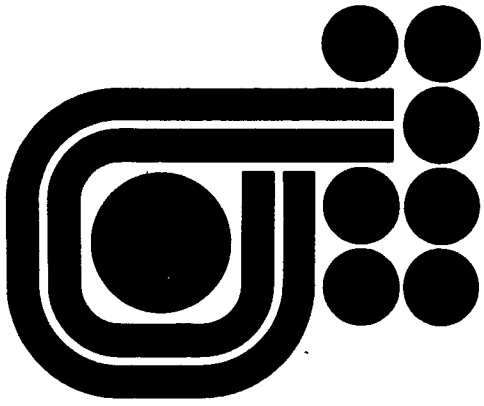
ELECTROSURGERY ANALYZER
Model RF301B

OPERATOR'S MANUAL



BIO-TEK
INSTRUMENTS, INC.

1 MILL STREET
BURLINGTON, VERMONT 05401

TO: RF301B Users
FROM: Allen Devoid/Applications Engineer
SUBJECT: RF Leakage Mesurement
DATE: March 9, 1982

To avoid damaging ESU when measuring RF leakage of the ACTIVE ELECTRODE, set RF301B "LOAD RESISTANCE" to "500 ohm" and push both "OPEN CIRCUIT" and "ACTIVE ELECTRODE" test switches simultaneously.

BIO-TEK
ELECTROSURGERY ANALYZER
MODEL RF301B

OPERATOR'S MANUAL

MANUAL PART NUMBER - 94013

REVISION C

FOR

SERIAL NUMBER 2000 AND UP

MANUAL PRICE $10

FROM

BIO-TEK INSTRUMENTS, INC.
ONE MILL STREET
BURLINGTON, VT 05401 U.S.A.
(800) 451-5172

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1.0 INTRODUCTION

The Model RF301B is designed to measure the power output of electrosurgery units. The instrument is accurate and simple to operate. Test data can be used for calibration, quality assurance diagnosis and reference for establishing trends in the operating performance of electrosurgery units.

1.1 Application

The Model RF301B can be used by technical and non-technical personnel to test all electrosurgery units. The proper operation of an electrosurgery unit and calibration are easily accomplished using the Model RF301B. The power output can be recorded for each setting of the electrosurgery unit on the RF3R tag and attached to the front panel so that personnel using the electrosurgery unit can depend on the consistancy of the power output.

The Model RF301B can be used by professional people in the operating room or by engineering and maintenance people during routine inspections. It is portable and easily transported from facility to facility. The rugged case makes the Model RF301B ideal for field service work.

1.2 Establishing Test Criteria

The acceptable output and standard for performance should include the manufacturer's specifications with respect to power output at a specified load and a specified frequency. The manufacturer's specifications are bench marks to use in establishing acceptable performances.

Safety standards should be established for electrosurgery units as well as all other devices used in the hospital. (See electrical Safety Program Guide; contact the factory.)

1.3 Incoming Inspection

Check the shipping carton for the following accessories which are shipped with every model.

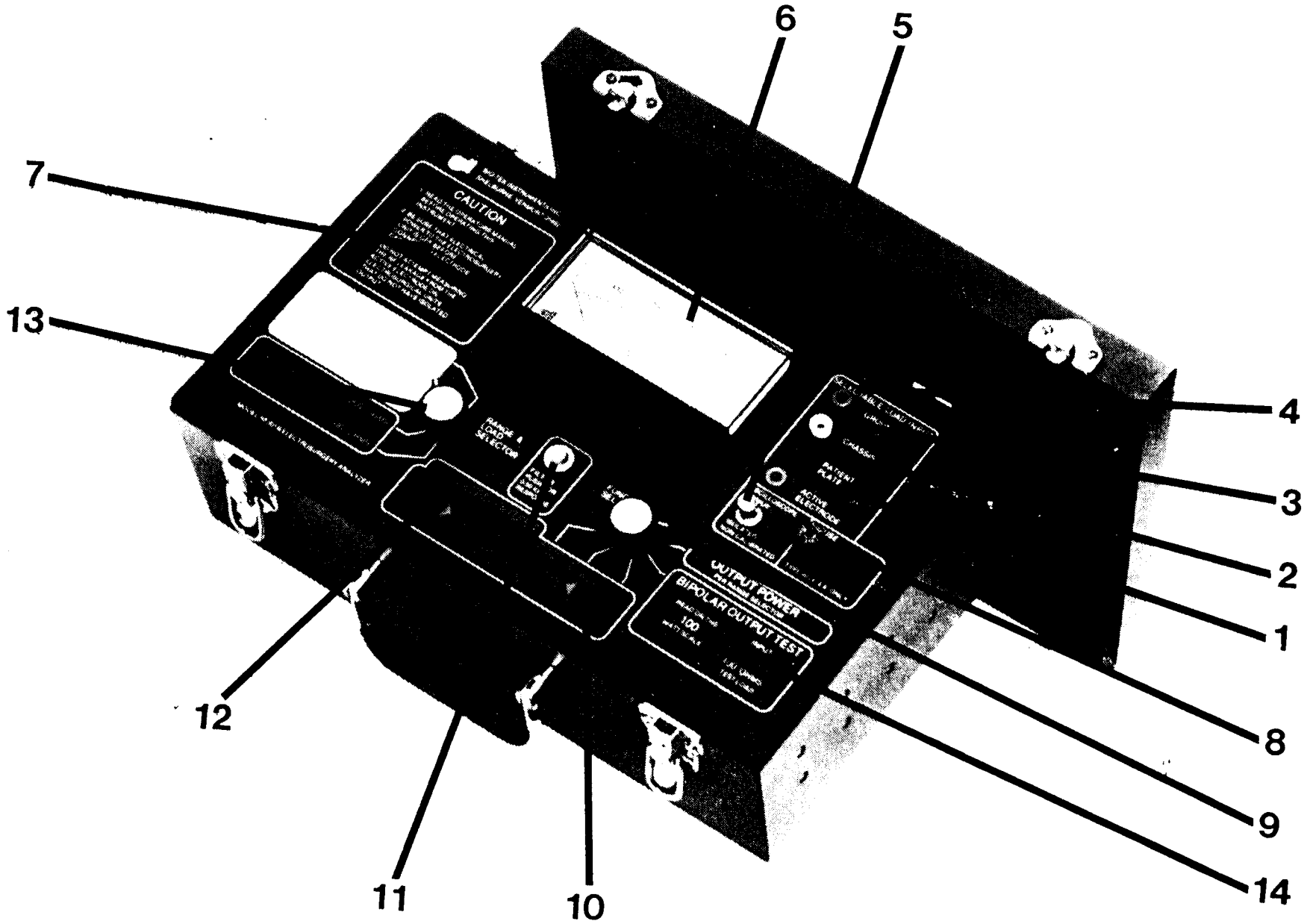
1 red 5' lead with banana plug on both ends
1 black 5' lead as above
1 white 5' lead as above
1 green 5' lead as above
1 large clamp with banana jack
3 alligator clips
100 RF3R inspection labels
2 instruction manuals
1 ground adapter
5 fuses

