



TERMALINE<sup>®</sup> COAXIAL  
LOAD RESISTOR  
8400 SERIES

OPERATION MANUAL

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INSTRUCTION BOOK P/N 920-8400S REV. A  
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# Safety Precautions

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The following are general safety precautions that are not necessarily related to any specific part or procedure, and do not necessarily appear elsewhere in this publication. These precautions must be thoroughly understood and apply to all phases of operation and maintenance.

## **WARNING**

### **Keep Away From Live Circuits**

Operating Personnel must at all times observe general safety precautions. Do not replace components or make adjustments to the inside of the test equipment with the high voltage supply turned on. To avoid casualties, always remove power.

## **WARNING**

### **Shock Hazard**

Do not attempt to remove the RF transmission line while RF power is present.

## **WARNING**

### **Do Not Service Or Adjust Alone**

Under no circumstances should any person reach into an enclosure for the purpose of service or adjustment of equipment except in the presence of someone who is capable of rendering aid.

## **WARNING**

### **Safety Earth Ground**

An uninterruptible earth safety ground must be supplied from the main power source to test instruments. Grounding one conductor of a two conductor power cable is not sufficient protection. Serious injury or death can occur if this grounding is not properly supplied.

## **WARNING**

### **Resuscitation**

Personnel working with or near high voltages should be familiar with modern methods of resuscitation.

## **WARNING**

### **Remove Power**

Observe general safety precautions. Do not open the instrument with the power applied.

## Safety Symbols

### WARNING

Warning notes call attention to a procedure which, if not correctly performed, could result in personal injury.

### CAUTION

Caution notes call attention to a procedure which, if not correctly performed, could result in damage to the instrument.



The caution symbol appears on the equipment indicating there is important information in the instruction manual regarding that particular area.

**Note:** *Calls attention to supplemental information*

## Warning Statements

The following safety warnings appear in the text where there is danger to operating and maintenance personnel, and are repeated here for emphasis.

### WARNING

When power is in the upper range of the load's capacity, the radiator will become hot - care should be used in touching the equipment.

[See page 6](#)

### WARNING

Never attempt to connect or disconnect RF equipment from the transmission line while RF power is being applied.  
Leaking RF energy is a potential health hazard.

[See page 7](#)

## Caution Statements

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The following cautions appear in the text whenever the equipment is in danger of damage, and are repeated here for emphasis.

**CAUTION**

The load is designed for operation in a horizontal plane only, with mounting brackets down. Do not operate in any other position.

[See page 5](#)

**CAUTION**

Do not operate this equipment continuously above the rated 600 W. Load failure will result.

[See page 7](#)

## **Safety Statements**

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### **USAGE**

ANY USE OF THIS INSTRUMENT IN A MANNER NOT SPECIFIED BY THE MANUFACTURER MAY IMPAIR THE INSTRUMENT'S SAFETY PROTECTION.

### **USO**

EL USO DE ESTE INSTRUMENTO DE MANERA NO ESPECIFICADA POR EL FABRICANTE, PUEDE ANULAR LA PROTECCIÓN DE SEGURIDAD DEL INSTRUMENTO.

### **BENUTZUNG**

WIRD DAS GERÄT AUF ANDERE WEISE VERWENDET ALS VOM HERSTELLER BESCHRIEBEN, KANN DIE GERÄTESICHERHEIT BEEINTRÄCHTIGT WERDEN.

### **UTILISATION**

TOUTE UTILISATION DE CET INSTRUMENT QUI N'EST PAS EXPLICITEMENT PRÉVUE PAR LE FABRICANT PEUT ENDOMMAGER LE DISPOSITIF DE PROTECTION DE L'INSTRUMENT.

### **IMPIEGO**

QUALORA QUESTO STRUMENTO VENISSE UTILIZZATO IN MODO DIVERSO DA COME SPECIFICATO DAL PRODUTTORE LA PROZIONE DI SICUREZZA POTREBBE VENIRNE COMPROMESSA.

**SERVICE**

SERVICING INSTRUCTIONS ARE FOR USE BY SERVICE - TRAINED PERSONNEL ONLY. TO AVOID DANGEROUS ELECTRIC SHOCK, DO NOT PERFORM ANY SERVICING UNLESS QUALIFIED TO DO SO.

