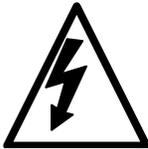




OPERATION MANUAL

ACG-3 XL RF Power Generator



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.



This product is manufactured at an MKS Instruments' ISO-9001:2000-Quality-System-compliant facility.

Notice

The material contained in this manual is subject to change without notice. No part of this manual may be reproduced or utilized in any form or by any means, electronic or mechanical, including photocopying or electronic transmission or other means of reproduction or distribution without prior written consent of MKS, ENI Products. The drawings, specifications and other technical information contained in this manual are the property of MKS, ENI Products and shall not be copied, reproduced or used in any way, in whole or in part, as the basis of manufacture or sale of similar items without the prior written consent of MKS, ENI Products.

Warranty

MKS, ENI Products warrants to the original purchaser for a period of one year from the date of delivery, each instrument to be free from defects in materials and workmanship. For a period of one year, MKS, ENI Products will, at its option, adjust, repair, or replace defective parts, without charge to the original purchaser, so that the instrument performs according to its specifications.

When warranty service is required, the instrument must be returned, transportation prepaid, to the factory or to one of MKS, ENI Products' 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.

THIS LIMITED WARRANTY IS EXCLUSIVE AND MKS, ENI PRODUCTS MAKES NO OTHER WARRANTIES, EXPRESS OR IMPLIED, AND ALL OTHER EXPRESS ORAL OR WRITTEN WARRANTIES AND ALL WARRANTIES IMPLIED BY LAW, INCLUDING ANY WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE OR OTHER WARRANTY OF QUALITY ARE EXCLUDED AND DISCLAIMED. IN NO EVENT SHALL MKS, ENI PRODUCTS BE LIABLE FOR SPECIAL, INDIRECT, INCIDENTAL OR CONSEQUENTIAL DAMAGES RESULTING FROM BREACH OF ANY WARRANTY, WHETHER EXPRESS OR IMPLIED, INCLUDING ANY IMPLIED WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE, OR FROM ANY CAUSE WHATSOEVER, INCLUDING NEGLIGENCE. Buyer's sole and exclusive remedy under this warranty shall be repair or replacement as set forth above, or if MKS, ENI Products is unable to repair or replace the defective part within a reasonable time, a refund of the price of the part or goods that give rise to the warranty claim.

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 MKS, ENI Products receives the unit, a firm quote and estimated date of completion will be given.

For Technical Assistance for your particular application, contact the nearest MKS, ENI Products 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 MKS, ENI Products.

Sales & Service Locations

ROCHESTER, NY	MKS Instruments, Inc. 100 Highpower Road Rochester, NY 14623	Tel: (585) 427-8300 Fax: (585) 427-7839
	Toll Free USA Sales Hotline:	1-800-267-5362
	Toll Free USA Service Hotline:	1-800-724-EN11 (3641)
SAN JOSE, CA	MKS Instruments, Inc. 70 Rio Robles San Jose, CA 95134	Tel: (408) 750-0300 Fax: (408) 428-0390
AUSTIN, TX	MKS Instruments, Inc. 1321 Rutherford Lane Suite 200 Austin, TX 78753	Tel: (512) 719-8000 Fax: (512) 719-8095
ENGLAND	1 Anchorage Court Caspian Road Altrincham, Cheshire WA14 5HH, England	Tel: 44-161-929-5500 Fax: 44-161-929-5511
GERMANY	Sielminger Str. 63 D-70771 Leinfelden- Echterdingen (Stetten) Stuttgart, Germany	Tel: 49-711-947700 Fax: 49-711-9477025
JAPAN	1-21-15 Aoyagi Kunitachi Tokyo 186-0013 Japan	Tel: 81-425-229-011 Fax: 81-425-222-636
KOREA	1 st Floor, DK Plaza-I 375-1, Geumgok-dong City Bundangogu, Seongnam Kyonggi-do, Korea 463-805	Tel: 82-31-717-9244 Fax: 82-31-717-9244
SINGAPORE	Blk 4010 Techplace 1 #01-07/08/09 Ang Mo Ko Ave 10 Singapore 569626	Tel: 65-6451-1062 Fax: 65-6451-0172
TAIWAN	2F, No. 47, Ln. 2, Sect. 2 Kuang Fu Rd. Hsinchu 300 Taiwan, ROC	Tel: 886-3-575-3040 Fax: 886-3-575-3048
P.R. of CHINA	West end of 2 nd floor, No. 3 building (T20-3) No. 258 Jinzang Rd., Shanghai Jin Qiao Export Processing Zone Pudong, Shanghai 201206 P.R. of China	Tel: 86-21-5834-7934 or 86-21-5834-7914 Fax: 86-21-5834-7794

