



MODULOAD[®] RF LOAD RESISTOR
SERIES 8650B

OPERATION MANUAL

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INSTRUCTION BOOK PART NUMBER 920-8650S REV. F

MODULOAD, ECONOLOAD, ECONOLINE, AND THRULINE 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.

	This symbol indicates that a shock hazard exists if the precautions in the instruction manual are not followed.
	The caution symbol appears on the equipment indicating there is important information in the instruction manual regarding that particular area. Refer to page 12 for specific instructions.
	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
Do not attempt to handle or move this unit alone. More than one person is needed to move this unit to avoid possible injury.

See page 6.

WARNING
Ethylene glycol is toxic. Do not take internally. Avoid contact with eyes, skin, and clothing. Avoid breathing vapor. Wash thoroughly after handling.

See page 7

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

See pages 15, 18, and 21.

WARNING
Disconnect from RF power sources and the AC line before any disassembly or service. Electrical shock hazard.

See page 17.

WARNING
Improper wiring could result in electric shock and death.

See page 18.

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.

See page 7.

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.

See page 7.

CAUTION

Use only distilled water or the supplied ethylene glycol as coolant. Do not use tap water, automotive antifreeze, sealants, or leak stopping material. Use of these materials will damage the instrument and void all warranties.

See page 7.

CAUTION

Operation without sufficient coolant can damage the unit.

See page 9.

CAUTION

Do not block air flow. Air enters through the side openings of the Moduload and exhausts through the top.

See page 12.

CAUTION

Do not operate the load without proper coolant levels. Operation without sufficient coolant can damage the unit.

See page 12.

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.

See page 12.

CAUTION

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

See page 12.

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.

See page 13.

CAUTION

Incorrect hose connections will reverse coolant flow and could destroy the load.

See page 17.

CAUTION

Do not attempt further disassembly of this part.

See page 26.

CAUTION

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

See page 28.

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.

See page 28.

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.

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

8655B115-6	8655B230-5	8655B230-6
8656B115-6	8656B230-5	8656B230-6

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

There are some unique terms used throughout this literature. They are defined here to clarify any misunderstanding.

Moduload — The entire unit.

Load — The component which connects to the RF line. It is connected to the HEAT EXCHANGER with two hoses. It contains the RESISTOR.

Heat Exchanger — The component containing the pump, blower, coolant reservoir, control panel, and electrical access box. It is connected to the LOAD with two hoses.

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

Literature Contents

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

Theory of Operation — Describes how the Moduload works.

Installation — Describes the power supply and load connection instructions.

Operating Instructions — Describes the base level operation instructions.

Maintenance — Lists routine maintenance tasks as well as troubleshooting for common problems. Specifications and parts information are also included.

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The Bird 8655B/56B 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. 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:

- RF Load Assembly

Contains the resistor element with its internal water cooling system.

- 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.

- 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 8655B/56B Moduload Load Resistor may be used for direct RF power measurements within the equipment ratings.

Power and Utility Requirements

The 8655B/56B loads are offered in three standard forms which differ in the AC input power requirements.

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

Items Supplied

The 8655B and 8656B loads are equipped with standard connectors. The Model 8655B has a 3-1/8 inch EIA flanged connector. The Model 8656B has a 3-1/8 inch unflanged connector.

Items Required

- A mating connector on the coaxial transmission line.
- A conveniently located AC power receptacle to plug in the power cable.
- Distilled water for coolant.

Optional Items

Dolly (P/N 6772B011)

For ease in moving the load.

Note: Consult the Bird Electronic Catalog for more information.

Ethylene Glycol (P/N 5-1134-3)

A one gallon container of industrial grade ethylene glycol.

