



8320 SERIES
TENULINE® ATTENUATOR

OPERATION MANUAL

©COPYRIGHT 2017 BY BIRD TECHNOLOGIES, INC
INSTRUCTION BOOK PART NUMBER 920-8320S REV. B

TENULINE® IS A REGISTERED TRADEMARK
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 applied.

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

The vent plug must be installed at all times when the unit is in operation or cooling. Always check to ensure vent plug is installed prior to operation. Failure to do this could result in damage to the equipment and endanger the operator's safety.

See pages [6](#) and [8](#).

WARNING

Leaking RF energy is a potential health hazard.
Never attempt to connect or disconnect equipment from the transmission line while RF power is being applied.
Severe burns, electrical shock, or death can occur.

See pages [7](#), [9](#), and [10](#).

WARNING

Using the attenuator in the upper end of its power dissipation range will cause the housing to become hot!
Care should be exercised in touching them.

See page [8](#).

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

The Attenuator is designed to be operated in the horizontal position, with mounting brackets down. Operation in any other orientation will cause insufficient cooling of the unit leading to premature failure.

See page [5](#).

CAUTION

The input and output ends of these attenuators are clearly labeled. Do not couple an attenuator backwards to the direction of power flow. Destruction of the output resistor will result.

See pages [7](#) and [8](#).

CAUTION

Avoid putting direct pressure on the Input connector. The input connector may be inadvertently damaged causing inaccurate operation or premature failure.

See page [15](#).

CAUTION

Use care when removing or installing end cover to avoid damaging end cover seal or the o-ring seal on the RF output section.

See page [16](#).

CAUTION

Do not overfill the coolant tank with coolant. Room must be allowed for expansion of the heated coolant.

See page [19](#).

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 EFFETTUARRE ALCUNA RIPARAZIONE A MENO CHE QUALIFICATI A FARLA.

About This Manual

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

8321

8322

8323

8325

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.

Chapter Layout

Introduction — Provides general information about the 8320 series attenuators.

Theory of Operation — Describes in detail the construction of the 8320 series attenuators and how cooling is achieved.

Installation — Provides instructions on how to setup the 8320 series attenuators for worry free operation.

Operating Instructions — Details the steps required to safely operate the 8320 series attenuators.

Maintenance — Provides routine maintenance inspections and procedures, detailed troubleshooting should malfunctions occur, and step by step repair procedures.

Specifications — Gives detailed specifications for each 8320 series model, as well as a comprehensive list of available replacement parts and optional RF connectors.

TABLE OF CONTENTS

Safety Precautions	i
Safety Symbols	ii
Warning Statements	iii
Caution Statements	iv
Safety Statements	v
About This Manual	vii
Changes to this Manual	vii
Chapter Layout	vii
Chapter 1 Introduction	1
General Description	1
Operating Environment	1
RF Connectors	2
Chapter 2 Theory of Operation	3
Attenuator Construction	3
Cooling	3
Coolant Expansion	4
Heat Dissipation	4
Chapter 3 Installation	5
Unpacking and Inspection	5
Location	5
Mounting	6
Setup	6
Vent Plug Installation (Model 8325)	6
Installing in a 50 Ohm Line	7
Chapter 4 Operating Instructions	8
Normal Operation	8
Emergency Shutdown	9

Chapter 5 Maintenance	10
RF Assembly Resistance Test	10
DC Resistance Measurement	10
Preventive Maintenance	12
Periodic Inspection	12
Clean Outside Surfaces	12
Clean Connectors	12
Troubleshooting	13
Repair Procedures	14
Coolant Leakage Repair	14
Replace RF Connector	14
Replace Coolant Tank Output End Cover Seal	14
Replace Coolant Tank Input O-ring Seal	17
Replace RF Assembly	18
Coolant Level Inspection	18
Storage	19
Customer Service	20
Shipping	20
Chapter 6 Specifications	21
Specifications	21
Replacement Parts	22
Available QC Type Connectors	23
Limited Warranty	25

General Description

The Series 8320 Tenuline Attenuator are low reflection resistance networks for use in reducing RF power in 50 ohm transmission lines by known and controlled amounts. See ["Outline Drawing" on page 2](#).

Over the frequency range of DC to 500 MHz, the power output will be reduced by 30 dB (99.9 percent) \pm 0.5 dB. Up to 500 MHz, the input VSWR will not exceed 1.1 and the out put VSWR 1.15. These attenuators are useful for lowering a high input RF power to a level suitable for feeding into a scope, frequency counter or similar device.

They are self-contained instruments that require no external source of power or utility service.

