121.

RADIOTRONICS

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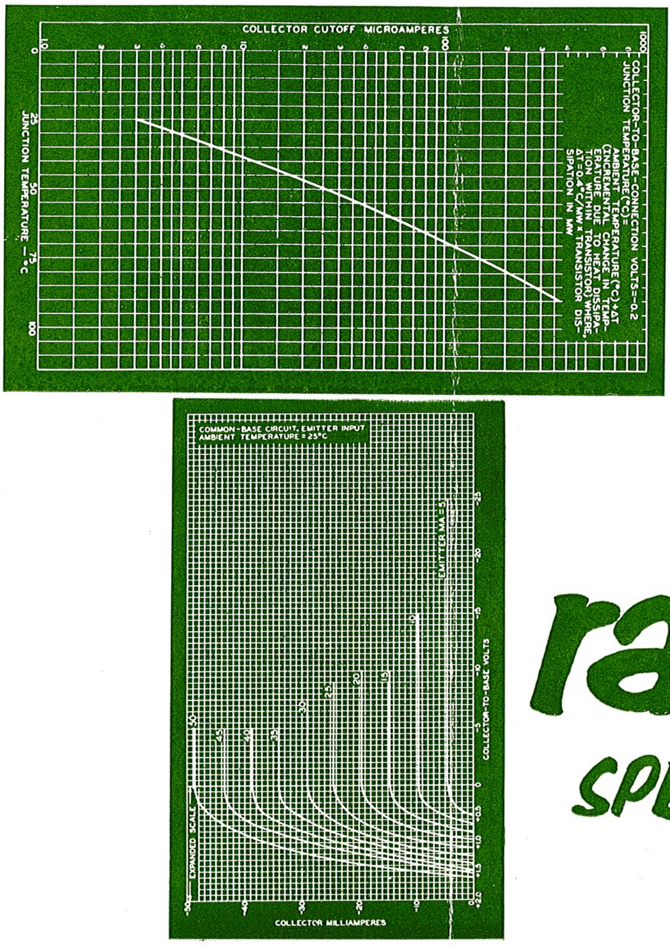
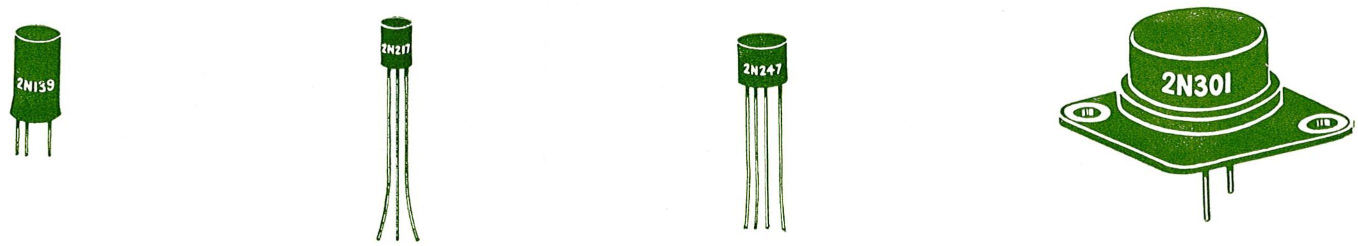


Transistor

SPECIAL ISSUE NO. 1



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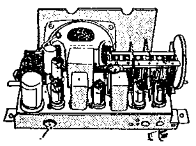

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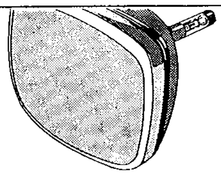

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N.B. For some types technical data is not yet available. This will be published in later issues of Radiotronics and may then be added to the present classification.

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TRANSISTOR OPERATING CONSIDERATIONS

The maximum ratings in the tabulated data are limiting values above which the life and performance of the various transistors may be impaired. So that these ratings will not be exceeded, the equipment designer must determine an average design value below each absolute rating such that the absolute values will never be exceeded under any likely combinations of ambient temperature, supply voltage variation, load variation or manufacturing variation in the equipment itself.

Transistors should not be connected into or disconnected from circuits with the power on because high transient currents may cause them to be permanently damaged.

The flexible lead types are normally soldered into the circuit but the leads can be trimmed to fit the linotetrar 3 pin socket. The soldered joint may be made close to the glass stem provided care is taken to conduct excessive heat away from the lead seals. Otherwise, the heat of the soldering operation will crack the glass around the leads and damage the transistor. When dip soldering is employed in the assembly of printed circuits, the temperature of the solder should not exceed 230°C for a maximum immersion period of 10 seconds.

The base pins of plug-in types fit the small round linotetrar 3 pin socket which may be mounted to hold the transistor in any position.

The base and emitter pins of the 2N301 and 2N301A can be fitted into a socket but connection can also be made by soldering to the pins. In this case, exactly the same precaution must be taken as with the small flexible lead types to prevent damage to the transistor.

In class B service, if the transistors are operated near their collector dissipation ratings and maximum supply voltage ratings it is important that circuit arrangements be made to prevent thermal runaway. This may be accomplished for the types listed as "Large Signal A-F Amplifiers" by reducing the base-to-emitter forward bias by approximately 2 mV/°C temperature rise in order to maintain a constant collector operating point as the ambient temperature varies. The same factor applies to the 2N301 and 2N301A for each degree centigrade of the mounting flange temperature above 25°C.

SPECIAL NOTES ON THE 2N301 AND 2N301A

In class A service to ensure stable operation it is necessary to provide some degeneration in the emitter circuit. This degeneration may be accomplished by using an unbypassed resistor of one ohm in the emitter circuit.

It is important that the mounting flange, which serves as the collector, be thermally connected to a heat sink. This can be done by direcly clamping the heat sink to the chassis in a case where it is convenient to have the chassis and collector at the same potential. In other applications where electrical insulation is required it is necessary to use either a $\frac{1}{8}$" anodized aluminium insulator having high thermal conductivity or a 0.002" mica insulator between the flange and the chassis. If the former is used the aluminium washer should be drilled or punched to provide the two mounting holes and clearance holes for the emitter and base pins. All burrs should then be removed and the washer anodized. To ensure that the anodized insulating layer is not destroyed during mounting, all burrs around holes in the chassis should also be carefully removed. To complete the insulation, fibre washers should be used between the mounting bolts and the chassis. The completely insulated mounting and a method of making a good electrical connection are illustrated in Fig. 1.

