PRELIMINARY

INSTRUCTION BOOK

FOR

MODELS 8722 AND 8723-010

TERMALINE®

RF LOAD RESISTORS

Bird Electronic Corporation

30303 Aurora Road, Cleveland, Ohio 44139-2794

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.

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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. 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.

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MODELS COVERED IN THIS INSTRUCTION BOOK

8722
8723-010

SAFETY PRECAUTIONS

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.

Keep away from live circuits.

Operating personnel must at all times observe normal safety regulations. Do not attempt to replace parts or disconnect an RF transmission or any other high voltage line while power is applied. When working with high voltage always have someone present who is capable of rendering aid if necessary. Personnel working with or near high voltage should be familiar with modern methods of resuscitation.

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 following will appear in the text of this publication and are shown here for emphasis.

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************************************************************
*                      C A U T I O N                       *
*                                                          *
* Never reverse the cooling water connections.  It is      *
* very important for the safety of the load resistor to    *
* observe proper flow direction.  Also, when the load is   *
* first installed or is reconnected, run the water for     *
* approximately a minute to fill the system and remove     *
* all bubbles before turning on the RF power.              *
************************************************************
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************************************************************
*                      C A U T I O N                       *
*                                                          *
* Do not operate this equipment above the rated 5kW.       *
************************************************************
```

Continued

****
* CAUTION *
*
* Any more than 5W of power applied to the load resistor *
* without water cooling will quickly damage the equipment.*
****

****
* CAUTION *
*
* Do not submerge the device during the cleaning process. *
* The fluid could enter the inside of the system and *
* cause the failure of the device when power is applied. *
****

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

****
* WARNING *
*
* Provide adequate ventilation and observe normal *
* precautions when using dry cleaning solvents. Many dry *
* cleaning agents emit toxic fumes that may be harmful to *
* your health if inhaled. *
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MODELS 8722/23-010 TERMALINE® LOAD RESISTOR

INTRODUCTION

PURPOSE AND FUNCTION

The Models 8722/23-010 Load Resistors are designed as compact, low reflection and nonradiating termination of coaxial transmission lines. Cooled by internal water flow, they generate almost no ambient heat, making installation space minimal and convenient.

This subminiature unit may be carried easily and installed anywhere, for use in whatever position desired.

PERFORMANCE CHARACTERISTICS AND CAPABILITIES

A Model 8722/23-010 can absorb up to 5000 watts continuously and dissipate it harmlessly as heat over a frequency range of dc to 1800MHz. It will show a maximum VSWR of 1.1 to 1 from dc to 1000MHz and 1.2 to 1.0 from 1000 to 1800MHz. See specifications for further details.

Power input is through a 50 ohm 1-5/8 inch EIA flanged connector. The RF power is converted to heat in the load resistor, and directly dissipated by means of the water cooling system. Water flow through the inside of the resistor directly absorbs the dissipated power of the resistive film.

DIMENSIONS AND WEIGHT

This load has a body length of 10-3/4 inches (273mm). A pair of water supply tubes adds approximately another 5 to 8 inches (127 to 203mm) to the overall length. The major body diameter is 1-5/8 inch (41mm); however, the 1-5/8 inch EIA swivel flange connector diameter is 3-1/2 inches (89mm). The weight is only 2 lbs., 8 oz. (1.13kg) and the shipping weight is 5 lbs. (2.27kg).

UTILITY REQUIREMENTS

These units are passive devices that are self-contained and do not need any external source of power or utilities to function. They do need a source of running water, however, to provide for cooling. The water must flow from a rate of 1 gallon (3.8 liter) per minute at a water temperature of +5°C (41°F) to a rate of 4 gallons (15 liter) per minute at +80°C (+176°F) in order to provide adequate heat dissipation.

ENVIRONMENTAL REQUIREMENTS

The load should be operated in a dust and vibration-free environment. The ambient temperature range should remain between +5°C and +80°C (+41°F and +176°F) for proper operation. However, this is not critical for cooling.

ITEMS FURNISHED

