Edwards

Instructions
07-D386-37-881
January 1986

Series 1000 Vacuum gauges & Controllers

Model

Controller 1105 Pirani Penning

Ordering number

07-D386-37-000 mbar
07-D386-38-000 torr

Contents

Illustrations

Safety

Before connecting the instrument to a vacuum system you are recommended to read these instructions to enable full use of all the facilities available to be made.

Warning

High voltages exist within the unit when the power is on. All standard safety procedures associated with the safe handling of electricity must be observed.

Warning

An instrument failure, gross RF interference or poor power supply could cause a malfunction of a relay output. If malfunction of a relay could cause danger to life or limb, additional safeguards must be taken.

Caution

It is important to check the mains input supply voltage setting on the rear panel. There are four voltage settings 100V, 120V, 140V, 200V 220V and 240V.

e.g. If your supply is 220V and the unit is set to 240V the unit will not run properly. In this case set the unit to 220V. Adjustment instructions for setting the voltage on the rear panel are detailed in the installation section of these instructions.

1 General description

The Controller 1105 is one of a new range of microprocessor based instruments for vacuum measurement and process control. This model operates two Pirani and heads and one Penning gauge head and covers the pressure range 1000 to 5 x 10^{-8} mbar. It will also measure in units of pascal or torr. The range is covered by four Pirani gauge heads, Edwards PRL10, PRM10 (PRM10CR corrosion resistant) PRH10 and one Penning gauge head CP25. The individual pressure ranges are detailed in section 2-Specification. There are four independant relays on the relay module, each giving set points for pressure control. These may be allocated to any or all heads at option. A stick-on label is provided to enable gauge heads and set-points to be recorded.

The instrument has a large easy to read crystal display (LCD). The pressure and the head selected is displayed. The gauge head required being selected by the up △ down ▽ controls on the front panel. The Penning gauge head can be switched ON/OFF manually when it is selected (gauge No. 3 selected and © is pressed), or automatically by Pirani gauge head No. 1 pressure circuit. This operates at approximately 10^{-1} mbar, see figure 3. When used automatically both gauge heads should be positioned in the same vacuum chamber (No. 1 and No. 3). When the Penning gauge is selected the display will indicate PE = 0 (Penning gauge switched off), PE =1 (Penning gauge switched on) or PE = ? (Penning switched by Pirani).

The Pirani module has two recorder outputs one for each channel. These are taken to a 3-pole chassis socket on the rear of the unit (figure.1). The Penning module has a similar arrangement, a single 3-pole chassis socket to cover it complete range (figure 1). A 3-pole connector plug is provided with each module. Connexion details are given in Installation at 3.4. A graph of recorder output of voltage/pressure for each gauge head is supplied with these instructions.

1.1 Memory back-up

A new memory back-up system is provided which enables the pressure set-points set by the operator to be held in memory when the power supply fails or is switched off. When power is restored the set-points are immediately re-established.

This system operates without the need for a battery. An E^2PROM/RAM (Electrically Erasable and Programmable Read Only Memory/Random Access Memory) arrangement enables data to be transferred automatically from the RAM to E^2PROM whenever it is altered. At power switch-on, the data stored in E^2PROM is reloaded into RAM.

1.2 Pirani operating principle

Pirani gauges depend on the fact that, at low pressures, the thermal conductivity of any gas varies with the pressure, because the number of molecules available to transport heat diminishes as the pressure falls. The interior of the gauge head is open to the vacuum system, and contains a metal filament that is heated by an electric current from the Pirani module. The filament forms one arm of a Wheatstone bridge, which is mounted in the gauge head. As pressure falls, the rate of heat loss from the filament to its cool surroundings diminishes, so the filament temperature tends to rise, and therefore its electrical resistance. This tends to unbalance the Wheatstone bridge. The out-of-balance voltage is applied to an electronic servo, which adjusts the electrical supply to the bridge, so as to keep the filament temperature constant. The varying bridge voltage is measured by the electronic circuits and is displayed as a voltage, or pressure, as required.

1.3 Penning operating principle

A high voltage (2.7kV) is provided by the instrument power circuits to operate the Penning gauge head. The voltage is applied between the anode and cathode electrodes in the head. A glow discharge is produced when the pressure inside the head is reduced to about 100 mbar. Electrons are drawn from the cathode and accelerate towards the anode. A magnetic field provided by surrounding magnets deflects the electrons passing through the field so that they follow a complex spiral path. Collisions occur with the gas molecules present causing ionization, producing positive ions and additional electrons. Both causing further ionization. The sum of the positive ion current to the cathode and electron current to the anode, constitutes, the gauge head current. This current forms the output.

The output current is approximately proportional to the gas pressure up to about - 10^{-4} mbar. At higher pressures the current rises at a diminishing rate until it reaches a maximum at about 1 mbar, thereafter falling until the discharge goes out at about 100 mbar. When the pressure is reduced from atmosphere, the current varies in approximately the same way in reverse.

The output current from the gauge head is processed by the instrument electronics to form the outputs to operate the display circuits and recorder outputs.

