Product User Manual

♦

Model GA4010
3kW Magnetron Head

Document # 930002, Rev. 2

GAE GERLING APPLIED ENGINEERING, INC.
P.O. Box 580816 ♦ Modesto, CA 95358
www.2450mhz.com

REVISION HISTORY			
REV.	**DESCRIPTION**	**DATE**	**APPROVAL**
2	MISC. UPDATES	13FEB04	JFG

WARRANTY

Products manufactured and sold by Gerling Applied Engineering, Inc. ("GAE") are warranted to be free of defects in materials and workmanship under normal use and service for a period of twelve (12) months from the date of original shipment. GAE's obligation under this warranty is limited to repairing or replacing, at GAE's option, all non-consumable component parts. Consumable parts are specifically excluded from this warranty and may include, but are not be limited to, magnetrons, fuses, lamps, seals, o-rings, v-belts, and fluids. All warranty repairs are to be done at GAE's facility or as otherwise authorized by GAE. All shipping charges for warranty repair or replacement are the purchaser's responsibility unless otherwise agreed to by GAE.

This warranty supercedes all other warranties, expressed or implied. No warranty is given covering the product for any particular purpose other than as covered by the applicable product specifications. GAE assumes no liability in any event for incidental or consequential damages, financial losses, penalties or other losses incurred in conjunction with the use of GAE products.

DOCUMENT CONVENTIONS

NOTE: *Means the reader should take note. Notes contain helpful information, suggestions, or references to other sections, chapters, or documents.*

CAUTION: *Means the reader should be careful. You are doing something that might result in equipment damage or loss of data.*

WARNING: *Means danger. A situation exists that could cause bodily injury or death. All personnel must be aware of the hazards involved with high voltage electrical circuitry and high power microwave devices.*

WARNING

This unit is capable of producing a microwave field that is potentially hazardous to operating personnel. It must never be connected or operated in a manner that allows a field in excess of 10 milliwatts per square centimeter to be generated in an area accessible to operating personnel. Contact GAE, Inc. for technical support prior to installation and/or operation of this unit if there is any question or concern about microwave leakage.

All waveguide flange and electrical cable connections must be secure prior to operation of this unit. Never operate the microwave generator without a properly rated absorbing load attached. To ensure safe operation and prevent microwave leakage, the equipment must be periodically inspected and maintained as required or recommended.

WARNING

Lethal voltages may exist inside this unit during operation. All maintenance and service must be done by qualified technical personnel only. Under no circumstances should improperly trained or underskilled personnel be allowed access inside this unit.

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ATTACHMENTS:

Document Type	Number	Title
Drawing	910221	Schematic Diagram, GA4010
Tech. Serv. Doc.	940002	Magnetron/Electromagnet Removal and Replacement

EQUIPMENT DESCRIPTION

The model GA4010 3kW Magnetron Head is designed for use with any one of several model high voltage power supplies (HVPS) manufactured by AGL, Inc. or its predecessor companies (ASTeX/Gerling Laboratories, Inc. and Gerling Laboratories). The GA4010 is functionally identical to the Gerling Labs model GL107 and can be used with any of the following power supplies:

GL108	3kW HV Supply, Medium Ripple, Bench Mount
GL110	3kW HV Supply, Standard Waveform, Bench Mount
GL120	3kW HV Supply, Low Ripple, Rack Mount
GL124	3kW HV Supply, Low Ripple, Bench Mount
GL125	3kW HV Supply, Standard Waveform, Rack Mount
GL126	3kW HV Supply, Medium Ripple, Rack Mount

Electrical Specifications

Output Power	0 – 3kW, continuously adjustable
Magnetron	Model GA8002 (modified Hitachi 2M131-04A)
Output Frequency	2450 MHz +/- 50 MHz
Output Flange	WR284 Round (with taper for quick-disconnect clamp)
Indicators	Standby On incandescent lamp (amber) Microwave On incandescent lamp (red)

