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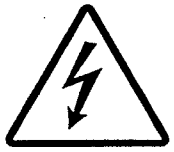
Find the *MKS Instruments / ENI GEW-30A* at our website: *Click HERE*

OPERATION MANUAL

Genesis

RF Plasma Generator

GEW-30A



HIGH RF VOLTAGES MAY BE PRESENT AT THE OUTPUT OF THIS UNIT. *All operating personnel should use extreme caution in handling these voltages and be thoroughly familiar with this manual.*



DO NOT USE ANY CFC (CHLOROFLUOROCARBON) SOLVENT IN THE MAINTENANCE OF THIS PRODUCT. In recognition of our responsibility to protect the environment, this product has been manufactured without the use of CFC's. The no-clean flux now used in all soldering operations may leave a small inert residue that will not affect the performance of the product. The use of CFC's for cleaning or maintenance may result in partial liquification of the no-clean flux residue, which will damage the unit and void the warranty.

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Revision Level: A 09/28/01

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When warranty service is required, the instrument must be returned, transportation prepaid, to the factory or to one of ENI's designated service centers. If, in our opinion, the instrument has been damaged by accident, unreasonable use, buyer-supplied software or interfacing, improper site preparation or maintenance, or abnormal conditions of operation, repairs will be billed at standard rates. In this case, an estimate will be submitted before the work is started.

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Service And Technical Assistance

For Service or Repair contact the closest Customer Service Department with the following information:

- Model and serial number
- Purchase order number
- Detailed description of malfunction
- Your company's "Bill To" and "Ship To" address

You will receive a RMA (Return Materials Authorization) number, the warranty status of the unit to be returned and estimated repair charge, if any. The RMA number is your authorization number. Please type this number on your purchase order and shipping label. After ENI receives the unit, a firm quote and estimated date of completion will be given.

For Technical Assistance for your particular application, contact the nearest ENI Sales and Service Center. The following information will help us provide you with prompt and efficient service:

- All of the information contained on the unit's name plate.
- Names and telephone numbers of important contacts.
- Detailed description (i.e. physical damage and/or performance anomalies, quantitative and/or qualitative deviation from specifications), including miscellaneous symptoms, dates and times.
- The environment and circumstances under which the issue developed
- Supporting test data and/or records that can be provided.
- Any previous, related conversations and/or correspondence with ENI.

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AUSTIN, TX	4150 Freidrich Lane Suite J Austin, TX 78744	Tel: (512) 462-2191 Fax: (512) 462-9411
UNITED KINGDOM	Highway House Norreys Drive Maidenhead Berks, SL6 4BN United Kingdom	Tel: 44-1628-775911 Fax: 44-1628-775902
GERMANY	Sielminger Str. 63 D-70771 Leinfelden-Echterdingen (Stetten) Stuttgart, Germany	Tel: 49-711-947700 Fax: 49-711-9477025
JAPAN	1-21-15 Aoyogi Kunitachi Tokyo 186-0013 Japan	Tel: 81-42-522-9011 Fax: 81-42-522-2636
TAIWAN	No. 49-1, Lane 2, Sect. 2 Kuang Fu Rd. Hsinchu 300, Taiwan Republic of China	Tel: 886-3-575-1199 Fax: 886-3-575-1022

Product and Applications information also available on the Internet at:

http://www.enipower.com

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Chapter 1

Introduction

The GEW-30A Genesis Plasma Generator is a rugged RF power source for plasma etching, CVD, and sputtering applications. Featuring precise power control and digital interfacing, this Genesis generator provides the exceptional reliability and repeatability required for today's demanding plasma processes.

Operating at the frequency of 40.68 MHz, the GEW-30A Genesis generator produces 3000 W of power into a 50Ω load. The DSP-based control module automatically measures forward RF power and reflected RF power, maintaining constant power output within ±2% of set point over a Dynamic Power Range of 0 to 3000 watts.

Precise power calibration is traceable to NIST (National Institute of Standards and Technology) through the ENI Power Standard. Low harmonic distortion and spurious-free performance complement the unit's RF power output control and unconditional RF stability.

A rugged RF power section ensures substantial power delivery into fixed match systems. The DSP-based control constantly monitors internal subsystem status to maximize system availability. Extensive built-in diagnostics and internal fail-safe memory simplify maintenance requirements and increase system uptime.

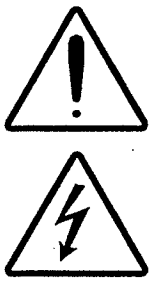
A 9-pin digital interface provides remote control, monitoring and diagnostic capability via the RS-232 serial link to a computer or host terminal. Optional custom interface cards are also available.

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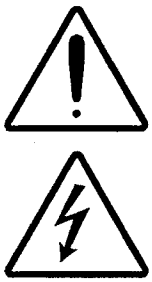
1.1 About This Manual

This manual covers the GEW-30A High Frequency (HF) Genesis generator, which produces 3000 W at 40.68 MHz. It also provides all of the information required to safely install, set up, and operate your generator. While every attempt has been made to provide a concise set of installation and operating procedures in the Getting Started Quickly section, detailed instructions are also included.

It is essential that you become thoroughly familiar with the contents of this manual prior to using your generator. If used properly, the information contained in this manual will not only promote reliable generator performance but will also encourage a safe operating or service environment for all individuals.



If this equipment is used in a manner not specified by the manufacturer, then the protection provided by the equipment may be impaired.



This equipment contains NO USER SERVICEABLE PARTS. In the event that equipment servicing is required, please contact an authorized ENI service center.

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1.1.1 Finding Your Way Around

This manual is divided into four chapters and three appendices. The main Table of Contents will help you to quickly locate the chapter that contains the information you may be seeking. The following is a brief description of each chapter.

Chapter 1	The chapter you are reading. This chapter provides information on the content of the manual, the documentation conventions used, safety considerations that need to be observed and a concise Getting Started Quickly section.
Chapter 2	Acquaints the user with the GEW-30A Genesis Plasma Generator. It covers major features and front and rear panel descriptions, as well as everything needed to install and set up your generator from Unpacking and Inspection to Initial Power Up.
Chapter 3	Covers in more detail how to operate your generator and take advantage of all of its features.
Chapter 4	Details common troubleshooting situations and solutions.
Appendix A	Provides complete physical and electrical characteristics of your generator.
Appendix B	Provides a glossary of all the symbols used in this manual and on the generator.
Appendix C	Provides a glossary of new terms that have been used throughout this manual.

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1.1.2 Documentation Conventions

The following methods of formatting have been used to call attention to important information in this manual.

Commands

Many parts of this manual refer to computer commands and data. It is important to recognize the conventions used in this manual in order to understand the meaning of these commands.

Angle Brackets	< >	These brackets are shown for command parameters. They are not part of the command and should not be entered.
Rounded Brackets	( )	These brackets contain hex equivalent numbers for printable or non-printable characters. The lower-case h (h) stands for hexadecimal.
Square Brackets	[ ]	These brackets indicate a symbol name for special control codes or non-printable characters. Examples of commonly used control codes are listed below.

[LF]	Line Feed	(0Ah)
[CR]	Carriage Return	(0Dh)
[ESC]	Escape	(1Bh)

Definitions



This icon is used to set off a definition of a new term used in this manual. Appendix C provides a complete list of all the new terms used here.

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1.2 Safety Considerations

Certain safety-related considerations must be observed before installing, operating, or servicing this equipment. Symbolic and/or textual labels and markings are used in and/or on the equipment, as well as in this product manual, to convey and/or identify such important information. Please look for these labels and markings, and follow their direction.

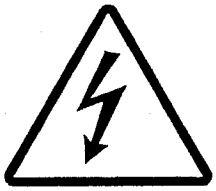
1.2.1 Exclamation Point Within a Triangle



Symbol Definition: Caution, refer to accompanying documents

The "exclamation point within a triangle" symbol (reference ISO Publication 3864, No. B.3.1) is used in and/or on the equipment to alert the installer, operator, or service personnel to the presence of important related installation, operation, and/or service instructions and to direct such personnel to the product manual for that information. This symbol is also used within the product manual itself to identify important instructions.

1.2.2 Lightning Bolt Within a Triangle



Symbol Definition: Caution, risk of electric shock

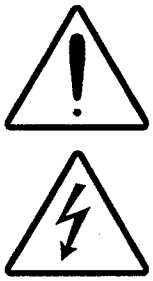
The "lightning bolt within a triangle" symbol (reference IEC Publication 417, Symbol No. 5036, and ISO Publication 3864, No. B.3.6) is used in and/or on the equipment to alert the user, operator or service personnel to the presence of uninsulated voltage within the enclosure of sufficient magnitude to constitute a risk of electric shock. Only authorized service personnel with a schematic diagram and a thorough knowledge of the voltages existing within the equipment shall remove covers or panels bearing this symbol. This symbol is also used within the product manual itself to identify important operating and/or maintenance instructions, which, if not followed carefully, could result in personal injury or even death.

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1.2.3 Service Warning



Service Warning Marking
Figure 1.2.3



ENI is responsible for safety, reliability, and performance of the equipment only if:

- *Assembly operations, extensions, readjustments, modifications, or repairs are carried out by authorized personnel.*
- *The electrical installation is made in accordance with the installation instructions provided and the room in which the equipment is installed complies with the environmental requirements.*
- *The equipment is used in accordance with the instructions for use.*

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1.2.4 Non-ionizing Electromagnetic Radiation Warning Triangle



Symbol Definition: Caution, non-ionizing electromagnetic radiation

The "non-ionizing electromagnetic radiation warning triangle" symbol (reference IEC Publication 417, Symbol No. 5140, and ISO Publication 3864) is used on the equipment to alert the installer, operator, or service personnel that the equipment is capable of producing elevated, potentially dangerous, levels of non-ionizing electromagnetic radiation, particularly RF radiation.

1.2.5 Heavy Object Warning Triangle



Symbol Definition: Caution, heavy object

Equipment bearing this label is identified as weighing in excess of 16 kg (35 lbs.) and should, therefore, be moved by two people. To avoid muscle strain and/or back injury, movers should use lifting aids and proper lifting techniques.

1.2.6 Technical Support

On the back of the generator is a label with an "800" number for ENI Technical Support. Should you have any difficulties with your generator and have exhausted all possibilities in the Troubleshooting Chapter, please feel free to call us.

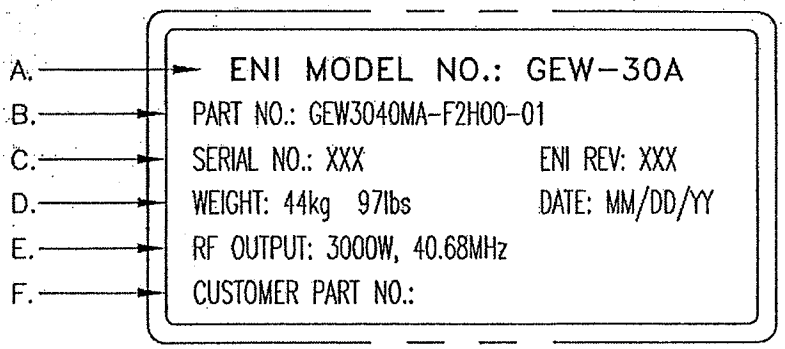


Technical Support Label
Figure 1.2.6

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1.3 Nameplate

The GEW-30A Genesis Plasma Generator can be identified by the label at the back of the unit that contains the following information.



GEW-30A Serial Tag Label

Figure 1.3

A. **ENI MODEL NUMBER:**
This model number uniquely identifies the unit.

B. **PART NO.:**
The assembly number uniquely identifies product configuration. (See section 1.4 for more information on the model number.)

C. **SERIAL NO.:**
The number is sequentially assigned as the product is manufactured.
ENI REV:
The revision letter identifies the product configuration. Revision A is the initial revision level.

D. **WEIGHT:**
The weight of the unit in kilograms and pounds.
DATE:
The date of manufacture in MM/DD/YY format.

E. **RF OUTPUT:**
The output of the unit in watts and megahertz.

F. **CUSTOMER PART NO.:**
A number that is specific to the customer who ordered the unit and that contains their own part number and revision level.

