User's Guide

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CL551

Portable Temperature Calibrator

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OMEGA

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WARNING: These products are not designed for use in, and should not be used for, patient connected applications.

INTRODUCTORY NOTE

ATTENTION: THIS MANUAL MUST BE REFERRED TO INSTRUMENTS WITH SERIAL N. 006880 ONWARDS.

*This publication contains operating instructions, as well as a description of the principles of operation, of the **CL551** portable temperature calibrator. The information covers all models of the instrument, including the basic equipment and its options and accessories.*
The instructions reported in this manual, for the above mentioned equipment, are those relevant to:

- *Start-up preparation*
- *Operation description*
- *Start-up instructions*
- *Shut-down instructions*
- *Typical faults and their remedies*

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*The instrument uses sophisticated analog and digital technologies. Repair and service require highly qualified personnel. **OMEGA Engineering, inc** will supply, on request, all pertinent instructions and procedures for service and calibration. **OMEGA Engineering, inc** specialists will be glad to give any technical support you may require.*

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1 GENERAL PERFORMANCE

A highly accurate and powerful system to test and calibrate temperature sensors built into a single compact instrument.
Temperature parameter represents the most important factor to fulfil quality, operational safety and reliability of industrial processes.
Thermocouples, resistance thermometers and any other temperature sensor, when installed in an industrial process, should be inspected as they undergo mechanical, thermal and chemical stresses which accelerate their aging.
Therefore it is a recommended procedure to inspect, check and calibrate each sensor during the commissioning phase and at regular programmed time intervals.

The temperature calibrator **OMEGA** series **CL551** is a transportable unit designed to obtain a controlled temperature with high stability, high uniformity in a range from ambient temperature to +550 °C.
The internal metal block, designed with a self lock feature to avoid dangerous undesired block drop , is interchangeable and equipped with six holes with immersion depth up to 185 mm.
The portable temperature calibrator **CL551** is a multifunction instrument designed to meet the needs of instrumentation engineers, both in laboratory and in field work.

Accurate, compact, rugged, easy to use; the ideal solution to test and calibrate:

- thermocouples
- resistance thermometers
- thermostats
- gas filled thermometers
- mercury thermometers
- material thermal test

CL551 has been designed using the most advanced thermal and electronic technologies to provide high stability and accuracy with easy operation combined with a powerful operating flexibility.

1.1 Specifications

- **Range:** from ambient temperature to +550 °C (standard)
- **Stability:** ±0.05 °C at 450°C
- **Stabilizing time:** 10 min.
- **Heating rate:** 20 °C/min
- **Cooling rate:** from 10 to 25°C/min
- **Radial uniformity:** ±0.2°C at 450°C
- **Axial uniformity:** ±0.8°C at 80mm
- **Switch test function:** with 12 Vdc power supply
- **Display:** Alphanumeric high contrast dot matrix LCD display a 2 lines of 16 characters backlight device
- **Display resolution:** 0.1 or 0.01 °C
- **Display limit of error:** ±0.3°C at 450°C
- **Real time clock:** with internal battery back up
- **A/D converter:** 15 bit resolution plus polarity
- **Display response time:** 10 readings/second
- **Digital interface:** RS232
- **Heater:** with stainless steel jacket
- **Internal metal block:** standard aluminum with n. 6 holes ø 3.175 / 4.75 / 6.5 / 8.0 / 9.5 / 19 / 4.7 mm
- **Electronic section:** in a separate metal shell
- **Internal temperature sensor:** Pt100 Class A sensor (control and indication)
- **External temperature sensor:** an auxiliary input connector for Pt100 sensor is available for the back panel supplied on request
- **Temperature control:** PID with optimized tuning constants
- **Heat/cool control:** full automatic switch-over
- **Protection grid:** removable
- **Mains line connection:** socket for mains line cable equipped with a protection fuse
- **Power supply:** 110 or 220 Vac (to be specified) 50/60 Hz
- **Power:** 800 VA
- **Chassis:** separate shell for thermal and electronic sections with a carrying handle
- **Size:** 370 x 300 x 140mm
- **Weight:** Nett 10 kg Gross 17 kg
- **Aluminum case dimensions :** (optional) 250 x 350 x 410 mm
- **Packing dimensions:** 450 x 450 x 350 mm

2 GENERAL FEATURES

2.1 Temperature stability

The internal microcontroller system handles, through the keyboard, man-machine communications, the internal logic and grants the stability of the internal thermal equalizing metal block of ±0.05 °C.
The temperature control uses a sophisticated PID algorithm with memory stored optimized tuning constants.
For special tests the operator could, through a security code, load different tuning constants.

2.2 Application flexibility

The operative mode set-up is made simple and easy with a sequence of menu pages that only requires **<F>** (Function), **<E>** (Enter), **<▲>** increase and **<▼>** decrease instructions.

The panel lamp and keys have the following features:

"HEATING" LED	indicates the power applied to the oven
"COOLING" LED	indicates cooling action through the modulated fan
"SWITCH TEST"	indicates thermostat switch-over
<F>	key for function selection
<▲> and **<▼>**	parameter adjustment
<E>	Enter key for new instruction acknowledgement

The instrument will also provide some acoustic signals as it follows:

single "beep"	operator instruction acknowledgment when the **<E>** key is pressed
multiple "beep" (five times)	the temperature is stabilized on the set-point value and the instrument is ready for the calibration of the sensor .

2.3 Internal digital indicator

The internal digital indicator is a dot matrix LCD display with 2 lines of 16 characters equipped with a backlight device for easy reading also in poor light condition.
The operator could select the required operative function, the set-point value and read the temperature value of the internal thermal equalizing block.
The temperature is obtained with a class A Pt100 resistance thermometer Pt 100.
The measurement limit of error is ± 0.3°C at 450°C.
The overall limit of error can be improved using an external high accuracy calibrated resistance thermometer that can be supplied on request.

