TECHNICS

TECHNICS WEST INC.

500-II

PLASMA SYSTEM

TABLE OF CONTENTS

1.0 INSTALLATION

1.1 Unpacking and Handling

1.1.1 The TECHNICS 500-II PLASMA SYSTEM is thoroughly tested and inspected and then carefully packed for shipment. A standard system is shipped in two packages: one containing the mechanical pump and the other containing the 500-II, strip chart recorder and stainless steel pump line, plus seals and clamps.

1.1.2 Both packages are clearly marked as to which side is up. These warnings must be observed as the pump is shipped charged with oil which will leak out if the pump is not kept upright.

1.1.3 Inspect both packages for signs of shipping damage. If there is evidence of rough handling or damage, return it (them) to the carrier unopened.

1.1.4 After visual inspection of the packages, carefully open them and remove the contents, exercising the care due any precision instrument. Open the 500-II chamber door and carefully remove any packing material. If there is any evidence of damage, file a damage claim, save the shipping materials and notify TECHNICS WEST Service Department.

1.2 Services Required

1.2.1 The 500-II is equipped with a six (6) foot, three prong, grounded power cord that will plug into a standard 110V, 60 Hz, 15A outlet.

1.2.2 The mechanical pump is similarly equipped and requires a similar outlet.
*NOTE: The pump and 500-II together draw more than 15 amps, so they should plug into different circuits.

1.2.3 The mechanical pump exhaust should be piped into an exhaust line and vented in a safe area.

1.2.4 The strip chart recorder may be plugged into the same outlet as the 500-II.

1.3 Installation

*NOTE: Make sure all power switches are off before plugging in either the 500-II or the mechanical pump.

1.3.1 The 500-II may be operated in almost any environment, although a dust free, low humidity, moderate temperature location is preferred. Care should be taken that the sides and rear of the unit are not obstructed in a manner that will impede the flow of cooling air.

1.3.2 The mechanical pump is normally located on the floor to the rear of the 500-II. Care should be taken in handling the pump that no foreign matter enters the pump through either its inlet or exhaust port.

1.3.3 A three (3) foot flexible stainless steel hose is used to connect the pump to the chamber. Centering rings, seals, and clamps are provided to make the connections at both ends of the tubing. Make sure all sealing surfaces are clean and unscratched. Carefully line up all components before clamping. Do not try to bend the tubing too sharply as it will collapse or rupture.

1.3.4 Plasma gases are introduced into the 500-II via fittings labeled "GAS 1" and "GAS 2" on the rear panel. These fittings accept 1/4" OD metal or plastic tubing. Gas pressures must not exceed 5 PSIG.

1.3.5 Vent or backfilling gas is introduced into the 500-II via a fitting labeled "VENT" on the rear panel. It also accepts 1/4" OD plastic or metal tubing. Vent gas pressures should not exceed 5 PSIG.

2.0 SAFETY

LETHAL VOLTAGES ARE PRESENT AT MANY PLACES IN THE 500-II. EXTREME CAUTION SHOULD BE EXERCISED WHENEVER THE COVER IS REMOVED FROM THE UNIT; MAINTENANCE AND/OR TROUBLE SHOOTING SHOULD BE ATTEMPTED ONLY BY QUALIFIED PERSONNEL.

3.0 THEORY OF OPERATION

3.1 General

The Technics 500-II Plasma System was designed to strip photoresist from wafers by surrounding them with a controlled plasma. To accomplish this in a repeatable manner, appropriate sensors, controls, and displays have been incorporated. A process may be controlled either manually, in which case the operator must initiate each successive step, or automatically, in which case the operator merely starts the process and it is thereafter controlled by sensed or programmed signals.

3.2 Major Components

Figure I is a block diagram depicting the major components of the TECHNICS 500-II Plasma System.

3.2.1 Chamber

Plasma is generated by creating electric fields between electrodes in an aluminum chamber that has been evacuated and then partially backfilled with oxygen. This oxygen rich plasma combines with photoresist on wafers and the resultant carbon dioxide and carbon monoxide is pumped out of the system. An 'O' ring sealed door provides access for loading and unloading. The door contains a viewport so that the process may be observed.

3.2.1 Mechanical Pump

A Leybold Heraeus D16AC 14.1 CFM mechanical pump is used to initially evacuate the chamber and then to remove the reaction products. It is charged with Fomblin oil, a perfluorinated polyether especially developed to withstand the corrosive nature of the pumped gases, and designed for use with greater than atmospheric concentrations of oxygen.

3.2.3 Systems Control Panels

Process and operating controls are conveniently located at the front of the 500-II. All but the main POWER and START/STOP switches are located behind a hinged door so that, once operating parameters are programmed, they are isolated from the operator to assure repeatable operation. (Refer to Figure II)

3.2.4 Display Panel

Significant process parameters are constantly being measured and displayed so that the operator can monitor the process. A status display indicates the condition of the system at all times. (Refer to Figure III)

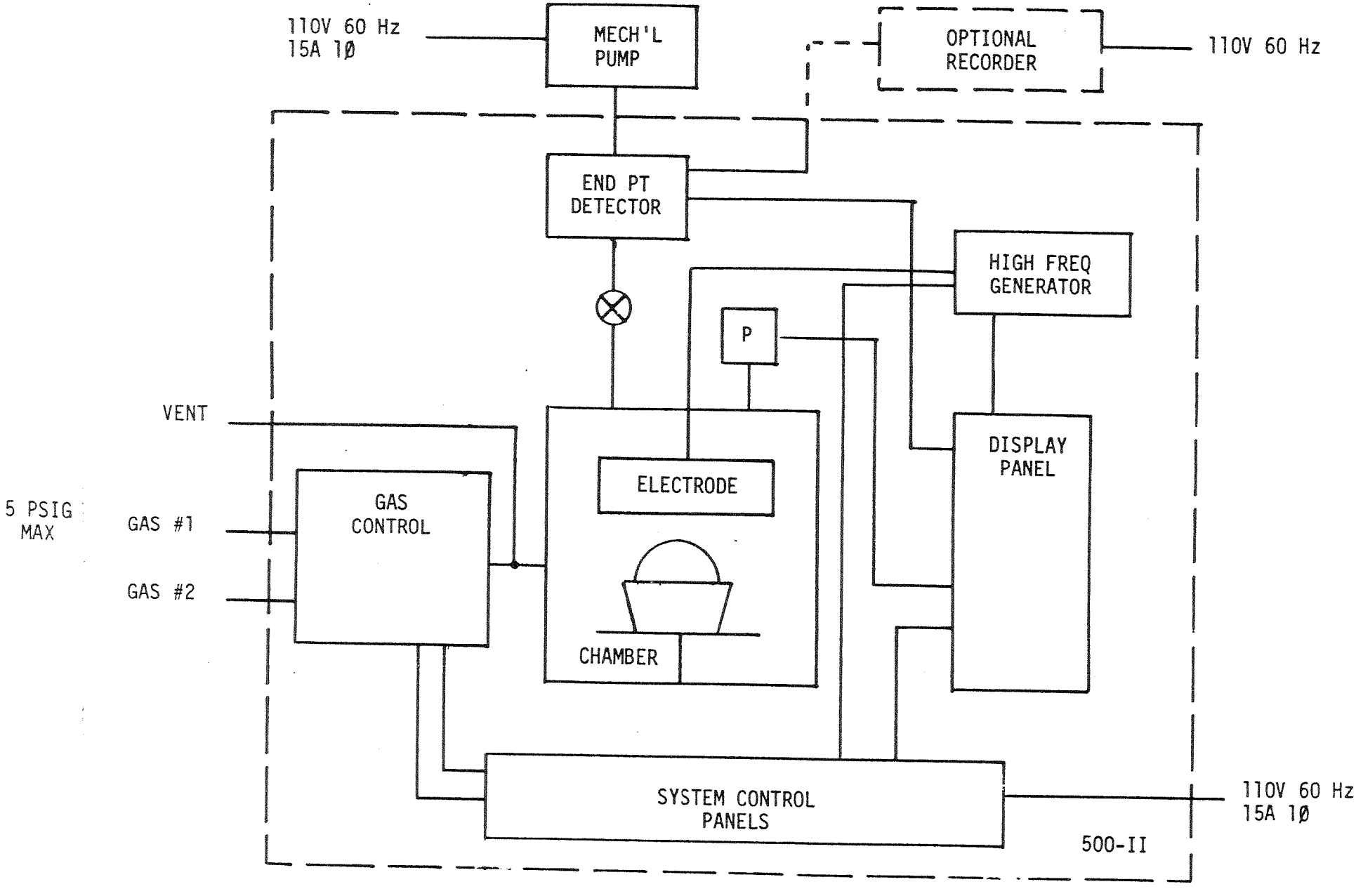
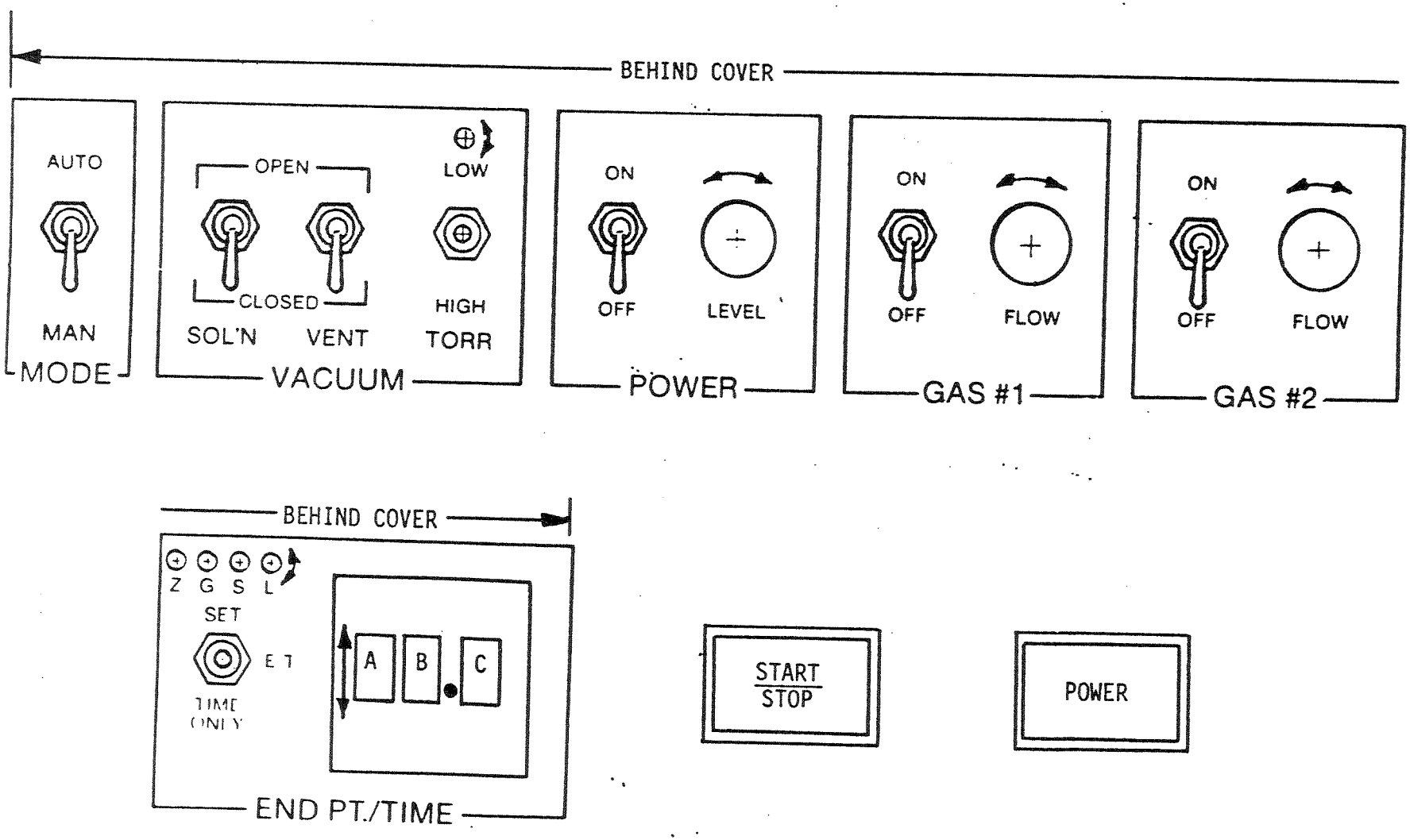


FIGURE I
Ref. Para 3.2



SYSTEM CONTROL PANELS

FIGURE II
Ref. Para 3.2.3

FIGURE III

Ref. Para 3.2.4

3.2.5 Gas Control

Solenoid shut off valves in series with precise, manually adjustable mass flow control valves insure that gas is introduced at a precise and constant rate.

3.2.6 High Frequency Generator

The high frequency generator provides the voltage applied to the electrodes to initiate and sustain the plasma. It operates at approximately 30 KHz and approximately 400 volts, delivering up to 500 watts of power to the electrodes.

3.2.7 End Point Detector

Ascertaining when all the photoresist has been removed from the wafers is accomplished by creating another plasma in the exhaust line and optically measuring the intensity of the carbon dioxide emmission spectra. Once the intensity has exceeded (at the start of the process) and then fallen below (at the end of the process) a preset level and has reached a degree of constancy (slope of the intensity or time curve), the process is terminated, unless additional processing time has been programmed.

3.2.8 Strip Chart Recorder

The strip chart recorder may be attached to the rear of the 500-II, where it is fed a signal indicative of the rate of removal of photoresist, as sensed by the detector in the end point detector system. (see 3.2.7) Use of a strip chart recorder is recommended when programming the system.

4.0 OPERATING PROCEDURES

4.1 Introduction

The system control panels contain all the controls and adjustments necessary to operate the system. In general, they are functionally grouped and delineated. Figure II depicts the control panels. The measurable effect of adjustments is displayed on the display panel, as is the status of the system. Figure III depicts the display panel. The following discussions explain the purpose of each control and the evidence of its proper operation.

4.1.1 POWER

This is a push button switch that applies power throughout the 500-II, except to the mechanical pump and recorder. It becomes illuminated when the power is on. Depressing it when illuminated removes power from the unit (but not from the mechanical pump or recorder).

4.1.2 START/STOP

This is a push button switch used only in the automatic mode (see 4.1.3). Once a program has been established, depressing the START/STOP switch will cause the system to automatically cycle through the programmed process. Once the proces is complete, an audible alarm will sound until the START/STOP switch is again depressed, silencing the alarm.

4.1.3 MODE

The operator may select either AUTO (automatic) or MAN (manual) operation by placing the MODE toggle switch in the appropriate position. If manual operation is selected, the system will respond to commands initiated by other switches and controls and will remain in that status until changed by the operator. In automatic operation, all other controls and switches must be properly set, and, after the STOP/START switch has been depressed (started), the system wil automatically cycle. See 4.2.1 and Figure IV.

4.1.4 VACUUM

This set of three toggle switches control the vacuum components in the system. The SOL'N switch controls the solenoid valve between the chamber and the pump. When in the OPEN position, the pump is evacuating the chamber; when CLOSED, the pump is isolated from the chamber. The VENT switch similarly controls the vent valve. (If the MODE switch is in MAN and both SOL'N and VENT switches are in the OPEN position, vent gas will be continuously pumped through the system. This is useful if it is desired to purge the chamber after cleaning). See Figures Va and Vb.