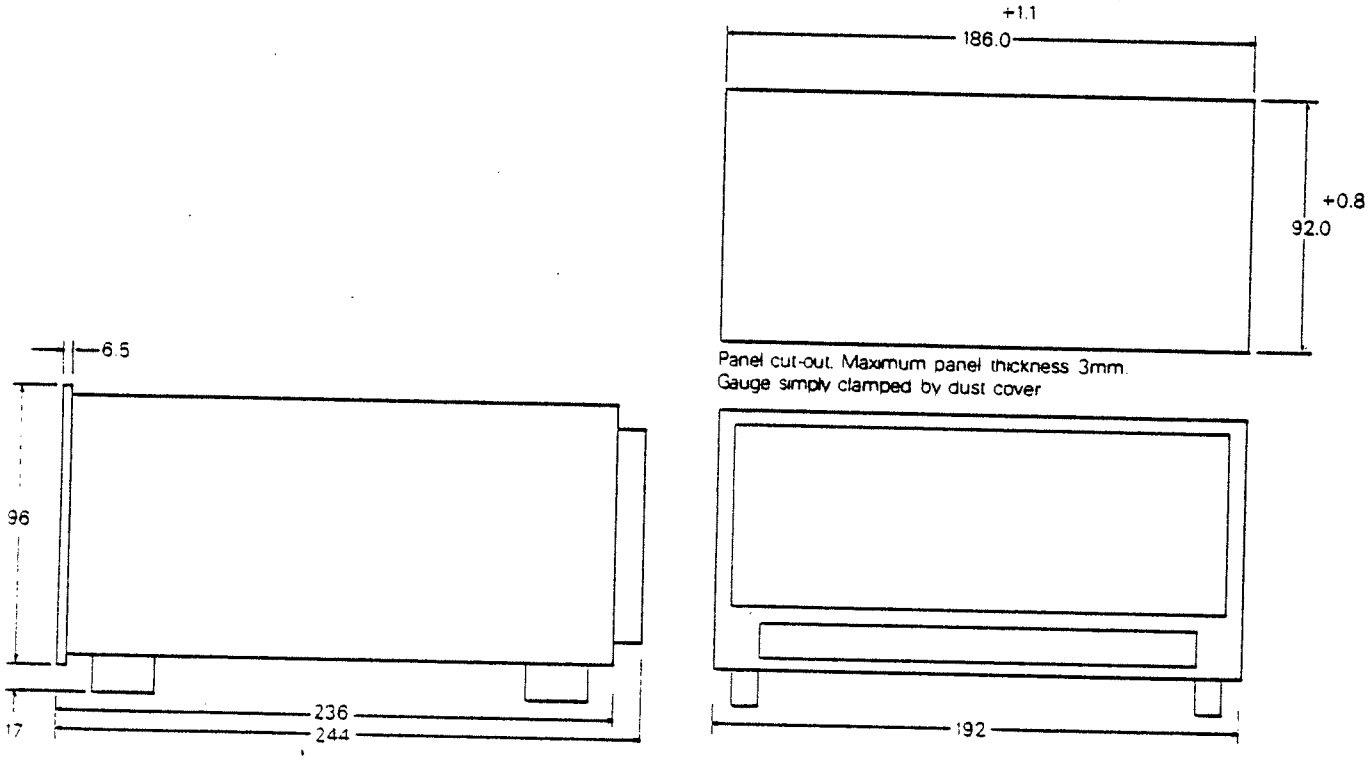
2 Specification

Pressure range	1000 to 5 x 10^{-8*} mbar
Display	Liquid crystal (LCD)
Gauge heads:	
Pirani PRL10	10 to 10^{-4} mbar
Pirani PRM10	200 to 10^{-3} mbar
Pirani PRM10CR (corrosion resistant)	200 to 10^{-3} mbar
Pirani PRH10	1000 to 10^{-3} mbar
Penning CP25	10^{-2} to 5 x 10^{-8*} mbar *with indium seal
Recorder outputs:	
Pirani (A or B)	-0 to -10V d.c. at 100 Kohms load (1 Kohm output resistance giving a maximum current of 5mA into a 1 Kohm load).
Penning (A) high range 10^{-2} to 1.2 x 10^{-5} mbar	0 to -10V d.c. at 100 Kohms load (1 Kohm output resistance giving a maximum current of 5mA into a 1 Kohm load).
Penning (B) low range 2.5 x 10^{-5} to 5 x 10^{-8} mbar	0 to -10V d.c. at 100 Kohms load (1 Kohm output resistance giving a maximum current of 5mA into a 1 Kohm load).
Relays:	Four independant relays RLA, RLB, RLC and RLD, each with adjustable upper and lower set-points.
Contact rating	8A at 240V a.c. Can be connected normally open or normally closed.
Ambient operating range:	
temperature	0°C to 45°C
humidity	10% to 80%
Power consumption	30W (maximum)
Electrical supply	100, 120, 140, 200, 220, 240V a.c.
Electrical lead	2m
Panel dimension (mm)	192 x 96 DIN 43700 depth 280
Weight	3.5kg

Ordering information

Model	**Ordering number**
Controller 1105 (two Pirani, one Penning)	D386-37-000
Pirani gauge head PRL10K	D021-58-000
Pirani gauge head PRM10K	D021-66-000
Pirani gauge head PRM10KCR	D021-57-000
Pirani gauge head PRH10K	D021-59-000
Penning gauge head CP25K	D145-37-000
Extension leads (Pirani):	
5 metres	07-D368-17-005
15 metres	07-D368-17-015
30 metres	07-D368-17-030
Extension leads (Penning):	
5 metres	07-D368-13-005
15 metres	07-D368-14-015
30 metres	07-D368-14-030

Fixing holes centres for panel mounting (mm):



Note: When panel mounting a unit, remove the instrument sleeve first and carefully push the unit through the front of the cut-out hole. Refit the sleeve from the back of the panel. The unit may also be rack mounted in a 19in x 3U panel (DIN 41 494).

3 · Installation (refer to figure 1)

(Refer to Figure 1) The power supply ON/OFF switch is on the rear panel

Warning

High voltages exist within the unit when the power is on. All appropriate safety precautions for the servicing and operating of electronic equipment must be observed. Whenever the unit cover is to be removed, switch off and disconnect the power supply.

3.1 Power supply connexions

Caution

This equipment must be earthed. The unit contains power input filters that could cause the case to be live if the unit is not earthed correctly.

When connecting the power plug to the supply cable connect as follows:

Yellow and green to EARTH (ground)
Brown to LIVE
Blue to NEUTRAL

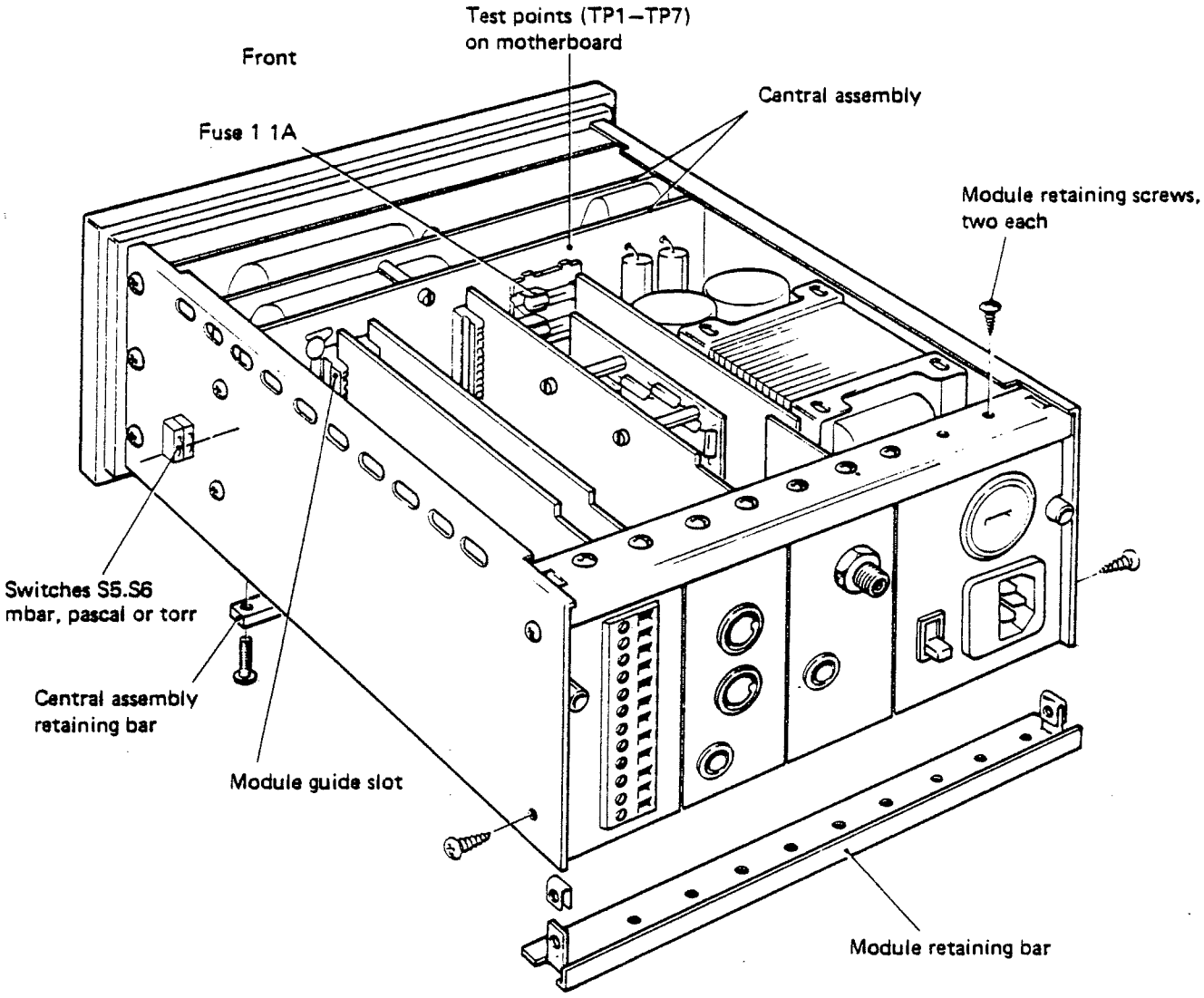
3.2 Voltage adjustments

The operating voltage is adjusted on the rear panel of the unit on the power supply module. The voltage set is shown by the two arrows meeting at the top of the adjustment (see figure 1). Use a small coin or a wide bladed screwdriver to make any adjustment. When making an adjustment ensure that the fusing is correct i.e. 100 to 140V, 500mA anti-surge and 200 to 240V, 250mA anti-surge.

To check the fuse simply pull the fuse carrier out next to the power input chassis plug. The fuse carrier contains storage for one spare fuse.

NOTE: Relay connexions

The relay connexions on the back panel of the instrument are shown in the de-energized condition as on the mimic diagram. Connexion may be made to the any of the contacts to enable a normally open, or normally closed condition as required.



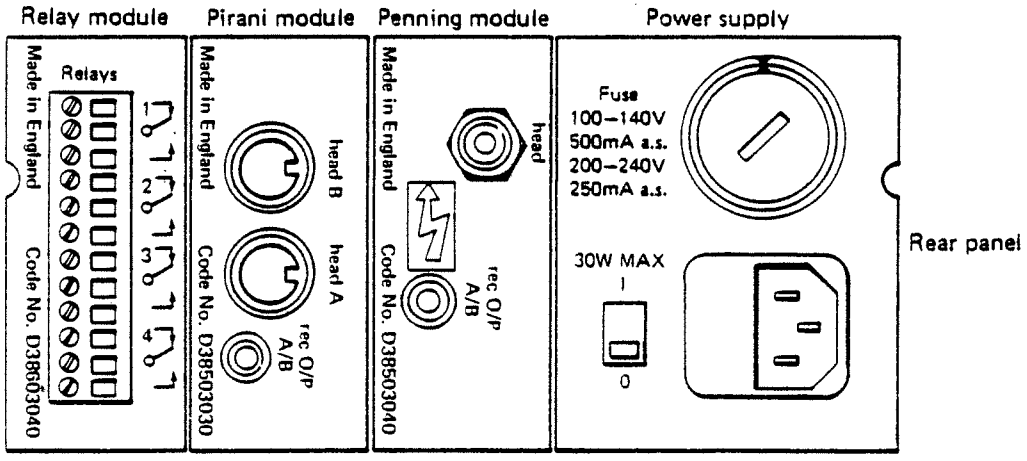


Figure 1 Controller 1105 – assembly diagram

3.3 Connecting gauge heads

Caution

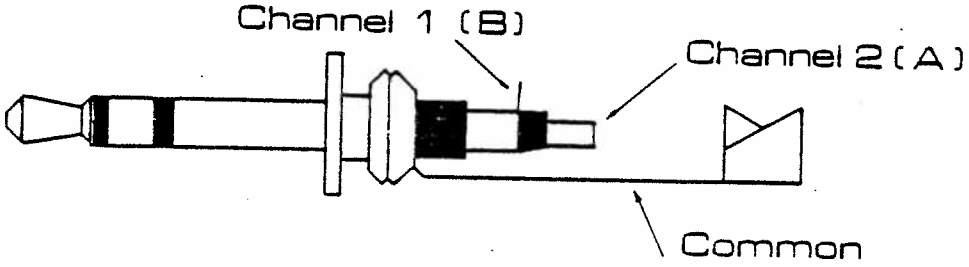
To prevent possible damage to the gauge heads the power must be switched off when connecting or disconnecting the gauge head leads. Do not vent a system to atmosphere by disconnecting a gauge head.

Connect the Pirani gauge head leads to the Pirani sockets on the rear panel, head B(1) and head A(2) as required. Connect the Penning gauge head lead to the Penning socket on the rear panel (3), see figure 1. These numbers will correspond to the readout on the display. When the gauge head leads are connected the instrument is ready for use.

Note: The Penning gauge is switched by Pirani gauge number 1, therefore these two gauges must be positioned in the same vacuum chamber.

3.4 Connecting a recorder

The recorder outputs for each channel are positioned on the rear panel of the Controller. On the Pirani module both channel outputs are taken to a single output socket. See plug diagram for connexions.



For the Penning module channel 2(A) is the high pressure output range and channel 1(B) is for the low pressure range.

3.5 Replacing a module

To replace a module proceed as follows, refer to figure 1:

Switch the power OFF

Remove the four cover retaining screws from the rear panel and remove the cover.

Next remove the two module retaining screws on the module to be removed.

Turn the unit over and remove the module locking bar.

Carefully tilt and pull the module free of the unit. Refit a replacement or new module in reverse order. Note the module guide slots when fitting a module.

3.6 Pressure display (mbar, torr or Pascal)

Generally instruments are dispatched to read pressure in mbar unless ordered to read pascal or torr. To change the units displayed remove the cover from the instrument and turn it over. Locate switches S1 and S2 on the back of the display panel, refer to figure 1. To display pressure in torr, close switch S1 (brown). To display pressure in pascal, close switch S2 (red). You can check the units of pressure by looking at the display when the power is on.

3.7 Overheating

Should the instrument overheat for any reason, a temperature sensitive device (thermistor) in the power supply module will detect any excessive rise in temperature and cause the instrument power supply to switch off. The input fuse may not fail. If this happens switch the unit off and allow it to cool down for about twenty minutes before switching on again.

4 Operation

4.1 General

Ensure that all leads are properly connected and switch the power on. The pressure on head 1 will display, normally in mbar. If other units of pressure are required refer to 3.6. To read pressure on heads 2 or 3 simply press either of the front panel switches, △ will increment and ▽ will decrement.

There are four channels to select from. Channel 1 reads Pirani gauge head 1 pressure. Channel 2 reads Pirani gauge head 2 pressure and Channel 3 reads the Penning gauge head 3 pressure.

Channel 4 will display the letter H (high) and the pressure from Pirani gauge 1 as long as the pressure remains above 5×10^{-3}mbar. When pressure falls below 5×10^{-3}mbar and is valid (i.e. no errors) Then the pressure from the Penning gauge will display with the letter L (low).

4.1.1 Penning gauge switching

Improvements have been made to the switching arrangement of the Penning gauge to increase gauge head life before cleaning and to remind the operator of Penning gauge head selection. This change is identified by the addition of the letter E after the serial number on the instrument.

The Penning gauge head EHT is now switched on at 10^{-2}mbar when in automatic control instead of 10^{-1} mbar. That is with PE = ? selected (Penning switched by Pirani) see figure 3.

