

**Precision Pressure Transducer
Premium Version, Model CPT9000**



Precision Pressure Transducer, Model CPT9000



EN Operating instructions model CPT9000

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Prior to starting any work, read the operating instructions!

Keep for later use!

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1. General Information

- The CPT9000 Precision Pressure Transducer described in the operating instructions has been designed and manufactured using state-of-the-art technology. All components are subject to stringent quality and environmental criteria during production. Our management systems are certified to ISO 9001 and ISO 14001.
- These operating instructions contain important information on handling the instrument. Working safely requires that all safety instructions and work instructions are observed.
- Observe the relevant local accident prevention regulations and general safety regulations for the instrument's operating range.
- The operating instructions are part of the instrument and must be kept in the immediate vicinity of the instrument and readily accessible to skilled personnel at any time. Pass the operating instructions onto the next operator or owner of the instrument.
- Skilled personnel must have carefully read and understood the operating instructions prior to beginning any work.
- The general terms and conditions contained in the sales documentation shall apply.
- Subject to technical modifications.
- Factory calibrations are carried out in accordance with international standards.

■ Further information:

Mensor Corporation

- Address: 201 Barnes Dr., San Marcos, TX 68666
- Internet address: www.mensor.com
- Relevant data sheet: CT 25.12
- Application consultant: Tel.: (+1) 512-396-4200
(+1) 800-984-4200 (USA only)
Fax: (+1) 512-396-1820
E-Mail: sales@mensor.com
techservices@mensor.com

WIKA Alexander Wiegand SE & Co. KG

- Address: Alexander Wiegand-Straße
63911 Klingenberg, Germany
- Internet address: www.wika.de / www.wika.com
- Relevant data sheet: CT 25.12
- Application consultant: Tel.: (+49) 9372/132-5015
Fax: (+49) 9372/132-8767
E-Mail: CTsales@wika.com

1.1 Warranty

All products manufactured by Mensor are warranted to be free of defects in workmanship and materials for a period of two year from the date of shipment. No other express warranty is given, and no affirmation of Seller, by words or actions, shall constitute a warranty. SELLER DISCLAIMS ANY IMPLIED WARRANTIES OF MERCHANTABILITY OR FITNESS FOR ANY PARTICULAR PURPOSES WHATSOEVER. If any defect in workmanship or material should develop under conditions of normal use and service within the warranty period, repairs will be made at no charge to the original purchaser, upon delivery of the product(s) to the factory, shipping charges prepaid. If inspection by Mensor or its authorized representative reveals that the product was damaged

by accident, alteration, misuse, abuse, faulty installation or other causes beyond the control of Mensor, this warranty does not apply. The judgment of Mensor will be final as to all matters concerning condition of the product, the cause and nature of a defect, and the necessity or manner of repair. Service, repairs or disassembly of the product in any manner, performed without specific factory permission, voids this warranty.

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1.2 Radio Frequency Emission Notices



USE SHIELDED CABLES TO CONNECT EXTERNAL DEVICES TO THIS INSTRUMENT TO MINIMIZE RF RADIATION

1.2.1 FCC Emission Notice

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a residential environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications.

1.2.2 CE Emission Notice

This equipment is of the emission class B, intended for operation in industrial, residential or commercial environments.

1.3 Software License Agreement

This product contains intellectual property, i.e. software programs, that are licensed for use by the end user/customer (hereinafter “end user”).

This is not a sale of such intellectual property.

The end user shall not copy, disassemble or reverse compile the software program.



The software programs are provided to the end user “as is” without warranty of any kind, either express or implied, including, but not limited to, warranties of merchantability and fitness for a particular purpose. The entire risk of the quality and performance of the software program is with the end user.

Mensor and its suppliers shall not be held to any liability for any damages suffered or incurred by the end user (including, but not limited to, general, special, consequential or incidental damages including damages for loss of business profits, business interruption, loss of business information and the like), arising from or in connection with the delivery, use or performance of the software program.

1.4 Mensor Service Plus

1.4.1 After the Warranty

Mensor’s concern with the performance of this instrument is not limited to the warranty period. We provide complete repair, calibration and certification services after the warranty for a nominal fee.

1.4.2 Calibration Services

In addition to servicing our own products Mensor can perform a complete pressure calibration service, up to 30,000 psi, for all of your pressure instruments. This service includes an accredited calibration.

1.4.3 Certifications and Accreditations

Mensor is registered to ISO 9001:2008. The calibration program at Mensor is accredited by A2LA, as complying with both the ISO/IEC 17025:2005 and the ANSI/NCSL Z540-1-1994 standards.

2. Short Overview

The CPT9000 pressure transducer is a high accuracy digital output pressure transducer and is available in gauge, absolute and bidirectional pressure ranges with full scale pressure ranges as low as 10" H₂O to as high as 15,015 psia .



Figure 2.1

2.1 Features

Here is a short list of significant features designed into the CPT9000:

- Accuracy to 0.008% IS-33
- Wide voltage power input range
- IP-67 rating for harsh environments
- All 316L SS wetted path on ranges >5 psi
- Command emulation for digital communications
- User selectable units
- Compact size

2.2 Scope of Delivery

- Precision Pressure Transducer model CPT9000
- Power cord with 1.5 m (5 ft) length
- Operating instruction
- Factory calibration certificate
- Selected fitting

3. Safety

3.1 Explanation of Symbols

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DANGER!

... indicates a directly dangerous situation resulting in serious injury or death, if not avoided.



WARNING!

... indicates a potentially dangerous situation that can result in serious injury or death, if not avoided.



CAUTION!

... indicates a potentially dangerous situation that can result in light injuries or damage to property or the environment, if not avoided.



DANGER!

... identifies hazards caused by electrical power. Should the safety instructions not be observed, there is a risk of serious or fatal injury.



WARNING!

... indicates a potentially dangerous situation that can result in burns, caused by hot surfaces or liquids, if not avoided.



Information

... points out useful tips, recommendations and information for efficient and trouble-free operation.

3.2 Intended Use

The CPT9000 pressure transducer is designed to measure pressure with extreme accuracy as stand-alone devices or as incorporated in OEM type applications. It is characterized over a wide temperature range and is designed to be used in environments that are much more harsh than tolerable by previous generations of Mensor pressure transducers.

3.3 Improper Use



WARNING!

Injuries through improper use

Improper use of the instrument can lead to hazardous situations and injuries.

- ▶ Do not use the transducer within hazardous areas
- ▶ Do not use the transducer with oxygen as a medium
- ▶ Do not attempt to disassemble the transducer

Any use beyond or different than the intended use is considered improper use.

3.4 Responsibility of the Operator

The instrument is used in the industrial sector. The operator is therefore responsible for legal obligations regarding safety at work.

The safety instructions within these operating instructions, as well as the safety, accident prevention and environmental protection regulations for the application area must be maintained.

The operator is obliged to maintain the product label in a legible condition.

The operator must ensure that:

- Mechanical vibration, mechanical shock are minimized
- The transducer is installed in areas without soot, vapor, dust and corrosive gases
- The transducer is not used in hazardous environments, flammable atmospheres
- The operating personnel are regularly instructed in all topics regarding work safety, first aid and environmental protection and know the operating instructions and in particular, the safety instructions contained therein
- The transducer is suitable for the particular application in accordance with its intended use
- Personal protective equipment is available

3.5 Personnel Qualification



WARNING!

Risk of injury should qualification be insufficient

Improper handling can result in considerable injury and damage to equipment.