Figure 1 Top View, All Models

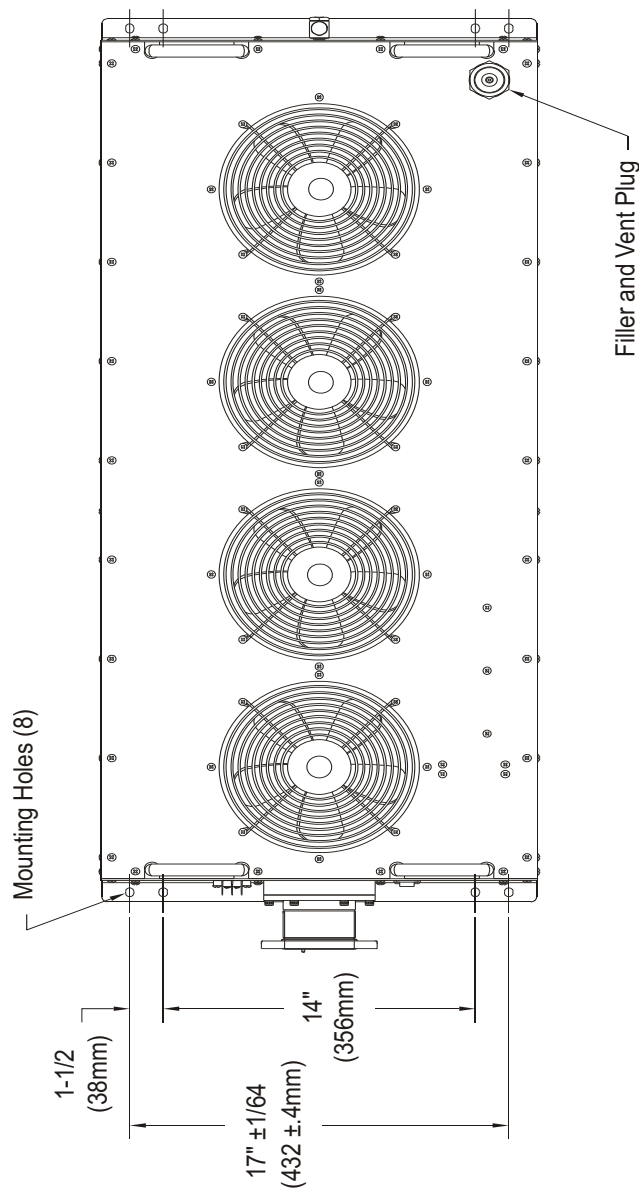


Figure 2 Side View, Models 8655B and 8656B

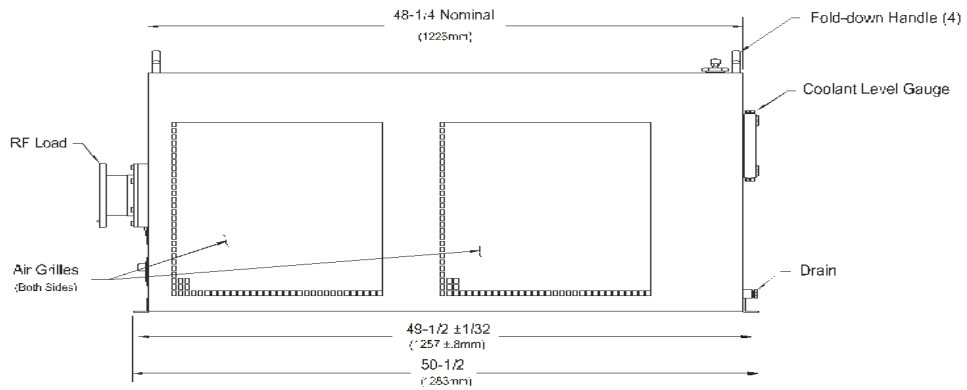
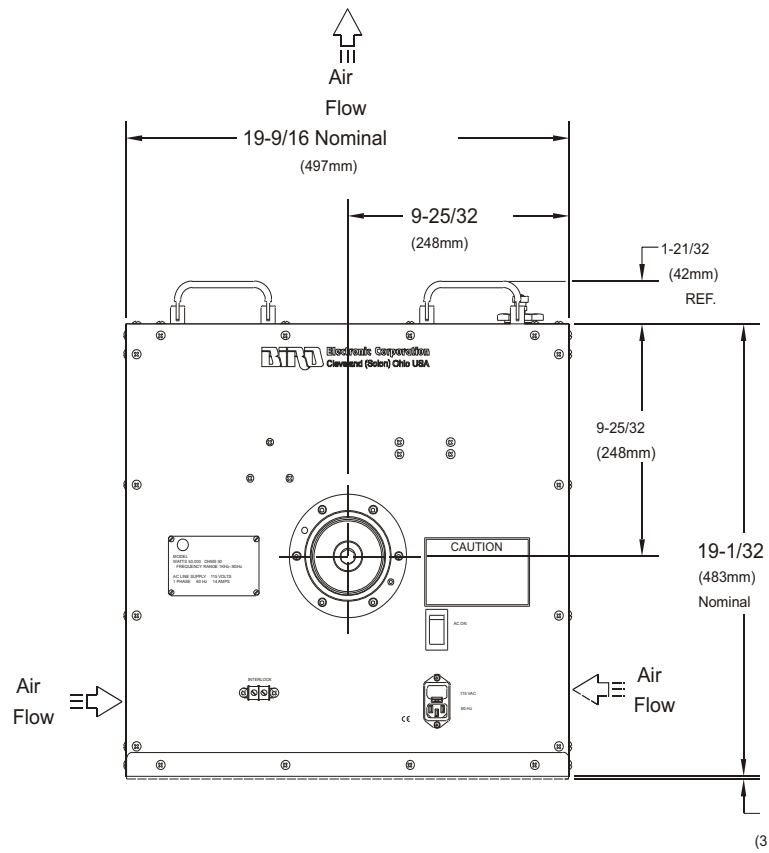


Figure 3 End View, All Models



The Econoload Load Resistor is unique in having its coolant flow over the outer surface of the substrate. This eliminates the need for an intermediate heat transfer system thus reducing the load size to a minimum.

Heat Transfer

The 50 ohm resistor consists of a substrate coated with resistive film. The heat generated by absorption of RF power is transferred from the film to the coolant flowing over it and through a restricted chamber surrounding the resistor body. This coolant passes over the entire length of the resistor and is cooled in the forced air heat exchanger.

Interlock

Dissipation of the heat generated by RF power is critically dependent on a minimum coolant flow of eight gallons per minute at all times, regardless of coolant temperature. If coolant flow drops below a preset value, the pressure switch opens and immediately causes the transmitter to shutdown. The pressure switch is a “normally open” type (i.e., its electrical contacts open when deactivated), and are closed during normal operation.

After coolant flow is restored, a time delay relay keeps the interlock open for an additional 2 seconds. This ensures proper operation of the cooling system before RF power is applied to the load thus preventing resistor damage or burnout.

The interlock circuit also contains a temperature switch to monitor the coolant temperature. This switch is normally closed. It will only open if the system becomes too hot to adequately cool the load. Once the system cools, the switch closes. Though, as with the pressure switch, the time delay relay impedes the closure of the interlock contacts for two seconds.

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

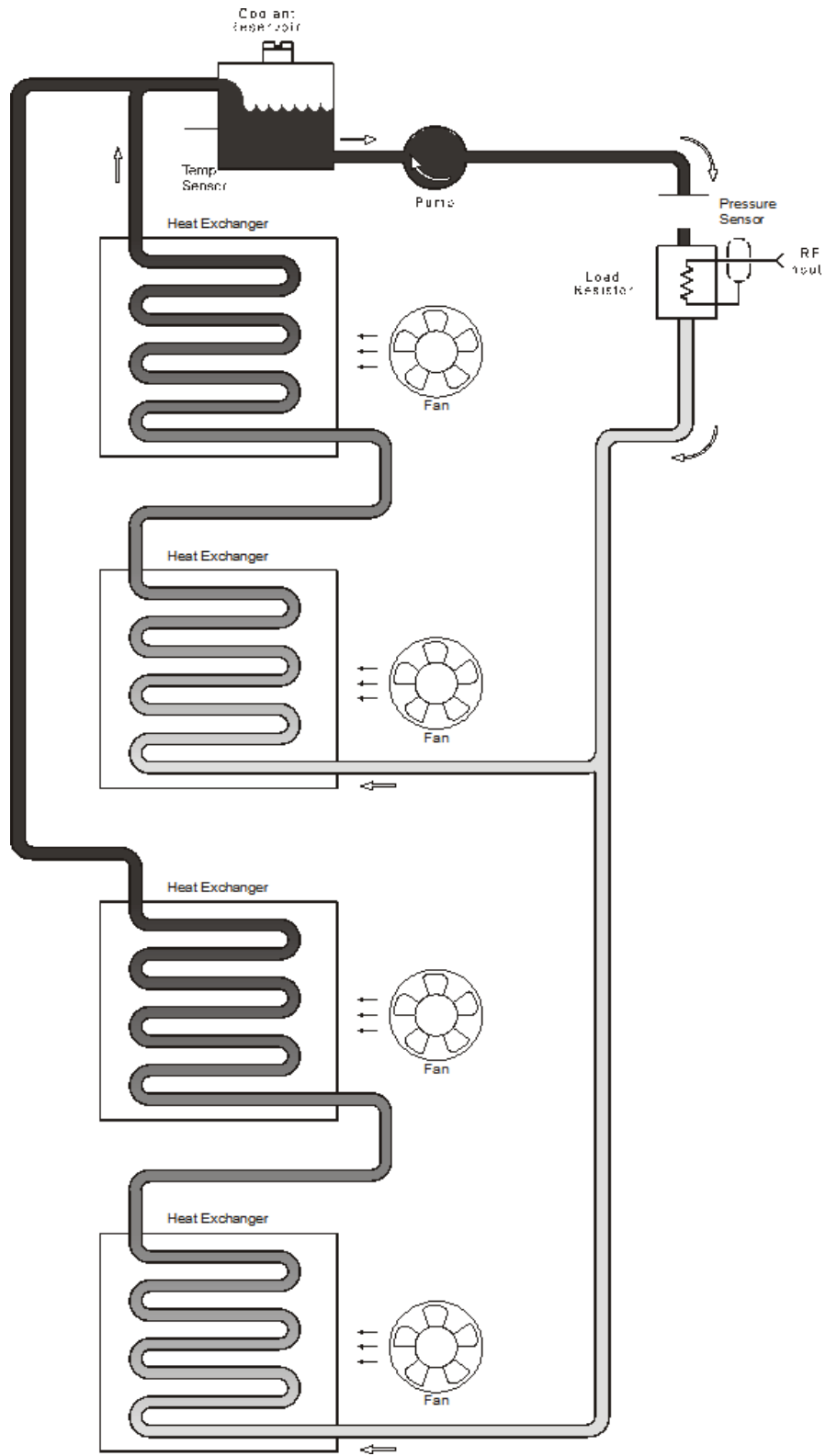
Do not attempt to alter the pressure switch setting or disturb the coolant pump.

