87-900-050-01
April 1993

Instruction Manual

MultiVac controller
VacIon® pump high voltage card

Model 929-3025

Model 929-3035

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SAFETY SUMMARY

Operators and service personnel must be aware of all hazards associated with this equipment. They must know how to recognize hazardous and potentially hazardous conditions, and know how to avoid them. The consequences of unskilled, improper, or careless operation of the equipment can be serious. This product must only be operated and maintained by trained personnel. Every operator or service person must read and thoroughly understand operation/maintenance manuals and any additional information provided by Varian. All warnings and cautions should be read carefully and strictly observed. Address any safety, operation, and/or maintenance questions to your nearest Varian office.

The following format is used in this manual to call attention to hazards:

WARNING

Warnings are used when failure to observe instructions or precautions could result in injury or death.

CAUTION

Cautions are used when failure to observe instructions could result in damage to equipment, whether Varian-supplied or other associated equipment.

NOTE

Information to aid the operator in obtaining the best performance from the equipment.

1-1 General

The VacIon Pump (VIP) High Voltage (H.V.) card is a power supply designed to meet a wide range of requirements when used in conjunction with the MultiVac controller base unit.

It is a compact and light card, specifically designed to operate ion pumps with both positive and negative polarity from 20 l/s to 60 l/s and up to 200 W output power.

The card is programmed with 6 pre-defined pump settings. Using a patented operation principle, the controller is capable of reading pressure down to the 10^{-11} Torr range, while optimizing the pumping speed in the entire operating range.

1-2 Description

The card is basically composed of 3 parts (see Fig.1-1):

a) High frequency switching PCB for high voltage generation and control. The ac voltage from base unit is rectified and feeds a group of power MOSFETS. A power wave modulator (PWM) generates a high frequency square wave with a variable duty-cycle.
This wave is then applied to the gates of the power MOSFETS making them commutate between conduction and interdiction. The output is applied to a transformer whose secondary winding is connected to a high voltage multiplier. The resulting output voltage and current are continuously measured and compared with the desired values set by the microprocessor. The PWM changes its output proportionally to mantain the disired values.

b) High voltage multiplier module.
This is composed of a multiplier ladder made by capacitors and diodes that rectify and multiply the voltage coming from the secondary of the transformer and then sent to the output connector.

c) Read-out circuitry.
The output voltage and the current drawn by the pump are continuously updated. This information is sent to the PWM controller closing the output regulation loop and also converted into a digital signal and sent to the microprocessor in the base unit.

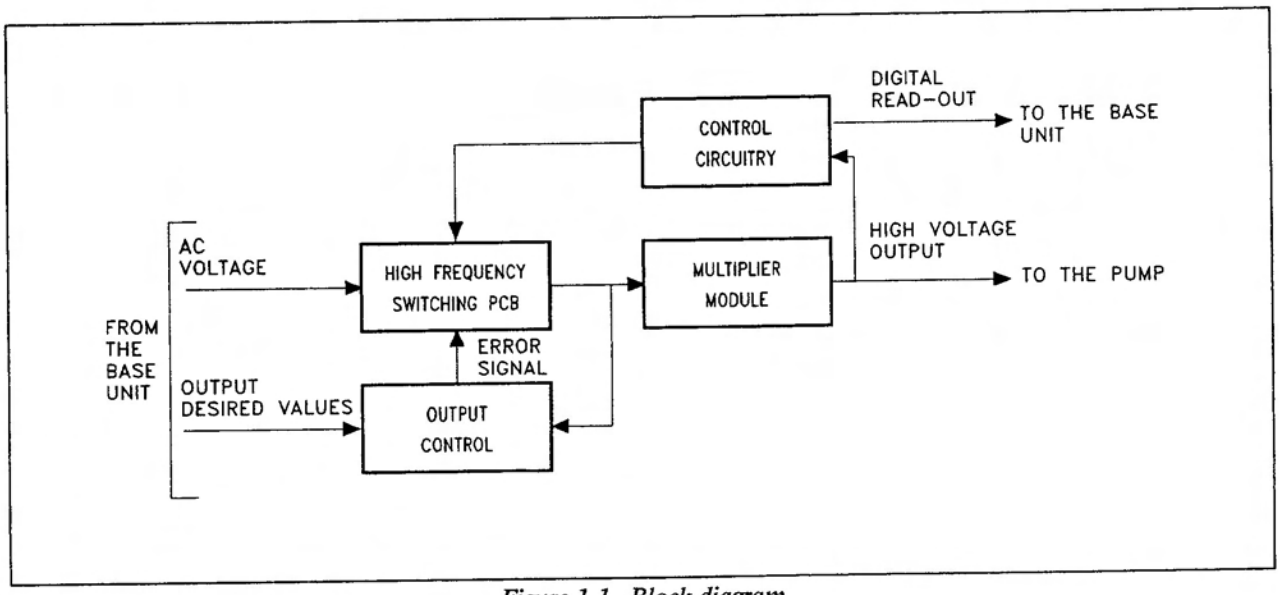


Figure 1-1 - Block diagram

1-3 H.V. card specifications

(See Table 1 for the different pump models)

Output (max):	
- Voltage	± 7000 Vdc + 2% -10% (see Fig. 1.2)
- Current	200 mA maximum
- Power	200 W maximum
- Polarity	Positive or negative selected through internal module
- Recorder	Analog signal 0 to + 5 Vdc (see Fig. 1.3) (Minimum recorder input impedance 1 MΩ) Logarithmic, proportional to pressure
- For Protect mode of operation see Table 2.	
- For Step mode of operation see Table 3.	
Weight	2,5 kg (5.5 lbs)

Table 1 - Start mode of operation

Table 1

Pump size/type	Model number	Maximum voltage and polarity	Short circuit current	Maximum power
60, 45, 30 l/s StarCell	919-0103 919-0102 919-0101	-7000V	250 mA	200 W
20 l/s StarCell	919-0110	-7000V	150 mA	150 W
60 l/s Triode	911-5034	-5000V	250 mA	200 W
20, 30 l/s Triode	911-5030 911-5032	-5000V	150 mA	150 W
60 l/s Diode	911-5038	+5000V	250 mA	200 W
20, 30 l/s Diode	911-5036 911-5037	+5000V	150 mA	150 W

Table 2 - Protect mode of operation

When the current value exceeds the trip current for more than 0,2 seconds, the power supply turns off the high voltage, and an error message is displayed.

Table 2

Pump size/type	Protect trip current
60, 45, 30 l/s StarCell	30 mA
20 l/s StarCell	20 mA
60 l/s Triode	30 mA
20,30 l/s Triode	20 mA
60 l/s Diode	30 mA
20,30 l/s Diode	20 mA

Table 3 - Step mode of operation

When the current reaches the value listed in the table, the controller changes the voltage output.

Table 3

Pump size/type	Current value for switching from 7.0 to 5 KV		Current value for switching from 5 to 3 KV
60, 45, 30 l/s StarCell	1.3×10^{-4} A	see also Fig. 1-4	3.8×10^{-6} A
20 l/s StarCell	6.5×10^{-5} A		1.9×10^{-6} A
60 l/s Triode	-	see also Fig. 1-5	6.7×10^{-6} A
20,30 l/s Triode	-		2.8×10^{-6} A
60 l/s Diode	-		6.7×10^{-6} A
20,30 l/s Diode	-		2.7×10^{-6} A