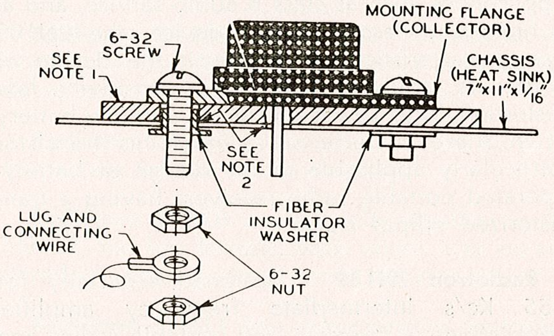


Fig. 1.

The mounting flange should never be soldered to the heat sink because the heat of the soldering process will permanently damage the transistor.

Radiotron Transistors

Radiotron 2N77 is designed especially for low-power audio applications where extreme stability is paramount such as in hearing-aid applications.

The extreme stability, very low cut-off collector current, and excellent uniformity of characteristics of this transistor are the results of its design and its closely controlled processing and manufacturing techniques.

The 2N77 features an average noise factor of 6.5 db, a matched-impedance, low-frequency power gain of 44 db, and a collector-to-emitter alpha frequency cut-off of 700 Kc/s.

Radiotron 2N104 is intended for low-power audio applications. This transistor is hermetically sealed, and utilizes an insulated metal envelope.

The extreme stability, low collector cut-off current, and excellent uniformity of characteristics of this transistor both initially and during life are the result of its design, and its closely controlled processing and manufacturing techniques.

Radiotron 2N105 is designed especially for audio-frequency amplifier service in hearing-aid applications.

The 2N105 features an exceptionally low average noise factor of 4.5 db, a matched-impedance, low-frequency power gain of 42 db, a collector-to-emitter alpha-frequency cut-off of 750 Kc/s and a very low maximum cut-off collector current of 5 microamperes.

Radiotron 2N109 is used especially in class B push-pull power output stages of battery-operated portable radio receivers and audio amplifiers operating at power output levels of approximately 150 milliwatts.

Intended especially for use in large-signal applications such as class B audio service, and as a high-gain class A driver device, the 2N109 has characteristics which permit the design of amplifiers requiring high power sensitivity, low distortion, high power efficiency, and low battery drain. These characteristics make this transistor particularly applicable to the design of battery-operated portable radio receivers having a transistorized output stage.

Radiotron 2N139 is designed especially for 455 Kc/s intermediate frequency amplifier applications in transistorized portable radios and automobile radios operating from either a 6 or 12 volt supply.

In a common emitter type of circuit, arranged to provide stability and interchangeability with some sacrifice in gain, the 2N139 features a power gain of 30 db at 455 Kc/s.

Radiotron 2N140 has parameters controlled especially for converter and mixer-oscillator applications in standard A-M broadcast-band transistorized portable radios and automobile radios operating from either a 6 or 12 volt supply.

In a stabilised common emitter circuit the 2N140 features a conversion power gain of 27 db at 1 Mc/s. Moreover, the parameters of the transistor are controlled to provide satisfactory operation under low-voltage conditions.

Radiotron 2N175 is a low-noise transistor intended particularly for use in pre-amplifier or input stages of transistorized audio amplifiers operating from extremely small input signals. Free from microphonism and hum and having an extremely low noise factor, the 2N175 makes possible higher small-signal sensitivity of transistorized audio equipment such as hearing-aids, microphone pre-amplifiers, and recorders. In addition, the low noise factor and the low input impedance characteristic of the 2N175 permit the design of audio amplifiers in which the transistor is operated directly from low-impedance, low-level devices such as magnetic microphones and magnetic pickups without an input coupling transformer.

Radiotron 2N206 is intended for use in audio applications where extreme stability is paramount.

The extreme stability, low collector cut-off current (emitter circuit open), and excellent uniformity of characteristics of this transistor both initially and during life are the result of its design and its closely controlled processing and manufacturing techniques.

Radiotron 2N215 is electrically identical to the 2N104, but has flexible leads which may be soldered or welded directly in to the circuit.

Radiotron 2N217 is electrically identical to the 2N109, but has flexible leads which may be soldered or welded directly into the circuit.

Radiotron 2N218 is electrically identical to the 2N139, but has flexible leads which may be soldered or welded directly into the circuit.

Radiotron 2N219 is electrically identical to the 2N140, but has flexible leads which may be soldered or welded directly into the circuit.

Radiotron 2N220 is electrically identical to the 2N175, but has flexible leads which may be soldered or welded directly into the circuit.

Radiotron 2N247 is a drift transistor designed specifically for use as a radio-frequency amplifier in military and commercial equipment and in entertainment-type receivers operating at frequencies covering the A-M broadcast band and up into the short-wave bands.

In a unilateralized common emitter circuit with base input, this transistor can provide a power gain as high as 45 db at 1.5 Mc/s. and 24 db at 10.7 Mc/s.

Radiotron 2N267 is a drift transistor similar to the 2N247, but is in a smaller metal case with only 3 flexible leads. It is intended for compact design where a high frequency transistor of small size is the primary consideration.

Radiotron 2N269 features excellent stability and exceptional uniformity of characteristics. It is designed specifically for use in low-level, medium-speed "on-off" control circuits, particularly bistable (flip-flop) and gating circuits of electronic computers.

Radiotron 2N270 is designed especially for use in large-signal audio-frequency applications such as single-ended or double-ended power output stages and high-gain class A driver stages of radio receivers and audio amplifiers. In push-pull class B amplifier service, two 2N270's can deliver a maximum-signal power output of approximately 500 milliwatts with a power gain of 32 db.

Radiotron 2N274 is designed primarily for r-f amplifier service in very compact military, mobile, and communications equipment, and in entertainment-type receivers operating at frequencies covering the A-M broadcast band and up into the short-wave bands. This transistor will also find wide application as an intermediate-frequency amplifier or as a mixer oscillator (converter).

Radiotron 2N301 and 2N301-A are power transistors designed specifically for use in class A power output stages of audio frequency amplifiers, particularly in automobile radio receivers and military and commercial communications equipment. They are also useful in class B push-pull amplifier stages of such equipment. The 2N301-A differs from the 2N301 in that it has a higher maximum d.c. and peak collector-to-base voltage rating and is intended for those military and commercial applications requiring such high voltages.

Radiotrons 2N370, 2N371 and 2N372: are drift transistors designed for use in all-wave portable receivers, the **2N370** as r-f amplifier,
the **2N371** for oscillator service,
and the **2N372** for mixer service.

As such these three transistors form a complement for high-gain r-f tuners.

Radiotron 2N384 is designed primarily for use as an oscillator up to 250 Mc/s or as an r-f amplifier in compact mobile communications equipment for military or industrial use. The 2N384 will also find wide application as an intermediate-frequency amplifier and low-level video amplifier in entertainment-type receivers, and as a pulse amplifier and high-speed switching device in electronic computers.

