INSTRUCTION BOOK FOR

BIRD

SERIES 8320
TENULINE® ATTENUATOR

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.

Keep away from live circuits.

Operating personnel must at all times observe normal safety regulations. Do not attempt to replace parts or disconnect a RF transmission or any other high voltage line while power is applied. When working with high voltage always have someone present who is capable of rendering aid if necessary. Personnel working with or near high voltage should be familiar with modern methods of resuscitation.

The following will appear in the text of this publication and is shown here for emphasis.

CAUTION

This equipment is designed for operation in a horizontal position only, with mounting brackets down. Do not operate in any other manner.

WARNING

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

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.

SAFETY PRECAUTIONS

WARNING

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

CAUTION

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

WARNING

Using these attenuators in the upper end of their power dissipation ranges will cause their housings to become hot! Care should be exercised in touching them.

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SERIES 8320 TENULINE® ATTENUATOR

INTRODUCTION

PURPOSE AND FUNCTION

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. They are self-contained instruments that require no external source of power or utility service. The radiators have cooling fins spaced evenly along their lengths for efficient cooling. 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.

PERFORMANCE CHARACTERISTICS AND CAPABILITIES

Relying only on ambient air currents, these attenuators will safely absorb, and dissipate harmlessly as heat, up to their maximum rated input power. Over the frequency range of dc to 500MHz, the power output will be reduced by 30dB (99.9%) $\pm$0.5dB. Up to 500MHz, the input VSWR will not exceed 1.1 and the output VSWR 1.15.

DIMENSIONS AND WEIGHT

The dimensions and weight of these attenuators are given in the Specifications, on Page vi. The weights given are net weights. Therefore, the shipping weights will be approximately 20% higher.

POWER AND UTILITY REQUIREMENTS

These attenuators are passive devices that are self-contained; therefore, do not need any external source of power or utilities to functions.

ENVIRONMENTAL REQUIREMENTS

Operate these attenuators in a dust and vibration free environment. The ambient temperature range should remain between -40°C and $+45^{\circ}$C (-40°F and $+113^{\circ}$F) for proper operation. Allow at least 6" (150mm) of clearance around the unit to permit an unimpeded access of convection air currents for adequate heat dissipation.

ITEMS FURNISHED

The Series 8320 Attenuators are equipped with a Bird Quick-Change "QC" design connectors. Female N type connectors are normally supplied for the input and output but may be conveniently and easily interchanged with other AN type "QC" connectors. This instruction book is the only other item furnished as standard equipment.

ITEM REQUIRED

The only other items required are two matching connectors on the coaxial transmission line to which the load will be connected.

TOOLS AND TEST EQUIPMENT

Only simple tools such as screwdrivers will be necessary for disassembly of this equipment. A resistance bridge or ohmmeter with an accuracy of 1% or better at 50 ohms is useful for checking the resistance values of the RF Section assembly.

SPECIFICATIONS FOR SERIES 8320 TENULINE® ATTENUATOR

Impedance	50 ohms nominal
VSWR	
Input	1.1:1.0 maximum dc-500MHz
Output	1.15:1.0 maximum dc-500MHz
Connectors	
Input	Bird "QC", Female N Normally Supplied
Output	Bird "QC", Female N Normally Supplied
Power Rating	
Model 8321	50W
Model 8322	200W
Model 8323	100W
Model 8325	500W
Frequency Range	dc-500MHz
Attenuation	30dB ± 1/2dB, dc-500MHz
Calibration Frequencies (to ± 0.2dB)	30, 100, 200, 300, 400 and 500MHz
Dimensions	
Model 8321	10-7/32"L x 3-15/16"W x 6-11/32"H (260 x 100 x 161mm)
Model 8322	17-1/2"L x 5-15/16"W x 8-1/2"H (445 x 151 x 216mm)
Model 8323	10-11/32"L x 5-15/16"W x 8-1/2"H (263 x 151 x 216mm)
Model 8325	17-1/2"L x 5-15/16"W x 8-1/2"H (445 x 151 x 216mm)