All models are portable and have a convenient carrying handle nested among the cooling fins on the top side. If desired the attenuator may be permanently mounted, see ["Mounting" on page 6](#).

Operating Environment

The Tenuline Attenuators should be operated in a dust and vibration free environment.

They rely only on ambient air currents, these attenuators will safely absorb, and dissipate, up to their maximum rated input power. The radiators having cooling fins spaced evenly along their lengths to efficiently dissipate heat generated during operation.

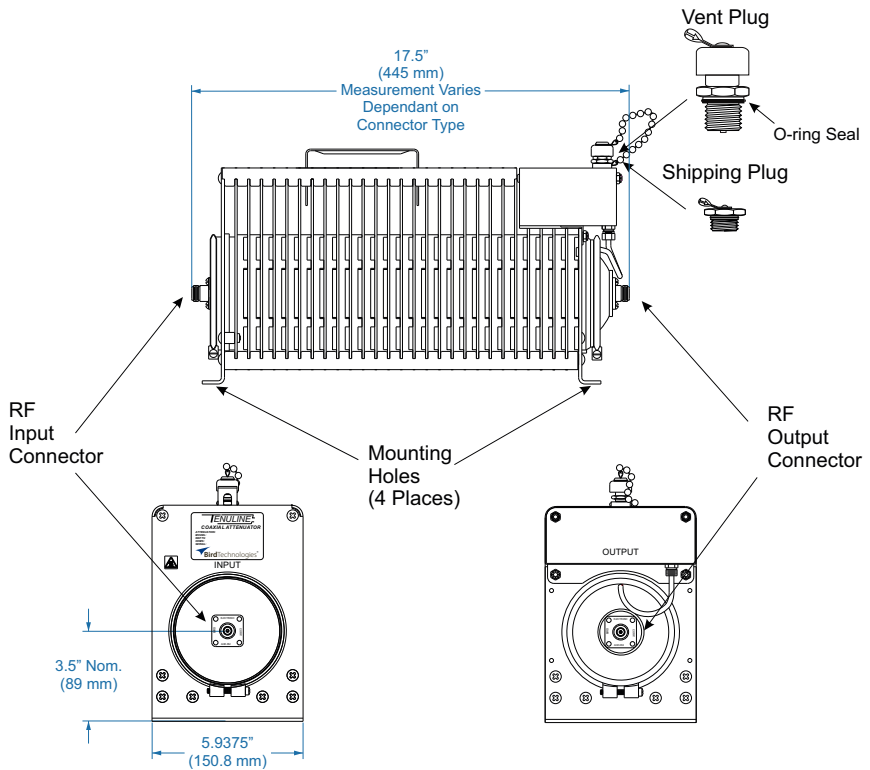
Allow at least 6 inches (150 mm) of clearance around the unit to allow sufficient convection air currents for adequate heat dissipation. The ambient temperature range should remain between -40°C and +45°C (-40°F and 113°F) for proper operation. See ["Specifications" on page 21](#) for the rated power, dimensions and weight of the attenuators.

RF Connectors

The Series 8320 Attenuators are equipped with a Bird Quick-Change (QC) connectors.

Female N type connectors are normally supplied for the input and output but may be conveniently and easily interchanged with other Bird QC connectors. See "[Available QC Type Connectors](#)" on [page 23](#) for a list of available connectors. See "[Replace RF Connector](#)" on [page 14](#) for replacement instructions.

Figure 1 Outline Drawing



Note: Model 8325 is shown in Figure 1.

The Series 8320 may be used for the isolation of power sources up to their maximum power rating and for low level monitoring. The low power value obtained at the output of the attenuator can easily be fed into an oscilloscope or terminated in a small RF load resistor.

Attenuator Construction

The Series 8320 Attenuators are symmetrical “T” pads, with the power distribution on the legs being different. The value of the resistance on each leg varies; therefore, according to the power it is to absorb. On the input resistance element, a proportionately larger resistor is of course required for its much greater power dissipation. A “T” configuration is used to provide equal input and output impedances for the 50 ohm transmission line attenuation.

The input resistor is joined to the “T” leg joint in an exponentially tapered housing to provide a linear reduction in surge impedance directly proportional to the distance along the resistor. The output resistor is enclosed in a housing designed to return the attenuator to the characteristic impedance of 50 ohms. This arrangement produces a uniform and practically reflection-less attenuation characteristic over the stated frequencies of the attenuator.

This system of film-on-ceramic cylindrical resistors immersed in a dielectric coolant constitutes the RF Assembly. The dielectric constant of the cooling fluid and the tapered input and output resistor housings provide the proper electrical characteristics for the coaxial line attenuation throughout the internal circuitry.

