

PRODUCT ENG'G

S/N 5116



## INSTRUCTION MANUAL

**Type 1840-A**  
**Output Power Meter**

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# GENERAL RADIO

## WARRANTY

We warrant that this product is free from defects in material and workmanship and, properly used, will perform in full accordance with applicable specifications. If, within a period of ten years after original shipment, it is found, after examination by us or our authorized representative, not to meet this standard, it will be repaired or, at our option, replaced as follows:

- No charge for parts, labor or transportation during the first three months after original shipment;
- No charge for parts or labor during the fourth through the twelfth month after original shipment for a product returned to a GR service facility;
- No charge for parts during the second year after original shipment for a product returned to a GR service facility;
- During the third through the tenth year after original shipment, and as long thereafter as parts are available, we will maintain our repair capability and it will be available at our then prevailing schedule of charges for a product returned to a GR service facility.

This warranty shall not apply to any product or part thereof which has been subject to accident, negligence, alteration, abuse or misuse; nor to any parts or components that have given normal service. This warranty is expressly in lieu of and excludes all other warranties expressed or implied, including the warranties of merchantability and fitness for a particular purpose, and all other obligations or liabilities on our part, including liability for consequential damages resulting from product failure or other causes. No person, firm or corporation is authorized to assume for us any other liability in connection with the sale of any product.

# Type 1840-A

## Output Power Meter

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Concord, Massachusetts, U.S.A. 01742  
Form 1840-0100-G  
November, 1972  
ID 2642

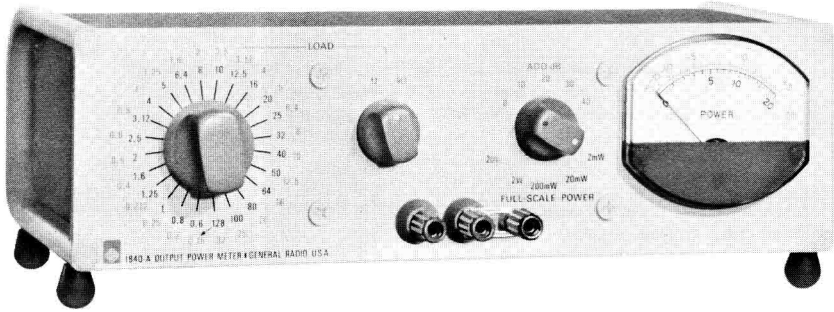


Figure 1. Panel view of the Type 1840-A Output Power Meter.

## 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  $\Omega$  to 32 k $\Omega$  in two ranges; yielding 48 individual impedances spaced approximately  $\sqrt{2}$  apart.

### ACCURACY

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

**Impedance:** At 1 kHz,  $\pm 6\%$  max,  $-0.5\%$  avg;  
 70 Hz to 2.5 kHz,  $\pm 7\%$  above 10 k $\Omega$ ;  
 70 Hz to 5 kHz,  $\pm 7\%$  below 10 k $\Omega$ ;  
 at 20 Hz,  $-15\%$  max,  $-8\%$  avg;  
 at 20 kHz,  $\pm 50\%$  max,  $\pm 12\%$  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

### CAUTION

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

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**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 multi-tap 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 ( $\approx 1.26$  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.



# TYPE 1840-A OUTPUT POWER METER

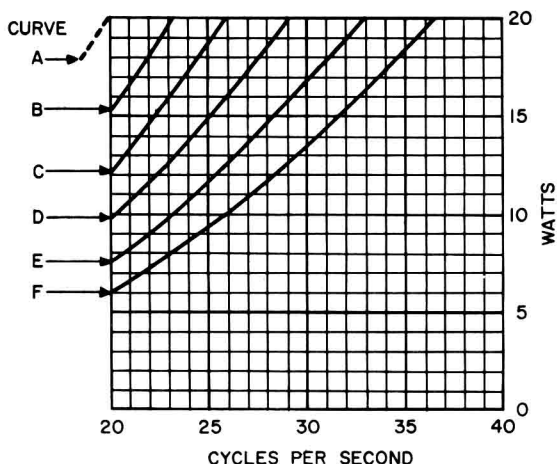


Figure 2. Power limitations vs frequency and impedance setting (see Table 1).