Mechanical Specifications

Cooling Air	Forced air provided by internal fans
Cooling Water	Flow: 1.0 gpm nominal (0.5 gpm min.) Inlet pressure: 30 – 70 psig Inlet temp: ambient dew point min., 30°C max.
Ambient Conditions	Temperature: -10 to 50 °C non-operating; 10 to 40 °C operating Relative Humidity: 0 to 90%, non-condensing
Overall Dimensions	Chassis: 12” wide x 12” deep x 15” high Waveguide extension: 2”
Net Weight	52 lb. (23.6 kgm)

INSTALLATION

Preliminary Inspection

Upon arrival at the installation site the GA4010 should be thoroughly inspected for damage or wear caused during shipping. Any visible damage to the packaging material or GA4010 should be noted and reported immediately to the shipping company in accordance with standard claims procedures.

Facilities Requirements

- Electrical Power: All electrical power required by the GA4010 is provided by the HVPS with which the GA4010 is used.
- Ventilation: Adequate clearance must be provided near the ventilation ports on the front, back and top of the GA4010 such that air is allowed to flow without restriction.
- Environment: Indoors only, must be clean and dry.

Mounting Position

The GA4010 may be mounted on a horizontal surface such that the broad wall of the output waveguide is horizontal. Orientation may be either normal (magnetron up) or inverted (magnetron down) as long as the axis of the magnetron is vertical. Maximum allowable tilt of the magnetron axis is 5 degrees.

Electrical Connections

- Control Power: 9-pin cable connects between HVPS and J1 on GA4010.
- High Voltage: 2-pin cable connects between HVPS and J3 on GA4010.

Water Cooling

The magnetron contained within the magnetron head requires water cooling during operation. The nominal water flow is 1.0 gpm and the minimum required flow is 0.5 gpm. An internal solenoid valve automatically turns on water flow whenever the system is in operation. It is recommended that a source of water be permanently connected and pressurized at all times to ensure the availability of cooling water during operation.

The water source must be connected to the upper connection fitting and the drain connected to the lower fitting. The connection fittings provided with the GA4010 are self-sealing to allow disconnection while under pressure.

The self-sealing water connection fittings prevent water from draining when the source and drain are disconnected. To prevent internal damage to the GA4010, steps must be taken to drain the water prior to storage or shipping in the event that freezing temperatures may be encountered.

CAUTION: *Permanent damage to the magnetron can occur if the GA4010 is operated without adequate water flow. It is recommended that a suitable external water flow interlock device be installed on the drain side of the water connections and its electrical contacts be included in the interlock chain of the HVPS.*

CAUTION: *The minimum inlet temperature of the cooling water must be above the ambient dew point temperature. Allowing the cooling water inlet temperature to drop below the ambient dew point can allow moisture condensation inside the microwave generator and/or waveguide circulator and cause equipment damage.*

Microwave Output

The GA4010 must be connected to a suitable waveguide load which prevents excessive microwave energy leakage and/or reflected power.

Microwave Leakage – Regulatory limits for microwave leakage relate to standards for human safety and interference with other electronic devices. Standards for human safety as adopted by OSHA, the International Electrotechnical Commission (IEC) and other regulatory agencies limit leakage to 5 mW/cm^2 measured at 5 cm from the leakage source under normal operating conditions, and 10 mW/cm^2 at 5 cm from the source under abnormal operating conditions. The U.S. Federal Communications Commission (FCC) has established regulations limiting the emission of energy at frequencies outside the ISM bands. The GA4010 meets these requirements when connected to a suitable waveguide load.

Reflected Power – Microwave power that is reflected back to the magnetron from a waveguide load can cause permanent damage to and/or shorten the life of the magnetron. Care should be taken to ensure that reflected power does not exceed 200 Watts. It is recommended that a suitable waveguide isolator be connected at the output flange of the GA4010 to prevent reflected power from reaching the magnetron.

BASIC OPERATION

The purpose of this discussion is to provide a basic understanding of the system operation such that a reasonably skilled electronics technician can perform basic diagnostics and service in the event of malfunction. However, any problem that develops which can not be diagnosed and solved by reference to the following discussion should be referred to GAE, Inc. for further assistance.