The Model 8722/23-010 is equipped with a 1-5/8 inch EIA swivel flange RF connector and 1/4 inch Female pipe threaded nuts for the water supply lines. A coupling kit, P/N 4712-020, is available as an optional accessory. This instruction book is the only additional item furnished.

ITEMS REQUIRED

The only items required are a 1-5/8 inch EIA flange coupling kit for the RF transmission line and 1/4 inch pipe thread fittings on the ends of the water lines. The Model 8722 has Female fittings and the Model 8723-010 has male fittings.

TOOLS AND TEST EQUIPMENT

An adjustable wrench is the only tool required for dismounting this load. A resistance bridge or an ohmmeter with an accuracy of 1% or better at 50 ohms is recommended for checking the resistance value of the load resistor.

SPECIFICATIONS FOR 8722/23-010 TERMALINE® LOAD RESISTOR

Power Rating	5kW continuous
RF Input Impedance	50 ohms nominal
VSWR Model 8722	1.1 to 1.0 max. dc to 1000MHz 1.2 to 1.0 max. 1GHz to 1.8GHz
Model 8723-010	1.1 to 1.0 max. 1487MHz to 1507MHz
Connectors	1-5/8" EIA flanged (swivel)
Frequency Range	
Model 8722	dc to 2000MHz
Model 8723-010	1487MHz to 1507MHz
Dimensions	10-3/4"L x 2-39/64" Dia. major body diameter (273 x 66.3mm) not including 5 to 8" (127 x 203mm) water supply tubes
Connector Flange Diameter	3-1/2" (89mm)
Water Temperature	+5°C to +80°C (+41°F to +176°F)
Cooling Method	Forced liquid flow, potable water or 1/3 ethylene glycol and 2/3 potable water*
Flow Rate	1 to 4 gal./min.
Weight	2 lbs. 8 oz. (1.13kg)
Operating Position	Any attitude
Finish	Black Lusterless Enamel

*Certain other coolants maybe used without detrimental effects to the internal parts of the load. However, the VSWR specification will be altered. Before any such use, consult Bird Electronic Engineering Department.

SECTION I - INSTALLATION

1-1. GENERAL

1-2. The Models 8722/23-010 TERMALINE® Load Resistor units may be installed in any position or attitude required. Their relatively small size permits mounting in a very limited space since cooling is by water flow rather than air convection. No clearance for air flow is needed. It is also comparatively easy to carry and to relocate as necessary.

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**********************************************************
*                      C A U T I O N                     *
*                                                        *
* Never reverse the cooling water connections.  It is    *
* very important for the safety of the load resistor to  *
* observe proper flow direction.  Also, when the load is *
* first installed or is reconnected, run the water for   *
* approximately a minute to fill the system and remove   *
* all bubbles before turning on the RF power.            *
**********************************************************
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1-3. The input and output water conducting tubes are made of copper and can be bent as necessary to fit. However, care should be exercised not to pinch the tubes in bending as this would restrict the flow and cause the device to operate improperly. The tube at the center of the water chamber is the water input and the outer is the water output tube. Water connections on the load are 1/4 inch FPT fittings.

1-4. Attach the RF coaxial transmission line with a 1-5/8 inch EIA connector kit, Part Number 4712-020. The center conductor bullet should be clean. Bottom it firmly and tighten the four screw and nut sets evenly and securely. Note - Always handle the load with care to prevent subjection to unnecessary shock or impact.

FIGURE 1-1. OUTLINE DRAWING MODEL 8722.

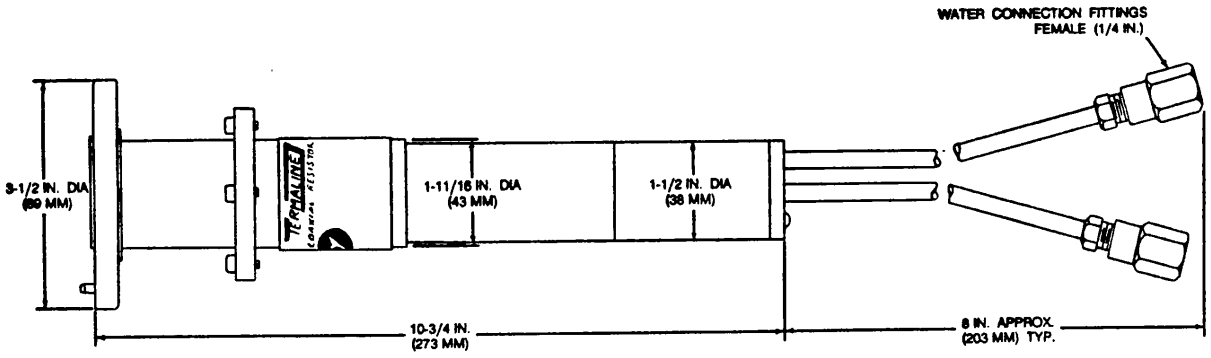
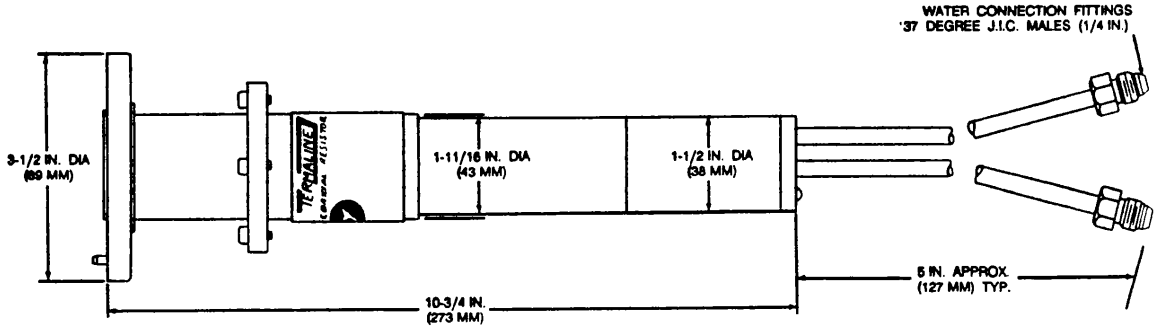


FIGURE 1-2. OUTLINE DRAWING MODEL 8723-010.



SECTION II - THEORY OF OPERATION

2-1. GENERAL

2-2. The Models 8722/23-010 RF Load Resistors are unique in that they use primarily an external water supply for the cooling of the resistor element. By using this technique, the need for an intermediate dielectric fluid to transfer the heat generated in the resistive element has been eliminated, reducing the physical size of the load to a virtual minimum. This simplified system allows use of the load in more varied environments and attachment at any attitude (see Specifications, page vi).

2-3. For the direct reading of power measurements up to 5kW, these loads may be used in conjunction with a Bird Model 4712 THRULINE® Wattmeter.

2-4. HEAT TRANSFER

2-5. Cold water enters the unit by the center pipe and is directed by a center flow tube to the RF input end of the load resistor where it passes through peripheral holes in the wall. This flow tube, supported at both ends, is constructed of dielectric material so that it will not affect the electrical properties of the device. The water is then directed backwards over the outside surface of the resistor tube. This tube has a resistive film of very uniform thickness deposited on its outside surface. The high strength of the resistor tube is manufactured from good thermal conductivity material. The heat generated by the RF energy absorbed is readily given off to the water flowing over its comparatively thin wall. The heat is carried off by the water, passing over the surface, and the RF power absorbed by the load is translated into an increased temperature of the water flowing out of the load. The value of this power may be easily calculated, if the water flow is known, by using the following formula:

$$P = 0.263\ (T_1 - T_2)\ GPM$$

Where: P = Power in kilowatts
T_1 = Outlet water temperature in °C
T_2 = Inlet water temperature in °C
GPM = Water flow in gallons per minute

In °F the formula is: $P = 0.146\ (T_1 - T_2)\ GPM$

SECTION III - OPERATING INSTRUCTIONS

3-1. USE AND FUNCTION OF CONTROLS

3-2. The load, being a passive device, has no indicators or operating controls.

3-3. INITIAL ADJUSTMENTS

3-4. No initial adjustments are required other than to connect the load to the RF source by means of the coaxial air line with suitable coupling kit.

3-5. START-UP

3-6. Turn on the water flow and wait a moment for all the air to be purged out of the lines before turning on the RF power.

3-7. COOLING WATER FOR MODELS 8722/23-010

3-8. The electrical performance of these RF loads is affected by impurities or other chemical additives in the cooling water. The presence of salts in the water definitely makes the device unusable because it causes a rapid increase in VSWR. Therefore, sea water or silty water should not be used for cooling the loads. A mixture of 33% ethylene glycol may be used without unfavorable effects; however, if other coolants are to be used, please consult the company regarding such usage.

3-9. The thermal performance of these loads is also affected by impurities, particularly those impurities that accumulate in the form of scale on the exposed surfaces of the fluid paths of the load assembly. These deposits may result in an increase in the thermal and/or fluid resistance(s) of the load and may in turn cause the load to overheat and fail.

3-10. The following types of water are considered safe for the cooling of the Models 8722/23-010 Load Resistor: filtered, city, or soft water. In general, any potable water is suitable for cooling the load.

3-11. NORMAL OPERATION

3-12. Operation of this equipment is rather simple. First, turn on the water supply, before applying any RF power. Set the flow between 1 gpm for +5°C (+41°F) water temperature and 4 gpm for 80°C (+176°F); i.e., add 1 gpm to the flow rate for each 25°C increase in water temperature above 5°C.

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**********************************************************
*                      C A U T I O N                     *
*                                                        *
* Do not operate this equipment above the rated 5kW.     *
**********************************************************
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3-13. SHUTDOWN

3-14. Always turn off the RF power first, letting the water flow continue for a few minutes to cool the load.

3-15. EMERGENCY SHUTDOWN

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************************************************************
*                      C A U T I O N                       *
*                                                          *
* Any more than 5W of power applied to the load resistor   *
* without water cooling will quickly damage the equipment. *
************************************************************
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```
************************************************************
*                      W A R N I N G                       *
*                                                          *
* Never attempt to disconnect any RF equipment from the    *
* transmission line while RF power is being applied.       *
* Leaking RF energy is a potential health hazard.          *
************************************************************
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3-16. Any cessation of water flow while the RF power is still being applied will almost certainly result in overheating, causing damage to the load resistor and possible injury to the operator. Always turn off the RF power source immediately if water flow should fail.

SECTION IV - MAINTENANCE

4-1. GENERAL

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**********************************************************
*                      W A R N I N G                     *
*                                                        *
* Provide adequate ventilation and observe normal        *
* precautions when using dry cleaning solvents. Many dry *
* cleaning agents emit toxic fumes that may be harmful to *
* your health if inhaled.                                *
**********************************************************
```

```
**********************************************************
*                      C A U T I O N                     *
*                                                        *
* Do not submerge the device during the cleaning process. *
* The fluid could enter the inside of the system and     *
* cause the failure of the device when power is applied. *
**********************************************************
```