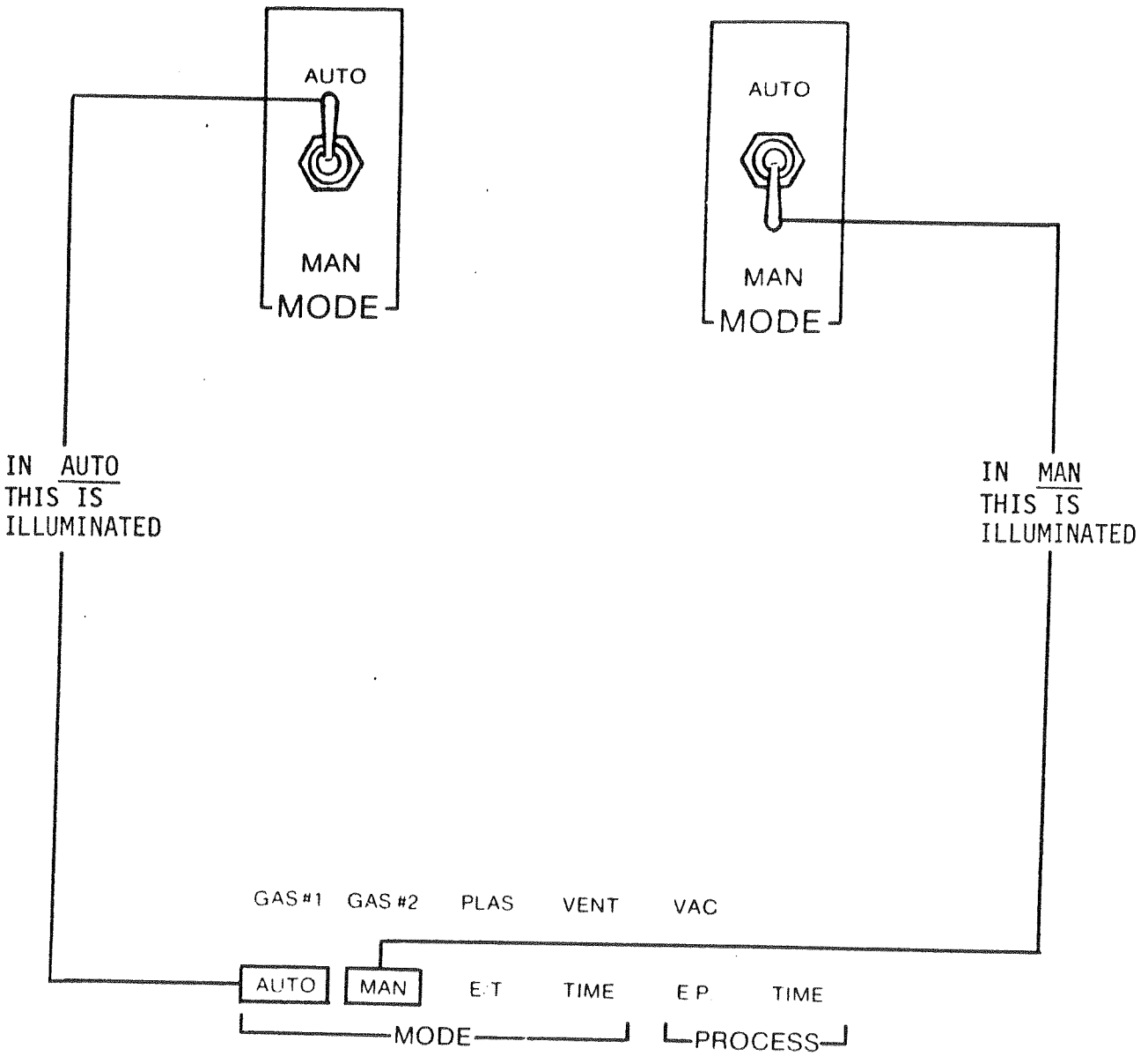


FIGURE IV

Ref. Para 4.1.3

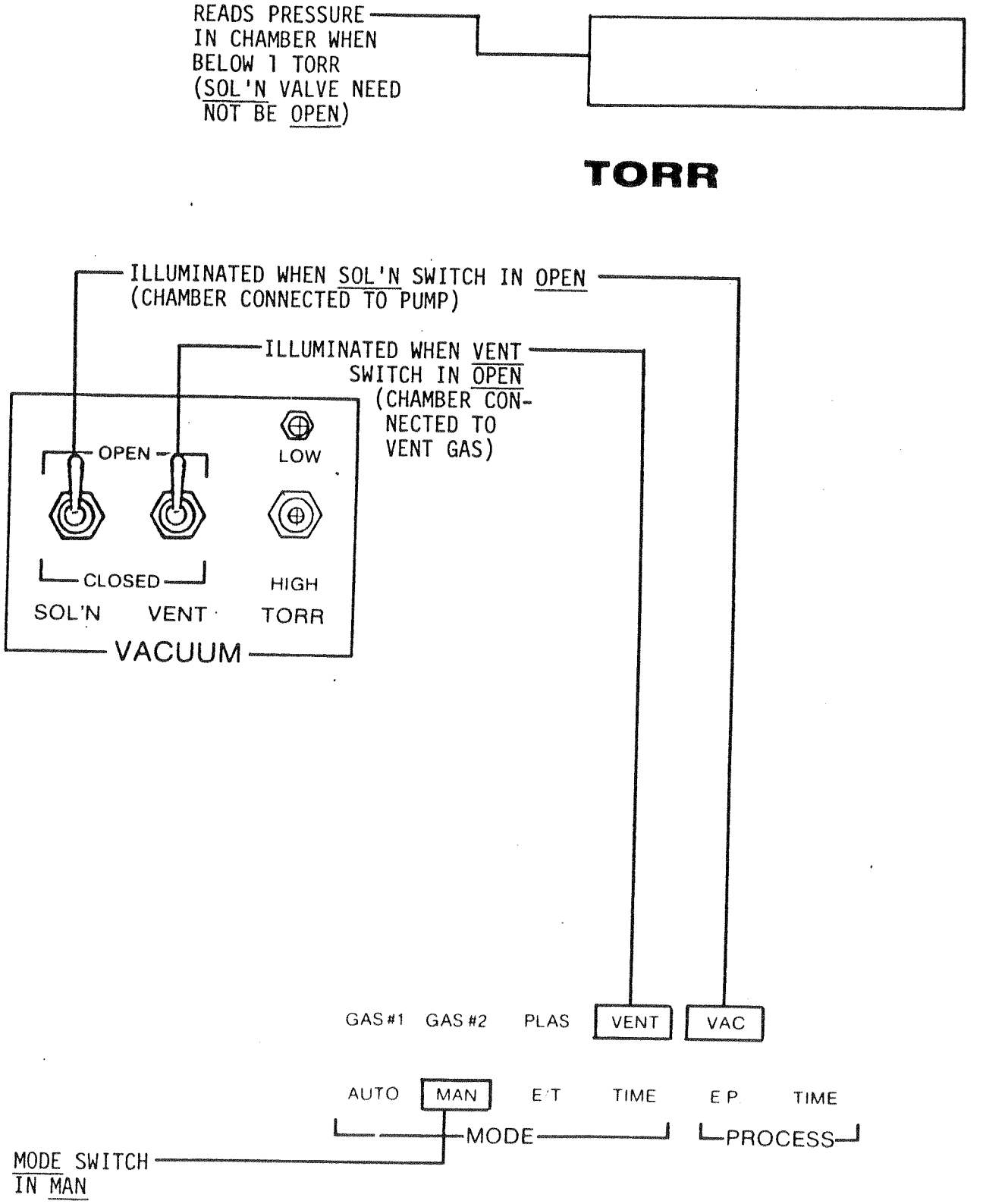


FIGURE Va

Ref. Para 4.1.4

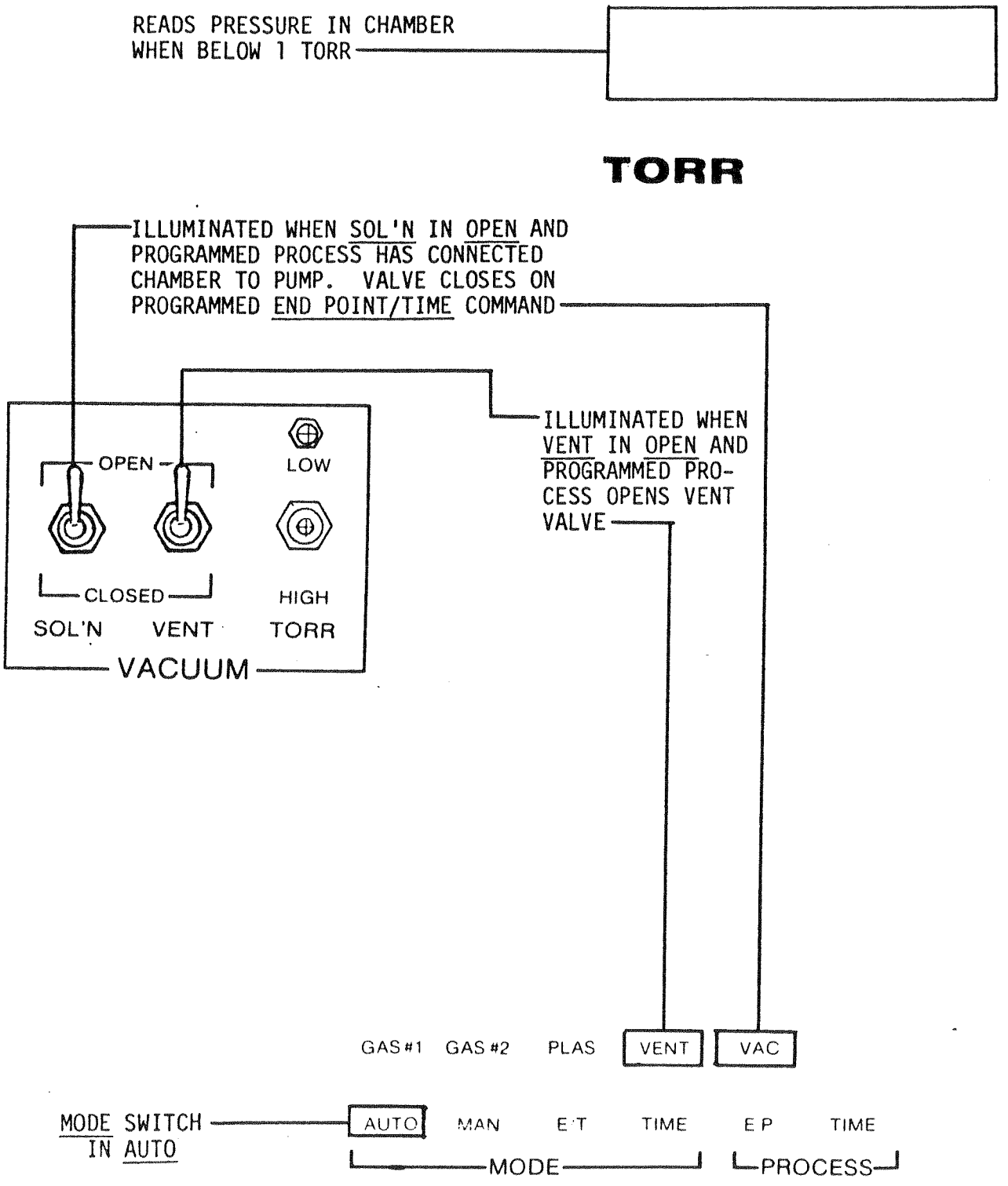


FIGURE Vb

Ref. Para 4.1.4

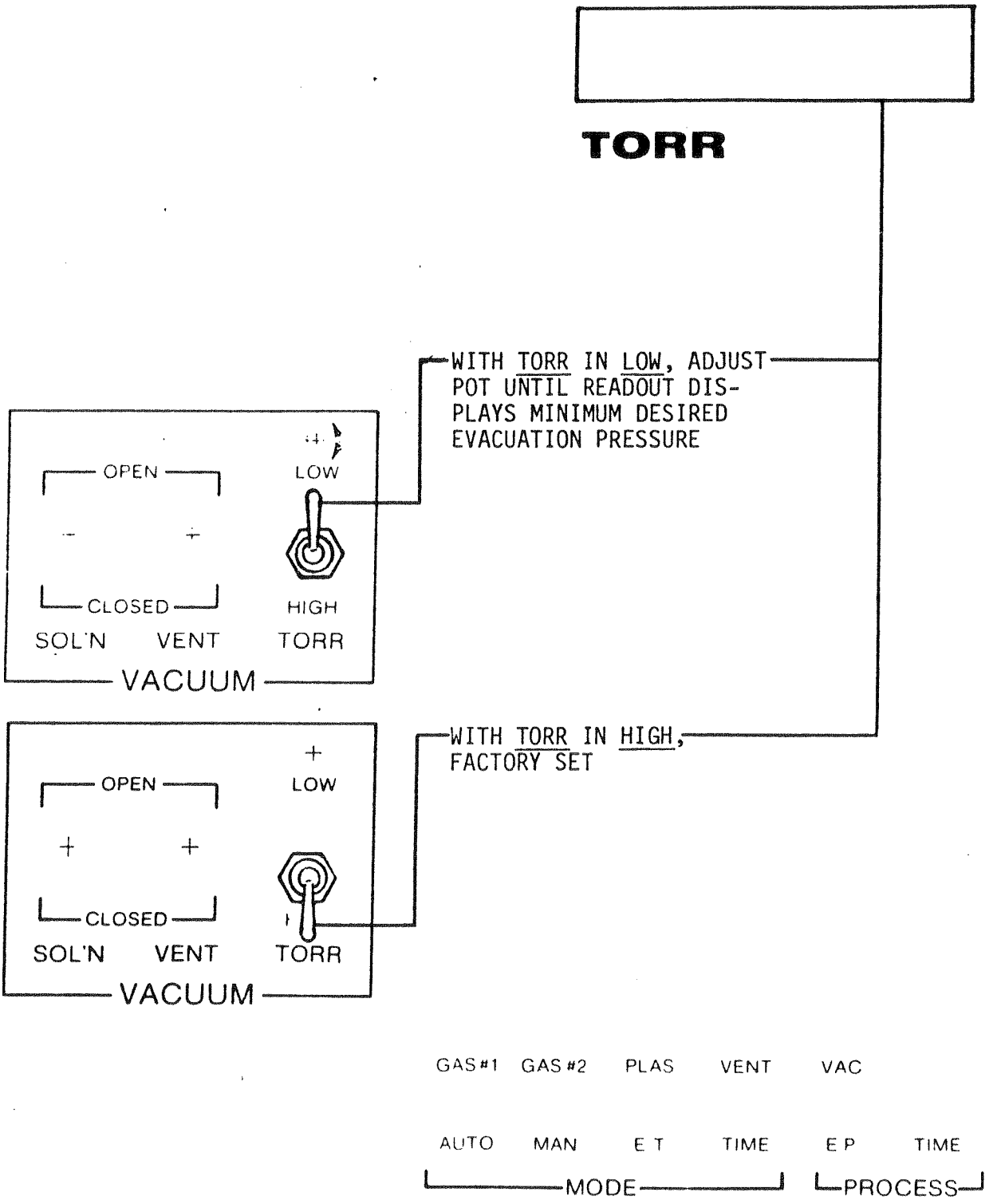


FIGURE VI

Ref. Para 4.1.4

The TORR switch is a spring loaded, three position switch that, in its center position, does not effect the system. It is used to program pressure levels for desired processes. In the LOW position, it causes the TORR display to read a pressure level that can be set by adjusting the pot right above the switch. This is the pressure to which the chamber must be evacuated, in the automatic mode, before gas #1 or gas #2 can be introduced. In the HIGH position, the factory set pressure below which plasma can be initiated is displayed in the TORR readout. See Figure VI.

4.1.5 POWER

The switch and knob in this group turn on and adjust the high frequency generator. See Figure VII.

4.1.6 GAS #1 AND GAS #2

These switches and knobs control the flow of gas into the chamber. In the ON position, a solenoid valve in that gas line opens, connecting the chamber to that gas supply. Also in the circuit is a flow controller that can be used to adjust via the FLOW knob, the flow of gas so that processing can occur at a programmable pressure. The SOL'N switch must be OPEN and the VENT switch closed to properly make this setting. See Figure VIII.

