Appendix A — Glossary of Vacuum Technology

Partial Pressure:

is the contribution that each component gas makes to the total pressure of the system and can be expressed directly in millibar, or in parts per million (ppm). The partial pressure of a gas can be obtained by measuring the height of the appropriate peak on the mass spectrum.

Total Pressure:

is the sum of the partial pressures.

Minimum detectable partial pressure:

is the smallest component pressure that the spectrometer can detect.

Maximum Operating Pressure:

is the highest total pressure at which the instrument may be safely operated.

Resolution:

is a measure of the instrument's capability of separating adjacent mass peaks. For example, 50% valley resolution means that the valley between two adjacent peaks of equal height and separated by one mass unit will be 50% of the height of either of the peaks.

amu:

Atomic Mass Unit, for example from mass position 27½ to 28½ is 1 amu.

Mass Window:

range of scan. For example, if it is required to scan from mass 28 to 32, set first mass to 27½ and use a mass window of 5 amu to give last mass of 32½.

Bakeout:

is a technique used to obtain low background pressures and a clean vacuum system and involves raising the temperature of the system to (say) 250°C for several hours while under vacuum.

Emission:

is a measure of the total electron current leaving the filament. (Hence linked to sensitivity of instrument).

Low Work-function Filaments:

emit electrons at lower surface temperatures than the standard tungsten filaments and are used primarily where samples may be subject to thermal reaction.

Ionising Current:

is that part of the emission which causes ionisation within the ion source by electron impact.

Parts per Million (ppm):

is a measure of concentration expressed as a fraction of the total pressure (taken as 10^6 parts).

Base Peak:

Largest peak in spectrum of a pure component.

Cracking Pattern:

Tabulation of relative peak heights in spectrum of a pure component. (Usually written using 100 for height of base peak).

Relative Sensitivity:

Relative height of a base peak for particular component compared to that for reference compound (often nitrogen) at the same partial pressure.

Foreline Trap:

A cylinder filled with activated alumina which absorbs oil vapour typical of those generated by rotary vacuum pumps. When placed in the backing line of a diffusion pump or between a roughing pump and the vacuum system it can reduce backstreaming hydrocarbon contamination to negligible levels.

Torr:

A unit of pressure equivalent to one millimetre of mercury. The torr was the standard unit for vacuum measurement for some time among the high vacuum technologists, and has recently been superseded by millibar.

Millibar:

A unit of pressure. One atmosphere = 1013 millibar. This is the unit now accepted by the EEC as the standard for vacuum measurement. (1 millibar = 0.75 torr).

Pascal:

A unit of pressure equal to one Newton per square metre. Proposed as the new standard at one time it was later decided to be too small a unit and was replaced by the millibar.

Cold Trap:

A cylindrical vessel containing a flask which may be filled with liquid Nitrogen, which is generally placed immediately up-stream of an oil diffusion pump. Vapours in the system and most important, oil backstreaming from the pump condense on the cold surface thereby reducing system contamination. Effective protection against backstreaming is obtained from the VG-Micromass cold traps without the use of liquid nitrogen, the trap acting as an optical baffle. The surface of the flask is polished to reduce radiation losses. There are special techniques for filling cold traps.

Backstreaming:

is the migration of vapours under molecular flow or near molecular flow conditions against the apparent direction of pumping or gas flow.

Molecular Flow:

is the condition of gas transport where the mean free path of the molecules is such that collisions occur with the walls of the vacuum vessel rather than between molecules. The result of this is that molecules can travel in the opposite direction to the bulk gas flow. Pressures when molecular flow occurs are typically below 10^{-4} torr. There exists an indeterminate region between 10^{-2} and 10^{-4} torr where an unpredictable mixture of viscous and molecular flow occurs. Protection against backstreaming should be provided in this region where appropriate.

Viscous Flow:

is the condition of gas transport where the mean free path of the molecules is such that collisions occur between molecules rather than between a molecule and the vessel wall (except of course for molecules at the wall). The result is that all molecules travel with the bulk gas flow. Viscous flow conditions exist at pressures above 10^{-2} torr.