Cooling

The dielectric coolant is carefully chosen for its desirable dielectric properties, to which the diameters of the resistors and housings are matched, and for its high thermal stability characteristics.

The coolant used is 10C Transformer Oil, P/N 5-030.

- Model 8321 requires approximately 1 pint (0.47 liter)
- Model 8322, 0.7 gallons (2.65 liter)
- Model 8323, 0.35 gallons (1.3 liter)
- Model 8325, 0.9 gallons (3.4 liter).

Coolant Expansion

Models 8321, 8322 and 8323 allow for expansion of the coolant by using under-filled radiator tanks and a derating of their load carrying capacities.

Model 8325 includes an expansion tank and a vent plug located on the output end at the top. When power is applied to the attenuator, the coolant expands into the expansion tank, as the air in the expansion tank is compressed it is allowed to escape through the vent plug.

Heat Dissipation

Heat Dissipation is accomplished by convection, the cooling fluid carries the heat generated in the resistor elements to the walls of the coolant housing. This housing is encased in a set of radiating fins which are attached to its outer surface. These radiating surfaces dissipate the heat of the coolant into the surrounding air.

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.*

Location

CAUTION

The Attenuator is designed to be operated in the horizontal position, with mounting brackets down.
Operation in any other orientation will cause insufficient cooling of the unit leading to premature failure.

The Series 8320 TENUline® Attenuators should be located to allow operation in the horizontal position only, with the handle up and mounting brackets down.

Allow at least six inches (150 mm) of clearance around the unit in an area with freely circulating ambient air. Unimpeded airflow of convection air currents is required for adequate heat dissipation.

Position the attenuator to permit the shortest possible cable lengths between the unit and the transmitting equipment.

The attenuator is not intended or recommended for outdoor use where it will be unprotected and exposed to the elements.

Mounting

The attenuator is designed for either portable operation or fixed installation, that is, it may operated with or without being secured to a bench or other horizontal surface.

Model 8321 is equipped with rubber bumper feet which can be removed for permanent mounting. The holes are tapped for 8-32 screws.

For Models 8322, 8323 and 8325, the front and rear fins are made of heavier gauge material bent outward 90° to form mounting flanges. At each corner of these flanges is a 9/32 inch (7mm) diameter mounting hole. The holes are arranged in a rectangle, see "[Specifications](#)" on [page 21](#) for the dimensions. The attenuator may be secured to a horizontal surface using customer provided screws, nuts and lock washers.

Setup

Vent Plug Installation (Model 8325)

WARNING

The vent plug must be installed at all times when the unit is in operation or cooling. Always check to ensure vent plug is installed prior to operation. Failure to do this could result in damage to the equipment and endanger the operator's safety.

Before placing the Model 8325 Attenuator into service, the solid shipping plug, P/N 2450-049 must be removed and replaced by the spring loaded vent plug, P/N 2450-094. The two plugs are linked together by a piece of bead chain.

1. Locate the vent hole for the plug, located on the top near the rear.
See [Figure 1 on page 2](#).
2. Remove the shipping plug.
3. Verify the O-Ring is installed on the vent plug.
4. Install the vent plug
5. Retain the shipping plug for use in transporting the attenuator.
The shipping plug should be placed back in the vent hole whenever the attenuator is to be shipped. Take care not to lose the O-Ring seal.

Installing in a 50 Ohm Line

WARNING

Leaking RF energy is a potential health hazard.
Never attempt to connect or disconnect equipment from the transmission line while RF power is being applied.
Severe burns, electrical shock, or death can occur.

Models 8322, 8323 and 8325 are labeled INPUT and OUT PUT on the respective ends.

Model 8321 is labeled on the output end only.

The proper ends of these attenuators may also be identified by the input connector being mounted on the flat gold colored disc whereas the output connector is mounted on the rounded silver colored dome.

CAUTION

The input and output ends of these attenuators are clearly labeled. Do not couple an attenuator backwards to the direction of power flow. Destruction of the output resistor will result.

1. Perform the RF Assembly Test on the Attenuator, see "[RF Assembly Resistance Test](#)" on page 10.
2. Connect the transmitting equipment under test to the input of the attenuator.
Use 50 ohm coaxial cabling (RG-8A/U, RG-9/U, RG-213/U or equivalent) equipped with plugs which mate with the connectors on the attenuator.
3. Connect the output to a suitable load.
4. Proceed according to "[Operating Instructions](#)" on page 8.