Continued

SPECIFICATIONS FOR 8320 SERIES TENULINE® ATTENUATORS

Ambient Temperature	−40°C to +45°C(−40°F to +113°F)
Cooling Method	Dielectric and air convection currents
Weight	
Model 8321	6-1/2 lbs. (3kg)
Model 8322	19 lbs. (9kg)
Model 8323	11 lbs. (5kg)
Model 8325	25 lbs. (11kg)
Operating Position	Horizontal only
Finish	Light navy grey baked enamel
Mounting Rectangle	
Model 8321	7" x 3" (178 x 76mm)
Model 8322	14-3/8" x 5-1/8" (365 x 130mm)
Model 8323	7-15/32" x 5-1/8" (190 x 130mm)
Model 8325	15" x 5-1/8" (381 x 130mm)

SECTION I - INSTALLATION

1-1. LOCATION

> **CAUTION**
>
> This equipment is designed for operation in a horizontal position only, with mounting brackets down. Do not operate in any other manner.

1-2. Allow at least six inches (150mm) of clearance around the unit, to permit an unimpeded access of convection air currents for adequate heat dissipation. Place the attenuator to permit the shortest possible cable length between the unit and the transmitting equipment. Operate the attenuator in a horizontal position only, with the handles on top.

1-3. MOUNTING

1-4. The attenuator may be used for portable operation or for fixed installation, that is, it may stand free or be secured to a bench or any convenient flat surface. 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 3/8'' hole. The holes are arranged in a rectangle, see Specifications, Page vii, and the fasteners must be placed throughout the bench and the holes. Secure the screws in place with nuts and lock washers. Model 8321 is equipped with rubber bumper feet which can be removed for permanent mounting. The holes are tapped for #8-32 screws. All models have a convenient carrying handle nested among the cooling fins on the top side.

> **WARNING**
>
> The vent plug must be used at all times when the unit is in operation or cooling. Failure to do this could result in damage to the equipment and endanger the operator's safety.

1-5. 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 vent hole for this plug is located on the top near the rear. The two plugs are linked together by a piece of bead chain. 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.

SECTION II - THEORY OF OPERATION

2-1. GENERAL

2-2. 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.

2-3. 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 reflectionless attenuation characteristic over the stated frequencies of the attenuator.

2-4. This system of film-on-ceramic cylindrical resistors immersed in a heat resistant dielectric coolant constitutes the RF section assembly. 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.

2-5. 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) and Model 8325, 0.9 gallons (3.4 liter). For Model 8325 expansion of the coolant when power is applied to the attenuator, is accomplished by allowing the air, which is compressed by the expanding coolant, to escape through the vent plug located on the top and near the rear face of the unit. Models 8321, 8322 and 8323 allow for expansion of the coolant by using underfilled radiator tanks and a derating of their load carrying capacities.

2-6. By convection, the cooling fluid carries the heat generated in the various 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.

2-7. The Series 8320 may be used for the isolation of power sources up to their maximum rated wattages and for low level monitoring. The low power value obtained at the output of the attenuator can easily be read on an oscilloscope or terminated in a small RF load resistor.

SECTION III - OPERATING INSTRUCTIONS

3-1. USE AND FUNCTION OF CONTROLS

3-2. These attenuators, being passive devices, have no indicators or operating controls.

3-3. INITIAL ADJUSTMENTS

3-4. No initial adjustments are necessary other than to connect the attenuator to the RF source and load by means of coaxial cables equipped with suitable matching connector plugs.

3-5. START-UP

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.

3-6. Models 8322, 8323 and 8325 are labeled INPUT and OUTPUT 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. Connect the attenuator to the transmitting equipment under test and to a suitable load with 50 ohm coaxial cabling (RG-8A/U, RG-9/U, RG-213/U or equal) equipped with plugs which mate with the RF input and output connectors of the attenuator. After the transmitter has been connected to the attenuator, proceed according to the transmitter manufacturer's instructions. 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.

3-7. NORMAL OPERATION

WARNING

Using these attenuators in the upper end of their power dissipation ranges will cause their housings to become hot! Care should be exercised in touching them.

3-8. Because the Series 8320 Attenuators are passive devices and have no indicators or controls, they require no operating procedures or surveillance when the stated performance limits are not exceeded. They should function faultlessly, absorbing and converting the excess RF energy into heat indefinitely, if they are properly maintained and not subjected to an overload.

3-9. OPERATION UNDER EMERGENCY, ADVERSE OR ABNORMAL CONDITIONS

3-10. The Series 8320 TENULINE® Attenuators are not intended or recommended for outdoor use where they will be unprotected and exposed to the elements. They 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.