System Control

The HVPS to which the GA4010 is connected contains circuitry that generates a 24 Vac control signal when the “System Start” button is pressed. This “system on” signal (J1, pin B) places the system in “Standby” mode and turns on the water solenoid valve and “Standby On” indicator in the GA4010. The signal then passes back to the HVPS as an “interlock return” signal (J1, pin F) and ensures proper connection of the GA4010 prior to turning on high voltage.

Simultaneously, a 120 Vac signal is delivered to the GA4010 (J1, pin A) which turns on the cooling fans. The electromagnet and filament voltage control circuits located in the HVPS are also activated at this time and their respective signals are delivered to the GA4010 (J1, pins C, D and E).

Once all of the external and system interlocks are satisfied, the “Microwave On” button on the HVPS can be pressed to turn on high voltage and place the system into “Operate” mode. This then sends another 24 Vac control to the GA4010 (J1, pin H) and turns on the “Microwave On” indicator. High voltage is also delivered to the GA4010 (J3, pin A) at this time.

Power Control

Microwave power output is controlled by varying the current through the electromagnet while maintaining a fixed high voltage on the anode of the magnetron. The electromagnet establishes a magnetic field inside the magnetron which in turn determines the level of current that is allowed to pass through the magnetron for a given anode voltage. With the anode voltage fixed, decreasing the electromagnet current will decrease the magnet field and allow more anode current resulting in higher output power.

Filament Voltage Control

The filament voltage must be reduced as microwave output power is increased. It is necessary to maintain a constant (or nearly constant) filament temperature during operation, so the filament voltage is reduced to compensate for excess heating caused by electron back-bombardment as output power is increased.

USER MAINTENANCE

All service and repair of the GA4010 should be performed by a properly qualified service technician having a reasonable background in high voltage power supplies. GAE, Inc. personnel are available to assist with any maintenance problem.

WARNING: *Lethal voltages can exist inside the GA4010 during periods of operation. Always disconnect line power before performing any type of service. All service personnel must be aware of the hazards involved with high voltage electrical circuitry and high power microwave devices.*