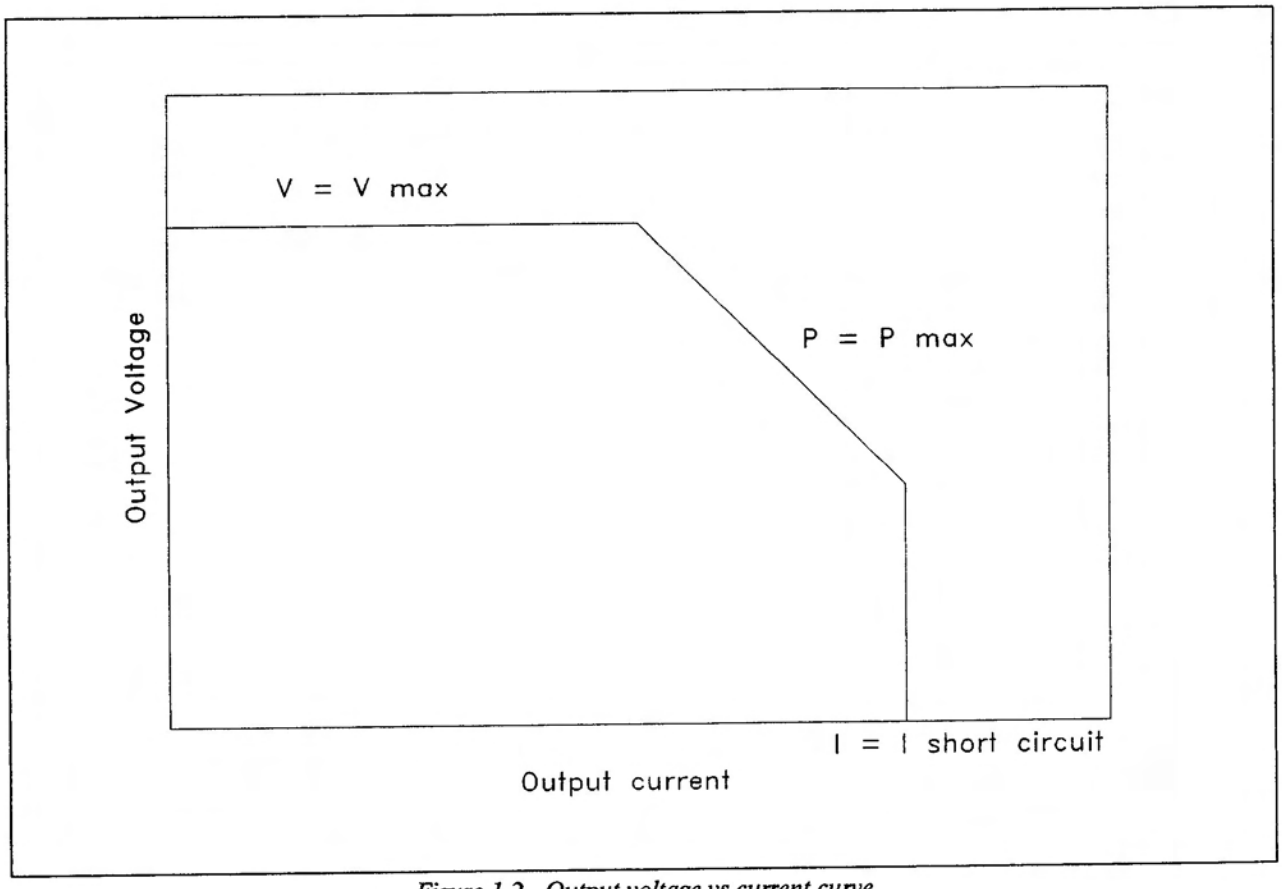


Figure 1-2 - Output voltage vs current curve

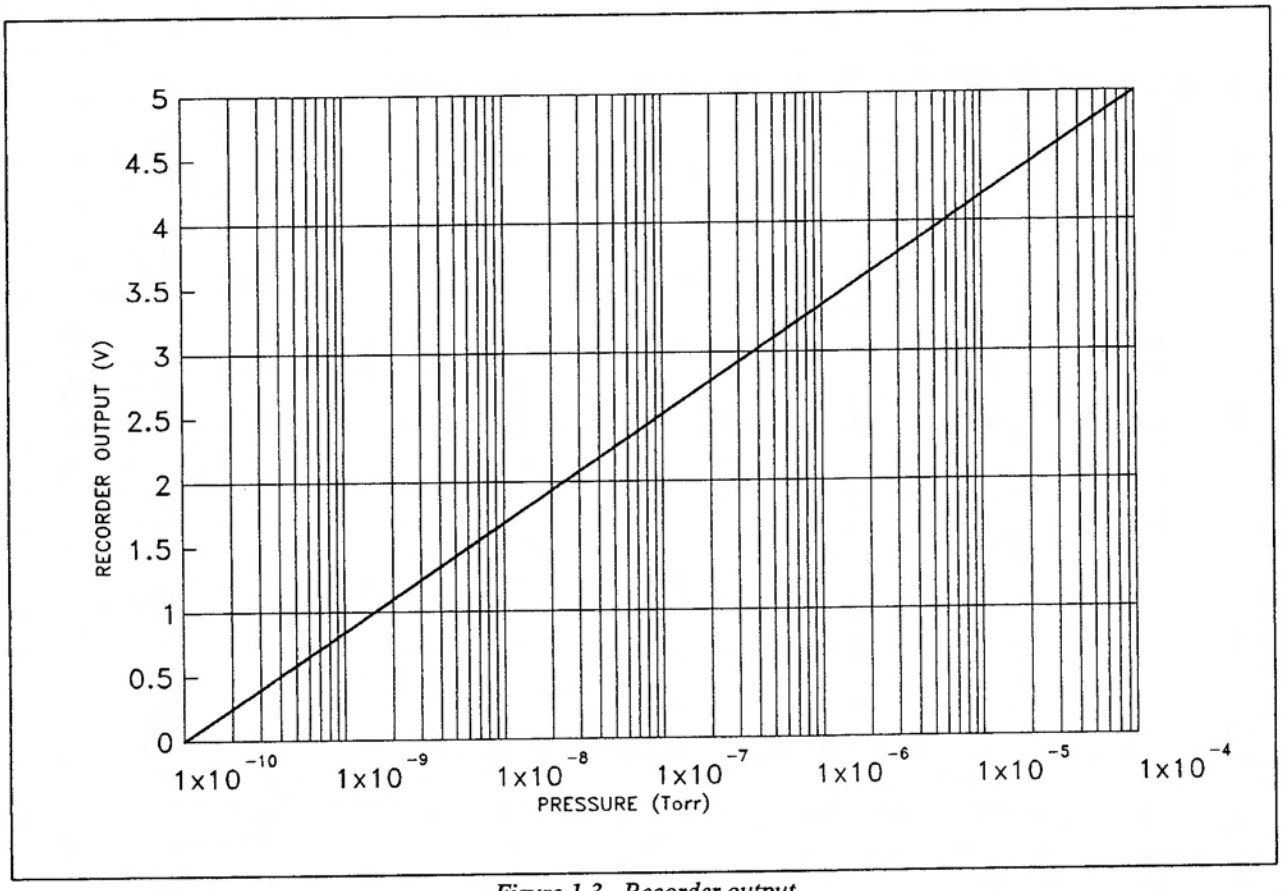


Figure 1-3 - Recorder output

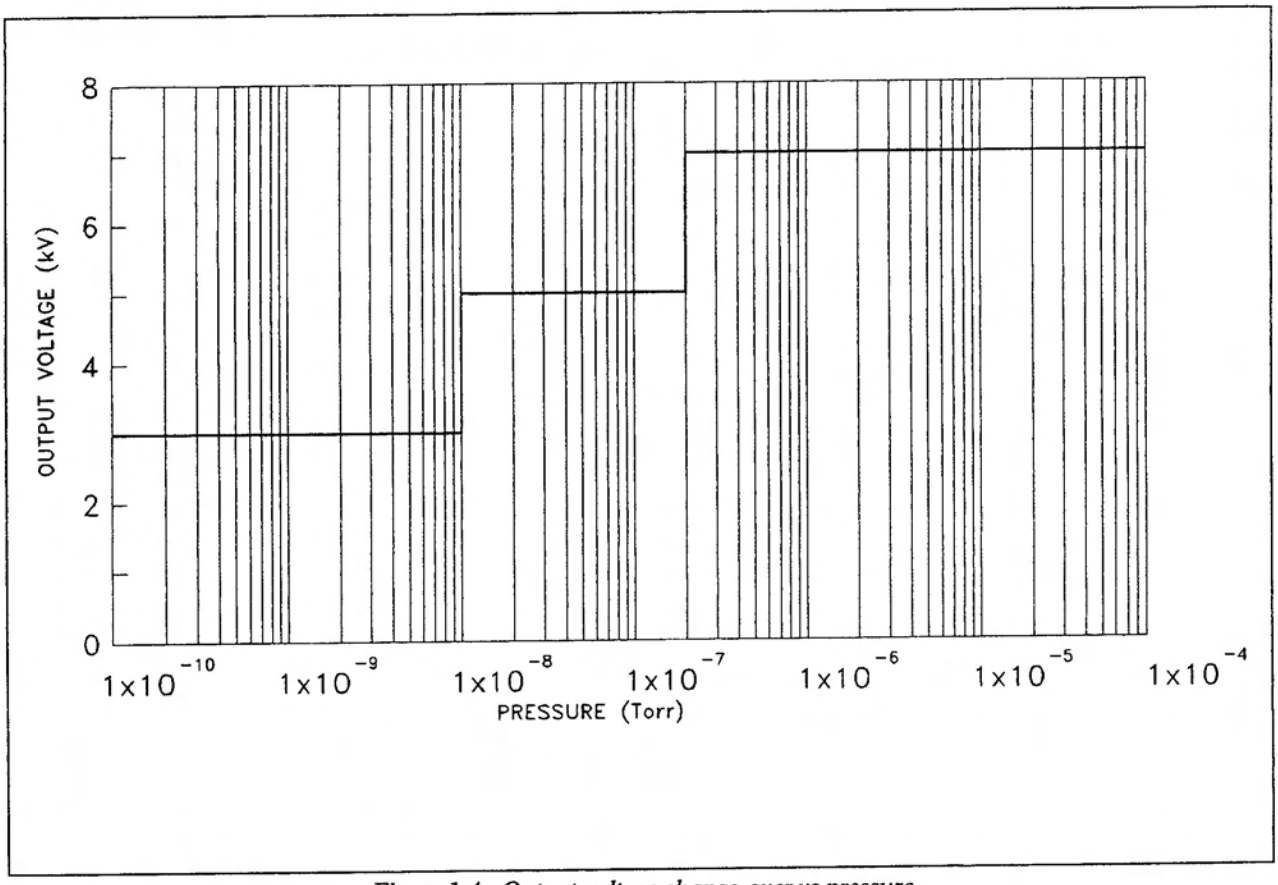


Figure 1-4 - Output voltage change-over vs pressure
(for 20, 30, 45, 60 l/s StarCell pumps)

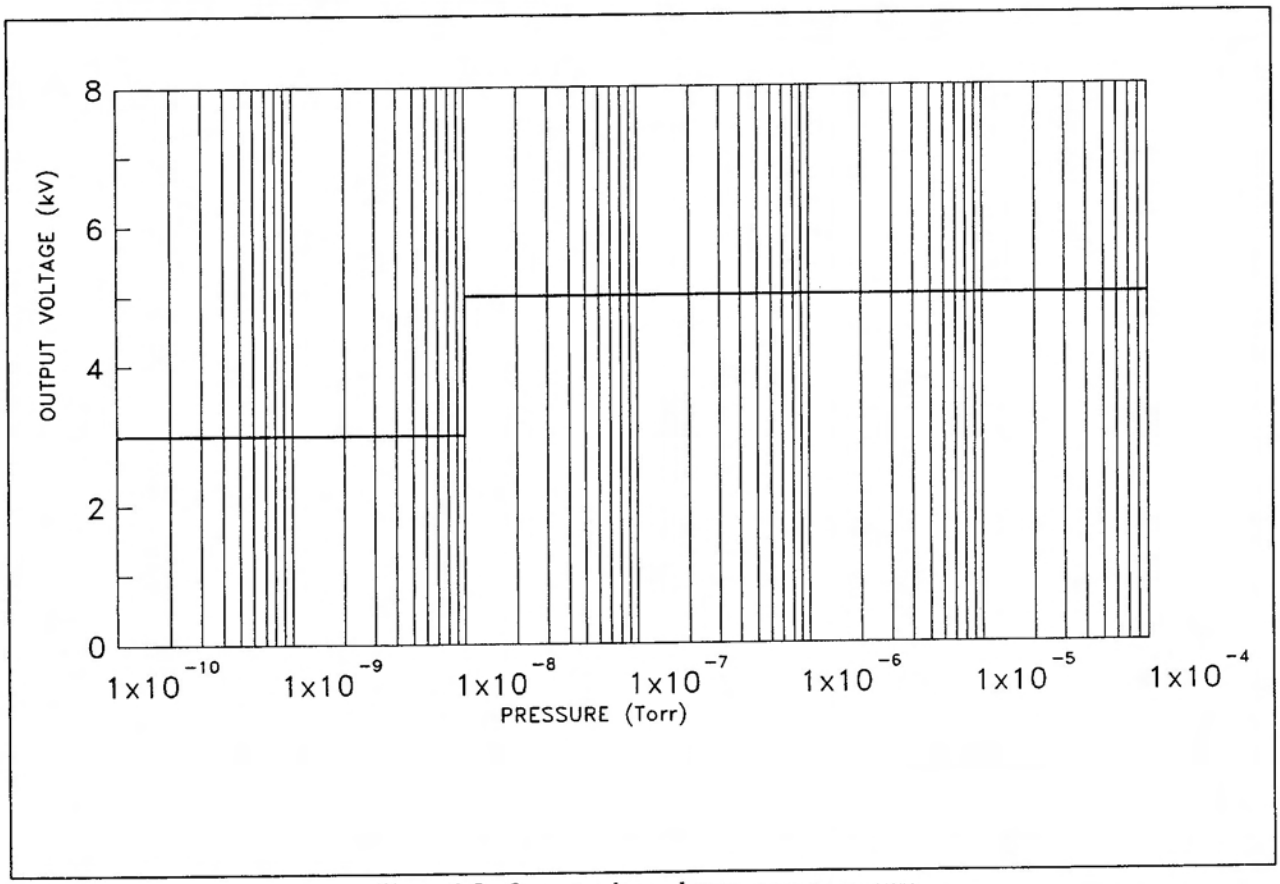


Figure 1-5 - Output voltage change-over vs pressure
(for 20, 30, 60 l/s triode and diode pumps)

1-4 H.V. card outline

The outline dimensions for the H.V. card are shown in Fig. 1-6.