**TABLE 1**  
**IMPEDANCE SETTING**

Figure 2 Curves	A	B	C	D	E	F	Direct Current For 0.5 DB Error
$\Omega$	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
K $\Omega$	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.

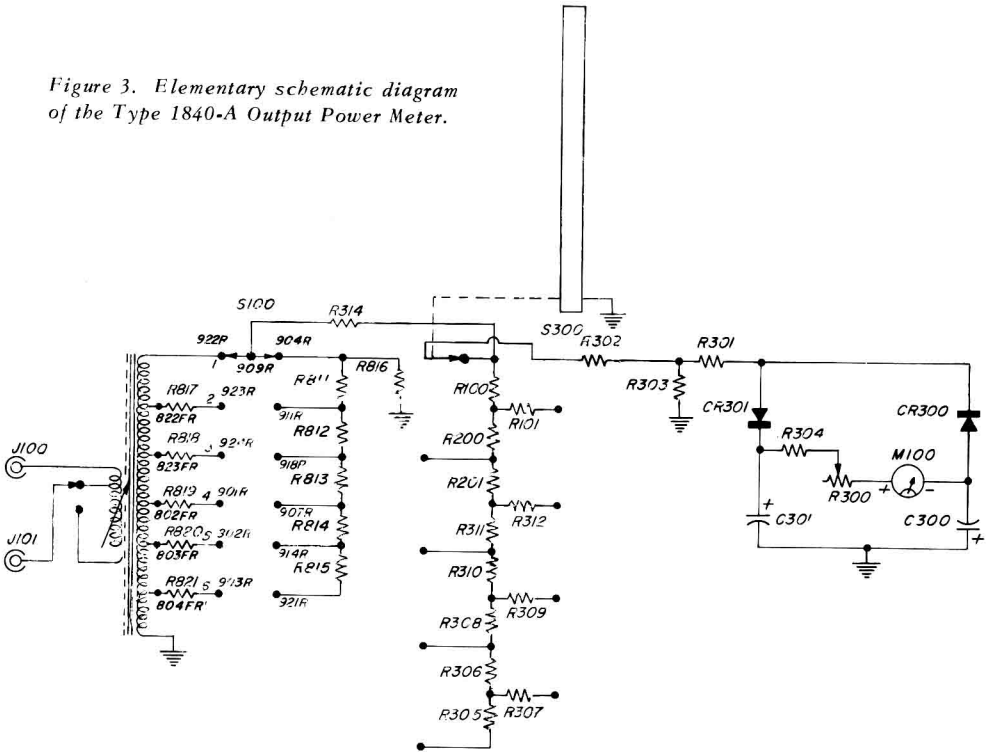
The following table lists the controls and connectors on the panel of the Type 1840-A Output Power Meter:

NAME	TYPE	FUNCTION
LOAD	2-position ( $\Omega$ -K $\Omega$ ) switch and 24-position rotary switch.	These two switches select the load. When the $\Omega$ -K $\Omega$ switch is in the $\Omega$ position, any value between 0.6 and 128 ohms can be selected on the inner (white) scale of the rotary switch. When the $\Omega$ -K $\Omega$ switch is in the K $\Omega$ 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 <u>added algebraically</u> 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 1-16 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.

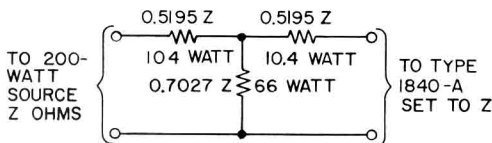


Figure 4. "T"-Network attenuator.

### 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 METER INDICATION ACCURACY. The error in the full-scale power reading is less than 0.5 db between 50 and 6,000 cps. It is less than 1.5 db at 20 and 20,000 cps if the power limitations of Figure 2 are observed.