4-2. The Model 8722/23-010 Coaxial Load Resistor is a rugged unit and of a simple design requiring only nominal and routine attention. The load is designed to operate for long periods of time if care is taken not to exceed its power handling capabilities.

4-3. CLEANING

4-4. The outside surface of the unit should be wiped free of dust and dirt at regular intervals if necessary. Disconnect the load resistor from the transmission line and clean the RF input connector, both metallic and insulator surfaces. Use an aerosol type contact cleaner or any good dry cleaning solvent on a cloth. Always handle the load with care to prevent subjection to unnecessary shock or impact.

4-5. TROUBLESHOOTING

PROBLEM	POSSIBLE CAUSE	REMEDY
High exit temperature	Overheating	Reduce RF power. Increase flow rate of water.
	Obstruction in water flow system	Check water lines for source of blockage.
Resistor value changed See Paragraph 4-12	Resistor damaged	Replace resistor or return to factory for service.

4-6. INSPECTION

4-7. Check the water connections from time to time for leaks, and the load itself for cleanliness. (See Paragraph 4-3, Cleaning)

4-8. PREVENTIVE MAINTENANCE

4-9. The necessary preventive maintenance procedures are covered in Paragraph 4-4, Cleaning.

4-10. REPAIRS

4-11. Repairs beyond what is covered in this instruction book will require returning the equipment to Bird Electronic Corporation for service. Please consult the factory.

