User's Guide

OMEGA®

An OMEGA Technologies Company

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

PCL10 / PCL11

Hand-Held Pressure Indicator-Calibrator

omega.com™
OMEGA

OMEGAnet℠ On-Line Service	Internet e-mail
http://www.omega.com	info@omega.com

Servicing North America:

USA: ISO 9001 Certified
One Omega Drive, Box 4047
Stamford, CT 06907-0047
Tel: (203) 359-1660 FAX: (203) 359-7700
e-mail: info@omega.com

Canada:
976 Bergar
Laval (Quebec) H7L 5A1
Tel: (514) 856-6928 FAX: (514) 856-6886
e-mail: info@omega.ca

For immediate technical or application assistance:

Usa and Canada:
Sales Service: 1-800-826-6342 / 1-800-TC-OMEGA℠
Customer Service: 1-800-622-2378 / 1-800-622-BEST℠
Engineering Service: 1-800-872-9436 / 1-800-USA-WHEN℠
TELEX: 996404 EASYLINK: 62968934 CABLE: OMEGA

Mexico and Latin America:
Tel: (95) 800-826-6342 FAX: (95) 203-359-7807
En Español: (95) 203-359-7803
e-mail: espanol@omega.com

Servicing Europe:

Benelux:
Postbus 8034, 1180 LA Amstelveen, The Netherlands
Tel: (31) 20 6418405 FAX: (31) 20 6434643
Toll Free in Benelux: 0800 0993344
e-mail: nl@omega.com

Czech Republic:
ul. Rude armady 1868, 733 01 Karvina-Hranice, Czech Republic
Tel: 420 (69) 6311899 FAX: 420 (69) 6311114
Toll free: 0800-1-66342
e-mail: czech@omega.com

France:
9, rue Denis Papin, 78190 Trappes
Tel: (33) 130-621-400 FAX: (33) 130-699-120
Toll Free in France: 0800-4-06342
e-mail: france@omega.com

Germany/Austria:
Daimlerstrasse 26, D-75392 Deckenpfronn, Germany
Tel: 49 (07056) 3017 FAX: 49 (07056) 8540
Toll Free in Germany: 0130 11 21 66
e-mail: info@omega.de

United Kingdom: ISO 9002 Certified
One Omega Drive , River Bend Technology Centre
Northbank, Irlam, Manchester
M44 5EX, England
Tel: 44 (161) 777-6611 FAX: 44 (161) 777-6622
Toll Free in United Kingdom: 0800-488-488
e-mail: info@omega.co.uk

INTRODUCTORY NOTE

This publication contains operating instructions, as well as a description of the principles of operation, of ***PCL10*** *and* ***PCL11*** *pressure calibrators.*

OMEGA *has used the best care and efforts in preparing this book and believes the information in this publication are accurate. The* ***OMEGA*** *products are subjected to continuous improvement, in order to pursue the technological leadership; these improvements could require changes to the information of this book.*
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PCL10 *and* ***PCL11*** *units use sophisticated analogic and digital technologies. Any maintenance operation must be carried out by qualified personnel* ***ONLY****. We recommend to contact our technicians for any support requirements.*

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PCL10 *and* ***PCL11*** *is fully tested in conformity with the directive n°89/336/CEE Electromagnetic Compatibility.* ***OMEGA*** *shall not be liable in any event, technical and publishing error or omissions, for any incidental and consequential damages, in connection with, or arising out of the use of this book.*

TABLE OF CONTENTS

1 PERFORMANCE

PCL10/11 is a portable instrument for relative (gauge) and differential pressure measurement.
When connected to an auxiliary device such as a pump, a volume adjuster and a ventilation valve it can be used as a pressure calibrator.
A complete system testing, measuring and calibrating built in a single, compact portable instrument.
Thanks to its compactness, roughness and user friendly operative mode, **PCL10/11** is the ideal instrument for field measurements, tests and calibrations.
Accurate, compact, rugged, easy to use; the ideal solution to measure and simulate:

- **Volts** (only measurements)
- **milliAmperes** (only measurements)
- **gauge pressure**
- **differential pressure**

PCL10/11 has been developed using the most advanced microcontroller technique to provide high accuracy on extended ranges and a powerful operating flexibility.
The calibration uses computerized procedures and the relevant calibration data are memory stored to ensure high accuracy.
The pressure/differential pressure measurement uses a base piezoresistive sensor individually and fully characterized for linearity and temperature coefficient.
In addition to pressure measurement the instrument is equipped with a second channel designed for voltage (up to 30 V) and current (up to 22 mA) measurements.
The selection of operating functions is made on a polycarbonate thermoformed membrane keyboard which assures up to one million operations per key.
Both pressure and electrical parameter readings are indicated on a high quality LCD dot matrix display equipped with a backlight device for easy readings also in poor light conditions.
The case, made in shock-resistant ABS, is ergonomically designed for an easy practical use.
The instrument is powered by four Ni-MH rechargeable batteries; an external battery charger is supplied as a standard accessory.

1.1 Specifications

- **Pressure and ΔP ranges:**
  see instrument codes
- **Vacuum ranges:**
  -10% of the measuring range
  (10 bar and 20 bar ranges only are limited to -0.8 bar)
- **Keyboard selectable technical units:**
  mbar, bar, psi, mmwc (mmH_2O), cmwc (cmH_2O), mwc (mH_2O), inwc (inH_2O), mmHg, mHg, inHg, kPa, hPa, matm, atm, torr, $Lbin^2$, kgm^2, $kgcm^2$
- **Scale factor and square root:**
  for direct flow measurement
- **Pressure media:**
  compatible with most common non-corrosive, non-reducing, non-condensing and non explosive gases
- **Pressure ports:**
  1/8" BSPPF
- **Accuracy:**
  Table A = 1 ±(0.1% of reading + 0.03% of f.s.)
  Table A = 2 ±(0.05% of reading + 0.02% of f.s.)
  The relative accuracy shown above are stated for 90 days and the operative conditions are from +5°C to +45°C.
  Outside the above temperature band the temperature drift is ±0.004% rdg/°C
- **Position effect:**
  negligible (excluded 20 mbar range)
- **Electrical ranges:**
  0 to 30.000 V
  0 to 22.000 mA
- **Electrical ranges accuracy:**
  ± (0.05% of reading + 0.01% of f.s.)
  The relative accuracy shown above is stated for 90 days and the operative conditions are from +18°C to +28°C.
  Outside the above temperature band the temperature drift is ±0.002% of rdg/°C
- **Common mode rejection:**
  >140 dB at 50/60 Hz ± 1 Hz
- **Normal mode rejection:**
  > 60 dB at 50/60 Hz ± 1 Hz
- **Shunt (current channel):**
  < 110 Ω
- **Impedance (voltage channel):**
  > 1 MΩ
- **Maximum voltage input (voltage channel):**
  50V
- **Maximum current input (current channel):**
  50 mA
- **Short-circuit protection (loop power supply):**
  Fuse + Electronic
- **Overcurrent protection (current channel):**
  Fuse
- **Maximum load (passive loop):**
  900 Ω at 20 mA
- **Display:**
  dot matrix LCD (2 lines of 16 characters each) with backlight device.
- **Operative life:**
  8 hours without printing and without load on 20 mA passive current loop
  4 hours without printing and with load on 20 mA passive current loop

- **Data memory:**
  up to 50 group of data
- **Working temperature limits:**
  from -5°C to 50°C
- **Storing temperature:**
  from -20°C to 60°C
- **Power supply:**
  Ni-MH batteries package
- **Case:**
  Injection moulded ABS with internal metal coating in compliance with EMC
- **External dimensions:**
  100 x 60 x 240 mm (without pressure module)
  100 x 60 x 285 mm (with pressure module)
- **Weights:**
  net 1 Kg (instrument + pressure module)
  gross with packing 1,5 Kg

1.1.1 Ranges and resolution

Bar		PSI		mH20	at 4°C	kPa		InH20	at 4°C	Lb/In2	
-0,880	22,000	-12,76	319,08	-8,97	224,34	-8,80	2200,0	-353	8832	-12,76	319,08
-0,880	11,000	-12,76	159,54	-8,97	112,17	-8,80	1100,0	-353	4416	-12,76	159,54
-0,550	5,500	-7,98	79,77	-5,61	56,08	-5,50	550,0	-220,8	2208,1	-7,98	79,77
-0,2200	2,2000	-3,191	31,908	-2,243	22,434	-2,200	220,00	-88,3	883,2	-3,191	31,908
Bar		**PSI**		**mH20**	**at 4°C**	**kPa**		**InH20**	**at 4°C**	**Lb/In2**	
-0,1100	1,1000	-1,595	15,954	-1,122	11,217	-1,100	110,00	-44,2	441,6	-1,595	15,954
mBar		**PSI**		**cmH20**	**at 4°C**	**kPa**		**InH20**	**at 4°C**	**Lb/In2**	
-55,0	550,0	-0,798	7,977	-56,1	560,8	-5,50	55,00	-22,08	220,81	-0,798	7,977
mBar		**PSI**		**mmH20**	**at 4°C**	**kPa**		**InH20**	**at 4°C**	**Lb/In2**	
-22,00	220,00	-0,3191	3,1908	-224,3	2243,4	-2,200	22,000	-8,83	88,32	-0,3191	3,1908
mBar		**PSI**		**mmH20**	**at 4°C**	**hPa**		**InH20**	**at 4°C**	**Lb/In2**	
-11,00	110,00	-0,1595	1,5954	-112,2	1121,7	-11,00	110,00	-4,42	44,16	-0,1595	1,5954
mBar		**mPSI**		**mmH20**	**at 4°C**	**hPa**		**InH20**	**at 4°C**	**Lb/In2**	
-2,200	22,000	-31,91	319,08	-22,43	224,34	-2,200	22,000	-0,883	8,832	-0,0319	0,3191