Channel 4 displays letter H (high) when the Penning gauge is switched off manually.

Channel 4 displays letter L (low) when the Penning gauge is switched on manually.

While pressure is being displayed small arrows may be observed at the left hand side of the display area. These indicate small changes of pressure. A single flash of the inner arrows indicates a change of 4 millivolt in the gauge module output selected, and a single flash of the upper or lower arrows indicates a change of 8 millivolts. The 'low sensitivity' can be changed to 'high sensitivity' to give changes of 1 millivolt and 2 millivolts respectively, see figure 3. This facility is of use when detecting leaks in a vacuum system, either by noting the rate of increase of pressure when a chamber is valved off from pumps, or by noting the change in apparent pressure when a suitable search gas is applied to the outside of a leak. The sensitivity varies with pressure. With a PRM10 the maximum number of millivolts for a displayed unit of pressure is in the region of 1 mbar, where there are approximately 40 millivolts change between a reading of 1.0 mbar and a reading of 1.1 mbar.

The relay set points are indicated by the vertical numbers 1 to 4 on the front panel. The low pressure set point is indicated by ▼ next to the relay selected (relay energised). The gauge head selected being indicated on the display right hand side. Relays de-energised are shown by ▲ alongside the relay number see figure 3. The setting up procedure for the set-points is given in section 5.3. When pressure falls below the 'low' pressure set-point the relay energises (external contact closes). When the pressure reaches the 'high' set-point the relay de-energises (external contact opens). If the 'high' set-point is set to a value below that of the 'low' set-point, the relay operates on the high set-point only i.e. energises below 'high' set-point and de-energises at the high set-point.

Note that when in manual operation the Penning gauge is not protected by the Pirani gauge and therefore at very high pressure a relay selected for operation with the Penning could become energised.

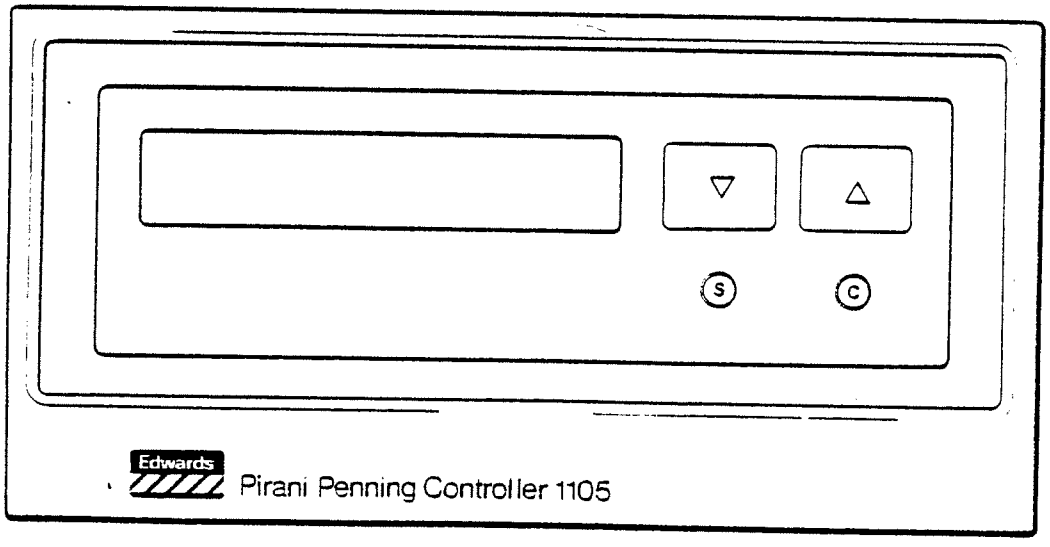
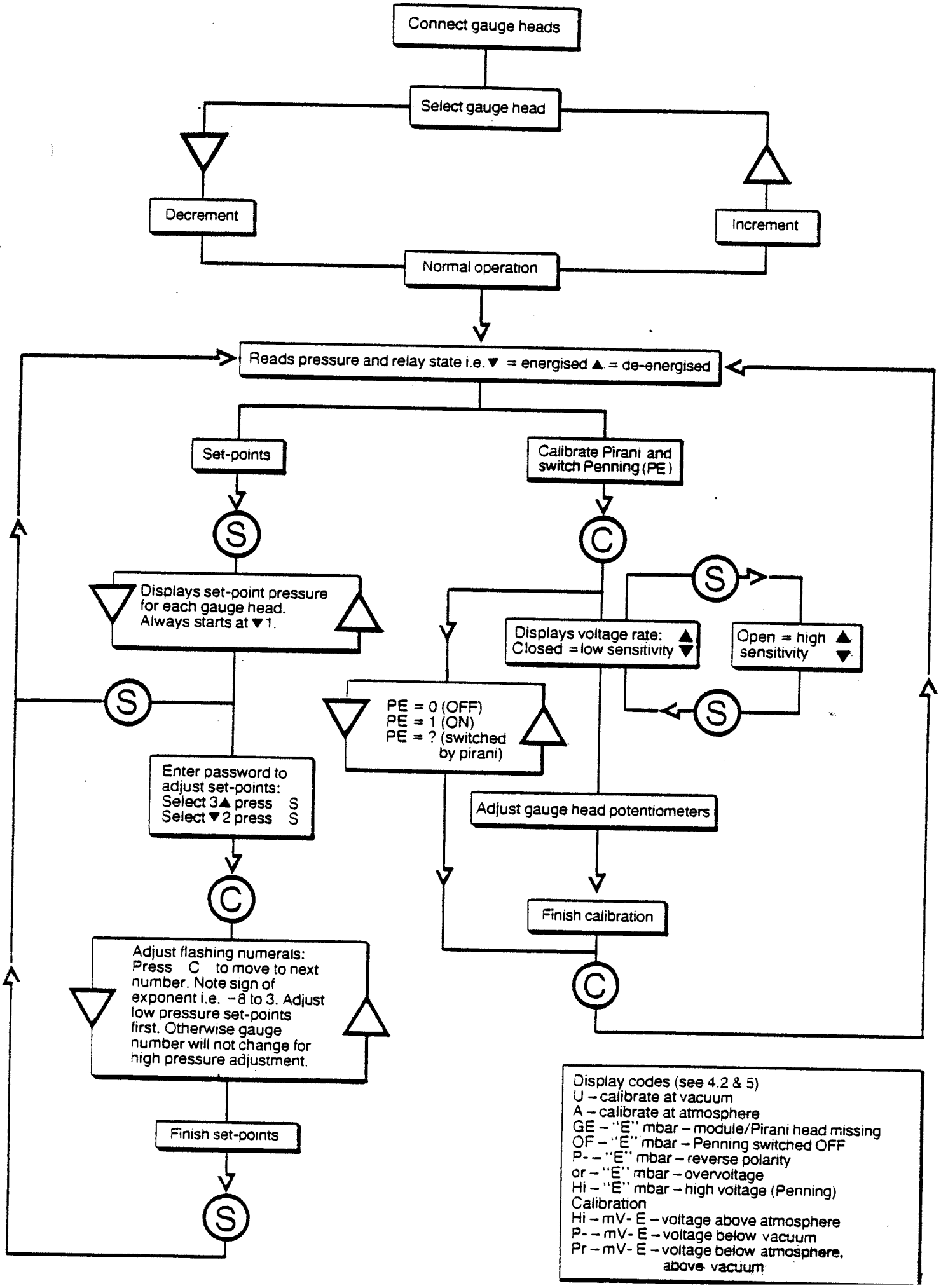