The water pressure switch, installed on the RF load’s water input is a “normally open” type; (i.e., its electrical contacts open 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 delay 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.

After coolant flow is restored, the time delay relay keeps the interlock switch open for a predetermined interval (normally set at about 2 seconds). This ensures proper operation of the cooling system before RF power is applied to the load thus preventing resistor damage or burnout.

Figure 4 System Block Diagram



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.

The Model 8655B/56B 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 49-1/2 inch (432 x 1257 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.

Note: *Use number 22 AWG (or heavier) wire for interlock connections.*

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 either be 115V 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/yellow, is the ground wire.

Note: For proper protection, if a 3-wire type plug and outlet is not used, fasten the green/yellow 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/yellow wire at the supply end is properly grounded.

Coolant

Before shipment, the Moduload is drained of coolant to avoid possible damage from freezing in transit. 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 load's electrical and thermal performance can become impaired by impurities or additives in the coolant. Impurities which accumulate as scale on the resistor surface are especially damaging.

The coolant must be either; distilled water or a mixture of distilled water and ethylene glycol. Distilled water is the primary coolant for the Bird 8650. Ethylene glycol should be added to prevent bacterial growth and freezing.

Note: 10% – 35% ethylene glycol is recommended. Using at least 10% will prevent bacteria growth and 35% will protect against freezing to -20°C . [Figure 5](#) and [Figure 6](#) show the coolant's freezing point for a given percentage of ethylene glycol in the mix.

To ensure proper mixing add the water first, then the ethylene glycol

WARNING

Ethylene glycol is toxic. Do not take internally. Avoid contact with eyes, skin, and clothing. Avoid breathing vapor. Wash thoroughly after handling.

CAUTION

Use only distilled water or the supplied ethylene glycol as coolant. Do not use tap water, automotive antifreeze, sealants, or leak stopping material. Use of these materials will damage the instrument and void all warranties.

The following example shows the weights to make a 65% distilled water to 35% ethylene glycol mixture in 5 and 55 gallon quantities:

	5 Gal. (18.9 L)	55 Gal. (208.2 L)
Distilled Water	28.0 lb (12.7 kg)	310 lb (140.6 kg)
Ethylene Glycol	15.2 lb (6.9 kg)	167 lb (75.7 kg)

Figure 5 Freezing Point of Ethylene Glycol /Water Mixture °F

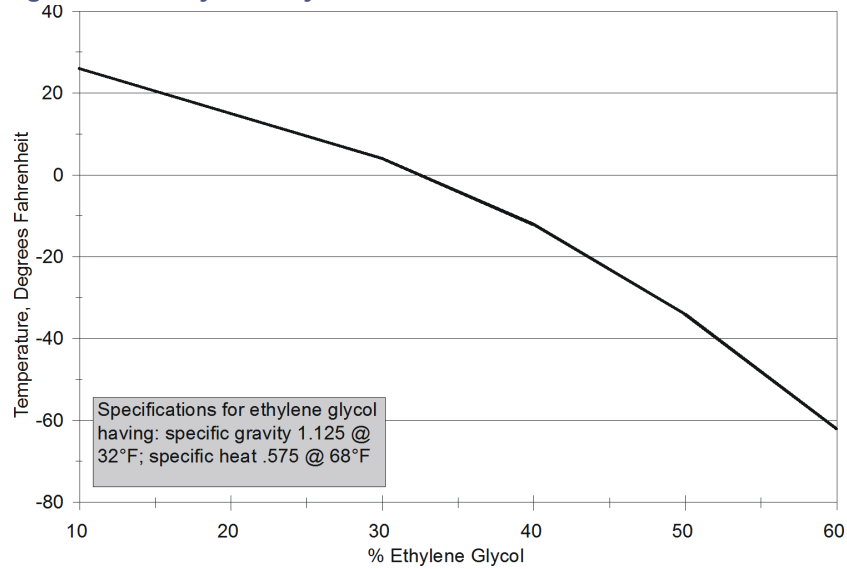
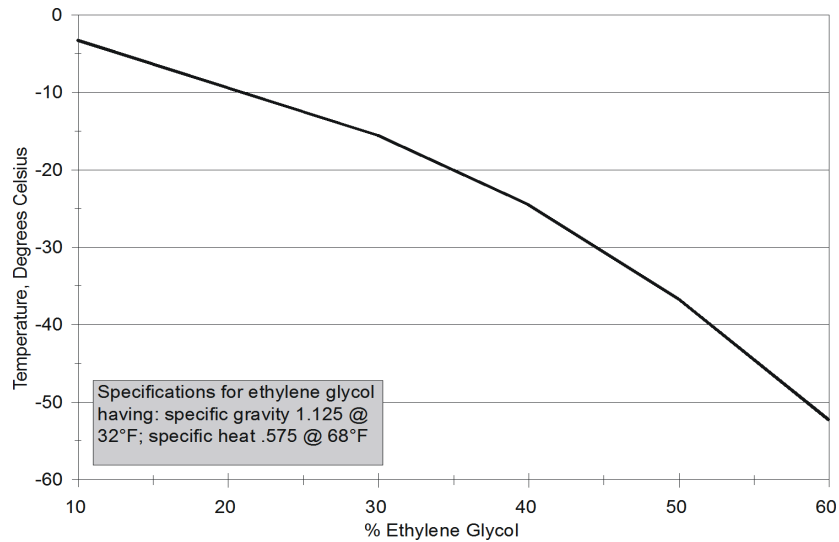