The 500-II has provision for introducing two gases concurrently, but not sequentially. The TORR readout displays the total pressure.

To ascertain the ratio of the gases, merely compare the pressure contibuted by each (by switching GAS #1 OFF and GAS #2 ON and noting the pressure, and then switching GAS #2 OFF and GAS #1 ON and noting the pressure. Similar results can be obtained by using the pressure flow curves in Figure IX).

4.1.7 END POINT/TIME

This group of controls is used to establish the conditions that must be satisfied before the process will automatically terminate. The spring loaded switch may be set in either E/T or TIME ONLY. (The SET position is used in conjunction with setting the Z,G,S, and L pots). The timer allows the operator to set times of up to 99.9 minutes as discussed below.

With the END POINT/TIME switch in the TIME ONLY position, the plasma will be turned on the length of time dialed into the timer. This time will be displayed in the MINUTES readout when the process starts and decrease to zero as the time elapses. When zero is reached, the plasma is extinguished, the chamber is isolated from the pump, the gas valve (s) close and an audible alarm sounds until the START/STOP button is depressed, at which time the vent valve will open, returning the chamber to atmosphere.

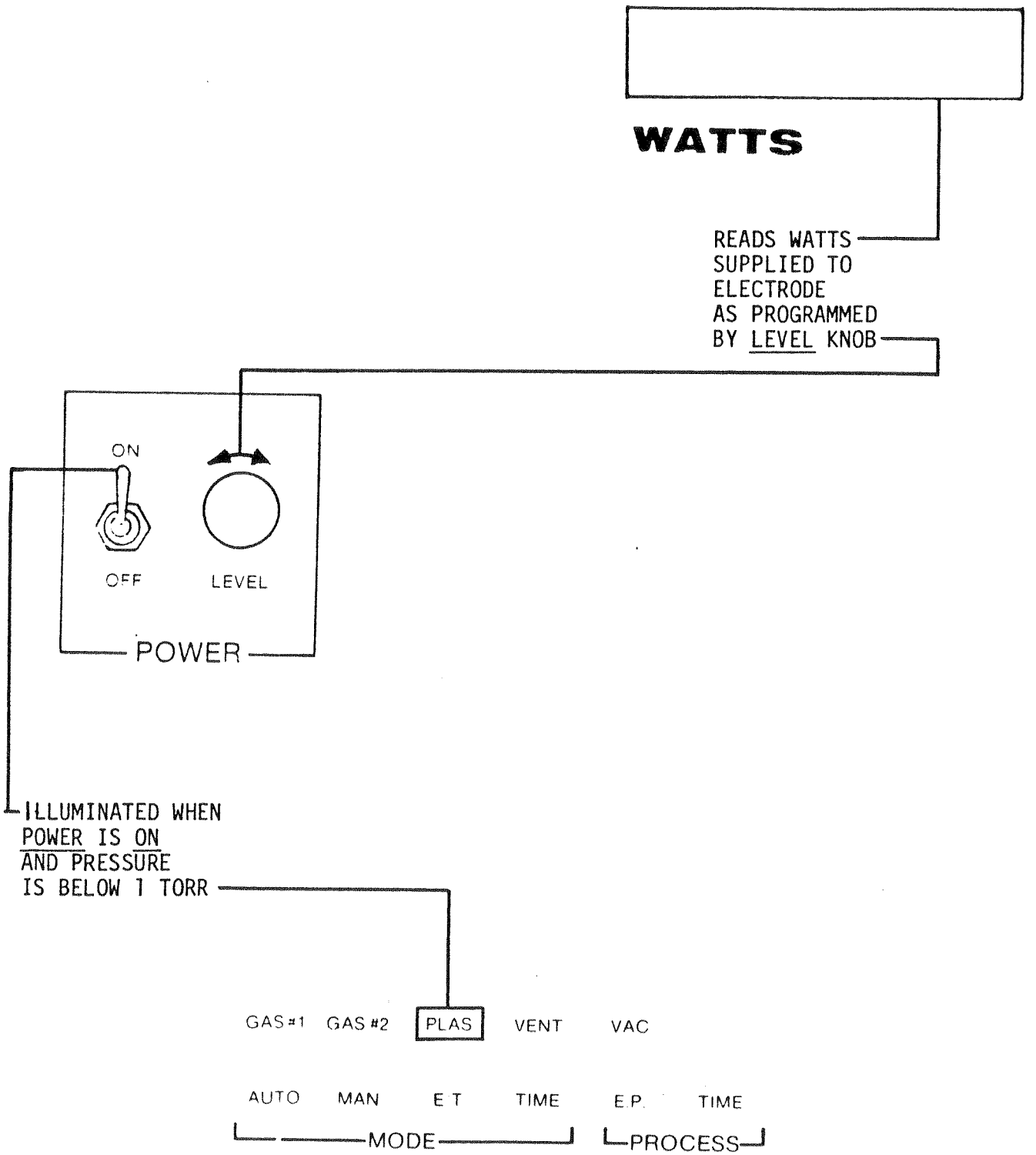


FIGURE VII

Ref. Para 4.1.5

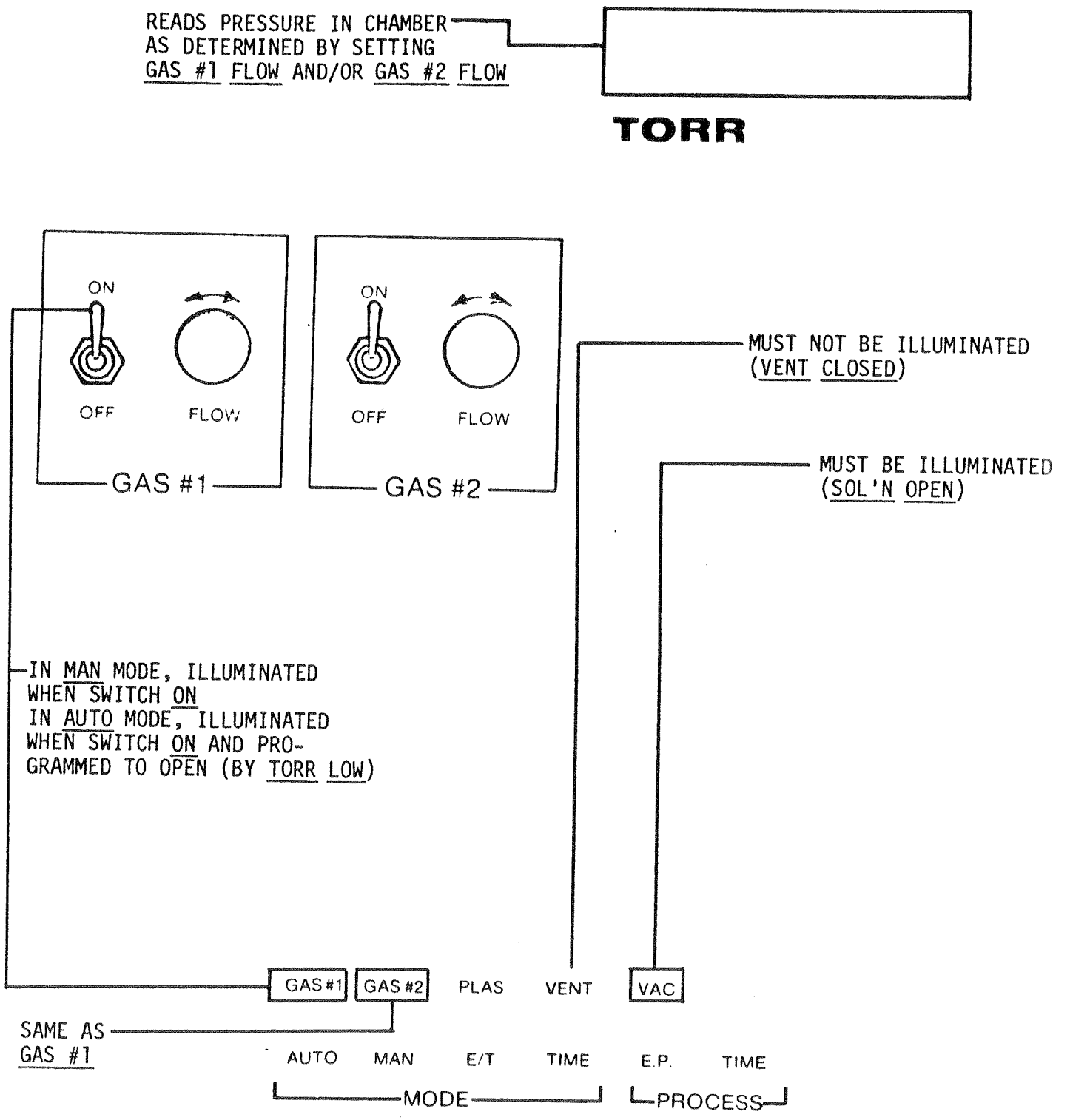


FIGURE VIII
Ref. Para 4.1.6

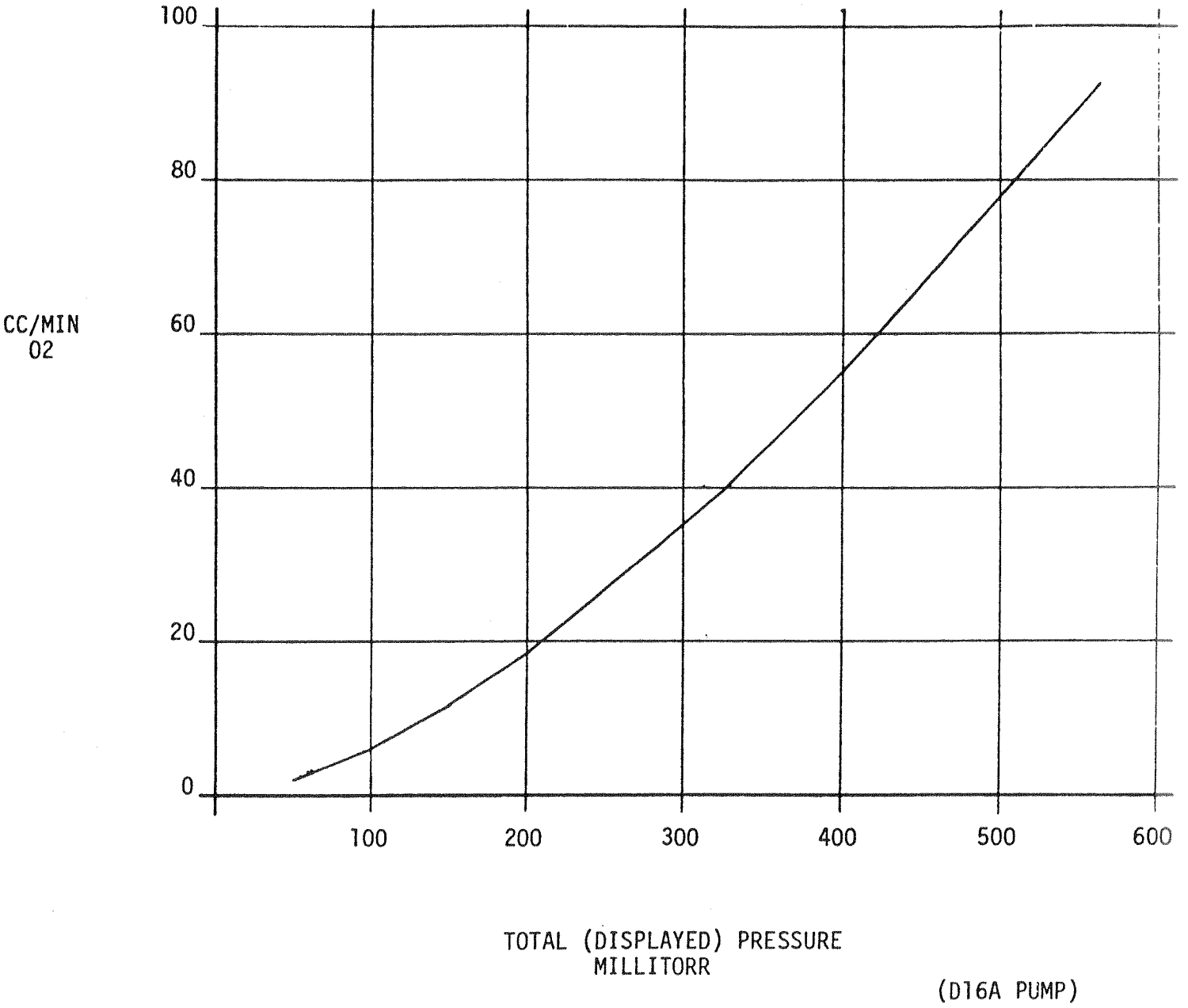


FIGURE IX

Ref. Para 4.1.6

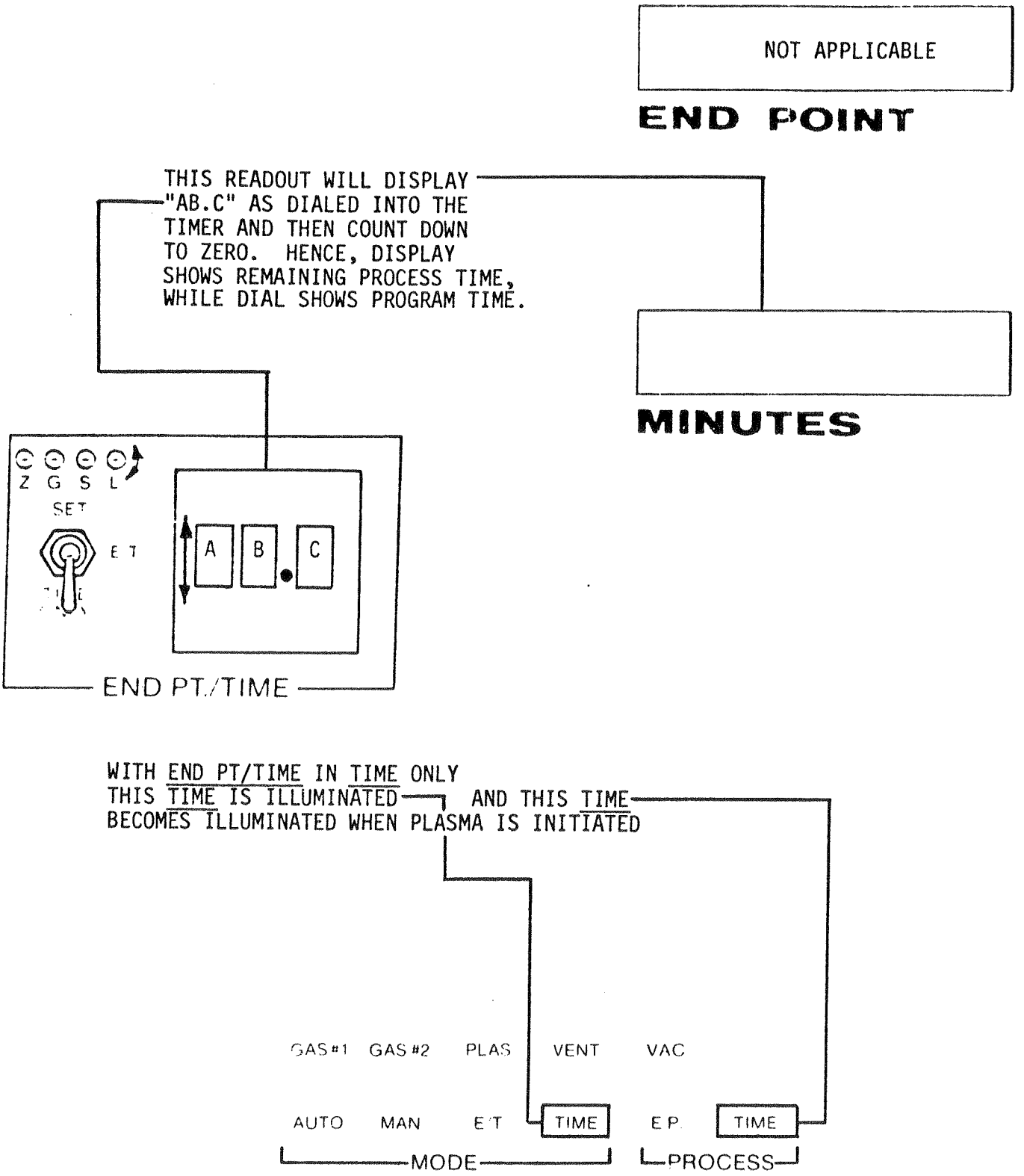


FIGURE Xa

Ref. Para 4.1

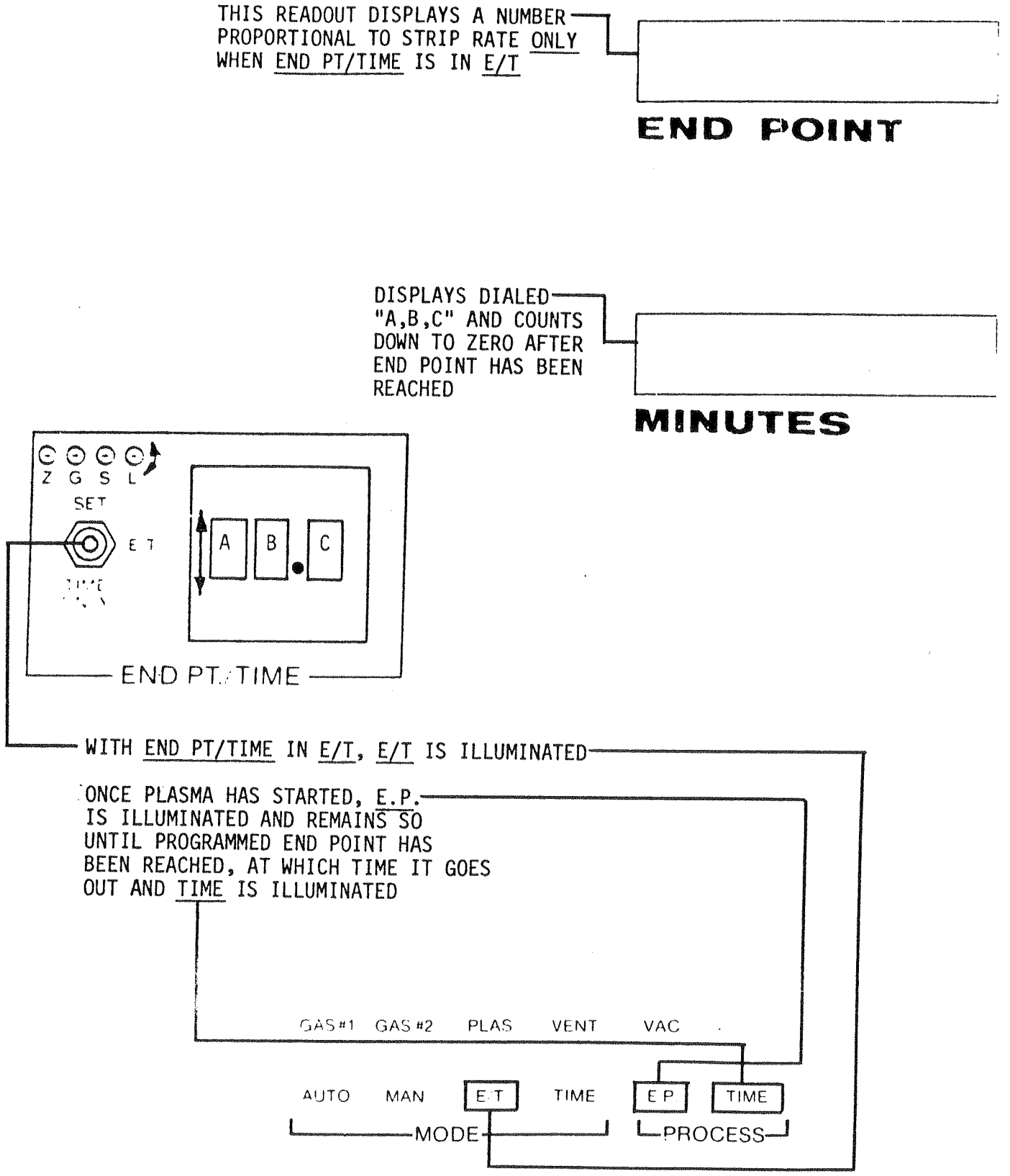


FIGURE Xb

Ref. Para 4.1.6

With the END POINT/TIME switch in the E/T position, the plasma will be turned on shortly after the TORR LOW point has been reached and plasma gas flow initiated and continue until all programmed end point settings have been reached and the dialed time has elapsed, only now the dialed time commences on satisfaction of the end point settings. After the dialed time has elapsed, the same sequence of events occurs as when the END POINT/TIME switch is in the TIME ONLY position. For programming the end point, see figures Xa and Xb.

4.2 INTERNAL ADJUSTMENTS

All internal adjustments have been factory set.

4.3 PROGRAMMING THE 500-II

4.3.1 PRELIMINARY

a) Start the mechanical pump and allow it to warm up for at least ten minutes. Fomblin oil is quite viscous and may cause the pump integral overload switch to trip, in which case, wait a few seconds, and try again. The vacuum (SOL'N) valve should be open, as should the chamber door. (To reduce pump load during warm up)

b) After warm-up: Put the switches and controls on the 500-II in the positions listed below: (Ref: Figure II)

POWER:	OFF
START/STOP:	N/A
MODE:	MANUAL
VACUUM:	SOL'N - CLOSED
	VENT - CLOSED
TORR:	CENTERED
POWER:	OFF
LEVEL:	FULLY CCW
GAS #1 AND GAS #2:	OFF
FLOW:	FULLY CW (DO NOT OVERTIGHTEN)
END POINT/TIME:	TIME ONLY
	TIMER 00.0

c) Turn on the unit by depressing the POWER switch which should become illuminated.

d) Make sure the chamber is free of debris.

e) Close the door and put the SOL'N switch in the OPEN position. The TORR display should soon read a rapidly decreasing pressure that should bottom out at about 25 microns or .025 TORR.

f) Put the TORR switch in the HIGH position. The TORR readout should read .9 to 1.1 indicating that interlocks are properly set.

g) Release the TORR switch. The system should now be ready for programming.

4.3.2 PROGRAMMING THE AUTO-TIME ONLY MODE

a) Put the TORR switch in the LOW position and adjust the pot immediately above it to read the pressure at which you wish processing to start (.100 is typical).

b) Release the TORR switch.

c) Turn GAS #1 (and/or GAS #2 ON) and adjust the flow/s until the desired processing pressure is displayed in the TORR readout. (See 4.1.6 if 2 gases are used) (.200 is typical).

