2N105

JUNCTION TRANSISTOR

GERMANIUM P-N-P ALLOY TYPE

For small signal audio frequency applications

GENERAL DATA

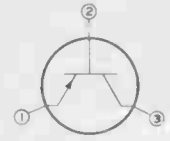
Electrical:

Minimum DC Collector-to-Base Voltage for dc collector current of −10 μamp with emitter open, and at ambient temperature of 25°C	−35	volts
Maximum DC Collector Current for dc collector-to-base voltage of −12 volts with collector open, and at ambient temperature of 25°C	−5	μamp

Mechanical:

Mounting Position	Any
Maximum Length (Excluding flexible leads)	0.255"
Maximum Diameter	0.135"
Case	Metal, Insulated
Envelope Seals	Hermetic
Leads, Flexible	3
Length	1.5" ± 0.015"
Orientation and diameter	*See Dimensional Outline at front of this Section*

BOTTOM VIEW



AUDIO-FREQUENCY AMPLIFIER -- Class A

Maximum Ratings, *Absolute Values:*

DC COLLECTOR-TO-BASE VOLTAGE	−25 max.	volts
DC COLLECTOR CURRENT	−15 max.	ma
DC EMITTER CURRENT	15 max.	ma
COLLECTOR DISSIPATION	35 max.	mw
AMBIENT TEMPERATURE (During operation)	50 max.	°C
STORAGE-TEMPERATURE RANGE	−55 to +70	°C

Characteristics, *At Ambient Temperature of 25°C:*

	Common-Emitter Circuit, Base Input		
DC Collector-to-Emitter Voltage	−1.2	−4	volts
DC Collector Current	−0.5	−0.7	ma
Power Gain:			
With load resistance = 4700 ohms, and input resistance = 4700 ohms.	32.5	–	dB
With load resistance = 20,000 ohms, and input resistance = 2300 ohms.	–	42	dB

2N105

JUNCTION TRANSISTOR

Noise Factor: Measured with a noise diode and thermocouple voltmeter with load resistance = 20,000 ohms, generator resistance = 1000 ohms, and equivalent noise bandwidth = 12.3 kc with geometric mean of 300 cps			
Maximum value.	16.5	–	db
Typical value.	7.5	–	db
Small-Signal T Parameters:*			
DC Collector-to-Emitter Voltage (V_{CE}).	-1.3	-4	volts
DC Collector Current (I_C).	-0.3	-0.7	ma
Emitter Resistance (r_e).	73	34	ohms
Base Resistance (r_b)	1400	976	ohms
Mutual Resistance (r_m)	3.66	3.39	megohms
Collector Resistance (r_c).	3.74	3.45	megohms
Current Transfer Ratio (α_f)■	-45	-55	
Small-Signal Hybrid-π Parameters:*			
DC Collector-to-Emitter Voltage (V_{CE}).	-1.3	-4	volts
DC Collector Current (I_C).	-0.3	-0.7	ma
Resistance $r_{bb'}$.	260	250	ohms
Conductance $g_{b'e}$	220	380	μmhos
Conductance g_{ce}.	3.1	4.5	μmhos
Conductance $g_{b'c}$	0.20	0.21	μmho
Capacitance $C_{b'e}$	2500	4500	μμf
Capacitance $C_{b'c}$	27	17	μμf
Intrinsic Transconductance (g_m). . . .	10000	21000	μmhos
Frequency● for unity power amplification.	1.9	2.6	Mc
Small-Signal H Parameters:*			
DC Collector-to-Emitter Voltage (V_{CE}).	-1.3	-4	volts
DC Collector Current (I_C). . . .	-0.3	-0.7	ma
Input Resistance, output circuit shorted (h_i)	4800	2880	ohms
Reverse Voltage Transfer Ratio, input circuit open (h_r).	9.1×10^{-4}	5.5×10^{-4}	
Forward Current Transfer Ratio, output circuit shorted (h_f)	45	55	
Output Conductance, input circuit open (h_o).	12.4	16.3	μmhos

* As derived from corresponding equivalent circuit shown under type 2N104.

■ Measured at 1 kc.

●: See next page.

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2N105

JUNCTION TRANSISTOR

Common-Base Circuit, Emitter Input

DC Collector-to-Base Voltage	-4	volts
DC Collector Current	-0.7	ma
Power Gain:		
With load resistance = 0.5 megohm, and input resistance = 180 ohms	33.2	db
Frequency at which the current transfer ratio drops to one-half the square root of two times its value at 1 kc	700	kc

Common-Collector Circuit, Base Input

DC Emitter-to-Collector Voltage	1.3	volts
DC Emitter Current	0.3	ma
Power Gain:		
With load resistance = 13,000 ohms, and input resistance = 0.5 megohm	16	db

• This frequency (figure of merit) may be calculated from the equation

$$f = \frac{1}{4\pi}\sqrt{\frac{g_m}{r_{bb'}\, C_{b'c}\, C_{b'e}}}$$

OPERATING CONSIDERATIONS

The 2N105 should not be connected into or disconnected from circuits with the power on because high transient currents may cause permanent damage to the transistor.

The *flexible leads* of the 2N105 are usually soldered to the circuit elements. Soldering of the leads may be made close to the glass stem provided care is taken to conduct excessive heat away from the lead seal. Otherwise, the heat of the soldering operation will crack the seals of the leads and damage the transistor.

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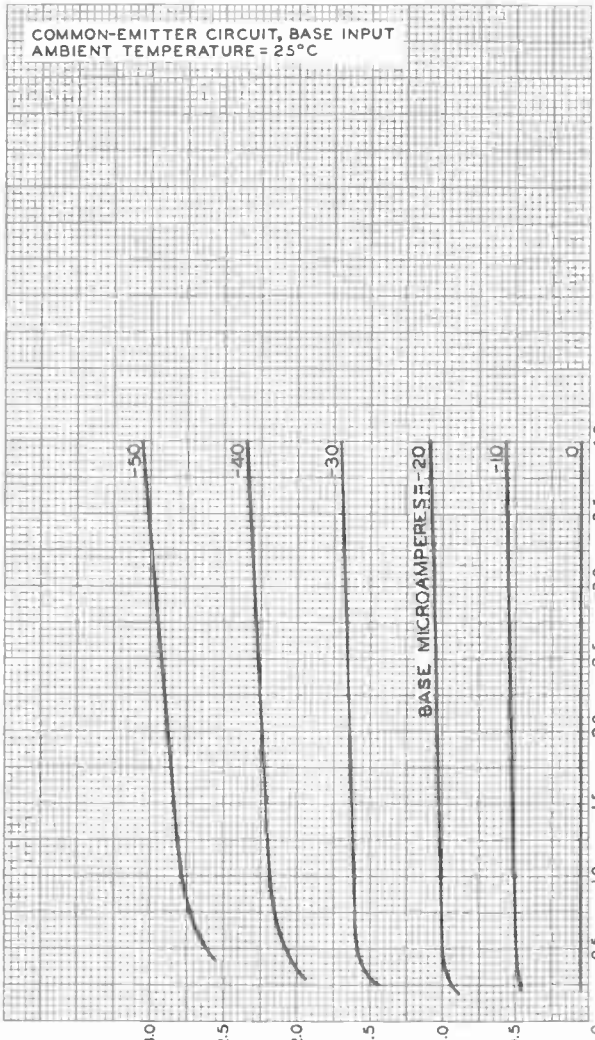
RCA

2N105

AVERAGE COLLECTOR CHARACTERISTICS



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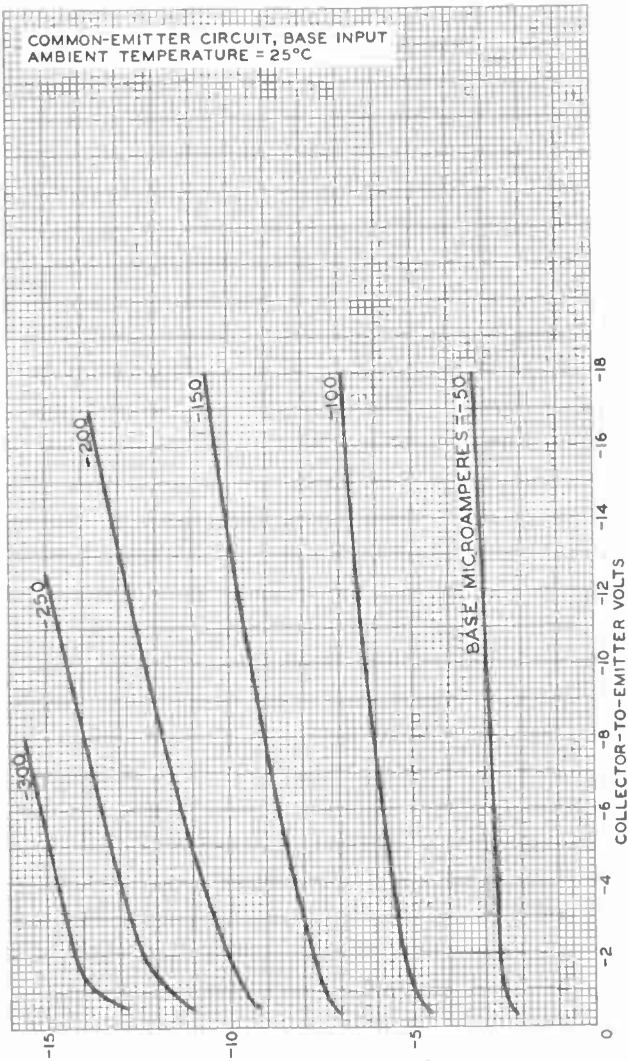
92CM-8571RI

2N105

2N105

AVERAGE COLLECTOR CHARACTERISTICS



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92CM-8572R1

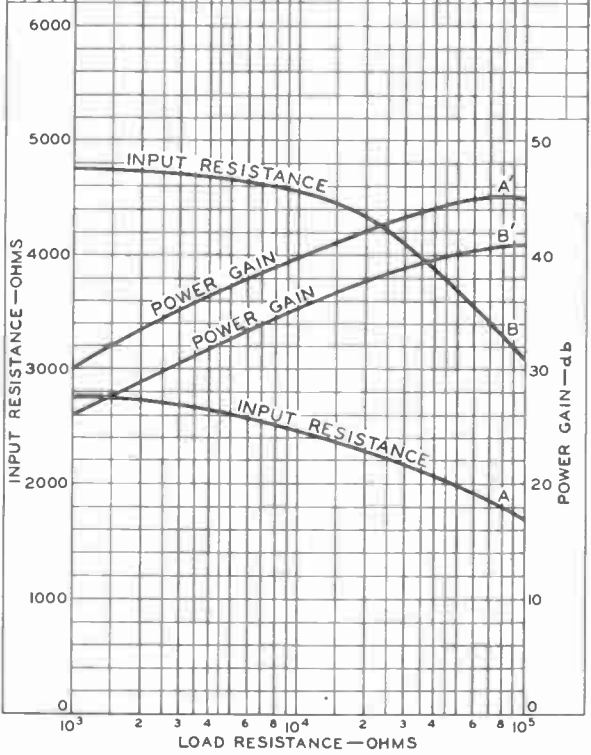
RCA

2N105

OPERATION CHARACTERISTICS

COMMON-EMITTER CIRCUIT, BASE INPUT
AMBIENT TEMPERATURE = 25°C

CURVE	COLLECTOR-TO-EMITTER VOLTS	COLLECTOR MA
A & A′	−4	−0.7
B & B′	−1.3	−0.3



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92CM-8582RI

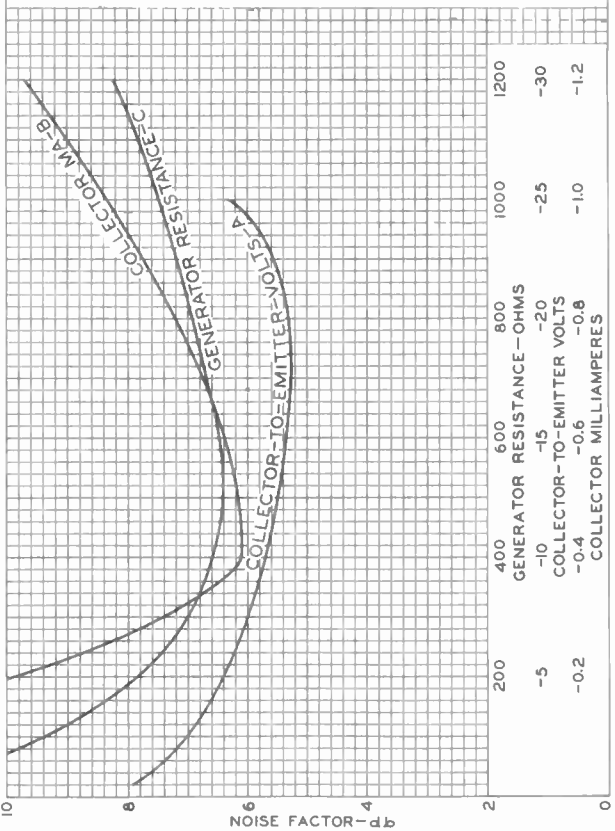
RCA

2N105

TYPICAL NOISE CHARACTERISTICS

COMMON-EMITTER CIRCUIT, BASE INPUT
AMBIENT TEMPERATURE=25°C
MEASURED WITH A NOISE DIODE AND THERMOCOUPLE VOLT-METER WITH LOAD RESISTANCE=20000 OHMS AND EQUIVALENT NOISE BANDWIDTH=12.3 KC WITH GEOMETRIC MEAN OF 300 CPS

CURVE	GENERATOR RESISTANCE (OHMS)	COLLECTOR-TO-EMITTER VOLTS	COLLECTOR MA
A	1000	—	-0.3
B	1000	-1.3	—
C	—	-1.3	-0.3



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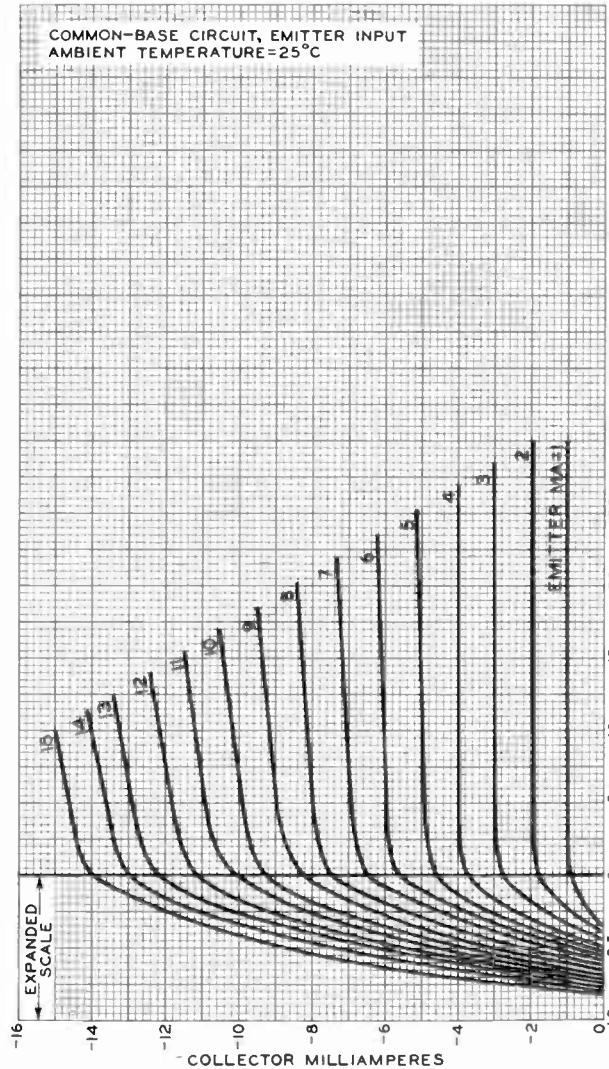
2N105

AVERAGE COLLECTOR CHARACTERISTICS



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92CM-8580RI

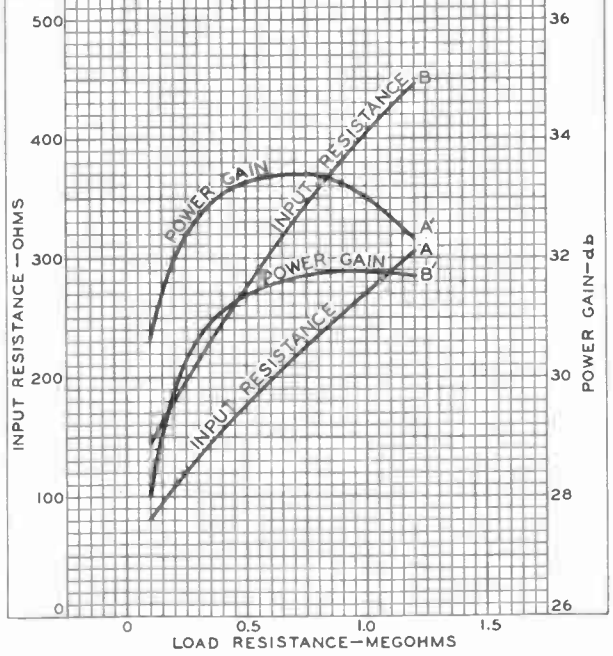
RCA

2N105

OPERATION CHARACTERISTICS

COMMON-BASE CIRCUIT, EMITTER INPUT
AMBIENT TEMPERATURE = 25°C

CURVE	COLLECTOR-TO-BASE VOLTS	COLLECTOR MA
A & A'	-4	-0.7
B & B'	-1.3	-0.3



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RADIO CORPORATION OF AMERICA, SOMERVILLE, NEW JERSEY

92CM-8576R1

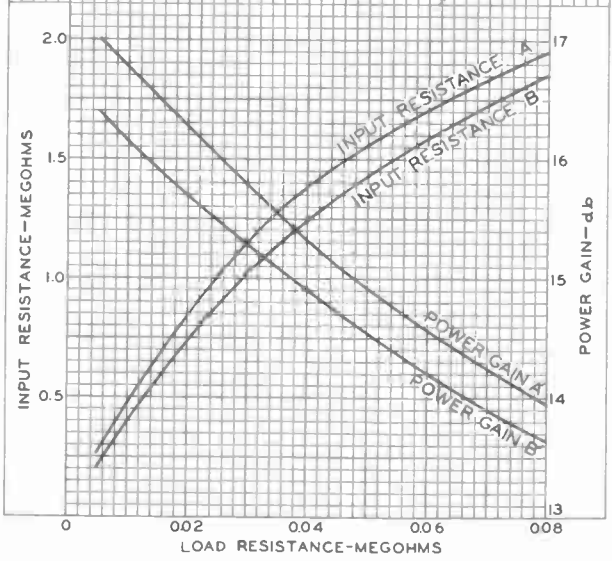
RCA

2N105

OPERATION CHARACTERISTICS

COMMON-COLLECTOR CIRCUIT, BASE INPUT
AMBIENT TEMPERATURE=25°C

CURVE	EMITTER-TO-COLLECTOR VOLTS	EMITTER MA
A & A'	4	0.7
B & B'	1.3	0.3



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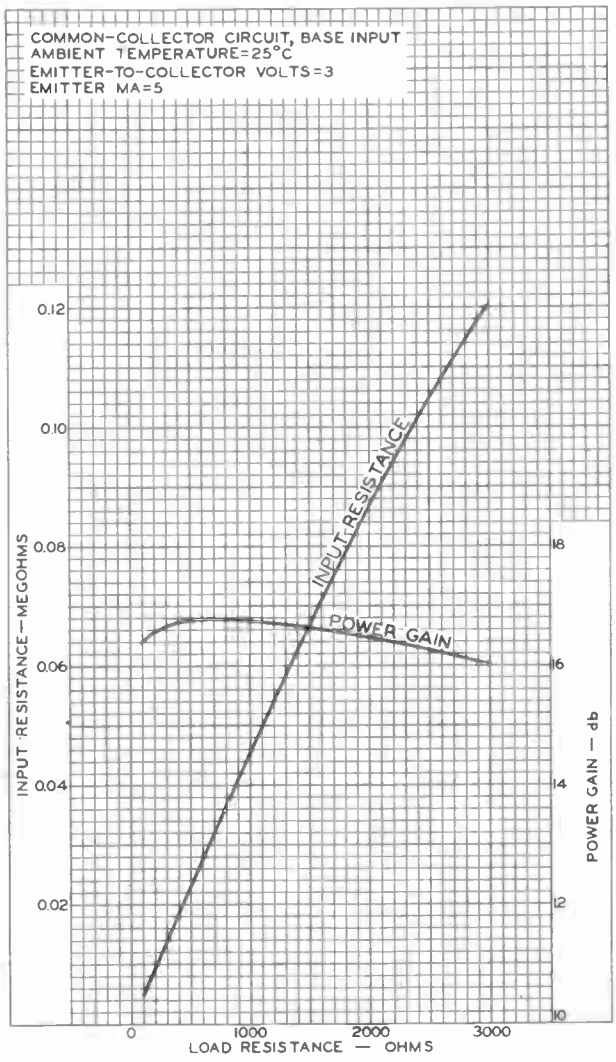
2N105

OPERATION CHARACTERISTICS



SEMICONDUCTOR DIVISION
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92CM-8573RI

2N247

DRIFT TRANSISTOR

GERMANIUM P-N-P ALLOY TYPE

For radio-frequency amplifier applications

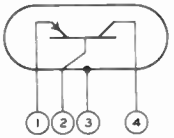
GENERAL DATA

Electrical, *At Ambient Temperature of 25°C:*

Minimum DC Collector-to-Base Voltage for dc collector current of -50 μamp with emitter open	-40	volts
Maximum DC Collector Current for dc collector-to-base voltage of -1 volt with emitter open	-10	μamp
Maximum DC Collector Current for dc collector-to-base voltage of -30 volts with emitter open	-16	μamp
Minimum DC Emitter-to-Base Voltage for dc emitter current of -50 μamp with collector open	-1	volt

Mechanical:

Mounting Position	Any
Maximum Length (Excluding flexible leads)	0.375"
Maximum Diameter	0.360"
Case	Metal, Insulated
Envelope Seals	Hermetic
Leads, Flexible	4
Minimum length	1.5"
Orientation and diameter	*See Dimensional Outline*



RADIO-FREQUENCY AMPLIFIER -- Class A

Maximum Ratings, *Absolute Values:*

DC COLLECTOR-TO-BASE VOLTAGE	-35 max.	volts
DC EMITTER-TO-BASE VOLTAGE	-1 max.	volt
DC COLLECTOR CURRENT	-10 max.	ma
DC EMITTER CURRENT	10 max.	ma
COLLECTOR DISSIPATION (At ambient temperatures up to 71°C)	35 max.	mw
AMBIENT TEMPERATURE (During operation)	71 max.	°C
STORAGE-TEMPERATURE RANGE	-55 to +85	°C

Characteristics, *At Ambient Temperature of 25°C:*

Common-Emitter Circuit, Base Input

DC Collector-to-Emitter Voltage	-9	volts
DC Collector Current	-1	ma
Current Transfer Ratio (α_f)■	-60	

■: See next page.

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RADIO CORPORATION OF AMERICA, SOMERVILLE, NEW JERSEY

2N247

RCA

2N247

DRIFT TRANSISTOR

Small-Signal Hybrid-π Parameters:*		
DC Collector-to-Emitter Voltage (V_{CE})	-9	volts
DC Collector Current (I_C)	-1	ma
Resistance $r_{bb'}$	40	ohms
Conductance $g_{b'e}$	640	μmhos
Conductance g_{ce} (Approx.)	0	μmhos
Conductance $g_{b'c}$ (Approx.)	0	μmhos
Capacitance $C_{b'e}$	200	$\mu\mu$f
Capacitance $C_{b'c}$	1.7	$\mu\mu$f
Interlead Capacitance between collector and base leads with interlead shield connected to ground and all leads cut to 5/16"	0.003	$\mu\mu$f
Intrinsic Transconductance (g_m)	37000	μmhos
Frequency• for unity power amplification.	132	

Common-Base Circuit, Emitter Input

DC Collector-to-Base Voltage	-9	volts
DC Collector Current	-1	ma
Current Transfer Ratio (α_f)■	0.984	
Frequency at which the current transfer ratio drops to one-half the square root of two times its value at 1 kc.	30	Mc

Typical Operation, *At Ambient Temperature of 25°C:*

Common-Emitter Circuit, Base Input

At frequency of	*1.5*	*10.7*	*Mc*
DC Collector-to-Emitter Voltage	-9	-9	volts
DC Collector Current	-1	-1	ma
DC Base-to-Emitter Voltage	-0.2	-0.2	volt
Input Resistance, output circuit shorted.	1350	170	ohms
Output Resistance, input circuit shorted.	70000	4500	ohms
Power Gain▲	45	24	db

* As derived from corresponding equivalent circuit shown under type 2N104.

• This frequency (figure of merit) may be calculated from the equation

$$f = \frac{1}{4\pi}\sqrt{\frac{g_m}{r_{bb'} \cdot C_{b'c} \cdot C_{b'e}}}$$

■ Measured at 1 kc.

▲ Measured in a single-tuned unilateralized circuit matched to the generator and load impedances for maximum transfer of power. Transformer insertion losses not included.

OPERATING CONSIDERATIONS

The 2N247 should not be connected into or disconnected from circuits with the power on because high transient currents may cause permanent damage to the transistor.

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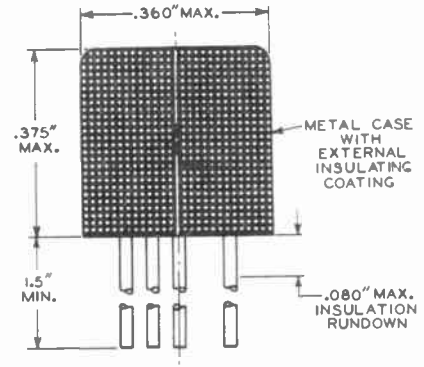
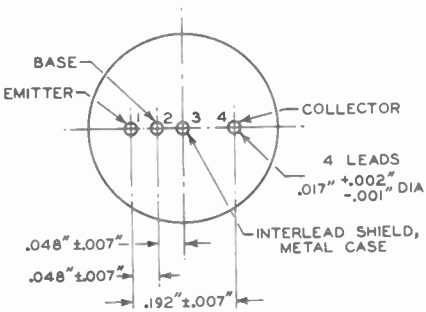
2N247

DRIFT TRANSISTOR

The *flexible leads* of the 2N247 are usually soldered to the circuit elements. Soldering of the leads may be made close to the glass stem provided care is taken to conduct excessive heat away from the lead seal. Otherwise, the heat of the soldering operation will crack the seals of the leads and damage the transistor.

When dip soldering is employed in the assembly of printed circuitry using the 2N247, the temperature of the solder should not exceed 230°C for a maximum immersion period of 10 seconds.