2.4.2 ACCURACY OF IMPEDANCE INDICATION. The impedance error is within  $\pm(5\% + 0.02 \text{ ohm})$  from 20 cps to 2 kc at power levels above 2 milliwatts and from 250 cps to 1.5 kc on the 2-milliwatt scale. At 20 kc, maximum error is not more than 50% if the limitations of Figure 2 are observed.

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

2.4.4 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.

2.4.5 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.





## PARTS LIST

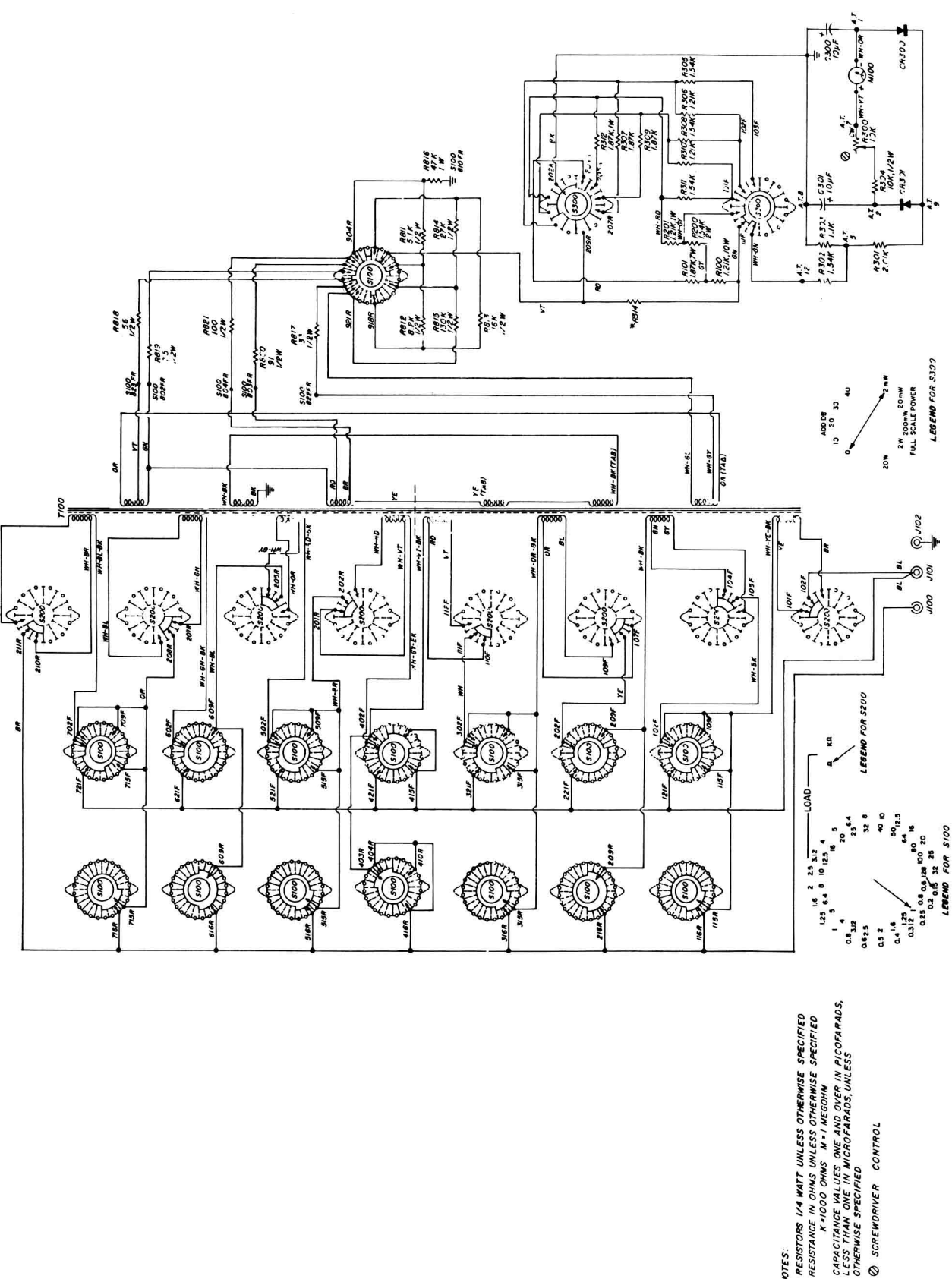
## EXPLANATION OF CONTACT NUMBERING ON ROTARY SWITCHES

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.