2.4 External digital indicator

When high accuracy is required, the portable temperature calibrator **CL551** can be used in combination with high accuracy indicator and an external high accuracy calibrated resistance thermometer (ask for the pertinent literature).

2.5 Digital interface

The calibrator is standard equipped with a full bi-directional RS232 digital interface for any communication with a Personal Computer. The Portable Temperature Calibrator can be part of an automatic calibration system with a programmable cycle and the acquisition of all data required to generate a full calibration report.
OMEGA engineers are ready to support you with components, accessories and software that can fulfil your application requirements.

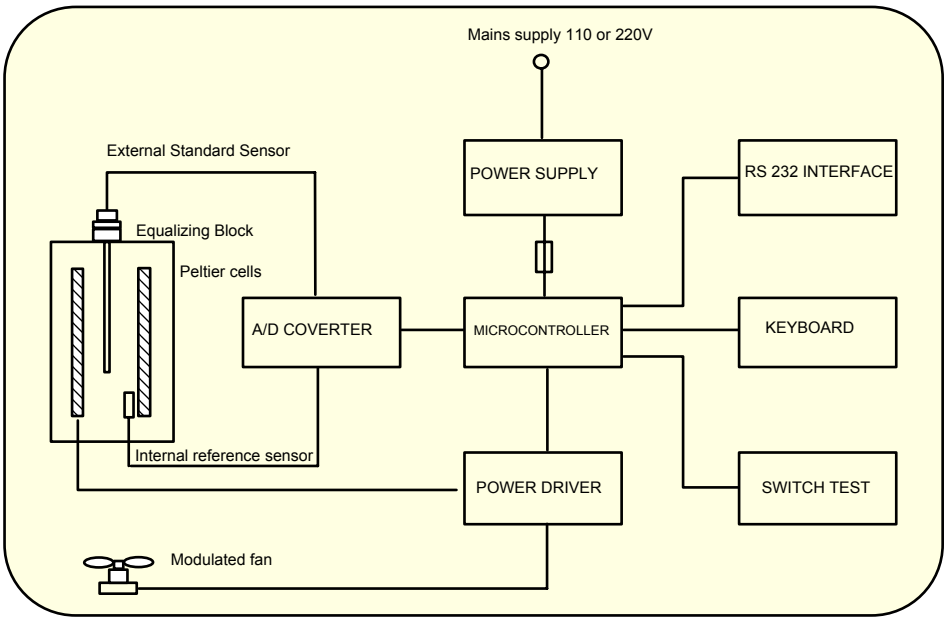
3 PHYSICAL DESCRIPTION

The **CL551** portable temperature calibrator consists of two modules mechanically and electrically interconnected.
The module on the left incorporates the heater, the thermal equalizing metal block, the resistance temperature sensor and a modulated air blower.
The module on the right is endowed with an alphanumeric dot matrix LCD display with a backlight device, a microcontroller mother board with all base functions, an operator keyboard, a power package.

The portable temperature calibrator is supplied in an aluminum case with cover and carrying handle to assure easy transportation and better protection of the instrument against mechanical knocks or scratches.

4 FUNCTIONAL DESCRIPTION

The **CL551** portable temperature calibrator functional block diagram is shown below.



The instrument functional blocks are the following ones:

- **power supply**
- **microcontroller (central unit + memory)**
- **A/D converter**
- **power driver**
- **keyboard**
- **switch test**
- **digital interface**
- **digital display**

5 PRE-OPERATIONAL CHECK

5.1 Unpacking

Remove the instrument from its packing case and remove any shipping ties, clamps, or packing materials. Carefully follow any instruction given on any attached tag. Inspect the instrument from scratches, dents, damages to case corners etc. which may have occurred during shipment.
If any mechanical damage is noted, report the damage to the shipping carrier and then notify **OMEGA** directly or its nearest agent, and retain the damaged packaging for inspection.
A label, on the back of the instrument case, indicates the serial number of the instrument. Refer to this number for any inquiry for service, spare parts supply or application and technical support requirements. **OMEGA** keeps an updated data base with all information regarding your instrument.

5.2 Preparation for the start-up

Remove the calibrator from the carrying case and place it on a flat surface.
Connect the instrument to a mains supply with the nominal voltage specified on the back label (115 or 230 Vac).
Remember that the instrument requires a power of approximately 800 VA. For safe operations the equipment must be correctly connected to ground.

5.3 Wiring practice

Although most temperature indicators are designed to be insensitive to transient or noise, the following recommendations should be followed to reduce pick up in the signal leads and to ensure good general performances. The signal leads should not be run near ac line wiring, transformer and heating elements. Connection leads should, if possible, be twisted and shielded with the shield grounded at the end of the cable. When shielded cables are used the shield must be connected to the positive terminal. Appropriate extension wires should be used for thermocouples unless the thermocouple leads permit direct connection.
Make sure that both the thermocouple and the compensating cable are connected with the correct polarity. If in doubt, the polarity of the compensating leads can be checked by connecting a length of lead to the indicator, shortening the free ends of the wires together and noting that the indicator reading increases when the wires connection is heated.
Color codes of compensating cables change in different countries. Check the appropriate table (A).
For Resistance Temperature Detector connection use a cable of adequate gauge to lower the overall input resistance.
The use of a cable with a good resistance balance between conductors is also necessary.

