

# Edwards



Instructions  
07-D386-15-880  
March 1983

Series 1QOD Vacuum gauges & Controllers

Model

Controller 11O1 Pirani

Ordering number

**07-D386-15-00Q**

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# Contents

	Page
Safety	3
<b>1 General description</b>	<b>4</b>
1.1 Operating principle	4
<b>2 Specification</b>	<b>5</b>
<b>3 Installation</b>	<b>7</b>
3.1 Power supply connexions	7
3.2 Voltage adjustments	7
3.3 Connecting gauge heads	9
3.4 Upgrading and replacing modules	9
3.5 Pressure display (mbar, torr or pascal)	9
<b>H Operation</b>	<b>10</b>
4.1 General	10
4.2 Error signals	12
<b>5 Calibration and set-point adjustment</b>	<b>12</b>
5.1 Gauge head calibration	12
5.2 Viewing and adjusting the pressure set-points	12
<b>6 Maintenance</b>	<b>14</b>
6.1 Handling considerations	14
6.2 Voltage checks	14
6.3 Fuses	15
<b>7 Spares</b>	<b>15</b>
<b>Communication with Edwards</b>	<b>15</b>
<b>Illustrations</b>	
Figure 1 Controller 1101 - assembly diagram	8
Figure 2 Controller 1101 - front panel	10
Figure 3 Controller 1101 - control diagram	11

# 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.

## i 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 HF 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.

Note: An internal battery (BT1 on figure 1) is provided to back-up the microprocessor memory. The battery (2.7V) is normally charged by the power supply. Power should be on for 5% of the time. The battery takes about three days to charge.

# 1 General description

The Controller 1101 is one of a new range of microprocessor based instruments for vacuum measurement and process control. This model operates two Pirani gauge heads over the pressure range 1000 to  $10^{-4}$  mbar. It will also measure in units of pascal or torr. The pressure range is covered by four Pirani gauge heads, Edwards PRL10, PRM10 (PRM10CR) corrosion resistant) and PRH10. The individual pressure ranges are detailed in section 2, specifications. There are four independent relays on the relay module giving set points for pressure control. These may be allocated to either or both heads at option. A stick-on label is provided to enable the gauge type and set-points to be recorded.

The instrument has a large easy to read liquid crystal display (LCD). The pressure and the head selected is displayed. The gauge head required being selected by the up A down ^7 controls on the front panel. This model can be upgraded to a four head unit by the addition of a plug-in module which is available as an accessory. Each Pirani module has two recorder outputs, one for each channel. A DIN plug/socket is provided for each output. Graphs of pressure/voltage are provided with these instructions and with the gauge heads.

When the Controller is switched ON after being previously used, the configuration will always be the same as that set when it was switched OFF.

## 1.1 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.

## 2 Specification

Pressure range	1000 to $10^{-1}$ * mbar
Display-	Liquid crystal (LCD)
Gauge heads:	
Pirani PRL10	1000 to $10^{-3}$ mbar
Pirani PRM10	200 to $10^{-3}$ mbar
Pirani PRM10CR (corrosion resistant)	200 to $10^{-4}$ mbar
Pirani PRH10	10 to $10^{-4}$ mbar
Recorder outputs A and B:	
Pirani	-64 to -3300mV d.c. at 10kohms impedance
Relays:	Four independant relays RLA, RLB, RLC and RLD each with adjustable upper and lower set-points.
Contact rating	8A at 240V a.c. Contacts normally open N/O (can be changed to normally closed N/C with internal links on relay p.c.b.).
Ambient operating range:	
temperature	0°C to 45°C
humidity	10% to 80%
Power consumption	30W (maximum)
Electrical supplies	100/120V, 220/240V a.c. +6% -16% 50/60Hz
Electrical lead	2m
Panel dimension (mm)	192 mm x 96 DIN 43700 depth 280
Weight	3.5kg