3-11. SHUTDOWN

3-12. These attenuators, being passive devices, cannot be shut off. The source of RF energy must be cut off instead.

3-13. EMERGENCY SHUTDOWN

WARNING

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

3-14. Turn off RF power at its source.

SECTION IV - MAINTENANCE

4-1. TROUBLESHOOTING

PROBLEM	POSSIBLE CAUSE	REMEDY
Leakage of Coolant Oil Around Clamping Bands or Radiator Housing	Clamping band not tight	Tighten slightly with a screwdriver.
	Faulty O-Ring (input)	Replace per Paragraph 4-18.
	Faulty O-Ring (output)	Replace per Paragraph 4-18.
Excessive Overheating of the Radiator	Transmitter power too high	Reduce transmitter power.
	Faulty RF section assembly	Replace per Paragraph 4-18.
	Coolant oil level too low	Add more coolant oil to the radiator per Paragraph 4-13 through 4-17.
High or Low DC Resistance Values Per Paragraph 4-9	Faulty RF input connector	Replace per paragraph 4-12.
	Loose RF input connector	Tighten with a screwdriver
	Faulty RF section assembly	Replace per paragraph 4-18.

4-2. CLEANING

4-3. The outside surface of the attenuator should be wiped free of dust and dirt when necessary. The principle maintenance required by the operator will be to periodically 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. 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.

4-4. INSPECTION

4-5. Periodically inspect the clamping bands around the connectors, for signs of possible coolant leakage, see Paragraph 4-6 for proper action. Check the connector assembly for tightness. Inspect the cooling fins for accumulation of dust and lint and the painted metal parts for signs of corrosion. Also, occasionally check the coolant level in the radiator tank.

4-6. PREVENTIVE MAINTENANCE

4-7. If there are signs of coolant leakage around the clamping bands, try tightening them. If the leakage persists, it is likely that the O-Ring seal is damaged or deteriorated. Replace it; see Paragraph 4-13. Wipe the cooling fins clean of accumulated dust and lint in order to preserve their efficiency in the transferring heat to the environment. 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.

4-8. RF ASSEMBLY TESTS

4-9. 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. For these measurements, a resistance bridge, or ohmmeter with an accuracy of 1% or better at 50 ohms should be used. Use low resistance leads, preferable a short piece of 50 ohm cable (RG-8A/U or RG-9B/U) with attached Male plugs which mate with the Female connectors on the attenuator. When the resistance of the equipment is checked at room temperature, the measured readings should be with ± 2 ohms of their nominal resistance values, commonly 93.7 ohms input to output and 50 ohms from either end to ground. It is recommended that for reference purposes, these resistance values should be measured and recorded upon receipt of the attenuator and then checked periodically thereafter.

4-10. DISASSEMBLY

4-11. There are no special techniques required for the repair or replacement of components in these TENULINE® Attenuators. A screwdriver and possibly an adjustable wrench are the only tools needed. The paragraphs below outline the component removal procedures.

4-12. RF Connector - The connectors are a "Quick-Change" design which permits easy interchange with the use of only a screwdriver. This process does not interfere with the essential coaxial continuity of the attenuator RF input, output or the coolant oil seals. For replacement, proceed as follow:

a. Remove the four 8-32 x 5/16 round head machine screws from the corners of the RF connector.

b. Pull the connector straight out of its socket.

4-13. Coolant and Seals, Models 8321, 8322 and 8323 - To replace or examine the coolant oil, proceeds as follows:

a. Carefully raise up the back (output connector) end of the attenuator until the unit is resting on its front (input connector) end.

b. Brace the attenuator into a vertical position to avoid tipping it over. Take care not to exert excessive downward pressure on the attenuator while it is in this position and thereby damage the input connector.

c. Remove the V Band Clamp by loosening the 8-32 screw on its clamping blocks.

d. Remove the output end cover assembly which has a specially designed center bushing, P/N 2430-089, sealing the attenuator output housing. Be careful when disassembling to avoid damaging either the sealing ring, P/N 2430-089, on the output ring diaphragm or the O-Ring, P/N 5-176, on the output housing. The interior of the radiator tank and the RF section assembly are now exposed to view.

e. Check the coolant level.