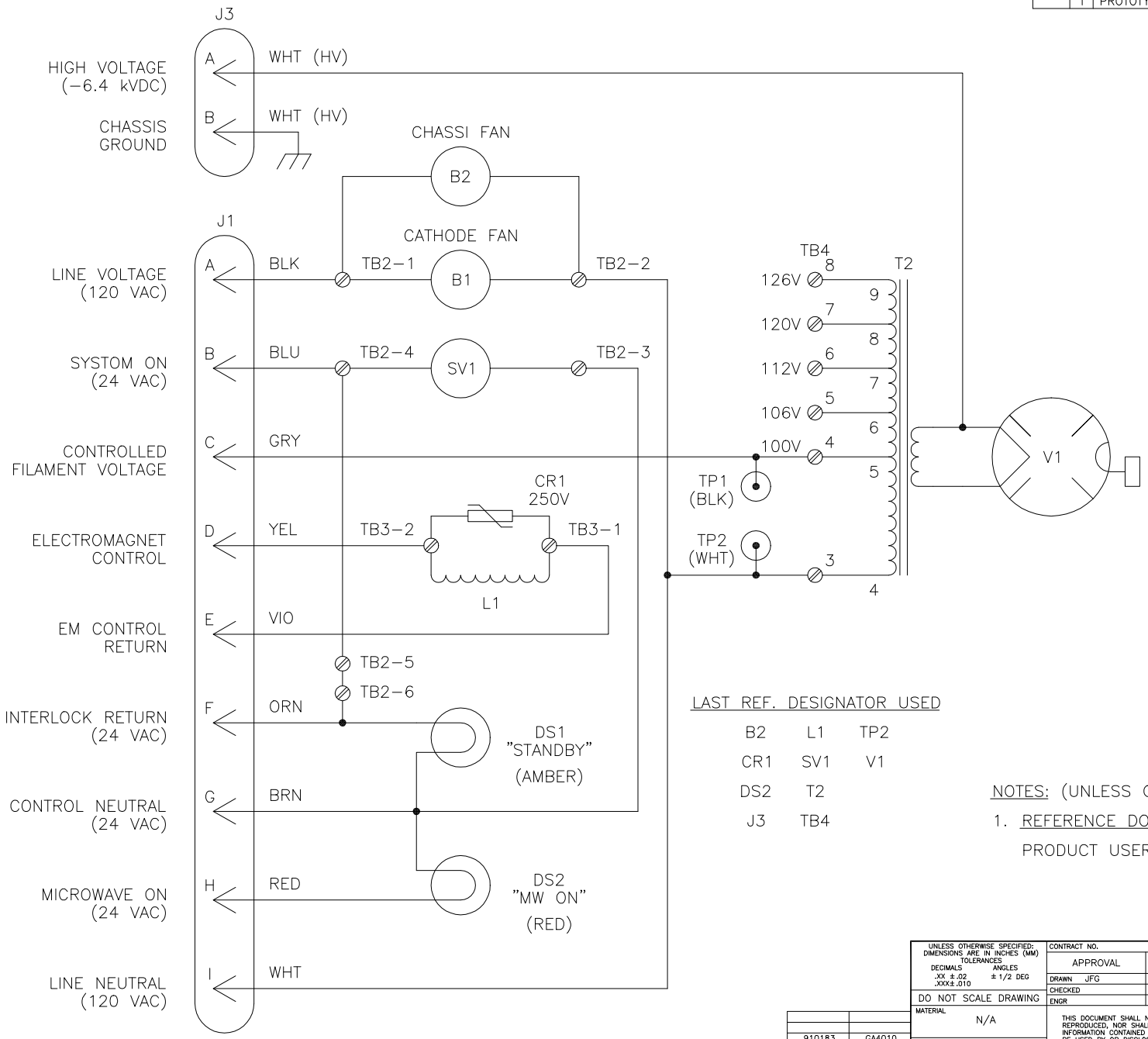
WARNING: *Excessive leakage of microwave energy generated by the GA4010 can be lethal. Never connect line power to the system without a suitable waveguide load connected to the output flange of the GA4010.*

CAUTION: *Permanent damage to the magnetron can occur if the GA4010 is operated without adequate water flow. It is recommended that a suitable external water flow interlock device be installed on the drain side of the water connections and its electrical contacts be included in the interlock chain of the HVPS.*

Magnetron and Electromagnet Replacement

Refer to Technical Service Document # 940002 for procedures to remove and replace the magnetron and electromagnet. The initial set-up procedures as outlined in the HVPS operation manual should be performed after replacement of either of these two components. Specific attention should be given to the procedures for power output and filament voltage adjustment.

REVISIONS				
ZONE	REV	DESCRIPTION	DATE	APPROVED
	1	PROTOTYPE RELEASE	15APR99	JFG



LAST REF. DESIGNATOR USED

B2	L1	TP2
CR1	SV1	V1
DS2	T2	
J3	TB4	

NOTES: (UNLESS OTHERWISE SPECIFIED)

1. REFERENCE DOCUMENTS:
   PRODUCT USER MANUAL # 930002

DWG NO. 910221 | SH 1 | REV 1

910183	GA4010
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UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE IN INCHES (MM) TOLERANCES DECIMALS .XX ± .02 .XXX± .010 ANGLES ± 1/2 DEG

DO NOT SCALE DRAWING

MATERIAL N/A

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3kW MAGNETRON HEAD SCHEMATIC DIAGRAM

SIZE	DWG. NO.	REV
C	910221	1

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Magnetron and Electromagnet
Removal and Installation Procedure

APPROVALS			REVISIONS			
	INITIALS	**DATE**	**REV**	**DESCRIPTION**	**DATE**	**APPR**
Drawn	JFG	15APR99	B	Redrawn	04MAR00	JFG
Engineering						
Manufacturing						
Marketing						

1. Introduction

1.1. Scope

This procedure covers microwave generators currently using the model GA8002 magnetron manufactured by GAE, Inc. It may also be used to install the GA8002 into generators currently using the model AG9131 magnetron manufactured by AGL, Inc.

