TECHNICAL MANUAL

for

POWER REDUCTION TEST SET

MODEL 3142

BIRD ELECTRONIC CORPORATION
CLEVELAND (SOLON), OHIO

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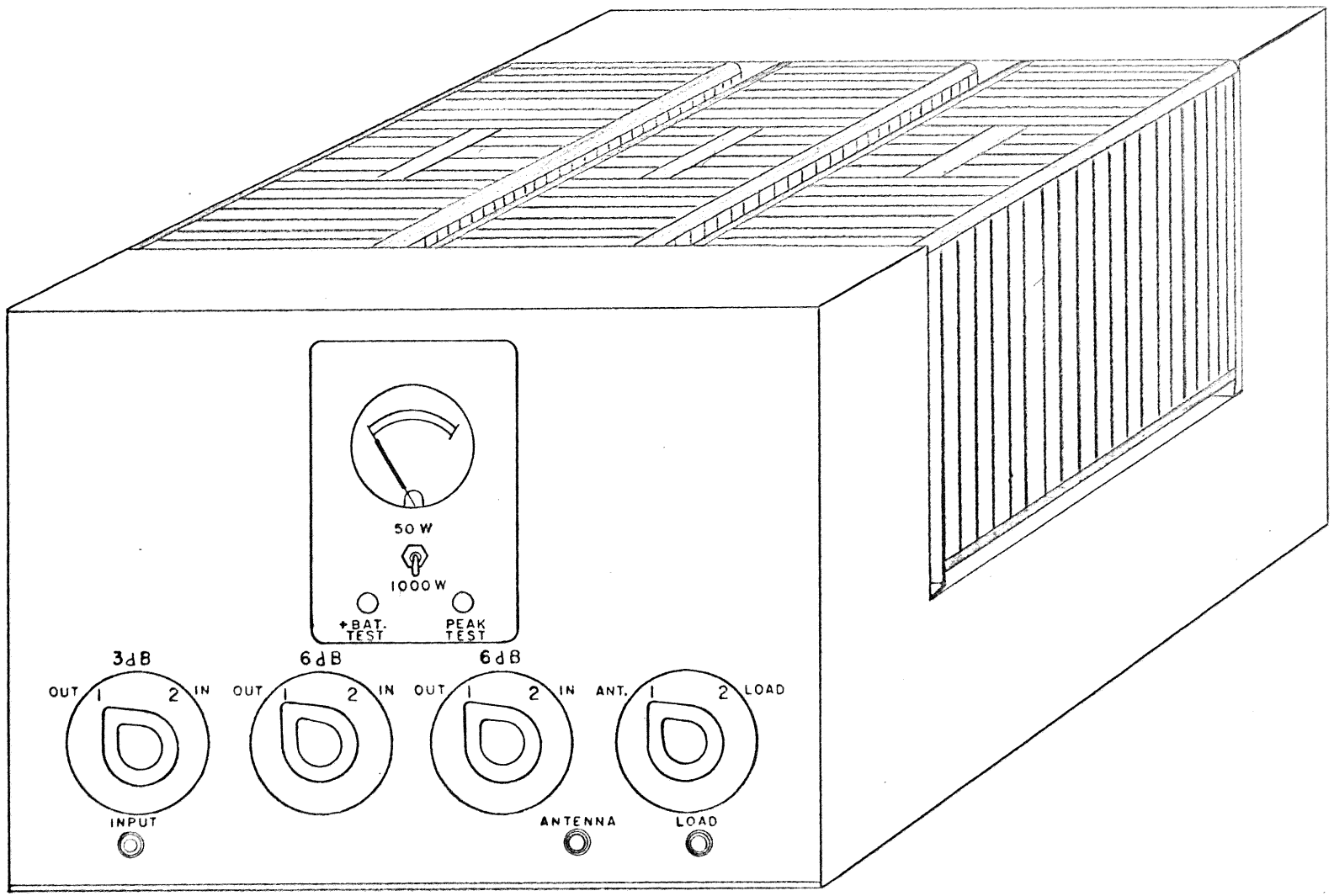


POWER REDUCTION TEST SET MODEL 3142

INTRODUCTION AND DESCRIPTION

Section I

1-1 Scope

This technical manual provides operation, service, maintenance, troubleshooting, and repair instructions for the Power Reduction Test Set, Model 3142, manufactured by Bird Electronic Corporation, Cleveland (Solon), Ohio. This manual is intended to be used by technicians who are responsible for the operation and maintenance of the test set.