92CS-9122R1

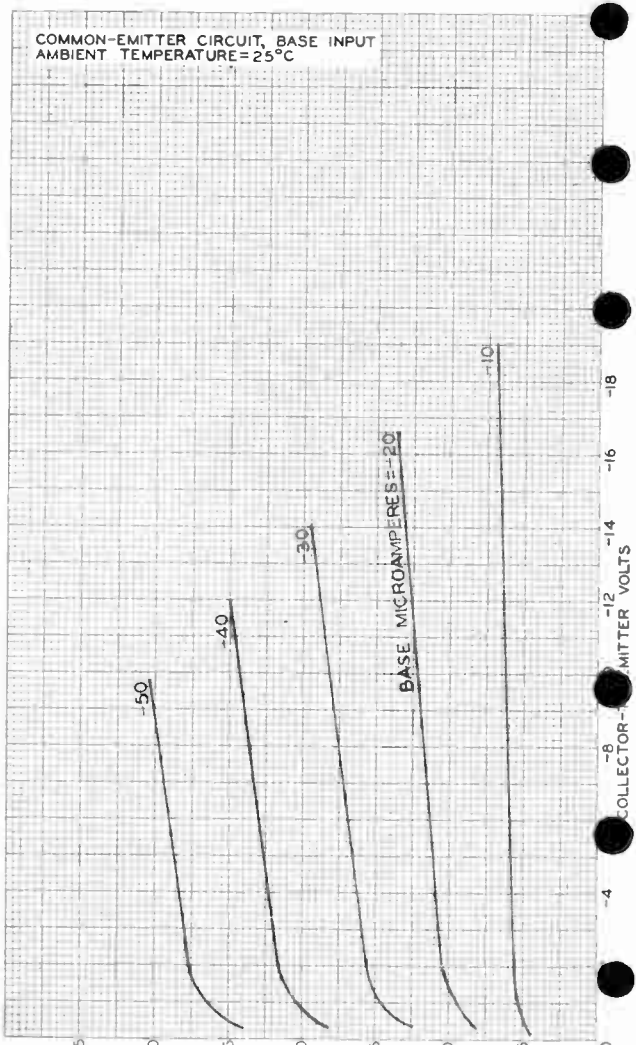
SEMICONDUCTOR DIVISION
RADIO CORPORATION OF AMERICA, SOMERVILLE, NEW JERSEY

2N247

RCA

2N247

AVERAGE COLLECTOR CHARACTERISTICS



92CM-9107

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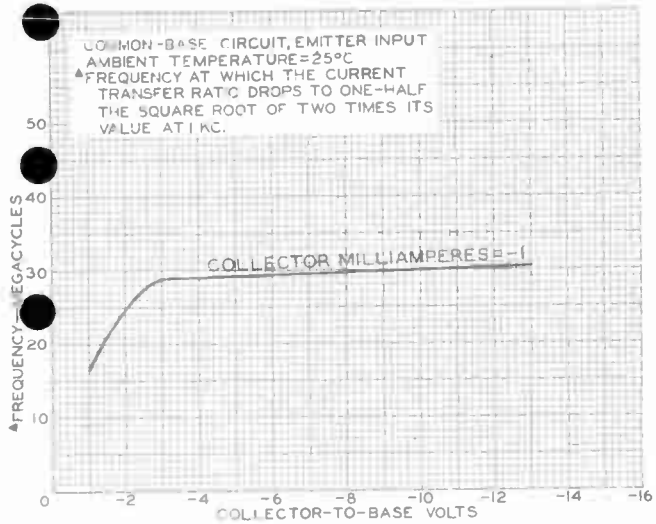
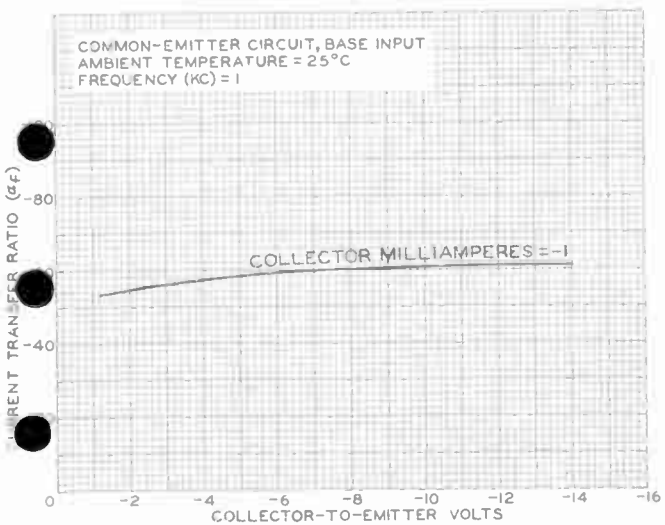
RCA

2N247

AVERAGE CHARACTERISTICS

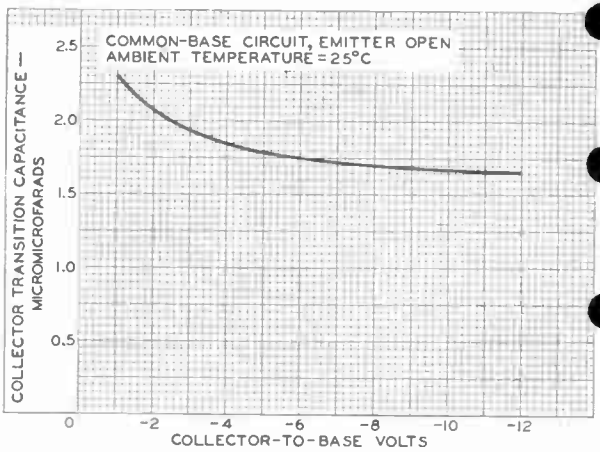


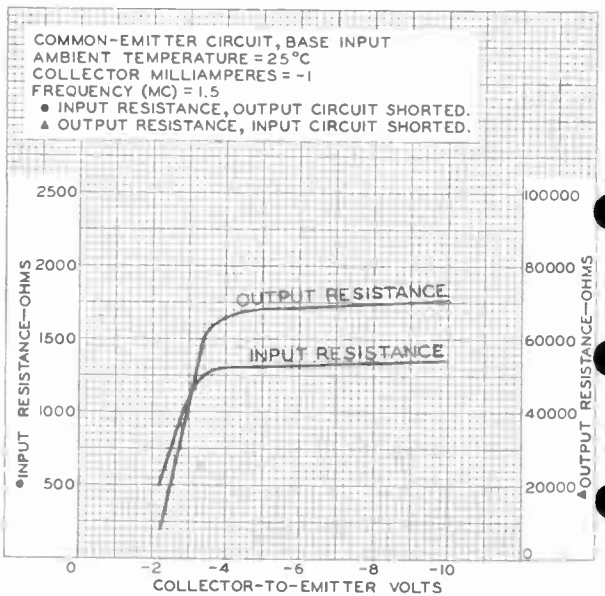


RCA

2N247

AVERAGE CHARACTERISTICS





2N331

JUNCTION TRANSISTOR

GERMANIUM P-N-P ALLOY TYPE

For small-signal audio-frequency-amplifier applications

Supersedes Type 2N206

GENERAL DATA

Electrical:

Maximum DC Collector-Cutoff Current (I_{CBO}) for dc collector-to-base volts = -30 with emitter open, and at ambient temperature of 25° C.	-16	μa
Maximum DC Emitter-Cutoff Current (I_{EBO}) for dc emitter-to-base volts = -12 with collector open, and at ambient temperature of 25° C.	-16	μa
DC Collector-to-Emitter Saturation Voltage for dc collector ma. = -150, dc base ma. = -6, and at ambient temperature of 25° C	-0.18	volt
Junction-Temperature Rise (In free air)	0.3	°C/mw

Mechanical:

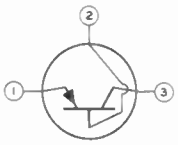
Operating Position	Any
Maximum Length (Excluding flexible leads)	0.260"
Maximum Diameter	0.370"
Dimensional Outline	JEDEC No. TO-9
Case	Metal
Envelope Seals	Hermetic
Leads, Flexible	3
Minimum length	1.5"
Orientation and diameter	*See Dimensional Outline*
Base	JEDEC No. E3-51

BOTTOM VIEW

Lead 1 - Emitter

Lead 2 - Base

Lead 3 - Collector



AUDIO-FREQUENCY AMPLIFIER — Class A

Maximum Ratings, *Absolute-Maximum Values:*

DC COLLECTOR-TO-BASE VOLTAGE	-30 max.	volts
DC EMITTER-TO-BASE VOLTAGE	-12 max.	volts
DC COLLECTOR CURRENT	-200 max.	ma
DC EMITTER CURRENT	200 max.	ma

RCA

2N331

JUNCTION TRANSISTOR

COLLECTOR DISSIPATION:				
At ambient temperature of 25° C. . . .	200 max.			mw
At ambient temperature of 55° C. . . .	60 max.			mw
At ambient temperature of 71° C. . . .	25 max.			mw
AMBIENT TEMPERATURE (During operation) .	71 max.			°C
STORAGE-TEMPERATURE RANGE.	-65 to +85			°C

Characteristics, *At Ambient Temperature of 25° C:*

Common-Emitter Circuit, Base Input

DC Collector-to-Emitter Voltage.	-6			volts
DC Emitter Current	1			ma
Small-Signal Current Gain■	50			
Power Gain:				
With load resistance = 70,000 ohms, and input resistance = 912 ohms. . . .	44			db
Noise Factor:				
Measured with a noise diode and thermocouple voltmeter with load resistance = 20,000 ohms, generator resistance = 1000 ohms, and equivalent noise bandwidth = 12.3 kc with geometric mean of 300 cps. . .	9			db
DC Collector-to-Emitter Voltage. . .	-1.5	-1.5	-1.5	volts
DC Collector Current	-50	-100	-150	ma
DC Current Gain.	60	55	50	

Small-Signal T Parameters:*

DC Collector-to-Emitter Voltage (V_{CE}).	-3	-6	volts
DC Emitter Current (I_E).	0.5	1	ma
Emitter Resistance (r_e).	43.4	19.6	ohms
Base Resistance (r_b)	650	530	ohms
Mutual Resistance (r_m)	2.09	2.1	megohms
Collector Resistance (r_c).	2.14	2.14	megohms
Current Gain■ (α_{fe}).	42	50	

Small-Signal Hybrid-π Parameters:*

DC Collector-to-Emitter Voltage (V_{CE}).	-3	-6	volts
DC Emitter Current (I_E).	0.5	1	ma
Resistance $r_{bb'}$.	88	84	ohms
Conductance $g_{b'e}$	412	692	μmhos
Conductance g_{ce}.	5	7.65	μmhos
Conductance $g_{b'c}$	0.357	0.323	μmho
Capacitance $C_{b'e}$	2920	4750	μμf
Capacitance $C_{b'c}$	49	36	μμf
Intrinsic Transconductance (g_m). . .	17300	34600	μmhos

Small-Signal H Parameters:*

DC Collector-to-Emitter Voltage (V_{CE}).	-3	-6	volts

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2N331

JUNCTION TRANSISTOR

DC Emitter Current (I_E) . .	0.5	1	ma
Input Resistance, output circuit shorted (h_i) . . .	2510	1530	ohms
Reverse Voltage Gain, input circuit open (h_r)	8.69×10^{-4}	4.67×10^{-4}	
Forward Current Gain, output circuit shorted (h_f) . . .	42	50	
Output Conductance, input circuit open (h_o)	20×10^{-6}	23.8	μmhos

Common-Base Circuit, Emitter Input

DC Collector-to-Base Voltage . . .	-3	-6	volts
DC Emitter Current	0.5	1	ma
Small-Signal Current Gain■	0.976	0.980	
Alpha-Cutoff Frequency	0.95	1.16	Mc

■ Measured at 1 kc.

* As derived from corresponding equivalent circuit shown under type 2N104.

OPERATING CONSIDERATIONS

The 2N331 should not be connected into or disconnected from circuits with the power on because high transient currents may cause permanent damage to the transistor.

The *flexible leads* of the 2N331 are usually soldered to the circuits elements. Soldering of the leads may be made close to the glass stem provided care is taken to conduct excessive heat away from the lead seal. Otherwise, the heat of the soldering operation will crack the glass seals of the leads and damage the transistor.

The 2N331 is intended for use in single-side printed-circuit boards and in conventional wire-in-type circuits. If the 2N331 is used in double-side printed-circuit boards or in printed-circuit boards utilizing eyelets, it may be necessary to use an insulating washer or similar standoff device made of good dielectric material to prevent the solder from shorting the leads to each other or to the board.

When dip soldering is employed in the assembly of printed circuitry using the 2N331, the temperature of the solder should not exceed 255° C for a maximum immersion period of 10 seconds.

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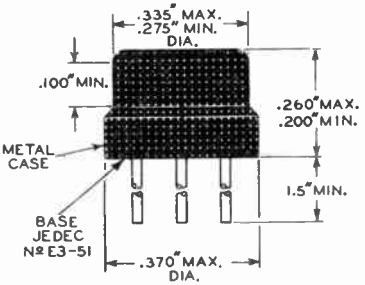
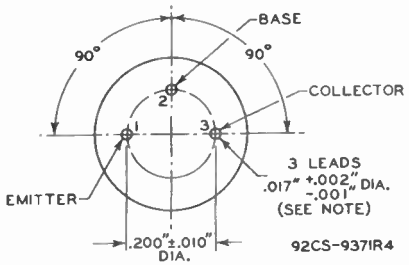
RCA

2N331

JUNCTION TRANSISTOR





NOTE: THE SPECIFIED LEAD DIAMETER APPLIES IN THE ZONE BETWEEN 0.050" AND 0.250" FROM THE BASE SEAT. BETWEEN 0.250" AND 1.50", A MAXIMUM DIAMETER OF 0.021" IS HELD. OUTSIDE OF THESE ZONES, THE LEAD DIAMETER IS NOT CONTROLLED.

SEMICONDUCTOR and MATERIALS DIVISION
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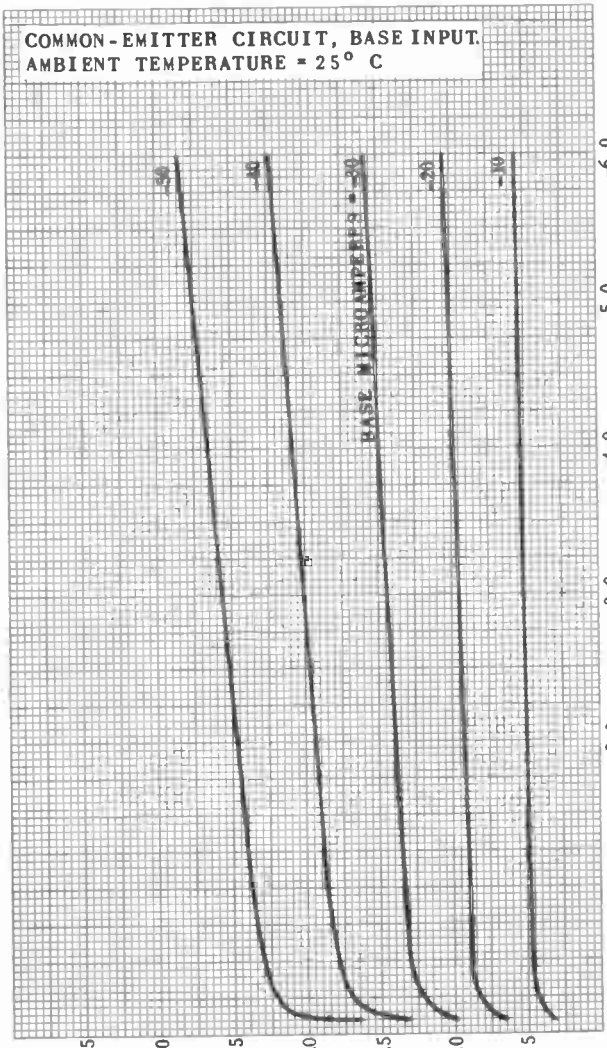
2N331

AVERAGE COLLECTOR CHARACTERISTICS



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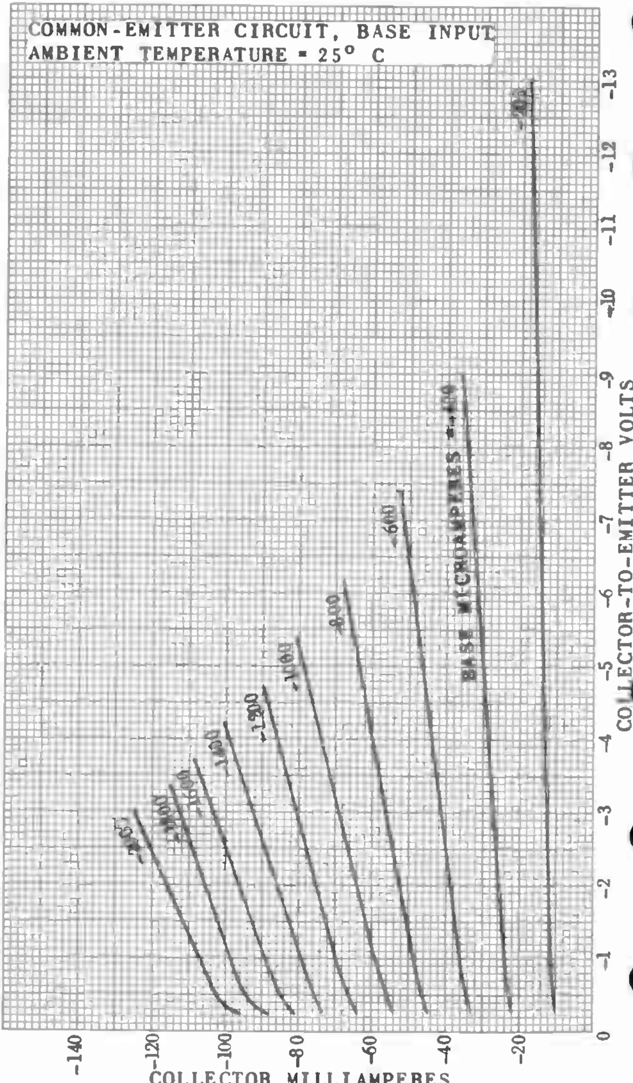
92CS-9596

2N331

RCA

2N331
AVERAGE COLLECTOR CHARACTERISTICS



92CS-9597

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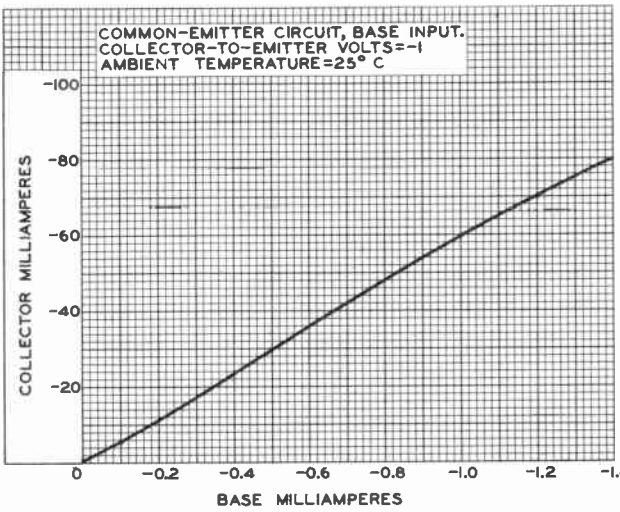
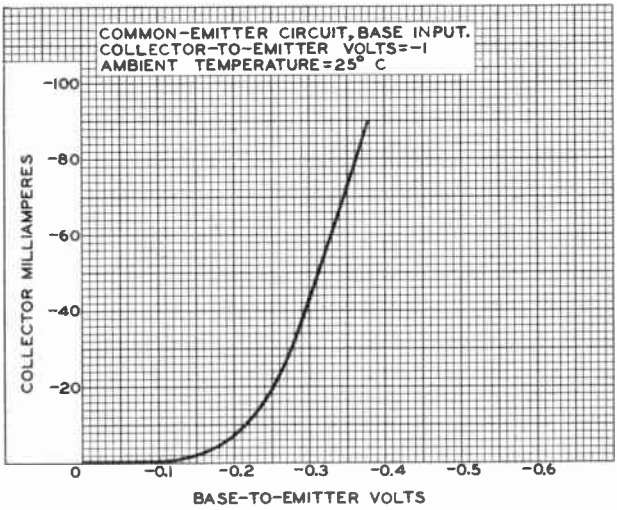
RCA

2N331

AVERAGE TRANSFER CHARACTERISTICS



92CS-9622

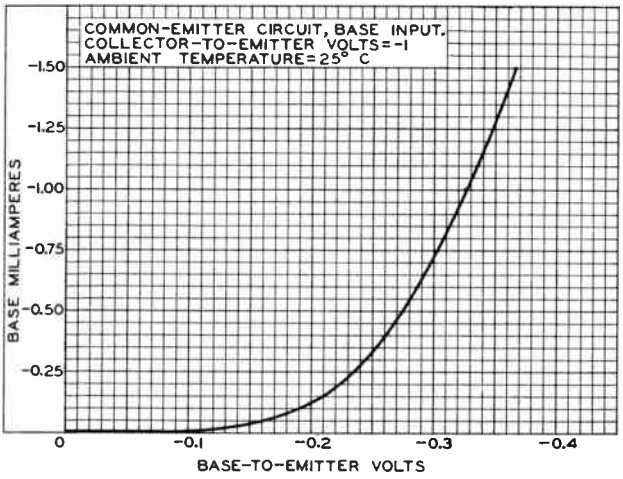


92CS-9621

RCA

2N331

AVERAGE BASE CHARACTERISTIC



92CS-9598

2N456

POWER TRANSISTOR

GERMANIUM P-N-P ALLOY TYPE

For industrial and military applications

GENERAL DATA

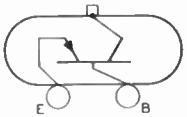
Mechanical:

Operating Position	Any
Maximum Overall Length	0.88"
Maximum Seated Length	0.40"
Maximum Length of Mounting Flange	1.562"
Maximum Width of Mounting Flange	1.031"
Case	Metal
Mounting Flange	Metal
Envelope Seals	Hermetic
Socket	Loranger Mfg. Corp. No. 2149, or equivalent

Terminal Connections (*See Dimensional Outline*):

E – Emitter

B – Base



MOUNTING FLANGE–Collector, Metal Case

INDUSTRIAL SERVICE

Such as in power-switching, dc-to-dc converter, and audio-frequency-amplifier applications

Maximum Ratings, *Absolute-Maximum Values:*

PEAK COLLECTOR-TO-BASE VOLTAGE	−40 max.	volts
PEAK EMITTER-TO-BASE VOLTAGE	−20 max.	volts
PEAK COLLECTOR CURRENT	−5 max.	amp
PEAK EMITTER CURRENT	5 max.	amp
PEAK BASE CURRENT	3 max.	amp
TRANSISTOR DISSIPATION:•		
At mounting-flange temperature of 25° C or below	50 max.	watts
At mounting-flange temperature of 55° C.	29 max.	watts
At mounting-flange temperature of 85° C.	8 max.	watts
MOUNTING-FLANGE TEMPERATURE (During operation)	95 max.	°C
STORAGE-TEMPERATURE RANGE	−65 to +100	°C

Characteristics, *At Mounting-Flange Temperature of 25° C:*

Common-Emitter Circuit, Base Input

DC Collector-to-Emitter Voltage	−1.5	volts
DC Collector Current	−2	amp
DC Current Gain (h_{FE})	52	

2N456

2N456

POWER TRANSISTOR

Typical Operation:

In common-emitter, base-input, power-switching circuit at mounting-flange temperature of 25° C

DC Supply Voltage	−28	−28	−28	−28	volts
DC Base-Bias Voltage	1.5	1.5	1.5	1.5	volts
"Turn-On" Base Current	−6	−16.4	−56	−180	ma
"Turn-Off" Base Current	0	0	0	0	ma
Base-Bias Resistor	150	150	150	150	ohms
Generator Resistance	50	50	50	50	ohms
Load Resistor	56	28	14	7	ohms
Switching Time:▲					
Delay time	10	10	10	10	μsec
Rise time	130	120	90	90	μsec
Storage time	25	20	20	15	μsec
Fall time	85	80	80	65	μsec
"On" Condition:■					
DC collector-to-emitter voltage	−0.25	−0.6	−0.5	−0.7	volt
DC base-to-emitter voltage	−0.39	−0.6	−0.75	−0.9	volt
DC collector current	−0.49	−0.98	−1.96	−3.9	amp
Driving power	2.34	9.9	42.6	160	mw
Transistor dissipation	123	600	873	2880	mw
Power gain	33.7	31.9	31.3	24.6	db
Efficiency	99.3	97.8	98.3	97.4	%
Power output	13.1	26.8	54	106	watts

● For applications not limited by thermal runaway, the maximum transistor-dissipation rating at a given mounting-flange temperature between 25° C and 95° C may be calculated from the following formula:

$$P_T = P_0 - (T-25)/K$$

where:

P_T = Maximum transistor-dissipation rating in watts at a mounting-flange temperature of T.

P_0 = Maximum transistor-dissipation rating in watts at a mounting-flange temperature of 25° C.

T = Mounting-flange temperature in °C.

K = Thermal resistance (1.4 max. °C/watt).