Note: *When reconnecting the antenna, it may become necessary to slightly readjust the transmitter due to possible differences in VSWR between the attenuator and the antenna system.*

The Series 8320 TENU LINE® Attenuators should function faultlessly, absorbing and converting RF energy into heat indefinitely, if they are properly maintained and not subjected to an overload.

Normal Operation

CAUTION

The input and output ends of these attenuators are clearly labeled. Do not couple an attenuator backwards to the direction of power flow. Destruction of the output resistor will result.

Note: *The Series 8320 TENU LINE® Attenuators are not intended or recommended for outdoor use where they will be unprotected and exposed to the elements.*

1. Install the attenuator in the transmission line, see "[Installing in a 50 Ohm Line](#)" on page 7.

WARNING

The vent plug must be installed at all times when the unit is in operation or cooling. Always check to ensure vent plug is installed prior to operation. Failure to do this could result in damage to the equipment and endanger the operator's safety.

2. (Model 8325) Verify the Vent Plug has been installed, see "[Vent Plug Installation \(Model 8325\)](#)" on page 6.

WARNING

Using the attenuator in the upper end of its power dissipation range will cause the housing to become hot!
Care should be exercised in touching them.

3. Proceed according to the transmitter manufacturer's instructions. The attenuator may be subjected to very moderate overloads for limited periods of time without overheating. However, this should be done very cautiously to guard the attenuator against the dangers of overheating.

Emergency Shutdown

Should there be any abnormal operation or failure of the attenuator, shut down the transmitter immediately and allow the unit to cool before performing any maintenance.

WARNING

Leaking RF energy is a potential health hazard.

Never attempt to connect or disconnect equipment from the transmission line while RF power is being applied.

Severe burns, electrical shock, or death can occur.

1. Disable RF power at the transmitter.

RF Assembly Resistance Test

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

Accurate measurement of the DC resistance between the input to ground, output to ground, and input to output will provide a good check of the condition of the attenuator.

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 attenuator should be stabilized between 20°C to 25°C (68°F to 77°F).

DC Resistance Measurement

WARNING

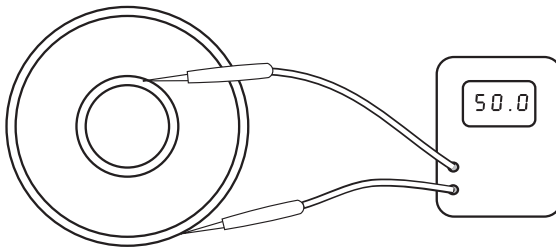
Never attempt to connect or disconnect RF equipment from the transmission line while RF power is being applied.
Leaking RF energy is a potential health hazard.

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

1. Turn off RF power before making any disconnections.
2. Disconnect the RF coaxial line.
3. Take the following measurements:

- a. Connect the multimeter test leads across the center and outer conductor of the attenuators INPUT connector. See [Figure 2](#).
Result should be 50 ± 2 Ohms
 - b. Connect the multimeter test leads across the center and outer conductor of the Attenuators OUTPUT connector.
Result should be 50 ± 2 Ohms
 - c. Connect the multimeter test leads across the INPUT center conductor and the OUTPUT center conductor.
Result should be 93.7 ± 2 Ohms
4. Record the value of the resistance *before* the attenuator 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 Attenuator.

Figure 2 *Measuring DC Resistance*



Preventive Maintenance

Periodic Inspection

1. Check the connector assemblies for tightness.
2. Inspect connector mating surfaces for dirt or grime, [Clean Connectors](#) as necessary.
3. Inspect the cooling fins for accumulation of dust and lint and the painted metal parts for signs of corrosion, [Clean Outside Surfaces](#) as necessary. If any portions of the radiator have become corroded or rusted, clean the areas with a fine flint sandpaper, and then touch them up with grey enamel.
4. Inspect the clamping bands around the connectors, for signs of possible coolant leakage. If evidence of leakage is found, see [Coolant Leakage Repair](#).

Clean Outside Surfaces

The outside surface of the attenuator should periodically be wiped free of dust and dirt. Wipe the accumulated dust and lint off of the radiator fins. Excessive collection of dust and lint on the cooling fins will interfere with the efficient dissipation of heat.

Clean Connectors

If the Teflon insulator or metallic contact surfaces of the connectors should become dirty or grimy, wipe them off with a soft cloth. Use a contact cleaner that is self-drying and non-residue forming to clean the inaccessible internal parts.

Troubleshooting

Use the following table to aid in isolating problems, their possible cause, and corrective action.