4-14. Coolant and Seals, Model 8325 - To replace or examine the coolant oil proceed as follows:

a. Carefully raise up the back (output connector) end of the attenuator until the unit is resting on its front (input connector) end.

b. Brace the attenuator into a vertical position to avoid tipping it over. Take care not to exert excessive downward pressure on the attenuator, while it is in this position, and thereby damage the input connector.

c. Use a 7/16 wrench to loosen the captive compression nut that connects the access tube to the reservoir expansion tank. The reservoir is located on the top rear side of the attenuator.

d. The nut must be completely unscrewed from the threaded fitting on the reservoir tank.

e. Now release and remove the clamping band by loosening the 10-32 screw on its clamping block.

f. Remove the domed end cover assembly which has a specially designed center busing ring, P/N 2430-089, sealing the attenuator output housing. Be careful when disassembling not to damage either this sealing ring which is fitted on the coolant cylinder or the O-Ring, P/N 5-243, on the output housing. The interior of the radiator and the RF section assembly are now exposed to view.

4-15. COOLANT LEVEL

CAUTION

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

4-16. Models 8321, 8322 and 8323 - The level of the dielectric coolant, P/N 5-030, should remain constant in the unit even after prolonged usage under normal operating conditions. As shipped, the coolant is at a factory determined level, and should be about 7/8 inch (22.2mm) 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. However, loss f up to 10% of the full tank capacity should not impair the operating efficiency of the attenuator. The coolant should be a clear light yellow color. If not, it is contaminated and should be replaced. Inspect occasionally around the clamping bands at the input and output ends for possible coolant leakage. If necessary, tighten the clamping screw and make certain the diaphragm and output housing seals are in good condition; i.e., soft, pliable and free from surface cracks.

a. To Add Coolant - Add coolant directly into the radiator tank until it reaches the proper level, see Paragraph 4-16.

b. To replace all of the coolant, use the following procedure:

1. Pick up the attenuator and carefully pour out the coolant into a suitable container. Allow as much to drip out as possible.

2. Replace the coolant with fresh coolant, filling the radiator tank to the proper level, see Paragraph 4-16.

4-17. Mode 8325 - The level of the dielectric coolant oil, P/N 5-030, should remain constant in the unit, even after prolonged usage under normal operating conditions. As shipped the coolant is at a factory determined level which should approximately fill the entire cylindrical radiator tank. Expansion of the heated coolant is provided for by the expansion reservoir tank. The vent plug allows the release of excess internal pressure. However, the loss of up to 10% of the full radiator tank capacity should not impair the operating efficiently of the attenuator. The coolant should be a clear light yellow color, if not, it is contaminated and should be replaced. Inspect occasionally around the clamping bands at the input and output ends for possible coolant leakage. Tighten the clamping screw if necessary, and make certain the diaphragm and output housing seals are in good conditions; i.e., soft, pliable and free from surface cracks.

a. To Add Coolant - Remove vent plug and add coolant directly into the reservoir tank. Fill to a depth of only about 1/8 inch in reservoir.

b. To replace all of the coolant, follow the procedure of Paragraph 4-14.

1. Pick up the attenuator and carefully pour out the coolant into a suitable container. Allow as much to drip out as possible.

2. Replace the coolant with fresh coolant, filling the radiator tank to the proper level, see Paragraph 4-19.

4-18. RF LOAD RESISTOR ASSEMBLY

4-19. RF Load Resistor Assembly (All Models) - To replace the load resistor assembly, use the same procedure as in Paragraph 4-13 or 4-14 and then continued as follows:

a. Carefully pour the coolant into a clean container. If the coolant is uncontaminated it can be reused, otherwise discard it.

b. Release the clamping band from the input end as in Paragraph 4-13c or Paragraph 4-14e and remove it.

c. The RF section assembly can now be removed through the input end. Grasp the "QC" connector and carefully work the assembly free and then pull it out of the radiator tank. Inspect the input O-Ring seals, P/N 5-229, for Model 8321 and P/N 8110-039 for Models 8322, 8323, and 8325, or signs of deterioration.

d. The RF section assembly is not subject to further disassembly in the field. A defective unit must be returned to the factory for repair.

4-20. RF Connector - To install a new connector, reverse the procedures in Paragraph 4-12. Be sure that the projecting center pin on the connector is carefully engaged and properly seated in the mating socket of the load resistors and then push it firmly home.