▲ "Turn-On" Time = $T_d + T_r$; "Turn-Off" Time = $T_s + T_f$

■ *"On" Condition Equations:*

Driving power = DC base-to-emitter voltage × DC base current

Transistor dissipation = (DC collector-to-emitter voltage × DC collector current) + driving power

Power output = (DC supply voltage − DC collector-to-emitter voltage) × DC collector current

Power gain = Power output ÷ driving power

Efficiency = Power output ÷ (Power output + transistor dissipation)

SEMICONDUCTOR and MATERIALS DIVISION
RADIO CORPORATION OF AMERICA, SOMERVILLE, NEW JERSEY

2N456

POWER TRANSISTOR

CHARACTERISTICS RANGE VALUES FOR EQUIPMENT DESIGN

Unless otherwise specified, voltage values are given with respect to base and mounting-flange temperature = 25° C

	Typical Values	Range Values Min.	Max.	
DC Collector Breakdown Voltage (BV_{CBO}) for dc collector ma. = −2 with emitter open. . . .	−	−40	−	volts
DC Collector-to-Emitter Breakdown Voltage: (BV_{CEO}) for dc collector ma. = −300 with base open . . .	−30	−	−	volts
(BV_{CES}) with base connected to emitter.	−50	−	−	volts
DC Emitter Breakdown Voltage (BV_{EBO}) for dc emitter ma. = −2 with collector open. . .	−60	−20	−	volts
DC Collector-to-Emitter Saturation Voltage (V_{CE}) for dc collector amperes = −5 and dc base amperes = −1.	−0.24	−	−1	volt
DC Collector-to-Emitter Punch-Through Voltage (V_P).	−	−40	−	volts
DC Collector-Cutoff Current (I_{CBO}): For dc collector volts = −0.5 with emitter open. . .	−65	−	−	μa
For dc collector volts = −30 with emitter open . . .	−100	−	−500	μa
Thermal Resistance.	1	−	1.4	°C/watt

**OPERATING CONSIDERATIONS,
DIMENSIONAL OUTLINE,
SUGGESTED MOUNTING ARRANGEMENT,
and
CURVES (Up to collector-to-emitter volts = 40)
shown under Type 2N457 also apply to the 2N456**

SEMICONDUCTOR and MATERIALS DIVISION
RADIO CORPORATION OF AMERICA, SOMERVILLE, NEW JERSEY

2N457

POWER TRANSISTOR

GERMANIUM P-N-P ALLOY TYPE

For industrial and military applications

GENERAL DATA

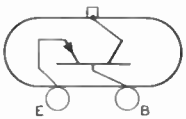
Mechanical:

Operating Position	Any
Maximum Overall Length	0.88"
Maximum Seated Length	0.40"
Maximum Length of Mounting Flange	1.562"
Maximum Width of Mounting Flange	1.031"
Case	Metal
Mounting Flange	Metal
Envelope Seals	Hermetic
Socket	Loranger Mfg. Corp. No. 2149, or equivalent

Terminal Connections (*See Dimensional Outline*):

E – Emitter

B – Base



MOUNTING FLANGE – Collector, Metal Case

INDUSTRIAL SERVICE

Such as in power-switching, dc-to-dc converter, and audio-frequency-amplifier applications

Maximum Ratings, *Absolute-Maximum Values:*

PEAK COLLECTOR-TO-BASE VOLTAGE	−60 max.	volts
PEAK EMITTER-TO-BASE VOLTAGE	−20 max.	volts
PEAK COLLECTOR CURRENT	−5 max.	amp
PEAK EMITTER CURRENT	5 max.	amp
PEAK BASE CURRENT	3 max.	amp
TRANSISTOR DISSIPATION:		
At mounting-flange temperature of 25° C or below	50 max.	watts
At mounting-flange temperature of 55° C	29 max.	watts
At mounting-flange temperature of 85° C	8 max.	watts
MOUNTING-FLANGE TEMPERATURE (During operation)	95 max.	°C
STORAGE-TEMPERATURE RANGE	−65 to +100	°C

Characteristics, *At Mounting-Flange Temperature of 25° C:*

Common-Emitter Circuit, Base Input

DC Collector-to-Emitter Voltage	−1.5	volts
DC Collector Current	−2	amp
DC Current Gain (h_{FE})	52	

SEMICONDUCTOR and MATERIALS DIVISION
RADIO CORPORATION OF AMERICA, SOMERVILLE, NEW JERSEY

RCA

2N457

POWER TRANSISTOR

Typical Operation:

In common-emitter, base-input, power-switching circuit at mounting-flange temperature of 25° C

DC Supply Voltage	-28	-28	-28	-28	volts
DC Base-Bias Voltage	1.5	1.5	1.5	1.5	volts
"Turn-On" Base Current	-6	-16.4	-56	-180	ma
"Turn-Off" Base Current	0	0	0	0	ma
Base-Bias Resistor	150	150	150	150	ohms
Generator Resistance	50	50	50	50	ohms
Load Resistor	56	28	14	7	ohms
Switching Time:▲					
Delay time	10	10	10	10	μsec
Rise time	130	120	90	90	μsec
Storage time	25	20	20	15	μsec
Fall time	85	80	80	65	μsec
"On" Condition:■					
DC collector-to-emitter voltage	-0.25	-0.6	-0.5	-0.7	volt
DC base-to-emitter voltage	-0.39	-0.6	-0.75	-0.9	volt
DC collector current	-0.49	-0.98	-1.96	-3.9	amp
Driving power	2.34	9.9	42.6	160	mw
Transistor dissipation	123	600	873	2880	mw
Power gain	33.7	31.9	31.3	24.6	db
Efficiency	99.3	97.8	98.3	97.4	%
Power output	13.1	26.8	54	106	watts

● For applications not limited by thermal runaway, the maximum transistor-dissipation rating at a given mounting-flange temperature between 25° C and 95° C may be calculated from the following formula:

$$P_T = P_0 - (T-25)/K$$

where:

P_T = Maximum transistor-dissipation rating in watts at a mounting-flange temperature of T.

P_0 = Maximum transistor-dissipation rating in watts at a mounting-flange temperature of 25° C.

T = Mounting-flange temperature in °C.

K = Thermal resistance (1.4 max. °C/watt).

▲ "Turn-On" Time = $T_d + T_r$; "Turn-Off" Time = $T_s + T_f$

■ *"On" Condition Equations:*

Driving power = DC base-to-emitter voltage x DC base current

Transistor dissipation = (DC collector-to-emitter voltage x DC collector current) + driving power

Power output = (DC supply voltage − DC collector-to-emitter voltage) x DC collector current

Power gain = Power output ÷ driving power

Efficiency = Power output ÷ (Power output + transistor dissipation)

SEMICONDUCTOR and MATERIALS DIVISION
RADIO CORPORATION OF AMERICA, SOMERVILLE, NEW JERSEY

2N457

POWER TRANSISTOR

CHARACTERISTICS RANGE VALUES FOR EQUIPMENT DESIGN

Unless otherwise specified, voltage values are given with respect to base and mounting-flange temperature = 25° C

	Typical Values	Range Values Min.	Max.	
DC Collector Breakdown Voltage (BV_{CBO}) for dc collector ma. = −2 with emitter open. . . .	–	−60	–	volts
DC Collector-to-Emitter Breakdown Voltage. (BV_{CEO}) for dc collector ma. = −300 with base open . . .	−40	–	–	volts
(BV_{CES}) with base connected to emitter.	−60	–	–	volts
DC Emitter Breakdown Voltage (BV_{EBO}) for dc emitter ma. = −2 with collector open. . .	–	−20	–	volts
DC Collector-to-Emitter Saturation Voltage (V_{CE}) for dc collector amperes = −5 and dc base amperes = −1.	−0.24	–	−1	volt
DC Collector-to-Emitter Punch-Through Voltage (V_P).	–	−60	–	volts
DC Collector-Cutoff Current (I_{CBO}):				
For dc collector volts = −0.5 with emitter open	−65	–	–	μa
For dc collector volts = −30 with emitter open	−100	–	−500	μa
Thermal Resistance.	1	–	1.4	°C/watt

OPERATING CONSIDERATIONS

The 2N457 should not be connected into or disconnected from circuits with the power on because high transient currents may cause permanent damage to the transistor.

This transistor utilizes the Loranger Mfg. Corp. socket No. 2149, or equivalent. Electrical connection can also be made to the base and emitter pins by soldering directly to the pins. Soldering of connections to the pins may be made close to the pin seals provided care is taken to conduct excessive heat away from the pin seal, otherwise the heat of the soldering operation will crack the glass seals of the pins and damage the transistor.

Under no circumstances should the mounting flange be soldered to the heat sink because the heat of the soldering operation will permanently damage the transistor.

In applications where the chassis is connected to the positive terminal of the voltage supply, it will be necessary

SEMICONDUCTOR and MATERIALS DIVISION
RADIO CORPORATION OF AMERICA, SOMERVILLE, NEW JERSEY

2N457

POWER TRANSISTOR

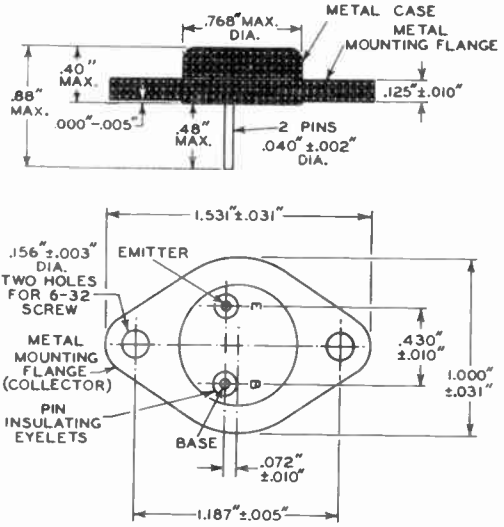
to use an anodized-aluminum insulator having high thermal conductivity, or a 0.002" mica insulator between the mounting flange and the chassis. To prevent a short circuit between the mounting bolt and the chassis, it is important that a fibre washer be used between the bolt and the chassis. *(See Suggested Mounting Arrangement)*

It is important that the mounting flange which serves as the collector be securely fastened to a heat sink. Depending on the application, the chassis (heat sink) may be connected either to the positive or negative terminal of the voltage supply.

It is to be noted that the metal case of this transistor operates at the collector voltage. Because of the possibility of shock hazard when the metal case of this transistor is at a voltage appreciably above or below ground potential, suitable precautionary measures should be taken.

2N457

POWER TRANSISTOR

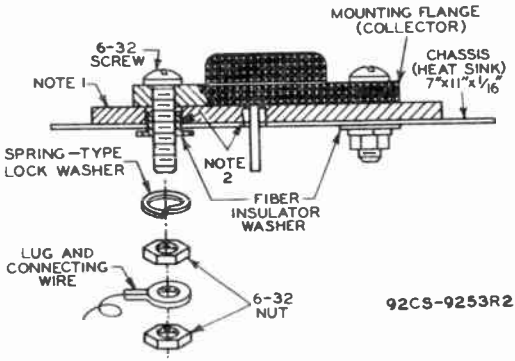


SEMICONDUCTOR and MATERIALS DIVISION
RADIO CORPORATION OF AMERICA, SOMERVILLE, NEW JERSEY

2N457

POWER TRANSISTOR

SUGGESTED MOUNTING ARRANGEMENT



NOTE 1: 0.002" MICA INSULATOR OR ANODIZED-ALUMINUM INSULATOR (DRILLED, OR PUNCHED WITH BURRS REMOVED).

NOTE 2: REMOVE BURRS FROM CHASSIS HOLES.

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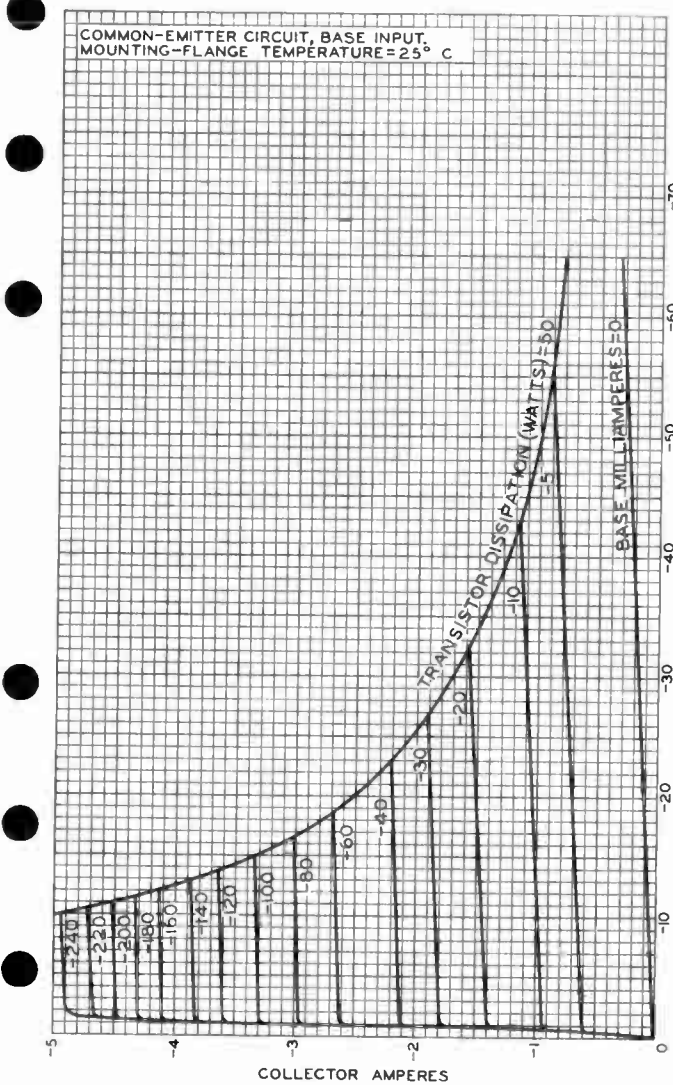
RCA

2N457

AVERAGE COLLECTOR CHARACTERISTICS

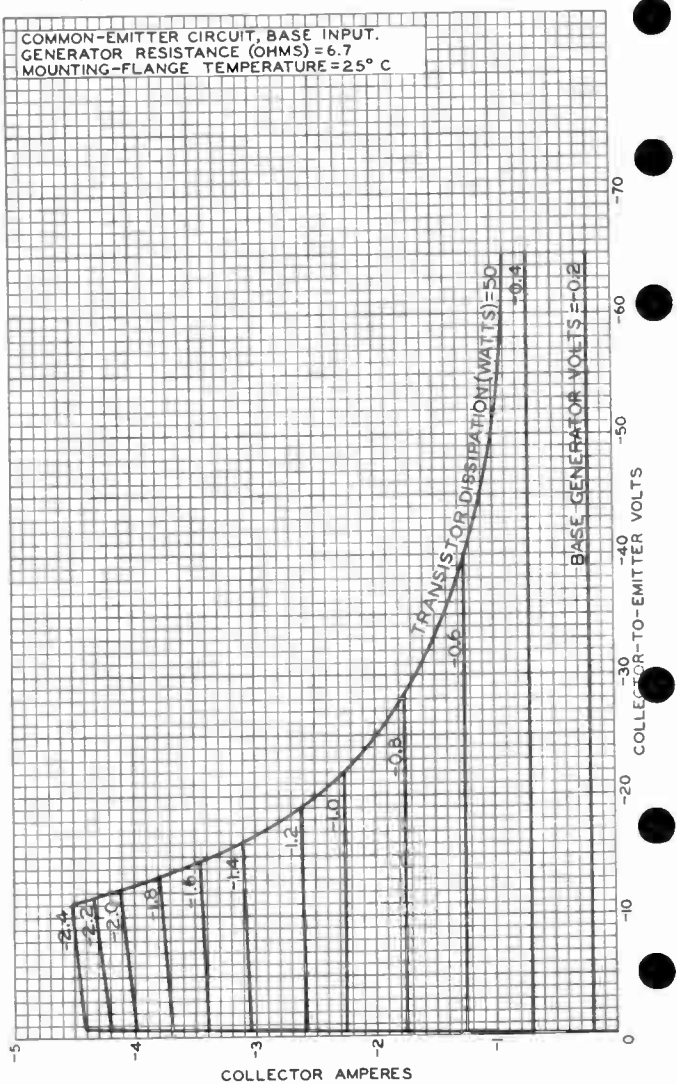


2N457

RCA

2N457

AVERAGE COLLECTOR CHARACTERISTICS



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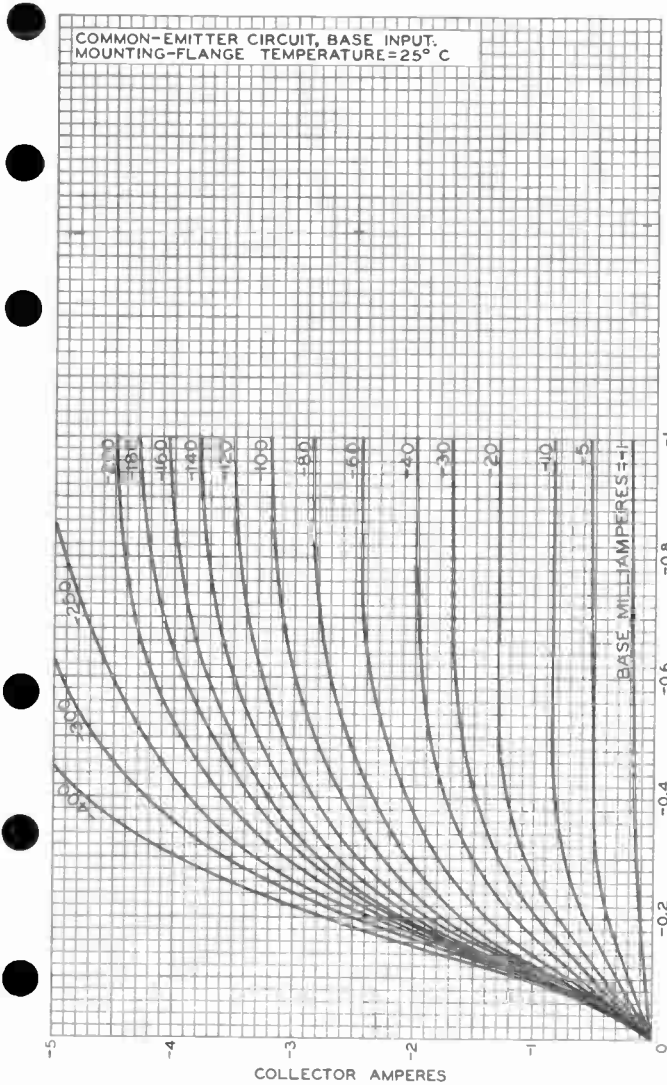
92CM-9827R1

RCA

2N457

AVERAGE COLLECTOR CHARACTERISTICS



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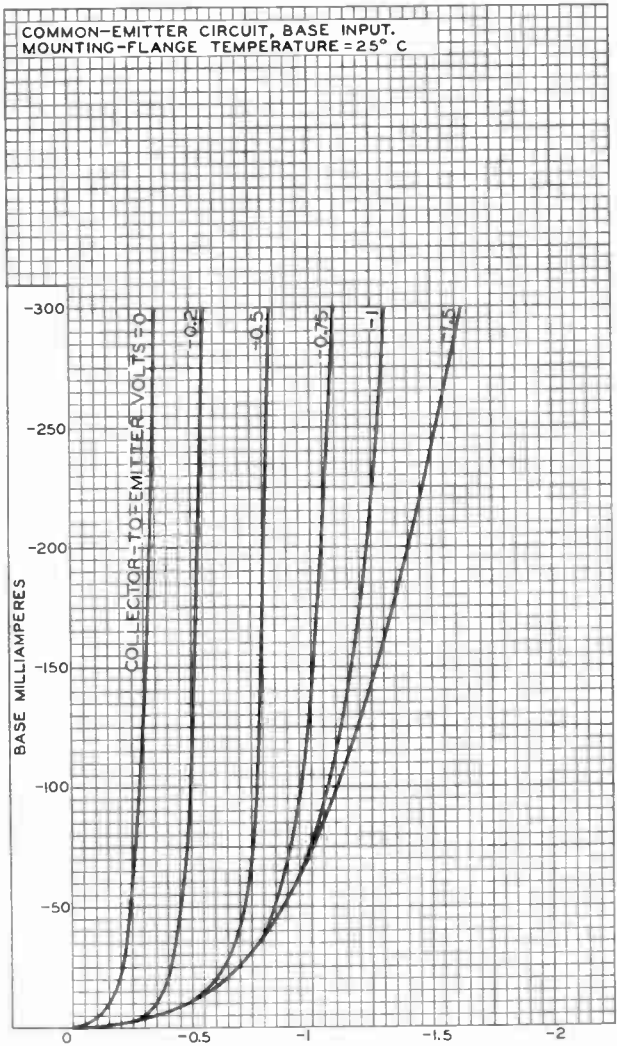
RADIO CORPORATION OF AMERICA SOMERVILLE NEW JERSEY

RCA

2N457

AVERAGE BASE CHARACTERISTICS

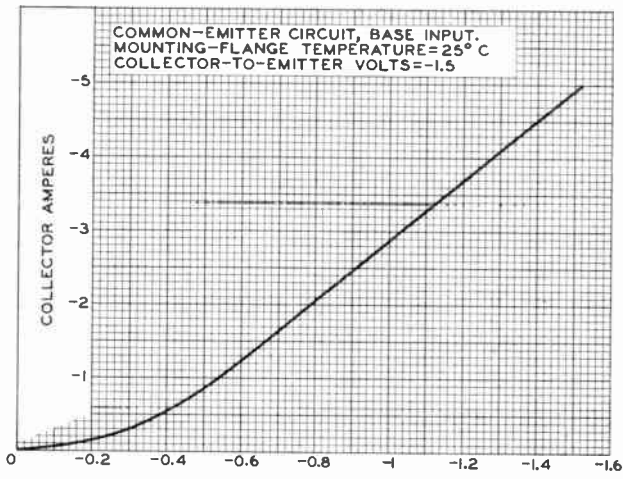


SEMICONDUCTOR and MATERIALS DIVISION 92CM-9829

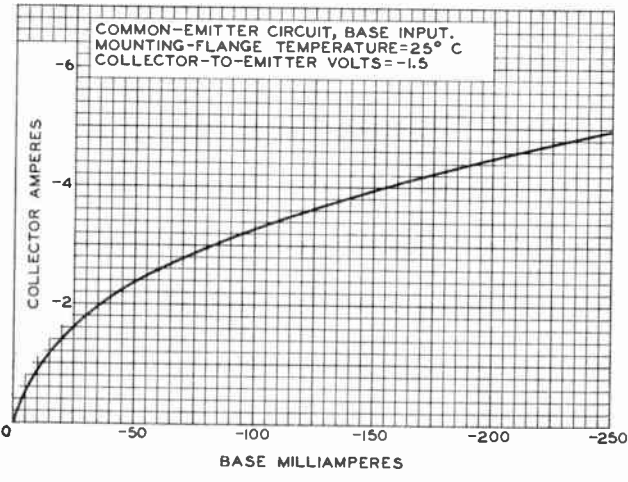
RADIO CORPORATION OF AMERICA, SOMERVILLE, NEW JERSEY

2N457

AVERAGE CHARACTERISTICS



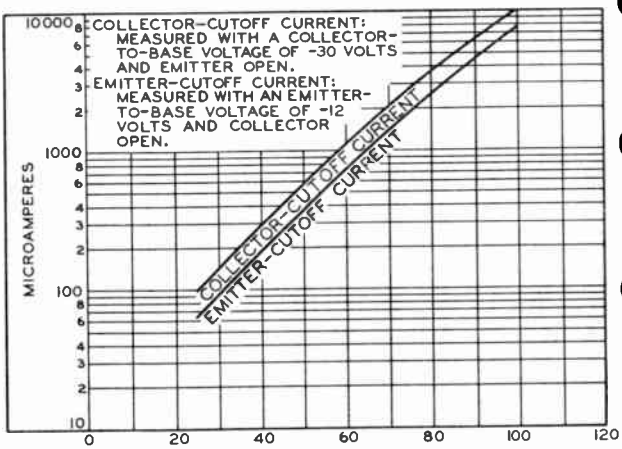
92CS-9837



92CS-9834

2N457

AVERAGE CUTOFF-CURRENT CHARACTERISTICS



92CS-9830

2N544

DRIFT TRANSISTOR

GERMANIUM P-N-P ALLOY TYPE

For radio-frequency amplifier applications

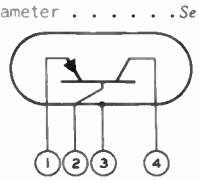
GENERAL DATA

Electrical, *At Ambient Temperature of 25° C:*

Minimum DC Collector-to-Base Voltage for dc collector current of −50 μa with emitter open	−18	volts
Maximum DC Collector Current for dc collector-to-base voltage of −12 volts with emitter open	−4	μa
Maximum DC Emitter Current for dc emitter-to-base voltage of −1 volt with collector open	−12	μa
Interlead Capacitance between collector and base leads with interlead shield connected to ground and all leads cut to 5/16"	0.03	μμf

Mechanical:

Operating Position	Any
Maximum Length (Excluding flexible leads)	0.375"
Maximum Diameter	0.360"
Case	Metal
Envelope Seals	Hermetic
Leads, Flexible	4
Minimum length	1.5"
Orientation and diameter	*See Dimensional Outline*



RADIO-FREQUENCY AMPLIFIER — Class A

Maximum Ratings, *Absolute Values:*

COLLECTOR-TO-BASE VOLTAGE (DC + Peak AC)	−18 max.	volts
EMITTER-TO-BASE VOLTAGE (DC + Peak AC)	−1 max.	volt
DC COLLECTOR CURRENT	−10 max.	ma
DC EMITTER CURRENT	10 max.	ma
COLLECTOR DISSIPATION:		
At ambient temperature of 25° C.	80 max.	mw
At ambient temperature of 55° C.	50 max.	mw
At ambient temperature of 71° C.	35 max.	mw
AMBIENT TEMPERATURE (During operation)	71 max.	°C
STORAGE-TEMPERATURE RANGE	−65 to +85	°C

TENTATIVE DATA

SEMICONDUCTOR DIVISION
RADIO CORPORATION OF AMERICA, SOMERVILLE, NEW JERSEY

2N544

2N544

DRIFT TRANSISTOR

Characteristics, *At Ambient Temperature of 25° C:*

Common-Emitter Circuit, Base Input

DC Collector-to-Emitter Voltage	−12	volts
DC Emitter Current	1	ma
Current Transfer Ratio (α_f)■	−60	

Common-Base Circuit, Emitter Input

DC Collector-to-Base Voltage	−12	volts
DC Emitter Current	1	ma
Current Transfer Ratio (α_f)■	0.984	
Alpha-Cutoff Frequency	30	Mc

Typical Operation, *At Ambient Temperature of 25° C:*

At frequency of	*1.5*	*1.5*	*1.5*	*Mc*
DC Collector-to-Emitter Voltage	−6	−9	−12	volts
DC Emitter Current	0.5	0.5	0.5	ma
Input Resistance, ac output circuit shorted	1300	1700	2100	ohms
Output Resistance, ac input circuit shorted	0.11	0.18	0.28	megohm
Intrinsic Transconductance	18900	18900	18900	μmhos
Collector-to-Base Capacitance	1.85	1.65	1.55	μμf
Maximum Power Gain▲	41.1	44.4	47.3	db
Useful Power Gain:				
In neutralized circuit	30.4	30.4	30.4	db
In unneutralized circuit	25.1	25.1	25.1	db

■ Measured at 1 kc.

▲ Measured in a single-tuned unilateralized circuit matched to the generator and load impedances for maximum transfer of power. Transformer insertion losses not included.

OPERATING CONSIDERATIONS

The 2N544 should not be connected into or disconnected from circuits with the power on because high transient currents may cause permanent damage to the transistor.

The *flexible leads* of the 2N544 are usually soldered to the circuits elements. Soldering of the leads may be made close to the glass stem provided care is taken to conduct excessive heat away from the lead seal. Otherwise, the heat of the soldering operation will crack the seals of the leads and damage the transistor.

The 2N544 utilizes shielding to minimize interlead capacitance and to minimize coupling to adjacent circuit components. This shielding is provided by lead 3 (center lead) situated between the collector lead and the base lead and internally connected to the metal case. For optimum performance, it is recommended that lead 3 be connected to the circuit ground.

When dip soldering is employed in the assembly of printed circuitry using the 2N544, the temperature of the solder should not exceed 230° C for a maximum immersion period of 10 seconds.

