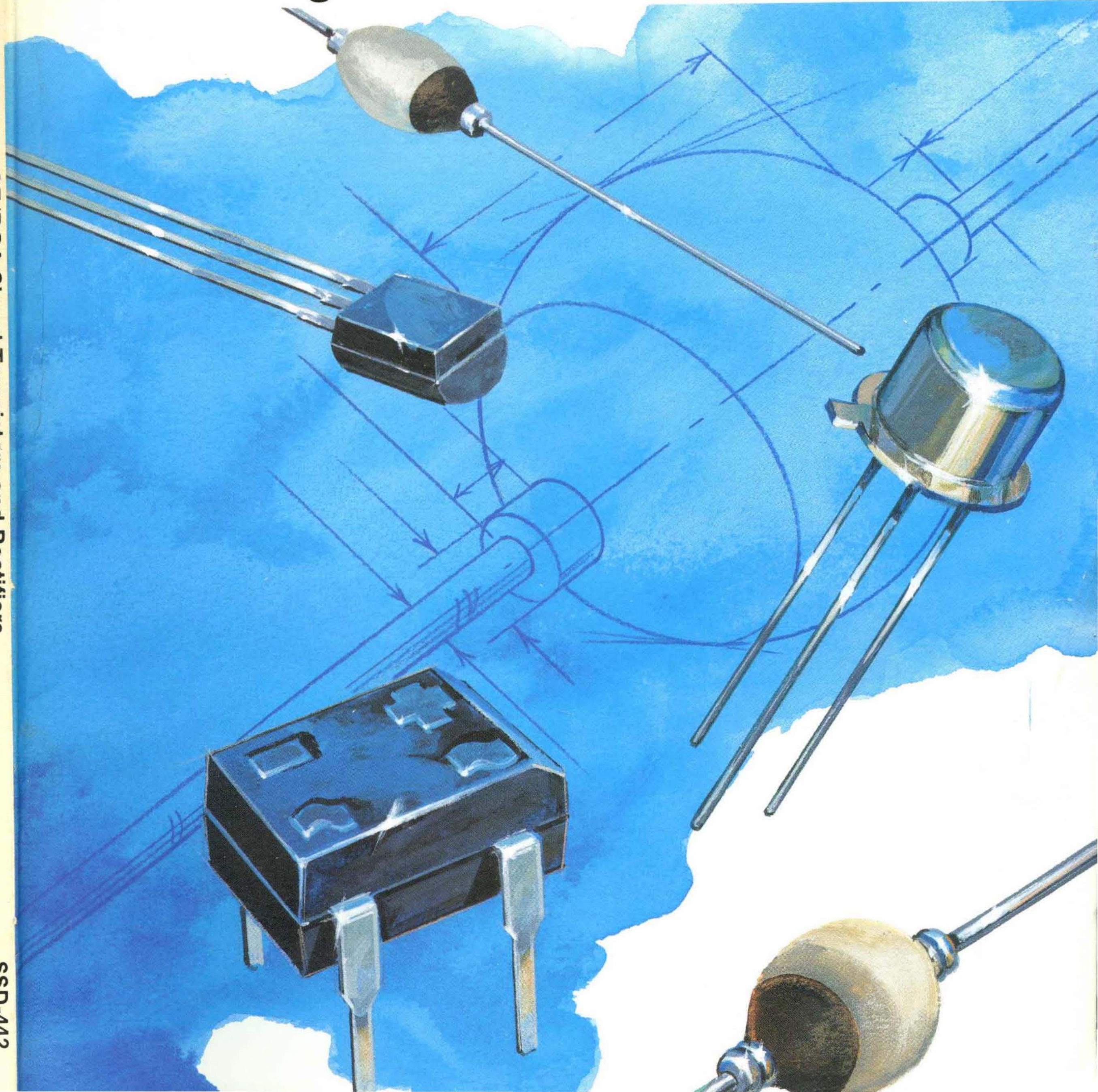
GE Solid State
Data Book

ARROW ELECTRONICS, INC.
ARROW/KIERULFF ELECTRONICS GROUP

GE/RCA Signal Transistors and Rectifiers



GE/RCA Signal Transistors and Rectifiers

SSD-442

GE/RCA Signal Transistors and Rectifiers

This DATA BOOK provides detailed technical information on the full line — more than 200 device types — of GE/RCA small-signal bipolar semiconductor devices and silicon rectifiers. An **Index to Devices** provides a complete numeric-alpha-numeric listing of these devices. Definitive device ratings and characteristics are shown in three major data sections as follows:

Signal Transistors — a wide variety of n-p-n and p-n-p transistors, including Darlington types.

Unijunction Transistors and Switches — Unijunction and programmable unijunction transistors and silicon unilateral and bilateral switches.

Silicon Rectifiers — Ultra-fast-recovery types, axial-lead general-purpose types, and full-wave bridge rectifiers.

A **Dimensional Outlines and Hardware** section provides details concerning the various packages in which the GE/RCA line of small-signal devices and rectifiers are supplied; and suggested hardware and mounting arrangements.

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GE/RCA/Intersil Semiconductors

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Type	Structure	I_C [Max.] mA	$V_{(BR)CEO}$ [Min.] V	Beta Range h_{FE}	Package	File No.	Page
2N3390	n-p-n	100	18	400-800	TO-98	2053	15
2N2923	n-p-n	100	25	115 Typ.	TO-98	2051	11
2N2924	n-p-n	100	25	155 Typ.	TO-98	2051	11
2N2925	n-p-n	100	25	215 Typ.	TO-98	2051	11
2N2926	n-p-n	100	25	35-470	TO-98	2052	13
2N3391	n-p-n	100	25	250-500	TO-98	2053	15
2N3391A	n-p-n	100	25	250-500	TO-98	2053	15
2N3392	n-p-n	100	25	150-300	TO-98	2053	15
2N3393	n-p-n	100	25	90-180	TO-98	2053	15
2N3394	n-p-n	100	25	55-110	TO-98	2053	15
2N5172	n-p-n	100	25	100-500	TO-98	2061	43
MPS5172	n-p-n	100	25	100-500	TO-92	2061	43
PN5172	n-p-n	100	25	100-500	TO-92	2061	43
2N3858	n-p-n	100	30	60-120	TO-98	2060	23
2N3859	n-p-n	100	30	100-200	TO-98	2060	23
2N3860	n-p-n	100	30	150-300	TO-98	2060	23
2N5232	n-p-n	100	50	250-500	TO-98	2063	45
2N5232A	n-p-n	100	50	250-500	TO-98	2063	45
2N5249	n-p-n	100	50	400-800	TO-98	2064	45
2N5249A	n-p-n	100	50	400-800	TO-98	2064	45
2N3858A	n-p-n	100	60	60-120	TO-98	2060	23
2N3859A	n-p-n	100	60	100-200	TO-98	2060	23
MPS-L01	n-p-n	150	120	50-300	TO-92	2071	98
2N4124	n-p-n	200	25	120-360	TO-92	2057	32
2N4123	n-p-n	200	30	50-150	TO-92	2057	32
2N3903	n-p-n	200	40	50-150	TO-92	2056	28
2N3904	n-p-n	200	40	100-300	TO-92	2056	28
2N5305	n-p-n	300	25	2K-20K	TO-98	2065	51
2N5306	n-p-n	300	25	7K-70K	TO-98	2065	51
GES5305	n-p-n	300	25	2K-20K	TO-92	2065	51
GES5306	n-p-n	300	25	7K-70K	TO-92	2065	51
GES5306A	n-p-n	300	25	7K-70K	TO-92	2065	51
2N5306A	n-p-n	300	40	7K-70K	TO-98	2065	51
2N5307	n-p-n	300	40	2K-20K	TO-98	2065	51
2N5308	n-p-n	300	40	7K-70K	TO-98	2104	55
2N5308A	n-p-n	300	40	7K-70K	TO-98	2104	55
GES5307	n-p-n	300	40	2K-20K	TO-92	2104	55
GES5308	n-p-n	300	40	7K-70K	TO-92	2104	55
GES5308A	n-p-n	300	40	7K-70K	TO-92	2104	55
GES2221	n-p-n	400	30	40-120	TO-92	2068	66
GES2222	n-p-n	400	30	100-300	TO-92	2068	66
MPS2222	n-p-n	400	30	100-300	TO-92	2068	66
PN2222	n-p-n	400	30	100-300	TO-92	2068	66
GES2221A	n-p-n	400	40	40-120	TO-92	2070	68
GES2222A	n-p-n	400	40	100-300	TO-92	2070	68
MPS2222A	n-p-n	400	40	100-300	TO-92	2070	68
PN2222A	n-p-n	400	40	100-300	TO-92	2070	68
2N3414	n-p-n	500	25	75-225	TO-98	2054	19
2N3415	n-p-n	500	25	180-540	TO-98	2054	19
GES3414	n-p-n	500	25	75-225	TO-92	2054	19
GES3415	n-p-n	500	25	180-540	TO-92	2054	19
MPS-A12	n-p-n	500	20	20K Min.	TO-92	2073	89
MPS-A13	n-p-n	500	30	5K Min.	TO-92	2074	91
MPS-A14	n-p-n	500	30	10K Min.	TO-92	2074	91
2N4424	n-p-n	500	40	180-540	TO-92	2059	40
2N3416	n-p-n	500	50	75-225	TO-92	2054	19
2N3417	n-p-n	500	50	180-540	TO-92	2054	19
GES3416	n-p-n	500	50	75-225	TO-92	2054	19
GES3417	n-p-n	500	50	180-540	TO-92	2054	19
MPS-A05	n-p-n	500	60	50 Min.	TO-92	2072	86
MPS-A06	n-p-n	500	80	50 Min.	TO-92	2072	86
MPS-A43	n-p-n	500	200	50-200	TO-92	2075	92
MPS-A42	n-p-n	500	300	40 Min.	TO-92	2075	92
MPS6532	n-p-n	600	30	30 Min.	TO-92	2079	84
2N4400	n-p-n	600	40	50-150	TO-92	2058	36

N-P-N Signal Transistor Selector Guide

Type	Structure	I_C [Max.] mA	$V_{(BR)CEO}$ [Min.] V	Beta Range h_{FE}	Package	File No.	Page
2N4401	n-p-n	600	40	100-300	TO-92	2058	36
MPS6531	n-p-n	600	40	40-120	TO-92	2079	84
GES5551	n-p-n	600	160	80-250	TO-92	2094	73
GES5810	n-p-n	750	25	60-200	TO-92	2095	75
GES5812	n-p-n	750	25	150-500	TO-92	2095	75
GES5814	n-p-n	750	40	60-160	TO-92	2096	78
GES5816	n-p-n	750	40	100-200	TO-92	2096	78
GES5818	n-p-n	750	40	150-300	TO-92	2096	78
GES2218	n-p-n	800	30	35 Min.	TO-92	2067	64
GES2219	n-p-n	800	30	35 Min.	TO-92	2067	64
GES2218A	n-p-n	800	40	75 Min.	TO-92	2067	64
GES2219A	n-p-n	800	40	75 Min.	TO-92	2067	64

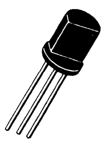
P-N-P Signal Transistor Selector Guide

2

Type	Structure	I_C [Max.] mA	$V_{(BR)CEO}$ [Min.] V	Beta Range h_{FE}	Package	File No.	Page
2N6076	p-n-p	-100	-25	100-500	TO-98	2061	43
2N4126	p-n-p	-200	-25	120-360	TO-92	2057	32
2N4125	p-n-p	-200	-30	50-150	TO-92	2057	32
2N3905	p-n-p	-200	-40	50-150	TO-92	2056	28
2N3906	p-n-p	-200	-40	100-300	TO-92	2056	28
MPS-A63	p-n-p	-300	-30	5K Typ.	TO-92	2076	94
MPS-A64	p-n-p	-300	-30	10K Typ.	TO-92	2076	94
MPS-A65	p-n-p	-300	-30	50K Min.	TO-92	2077	96
2N5365	p-n-p	-300	-40	40-120	TO-98	2066	59
2N5366	p-n-p	-300	-40	100-300	TO-98	2066	59
MPS3638	p-n-p	-350	-25	30 Min.	TO-92	2078	82
MPS3638A	p-n-p	-350	-25	100 Min.	TO-92	2078	82
GES2906	p-n-p	-350	-40	40-120	TO-92	2070	68
GES2907	p-n-p	-350	-40	100-300	TO-92	2070	68
MPS2906	p-n-p	-350	-40	40-120	TO-92	2070	68
MPS2907	p-n-p	-350	-40	100-300	TO-92	2070	68
GES2906A	p-n-p	-350	-60	40-120	TO-92	2070	68
MPS2906A	p-n-p	-350	-60	40-120	TO-92	2070	68
GES2907A	p-n-p	-350	-60	100-300	TO-92	2070	68
MPS2907A	p-n-p	-350	-60	100-300	TO-92	2070	68
MPS-A55	p-n-p	-500	-60	50 Min.	TO-92	2072	86
MPS-A56	p-n-p	-500	-80	50 Min.	TO-92	2072	86
MPS-A93	p-n-p	-500	-200	30-150	TO-92	2075	92
MPS-A92	p-n-p	-500	-300	30 Min.	TO-92	2075	92
2N4402	p-n-p	-600	-40	50-150	TO-92	2058	36
2N4403	p-n-p	-600	-40	100-300	TO-92	2058	36
GES2904	p-n-p	-600	-40	40-120	TO-92	2069	71
GES2905	p-n-p	-600	-40	100-300	TO-92	2069	71
MPS6534	p-n-p	-600	-40	40-120	TO-92	2079	84
GES2904A	p-n-p	-600	-60	40-120	TO-92	2069	71
GES2905A	p-n-p	-600	-60	100-300	TO-92	2069	71
MPS-L51	p-n-p	-600	-100	40-250	TO-92	2071	98
GES5401	p-n-p	-600	-150	60-240	TO-92	2094	73
GES5811	p-n-p	-750	-25	60-200	TO-92	2095	75
GES5813	p-n-p	-750	-25	150-500	TO-92	2095	75
GES5815	p-n-p	-750	-40	60-160	TO-92	2096	78
GES5817	p-n-p	-750	-40	100-200	TO-92	2096	78

2N2923, 2N2924, 2N2925

Silicon Transistors



TO-98

The GE/RCA 2N2923, 2N2924, and 2N2925 types are planar passivated NPN silicon transistors intended for general purpose applications. The planar passivated construction assures excellent device stability and life. These high performance, high value devices are made possible by utilzing advanced manufacturing techniques and epoxy encapsulation.

These types are supplied in JEDEC TO-98 package.

Devices in TO-98 package are supplied with and without seating flange (see Dimensional Outline).

MAXIMUM RATINGS, *Absolute-Maximum Values:*

COLLECTOR TO EMITTER VOLTAGE (V_{CEO})	25 V
EMITTER TO BASE VOLTAGE (V_{EBO}	5 V
COLLECTOR TO BASE VOLTAGE (V_{CBO})	25 V
CONTINUOUS COLLECTOR CURRENT (Note 1)	100 mA
TOTAL POWER DISSIPATION ($T_A \leq 25°C$) (P_T) (Note 2)	360 mW
TOTAL POWER DISSIPATION ($T_A \leq 55°C$) (P_T) (Note 2)	250 mW
OPERATING TEMPERATURE (T_J)	– 55° to + 150°C
STORAGE TEMPERATURE (T_{stg})	– 55° to + 150°C
LEAD TEMPERATURE, 1/16" ± 1/32" (1.5mm ± 0.8mm) from case for 10s max. (T_L)	+ 260°C

NOTES:
1. Determined from power limitations due to saturation voltage at this current.
2. Derate 3.6 mW/°C increase in ambient temperature above 25°C.

File Number **2051**

2N2923, 2N2924, 2N2925

ELECTRICAL CHARACTERISTICS, At Ambient Temperature (T_A) = 25°C Unless Otherwise Specified

CHARACTERISTICS	SYMBOL	LIMITS			UNITS
		2N2923,2N2924,2N2925			
		MIN.	TYP.	MAX	
Collector Cutoff Current (V_{CB} = 25V)	I_{CBO}	–	–	0.1	µA
(V_{CB} = 25V, T_A = 100°C)	I_{CBO}	–	–	15	µA
Emitter Cutoff Current (V_{EBO} = 5V)	I_{EBO}	–	–	0.1	µA
DC Forward Current Transfer Ratio (V_{CE} = 4.5V, I_C = 2 mA) 2N2923	h_{FE}	–	115	–	–
2N2924		–	155	–	–
2N2925		–	215	–	–
Small-Signal Forward Current Transfer Ratio (V_{CE} = 10V, I_C = 2 mA, f = 1kHz) 2N2923	h_{fe}	90	–	180	–
2N2924		150	–	300	–
2N2925		235	–	470	–
Input Impedance (V_{CE} = 10V, I_C = 2 mA, f = 1kHz)	h_{fb}	–	15	–	Ω
Gain Bandwidth Product (I_C = 4 mA, V_{CB} = 5V)	f_T	–	160	–	MHz
Noise Figure (I_C = 100µA, V_{CE} = 5V, f = 10kHz, BW = 1 Hz, Rg = 2000Ω) For 2N2925 only	NF	–	2.8	–	dB
Collector Capacitance (V_{CB} = 10 V, I_E = 0, f = 1MHz)	C_{cbo}	4.5	7	10	pF

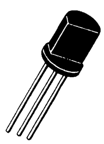
File No. 2051

TERMINAL CONNECTIONS

Lead 1 - Emitter
Lead 2 - Collector
Lead 3 - Base

2N2926

Silicon Transistors



TO-98

The GE/RCA 2N2926 is a planar passivated NPN silicon transistor intended for general purpose applications. The planar passivated construction assures excellent device stability and life. This high performance, high value device is made possible by advanced manufacturing techniques.

This type is supplied in JEDEC TO-98 package.

Devices in TO-98 package are supplied with and without seating flange (see Dimensional Outline).

MAXIMUM RATINGS, *Absolute-Maximum Values:*

COLLECTOR TO EMITTER VOLTAGE (V_{CEO})	25 V
EMITTER TO BASE VOLTAGE (V_{EBO})	5 V
COLLECTOR TO BASE VOLTAGE (V_{CBO})	25 V
CONTINUOUS COLLECTOR CURRENT (I_C) (Note 1)	100 mA
TOTAL POWER DISSIPATION ($T_A \leq 25°C$) (P_T)(Note 2)	200 mW
TOTAL POWER DISSIPATION ($T_A \leq 55°C$) (P_T)(Note 2)	120 mW
OPERATING TEMPERATURE (T_J)	−55° to +100°C
STORAGE TEMPERATURE (T_{STG})	−55° to +150°C
LEAD TEMPERATURE, 1/16" ± 1/32" (1.58mm ± 0.8mm) from case for 10s max (T_L)	+260°C

NOTES:
1. Determined from power limitations due to saturation voltage at this current.
2. Derate 2.67mW/°C increase in ambient temperature above 25°C.

File Number **2052**

2N2926

ELECTRICAL CHARACTERISTICS, At Ambient Temperature (T_A) = 25°C Unless Otherwise Specified

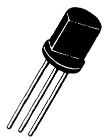
CHARACTERISTICS	SYMBOL	LIMITS			UNITS
		MIN.	TYP.	MAX.	
Collector Cutoff Current (V_{CB} = 18V)	I_{CBO}	–	–	0.5	μA
(V_{CB} = 18 V, T_A = 100°C	I_{CBO}	–	–	15	μA
Emitter Cutoff Current (V_{EB} = 5V)	I_{EBO}	–	–	0.5	μA
Small-Signal Forward Current Transfer Ratio (V_{CE} = 10V, I_C = 2mA, f = 1Hz)	h_{fe}	35		470	–
Input Impedance (V_{CE} = 10V, 1_C = 2ma, f = 1Hz)	h_{ib}	–	15	–	Ω
Gain Bandwidth Product (I_C = 2mA, V_{CB} = 5V	f_T	–	120	–	MHz
Collector Capacitance (V_{CB} = 10V, I_E = 0, f = 1MHz)	C_{ob}	4.5	7	10	pF

TERMINAL CONNECTIONS

Lead 1 - Emitter
Lead 2 - Collector
Lead 3 - Base

2N3390-94, 2N3391A

Silicon Transistors



TO-98

The GE/RCA 2N3390-94, 2N3391A are planar, passivated NPN silicon transistors designed for use in general-purpose and high gain amplifier or driver applications. These types are supplied in JEDEC TO-98 package.

Devices in TO-98 package are supplied with and without seating flange (see Dimensional Outline).

MAXIMUM RATINGS, *Absolute-Maximum Values:*

COLLECTOR TO EMITTER VOLTAGE (V_{CEO}) .... 25 V
EMITTER TO BASE VOLTAGE (V_{EBO}) .... 5 V
COLLECTOR TO BASE VOLTAGE (V_{CBO}) .... 25 V
CONTINUOUS COLLECTOR CURRENT (I_C) .... 100 mA
TOTAL POWER DISSIPATION ($T_A \leq 25°C$) (P_T) .... 350 mW
TOTAL POWER DISSIPATION ($T_C \leq 25°C$) (P_T) .... 1 W
DERATE FACTOR ($T_A > 25°C$) .... 2.8 mW/°C
DERATE FACTOR ($T_C > 25°C$) .... 8 mW/°C
OPERATING TEMPERATURE (T_J) .... −55° to +150°C
STORAGE TEMPERATURE (T_{STG}) .... −55° to +150°C
LEAD TEMPERATURE, 1/16" ± 1/32" (1.58mm ± 0.8mm) from case for 10s max (T_L) .... +260°C

ELECTRICAL CHARACTERISTICS, At Ambient Temperature (T_A) = 25°C Unless Otherwise Specified

CHARACTERISTICS	SYMBOL	LIMITS MIN.	TYP.	MAX.	UNITS
Collector-Emitter Breakdown Voltage (I_C = 1 mA, I_B = 0)	BV_{CEO}	25	–	–	V
Collector-Base Breakdown Voltage (I_C = 0.1μA, I_E = 0)	BV_{CBO}	25	–	–	V
Collector Cutoff Current (V_{CB} = 18V, I_E = 0)	I_{CBO}	–	–	0.1	μA
Emitter Cutoff Current (V_{EB} = 5V, I_C = 0)	I_{EBO}	–	–	0.1	μA
DC Forward Current Transfer Ratio (I_C = 2mA, V_{CE} = 4.5V)					
3390	h_{FE}	400	–	800	–
3391, 3391A	h_{FE}	250	–	500	–
3392	h_{FE}	150	–	300	–
3393	h_{FE}	90	–	180	–
3394	h_{FE}	55	–	110	–
Output Capacitance (V_{CB} = 10V, I_E = 0, f = 1MHz)	C_{ob}	–	2	10	pF
Noise Figure (I_C = 100μA, V_{CE} = 4.5V, R_S = 5000 Ω) For 2N3391A only	NF	–	1.9	5	dB

File Number **2053**

2N3390-94, 2N3391A

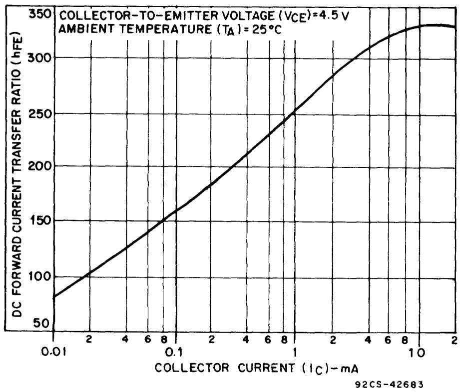


Fig. 1—Typical dc forward current transfer ratio characteristic for 2N3391 and 2N3391A.