**SERVICIO**

LAS INSTRUCCIONES DE SERVICIO SON PARA USO EXCLUSIVO DEL PERSONAL DE SERVICIO CAPACITADO. PARA EVITAR EL PELIGRO DE DESCARGAS ELÉCTRICAS, NO REALICE NINGÚN SERVICIO A MENOS QUE ESTÉ CAPACITADO PARA HACERLO.

**WARTUNG**

ANWEISUNGEN FÜR DIE WARTUNG DES GERÄTES GELTEN NUR FÜR GESCHULTES FACHPERSONAL.

ZUR VERMEIDUNG GEFÄHRLICHE, ELEKTRISCHE SCHOCKS, SIND WARTUNGSARBEITEN AUSSCHLIEßLICH VON QUALIFIZIERTEM SERVICEPERSONAL DURCHZUFÜHREN.

**ENTRETIEN**

L'EMPLOI DES INSTRUCTIONS D'ENTRETIEN DOIT ÊTRE RÉSERVÉ AU PERSONNEL FORMÉ AUX OPÉRATIONS D'ENTRETIEN. POUR PRÉVENIR UN CHOC ÉLECTRIQUE DANGEREUX, NE PAS EFFECTUER D'ENTRETIEN SI L'ON N'A PAS ÉTÉ QUALIFIÉ POUR CE FAIRE.

## About This Manual

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This instruction book covers the following models of Termaline Load Resistors.

8401

8404

## Changes To The Manual

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We have made every effort to ensure this manual is accurate at the time of publication. If you should discover any errors or if you have suggestions for improving this manual, please send your comment to our factory. This manual may be periodically updated. When inquiring about updates to this manual, refer to the part number and revision level on the title page.

## Chapter Layout

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This instruction book is arranged so that essential information on safety is contained in the front of the book. Reading the Safety Precaution section before operating the equipment is strongly advised.

The remainder of this Instruction Book is divided into chapters and sections.

**Operation** — First time operators should read [Chapter 1, Introduction, page 1](#), [Chapter 2, Theory of Operation, page 4](#), and [Chapter 3, Installation, page 5](#), to get an overview of equipment capabilities and how to install it. An experienced operator can refer to [Chapter 4, Operating Instructions, page 6](#). All instructions necessary to operate the equipment, are contained in this section.

**Maintenance** — All personnel should be familiar with calibration and repair information found in [Chapter 5, Maintenance, page 8](#). If a failure should occur, the troubleshooting section will aid in isolating and repairing the failure.

**Parts** — For location of major assemblies or parts refer to the part lists and associated drawings in [Chapter 5, Maintenance, page 8](#).

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This publication refers to the Termaline Load Resistor models 8401 and 8404. The differences between the models are listed in the specifications. Both models will generally be referred to as a load throughout this manual.

## Purpose and Function

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These loads are portable, general purpose 50 ohm coaxial transmission line terminations. They are self-contained units requiring no outside power source or additional equipment. They provide accurate, dependable, and practically non-reflective termination for testing and adjusting transmitters operating in the stated frequency band.

Some examples of the uses of these loads are:

- As a substitute antenna.
- For tuning RF transmitters - under non-radiating conditions.
- For making routine tests and adjustments.
- As a substitute for any 50 ohm circuit loading element.

## Description

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These models are rectangular in shape with transverse fins encasing an oil-dielectric-filled coolant cylinder. A retractable handle is recessed in the radiator fins. Extra thick fins at the front and rear are bent 90° to form bottom mounting flanges. These flanges are supports for free standing use or brackets for fixed mounting. Flange holes are provided for this purpose.

## Performance and Capabilities

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The Loads can absorb and dissipate up to 600 W of RF power continuously. They show a maximum VSWR of 1.1 to 1.0 from DC to 1000 MHz and 1.25 to 1.0 from 1000 to 2800 MHz, 1.3 to 1.0 from 2800-3000 MHz.