Figure 6 Freezing Point of Ethylene Glycol /Water Mixture °C



Filling the Coolant Reservoir

CAUTION

Operation without sufficient coolant can damage the unit.

Note: *The Bird 8650R has a coolant capacity of about 17 quarts (16.1 liters).*

1. Ensure the drain plug is in place and that the hose connections are correct and properly tightened.
2. Remove the filler cap located on the unit's top.
3. Add about 6 quarts (5.7 liters) of coolant.
4. Replace the filler cap.
5. 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.

Note: *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.*

6. Repeat Steps 1 to 5 twice more, with about 5.5 quarts (5.2 liters) each time, or until the fluid remains steady at the proper level.

Note: *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.*

7. Run the unit for about five minutes to remove any trapped air in the system.
8. 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.*

Introducing contaminants 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 and with an improper water supply. If the coolant system has been contaminated, flush it out. See ["Flushing the System" on page 17.](#)

Blower Fans

The fans are wired direct to the AC line and, when activated, operate along with the pump. 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 8655B/56B the connections are as follows.

Model 8655B (3-1/8 inch EIA, 50 ohm, swivel flanged)

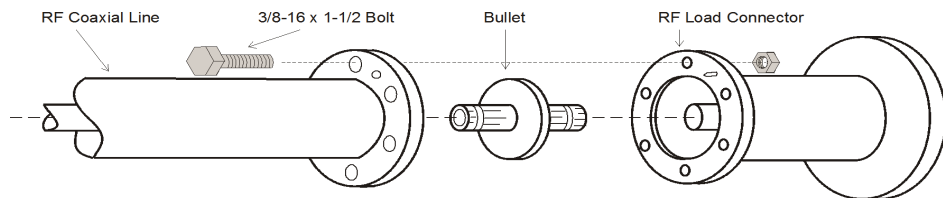
Note: Use the 3-1/8" EIA Coupling Kit (p/n 4600-020), which includes six 3/8-16 x 1-1/2" bolt and nut sets, O-Ring, and insulated center bullet.

1. Insert the center bullet and push into the seat insulator in the facing.
2. Install the O-Ring into the groove, if required.
3. Connect the coaxial input in a straight line and push carefully on the center contact to close.

Note: The swivel flange on the load makes connection independent of a fixed flange on coaxial input line.

4. Insert the bolt sets around the flange connection and tighten evenly.

Figure 7 Model 8655B Coupling Kit

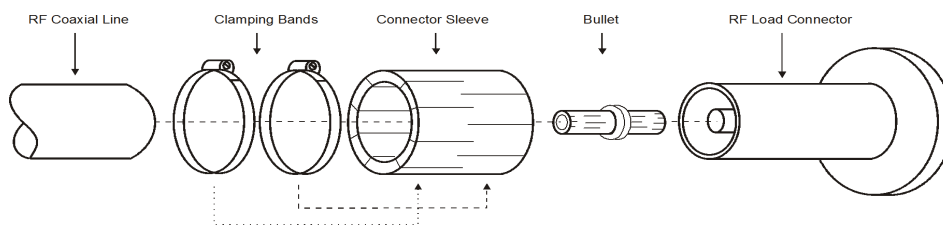


Model 8656B (3-1/8 inch unflanged, 50 ohm impedance)

Note: Use the Bird Coupling Kit P/N 5-726, consisting of two clamping bands, an outer sleeve, and the center coupling bullet.

1. Insert the center bullet, and bottom it on the midpoint nibs.
2. Position the outer sleeve, with clamps, over the input connector.
3. Seat the transmission line snugly against the coupling stops.
4. Position the clamp bands evenly about 3-3/4 inches apart, and tighten.

Figure 8 Model 8656B Coupling Kit



Preliminary Equipment Check

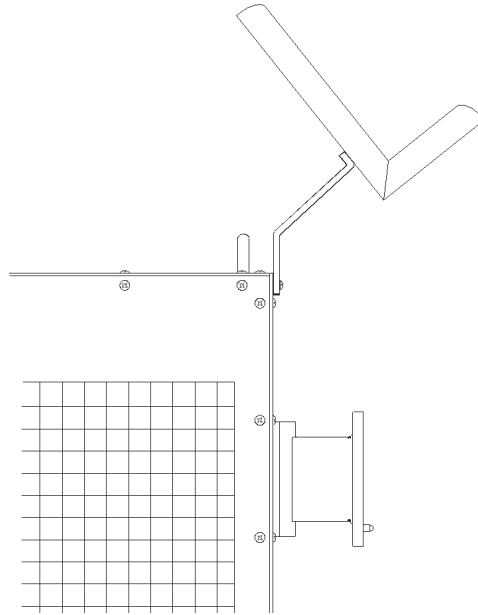
Check the RF load for acceptable electrical condition. See "[RF Assembly Resistance Test](#)" on page 15.

Meter Rack

Note: The Meter Rack is used to hold the meter at the correct angle, for the best possible viewing.

1. Assemble the rack using four #6-32 x 3/8 screws.
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 head screws.

Figure 9 Meter Rack Assembly



**CAUTION**

Do not operate the load without proper coolant levels. Operation without sufficient coolant can damage the unit.

Use and Function of Controls

The Models 8655B and 8656B 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. See ["Coolant" on page 7](#).

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. Ensure the coolant level is adequate. See ["Coolant" on page 7](#).
2. Verify fan operation. See ["Blower Fans" on page 9](#).
3. Turn interlock supply on.
4. Turn on 115V or 230V power.
5. 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 if an emergency arises.