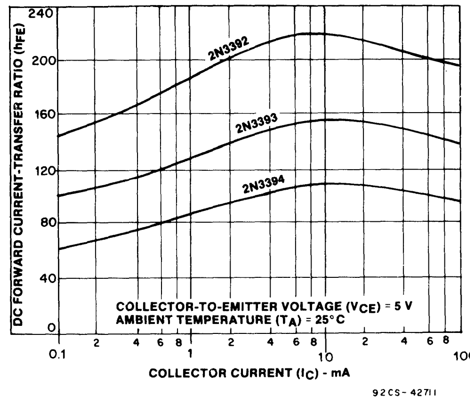


Fig. 2—Typical dc forward current transfer ratio characteristic for 2N3392, and 2N3393, and 2N3394.

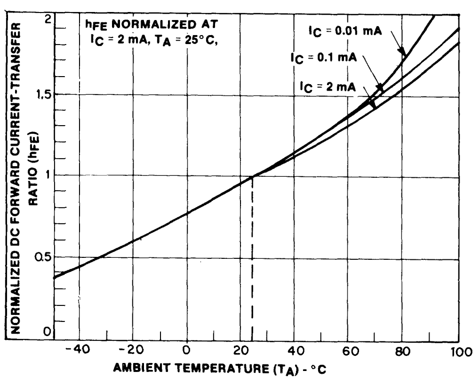


Fig. 3—Normalized dc forward current transfer ratio characteristics for 2N3391 and 2N3391A.

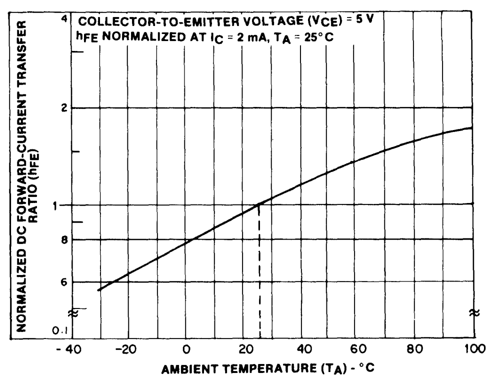


Fig. 4—Normalized dc forward current transfer ratio characteristics for 2N3392, 2N3393, and 2N3394.

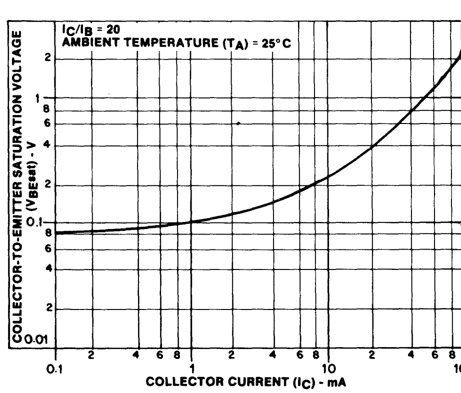


Fig. 5—Typical collector-to-emitter saturation voltage characteristic for 2N3392, 2N3393, and 2N3394.

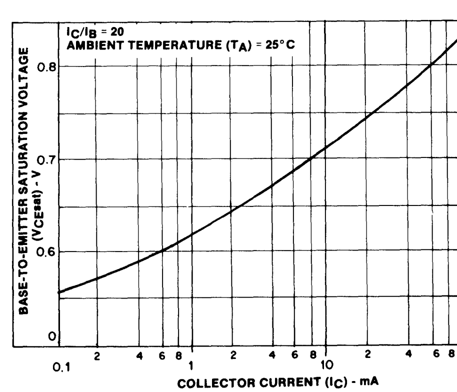


Fig. 6—Typical base-to-emitter voltage characteristic for 2N3392, 2N3393, and 2N3394.

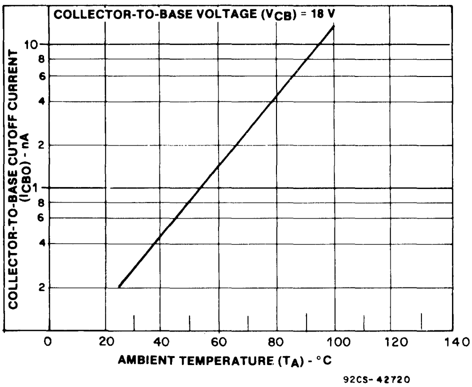


Fig. 7—Typical collector-to-base cutoff current characteristic for 2N3391, 2N3391A, 2N3392, 2N3393, and 2N3394.

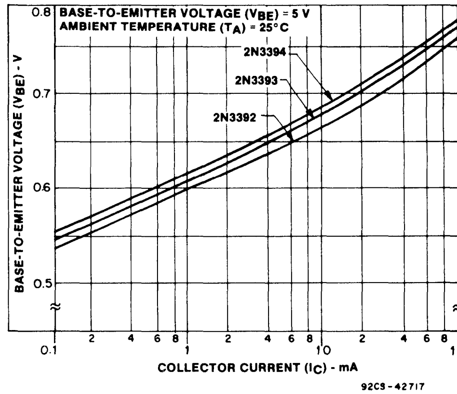


Fig. 8—Typical base-to-emitter voltage characteristic for 2N3392, 2N3393, and 2N3394.

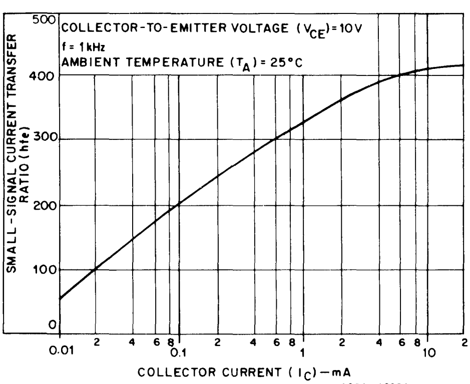


Fig. 9—Typical small-signal transfer ratio characteristic for 2N3391 and 2N3391A.

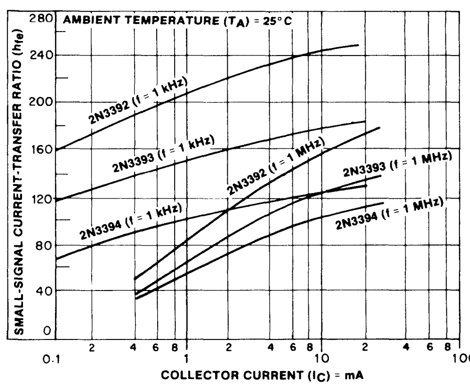


Fig. 10—Typical small-signal current tansfer ratio characteristic for 2N3392, 2N3393, and 2N3394.

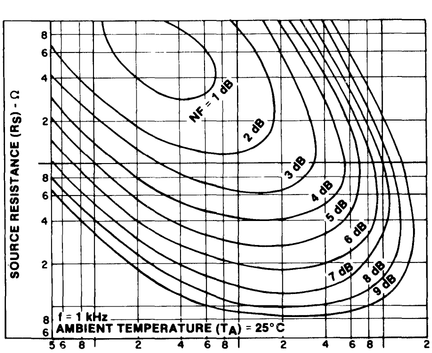


Fig. 11—Typical contours of constant noise figure for 2N3391 and 2N3391A.

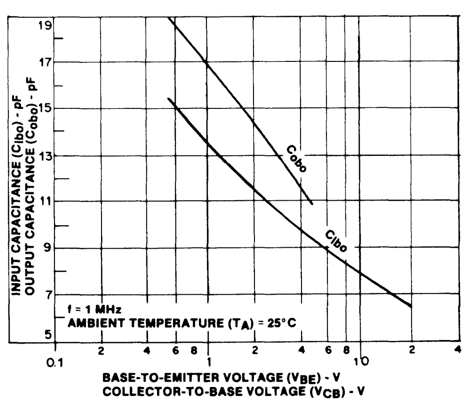


Fig. 12—Typical input, output capacitance characteristics for all types.

2N3390-94, 2N3391A

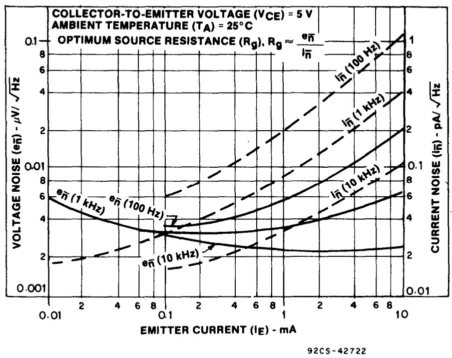


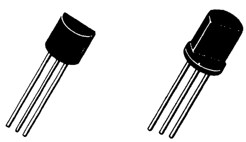
Fig. 13–Equivalent input noise-voltage and noise-current characteristics for 2N3392, 2N3393, and 2N3394.

TERMINAL CONNECTIONS

Lead 1 - Emitter
Lead 2 - Collector
Lead 3 - Base

2N3414-17, GES3414-17

Silicon Transistors



TO-92 TO-98

The GE/RCA Types 2N3414-17 and GES3414-17 are planar epitaxial passivated NPN silicon transistors intended for general purpose industrial circuits. These transistors are especially suited for high level linear amplifiers or medium speed switching circuits in industrial control applications. These types are supplied in JEDEC TO-92 package (GES3414-17) and in JEDEC TO-98 package (2N3414-17).

Devices in TO-98 package are supplied with and without seating flange (see Dimensional Outline).

MAXIMUM RATINGS, *Absolute-Maximum Values:*

	2N3414,15 GES3414,15	2N3416,17 GES3416,17	
COLLECTOR TO EMITTER VOLTAGE (V_{CEO})	25	50	V
EMITTER TO BASE VOLTAGE (V_{EBO})	5	5	V
COLLECTOR TO BASE VOLTAGE (V_{CBO})	25	50	V
CONTINUOUS COLLECTOR CURRENT (I_C) (Note 1)	500	500	mA
TOTAL POWER DISSIPATION ($T_A \leq 25°C$) (P_T)(Note 2)	360		mW
TOTAL POWER DISSIPATION ($T_A \leq 65°C$) (P_T)(Note 2)	260		mW
OPERATING TEMPERATURE (T_J)	−55 to +150		°C
STORAGE TEMPERATURE (T_{STG})	−55° to +150°C		
LEAD TEMPERATURE, 1/16" ± 1/32" (1.58mm ± 0.8mm) from case for 10s max (T_L)	+260		°C

NOTES:
1. Determined from power limitations due to saturation voltage at this current.
2. Derate 7.2mW/°C increase in case temperature about 25°C.

File Number **2054**

2N3414-17, GES3414-17

ELECTRICAL CHARACTERISTICS, At Ambient Temperature (T_A) = 25°C Unless Otherwise Specified

CHARACTERISTICS	SYMBOL	LIMITS				UNITS
		3414,5		3416,7		
		MIN.	MAX.	MIN.	MAX	
Collector Cutoff Current (V_{CB} = 25V)	I_{CBO}	–	0.1	–	–	μA
(V_{CB} = 25V, T_A = 100°C)		–	15	–	–	
Collector Cutoff Current (V_{CB} = 50V)	I_{CBO}	–	–	–	0.1	
(V_{CB} = 50V, T_A = 100°C)		–	–	–	15	
Emitter Cutoff Current (V_{EB} = 5V)	I_{EBO}	–	0.1	–	0.1	
Collector Saturation voltage (I_B = 3mA, I_C = 50mA)	$V_{CE(SAT)}$	–	0.3	–	0.3	V
Base Saturation Voltage (I_B = 3mA, I_C = 50mA)	$V_{BE(SAT)}$	–	0.85	–	0.85	
–		3414,6		3415,7		–
DC Forward Current Transfer Ratio (V_{CE} = 4.5V, I_C = 2mA)	h_{FE}	75	225	180	540	–
Small-Signal Forward Current Transfer Ratio (V_{CE} = 4.5V, f = 1kHz)	h_{fe}	75		180	–	
–		3414,15		3416,17		–
Small-Signal Forward Current Transfer Ratio (V_{CE} = 10V; I_C = 1 mA; f = 1Hz)	h_{fe}	180	330	150	300	–
Input Impedance	h_{ie}	5100	9000	4200	8300	Ω
Output Admittance	h_{oe}	14	21	10	20	μmhos
Voltage Feedback Ratio	h_{re}	0.27	0.45	0.2	0.4	X 10-3

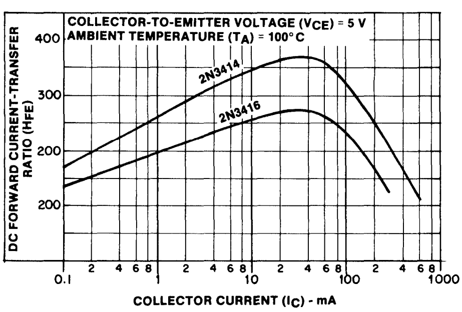


Fig. 1 — Typical dc forward-current transfer ratio characteristics.

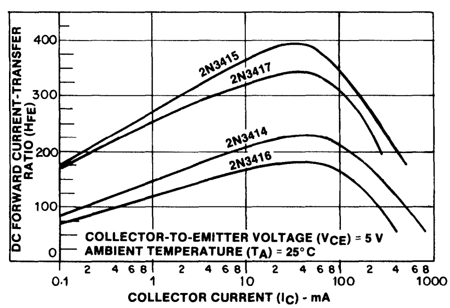


Fig. 2 — Typical dc forward-current transfer ratio characteristics.

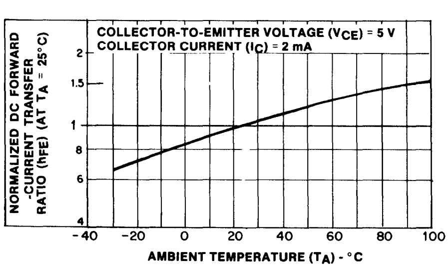


Fig. 3 — Normalized dc forward current transfer ratio characteristic.

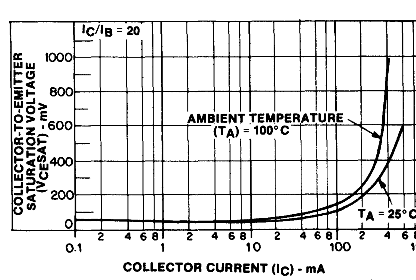


Fig. 4 — Typical collector-to-emitter saturation voltage characteristics.

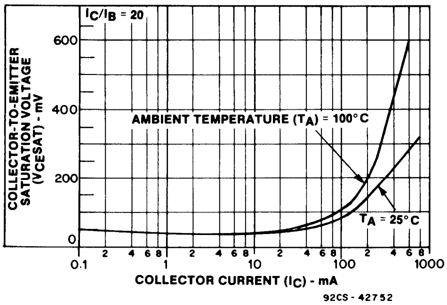


Fig. 5 — Typical collector-to-emitter saturation voltage characteristics.

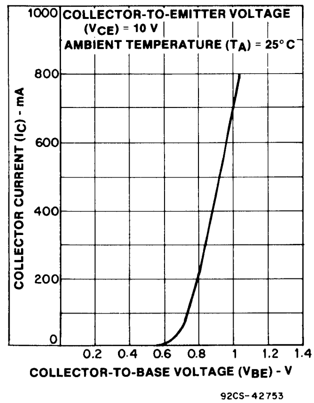


Fig. 6 — Typical collector current characteristics.

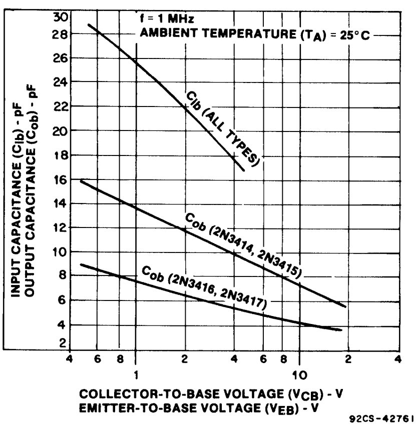


Fig. 7 — Typical input and output capacitance characteristics.

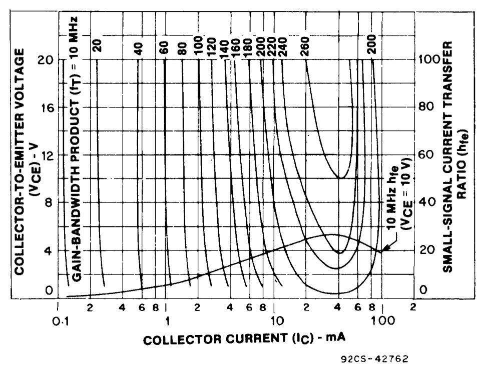


Fig. 8 — Typical gain-bandwidth product characteristics; and small-signal current transfer ratio characteristic for 2N3414, 2N3415, GES3414 and GES3415.

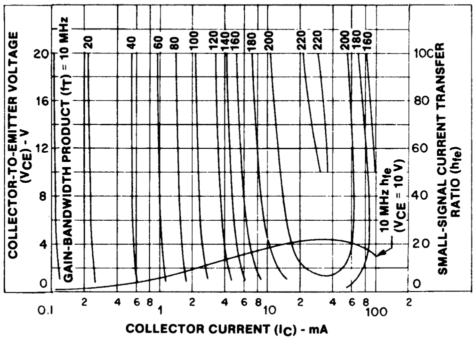


Fig. 9 — Typical gain-bandwidth product characteristics; and small-signal current transfer ratio characteristic for 2N3416, 2N3417, GES3416 and GES3417.

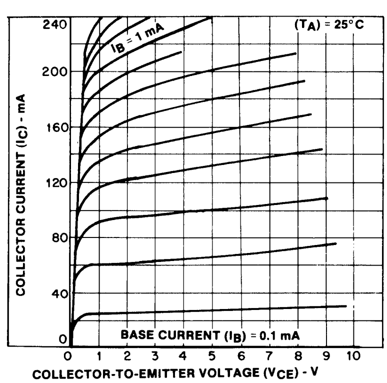


Fig. 10 — Typical collector characteristics for 2N3414, 2N3415, GES3414 and GES3415.

2N3414-17, GES3414-17

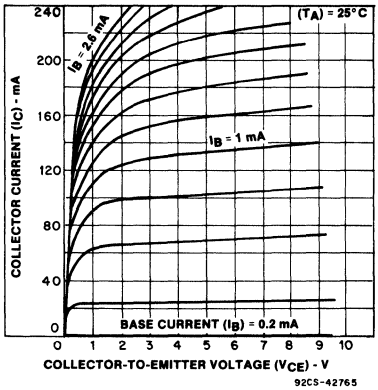


Fig. 11 — Typical collector characteristics for 2N3416, 2N3417, GES3416 and GES3417.

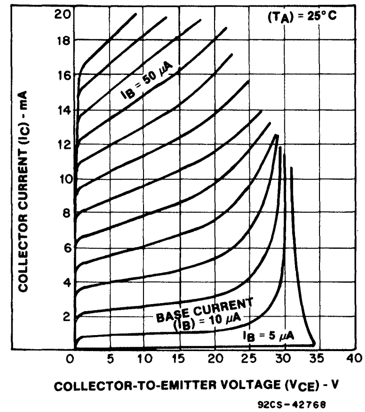


Fig. 12 — Typical collector characteristics for 2N3414, 2N3415, GES3414, and GES3416.

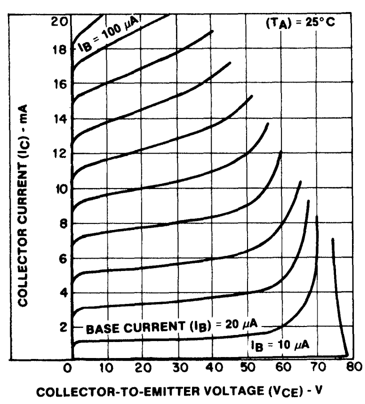


Fig. 13 — Typical collector characteristics for 2N3416, 2N3417, GES3416, and GES3417.

TERMINAL CONNECTIONS

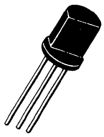
TO-92 Package
Lead 1 - Emitter
Lead 2 - Base
Lead 3 - Collector

TERMINAL CONNECTIONS

TO-98 Package
Lead 1 - Emitter
Lead 2 - Collector
Lead 3 - Base

2N3858-60, 2N3858A, 2N3859A

Silicon Transistors



TO-98

The GE/RCA 2N3858, 2N3859 and 2N3860 are planar epitaxial passivated NPN silicon transistors designed primarily for AM radio I.F. and converter applications. These types are supplied in JEDEC TO-98 package.

Devices in TO-98 package are supplied with and without seating flange (see Dimensional Outline).

2

MAXIMUM RATINGS, *Absolute-Maximum Values:*

	2N3858 2N3859 2N3860	2N3858A 2N3859A	
COLLECTOR TO EMITTER VOLTAGE (V_{CEO})	30	60	V
EMITTER TO BASE VOLTAGE (V_{EBO})	4	6	V
COLLECTOR TO BASE VOLTAGE (V_{CBO})	30	60	V
CONTINUOUS COLLECTOR CURRENT (I_C)(Note 1)	100	100	mA
TOTAL POWER DISSIPATION ($T_A \leq 25°C$) (P_T) (Note 2)	360	360	mW
OPERATING TEMPERATURE (T_J)	−55 to +125		°C
STORAGE TEMPERATURE (T_{stg})	−55 to +150		°C
LEAD TEMPERATURE, 1/16" ± 1/32" (1.58mm ± 0.8mm) from case for 10s max (T_L)	+260		°C

NOTES:

1. Determined from power limitations due to saturation voltage at this current.
2. Derate 3.6 mW/°C increase in ambient temperature above 25°C.