Bar		mHg	at 0°C	torr		Kg/cm2		Atm		InHg	at 0°C
-0,880	22,000	-0,660	16,501	-660	16501	-0,897	22,434	-0,868	21,712	-25,99	649,7
-0,880	11,000	-0,660	8,251	-660	8251	-0,897	11,217	-0,868	10,856	-25,99	324,83
-0,550	5,500	-0,413	4,125	-413	4125	-0,561	5,608	-0,543	5,428	-16,24	162,42
-0,2200	2,2000	-0,1650	1,6501	-165,0	1650,1	-0,2243	2,2434	-0,2171	2,1712	-6,50	64,97
Bar		**mmHg**	**at 0°C**	**torr**		**Kg/cm2**		**Atm**		**InHg**	**at 0°C**
-0,1100	1,1000	-82,5	825,1	-82,5	825,1	-0,1122	1,1217	-0,1086	1,0856	-3,248	32,483
mBar		**mmHg**	**at 0°C**	**torr**		**Kg/m2**		**mAtm**		**InHg**	**at 0°C**
-55,0	550,0	-41,3	412,5	-41,3	412,5	-561	5608	-54,3	542,8	-1,624	16,242
mBar		**mmHg**	**at 0°C**	**torr**		**Kg/m2**		**mAtm**		**InHg**	**at 0°C**
-22,00	220,00	-16,50	165,01	-16,50	165,01	-224,3	2243,4	-21,71	217,12	-0,650	6,497
mBar		**mmHg**	**at 0°C**	**torr**		**Kg/m2**		**mAtm**		**InHg**	**at 0°C**
-11,00	110,00	-8,25	82,51	-8,25	82,51	-112,2	1121,7	-10,86	108,56	-0,3248	3,2483
-2,200	22,000	-1,650	16,501	-1,650	16,501	-22,43	224,34	-2,171	21,712	-0,0650	0,6497

2 GENERAL FEATURES

2.1 Input and output flexibility

An advanced flexibility of performance has been achieved using the microcontroller technique. Each instrument, through a menu-driven procedure, allows simultaneous measurement of pressure (gauge or ΔP) and of the typical loop signal in current (up to 22 mA) or voltage (up to 30 V). The microcontroller performs linearization and temperature compensation of the piezoresistive pressure sensor using the characterization data stored in the pressure module memory.

2.2 Self calibration

The hardware-firmware design allows the automatic calibration of the instrument. The calibration procedure is protected by a security code.

2.3 Keyboard

A thermoformed metal-click tactile polycarbonate membrane keyboard, with a working life of one million operations per key, seals the internal electronics from the surrounding environment. The contact closure of membrane keys is acknowledged, as a coded signal, directly by the microprocessor.

2.4 Display

The high contrast alphanumeric LCD display with dot matrix (7x5 dots per character-16 characters), in the normal operative mode, simultaneously indicates pressure symbol and value, current or voltage symbol and value.
It is also used for operator's messages, instrument configuration set-up, special operative modes, etc.
It is equipped with a backlight device to allow easy readings even in poor light conditions.
The method to adjust the display contrast is described in par. 8.7.

2.5 Digital interface

A digital interface with TTL logic levels is available as a standard for communication with external units. A serial data port provides a communication capability at a logic level of 0-5 V (four wires: Tx, Rx, GND, Vcc). A TTL to RS 232 adapter is available as an option.

2.6 Scale factor function

Easy menu-driven set-up to read or simulate electrical signal values in terms of engineering units. Four programmable alphanumeric characters are available on the display to show the symbol of the parameter (i.e. mbar, etc.). The display will indicate the scaled input value.

2.7 Square root function

It can be programmed during the set-up procedure to obtain direct readings of flow from a dP transmitter signal. The display limits are -9999 and +30000.

2.8 Pressure measurement damping

To allow measurement of unstable input signals using a special algorithm based on a combination of working band and average weight.

2.9 Case

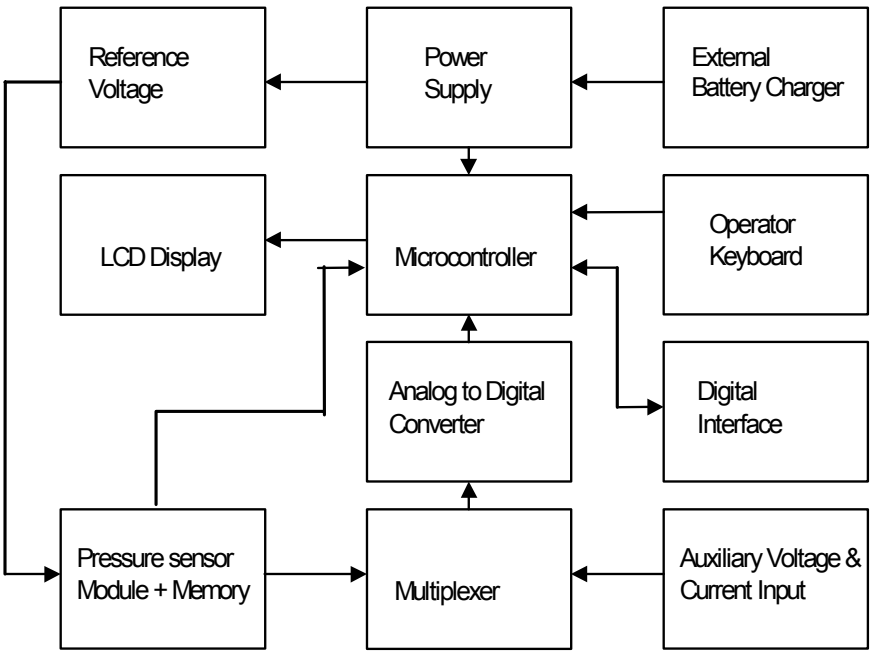
The case is designed for an easy hand held operation and transportation. The body is injection molded, shock-resistant ABS with internal metal coating. An ABS case for instrument + printer + pumps + accessories is available on request.

3 PHYSICAL DESCRIPTION

The **PCL10/11** palm-top indicator consists of a rugged and compact case, a replaceable pressure module, a mother board with all basic functions, a daughter board for the auxiliary functions (mA and V readings), a tactile membrane keyboard, a LCD display and a group of four nickel-metalhydride rechargeable batteries.
The internal surface of the case is metal coated to improve compliance with EMC.
The battery package is located on the lower back part of the case, and is accessible through a cover fastened by a metal screw.
The two sections of the case are joined together by four metal screws located on the back side.
The optional leather case, with shoulder strap, assures a better protection of the instrument against mechanical knocks or scratches.

4 FUNCTIONAL DESCRIPTION

The **PCL10/11** portable calibrator block diagram is shown below.



- **power supply**
- **reference voltage signal**
- **microcontroller (central unit + memory)**
- **input circuit**
- **LCD display**
- **operative keyboard**
- **replaceable pressure module with characterisation data memory**

4.1 Power supply

The instrument is powered by four internal batteries that can be recharged through an external charger module supplied as a standard accessory. The internal batteries are Ni-MH rechargeable AA type with a nominal voltage of 1.25 V.
The voltage of the four batteries in series (approximately 5 V) is connected to the input of a switching circuit to generate the voltages for the pressure transducer, the analog and digital circuits. The power supply circuit, is also configured as a voltage multiplier to generate a voltage of 24 Vdc for the final output stage operating both into active or passive loops.
The above voltage levels are required to work with an external load up to 900Ω to supply the external current loop (see par. 7.8).

4.2 Operative keyboard

The front panel is a tactile polycarbonate membrane keyboard, and has a working life of one million operations per key.
The contact closure of the membrane keyboard is acknowledged as a coded signal by the microprocessor that recognizes the operator's instructions .
Keys are interconnected on a 4 x 3 matrix; the microprocessor identifies the active key directly.
The values of the **<▲>** and **<▼>** keys (membrane slidewires) are acknowledged through the converters built in the microprocessor chip.

<**ON**>	Power ON switch
<**OFF**>	Power OFF switch
<Lamp>	Switches -On- the LCD back-light display

<PAGE>	Scrolls display/menu pages
<PRINT>	Enables printout of data
<▲> <▼>	Data selection
<**STATUS**>	Instrument configuration review and set-up data storage
<**ZERO**>	Pressure channel zero reset
<**HOLD**>	To freeze and temporary memory store data
<**DAMP**>	Pressure measurement signal damping
<**STORE**>	Memory load / Operator's message acknowledgements
<**SET-UP**>	Instrument configuration
<**PEAK**>	Maximum value identification and measurement
<**VALLEY**>	Minimum value identification and measurement
<**CONV**>	Convert displayed data to electrical data (scale factor only)
<**LCD-**>	Adjust the LCD contrast
<**LEAK**>	Leak test procedure to allow the test of leak in terms of pressure decay over time
<ALARM RESET>	Switch -Off- the acoustic alarm
<**ENTER**>	Memory load key

4.3 Pressure Module

The replaceable Pressure Module incorporates a fully characterised piezoresistive sensor and communicates with basic unit via a 15 pin connector.
Temperature/pressure characterisation data are stored in a non volatile EEPROM, resident in the replaceable module.
An extended number of Pressure Module units are available in a wide variety of pressure measurement ranges (see table B Par. 1.1).
Any Pressure Module can be used in any basic unit and the measurement system will provide measurement accuracy in conformance with the declared specifications.

4.4 Microcontroller

The microcontroller handles all the logic functions of the instrument, performs the linearization for pressure transducers, compensates for the reference junction temperature, drives the digital display and acknowledges all the operator's instructions.
The core of the circuit is a single-chip microcomputer that utilises HCMOS technology to provide the low power characteristics and high noise immunity of CMOS plus the high speed operation of HMOS.
The microcomputer provides highly sophisticated, on- chip peripheral functions including: 256 bytes of static RAM, an 8 channel analog to digital (A/D) converter (used to read the battery package voltage, the analog keyboard, the battery charger, the short-circuit and the overload on the external current loop), a serial communication interface (SCI) subsystem, and a serial peripheral interface (SPI) subsystem.
The microprocessor works with an 8/16 bit communication bus to EPROM and EEPROM memories and is interfaced with a decoder, a latch of address and an inverter-driver.

4.5 Firmware

The operating system firmware handles all logic instructions to the internal peripheral circuits and performs the computation of the linearization equations.
The application system firmware is resident on the non-volatile memory (EEPROM) of the microprocessor chip.
It is used to store the installation parameters (autocalibration data, program data, etc.)

4.6 Digital display

The digital display, mounted on an auxiliary board, uses high contrast LCD technology (STN liquid).
The character generation is made by a secondary dedicated microprocessor driven by two integrated circuits with signal input from the bus of the main microprocessor.
The 16 characters are displayed with a 7x5 dot matrix.
PCL10/11 is standard equipped with a backlight device for easy readings in poor light conditions.