Check the Model RF301B for damage. If damage is found, retain the shipping container and packing and file a claim with the carrier.

2.0 DESCRIPTION

The Model RF301B is enclosed in a reinforced Formica™ case with a removable cover. The case has air holes on all sides and the bottom to facilitate cooling of the power resistors. Care should be taken not to allow liquids to penetrate the case. The front panel houses the meter, fuses, jacks, function switch, range switch, and filter switch. In the upper right hand corner are abbreviated instructions.

A prop bar is located at the bottom of the case to tilt the Model RF301B for easier view during measurement.


6
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CAUTION
RANGE & LOAD SELECTION
OUTPUT POWER
BIPOLAR OUTPUT TEST
ACTIVE ELECTRODE
PATIENT PLATE

FRONT PANEL FUNCTIONS

1.	ACTIVE ELECTRODE JACK	Connects the RF301B to the active electrode of the electrosurgery unit.
2.	PATIENT PLATE JACK	Connects the RF301B to the patient or ground plate of the electosurgery unit.
3.	CHASSIS JACK	Connects the RF31B to the chassis of the electrosurgery unit.
4.	GROUND JACK	Connects the RF301B to ground for isolation measurements.
5.	OSCILLOSCOPE OUTPUT CONNECTOR	Allows the waveform of the electrosurgery unit to be analyzed under load conditions.
6.	METER	Large meter reads directly in power on four ranges, 0-25, 0-100, 0-500, and 0-670 watts.
7.	ABBREVIATED INSTRUCTIONS	Provides user with step by step test procedure for easy reference.
8.	FUSE	Protects the sensitive meter from overloads.
9.	FUNCTION SWITCH	Selects the desired test from either output power or the various isolation tests.
10.	ACTIVE ISOLATION SWITCH	This switch protects the meter from accidental connection to high power.
11.	FILTER SWITCH	Allows the operator to measure only that portion of the power in the range of human sensation.

12. OPEN CIRCUIT SWITCH	This push button allows "no load" R.F. leakage to be tested.
13. RANGE SWITCH	Selects the load and meter range for proper measurement of all types of electrosurgery unit outputs.
14. BIPOLAR INPUT JACKS	This connects a bipolar ESU to the 100 ohm 100 watt range.

3.0 OPERATING INSTRUCTIONS

3.1 Safety Precautions

Electrosurgery units emit high frequency currents at voltages from 100 to 500 volts. The operator must be certain that the electrosurgery unit is off or non-active when making the necessary connections.

3.2 Ranges

Each load setting on the range switch is read on a particular scale on the meter. The meter scale to be read is indicated on the front panel near the range switch under " Range". The 500 indicates that for load impedance of 300, 400, 500 ohms, the middle black scale 0-500 watts is used.

The 670 indicates that for load impedances of 200 and 100 ohms, the lower blue scale of 0-670 watts is used.

The only time that neither of these scales is used is when the funciton switch is on "Isolated Output" or the Bipolar input is being used. When the funciton switch is on "Chassis", "Patient Plate", or "Active Electrode", the scale to be used is the top red scale which reads 0 to 25 watts. When the funciton switch is on Bipolar output, the brown 10 watt scale is used.