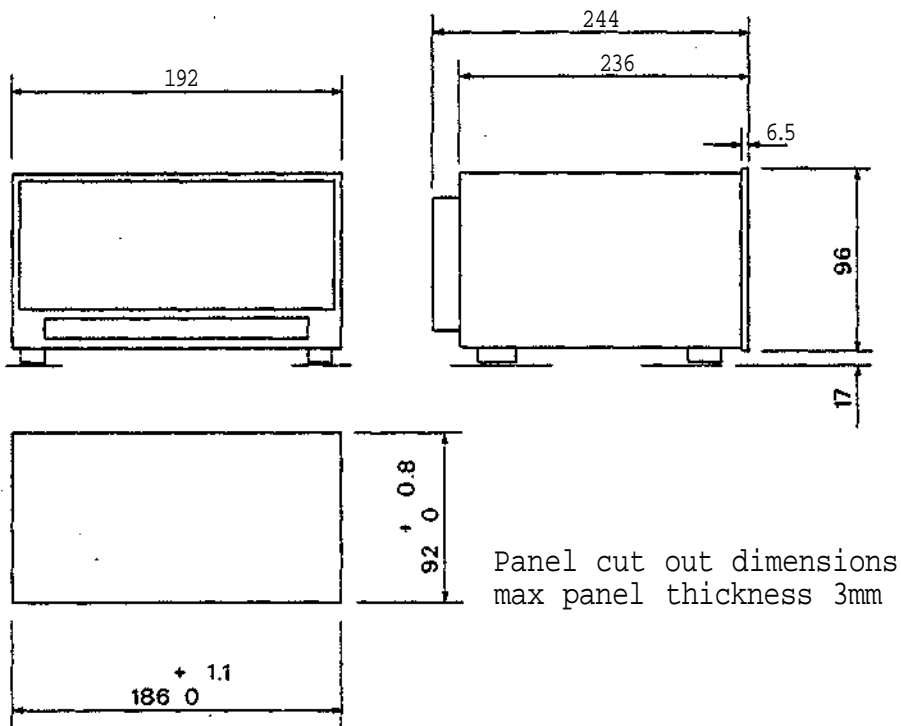
## Ordering information

Model	Ordering number
Controller 1101 (two heads)	07-D386-15-000
Pirani module (additional)	07-D386-02-030
Pirani gauge head PRL10	07-D021-58-000
Pirani gauge head PRM10	07-D021-66-000
Pirani gauge head PRM10KCR (corrosion resistant)	07-D021-57-000
Pirani gauge head PRH10	07-D021-59-000

### Gauge head extension leads:

5 metres	07-D368-13-000
15 metres	07-D368-14-000
30 metres	07-D368-14-000

## Dimensions



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 CRefer to figure 1)

The power ON/OFF switch is located 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 LITE  
Blue to NEUTRAL

#### 3.2 Voltage adjustments

Slide the transparent power input cover on the rear panel down to observe the power setting. The voltage setting is displayed on the link card. To change the voltage, pull the fuse tab down and carefully remove the link card with a pair of pliers. The voltage set is that displayed when the card is fully located. Also ensure correct fuse is fitted for the supply being used i.e. 220/2U0V 0.5A or 100/120V 1A (slow blow).

Note: The contacts of the relays in the relay unit are wired in the normally open (N/O) condition. That is, open circuit between op (operate) and c (common) on the edgeblock connector. To change the "contacts of a relay to a normally closed (N/C) condition, simply remove the relay unit and resolder the appropriate link on the p.c.b. as shown in the example below:

RLA normally open

RLA normally closed

\*=====\*

\* \* \*

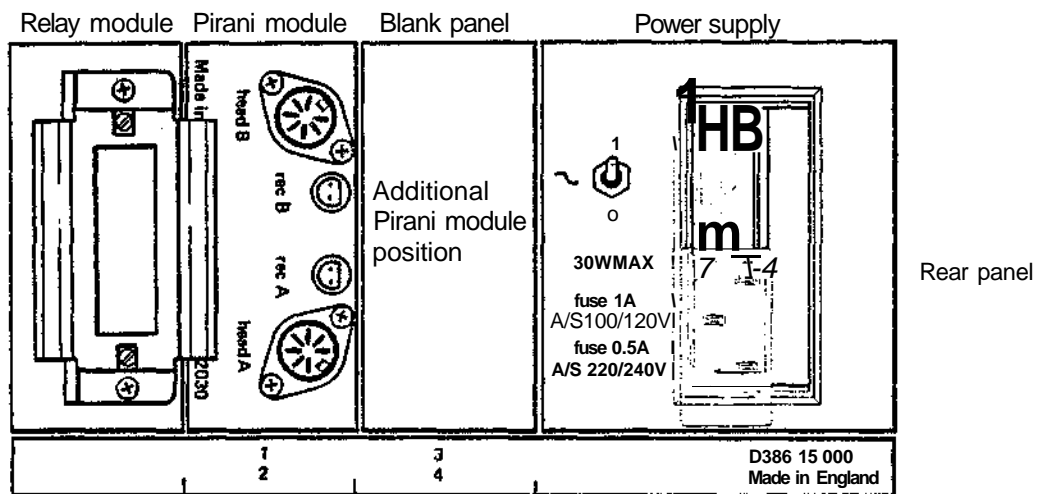
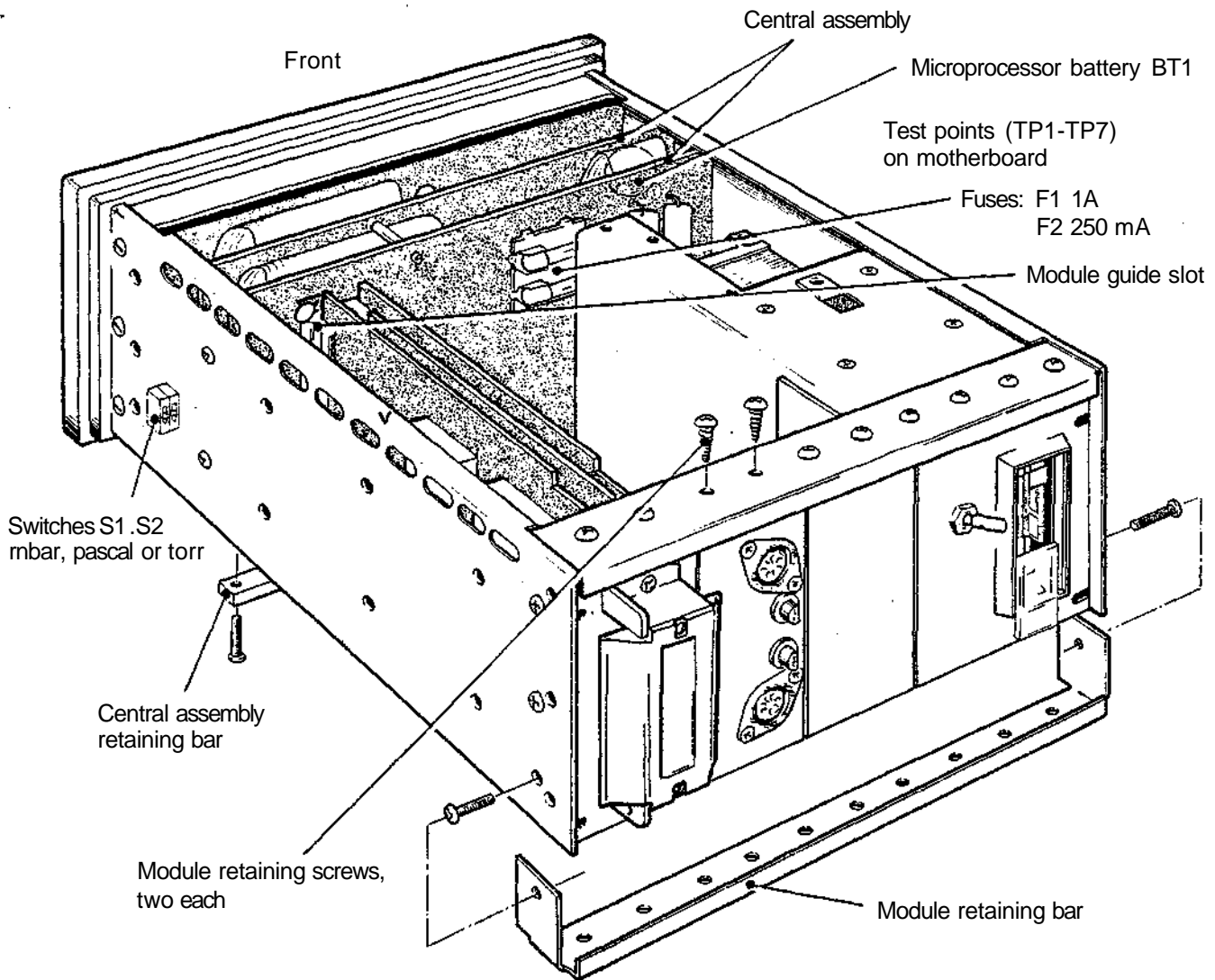


Figure 1 Controller 1101 — assembly diagram



### 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 gauge head leads to the Pirani sockets on the rear panel, head B(1) and head A(2) as required, 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.

### 3.4 Upgrading and replacing modules

It may be necessary to upgrade the instrument to a four gauge model or change a module. An additional module may be fitted next to the existing Pirani module giving head B(3) and head A(4). These new numbers will appear on the display automatically when an upgrade module is fitted. To replace or add 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 (this could be the centre blanking plate if upgrading).

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.

### 3.5 Pressure display (mbar, torr or pascal)

Generally, instruments are dispatched to read pressure in mbar. If other units are required, remove the cover from the instrument and turn it over as in 3«4« Locate switches S1 and S2 on the rear 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 pressure units by looking at the display when the power is on.