1-2 Purpose

The Model 3142 is a power reduction test set that also measures the output power either average or peak. It reduces power output of a transmitter by use of a 3 dB and two 6 dB attenuators in series. The switching arrangement allows full power output or power reductions of transmitter input power by a ratio of 2, 4, 8, 16, 32 to 1 at output of test set. It measures forward power at the output connector in range of 1000 watts and 50 watts. It indicates either average or peak power as required.

1-3 Technical Characteristics

Technical characteristics for the Bird Model 3142 Power Reduction test Set are given in Table 1.

TECHNICAL CHARACTERISTICS

Model 3142 Power Reduction Test Set

Table 1

Specification:

Input Power Rating: 1000 Watts (PEP)

250 Watts (AVG.)

Impedance: 50 Ohms Nominal

Input & Output RF Connectors: Female N

Maximum Insertion VSWR: 1.30 Max.

Frequency: 2 to 32 MHz

Accuracy of Output Power Measurement : ±8% of Full Scale @ all power levels.

Power Reduction Available:

Attenuation	Power Reduction	Maximum Variance
0	0	+0.4 dB
3 dB	2 to 1	±0.8 dB
6 dB	4 to 1	±0.8 dB
9 dB	8 to 1	±0.8 dB
12 dB	16 to 1	±0.8 dB
15 dB	32 to 1	±0.8 dB

Finish: Light Navy Grey Baked Enamel (MIL-E-15090)

Weight: 100 lbs. max.

Physical Dimensions: 20" x 24" x 14"

Width Depth Height

Battery Requirements for Wattmeter:

5.40 volt - Mallory TR-164 or equal
12.60 volt - Mallory TR-169 or equal

1.4 Description

The Power Reduction Test Set is a portable unit encased in a aluminum housing with front and back cover plates. The cover plates are secured to the main body by screws. Mounted to the front cover plate are the wattmeter, four switches, and input and output RF connectors.

The wattmeter is encased in its own aluminum housing with a removable back panel to allow access to the batteries and its operating components.

The three attenuators are self-contained units housed in aluminum radiators. The attenuators are connected by RF Cables to three two-circuit, two-position Coaxial Switches. This then allows various combinations of the three attenuators to be switched in series depending on power output desired. The fourth switch is a single circuit, two-position unit that allows switching either to an antenna or to a dummy load. Connected to this output switch is a 50 ohm precision nickel plated brass transmission line. Two sockets on the line section are provided for the insertion of the two power sensing plug-in elements. The plug-in elements sense the transmission through the line section by use of reactive coupling circuits.

The batteries for powering the amplifier section of the wattmeter are mounted inside the rear cover of the wattmeter. Battery types used are listed in Table 1, Technical Characteristics.

1-5 Theory of Operation

When the Test Set is connected into the system, the output from the transmitter is connected to the input of the test set. The switches

are then positioned to insert the attenuators in the flow path as required. The attenuators are L-Pad design and there is one 3 dB and two 6 dB attenuators in the test set. This allows up to 15 dB of power reduction or 32 to 1 power reduction at the output connector than at the input connector of the test set.

The operation of this wattmeter is based on the traveling wave concept of RF transmission. As RF power is applied to a transmission line, there is a forward wave traveling from the transmitter to the antenna or load, and a reflected wave traveling from the antenna or load to the transmitter. The closer the antenna is matched to the transmission line, the smaller the reflected wave will be.