4-21. Coolant and Seal Models 8321, 8322 and 8323 - proceed as follows:

a. Inspect the output cover sealing ring (Model 8321, P/N 8321-025; Models 8322 and 8323, P/N (2430-089) on the output ring diaphragm and the output end O-Ring (Model 8321, P/N 5-176, Models 8322 and 8323 P/N 5-243). They should both be soft pliable and free of surface cracks. If not, replace them.

b. After adding to or replacing the coolant, if required, reverse the procedure in Paragraph 4-13.

4-22. Coolant and Seals, Model 8325 - Inspect the output cover sealing ring, P/N 2430-978, on the coolant cylinder and the output O-Ring, P/N 5-243. They should both be soft, pliable and free of surface cracks. If not, replace them.

4-23. **REASSEMBLY**

a. If the input O-Ring is not soft, pliable and free of surface cracks, replace it.

b. After replacing the RF load resistor assembly, if necessary, reverse the procedure in Paragraph 4-13 or 4-14.

4-24. **REPAIRS**

4-25. Repairs, beyond what is covered in this instruction book, will require return of the equipment to Bird Electronic Corporation for service. Please consult the factory.

SECTION V - PREPARATION FOR RESHIPMENT

5-1. GENERAL

5-2. Pack and brace the attenuator in a suitable shipping container, a sturdy corrugated paper box is satisfactory. It is not necessary to remove the dielectric coolant before shipping, but do not forget to replace the vent plug with the shipping plug on Model 8325.

SECTION VI - STORAGE

6-1. GENERAL

6-2. No special preparations for storage are necessary other than to cover the equipment to keep out dust and dirt. Store this unit in a dry and dust free environment where the ambient temperature will remain within the $-40^{\circ}C$ to $+45^{\circ}C$ ($-40^{\circ}F$ to $+113^{\circ}F$) working range of the equipment.

SECTION VII - REPLACEMENT PARTS LIST

7-1. **SERIES 8320**

ITEM	QUANTITY	DESCRIPTION	PART NUMBER
1	1	RF Section Assembly	
		Model 8321	8321-002
		Models 8322/25	8322-002-1
		Model 8323	8323-002
2	1	Radiator Assembly	
		Model 8321	2400-025
		Model 8322	2440-020
		Model 8323	2400-015
3	1	Radiator Handle	
		Models 8321/23	2400-017
		Model 8322	2440-009
		Model 8325	2430-028
4	2	Connectors, RF	*See Below
5	2	Clamping Band Assembly	
		Model 8321	7500-254
		Models 8322/23/25	2430-055
6	1	End Cover Assembly - 8322/23	8322-005
7		Dielectric Coolant	
	1 pint (0.31 liter)	Model 8321	5-030-1 (1 Pint Container)
	0.7 gallon (2.65 liter)	Model 8322	5-030-3 (1 Gallon Container)
	0.35 gallon (1.3 liter)	Model 8323	5-030-2 (1/2 Gallon Container)
	0.9 gallon (3.4 liter)	Model 8325	5-030-3 (1 Gallon Container)
8	1	Input End O-Ring	
		Model 8321	5-229
		Models 8322/23/25	8110-039

Continued

ITEM	QUANTITY	DESCRIPTION	PART NUMBER
9	1	Output End O-Ring Models 8321/22/23/25	5-176
10	1	Output Cover Seal Model 8321	8321-025
11	4	Bumper Feet (8321 only)	5-049
12	1	Vent Plug (8325 only)	2450-094
13	1	Shipping Plug (8325 only)	2450-049
14	2	O-Ring, Vent and Shipping Plugs (8325 only)	5-504
15	1	Chain Assembly (8325 only)	8180-094
16	1	Output Cover Assembly (8325 only)	5-243

*Available "QC" Type Connectors

N-Female	4240-062	BNC-Male	4240-132
N-Male	4240-063	LT-Female	4240-018
HN-Female	4240-268	LT-Male	4240-012
HN-Male	4240-278	C-Female	4240-110
LC-Female	4240-031	C-Male	4240-110
LC-Male	4240-025	UHF-Female (SO-239)	4240-050
BNC-Female	4240-125	UHF-Male (PL-259)	4240-179
7/8" EIA Air Line	4240-002		