Moduload® RF Load Resistor with Load Protection

Including Models
8645-LP & 8655-LP

Operation Manual

Instruction Book Part Number 920-Moduload-LP, rev A

Safety Precautions

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

WARNING

Keep Away From Live Circuits

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

WARNING

Shock Hazard

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

WARNING

Do Not Service Or Adjust Alone

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

WARNING

Safety Earth Ground

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

WARNING

Resuscitation

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

WARNING

Remove Power

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

Safety Symbols

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

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

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

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
HEAVY. Do not lift this unit alone.

On page 7.

WARNING
Disconnect the unit from all power sources before servicing.
The unit may be energized from multiple sources.
The potential for electric shock exists.

On pages 8, 14, 15, 17, 19, 20, 23, and 25.

WARNING
Improper wiring could result in electric shock and death.

On page 8.

WARNING
Connect the power cord to the Moduload
BEFORE connecting to AC mains.

On page 8.

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

On pages 9 and 16.

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.

On pages 11 and 16.

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

On page 17.

WARNING
Radiator fins are very sharp. Avoid contact with the radiator fins. Failure to comply may result in severe cuts and bleeding.

On page 22.

WARNING
Dangerous voltages are present.
Disconnect the unit from all power line and RF power sources before servicing. Do not disconnect the unit from the RF transmission line while RF power is applied.
Failure to comply may result in severe electrical shock or death.

On page 22.

Caution Statements

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

CAUTION
When the protection switch is deactivated, high VSWR is present.
Ensure actively transmitting components can withstand high levels of reflected power or have a means to stop or lock-out transmission if the interlock is inactive.

On page 2 and 11

CAUTION
Do not block air flow. The air intake vents on the side of the heat exchanger and the exhaust on top must not be obstructed.

On page 7.

CAUTION
Do not operate without the interlock or with the load protection switch disabled or disconnected.
Even momentary application of RF power while coolant is not circulating could cause immediate destruction of the load.

On pages 8 and 12.

> CAUTION
> Check the local electrical code for proper AC hookup prior to operation of the unit. Make sure the neutral or return hookup is only used for that purpose.

On page 8

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

On page 9 and 16.

> CAUTION
> Operation without sufficient coolant can damage the unit.

On pages 9, 12, and 16.

> **CAUTION**
> Ensure the RF coaxial line is adequately supported.
> Do not allow transmission line or external RF devices to hang from the load flange.
> Failure to support the transmission line/load connection may result in equipment damage.

On page 11

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

On page 17.

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 HACERIO.

WARTUNG

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

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

ENTRENTIEN

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 EFFETTUARRE 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:

8645-LP 8655-LP

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 inside the HEAT EXCHANGER, connected by two hoses. It contains the RESISTOR.

Heat Exchanger — The parts of the Moduload left when the LOAD is removed. It contains the pump, fans, coolant reservoir, and controls.

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.

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.

Table of Contents

Chapter 1 Introduction

Bird 8645-LP and 8655-LP Moduloads with Load Protection are self-cooling, nonradiating, low reflection terminations for high power RF lines. The Load Protection is provided by a line section RF Switch on the RF input to the load. When the load is off, the RF switch is off and it presents a high-VSWR/open circuit to the transmitter thus protecting the load. When the Moduload is powered on, the interlock circuit activates the RF switch and allows RF power into the load.

The Moduload has an interlock which triggers as a result of either high coolant temperature or low coolant flow. It will also be active for about 2 seconds after power up or reset to ensure proper operation of the cooling system before applying RF power.

The Moduloads have a VSWR of less than 1.1:1 and a frequency range from 1 kHz to 120 MHz. The 8645 will dissipate up to 25 kW (depending on frequency), the 8655 will dissipate up to 50 kW (depending on frequency).

Moduload Features

- Self-contained water-based cooling system.
- Time-delay interlock ensures steady coolant flow before RF power is applied.
- Load protection RF Switch, presents open RF path when the Moduload's interlock is active.
- Useable with CW, AM, FM, SSB, and TV modulation, and certain pulse types. Contact Bird for information on using Moduloads with pulsed signals.

Indicators

- Coolant Level Gauge
- Load protection RF Switch closed indicator

Resistor

Bird 8645 and 8655 Series Moduloads consist of a thin-film-on-ceramic resistor immersed in coolant. The coolant flows directly over the resistor instead of using an intermediate heat transfer system, reducing the load size to a minimum. After passing over the entire length of the resistor, the coolant is cooled in a forced air heat exchanger.

Coolant

The coolant should be distilled water or a mixture of distilled water and ethylene glycol. Impurities or chemical additives in the coolant, especially ones which are deposited as scale on the resistor, reduce the load's electrical and thermal performance. Increased thermal resistance may cause the load to overheat and fail.

Thermal Expansion

When the coolant is heated, thermal expansion causes an increase in the internal pressure. The vent plug relieves this pressure while protecting the coolant from dirt or other contaminants.

Thermal Interlock

The Moduload is equipped with a normally closed thermoswitch which opens when the coolant temperature exceeds 79 °C (174 °F), opening the interlock.

Flow Interlock

Dissipation of the heat generated by RF power is critically dependent on coolant flow, regardless of coolant temperature. When coolant flow drops below the factory set limit, the low flow switch opens causing immediate transmitter shutdown. The flow switch is a “normally open” type, and is closed during normal operation.

After 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, preventing resistor damage or burnout.

Load Protection RF Switch

CAUTION

When the protection switch is deactivated, high VSWR is present.
Ensure actively transmitting components can withstand high levels of reflected power or have a means to stop or lock-out transmission if the interlock is inactive.

The Load Protection RF switch disconnects RF passing through the switch should the other load interlocks be tripped. The Load Protection Switch contains a high voltage relay, which is used to open or close the flow of RF through the Switch’s line section.

8645 Series Moduload-LP

- Operational Frequency range: 1 kHz to 120 kHz
- Max Power dissipation:
  - 25 kW at 1 kHz
  - 16 kW at 120 MHz