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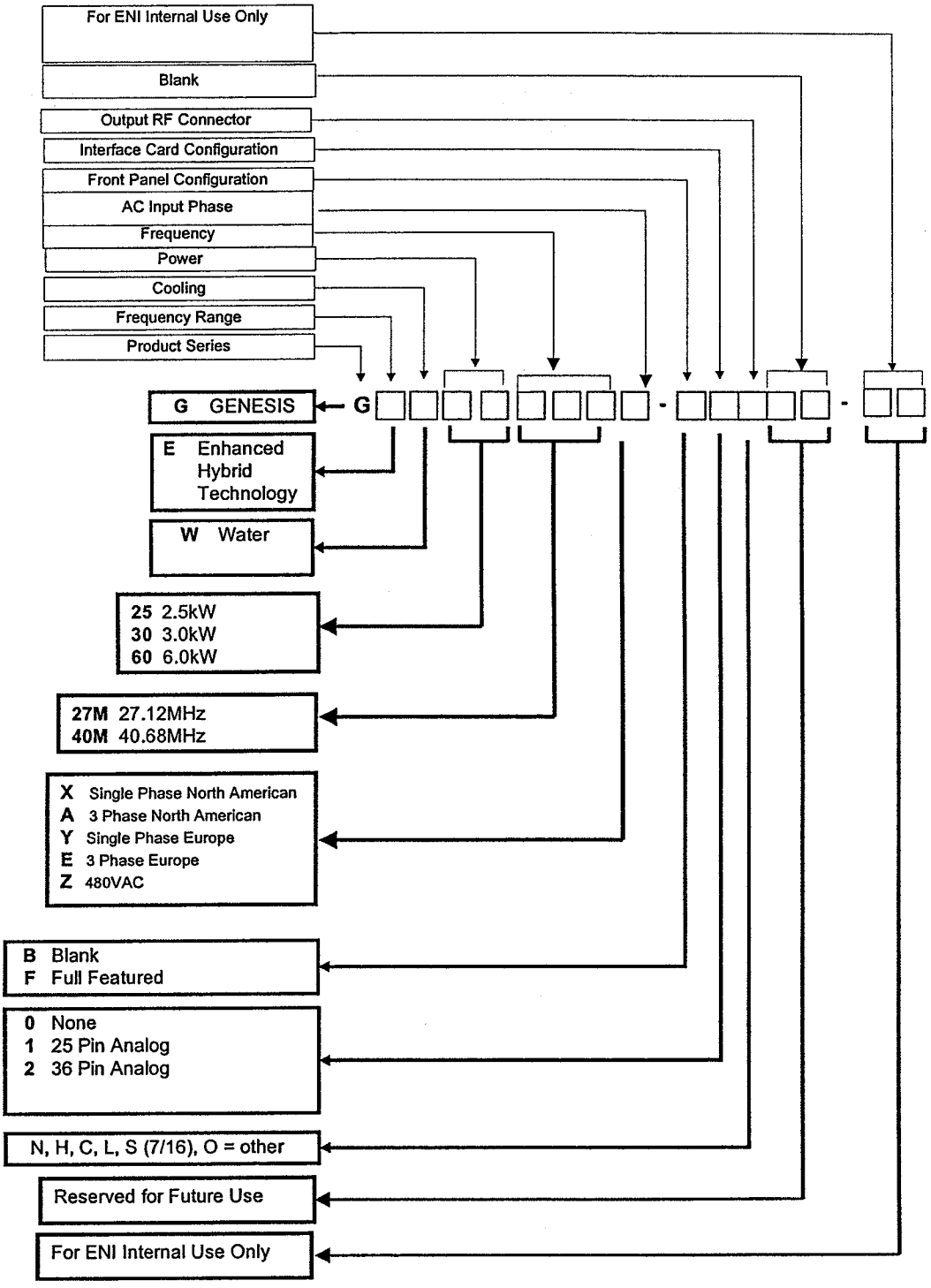
1.4 Generator Options at a glance

Before the unit is installed and powered up, it is important to ensure that the correct unit was received. The model numbers of the Genesis line of generators have been configured in such a way that it is easy to tell what option has been installed on a specific unit. The number generated from this matrix defines the configuration of that unit and results in a part number that will be utilized throughout the manufacturing process.

The matrix below should be used to compare the configuration of the unit that was initially ordered to the configuration of the unit received. If they are different, contact the nearest ENI Sales or Service location for assistance.

This part number interpreter is comprised of 18 separate fields. In these fields, letters and numbers are used to define the final configuration of a unit. The unit you have received should have the value "30" in the fourth and fifth fields of the final part number. Check the serial tag on the back of the generator. If it doesn't have "30" in the part number, contact the nearest ENI Sales or Service location for assistance.

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Genesis Part Number Interpreter

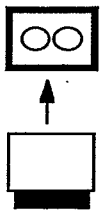
Figure 1.4

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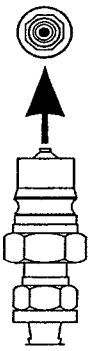
1.5 Getting Started Quickly

This section is intended to provide you with a set of instructions to enable you to quickly set up and start running your generator. References to more detailed information are provided at the end of each step.

To quickly set up your GEW-30A Genesis generator, follow the procedure below:



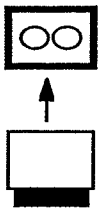
1. Connect the solenoid valve plug.
   (See section 2.9 for a description of the solenoid valve.)



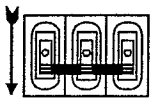
2. Connect the water inlet and outlet hoses securely to the water inlet and outlet connections on the rear panel of the generator.
   (See section 2.9 for more information on the connectors.)



3. Once they are securely connected, turn both water valves to the open position.

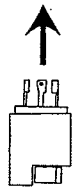


4. Insert the External Interlock plug into the interlock connector on the rear panel marked "INTERLOCK." AC Power will not engage until this interlock is defeated (plugged).
   (See section 2.6 for more information about the safety interlocks.)

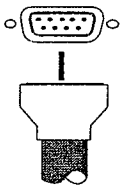


5. Make sure the AC Mains Circuit Breaker is in the OFF position (The **O** symbol should be showing).

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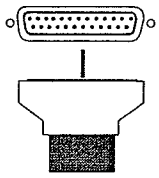


6. Connect AC power to the terminal block on the back of the unit. Make sure the line voltage matches the voltage you selected when the unit was ordered.
(See section 2.8 for more information on AC Power Requirements.)



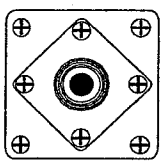
7. Connect the 9-pin male serial digital interface to the female serial interface connector on the rear panel.

   See Table 2.4.1 for pin outs.

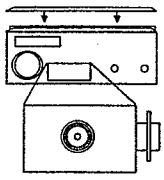


8. Connect an analog control cable to the analog interface connection on the rear panel.

   There is a safety interlock in Pins 3 and 21. This interlock must also be defeated (in this case shorted) for the unit to work. AC power will not engage unless this interlock is defeated.

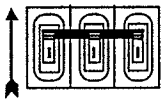


9. Connect the load from the plasma chamber to the RF output connection. This will vary depending upon the application you are using.

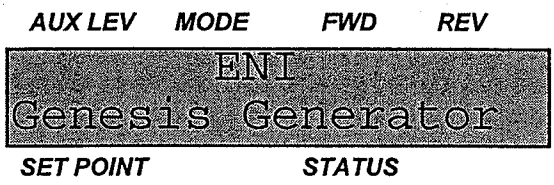


10. Make sure that the unit covers and the RF output cover are on. There are safety interlocks in all these locations that must be engaged or the unit will not work. (See section 2.6 for more information about the safety interlocks.)

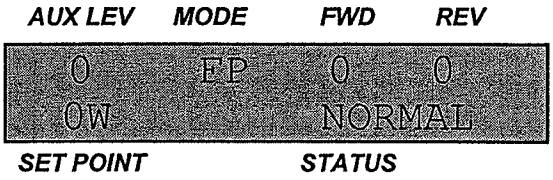
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11. Move the AC mains switch up to the ON position (The **I** symbol should be showing). You should hear the contactor engage. The front panel display should appear as follows:



The display will clear and show the following:



12. From the terminal, you should see the following message:

```
Power up delay in effect-please wait
```

Then the terminal will show the following:

```
ENI monitor on
```

13. The generator is now ready to run RF.

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Chapter 2

System Installation

2.1 Unpacking/Inspection

2.1.1 Mechanical Inspection

If damage to the shipping carton is evident, request the carrier's agent be present when the unit is unpacked. Check for equipment damage and inspect the cabinet and panels for dents and scratches.

2.1.2 Claim for Damage

Please notify ENI directly or your authorized ENI representative if the product is mechanically damaged or fails to meet specifications upon receipt. Retain our shipping carton and packing material for the carrier's inspection as well as for subsequent use to return the unit should this become necessary.

2.1.3 Packaging for Reshipment

Whenever possible, the original shipping carton and packing material should be used for reshipment. If the original packing material is not available, wrap the instrument in heavy paper or plastic. Use a strong shipping container. If a cardboard carton is used, it should be at least 200-lb. test material.

Use shock-absorbing material around all sides of the instrument to provide a firm cushion and to prevent movement inside the container wall on each side. Protect the front panel by means of cardboard spacers inserted between the front panel and the shipping carton. Make sure that the instrument cannot move in the container during shipping. Seal the carton with a good grade of shipping tape and mark the container: **FRAGILE! ELECTRONIC INSTRUMENT.**



Drain water before shipment.

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2.1.4 Accessories Kit

An accessories kit accompanies each GEW-30A unit and consists of the following items:

	ENI Part Number
• Product Manual, GEW-30A	1101-001
• Interlock Cover, RF Output (to be mounted onto rear panel)	000-1101-729
• Label, Non-ionizing EM Radiation Warning Triangle (pre-affixed to top surface of 000-1101-729)	751071
• Terminal Block Cover, AC Input (to be mounted onto rear panel)	000-1101-730
• Strain Relief (pre-installed onto 000-1101-730)	421031
• Label, Lightning Bolt in a Triangle (pre-affixed to top surface of 000-1101-730)	MR5KCAB-029-01
• Label, Exclamation Point in a Triangle, two (one pre-affixed to top surface of 000-1101-729 and one pre-affixed to top surface of 000-1101-730)	MR5KCAB-030-01
• Assembly Drawing, Solenoid Water Valve Installation	007-1096-140
• Bracket, Solenoid Water Valve (to be mounted onto rear panel)	000-1096-710
• Philips Pan Head SEMS Screws (M4 × 12 mm), eight (four for mounting 000-1101-730 onto rear panel, and four for mounting 000-1096-710 onto rear panel)	800031
• S.S. Adapter (1/4" NPT Male × 3/8" O.D. TUBE) (to be installed into Cooling Water Inlet of rear panel)	731057
• Solenoid Water Valve [after first being outfitted with 731088 (which then gets slid over 731057), valve is to be fastened to 000-1096-710 by first removing and then reusing two of its own bolt / lock washer sets (the two sets nearest its Water Outlet)]	731086
• S.S. Adapter (3/8" O.D. TUBE Receptacle × 3/8" NPT Male) (to be installed as adapter between Water Outlet of 731086 and 3/8" O.D. TUBE end of 731057)	731088
• 1/4" Ring-Tongue Terminal (16-22 AWG) (to be installed onto GRN/YEL wire of 731086)	1952
• 2-Pin Receptacle with Screw Terminals, three (wile two have pre-installed 2" loop of 1627, third is to be installed onto RED wires of 731086 as per 007-1096-140)	221465
• 22 AWG Stranded BLK Wire, two 2" lengths (each pre-installed onto a separate 221465 as loop circuit)	1627

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2.1.5 Instructions for Lifting and Carrying

Because the GEW-30A weighs 44 kg (97 lbs), lifting and carrying this unit must be carefully performed by at least two people (properly trained in the lifting and moving of heavy equipment), using a suitable equipment lift cart (with adequate size and load ratings), and only flat, level floor surfaces. Please review section 1.2.5 in this manual for more details.