## ELECTRICAL PARTS LIST

Ref Des	Description	GR Part No.	Fed Mfg Code	Mfg Part No.	Fed Stock No.
<b>RESISTORS</b>					
R100	1.21 k $\Omega$ $\pm$ 1% 10 W	Part of			
R101	1.87 k $\Omega$ $\pm$ 1% 7 W	1840-0410	24655	1840-0410	5905-933-6806
R200	1.54 k $\Omega$ $\pm$ 1% 2 W	Part of			
R201	1.21 k $\Omega$ $\pm$ 1% 1 W	1840-0420	24655	1840-0420	5905-933-6807
R300	Pot., Wire-wound 10 k $\Omega$ $\pm$ 10%	6050-1800	12697	43 WK, 10 k $\Omega$ $\pm$ 10%	5905-794-3858
R301	Film, 2.61 k $\Omega$ $\pm$ 1% 1/4 W	6350-1261	75042	CEB, 2.61 k $\Omega$ $\pm$ 1%	5905-583-6885
R302	Film, 1.54 k $\Omega$ $\pm$ 1% 1/4 W	6350-1154	75042	CEB, 1.54 k $\Omega$ $\pm$ 1%	
R303	Film, 1.1 k $\Omega$ $\pm$ 1% 1/4 W	6350-1110	75042	CEB, 1.1 k $\Omega$ $\pm$ 1%	5905-681-3222
R304	Composition, 6.8 k $\Omega$ $\pm$ 5% 1/2 W	6100-2685	01121	RC20GF682J	5905-279-3503
R305	Film, 1.54 k $\Omega$ $\pm$ 1% 1/4 W	6350-1154	75042	CEB, 1.54 k $\Omega$ $\pm$ 1%	
R306	Film, 1.21 k $\Omega$ $\pm$ 1% 1/4 W	6350-1121	75042	CEB, 1.21 k $\Omega$ $\pm$ 1%	5905-577-7504
R307	Film, 1.87 k $\Omega$ $\pm$ 1% 1/4 W	6350-1187	75042	CEB, 1.87 k $\Omega$ $\pm$ 1%	
R308	Film, 1.54 k $\Omega$ $\pm$ 1% 1/4 W	6350-1154	75042	CEB, 1.54 k $\Omega$ $\pm$ 1%	
R309	Film, 1.87 k $\Omega$ $\pm$ 1% 1/4 W	6350-1187	75042	CEB, 1.87 k $\Omega$ $\pm$ 1%	
R310	Film, 1.21 k $\Omega$ $\pm$ 1% 1/4 W	6350-1121	75042	CEB, 1.21 k $\Omega$ $\pm$ 1%	5905-577-7504
R311	Film, 1.54 k $\Omega$ $\pm$ 1% 1/4 W	6350-1154	75042	CEB, 1.54 k $\Omega$ $\pm$ 1%	
R312	Film, 1.87 k $\Omega$ $\pm$ 1% 1 W	6550-1187	75042	MEF, 1.87 k $\Omega$ $\pm$ 1%	5905-577-6439
R314	Composition*				
R811	Composition, 33 $\Omega$ $\pm$ 5% 1/2 W	6100-0335	01121	RC20GF330J	5905-192-4490