File Number **2060**

2N3858-60, 2N3858A, 2N3859A

ELECTRICAL CHARACTERISTICS, At Ambient Temperature (T_A) = 25°C Unless Otherwise Specified

CHARACTERISTICS	SYMBOL	LIMITS			UNITS
		MIN.	TYP.	MAX.	
Collector Cutoff Current (V_{CB} = 40V)	I_{CBO}	–	–	50	nA
(V_{CB} = 40V, T_A = 100°C)		–	–	10	μA
Emitter Cutoff Current (V_{EBO} = 5V)	I_{EBO}	–	–	100	nA
DC Forward Current Transfer Ratio 2N3858A (V_{CE} = 1V, I_C = 10mA)	h_{FE}	60	–	–	–
2N3859A (V_{CE} = 1V, I_C = 10mA)		100	–	–	–
2N3858, 58A (V_{CE} = 4.5V, I_C = 2 mA)		60	–	120	–
2N3859, 59A (V_{CE} = 4.5V, I_C = 2 mA)		100	–	200	–
2N3860 (V_{CE} = 4.5V, I_C = 2 mA)		150	–	300	–
Collector–Base Breakdown Voltage (I_C = 0.1mA)	BV_{CBO}	40	–	–	V
Emitter–Base Breakdown Voltage (I_E = 0.1mA)	BV_{EBO}	5	–	–	
Collector–Emitter Breakdown Voltage (I_C = 1ma)	BV_{CEO}	40	–	–	
Collector Saturation Voltage (I_C = 10mA, I_B = 1mA)	$V_{CE(SAT)}$	–	–	0.125	
Gain Bandwidth Product (V_{CE} = 10V, I_C = 2mA) 2N3858, A	f_T	90	125	250	MHz
2N3859, A		90	140	250	
2N3860		90	170	250	
Collector–Base Time constant (V_{CE} = 10V, I_C = 2mA)	$r_b'C_c$	–	65	150	ps
Output Capacitance, Common Base (V_{CB} = 10V, I_E = 0, f = 1Mc)	C_{cbo}	2	2.7	4	pF
Input Capacitance, Common Base (V_{EB} = 0.5V, I_E = 0, f = 1Mc)	C_{ibo}	–	10	–	
Case Capacitance	–	–	0.66	–	

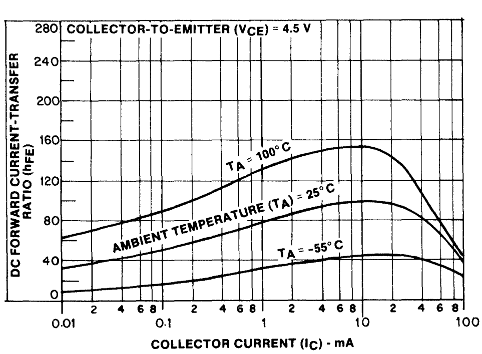


Fig. 1 – Typical dc forward current transfer ratio characteristics for 2N3858 and 2N3858A.

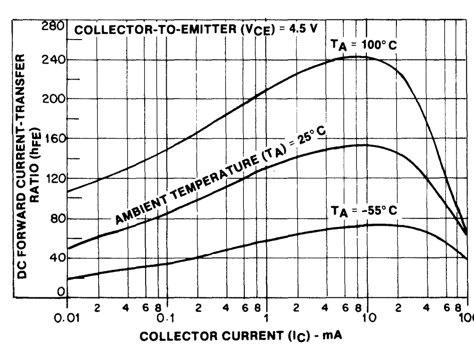


Fig. 2 – Typical dc forward-current transfer ratio characteristics for 2N3859 and 2N3859A.

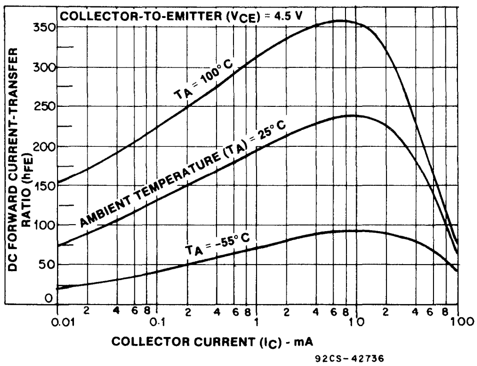


Fig. 3 – Typical dc forward-current transfer ratio characteristics for 2N3860.

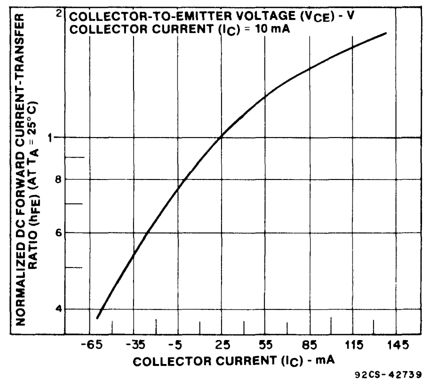


Fig. 4 – Normalized dc forward current transfer ratio characteristic for all types.

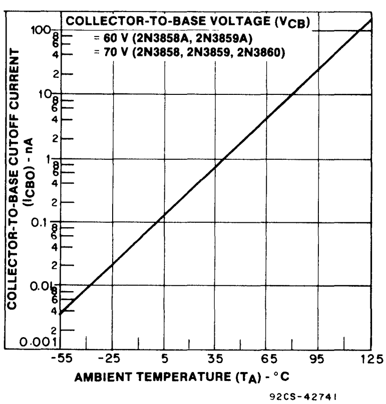


Fig. 5 – Typical collector-to-base cutoff current characteristic for all types.

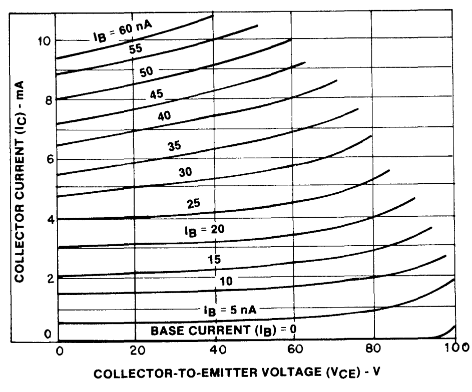


Fig. 6 – Typical collector characteristics for 2N3858.

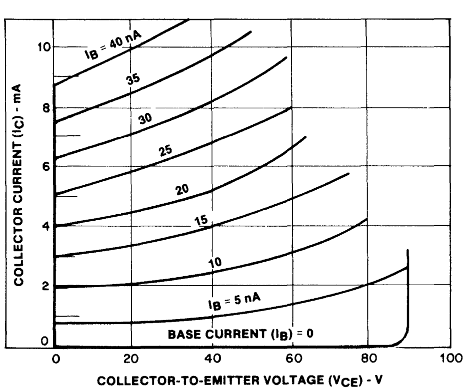


Fig. 7 – Typical collector characteristics for 2N3859.

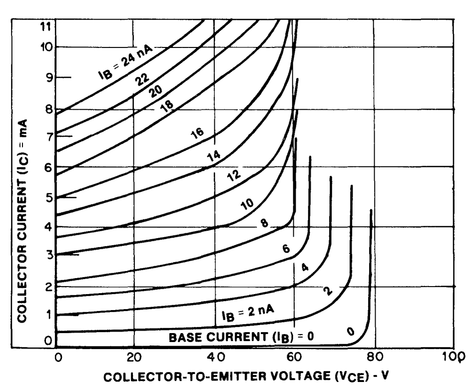


Fig. 8 – Typical collector characteristics for 2N3860.

2N3858-60, 2N3858A, 2N3859A

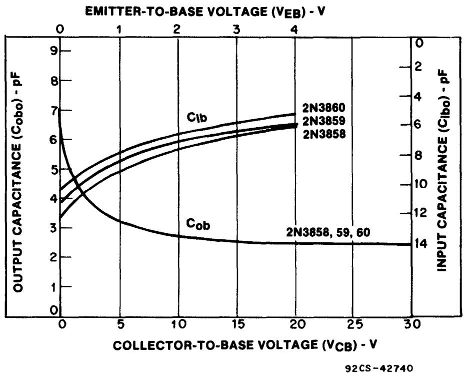


Fig. 9 — Typical output and input characteristics for 2N3858, 2N3859 and 2N3860.

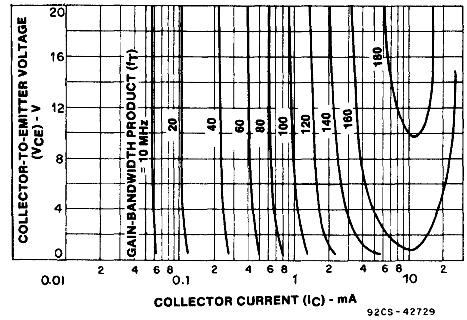


Fig. 10 — Typical gain-bandwidth characteristics for 2N3858 and 2N3858A.

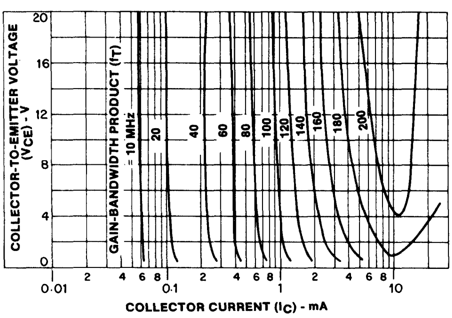


Fig. 11 — Typical gain-bandwidth product characteristics for 2N3859 and 2N3859A.

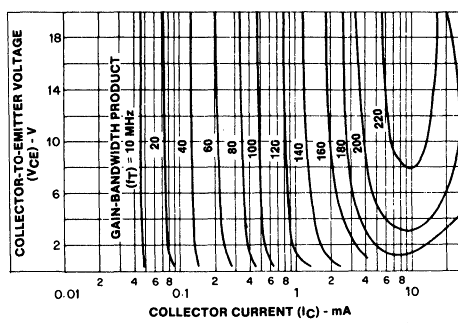


Fig. 12 — Typical gain-bandwidth product characteristics for 2N3860.

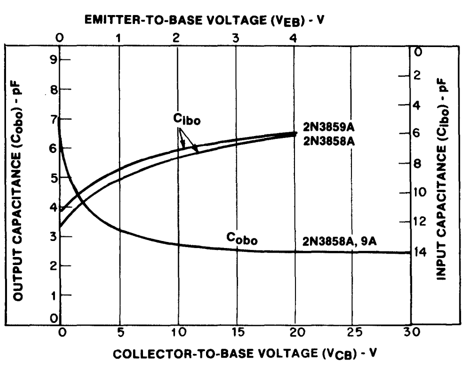


Fig. 13 — Typical output and input capacitance characteristics for 2N3858A and 2N3859A.

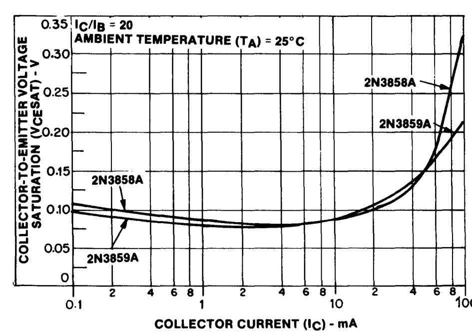


Fig. 14 — Typical collector-to-emitter saturation voltage characteristics 2N3858A and 2N3859A.

2N3858-60, 2N3858A, 2N3859A

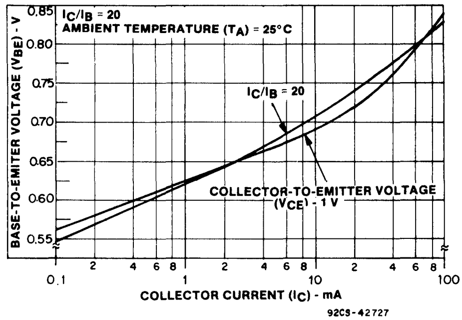


Fig. 15 — Typical base-to-emitter voltage characteristics for 2N3858A and 2N3859A.

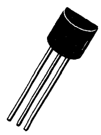
2

TERMINAL CONNECTIONS

Lead 1 - Emitter
Lead 2 - Collector
Lead 3 - Base

2N3903, 2N3904, 2N3905, 2N3906

Silicon Transistors



TO-92

The GE/RCA 2N3903, 2N3904 NPN types and 2N3905, 2N3906 PNP types are planar epitaxial silicon transistors designed for general purpose switching and amplifier applications. PNP values are negative; observe proper polarity. These types are supplied in JEDEC TO-92 package.

MAXIMUM RATINGS, *Absolute-Maximum Values:*

	2N3903 2N3904	2N3905 2N3906	
COLLECTOR TO EMITTER VOLTAGE (V_{CEO})	40	−40	V
COLLECTOR TO BASE VOLTAGE (V_{CBO})	60	−60	V
EMITTER TO BASE VOLTAGE (V_{EBO})	6	−5	V
CONTINUOUS COLLECTOR CURRENT (I_C)	200		mA
TOTAL POWER DISSIPATION $T_A \leq 25°C$ (P_T)	350		mW
DERATE FACTOR, $T_A > 25°C$	2.8		mW/°C
OPERATING TEMPERATURE (T_J)	−55 to +135		°C
STORAGE TEMPERATURE (T_{STG})	−55 to +125		°C
LEAD TEMPERATURE, 1/16" ± 1/32" from case for 10s max (T_L)	+230		°C

File Number **2056**

2N3903, 2N3904, 2N3905, 2N3906

ELECTRICAL CHARACTERISTICS, At Ambient Temperature (T_A) = 25°C Unless Otherwise Specified

CHARACTERISTICS	SYMBOL	LIMITS 2N3903 2N3904 MIN.	LIMITS 2N3903 2N3904 MAX.	LIMITS 2N3905 2N3906 MIN.	LIMITS 2N3905 2N3906 MAX	UNITS
Collector-Emitter Breakdown Voltage (I_C = 1mA, I_B = 0)	$V_{(BR)ECO}$	40	–	−40	–	V
Collector-Base Breakdown Voltage (I_C = 10μA, I_E = 0)	$V_{(BR)CBO}$	60	–	−40	–	V
Emitter-Base Breakdown Voltage (I_E = 10μA, I_C = 0)	$V_{(BR)EBO}$	6	–	−5	–	V
Collector Cutoff Curernt (V_{CE} = 30V, $V_{BE(OFF)}$ = 3V)	I_{CEV}	–	50	–	−50	nA
Base Cutoff Current (V_{CE} = 30V, $V_{BE(\ OFF)}$ ½ 3V)	I_{BEV}	–	50	–	−50	nA
Collector-Emitter Saturation Voltage (I_C = 10mA, I_B = 1mA)*	$V_{CE(SAT)}$	–	0.2	–	−0.25	V
(I_C = 50mA, I_B = 5mA)*		–	0.3	–	−0.4	V
Base Emitter Saturation Voltage (I_C = 10mA, I_B = 1mA)*	$V_{BE(SAT)}$	0.65	0.85	0.65	−0.85	V
(I_C = 50mA, I_B = 5mA)*		–	0.95	–	−0.95	V

–	–	2N3903 MIN.	2N3903 MAX.	2N3904 MIN.	2N3904 MAX.	2N3905 MIN.	2N3905 MAX.	2N3906 MIN.	2N3906 MAX.	–
DC Forward Current Transfer Ratio (V_{CE} = 1V, I_C = 100 μA)	h_{FE}	20	–	40	–	30	–	60	–	–
(V_{CE} = 1V, I_C = 1 mA)	h_{FE}	35	–	70	–	40	–	80	–	–
(V_{CE} = 1V, I_C = 10 mA)*	h_{FE}	50	150	100	300	50	150	100	300	–
(V_{CE} = 1V, I_C = 50 mA)*	h_{FE}	30	–	60	–	30	–	60	–	–
(V_{CE} = 1V, I_C = 100 mA)*	h_{FE}	15	–	30	–	15	–	30	–	–
Collector-Base Capacitance (V_{CB} = 5V, I_E = 0, f = 1MHz)	C_{cb}	–	4	–	4	–	4.5	–	4.5	pF
Emitter-Base Capacitance (V_{EB} = 5V, I_E = 0, f = 1MHz)	C_{eb}	–	8	–	8	–	8	–	10	pF
Gain Bandwidth Product (V_{CE} = 20V, I_E = 10mA, f = 100MHz)	f_T	250	–	300	–	200	–	250	–	MHz

*Pulse conditions: ≤ 300 μs pulse width, ≤ 2% duty cycle.

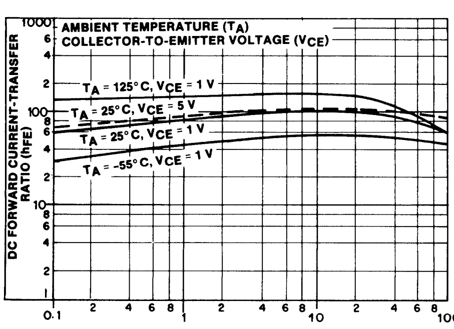


Fig. 1 — Typical dc forward current transfer ratio characteristics for 2N3903.

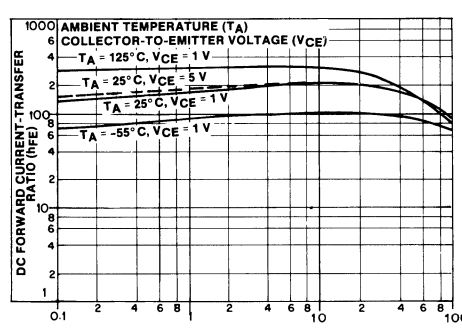


Fig. 2 — Typical dc forward current transfer ratio characteristics for 2N3904.

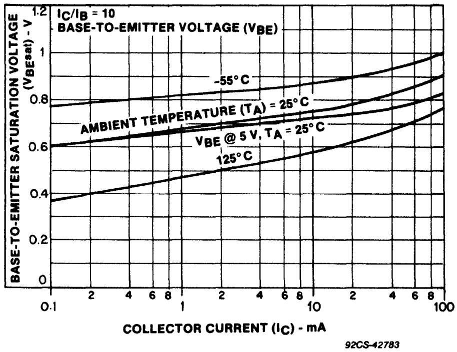


Fig. 3 — Typical base-to-emitter saturation voltage characteristics for 2N3903 and 2N3904.

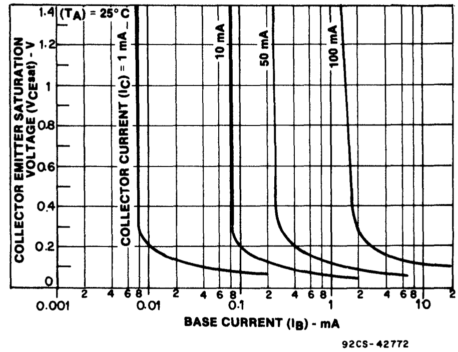


Fig. 4 — Typical collector-to-emitter saturation voltage characteristics for 2N3903 and 2N3904.

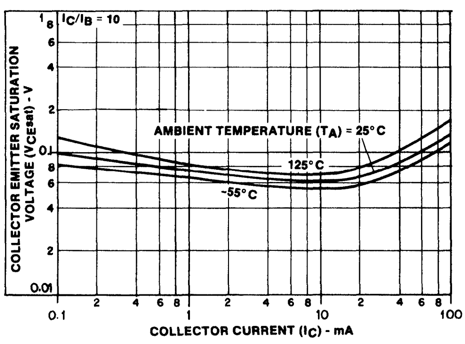


Fig. 5 — Typical collector-to-emitter saturation voltage characteristics for 2N3903.

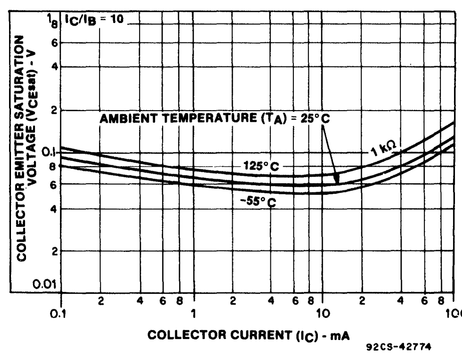


Fig. 6 — Typical collector-to-emitter saturation voltage characteristics for 2N3904.

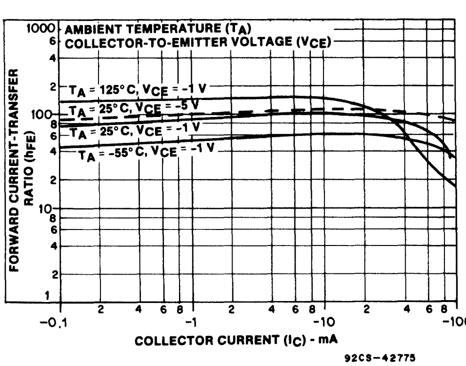


Fig. 7 — Typical dc forward-current transfer ratio characteristics for 2N3905.

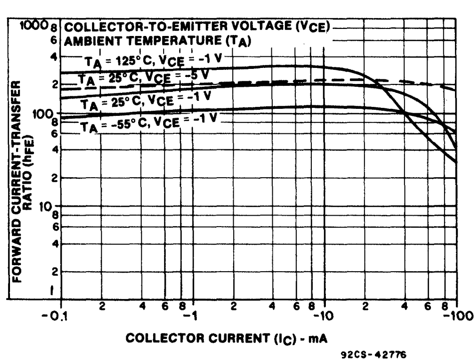


Fig. 8 — Typical dc forward-current transfer ratio characteristics for 2N3906.

2N4123, 2N4124, 2N4125, 2N4126

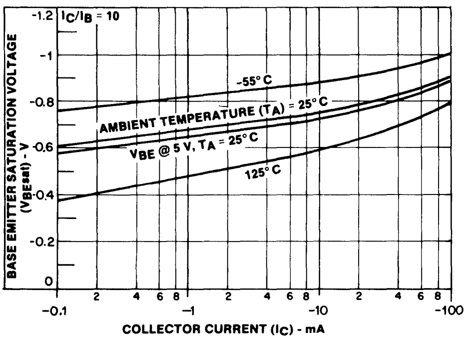


Fig. 9 — Typical base-to-emitter saturation voltage characteristics for 2N3905 and 2N3906.