Product and Applications information also available on the Internet at:

<http://www.mksinst.com>

This page intentionally left blank.

TABLE OF CONTENTS

	General Information	1
Chapter 1	Safety	1-1
1.1	Labels.....	1-1
1.1.1	Important Operating or Maintenance Cautions.....	1-1
1.1.2	Shock Hazard Warnings.....	1-1
1.1.3	Service	1-2
1.1.4	Nameplate	1-2
Chapter 2	System Installation	2-1
2.1	INITIAL INSPECTION	2-1
2.1.1	Mechanical Inspection.....	2-1
2.1.2	Claim for Damage	2-1
2.1.3	Packaging for Reshipment	2-1
2.2	INSTALLATION REQUIREMENTS	2-2
2.2.1	Power Requirements.....	2-2
2.2.2	Power Cable Ground Protection.....	2-3
2.2.3	Cooling.....	2-3
2.2.4	Initial System Test.....	2-3
2.2.5	Accessory Connector Supplied	2-4
2.3	RACK MOUNTING.....	2-4
2.4	SYSTEM INTERCONNECTION.....	2-4
Chapter 3	ACG-3 XL Operation	3-1
3.1	OPERATION	3-1
3.2	FRONT PANEL DEVICES.....	3-1
3.2.1	Indicators.....	3-2
3.2.2	Switches	3-2
3.2.3	Potentiometers and Metering	3-3
3.2.4	Diagnostic Self-Test Circuit	3-3

3.3	BACK PANEL	3-4
3.3.1	RF Output Connector.....	3-4
3.3.2	Fuses.....	3-4
3.3.3	Accessories Connector	3-5
Appendix A	Specifications	A-1
Glossary		

General Information

Introduction

The ENI Model ACG-3 XL Power Generator is an all solid state, air-cooled power source expressly designed for use in gas plasma and sputtering applications. Completely self-contained, the ACG-3 XL provides all of the control and monitoring functions needed in a state-of-the-art power generator. It will provide a maximum continuous power output of 300W into a 50 Ω impedance.

The reliable operation of any solid state power generator is directly influenced by the sophistication of its power control circuitry. The ACG-3 XL automatic power control module measures forward RF power, reflected RF power, and the current draw of each

RF power amplifier module. Should any of these parameters exceed a preset limit, the automatic power control will immediately fold back its RF output power so that the components always remain within their safe operating limits. Besides assuring safe operation of the ACG-3 XL the automatic power control module maintains power output levels to within $\pm 5\%$ of set point over a 120 to 300W power range at VSWR's of up to 1.1:1. In addition, the automatic power control eliminates power output drift due

