GenRad

WARRANTY

We warrant that this product is free from defects in material and workmanship and, when properly used, will perform in accordance with GenRad's applicable published specifications. If within one (1) year after original shipment it is found not to meet this standard, it will be repaired or at the option of GenRad, replaced at no charge when returned to a GenRad service facility.

CHANGES IN THE PRODUCT NOT APPROVED BY GENRAD SHALL VOID THIS WARRANTY.

GENRAD SHALL NOT BE LIABLE FOR ANY INDIRECT, SPECIAL, OR CONSEQUENTIAL DAMAGES, EVEN IF NOTICE HAS BEEN GIVEN OF THE POSSIBILITY OF SUCH DAMAGES.

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

SERVICE POLICY

Your local GenRad office or representative will assist you in all matters relating to product maintenance, such as calibration, repair, replacement parts and service contracts.

GenRad policy is to maintain product repair capability for a period of five (5) years after original shipment and to make this capability available at the then prevailing schedule of charges.

Instruction

GR 1840-A

Output Power Meter

1840-0100-J

Concord, Massachusetts, U.S.A. 01742
December, 1978
ID-2642

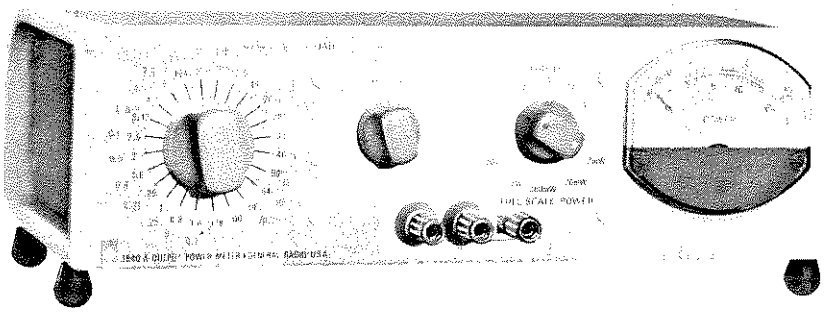


Figure 1. Panel view of the Type 1840-A Output Power Meter.

SPECIFICATIONS

RANGES

Power: 0.1 mW to 20 W, 40 Hz to 20 kHz. Below 40 Hz, max rating is reduced by up to 50% (at 25 Hz), depending on impedance selected. Auxiliary dB scale reads from −15 to +43 dB re 1 mW.

Impedance: 0.6 Ω to 32 kΩ in two ranges; yielding 48 individual impedances spaced approximately $\sqrt[3]{2}$ apart.

ACCURACY

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.

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.

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

GENERAL

Mounting: Convertible-Bench Cabinet. Adaptors for rack mounting available.

Dimensions (width x height x depth): 12 x 4 x 8 in. (305 x 105 x 205 mm). Rack-adaptor panel height, 3½ in.

Weight: Net, 10¾ lb (4.9 kg); shipping, 17 lb (8 kg).

Catalog Number	Description	
1840-9701	**1840-A Output Power Meter**	

*At full-scale on all ranges; other impedances apply only at full-scale on ranges of 20 mW and above.

CAUTION

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

SECTION **1**

INTRODUCTION

1.1 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.

1.2 DESCRIPTION.

The Type 1840-A comprises an essentially constant load and a multitap transformer that transforms the load to 48 discrete impedance values, logarithmically distributed over the range from 0.6 ohm to 32 kilohms. 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 root-mean-square detector (meter plus rectifiers) calibrated in both watts and decibels, the latter referred to 1 milliwatt. 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.

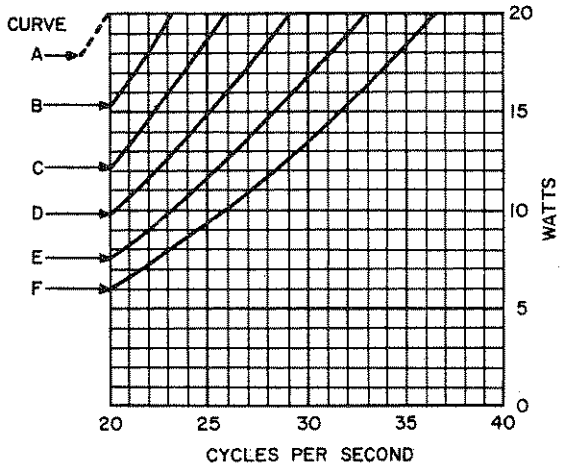


Figure 2. Power limitations vs frequency and impedance setting (see Table 1).