Radiotron 2N398 is specifically designed for use in high-voltage, "on-off" control applications, particularly in neon indicator circuits relay puller circuits, incandescent-lamp driver circuits, and direct indicating counter circuits of electronic computers.

The 2N398 features a maximum voltage rating of 105 volts for collector-to-base breakdown and for collector-to-emitter punch-through. This valve permits the design of neon indicator circuits in which the 2N398 can switch the full firing voltage of the indicator lamp. Because the 2N398 has a minimum d.c. current transfer ratio of 20, neon indicating circuits can be designed to perform the functions of a logic circuit without the use of a separate logic stage.

TRANSISTORS FOR RECEIVERS

Listed below are eight junction transistors manufactured primarily for use in compact entertainment receivers.

Radiotron 2N405 is intended for class A audio frequency driven service.

Radiotron 2N406 is electrically identical to the 2N405, but has flexible leads which may be soldered or welded directly into the circuit.

Radiotron 2N407 is intended for class A and B audio service.

Radiotron 2N408 is electrically identical to the 2N407, but has flexible leads which may be soldered or welded directly into the circuit.

Radiotron 2N409 is intended for 455 Kc/s. intermediate frequency applications.

Radiotron 2N410 is electrically identical to the 2N409, but has flexible leads which may be soldered or welded directly into the circuit.

Radiotron 2N411 has characteristics controlled especially to meet the requirements of converter and mixer-oscillator applications in the standard A-M broadcast band.

Radiotron 2N412 is electrically identical to the 2N411, but has flexible leads which may be soldered or welded directly into the circuit.

SMALL SIGNAL

TYPE	Class of Service	Base	MAXIMUM RATINGS (Absolute)				Max. I_{co} for stated V_{CB}	Alpha Cut-off Freq.
			D.C. Collector to Base Volts	D.C. Collector Current mA.	Collector Dissipation mW.	Ambient Temperature (Ta) °C.	µA	$f_{\alpha b}$—Kc/s
2N77	Class A A-F Amplifier	C	−25	−15	35 at 50°C	50	−10 at V_{CB}=−12v.	700
2N104 2N215	Class A A–F Amplifier	A C	−30	−50	35 at 70°C.	70	−10 at V_{CB}=−12v.	700
			Junction Temp. Rise (in free air) is 0·4°C./mW.					
2N105	Class A A–F Amplifier	B	−25	−15	35	50	—5 at V_{CB}=−12v.	750
2N175 2N220	Class A low noise A–F Amplifier	A C	−10	−2	20 at 50°C.	50	−12 at V_{CB}=−25v.	850
2N206	Class A A–F Amplifier	C	−30	−50	75 at 25°C.	—	−10 at V_{CB}=−30v.	780
			Junction Temp. Rise (in free air) is 0·3°C./mW.					
2N405 2N406	Class A A–F Amplifier	A C	−12	−35	150 at 25°C. 20 at 71°C.	71		

SWITCHING

2N269	Low level switch	C	—20 D.C. —25 Peak	−100	120 at 25°C. 10 at 71°C	71	−2·5 at V_{CB}=−2·5v.	4000
			Junction Temp. Rise (in free air) is 0.35°C/ mW					
2N398	High voltage on-off control	F	−100	−100	50 at ● 25°C. 10 at ● 55°C.	55	−14 at V_{CB}=−2·5v. (T_a=25°C.)	
2N404	Medium Speed Switching	F	—20 D.C. −25 Peak	−100	120 at 25°C. 10 at 71°C.	71	− 2.5 at V_{CB}=−2.5v	4,000

● Combined collector and emitter dissipation.

A-F AMPLIFIERS

TYPICAL OPERATION, COMMON EMITTER CIRCUIT (Ambient Temperature = 25°C.)

D.C. Collector to Emitter Volts	D.C. Collector Current mA.	POWER GAIN			Noise Factor db	Small Signal H Parameters				TYPE
		Input—Resistance ohms	Load Resistance ohms	Power Gain db		h_{ie} ohms	h_{re}	h_{fe}	h_{oe} μmhos	
−4	−0·7	1980	100,000	44·1	6·5	2720	$3{\cdot}23 \times 10^{-4}$	55	14	**2N77**
−6	−1·0	1400	20,000	41	12 max.	1667	$4{\cdot}95 \times 10^{-4}$	44	22·8	**2N104** **2N215**
−1·3	−0·3	4700	4,700	32·5	16·5 max.	4800	$9{\cdot}1 \times 10^{-4}$	45	12·4	**2N105**
−4	−0·5	2000	70,000†	43	6 max.	3570	$9{\cdot}44 \times 10^{-4}$	65	25	**2N175** **2N220**
−5	−1·0	1200	20,000	46	9	1650	$6{\cdot}0 \times 10^{-4}$	49	27·5	**2N206**
−6 $I_E = 1$mA.		750	85,000†	43		—	—	35	—	**2N405** **2N406**

TRANSISTORS

TYPICAL OPERATION IN LOW-LEVEL SWITCHING SERVICE FOR COMMON EMITTER CIRCUIT

	TYPE
D.C. Collector current .. −12 / −24 mA. D.C. Base current .. −0·4 / −1 mA. Max. D.C. Collector-Emitter Voltage .. .. −0·15 / −0·2 volt Max. D.C. Base-emitter Voltage .. .. .. −0·35 / −0·4 volt Minimum change in Temperature of Transistor Junctions such that the collector current will double for a D.C. collector-base voltage equal to or greater than −2·5 volts (but not more than −25v.) and with emitter open .. 10°C.	**2N269**
D.C. Collector Breakdown Voltage (BV_{CBO}) with D.C. collector current (I_C) = −50μA., D.C. emitter current (I_E) = 0. .. .. △ −105 volts D.C. Emitter Breakdown Voltage (BV_{EBO}) with D.C. emitter current (I_E) = −50μA, D.C. collector current (I_C) = 0. .. △ −50 volts D.C. Collector-Emitter (Punch-through)* Voltage. .. .. △ −105 volts △ Range value — min. D.C. Collector-Emitter Saturation Voltage (V_{CE}) with D.C. collector current (I_C) = −5mA., D.C. base current (I_B) = 0·25 mA. ... ... −0·20 v. (−0·35 v. max.) D.C. Base-Emitter Saturation Voltage (V_{BE}) with D.C. collector current (I_C) = −5mA., D.C. base current (I_B) = −0·25 mA. ... −0·30 v. (−0·40 v. max.) Large-Signal D.C. Current Transfer Ratio (α_{FE}) with D.C. collector current (I_C) = −5 mA., D.C. collector-emitter voltage (V_{CE}) = −0·35 v. ... ... 60 (20 min.)	**2N398**
Operation as for 2N269	**2N404**

*The D.C. collector-emitter (punch through) voltage is determined by connecting a high impedance voltmeter (≧11MΩ) between the emitter and base and measuring the collector-emitter voltage, which causes the emitter to assume an emitter-base floating voltage of −1·0 volt.