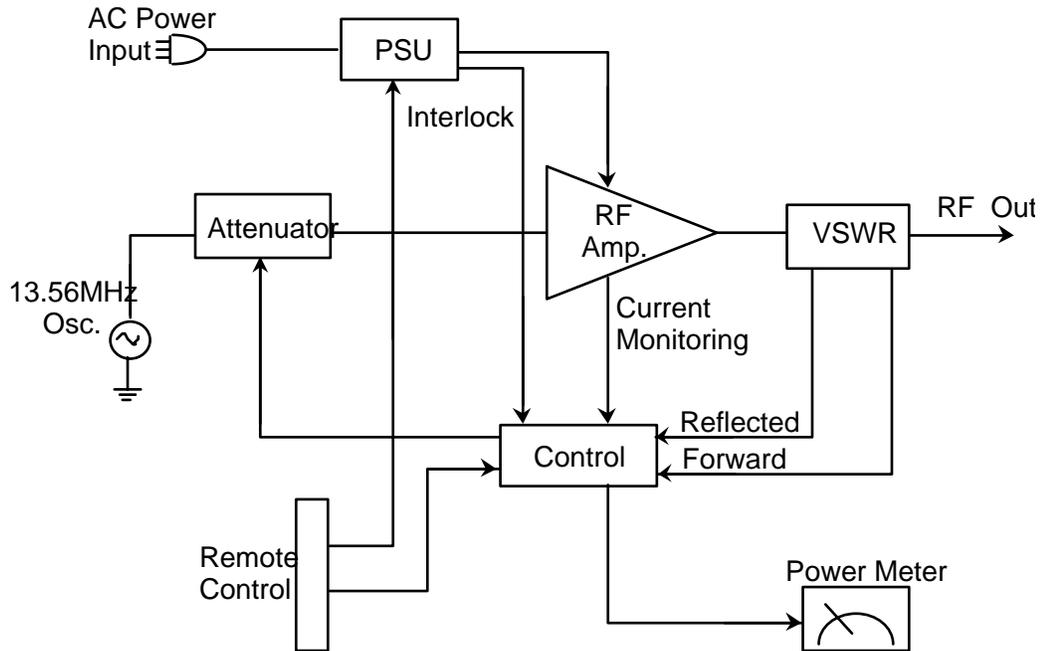
to line voltage variations and component aging, and reduces output hum and ripple to insignificant levels. An external DC voltage or pulse fed into the rear panel connector will permit the power output of the generator to be accurately controlled by a computer program that includes end point detection information.

The ACG-3 XL is provided with an external computer interface bus which is compatible with TTL logic levels. This interface bus permits RF power to be turned ON or OFF, indicates to the computer when the unit is developing its maximum power and indicates lack of air cooling or RF power. In addition, external analog voltages are available at the interface connector for both forward and reverse power indications. These voltages are calibrated precisely at 1.0V per kW and therefore a digital panel voltmeter will read power directly in kilowatts. The use of conservatively rated solid state components and automatic power control insures the user of reliable and continuous performance with an absolute minimum of maintenance. However, should service be required, all of the modules are easily removed for replacement or repair. The very low DC voltages used in the generator greatly reduce the potential hazards associated with its servicing when compared with vacuum tube equipment.

A wide range of AC line voltages is readily accommodated by the multitap AC line transformer and the connections verified by a built-in diagnostic meter indicator. The ACG-3 XL may be rack-mounted using the optional rack-mounting kit into any 19-inch relay rack, or operated remotely within the plasma system cabinetry. The unit is provided with an extremely well-shielded and filtered power supply virtually eliminating conducted line leakage.

An extremely sharp low-pass filter at the output of the unit insures that all harmonics are reduced to very low levels. Extensive use of shielding and RF suppression techniques permits the unit to more than meet FCC requirements for ISM equipment at the same time that it eliminates any RF susceptibility problems for associated plasma system circuitry.

The following diagram outlines each assembly's function.



ACG-3 XL Overall Block Diagram

This manual is divided into three sections. Please refer to the following descriptions to help you locate the information you need.

Chapter 1	Deals with precautionary details. Please read this section if you are unfamiliar with the unit or MKS, ENI Products' warranty procedures.
Chapter 2	Tells you how to install and power up the system for the first time.
Chapter 3	Describes operational details of the generator. Both a formal specification and the unit's Interconnect schematic are located at the end of this section.

This page intentionally left blank.

Chapter 1

Safety

1.1 Labels

Labels are provided to alert operating and service personnel to conditions that may cause personal injury or damage to the equipment from misuse or abuse. Please read the labels and understand their meaning.

1.1.1 Important Operating or Maintenance Cautions

CAUTION !

This caution label is used in the manual to advise the reader of important operating or maintenance procedures which must be carefully followed to maintain equipment reliability.

1.1.2 Shock Hazard Warnings

WARNING ⚡

This warning label is used in the manual to warn the reader of a procedure or practice which could result in personal injury if not followed carefully.

1.1.3 Service

CAUTION !