3.3 Set-Up Measurements for Variable Load Output

1. Connect the color-coded leads to the appropriate colored jacks on the Model RF301B.
2. Connect the small alligator clip to the other ends of the black and red leads.
3. Connect the large alligator clip to the free end of the white lead.
4. Connect the ground adapter to the free end of the green lead.
5. Turn the function switch to "Output Power".
6. Place the "range" switch in the load impedance desired.
7. Plug the electrosurgery unit into an appropriate power receptacle.
8. Plug the patient plate electrode (ground plate) into the electosurgery unit and attach the black lead to the other end of the electrode.
9. Plug the active electrode lead into the electrosurgery unit and attach the red lead to the active electrode.

10. Insulate both leads from each other and other conductive surfaces using a dry cloth.

11. Plug the green lead with the ground adapter into a ground pin of a grounded receptacle.

12. Attach the white lead with the large clamp to the chassis of the electrosurgery unit. Make sure the clamp is on a bare screw or connector that is attached to the chassis.

13. This set up permits all tests to be made.

3.4 Output Measurement

1. Consult the manufacturer's specifications for load impedance for power specifications.

2. Set the range switch on the load specified.

3. Fill in the data on the top of the electrosurgery unit performance record tag and indicate by the serial number the load impedance used for output measurements.

4. Turn the electrosurgery unit "ON".

5. Set the power setting of the electrosurgery unit on the first setting or part way up.

6. Activate the cut and then the coag switch and record the power setting, cut power, and coag power on the "Performance Record" tag.

7. Repeat step 6 for four more power settings up to and including full power.

3.5 Heavy Load Test

1. Put the function switch of the Model RF301B on "Output Power".

2. Set the range switch on the 100 ohm, 670 watt range.

3. Set the electrosurgery unit on a power setting used in Section 3.3.

4. Turn the electrosurgery unit ON and activate the cut switch.

5. Compare the power output with the output obtained with the manufacturer's test load in Section 3.3.

6. Activate the coag switch and compare the reading.

7. Test other power settings in the same manner including the maximum power setting.

8. The output power may be different. If the output power is less than half the output obtained in Section 3.3, the electrosurgery unit should be checked by maintenance.

9. Record the output power at maximum setting on the Inspection Tag.

3.6 Low Frequency Output Test

1. Set the range of the Model RF301B on the electrosurgery unit manufacturer's recommended test load.

2. Set the function switch of the Model RF301B on "Output Power".

3. Set the power setting of the electrosurgery unit on the maximum setting.

4. Turn the electrosurgery unit "ON".

5. Activate the cut switch.

6. Push the "Filter" switch.

7. The Model RF301B should read zero or less than 10 watts.

8. Push the coag switch and again the RF301B should read zero or less than 10 watts.

9. If the RF301B reads zero or less than 10 watts on the above two tests, check "negligible" in the "Isolation Test" on the performance record.

10. If there is a substantial reading when the "Filter" button is activated, the proper operation of the electrosurgery unit must be checked before use. Check the "Not Satisfactory" square on the performance record.

3.7 Isolation Check

Care must be taken in measuring the radio frequency (RF) leakage from the chassis and electrodes to ground. On electrosurgery units with isolated output electrodes, the radio frequency leakage must be measured from the chassis, the patient plate and the active electrode. On non-isolated electrosurgery units, only the chassis and ground plate radio frequency leakage can be measured. <u>DO NOT MEASURE THE RADIO FREQUENCY LEAKAGE FROM ACTIVE ELECTRODE ON NON-ISOLATED ELECTROSURGERY UNITS</u>. The Model RF301B may be damaged if this is done.

The high frequency leakage to ground from the electosurgery analyzer is measured as follows.

1. Set the range switch on the load recommmended by the

manufacturer.

2. Set the power setting of the electrosurgery unit on the maximum setting.

3. Turn the electrosurgery unit "ON".

4. Turn the function switch to "Chassis" isolation.

5. Operate the cut switch. Read the leakage under load on the top scale.

6. Push the Open Circuit Switch and then operate the cut switch for open circuit RF leakage.

7. Operate the coag switch. Read the leakage under load on the top scale.

8. Push the Open Circuit Switch and operate the coag switch for open circuit RF leakage.

9. Turn the function switch to "Patient Plate". Operate the electrosurgery analyzer and read the leakage on the red scale.

10. Repeat step 9 while pushing the open circuit switch. This provides open circuit RF leakage.

    DO NOT CARRY OUT THE NEXT STEP UNLESS THE ELECTROSURGY UNIT HAS AN ISOLATED OUTPUT. Proceed to step 13 for non-isolated electrosurgery units.

11. Turn the function switch to "Active Electrode" and operate the electrosurgery unit while pushing the test switch under the Active Electrode switch.

12. Repeat step 11 while pushing both the Open Circuit switch and the Active Electrode switch.

13. If the maximum RF leakage is less than the manufacturer's specifications or less than established limit, check "O.K." on the performance record.

3.8 Measuring the Output Current of Electrosurgery Units.

The Model RF301B meter reads the power output of electrosurgery units. If the r.m.s. current (root mean square current) is desired, it can be calculated.

The Current "I" is equal to the square root of the Power "P" divide by the Load Impedance "Z". In equation form it is as follows:

$$I = \sqrt{P/Z}$$

For example, given a power reading of 410 watts on the 50 ohm range, current is:

$$I = \sqrt{410/500}$$

$$I = \sqrt{.82}$$

$$I = .906 \text{ amperes r.m.s.}$$

See Table 1 for easy reference to many current levels.