R812	Composition, 22 $\Omega$ $\pm$ 5% 1/2 W	6100-0225	01121	RC20GF220J	5905-279-3519
R813	Composition, 51 $\Omega$ $\pm$ 5% 1/2 W	6100-0515	01121	RC20GF510J	5905-279-3517
R814	Composition, 33 $\Omega$ $\pm$ 5% 1/2 W	6100-0335	01121	RC20GF330J	5905-192-4490
R815	Composition, 130 k $\Omega$ $\pm$ 5% 1/2 W	6100-4135	01121	RC20GF134J	5905-249-9468
R816	Composition, 47 k $\Omega$ $\pm$ 5% 1 W	6110-3475	01121	RC32GF473J	5905-299-2013
R817	Composition, 33 $\Omega$ $\pm$ 5% 1/2 W	6100-0335	01121	RC20GF330J	5905-192-4490
R818	Composition, 56 $\Omega$ $\pm$ 5% 1/2 W	6100-0565	01121	RC20GF560J	5905-279-1897
R819	Composition, 75 $\Omega$ $\pm$ 5% 1/2 W	6100-0755	01121	RC20GF750J	5905-279-1758
R820	Composition, 91 $\Omega$ $\pm$ 5% 1/2 W	6100-0915	01121	RC20GF910J	5905-279-3516
R821	Composition, 100 $\Omega$ $\pm$ 5% 1/2 W	6100-1105	01121	RC20GF101J	5905-190-8889
<b>OTHER</b>					
C300	Capacitor, Elec 10 $\mu$ F 50 dcwv	4450-3100	56289	D33610	5910-723-2517
C301	Capacitor, Elec 10 $\mu$ F 50 dcwv	4450-3100	56289	D33610	5910-723-2517
CR300	Diode, Type 1N34AS	6082-1003	93332	1N34A (S)	5961-170-4430
CR301	Diode, Type 1N34AS	6082-1003	93332	1N34A (S)	5961-170-4430
J100	Binding Post	4060-0400	4060-0400		5940-951-9300
J101	Binding Post	4060-0410	24655	4060-0410	
J102	Binding Post	4060-1800	24655	4060-1800	
M100	Meter, 50 $\mu$ A 1500 $\Omega$	5730-1280	40931	5 $\mu$ A, 1500 $\Omega$	
S100	Switch, Rotary Wafer	7890-2440	24655	7890-2440	5930-933-6779
S200	Switch, Rotary Wafer	7890-2420	24655	7890-2420	5930-933-6778
S300	Switch, Rotary Wafer	7890-2430	24655	7890-2430	5930-933-6777
T100	Transformer	0365-4001	24655	0365-4001	6120-933-6601

