♦ PRECISION INSTRUMENTS FOR TEST AND MEASUREMENT ♦

1840-A SERIES

Output Power Meter

User and Service Manual

1840-A im/September, 2002

IET LABS, INC.
Standards • Decades • Strobes • Sound Level Meters • Bridges
formerly manufactured by GenRad
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WARRANTY

We warrant that this product is free from defects in material and workmanship and, when properly used, will perform in accordance with applicable IET specifications. If within one year after original shipment, it is found not to meet this standard, it will be repaired or, at the option of IET, replaced at no charge when returned to IET. Changes in this product not approved by IET or application of voltages or currents greater than those allowed by the specifications shall void this warranty. IET shall not be liable for any indirect, special, or consequential damages, even if notice has been given to the possibility of such damages.

THIS WARRANTY IS IN LIEU OF ALL OTHER WARRANTIES, EXPRESSED OR IMPLIED, INCLUDING BUT NOT LIMITED TO, ANY IMPLIED WARRANTY OF MERCHANTIBILITY OR FITNESS FOR ANY PARTICULAR PURPOSE.

WARNING

OBSERVE ALL SAFETY RULES
WHEN WORKING WITH HIGH VOLTAGES OR LINE VOLTAGES.

Dangerous voltages may be present inside this instrument. Do not open the case
Refer servicing to qulified personnel

HIGH VOLTAGES MAY BE PRESENT AT THE TERMINALS OF THIS INSTRUMENT

WHENEVER HAZARDOUS VOLTAGES (> 45 V) ARE USED, TAKE ALL MEASURES TO AVOID ACCIDENTAL CONTACT WITH ANY LIVE COMPONENTS.

USE MAXIMUM INSULATION AND MINIMIZE THE USE OF BARE CONDUCTORS WHEN USING THIS INSTRUMENT.

Use extreme caution when working with bare conductors or bus bars.

WHEN WORKING WITH HIGH VOLTAGES, POST WARNING SIGNS AND KEEP UNREQUIRED PERSONNEL SAFELY AWAY.

CAUTION

DO NOT APPLY ANY VOLTAGES OR CURRENTS TO THE TERMINALS OF THIS INSTRUMENT IN EXCESS OF THE MAXIMUM LIMITS INDICATED ON THE FRONT PANEL OR THE OPERATING GUIDE LABEL.

Section 1
SPECIFICATIONS

1.1 Ranges of Measurement

Power Range:
0.1 mW to 20 watts in five ranges, 40 Hz to 20 kHz; maximum rating is reduced by up to 50% (at 25 Hz), depending on impedance selected.

An auxiliary dB scale on the meter reads from -15 to +43 dB, referred to 1 mW.

Impedance Range:
0.6 Ω to 32 kΩ in two ranges; yielding 48 individual impedances spaced approximately $\sqrt[6]{4}$ apart.

1.2. Accuracy

Impedance: At 1 kHz, ±6% max, -0.5% avg;
70 Hz to 2.5 kHz, ±7% above 10 kΩ;
70 Hz to 5 kHz, ±7% below 10 kΩ;
at 20 Hz, -15% max, -8% avg;
at 20 kHz, ±50% max, ±12% avg.

When impedance is specified, accuracy applies at full-scale on all ranges and impedances at 1 kHz;
when frequency ranges are specified, accuracy is at full-scale at ranges ≥20 mW at the specified impedances.
When a frequency limit is specified, accuracy is at full-scale at all impedances.

Power: At 1 kHz, ±0.3 dB;
50 Hz to 6 kHz, ±0.5 dB;
30 Hz to 10 kHz, ±1 dB;
at 20 Hz, -1.5 dB max, -1 dB avg;
at 20 kHz, -5 dB max, ±1.5 dB avg.

Waveform Error: Meter will indicate true rms with as much as 20% second and third harmonics present in the input signal.

1.3 General

Cabinet: Convertible bench cabinet, aluminum panel. Cabinet has extension legs to permit instrument to be used in a tilted position. Panel extensions, Type 480-P212 Adaptor Plate Sets, are available for relay-rack mounting.

Dimensions: Panel - 12” W x 3.5” H (305 x 90 mm);
depth behind panel - 6.5” (170 mm).

Net Weight: 10.8 pounds (4.9 kg).

Figure 1. Panel view of the Type 1840-A Output Power Meter.

Section 2
INTRODUCTION

CAUTION
Do not overload by more than 30 dB short-term (40 W max) to avoid permanent damage.