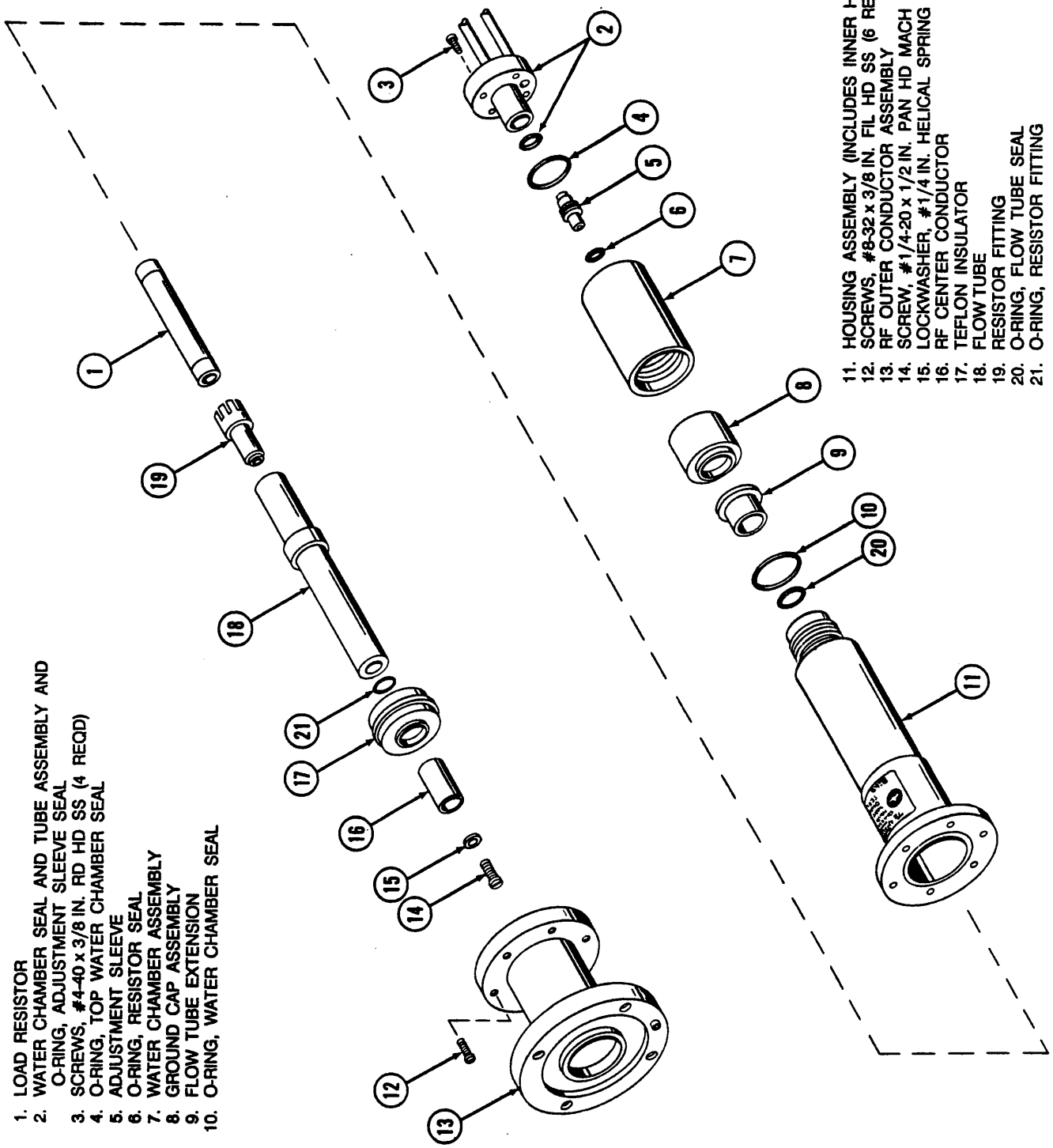
4-12. RF LOAD RESISTOR

4-13. Accurate measurement of the dc resistance between the inner and outer conductors of the RF input connector will provide a good check of the condition of the load resistor. For this measurement, a resistance bridge or an ohmmeter with an accuracy of one percent or better at 50 ohms should be used. Use low resistance leads, preferably a short piece of 50 ohm coaxial cable. The measured resistance should not deviate more than 2 ohms from the value stamped on the manila tag attached to the load. It is recommended that this resistance check be performed each time the load is to be used.

4-14. REPLACEMENT PROCEDURE FOR RESISTOR AND RELATED PARTS

4-15. This series of water cooled loads is designed to be quickly and easily repaired in the field. If in performing the dc resistance check described in Paragraph 4-13 a significant change in resistance is noted, or if for any reason the resistive element or any other part should fail, inexpensive replacement parts are available. They can be readily installed in the load, using the following procedures. Part numbers designated by brackets [] in this text are so indicated in Figure 4-1.

