RF POWER SUPPLY
OPERATOR'S MANUAL

LF SERIES
RF SERIES
HF SERIES

REVISION 4.11

RF Plasma Products, Inc

WARNING

TO AVOID POSSIBLE SHOCK OR FIRE HAZARDS, CONNECTION OF THIS POWER SUPPLY SHOULD BE PERFORMED IN COMPLIANCE WITH THE NATIONAL ELECTRICAL CODE (ANSI C1) AND/OR ANY OTHER REQUIREMENTS APPLICABLE TO THE USER. INSTALLATION, OPERATION AND MAINTENANCE SHOULD BE PERFORMED BY QUALIFIED PERSONNEL.

RF POWER SUPPLIES
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DOCUMENT NUMBER 21-10483-901

STATEMENT OF WARRANTY

SOLID STATE SERIES POWER SUPPLIES ARE WARRANTED TO THE ORIGINAL PURCHASER AGAINST DEFECTIVE MATERIAL AND WORKMANSHIP FOR A PERIOD OF TWO YEARS FROM THE DATE OF DELIVERY. RF PLASMA PRODUCTS WILL REPAIR OR REPLACE, AT ITS OWN OPTION, ALL DEFECTIVE EQUIPMENT RETURNED FREIGHT PREPAID DURING THE WARRANTY PERIOD WITHOUT CHARGE (LABOR CHARGE ONLY DURING YEAR TWO) PROVIDED THERE IS NO EVIDENCE THAT THE EQUIPMENT HAS BEEN MISHANDLED OR ABUSED.

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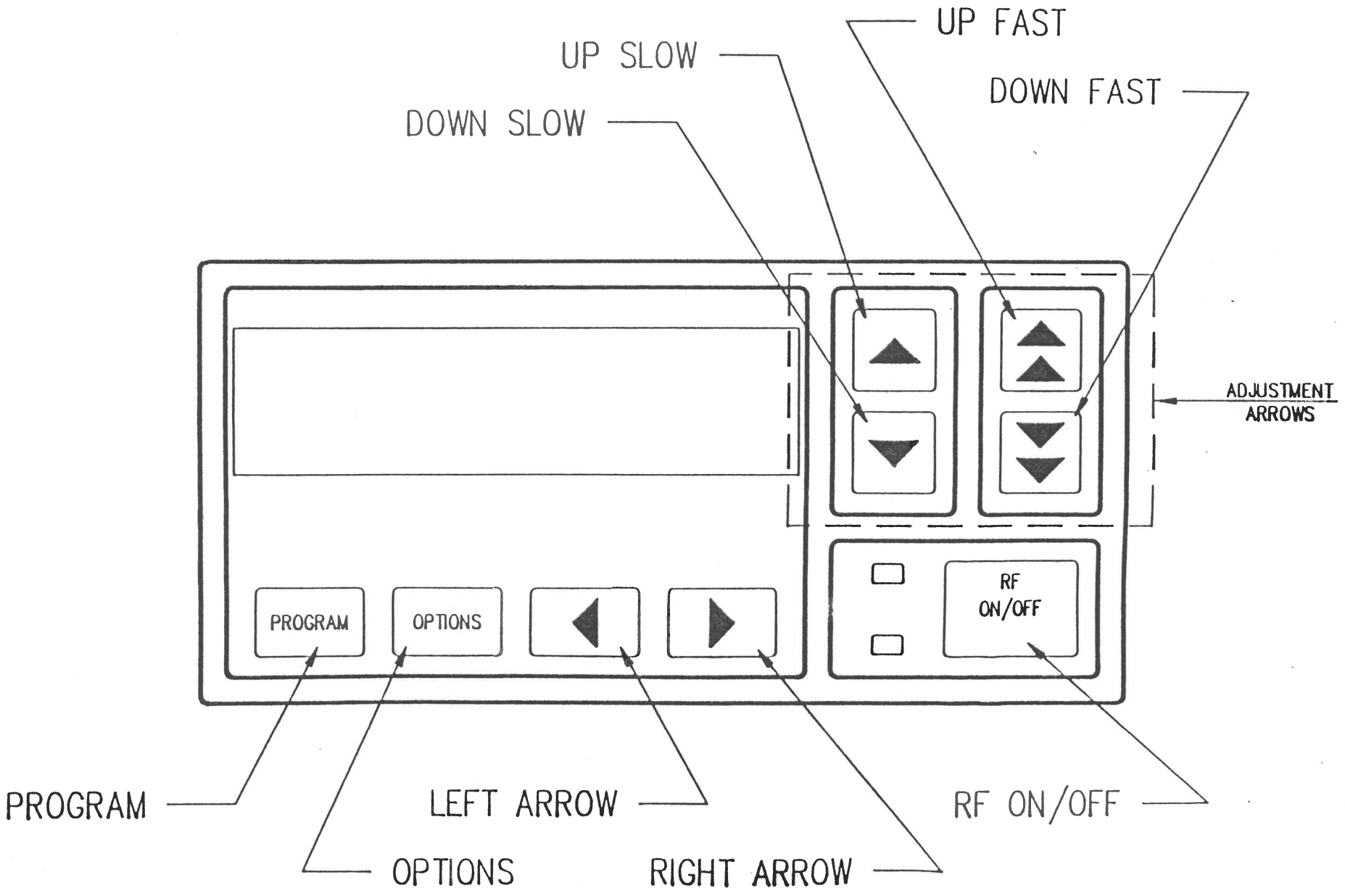
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UP SLOW
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PROGRAM
LEFT ARROW
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FIG. I

SECTION I

GENERAL INFORMATION

1.1 INTRODUCTION

This volume provides the operating instructions for solid state series generator (also referred to as the generator, the equipment or the power supply), manufactured by RF PLASMA PRODUCTS Inc., Voorhees, New Jersey.

This volume discusses the purpose, application and technical characteristics of the generator.

1.2 PURPOSE

The generator you have received is a unique microprocessor based RF power supply designed to provide the user with a flexible set of options for control. The generator provides the user with a pure, stable power source at 13.56 Mhz (at 60.00 Mhz for the HF10) from 0 to the supply's rated power.

1.3 RATED POWER

The rated power for the solid state series generators are as follows ...

RF5S	---	500 Watts
RF10S	---	1000 Watts
HF10	---	1000 Watts
RF20	---	2000 Watts
RF30	---	3000 Watts
RF50	---	5000 Watts

1.4 GENERAL DESCRIPTION

With RF ON, forward and reflected power are shown on the top line of the Vacuum Fluorescent Display (VFD). With RF OFF, setpoint and max power are shown on the top line of the VFD. Additional generator status information is typically displayed on the bottom line of the VFD. Blinking mnemonics on the bottom line of the VFD convey limit or alarm conditions as well as the quality of the match.

The generator is a simple stand alone RF power supply in the PANEL mode. PANEL mode is front panel operation. Power level is set via the four adjustment arrow buttons on the front panel. Feedback for regulating circuits is supplied by the internal directional coupler.

For more on panel programming, see section IV in this manual.

The ANALOG control mode allows control of the generator via external analog control signals.

SERIAL control is the most flexible control mode. The unit can be configured to operate in any mode with the minimum number of external connections to the system controller. Under SERIAL control the supply may be configured, power level set and status monitored over a simple serial link.

1.5 THE FRONT PANEL

1.5.1 POWER

This is the AC power switch for the generator.

1.5.2 RF ON/OFF BUTTON

When RF is ON, this button is always active and turns RF OFF when momentarily depressed.

When RF is OFF and front panel RF ON is permitted, this button turns RF ON when momentarily depressed.

1.5.3 MULTIFUNCTION BUTTONS

There are 8 additional tactile buttons on the front panel of the generator. These multifunction buttons (4 below the VFD and 4 to the right of the VFD) are explained in detail in the PANEL PROGRAMMING SECTION (IV) of this manual.

1.6 REAR PANEL CONTROLS AND CONNECTIONS

1.6.1 BREAKER

This breaker provides overcurrent protection for the power supply. It DOES NOT provide short circuit protection. An additional breaker with high current interrupt capacity or a set of fuses should be included in the system for safety. This breaker is the AC main disconnect for the generator. To operate the supply, place the lever in the up position.

1.6.2 AC INPUT

Attach included line cord to unit.

1.6.3 CEX IN

Common exciter input for applications requiring synchronous operation of RF generators. Source can be another RF series generator or CEX product.

1.6.4 CEX OUT

Common exciter output for applications requiring synchronous operation of RF generators. Level compatible with CEX input of RF series generators.

NOTE: The following items all refer to ANALOG interface (38 pin ELCO connector). Refer to Fig. 2 and Table 2.

1.6.5 POWER/VOLTAGE* AND RF/DC* INPUTS

These inputs are used to select the control modes.

PWR/VLT*	RF/DC*	CONTROL SELECTED
H	H	Forward Power Control
H	L	AUX Voltage Channel
L	H	RF Voltage Channel
L	L	DC Voltage Channel

H = +5V or open pin L = Ground or low logic level

1.6.6 PRESET INVOKE*

In ANALOG operation PRESET INVOKE* is the invoke selected preset function. Pulling this pin from a high to a low level will enable the preset selected by programming pins PP0, PP1 and PP2. Note that a high to low TRANSITION is needed to invoke the selected preset. Input is TTL compatible.

1.6.7 PP0, PP1 AND PP2

These pins form a truth table that selects a preset in the following manner ...

PP2	PP1	PP0	SELECTS
0	0	0	Preset # 0
0	0	1	Preset # 1
0	1	0	Preset # 2
0	1	1	Preset # 3
1	0	0	Preset # 4
1	0	1	Preset # 5
1	1	0	Preset # 6
1	1	1	Presets Disabled

... where 0 is pin tied to Ground. Refer to Section III and Figure 13.

1.6.8 EXTINLK

External interlock is the system interlock. To enable RF, the EXTINLK pin must be grounded. An open interlock will result in immediate loss of RF power.

1.6.9 RFGATE

To operate as a pulsed RF generator, apply a pulse train to this terminal. At the time of the transition from 0 to the high level, the output power will be selected by the setpoint # 1 level. On the high to low transition, the power will be selected by the setpoint # 2 level. Refer to Section 2.4, FULL ANALOG OPERATION. Input is TTL compatible.

1.6.10 RAMP ENABLE

In ANALOG operation RAMP ENABLE is the ramp FROM RF ON function. Pulling this pin from a high to low level enables ramping. Input is TTL compatible.

1.6.11 RFENABLE*

In ANALOG operation RFENABLE* is the RF ON/OFF function. Pulling this pin from a high to a low level enables RF. Note that a high to low transition is REQUIRED to turn RF ON. Input is TTL compatible.

1.6.12 RFENABLED*

RFENABLED* is a status line indicating that RF is ON, or RF is ON and OK. In addition, in the preset mode the logic is reversed and it becomes the PRESET ENABLE signal for the PS2A Matching Network Controller. Refer to Section 2.4.

* NOTE ** This is an open collector output. A 10K Ohm pullup resistor to 5 or 15 volts is necessary.

1.6.13 GATE ENABLE

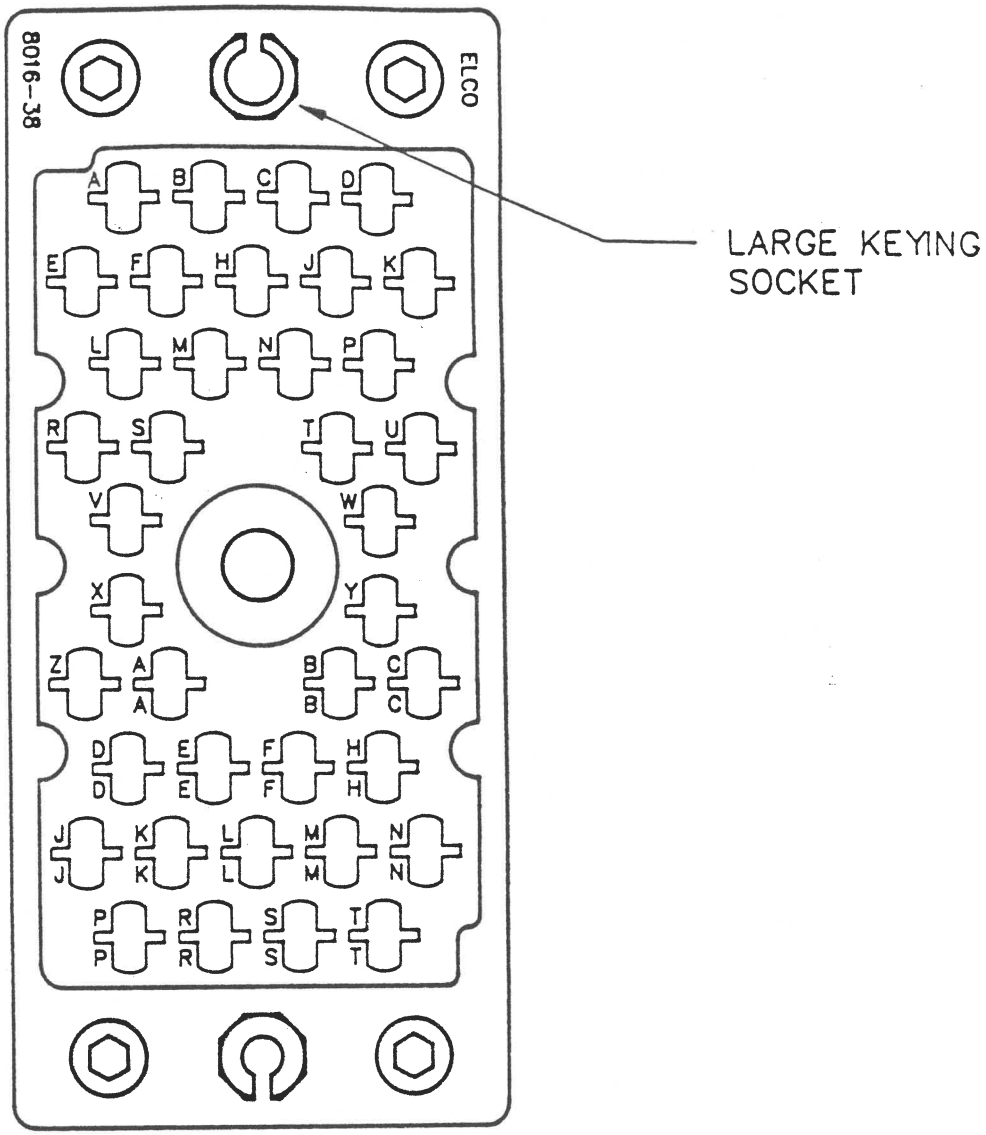
Pulling this pin low enables the ANALOG pulse mode. Input is TTL compatible.

1.6.14 +15V

+15V is a + 15 volt DC source that can be used to generate a positive external setpoint for ANALOG operation. Unit must be programed for positive polarity. See POLARITY PROGRAMMING. +15V has 10 Ohm output impedance.

1.6.15 -15V

-15V is a - 15 volt DC source that can be used to generate a positive external setpoint for ANALOG operation. Unit must be programed for positive polarity. See POLARITY PROGRAMMING. -15V has 10 Ohm output impedance.



VIEW OF CONNECTOR FROM REAR OF UNIT

FIGURE 2

1.6.16 +5V

1.6.17 INCMON/MP1

INCMON is an ANALOG output that has several uses. In the normal mode of operation there is a voltage present on this terminal that is linearly related to the forward power. The voltage is 5 V at rated power. Accuracy is +/- .5 % full scale +/- 3% reading; resolution is 1 Watt.
In the preset mode, the terminal is a forward power monitor, while RF is ON, and a preset voltage for the tune capacitor in the AM-SERIES matching network when RF is turned OFF. Refer to Figure 7 and Section 2.4.

1.6.18 REFMON/MP2

REFMON is an ANALOG output that has several uses. In the normal mode of operation there is a voltage present on this terminal that is linearly related to the forward power. The voltage is 5 V at rated power. Accuracy is +/- .5 % full scale +/- 3% reading; resolution is 1 Watt.
In the preset mode, the terminal is a reflected power monitor, while RF is ON, and a preset voltage for the load capacitor in the AM-SERIES matching network when RF is turned OFF. Refer to Figure 7 and Section 2.4.

1.6.19 RF PROBE

The feedback necessary for RF voltage control is applied to this terminal. Input is differential with an impedance of 10K Ohms. See Section 2.4 and Figures 6 & 7.

1.6.20 DC PROBE

The feedback necessary for DC bias voltage control is applied to this terminal. Input is differential with an impedance of 10K Ohms. See Section 2.4 and Figures 6 & 7.

1.6.21 AUX PROBE

The feedback necessary for AUX voltage control is applied to this terminal. Input is differential with an impedance of 10K Ohms. See Section 2.4 and Figures 6 & 7.

1.6.22 FBL - FEEDBACK LOW

The voltage control feedback channels are all differential. The aforementioned probe input terminals are all the HIGH inputs. This terminal is the LOW side of all probe inputs.

1.6.23 SETPOINT # 1

SETPOINT # 1 is the standard power and voltage setpoint input. In the power mode, the setpoint is linear over a +-5 or +- 10 volt range from 0 to rated power. See RANGE and POLARITY PROGRAMMING. Input impedance is 10K Ohms. In the voltage control mode, the control loop will alter the power until the setpoint and feedback signals are equal. The voltage-setpoint/power transfer function is a function of the probe attenuation and load impedance.

** NOTE ** SETPOINT # 1 is also used as the high power level in ANALOG pulse operation.

1.6.24 SETPOINT # 2

SETPOINT # 2 is the secondary power and voltage setpoint input. In the power mode, the setpoint is linear over a +-5 or +- 10 volt range from 0 to rated power. See RANGE AND POLARITY PROGRAMMING. Input impedance is 10K Ohms.

** NOTE ** This input is typically used as the low power level in ANALOG pulse operation.

1.6.25 GROUND SENSE

The GROUND SENSE line is the reference input for setpoint and monitor outputs. This pin should be connected to system ground at the SOURCE COMMON of all setpoint analog signals. Do not jumper to ground at the generator unless the GROUND SENSE feature is not to be used.

1.6.26 REMOTE LIMIT IN

The REMOTE LIMIT IN signal is designed to fold the generator back under external limit conditions. Typically used in dual bias systems. Input impedance is 10K Ohms. See Section 2.5.

1.6.27 REMOTE LIMIT OUT

REMOTE LIMIT OUT is a non-linear analog signal which represents the level of reflected power sensed by the supply. Typically used in dual bias systems. See Section 2.5.

1.6.28 PUP

Interface pull up voltage.

TABLE 1

ANALOG INTERFACE PIN LIST

PIN	LABEL	FUNCTION	SIGNAL
A	POWER/VOLTAGE*	SELECT VOLTAGE OR POWER	DIG
B	RF/DC*	SELECT RF OR DC VOLTS	DIG
CC	PRESET INVOKE*	INVOKES SELECTED PRESET (PP0, PP1 AND PP2)	DIG
U	PP0	PRESET SELECT PIN 0	DIG
BB	PP1*	PRESET SELECT PIN 1	DIG
FF	PP2	PRESET SELECT PIN 2	DIG
W	EXTINTLK	EXTERNAL INTERLOCK	DIG
S	RFGATE	ANALOG GATE INPUT	DIG
DD	RAMP ENABLE*	ANALOG RF ON RAMPING*	DIG
F	RFENABLE*	ANALOG RF ENABLE	DIG
M	RFENABLED*	RF STATUS LINE	DIG
EE	GATE ENABLE*	GATE ENABLE*	DIG
AA	EPO	EPO SWITCH CONTACTS OPTIONAL	---
Z	EPO	EPO SWITCH CONTACTS OPTIONAL	---
PP	+15V	+15 VOLTS	---
TT	-15V	-15 VOLTS	---
NN	+5V	+5 VOLTS	---
H	INC MON/MP1	INCIDENT MONITOR	ANA
J	REF MON/MP2	REFLECTED MONITOR	ANA
C	RF PROBE	RF VOLTAGE INPUT	ANA
D	DC PROBE	DC VOLTAGE INPUT	ANA
LL	AUX IN	AUX PROBE VOLTAGE INPUT	ANA
T	FBL	FEEDBACK LOW	ANA

TABLE 1 cont.

ANALOG INTERFACE PIN LIST

PIN	LABEL	FUNCTION	SIGNAL
E	SETPOINT # 1	POWER OR VOLTAGE SETPOINT	ANA
R	SETPOINT # 2	POWER OR VOLTAGE SETPOINT	ANA
V	GROUND SENSE	REFERENCE INPUT FOR CONTROL GROUND	ANA
P	REMOTE LIMIT IN	EXTERNAL LIMIT INPUT	ANA
Y	REMOTE LIMIT OUT	INTERNAL LIMIT OUTPUT	ANA
N	SHIELD	SHIELD CONNECTION	---
L	GROUND	DIGITAL GROUND	---
RR	GROUND	DIGITAL GROUND	---
K	GROUND	DIGITAL GROUND	---
MM	PUP	PULL UP (ATTACH TO +5V)	---

1.7 TECHNICAL SPECIFICATIONS

TABLE 2

REF #	PARAMETER	SPECIFICATION
1	FREQUENCY	
	1a. RF5S/10S/20/30/50	13.56 Mhz +-.01 %
	1b. HF10	60.00 Mhz +-.01 %
2	FREQUENCY STABILITY	+- .005 % SHORT TERM
3	RF OUTPUT POWER	RF5S 500 Watts into 50 Ohms RF10S 1000 Watts into 50 Ohms HF10 1000 Watts into 50 Ohms RF20 2000 Watts into 50 Ohms RF30 3000 Watts into 50 Ohms RF50 5000 Watts into 50 Ohms
4	OUTPUT IMPEDANCE	50 +-5 Ohms nominal.
5	METERING ACCURACY	Forward power +-.5 % FS +- 3% reading
6	CONNECTOR	Type N to 2000 Watts Type 7/16 DIN 3000, 5000 Watts
7	POWER STABILITY	0.5 % long term.
8	FORWARD POWER REGULATION	1 % into 50 Ohm load.
8b	LINE REGULATION	Related to RMS line voltage. Within range of taps settings, all specifications will be met. Below 5% low line, derate max power 1.5% for every 1% line change to a minimum 18% low line. Unit not specified to operate below 190 VAC.
9	LOAD MISMATCH TOLERANCE	Continuous duty into any passive load without failure or oscillation.
10	HARMONIC DISTORTION	All harmonics more than 45 dB down (typically 55 dB)
11	NOISE, HUM, RIPPLE	-40 dB at full power.
12	COMMON EXCITER INPUT	Input impedance 50 Ohms 7-20 volts P-P at operating frequency.

TABLE 2 cont.

REF #	PARAMETER	SPECIFICATION
13	COMMON EXCITER OUTPUT	Output impedance 50 Ohms 12 volts P-P at operating frequency adjustable 0 to 15 V P-P. .005% / C
14	TEMPERATURE COEFFICIENTS	+-.025% / C
15	PROTECTION	Forward power limits on PA current or excessive reflected power ... RF5S --- 37 Watts RF10S --- 75 Watts HF10 --- 150 Watts RF20 --- 150 Watts RF30 --- 600 Watts RF50 --- 450 Watts ... short and open circuit protected.
16	SPURIOUS RADIATION	13.56 Mhz supplies meet or exceed FCC specifications.
17	OPERATING AMBIENT	0 to 40 degrees Celsius.
17a	WATER FLOW/TEMPERATURE	HF10 1 GPM RF30 2.5 GPM both at 35 deg Celsius max.
18	HUMIDITY	80% non-condensing.

TABLE 2 cont.

REF #	PARAMETER	SPECIFICATION
19	POWER REQUIRED	RF5S 100-125 VAC 50/60 HZ Single phase 11 AMPS or 198-250 VAC 50/60 HZ Single phase 6 AMPS RF10S 198-250 VAC 50/60 HZ Single phase 11 AMPS HF10 198-250 VAC 50/60 HZ Three phase 6 AMPS RF20 198-250 VAC 50/60 HZ Three phase 14 AMPS or 198-250 VAC 50/60 HZ Single phase 28 AMPS RF30 198-250 VAC 50/60 HZ Three phase 19 AMPS RF50 198-250 VAC 50/60 HZ Three phase 35 AMPS
20	CIRCUIT PROTECTION	RF5S (208V) 8 AMP overcurrent RF5S (115V) 15 AMP overcurrent RF10S 15 AMP overcurrent HF10 8 AMP overcurrent RF20 (3 Ph) 18 AMP overcurrent RF20 (1 Ph) 38 AMP overcurrent RF30 25 AMP overcurrent RF50 45 AMP overcurrent All with 1000 AMP interrupt capacity.

1.8 STANDARD ACCESSORIES

1.8.1 AC LINE CORD

1.8.2 PROGRAMMING PLUG

The PROGRAMMING PLUG is the mate to the ANALOG interface connector. A full complement of pins are supplied.

1.8.3 DC VOLTAGE CONTROL CABLE

Supplied when purchased with AM-SERIES matching network and controller.

1.8.4 OPERATORS MANUAL

1.9 FACTORY REPAIR

When factory repair is desired, proceed as follows:

1) Document problem encountered.

2) Contact RF PLASMA PRODUCTS Customer Service Department for factory return authorization number.

SECTION II

INSTALLATION AND OPERATION

2.1 GENERAL

This section contains the installation and operating procedure for the power supply. The operating functions, controls and indicators are described in detail.

2.2 UNPACKING

Retain all packing materials until it has been verified that no internal damage has occurred to the unit in shipping.

2.2.1 The RF5S, RF10S, LF10 and HF10 generators are shipped in a standard slotted carton with foam inserts. Unpack as follows:

1) Remove foam cap from unit.

2) Carefully remove unit from carton.

3) Remove plastic bag from around unit.

4) Discard packet of dessicant.

5) Inspect for possible damage incurred during shipping.

6) If damage exists, notify carrier and RF Plasma Products. Save all shipping and packing materials. Do not return without instructions from RF Plasma Products.

2.2.2 The RF20, RF30 and RF50 generators are shipped in a wooden crate with foam inserts. Unpack as follows :

1) Remove crate lid and foam cap from unit.

2) Carefully remove unit from crate.

3) Remove plastic bag from around unit.

4) Discard packet of dessicant.

5) Inspect for possible damage incurred during shipping.

6) If damage exists, notify carrier and RF Plasma Products. Save all shipping and packing materials. Do not return without instructions from RF Plasma Products.

2.3 INSTALLATION

2.3.1 LINE TAPS

The generators operate on 190-260 VAC lines (the RF5S may operate on 95-130 VAC lines). Therefore, it may be necessary to change the taps on the primary power transformer on site. Before installation of the generator in the system, carefully remove the cover from the supply (bottom of unit for RF5S), then select the appropriate taps as shown in Appendix A.

2.3.2 WATER COOLED SUPPLIES

Connect fittings for water cooling. Connections are provided to accept 1/8 inch NPT male pipe fittings. The unit is designed to operate normally with not less than 1.0 gallons per minute. If in doubt, or the available process water flow is near this flow rate, the actual flow should be checked.

** NOTE ** The generator is protected against damage caused by lack of coolant flow. However, inadequate coolant flow will result in OVER TEMPERATURE condition and RF will be shut off until normal internal temperatures are restored.

The water used for cooling should be clean and free of any contaminants that may cause a buildup of corrosion or scale inside the heatsink tubing. This condition would reduce the electrical ruggedness of the supply by reducing the amount of cooling to the power transistors.

** CAUTION ** DO NOT apply excessive torque to the water inlet and outlet fittings on the rear of the generator. Avoid the use of excessive amounts of thread compound that may obstruct the cooling passages in the heatsink.

** NOTE ** Distilled water should be used, if possible, to eliminate lime or other mineral buildup in the copper heat exchanger. If tap water with a high mineral content is used for cooling, it may be necessary to periodically flush the unit by pumping through a commercial lime or scale removing agent. Typically, this agent is a household or industrial product. The unit should be flushed for approximately 5 minutes or until the scale is entirely removed. For further recommendations, consult the factory.

2.3.3 THERMAL CONSIDERATIONS

Take care to observe the maximum ambient temperature specifications. Ensure proper ventilation of the cabinet that will enclose the operational generator. Free air flow is required on both sides of the unit.

