
INSTRUCTION BOOK

OPERATING INSTRUCTIONS

**MODULOAD® RF LOAD RESISTOR
MODELS 8655 & 8656**

BIRD
Electronic Corporation
Cleveland (Solon) Ohio USA

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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 applied to all phases of operation and maintenance.

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.

Shock Hazard

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

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.

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.

Resuscitation

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

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.
--



This 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 Never attempt to connect or disconnect an RF cable while power is on at the RF power source. Radiated RF energy is a potential health hazard.
--

WARNING

Ethylene glycol is a toxic material. Do not take internally. Avoid eye contact. Inhaling the vapors may be irritating to the lungs.

WARNING

The resistor used in this load consists of a resistive film on a special substrate. If the substrate is broken, there will probably be sharp pieces or splinters inside the load housing. Caution should be exercised to avoid possible injury.

WARNING

Do not attempt to handle or move this unit alone. More than one person is needed to move this unit to avoid possible injury.

Caution Statements

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

CAUTION

Before any RF operation of the load is attempted, the transmitter interlock and ac line attachment to the equipment must be made. First attach the transmitter interlock connections to the two binding posts on the front panel and then connect the power cable.

CAUTION

The 115 Vac or 230 Vac line may be connected, but the ac power must not be turned on unless coolant is in the system and filled to the correct level. Damage to the pump will result otherwise.

CAUTION

Operation without sufficient coolant can damage the unit.

CAUTION

Do not use any sealant, leak-stopping material, or automotive antifreeze in the coolant. Use only potable water and pure ethylene glycol.

CAUTION

Do not attempt to alter the flow switch setting or disturb the coolant pump.

CAUTION

Do not operate the load without connecting the interlock. Even momentary application of power to the load while the cooling circulation is off, or possibly functioning improperly, will cause almost immediate destruction of the resistor element.

CAUTION

Do not apply more than the rated RF power to the load. Excessive RF power will damage the load resistor.

CAUTION

Do not block air flow. Air enters the housing through the grill openings and exhausts through the circular fan openings.

CAUTION

Do not disconnect the line power first. Even a momentary application of RF power to the load while the cooling circulation is off will cause almost immediate destruction of the resistor element.

CAUTION

Failure to follow the special storage instructions may result in damage to the unit. Consult the factory for the special instructions.

CAUTION

Failure to properly prepare the unit for shipment using the special storage instructions may result in damage to the unit. Consult the factory for the special instructions.

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 GEFÄHRLICHER, ELEKTRISCHER 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.



CONNECT INTERLOCK TO TRANSMITTER BEFORE OPERATING.

BRANCHER LE VERROUILLAGE À L'ÉMETTEUR AVANT EMPLOI.

CONECTE EL INTERBLOQUEO AL TRANSMISOR ANTES DE LA OPERACION.

VOR INBETRIEBNAHME VERRIEGELUNG AM SENDER ANSCHLIESSEN.

PRIMA DI METTERE IN FUNZIONE L'APPARECCHIO, COLLEGARE IL DISPOSITIVO DI BLOCCO AL TRASMETTITORE.

About This Manual

This instruction manual covers the Models 8655 and 8656 Moduload RF Load Resistors, which specifically includes the following models.

8655-115-5	8655-115-6	8655-230-5	8655-230-6
8655-115-5-N	8655-115-6-N	8655-230-5-N	8655-230-6-N
8656-115-5	8656-115-6	8656-230-5	8656-230-6
8656-115-5-N	8656-115-6-N	8656-230-5-N	8656-230-6-N

This instruction book is arranged so essential information on safety is contained in the front of the book. Reading the Safety Precautions 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, and Chapter 3 - Installation, to get an overview of equipment capabilities and how to install it. An experienced operator can refer to Chapter 4 - Operating Instructions. All instructions necessary to operate the equipment are contained in this section.

Maintenance

All personnel should be familiar with preventive maintenance found in Chapter 5 -Maintenance. 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 parts lists and associated drawings in Chapter 5.

Changes To The Manual

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

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This instruction book is intended for use by operators of the Models 8655 and 8656 Moduload Load Resistor.

This chapter contains introductory information including product specifications.

Purpose and Function

The Model 8655/56 Moduload Coaxial Load is a self-cooling, low reflection, non-radiating termination for high power RF transmission lines.

The Load is for use on CW, AM, FM, SSB, and TV modulation envelopes. The load may also be used within certain limits on radar or pulse modes. Information for use involving pulse type signals should be obtained directly from Bird Electronic Corporation.

Performance Characteristics and Capabilities

The Loads are capable of continuous power dissipation of 50 kW with a maximum voltage standing wave ratio (VSWR) of 1.10 from 1000 Hz to 900 MHz. These models provide direct connection to 3-1/8 inch 50 ohm coaxial lines.

The equipment consists of three basic systems.

1. **RF Load Assembly:** Contains the resistor element with its internal water cooling system.
2. **Control System:** Includes the electrical circuitry required to prevent damage to the transmitter in case of malfunction of the load, and to protect the RF load should the water flow slow down.
3. **Heat Exchanger System:** The heat exchanger components consist essentially of the pump/motor, collector tank, four cover fans and four finned water cooling heat exchangers arranged in a mated pair sets.

When used in conjunction with the appropriate Bird Model Thruline Wattmeter, such as those used in the 4600 and 4800 series, the 8655/56 Moduload Load Resistor may be used for direct RF power measurements within the equipment ratings.

Power and Utility Requirements

The 8655/56 loads are offered in four standard forms which differ in the ac input power requirements.

- ♦ -115-5 for 115 V, 50 Hz
- ♦ -115-6 for 115 V, 60 Hz
- ♦ -230-5 for 230 V, 50 Hz
- ♦ -230-6 for 230 V, 60 Hz

Environmental Requirements

These loads are not intended for use outdoors where they would be exposed to the elements. They should be used indoors in a clean, dry, dust and vibration-free environment. The ambient temperature range is determined by the coolant. For details of the temperature ranges refer to the specifications. It is important that the room temperature remain within these limits for proper operation of the unit, otherwise a derating of the load value will be necessary.

Items Supplied

The 8655 and 8656 loads are equipped with standard connectors. The Model 8655 has a 3-1/8 inch EIA flanged connector. The Model 8656 has a 3-1/8 inch unflanged connector. They are supplied with a container of ethylene glycol, for making the coolant mixture, when ordered.

- Items Required**
- ♦ A mating connector on the coaxial transmission line.
 - ♦ A conveniently located ac power receptacle to plug in the power cable.
 - ♦ Potable water for coolant.
- Tools Needed**
- ♦ Screwdrivers and wrenches — needed to disassemble the load
 - ♦ Digital Multimeter or Ohmmeter with an accuracy of 1 percent or better at 50 ohms — needed to check the dc resistance of the RF load resistor.
- Optional Items**
- Dolly, P/N 6772-011 — For ease in moving the load. Consult the Bird Electronic Catalog for more information.
- Ethylene Glycol, P/N 5-1134-3 — A one gallon container of industrial grade ethylene glycol.

Specifications

Impedance, Nominal	50 ohms
Power Rating	50 kW maximum duty
Frequency Range	1 kHz - 900 MHz
Connectors: Model 8655-() ¹ Model 8656-() ¹	3-1/8" EIA Flanged (50 ohm) 3-1/8" Unflanged (50 ohm) (flush center conductor)
VSWR	1.10 maximum 1000 Hz - 900 MHz
Modes	CW, AM, FM, TV, SSB
Ambient Temperature: 50 kW continuous With potable water only With 35% ethylene glycol mixture ² 40 kW continuous With potable water only ² With 35% ethylene glycol mixture ²	+5°C to +30°C (41°F to 86°F) -20°C to +25°C (-4°F to +77°F) +5°C to +45°C (41°F to 113°F) -20°C to +35°C (-4°F to +95°F)
AC Power Required 115 V, 50 Hz 115 V, 60 Hz 230 V, 50 Hz 230 V, 60 Hz	15 amps 15 amps 8 amps 8 amps
Dimensions, Nominal	19-1/32"H x 19-9/16"W x 44-1/4"L without connector (483 x 497 x 1124 mm)
Coolant	17 qts (16 liters) potable water ² or 35% ethylene glycol mixture ²
Weight, Nominal	275 lbs (124.7 kg)
Finish	Grey Powder Coat
Meets European Standards	EN 55011; Class A, and EN 50082-2, which are in accordance with council directive 89/336/EEC and 92/31/EEC

- 1 -115-5 added for 115 V 50 Hz
 -115-6 added for 115 V 60 Hz
 -230-5 added for 230 V 50 Hz
 -230-6 added for 230 V 60 Hz

- 2 Potable Water: Standards for potable water have been established by the U.S. Public Health Service at a maximum of 500 ppm of total dissolved solids (ppm - parts per million or 1 mg per liter). Hardness of water (content of calcium and magnesium salts) should be less than 75 ppm. If the quality of the available water supply is doubtful or the mineral content is questionable, use distilled water or, distilled water and ethylene glycol mixture.