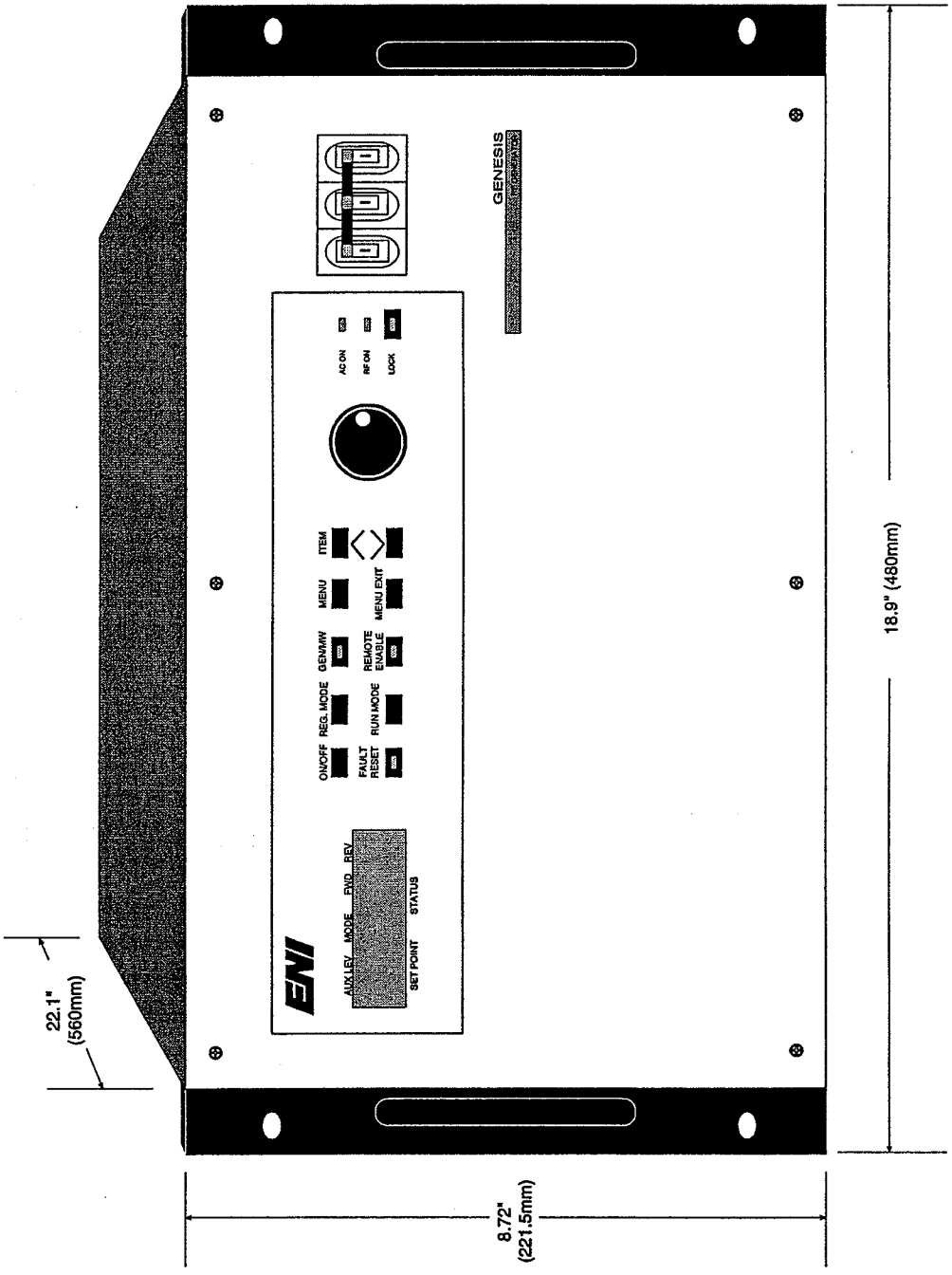
The GEW-30A is equipped with two handles on its forward-facing surface (one each, on the unit's left and right rack-mount brackets; refer to Figure 2.2.1). These handles are provided as convenient gripping points for sliding the unit onto a secured equipment lift cart and/or onto the shelf of a stationary equipment rack.

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2.2 Installation Requirements

2.2.1 GEW-30A Dimension Requirements

The following figure shows the dimension requirements for a standard 19-inch-rack-mounted GEW-30A.



GEW-30A Front & Side Dimension Requirements w/ Fully Functional Front Panel

Figure 2.2.1

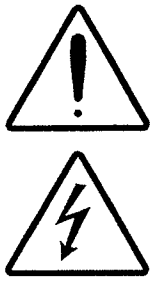
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2.2.2 Power Requirements

The AC Input Ratings of the GEW-30A Generator are indicated on a label attached to its back panel. Those ratings are as follows:

3/PE~ 200-208V 30A 50-60Hz

Upstream Disconnect Device



NRTL listing of model GEW-30A requires that its installation include an upstream current-limiting disconnect device rated 50-60 Hz, 240 V ~ minimum, and no more than 30 A. The upstream disconnect device must be located within sight of the GEW-30A unit, must remain user-accessible at all times, and must be labeled so as to indicate the equipment it disconnects. During installation, removal, and/or servicing of the GEW-30A unit, place the upstream disconnect device into its off (open) position, and follow lock and tag (lock-out/tag-out) procedures to control hazardous energy (reference appropriate regional regulations and requirements). No circuit should be connected or wired when electricity is present.

2.2.3 Equipment Installation (Overvoltage) Category

INSTALLATION CATEGORY II:
Local level, appliances, portable equipment, etc., with smaller transient overvoltages than distribution level and fixed equipment.

2.2.4 Equipment Pollution Degree

POLLUTION DEGREE 2:
Normally only non-conductive pollution occurs. Occasionally, however, a temporary conductivity caused by condensation must be expected.

2.2.5 Equipment Internal Fuse Ratings

Fuses F4, F5, and F6 [ENI Part No. 301016 (Littelfuse Part No. 239003)] on Housekeeping Power Supply PCB Assembly:
3 AT, 250 V.

2.2.6 Equipment Internal Battery Ratings

Lithium Battery BT1 [ENI Part No. 131000 (Renata Part No. CR2477N)] on Control PCB Assembly:
3 V, 950 mAh

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2.2.7 Ventilation Requirements

The GEW-30A generator has rear-panel ventilation openings only. Accordingly, for cooling purposes, installation of this equipment requires that unrestricted access to fresh air be maintained in the region rearward of the equipment rear panel.

2.2.8 Rack Installation

To ensure proper operation of the GEW-30A Genesis, it is important to provide correct mechanical support within a rack installation.

The GEW-30A Genesis generator can be installed in a cabinet assembly. The procedures for this depend upon the type of cabinet used. At the time the unit was ordered, the cabinet type was specified. Information is given below on installing the unit into the most common cabinet assembly.

19-inch Cabinet

The front panel can be ordered with a hole pattern for mounting in a 19" EIA rack. However, the generator must be supported on a rack shelf since the front panel is not strong enough to support the weight of the generator. Ground braid must be connected from the generator ground stud to the chassis ground on the cabinet.



Because of the weight of the generator, extreme caution should be used during installation. Steps should be taken to ensure that the rack will not tip when the unit is extended out of the rack.

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2.3 System Interconnect

The GEW-30A Genesis generator is available with two options for the analog interface and they are:

- No interface card
- 36-pin analog

In order to maintain EMC compliance, cables should be constructed using Alpha Supra-Shield or equivalent cable and metallized backshells providing 360° shield termination. Each of these options is described in detail below and the appropriate pin-out table is also given.

2.3.1 36-pin Analog I/O Interface (ENI P/N: 000-1082-307)

The analog I/O Interface for the GEW-30A generator provides:

PIN	FUNCTION	TYPE	DESCRIPTION
1	+5 V Pull-Up		+5 V supply with 100Ω internal resistor. This is used to power LED's in a remote test box.
2 20	RF ON Input	AO	This TTL input allows RF to be turned on and off when the generator is in remote mode. A logic low is required to turn RF on. Pin 2 is the ground reference.
3 21	INTERLOCK OK INPUT	DI	This TTL input must be low to allow RF to be turned on. Pin 3 is the input; Pin 21 is the ground reference.
4 22	ALARM RESET INPUT	DI	This TTL input allows generator faults to be reset if the generator is in remote mode and the generator is now in an operational state. A falling edge held low for a minimum of 50 ms is required to cause a reset. Pin 4 is the input; Pin 22 is the ground reference.
5 23	REMOTE INPUT	DI	This TTL input puts the generator in remote mode if the front panel has "remote enable" selected. A logic low selects remote mode. Pin 5 is the input; Pin 23 is the ground reference.
6 24	LOAD-LEVELING INPUT	DI	This TTL input is used if option jumpers JP8 and JP9 are installed on the interface board. If in Remote mode, a TTL logic low places the generator in load-leveling mode. Pin 6 is the input; Pin 24 is the ground reference.
8 26	POWER ON READBACK OUTPUT	DO	This open collector output indicates that power is on when Pin 8 is active low. Pin 26 is the ground reference.
9 27	RF ON READBACK OUTPUT	DO	This open collector output indicates that RF is on when Pin 9 is active low. Pin 27 is the ground reference.
10 28	REMOTE READBACK OUTPUT	DO	This open collector output indicates that the generator is in remote mode when Pin 10 is active low. Pin 28 is the ground reference.
11 29	ALARM READBACK OUTPUT	DO	This open collector output indicates that the generator is in a faulted inactive state when Pin 11 is open. Pin 29 is the ground reference. Active low indicates a normal condition.

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PIN	FUNCTION	TYPE	DESCRIPTION
14 32	RF POWER SET INPUT	AI	This analog input allows control of the generator output when the generator is in remote mode. The input is scaled so that a differential value of 10 V causes an output power of 3000 W. Pin 4 is the positive-going input and Pin 32 is the negative-going input of a differential amplifier.
16 34	FORWARD POWER READBACK OUTPUT	AO	This analog output indicates the forward power of the generator. The output is scaled so that a differential output of 10 V represents a Forward Power of 3000 W. Pin 16 is the positive-going output and Pin 34 is the negative-going output. JP10 is set for single-ended DAC output.
17 35	REVERSE POWER READBACK OUTPUT	AO	This analog output indicates the reverse power of the generator. The output is scaled so that a differential output of 10 V represents a Reverse Power of 500 W. Pin 17 is the positive-going output and Pin 35 is the negative-going output. JP11 is set for single-ended DAC output.

DI = Digital Input DO = Digital Output AI = Analog Input AO = Analog Output

Note 1: *For all isolated transistor outputs.*
Transistor OFF (switch open) - VCEmax = 40 VDC (IC < 500 uA)
Transistor ON (switch closed) - ICmax = 10 mA (VCE < 1 V)

Note 2: *For all ground referenced logic level inputs.*
HIGH = 2 VDC min to 30 VDC max.
LOW = -0.2 VDC min to 1 VDC max.

36-pin Analog I/O Interface Pin Outs

Table 2.3.1

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2.4 Remote Digital Interface

The digital interface provides control and monitoring of the generator using standard RS-232 voltage levels in a 7- or 8-bit serial packet. The interface also supports parity and either 1 or 2 stop bits. Data rates may be up to 115.2 k baud.

In order to maintain EMC compliance, cables should be constructed using Alpha Supra-Shield or equivalent cable and metallized backshells providing 360° shield termination.

There is a default communication jumper that is used to provide a starting point if the communication parameters are unknown when the unit is first powered up. Since it is necessary to open the unit up for installation of the default communication jumper, it is only there as a last resort. The default communication parameters are 9600 baud, no parity, 8 data bits and 2 stop bits.

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2.4.1 Communication Configuration

A standard, 9-pin female, filtered, type "D" connector provides the electrical connection as defined in the table below.

Pin	Function	Description
1	N/C	
2	TX RS232	RS-232 Tx data output
3	RX RS232	RS-232 Rx data input
4	N/C	
5	Digital Ground	This pin is connected to the digital ground of the controller.
6	N/C	
7	N/C	
8	N/C	
9	N/C	

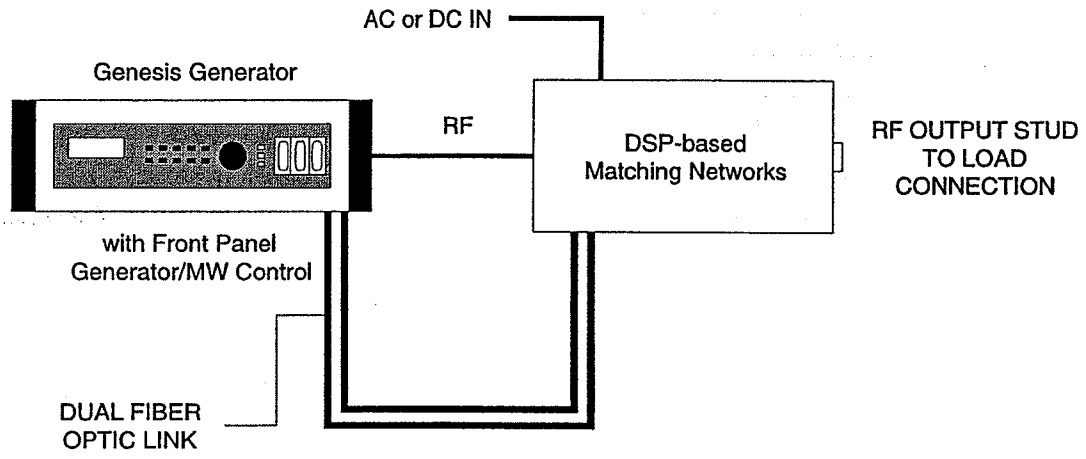
Hardware Configuration for Remote Digital Interface

Table 2.4.1

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2.5 MATCHWORK® Interconnection

The following diagram shows the typical interconnection of a GEW-30A Genesis generator using ENI's DSP-based matching networks with an optional MW local control and a generator front panel MW control. The interconnect consists of three types of cabling: AC power, RF power, and control.