- ▶ The activities described in these operating instructions may only be carried out by skilled personnel who have the qualifications described below.

Skilled personnel

Skilled personnel, authorized by the operator, are understood to be personnel who, based on their technical training, knowledge of measurement and control technology and on their experience and knowledge of country-specific regulations, current standards and directives, are capable of carrying out the work described and independently recognizing potential hazards.

Operating personnel

The personnel trained by the operator are understood to be personnel who, based on their education, knowledge and experience, are capable of carrying out the work described and independently recognizing potential hazards.

Special knowledge for working with instruments for hazardous areas:

The skilled (electrical) personnel must have knowledge of ignition protection types, regulations and provisions for equipment in hazardous areas.

Special operating conditions require further appropriate knowledge, e.g. of aggressive media.

3.6 Personal Protective Equipment

The personal protective equipment is designed to protect the skilled personnel from hazards that could impair their safety or health during work. When carrying out the various tasks on and with the instrument, the skilled personnel must wear personal protective equipment.

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Follow the instructions displayed in the work area regarding personal protective equipment!

The requisite personal protective equipment must be provided by the operating company.



Wear safety goggles!

Protect eyes from flying particles and liquid splashes.



Wear a protective helmet!

Protects the head from falling objects.

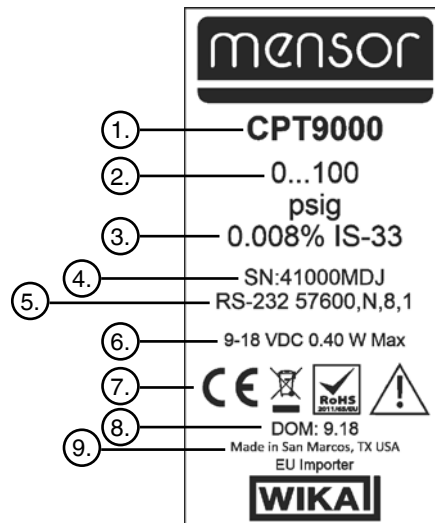


Wear safety shoes!

Protect feet from falling objects or objects lying around, as well as against toxic or hazardous liquids and aggressive media.

3.7 Labeling, Safety Marks

3.7.1 Product Label



① Model	⑤ Communications
② Range	⑥ Power Requirements
③ Accuracy	⑦ Symbols
④ Serial Number	⑧ Date of Manufacture
	⑨ Origin

3.7.2 Symbols



Before mounting and commissioning the instrument, ensure you read the operating instructions!



CE, Communauté Européenne
Instruments bearing this mark comply with the relevant European directives.



This marking on the instruments indicates that they must not be disposed of in domestic waste. The disposal is carried out by return to the manufacturer or by the corresponding municipal authorities (see EU directive 2012/19/EU).

3.8 Warnings and Cautions



WARNING!
HIGH PRESSURE! High pressure gases are potentially hazardous. Energy stored in these gases and liquids can be released suddenly and with extreme force. High pressure systems should be assembled and operated only by personnel who have been trained in proper safety practices.



WARNING!
NOT EXPLOSION PROOF! Installation of this instrument in an area requiring devices rated as intrinsically safe is not recommended.



WARNING!
POSSIBLE INJURY! The tubing, valves, and other apparatus attached to the gauge must be adequate for the maximum pressure which will be applied, otherwise physical injury to the operator or bystanders is possible.



CAUTION
USE THE PROPER PRESSURE MEDIUM! Only use media compatible with materials of construction as specified . This transducer is not designed for oxygen use.



CAUTION
As with most sensitive electronic equipment, switch the power switch off before connecting or disconnecting to a power source to prevent data loss. Do not position the equipment so that it is difficult to disconnect the AC power cord.



WARNING!
Detachable main power supply cord with inadequate ratings should not be used. See Section 9.2 Specifications for power ratings.

Additional Warning and Caution notices are found throughout this manual.

4. Transport, Packaging and Storage

4.1 Transport

Check the CPT9000 for any damage that may have been caused by transport. Obvious damage must be reported immediately.



CAUTION!

Damage through improper transport

- While unlikely, with improper transport, damage can occur. When unloading packed goods upon delivery as well as during internal transport, proceed carefully and observe the symbols on the packaging.
- If the instrument is transported from a cold into a warm environment, the formation of condensation may result in instrument malfunction. Before putting it back into operation, wait for the instrument temperature and the room temperature to equalize.

4.2 Packaging and storage

Permissible conditions at the place of storage

- Storage Temperature: -40 ... 85°C
- Humidity: 5 ... 95% relative humidity (no condensation)

Avoid exposure to the following factors:

- Direct sunlight or proximity to hot objects
- Mechanical vibration, excessive mechanical shock
- Soot, vapor, dust and corrosive gases
- Hazardous environments, flammable atmospheres

5. Installation

Personnel: Skilled electrical personnel



WARNING!
READ THESE INSTRUCTIONS BEFORE INSTALLATION!

Only use original parts (see Chapter 10 “Accessories”).



WARNING!
Physical injuries and damage to property and the environment caused by hazardous media
Upon contact with hazardous media (e.g. oxygen, acetylene, flammable or toxic substances), harmful media (e.g. corrosive, toxic, carcinogenic, radioactive), and also with refrigeration plants and compressors, there is a danger of physical injuries and damage to property and the environment.

Should a failure occur, aggressive media with extremely high temperature and under high pressure or vacuum may be present at the instrument.

- ▶ For these media, in addition to all standard regulations, the appropriate existing codes or regulations must also be followed.
- ▶ Wear the requisite protective equipment (see Chapter 3.6 “Personal Protective Equipment”).



CAUTION
Damage to the Instrument

When working on open electrical circuits (printed circuit boards) there is a risk of damaging sensitive electronic components through electrostatic discharge.

- ▶ The correct use of grounded working surfaces and personal armbands is required.

5.1 Mounting

The transducer may be mounted via its process connection or with any ring clamps along its body. Having the sensor oriented in a position other than vertical (with the port down) might cause a slight zero shift than can be removed by re-zeroing the transducer.

5.1.1 Pressure Connections

The CPT9000 has a JIC4 type female connection. When installing a mating connector, do not torque the connector with more than 13 ft-lbs or galling might occur. The transducer is supplied with a crush washer that can be used to further eliminate leaks.

5.1.2 Safety Relief Valves

Mensor recommends that an appropriately sized relief valve be placed in line with the pressure port of the transducer.

5.1.3 Pressure Media

A media comparable with the wetted parts of the transducer must be used.



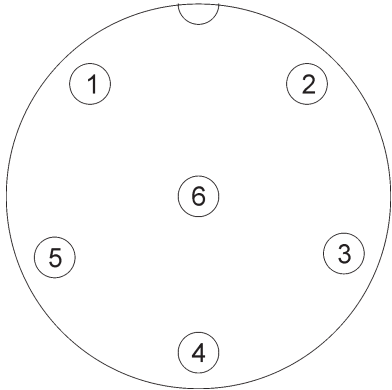
CAUTION
USE THE PROPER PRESSURE MEDIUM! Only use media compatible with materials of construction as specified .
This transducer is not designed for oxygen use.

Installation

5.1.4 Electrical Connections

Note: Power supply should be 9 to 18 VDC (12 VDC nominal).