## Dimensions and Weight

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The loads are 16-1/16 inches L x 5-15/16 inches W x 8-1/2 inches H (408 x 151 x 216 mm). They have a net weight of 19.6 lb (8.9 kg) and a shipping weight of approximately 25 lb (11.34 kg).

## Power and Utility Requirements

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These load resistors are passive devices that are self contained and do not require a source of power or utility service to perform their function, other than the RF input power.

## Environmental Requirements

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The load should be operated in an environment as free of dust and vibration as possible. For proper operation the ambient temperature should remain within the range of -40°C to +45°C (-40°F to +113°F) . Allow at least 12 inches of clear space around the load to provide an unimpeded flow of convection air currents for adequate heat dissipation.

## Items Supplied

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The load is equipped with:

- Model 8401 — Female N connector of a patented “Quick-Change” design.
- Model 8404 — Female N with a male N/male N adapter, dust cap, and secured by a ball chain anchor.
- Instruction Manual.

## Items Required

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Only a coaxial cable with the appropriate connector plug is needed for connecting these load resistors to the source of RF power.

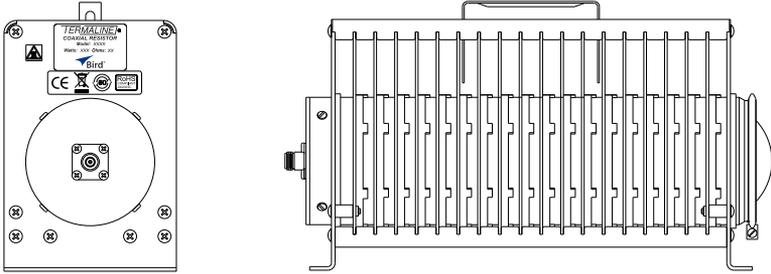
## Tools and Test Equipment

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- Screwdrivers — for disassembly of this equipment.

- An ohmmeter with an accuracy of 1 percent or better at 50 ohms is recommended for checking the resistance value of the resistor.

**Figure 1 Model 8401**



The Termaline Load Resistors consist essentially of a carbon film-on-ceramic resistor immersed in a dielectric coolant. The resistor, individually selected for its accuracy, is enclosed in a special exponentially tapered housing. This provides a linear reduction in surge impedance directly proportional to the distance along the resistor. When surrounded by the dielectric coolant, the characteristic impedance is therefore 50 ohms at the front (connector end), 25 ohms at the mid-point to compensate for the resistance already passed over, and zero ohms at the rear where the resistor joins the housing, forming the return conductor of the coaxial circuit. This produces a uniform and practically reflection-less line termination over the stated frequencies for the load resistor

## Cooling

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The dielectric coolant is chosen for its desirable dielectric and thermal characteristics. Cooling of the load is accomplished by natural fluid and air convection currents. The 0.7 gallon of dielectric coolant carries the electrically generated heat from the resistor to the walls of the cylindrical cooling tank. This tank is encased in a set of radiating fins constructed from heavy gauge aluminum alloy and firmly pressed onto the cylinder. The heat from the dielectric fluid is transferred to the surrounding air by the fins.

Expansion of the coolant, caused by the rise in its temperature, is allowed by means of a synthetic rubber diaphragm (not visible) inside the rear cover dome of the unit.

## Location

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### CAUTION

The load is designed for operation in a horizontal plane only, with mounting brackets down. Do not operate in any other position.

Install the Termaline Load Resistor in a location that:

- Has sufficient room to provide at least 12 inches (304.8 mm) of free space around and above the unit.
- Is the shortest possible distance, or cable length from the transmitting equipment.
- Ensures the operation of the load in a horizontal position only, with the handle on top.

## Mounting

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The load may be used for portable operation or for fixed installation, that is, it may stand free or may be secured to a bench or any convenient flat surface. The front and rear fins are made of heavier gauge material bent outward 90 degrees to form mounting flanges. At each corner of these flanges is a rubber bumper foot attached with an acorn nut. To fasten the load by means of its base mounting flanges:

1. Remove the four rubber bumpers
2. Fasten the load with four screws. Put one screw in each of the four 9/32 inch holes.

**Note:** Use screws up to 1/4 inch diameter.

The holes are arranged in a 5-1/8 x 12-1/7/32 inch rectangle (130.2 x 318.3 mm).