TABLE 1
Power To Current Conversion For The Model RF301

CURRENT	POWER			
Current "I" Amperes (r.m.s.)	500 Ohm Load (Watts)	400 Ohm Load (Watts)	200 Ohm Load (Watts)	100 Ohm Load (Watts)
.10	5	4	2	1
.20	20	16	8	4
.30	45	36	18	9
.40	80	64	32	16
.45	101	81	41	20
.50	125	100	50	25
.55	151	121	61	30
.60	180	144	72	36
.65	211	169	85	42
.70	245	196	98	49
.75	281	225	113	56
.80	320	256	128	64
.85	361	289	145	72
.90	405	324	162	81
.95	451	361	181	90
1.00	500	400	200	100
1.05	-	441	221	110
1.10	-	484	242	121
1.15	-	-	265	132
1.20	-	-	288	144
1.25	-	-	313	156
1.30	-	-	338	169
1.35	-	-	365	182
1.40	-	-	392	196
1.45	-	-	421	210
1.50	-	-	450	225
1.55	-	-	481	240
1.60	-	-	512	256
1.65	-	-	545	272
1.70	-	-	578	289
1.75	-	-	613	306
1.80	-	-	648	324
1.85	-	-	-	342
1.90	-	-	-	361
2.00	-	-	-	400
2.10	-	-	-	441
2.20	-	-	-	484
2.30	-	-	-	529
2.40	-	-	-	576
2.50	-	-	-	625
2.60	-	-	-	676

.9 Measuring the Output Voltage of Electrosurgery Units

The A.C. r.m.s. voltage of electrosurgery units can be calculated. The output voltge is equal to the square root of the product of the Power "P" and the Load Impedance "Z". In equation form:

$$V = \sqrt{P \times Z}$$

For example, given a power reading of 41 watts on the 500 ohm range, the voltage is:

$$V = \sqrt{410 \times 500}$$

$$V = \sqrt{205{,}000}$$

$$V = 452.8 \text{ volts R.M.S.}$$

See Table 2 for easy reference to many voltages.

TABLE 2
Power To Voltage Conversion For The Model RF301

VOLTAGE	POWER			
Voltage Volts (r.m.s.)	500 Ohm Load (Watts)	400 Ohm Load (Watts)	200 Ohm Load (Watts)	100 Ohm Load (Watts)
50	5	6	13	25
60	7	9	18	36
75	11	14	28	56
85	15	18	36	72
100	20	25	50	100
110	24	30	61	121
125	31	39	78	156
135	37	46	91	182
150	45	56	113	225
160	51	64	128	256
175	61	77	153	306
185	68	86	171	342
200	80	100	200	400
210	88	110	221	441
225	101	127	253	506
235	110	138	276	552
250	125	156	312	625
260	135	169	338	676
275	151	189	378	-
300	180	225	450	-
325	211	264	528	-
350	245	306	613	-
375	281	352	-	-
400	320	400	-	-
425	361	452	-	-
450	405	506	-	-
475	451	-	-	-
500	500	-	-	-

.10 Measuring the R.F. Leakage to Ground in Milliameters

The A.C., r.m.s. current flow to ground during R.F. isolation testing can be calculated from the power readings. Using ohms law, the current is equal to the square root of the power, R, divided by the resistance load, Z.

$$I = \sqrt{P/Z}$$

For example, given a power reading of 4 watts, the current is:

$$I = \sqrt{4/100}$$

$$I = \sqrt{.04}$$

$$I = 200 \text{ milliamps}$$

See Table 3 for easy reference to many voltages.

.11 Measuring Output of Bipolar Electrosurgery Devices.

1. Connect any two leads from the two brown "Bipolar input" jacks to the bipolar output of the electrosurgery device.

2. Put the function switch on "Bipolar Output".

3. Turn the electosurgery unit on and adjust the output power to various levels.

4. Read on the brown 100 watt scale.

.12 Measuring Power Output of Low Power Electosurgery Devices (0 to 25 watts).

1. Put the function switch on "ISOLATED OUTPUT - PATIENT PLATE".

2. Connect the output of the electrosurgery device (two leads) to the black PATIENT PLATE jack and to the green GROUND jack. Disconnect all other leads.

3. Set the electrosurgery device to minimum power then turn it on and adjust for the desired level. Read power output on the red 25 watt scale.

CAUTION: Application of excess power (greater than 25W) will blow the fuse and could possibly damage the instrument. When in doubt, start with a higher scale such as in section 3.11.

TABLE 3

Power to Current Conversion for the R.F. Isolation Scale 0-25 Watts

POWER Watts	CURRENT Milliamperes
1	100
2	141
3	173
4	200
5	223
6	245
7	264
8	283
9	300
10	316
11	331
12	346
13	361
14	374
15	387
16	400
17	412
18	424
19	436
20	447
21	458
22	469
23	479
24	489
25	500

NOTE: When set up as in steps 1, and 2, above, the position of the RANGE & LOAD switch and the two slide switches have no effect on the readings obtained.

.13 Oscillosocpe Output

The Model RF301B is equipped with a BNC connector that is inductively coupled to a conductor internal to the Model RF301B. This permits viewing of the waveform to verify proper operation of the electrosurgery unit. The oscilloscope output is not calibrated for amplitude, however, precise frequency measurement can be made.