2.1 Purpose

The Type 1840-A Output Power Meter (Figure 1) is an adjustable, passive network for the determination of the power output and of the internal impedance of audio-frequency generators, amplifiers, transducers, and other sources of audio-frequency power. The power output is Indicated directly, and the internal impedance is indicated by the impedance setting that yields maximum power output.

2.2 Description

The Type 1840-A comprises an essentially constant load and a multi-tap transformer that transforms the load to 48 discrete impedance values, logarithmically distributed over the range from 0.6 Ω to 32 kΩ. Successive steps vary approximately as the sixth root of four (≅ 1.26 to 1), permitting a close approximation to any value within the range.

The fixed load Incorporates a "T" -network attenuator, calibrated in 10-decibel (10 to 1 power) steps. It is terminated in a quasi-rms detector (meter plus rectifiers) calibrated in both watts and decibels, the latter referred to 1 mW. Compensating resistors are employed to adjust for resistance removed as the secondary of the transformer is tapped down.

BECAUSE THE TYPE 1840-A INCORPORATES A TRANSFORMER, CARE MUST BE EXERCISED WHEN TESTING DEVICES, PARTICULARLY TRANSISTORS, THAT MIGHT BE DAMAGED BY EXCESSIVE MAGNETIZING CURRENT AT LOW FREQUENCIES. Figure 2 indicates the power-vs-frequency limitations for the various settings, imposed by this consideration. The curves were determined by the primary volts per turn required to produce approximate saturation of the transformer core.

Figure 3 shows a simplified schematic diagram of the Type 1840-A Output Power Meter.

The convertible bench cabinet that houses the Type 1840-A is equipped with adjustable front feet to tilt the unit for easier reading of the meter. To lock the feet In the fully extended position, rotate them until a click is heard. Further rotation releases the locks for return of the feet to the retracted position.

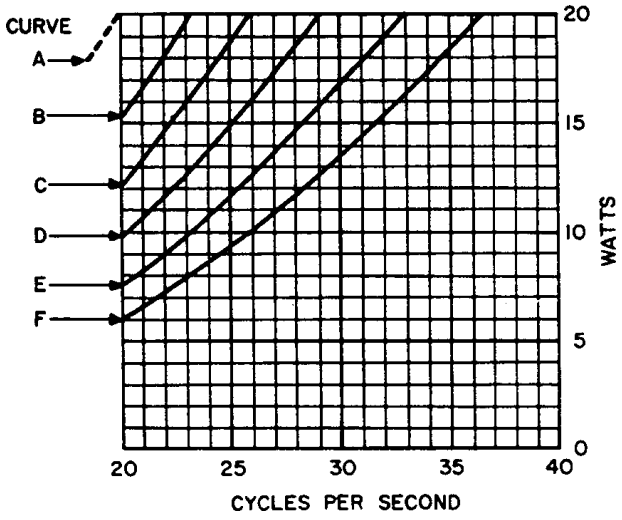


Figure 2. Power limitations vs frequency and impedance setting (see Table 1).