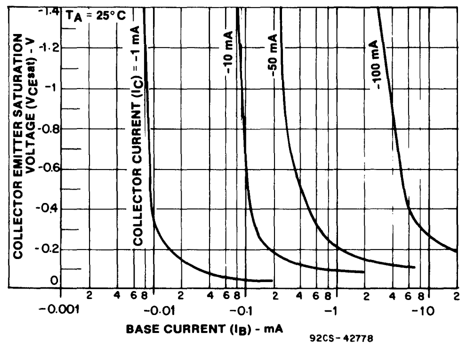


Fig. 10 — Typical collector-to-emitter saturation voltage characteristics for 2N3905 and 2N3906.

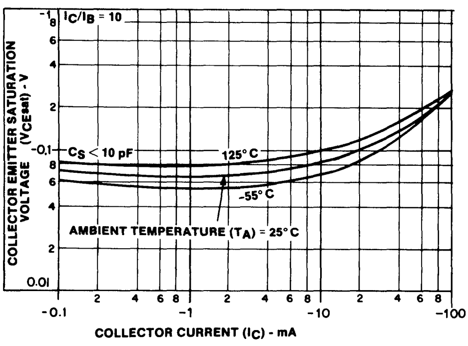


Fig. 11 — Typical collector-to-emitter saturation voltage characteristics for 2N3905.

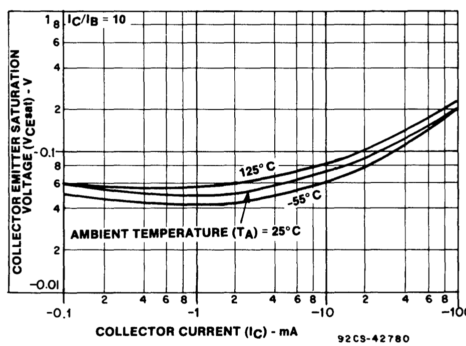


Fig. 12 — Typical collector-to-emitter saturation voltage characteristics for 2N3906.

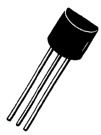
TERMINAL CONNECTIONS

Lead 1 - Emitter
Lead 2 - Base
Lead 3 - Collector

2

2N4123, 2N4124, 2N4125, 2N4126

Silicon Transistors



TO-92

The GE/RCA 2N4123, 2N4124 NPN types and 2N4125, 2N4126 PNP types are planar epitaxial passivated silicon transistors designed for general purpose amplifier applications. PNP values are negative; observe proper polarity.

These types are supplied in JEDEC TO-92 package.

MAXIMUM RATINGS, *Absolute-Maximum Values:*

	2N4123	2N4124	2N4125	2N4126	
COLLECTOR TO EMITTER VOLTAGE (V_{CEO})	30	25	−30	−25	V
COLLECTOR TO BASE VOLTAGE (V_{CBO})	40	30	−30	−25	V
EMITTER TO BASE VOLTAGE (V_{EBO})	5	5	−4	−4	V
CONTINUOUS COLLECTOR CURRENT (I_C)		200			mA
TOTAL POWER DISSIPATION ($T_A \leq 25°C$)		350			mW
TOTAL POWER DISSIPATION ($T_C \leq 25°C$) (P_T)		1			W
DERATE FACTOR $T_A > 25°C$		2.8			mW/°C
DERATE FACTOR $T_C > 25°C$		8			mW/°C
OPERATING TEMPERATURE (T_J)		−55 to +150			°C
STORAGE TEMPERATURE (T_{STG})		−55 to +150			°C
LEAD TEMPERATURE, 1/16" ± 1/32" (1.58mm ± 0.8mm) from case for 10s max. (T_L)		+260			°C

File Number **2057**

ELECTRICAL CHARACTERISTICS, At Ambient Temperature (T_A) = 25°C Unless Otherwise Specified

CHARACTERISTICS	SYMBOL	LIMITS 2N4123 MIN.	2N4123 MAX.	2N4124 MIN.	2N4124 MAX	2N4125 MIN.	2N4125 MAX.	2N4126 MIN.	2N4126 MAX	UNITS
Collector-Emitter Breakdown Voltage (I_C = 1 mA, I_B = 0)	$V_{(BR)CEO}$	30	—	—	—	-30	—	—	—	V
(I_C = 1 mA, V_{BE} = 0)		—	—	25	—	—	—	-25	—	V
Collector-Base Breakdown Voltage (I_C = 10μA, I_E = 0)	$V_{(BR)CBO}$	40	—	30	—	-30	—	-25	—	V
Emitter-Base Breakdown Voltage (I_E = 10μA, I_C = 0)	$V_{(BR)EBO}$	5	—	5	—	-4	—	-4	—	V
Collector Cutoff Current (V_{CB} = 20V, I_E = 0)	I_{CBO}	—	50	—	50	—	-50	—	-50	nA
Emitter-Base Reverse Current (V_{EB} = 3V, I_C = 0)	I_{EBO}	—	50	—	50	—	-50	—	-50	nA
DC Forward Current Transfer Ratio (V_{CE} = 1V, I_C = 2mA)	h_{FE}	50	150	120	360	-50	-150	-120	-360	—
(V_{CE} = 1V, I_C = 50mA)*		25	—	60	—	-25	—	-60	—	—
Small-Signal Forward Current Transfer Ratio (V_{CE} = 20V, I_C = 10mA, f = 100 MHz)	h_{fe}	2.5	—	3	—	2	—	2.5	—	—
(V_{CE} = 1V, I_C = 2 mA, f = 1 kHz)		50	200	120	480	50	200	120	480	—
Collector-Emitter Saturation Voltage (I_C = 50mA, I_B = 5mA)*	$V_{CE(SAT)}$	—	0.3	—	0.3	—	-0.4	—	-0.4	V
Base Emitter Saturation Voltage (I_C = 50mA, I_B = 5mA)*	$V_{BE(SAT)}$	—	0.95	—	0.95	—	-0.95	—	-0.95	V
Collector-Base Capacitance (V_{CB} = 5V, I_E = 0, f = 100 kHz)	C_{ob}	—	4	—	4	—	4.5	—	4.5	pF
Emitter-Base Capacitance (V_{EB} = 0.5V, I_C = 0, f = 100 kHz)	C_{ib}	—	8	—	8	—	10	—	10	pF
Gain Bandwidth Product (V_{CE} = 20V, I_E = 10mA, f = 100 MHz)	f_T	250	—	300	—	200	—	250	—	MHz
Noise Figure (Broad Band) (I_C = 100mA, V_{CE} = 5V, R_S = 1kΩ Bandwidth = 10 Hz to 15.7 kHz)	NF	—	6	—	5	—	5	—	4	dB

* Pulse Conditions: ≤ 300μs Pulse width, ≤ 2% Duty Cycle.

2

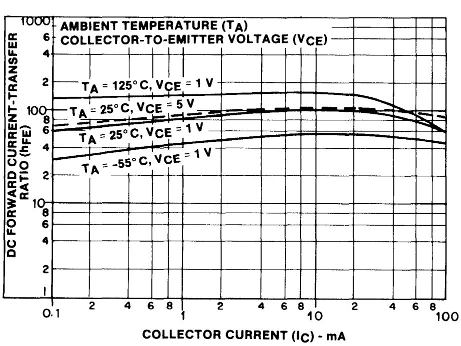


Fig. 1 — Typical dc forward current transfer ratio characteristics for 2N4123.

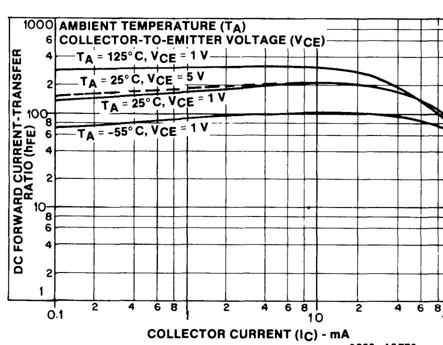


Fig. 2 — Typical dc forward current transfer ratio characteristics for 2N4124.

2N4123, 2N4124, 2N4125, 2N4126

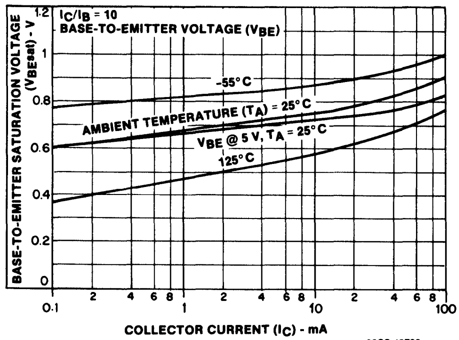


Fig. 3 — Typical base-to-emitter saturation voltage characteristics for 2N4123 and 2N4124.

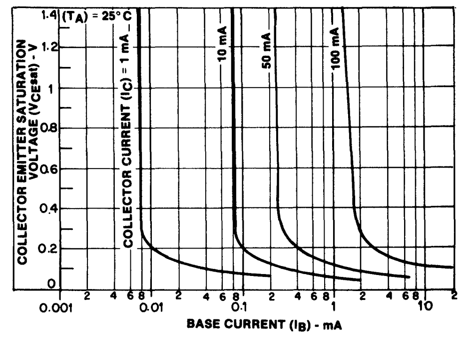


Fig. 4 — Typical collector-to-emitter saturation voltage characteristics for 2N4124 and 2N4123.

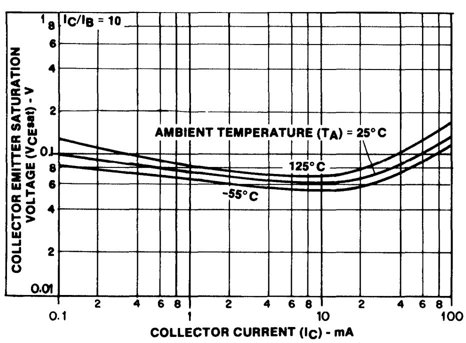


Fig. 5 — Typical collector-to-emitter saturation voltage characteristics for 2N4123.

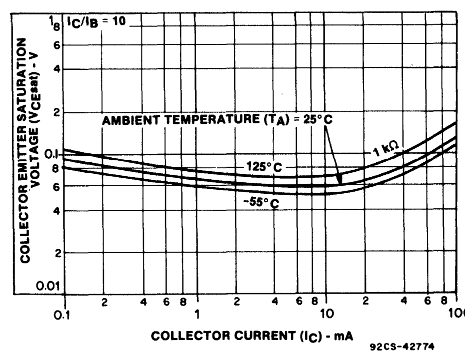


Fig. 6 — Typical collector-to-emitter saturation voltage characteristics for 2N4124.

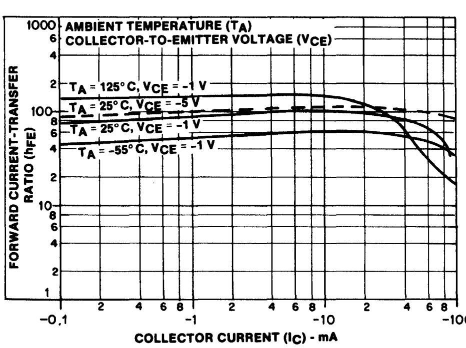


Fig. 7 — Typical dc forward-current transfer ratio characteristics for 2N4125.

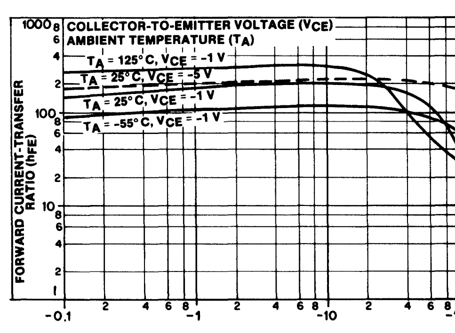


Fig. 8 — Typical dc forward-current transfer ratio characteristics for 2N4126.

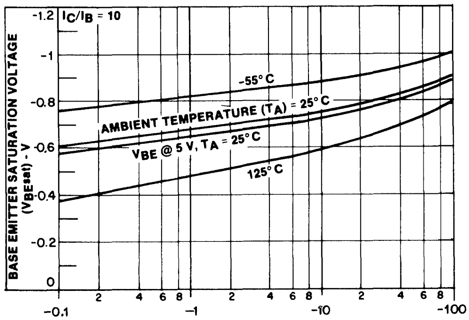


Fig. 9 — Typical base-to-emitter saturation voltage characteristics for 2N4125 and 2N4126.

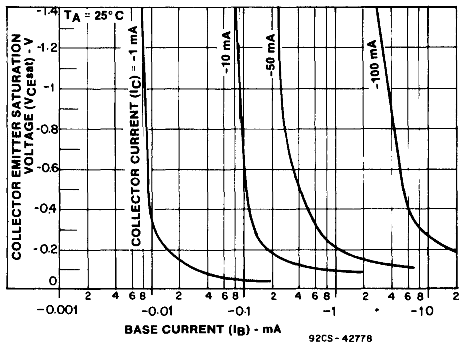


Fig. 10 — Typical collector-to-emitter saturation voltage characteristics for 2N4125 and 2N4126.

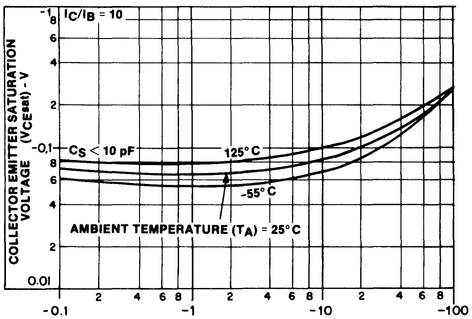


Fig. 11 — Typical collector-to-emitter saturation voltage characteristics for 2N4125.

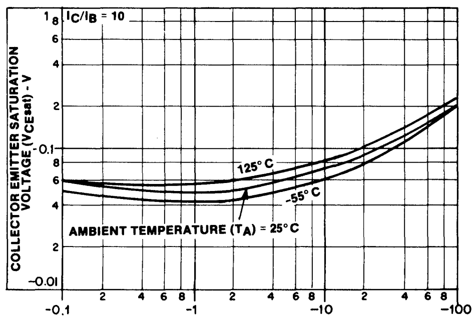


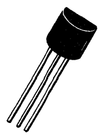
Fig. 12 — Typical collector-to-emitter saturation voltage characteristics for 2N4126.

TERMINAL CONNECTIONS

Lead 1 - Emitter
Lead 2 - Base
Lead 3 - Collector

2N4400, 2N4401, 2N4402, 2N4403

Silicon Transistors



TO-92

The GE/RCA 2N4400, 2N4401 NPN types and 2N4402, 2N4403 PNP types are planar epitaxial passivated silicon transistors designed for general purpose switching and amplifier applications. PNP values are negative; observe proper polarity. These types are supplied in JEDEC TO-92 package.

MAXIMUM RATINGS, *Absolute-Maximum Values:*

	2N4400 2N4401	2N4402 2N4403	
COLLECTOR TO EMITTER VOLTAGE (V_{CEO})	40	−40	V
COLLECTOR TO BASE VOLTAGE (V_{CBO})	60	−40	V
EMITTER TO BASE VOLTAGE (V_{EBO})	6	−5	V
CONTINUOUS COLLECTOR CURRENT (I_C)	600	−600	mA
TOTAL POWER DISSIPATION ($T_A \leq 25°C$)	350	350	mW
TOTAL POWER DISSIPATION ($T_C \leq 25°C$) (P_T)	1	1	W
DERATE FACTOR $T_A > 25°C$	2.8	2.8	mW/°C
DERATE FACTOR $T_C > 25°C$	8	8	mW/°C
OPERATING TEMPERATURE (T_J)	−55 to +150		°C
STORAGE TEMPERATURE (T_{STG})	−55 to +150		°C
LEAD TEMPERATURE, 1/16" ± 1/32" (1.58mm ± 0.8mm) from case for 10s max. (T_L)	+230		°C

File Number **2058**

2N4400, 2N4401, 2N4402, 2N4403

ELECTRICAL CHARACTERISTICS, At Ambient Temperature (T_A) = 25°C Unless Otherwise Specified

CHARACTERISTICS	SYMBOL	LIMITS								UNITS
		2N4400		2N4401		2N4402		2N4403		
		MIN.	MAX.	MIN.	MAX	MIN.	MAX.	MIN.	MAX	
Collector-Emitter Breakdown Voltage (I_C = 1 mA, I_B = 0)	$V_{(BR)CEO}$	40	—	40	—	−40	—	−40	—	
Collector-Base Breakdown Voltage (I_C = 100μA, I_E = 0)	$V_{(BR)CBO}$	60	—	60	—	−40	—	−40	—	V
Emitter-Base Breakdown Voltage (I_E = 100μA, I_C = 0)	$V_{(BR)EBO}$	6	—	6	—	−5	—	−5	—	
Collector Cutoff Current (V_{CB} = 35V, $V_{EB(OFF)}$ = 0.4V)	I_{CEV}	—	100	—	100	—	−100	—	−100	nA
Base Cutoff Current (V_{CE} = 35V, $V_{EB(OFF)}$ = 0.4V)	I_{BEV}	—	100	—	100	—	100	—	100	
DC Forward Current Transfer Ratio (V_{CE} = 1V, I_C = 0.1mA)	h_{FE}	—	—	20	—	—	—	30	—	—
(V_{CE} = 1V, I_C = 1mA)		20	—	40	—	30	—	60	—	—
(V_{CE} = 1V, I_C = 10mA)		40	—	80	—	50	—	100	—	—
(V_{CE} = 2V, I_C = 150mA)*		50	150	100	300	50	150	100	300	—
(V_{CE} = 2V, I_C = 500mA)*		20	—	30	—	20	—	20	—	—
Small-Signal Forward Current Transfer Ratio (V_{CE} = 10V, I_C = 1mA, f = 1 kHz)	h_{fe}	20	250	40	500	30	250	60	500	—
Collector-Emitter Saturation Voltage (I_C = 150mA, I_B = 15mA)*	$V_{CE(SAT)}$	—	0.4	—	0.4	—	−0.4	—	−0.4	
(I_C = 500mA, I_B = 50mA)*		—	0.75	—	0.75	—	−0.75	—	−0.75	V
Base Emitter Saturation Voltage (I_C = 150mA, I_B = 15mA)*	$V_{BE(SAT)}$	0.75	0.95	0.75	0.95	—	−0.4	—	−0.4	
(I_C = 500mA, I_B = 50mA)*		—	1.2	—	1.2	—	−0.75	—	−0.75	
Collector-Base Capacitance (V_{CB} = 5V, I_E = 0, f = 1 MHz)	C_{cb}	—	6.5	—	6.5	—	—	—	—	
(V_{CB} = 10V, I_E = 0, f = 1 MHz)		—	—	—	—	—	8.5	—	8.5	pF
Emitter-Base Capacitance (V_{EB} = 0.5V, I_C = 0, f = 1 MHz)	C_{eb}	—	30	—	30	—	30	—	30	
Gain Bandwidth Product (V_{CE} = 10V, I_E = 20mA, f = 100 MHz)	f_T	—	200	—	250	150	—	200	—	MHz
Input Impedance (V_{CE} = 1 mA, V_{CE} = 10V, f = 1 kHz)	h_{ie}	0.5	0.75	1	15	750	7.5	1.5	15	kΩ
Voltage Feedback Ratio (V_{CE} = 1 mA, V_{CE} = 10V, f = 1 kHz)	h_{re}	0.1	8	0.1	8	0.1	8	0.1	8	x 10-4
Output Admittance (V_{CE} = 1 mA, V_{CE} = 10V, f = 1 kHz)	h_{oe}	1	30	1	30	1	100	1	100	μmhos
Delay Time	t_d	—	15	—	15	—	15	—	15	
Rise Time (I_C = 150 mA, I_{B1} = 15mA (V_{CE} = 30, $V_{EB(OFF)}$ = 2V)	t_r	—	20	—	20	—	20	—	20	ns
Storage Time	t_s	—	225	—	225	—	225	—	225	
Fall Time (I_{B1} = I_{B2} = 15 mA) (V_{CE} = 30 V, I_C = 150 mA)	t_f	—	30	—	30	—	30	—	30	

*Pulse Conditions: Pulse width ≤ 300μsec, Duty Cycle ≤ 2%.

2N4400, 2N4401, 2N4402, 2N4403

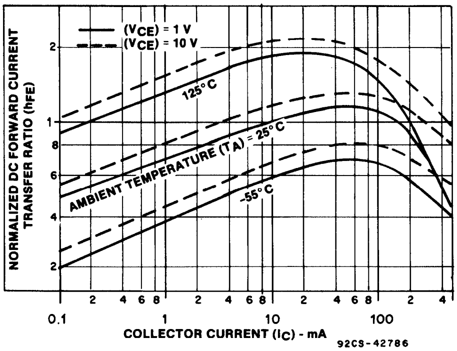


Fig. 1 — Normalized dc forward current transfer ratio characteristics for 2N4400 and 2N4401.

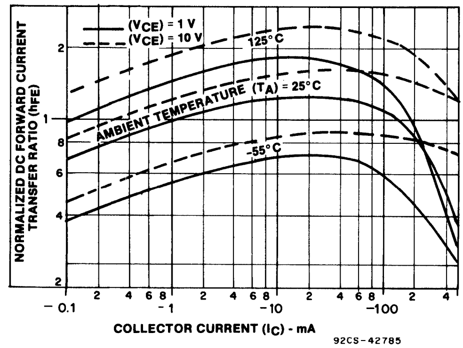


Fig. 2 — Normalized dc forward current transfer ratio characteristics for 2N4402 and 2N4403.

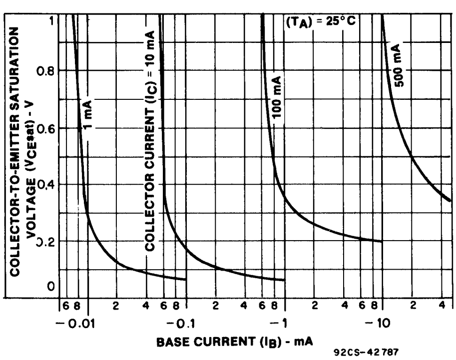


Fig. 3 — Typical collector-to-emitter saturation voltage characteristics 2N4400 and 2N4401.