Figure 1
8655/56-115-6 Outline Drawing

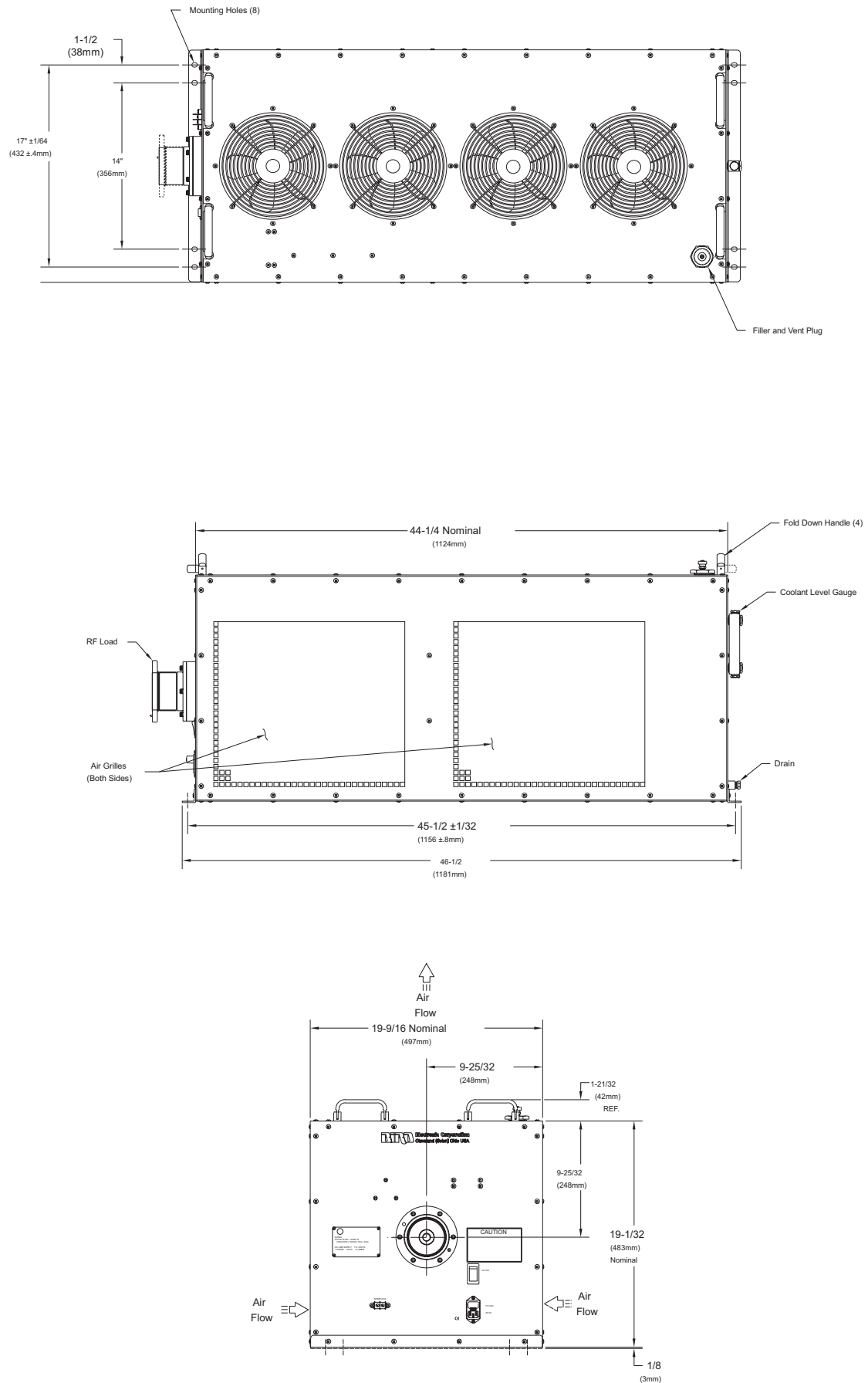
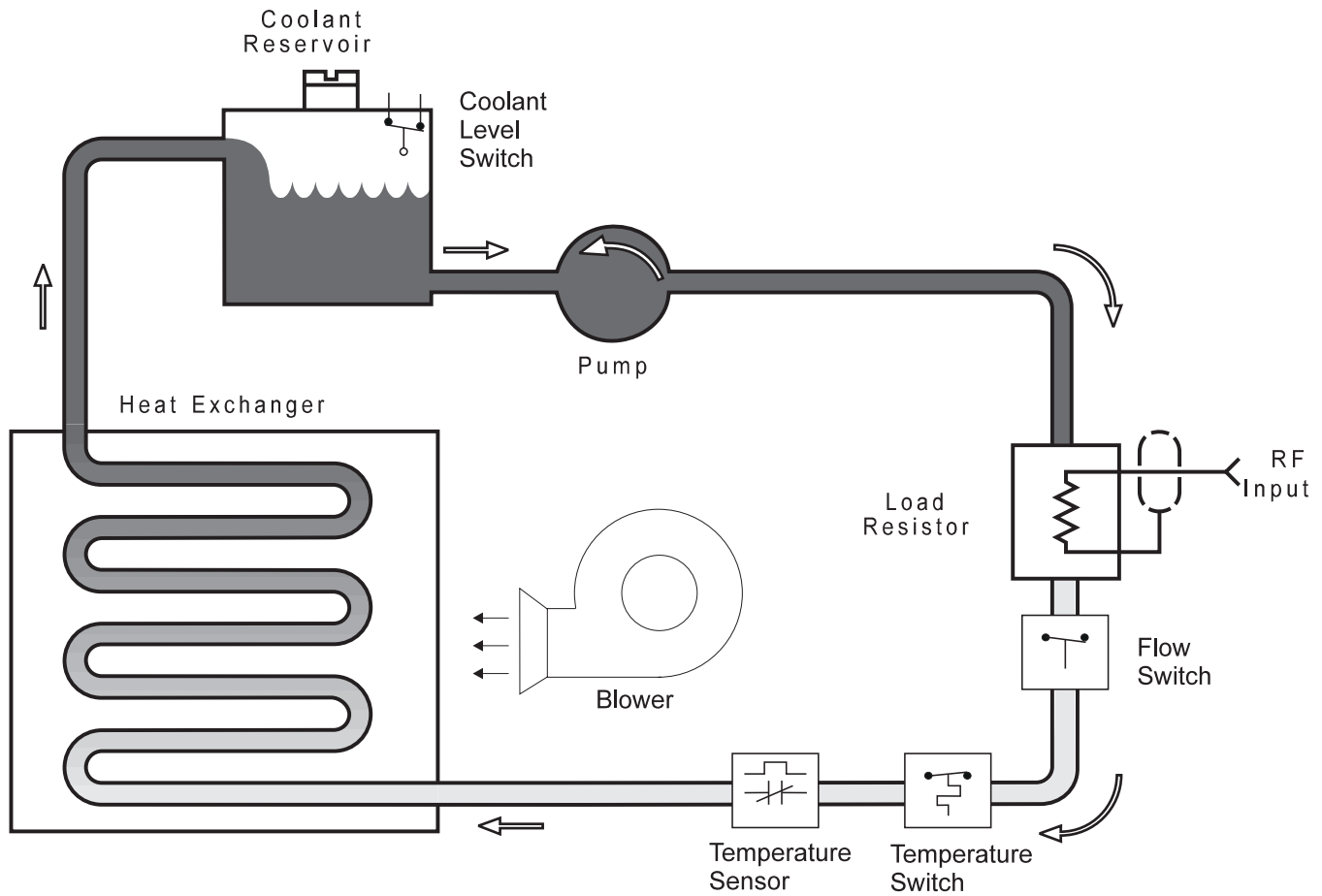


Figure 2
System Block Diagram



The Model 8755/56 Termaline Coaxial Load Resistor installed in this unit is unique in having its water supply primarily directed over the outer, wet-film type, resistive coating of the substrate. This technique is valuable in eliminating the need for an intermediate heat transfer fluid system. This method reduces the physical size of the load to a virtual minimum. The construction and materials permit field repair of the unit (refer to the Maintenance Chapter). While reading the following paragraphs, refer to figure 2.