-r v\_ipci auiui i

#### 4.1 General (refer to figure 3 - control diagram)

Switch the power ON. Pressure at head 1 will be displayed, normally in mbar. If other units of pressure are required refer to 3.5. To read pressure on head 2, press either of the front panel switches, /\ will increment and \7 will decrement. The head number is displayed on the right hand side.

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 millivolts 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 V 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 A 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 pressures 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.

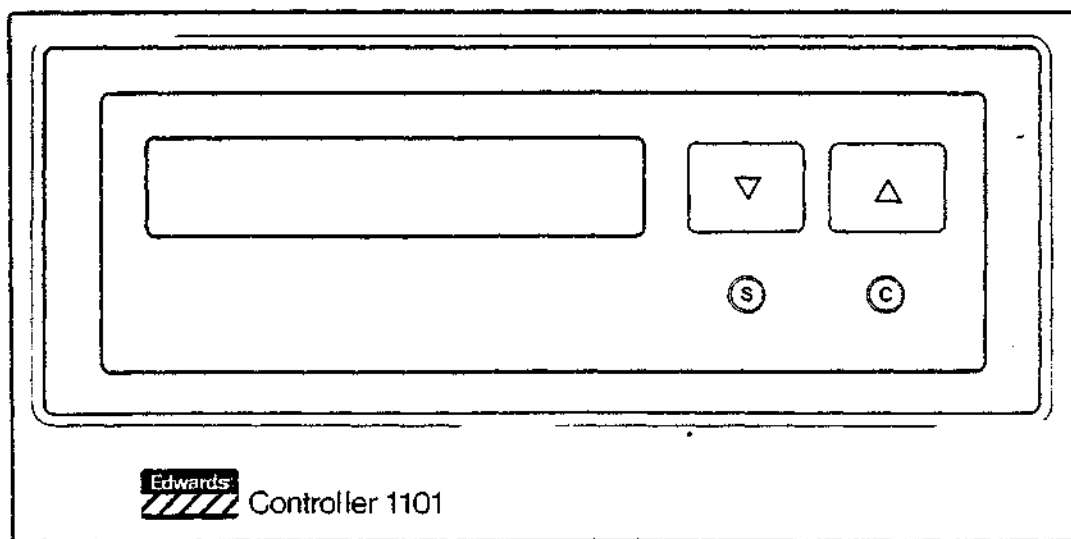


Fig. 2 Controller 1101 — front panel

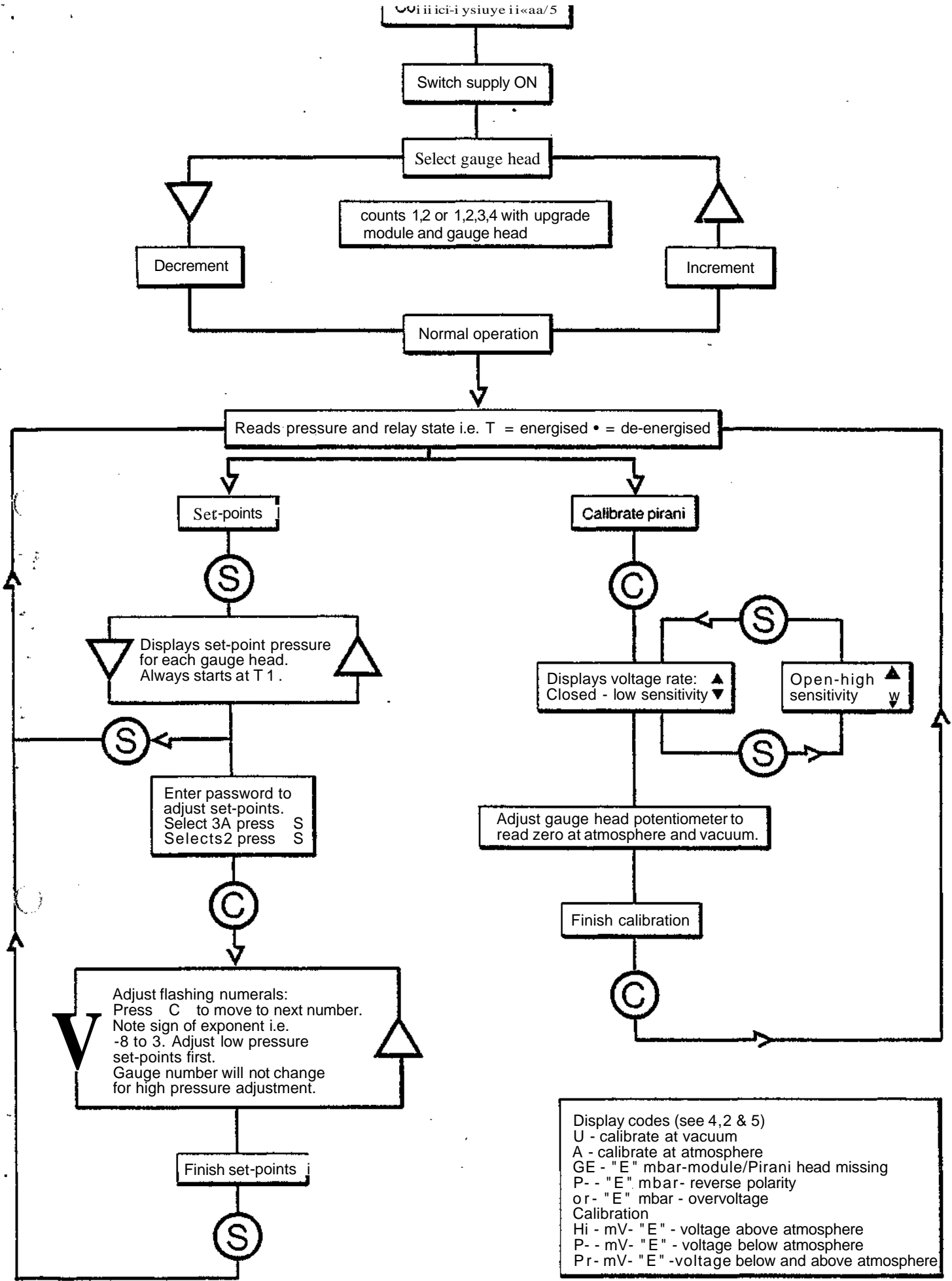


Figure 3 Controller 1101 - control diagram

## 4.2 Error signals

Error signals may be received when trying to read pressure. These are interpreted as follows ('E' flashing). Reference should be made to 5.1 below:

- GE \*E'mbar** Module or Pirani gauge head missing  
**P- E'mbar** Reverse Polarity (gauge indicates below vacuum reading, fault or calibration error)  
**or '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<sup>mV</sup><sub>vE</sub>** Voltage above usual Atmosphere adjustment range  
**P-<sup>m</sup><sub>vE</sub>** Voltage below usual Vacuum adjustment range  
**Pr<sup>m</sup><sub>E</sub>** Voltage below usual Atmosphere adjustment range and above usual Vacuum adjustment range.

## 5 Calibration S. set-point adjustment

### 5.1 Gauge head calibration(refer to figure 3)

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. First select the gauge head for calibration as in 4.1 above.

To select calibrate press push-button (C) 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 at 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  $\pm 63\text{mV}$  from vacuum, or  $\pm 198\text{mV}$  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<sup>mV</sup><sub>E</sub>, 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  $P^{mV}E$ , 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 mbar.

Note: When in calibrate (S) switches the display rate to high sensitivity as shown by the outer rate arrows on the left hand side of the display flashing on. Pressing (D ^S^in switches the display rate back to coarse again. This is shown by the inner arrows flashing on. When returning to normal operation, when calibration is complete, by pressing (C) again, the display rate will be coarse or high sensitivity as last selected in the calibrate mode.