The pinouts on the six pin connector and RS-232 and RS-485 Cable connections are:



External Connector Pinouts

Pin	Function	Pigtail Color
1	+9-18V	Brown
2	RS-485 TX-	White
3	RS-485 RX-	Blue
4	RS-485 RX+ or RS-232 RX	Black
5	Ground	Gray
6	RS-485 TX+ or RS-232 TX	Pink

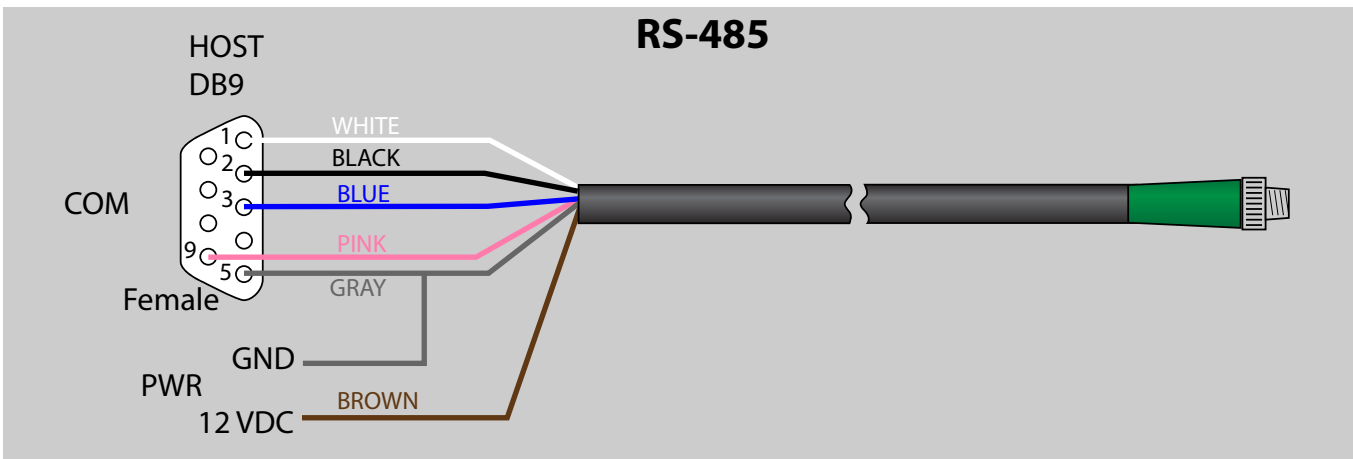
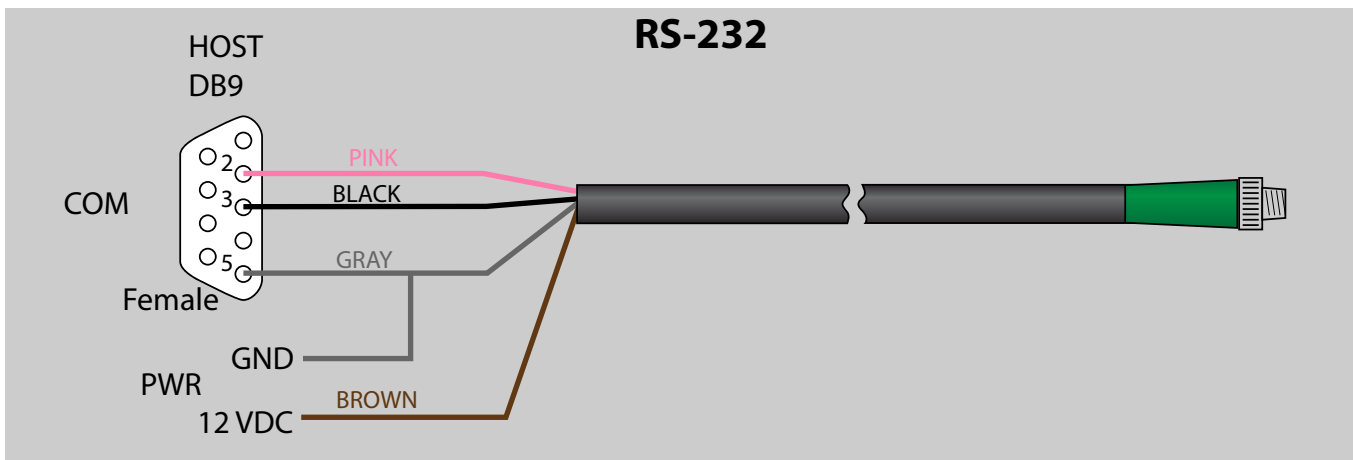


Figure 5.1.4 COM Connection Pin-out and RS-232 / RS-485 cable connections

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6. Operation

6.1 General Operation

The CPT9000 transducer can be ordered with either an RS-232 or RS-485 full duplex output. The communications protocol is defaulted to 57600,N,8,1. The baud rate can be changed via remote commands. Connector pinouts and RS-232 and RS 485 cable connections are shown in Figure 5.1.2. The transducer has multiple command sets with which it can communicate with the host. These are set through the CMD_SET command.

Due to the nature of the various RS-485 converters available there may be communication issues. We have determined that our devices work with the ACCES I/O PRODUCTS devices. At this time we are not in a position to comment on any other make of RS-485 converters and their suitability for use with our products.



6.1.1 Caution

Command and Query Format

Commands must be sent in ASCII format and terminated with a carriage return (<CR>) optionally followed by a linefeed (<LF>). Commands are not case sensitive. Query strings are terminated with a “?” prior to the termination character(s). If the transducer is put in a burst output mode, the output of the transducer is in a binary output mode. The host communications program must synchronize with the output of the transducer. The transducer’s output to a pressure value query is programmable depending on what the user wants in the output string.

6.1.1.1 RS-485 Command and Query Format

On RS-485 versions of the CPT9000, the commands must be preceded by a “#”, an address or a “*”. In RS-485 the ADDRESS command sets the address in ranges from “0” to “9” and “A” to “Z”. The global address character is the “*”. When data is required for a command, a space (only) should delimit command and data fields.

6.1.1.2 RS-232 Command and Query Format

On RS-232 versions of the CPT9000, the “#” or address character is not necessary to precede the command for the Sensor command set. But, the Mensor Legacy command set still requires a preceding “#” and address character. With the default sensor command set in RS-232, the start character and address character are not required.

6.1.1.3 Command Error Detection and Debugging

The CPT9000 has built in responses to correct and incorrect data. The responses can be used to help debug the software. In the Sensor command set, the device will return “Ready” in response to a valid data command. If the device is in the Mensor Legacy command set, an “R” will be returned in response to valid data. If the data is determined to be invalid, the Sensor command set will return “Invalid Data”. The Mensor Legacy command set will still return an “R” character when invalid data is sent. This is a limitation of the Mensor Legacy command set. The Sensor command set will return “Unknown command” if the command is not found, while the Mensor Legacy command set will ignore it and not respond. This paragraph is summarized below in the following table:

Mensor Legacy Command Set

Case	Return Value
Valid data command	"R"
Invalid data command	"R"
Invalid command	Nothing

Sensor Default Command Set

Case	Return Value
Valid data command	"Ready"
Invalid data command	"Invalid Data"
Invalid command	"Unknown Command"
Query Customer password protected command	"User Password Needed"

Table 6.1.1.3 Command set returns for given cases

Also, it is important to note that when sent data is determined to be valid, the value will be stored in RAM. Only after the SAVE command is sent is the data saved permanently. This applies to all command sets.

6.1.2 CPT9000 Commands and Queries

Commands with complex outputs are explained in tables following the command set.