Table 1
Impedance Setting

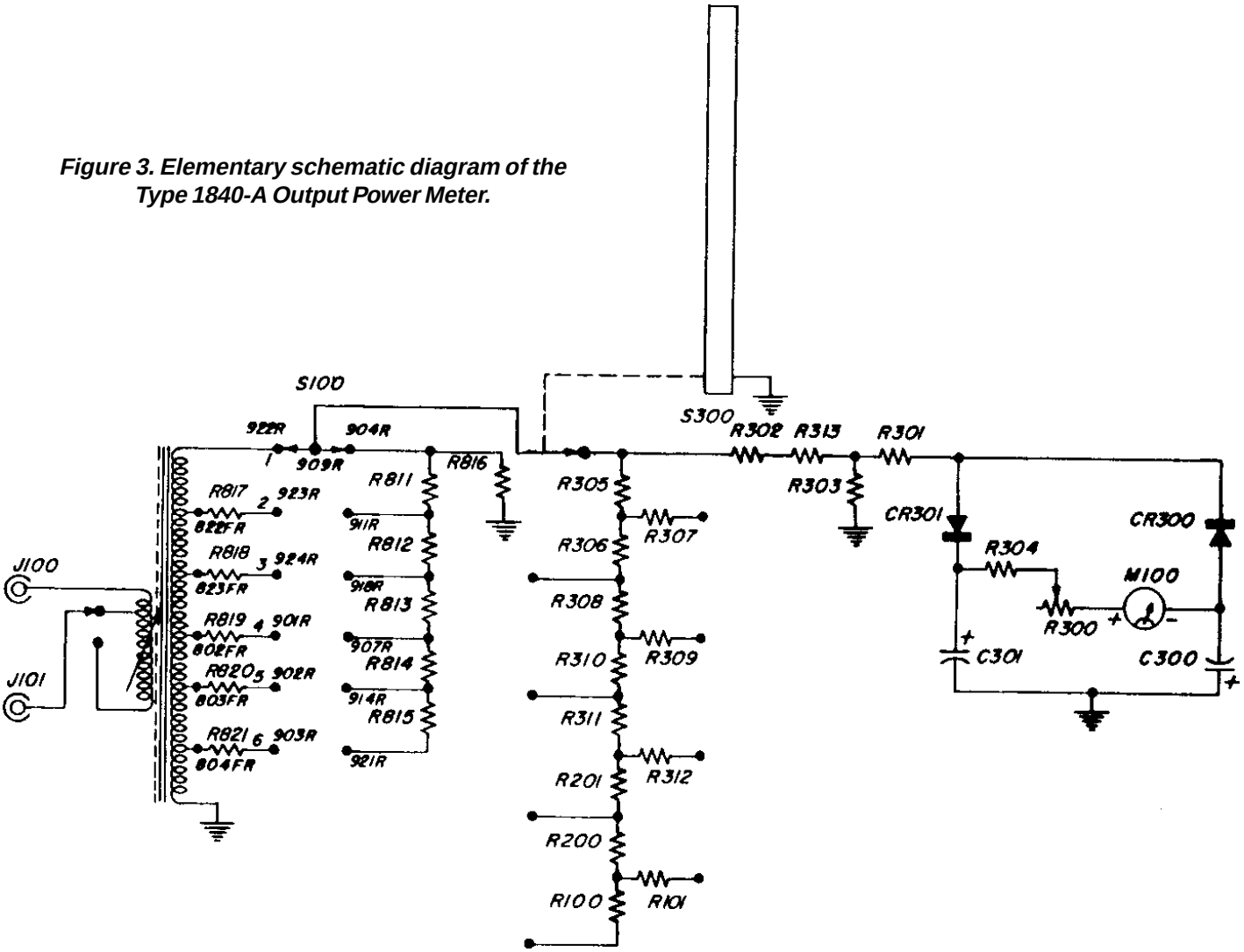
Figure 2 Curves	A	B	C	D	E	F	Direct Current For 0.5 dB Error
Ω	0.6	0.8	1	1.25	1.6	2	2 A
	2.5	3.12	4	5	6.4	8	1 A
	10	12.5	16	20	25	32	0.5 A
	40	50	64	80	100	128	250 mA
K Ω	0.15	0.2	0.25	0.312	0.4	0.5	12.5 mA
	0.6	0.8	1	1.25	1.6	2	63 mA
	2.5	3.12	4	5	6.4	8	8 mA
	10	12.5	16	20	25	32	16 mA

2.3 Controls and Connectors

The following table lists the controls and connectors on the panel of the Type 1840-A Output Power Meter:

Name	Type	Function
LOAD	2-position (W-KW) switch and 24-posltlon rotary switch.	These two switches select the load. When the Ω-kΩ switch Is in the Ω position, any value between 0.6 and 128 ohms can be selected on the inner (white) scale of the rotary switch. When the Ω-kΩ switch is in the kΩ position, any value between 0.15 and 32 kΩ can be selected on the outer (red) scale of the rotary switch.
FULL-SCALE POWER and ADD dB Switch	5-position rotary switch.	This switch selects the power and decibel levels. The lower figures (white) give the full-scale power reading of the meter. The upper figures (red) indicate the decibels that must be added algebraically to the meter reading.
None	Jack-top binding posts (three).	The unknown is connected at the red (high) and black (low) binding posts. The case binding post (metal top) can be connected to the low post by means of the captive strap; it can be left floating, or It can be independently grounded, as desired. For best accuracy at high frequencies, disconnect the grounding strap from the low Input terminal.

Figure 3. Elementary schematic diagram of the Type 1840-A Output Power Meter.



NOTE S100

Positions 1-4 and 23 & 24	8 PRI Windings in parallel
Positions 5-10	2 PRI Windings in Series 4 in parallel
Positions 1-16	4 PRI Windings in Series 2 in parallel
Positions 17-22	8 PRI Windings in Series Nominal Primary Resistance 303 Ω.