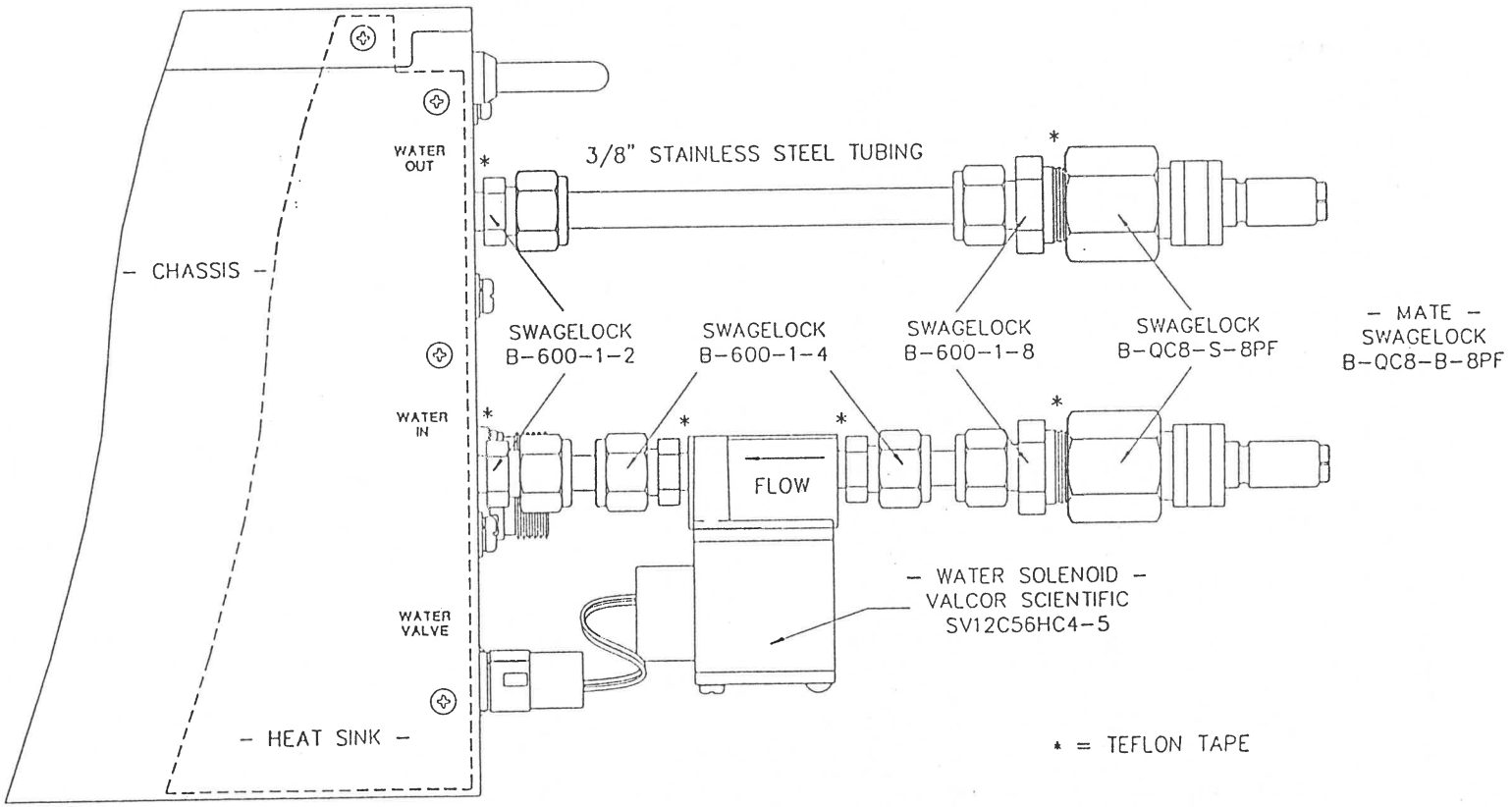


FIGURE 17

ILLUSTRATION – WATER FITTINGS/CONNECTIONS

2.3.4 CHECKOUT

If possible check the operation of the generator into a dummy load upon receipt. See Figure 4 for checkout configuration.

1) Connect AC line cord.

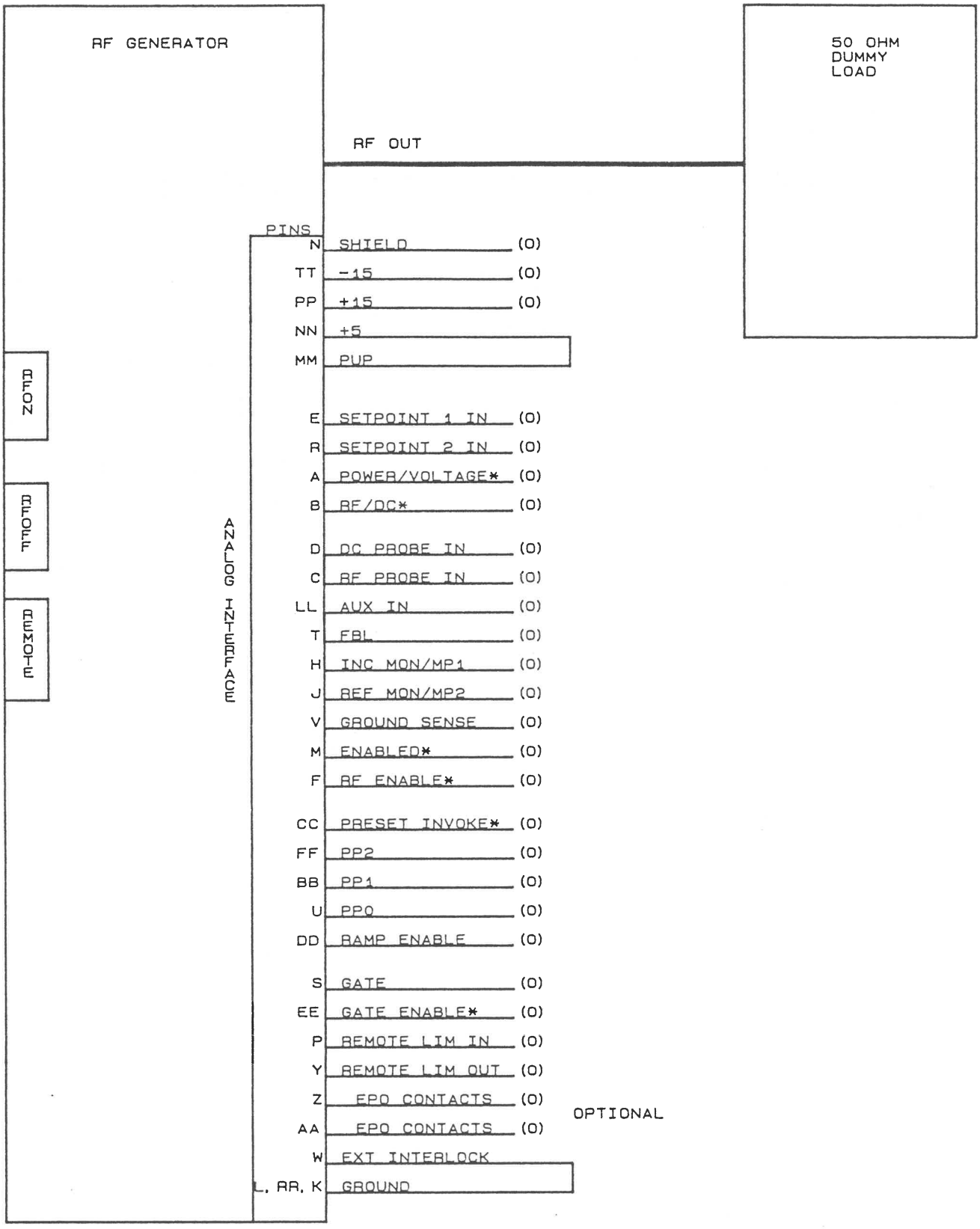
2) Connect programming plug.

3) Connect unit to dummy load.

4) Turn RF ON by depressing RF ON button on the front panel of unit. Supply should be capable of delivering rated power to the load.

5) Unit can now be configured for the particular application.

FIG 3 CHECKOUT CONFIGURATION



NOTE: (O) INDICATES OPEN TERMINAL
* INDICATES NEGATIVE LOGIC

2.4 OPERATIONAL DESCRIPTION

To fully utilize the features available on the solid state generator the user should become familiar with the examples outlined in the application section.

It will be necessary to refer to Sections I and IV, Rear Panel Controls and Front Panel Operation respectively, during this discourse.

2.4.1 FRONT PANEL CONTROL

This is the simplest of the three modes of operation. Panel control utilizes the front panel for control of RF ON/OFF, setpoint and max power setting.

To configure the unit for panel control, set up as in FIG 4.

1) Connect RF output cable to load via matching network.

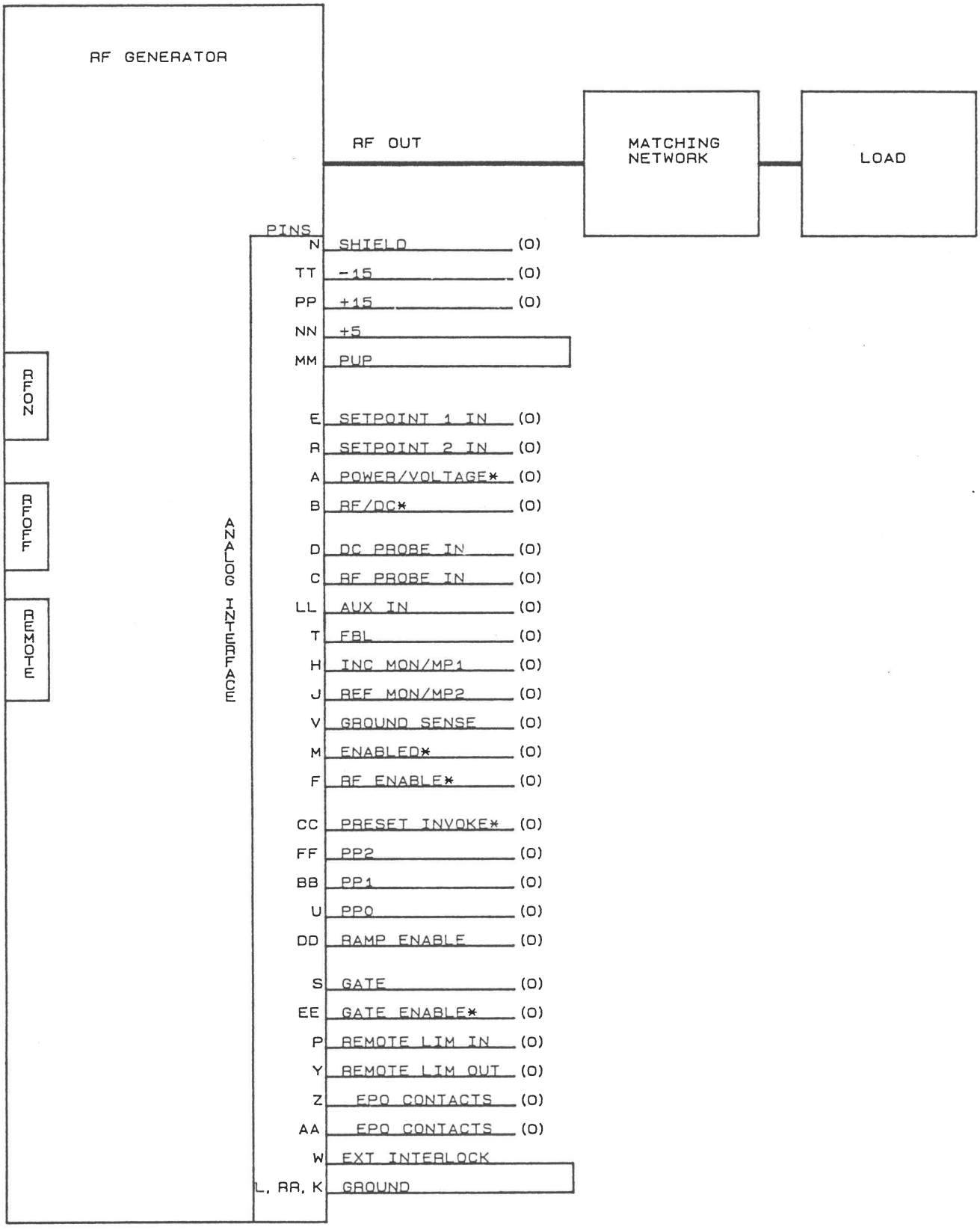
2) Connect programming plug. As shipped the programming plug connects the external interlock to ground. If desired the user can connect the interlock to the system interlock string.

3) To set setpoint with RF off, use the adjustment arrows on the front panel to select setpoint.

4) Depress RF ON/OFF button to turn RF on. Likewise, depress RF ON/OFF button to turn RF off.

5) Use adjustment arrows to adjust power to desired level.

FIG 4 LOCAL OPERATION



NOTE: (O) INDICATES OPEN TERMINAL
* INDICATES NEGATIVE LOGIC

2.4.2 ANALOG MODE

ANALOG MODE allows full ANALOG control of the unit. The front panel setpoint and RF ON key are no longer functional. RF OFF, while RF is ON, is active as usual.

To configure for full ANALOG see Figures 6 AND 7.

1) Connect ground sense to controller ground.

2) Tie external interlock to ground or system interlock.

3) RFENABLE* input expects a high to low transition to turn RF ON and a low to high to turn RF OFF.

4) Program polarity and range functions. Setpoint and feedback must be same polarity. For example, if a voltage probe with a negative output is used, a negative setpoint must be used.

5) If desired, program probe constant.

6) Optional ANALOG connections

   A) GATE ENABLE. See Pulse Mode application.

   B) GATE SIGNAL. See Pulse Mode application.

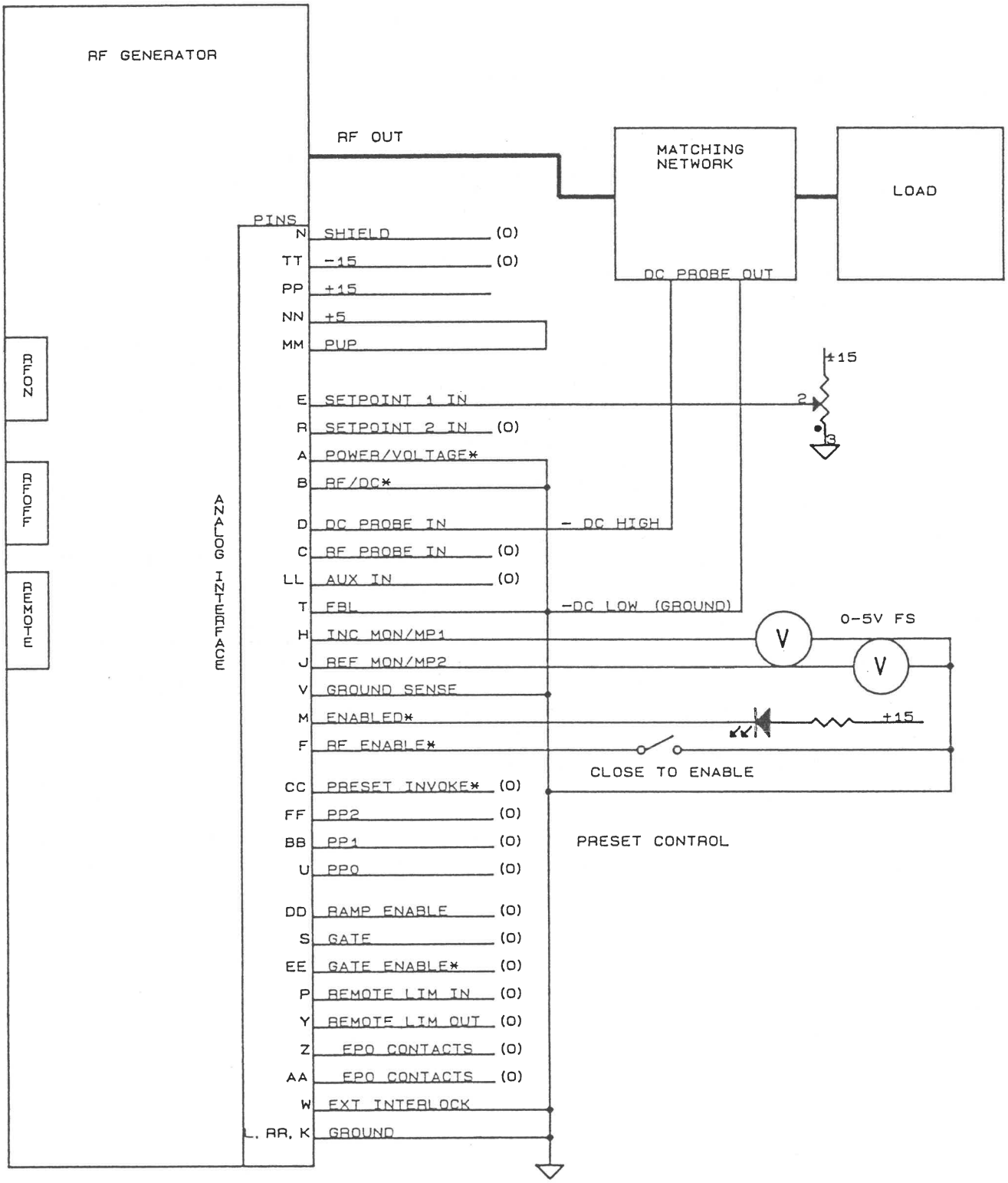
   C) INCIDENT, REFLECTED POWER MONITORS. These ANALOG outputs are proportional to power output. 5V = rated power for incident monitor and 5V = 10% of rated power for reflected monitor.

   D) STATUS INDICATOR RFENABLED*. This open collector output is normally low if RF is on (see RF ON & OK and Presets Functions).

7) Unit is now ready to operate in ANALOG control. Enter programming environment and enable ANALOG to enter ANALOG MODE. Upon return to the status environment the operational field will indicate ANALOG.

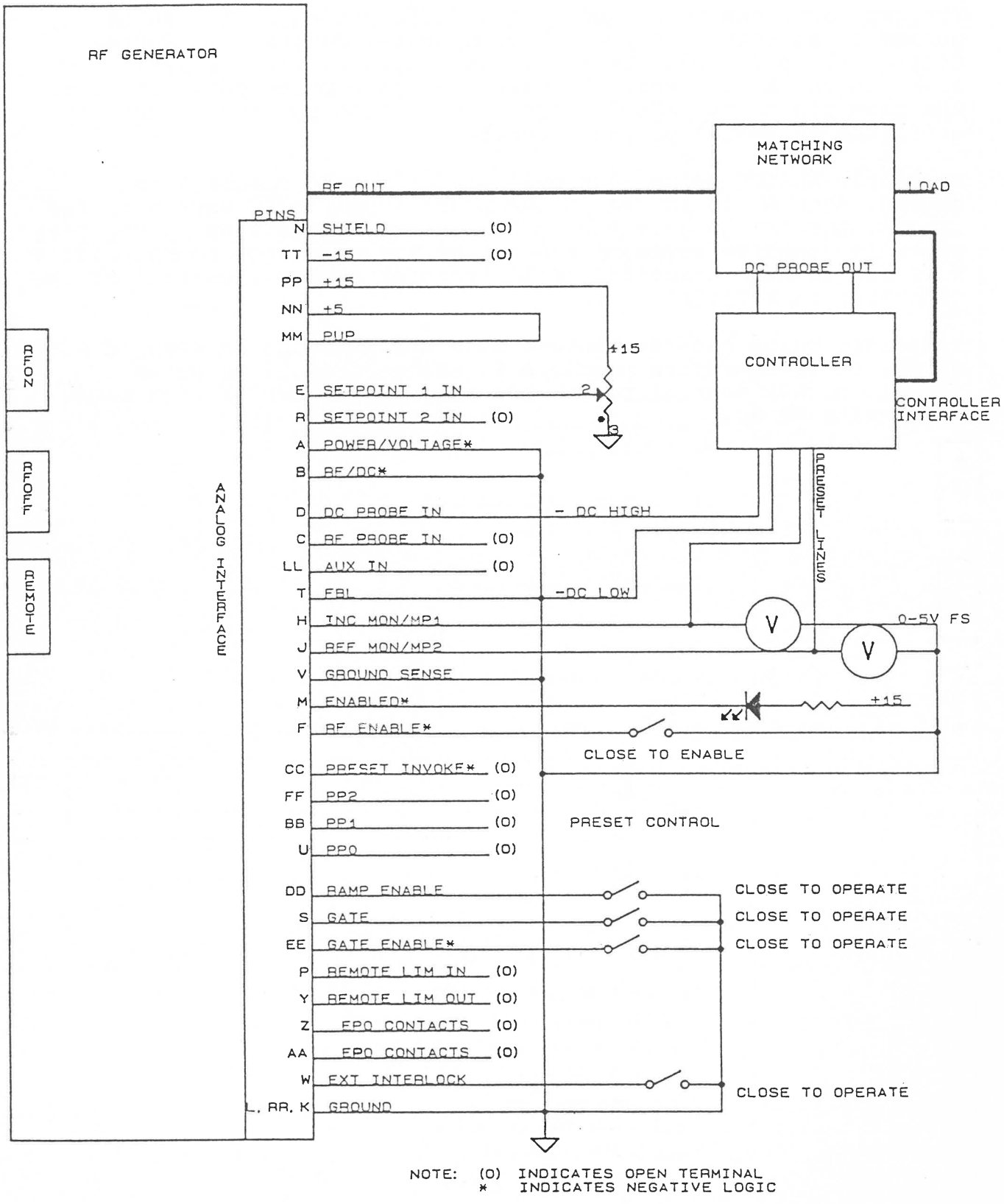
8) To operate, pull RFENABLE input low and adjust setpoint (observing the previously programed range) for desired power. If in the voltage control mode, adjust setpoint to the desired feedback level. For example, given a 200:1 probe and a desired electrode voltage of -400 volts, the setpoint would be -2 volts.

FIG 5 FULL ANALOG -DC VOLTAGE CONTROL



NOTE: (O) INDICATES OPEN TERMINAL
* INDICATES NEGATIVE LOGIC

FIG 6 FULL ANALOG DCV WITH PRESETS



NOTE: (O) INDICATES OPEN TERMINAL
* INDICATES NEGATIVE LOGIC

2.4.3 ANALOG PULSE MODE

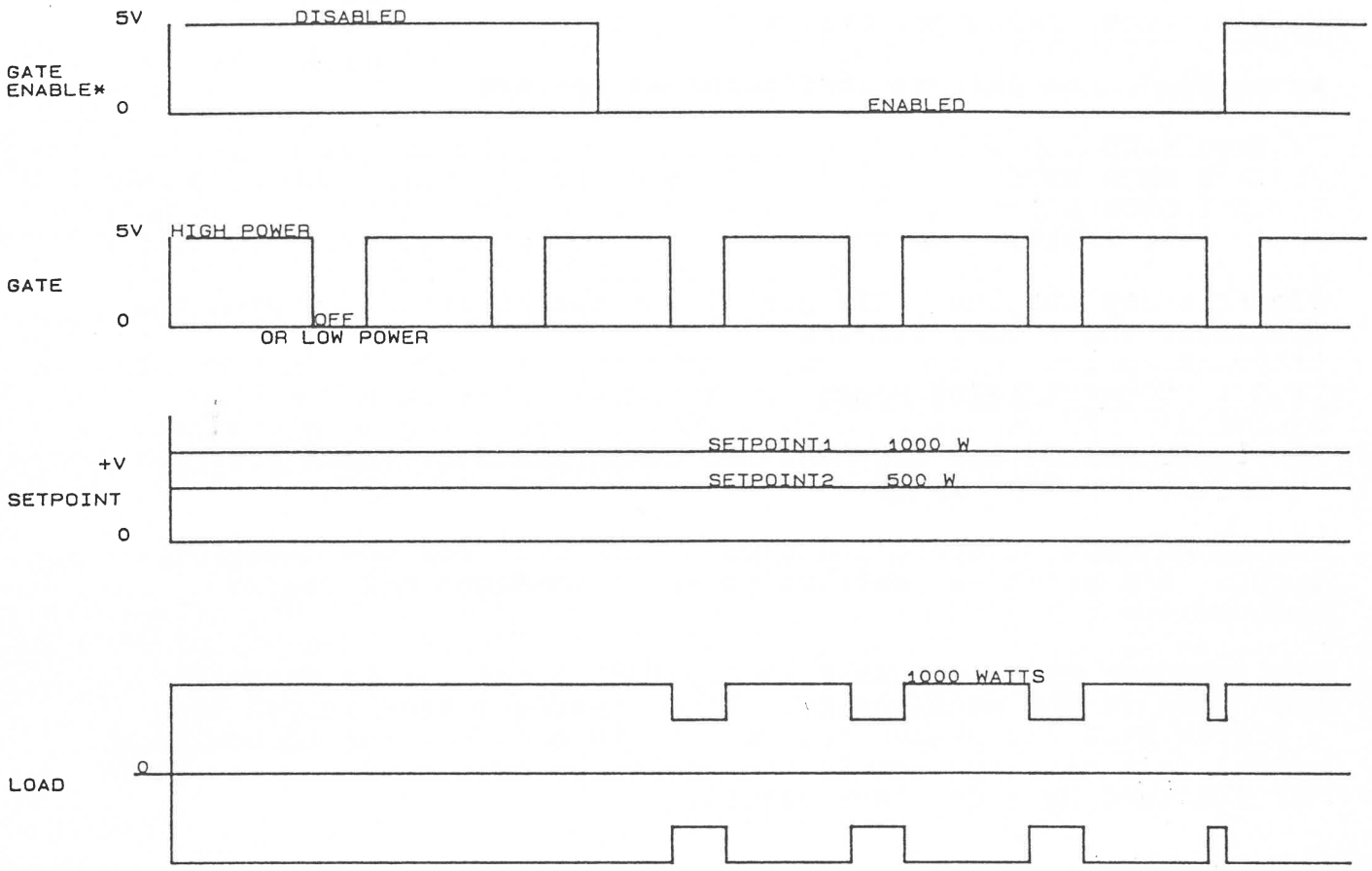
Refer to Figure 8.

The generator can be pulsed in two different ways. It can be pulsed in an ANALOG mode or through Serial Control. In Serial Control all pulse parameters can be programed via the serial link. In the ANALOG mode the user applies a pulse gate signal to the gate pin on the ANALOG interface. ANALOG pulsing is not available in serial or panel control.

To enable ANALOG pulse mode pull pin EE (gate enable) to ground. When RF is turned ON the power supply will expect to see transitions on the gate pin. A high to low transition on the gate pin will transfer setpoint control of the generator to setpoint # 2. A low to high transition will transfer setpoint control of the generator to setpoint # 1.

Setpoint, pulse enable, control mode and gate can be changed with RF ON. It is therefore possible to change from CW to pulse operation, RFP control to DCV control, duty cycle or high power level with RF ON.

FIG 7 ANALOG PULSE MODE



2.4.5 SERIAL CONTROL

The solid state series generators communicate over either an RS232 compatible serial interface or an RS485 interface. Both interfaces allow the user to remotely control and monitor the operation of the unit.

2.4.5.1 RS232 INTERFACE OPTION

As shipped, the unit is configured as follows:

9600 BAUD
8 DATA BITS
1 STOP BIT
NO PARITY

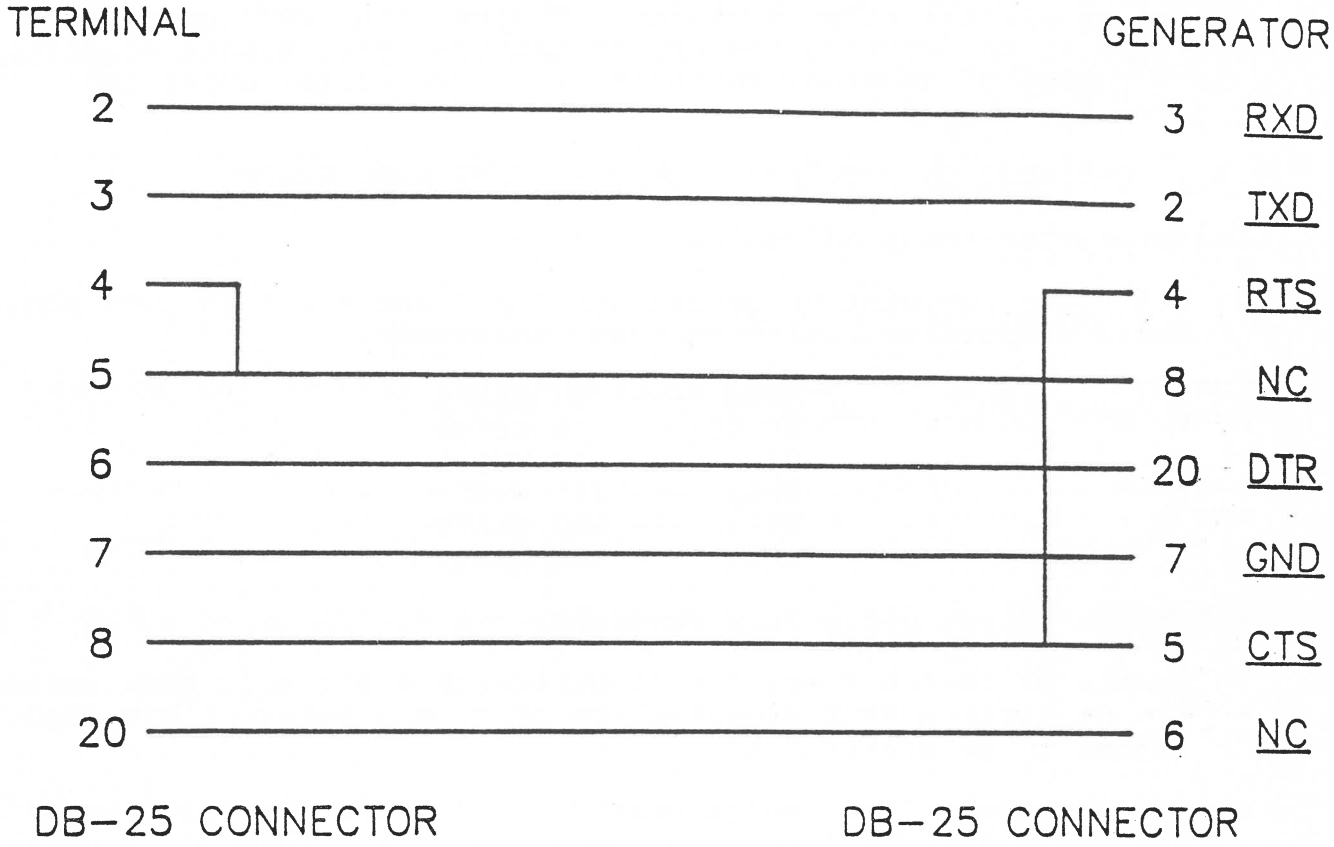
Figure 9 depicts the RS232 pinout for the interface between the generator and a dumb terminal.

