TYPE 1233-A POWER AMPLIFIER

GENERAL RADIO COMPANY

CAMBRIDGE 39 MASSACHUSETTS

NEW YORK CHICAGO LOS ANGELES

U. S. A.

OPERATING INSTRUCTIONS

for

TYPE 1233-A POWER AMPLIFIER

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Panel View of the Type 1233-A Power Amplifier

SPECIFICATIONS

Frequency Range: Three ranges are provided:
20 cycles to 20 kilocycles
20 kilocycles to 1.5 Mc
20 cycles to 3 Mc

Power Output:
20 c-to-20 kc range — 15 watts from 50 c to 15 kc; 8 watts at 20 c and 20 kc.
20 kc-to-1.5 Mc range — 15 watts from 20 kc to 0.5 Mc; 8 watts at 1.5 Mc.
Maximum available power output at low distortion depends upon power-line voltage. Rated output is obtainable at 105 line volts. At higher line voltages, output is greater.

Voltage Output: 20 c-to-3 Mc range — 150 volts, peak-to-peak.

Load Impedance:
20 c-to-20 kc range — 600 or 150 ohms, balanced or grounded.
20 kc-to-1.5 Mc range — 50 ohms, grounded.
20 c-to-3 Mc range — deflection-plate terminals of cathode-ray oscilloscope, connected with 36-inch leads and with an effective input resistance of at least one megohm.

Transient Response: 20 c-to-3 Mc range — approximately 0.1 microsecond rise time, with negligible overshoot.

Input Voltage: Less than 0.2 volt for full output.

Input Impedance: 100,000 ohms in parallel with 37 $\mu\mu$f (grounded).

Distortion: Less than 3% at rated output on all ranges.

Noise Output:
20 c-to-20 kc range, 60 db below 15 watts output.
20 kc-to-1.5 Mc range, 70 db below 15 watts output.
20 c-to-3 Mc range, less than 0.3 volt peak-to-peak balanced.

Frequency Response: See typical curves.

Power Supply: 105 to 125 (or 210 to 250) volts, 40 to 60 cycles a-c.

Power Consumption: Approximately 140 watts at 15 watts output; approximately 120 watts at zero output.

Voltmeter:
Ranges, 150, 50, and 15 volts full scale.
Accuracy, ±5% of full scale.

Mounting: The panel is designed for mounting in a 19-inch relay rack, but removable end frames are supplied so that it may be used equally well on a table.

Tubes: 2 — 6AC7 2 — 6AG7
2 — 807 1 — 6J6

Terminals: Type 874 Coaxial Terminals at input and output. Adjacent ground posts for connecting by Type 274-MB Plugs are provided.
Two insulated binding posts for balanced output.

Accessories Supplied: Seven-foot power cord; two Type 274-MB Double Plugs; two spare line fuses; two Type 874-C Cable Connectors.

Accessories Available: Type 874-R10 Patch Cords; Type 874 Connectors and Adaptors.

Dimensions: 19⅜ x 14¼ x 7½ inches, overall.

Net Weight: 45 pounds.

U.S. Patent Nos. 2,125,816 and 2,548,457

OPERATING INSTRUCTIONS

for

TYPE 1233-A POWER AMPLIFIER

SECTION 1.0 DESCRIPTION

1.1 PURPOSE

The Type 1233-A Power Amplifier was designed for use with a low-level signal source to provide a moderate amount of power output within its frequency range. The circuit is arranged to provide maximum flexibility for general purpose application. For example, at one position of the output switch the Type 1233-A functions as a wide-range oscilloscope-deflection amplifier. A particular feature of the Type 1233-A is an aperiodic frequency range providing appreciable power output up to 1.5 Mc.

1.2 FREQUENCY RANGE, POWER OUTPUT, AND LOAD IMPEDANCE

The Type 1233-A Power Amplifier is arranged to operate over three frequency ranges as selected by the output switch.

1.21 20 Cycles to 20 Kilocycles Range: The rated power output from 50 cycles to 15 kilocycles is 15 watts. The output is available for balanced or grounded, 600- or 150-ohm loads, as selected by the output switch. At 20 cycles and 20 kilocycles the rated power output drops to 8 watts.

1.22 20 Kilocycles to 1.5 Mc Range: The rated power output from 20 kilocycles to 0.5 Mc is 15 watts into a 50-ohm load, dropping to 8 watts at 1.5 Mc.

1.23 20 Cycles to 3 Mc Range: This output is balanced to ground and up to 150 volts peak to peak is available with a high-impedance load. The voltage gain is approximately 60 db.