Problem	Possible Cause	Corrective Action
Leakage of coolant oil around clamping bands or radiator housing.	Clamping band not tight.	Tighten slightly with a screwdriver. See "Coolant Leakage Repair" on page 14 .
	Faulty input or output O-Ring.	Replace, see "Replace Coolant Tank Output End Cover Seal" on page 14 or "Replace Coolant Tank Input O-ring Seal" on page 17 .
Excessive overheating of the radiator.	Transmitter power too high.	Reduce transmitter power.
	Faulty RF section assembly.	Replace, see "Replace RF Assembly" on page 18 .
	Coolant oil level too low.	Add more coolant oil to the radiator. See "Coolant Level Inspection" on page 18 .
High or low DC resistance.	Faulty RF input connector.	Replace, see "Replace RF Connector" on page 14 .
	Loose RF input connector.	Tighten with a screwdriver.
	Faulty RF section assembly.	Replace, see "Replace RF Assembly" on page 18 .

Repair Procedures

Repairs, beyond what is covered in this manual, may require return of the equipment to Bird Technologies for service. See ["Customer Service" on page 20](#).

Coolant Leakage Repair

If there are signs of coolant leakage around the clamping bands. First attempt to tighten the bands.

If the leakage persists, it is likely that the O-Ring seal is damaged or deteriorated and should be replaced.

- For Leakage at the Output End Cover, see ["Replace Coolant Tank Output End Cover Seal" on page 14](#).
- For Leakage at the Input End Cover, See ["Replace Coolant Tank Input O-ring Seal" on page 17](#).

If leakage is significant, check the coolant level in the radiator tank. See ["Coolant Level Inspection" on page 18](#).

Replace RF Connector

The following procedure may be used to remove and replace Bird QC connectors.

1. Remove four 8-32 round head machine screws from the corners of the connector flange.
2. Pull the connector straight out.
3. Align the replacement connectors center contact pin with the socket and seat QC connector.
4. Install four 8-32 round head machine screws in the corners of the connector flange to secure the QC connector in place.

Replace Coolant Tank Output End Cover Seal

The differences between models will be identified when a step applies to specific model(s).

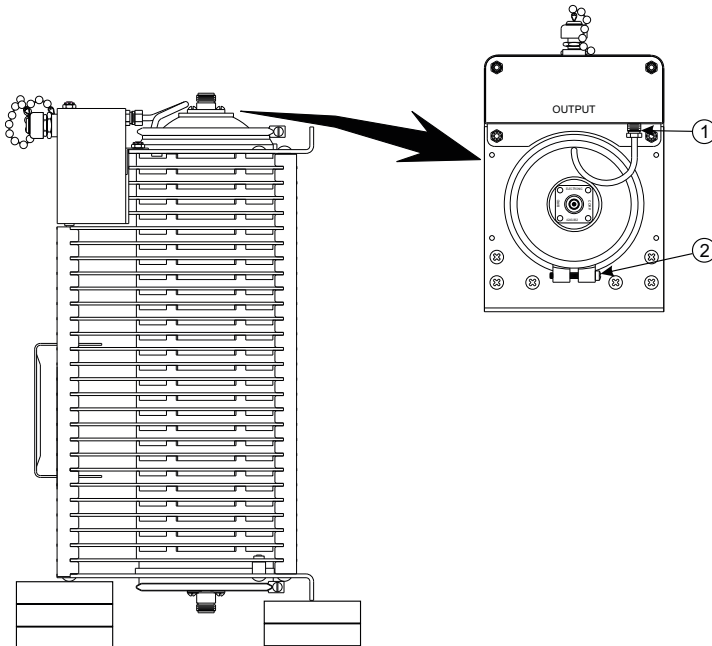
Remove Output End Cover

CAUTION

Avoid putting direct pressure on the Input connector. The input connector may be inadvertently damaged causing inaccurate operation or premature failure.

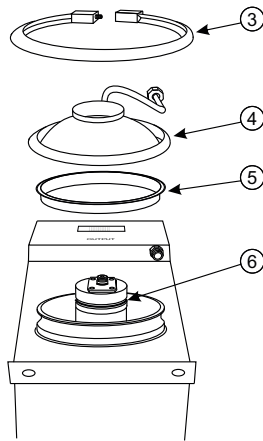
1. Position the attenuator vertically on a flat surface with the output connector facing up, block and brace the unit to avoid falling from this position. See [Figure 3 on page 15](#).
2. (Model 8325) Loosen the compression nut (1) connecting the pressure relief tube to the expansion tank using a 7/16 inch wrench. See [Figure 3 on page 15](#).
Pull the nut away from the tank slightly.
3. Loosen the 10-32 screw (2) securing the band clamp to the output end cover.