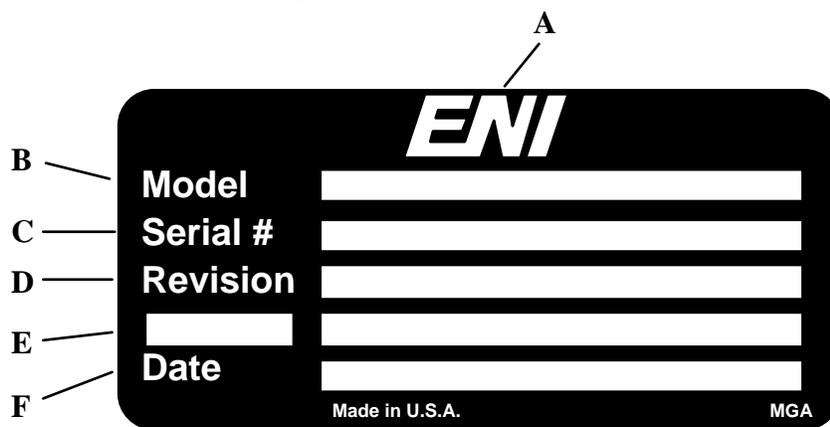
WARNING ⚡

MKS, ENI PRODUCTS 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.

1.1.4 Name Plate

The ACG-3 XL can be identified by a name plate at the rear of the unit and contains the following information.



A.	Manufacturer: MKS, ENI Products, Rochester NY, USA	D.	Revision: The revision letter identifying product configuration is contained on this line. Revision A is the initial revision level.
B.	Model: The assembly number that uniquely identifies product configuration is contained on this line.	E.	This line contains customer name and customer identification number.
C.	Serial #: This line contains a number which is sequentially assigned as the product is manufactured.	F.	Date: Proper identification of the date of manufacture is contained on this line.

Chapter 2

System Installation

2.1 Initial 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 MKS, ENI Products directly or your authorized MKS, ENI Products representative if the generator 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 lbs. 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"

2.2 Installation Requirements

2.2.1 Power Requirements

The ACG-3 XL is designed for operation from either a 100-120VAC or 200-240VAC 50/60Hz single phase line. The correct fuses should be checked and installed before changing voltage ranges. They are as follows:

100-120VAC Operation: 12 ASB (two required)

200-240VAC Operation: 6 ASB (two required)

Initial set-up and connection to the AC line is as follows:

- 1) Measure the AC Line voltage with a suitable voltmeter.
- 2) Remove the cover of the generator and locate the voltage select terminal block, located under the high voltage-cover. The high voltage cover has the connection information printed on it, as shown in Figure 2.2.1.
- 3) Adjust the black line and the jumpers to the nearest nominal voltage listing.

Line Voltage	Black Line	Jumpers	
100	2	2 & 7	1 & 6
107	3	3 & 8	1 & 6
115	4	4 & 9	1 & 6
120	5	5 & 10	1 & 6
200	7	2 & 6	Remove Jumpers
208	8	3 & 6	
225	9	4 & 6	
240	10	5 & 6	

Figure 2.2.1 Terminal Block Connections

- 4) Plug in the generator and turn on the “AC ON” switch. Rotate the meter select switch to the “PA Volts” position and observe the voltage reading on the generator front panel (250=50.0 V). The reading should be between 47V-51V. If lower than 47V, turn off and unplug the unit, then select the next lower nominal voltage listing. If the reading is higher than 51V, select the next higher listing.
- 5) Recheck the voltage reading and then replace the high voltage cover and the unit cover.

2.2.2 Power Cable Ground Protection

To protect operating personnel, the generator is equipped with a three-conductor cable consisting of a black hot line, a white common line, and a green chassis ground. For U.S. delivery, the Model ACG-3 XL is supplied with a three wire 20A, 250V plug NEMA L6-20P. This plug must be inserted into a properly wired 20A, three-wire ground receptacle NEMA L6-20R.

2.2.3 Cooling

The generator is protected from lack of cooling air or excessive ambient temperature by an overheat protection circuit. A thermostat attached to the main heat sink is activated when internal temperature becomes excessive. When this condition occurs, the generator will turn off its RF power until normal internal temperatures are restored. The generator will repeat the overheat condition until the cause of the problem is corrected.