1.3 INPUT VOLTAGE AND IMPEDANCE

Less than 0.2 volt at the input is required to produce full output. The input impedance is equivalent to 100,000 ohms in parallel with 37$\mu\mu$f.

1.4 OUTPUT VOLTMETER

The output voltmeter indicates terminal voltage and is provided with full-scale ranges of 150, 50 and 15 volts. The meter can also be switched to indicate the plate current of the output amplifier tubes.

SECTION 2.0 OPERATION

2.1 CONTROLS

The controls consist of the following: OFF-ON switch with pilot light, an OUTPUT range selector and a METER RANGE switch.

2.2 TERMINALS

Type 874 Coaxial Connectors are provided at the INPUT and OUTPUT. Ground binding posts at 3/4-inch spacing with the center conductor of these connectors permit connection to be made also by means of Type 274-MB Double Plugs if desired. Two insulated binding posts are provided at the output, which are used when BALANCED output is selected. The 115v/230v, 40-60 cycle line cord receptacle is on the back of the instrument.

2.3 FUSES

The line fuses are on the back of the instrument. Two-ampere Slow-Blow type are used for 115-volt operation. One-ampere Slow-Blow type are used for 230-volt operation.

2.4 INSTALLATION

The panel is designed for mounting in a 19-inch relay rack, but removable end frames are supplied so that the instrument can be used equally well on a table. In either case ventilation should not be appreciably restricted or overheating may result. If possible the space immediately above the Type 1233-A should be kept free of other instruments, and any instruments below should not produce large amounts of heat.

2.5 OPERATION

The essential operating information is contained in the engraving of the OUTPUT range selector.

2.51 Input: Less than 0.2 volts are required at the INPUT to produce full output in all cases.

2.52 Load Resistance: For proper operation the load should match the value engraved at the desired setting of the range selector. For loads differing in value from those provided an external matching transformer may be used if maximum output is desired with low distortion.

2.53 Output: To keep distortion low the output voltage should be limited to a value representing rated power output into the indicated load resistance.

POWER watts	LOAD RESISTANCE ohms	R-M-S VOLTAGE
15	600	95
15	150	47.5
15	50	27.4
8	600	69.3
8	150	34.6
8	50	20.0

On the 20c to 3 Mc BAL HIGH impedance range the terminal-to-terminal peak-to-peak voltage should be limited to 150 volts. This range is intended primarily for cathode-ray-oscilloscope deflection use. The frequency compensation of this range has been adjusted so that the transient response shows negligible overshoot when the balanced output is connected directly to the deflection plate terminals of a standard cathode-ray oscillograph with 36-inch leads. The effective input resistance of each terminal to ground should be at least 1 megohm to prevent reduction of low frequency response. For BALANCED output insulated binding posts are used. In the 20 cycles to 3 Mc range grounded output can be obtained by connecting between one of the insulated binding posts and the ground post, but the distortion will be considerably higher than with balanced output, and the voltage should be limited to 50 volts peak to peak. In the 20 cycles to 20 kilocycles range the BALANCED output is actually an ungrounded output, and any desired load impedance relationship with respect to ground may be used.

2.54 Meter: For the 20 cycles to 20 kilocycles, and 20 kilocycles to 1.5 Mc ranges the voltmeter circuit is switched to the proper output terminals by the range selector. The voltmeter range is independently selected by the METER RANGE switch. On the 20 cycles to 3 Mc range the voltmeter circuit is switched to the unused grounded output terminals making the meter available for external use. The input impedance of this meter circuit is about 15,000 ohms. If desired and if the loading effect of the voltmeter can be tolerated, an external jumper can be used to connect it to either of the insulated output terminals for the 20 cycles to 3 Mc range. The meter can also be switched by means of the METER RANGE switch to indicate the plate current of the output amplifier tubes. The zero signal plate current is approximately 80 milliamperes increasing to a full signal value of approximately 120 milliamperes.

2.55 Line Supply Voltage: The power transformer is designed for either 115- or 230-volt operation at 40 to 60 cycles. The instrument is normally supplied connected for 115-volt operation in which case transformer terminals No. 1 and No. 3 are connected together, and No. 2 and No. 4 are connected together by jumpers. For 230-volt operation these jumpers must be removed, and No. 2 and No. 3 connected together. The fuses for 230-volt operation are 1 ampere Slow-Blow instead of the 2 ampere Slow-Blow fuses used for 115-volt operation.