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 amp
		2.5	3.12	4	5	6.4	8	1 amp
		10	12.5	16	20	25	32	0.5 amp
		40	50	64	80	100	128	250 ma
KΩ		0.15	0.2	0.25	0.312	0.4	0.5	125 ma
		0.6	0.8	1	1.25	1.6	2	63 ma
		2.5	3.12	4	5	6.4	8	32 ma
		10	12.5	16	20	25	32	16 ma

1.3 CONTROLS AND CONNECTORS.

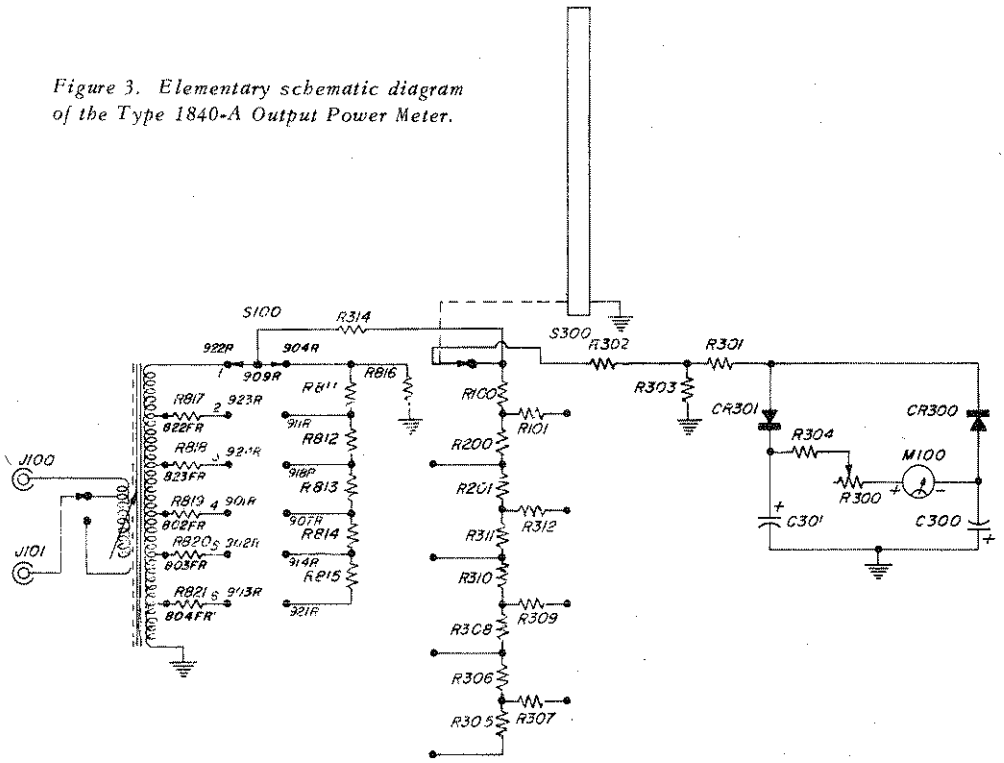
The following table lists the controls and connectors on the panel of the Type 1840-A Output Power Meter:

NAME	TYPE	FUNCTION
LOAD	2-position (Ω-KΩ) switch and 24-position 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 kilohms can be selected on the outer (red) scale of the rotary switch.
FULL-SCALE POWER and ADD DB	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.

(Continued)

NAME	TYPE	FUNCTION
None	Jack-top binding posts (three).	The unknown is connected at the high (left) and 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 11-16 4 PRI WINDINGS IN SERIES 2 IN PARALLEL
POSITIONS 17-22 8 PRI WINDINGS IN SERIES NOMINAL PRIMARY RESISTANCE 303 OHMS
SECONDARY IN POSITION 1 WHEN S100 IS IN POSITIONS 23-5-11-17 NOMINAL SECONDARY RESISTANCE 89 OHMS
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 2

OPERATING PROCEDURE

2.1 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 WATTS, to avoid damage to the meter.

2.2 HIGHER-POWER SOURCES.

To use the Type 1840-A with sources of higher power (up to 200 watts), a "T"-network attenuator (Figure 4) should be used. To find the proper impedance (Z), operate the source below 20 watts. 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.

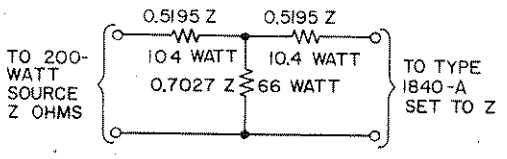


Figure 4. "T"-Network attenuator.

2.3 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.

2.4 ACCURACY OF MEASUREMENTS.

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

2.4.2 REACTANCE 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.

2.4.3 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.