2.4.5.2 COMMUNICATION MODES

The power supply has two modes of communication. These are the human and computer modes.

The human mode of operation prompts the user for the necessary inputs, and provides descriptive error messages and status information.

The computer mode is much more cryptic in nature. In general the commands are much shorter. Error messages are limited to a simple NACK and status information is encoded. The acknowledge signal is a carriage return and the error acknowledge is an ASCII "N" followed by a carriage return.



RS-232 CABLE DIAGRAM

2.5 MULTI-GENERATOR OPERATION

It is possible to operate several generators into the same load if care is taken to ensure that each generator is adequately protected from high reflected power conditions. To fully protect a given generator it is necessary to fold back all the other supplies when high reflected power is detected. This necessitates the utilization of the REMOTE LIMIT OUTPUT signal on the generator that is to be protected and the REMOTE LIMIT INPUT signal on all the other supplies. If other than RFPP generators are used in the system, the use of external directional couplers and a method of external foldback may be required. Refer to Figures 10, 11 and 12.

2.5.1 CALIBRATION PROCEDURE FOR DUAL GENERATOR SYSTEM

Calibrate the setup as follows:

1) Set power setpoint on generators " A " and " B " to just above their respective reflected power threshold.

RF5S	---	37 Watts
RF10S	---	75 Watts
HF10	---	150 Watts
RF20	---	150 Watts
RF30	---	600 Watts
RF50	---	450 Watts ...

2) Remove output cable from generator " B ".

3) Enable RF in " A " and " B ". Generator " B " will then emit a remote limit output signal to be used as a remote limit input signal on generator " A ".

4) Adjust remote limit on generator " A " (See Fig. 11) until reflected power indicated on generator " A " folds to 0 watts.

5) Disable RF in " A " and " B ".

6) Reconnect output cable from generator " B " to load.

7) Disconnect output cable from generator " A ".

8) Enable RF in " A " and " B ". Generator " A " will then emit a remote limit output signal to be used as a remote limit input signal on generator " B ".

9) Adjust remote limit on generator " B " (See Fig. 11) until reflected power indicated on generator " B " folds to 0 watts.

10) Reconnect output cable from generator " A " to load.

11) Remote limit outputs for a dual generator system are now calibrated.

2.5.2 CALIBRATION PROCEDURE FOR QUAD GENERATOR SYSTEM

Operation with three or more generators into a single load requires the use of the RL-1 remote limit interface box option.

Calibrate the setup as follows:

1) Connect all remote limit inputs and outputs to the RL-1 as shown in Figure 11. Remove cover from RL-1.

2) Set power setpoint on all generators to just above their respective reflected power threshold.

RF5S	---	37 watts
RF10S	---	75 watts
HF10	---	150 watts
RF20	---	150 watts
RF30	---	600 Watts
RF50	---	450 watts

3) Remove output cable from generator " A ".

4) Enable RF in generators " A ", " B ", " C " AND " D ".

5) Adjust channel A Gain Pot in the RL-1 for a 1.5 volt output.

6) Disable RF in all generators.

7) Repeat steps 3 thru 6 for all remaining channels, at which point the RL-1 will have been adjusted.

8) Adjust remote limit pots on all generator control boards as per instructions in Section 2.5.1. Any open cable will then fold back forward power on the other generators.

FIG 9 DUAL GENERATOR CONFIGURATION
RF GENERATOR

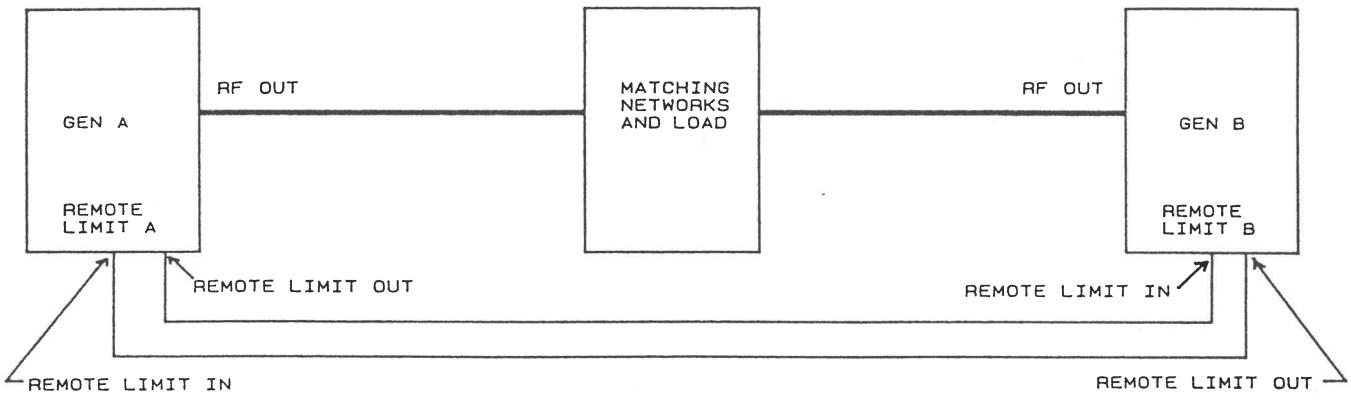


FIG 10 QUAD GENERATOR CONFIGURATION
RF GENERATOR

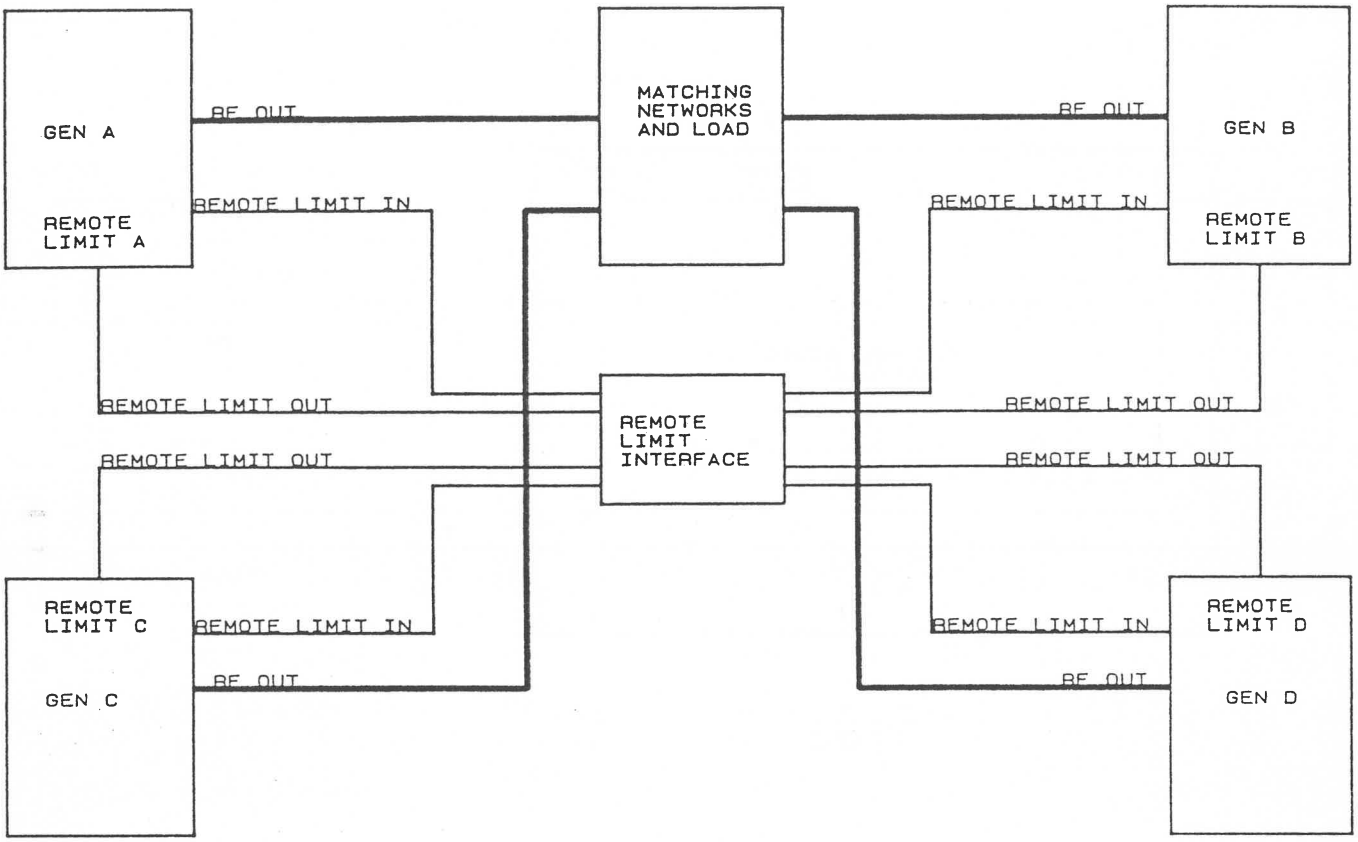
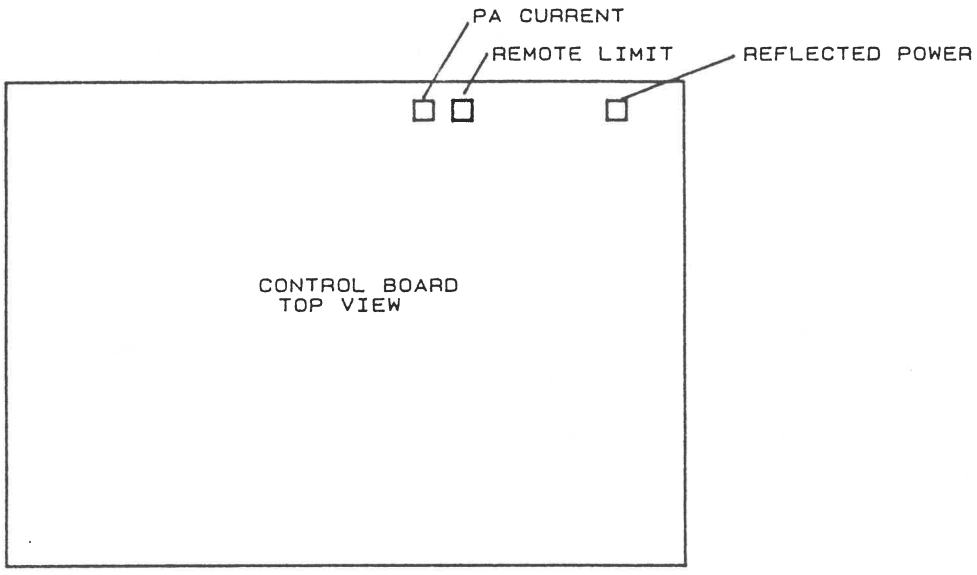
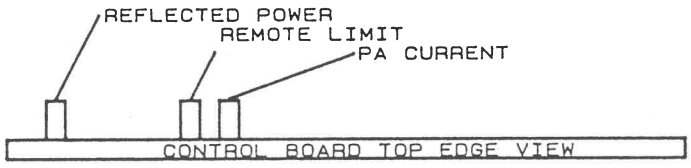


FIG 11 LIMIT POT ADJUSTMENT LOCATION



RF5S



ALL OTHER RF GENERATORS

SECTION III

PRESETS

3.1 INTRODUCTION

The PRESETS feature allows the end user to program up to 6 separate presets that may be executed either individually or as part of a programed recipe. Presets are programed at the front panel. Preset control is possible from the front panel, the rear panel or across the serial interface.

Please refer to the FRONT PANEL PROGRAMMING and PROGRAMMING ENVIRONMENT COLUMNS documentation during this discourse.

3.2 PRESET PARAMETERS

There exist 6 programmable presets (1 - 6) as well as two non-programmable presets (0 and 7).

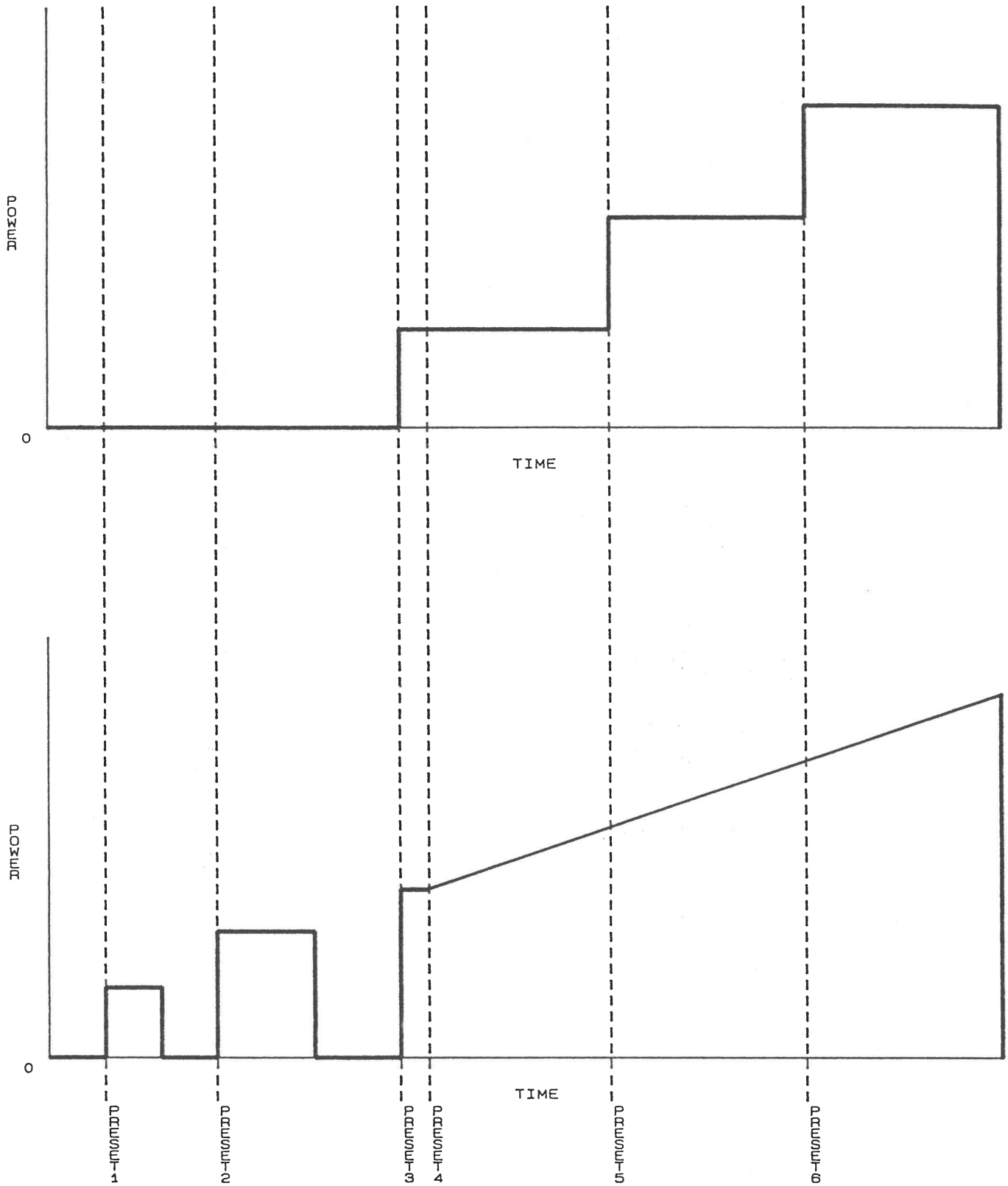
Preset 7 is PRESETS DISABLED. Standard generator operation.

Preset 0 is an executable preset which ALWAYS has a 0 setpoint (watts or volts).

Associated with each of the programmable presets (except where indicated) are the following parameters ...

(1)	CONTROL MODE	RF Power AUXiliary RF Volts DC Volts
(2)	RAMPING	Enable (RF Power ONLY) Disable
(3)	SETPOINT	Watts (RF Power ONLY) Volts
(4)	INTERVAL	0:00:00 to 9:00:00 (Ramping On) 0:00:00 to 18:12:15 (Ramping Off)
(5)	AUTOSEQUENCE	Enable Disable
(5a)	JUMP TO PRESET	Next preset to execute number.

FIG 12 PRESET TIMING



3.3 PRESET OPERATION

3.3.1 INDIVIDUAL PRESETS

Consider the bottom example of Figure 12, PRESETS TIMING. For the purpose of this example the generator will have RF enabled and preset # 1 will have been programed for RF Power control, 200 watts, a 1 minute time interval, ramping disabled and auto sequencing disabled.

*** NOTE *** For an individual preset to be executed, its AUTO SEQUENCING function must be DISABLED.

Before preset # 1 is selected, the generator was either operating with presets disabled or running preset # 0 (0 setpoint). When preset # 1 is enabled, the generator will run at its programed power level (200 watts) for its programed time interval (1 minute). When the preset's time interval has elapsed, preset # 0 WILL begin execution and the power level WILL drop to 0 watts. When the programed INTERVAL for an individual preset has expired the generator will ALWAYS run preset # 0 (0 setpoint).

3.3.2 SEQUENTIAL PRESETS

For a running preset to automatically begin executing another preset (including re-executing itself) upon expiration of its time interval, its AUTO SEQUENCING function must be ENABLED and the " preset to jump to " parameter for the executing preset must be programed.

Consider the top example of Figure 12, PRESETS TIMING. For the purpose of this example preset # 5 will have been programed for RF Power control, 200 watts, a 1 minute time interval, ramping disabled and auto sequencing ENABLED. Preset # 6 will have been programed for RF Power control, 400 watts, a 1 minute time interval, ramping disabled, and auto sequencing disabled.

*** NOTE *** Presets execution does not have to be sequential and is portrayed in this manner solely out of convenience.

Assuming the generator is running preset # 5 at its programed power level (200 watts) for its programed time interval (1 minute). Since auto sequencing is ENABLED, when the time interval for preset # 5 has elapsed, preset # 6 will AUTOMATICALLY begin executing under RF Power control, at the new setpoint of 400 watts, for 1 minute with ramping disabled. Since auto sequencing for preset # 6 is disabled, when its 1 minute time interval has elapsed, preset # 0 will begin execution and the power level will drop to 0 watts.

3.3.3 PRESETS AND MULTI-GENERATOR SYSTEMS

Once again, refer to Figure 12, PRESETS TIMING, for this example with the two generators having the following programed presets ...

TOP GENERATOR

P#	Control	Setpt	Interval	Ramp	Auto	Jump To
1	DC Volts	0V	00:02:00	OFF	OFF	N/A
2	DC Volts	0V	00:04:00	OFF	OFF	N/A
3	DC Volts	200V	00:00:02	OFF	ON	4
4	DC Volts	200V	00:10:00	OFF	ON	5
5	DC Volts	400V	00:10:00	OFF	ON	6
6	DC Volts	600V	00:10:00	OFF	OFF	0

BOTTOM GENERATOR

P#	Control	Setpt	Interval	Ramp	Auto	Jump To
1	RF Power	100W	00:02:00	OFF	OFF	N/A
2	RF Power	150W	00:04:00	OFF	OFF	N/A
3	RF Power	200W	00:00:02	OFF	ON	4
4	RF Power	300W	00:10:00	ON	ON	5
5	RF Power	400W	00:10:00	ON	ON	6
6	RF Power	500W	00:10:00	ON	OFF	0

Additionally, for the purpose of this example, both generators will be operating under control of THE SAME analog system. The system, using a rudimentary signal switch box with 4 digital lines going to each of the two generators, can now control a complete process requiring multiple generators WITHOUT HAVING TO MAINTAIN EITHER SETPOINT OR TIMING CONTROL OF THE PROCESS. The process would proceed as follows ...

The controlling analog system would begin the process with both generators executing preset # 0. This is accomplished by tying analog pins FF, BB, and U to GND and then forcing a transition on analog pin CC from 5V to GND. For more information on analog preset selection/enabling consult the EXECUTING PRESETS section of this discourse.

At the desired time (with RF enabled on both supplies) the analog system would " switch " to select and then enable preset # 1 on both generators. The TOP generator would run at 0 volts for 2 minutes while the BOTTOM generator would run at 100 watts for the same time interval. With the timeout of preset # 1, BOTH generators (the programed interval is identical) would immediately begin running preset # 0 since neither generator has the auto sequencing function enabled for preset # 1.

Preset # 2, albeit with different power levels and time intervals, would function in the same manner. Once enabled, both generators would run preset # 2 until timing out at which point (same interval) both generators would run preset # 0 (auto sequencing disabled in both).

When ready, the controlling analog system would select and enable preset # 3 on both generators. The TOP generator would then begin running at 200V while the BOTTOM generator would commence running at 200 watts. BOTH generators would run at their respective levels for 2 seconds. After timing out, both generators would AUTOMATICALLY begin running their respective preset # 4 because both have their AUTO SEQUENCE FUNCTIONS ENABLED and JUMP TO PRESET set at 4.

At this point the analog system may let the process being performed run without being REQUIRED to control it. Since presets # 3, # 4, and # 5 ALL have their AUTO SEQUENCE FUNCTIONS ENABLED and both supplies have the identical JUMP TO PRESET selections, upon timing out they will AUTOMATICALLY switch to begin running the next selected preset.

Presets # 4, # 5 and # 6 on the BOTTOM generator together perform a " linear " ramp from 200 to 500 watts over an (total time) interval of 30 minutes. Each of the three presets ramps FROM THE EXISTING POWER LEVEL (UPON ENABLING OF THE PRESET) TO ITS PRESET SETPOINT.

While the analog system is not REQUIRED to " control " presets that are auto sequencing, it may at ANY TIME select and enable an alternate preset or disable presets entirely in order to wrest control away from the sequencing presets. Finally, turning RF OFF on a generator while a preset is running, WILL ALWAYS force the generator to run preset # 0.

3.4 PROGRAMMING PRESETS

Presets are easily programed from the front panel and may be selected and/or enabled from the front panel, over the analog interface or serially.

Preset programming is possible provided that neither a programmable preset nor preset # 0 is running. If one of these presets are running, the parameters for an individual preset may be VIEWED BUT NOT ALTERED.

Provided that presets are disabled, use the PROGRAM and OPTION buttons on the front panel to move to the top of the PRESETS column. Then, using the RIGHT ARROW button, move down the column until the entry ...

Program Preset # n

... is displayed on the bottom line of the Vacuum Fluorescent Display (VFD). At this point use the ADJUSTMENT ARROWS to select the preset number to be programed.

Press the RIGHT ARROW button to move down the column to the entry ...

Pn Control ????????

... where, using the ADJUSTMENT ARROWS, the mode of control for preset n may be selected.

*** NOTE *** Whenever the mode of control for a preset being programed is ALTERED, the SETPOINT for that preset is UNCONDITIONALLY CHANGED to 0 and RAMPING for that preset is UNCONDITIONALLY DISABLED.

If the mode of control for this preset was RF Power, pressing the RIGHT ARROW button at this point will move the user down the column to the entry ...

Pn Ramping ???????

... where, using the ADJUSTMENT ARROWS, the ramping function for preset n may be enabled or disabled.

***NOTE *** If the control mode for this preset WAS NOT RF Power, the P# Ramping entry will be skipped making the next programmable entry P# Setpoint.

Press the RIGHT ARROW button to move down the column to the entry ...

Pn Setpoint ####c

... where, using the ADJUSTMENT ARROWS, the desired setpoint for preset n may be selected. The character c will be a W if under power control and a V if under voltage control. Additionally, the setpoint value WILL BE 0 if the control mode for this preset has been altered.

Press the RIGHT ARROW button to move down the column to the entry ...

Pn Interval ##:##:##

... where, using the ADJUSTMENT ARROWS, the desired interval for preset n may be selected. If ramping is enabled, the MAXIMUM ramp interval will be 9:00:00 hours. If ramping is disabled (or under voltage control), the MAXIMUM run interval is 18 hours 12 minutes and 15 seconds.

Press the RIGHT ARROW button to move down the column to the entry ...

Pn AutoSeq ????????

... where, using the ADJUSTMENT ARROWS, the automatic sequencing function for preset n may be enabled or disabled. If the automatic sequencing function is disabled, this entry becomes the last programmable parameter for this preset. However, if the automatic sequencing function is enabled, pressing the RIGHT ARROW button will move the user down the column to the entry ...

Pn Jump to Preset #

... where, using the ADJUSTMENT ARROWS, the desired preset to automatically sequence (jump) to for preset n may be selected.

3.5 EXECUTING PRESETS

Presets only execute with RF ON. While the setpoint may be zero watts or 0 volts for a given preset, for the preset's time interval to run and expire, RF must be ON.

*** NOTE *** Whenever a programmable preset or preset # 0 is enabled, both the PROCESS PULSING and SETPT RAMPING functions (see PULSING and OPERATE columns of PROGRAMMING ENVIRONMENT COLUMN sheet) are UNCONDITIONALLY DISABLED.

3.5.1 PANEL

Enter the PROGRAMMING ENVIRONMENT and use the OPTION button to move to the top of the PRESETS column. On the bottom line of the VFD will be displayed either ...

Run(ning) Preset # n (if a preset is executing)

Presets Disabled (if presets are disabled).

Use the ADJUSTMENT ARROWS to select the desired preset to be executed or to disable presets. Press the PROGRAM button to ENABLE the selection.

3.5.2 ANALOG

When under ANALOG control configure analog pins FF , BB and U to select the desired preset as follows ...

PIN FF	PIN BB	PIN U	SELECTS
0	0	0	Preset # 0
0	0	1	Preset # 1
0	1	0	Preset # 2
0	1	1	Preset # 3
1	0	0	Preset # 4
1	0	1	Preset # 5
1	1	0	Preset # 6
1	1	1	Presets Disabled

... where 0 is PIN tied to GND. Refer to Figure 14.

Then force a TRANSITION from 5V to GND on pin CC of the analog interface. This TRANSITION causes the selected preset (pins FF, BB and U above) to be ENABLED.