† Output resistance (input shorted).

LARGE SIGNAL

TYPE	Class of Service	Base	MAXIMUM RATINGS (Absolute)				Max. I_{co} for stated V_{CB} μA	Large Signal D.C. Current Transfer Ratio α_{FE}
			D.C. Collector to Base Volts	D.C. Collector Current mA.	Collector Dissipation mW.	Ambient Temperature (Ta°C.)		
2N109 2N217	Large Signal A–F Amplifier	A C	−25 Peak −12*	−70 Peak −35 Avg.	150 at 25°C 50 at 55°C. 20 at 71°C.	71	−10 at V_{CB}=−25v.	−75 for V_{CE}=−1 v. I_C=−50mA.
2N270	Large Signal A–F Amplifier	H	−25 peak −12*	−150 peak −75 avg.	150 at T_a=50°C.	50†	−16 at V_{CB}=−25v.	−70 for V_{CE}=−1v. I_C=−150mA
2N407 2N408	Large Signal A–F Amplifier	A C	−20				−14 max.	−65

POWER

TYPE	Class of Service	Base	MAXIMUM RATINGS (Absolute)				Max. I_{co} for stated V_{CB} μA	Large Signal D.C. Current Transfer Ratio α_{FE}
			D.C. Collector to Base Volts	D.C. Collector Current mA.	Collector Dissipation mW.	Mounting Flange Temperature (Tm °C.)		
2N301 2N301A	Large Signal A–F Power Amplifier	E E	−40 peak −20* −60 peak −30*	−2000 peak −1000 avg.	12000 at T_m=55°C. 5500 at T_m=71°C.	85	−220 at T_m = 25°C. V_{CB}=−12v.	−70 for V_{CE}=−1·5v. I_C=−1A.
			Derate	by 0·4 W/°C.	above T_m =	55°C.		

* For Inductive Load.

† Junction Temperature Rise (in free air) = 0·25° C/mW

A - F AMPLIFIERS

TYPICAL OPERATION, COMMON EMITTER CIRCUIT (AMBIENT TEMP. = 25°C.)						TYPE
TYPICAL OPERATION IN CLASS B PUSH-PULL SERVICE FOR COMMON EMITTER, BASE INPUT CIRCUIT						
D.C. Supply Voltage	−4·5	−9·0 volts	Signal Source Impedance (base to base)	1500	1500 ohms	**2N109**
Zero-Signal D.C. Base-Emitter Volts	−0·15	−0·15 volts	Load Impedance (collector to collector)	400	800 ohms	
Peak Collector Current (per transistor)	−35	−40 mA.	Signal Frequency	1000	1000 c/s.	
Zero-Signal D.C. Collector Current (per transistor)	−2	−2 mA.	Circuit Efficiency	60	69 %	
			Power Gain✦	30	33 db	
Max.-Signal D.C. Collector Current (per transistor)	−11·5	−13 mA.	Total Harmonic Distortion	7	7%	**2N217**
			Max.-Signal Power Output Signal.	75	160 mW.	

TYPICAL OPERATION IN CLASS B PUSH-PULL SERVICE FOR COMMON EMITTER, BASE INPUT CIRCUIT				TYPE
D.C. Supply Voltage	−12 volts	Load Impedance (per collector)	150 ohms	
Zero-Signal D.C. Base Emitter Volts	−0·11 volts	Signal Frequency	1000 c/s	
Zero-Signal D.C. Collector Current (per transistor)	−2 mA.	Circuit Efficiency	75%	
		Power Gain✦	32 db	**2N270**
Max.-Signal D.C. Collector Current (per transistor)	−35 mA.	Total Harmonic Distortion at 500 mW.	10% max.	
		at 10 mW.	5% max.	
Signal Source Impedance	1000 ohms	Max.-Signal Power Output	500 mW.	
				2N407 **2N408**

AMPLIFIERS

TYPICAL OPERATION FOR COMMON-EMITTER, BASE INPUT CIRCUIT AT T_m=55°C.						TYPE
	Class A	Class B (p—p)		Class A	Class B	
D.C. Supply Voltage	−14·4	−14·4 volts●	Signal Frequency	400	400 c/s	
			Circuit Efficiency	47	67%●	**2N301**
Zero-Signal D.C. Base to Emitter Voltage	−0·24	−0·13 volts	Power Gain✦	32·5	30db ●	
Peak Collector Current	−0·8	−2·0 amp.	Total Harmonic Dist. :			
Zero-Signal D.C. Collector Current	−0·4	−0·05 amp.	at 2·7 watts	10	—% max.	
Max.-Signal D.C. Collector Current	—	−0·64 amp.	at 12 watts	—	10% max.●	**2N301A**
D.C. Collector-Emitter Voltage	−13·6	— volts	Max.-Signal Power Output	2·7	12 W.●	
Signal Source Impedance	50	15 ohms	Emitter Resistor (unbypassed)	1	— ohm	
Load Impedance	34	6 ohms				

✦ Measured at primary of output transformer.

● Value is for two transistors.

MEDIUM FREQUENCY—CONVERTERS,

TYPE	Class of Service	Base	MAXIMUM RATINGS (Absolute) D.C. Collector to Base Volts	D.C. Collector Current mA.	Collector Dissipation mW.	Ambient Temperature °C.	Max. I_{co} for stated V_{CB} µA	Alpha Cut-off Freq. $f_{\alpha b}$—Mc/s
2N139 2N218	Class A 455–Kc/s Amplifier	A C	—16	—15	35 at 55°C.	71	—6 at V_{CB}=—12v.	6.7
2N140 2N219	540—1640 Kc/s Converter	A C	—16	—15	35 at 55°C.	71	—6 at V_{CB}=—12v.	10
2N409 2N410	Class A 455 Kc/s Amplifier	A C	—20				—14	
2N411 2N412	540—1640 Kc/s Converter	A C	—12					

HIGHER FREQUENCY—CONVERTERS,

2N247	Mixer-Osc. R–F and I–F Amplifier	D	—35	—10	35 at 71°C.	71	—16 at V_{CB}=—12v.	30
△ 2N267	Mixer-Osc. R–F and I–F Amplifier	C	—35	—10	35 at 71°C.	71	—16 at V_{CB}=—12v.	30
2N274	Mixer-Osc. R–F and I–F Amplifier	G	—35	—10	35 at 71°C.	71	—16 at V_{CB}=—12v.	30
2N370	R–F Amplifier	D	—20	—10	80 at 25°C. 10 at 71°C.	71	—20 at V_{CB}=—12v.	
2N371	R–F Oscillator	D	—20	—10	80 at 25°C. 10 at 71°C.	71	—20 at V_{CB}=—12v.	
2N372	Mixer	D	—20	—10	80 at 25°C. 10 at 71°C.	71	—20 at V_{CB}=—12v.	
2N384	R–F Amp. V.H.F. Osc. I–F Amp. Video Amp.	G	—30	—10	120 at 25°C. 35 at 71°C.	71	—16 at V_{CB}=—12v.	100

△ Same as 2N247 except for dimensions, leads and increase in Base-Collector lead capacitance from 0·003 µµF to 0·20 µµF.