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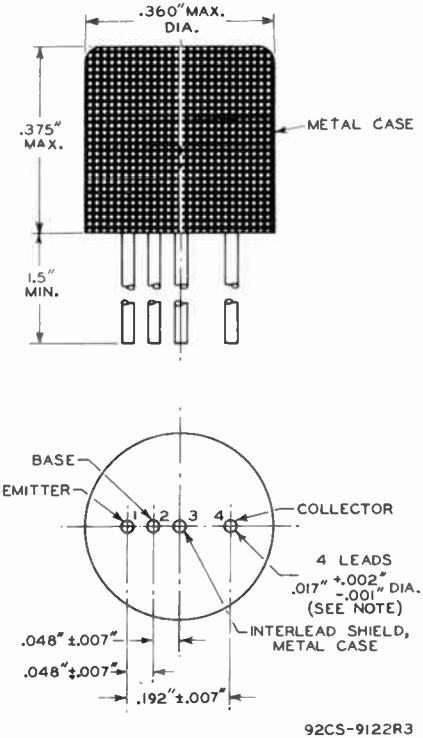
TENTATIVE DATA

2N544

DRIFT TRANSISTOR



NOTE: THE SPECIFIED LEAD DIAMETER APPLIES IN THE ZONE BETWEEN 0.050" AND 0.250" FROM THE BASE SEAT. BETWEEN 0.250" AND 1.50", A MAXIMUM DIAMETER OF 0.021" IS HELD. OUTSIDE OF THESE ZONES, THE LEAD DIAMETER IS NOT CONTROLLED.

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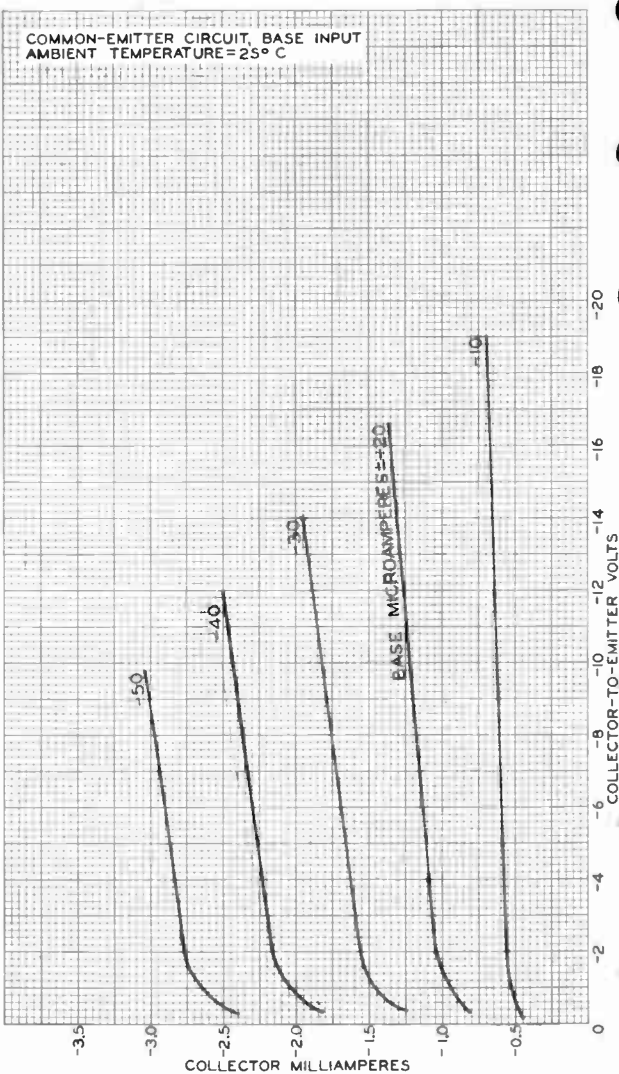
2N544

RCA

2N544

AVERAGE COLLECTOR CHARACTERISTICS



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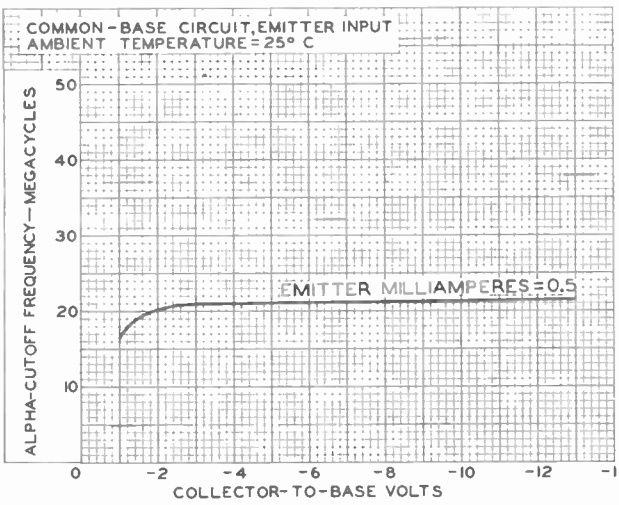
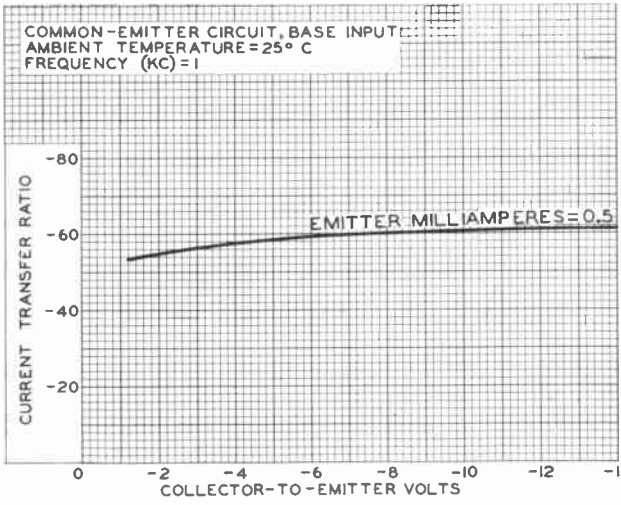
2N544

AVERAGE CHARACTERISTICS



92CS-9514



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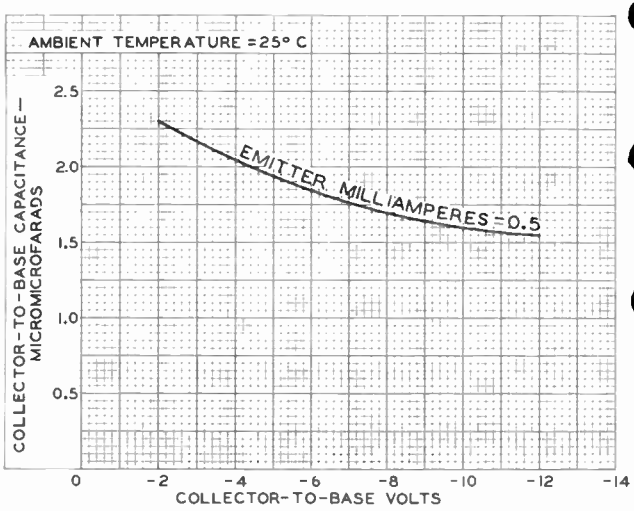
92CS-9515

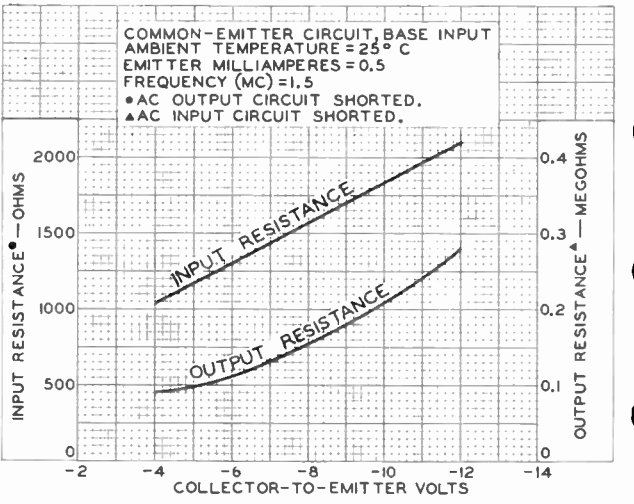
RCA

2N544

AVERAGE CHARACTERISTICS



92CS-9516



92CS-9517

SEMICONDUCTOR DIVISION
RADIO CORPORATION OF AMERICA, SOMERVILLE, NEW JERSEY

2N561

POWER TRANSISTOR

GERMANIUM P-N-P ALLOY TYPE

For industrial and military applications

GENERAL DATA

Mechanical:

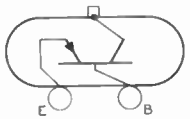
Operating Position	Any
Maximum Overall Length	0.72"
Maximum Seated Length	0.32"
Maximum Length of Mounting Flange	1.562"
Maximum Width of Mounting Flange	1.031"
Case	Metal
Mounting Flange	Metal
Envelope Seals	Hermetic

Socket . . . Loranger Mfg. Corp. Socket No.2149, or equivalent

Terminal Connections *(See Dimensional Outline)*:

E - Emitter

B - Base



MOUNTING FLANGE-Collector, Metal Case

INDUSTRIAL SERVICE

Such as in power-switching, dc-to-dc-converter, and audio-frequency-amplifier applications

Maximum Ratings, *Absolute-Maximum Values:*

PEAK COLLECTOR-TO-BASE VOLTAGE	-80 max.	volts
PEAK COLLECTOR-TO-EMITTER VOLTAGE:		
With base open	-50 max.	volts
With base connected to emitter	-65 max.	volts
With load between base and emitter	*See Rating Chart I*	
PEAK EMITTER-TO-BASE VOLTAGE	-60 max.	volts
PEAK COLLECTOR CURRENT	-10 max.	amp
DC COLLECTOR CURRENT	-5 max.	amp
PEAK EMITTER CURRENT	10 max.	amp
DC EMITTER CURRENT	5 max.	amp
PEAK BASE CURRENT	-5 max.	amp
DC BASE CURRENT	-2 max.	amp
TRANSISTOR DISSIPATION:•		
At mounting-flange temperature of 25° C or below	50 max.	watts
At mounting-flange temperature of 55° C	30 max.	watts
At mounting-flange temperature of 85° C	10 max.	watts
MOUNTING-FLANGE TEMPERATURE (During operation)	100 max.	°C
STORAGE-TEMPERATURE RANGE	-65 to +100	°C

Characteristics, *At Mounting-Flange Temperature of 25° C:*

Common-Emitter Circuit, Base Input

DC Collector-to-Emitter Voltage	-1.5	volts

SEMICONDUCTOR and MATERIALS DIVISION
RADIO CORPORATION OF AMERICA, SOMERVILLE, NEW JERSEY

RCA

2N561

POWER TRANSISTOR

DC Collector Current			-1		amp
Small-Signal Input Impedance			20		ohms
Small-Signal Current Gain (h_{fe})▲			65		
DC Current Gain (h_{FE})			75		

Typical Operation:

In typical common-emitter, base-input, "on-off" power-switching circuit at mounting-flange temperature of 25° C

DC Supply Voltage	-28	-28	-28	-28	volts
DC Base-Bias Voltage	1.5	1.5	1.5	1.5	volts
Generator Resistance	50	50	50	50	ohms
Base-Bias Resistor	150	150	150	150	ohms
Load Resistor	56	28	14	7	ohms
"Turn-On" Base Current	-6	-16.4	-56	-180	ma
"Turn-Off" Base Current	0	0	0	0	ma
Switching Time:§					
Delay time (T_d)	10	10	10	10	μsec
Rise time (T_r)	130	120	90	90	μsec
Storage time (T_s)	25	20	20	15	μsec
Fall time (T_f)	85	80	80	65	μsec
"On" Condition:■					
DC collector-to-emitter voltage	-0.25	-0.6	-0.5	-0.7	volt
DC base-to-emitter voltage	-0.39	-0.6	-0.75	-0.9	volt
DC collector current	-0.49	-0.98	-1.96	-3.9	amp
Driving power	2.34	9.9	42.6	160	mw
Power gain	33.7	31.9	31.3	24.6	db
Efficiency	99.3	97.8	98.3	97.4	%
Power output	13.1	26.8	54	106	watts
Transistor dissipation	123	600	873	2880	mw

In typical dc-to-dc converter circuit at mounting-flange temperature of 25° C

DC Supply Voltage	28	volts
DC Supply Current	4.2	amp
Power Input	118	watts
Base-to-Emitter Driving Power	0.25	watt
Switching-Repetition Rate	700	cps
DC Output Voltage	420	volts
DC Output Current	250	ma
Efficiency	88	%
Power Output	105	watts
Losses:		
Primary winding (Copper)	2.62	watts
Secondary winding (Copper)	1.5	watts
Base-feedback winding (Copper)	0.07	watt
Transistor dissipation (During conduction)	2	watts
Biasing resistors	2	watts
Transformer core, silicon rectifiers, and transient	5.5	watts

SEMICONDUCTOR and MATERIALS DIVISION
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2N561

POWER TRANSISTOR

As class-A audio-frequency power amplifier in common-emitter circuit, base input, at mounting-flange temperature of 25° C

DC Collector-to-Emitter Voltage	-28	-28	-28	-28	volts
DC Collector Current	-0.2	-0.4	-1	-1.5	amp
Signal Frequency	400	400	400	400	cps
Emitter Resistance (Unbypassed)	0.5	1	1	2	ohms
Generator Resistance	100	50	25	15	ohms
Load Resistance	200	80	30	20	ohms
Transducer Power Gain	44.2	36.5	30.8	22.3	db
Total Harmonic Distortion	6.6	5.5	5	4.3	%
Power Output	2	5	10	15	watts

As push-pull class-B audio-frequency power amplifier in common-emitter circuit, base input, at mounting-flange temperature of 25° C

Unless otherwise specified, values are for 2 transistors

DC Collector-to-Emitter Voltage	-28	-28	-28	-28	volts
DC Supply Current	-0.263	-0.505	-1.62	-2.9	amp
Signal Frequency	400	400	400	400	cps
Emitter Resistance (Unbypassed)	0.5	0.5	0.5	0.5	ohm
Generator Resistance (Per transistor)	150	100	10	10	ohms
Load Resistance (Collector to collector)	300	150	40	20	ohms
Efficiency	67.8	70.7	66.1	61.6	%
Transducer Power Gain	38.1	35.4	25.9	22	db
Total Harmonic Distortion	3.8	5	3.8	8	%
Power Output	5	10	30	50	watts

● For switching applications requiring operation at ratings above these specified values, refer to Rating Charts III and IV, "Maximum Transistor Dissipation vs Pulse Duration". For applications limited by thermal runaway, refer to Rating Chart II, "Maximum Transistor Dissipation vs Circuit-Stability Factor x Collector-to-Emitter Volts". For applications not limited by thermal runaway, the maximum transistor dissipation at a given mounting-flange temperature between 25° C and 100° C may be calculated from the following formula:

$$P_T = P_0 - (T - 25)/K$$

where:

P_T = Maximum transistor dissipation in watts at a mounting-flange temperature of T.

P_0 = Maximum transistor dissipation in watts at a mounting-flange temperature of 25° C.

T = Mounting-flange temperature in °C.

K = Thermal resistance (1.5 max. °C/watt).

▲ Measured at 1 kc.

RCA

2N561

POWER TRANSISTOR

■ "On"-Condition Equations:

Driving power = DC base-to-emitter voltage × DC base current.

Transistor dissipation = (DC collector-to-emitter voltage × DC collector current) + driving power.

Power output = (DC supply voltage - DC collector-to-emitter voltage) × DC collector current.

Power gain = power output ÷ driving power.

§ Efficiency = power output ÷ (power output + transistor dissipation).

"Turn-on" time = $T_d + T_r$; "turn-off" time = $T_s + T_f$.

CHARACTERISTICS RANGE VALUES FOR EQUIPMENT DESIGN

At mounting-flange temperature of 25° C

	Typical Values	Range Values Min.	Max.	
DC Collector-to-Base Breakdown Voltage (BV_{CBO}) for dc collector ma. = -3 with emitter open.	-	-80	-	volts
DC Collector-to-Emitter Breakdown Voltage: For dc collector ma. = -300 with base open (BV_{CEO})	-80	-50	-	volts
With base connected to emitter (BV_{CES}). . . .	-90	-65	-	volts
DC Emitter-to-Base Breakdown Voltage (BV_{EBO}) for dc emitter ma. = -3 with collector open. . . .	-100	-60	-	volts
DC Collector-to-Emitter Saturation Voltage (V_{CE}) for dc collector amperes = -4 and dc base ma. = -400	-0.4	-	-0.8	volt
DC Collector-to-Emitter Punch-Through Voltage (V_P)	-120	-78.5	-	volts
DC Collector-Cutoff Current (I_{CBO}): For dc collector-to-base volts = -0.5 with emitter open	-65	-	-150	μa
For dc collector-to-base volts = -30 with emitter open	-100	-	-500	μa
DC Emitter-Cutoff Current (I_{EBO}) for dc base-to-emitter volts = -12 with collector open. . . .	-65	-	-200	μa

2N561

POWER TRANSISTOR

	Typical Values	Range Values Min.	Max.	
DC Current Gain (h_{FE}) for dc collector-to-emitter volts = -1.5 and dc collector amperes = -4. . . .	26	20	50	
Alpha-Cutoff Frequency ($f_{\alpha e}$) for dc collector-to-emitter volts = -1.5 and dc collector amperes = -1. . . .	6.5	5	-	kc
Thermal Resistance	1	-	1.5	°C/watt

OPERATING CONSIDERATIONS

The *base and emitter pins* of the 2N561 fit the Loranger Mfg. Corp. socket No.2149, or equivalent. When a socket is not used, connections can be soldered directly to the base and emitter pins. Soldering of the connections to the pins may be made close to the pin seals provided care is taken to conduct excessive heat away from the pin seals. Otherwise, the heat of the soldering operation will crack the glass seals of the pins and damage the transistor.

In applications where the chassis is connected to the positive terminal of the voltage supply, it will be necessary to use an anodized-aluminum insulator having high thermal conductivity, or a 0.002" mica insulator between the mounting flange and the chassis. An aluminum washer should be drilled or punched to provide the two mounting holes, and the clearance holes for the emitter and base pins. The burrs should then be removed from the washer and the washer finally anodized. To insure that the anodized insulating layer is not destroyed during mounting, it will also be necessary to remove the burrs from the holes in the chassis. Furthermore, to prevent a short circuit between the mounting bolt and the chassis, it is important that a fibre washer be used between the bolt and the chassis. *(See Suggested Mounting Arrangement).*

It is important that the mounting flange which serves as the collector be securely fastened to a heat sink. Depending on the application, the chassis (heat sink) may be connected either to the positive or negative terminal of the voltage supply.

It is to be noted that the metal case of this transistor operates at the collector voltage. Consideration, therefore, should be given to the possibility of shock hazard if the metal case of this transistor is to operate at a voltage appreciably above or below ground potential. In such cases, suitable precautionary measures should be taken.

Under no circumstances should the mounting flange be soldered to the heat sink because the heat of the soldering operation will permanently damage the transistor.

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2N561

POWER TRANSISTOR

The 2N561 should not be connected into or disconnected from circuits with the power on because high transient currents may cause permanent damage to the transistor.

To prevent damage to the transistor by thermal runaway, an external resistance may be placed in the emitter or collector circuit. The minimum value of this resistance may be obtained from the following equation:

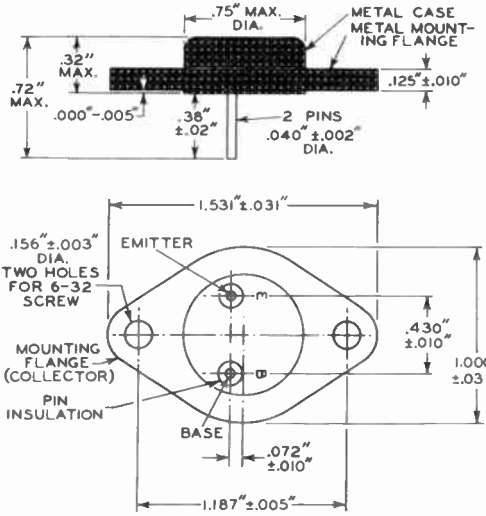
$$R_{min.} = \frac{E^2}{4\left(P_o + \frac{25}{K}\right)}$$

where:

E = DC collector supply voltage (Volts)

P_o = Collector-to-emitter voltage x collector current at desired operating point (Watts)

K = Thermal resistance -- transistor and heat sink (°C/watt)



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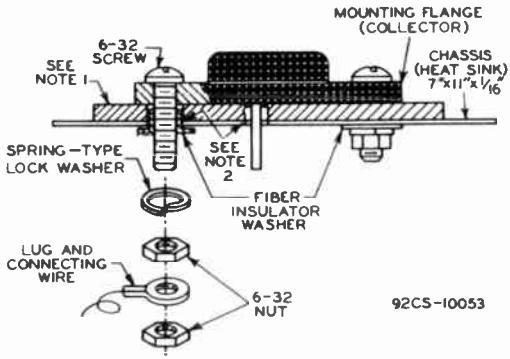
2N561

POWER TRANSISTOR

SUGGESTED MOUNTING ARRANGEMENT



NOTE 1: 0.002" MICA INSULATOR OR ANODIZED-ALUMINUM INSULATOR, DRILLED OR PUNCHED WITH BURRS REMOVED.

NOTE 2: REMOVE BURRS FROM CHASSIS HOLES.

SEMICONDUCTOR and MATERIALS DIVISION
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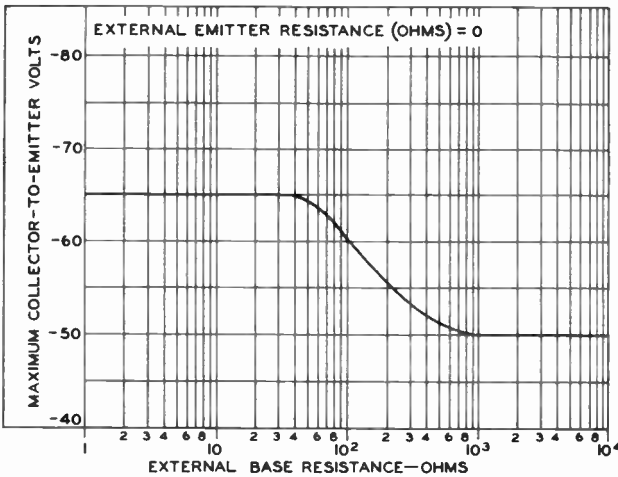
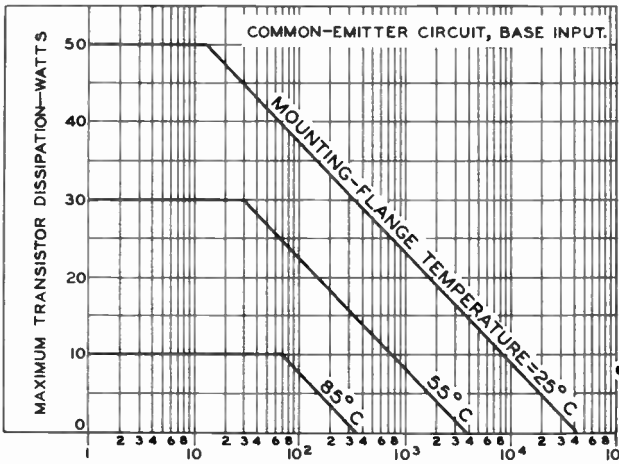
2N561

RATING CHART I



92CS-10054

RATING CHART II



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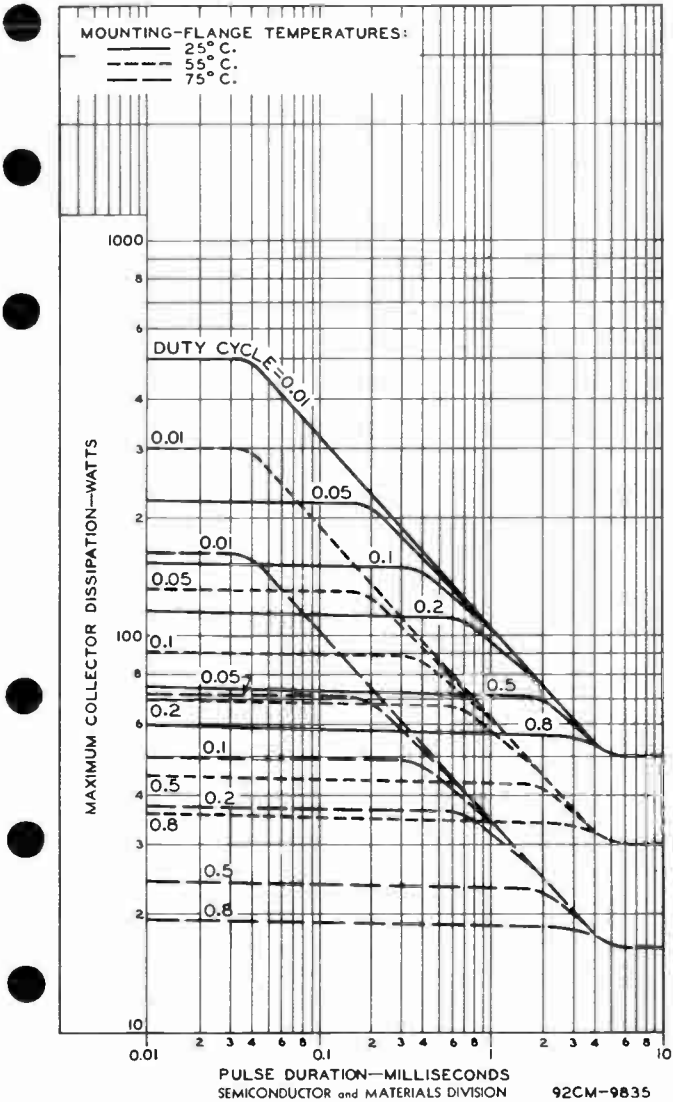
RCA

2N561

RATING CHART III



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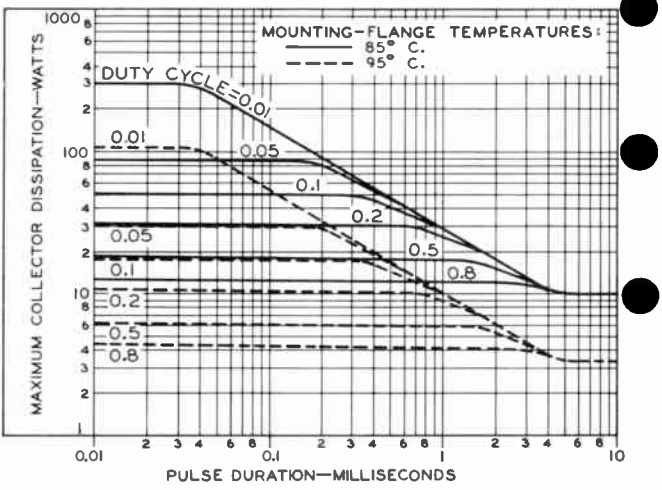
92CM-9835