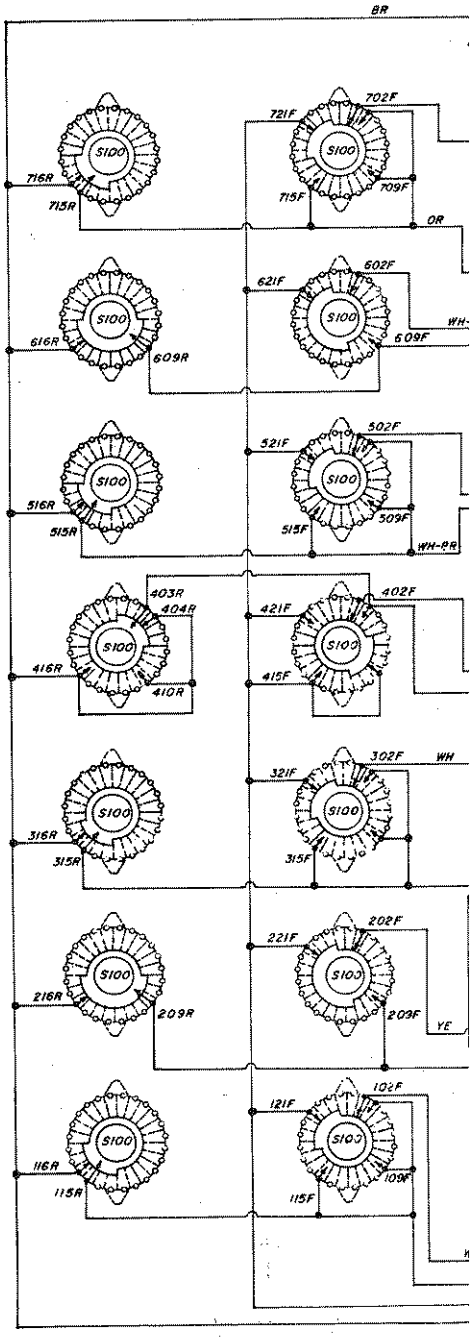
MECHANICAL PARTS LIST

Qnt	Description	GR Part No.
1	Knob, 1-5/16 dia, LOAD includes	5500-5421
1	Retainer	5220-5401
1	Knob, 15/16 dia, LOAD includes	5500-5321
1	Retainer	5220-5402
1	Knob, 15/16 dia, ADD DB includes	5500-5325
1	Retainer	5220-5402
4	Foot, Rubber	5260-0700

ELECTRICAL PARTS LIST

Ref Des	Description	GR Part No.	Fed Mfg Code	Mfg Part No.
C 300	CAP ALUM 10 UF 150V	4450-3100	56289	30D106G150
C 301	CAP ALUM 10 UF 150V	4450-3100	56289	30D106G150
CR 300	DIODE 1N34A 60PIV IR 30UA GE	6082-1003	03877	1N34A
CR 301	DIODE 1N34A 60PIV IR 30UA GE	6082-1003	03877	1N34A
J 100	BINDING POST ASM	0938-3002	24655	0938-3002
J 101	BINDING POST ASM	0938-3002	24655	0938-3002
J 102	BINDING POST ASM	0938-3022	24655	0938-3022
M 100	METER	5730-1280	24655	5730-1280
R 100	RESISTOR A=1.87K B=1.21K	1840-0410	24655	1840-0410
R 101	RESISTOR A=1.87K B=1.21K	1840-0410	24655	1840-0410
R 200	RESISTOR A=1.54K B=1.21K	1840-0420	24655	1840-0420
R 201	RESISTOR A=1.54K B=1.21K	1840-0420	24655	1840-0420
R 300	POT WW TRM 10K OHM 10 PCT 1T	6050-1800	24655	6050-1800
R 301	RES FLM 2.61K 1 PCT 1/4W	6350-1261	81349	RN60D2611F
R 302	RES FLM 1.54K 1 PCT 1/2W	6450-1154	81349	RN65D1541F
R 303	RES FLM 1.1K 1 PCT 1/4W	6350-1110	81349	RN60D1101F
R 304	RES COMP 6.8 K 5PCT 1/2W	6100-2685	81349	RCR20G682J
R 305	RES FLM 1.54K 1 PCT 1/4W	6350-1154	81349	RN60D1541F
R 306	RES FLM 1.21K 1 PCT 1/4W	6350-1121	81349	RN60D1211F
R 307	RES FLM 1.87K 1 PCT 1/4W	6350-1187	81349	RN60D1871F
R 308	RES FLM 1.54K 1 PCT 1/4W	6350-1154	81349	RN60D1541F
R 309	RES FLM 1.87K 1 PCT 1/4W	6350-1187	81349	RN60D1871F
R 310	RES FLM 1.21K 1 PCT 1/4W	6350-1121	81349	RN60D1211F
R 311	RES FLM 1.54K 1 PCT 1/4W	6350-1154	81349	RN60D1541F
R 312	RES FLM 1.87K 1 PCT 1W	6550-1187	81349	RN75D1873F
R 314	VALUE DETERMINED BY LAB	----------		
R 811	RES COMP 5.1 K OHM 5PCT 1/2W D	6100-2515	81349	RCR20G512J
R 812	RES COMP 8.2 K 5PCT 1/2W	6100-2825	81349	RCR20G822J
R 813	RES COMP 16 K OHM 5PCT 1/2W D	6100-3165	81349	RCR20G163J
R 814	RES COMP 27 K 5PCT 1/2W	6100-3275	81349	RCR20G273J
R 815	RES COMP 130 K OHM 5PCT 1/2W D	6100-4135	81349	RCR20G134J
R 816	RES COMP 47 K 5PCT 1W	6110-3475	81349	RCR32G473J
R 817	RES COMP 33 OHM 5PCT 1/2W	6100-0335	81349	RCR20G330J
R 818	RES COMP 56 OHM 5PCT 1/2W	6100-0565	81349	RCR20G560J
R 819	RES COMP 75 OHM 5PCT 1/2W D	6100-0755	81349	RCR20G750J
R 820	RES COMP 91 OHM 5PCT 1/2W D	6100-0915	81349	RCR20G910J
R 821	RES COMP 100 OHM 5PCT 1/2W	6100-1105	81349	RCR20G101J
S 100	SWITCH ROTARY ASM	7890-2440	24655	7890-2440
S 200	SWITCH ROTARY ASM	7890-2420	24655	7890-2420
S 300	SWITCH ROTARY ASM	7890-2430	24655	7890-2430
T 100	TRANSFORMER AUDIO	0365-4001	24655	0365-4001