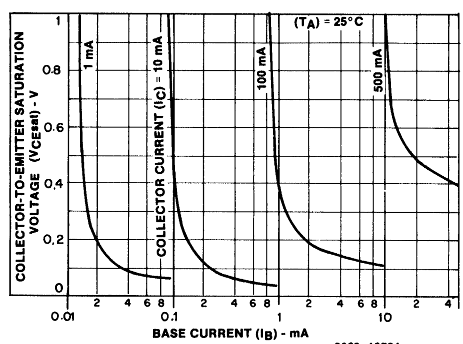


Fig. 4 — Typical collector-to-emitter saturation voltage characteristics 2N4402 and 2N4403.

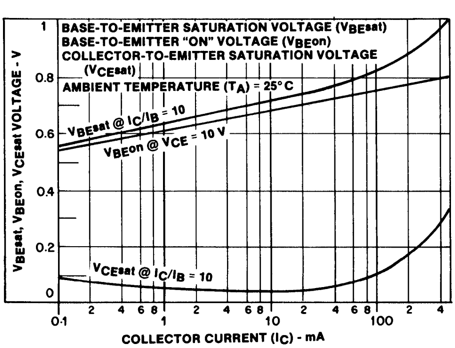


Fig. 5 — Typical V_{BE}^{sat}, V_{BE}^{on}, and V_{CE}^{sat} voltage characteristics for all types. (PNP voltage and current values are negative)

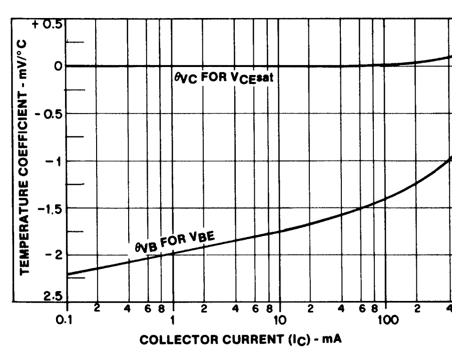
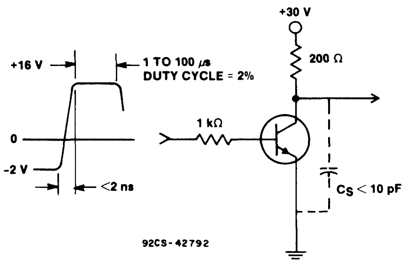
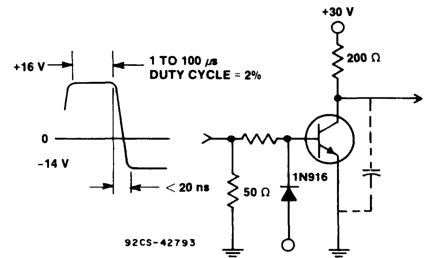


Fig. 6 — Typical temperature coefficient characteristics for all types. (PNP voltage and current values are negative)

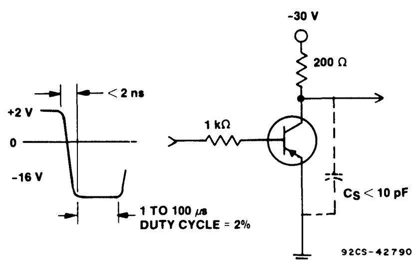


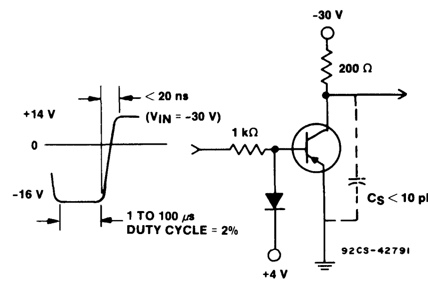


SCOPE RISE TIME < 4 ns.
C_S = TOTAL SHUNT CAPACITANCE OF TEST JIGS, CONNECTORS AND OSCILLOSCOPE.

Fig. 7 — "Turn-on" switching time waveform and test circuit for 2N4400 and 2N4401.

Fig. 8 — "Turn-off" switching time waveform and test circuit for 2N4400 and 2N4401.





SCOPE RISE TIME < 4 ns.
C_S = TOTAL SHUNT CAPACITANCE OF TEST JIG CONNECTORS AND OSCILLOSCOPE.

Fig. 9 — "Turn-on" switching time waveform and test circuit for 2N4402 and 2N4403.

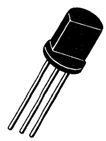
Fig. 10 — "Turn-off" switching time waveform and test circuit for 2N4402 and 2N4403.

TERMINAL CONNECTIONS

Lead 1 - Emitter
Lead 2 - Base
Lead 3 - Collector

2N4424

Silicon Transistors



TO-98

Features:
- *Low Saturation Voltage*
- *High Beta*
- *900 mW @ T_C = 25°C*

The GE/RCA 2N4424 type is a planar, passivated, epitaxial NPN silicon transistor intended for general purpose industrial circuits. This transistor is especially suited for high level linear amplifiers or medium speed switching circuits in industrial control applications. This type is supplied in JEDEC TO-98 package.

Devices in TO-98 package are supplied with and without seating flange (see Dimensional Outline).

MAXIMUM RATINGS, *Absolute-Maximum Values:*

COLLECTOR TO EMITTER VOLTAGE (V_{CEO})	40 V
EMITTER TO BASE VOLTAGE (V_{EBO})	5 V
COLLECTOR TO BASE VOLTAGE (V_{CBO})	60 V
CONTINUOUS COLLECTOR CURRENT (I_C) (Note 1)	500 mA
TOTAL POWER DISSIPATION ($T_A \leq 25°C$) (P_T) (Note 2)	360 mW
TOTAL POWER DISSIPATION ($T_A \leq 65°C$) (P_T) (Note 2)	250 mW
OPERATING TEMPERATURE (T_J)	−55° to +150°C
STORAGE TEMPERATURE (T_{STG})	−55° to +150°C
LEAD TEMPERATURE, 1/16" ± 1/32" (1.58mm ± 0.8mm) from case for 10 sec. max. (T_L)	+260°C

NOTES:
1. Determined from power limitations due to saturation voltage at this current.
2. Derate 2.88mW/°C increase in ambient temperature above 25°C

File Number **2059**

ELECTRICAL CHARACTERISTICS, At Ambient Temperature (T_A) = 25°C Unless Otherwise Specified

CHARACTERISTICS	SYMBOL	LIMITS MIN.	LIMITS MAX.	UNITS
Collector Cutoff Current (V_{CB} = 40V)	I_{CBO}	–	30	nA
(V_{CB} = 40V, T_A = 100°C)	I_{CBO}	–	10	μA
(V_{CB} = 40V base-emitter junction short-circuited)	I_{CES}	–	30	nA
Emitter Cutoff Current (V_{EB} = 5V)	I_{EBO}	–	100	
DC Forward Current Transfer Ratio (V_{CE} = 4.5V, I_C = 2 mA)	h_{FE}	180	540	–
Collector Emitter Breakdown Voltage (I_C = 10 mA)	$V_{(BR)CEO}$	40	–	V
Collector Base Breakdown Voltage (I_C = 10 μA)	$V_{(BR)CBO}$	60	–	
Emitter Base Breakdown Voltage (I_E = 0.1 μA)	$V_{(BR)EBO}$	5	–	
Collector Saturation Voltage (I_B = 3 mA, I_C = 50 mA)	$V_{CE(sat)}$	–	0.3	
Base Saturation Voltage (I_B = 3 mA, I_C = 50 mA)	$V_{BE(sat)}$	–	0.85	
Small-Signal Forward Current Transfer Ratio (V_{CE} = 4.5 V, I_C = 2 mA, f = 1 kHz)	h_{fe}	180	–	–
(V_{CE} = 10V, I_C = 1 mA, f = 1 kHz)		180 typ.		
Input Impedance (V_{CE} = 10V, I_C = 1 mA, f = 1 kHz)	h_{ie}	5100 typ.		Ω
Output Admittance (V_{CE} = 10V, I_C = 1 mA, f = 1 kHz)	h_{oe}	14 typ.		μmhos
Voltage Feedback Ratio (V_{CE} = 10V, I_C = 1 mA, f = 1 kHz)	h_{re}	0.27 typ.		x 10-3

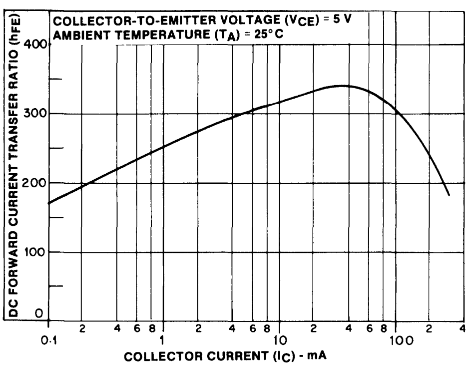


Fig. 1 — Typical dc forward current transfer ratio characteristics.

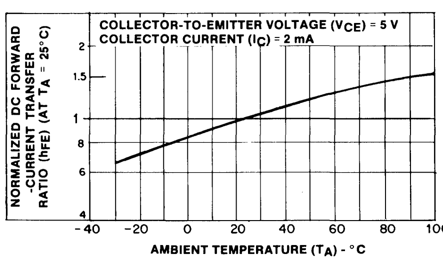


Fig. 2 — Normalized dc forward current transfer ratio characteristics.

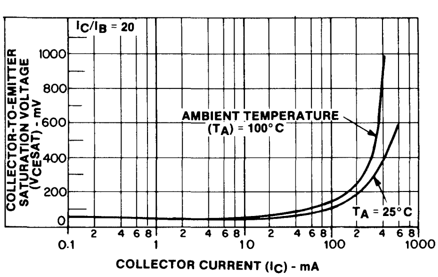


Fig. 3 — Typical collector-to-emitter saturation voltage characteristics.

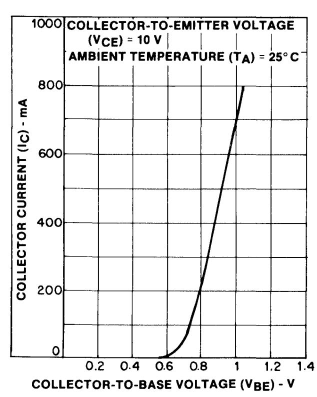


Fig. 4 — Typical collector current characteristic.

2N4424

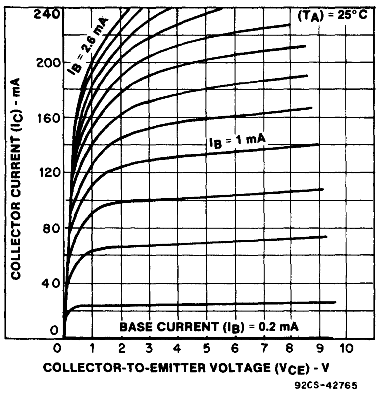


Fig. 5 — Typical collector current characteristics.

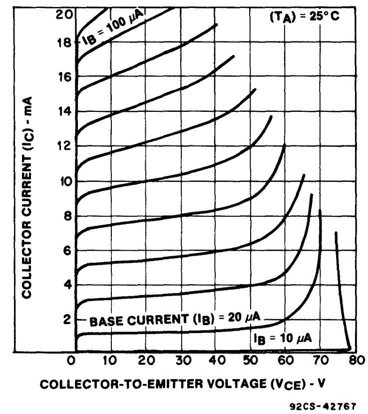


Fig. 6 — Typical collector currect characteristics.

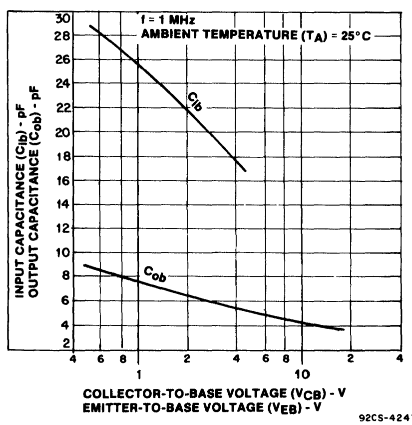


Fig. 7 — Typical input and output capacitance characteristics.

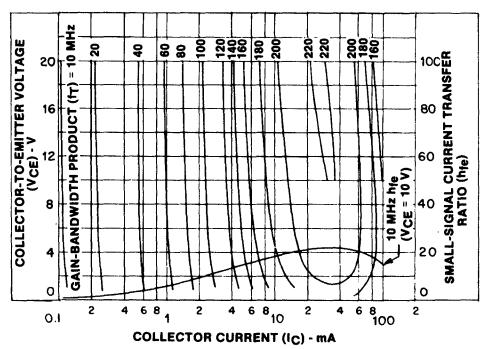


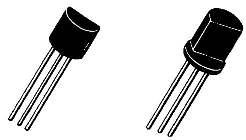
Fig. 8 — Typical gain-bandwidth product characteristics.

TERMINAL CONNECTIONS

Lead 1 - Emitter
Lead 2 - Collector
Lead 3 - Base

2N5172, MPS5172, PN5172, 2N6076

Silicon Transistors



TO-92 TO-98

The GE/RCA 2N, MPS, PN5172 are NPN and 2N6076 is a PNP silicon transistors designed for general purpose applications. The planar, passivated construction assures excellent device stability and life. This high performance and high value is made possible by advanced manufacturing techniques, epoxy encapsulation and utilization of full line beta distribution. Significant savings may be realized by designing equipment utilizing these "full line distribution" type transistors.

PNP values are negative; observe proper polarity. These types are supplied in JEDEC TO-92 package (MPS5172, PN5172) and in JEDEC TO-98 package (2N5172, 2N6076).

Devices in TO-98 package are supplied with and without seating flange (see Dimensional Outline).

MAXIMUM RATINGS, *Absolute-Maximum Values:*

COLLECTOR TO EMITTER VOLTAGE (V_{CEO}) .... 25 V
COLLECTOR TO BASE VOLTAGE (V_{CBO}) .... 25 V
EMITTER TO BASE VOLTAGE (V_{EBO}) .... 5 V
CONTINUOUS COLLECTOR CURRENT (I_C) (Note 1) .... 100 mA
TOTAL POWER DISSIPATION ($T_A \leq 25°C$) (P_T) (Note 2) .... 360 mW
OPERATING TEMPERATURE (T_J) .... −55° to +150°C
STORAGE TEMPERATURE (T_{STG}) .... −55° to +150°C
LEAD TEMPERATURE, 1/16" ± 1/32" (1.58mm ± 0.8mm) from case for 10 sec. max. (T_L) .... +260°C

NOTES:
1. Determined from power limitations due to saturation voltage at this current.
2. Derate 3.6mW/°C increase in ambient temperature above 25°C

File Number **2061**

2N5172, MPS5172, PN5172, 2N6076

ELECTRICAL CHARACTERISTICS, At Ambient Temperature (T_A) = 25°C Unless Otherwise Specified

CHARACTERISTICS	SYMBOL	LIMITS MIN.	LIMITS MAX.	UNITS
Collector Cutoff Current (V_{CB} = 25V)	I_{CBO}	—	100	nA
(V_{CB} = 25V, T_A = 100°C)	I_{CBO}	—	10	μA
(V_{CB} = 25V, base-emitter junction short-circuited)	I_{CES}	—	100	
Emitter Cutoff Current (V_{EB} = 5V)—5172	I_{EBO}	—	100	nA
(V_{EB} = 3V)—6076	I_{EBO}	—	100	
DC Forward Current Transfer Ratio (V_{CE} = 10 V, I_C = 10 mA)	h_{FE}(1)	100	500	—
Collector Emitter Breakdown Voltage (I_C = 10 mA)	$V_{(BR)CEO}$	25	—	
Collector Saturation Voltage (I_C = 10mA, I_B = 1 mA)	$V_{CE(sat)}$	—	0.25	V
Base Saturation Voltage (I_C = 10 mA, I_B = 1 mA)	$V_{BE(sat)}$	—	0.8	
Base Emitter Voltage (V_{CE} = 10V, I_C = 10mA)	V_{BE}	0.5	1.2	
Small-Signal Forward Current Transfer Ratio (V_{CE} = 10 V, I_C = 10 mA, f = 1 kHz)	h_{fe}	100	750	—
Output Capacitance, Common Base (V_{CB} = 10V, I_E = 0, f = 1 kHz)	C_{cb}	1	13	pF
Gain Bandwidth Product (V_{CB} = 5 V, I_C = 2 mA)	f_T	200 Typ.		MHz

(1) Typically a minimum of 50% of the distribution will have $h_{FE} > 150$ at stated conditions.
Note: Polarities are absolute.

TERMINAL CONNECTIONS

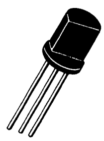
TO-92 Package
Lead 1 - Emitter
Lead 2 - Base
Lead 3 - Collector

TERMINAL CONNECTIONS

TO-98 Package
Lead 1 - Emitter
Lead 2 - Collector
Lead 3 - Base

2N5232, 2N5232A

Silicon Transistors



TO-98

The GE/RCA 2N5232 and 2N5232A are planar epitaxial passivated NPN silicon transistors designed especially for low noise preamplifier and small signal industrial amplifier applications. The units feature low collector saturation voltage, tight beta control and excellent low noise characteristics. The 2N5232A includes a noise figure specification. These types are supplied in JEDEC TO-98 package.

Devices in TO-98 package are supplied with and without seating flange (see Dimensional Outline).

2

MAXIMUM RATINGS, *Absolute-Maximum Values:*

COLLECTOR TO EMITTER VOLTAGE (V_{CEO})	50 V
EMITTER TO BASE VOLTAGE (V_{EBO})	5 V
COLLECTOR TO BASE VOLTAGE (V_{CBO})	70 V
CONTINUOUS COLLECTOR CURRENT (I_C) (Note 1)	100 mA
TOTAL POWER DISSIPATION ($T_A \leq 25°C$) (P_T) (Note 2)	360 mW
OPERATING TEMPERATURE (T_J)	−55° to +125°C
STORAGE TEMPERATURE (T_{STG})	−55° to +150°C
LEAD TEMPERATURE, 1/16" ± 1/32" (1.58mm ± 0.8mm) from case for 10s max. (T_L)	+260°C

NOTES:
1. Determined from power limitations due to saturation voltage at this current.
2. Derate 3.6mW/°C increase in ambient temperature above 25°C

File Number **2063**

2N5232, 2N5232A

ELECTRICAL CHARACTERISTICS, At Ambient Temperature (T_A) = 25°C Unless Otherwise Specified

CHARACTERISTICS	SYMBOL	LIMITS MIN.	TYP.	MAX.	UNITS
Collector Cutoff Current (V_{CB} = 50V)	I_{CBO}	–	–	30	nA
(V_{CB} = 50V, T_A = 100°C	I_{CBO}	–	–	10	μA
Collector Cutoff Current (V_{CB} = 50V, base-emitter junction short-curcuited)	I_{CES}	–	–	30	nA
Emitter Cutoff Current (V_{EB} = 5V)	I_{EBO}	–	–	50	nA
DC Forward Current Transfer Ratio (V_{CE} = 5V, I_C = 2 mA)	h_{FE}	250	–	500	–
(V_{CE} = 5V, I_C = 100μA)	h_{FE}	–	170*	–	–
Small-Signal Forward Current Transfer Ratio (V_{CE} = 5 V, I_C = 2 mA, f = 1 kHz)	h_{fe}	250	–	750	–
Collector Emitter Breakdown Voltage (I_C = 10 mA)	$V_{(BR)CEO}$**	50	–	–	V
Collector Base Breakdown Voltage (I_C = 10 μA)	$V_{(BR)CBO}$	70	–	–	V
Emitter Base Breakdown Voltage (I_E = 10 μA)	$V_{(BR)EBO}$	5	–	–	V
Collector Saturation Voltage (I_C = 10 mA, I_B = 1 mA)	$V_{CE(sat)}$**	–	–	0.125	V
Base Saturation Voltage (I_C = 10 mA, I_B = 1 mA)	$V_{BE(sat)}$**	–	–	0.78	V
Base Emitter Voltage (V_{CE} = 10 V, I_C = 2 mA)	V_{BE}	0.5	–	0.9	V
Output Capacitance, Common Base (V_{CB} = 10 V, I_E = 0, f = 1MHz)	C_{cb}	–	–	4	pF
Noise Figure (I_C = 100 μA, V_{CE} = 5 V, R_R = 5kΩ, f = 1 kHz, BW = 15.7 kHz) For 2N5232A only.	NF		1	5	dB

*Typically, a minimum of 95% of the distribution is above this value.
**Pulse conditions: 300 μs pulse width, ≤2% duty cycle.

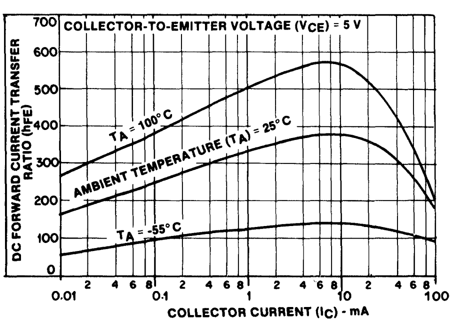


Fig. 1 — Typical dc forward current transfer ratio characteristics.

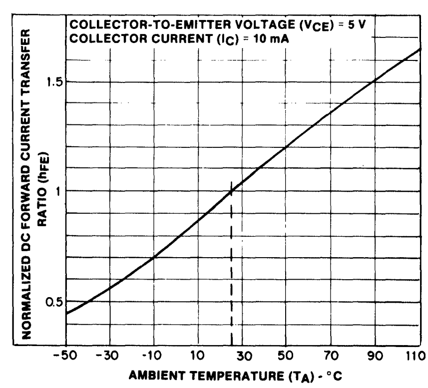


Fig. 2 — Normalized dc forward-current transfer ratio characteristic.

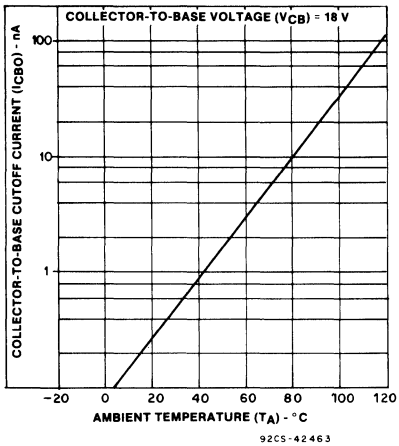


Fig. 3 — Typical collector cutoff current characteristic.