Generator System Interconnection
w/ local front panel MW control from generator
Figure 2.5

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2.6 Safety Interlocks

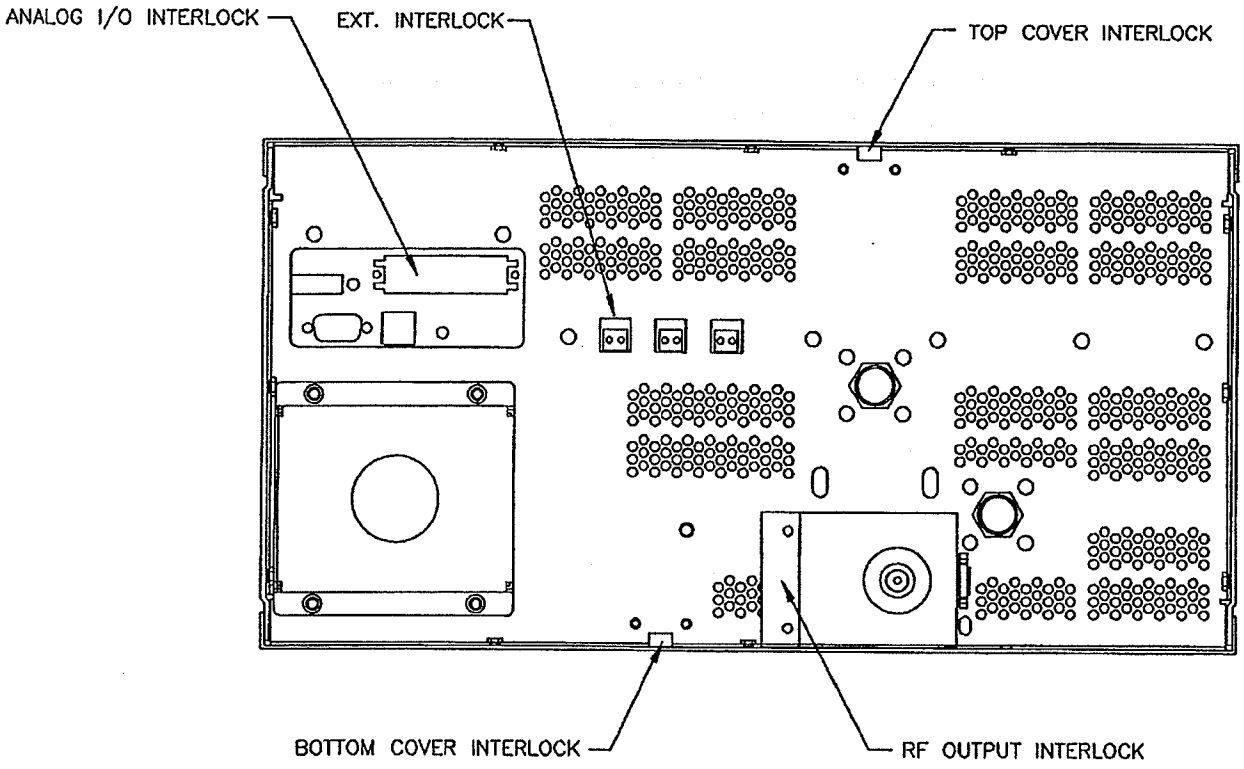
For user safety, the GEW-30A Genesis generator is equipped with a complete interlock system consisting of three switches, an RF output enclosure, an external interlock plug and a circuit closure.

The first switch is on the top cover to the rear; the second switch is on the bottom cover to the rear. Another interlock is under the cover for the RF output. The external interlock plug is located on the rear panel above the RF output cover and is labeled. The final interlock is the Analog I/O Interface, and the circuit closure is via Pins 3 and 21 on the Analog Remote Interface. All five interlocks must be engaged before power to the generator can be activated – both the top cover and the RF cable cover must be fully installed, the external interlock plug has to be in place, and a connection must be made between 3 and 21 of the Analog Interface.

If any of the five interlocks open during operation, the main AC contactor will trip. The contactor cannot be closed until all of the safety interlocks are once again closed. Because the Analog I/O Interface interlock connection (Pins 3 and 21) is software-controlled, it should not be used for user-safety purposes, but for less critical convenience purposes only.

In order to maintain EMC compliance, ferrite cores must be installed on wires to external interlock plugs. Applicable part is ENI P/N 231183 (Fair-Rite P/N 0443167251); correct installation must include three turns of the interlock wires around the ferrite core. Care should be taken to position the wrapped core as close to the generator rear panel as possible.

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GEW-30A Safety Interlock Locations - Rear View

Figure 2.6

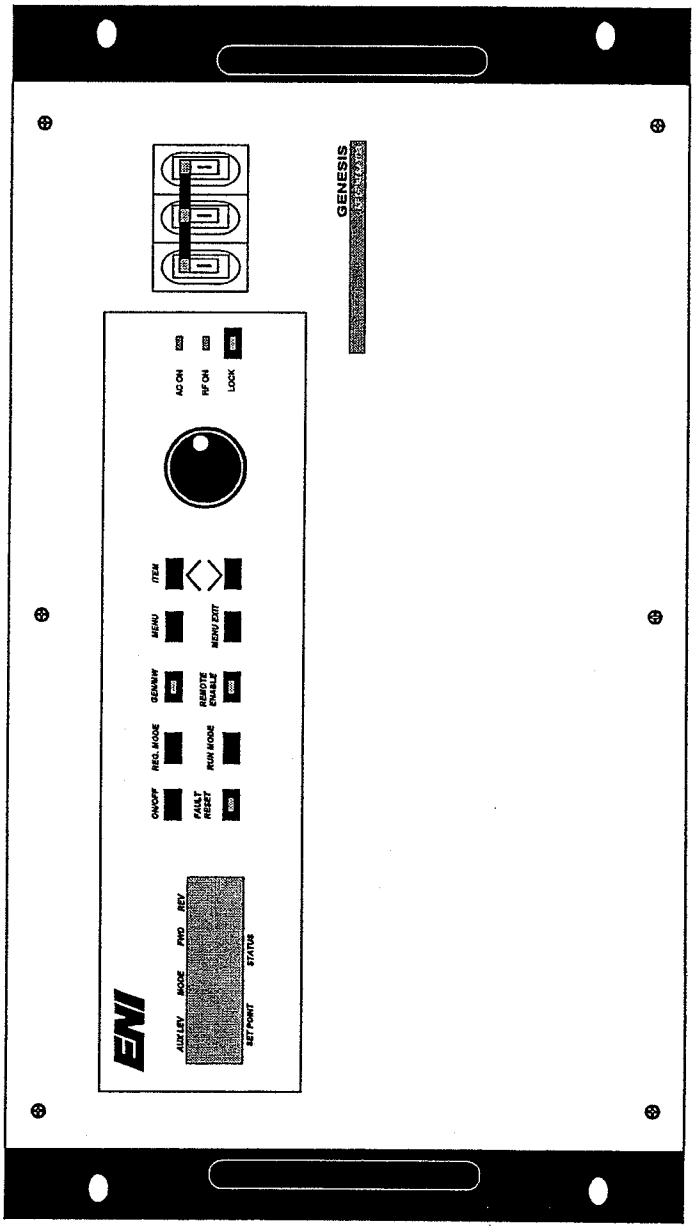
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2.7 Panels and Controls

This section describes in detail all the front and rear panel controls and connections that are used on your generator.

2.7.1 Front Panel

Eleven buttons and a digitizing knob are provided for normal control and setup of the generator.



GEW-30A Front View with a Fully Functional Front Panel

Figure 2.7.1a

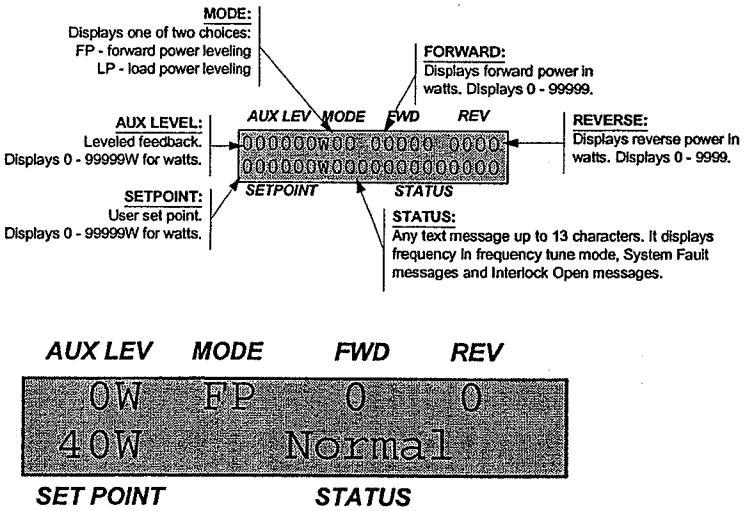
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Display

The display is a backlit Liquid Crystal Display that can display two rows of 20 characters. Items that are shown on the display are grouped into two main categories. The top line of the display is used to show the output of the Genesis RF Generator regardless of the controlling source (i.e., front panel or ENI monitor).

The AUX LEV, FWD, and REV fields cannot be changed by the user. These fields will change, however, depending upon the status of the generator. The AUX LEV (Aux. Level) will show the current output level. If in Load Leveling, it will show load power. If in Forward Leveling, it will show FWD power. The FWD field shows the amount of power in watts that is applied as forward power. The REV field shows the amount of power in watts that is applied as reverse power. The MODE field is used to show the leveling mode that is currently in use. The possible choices for this field read FP for forward power and LP for load power.

The second line shows the set point in watts and the status portion of the display will indicate "NORMAL".



Example of display

Figure 2.7.1b

LEDs

There are a total of six LEDs in the front panel. Three are positioned to the right of the digitizer knob (one in the LOCK button) and the other three are located in three of the buttons on the front panel (Fault Reset, Gen/MW, Remote Enable) to the left of the digitizer knob.

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Controls

Buttons for Normal Operation

Seven buttons are used for normal control of the GEW-30A Genesis RF Generator. These buttons allow control of the following functions:

- Display the status of the generator or the attached matching network.
- RF output On/Off
- Fault Reset
- Selection of Menu and Menu Exit
- Menu Item up and down
- Front Panel lock

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Button	Description
GEN/MW 	This button is used when the generator is connected to a matching network. When the LED in the button is extinguished, the front panel is controlling and monitoring the generator, and when the LED is lit, the front panel is controlling and monitoring the matching network. Control and monitoring of the generator and the matching network is toggled by pressing this button.
ON/OFF 	This button is used to enable and disable the RF output from the generator. Pressing the button will turn the RF ON LED (to the right of the digitizer knob) on and pressing it again will turn the RF ON LED off, disabling RF output.
FAULT RESET 	This button is used to clear any faults that occur in the generator. When a fault occurs, the FAULT RESET LED will illuminate. To clear the fault, the button should be pressed. If the fault can be cleared, the LED will extinguish.
MENU 	This button is used to access the menu(s) to change system and generator settings.
MENU EXIT 	This button is used to exit the menu(s) and return to the normal display.
	These two buttons move the menu option selection up or down.
LOCK 	This button will lock the front panel to prevent any changes using the front panel digitizer knob and the other buttons except for the LOCK button. To unlock the front panel, the LOCK button should be pressed again and the LED will extinguish.