FIG 13 DUAL GENERATOR PRESET CONNECTION

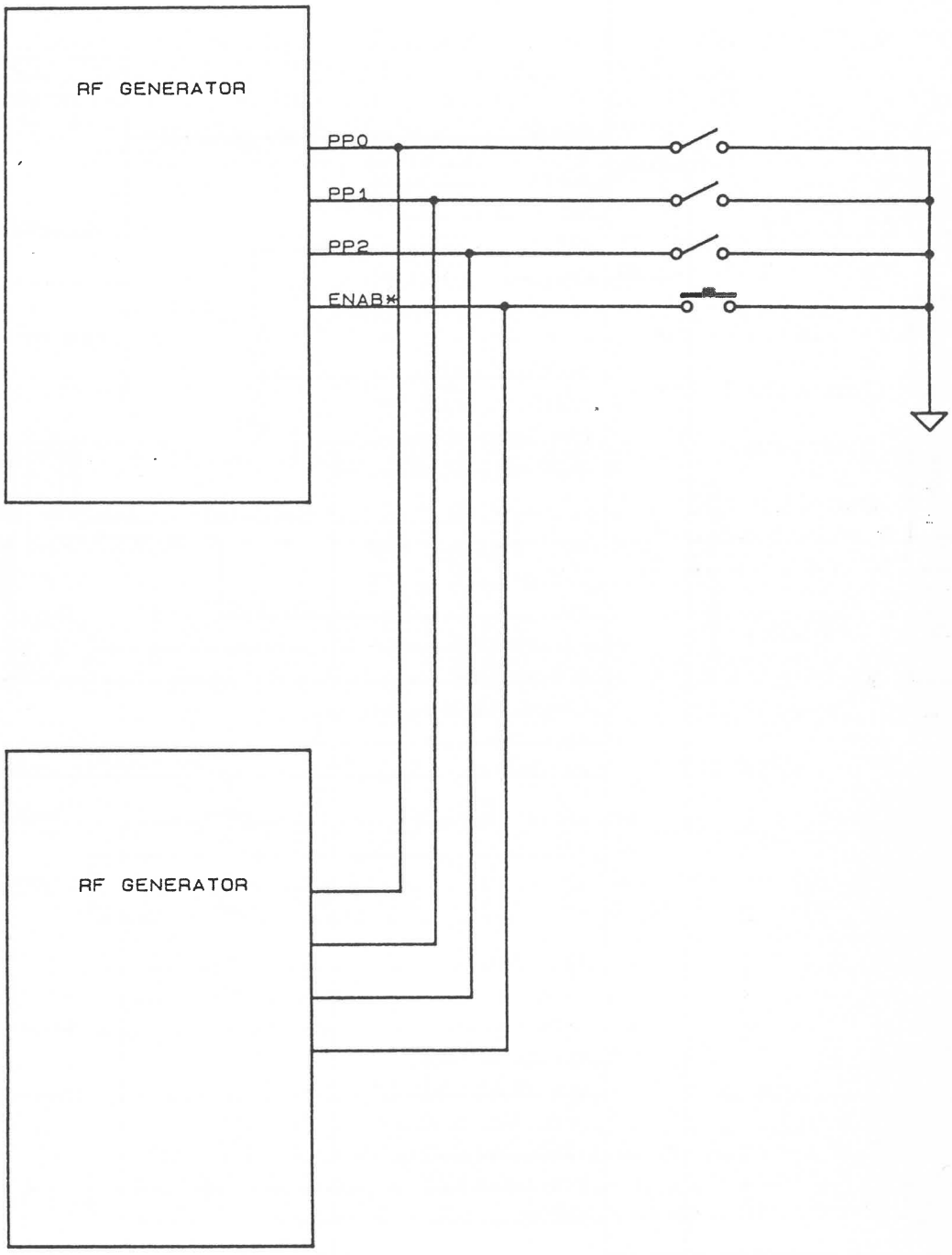
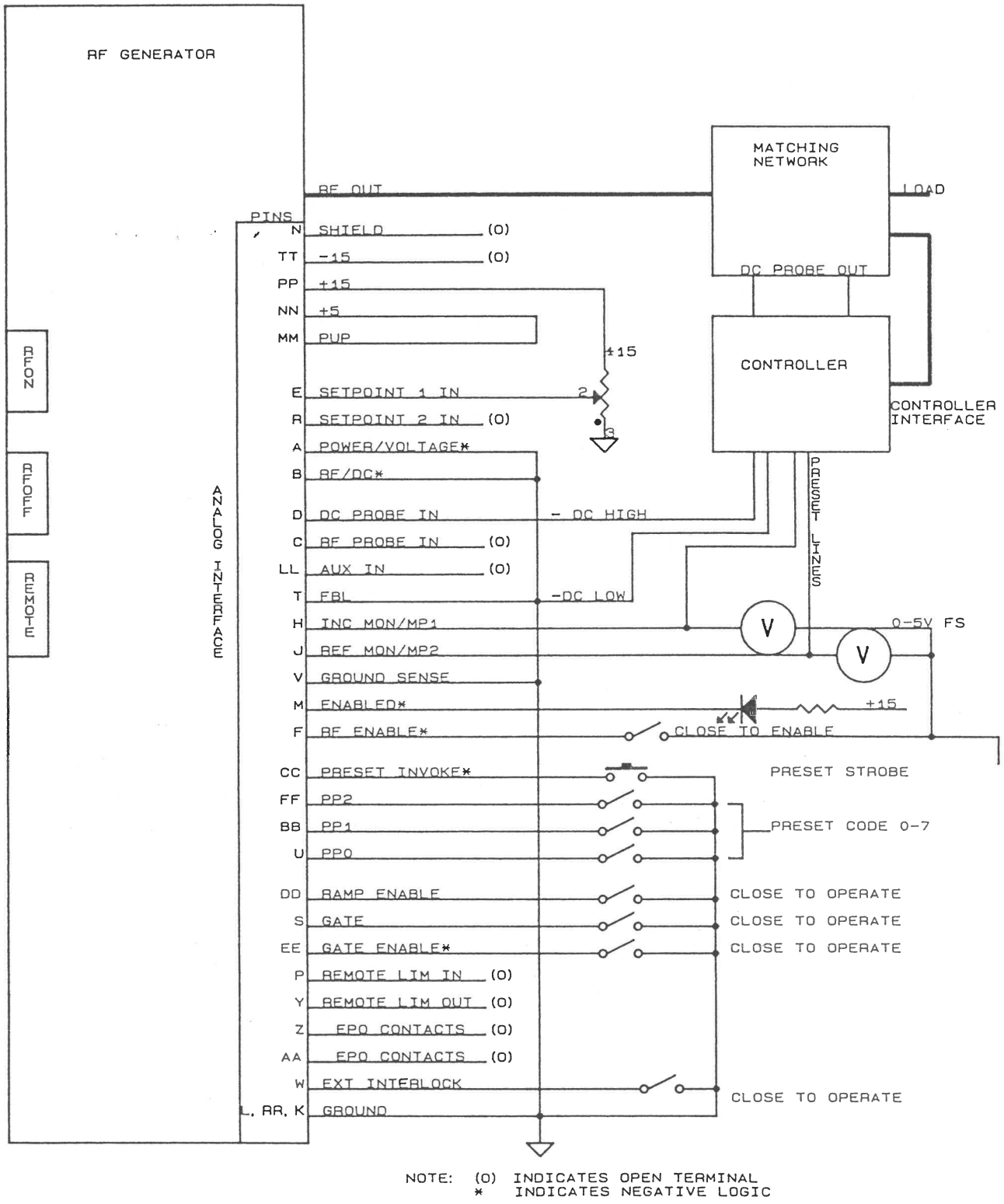


FIG 14 FULL ANALOG DCV WITH PRESETS
(MATCHING NETWORK AND SEQUENCE)



NOTE: (O) INDICATES OPEN TERMINAL
* INDICATES NEGATIVE LOGIC

3.5.3 SERIAL

When operating under serial control of the generator, the desired preset is selected using either the human mode command " RUN " or the computer mode command " RP " .

At the " Command> " prompt in human mode enter the text string representative of the desired preset, a space and the command " RUN " followed by a carriage return. The text strings are as follows ...

TEXT	PRESET SELECTED
DISABLE	Presets Disabled
P0	Preset # 0
P1	Preset # 1
P2	Preset # 2
P3	Preset # 3
P4	Preset # 4
P5	Preset # 5
P6	Preset # 6

ex. Command> P1 RUN <cr> ... to execute preset # 1.

In computer mode, enter the desired text string (see above), a space and the command " RP " followed by a carriage return.

ex. P3 RP <cr> ... to execute preset # 3.

*** NOTE *** To save time/space the string " DISABLE " may be replaced with the ASCII character 0 .

Additionally, the parameters of a programmable preset may be transmitted serially to the host computer or terminal at any time. This is accomplished via the serial commands P1? , P2? , P3? , P4? , P5? and P6? .

In human mode, the response to one of these queries might be ...

```
hi P2?

P2 Control RF Power

P2 Setpoint     400W

P2 Ramping  Enabled

P2 Interval  0:01:00

P2 AutoSeq  Disabled

P2 Jump to Preset  0
```

In computer mode, the response to the same query would be ...

3 400 1 60 0 0

3.6 PRESET CLOCK

This feature will display the length of time that the selected preset has been running. The time is displayed (if enabled) in place of the CEX and PULSE mnemonics on the bottom line of the Vacuum Fluorescent Display (VFD) in the STATUS ENVIRONMENT. The timer is reset whenever a new programmable preset is selected and is " frozen " when preset # 0 is selected (by an RF OFF or jump) or preset # 7 (presets disabled) is selected.

SECTION IV

PROGRAMMING FROM THE FRONT PANEL

4.1 STATUS ENVIRONMENT AND ADJUSTMENT BUTTONS

During standard operation of the generator, the two line front panel display might be displaying with RF ON ...

```
Top    line          Fwd 500W   Ref    0W
Bottom line          RFP PANEL  CEX PULSE
```

... or with RF OFF ...

```
Top    line          Set 2000W  Max 2222W
Bottom line          RFP PANEL  CEX PULSE
```

This standard operation display is called the STATUS ENVIRONMENT.

In the STATUS ENVIRONMENT with RF OFF the adjustment buttons increase or decrease setpoint. With RF ON the adjustment buttons increase or decrease forward power or bias voltage.

To program selected parameters from the front panel, the user must leave the STATUS ENVIRONMENT and enter what is called the PROGRAMMING ENVIRONMENT.

4.2 PROGRAMMING ENVIRONMENT AND PROGRAM BUTTON

Entrance to the PROGRAMMING ENVIRONMENT is controlled by the PROGRAM button. Once the PROGRAM button has been pressed, the display's top line changes to indicate with RF ON ...

forward power or bias voltage and reflected power as well as the present PROGRAMMING COLUMN. For example ...

```
500     0    ANALOG    ... OR ...    500     0    PULSING
```

... or with RF OFF ...

setpoint in watts or volts and the present PROGRAMMING COLUMN. For example ...

```
500          OPERATE    ... OR ...    500          SYSTEM
```

... and the display's bottom line changes to show the top entry in the present PROGRAMMING ENVIRONMENT COLUMN. Consult the PROGRAMMING ENVIRONMENT COLUMN sheet in this manual.

TABLE 3

PROGRAMMING ENVIRONMENT COLUMNS

ANALOG COLUMN	PRESETS COLUMN	PULSING COLUMN	OPERATE COLUMN	SYSTEM COLUMN	SOFTKEY COLUMN
Analog Enabled / Disabled	Run(ning) Preset # 6 / Preset # 5 / Preset # 4 / Preset # 3 / Preset # 2 / Preset # 1 / Preset # 0	Proc Hi Power ####W / 0W	Max Power ####W / 0W	Sensitivity 4096 / 0	Panel Password 32767 / -32768
Control RF Power / AUXiliary / RF Volts / DC Volts	Presets Disabled	Proc Low Power ####W / 0W	L: ####mv T: ####mv	Douse 4096 / 0	
Polarity Positive / Negative	Pres. Clock Enabled / Disabled	Proc Hi Time 10000ms / 0ms	Load Preset A 5000mv / 0mv	Sustain ####W / 0W	
Voltage Range 10V / 5V	Program Preset # 6 / 1	Proc Duty Cycle 100% / 1%	Tune Preset A 5000mv / 0mv	Suppression Enabled / Disabled	
Exciter Master / Slave	P# Control RF Power / Auxiliary / RF Volts / DC Volts	Proc Pulse Enabled / Disabled	Load Preset B 5000mv / 0mv	ARC Delay 32400ms / 1ms	
Panel RF ON Enabled / Disabled	P# Ramping Enabled / Disabled	Save Proc Parameters	Tune Preset B 5000mv / 0mv	ARC Delay Enabled / Disabled	
Panel Setpt Enabled / Disabled	P# Setpoint ####W / ####V	Strt Hi Power ####W / 0W	Using Preset Pair B / A	Compliance 100% / 1%	
RF ON & OK Enabled / Disabled	P# Interval ##:##:## / 00:00:00	Strt Low Power ####W / 0W	Load & Tune Enabled / Disabled	REF Power Alarm ###W / 1W	
	P# AutoSeq Enabled / Disabled	Strt Hi Time 10000us / 0us	Ramp Time 9:00:00 / 0:00:01	Baud Rate 19200bps / 9600bps / 4800bps / 2400bps / 1200bps / 600bps / 300bps / 150bps	
	P# Jump to Preset 6 / 0	Strt Duty Cycle 100% / 0%	Setpt Ramp Enabled / Disabled	Serial Mode Computer / Human	
		Strt Duration 9999ms / 0ms	Probe Constant 10000 / 1	Service Code ????	
		Strt Pulse Enabled / Disabled	VIC 100 / 5		
		Save Strt Parameters	PIC 100 / 5		
			Voltage Scale 100 / 5		
			RF ON Clock Enabled / Disabled		
			Watts Default ####W / 0W		
			Volts Default ####V / 0V		

4.5.4 PULSING

The next field (5 characters) on the bottom line of the VFD indicates whether process or analog pulsing is enabled.

" PULSE " indicates that pulsing is enabled. A blank field indicates that pulsing is disabled.

** NOTE ** If either the RF ON CLOCK or PRESET CLOCK are enabled, both the EXT CEX and PULSE mnemonics will be replaced by the display of the appropriate timer.

4.6 ALARM AND LIMIT CONDITION MNEMONICS

When in the STATUS ENVIRONMENT and an alarm or limit condition is detected, the bottom line of the VFD will alternate between a static STATUS ENVIRONMENT line and a blinking indication of the alarm or limit detected. Alarms and limits are indicated on the VFD via mnemonics separated by spaces based upon whether or not RF is ON. The alarm and limit conditions are described below as they would appear on the bottom line of the display. A blank field indicates that the corresponding alarm is not present.

** NOTE ** When in the PROGRAMMING or SERVICE ENVIRONMENTS, alarm and limit conditions are indicated by a blinking " Alarm " message that will alternate with the static column indicator in the upper right hand corner of the VFD.

4.6.1 RF OFF ALARM AND LIMIT MNEMONICS

4.6.1.1 COVER INTERLOCK ALARM (3 SPACES)

" CVR " indicates that a cover (internal) interlock condition exists. RF will NOT turn on under the cover interlock condition.

4.6.1.2 EXTERNAL INTERLOCK ALARM (3 SPACES)

" EXT " indicates that an external interlock condition exists. This is typically used as the system interlock. RF will NOT turn on under external interlock condition.

4.6.1.3 BIAS FAILURE (4 SPACES)

" BIAS " indicates that a FET (or FETs) on at least one of the PA modules has failed to BIAS up properly (at AC on) and until that FET(s) is replaced RF will be prevented from turning ON.

4.6.1.4 FAN FAIL / TEMPERATURE / PA UNBALANCE ALARM (3 SPACES)

" FAN " indicates that the air flow within the chassis has been reduced to a low enough level that RF should be turned OFF or be prevented from turning ON.

" TMP " indicates that the PA module temperature had reached a RF shutoff threshold.

" PAU " indicates that one (or more) of the 50 AMP fuses on the interconnect board is blown. A possible cause for the blown fuse in the RF20, RF30 or RF50 power supplies might be the occurence of a substantial imbalance between the PA modules.

4.6.1.4 HIGH OR LOW LINE VOLTAGE ALARM (3 SPACES)

" HLV " indicates that the line voltage exceeds the nominal primary power tap setting by more than 5%. " LLV " indicates that the line voltage is below the nominal primary power tap setting by more than 5%. RF will NOT turn on under a high line condition.

4.6.2 RF ON ALARM AND LIMIT MNEMONICS

4.6.2.1 MAX POWER LIMIT (4 SPACES)

" MAXP " indicates that the requested forward power exceeds the programed max power limit. This means that the load power required is above the max power threshold. In voltage control it has the same meaning. The power required to develop the requested voltage is above the programed max power limit. A max power limit may also occur under reflected or PA current limit conditions.

4.6.2.2 REF LIMIT (4 SPACES)

" REFP " indicates that the generator is in reflected power limit.

4.6.2.3 PA CURRENT LIMIT (3 SPACES)

" PAC " indicates that the maximum current level has been reached in the power amplifier.

4.6.2.4 RF OUTPUT ALARM (5 SPACES)

" RFOUT " indicates a forward power compliance error. If the ratio of reflected to incident power exceeds the programed ratio, a compliance error exists. Default value is factory set for 5%.

4.7 PROGRAMMING ENVIRONMENT COLUMNS

4.7.1 ANALOG COLUMN

Analog	Enabled Disabled	--- use the ADJUSTMENT ARROWS to display the desired state of this programmable feature. Enabling Analog will permit entrance into the ANALOG control state. Disabling Analog will return the generator to the PANEL control state. Entering or leaving ANALOG control while RF is ON is NOT PERMITTED.
Control	RF Power AUXiliary RF Volts DC Volts	--- use the ADJUSTMENT ARROWS to display the desired state of this programmable feature. RF Power selects power control, while AUXiliary, RF Volts and DC Volts select the auxiliary voltage control, RF voltage control and DC voltage control terminals, respectively, as the source of feedback for voltage control. Changing control FROM THE FRONT PANEL AFTER Analog is Enabled is NOT PERMITTED.
Polarity	Positive Negative	--- use the ADJUSTMENT ARROWS to display the desired state of this programmable feature. Positive selects positive polarity over the chosen voltage range (below) for the setpoint and feedback channels. Negative selects negative polarity over the voltage range for the setpoint and feedback channels.
Voltage Range	10V 5V	--- use the ADJUSTMENT ARROWS to display the desired state of this programmable feature. 10V selects the 0 to +/- (from polarity above) 10 volt range for the setpoint and feedback channels. 5V selects the 0 to +/- (polarity) 5 volt range for the setpoint and feedback channels.
Exciter	Master Slave	--- use the ADJUSTMENT ARROWS to display the desired state of this programmable feature. Master indicates that the source of excitation for the generator comes from the internal exciter. Slave indicates that the excitation source is coming from the external excitation terminal on the rear of the generator.

Panel RF ON	Enabled Disabled	---	use the ADJUSTMENT ARROWS to display the desired state of this programmable feature. When Panel RF ON is Enabled and the generator is operating in the ANALOG state, the RF ON button on the front panel (and not the RFENABLE* analog interface pin) controls the turning ON and OFF of RF.
Panel Setpt	Enabled Disabled	---	use the ADJUSTMENT ARROWS to display the desired state of this programmable feature. When Panel Setpt is Enabled and the generator is operating in the ANALOG state, the ADJUSTMENT ARROWS on the front panel control setpoint.
RF ON & OK	Enabled Disabled	---	use the ADJUSTMENT ARROWS to display the desired state of this programmable feature. When RF ON & OK is enabled, the RFENABLED* analog interface pin will be low if and only if RF is ON AND all limit and alarm conditions indicate satisfactory operation. When RF ON & OK is disabled, the RFENABLED* pin will be low unconditionally when RF is ON. ** NOTE ** The RF ON & OK feature does not work when Presets enabled/disabled is Enabled.

4.7.2 PRESETS COLUMN

For additional information on PRESETS consult section III in this manual. Please note that PRESET PROGRAMMING is NOT PERMITTED while under ANALOG control.

Run(ning) Preset # 6 --- access to this menu entry will display
0 the presently executing preset or text
Presets Disabled indicating that presets are disabled. Use the ADJUSTMENT ARROWS to select the desired preset to execute or to disable presets. After selecting the preset to execute (or presets disabled), press the PROGRAM button to " invoke " your selection.

Pres. Clock Enabled --- use the ADJUSTMENT ARROWS to display the
Disabled desired state of this programmable feature. When enabled, the preset clock will cause the display of the CEX and PULSE mnemonic fields in the STATUS ENVIRONMENT to be replaced with the display of a preset timer. This timer will display the length of time that a programmable preset (1 - 6) has been running. It is reset to 0 each time a new programmable (1 - 6) preset is invoked. Additionally, the timer is " frozen " if RF was turned OFF while a programmable preset was executing.

Program Preset # 6 --- use the ADJUSTMENT ARROWS to display the
1 programmable preset number to program/view. Once this number has been selected, programmable preset parameters will all pertain to this preset number. (i.e. If it is desired to program/view a given parameter, the Program Preset number for that parameter must be previously selected.)

P# Control RF Power --- use the ADJUSTMENT ARROWS to display the
AUXiliary desired state of this programmable
RF Volts feature. RF Power selects power control
DC Volts for preset P# while AUXiliary, RF Volts and DC Volts select the auxiliary voltage control, RF voltage control and DC voltage control terminals, respectively, as the source of feedback for voltage control for preset P#.
** NOTE ** Changing the control mode for preset P#, automatically zeroes the setpoint parameter and disables the ramping function parameter for preset P#.

P# Ramping Enabled --- use the ADJUSTMENT ARROWS to enable or
Disabled disable the ramping function for P# under power control. If Ramping is enabled, a ramp (up or down) in power from the existing setpoint TO P# Setpoint over P# Interval will occur. If P# Ramping is disabled, the generator will RUN AT P# Setpoint for P# Interval.
** NOTE ** If the mode of control for P# is voltage control, this entry will not be displayed for P#.

P# Setpoint ####W --- use the ADJUSTMENT ARROWS to display the
####V desired setpoint level in volts or watts for preset P#.

P# Interval ##:##:## --- use the ADJUSTMENT ARROWS to select the
00:00:00 time interval for P#. If P# Ramping is enabled, the programmable interval for this preset is from 0 seconds to 9 hours and RF output will be ramped to P# Setpoint over P# Interval. If P# Ramping is disabled or operating under voltage control, the programmable interval for this preset is from 0 seconds to 18 hours, 12 minutes, 15 seconds and the generator will RUN AT P# Setpoint for P# Interval.

P# AutoSeq Enabled --- use the ADJUSTMENT ARROWS to enable or disable the automatic sequencing function for P#. If AutoSeq is enabled for P#, at the conclusion of the execution of preset P# (P# Interval timeout) the programed Jump to Preset P# will automatically begin executing. If AutoSeq is disabled for P#, upon timeout of P# Interval preset # 0 will automatically begin executing.

P# Jump to Preset 6 --- use the ADJUSTMENT ARROWS to select the
0 preset that will execute upon termination (via timeout) of the presently executing preset.
** NOTE ** If AutoSeq is disabled for P#, this entry will not be displayed.

4.7.3 PULSING COLUMN

Proc Hi Power ####W --- use the ADJUSTMENT ARROWS to display the
0W desired process pulse high power level. This level, set between 0 and RATED POWER, is the high power level for process (continuous pulse train) pulsing of the generator (Refer to Fig. 15). Process pulsing may be effected while in either serial or panel control ONLY. In analog control refer to the discourse on analog pulsing in this manual.

Proc Lo Power ####W --- use the ADJUSTMENT ARROWS to display the
0W desired process pulse low power level. This level, set between 0 and RATED POWER, is the low power level for process (continuous pulse train) pulsing of the generator (Refer to Fig. 15). Process pulsing may be effected while in either serial or panel control ONLY. In analog control refer to the discourse on analog pulsing in this manual.

Proc Hi Time 10000ms --- use the ADJUSTMENT ARROWS to display the
1ms desired process pulse high time. This time interval (in milliseconds) is the time spent at the high power level during process pulsing of the generator (Refer to Fig. 15). Process pulsing may be effected while in either serial or panel control ONLY. In analog control refer to the discourse on analog pulsing in this manual.

Proc Duty Cycle 100% --- use the ADJUSTMENT ARROWS to display the
1% desired process pulse duty cycle. This duty cycle is defined as the ratio of process pulse high time to pulse period. Process pulsing may be effected while in either serial or panel control ONLY. In analog control refer to the discourse on analog pulsing in this manual.

Proc Pulse Enabled --- use the ADJUSTMENT ARROWS to display the
            Disabled   desired state of this programmable
                        feature. When enabled with RF ON, Proc
                        Pulse will cause the generation of a
                        continuous RF power pulse train whose
                        parameters are described above (Refer to
                        Fig. 15). Process pulsing may be
                        effected while in either serial or panel
                        control ONLY. In analog control refer to
                        the manual's discourse on analog pulsing.

Save Proc Parameters --- pressing the PROGRAM button at this menu
                         entry will cause the present programed
                         values for process pulsing to be stored
                         into non-volatile memory, thus becoming
                         the " new " default values. Pressing the
                         PROGRAM button at this menu entry DOES
                         NOT return the operator to the STATUS
                         ENVIRONMENT but rather displays a
                         function performed " Finished " message.

A WORD ON PROGRAMMING START PULSE PARAMETERS

Start pulsing parameters are unique, in that, while they have individual programmable ranges, they also as a group must satisfy the formula ...

((HIGH POWER * DUTY) + LOW POWER (100 - DUTY)) <

RF5S --- 37 WATTS
RF10S --- 75 WATTS
HF10 --- 150 WATTS.
RF20 --- 150 WATTS.
RF30 --- 600 WATTS.
RF50 --- 450 WATTS.

As such, copies of the parameters are maintained while they are being programed and the copies are only stored into the actual start pulse memory locations after their group validity is verified. This verification is only performed at the ...

Strt Pulse Enabled

and

Save Strt Parameters

menu entries. If the validity check fails while attempting to program (PROGRAM button) these two entries, an " Invalid Start Params " message will be displayed for a few seconds, followed by the display returning to the original entry. If the parameters satisfy the equation the menu entry function (described on the following pages) is performed.

FIG 15 PROCESS PULSE TIMING

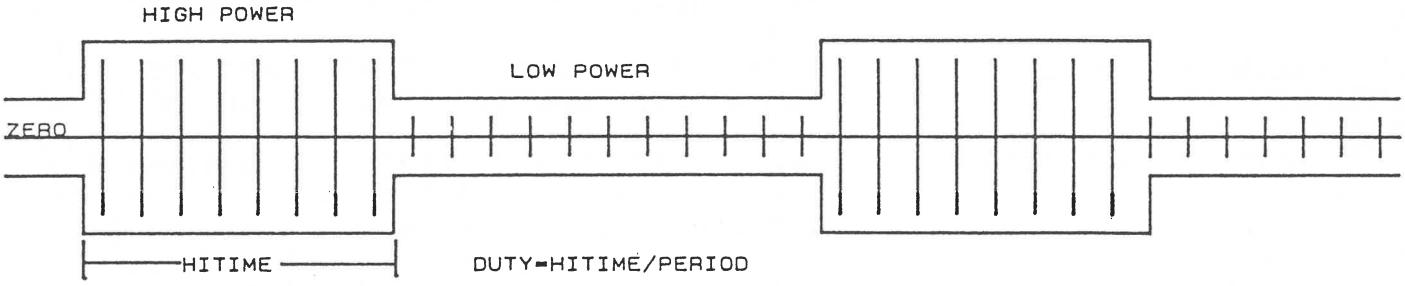
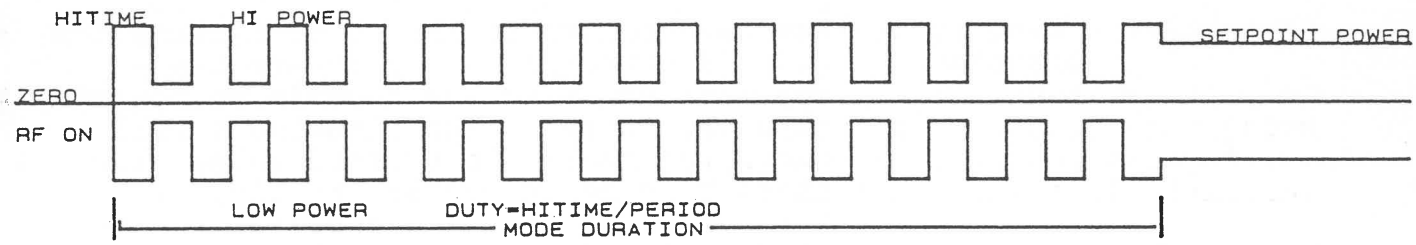


FIG 16 START PULSE TIMING



Strt Hi Power ####W
0W
--- use the ADJUSTMENT ARROWS to display the desired start pulse high power level. This level, set between 0 and RATED POWER, is the high power level for a short burst of RF power at RF ON used for ignition purposes (See Fig. 16).

Strt Lo Power ####W
0W
--- use the ADJUSTMENT ARROWS to display the desired start pulse low power level. This level, set between 0 and RATED POWER, is the low power level for a short burst of RF power at RF ON used for ignition purposes (See Fig. 16).

Strt Hi Time 10000us
1us
--- use the ADJUSTMENT ARROWS to display the desired start pulse high time. This time interval (in microseconds) is the time spent at the high power level during start pulsing of the generator (See Fig. 16).

Strt Duty Cycle 100%
1%
--- use the ADJUSTMENT ARROWS to display the desired start pulse duty cycle. This duty cycle is defined as the ratio of start pulse high time to pulse period (See Fig. 16).

Strt Duration 9999ms
0ms
--- use the ADJUSTMENT ARROWS to display the desired start pulse duration. This duration (in milliseconds) is defined as the period of time that the supply will pulse before going to setpoint (See Fig. 16).

Strt Pulse Enabled
Disabled
--- use the ADJUSTMENT ARROWS to display the desired state of this programmable feature. Pressing the PROGRAM button at this menu entry (when Enabled) will cause the present programed values for start pulsing to be checked and, if valid, the start pulse feature will be enabled for subsequent RF ON requests. Additionally, the operator will be returned to the STATUS ENVIRONMENT. If invalid, an appropriate message will be displayed.

Save Strt Parameters --- pressing the PROGRAM button at this menu entry will cause the present programed values for start pulsing (if valid) to be stored into non-volatile memory, thus becoming the " new " default values. Pressing the PROGRAM button at this menu entry DOES NOT return the operator to the STATUS ENVIRONMENT but rather displays an appropriate (validity) message.

4.7.4 OPERATE COLUMN

Max Power ####W --- use the ADJUSTMENT ARROWS to display the
0W desired maximum output power level. This power level may be set within the allowable range of 0 WATTS to ...

RF5S --- 555 WATTS
RF10S --- 1111 WATTS
HF10 --- 1111 WATTS
RF20 --- 2222 WATTS.
RF30 --- 3333 WATTS.
RF50 --- 5555 WATTS.

L: ####mv T: ####mv --- this menu entry will display the positions of the Load and Tune capacitors of the associated matching network. This is accomplished by reading 2 of the 3 voltage input channels based on the present mode of control. Refer to Installation Guide for connections procedure.

Load Preset A 5000mv --- use the ADJUSTMENT ARROWS to display the
0mv desired matching network load level for preset pair A. 2500 mv represents the midpoint of the capacitor adjustment. (See Load & Tune and Using Preset Pair below)

Tune Preset A 5000mv --- use the ADJUSTMENT ARROWS to display the
0mv desired matching network tune level for preset pair A. 2500 mv represents the midpoint of the capacitor adjustment. (See Load & Tune and Using Preset Pair below)

Load Preset B 5000mv --- use the ADJUSTMENT ARROWS to display the
0mv desired matching network load level for preset pair B. 2500 mv represents the midpoint of the capacitor adjustment. (See Load & Tune and Using Preset Pair below)

Tune Preset B 5000mv --- use the ADJUSTMENT ARROWS to display the
0mv desired matching network tune level for preset pair B. 2500 mv represents the midpoint of the capacitor adjustment. (See Load & Tune and Using Preset Pair below)

Using Preset Pair	B A	---	use the ADJUSTMENT ARROWS to display the desired matching network preset pair to use, if enabled (see Load & Tune below) as the tune and load capacitor levels. Changing the matching network preset pair to be used FROM THE FRONT PANEL AFTER Analog is Enabled is NOT PERMITTED.
Load & Tune	Enabled Disabled	---	use the ADJUSTMENT ARROWS to display the desired state of this programmable feature. Load & Tune places the generator in matching network control mode. The monitor outputs are redefined during the RF OFF period to supply control voltages (as selected by the Using Preset Pair menu entry above) for the PS2A controller. In addition, the RFENABLED* output polarity is inverted and used to place the controller in remote when RF is disabled. Thus, when RF is ON, the matching network is in automatic and the preset terminals are ignored. When RF is turned OFF, the controller goes to remote and uses the preset terminals to position the tune and load capacitors. ** NOTE ** The RF ON & OK feature does not work when presets are enabled.
Ramp Time	9:00:00 0:00:01	---	use the ADJUSTMENT ARROWS to display the desired ramp up time interval. When Ramp Up is enabled, this interval is the length of time that it will take to ramp up to setpoint at RF ON.
Setpt Ramp	Enabled Disabled	---	use the ADJUSTMENT ARROWS to display the desired state of this programmable feature. When enabled, this feature will cause a uniform ramping (up) of power to setpoint at RF ON.
Probe Constant	10000 1	---	use the ADJUSTMENT ARROWS to display the desired Probe Constant value. This value is a scaling factor that allows the display of the probe voltage when operating in voltage control. The value chosen for Probe Constant is the attenuation factor of the probe.