## 5.2 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 T shows the low pressure setting and the flashing A shows the high pressure setting. When set-point (|) is first selected the display will always be that set for relay number 1. To view the other set-points simply press Zi 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 A and press (S) , then select T 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. T2 not 2 A. **Gauge number will not change for high pressure adjustment.**

To select a particular relay press one of the triangle switches on the front panel. The up switch Z\ will increment and the down switch \ 7 will decrement. Note that the flashing • on the display is for setting the low pressure operation (relay energised) and the flashing A is for setting the high pressure operation (relay de-energised).

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

Next press © 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 ZÄ. down V switches. When this adjustment is complete press (5) and adjust the decimal part of the mantissa if required as before. Finally press (5) 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 Z A down V controls. The flashing indication is moved by pressing (5) when in set-point adjust (§).

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

When in normal operation the **A V** switches select the gauge head number and pressure for display.

## B 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

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 possibility of accidental damage will be minimized.

#### 6.2 Voltage checks

There are seven test points situated 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 supply fuse is 0.5A for 220/240V and 1.0A for 100/120V. There are two fuses on the motherboard, F1 1A to protect the 11V nominal supply and F2 250mA to protect the relay supplies, both anti-surge.

### ~7Spares

Item	Ordering number
Pirani module complete	07-D385-02-030
Central assembly 1001	14-D386-02-152
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 should 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.

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.