Figure 2 Controller 1105 front panel controls


Connect gauge heads
Select gauge head
Decrement
Increment
Normal operation
Reads pressure and relay state i.e. ▼ = energised ▲ = de-energised
Set-points
Calibrate Pirani and switch Penning (PE)
S
C
Displays set-point pressure for each gauge head. Always starts at ▼1.
Displays voltage rate: ▲ Closed = low sensitivity ▼
Open = high ▲ sensitivity ▼
PE = 0 (OFF)
PE = 1 (ON)
PE = ? (switched by pirani)
Enter password to adjust set-points:
Select 3▲ press S
Select ▼2 press S
Adjust gauge head potentiometers
Finish calibration
Adjust flashing numerals: Press C to move to next number. Note sign of exponent i.e. −8 to 3. Adjust low pressure set-points first. Otherwise gauge number will not change for high pressure adjustment.
Finish set-points
Display codes (see 4.2 & 5)
U – calibrate at vacuum
A – calibrate at atmosphere
GE – "E" mbar – module/Pirani head missing
OF – "E" mbar – Penning switched OFF
P- – "E" mbar – reverse polarity
or – "E" mbar – overvoltage
Hi – "E" mbar – high voltage (Penning)
Calibration
Hi – mV- E – voltage above atmosphere
P- – mV- E – voltage below vacuum
Pr – mV- E – voltage below atmosphere, above vacuum

4.2 Error signals

Error signals may be received when trying to read pressure. These are interpreted as follows ('E' flashing):

GE **'E'mbar** Module or Pirani gauge head missing
OF **'E'mbar** Penning switched off (pressure high)
P- **'E'mbar** Reverse Polarity
or- **'E'mbar** Overvoltage
Hi **'E'mbar** Overvoltage (gauge indicates above atmosphere or normal Penning range – fault)

Out-of-range signals may be received when trying to calibrate a Pirani gauge. These should be interpreted as follows:-

$Hi^{mV}_{mV}E$ Voltage above usual Atmosphere adjustment range
$P-^{mV}E$ Voltage below usual Vacuum adjustment range
$Pr^{mV}E$ Voltage below usual Atmosphere adjustment range and above usual Vacuum adjustment range.

5 Calibration & set point adjustment

5.1 Pirani gauge calibration

To check the calibration of a Pirani gauge head at atmosphere or at high vacuum, calibrate is selected. Before this is done ensure that the gauge head is at a high vacuum well below the minimum pressure which the gauge will indicate, and that the indicated pressure is close as possible to that pressure. Alternatively the gauge may be set at atmospheric pressure.

To select calibrate press push-button Ⓒ once. The display will be mV (millivolts) and show the calibration error. The error will be the two left-hand digits followed by the sign of the error + (high) or -(low). The third digit indicates whether the calibration is for vacuum U or atmosphere A. The appropriate potentiometer on the gauge head should be adjusted to obtain a reading of 00 (+ or -), when both vacuum and atmosphere adjustments have been made the gauge head is correctly calibrated.

If the error found is greater than $\pm$ 63mV from vacuum, or $\pm$ 198mV from atmosphere, an error signal will be displayed. If this is Hi-E it indicates an output above that which is normal for atmosphere. If the setting is being carried out at atmosphere it may be possible to reduce the error to within normal range, using the 'set atm' head potentiometer on the gauge head. If not, the gauge head or Pirani module is faulty.

If the display is P--E, the voltage is below the normal vacuum range. If the adjustment is being made at high vacuum, it may be possible to reduce the error to within normal range using the 'set vac' potentiometer on the gauge head. If not, the gauge head or Pirani module is faulty.

If the display is Pr-E, the voltage is within the normal pressure measurement range, but is above the normal vacuum setting range and below the normal atmosphere setting range. After checking that the gauge head is at high vacuum or atmosphere, the appropriate head potentiometer 'atm' or 'vac' may be adjusted to find out whether the display can be returned to within the normal range. If not, the gauge head is faulty.

When calibration is completed, return to normal pressure measurement by pressing C again when the mV symbol will be replaced by normal pressure measurement.

5.2 Penning gauge

The operating parameters are set at the factory and calibration by the user is not required.

5.3 Viewing and adjusting the pressure set-points (refer to figure 3)

To view the set-points press (S) as in figure 3. The display will show the setting for relay number 1. The flashing ▼ shows the low pressure setting and the flashing ▲ shows the high pressure setting. When set-point (S) is first selected the display will always be that set for relay number 1. To view the other set-points simply press △ to increment and ▽ to decrement. To return to normal operation press (S) again.

To adjust the pressure set-points at which the relays are to operate it is necessary to enter a 'password'. Select 3 ▲ and press (S), then select ▼ 2 and press (S) again. This is the password. When the password has been entered the pressure set-points can be adjusted. When making an adjustment always set the low pressure setting first e.g. ▼ 2 not 2 ▲. The gauge number cannot be altered when in high pressure adjustment.

To select the actual pressures at which the relays are to operate press (C). The flashing will move to the large digit on the right. This is the gauge head number selected. The up down switches will increment or decrement this number as required.

Next press (C) again and the flashing will move to the pressure settings on the left hand side of the display. The first number (mantissa) is adjusted as before by the up △ down ▽ switches. When this adjustment is complete press (C) and adjust the decimal part of the mantissa if required as before. Finally press (C) to move the flashing indication to the exponent and adjust to the required value.

Adjusting set-points on the display is made wherever the 'flashing' occurs with the up △ down ▽ controls. The flashing indication is moved by pressing (C) when in set-point adjust (S).

Press (S) to return to normal operation. The set-point conditions will be frozen.

When in normal operation the up △ down ▽ switches select the gauge head number and pressure for display.

6 Maintenance

Warning

High voltages exist within the unit when the power is on. All appropriate safety precautions for the servicing and operating of electronic equipment must be observed. Whenever the unit cover is to be removed, switch off and disconnect the power supply first.

6.1 Handling considerations

Please follow these guidelines when it is necessary to open the unit and handle internal circuitry or components.

CMOS integrated circuits can be damaged by static discharge to their inputs. The likelihood of static build up is proportional to the dryness of the air and can be particularly troublesome in cold, dry climates, or hot desert climates.

In order to minimize the chances of discharging body charge into the IC inputs, always handle circuit boards by the edge. When moving a board from one surface to another, always touch the new surface or location before laying down or inserting the board, so that you, the board, and the surface or equipment are all at the same electrical potential. In dry climates, it is always wise to minimize the amount of movement when handling or replacing ICs in circuit boards. When handling a circuit board or IC to another person, always touch the person first.

Wood and paper are the safest surfaces to work on. Plastic should be avoided. Metal is acceptable as long as the metal is always touched with the hands prior to laying down the ICs or circuit boards.

If the above precautions are observed, the possibity of accidental damage will be minimized.

