



TERMALINE® LOAD RESISTOR
SERIES 8720

OPERATION MANUAL

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INSTRUCTION BOOK P/N 920-8720 REV. B

TERMALINE ARE REGISTERED
TRADEMARKS OF BIRD ELECTRONIC CORPORATION

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. 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 on.

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.



This symbol indicates that the unit radiates heat and should not be touched while hot.

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 using dry cleaning solvents, provide adequate ventilation and observe normal safety precautions. Many dry cleaning agents emit toxic fumes that could be harmful to your health, if inhaled.

On pages 6.

WARNING

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

On page 7.

Caution Statements

The following equipment cautions appear in the text and are repeated here for emphasis.

CAUTION

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.

On page 3.

CAUTION

Do not excessively overload these units above the rated 5 kilowatts of power. Overload for any length of time will cause resistor failure.

On page 5.

CAUTION

Any more than 5 W of power applied to the load resistor without water cooling will quickly damage the equipment. The new sealed system effectively protects the resistive film from possible moisture damage by any condensate formation. Flow of cooling water through the system without applied power represents no danger.

On pages 5.

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.

On page 6.

Safety Statements

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.

ASSISTENZA TECNICA

LE ISTRUZIONI RELATIVE ALL'ASSISTENZA SONO PREVISTE ESCLUSIVAMENTE PER IL PERSONALE OPPORTUNAMENTE ADDESTRATO. PER EVITARE PERICOLOSE SCOSSE ELETTRICHE NON EFFETTUARE ALCUNA RIPARAZIONE A MENO CHE QUALIFICATI A FARLA.

About This Manual

This manual covers the operating and maintenance instructions for the following models:

8720

Changes to this Manual

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

Terminology

The following terms will be used throughout this manual to refer to certain components of the Econoload:

Econoload or Load — The entire unit. It contains the RESISTOR.

Resistor — A subcomponent of the LOAD. This is the ceramic resistor which actually absorbs the RF power.

Chapter Layout

Introduction — Describes the features of the Econoload RF Load, lists equipment supplied and optional equipment, and provides power-up instructions.

Installation — Describes how to install the Econoload.

Theory of Operation — Describes how the load works on a fundamental level.

Operating Instructions — Describes the features of the Econoload RF Load and its process of operation.

Maintenance — Lists routine maintenance.

Specifications — List the specification for the 8720 Econoload.

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Purpose and Function

The Model 8720 Load Resistor is designed as a compact, low reflection and nonradiating termination of coaxial transmission lines. Cooled by internal water flow, it generates almost no ambient heat, making installation space minimal and convenient.

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

Performance Characteristics and Capabilities

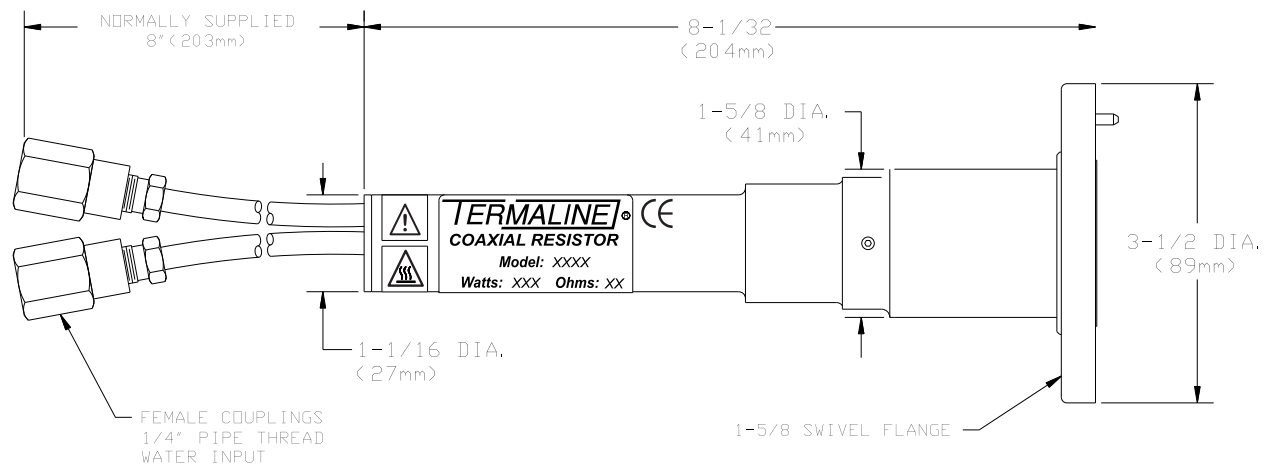
A Model 8720 can absorb up to 5000 Watts continuously and dissipate it harmlessly as heat over a frequency range of DC to 2000 MHz. It will show a maximum VSWR of 1.1 to 1.0 from DC to 500 MHz, 1.15 to 1.0 for 500 to 900 MHz and 1.25 to 1.0 from 900 to 2000 MHz.