2.2.4 Initial System Test

1. Ensure that the ACG-3 XL is properly connected to a suitable 100-120VAC or 200-240 VAC 50/60 Hz line. Also check to see that the proper transformer primary tap has been selected. Using the METER SELECT switch, the Power Amplifier voltage should read +48-50V with the AC LINE switch on and RF POWER off. Turn unit off, return METER SELECT switch to RF power.
2. Connect output of unit to a suitable 1000W, 50 Ω load.
3. Rotate the POWER ADJUST fully CCW and be sure the RF POWER switch is in the OFF/REMOTE position.
4. Turn on the AC LINE switch. The AC ON light should be on, all other lights should be off. There should be no meter reading. The internal cooling fan should be operating.
5. Turn on the RF POWER switch. The RF ON light should be on. The MAXIMUM POWER and OVERHEAT lights should be off. There should be no meter reading.
6. Rotate the POWER ADJUST to obtain at least 300W with the front panel METER switch in the forward power position. The MAXIMUM POWER light may be on at 300W if the AC line voltage is at or near its low limit. This is normal.
7. Set METER switch on the front panel to the REVERSE power position. The meter reading should go to zero.
8. Return the METER switch to the FORWARD POWER POSITION. Turn off the RF POWER switch.

9. Disconnect the ACG-3 XL output connector from the 50Ω load and turn on the RF POWER switch. Observe that the forward and reverse meter readings are 50W each. The MAXIMUM POWER light should be on to indicate that the unit is being limited by the internal protection circuit and is no longer controlled by the front panel POWER ADJUST.
10. Rotate the POWER ADJUST CCW to reduce the output power. As the power is reduced below 50W, the MAXIMUM POWER lamp will be off as power control and leveling are restored.

2.2.5 Accessory Connector Supplied

Supplied with each generator is a 15-pin, Type "D" connector. This connector mates with the accessories jack. To make connections to this connector, it must first be disassembled as follows:

1. Remove the three screws in the split shell and remove the two halves to expose the terminals.
2. Connect the wires as explained in Section 3.2.3.
3. Replace the two halves of the shell and tighten the three screws.

2.3 Rack Mounting

Mounting brackets are supplied for standard 19-inch relay rack installations. Remove the three #8-32 screws on each side of the cover nearest the front panel. Attach the rack mounting brackets firmly using the hardware removed above. The rubber feet may be unscrewed and removed if necessary.

2.4 System Interconnection

The following diagram shows the normal interconnection of the ACG-3 XL to a system:



The remote control connection allows a computer or external control unit to adjust and read back power via the accessories connector (See Section 3.3). The RF out connection is made to either a load (often a plasma chamber) or a matching network.

Chapter 3

ACG-3 XL Operation

3.1 Operation

Before operating the generator, become familiar with the front and rear panel switches, indicators, and connectors.

3.2 Front Panel Devices

Familiarize yourself with the following front panel devices as shown in Figure 3.2:

