User Guide

http://www.omega.com
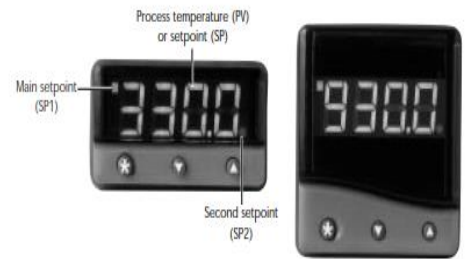e-mail: info@omega.com

CN9300/CN9500
Autotune Temperature Controllers

Below is a chart that will be referenced throughout the user guide

1) Pic.1 shows you how to enter program mode, how to change levels, and how to exit program mode. (also on page 6 of manual)

The controller has two modes, program mode and operating mode. When in program mode the controller can be programmed with settings and functions to suit the application. When in operating mode the controller uses the setting and functions entered in the program mode to control the application.

USING PROGRAM MODE

Note: The controller will auto-exit program mode after 60 seconds of inactivity.

To enter program mode from normal operating mode
Press and hold both ▲ and ▼ buttons for at least 3 seconds.
Release the buttons together when the function `tunE` is displayed, this is the program entry point.
The controller will now alternately display the function and option (setting of that function), e.g. `tunE` and *oFF*.

To view function on the same level
Press ▲ or ▼ button once to view the next function.
Press and hold ▲ or ▼ buttons to scroll through functions.

To display the current option or value for a function
On release of ▲ or ▼ buttons, option alternates with the function.

To change an option value or setting
Press and hold the ✳ button, then press ▲ to increase or ▼ to decrease the value or select the next option.

Note: Check the new option value before moving to another function or exiting program mode.

To change levels
Press and hold ▼ to scroll through the functions until *LEUL* is displayed. Release ▼ to display current level. Press and hold the ✳ button, then press ▲ to increase or ▼ to decrease the level. Release buttons when required level is obtained.

To exit program mode
Press and hold both ▲ and ▼ buttons for at least 3 seconds.

Note: Control commences with any new instructions now entered in the memory.

REMINDER OF INSTRUMENT ADJUSTMENTS
Press ▲ ▼ together for 3 seconds for program entry or exit.
Press ▲ or ▼ to scroll through functions.
Press ✳ ▲ together or ✳ ▼ together to change levels or alter options.
Note: If in difficulty by becoming "lost" in program mode, press ▲ and ▼ together for 3 seconds to return to display mode, check the Menu Navigation summary above and try again.

Pic.1

Follow the step below only if your controller has not been tuned & updated else skip to step 5

2) Must Complete steps 1-4 in pic.2 in program mode (also on page 5 of manual)
   a. Select Input Sensor- look at pic.3 which shows all cases. For RGA we want " tc K -50 to 1200^0C " (also on page 31 in manual)
   b. Select Units ^{0}C or ^{0}F
   c. Select the Type of Setpoint SSd or rLy,
   d. Enter setpoint value

This section details the four step initial configuration that enables control with factory PID settings to start, once the setpoint has been entered.

POWER-UP

On power-up the controller will display the self test sequence and brief display blanking and then alternately display ┌ ∩Pt and *nonE*

1 SELECT INPUT SENSOR

Press and hold ✱ and use either the ▲ or ▼ buttons to scroll through the sensor selection (see table p.31). When the correct sensor is displayed, release the buttons. The controller will now alternately display selected sensor type ┌ ∩Pt and eg. *tc.S*

2 TO SELECT °C/°F

Press and release the ▲ button, the controller will now alternately display ∪∩┌ t and *nonE*. Press and hold the ✱ button and using the ▲ button select °C, °F, **Bar**, **PSI**, **Ph**, **Rh** or **SEt** as required. Release the buttons when the correct unit is displayed.

The controller will now alternately display selected range (eg. °C) and *unit*.

3 TO SELECT SP1 (Main setpoint output device)

Note:	Dual Relay and Dual SSd Output Options Models CN9311 / CN9511 and CN9322 / CN9522 have their outputs pre-configured.

Press and release the ▲ button, the controller will now alternately display SP 1.d and *nonE*. Press and hold the ✱ button and using the ▲ button select **SSd** or **rLY** as required. Release the buttons when the correct device is displayed. The controller will now alternately display SP 1.d and selected output device (eg. **SSd**).