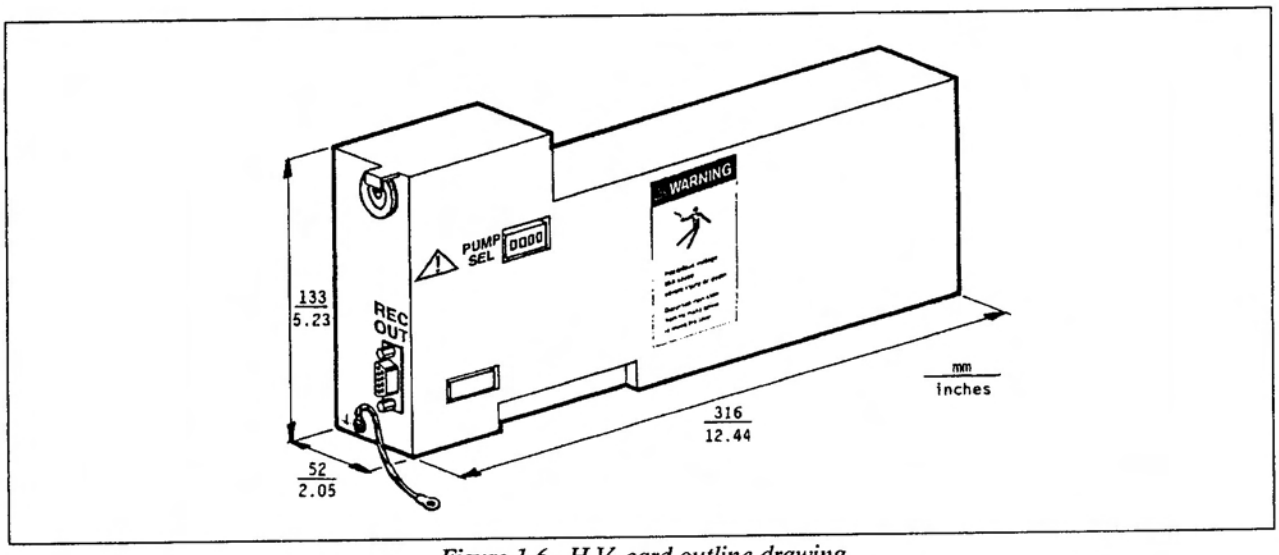


Figure 1-6 - H.V. card outline drawing

2-1 General

Inspect the VIP HV card for any shipping damage. The HV card is factory set to:

- model 929-3025 set to Negative polarity (20 l/s StarCell pump as default setting)
- model 929-3035 set to Positive polarity (20 l/s Diode pump as default setting)

WARNING

High voltage developed in the card can cause severe injury or death. Before servicing the card disconnect the input power cable of the MultiVac controller base unit.