NOTE: This procedure can **NOT** be used to install the GA8002 magnetron into microwave generators currently using the model GL131C magnetron manufactured by AGL, Inc. (formerly Gerling Labs and ASTeX/Gerling Labs, Inc.) or the model L-3858 magnetron manufactured by Litton Industries. These generators must first be updated for use with the GA8002 magnetron (or AG9131) as described in GAE Technical Service Document # 940001.

1.2. Reference Documents

Drawing 910220 Magnetron/Electromagnet Removal and Replacement

2. Magnetron Removal and Installation

2.1. Removal

2.1.1. Refer to Drawing 910220 for location of **ITEMS** referenced in the following discussion.

2.1.2. DISCONNECT THE POWER SOURCE FROM THE ELECTRIC POWER CONNECTION AND COOLING WATER CONNECTION.

2.1.3. Remove outer cover(s) as necessary to gain access to the magnetron housing.

2.1.4. Disconnect the water hoses from the magnetron. MAKE SURE THAT WATER DOES NOT ENTER THE ELECTROMAGNET HOUSING. It is recommended that a rag or other absorbent material be placed around the cooling tubes while disconnecting the hoses.

2.1.5. Carefully disconnect the Fan Cord (not referenced) from the **FAN**.

2.1.6. Remove the four screws which secure **TOP COVER** and remove the **FAN** and **TOP COVER** as an assembly from the power source.

2.1.7. Remove the two screws holding the vertical **SIDE COVER** at the bottom of the cover. Remove the cover from the power source.

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2.1.8. With a suitable Phillips screwdriver carefully loosen and remove the screws securing the inside leads on the **HV FEED-THRU ASSY** to the magnetron filament leads.

2.1.9. Carefully bend the magnetron filament leads straight up.

2.1.10. Remove the three #8 kepnuts that hold the **UPPER POLE PIECE** to the **UPPER ELECTROMAGNET RETAINER**.

2.1.11. Remove the **UPPER POLE PIECE**.

2.1.12. Remove the used **GA8002 MAGNETRON**. Save the thrust ring washer which is resting on top of the magnetron.

2.1.13. Optional: Return the used magnetron to GAE, Inc. for a no-cost failure analysis report.

2.2. Installation

2.2.1. Refer to Drawing 910220 for location of **ITEMS** referenced in the following discussion.

2.2.2. Insert the new **GA8002 MAGNETRON** into the housing and ensure it is properly seated into the socket of the **LOWER POLE PIECE**.

2.2.3. Ensure that the thrust ring washer is resting on top of the magnetron core assembly and around filament lead mast. Note that only one thrust ring washer is required and that one may have been supplied with the replacement GA8002 magnetron.

2.2.4. Install the **UPPER POLE PIECE** onto the **UPPER ELECTROMAGNET RETAINER** with the flange towards the bottom. Tighten the #8 nuts previously removed until they are just snug. Do not over tighten.

2.2.5. Install and hand tighten the **THRUST RING** while gently rocking the magnetron by its cooling lines until the magnetron is firmly seated and snug in place. The stem of the magnetron must be centered and vertical. Finish tightening the three #8 nuts securing the **UPPER POLE PIECE**.

2.2.6. Carefully insert the **THRUST RING INSULATOR** around the magnetron filament leads and into the **THRUST RING**.

2.2.7. Carefully bend the magnetron filament leads so that they are positioned towards the HV Feedthru leads. Secure the filament leads to the leads from the HV Feedthru (attached to the filament housing wall) using the previously removed screws and nuts. Position these connections such that they are separated from each other and approximately mid-way between the bottom and top of the filament housing.