VIC	100 5	---	use the ADJUSTMENT ARROWS to display the desired Voltage Integration Constant value. Increasing this value from 5 slows the response of the generator when in voltage control.
PIC	100 5	---	use the ADJUSTMENT ARROWS to display the desired Power Integration Constant value. Increasing this value from 5 slows the response of the generator when in power control.
Voltage Scale	100 1	---	use the ADJUSTMENT ARROWS to display the desired Voltage Scale value. This value is a scaling factor used to accommodate alternate full scale setpoint/feedback signals. The Voltage Scale parameter should be the INTEGER UPPER BOUND of the voltage probe being used (i.e. 2.2 volt probe --- Voltage Scale = 3).
RF ON Clock	Enabled Disabled	---	use the ADJUSTMENT ARROWS to display the desired state of this programmable feature. The RF ON Timer, if enabled, will cause the length of time (in hrs:mins:secs format) RF has been ON to be displayed in place of the CEX and PULSE mnemonics on the bottom line of the VFD in the STATUS ENVIRONMENT. The RF ON Timer is reset to 0 only when RF is turned OFF. Additionally, this running timer is maintained in memory even if the RF ON Timer is disabled.
Watts Default	####W 0W	---	use the ADJUSTMENT ARROWS to display the desired default front panel wattage setpoint level. This wattage setpoint will be the default RF Power control setpoint on subsequent power-ups of the supply.
Volts Default	####V 0V	---	use the ADJUSTMENT ARROWS to display the desired default front panel voltage setpoint level. This voltage setpoint will be the default voltage control setpoint on subsequent power-ups of the supply.

4.7.5 SYSTEM COLUMN

Sensitivity	4096 0	---	use the ADJUSTMENT ARROWS to display the desired arc sensitivity (setpoint to feedback differential) that will indicate the occurrence of an arc. This differential is measured in A/D counts within the generator and may require application dependent, empirical testing to determine it's proper value. ** NOTE ** RF must be ON, the generator must be operating in voltage control and Suppression must be enabled for Arc Suppression to be functional.
Douse	4096 0	---	use the ADJUSTMENT ARROWS to display the desired incident power reduction value. When an arc is detected, the value in the incident power DAC is repetitively reduced by DOUSE until EITHER the arc is extinguished OR the minimum forward power level (SUSTAIN) is reached. This value is measured in DAC counts within the generator and may require application dependent, empirical testing to determine it's proper value. ** NOTE ** RF must be ON, the generator must be operating in voltage control and Suppression must be enabled for Arc Suppression to be functional.
Sustain	####W 0W	---	use the ADJUSTMENT ARROWS to display the desired minimum power level to reduce forward power to (without extinguishing the plasma) in the event that an arc is detected. This power level, set within the allowable range may require application dependent, empirical testing to determine it's proper value. ** NOTE ** RF must be ON, the generator must be operating in voltage control and Suppression must be enabled for Arc Suppression to be functional.
ARC Delay	32secs 1secs	---	use the ADJUSTMENT ARROWS to display the desired ARC Delay time interval. ARC Delay (when enabled --- see below) will, IF SUPPRESSION IS ENABLED AND CONTROLLING ON VOLTAGE, delay the arc suppression function for the programed time interval.

ARC Delay Enabled --- use the ADJUSTMENT ARROWS to display the
           Disabled   desired state of this programmable
                        feature. ARC Delay (when enabled) will,
                        IF SUPPRESSION IS ENABLED AND CONTROLLING
                        ON VOLTAGE, delay the arc suppression
                        function for " ARC Delay seconds " (see
                        above). This feature is used to prevent
                        the inadvertent detection of arcs while
                        setpoint is being achieved (from RF ON)
                        or after an arc has been extinguished.

Suppression Enabled --- use the ADJUSTMENT ARROWS to display the
            Disabled   desired state of this programmable
                         feature. Suppression (when enabled), IF
                         RF IS ON AND CONTROLLING ON VOLTAGE, will
                         fold back RF (DOUSE) upon detection of
                         an arc (SENSITIVITY) until a
                         programmable (SUSTAIN) power level is
                         reached in an effort to put out the arc.
                         If the arc is successfully extinguished,
                         the generator will increase the RF level
                         back to the previous setpoint.

Compliance 100% --- use the ADJUSTMENT ARROWS to display the
              1%   desired compliance alarm generation level
                      in percent. This blinking " RFOUT "
                      mnemonic alarm will be displayed in the
                      event that the ratio of reflected power
                      to incident power exceeds this
                      programmable parameter.

REF Power Alarm ###W --- use the ADJUSTMENT ARROWS to display the
                  1W   desired reflected power alarm generation
                         level within the allowable range of 1
                         WATT to ...

                                RF5S --- 37 WATTS
                                RF10S --- 75 WATTS
                                HF10 --- 150 WATTS.
                                RF20 --- 150 WATTS.
                                RF30 --- 600 WATTS.
                                RF50 --- 450 WATTS.

                         This blinking " REFP " mnemonic alarm
                         will be displayed in the event that
                         reflected power exceeds this programmable
                         parameter. THIS IS NOT A METHOD TO SET
                         THE REFLECTED POWER LIMIT. THAT LIMIT IS
                         FACTORY SET IN HARDWARE AND AS SUCH MAY
                         NOT BE MODIFIED.

Baud Rate	19200bps 9600bps 4800bps 2400bps 1200bps 600bps 300bps 150bps	--- use the ADJUSTMENT ARROWS to display the desired serial communication baud rate.
Serial Mode	Human Computer	--- use the ADJUSTMENT ARROWS to display the desired serial communication mode. HUMAN mode is generally more descriptive while COMPUTER mode is much more cryptic (See Section V for more on Serial Mode).
Service Code	????	--- use the ADJUSTMENT ARROWS to display the appropriate service code and then press the PROGRAM button. If the code is correct, entrance to the SERVICE ENVIRONMENT will be allowed.

SECTION V

SERIAL PROGRAMMING

5.1 COMMAND REFERENCE TABLE

TABLE 4

() INDICATES NUMBER OF PARAMETERS EXPECTED

The following commands are not restricted to SERIAL CONTROL.

	COMMAND		FUNCTION
REF	HUMAN	COMPUTER	
1	Q	Q	LONG FORM STATUS
2	R	R	SHORT FORM STATUS
3	SETPOINT?	SP?	RETURNS SETPOINT
4	MAX?	M?	RETURNS MAX POWER SETTING
5	WATTS?	W?	RETURNS FORWARD POWER
6	MVS?	V?	RETURNS VOLTAGE
7	DCV?	0?	READ AND DISPLAY THE VOLTAGE PRESENT ON THE DC VOLTAGE FEEDBACK CHANNEL.
8	RFV?	1?	READ AND DISPLAY THE VOLTAGE PRESENT ON THE RF VOLTAGE FEEDBACK CHANNEL.
9	AUX?	2?	READ AND DISPLAY THE VOLTAGE PRESENT ON THE AUXILIARY FEEDBACK CHANNEL.
10	REF?	R?	RETURNS REFLECTED POWER
11	CEX?	CX?	RETURNS CONTROLLING EXCITER
12	P1?	P1?	RETURNS PRESET # 1 PROGRAMED PARAMETERS
13	P2?	P2?	RETURNS PRESET # 2 PROGRAMED PARAMETERS

COMMAND REFERENCE TABLE cont.

REF	COMMAND HUMAN	COMMAND COMPUTER	FUNCTION
14	P3?	P3?	RETURNS PRESET # 3 PROGRAMED PARAMETERS
15	P4?	P4?	RETURNS PRESET # 4 PROGRAMED PARAMETERS
16	P5?	P5?	RETURNS PRESET # 5 PROGRAMED PARAMETERS
17	P6?	P6?	RETURNS PRESET # 6 PROGRAMED PARAMETERS
18	PROCESS?	CPP?	RETURNS PROCESS PULSE PARAMETERS
19	START?	CSP?	RETURNS START PULSE PARAMETERS
20	POSITION?	PS?	RETURNS MATCHING NETWORK TUNE AND LOAD CAPACITOR POSITIONS
21	PRESETS?	P?	RETURNS MATCHING NETWORK PRESET VALUES
22	PROBE?	PB?	SET DC PROBE ATTENUATION FACTOR
23	VIC?	VC?	RETURNS VOLTAGE INTEGRATION VALUE
24	PIC?	PC?	RETURNS POWER INTEGRATION VALUE
25	COMPLIANCE?	%?	RETURNS COMPLIANCE LIMIT
26	SENSE?	B?	RETURNS ARC SUPPRESSION SENSITIVITY PARAMETER
27	DOUSE?	D?	RETURNS FORWARD POWER REDUCTION GAIN UNDER ARC SUPPRESSION
28	SUSTAIN?	S?	RETURNS ARC SUPPRESSION MINIMUM POWER LEVEL
29	RESET	RESET	COLD START
30	HI	***	SERIAL CONTROL ENTRANCE

COMMAND REFERENCE TABLE cont.

REF	COMMAND HUMAN	COMMAND COMPUTER	FUNCTION
31	ELAPSED?	ELAPSED?	DISPLAY THE LENGTH OF TIME RF HAS BEEN ON.
32	VERS?	VERS?	DISPLAY THE SOFTWARE VERSION.
33	LOOP?	LOOP?	DISPLAY THE CONTROL LOOP BYPASS/USE PARAMETER.
34	DCAMPS?	DCAMPS?	READ AND DISPLAY THE DC RAIL VOLTAGE AND PA CURRENT.
35	PDIS?	PDIS?	CALCULATE AND DISPLAY THE POWER DISSIPATED PER DEVICE VALUE.
36	EFF?	EFF?	DISPLAY THE CALCULATED " EFFICIENCY " OF THE GENERATOR.
37 (1)	EXAMINE	(1) EXAMINE	PERFORM A REPETITIVE (25) DUMP OF THE 16 BYTES FROM THE GIVEN ADDRESS.
38	PWRLIM?	PWRLIM?	DISPLAY THE ABSOLUTE MAXIMUM POWER LIMIT.
39	INCFS?	INCFS?	DISPLAY THE INCIDENT POWER MONITOR FULL SCALE VALUE.
40	REFFS?	REFFS?	DISPLAY THE REFLECTED POWER MONITOR FULL SCALE VALUE.
41	SETFS?	SETFS?	DISPLAY THE ANALOG SETPOINT FULL SCALE VALUE.
42	FWDERR?	FWDERR?	DISPLAY THE DIRECTIONAL COUPLER INCIDENT POWER ERROR CORRECTION IN %.
43	REFERR?	REFERR?	DISPLAY THE DIRECTIONAL COUPLER REFLECTED POWER ERROR CORRECTION IN %.

COMMAND REFERENCE TABLE cont.

REF	COMMAND HUMAN	COMMAND COMPUTER	FUNCTION
44	DISSADJ?	DISSADJ?	DISPLAY THE PRESENT DISSIPATION ADJUSTMENT PARAMETER.
45	DISSTARG?	DISSTARG?	DISPLAY THE PRESENT DISSIPATION POWER THRESHOLD FOR FOLDBACK.
46	(1) POINT?	(1) POINT?	DISPLAY THE CONTENTS OF POINT (1) OF THE CALIBRATION TABLE.
47	POINTS?	POINTS?	DISPLAY THE TEMPORARY (POST-CALIBRATION) CALIBRATION TABLE.
48	TABLE?	TABLE?	DISPLAY THE EXISTING CALIBRATION TABLE.
49	SPECIAL?	SPECIAL?	DISPLAY THE SOFTWARE SPECIAL PARAMETER.
50	MINVOLT?	MINVOLT?	DISPLAY THE MAINTAINED VOLTAGE PARAMETER.
51	MINSETPT?	MINSETPT?	DISPLAY THE MINIMUM SETPOINT PARAMETER.

COMMAND REFERENCE TABLE cont.

The following commands will work ONLY after entering SERIAL CONTROL (See " HI " command above).

REF		COMMAND HUMAN	COMPUTER	FUNCTION
52		RFON	G	RF ON
53		RFOFF	S	RF OFF
54		ANALOG SETPOINT	ES	REAR PANEL SETPOINT
55		LOCAL SETPOINT	IS	FRONT PANEL SETPOINT
56		SERIAL SETPOINT	HS	HOST SETPOINT
57	(1)	SETMAX	M	SET MAX POWER LIMIT
58	(1)	WATTS	W	SELECT POWER SETPOINT
59	(1)	MVS	V	SELECT VOLTAGE SETPOINT
60		AUX CONTROL	XR	SELECT AUXILIARY CONTROL
61		DCV CONTROL	DR	SELECT DC VOLTAGE CONTROL
62		RFP CONTROL	IR	SELECT RF POWER CONTROL
63		RFV CONTROL	AR	SELECT RF VOLTAGE CONTROL
64		-10V RANGE	-10VR	-10 VOLT RANGE SETPOINT/FEEDBACK
65		-5V RANGE	-5VR	-5 VOLT RANGE SETPOINT/FEEDBACK
66		10V RANGE	10VR	10 VOLT RANGE SETPOINT/FEEDBACK
67		5V RANGE	5VR	5 VOLT RANGE SETPOINT/FEEDBACK
68		EXT CEX	EC	SELECT EXTERNAL EXCITER
69		INT CEX	IC	SELECT INTERNAL EXCITER
70		DISABLE RFOK	DOK	DISABLE RF ON AND NO ALARMS SIGNAL FUNCTION
71		ENABLE RFOK	EOK	ENABLE RF ON AND NO ALARMS SIGNAL FUNCTION

COMMAND REFERENCE TABLE cont.

REF		COMMAND HUMAN	COMPUTER	FUNCTION
72		DISABLE PRECLOCK	DPC	DISABLE PRESET CLOCK TIMER
73		ENABLE PRECLOCK	EPC	ENABLE PRESET CLOCK TIMER
74	(1)	RUN	RP	SELECT & ENABLE PRESET
75	(1)	DUTY	D	SET PROCESS PULSE DUTY
76	(1)	HIPOWER	HP	SET PROCESS PULSE HIPOWER
77	(1)	HITIME	HT	SET PROCESS PULSE HITIME
78	(1)	LOPOWER	LP	SET PROCESS PULSE LOPOWER
79	(4)	PP	PP	SET ALL PROCESS PULSE PARAMETERS
80		+P	+P	ENABLE PROCESS PULSE
81		-P	-P	DISABLE PROCESS PULSE
82		SAVE	SAV	SAVE PROCESS PULSE PARAMETERS
83		RECALL	REC	RECALL PROCESS PULSE PARAMETERS
84	(5)	SP	SP	SET ALL START PULSE PARAMETERS
85		+S	+S	ENABLE START PULSE
86		-S	-S	DISABLE START PULSE
87	(1)	MP1	MP1	SET MATCHING PRESET A TUNE CAPACITOR
88	(1)	MP2	MP2	SET MATCHING PRESET A LOAD CAPACITOR
89	(1)	MP3	MP1	SET MATCHING PRESET B TUNE CAPACITOR
90	(1)	MP4	MP2	SET MATCHING PRESET B LOAD CAPACITOR
91	(1)	PAIR	PAIR	SELECT MATCHING NETWORK PRESET PAIR TO USE

COMMAND REFERENCE TABLE cont.

REF		COMMAND HUMAN	COMPUTER	FUNCTION
92		DISABLE PRESETS	DP	DISABLE MATCHING NETWORK PRESETS FUNCTION
93		ENABLE PRESETS	EP	ENABLE MATCHING NETWORK PRESETS FUNCTION
94	(1)	UPRAMP	UP	SET UP RAMPING TIME INTERVAL
95		DISABLE UPRAMPING	DU	DISABLE UP RAMPING
96		ENABLE UPRAMPING	EU	ENABLE UP RAMPING
97	(1)	PROBE	PB	SET DC PROBE ATTENUATION FACTOR
98	(1)	VIC	VIC	SET VOLTAGE CONTROL LOOP INTEGRATION CONSTANT
99	(1)	PIC	PIC	SET POWER CONTROL LOOP INTEGRATION CONSTANT
100	(1)	VSCALE	VS	SET VOLTAGE SETPOINT SCALE CONSTANT
101		DISABLE RFCLOCK	DRC	DISABLE RF ON TIMER
102		ENABLE RFCLOCK	ERC	ENABLE RF ON TIMER
103	(1)	SENSE	AB	SET ARC SUPPRESSION SENSITIVITY PARAMETER
104	(1)	DOUSE	AD	SET FORWARD POWER REDUCTION GAIN UNDER ARC SUPPRESSION
105	(1)	SUSTAIN	AS	SET ARC SUPPRESSION MINIMUM POWER LEVEL
106		DISABLE SUPPRESSION	DAS	DISABLE ARC SUPPRESSION
107		ENABLE SUPPRESSION	EAS	ENABLE ARC SUPPRESSION
108	(1)	ARCDELAY	AD	SET ARC DELAY INTERVAL
109		DISABLE DELAYING	DD	DISABLE ARC DELAY
110		ENABLE DELAYING	ED	ENABLE ARC DELAY

COMMAND REFERENCE TABLE cont.

REF		COMMAND HUMAN	COMPUTER	FUNCTION
111	(1)	COMPLIANCE	%	SET ALARM THRESHOLD FOR RF OUTPUT
112		BYE	BYE	EXIT SERIAL CONTROL

*** DISCLAIMER ***

THE FOLLOWING COMMANDS ARE TO BE USED BY QUALIFIED RF PLASMA PRODUCTS SERVICE PERSONNEL ONLY.

THEY MAY NOT BE USED BY ANYONE OTHER THAN SAID PERSONNEL EXCEPT WITH THE EXPRESS PERMISSION OF RF PLASMA PRODUCTS, Inc.

USE OF THESE COMMANDS BY ANYONE OTHER THAN RFPP SERVICE PERSONNEL, WITHOUT EXPRESS PERMISSION FROM RF PLASMA PRODUCTS, Inc., IS A VIOLATION OF THE UNIT'S WARRANTY.

COMMAND REFERENCE TABLE cont.

	COMMAND			FUNCTION
REF	HUMAN		COMPUTER	
113	(1) VERSION	(1)	VERSION	SELECTS GENERATOR TYPE.
114	PACURRENT		PACURRENT	SET THE PACURRENT SOFTWARE ALARM.
115	DISABLE POT		DPOT	DISABLES SOFTWARE CONTROL LOOP.
116	ENABLE POT		EPOT	ENABLES SOFTWARE CONTROL LOOP.
117	(1) PWRLIM	(1)	PWRLIM	SET ABSOLUTE MAXIMUM POWER LIMIT.
118	(1) INCFS	(1)	INCFS	SET THE INCIDENT MONITOR FULL SCALE VALUE.
119	(1) REFFS	(1)	REFFS	SET THE REFLECTED MONITOR FULL SCALE VALUE.
120	(1) SETFS	(1)	SETFS	SET THE ANALOG SETPOINT FULL SCALE VALUE.
121	(1) FWDERR	(1)	FWDERR	SET THE DIRECTIONAL COUPLER INCIDENT POWER CORRECTION (IN %).
122	(1) REFERR	(1)	REFERR	SET THE DIRECTIONAL COUPLER REFLECTED POWER CORRECTION (IN %).
123	(1) DISSADJ	(1)	DISSADJ	SET THE DISSIPATION ADJUSTMENT PARAMETER.
124	(1) DISSTARG	(1)	DISSTARG	SET THE DISSIPATION POWER THRESHOLD FOR FOLDBACK.

COMMAND REFERENCE TABLE cont.

REF		COMMAND HUMAN		COMMAND COMPUTER	FUNCTION
125		CALIBRATE		CALIBRATE	CALIBRATES THE GENERATOR'S CALIBRATION TABLE.
126	(1)	CALPOINT	(1)	CALPOINT	CALIBRATES ONE POINT IN THE GENERATOR'S CALIBRATION TABLE.
127	(2)	CALRANGE	(2)	CALRANGE	CALIBRATES A RANGE OF POINTS IN THE GENERATOR'S CALIBRATION TABLE.
128	(2)	POINT	(2)	POINT	STORE POWER LEVEL IN TEMPORARY CALIBRATION TABLE LOCATION.
129		SAVEPOINTS		SAVEPOINTS	STORES TEMPORARY CALIBRATION TABLE INTO PERMANENT CALIBRATION TABLE.
130	(2)	SETMON	(2)	SETMON	SETS MATCHING NETWORK PRESETS AND MONITOR OUTPUTS CORRECTION FACTOR.
131	(1)	SET1ST	(1)	SET1ST	SETS ANALOG SETPOINT CORRECTION FACTOR.
132	(1)	SETRFB	(1)	SETRFB	SETS REMOTE FEEDBACK CORRECTION FACTOR.
133	(1)	SETVLT	(1)	SETVLT	SETS DC RAIL VOLTAGE CORRECTION FACTOR.
134	(1)	SETPAC	(1)	SETPAC	SETS PA CURRENT CORRECTION FACTOR.
135	(1)	SPECIAL	(1)	SPECIAL	SELECTS SOFTWARE SPECIAL.
136		MINVOLT		MINVOLT	SET THE MAINTAINED VOLTAGE PARAMETER.
137		MINSETPT		MINSETPT	SET THE MINIMUM SETPOINT PARAMETER.

5.2 DETAILED COMMAND DESCRIPTIONS

BY REFERENCE NUMBER AS SHOWN IN COMMAND REFERENCE TABLE.

In human mode a valid serial command will be acknowledged with the execution of the command and the transmission of a [reprompt] (either " <cr> <cr> hi " or " <cr> <cr> Command> "). An invalid command will cause the transmission of an appropriate error message and a [reprompt].

In computer mode a valid serial command will be acknowledged with the execution of the command and a [reprompt] (" <cr> "). An invalid command will cause the transmission of the letter " N " and a [reprompt].

1) Q — is the long form of the generator status command. While computer and human modes of the this command transmit essentially the same information, their respective forms vary greatly. The HUMAN mode version of Q will display forward power or bias voltage, reflected power, setpoint (in watts or volts, max power setting, mode of control (power or voltage), operational mode (panel, analog or serial), the selection of an external controlling exciter, process pulsing indication and all alarm conditions.

example: hi Q <cr>

might yield: <cr> <cr> Fwd 1200W Ref 1W
<cr> <cr> Set 1200W Max 2000W
<cr> <cr> RFP PANEL
<cr> <cr> HIGH LINE VOLTAGE ALARM [reprompt]

Q — is the same command when operating in COMPUTER mode. The COMPUTER mode Q returns the same 7 byte character code as described in the COMPUTER mode R command described below and, in addition, returns forward power or bias voltage, reflected power, setpoint (in watts or volts) and the max power setting.

example: <cr> Q <cr>

might yield: XXXXXXX AAAA BBBB CCC DDDD [reprompt]

where XXXXXXX is the 7 character ASCII described below in " R " .
AAAA is setpoint in watts or voltage.
BBBB is incident power in watts.
CCC is reflected power in watts.
DDDD is maximum power in watts.

2) R — is the short form of the generator status command. While computer and human modes of the this command transmit essentially the same information, their respective forms vary greatly. The HUMAN mode version of R will display forward power or bias voltage, reflected power, setpoint (in watts or volts, max power setting and an indication of any alarm conditions (AOK = none, NOK = at least one).

example: hi R <cr>

might yield: <cr> <cr> Fwd 400W Ref 0W
<cr> <cr> Set 400W Max 500W NOK

R — is the same command when operating in COMPUTER mode. The difference between is that in COMPUTER mode a 7 character ASCII string is transmitted instead of the " friendly " textual response in HUMAN mode.

The seven character ASCII string (hex 30 to 3F) is encoded as follows:

CHAR #	INDICATES	SPECIFICS
1	MODE	2 = SERIAL , 1 = ANALOG 0 = PANEL
2	CONTROL	3 = RF POWER , 2 = RF VOLTAGE 1 = DC VOLTAGE , 0 = AUX VOLTAGE
3	SETPOINT	2 = SERIAL , 1 = ANALOG 0 = PANEL

CHAR #	BIT 3	BIT 2	BIT 1	BIT 0
4	RFON	REF LIM	MAXPWR LIM	PA CURR LIM
5	RFOK/RDY		EXT CEX	RF GATE
6	TEMP	CVR INTLK	EXT INTLK	
7	RF OUTPUT	HI LINE	LO LINE	

example: <cr> R <cr>

might yield: 2328900 <cr>

indicating SERIAL MODE, RF POWER CONTROL, SERIAL SETPOINT, RF is ON, NO ALARMS are present and PULSING is in effect.

3) SETPOINT? returns the present setpoint in watts or volts based on the means of control, power or voltage.

example: hi SETPOINT? <cr>

might yield: <cr> <cr> Set 750W [reprompt]

or if under voltage control it might result in ...

<cr> <cr> Set 1.500V [reprompt]

SP? is the same command when operating in COMPUTER mode.

example: <cr> SP? <cr>

might yield: 750 [reprompt]

4) MAX? will return the present maximum power limit in watts.

example: hi MAX? <cr>

might yield: <cr> <cr> Max Power 500W [reprompt]

M? is the same command when operating in COMPUTER mode.

example: <cr> M? <cr>

might yield: 500 [reprompt]

5) WATTS? returns the present forward power (provided the generator is in power control) of the unit in watts.

example: hi WATTS? <cr>

might yield: <cr> <cr> Fwd 1800W [reprompt]

W? is the same command when operating in COMPUTER mode.

example: <cr> W? <cr>

might yield: 1800 [reprompt]

(note: if in voltage control and a WATTS? or W? request is made, the directional coupler will be read and the wattage calculation will be returned)

6) MVS? will return the present bias voltage feedback reading in volts for the present mode of voltage control.

Assuming a negative polarity, a 1000 to 1 probe and a 1 volt setpoint ...

example: hi MVS? <cr>

might yield: <cr> <cr> Vlt- 1000V [reprompt]

V? is the same command when operating in COMPUTER mode.

example: <cr> V? <cr>

might yield: - 1000 [reprompt]

7) DCV? assuming an appropriate voltage probe is connected, will return the present bias voltage feedback reading (in volts) at the DC Voltage control input channel.

Assuming that an appropriate probe is connected to the DC Volt input on the rear panel ...

example: hi DCV? <cr>

might yield: <cr> <cr> - 1000V [reprompt]

0? is the same command when operating in COMPUTER mode.

example: <cr> 0? <cr>

might yield: - 1000 [reprompt]

8) RFV? assuming an appropriate voltage probe is connected, will return the present bias voltage feedback reading (in volts) at the RF Voltage control input channel.

Assuming that an appropriate probe is connected to the RF Volt input on the rear panel ...

example: hi RFV? <cr>

might yield: <cr> <cr> - 500V [reprompt]

1? is the same command when operating in COMPUTER mode.

example: <cr> 1? <cr>

might yield: - 500 [reprompt]

9) AUX? assuming an appropriate voltage probe is connected, will return the present bias voltage feedback reading (in volts) at the AUX Voltage control input channel.

Assuming that an appropriate probe is connected to the AUX Volt input on the rear panel ...

example: hi AUX? <cr>

might yield: <cr> <cr> 2000V [reprompt]

2? is the same command when operating in COMPUTER mode.

example: <cr> 2? <cr>

might yield: 2000 [reprompt]

10) REF? returns the present reflected power in watts.

example: hi REF? <cr>

might yield: <cr> <cr> Ref 2W [reprompt]

R? is the same command when operating in COMPUTER mode.

example: <cr> R? <cr>

might yield: 2 [reprompt]

11) CEX? will indicate if the internal exciter is controlling excitation or acting as a " slave " to an external controlling exciter.

example: hi CEX? <cr>

might yield: <cr> <cr> Exciter Master [reprompt]

CX? is the same command when operating in COMPUTER mode.

example: <cr> CX? <cr>

might yield: 0 [reprompt] (note: 0 = Master, 1 = Slave)

12) P1? will return the present programed parameters for preset # 1.

example: hi P1? <cr>

might yield:
```
<cr> <cr> P2 Control RF Power
<cr> <cr> P2 Setpoint     400W
<cr> <cr> P2 Interval  0:01:00
<cr> <cr> P2 Ramping  Enabled
<cr> <cr> P2 AutoSeq  Disabled  [reprompt]
```

P1? is the same command when operating in COMPUTER mode.

example: <cr> P1? <cr>

might yield: 3 400 60 1 0 [reprompt]

13) P2? will return the present programed parameters for preset # 2. Operation is the same as 9).

14) P3? will return the present programed parameters for preset # 3. Operation is the same as 9).