Heat Transfer

The 50 ohm resistor consists of a substrate made of a special compound which has a permanently deposited resistive film. The heat generated by absorption of RF power is transferred from the film to the water which flows over it through a restricted chamber surrounding the resistor body. This water, first carried to the front of the load resistor, passes over the entire length of the resistor and discharges through the sealed water chamber at the rear. The composite dielectric characteristics and the distinctive design of these enclosures provide a very accurate 50 ohm termination over the specified frequency range of this load, from 1000 Hz to 900 MHz.

The absence of intermediate cooling fluids considerably simplifies the construction and sealing of this unit. It can be readily disassembled in the field for resistor element replacement (refer to the Maintenance Chapter).

Flow Interlock Control Circuit

The interlock control circuit provides instantaneous fail-safe protection of the transmitter and load in the event of even momentary interruption of the cooling water supply. This protection is necessary because dissipation of the heat generated by the RF power is critically dependent upon a required minimum water supply at all times regardless of system water temperature.

CAUTION

Do not attempt to alter the flow switch setting or disturb the coolant pump.

The water pressure switch, installed on the RF load's water input is a "normally open" type; i.e., its electrical contact opens when deactivated. Closed during equipment operation, the switch is adjusted to open whenever water pressure drops below the safe flow level for the specific unit. When this occurs, the time relay is instantly deactivated, thereby opening the interlock circuit and causing immediate transmitter shutdown. Also, the centrifugal impeller of the water pump is carefully selected for the necessary flow rate. The proper operation of this equipment depends on these conditions being maintained.

The time delay switch keeps the interlock switch open for a predetermined interval (set at about 2 seconds, nominal). This special safeguard assures proper operation of the cooling system before RF power can be applied to the load, preventing damage or burnout of the resistor element.

This chapter provides information for on site requirements, unpacking, inspection, and preparing the equipment for use.

The Model 8655/56 Moduload is to be installed and operated in a horizontal position. The unit is shipped horizontal, and normally stands on its attached base brackets.

WARNING

Do not attempt to handle or move this unit alone. More than one person is needed to move this unit to avoid possible injury.

For installation of the equipment, mounting angle brackets are attached to the front and back edges of the enclosure. They may be removed by unscrewing the four 8-32 Phillips Truss head screws holding each bracket. These brackets have two elongated holes each on 17 inch by 45-1/2 inch (432 x 1156 mm) centers to accommodate four 1/4 inch screws that may be used for mounting the unit.

The load can be operated anywhere that adequate ac line power, and ventilation are available. Ensure the ambient temperatures do not exceed those given in the specifications.

 **Note:** Since 50 kW is equivalent to 170,650 Btu/h, a sufficient quantity of air must be provided. Allow room for unobstructed air intake over the whole surface of the grilles, on both sides of the equipment, and a clearance of at least three feet over the top of the unit.

**Interlock
Connections**

A terminal strip provides connection to the transmitter's internal safety interlock circuitry. An active interlock state occurs as a result of either high coolant temperature or no coolant flow. It will also be active for almost two seconds after power up.

Interlock connections are made to the terminal strip on the front of the unit.

1. Use number 22 AWG (or heavier) wire for interlock connections.
2. Connect the interlock wires to the interlock terminal strip as required for the transmitter in use.

AC line Attachment

CAUTION

Before any RF operation of the load is attempted, the transmitter interlock and ac line attachment to the equipment must be made. First attach the transmitter interlock connections to the two binding posts on the front panel and then connect the power cable.

CAUTION

The 115 Vac or 230 Vac line may be connected, but the ac power must not be turned on unless coolant is in the system and filled to the correct level. Damage to the pump will result otherwise.

The ac power supply may be either 115 or 240V depending on the unit requirements. AC line power is supplied to the 3-wire ac panel module socket by means of the 10 foot (3.05 m) cable and matching socket that is furnished with the equipment. The third wire in the cable, coded green, is the ground. For proper

protection, if a 3-wire type plug and outlet is not used, fasten the green wire at the supply end to a satisfactory ground.

Before applying ac power to the unit, make sure:

- ♦ Coolant is in the system
- ♦ Coolant is filled to the correct level
- ♦ The green wire at the supply end is fastened to ground.

Figure 3
Freezing Point of
Ethylene Glycol/Water
Mixture °F

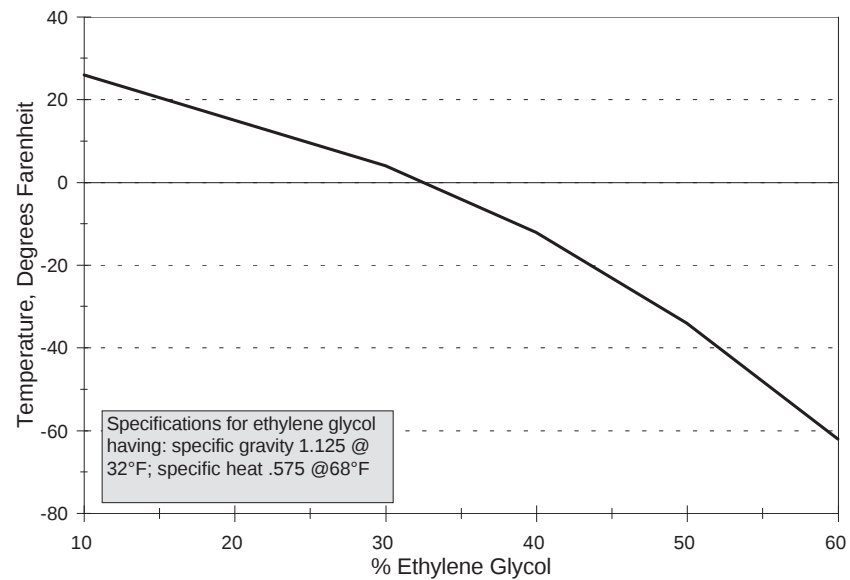
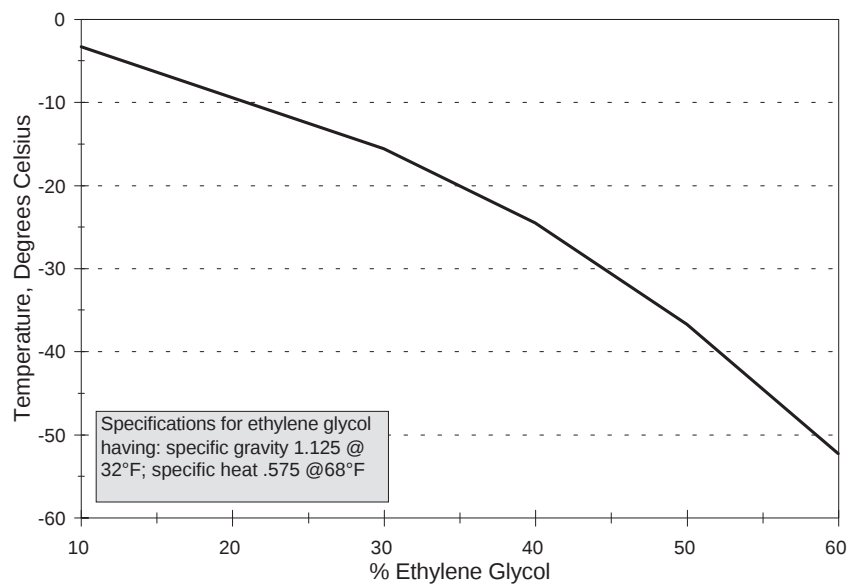


Figure 4
Freezing Point of
Ethylene Glycol/Water
Mixture °C



Coolant

WARNING

Ethylene glycol is a toxic material. Do not take internally. Avoid eye contact. Inhaling the vapors may be irritating to the lungs

CAUTION

Do not use any sealant, leak-stopping material, or automotive antifreeze in the coolant. Use only potable water and pure ethylene glycol.

Before shipment, the Moduload is drained of coolant to avoid possible damage in transit from freezing. The system must be refilled with coolant before it can be put into operation. The unit operates with 17 quarts (16.1 liters) of coolant. The coolant must be either; potable water or a mixture of potable water and ethylene glycol.

Mixing Water and Ethylene Glycol

Ethylene Glycol should be added to the potable water to prevent bacterial growth and freezing. Bird recommends 10 - 35% ethylene glycol mix in the Moduloads. Using at least 10% will protect against bacteria growth and 35% will protect against freezing to -20°C. Refer to figure 3 for °F and figure 4 for °C.

Only use potable water and industrial grade ethylene glycol. *Do not use any commercial antifreeze preparations.* Refer to the Specifications for the definition of potable water.

The following example shows the weights to mix 65% potable water to 35% ethylene glycol in 5 or 55 gallon quantities.