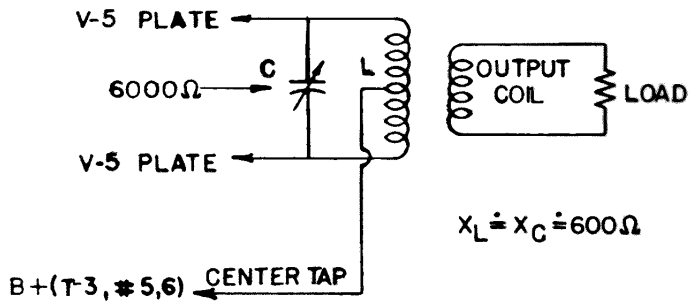
2.56 Caution: High voltage is exposed when the dust cover is removed.

2.6 SPECIAL APPLICATIONS

The available power output drops rapidly above 1.5 Mc on the 20 kilocycles to 1.5 Mc range. However, full output can be obtained at any particular frequency up to 5 Mc by connecting a suitable external tuned circuit in place of the output transformer. This can easily be accomplished by simply removing the plate connectors on the Type 807 tubes, substituting leads, to the external circuit, equipped with similar plate connectors; and attaching a lead to high voltage plate supply (terminals #5 and #6 on the small toroidal transformer, T-3), from the center tap of the external tuning inductor. The "special output circuit" diagram shows the arrangement schematically.

The load presented to the output tubes should be 6000 ohms plate-to-plate. The tuning capacitor should be rated at 1500 volts test. The reactance of the inductance and tuning capacitor should be about 600 ohms at the operating frequency. Proper matching of any reasonably low load resistance can be experimentally obtained by adjusting the number of turns and/or the coupling of the output coil.

Caution: Precautions must be taken to avoid contact with the high voltage on the capacitor and inductor. Protection from high voltage inside the Type 1233-A can be obtained by passing the necessary leads to the external circuit through the perforations in the dust cover. The external circuit should be suitably enclosed.



Special Output Circuit

SECTION 3.0 PRINCIPLES OF OPERATION

3.1 ELEMENTARY CIRCUIT

The elementary schematic diagram illustrates the functional details of the amplifier. There are three stages of push-pull amplification. Wide-band coupling networks are used between stages producing a flat response to 5 Mc. The input stage functions as a phase splitter by virtue of an essentially infinite common cathode resistor. Three possible output systems following the last stage of amplification are selected by the output switch. Two of these are transformer-coupled and furnish power output. The third permits the amplifier to function as a wide-band voltage amplifier with push-pull output, the overall response extending to 3 Mc. In the 20 cycles to 20 kilocycles range the output is available either grounded or ungrounded and for either 150- or 600-ohm loads as selected by the output switch. The output voltmeter uses a full-wave bridge circuit and operates as an "average" type voltmeter up to 5 Mc. The voltmeter is connected across the output terminals for the two transformer-coupled ranges and is switched to the then unused grounded output terminals for the 20 cycles to 3 Mc range.

3.2 CIRCUIT

The wiring diagram shows the complete circuit of the instrument.

3.21 Power Supply: The power supply consists of a plate supply delivering 250 milliamperes at 400 volts using selenium rectifiers in a full-wave voltage-doubler circuit; a bias supply delivering 30 milliamperes at 100 volts using selenium rectifiers in a "center-tapped" circuit; and two a-c heater supplies. L-1 is a peak current limiting choke in the voltage-doubler supply. A two-section LC filter is used in the plate supply. An RC filter is used in the bias supply. V-7 is a screen grid voltage regulator for V-5 and V-6. Its function is to maintain a relatively constant screen voltage with the large screen current variation that occurs in the output stage. Actually this circuit is just a d-c "cathode follower". The grid voltage is obtained from the plate supply via the voltage divider R-44, R-45. R-42 and R-43 are v-h-f parasitic oscillation suppressors. R-52 is an adjustment for minimizing hum due to the heater supply.

3.22 Input Amplifier: V-1 and V-2 are the input amplifier tubes. This stage functions as a phase splitter providing push-pull output with a grounded source. The common cathode resistor, R-3 and R-4 in parallel, is returned to the 100-volt negative bias supply which permits a relatively high resistance to be used. Since this resistance is large compared to the dynamic resistance looking back into the cathodes of V-1 and V-2, the circuit functions as though no cathode resistor were present, and the input signal divides equally between V-1 and V-2. The result is essentially equivalent to applying a push-pull signal grid-to-grid of this stage. An unbypassed screen grid dropping resistor aids

maintaining a balanced output. R-2, R-5, R-6 and R-7 are v-h-f parasitic oscillation suppressors. L-8 and L-9 are series-peaking video-coupling coils.