The plug-in elements sample the RF waves traveling through the line section and energy is produced in the coupling circuit of the plug-in element by inductance and capacitance. The inductive currents will flow according to the direction of the traveling waves producing them. The capacitance portion of these currents is independent of the traveling waves. The resultant is that the current produced from the waves traveling in one direction will add in phase, while the current produced from the waves traveling in the opposite direction will subtract in phase. Because of the highly directional characteristics of the element, the resultant direct current which is sensed by the microammeter indicates the power level of only the RF waves traveling in one direction depending on the rotation of the element in the socket.

Besides reading average power the wattmeter in the test set is designed to read peak power when the Peak button is depressed.

This is accomplished by use of a battery-powered Amplifier system that is inserted between the element output and the indicating meter

when the Peak read button is depressed. The battery check circuit is energized when the pushbutton is pressed. If the voltage of the 12-volt battery is within the limits necessary to properly operate the amplifier circuit, the needle of the meter will deflect beyond the battery test mark on the meter. If it fails to reach the mark, the batteries require replacement. The battery test circuit reads only the output of the 12-volt battery, but experience has indicated that the life of the 6-volt battery exceeds that of the 12-volt battery. Replacement of the two batteries simultaneously will assure that sufficient battery power will be available when the meter indicates in the required battery test range.

OPERATING INSTRUCTIONS

Section II

2-1 Controls and Instruments

The purpose, and use of operating controls and instruments are given in Table II.

Table II Controls and Instruments

Input RF Connector	Antenna input to be connected here.
Load RF Connector	Dummy Load input to be connected here.
3 dB Switch 1	The "IN" position reduces the transmitter output signal by a ratio of 2 to 1.
6 dB Switch 2	The "IN" position reduces the transmitter output signal by a ratio of 4 to 1.
6 dB Switch 3	The "IN" position reduces the transmitter output signal by a ratio of 4 to 1.
Antenna-Load Switch 4	This is the test set output switch. It determines to what output RF connector the power will be applied.
Wattmeter Toggle Switch	Determines whether wattmeter will read on the 1000 W range or 50 watt range.
Battery Test Button	When depressed, it causes meter to indicate state of battery charge.
Peak Read Button	In normal up position, meter indicates average power. When depressed, meter indicates peak power.

2-2 Installation

The test set can be installed in any convenient location near the transmitter. It should be positioned so it has free ciculation of the surrounding air. It is especially important that the top of the unit be kept free of any obstructions.

The RF connectors on the front of the test set are 50 ohm Female N connectors. Connections are readily made using Male N type cable plugs.

Before applying the transmitter power to the input the following checks should be made.

1. All cable connections to the RF connectors are secure.
2. The output switch is in the proper position, depending on whether the signal is going to the Antenna or Load.
3. The Attenuator switches are "IN" or "OUT" depending on what power reduction is required of the transmitter signal.
4. Make certain the pointer on the meter is on zero. Adjust the meter zero screw if necessary.
5. Press the "Battery Test" pushbutton and note the meter indication. The meter pointer must move to the area to the right of the "Battery Test" mark.
6. Put the Wattmeter toggle switch in the 1000 watt forward position.

2-3 Determining Peak Power

To determine peak pulse power or peak envelope power of the traveling waves, proceed the same as for average power, except that the Peak Read pushbutton should be depressed and turned 1/4 turn clockwise to lock in Peak Read position.

C A U T I O N

After using the wattmeter in the peak reading position, be sure to release the Peak Read pushbutton so that the switch is up. Battery life with the button down is approximately 50 hours. Releasing the button will extend calendar life of the batteries.

MAINTENANCE

Section III

3-1 Maintenance

Maintenance of the Model 3142 Power Reduction Test Set is normally limited to cleaning and periodically replacing the batteries for the wattmeter.

When the test set is not connected into a transmission system, it is good practise to keep the RF connector covered along with the top of the test set. This prevents dust and dirt from entering into the connectors and into the test set itself.