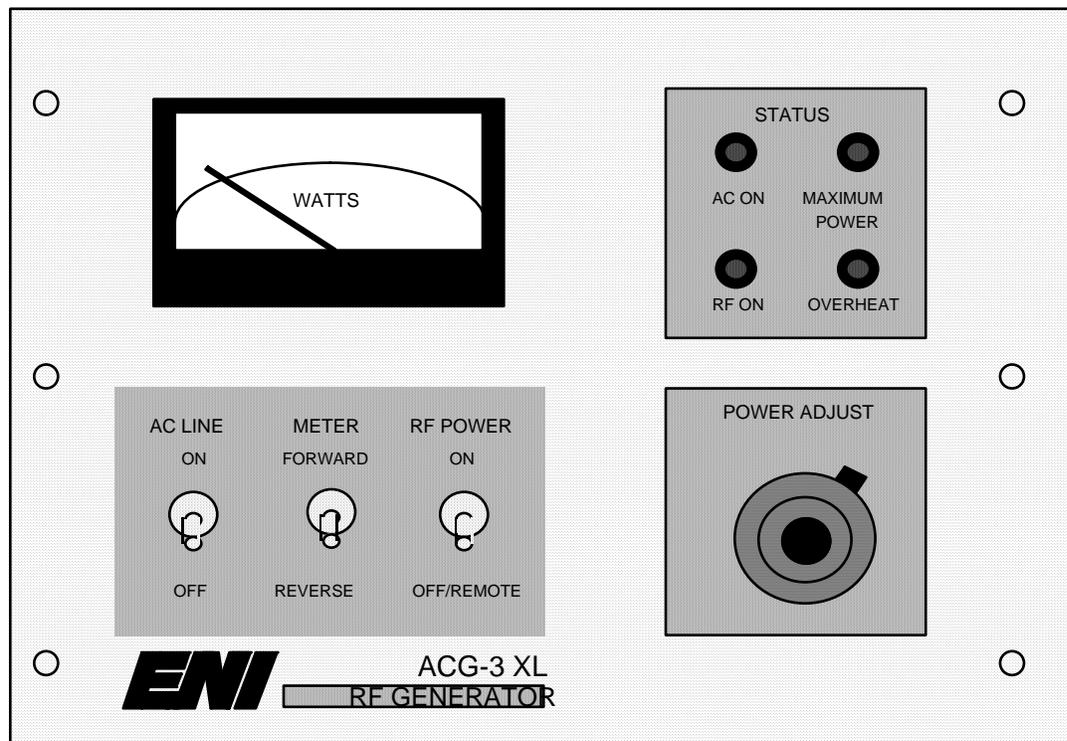


Figure 3.2: ACG-3 XL Front Panel Meter

3.2.1 Indicators

LED	Function
AC ON	Indicates when AC power is being applied to the generator.
RF ON	Indicates when RF is being supplied by the generator. This light is OFF in the case of an OVERHEAT fault.
Maximum Power	Indicates lack of forward power control leveling. This is usually caused by conditions of high VSWR when either the Reverse Power Sensing or Power Amplifier Current Sensing has reduced the output power to protect the generator.
Overheat	Indicates that either thermostat located on the RF heatsink has closed due to excessive heatsink temperature; driver class A bias is removed until the unit cools. The function is self-resetting and no maintenance is needed.

3.2.2 Switches

Switch	Function
AC ON	Turns on all power supplies and control circuits.
RF Power ON/OFF	In the ON position, the 13.56MHz oscillator is activated, which provides the input to the RF power amplifier. In the OFF-REMOTE position, the 13.56MHz oscillator will only be activated when Pin 4 (RF ON) on the rear panel connector is at +5V. The driver voltage regulator is also activated and all driver biases are present.
Meter	Indicates forward or reverse power, depending on the position of the switch.

3.2.3 Potentiometers and Metering

Function	
Power Adjust	Varies power output of the ACG-3 XL from <1W to >300W. The ten-turn dial has a logging scale and a dial lock for repeatability of any power setting. To operate the lock, press down on the lever. To break the lock, push the lever to the up position.
Meter	The meter indicates forward power output (Watts) of the generator when the meter switch is in the <u>forward</u> position. The meter indicates the power reflected from the load when the meter switch is in the <u>reverse</u> position. Power delivered to the load equals forward power minus reflected power.

3.2.4 Diagnostic Self-Test Circuit

Located under the cover, this five-position switch allows monitoring of the following important voltages and currents.

Position	Labeled	Function
1	RF Power	Forward and reverse RF power by switch selection. Power selection is made with the "meter select" switch located on the front panel. The switch is normally left in this position.
2	P.A. Current	The meter reads the DC current draw of the corresponding power amplifier with a full scale of 17.5A; dividing the reading by 20 results in the actual current draw in amps. (Example: 260W divided by 20 = 13A.)
3	PA Volts	The meter reads the DC voltage of the unregulated power supply feeding the power amplifier with a full scale of 70V; dividing the reading by 5 results in the actual voltage. (Example: 250W divided by 5 = 50V.)
4	Driver Current	The meter reads the DC current draw of the driver amplifier with a full scale of 7A; dividing the meter reading by 50 results in the actual current draw in amps. (Example: 150W divided by 50 = 3A.)
5	Driver Volts	The meter reads the DC voltage of the driver power supply with a full scale reading of 35V; dividing the meter reading by 10 results in the actual voltage of the driver supply. (Example: 250W divided by 10 = 25V.)