15) P4? will return the present programed parameters for preset # 4. Operation is the same as 9).

16) P5? will return the present programed parameters for preset # 5. Operation is the same as 9).

17) P6? will return the present programed parameters for preset # 6. Operation is the same as 9).

18) PROCESS? returns the 4 programed process pulse parameters.

example: hi PROCESS? <cr>

might yield: <cr> <cr> Proc Hi Power 500W
<cr> <cr> Proc Low Power 50W
<cr> <cr> Proc Hi Time 100ms
<cr> <cr> Proc Duty Cycle 10% [reprompt]

CPP? is the same command when operating in COMPUTER mode.

example: <cr> CPP? <cr>

might yield: 500 50 100 10 [reprompt]

19) START? returns the 5 programed start pulse parameters.

example: hi START? <cr>

might yield: <cr> <cr> Strt Hi Power 500W
<cr> <cr> Strt Low Power 0W
<cr> <cr> Strt Hi Time 100us
<cr> <cr> Strt Duty Cycle 10%
<cr> <cr> Strt Duration 300ms [reprompt]

CPP? is the same command when operating in COMPUTER mode.

example: <cr> CSP? <cr>

might yield: 500 0 100 10 300 [reprompt]

20) POSITION? returns (in order) the matching network tune and load capacitor positions.

example: hi POSITION? <cr>

might yield: <cr> <cr> T: 2555mv L: 2450mv [reprompt]

PS? is the same command when operating in COMPUTER mode.

example: <cr> PS? <cr>

might yield: 2555 2450 [reprompt]

21) PRESETS? returns the programed matching network preset pair tune and load values in millivolts, an indication as to which preset pair is to be used and an indication as to whether or not the presets are enabled.

example: hi PRESETS? <cr>

might yield: <cr> <cr> Tune Preset A 2500mv
<cr> <cr> Load Preset A 3000mv
<cr> <cr> Tune Preset B 1200mv
<cr> <cr> Load Preset B 2200mv
<cr> <cr> Using Preset Pair A
<cr> <cr> Presets Disabled [reprompt]

P? is the same command when operating in COMPUTER mode.

example: <cr> P? <cr>

might yield: 2500 3000 1200 2200 0 0 [reprompt]

(note: 0 = preset pair A, 1 = preset pair B)

(note: 0 = disabled, 1 = enabled)

22) PROBE? returns the DC probe attenuation factor. This factor is used in voltage control to display the correct bias voltage level (with RF ON) at the panel and when queried serially.

example: hi PROBE? <cr>

might yield: <cr> <cr> Probe Constant 200 [reprompt]

Indicating that a DC probe with an attenuation factor of 200:1 (like the standard AM-10 DC probe) is thought to be in use.

PB? is the same command when operating in COMPUTER mode.

example: <cr> PB? <cr>

might yield: 200 [reprompt]

23) VIC? returns the present value for the voltage control loop integration constant. This constant is used to speed up (low value) or slow down (high value) the voltage control loop.

example: hi VIC? <cr>

might yield: <cr> <cr> VIC 5 [reprompt]

VC? is the same command when operating in COMPUTER mode.

example: <cr> VC? <cr>

might yield: 5 [reprompt]

24) PIC? returns the present value for the power control loop integration constant. This constant is used to speed up (low value) or slow down (high value) the power control loop.

example: hi PIC? <cr>

might yield: <cr> <cr> PIC 5 [reprompt]

PC? is the same command when operating in COMPUTER mode.

example: <cr> PC? <cr>

might yield: 5 [reprompt]

25) COMPLIANCE? will return the programed ratio of reflected power to incident power (in percent) that when detected will trigger a reflected power output alarm.

example: hi COMPLIANCE? <cr>

might yield: <cr> <cr> Compliance 5% [reprompt]

%? is the same command when operating in COMPUTER mode.

example: <cr> %? <cr>

might yield: 5 [reprompt]

26) SENSE? returns the present arc sensitivity parameter for arc suppression. This parameter is the differential between the setpoint and feedback signals required for the software to detect an arc.

example: hi SENSE? <cr>

might yield: <cr> <cr> Sense 80 [reprompt]

B? is the same command when operating in COMPUTER mode.

example: <cr> B? <cr>

might yield: 80 [reprompt]

27) DOUSE? will return the present forward power foldback gain in arc suppression. Each time the unit detects an arc, forward power is reduced by this (DAC counts) amount.

example: hi DOUSE? <cr>

might yield: <cr> <cr> Douse 100 [reprompt]

D? is the same command when operating in COMPUTER mode.

example: <cr> D? <cr>

might yield: 100 [reprompt]

28) SUSTAIN? returns the present minimum power level during arc suppression parameter. RF will not fold back beyond this point.

example: hi SUSTAIN? <cr>

might yield: <cr> <cr> Sustain 40W [reprompt]

S? is the same command when operating in COMPUTER mode.

example: <cr> S? <cr>

might yield: 40 [reprompt]

29) RESET — is the " cold start " command for the unit.

example: hi RESET <cr>

The unit will respond with a power on reset and the appropriate, human or computer, prompt.

RESET — is the same command when operating in COMPUTER mode.

example: <cr> RESET <cr>

The unit will respond with a power on reset and the appropriate, human or computer, prompt.

30) HI — is the password for entrance into serial control of the generator. It permits the use of commands 16 through 61. RF must be OFF and analog control must be disabled for entrance into serial control.

example: hi HI <cr>

might yield: <cr> <cr> Command>

*** — is the same command when operating in COMPUTER mode.

example: <cr> *** <cr>

might yield: <cr>

COMPUTER mode but with RF ON

example: <cr> *** <cr>

will yield: N [reprompt]

31) ELAPSED? — returns the length of time RF has been ON since RF was last turned ON.

example: hi ELAPSED? <cr>

might yield: <cr> <cr> hhh:mm:ss [reprompt]

ELAPSED? — is the same command when operating in COMPUTER mode.

example: <cr> ELAPSED?

might yield: <cr> <cr> hhh:mm:ss [reprompt]

32) VERS? returns the software version residing in the unit.

example: hi VERS? <cr>

might yield: <cr> <cr> RF1025 V2.6 [reprompt]

VERS? is the same command when operating in COMPUTER mode.

example: <cr> VERS?

might yield: <cr> <cr> RF1025 V2.6 [reprompt]

33) LOOP? returns the state of the programmable software control loop use/bypass flag.

example: hi LOOP? <cr>

might yield: <cr> <cr> Use Control Loop [reprompt]

LOOP? is the same command when operating in COMPUTER mode.

example: <cr> LOOP?

might yield: <cr> <cr> Bypass Control Loop [reprompt]

34) DCAMPS? returns the DC rail voltage and PA current amperage level of the generator.

example: hi DCAMPS? <cr>

might yield: <cr> <cr> DCV 49.1V PAC 9.7A [reprompt]

DCAMPS? is the same command when operating in COMPUTER mode.

example: <cr> DCAMPS?

might yield: <cr> <cr> DCV 50.2V PAC 7.2A [reprompt]

35) PDIS? returns the power dissipated per device within the generator.

example: hi PDIS? <cr>

might yield: <cr> <cr> Dissip/Device 65.0W [reprompt]

PDIS? is the same command when operating in COMPUTER mode.

example: <cr> PDIS?

might yield: <cr> <cr> Dissip/Device 67.7W [reprompt]

36) EFF? returns the calculated line to load efficiency of the generator in percent.

example: hi EFF? <cr>

might yield: <cr> <cr> Efficiency 42.6% [reprompt]

EFF? is the same command when operating in COMPUTER mode.

example: <cr> EFF?

might yield: <cr> <cr> Efficiency 28.0W [reprompt]

37) EXAMINE performs a 25 iteration " dump " (in hexadecimal) of the 16 bytes of memory beginning at the supplied address. After each dump iteration a carriage return is performed.

example: hi 8192 EXAMINE <cr>

might yield: <cr> <cr>

(25 times) 2000 C8 02 AA 73 B5 C3 03 00 00 00 08 92 C3 B5 71 52

[reprompt]

EXAMINE is the same command when operating in COMPUTER mode.

example: hi 8192 EXAMINE <cr>

might yield: <cr> <cr>

(25 times) 2000 C8 02 AA 73 B5 C3 03 00 00 00 08 92 C3 B5 71 52

[reprompt]

38) PWRLIM? returns the absolute maximum power that the generator will be allowed to produce. This level is the upper bound for MAX POWER setting (see PROGRAMMING ENVIRONMENT).

example: hi PWRLIM? <cr>

might yield: <cr> <cr> Power Limit 2222W [reprompt]

PWRLIM? is the same command when operating in COMPUTER mode.

example: <cr> PWRLIM? <cr>

might yield: <cr> <cr> Power Limit 555W [reprompt]

39) INCFS? returns the programmable Incident Monitor full scale output parameter.

example: hi INCFS? <cr>

might yield: <cr> <cr> Inc Monitor FS 2000W [reprompt]

INCFS? is the same command when operating in COMPUTER mode.

example: <cr> INCFS? <cr>

might yield: <cr> <cr> Inc Monitor FS 500W [reprompt]

40) REFFS? returns the programmable Reflected Monitor full scale output parameter.

example: hi REFFS? <cr>

might yield: <cr> <cr> Ref Monitor FS 200W [reprompt]

REFFS? is the same command when operating in COMPUTER mode.

example: <cr> REFFS? <cr>

might yield: <cr> <cr> Ref Monitor FS 50W [reprompt]

41) SETFS? returns the programmable Analog Setpoint full scale input parameter.

example: hi SETFS? <cr>

might yield: <cr> <cr> Setpoint FS 500W [reprompt]

SETFS? is the same command when operating in COMPUTER mode.

example: <cr> SETFS? <cr>

might yield: <cr> <cr> Setpoint FS 2000W [reprompt]

42) FWDERR? returns the signed programmable Incident power correction parameter for the directional coupler (in percent).

example: hi FWDERR? <cr>

might yield: <cr> <cr> Fwd Error - 0.0% [reprompt]

FWDERR? is the same command when operating in COMPUTER mode.

example: <cr> FWDERR? <cr>

might yield: <cr> <cr> Fwd Error - 0.0% [reprompt]

43) REFERR? returns the signed programmable Reflected power correction parameter for the directional coupler (in percent).

example: hi REFERR? <cr>

might yield: <cr> <cr> Ref Error - 0.0% [reprompt]

REFERR? is the same command when operating in COMPUTER mode.

example: <cr> REFERR? <cr>

might yield: <cr> <cr> Ref Error - 0.0% [reprompt]

44) DISSADJ? returns the programmable amount (in counts) to reduce MAX POWER by in the event that DEVICE OVERDISSIPATION is detected. Each control loop cycle OVERDISSIPATION is detected, MAX POWER is reduced by this amount until setpoint is indirectly limited (setpoint cannot exceed MAX POWER when attempting to deliver RF). Recovery from OVERDISSIPATION is affected by increasing MAX POWER by 1/10 of DISSADJ? (counts) each control cycle that OVERDISSIPATION is NOT detected.

example: hi DISSADJ? <cr>

might yield: <cr> <cr> Dissip Adjust 400 [reprompt]

DISSADJ? is the same command when operating in COMPUTER mode.

example: <cr> DISSADJ? <cr>

might yield: <cr> <cr> Dissip Adjust 400 [reprompt]

45) DISSTARG? returns the programmable power dissipation level which, if exceeded, indicates that the software is detecting DEVICE OVERDISSIPATION in the unit. Each control loop cycle OVERDISSIPATION is detected, MAX POWER is reduced by DISSADJ? (counts) until setpoint is indirectly limited (setpoint cannot exceed MAX POWER when attempting to deliver RF). Recovery from OVERDISSIPATION is affected by increasing MAX POWER by 1/10 of DISSADJ? (counts) each control cycle that OVERDISSIPATION is NOT detected.

example: hi DISSTARG? <cr>

might yield: <cr> <cr> Dissip Target 110W [reprompt]

DISSTARG? is the same command when operating in COMPUTER mode.

example: <cr> DISSTARG? <cr>

might yield: <cr> <cr> Dissip Target 110W [reprompt]

46) POINT? returns the calibration table power value for the supplied index. The index must be between 0 and 64 inclusive.

example: hi 10 POINT? <cr>

might yield: <cr> <cr> Point 10 is 115W [reprompt]

POINT? is the same command when operating in COMPUTER mode.

example: <cr> 10 POINT? <cr>

might yield: <cr> <cr> Point 10 is 34W [reprompt]

47) POINTS? displays the contents of the temporary calibration table.

example: hi POINTS? <cr>

might yield:
```
<cr> <cr>  p1  p2  p3  p4  p5  p6  p7  p8
<cr> <cr>  .   .   .   .   .   .   .   .
<cr> <cr>  .   .   .   .   .   .   .   .
<cr> <cr>  p57 p58 p59 p60 p61 p62 p63 p64
[reprompt]
```

POINTS? is the same command when operating in COMPUTER mode.

example: <cr> POINTS? <cr>

might yield:
```
<cr> <cr>  p1  p2  p3  p4  p5  p6  p7  p8
<cr> <cr>  .   .   .   .   .   .   .   .
<cr> <cr>  .   .   .   .   .   .   .   .
<cr> <cr>  p57 p58 p59 p60 p61 p62 p63 p64
[reprompt]
```

48) TABLE? displays the contents of the calibration table that resides in non-volatile memory.

```
example:     hi TABLE? <cr>

might yield: <cr> <cr>  p1  p2  p3  p4  p5  p6  p7  p8
             <cr> <cr>  .   .   .   .   .   .   .   .
             <cr> <cr>  .   .   .   .   .   .   .   .
             <cr> <cr>  p57 p58 p59 p60 p61 p62 p63 p64
             [reprompt]
```

TABLE? is the same command when operating in COMPUTER mode.

```
example:     <cr> TABLE?

might yield: <cr> <cr>  p1  p2  p3  p4  p5  p6  p7  p8
             <cr> <cr>  .   .   .   .   .   .   .   .
             <cr> <cr>  .   .   .   .   .   .   .   .
             <cr> <cr>  p57 p58 p59 p60 p61 p62 p63 p64
             [reprompt]
```

49) SPECIAL? returns the software special, if any (0 = none), that is enabled in the unit.

```
example:     hi SPECIAL? <cr>

might yield: <cr> <cr> Software Special   0  [reprompt]
```

SPECIAL? is the same command when operating in COMPUTER mode.

```
example:     <cr> SPECIAL?

might yield: <cr> <cr> Software Special   1  [reprompt]
```

50) MINVOLT? returns the maintained counts value that will be written to the hardware in order to " maintain " a plasma in the event that setpoint is reduced rather than RF turned OFF at the end of a process cycle. See " Maintained Cts " parameter in Section VI.

example: hi MINVOLT? <cr>

might yield: <cr> <cr> Maintained Cts 0 [reprompt]

MINVOLT? is the same command when operating in COMPUTER mode.

example: <cr> MINVOLT?

might yield: <cr> <cr> Maintained Cts 100 [reprompt]

51) MINSETPT? returns the minimum setpoint (in counts) value that is required to produce RF. Any setpoint below this level will be treated as zero setpoint. See " Minimum Counts " parameter in Section VI.

example: hi MINSETPT? <cr>

might yield: <cr> <cr> Minimum Counts 100 [reprompt]

MINSETPT? is the same command when operating in COMPUTER mode.

example: <cr> MINSETPT?

might yield: <cr> <cr> Minimum Counts 50 [reprompt]

52) RFON — is the command to turn RF power on.

example: Command> RFON <cr>

G — is the same command when operating in COMPUTER mode.

example: <cr> G <cr>

53) RFOFF — is the command to turn RF off.

example: Command> RFOFF <cr>

S — is the same command when operating in COMPUTER mode.

example: <cr> S <cr>

54) ANALOG SETPOINT — selects the rear panel as the source of the setpoint.

example: Command> ANALOG SETPOINT <cr>

ES — is the same command when operating in COMPUTER mode.

example: <cr> ES <cr>

55) LOCAL SETPOINT — selects the front panel as the source of the setpoint.

example: Command> LOCAL SETPOINT <cr>

IS — is the same command when operating in COMPUTER mode.

example: <cr> IS <cr>

56) SERIAL SETPOINT — selects the serial interface as the source of the setpoint.

example: Command> SERIAL SETPOINT <cr>

HS — is the same command when operating in COMPUTER mode.

example: <cr> HS <cr>

57) SETMAX — is the command to modify the maximum power limit in watts.

example: Command> 500 SETMAX <cr>

M — is the same command when operating in COMPUTER mode.

example: <cr> 500 M <cr>

58) WATTS — is the serial control POWER setpoint command. This command will work ONLY if the generator is operating in power control AND the setpoint value is BELOW the maximum power setting.

example: Command> 500 WATTS <cr>

W — is the same command when operating in COMPUTER mode.

example: <cr> 500 W <cr>

59) MVS — is the voltage setpoint command. The user enters a value (in millivolts) that corresponds to the desired electrode voltage referred to the probe output.

Assuming a system utilizing a 200:1 voltage probe, the operator wishes to operate his system at 400 VOLTS DC. The voltage setpoint is therefore equal to 400/200 or 2.0 Volts (2000 millivolts).

example: Command> 2000 MVS <cr>

V — is the same command when operating in COMPUTER mode.

example: <cr> 2000 V <cr>

60) AUX CONTROL — selects the auxiliary voltage control terminal as the source of feedback for voltage control.

example: Command> AUX CONTROL <cr>

XR — is the same command when operating in COMPUTER mode.

example: <cr> XR <cr>

61) DCV CONTROL — selects the DC voltage control terminal as the source of feedback for voltage control.

example: Command> DCV CONTROL <cr>

DR — is the same command when operating in COMPUTER mode.

example: <cr> DR <cr>

62) RFP CONTROL — selects power control.

example: Command> RFP CONTROL <cr>

IR — is the same command when operating in COMPUTER mode.

example: <cr> IR <cr>

63) RFV CONTROL — selects the RF voltage control terminal as the source of feedback for voltage control.

example: Command> RFV CONTROL <cr>

AR — is the same command when operating in COMPUTER mode.

example: <cr> AR <cr>

64) -10V RANGE — selects NEGATIVE polarity AND 0 to -10 volt range for the setpoint and feedback channels.

example: Command> -10V RANGE <cr>

-10VR — is the same command when operating in COMPUTER mode.

example: <cr> -10VR <cr>

65) -5V RANGE — selects NEGATIVE polarity AND 0 to -5 volt range for the setpoint and feedback channels.

example: Command> -5V RANGE <cr>

-5VR — is the same command when operating in COMPUTER mode.

example: <cr> -5VR <cr>

66) 10V RANGE — selects POSITIVE polarity AND 0 to 10 volt range for the setpoint and feedback channels.

example: Command> 10V RANGE <cr>

10VR — is the same command when operating in COMPUTER mode.

example: <cr> 10VR <cr>

67) 5V RANGE — selects POSITIVE polarity AND 0 to 5 volt range for the setpoint and feedback channels.

example: Command> 5V RANGE <cr>

5VR — is the same command when operating in COMPUTER mode.

example: <cr> 5VR <cr>

68) EXT CEX — selects the external exciter terminal on the rear panel as the source of excitation. The excitation source MAY NOT be changed with RF ON.

example: Command> EXT CEX <cr>

Same as previous but with RF ON ...

example: Command> EXT CEX <cr>

The unit will respond with an appropriate error message followed by a [reprompt].

EC — is the same command when operating in COMPUTER mode.

example: <cr> EC <cr>

69) INT CEX — selects the external exciter terminal on the rear panel as the source of excitation. The excitation source MAY NOT be changed with RF ON.

example: Command> INT CEX <cr>

Same as previous but with RF ON ...

example: Command> INT CEX <cr>

The unit will respond with an appropriate error message followed by a [reprompt].

IC — is the same command when operating in COMPUTER mode.

example: <cr> IC <cr>

70) DISABLE RFOK — disables the RF ON and OK function. When this function is disabled, RFENABLED* on the rear panel interface is low unconditionally when RF is ON.

example: Command> DISABLE RFOK <cr>

DOK — is the same command when operating in COMPUTER mode.

example: <cr> DOK <cr>

71) ENABLE RFOK — enables the RF ON and OK function. When this function is enabled, RFENABLED* is low only if RF is ON AND all limit and alarm conditions indicate satisfactory operation.

example: Command> ENABLE RFOK <cr>

EOK — is the same command when operating in COMPUTER mode.

example: <cr> EOK <cr>

72) DISABLE PRECLOCK — will disable the display of the preset timer. (see PRESETS section in this manual)

example: Command> DISABLE PRECLOCK <cr>

DPC — is the same command when operating in COMPUTER mode.

example: <cr> DPC <cr>

73) ENABLE PRECLOCK — will enable the display of the preset timer. (see PRESETS section in this manual)

example: Command> ENABLE PRECLOCK <cr>

EPC — is the same command when operating in COMPUTER mode.

example: <cr> EPC <cr>

74) RUN — is the serial command to enable AND begin execution of the given preset. (See PRESETS section in this manual)

example: Command> P1 RUN <cr>

will cause PRESET # 1 to be enabled AND start executing.

RUN — is the same command when operating in COMPUTER mode.

example: <cr> P6 RUN <cr>

will cause PRESET # 6 to be enabled AND start executing.

75) DUTY — sets the duty cycle of the serial or panel process pulse mode. Duty is defined as the ratio of HITIME to pulse period.

example: Command> 10 DUTY <cr>

D — is the same command when operating in COMPUTER mode.

example: <cr> 10 D <cr>

76) HIPOWER — is the command to select the serial or panel process pulse high power level in watts.

example: Command> 500 HIPOWER <cr>

HP — is the same command when operating in COMPUTER mode.

example: <cr> 500 HP <cr>

77) HITIME — is the command to set the serial or panel process pulse high time in milliseconds.

example: Command> 100 HITIME <cr>

HT — is the same command when operating in COMPUTER mode.

example: <cr> 100 HT <cr>

78) LOPOWER — is the command to select the serial or panel process pulse low power level in watts.

example: Command> 50 LOPOWER <cr>

LP — is the same command when operating in COMPUTER mode.

example: <cr> 50 LP <cr>

79) PP — programs the serial or panel process pulse mode parameters with a single command. Process pulsing allows the user to program a continuous pulse train The following four parameters IN ORDER are needed to configure the process pulse.

HIPOWER,	in watts	(ex. 500)
LOPOWER,	in watts	(ex. 100)
HITIME,	in milliseconds	(ex. 10)
DUTY,	in percent.	(ex. 50)

example: Command> 500 100 10 50 PP <cr>

PP — is the same command when operating in COMPUTER mode.

example: <cr> 500 100 10 50 PP <cr>

80) +P — enables serial process pulsing. (See description of PULSING in this manual)

example: Command> +P <cr>

+P — is the same command when operating in COMPUTER mode.

example: <cr> +P <cr>

81) -P — disables serial process pulsing. (See description of PULSING in this manual)

example: Command> -P <cr>

-P — is the same command when operating in COMPUTER mode.

example: <cr> -P <cr>

82) SAVE — will copy the present process pulse parameters from RAM to non-volatile RAM. Once in non-volatile RAM, these parameters become the default parameters on power-up.

example: Command> SAVE <cr>

SAV — is the same command when operating in COMPUTER mode.

example: <cr> SAV <cr>

83) RECALL — will cause the process pulse parameters stored in non-volatile RAM to be copied into volatile RAM. This allows a set of process pulse parameters to be changed (with RF ON) with a single command while process pulsing is occurring.

example: Command> RECALL <cr>

REC — is the same command when operating in COMPUTER mode.

example: <cr> REC <cr>

84) SP — programs the start pulse parameters. Start pulsing allows the user to program a burst of RF, which will occur at an RF start command, without the accustomed limits. The following five parameters IN ORDER are needed to configure the start pulse.

```
HIPOWER,  in watts         ( ex. 500 )
LOPOWER,  in watts         ( ex.   0 )
HITIME,   in microseconds  ( ex. 100 )
DUTY,     in percent.      ( ex.  10 )
DURATION, in milliseconds  ( ex. 300 )
```

example: Command> 500 0 100 10 300 SP <cr>

SP — is the same command when operating in COMPUTER mode.

example: <cr> 500 100 10 50 SP <cr>

85) +S — enables start pulsing. (See description of START PULSING in this manual)

example: Command> +S <cr>

+S — is the same command when operating in COMPUTER mode.

example: <cr> +S <cr>

86) -S — disables start pulsing. (See description of START PULSING in this manual)

example: Command> -S <cr>

-S — is the same command when operating in COMPUTER mode.

example: <cr> -S <cr>

87) MP1 is the command to set the matching network preset pair A TUNE capacitor position. The range is 0 to 4999 millivolts, with 2500 representing the midpoint of the capacitor adjustment

example: Command> 2500 MP1 <cr>

MP1 is the same command when operating in COMPUTER mode.

example: <cr> 2500 MP1 <cr>

88) MP2 is the command to set the matching network preset pair A LOAD capacitor position. The range is 0 to 4999 millivolts, with 2500 representing the midpoint of the capacitor adjustment

example: Command> 2500 MP2 <cr>

MP2 is the same command when operating in COMPUTER mode.

example: <cr> 2500 MP2 <cr>

89) MP3 is the command to set the matching network preset pair B TUNE capacitor position. The range is 0 to 4999 millivolts, with 2500 representing the midpoint of the capacitor adjustment

example: Command> 1200 MP3 <cr>

MP3 is the same command when operating in COMPUTER mode.

example: <cr> 1200 MP3 <cr>

90) MP4 is the command to set the matching network preset pair B LOAD capacitor position. The range is 0 to 4999 millivolts, with 2500 representing the midpoint of the capacitor adjustment

example: Command> 2200 MP4 <cr>

MP4 is the same command when operating in COMPUTER mode.

example: <cr> 2200 MP4 <cr>

91) PAIR — is the command to select which matching network preset pair is to be used as the the matching network TUNE and LOAD capacitor positions when matching network presets are enabled.

example: Command> 0 PAIR <cr>

... and preset pair A will be selected.

PAIR — is the same command when operating in COMPUTER mode.

example: <cr> 1 PAIR <cr>

... and preset pair B will be selected.

92) DISABLE PRESETS — will disable the matching network pretune function (see ENABLE PRESETS below).

example: Command> DISABLE PRESETS <cr>

DP — is the same command when operating in COMPUTER mode.

example: <cr> DP <cr>

93) ENABLE PRESETS — will enable the matching network pretune function. With this function enabled, the generator can control the preset position of the load and tune capacitors of the AM-10 series automatic matching network. This allows the system to pretune to the optimum ignition condition with RF off, assuring a minimum tune time once RF has been enabled. In this mode the monitor outputs are used to supply a preset voltage for the network controller when RF is off. When RF is turned on, the monitors become incident and reflected monitors again. The RFENABLED* status output is used to enable the PS2A network controller pretune process.

example: Command> ENABLE PRESETS <cr>

EP — is the same command when operating in COMPUTER mode.

example: <cr> EP <cr>

94) UPRAMP — will program the up ramping time interval (up to 9 hours). This function, when enabled, permits a linear increase in power over a given time interval from either 0 watts (RF off) to setpoint. Each control loop cycle the power/millisecond increment is recalculated based on the (new) setpoint. i.e. The generator will constantly attempt to ramp to setpoint even if the setpoint changes. This function, when enabled, is invoked at RF on.

example: Command> 60 UPRAMP <cr>

... and a 1 minute linear ramp up interval will be programed or

example: Command> 14400 UPRAMP <cr>

... and a 4 hour linear ramp up interval will be programed.

UP — is the same command when operating in COMPUTER mode.

example: <cr> 60 UP <cr>

95) DISABLE UPRAMPING — disables the up ramping function. This function, when enabled, permits a linear increase in power over a given time interval from either 0 watts (RF off) to setpoint. Each control loop cycle the power/millisecond increment is recalculated based on the (new) setpoint. i.e. The generator will constantly attempt to ramp to setpoint even if the setpoint changes. This function, when enabled, is invoked at RF on.

example: Command> DISABLE UPRAMPING <cr>

DU — is the same command when operating in COMPUTER mode.

example: <cr> DU <cr>

96) ENABLE UPRAMPING — enables the up ramping function. This function, when enabled, permits a linear increase in power over a given time interval from either 0 watts (RF off) to setpoint. Each control loop cycle the power/millisecond increment is recalculated based on the (new) setpoint. i.e. The generator will constantly attempt to ramp to setpoint even if the setpoint changes. This function, when enabled, is invoked at RF on.

example: Command> ENABLE UPRAMPING <cr>

EU — is the same command when operating in COMPUTER mode.

example: <cr> EU <cr>

97) PROBE — will set the scale factor that will ensure the correct display of electrode voltage. The number that is entered is the attenuation factor of the voltage probe.