To ensure proper mixing of the solution, the water must be added first, then the ethylene glycol.

Example:

Ingredient	Ant. for 5 Gallons	Amt. for 55 Gallons
Potable Water	28.0 lb.	310 lb.
Ethylene Glycol	15.2 lb.	167 lb.

Filling Coolant Reservoir

The coolant capacity of the unit is approximately 17 quarts (16.1 liters).

CAUTION

Operation without sufficient coolant can damage the unit.

Fill the coolant reservoir by following the instructions below.

1. Make sure the drain plug is in place.
2. Remove the filler cap (located on the top of the unit).
3. Pour approximately 6 quarts (5.7 liters) of coolant into the unit.
4. Turn on the motor, for only a few seconds, to pull the liquid into the system and draw the coolant level down to the bottom of the tank. Do not run the pump too long, as partially dry operation may damage its mechanism.

 Note: A convent method is to watch the coolant level through the reservoir filler. Stop the pump when the coolant level approaches the bottom of the tank.

5. Repeat filling in the above manner twice more, with about 5.5 quarts (5.2 liters) each time, or until the fluid remains steady at the proper level. The unit should be full to a level of about 4-5/8 inches (117 mm) below the top face of the filler tube opening, or to the high mark on the gauge. Add coolant if necessary to bring to the required level.
6. Run the unit for about five minutes to remove any trapped air in the system.
7. Recheck the fluid level before applying RF power.

 Note: The filler plug is equipped with a breather vent to relieve internal pressure caused by the heated coolant. It is normally closed, but is set to open at 2 lb/in².

The electrical performance of the load is affected by impurities or other chemical additives in the cooling liquid. Therefore, the cooling liquid should be potable water with pure industrial grade ethylene glycol added if required. The coolant should be kept clean at all times.

Introducing contaminates from unsuitable coolant liquids could coat the cooling system components, particularly the resistor surface. This would unfavorably affect the thermal performance and VSWR of the load. When this is suspected always check the VSWR. General scale accumulation is not likely unless the load resistor is used outside the unit, with an improper water supply. If the coolant system has been contaminated, flush it out according to the instructions in the Maintenance Chapter.

Blower Fans

The fans are wired direct to the ac line and will always operate along with the pump when the ac line power is turned on. In addition to the basic function of producing the required air flow through the radiators, this ventilation also aids in cooling the pump/motor unit.

Connecting RF Power To Load

Connect the coaxial RF transmission line to the unit. For the respective Models 8655/56 the connections are as follows.

Figure 5
Model 8655
Coupling Kit

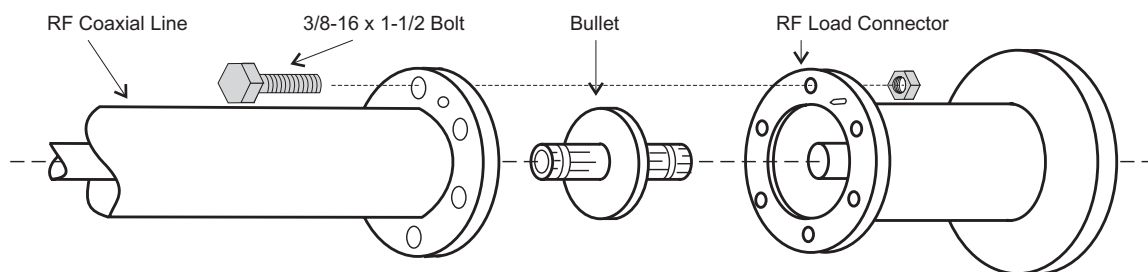
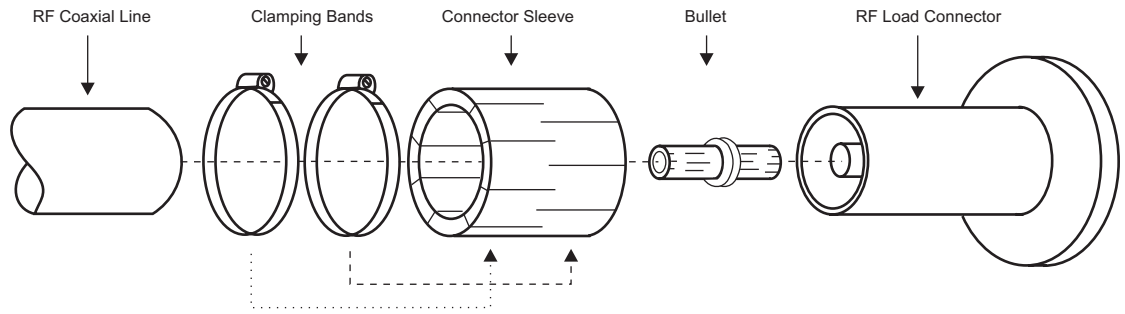


Figure 6
Model 8656
Coupling Kit



Model 8655 Model 8655 — 3-1/8 inch EIA, 50 ohm, swivel flanged. Refer to figure 5 while following the instructions below.

1. Use 3-1/8" EIA Coupling Kit, Bird P/N 4600-020, which includes six 3/8-16 x 1-1/2" bolt and nut sets, O-Ring, and insulated center bullet.
2. Insert the center bullet, push into seat insulator in facing, and install the O-Ring in the groove if required.
3. Connect the coaxial input in a straight line, push in carefully on the center contact to close. The swivel flange on the load makes connection independent of a fixed flange on the coaxial input line.
4. Insert the bolt sets around the flange connection, and tighten evenly.

Model 8656 Model 8656 — 3-0/8 inch unflanged, 50 ohm impedance. Refer to figure 6 while following the instructions below.

1. Use the Bird Coupling Kit P/N 5-726, consisting of two clamping bands, an outer sleeve, and the center coupling bullet.
2. Insert the center bullet, and bottom it on the midpoint nibs.
3. Position the outer sleeve, with clamps, over the input connector.
4. Seat the transmission line snugly against the coupling stops.
5. Position the clamp bands evenly about 3-3/4 inches apart, and tighten.

Preliminary Equipment Check

Check the RF load for acceptable electrical condition. Refer to the Maintenance Chapter for the procedure to determine load impedance. Below is the test equipment needed, and critical parameters.

Equipment Needed: Digital Multimeter

Accuracy: 1 percent at 50 ohms, ± 1 digit

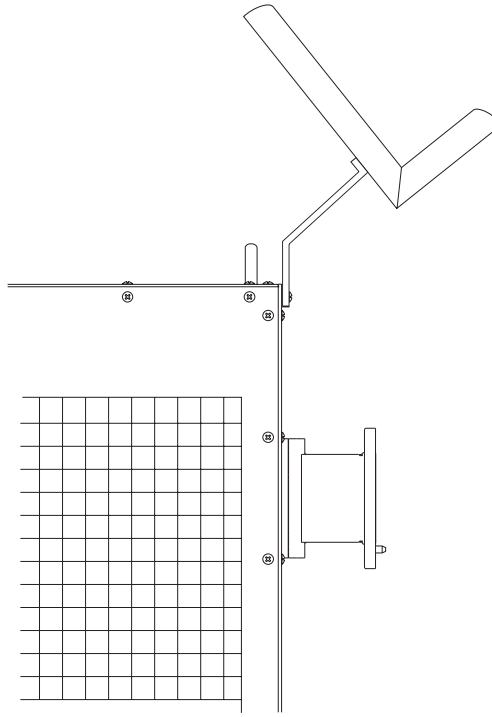
Meter Rack

The Meter Rack is used to hold the meter at the correct angle, for the best possible viewing. Assemble and install as instructed below. While following the instructions, refer to figure 7.

1. Assemble the kit using four #6-32 x 3/8 screws (supplied).

2. Remove the two screws from the panel at a desired mounting location.
3. Mount the assembled Meter Rack using #8-32 x 3/8 phillips truss (supplied).

Figure 7
Meter Rack



Use and Function of Controls

The Models 8655 and 8656 loads have no operating controls, other than the ON/OFF switch; therefore, they do not require an operator in attendance.

Initial Adjustments and Control Settings

There are no adjustments or settings required beyond confirming that the cooling system contains an adequate level of coolant for proper operation. Refer to Chapter 3 -Installation.

Equipment Startup

CAUTION

Do not operate the load without connecting the interlock. Even momentary application of power to the load while the cooling circulation is off, or possibly functioning improperly, will cause almost immediate destruction of the resistor element.

CAUTION

Do not apply more than the rated RF power to the load. Excessive RF power will damage the load resistor.

CAUTION

Do not block air flow. Air enters the housing through the grille openings and exhausts through the circular fan openings.

1. Make sure coolant level is adequate, and verify fan operation.
2. Turn interlock supply on.
3. Turn on 115V or 230V power.
4. Apply RF to the load.