4.7 Battery charger

The auxiliary module, supplied as a standard accessory, allows operations from 100-120 Vac or 230-240 Vac 50/60 Hz.
The calibrator, if needed, can be operated directly from a line source through the charger.
The plastic case of the battery charger incorporates the line voltage plug and a cable with a connector for interconnection to the instrument.

The charger circuit is designed with an insulating transformer and a voltage stabiliser circuit. The step-down transformer reduces the power line (100, 115 or 230 Vac nominal) to a value of 10 Vac. The above voltage is full wave rectified, filtered and stabilised. The output voltage of 6,66 V is the ideal value to recharge the internal Ni-MH batteries.

4.8 Digital interface

The digital interface circuit is essentially based on the serial communication interface subsystem (SCI) on the chip of the microprocessor at 0 up to +5V level.
An adapter to convert TTL to RS 232 voltage levels can be obtained on request.

5 UNPACKING

Remove the instrument from its packing case and remove any shipping ties, clamps, or packing materials.
Carefully follow any instructions given on any attached tags.
Inspect the instrument against 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 bottom, 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 will keep a data base with all pieces of information regarding your instrument.

6 PRE-OPERATIONAL CHECK

The **PCL10/11** portable calibrator is powered by four Ni-MH rechargeable batteries.
The external battery charger, supplied as a standard , can be ordered for either 100/120 Vac or 230/240 Vac power source.
Before using the instrument carefully verify the nominal voltage value of the charger with the available mains power line.
The instrument should be used in environments where the temperature does not exceed the specified limits (from -5°C to +50°C) and where the relative humidity is lower than 95%.

In case of “low” battery condition (voltage lower than 4.6 V) the display will show the symbol .
A battery symbol means that the battery package has enough energy for about 30 minutes’ operation.
In this condition the instrument batteries must be recharged.

WARNING :

THE INSTRUMENT IS SUPPLIED WITH NI-MH RECHARGEABLE BATTERIES.
DO NOT USE NORMAL ALKALINE BATTERIES.
ALKALINE BATTERIES, WHEN CONNECTED TO A DC VOLTAGE SUPPLY UNDERTAKE AN OVERHEATING PROCESS WITH A RISK OF EXPLOSION.

7 OPERATION & APPLICATIONS

The **PCL10/11** portable calibrator is factory calibrated before shipment.
During the start-up the operator should only select and load the pertinent application parameter as described below.

7.1 Rechargeable batteries

The **PCL10/11** portable calibrator is powered by a built-in rechargeable battery package .
The instrument is shipped with an average level of charge.
After unpacking, a full charge of the batteries is recommended; connect the instrument to the charger module ("OFF" condition) for a period of 10 hours minimum.
The Ni-MH rechargeable batteries do not suffer when used in cyclic operations.
The cyclic operation is understood as a method of operation by which the battery is continually charged and discharged.
Note that a battery, at its lower limit of discharge, risks a non uniform cell polarization: this condition makes it difficult to recharge it with the charger supplied.
Avoid leaving the instrument, with batteries totally or partially discharged, for a long time without recharging them.
To charge the batteries use only the original supplied charging module. The module incorporates protection and current limiting devices not normally found in other commercial chargers.

7.2 Battery charger

The external battery charger is configured, before shipment, for a supply voltage of 100, 115 or 230 Vac, upon order specification. The nominal voltage value is indicated on the front label of the battery charger.

7.3 How to maximize the life span of the battery

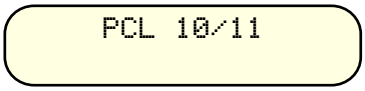
Disconnect the ac mains supply when the battery is charged. Use the battery until it is completely discharged.
Leaving the ac mains supply plugged in will decrease the life of the battery. It's possible to leave the AC mains supply plugged-in 2 or 3 more days after the normal (10 hours) charge without batteries damages.
Note that the operating time decreases at low temperatures.
A Ni-MH battery can be recharged about 500 times when used with the recommended instructions.

7.5 Start-up

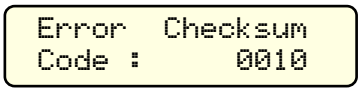
PCL10/11 can perform a wide variety of simple and complex pressure based measurements, tests and calibrations.
Using the menu driven set-up procedures the system can be easily configured for the required measurement mode.
The present paragraph describes, step by step, the use of **PCL10/11** to perform basic pressure measurements.

ATTENTION: ALL THE VALUES IN THE FOLLOWING FIGURES ARE ONLY LISTED AS AN EXAMPLE.

During set-up and load memory remember that the instructions of the manual related to key operation have the following meaning:
<A> + <B> Press the **<A>** key and keeping the pressure on it, press then the **<B>** key.
<A> , <B> Press in sequence, first the **<A>** key and then the **<B>** key.
To power-on the instrument, press the <**ON**> key; the indication



will appear for a few seconds.
The instrument runs an autodiagnostic routine for the self-checking of critical circuits and components.
A positive check will be shown eg. with the following indication :



for about one second.
The number in the "Code" line indicates that some memory data have been lost.
The paragraph of this manual points out of the different type of lost data can be notified.

- Press the <**PAGE**> key to obtain the following indication relevant with the type of pressure module installed.

```
 10 Bar     0.05%
 Press    (PAGE)
```

The example indicates that a pressure module 0 to 10 bar fs with an accuracy of 0.05% of the reading has been installed.

- Press the <**PAGE**> key to enter the operative mode and to obtain eg. the following pages indicating that the auxiliary measurement channel (second line of the display) is respectively Voltage (V) with a resolution of 1 mV or Current with a resolution of 1 μA:

```
 P1    0.000 Bar
 V1    0.000 V
```

or eg.

```
 P1    0.000 Bar
 mA1   0.000 mA
```

The instrument is ready for pressure measurement and simultaneously voltage or current measurement.

If a low battery condition is present a “Battery” symbol '' will be displayed in all operative pages.
If the “Pressure Module” is not installed the following message will be shown :

```
!!  NO Module  !!
Turn Off & insert
```

- To insert the Pressure Module switch first the instrument -Off- to avoid any possible damage ;
- Insert the required Pressure Module ;
- Switch the instrument “On” again.

7.6 Instrument Configuration review (Status)

To review the configuration of the instrument on the display press the <**STATUS**> key.
The indication will be as it follows:

```
Batt.     18/08/96
   5.3    10:45:20
```

or eg.

```
Batt.     18/08/96
AC 5.3    10:45:20
```

An “AC” symbol (on the above display : below on the left) will be displayed when the instrument is connected to a battery charger to confirm that the charging voltage level is present in the instrument power supply circuit.
The “low” limit of the battery voltage, for the correct operation of the instrument, is +4.6V.

Any date and time information will be displayed only when the memory module with the real time clock is installed in the instrument (see table D=1 on Par. 1.1).
Without any memory module and real time clock the above indication will be as it follows :

```
Batt.     04/03/97
   5.3    18:12:51
```

or eg.

```
Batt.     --------
   5.3    --------
```

- When the real time clock is installed to change the time and date format (eg. European to USA) press <**ENTER**> + <**PAGE**> keys. The displayed indication will change as it follows :

```
Batt.     18/08/96
   5.3    10:45:20
```

<**ENTER**> + <**PAGE**>

```
Batt.     08/18/96
   5.3    10a45:20
```

from “day/month/year” to “month/day/year” and about time from 0 to 24 :00 :00 using an am (“a”) or pm (“p”) indication.

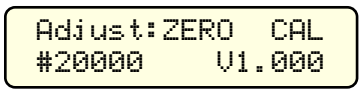
- Press the <**STATUS**> key to review the type of Pressure Module installed and to obtain ie. the following indication :

```
 2 Bar     0.1%
S/N  10000  V1
```

The Pressure Module installed in this example has a full scale range of 2 bars with an accuracy of 0.1% of the reading and is identified by the Serial number 10000.

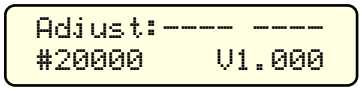
The “V1” message indicates that the characterization matrix used is version n. 1.

- Press the <**STATUS**> key to obtain the configuration (status) of the instrument with ie. the following indication :



The “**ZERO**” message, when displayed, indicates that an autozero procedure was carried out.
The “**CAL**” message, when displayed, indicates that the “user's calibration” has been activated.

- Press <**ENTER**> + <**PAGE**> keys if you require to remove the user's calibration.
- Press <**ENTER**> + <**PAGE**> keys if you require to remove the zero correction obtaining the following indication :



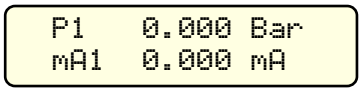
In the second line are displayed the serial number of the instrument and the identification code of the version of firmware installed.
The above information is extremely useful to understand the update status of the instrument and to simplify information exchange with **OMEGA** engineers during repair or service activities.

7.7 Display contrast and backlight adjustment

The high contrast alphanumeric LCD display is equipped with a backlight device to allow easy readings even in poor light conditions.
The backlight can be switched -On- using the <**LAMP**> key.
The contrast of the display can be adjusted using
<**ENTER**> + <▲> key to increase or
<**ENTER**> + <▼> key to decrease the contrast.

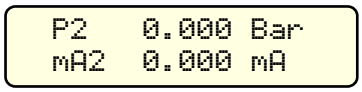
7.8 Normal operative mode

In the normal operative mode the instrument shows ie. the following indication :



The number “1”, marked on the right side of “P” and “mA”, indicates that the page n.1 is displayed. The above page number refers to the possibility of freezing/memory store the measured value using the <**HOLD**> key.
Five pages of memory stored data are available.
An asterisk “*” will mark the memory stored parameters :

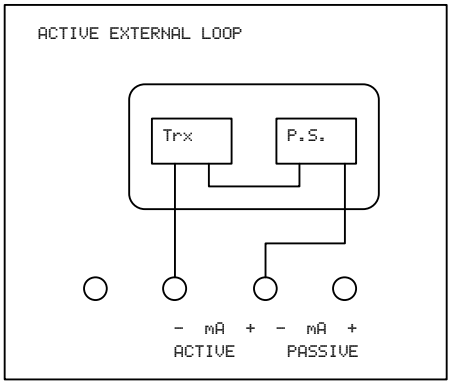
The operator can make additional measurements, while keeping in to memory the previously memory stored data, pressing the <**PAGE**> key obtaining ie. the following indication :

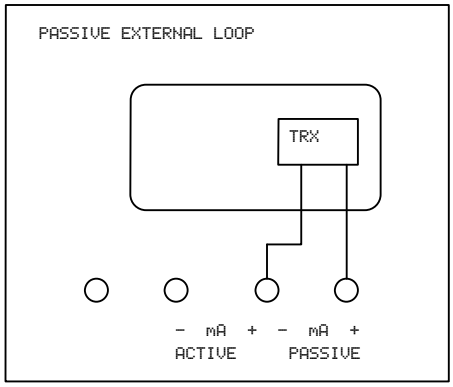


The operator can review all memory stored data pages using the <**PAGE**> key in repeated sequence.
When displayed the operator can cancel the displayed memory stored page (marked with an asterisk) pressing the <**HOLD**> key.