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 MEGOHM

CAPACITANCE VALUES ONE AND OVER IN PICOFARADS, LESS THAN ONE IN MICROFARADS, UNLESS OTHERWISE SPECIFIED

⌀ *SCREWDRIVER CONTROL*

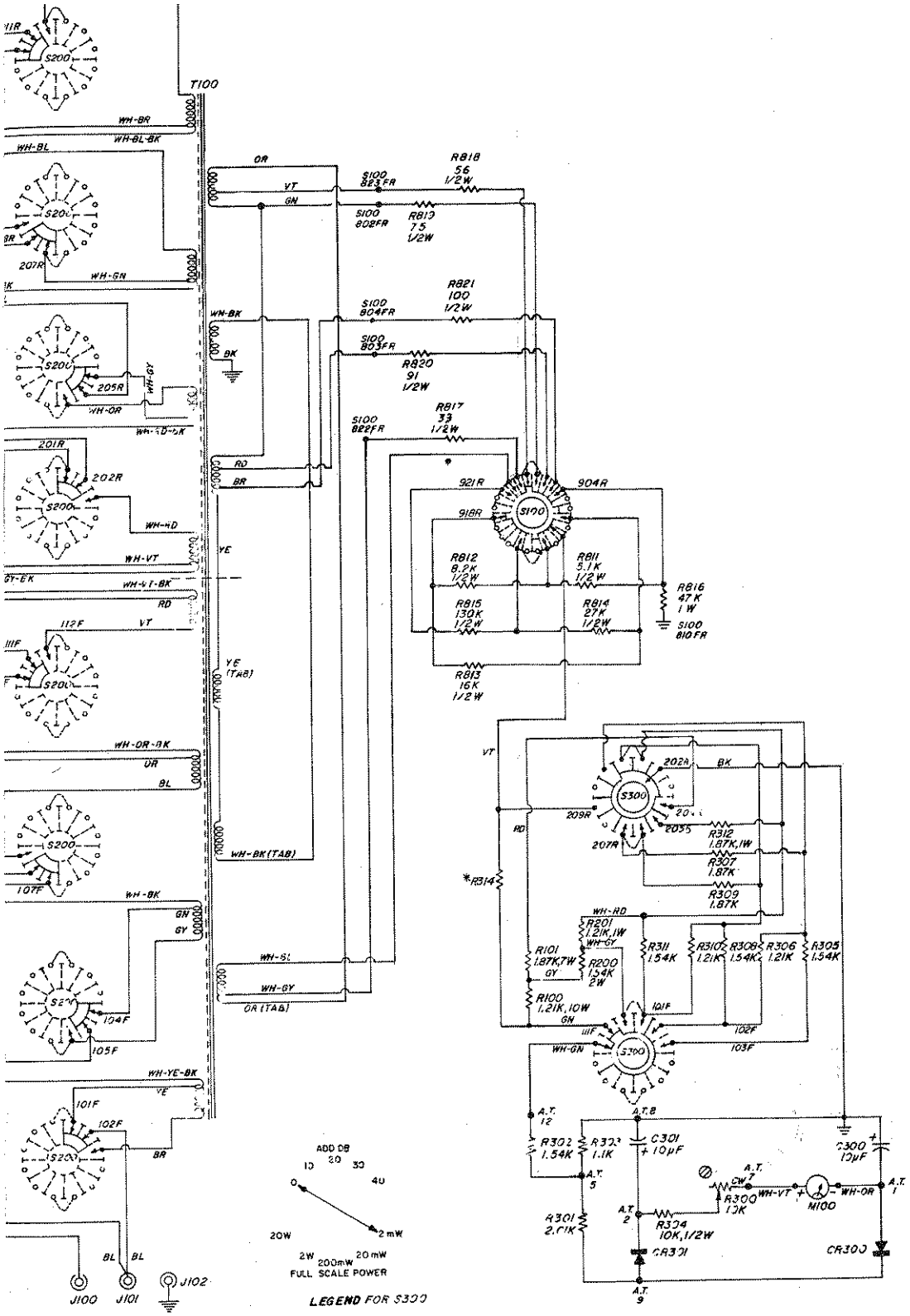


Figure 5. Schematic diagram of the Type 1840-A Output Power Meter.

FEDERAL MANUFACTURER'S CODE

From Federal Supply Code for Manufacturers Cataloging Handbooks H4-1
(Name to Code) and H4-2 (Code to Name) as supplemented through August, 1968.