Should an emergency arise 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 8655B/56B RF Loads is affected by impurities or other chemical additives in the cooling liquid. Therefore, the cooling liquid should be distilled water, or distilled 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 8655B/56B may will be capable of direct reading of RF power measurements within the equipment.s rating.

Troubleshooting

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

Problem	Possible Cause	Correction
Transmitter will not 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 thermosthwitch	Check thermosthwitch.
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. See "Flushing the System" on page 17.
	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. See "Installation" on page 6.
	RF power overload	Reduce power output from transmitter. Check over-temperature thermo-switch.
Moduload will not come on.	No line power	Check AC power source and power cord.
	Fuses burned out	Replace fuses. Check for cause. See "Replacing the Fuse" on page 22.
	Defective switch	Replace switch. See "Replacing the Water Pressure Switch" on page 21.

RF Load Resistor

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

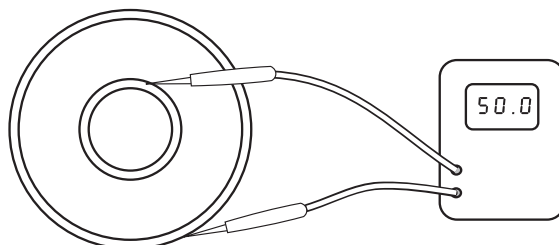
WARNING

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 10](#).
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 10 *Measuring DC Resistance*



Routine Service Checks

Inspecting the Coolant

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, see "[Coolant](#)" on page 7.

Inspecting the External Surface

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. See [Cleaning](#).

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.

- **Equipment Needed:**
- Lint-free cleaning cloth
- Mild detergent

Cleaning the Instrument Housing and Panels

1. Remove loose dirt and grime, gently, using a soft clean cloth dampened with a warm solution of mild detergent and water.

Note: *A vacuum can be used to clean the radiators if necessary.*

2. Remove the 26 screws from the top panel to gain access to the radiators.
3. Clean off dust and lint, if any, with a radiator brush or stiff bristle brush.
4. Check under the ribs of the air intake 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.

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

Cleaning the Connector and Outside Surface

Note: Use a soft, clean cloth dampened with mild detergent.

- Wipe dust and dirt from the outside surface of the unit

Note: ●This should be performed at regular intervals.

- Check the condition of the RF coaxial connector.
- Clean the RF input connector, If needed, use a self-drying contact cleaner that leaves no residue.

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.

<p style="text-align: center;">WARNING Disconnect from RF power sources and the AC line before any disassembly or service. Electrical shock hazard.</p>
--

<p style="text-align: center;">CAUTION Incorrect hose connections will reverse coolant flow and could destroy the load.</p>
--

Normal Coolant Flush

As scheduled maintenance or If the coolant is contaminated, old and needs to be replaced, the system should be thoroughly flushed.

1. Drain the circulating system as completely as possible.
2. Fill the unit with fresh, clean, distilled water.
3. Run the load with coolant but without RF power applied for a period of five minutes.
4. Drain and discard the water.
5. Repeat the Steps 2 - 4 until the drained liquid is clear.
6. Fill the unit with distilled water and/or approved ethylene glycol mixture per "[Coolant](#)" on page 7.

Coolant Flush after Load Replacement

Prior to installing a repaired load or a new load the cooling system needs to be flushed to remove any debris or containments that may remain when a damaged load is removed.

1. Open the drain plug.
2. Drain and discard the coolant.
3. Close drain plug.
4. Connect a suitable hose from the outlet of the pump to a drain or container to hold the discarded coolant.
5. Connect a second hose from the inlet of the heat exchanger to a source of clean potable water.
6. Open the fill cap.
7. Turn on water source and allow the tank to fill.
8. Replace the fill cap.
9. Leave the water source on and allow the system to flush for 1 to 3 minutes.
10. Turn the water source off.
11. Reverse the position of the hoses.
12. Flush the system with the water flowing in the opposite direction for 1 to 3 minutes.
13. Repeat steps 9 - 12 until there are no signs of debris or contaminants in the water being discharged.
14. Remove the hoses.
15. Reinstall the load.
16. Fill the unit with distilled water and/or approved ethylene glycol mixture per "[Coolant](#)" on page 7.

Note: *If the unit is to remain fully or partially drained for two weeks or more, see "[Storage](#)" on page 28.*

Repair and Replacement Procedures

WARNING
Disconnect from RF power sources and the AC line before any disassembly or service.
Electrical shock hazard.

WARNING
Improper wiring could result in electric shock and death.

The 8655B/56B 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.

RF Load Assembly

Removing the RF Load

Note: *The full load assembly may be removed from the case as in the following procedure.*

Note: *Resistor repair in the load may be done without removing the water connections; see "[Load Resistor Internal Repair](#)" on page 23.*

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

- **Equipment Needed:**
- Common hand tools

WARNING
Never attempt to connect or disconnect an RF transmission line 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.
3. Remove the 3/8-16 bolt and nut sets that secure the flanges.
4. Separate the transmission coaxial air line from the load connector.

Note: *Make sure the center conductor bullet remains in the transmission line.*

5. Take off the top panel by removing the 26 screws around its perimeter.
6. Turn all four handles outward and slightly lift up the top panel assembly.
7. Reach under the top panel and press the connector latch of the fan power cable.

Note: *This will disconnect the small fan-supply plug from its mating connector seated on top of the radiator block.*

8. Unscrew the drain plug located at the bottom center of the rear panel.
9. Allow the coolant to drain.

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

10. Unscrew both hose clamps on the water connections to the load resistor.

Note: The water inlet is through the pressure switch tee fitting at the back of the load. The water outlet is located on the lower side of the load.

11. Disconnect the orange wire and black wire from the pressure switch (located at the load input).
12. Disconnect the black, white, and greens wires from the pump power cable located at the terminal block on the inside of the front panel.
13. Disconnect the six-pin front panel connector located at the in-line connector on the top of the radiator bracket near the front panel.
14. Remove the two 5/16 hex head screws from the load clamp.
15. Remove the upper half of the load clamp from the load.
16. Remove the 16 screws that secure the perimeter of the front panel.
17. Remove the front panel with the load attached.
18. Remove the nuts and lock-washers that secure the load to the front panel.
19. Remove the socket hard cap screws that secure the water chamber to the load.
20. Remove the water chamber.

Note: After the water chamber has been removed, the front panel can be removed from the load.

21. Do one of the following:
 - If servicing the load, see "[Load Resistor Internal Repair](#)" on page 23.
 - If not servicing the load, replace the water chamber and its mounting hardware and return the load to the factory of service.
22. Replace the load resistor by careful reversal of the above procedure.