4 TO ENTER INITIAL CONFIGURATION INTO CONTROLLER MEMORY

Press and hold both ▲ and ▼ buttons for 3 seconds. The process temperature (e.g. **23°C**) and *ParK* will be alternately displayed as no setpoint has yet been selected.

TO SET THE MAIN SETPOINT

To display the setpoint, press and hold the ✱ button. °C and *0* or °F and *32* will be alternately displayed. Press and hold the ✱ button. Press ▲ to increase or ▼ to decrease the setpoint. The main setpoint LED will flash indicating that SP1 output is ON. The controller will now be set with the factory PID settings.

Pic. 2

Option/Sensor type		Sensor range			Linearity
Thermocouples					
tc b	B	0 to 1800 °C	32 to 3272 F	Pt-30%Rh/Pt-6%Rh	2.0 *
tc E	E	0 to 600 °C	32 to 1112 F	Chromel/Con	0.5
tc J	J	0 to 800 °C	32 to 1472 F	Iron/Constantan	0.5
tc K	K	-50 to 1200 °C	-58 to 2192 F	Chromel/Alumel	0.25*
tc L	L	0 to 800 °C	32 to 1472 F	Fe/Konst	0.5
tc n	N	-50 to 1200 °C	-58 to 2192 F	NiCrosil/NiSil	0.25*
tc r	R	0 to 1600 °C	32 to 2912 F	Pt-13%Rh/Pt	2.0*
tc s	S	0 to 1600 °C	32 to 2912 F	Pt-10%Rh/Pt	2.0*
tc t	T	-200 / 250 °C	-273 / 482 F	Copper/Con	0.25*

Resistance thermometer				
rtd	-200 / 400 C	-273 / 752 F	Pt100/RTD-2	0.25*

Linear process inputs (Input mV range: 0 to 50mV)

Displays	0 - 20mV	4 - 20mV	setpoint limits	
Lin1	0 - 100		0 - 400	± 0.5%
Lin2		0 - 100	-25 - 400	± 0.5%
Lin3	0 - 1000		0 - 3000	± 0.5%
Lin4		0 - 1000	-250 - 3000	± 0.5%
Lin5	0 - 2000		0 - 3000	± 0.5%

Notes: 1 Linearity: 5-95% sensor range
2 * Linearity B:5° (70° - 500°C) K/N:1° >350°C exceptions: R/S: 5°<300°C T:1° <- -25° >150°C RTD/Pt100: 0.5° <-100°C

Pic.3

3) When steps above are finished you need to manually enter the following conditions below (also shown in page 3). The instructions/how it looks on the controller is shown in pic.4 & pic.5 (also on page 16 of manual)

   a. Proportional band/gain 10^0C
   b. Integral time/reset 5min
   c. Proportional Cycle time 20 secs
   d. Derivative time/Rate 25 secs
   e. DAC Derivative approach control 1.5

The functions and options are available in four levels.

Note: A Functions Menu is shown on the cover fold-out

LEVEL 1

Function **Options** *[Factory settings] shown in brackets*

SELECT AUTOTUNE

`tunE` *[oFF]* **on ParK At.Sp**

Used to switch the Autotune feature on and off, to select **ParK** or Autotune at setpoint.
ParK temporarily turns the output(s) off. To use select **ParK** and exit program mode. To disable re-enter program at **`tunE`** and select **oFF**.
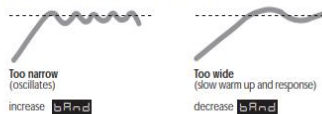
SP1 OPERATING PARAMETERS

`bAnd` **0.1 to * °C/°F** *[10°C/18°F]*

**SP1 proportional band/Gain or Hysteresis**
* 25% sensor maximum
Proportional control eliminates the cycling of on-off control. Heater power is reduced, by time proportioning action, across the proportional band.