d) Turn POWER toggle switch ON and adjust the LEVEL control to the desired level as indicated in the WATTS readout.

e) Dial in the desired process time on the END POINT/TIME timer.

f) Put the SOL'N switch in the CLOSED position.

g) Put the VENT switch in the OPEN position and allow the chamber to come up to atmosphere.

h) Put MODE switch in AUTO.

i) Put SOL'N switch in OPEN.

j) Close door over controls.

The system is now programmed.

4.3.3 SEQUENCE OF EVENTS AUTO/TIME ONLY MODE

The following is a sequence of events that the system will go through. The displays that will appear are tabulated in figure XI.

a) Load wafers and close door.

b) Push START/STOP switch.

c) Process pressure (.100 TORR) is reached and gas #1 (and gas #2 if used) is introduced.

d) Pressure rises to .200 Torr, time delay elapses and plasma is initiated and MINUTES start counting down from 10.0.

e) 9.9 minutes elapse

f) 0.1 more minutes elapse, alarm sounds, power and gas flow terminate

g) Push STOP/START switch

	EVENT	a	b	c	d	e	f	g	h	i
	POWER	Lit	Lit	Lit	Lit	Lit	Lit.	Lit	Lit	Lit
	STOP/START	-	-	-	-	-	Lit	-		
	WATTS	000	000	000	300	300	000	000		
	TORR	1.	①	.100	.200	.200	1.	1.		
	END PT	③	③	③	③	③	③	③		
	MINUTES	00.0	00.0	00.0	10.0	.1	0.00	0.00		
MODE	GAS #1	-	-	Lit	Lit	Lit	-	-		
MODE	GAS #2	-	-	②	②	②	-	-		
MODE	AUTO	ON	ON	ON	ON	ON	ON	ON		
MODE	MAN	-	-	-	-	-	-	-		
MODE	PLAS	-	-	-	ON	ON	-	-		
MODE	VENT	ON	-	-	-	-	-	ON		
MODE	E/T	-	-	-	-	-	-	-		
MODE	TIME (MODE)	ON	ON	ON	ON	ON	ON	ON		
PROCESS	VAC	-	Lit	Lit	Lit	Lit	Lit	-		
PROCESS	E.P.	-	-	-	-	-	-	-		
PROCESS	TIME(PROCESS)	-	-	-	Lit	Lit	Lit	-		
	ALARM	-	-	-	-	-	ON	-		

① PRESSURE WILL START DROPPING AFTER A FEW MINUTES
② WILL BE LIT IF 2 GASES USED
③ WILL NOT BE ZERO BUT DISPLAY WILL BE MEANINGLESS

FIGURE XI
Ref. Para 4.3.3

Vent valve opens and chamber vents to atmosphere.

The cycle is now completed. The door may be opened and wafers removed.

4.3.4 PROGRAMMING THE END POINT DETECTOR

4.3.4.1 INTRODUCTION

The heart of the end point detector is a sensor sensitive to the emmission spectra of carbon dioxide. Its output is proportional to the amount of carbon dioxide in the plasma it is observing. The manner in which this output is modified and utilized determines the termination process.

As wafers are stripped, the concentration of carbon dioxide in the plasma will first increase and then decrease until only undetectable amounts remain. A theoretical plot of detector output would look like Figure XIIa. In reality, particularly if many wafers are being stripped, the curve is more apt to look like Figure XIIb. The irregularities in this curve can cause sensing circuitry to deduce the process is complete before it actually is. Therefore, the sensor output circuitry must preclude being fooled by spurious signals.

In order for the end point detector to deduce that the process is in fact complete, two conditions must be satisfied.

a) The signal must have first exceeded and then fallen below a preset level.

b) The rate at which the signal is falling (the slope of the amplitude-time curve) must be below a preset level.

If both these conditions are met, the end point detector will direct the 500-II to proceed to the next programmed step.

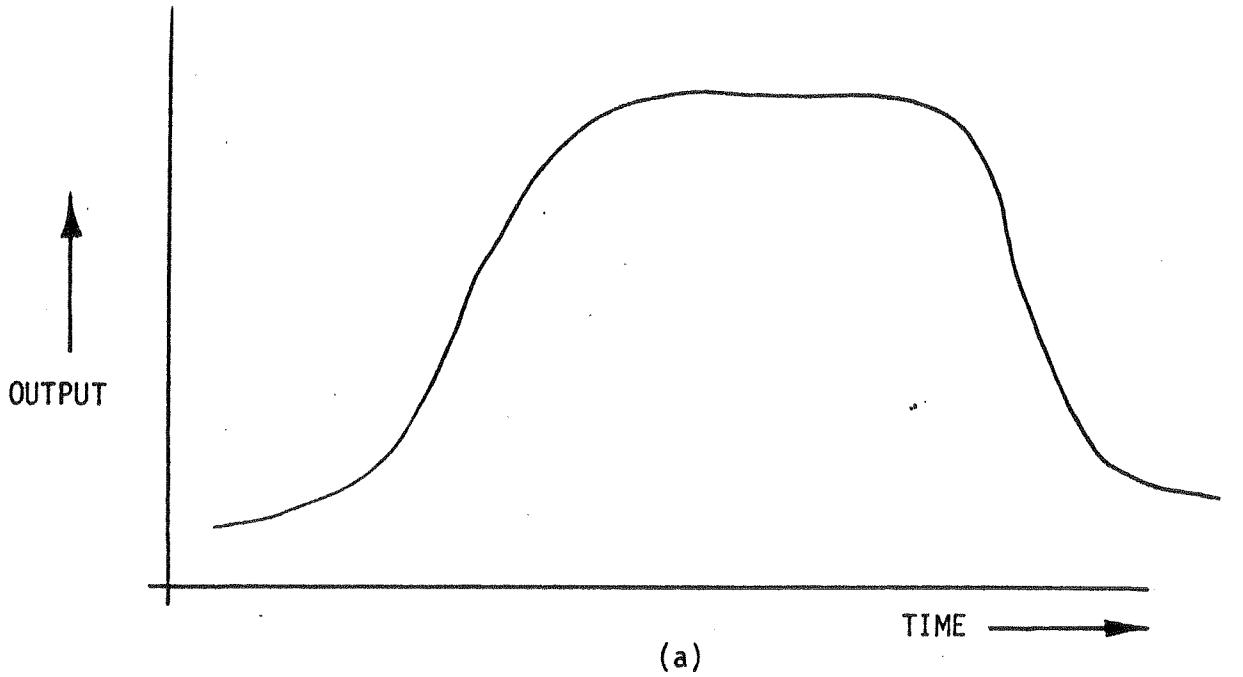
Two other factors must be considered-what is the background detector signal and what is the maximum signal it will generate? The first of these factors is handled by presetting a zero level. The second can only be handled by stripping a typical batch of wafers and adjusting the gain to a desirable level.

All four of these adjustments are easily set via the Z,G,S, and L pots located above the SET-E/T-TIME ONLY switch. A strip chart recorder is required to properly adjust these parameters.

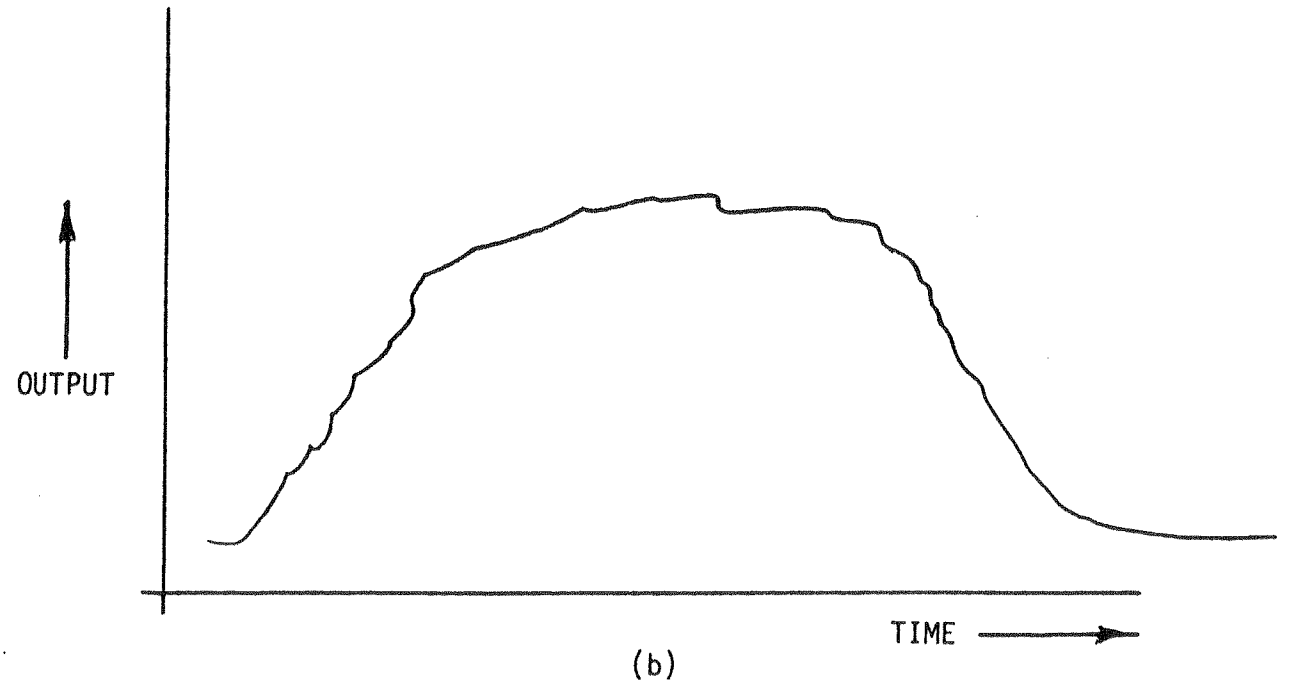
After end point has been detected, stripping can be continued for a preset time. This is accomplished by dialing in the desired time on the END POINT/TIME timer.