Current measurement on active and passive loops.

The mA input channel of **PCL10/11** can operate directly on active and passive loops. This means that the instrument has an internal power supply able to compensate for the voltage level present into the loop.
If the internal power supply is connected to a short circuit or the load requires more then 20 mA, a message “PS ovc” (power supply overcurrent) will be displayed.
The internal power supply uses an electronic circuit to limit the maximum output current to 25 mA and a fuse, F2 (see Par. 11.2), to preserve itself from external overvoltage and overcurrent.





7.9 Zero adjustment

The pressure sensor installed into the Pressure Module is temperature compensated. However, the pressure transducer could present zero drifting due to a temperature variation exceeding the characterization limits or to a long term working time. Any time the operator requires accurate pressure measurement or to run a leak test, a zero adjustment of the pressure transducer is strongly recommended.
During the normal operative mode the display indication is eg. the following :

```
P1    0.008 Bar
mA1   0.000 mA
```

To run the autozero procedure remove tubings from the pneumatic connector and start the autozero procedure pressing the <**ZERO**> key. The instrument will display an “Autozero” message and a four second countdown :

```
Autozero
Please wait ..4
```

At the end of the countdown the display will confirm that the pressure measurement is now reset to zero as it follows :

```
P1    0.000 Bar
mA1   0.000 mA
```

If the correction required is too high (this can be caused by pneumatic tubes connected to the input terminals) the instrument will display the following message :

```
P1    Zero Er
mA1   0.000 mA
```

Review the pneumatic input connection and try the autozero procedure again through the <**ZERO**> key.
To disable the 'zero correction' switch-OFF the **PCL10/11** (see also Par. 7.6).
If unsuccessful see the indication at Par. 7.6 “Review instrument configuration (Status)”.

7.10 Pressure measurement damping

When measuring a very unstable pressure process, there is a great need of a reading stabilization.
PCL10/11 is equipped with a combination of :

- **working band**
- **average weight**

The working band is used to define the maximum and minimum values between which the process which is being analyzed has to oscillate. The average weight is a value obtainable from the practical use. It is used to define the number of fluctuations into the working band where the average value is to be calculated. The working band, in addition to the weighted average, is used not to have long response times when the oscillations are extremely high. At first the working band should be excluded. Then the entity of the oscillation (in digits) with an average weight set at zero (and working band = Off) should be verified and extimated. This is to say that the maximum value of the pressure oscillation plus the 20% is the value of the working band to be programmed. The weighted average will be increased progressively from 0 to 7 according to the operative requirements.
During the normal operative measurement mode eg. as it follows :

```
P1    0.000 Bar
mA1   0.000 mA
```

- Press the <**DAMP**> key to enable the above described operative mode. A “d” is marked on the right side of the “P” symbol as it follows :

```
P1d   0.000 Bar
mA1   0.000 mA
```

- Press again the <**DAMP**> key to disable this special operative mode.

<u>To install the required calculation data</u> of the “Damp” routine follow the below indicated procedure :

With the instrument in the normal operative mode eg. with the following indication :

```
P1    0.000 Bar
mA1   0.000 mA
```

- Press the <**ENTER**> + <**STATUS**> key to enter the configuration procedure
- Press the <**STATUS**> key several times to obtain the following indication :

```
Damp  P       5 -
Band  P   Off
```

- Press the <**ENTER**> key to select the parameter to be adjusted.
- Press <▲> and <▼> keys to adjust the required value. Remember that with a 0 (zero) setting the parameter will be excluded and the message “Off” will be displayed.

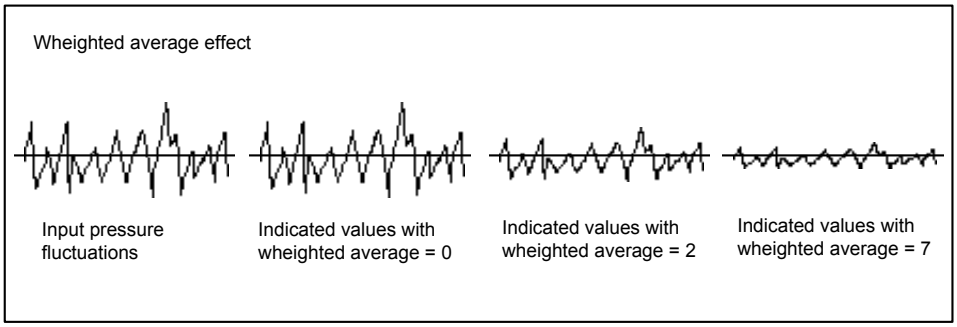
  The adjustment can be as it follows :
  - **Damp P** : from 0 (no damp effect) to 7 (high damp effect- high average weight)
  - **Band P** : from 0 (Off = excluded) to 200
- If the instrument is not equipped with the internal data memory the above selection can be memory stored using <**ENTER**> + <**PAGE**> keys. In this case the data will be kept also when the instrument is switched “Off”.
- Press the <**PAGE**> key to return to the normal operative mode

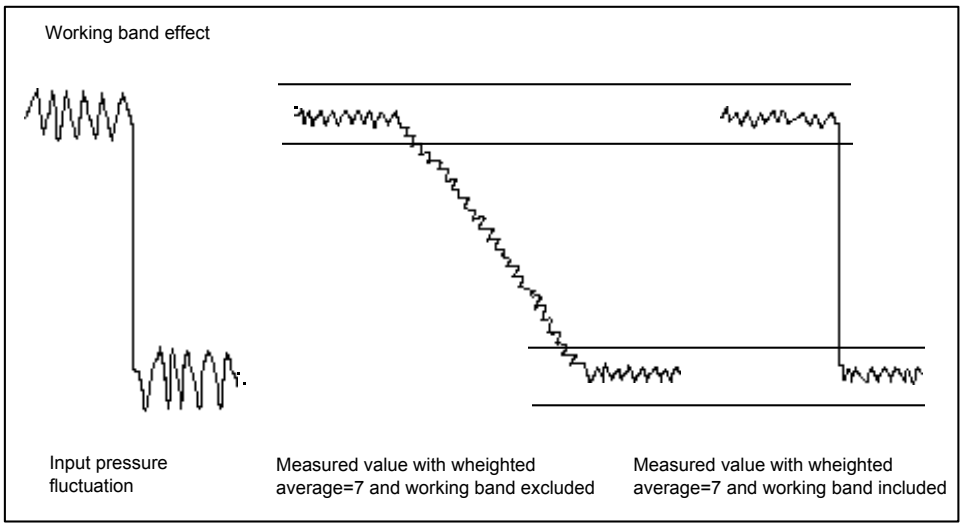
7.10.1 Averaged Value Calculation Algorythm

The working band and the Weighted average allows to measure very unstable processes. In order to use parameters in a correct way, it's useful to understand their working way, which is explained in the following figures:

a) If all the successive acquisitions are always comprised in the working band, the average value will be calculated according to the weighted average programmed.

b) If during the acquisition, the process is subdued to variations exceeding the working band, the algorithm will move the working band (always considering the programmed limits), ensuring a fast response and displaying time.





7.11 Technical unit selection

The required technical unit can be selected as it follows.
With the instrument in the normal operative mode ie. see the following indication :

```
P1    0.000 Bar
mA1   0.000 mA
```

- Press <**ENTER**> + <**STATUS**> keys to abilitate the technical unit selection :

```
Unit P   : Bar ←
In mA/V  : V   --
```

  The arrow on the right side marks which parameter can be modified.

- Press the <**ENTER**> key to select the required line
- Press <▲> or <▼> key to select the required parameter
- Press the <**PAGE**> key to confirm and to memory store the new selection. The instrument will return to the main operative page

The pressure technical units that can be selected are the following :

PSI
mmwc (mmH_2O) / mwc (mH_2O) at 4°C
Bar / mBar
KPa / hPa/MPa
inwc (inH_2O) at 4°C
lbi^2 (lb/in^2)
mmHg / mHg at 0°C
kgc^2 (kg/cm^2) / kgm^2 (kg/m^2)
Atm

The electrical technical units that can be selected are the following :

----	the indication of the second line of the display is disabled.
mA	0 - 20 mA
V	0 - 30 V
X mA	0 - 20 mA with scale factor mode
X V	0 - 30 V with scale factor mode
SWno	test switch normally open
SWnc	test switch normally closed

The selection Bar/mBar, mmwc/mwc, kPa/hPa/Mpa depends on the type of Pressure Module installed.

7.12 Voltage and Current measurements

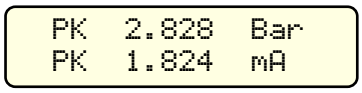
PCL11 is equipped for direct current and voltage measurements.
The ranges are :

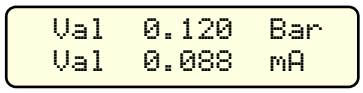
- Volt : 0 ... 30 V with 1 mV resolution
- mA : 0 ... 22 mA with 1 µA resolution

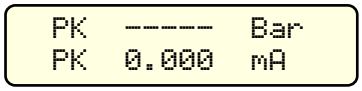
7.13 Peak & Valley measurement

From the start-up the instrument will continuously update the identified maximum (peak) and minimum (valley) values.
The above data can be displayed using respectively :
<**ENTER**> + <**PEAK**> keys for the maximum value
<**ENTER**> + <**VALLEY**> keys for the minimum value.

The display indication will be eg. as it follows :







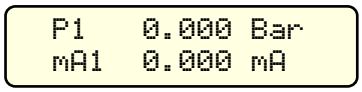
The message "**----**" indicates that a computation error was present therefore no data are available.
The memory stored and displayed minimum and maximum values can be reset using <**ZERO**> + <**HOLD**> keys.

