C 0 to 800 °C 199 9 to +300 0 °C 0 to 450 °C 199 9 to +600 0 °C 0 to 2192 °F 0 0 to 800 0 °F	J	01 04 07 10 30 A3 B6	0 to 400 °C 0 to 1000 °C 0 0 to 400 0 °C 0 0 to 200 0 °C 0 to 800 °F 0 to 400 °F	J	02 05 08 22 A1 A6	0 to 600 °C 0 to 1200 °C 0 0 to 800 0 °C 0 0 to 600 0 °C 0 to 1600 °F -199 9 to +999 9 °F	J	03 06 09 23 A2 A9
R	0 to 1600 °C *1 0 to 3200 °F *1	R	01 A1	0 to 1769 °C *1 0 to 3216 °F *1	R	02 A2	0 to 1350 °C *1	R	04
S	0 to 1600 °C *1 0 to 3200 °F *1	S	01 A1	0 to 1769 °C *1 0 to 3216 °F *1	S	02 A2			
B	400 to 1800 °C 800 to 3200 °F	B	01 A1	0 to 1820 °C *1 0 to 3308 °F *1	B	02 A2			
E	0 to 800 °C 0 to 1600 °F	E	01 A1	0 to 1000 °C 0 to 1832 °F	E	02 A2			
N	0 to 1200 °C 0 to 2300 °F	N	01 A1	0 to 1300 °C 0 to 2372 °F	N	02 A2	0 0 to 800 0 °C 0 0 to 999 9 °F	N	06 A5
T	199 9 to +400 0 °C *2 0 0 to 350 0 °C 100 0 to +400 0 °F	T	01 04 A3	199 9 to +100 0 °C *2 199 9 to +752 0 °F *2 0 0 to 450 0 °F	T	02 A1 A4	100 0 to +200 0 °C -100 0 to +200 0 °F 0 0 to 752 0 °F	T	03 A2 A5
W5Re/W26Re	0 to 2000 °C	W	01	0 to 2320 °C	W	02	0 to 4000 °F	W	A1
PLII	0 to 1300 °C 0 to 2400 °F	A	01 A1	0 to 1390 °C 0 to 2534 °F	A	02 A2	0 to 1200 °C	A	03
U	-199 9 to +600 0 °C *2 -199 9 to +999 9 °F *2	U	01 A1	-199 9 to +100 0 °C *2 -100 0 to +200 0 °F	U	02 A2	0 0 to 400 0 °C 0 0 to 999 9 °F	U	03 A3
L	0 to 400 °C 0 to 800 °F	L	01 A1	0 to 800 °C 0 to 1600 °F	L	02 A2			
Pt100	-199 9 to +649 0 °C -100 0 to +100 0 °C 0 0 to 100 0 °C 0 0 to 500 0 °C -199 9 to +999 9 °F -199 9 to +100 0 °F 0 0 to 200 0 °F	D	01 04 07 10 A1 A4 A7	-199 9 to +200 0 °C -100 0 to +200 0 °C 0 0 to 200 0 °C -199 9 to +400 0 °F -199 9 to +300 0 °F 0 0 to 400 0 °F	D	02 05 08 A2 A5 A8	-100 0 to +50 0 °C 0 0 to +50 0 °C 0 0 to 300 0 °C -199 9 to +200 0 °F 0 0 to 100 0 °F 0 0 to 500 0 °F	D	03 06 09 A3 A6 A9
JPt100	-199 9 to +649 0 °C -100 0 to +100 0 °C 0 0 to 100 0 °C 0 0 to 500 0 °C	P	01 04 07 10	-199 9 to +200 0 °C -100 0 to +200 0 °C 0 0 to 200 0 °C	P	02 05 08	-100 0 to +50 0 °C 0 0 to +50 0 °C 0 0 to 300 0 °C	P	03 06 09

*1 Accuracy is not guaranteed between 0 to 399 °C (0 to 751 °F)
*2 Accuracy is not guaranteed between -199 9 to -100.0 °C (-199.9 to -148.0 °F)

●Voltage/current inputs

Type	Range	Code		Type	Range	Code	
0 to 5 V DC	0 0 to 100 0 %	4	01	0 to 20 mA DC	0 0 to 100 0 %	7	01
0 to 10 V DC	0 0 to 100 0 %	5	01	4 to 20 mA DC	0 0 to 100 0 %	8	01
1 to 5 V DC	0 0 to 100 0 %	6	01				

APPENDIX B.