Figure 1 8645 Series Moduload Outline Drawing

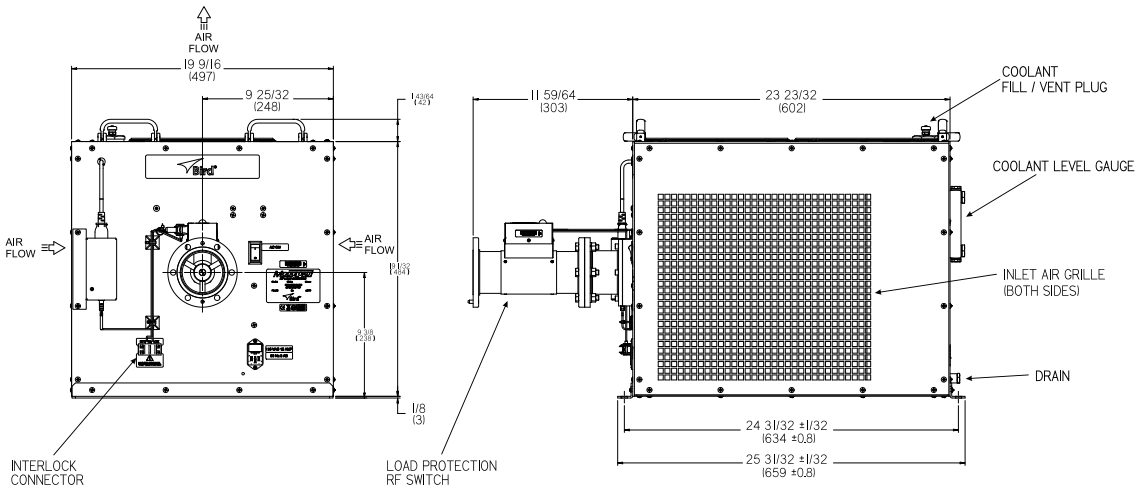
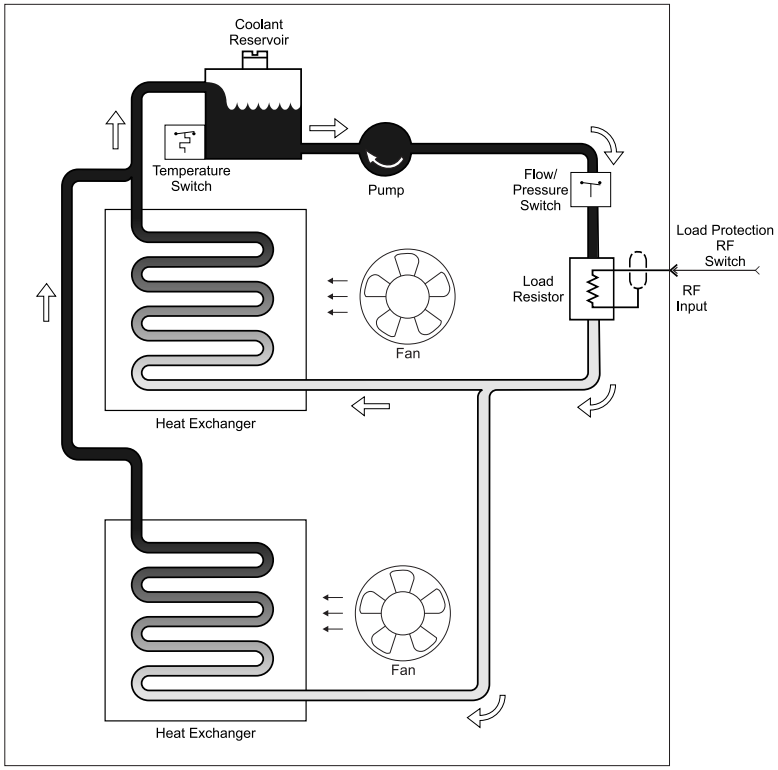


Figure 2 8645 Series Moduload System Diagram



8655 Series Moduload-LP

- Operational Frequency range: 1 kHz to 120 kHz
- Max Power dissipation:
  - 50 kW at 1 kHz
  - 20 kW at 60 MHz
  - 16 kW at 120 MHz

Figure 3 8655 Series Moduload Outline Drawing

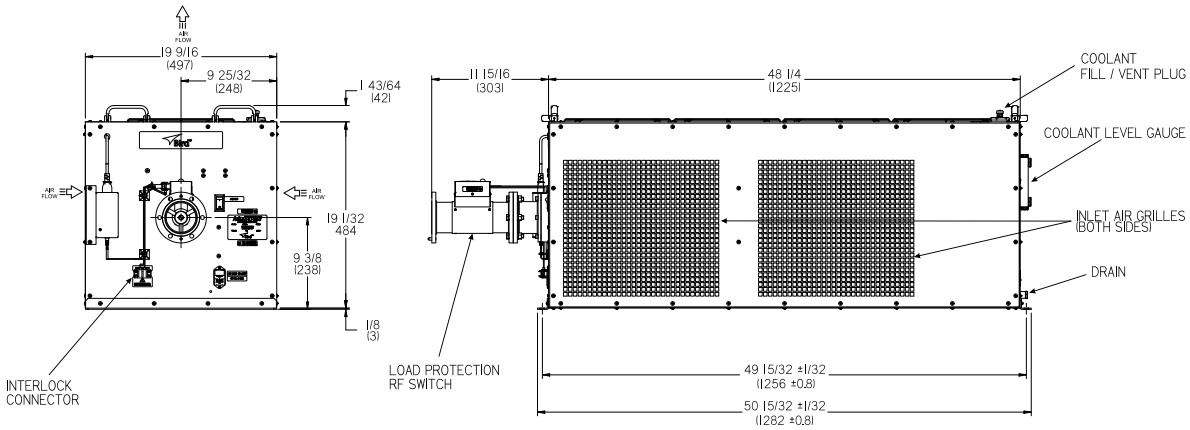
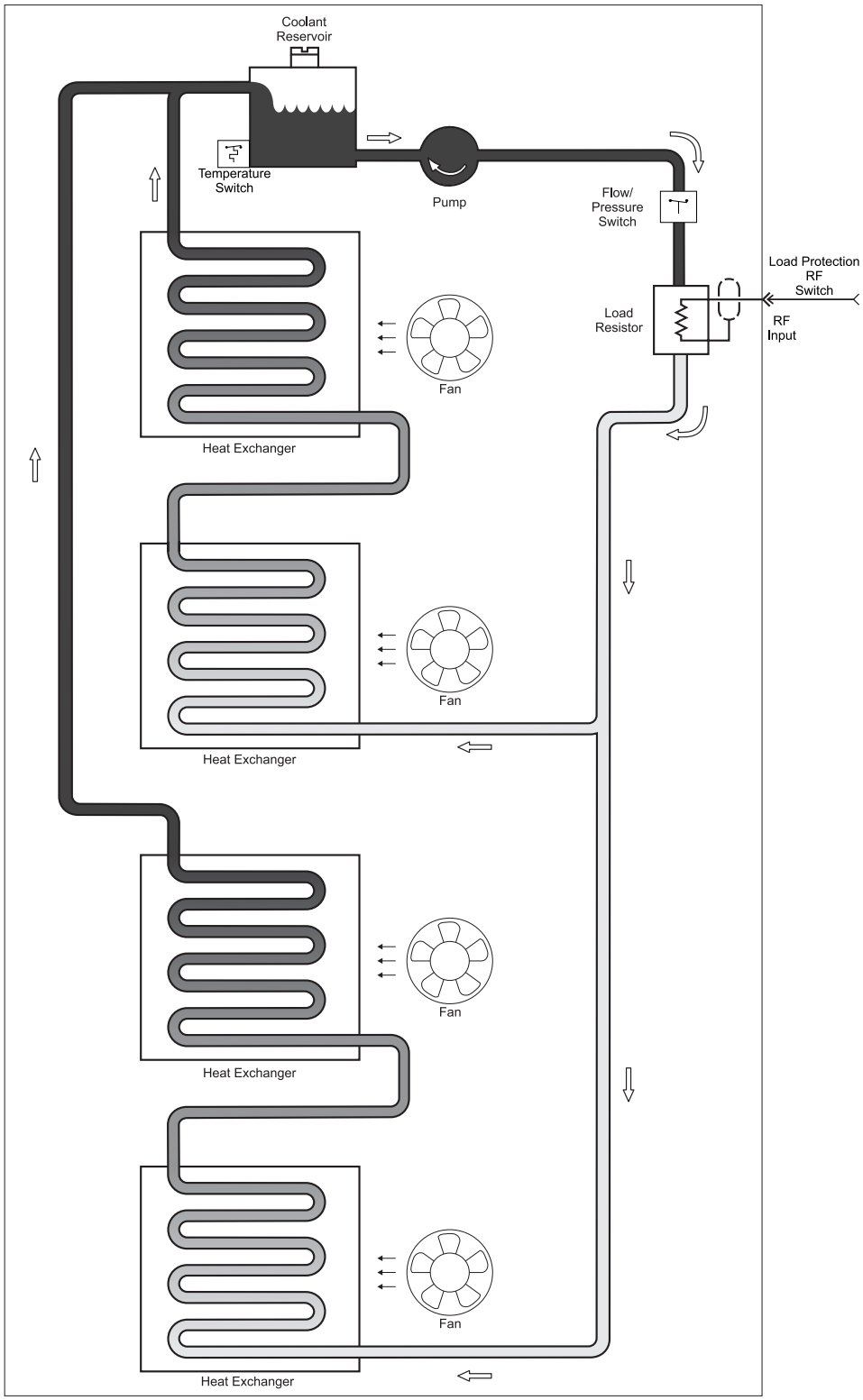


Figure 4 8655 Series Moduload System Diagram



Chapter 2 Installation

This chapter provides information on site requirements, unpacking, inspection, and preparing the Bird 8640 Moduload for use.