The following convention is used for the following command set tables:

n – 1 placeholder for digits and decimal point

C – 1 character placeholder for alpha character A-Z

<cr> - carriage return – ASCII 13

<lf> - line feed – ASCII 10

± - 1 place holder for a + or – sign, or blank which implies +

↵<sp> - 1 place holder for a space

X – address placeholder or “*” for universal queries to be sent to all instruments

Y(1,2,3...) – strings as defined in description

<yy,mm,dd> - Last two digits of year, month, day.

All commands, queries, and responses will be terminated with a <cr><lf>.

All commands that are password protected are designated with “(Password Protected)” in the Query column below.

Global Commands			
Query	Command	Data	Description
ADDRESS?	ADDRESS<sp><C> (RS-485 only)	C	Transducer address 0-9, A-Z
*IDN?/ID?	N/A	Manu,Model,SN,SW Version	Manufacturer, Model, SN, SW Version
N/A	SAVE		Saves Data to EEPROM
TYPE?	N/A	C	Pressure type - 1 char
FILTER?	FILTER<sp><n>	n	Filter percentage 1 to 99
WINDOW?	WINDOW<sp><nn>	n	Set 0 ... 99 to correspond to a filter window of 0 ... 0.099%FS
STRING1?	STRING1<sp><CCCCCCCCCCCCCCCC>	CCCCCCCCCCCCCCCC	Storage string 1 - 16 char
STRING2?	STRING2<sp><CCCCCCCCCCCCCCCC>	CCCCCCCCCCCCCCCC	Storage string 1 - 16 char
BAUD?	BAUD<sp><n>	n	Baud Rate - 9600, 19200, 57600, 115200
ERR?	N/A	n	Returns top error code on 11 deep LIFO stack
N/A	CERR		Clears Error stack
N/A	DEFAULT		Defaults parameters per Table 6.1.2.2
CMD_SET?	CMD_SET<sp><n>		Selects command set per Table 6.1.2.3 (This command is included in all command sets.)
ROOT?	N/A	+n.nnnnnnE+nn	Square root pressure output

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N/A	PWD_CHANGE<sp><n,n>	nnnn,nnnn	Change password <n,n> = <old,new>
N/A	PWD<sp><n>	nnnn	Send password
Pressure Related Commands			
PRESS?	N/A		Returns configurable output from active channel in current units see Table 6.1.2.10 & Output Control Commands section.
RANGE_MIN?	N/A	+n.nnnnnnnE+nn	Minimum range in current units.
RANGE_MAX?	N/A	+n.nnnnnnnE+nn	Maximum range in current units
PRESS_LIM_MIN?	PRESS_LIM_MIN<sp><n>	+n.nnnnnnnE+nn	Low alarm limit in current units. See 6.1.2.4
PRESS_LIM_MAX?	PRESS_LIM_MAX<sp><n>	+n.nnnnnnnE+nn	High alarm limit in current units. See 6.1.2.4
UNIT_INDEX?	UNIT_INDEX<sp><n>	n	Mensor unit index: 1-39 or 99 for CUST_UNIT. See Table 6.1.2.5
UNIT?	N/A	ccccccccc	Unit text 10 char - mmHg, psi, kPa...
CUST_UNIT?	CUST_UNIT<sp><n>	+n.nnnnnnnE+nn	Sets custom unit multiplication (xx/psi). See Section 6.1.2.6
Calibration Related Commands			
CAL_DATE?	CAL_DATE<sp><yy,mm,dd> (Password Protected)	nn,nn,nn	Calibration date
SPAN?	CAL_SPAN<sp><n> (Password Protected)	+n.nnnnnnnE+nn	Customer span multiplier - 0.99 to 1.01. See Section 6.1.2.7
ZERO?	CAL_ZERO<sp><n> (Password Protected)	+n.nnnnnnnE+nn	Customer zero adder. See Section 6.1.2.7
INTERVAL?	CAL_INTERVAL<sp><n> (Password Protected)	n	Calibraion interval in days
TARE?	TARE<sp><n>	n	Turns tare on/off - 1/0
TARE_OFFSET?	N/A	+n.nnnnnnnE+nn	Gets the offset if Tare is set to 1
Linearity Related Commands			
LIN_COEFF?	CAL_LIN_COEFF<sp><n,n> (Password Protected)	+n.nnnnnnnE+nn	Customer linearity coefficients
LIN_SEGS?	CAL_LIN_SEGS<sp><n> (Password Protected)	n	Linearity correction segments 0 to 10
Temperature Related Commands			
TEMP?	N/A	+nnn.n	Temperature in deg. C.

TEMP_LIM_MIN?	TEMP_LIM_MIN<sp><n>	+n.nnnnnnnE+nn	Temperature low alarm limit. See Section 6.1.2.8
TEMP_LIM_MAX?	TEMP_LIM_MAX<sp><n>	+n.nnnnnnnE+nn	Temperature high alarm limit. See Section 6.1.2.8
Altitude/Rate Related Commands			
ALT?	N/A	+n.nnnnnnnE+nn	Altitude in current units
ALT_UNIT?	ALT_UNIT<sp><cc>	c	Altitude unit - ft, m. See Section 6.1.2.9
SEA_LEVEL?	CAL_SEA_LEVEL<sp><n> (Password Protected)	+n.nnnnnnnE+nn	Sea level adjustment in altitude units. See Section 6.1.2.9
RATE_BASE?	RATE_BASE	c	Rate denominator - s,m,h,3h
Uncertainty Related Command			
UNC?	N/A	+n.nnnnnnnE+nn	Measurement uncertainty in current units
Output Control Commands			
OUTPUT_MASK?	OUTPUT_MASK<sp><n>	n	Configures output for PRESS? Query and Continuous Output- see 6.1.2.10
BURST_MASK?	BURST_MASK<sp><n>	n	Configures output for Burst Mode – See Table 6.1.2.11
N/A	BURST <sp><n>	n	0 - burst off 1 - burst on

Table 6.1.2 – Sensor Command Set

Password Protection

In the Sensor Command Set, data that affects calibration is protected by a user settable 4 character password (designated as “Password Protected”). The default password is “0000”. This is changed using the PWD_CHANGE command. It should be changed once the user receives the device. The factory password will override the user’s password in the case that the user loses their password.

Filter & Window

The filter is a percentage of the previous reading averaged with the current reading - as long as the current reading is within the window of the previous reading. The window is set as a %FS of the transducer’s range. If the current reading is outside of the window from the previous reading, the filter is unused and the current reading is displayed without manipulation. This scheme allows the user to tune the transducer’s response as they like. It also allows the transducer to respond to rapid pressure changes without having to change the filter. The default values are 0.008% FS for the window and a filter of 90%.

Character Strings

STRING1 and STRING2 are 16 character strings that are left blank from the factory and can be set by the user as desired.