3.23 Driver Amplifier: V-3 and V-4 are the driver amplifier tubes. This stage in addition to supplying gain must supply sufficient undistorted voltage to the grids of the output amplifier to produce full power output. For this reason and since the wide-frequency range dictates relatively small plate load resistors, larger tubes are used here than in the input stage. Unbypassed cathode and screen grid dropping resistors help maintain balanced push-pull output from this stage. The potentiometer R-19 permits balancing the signal voltage on the grids of the output amplifier. R-14 and R-15 are v-h-f parasitic oscillation suppressors. L-6 and L-7 are series-peaking video coupling coils. The potentiometer R-54 permits balancing the d-c plate-currents of driver-amplifier tubes, by applying differential grid bias to these tubes.

3.24 Output Amplifier: V-5 and V-6 are the output amplifier tubes. This push-pull stage supplies power output by means of the low-frequency transformer T-2 or the high-frequency transformer T-3. It also can be switched to supply push-pull voltage output by means of a series-peaked video network, R-29, R-30, C-9, C-10, L-4, R-57, and L-5, R-58. R-57 and R-58 are used to produce a gradual roll-off of the high frequency response in the interest of good transient response. Without these resistors the response would be essentially flat to 5 Mc but the transient response would show about 10% overshoot with little improvement in rise time. Fixed bias is used in this stage and is obtained by means of a voltage dividing network from the 100-volt bias supply. Each tube has an independent grid bias adjusting potentiometer. R-23 is the grid bias potentiometer for V-5; R-24 is the grid bias potentiometer for V-6. R-27 and R-28 are v-h-f parasitic oscillation suppressors.

3.25 Voltmeter Circuit: D-1 and D-2 are crystal diodes used in the voltmeter circuit. A form of bridge circuit is used which functions as a full-wave "average" voltmeter up to 5 Mc. Range switching is accomplished in the d-c meter circuit. The rheostats R-34, R-36, and R-38 are the calibrating adjustments for the 15-, 50-, and 150-volt ranges respectively. For plate current metering R-39 and R-40 provide a full-scale meter sensitivity of 150 milliamperes.

SECTION 4.0 CALIBRATION AND ADJUSTMENT

There are seven screw-driver adjustments provided in the instrument. These adjustments are initially made at the factory and should not require adjustment in the field unless tubes and/or components are replaced. The function of each one of the adjustments has been described in Principles of Operation. If it is desired to follow through the complete adjustment procedure, it is recommended that it be done in the order given and after the instrument has been operating for a sufficient time to become thoroughly warmed up.

4.1 R-23, R-24

Function: output amplifier bias adjustments.
Location: front of chassis - beside 807 tubes - accessible from top.
OUTPUT switch: 20 cycles to 20 kilocycles range.

INPUT: shorted.
Insert a milliammeter between plate cap and V-5 (see note).
Adjust R-23 for 40 milliamperes plate current.
Remove milliammeter and replace plate cap on V-5 (see note).
Insert milliammeter between plate cap and V-6 (see note).
Adjust R-24 for 40 milliamperes plate current.
Remove milliammeter and replace plate cap on V-6 (see note).
Repeat above as there may be a slight interaction of the adjustments.

NOTE: Line switch must be turned off while plate connection is opened or damage may result to tubes.

4.2 R-54

Function: driver amplifier d-c balancing adjustment.
Location: top of chassis between tubes and electrolytic capacitors.
Set R-19 so that there is same plate load resistance for V-3 and V-4 as measured by an ohm meter (instrument power off).
Connect 0 to 10 volt meter between the grid ends of L-6 and L-7. Turn instrument on and allow it to warm up. Adjust R-54 for zero indication on the voltmeter.

4.3 R-19

Function: output amplifier grid signal balancing adjustment.
Location: front of chassis - between 807 tubes - accessible from top.
OUTPUT switch: 20 cycles to 20 kilocycles - 600 ohms - grounded.
Load: 600 ohms.
INPUT: 1 kilocycle low distortion - adjust level to produce 95 volts output. Connect a distortion meter across the output using an external voltage divider if necessary to bring the voltage level within its range (see note).
Adjust R-19 for minimum distortion.

NOTE: A wave analyzer may be used if desired, in which case it should be tuned to the second harmonic.