3-2 Cleaning

Clean the exterior of the test set with a clean, dry cloth. Clean the meter glass with a damp cloth.

Check the inside of the RF connectors on the front panel for dirt and contamination. Clean reachable portions of the connectors with a cotton swab stick. Blow out dirt if necessary with clean, dry, low-pressure compressed air.

3-3 Wattmeter Battery Replacement

This wattmeter uses battery power to operate the amplifier which provides peak power readings. Two batteries are required. Refer to Table 1, Technical Characteristics, for a listing of battery type requirements.

To install new batteries, proceed as follows:

a. Remove the four machine screws that secure the wattmeter panel to the front of the test set. Pull the wattmeter panel away from the test set carefully and rest in a convenient position.

b. Remove the six machine screws that secure the wattmeter back to the housing. Carefully pull the back from the housing.

C A U T I O N

Careless removal of the wattmeter back will break the wires that connect the batteries to the amplifier.

c. Open the metal retaining strap and remove old batteries and insert new batteries in position, carefully observing polarity markings on the battery bracket.

d. When batteries are positioned in the bracket, provided, re-install the strap to retain them.

C A U T I O N

After batteries are installed, make sure the unit is not allowed to stand unused with the Peak Read switch pushbutton in the depressed position. Battery life with the button depressed is approximately 50 hours.

e. Press the Battery Test pushbutton and watch the meter indication. The meter pointer must move to the right of the Battery Test mark. If the meter fails to indicate to the required level with new batteries, it is probably due to incorrect installation of the batteries, or battery leads that were damaged due to rough handling.

f. When proper meter indication is attained, install the meter back panel with the six machine screws.

TROUBLESHOOTING

4-1 Troubleshooting Chart

Table III, Troubleshooting Chart, provides a list of the most probable causes of trouble which might develop in the Wattmeter. For each trouble there is a list of probable causes and remedies. Refer to the troubleshooting chart in the event of trouble in the test set.

Table III - Troubleshooting Chart

Symptom	Probable Causes	Remedy
No Meter Indication (average or Peak)	No RF Power Applied to test set.	Check Transmitter and Cables.
	Defective Attenuation Switch	Replace Switch
	Open or shorted DC Meter Cable.	Replace Cable.
	Defective Meter.	Replace Meter.
No Meter Indication (Peak only)	Battery leads broken.	Repair Battery Leads.
	Defective components in Amplifier Assy.	Replace Amplifier Assy.
Intermittent or Inconsistent Meter Readings.	Faulty Antenna or Load	Correct Fault in Antenna or Load.
	Faulty Transmission Line	Correct or Replace Transmission line.
	Faulty Attenuator Switch	Correct or replace Switch.
	Faulty RF Connectors	Correct or replace Connectors.
	Faulty Attenuator	Replace Attenuator
	Sticking or Defective Meter.	Replace Meter

4-2 Method of determining Attenuator trouble.

The following procedure can be used to determine if one of the Attenuators may be in need of replacement. The test consists of a simple D.C. Resistance Check at the input connector and at the load output connector. The test equipment necessary is an accurate Ohmmeter or Wheatstone Bridge with an accuracy of at least 1 percent.

A. Checking the 3 dB Attenuator

1. Connect DC Resistance measuring equipment to the input connector. The output switch should be in the load position and the connector should be left open without any termination.
2. The 3 dB attenuator switch should be in the "IN" position and the two 6 dB switches in the "OUT" position.
3. Measure R_{dc} and record. It should measure 138 ohms ±5 ohms.
4. Connect the DC Resistance measuring equipment to the load output connector and let input connector be open without connection.
5. Measure R_{dc} and record. It should measure 123 Ohms ±5 ohms.
6. If R_{dc} measurements are outside specifications, then before replacing, make certain there are no loose RF connections and check cables by making DC continuity checks for open or short circuits. A meggar test would help to show cable problems under power conditions.