Normal Shutdown

CAUTION

Do not disconnect the line power first. Even a momentary application of RF power to the load while the cooling circulation is off will cause almost immediate destruction of the resistor element.

1. Turn RF power to the load off.
2. Wait five minutes, allowing the pump and fans to return coolant to ambient room temperature.
3. Turn ac power off.

 Note: Stopping the pump automatically opens the interlock connection.

Emergency Shutdown

With the use of interlock capability, the Load will automatically turn off the transmitter's RF power of an emergency arises.

If an emergency arises that is not a fault of the unit, always turn off the source of RF power first, and then the ac power to the Load.

Performance Notes

The electrical performance of the Model 8655/56 RF Loads is affected by impurities or other chemical additives in the cooling liquid. Therefore, the cooling liquid should be potable water, or potable water with industrially pure ethylene glycol. Do not use any additives

Thermal performance is affected by impurities, particularly those which accumulate in the form of scale on the surface of the ceramic tube and any other water passages. This results in an increase of thermal resistance of the load, and in turn, may cause the load to overheat and fail.

Used in conjunction with the appropriate Bird model wattmeter, such as the Series 4600 and 4800 Thruline Wattmeter, the Model 8655/56 may will be capable of direct reading of RF power measurements within the equipment's rating.

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

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

Troubleshooting

Table 1 contains troubleshooting information for problems which can occur during normal operation. Locate the problem, review the possible cause, and perform the action listed.

Table 1
Troubleshooting

Problem	Possible Cause	Correction
Transmitter won't come on or shuts off repeatedly.	Insufficient coolant flow.	Check coolant gauge.
		Check for blockage in circulatory system.
		Check for coolant leaks.
	Defective flow switch	Check flow switch
	Defective pump.	Check pump.
	Overheating	Check for sufficient coolant.
	Defective thermost switch	Check thermost switch
		Check for excessive room temperature.
Check fans for jamming and grilles for blockage.		
Excessive reflected power	Damaged resistor	Check resistance value of RF section.
	Contaminated coolant	Drain, flush, and refill coolant system.
	Insufficient coolant	Check for coolant leaks and add more coolant.
Coolant leaking	Loose connections	Check and tighten all connections.
	Worn or cracked tubing	Replace defective tubing.
New or unusual noises.	Fans	Check for loose fan blades.
	Pump	Check pump for signs of failure.
	Circulatory system	Check for any sign of coolant leakage.
Burnt out resistor	Transmitter not connected to interlock terminals.	Follow installation procedure.
	RF power overload	Reduce power output from transmitter.
		Check overtemp. thermost switch
Moduload will not come on.	No line power	Check ac power source and power cord.
	Fuses burned out	Replace fuses. Check for cause.
	Defective switch	Replace switch.

Cleaning

The most important cleaning task is to remove accumulations of dust, lint, and grime that could interfere with proper air circulation and therefore efficient heat transfer. The heat exchanger surfaces, particularly on the inside, should be checked periodically for possible collection of dust and lint. When cleaning is necessary, follow these instructions.

Preparation:

- ♦ Material: Lint-free cleaning cloth
- ♦ Mild detergent

Instrument Housing and Panels

1. Gently remove loose dirt and grime using a soft clean cloth dampened with a mild warm solution of detergent and water.
2. A vacuum can be used to clean the coils if necessary. Remove the 26 screws from the top panel to gain access to the coil.
3. Clean off dust and lint, if any, with a radiator brush or stiff bristle brush.
4. Check under the ribs of the exhaust grille (at the side) for dust collection. If there is a buildup, remove the grille and clean under the ribs.
5. Replace top panel and screws.

Heavy coatings of lint on any surfaces of the heat exchanger unit can impair the efficiency of the Moduload unit. Keep them clean.

Connector and Outside Surface

The outside surface of the unit should also be wiped free of dust and dirt at regular intervals. Use a soft, clean cloth dampened with mild detergent. Check the condition of the RF coaxial connector. If needed, clean the RF input connector using a self-drying contact cleaner, that leaves no residue.

RF Load Resistor

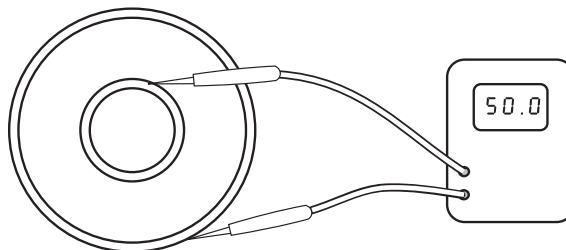
Measure dc Resistance

Preparation:

- ♦ Tools: Common hand tools
- ♦ Ohmmeter with an accuracy of $\pm 1\%$ at 50 ohms.
- ♦ Temperature of the load between 20°C to 25°C (68°F to 77°F)

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 condition of the resistor over time. The tracking of the dc resistance must start *before* the resistor is first put into service. Perform the following steps and record the value for future comparison. Check and record the resistance of the load periodically according to use.

Figure 8
Measuring dc
Resistance



WARNING

Never attempt to connect or disconnect an RF cable while power is on at the RF power source. Radiated RF energy is a potential health hazard.

1. Turn off RF power and interlock circuitry before any electrical disconnections are made.
2. Disconnect RF coaxial line.
3. Connect the multimeter test leads across the center and outer conductor of the load resistor. Refer to figure 8.
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.

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

Routine Service Checks

Inspect the coolant level at regular intervals, when the equipment is in use. Normally check once or twice a week, more often if it is used continuously or under high ambient temperatures. The coolant level should remain at the upper gauge mark on the back panel, whether the unit is running or not. For test measurement and addition of liquid if required, refer to the Coolant paragraph in chapter 3. Use only potable water and industrially pure ethylene glycol. Do not use automotive antifreeze or de-ionized water.

The radiator surface, particularly on the inside, should be checked periodically for possible collection of dust and lint. A heavy lint coating on the inside surface of the radiator can impair the cooling efficiency of the unit. Follow the instructions below for cleaning.

1. Remove the 26 screws from the edges of the top panel and remove the panel.
2. Clean off any collected dust and lint with a radiator brush or any stiff bristle brush.
3. Replace the top panel.

Flushing the System

Whenever maintenance work has been performed, including resistor repair, or there is a reason to suspect that contamination has been introduced or dislodged into the coolant, the system should be thoroughly flushed. Do this by the following steps:

1. Run the load with coolant but without RF power applied for a period of three to five minutes.
2. Drain the circulating system as completely as possible.
3. Fill the unit with fresh, clean, potable water.
4. Repeat the sequence as required until the drained liquid is clear.
5. Fill the unit with potable water and/or approved ethylene glycol mixture per the Coolant paragraph.

If the unit is to remain fully or partially drained for two weeks or more, refer to the Storage section in the Maintenance chapter.

Repair and Replacement Procedure

The 8655/56 Moduload Load Resistor is designed for independent, long term, trouble-free operation. Regular mechanical maintenance procedures, other than routine checks and cleaning care described previously, are not required. In the case of malfunction of the unit or replacement of a major component, resistor repair excepted, the entire load may be returned to the factory. This applies especially to any unit under the one year warranty. Consult the factory.

 **Note:** Do not tamper with operational settings or perform other unauthorized maintenance work during the first year. It could be cause to void the warranty.

Field repair of the load resistor may be performed as described in the Load Resistor Internal Repair paragraph. Other replacement instructions, that might be needed, are given in this section.

If in performing the dc resistance check a significant change in resistance is noted, or if for any reason the resistive element should fail, the element should be replaced. Replacement resistors are available. Installation is described below.

RF Load Resistor

Resistor repair in the load may be done without removing the water connections; follow procedures in the Load Resistor Internal Repair paragraph. It contains full dismounting and resistor change procedures. The full load assembly may be removed from the case as in the following procedure. Then follow the Load Resistor Internal Repair section.

 **Note:** Notice the angular position of all elbows and associated parts as they must be returned to relatively the same position when reassembled.

Preparation:

♦ Tools: Common Hand Tools

WARNING

Never attempt to connect or disconnect an RF cable while power is on at the RF power source. Radiated RF energy is a potential health hazard.

1. Turn off RF power and interlock circuitry before any electrical disconnections are made.
2. Disconnect the RF coaxial line. Loosen and remove the 3/8-16 bolt and nut sets that secure the flanges.
3. Separate the transmission coaxial air line from the load connector. Make sure the center conductor bullet remains in the transmission line.