1. To use the oscilloscope output, connect an oscilloscope to the output connector.

2. Set the amplitude selector of the oscilloscope on 1 volt/cm.

3. Set the time sweep selector on 1 microsecond/cm

4. Then adjust the signal to maximum amplitude and time for effective analysis while using the maximum output power of the electrosurgery unit.

.0 THEORY

The Model RF301B is a precise instrument for measuring the output power of electrosurgery units. The Model RF301B simulates the load seen by the electrosurgery machine during an operation. The resistive loads inside the Model RF301B are nonindictive, accurate and will not be damaged by prolonged use at the maximum output of the electrosurgery machine. The measuring system is a precise thermocouple which measures the electrical power for any frequency from D.C. to 2 megahertz. The thermocouples are connected to a precision analogue meter which reads directly in power. The meter is protected by a fast blow instrument fuse.

The filter switch is connected to precision inductive and capacitive components which act as a low pass filter. The meter will read the low frequency component of the incoming power when the filter switch is activated.

5.0 SERVICE INFORMATION

The Model RF301B is a rugged instrument and service should be minimal. If problems do arise, there may be several causes that are easily diagnosed.

5.1 Blown Fuse

1. If the Model RF301B does not read anything during the tests described in Section 3, the fuse may be blown.
2. Remove the fuse by unsrewing the fuse holder cap.
3. Examine the fuse to see if the slim strand of wire in the glass tube is broken.
4. Test the fuse with an ohmmeter if possible. The impedance from one end of the fuse to the other should be less than 1.5 ohms.
5. If the fuse is blown, replace the fuse with the spare fuse.
6. If the fuse is not blown proceed to Section 5.2.

5.2 Faulty Thermocouple

1. If the Model RF301B does not read anything during the tests described in Section 3 and the fuse isn't blown, the power measuring themocouple may be faulty.
2. Remove the four screws in each corner of the front panel of the Modle RF301B.
3. Carefully lift the front panel out of the case and tilt the back up towards you.
4. Using an ohmmeter, measure the impedance of the meter. Connect one lead to each terminal of the meter and take a reading. The resistance should be below 5 ohms.
5. If the resistance is greater than 5 ohms, the thermocouple is faulty.
6. A new meter can be ordered from the factory at a nominal charge or the Model RF310B can be returned to the factory for repair.

6.3 Warranty Repair

If the Model RF301B malfuncitons during the first year of use, return it to the factory prepaid, insured for $950.00 to the following address:

Service Department
Bio-Tek Instruments, Inc.
One Mill Street
Burlington, VT 05401

The instrument will be repaired at no charge unless there is evidence of abuse.

6.0 SPECIFICATIONS

Selectable Loads and Ranges for Power Output:

Load (ohms)	Range (watts)
500	500
400	500
300	500
200	670
100	670

Bipolar Output: Load = 100 ohms. Range 0-100 watts

Isolation Test Load: Selectable, 500, 400, 300, 200, or 100 ohms

Isolation Test Range: 0-25 watt using 100 ohms to ground

Isolation Tested From: Plate, Electrode and Chassis

Frequency Response: 0-50K Hz (with frequency switch pushed)
0-5 Mega Hz

Load Accuracy: ± of range load selected.

Power Output Accuracy: ± 5% of full meter scale of selected range.

Current Conversion: Chart is supplied in Instruction Manual

Physical Dimensions: Height 12.7cm/5"

Width 37cm/14 3/8"

Depth 24cm/8 3/4"

Weight 5Kg/11 lbs.

Oscilloscope: Isolated through a transformer (uncalibrated)

Power Requirements: None

Display Capability: Large 4 1/2" meter

Scale Division for Meter:

Range (watts)	Divisions (watts)
500	10
670	20
25	0.5
100	2

7.0 CALIBRATION AND INSTRUMENT CHECK

The Model RF301B is an ultrastable instrument. It is recommended that the instrument be returned to the factory every two years for a calibration check. Return the Model RF301B to the factory, prepaid and insured, with a purchase order requesting a calibration check.

7.1 Calibration Check

7.1.1 Set the funciton switch on "Output Power".

7.1.2 Connect the red and black leads to red and black jacks on the Model RF301B.

7.1.3 Connect the red lead and the black lead to a 120 volt power source. An adapter cord set is available from the factory. It connects 120 volts plug through a 2 amp fuse to two banana plugs that insert into the Model RF301B. (Adapter Cord Set, Model RF102, $15.00.)

7.1.4 With the Model RF301B connected to the 120 volt power supply, the correct meter reading can be calculated.

Correct Meter Reading (C.M.R.) - V^2/R

Where the V^2 is the A.C. voltage at the receptacle and R is the resistance the range switch is on. The accuracy of the Model RF301B is $\pm$ 5% of full scale. The readings thus obtained on the 500 range must be within 25 watts of the calculated C.M.R. The reading on the 670 range must be within 33.3 watts. For example, on the 500 range, at 120 volts, the meter should read (120 x 120)/500.

$$\text{C.M.R.} = \frac{14,400}{500}$$

$$\text{C.M.R.} = 28.8 \text{ watts}$$

if the Model RF301B reads from 5 to 50 watts, the RF301B is within specification, however, the RF301B should read close to 28 watts.