Differential Pumping:

is a technique whereby any part of the vacuum system is maintained at a higher pressure than another by restricting the pumping speed for the gas from that high pressure part. For example if gas flows into a mass spectrometer source at a given rate Q and the pumping speed from the source is S then the pressure in the source

$$P_S = \frac{Q}{S}$$

If the gas then flows through an analyser region where a lower pressure is required to be maintained to minimise ion-molecule collisions and the pumping speed from that region is 10S then the pressure P_A will be

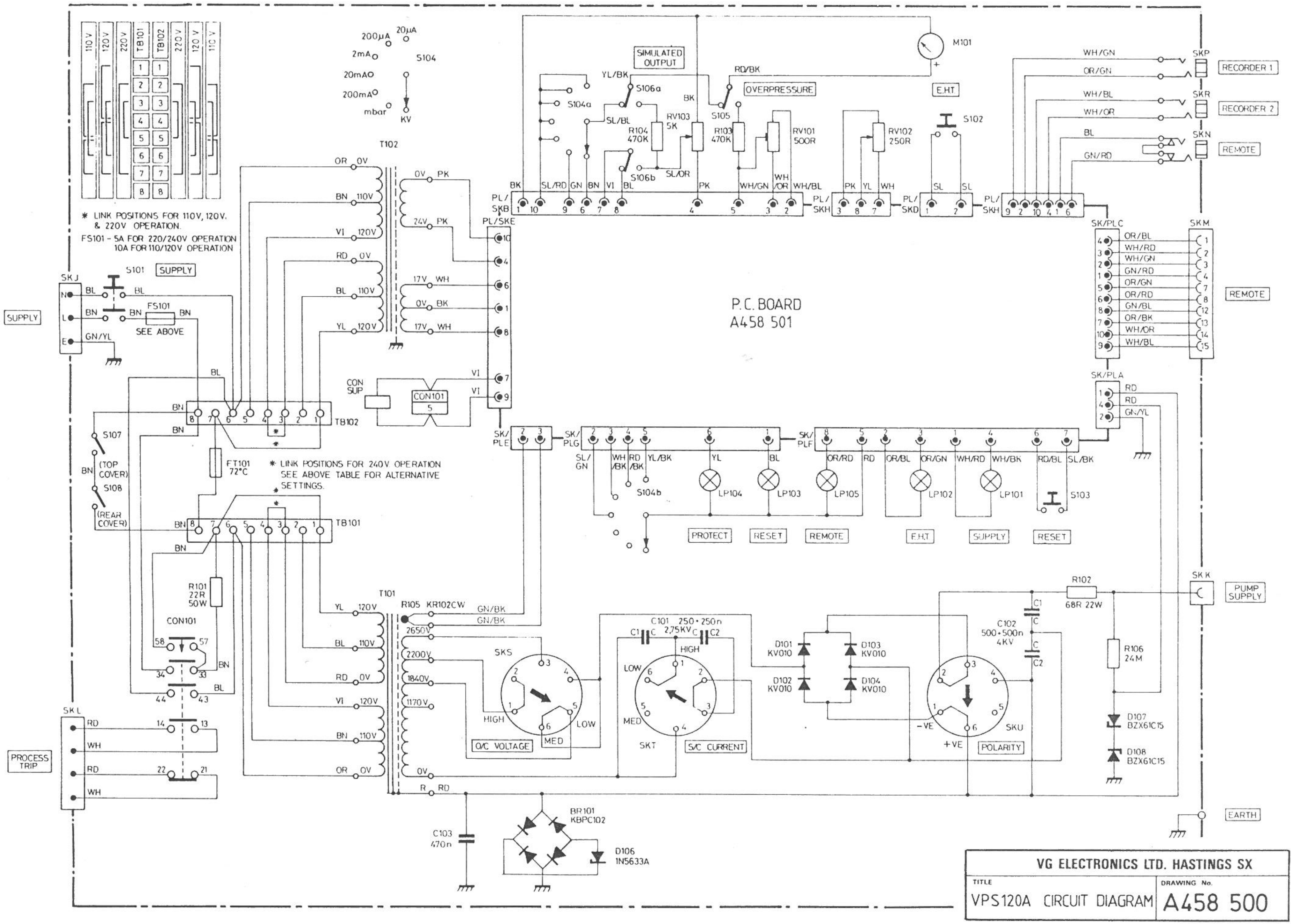
$$P_A = \frac{Q}{10S} = \frac{P_S}{10}$$

thus providing a pressure differential between the two regions of 1 : 10. Several stages of differential pumping may be used in some cases.