Too narrow (oscillates) — increase **bAnd**
Too wide (slow warm up and response) — decrease **bAnd**

`i.nt.t` **oFF 0.1 to 60 minutes** *[5.0]*

SP1 integral time/reset
Auto-corrects proportional control offset error

Too short (overshoots and oscillates)
Too long (slow warm up and response)
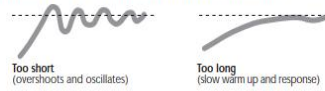
`dErt` **oFF 1 - 200 seconds** *[25]*

SP1 derivate time/rate
Suppresses overshoot and speeds response to disturbances

Too short (slow warm up and response, under corrects) *
Too long (oscillates and over corrects) * disturbance

`dAC` **0.5 - 5.0 x bAnd** *[1.5]*

SP1 derivative approach control dAC
Tunes warm-up characteristics, independent of normal operating conditions, by controlling when derivative action starts during warm-up (smaller dAC value = nearer setpoint).

Too small (overshoots)
Too large (slow stepped warm up)

Pic.4

LEVEL 1 (continued)

`CYC.t` **A - - on.oF 0.1 - 81 sec** *[20]*
SP1 proportional cycle-time (see pages 9/10)
Determines the cycle rate of the output device for proportional control. Select **on.oF** for ON/OFF mode.

`oFSt` *[0]* **to * °C/°F**
SP1 offset/manual reset
* ±50% **bAnd**. Applicable in proportional and ON/OFF mode with integral disable: **Int.t oFF**.

`SP.Lk` *[oFF]* **on**
Lock main setpoint
Locks the setpoint preventing unauthorised adjustment.

PROGRAMMER SETTINGS (see page 11)

`SPrr` *[0]* **to 9995 deg/hour**
Sets the ramp rate

`SPrn` **on** *[oFF]* **hoLd**
Switches the ramp on or off, or hold at last ramp value

`SoAk` *[oFF]* **0 to 1440 min**
Sets the soak time

SP2 OPERATING PARAMETERS (see pages 12/13)

`SEt.2` **0 to * °C/°F** *[0]*
Adjust SP2 setpoint
* Deviation Alarms **DV.hi, DV.Lo, bAnd** 25% sensor maximum (see figure 7).
* Full scale alarms **FS.hi, FS.Lo** sensor range f/s (see figure 8)

`bnd.2` **0.1 - * °C/°F** *[2.0 °C/3.6°F]*
Adjust SP2 hysteresis or proportional band/gain (see **CyC.2** setting)
* 25% sensor f/s

`CYC.2` *[on.oFF]* **0.1–81 seconds**
Select SP2 ON/OFF or proportional cycle-time
Select on.oFF for ON/OFF mode, or the cycle rate of SP2 output device for proportional mode.

Pic.5

4) (optional) the cycle time can be edited (20 sec as shown above is the factory set time) there are two ways to find more precise cycle time for testing.
   a. Option 1 is Tune method (Best method) see pic.6 below to setup once testing is complete look at pic.8 & pic.9 to manual enter the calculated cycle time. (also on manual page 7)

Select the most appropriate method of Autotune , Tune or Tune at Setpoint, to suit the application.

Note: The proportional cycle-time can be pre-selected before starting Autotune, **see PROPORTIONAL CYCLE-TIME.**

The **TUNE** program should be run with the load cool. The output is cycled at 75% of the setpoint value to avoid any overshoot during the tuning cycle. The warm-up characteristics are monitored and set DAC which minimises overshoot on subsequent warm-ups.

The **TUNE AT SETPOINT** program is recommended:

when the setpoint is below 100°C/200°F, where TUNE's tuning cycle at 75% setpoint may be too close to ambient to produce good results;
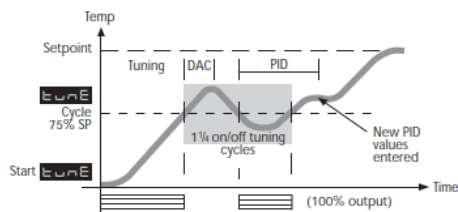
when the process is already hot and the cooling rate is slow;

when controlling multi-zone or heat-cool applications;

to re-tune if the setpoint is changed substantially from previous Autotune.

Note: dAC is not re-tuned by **TUNE AT SETPOINT.**

TUNE PROGRAM

Enter program mode and select ᵗᵘⁿᴱ

The controller will alternately display ᵗᵘⁿᴱ and *oFF*.