On the 400 range at 120 volts, the meter should read:

$$\text{C.M.R.} - \frac{14,400}{400} = 36 \text{ watts } (\pm 25 \text{ watts})$$

On the 300 range at 120 volts, the meter should read:

$$\text{C.M.R.} = \frac{14,400}{300} = 48 \text{ watts } (\pm 25 \text{ watts})$$

On the 200 range at 120 volts, the meter should read:

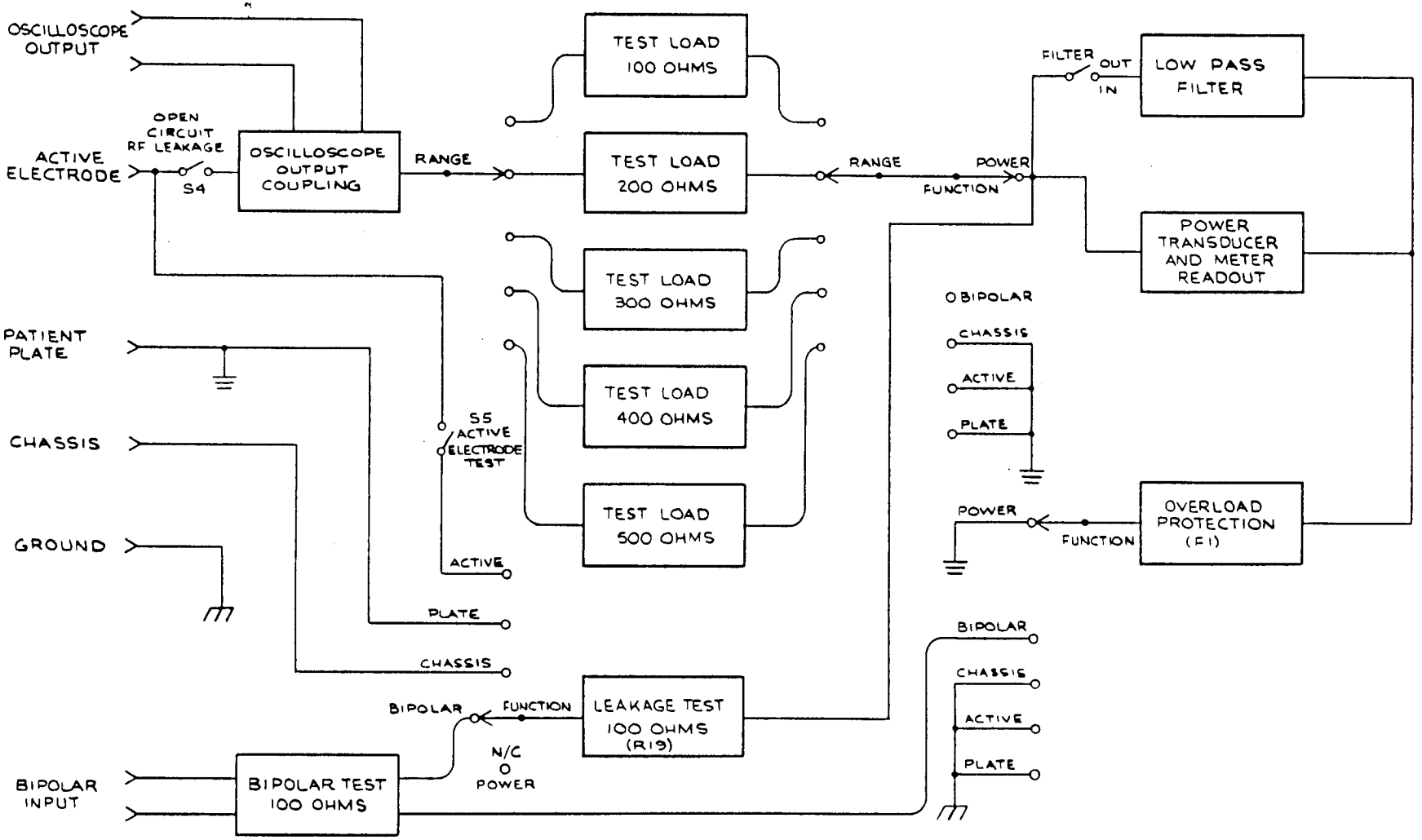
$$\text{C.M.R.} = \frac{14,400}{200} = 72 \text{ watts } (\pm 33.3 \text{ watts})$$

On the 100 range at 120 volts, the meter should read:

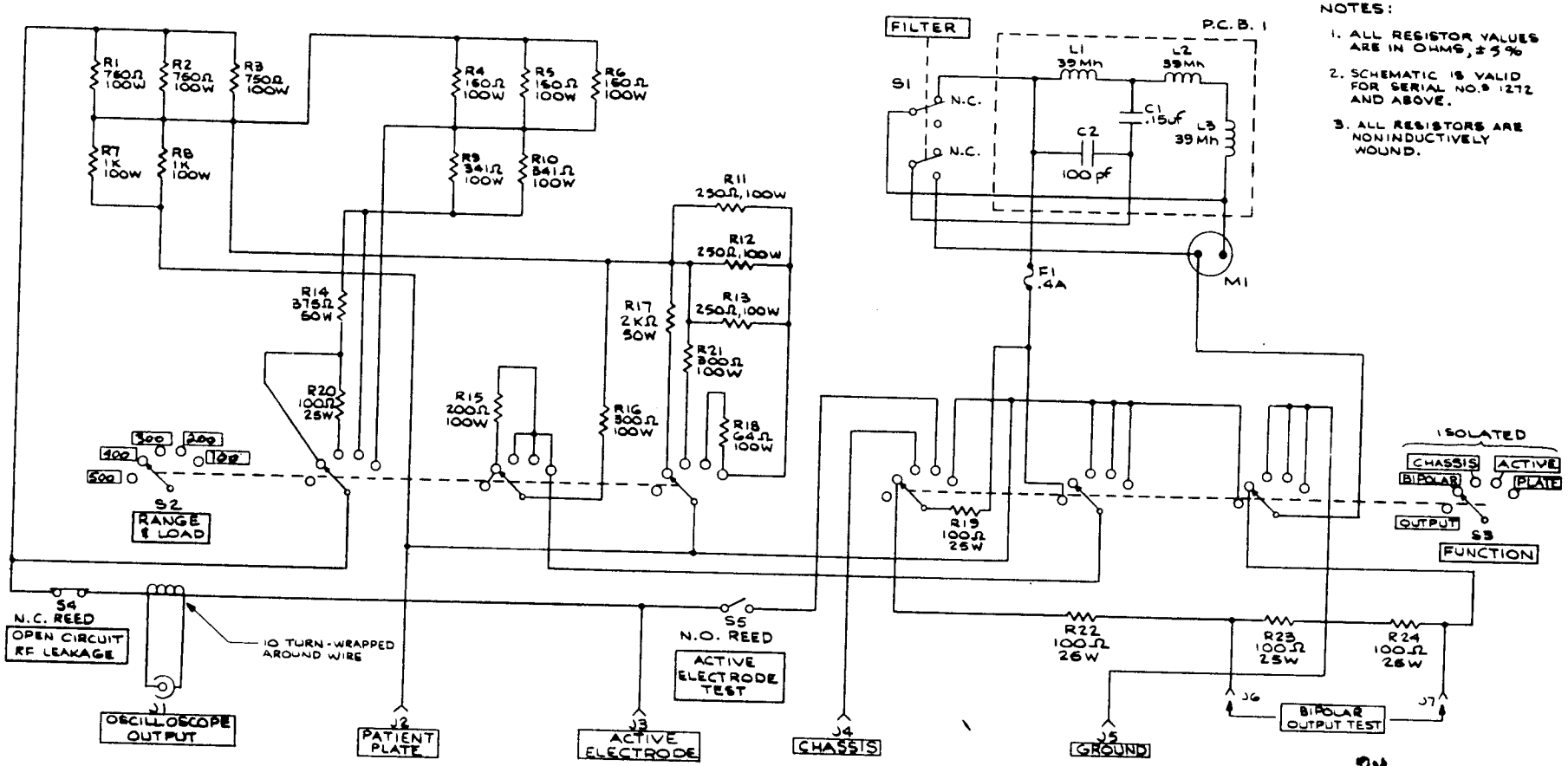
$$\text{C.M.R.} = \frac{14,400}{100} = 144 \text{ watts } (\pm 33.3 \text{ watts})$$

7.1.5 This test procedure verifies the proper operation of the Model RF301B.

7.1.6 If the Model RF301B does not indicate any power reading, consult Section 5.0, Service Information.



BLOCK DIAGRAM


NOTES:
1. ALL RESISTOR VALUES ARE IN OHMS, ± 5%
2. SCHEMATIC IS VALID FOR SERIAL NO.'S 1272 AND ABOVE.
3. ALL RESISTORS ARE NONINDUCTIVELY WOUND.
FILTER
P.C.B. 1
L1 39 MH
L2 39 MH
L3 39 MH
C1 .15 uf
C2 100 pf
S1
N.C.
N.C.
F1 .4A
M1
R1 750Ω 100W
R2 750Ω 100W
R3 750Ω 100W
R4 160Ω 100W
R5 160Ω 100W
R6 160Ω 100W
R7 1K 100W
R8 1K 100W
R9 341Ω 100W
R10 341Ω 100W
R11 250Ω, 100W
R12 250Ω, 100W
R13 250Ω, 100W
R14 375Ω 50W
R15 200Ω 100W
R16 300Ω 100W
R17 2KΩ 50W
R18 64Ω 100W
R19 100Ω 25W
R20 100Ω 25W
R21 300Ω 100W
R22 100Ω 25W
R23 100Ω 25W
R24 100Ω 25W
500
200
100
40Ω
50Ω
S2
RANGE Ω LOAD
ISOLATED
CHASSIS
ACTIVE
BIPOLAR
PLATE
OUTPUT
S3
FUNCTION
S4
N.C. REED
OPEN CIRCUIT RF LEAKAGE
10 TURN-WRAPPED AROUND WIRE
S5
N.O. REED
ACTIVE ELECTRODE TEST
J1
OSCILLOSCOPE OUTPUT
J2
PATIENT PLATE
J3
ACTIVE ELECTRODE
J4
CHASSIS
J5
GROUND
J6
J7
BIPOLAR OUTPUT TEST
BIO-TEK INSTRUMENTS, INC.
ONE MILL STREET
BURLINGTON, VT 05401
RF301B SCHEMATIC
DRAWN
CHK'D
DWG NO
3018004-SC
SCALE NONE
SHEET 1 OF 1
B Change S2 Label Order
A Release to Production & Rev per ECO 000044
DESCRIPTION
DATE/BY