4.3.4.2 PRELIMINARY

a) Repeat all steps outlined in 4.3.1 a) through h) except put the END POINT/TIME switch in the E/T position.



(a)



(b)

FIGURE II

Ref. Para 4.3.4.1

b) Repeat all steps outlined in 4.3.2 a) through j) except dial in 90.0 on the END POINT/TIME timer.

c) Connect the strip chart recorder to the rear of unit, using the cable provided. Set the INPUT switch to 1 volt full scale deflection and the chart speed to 1 cm/min. Adjust the ZERO knob so the pen lines up with the right hand side of the chart paper. The ATTN knob should be in the fully CCW detented position. Refer to the enclosed instruction manual as required.

d) Vent the chamber to atmospheric pressure.

e) Put the POWER toggle switch in the OFF position.

4.3.4.3 PROGRAMMING PROCEDURE

NOTE: Programming circuits respond slowly and interact with one another. Hence, calibration must be done slowly and carefully.

a) Load a boat containing a few (3-6) typical wafers into the chamber. Close the door.

b) Depress the START/STOP switch.

Allow the chamber to be pumped down to the set point pressure and the gas stabilization delay period to elapse before proceeding.

c) Once the E/P indicator illuminates, hold the END POINT/TIME switch in the SET position and, using a jeweler's screwdriver, adjust the "L" trimpot for a reading of 200 on the END POINT front panel meter. This should concurrently cause a 20% deflection on the strip chart recorder.

d) Return the END POINT/TIME switch to the E/T position.

e) Adjust the Z trimpot for a reading between 95 and 105 on the END POINT meter. There are significant time delays in this circuitry; do not proceed until a steady reading has been observed.

NOTE: In the above steps, no plasma will be initiated. Also, the E/P light may go out, the TIME light come on, and the 90.0 minutes start decreasing.

f) Turn the POWER switch on and adjust the power level to 450 watts. Allow a minute or two for the load to attain its maximum ashing rate. The END POINT meter reading should be increasing.

g) Adjust the G trimpot so the END POINT meter reads between 700 and 800.

h) Turn the POWER switch to "OFF" and allow the meter to stabilize to a new reading. Re-adjust the ZERO trimpot for a meter indication of 95 to 105.

NOTE: It may be necessary to go between adjustments a few times to correctly adjust the meter. This is due to inter-action of the controls. The Z trimpot is always adjusted without a plasma, and the G trimpot with a plasma and while the wafers are at their maximum ashing rate.

i) Turn the "S" (slope) trimpot fully counter-clockwise.

j) Depress the START/STOP pushbutton, and set the thumbwheel switch to 00.0 minutes. Make sure that the POWER switch is on.

k) When the chamber is fully vented to atmosphere, unload the wafers, and re-load the chamber with the same number of photoresisted wafers. Close the chamber door and depress the START/STOP pushbutton.

l) Allow the system to go through the complete automatic cycle, taking periodic readings of the END POINT meter, or observing the strip chart recorder. This will determine if the END POINT DETECTOR is properly set up for the wafers being stripped.

m) It may take a few loads of wafers to optimize the trimpot settings, but any further adjustments should be unnecessary provided the operating parameters (gas, pressure and power) don't change.

n) The slope may be adjusted to allow "end-point" to be reached at another part of the ashing process. The slope is the change in meter reading per unit time and is adjustable over a range of 10 to 150 counts/minute.

Once the END POINT DETECTOR has been set up initially, further adjustments are normally not necessary unless some process changes are made or the detection, slope, etc., is to be optimized.

Load size variations usually won't affect the trimpot settings, although the meter and recorder may go off their scales during the peak of the ashing cycle. Any information on the meter or recorder during this time is not important for the proper operation of the END POINT DETECTOR.

4.3.5 SEQUENCE OF EVENTS IN THE E/T MODE
(Refer to Figure XIII)

a) Set all process parameters, load wafers and close the chamber door (assume 5 minutes on time).

b) Depress START/STOP switch.

c) Process pressure (.100 torr) is reached and GAS #1 (and GAS #2 if used) is introduced.

d) Pressure rises, then falls to .200 torr, time delay elapses, and plasma is initiated.

e) Stripping occurs and approaches completion.

f) Stripping completed to extent that END POINT meter reads less than 200 and slope of curve is flatter than programmed level.

END POINT "control" terminates and TIME "control" begins as indicated by status lights.

g) 4.9 minutes later

h) 0.1 minutes later, alarm sounds

i) Depress START/STOP switch and system vents

	EVENT	a	b	c	d	e	f	g	h	i
	POWER	Lit	Lit	Lit	Lit	Lit	Lit.	Lit	Lit	Lit
	STOP/START	-	-	-	-	-	-	-	Lit	-
	WATTS	0	0	0	450	450	450	450	0	0
	TORR	1.	①	.100	.200	.200	.200	.200	.200	1.
	END PT	③	③	③	④	⑤	⑥	⑦	⑦	③
	MINUTES	00.0	00.0	5.0	5.0	5.0	5.0	0.1	0.0	0.0
MODE	GAS #1	-	-	Lit	Lit	Lit	Lit	Lit	-	-
MODE	GAS #2	-	-	②	②	②	②	②		
MODE	AUTO	Lit	Lit	Lit	Lit	Lit	Lit	Lit	Lit	Lit
MODE	MAN	-	-	-	-	-	-	-	-	-
MODE	PLAS	-	-	-	Lit	Lit	Lit	Lit	-	-
MODE	VENT	Lit	-	-	-	-	-	-	-	Lit
MODE	E/T	Lit	Lit	Lit	Lit	Lit	Lit	Lit	Lit	Lit
MODE	TIME (MODE)	-	-	-	-	-	-	-	-	-
PROCESS	VAC	-	Lit	Lit	Lit	Lit	Lit	Lit	Lit	-
PROCESS	E.P.	-	-	Lit	Lit	Lit	-	-	-	-
PROCESS	TIME	-	-	-	-	-	Lit	Lit	Lit	-
	ALARM	-	-	-	-	-	-	-	ON	-

①, ②, & ③ SAME AS FIGURE XI
④ WILL START TO INCREASE ⑤ WILL REACH MAXIMUM AND START TO DECREASE ⑥ STRIPPING ALMOST COMPLETE, READING IS LESS THAN 200 ⑦ READING IS ESSENTIALLY CONSTANT.

FIGURE XIII
Ref. Para 4.3.5

5.0 PREVENTIVE MAINTENANCE

5.1 The 500-II

No routine maintenance of the 500-II is required. Periodic cleaning of the chamber interior is suggested.

5.2 The Mechanical Pump

Refer to the manufacturer's manual included at the back of this manual.

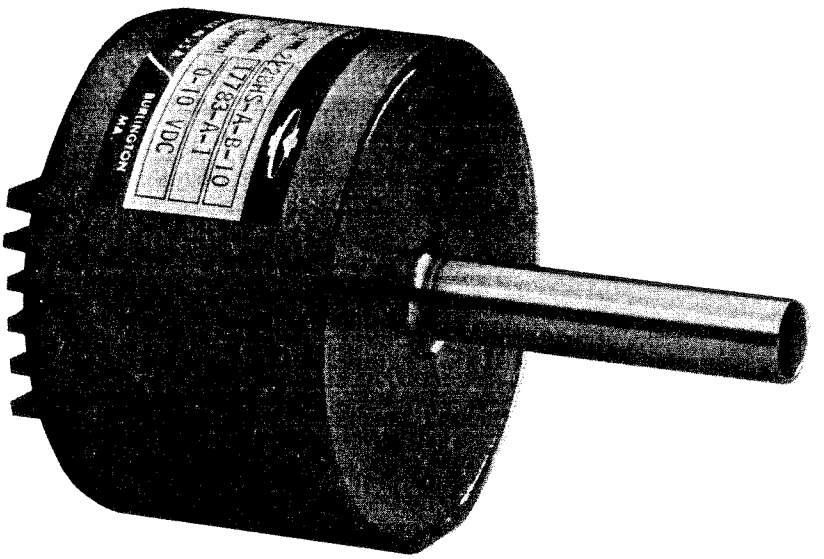
This pump is factory charged with Fomblin Y25/5 oil which is a non-hydrocarbon base and is designed specifically for safe oxygen service applicatons.

NOTE: DO NOT add any type of standard pump oils. The presence of hydrocarbon oils in oxygen concentrations greater than atmosphere may present an explosive hazard to equipment and personnel.

Manual 195-107360A-12/81

INSTRUCTION MANUAL

MKS BARATRON®
Type 222B
ABSOLUTE PRESSURE GAUGE



MKS Instruments Inc.
34 Third Ave.
Burlington, Ma. 01803

Telephone (617)-272-9255
Telex 94-9375

MKS INSTRUMENTS, INC.

WARRANTY

MKS Instruments, Inc. (MKS) warrants that all equipment manufactured by **MKS** shall be free from defects in materials and workmanship for a period of one year from date of shipment. For the period commencing with the date of shipment of the equipment and ending one year later, **MKS** will, at its option, either repair or replace any part which is defective in materials or workmanship without charge to the purchaser. The foregoing shall constitute the sole remedy of the purchaser for any breach by **MKS** of this warranty.

The purchaser, before returning any equipment covered by this warranty, which is asserted to be defective by the purchaser, shall make specific written arrangements with respect to the responsibility for shipping the equipment and handling and other incidental charges, with the **MKS** sales representative or distributor from which the equipment was purchased, or in the case of a direct purchase, from **MKS** home office in Burlington, Massachusetts, USA.

The warranty does not apply to any equipment which has not been used in accordance with the specifications recommended by **MKS** for the proper and normal use of the equipment. **MKS** shall not be liable under any circumstances for consequential or incidental damages in connection with, or arising out of the sale, performance or use of, the equipment covered by this warranty.

THIS WARRANTY IS IN LIEU OF ALL OTHER WARRANTIES BY **MKS,** EXPRESSED OR IMPLIED, INCLUDING WARRANTIES OF MERCHANTABILITY, WARRANTIES OF FITNESS FOR A PARTICULAR PURPOSE AND WARRANTIES AGAINST INFRINGEMENT OF ANY PATENT.

Manual 195-107360A-12/81

INSTRUCTION MANUAL

MKS BARATRON®
Type 222B
ABSOLUTE PRESSURE GAUGE

MKS Instruments Inc.
34 Third Ave.
Burlington, Ma. 01803

Telephone (617)-272-9255
Telex 94-9375

TABLE OF CONTENTS

INSTALLATION AND OPERATING INSTRUCTIONS FOR MKS BARATRON® TYPE 222B ABSOLUTE PRESSURE GAUGE

Section 1 GENERAL DESCRIPTION

The MKS Baratron® Type 222BHS Absolute Pressure Transducer is composed of two basic parts: (1) A corrosion resistant, taut diaphragm Inconel sensor and (2) Printed Circuit (PC) Board mounted Electronics (signal conditioner).

Shown below is the sensor in cross-sectional view.

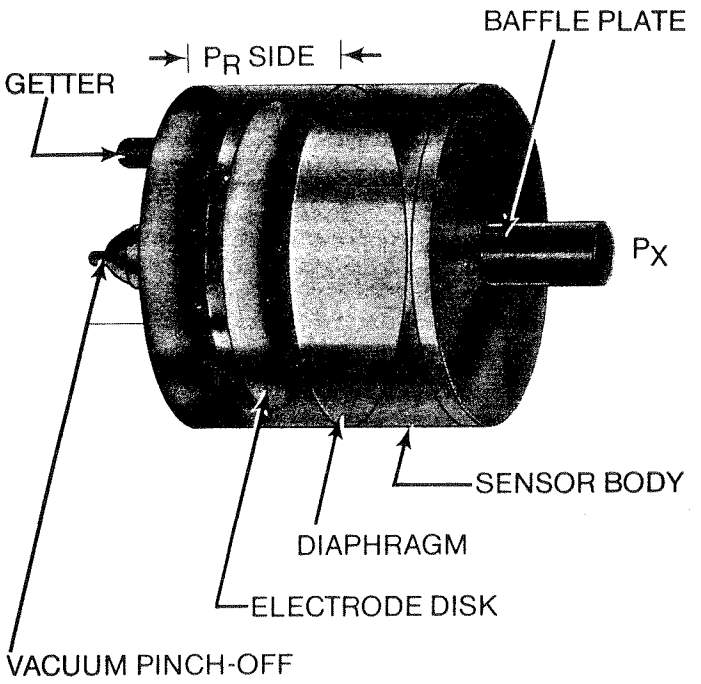


FIGURE 1

The P_X side of the sensor is exposed to the gaseous media whose pressure is to be measured, while the P_R (reference) side of the sensor is vacuum evacuated to $<10^{-7}$ Torr, sealed via a soft copper pinch-off tube, and gettered to maintain vacuum integrity.

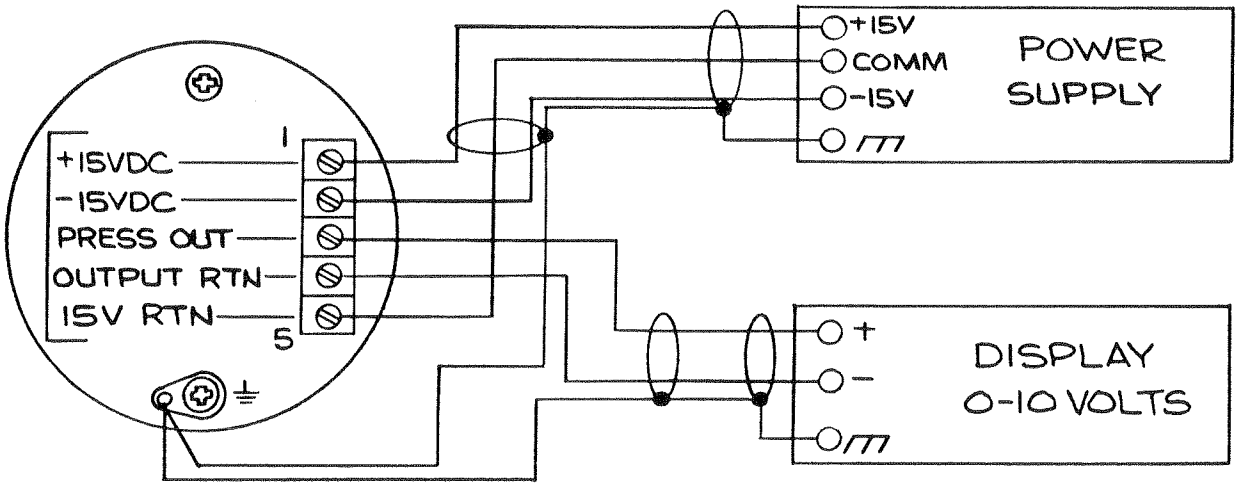
The electronic circuitry (signal conditioner) is mounted on the reference side of the sensor where it is connected to the sensor feedthrough terminal.

A drawn aluminum can forms the protective cover for the transducer and a PC mounted terminal block allows for ±15 VDC power input and 0-10 VDC pressure signal output.