FIGURE 4-1. EXPLODED VIEW MODEL 8722/23-010.



a. Disconnect the load from RF power and water coolant lines. Drain water from load. Air pressure applied to input tube will purge any residual coolant.

b. Stand the load upright on a bench with connector end down.

c. Remove the four 4-40 x 3/8 inch round head machine screws [3] that secure the water chamber seal and tube assembly [2]. Remove this assembly and also the top water chamber seal O-Ring [4].

d. Using a 1/4 inch Allen wrench, remove the adjustment sleeve [5] located just inside the water chamber. Be careful not to lose the resistor seal O-Ring [6] that fits on the adjustment sleeve.

e. Grasp the water chamber assembly [7] firmly in one hand while holding the resistor housing assembly [11] in the other hand. Twist counterclockwise to remove the water chamber. With the water chamber removed, the resistor ground cap assembly [8] is exposed.

f. The ground cap can be pulled straight up off the load resistor [1]. Occasionally the load resistor will come out with the resistor cap assembly. This is an acceptable condition and if the resistor is not defective, it can easily be reinstalled or replaced, by inserting it in the housing [11] and pushing it firmly in place with a slight twisting motion as described in subparagraph 4-18a.

g. This completes the disassembly for typical resistor and associated parts replacement. Further disassembly may be required as described in paragraph 4-19, Replacement Procedure for Fractured Resistors.

4-16. PARTS INSPECTION

4-17. At this time, if the resistor has been successfully removed, inspect it carefully to ensure that it has not been fractured. In the majority of cases, even in the event of complete resistor failure, the resistor substrate will remain intact. Next, examine the inside of the load housing assembly for any visible damage to internal parts. If no damage has been found, proceed with paragraph 4-18. If however, the resistor has been broken, other internal parts appear to be damaged, or if they do not fit together properly, proceed to paragraph 4-19, Replacement Procedure for Fractured Resistors or Damaged Internal Parts. NOTE - Inspect all O-Rings thoroughly; do not use if they show signs of cuts, nicks, or lack of resiliency.

4-18. RESISTOR REPLACEMENT

a. Insert the new resistor [1] into the load housing until it reaches the resistor fitting, then gently rotate and rock the resistor until it starts to enter its way into the resistor fitting [19]. Push the resistor firmly in until it bottoms in the fitting. If the resistor seems to be loose, refer to subparagraph 4-21a, Connector and Front End Assembly for instructions on how to tighten the resistor fitting.

b. The resistor ground cap [8] can now be replaced. Push it on the resistor with the open or lipped side down towards the resistor housing. Now replace the water chamber assembly [7]. Position it over the ground cap assembly [8] and screw it firmly onto the load housing assembly [11].

c. Using the 1/4 inch Allen wrench to hold the adjustment sleeve [5] horizontally, position the resistor seal O-Ring [6] on the opposite end. Holding the load unit in a horizontal position in the other hand, carefully screw the adjustment sleeve [5] into the water chamber assembly [7] until it is snug but not tight against the resistor. Make sure the O-Ring hasn't fallen off during assembly.

d. Place the top water seal O-Ring [4] in the groove provided on the end of the water chamber [7]. Replace the water chamber seal and tube assembly [2] and secure it with the four 4-40 x 3/8 inch round head stainless steel screws [3]. Tighten the screws alternately and securely.

e. After assembly is completed, check the dc resistance of the load per paragraph 4-13. Then connect the load to a water source and check for leaks. If no leaks are found and the results of the dc resistance check are satisfactory, the load is ready for service.

4-19. REPLACEMENT PROCEDURE FOR FRACTURED RESISTORS OR DAMAGED PARTS

4-20. RESISTOR REMOVAL

The load should already be disassembled to the point of paragraph 4-16f. Continue with the steps below:

a. Remove the six 8-32 x 3/8 inch fillister head machine screws holding the flanged outer conductor assembly [13] to the load housing [11]. When removing the 8-32 x 3/8 inch screws be careful to hold the outer conductor in place as it will fall off when the last screw is released.

b. Grasp the center conductor [16] and firmly pull the whole resistor assembly out of the housing assembly [11]. This resistor assembly consists of 1)RF center conductor, 2)Teflon insulator [17], 3)flow tube [18], 4)resistor fitting [19], and 5)the 1/4-20 fastening screw and washer.

c. Hold the center conductor [16] and unscrew the 1/4-20 x 1/2 inch screw inside the center conductor counterclockwise. The whole assembly will come apart. The resistor fitting [19], exposed at the end of the flow tube [18], is removed by merely pushing it in through the flow tube.

d. This completes a thorough disassembly of the unit. If the resistor has been fractured or other damage has occurred, rinse all of the parts thoroughly under clear running tap water to remove any chips or pieces that may have been caught in the load. Replace any damaged parts.