Note: Be sure to replace the coolant per the coolant section. Check for leaks, especially at the restored connections. See "[Coolant](#)" on page 7.

Pump/Motor Removal

Note: 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.
2. Turn all four handles outward and slightly lift up the top panel assembly.
3. Reach under the top panel and press the connector latch of the fan power cable.

Note: This will disconnect the small fan-supply plug from its mating connector seated on top of the radiator block.

4. Unscrew the drain plug located at the bottom center of the rear panel.
5. Allow the coolant to drain.

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

6. Detach the three connecting wire leads of the pump power cable from the three-lug terminal block on the inside of the front panel.

Note: For reference the color codes of the motor supply wires match the input wires.

7. Loosen the following:
 - The hose from the input of the pump.
 - The hose from the output on the pump.
8. Remove the four 1/4-20 nuts and lockwashers that secure the pump and mounting bracket to the isolation mounts on the frame.

Note: Use 9/16 inch wrenches.

9. Move the pump assembly slowly forward while detaching the hoses.
10. Lift the pump/motor/bracket assembly out of the equipment.

Note: Make note of the fitting positions.

11. Twist off, counterclockwise, the whole parts of the fittings.

Note: Do not disturb the 25° upward tilt of the 90° input elbow.

Note: Store the detached parts with the disassembled unit and return the pump/motor /bracket assembly to the factory for replacement.

Installing the Pump/Motor Assembly

To install the pump/motor reverse the removal procedures.

Note:

- When installing the pump/motor, make sure the unit is placed so that the top panel will not hit the top of the unit.
- Coat only the external threads 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.
- Twist on the threaded fittings, until the treaded joints are tight and all parts are in their original angular position.
- Rewire to the same terminal block connections.

Replacing the Water Pressure Switch

The water pressure (Safety Control) switch is changed by 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.

- **Equipment Needed:**
- Common hand tools

WARNING

Never attempt to connect or disconnect an RF transmission line 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.
3. Remove the 3/8-16 bolt and nut sets that secure the flanges.
4. Separate the transmission coaxial air line from the load connector.
Note: *Make sure the center conductor bullet remains in the transmission line.*
5. Take off the top panel by removing the 26 screws around its perimeter.
6. Turn all four handles outward and slightly lift up the top panel assembly.
7. Reach under the top panel and press the connector latch of the fan power cable.
Note: *This will disconnect the small fan-supply plug from its mating connector seated on top of the radiator block.*
8. Unscrew the drain plug at the bottom center of the rear panel.
9. Allow the coolant to drain.
Note: *Do not replace the drain plug with any substitute plug, use the plug removed.*
10. Disconnect the orange and black wires from the pressure switch.
Note: *The water inlet is through the pressure switch at the back of the load input nipple.*
11. Detach the switch assembly from the load.
Note: *The switch is ready for service or replacement.*
Note: *When replacing the switch fittings be sure to coat only the external threads with joint sealing compound.*
Note: *When reinstalling the switch assembly, twist on the components until the switch body is in the original angular alignment with the load resistor housing.*
12. Restore the wire connections.
13. Refill the equipment with coolant to the proper level.
14. Check the refitted joints thoroughly.
15. Test the switch operation by a preoperational run, as described in "[Coolant](#)" on page 7, without RF power.
16. Inspect for leaks by running the coolant pump for a few minutes without the top panel.

Replacing the Time Delay Relay for 8655B and 8656B

The time delay relay is factory set for an approximate two second delay, isolating the circuit relay. See "[Flow Interlock Control Circuit](#)" on page 4.

Note: *The relay is located on the upper right inside of the front panel.*

Note: *The relay cartridge cannot be disassembled or repaired in the field.*

1. Record the color and routing of the wires on each relay terminal.
2. Remove the wires from the relay terminals.
3. Remove the nut and washers that secure the relay to the panel.
4. Remove the relay.
5. Install the replacement relay by reversing Step 2 through Step 4,

Replacing the Fuse

- **Equipment Needed:**

- Common hand tools

1. Disconnect AC power line.
2. Lift up on the tab that secures the drawer the AC receptacle.

Note: *Use the flat blade of a screwdriver.*

3. Pull the drawer straight out.
4. Remove the fuse.
5. Replace with the same type and rating fuse.
6. Return the drawer to the receptacle.
7. Reconnect the AC power line.
8. Check the unit for proper operation.

Load Resistor Internal Repair

The water cooled load used in the Moduload is designed to be quickly and easily repaired in the field. If in performing the DC resistance check ("[RF Assembly Resistance Test](#)" on page 15), significant changes in resistance are noticed or if for any reason the resistive element should fail, replacement resistors are available. See "[Replacement Parts List](#)" on page 30.

Removing the Resistor Main Housing

Removing the Resistor

Note: *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.*

Note: *The ground cap assembly is fitted tightly within the water chamber and should normally remain with it. If the ground cap is still on the end of the resistor, remove it before proceeding.*

1. Do one of the following:
 - **If the inner flow tube has stayed in the resistor section:**

- a. Grasp the resistor stop sleeve on the flow tube.
- b. Pull out the assembly.

Note: *This includes the cushioning O-Ring which fits loosely below the stop sleeve.*

Note: *Do not lose the O-Ring.*

- If the brass resistor sleeve is removed:

Notice that it has a small escape hole at the side, and an access counterbore leading to it.

Note: *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.*

- If the resistor is intact:
 - a. Pull it straight out of the load housing.

Note: *The outer flow tube is captive and will not come out of the housing at this stage.*

Inspecting the Resistor

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.

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.

Replacing the Resistor

Note: 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. Rotate, and rock, carefully, the resistor until it starts to enter its way into the resistor fitting.
3. Push the resistor into the fitting until it bottoms on the spacer ring.
4. Ensure the spacer ring is in the proper place.

Note: 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.

5. Do one of the following:

- **If damaged:**

- a. Replace the inner flow tube.

- **If undamaged:**

- a. Place the original flow tube inside the resistor.
- b. Lower it until it reaches the resistor fitting.
- c. 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.

6. Slide the back-up resistor sleeve and O-Ring down the inner flow tube until it rests on the end of the resistor.

Note: There is no need to disturb the resistor cap assembly in the water chamber for this procedure. If the ground cap has been removed, replace it on the end of the resistor before continuing.

7. Install the water chamber gently rocking and twisting the chamber to achieve the proper flat seat on the outer housing.