3.3 Back Panel

Familiarize yourself with the following rear panel devices as shown in Figure 3.3:

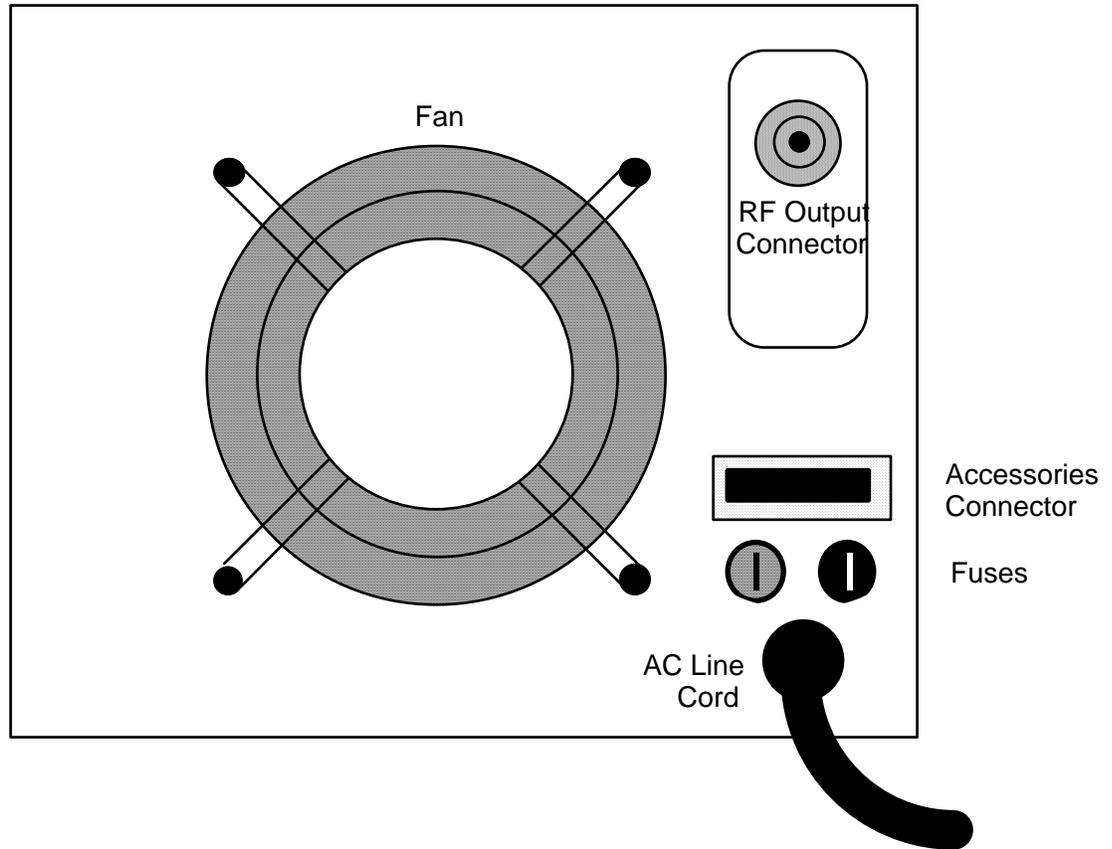


Figure 3.3: ACG-3 XL Back Panel

3.3.1 RF Output Connector

The RF output of the generator is delivered through this Type “N” coaxial connector.

3.3.2 Fuses

Both sides of the AC line are fused. Recommended fuses are: Type 3AG, 12A slow blow for 100 to 125V_{AC}; Type 3AG, 6A slow blow for 200-240V_{AC}.