Section 2 INSTALLATION & OPERATION

Although the 222B may be mounted in any attitude, it is recommended that it be placed in a system with the P_X port facing down, as this allows contamination to fall away from the pressure sensing diaphragm. Any standard vacuum fitting may be used (Cajon VCR, Ultra Torr, K-F flange, etc.). Also, the sensor port is more than able to carry the weight of the transducer.

NOTE: If using Swagelock fittings, do not overtighten beyond proper value specified for the fitting (1¼ *TURNS FROM HAND TIGHT)* as tubing (sensor inlet port) will "flare out", and this can *VOID* the warranty on the 222BHS transducer.



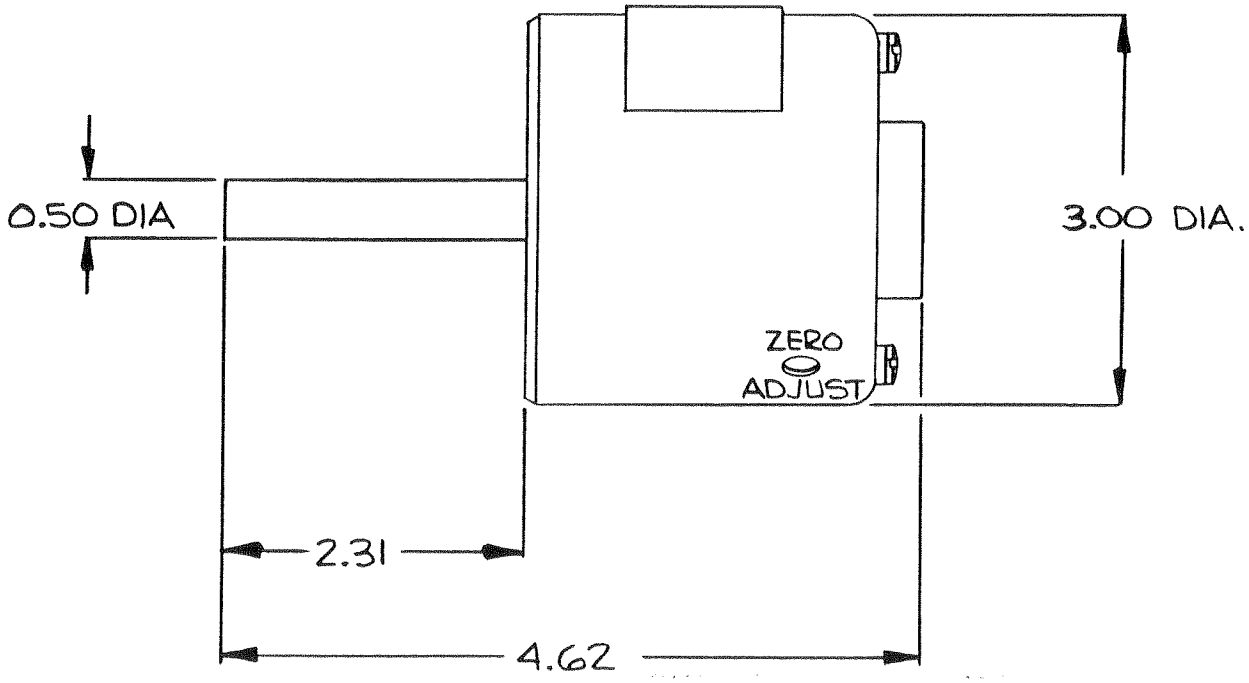


FIGURE 2

DESCRIPTION		COLOR CODE FOR MKS CABLES
+15 Volt Power Input		Green
−15 Volt Power Input		White
Pressure Output Signal		Red
Output Signal Return	Internally Connected	Black (paired with Red)
Power Supply Return		Black (paired with green)
Chassis (Case) Ground		Black (shields)

The external power supply must be capable of supplying ±15 volts, ±2%, at 35 mA minimum. Noise and and ripple should be less than 20 MV P-P. Any readout device may be used that has input capabilities 0 to 10 VDC and impedance greater than 10K ohms.

NOTE: The ground of any external power supply and readout should be the same as the sensor ground (chassis ground), to minimize any possible ground loops which can affect the performance and stability of the system. *See Figure 2.*

SPECIAL NOTE (When 222B is replacing 222A)

The 222B Transducer Electrical connections differ from earlier 222A Transducers in that separate terminals are available on the 222B for the signal return and 15V power return; however, they are connected internally. Therefore, existing cables on 222A which connect to the top *four* terminals (+15, −15, output, and Return) can be used "as is" on the 222B. If 5 wires are connected to the 222A, then the "case" wire must be moved to the "Case" connection on the cover of the 222B.

ZERO ADJUSTMENT

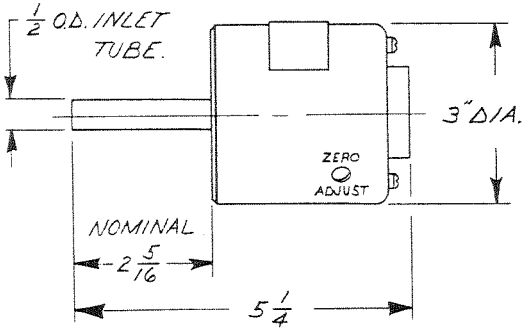
The absolute gauge zero should be adjusted by pumping to a pressure below the gauge resolution and adjusting the zero potentiometer at the gauge (or at the front panel if an MKS PDR is used) until the output is zero volts or the display is 0000. The gauge should be on for at least 15 minutes before setting this zero control.

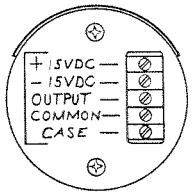
Please Note: If the vacuum pump used in conjunction with the system on which the 222 BHS is mounted is not capable of pumping to a sufficiently low pressure to set the transducer zero (e.g., one should be able to pump to 1 micron = 1 milliTorr to set the zero on a 222 BHS- - 10- Torr transducer), another means of pumping to set zero can be used. Most facilities have vacuum leak detectors available, which will typically pump to pressures below 1 micron. If such a unit is available, the following zeroing procedure can be used:

Mount the 222 BHS transducer on the leak detector *IN THE SAME PLANE OF ORIENTATION AS IT WOULD BE ON THE PROCESSING SYSTEM*, pump below 1 micron and set the zero.

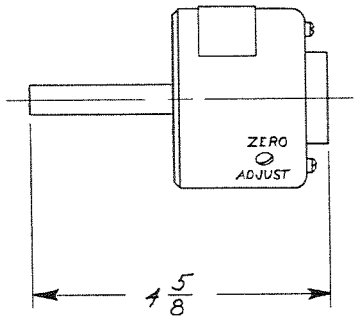
In production operations such as semi-conductor manufacturing, it is recommended that the transducer zero be verified in this same manner each time the equipment is shut down for routine maintenance.

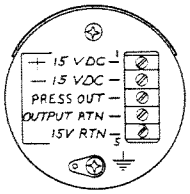
DWG. NO. B 106781	REV.	DESCRIPTION	BY/DATE	ECO	ENG	APP'D.
	A	FIRST DRAWN	J.S 9/22/80			
		PRODUCTION RELEASE	A H 9-23-80	1239		9/23/80





TYPE 222A





TYPE 222B
(ALL DIMENSIONS ARE THE SAME AS TYPE 222A EXCEPT AS SHOWN.)

TABLE 1: INPUT/OUTPUT CONNECTIONS

222A (ABSOLUTE) NOMENCLATURE	222B (ABSOLUTE) NOMENCLATURE	COMMENTS
+ 15 VDC	+ 15 VDC	SAME FOR BOTH MODELS.
— 15 VDC	— 15 VDC	SAME FOR BOTH MODELS.
"OUTPUT"	"PRESS. OUT"	0-10 VDC ANALOG OUTPUT CORRESPONDING TO 0 TO FULL SCALE OF TRANSDUCER.
"COMMON"	"OUTPUT RET."	OUTPUT RETURN OR OUTPUT GROUND IS SEPARATED FROM POWER SUPPLY RETURN ON 222B.
CASE	⏚	CASE GROUND ON 222B IS SEPARATE GROUND LUG.
NOT AVAILABLE AS SEPARATE CONNECTION.	± 15 V RETURN	OUTPUT RETURN OR OUTPUT GROUND IS SEPARATED FROM POWER SUPPLY RETURN ON 222B.

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES AND TOLERANCES ARE AS FOLLOWS:
FRACTIONS ±1/64
DECIMALS ±.01 2PL
±.005 3PL
ANGLES ±2°
SURFACE FINISH 63 OR BETTER ALL OVER.
DEBURR ALL METAL PARTS.

DRAFTSMAN J STAMULIS	DATE 9-22-80	MKS INSTRUMENTS INC. BURLINGTON, MASS.
CHECKER	DATE 9/22/80	
ENG.	DATE	COMPARISON OUTLINES 222A/222B SENSORS
APP'D	DATE 9/23/80	
222A, 222B		SCALE 4/1 DWG. NO. B 106781
USED ON	NEXT ASS'Y.	MAT'L: DO NOT SCALE DRAWING

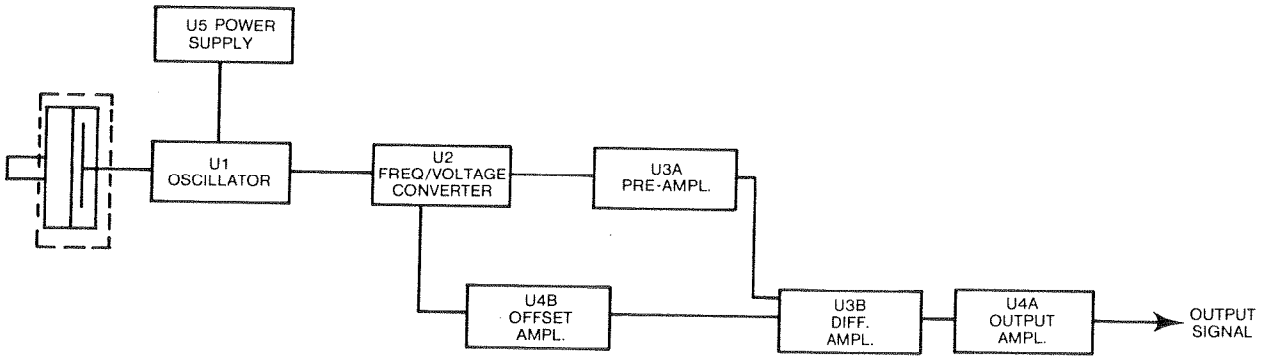
P-3328

4

FIGURE 3

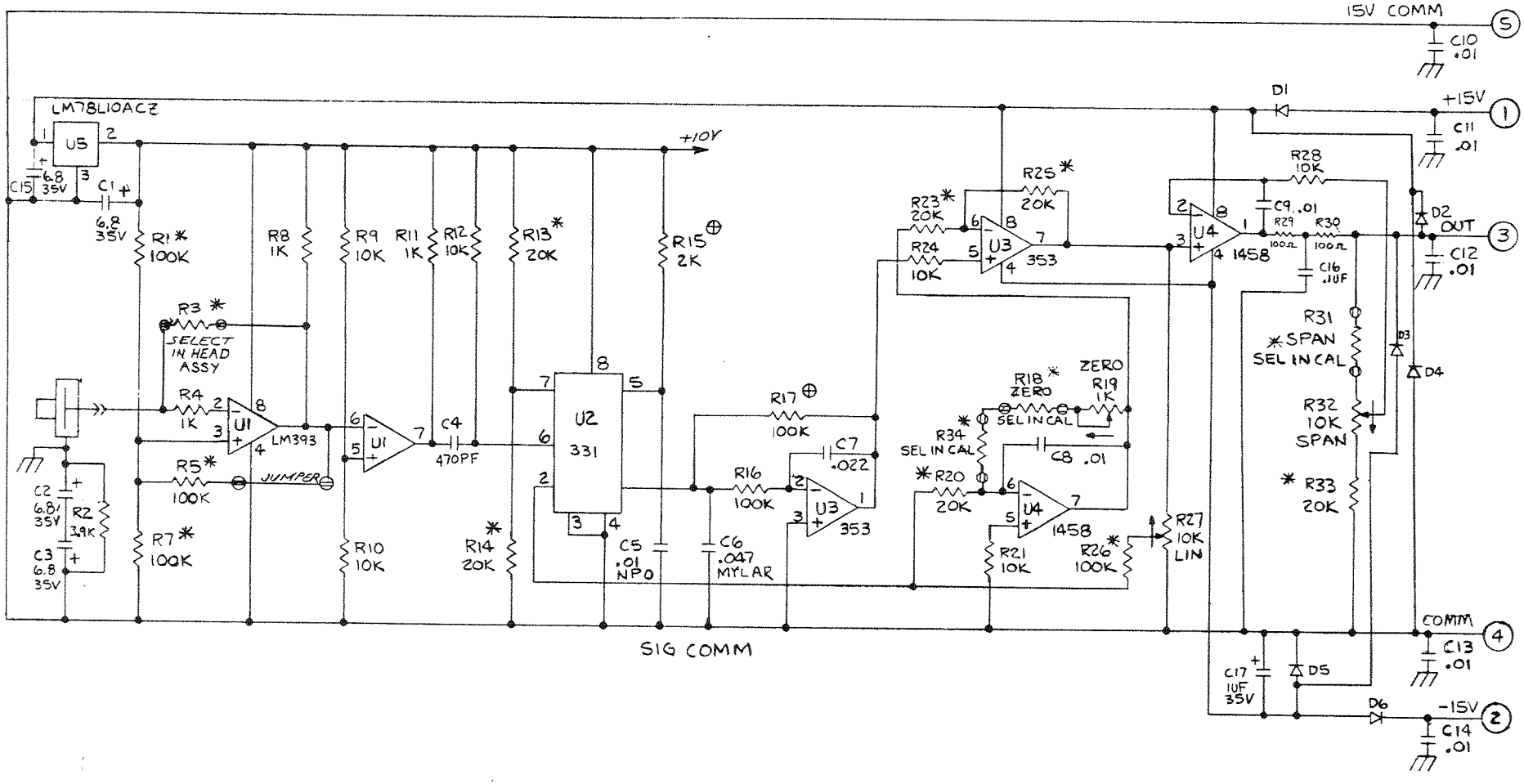
Section 3 CIRCUIT DESCRIPTION

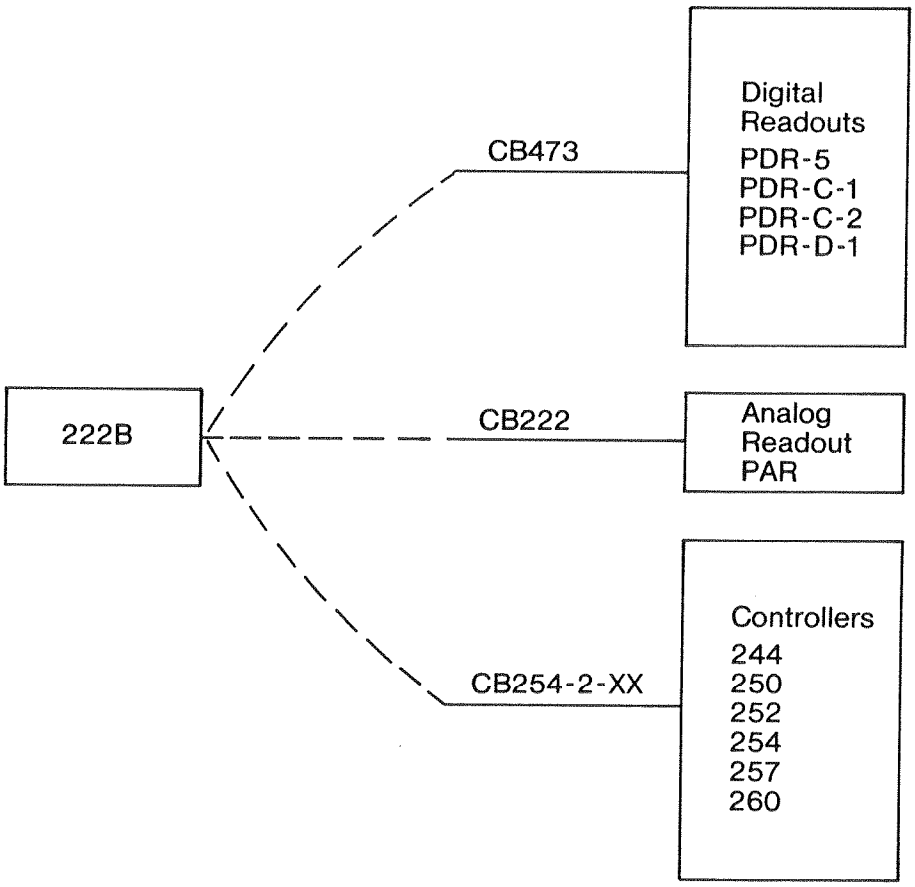
The variable capacitance sensor consists of a rigidly mounted capacitive electrode located on the back or reference side of a metal diaphragm. The reference side is permanently evacuated and sealed, thus making the pressure measurement totally independent of the gas type or composition. When pressure is applied to the diaphragm, its deflection produces a change in the distance between the electrode and diaphragm and a resultant capacitance change. This capacitance change, in turn, produces a change in the output of the oscillator U1. The frequency output of U1 is sent to a frequency-to-voltage converter U2, and when coupled with a preamplifier U3A, produces an analog DC voltage proportional to pressure. The analog voltage is further signal-conditioned with a zero offset being provided by U4B, which is subtracted in Diff. Ampl. U3B and the proper gain being supplied by U4A. This produces an output signal of 0-10 VDC which is directly proportional to the applied pressure.