Unpacking and Inspection

1. Carefully inspect shipping container for signs of damage.
   - If the shipping container is damaged, do not unpack the unit. Immediately notify the shipping carrier and Bird Technologies.
   - If the shipping container is not damaged, unpack the unit. Save shipping materials for repackaging.
2. Inspect unit for visual signs of damage.

   Note: *If there is damage, immediately notify the shipping carrier and Bird Technologies.*

Items Supplied

- Moduload
- Instruction Manual
- Power Meter Rack-Mount Kit

Items Required but not Supplied

- No. 22 AWG wire, with ring terminals, for interlock connection
- RF Coupling Kit
- Distilled Water

Optional Items Available

- Dolly (Bird P/N 6771-011) for moving the load
- Ethylene Glycol, Industrial Grade, 1 Gallon - available from Bird

Placement

WARNING
HEAVY. Do not lift this unit alone.

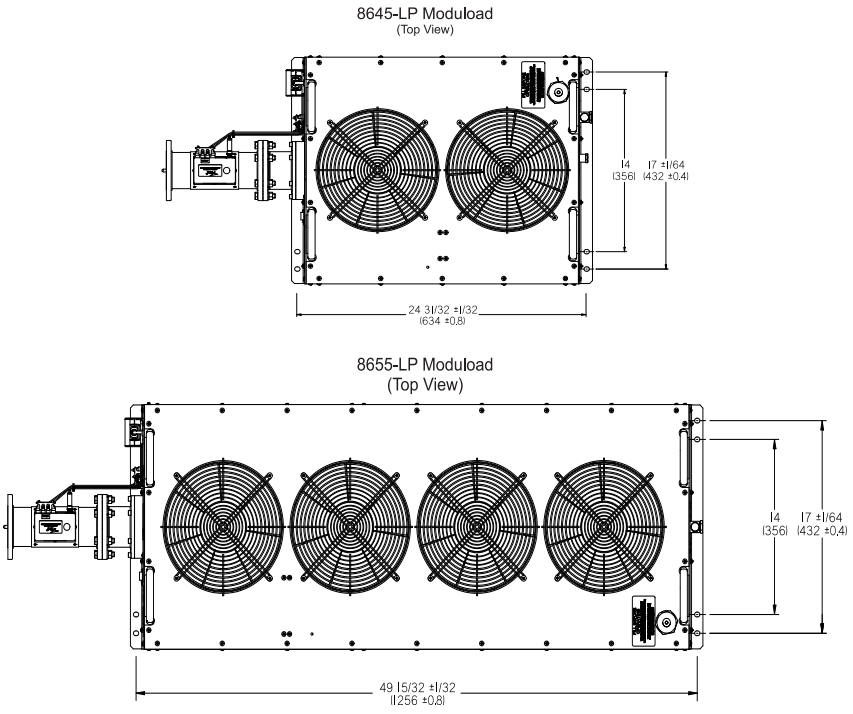
CAUTION
Do not block air flow. The air intake vents on the side of the heat exchanger and the exhaust on top must not be obstructed.

- Do not use outdoors or in areas of condensing humidity.
- Surrounding air must be free of contaminants or particles that could be drawn into the air intakes.
- The heat exchanger must be operated in a horizontal position.
- AC power is required.
- Allow a minimum of one foot clearance along the sides and three feet over the top to allow unobstructed air intake and exhaust.
- In small rooms or restricted areas, outside venting is recommended. Ductwork must not have sharp bends that would restrict air flow or create back pressure.

Mounting

The Moduload is equipped for either portable use or fixed installation. There are mounting slots located on the front and rear mounting brackets. Use screws with a $\frac{1}{4}$ inch (6.4 mm) maximum diameter. The brackets may be removed by removing the screws holding them to the Moduload.

Figure 5 Mounting Hole Locations



DC Resistance

Before first using the load, get a resistance baseline for future maintenance. Refer to "RF Assembly Resistance Test" on page 15 for instructions.

Power Meter Rack

If the Moduload will be used with a power meter, install the meter rack to provide a convenient place to keep the meter. Use the supplied #6-32 x $\frac{1}{4}$ screws to assemble the rack. To install the rack, remove two screws from the Moduload where the rack will be mounted, then screw it into place with the supplied #8-32 x $\frac{3}{8}$ screws.

> WARNING
> Disconnect the unit from all power sources before servicing.
> The unit may be energized from multiple sources.
> The potential for electric shock exists.

> WARNING
> Improper wiring could result in electric shock and death.

Interlock Connection

> CAUTION
> Do not operate without the interlock or with the load protection switch disabled or disconnected.
> Even momentary application of RF power while coolant is not circulating could cause immediate destruction of the load.

- Use number 22 AWG (or heavier) wire for interlock connection. Attach solderless ring terminals to the wire for ease of installation.
- Connect the interlock wires to the interlock terminal strip as required for the transmitter.

Note: *Interlock contact resistance could be as high as 10 ohms for circuits drawing less than 250 mA.*

AC Mains Connection

> WARNING
> Connect the power cord to the Moduload
> BEFORE connecting to AC mains.

> CAUTION
> Check the local electrical code for proper AC hookup prior to operation of the unit.
> Make sure the neutral or return hookup is only used for that purpose.

The AC power supply required for this unit is 115/230 V, depending on the model, @ 50/60 Hz, 1ϕ. The unit is equipped with an IEC 320 “cold” (70 °C) AC inlet.

Coolant

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 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.

Distilled water is the primary coolant for the Bird 8645-LP/8655-LP units. Ethylene glycol should be added to prevent bacterial growth and freezing; 10% to 35% ethylene glycol is recommended. Using at least 10% will prevent bacterial growth and at least 35% will protect against freezing to – 20°C.

Note: *When using both ethylene glycol and distilled water, add the water first, then the ethylene glycol, to ensure proper mixing.*

Figure 6 on page 10 shows the coolant's freezing point for a given percentage of ethylene glycol in the mix. 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)

Adding Coolant

The coolant capacity of each Moduload model is shown below:

Coolant Capacities

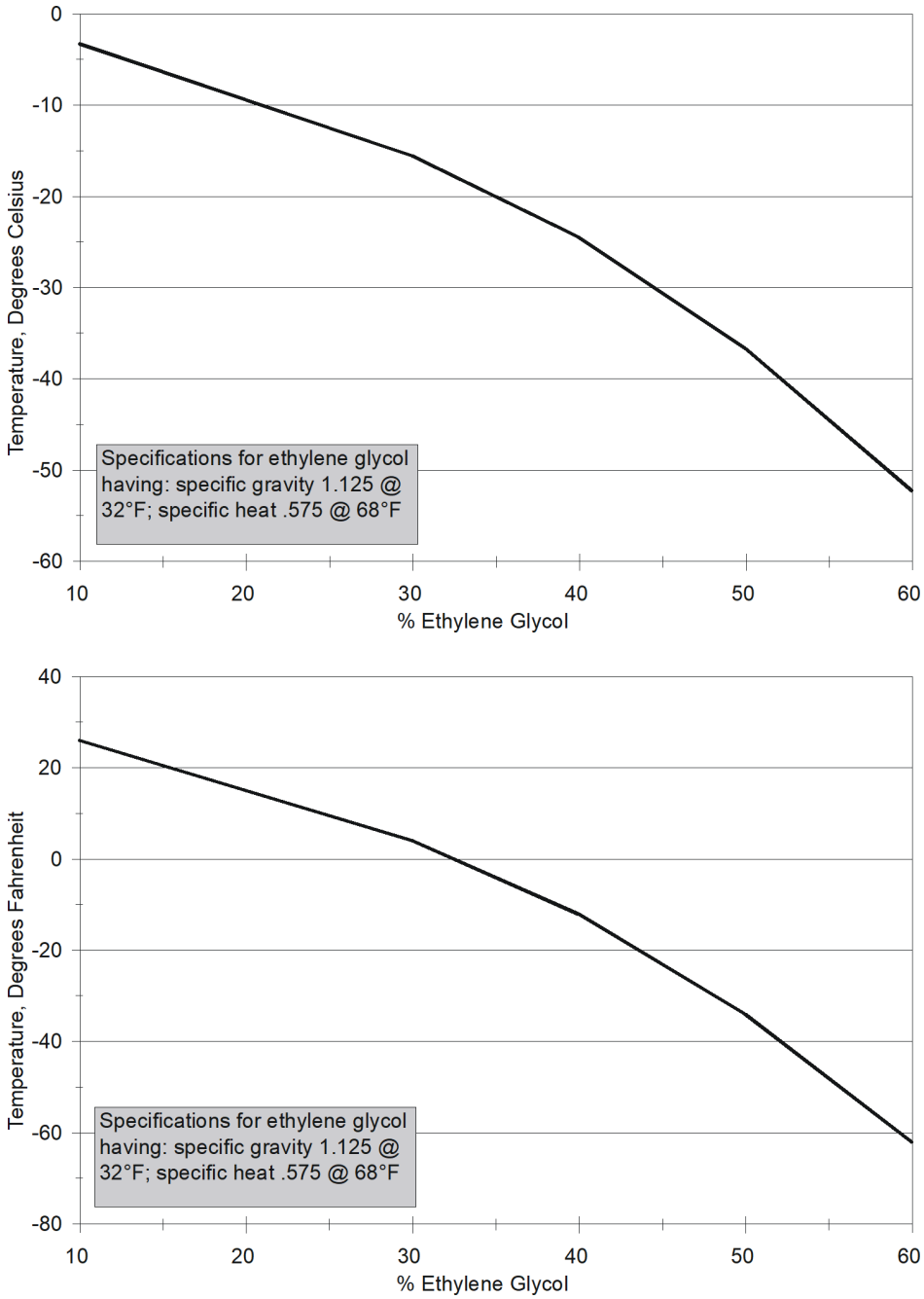
8645-LP	9 quarts (8.5 liters)
8655-LP	17 quarts (16.1 liters)

To fill the coolant reservoir, follow these steps:

CAUTION
Operation without sufficient coolant can damage the unit.

1. Ensure that the drain plug is in place.
2. Remove the filler cap on top of the heat exchanger.
3. Add coolant:
   - 8645-LP - about 3 quarts (2.9 L)
   - 8655-LP - about 6 quarts (5.7 liters)
4. Turn the unit on for a few seconds to draw coolant into the system.
5. Repeat steps 3 and 4 twice more, until the coolant remains steady at or just below the high mark on the level gauge.
6. Replace the filler cap.
7. Turn the unit on and run it for five minutes to remove any air trapped in the system.

Figure 6 Freezing Point of Ethylene Glycol / Distilled Water Mixture



Connecting RF Power

After installing the Moduload, the RF transmission line can be attached using standard coaxial line coupling kits.

WARNING

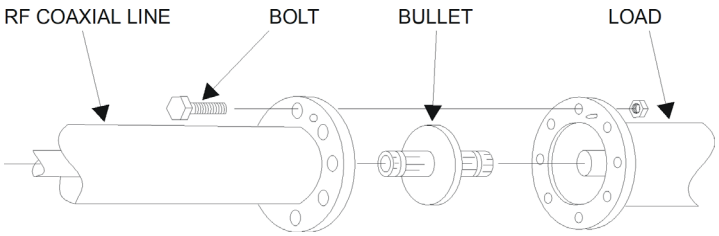
Never attempt to connect or disconnect RF equipment from the transmission line while RF power is being applied.
Leaking RF energy is a potential health hazard.

CAUTION

When the protection switch is deactivated, high VSWR is present.
Ensure actively transmitting components can withstand high levels of reflected power or have a means to stop or lock-out transmission if the interlock is inactive.

Swivel Flanged Coupling: To couple the swivel flange with a flanged RF transmission line, use an appropriate coupling kit. Refer to Figure 7 while following the instructions below:

Figure 7 Swivel Flanged Coupling



1. Insert the center bullet and push it in until it is fully seated.
2. Connect the coaxial input in a straight line and push carefully on the center conductor to close.

   Note: *The swivel flange on the load makes connection independent of the orientation of the fixed flange on the coaxial input outer conductor.*
3. Insert the bolt sets and tighten evenly all around to transmission line manufacturer's recommended torque. Use all of the bolts.

CAUTION

Ensure the RF coaxial line is adequately supported.
Do not allow transmission line or external RF devices to hang from the load flange.
Failure to support the transmission line/load connection may result in equipment damage.

4. The transmission line flange when connected to the Load Protection Switch/ModuLoad must be supported to avoid deformation of the Moduload's front panel and possible equipment damage.

CAUTION
Operation without sufficient coolant can damage the unit.

CAUTION
Do not operate without the interlock or with the load protection switch disabled or disconnected.
Even momentary application of RF power while coolant is not circulating could cause immediate destruction of the load.

Normal Operation

1. Check that the coolant level. See Figure 8
   a. Add coolant, if level is below **Min.** mark.
2. Turn on the Moduload using the AC Power Switch. See Figure 9.
3. Check that the fans are running properly.
   a. Air should be blowing out of all the grates along the top of the Moduload.
4. Wait about 2 seconds for proper coolant flow and for the interlock to close.
5. Verify the Load Protection Switch closed indicator is illuminated (green). See Figure 9.
6. Apply RF power.

Figure 8 Coolant Sight Gauge

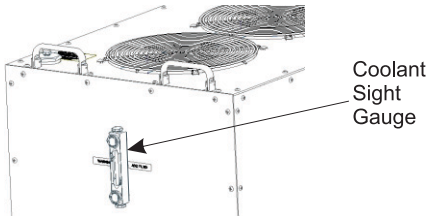
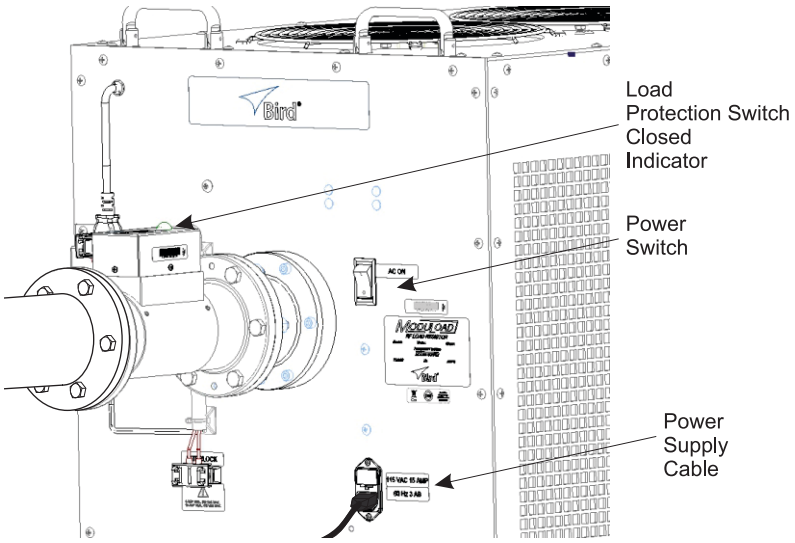


Figure 9 Power On Controls/Indicators



Shutdown

1. Turn off RF power at the source.
2. Wait five minutes for the system to cool to room temperature.
3. Turn off the Moduload using the AC Power Switch.