OSCILLATORS and AMPLIFIERS

TYPICAL OPERATION, COMMON EMITTER CIRCUIT (Ambient Temperature = 25°C.)

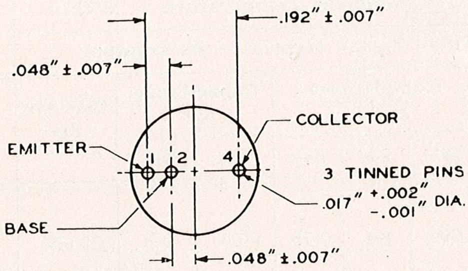
D.C. Collector to Emitter Volts	D.C. Collector Current mA.	h_{fe}	Power Gain: Input-Resistance ohms	Power Gain: Output Resistance (Input Shorted) ohms	Power Gain: Power Gain db	Small Signal Hybrid—π Parameters: Resistance $r_{bb'}$ ohms	Conductance μmhos: $g_{b'e}$	Conductance μmhos: g_{ce}	Conductance μmhos: $g_{b'c}$	Capacitance $\mu\mu$F: $C_{b'e}$	Capacitance $\mu\mu$F: $C_{b'c}$	Intrinsic g_m μmhos	TYPE
—9	—1	48	500	30,000	38	75	800	8·6	0·25	1100	9·5	38,600	2N139 2N218
—9	—0·6	75	700	75,000	32	85	480	5·4	0·23	650	9·5	22,600	2N140 2N219
													2N409 2N410
													2N411 2N412

OSCILLATORS and AMPLIFIERS

—9	—1	60	1350 at 1·5 Mc/s 170 at 10·7 Mc/s	70,000 at 1·5 Mc/s. 4500 at 10·7 Mc/s	45 24	40	640	0	0	200	1·7	37,000	2N247
—9	—1	60	1350 at 1·5 Mc/s 170 at 10·7 Mc/s	70,000 at 1·5 Mc/s 4500 at 10·7 Mc/s	45 24	40	640	0	0	200	1·7	37,000	2N267
—9 I_E=1mA		60	1350 at 1·5 Mc/s 170 at 10·7 Mc/s	70,000 at 1·5 Mc/s 4500 at 10·7 Mc/s	45 24	40	640	0	0	200	1·7	37,000	2N274
—12 I_E=1mA		90	80 at 20 Mc/s	11,000 at 20 Mc/s								20,700	2N370
—12 I_E=1mA		36	—	—									2N371
—12 I_E=1·5 mA		61·5	80 at 20 Mc/s	250,000 at 455 Kc/s								20,700	2N372
—12 I_E=1·5 mA		61·5	350 at 10·7 Mc/s 30 at 50 Mc/s	15,000 at 10·7 Mc/s 5000 at 50 Mc/s	30 15	50	960			90	1·3	56,800	2N384

BASE DIAGRAMS

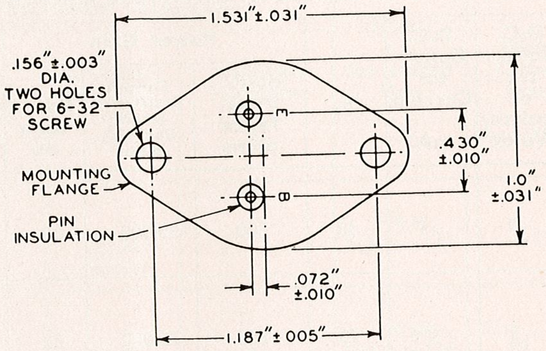
A



PIN-SPACING TOLERANCES ARE NOT CUMULATIVE

2N104 2N109 2N139 2N140 2N175 2N405 2N407 2N409 2N411

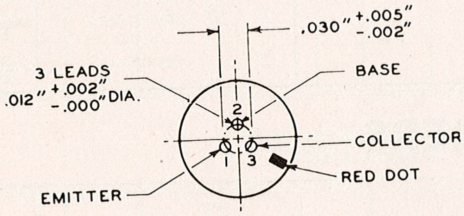
E



E=EMITTER
B=BASE
MOUNTING FLANGE=COLLECTOR

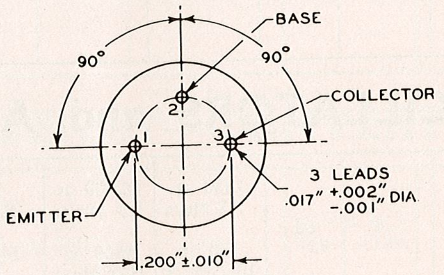
2N301 2N301A

B



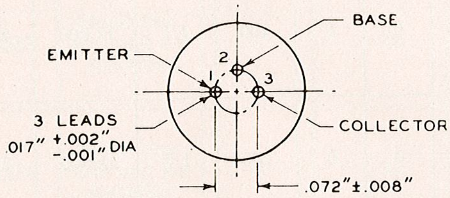
2N105

F



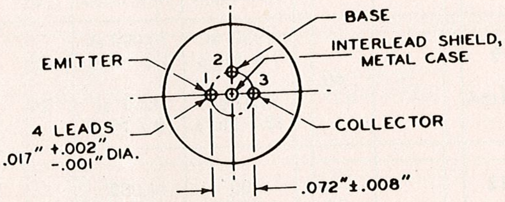
2N398 2N404

C



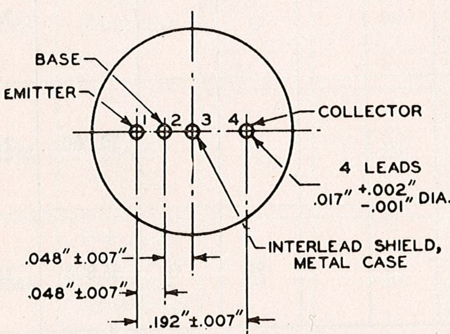
2N77 2N206 2N215 2N217 2N218 2N219 2N220 2N267 2N269 2N406 2N408 2N410 2N412