6.2 Voltage checks

There are seven test points on the motherboard (TP1 to TP7) from which voltages can be checked if a fault is suspected, see figure 1. The voltages may be checked with a suitable multimeter or for greater accuracy with a digital voltmeter (d.v.m.). Test point 1 is 0V and may be used for the common terminal. Access to some of the test points is difficult and it is recommended that the plug-in modules are removed as necessary:

Test point	Voltage	Adjustment
1	0	-
2	5V +6% - 0	RV1
3	+15.6V	RV3
4	-15.6V ±1%	RV2
5	not used	-
6	+11V	nominal
7	squarewave +3V	d.c. -

6.3. Fuses

The mains input fuse is 250mA anti-surge for 100 to 140V and 500mA anti-surge for 200 to 240V. There is one fuse on the motherboard to protect the 11V nominal supply, F1 1A (antisurge).

7 Spares

Item	Ordering number
Pirani module complete	07-D385-03-030
Penning module complete	07-D385-03-040
Central assembly 1105	14-D386-03-156
Display board	14-D386-02-030
Display panel	14-D386-01-030

COMMUNICATION WITH EDWARDS

Any communication relating to the subject of this instruction should be addressed to Edwards High Vacuum or to the supplier from whom it was purchased.

Please specify:

1) the model, serial number and code.

2) the date of purchase.

3) your order number and the suppliers sales reference.

Equipment MUST NOT be returned to the supplier without prior arrangement.

IMPORTANT Health and Safety

Under Section 3 of the Health and Safety at Work Etc Act 1974 every employer has a duty to conduct his business so as not to expose persons not in his employment to risks to their health and safety. When goods are returned to the supplier, therefore, warning must be given if their usage is likely to render the equipment hazardous in any way. Your attention is drawn to FORM HSC001 attached.

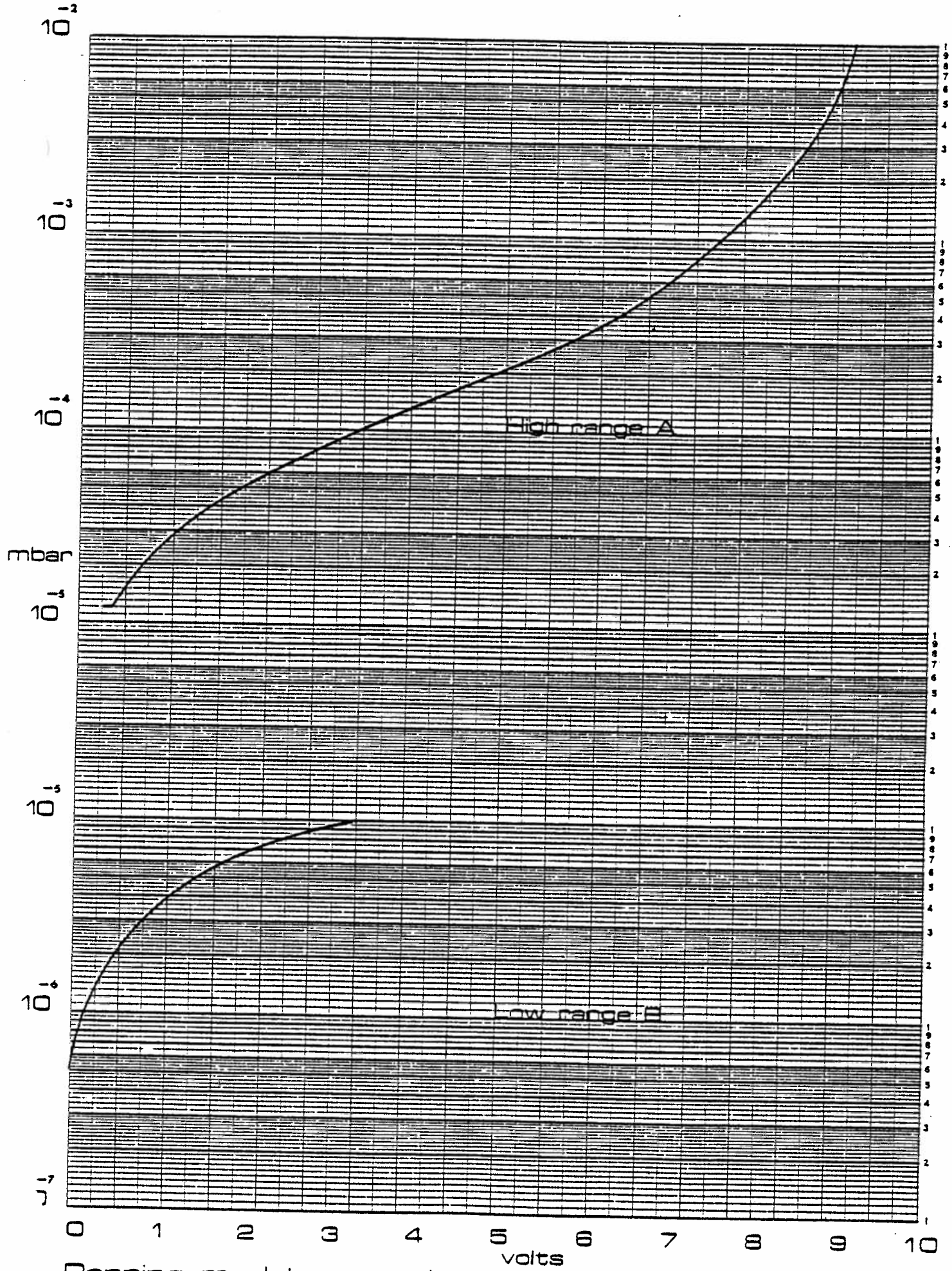
Edwards High Vacuum and its distributors reserve the right to refuse acceptance of any equipment returned which they have reason to believe may be hazardous.

Damage in transit

If any damage has occurred in transit, it is important to inform both the carrier and the supplier within three days of delivery.

Penning CP25 typical voltage/pressure readings

Pressure mbar	Voltage	
1.5×10^{-2}	9.260	
1.4×10^{-2}	9.238	
1.2×10^{-2}	9.159	
1.0×10^{-2}	9.080	
6.0×10^{-3}	8.916	
4.0×10^{-3}	8.695	
3.0×10^{-3}	8.520	
2.0×10^{-3}	8.182	
1.0×10^{-3}	7.535	
8.0×10^{-4}	7.261	Range A
6.0×10^{-4}	6.911	
4.0×10^{-4}	6.356	
2.0×10^{-4}	5.047	
1.0×10^{-4}	3.373	
8.0×10^{-5}	2.875	
6.0×10^{-5}	2.298	
4.0×10^{-5}	1.630	
2.0×10^{-5}	0.759	
1.5×10^{-5}	0.536	
1.2×10^{-5}	0.406	
1.0×10^{-5}	0.321	
1.0×10^{-5}	3.341	
8.0×10^{-6}	2.521	
6.0×10^{-6}	1.765	
4.0×10^{-6}	1.122	
2.0×10^{-6}	0.504	
1.0×10^{-6}	0.252	
9.0×10^{-7}	0.228	Range B
8.0×10^{-7}	0.204	
7.0×10^{-7}	0.177	
6.0×10^{-7}	0.155	
5.0×10^{-7}	0.126	
4.0×10^{-7}	0.102	
3.0×10^{-7}	0.078	
2.0×10^{-7}	0.051	
1.0×10^{-7}	0.027	
5.0×10^{-8}	0.012	
0.0×10^{-8}	0.000	