2-1.1 Polarity change over

If there is a need to change the output polarity, proceed as follows:

- Be sure that no power is applied to the MultiVac controller base unit (remove the power cable).
- Remove the VIP HV card from base unit.
- On the HV card undo the 5 screws, indicated by the arrows (see Fig. 2-1) and open in two parts the card.
- Following Fig. 2-2 undo the screws 1, 2, 3 and remove the multiplier module.
- Select the desired polarity according to the pump in operation by turning the module and reinstall it.
- Reinsert the VIP HV card.

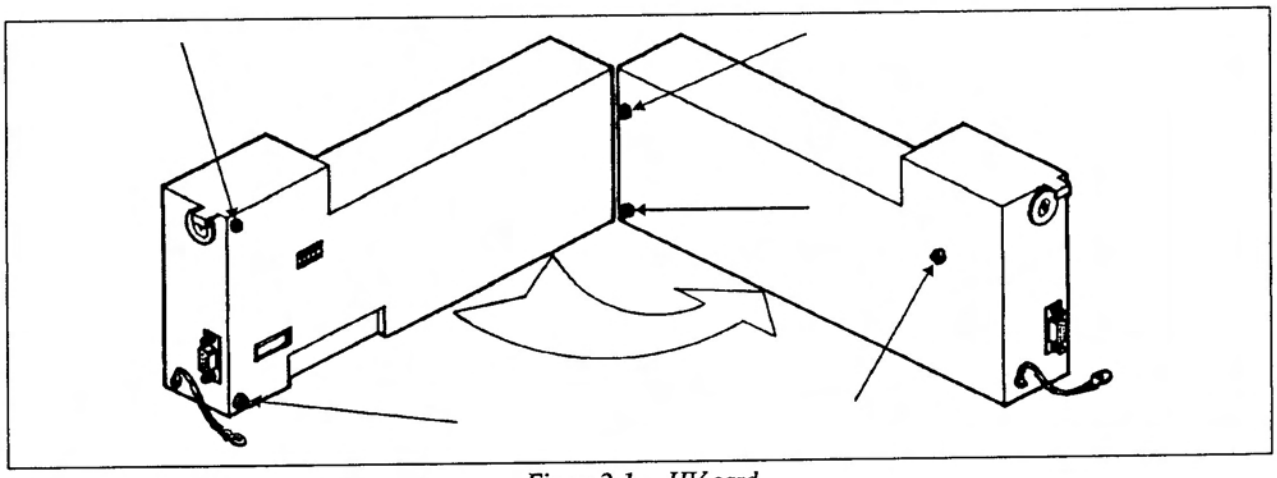


Figure 2-1 - HV card

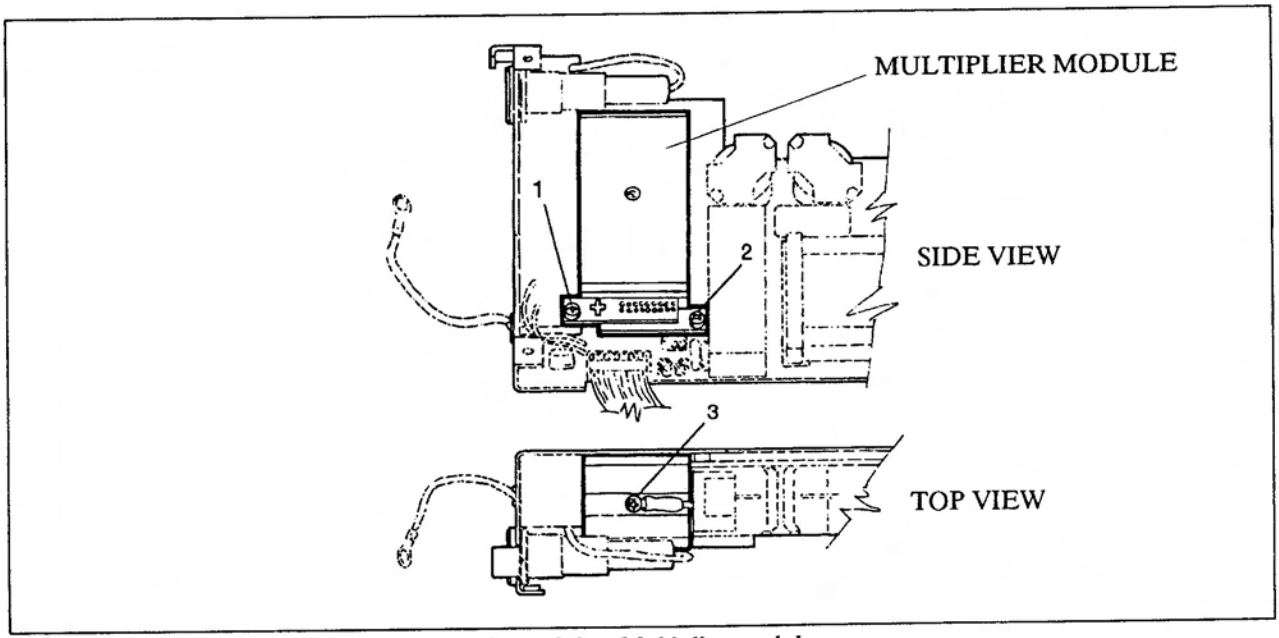


Figure 2-2 - Multiplier module

2-1.2 Pump size selection

The output voltage and current are selected by the dip switches located on the VIP HV card (see Fig. 2-3).
To change the pump size proceed as follows:

- Be sure that no power is applied to the-MultiVac controller base unit (remove the power cable).
- Remove the VIP HV card from base unit.
- Select the desired pump size putting the dip switches in the right configuration following the Table 4. Then, install the card into the base unit, following paragraph 2-2.

Table 4

Pump size/type	Dip switch selections			
	1	2	3	4
30, 45, 60 l/s StarCell	OFF	ON	OFF	ON
20 l/s StarCell	ON	ON	OFF	ON
60 l/s triode	OFF	OFF	ON	ON
20, 30 l/s triode	ON	OFF	ON	ON
60 l/s diode	OFF	ON	ON	ON
20, 30 l/s diode	ON	ON	ON	ON

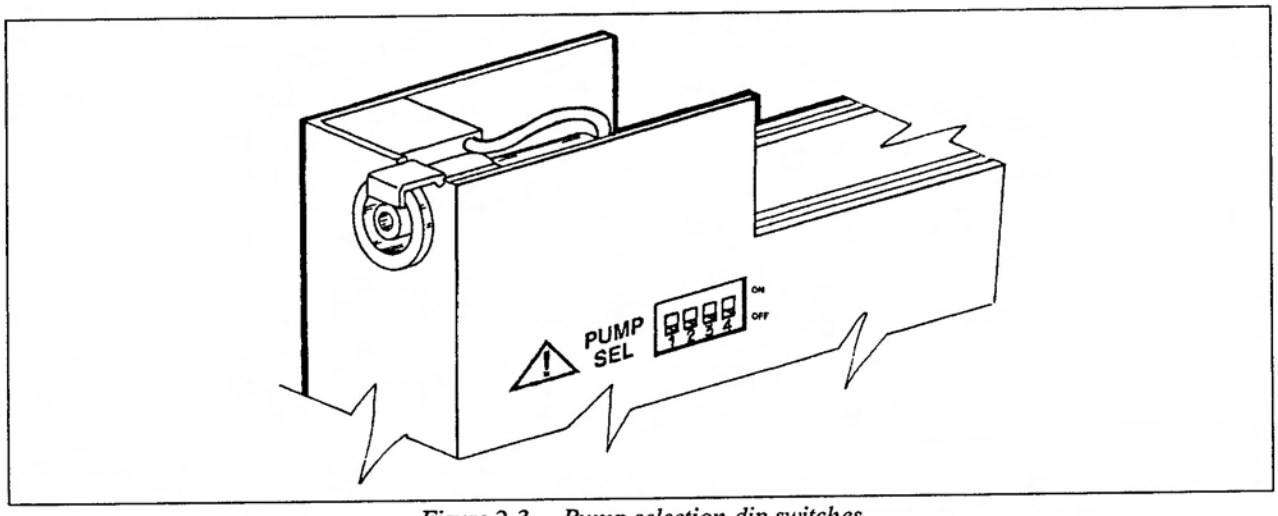


Figure 2-3 - Pump selection dip switches

2-2 VIP HV card installation

Insert the HV card into the MultiVac base unit as directed in Fig. 2-4.