4-21. CONNECTOR AND FRONT END ASSEMBLY

a. Install the resistor fitting [19] on the load resistor [1]. These parts should fit together with a very snug but not excessively tight fit. Adjust the finger contacts on the resistor fitting [19] to achieve this fit. The resistor fitting fingers can be tightened by rolling them, minus the resistor, against a flat hard surface bending them in slightly until a snug fit on the resistor is achieved. To loosen them, gently bend them outward using your finger or a round dowel such as a pencil.

b. The assembled resistor and fitting assembly is now inserted into the flow tube [18]. The fitting enters first and the assembly is manipulated until the resistor fitting enters the smaller hole at the end of the flow tube. An O-Ring seal in the small bore may restrict entry of the resistor fitting, but a small amount of silicon oil on this O-Ring will assist in assembling the resistor and fitting in the flow tube.

c. Place the Teflon insulator on the flow tube so that the flow tube enters the counterbore provided for it. The RF input connector's center conductor [16] is installed in place using the 1/4-20 x 1/2 pan head screw and 1/4 inch lock washer. Hold the center conductor firmly when tightening the 1/4-20 screw but do not use any tools that will nick the surface. A strap wrench is useful for this purpose.

d. Insert the whole resistor-center conductor assembly into the housing assembly [11] and push in firmly until it is seated in place. The outer conductor assembly [13] can be put in place and secured with the six 8-32 x 3/8 inch fillister head machine screws.

e. Final assembly is completed by following the instructions of steps b. through e. of paragraph 4-18.

4-22. RETESTING

4-23. After completion of any of the above replacement or reassembly operations and the tests per subparagraph 4-18e, power test the restored load at 5kW with 50/60Hz current for approximately 1/2 hour with requisite water flow.

SECTION V - PREPARATION FOR RESHIPMENT

5-1. GENERAL

5-2. With the RF power shut off, disconnect the Model 8722/23-010 from both the RF coaxial line and the water lines. Drain the water out of the load. Wrap the RF connector with padding and tape securely in place. Pack and brace the load in a suitable shipping container, such as a corrugated paper box.

SECTION VI - STORAGE

6-1. GENERAL

6-2. No special preparations for storage are necessary other than to cover the equipment to keep out dust and dirt. Store this unit in a dry and dust-free environment where the ambient temperature will remain within +1°C to +80°C (+34°F to +176°F).

SECTION VII - REPLACEMENT PARTS LIST

7-1. MODELS 8722 AND 8723-010

7-2. Drawing reference numbers are equivalent to circled numbers on drawings.

ITEM	QUANTITY	DWG REF NO.	DESCRIPTION	PART NUMBER
1	1	1	Load Resistor	8722-010
2	1	2	Water Chamber Seal & Tube Assembly	
			Model 8722	8722-006
			Model 8723-010	8723-012
3	1	7	Water Chamber Assembly	8722-008
4	1	5	Adjustment Sleeve	8722-012
5	1	8	Resistor Cap Assembly	8722-004
6	1	11	Housing Assembly (front)	8722-002
	1	11A	Inner (rear)	8722-007
7	1	13	RF Outer Conductor Assembly	8722-005
8	1	16	RF Center Conductor	4712-005
9	1	17	Teflon Insulator	8722-011
10	1	18	Flow Tube	8722-009
11	1	19	Resistor Fitting	8722-020
12	1	4	O-Ring Top Water Chamber Seal	5-1947
13	1	6	O-Ring Resistor Seal	5-1945
14	1	10	O-Ring Water Chamber Seal	5-1924
15	1	20	O-Ring Flow Tube Seal	5-1944
16	1	21	O-Ring Resistor Fitting	5-1943
17	1	--	O-Ring Adjustment Sleeve Seal (Part of Item No. 2)	5-1946
18	4	3	Water Chamber Screws 4-40 x 3/8" Round Head Stainless Steel	Standard

Continued

ITEM NUMBER	QUANTITY	DWG REF	NO.	DESCRIPTION	PART
19	6	12		Flange Screws 8-32 x 3/8" Fillister Head Stainless Steel	Standard
20	1	14		Center Conductor screw 1/4-20 x 1/2" pan head machine screws	Standard
		15		Center Conductor Lock Washer 1/4 Heavy Slit Stainless Steel	Standard
21	1	--		1-5/8" Coupling Kit Consists of: 1 - Anchor Bullet 1 - O-Ring 4 - 5/16-18 x 1- 1/2" Screw and Nut Sets	4712-020