- Press the <**PAGE**> key to return to the normal operative mode.

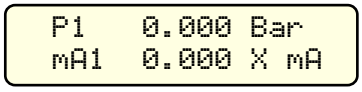
7.14 Scale factor program

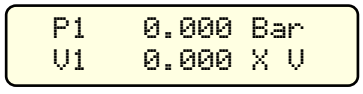
The "scale factor" function is a method with a view to read or to simulate electrical signal values in terms of engineering units.

- From the normal operative mode :

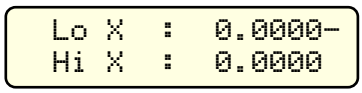


- Press <**ENTER**> + <**STATUS**> keys and then the <**ENTER**> .
- Press <▲> key several times to obtain one of the following indications :



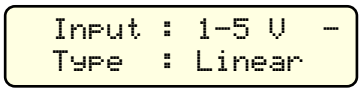


- Press <**STATUS**> key to obtain the following indication :



- The two parameters refer to the technical value required scaled from a linear input electrical signal.
- Press <**ENTER**> key to move the arrow to the right column to mark the required parameter to be adjusted
- Press <▲> and <▼> keys to set the required value. The limits of the setting are -9999 and +30000.
- Press <**STORE**> key to adjust the decimal point position (0.0000 - 0.000 - 0.00 - 0.0 - 0).

- Press <**SET UP/STATUS**> key to confirm the above setting and to memory store the new data. A new display page will be obtained :

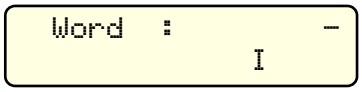


The following input ranges and type of Xscaling are available :

0 - 20 mA
4 - 20 mA
0 - 10 V
1 - 5 V

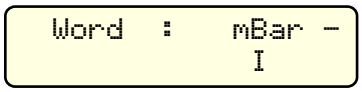
Linear
Square

- Press <**ENTER**> key to move the arrow to the right column to mark the required parameter to be adjusted
- Press <▲> and <▼> keys to set the required value.
- Press the <**SET UP/STATUS**> key to confirm the above setting and to memory store the new data. A new display page will be obtained :



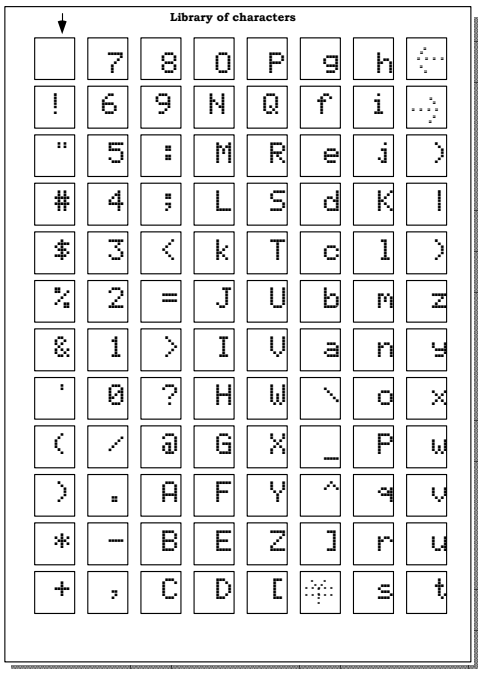
This page allows to load the symbol of the required technical unit to be displayed in this scale factor operative mode. Four alphanumeric characters are available.

- Press <**ENTER**> key to move the arrow to the second line in order to mark the position of the character to be set or modified
- Press <▲> and <▼> keys to set the required character in each of the four position.
- Press <**SET UP/STATUS**> key to confirm the above setting and to memory store the new data. An example of the loaded symbol is the following :



- If the instrument is not equipped with the internal data memory the above selection can be memory stored using <**ENTER**> + <**PAGE**> keys. In this case the data will be kept also when the instrument is switched “Off”.
- Press <**PAGE**> key to return to the normal operative mode

The available procedure alphanumeric characters that can be used as a symbol of the measured or simulated parameter are the following :



When the Scale Factor mode is operative press <**ENTER**> + <**CONV**> keys to obtain the electric signal equivalent to the actual displayed technical unit.

Scale factor principle of operation

The Xscaling mode operates as it follows :

$$Display(linear) = \frac{(Input.mA/V - LO) \bullet (HIx - LOx)}{HI - LO} + LOx$$

$$Display(square) = \sqrt{\frac{(Input.mA/V - LO) \bullet (HIx - LOx)^2}{HI - LO}} + LOx$$

In the above equations the different combinations can be as it follows :

	LO	HI
0 - 20 mA	0	20
4 - 20 mA	4	20
0 - 10 V	0	10
1 - 5 V	1	5

The display page will be eg. as it follows :

```
P1    0.000 Bar
mA1   0.000 xxxx
```

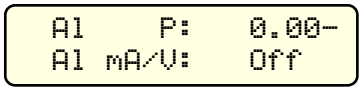
The indication “xxxx” will be “XmA” if no alphanumeric symbol or the previously loaded symbol (up to four alphanumeric characters) has been selected.

7.15 Alarm setting and operative mode

This procedure allows to set the required alarm level.
With the instrument in the normal operative mode with eg. the following indication :

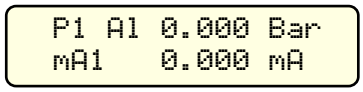
```
P1    0.000 Bar
mA1   0.000 mA
```

- Press the <**ENTER**> + <**STATUS**> key to enter the procedure
- Press the <**STATUS**> key several times to obtain the following indication :



- Press the <**ENTER**> key to move the arrow to the required line of the display
- Press <▲> and <▼> keys to set the required alarm level value. Remember that when the set is 0 (zero) the alarm is excluded and the message “Off” will appear
- Press the <**SET UP/STATUS**> key to confirm the above setting and to memory store the new data.
- Press the <**PAGE**> key to return to the normal operative mode

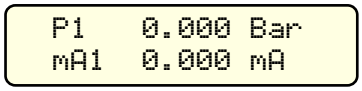
During the normal operative mode the presence of an alarm condition will be announced by an acoustic signal and a message “Al” eg. as it follows :



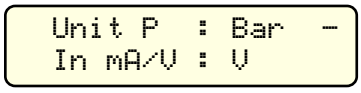
The acoustic signal can be cancelled with the **<ALARM RESET>** key. The message “Al" will be kept in the display. Both the acoustic signal and the message “Al” will automatically disappear when the signal returns below the alarm level.

7.16 Pressure switch test

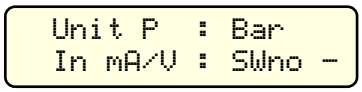
The instrument can be used to test pressure switch but the availability of a pressure pump equipped with a needle valve is required.
When in the normal operative mode with eg. the following indication :

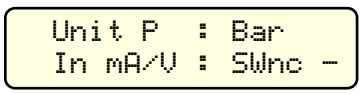


- Press <**ENTER**> + <**STATUS**> keys to enter the general installation procedure



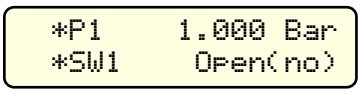
- Move the arrow on the left side of the display to the second line using the <**ENTER**> key
- Press <▲> or <▼> key to select one of the two indications as it follows :





- Press the <**PAGE**> key to acknowledge the selection and to return to the normal operative mode

When a SWno (Switch normally open) has been selected connect the pressure switch to the terminals “mA Passive” on the right side of the instrument. The pressure switch under test opened the contact. When the pressure switch commutates its contact the pressure displayed value will be frozen and marked with an “*”.



- Press the <**HOLD**> key to reset the instrument

An opposite status will be active when operating with normally closed type of pressure switch.
If instead of selecting “SWno” or “SWnc” the operative mode “SW” is selected the instrument can be used to identify the hysteresis value of the pressure switch displaying both sides of the contact switchover.

7.17 Leak test

PCL10/11 provides the ability to detect and quantify leaks in terms of pressure decay over a programmable time.
The instrument will monitor the actual pressure for the programmed time interval and, at the end of the monitoring time period, display the measured change in pressure.
The leak test can be made in vessel, operative gas network or non operative network.
The operative gas network can be checked directly where other applications require the availability of a pump and adaptors.
The leak test mode can be abilitated with keys <**ENTER**> + <**LEAK**> obtaining the following indication :

```
Leak Test
Time:     60 s -
```

- Press the <▲> or <▼> key to adjust the required test time
- Press the <**LEAK/STORE**> key to start the test. A new displayed page with a countdown indication will be shown :

```
Leak Test  -58s
P  :  1.880 Bar
```

- At the end of the test the following displayed page will indicate the total pressure decay (pressure value at the start of the procedure minus the pressure value at the end of the test).

```
Leak Test Result
     0.804 Bar
```

7.18 User's Calibration

The procedure described below allows **PCL10/11** recalibration by using an external pressure reference source. The value that can be used for this purpose must be between 10% and 100% of the span.
The internal microprocessor will align the zero and span values to the reference pressure value.
To recalibrate the unit proceed as follows:

- Switch <**ON**> keeping the <**Page**> key pressed. The display will show :

```
! CALIBRATION !
ENTER PASSWORD
```

- Enter password pressing <**DAMP**>, <**HOLD**>, <**DAMP**> in sequence.
- Press three times the <**STATUS**> key. The display will show the following indication :

```
User Cal    xxx%
X X X X X X X X X
```

(The value indicated above is just an example. You can find a different value.)

- Press <▲> or <▼> keys to set the reference pressure value (in % of the span). If you want to read the reference pressure value in engineering units, press the <**ZERO**> key. For example the display will show :

```
User Cal     85%
X X X X X X X X X
```

<**ZERO**>

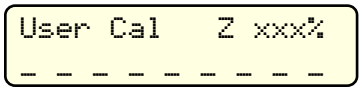
```
User Cal  8.500 Bar
PhNCal : X X X X X
```

The second line shows the actual value measured by A/D converter in digital units.