NOTE
Connect the ground braid to the MultiVac base unit rear panel as directed in Fig. 2-5.

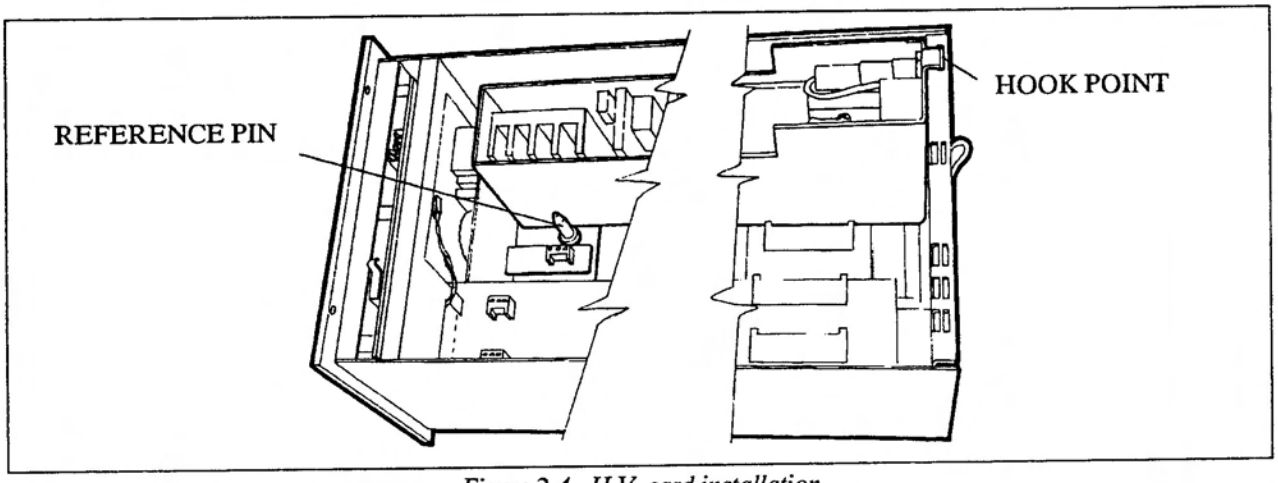


Figure 2-4 - H.V. card installation

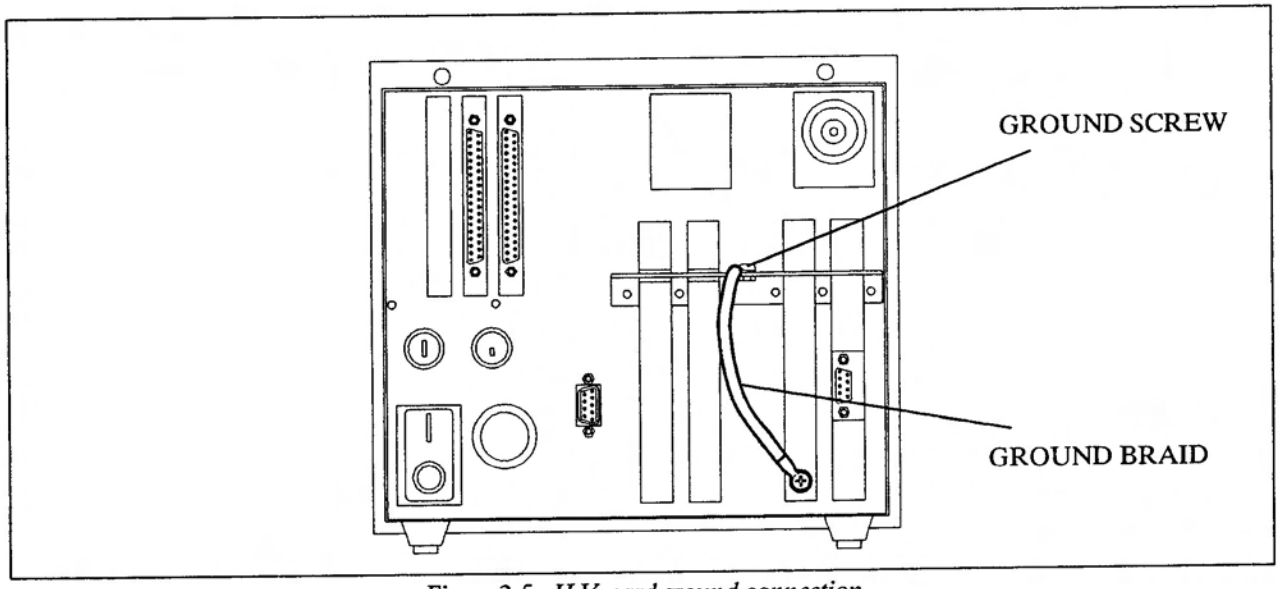


Figure 2-5 - H.V. card ground connection

2-3 Pump connection

The pump is connected to the controller rear panel via the Fischer connector, by a coaxial high voltage cable assembly.

WARNING

High voltage can cause severe injury or death.
When installing the connector:
- Turn the power off.
- Make sure that the ground spring is in place.
- Install the pump connector and secure it with screws.
- Plug the controller connector.
When removing the connector make sure that power is off.

2-4 Recorder output connection

An external analog recorder can be connected to the recorder output connector J1 (Fig. 2-6) pin 3 (ground) and pin 1 (positive) taking care that the minimum recorder input impedance should be 1 MΩ

