

# high precision thermometer

## PHP 601



### Main applications include:

- Temperature measurements using RTDs and/or thermocouples
- Absolute or differential measurements over two channels.
- Differential thermal analysis.
- Checking the temperature stability of furnaces or baths.
- Monitoring (alarm) and temperature recording.

- Resolution 0.001°C
- Accuracy 0.005°C
- Self-contained
- RTDs and thermocouples
- Dual inputs
- RS 232 or IEEE 488 interfaces

### functions

The PHP 601 is a high accuracy, dual input thermometer suitable for use with RTDs (e.g.: Pt 100) and thermocouples. The PHP 601 is capable of storing sensor characteristics and coefficients and can scan up to 12 sensors using the model SHP 101 Scanner.

Its main applications include the calibration of temperature sensors. By using our CAL'EXPERT software to drive the PHP 601 thermometer, scanner and a thermal device such as temperature bath, dry block calibrator or oven, a complete calibration procedure can be performed, reports generated and certificates printed for individual sensors.

#### Resistance measurement (1)

All ranges	Accuracy (2)		
	Stability 24 hours	90 days	1 year
25 to 3 200	0.0005%Cal	0.0015% + 0.0005%	0.0030% + 0.0005%

(1) 4 wire configuration, all currents. For the 3 wire configuration, add 1m .

(2) Accuracy is expressed in ± (% reading + % range) at 23°C ± 1°C.

#### DC voltage measurement

Range	Measurement range	Resolution	Accuracy (1)		
			Stability 24 hours	90 days	1 year
100 mV	- 50 to + 117.5 mV	0.2 µV	0.001% + 0.4 µV	0.004% + 0.6 µV	0.008% + 0.8 µV

(1) Accuracy is expressed in ± (% reading + nV) at 23°C ± 1°C.

Temperature coefficient 10% of accuracy/°C over 90 days.

## Temperature measurement .....

Direct reading in mV or °C, °F or K.

- From 1 to 4 calibration points may be entered for all types of sensors.
- Digital filter.
- Programming using either the RS 232 link (standard) or the IEEE 488 link (option).

- Direct control of the SHP 101 scanner.
- Storage of up to 5000 measurements together with date.
- Measurements triggered by internal or external event.
- 2 alarm outputs relays.

## RTD measurement .....

Measurement of all types of sensors as described below:

- Standardized sensors according to IEC Publication 751/1995,
  - = 3851, Pt 100, 200, 500 and 1000.
  - JISC 1604/1989, a = 3912, JPt 100.
  - EIT 90, = 3926, Pt 100.
  - DIN 43760, = 618, Ni 100.
  - MIL-T 24388C, = 672, Ni 120.
  - MINCO 16/9, = 427, Cu 10.

- Callendar and Van Dusen equations defined by coefficients (Ro, A, B, C) or by 4 couples of points (resistance/temperature).

- EIT 90 equations defined by R at 0.01°C and the deviation function coefficients or by resistance values at fixed points.

- Polynomial equations defined per point (25 points max.).

For sensors not complying to the International Temperature Scale (ITS 90) correction of the deviation ITS 90-IPTS 68, 1993 is applied.

- Choice of 6 measuring currents (0.125 up to 4 mA), 3 current waves (direct, pulse and alternate) together with  $1/\sqrt{2}$  function to define self-heating measurement.
- 3 or 4 wire configuration.