Code	Manufacturer
00136	McCoy Electronics Co., Mt. Holly Springs, PA 17065
00137	Jones Mfg. Co., Chicago, IL 60607
00194	Wilson Electronics Corp., Los Angeles, CA 90053
00327	Welwyn International, Westlake, OH 44145
00424	Schweber Electronics, Westbury, NY 11590
00656	Aerovox Corp., New Bedford, MA 02745
00779	Amp, Inc., Harrisburg, PA 17105
01009	Alden Products Co., Brockton, MA 02413
01121	Allen-Bradley Co.(Electronics Div., Milwaukee, WI 53204
01255	Litton Industries Inc., Beverly Hills, CA 90213
01295	Texas Instruments, Inc., Dallas, TX 75222
01930	Amerock, Corp., Rockford, IL 61101
02111	Spectrol Electronics Corp., City of Industry, CA 91746
02114	Ferroxcube Corp., Saugerties, NY 12477
02606	Fenwal Lab Inc., Morton Grove, IL 60053
02660	Amphenol Electron Corp., Broadview, IL 60153
02768	Fastex, Des Plains, IL 60016
03042	Carter Ink Co., Cambridge, MA 02142
03508	G. E. Semicon Prod., Syracuse, NY 13201
03636	Grayburne, Yonkers, NY 10703
03877	Transitron Electronics, Wakefield, MA 01880
03911	Claires Corp., New York, NY 10001
04009	Arrow Hart, Hartford, CT 06106
04643	Digitronics Corp., Albertson, NY 11507
04713	Motorola, Phoenix, AZ 85008
04819	Component Mfg. Service, Inc., West Bridgewater, MA 02379
05079	Tansitor Electronics, Bennington, VT 05201
05402	Controls Co. of America, Melrose Park, IL 60160
05574	Viking Industries, Inc., Chatsworth, CA 91311
05624	Barber-Colman Co., Rockford, IL 61101
05748	Barnes Mfg. Co., Mansfield, OH 44901
05820	Wakefield Engineering Inc., Wakefield, MA 01880
06743	Clevite Corp., Cleveland, OH 44110
07126	Digitran Co., Pasadena, CA 91105
07127	Eagle Signal (E.W. Bliss Co.), Baraboo, WI 53913
07233	Cinch Graphik, City of Industry, CA 91744
07261	Avnet Corp., Culver City, CA 90230
07263	Fairchild Semiconductor, Mountain View, CA 94040
07387	Bertcher Corp., No. Los Angeles, CA 90032
07595	Amer. Semiconductor, Arlington Hts, IL 60004
07828	Bodine Corp., Bridgeport, CT 06605
07829	Bodine Electric Co., Chicago, IL 60618
07910	Cont. Device Corp., Hawthorne, CA 90250
07983	Stare Labs, Inc., New York, NY 10003
07999	Borg Instruments, Delavan, WI 53115
08730	Vemaline Products Co., Franklin Lakes, NJ 07417
09213	G.E. Semiconductor, Buffalo, NY 14207
09353	C & K Components Inc., Watertown, MA 02172
09408	Star-Tronics Inc., Georgetown, MA 01830
09823	Burgess Battery Co., Freeport, IL 61032
09856	Fenwal Electronics, Inc., Framingham, MA 01701
09927	Burndy Corp., Norwalk, CT 06852
12236	CTS of Berne, Inc., Berne, IN 46711
11599	Chandler Evans Corp., W. Hartford, CT 06101
11983	Northrotics Co., Inc., Minneapolis, MN 55427
12040	National Semiconductor, Santa Clara, CA 95051
12045	Electronic Transistors Corp., Flushing, NY 11354
12498	Teledyne Semiconductor, Mountain View, CA 94043
12617	Hamlin, Inc., Lake Mills, WI 53551
12672	R. C. A., Woodbridge, NJ 07095
12697	Clarostat Mfg. Co., Inc., Dover, NH 03820
12954	Dickson Electronics Corp., Scottsdale, AZ 85252
12969	Unitrode Corp., Watertown, MA 02172
13084	Electrocraft Corp., Hopkins, MN 55343
13103	Thermalloy, Inc., Dallas, TX 75234
13327	Sehlinon Devices, Tappan, NY 10983
13919	Burr Brown Research Corp., Tucson, AZ 85706
14195	Electronic Controls, Inc., Wilton, CT 06897
14433	I.T.T. Semiconductors, W. Palm Beach, FL 33402
14482	Watkins & Johnson Co., Palo Alto, CA 94304
14655	Cornell Dubilier Electronics, Newark, NJ 07101
14674	Corning Glass Works, Corning, NY 14830
14749	Acopian, Easton, PA 18042
14752	Electro Cube, Inc., San Gabriel, CA 91776
14936	General Instrument Corp., Hicksville, NY 11802
15116	Microsol Magnetics, Inc., Los Angeles, CA 90053
15238	I.T.T. Semiconductors, Lawrence, MA 08142
15476	Digital Equipment Corp., Maynard, MA 01754
15605	Cutler Hammer, Inc., Milwaukee, WI 53202
15782	Houston Instrument Corp., Bellaire, TX 77401
15937	Spruce Pine Mica Co., Spruce Pine, NC 28777
16179	Omni Spectra Mich Div., Farmington, MI 48024
16352	Computer Diode Corp., Lodi, NJ 07644
16636	Indiana General Corp., Oglesby, IL 61348
16758	Delco Electronic Div., GMC, Kokomo, IN 46901
16950	Precision Dynamics Corp., Burbank, CA 91504
16952	American Micro Devices, Inc., Summerville, SC 29483
17117	Electronic Molding Corp., Woonsocket, RI 02895
17271	Singer Co., Diehl Div., Somerville, NJ 08876
17850	Zeltex, Inc., Concord, CA 94520
17856	Siliconix, Inc., Santa Clara, CA 95054
18324	Signetics, Corp., Sunnyvale, CA 94086
18547	New Product Engineering Inc., Wabash, IN 46992
18677	Scanbe Manufacturing Corp., El Monte, CA 91731
18736	Voltronics Corp., Hanover, NJ 07936
18738	Computer Diode Corp., S. Fairlawn, NJ 07936
19048	Computer Diode Corp., S. Fairlawn, NJ 07410
19178	Zero Manufacturing Co., Manson, MA 01057
19373	Eastron Corp., Haverhill, MA 01830
19396	Illinois Tool Works, Paknon Div., Chicago, IL 60634
19617	Cabtron Corp., Chicago, IL 60622
19644	L.R.C. Electronics, Horsehead, NY 14845
19701	Electra Mfg. Co., Independence, KS 67301
20754	K.M.C. Semiconductor, Long Valley, NJ 07853
21335	Fafnir Bearing Co., New Britain, CT 06050
21799	Lonow-Fugle Electronics, Watchung, NJ 07060
22753	UID Electronics Div., AMF Inc., Hollywood, FL 33022