\*Value determined by GR Laboratory



# FEDERAL MANUFACTURERS CODE

From Federal Supply Code for Manufacturers Cataloging Handbooks H4-1  
(Name to Code) and H4-2 (Code to Name) as supplemented through June, 1967.

Code	Manufacturers Name and Address	Code	Manufacturers Name and Address
00192	Jones Mfg. Co., Chicago, Illinois	38443	Marlin-Rockwell Corp., Jamestown, N. Y.
00194	Walsco Electronics Corp., Los Angeles, Calif.	40931	Honeywell Inc., Minneapolis, Minn. 55408
00656	Aerovox Corp., New Bedford, Mass.	42190	Muter Co., Chicago, Ill. 60638
01009	Alden Products Co., Brockton, Mass.	42498	National Co. Inc., Melrose, Mass. 02176
01121	Allen-Bradley, Co., Milwaukee, Wisc.	43991	Norma-Hoffman Bearings Corp., Stanford, Conn. 06904
01295	Texas Instruments, Inc., Dallas, Texas	49671	RCA, New York, N. Y.
02114	Ferroxcube Corp. of America, Saugerties, N. Y. 12477	49956	Raytheon Elec. Co., Waltham, Mass. 02154
02606	Fenwal Lab. Inc., Morton Grove, Ill.	53021	Sangamo Electric Co., Springfield, Ill. 62705
02660	Amphenol Electronics Corp., Broadview, Ill.	54294	Shallcross Mfg. Co., Selma, N. C.
02768	Fastex Division of Ill. Tool Works, Des Plaines, Ill. 60016	54715	Shure Brothers, Inc., Evanston, Ill.
03508	G. E. Semiconductor Products Dept., Syracuse, N. Y. 13201	56289	Sprague Electric Co., N. Adams, Mass.
03636	Grayburne, Yonkers, N. Y. 10701	59730	Thomas and Betts Co., Elizabeth, N. J. 07207
03888	Pyrofilm Resistor Co., Cedar Knolls, N. J.	59875	TRW Inc. (Accessories Div), Cleveland, Ohio
03911	Clairex Corp., New York, N. Y. 10001	60399	Torrington Mfg. Co., Torrington, Conn.
04009	Arrow, Hart and Hegeman Electric Co., Hartford, Conn. 06106	61637	Union Carbide Corp., New York, N. Y. 10017
04713	Motorola Semi-Conduct Product, Phoenix, Ariz. 85008	61864	United-Carr Fastener Corp., Boston, Mass.
05170	Engineered Electronics Co., Inc., Santa Ana, Calif. 92702	63060	Victoreen Instrument Co., Inc., Cleveland, Ohio
05624	Barber-Colman Co., Rockford, Ill. 61101	63743	Ward Leonard Electric Co., Mt. Vernon, N. Y.
05820	Wakefield Eng., Inc., Wakefield, Mass. 01880	65083	Westinghouse (Lamp Div), Bloomfield, N. J.
07127	Eagle Signal Div. of E. W. Bliss Co., Baraboo, Wisc.	65092	Weston Instruments, Weston-Newark, Newark, N. J.
07261	Avnet Corp., Culver City, Calif. 90230	70485	Atlantic-India Rubber Works, Inc., Chicago, Ill. 60607
07263	Fairchild Camera and Instrument Corp., Mountain View, Calif.	70563	Amperite Co., Union City, N. J. 07087
07387	Birtcher Corp., No. Los Angeles, Calif.	70903	Belden Mfg. Co., Chicago, Ill. 60644
07595	American Semiconductor Corp., Arlington Heights, Ill. 60004	71126	Bronson, Homer D., Co., Beacon Falls, Conn.
07828	Bodine Corp., Bridgeport, Conn. 06605	71294	Canfield, H. O. Co., Clifton Forge, Va. 24422
07829	Bodine Electric Co., Chicago, Ill. 60618	71400	Bussman Mfg. Div. of McGraw Edison Co., St. Louis, Mo.
07910	Continental Device Corp., Hawthorne, Calif.	71590	Centralab, Inc., Milwaukee, Wisc. 53212
07983	State Labs Inc., N. Y., N. Y. 10003	71666	Continental Carbon Co., Inc., New York, N. Y.
07999	Amphenol Corp., Borg Inst. Div., Delavan, Wisc. 53115	71707	Coto Coil Co. Inc., Providence, R. I.
08730	Vemaline Prod. Co., Franklin Lakes, N. J.	71744	Chicago Miniature Lamp Works, Chicago, Ill.