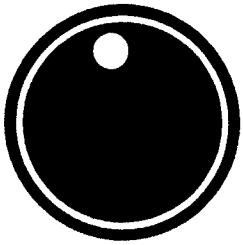
GEW-30A Front Panel Buttons

Table 2.7.1

Chapter 3 will go into more detail on how to use these controls to change the settings of the generator.

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ADJUST Knob



Front Panel ADJUST Knob
Figure 2.7.1a

The ADJUST Knob (also known as the digitizer knob) is used to select a certain value in the menu options or on the normal display. It is only available on the Fully Functional Front Panel and Remote Front Panel. Without entering any of the menus, the digitizer knob can only be used to change the value of the set point from 0 W to 3000 W. Rotating the knob clockwise increases the subject value and rotating it counter-clockwise decreases the value. Also, rotating the knob "faster" results in larger value changes (coarse adjustment), and rotating it "slower" results in smaller value changes (fine adjustment).

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2.7.2 Rear Panel

Connections

The following table briefly describes all of the rear panel connections for the GEW-30A Genesis Generator.

Connector	Description
Water In	This connection provides for water to flow into the generator for cooling purposes. It is designed for ¼" male (NPT) pipe thread.
Water Out	This connection provides for water to flow out of the generator for cooling purposes. It is designed for ¼" male (NPT) pipe thread.
RF Output	Provides RF power to the plasma chamber. The type of connector is specified at the time the unit is ordered.
Water Flow Readback	This two-pin connection is provided to enable the DSP controller to monitor the condition of water flow into and out of the generator.
24 V Solenoid Supply	This two-pin connection is provided for use with the standard solenoid kit.
External Interlock	This two-pin safety interlock must be shorted to allow the generator to operate. A plug is provided in the accessories kit to allow the interlock to be shorted. Removal of the plug disables the interlock.
Analog I/O Interface	The analog interface uses a 36-pin connector, but can also be any interface specified by the customer. Customized interface cards can be installed. A user interlock exists in Pins 3 and 21. (Other Interfaces are supported.)
DC Bias Input	This connector has an SMB-type jack for DC Bias Leveling feedback.
AC Input	This connection is used to provide the AC power to the unit. The following AC Input Ratings apply: 3/PE~ 200-208V 30A 50-60Hz
Digital MW Fiber Optic	These two connections are for two optional fiber optic cables (one to send data and one to receive data) to connect the generator to an optional remote front panel.
Remote Front Panel	This connection is a six-pin modular connector.
Serial Interface	This interface is used to connect the generator to a terminal. The standard is a Subminiature Type "D" 9-pin digital connection.
External RF Input	This connection is optional and is an SMB jack used for an external RF source. Customized interface cards can be installed.

GEW-30A Rear Panel Connections

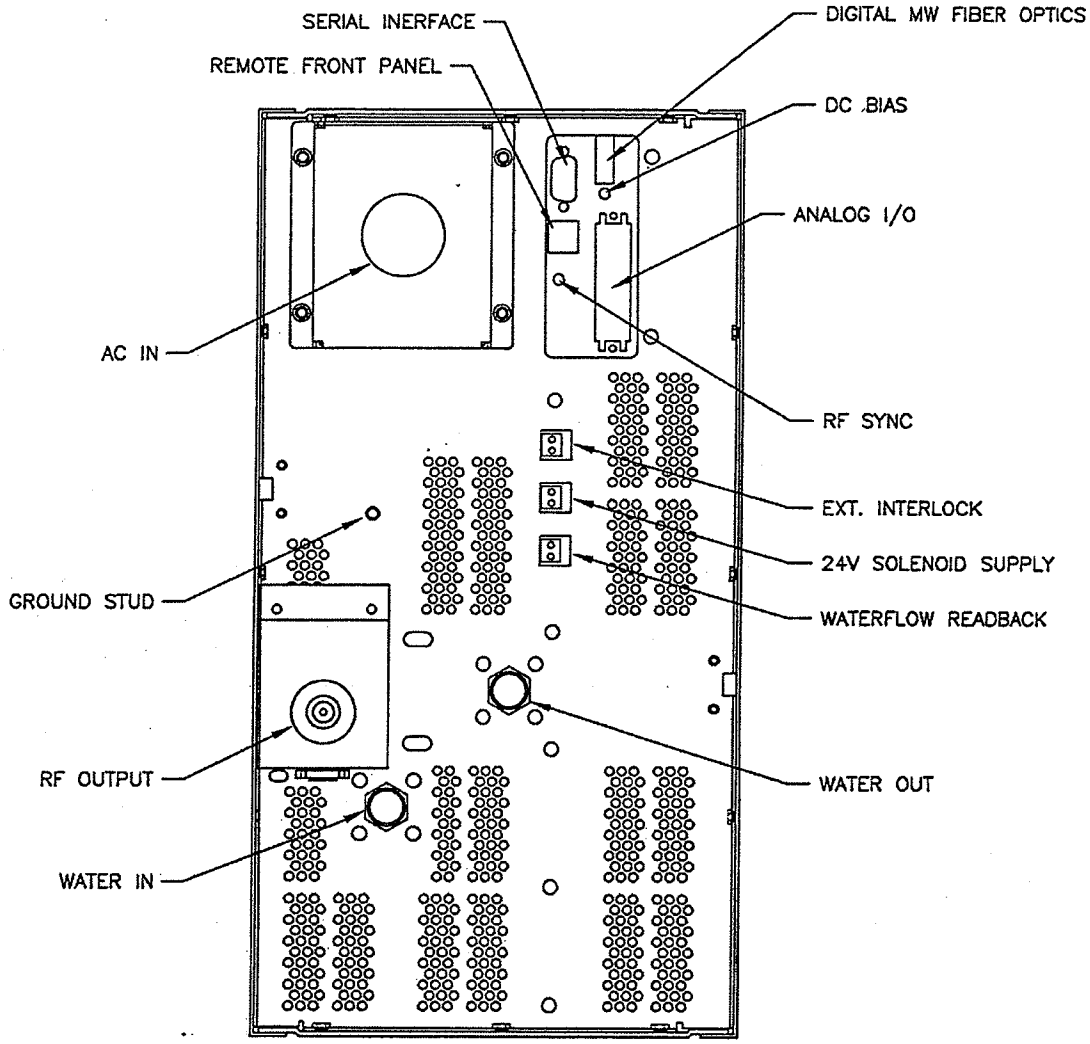
Table 2.7.2

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Rear Panel Drawing

Figure 2.7.2 shows the rear panel for the GEW-30A Genesis Generator and calls out each of the connectors as described in the table from the previous page.

In order to maintain EMC compliance, wires to external interlock plugs (Ext. Interlock, 24 V Solenoid Value and Water Flow Readback) must be wound 3 times on a ferrite core, ENI P/N 231183 (Fair-Rite P/N 0443167251), positioned as close to the rear panel as possible.

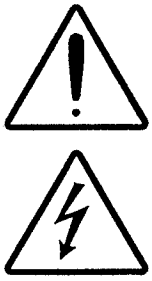


GEW-30A Genesis Rear Panel View
Figure 2.7.2

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2.8 AC Power Connections

The AC power source requirements for model GEW-30A are described in section 2.2.2 of this product manual.



During installation, removal, and/or maintenance of the GEW-30A unit, place the upstream disconnect device into its off (open) position, and follow lock and tag (lock-out/tag-out) procedures to control hazardous energy (reference appropriate regional regulations and requirements). Installation, removal, and/or maintenance of the GEW-30A unit should not be performed when electricity is present. Please refer to section 2.2.2 of this product manual for additional information.

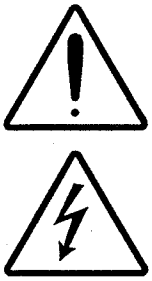
On its back panel, the GEW-30A Generator features an AC Input terminal block (see Figure 2.7.2) for connection to AC power. Consequently, NRTL listing of this unit requires that it be permanently installed into an equipment rack. The terminal block is equipped with four size-M6 screw terminals, which are compatible with ¼" ring-tongue wire terminations. An adhesive label (affixed to the generator back panel and positioned directly below the terminal block) identifies the function of each screw terminal. Please note that the screw terminal closest to the center of the unit is connected to the generator chassis and serves as the Protective Earth (Ground) connection point for the generator. This terminal must be correspondingly connected to frame ground through the AC distribution panel of the system. As the AC Input connections are made, the screw terminals on the terminal block shall be tightened to the required 30 kgf·cm torque specification identified by the terminal block manufacturer.



This equipment is identified as having a characteristic earth leakage current in excess of 3.5 mA. As such, proper earth connection to the equipment is essential and must be made before connecting the AC power source.

An AC Input terminal block cover outfitted with a line cord strain relief and eight Philips Pan Head SEMS screws (M4 × 12 mm) are among the items included in the accessories kit that accompanies each GEW-30A generator. Four of the SEMS screws are provided for mounting the terminal block cover to the unit's rear panel, and an installation torque specification of 18-20 in·lbs applies. An AC line cord assembly is not provided with the GEW-30A.

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Because an AC line cord assembly is not provided with model GEW-30A, NRTL listing of this unit applies certain related installation component selection restrictions. Accordingly, for each component type listed below, only candidates having all of the indicated attributes are to be considered acceptable for installation and subsequent use to power the GEW-30A.

Cordage:
1. Must be NRTL listed.
2. Must have 240 V voltage rating minimum.
3. Must have 90°C temperature rating minimum.
4. Must have copper conductors.
5. Must be capable of handling 30 A under operating ambient temperature.
6. Must have overall O.D. compatible with the 18 - 25 mm O.D. range rating of the strain relief provided.

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2.9 Cooling Water Requirements

The safe operating ambient air temperature range for the GEW-30A generator is a minimum of 5°C and maximum of 40°C. The generator requires water to cool the unit during operation. The recommended flow of water into and out of the generator is a minimum of 7.5 liters (2.0 gallons) per minute at a maximum pressure of 60 psi. The temperature of the cooling water must be between +5°C and +35°C. The water inlet and outlet fittings are ¼" female NPT pipe on the rear panel and have been designed to accept ¼" male (NPT) pipe thread.



If conditions exist where the water coolant temperature is below the ambient dew point temperature, ENI recommends that either 1) in-line solenoid valves be installed on the water connections to the generator and be closed when generator RF power is off or 2) coolant water temperature be adjusted to prevent condensation.

Follow this recommendation to prevent condensation from forming when the generator is off; failure to do so may result in extensive damage to the generator! Contact ENI Service for more information.

A solenoid water valve and related installation components are among the items included in the accessories kit which accompanies each GEW-30A generator. A complete list of items in the accessories kit can be found in section 2.1.4 of this product manual.

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2.9.1 Water Fittings Connection

Leak-free water connections are necessary for generator reliability. To ensure this, the following procedure must be followed for all ¼-inch NPT pipe fittings. The materials and parts needed for this procedure are:

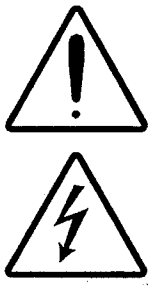
- Teflon tape, 0.5 in. (ENI P/N: 521257)
- Torque wrench as specified below.

1. Check fittings' and water ports' pipe threads for metal splinters, signs of cross-threading (e.g., channel cut across the threads), impact damage, or signs of excessive wear. Repair or replace parts as necessary. Remove all pieces of used Teflon pipe tape.
2. Wrap Teflon pipe tape around the threaded male portion of the fittings.
   - Use new tape each time you make a connection.
   - Wrap the tape so it will tighten into the threads when you screw in the fittings. Pointing the fitting towards yourself, make the tape wrap in a clockwise (CW) direction.
   - Wrap tightly and make two (2) layers of tape around the fittings' threads.
3. Screw in fittings carefully by hand, "hand-tight" only.
4. Ensure that the unit's water ports will not twist when the connections are tightened further. If the unit does not have a built-in hex bracket or water guard retrofit for the water ports, brace the ports with an open-end wrench.
5. Use a torque wrench to tighten fittings to **150 to 170 lb.-in. or 12.5 to 14.2 lb.-ft. range.** (Metric equivalents: 1.73 kg-m to 1.96 kg-m and 16.9 N-m to 19.2 N-m.) Service centers and Manufacturing use calibrated 150-lb. wrenches.
6. If water leaks through the connection just made, **do not tighten fitting further! Undo the connection and repeat** the procedure with an extra layer of Teflon tape on the fitting.