Emergency Shutdown

1. Turn off RF power at the source.
2. Turn off the Moduload using the AC Power Switch.

> **Note:** *If the interlock is properly connected, RF power will be automatically turned off if a fault occurs in the Moduload.*

WARNING
Disconnect the unit from all power sources before servicing.
The unit may be energized from multiple sources.
The potential for electric shock exists.

Troubleshooting

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

PROBLEM	POSSIBLE CAUSE	CORRECTION
Heat exchanger not operating.	No AC power.	Connected the unit to AC mains.
	Unit turned off.	Set the line switch to ON.
	Fuse burnout.	Replace fuse after correcting the burnout cause. See "Fuse Replacement" on page 19.
Coolant leaking.	Loose connections.	Tighten drain plug and all connections.
	Worn or cracked hose.	Replace defective hose.
Interlock opening repeatedly.	Insufficient coolant flow.	Check coolant level. Add coolant if necessary. See "Changing Coolant" on page 17.
	Defective flow switch.	Check flow switch. See "Replace the Pressure Switch" on page 21.
	RF power too high.	Lower RF power.
	Ambient temperature too high.	Lower ambient temperature.
	Air intakes or exhaust are blocked.	Check that clearances are at least 1 foot on the sides and 3 feet on top.
		Clean panels. See "Cleaning" on page 15.
Load Protection Switch deactivated.	Interlock open.	Correct cause, see Interlock opening repeatedly.
	No power.	Check load protection switch power supply.
	Loose wiring connections.	Check wiring between Load Protection Switch and Moduload Interlock Connector.
Excessive reflected power.	Load Protection Switch deactivated.	Check Interlock, if interlock is open determine cause, see interlock opening repeatedly. If interlock is closed check load protection switch power supply and interlock wiring, see Load Protection Switch deactivated.
	DC resistance of the load has changed.	Check DC resistance. See "RF Assembly Resistance Test" on page 15.

Maintenance

WARNING
Disconnect the unit from all power sources before servicing.
The unit may be energized from multiple sources.
The potential for electric shock exists.

Cleaning

The outside surface of the unit should be wiped free of dust and dirt when necessary. Clean the RF connector, both metallic and insulating surfaces, with a dry, non-residue forming solvent.

If dust has collected on the radiator coils, remove the top panel and vacuum the coils. To remove the panel:

1. Remove the screws around the edge of the top panel.
2. Lift the top panel to access the fan power connector then disconnect the fan cable.
3. Remove the top panel.

Inspecting

Routinely check the load's center and outer conductors for visible damage or excessive wear. The coolant level should be checked once a week, more often if the Moduload is used continuously or under high ambient temperatures. The coolant level should be above the min. mark on the gauge even when the unit is on. To add coolant, see "Changing Coolant" on page 17.

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 ± 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

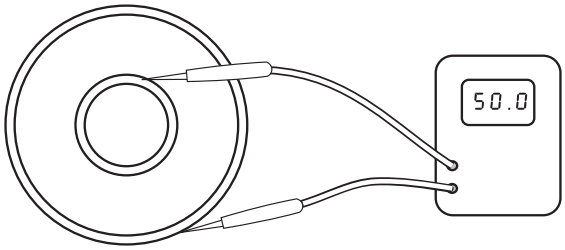
WARNING

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. Turn on Moduload using AC Power Switch.
    a. Verify fans are running.
    b. Verify Load Protection Switch closed indicator is illuminated (green).
4. Connect the multimeter test leads across the center and outer conductor of the load resistor. See Figure 10.
5. 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



Coolant

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.

CAUTION

Operation without sufficient coolant can damage the unit.

Changing Coolant

Note: *Follow these instructions to change the coolant.*

- To just add coolant, go to step 5.
- To just drain the coolant, follow steps 1 – 4.

Drain Coolant

1. Get a clean container to hold the old coolant, container capacity should exceed Moduload's coolant capacity.
    - 8645-LP contains approximately 9 quarts (8.5 liters)
    - 8655-LP contains approximately 17 quarts (16.1 liters)
2. Remove the filler cap on top of the heat exchanger.

    Note: *This will allow the coolant to drain faster.*
3. Unscrew and remove the drain plug on the rear of the load. Drain the coolant into the container.

    Note: *If the coolant has no contaminants it may be reused.*
4. Replace the drain plug and screw it tightly into place.

Add Coolant

5. Remove the filler cap on top of the heat exchanger.
6. Add coolant:
    - 8645-LP - about 3 quarts (2.9 L)
    - 8655-LP - about 6 quarts (5.7 liters)
7. Turn the unit on for a few seconds to draw coolant into the system.
8. Repeat steps 6 and 7 twice more, until the coolant remains steady at or just below the high mark on the level gauge.
9. Replace the filler cap.
10. Turn the unit on and run it for five minutes to remove any air trapped in the system.

Flushing the Coolant

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.

Note: If the unit is to remain fully or partially drained for two weeks or more, see "Preparation for Storage or Shipment" on page 27.

WARNING

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

CAUTION

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

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. See "Drain Coolant" on page 17.
2. Fill the unit with fresh, clean, distilled water. See "Add Coolant" on page 17.
3. Run the load with coolant but without RF power applied for a period of five minutes.
4. Drain and discard the water. See"Drain Coolant" on page 17.
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, see "Coolant" on page 9.

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. Drain the circulating system as completely as possible. See "Drain Coolant" on page 17.
2. 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 9.

Repair

> WARNING
> Disconnect the unit from all power sources before servicing.
> The unit may be energized from multiple sources.
> The potential for electric shock exists.

Fuse Replacement

Note: *The cause of the fuse failure should be corrected prior to returning the Moduload to service.*

1. Disconnect AC power line.
2. Use a flat blade screwdriver to lift the tab securing the fuse drawer, above the AC mains connector.
3. Remove the defective fuse.
4. Replace with the same type and rating fuse.

Moduload Supply Voltage	Fuse Value	Fuse Quantity
230 VAC	8 amp	2
115 VAC	15 amp	1

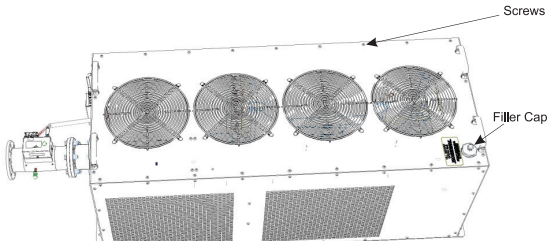
5. Replace the fuse drawer.

Moduload Top Panel Assembly Removal

Removal

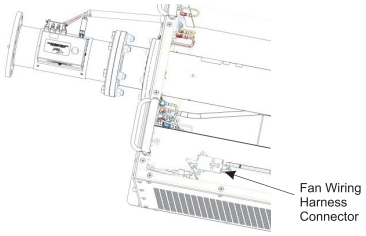
1. Remove screws securing the top panel to the Moduload. See Figure 11.
    a. 8645-LP - remove 18 screws.
    b. 8655-LP - remove 26 screws.
2. Remove the filler cap.

Figure 11 Moduload Top View



3. Lift top assembly enough to access the fan wire harness connector.
4. Disconnect fan wire harness connector.

Figure 12 Moduload Wiring Harness



Installation

5. Position the top panel over the moduload.
6. Connect the fan wire harness cable.
7. Install the screws to secure the top.
8. Install coolant tank cap.