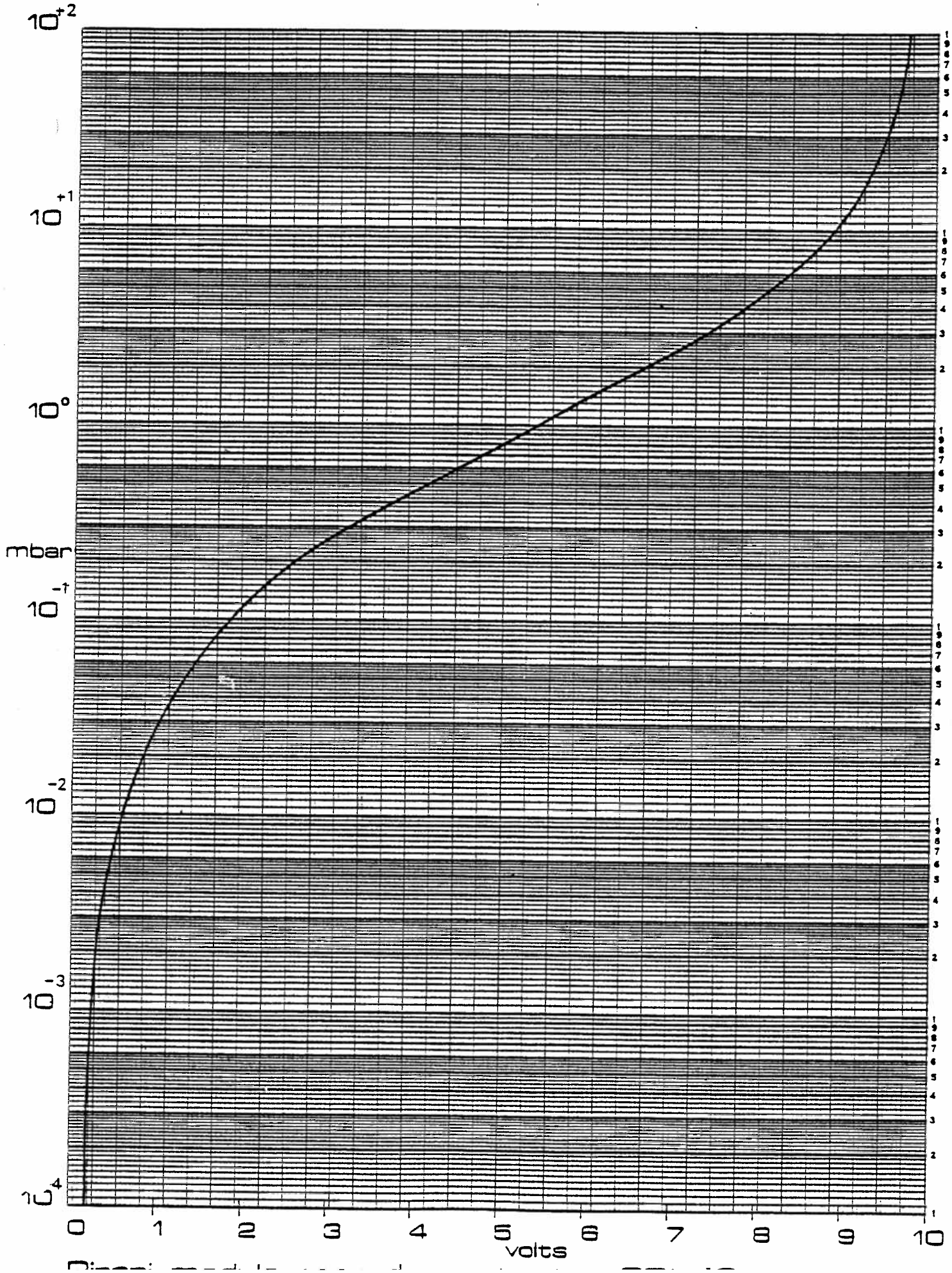
Penning module recorder outputs A&B CP25

PRL10 Pressure/voltage rec o/p Data

Pressure mbar	Voltage
1000 (atm)	9.730
100	9.627
80	9.605
60	9.568
40	9.488
20	9.252
10	8.807
8.0	8.604
6.0	8.303
4.0	7.775
2.0	6.644
1.0	5.365
8.0	4.951
6.0	4.428
4.0	3.730
2.0	2.696
1.0×10^{-1}	1.890
8.0	1.673
6.0	1.432
4.0	1.142
2.0	0.775
1.0×10^{-2}	0.533
8.0	0.472
6.0	0.408
4.0	0.339
2.0	0.264
1.0×10^{-3}	0.222
8.0	0.211
6.0	0.202
4.0	0.197
2.0	0.068
1.0×10^{-4}	0.183