Note: 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.

8. Place the resistor housing through the front panel opening, and into the water chamber.
9. Turn the housing, gently, clockwise to thread it on, eventually bottoming it in its original position.
10. Reverse "[Removing the RF Load](#)" on page 18.

Note: Do not replace the top panel until after this section is completed.

11. Check the DC resistance between the outer and inner conductors; it should be approximately 50 ohms. See "[RF Assembly Resistance Test](#)" on page 15, and [Figure 10 on page 15](#).
12. If the resistance check passes, flush out. See "[Flushing the System](#)" on page 17.
13. Inspect for leaks by running the coolant pump for a few minutes without the top panel.

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.

14. Install the top panel.

Replacing Fractured Resistors or Damaged Internal Parts

Removing Resistor

Note: Refer to [Figure 11 on page 26](#) for this procedure.

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. 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 11](#).
3. Remove the outer conductor assembly.
4. Remove the input center conductor assembly by pulling it out of the housing.
5. Remove any remaining pieces of the resistor.

Note: 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.

6. Inspect the inside of the load housing for damage.
7. Pull the inner flow tube from the water chamber.
8. Inspect carefully for broken pieces.
9. Grasp the projecting hub of the ground cap assembly firmly and pull it straight off with a strong even force.
10. Wash all the inside portions of the three assemblies; input section, load housing, and water chamber, thoroughly with distilled water.
11. Inspect all O-rings for damage before reassembling the load.

Installing the Resistor

1. Test the tightness of the replacement resistor by inserting it into the fitting of the input center conductor assembly.

Note: The resistor should not have to be forced into the fitting, but should be quite snug.

2. Do one of the following:
 - If the fitting is loose in the fitting, press the slotted finger contacts together slightly and try the resistor again.

Note: Continue this procedure until a snug fit is obtained.

- If the fitting is snug, proceed to Step 3.
3. Bottom the resistor in the fitting.
4. Insert the resistor, and the input center conductor assembly, into the load housing with the resistor still in place in the fitting.
5. Secure the outer conductor assembly with the six 1/4-20 x 1-1/2 inch socket head cap screws.

Assembling the Unit

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.

Assembling the Front Connector

1. Remove the six screws at the front of the housing to release the conductors.
2. Change the O-Ring seal to the outer water flow tube once the inner conductor has been pulled out

CAUTION
Do not attempt further disassembly of this part.

3. If necessary, return the part to the factory for repair.
 4. Replace the ground cap assembly on the exposed end of the resistor as shown in [Figure 11](#).
 5. Replace the O-ring and resistor sleeve.
- Note:** The counterbore faces 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.
6. Replace the front panel on the load then replace the water chamber and 1/4-20 socket head cap screws.
 7. Reassemble the load into the heat exchanger assembly. Reverse "[Removing the RF Load](#)" on page 18.

Figure 11 Removing the Resistor

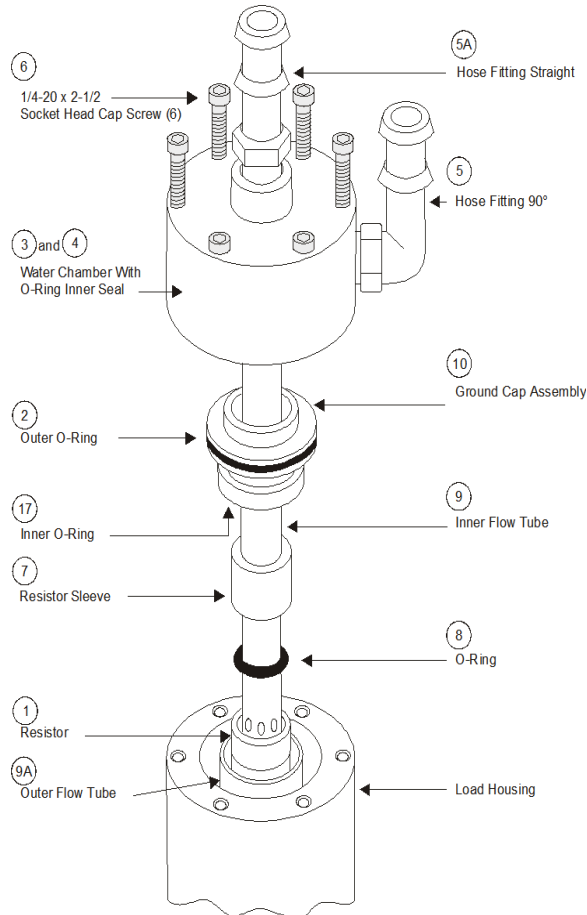
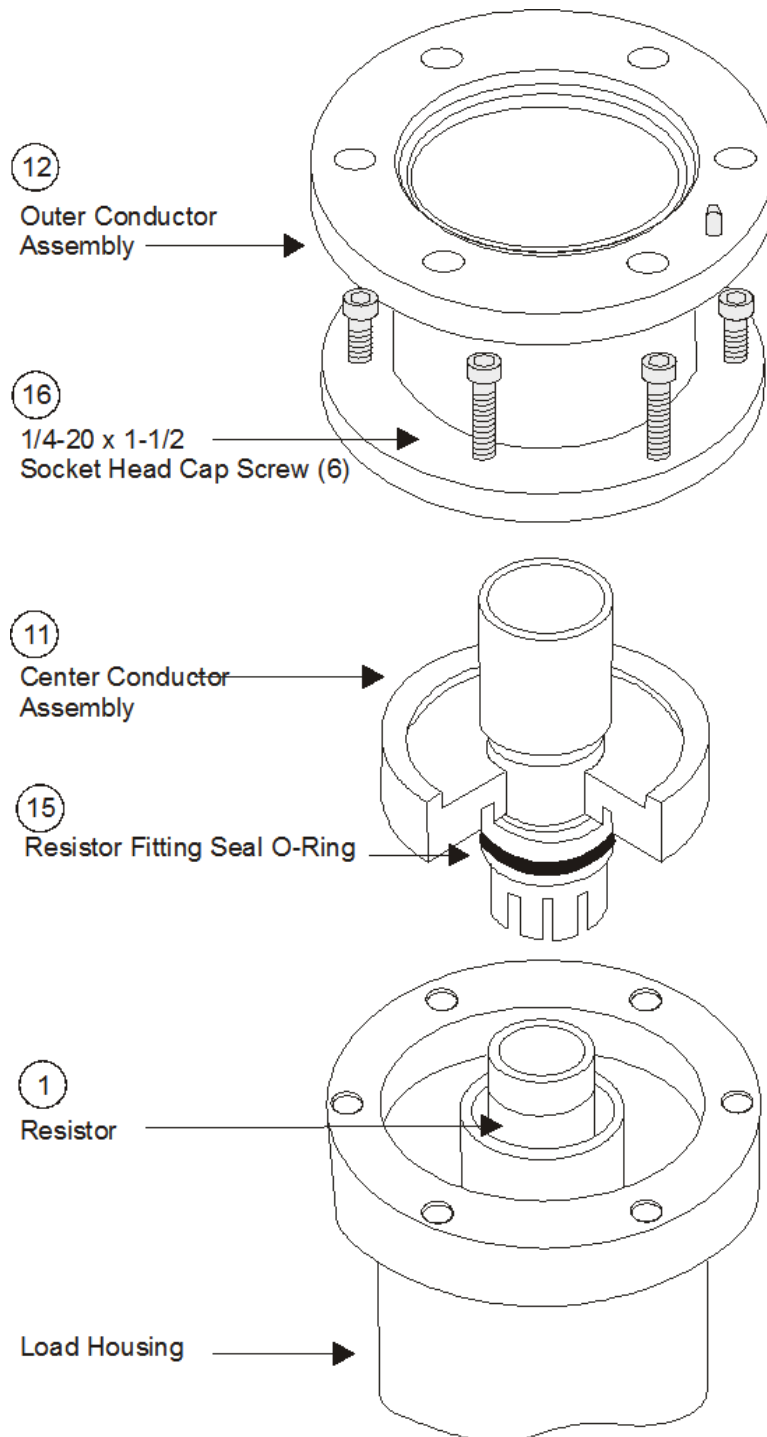