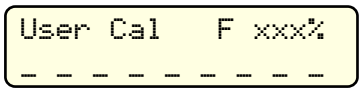
- Press the <**ZERO**> key to return to the previous page.
- Leave inputs HP/LP at zero pressure and press <**PAGE**> to run the zero calibration. On the display a countdown will start :

```
Please Wait  ...1
_ _ _ _ _ _ _ _ <
```

If the zero calibration procedure is inside the limits, you will have the message :

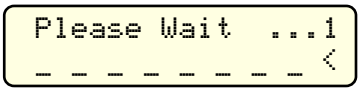


You can proceed with the next step.
If the zero calibration procedure is out of limits, you will have the message :

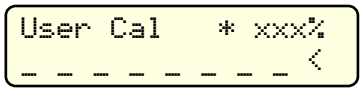


In this case check connections for zero input pressure and restart zero calibration.

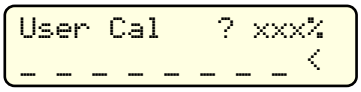
- Press <**ENTER**> to put the cursor on the second line, to generate the reference pressure value and wait for few seconds to stabilize the system. Press <**PAGE**> to start the calibration. The following message will appear on display :



If the calibration is inside the limits, the display will show :



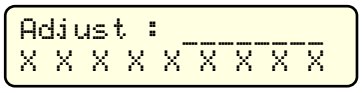
You can proceed with the next step. This means that the User's calibration is accepted.
If the span calibration procedure is out of limits, you will have the message :



In this case, check the connections to the reference pressure source and repeat the calibration procedure by pressing the <**PAGE**> key.

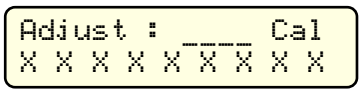
To enable and disable the User's calibration follow the procedure described below :

- With the instrument in operative mode press the <**STATUS**> key until the display shows :



User's calibration disabled

Keeping pressed the <**ENTER**> key press the <**STATUS**> key to enable the User's calibration. The display will show the following message :



User's calibration enabled

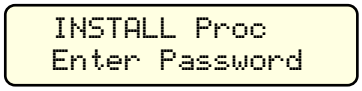
Repeat the same procedure to disable the User's calibration.

The User's calibration won't erase **OMEGA** factory calibration. When enabled, it can be used by the customer to define a personal work range. When disabled the instrument will work with the factory calibration ignoring the other.

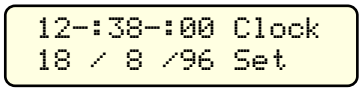
8 INSTRUMENT CONFIGURATION

The configuration of the instrument can be modified using the following procedure :

- The procedure starts with the instrument switched -Off-.
- To enter the configuration procedure keep the <**STATUS**> key pressed and press the **<ON>** key to obtain the following indication :



- Press <**ENTER**>, <**STORE**>, <**ENTER**> in sequence to obtain the following indication :



If the real time clock is not installed all the above numbers are replaced with 0.

- Press the <**ENTER**> key to select the parameter to be modified
- Press the <▲> or <▼> key to adjust the new value
- Press the <**STATUS**> key to confirm and to memory store the new data. A new display page will be shown as it follows :

The digital communication speed can be selected from : 300, 600, 1200, 2400, 4800, 9600, 19200

- Press the <**STATUS**> key to confirm and to memorize the new data.
- Switch the instrument -**Off**- to exit from the configuration procedure.

9 CalpMan Application PC Software

9.1 Introductory note

Standard Agencies and Quality Auditors require the collection, the organization and analysis of traceability documents for all the equipments installed in the process or used in laboratory.
A supporting software for Windows **Calpman** (**Cal**ibration **P**rocedure **Man**ager) is available, and supplied together with a memory module installed into the instrument and a digital interface cable when the Table D=1 option is specified, to transfer a selection of calibration routines from a PC to the internal memory of the instrument in order to simplify field calibrations selecting the appropriate tag number.
Test and calibration data can be memory stored and downloaded to a PC to document the calibration activity that allows to build a quality control chart/data bank from a single calibration sheet to a detailed historical report.
Each instrument, called “Tag”, to be calibrated/inspected is identified by a 16 alphanumeric characters.
Three additional lines of 16 characters are available for a more detailed description of the instrument to be calibrated. A typical example is shown below :

Tag = Pressure Trx 128
Auxiliary information = High temp trap
Area n.21T68
Stafford Station

The overall capabilities of the combination **PCL10/11** + **CalpMan** software are the following :

- PCL10/11 can store up to 50 Tags
- Each Tag can be tested at up to 5 different calibration steps (P **T**est **P**oint)
- Each Tag can be identified with an alphanumeric code of 16 characters
- Plant location/Plant section can be identified with three additional lines every 16 alphanumeric characters
- The Operator/Inspector’s name can be written with up to 16 alphanumeric characters
- Test procedure can be prepared on a PC and downloaded to a **PCL10/11** when required
- Test procedure can be eventually directly loaded in the field and downloaded to the PC
- Direct test of Pressure gauges or pressure analog/digital indicators
- Direct test of Pressure Transmitters with comparison P inlet to electrical signal output
- Direct test of Pressure Transmitters with comparison P inlet to scaled pressure technical unit
- Direct test of Pressure Transmitters at actual programmed Pressure test point or with automatic calculation of actual error with inlet pressure in an acceptable deviation band from the Pressure Test Point level.

9.2 Software Installation

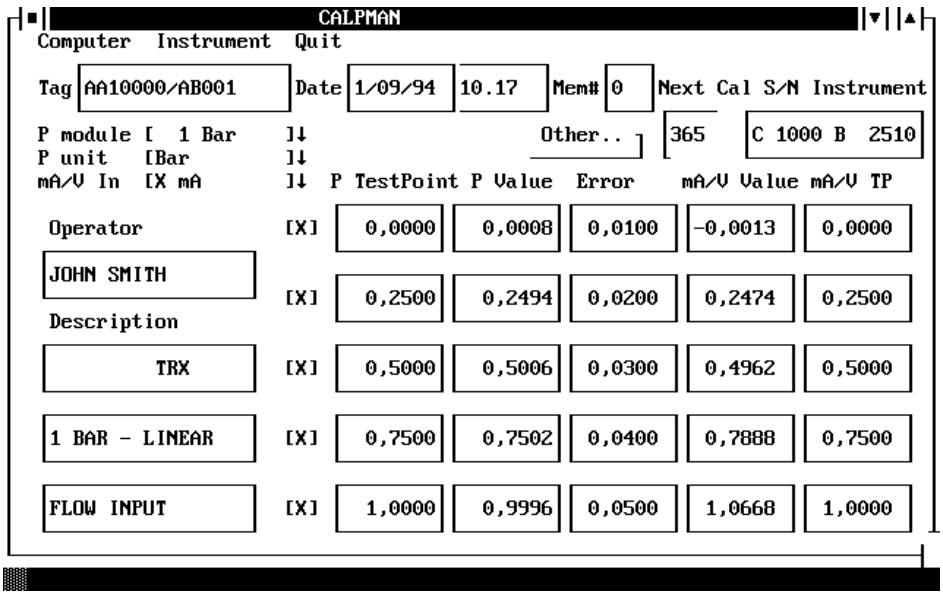
Calpman runs on IBM PC under WINDOWS 3.1. Minimum requirements are a 386 CPU with 2Mbyte Ram and 1 Mbyte on hard disk, Monochromatic or colour monitor and a Microsoft mouse or a compatible one.
In order to install **Calpman** for Windows, follow the below procedure:

- Place the **Calpman** disk in a 3.5" diskette drive;
- From the Windows Program Manager's File Menu, select **<RUN>**;
- Enter the filename A:SETUP.EXE (substitute the letter A for the disk drive that contains **Calpman** diskette)
- Follow the on screen instructions making sure to provide the correct path to your **Calpman** directory when prompted.

Once installed, the **CalpMan** icon will appear on your Windows screen and it will be possible to boot it by clicking on the icon as usual.

9.3 General structure of the CalpMan software

The general structure of the **CalpMan** software can be easily explained taking into consideration the following PC “Tag” main page and the auxiliary page relevant to “Other” parameters.



The understanding of the above page content requires the explanation of the terminology used and of the objective (or result) of each parameter taken into consideration.

Tag
16 alphanumeric characters are available to load the identification code of each component/equipment/instrument that has to be periodically inspected.
eg. Pressure Trx 128 or P Trx 128/21/T68

Note
Three lines, each of 16 alphanumeric characters, are available to load additional identification information eg. relevant with the section of the process, the area and the name of the plant as it follows :

High Temp Trap
Area n. 21/T68
Stafford Station

Operator
16 alphanumeric characters to identify the name of the operator/inspector responsible for the practical inspection and/or reallignement
eg. J.H.Bellamy

Date
Actual date or inspection or verification. The date is automatically loaded from the internal real time clock of the instrument.

Mem#
Memory slot number automatically loaded during downloading procedure from the PC

Next Cal
Time interval for the next calibration (or calibration interval time) required by the considered “Tag”

S/N Instrument
Serial number of the PCL10/11 used.

P module
The full scale of the pressure module installed on **PCL10/11** (eg. “10 bars” pressure module)
Can be selected using the installed library.

P unit
The technical unit to be used that can be selected from the installed library (eg. mbar, bar, psi, mmH2O, inH2O, inHg, mmHg, kPa, atm)

mA/V In
The electrical parameter of the pressure transmitter output that can be selected between “V” and “mA”

P TP
Test Point value of pressure required for a full inspection of the relevant “Tag”.
Up to 5 test points are available (eg. for a pressure gauge 0-10 bars the test point could be 0 - 2.5 - 5 - 7.5 - 10 bars.

P value
Actual pressure value recognized during the test and automatically loaded during the test procedure.

P error
Actual error automatically loaded during the test procedure

mA/V Value
Actual electrical signal measured at the relevant test point

mA/V TP

()
When full required pieces of information are loaded for the specific test point a “x” mark will confirm the instrument acknowledgement

Three general buttons are present on the top right of the main page :

Quit
Press this button to exit the CalpMan procedure. The following subpage will be displayed :

- **About**
  Gives general information relevant with the calpman - Calibration Procedure Manager software package.
- **Config**
  This page allows the configuration of the digital communication data of the PC to be used with the CalpMan software package.
  Require the identification and the selection of the communication port COM 1 or COM 2 of the PC.
  Require the setting of the transmission rate of the PC that should be the same value used into the configuration of **PCL10/11** (19200 - 9600 - 4800 - 2400 - 1200 - 600 - 300)

Instrument
Allows the selection of the below indicated activities :

- **Load from instrument**
  To load a test procedure from the internal memory of the **PCL10/11** to the PC memory.
- **Save on Instrument**
  To save the active test procedure, relevant with a specific Tag code, into the **PCL10/11** memory.
  A further message requires confirmation.
- **Clear Tag**
  To cancel one Tag from that installed in the **PCL10/11** memory.
  A further message requires confirmation.
- **Clear All Tags**
  To cancel all Tag procedures installed in the **PCL10/11** memory.
  A further message requires confirmation.