Pressure less than 1.0×10^{-4} mbar to 0.178V

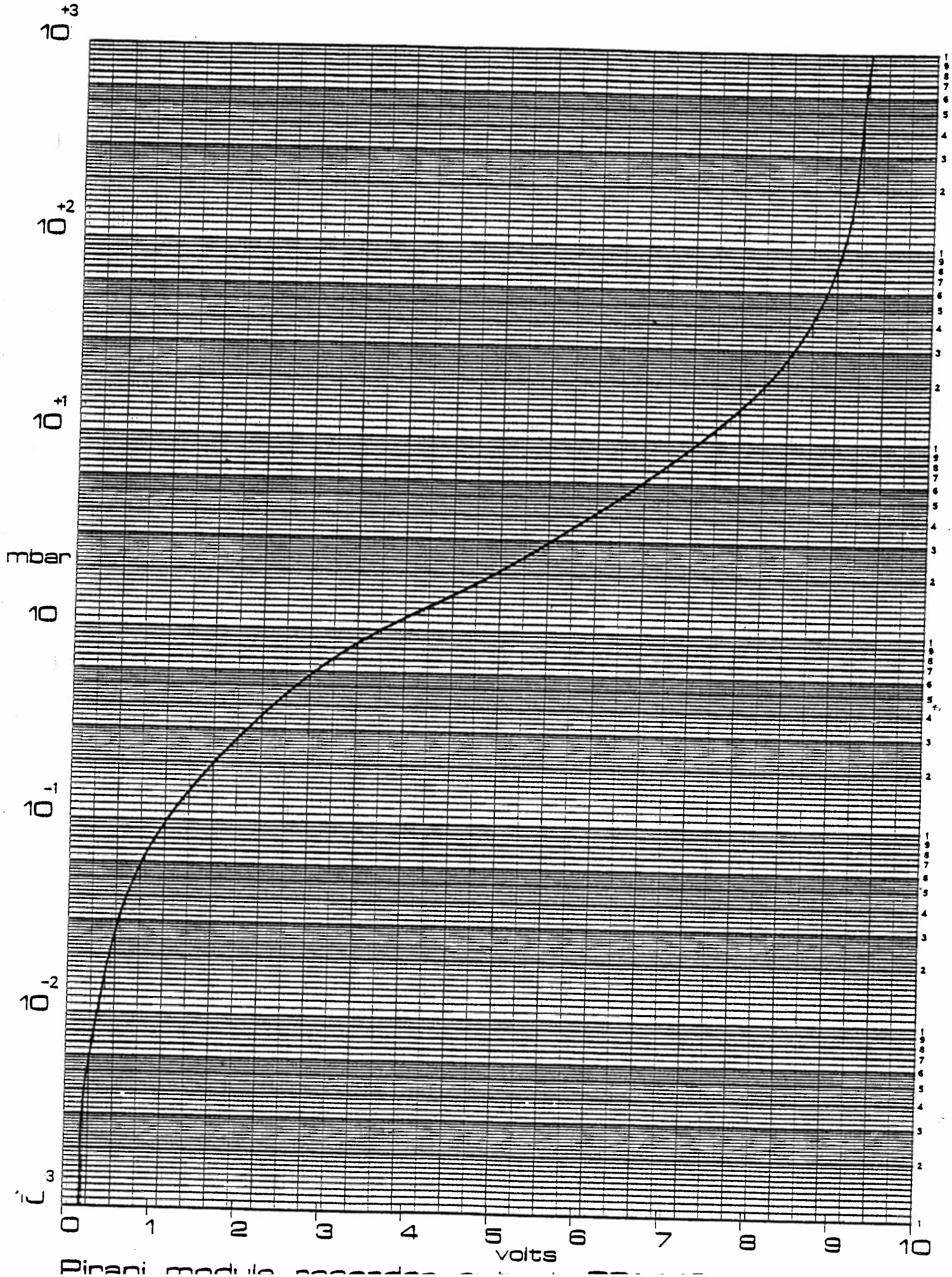
Pressure range 10 mbar to 10^{-4} mbar


10^{+2}
10^{+1}
10^{0}
mbar
10^{-1}
10^{-2}
10^{-3}
10^{-4}
0
1
2
3
4
5
6
7
8
9
10
volts

PRM-10 & PRM10CR (corrosion resistant)

Pressure mbar	Voltage
1000 (atm) 400 200 100	9.257 9.126 9.085 4.015
80 60 40 20 10	8.923 8.845 8.695 8.248 7.545
8.0 6.0 4.0 2.0 10^{0}	7.214 6.752 6.138 4.862 3.808
8.0 6.0 4.0 2.0 10^{-1}	3.380 2.916 2.388 1.601 1.148
8.0 6.0 4.0 2.0 10^{-2}	0.959 0.803 0.636 0.433 0.325
5.0 10^{-3}	0.253 0.192

Pressure less than 1.0×10^{-3} mbar = 0.178V



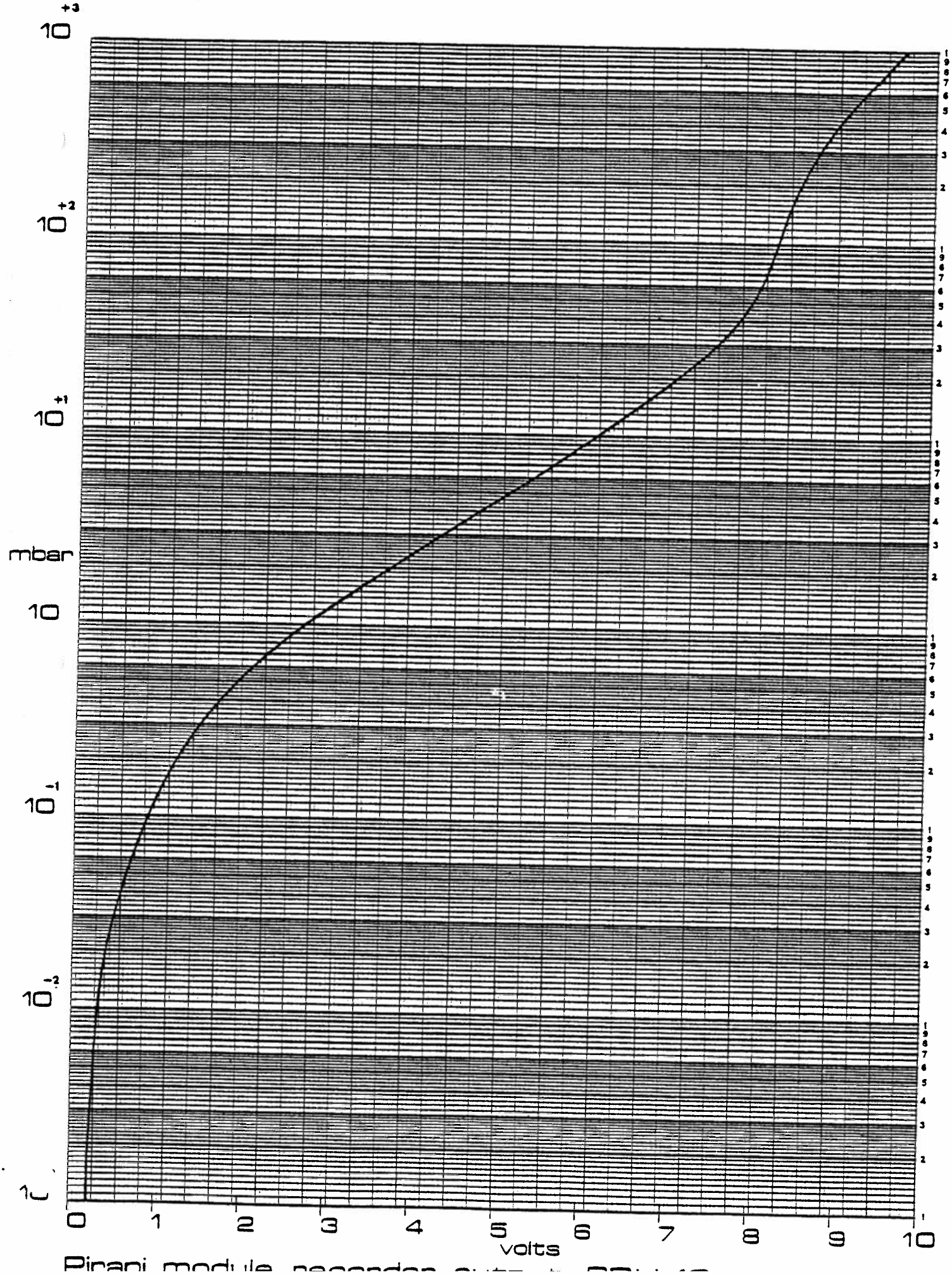
Pirani module

PRH-10 Pressure/voltage rec o/p Data

Pressure mbar	Voltage
1000 (atm)	9.540
900	9.510
800	9.382
700	9.280
600	9.166
500	9.030
400	8.850
300	8.643
200	8.415
100	8.160
80	8.076
60	7.950
40	7.700
20	7.070
10	6.200
8.0	5.850
6.0	5.400
4.0	4.734
2.0	3.633
1.0	2.668
8.0	2.402
6.0	2.085
4.0	1.699
2.0	1.176
1.0×10^{-1}	0.806
8.0	0.714
6.0	0.615
4.0	0.500
2.0	0.358
1.0×10^{-2}	0.275
8.0	0.258
6.0	0.239
4.0	0.219
2.0	0.197
1.0×10^{-3}	0.189

Pressure less than 1.0×10^{-3} mbar = 0.178V

Pressure range 1000 mbar to 10^{-3} mbar



Pirani module