Code	Manufacturer
23338	Wavetek Div., John Fluke, San Diego, CA 92112
23342	Avnet Electronics Corp., Franklin Park, IL 60131
24355	Analog Devices, Cambridge, MA 02142
24446	General Electric, Schenectady, NY 12305
24454	General Electric Electronics Comp., Syracuse, NY 13201
24455	General Electric Lamp Div., Cleveland, OH 44112
24602	E.M.C. Technology, Cherry Hill, NJ 08034
24655	General Radio Co., Concord, MA 01742
25289	S. G. & G. Inc., Bedford, MA 01730
26806	American Zettler, Inc., Costa Mesa, CA 92626
28480	Hewlett Packard, Palo Alto, CA 94304
28520	Heyman Mfg. Co., Kenilworth, NJ 07033
28959	Hoffman Electronics Corp., El Monte, CA 91734
30646	Beckman Instruments, Inc., Cedar Grove, NJ 07009
30874	I.B.M., Armonk, NY 10504
32001	Jensen Mfg. Co., Chicago, IL 60638
33173	General Electric Comp., Owensboro, KY 42301
34141	Koehler Mfg. Co., Inc., Marlboro, MA 01752
36928	Constants, Co., Montreal Quebec
37942	P. R. Mallory & Co., Inc., Indianapolis, IN 46206
38443	Martin Rockwell Corp., Jamestown, NY 14701
39317	McGill Manufacturing Co., Inc., Valparso, IN 46383
40933	Honeywell, Inc., Minneapolis, MN 55408
42190	Muter Co., Chicago, IL 60638
42498	National Co., Inc., Melrose, MA 02176
43991	Norma Hoffman, Stanford, CT 06904
49671	R. C.A., New York, NY 10020
49956	Raytheon Mfg. Co., Waltham, MA 02154
50088	Mostek, Carrollton, TX 75006
53021	Samsano Electric Co., Springfield, IL 62705
54294	Shallcross Mfg. Co., Selma, NC 27576
54715	Shure Brothers, Inc., Evanston, IL 60202
56289	Sprague Electric Co., North Adams, MA 01247
59730	Thomas & Betts Co., Elizabeth, NJ 07207
59875	T.R.W. Inc., (Accessories Div), Cleveland, OH 44117
60399	Torrington Mfg. Co., Torrington, CT 06790
61637	Union Carbide Corp., New York, NY 10017
61854	United Carr Fastener Corp., Boston, MA 02142
63060	Victoreen Instrument Co., Cleveland, OH 44104
63743	Ward Leonard Electric, Mt. Vernon, NY 10550
65083	Westinghouse (Lamp Div), Bloomfield, NJ 07003
65092	Weston Instruments, Newark, NJ 07114
70106	Arushnel Capacitor Co., New Bedford, MA 02742
70109	Adams and Westlake Co., Elkhart, IN 46514
70485	Atlantic India Rubber Works, Inc., Chicago, IL 60607
70863	Amperite Co., Union City, NJ 07087
70903	Belden Mfg. Co., Chicago, IL 60644
71126	Branson Horse D., Benton Falls, CT 06403
71279	Cambridge Thermonic, Corp., Cambridge, MA 02138
71294	Canfield Co., Clifton Forge, VA 24422
71400	Bussmann Mfg. Co., St. Louis, MO 63107
71450	CTS Corp., Elkhart, IN 46514
71468	ITT-Cannon Electric Inc., Los Angeles, CA 90031
71482	C.P. Clare & Co., Chicago, IL 60645