Secondary in Position 1 when S100 is in positions 23-5-11-17 Nominal Secondary Resistance 89 Ω.
Secondary in Position 2 when S100 is in positions 24-6-12-18
Secondary in Position 3 when S100 is in positions 1-7-13-19
Secondary in Position 4 when S100 is in positions 2-8-14-20
Secondary in Position 5 when S100 is in positions 3 -9-15 -21
Secondary in Position 6 when S100 is in positions 4-10-16-22

Section 3
OPERATING PROCEDURE

3.1 Determination of Unknown Impedance

To find the value of an unknown source impedance, set the LOAD switches to their highest readings and reduce these readings, step-by-step, until the maximum power reading of the meter is obtained. The source impedance is the value Indicated by the LOAD switches that gives this maximum meter reading. **ALWAYS START WITH THE FULL SCALE POWER SWITCH SET TO 20 W, to avoid damage to the meter.**

3.2 Higher-Power Sources

To use the Type 1840-A with sources of higher power (up to 200 W), a "T" -network attenuator (Figure 4) should be used. To find the proper impedance (Z), operate the source below 20 W. The resistance can then be calculated and the proper values can be inserted in the circuit.

Connect the "T' attenuator (Figure 4) between the source and the Type 1840-A. The attenuator adds 10 db to the meter-switch indication, and the meter now reads 200 watts full-scale.

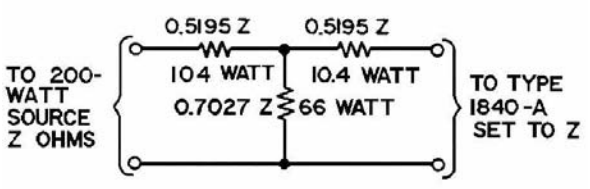


Figure 4. "T" = Network attenuator.

3.3 Insertion Losses

The insertion loss of an audio device can be determined from the output of a system before and after the Insertion of the device in question. The difference between the two maximized decibel readings is the insertion loss in decibels.

Similarly, the Insertion loss of a transformer can be measured. Note the decibel readings before and after Insertion of the transformer into the circuit. The difference between these two readings is the insertion loss.

3.4 Accuracy of Measurements

3.4.1 Waveform Accuracy

The quasi-rms circuit assures reasonable freedom from error introduced by the harmonic conteni of normally encountered waveforms (20% second and third harmonies).

3.4.2 Resctance Accuracy

Highly reactive sources are improperly terminated by the Type 1840-A and yield erroneous readings. The reactance present in most audio devices will have a negligible effect on the accuracy.

3.4.3 Direct-Current Accuracy

Table 1 gives the values of direct current that can traverse the Type 1840-A for each impedance setting, without exceeding a maximum error of 0.5 dB.

Section 4
MAINTENANCE

4.1 Mechanical Parts List

Qnt	Description	IET Pan No.	Qnt	Description	IET Pan No.
1	Knob, 1-5/16 dia, **LOAD** includes	5500-5421	1	Retainer	5220-5402
			1	Knob, 15/16 dia, **ADD** dB includes	5506-5325
1	Retainer	5220-5401			
1	Knob, 15/16 dia, **LOAD** includes	5500-5321	1	Retainer	5220-5402
			4	Foot, Rubber	5260-0700

4.2 Electrical Parts List

Ref Des	Description	IET Part No.	Fed Mfg Code	Mfg Part No.
C300	CAP ALUM 10 µF 150V	4450-3100	56289	30D106G150
C301	CAP ALUM 10 µF 150V	4450-3100	56289	30D106G150
CR300	DIODE 1N34A 60 PIV IR 30 mA GE	6082-1003	03877	1N34A
CR301	DIODE 1N34A 60 PIV IR 30 mA GE	6082-1003	03877	1N34A
J100	BINDING POST ASM	0938-3002	24655	0938-3002
J101	BINDING POST ASM	0938-3002	24655	0938-3002
J102	BINDING POST ASM	0938-3022	24655	0938-3002
M100	METER	5730-1280	24655	5730-1280
R100	RESISTOR A=1.87 K B=1.21K	1840-0410	24655	1840-0410
R101	RESISTOR A=1.87K B=1.21K	1840-0410	24655	1840-0410
R200	RESISTOR A=1.54K B=1.21K	1840-0420	24655	1840-0420
R201	RESISTOR A=1.54K B=1.21K	1840-0420	24655	1840-0420
R300	POT WW TRM 10K OHM 10 % 1T	6050-1800	24655	6050-1800
R301	RES FLM 2.61K 1 % 1/4W	6350-1261	81349	RN60D2611F
R302	RES FLM 1.54K 1 % 1/2W	6450-1154	81349	RN65D1541F
R303	RES FLM 1.1K 1 % 1/4W	6350-1110	81349	RN60D1101F
R304	RES COMP 6.8 K 5 % 1/2W	6100-2685	81349	RCR20G682J

ELECTRICAL PARTS LIST (continuation.)