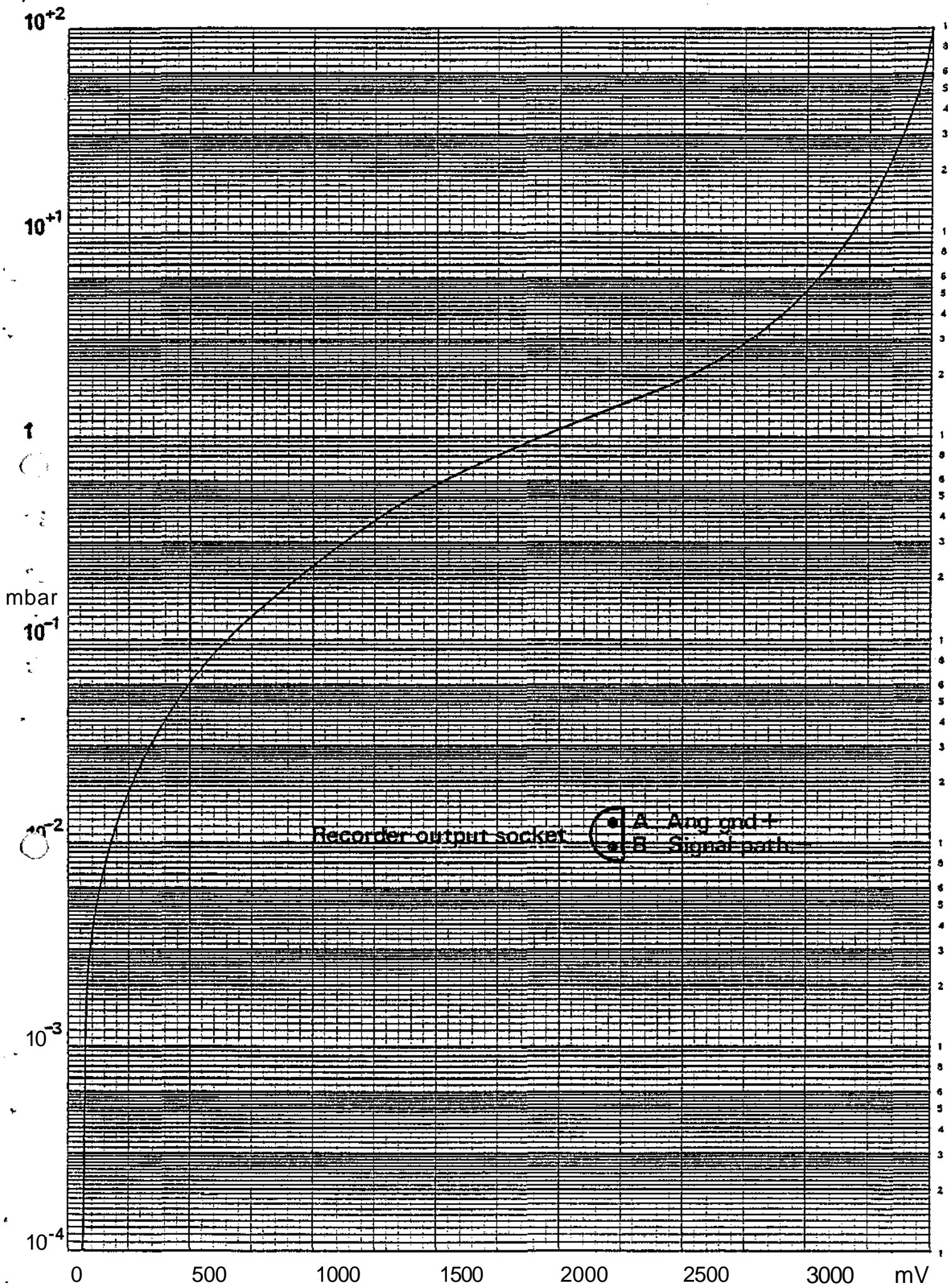
**PHLO Pressure/voltage reo o/p Data**

Pressure nbar	Voltage mV
1000 (atm)	3500
100	3463
80	3455
60	3442
40	3413
20	3328
10	3168
8.0	3095
6.0	2987
4.0	2797
2.0	2390
1.0	1930
8.0	1781
6.0	1593
4.0	1342
2.0	970
$1.0 \times 10^{-1}$	680
8.0	602
6.0	515
4.0	411
2.0	279
$1.0 \times 10^{-2}$	192
8.0	170
6.0	147
4.0	122
2.0	95
$1.0 \times 10^{-3}$	80
8.0	76
6.0	73
4.0	71
2.0	68
$1.0 \times 10^{-4}$	66