09213	General Electric Semiconductor, Buffalo, N. Y.	71785	Cinch Mfg. Co. and Howard B. Jones Div., Chicago, Ill. 60624
09408	Star-Tronics Inc., Georgetown, Mass. 01830	71823	Darnell Corp., Ltd., Downey, Calif. 90241
09823	Burgess Battery Co., Freeport, Ill.	72136	Electro Motive Mfg. Co., Wilmington, Conn.
09922	Burdry Corp., Norwalk, Conn. 06852	72259	Nytronics Inc., Berkeley Heights, N. J. 07922
11236	C.P.S. of Berne, Inc., Berne, Ind. 46711	72619	Dialight Co., Brooklyn, N. Y. 11237
11599	Chandler Evans Corp., W. Hartford, Conn.	72699	General Instrument Corp., Capacitor Div., Newark, N. J. 07104
12498	Teledyn Inc., Crystalonics Div., Cambridge, Mass. 02140	72765	Drake Mfg. Co., Chicago, Ill. 60656
12672	RCA Commercial Receiving Tube and Semi- conductor Div., Woodridge, N.J.	72825	Hugh H. Eby, Inc., Philadelphia, Penn. 19144
12697	Clarostat Mfg. Co. Inc., Dover, N. H. 03820	72962	Elastic Stop Nut Corp., Union, N. J. 07083
12954	Dickson Electronics Corp., Scottsdale, Ariz.	72982	Erie Technological Products Inc., Erie, Penn.
13327	Solotron Devices, Tappan, N. Y. 10983	73138	Beckman, Inc., Fullerton, Calif. 92634
14433	ITT Semiconductors, W. Palm Beach, Florida	73445	Amperex Electronics Co., Hicksville, N. Y.
14655	Cornell Dubilier Electric Co., Newark N. J.	73559	Carling Electric Co., W. Hartford, Conn.
14674	Coming Glass Works, Coming, N. Y.	73690	Elco Resistor Co., New York, N. Y.
14936	General Instrument Corp., Hicksville, N. Y.	73899	J. F. D. Electronics Corp., Brooklyn, N. Y.
15238	ITT, Semiconductor Div. of Int. T. and T, Lawrence, Mass.	74193	Heinemann Electric Co., Trenton, N. J.
15605	Cutler-Hammer Inc., Milwaukee, Wisc. 53233	74861	Industrial Condenser Corp., Chicago, Ill.
16037	Spruce Pine Mica Co., Spruce Pine, N. C.	74970	E. F. Johnson Co., Waseca, Minn. 56093
19644	LRC Electronics, Horseheads, New York	75042	IRC Inc., Philadelphia, Penn. 19108
19701	Electra Mfg. Co., Independence, Kansas 67301	75382	Kulka Electric Corp., Mt. Vernon, N. Y.
21335	Fafnir Bearing Co., New Briton, Conn.	75491	Lafayette Industrial Electronics, Jamaica, N.Y.
24446	G. E. Schenectady, N. Y. 12305	75608	Linden and Co., Providence, R. I.
24454	G. E., Electronic Comp., Syracuse, N. Y.	75915	Littelfuse, Inc., Des Plaines, Ill. 60016
24455	G. E. (Lamp Div), Nela Park, Cleveland, Ohio	76005	Lord Mfg. Co., Erie, Penn. 16512
24655	General Radio Co., W. Concord, Mass 01781	76149	Malloy Electric Corp., Detroit, Mich. 48204
26806	American Zettler Inc., Costa Mesa, Calif.	76487	James Millen Mfg. Co., Malden, Mass. 02148
28520	Hayman Mfg. Co., Kenilworth, N. J.	76545	Mueller Electric Co., Cleveland, Ohio 44114
28959	Hoffman Electronics Corp., El Monte, Calif.	76684	National Tube Co., Pittsburg, Penn.
30874	International Business Machines, Armonk, N.Y.	76854	Oak Mfg. Co., Crystal Lake, Ill.
32001	Jensen Mfg. Co., Chicago, Ill. 60638	77147	Patton MacGuyre Co., Providence, R. I.
35929	Constanta Co. of Canada Limited, Montreal 19, Quebec	77166	Pass-Seymour, Syracuse, N. Y.
37942	P. R. Mallory and Co. Inc., Indianapolis, Ind.	77263	Pierce Roberts Rubber Co., Trenton, N. J.
		77339	Positive Lockwasher Co., Newark, N. J.
		77542	Ray-O-Vac Co., Madison, Wisc.
		77630	TRW, Electronic Component Div., Camden, N. J. 08103
		77638	General Instruments Corp., Brooklyn, N. Y.
		78189	Shakeproof Div. of Ill. Tool Works, Elgin, Ill. 60120