Assuming a standard AM-10 DC probe which is 200:1 ...

example: Command> 200 PROBE <cr>

PB — is the same command when operating in COMPUTER mode.

example: <cr> 200 PB <cr>

98) VIC — is the voltage control loop constant. Increasing this constant from 5 slows the response of the unit in voltage control.

example: Command> 10 VIC <cr>

VIC — is the same command when operating in COMPUTER mode.

example: <cr> 10 VIC <cr>

99) PIC — is the power control loop constant. Increasing this constant from 5 slows the response of the unit in power control.

example: Command> 10 PIC <cr>

PIC — is the same command when operating in COMPUTER mode.

example: <cr> 10 PIC <cr>

100) VSCALE — sets the scaling factor used to accommodate alternate full scale setpoint/feedback signals. The VSCALE parameter should be the INTEGER UPPER BOUND of the voltage probe being used (i.e. 2.2 volt probe --- Voltage Scale = 3).

example: Command> 3 VSCALE <cr>

VS — is the same command when operating in COMPUTER mode.

example: <cr> 3 VS <cr>

101) DISABLE RFCLOCK — will disable the display of the RF ON timer. This timer keeps track of the length of time RF has been ON and is maintained even though its display may be disabled.

example: Command> DISABLE RFCLOCK <cr>

DRC — is the same command when operating in COMPUTER mode.

example: <cr> DRC <cr>

102) ENABLE RFCLOCK — will disable the display of the RF ON timer. This timer keeps track of the length of time RF has been ON and is maintained even though its display may be disabled.

example: Command> ENABLE RFCLOCK <cr>

ERC — is the same command when operating in COMPUTER mode.

example: <cr> ERC <cr>

103) SENSE — sets the arc sensitivity parameter for arc suppression. This parameter is the differential between the setpoint and feedback signals required for the software to detect an arc.

example: Command> 80 SENSE <cr>

AB — is the same command when operating in COMPUTER mode.

example: <cr> AB <cr>

104) DOUSE — sets the forward power foldback gain in arc suppression. Each time the unit detects an arc, forward power is reduced by this (DAC counts) amount.

example: Command> 100 DOUSE <cr>

AD — is the same command when operating in COMPUTER mode.

example: <cr> 100 AD <cr>

105) SUSTAIN — sets the minimum power level during arc suppression parameter. RF will not fold back beyond this point.

example: Command> 60 SUSTAIN <cr>

AS — is the same command when operating in COMPUTER mode.

example: <cr> 60 AS <cr>

106) DISABLE SUPPRESSION — disables the arc suppression feature. This feature, when enabled, will fold RF back (limited by SUSTAIN) DOUSE DAC counts each control loop cycle, if it is determined that the differential between the setpoint and feedback readings is greater than SENSE.

example: Command> DISABLE SUPPRESSION <cr>

DAS — is the same command when operating in COMPUTER mode.

example: <cr> DAS <cr>

107) ENABLE SUPPRESSION — enables the arc suppression feature. This feature, when enabled, will fold RF back (limited by SUSTAIN) DOUSE DAC counts each control loop cycle, if it is determined that the differential between the setpoint and feedback readings is greater than SENSE.

example: Command> ENABLE SUPPRESSION <cr>

EAS — is the same command when operating in COMPUTER mode.

example: <cr> EAS <cr>

108) ARCDELAY — is the command to set the delay (in milliseconds) that is to occur while setpoint is ramping up and arc suppression is enabled. This delay prevents the inadvertent detection of arcs while setpoint is ramping. Arc delaying must also be enabled for this delay to occur.

example: Command> 5000 ARCDELAY <cr>

AD — is the same command when operating in COMPUTER mode.

example: <cr> 5000 AD <cr>

109) DISABLE DELAYING — disables the arc delay function. This function causes a delay (in ms), ARCDELAY to occur while setpoint is ramping up and arc suppression is enabled. This delay prevents the inadvertent detection of arcs while setpoint is ramping.

example: Command> DISABLE DELAYING <cr>

DD — is the same command when operating in COMPUTER mode.

example: <cr> DD <cr>

110) ENABLE DELAYING — enables the arc delay function. This function causes a delay (in ms), ARCDELAY to occur while setpoint is ramping up and arc suppression is enabled. This delay prevents the inadvertent detection of arcs while setpoint is ramping.

example: Command> ENABLE DELAYING <cr>

ED — is the same command when operating in COMPUTER mode.

example: <cr> ED <cr>

111) COMPLIANCE — will set the reflected power to forward power ratio threshold for the reflected power output alarm indicator.

example: Command> 5 COMPLIANCE <cr>

% — is the same command when operating in COMPUTER mode.

example: <cr> 5 % <cr>

112) BYE — is the command to exit from serial control of the generator. It returns programmable control of the generator to the front panel. RF must be OFF to exit from serial control.

example: Command> BYE <cr>

will yield: <cr> <cr> hi

BYE — is the same command when operating in COMPUTER mode.

example: <cr> BYE <cr>

will yield: <cr>

Same as previous but with RF ON ...

example: <cr> BYE <cr>

will yield: N <cr>

*** DISCLAIMER ***

THE FOLLOWING COMMANDS ARE TO BE USED BY QUALIFIED RF PLASMA PRODUCTS SERVICE PERSONNEL ONLY.

THEY MAY NOT BE USED BY ANYONE OTHER THAN SAID PERSONNEL EXCEPT WITH THE EXPRESS PERMISSION OF RF PLASMA PRODUCTS, Inc.

USE OF THESE COMMANDS BY ANYONE OTHER THAN RFPP SERVICE PERSONNEL, WITHOUT EXPRESS PERMISSION FROM RF PLASMA PRODUCTS, Inc., IS A VIOLATION OF THE UNIT'S WARRANTY.

113) VERSION — is the command to select the type of generator that the software resides in.

example: Command> RF5S VERSION <cr>

VERSION — is the same command when operating in COMPUTER mode.

example: <cr> RF20 VERSION <cr>

114) PACURRENT — sets the PA current software alarm level. Issue this command with RF ON at the level that it is desired that the PAC alarm indication should occur. ** NOTE ** This PA Current Limit setting DOES NOT affect the HARDWARE PA Current Limit, but merely serves as a PA Current LEVEL indicator.

example: Command> PACURRENT <cr>

PACURRENT — is the same command when operating in COMPUTER mode.

example: <cr> PACURRENT <cr>

115) DISABLE POT — will enable the software control loop in the generator should it have been previously disabled by the ENABLE POT command below. Disabling POT causes the generator to operate as it was shipped by " USE "ing the control loop. See Section VI on the SERVICE ENVIRONMENT.

example: Command> DISABLE POT <cr>

DPOT — is the same command when operating in COMPUTER mode.

example: <cr> DPOT <cr>

116) ENABLE POT — will disable the software control loop. To test a hardware function without " interference " from the software, issue the ENABLE POT command. See Section VI on the SERVICE ENVIRONMENT.

example: Command> ENABLE POT <cr>

EPOT — is the same command when operating in COMPUTER mode.

example: <cr> EPOT <cr>

117) PWRLIM — sets the absolute maximum power that the generator will be allowed to produce. This level is the upper bound for MAX POWER setting (see PROGRAMMING ENVIRONMENT).

example: Command> 555 PWRLIM <cr>

PWRLIM — is the same command when operating in COMPUTER mode.

example: <cr> 2222 PWRLIM <cr>

118) INCFS — sets the programmable Incident Monitor full scale output parameter.

example: Command> 500 INCFS <cr>

INCFS — is the same command when operating in COMPUTER mode.

example: <cr> 2000 INCFS <cr>

119) REFFS — sets the programmable Reflected Monitor full scale output parameter.

example: Command> 50 REFFS <cr>

REFFS — is the same command when operating in COMPUTER mode.

example: <cr> 200 REFFS <cr>

120) SETFS — sets the programmable Analog Setpoint full scale input parameter.

example: Command> 5000 SETFS <cr>

SETFS — is the same command when operating in COMPUTER mode.

example: <cr> 1000 SETFS <cr>

121) FWDERR — sets the signed programmable Incident power correction parameter for the directional coupler (in percent). The allowable range for this parameter is -12.5% to 12.5% but the percentage should be entered as a whole number.

example: Command> 52 FWDERR <cr>

will yield: a 5.2% Incident power correction factor.

FWDERR — is the same command when operating in COMPUTER mode.

example: <cr> -103 FWDERR <cr>

will yield: a -10.3% Incident power correction factor.

122) REFERR — sets the signed programmable Reflected power correction parameter for the directional coupler (in percent). The allowable range for this parameter is -12.5% to 12.5% but the percentage should be entered as a whole number.

example: Command> -11 REFERR <cr>

will yield: a -1.1% Reflected power correction factor.

REFERR — is the same command when operating in COMPUTER mode.

example: <cr> 97 REFERR <cr>

will yield: a 9.7% Reflected power correction factor.

123) DISSADJ — sets the programmable amount (in counts) to reduce MAX POWER by in the event that DEVICE OVERDISSIPATION is detected. Each control loop cycle OVERDISSIPATION is detected, MAX POWER is reduced by this amount until setpoint is indirectly limited (setpoint cannot exceed MAX POWER when attempting to deliver RF). Recovery from OVERDISSIPATION is affected by increasing MAX POWER by 1/10 of DISSADJ? (counts) each control cycle that OVERDISSIPATION is NOT detected.

example: Command> 400 DISSADJ <cr>

DISSADJ? — is the same command when operating in COMPUTER mode.

example: <cr> 500 DISSADJ <cr>

124) DISSTARG — sets the programmable power dissipation level which, if exceeded, indicates that the software is detecting DEVICE OVERDISSIPATION in the unit. Each control loop cycle OVERDISSIPATION is detected, MAX POWER is reduced by DISSADJ? (counts) until setpoint is indirectly limited (setpoint cannot exceed MAX POWER when attempting to deliver RF). Recovery from OVERDISSIPATION is affected by increasing MAX POWER by 1/10 of DISSADJ? (counts) each control cycle that OVERDISSIPATION is NOT detected.

example: Command> 100 DISSTARG <cr>

DISSTARG — is the same command when operating in COMPUTER mode.

example: <cr> 110 DISSTARG <cr>

125) CALIBRATE — will calibrate the entire (64 point) temporary calibration table. As each point is calibrated, prompts to enter power levels and normalizing messages are displayed. Termination of calibration is indicated by a " Max Counts " message and remaining uncalibrated points are approximated. For more on calibration see Section VI.

example: Command> CALIBRATE <cr>

CALIBRATE — is the same command when operating in COMPUTER mode.

example: <cr> CALIBRATE <cr>

126) CALPOINT — will calibrate a given point in the temporary calibration table. As the point is calibrated, a prompt to enter power level and normalizing message is displayed. Termination of calibration is indicated by a " Max Counts " message and remaining uncalibrated points are approximated.
For more on calibration see Section VI.

example: Command> 5 CALPOINT <cr>

will yield: the calibration of point 5 in the temporary table.

CALPOINT — is the same command when operating in COMPUTER mode.

example: <cr> 12 CALPOINT <cr>

will yield: the calibration of point 10 in the temporary table.

127) CALRANGE — will calibrate a range of points in the temporary calibration table. As each point is calibrated, prompts to enter power levels and normalizing messages are displayed. Termination of calibration is indicated by a " Max Counts " message and remaining uncalibrated points are approximated. For more on calibration see Section VI.

example: Command> 1 16 CALRANGE <cr>

will yield: the calibration of points 1 through 16 in the temporary table.

CALRANGE — is the same command when operating in COMPUTER mode.

example: <cr> 32 35 CALRANGE <cr>

will yield: the calibration of points 32 through 35 in the temporary table.

128) POINT — stores power level in temporary calibration table index location.

example: Command> 35 10 POINT <cr>

will yield: 35 watts stored in point # 10 of the temporary table.

POINT — is the same command when operating in COMPUTER mode.

example: <cr> 5 1 POINT <cr>

will yield: 5 watts stored in point # 1 of the temporary table.

129) SAVEPOINTS — is the command to save the temporary calibration table into non-volatile memory. Once the calibration is saved thusly, it becomes the new calibration table for the generator. Ensure that the temporary table is correct (see POINTS? command) before issuing a SAVEPOINTS command.

example: Command> SAVEPOINTS <cr>

SAVEPOINTS — is the same command when operating in COMPUTER mode.

example: <cr> SAVEPOINTS <cr>

130) SETMON — given the existing and desired (in order) monitor output voltages expressed in millivolts, SETMON will automatically calculate the monitor output correction factor. For more on correction factors consult Section VI in this manual.
** NOTE ** This parameter is factory set and SHOULD NOT require adjustment in the field.

example: Command> 4950 5000 SETMON <cr>

SETMON — is the same command when operating in COMPUTER mode.

example: <cr> 2875 3000 SETMON <cr>

131) SET1ST — given the existing analog voltage setpoint expressed in millivolts, SET1ST will automatically calculate the analog setpoint correction factor. For more on correction factors consult Section VI in this manual.
** NOTE ** This parameter is factory set and SHOULD NOT require adjustment in the field.

example: Command> 4000 SET1ST <cr>

SET1ST — is the same command when operating in COMPUTER mode.

example: <cr> 4500 SET1ST <cr>

132) SETRFB — given the existing analog feedback signal expressed in millivolts, SETRFB will automatically calculate the analog feedback correction factor. For more on correction factors consult Section VI in this manual.
** NOTE ** This parameter is factory set and SHOULD NOT require adjustment in the field.

example: Command> 2000 SETRFB <cr>

SETRFB — is the same command when operating in COMPUTER mode.

example: <cr> 4000 SETRFB <cr>

133) SETVLT — given the existing nominal line voltage to tenths of an Volt expressed as a whole number, SETVLT will automatically calculate the DC rail voltage correction factor. For more on correction factors consult Section VI in this manual.
** NOTE ** This parameter is factory set and SHOULD NOT require adjustment in the field.

example: Command> 505 SETVLT <cr>

will yield: the calculation of the DC rail voltage correction factor at 50.5 volts.

SETVLT — is the same command when operating in COMPUTER mode.

example: <cr> 500 SETVLT <cr>

will yield: the calculation of the DC rail voltage correction factor at 50.0 volts.

134) SETPAC — given the existing PA current (SETPAC should be issued at around 30 Amps) to tenths of an Amp expressed as a whole number, SETPAC will automatically calculate the PA current correction factor. For more on correction factors consult Section VI in this manual.
** NOTE ** This parameter is factory set and SHOULD NOT require adjustment in the field.

example: Command> 300 SETPAC <cr>

will yield: the calculation of the PA current correction factor at 30.0 Amps.

SETPAC — is the same command when operating in COMPUTER mode.

example: <cr> 300 SETPAC <cr>

will yield: the calculation of the PA current correction factor at 30.0 Amps.

135) SPECIAL — sets the software special, if any (0 = none), that is to be invoked in the unit. For more on Software Specials, consult the factory.

example: Command> 1 SPECIAL <cr>

SPECIAL — is the same command when operating in COMPUTER mode.

example: <cr> 0 SPECIAL <cr>

136) MINVOLT — sets the PRESENT contents of the hardware DAC (power port) as the maintained counts value that will be written to the hardware in order to " maintain " a plasma in the even that setpoint is reduced rather than RF turned OFF at the end of a process cycle. See " Maintained Cts " parameter in Section VI.

example: Command> MINVOLT <cr>

MINVOLT — is the same command when operating in COMPUTER mode.

example: <cr> MINVOLT <cr>

137) MINSETPT — sets PRESENT voltage setpoint as the minimum setpoint (in counts) value that is required to produce RF. Any setpoint below this level will be treated as zero setpoint. See " Minimum Counts " parameter in Section VI.

example: Command> MINSETPT <cr>

MINSETPT — is the same command when operating in COMPUTER mode.

example: <cr> MINSETPT <cr>

SECTION VI

FRONT PANEL SERVICING OF THE GENERATOR

*** DISCLAIMER ***

THE SERVICE ENVIRONMENT IS TO BE ACCESSED BY QUALIFIED RF PLASMA PRODUCTS SERVICE PERSONNEL ONLY.

THE SERVICE ENVIRONMENT IS NOT TO BE ENTERED BY ANYONE OTHER THAN SAID PERSONNEL EXCEPT WITH THE EXPRESS PERMISSION OF RF PLASMA PRODUCTS, Inc.

ENTRANCE INTO THE SERVICE ENVIRONMENT BY ANYONE OTHER THAN RFPP SERVICE PERSONNEL, WITHOUT EXPRESS PERMISSION FROM RF PLASMA PRODUCTS, Inc., IS A VIOLATION OF THE UNIT'S WARRANTY.

6.1 INTRODUCTION

While occasional servicing of the your RF Plasma Products generator would (in the past) entail removing the unit's cover, there does exist a service and diagnostic capability from the front panel. By using the menu found in this SERVICE ENVIRONMENT, the problem with the generator may be isolated to a given area, thereby speeding up servicing and reducing down time in the field.

In addition periodic, routine calibration of the unit with a trusted wattmeter may be performed from within the SERVICE ENVIRONMENT.

6.2 ACCESS AND EXIT

At the bottom of the PROGRAMMING ENVIRONMENT SYSTEM COLUMN is found the menu entry ...

Service Code 0000

Upon reaching the above entry, the ADJUSTMENT ARROWS will increase or decrease the numeric (0 - 9999) code value.

Access to the SERVICE ENVIRONMENT through the front panel is effected by entering the correct (up to) four digit code and pressing the PROGRAM button.

At this point you will be prompted as to whether or not you wish to remain in the SERVICE ENVIRONMENT by ...

Leave Service Menu

Pressing the PROGRAM button will return you to the bottom of the PROGRAMMING ENVIRONMENT SYSTEM COLUMN. Pressing the RIGHT ARROW button will take you to the top of the SERVICE ENVIRONMENT MININIT COLUMN.

To exit from the SERVICE ENVIRONMENT return to the top of the SERVICE ENVIRONMENT MININIT COLUMN and press the LEFT ARROW button. At the " Leave " prompt press the PROGRAM button to exit or the RIGHT ARROW button to remain in the SERVICE ENVIRONMENT.

TABLE 5

SERVICE ENVIRONMENT COLUMNS

MININIT COLUMN	FETBias COLUMN	MONITOR COLUMN	POWER COLUMN	SPECIAL COLUMN
Leave Service Menu				
Generator is a RF50 RF30 RF20 HF10 RF10S RF5S	No Biasing Errors Failed FET A#Q# A1Q1 ...	Use Control Loop Bypass	Power Limit ####W 0W	Set MATCH Correction
				[Adjust Out To 1.000V]
Initialize Cal-Table	Calibrate All FETs	DCV ##.#V PAC ##.##A	Inc Monitor FS ####W 0W	Set SETPT Correction
		Dissip/Device ###.#W		[Adjust In To 1.000V]
Store Default Params	Calibrate FET A#Q# A1Q1	[DRV ###.#V DD ###.#W]	Ref Monitor FS ####W 0W	Set RFB Correction
				[Adjust In To 1.000V]
Air Cooled Supply Water	Save FET Bias Levels	[Heatsink Temp ##.#]	Setpoint FS ####W 0W	Calibrate All Points
		Efficiency ##.#%		Calibrate Range
Over Temp Alarm 100 1		Dump Address FFFFh 0000h	Fwd Error 12.5% -12.5%	Calibrate Point
				Point ## is ####W
Nominal Line 65.0V 40.0V		FFFF ## ## ## ## ## 0000	Ref Error 12.5% -12.5%	[Point ## Power ####W]
				Save Points
Set Line Correction		Target Address FFFFh 0000h	Dissip Target 200W 25W	Soft Special A 32767 -32768
[Adjust to Rail ##.#V]				
		FFFFh contains ####h 0000h	Dissip Adjust 4096 0	Soft Special B 32767 -32768
Set PAC Correction				
			Ignition Limit ####W 0W	Minimum Counts 4096 0
[Turn RF ON to nnA]				
			Coil Cool 0:01:00 0:00:00	Maintained Cts 4096 0
[Adjust to nnA ##.##A]				
				Panel Password 32767 -32768
Set PA Current Limit				

6.3 MOVEMENT WITHIN THE SERVICE ENVIRONMENT

INTER-COLUMN movement in the SERVICE ENVIRONMENT is controlled by the OPTIONS button. The sequence being ...

MININIT --> FETBIAS --> MONITOR --> POWER --> SPECIAL --> MININIT

INTRA-COLUMN movement is controlled by the LEFT (up the column) and RIGHT (down the column) ARROW buttons.

Refer to the GENERAL INFORMATION section of this manual for more on movement.

6.4 PROGRAMMING PARAMETERS WITHIN THE SERVICE ENVIRONMENT

Unless otherwise specified parameter programming in the SERVICE ENVIRONMENT is accomplished using the ADJUSTMENT ARROWS.

Refer to the GENERAL INFORMATION section of this manual for more on parameter programming.

6.5 RF ON AND OFF IN THE SERVICE ENVIRONMENT

RF may be turned OFF at ANY time while in the SERVICE ENVIRONMENT. In addition, while in the SPECIAL COLUMN, turning RF OFF will terminate the calibration of the point in the table being calibrated.

RF may be turned ON at any time while in the SERVICE ENVIRONMENT, provided that no alarms or interlocks are present. Caution should be exercised when doing this due to the fact that " descriptive " alarm messages are not displayed while in the SERVICE ENVIRONMENT and service personnel are only alerted to a problem by a blinking " ALARM " message in the upper right corner of the display.

** NOTE **
RF does go ON during calibration (SPECIAL COLUMN) of the generator, but the ON function is controlled by pressing the PROGRAM button (at the menu entry) to perform the task and NOT by the RF ON button.

6.6 COLUMNS

6.6.1 MININIT COLUMN

Generator is a ????? --- selects the " type " of generator. In effect service personnel can " tell " the software what " type " of generator it is in. This " type " parameter is used in calculating default power levels, power limits and other generator dependent parameters. Upon completion of the programming of this parameter a " Finished " message will be displayed.

Water Cooled Supply Air --- selects the method of heat sink cooling used in a given power supply. This parameter will dictate the temperature threshold for " TMP " alarms. Upon completion of the programming of this parameter a " Finished " message will be displayed.

Initialize Cal-Table --- when the PROGRAM key is pressed at this entry a (re)initialization of the non-volatile RAM calibration table is performed. The remaining non-volatile parameters are NOT affected by this. This initialization allows the service personnel to make power with the unit although the accustomed accuracy (post-calibration) will not be seen. Upon completion of the programming of this parameter a " Finished " message will be displayed.
** CAUTION **
If the generator has been previously calibrated, pressing the PROGRAM button at this point will cause the prior Calibration Table parameters to be overwritten.

Store Default Params --- when the PROGRAM key is pressed at this entry a (re)initialization of part of the non-volatile RAM is performed. The calibration table is NOT affected by this. This initialization allows the service personnel to perform some basic functions and set up the generator for the customer. Upon completion of the programming of this parameter the " Finished " message will be displayed.
** CAUTION **
If the generator has been previously initialized, pressing the PROGRAM button at this point will cause the default parameters to be overwritten.

Air Cooled Supply Water --- selects whether or not the power supply's primary cooling means is via air or water circulation. An air cooled supply that is operating with insufficient air flow will generate a " FAN " alarm. Water cooled supplies cannot generate such an alarm.

Over Temp Alarm 100 1 --- selects the heatsink centigrade temperature RF OFF threshold. If the power supply senses a heatsink temperature in excess of this threshold, a " TMP " alarm will be generated and RF will be shut OFF and not allowed to be turned ON until sufficient cooling of the heatsink has occurred.

Nominal Line 65.0V 40.0V --- selects the nominal line voltage for the generator based on the taps settings. Low and high line voltage alarms use this line voltage as a base line voltage as triggers. Upon completion of the programming of this parameter the " Finished " message will be displayed.

Set Line Correction --- while reading the DC line voltage at ...

RF5S --- Rear Screw Terminal E1
RF10S --- F1 on the Interconnect Board
HF10 --- F1 on the Interconnect Board
RF20 --- F1 on the Interconnect Board
RF30 --- F1 on the Interconnect Board
RF50 --- Any Fuse on the DC Fuse Block

... pressing the PROGRAM button will allow service personnel to correct for MINOR variations that occur during the reading of the line voltage channel.

Adjust to Rail ##.#V --- use the ADJUSTMENT ARROWS to alter the displayed DC line voltage until it matches the existing (measured above) DC line setting. Pressing the PROGRAM button at this point will store the line voltage correction factor (gain adjustment). The Low and High Line Voltage Alarm parameters (5% below and 5% above FACTORY SET NOMINAL) are NOT affected by this function.

GENERATOR	FACTORY SET NOMINAL DC
RF5S	58 Volts
RF10S	50.5 Volts
HF10	55 Volts
RF20	50 Volts
RF30	47.5 Volts
RF50	49 Volts

Pressing of the PROGRAM button will also return the service personnel to the previous menu entry (above).
** NOTE **
RF will not be allowed to go ON with a HIGH LINE VOLTAGE ALARM.

Set PAC Correction --- pressing the PROGRAM button at this menu entry will allow service personnel to correct variations that occur during the reading of the PA current channel.

Turn RF ON to nnA --- Connect a voltmeter to one of the following ...

(1) RF5S across R42 on the PA module
(2) RF10S or HF10 across J4 pins 1 and 2 on the Interconnect Board
(3) RF20 or RF30 (1st PA --- see Note) across J4 pins 1 and 2 on the Interconnect Board
(4) RF50 (1st PA --- see Note) across J14 pins 1 and 2 on the Interconnect Board

The meter shunt values are (1) .0125 Ohms and (2 & 3) .01 Ohms. Turn RF ON and increase forward power until either ...

RF5S --- .188 VDC (15 AMPS)
All others --- .30 VDC (30 Amps)

is displayed on the voltmeter. At this point press the PROGRAM button.

*** Note *** As each PA is calibrated (all 8 FETs), the meter must be moved to different Interconnect Board pins to calibrate subsequent PAs.

Pins	PA 2	PA 3	PA 4	PA 5	PA 6
RF20	3,4				
RF30	3,4	35,37			
RF50	3,4	5,6	7,8	9,10	11,12

Adjust to nnA ##.#A --- using the ADJUSTMENT ARROWS increase or decrease the displayed amperes until it matches the measured (voltmeter) amperes (RF5S 15A -- RF10S, HF10, RF20, RF30 or RF50 -- 30A). Pressing the PROGRAM button will store the PA current correction factor (gain adjustment) for the generator as well as return personnel to the " Set PAC Correction " menu entry. In the case of multiple PA power supplies (RF20, RF30 or RF50), the meter must be moved to determine the highest PA current reading which should be used as a reference.

Set PA Current Limit --- turn RF ON and, using the ADJUSTMENT ARROWS, increase RF to the power level at which point it is desired that the PAC alarm indication should be displayed. Pressing the PROGRAM button will set the present PA Current level as the ALARM level. Upon completion of the programming for this parameter a " Finished " message will be displayed.
** NOTE ** This PA Current Limit setting DOES NOT affect the HARDWARE PA Current Limit, but merely serves as a PA Current LEVEL indicator.

6.6.2 FETBIAS COLUMN

No Biasing Errors --- displays locations of FETs that have failed to bias up. If no FET failures were detected the " No Biasing Errors " message will be displayed. " A1Q3 " would indicate that FET Q3 of PA 1 had failed the power on bias check. The " ... " following a Failed FET message indicates that additional FETs have failed. To view the next Failed FET press the PROGRAM button.

Failed FET A#Q#
A1Q1 ...

FET CALIBRATION

Biasing (calibrating) FETs is accomplished in the following manner:

Connect a voltmeter to one of the following ...

(1) RF5S across R42 on the PA module
(2) RF10S or HF10 across J4 pins 1 and 2 on the Interconnect Board
(3) RF20 or RF30 (1st PA --- see Note below) across J4 pins 1 and 2 on the Interconnect Board
(4) RF50 (1st PA --- see Note below) across J14 pins 1 and 2 on the Interconnect Board

The meter shunt values are (1) .0125 Ohms and (2, 3 & 4) .01 Ohms.

Press the adjustment (up) arrows until 1.0 mV (1.25 mV for the RF5S) is displayed on the voltmeter which represents 100 mA. At this point press the PROGRAM button. If you are calibrating ALL the FETS the next successive FET will be displayed for calibration. If this is the only FET to be calibrated OR is the last FET to be calibrated, the user will be returned to the entry that commenced calibration.

*** Note *** As each PA is calibrated (all 8 FETs), the meter must be moved to different Interconnect Board pins to calibrate subsequent PAs.

Pins	PA 2	PA 3	PA 4	PA 5	PA 6
RF20	3,4				
RF30	3,4	35,37			
RF50	3,4	5,6	7,8	9,10	11,12

Calibrate All FETs --- When the PROGRAM key is pressed at this entry, all FETs will be ready for biasing. Bias the FETs one after the other in the manner as described above.

Calibrate FET A#Q# --- use the adjustment arrows to select the FET to be calibrated. When the PROGRAM key is pressed at this entry, the selected FET will be ready for biasing. Bias the FET in the same manner as described above.

Save FET Bias Levels --- when the PROGRAM key is pressed at this entry, all RAM copies of FET bias levels will be written to their corresponding non-volatile locations for use on subsequent power ups of the generator.

6.6.3 MONITOR COLUMN

Use Bypass	Control Loop	--- the generator operates normally when the software control loop is being " Used ". To test a hardware function that service personnel suspect is causing a problem, without " interference " from the software, select the " Bypass " feature. This allows service personnel to write directly to the hardware with RF ON and set various power levels. For additional assistance with this feature contact the factory.
DCV ##.#V PAC ##.##A		displays the present PA DC power supply line voltage and DC current through the PA module to tenths of volt/ampere resolution. Since RF may be turned ON and increased or decreased while in the MONITOR column, service personnel will be able to observe how changes in RF operation impact generator performance with respect to PA DC line voltage and DC current through the PA module.

** NOTE ** If you have a RF5S power supply the ...

Dissip/Device ###.#W

... parameter will be displayed. However, if you have any other type of supply (i.e. your supply has an interconnect board) the ...

DRV ###.#V DD ###.#W

and

Heatsink Temp ##.#

... entries will be displayed.

Dissip/Device ###.#W --- displays the present power dissipation per PA module transistor/device ...