Replacing the Interlock Relay

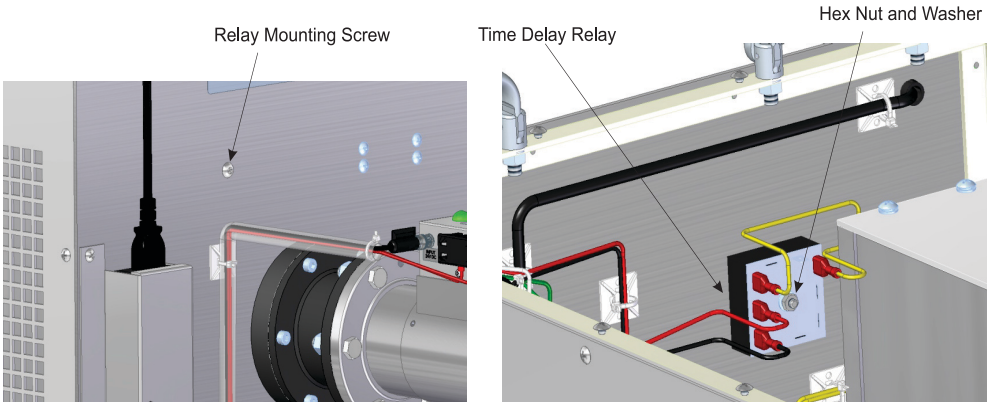
The interlock relay cannot be repaired in the field. To replace it, follow the instructions below for your model.

WARNING
Disconnect the unit from all power sources before servicing. The unit may be energized from multiple sources. The potential for electric shock exists.

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

1. Remove the top panel. See "Moduload Top Panel Assembly Removal" on page 19.
2. Record the color of each wire and the relay terminal to which it connects.
3. Remove the wires from the relay.
4. Loosen and remove the nut and washers that secure the relay to the panel.
5. Remove the relay from its mounting screw.
6. Install the replacement relay on the mounting screw.
7. Install washer and nut to secure relay in place.
8. Connect wires to the relay.
9. Install the top panel.

Figure 13 Interlock Time Delay Relay



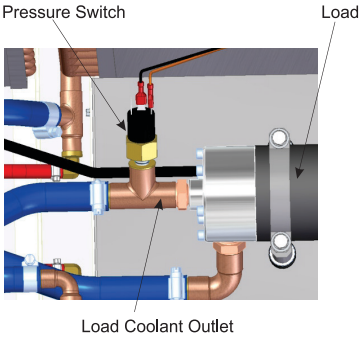
Replace the Pressure Switch

Removal

1. Remove the top panel. See "Moduload Top Panel Assembly Removal" on page 19.
2. Drain the coolant. See "Drain Coolant" on page 17.
3. Record the color of each wire and the terminal to which it connects.
4. Disconnect the wires from the pressure switch terminals.
5. Unscrew the switch from the output plumbing assembly of the load.

   Note: *Use a ¾ inch wrench on the hex portion of the pressure switch.*

Figure 14 Pressure Switch



Installation

6. Apply a thin coating of Teflon based thread sealant to the male threads of the pressure switch.
7. Thread the switch into the output plumbing assembly.
8. Tighten the pressure switch using a ¾ inch wrench.
9. Connect wires to the Pressure Switch terminals.
10. Fill the system with coolant, see "Add Coolant" on page 17.
11. Check for leaks by running the unit with the top panel removed.
12. Ensure the interlock circuit is working by checking the resistance between the two terminals of the interlock terminal strip on the front panel.

    Note: *Two seconds after the unit is turned on, the relay contact should close providing a low resistance. When the unit is turned off, the resistance should go high.*

13. Remove power from the unit.
14. Install the top panel. See "Moduload Top Panel Assembly Removal" on page 19.

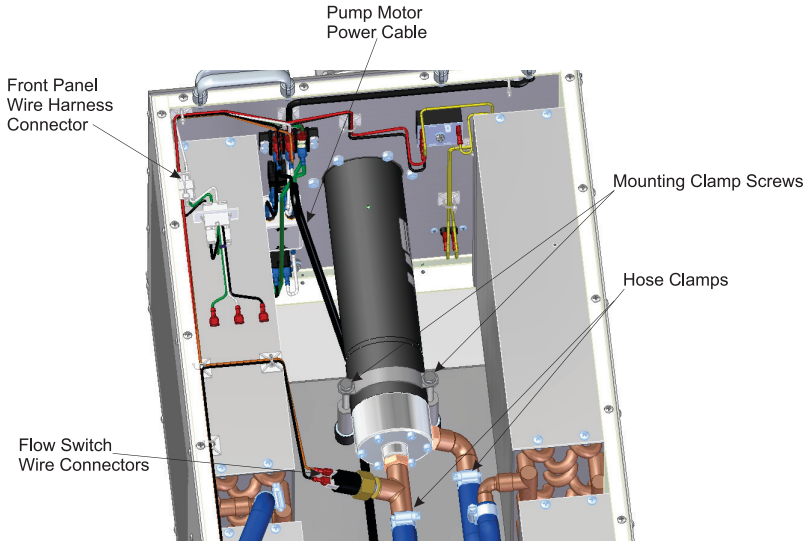
Removing the Load

WARNING
Radiator fins are very sharp. Avoid contact with the radiator fins. Failure to comply may result in severe cuts and bleeding.

WARNING
Dangerous voltages are present.
Disconnect the unit from all power line and RF power sources before servicing. Do not disconnect the unit from the RF transmission line while RF power is applied.
Failure to comply may result in severe electrical shock or death.

1. Disconnect the RF line.
2. Drain the coolant (See "Drain Coolant" on page 17).
3. Remove the top panel. See "Moduload Top Panel Assembly Removal" on page 19.
4. Loosen the hose clamps on both water hose connections to the load.
5. Remove the screws that secure the load mounting clamp. Remove the top half of the mounting clamp.
6. Disconnect the wires from the pressure switch.
7. Disconnect the front panel wire Harness at the connector on top of the radiator.

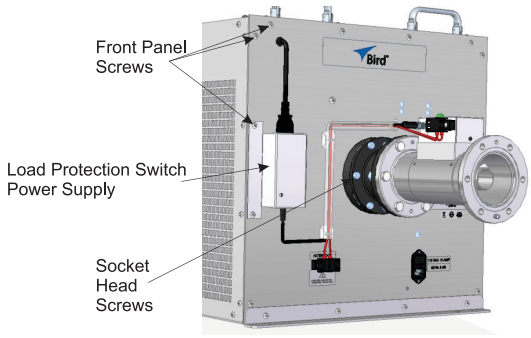
Figure 15 Removing the Load



8. Record the wire colors and locations then disconnect the pump motor wires from the front panel terminal block (TB 1) (Figure 15).
9. Disconnect the cables from the Load Protection Switch Power Supply.
10. Remove the Load Protection Switch Power Supply, and set aside.
11. Remove the 16 screws that secure the front panel to the unit then tilt the top of the panel away from the unit and remove the two water hoses from the load water pipes. See Figure 16.
12. Remove the front panel with the load attached.
13. Remove the nuts and lock washers from the socket head screws that secure the load to the panel.
14. Remove the socket head cap screws that secure the water chamber to the load then remove the water chamber.

15. Inspect the water chamber to be sure it is in good condition and that the inner o-ring seal is good. If appropriate, order replacement parts.