Power input is through a Bird 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

This load has a body length of 8-1/32 inch (204 mm). A pair of water supply tubes adds another 8 inches (203 mm) to the overall length. The major body diameter is 1-5/8 inch (41 mm), however, the 1-5/8 inch EIA swivel flange connector diameter is 3-1/2 inch (89 mm). The weight is only 2lb, 2 oz (96 kg) and the shipping weight is 5 lbs (2.27 kg).

Figure 1 8720 Water Load



Utility Requirements

The Model 8720 is a passive device that is self-contained and does not need any external source of power or utilities to function. It does need a source of running water, however, to provide for its cooling. The water must flow from a rate of one gallon (3.8 liter) per minute at a water temperature of +5°C (+41°F) to a rate of four gallons (15.2 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 8720 is equipped with a 1-5/8 inch EIA swivel flanged RF connector and 1/4 inch female pipe threaded nuts for the water supply lines. This operation manual is the only additional item furnished.

Items Required

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

Tools and Test Equipment

An adjustable wrench is the only tool that would be useful for mounting this load. A resistance bridge or an ohmmeter with an accuracy of one percent or better at 50 ohm is recommended for checking the resistance value of the load resistor (see ["RF Assembly Resistance Test" on page 7](#)).

General

The Model 8720 Termline Load Resistor unit may be installed in any position or attitude required. Its relatively small size permits mounting in a very limited space since cooling is by water flow rather than air convection. No clearance for airflow is needed. It is also comparatively easy to carry and to relocate as necessary.

CAUTION

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.

The input and output water conducting tubes are made of copper and can be easily bent as required for connection. 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 fitting at the center of the water chamber is the water input and outer is the water output tube. Water connections on the load are 1/4 inch female pipe thread fittings.

Check the resistance of the RF Assembly, see ["RF Assembly Resistance Test" on page 7](#).

Attach the RF coaxial transmission line with a 1-518 inch EIA coupling kit, P/N 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 subjecting the load to unnecessary shock or impact.*

General

The Model 8720 RF Load Resistor is unique in that it uses 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" on page 9](#)).

For the direct reading of power measurements up to 5 kW, these loads may be used in conjunction with any Bird Series 4700 Thruline Wattmeter.

Heat Transfer

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 inside surface of the ceramic resistor tube. This tube has a resistive film of very uniform thickness deposited on its outside surface. The resistor substrate is manufactured from high thermal conductivity ceramic that is very strong. The heat generated by the RF energy absorbed is readily conducted through its comparatively thin wall. This ceramic also essentially isolates the water electrically from fields inherent to the coaxial line. The heat is carried off by the water passing over the inner 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:

$$P = 0.146(T_1 - T_2)GPM$$

Use and Function of Controls

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

Initial Adjustments

No initial adjustments are required other than to connect the load to the RF source by means of a coaxial line with a suitable coupling.

Start-Up

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.

Cooling Water for the Model 8720

The electrical performance of these RF loads will be affected by impurities or other chemical additives in the cooling water. The presence of salts in the water definitely make the device unusable because they cause a rapid increase in VSWR. Therefore, sea water or silty water should not be used for cooling the loads.

The thermal performance of these loads can be 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.

The following types of water are considered safe for the cooling of the Model 8720 Load Resistor filtered city or soft water. In general, any potable water is suitable for cooling the load.

Normal Operation

Operation of this equipment is rather simple. First, turn on the water supply, before applying any RF power. Set the flow between 1 gpm (3.8 liter) for +5°C (+41°F) water temperature and 4 gpm (15 liter) 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.

CAUTION

Do not excessively overload these units above the rated 5 kilowatts of power.
Overload for any length of time will cause resistor failure.

CAUTION

Any more than 5 W of power applied to the load resistor without water cooling will quickly damage the equipment. The new sealed system effectively protects the resistive film from possible moisture damage by any condensate formation. Flow of cooling water through the system without applied power represents no danger.

Shutdown

Always turn off the RF power first, allow coolant to continue to flow for a few minutes to cool down the resistive element.

Emergency Shutdown

Immediately remove RF power if water flow is interrupted.