RCA

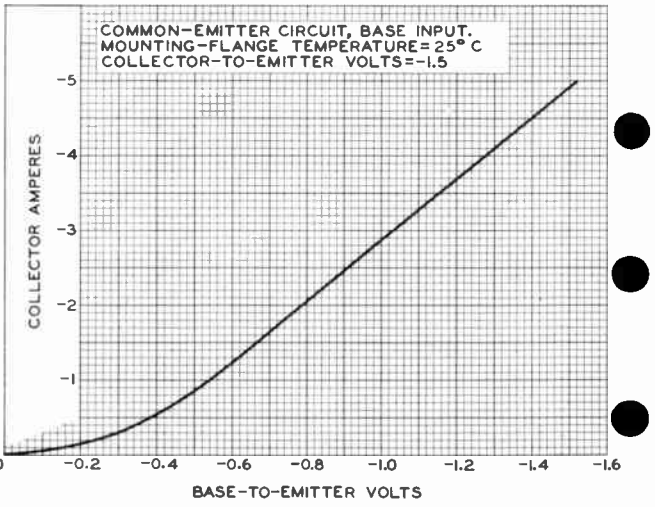
2N561

RATING CHART IV



92CS-9836

AVERAGE CHARACTERISTIC



92CS-9837

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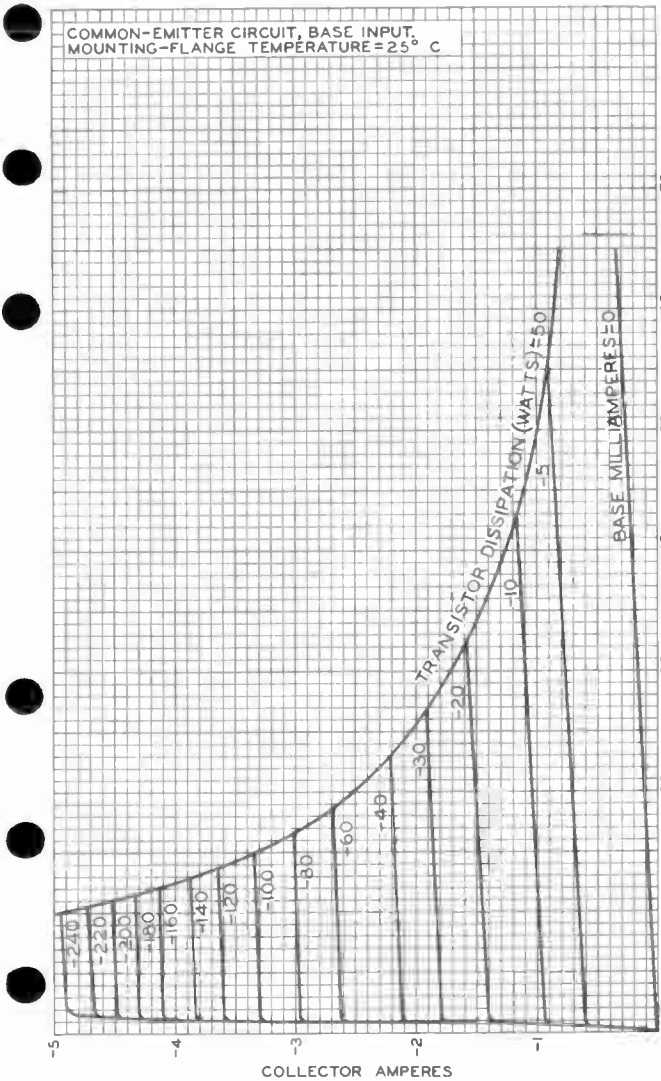
RADIO CORPORATION OF AMERICA, SOMERVILLE, NEW JERSEY

RCA

2N561

AVERAGE COLLECTOR CHARACTERISTICS



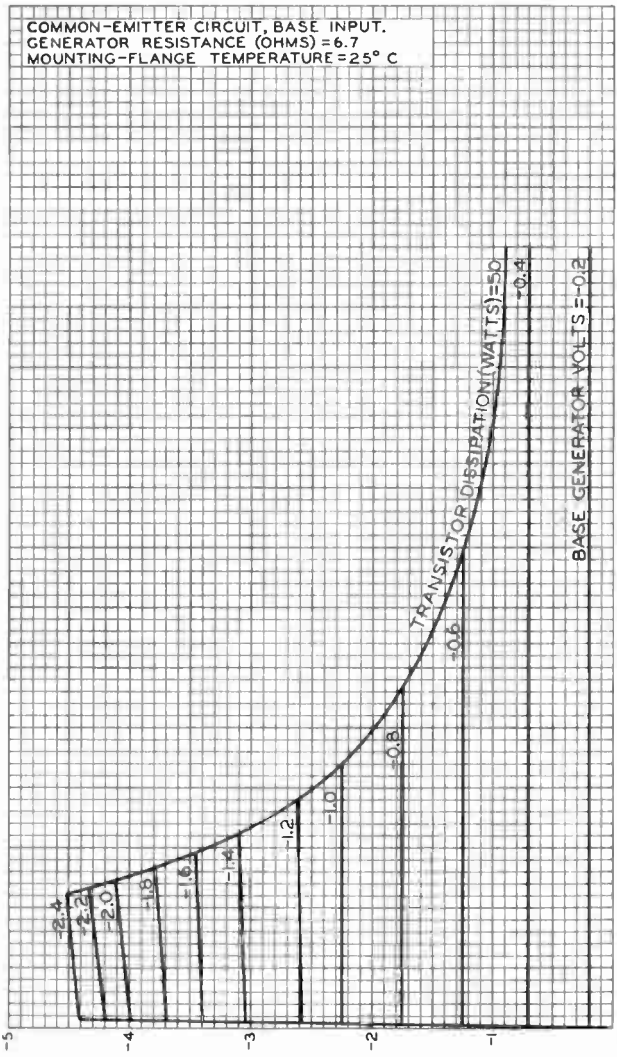
SEMICONDUCTOR and MATERIALS DIVISION
RADIO CORPORATION OF AMERICA SOMERVILLE, NEW JERSEY

92CM-9826R1

RCA

2N561

AVERAGE COLLECTOR CHARACTERISTICS



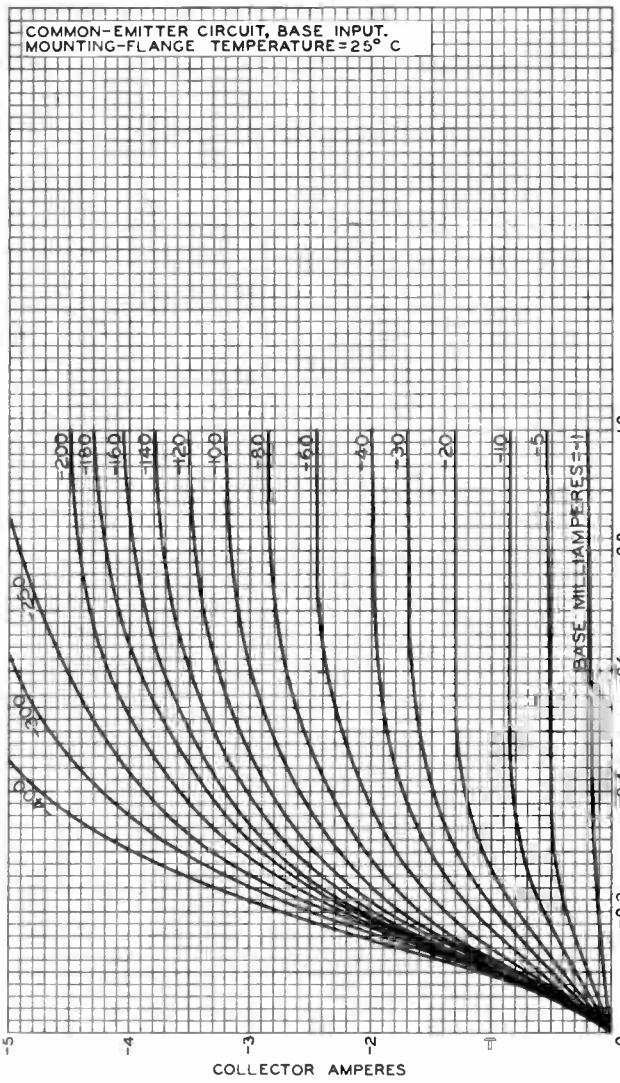
SEMICONDUCTOR and MATERIALS DIVISION
RADIO CORPORATION OF AMERICA SOMERVILLE, NEW JERSEY

92CM-9827RI

RCA

2N561

AVERAGE COLLECTOR CHARACTERISTICS



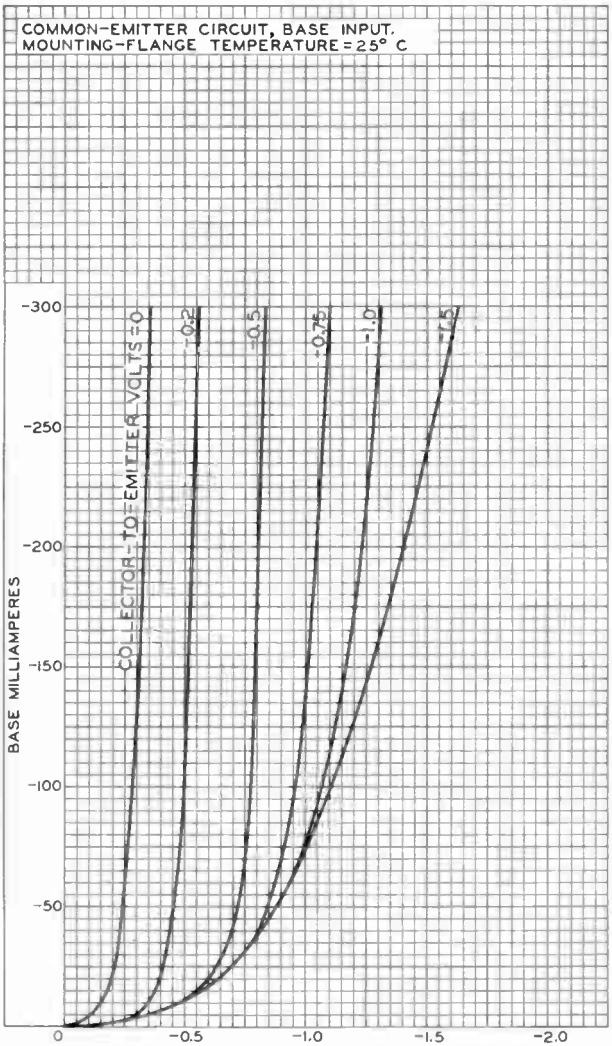
SEMICONDUCTOR and MATERIALS DIVISION 92CM-9828

RADIO CORPORATION OF AMERICA, SOMERVILLE, NEW JERSEY

RCA

2N561

AVERAGE BASE CHARACTERISTICS

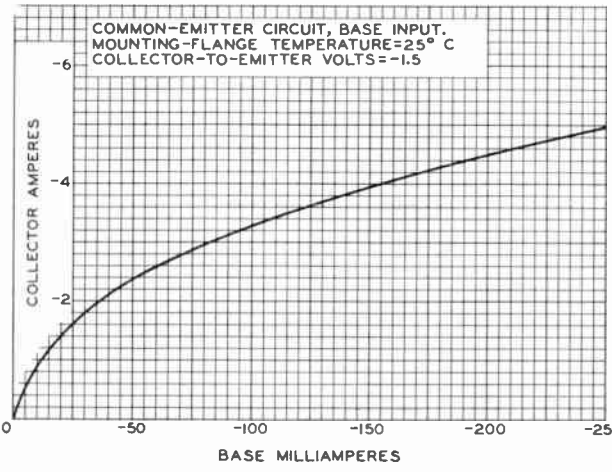


SEMICONDUCTOR and MATERIALS DIVISION
RADIO CORPORATION OF AMERICA SOMERVILLE, NEW JERSEY
92CM-9829

RCA

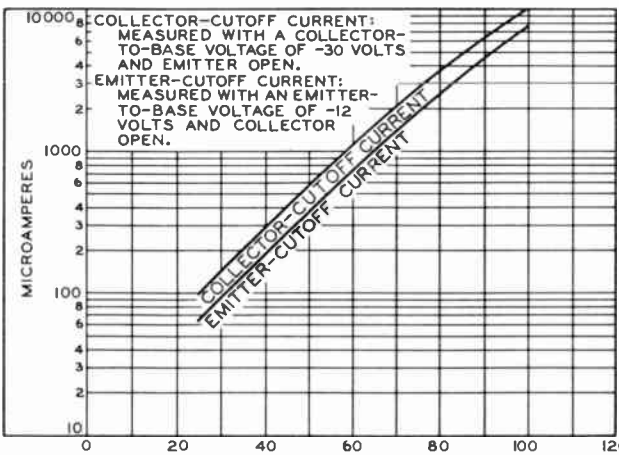
2N561

AVERAGE CURRENT-TRANSFER CHARACTERISTIC



92CS-9834

AVERAGE CUTOFF-CURRENT CHARACTERISTICS



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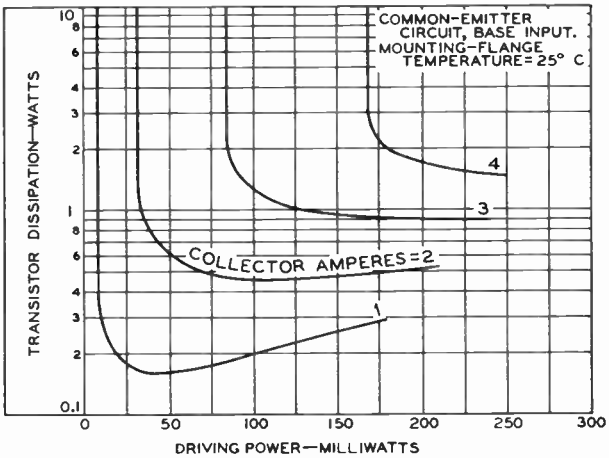
92CS-9830RI

2N561

AVERAGE PERFORMANCE CHARACTERISTICS



92CS-9831

2N640
DRIFT TRANSISTOR

GERMANIUM P-N-P ALLOY TYPE

For radio-frequency-amplifier applications in automobile-radio receivers

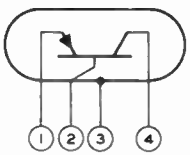
GENERAL DATA

Electrical:

Minimum DC Collector-to-Base Breakdown Voltage (BV_{CBO}) for dc collector μa = -50 with emitter open, and at ambient temperature of 25° C.	-34	volts
Maximum DC Collector-Cutoff Current (I_{CBO}) for dc collector-to-base volts = -12 with emitter open, and at ambient temperature of 25° C.	-5	μa
Maximum DC Emitter-Cutoff Current (I_{EBO}) for dc emitter-to-base volts = -1 with collector open, and at ambient temperature of 25° C	-8	μa
Interlead Capacitance between collector and base leads with interlead shield connected to ground and all leads cut to 5/16"	0.03	$\mu\mu f$
Thermal Resistance	0.75	°C/mw

Mechanical:

Operating Position	Any
Maximum Length (Excluding flexible leads)	0.375"
Maximum Diameter	0.360"
Dimensional Outline	JEDEC No. TO-7
Case	Metal
Envelope Seals	Hermetic
Leads, Flexible	4
Minimum length	1.5"
Orientation and diameter	*See Dimensional Outline*
Base	JEDEC No. E4-48



RADIO-FREQUENCY AMPLIFIER — Class A

Maximum Ratings, *Absolute-Maximum Values:*

DC COLLECTOR-TO-BASE VOLTAGE	-34 max.	volts
DC EMITTER-TO-BASE VOLTAGE	-1 max.	volt

SEMICONDUCTOR and MATERIALS DIVISION
RADIO CORPORATION OF AMERICA, SOMERVILLE, NEW JERSEY

RCA

2N640

DRIFT TRANSISTOR

DC COLLECTOR CURRENT	−10 max.	ma
DC EMITTER CURRENT	10 max.	ma
TRANSISTOR DISSIPATION:		
At ambient temperature of 25° C.	80 max.	mw
At ambient temperature of 55° C.	50 max.	mw
At ambient temperature of 71° C.	35 max.	mw
AMBIENT TEMPERATURE (During operation)	71 max.	°C
STORAGE-TEMPERATURE RANGE	−65 to +85	°C

Characteristics, *At Ambient Temperature of 25° C:*

Common-Emitter Circuit, Base Input

DC Collector-to-Emitter Voltage	−12	−12	volts
DC Collector Current	−0.5	−1	ma
Current Gain■	50	60	
Base-to-Collector Capacitance ($C_{b'c}$)	1.55	1.55	μμf

Common-Base Circuit, Emitter Input

DC Collector-to-Base Voltage	−12	−12	volts
DC Collector Current	−0.5	−1	ma
Current Gain■	0.980	0.984	
Alpha-Cutoff Frequency	28	42	Mc

Typical Operation, *At Ambient Temperature of 25° C:*

Common-Emitter Circuit, Base Input

DC Collector-to-Emitter Voltage	−12	−12	volts
DC Emitter Current	0.5	1	ma
Signal Frequency	1.5	1.5	Mc
Input Resistance	2000	1000	ohms
Output Resistance	0.28	0.18	megohm
Power Gain:			
Maximum♦	47	47.5	db
Useful, with circuit unneutralized	25	28	db

■ Measured at 1 kc.

♦ Measured in a single-tuned unilateralized circuit matched to the generator and load impedances for maximum transfer of power. Transformer insertion losses not included.

OPERATING CONSIDERATIONS

The 2N640 should not be connected into or disconnected from circuits with the power on because high transient currents may cause permanent damage to the transistor.

The *flexible leads* of the 2N640 are usually soldered to the circuit elements. Soldering of the leads may be made close to the glass stem provided care is taken to conduct excessive heat away from the lead seal. Otherwise, the heat of the soldering operation will crack the seals of the leads and damage the transistor.

When dip soldering is employed in the assembly of printed circuitry using the 2N640, the temperature of the solder

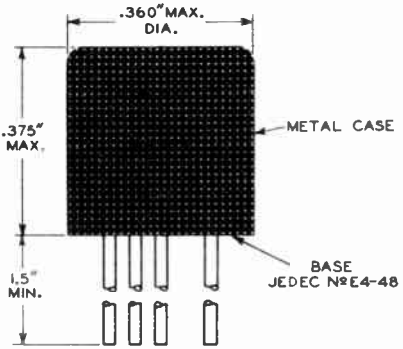
SEMICONDUCTOR and MATERIALS DIVISION
RADIO CORPORATION OF AMERICA, SOMERVILLE, NEW JERSEY

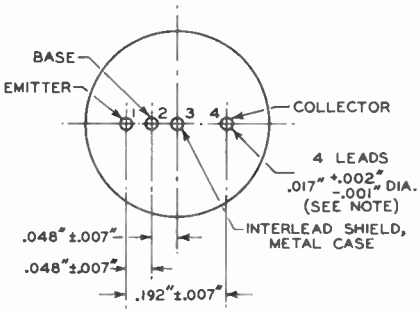
should not exceed 255° C for a maximum immersion period of 10 seconds for single-dip processes.

The 2N640 utilizes shielding to minimize interlead capacitance and to minimize coupling by adjacent circuit components. This shielding is provided to lead 3 (center lead) situated between the collector lead and the base lead and internally connected to the metal case. For optimum performance, it is recommended that lead 3 be connected to the chassis ground.

2N640

DRIFT TRANSISTOR





92CS-9122R5

NOTE: THE SPECIFIED LEAD DIAMETER APPLIES IN THE ZONE BETWEEN 0.050" AND 0.250" FROM THE BASE SEAT. BETWEEN 0.250" AND 1.50", A MAXIMUM DIAMETER OF 0.021" IS HELD. OUTSIDE OF THESE ZONES, THE LEAD DIAMETER IS NOT CONTROLLED.

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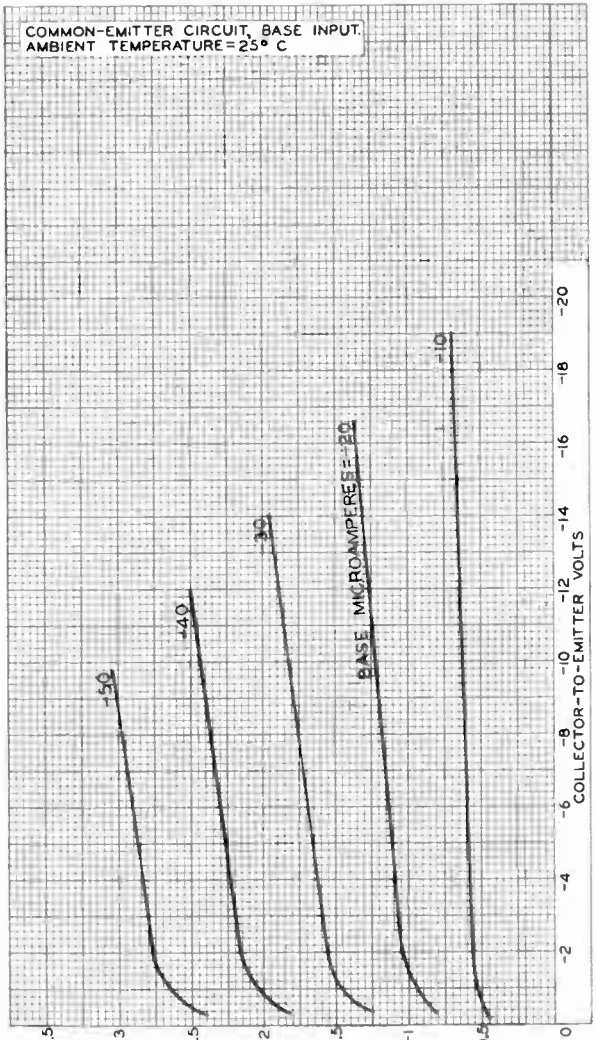
2N640

AVERAGE COLLECTOR CHARACTERISTICS



92CM-9107

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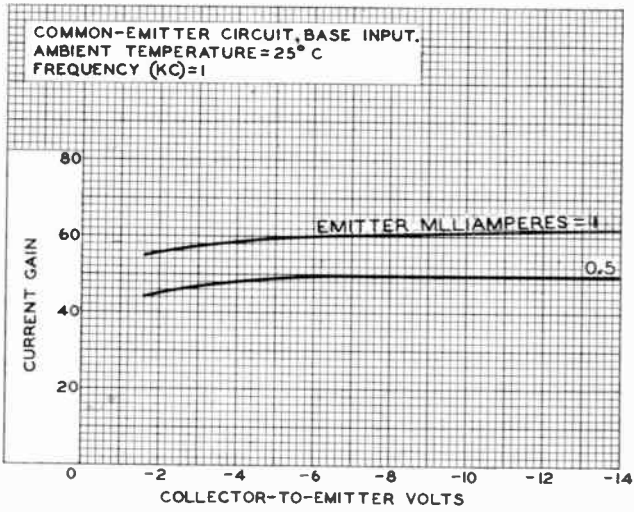
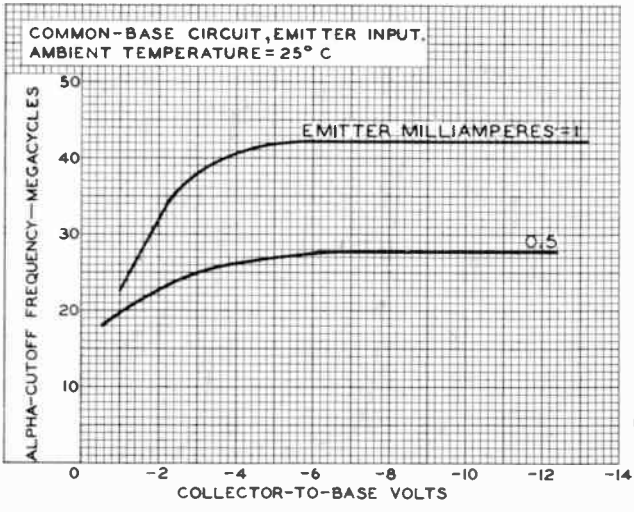
2N640

2N640

AVERAGE CHARACTERISTICS



92CS-9782R1



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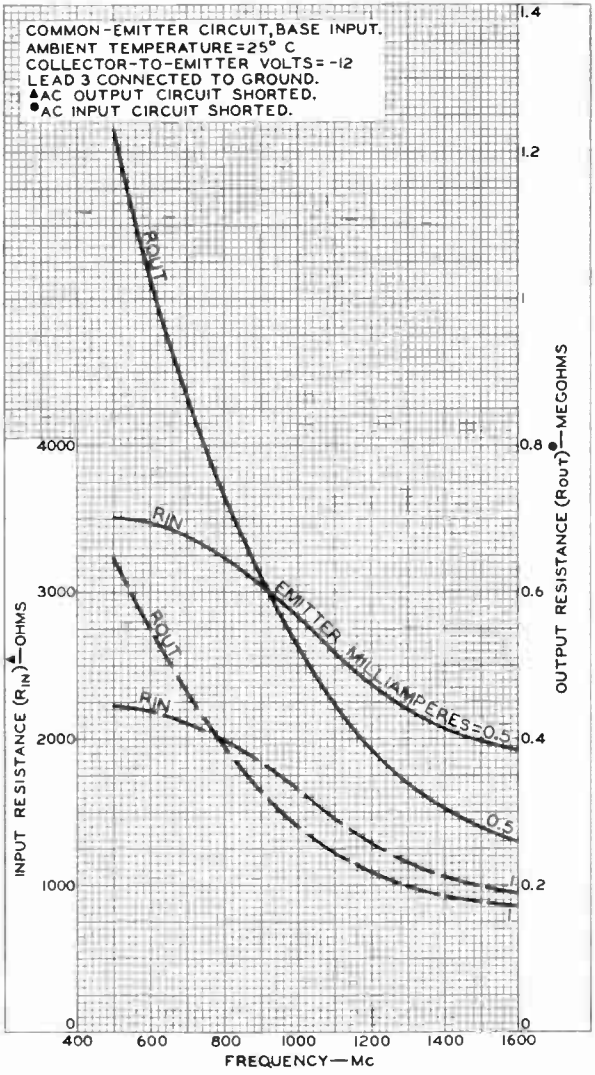
RADIO CORPORATION OF AMERICA, SOMERVILLE, NEW JERSEY

92CS-9781

RCA

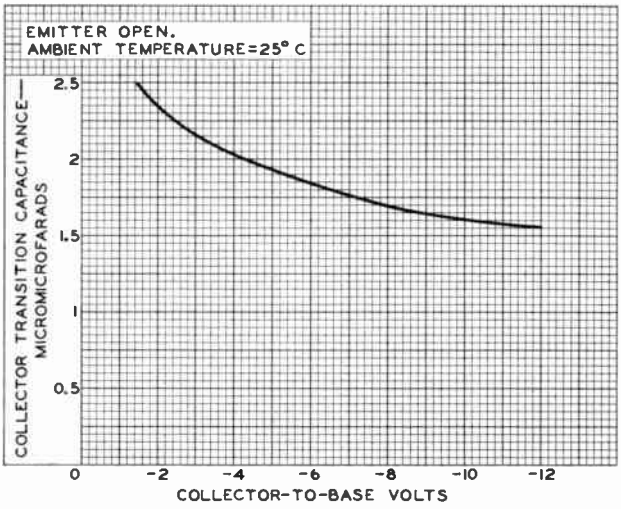
2N640

PERFORMANCE CHARACTERISTICS



2N640

AVERAGE CHARACTERISTIC



92CS-9784

2N641

DRIFT TRANSISTOR

GERMANIUM P-N-P ALLOY TYPE

For intermediate-frequency-amplifier applications in automobile-radio receivers

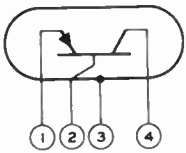
GENERAL DATA

Electrical:

Minimum DC Collector-to-Base Breakdown Voltage (BV_{CBO}) for dc collector μa = −50 with emitter open, and at ambient temperature of 25° C.	−34	volts
Maximum DC Collector-Cutoff Current (I_{CBO}) for dc collector-to-base volts = −12 with emitter open, and at ambient temperature of 25° C.	−7	μa
Maximum DC Emitter-Cutoff Current (I_{EBO}) for dc emitter-to-base volts = −1 with collector open, and at ambient temperature of 25° C	−8	μa
Interlead Capacitance between collector and base leads with interlead shield connected to ground and all leads cut to 5/16"	0.03	$\mu\mu f$
Thermal Resistance	0.75	°C/mw

Mechanical:

Operating Position	Any
Maximum Length (Excluding flexible leads)	0.375"
Maximum Diameter	0.360"
Dimensional Outline	JEDEC No. TO-7
Case	Metal
Envelope Seals	Hermetic
Leads, Flexible	4
Minimum length	1.5"
Orientation and diameter	*See Dimensional Outline*
Base	JEDEC No. E4-48



INTERMEDIATE-FREQUENCY AMPLIFIER — Class A

Maximum Ratings, *Absolute-Maximum Values:*

DC COLLECTOR-TO-BASE VOLTAGE	−34 max.	volts
DC EMITTER-TO-BASE VOLTAGE	−1 max.	volt

SEMICONDUCTOR and MATERIALS DIVISION
RADIO CORPORATION OF AMERICA, SOMERVILLE, NEW JERSEY

2N641

2N641

DRIFT TRANSISTOR

DC COLLECTOR CURRENT	−10 max.	ma
DC EMITTER CURRENT	10 max.	ma
TRANSISTOR DISSIPATION:		
At ambient temperature of 25° C.	80 max.	mw
At ambient temperature of 55° C.	50 max.	mw
At ambient temperature of 71° C.	35 max.	mw
AMBIENT TEMPERATURE (During operation)	71 max.	°C
STORAGE-TEMPERATURE RANGE	−65 to +85	°C

Characteristics, *At Ambient Temperature of 25° C:*

Common-Emitter Circuit, Base Input

DC Collector-to-Emitter Voltage	−12	−12	volts
DC Collector Current	−0.5	−1	ma
Current Gain■	50	60	
Base-to-Collector Capacitance ($C_{b'c}$)	1.55	1.55	μμf

Common-Base Circuit, Emitter Input

DC Collector-to-Base Voltage	−12	−12	volts
DC Collector Current	−0.5	−1	ma
Current Gain■	0.980	0.984	
Alpha-Cutoff Frequency	28	42	Mc

Typical Operation, *At Ambient Temperature of 25° C:*

Common-Emitter Circuit, Base Input

DC Collector-to-Emitter Voltage	−12	−12	−12	−12	volts
DC Emitter Current	0.5	1	0.5	1	ma
Signal Frequency	262.5	262.5	455	455	kc
Input Resistance	3700	2300	3500	2200	ohms
Output Resistance	3	1.2	1.3	0.66	megohms
Power Gain (Single-stage):					
Maximum♦	58	60	52	54.5	db
Useful:					
With circuit neutralized	38	41	36	40	db
With circuit unneutralized	33.5	36	32	34	db

■ Measured at 1 kc.