B. Checking the 6 dB Attenuators

1. Repeat step 1 for checking 3 dB attenuators.
2. The first 6 dB attenuator switch should be in the "IN" position and the other 6 dB and the 3 dB switches should be in the "OUT" position.
3. Measure R_{dc} and record. It should measure 75 ohms ±4 ohms.
4. Repeat step 4 for checking 3 dB attenuator.
5. Measure R_{dc} and record. It should measure 51 ohm ±2.5 ohms.
6. If R_{dc} measurements are outside specifications, then before replacing, make certain there are no loose RF connections and check cables by making DC continuity checks for open or short circuits. A meggar test would help to show cable problems under power conditions.
7. Repeat steps 1 through 6 for the second 6 dB attenuator, remembering to switch "IN" this attenuator and switch "OUT" the other 6 dB attenuator that was just measured.

SECTION V

REPAIR

5-1 General

Repair of the Power Reduction Test Set, Model 3142 consists primarily of replacement of faulty components and assemblies. Because most parts are operating at levels much lower than their rated levels, the frequency of part replacement is very low, provided the unit is properly handled, not subjected to excessive loads, and properly maintained. If repair or parts replacement is required, follow procedures consistent with good electronic repair practice.

5-2 Attenuator Removal and Replacement

a. Remove the front and back cover plates of the test set by removing the four side screws that hold it to the main body. The back cover plate can completely withdrawn, however the front cover plate should be carefully extended forward because of cabling attached to the Switches, RF Connectors, and to the Wattmeter.

b. Remove the cabling attached to the input and output of the attenuator. Make certain to mark the ends of the cable so that they can be properly reconnected later.

c. Remove the four screws from the bracket feet of the attenuator that hold it to the main body. The Attenuator can be removed and replaced with a new unit.

d. Installing a new Attenuator should be done in the inverse order to the old unit that was removed.

5-3 Attenuation Switch Removal and Replacement

a. Remove the front panel cover plate of the test set by removing the four side screws that hold it to the main body. Carefully pull it forward until the cabling can be removed from the Switch.

b. Make certain to mark the ends of the Cable with the switch connector identification it was attached to. Cable connections to the Switches must be correct, otherwise the Power Reduction Test Set will not function properly. Therefore, whenever, a cable is disconnected from a switch it must be returned to the identical connector on a new switch.

c. After cabling has been marked and disconnected, remove the 3 screws on the front of the switch. Before removing the screws completely, remove the knob by unthreading the Allen screw in the knob.

d. The Switch can then be removed and a new one installed in the inverse order to the old one that was removed.

5-4 Meter Removal and Replacement

a. Remove the four machine screws that secure the wattmeter panel to the front of the test set. Pull the wattmeter panel away from the test set carefully and rest in a convenient position.

b. Remove the six machine screws that secure the wattmeter back to the housing. Carefully remove the back panel from the housing. Disconnect the leads from the meter terminals. These are friction-type slip-on connections.

c. Remove the two machine screws that hold the meter at the sides of the meter housing. Lift the meter from the housing.

d. Position the new meter in the housing; secure with two machine screws. Connect the leads of the meter cable to the meter, making sure the color codings on the meter coincide with the wire colors. Install the back panel on the wattmeter housing.

5-5 Amplifier Removal and Replacement

a. Remove the back panel from the wattmeter. Disconnect the three battery cable leads from the terminals of the amplifier. Disconnect the two meter cable leads from the terminals of the amplifier.

b. Disconnect the DC lead cable from the amplifier input terminal.

c. Remove the four machine screws that secure the amplifier assembly to the bottom of the housing. Lift the amplifier assembly from the housing.

d. Position the new amplifier assembly in the housing; secure with four machine screws.

e. Connect the leads of the battery cable and from the meter cable to the terminals of the amplifier, taking care to match the color codings of the terminals with the color codings of the cable leads.

f. Connect the DC cable between the amplifier and the line section.

g. Install the back panel on the meter assembly.