To remove the load resistor unit:

1. Take off the top panel by removing the 26 screws around its perimeter. Turn all four handles outward and lift up the top panel assembly, disconnecting the small fan-supply plug from its socket seated on top of the radiator block.
2. Unscrew the drain plug at the bottom center of the rear panel of the unit and allow the coolant to drain.

⚠ Note: Do not replace the drain plug with any substitute plug, use the plug removed.

3. Unscrew the hose clamps on both of the water connections to the load resistor. The water inlet is through the pressure switch at the back of the load input nipple, which has a special tee fitting on the side pipe at 60° underneath.

4. Remove the six 1/4-20 nuts from the inside of the front panel. Use a 7/16 wrench. Nuts on the bottom side are accessible with a short length end-wrench

⚠ Note: Loosen the *nuts only*, do not twist or disturb the screw heads on the front of the load resistor flange, as this will open its front connection.

5. Remove the two 5/16-18 hex head screws that secure the mounting clamp on the load body. Remove the top half of the clamp.

6. Pull the load assembly a few inches from the front panel. Disconnect the blue lead, (with eyelet) of the pressure switch connection, from the terminal strip on the inside of the front panel, center position. Before removing fittings from the load resistor note their positions.

⚠ Note: Do not disturb the water chamber fastened by six socket head cap screws on the bolt circle at the back of the load unit, until the load assembly is removed from the Moduload assembly.

7. Unscrew the switch from the leg of the inlet “tee” fitting. Use an 11/16 inch end-wrench on the flattened hub next to the 1/4 inch NPT stem of the pressure switch. The outlet elbow must also be removed. The load resistor can now be withdrawn through the front panel.

⚠ Note: Keep these components carefully stored with the disassembled unit.

8. If the load resistor is to be returned to the factory for repair, store the components with the Moduload unit until further use. Consult the factory. If the unit is to be field repaired, proceed with the resistor replacement instructions as described in the Internal Repair of the Load Resistor section.

9. Replace the load resistor by careful reversal or the above procedure. Be sure to replace the coolant, per the coolant section. Check for leaks, especially at the restored connections.

Pump/Motor Removal

For removal and replacement of the pump/motor proceed as follows.

⚠ Note: The back panel of the Moduload housing may have to be taken off to remove the pump/motor unit.

1. Take off the top panel by removing the 26 screws around its perimeter. Turn all four handles outward and lift up the top panel assembly, disconnecting the small fan-supply plug from its socket seated on top of the radiator block.

2. Unscrew the drain plug at the bottom center of the rear panel of the unit and allow the coolant to drain.

⚠ Note: Do not replace the drain plug with any substitute plug, use the plug removed.

3. Detach the three connecting wire leads from the three-lug terminal block on the inside of the front panel. For reference the color codes of the motor supply wires generally match the input wires, with the green ground wire going on the blue ground wire from the socket.
4. Loosen the hose clamp nearest the pump on the input hose and loosen it from the 90° input elbow at the center of the volute. In the same way, loosen the output hose from the output on the pump.
5. Reach under the input elbow with a 1/2 inch open-end wrench and unscrew the hex compression nut on the copper drain tube at the base of the volute. Free it completely from the fitting.
6. Remove the four 3/8-16 screw and nut fastenings that secure the motor base to the isolation bracket. Use 9/16 inch wrenches.
7. Move the pump assembly slowly forward while detaching the hoses.
8. Lift the pump/motor assembly out of the equipment.
9. Make note of the fitting positions. Twist off, counterclockwise, the whole parts of the fittings. Do not disturb the 25° upward tilt of the 90° input elbow. Store the detached parts with the disassembled unit and return the pump/motor unit to the factory for replacement.

Pump/Motor Assembly

To install the pump/motor reverse the removal procedures.

Additional Notes:

1. When installing the pump/motor, make sure the unit is placed so that the top panel will not hit the top of the unit.
2. Coat only the external joints with a pipe sealing compound when replacing the threaded fittings. Coat only the external threads, to avoid pressing the pipe sealing compound into the cooling system and contaminating the coolant.
3. Twist on the threaded fittings, until the threaded joints are tight and all parts are in their original angular position.
4. Rewire to the same terminal block connections.

Water Pressure Switch Removal

The water pressure (Safety Control) switch is changed by virtually the same process that is used for replacing the load resistor. Perform the following disassembly operations. It is not necessary to fully remove the load resistor from the unit, or to disturb its output fitting.

 **Note:** Notice the angular position of all elbows and associated parts as they must be returned to relatively the same position when reassembled.

Preparation:

- ♦ **Tools:** Common Hand Tools

WARNING

Never attempt to connect or disconnect an RF cable while power is on at the RF power source. Radiated RF energy is a potential health hazard.

1. Turn off RF power and interlock circuitry before any electrical disconnections are made.

2. Disconnect the RF coaxial line. Loosen and remove the 3/8-16 bolt and nut sets that secure the flanges.
3. Separate the transmission coaxial air line from the load connector. Make sure the center conductor bullet remains in the transmission line.

To remove the load resistor unit:

1. Take off the top panel by removing the 26 screws around its perimeter. Turn all four handles outward and lift up the top panel assembly, disconnecting the small fan-supply plug from its socket seated on top of the radiator block.
2. Unscrew the drain plug at the bottom center of the rear panel of the unit and allow the coolant to drain.

 Note: Do not replace the drain plug with any substitute plug, use the plug removed.

3. Unscrew the hose clamps on both of the water connections to the load resistor. The water inlet is through the pressure switch at the back of the load input nipple, which has a special tee fitting on the side pipe at 60° underneath.
4. Detach the switch assembly from the load. The switch is ready for service or replacement.

Water Pressure Switch Assembly

For assembly instructions, reverse the above procedure for removal. When the switch has been installed proceed as follows.

 Note: When replacing the switch fittings be sure to coat only the external threads with joint sealing compound. When reinstalling the switch assembly, twist on the components until the switch body is in the original angular alignment with the load resistor housing.

1. Restore the hose and wire connections.
2. Refill the equipment with coolant to the proper level.
3. Check the refitted joints thoroughly.
4. Test the switch operation by a preoperational run, as described in the Coolant section of Chapter 3 - Installation, without RF power. Run the coolant pump a few minutes without the top panel; inspect for leaks.

Time Delay Relay

The time delay relay is factory set for an approximate two (2) second delay, isolating the circuit relay. Refer to the Flow Interlock Control Circuit section. The relay is located on the upper right inside of the front panel, mounted in an octal socket.

The relay cartridge cannot be disassembled or repaired in the field. A faulty relay should be replaced as follows:

1. Loosen the 8-32 pan head screws at the top of the relay clamp to release the retaining prongs of the clamp.
2. Pull the time delay relay cartridge straight out of the socket.
3. Install the new cartridge, when inserting the relay, rotate the cartridge for alignment of the center post nub in the socket.

4. Match the side slots in the socket holder with the prongs of the clamp. Fit the clamp in the slots and turn the head screw until snug.

Load Resistor Internal Repair

The water cooled load used in this Moduload is designed to be quickly and easily repaired in the field. If in performing the dc resistance check described earlier, a significant change in resistance is noticed or if for any reason the resistive element should fail, replacement resistors are available. Refer to the Replacement Parts List. Installation of the resistors is described in this section.

The entire load resistor unit need not be removed from the Moduload unit as a piece. It is simpler to disassemble it in place, leaving the water connections to the water chamber undisturbed. Follow these procedures for removing the main housing portion only.

Resistor Removal

1. Unscrew the six 1/4-20 x 2-1/2 inch socket head cap screws holding the water chamber to the main load housing. Use a 3/16 inch hex socket wrench.
2. When all screws are loose, pull the water chamber assembly, with screws, straight off. It may be necessary to rock the chamber gently while pulling it off.
3. Remove the six 1/4-20 nuts and washers on the inside of the front panel flange fastening, but do not loosen the screws.
4. Loosen the saddle clamp on the resistor body, and carefully draw the main portion of the housing out of the front end, leaving the water chamber attached to its water lines.

The inner flow tube will usually come out with the water chamber assembly being held to it by the compression of the inner O-Ring water input seal. This is normal and if the resistor body is unbroken there will be no need to remove the inner flow tube from the water chamber assembly. The ground cap assembly is fitted tightly within the water chamber and should normally remain with it.

5. If the inner flow tube has stayed in the resistor section, grasp the resistor stop sleeve on the flow tube and pull out the assembly. This includes the cushioning O-Ring which fits loosely below the stop sleeve. Do not lose the O-Ring.
6. If the brass stop sleeve is removed, notice that it has a small escape hole at the side, and an access counterbore leading to it. In reassembly, be sure this counterbore is facing toward the O-Ring and the resistor. It is necessary for internal water venting. The water outlet holes, and also the small shoulder at the base of the inner flow tube, must fit into the mating recess in the input fitting at the bottom.
7. If the resistor is intact, pull it straight out of the load housing. The outer flow tube is captive and will not come out of the housing at this stage.