Ion:

is an atom or molecule which is charged. This charge may result from one or more of the electrons being stripped from the neutral atom or molecule (the usual result of electron bombardment) in which case the net charge is positive; or it may result from the capture of an electron by the atom or molecule resulting in a net negative charge. The latter process is less likely to happen in a normal electron bombardment process (about 1 in 10^4 ions produced are negative) except for a number of molecules which have a high affinity for electrons (e.g. Chlorine).

APPENDIX B - CIRCUIT DIAGRAMS



* LINK POSITIONS FOR 110V, 120V, & 220V OPERATION.

FS101 - 5A FOR 220/240V OPERATION
10A FOR 110/120V OPERATION

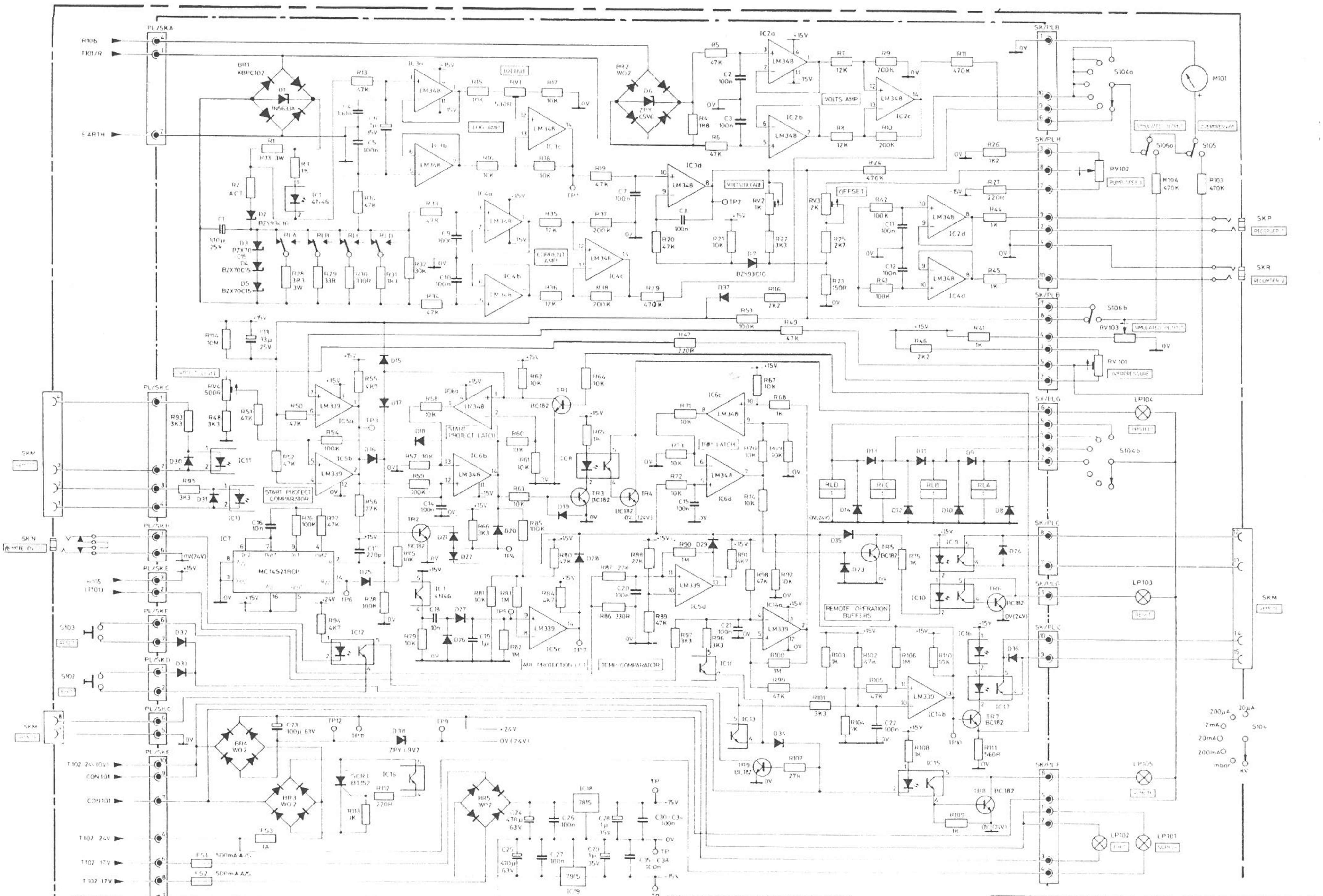
* LINK POSITIONS FOR 240V OPERATION SEE ABOVE TABLE FOR ALTERNATIVE SETTINGS.