♦ Measured in a single-tuned unilateralized circuit matched to the generator and load impedances for maximum transfer of power. Transformer insertion losses not included.

OPERATING CONSIDERATIONS

The 2N641 should not be connected into or disconnected from circuits with the power on because high transient currents may cause permanent damage to the transistor.

The *flexible leads* of the 2N641 are usually soldered to the circuit elements. Soldering of the leads may be made close to the glass stem provided care is taken to conduct excessive

SEMICONDUCTOR and MATERIALS DIVISION
RADIO CORPORATION OF AMERICA SOMERVILLE, NEW JERSEY

2N641

DRIFT TRANSISTOR

heat away from the lead seal. Otherwise, the heat of the soldering operation will crack the seals of the leads and damage the transistor.

When dip soldering is employed in the assembly of printed circuitry using the 2N641, the temperature of the solder should not exceed 255° C for a maximum immersion period of 10 seconds for single-dip processes.

The 2N641 utilizes shielding to minimize interlead capacitance and to minimize coupling to adjacent circuit components. This shielding is provided by lead 3 (center lead) situated between the collector lead and the base lead and internally connected to the metal case. For optimum performance, it is recommended that lead 3 be connected to the chassis ground.

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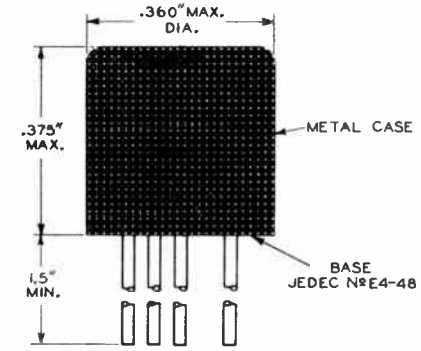
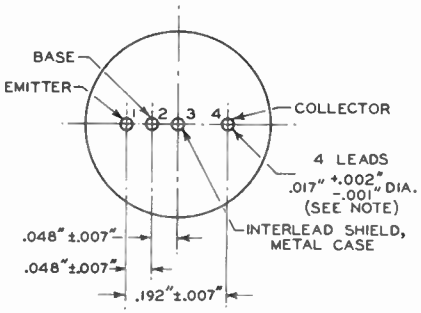
2N641
DRIFT TRANSISTOR





92CS-9122R5

NOTE: THE SPECIFIED LEAD DIAMETER APPLIES IN THE ZONE BETWEEN 0.050" AND 0.250" FROM THE BASE SEAT. BETWEEN 0.250" AND 1.50", A MAXIMUM DIAMETER OF 0.021" IS HELD. OUTSIDE OF THESE ZONES, THE LEAD DIAMETER IS NOT CONTROLLED.

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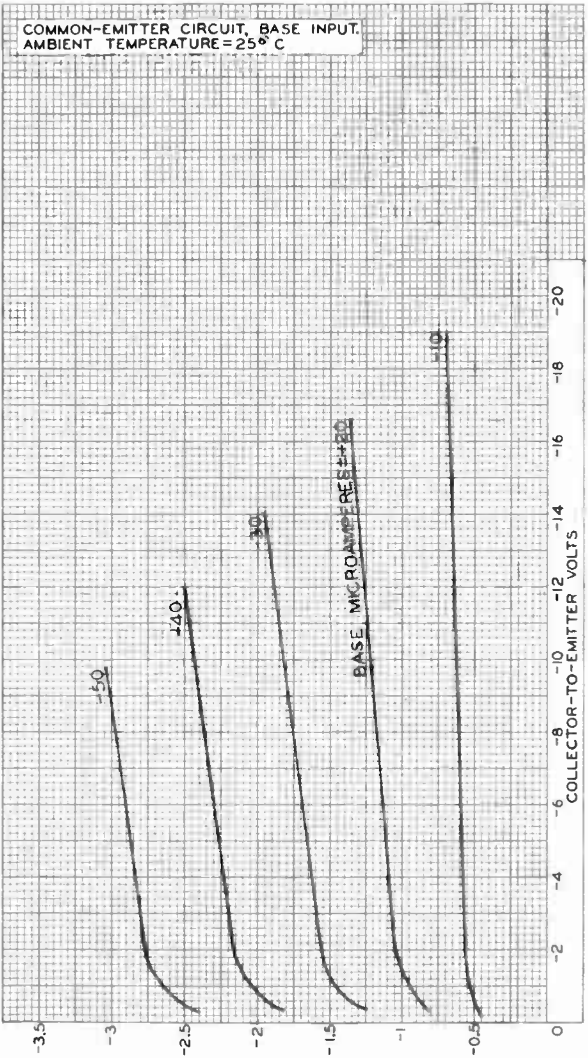
RADIO CORPORATION OF AMERICA, SOMERVILLE, NEW JERSEY

2N641

2N641

AVERAGE COLLECTOR CHARACTERISTICS



92CM-9107

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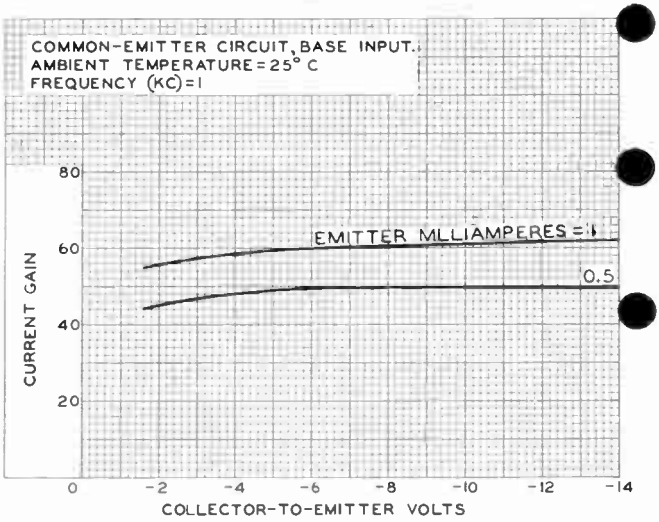
RADIO CORPORATION OF AMERICA SOMERVILLE NEW JERSEY

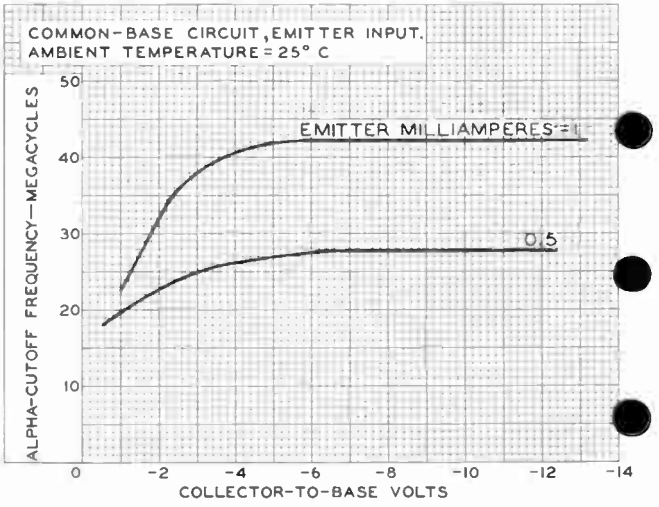
2N641

2N641

AVERAGE CHARACTERISTICS



92CS-9782R1



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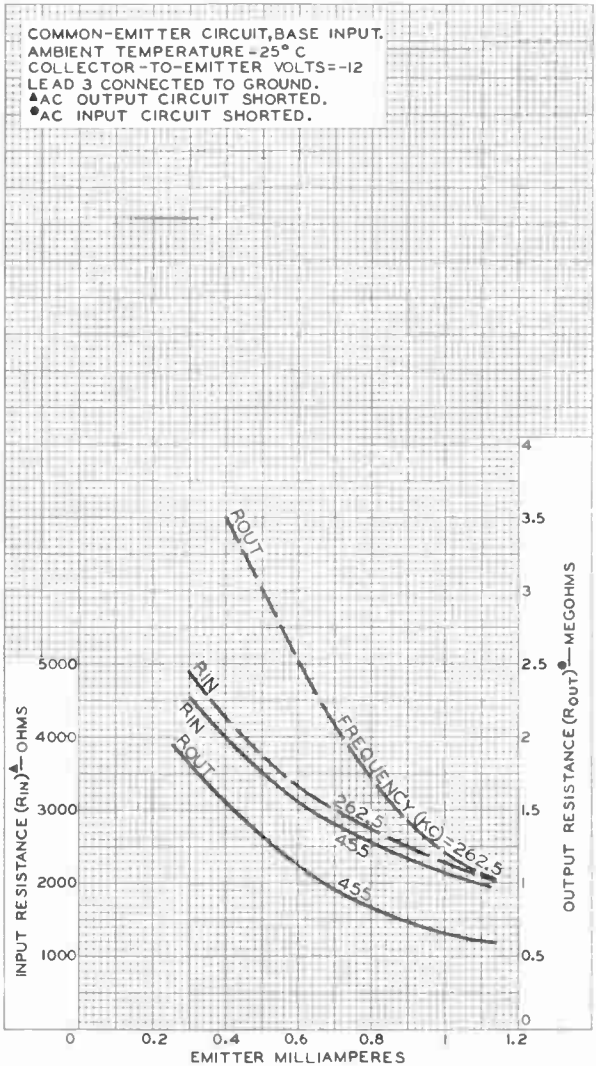
RADIO CORPORATION OF AMERICA SOMERVILLE NEW JERSEY

92CS-9781

RCA

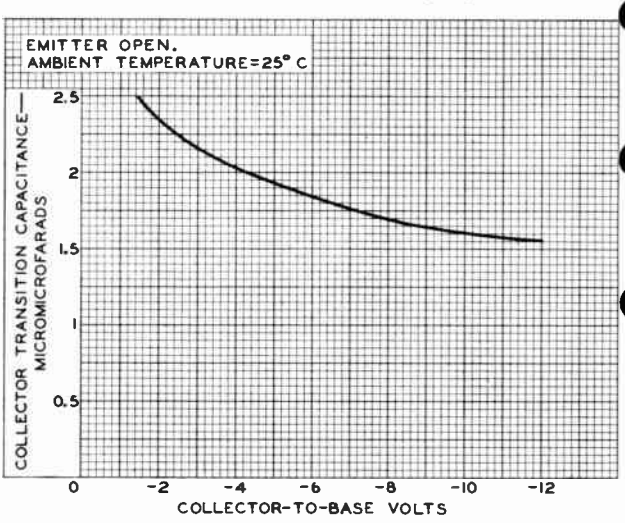
2N641

PERFORMANCE CHARACTERISTICS



2N641

AVERAGE CHARACTERISTIC



92CS-9784

2N642

DRIFT TRANSISTOR

GERMANIUM P-N-P ALLOY TYPE

For converter applications in automobile-radio receivers

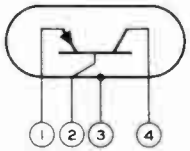
GENERAL DATA

Electrical:

Minimum DC Collector-to-Base Breakdown Voltage (BV_{CBO}) for dc collector μa = -50 with emitter open, and at ambient temperature of 25° C.	-34	volts
Maximum DC Collector-Cutoff Current (I_{CBO}) for dc collector-to-base volts = -12 with emitter open, and at ambient temperature of 25° C.	-7	μa
Maximum DC Emitter-Cutoff Current (I_{EBO}) for dc emitter-to-base volts = -1 with collector open, and at ambient temperature of 25° C	-8	μa
Interlead Capacitance between collector and base leads with interlead shield connected to ground and all leads cut to 5/16"	0.03	$\mu\mu f$
Thermal Resistance	0.75	°C/mw

Mechanical:

Operating Position	Any
Maximum Length (Excluding flexible leads)	0.375"
Maximum Diameter	0.360"
Dimensional Outline	JEDEC No. TO-7
Case	Metal
Envelope Seals	Hermetic
Leads, Flexible	4
Minimum length	1.5"
Orientation and diameter	*See Dimensional Outline*
Base	JEDEC No. E4-48



CONVERTER SERVICE

Maximum Ratings, *Absolute-Maximum Values:*

DC COLLECTOR-TO-BASE VOLTAGE	-34 max.	volts
DC EMITTER-TO-BASE VOLTAGE	-1 max.	volt

2N642

2N642

DRIFT TRANSISTOR

DC COLLECTOR CURRENT	-10 max.	ma
DC EMITTER CURRENT	10 max.	ma
TRANSISTOR DISSIPATION:		
At ambient temperature of 25° C	80 max.	mw
At ambient temperature of 55° C	50 max.	mw
At ambient temperature of 71° C	35 max.	mw
AMBIENT TEMPERATURE (During operation)	71 max.	°C
STORAGE-TEMPERATURE RANGE	-65 to +85	°C

Characteristics, *At Ambient Temperature of 25° C:*

Common-Emitter Circuit, Base Input

DC Collector-To-Emitter Voltage	-12	-12	volts
DC Collector Current	-0.5	-1	ma
Current Gain■	50	60	
Base-to-Collector Capacitance ($C_{b'c}$)	1.55	1.55	μμf

Common-Base Circuit, Emitter Input

DC Collector-To-Base Voltage	-12	-12	volts
DC Collector Current	-0.5	-1	ma
Current Gain■	0.980	0.984	
Alpha-Cutoff Frequency	28	42	Mc

Typical Operation:

In self-excited, common-emitter, base input converter circuit at ambient temperature of 25° C

DC Collector-to-Emitter Voltage	-12	volts
DC Emitter Current	0.6	ma
Signal Frequency	1	Mc
Input Resistance	2600	ohms
Output Resistance for intermediate frequency (kc) = 262.5	2.5	megohms
RMS Base-to-Emitter Oscillator-Injection Voltage	100	millivolts
Power Gain:		
Maximum available	50	db
Useful conversion	40	db

■ Measured at 1 kc.

OPERATING CONSIDERATIONS

The 2N642 should not be connected into or disconnected from circuits with the power on because high transient currents may cause permanent damage to the transistor.

The *flexible leads* of the 2N642 are usually soldered to the circuit elements. Soldering of the leads may be made close to the glass stem provided care is taken to conduct excessive heat away from the lead seal. Otherwise, the heat of the soldering operation will crack the seals of the leads and damage the transistor.

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RADIO CORPORATION OF AMERICA, SOMERVILLE, NEW JERSEY

2N642

DRIFT TRANSISTOR

When dip soldering is employed in the assembly of printed circuitry using the 2N642, the temperature of the solder should not exceed 255° C for a maximum immersion period of 10 seconds for single-dip processes.

The 2N642 utilizes shielding to minimize interlead capacitance and to minimize coupling to adjacent circuit components. This shielding is provided by lead 3 (center lead) situated between the collector lead and the base lead and internally connected to the metal case. For optimum performance, it is recommended that lead 3 be connected to the chassis ground.

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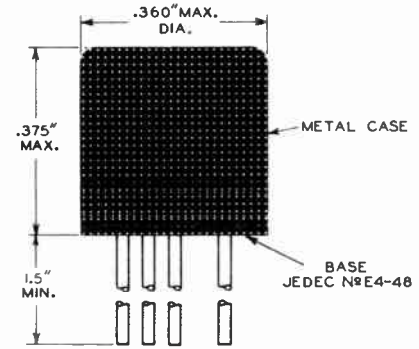
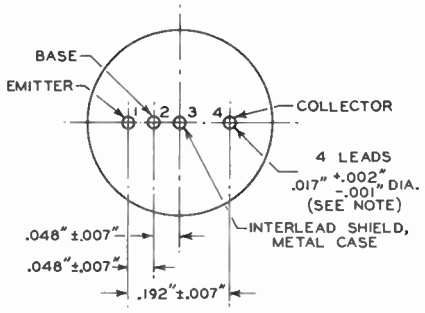
2N642

DRIFT TRANSISTOR





92CS-9122R5

NOTE: THE SPECIFIED LEAD DIAMETER APPLIES IN THE ZONE BETWEEN 0.050" AND 0.250" FROM THE BASE SEAT. BETWEEN 0.250" AND 1.50", A MAXIMUM DIAMETER OF 0.021" IS HELD. OUTSIDE OF THESE ZONES, THE LEAD DIAMETER IS NOT CONTROLLED.

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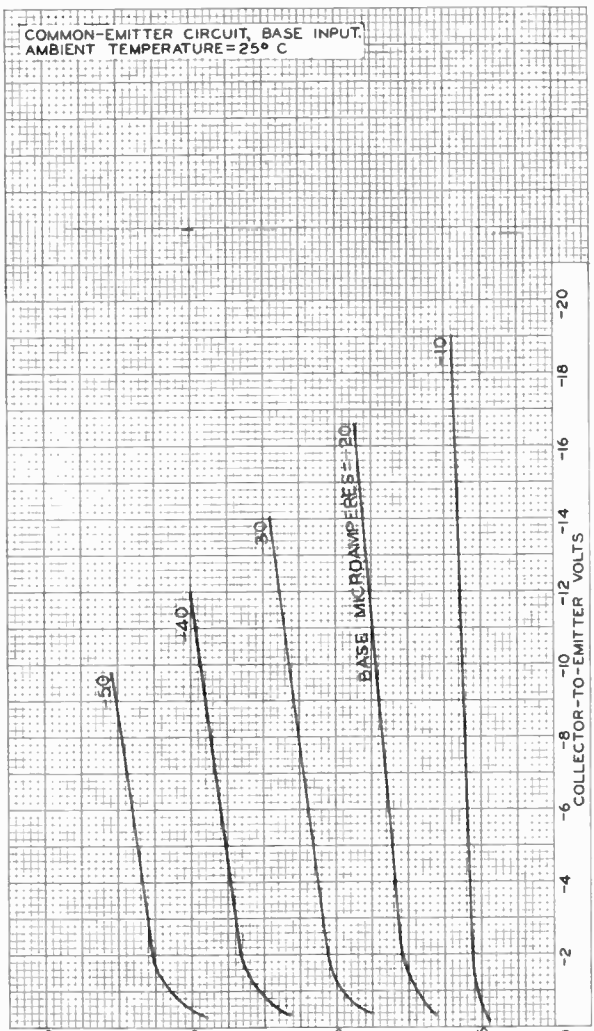
2N642

AVERAGE COLLECTOR CHARACTERISTICS



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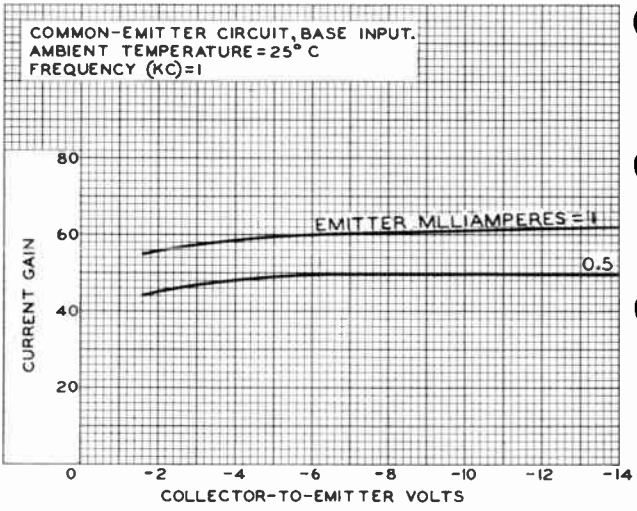
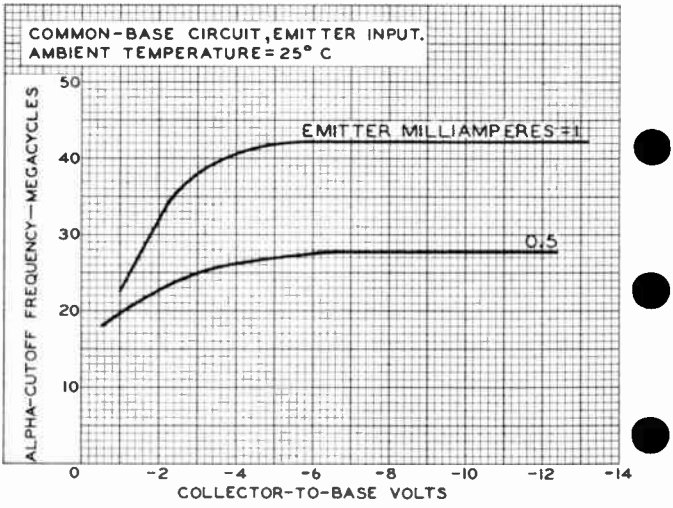
RCA

2N642

AVERAGE CHARACTERISTICS



92CS-9782RI



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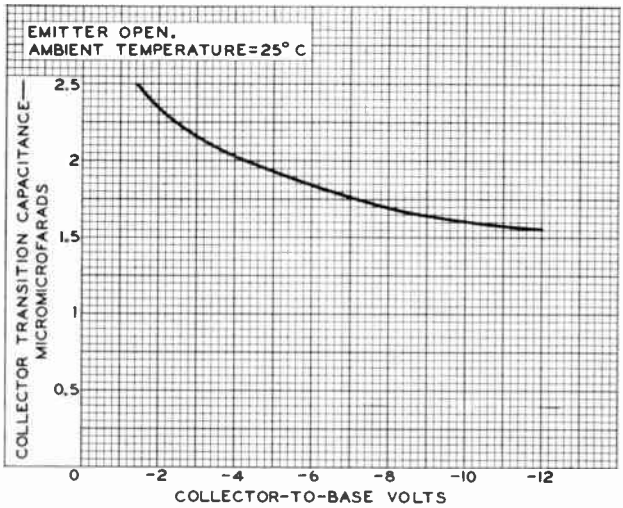
92CS-9781

2N642

AVERAGE CHARACTERISTIC



92CS-9784

2N1014

POWER TRANSISTOR

GERMANIUM P-N-P ALLOY TYPE

For industrial and military applications

The 2N1014 is the same as the 2N561 except for the following items:

INDUSTRIAL SERVICE

Such as in power-switching, dc-to-dc-converter, and audio-frequency-amplifier applications

Maximum Ratings, *Absolute-Maximum Values:*

PEAK COLLECTOR-TO-BASE VOLTAGE.	-100 max.	volts
PEAK COLLECTOR-TO-EMITTER VOLTAGE:		
With base open.	-65 max.	volts
With base connected to emitter.	-80 max.	volts
With load between base and emitter. . . .	*See Rating Chart I*	