Table A
Colour code & polarity for extension wires (ANSI)

Thermocouple			**Wires**	**Colour code**
E	Chromel	(+)	Chromel	Purple
	Constantan	(-)	Constantan	Red
J	Iron	(+)	Iron	White
	Constantan	(-)	Constantan	Red
K	Chromel	(+)	Chromel	Yellow
	Alumel	(-)	Alumel	Red
R	Pt 13% Rh	(+)	Copper	Black
	Platinum	(-)	Alloy 11	Red
S	Pt 10% Rh	(+)	Copper	Black
	Platinum	(-)	Alloy 11	Red
T	Copper	(+)	Copper	Blue
	Constantan	(-)	Constantan	Red
B	Pt 6% Rh	(+)	Copper	
	Pt 30% Rh	(-)	Copper	
N	Nicrosil	(+)	Nicrosil	Orange
	Nisil	(-)	Nisil	Red

5.4 Thermocouple wires

When making measurements where additional wires have to be connected to the thermocouple leads, care must be exercised in selecting these wire types, not only when they are claimed to be of the same composition as the thermocouple involved, but, also, of the same "quality".
Performance results, where high precision is required and in circumstances where some types of thermocouple wire leads are added to the original installation, should be reviewed carefully for the impact of the choice of the additional wire leads.
The quality of the thermocouple wire is established by the limit of error to be expected with its use.
There are three recognized levels of quality:

- Special or Premium grade
- Standard grade
- Extension wire grade

The error limits determining the grade quality differ from thermocouple type to thermocouple type, reflecting the degree of difficulty in maintaining the precise levels of purity of the metal used.
The table below summarizes the error limits for Premium and Standard grades, while the Extension grade wire is characterized by limits of error exceeding those in the table.
Errors up to ±4°C may be experienced when using the Extension grade thermocouple wire for J and K thermocouples.

Limit of Error of thermocouples
The range indicated is the temperature limit for the indicated errors. Cold junction at 0 °C

Tc	Class 1	Class 2	Class 3
type T	0.5°C (-40 to +125°C) 0.004 . T (T >125°C)	1°C (-40 to 133°C) 0.0075 . T (T >133 °C)	1°C (-67 to 40°C) 0.015. T (T <-67°C)
T range	-40 to +350°C	-40 to +350°C	-200 to 40°C
type E	1.5°C (-40 to 375°C) 0.004.T (T >375°C)	2.5°C (-40 to 333 °C) 0.0075.T (T >333°C)	2.5°C (-167 to +40°C) 0.015.T (T <-167°C)
T range	-40 to 800°C	-40 to 900°C	-200°C to 40°C
type J	1.5°C (-40 to 375°C) 0.004.T (T >375°C)	2.5°C (-40 to 333 °C) 0.0075.T (T >333°C)	2.5°C (-167 to +40°C) 0.015.T (T <-167°C)
T range	-40 to 750°C	-40 to 750°C	-----
type K & N	1.5°C (-40 to 375°C) 0.004.T (T >375°C)	2.5°C (-40 to 333 °C) 0.0075.T (T >333°C)	2.5°C (-167 to +40°C) 0.015.T (T <-167°C)
T range	-40 to 1000°C	-40 to 1200°C	-200°C to 40°C
type R & S	1°C (0 to 1100°C) 1 + 0.003 (T-100) (T >1100°C)	1.5°C (-40 to 600 °C) 0.0075.T (T >600°C)	4°C (600 to +800°C) 0.005.T (T>800°C)
T range	0 to 1600°C	0 to 1600°C	----
type B	1°C (0 to 1100°C) 1 + 0.003 (T-100) (T >1100°C)	1.5°C (-40 to 600 °C) 0.0075.T (T >600°C)	4°C (600 to +800°C) 0.005.T (T>800°C)
T range	-----	600 to 1700°C	600 to 1700°C

Note : Specially selected "premium grade" wires are available on request

6 SAFETY RECOMMENDATIONS

- Since the **CL551** temperature calibrator is a transportable instrument also designed for field use, make sure that the mains line socket is correctly grounded.
- During maintenance and repair operations make sure that the equipment has cooled down and has been disconnected from the mains line supply.
- During long term tests at high temperatures the upper protection grill may become hot; handle the oven to avoid thermal hazard and make sure that it has cooled down before putting it into its case.
- Do not fill the thermal equalizer block holes with any type of fluid.
- Do not insert the sensor to be tested in the oven at high temperature.
- Do not use the temperature calibrator near flammable compounds.

ATTENTION:

THE EQUIPMENT HAS BEEN DESIGNED TO PROTECT THE OPERATOR FROM ELECTRICAL AND HIGH TEMPERATURE HAZARDS. HOWEVER, THE FOLLOWING CAUTIONS SHOULD BE TAKEN:

WEAR PROTECTIVE GLOVES.

DO NOT PLACE ANY COMPONENT ON THE TOP OF THE OVEN.

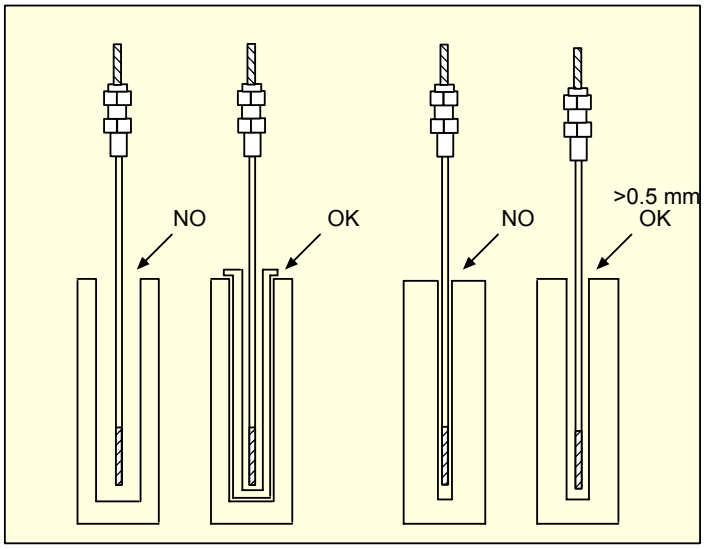
DO NOT OPERATE THE UNIT CLOSE TO FLAMMABLE COMPOUNDS.