Pressure less than  $1.0 \times 10^{-4}$  nbar to 64mV

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

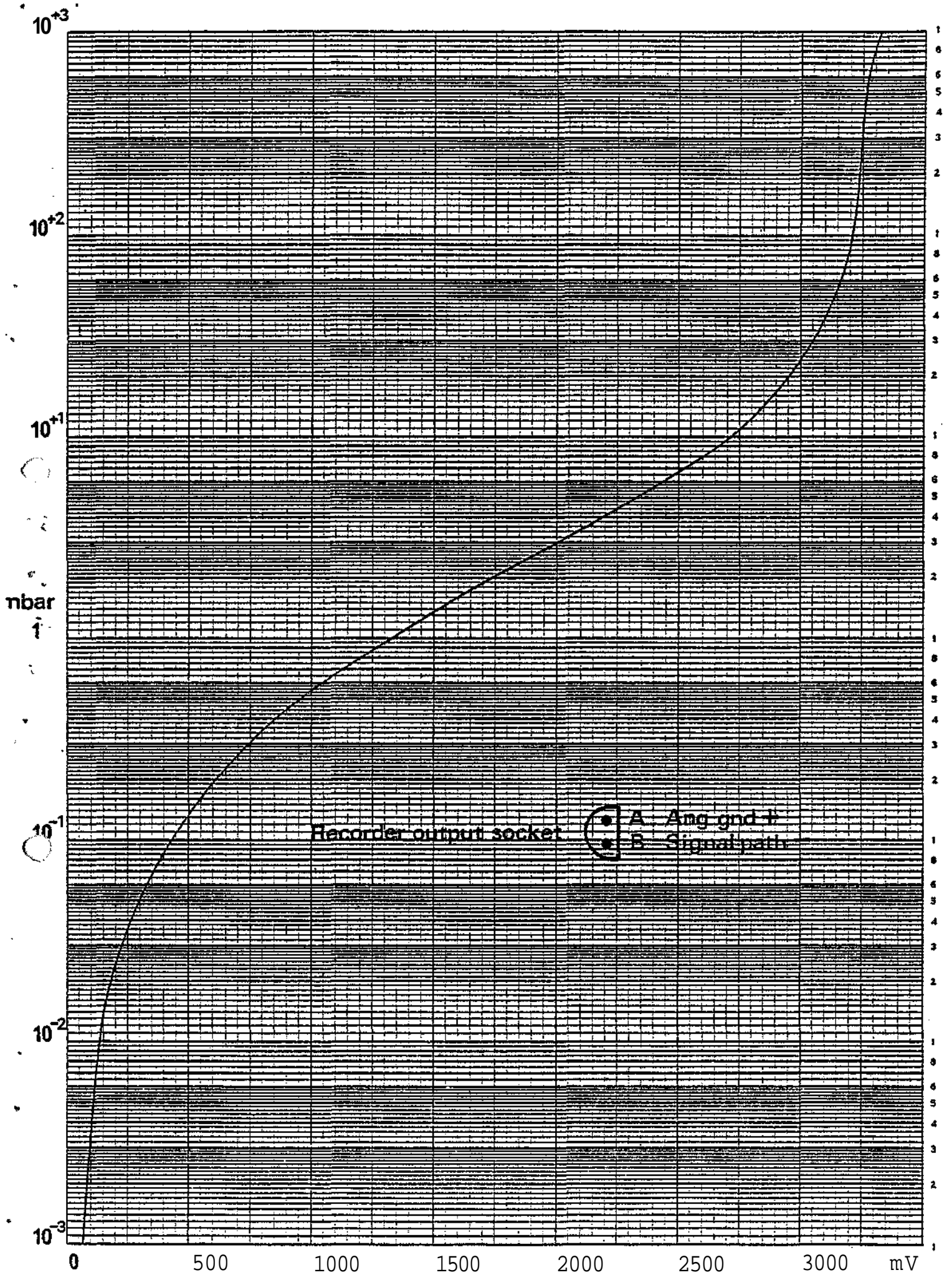




Pirani module recorder outputs—PR L1Q—

PRM-10 & PRM10CR (corrosion resistant)

Pressure mbar	Voltage mV
1000 (atm)	3330
400	3283
200	3268
100	3243
80	3210
60	3182
40	3128
20	2967
10	2714
8.0	2595
6.0	2429
4.0	2208
2.0	1749
1.0	1370
8.0	1216
6.0	1049
4.0	859
2.0	576
1.0	413
8.0	345
6.0	289
4.0	229
	156
10 *	117
	91
10 *	69