4.4 R-52

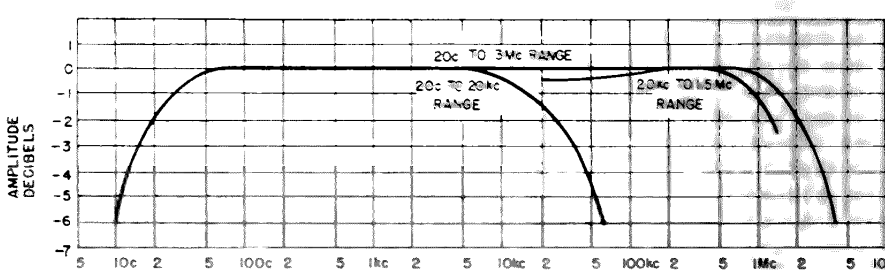
Function: hum adjustment.
Location: top of chassis - center left - accessible from top.
OUTPUT switch: 20 cycles to 20 kilocycles - 600 ohms - grounded.
Load: 600 ohms.
INPUT: shorted.
Connect a noise meter across output (see note).
Adjust R-52 for minimum noise.

NOTE: A wave analyzer may be used if desired, in which case it should be tuned to the line frequency.

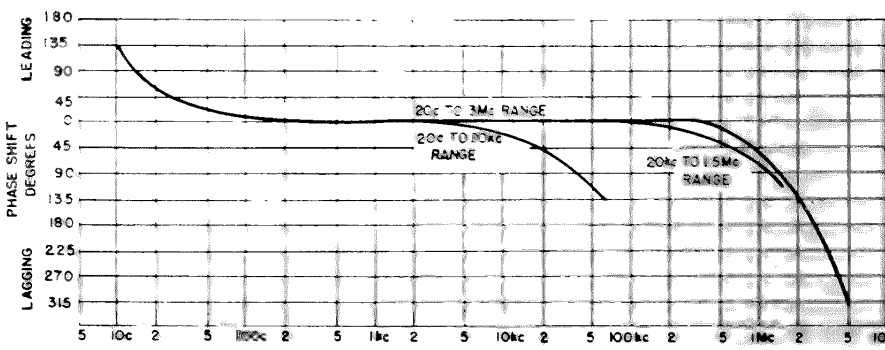
4.5 R-34, R-36, R-38

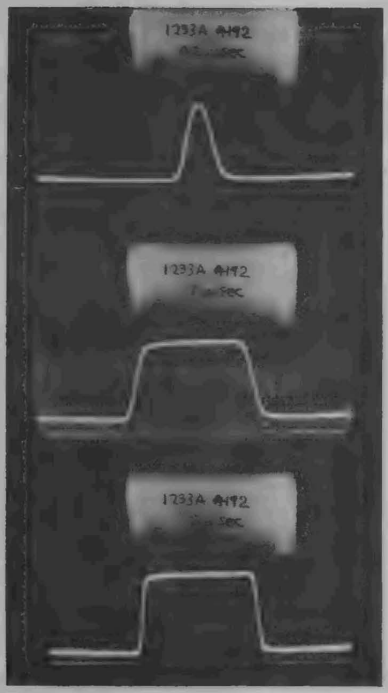
Function: voltmeter calibration adjustments.
Location: bottom-front right - accessible from the bottom (see note).
OUTPUT switch. 20 cycles to 5 Mc range.
METER RANGE switch: OUTPUT VOLTAGE 150.
Apply 120 volts 60 cycles to coaxial OUTPUT terminal.
Use accurate a-c meter for monitoring applied voltage (standard 60-cycle type of instrument preferred to diode type).
Set meter to 12 by means of R-38.
METER RANGE switch: OUTPUT VOLTAGE 50.
Apply 40 volts.
Set meter to 40 by means of R-36.
METER RANGE switch: OUTPUT VOLTAGE 15.
Apply 12 volts.
Set meter to 12 by means of R-34.

NOTE: Adjustments should be made with the instrument in an upright position. The instrument with the bottom dust cover removed can be placed on a bench so that the front-right corner projects beyond the edge, making the the adjustments accessible but keeping the instrument in the normal position.



Typical response curves for the three amplifier ranges. The 20-cycle-to-3-megacycle range is given a smooth roll-off at the high end to assure good transient response.





At the left are shown three photographs of oscillograph traces indicating typical pulse response characteristics of the 20c to 3Mc range. The output of the Type 1233-A was connected to the CRO deflection plates with 36-inch open-wire leads. The rise time of the input pulse was less than 0.03 microseconds, and the three pulses, from top to bottom, are 0.2, 1, and 2 microseconds long.