6.1.2.1 Error Query

If errors occur, they are stored in volatile memory in an 11 deep LIFO stack. If the user sends ERR?, the last occurring error will be transmitted and pop off the queue. Sending CERR will erase the error queue. The following table lists the trappable errors:

Code	Error	Cause
0	NO ERROR	No error has occurred since last power up.
1	SENSOR IS OVER PRESSURE	The calculated pressure was greater than the value stored in PRESS_LIM_MAX
2	SENSOR IS UNDER PRESSURE	The calculated pressure was less than the value stored in PRESS_LIM_MIN
3	SENSOR IS OVER TEMPERATURE	The calculated temperature was greater than the value stored in TEMP_LIM_MAX
4	SENSOR IS UNDER TEMPERATURE	The calculated temperature was less than the value stored in TEMP_LIM_MIN
5	BOOTLOADER NOT DETECTED	The microcontroller bootloader was not detected
6	I2C TIMEOUT	The microcontroller timed out trying to read or write using I2C
7	UART BUFFER OVERFLOW	The UART buffer received more than 512 bytes of data
8	ERROR QUEUE IS FULL	The error queue is now full. This is the last error to fill the stack
9	OUT OF CAL	The transducer exceeded calibration window
10	EEPROM RUNNING OUT OF SPACE	The EEPROM is 100% full
11	ADC STALLED AND RESET	If ACD doesn't respond in 50ms (standard) then ADC resets

Table 6.1.2.1 – Possible Errors and Causes

6.1.2.2 Default Command

DEFAULT - This will default the following parameters to the shown settings:

Parameter	Setting
Filter	90
Window	8
Baud	57600
Error Queue	Erased
CMD_SET	0
PRESS_LIM_MIN	Minimum Range. -5% of FS or zero is zero based
PRESS_LIM_MAX	Maximum Range +5% of FS
CUST_UNIT	1
OUTPUT_MASK	0

Table 6.1.2.2 - Default Settings

6.1.2.3 Setting the Command Set

CMD_SET - This will set the transducer to communicate using different command sets:

Command Set	Description
0	Sensor Default Command Set
1	Mensor Legacy

Table 6.1.2.3 – Command Set List

6.1.2.4 Limits for Pressure Alarms Commands

PRESS_LIM_MIN & PRESS_LIM_MAX – These commands set the limits for pressure alarms. If the pressure exceeds the PRESS_LIM_MAX, an error will be generated and placed in the error queue. Similarly, if the pressure drops below the PRESS_LIM_MIN, an error will be generated and placed in the error queue.

6.1.2.5 Setting Pressure Units

UNIT_INDEX - This command sets the output units per the following table:

Unit Index	Units	Unit Index	Units
1	psi	21	Torr
2	inHg 0C	22	kPa
3	inHg 60F	23	Pa
4	inH2O 4C	24	dy/cm2
5	inH2O 20C	25	g/cm2
6	inH2O 60F	26	kg/cm2
7	ftH2O 4C	27	MSW 0C
8	ftH2O 20C	28	osi
9	ftH2O 60F	29	psf
10	mTorr	30	tsf
11	inSW 0C	31	Not Used
12	ftSW 0C	32	uHg 0C
13	atm	33	tsi
14	bar	34	mHg 0C
15	mbar	35	hPa
16	mmH2O 4C	36	Mpa
17	cmH2O 4C	37	mmH2O 20C
18	MH2O 4C	38	cmH2O 20C
19	mmHg 0C	39	mH2O 20C
20	cmHg 0C	99	CUST_UNIT

Table 6.1.2.5 - Available Unit Codes and Units

6.1.2.6 Customer Units

The CUST_UNIT multiplier in conjunction with UNIT_INDEX 99 allows the user to set their own units. The CUST_UNIT is a multiplier times psi to achieve the customer's unit value.

6.1.2.7 Calibration Adjustments

SPAN & ZERO - These are calibration multipliers and offset respectively. The zero is an offset applied to all output pressure values. The span is a multiplier times all pressure output values.

6.1.2.8 Temperature Limits and alarms

TEMP_LIM_MIN & TEMP_LIM_MAX – These set the temperature limits that trip alarms just like the PRESS_LIM_MIN and MAX.

6.1.2.9 Sea level and Altitude Units Settings

SEA_LEVEL & ALT_UNIT – These commands set the altitude units in meters or feet and allow the user to set a sea level adjustment in altitude units. This is only applicable for absolute pressure transducers with a maximum range of <= 30 psia.

6.1.2.10 Output String Setting

PRESS? & OUTPUT_MASK - PRESS? is a programmable output query that returns an ASCII string based on the selections set by the OUTPUT_MASK variable. The selected parameters will populate the output string with commas separating the variables in the order in which they appear in the following table:

Parameter	Description	Weight	Format	Max Length in characters (plus 1 comma between fields)
Pressure	Pressure in current units	Fixed	+n.nnnnnnnE+nn	14
Units	Unit Description	1	CCCCCCCCC	10
Rate	Pressure rate in current units/time base	2	+n.nnnnnnnE+nn	14
Uncertainty	Measurement uncertainty in current units	4	+n.nnnnnnnE+nn	14
Temperature	Sensor temperature in current temp units	8	+nnn.n	6
Stable	0/1 – unstable/stable	16	n	1
Error	0/1 – no errors, error(s) in stack	32	n	1
Checksum	Checksum of output string	64	n	2
Address ¹⁾	Address added to all outputs	128	n	2

Table 6.1.2.10 - Query Mode Mask Description

6.1.2.11 Burst Mode Output Setting

BURST_MASK – This sets the mask of the output parameters in burst output mode.

The transducer has the ability to continually output a limited set of binary data based on the selections set by the BURST_MASK variable. The selected parameters will populate the output string with no delimiters in the order in which they appear in the following table:

Parameter	Description	Weight	Format	Max Length
Pressure	Pressure in current units - IEEE754	Fixed	IEEE 754	32 bits
Rate	Pressure rate in current units/time base – IEEE754	1	IEEE 754	32 bits
Uncertainty	Measurement uncertainty in current units – IEEE754	2	IEEE 754	32 bits
Temperature	Sensor temperature in current temp units	4	IEEE 754	32 bits
Stable	0/1 – unstable/stable	8	n	8 bits
Error	0/1 – no errors, error(s) in stack	16	n	8 bits
Checksum	Checksum of output string	32	n	8 bits

Table 6.1.2.11 - Burst Mode Mask Description

1) If "Address" is turned on all responses will begin with the address followed by a comma and space.

6.1.3 MENSOR Legacy Command Set

This command and query set replicates the communications with legacy Mensor products – the 61xx, CPT61xx, 6000, CPT6010 and most of the removable sensors from Mensor pressure calibrators (PCS400M, PCS 6000, CPC6000, CPC8000). The command set enabled and stored sets the power-on command set for the transducer. From any command set, the CMD_SET command can select which one is used.

Command Set 1 – Mensor Legacy

P/W	Command	Command String	Return String	Description
None	?	#X?	X<sp>±Y	Basic query to return readings. Pressure in native units are returned
None	A<x>	#XA<sp>Y	R	Sets address of sensor X to Y (0-9,A-Z)
None	CMD_SET<Y>	#XCMD_SET<sp>Y	R	Change CPT9000 into different command sets. 1 is Mensor Legacy. 0 is Sensor command set
None	DC?	#XDC?	X<sp>DC<sp>Y	Returns the date of calibration where Y is mmddyy
Cust	DC<Y>	#XDC<sp>Y	R	Loads the date of calibration where Y is mmddyy
None	DT?	#XDT?	X<sp>DT<sp>NNN	Returns the temperature a/d DAC offset
None	FL?	#XFL?	X<sp>FL<sp>NN	Returns the filter – it is the percentage of old reading added to new reading: 0 to 99
None	FL<X>	#XFL<sp>NN	R	Sets the filter percentage
None	FS?	#XFS?	X<sp>FS<sp>NN	Returns the % FS uncertainty
None	ID?	#XID?	X<sp> ID <sp> AAAAAAAA, <sp>BBBBBBBB, <sp>CCCCCCCC, <sp>VD.DD	Returns transducer id. 'AA...' is an id string, 'BB...' is a model string, 'CC...' is the serial number string, D.DD is the firmware version
None	M?	#XM?	X<sp>M<sp> Y	Returns the operation mode
None	R-?	#XR-?	X<sp>R-<sp>Y	Returns range floor value
None	R+?	#XR+?	X<sp>R+<sp>Y	Returns range ceiling value
None	SAVE	#XSAVE	R	Saves all data to EEPROM. "R" is sent when save is complete

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None	SC?	#XSC?	X<sp>SC<>Y	Returns the customer span correction multiplier
Cust	SC<X>	#XSC<sp>Y	R	Loads a customer span correction multiplier
None	T?	#XT?	X<sp>T<sp>C	Returns pressure type
None	W?	#XW?	X<sp>W<sp>NN	Returns the filter window in %FS.
Mens	W<NN>	#XW<sp>NN	R	Sets the filter window in counts. Readings inside this window are filtered.
None	ZC?	#XZC?	X<sp>ZC<sp>Y	Returns customer zero correction value in current units.
Cust	ZC<X>	#XZC<sp>Y	R	Sets customer zero correction value in current units.