222B Block Diagram

1. RESISTORS 1/4W, 5%
2. CAPACITORS EXPRESSED IN UF
3. * DENOTES RN60C RESISTOR 1%
4. ⊕ DENOTES WW RESISTOR
5. R18, R31, & R34 ARE SELECTED IN CALIBRATION
6. ALL DIODES IN5059




Digital
Readouts
PDR-5
PDR-C-1
PDR-C-2
PDR-D-1
CB473
222B
CB222
Analog
Readout
PAR
Controllers
244
250
252
254
257
260
CB254-2-XX

MKS Cables

Section 4 REPAIRS

Should any difficulties be encountered in the use of your instrument, it is recommended that you contact any authorized MKS sales office or home office for repair instructions.

If it is necessary to return the instrument to MKS for repair, it is desirable to have an ERA No. _____ (Equipment Return Authorization Number) issued by MKS for identification purposes.

NOTE 1: It is *NOT* recommended that the customer attempt to repair the Signal Conditioner Electronics, as replacement of most PC Board Components will require complete recalibration of the unit.

NOTE 2: It is *NOT* recommended that the customer attempt to clean the sensor except in the case of water soluble deposited material such as ammonium chloride from the exhaust line of a low pressure CVD Nitride Reactor. In this case the following procedure may be followed:

1. Remove the cover from the 222BHS Transducer
2. Carefully remove the PC Board
3. Place the sensor *only* in an ultrasonic cleaner with *HOT WATER* and attempt to remove deposit material. After all residue is removed, reassemble transducer, vacuum pump to remove water vapor and reset zero.

MKS INSTRUMENTS, INC.
SERVICE AND REPAIR FACILITIES

MKS INSTRUMENTS, INC.
34 Third Avenue
Burlington, MA 01803
Phone: 617-272-9255
Telex: 94-9375

Western Regional Office
3350 Scott Blvd.
Bldg. 3, Suite 301
Santa Clara, CA 95051
Phone: 408-988-4040

MKS Instruments Deutschland GmbH
Breithornstrasse 2
8000 Munchen 82 West Germany
Phone: (89) 423025/423026
Telex: 52997 MKS-D

Chell Instruments, Ltd.
Tudor House
Grammar School Road
North Walsham, Norfolk NR28-9 JH
Phone: (06924) 2488/9
Telex: 851-97198 attn: Chell

Astech Corporation
Wakoh Shinjuku Plaza 2F
No. 7-26, Nishi-Shinjuku 7-Chone
Shinjuku-ku, Tokyo 160, Japan
Phone: Tokyo (03) 366-0811
Telex: J24171 ASTECH TOKYO
Cable: ASTECHNOLOGY, TOKYO

TABLE OF CONTENTS

TECHNICS MODEL 500-II

PLASMA SYSTEM

SECTION ONE: GENERAL INFORMATION

1.0 WARRANTY

Technics, Inc., Standard Warranty is to assume system responsibility. All products manufactured by the seller are warrantied to be free of defects in materials or workmanship for one year on parts and 90 days on labor, from the date of shipment. Technics, Inc., will warranty all products not manufactured by them for a period not to exceed the manufacturer's warranty. Should the buyer have any claims against the purchased system, Technics assumes full system responsibility for insuring prompt repair. All warrantied shipments are F.O.B. Technics, Inc., San Jose, CA 95131.

2.0 CUSTOMER INQUIRY

Customer inquiries regarding system applications, service, or spare parts information should be directed to Technics, Inc., San Jose, CA 95131 at (408) 946-8700.

SECTION TWO: SYSTEM OVERVIEW

1.0 INTRODUCTION

The Technics Model 500-II Low Temperature Plasma System is designed for production use in photoresist stripping of high resolution integrated circuits, organic ashing, surface cleaning and treatment, and trace element studies. To accomplish this in a repeatable manner, appropriate sensors, controls, and displays have been incorporated.

2.0 MAJOR COMPONENTS

2.1 Chamber/Electrodes

The system is supplied with an aluminum chamber equipped with a full-swing-away door for ease of loading. The O-Ring sealed chamber door is provided with a three inch diameter quartz viewport equipped with an ultraviolet filter and implosion guard for maximum operator comfort and safety. The internal planar electrode assembly is designed for optimum plasma uniformity. This "electrode cage" assembly can accommodate two boats of four inch (100mm) wafers (50), two boats of three inch wafers (50), or three boats of two inch wafers (75). An electrode cage is available for five inch (125mm) capability and will accommodate one boat of wafers (25).

2.2 Gas Control System

Solenoid shut off valves in series with precise, manually adjustable flow control valves insure the gas is introduced at a constant rate. The unique gas flow design optimizes gas mixing and uniformity by controlling the gas dispersion through a series of inlets above the top electrodes. The spent species are exhausted through a strategically located outlet below the bottom electrodes. This design produces uniform gas flow throughout the entire chamber.

2.3 Vacuum Pump

A two-stage, direct drive, 14 cfm mechanical pump supplies the necessary pumping capability for initial chamber evacuation and to maintain sufficient gas flow during the ashing process. The standard pump is provided with Fomblin Y25/5 perflourinated polyether, an inert pump fluid designed for use with greater than atmospheric concentrations of oxygen.

2.4 RF Power Supply

The RF Power Supply is a compact, solid state, 35 khz, 500 watt, fully regulated, continuously variable generator. The power is directly coupled to the reactor electrodes, eliminating the need for an impedence matching network and associated process variables. The power supply is supplied with a vacuum interlock for operator safety.

2.5 System Control/Display Panels

The process controls are conveniently located on the lower front panel of the 500-II. All but the main power and START/STOP are located behind a hinged door, so that once operating parameters are established, the hinged door can be closed and the system can be operated using "one button". The significant process parameters (i.e., watts, torr, minutes, and endpoint) are continuously measured and digitally displayed so that the operator can easily monitor the process. A status display indicates the condition (mode) of the system at all times.

2.6 Endpoint Detector

The 500-II is equipped with a photo-optical endpoint detection system. This system automatically and precisely monitors the stripping reaction and terminates the process when all of the substrate have been completely stripped. Our unique design accommodates for run-to-run variations including; load size, amount of photo resist on each wafer, and process parameter variations and ultimately reduces process time to an absolute minimum. The included strip chart recorder allows for ease in set-up and calibration of the endpoint detector.

2.7 Safety Features

The 500-II is equipped with the following safety features allowing for maximum operator comfort and safety.

a) The quartz viewport is shielded with an ultraviolet filter and implosion guard.

b) The RF generator is interlocked to the Hi Torr setpoint so that RF power cannot be applied to the electrodes while the chamber is at atmosphere.

c) Safety interlocks which will not allow the system to be powered while the top cover is removed.

PLEASE NOTE: LETHAL VOLTAGES ARE PRESENT AT MANY POINTS IN THE 500-II. EXTREME CAUTION SHOULD BE EXERCISED WHENEVER THE COVER IS REMOVED FROM THE UNIT. MAINTENANCE AND/OR TROUBLESHOOTING SHOULD BE ATTEMPED ONLY BY QUALIFIED PERSONNEL.

SECTION THREE: FACILITIES/INSTALLATION INFORMATION

1.0 FACILITIES REQUIRED

The following are the recommended services and supplies required prior to start-up of the 500-II Plasma System.

1.1 Electrical Requirements

Main Power: The 500-II Plasma System is equipped with a six foot long, three prong grounded power cord and requires 115VAC, 10A, 50/60 Hz, 1 Phase.

Vacuum Pump: The Leybold Heraeus Model D16AC Mechanical Pump requires 115VAC, 15A, 50/60 Hz, 1 Phase.

PLEASE NOTE: THE 500-II SYSTEM AND THE VACUUM PUMP TOGETHER DRAW MORE THAN 15A, SO THEY SHOULD PLUG INTO SEPARATE CIRCUITS.

Strip Chart Recorder: Requires a 115VAC, 5A, 60 Hz power outlet.

Options: The motorguard 1 x 21 External Oil Purification System requires a 115VAC, 5A, 60 Hz power outlet.

1.2 System Exhaust

Process gases from the mechanical pump are exhausted through a one-inch (I.D.) Tube connection on the mechanical pump. This tube should connect into house exhaust and vent into a safe area. The maximum pump throughput is 14.1 cfm.

1.3 Gas Requirements

The gas connections are made to the rear panel of the 500-II by means of 1/4" compression fittings, teflon, or stainless steel (1/4" O.D.) tubing is recommended for the external gas lines. In either case, the tubing should be clean and free of defects and plumbing should be accomplished with a minimum number of fittings to insure a leak tight gas system. The rear panel of the 500-II has three gas inlets labeled Gas #1, Gas #2, and Vent. The regulated gas output pressure to the 500-II should not exceed 15 psig.

2.0 UNPACKING AND INSPECTION

The Technics 500-II Plasma System is shipped in three packages: One containing the mechanical pump, one containing the electrode cage assembly, and the other containing the 500-II strip chart recorder, stainless steel pump line, plus clamps and seals. These packages are clearly marked as to which side is up. These warnings must be observed as the pump is shipped filled with oil which will leak out if the pump is not kept upright. Inspect the packages for signs of shipping damage. If there is evidence of rough handling, return it (them) to the carrier unopened. After visual inspection of the packages, carefully open them and remove the contents. Open the 500-II chamber door and carefully remove any packing material. If there is any evidence of damage, file a damage claim, save the shipping materials and notify the Technics Service Department. Also, at this time, please take an inventory of all parts received compared with the purchase order and report any shortages within 10 days after receipt of shipment.

3.0 EQUIPMENT SET-UP

3.1 Introduction

The 500-II is a table top plasma system. The system can be operated in any environment; however, a dust free, low humidity moderate temperature environment is preferred. Care should be taken so that the sides and the rear of the unit are not obstructed in a manner that will impede the flow of cooling air.

3.2 System/Pump Placement

The 500-II should be placed on a table top with the vacuum pump located on the floor to the rear of the system or in a service access aisle.

3.3 Electrode Cage Installation

The electrode cage has been packed separately to avoid any damage which could be incurred during shipment. Check the cage for any loose screws. (Refer to drawing: Chamber Electrode Screw Panels in Schematic Section.) Locate holes A-F (Figures 1 & 2), secure screws B, C. E, & F first, then A, and finally, D. If you secure D before any of the other screws, you could possibly break the RF Feedthru Seal. Be careful not to snug screws until they are all in place - then firmly snug in order previously mentioned.

DO NOT OVERTIGHTEN ANY SCREWS AS THE CERAMIC SPACERS BREAK VERY EASILY.

NOTE: Screws B & C may be difficult to put in. We have found that by using a 12" (or longer) screwdriver, with a little vacuum grease on the tip to hold the screw, you can reach the back of the chamber easily.

3.4 Vacuum Connection

The connection between the system exhaust (located at rear panel) and the vacuum pump inlet is achieved by means of a forty inch length of stainless steel convoluted bellows, terminated with KF-25 flange connectors. Make sure that the sealing surfaces are unscratched, clean, and slightly greased. Connect the bellows such that the centering rings are sandwiched between each flange and are held together with the quick-disconnect clamps provided. Do not try to bend the tubing to sharply, as it may collapse or rupture.

3.5 Gas Connection

Located on the rear panel below the main vacuum connection are three gas inlets labeled: Gas #1, Gas #2, and Vent. Connect the appropriate gas line to each inlet. Do NOT over-tighten compression fittings as the tubing may collapse.

3.6 Strip Chart Recorder

Attach the interface cable to the rear of the strip chart recorder; inner wire lug to the positive (+) terminal and the outer wire lug to the (-) terminal. Connect the other end of the interface cable to the rear of the 500-II. Plug in the strip chart power cord. (Refer to the auxiliary manual for instructions on installation of the chart paper and pen.) With the power on; set the input switch to 1 Volt full scale deflection and the chart speed to 1 cm/min. Adjust the Zero such that the pen lines up with the right hand side of the chart paper. The ATTN knob should be in the fully CCW detented position.

3.7 Power Connection

At this point, with the 500-II and pump properly positioned and the vacuum and gas lines connected, it is time to apply power to the system.

NOTE: Before plugging in the power cords for the 500-II or vacuum pump, make sure that the main power switches are in the OFF position. Now plug in the power cords and proceed to the next section: OPERATING PROCEDURE

SECTION FOUR: OPERATING PROCEDURE

1.0 INTRODUCTION

The system control panel contains all the controls and adjustments necessary to operate the system. The measurable effect of the adjustments are digitally displayed on the right front panel, as is the status of the system.

2.0 CONTROL PANEL DESCRIPTION

2.1 Power

This is a push button switch that applies power throughout the 500-II except to the mechanical pump and recorder. It becomes illuminated when the power is on. Depressing it when illuminated removes power from the unit (but not from the mechanical pump or recorder).

2.2 Start/Stop

This is a push button switch used only in the automatic mode. Once a program has been established, depressing the START/STOP switch will cause the system to automatically cycle through the programmed process. Once the process is complete, an audible alarm will sound until the START/STOP switch is again depressed, silencing the alarm.

THE FOLLOWING CONTROLS ARE LOCATED BEHIND THE HINGED DOOR:

2.3 Mode

The operator may select either AUTO (automatic) or MAN (manual) operation by placing the MODE toggle switch in the appropriate position. If manual operation is selected, the system will respond to commands initiated by other switches and controls and will remain in that status until changed by the operator. In the automatic mode, all other controls and switches must be properly set, and after the START/STOP switch has been depressed (started), the system will automatically cycle.

2.4 Vacuum

This set of three toggle switches controls the vacuum components in the system. The SOLN switch controls the solenoid valve between the chamber and the pump. When in the OPEN position, the pump is evacuating the chamber; when closed, the pump is isolated from the chamber. The VENT switch similarly controls the vent valve. The TORR switch is a spring loaded, three position switch that, in its center position, does not affect the system. It is used to program pressure levels for desired processes. In the low position, it causes the TORR display to read a pressure level that can be set by adjusting the pot right above the switch. This is the pressure to which the chamber must be evacuated (Factory set at .050 torr), in the automatic mode, before Gas #1 and/or Gas #2 can be introduced. The HIGH Torr setpoint is the pressure (Factory set at .999 Torr) to which the system must be evacuated in order to initiate a plasma.