## Use and Function of Controls

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Because these are passive devices, there are no operating controls on the Load Resistors.

## Initial Adjustments

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No initial adjustments are required other than to connect the load to the RF source by means of a coaxial cable equipped with a suitable matching connector plug.

## Start-up

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1. Connect a Male N type plug, which mates with the RF input connector, to the load.
2. Connect the Termaline Load Resistor to the transmitting equipment under test with 50 ohm coaxial cable.
3. After the transmitter has been connected to the load, proceed according to the transmitter manufacturer's instructions.

When reconnecting the antenna, it may become necessary to slightly readjust the transmitter due to possible differences in VSWR between the load and the antenna system.

## Normal Operation

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**WARNING**

When power is in the upper range of the load's capacity, the radiator will become hot - care should be used in touching the equipment.

Having no indicators or controls, these loads require no special operating procedures or surveillance when properly used.

## Operating Under Emergency, Adverse, or Abnormal Conditions

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**CAUTION**

Do not operate this equipment continuously above the rated 600 W.  
Load failure will result.

## Shutdown

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Because the loads are passive devices, there is no way to turn them off. Power must be shut off at the source of the RF energy.

## Emergency Shutdown

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**WARNING**

Never attempt to connect or disconnect RF equipment from the transmission line while RF power is being applied.  
Leaking RF energy is a potential health hazard.

Turn off the RF power at the source.

This chapter contains operator maintenance instructions, troubleshooting, and parts information.

### Troubleshooting

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Problem	Possible Cause	Remedy
Leakage of coolant oil around band or radiator housing	Clamping band not tight.	Tighten clamping band with a screwdriver.
	Faulty o-ring (front).	Replace per the RF Load Resistor paragraph.
	Faulty diaphragm (rear).	Replace per the Diaphragm and Coolant Oil paragraph.
Overheating of the radiator	Transmitter power is too high.	Reduce the transmitter power.
	Coolant Lever is too low.	Add more coolant per the Diaphragm and Coolant Oil paragraph.
	Faulty RF section.	Replace the RF section per the RF load Assembly paragraph
High or low DC resistance values.	Faulty RF input connector.	Replace per the RF load Assembly paragraph
	Loose RF input connector.	Tighten the connector with a screwdriver
	Faulty RF section assembly	Replace the RF section per the RF load Assembly paragraph

### Cleaning

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The principle maintenance required by the operator will be the cleaning of the radiator fins. Periodically wipe away the accumulated dust and lint. If the insulator or metallic contact surfaces of the connector should become dirty or grimy, wipe them off with a soft cloth and use a contact cleaner that is self drying and leaves no residue to clean the inaccessible internal parts.

## Inspection

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With the rugged and simple construction of the Load Resistors, periodic inspection will be necessary at only about six-month intervals. Inspection should include the items listed below:

1. Oil Leakage - Check for coolant oil seepage around the radiator tank, particularly at the front and back around the underside of the clamping band.
2. Inspect the Load for completeness and general condition of the equipment.

The Troubleshooting Chart lists the symptoms of commonly encountered troubles, their causes, and suggested corrective measures. Use the chart as a guide when analyzing symptoms.

## Preventive Maintenance

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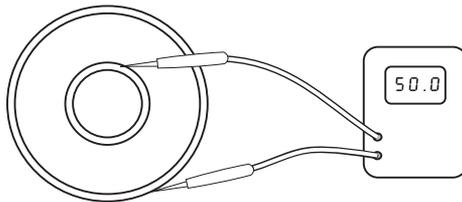
Because of the basic simplicity of construction, no special maintenance procedures are required. Keep the equipment clean, and occasionally check the coolant level in the radiator tank.

## DC Resistance

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Check the condition of the load resistor by accurate measurement of the DC resistance between the inner and outer conductors of the RF connector. Use an ohmmeter with an accuracy of 1 percent or better at 50 ohms for this purpose. The measured resistance should be a nominal 50 ohms,  $\pm 2$  ohms. Perform this test only when the load has cooled down to room temperature. Refer to [Figure 2](#).