Figure 3 Output End Cover Removal



4. Remove the Band Clamp (3). See [Figure 4 on page 16](#).

Figure 4 Output End Cover Components



CAUTION

Use care when removing or installing end cover to avoid damaging end cover seal or the o-ring seal on the RF output section.

5. Lift the End Cover (4) off of the attenuator assembly.
6. Remove the End Cover seal (5).

Install Output End Cover

1. Check coolant level. See "[Coolant Level Inspection](#)" on page 18.
2. Inspect the RF output section o-ring seal (6).
The o-ring should be soft and pliable, and free of surface cracks. If damaged or hardened the o-ring should be replaced. See "[Replacement Parts](#)" on page 22.
3. Inspect the End Cover seal (5).
The o-ring should be soft and pliable, and free of surface cracks. If damaged or hardened the o-ring should be replaced. See "[Replacement Parts](#)" on page 22.
4. Install the End Cover seal on the coolant tank.

CAUTION

Use care when removing or installing end cover to avoid damaging end cover seal or the o-ring seal on the RF output section.

5. Install the End Cover (4).
Push the End Cover slowly onto the RF output section until seated against the End Cover seal and the coolant tank.

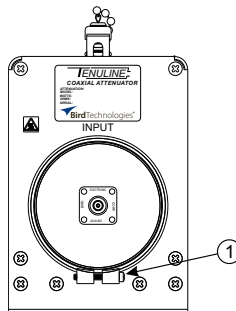
6. Attach the Band Clamp (3).
7. Tighten the 10-32 screw (2) securing the band clamp to the output end cover. See [Figure 3 on page 15](#).
8. (Model 8325) Tighten the compression nut (1) connecting the pressure relief tube to the expansion tank using a 7/16 inch wrench.

Replace Coolant Tank Input O-ring Seal

To change the input o-ring seal, the output end cover must be removed and the coolant drained from the coolant tank.

1. Remove the output end cover. See ["Remove Output End Cover" on page 15](#).
2. Carefully pour the coolant into a clean container.
If the coolant is uncontaminated it can be reused, otherwise discard it.
3. Loosen the 10-32 screw (1) securing the band clamp to the RF input. See [Figure 5 on page 17](#).

Figure 5 Input O-Ring Removal



4. Remove the Band Clamp.
5. Lift the RF input section out of the attenuator assembly far enough to remove the o-ring.
If replacing the entire RF Assembly, completely remove assembly from the coolant tank.
6. Remove the o-ring seal from the input of the RF Assembly.
7. Inspect the input o-ring seal.
The o-ring should be soft and pliable, and free of surface cracks. If damaged or hardened the o-ring should be replaced. See ["Replacement Parts" on page 22](#).
8. Install o-ring seal on the RF input section.
9. Press the RF Input section into the attenuator until seated against the coolant tank.
10. Attach the Band Clamp.
11. Tighten the 10-32 screw (1) securing the band clamp to the RF input. See [Figure 5 on page 17](#).

12. Refill the coolant chamber to the levels shown in "[Coolant Level Inspection](#)" on page 18.
13. Install the output end cover. See "[Install Output End Cover](#)" on page 16.

Replace RF Assembly

To replace the RF Assembly follow the steps in "[Replace Coolant Tank Input O-ring Seal](#)" on page 17.

The RF Assembly does not contain any replaceable components and must be replaced in its entirety, see "[Replacement Parts](#)" on page 22.

Coolant Level Inspection

The level of the dielectric coolant, P/N 5-030, should remain constant in the unit even after prolonged usage under normal operating conditions. However, loss of up to 10 percent of the full tank capacity should not impair the operating efficiency of the attenuator.

Model 8325 Coolant Level Check

Note: *The Model 8325 coolant level may be check without disassembling the attenuator using this procedure, if the unit is already partially disassembled, check the coolant level using the [All Models Coolant Level Check](#).*

1. Remove RF Power and allow attenuator to cool to room temperature.
2. With Attenuator in horizontal position remove Vent or Shipping Plug from expansion tank.
3. Verify coolant level is approximately 1/8 inch (3.2 mm) deep within the expansion tank. Add coolant if the coolant is not visible in the tank or depth is less than 1/8 inch (3.2 mm).