Inspection

If the resistor has been successfully removed, inspect it to make sure it has not been fractured. In most cases, even in the event of a resistor failure, the resistor substrate will remain intact. Also, examine the inside of the load housing assembly for any visible damage to the internal parts. If no damage is found, continue with Resistor Replacement. However, if the resistor is broken, other internal

parts appear to be damaged, or if they do not fit together properly, proceed to Replacement Procedure for Fractured Resistors.

Resistor Replacement

Use this section only if there has been no damage done to the resistors or other internal parts of the load.

1. Insert the new resistor into the load housing until it reaches the resistor fitting.
2. Carefully rotate, and rock, the resistor until it starts to enter its way into the resistor fitting. Push the resistor into the fitting until it bottoms on the spacer ring. Ensure the spacer ring is in the proper place. If the resistor seems to be loose, refer to the procedure for the replacement of fractured resistors or damaged internal parts. That section has instructions on how to tighten the resistor fitting.
3. If damaged, replace the inner flow tube. If undamaged, place the original flow tube inside the resistor. Lower it until it reaches the resistor fitting. Gently work and twist the inner flow tube until it seats in the bottom of the resistor fitting.

 Note: this operation may also be done if the inner flow tube is still in position in the water chamber when the main housing is being reinstalled.

4. Slide the back-up resistor sleeve and O-Ring down the inner flow tube until it rests on the end of the resistor. There is no need to disturb the resistor cap assembly in the water chamber for this procedure.
5. Replace the water chamber gently rocking and twisting the chamber to achieve the proper flat seat on the outer housing. If the water chamber does not seem to fit properly, refer back to step 3 to make sure the inner flow tube is properly in place.
6. Place the resistor housing through the front panel opening, and into the water chamber. Gently turn the housing clockwise to thread it on, eventually bottoming it in its original position.
7. Reverse the procedure of the RF Load Dismounting paragraph, to restore the original condition. Do not replace the top panel until after this section is completed.
8. Check the dc resistance between the outer and inner conductors; it should be approximately 50 ohms. Refer to the Measure dc Resistance section, and figure 8.
9. If the resistance check passes, fill the unit with coolant, perform the flush out procedures of the RF Load Dismounting section, and check for leaks.

 Note: After the completion of this or any of the resistor repair procedures, run the pump/motor for five minutes and check thoroughly for leaks before applying RF power to the load.

10. Install the top panel.

Replacement of Fractured Resistors or Damaged Internal Parts

Resistor Removal

The load should already be disassembled to the point of the Resistor Removal section. Refer to figure 9 while following the instructions below.

1. Turn the load on end, with the RF input connector up, to allow debris, if present, to fall out of the load housing.
2. Loosen and remove the 1/4-20 x 1-1/2 inch socket head screws from the flanged end of the load housing assembly, as shown in figure 9.
3. Remove the outer conductor assembly.

Input Center Conductor Assembly

1. Remove the input center conductor assembly by pulling it out of the load housing.
2. Remove any remaining pieces of the resistor.
3. Normally, in the disassembly, the outer flow tube will remain with the load housing. Restore it to that position after inspection and cleaning if it should come out. Inspect the inside of the load housing for damage.
4. If the outer flow tube is in place in the water chamber, pull it out. Inspect carefully for broken pieces. Then grasp the projecting hub of the resistor cap assembly firmly with your fingers, and it pull straight off with a strong even force.
5. Thoroughly wash all the inside portions of the three assemblies; input section, load housing, and water chamber, with potable water.

Resistor Replacement

1. Insert the replacement resistor into the resistor fitting of the input center conductor assembly, to test its tightness. The resistor should not have to be forced into the fitting, but should be quite snug.
2. If the fitting is loose in the fitting, press the slotted finger contacts together slightly and try the resistor again. Continue this procedure until a snug fit is obtained.
3. Bottom the resistor in the fitting.
4. With the resistor still in place in the resistor fitting insert the resistor, and the input center conductor assembly, into the load housing.
5. Replace the outer conductor assembly, and the six 1/4-20 x 1-1/2 inch socket head cap screws, and tighten.

Final Assembly

1. Stand the load on its end with the RF input connector down.
2. Place the inner flow tube inside the resistor and lower it until it reaches the resistor fitting.
3. Gently move and twist the inner flow tube until it seats in the bottom of the resistor fitting.

Front Connector Assembly

The front connector assembly consists of the inner conductor and the outer conductor. They can be released by removing the six screws at the front of the housing. When the inner conductor has been pulled out, the O-Ring seal to the outer water flow tube can be changed, if needed. Do not attempt further disassembly of this part. If necessary, return the part to the factory for repair.

Fuse Replacement

Preparation:

- ♦ Observe general safety precautions.
- ♦ Tools needed: Common hand tools; fuse puller
- ♦ Disconnect ac power main.
 1. Remove the fuse drawer from the ac receptacle.
 2. Lift up on the tab that secures the drawer. Use the flat blade of a screwdriver.
 3. Pull the drawer straight out.
 4. Use a fuse puller, or a flat blade screwdriver, to remove the fuse.
 5. Replace with the same type and rating fuse.
 6. Return the drawer to the receptacle.
 7. Reconnect the ac power main and check the unit for proper operation.

Bird Electronic Corporation maintains a complete repair and calibration facility at the following address:

Customer Service**Sales / Repair Facility****U.S.A. Sales and Manufacturing**

Service Group
 Bird Electronic Corporation
 30303 Aurora Road
 Cleveland (Solon), Ohio 44139-2794
 Phone: (440) 248-1200
 Fax: (440) 248-5426

Sales Facilities**European Sales Office**

For the location of the sales office nearest you, give us a call or visit our Web site at:

www.bird-electronic.com

Storage**CAUTION**

Failure to follow the special storage instructions may result in damage to the unit. Consult the factory for the special instructions.

If the unit is to be stored it should be stored filled with coolant if possible. If storing the unit filled is not possible, consult the factory for special instructions.

Drainage

If the unit is to be stored partly drained or fully drained for two weeks or longer, consult the factory for special instructions.

Shipment**CAUTION**

Failure to properly prepare the unit for shipment using the special storage instructions may result in damage to the unit. Consult the factory for the special instructions.