PARTS LIST

RESISTORS				TYPE	
R-1	=	100 K Ohms	±10%	REC-20BF	
R-2	=	56 Ohms	±10%	REC-20BF	
R-3	=	8.2 K Ohms	± 5%	REC-41BF	
R-4	=	8.2 K Ohms	± 5%	REC-41BF	
R-5	=	56 Ohms	±10%	REC-20BF	
R-6	=	56 Ohms	±10%	REC-20BF	
R-7	=	56 Ohms	±10%	REC-20BF	
R-8	=	33 K Ohms	± 5%	REC-30BF	
R-9	=	1.5 K Ohms	± 5%	REC-30BF	
R-10	=	1.5 K Ohms	± 5%	REC-30BF	
R-11	=	560 K Ohms	±10%	REC-20BF	
R-12	=	68 Ohms	± 5%	REW-3C	
R-13	=	560 K Ohms	±10%	REC-20BF	
R-14	=	56 Ohms	±10%	REC-20BF	
R-15	=	56 Ohms	±10%	REC-20BF	
R-16	=	30 K Ohms	± 5%	REC-41BF	
R-17	=	30 K Ohms	± 5%	REC-41BF	
R-18	=	1.5 K Ohms	± 5%	REPO-42	
R-19	=	250 Ohms	±10%	POSW-3	
R-20	=	1.5 K Ohms	± 5%	REPO-42	
R-21	=	10 K Ohms	±10%	REC-30BF	
R-22	=	100 K Ohms	±10%	REC-20BF	
R-23	=	10 K Ohms	±10%	POSW-3	
R-24	=	10 K Ohms	±10%	POSW-3	
R-25	=	100 K Ohms	±10%	REC-20BF	
R-26	=	1.5 K Ohms	±10%	REC-20BF	
R-27	=	56 Ohms	±10%	REC-20BF	
R-28	=	56 Ohms	±10%	REC-20BF	
R-29	=	1 K Ohm	± 5%	10 watt REPO-42-2	
R-30	=	1 K Ohm	± 5%	10 watt REPO-42-2	
R-31	=	15 K Ohms	± 5%	REC-41BF*	
R-32	=	510 Ohms	± 5%	REC-20BF	
R-33	=	510 Ohms	± 5%	REC-20BF	
R-34	=	1 K Ohm	±10%	POSW-3	
R-35	=	3.9 K Ohms	± 5%	REC-20BF	
R-36	=	5 K Ohms	±10%	POSW-3	
R-37	=	12 K Ohms	± 5%	REC-20BF	
R-38	=	10 K Ohms	±10%	POSW-3	
R-39	=	6.9 K Ohms	± 1%	REF-1	C.C.Co.
R-40	=	10 Ohms	± 1%	ZREPR-2	
R-41	=	100 K Ohms	±10%	REC-20BF	
R-42	=	56 Ohms	±10%	REC-20BF	
R-43	=	56 Ohms	±10%	REC-20BF	
R-44	=	75 K Ohms	± 5%	REC-41BF	
R-45	=	27 K Ohms	± 5%	REC-30BF	
R-46	=	400 Ohms	± 5%	REPO-22	
R-47	=	1.8 K Ohms	± 5%	REC-41BF	

*MUST Be Allen-Bradley

R-48 =	470 Ohms	±10%	REW-4C
R-49 =	470 Ohms	±10%	REW-4C
R-50 =	470 Ohms	±10%	REW-4C
R-51 =	100 Ohms	±10%	REW-6C
R-52 =	50 Ohms	±10%	POSW-3
R-53 =	15 Ohms	±10%	REW-3C (Part of P-1 socket)
R-54 =	2.5 K Ohms	±10%	POSW-3
R-55 =	300 K Ohms	±5%	REC-20BF
R-56 =	300 K Ohms	±5%	REC-20BF
R-57 =	3300 Ohms	±10%	REC-20BF
R-58 =	3300 Ohms	±10%	REC-20BF
C-1 =	.15 μf	±10%	COL-57
C-2 =	.02 μf	+20% -10%	COU-19
C-3 =	.02 μf	+20% -10%	COU-19
C-4 =	.047 μf	±10%	COL-71
C-5 =	.047 μf	±10%	COL-71
C-6 =	.15 μf	±10%	COL-57
C-7 =	.15 μf	±10%	COL-57
C-8 =			
C-9 =	.15 μf	±10%	COL-57
C-10 =	.15 μf	±10%	COL-57
C-11 =	.5 μf	±10%	COL-4
C-12 =	20 μf		
C-13 =	40 μf	450 V.D.C.	COEB-25
C-14 =	20 μf		
C-15 =	40 μf		
C-16 =	40 μf		
C-17 =	40 μf	250 V.D.C.	COEB-15-2
C-18 =	40 μf		
C-19 =	160 μf	250 V.D.C.	COEB-15-2
C-20 =	160 μf	250 V.D.C.	COEB-15
C-21 =	40 μf	450 V.D.C.	COE-18
C-22 =	100 μf	450 V.D.C.	COE-10
C-23 =	.005 μf	+20% -10%	COU-15
C-24 =	.005 μf	+20% -10%	COU-15
C-25 =	15 μμf	±10%	COM-20B