All Models Coolant Level Check

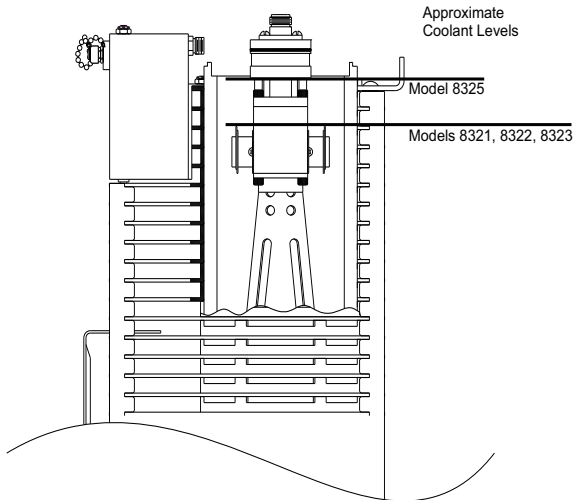
4. Remove the output end cover. See "[Remove Output End Cover](#)" on page 15.
 - Measure the level of the coolant, see [Figure 6 on page 19](#).
(Model 8321, 8322, 8323) The coolant should be about 7/8 inch (22.2 mm) below the face of the output end, with the unit in a vertical position. The coolant should just cover the upper surface of the cubical center block of the RF section assembly.
 - (Model 8325) Coolant should nearly fill the entire coolant tank, the external expansion tank will provide room for expansion during operation.

CAUTION

Do not overfill the coolant tank with coolant. Room must be allowed for expansion of the heated coolant.

5. Add coolant directly into the coolant tank, if required.

Figure 6 Coolant Levels



6. Check the color of the coolant.
The coolant should be a clear light yellow color. If not, it is contaminated and should be replaced.
7. Replace coolant, if required.
 - a. Pick up the attenuator and carefully pour out the coolant into a suitable container. Allow as much to drip out as possible.
 - b. Replace the coolant with fresh coolant, filling the radiator tank to the proper level.
8. Install the output end cover. See ["Install Output End Cover" on page 16.](#)

Storage

If storing the attenuator for a long period of time, cover the equipment to keep out dust and dirt.

Store this unit in a dry and dust free environment where the ambient temperature will remain within the -40°C to $+45^{\circ}\text{C}$ (-40°F to $+113^{\circ}\text{F}$) working range of the equipment.

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>

Shipping

Model 8321, 8322, and 8323 may be shipped without emptying the coolant.

Model 8325 if the shipping plug installed, it is not necessary to empty the coolant.

Before shipping the attenuator, take the following precautions:

1. Remove the vent plug (Model 8325).
2. Replace the vent plug them with the shipping plug (Model 8325).

Note: *With the shipping plug installed, it is not necessary to empty out the coolant.*

3. Wrap the vent plug with padding and tape them to the side of the attenuator for protection. (Model 8325)
4. Pack the attenuator in the original carton.
If the original carton is not available, pack and brace the attenuator in a suitable shipping container such as a sturdy corrugated cardboard box.

Specifications

<i>Parameter</i>	<i>Specification</i>
Impedance	50 ohms nominal
VSWR	
Input	1.1 max., DC - 500 MHz
Output	1.15 max., DC - 500 MHz
Connectors	
Input	Bird "QC", Female N normally supplied
Output	Bird "QC", Female N normally supplied
Power Rating	
Model 8321	50 W
Model 8322	200 W
Model 8323	100 W
Model 8325	500 W
Frequency Range	DC - 500 MHz
Attenuation	30 dB \pm 1/2 dB, DC - 500 MHz
Calibration Frequencies (to \pm 0.2 dB)	30, 100, 200, 300, 400, and 500 MHz
Weight	
Model 8321	6-1/2 lb (3 kg)
Model 8322	19 lb (9 kg)
Model 8323	11 lb (5 kg)
Model 8325	25 lb (11 kg)
Dimensions, Nominal	
Model 8321	10-7/32"L x 3-15/16"W x 6-11/32"H (260 x 100 x 161 mm)
Model 8322	17-1/2"L x 5-15/16"W x 8-1/2"H (445 x 151 x 216 mm)
Model 8323	10-11/32"L x 5-15/16"W x 8-1/2"H (263 x 151 x 216 mm)
Model 8325	17-1/2"L x 5-15/16"W x 8-1/2"H (445 x 151 x 216 mm)
Ambient Operating Temperature	40°C to +45°C (-40°F to +113°F)
Operating Position	Horizontal Only
Cooling Method	Dielectric and air convection currents

Mounting dimensions	Model 8321 7" x 3" (178 x 76 mm) Model 8322 14-3/8" x 5-1/8" (365 x 130 mm) Model 8323 7-15/32" x 5-1/8" (190 x 130 mm) Model 8325 15" x 5-1/8" (381 x 130 mm)
Finish	Gray Powder Coat
CE	Meets European EMC Standards: EN55011 and EN50082-1, which are in accordance with council directives 89/336/EEC & 92/31/EEC. Meets European Safety Standard EN 61010-1, Which is in accordance with council directive 73/23/EEC & 93/68/EEC.