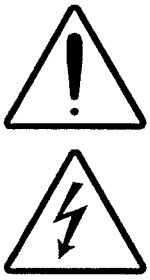
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2.10 Maintenance & Cleaning

The GEW-30A generator is designed and built to require only the following minimal cleaning and maintenance. It is recommended that the unit be periodically wiped down on the outside with a damp cloth to remove any build-up of dust and dirt.



During maintenance and/or cleaning of the GEW-30A unit, place the upstream disconnect device into its off (open) position, and follow lock and tag (lock-out/tag-out) procedures to control hazardous energy (reference appropriate regional regulations and requirements). Maintenance and/or cleaning of the GEW-30A unit should not be performed when electricity is present. Please refer to section 2.2 of this product manual for additional information.



This equipment contains NO USER SERVICEABLE PARTS. In the event that equipment servicing is required, please contact an authorized ENI service center.

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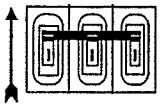
2.11 System Check

Before the GEW-30A Genesis generator can be used, it is imperative that the following system check be done to ensure optimal and safe operation.

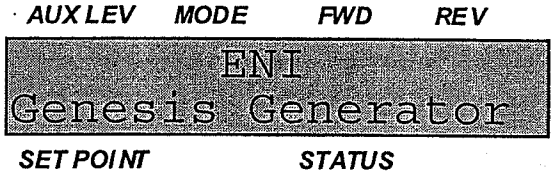
1. Make sure the solenoid plug is attached to the solenoid connector on the rear panel marked "SOLENOID." (See section 2.9.)
2. Assure that the water hoses are securely connected to the water connectors on the rear panel. (See section 2.9 for more information on the connectors.)
3. Check that the external interlock plug is inserted in the interlock connector on the rear panel marked "INTERLOCK." AC Power contactor will not engage until this interlock is defeated (plugged). (See section 2.6 for more information about the safety interlocks.)
4. Make sure that the AC supply is connected and that it is 208 VAC, 3-phase. (See section 2.8 for more information on AC Power Requirements.)
5. Check that the RS-232 serial cable is connected to the 9-pin D-type serial connector on the rear panel.
6. Be sure the Analog Interface is connected to the 36-pin analog I/O connector on the rear panel.
7. Assure that the RF output cable is connected to the RF Output connector on the rear panel.
8. Check that the RF output cover is on, closing the RF interlock. AC Power will not engage until this interlock is closed.

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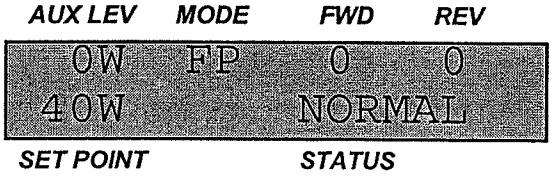
2.12 Initial Power Up



1. Move the AC mains switch up to the ON position (The **I** symbol should be showing). You should hear the contactor engage. The front panel display should appear as follows:



2. The following display is shown after contact closure.



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Chapter 3

GEW-30A Genesis Operation

Simple operation has been designed into the GEW-30A Genesis generator to accommodate various plasma applications. User input has been simplified to require just a few parameters.

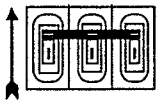
3.1 Basic Operation

The GEW-30A Genesis generator is designed to be used with minimal input from the user.

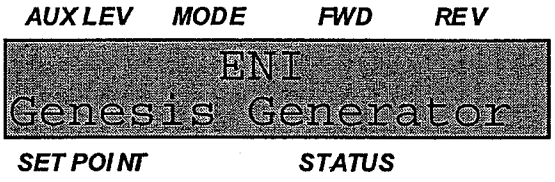
3.1.1 Generator Operation through the Front Panel

Turning on AC Mains Power

Before operation of the front panel begins, make sure the system check has been performed in section 2.11. After that has been done, the generator should be turned on. To do this, follow the procedure below:

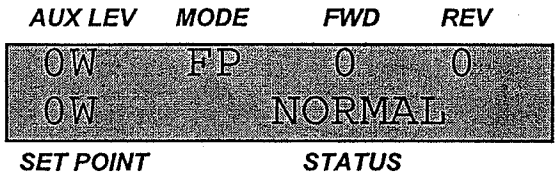


Move the AC mains switch up to the ON position (The **I** symbol should be showing). You should hear the contactor engage. The front panel display should appear as follows:



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After the contactor is engaged, the front panel should appear as follows:



Ensuring that the Front Panel/Remote Front Panel is unLOCKed

LOCK

The LOCK LED must be off to use the front panel. Push the LOCK button to turn the LED off.

The LOCK button prevents all front panel controls (except the Lock button itself) from working. This provides protection against inadvertent movement of the rotary knob. An LED inside the button is turned on to indicate that the lock function is active. The LOCK condition, when active, locks out the entire front panel (except for the LOCK button itself).

Setting the RF power

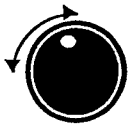
Next, the amount of power in watts has to be set and RF power has to be requested.

To request RF power, do the following:

ON/OFF

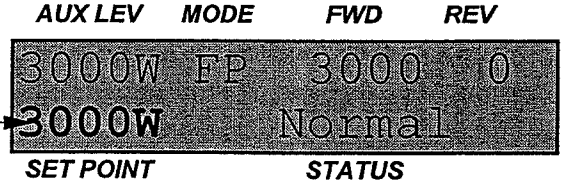
1. Press the ON/OFF button first to enable the RF power output. The RF ON LED will illuminate (located to the right of the digitizer knob and to the left of the circuit breaker).

RF ON



2. Use the digitizer knob to set the amount of power in watts from 0 W to 3000 W. Watch the display until the desired wattage appears on the second line above the set point field.

This field will change from 0 - 9999W by using the digitizer knob



"NORMAL" will be displayed in the ***STATUS*** field rather than a frequency.

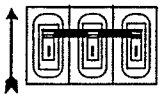
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3.1.2 Generator Operation through the ENI Monitor

This section details how to operate the GEW-30A Genesis Generator using the ENI Monitor.

Turning on the generator

Before any of the various settings can be set, the generator should be turned on.



Move the AC mains switch up to the ON position, if it is not on already. The following display should appear:

```
Power Up Delay in effect, please wait
```

The display will clear, then display the following:

```
ENI Monitor ON
```

Ensuring that the ENI Monitor has control

<CR>

*****

A prompt (*) should appear after a carriage return is entered. If the unit is in remote mode, the terminal should not have control. A question mark (?) should be returned at the terminal.

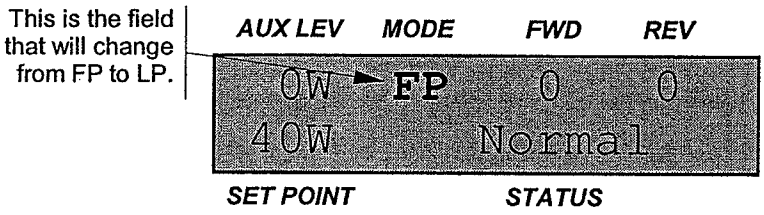
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Selecting the mode of operation

Presently there are two modes of operation supported by the generator. The choices are: FP for forward power leveling and LP for load power leveling. They are not accessible through the front panel and can only be changed through the ENI monitor.

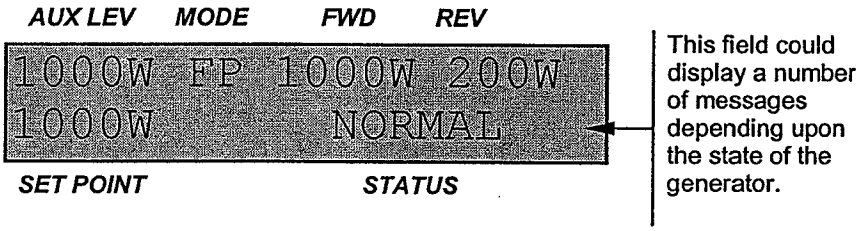
To select the mode, do the following:

1. At the command prompt (*), type the LLT command with a 0 or 1 and press ENTER.



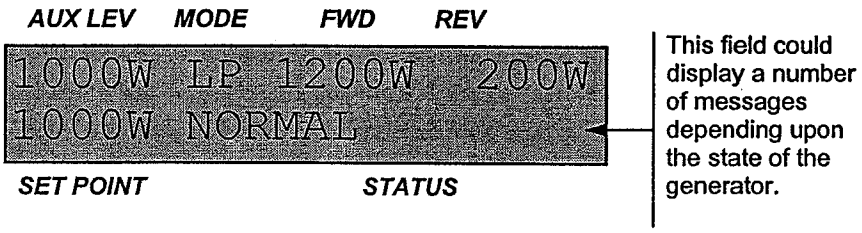
LLT0 **<CR>**

Typing LLT0 forces the mode into forward power leveling. The following example uses FP for the MODE. The front panel will display the following assuming a set point of 1000 W and 200 W reflected is set.



LLT1 **<CR>**

Typing LLT1 forces the mode into load power leveling. The following example uses LP for the MODE. In this case, load can mean forward or reverse power. The front panel will display the following assuming a set point of 1000 W and 200 W reflected is set.



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Changing the requested power

Once the ENI monitor has established control of the generator, the requested power can be entered.

OEM XXXX <CR>

1. Type the command **OEM XXXX** from the ENI Monitor keyboard and press Enter. You can enter in place of XXXX any value from 0 to 3000. This is the number of watts you want the generator to be set to produce. The value you entered should appear on the Front Panel display under the SET POINT field.

RSE <-> <CR>

2. Type the command **RSE** to return the set point to the ENI monitor. The escape key can be used to escape the continuous monitoring.

To request RF power, do the following:

TRG <CR>

3. Type the command **TRG** from the ENI Monitor keyboard and press Enter. The RF ON LED will illuminate (located to the right of the digitizer knob and to the left of the circuit breaker). To turn off the RF power, type **OFF** from the ENI Monitor keyboard.

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3.1.3 Matching Network Configuration for Generator Control

Operating the Matching Network through the ENI Monitor is possible with the entire line of Genesis generators.

Setting up the MATCHWORK® for Generator control

Control of the MW is possible through the generator upon setting the MATCHWORK into generator control mode. To do this, you must establish communications with the MATCHWORK and perform the following steps:

KEY1234 **<CR>**

1. To enter the CAL menu, the Level B commands must be accessed. Type KEY1234 and press ENTER.

CAL

2. At the command prompt, type the command CAL.
   Note: Do not type CAL9 directly, you will not be able to save any of the changes.
   The matching network will attempt to communicate with the generator immediately, even though there is no connection between the two, and a flurry of information will appear across the screen disabling any further communications.

3. A menu of numbered options appears.

```
*CAL
MATCH WORK SETUP PROCEDURE 6-13-96


[ MATCHWORK CALIBRATION MENU ]
[ Press :
   1    - For Cal Starting point

   3    - For Matchwork DC Bias Cal
   4    - For Matchwork Vp-p Cal
   5    - For Matchwork V protect Cal
   6    - For Matchwork Sensors Cal
   7    - For Matchwork Low Power Cal
   8    - For C1 and C2 Capacitor Position Cal

   9    - For Switch Selection

   E    - To  View Calibration Settings
   F    - To  Save Calibration Permanently & Exit

{ENTER} - to EXIT now ]
```

9 **<CR>**

4. Select and enter number 9 - Switch Selections.

```
[ SWITCH SELECTION ]
[ Press :
   1    - To Toggle Control Type,  Host/Front/Gen/Aux
   2    - To Roll Matchwork Type,  MW10LD/MW20LD/40MHz

{ENTER} - to EXIT now ]
```

1 **<CR>**

5. Select option 1, the Gen control option, following the menu directions and then press ENTER.

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F

6. You will see the CAL menu again. Type F to save the changes and exit.

```
*CAL
MATCH WORK SETUP PROCEDURE 6-13-96


[ MATCHWORK CALIBRATION MENU ]
[ Press :
   1    - For Cal Starting point

   3    - For Matchwork DC Bias Cal
   4    - For Matchwork Vp-p Cal
   5    - For Matchwork V protect Cal
   6    - For Matchwork Sensors Cal
   7    - For Matchwork Low Power Cal
   8    - For C1 and C2 Capacitor Position Cal

   9    - For Switch Selection

   E    - To  View Calibration Settings
   F    - To  Save Calibration Permanently & Exit

{ENTER} - to EXIT now ]
```

A flurry of information will be seen until you disconnect the communication line.