71590	Centralab, Inc., Milwaukee, WI 53212
71668	Continental Carbon Co., Inc., New York, NY 10001
71707	Coto Coil Co., Inc., Providence, RI 02908
71729	Crescent Box Corp., E. Philadelphia, PA 19134
71744	Chicago Miniature Lamp., Chicago, IL 60640
71785	Cloch Jones, Chicago, IL 60624
71823	Darnell Corp., Ltd., Downey, CA 90241
72136	Electromotive Mfg. Co., Willimantic, CT 06226
72228	Continental Screw Co., New Bedford, MA 02742
72259	Nytronics, Inc., Berkeley Hts, NJ 07922
72619	Dialight Co., Brooklyn, NY 11223
72699	General Instrument Corp., Newark, NJ 07104
72765	Drake Mfg. Co., Chicago, IL 60631
72794	Dzus Fastener Co., Inc., West Islip, NY 11795
72825	Eby Co., Hugh H., Philadelphia, PA 19144
72962	Elastic Stop Nut Corp., Union, NJ 07083
72982	Erie Technological Products, Erie, PA 16512
73445	Amperex Electronic Corp., Hicksville, LI, NY 11801
73559	Carling Electric Co., W. Hartford, CT 06110
73690	Elco Hevstor Co., New York, NY 10001
73899	J F D. Electronics Corp., Brooklyn, NY 11219
73957	Grove-Fin Corp., Ridgefield, NJ 07657
74193	Heinemann Electric Co., Trenton, NJ 08602
74545	Hubbell, Inc., Orange, CT 06477
74861	Industrial Condenser Corp., Chicago, IL 60618
74868	Amphenol RF Division, Danbury, CT 06810
74970	Johnson Co., E.F., Waseca, MN 56093
75042	IRC Div. of TRW, Burlington, IA 52601
75382	Kulka Electric Corp., Mt. Vernon, NY 10551
75491	Lafayette Industrial Electronics, Syosset, NY 11791
75608	Linden & Co., Providence, RI 02905
75915	Littelfuse, Inc., Des Plaines, IL 60016
76005	Lord Mfg. Co., Erie, PA 16512
76149	Mallory Electric Corp., Detroit, MI 48204
76381	Minnesota Mining, St. Paul, MN 55101
76487	Millen Mfg. Co., Inc., Malden, MA 02148
76545	Mueller Electric Co., Cleveland, OH 44114
76854	National Tube Co., Pittsburg, PA 15230
76854	Oak Mfg. Co., Crystal Lake, IL 60014
77147	Patton MacGuyer Co., Providence, RI 02905
77166	Pass-Seymour, Syracuse, NY 13209
77763	Pierce-Roberts Rubber Co., Trenton, NJ 08638
77939	Positive Lockwasher Co., Newark, NJ 07101
77342	American Machine & Foundry Co., Princeton, IN 47576
77547	Ray-O-Vac Co., Madison, WI 53703
77630	T.R.W. Electronic Comp., Camden, NJ 08103
77638	General Instruments Corp., Brooklyn, NY 11211
78189	Shakeproof (ITT), Tool West, Elgin, IL 60120
78277	Sigma Instruments Inc., South Braintree, MA 02184
78488	Stackpole Carbon Co., St. Mary's, PA 15827
78553	Tinnerman Products, Inc., Cleveland, OH 44101
78889	R.C.A., Rec. Tube & Semicond., Harrison, NJ 07029
79136	Waldes Kohinoor Co., New York, NY 11101