RF5S --- 4 devices
RF10S --- 8 devices
HF10 --- 8 devices
RF20 --- 16 devices
RF30 --- 24 devices
RF50 --- 48 devices.

Power dissipation is a key indicator of generator performance. Since RF may be turned ON and increased or decreased while in the MONITOR column, service personnel will be able to observe how changes in RF operation affect device dissipation.

DRV ###.#V DD ###.#W --- displays the present drain voltage on a single PA (DRV) and the power being dissipated by an individual transistor/device (DD). See the above description of the " Dissip/Device " entry.

Heatsink Temp ##.# --- displays the present heatsink temperature in degrees Centigrade.

Efficiency ##.#% --- displays the present efficiency of the RF power amplifier circuitry within the generator. Efficiency is another indicator of generator performance. Since RF may be turned ON and increased or decreased while in the MONITOR column, service personnel will be able to observe how changes in RF operation affect the efficiency of the generator.

Dump Address ####h --- using the ADJUSTMENT ARROW buttons select the address in memory that you would like displayed (see the above section on entering the service code for more help in selecting your Dump Address). Once the address has been selected, press the RIGHT ARROW button to view the address and its byte-size (8 bit) contents as well as the contents of the 4 subsequent byte locations.

nn nn nn nn nn --- will display the DUMP address and its byte-size (8 bit) contents as well as the contents of the 4 subsequent byte locations. The 5 byte section of memory (in hex) will be updated every 40 milliseconds. This feature is particularly useful in tracking down interface problems as well as software bugs that may crop up.
If RF is OFF, use the ADJUSTMENT ARROWS to increase or decrease the base memory address to be displayed.
** CAUTION **
If RF is ON and the source of setpoint for the generator is the front panel the ADJUSTMENT ARROWS will increase or decrease the setpoint.

Target Address ####h --- using the ADJUSTMENT ARROW buttons select the address in memory whose word-size contents (16 bit) you would like displayed (see the above section on entering the service code for more help in selecting your Target Address). Once the address has been selected, press the RIGHT ARROW button to view the address and its word-size (16 bit) contents.

####h contains nnnnh --- displays the Target Address and its word-size (16 bit) contents. If RF is OFF, use the ADJUSTMENT ARROWS to increase or decrease the Target Address to view the contents of additional locations.
** CAUTION **
If RF is ON and the source of setpoint for the generator is the front panel the ADJUSTMENT ARROWS will increase or decrease the setpoint.

6.6.4 POWER COLUMN

Power Limit ####W --- allows the service personnel to program the ABSOLUTE MAXIMUM power level for a given generator. While some generators may be able to exceed the rated wattage, it is NOT recommended that this limit be set above the rated wattage. Press the PROGRAM button to store the selected parameter value in non-volatile memory at which point the " Finished " message will be displayed.

Inc Monitor FS ####W --- in some applications it may be desirable to change the scale of the incident monitor output from the default rated power. Use the ADJUSTMENT ARROWS to increase or decrease the incident monitor full scale value to the desired setting. Press the PROGRAM button to store the selected parameter value in non-volatile memory at which point the " Finished " message will be displayed.

Ref Monitor FS ####W --- in some applications it may be desirable to change the scale of the reflected monitor output from the default reflected power. Use the ADJUSTMENT ARROWS to increase or decrease the reflected monitor full scale value to the desired setting. Press the PROGRAM button to store the selected parameter value in non-volatile memory at which point the " Finished " message will be displayed.

Setpoint FS ####W --- in some applications it may be desirable to change the scale of the analog setpoint input from the default rated power. Use the ADJUSTMENT ARROWS to increase or decrease the analog setpoint full scale value to the desired setting. Press the PROGRAM button to store the selected parameter value in non-volatile memory at which point the " Finished " message will be displayed.

Fwd Error s##.#% --- is a software gain adjustment for Forward Power in the directional coupler. Use the ADJUSTMENT ARROW buttons to increase or decrease this value between -12.5% and 12.5% gain. Press the PROGRAM button to store the selected parameter value in non-volatile memory at which point the " Finished " message will be displayed.

Ref Error	s##.#% ---	is a software gain adjustment for Reflected Power in the directional coupler. Use the ADJUSTMENT ARROW buttons to increase or decrease this value between -12.5% and 12.5% gain. Press the PROGRAM button to store the selected parameter value in non-volatile memory at which point the " Finished " message will be displayed.
Dissip Target	###W --- 25W	is the MAXIMUM level of power dissipation per PA module transistor. Foldback will occur if this threshold is reached. This parameter is factory preset to prevent excessive overdissipation and possible device damage. Should alteration of this parameter be needed, use the ADJUSTMENT ARROWS to modify the Target point within the allowed range. Press the PROGRAM button to store the selected parameter value in non-volatile memory at which point the " Finished " message will be displayed.
Dissip Adjust	4096 ---	is the gain for dissipation regulation. This parameter is factory preset to prevent continuous high dissipation and possible device damage. Should alteration of this parameter be desired, use the ADJUSTMENT ARROWS to modify the Dissip Adjust level within the allowed range. Press the PROGRAM button to store the selected parameter value in non-volatile memory at which point the " Finished " message will be displayed.

6.6.5 SPECIAL COLUMN

Set MATCH Correction --- will allow service personnel to calculate and store the gain adjustment for the generator's monitor outputs. Pressing the PROGRAM button at this point will cause a 1.000 DC volt signal to be transmitted out the monitor outputs and allow the calculation to proceed.

Adjust Out To 1.000V --- while measuring the voltage at one of the generator's monitor outputs (expected to be 1.000 DC volt), use the ADJUSTMENT ARROW buttons to increase or decrease the measured voltage until it reads 1.000 DC volt. Once the measured value is correct, press the PROGRAM button again to store the new gain in non-volatile memory and return to the " Set MATCH Correction " entry.

Set SETPT Correction --- will allow service personnel to calculate and store the gain adjustment for the generator's analog setpoint input. To program this gain the generator must be in voltage control with RF OFF. Pressing the PROGRAM button at this point will allow the calculation to proceed.

Adjust In To 1.000V --- apply a true 1.000 DC volt to the setpoint input of the generator and use the ADJUSTMENT ARROW buttons to increase or decrease the voltage displayed in the upper left corner of the display until it reads 1.000 volt. Once the displayed value is correct, press the PROGRAM button again to store the new gain in non-volatile memory and return to the " Set SETPT Correction " entry.

Set RFB Correction --- will allow service personnel to calculate and store the gain adjustment for the generator's feedback input. To program this gain the generator must be in voltage control. Pressing the PROGRAM button at this point will allow the calculation to proceed.

Adjust In To 1.000V --- assuming a probe constant of 1000, apply a true 1.000 DC volt to the setpoint input of the generator, turn RF ON and monitor (with a voltmeter) the feedback input of the generator. Use the ADJUSTMENT ARROW buttons to increase or decrease the voltage displayed on the meter until it reads 1.000 volts. Once the metered value is correct, press the PROGRAM button again to store the new gain in non-volatile memory and return to the " Set RFB Correction " entry.

6.6.5.1 RF POWER CALIBRATION

All solid state power supplies are factory calibrated and do not require calibration upon receipt. Should calibration become necessary it can be done from the front panel.

Inside the generator, there exists a table of 65 power levels or points that are used to control the output power of the generator. These points reside in non-volatile memory and have to be programed prior to attempting to turn RF ON. The LIMIT COLUMN entry " Initialize Cal-Table " stuffs the calibration table with a rough set of points so that RF may be turned ON for additional tests, but for precise control of the generator a calibration MUST be performed.

Place a DIGITAL wattmeter, capable of measuring the RATED POWER of the generator, in-line between the generator and a 50 Ohm load. For cabling, use either RG-213 cable (NOT to exceed THREE feet in length between the generator and the wattmeter) or RG-217 cable (NOT to exceed SIX feet in length between the generator and the wattmeter).

As each point is calibrated, in any of the three Calibration menu entries below, the bottom line of the display will first change to indicate that the generator is " normalizing " on the estimated power level. i.e. ...

Normalizing Point ##

After " normalization " has been completed, service personnel will be instructed to enter the power level (READ FROM THE WATTMETER AND NOT THE DISPLAY) for the given point by the bottom line of the display changing to ..

Point ## Power ####W

Enter the power level (FROM THE WATTMETER) in the same manner as was used to enter the service code. After the level has been entered press the PROGRAM button to save it in a temporary working copy of the calibration table and (depending on the menu entry and point being programed) either proceed to the next point or return to the original menu entry.

If you wish to suspend calibration and

1) are " normalizing ", simply turn RF OFF.
2) are " entering " a power level, press the PROGRAM button and then turn RF OFF.

and the display will return to the original menu entry.

If at any time during calibration a " MAX COUNTS " error message appears on the bottom line of the display, this indicates that the remaining calibration table points will have to be mathematically estimated. At this time all remaining points, including the one that generated the "MAX COUNTS" message, are calculated and stored in the temporary working copy of the table. To remove the " MAX COUNTS " message, press the PROGRAM button and the display reverts to the original menu entry.

Calibrate All Points --- pressing the PROGRAM button will commence calibration of the unit. See the above discussion for calibration description.
** NOTE **
It is HIGHLY recommended that, as service personnel perform this function, that a hardcopy of the points (power levels) be kept as they are programed.

Calibrate Range --- after pressing the PROGRAM button, the service personnel will be prompted to enter a first point to calibrate which must be between 1 and 63 inclusive and then a last point to calibrate which must be between the first point and 64 inclusive. Points are entered (in decimal) in the same manner as the service code was entered. If an erroneous point is entered, the program returns to the original menu entry. Once a correct range has been entered, the calibration of the range will commence as described above.

Calibrate Point --- after pressing the PROGRAM button, the service personnel will be prompted to enter the point number that is to be calibrated. This number must be within 1 and 64 inclusive. If an invalid point is entered, the service personnel are returned to the original menu entry. Once a correct point value has been entered, calibration of the point begins as described in the above discussion.

Point ## is ####W --- will display the present 64 (1 - 64) NON-ZERO (point 0 is ALWAYS 0) points found in the table. This is the " view " function for this menu entry. Use the ADJUSTMENT ARROW buttons to increase or decrease the point index and view the whole table. Pressing the PROGRAM button activates the " stuff " function, whereby the value for the presently displayed point may be adjusted in the working copy of the calibration table. At this time the ADJUSTMENT ARROW will adjust the power value in much the same manner as the service code was entered. After the " new " point power level has been selected, pressing the PROGRAM button again causes the programed power level to be saved in the working copy of the calibration table. At this time the " stuff " function is terminated and " view " portion of this entry is restarted.

Save Points --- stores the existing working copy of the calibration in both non-volatile memory and into the RAM copy of non-volatile memory. The use of non-volatile memory for the table insures that subsequent power-ups of the generator will have the same data for the calibration table. Once all the points have been stored, the " Finished " message will appear on the bottom line of the display.

Soft Special A 32767 --- selects the appropriate A type " software
-32768 special " (if any) as requested by the customer. A zero (0) programed in this location indicates that no " A " specials are invoked. An example of a software special might be the request for a specific non-standard control function.

Soft Special B 32767 --- selects the appropriate B type " software
-32768 special " (if any) as requested by the customer. A zero (0) programed in this location indicates that no " B " specials are invoked. An example of a software special might be the request for a specific non-standard control function.

Minimum Counts	4096 0	---	it is possible to dictate the minimum voltage setpoint (in counts) that it will take to produce RF. This is accomplished via the " Minimum Counts " parameter. Provided the user has entered the Service Environment under rear panel voltage control, at this entry the voltage setpoint in counts is constantly displayed. Once you have adjusted the remote setpoint to the desired " minimum " level, pressing the PROGRAM button will cause the present setpoint counts value to be stored and used as a minimum required setpoint for future voltage control processes. ** Note ** Due to possible fluctuations in analog setpoint reads, it is recommended that this value be set approximately .05 volts BELOW your application requirements.
Maintained Cts	4096 0	---	provided the setpoint exceeds the " Minimum Counts " value (see above) it is possible to force a minimum maintained setpoint while RF is ON. This facilitates the maintenance of a plasma, if desired, in the event that RF (setpoint) is decreased rather than turned off in a repetitive process environment. Example: If RF is ON and, if under rear panel voltage control, the user may adjust RF (analog setpoint) until the desired maintained value is displayed on the top line of the VFD. The diagnostic value displayed on the bottom line is the actual D/A converter counts value that is being written to the hardware with RF ON.
Panel Password	32767 -32768	---	selects the front panel password number which, if the appropriate software special is invoked, will have to be correctly entered by anyone attempting to access the PROGRAMMING ENVIRONMENT.

SECTION VII

FOR LOW FREQUENCY USERS

7.1 INTRODUCTION

This chapter provides specifications and operational information not previously covered in this manual for low frequency solid state series generators (also referred to as the generator, the equipment or the power supply), manufactured by RF PLASMA PRODUCTS Inc., Voorhees, New Jersey.

7.1.1 PURPOSE

The generator you have received is a unique microprocessor based RF power supply designed to provide the user with a flexible set of options for control. The generator provides the user with a pure, stable power source from between 50.0 Khz and 460.0 Khz from 0 to the supply's rated power.

7.1.2 RATED POWER

The rated power for the solid state series generator is 1000 Watts.

7.2 LOW FREQUENCY TECHNICAL SPECIFICATIONS

TABLE 6

REF #	PARAMETER	SPECIFICATION
1	FREQUENCY	50.0 - 460.0 Khz in 100 Hz steps +-.05%.
2	FREQUENCY STABILITY	+- .005 % SHORT TERM
3	RF OUTPUT POWER	1000 Watts into 50 Ohms
4	OUTPUT IMPEDANCE	50 +-5 Ohms nominal.
5	METERING ACCURACY	
	LEVELING ACCURACY 50 - 460 Khz	
	a) Forward Power Leveling to 2:1 VSWR	+-.5% Full Scale +- 5% of Reading
	b) Load Power Leveling to 3:1 VSWR	+-.5% Full Scale +- 10% of Reading
	LEVELING ACCURACY +- 10% CENTER FREQUENCY RANGE	
	a) Forward Power Leveling to 2:1 VSWR	+-.5% Full Scale +- 3% of Reading
	b) Load Power Leveling to 3:1 VSWR	+-.5% Full Scale +- 3% of Reading
6	CONNECTOR	Type N
7	POWER STABILITY	0.5 % long term.
8	FORWARD POWER REGULATION	1 % into 50 Ohm load.
8b	LINE REGULATION	Related to RMS line voltage. Within range of taps settings, all specifications will be met. Below 5% low line, derate max power 1.5% for every 1% line change to a minimum 18% low line. Unit not specified to operate below 190 VAC.
9	LOAD MISMATCH TOLERANCE	Continuous duty into any passive load without failure or oscillation.
10	HARMONIC DISTORTION	All harmonics more than 45 dB down (typically 55 dB)

TABLE 6 cont.

REF #	PARAMETER	SPECIFICATION
11	NOISE, HUM, RIPPLE	-40 dB at full power.
12	COMMON EXCITER INPUT	Input impedance 50 Ohms 7-20 volts P-P at operating frequency.
13	COMMON EXCITER OUTPUT	Output impedance 50 Ohms 12 volts P-P at operating frequency adjustable 0 to 15 V P-P. .005% / C
14	TEMPERATURE COEFFICIENTS	+-.025% / C
15	PROTECTION	Forward power limits on PA current or reflected power in excess of 75 Watts (short and open circuit protected).
16	SPURIOUS RADIATION	The supply meets or exceeds FCC specifications.
17	OPERATING AMBIENT	0 to 40 degrees Celsius.
18	HUMIDITY	80% non-condensing.
19	POWER REQUIRED	LF10 198-250 VAC 50/60 HZ Single phase 11 AMPS
20	CIRCUIT PROTECTION	LF10 15 AMP overcurrent With 1000 AMP interrupt capacity.

7.3 PROGRAMMING ENVIRONMENT ADDITIONS

An entire column as well as a few additional menu entries have been added to the PROGRAMMING ENVIRONMENT for the low frequency series of solid state power supplies. Listed below are descriptions and column locations for said additions. Please consult TABLE 7, found in this section, during this discourse.

7.3.1 TUNING COLUMN

Frequency 460.0Khz --- 50.0Khz — use the ADJUSTMENT ARROWS to display the frequency at which the generator should operate. Please note that changes to this parameter may be limited by the programmable upper and lower frequency limit parameters found in the SERVICE ENVIRONMENT.

** NOTE ** With AUTO-TUNING enabled AND RF ON changes to the frequency parameter are NOT allowed.

Fine Tune 10.0Khz --- 0.1Khz — use the ADJUSTMENT ARROWS to display the frequency increment/decrement value when AUTO-TUNING in the " Fine " range. See discussion of the AUTO-TUNING feature below.

Coarse Tune 10.0Khz --- 0.1Khz — use the ADJUSTMENT ARROWS to display the frequency increment/decrement value when AUTO-TUNING in the " Coarse " range. See discussion of the AUTO-TUNING feature below.

Fine Trip 100W --- 1W — use the ADJUSTMENT ARROWS to display the lower bound of the " Fine " range when AUTO-TUNING. This reflected power level sets the boundary between " Fine " tuning and tuning disabled. See discussion of the AUTO-TUNING feature below.

Coarse Trip 100W --- 1W — use the ADJUSTMENT ARROWS to display the lower bound of the " Coarse " range when AUTO-TUNING. This reflected power level sets the boundary between " Fine " tuning and " Coarse " tuning. See discussion of the AUTO-TUNING feature below.

7.3.2 ANALOG COLUMN

Load Power Leveling Fwd --- use the ADJUSTMENT ARROWS to display the desired state of this programmable feature. Selecting LOAD POWER LEVELING will cause the supply to regulate on net output power (Forward - Reflected). Selecting FWD POWER LEVELING will cause the generator to regulate on output or incident power.

7.3.3 PRESETS COLUMN

P# Load Pwr Leveling Fwd --- use the ADJUSTMENT ARROWS to display the desired means of output power regulation for the preset being programed. See above.

P# Freq. 460.0Khz 50.0Khz --- use the ADJUSTMENT ARROWS to display the desired operational frequency for the preset being programed. See below.

TABLE 7

LOW FREQUENCY

PROGRAMMING ENVIRONMENT COLUMNS

TUNING COLUMN	
Frequency	460.0Khz
	50.0Khz
Fine Tune	10.0Khz
	0.1Khz
Coarse Tune	10.0Khz
	0.1Khz
Fine Trip	100W
	1W
Coarse Trip	100W
	1W

ANALOG COLUMN	
Analog	Enabled
	Disabled
Control	RF Power
	AUXiliary
	RF Volts
	DC Volts
Load Power Leveling Fwd	
Polarity	Positive
	Negative
Voltage Range	10V
	5V
Exciter	Master
	Slave
Panel RF ON	Enabled
	Disabled
Panel Setpt	Enabled
	Disabled
RF ON & OK	Enabled
	Disabled

PRESETS COLUMN	
Run(ning)	Preset # 6
	Preset # 5
	Preset # 4
	Preset # 3
	Preset # 2
	Preset # 1
	Preset # 0
Presets	Disabled
Pres. Clock	Enabled
	Disabled
Program Preset #	6
	1
P# Control	RF Power
	Auxiliary
	RF Volts
	DC Volts
P# Ramping	Enabled
	Disabled
P# Setpoint	####W
	####V
P# Load Pwr Leveling Fwd	
P# Interval	##:##:##
	00:00:00
P# Freq.	460.0Khz
	50.0Khz
P# AutoSeq	Enabled
	Disabled
P# Jump to Preset	6
	0

PULSING COLUMN	
Proc Hi Power	####W
	0W
Proc Low Power	####W
	0W
Proc Hi Time	10000ms
	0ms
Proc Duty Cycle	100%
	1%
Proc Pulse	Enabled
	Disabled
Save Proc Parameters	
Strt Hi Power	####W
	0W
Strt Low Power	####W
	0W
Strt Hi Time	10000us
	0us
Strt Duty Cycle	100%
	0%
Strt Duration	9999ms
	0ms
Strt Pulse	Enabled
	Disabled
Save Strt Parameters	

OPERATE COLUMN	
Max Power	####W
	0W
L: ####mv	T: ####mv
Load Preset A	5000mv
	0mv
Tune Preset A	5000mv
	0mv
Load Preset B	5000mv
	0mv
Tune Preset B	5000mv
	0mv
Using Preset Pair	B
	A
Load & Tune	Enabled
	Disabled
Ramp Time	9:00:00
	0:00:01
Setpt Ramp	Enabled
	Disabled
Probe Constant	10000
	1
VIC	100
	5
PIC	100
	5
Voltage Scale	100
	5
RF ON Clock	Enabled
	Disabled
Watts Default	####W
	0W
Volts Default	####V
	0V

SYSTEM COLUMN	
Sensitivity	4096
	0
Douse	4096
	0
Sustain	####W
	0W
Suppression	Enabled
	Disabled
ARC Delay	32400ms
	1ms
ARC Delay	Enabled
	Disabled
Compliance	100%
	1%
REF Power Alarm	###W
	1W
Baud Rate	19200bps
	9600bps
	4800bps
	2400bps
	1200bps
	600bps
	300bps
	150bps
Serial Mode	Computer
	Human
Service Code	????

SOFTKEY COLUMN	
Panel Password	32767
	-32768

7.4 VARIABLE FREQUENCY AUTO-TUNING

The capability exists within the LF10 power supply to strike a plasma and tune out reflected power by adjusting the operating frequency of the power supply over a predetermined bandwidth. This capability, AUTO-TUNING, is accomplished via several programmable parameters (some to be determined empirically on site by the end user) and the 100 Hz frequency resolution provided by the LF10 variable frequency power supply.

The bandwidth over which to AUTO-TUNE, when to tune and the amount of frequency shift are programmable parameters whose settings are dictated by the Q of the system and the process. These programmable parameters provide the user with a great deal of control over both the sensitivity to tune and speed with which a match is achieved.

Provided it is enabled, AUTO-TUNING will occur over the " Min Freq. " and " Max Freq. " (found in the SERVICE ENVIRONMENT POWER Column) range. Once the optimum system/process operating frequency has been determined, set these parameters so as to allow for variances between process runs. In other words, program in an operational frequency window large enough to provide for process differences but small enough to ensure reasonable tune times.

As it attempts to strike the plasma and tune out reflected power, the LF10 will adjust the operating frequency in " Coarse " and " Fine " steps. The " Coarse " or " Fine " determination is made based on the detected amount of reflected power. The steps are frequency shifts in multiples of 100 Hz.

With AUTO-TUNING enabled, a check on reflected power (for tuning purposes) is affected approximately every 80 milliseconds in the LF10 power supply. The direction to tune is based on the operational bandwidth and a comparison of the " just sampled " reflected power with the " last sampled " level.

Below the " Fine " trip level (of reflected power) frequency shifts WILL NOT OCCUR as if AUTO-TUNING is disabled. If reflected power exceeds the " Fine " trip level, shifts in frequency of the " Fine " tune magnitude will be made. In the event that reflected power exceeds the " Coarse " trip level, the adjustment in frequency will be of the " Coarse " tune magnitude.

7.5 LOW FREQUENCY SERIAL COMMANDS

For information on programming the supply over the serial interface, please consult section V.

The following command additions may be executed at any time over the serial link.

FREQ? will return the present operational frequency in Khz.

example: hi FREQ? <cr>

might yield: <cr> <cr> Frequency 380.0Khz [reprompt]

FQ? is the same command when operating in COMPUTER mode.

example: <cr> FQ? <cr>

might yield: 3800 [reprompt]

*** NOTE *** In computer mode the returned frequency is displayed in 100 Hz form. (3800 = 380.0Khz)

LEVEL? displays the presently selected means of output power regulation.

example: hi LEVEL? <cr>

might yield: <cr> <cr> Fwd Power Leveling [reprompt]

LVL? is the same command when operating in COMPUTER mode.

example: <cr> LVL? <cr>

might yield: 0 [reprompt]

*** NOTE *** In computer mode 1 = Load Power Leveling and
0 = Forward Power Leveling

The following commands will only execute properly if issued when the user has " logged on " serially to the supply. (i.e. at the " Command> " prompt).

FREQ — is the serial operational frequency selection command. The frequency should be entered in 100 Hz form.

example: Command> 3000 FREQ <cr>

... would result in the selection of 300.KHz as the operational frequency.

FQ — is the same command when operating in COMPUTER mode.

example: <cr> 2800 FQ <cr>

DISABLE LOADLVL — is the command to enable forward power leveling as the means of output power regulation.

example: Command> DISABLE LOADLVL <cr>

DL — is the same command when operating in COMPUTER mode.

example: <cr> DL <cr>

ENABLE LOADLVL — is the command to enable load power leveling as the means of output power regulation.

example: Command> ENABLE LOADLVL <cr>

EL — is the same command when operating in COMPUTER mode.

example: <cr> EL <cr>

7.6 SERVICE ENVIRONMENT ADDITIONS

A few additional menu entries have been added to the SERVICE ENVIRONMENT for the low frequency series of solid state power supplies. Listed below are descriptions and column locations for said additions. Please consult TABLE 8, found in this section, during this discourse.

7.6.1 POWER COLUMN

Min Freq. maximum 50.0Khz --- use the ADJUSTMENT ARROWS to display the desired lower bound frequency level. Future attempts to lower the operational frequency (within the PRESETS or OPERATE columns in the PROGRAMMING ENVIRONMENT) below this level will not be allowed. Press the PROGRAM button when selection is complete and the " Finished " message will be displayed.

Max Freq. 460.0Khz minimum --- use the ADJUSTMENT ARROWS to display the desired upper bound frequency level. Future attempts to raise the operational frequency (within the PRESETS or OPERATE columns in the PROGRAMMING ENVIRONMENT) below this level will not be allowed. Press the PROGRAM button when selection is complete and the " Finished " message will be displayed.

TABLE 8

LOW FREQUENCY

SERVICE ENVIRONMENT COLUMNS

MININIT COLUMN	FETBias COLUMN	MONITOR COLUMN	POWER COLUMN	SPECIAL COLUMN
Leave Service Menu				
Generator is a LF10	No Biasing Errors Failed FET A#Q# A1Q1 ...	Use Control Loop Bypass	Power Limit ####W 0W	Set MATCH Correction
Initialize Cal-Table		DCV ##.#V PAC ##.##A	Inc Monitor FS ####W 0W	[Adjust Out To 1.000V]
Store Default Params	Calibrate All FETs	DRV ###.#V DD ###.#W	Ref Monitor FS ####W 0W	Set SETPT Correction
Air Cooled Supply Water	Calibrate FET A#Q# A1Q1	Heatsink Temp ##.#	Setpoint FS ####W 0W	[Adjust In To 1.000V]
Over Temp Alarm 100 1	Save FET Bias Levels	Efficiency ##.#%	Fwd Error 12.5% -12.5%	Set RFB Correction
Nominal Line 65.0V 40.0V		Dump Address FFFFh 0000h	Ref Error 12.5% -12.5%	[Adjust In To 1.000V]
Set Line Correction		FFFF ## ## ## ## ## 0000	Dissip Target 200W 25W	Calibrate All Points
[Adjust to Rail ##.#V]		Target Address FFFFh 0000h	Dissip Adjust 4096 0	Calibrate Range
Set PAC Correction		FFFFh contains ####h 0000h	Ignition Limit ####W 0W	Calibrate Point
[Turn RF ON to nnA]			Coil Cool 0:01:00 0:00:00	Point ## is ####W
[Adjust to nnA ##.##A]			Min Freq. maximum 50.0Khz	[Point ## Power ####W]
PAC Alarm 100.00A 0.00A			Max Freq. 460.0Khz minimum	Save Points
				Soft Special A 32767 -32768
				Soft Special B 32767 -32768
				Minimum Counts 4096 0
				Maintained Cts 4096 0
				Panel Password 32767 -32768

APPENDIX A

TRANSFORMER LEGENDS

TRANSFORMER LEGEND RF-20/30/50/HF-10

(SILKSCREEN SUPERSEDES MANUAL)

NOM VOLTAGE	PHASE A	PHASE B	PHASE C	JUMPERS		
198	2	7	12	2-8	7-13	12-3
208	2	7	12	2-9	7-14	12-4
220	2	7	12	2-10	7-15	12-5
230	1	6	11	1-8	6-13	11-3
240	1	6	11	1-9	6-14	11-4
250	1	6	11	1-10	6-15	11-5

190-260 VAC

NOM VOLTAGE	PHASE A	PHASE B	PHASE C	JUMPERS
340	2	7	12	3-8-13-N
360	2	7	12	4-9-14-N
380	2	7	12	5-10-15-N
400	1	6	11	3-8-13-N
420	1	6	11	4-9-14-N
430	1	6	11	5-10-15-N

340-450 VAC

TRANSFORMER LEGEND RF5S/RF-10S/LF-10
(SILKSCREEN SUPERSEDES MANUAL)

NOM VOLTAGE	INPUT	JUMPERS
99	2, 3	2-6 3-7
108	2, 4	2-8 4-8
115	1, 3	3-7 1-5
125	1, 4	4-8 1-5
198	2, 7	3-6
208	2, 8	3-6
218	2, 8	4-6
230	1, 7	3-5
240	1, 7	4-5
250	1, 8	4-5

RF5S 95-130, 190-260 VAC

NOM VOLTAGE	PHASE A	PHASE B
198	2	7
208	2	7
220	2	7
230	1	6
240	1	6
250	1	6

RF-10S/LF-10 190-260 VAC