**Figure 2** DC Resistance Measurement



## Disassembly

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There are no special techniques required for the repair or replacement of components in the loads. A screwdriver is the only tool needed.

## **RF Connector Replacement**

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The connector is a patented “Quick Change” design which permits easy interchange with the use of only a screwdriver. This process does not interfere with the essential coaxial continuity of the load resistor RF input or the coolant oil seal. For replacement, proceed as follows:

1. Remove the four 8-32 x 5/16 inch round head machine screws from the corners of the RF connector.
2. Pull the connector straight out of its socket.

## **Diaphragm and Coolant Oil**

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Remove the diaphragm to replace or examine the coolant oil. Replacement of the diaphragm and coolant are listed in the steps below:

1. Stand the load vertically, with the back end up. Brace it carefully to avoid tipping it over.
2. Loosen the clamp screw until the clamping band is released.
3. Remove the diaphragm cover and lift the diaphragm from the back end of the radiator tank. Inspect the diaphragm. It should be soft and pliable. If it has hardened or shows signs of surface cracks, replace it.
4. The coolant oil level should be about one inch below the top of the radiator cylinder. If the oil appears to be contaminated; i.e., it doesn't have a clear light yellow color, replace it.

## **RF Load Resistor Assembly**

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To replace the load resistor assembly, it is not necessary to drain the unit of coolant oil. Follow the steps below:

1. Stand the load vertically, with the front end up.
2. Loosen the clamp screw until the clamping band is released.
3. Hold the load assembly by the RF connector and pull the assembly slowly out of the radiator. Allow the excess coolant to drip back into the radiator.
4. Inspect the O-Ring seal which is located just inside the mounting flange of the resistor assembly. Do not reuse the O-Ring if it is not soft and pliable or if it shows signs of surface cracks.

## Assembly

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### RF Connector

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Before pushing the RF connector in, be sure that the projecting center contact pin on the connector is carefully engaged and properly seated in the mating socket of the load resistor input.

Install the four 8-32 x 5/16 inch round head machine screws into the corners of the RF connector.

### Diaphragm and Coolant Oil

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To assemble, follow the instructions below.

1. Fill the unit with coolant until the level is about one inch below the top of the radiator cylinder.
2. Install the diaphragm and place the diaphragm cover on the back end of the radiator tank.
3. Install and tighten the clamping band screw.
4. Check for leaks. Pay particularly close attention to the area around the clamping band.

### RF Load Resistor Assembly

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To replace the assembly:

1. Hold the load assembly by the RF connector and slowly lower the assembly into the radiator
2. Place the clamp band on and tighten the clamp screw until the clamping band is tight.
3. Place the unit on its flanges, in a horizontal position.
4. Check for leaks. Pay particularly close attention to the area around the clamping band.

## Repairs

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Any maintenance or service procedure beyond the scope of those provided in this section should be referred to a qualified service center.

## Preparation For Shipment

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Wrap and tape the RF connector to keep out foreign material, then pack and brace the load in a suitable container. A sturdy corrugated paper box is recommended.

## Storage

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No special preparations are needed for storage other than to cover the equipment to keep out dust and dirt. Store the unit in a clean dry environment where the ambient temperature will remain within the approximate working range of the instrument -40°C to +45°C (-40°F to +113°F).

## Customer Service

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Any maintenance or service procedure beyond the scope of those in this chapter should be referred to a qualified service center.

If the unit needs to be returned for any reason, request an Return Material Authorization (RMA) through the Bird Technologies website. All instruments returned must be shipped prepaid and to the attention of the RMA number.