Replacement Parts

Some replacement parts for older models (8321, 8322, 8323) are no longer available.

<i>Item</i>	<i>Qty</i>	<i>Part Number</i>
RF Assembly		
Model 8322	1	8322-002-1
Model 8325	1	8322-002-1
Radiator Assembly		
Model 8321	1	2400-025
Model 8323	1	2440-015
Model 8325	1	2430-123
Radiator Handle		
Model 8321	1	2400-017
Model 8322	1	2440-009
Model 8323	1	2400-017
Model 8325	1	2430-028
Clamp Band Assembly		
Model 8321	1	7500-254
Model 8322, 8323, 8325	1	2430-055
End Cover Assembly		
Model 8325	1	8325-015
Dielectric Coolant		
Model 8321	1 pint (0.31 liter)	5-030-2 (1/2 Gallon)
Model 8322	0.7 Gallon (2.65 liter)	5-030-3 (1 Gallon)
Model 8323	0.35 Gallon (1.3 liter)	5-030-2 (1/2 Gallon)
Model 8325	0.9 Gallon (3.4 liter)	5-030-3 (1 Gallon)

<i>Item</i>	<i>Qty</i>	<i>Part Number</i>
Input End O-Ring Model 8321	1	5-229
Model 8322, 8323, 8325	1	8110-039
Output End O-Ring (RF Assembly output) All Models	1	5-243
Output End Cover Seal Model 8322	1	2430-089
Model 8323	1	2430-089
Model 8325	1	2430-089
Vent & Shipping Plug Kit (includes 1 each: vent & shipping plugs, o-ring, chain assembly, and screw)		RPK8000-1
Vent Plug	1	2450-094
Shipping Plug	1	2450-049
Chain Assembly	1	8180-094
O-Ring (Used for Vent/Shipping Plug)	1	5-504
Bumper Feet		5-049

Available QC Type Connectors

Connector	Part Number
N-Female	4240-062
N-Male	4240-063
HN-Female	4240-268
HN-Male	4240-278
LC-Female	4240-031
LC-Male	4240-025
BNC-Female	4240-125
BNC-Male	4240-132
SMA-Female	4240-336
SMA-Male	4240-334
7/8" EIA	4240-002
1-5/8" EIA Fixed	4240-096
7/16" EIC (Jack) Type 169-4	4240-344
LT-Female	4240-018
LT-Male	4240-012

C-Female	4240-100
C-Male	4240-110
UHF-Female	4240-050
UHF-Male	4240-179
TNC-Female	4240-156
TNC-Male	4240-160
SC-Female	4240-090
Mini UHF-Female	4240-346
7/16" EIC (Plug) Type 169-4	4240-363
1-5/8" EIA Swivel	4240-208
Open Term. #10-32 Nut	4240-080

Limited Warranty

All products manufactured by Seller are warranted to be free from defects in material and workmanship for a period of one (1) year, unless otherwise specified, from date of shipment and to conform to applicable specifications, drawings, blueprints and/or samples. Seller's sole obligation under these warranties shall be to issue credit, repair or replace any item or part thereof which is proved to be other than as warranted; no allowance shall be made for any labor charges of Buyer for replacement of parts, adjustment or repairs, or any other work, unless such charges are authorized in advance by Seller.

If Seller's products are claimed to be defective in material or workmanship or not to conform to specifications, drawings, blueprints and/or samples, Seller shall, upon prompt notice thereof, either examine the products where they are located or issue shipping instructions for return to Seller (transportation-charges prepaid by Buyer). In the event any of our products are proved to be other than as warranted, transportation costs (cheapest way) to and from Seller's plant, will be borne by Seller and reimbursement or credit will be made for amounts so expended by Buyer. Every such claim for breach of these warranties shall be deemed to be waived by Buyer unless made in writing within ten (10) days from the date of discovery of the defect.

The above warranties shall not extend to any products or parts thereof which have been subjected to any misuse or neglect, damaged by accident, rendered defective by reason of improper installation or by the performance of repairs or alterations outside of our plant, and shall not apply to any goods or parts thereof furnished by Buyer or acquired from others at Buyer's request and/or to Buyer's specifications. 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.