Table 6.1.3 – Mensor Legacy Command Set

7. Maintenance and Recalibration



For contact details, please see Chapter 1 “General information” or the back page of the operating instructions.

7.1 Maintenance

The CPT9000 was designed for maintenance-free operation. User maintenance is not recommended. If you have questions not covered by this manual, call 1-800-984-4200 (USA only), or 1-512-396-4200 for assistance, or send an email to techservices@mentor.com.

7.1.1 Beyond the Warranty

Take advantage of Mensor’s expert product care. Mensor provides complete maintenance and calibration services, available for a nominal fee. Our service staff is knowledgeable in the innermost details of all of our transducers. We maintain units that are in operation in many different industries and in a variety of applications, and by users with a wide range of requirements. Returning your transducer to Mensor for service benefits you in several ways:

- Our extensive knowledge of the transducer assures you that it will receive expert care.
- Repair or replacement of the CPT9000 transducers will be available up to 7 years after the production life cycle of the product, pending external vendor parts or equivalent parts availability. The production life cycle is defined as the time from the product series launch to the announcement of discontinuation (typically 8 to 10 years).
- All repairs should be performed by Mensor due to the complexity of performing these repairs.

7.2 Recalibration

The CPT9000 automatically calculates the pressure reading for all effects of temperature, hysteresis, repeatability and non-linearity within the compensated temperature range. The process is referred to as dynamic compensation because each reading is adjusted before it is output. Thus, a calibrated CPT9000 operated within its temperature band, and with proper zero and span adjustments, will provide accurate pressure measurements.

The CPT9000 should have the calibration verified periodically to ensure stability. The recommended calibration interval for this instrument is given in the Specifications section under “Calibration Interval” in Section 9.1.

7.2.1 Calibration Services by Mensor or WIKA worldwide

Mensor and WIKA worldwide have extensive experience and knowledge of Mensor products. Calibration of the transducers can be performed at the addresses below or by competent internal or external labs using the procedures in this section.

Service Center USA	Service Center Europe
Mensor website: www.mentor.com tel: 1-512-396-4200 1-800-984-4200 fax: 1-512-396-1820 email: tech.support@mentor.com	WIKA Alexander Wiegand SE & Co. KG website: www.wika.de / www.wika.com tel: (+49) 9372 132-0 fax: (+49) 9372 132-406 email: CTServiceTeam@wika.com
Service Center China	
WIKA China website: www.wika.cn contact: Baggio Li tel: (+86) 512 6878 8000 fax: (+86) 512 6809 2321 email: baggio.li@wika.com	

Maintenance and Recalibration

7.2.2 Environment

For maximum accuracy, allow the CPT9000 to warm up a minimum of 15 minutes in ambient temperature within the compensated range prior to a calibration. In addition, the instrument should be at rest on a stable platform that is free of excessive vibration, shock and with minimal temperature change.

7.2.3 Pressure Standards

Mensor recommends the use of appropriately accurate primary pressure standards when calibrating this instrument. Such standards should be sufficient so that when the techniques of the ISO Guide to the Expression of Uncertainty in Measurement (GUM) are applied, the instrument meets its accuracy statements as required by ISO/IEC 17025:2005, or other applicable standards.

7.2.4 Media

The recommended calibration medium is dry nitrogen or clean dry instrument air. For ranges above 5 psi any liquid media compatible with 316L SS is acceptable. A reference height variation between the standard and the CPT9000 can cause errors. A calculation should be made to compensate for this difference.

7.2.5 Setup

The schematic in Figure 7.2.5 shows a typical setup used to calibrate the CPT9000.

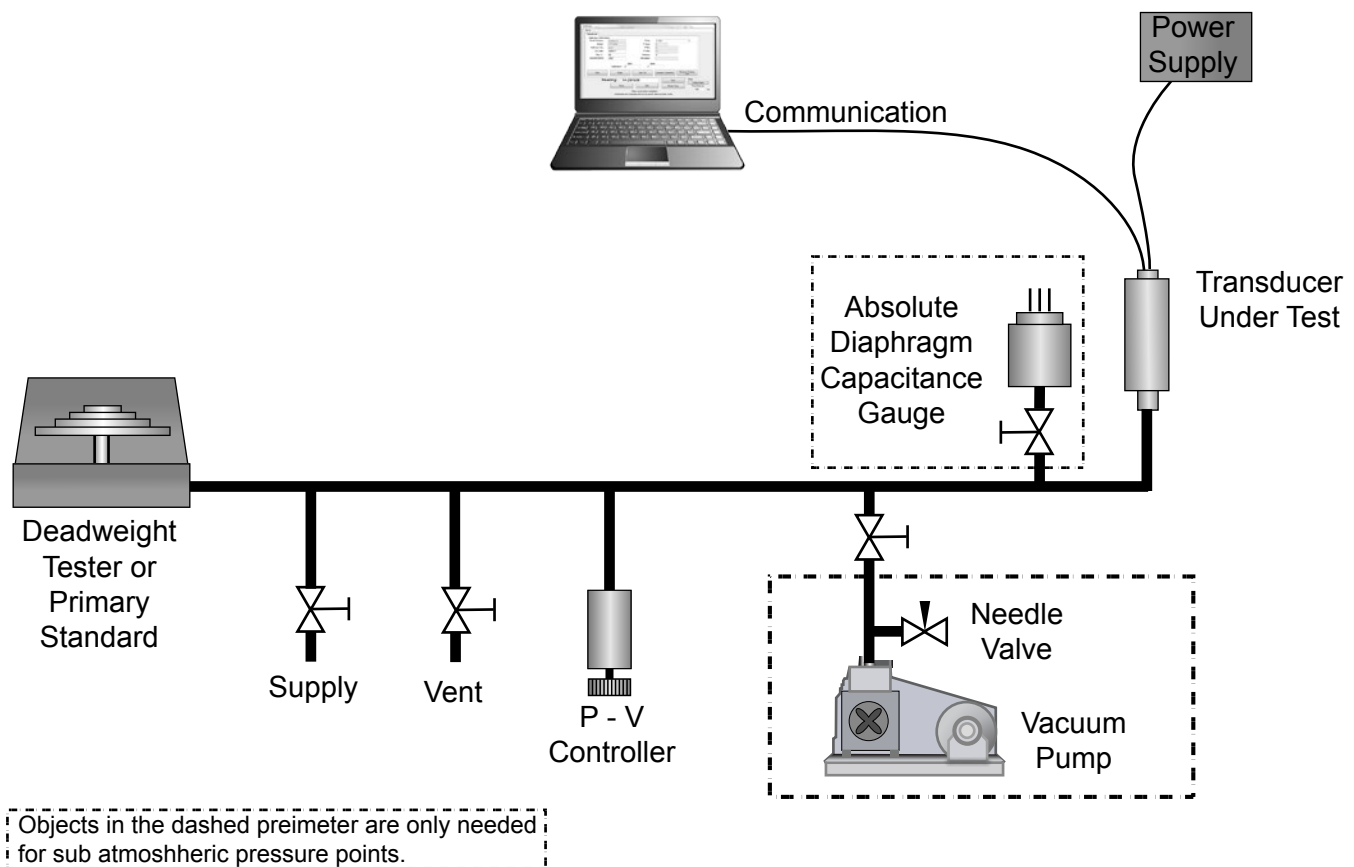


Figure 7.2.5 - Calibration Setup

When calibrating absolute transducers and approaching very low absolute pressures, you must use a needle valve or controlled leak to maintain a small pressure (600 mTorr, 80 Pa recommended) throughout the system. If you try to run calibration points below that pressure, the system will have significant pressure gradients in it unless left to stabilize for an extended period of time.