Figure 16 Front Panel



Removing the Pump

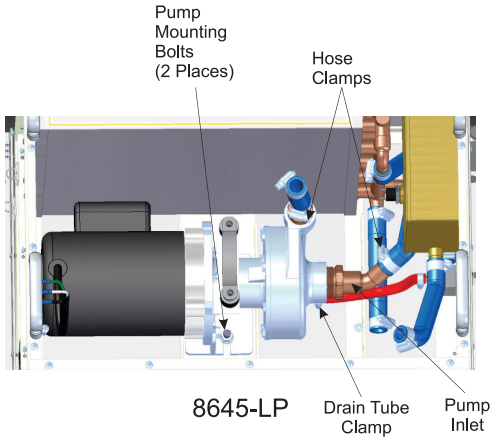
> WARNING
> Disconnect the unit from all power sources before servicing. The unit may be energized from multiple sources. The potential for electric shock exists.

1. Drain the coolant (See "Drain Coolant" on page 17).

8645-LP Only

a. Remove the load (See "Removing the Load" on page 22).
b. Loosen the hose clamps on the input and output hoses to the pump.
c. Remove the hoses.
d. Loosen the hose clamp on the drain tube at the base of the pump.
e. Remove the drain tube.
f. Remove two hex nuts, lock washers, and flat washers, securing the base of the pump to the Moduload.
g. Remove the pump, carefully, from the unit.
h. Note the position and direction of the fittings, then twist them off counterclockwise.

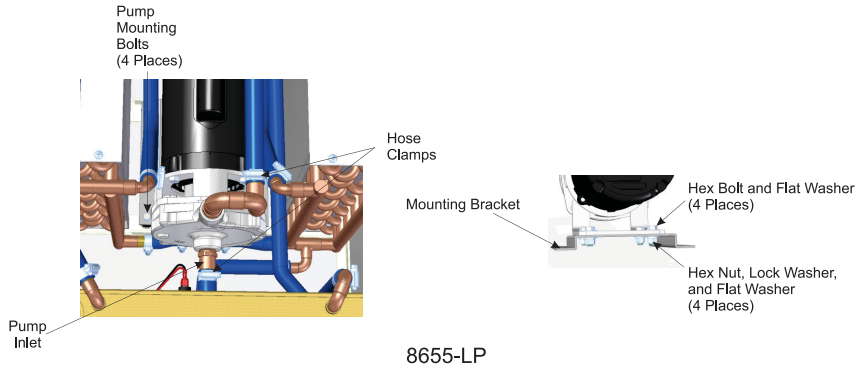
Figure 17 8645-LP Pump Removal



8655-LP Only

a. Disconnect the pump wire leads from the terminal block on the inside of the front panel.
b. Loosen the hose clamps on the input and output hoses to the pump.
c. Remove the hoses.
d. Remove four hex nuts and lock washers securing the pump's mounting bracket to the Moduload.
e. Remove the pump, carefully, from the unit.
f. Remove the bolts securing the base of the pump to the pump's mounting bracket.
g. Note the position and direction of the fittings, then twist them off counterclockwise.

Figure 18 8655-LP Pump Removal



2. To Install the pump, reverse the above steps.

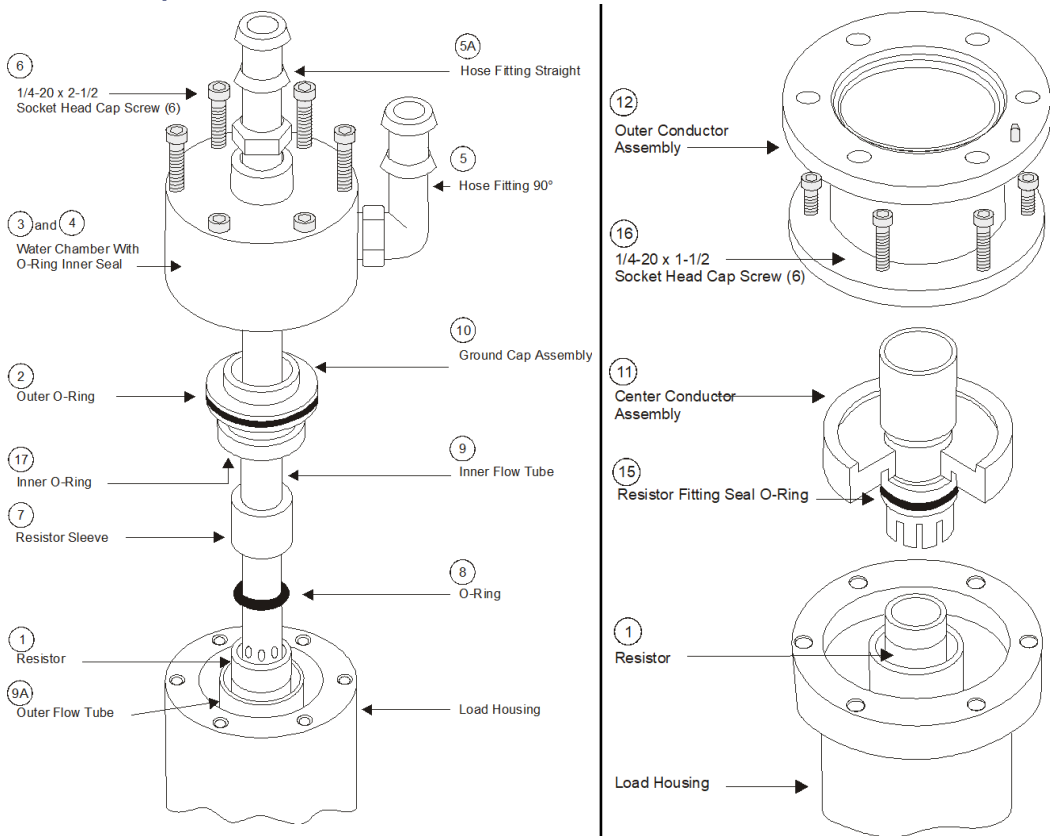
Note: *When replacing the threaded fittings, carefully coat the external threads, ONLY, with a pipe sealing compound. Coating only the external threads reduces the chances of contaminating the coolant.*

Servicing the Resistor

The load is designed to be quickly and easily repaired in the field. If a significant change in the DC resistance is noted or if the resistor should fail, inexpensive replacement resistors are available.

> WARNING
> Disconnect the unit from all power sources before servicing.
> The unit may be energized from multiple sources.
> The potential for electric shock exists.

Figure 19 Load, Exploded View



Removing the Resistor

Note: *Numbers in brackets [ ] refer to the labeled parts in* Figure 19.

1. Disconnect the load (see "Removing the Load" on page 22).
2. Turn the load on end with the hose fitting up.
3. Use a $^{3}/_{16}$ hex socket wrench to back the cap screws [6] approximately $^{1}/_{2}$ inch.
4. Pull the water chamber assembly out. It may be necessary to rock the chamber gently while pulling.

Note: *If the resistor [1] is intact it may be pulled straight out of the load housing and is ready for replacement. The outer flow tube is captive and will not come out of the housing at this stage.*

The ground cap assembly [10] and the inner flow tube [9] should come out with the water chamber assembly. To remove the ground cap assembly [10], hold the resistor sleeve [7] on the flow tube and pull out the assembly. This includes the cushioning O-Ring [8] which fits loosely below the stop sleeve; do not lose it.

The resistor sleeve [7] has a small escape hole at the side and an access counter bore leading to it. If the sleeve is removed, be sure this counterbore faces the O-Ring and the resistor [1] during reassembly. This is essential for internal water venting. The base of the inner flow tube has water outlet holes and a small shoulder. At reassembly, these must fit into mating recesses in the input fitting.

Inspecting the Resistor

Note: *Carefully check the resistor [1] for fractures.*

Note: *Even in the event of resistor failure the resistor substrate will usually remain intact.*

Check the inside of the load housing for damage to the internal parts.

- If no damage has been found proceed to ""Replacing the Resistor" on page 26".
- If the resistor is broken, other internal parts are damaged, or if the parts do not fit together properly, proceed to ""Removing a Fractured Resistor" on page 26".