MODEL: RF301B PARTS LIST

RUN#_____ QTY_____

301B001-PLB
FRONT PANEL ASSEMBLY

REV	DESCRIPTION	ECO	DATE	ENG	PROD
A	ORIGINAL	623	3/04/83		
B	CHANGE TO 7 DIGIT NUMBER	717	6/30/83		

PART # BIO-TEK	DESCRIPTION	MANUF. P/N	MANUFACT.	REF DESG.	QTY	EXT QTY
12019	4-40 x 3/16" PH SCREW				20	
12021	4-40 x 5/8" PH SCREW				2	
14004	6-32 HEX NUT				4	
14006	10-32 HEX NUT				2	
15006	10-32 LOCKNUT				2	
16003	#6 LOCKWASHER				4	
33035	300 100 WATT 5%			R16	1	
33036	200 100 WATT 5%			R15	1	
33038	64 100 WATT 5%			R18	1	
33039	375 100 WATT 5%			R14	1	
33040	2K 100 WATT 5%			R17	1	
33041	100 100 WATT 5%			R19,20 22,23,24	5	
42001	RED BANANA JACK			J3	1	
42002	BLACK BANANA JACK			J2	1	
42003	WHITE BANANA JACK			J4	1	
42004	GREEN BANANA JACK			J5	1	
42005	BROWN BANANA JACK			J6,7	2	
42006	BNC CONNECTOR			J1	1	
42031	22-18, 3/8 TERMINAL				1	
42036	16-14, #6				29	

	TERMINAL		
43024	P.C. BOARD	PCB-1	1
301B008	SUB-PANEL		1
44039	OVERLAY		1
45002	LARGE KNOB		2
45007	BLACK SQUARE BUTTON		2
46002	4/10 AMP FUSE	F1	1
46010	FUSE HOLDER		1
49014	PCB TERMINALS		4
301B009	REED SWITCH MOUNT		1
301B011	REED SWITCH SLIDER		2
49037	SPRING		1
49038	MAGNET		2
49048	LARGE SPRING CLIP		3
49049	SMALL SPRING CLIP		7
51010	POS. TO POS. SHORTING BAR		7
51011	DECK TO DECK SHORTING BAR		1
51006	ROTARY SWITCH	S2,3	2
52007	PUSH BUTTON SWITCH	S1	1
56001	REED SWITCH	S4,5	2
63001	39uH INDUCTOR	L1,2,3	3
83002	100PF CAP	C2	1
84004	.15uF CAP	C1	1
92006	METER	M1	1
301B013	DRESS NUT		1

MODEL: RF301B PARTS LIST PAGE_1_OF_1_

RUN#_____ QTY_____

301B002-PLB
RESISTOR PACK

REV	DESCRIPTION	ECO	DATE	ENG	PROD
A	ORIGINAL				
B	CHANGE 44054 TO 301B010	1148	10/24/83		

PART # BIO-TEK	DESCRIPTION	MANUF. P/N	MANUFACT.	REF DESG.	QTY	EXT QTY
19003	POP RIVET				26	
33031	750 100 WATT 5%			R1,2,3	3	
33032	1K 100 WATT 5%			R7,8	2	
33033	150 100 WATT 5%			R4,5,6	3	
33034	341 100 WATT 5%			R9, 10	2	
33035	300 100 WATT 5%			R21	1	
33037	250 100 WATT 5%			R11,12, 13	3	
301B010	MOUNTING PLATE				1	
49048	LARGE SPRING CLIP				14	

MODEL: RF301B

PARTS LIST

PAGE 1 OF 1

RUN#_____

QTY_____

301B003-PLA
CASE ASSEMBLY

REV	DESCRIPTION	ECO	DATE	ENG	PROD
A	ORIGINAL				

PART # BIO-TEK	DESCRIPTION	MANUF. P/N	MANUFACT.	REF DESG.	QTY	EXT QTY
12035	6-32 x 3/4" BLACK SCREW				4	
17010	1/8" WASHER				3	
19006	POP RIVET				7	
44018	FORMICA CASE				1	
49074	10" BAIL W/FEET				1	
93021	SERIAL NUMBER TAG				1	
49076	RIGHT STAND SUPPORT				1	
49077	LEFT STAND SUPPORT				1	

MODEL: RF301B

PARTS LIST

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RUN#_____

QTY_____

301B006-PLC
ACCESSORIES

REV	DESCRIPTION	ECO	DATE	ENG	PROD
A	ORIGINAL				
B	ADD 71005	849	8/09/83		
C	DELETE 71005, ADD 71007	889	9/02/83		

PART # BIO-TEK	DESCRIPTION	MANUF. P/N	MANUFACT.	REF DESG.	QTY	EXT QTY
46002	4/10 AMP FUSE				5	
48003	LARGE CLAMP				1	
48005	GROUND ADAPTER				1	
48008	BLACK STACKING PLUG				2	
48009	ALLIGATOR CLIP				3	
48020	WHITE STACKING PLUG				2	
48021	RED STACKING PLUG				2	
48022	GREEN STACKING PLUG				2	
71007*	GREEN, 16 AWG WIRE				5'	
71007*	BLACK, 16 AWG WIRE				5'	
71007*	WHITE, 16 AWG				5'	
71007*	RED, 16 AWG WIRE				5'	

*NOT KITTED