VG ELECTRONICS LTD. HASTINGS SX

TITLE
VPS120A CIRCUIT DIAGRAM

DRAWING No.
A458 500

1/83/B



NOTE - ALL DIODES 1N914 UNLESS OTHERWISE STATED
IC8-10,12,15,16 & 17 TO BE CNY17 - 2
IC11 & 13 TO BE 4N33

VG ELECTRONICS LTD. HASTINGS SX

TITLE

VPS120A P.C.B. CIRCUIT DIAG.

DRAWING No.

A458 501

APPENDIX C - SPARE PARTS

Description	V.G.E. Part No.
Control P.C.B. Sub-Assy.	A548-300
E.H.T. Transformer (T101).	381-223
Control Transformer (T102).	381-224
Control Relay (CON101).	347-178
Timing Element (for CON101).	347-179
R.C. Link (for CON101).	347-180
Fuse (FS1, FS2) 20mm, 500mA, Anti-Surge.	351-412
Fuse (FS3) 20mm, 1A, Quick-Blow.	351-315
Fuse (FS101) 220/240V 1 1/4" 5A Quick-Blow.	351-121
110/120V 1 1/4" 10A Quick-Blow.	351-126
Fuse Thermal (FT101) 72°C.	351-522
Lamp (LP101) 28v 40mA - T 1 3/4 min Flange.	364-021
Lamp (LP102-105) 24v 50mA - T4.5.	364-025
Connector 63mm (1/4") 2 pole Jack (PLN, P.R.)	332-012
Connector 3 pole supply (PLJ).	333-077
Connector 4 pole (PLL).	333-072
Connector 15 way 'D' type (PLM).	335-062
Connector Cover (for PLM).	335-063
Cable Clamp (for PLL).	339-101
Earthing Lead	A425-304

	V.G. Part No.
Ion Pump Lead.	IPLS

PENDIX D - RECOMMENDED POWER SUPPLIES AND SETTINGS FOR SOME COMMON ION PUMPS

NUFACTURER	TYPE	MODEL	VPS POWER SUPPLY	SPEED ls^{-1}	SETTING	O/C VOLTAGE POLARITY kV	S/C CURRENT mA
I	DIODE	JD8	VPS120A	8	+ 3.5	LOW *	37 (LOW)
r Ferranti)	"	JD15	"	15	+ 7.5	HIGH	37 (LOW)
"	"	JD50	"	50	+ 3.5	LOW *	74 (MED)
"	"	JD80	"	80	+ 7.5	HIGH	148 (HIGH)
"	"	JD145	VPS1000	145	+ 7.5	HIGH	375 (LOW)
"	"	JD270	"	270	+ 7.5	HIGH	750 (MED)
"	"	JD500	"	500	+ 7.5	HIGH	1500 (HIGH)
"	TRIODE	JK20	VPS120A	20	- 5.5	LOW	123 (MED)
"	"	JK110	"	170	- 5.5	LOW	246 (HIGH)
"	"	JK220	VPS1000	220	- 5.2	LOW	520 (MED)
"	"	JK420	"	400	- 5.2	LOW	1040 (HIGH)
RIAN	VACION DIODE	911-5005	VPS120A	8	+ 3.5		37 (LOW)
"	HI-Q DIODE	911-5041	"	20	+ 7.5	HIGH	560 (MED)
"	"	912-7000	VPS1000	140	SEE AEI JD140		
"	VACION DIODE	912-7008	"	270	SEE AEI JD270		
"	" "	912-7066	"	500	SEE AEI JD500		
"	VACION TRIODE	911-5030	VPS120A	20	SEE AEI JK20		
"	" "	911-5032	"	30	- 5.5	LOW	123 (MED)
"	" "	911-5034	"	60	- 5.5	LOW	123 (MED)
"	" "	912-7016	"	110	SEE AEI JK110		
"	" "	912-7014	VPS1000	220	SEE AEI JK220		
"	" "	912-7022	"	400	SEE AEI JK400		
YBOLD HERAEUS	DIODE	1Z8	VPS120A	8	+ 3.5	LOW *	37 (LOW)
" "	TRIODE	1Z30	"	30	- 6.2	MED	295 (HIGH)
" "	"	1Z80	"	80	- 6.2	MED	295 (HIGH)
" "	"	1Z120	"	120	- 6.2	MED	295 (HIGH)
" "	"	1Z270	VPS1000	270	- 6.2	MED	620 (MED)
" "	"	1Z500	"	500	- 6.2	MED	1240 (HIGH)