7 OPERATION & APPLICATION

7.1 Calibration by comparison

To verify or calibrate a temperature sensor by comparison with an internal or external Pt100 standard follow the procedure indicated below. For correct operations strictly follow the following recommendations:

- Measure the outside diameter of the sensor to be tested.
- Insert the sensor to be tested in one hole of the thermal equalizing block. For a correct calibration the outside diameter of the sensor under test should be approximately 0.5 mm less than the inside diameter of the hole;
- If required use the appropriate well adapter (see the figure below).
- Do not force the sensor to be tested into the thermal equalizing block (see the figure below).

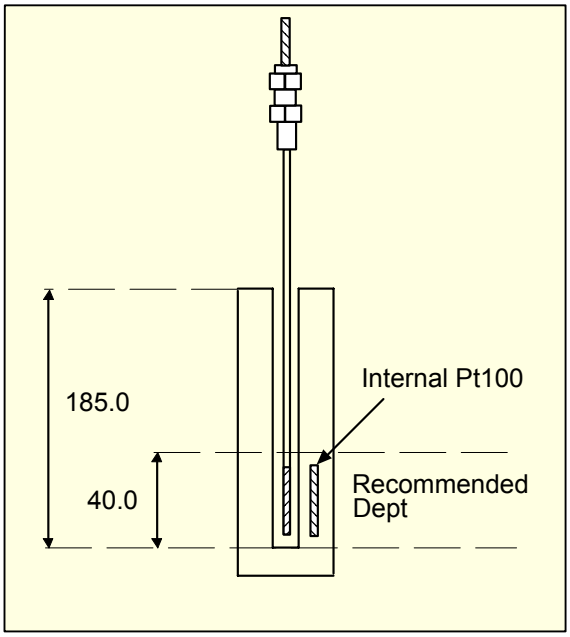


ATTENTION

DO NOT INSERT THE SENSOR UNDER TEST IN THE THERMAL EQUALIZING BLOCK WHEN THE OVEN IS AT A HIGH TEMPERATURE. THERMAL SHOCK COULD DAMAGE THE SENSING ELEMENT OF THE PROBE.
AT THE END OF THE TEST DO NOT REMOVE IMMEDIATELY THE PROBE/S FROM THE THERMAL EQUALIZING BLOCK. WAIT FIRST FOR THE TEMPERATURE CALIBRATOR TO COOL.
AT THE END OF THE OPERATION : WAIT FOR THE THERMAL EQUALIZING BLOCK TO BE COMPLETELY COOLED BEFORE PLACING THE CALIBRATOR INTO THE CARRYING CASE.

7.1.1 Calibration using the internal Pt100 sensor

- Start the calibration only at ambient temperature.
- Insert the sensor under test in the correct hole with the sensing element into the recommended calibration zone as indicated in the following figure.
- Switch the instrument on using the main switch on the rear panel.
- Pressing the **<▲>** key the set-point values will increase.
- Pressing the **<▼>** key the set-point values will decrease.
- To confirm values, press the **<E>** key until a sound is made by unit.
- Verify the reading temperature on the display with the values reported on the Certificate of Conformity and make the relative modifications.
- Calibrate the value read on the sensor under test with the correct value on the indicator. The check can be accomplished with several temperature values. In order to follow this procedure just set up the set-point to the relevant temperature value and wait for stabilization.

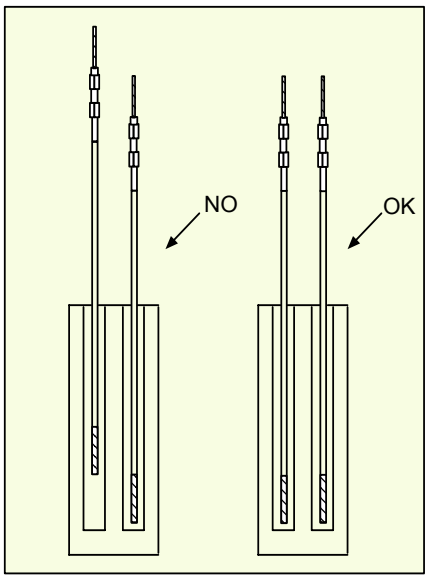


7.1.2 Calibration using an external standard Pt100 sensor

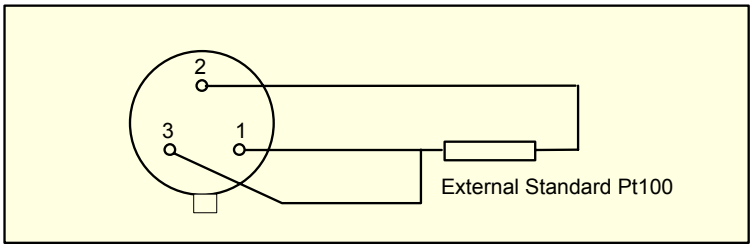
- Start the calibration procedure only at ambient temperature.
- Insert both the sensor under test and the external standard Pt100 in the relevant holes of the thermal equalizing block and keep the sensing elements of the probes at the same depth as indicated in the figure below.

The errors of temperature, due to the differences in depths, remain within ± 0.2 °C.

- Switch -ON- the instrument
- Verify the reading temperature of the reference sample with the values reported on the Certificate of Conformity make necessary relative variations.
- Calibrate the value read on the sensor under test with the correct value reported on the official Certificate of Conformity.
- The check can be accomplished with several temperature values. In order to follow this procedure just set up the set-point to the relevant temperature value and wait for stabilization.

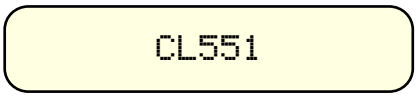


- The external standard Pt100 must be connected to the back panel connector using the component supplied as a standard accessory.
- The new configuration must be selected through the set-up procedure.