RECTIFIERS

RX-1 =	2RE-3
RX-2 =	2RE-3
RX-3 =	2RE-19
RX-4 =	2RE-19
RX-5 =	2RE-19
RX-6 =	2RE-19

CRYSTAL DIODES

D-1 =	Type 1N34-A
D-2 =	Type 1N34-A

INDUCTORS

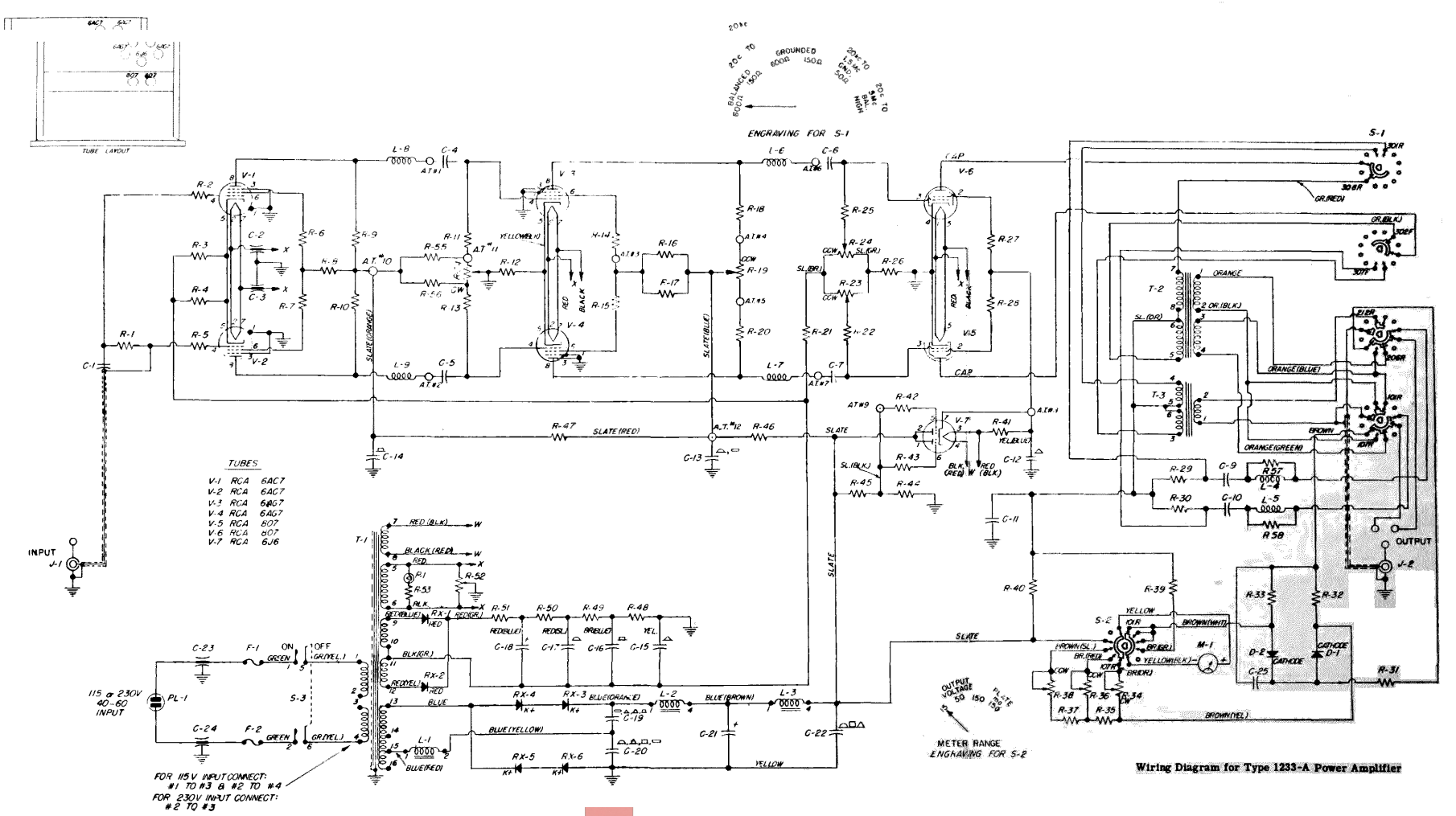
L-1	= 25 mh	±10%	745-410
L-2	= 2.3 h	±10%	345-453
L-3	= 2.3 h	±10%	345-453
L-4	= 42 μh	± 5%	ZCHA-41
L-5	= 42 μh	± 5%	ZCHA-41
L-6	= 55 μh	± 5%	ZCHA-42
L-7	= 55 μh	± 5%	ZCHA-42
L-8	= 36 μh	± 5%	ZCHA-40
L-9	= 36 μh	± 5%	ZCHA-40