Troubleshooting

The table below contains troubleshooting information for problems which can occur during normal operation. This manual cannot list all malfunctions that may occur, or their corrective actions. If a problem is not listed or is not corrected by the listed actions, notify a qualified service center.

Problem	Possible Cause	Correction
Overheating or high exit water temperature	Excessive power	Reduce RF power
	Insufficient water flow	Increase water flow
	Obstruction in water flow system	Check the coolant circulation system
Excessive reflected power	DC resistance of the load has changed	Check DC resistance (See "RF Assembly Resistance Test" on page 7)
	Contaminated water	Check the resistor for scaling. Replace if necessary.
		Check that the water meets the standards listed in "Specifications" on page 9 . Use distilled water if necessary.

Cleaning

WARNING

When using dry cleaning solvents, provide adequate ventilation and observe normal safety precautions. Many dry cleaning agents emit toxic fumes that could be harmful to your health, if inhaled.

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.

Wipe off dust and dirt from the housing with a dry cloth. Uncouple the RF connector and also wipe it off with a clean dry cloth. Use a self-drying non-residue forming contact cleaner on the inaccessible portions, especially the metallic contact surfaces and the exposed faces of the TFE insulators.

Inspection

Check the water connections from time to time for leaks and the load itself for cleanliness. (see ["Cleaning" on page 6](#)).

Preventive Maintenance

The necessary preventive maintenance procedures are covered in ["Inspection" on page 6](#).

Customer Service

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

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

<http://www.birdrf.com>

RF Assembly Resistance Test

Note: *These tests are by no means a necessity to the operation of the load but merely guidelines for the users information.*

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.

Checking the DC resistance is simply used to measure a change in the resistance over time. Tracking the DC resistance should start *before* the unit is first put into service. Perform the following steps and record the value for future comparison. Resistance measurements should be taken periodically according to use.

Preparation:

- Tools: Common hand tools.
- Ohmmeter with an accuracy of $\pm 1\%$ at 50 ohms (or use a resistance bridge).
- Use low resistance leads, preferably a short piece of 50 ohm coaxial cable fitted with an appropriate connector or alligator clips.
- Temperature of the load should be stabilized between 20°C to 25°C (68°F to 77°F).

DC Resistance Measurement

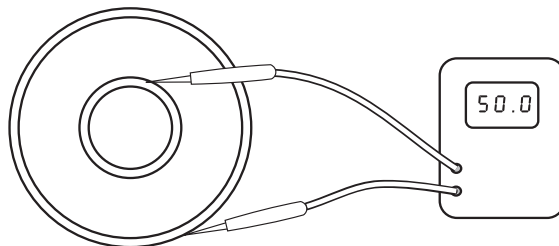
WARNING

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.

Note: *It is recommended that this resistance check be performed each time the load is to be used.*

1. Turn off RF power and interlock circuitry before making any disconnections.
2. Disconnect the RF coaxial line.
3. Connect the multimeter test leads across the center and outer conductor of the load resistor. See [Figure 2](#).
4. Record the value of the resistance *before* the load is put into service. Compare subsequent values with the latest reading. If the values vary more than 2 ohms this could be an indication of a failing resistive element.

Figure 2 Measuring DC Resistance



Disassembly

WARNING

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

Other than disconnecting the Model 8720 from the coaxial transmission line and the water lines, no special disassembly procedures are necessary. (See ["Installation" on page 3](#)). Repairs must be performed by Bird, see ["Customer Service" on page 7](#).

Preparation for Shipment

Disconnect the Model 8720 from both the RF coaxial line, with the RF power shut off, 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, a corrugated paper box should suffice.

Storage

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 -5°C to +80°C (+23°F and +176°F).

Replacement Parts List

There are no field replaceable parts in the Model 8720 because it is a sealed and self-contained unit.

Frequency Range	DC– 2000 MHz
Power Rating	5 kW continuous duty
Impedance	50 ohms nominal
VSWR	
DC to 500 MHz	1.10 max
500 to 900 MHz	1.15 max
900 to 2000 MHz	1.25 max
Connector	1-5/8 inch EIA swivel flange
Cooling Method	Force liquid flow, 1 to 4 gallons (3.8 to 15.2 liters) per minute
Water Temperature	+5°C to +80°C(+41°F to +176°F)
Dimensions	8-1/32" L ¹ x 1-5/8" major body dia.(204 x41 mm)
Weight, Nominal	2.2 lb. (0.96 kg)
Operating Orientation	Any

1 Not including 8 inch (203 mm) water supply tubes.

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 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.