Ref Des	Description	IET Part No.	Fed Mfg Code	Mfg Part No.
R305	RES FLM 1.54K 1 % 1/4W	6350-1154	81349	RN60D1541F
R306	RES FLM 1.21K 1 % 1/4W	6350-1121	81349	RN60D1211F
R307	RES FLM 1.87K 1 % 1/4W	6350-1187	81349	RN60D1871F
R308	RES FLM 1.54K 1 % 1/4W	6350-1154	81349	RN60D1541F
R309	RES FLM 1.87K 1 % 1/4W	6350-1187	81349	RN60D1871F
R310	RES FLM 1.21K 1 % 1/4W	6350-1121	81349	RN60D1211F
R311	RES FLM 1.54K 1 % 1/4W	6350-1154	81349	RN60D1541F
R312	RES FLM 1.87K 1 % 1W	6550-1187	81349	RN75D1873F
R314	VALUE DETERMINED BY LAB	----------	-------	----------
R811	RES COMP 5.1 K OHM 5% 1/2W D	6100-2515	81349	RCR20G512J
R812	RES COMP 8.2 K 5% 1/2W	6100-2825	81349	RCR20G822J
R813	RES COMP 16 K OHM 5% 1/2W D	6100-3165	81349	RCR20G163J
R814	RES COMP 27 K 5% 1/2W	6100-3275	81349	RCR20G273J
R815	RES COMP 130 K OHM 5% 1/2W D	6100-4135	81349	RCR20G134J
R816	RES COMP 47 K 5% 1W	6110-3475	81349	RCR32G473J
R817	RES COMP 33 OHM 5% 1/2W	6100-0335	81349	RCR20G330J
R818	RES COMP 56 OHM 5% 1/2W	6100-0565	81349	RCR20G560J
R819	RES COMP 75 OHM 5% 1/2W D	6100-0755	81349	RCR20G750J
R820	RES COMP 91 OHM 5% 1/2W D	6100-0915	81349	RCR20G910J
R821	RES COMP 100 OHM 5% 1/2W	6100-1105	81349	RCR20G101J
S100	SWITCH ROTARY ASM	7890-2440	24655	7890-2440
S200	SWITCH ROTARY ASM	7890-2420	24655	7890-2420
S300	SWITCH ROTARY ASM	7890-2430	24655	7890-2430
T100	TRANSFORMER AUDIO	0365-4001	24655	0365-4001

4.3 Explanation of contact Numbering on Rotary Switches

Rotary switch sections are shown as viewed from the panel end of the shaft. The first digit of the contact number refers to the section. The section nearest the panel is 1, the next section back is 2, etc. The next two digits refer to the contact. Contact 01 is the first position clockwise from a strut screw (usually the screw above the locating key), and the other contacts are numbered sequentially (02, 03, 04, etc.), proceeding clockwise around the section. A suffix F or R indicates that the contact is on the front or rear of the section, respectively.

NOTES:
Resistors 1/4 watt unless otherwise specified.
Resistance in ohms unless otherwise specified.
K =1000 ohms M = 1 Meghom
Capacitance values one and over in Picofarads, less than one in Microfarads, unless otherwise specified.

⊘ Screwdriver Control

4.4 Meter Window Care

The clear acrylic meter window can become susceptible to electrostatic-charge buildup and can be scratched, if improperly cleaned.

It is treated inside and out in manufacturing with a special non-abrasive anti-static solution. Statnul or any other antistatic application, which normally should preclude any interference in meter operation caused by electrostatic effects. The problem is evidenced by the inability of the meter movement to return promptly to a zero reading, once it is deenergized. As supplied by IET Labs, the meter should return to zero reading within 30 seconds, immediately following the placement of a static charge, as by rubbing the outside surface. This meets the requirements of ANSI standard C39.1-1972.

If static-charge problems occur, possibly as the result of frequent cleaning, the window should be carefully polished with a soft dry cloth, such as cheesecloth or nylon chiffon.

Then, a coating of Stanul should be applied with the polishing cloth.

CAUTION

Do not use any kind of solvent. Kleenex or paper towels can scratch the window surface.
If it should be necessary to place limit marks on the meter window, paper-based masking tape is recommended, rather than any kind of marking pen, which could be abrasive or react chemically with the acrylic.