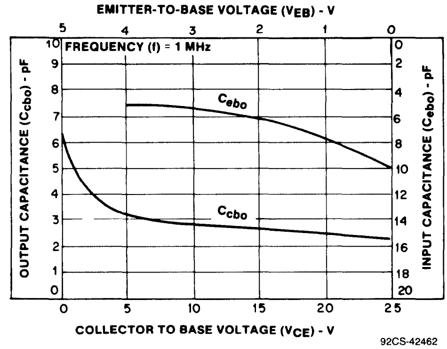


Fig. 4 — Typical input and output capacitance characteristics.

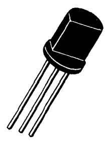
2

TERMINAL CONNECTIONS

Lead 1 - Emitter
Lead 2 - Collector
Lead 3 - Base

2N5249, 2N5249A

Silicon Transistors



TO-98

The GE/RCA 2N5249 and 2N5249A are planar epitaxial passivated NPN silicon transistors designed especially for low noise preamplifier and small signal industrial amplifier applications. The units feature low collector saturation voltage, tight beta control and excellent low noise characteristics. The 2N5249A includes a noise figure specifiation. These types are supplied in JEDEC TO-98 package.

Devices in TO-98 package are supplied with and without seating flange (see Dimensional Outline).

MAXIMUM RATINGS, *Absolute-Maximum Values:*

COLLECTOR TO EMITTER VOLTAGE (V_{CEO})	50 V
COLLECTOR TO BASE VOLTAGE (V_{CBO})	70 V
EMITTER TO BASE VOLTAGE (V_{EBO})	5 V
CONTINUOUS COLLECTOR CURRENT (I_C) (Note 1)	100 mA
TOTAL POWER DISSIPATION ($T_A \leq 25°C$) (P_T) (Note 2)	360 mW
TOTAL POWER DISSIPATION ($T_A \leq 55°C$) (P_T) (Note 2)	260 mW
OPERATING TEMPERATURE (T_J)	−55° to +125°C
STORAGE TEMPERATURE (T_{STG})	−55° to +150°C
LEAD TEMPERATURE, 1/16" ± 1/32" (1.58mm ± 0.8mm) from case for 10s max. (T_L)	+260°C

NOTES:
1. Determined from power limitations due to saturation voltage at this current.
2. Derate 3.3mW/°C increase in ambient temperature above 25°C

File Number **2064**

2N5249, 2N5249A

ELECTRICAL CHARACTERISTICS, At Ambient Temperature (T_A) = 25°C Unless Otherwise Specified

CHARACTERISTICS	SYMBOL	LIMITS MIN.	TYP.	MAX.	UNITS
Collector Cutoff Current (V_{CB} = 50V)	I_{CBO}	–	–	30	nA
(V_{CB} = 50V, T_A = 100°C		–	–	10	μA
Collector Cutoff Current (V_{CB} = 50V, base-emitted junction short-circuited)	I_{CES}	–	–	30	nA
Emitter Cutoff Current (V_{EB} = 5V)	I_{EBO}	–	–	50	
DC Forward Current Transfer Ratio (V_{CE} = 5 V, I_C = 2 mA)	h_{FE}	400	–	800	–
(V_{CE} = 5 V, I_C = 100 μA)		–	300*	–	
Small-Signal Forward Current Transfer Ratio (V_{CE} = 5 V, I_C = 2 mA, f = 1 kHz)	h_{fe}	400	–	1200	–
Collector Emitter Breakdown Voltage (I_C = 10 mA)	$V_{(BR)CEO}$**	50	–	–	V
Collector Base Breakdown Voltage (I_C = 10 μA)	$V_{(BR)CBO}$	70	–	–	
Emitter Base Breakdown Voltage (I_E = 10 μA)	$V_{(BR)EBO}$	5	–	–	
Collector Saturation Voltage (I_C = 10mA, I_B = 1 mA)	$V_{CE(sat)}$**	–	–	0.125	
Base Saturation Voltage (I_C = 10 mA, I_B = 1 mA)	$V_{BE(sat)}$**	–	–	0.78	
Base Emitter Voltage (V_{CE} = 10V, I_C = 2 mA)	V_{BE}	0.5	–	0.9	
Output Capacitance, Common Base (V_{CB} = 10V, I_E = 0, f = 1 MHz)	C_{cb}	–	–	4	pF
Noise Figure (I_C = 100 μA, V_{CE} = 5 V, R_g = 5 kΩ, f = 1kHz, BW = 15.7 kHz) For 2N5249A only.	NF	–	–	3	dB

*Typically a minimum of 95% of the distribution is above this value.
**Pulse conditions: 300 μs pulse width, ≤2% duty cycle.

2

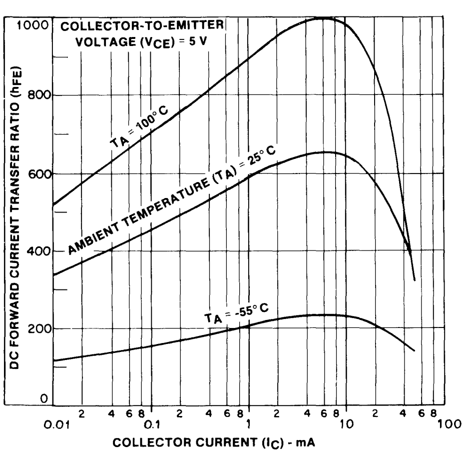


Fig. 1 — Typical dc forward-current transfer ratio characteristics.

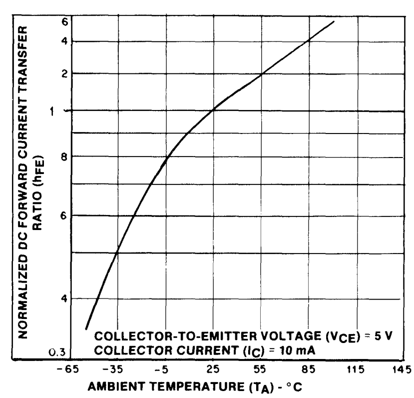


Fig. 2 — Normalized dc forward-current transfer ratio characteristic.

2N5249, 2N5249A

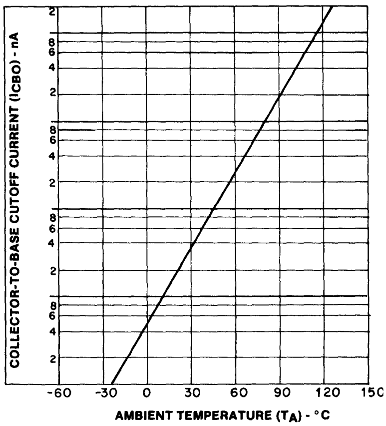


Fig. 3 — Typical collector cutoff current characteristic.

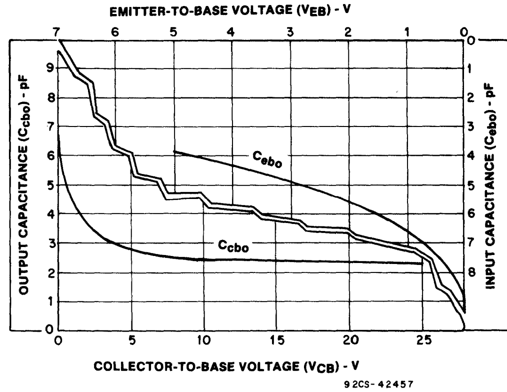


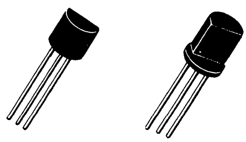
Fig. 4 — Typical input and output capacitance characteristics.

TERMINAL CONNECTIONS

Lead 1 - Emitter
Lead 2 - Collector
Lead 3 - Base

2N5305, 6, 6A, GES5305, 6, 6A

Silicon Darlington Transistors



TO-92 TO-98

2

The GE/RCA 2N5305, 06, 06A and GES5305, 6, and 6A are planar, epitaxial, passivated NPN silicon Darlington transistors designed for preamplifier stages requiring input impedances of several megohms or extremely low-level, high-gain low-noise amplifier applications. These types can be used in medium-speed switching circuits in consumer and industrial control applications.

The 2N5305, 6, and 6A are supplied in JEDEC TO-98 package, the GES5305, 6, and 6A are supplied in JEDEC TO-92 package.

Devices in TO-98 package are supplied with and without seating flange (see Dimensional Outline).

MAXIMUM RATINGS, *Absolute-Maximum Values:*

COLLECTOR TO EMITTER VOLTAGE (V_{CEO})	25 V
EMITTER TO BASE VOLTAGE (V_{EBO})	12 V
COLLECTOR TO BASE VOLTAGE (V_{CBO})	25 V
CONTINUOUS COLLECTOR CURRENT (I_C)	300 mA
COLLECTOR CURRENT (PULSED)* (I_C)	500 mA
CONTINUOUS BASE CURRENT (I_B)	50 mA
TOTAL POWER DISSIPATION ($T_A \leq 25°C$) (P_T)	400 mW
DERATE FACTOR ($T_A > 25°C$)	4 mW/°C
OPERATING TEMPERATURE (T_J)	−65° to +125°C
STORAGE TEMPERATURE (T_{STG})	−65° to +150°C
LEAD TEMPERATURE, 1/16" ± 1/32" (1.58mm ± 0.8mm) from case for 10s max (T_L)	+260°C

*Pulsed Conditions: Pulse width ≤ 300 μs, Duty factor ≤ 2%.

File Number **2065**

2N5305, 6, 6A, GES5305, 6, 6A

ELECTRICAL CHARACTERISTICS, At Ambient Temperature (T_A) = 25°C Unless Otherwise Specified

CHARACTERISTICS	SYMBOL	LIMITS MIN.	LIMITS MAX.	UNITS
Collector-To-Emitter Breakdown Voltage (I_C = 10 mA, I_B = 0)	BV_{CEO}	25	–	
Collector-To-Base Breakdown Voltage (I_C = 0.1μA, I_E = 0)	BV_{CBO}	25	–	V
Emitter-To-Base Breakdown Voltage (I_E = 0.1μA, I_C = 0)	BV_{EBO}	12	–	
DC Forward Current Transfer Ratio (I_C = 2mA, V_{CE} = 5V) 2N5305, GES5305		2,000	20,000	
(I_C = 100mA, V_{CE} = 5V) 2N5305, GES5305	h_{FE}	6,000	–	–
(I_C = 2 mA, V_{CE} = 5V) 2N5306, GES5306A		7,000	70,000	
(I_C = 100mA, V_{CE} = 5V) 2N5306, GES5306A		20,000	–	
Collector-To-Emitter Saturation Voltage (I_C = 200mA, I_B = 0.2mA)	V_{CE}(sat)	–	1.4	
Base-To-Emitter Saturation Voltage (I_C = 200mA, I_B = 0.2mA)	V_{BE}(sat)	–	1.6	V
Base-To-Emitter Voltage (I_C = 200mA, V_{CE} = 5V)	V_{BE}	–	1.5	
Collector-To-Base Cutoff Current (V_{CB} = 25V, I_E = 0)	I_{CBO}	–	100	nA
(V_{CB} = 25V, I_E = 0, T_A = 100°)C)		–	20	μA
Small-Signal Current Transfer Ratio (V_{CE} = 5V, I_C = 2mA, f = 1 KHZ) 2N5305, GES5305	h_{fe}	2,000	–	
(V_{CE} = 5V, I_C = 2mA, f = 1 KHZ) 2N5306, 6A, GES5306, 6A		7,000	–	–
(V_{CE} = 5V, I_C = 2mA, f = 10 MHZ)	$\|h_{fe}\|$	15.6	–	dB
Input Capacitance (V_{EB} = 0.5V, f = 1 MHZ)	C_{eb}	10.5 Typical		pF
Output Capacitance (V_{CB} = 10V, f = 1 MHZ)	C_{cb}	7.6 Typical	10	
Input Impedance (V_{CE} = 5V, I_C = 2mA, f = 1KHz)		650 Typical		KΩ
Gain-Bandwidth Product (V_{CE} = 5V, I_C = 2mA, f = 10MHz)	f_T	60	–	MHZ
Noise Figure (V_{CE} = 5V, I_C = 0.6mA, Rg = 160 kΩ, f = 10 Hz, to 10 kHz, Bandwidth = 15.7 kHz) 2N5306A, GES5306A	$\bar{e_n}$	195 Typical	230	nV/√Hz

TERMINAL CONNECTIONS

TO-92 Package
Lead 1 - Emitter
Lead 2 - Base
Lead 3 - Collector

TERMINAL CONNECTIONS

TO-98 Package
Lead 1 - Emitter
Lead 2 - Collector
Lead 3 - Base

2N5305, 6, 6A, GES5305, 6, 6A

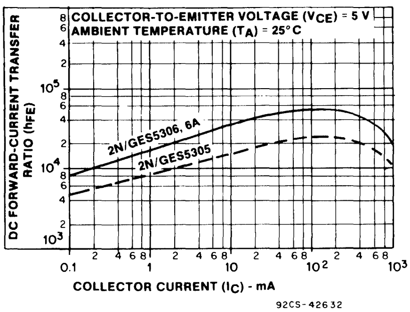


Fig. 1 — Typical dc forward-current transfer ratio characteristics.

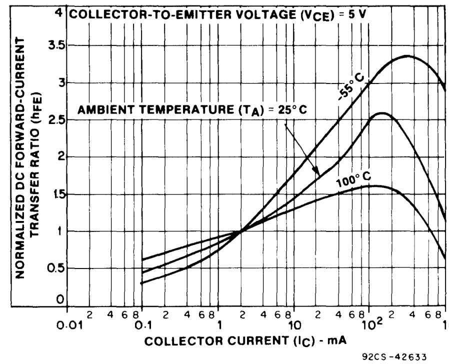


Fig. 2 — Normalized dc forward-current transfer ratio characteristics.

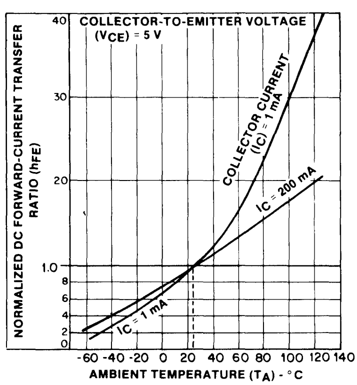


Fig. 3 — Normalized dc forward-current transfer ratio characteristics.

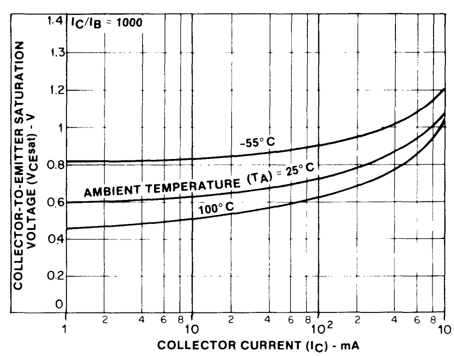


Fig. 4 — Typical collector-to-emitter saturation voltage characteristics.

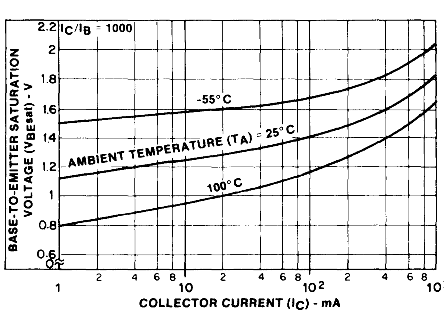


Fig. 5 — Typical base-to-emitter saturation voltage characteristics.

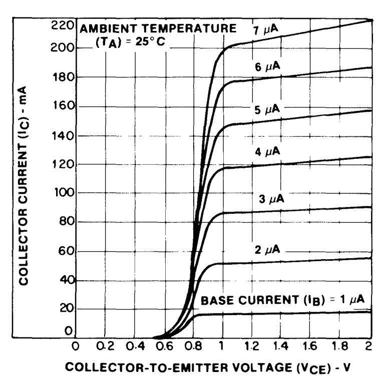


Fig. 6 — Typical output characteristics.

2N5305, 6, 6A, GES5305, 6, 6A

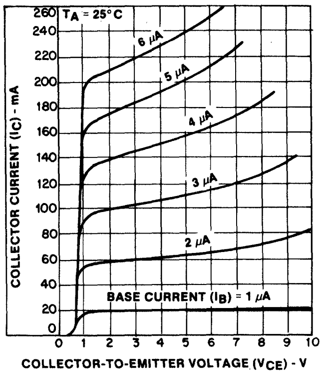


Fig. 7—Typical output characteristics.

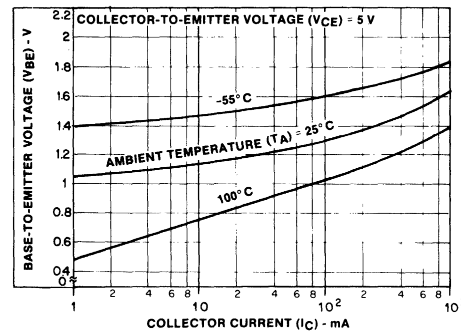


Fig. 8—Typical transfer characteristics.

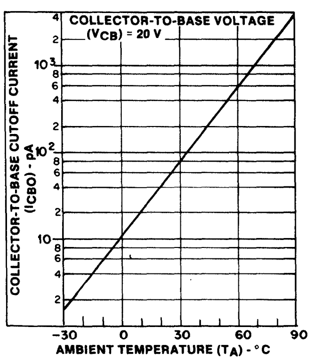


Fig. 9—Typical collector-to-base cutoff current characteristic.

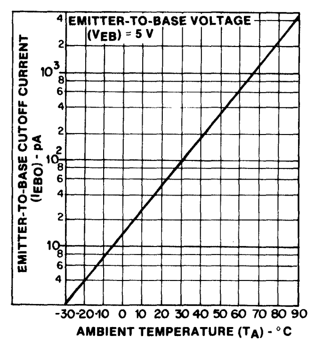
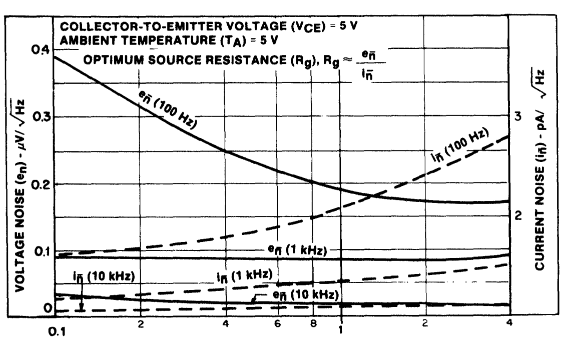


Fig. 10—Typical emitter-to-base cutoff current characteristic.



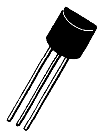
NOTE:
DUE TO THE NOISE CHARACTERISTICS OF THIS DEVICE VERSUS FREQUENCY, CALCULATION OF NOISE FIGURE (NF) FROM $e_{\bar{n}}$, $i_{\bar{n}}$ VALUES IS NOT ACCURATE [AS IS THE CASE WITH FIELD-EFFECT TRANSISTORS (FETs)].

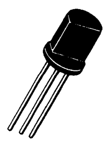
92CS-42629

Fig. 11—Equivalent input noise-voltage and noise-current characteristics

2N5307, 8, 8A, GES5307, 8, 8A

Silicon Darlington Transistors


TO-92


TO-98

The GE/RCA 2N5307, 08, 08A and GES5307, 8, and 8A are planar, epitaxial, passivated NPN silicon Darlington transistors designed for preamplifier stages requiring input impedances of several megohms or extremely low-level, high-gain low-noise amplifier applications. These types can be used in medium-speed switching circuits in consumer and industrial control applications.

The 2N5307, 08, and 08A are supplied in JEDEC TO-98 package, the GES5307, 08, and 08A are supplied in JEDEC TO-92 package.

Devices in TO-98 package are supplied with and without seating flange (see Dimensional Outline).

MAXIMUM RATINGS, *Absolute-Maximum Values:*

COLLECTOR TO EMITTER VOLTAGE (V_{CEO})	40 V
EMITTER TO BASE VOLTAGE (V_{EBO})	12 V
COLLECTOR TO BASE VOLTAGE (V_{CBO})	40 V
CONTINUOUS COLLECTOR CURRENT (I_C)	300 mA
COLLECTOR CURRENT (PULSED)* (I_C)	500 mA
CONTINUOUS BASE CURRENT (I_B)	50 mA
TOTAL POWER DISSIPATION ($T_A \leq 25°C$) (P_T)	400 mW
DERATE FACTOR ($T_A > 25°C$)	4 mW/°C
OPERATING TEMPERATURE (T_J)	−65° to +125°C
STORAGE TEMPERATURE (T_{STG})	−65° to +150°C
LEAD TEMPERATURE, 1/16" ± 1/32" (1.58mm ± 0.8mm) from case for 10s max (T_L)	+260°C

*Pulsed Conditions: Pulse width ≤ 300 μs, Duty factor ≤ 2%.

File Number **2014**

2N5307, 8, 8A, GES5307, 8, 8A

ELECTRICAL CHARACTERISTICS, At Ambient Temperature (T_A) = 25°C Unless Otherwise Specified

CHARACTERISTICS	SYMBOL	LIMITS MIN.	MAX.	UNITS
Collector-To-Emitter Breakdown Voltage (I_C = 10 mA, I_B = 0)	BV_{CEO}	40	–	V
Collector-To-Base Breakdown Voltage (I_C = 0.1μA, I_E = 0)	BV_{CBO}	40	–	V
Emitter-To-Base Breakdown Voltage (I_E = 0.1μA, I_C = 0)	BV_{EBO}	12	–	V
DC Forward Current Transfer Ratio (I_C = 2mA, V_{CE} = 5V) 2N5307, GES5307	h_{FE}	2,000	20,000	–
(I_C = 100mA, V_{CE} = 5V) 2N5307, GES5307		6,000	–	
(I_C = 2 mA, V_{CE} = 5V) 2N5308, GES5308A		7,000	70,000	
(I_C = 100mA, V_{CE} = 5V) 2N5308, GES5308A		20,000	–	
Collector-To-Emitter Saturation Voltage (I_C = 200mA, I_B = 0.2mA)	V_{CE}(sat)	–	1.4	V
Base-To-Emitter Saturation Voltage (I_C = 200mA, I_B = 0.2mA)	V_{BE}(sat)	–	1.6	V
Base-To-Emitter Voltage (I_C = 200mA, V_{CE} = 5V)	V_{BE}	–	1.5	V
Collector-To-Base Cutoff Current (V_{CB} = 25V, I_E = 0)	I_{CBO}	–	100	nA
(V_{CB} = 25V, I_E = 0, T_A = 100°)C)		–	20	μA
Small-Signal Current Transfer Ratio (V_{CE} = 5V, I_C = 2mA, f = 1 KHZ) 2N5307, GES5307	h_{fe}	2,000	–	–
(V_{CE} = 5V, I_C = 2mA, f = 1 KHZ) 2N5308, 8A, GES5308, 8A		7,000	–	
(V_{CE} = 5V, I_C = 2mA, f = 10 MHZ)	$\lvert h_{fe} \rvert$	15.6	–	dB
Input Capacitance (V_{EB} = 0.5V, f = 1 MHZ)	C_{eb}	10.5 Typical		pF
Output Capacitance (V_{CB} = 10V, f = 1 MHZ)	C_{cb}	7.6 Typical	10	pF
Input Impedance (V_{CE} = 5V, I_C = 2mA, f = 1KHz)		650 Typical		KΩ
Gain-Bandwidth Product (V_{CE} = 5V, I_C = 2mA, f = 10MHz)	f_T	60	–	MHZ
Noise Figure (V_{CE} = 5V, I_C = 0.6mA, Rg = 160 kΩ, f = 10 Hz, to 10 kHz, Bandwidth = 15.7 kHz) 2N5308A, GES5308A	$\bar{e_n}$	195 Typical	230	nV/√Hz

2N5307, 8, 8A, GES5307, 8, 8A

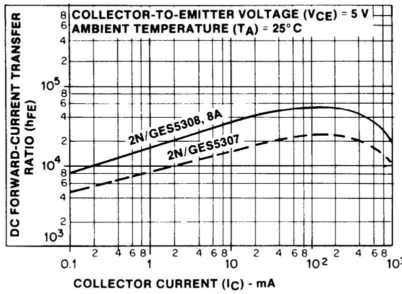


Fig. 1 — Typical dc forward-current transfer ratio characteristics.