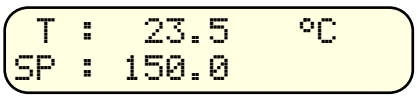
7.2 Power ON

- To power the instrument press the back panel switch -**ON**-
  The indication of the following running figure will appear for few seconds while a diagnostic routine checks critical circuits and components.



- Once the diagnostic routine is ended , the heater is forced to continuous cooling by means of a ventilation fan at its maximum speed. A green Led is lit on until the set-point is confirmed or a new set-point value is entered.

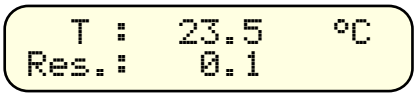
The display shows the current heater temperature and the last set-point value entered.



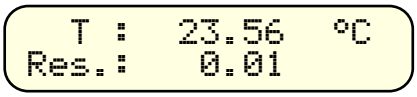
- In the example above, the display shows a blinking message (**SP:150.0**) until the operator validates the value of **150.0** as the relevant set-point by pressing the **<E>** key.
- Using the <▲> / <▼> keys a new set-point value can be selected to become the relevant set-point value, when the operator validates it by pressing the **<E>** key. An acoustic beep, together with a temporary indication (■) right on the screen, will indicate that the value has correctly been stored into memory.

7.2.1 Display resolution

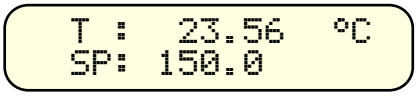
CL551 provides two resolutions of the display: 0.1 °C and 0.01 °C.
To select the correct resolution press several times the **<F>** key until you obtain the following display:



- Press **<▲>** key to have 0.01°C resolution.



- Press the <**F**> key to return to normal operative conditions. The indication will return to the following indication:



Note : *If no further indication is supplied by the operator, the instrument automatically resumes the initial conditions.*

7.2.2 Temperature switch test

CL551 has been designed for the set-point control of temperature switch. For this purpose, two terminals for the electrical connection to the thermostat under test are installed on the rear part of the instrument, while on the front side of it, a red LED indicates:

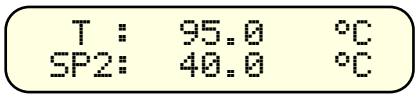
- close contact **<ON>** (light on)
- open contact **<OFF>** (light off)

The thermostat test is carried out by varying constantly the heater temperature. In order to follow this procedure, use SP-2 and Ramp functions, verify the right switching of the thermostat contact on the Test LED and contemporaneously check the temperature value on the display.
The difference between the set value supplied and the temperature, highlights the **▲t** of the thermostat.
To verify the right functioning of the thermostat proceed as it follows:

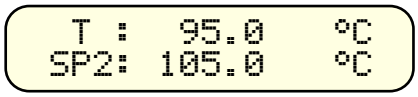
- Insert the sensing elements of the thermostat into the relevant hole of the thermal equalizing block.
- Electrically connect the output connecting terminals of the thermostat with the two terminals located on the upper part of the instrument.
- Adjust the set-point of the thermostat to the test value (e.g.: 100 °C - see diagram).
- Energize **CL551**.
- Wait for the control routine to be done and adjust the SP to 95° C using the **<▲>** key.
- Press the **<E>** key to confirm the value.

Within a minute the heater temperature will settle to 95°C.

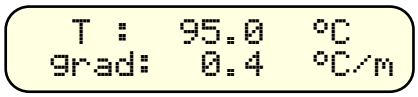
- When the temperature is settled, press the **<F>** key. The display will show:



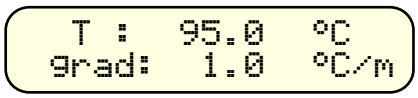
- Press the **<▲>** key to set the SP-2: value to 105.0:



- Press the **<E>**key to confirm.
- Then press the **<F>** key until you obtain:

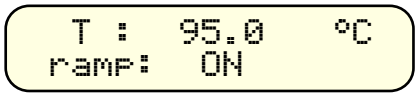


- Press the **<▲>** or **<▼>** key to determine a speed variation of the heater set-point temperature similar to the acknowledgement time of the thermostat (e.g.: 1 ° / min.):



- Press the **<E>** key to confirm.
- Press the **<F>** key to obtain:

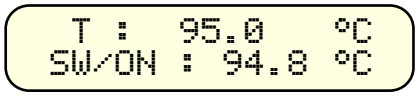
- Press **<▲>** to obtain:



- Press the **<E>** key to confirm.

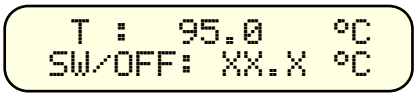
From now on the heater temperature will vary from 95.0 to 105.0 °C with increments of 1 °C per minute.
The operator will verify the temperature value on the display when the Test light is OFF.

- Press the <**E>** key 5 times and the display will show up the following message:



SW/ON :94.8 is the value in °C to close the contact of the thermostat

SW/ON :xx.x is the value in °C to open the contact of the thermostat

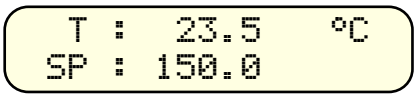


7.3 Set-up procedure - 1st level

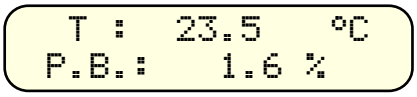
The 1st level of the set-up procedure allows the operator to modify , if required, the configuration of the following parameters:

- tuning constant of the PID algorithm
- internal/externalPt100 reference sensor
- cooling rate
- °C/°F selection
- default parameters
- security code (n. 2 as a standard)

To enter this procedure start from the normal operating function and from the following indication:

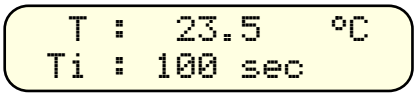


- press simultaneously **<▲> + <F>** keys to enter the 1st level of the set-up procedure and to obtain the following indication relevant to the Proportional Band constant:

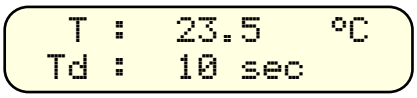


The PID constants are experimentally defined and memory loaded for tuning optimization.
The operator can eventually change the value for special applications only.
It is recommended for routine applications to use the "default" stored values
To adjust a new value use **<▲>** and **<▼>** cursors and memory store with the **<E>** key.