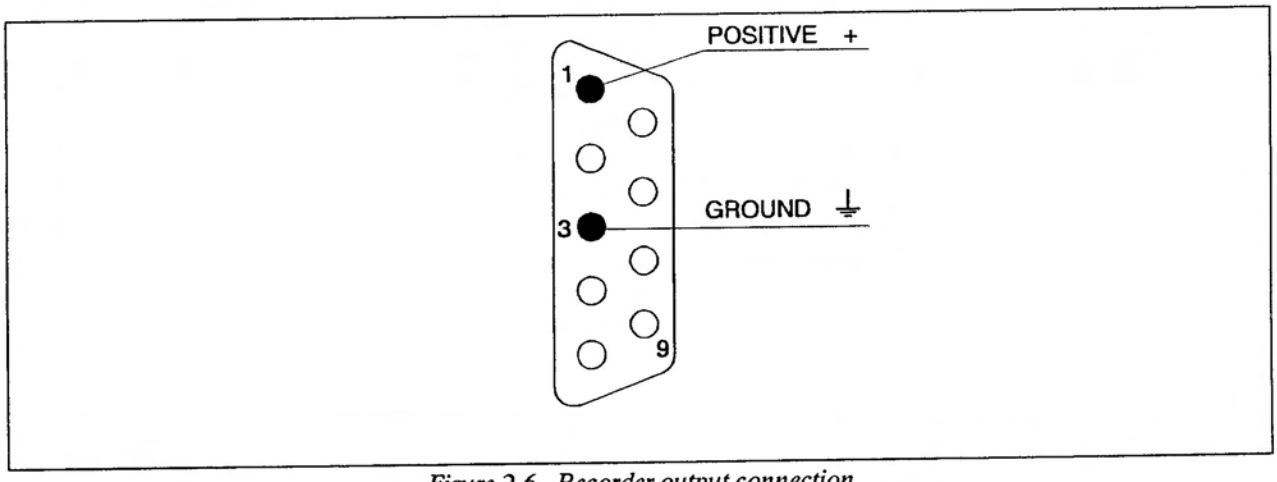
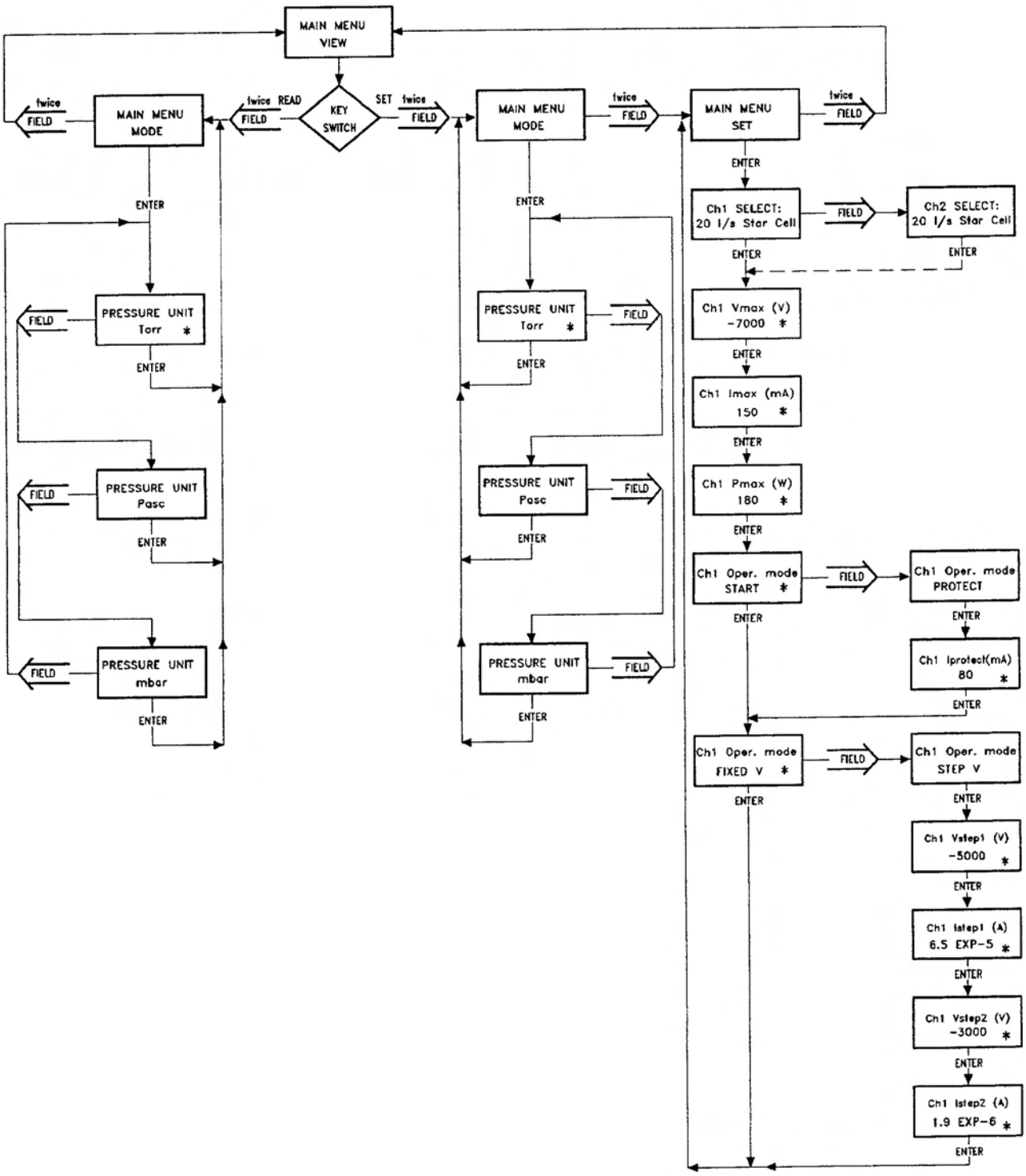


Figure 2-6 - Recorder output connection



Flow chart No. 1

3-1 Programming the MultiVac controller

At the first installation the MultiVac controller must be programmed according to the desired mode of operation of the pumps.
The user may choose the following operating modes:

1) **START or PROTECTED mode**

2) **STEP or FIXED VOLTAGE mode**

In the **START mode** of operation the controller supplies full power, disregarding the pump condition, up to the short circuit current (ref. table 1). This operating mode should be used to start the pump at high pressure.

In the **PROTECTED mode** of operation the controller limits the output current (ref. table 2) and it turns off the high voltage when the current value exceeds the trip current for more than 0.2 seconds.

In the **STEP mode** of operation when the current drawn by the pump reaches the value listed in table 3, the controller change the voltage output.

In the **FIXED VOLTAGE mode** of operation the output voltage remains always at the maximum value (ref. Fig. 1-2).

3-2 Controller Start-up

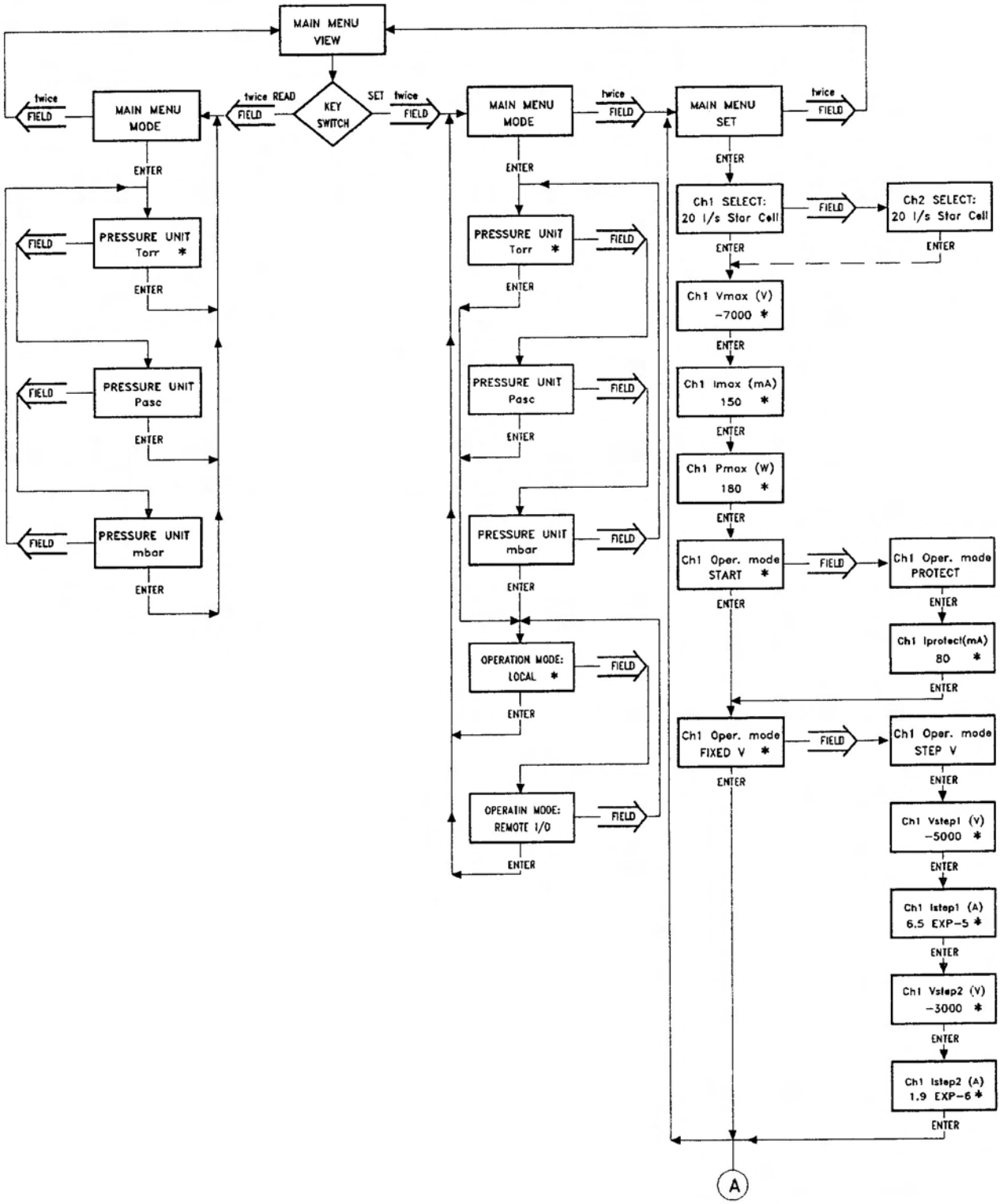
Make all vacuum manifold and electrical connections and refer to the Ion Pump instruction manual prior to operate the MultiVac controller.
Plug the controller power cable into a suitable power source, put the channels enable switch to OFF and switch the power ON (rear panel). Follow the Flow chart No. 1 to select the desired operating mode for pump size/type (ref. table 4).