7. Now connect the fiber optic link from the MW to the generator's MW interface connector.

8. The MATCHWORK® is now in generator control mode.

Note: *Communications with the MATCHWORK require an RS-232-to-Fiber-Optic convertor (ENI P/N: MWI-232-01).*

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3.1.4 Matching Network Operation through the Generator

The GEW-30A Genesis Generator can control and view the output of the matching network on the generator's front panel once the MATCHWORK® is set up in generator control mode.

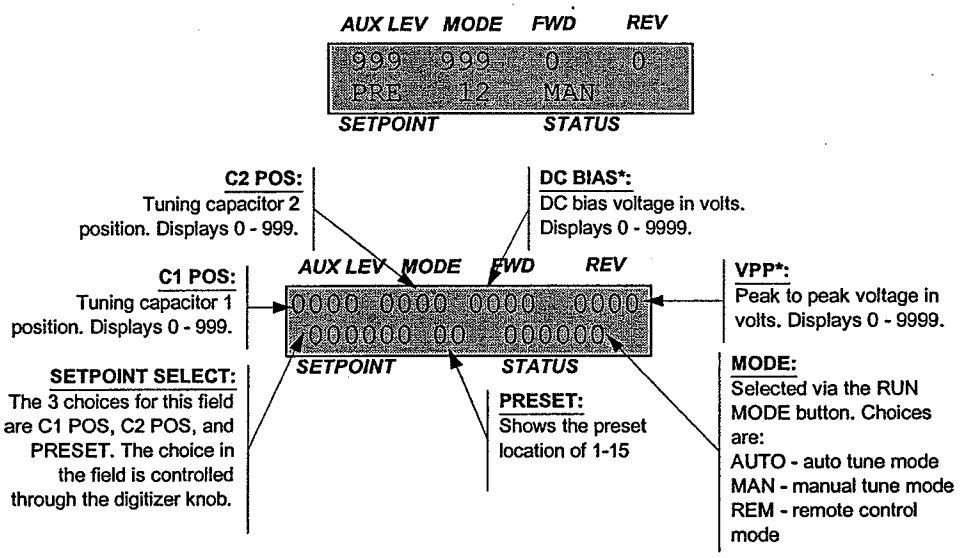
Activating the front panel to display MW status/Readbacks

To display the status of the connected matching network, complete the following steps:

GEN/MW

1. Press the GEN/MW button on the front panel to switch the display from showing the status of the generator to that of the matching network.

2. The display should look like this:



* = These fields are for readback status. They cannot be changed by the user.

GEN/MW

3. Pressing the GEN/MW button again will return the display to showing the status of the generator.

4. Use the ITEM ^ and v to change control of C1, C2 and presets.

RUN MODE

5. Pressing the RUN MODE button will switch from manual to Auto-Tune.

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3.1.5 Changing the Matching Network parameters

In setting up the MATCHWORK® fields, it is possible to do the following from the front panel:

- Manually tune the position of C1 or C2
- Manually recall any previously saved presets

Note: *Preset values cannot be created at this time.*

- Toggle between the three control modes: (MAN) Manual, AUTO and REM (Remote) mode.
- View DC Bias or Vpp fields while RF is on.

Note: *The DC Bias and Vpp fields are simply reporting fields and the values cannot be changed.*

The specifics for these fields will depend upon the application you are using.

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3.2 ENI Monitor Software Commands

The commands that are available to the user using the ENI monitor for the GEW-30A Genesis Generator are grouped into five different categories.

- Basic Monitor
- Generator Control
- Generator Readback
- MATCHWORK® Control
- MATCHWORK Readback

3.2.1 Basic Monitor

The basic monitor commands allow the user limited access to the Controller software.

Command	Options	Description
CHK	**<x/y>**	Returns software checksum.
HEL	**<x>**	x = help screen number The HEL command displays one of N help screens, depending upon the key level in effect at the time and the user argument supplied with the command. Typing HEL or HEL0 displays the top-level help-screen menu appropriate for the key level that is in effect at the moment. The menu for key level 0 has 10 options. The menu for key level A has 11 options. The user argument may be any valid hexadecimal character (0...9, A...F). If there is no corresponding help screen for the supplied argument, the top-level screen is displayed. For example, if you type HELC while at key level 0, the system will display the top-level help screen for key level 0.
IDE*	**<n>**	This command will select the ENI device that will be transmitting on the bus while all other devices tri-state their transmitters. An **IDE n<cr>** will change the address of the device transmitting on the bus while all other devices tri-state their transmitters and enter into *listen mode*. An **IDE<cr>** will be interpreted as an address of **00H.** **<n>** = any valid address from ***0-FFH***
KEY	**0/1234**	Set Key level (0=basic, 1234 enables level A)
LIT*		Disable serial link integrity checking.

Basic Monitor Commands

Table 3.2.1

* *These commands are available in version 1.1 of the software and any versions that follow it.*

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3.2.2 Generator Control

The generator control commands allow the user to control some of the operation of the generator from the ENI Monitor.

Command	Options	Description
EKO	**<x>**	0 = Enables Monitor Echo of input commands. 1 = Disables Monitor Echo of input commands.
FRE		The FRE command resets any system faults caused in the generator.
LLT	**<n>**	Selects the control loop leveling method. **n = 0** Forward power leveling **n = 1** Load power leveling
OEM	**<x>**	x = number of watts from 0 to 3000 The OEM command allows the user to set the number of watts for the RF output power level.
OFF		This command allows the user to turn OFF the RF power.
SBD*	**<baud rate>**	Sets the Monitor baud rate: 0 = 300, 1 = 600, 2 = 1200, 3 = 2400, 4 = 4800, 5 = 9600, 6 = 19200, 7 = 38400, 9 = 115200
TRG		This command allows the user to turn ON the RF power.

Generator Control Commands

Table 3.2.2.

* *These commands are available in version 1.1 of the software and any versions that follow it.*

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3.2.3 Generator Readback

These commands are used to read back operating status information on the generator. Commands that show the optional dash parameter **<->** can read back continuously if this option is used. Pressing the **ESC** key, or sending an escape character (1Bh) will break the continuous loop.

Command	Options	Description
MON	**<n>**	Returns the current value of a specified generator operating parameter that may be useful for debugging system problems. n = a hex number from 0-F that specifies the parameter to monitor. MON 0 will recall a menu of available parameters.
RFV	**<=>**	Returns a 16-bit hex value that represents the generator's current fault status. If the = option is used, verbose words will be output instead of a 16-bit number. Each bit is defined as follows: BIT 0 RF Overheat BIT 1 Fan Fault BIT 2 Driver Voltage Fault BIT 3 PSU Voltage Limit BIT 4 Forward Power Fault BIT 5 Reverse Power Fault BIT 6 PSU Current Limit BIT 7 Dissipation Power Limit BIT 8 - 15 Not Used
ROD	**< - >**	Returns the generator's current dissipated power in watts.
ROF	**< - >**	Returns the generator's current forward power in watts.
ROL	**< - >**	Returns the generator's current load power in watts.
ROR	**< - >**	Returns the generator's current reflected power in watts.
RPS	**< = > verbose**	Returns an 8-bit hex value that represents the generator's current operating status. Each bit is defined as follows for the bit = 1 (set); the opposite state is true when the bit = 0 (cleared). BIT 0 Analog Remote Mode BIT 1 Load Power Leveling BIT 2 System Fault BIT 3 Interlock Open BIT 4 Max. Power Condition BIT 5 RF On BIT 6 Digital Remote Mode BIT 7 External RF Used BIT 8 Auto Fault Reset Mode BIT 9 Echo OFF Mode BIT 10 Not Used BIT 11 Not Used BIT 12 Freq. Tuning Mode BIT 13 Not Used BIT 14 Pulse Power Mode BIT 15 General Protection Disabled
RSE	**< - >**	Returns the current set point power level in watts.
RVE	**< = > verbose**	Returns the version number of the software currently installed on the control board.

Generator Readback Commands

Table 3.2.3

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3.2.4 MATCHWORK® Control

The following commands allow the user to directly control the Matching Network using the ENI Monitor:

Command	Options	Description
AUT		Forces the MATCHWORK into Auto Tune mode.
MAN		Forces the MATCHWORK into Manual Tune mode.
RCL	< 1-30 > < A - F >	Causes one of 36 stored capacitor positions to be recalled. This command can only be used in Manual Tune Mode.
SCO	<0-999>	Sets the C1 tuning capacitor position. The number following SCO represents a percentage (0 - 99.9%) of the full range of the capacitor. This command can only be used in Manual Tune mode.
SCT	<0-999>	Sets the C2 tuning capacitor position. The number following SCT represents a percentage (0 - 99.9%) of the full range of the capacitor. This command can only be used in Manual Tune mode.
SDT	<0-999>	Causes the MATCHWORK to delay before auto tuning begins. The time is set in 100 ms steps allowing a maximum time of 99.9 s before tuning begins.
STO	< 1-30 > < A - F >	Causes the current capacitor positions to be stored into one of 36 preset locations. This command can only be used in Manual Tune Mode.

MATCHWORK Control Commands

Table 3.2.4

Note: *The Matching Network needs to be connected to the generator per Figure 2.5 and set up according to section 3.1.3.*

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3.2.5 MATCHWORK® Readback via the Generator

These commands are used to cause information to be read back from the MATCHWORK. Commands that show the optional dash parameter **<->** can read back continuously if this option is used. Pressing the **ESC** key or sending an escape character (1Bh) will break the continuous loop.

Command	Options	Description
POW	**<->**	Causes the forward power through the MATCHWORK to be returned.
RCO		Causes the C1 capacitor position to be read back. A value for 0-999 will be returned representing the percentage (0-99.9%) of the full tuning range of the capacitor.
RCT		Causes the C2 capacitor position to be read back. A value for 0-999 will be returned representing the percentage (0-99.9%) of the full tuning range of the capacitor.
RDC	**<->**	Causes the DC Bias value to be returned (calibrated in volts).
RMG	**<->**	Causes the magnitude error at the input of the MATCHWORK to be returned.
ROT	**<=>**	Returns the amount of time that RF has been passed through the MATCHWORK. If ROT is typed alone, the value returned is the amount of time in hours only. If the <=> option is used, the value returned will be in the HH.MM.SS format.
RPH	**<->**	Causes the phase error at the input of the MATCHWORK to be returned.
RPP	**<->**	Causes the peak-to-peak voltage measured at the output stud to be returned. This command is only useful if the optional Vpp circuit is installed in the controller unit. If the circuit is not installed, random values may be returned.
RUT	**<=>**	Returns the amount of time the MATCHWORK has been powered on. If RUT is typed alone, the value returned is the amount of time in hours only. If the <=> option is used, the value returned will be in the HH.MM.SS format.

MATCHWORK Readback Commands

Table 3.2.5

Note: *The Matching Network needs to be connected to the generator per Figure 2.5 and set up according to section 3.1.3.*

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3.3 Remote Control Interface Communication Protocol

Data is transferred to and from the CPU using a simple ASCII protocol that functions with a standard terminal.

All ENI monitor commands are composed of three ASCII characters followed by numbers where applicable, terminated by a carriage return. All three command characters must be correct for a command to be accepted. All characters sent to the GEW-30A Genesis Generator over the ENI Monitor port are echoed by the generator. Thus, if the serial port is being driven by a computer, the computer can verify that the generator received the characters that were sent to it.

Commands containing numerical fields will only be accepted if the numerical portion is in a specified range.

Upon receipt of a carriage return (0x0D), the controller returns a carriage return and a line feed (0x0A) so that the terminal screen is correctly formatted. In addition, an asterisk (*) is used to indicate that the command has been accepted and executed. If an unrecognized command is received, a question mark (?) and bell character (0x07) are returned instead. The response is ordered as follows:

```
CR LF *      or
CR LF BEL ?
```

The ENI Monitor always returns one of these two responses after command execution. In addition, with the exception of the power up messages, there are no unprompted responses.

The following commands give an example of the types of messages that are available and their format:

HEL3	Causes Help screen number 3 to print.
RFV	Causes a 16-bit fault vector to be reported showing the system health.
RSE	Returns continuous readback of the set point.

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3.3.1 Space Characters

Commands sent to the generator may include space characters (0x20) as desired. The generator will echo such characters back to the sender, but will otherwise ignore them. Space characters are *not* saved in the software's internal receive buffer.