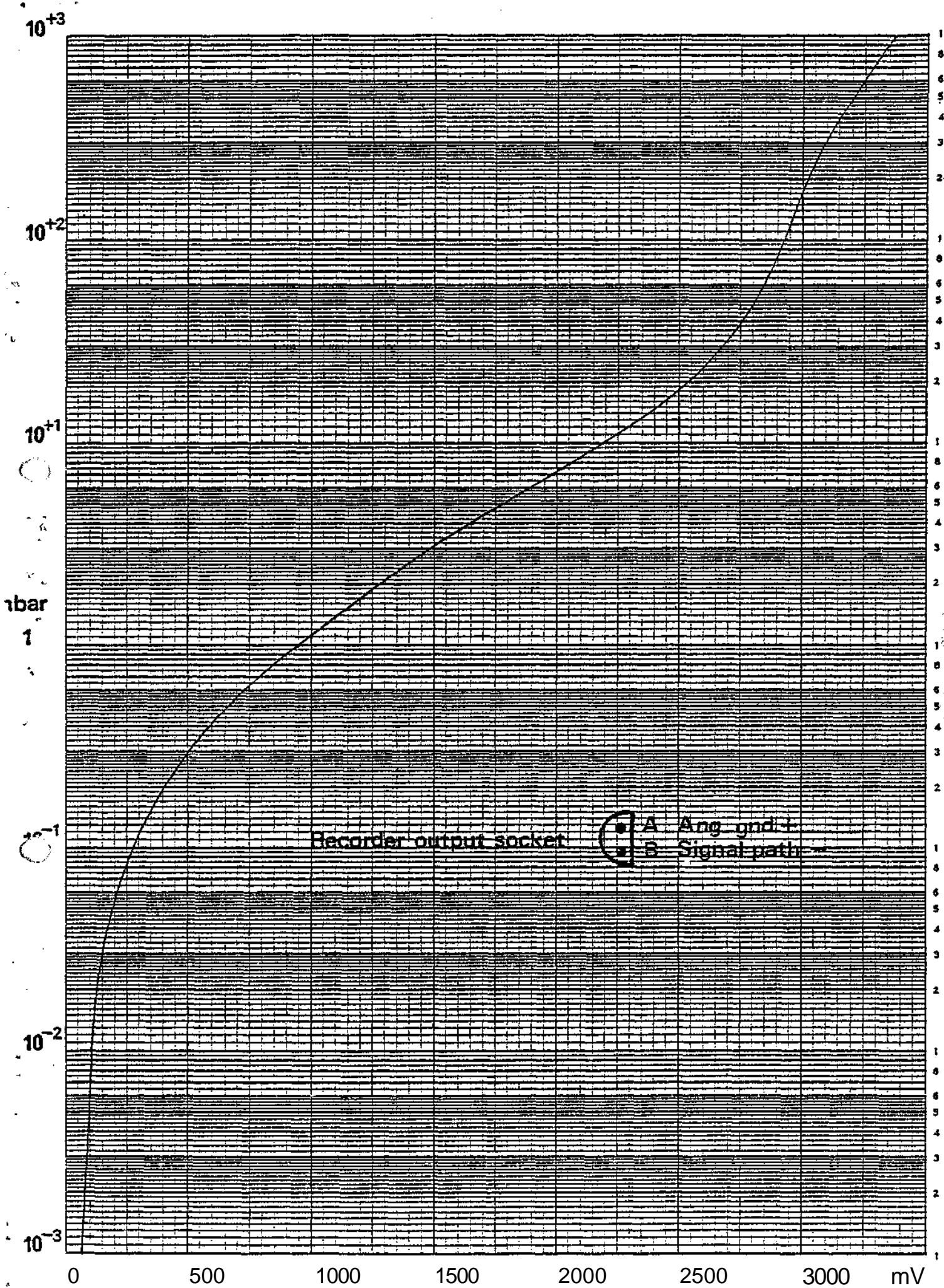
Pinani module recorder outputs—PRM 10 & PRM1OCR-

PRH-10 Pressure/voltage rec o/p Data

Pressure mbar	Voltage mV
1000 (atm)	3432
900	3421
800	3375
700	3338
" 600	3297
500	3247
400	3183
300	3109
200	3027
100	2935
80	2905
60	2859
40	2770
20	2544
10	2221
8.0	2103
6.0	1939
4.0	1703
2.0	1307
1.0	960
8.0	864
6.0	750
4.0	611
2.0	423
1.0 x 10 <sup>-1</sup>	290
8.0	257
6.0	220
4.0	178
2.0	129
1.0 x 10 <sup>-2</sup> *	99
8.0	93
6.0	86
4.0	79
2.0	71
1.0 x 10 <sup>-2</sup> ^	68

Pressure less than 1.0 x 10<sup>-3</sup> mbar = 64mV

Pressure range 1000 mbar to 10<sup>-3</sup> mbar



Pipani module recorder outputs—PR H 10—