The operating mode is factory set to START and STEP V.

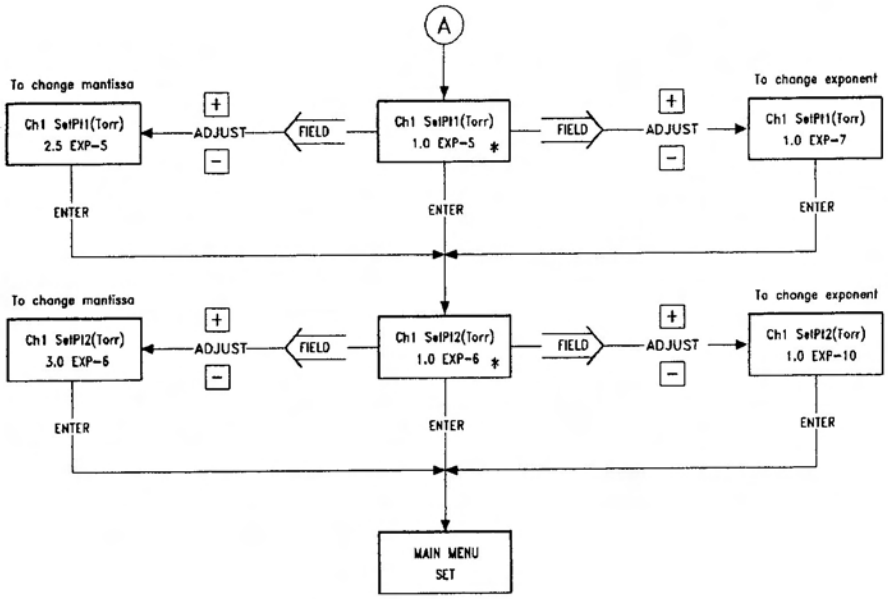
If two HV cards are installed, repeat the sequence done in the flow charts for the second pump, and select the operating conditions.

For different controller configurations follow the related flow charts according to the following table:

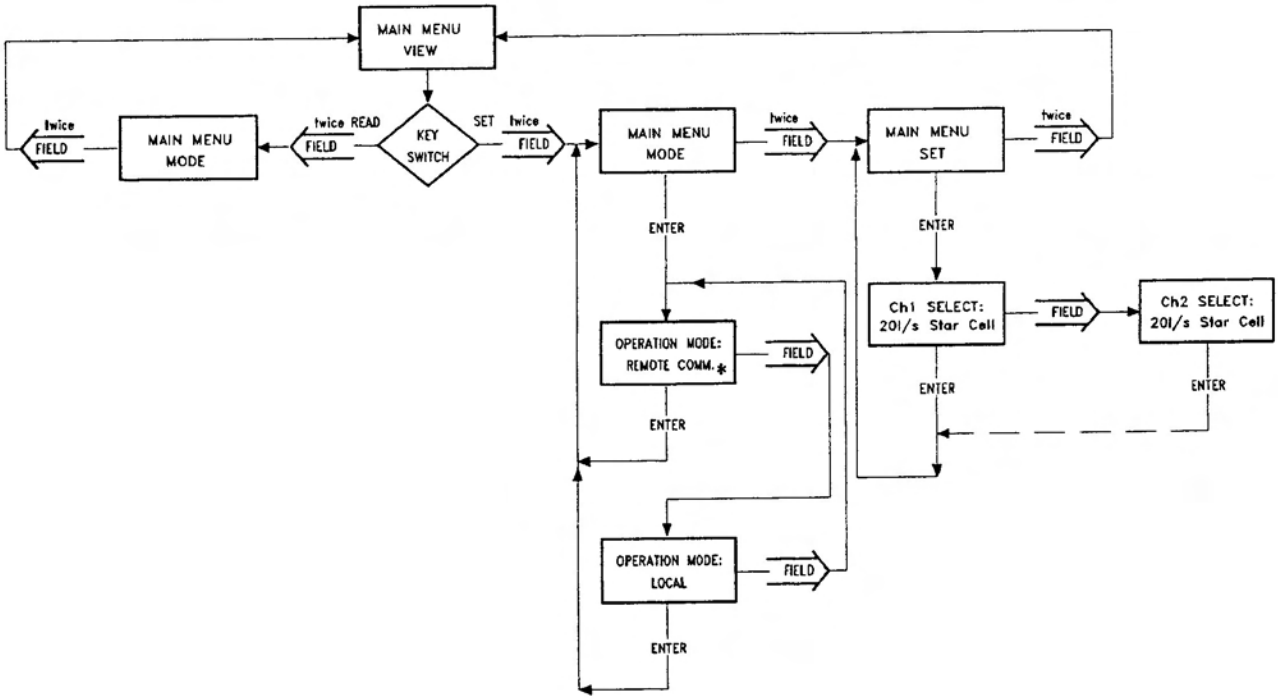
Controller configuration	Flow chart number
H.V. card installed	1
H.V. card, set point/remote card installed	2
H.V. card, RS232-422 card installed and enabled	3



Flow chart No. 2 (sheet 1 of 2)



Flow chart No. 2 (sheet 2 of 2)