When setting span while calibrating higher pressures (> 6,015 psia/401 bar) you must allow time (10 min. recommended) for temperature and pressure to stabilize.

7.2.6 Calibration & Communication Software

The Operation and Calibration software utility is available on the Mensor.com website from the main menu select **Service/Calibration** then **Download Software** then **PC Software**.

The purpose of this software is to communicate with the CPT9000 transducer. Calibration of the transducer output and configuration of various parameters can be accomplished. It has many features that allow you to read and adjust the rich feature set including:

- Changing filter settings
- Modifying custom identification strings
- Showing the CPT9000's error stack
- Setting the tare pressure on the CPT9000
- Modifying the output format of the sensor
- Changing the pressure units output

It also has many features to adjust various calibration parameters after the appropriate password is sent:

- Setting the calibration date
- Setting the calibration interval
- Setting custom pressure units
- Setting sea level adjustment on barometric range transducers
- Setting minimum and maximum pressure alarm limits
- Setting minimum and maximum temperature alarm limits
- Setting Zero and Span
- Adjusting the CPT9000 linearity
- Resetting the calibration password
- Restoring the factory calibration

8. Dismounting, Return and Disposal

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WARNING!

Physical injuries and damage to property and the environment through residual media

Residual media in the dismantled instrument can result in a risk to persons, the environment and equipment.

- ▶ Wear the requisite protective equipment (see Chapter 3.6 “Personal protective equipment”).
- ▶ Observe the information in the material safety data sheet for the corresponding medium.
- ▶ Wash or clean the dismantled instrument, in order to protect persons and the environment from exposure to residual media.

8.1 Dismounting



WARNING!

Physical injuries and damage to property and the environment through residual media

Upon contact with hazardous media (e.g. oxygen, acetylene, flammable or toxic substances), harmful media (e.g. corrosive, toxic, carcinogenic, radioactive), and also with refrigeration plants and compressors, there is a danger of physical injuries and damage to property and the environment.

- ▶ Before storage of the dismantled instrument (following use) wash or clean it, in order to protect persons and the environment from exposure to residual media.
- ▶ Wear the requisite protective equipment (see Chapter 3.6 “Personal protective equipment”).
- ▶ Observe the information in the material safety data sheet for the corresponding medium.



WARNING!

Risk of burns

During dismantling there is a risk of dangerously hot media escaping.

- ▶ Let the instrument cool down sufficiently before dismantling it!



WARNING!

Power should be switched off before disconnecting the device.!



WARNING!

Physical injury

When dismantling, there is a danger from aggressive media and high pressures.

- ▶ Wear the requisite protective equipment (see Chapter 3.6 “Personal protective equipment”).
- ▶ Observe the information in the material safety data sheet for the corresponding medium.
- ▶ Only disconnect the pressure measuring instrument/measuring assembly/test and calibration installations once the system has been depressurised.

8.2 Return

Strictly observe the following when shipping the instrument:

All instruments delivered to WIKA or Mensor must be free from any kind of hazardous substances (acids, bases, solutions, etc.) and must be cleaned before being returned.



WARNING!

Physical injuries and damage to property and the environment through residual media

Residual media in the dismounted instrument can result in a risk to persons, the environment and equipment.

- ▶ With hazardous substances, include the material safety data sheet for the corresponding medium.

When returning the instrument, use the original packaging or a suitable transport packaging.

To avoid damage:

1. Wrap the instrument in an anti-static plastic film.
2. Place the instrument along with shock-absorbent material in the packaging.
Place shock-absorbent material evenly on all sides of the transport packaging.
3. If possible, place a bag containing a desiccant inside the packaging.
4. Label the shipment as a highly sensitive measuring instrument.

Instruments with lithium ion rechargeable batteries or lithium metal batteries

The included lithium ion rechargeable batteries or lithium metal batteries are subject to the requirements of the dangerous Goods Act. For shipping, special packaging and labelling requirements must be observed. A dangerous goods expert must be consulted when preparing the item to be shipped. Do not send any damaged or defective rechargeable batteries. Cover open contacts with adhesive tape and package the rechargeable battery such that it cannot move inside the package and short circuits are prevented. The different requirements of the relevant transport carriers as regard to the Dangerous Goods Act and also additional national regulations must be observed.



Information on returns can be found under the heading "Service" on our local website.

8.3 Disposal

Incorrect disposal can put the environment at risk.

Dispose of instrument components and packaging materials in an environmentally compatible way and in accordance with the country-specific waste disposal regulations.



This marking on the instruments indicates that they must not be disposed of in domestic waste. The disposal is carried out by return to the manufacturer or by the corresponding municipal authorities.

9. Specifications

Accuracy specifications presented herein are obtained by comparison with primary standards traceable to a national metrology institute or recognized international standard organization. These specifications are obtained in accordance with the ISO Guide to the Expression of Uncertainty in Measurement (GUM). The calibration program at Mensor is accredited by the American Association of Laboratory Accreditation (A2LA) as complying with both the ISO/IEC 17025:2005 and the ANSI/NCSL Z540-1-1994 standards. If there is an exception to the requirements and recommendations of Z540 during a calibration the exception is noted on the individual calibration certificate.

Mensor reserves the right to change specifications without notice.

9.1 Measurement Specification

Accuracy ¹⁾	0.008% IS-33 ²⁾	0.008% Full Span
Measuring ranges		
Gauge pressure	0 ... 15 to 0 ... 1500 psig (0 ... 1 to 0 ... 100 bar)	0 ... 0.36 to 0 ... <15 psig (0 ... 25 mbar to 0 ... <1 bar)
Bi-directional ³⁾	-15 ... 145 to -15 ... 1500 psi (-1 ... 10 to -1 ... 100 bar)	-0.18 ... 0.18 to -15 ... <145 psi (-12.5 ... 12.5 mbar to -1 ... <10 bar)
Absolute pressure	0 ... 15 to 0 ... 1515 psia (0 ... 1 to 0 ... 101 bar abs.)	0 ... 5 to 0 ... <15 psia (0 ... 350 mbar abs. to 0 ... <1 bar abs.) AND 0 ... >1515 to 0 ... 15,015 psia (0 ... >101 to 0 ... 1001 bar)
Calibration interval	365 days	
Pressure units	39 and 1 user defined	
CPT9000 as barometric reference		
Measuring range	8 ... 17 psi abs. (552 ... 1,172 mbar abs)	
Accuracy ¹⁾	0.008% of reading	

- 1) It is defined by the total measurement uncertainty, with the coverage factor ($k = 2$) and includes the intrinsic performance of the instrument, the measurement uncertainty of the reference instrument, long-term stability, influence of ambient conditions, drift and temperature effects over the compensated range with recommended zero point adjustment every 30 days.
- 2) 0.008 % IS-33 accuracy: Between 0 ... 33 % of the full scale, the accuracy is 0.008% of one third of the full scale value and between 33 ... 100 % of the full scale, the accuracy is 0.008 % of reading.
- 3) The negative portion of a bidirectional range has the same accuracy as the equivalent positive range.