Press and hold ✱ and press ▲ once,

The controller will alternately display ᵗᵘⁿᴱ and *on*.

Exit program mode.

The **TUNE** program will now start. The controller will alternately display ᵗᵘⁿᴱ and the process temperature as it climbs to setpoint.
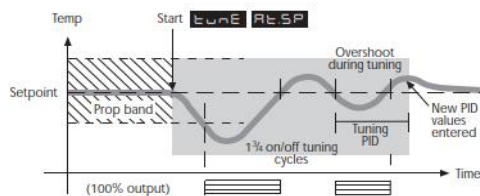
Note: During tuning, the main setpoint (SP1) LED will flash.

Pic.6

b. Option 2 is to Tune at setpoint see pic. page 8 to setup once testing is complete you can follow the same step as option 1 shown in pic.8 & pic.9 to manual enter calculated cycle time.(Also on page 8 of manual)

When the **TUNE** program is complete the alternating display stops and the process temperature is displayed. The PID values are entered automatically. The process temperature will rise to setpoint and control should be stable. If not, this may be because optimum cycle time is not automatically implemented. To set the cycle time see **PROPORTIONAL CYCLE-TIME.**

TUNE AT SETPOINT PROGRAM

Enter program mode and select ᵗᵘⁿᴱ

The controller will alternately display ᵗᵘⁿᴱ and *oFF*.

Select ᵗᵘⁿᴱ *At.SP*.

The controller will alternately display ᵗᵘⁿᴱ and *At.SP*.

Exit program mode.

The **TUNE AT SETPOINT** program will now start. The controller will alternately display ᵗᵘⁿᴱ and the process temperature.

Note: During tuning the main setpoint (SP1) LED will flash.

When the **TUNE AT SETPOINT** program is complete the alternating display stops and the process temperature is displayed. The PID values are entered automatically. The process temperature will rise to setpoint and control should be stable. If not, this may be because optimum cycle time is not automatically implemented. To set the cycle time see **PROPORTIONAL CYCLE-TIME.**

REMINDER OF INSTRUMENT ADJUSTMENTS

Press ▲ ▼ together for 3 seconds for program entry or exit.

Press ▲ or ▼ to scroll through functions.

Press ✱ ▲ together or ✱ ▼ together to change levels or alter options.

Note: If in difficulty by becoming "lost" in program mode, press ▲ and ▼ together for 3 seconds to return to display mode, check the Menu Navigation summary above and try again.

Pic.7

When the **TUNE** program is complete the alternating display stops and the process temperature is displayed. The PID values are entered automatically. The process temperature will rise to setpoint and control should be stable. If not, this may be because optimum cycle time is not automatically implemented. To set the cycle time see **PROPORTIONAL CYCLE-TIME**.

TUNE AT SETPOINT PROGRAM
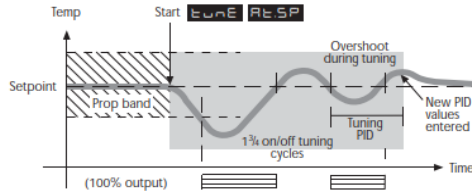
Enter program mode and select `tunE`

The controller will alternately display `tunE` and **oFF**.

Select `tunE` **At.SP**.

The controller will alternately display `tunE` and **At.SP**.

Exit program mode.

The **TUNE AT SETPOINT** program will now start. The controller will alternately display `tunE` and the process temperature.

Note: During tuning the main setpoint (SP1) LED will flash.

When the **TUNE AT SETPOINT** program is complete the alternating display stops and the process temperature is displayed. The PID values are entered automatically. The process temperature will rise to setpoint and control should be stable. If not, this may be because optimum cycle time is not automatically implemented. To set the cycle time see **PROPORTIONAL CYCLE-TIME**.

REMINDER OF INSTRUMENT ADJUSTMENTS
Press ▲ ▼ together for 3 seconds for program entry or exit.
Press ▲ or ▼ to scroll through functions.
Press ✳ ▲ together or ✳ ▼ together to change levels or alter options.
Note: If in difficulty by becoming "lost" in program mode, press ▲ and ▼ together for 3 seconds to return to display mode, check the Menu Navigation summary above and try again.