Computer
Allows the selection of the below indicated activities :

- **Load from file**
  To load on the CalpMan main page a test procedure memory stored on the PC.
- **Print**
  Allows the printout of the specific PC data page.
- **Clear tag**
  To clear the active Tag data page
- **Clear Tag result**
  To clear data relevant to a specific Tag code.
- **Other parameters**
  To display the “Other” parameter page

Other
Press this key to obtain the “Other” parameter page as indicated below, relevant with the scale factor data and auxiliary parameters.

In X
To select and memory store the required input signal from the list of ranges installed into the library of the program (0-20 mA, 4-20 mA, 0-10 V, 1-5 V).

Type X
To select the scale factor mode “Linear” or “Square”.

Dp X
To select and memory store the required position of the decimal point among 0.0000-0.000-0.00-0.0-0.

Lo X
To load the zero value of the technical unit range (eg. 0 bar).

Hi X
To load the full scale value of the technical unit range (eg. 80 bar).

Word X
To load the technical unit symbol relevant with the scale factor mode (eg. bar)

Alarm P
To load the required pressure alarm value (if required).

Alarm mA/V
To load the required input signal alarm value (if required)

Damp
Damp Band
see paragraph 7.10 for a better understanding of the “Damp” operative mode useful to obtain a good reading in-situ in presence of an unstable pressure process.
The use of the relevant “Damp” weight and “Damp Band” will allow repeatitive tests for higher accuracy.

Automatic Error
Enables or disables the automatic error mode

Error Band
To load the required error band value

Return
Press this key to return to the “Tag” main page

9.4 Pressure gauges test

This procedure allows to test pressure gauges or pressure digital indicators.
PCL10/11 must be connected to the pressure gauge and, using a tee adaptor, to a manual pump.
Pump pressure on the circuit to reach a pressure value below the Test point and then use the volume adjuster of the pump to obtain, on the pressure gauge dial, the required Test Point value.
The **CalpMan** software is equipped with a special routine for the automatic recognition of the deviation of the actual setting of the pressure gauge from the Test Point value setting compared with the preloaded error band.

9.5 Pressure transmitter test

This procedure allows the test of pressure transmitters.
This procedure can be programmed to be run comparing the input pressure with the electrical signal output or, using the scale factor mode, through a direct comparison of homogeneous data (eg. bars against bars).
As an accurate setting of the pressure level with a manual pump is critical, to simplify the operation, the **CalpMan** software is equipped with a special routine that allows to run a test and to identify the deviation error, on a specific Test point value, using any pressure Test Point setting inside a stated and acceptable band.
The system will recognize the generated pressure level and automatically compare it with the appropriate proportional deviation on the output signal.

9.6 Test result printout from PCL10/11

Directly from **PCL10/11**, using the optional impact type printer, a Report of Calibration can be obtained pressing the <**PRINT**> key.
A typical example is shown below :

```
PCL10/11

S/N B 65588
#C 65589 v 1.005

TAG Plant code
Pressure Trx 128

14 :42 28/11/96

Memory Report  0

TP1    -1.000 PSI
P1     -1.206 PSI
mA1     0.000emA
TP1    -1.000 mA
ErA     0.100 mA

TP3     3.000 PSI
P3      3.200 PSI
mA3     3.583 mA
TP3     3.000 mA
ErA     0.300 mA

ST4     4.000 PSI
P4      4.480 PSI
mA4     4.051 mA
TP4     4.000 mA
Er      0.051 mA

ST5     5.000 PSI
P5      5.588 PSI
mA5     5.388 mA
TP5     5.000 mA
Er      0.388 mA

High Temp Trap
Area n. 21T68
Stafford Station

Operator
J.H.Bellamy

...............
```

9.7 Test result printout from PC

A full Report of calibration per each specific Tag test can be obtained from the PC using **CalpMan**.
An example of a typical Report of Calibration is shown below.

Report of Calibration

OMEGA PCL10/11 S/N 65588B 65589
Module : 1 Bar
Pressure Unit : kpa
mA/V input : X mA

X scaling input : 4-20 mA
X scaling type : Linear
X scaling Lo : 10.0 mbar
X scaling Hi : 1000.0 mbar

Time : 22 :32 Date : 28/11/96

TAG : Pressure Trx 128

Description :
High temp trap
Area n. 21T68
Stafford Station

TP P	Value	TP mA/V	Value	Error
1.10	-8.31	3.0	-238.5	2.2 E
1.20	-8.31	3.1	-237.5	2.3 E
1.30	-8.31	3.2	-237.5	2.4 E
1.50	-8.32	3.4	-237.5	2.6 E

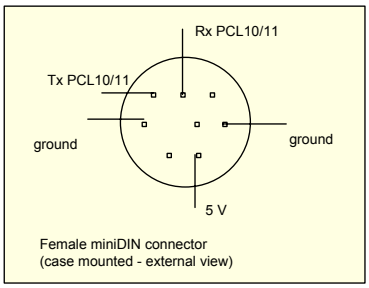
Error Method : Automatic
Operator : J.H.Bellamy

10 Digital interface

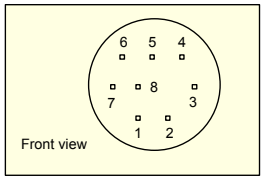
The **PCL10/11** portable indicator is equipped with a digital interface.
The interface circuit is essentially based on the serial communication interface subsystem (SCI) on the chip of the microcontroller.
The output voltage levels are TTL at 0 to +5 V.
An optional adapter to convert the voltage level from 0 to +5 V, to the RS232 levels, can be supplied on request.
This adapter is required to interface **PCL10/11** with a Personal Computer.

10.1 Digital output wiring practice

The wiring to the digital output signals is made through a mini DIN connector mounted on the lower end of the case.
The pertinent connections are indicated below.



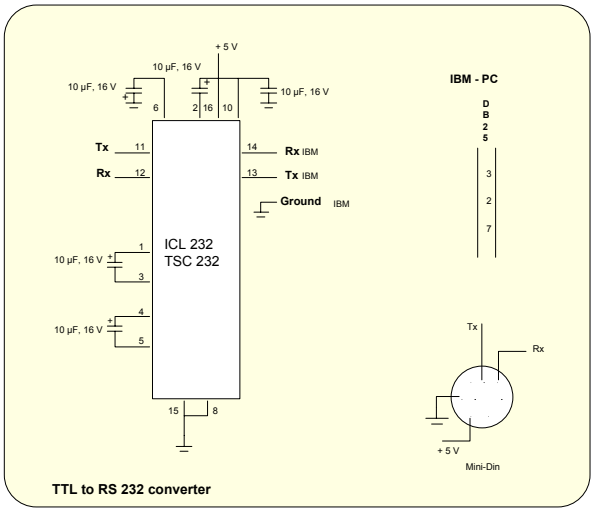
For easy interconnections a miniDIN connector with cable can be supplied on request. The color codes of the conductor can change with different suppliers; please check them before using.



	LINDY	**CINCH**
pin 1 :	brown	black
pin 2 :	red	green
pin 3 :	green	blue
pin 4 :	gray	gray
pin 5 :	purple	yellow
pin 6 :	blue	white
pin 7 :	orange	red
pin 8 :	yellow	brown

10.2 TTL to RS 232 adapter

The cat. BB530001, TTL to RS232 adapter, consists of a cable to which are connected a male mini DIN connector (for **PCL10/11**) and a DB 25 connector, that contains the electrical circuitry (for the PC).
The basic circuit and connections are as follows:



10.2.1 Communication protocol from PCL10/11 to a PC

The exchange of information when a **PCL10/11** is interconnected with a PC is as follows:

COMPUTER REQUEST

Computer		**PCL10/11**	
Tx IDNAME	→	Rx IDNAME	Proceed if the name is acknowledged
Rx IDNAME	←	Tx IDNAME	If not, do not answer
Tx Instruction	→	Rx Instruction	
Rx Instruction	←	Tx Instruction	
Tx char	→	Rx char	
Rx DATA 1	←	Tx DATA 1	
Tx char	→	Rx char	
Rx DATA 2	←	Tx DATA 2	
Tx char	→	Rx char	
Rx DATA 3	←	Tx DATA 3	
Tx char	→	Rx char	
Rx DATA 4	←	Tx DATA 4	
Tx char	→	Rx char	
Rx CHKSUM	←	Tx CHKSUM	

IDNAME, Instruction, DATA 1, DATA 2, DATA 3, DATA 4 and CHKSUM are 8-bit values (1 byte)

Notes	**Instruct**	**DATA 1**	**DATA 2**	**DATA 3**	**DATA 4**
Actual value mA / V	3	Value Hi(actual)	Value Lo(actual)	display(actual)	lin(actual)
Actual value Pressure	15	Value Hi(actual)	Value Lo(actual)	display(actual)	linP(actual)

display = (decimal point)	0	= 1.9999 (/ 10'000)
	1	= 19.999 (/ 1'000)
	2	= 199.99 (/ 100)
	3	= 1999.9 (/ 10)
	4	= 19999 (/1)
lin =	1	= mA
	2	= V

	3	= X mA
	4	= X V
lin P=	0	= PSI
	1	= mmwc (H_2O)
	2	= Bar
	3	= Pa
	4	= inwc (H_2O)
	5	= lbi2 (lb / in^2)
	6	= in Hg
	7	= mm Hg
	8	= torr
	9	= $Kgcm^2$
	10	= Atm

You can find some differencies using different pressure module due to range (Bar can be mBar) .

value = 2nd complement (16 bit) Value Hi x 256 + Value Lo

CHKSUM (checksum) = (DATA1 + DATA2 + DATA3 + DATA 4).AND.FF

What is stated above is useful to verify the integrity of transmitted and received data

The minimum time-out of **PCL10/11** is 5 seconds.