PROPORTIONAL & PID CONTROL ACTION OVERVIEW

Proportioning control continuously adjusts the output dependent on the relative positions of the process temperature and the setpoint. PID (Proportioning/Integral/Derivative) are control functions commonly used together in today's controls. These functions when used properly allow for the precise control of difficult processes.

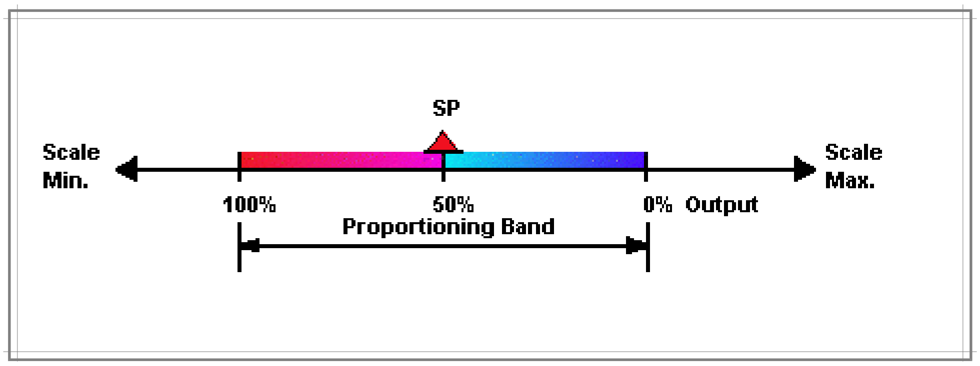
General:

1) Allows for the output to be a value other than 100% or 0%.

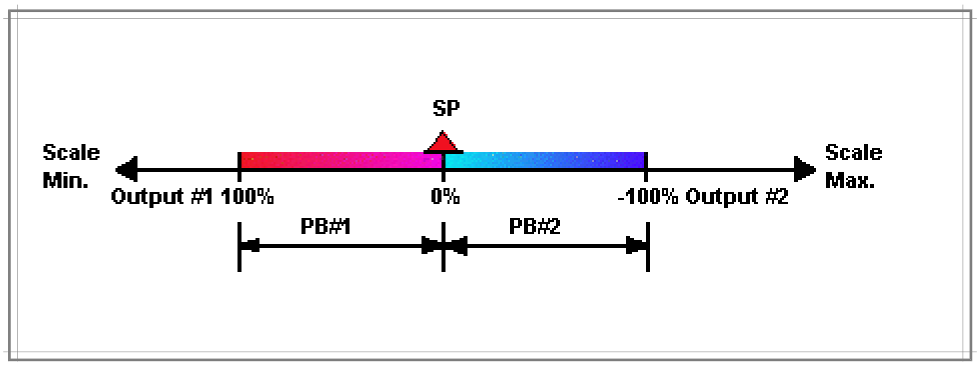
2) Temperature can be controlled without oscillations around the setpoint.

Definitions:

Proportioning Band: is the area around the setpoint where the controller is actually controlling the process; The output is at some level other than 100% or 0%. The band is generally centered around the setpoint (on single output controls) causing the output to be at 50% when the setpoint and the temperature are equal.



On (2) two output controls (i.e.: heat/cool) there are two proportioning bands. One is for heating and one is for cooling. In this case the bands generally end at the setpoint as shown below.