2.5 Power

The switch and knob in this group turn on and adjust the low frequency generator power output.

2.6 Gas #1 and Gas #2

These switches and knobs control the flow of gas into the chamber. In the ON position, a solenoid valve in the gas line opens connecting the chamber to the gas supply. Also in the circuit is a flow controller that is used to adjust (via the flow knob) the flow of gas into the chamber. The SOLN switch must be open and the VENT switch closed to properly achieve this setting). The 500-II has provisions for introducing two gases concurrently but not sequentially. The TORR readout displays the total pressure. To ascertain the ratio of the gases, merely compare the pressure contributed by each (by switching Gas #1 OFF and Gas #2 ON and noting the pressure, and then switching Gas #2 OFF and Gas #1 ON and noting the pressure.

2.7 End Point/Time

This group of controls is used to establish the conditions that must be satisfied before the process will automatically terminate. The spring-loaded switch may be set in either E/T or TIME ONLY. (The SET position is used in conjunction with setting the Z (zero), G (gain), S (slope), and L (level) pots).

PLEASE NOTE: The timer allows the operator to set times of up to 99.9 minutes as discussed below.

With the ENDPOINT/TIME switch in the TIME ONLY position, the plasma will be turned on the length of time dialed into the timer. This time will be displayed on the MINUTES readout when the process starts and decreases to zero as the time elapses. When zero is reached, the plasma is extinguished, the gas valve(s) close, and an audible alarm sounds until the START/STOP button is depressed, at which time the chamber will be isolated from the pump and the vent valve will open, returning the chamber to atmosphere. With the ENDPOINT/TIME switch in the E/T position, the plasma will be turned on shortly after the TORR low set point has been reached and the gas flow initiated and continued until all programmed endpoint settings have been reached and the dialed time commences on satisfaction of the endpoint settings. After the dialed time has elapsed, the same sequence of events occurs as when the ENDPOINT/TIME switch is in the TIME ONLY position.

3.0 INITIAL START-UP

3.1 With the 500-II and Vacuum Pump Main Power switches in the OFF position, set the following system controls.

a) Mode: Manual

b) Vac Sol'n Open

c) Vent Sol'n Closed

d) Power Control: OFF with knob fully CCW

e) Gas #1 & Gas #2: OFF

f) Gas #1 Adjust: Fully CCW

g) Gas #2 Adjust: Fully CCW

h) Endpoint/Time: Time Only

3.2 Apply power to the 500-II by depressing the main power switch on the lower right front panel.

NOTE: At this step; K-1 is energized in supplying power to the generator, which in turn supplies the + 15V and the ± 5V to the A & B Boards, Endpoint Board, and the front control panel.

The following displays should be illuminated: WATTS; 000, TORR; ± 1, ENDPOINT, MINUTES; 00.0, MAN, VAC, TIMER, AND "POWER" Lamps.

3.3 At this point, open the chamber door (to reduce pump load during warmup) and turn on the main power switch on the vacuum pump. Because of the high viscosity of the Fomblin Fluid, it may cause the pump integral overload switch to trip, in which case, wait a few seconds and try again. Once the pump has sufficiently warmed up (approximately 2-5 minutes) close the chamber door, and reopen the VAC SOLN switch. The TORR display will read a rapidly decreasing pressure. The system should pump to below .030 torr within two hours. If the system doens't achieve this pressure, check the vacuum connections to the pump. If all the connections are tight and a pressure of .030 is not achieved, refer to Section Five: System Maintenance, Leak Check Procedure.

3.4 After the system has achieved sufficient vacuum, the gas lines should be pumped back to the regulators. This is accomplished by turning on the front panel controls for Gas #1 and/or Gas #2 and fully opening (CCW) the needle valves. The system should recover to a base pressure of less than .035 torr within a reasonable amount of time. If not, there is a leak in the gas lines and the connections should be checked. When the gas lines are determined to be leak tight, close the Gas #1/Gas #2 needle valves (CW) and turn the solenoid switched to the "OFF" position.

3.5 At this point, open the gas cylinder regulator(s) and set the output pressure (not to exceed 15 psi).

3.6 Turn on the appropriate gas control(s) and adjust the flow (by reading the pressure on the TORR front panel display) to .175 - .2 torr.

3.7 Turn on the RF power and adjust level to 450-500 watts.

3.8 Let the system run (warm-up) for 1/2 hour.

3.9 After 1/2 hour, return system controls to the following positions:

1. RF Power: OFF
2. Gas #1 and/or Gas #2: OFF
3. VAC SOLN: Closed
4. Vent SOLN: Open

Let system chamber vent to atmosphere. The 500-II is now ready to program for use in the Auto Mode or to be used manually.

4.0 PROGRAMMING THE 500-II

4.1 Programming the Auto-Time Only Mode

a) With the system in the Manual Mode and pumped to below .030 Torr, turn on Gas #1 and/or Gas #2 control and adjust the flow(s) until the desired processing pressure is displayed on the TORR readout.

b) Turn the RF Power Switch on and adjust the control knob (CW) to the desired level.

c) Put the E/T-Timer in the TIME ONLY position.

d) Dial in the desired processing time on the ENDPOINT/TIME Thumbwheel Switch.

e) Put the "MODE" Switch in the AUTO Position.

f) Put the "VENT" Switch in the OPEN position and allow the chamber to come up to atmosphere.

g) Close the hinged door to cover the front panel controls.

h) The system is now programmed and can be operated using the START/STOP Switch.

SEQUENCE OF EVENTS IN THE AUTO/TIME ONLY MODE

The following are the sequence of events that the system will go through in the AUTO/TIME ONLY MODE.

a) Load the substrates in the system and close the door.

b) Push the START/STOP Switch.

c) The Vacuum Valve will open to pump the system down.

d) When the Lo Torr Setpoint is reached, the process gases will be introduced.

e) After a time delay has elapsed (allowing for the gas to stabilize), the RF power will come on.

f) At this point, the timer will start counting down, and when it reaches 00.0 the power and gas flow are terminated and the audible alarm sounds.

g) The operator pushes the START/STOP Switch to vent the system chamber to atmosphere.

h) Open the chamber door and remove processed substrates.

4.2 Programming the System Endpoint/Time Mode

Located in the optically opaque section of vacuum hose downstream from the process chamber is the heart of the endpoint detector; a photo cell sensitive to the emission spectra of carbon dioxide. Opposite the photo cell is an electrode for generating an extremely stable DC plasma using the chamber effluents. A regulated DC high voltage power supply is used for the discharge source so that the CO2 is re-ionized without dissociation. By looking at the byproduct gases downstream from the stripping chamber, temperature, power level, and ambient light flucuations will not cause the endpoint to trip prematurely. Consequently, sensitivity, stability, and repeatability are excellent.

As the wafers are stripped, the concentration of carbon dioxide in the plasma will first increase and then decrease until undetectable amounts remain. Any irregularities in the endpoint trace could cause the sensing circuit to deduce the process complete before it actually is. Therefore, the sensor output circuitry must preclude being fooled by spurious signals.

In order for the endpoint detector to deduce that process is in fact complete, two conditions must be satisfied.

a) The signal must have first exceeded and then fallen below a preset level.

b) The rate at which the signal is falling (the slope of the amplitude-time curve) must be below a preset level.

If both these conditions are met, the endpoint detector will direct the 500-II to proceed to the next programmed step.

Two other factors must be considered - what is the background detector signal and what is the maximum signal it will generate? The first of these factors is handled by presetting a zero level. The second can only be handled by stripping a typical batch of wafers and adjusting the gain to a desirable level.

All four of these adjustments are easily set via the Z, G, S, and L pots located above the SET-E/T-TIME ONLY switch. A strip chart recorder is required to properly adjust these parameters.

PLEASE NOTE: THE ENDPOINT DETECTOR HAS BEEN FACTORY SET, AND SHOULD NOT REQUIRE RE-CALIBRATION. IF ANY ADJUSTMENTS ARE NECESSARY, PLEASE REFER TO SECTION 3.1: ENDPOINT DETECTOR CALIBRATION PROCEDURE.

After endpoint has been detected, stripping can be continued for a preset time. This is accomplished by dialing in the desired time on the ENDPOINT/ TIME timer.

To program the 500-II for use in the Endpoint/Time Mode:

a) With the system in the manual mode and pumped below .030 torr, turn on the Gas #1 and/or Gas #2 control(s) and adjust the flow(s) until the desired processing pressure is displayed on the TORR readout.

b) Turn the RF power switch on and adjust the control knob (CW) to the desired level.

c) Put the E/T-Timer switch in the E/T position.

d) If any overstripping time is desired, dial in the time on the Thumb-wheel Switch.

e) Put the "MODE" Switch in the AUTO position.

f) Put the "VENT" Switch in the OPEN position and allow the chamber to come up to atmosphere.

g) Close the hinged door to cover the front panel controls.

h) The system is now programmed and can be operated using the START/STOP Switch.

SEQUENCE OF EVENTS IN THE E/T MODE

The following are the sequence of events that the system will go through in the AUTO E/T MODE:

a) Load substrates in the system and close the door.

b) Push the START/STOP Switch.

c) The vacuum valve will open to pump the system down.

d) When the Lo Torr setpoint is reached, the process gases will be introduced.

e) After a time delay has elapsed (allowing for the gas to stabilize) the RF will come on.

f) At this point, the endpoint display meter will begin to increase and then decrease until the display reads less then 200 and the slope of the curve is flatter than the programmed level.

g) The Endpoint mode terminates and the time mode begins (as indicated by status lights).

h) The timer will start counting down and when it reaches 00.0 the power and gas flow are terminated and the audible alarm sounds.

i) The operator pushes the START/STOP switch to vent the system chamber to atmosphere.

j) Open the chamber door and remove the processed substrates.

5.0 PROCESS INFORMATION

The following is a list of recommended gas/mixtures for common applications of the 500-II Plasma System.

GAS/MIXTURE	COMMON SUBSTRATE OR UNDERLYING MATERIAL	APPLICATION
O_2	Si, SiO_2, Si_3N_4, Al, Au, GaAs, Ceramic Glass, Plastics.	Removal of all types of photoresist and organic films, increase surface wettability
O_2/CF_4(2-5%)	Same As Above	Rapid removal of thick photoresist films.
Wet Air	Chrome Mask Plates	Descum Chrome Masks.
N_2/O_2(2-3%)	Nickel, Nichrome, Tantalum, Chrome	Rapid removal of photoresist films without oxidizing underlying substrate or affecting TCR values on resistor networks.
Ar/O_2(2-10%) He/O_2(2-10%)	Easily Oxidized Metals	Low temperature removal of organic contamination.
H_2*	Copper, Chrome, Nickel	Rejuvenation of metals covered by their oxides.
CF_4/O_2(4-20%)	Si_3N_4 over Al, Si, or SiO_2	Stripping or Isotropic etching of Si_3N_4.

*Please see Section Five: Item 2.2: Vacuum Pump for safety precautions which should be employed when using Hydrogen Gas.

a) The optimum operating pressure level has been determined to be between .175-.225 Torr, total gas pressure. As the power level is increased, the amount of heat generated will increase, affecting the ashing rate.

b) The substrate holders should be quartz, since a conductive material (such as aluminum), will cause the non-uniformities in the plasma.

SECTION FIVE: SYSTEM MAINTENANCE

1.0 INTRODUCTION

To keep the 500-II Plasma System and accessories in top working order; periodic maintenance will be required. The intervals between maintenance procedures will be dependent on each customers' individual use.

ANY SYSTEM MAINTENANCE SHOULD BE PERFORMED ONLY BY QUALIFIED PERSONNEL, AS SAFETY INTERLOCKS MAY REQUIRE TO BE OVER-RIDDEN FOR CERTAIN CALIBRATION PROCEDURES.

2.0 PREVENTIVE

2.1 Chamber/Electrode Cage Cleaning

The chamber and electrode cage may occasionally require cleaning. To remove the electrode cage:

a) Vent the 500-II to atmosphere.

b) Disconnect all power to the system. Refer to the drawing labeled: Chamber Electrode Screw Panels in the Schematic Section for screw designations.

c) Wearing nylon/rubber gloves, use a Phillips screwdriver (12" or longer) to remove the screws on the rear panel in the following order: D, B, C, E, F. Supporting the cage with your hand, remove the last screw; A, and carefully slide out the electrode cage.

d) Wipe down chamber walls and the electrode cage with a lint-free cloth and alcohol. Let dry.

e) Reinstall electrode cage as outlined in Section Three, Item 3.3

2.2 Vacuum Pump

The manufacturers' instruction manual is supplied in the auxiliary section.

The corrosive series pump is prepared for oxygen service and comes charged with Fomblin Y25/5* inert pump fluid. Fomblin is a non-corrosive, non-explosive pump fluid recommended for safe use with greater than atmospheric concentrations of oxygen.

The oil level should be checked regularly, and should always be 1/3 to 2/3 up the sight glass, when the pump is warm. Care should be taken so that no other types of mechanical pump oils are added to the Fomblin, as it may damage the pump's internal parts.

The frequency of oil change depends on the degree of contaminants in the oil. Please refer to the manufacturers' manual for the proper oil change procedure. Due to the buildup of contaminants in the pump fluid, the pumping speed will degrade with use. It is recommended that an external oil

*TM MONTEDISON, USA, INC.

purification system be used. This system will prolong the life of the Fomblin fluid; which is very expensive to replace. Technics offers an optional Motorguard 1 X 21 Filtration System which has proven inself to be very effective in filtering all of the contaminants from the Fomblin fluid.

If the pump is to be used with corrosive or volatile gases, proper safety precautions should be observed. A slight nitrogen (less the 2psi) purge should be installed in the air space above the Fomblin fluid to avoid any build-up of unreacted gases in the pump.

2.3 Leak Check Procedure

Periodic leak checking of the 500-II System should be performed to insure vacuum integrity and process repeatability.

2.3.1 Remove the gas lines (Vent, Gas #1, Gas #2) from the rear panel of the 500-II and reset the following controls:

a) System in Manual Mode

b) Power (RF): OFF (With knob fully CCW)

c) Gas #1 and Gas #2: CLOSED

d) Gas #1 and Gas #2 Adjust: Fully CCW

e) Vac Sol'n: CLOSED

f) Vent Sol'n: OPEN

Using rubber stoppers, plug Vent, Gas #1, and Gas #2 inlets located on the rear panel.

2.3.2 Put the "TORR" switch in the low position, and adjust the pot (located directly above the switch) for a front panel reading of .100± .003 TORR.

Now switch "TORR" to the HIGH position and note the reading. It should be .940± .020 Torr. (If not; adjust by referring the Section 3.4 Front Display Panel Calibration).

Starting at atmospheric pressure, close the chamber door, close the vent valve, and open the main vacuum valve. Time and record the following:

1) The time it takes to reach .100 Torr

2) The time it takes to reach .075 Torr (Spec. time is 1 min, 30 sec max)

3) The pressure after 5 minutes pumping down. (Spec is .030 Torr)

After 5 minutes, record the following pressures:

1) Open Vent: Note the pressure after one minute (Spec is .040 Torr)

2) Open Gas #1 Valve: Note the pressure after one minute (Spec is .040 Torr)

3) Open Gas #2 Valve: Note the pressure after one minute (Spec is .040 Torr)

4) Note the pressure one minute later (Spec is .025 Torr)

5) Close the vacuum valve, record the pressure rise after two minutes: (Spec is .040 Torr)

6) Subtract #4 from #5 and record the leak rate.

Reset the following controls:

1) Vac Sol'n OPEN

2) Vent Sol'n CLOSED

3) Gas #1: OFF (knob fully CW)

4) Gas #2: OFF (knob fully CW)

Remove the rubber stoppers and reconnect the gas and vent lines.