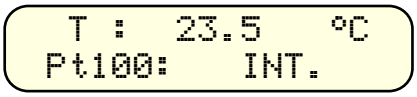
- Press the **<F>** key to obtain the following indication relevant to the Integral constant:

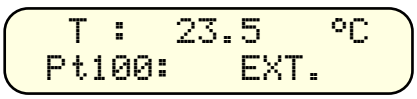


- Press the **<F>** key to obtain the following indication relevant to the Derivative constant:

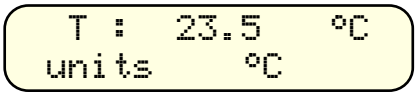


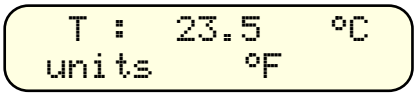
- Press the **<F>** key to select the Internal or External reference resistance thermometer (Pt100):



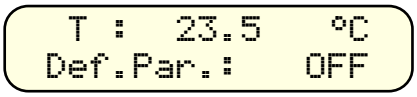


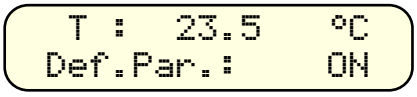
- Press the **<F>** key to select the required temperature unit:



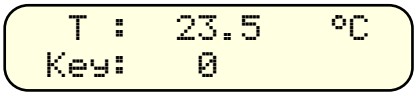


- Press the **<F>** key to enable or disable the Default parameter:

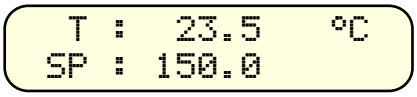




- Press the **<F>** key to select the access key number for the 2nd level of the set-up procedure:



- To enter the 2nd level of the set-up procedure adjust the key number to n. 2
- Press the **<F>** key or return to the normal operative condition with the following indication:

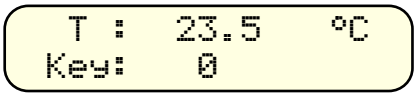


7.4 Set-up procedure - 2nd level

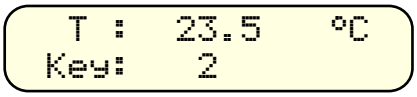
The 2nd level of the set-up procedure allows the operator to modify, if required, the configuration of the following parameters:

- security or access code
- baud rate
- machine code
- serial number

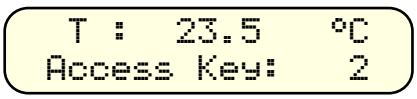
The 2nd level of the set-up procedure starts from the following indication that you can meet at the end of the 1st level of the set-up procedure.



- To enter this procedure select the access key n. 2 as it follows:

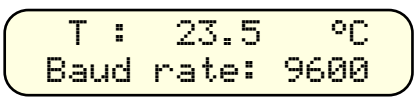


- Then press simultaneously <**F**> + <▲> keys to obtain the following indication:



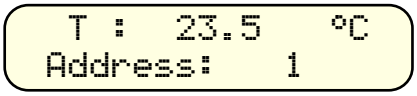
The operator can, if required, change the access key number to be memory stored with the **<E>** key.
The new number must be remembered for subsequent operations.

- Press the **<F>** key to enter the Baud rate adjustment step with the following indication:



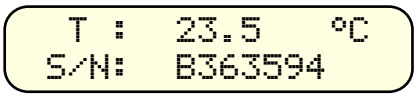
The Baud Rate can be adjusted for the required value among 19200, 9600, 4800, 2400, 1200, 600, 300.

- Press the **<F>** key to enter the machine code selection:

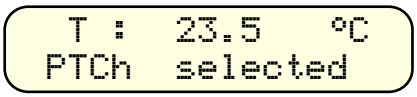


The machine code can be adjusted from 1 to 99.

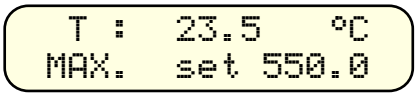
- Press the **<F>** key to select the page indicating the serial number of the instrument:



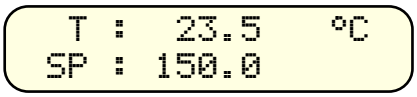
- Press the **<F>** key to review the type of sensor selected:



- Press the **<F>** key to set the max. temperature limit:



- Press simultaneously **<▲> + <F>** keys to exit this procedure and to return to the normal operative mode with the following indication:



7.5 P.I.D. tuning

The P.I.D. tuning parameters have been settled at works and they are stored as "Default Parameters".
The normal values are the following ones:

Prop. band : 3%
Integral Time : 100 sec.
Derivative Time : 10 sec.

For any special application, in case it should be necessary to change that parameter, proceed as it is shown at paragraph 3.

8 MAINTENANCE

The **CL551** portable temperature calibrator has been factory tested and calibrated before shipment. The calibration should be verified and re-adjusted if the instrument shows an error exceeding the declared specifications or when a critical active or passive component is replaced (either at component level or at board level). **OMEGA** engineers will give prompt support for any assistance request.