CHARACTERISTICS RANGE VALUES FOR EQUIPMENT DESIGN

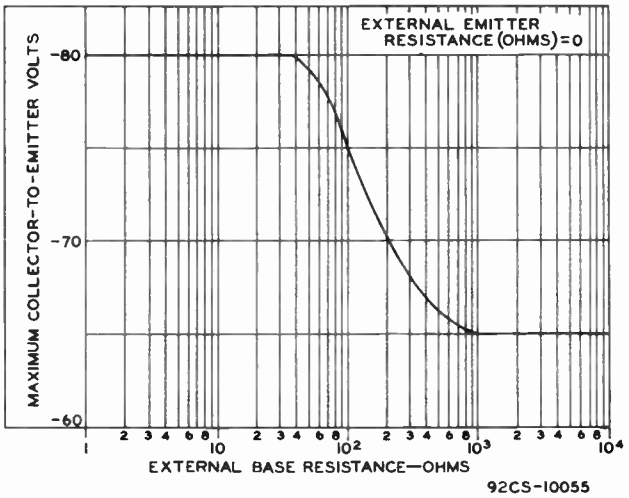
At mounting-flange temperature of 25° C

	Typical Values	*Range Values* Min.	Max.	
DC Collector-to-Base Breakdown Voltage (BV_{CBO}) for dc collector ma. = -3 with emitter open	-120	-100	-	volts
DC Collector-to-Emitter Breakdown Voltage:				
For dc collector ma. = -300 with base open (BV_{CEO}). .	-80	-65	-	volts
With base connected to emitter (BV_{CES})	-90	-80	-	volts

2N1014

2N1014

RATING CHART I



92CS-10055

2N1425

Drift-Field Transistor

GERMANIUM P-N-P ALLOY TYPE

For Intermediate-Frequency Amplifier Applications in Battery-Operated AM Radio Receivers

GENERAL DATA

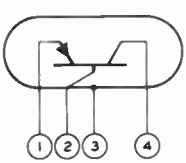
Electrical:

Minimum DC Collector-to-Base Voltage for dc emitter-to-base volts = -0.5, dc collector μa = -50, ambient temperature = 25° C	-24	volts
Maximum DC Collector-Cutoff Current (I_{CBO}) for dc collector-to-base volts = -12, emitter open, ambient temperature = 25° C.	-12	μa
Maximum DC Emitter-Cutoff Current (I_{EBO}) for dc emitter-to-base volts = -0.5, collector open, ambient temperature = 25° C	-12	μa
Interlead Capacitance between collector and base leads with interlead shield connected to ground and all leads cut to 5/16"	0.03	$\mu\mu f$
Junction-Temperature Rise (In free air)	0.6	°C/mw

Mechanical:

Operating Position	Any
Maximum Length (Excluding flexible leads)	0.375"
Maximum Diameter	0.360"
Dimensional Outline	JEDEC No. TO-7
Case	Metal
Seals	Hermetic
Leads, Flexible	4
Minimum length	1.5"
Orientation and diameter	*See Dimensional Outline*

Terminal Diagram:



INTERMEDIATE-FREQUENCY AMPLIFIER

Maximum and Minimum Ratings, *Absolute-Maximum Values:*

DC COLLECTOR-TO-BASE VOLTAGE	-24 max.	volts
DC EMITTER-TO-BASE VOLTAGE	-0.5 max.	volt
DC COLLECTOR CURRENT	-10 max.	ma
DC EMITTER CURRENT	10 max.	ma

2N1425

TRANSISTOR DISSIPATION:		
At ambient temperature of 25° C	80 max.	mw
At ambient temperature of 55° C	50 max.	mw
At ambient temperature of 71° C	23 max.	mw
AMBIENT TEMPERATURE (During operation). .	71 max.	°C
STORAGE-TEMPERATURE RANGE	-65 to +85	°C

Characteristics, *At Ambient Temperature of 25° C:*

Common-Emitter Circuit, Base Input

DC Collector-to-Emitter Voltage	-12	volts
DC Emitter Current.	1	ma
Small-Signal Current Transfer Ratio at 1 kc	50	

Common-Base Circuit, Emitter Input

DC Collector-to-Base Voltage.	-12	volts
DC Emitter Current.	1	ma
Small-Signal Current Transfer Ratio at 1 kc	0.980	
Alpha-Cutoff Frequency.	33	Mc

Typical Operation, *At Ambient Temperature of 25° C:*

In a common-emitter, base input, single-stage, 455-kc intermediate-frequency amplifier circuit

DC Supply Voltage	-6	-9	-12	volts
DC Collector-to-Emitter Voltage .	-5.7	-8.5	-11	volts
DC Emitter Current.	1	1	1	ma
Input Resistance.	1300	1350	1550	ohms
Output Resistance	0.31	0.415	0.525	megohm
Collector-to-Base Capacitance (C_{ob})	2.25	2.05	1.95	$\mu\mu$f
Maximum Power Gain▲	51	52.4	54.4	db
Useful Power Gain:				
In neutralized circuit.	33.8	34	34	db
In unneutralized circuit. . . .	30	30.3	30.4	db

▲ Measured in a single-tuned unilateralized circuit matched to the generator and load impedance for maximum transfer of power (transformer-insertion losses not included).

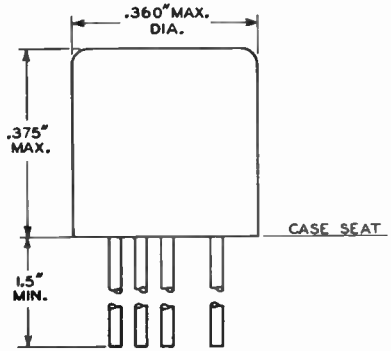
OPERATING CONSIDERATIONS

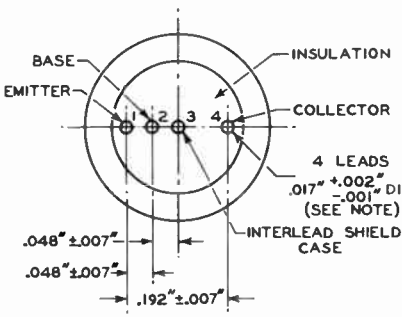
It is recommended that this transistor not be connected into or disconnected from circuits with the power on because high transient currents may cause permanent damage to the transistor.

The *flexible leads* of this transistor are usually soldered to the circuit elements. Soldering of the leads may be made close to the glass stem provided care is taken to conduct excessive heat away from the lead seal. Otherwise, the heat of the soldering operation will crack the seals of the leads and damage the transistor.

When dip soldering is employed in the assembly of printed circuitry using this transistor, the temperature of the solder should not exceed 255° C for a maximum immersion period of 10 seconds.

This transistor utilizes shielding to minimize interlead capacitance and coupling to adjacent circuit components. This shielding is provided by lead 3 situated between the collector lead and the base lead and internally connected to the case. For optimum performance, it is recommended that lead 3 be connected to the circuit ground.



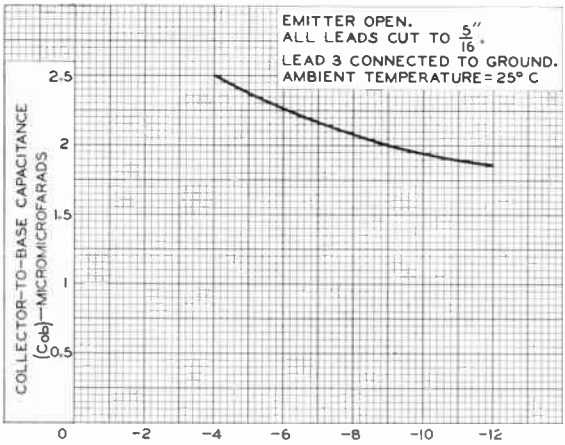


92CS-9122R6

NOTE: THE SPECIFIED LEAD DIAMETER APPLIES IN THE ZONE BETWEEN 0.05" AND 0.25" FROM THE CASE SEAT. BETWEEN 0.25" AND 1.5", A MAXIMUM DIAMETER OF 0.021" IS HELD. OUTSIDE OF THESE ZONES, THE LEAD DIAMETER IS NOT CONTROLLED.

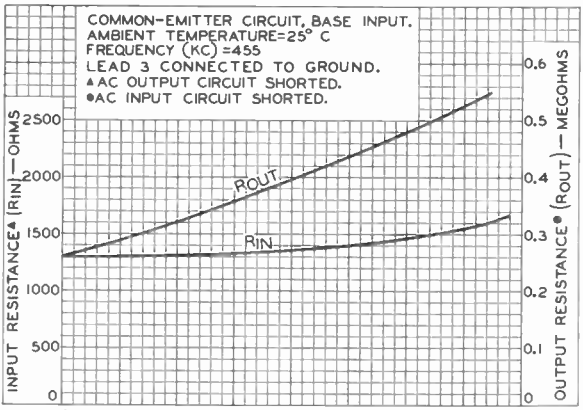
2N1425

TYPICAL CHARACTERISTIC



92CS-10418R1

PERFORMANCE CHARACTERISTICS



92CS-10419

RADIO CORPORATION OF AMERICA
Semiconductor & Materials Division
Somerville, N. J.

2N1426

Drift-Field Transistor

GERMANIUM P-N-P ALLOY TYPE

For Converter Applications in Battery-Operated AM Radio Receivers

GENERAL DATA

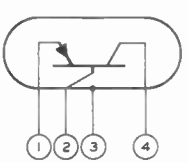
Electrical:

Minimum DC Collector-to-Base Voltage for dc emitter-to-base volts = -0.5, dc collector μa = -50, ambient temperature = 25° C	-24	volts
Maximum DC Collector-Cutoff Current (I_{CBO}) for dc collector-to-base volts = -12, emitter open, ambient temperature = 25° C.	-12	μa
Maximum DC Emitter-Cutoff Current (I_{EBO}) for dc emitter-to-base volts = -0.5, collector open, ambient temperature = 25° C	-12	μa
Interlead Capacitance between collector and base leads with interlead shield connected to ground and all leads cut to 5/16"	0.03	$\mu\mu f$
Junction-Temperature Rise (In free air)	0.6	°C/mw

Mechanical:

Operating Position	Any
Maximum Length (Excluding flexible leads)	0.375"
Maximum Diameter	0.360"
Dimensional Outline	JEDEC No. TO-7
Case	Metal
Seals	Hermetic
Leads, Flexible	4
Minimum length	1.5"
Orientation and diameter	*See Dimensional Outline*

Terminal Diagram:



CONVERTER

Maximum and Minimum Ratings, *Absolute-Maximum Values:*

DC COLLECTOR-TO-BASE VOLTAGE	-24 max.	volts
DC EMITTER-TO-BASE VOLTAGE	-0.5 max.	volt
DC COLLECTOR CURRENT	-10 max.	ma
DC EMITTER CURRENT	10 max.	ma

2N1426

TRANSISTOR DISSIPATION:		
At ambient temperature of 25° C	80 max.	mw
At ambient temperature of 55° C	50 max.	mw
At ambient temperature of 71° C	23 max.	mw
AMBIENT TEMPERATURE (During operation). .	71 max.	°C
STORAGE-TEMPERATURE RANGE	-65 to +85	°C

Characteristics, *At Ambient Temperature of 25° C:*

Common-Emitter Circuit, Base Input

DC Collector-to-Emitter Voltage	-12	volts
DC Emitter Current.	1	ma
Small-Signal Current Transfer Ratio at 1 kc	130	

Common-Base Circuit, Emitter Input

DC Collector-to-Base Voltage.	-12	volts
DC Emitter Current.	1	ma
Small-Signal Current Transfer Ratio at 1 kc	0.992	
Alpha-Cutoff Frequency.	33	Mc

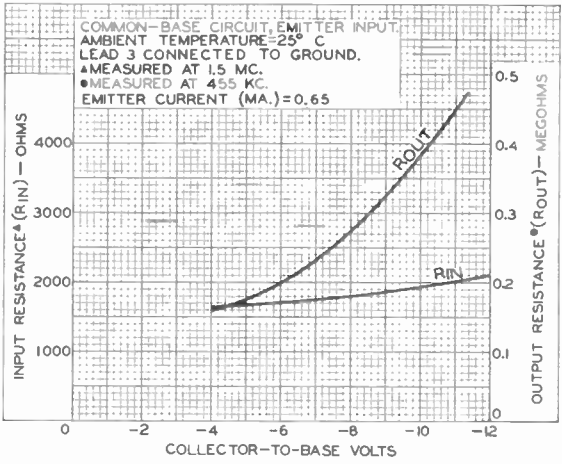
Typical Operation, *At Ambient Temperature of 25° C:*

In a common-emitter, base input, self-excited, 1.5-Mc converter circuit

DC Supply Voltage	-6	-9	-12	volts
DC Collector-to-Emitter Voltage . .	-5	-8	-11	volts
DC Emitter Current.	0.65	0.65	0.65	ma
Input Resistance.	1700	1800	2000	ohms
Output Resistance	0.18	0.27	0.45	megohm
RMS Base-to-Emitter Oscillator-Injection Voltage. . .	100	100	100	mv
Conversion Power Gain:				
Maximum available	43.5	43.5	48	db
Useful.	30.1	33.3	37.6	db

OPERATING CONSIDERATIONS and DIMENSIONAL OUTLINE shown under Type 2N1425 also apply to the 2N1426

PERFORMANCE CHARACTERISTICS



92CS-10420

2N1633

Drift-Field Transistor

GERMANIUM P-N-P ALLOY TYPE

For Intermediate-Frequency-Amplifier Applications in Battery-Operated AM Radio Receivers

GENERAL DATA

Electrical:

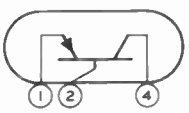
Minimum DC Collector-to-Base Breakdown Voltage (BV_{CBO}) for dc collector μa = −50, emitter open, ambient temperature = 25° C.	−34	volts
Maximum DC Collector-Cutoff Current (I_{CBO}) for dc collector-to-base volts = −12, emitter open, ambient temperature = 25° C.	−16	μa
Maximum DC Emitter-Cutoff Current (I_{EBO}) for dc emitter-to-base volts = −0.5, collector open, ambient temperature = 25° C.	−16	μa
Maximum Junction-Temperature Rise (In free air)	0.4	°C/mw

Mechanical:

Operating Position	Any
Maximum Overall Length	0.697"
Maximum Seated Length	0.495"
Maximum Diameter	0.260"
Dimensional Outline	JEDEC No. TO-40
Case	Metal and Plastic
Seals	Hermetic

Terminal Diagram:

Pin 1 – Emitter
Pin 2 – Base



Pin 4 – Collector

INTERMEDIATE-FREQUENCY AMPLIFIER

Maximum and Minimum Ratings, *Absolute-Maximum Values:*

DC COLLECTOR-TO-BASE VOLTAGE	−34 max.	volts
DC EMITTER-TO-BASE VOLTAGE	−0.5 max.	volt
DC COLLECTOR CURRENT	−10 max.	ma
DC EMITTER CURRENT	10 max.	ma
TRANSISTOR DISSIPATION:		
At ambient temperature of 25° C.	80 max.	mw
At ambient temperature of 55° C.	50 max.	mw
At ambient temperature of 71° C.	35 max.	mw
AMBIENT TEMPERATURE (During operation)	71 max.	°C
STORAGE-TEMPERATURE RANGE	−65 to +85	°C

2N1633

Characteristics, *At Ambient Temperature of 25° C:*

Common-Emitter Circuit, Base Input

DC Collector-to-Emitter Voltage	−12	volts
DC Emitter Current	1	ma
Small-Signal Current Transfer Ratio at 1 kc	75	

Common-Base Circuit, Emitter Input

DC Collector-to-Base Voltage	−12	volts
DC Emitter Current	1	ma
Small-Signal Current Transfer Ratio at 1 kc	0.986	
Alpha-Cutoff Frequency	40	Mc

Typical Operation, *At Ambient Temperature of 25° C:*

In a common-emitter, base-input, single-stage, 455-kc intermediate-frequency-amplifier circuit

DC Supply Voltage	−6	−9	−12	volts
DC Collector-to-Emitter Voltage	−5.7	−8.5	−11	volts
DC Emitter Current	1	1	1	ma
Input Resistance, ac output circuit shorted	1500	1550	1800	ohms
Output Resistance, ac input circuit shorted	0.35	0.475	0.6	megohm
Collector-to-Base Capacitance (C_{ob})	2.2▲	2.1▲	2▲	μμf
Maximum Power Gain●	52.6	53.8	55.7	db
Maximum Useful Power Gain:				
In neutralized circuit	36.7	36.7	36.7	db
In unneutralized circuit	31.2	31.3	31.4	db

In a common-emitter, base-input, two-stage, 455-kc intermediate-frequency-amplifier circuit

DC Supply Voltage	−6	−6	−9	−9	−12	−12	volts
DC Collector-to-Emitter Voltage	−5.7	−5.7	−8.5	−8.5	−11	−11	volts
DC Emitter Current	0.5	1	0.5	1	0.5	1	ma
Input Resistance, ac output circuit shorted	2800	1500	3000	1550	3400	1800	ohms
Output Resistance, ac input circuit shorted	0.7	0.35	0.9	0.475	1.2	0.6	megohms
Collector-to-Base Capacitance (C_{ob})	2.2▲	2.2▲	2.1▲	2.1▲	2▲	2▲	μμf
Maximum Power Gain●	52.2	52.6	53.3	53.8	55.6	55.7	db

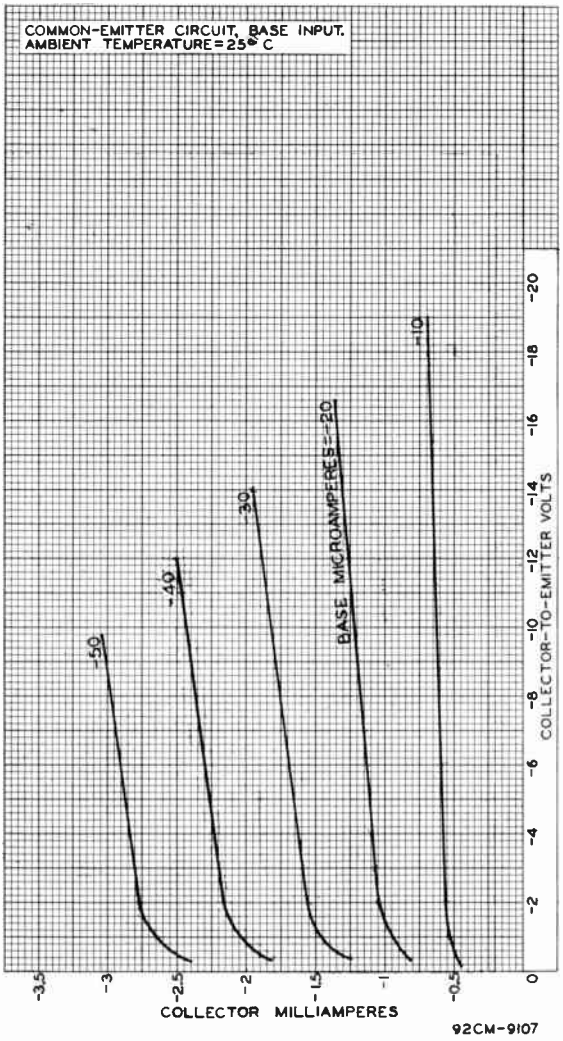
Useful Power Gain:							
In neutralized circuit. . .	32.4	35.2	32.4	35.2	32.4	35.2	db
In unneutralized circuit. . .	27.7	29.7	27.9	29.8	28	29.9	db

▲ Maximum variation from this value is 0.9 μμf.

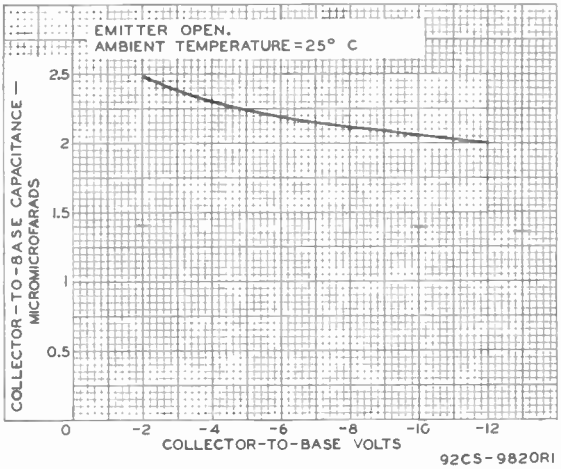
● Measured in a single-tuned unilateralized circuit matched to the generator and load impedance for maximum transfer of power (transformer-insertion losses not included).

OPERATING CONSIDERATIONS and DIMENSIONAL OUTLINE shown under type 2N1631 also apply to the 2N1633

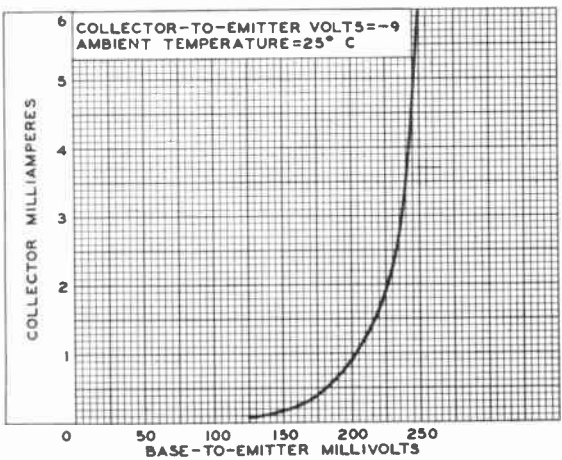
TYPICAL COLLECTOR CHARACTERISTICS



TYPICAL CHARACTERISTICS



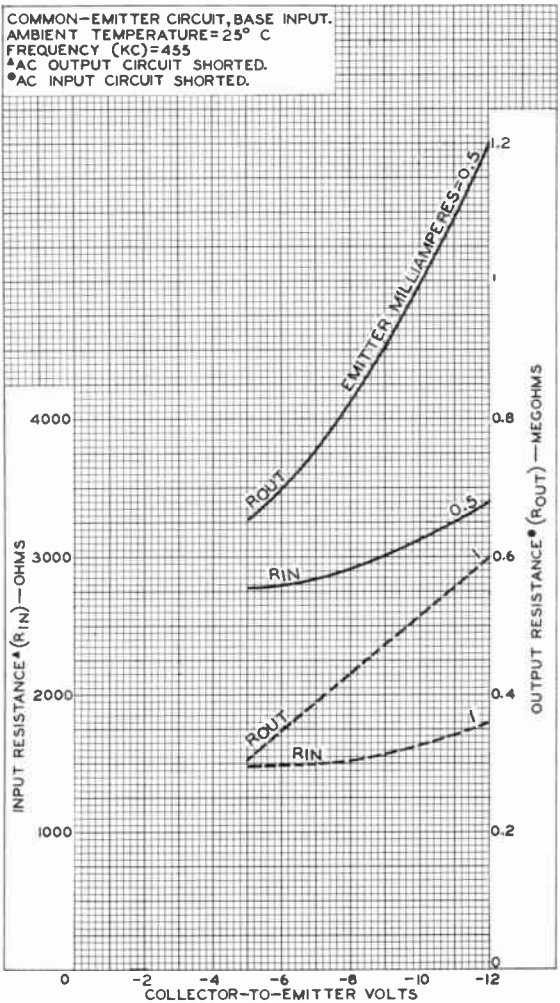
92CS-9820RI



92CS-10678

2N1633

TYPICAL CHARACTERISTICS



92CM-10562RI

Drift-Field Transistor

GERMANIUM P-N-P ALLOY TYPE

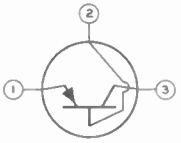
For Intermediate-Frequency-Amplifier Applications in Battery-Operated Radio Receivers

The 2N1634 is the same as the 2N1633 except for the following items:

Mechanical:

Maximum Length (Excluding flexible leads)	0.410"
Maximum Diameter	0.260"
Dimensional Outline	JEDEC No. TO-1
Case	Metal
Leads, Flexible	3
Minimum length	1.5"
Orientation and diameter	See *Dimensional Outline*

Terminal Diagram: BOTTOM VIEW



Lead 1 – Emitter

Lead 2 – Base

Lead 3 – Collector (Adjacent to red dot on side of case)

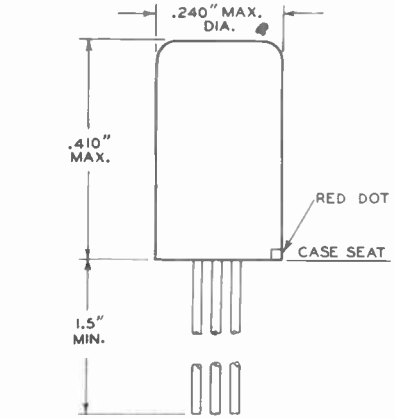
OPERATING CONSIDERATIONS

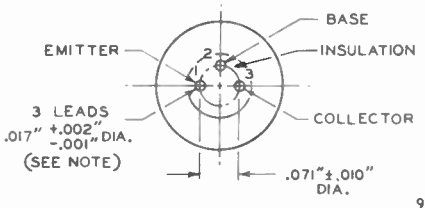
It is recommended that this transistor not be connected into or disconnected from circuits with the power on because high transient currents may cause permanent damage to the transistor.

The *flexible leads* of this transistor are usually soldered to the circuit elements. Soldering of the leads may be made close to the glass stem provided care is taken to conduct excessive heat away from the lead seal. Otherwise, the heat of the soldering operation will crack the seals of the leads and damage the transistor.

When dip soldering is employed in the assembly of printed circuitry using this transistor, the temperature of the solder should not exceed 255° C for a maximum immersion period of 10 seconds.

2N1634





92CS-9148R6

NOTE: THE SPECIFIED LEAD DIAMETER APPLIES IN THE ZONE BETWEEN 0.05" AND 0.25" FROM THE CASE SEAT. BETWEEN 0.25" AND 1.5", A MAXIMUM DIAMETER OF 0.021" IS HELD. OUTSIDE OF THESE ZONES, THE LEAD DIAMETER IS NOT CONTROLLED.