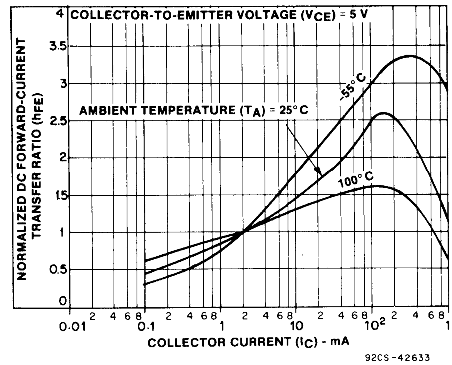


Fig. 2 — Normalized dc forward-current transfer ratio characteristics.

2

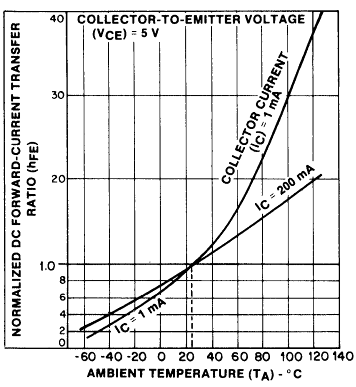


Fig. 3 — Normalized dc forward-current transfer ratio characteristics.

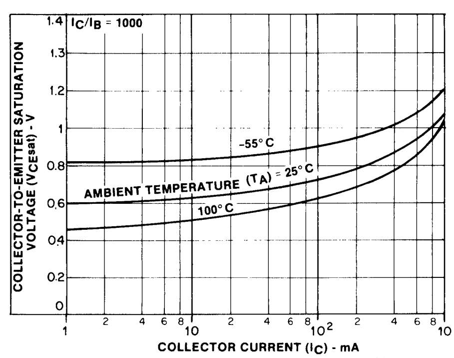


Fig. 4 — Typical collector-to-emitter saturation voltage characteristics.

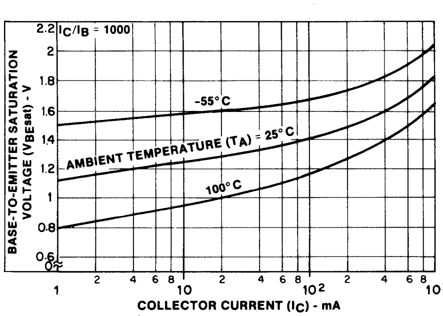


Fig. 5 — Typical base-to-emitter saturation voltage characteristics.

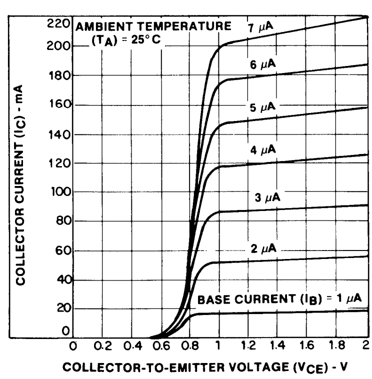


Fig. 6 — Typical output characteristics.

2N5307, 8, 8A, GES5307, 8, 8A

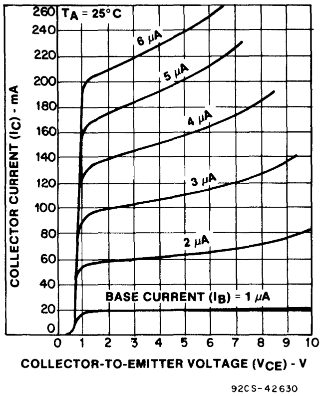


Fig. 7 — Typical output characteristics.

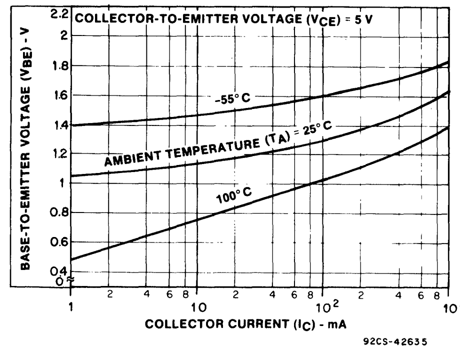


Fig. 8 — Typical transfer characteristics.

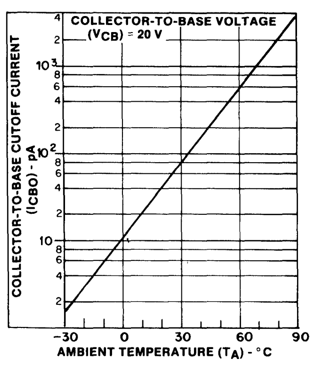


Fig. 9 — Typical collector-to-base cutoff current characteristic.

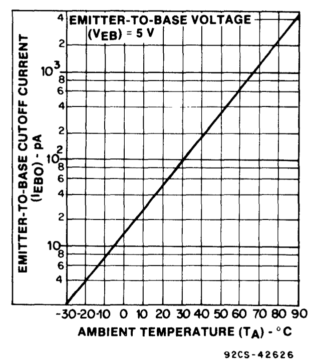
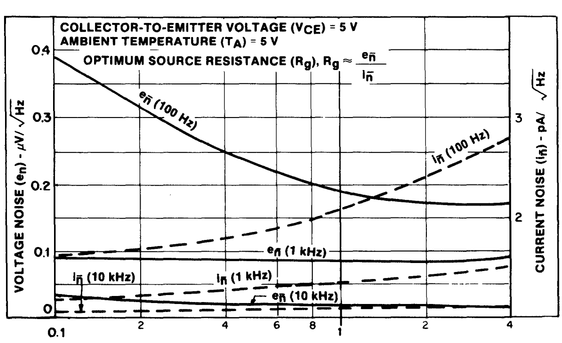


Fig. 10 — Typical emitter-to-base cutoff current characteristic.



NOTE:
DUE TO THE NOISE CHARACTERISTICS OF THIS DEVICE VERSUS FREQUENCY, CALCULATION OF NOISE FIGURE (NF) FROM $e_{\bar{n}}$, $i_{\bar{n}}$ VALUES IS NOT ACCURATE [AS IS THE CASE WITH FIELD-EFFECT TRANSISTORS (FETs)].

92CS-42629

Fig. 11 — Equivalent input noise-voltage and noise-current characteristics.

TERMINAL CONNECTIONS

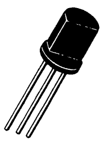
TO-92 Package
Lead 1 - Emitter
Lead 2 - Base
Lead 3 - Collector

TERMINAL CONNECTIONS

TO-98 Package
Lead 1 - Emitter
Lead 2 - Collector
Lead 3 - Base

2N5365, 2N5366

Silicon Transistors



TO-98

This GE/RCA series of economy transistors are planar epitaxial passivated PNP silicon devices. These units feature low collector saturation voltage, good current gain linearity over a wide collector current range, high gain-bandwidth product, and low noise. These characteristics make these units excellent for use in general purpose consumer and industrial amplifier and switching applications. These types are supplied in JEDEC TO-98 package.

Devices in TO-98 package are supplied with and without seating flange (see Dimensional Outline).

MAXIMUM RATINGS, *Absolute-Maximum Values:*

COLLECTOR TO EMITTER VOLTAGE (V_{CEO})	40 V
COLLECTOR TO BASE VOLTAGE (V_{CBO})	4 V
EMITTER TO BASE VOLTAGE (V_{EBO})	40 V
CONTINUOUS COLLECTOR CURRENT (I_C)	300 mA
COLLECTOR CURRENT (Pulsed) (I_C	700 mA
TOTAL POWER DISSIPATION ($T_A \leq 25°C$)**	360 mW
TOTAL POWER DISSIPATION ($T_A \leq 55°C$)**	260 mW
OPERATING TEMPERATURE (T_J)	−65 to +125 °C
STORAGE TEMPERATURE (T_{STG})	−65 to +150 °C
LEAD TEMPERATURE, 1/16" ± 1/32" (1.58mm ± 0.8mm) from case at 10s max. (T_L)	+260 °C

* Pulsed conditions: 10μs pulse width, ≤2% duty cycle.

** Derate 3.6mW/°C increase in ambient temperature above 25°C.

File Number **2066**

2N5365, 2N5366

ELECTRICAL CHARACTERISTICS, At Ambient Temperature (T_A) = 25°C Unless Otherwise Specified

CHARACTERISTICS	SYMBOL	LIMITS 2N5365 MIN.	TYP.	MAX.	2N5366 MIN.	TYP.	MAX	UNITS
Collector-Emitter Breakdown Voltage (I_C = 10 mA)	$V_{(BR)CEO}$	−40	—	—	−40	—	—	V
Collector Cutoff Current (V_{CB} = −40V)	I_{CBO}	—	—	−100	—	—	−100	nA
(V_{CB} = −40V, T_A = 100°C)		—	—	−10	—	—	−10	µA
Cutoff Current (V_{EB} = −4V)	I_{EBO}	—	—	−10	—	—	−10	µA
DC Forward Current Transfer Ratio (V_{CE} = −10V, I_C = −2mA)	h_{FE}	32	—	—	80	—		—
(V_{CE} = −10, I_C = −50mA)	h_{FE}	40	—	120	100	—	300	—
(V_{CE} = −5V, I_C = −300mA)	h_{FE}	20	—	—	40	—		—
Small-Signal Forward Current Transfer Ratio (V_{CE} = −10V, I_C = −2mA, f = 1kHz)	h_{fe}	32	—	180	80	—	450	—
Collector-Emitter Saturation Voltage (I_C = −50mA, I_B = −2.5mA)	$V_{CE(SAT)}$	—	—	−0.25	—	—	−0.25	V
(I_C = −300mA, I_B = −30mA)	$V_{CE(SAT)}$	—	—	−1	—	—	−1	V
Base-Emitter Voltage (V_{CE} = −10V, I_C = −2mA)	V_{BE}	−0.5	—	−0.8	−0.5	—	−0.8	V
Output Capacitance, Common Base (V_{EB} = −0.5V, I_E = 0, f = 1MHz)	C_{cb}	—	—	8	—	—	8	pF
Input Capacitance, Common Base (V_{EB} = −0.5V, I_C = 0, f = 1MHz)	C_{eb}	—	—	35	—	—	35	pF
Gain Bandwidth Product (V_{CE} = −10V, I_C = −2mA)	f_T	—	250	—	—	250	—	MHz

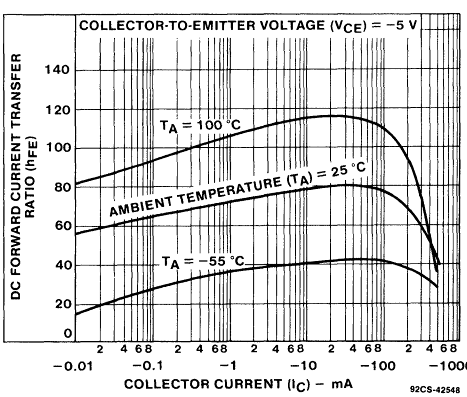


Fig. 1—Typical dc forward current transfer ratio characteristics for 2N5365.

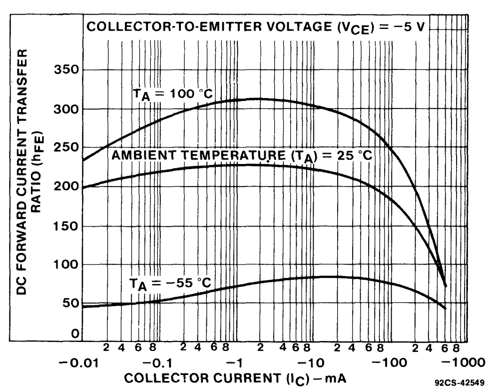


Fig. 2—Typical dc forward-current transfer ratio characteristics for 2N5366.

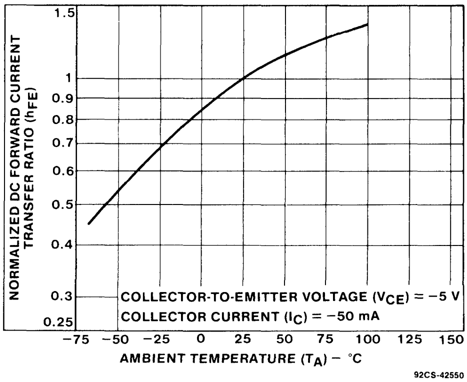


Fig. 3—Normalized dc forward-current transfer ratio characteristics for both types.

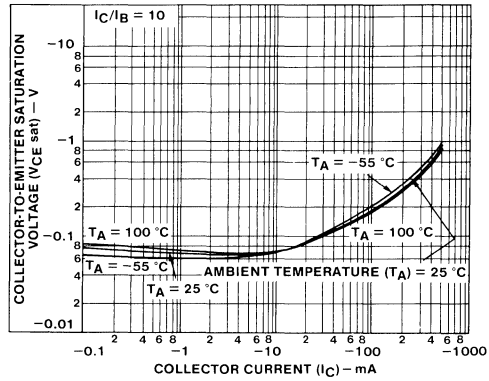


Fig. 4—Typical collector-to-emitter saturation voltage characteristics for 2N5365.

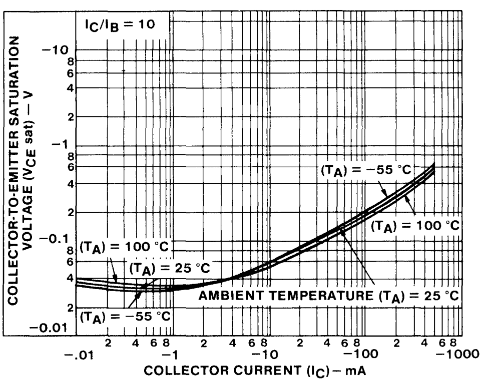


Fig. 5—Typical collector-to-emitter saturation voltage characteristics for 2N5366.

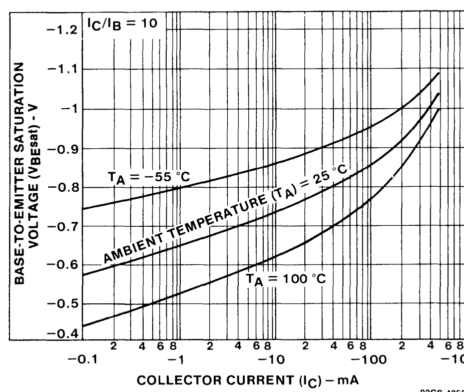


Fig. 6—Typical base-to-emitter saturation voltage characteristics for both types.

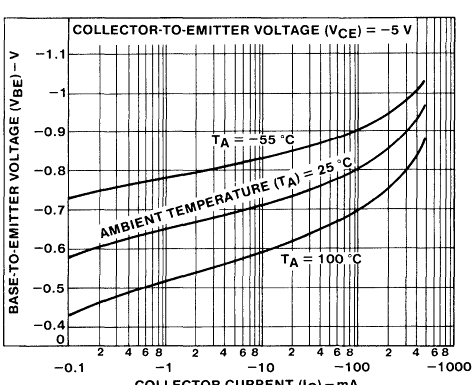


Fig. 7—Typical base-to-emitter voltage characteristics for 2N5365.

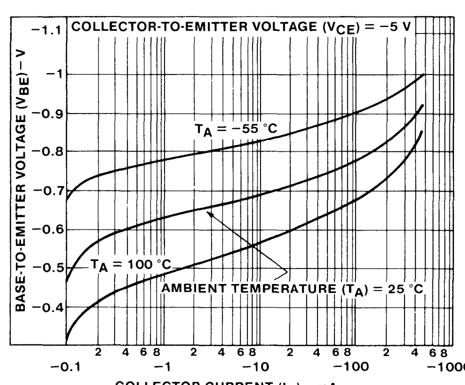


Fig. 8—Typical base-to-emitter voltage characteristics for 2N5366.

2

2N5365, 2N5366

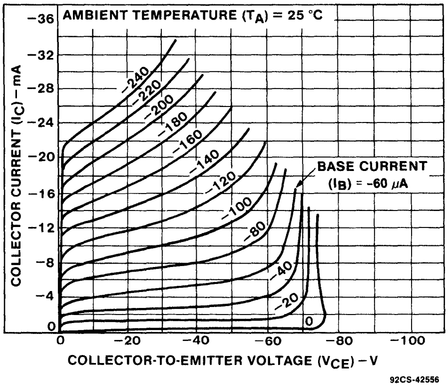


Fig. 9 — Typical collector current characteristics for 2N5365.

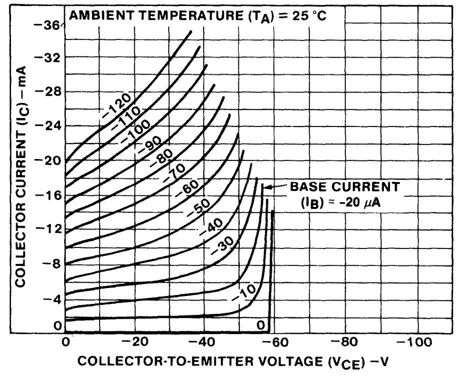


Fig. 10 — Typical collector current characteristics for 2N5366.

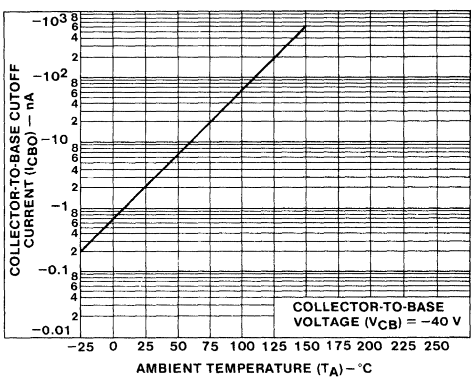


Fig. 11 — Typical collector-to-base cutoff current characteristics for both types.

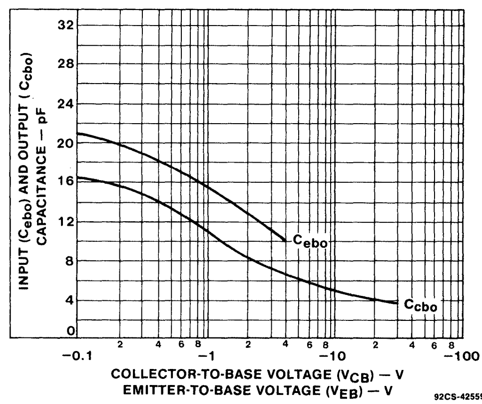


Fig. 12 — Typical input and output capacitance characteristics for both types.

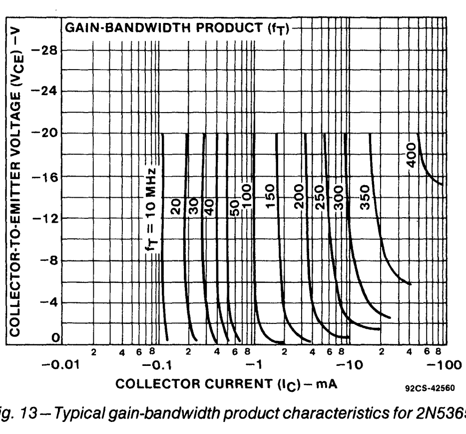


Fig. 13 — Typical gain-bandwidth product characteristics for 2N5365.

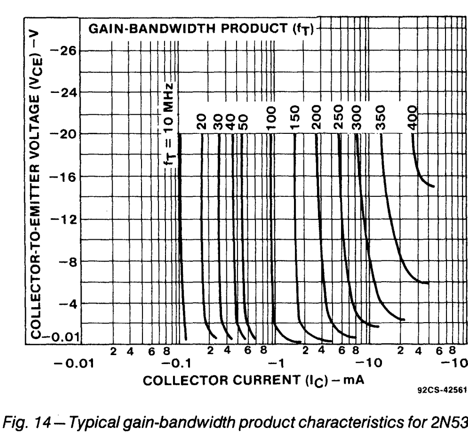


Fig. 14 — Typical gain-bandwidth product characteristics for 2N5366.

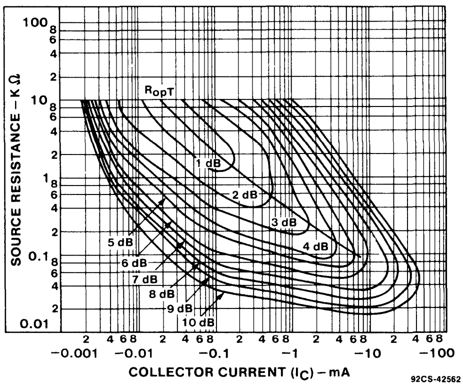


Fig. 15 — Typical noise figure characteristics for 2N5365.