Figure 12 Removing the Connector



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.

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

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>

Specifications

Econoload

Impedance, Nominal	50 ohms
Power Rating, Max	50 kW
Frequency Range	1 kHz - 900 MHz
Connector Model 8655-() ¹ Model 8656-() ¹	3-1/8" EIA Flanged 3-1/8" Unflanged (flush center conductor)
VSWR	1.10:1
Modes	CW, AM, FM, TV, SSB, and certain pulse types

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

System

Ambient Temperature	See Table 2-1.
AC Power Required	115 VAC @ 15 Amps, 50/60 Hz 230 VAC @ 8 Amps, 50/60 Hz
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) distilled water ² or 35% ethylene glycol mixture ²
Weight, Nominal	275 lbs (124.7 kg)
Finish	Grey Powder Coat

Table 2-1 Bird 8650 Series Ambient Temp. vs. Max. RF Power

Coolant ¹	35% E.G.	100% Dist. H ₂ O
45°C	NA	40.0 kW
35°C	40.0 kW	40.0 kW
30°C	40.0 kW	50.0 kW
5 to 25°C	50.0 kW	50.0 kW
-20 to 5°C	50.0 kW	NA

1 Below 5°C, ONLY use 35% E.G. and 65% Dist. H₂O mixture

Replacement Parts List

Models 8655B and 8656B

Item	Qty.	Description	Part Number
1	1	RF Load Resistor (Econoload): Model 8655 Model 8656	8775-100 ¹ 8776-100 ¹
2	1	Switch, Rocker	5A2384
3	1	AC Connector (Fuse Casing)	5-1844
4	1	Line Cord: 115V 230V	5-1836 5-1837
7	1	Relay, Time Delay After 7/1/13: Relay, Time Delay 115V Relay, Time Delay 230V	5A2787-1 5A2787-115 5A2787-230
10	1	Thermoswitch (79°C)	5A2788-1
12	1	Coolant tank Assy.	8650B030
13	1	Terminal strip assembly	8640-682
14	1	Pump/Motor/Bracket Assembly: 230V 60Hz 115V 50Hz 230V 50Hz 115V 60Hz	RPK8650-60-230 RPK8650-50-115 RPK8650-50-230 RPK8650-60-115
15	1	Drain Plug	8640-036
16	4	Handle - 90°, 2 position	5-882
17	1	Coolant gauge (replacement kit)	5-1200
18	1	Ethylene Glycol coolant	5-1134-3
19	1	Fuse Drawer 115 VAC 230 VAC	5-1845-FD 5A2310
20	1	Fuse 115 VAC (3AB Time Delay 15 amp 250V)	5-1828-36
	2	230 VAC (5x20, Time Delay, 8 amp, 250V)	5A2257-25
		Fan 864-5-115 (115 VAC) 864-5-230 (230 VAC)	5A2770-1 5A2770-2
		Fan panel assembly (includes fans, panel, wiring) 115 VAC 230 VAC	8650B003-1 8650B003-2

1 Load resistors installed per models listed in specifications.

Models 8775-100 and 8776-100 Load resistor for Moduload 8655B/56B Units

Item	Qty.	Description	Part Number
1	1	Resistor	8755-027-5
2	1	Outer resistor cap seal O-Ring	8410-009
3	1	Water Chamber	8755-014
4	1	O-Ring Inner Seal	5-099
5	1	Plumbing assy., Hose Fitting 90°	8650-040
5A	1	Pipe Load Input assy., Hose Fitting Straight, with space for pressure switch	8650-039
6	6	Socket Head Cap Screw, 1/4-20 x 2-1/2" Stainless Steel	1121-2508-00
7	1	Resistor Sleeve	8755-026
8	1	Sleeve back-up O-Ring	8110-059
9	1	Inner flow tube	8755-025
9A	1	Outer flow tube	8755-024
10	1	Resistor ground cap assembly	8755-005
17	1	Inner resistor cap seal O-Ring	5-567
18	1	R.F. Load Housing Assy.	8755-006

Front Connector Parts assigned Per Model Type

Model 8655 — 3-1/8" EIA Connector 50 Ohms

Item	Qty.	Description	Part Number
11	1	Center conductor input assembly	8755-007
12	1	Outer conductor assembly	8755-004

Model 8656B — 3-1/8" Unflanged Connector, Flush Center Conductor, 50 Ohms

Item	Qty.	Description	Part Number
11	1	Center conductor input assembly	8756-003
12	1	Outer conductor assembly	8756-002

Both Models, 8655B and 8656B

Item	Qty.	Description	Part Number
15	1	Center conductor assembly O-Ring	5-1127
16	6	Socket Head Cap Screw, 1/4-20 x 1-1/2" Stainless Steel	1121-1808-00

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.