2N1635

Drift-Field Transistor

GERMANIUM P-N-P ALLOY TYPE

For Converter Applications in Battery-Operated AM Radio Receivers

GENERAL DATA

Electrical:

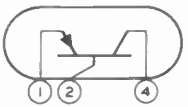
Minimum DC Collector-to-Base Breakdown Voltage (BV_{CBO}) for dc collector μa = -50, emitter open, ambient temperature = 25° C.	34	volts
Maximum DC Collector-Cutoff Current (I_{CBO}) for dc collector-to-base volts = -12, emitter open, ambient temperature = 25° C.	-16	μa
Maximum DC Emitter-Cutoff Current (I_{EBO}) for dc emitter-to-base volts = -0.5, collector open, ambient temperature = 25° C.	-16	μa
Maximum Junction-Temperature Rise (In free air)	0.4	°C/mw

Mechanical:

Operating Position	Any
Maximum Overall Length	0.697"
Maximum Seated Length	0.495"
Maximum Diameter	0.260"
Dimensional Outline	JEDEC No. TO-40
Case	Metal and Plastic
Seals	Hermetic

Terminal Diagram:

Pin 1 – Emitter
Pin 2 – Base



Pin 4 – Collector

CONVERTER

Maximum and Minimum Ratings, *Absolute-Maximum Values:*

DC COLLECTOR-TO-BASE VOLTAGE	-34 max.	volts
DC EMITTER-TO-BASE VOLTAGE	-0.5 max.	volt
DC COLLECTOR CURRENT	-10 max.	ma
DC EMITTER CURRENT	10 max.	ma
TRANSISTOR DISSIPATION:		
At ambient temperature of 25° C.	80 max.	mw
At ambient temperature of 55° C.	50 max.	mw
At ambient temperature of 71° C.	35 max.	mw

2N1635

AMBIENT TEMPERATURE (During operation). . .	71 max.	°C
STORAGE-TEMPERATURE RANGE	-65 to +85	°C

Characteristics, *At Ambient Temperature of 25° C:*

Common-Emitter Circuit, Base Input

DC Collector-to-Emitter Voltage	-12	volts
DC Emitter Current.	1	ma
Small-Signal Current Transfer Ratio at 1 kc	75	

Common-Base Circuit, Emitter Input

DC Collector-to-Base Voltage.	-12	volts
DC Emitter Current.	1	ma
Small-Signal Current Transfer Ratio at 1 kc	0.986	
Alpha-Cutoff Frequency.	45	Mc

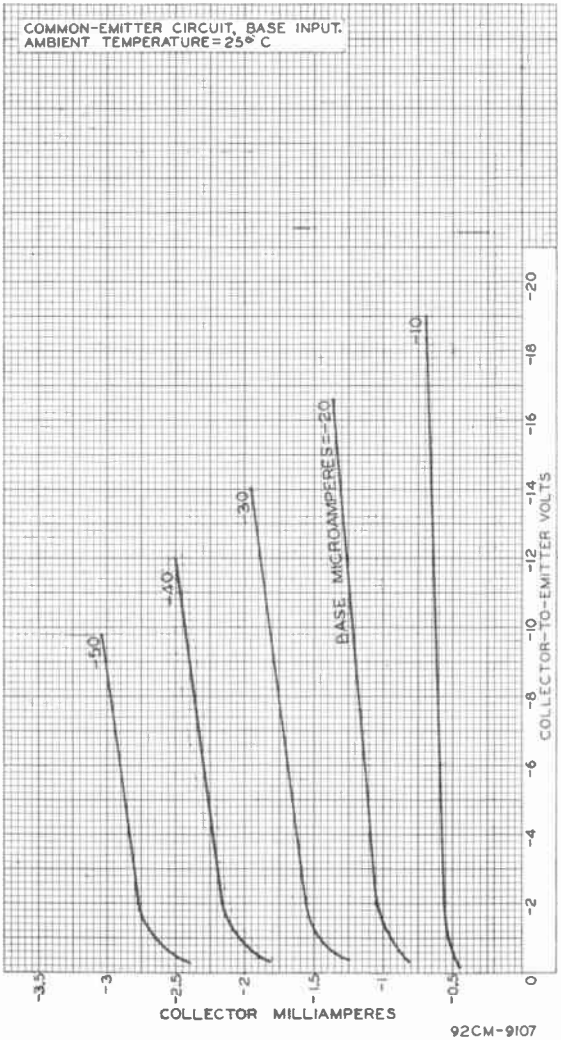
Typical Operation, *At Ambient Temperature of 25° C:*

In a common-emitter, base-input, self-excited, 1-Mc converter circuit

DC Supply Voltage	-9	volts
DC Collector-to-Emitter Voltage	-8.5	volts
DC Emitter Current.	0.65	ma
Input Resistance.	2000	ohms
Output Resistance	0.3	megohm
RMS Base-to-Emitter Oscillator-Injection Voltage.	100	mv
Conversion Power Gain	36	db

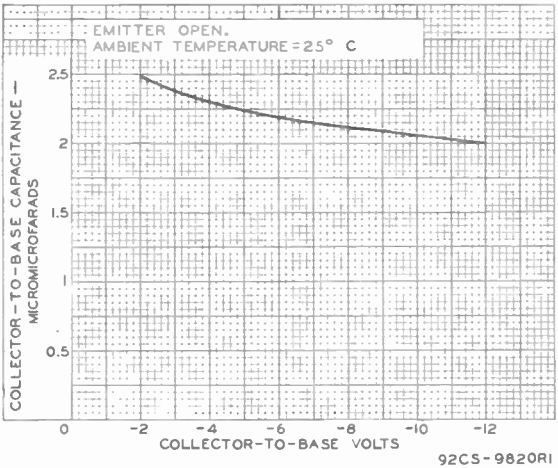
OPERATING CONSIDERATIONS and DIMENSIONAL OUTLINE shown under Type 2N1631 also apply to the 2N1635

TYPICAL COLLECTOR CHARACTERISTICS

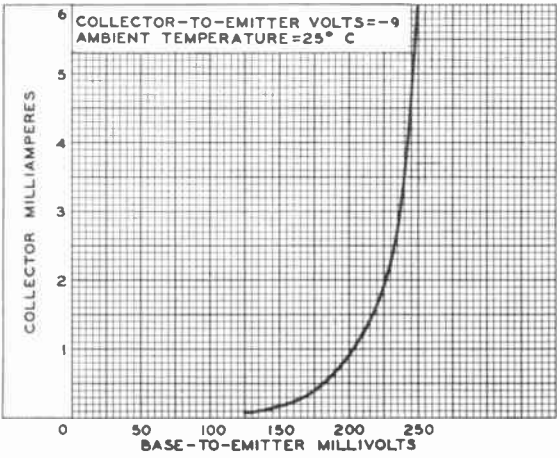


92CM-9107

TYPICAL CHARACTERISTICS

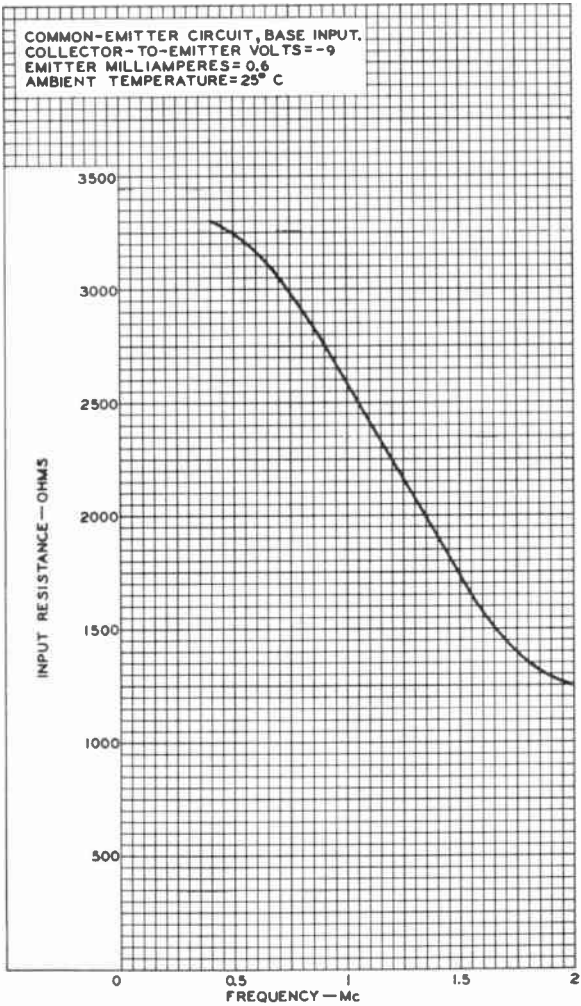


92CS-9820R1



92CS-10678

TYPICAL CHARACTERISTIC



92CM-10682

2N1636

Drift-Field Transistor

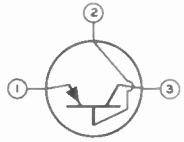
GERMANIUM P-N-P ALLOY TYPE

For Converter Application in Battery-Operated AM Radio Receivers

The 2N1636 is the same as the 2N1635 except for the following items:

Mechanical:

Maximum Length (Excluding flexible leads). . . . . 0.410"
Maximum Diameter . . . . . 0.260"
Dimensional Outline. . . . . .JEDEC No. TO-1
Case . . . . . .Metal
Leads, Flexible. 3
  Minimum length . . . . . 1.5"
  Orientation and diameter . . . . . .See *Dimensional Outline*
Terminal Diagram: BOTTOM VIEW



Lead 1 - Emitter

Lead 2 - Base

Lead 3 - Collector (Adjacent to red dot on side of case)

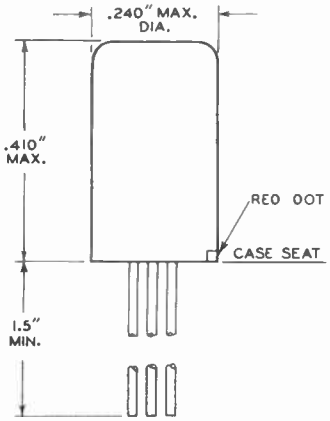
OPERATING CONSIDERATIONS

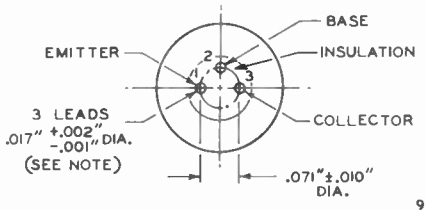
It is recommended that this transistor not be connected into or disconnected from circuits with the power on because high transient currents may cause permanent damage to the transistor.

The *flexible leads* of this transistor are usually soldered to the circuit elements. Soldering of the leads may be made close to the glass stem provided care is taken to conduct excessive heat away from the lead seal. Otherwise, the heat of the soldering operation will crack the seals of the leads and damage the transistor.

When dip soldering is employed in the assembly of printed circuitry using this transistor, the temperature of the solder should not exceed 255° C for a maximum immersion period of 10 seconds.

2N1636





92CS-9148R6

NOTE: THE SPECIFIED LEAD DIAMETER APPLIES IN THE ZONE BETWEEN 0.05" AND 0.25" FROM THE CASE SEAT. BETWEEN 0.25" AND 1.5", A MAXIMUM DIAMETER OF 0.021" IS HELD. OUTSIDE OF THESE ZONES, THE LEAD DIAMETER IS NOT CONTROLLED.

2N2015

Power Transistor

SILICON N-P-N DIFFUSED-JUNCTION TYPE

For Power Switching and Amplifier Service in Industrial and Military Applications

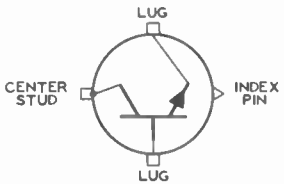
GENERAL DATA

Mechanical:

Operating Position	Any
Maximum Seated Length	0.520"
Maximum Diameter	1.250"
Dimensional Outline	JEDEC No. TO-36
Case	Welded, Metal
Seals	Hermetic

Terminal Diagram (See *Dimensional Outline*):

BOTTOM VIEW



INDUSTRIAL SERVICE

Such as dc-to-dc converter, inverter, chopper, relay-control, oscillator, regulator, pulse-amplifier, and class A and class B push-pull-amplifier circuits

Maximum and Minimum Ratings, *Absolute-Maximum Values:*

COLLECTOR-TO-BASE VOLTAGE	100 max.	volts
COLLECTOR-TO-EMITTER VOLTAGE:		
With base open (Sustaining voltage)[a]	50 max.	volts
EMITTER-TO-BASE VOLTAGE	10 max.	volts
COLLECTOR CURRENT	10 max.	amp
EMITTER CURRENT	-13 max.	amp
BASE CURRENT	6 max.	amp
TRANSISTOR DISSIPATION:[b]		
At case temperature[c] of 25° C or below	150 max.	watts
At case temperatures[c] above 25° C	See *Rating Chart*	
CASE-TEMPERATURE RANGE:[c]		
Operating and storage	-65 to +200	°C
LUG TEMPERATURE:[d]		
For 10 seconds maximum	235 max.	°C

Characteristics:

At case temperature of 25° C[c]

Forward Current-Transfer-Ratio		
Cutoff-Frequency (f_{ae})	25	kc

Collector-to-Base Capacitance (C_{ob}) with dc collector-to-base volts = 40. . .	400	μμf
Thermal Time Constant (τ_1).	30	msec

Typical Operation:

In accompanying pulse-response test circuit at case temperature[c] of 25° C

Collector Supply Voltage (V_{CC}).	24	volts
DC Base-Bias Voltage (V_{BB}).	−6	volts
"On" DC Collector Current	10	amp
"Turn-On" Base Current (I_{B_1}).	2	amp
Base Resistance (R_{B_1})	10	ohms
Base Resistance (R_{B_2})	10	ohms
Collector Resistance (R_C)	2	ohms
Switching Time:		
"Turn-on" time [Relay time (t_d) + rise time (t_r)]	4	μsec
"Turn-off" time [Storage time (t_s) + fall time (t_f)]	7	μsec

[a] The Collector-to-Emitter Sustaining Voltage ($V_{CEO(sus)}$) with the base open is that value of voltage which remains relatively constant over a wide range of collector currents, and approximates the collector voltage at which the effective alpha of the device is equal to unity ($\alpha_M = 1$; voltage at which the product of alpha (α), at low voltage, times the multiplication factor (M) equals unity).

[b] See accompanying *Rating Chart* and also *Transistor-Dissipation Rating Chart* in General Section.

[c] Measured at intersection of seating surface with mounting stud.

[d] Measured 1/16" ± 1/32" down from seating surface.

ELECTRICAL CHARACTERISTICS

Voltage values are given with respect to base and at case temperature[c] of 25° C unless otherwise specified

		Min.	Max.	
DC Collector-to-Emitter Voltage:				
With emitter reverse-bias volts = 1.5, dc collector ma. = 2	V_{CEX}	–	100	volts
With base open (Sustaining voltage), dc collector ma. = 200, dc base ma. = 0. . . .	$V_{CEO(sus)}$[a]	–	50	volts
DC Base-to-Emitter Voltage for dc collector-to-emitter volts = 4, dc collector amperes = 5 . .	V_{BE}	–	2.2	volts
DC Collector-Cutoff Current for dc collector volts = 30, dc emitter ma. = 0, case temperature =	I_{CBO}			
25° C		–	50	μa
150° C.		–	2	ma
DC Emitter-Cutoff Current for dc emitter volts = 10, dc collector ma. = 0	I_{EBO}	–	50	μa

DC Forward-Current Transfer Ratio for dc collector-to-emitter volts = 4, dc collector amperes =	h_{FE}			
5		15	50	
10		7.5	–	
Collector-to-Emitter Saturation Resistance for dc collector amperes = 5, dc base amperes = 0.5	R_S	–	0.25	ohm
Thermal Resistance: Junction-to-case	R_T	–	1.17	°C/watt

[a] The Collector-to-Emitter Sustaining voltage ($V_{CEO(sus)}$) with the base open is that value of voltage which remains relatively constant over a wide range of collector currents, and approximates the collector voltage at which the effective alpha of the device is equal to unity (V_{CM} = 1; voltage at which the product of alpha (α), at low voltage, times the multiplication factor (M) equals unity).

[c] Measured at intersection of seating surface with mounting stud.

OPERATING CONSIDERATIONS

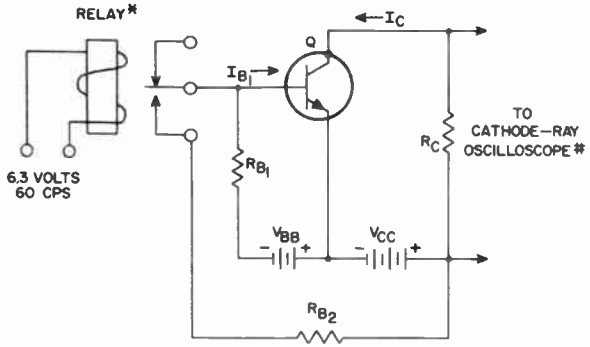
It is recommended that this transistor not be connected into or disconnected from circuits with the power on because high transient currents may cause permanent damage to the transistor.

Electrical connection can be made to the base and emitter lugs by means of clips or by soldering directly to the lugs. When soldering connections are made to the lugs, care should be taken to conduct excessive heat away from the lug seals, otherwise the heat of the soldering operation will crack the glass seals of the lugs and damage the transistor.

This transistor is provided with a single-ended stud for mounting to a heat sink and for electrical connection to the collector. (See accompanying *Suggested Mounting Arrangement*). Electrical connection to the base and to the emitter is made to their respective lugs.

It is to be noted that the case of this transistor operates at the collector voltage. Because of the possibility of shock hazard when the case of this transistor is at a voltage appreciably above or below ground potential, suitable precautionary measures should be taken.

PULSE-RESPONSE TEST CIRCUIT



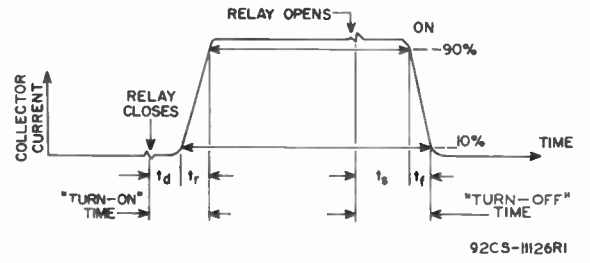
*C.P. CLARE TYPE HGP-1028 OR EQUIVALENT

TEKTRONIX TYPE 545 OR EQUIVALENT

92CS-11125R1

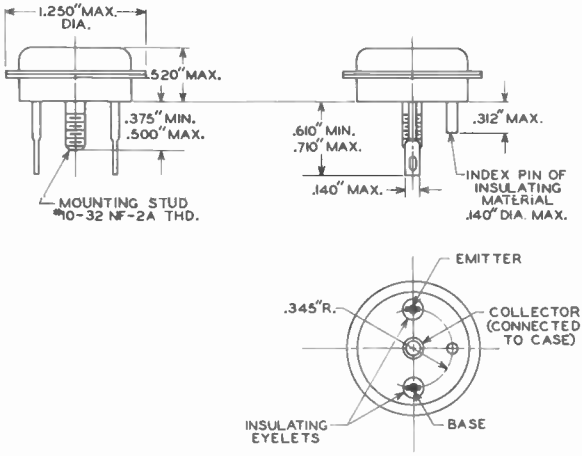
Q: Transistor type 2N2015

ASSOCIATED WAVE FORM

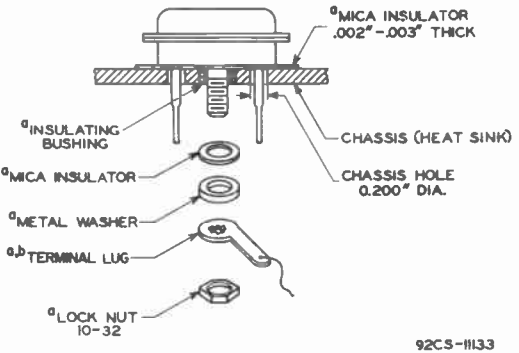


92CS-11126R1

JEDEC No. TO-36



SUGGESTED MOUNTING ARRANGEMENT

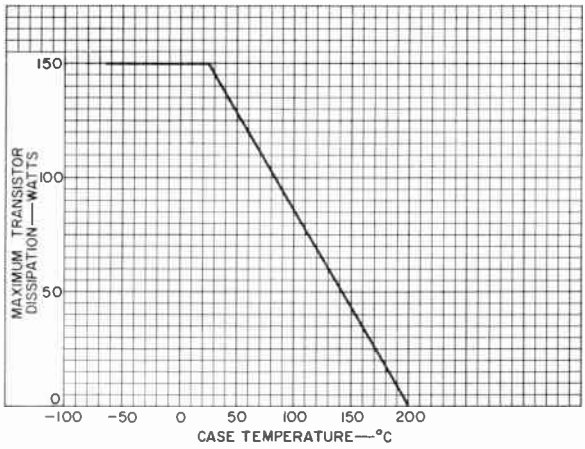


[a] SUPPLIED WITH EACH TRANSISTOR.

[b] SHAKEPROOF DIVISION, ILLINOIS TOOL WORKS, CATALOG No. 2102-6.

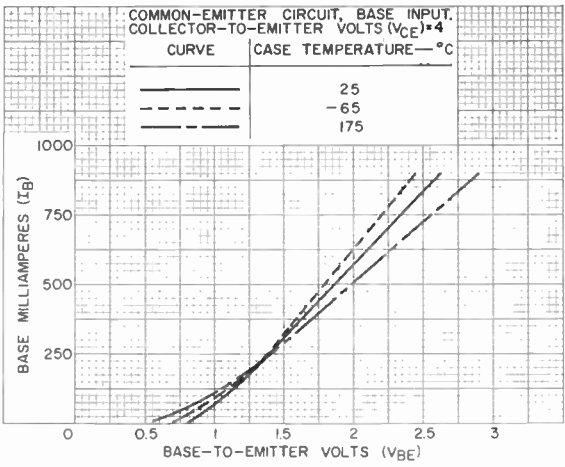
2N2015

RATING CHART



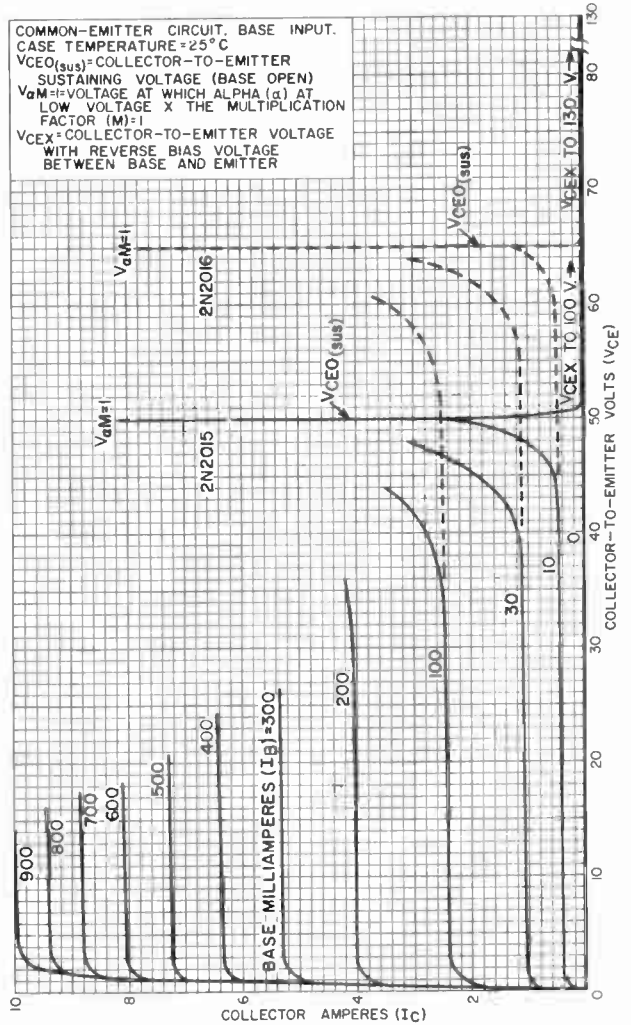
92CS-11089

TYPICAL BASE CHARACTERISTICS



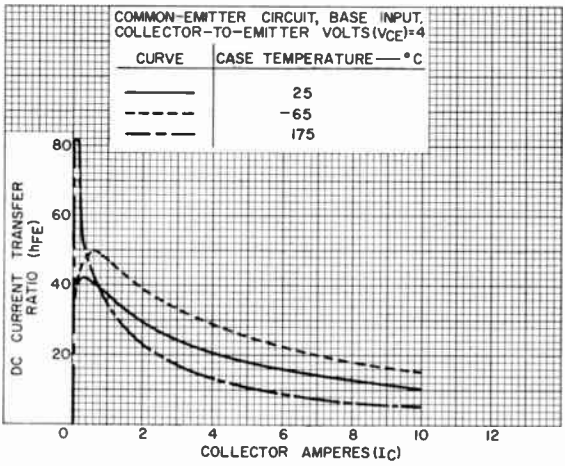
92CS-11093

TYPICAL COLLECTOR CHARACTERISTICS

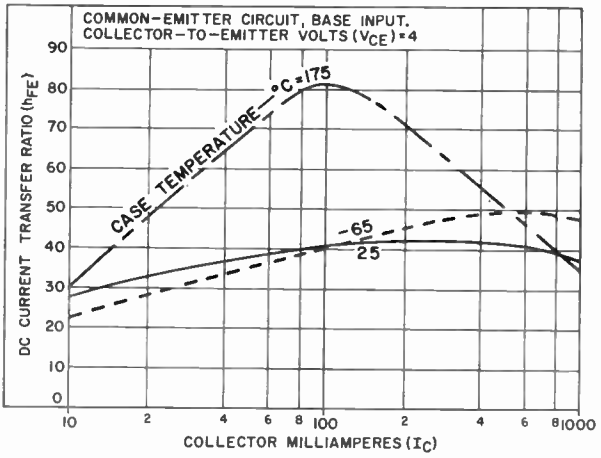


92CM-11092RI

TYPICAL DC-CURRENT-TRANSFER-RATIO CHARACTERISTICS

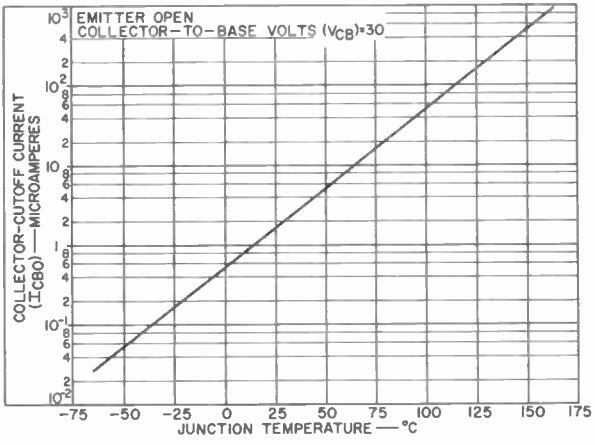


92CS-11090



92CS-11095

TYPICAL COLLECTOR-CUTOFF-CURRENT CHARACTERISTIC



92CS-11094

Power Transistor

SILICON N-P-N DIFFUSED-JUNCTION TYPE

For Power Switching and Amplifier Service in Industrial and Military Applications

The 2N2016 is the same as the 2N2015 except for the following items:

INDUSTRIAL SERVICE

Such as in dc-to-dc converter, inverter, chopper, relay-control, oscillator, regulator, pulse-amplifier, and class A and class B push-pull-amplifier circuits

Maximum Ratings, *Absolute-Maximum Values:*

COLLECTOR-TO-BASE VOLTAGE	130 max.	volts
COLLECTOR-TO-EMITTER VOLTAGE:		
With base open (Sustaining voltage)[a]. .	65 max.	volts

ELECTRICAL CHARACTERISTICS

		Min.	*Max.*	
DC Collector-to-Emitter Voltage:				
With emitter reverse-bias volts = 1.5, dc collector ma. = 2	V_{CEX}	–	130	volts
With base open (Sustaining voltage), dc collector ma. = 200, dc base current = 0	$V_{CEO}{}^{a}{}_{(sus)}$	–	65	volts

[a] The Collector-to-Emitter Sustaining Voltage ($V_{CEO(sus)}$) with the base open is that value of voltage which remains relatively constant over a wide range of collector currents, and approximates the collector voltage at which the effective alpha of the device is equal to unity ($\alpha_M = 1$; voltage at which the product of alpha (α), at low voltage, times the multiplication factor (M) equals unity).