10.2.2 Computer request for PCL10/11 settings

The computer must split a 16 bit word into 2 words of 8 bits as follows

Value Hi (....)	Value Lo (....)
Higher 8 bits	Lower 8 bits

Computer		**PCL10/11**	
Tx IDNAME	→	Rx IDNAME	Proceed if name acknoledged
Rx IDNAME	←	Tx IDNAME	If not, do not answer
Tx Instruction	→	Rx Instruction	
Rx Instruction	←	Tx Instruction	
Tx DATA 1	→	Rx DATA 1	
Rx char	←	Tx char	
Tx DATA 2	→	Rx DATA 2	
Rx char	←	Tx char	
Tx DATA 3	→	Rx DATA 3	
Rx char	←	Tx char	
Tx DATA 4	→	Rx DATA 4	
Rx char	←	Tx char	
Tx CHKSUM	→	Rx CHKSUM	
Rx char	←	Tx char	

PCL10/11 receives and verifies CHKSUM; when it isn't valid, it does not accept the transmitted data

Notes	**Instr**	**DATA 1**	**DATA 2**	**DATA 3**	**DATA 4**	**A B**
Set mA/V	25	Lin	x	x	x	--------
Set Pressure	26	LinP	x	x	x	--------

lin =	1	= mA
	2	= V
	3	= X mA
	4	= X V
lin P=	0	= PSI
	1	= mmwc (H_2O)
	2	= Bar
	3	= Pa
	4	= inwc (H_2O)
	5	= lbi2 (lb / in^2)

6	= in Hg
7	= mm Hg
8	= torr
9	= $Kgcm^2$
10	= Atm

You can find some differencies using different pressure module due to range (Bar can be mBar) .

CHKSUM = (DATA1 + DATA2 + DATA 3 + DATA 4) .AND.7F

10.2.3 Communication programs

You can find illustrated in this paragraph two examples of communication programs between **PCL10/11** and an IBM or IBM compatible PC.

Example A: (data transfer from PCL10/11 to a PC)

Set BAUD RATE=9600 on **PCL10/11**. Connect **PCL10/11** through adapter BB530001 (TTL-RS232 converter), to the personal computer communication port COM1.
Set **PCL10/11** in mBar/Bar. Run the program and the computer screen will display the actual reading value (once).

Example B: (PC instructions to PCL10/11)

Set BAUD RATE=9600 on **PCL10/11**. Connect **PCL10/11** through adapter BB530001 (TTL-RS232 converter), to the personal computer communication port COM1.
Set **PCL10/11** in mBar/Bar; run the program and **PCL10/11** will be set automatically to kPa.

A:

```
1Ø      CHAR = Ø
2Ø      IDNAME = 1
3Ø      INSTRUCTION = 15
35      OPEN "COM1: 96ØØ, N,8,1,CD,CS,DS,RS" FOR RANDOM AS # 1
4Ø      PRINT #1, CHR$ (IDNAME): REM TRANSMIT IDNAME TO PCL10/11
5Ø      WHILE LOC (1) = Ø: WEND: REM WAIT RECEIVING IDNAME FROM PCL10/11
6Ø      IDNAME = ASC(INPUT$ (1, 1)): REM READ RECEIVED IDNAME FROM PCL10/11
7Ø      PRINT #1, CHR$ (INSTRUCTION);
8Ø      WHILE LOC (1) =  Ø: WEND
9Ø      INSTRUCTION = ASC (INPUT$ (1, 1)
1ØØ     PRINT #1, CHR$ (CHAR);
11Ø     WHILE LOC (1) =  Ø: WEND
12Ø     DATA 1 = ASC (INPUT$ (1, 1))
13Ø     PRINT #1, CHR$ (CHAR);
14Ø     WHILE LOC (1) =  Ø: WEND
15Ø     DATA 2 = ASC (INPUT$ (1, 1))
16Ø     PRINT #1, CHR$ (CHAR);
17Ø     WHILE LOC (1) =  Ø: WEND
18Ø     DATA 3 = ASC (INPUT$ (1, 1))
19Ø     PRINT #1, CHR$ (CHAR);
2ØØ     WHILE LOC (1) =  Ø: WEND
21Ø     DATA 4 = ASC (INPUT$ (1, 1))
22Ø     PRINT #1, CHR$ (CHAR);
23Ø     WHILE LOC (1) =  Ø: WEND
24Ø     CHKSUM = ASC (INPUT$ (1, 1))
25Ø     IF CHKSUM <> ((DATA1 + DATA2 + DATA3 + DATA4) AND &HFF) THEN PRINT "Error": END
26Ø     VALUE = DATA1 * 256 + DATA2
27Ø     IF VALUE > 32767 THEN VALUE = 65536 - VALUE: REM 2'S COMPLEMENT
28Ø     PRINT "VALUE: " ; VALUE / 10 ^ ( 4 – DATA3 )
29Ø     END
```

B:

```
1Ø      CHAR = Ø
2Ø      IDNAME = 1
3Ø      INSTRUCTION = 56
4Ø      DATA1 = 3
7Ø      DATA2 = Ø
```

```
75        DATA3 = Ø
8Ø        DATA4 = Ø
9Ø        CHKSUM = (DATA1 + DATA2 + DATA3 + DATA4) AND &H7F
13Ø       OPEN "COM1: 96ØØ,N,8,1,CD,CS,DS,RS" FOR RANDOM AS #1
14Ø       PRINT #1, CHR$ (IDNAME)  ; : REM TRANSMIT IDNAME TO PCL10/11
15Ø       WHILE LOC (1) = Ø: WEND: REM WAIT RECEIVING IDNAME FROM PCL10/11
16Ø       IDNAME =  ASC (INPUT$ (1 , 1)): REM READ RECEIVED IDNAME FROM PCL10/11
17Ø       PRINT #1, CHR$ (INSTRUCTION) ;
18Ø       WHILE LOC (1) = Ø : WEND
19Ø       INSTRUCTION = ASC (INPUT$ (1 , 1))
2ØØ       PRINT #1, CHR$ (DATA1) ;
21Ø       WHILE LOC (1) = Ø : WEND
22Ø       CHAR = ASC (INPUT$ (1 , 1))
23Ø       PRINT #1, CHR$ (DATA2) ;
24Ø       WHILE LOC (1) = Ø : WEND
25Ø       CHAR = ASC (INPUT$ (1 , 1))
26Ø       PRINT #1, CHR$ (DATA3) ;
27Ø       WHILE LOC (1) = Ø : WEND
28Ø       CHAR = ASC (INPUT$ (1 , 1))
29Ø       PRINT #1, CHR$ (DATA4) ;
3ØØ       WHILE LOC (1) = Ø : WEND
31Ø       CHAR = ASC (INPUT$ (1 , 1))
32Ø       PRINT #1, CHR$ (CHKSUM) ;
33Ø       WHILE LOC (1) = Ø : WEND
34Ø       CHAR = ASC (INPUT$ (1 , 1))
35Ø       PRINT "Trasmitted."
39Ø       END
```

11 MAINTENANCE

The **PCL10/11** portable 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 Engineering, inc. will supply, on request, a technical reference manual, with all instructions and recommendations for service and calibration.
OMEGA Engineering, inc. engineers will give prompt support for any requests of assistance.

11.1 General recommendations

The total volume of the test circuit must be necessarily kept as small as possible ; as a consequence also small variations of the circuit volume bring about immediate in pressure variations.
Ideally, the parts of the pneumatic circuit shouldn't modify their volume when a variation of the temperature or of the pressure occur. Otherwise, continuous adjustments will be necessary.
The most critical component of the test circuit is the PVC flexible pipe that, if not carefully selected, may undergo great volume variations for its intrinsic elastic property. It is advisable to use PVC flexible pipes with thick-wall (6x4 mm) or Rilsan rigid pipes with 6x2 mm wall to prevent the above listed problems.
The same flexible pipe must be used for what is left of the pneumatic circuit. Don't use low cost or thin-wall PVC or plastic pipes .
If you don't consider the above recommendations, you should take into consideration volume variations in the circuit and the consequent necessity of pressure adjustment to keep it at the desired valve.

11.2 Safety recommendations

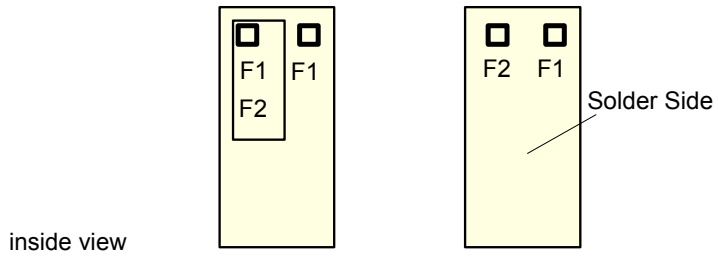
Pressure transducer/transmitters are normally linked to electrical potentials equal or near the ground potential.
However, in some applications, there may be present a common mode voltage to earth.
Check for voltage between input terminals and the ground, as this voltage can be transmitted to other devices connected to the indicator/calibrator.

11.3 Protection fuses replacement

The instrument is protected with self limiting circuits and slow blow fuses as follows:

IN Mode (V)
The input circuit is intrinsically protected up to 50 V by the input circuit high impedance.

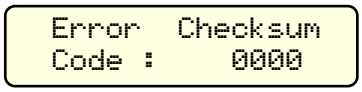
IN Mode (mA)
The input circuit is protected by the slow blow F1 fuse (100 mA) installed on the mother board of the instrument.



OUT Mode passive loop (24Vdc)
The output circuit is protected by the electronic limiter and by the slow blow F2 fuse (50 mA) installed on the mother board of the instrument.

11.4 Faulty operating conditions

During the start-up the presence of faulty conditions of the instrument is announced, with coded messages as ie. it follows:



The presence of four “0” in the “Code” line indicates that no faulty conditions were identified during the start-up routine.
The presence of one or more “0” indicates that data are possibly lost as it follows :

1	**1**	**1**	**1**
Set-up data (baud rate, language, etc.)	Calibration data (mA, V, module normalization)	Pressure Module user calibration	Pressure Module calibration matrix data

If the faulty condition is critical for the type of application, it is recommended to re-run the pertinent set-up procedure.

11.5 Storage

If the instrument has been left unused for a long time, it is recommended to remove the batteries.
Store the instrument in the original package, at a temperature from -20°C to +60°C, with R.H. less than 90%.
If the instrument has been unused for a month check the battery voltage, and charge the Ni-MH batteries for at least 12 hours.

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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