G



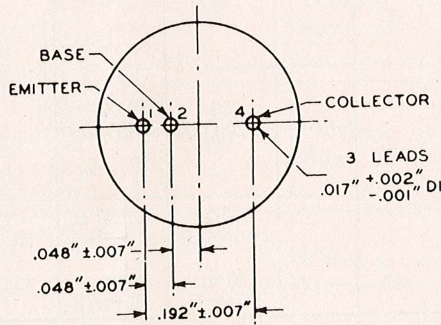
2N274 2N384

D



2N247 2N370 2N371 2N372

H



2N270

Six Transistor Receiver — Standard A-M Broadcast Band

B = 9 V.
C1 = Trimmer capacitor, 2-20 μμF.
C2 = Variable capacitor, 12-230 μμF.
C3 = 0.01 μF, paper, 150 V.
C4 = 0.04 μF, paper, 150 V.
C5 = 220 μμF, mica.
C6 = Variable capacitor, 10-105 μμF.
C7 = Trimmer capacitor, 0-20 μμF.
C8 = 10 μF, electrolytic, 3 V.
C9 = 75 μμF, mica.
C10 = 0.05 μF, paper, 150 V.
C11 = 0.05 μF, paper, 150 V.
C12 = 220 μμF, mica.
C13 = 0.05 μF, paper, 150 V.
C14 = 0.05 μF, paper, 150 V.
C15 = 33 μμF, mica.
C16 = 0.05 μF, paper, 150 V.
C17 = 220 μμF, mica.
C18 = 0.05 μF, paper, 150 V.
C19 = 2 μF, electrolytic, 12 V.
C20 = 50 μF, electrolytic, 12 V.
C21 = 100 μF, electrolytic, 12 V.
C22 = 50 μF, electrolytic, 12 V.
C23 = 0.01 μF, paper, 150 V.
C24 = 0.03 μF, paper, 150 V.
R1 = 33,000 ohms, 0.5 W.
R2 = 820 ohms, 0.5 W.
R3 = 100 ohms, 0.5 W.
R4 = 100,000 ohms, 0.5 W.
R5 = 8,200 ohms, 0.5 W.
R6 = 560 ohms, 0.5 W.
R7 = 560 ohms, 0.5 W.
R8 = 560 ohms, 0.5 W.
R9 = 1,800 ohms, 0.5 W.
R10 = 47,000 ohms, 0.5 W.
R11 = 560 ohms, 0.5 W.
R12 = 2,000 ohms, 0.5 W.
R13 = Potentiometer, 2,500 ohms, 0.5 W., volume-control.
R14 = 39,000 ohms, 0.5 W.
R15 = 51,000 ohms, 0.5 W.
R16 = 220 ohms, 0.5 W.
R17 = 5,100 ohms, 0.5 W.
R18 = 100 ohms, 0.5 W.
R19 = 10,000 ohms, 0.5 W.
R20 = 220,000 ohms, 0.5 W.
R21 = Thermistor, 300 ohms at 25°C, 108 ohms at 50°C.
R22 = 270 ohms, 0.5 W.
T1 = Antenna transformer.
T2 = Oscillator transformer.
T3, T4, T5 = Intermediate-frequency transformers.
T6 = Driver transformer with primary to secondary impedance (base-to-base, centre tapped) of 20,000 ohms to 2,000 ohms.
T7 = Class B output transformer with primary to secondary impedance (collector-to-collector, centre tapped) of 750 to 3.2 ohms.

T1 = Antenna transformer wound on the largest feasible ferrite core to provide the following characteristics:

Primary Inductance (With secondary open)	353 μH
Primary Q at 1 Mc/s, mounted on chassis with secondary open	200
Equivalent output resistance across secondary terminals, at 1 Mc/s with primary tuned	600 ohms

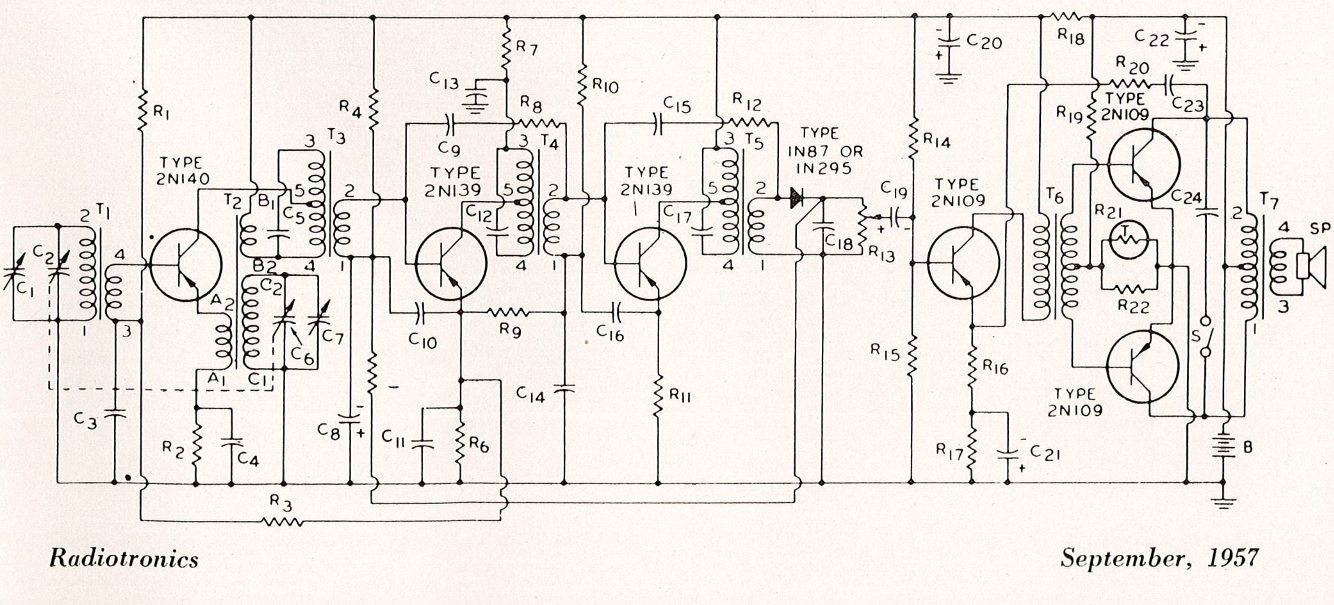
The primary should be wound on one end of the ferrite rod with spacing between turns equal to the thickness of the wire.