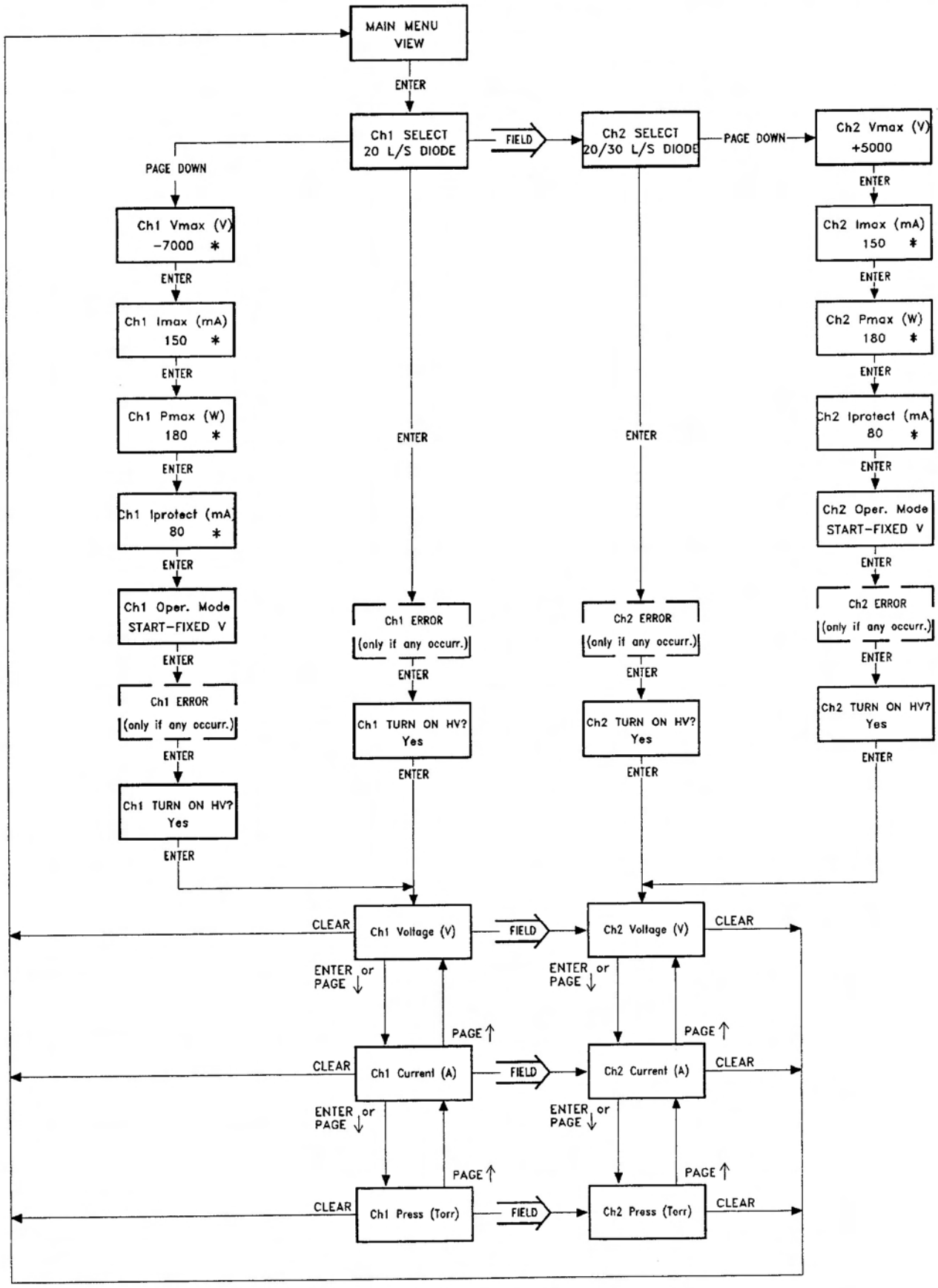


Flow chart No. 3

3-3 H. V. card switch on procedure

To switch on the H. V. card you must set the front panel CHANNELS switch to ON position, switch ON the controller and then follow the steps detailed in the flow chart number 4.

The position of READ/SET key is not of consequence.



Flow chart No. 4 - H. V. card switching on procedure

3-4 Pumps operating parameters reading

The last three blocks of flow chart n. 4 are the pump operating parameters reading.

In these pages you can read the pump current, voltage and pressure actual values.

The read-out is typically of the following type:

C	h	1				V	o	l	t	a	g	e	(| V |)
						-	7	0	0	0					

Figure 3-1 - Typical values reading page

Close to the read-out value, one of the symbols described in the following table can appear.

Symbol	Description
+ >	The value is increasing at a slow rate
+ > >	The value is increasing at a medium rate
+ > > >	The value is increasing at a fast rate
<-	The value is decreasing at a slow rate
< <-	The value is decreasing at a medium rate
< < <-	The value is decreasing at a fast rate
= =	The value is stable

Should the current value be very low (i.e. $< 1 \times 10^{-7}$A), the pressure value is not read and appear the message "LOW PRESSURE".

3-5 H. V. card switch off

To switch off the H. V. card there are two methods:

- a fast method for emergency situations;
- a standard method.

Each method is described in the following paragraphs.

3-5.1 Emergency switch off of the two pump

To switch off both the pumps at the same time, you can turn the CHANNELS front panel switch to the OFF position.

In this case the following message is displayed:

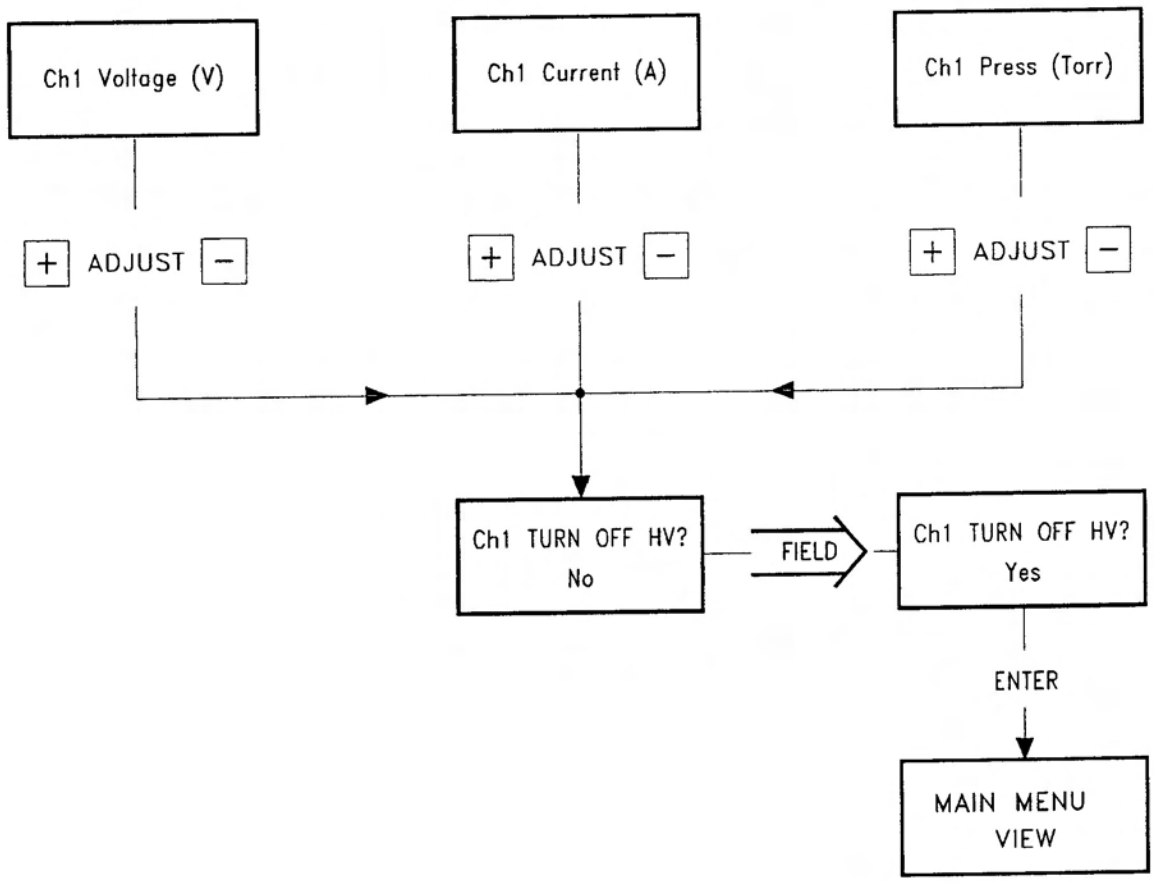
S	A	F	E	T	Y		I	N	T	E	R	L	O	C	K
S	E	E		M	A	N	U	A	L						

Figure 3-2

If you try to switch on the pumps, the message is displayed again. In this case it is necessary to press ENTER and then the High Voltage can be switched on following the procedure detailed in para. 3-3.

3-5.2 Standard switch off of one pump

To switch off one pump, you would follow the flow chart number 5 when you are in one of the pump parameter reading pages of the controller.



Flow chart No. 5 - Switching off of one pump

4-1 General

Replacement controllers are available on advance exchange basis through Varian Service, but, if necessary, information are provided to aid the operator in determining malfunctions and corrective steps to be taken through a simple check.

WARNING

High voltage in the controller can cause severe injury or death. Service must be performed by authorized personnel only.

Before servicing, turn power off and disconnect the power cord.

4-2 Troubleshooting

Symptom	Cause	Remedy
Display shows 0.0 EXP-8 current with the pump connected and H.V. ON at maximum voltage.	- The pressure into the pump is below 10^{-11} Torr range	- No failures, normal operation
	- The high voltage cable is open	- Measure the continuity of high voltage cable and/or change it
	- The High Voltage card is defective	- Change the High Voltage card
Display shows 0.0 voltage and maximum current with the pump connected and in START mode.	- The high voltage cable is shorted	- Check the high voltage cable
	- The pressure into the pump is high	- Check the pressure into the pump

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