Standard sensors	Measurement range	Range	Resolution	Stability 24 hours	Accuracy 90 days (1)	Accuracy 1 year (1)
Pt 100 at 0°C = 3851	- 210 to + 45°C - 210 to + 365°C - 210 to + 1 100°C	100	0.001°C	0.002°C	0.002% + 0.005°C	0.004% + 0.009°C
		200	0.002°C	0.004°C	0.002% + 0.006°C	0.004% + 0.010°C
		400	0.005°C	0.010°C	0.002% + 0.010°C	0.004% + 0.015°C
JPt 100 at 0°C = 3916	- 200 to + 44°C - 200 to + 358°C - 200 to + 510°C	100	0.001°C	0.002°C	0.002% + 0.005°C	0.004% + 0.009°C
		200	0.002°C	0.004°C	0.002% + 0.006°C	0.004% + 0.010°C
		400	0.005°C	0.010°C	0.002% + 0.010°C	0.004% + 0.015°C
Pt 100 at 0°C = 3926	- 210 to + 45°C - 210 to + 365°C - 210 to + 1 100°C	100	0.001°C	0.002°C	0.002% + 0.005°C	0.004% + 0.009°C
		200	0.002°C	0.004°C	0.002% + 0.006°C	0.004% + 0.010°C
		400	0.005°C	0.010°C	0.002% + 0.010°C	0.004% + 0.015°C
Pt 200 at 0°C = 3851	- 210 to + 45°C - 210 to + 365°C - 210 to + 1 100°C	200	0.001°C	0.002°C	0.002% + 0.005°C	0.004% + 0.009°C
		400	0.002°C	0.004°C	0.002% + 0.006°C	0.004% + 0.010°C
		800	0.005°C	0.010°C	0.002% + 0.010°C	0.004% + 0.015°C
Pt 500 at 0°C = 3851	- 210 to + 233°C - 210 to + 800°C - 210 to + 1 200°C	800	0.001°C	0.002°C	0.002% + 0.005°C	0.004% + 0.008°C
		1 600	0.002°C	0.004°C	0.002% + 0.006°C	0.004% + 0.010°C
		3 200	0.005°C	0.010°C	0.002% + 0.010°C	0.004% + 0.015°C
Pt 1000 at 0°C = 3851	- 210 to + 230°C - 210 to + 800°C	1 600	0.001°C	0.002°C	0.002% + 0.005°C	0.004% + 0.008°C
		3 200	0.002°C	0.004°C	0.002% + 0.006°C	0.004% + 0.010°C
Ni 100 at 0°C = 618	- 60 to + 30°C - 60 to + 180°C	100	0.001°C	0.002°C	0.004%	0.007°C
		200	0.001°C	0.002°C	0.005%	0.009°C
Ni 120 at 0°C = 672	- 40 to + 136°C - 40 to + 205°C	200	0.001°C	0.002°C	0.005%	0.008°C
		400	0.002°C	0.004°C	0.006%	0.010°C
Cu 10 at 25°C = 427	- 200 to + 260°C	25	0.002°C	0.004°C	0.002% + 0.007°C	0.004% + 0.010°C

(1) Accuracy is given in ± (% reading + n°C) or ± (n°C) at 23°C ± 1°C.

Temperature measurement with thermocouples .....

Types of sensors:

- Standardized according to IEC

Publication 580-1/1995 (thermocouples K, T, J, E, R, S, B and N).

Thermocouples U and L according to DIN 43710.

Thermocouple C according to Hoskins curve.

Thermocouple Platinel (Pl) according to Engelhard curve.

- Special thermocouple Molybdenum/Nickel Molybdenum (Mo).

- Polynomial equations defined per point (25 points max.).

True differential measurements.

Programmable internal or external reference junction compensation.

For sensors not complying to the International Temperature Scale (ITS 90) correction of the deviation ITS 90-IPTS 68, 1993 is applied.

Thermocouple	Measurement range	Resolution	Stability 24 hours	Accuracy (1)	
				90 days	1 year
K	- 250 to - 220°C	0,05°C	0,2°C	0,25°C	0,5°C
	- 220 to - 100°C	0,02°C	0,03°C	0,06°C	0,1°C
	- 100 to + 1 350°C	0,01°C	0,0015 % + 0,01°C	0,005 % + 0,015°C	0,01 % + 0,02°C
T	- 250 to - 220°C	0,05°C	0,1°C	0,15°C	0,3°C
	- 220 to - 90°C	0,02°C	0,03°C	0,06°C	0,1°C
	- 90 to + 400°C	0,01°C	0,015°C	0,025°C	0,04°C
J	- 210 to - 100°C	0,02°C	0,03°C	0,05°C	0,1°C
	- 100 to + 1 200°C	0,01°C	0,001 % + 0,01°C	0,004 % + 0,015°C	0,04°C
E	- 250 to - 180°C	0,05°C	0,1°C	0,15°C	0,3°C
	- 180 to - 100°C	0,02°C	0,02°C	0,04°C	0,06°C
	- 100 to + 980°C	0,01°C	0,001 % + 0,01°C	0,004 % + 0,01°C	0,008 % + 0,02°C
N	- 250 to - 175°C	0,05°C	0,2°C	0,25°C	0,5°C
	- 175 to - 100°C	0,02°C	0,04°C	0,06°C	0,1°C
	- 100 to + 1 300°C	0,01°C	0,02°C	0,004 % + 0,025°C	0,008 % + 0,03°C
S	- 50 to + 400°C	0,05°C	0,1°C	0,15°C	0,2°C
	+ 400 to + 1 768°C	0,02°C	0,05°C	0,004 % + 0,06°C	0,01 % + 0,1°C
R	- 50 to + 400°C	0,05°C	0,1°C	0,15°C	0,2°C
	+ 400 to + 1 768°C	0,02°C	0,05°C	0,004 % + 0,06°C	0,008 % + 0,08°C
B	+ 100 to + 400°C	0,2°C	0,4°C	0,6°C	1,0°C
	+ 400 to + 1 820°C	0,05°C	0,1°C	0,15°C	0,2°C
U	- 200 to - 70°C	0,02°C	0,03°C	0,05°C	0,08°C
	- 70 to + 600°C	0,01°C	0,01°C	0,004 % + 0,015°C	0,008 % + 0,02°C
L	- 200 to - 70°C	0,02°C	0,02°C	0,04°C	0,08°C
	- 70 to + 900°C	0,01°C	0,01°C	0,004 % + 0,015°C	0,008 % + 0,02°C
C	- 20 to + 2 310°C	0,02°C	0,02 % + 0,03°C	0,008 % + 0,05°C	0,015 % + 0,07°C
Pl	- 100 to + 1 400°C	0,02°C	0,0015 % + 0,01°C	0,005 % + 0,02°C	0,01 % + 0,03°C
Mo	0 to + 1 375°C	0,05°C	0,05°C	0,05°C	0,10°C