The secondary should be wound on the opposite end of the ferrite rod with no spacing between turns (close wound). The end of the primary winding nearest the secondary is the ground end. Use # 7/41 Litz wire. A ferrite rod about 8" long and ⅜" in diameter will provide excellent results.

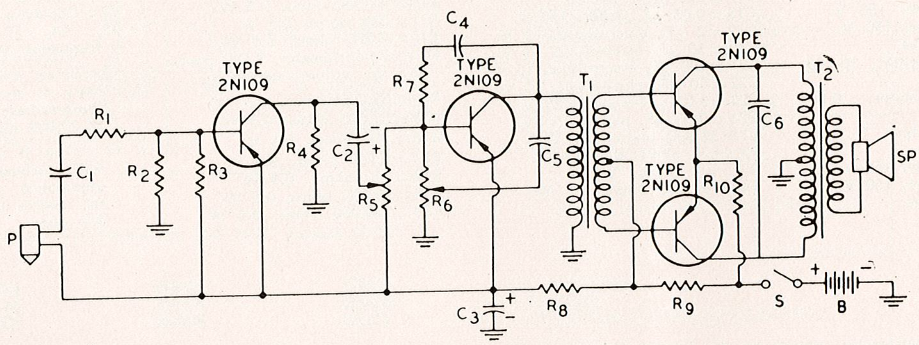
T2 = Oscillator transformer. Wind as follows:
Using a threaded resinite coil form about 1" long with internal threads to match a ¼"-diameter ferrite core about ⅜" in length, wind 4 turns near the centre of the coil form. This winding is located between the terminals marked A1 and A2 on the circuit diagram. The winding between terminals B1 and B2 consists of a 10-turn winding and is wound on top of the 4-turn winding. The winding between terminals C1 and C2 is wound on top of the other two windings and is a multilayer 115-turn winding. This winding should extend over a length of about ⅜". All the windings are universally wound with #5/44 Litz wire. A resinite collar with 6-terminals may be fitted over one end of the coil form to provide secure anchorage for the ends of the windings and convenient terminals for making connections to the windings. When the transformer is completed, connect a 120-μμF capacitor across the 115-turn winding and tune the ferrite core to obtain resonance at 1.455 Mc/s with the other two windings open circuited. The Q of this winding under the same conditions should be 100 or greater.

T3, T4, T5 = Intermediate-frequency transformers.
Using materials like those described for the Oscillator Transformer T2 wind T3, T4, and T5 to meet the following requirements:

	T3	T4	T5
Tuned resistance at primary tap	118,000	15,300	17,200 ohms
Primary (Terminals 1 and 2): Reflected resistance with secondary terminated	206,000	29,000	10,900 ohms
Secondary (Terminals 4 and 5): Reflected resistance with primary terminated	1,000	500	1,000 ohms
Turns Ratios:			
Terminals 3 and 5 to terminals 5 and 4	1.17	2.48	3.16
Terminals 5 and 4 to terminals 2 and 1	14.35	7.62	3.3
Terminals 3 and 4 to terminals 2 and 1	16.8	18.9	10.43
Core Material:	Ferrite	Ferrite	Ferrite
Unloaded Q (mounted in chassis)	110	61	110
Loaded Q (mounted in chassis)	35	35	35



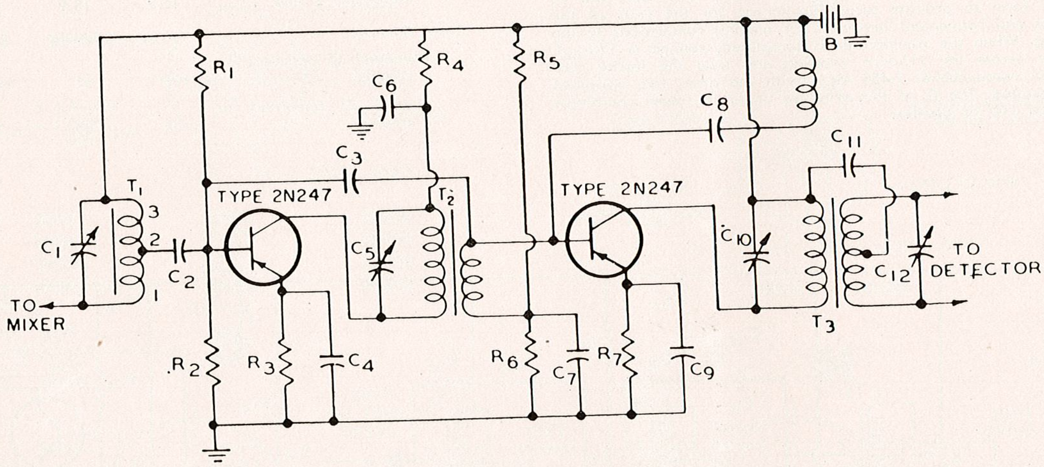
Gramophone Amplifier — Class B, Output 200 mW.



B = 9 V.
C1 = 0.01 μF, paper, 150 V.
C2 = 1 μF, electrolytic, 12 V.
C3 = 50 μF, electrolytic, 12 V.
C4 = 0.003 μF, paper, 150 V.
C5 = 0.002 μF, paper, 150 V.
C6 = 0.04 μF, paper, 150 V.
P = Phonograph cartridge, ceramic.
R1 = 1 megohm, 0.5 W.
R2 = 0.22 megohm, 0.5 W.
R3 = 4,700 ohms, 0.5 W.
R4 = 1,500 ohms, 0.5 W.
R5 = Potentiometer, 5,000 ohms, 0.5 W, volume-control.
R6 = Potentiometer, 0.1 megohm, 0.5 W, bass-boost.
R7 = 0.22 megohm, 0.5 W.
R8 = 680 ohms, 0.5 W.
R9 = 27 ohms, 0.5 W.
R10 = 33 ohms, 0.5 W.
SP = Speaker.
T1 = Interstage audio transformer with centre-tapped secondary to provide a 3,000-ohm load at the primary terminals with a 5,000-ohm load between the outer secondary terminals. D.C. primary current = 1.5 mA D.C. primary resistance = 300 ohms.
T2 = Output transformer with centre-tapped primary to provide a 550-ohm load between the outer primary terminals with the desired speaker connected to the secondary terminals. D.C. current unbalance between halves of primary = 1 mA. D.C. primary resistance = 15 ohms per section.