8.1 Defects and faults

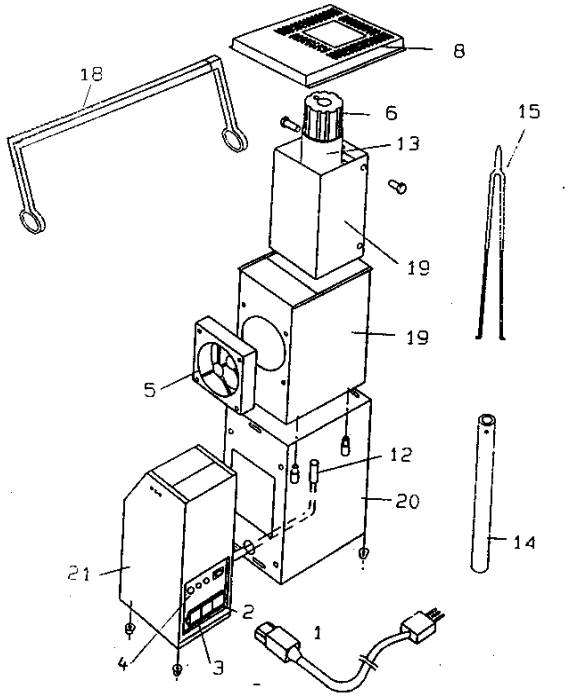
N°	FAULT DESCRIPTION	FAULTY COMPONENT OR FUNCTION	METHOD FOR REMOVAL
1	The control panel is working normally but it doesn't rise in temperature.	The heater element is cut off. The triac is cut off.	Replace the heater element or the triac after checking if they are damaged.
2	On pushing the main switch the fuse blows	Short circuit in the heater element or in another part of the circuit.	Replace (after check) the heater element or the part of the circuit which is damaged.
3	The temperature doesn't stop at the set point value.	Short circuit in the triac.	Replace the triac.
4	The set point value isn't the engaged value, or the temperature shown on the display is different from the actual temperature of the block.	The internal Pt100 or the Microcontroller is damaged.	Check and replace the damaged part.
5	The temperature doesn't fall to the right temperature.	The fan is damaged; the connection is cut off. The fan triac is cut off.	Check if there is tension at the fan ; if the circuit is active replace the fan. Otherwise, replace the fan triac.
6	The display shows -760°C and the calibrator doesn't heat.	The Pt100 is open Short circuit in the internal Pt100.	Replace Pt100.
7	The display shows 3 lines and the calibrator doesn't heat.	Short circuit in the Pt100.	Replace Pt100.
8	On connecting the electrical cable and pushing the main switch the calibrator doesn't work.	The fuse blows. The electrical cable is cut off. The main switch is damaged.	Check and replace the damaged part.

8.2 Spare parts

Aluminum carrying case with cover, handle and shoulder strap

POS.	DESCRIPTION
1	Socket
3	Fuse
4	Switch Test Plug
5	Fan
6	Equalizing Block
7	Diode
10	MicroController
11	Controller driver

12	Pt100 internal sensor
13	Heater Element
14	Well
15	Tweezers
16	Pt100 external connector
17	RS232 connector
18	Transport handle
19	Internal carpentry
20	Rear carpentry
21	Tuning container



8.3 Storage

Store the instrument in the original package, at a temperature from -30°C to +60°C, with R.H. less than 90%.

9 COMMUNICATION

9.1 Communication Protocol

CL551 is equipped with a RS232 bi-directional , half-duplex interface as standard.
Baud rate is set at 9600 baud as default. You can modify it through keyboard selecting following rate : 300, 600, 1200, 2400, 4800, 9600 and 19200 baud. Transmission parameters are 8 bit length, no parity and 1 bit stop. Address can be modified through keyboard and it is set 1 as default. RS232 interface connector is a 9 pin DB9 male connector.

Cable connection to a standard personal computer as follows :

9 pin CL551 9 pin PC connector 25 pin PC connector

2 ----------> 3 ----------> 2
3 ----------> 2 ----------> 3
5 ----------> 5 ----------> 7

Communication protocol is based on Answer to Request system.
CL551 will answer only if you sent a Request to it.

There are two kind of request :
RVAR to read a variable.
WVAR to set a variable.

9.2 Reading a variable

The instruction to read a variable has to be an ASCII code composed as follows :

$ character
Instrument Address
RVAR request string
Variable Index
Blank space
Carriage Return

For example, if the set point has to be read (Variable index = 0), supposing the instrument address to be 1:

$1RVAR0 \r

ASCII code	$	1	R	V	A	R	0		\r
HEX $ code	24	31	52	56	41	52	30	20	0D

The answer of the **CL551** will be as follows
* character
Carriage return
* character
Instrument Address
Answer string
Carriage Return

For example if set point is 50.5 °C , supposing the instrument address to be 1:

ASCII code	*	\r	*	1		S	P			:		0	0	5	0	.	5	\r
HEX $ code	2A	0D	2A	31	20	53	50	20	20	3A	20	30	30	35	30	2E	33	0D

List of Variable Index available

Variable	Index
Actual Setpoint	0
Ramp : ON /OFF	1

Second Setpoint	2
Ramp gradient	3
Resolution : 0.01° / 0.1°	4
Proportional band	5
Integral time	6
Derivative time	7
Pt100 : Internal / External	8
Engineering unit °C / °F	10
Default Parameters : ON/OFF	11
Key	12
Access Key	13
Baud Rate	14
Address	15
Switch ON value	22
Switch OFF value	23
Memory release	24
Actual temperature	100

9.3 Setting a variable

The instruction to write a variable has to be an ASCII code composed as follows :

$ character
Instrument Address
WVAR request string
Variable Index
Blank space
Value to be written
Carriage Return

For example, if the set point has to be set (Variable index = 0) to 123 °C , supposing the instrument address to be 1:
$1WVAR0 123\r

ASCII code	$	1	W	V	A	R	0		1	2	3	\r
HEX $ code	24	31	57	56	41	52	30	20	31	32	33	0D