(1) Accuracy is given for a reference junction at 0°C in ± (% reading + number of units) or in ± (number of units) at 23°C ± 1°C.

The uncertainty due to the internal reference junction is ± 0.15°C.

Temperature coefficient of the internal reference junction: ± 0.015°C/°C.

## general specifications

Three languages available for the menus and on-line help (English, French and German).

LCD graphic display with backlighting.

Connection using 4-mm plugs and LEMO sockets.

Mains supply and optional battery pack.

Presentation.....

ABS bench-type unit with tilt bail/handle.

Dimensions: 225 x 88 x 310 mm.

Weight: 2 to 3 kg depending on options.

## scanner SHP 101

(See separate leaflet).

This is a bench-type scanner dedicated to low level signals and intended to switch 12 (2 wire) inputs (thermocouples) or 6 (4 wire) inputs (RTDs) with the possibility

to mix both types of inputs.

Switching the channels may be performed either automatically by the PHP, or manually through the keypad on the front panel.

Outstanding repeatability between channels: ± 0.02°C.

Easy sensor connection by use of screw terminal blocks.

## calibration software LCL30

(See separate leaflet)

This software enables the user to define automatic calibration procedures. It provides control of generated or simulated temperatures and will measure the difference between the standard thermometer and the sensor being calibrated

This software allows:

- to program the calibration procedure.
- to select a standard sensor from a list which will be used as reference; this list is updated by the user.
- to control the thermal reference source.
- to collect the measurements.
- to print and save calibration reports for all the sensors.

It also enables the user to document and recall the history of calibrated sensors.

## accessories

- Standard sensor AN 5847 and "working" standard sensor AN 5848 are offered with various connections: plug, DIN socket or LEMO socket.
- LEMO-DIN adapter for connection to the probe equipped with DIN socket (PEM 40316).
- T 1200 sensor, standard thermocouple connectable by using plugs.
- Cable, 2-meter length (ACL 4603) with LEMO socket at one end and RTD free sensor connection at the other end.

## ordering instructions

High accuracy thermometer	PHP 601-1
High accuracy thermometer with battery pack and charger	PHP 601-2
High accuracy thermometer with IEEE 488.2 interface	PHP 601-3
High accuracy thermometer with battery pack, charger and IEEE 488.2 interface	PHP 601-4

Accessories .....	
Carrying case	AN 6901
Right-angle brackets for panel mounting	AN 5883
Rack mounting kit	AN 5884
RS 232 cable, 9-pin male/9-pin female	AN 5875
IEEE 488 cable, 2-meter	AN 5836
LEMO socket to be wired	ER 48379
Cable, 2-meter, LEMO/free	ACL 4603
Pt 100 standard sensor with plugs	AN 5847B
LEMO Pt 100 standard sensor	AN 5847C
Pt 100 reference sensor with plugs	AN 5848-20000A
LEMO Pt 100 reference sensor	AN 5848-30000A
LEMO Pt 100 reference sensor	AN 5848-30001A
Standard thermocouple	T 1200
LEMO-DIN adapter	PEM 40316
Automatic calibration software	LCL 30



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