NUFACTURE	TYPE	MODEL	VPS POWER SUPPLY	SPEED ls^{-1}	SETTING	O/C VOLTAGE POLARITY kV	S/C CURRENT mA
WARDS	DIODE	EPI/15	VPS120A	15	+ 7.5	HIGH	90 (LOW)
"	"	EPI/30	"	30	+ 7.5	MED	180 (MED)
"	"	EPI/125	"	125	+ 7.5	MED	300 (HIGH)
TEK	N.B. STANDARD VPS SERIES NOT RECOMMENDED FOR ULTEK 5, 11, 20, 25 ls^{-1} D I PUMPS						
TEK	(DIODE	DI	VPS120A	60	+ 5.5	LOW	)
"	("	CONVENTIONAL	"	80	+ 7.5	HIGH	) SEE
"	(DIODE	DI	VPS1000	120	+ 5.2	LOW	) MANUFACTURERS
"	("	CONVENTIONAL	"	150	+ 7.5	HIGH	) CURRENT
"	(DIODE	DI	"	220	+ 5.2	LOW	) RATINGS
"	("	CONVENTIONAL	"	270	+ 7.5	HIGH	)
"	(DIODE	DI	"	400	+ 5.2	LOW	)
"	("	CONVENTIONAL	"	500	+ 7.5	HIGH	)
CO	DIODE	DI MT-20	VPS120A	20	+ 5.5	LOW	62 (LOW)
"	"	DI MT-30	"	30	+ 5.5	LOW	62 (LOW)
"	"	DI MI-75	"	75	+ 5.5	LOW	246 (HIGH)
"	"	DI MI-150	VPS1000	150	+ 5.2	LOW	520 (MED)
"	"	DI MI-225	"	225	+ 5.2	LOW	520 (MED)
"	"	DI MI-300	"	300	+ 5.2	LOW	520 (MED)
"	"	DI MI-600	"	600	+ 5.2	LOW	1040 (HIGH)
"	"	DI MI-900	"	900	+ 5.2	LOW	1040 (HIGH)
ER	DIODE	PI-100	VPS120A	100	+ 5.5	LOW	246 (HIGH)
'	"	PI-200	VPS1000	200	+ 5.2	LOW	520 (MED)
'	"	PI-400	"	400	+ 5.2	LOW	1040 (HIGH)

FOR PUMPS WHICH REQUIRE 3.5kV, THE TRANSFORMER TAPPING MUST BE CHANGED, SEE SECTION 3:3.

ARGON PROCESSING OF ION PUMPS

INTRODUCTION

Argon processing is a conditioning technique for use with an ion pumped system; its application, in association with baking, is recommended as a valuable aid to the rapid attainment of low ultimate pressures, especially when the system is new. Alternatively, argon processing coupled with baking normally restores the performance of an ion pump that has deteriorated as the result of contamination arising from, possibly, prolonged exposure to atmospheric air, absorbtion of large quantities of gas or mild oxidation.

THE MECHANISM OF ARGON PROCESSING

Bombardment of the cathode by argon ions at relatively high pressure raises the temperature of the module, thereby liberating absorbed gases. In addition, operation at this high pressure results in a greatly increased sputtering rate so that clean cathode surfaces are quickly exposed and relatively large amounts of titanium are deposited on adjacent surfaces.

PROCEDURE

i) Bake out the entire system at 300-400°C into a roughing system capable of maintaining a pressure of at least 10^{-4} mbar during the bake out. The bake out should extend for at least 4 hours.

ii) After completion of the bake out, start the ion pump, valve off the roughing pump and reduce the baking temperature to 200-250°C.

iii) When the ion pump has pumped the system down to 10^{-8} mbar or below, admit argon to the system, raising the pressure to 5×10^{-5} mbar. Maintain this pressure for 5-10 minutes, then stop the argon flow, switch off the bakeout heaters, and allow the system to pump down.

RESULT

Following the above procedure, and assuming otherwise suitable conditions, pressures in the low 10^{-11} mbar range should readily be achieved after an overnight pumpdown.