The answer of the **CL551** will be as follows :

* character
Carriage return
* character
Instrument Address
Answer string
Carriage Return

ASCII code	*	\r	W	V	A	R	0		1	2	3	\r
HEX $ code	2A	0D	57	56	41	52	30	20	31	32	33	0D

For example, if the resolution has to be changed to 0.01° (Variable index = 4) , supposing the instrument address to be 1:
$1WVAR4 1\r

ASCII code	$	1	W	V	A	R	4		1	\r
HEX $ code	24	31	57	56	41	52	34	20	31	0D

The answer of the **CL551** will be as follows :

* character
Carriage return
* character
Instrument Address
Answer string
Carriage Return

ASCII code	*	\r	W	V	A	R	4		1	\r
HEX $ code	2A	0D	57	56	41	52	34	20	31	0D

List of Variable Index available

Variable	Index	Correct Value
Actual Setpoint	0	decimal value
Ramp : ON /OFF	1	1 for ON, 0 for OFF
Second Setpoint	2	decimal value
Ramp gradient	3	decimal value
Resolution : 0.01° / 0.1°	4	1 for 0.01°, 0 for 0.1°
Proportional band	5	decimal value
Integral time	6	decimal value
Derivative time	7	decimal value
Pt100 : Internal / External	8	1 for Internal, 0 for External
Engineering unit °C / °F	10	1 for °F, 0 for °C
Default Parameters : ON/OFF	11	1 for OFF, 0 for ON
Key	12	decimal value
Access Key	13	decimal value
Baud Rate	14	decimal value
Address	15	decimal value

WARRANTY/DISCLAIMER

OMEGA ENGINEERING, INC. warrants this unit to be free of defects in materials and workmanship for a period of **13 months** from date of purchase. OMEGA Warranty adds an additional one (1) month grace period to the normal **one (1) year product warranty** to cover handling and shipping time. This ensures that OMEGA's customers receive maximum coverage on each product.

If the unit should malfunction, it must be returned to the factory for evaluation. OMEGA's Customer Service Department will issue an Authorized Return (AR) number immediately upon phone or written request. Upon examination by OMEGA, if the unit is found to be defective it will be repaired or replaced at no charge. OMEGA's WARRANTY does not apply to defects resulting from any action of the purchaser, including but not limited to mishandling, improper interfacing, operation outside of design limits, improper repair, or unauthorized modification. This WARRANTY is VOID if the unit shows evidence of having been tampered with or shows evidence of being damaged as a result of excessive corrosion; or current, heat, moisture or vibration; improper specification; misapplication; misuse or other operating conditions outside of OMEGA's control. Components which wear are not warranted, including but not limited to contact points, fuses, and triacs.

OMEGA is pleased to offer suggestions on the use of its various products However, OMEGA neither assumes responsibility for any omissions or errors nor assumes liability for any damages that result from the use of its products in accordance with information provided by OMEGA, either verbal or written. OMEGA warrants only that the parts manufactured by it will be as specified and free of defects. OMEGA MAKES NO OTHER WARRANTIES OR REPRESENTATIONS OF ANY KIND WHATSOEVER, EXPRESSEO OR IMPUED, EXCEPT THAT OF TITLE, AND ALL IMPLIED WARRANTIES INCLUDING ANY WARRANTY OF MERCHANTABIUTY AND RTNESS FOR A PARTICULAR PURPOSE ARE HEREBY DISCLAIMED. LIMITATION OF LIABILITY: The remedies of purchaser set forth herein ate exclusive and the total liability of OMEGA with respect to this order, whether based on contract, warranty, negligence. Indemnification, strict liability or otherwise, shall not exceed the purchase price of the component upon which liability is based. In no event shall OMEGA be liable for consequential, incidental or special damages.

CONDITIONS: Equipment sold by OMEGA is not intended to be used, nor shall it be used: (1) as a "Basic Component" under 10 CFR 21 (NRC), used in or with any nuclear installation or activity; or (2) in medical applications or used on humans. Should any Product(s) be used in or with any nuclear installation or activity, medical application, used on humans, or misused in any way, OMEGA assumes no responsibility as set forth in our basic WARRANTY/DISCLAIMER language, and additionally, purchaser will indemnify OMEGA and hold OMEGA harmless from any liability or damage whatsoever arising out of the use of the Product(s) in such a manner.

RETURN REQUESTS / INQUIRIES

Direct all warranty and repair requests/inquiries to the OMEGA Customer Service Department. BEFORE RETURNING ANY PRODUCT(S) TO OMEGA, PURCHASER MUST OBTAIN AN AUTHORIZED RETURN (AR) NUMBER FROM OMEGA'S CUSTOMER SERVICE DEPARTMENT (IN ORDER TO AVOID PROCESSING DELAYS). The assigned AR number should then be marked on the outside of the return package and on any correspondence.

The purchaser is responsible for shipping charges, freight, insurance and proper packaging to prevent breakage in transit.

FOR **WARRANTY** RETURNS, please has the following information available BEFORE contacting OMEGA:

1. P.O. number under which the product was PURCHASED,
2. Model and serial number of the product under warranty, and
3. Repair instructions and/or specific problems relative to the product.

FOR **NON-WARRANTY** REPAIRS, consult OMEGA for current repair charges. Have the following information available BEFORE contacting OMEGA:

1. P.O. number to cover the COST of the repair,
2. Model and serial number of product, and
3. Repair instructions and/or specific problems relative to the product.

OMEGA's policy is to make running changes, not model changes, whenever an improvement is possible. This affords our customers the latest in technology and engineering.

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- ☑ Metering & Control Instrumentation
- ☑ Refractometers
- ☑ Pumps & Tubing
- ☑ Air, Soil & Water Monitors
- ☑ Industrial Water & Wastewater Treatment
- ☑ pH, Conductivity & Dissolved Oxygen Instruments

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