3.3.3 Accessories Connector

Pin	Function	Description
1	Maximum Power	Output; provides TTL compatible output for the maximum power condition. +5V = max. power, 0V = normal operation.
2	Reverse Power	Output; 1V per kW to allow reverse power reading on any external voltmeter having an input impedance of 1M Ω or more.
3	Forward Power	Output; 1V per kW to allow forward power reading on any external voltmeter having an input impedance of 1M Ω or more.
4	RF On	Input; allows TTL logic level control of the RF on function. +5V = RF On, 0V = RF Off.
5	External Control	The controlling voltage may be DC or pulse and any power level from 1W to 300W may be controlled by this input. In addition, the generator may be calibrated to accept an input of 1 volt per kW or any voltage up to 10 volts corresponding to full power output. For pulsed operation, rise time is less than 0.1ms. Overdrive limiting is provided so that 325W cannot be exceeded regardless of pulse amplitude. Refer to description of Pin 10 in this table.
6	Ground	Chassis ground is available at this pin.
7	RF On	Output; a readback of the RF On condition of the oscillator, TTL compatible. +5V = RF On, 0V = RF Off. This line is TTL low in the event of an overheat fault.
8	External Control Bias	10k Ω potentiometer for remote control through Pin 5.
9	RF On Bias	Via Pin 4, voltage is provided for a switch or relay contact closure to enable RF On.
10	Internal-External Power Control	Open circuit selects local control. 0V or short to ground selects external control.

No Connection: Pins 11 - 15

This page intentionally left blank.

ACG-3 XL Specifications

Frequency / Stability	13.56MHz / $\pm 0.005\%$									
Rated Power Output	300W into 50 Ω load.									
Mismatched Power Output	Worst phase forward power ref. to rating: 300W nominal into 1.5:1 VSWR 200W nominal into 2.0:1 VSWR 150W nominal into 3.0:1 VSWR									
Dynamic Power Range	< 3W to 300W									
RF Power Margin	$([\text{Open Loop Max Power} / \text{Rated Power}] - 1) \times 100\% = 67\%$ nominal									
Load Impedance Range	Unlimited									
RF Stability / Spurious Output	Unconditionally stable for any load within operational limits / < -60dBc									
Noise	AM & PM Noise: < -30dBc AM Noise: < 1%									
Harmonic Output /Distortion	< - 55dBc									
Power Control / Regulation	Front panel or remote power control, Automatic Forward Power Regulation Range: 0 to +10VDC; Slope: 30W/V									
	<table border="1"> <thead> <tr> <th>Power Range</th> <th>Load VSWR</th> <th>Regulation Tolerance</th> </tr> </thead> <tbody> <tr> <td>0-120W</td> <td>1.0:1-1.1:1</td> <td>$\pm 6\text{W}$</td> </tr> <tr> <td>120-300W</td> <td>1.0:1-1.1:1</td> <td>$\pm 5\%$</td> </tr> </tbody> </table>	Power Range	Load VSWR	Regulation Tolerance	0-120W	1.0:1-1.1:1	$\pm 6\text{W}$	120-300W	1.0:1-1.1:1	$\pm 5\%$
Power Range	Load VSWR	Regulation Tolerance								
0-120W	1.0:1-1.1:1	$\pm 6\text{W}$								
120-300W	1.0:1-1.1:1	$\pm 5\%$								
	Regulation tolerance is referenced from Set Point. Subject to limits of Forward & Reverse Power and Current. Accuracy relative to ENI Power Standard.									
Load Mismatch Protection	Automatic; forward power limits typically 0.1ms after reverse power reaches 50W or power amplifier exceeds preset limit.									

Primary AC Power Source	100/107/115/120 VAC $\pm 5\%$ at 12A; or 200/208/225/240 VAC $\pm 5\%$ at 6A; single phase 50-60Hz at 12A or less at full power output.
AC Line-to-Power Regulation	1% max, 0.5% typical change in rated output power from a nominal VAC to -5% change.
Cooling System	Forced Air; maximum ambient air temperature of +40°C.
Cabinet & Spurious Radiation	Surpasses FCC Part 18 specifications.
Power Indicator	Indicates forward/reverse power on front panel from 0 to 350W with 4% of full scale accuracy.
Size* (H x W x D)	6.3" x 8.4" x 14.75" nominal (16 x 21.3 x 37.5 cm) <i>*excluding handles, connectors & feet</i>
Weight	29 lbs. (13.15 kg)
External Control Interface	Type D Sub-miniature (matching connector supplied).
Interface Inputs	AC On RF On/Off Indicator (TTL compatible) External Control
Interface Outputs	Maximum Power Indicator (TTL Compatible) Forward & Reverse Power Indicators Calibrated at 1.00V per Kilwatt, direct reading on digital Voltmeter Overheat Indicator
RF Output Connector	Type N
Rack Mounting	19-inch adaptors supplied