## FEDERAL MANUFACTURERS CODE (Cont.)

Code	Manufacturers Name and Address	Code	Manufacturers Name and Address
78277	Sigma Instruments Inc., S. Braintree, Mass.	88140	Cutler-Hammer Inc., Lincoln, Ill.
78488	Stackpole Carbon Co., St. Marys, Penn.	88219	Gould Nat. Batteries Inc., Trenton, N. J.
78553	Tinnerman Products, Inc., Cleveland, Ohio	88419	Cornell Dubilier Electric Corp., Fuquay-Varina, N. C.
79089	RCA, Commercial Receiving Tube and Semi-conductor Div., Harrison, N. J.	88627	K and G Mfg. Co., New York, N. Y.
79725	Wiremold Co., Hartford, Conn. 06110	89482	Holtzer Cabot Corp., Boston, Mass.
79963	Zierick Mfg. Co., New Rochelle, N. Y.	89665	United Transformer Co., Chicago, Ill.
80030	Prestole Fastener Div. Bishop and Babcock Corp., Toledo, Ohio	90201	Mallory Capacitor Co., Indianapolis, Ind.
80048	Vickers Inc. Electric Prod. Div., St. Louis, Mo.	90750	Westinghouse Electric Corp., Boston, Mass.
80131	Electronic Industries Assoc., Washington, D.C.	90952	Hardware Products Co., Reading, Penn. 19602
80183	Sprague Products Co., N. Adams, Mass.	91032	Continental Wire Corp., York, Penn. 17405
80211	Motorola Inc., Franklin Park, Ill. 60131	91146	ITT Cannon Electric Inc., Salem, Mass.
80258	Standard Oil Co., Lafayette, Ind.	91293	Johanson Mfg. Co., Boonton, N. J. 07005
80294	Bourns Inc., Riverside, Calif. 92506	91598	Chandler Co., Wethersfield, Conn. 06109
83033	Meissner Mfg., Div. of Maguire Industries, Inc. Mount Carmel, Illinois	91637	Dale Electronics Inc., Columbus, Nebr.
80431	Air Filter Corp., Milwaukee, Wisc. 53218	91662	Elco Corp., Willow Grove, Penn.
80583	Hammarlund Co. Inc., New York, N. Y.	91719	General Instruments, Inc., Dallas, Texas
80740	Beckman Instruments, Inc., Fullerton, Calif.	91929	Honeywell Inc., Freeport, Ill.
81073	Grayhill Inc., LaGrange, Ill. 60525	92519	Electra Insulation Corp., Woodside, Long Island, N. Y.
81143	Isolantite Mfg. Corp., Stirling, N. J. 07980	92678	Edgerton, Germeshausen and Grier, Boston, Mass.
81349	Military Specifications	93332	Sylvania Electric Products, Inc., Woburn, Mass.
81350	Joint Army-Navy Specifications	93916	Cramer Products Co., New York, N. Y. 10013
81751	Columbus Electronics Corp., Yonkers, N. Y.	94144	Raytheon Co. Components Div., Quincy, Mass.
81831	Filton Co., Flushing, L. I., N. Y.	94154	Tung Sol Electric Inc., Newark, N. J.
81860	Barry Controls Div. of Barry Wright Corp., Watertown, Mass.	95076	Garde Mfg. Co., Cumberland, R. I.
82219	Sylvania Electric Products, Inc., (Electronic Tube Div.), Emporium, Penn.	95146	Alco Electronics Mfg. Co., Lawrence, Mass.
82273	Indiana Pattern and Model Works, LaPort, Ind.	95238	Continental Connector Corp., Woodside, N. Y.
82389	Switchcraft Inc., Chicago, Ill. 60630	95275	Vitramon, Inc., Bridgeport, Conn.
82647	Metals and Controls Inc., Attleboro, Mass.	95354	Methode Mfg. Co., Chicago, Ill.
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83587	Solar Electric Corp., Warren, Penn.	96256	Thordarson-Meissner Div. of McGuire, Mt. Carmel, Ill.
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84411	TRW Capacitor Div., Ogallala, Nebr.	96791	Amphenoc Corp. Jonesville, Wisc. 53545
84835	Lehigh Metal Products Corp., Cambridge, Mass. 02140	96906	Military Standards
84971	TA Mfg. Corp., Los Angeles, Calif.	97966	CBS Electronics Div. of Columbia Broadcast- ing Systems, Danvers, Mass.
86577	Precision Metal Products of Malden Inc., Stoneham, Mass. 02180	98291	Sealectro Corp., Mamaroneck, N. Y. 10544
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