Code	Manufacturer
79726	Wiremold Co., Hartford, CT 06110
79727	Continental WIRE Electronics Corp., Philadelphia, PA 19101
79963	Zierick Mfg. Co., Mount Kisco, NY 10549
80009	Tektronix, Inc., Beaverton, OR 97005
80030	Prestole Fastener, Toledo, OH 43605
80048	Vickers Inc., St. Louis, MO 63166
80103	Lambda Electronics Corp., Melville, NY 11746
80183	Sprague Products Co., North Adams, MA 01247
80211	Motorola Inc., Franklin Park, IL 60131
80251	Formica Corp., Cincinnati, OH 45232
80258	Standard Oil Co., Lafayette, IN 47902
80294	Bourns Laboratories, Inc., Riverside, CA 92506
80368	Sylvania Electric Products, Inc., New York, NY 10017
80431	Air Filter Corp., Milwaukee, WI 53218
80583	Hammarlund Co., Inc., New York, NY 10010
80894	Pure Carbon Co., St. Mary's, PA 15857
81030	International Instrument, Orange, CT 06477
81073	Grayhill Inc., LaGrange, IL 60525
81149	Isolantite Mfg. Corp., Sterling, NJ 07980
81312	Winchester Electronics Co., Inc., Oakville, CT 06779
81349	Military Specifications
81350	Joint Army-Navy Specifications
81483	International Rectifier Corp., El Segundo, CA 90245
81751	Columbus Electronics Corp., Yonkers, NY 10701
81831	Filtron Co., Flushing, NY 11354
81860	Barry Wright Corp., Watertown, MA 02172
82219	Sylvania Elec. Prod., Emporium, PA 15834
82223	Indiana Pattern & Model Works, LaPort, IN 46350
82388	Switchcraft, Inc., Chicago, IL 60630
82647	Metals & Controls, Inc., Attleboro, MA 02703
82807	Milwaukee Resistor Co., Milwaukee, WI 53204
82877	Rotron Mfg. Co., Inc., Woodstock, NY 12498
83003	Varo Semiconductor Div., Garland, TX 75040
83033	Meissner Mfg., Mt. Carmel, IL 62863
83068	Carr Fastener Co., Cambridge, MA 02142
83186	Victory Engineering, Springfield, NJ 07081
83361	Bearing Specialty Co., San Francisco, CA 94101
83587	Solar Electric Corp., Warren, PA 16365
83594	Burroughs Corp., Plainfield, NJ 07061
83740	Union Carbide Corp., New York, NY 10017
84411	TRW Capacitor Division, Ogallala, NB 69153
84635	Lehigh Metal Products, Cambridge, MA 02140
84970	Sarkes Tarzian, Inc., Bloomington, IN 47401
84971	T.A. Mfg. Corp., Los Angeles, CA 90039
85577	Precision Metal Products, Stoneham, MA 02180
86684	R.C.A. (Elec. Comp. & Devl., Harrison, NJ 07029
86687	R.E. C. Corp., New Rochelle, NY 10801
86800	Cont. Electronics Corp., Brooklyn, NY 11222
88140	Cutler-Hammer Inc., Lincoln, IL 62656
88219	Gould Nat. Batteries, Inc., Trenton, NJ 08607
88419	Cornell Dubilier, Fuquay-Varina, NC 27526
88627	K & G Mfg. Co., New York, NY 10003
89462	Heitzer Cabot Corp., Boston, MA 02119
89665	United Transformer Co., Chicago, IL 60697
89870	Berkshire Transformer Corp., Kent, CT 06757
90201	Mallory Capacitor Co., Indianapolis, IN 46206
90303	Mallory Battery Co., Tarrytown, NY 10691
90634	Gairon Industries, Inc., Metuchen, NJ 08840
90750	Westinghouse Electric Corp., Boston, MA 02118
90957	Hardwera Products Co., Reading, PA 19602
91032	Continental Wire Corp., York, PA 17405
91146	I.T.T. (Cannon), Salem, MA 01970
91210	Gerber Mfg. Co., Mishawaka, IN 46544
91293	Johanson Mfg. Co., Boonton, NJ 07005
91417	Harris Semiconductor, Melbourne, FL 32901
91506	Augat Brothers, Inc., Attleboro, MA 02703
91598	Chandler Co., Wethersfield, CT 06109
91637	Dale Electronics, Inc., Columbus, NE 68601
91662	Elco Corp., Willow Grove, PA 19090
91718	General Instruments Corp., Dallas, TX 75220
91836	Kings Electronics, Co., Inc., Tuckahoe, NY 11223
91916	Mepheco Tool Co., Inc., Hudson, NY 12534
91929	Honeywell, Inc., Freeport, IL 61032
92519	Electra Insul. Corp., Woodside, LI., NY 11377
92678	Edgerton Germeshausen, Georgetown, MA 01830
92702	I.M.C. Magnetics Corp., Westbury, NY 11591
92739	Ampex Corp., Redwood City, CA 94063
92986	Hudson Lamp Co., Kearny, NJ 07032
93332	Sylvania Elect. Prods., Inc., Woburn, MA 01801
93618	R & C Mfg. Co. of Penn, Inc., Ramsey, PA 16671
93916	Cramer Products Co., New York
94144	Raytheon Co., Components Div., Quincy, MA 02169
94154	Tung Sol Electric Inc., Newark, NJ 07101
94221	Weston Instruments, Inc., Archbald, PA 18403
94322	Tel Labs, Manchester, NH 03102
94689	Dickson Co., Chicago, IL 60618
94696	Magnecraft Electric Co., Chicago, IL 60630
94800	Atlas Industrial Corp., Brooklyn, NH 03033
95076	Garde Mfg. Co., Cumberland, RI 02864
95121	Quality Components, Inc., St. Marys, PA 15857
95146	Alco Electronics Mfg. Co., Lawrence, MA 01843
95238	Continental Connector Corp., Woodside, NY 11377
95275	Vitramon, Inc., Bridgeport, CT 06601
95348	Gordos Corp., Bloomfield, NJ 07003
95354	Methode Mfg. Co., Rolling Meadow, IL 60008
95712	American Brass Co., Torrington, CT 06790
96987	Weckesser Co., Inc., Chicago, IL 60646
96095	Hi-G Division of Aerovox Corp., Olean, NY 14760
96341	Microwave Associates, Inc., Burlington, MA 01801
96906	Military Standards,
96291	Solectro Corp., Mamaroneck, NY 10544
98474	Compar, Inc., Burlingame, CA 94010
98821	North Hills Electronic, Glen Cove, NY 11542
99117	Metavac, Inc., Flushing, NY 11358
99313	Varian Associates, Palo Alto, CA 94303
99378	Atlee Corp., Winchester, MA 01890
99800	Delevan Electronics, East Aurora, NY 14052