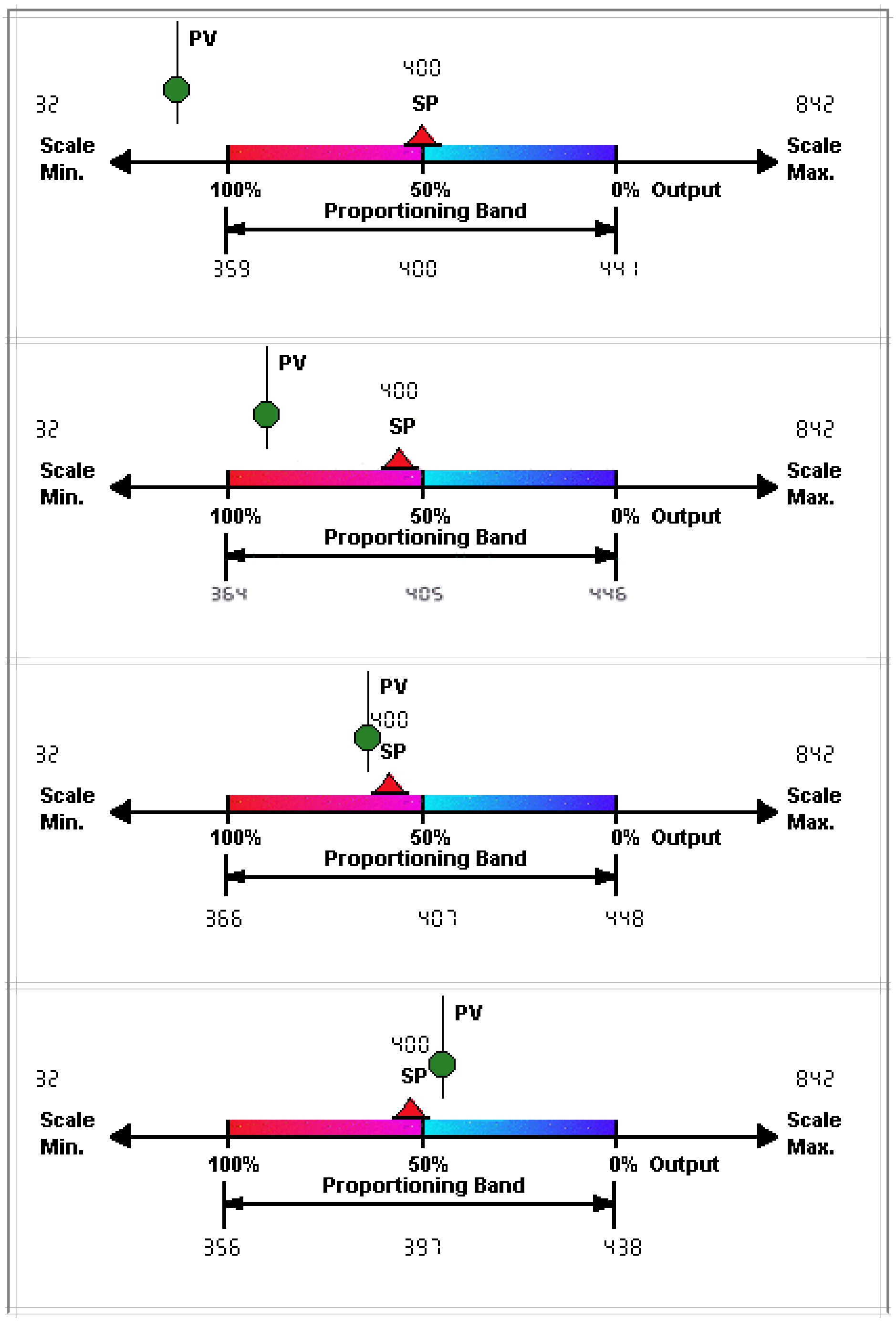
Proportioning bands are normally expressed in one of three ways:

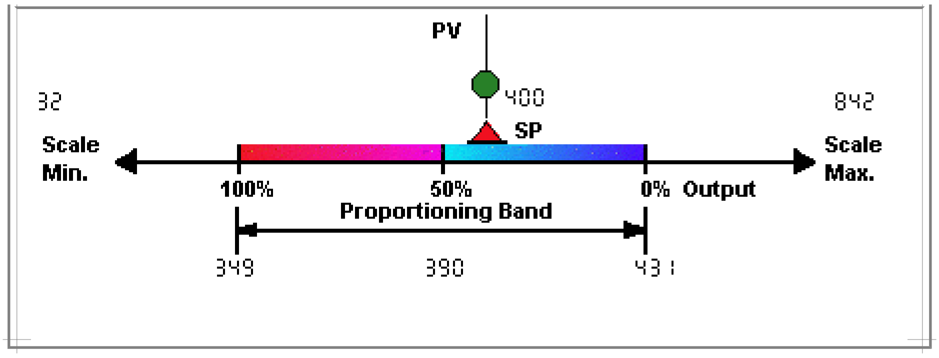
- As a percentage of full scale
- As a number of degrees (or other process variable units)
- Gain which equals 100%/proportioning band% (example PB% = 5; Gain = 20)

If the proportioning band is to narrow an oscillation around the setpoint will result. If the proportioning band is to wide the control will respond in a sluggish manner, could take a long time to settle out at set point and may not respond adequately to upsets.

Integral (Automatic Reset): Corrects for any offset (between setpoint and process variable) automatically over time by shifting the proportioning band. Reset redefines the output requirements at the setpoint until the process variable (temperature) and the setpoint are equal. Most current controls allow the user to adjust how fast reset attempts to correct for the temperature offset. Control manufacturers display the reset value as minutes, minutes/repeat (m/r) or repeats per minute (r/m). This difference is extremely important to note for repeats/ minute is the inverse of minutes or minutes/ repeat). The reset time constant must be greater (slower larger number m/r smaller number r/m) than the process responds. If the reset value (in minutes/repeat) is to small a continuous oscillation will result (reset will over respond to any offset causing this oscillation). If the reset value is too long (in minutes/ repeat) the process will take to long to settle out at setpoint. Automatic reset is disabled any time the temperature is outside the proportioning band to prevent problems during startup.

Below is an example of a single output (heat only temperature control) with a 10% proportioning band and a setpoint of 400. Note how reset shifts the proportioning band when the temperature (PV) enters the proportioning band.





Reset stops moving the proportioning band as soon as the setpoint and PV are equal. In the above example reset determined approximately 38% output is required to maintain setpoint. Stable control is achieved and the temperature matches the setpoint of 400.

Derivative (Rate): Shifts the proportioning band on a slope change of the process variable. Rate in effect applies the "brakes" in an attempt to prevent overshoot (or undershoot) on process upsets or startup. Unlike reset rate operates anywhere within the range of the instrument. Rate usually has an adjustable time constant and should be set much shorter than reset. The larger the time constant the more effect rate will have. Too large of a rate time constant will cause the process to heat too slowly. Too short and the control will be slow to respond to upsets. The time constant is the amount of time any effects caused by rate will be in effect when rate is activated due to a slope change.

Self Tuning /Adaptive Tuning / Pre-Tuning

Many control manufactures provide various facilities in their controls that allow the user to more easily tune (adjust) the PID parameters to their process. Below is a description of same.

Tuning On Demand with Upset: This facility typically determines the PID parameters by inducing an upset in the process. The controls proportioning is shut off (on-off mode) and the control is allowed to oscillate around a setpoint. This allows the control to measure the response of the process when heat is applied and removed (or cooling is applied). From this data the control can calculate and load appropriate PID parameters. Some manufactures perform this procedure at setpoint while others perform it at other values. Caution must be excersized for substantial swings in the process variable values will likely occur while the control is in this mode.

Adaptive Tuning: This mode tunes the PID parameters without introducing any upsets. When a control is utilizing this function it is constantly monitoring the process variable for any oscillation around the setpoint. If there is an oscillation the control adjusts the PID parameters in an attempt to eliminate them. This type of tuning is ideal for processes where load characteristics change drastically while the process is running. It cannot be used effectively if the process has externally induced upsets for which the control could not possibly tune out. For example: A press where a cold mold is inserted at some cyclic rate could cause the PID parameters to be adjusted to the point where control would be totally unacceptable.

Some manufactures call Tuning on demand Self Tune, Auto Tune or Pre-Tune. Adaptive tuning is sometimes called Self Tune, Auto Tune or Adaptive Tune. Since there is no standardization in the naming of these features questions must be asked to determine how they operate.