Figure 9
Resistor Removal

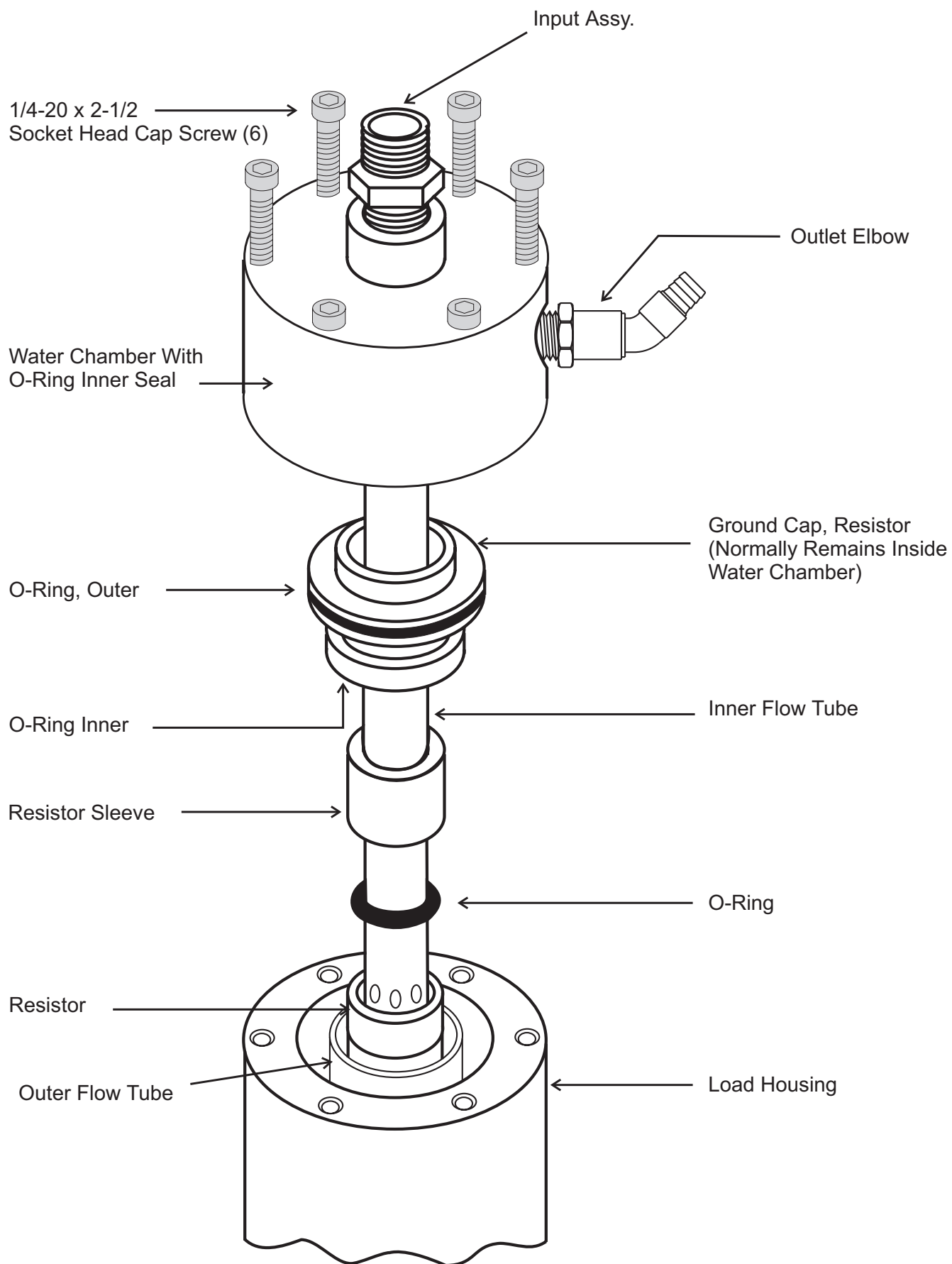
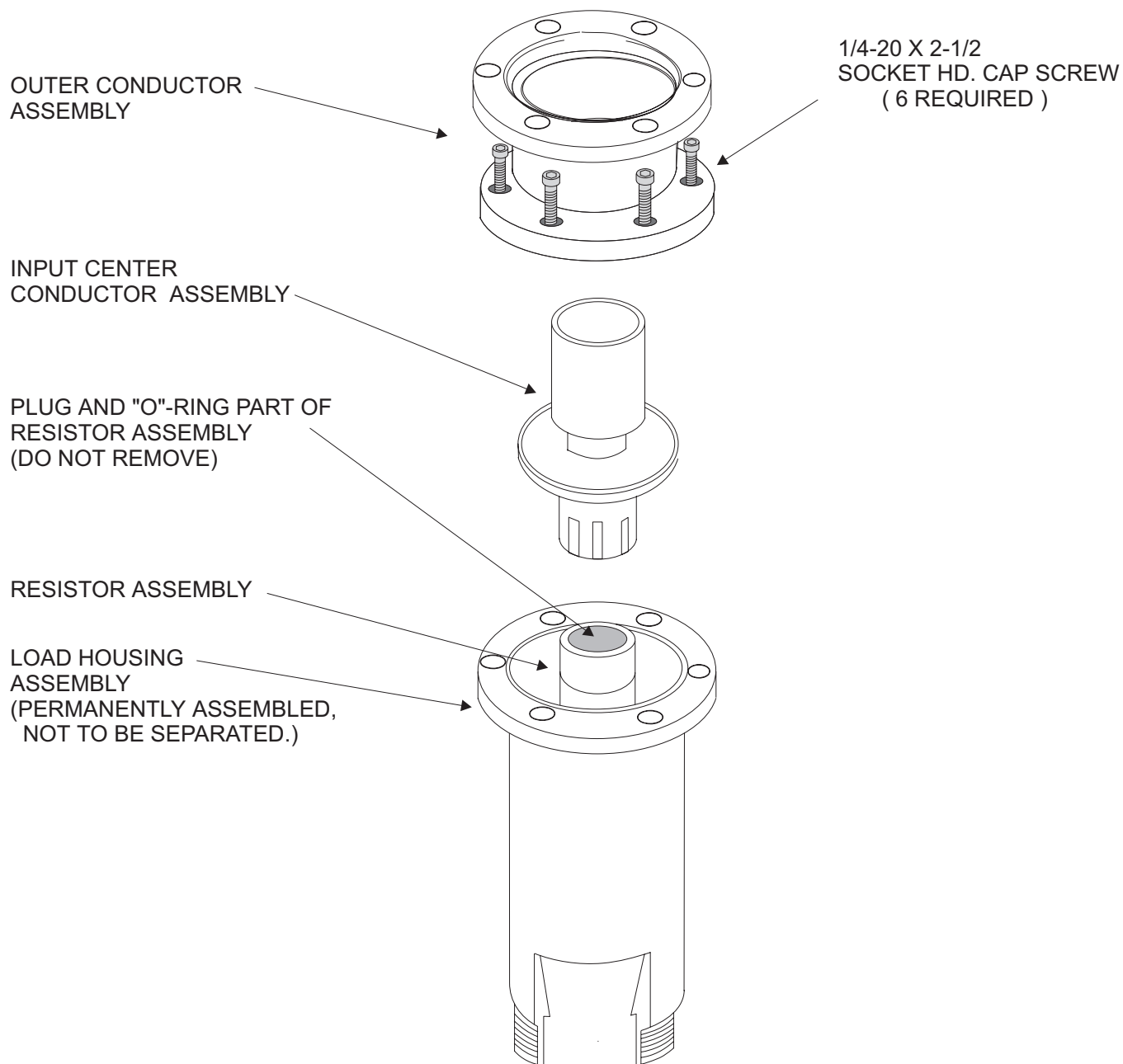


Figure 10
Connector Removal



If the unit is to be shipped, prepare the unit for shipping using the special storage instructions for Moduloads.

Item	Qty.	Description	Part Number
1	1	RF Load Resistor (Econoload): Model 8655 Model 8656	8775-101* 8776-101*
2	1	Switch, Rocker	5A2384
3	1	AC Connector (Fuse Casing)	5-1844
4	1	Line Cord: 115V 230V	5-1836 5-1837
5	1	Fan Socket	5-869-2
6	4	Fan starting capacitor	5-873-2
7	1	Relay Socket	8640-651
8	1	Relay retaining clamp	8630-193
9	1	Thermoswitch (77°C)	8640-066
10	1	Plumbing Assy.	8650-040
11	1	Coolant tank Assy.	8650-030
12	1	Terminal strip assembly	8640-682
13	1	Relay socket	8640-651
14	1	Relay clamp	8630-193
15	1	Pump/Motor Unit: 230V 60Hz 115V 50Hz 230V 50Hz 115V 60Hz	5-1165-1 5-1165-2 5-1165-2 5-1165-1
16	1	Drain Plug	8640-036
17	4	Handle - 90°, 2 position	5-882
18	1	Coolant gauge (replacement kit)	5-1200
19	1	Ethylene Glycol coolant	5-1134-3
20	1	Fuse Drawer	5-1845
21	2	Fuse, 3AB Time-Delay 15 amp 250V (MDA 15)	5-1828-36

* Load resistors installed per models listed in specifications.

Item	Qty.	Description	Part Number
22	1	Resistor	8755-027-5
23	1	Outer resistor cap seal O-Ring	5-567
24	1	Water Chamber	8755-014
25	1	Resistor Sleeve	8755-026
26	1	Sleeve back-up O-Ring	8110-059
27	1	Inner flow tube	8755-025
28	1	Outer flow tube	8755-024
29	1	Resistor ground cap assembly	8755-005
30	1	Plumbing assy.	8650-040

Replacement Parts List

Models 8655 and 8656

Item	Qty.	Description	Part Number
31	1	Center conductor input assembly	8755-007
32	1	Outer conductor assembly	8755-004

Models 8775-101 and 8776-101 Load Resistor for Modulo 8655/56 Units.

Item	Qty.	Description	Part Number
33	1	Center conductor input assembly	8756-003
34	1	Outer conductor assembly	8756-002

Front Connector Parts Assigned Per Model Type:

Item	Qty.	Description	Part Number
35	1	Center conductor assembly O-Ring	5-1127
36	6	Socket head cap screws 1/4-20 x 1-1/2" stainless steel	Standard

Model 8755 — 3-1/8" EIA Connector 50 ohms

Item	Qty.	Description	Part Number
1	1	Fan Panel Assembly: 115V 230V	8650-003-3 8650-003-4
2	1	Fan, Service Assembly: 115V 230V	8650-093-9 8650-093-10 8650-093-11 8650-093-12 8650-093-13 8650-093-14 8650-093-15 8650-093-16
3	1	Fan Propeller	5A2457

Model 8756 — 3-1/8" unflanged connector flush center conductor 50 ohms

Model 8755 and 8656

For All -N Models

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. 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.