SECTION VI

Replacement Parts List

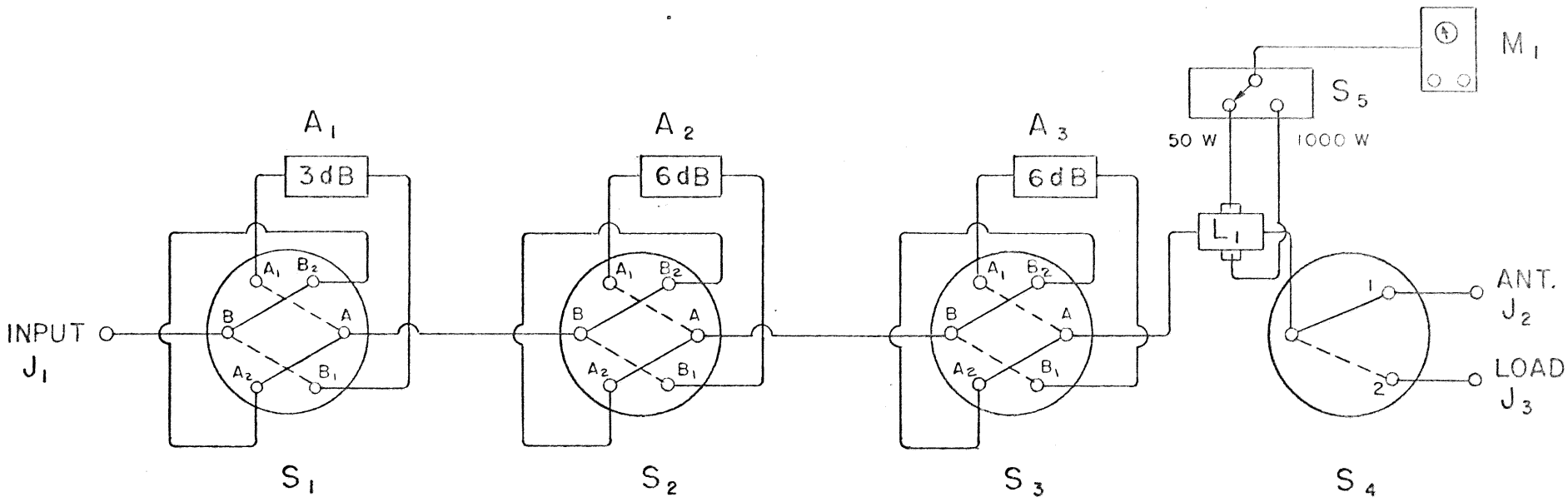
6-1 General

The parts list in this section list the replacement parts for the Power Reduction Test Set.

Replacement Parts List

Bird Part No.	Description	Qty.
8331-00	Attenuator, 3 dB	1
8332-00	Attenuator, 6 dB	2
72-2	Coaxial Switch	3
7422-000	Coaxial Switch	1
208011	Meter	1
4311-004	Amplifier Assy	1
1000H	Power Measuring Element	1
50H	Power Measuring Element	1
5-492	Battery, 12.6v (P.R. Mallory No. TR-169)	1
5-493	Battery, 5.4v (P.R. Mallory No. TR-164R)	1
4230-053	Line Section	1
4240-062	Line Section, Q.C. Female N Connector	1
4240-063	Line Section, Q.C. Male N Connector	1

SCHEMATIC DIAGRAM (MODEL 3142)



J_1, J_2, J_3 - FEMALE N JACKS, MOUNTED ON FRONT PANEL

S_1, S_2, S_3 - BEC MODEL 72-2 (2 CIRCUIT - 2 POSITION)

S_4 —— BEC MODEL 7422 (1 CIRCUIT - 2 POSITION)

S_5 —— D_P D_T - RANGE SELECTOR SWITCH

A_1 — BEC MODEL 8331 ATTENUATOR, 3dB

A_2, A_3 — BEC MODEL 8332 ATTENUATOR, 6dB

L_1 — BEC 4230-053 LINE SECTION WITH 1000H AND 50H ELEMENTS.

M_1 — WATTMETER ASSEMBLY.