3.3.2 Illegal Commands

Unrecognized commands or illegal parameters are ignored and annunciated by the return of a question mark character and a bell character. The same response occurs if the limits of the line buffer are exceeded (16 characters). Note that a carriage return on its own is a valid command that does nothing (no-op).

3.3.3 Leading Zeros and Missing User Arguments

The numerical part of the field sent by the terminal need not contain leading zeros, although leading zeros will be echoed if they are sent. Numbers sent to the terminal from the generator will generally have leading zeroes suppressed. If a required user argument is *omitted*, the generator will generally assume a value of zero for that argument.

3.3.4 Special Characters

Five characters have a special purpose, and are the only characters **not echoed** on the serial link.

ESC	The ESC character (0x1B) allows the operator to break out of continuous loops that were initiated with a dash character in the command line.
control-W	^W (0x17) is used to maintain link integrity.
control-Q	^Q (XON, 0x11) is used to resume serial output (from the generator) that was suspended via XOFF.
control-S	^S (XOFF, 0x13) is used to suspend serial output from the generator.
!!	These exclamation marks (0x21) are used to cause an immediate release of the RS-422 buffer if two consecutive exclamation marks are received in a row.

Special Command Characters
Table 3.3.4

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3.3.5 Power-up Message

The normal power-up text is shown below. ASCII control characters are shown in boldface.

CR is 0x0A, **LF** is 0x0D, and **BEL** is 0x07.

CR LF ENI Monitor on, type **HEL <CR>** for help

CR LF Power-up Delay In effect.

```
CR LF BEL *
```

3.3.6 Backspace Characters

Backspace or delete characters (0x08 or 0x7F) allow limited editing. When one of these characters is received, the last character in the line buffer is deleted and the following three characters are returned. (**BS** is the backspace char, 0x08, and **SP** is the space char, 0x20.)

```
BS SP BS
```

This ensures that a terminal screen backspaces its cursor and removes the last character.

3.3.7 Escape from Indefinite Loops

Some commands continue indefinitely. The escape character is used to exit from this condition. Upon receipt of the escape character, the controller will terminate the loop and respond with the standard command completion string, **CR LF** *.

3.3.8 Link Release Character

[!!] invokes a serial link release when operating as a bussed RS-422 communications link. The serial link release removes all device transmitters from the bus regardless of their address and sets all devices to *listen mode* where they wait for their address to be received.

3.3.9 XON and XOFF

When XOFF character (13h) is received (^S), transmission of RS-232 output data from the generator is halted. When XON character (11h) is received (^Q), transmission of RS-232 output data will resume from the generator.

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3.3.10 Key Level

Each command in the GEW-30A Genesis Generator repertoire is assigned to one of two **key levels**. Most commands are at key level A. This means that they are enabled by default on power-up of the GEW-30A Genesis Generator.

The remaining GEW-30A Genesis Generator commands are at key level B. These commands are for serious hardware and software debugging, and for factory-test or setup of the GEW-30A Genesis Generator. Level B commands do not appear in the user manual for this generator. Level B access is not granted to customers, but is only for ENI personnel. This is because level B commands have the potential for damaging the GEW-30A Genesis Generator (not to mention the user's equipment or process.). The Help screens reflect the commands that are available with the present level of security.

If you attempt to enter a command at an unauthorized access level, the system responds with:

```
*ACCESS DENIED
```


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3.3.11 Link Integrity Checking

The generator has a built-in function that detects the loss of the RS-232 serial link on the digital interface. This is called link integrity. If the RS-232 link seems to have been broken, the generator will shut off the RF power and not allow the RF to be turned back on until the link is restored.

The generator always defaults at power-on with this function disabled. To enable the function a **[^W]** must be sent from the host. Once the host initiates this function the generator will expect to see **[^W]** sent from the host on a continuous basis. If another **[^W]** is not received within one second of the last one sent, the generator will assume the host is no longer connected and produce a link integrity error, thereby shutting off the RF power.

If link integrity checking has been enabled by the host, you may later disable it with the **LIT** command.

Check for proper link integrity control in the following manner:

1. Turn the generator's AC power ON via the main AC breaker switch.
2. Turn the RF power ON via the front panel.
3. Send a **[^W]** by pressing the **W** key while holding down the **CTRL** key. Within one second, the RF power should go OFF because another **[^W]** was not sent.
4. Try to turn the RF power back ON via the front panel. It should not go ON.
5. Enter the command **RFV=**. The generator should return a Link Integrity fault.
6. Enter the command **LIT**. Again enter the **RFV=** command. The generator should now show no faults, and you should be able to turn RF power ON via the front panel.
7. With the RF power ON, send many **[^W]**s in succession. Make sure you send at least one every second and ensure the RF power stays ON while you are sending the **[^W]**s. Once you stop sending the **[^W]**s, the RF should go OFF as it did before. Reset the generator with the **LIT** command again.

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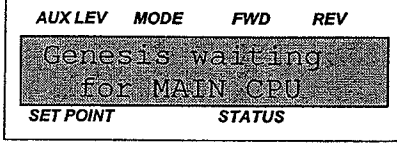
Chapter 4

Troubleshooting

This chapter lists solutions to the common problems a user may encounter when using the GEW-30A Genesis generator. If the problem doesn't match any of those on the following pages, please contact the nearest ENI Service location for assistance.

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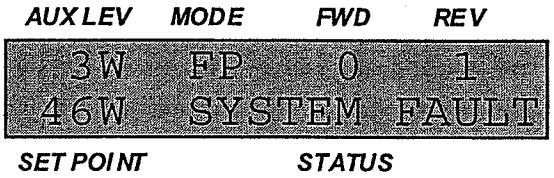
4.1 Hardware Faults

Symptoms	Probable Cause	Recommendations
AC ON does not light.	No AC line voltage.	Contact an authorized ENI Service location for assistance.
No RF Output.	Internal Damage.	Contact an authorized ENI Service location for assistance.
	Interlock string open.	Check cabinet and RF interlocks; check that the interlock pins of analog interface are connected together. Refer to the Analog Interface, Table 2.3.1.
Circuit Breaker Trips.	Short circuit.	Contact an authorized ENI Service location for assistance.
Front Panel displays: 	Control board not booting up.	Contact an authorized ENI Service location for assistance.

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4.2 System Faults

A fault that occurs within the unit will show up like the following on the front panel display:



These faults can only be diagnosed using an external control device such as the ENI Monitor. When the system fault occurs, a SYSTEM FAULT LED will illuminate on the front panel. Use the **RFV** and the **RPS** command (see section 3.2.3) on the ENI monitor to determine the fault. Using the equal sign (=) after the **RFV** command will show the fault in words instead of a numerical value.

Interlock status is shown on the front panel if the unit is open. "`INLK OPEN`" will be displayed on the STATUS line.

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4.3 Analog Remote Interface Faults

If the unit is connected to a controller, such as ENI's UTF-10, two more faults can be detected. One is an indicator driven (also known as a "Hard Fault") and the other appears on the display (also known as a "Soft Fault").

4.3.1 RF Overheat (Hard Fault)

This fault occurs when the RF temperature is above the limit. The RF OVERHEAT lamp will light up on the front panel of the test fixture.

4.3.2 MAX POWER (Soft Fault)

This fault occurs when the maximum power limit has been reached. The message will appear on the digital readout of the test fixture.

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Appendix A

GEW-30A Specifications

This appendix lists the complete physical and electrical characteristics for the GEW-30A Genesis Plasma Generator.

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GEW-30A Specifications

RF Output Frequency

40.68 MHz, fixed

RF Output Power Rating into Matched Load

3000 W into a 50 Ω load

RF Output Power Rating into Mismatched Load (All Phases)

Output Power	Load VSWR
3000 W (fwd)	1.3 : 1
2000 W (fwd)	2.0 : 1
1500 W (fwd)	3.0 : 1
500 W (fwd)	∞ : 1

Dynamic Power Range

0 - 3000 W

Load Impedance Range

Unlimited

RF Stability / Spurious Output

Unconditionally stable / < -40 dBc (for any load, within ratings)

Harmonic Output / Distortion

< -40 dBc (within ratings)

Power Control / Regulation

AC Line-to-Power: 0.5% max. change in output power over rated line voltage range.

Regulation tolerance is referenced from Set Point. Subject to limits of Forward & Reverse Power and Current; accuracy relative to ENI Power Standard (8000-517-TP).

Power Range	Reg. Tolerance
> 300 W	± 2%
≤ 300 W	± 6 W

Load Mismatch Protection

Automatic; forward power limits typically 0.25 ms after reverse power reaches a pre-programmed level of 500 W.

Primary AC Power Source

3/PE~, 200 - 208 V, 30 A, 50 - 60 Hz

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Power Consumption	7.7 kVA (nominal line, 60 Hz)
Power Factor at Maximum Output into a Matched 50Ω Load	> 0.70, nominal
Cooling System	Combination of water-cooling and forced-air cooling.

External Ambient Air:

Temperature Rating	5 - 40 °C
Relative Humidity Rating	80% RH (max) at up to 31 °C, derated linearly to 50% RH (max) at 40 °C

Cooling Water:

Inlet Temperature Rating	5 - 35 °C (see also section 2.9 for important details)
Pressure Maximum	413 kPa (60 psi)
Flow Rate Minimum	7.5 ltr/min (2.0 gal/min)
Connections	Accept ¼" male (NPT) pipe thread
Installation (Overvoltage) Category	INSTALLATION CATEGORY II: Local level, appliances, portable equipment, etc., with smaller transient overvoltages than distribution level and fixed equipment.
Pollution Degree	POLLUTION DEGREE 2: Normally only non-conductive pollution occurs. Occasionally, however, a temporary conductivity caused by condensation must be expected.
Maximum Sound Pressure Level	< 30 dBA above room ambient
Electromagnetic Compatibility (EMC)	EMC compliant with standards EN 50081-2 : 1992 Group 2, Class A EN 50082-2 : 1995

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Product Safety	NRTL Listed to standards CAN/CSA C22.2 No. 1010.1-92 Category 290 EN 61010-1 : 1993 Category 387 UL 3111-1 : 1994 Category 435
CE Compliance	CE marked
Power Indicator	Optional digital readout displays frequency and forward, reflected, & load power.
Size* (H x W x D)	221.5 mm x 480 mm x 560 mm (8.72" x 18.90" x 22.10") rack mount * *not including handles & connectors*
Weight	44 kg (97 lbs)
Remote Interface Connectors	Standard: Subminiature Type D, 9-pin Digital Interface; 36-pin Analog Interface
RF Output Connector	Type HN
Rack Mounting	19-inch adapters supplied
Equipment Internal Fuse Ratings	Fuses F4, F5, and F6 [ENI Part No. 301016 (Littelfuse Part No. 239003)] on Housekeeping Power Supply PCB Assy: 3AT, 250 V
Equipment Internal Battery Ratings	Lithium Battery BT1 [ENI Part No. 131000 (Renata Part No. CR2477N)] on Control PCB Assy: 3 V, 950 mAh

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Appendix B

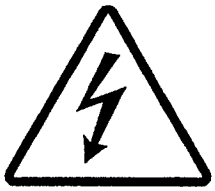
Glossary of Symbols

This appendix provides a definition of the symbols that have been used throughout this manual.



Caution, refer to accompanying documents

Figure B.1



Caution, risk of electric shock

Figure B.2



Caution, non-ionizing electromagnetic radiation

Figure B.3



Caution, heavy object

Figure B.4

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Appendix C

Glossary of Terms

This appendix provides a definition of new terms that have been used throughout this manual.

NIST	National Institute of Standards and Technology

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GLOSSARY OF ABBREVIATIONS

	AMPERES
P	AMPERES
SY	ASSEMBLY
	BRIDGE
P	CAPACITOR
R	CERAMIC
SIG	DESIGNATION
ECT	ELECTROLYTIC
D	FORWARD
	INTEGRATED CIRCUIT
	KILOHMS
	KILOHMS
	MILLIVOLTS
	PICOFARAD
V	PEAK INVERSE VOLTAGE
R	POWER
T	POTENTIOMETER
F	REFERANCE
Q	REQUIRED
L	REFLECTED
S	RESISTOR
B	SLOW BLOW
	MICROFARAD
	MICROFARAD
	MICROHENRY
	MICROHENRY
	VOLTS
CW	DC WORKING VOLTAGE
	WATTS
	WIRE WOUND

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