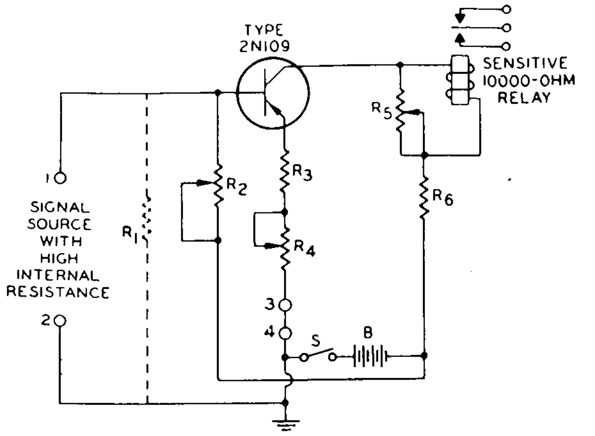
Battery Current:
No-signal current = 6 mA.
Average current = 26 mA.
Peak current = 42 mA.

Two Stage, 10.7 Mc/s. I-F Amplifier



B = 9 V.
C1 = 30 μμF, mica, 500 V.
C2 = 1,000 μμF, mica, 500 V.
C3 = 8.5 μμF, mica, 500 V.
C4 = 0.05 μF, paper.
C5 = Variable capacitor, 2-30 μμF.
C6 = 0.05 μF, paper, 150 V.
C7 = 0.05 μF, paper, 150 V.
C8 = 0.05 μF, paper, 150 V.
C9 = 0.05 μF, paper, 150 V.
C10 = Variable capacitor, 2-30 μμF.
C11 = 0.05 μF, paper, 150 V.
C12 = 30 μμF, mica, 500 V.
R1 = 39,000 ohms, 0.5 W.
R2 = 5,600 ohms, 0.5 W.
R3 = 1,000 ohms, 0.5 W.
R4 = 680 ohms, 0.5 W.
R5 = 39,000 ohms, 0.5 W.
R6 = 5,600 ohms, 0.5 W.
R7 = 1,000 ohms, 0.5 W.
T1 = Tap transformer, primary impedance (terminal 1 to terminal 3) = 4,250 ohms, tap impedance (terminal 1 to terminal 2) = 170 ohms, unloaded Q = 150, loaded Q = 27.3, Turns Ratio = 5:1.
T2 = I.F. air-core transformer, inductance to tune with 30 μμF, unloaded Q = 150, loaded Q = 27.3, Turns Ratio = 5:1.
T3 = I.F. air-core transformer, unloaded Q = 150, loaded Q = 27.3, Turns Ratio = 5:1.

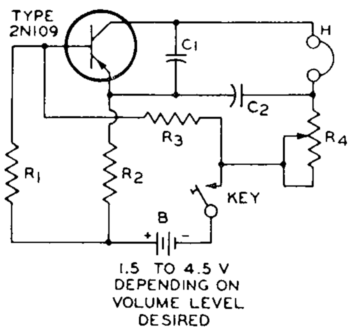
Sensitive Relay



B=22.5 V.
R1=1,000 ohms, 0.5 W.
R2=Bias-control potentiometer, 0.1 megohm, 0.5 W.
R3=10 ohms, 0.5 W.
R4=Input - impedance - control potentiometer, 1,000 ohms, 0.5 W.
R5=Sensitivity-control potentiometer, 0.1 megohm, 0.5 W.
R6=1,000 ohms, 0.5 W.

NOTES: (1) If a signal source with internal resistance is used, omit R1 and connect a jumper between terminals 3 and 4 as shown. Adjust R4 for best performance.
(2) If a signal source with a low internal resistance is used, connect the source between terminals 3 and 4, omitting the jumper. Connect R1 as shown. Adjust R4 to provide a direct connection from R3 to terminal 3.
(3) Relays having a D.C. coil resistance of less than 10,000 ohms may be used, provided the battery voltage is proportionately reduced. In such event, circuit sensitivity will be reduced.

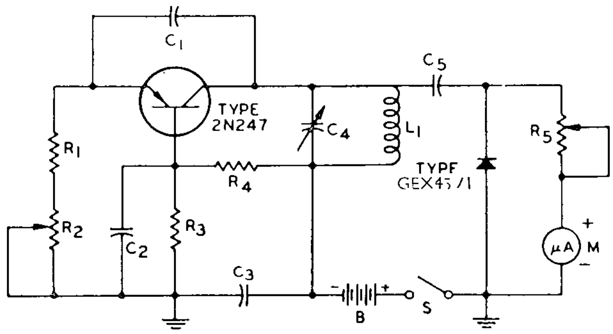
Code Practice Oscillator



B=(See note).
C1, C2=0.1 μF, paper, 150 V.
H=Headphones, 2,000-ohm, magnetic.
R1=2,200 ohms, 0.5 W.
R2=27,000 ohms, 0.5 W.
R3=3,000 ohms, 0.5 W.
R4=Volume control potentiometer, 50,000 ohms, 0.5 W.

NOTE: One to three series-connected dry cells may be used, depending upon the volume level desired.

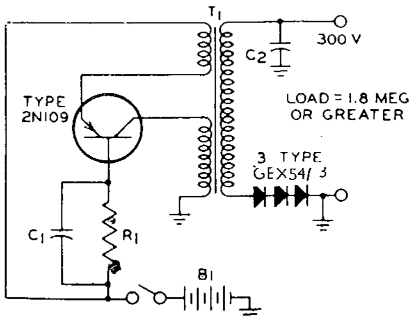
Grid-Dip Meter for measuring resonant frequencies for 2-50 Mc/s. approx.



B=9 V.
C1=10 $\mu\mu$F, mica, 500 V.
C2=0.05 μF, paper, 150 V.
C3=0.05 μF, paper, 150 V.
C4=Variable capacitor, 10-100 $\mu\mu$F.
C5=5 $\mu\mu$F, mica, 500 V.
L1=Air-core plug-in coil to resonate with C4.
M=D.C. Microammeter, range: 0 to 50 μA.
R1=220 ohms, 0.5 W.
R2=Potentiometer, 3,000 ohms, 0.5 W.
R3=3,900 ohms, 0.5 W.
R4=39,000 ohms, 0.5 W.
R5=Potentiometer, 0.25 megohms, 0.5 watt.

NOTE: R_1 and R_2 may be replaced with a single 1,000-ohm resistor, but there will be a small decrease in output at the lower and higher frequencies.

Portable Low-Drain High-Voltage Power Supply



B=12 V.
C1=0.01 μF, paper, 150 V.
C2=0.1 μF, paper, 600 V.
R1=22,000 ohms, 0.5 W.
T1=Transformer with 15-turn primary, 5-turn tickler and 530-turn secondary.

AWV