TRANSFORMERS

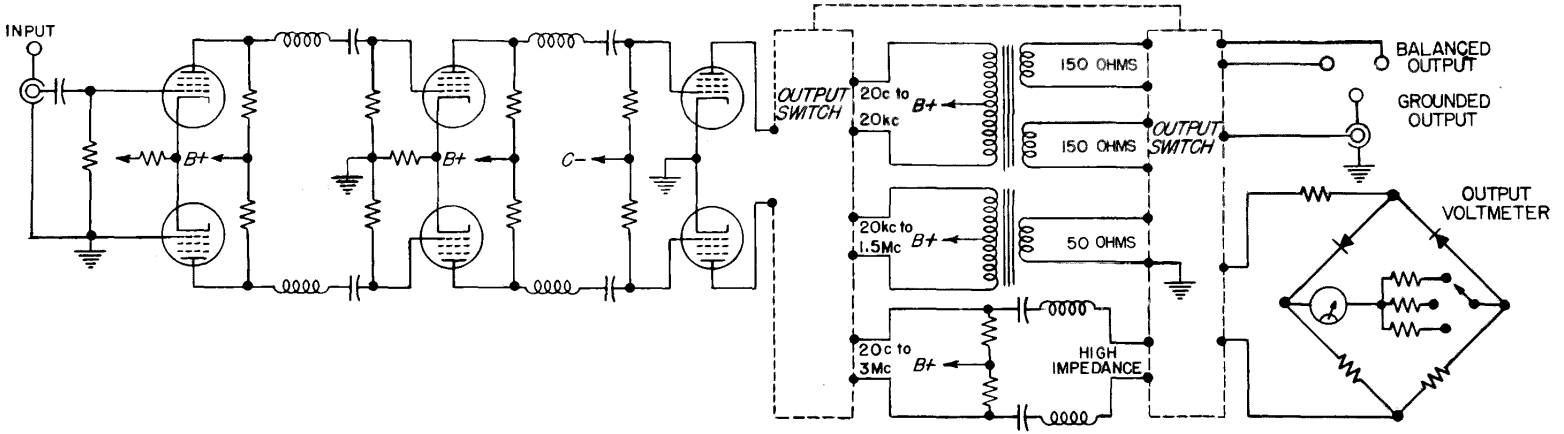
T-1	= Power Transformer	565-411-2
T-2	= Low Freq. Transformer	665-400
T-3	= High Freq. Transformer	1238-35

MISCELLANEOUS

M-1	= Meter 200 μa	MEBS-46	
S-1	= Switch	SWRW-54	
S-2	= Switch	SWRW-19	
S-3	= Switch	SWT-333	
F-1	= 2 amp Slow Blow 3AG	GR FUF-1	For 115V Oper.
F-2	= 2 amp Slow Blow 3AG	GR FUF-1	
F-1	= 1 amp Slow Blow 3AG	GR FUF-1	For 230V Oper.
F-2	= 1 amp Slow Blow 3AG	GR FUF-1	
PL-1	= Input Plug	CDPP-562A	
P-1	= Pilot Light	2LAP-939	
J-1	= Connector	874-307-2	
J-2	= Connector	874-307-2	



Wiring Diagram for Type 1233-A Power Amplifier



Elementary Schematic Diagram for Type 1233-A Power Amplifier