Specifications

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9.2 General Specification

Case	
Orientation effects	Negligible – completely removable with re-zeroing
Dimensions	See technical drawings
Weight	~250 g (depending on range)
Display	
Resolution	100 ppb or better
Warm-up time	15 min.
Connections	
Pressure connections	SAE J514/JIC 4
Overpressure limit	2X proof, 3X burst; static pressure < 50 psig
Materials, wetted parts	Ranges ≤ 5 psi – Silicon, 316 SS, glass filled resins, epoxy Ranges > 5 to 1500 psi – 316 SS Ranges > 1500 psi – 316 SS, fluorocarbon rubber
Pressure media	Ranges ≤ 5 psi – clean, dry, non-corrosive gases Ranges > 5 psi – media compatible with the listed wetted parts
Voltage supply	
Power supply	9 to 18 VDC (12 VDC nominal)
Power consumption	< 26 mA at 12 VDC +/-5%
Permissible ambient conditions	
Compensated temperature range	0 to 50 °C (32 to 155 °F)
Operating temperature range	-40 to 85 °C (-40 to 185 °F)
Storage temperature range	-40 to 85 °C (-40 to 185 °F)
Humidity	0 ... 95% r.h. (non-condensing)
Operating altitude	<3000 meters (10,000 feet)
Operating environment	IP-67
Measure port internal volume	<1 cc
Reference port internal volume	~ 40 cc
Communication	
Interface	RS-232 or RS-485
Baud rate	Default 57,600 baud - 9600, 19200 and 115200 user selectable
Measuring rate	50 values/second, default - (factory adjustable)
Command sets	See manual, Section 6 Operation

9.3 Approvals and Certificates

Compliance	CISPR 11 & A1, IEC 61000-4-2, 3, 4, 5, 6, 11, IEC 61000 A1, A2, IEC 61010-1
Calibration ⁴⁾	A2LA calibration certificate

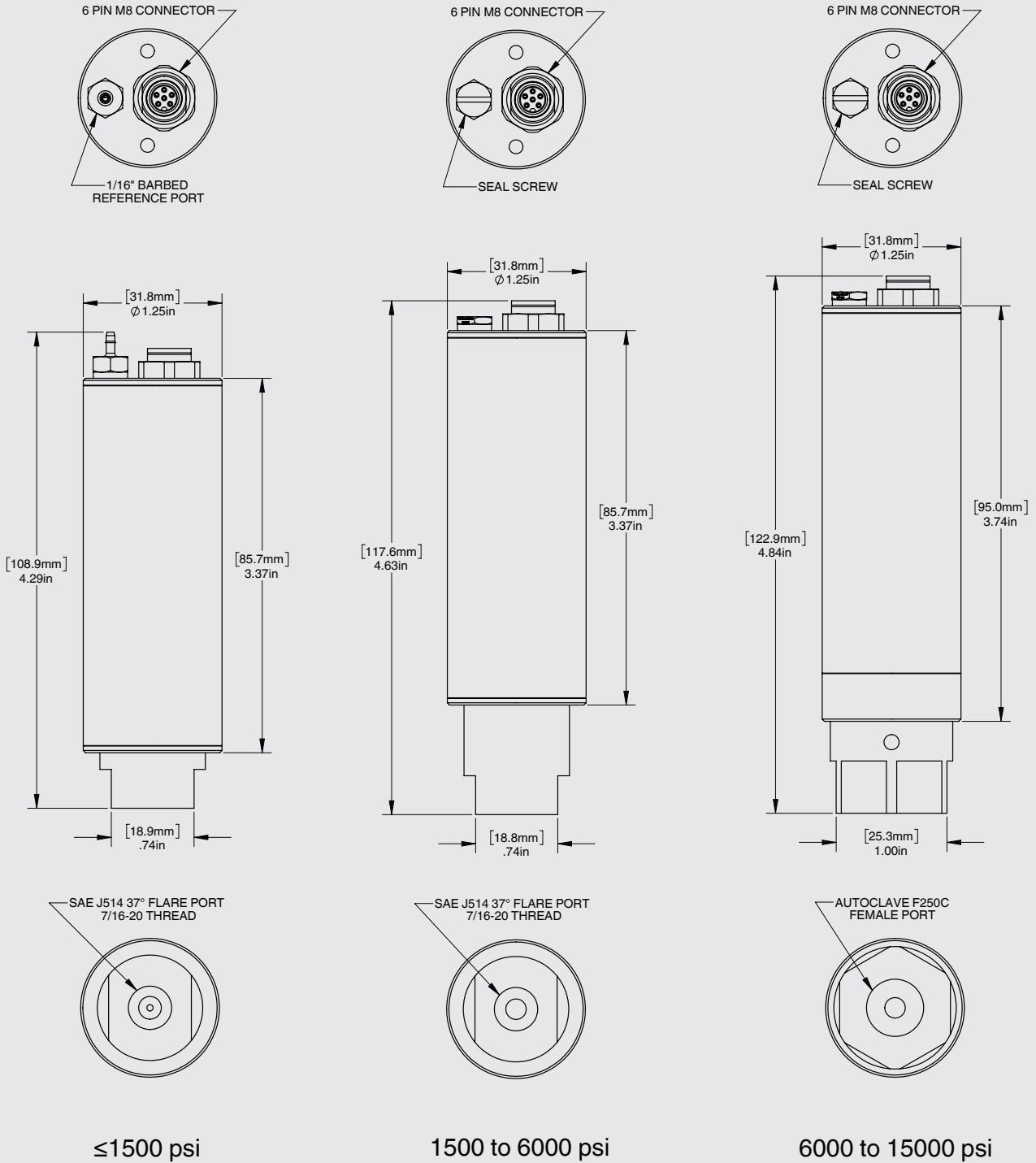
4) Calibration in a vertical position.

Specifications

9.4 Dimensions in mm (in)

Note: Reference port is for gauge type sensors only; for absolute type, and sealed gauge type, the port is plugged.)

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10. Accessories

10.1 Fittings & Gaskets

Mensor supplies a customer specified fitting with each transducer. Available fittings to connect to the transducer have the following Mensor Part numbers:

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Part Number	Description
6000604023	¼"Male NPT
6000604024	7/16-20 SAE
6000604025	¼ BSPP
4250040006	Copper gasket washer

Many other fittings are available, consult the factory if you need assistance.

10.2 Accessories

Part Number	Description
4050060021	Communication Cable
0020528001	Power Supply & RS-232 communication cable
0020528002	Power supply and RS-484 communication cable

WIKA subsidiaries worldwide can be found online at www.wika.com.



Mensor LP
201 Barnes Drive
San Marcos, TX 78666 • USA
Tel. (+1) 512 3964200-15
Fax (+1) 512 3961820
E-Mail sales@mensor.com
www.mensor.com



Imported to Europe by:
WIKA Alexander Wiegand SE & Co. KG
Alexander-Wiegand-Straße 30
63911 Klingenberg • Germany
Tel. +49 9372 132-0
Fax +49 9372 132-406
info@wika.de
www.wika.de

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