2.2.8. Reinstall the housing **SIDE COVER** and fasten it to the **FILAMENT HOUSING** with two the screws previously removed.

2.2.9. Install the **TOP COVER** and **FAN** assembly and secure it to the filament housing with the four sheet metal screws previously removed.

2.2.10. Reattach the fan cord to the **FAN**.

2.2.11. Reattach the cooling hoses to the cooling lines of the magnetron. DO NOT OVER TIGHTEN THE BANDS.

2.2.12. Replace outer access cover(s).

2.2.13. Perform the Set Up Procedures for installation of a new magnetron as described in the Installation, Operation and Maintenance Manual which was originally provided with the generator.

3. Electromagnet Removal and Installation

3.1. Removal

3.1.1. Refer to Drawing 910220 for location of **ITEMS** referenced in the following discussion.

3.1.2. DISCONNECT THE POWER SOURCE FROM THE ELECTRIC POWER CONNECTION AND COOLING WATER CONNECTION.

3.1.3. Follow steps 2.1.3 through 2.1.12 as outlined in the Standard Retrofit Procedure above for removal of the magnetron.

3.1.4. Remove the brown phenolic insulator block from around the connection between the filament transformer HV leads and **HV FEEDTHRU LEADS**.

3.1.5. Disconnect the filament transformer leads from the feedthru leads.

3.1.6. Disconnect the electromagnet leads from the two-position terminal block located on the side of the housing near the HV feedthru leads.

3.1.7. Remove the four sets of **3/8-16 BOLTS** (with nuts and washers) and left off the **UPPER ELECTROMAGNET RETAINER** with the filament housing intact.

3.1.8. Remove the **ELECTROMAGNET** along with the **INSULATORS** above (not below) the electromagnet. Also remove the plastic **CENTERING RING**.

3.2. Installation

3.2.1. Refer to Drawing 910220 for location of **ITEMS** referenced in the following discussion.

3.2.5. Set the **ELECTROMAGNET** onto the lower **INSULATOR** with the leads on top and towards the rear of the power source (away from the output flange).

3.2.6. Install the plastic **CENTERING RING** into the space between the **ELECTROMAGNET** and **LOWER POLE PIECE**.

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3.2.7. Set the other electromagnet Insulator on top of the **ELECTROMAGNET** and properly centered. Be sure the notches are aligned with those of the lower Insulator and the launch section assembly mounting holes.

3.2.8. Set the **UPPER ELECTROMAGNET RETAINER** (with filament housing attached) over the **ELECTROMAGNET** with the mounting holes aligned with those of the launch section assembly.

3.2.9. Install the four **3/8-16 BOLTS** through the launch section mounting holes from the bottom. Install the flat washers, split-ring lockwashers, and the hex nuts in that order. Tighten the hex nuts until the lockwasher is **approximately one-half compressed** (this is to allow for thermal expansion of the electromagnet).

3.2.10. Connect the leads of the electromagnet to the two-position terminal block (the order of connection is not important).

3.2.11. Connect the filament transformer HV leads to the **HV FEEDTHRU LEADS**. Also attach the flying HV lead from the rectifier assembly (on top of the plate transformer) to the near HV feedthru lead. Install the phenolic insulator block over these HV lead connections.

3.2.12. Follow steps 2.2.2 through 2.2.13 as outlined in the Standard Retrofit Procedure above for installation of the new **GA8002 MAGNETRON**.