### **Bird Service Center**

30303 Aurora Road  
Cleveland (Solon), Ohio 44139-2794  
Fax: (440) 248-5426  
E-mail: [bsc@birdrf.com](mailto:bsc@birdrf.com)

For the location of the Sales Office nearest you, visit our Web site at:

<http://www.birdrf.com>

## Specifications

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Impedance, Nominal	50 ohms
<b>VSWR, Max</b>	
DC-1000 MHz	1.1:1.0
1000-2800 MHz	1.2:1.0
2800-3000 MHz	1.3:1.0
Connectors	Female N "QC" type normally supplied
8401	Female N "QC" type normally supplied,
8401	plus UG-57G/U N(M) to N(M) adapter and dust cap
<b>Power Range</b>	600 W Continuous
<b>Frequency Range</b>	DC - 3000 MHz
Dimensions	16-1/16" L x 5-15/16" W x 8-1/2" H (408 x 151 x 216 mm)
<b>Ambient Temperature</b>	-40°C to +45°C (-40°F to +113°F)
Coolant Method	Oil dielectric and air convection currents
Weight	19.6 lb (9 kg)
Operating Position	Horizontal only
Finish	Grey Powder Coat

## Replacement Parts List

Item	Qty.	Description	Part Number
1	1	Radiator assembly	2440-001-1
2	1	RF Section assembly	8401-002
3	.7 Gal (2.65 liters)	Dielectric coolant	5-030-3 (1 Gallon)
4	1	"QC" connector	*see below
5	1	Diaphragm	2430-015
6	1	Diaphragm cover	2430-148
7	2	Clamp band (includes 10-32 x 1-1/2" clamping screw)	2430-055
8	1	O-Ring seal	5-453
9	4	Bumper foot	5-049
10	4	Acorn nut	8110-171
11	1	Radiator handle	2440-009
12	1	Plug, Filler	7500-040
13	1	O-Ring, Filler Plug	8110-041
14	1	Adapter, male N/male N (model 8404)	5-790-1
15	1	Dust cap (Model 8404)	5-297

\*Available QC Type Connectors

N-Female	4240-062	LT-Male	4240-012
N-Male	4240-063	C-Female	4240-100
HN-Female	4240-268	C-Male	4240-110
HN-Male	4240-278	UHF-Female (SO-239)	4240-050
LC-Female	4240-031	UHF-Male (PL-259)	4240-179
LC-Male	4240-025	7/8" EIA Air Line	4240-002
LT-Female	4240-018		

# Limited Warranty

All products manufactured by Seller are warranted to be free from defects in material and workmanship for a period of one (1) year, unless otherwise specified, from date of shipment and to conform to applicable specifications, drawings, blueprints and/or samples. Seller's sole obligation under these warranties shall be to issue credit, repair or replace any item or part thereof which is proved to be other than as warranted; no allowance shall be made for any labor charges of Buyer for replacement of parts, adjustment or repairs, or any other work, unless such charges are authorized in advance by Seller.

If Seller's products are claimed to be defective in material or workmanship or not to conform to specifications, drawings, blueprints and/or samples, Seller shall, upon prompt notice thereof, either examine the products where they are located or issue shipping instructions for return to Seller (transportation-charges prepaid by Buyer). In the event any of our products are proved to be other than as warranted, transportation costs (cheapest way) to and from Seller's plant, will be borne by Seller and reimbursement or credit will be made for amounts so expended by Buyer. Every such claim for breach of these warranties shall be deemed to be waived by Buyer unless made in writing within ten (10) days from the date of discovery of the defect.

The above warranties shall not extend to any products or parts thereof which have been subjected to any misuse or neglect, damaged by accident, rendered defective by reason of improper installation or by the performance of repairs or alterations outside of our plant, and shall not apply to any goods or parts thereof furnished by Buyer or acquired from others at Buyer's request and/or to Buyer's specifications. Routine (regularly required) calibration is not covered under this limited warranty. In addition, Seller's warranties do not extend to the failure of tubes, transistors, fuses and batteries, or to other equipment and parts manufactured by others except to the extent of the original manufacturer's warranty to Seller.

The obligations under the foregoing warranties are limited to the precise terms thereof. These warranties provide exclusive remedies, expressly in lieu of all other remedies including claims for special or consequential damages. SELLER NEITHER MAKES NOR ASSUMES ANY OTHER WARRANTY WHATSOEVER, WHETHER EXPRESS, STATUTORY, OR IMPLIED, INCLUDING WARRANTIES OF MERCHANTABILITY AND FITNESS, AND NO PERSON IS AUTHORIZED TO ASSUME FOR SELLER ANY OBLIGATION OR LIABILITY NOT STRICTLY IN ACCORDANCE WITH THE FOREGOING.