Removing a Fractured Resistor

1. Turn the load on end with the RF input connector up to allow any loose pieces of the resistor to fall out of the housing.
2. Use a $^{3}/_{16}$ hex socket wrench to remove the cap screws [16].
3. Remove the outer conductor assembly [12].
4. Pull out the center conductor assembly [11].
5. Remove any remaining pieces of the resistor carefully.

   Note: *Normally the outer flow tube will remain with the load housing. If it comes out, return it after inspection and cleaning.*
6. Check the inside of the load housing for damage.
7. Remove the inner flow tube [9] and ground cap assembly [10].

   Note: *Check them for broken pieces.*
8. Under clear running water, thoroughly wash the inside of the conductor assemblies, load housing, and water chamber.
9. Replace the ground cap assembly and the inner flow tube.

Replacing the Resistor

1. Insert the new resistor [1] into the resistor fitting of the center conductor assembly [15] to test its tightness.

   Note: *The resistor should be snug but should not have to be forced into the fitting. If the resistor is too loose, press the fitting fingers together slightly and try the resistor again. Continue closing the ends of the resistor fitting until a snug fit is obtained.*
2. Bottom the resistor in the fitting.
3. Insert the resistor and the center conductor assembly into the load housing.
4. Replace the outer conductor assembly [12] and screw it into place.
5. Stand the load on its end with the RF connector down.
6. Replace the ground cap assembly onto the exposed end of the resistor. Make sure that it seats on the load housing.

   Note: *If the inner flow tube [9] is separated from the water chamber assembly [3], place it inside the resistor and lower until it reaches the resistor fitting. Gently twist the flow tube until it seats in the bottom of the resistor fitting.*
7. Check that the O-Ring [8] is on the inner flow tube next to the resistor and the resistor sleeve [7] is right behind it.

8. Ensure the counterbore faces the O-Ring and the resistor.
9. Replace the water chamber [3], gently rocking and twisting the chamber to achieve a flat seat on the outer housing.

   Note: *If the water chamber does not fit properly make sure that the inner flow tube is properly placed.*
10. Tighten the water chamber screws [6].
11. Check the DC resistance between the inner and outer conductors; it should be about 50 ohms.

    Note: *Record this measurement as the new baseline reading.*
12. Install the load on the heat exchanger.
13. Connect the hoses and fill with coolant.
14. Run the pump for five minutes and check for leaks before applying RF power.

Replacing the Conductor

1. Use a $^{3}/_{16}$ Allen wrench to remove the cap screws [16] from the RF connector.
2. Remove the outer conductor assembly [12].

   Note: *If only the outer conductor needs replaced, install it now and screw it into place.*
3. Remove the center conductor assembly [11] by pulling it carefully out of the load housing.
4. Ensure the resistor [1] and inner flow tube [9] do not come out with the center conductor.
5. Insert the new center conductor assembly into load housing.
6. Ensure the resistor fitting makes a snug fit with the resistor.
7. Replace the outer conductor and screw it into place.

Preparation for Storage or Shipment

Store the Bird 8640 in a cool, dry area. For pure water-cooled units, the ambient temperature must be within 5°C to 50°C (41°F to 122°F). For units with 35% ethylene glycol, the ambient temperature must be within –25°C to 45°C (–13°F to 113°F). Drain the coolant (see "Drain Coolant" on page 17) if the unit will be stored for more than 30 days.

To ship, pack the unit in its original shipping container. If this is not available, securely pack and seal it in a sturdy wooden box or equivalent, with sufficient padding to avoid shock damage.

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

8645-LP / 8655-LP Series Moduload

Frequency Range	1 kHz – 120 MHz
Power Rating **8645-LP** **8655-LP**	 25 kW continuous duty 25 kW @ 1kHz; 16 kW @ 120 MHz 50 kW continuous duty 50 kW @ 1kHz; 20kW @ 60 MHz; 16 kW @ 120 MHz
Mode	CW, AM, FM, SSB, TV and certain pulse types
Impedance	50 ohms nominal
VSWR	1.10 to 1.00 max
RF Connector	3-1/8 inch EIA Flanged
Interlock Rating	NO or NC Connections 5A @ 250 Vac 10A @ 125 Vac 48 Vdc
Cooling Method	Water dielectric and forced air convection
Coolant[1]	Distilled water or distilled water/ethylene glycol mixture
Coolant Capacity **8645-LP** **8655-LP**	 9 qts. (8.5 L) nominal 17 qts. (16 L) nominal
AC Power **–115-6** **–230-5** **–230–6**	 115 VAC @ 11 A, 60 Hz 230 VAC @ 5.5 A, 50 Hz 230 VAC @ 5.5 A, 60 Hz
Fuse Rating **115 Vac** **230 Vac**	 15 A, 3AB time delay 8 A, 5x20 mm Time-Delay
Ambient Temperature[2] **Water only** **35% Ethylene Glycol**	 +5 to +45[2] °C (41 to 113 °F) –20 to +35[2] °C (–4 to +95 °F)
Dimensions **8645-LP** **8655-LP**	(dimensions include Load Protection Switch) 35-5/64"L x 19-9/16”W x 19-1/4”H (891 x 495 x 489 mm) 60-3/16"L x 19-9/16"W x 19-1/32"H(1528 x 495 x 489 mm)
Weight, Nominal **8645-LP** **8655-LP**	 164 lb. (74 kg) 285 lb. (129 kg)

1 Below 5°C, ONLY use 35% E.G. and 65% Dist. H_2O mixture

2 Above 30°C (86 °F) with water only, or 35°C (95 °F) with a 35% ethylene glycol mixture, derate power to: 8645-LP, 20 kW max., 8645-LP, 40 kW max.

Replacement Parts

The parts lists in this section identify the components of the Bird Moduload. Exploded views are used to illustrate the component parts and indicate their relation to each other. Each part in the exploded view has an item number referencing the part list.

Load

Item No.	Description	Qty	Part No.
RF Load (Complete) 8645 8655		1	 8745-101-1 8775-101
1	Resistor	1	8755-027
2	Outer O-Ring	1	8410-009
3	Water Chamber	1	8755-014
4	Water Chamber Inner O-Ring	1	5-099
5	**Fitting**, 90°	1	8640A089
5A	**Fitting, Straight, consisting of:** Bushing Nipple	 1 1	8645A003
6	**Screw** ¼-20 x 2-½ inch	6	1121-2508-00
7	Resistor Sleeve	1	8755-026
8	Sleeve O-Ring	1	8110-059
9	Inner Flow Tube	1	8755-025
9A	Outer Flow Tube	1	8755-024
10	Resistor Ground Cap	1	8755-005
11	**Center Conductor Assembly**	1	8755-007
12	**Outer Conductor Assembly**	1	8755-004
15	Center Conductor O-Ring	1	5-1127
16	**Screw** ¼-20 x 1-½ inch	6	1121-1808-00
17	Inner O-Ring	1	5-567

Heat Exchanger

Description	Qty	Part No.
AC Cord 115 230	1	 5-1836 5-1837
Fan Assembly 115 230	8654-LP 2 8655-LP 4	 5A2770-1 5A2770-2
Pump 115, 60 Hz 230, 50 Hz 230, 60 Hz	1	 8640B505-1 8640B505-2 8640B505-4
Flow Switch Assy	1	8645C004
Interlock Relay 115 230	1	 5A2787-115 5A2787-230
Fuse 115 230	2	 5-1828-36 (15 A 3AB time delay) 5A2257-25 (8 amp 5x20 mm)
Coolant Gauge Kit	1	5-1200
Ethylene Glycol	1 Gal.	5-1134-3

Load Protection Switch

Description	Qty	Part No.
Load Protection Switch	1	8640A931-2

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.