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REVISIONS				
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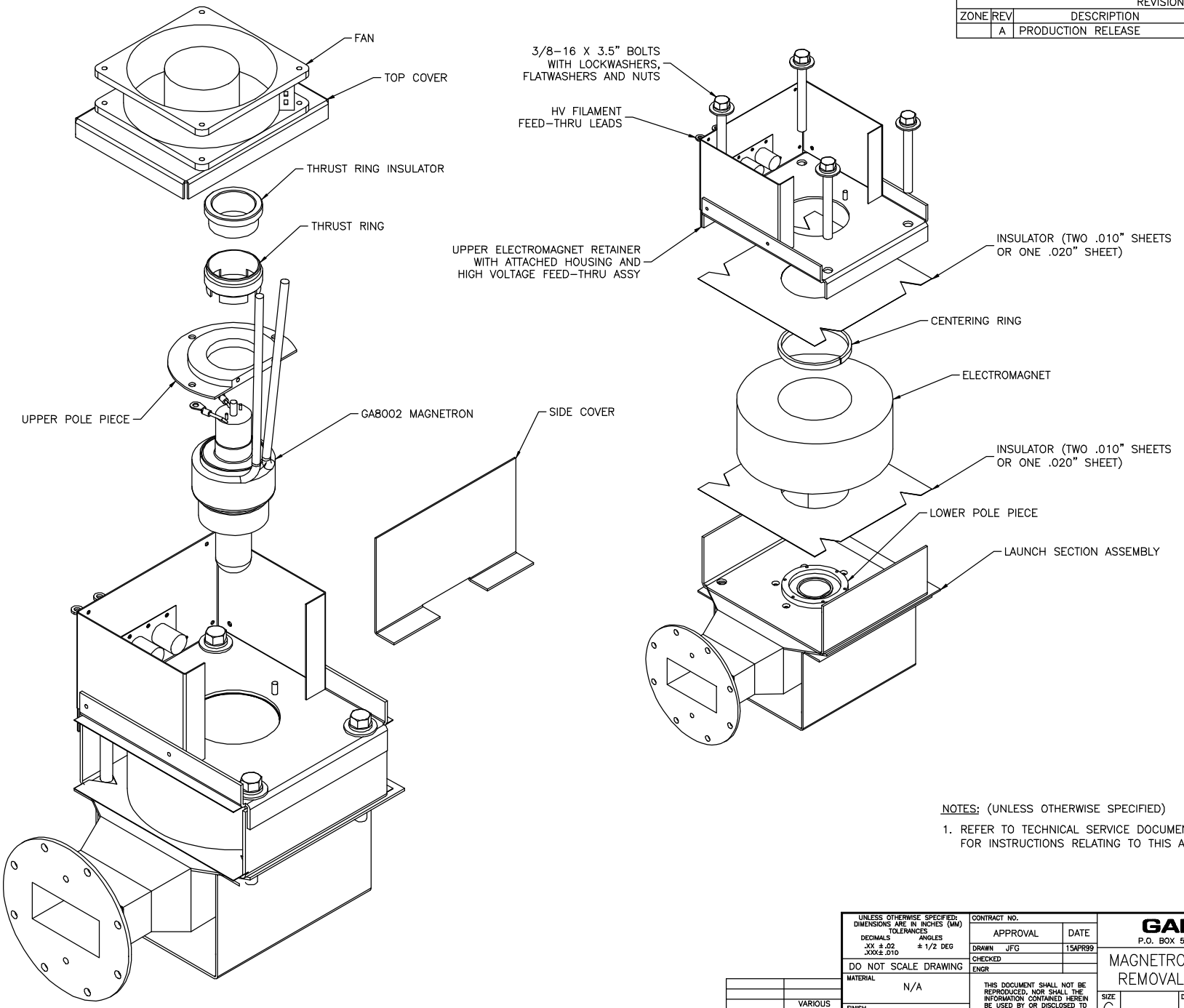
	A	PRODUCTION RELEASE	15APR99	JFG



NOTES: (UNLESS OTHERWISE SPECIFIED)

1. REFER TO TECHNICAL SERVICE DOCUMENT # 940002 FOR INSTRUCTIONS RELATING TO THIS ASSEMBLY.

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UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE IN INCHES (MM)
TOLERANCES
DECIMALS .XX ± .02 .XXX ± .010
ANGLES ± 1/2 DEG

DO NOT SCALE DRAWING

MATERIAL N/A

FINISH N/A

CONTRACT NO.

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MAGNETRON/ELECTROMAGNET REMOVAL & REPLACEMENT

SIZE	DWG. NO.	REV
C	910220	A

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