Pic.8

PROPORTIONAL CYCLE-TIME

The choice of cycle-time is influenced by the external switching device or load. eg. contactor, SSR, valve. A setting that is too long for the process will cause oscillation and a setting that is too short will cause unnecessary wear to an electro-mechanical switching device.

CYCLE-TIME SELECTION METHODS

The following methods of cycle-time selection may be used:

Autotune calculated
After Autotune has been run and completed the calculated cycle-time can be manually accepted or adjusted to suit the switching device. For selection method see **Select Autotune Calculated Cycle-time**.

Pre-select Autotune cycle-time
The controller can be programmed to automatically accept any calculated Autotune cycle-time. For selection method see **Pre-Select Automatic Acceptance of Any Autotune Cycle-time**,

Pre-select before Autotune
The controller can be programmed manually with any cycle-time between 0.1 and 81 sec. This cycle-time will not be changed by any Autotune functions. For selection method see **Pre-Select Cycle-time Before Autotune**,

Factory set
To use the 20 sec factory set cycle-time no action is needed whether autotune is used or not.

CYCLE-TIME RECOMMENDATIONS

Output Device	Factory Setting	Recommended Minimum	Load max (resistive)
Internal relay rLY/rLY1	20 seconds	10 seconds	2A/250 Vac
Internal relay rLY2	20 seconds	10 seconds	1A/250 Vac
Solid state drives SSd/SSd1/SSd2	20 seconds	0.1 seconds	Externally fitted SSR (n/a)

To Select AUTOTUNE CALCULATED CYCLE-TIME
On completion of Autotune enter program mode.

Select `CYC.t`

The controller will now alternately display `CYC.t` and **20** (the factory setting).

To view the calculated optimum cycle-time press and hold the ✳ button then press and hold ▼ until indexing stops. The controller will display the calculated cycle-time `CYC.t` and eg. **A 16**. This indicates that the calculated cycle-time is 16 seconds.

Pic.9

5) Now Ramp method can be done
   a. Select Ramp Rate & turn Ramp on, follow steps on page 11 (DO NOT SET SOAK)
   b. Setpoint 1 has already been set in step 2. If skipped simply exit program mode and hold * and up and down to setpoint value desired.

PROGRAMMER

RAMP-SOAK

This feature enables the controller to ramp up or down from current temperature to a target setpoint at a pre-determined rate. It then controls at the target setpoint for an adjustable soak period before switching off the heat output.

Set **Ramp rate** (0 to 9995 deg/hour)

Press ▲ and ▼ buttons for 3 seconds to enter program entry point ┣ ∪ ∩ ⴳ

Press ▲ to scroll to 5 P ┏ ┏

Press and hold ✱, then press ▲ or ▼ to scroll to required value.

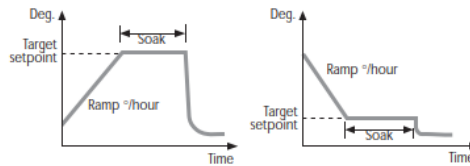Set **Soak** (if required) 0 to 1440 minutes

Press ▲ to scroll to 5 ◌ 𝖠 𝖄

Press and hold ✱, then press ▲ or ▼ to scroll to required soak period.

Set **Ramp On**   (Off) : On : hold

Press ▲ to scroll to 5 P ┏ ∩

Press and hold ✱, then press ▲ to select **On**

Exit program to enter settings into memory and commence ramp to target setpoint.

Notes

In **Ramp on** configuration, if power is removed from the controller, the Ramp will re-start when power is restored.

The **Ramp hold** option suspends the ramp at its last value.

If no **Soak** period has been set, control at target setpoint continues indefinitely.

SP2 deviation alarms follow the ramp setpoint and can be used to alarm "out of limits" ramp rate.

WARNING
The Soak timer is triggered when the ramp setpoint reaches the target setpoint. If the ramp rate is set too fast for the process, the Soak timer will be triggered before the process temperature reaches the target setpoint.

Programmer

11

Pic.10

THE FUNCTION MENU CHART IN THE FIRST PAGE OF THIS DOCUMENT GIVES YOU AN EXPLANATION AND SHOWS YOU HOW EACH NAME ON THE CONTROLLER LOOKS LIKE FOR ALL LEVELS. (This information is also on PAGES 16-21 on manual)