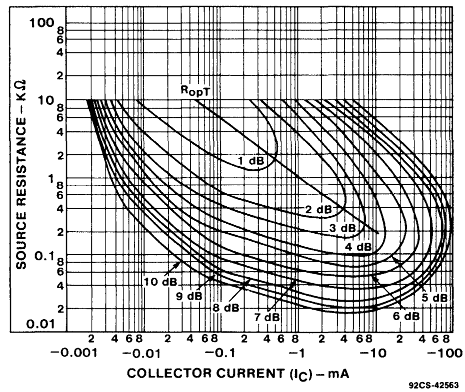


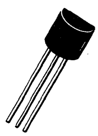
Fig. 16 — Typical noise figure characteristics for 2N5366.

TERMINAL CONNECTIONS

Lead 1 - Emitter
Lead 2 - Collector
Lead 3 - Base

GES2218A, 19A, GES2218, 19

Silicon Transistors



TO-92

The GE/RCA GES2218, A, 19, A series are planar epitaxial NPN silicon transistors designed for medium speed switches and as amplifiers from audio to VHF frequencies. These types are supplied in JEDEC TO-92 package.

MAXIMUM RATINGS, *Absolute-Maximum Values:*

	GES2218 GES2219	GES2218A GES2219A	
COLLECTOR TO EMITTER VOLTAGE (V_{CEO})	30	40	V
EMITTER TO BASE VOLTAGE (V_{EBO})	5	6	V
COLLECTOR TO BASE VOLTAGE (V_{CBO})	60	75	V
CONTINUOUS COLLECTOR CURRENT (I_C)	800	800	mA
TOTAL POWER DISSIPATION $T_C \leq 25°C$ (P_T)	3	1.8	W
TOTAL POWER DISSIPATION $T_A \leq 25°C$ (P_T)	0.8	0.5	W
DERATE FACTOR, $T_C > 25°C$	20	12	mW/°C
DERATE FACTOR, $T_A > 25°C$	5.33	3.33	mW/°C
OPERATING TEMPERATURE (T_J)	−65° to +200		°C
STORAGE TEMPERATURE (T_{STG})	−65° to +200		°C
LEAD TEMPERATURE 1/16" ± 1/32" (1.58mm ± 0.8mm) from case at 10s max. (T_L)	+260		°C

File Number **2067**

GES2218A, 19A, GES2218, 19

ELECTRICAL CHARACTERISTICS, At Ambient Temperature (T_A) = 25°C Unless Otherwise Specified

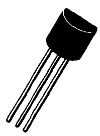
CHARACTERISTICS	SYMBOL	LIMITS GES2218 GES2219		GES2218A GES2219A		UNITS
		MIN.	MAX.	MIN.	MAX	
Collector-Emitter Breakdown Voltage (I_C = 10mA, I_B = 0)	BV_{ECO}	30	–	40	–	V
Collector-Base Breakdown Voltage (I_C = 10μA, I_E = 0)	BV_{CBO}	60	–	75	–	V
Emitter-Base Breakdown Voltage (I_E = 10μA, I_C = 0)	BV_{EBO}	5	–	6	–	V
Collector Cutoff Curernt (V_{CB} = 50V, I_E = 0)	I_{CBO}	–	0.01	–	–	μA
(V_{CB} = 60V, I_E = 0)	I_{CBO}	–	–	–	0.01	μA
Emitter Cutoff Current (V_{EB} = 3V, I_C = 0)	I_{EBO}	–	–	–	10	nA
Collector-Emitter Saturation Voltage (I_C = 150mA, I_B = 15mA)	$V_{BE(SAT)}$	–	0.4	–	0.3	V
(I_C = 500mA, I_B = 50mA)	$V_{BE(SAT)}$	–	1.6	–	1	V
Base-Emitter Saturation Voltage (I_C = 150mA, I_B = 15mA)	$V_{BE(SAT)}$	0.6	2	0.6	1.2	V
(I_C = 500mA, I_B = 50mA)	$V_{BE(SAT)}$	–	2.6	–	2	V
		GES2218 GES2218A		GES2219 GES2219A		
DC Forward Current Transfer Ratio (I_C = 0.1mA, V_{CE} = 10V)	h_{FE}	20	–	35		–
(I_C = 1mA, V_{CE} = 10V)	h_{FE}	25	–	50	–	–
(I_C = 10mA, V_{CE} = 10V)	h_{FE}	35	–	75	–	–
(I_C = 150mA, V_{CE} = 1V)	h_{FE}	20	–	50	–	–
(I_C = 500mA, V_{CE} = 10V)	h_{FE}	20	–	40	–	–
Gain Bandwidth Product (I_C = 20mA, V_{CE} = 20V, f = 100MHz)	f_T	250	–	250*	–	MHz

*f_T for 2219A = 300(min).

TERMINAL CONNECTIONS

Lead 1 - Emitter
Lead 2 - Base
Lead 3 - Collector

GES2221, GES2222, MPS2222, PN2222



TO-92

Silicon Transistors

Features:
- *Performance comparable to hermetic units*
- *High Gain*
- *Low $V_{CE(SAT)}$*
- *High Frequency*
- *Medium Voltage*

The GE/RCA GES2221, GES2222, MPS 2222 and PN2222 are planar passivated epitaxial NPN silicon devices specifically developed for high speed switching, amplifier and core driver applications. The PN, MPS, and GES prefixes can be used interchangeably, characteristics for each line are similar. These types are supplied in JEDEC TO-92 package.

MAXIMUM RATINGS, *Absolute-Maximum Values:*

	GES2221	GES2222 MPS2222 PN2222	
COLLECTOR TO EMITTER VOLTAGE (V_{CEO})	30	30	V
COLLECTOR TO EMITTER VOLTAGE (V_{CES})	40	40	V
EMITTER TO BASE VOLTAGE (V_{EBO})	5	5	V
COLLECTOR TO BASE VOLTAGE (V_{CBO})	60	60	V
CONTINUOUS COLLECTOR CURRENT (I_C)	400	400	mA
COLLECTOR CURRENT (pulsed)* (I_C)	800	800	mA
TOTAL POWER DISSIPATION $T_C \leq 25°C$ (P_T)	1	1	W
TOTAL POWER DISSIPATION $T_A \leq 25°C$ (P_T)	0.36	0.36	W
DERATE FACTOR, $T_C > 25°C$	10	10	mW/°C
DERATE FACTOR, $T_A > 25°C$	3.6	3.6	mW/°C
OPERATING TEMPERATURE (T_J)	−65 to +125		°C
STORAGE TEMPERATURE (T_{STG})	−65 to +200		°C
LEAD TEMPERATURE 1/16" ± 1/32" (1.58mm ± 0.8mm) from case at 10s max. (T_L)	+260		°C

*Pulsed conditions: 10μs pulse width, ≤2% duty cycle.

File Number **2068**

GES2221, GES2222, MPS2222, PN2222

ELECTRICAL CHARACTERISTICS, At Ambient Temperature (T_A) = 25°C Unless Otherwise Specified

CHARACTERISTICS	SYMBOL	LIMITS				UNITS
		GES2221		GES2222, MPS2222, PN2222		
		MIN.	MAX.	MIN.	MAX	
Collector-Emitter Breakdown Voltage (I_C = 10mA, I_B = 0)*	$V_{(BR)CEO}$	30	–	30	–	V
Emitter-Base Breakdown Voltage (I_E = 10μA, I_C = 0)	$V_{(BR)EBO}$	5	–	5	–	V
Collector-Base Breakdown Voltage (I_C = 10μA, I_E = 0)	$V_{(BR)CBO}$	60	–	60	–	V
Collector-Emitter Breakdown Voltage (I_C = 10μA, V_{BE} = 0)	$V_{(BR)CES}$	40	–	40	–	V
Collector-Emitter Saturation Voltage (I_C = 150mA, I_B = 15mA)*	$V_{CE(SAT)}$	–	0.3	–	0.3	V
(I_C = 500mA, I_B = 50mA)*		–	1.2	–	1.2	V
Base-Emitter Saturation Voltage (I_C = 150mA, I_B = 15mA)*	$V_{BE(SAT)}$	–	1.1	–	1.1	V
(I_C = 500mA, I_B = 50mA)*		–	2.4	–	2.4	V
DC Forward Current Transfer Ratio (V_{CE} = 1V, I_C = 150mA)*	h_{FE}	20	–	50	–	–
(V_{CE} = 10V, I_C = 0.1mA)		20	–	35	–	–
(V_{CE} = 10V, I_C = 1.0mA)		25	–	50	–	–
(V_{CE} = 10V, I_C = 10mA)*		35	–	75	–	–
(V_{CE} = 10V, I_C = 150mA)		40	120	100	300	–
(V_{CE} = 10V, I_C = 500mA)*		20	–	30	–	–
Collector Cutoff Current (V_{CB} = 50V, I_E = 0)*	I_{CBO}	–	10	–	10	nA
(V_{CB} = 50V, I_E = 0, T_A = 100°C)*		–	10	–	10	μA
Emitter-Base Reverse Current (V_{EB} = 3V, I_C = 0)	I_{EBO}	–	50	–	50	nA
Gain Bandwidth Product (V_{CE} = 20V, I_C = 20mA, f = 100MHz)	f_T	250	–	250	–	MHz
Collector-Base Capacitance (V_{CB} = 10V, I_E = 0, f = 1MHz)	C_{cb}	–	8	–	8	pF
Emitter-Base Capacitance (V_{EB} = 0.5V, I_C = 0, f = 1MHz)	C_{eb}	–	25	–	25	pF

*Pulse conditions: ≤ 300μs pulse width, ≤ 2% duty cycle.

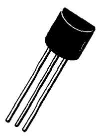
TERMINAL CONNECTIONS

Lead 1 - Emitter
Lead 2 - Base
Lead 3 - Collector

2

GES2906, 6A, 7, 7A, MPS2906, 6A, 7, 7A, GES2221A, 22A, MPS2222A, PN2222A

Silicon Transistors



TO-92

Features:
- *Low leakage currents*
- *High speed switching*
- *Epoxy encapsulation with proved reliablity—excellent characteristic stability under environmental stresses, 85°C @ 85% RH*
- *Low collector saturation voltages*

The GE/RCA GES2221A, 22A, MPS2222A, PN2222A NPN types, and GES2906, 06A, 07, 07A, MPS2906, 06A, 07, and 07A PNP types are planar epitaxial passivated silicon transistors intended for general purpose amplifiers, saturated switching, and core applications. The GES, MPS and PN prefixes can be used interchangeably, characteristics for each line are similar. PNP values are negative; observe proper polarity. These types are supplied in JEDEC TO-92 package.

MAXIMUM RATINGS, *Absolute-Maximum Values:*

	2221A 2222A	2906,06A 2907,07A	
COLLECTOR TO EMITTER VOLTAGE (V_{CEO})	40	−40	V
EMITTER TO BASE VOLTAGE (V_{EBO})	5	−5	V
COLLECTOR TO BASE VOLTAGE (V_{CBO})	75	−60	V
CONTINUOUS COLLECTOR CURRENT (I_C)	400	−350	mA
COLLECTOR CURRENT (peak)(I_C)	800	−700	mA
TOTAL POWER DISSIPATION $T_A \leq 25°C$ (P_T)	360	360	mW
TOTAL POWER DISSIPATION $T_C \leq 25°C$ (P_T)	1000	1000	mW
DERATE FACTOR, $T_A > 25°C$	3.6	3.6	mW/°C
DERATE FACTOR, $T_C > 25°C$	10	7	mW/°C
OPERATING TEMPERATURE (T_J)	−65 to +150		°C
STORAGE TEMPERATURE (T_{STG})	−65 to +125		°C
LEAD TEMPERATURE 1/16" ± 1/32" (1.58mm ± 0.8mm) from case at 10s max. (T_L)	+260		°C

File Number **2070**

GES2906, 6A, 7, 7A, MPS2906, 6A, 7, 7A, GES2221A, 22A, MPS2222A, PN2222A

ELECTRICAL CHARACTERISTICS, At Ambient Temperature (T_A) = 25°C Unless Otherwise Specified

CHARACTERISTICS	SYMBOL	LIMITS 2221A,22A MIN.	2221A,22A MAX.	2906,06A MIN.	2906,06A MAX	2907,07A MIN.	2907,07A MAX.	UNITS
Collector-Emitter Breakdown Voltage (I_C = 10mA, I_B = 0)*	$V_{(BR)ECO}$	40	—	−40	—	−40	—	V
Collector-Base Breakdown Voltage (I_C = 10μA, I_E = 0)	$V_{(BR)CBO}$	75	—	−60	—	−60	—	V
Emitter-Base Breakdown Voltage (I_E = 10μA, I_C = 0)	$V_{(BR)EBO}$	5	—	−5	—	−5	—	V
Collector-Cutoff Current (V_{CB} = 60V, I_E = 0)*	I_{CBO}	—	10	—	−20	—	−50	nA
(V_{CB} = 60V, I_E = 0, T_A = 100°C)*		—	10	—	−20	—	−20	μA
Collector-Emitter Saturation Voltage (I_C = 150mA, I_B = 15mA)*	$V_{CE(SAT)}$	—	0.3	—	−0.4	—	−0.4	V
(I_C = 500mA, I_B = 50mA)		—	1	—	−1.6	—	−1.6	V
Base-Emitter Saturation Voltage (I_C = 150mA, I_B = 15mA)*	$V_{CE(SAT)}$	—	1.1	—	−1.3	—	−1.3	V
(I_C = 500mA, I_B = 50mA)*		—	2	—	−2.6	—	−2.6	V

CHARACTERISTICS	SYMBOL	2221A MIN.	2221A MAX.	2222A MIN.	2222A MAX.	2906,06A MIN.	2906,06A MAX.	2907,07A MIN.	2907,07A MAX.	UNITS
DC Forward Current Transfer Ratio (V_{CE} = 1.0V, I_C = 150mA)*	h_{FE}	20	—	50	—	—	—	—	—	—
(V_{CE} = 10V, I_C = 0.1mA)		20	—	35	—	20	—	35	—	
(V_{CE} = 10V, I_C = 1.0mA)		25*	—	*50	—	25	—	50	—	
(V_{CE} = 10V, I_C = 10mA)		35	—	75	—	35	—	75	—	
(V_{CE} = 10V, I_C = 150mA)*		40	120	100	300	40	120	100	300	
(V_{CE} = 10V, I_C = 500mA)*		20	—	30	—	20	—	30	—	
Collector Capacitance (V_{CB} = 10V, I_E = 0, f = 1MHz)	C_{cb}	—	8	—	8	—	8	—	8	pF
Emitter-Base Capacitance (V_{EB} = 0.5V, I_C = 0, f = 1MHz)	C_{eb}	—	25	—	25	—	30	—	30	pF
Delay Time (I_{CS} = 150mA, I_{B1} = 15mA)	t_d	—	—	—	—	—	10	—	10	ns
Rise Time (I_{CS} = 150mA, I_{B1} = 15mA)	t_r	—	—	—	—	—	40	—	40	ns
Storage Time (I_{CS} = 150mA, I_{B1} = I_{B2} = 15mA)	t_s	—	—	—	—	—	80	—	80	ns
Fall Time (I_{CS} = 150mA, I_{B1} = 15mA)	t_f	—	—	—	—	—	30	—	30	ns
Turn-On Time (I_C = 150mA, V_{CC} = 30V, I_{B1} = 15mA)		—	35	—	35	—	—	—	—	ns
Turn-Off Time (I_C = 150mA, V_{CC} = 30V, I_{B1} = I_{B2} = 15mA)	t_{ON}	—	285	—	285	—	—	—	—	ns

*Pulse conditions: 300μs pulse width, 2% duty cycle.

2

GES2906, 6A, 7, 7A, MPS2906, 6A, 7, 7A, GES2221A, 22A, MPS2222A, PN2222A

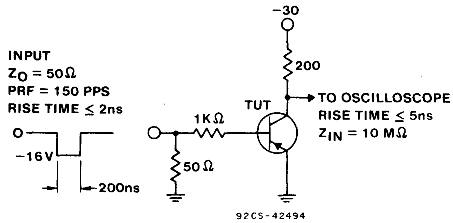


Fig. 1 — Delay time and rise time test circuit for pnp types (2906, 06A, 07, 07A).

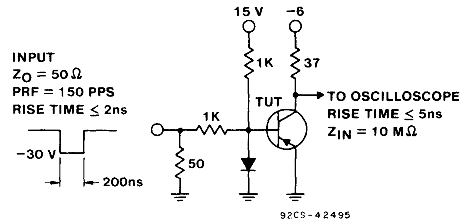


Fig. 2 — Storage time and fall time test circuit for pnp types (2906, 06A, 07, 07A).

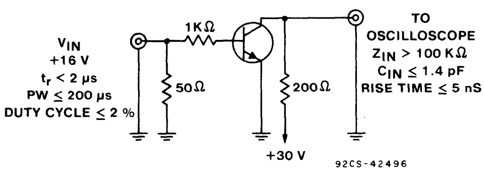


Fig. 3 — Turn-on time test circuit for npn types (2221A and 2222A).

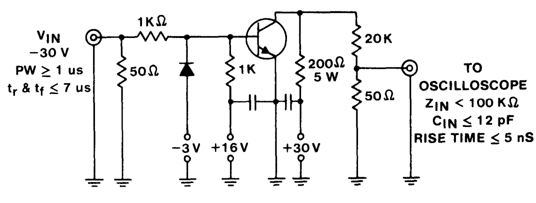


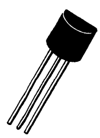
Fig. 4 — Turn-off time test circuit for npn types (2221A and 2222A).

TERMINAL CONNECTIONS

Lead 1 - Emitter
Lead 2 - Base
Lead 3 - Collector

GES2904, 04A, GES2905, 05A

Silicon Transistors



TO-92

The GE/RCA GES2904, 4A, 5, 5A, are planar epitaxial PNP silicon transistors designed for high-speed switching circuits. These types are supplied in JEDEC TO-92 package.

MAXIMUM RATINGS, *Absolute-Maximum Values:*

	GES2904 GES2905	GES2904A GES2905A	
COLLECTOR TO EMITTER VOLTAGE (V_{CEO})	40	60	V
COLLECTOR TO BASE VOLTAGE (V_{EBO})	5	5	V
COLLECTOR TO BASE VOLTAGE (V_{CBO})	40	60	V
CONTINUOUS COLLECTOR CURRENT (I_C)	600	600	mA
TOTAL POWER DISSIPATION $T_C \leq 25°C$ (P_T)	2000		mW
TOTAL POWER DISSIPATION $T_A \leq 25°C$ (P_T)	600		mW
DERATE FACTOR, $T_C \geq 25°C$	17		mW/°C
DERATE FACTOR, $T_A \geq 25°C$	3.43		mW/°C
OPERATING TEMPERATURE (T_J)	−65 to +135		°C
STORAGE TEMPERATURE (T_{STG})	−65 to +150		°C
LEAD TEMPERATURE 1/16" ± 1/32" (1.58mm ± 0.8mm) from case at 10s max. (T_L)	+260		°C

File Number **2069**

GES2904, 04A, GES2905, 05A

ELECTRICAL CHARACTERISTICS, At Ambient Temperature (T_A) = 25°C Unless Otherwise Specified

CHARACTERISTICS	SYMBOL	LIMITS GES2904 GES2905 MIN.	MAX.	GES2904A GES2905A MIN.	MAX	UNITS
Collector-Emitter Breakdown Voltage (I_C = 10mA, I_B = 0)	BV_{ECO}	40	–	60	–	V
Collector Cutoff Current (V_{CB} = 50V, I_E = 0)	I_{CBO}	–	0.02	–	0.01	μA
Base Cutoff Current (V_{CE} = 30V, V_{BE} = 0.5V)	I_B	–	50	–	50	nA
Collector Saturation Voltage (I_C = 150mA, I_B = 15mA)*	$V_{CE(SAT)}$	–	0.4	–	0.4	V
(I_C = 500mA, I_B = 50mA)*		–	1.6	–	1.6	
Base Emitter Saturation Voltage (I_C = 150mA, I_B = 15mA)*	$V_{CE(SAT)}$	–	1.3	–	1.3	
(I_C = 500mA, I_B = 50mA)*		–	2.6	–	2.6	

	SYMBOL	GES2904 MIN.	MAX.	GES2904A MIN.	MAX.	GES2905 MIN.	MAX.	GES2905A MIN.	MAX.	UNITS
Small-Signal Forward Current Transfer Ratio (I_C = 0.1mA, V_{CE} = 10V)	h_{fe}	20	–	40	–	35	–	75	–	–
(I_C = 1mA, V_{CE} = 10V)		25	–	40	–	50	–	100	–	
(I_C = 10mA, V_{CE} = 10V)		35	–	40	–	75	–	100	–	
(I_C = 150mA, V_{CE} = 10V)		40	120	40	120	100	300	100	300	
Gain Bandwidth Product (I_C = 50V, V_{CE} = 20V, f = 100MHz)	f_T	200	–	200	–	–	–	–	–	MHz

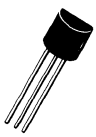
*Pulsed condition: ≤ 300μs pulse width, ≤ 2% duty cycle.

TERMINAL CONNECTIONS

Lead 1 - Emitter
Lead 2 - Base
Lead 3 - Collector

GES5401, GES5551

Silicon Transistors



TO-92

The GE/RCA GES5401 is a PNP and GES5551 is a NPN; they are complimentary silicon transistors designed for use in general-purpose, high amplifier applications. PNP values are negative; observe proper polarity.

These types are supplied in JEDEC TO-92 package.

2

MAXIMUM RATINGS, *Absolute-Maximum Values:*

	GES5401	GES5551	
COLLECTOR TO EMITTER VOLTAGE (V_{CEO})If	–150	160	V
EMITTER TO BASE VOLTAGE (V_{EBO})	–5	5	V
COLLECTOR TO BASE VOLTAGE (V_{CBO})	–160	180	V
CONTINUOUS COLLECTOR CURRENT (I_C)	–600	600	mA
TOTAL POWER DISSIPATION ($T_A \leq$ 25°C) (P_T)	350		mW
TOTAL POWER DISSIPATION ($T_C \leq$ 25°C) (P_T)	1		W
DERATE FACTOR ($T_A >$ 25°C)	2.8		mW/°C
DERATE FACTOR ($T_C >$ 25°C)	8		mW/°C
OPERATING TEMPERATURE (T_J)	–55° to +150		°C
STORAGE TEMPERATURE (T_{STG})	–55° to +150		°C
LEAD TEMPERATURE, 1/16" ± 1/32" (1.58mm ± 0.8mm) from case for 10s max (T_L)	–260		°C

ELECTRICAL CHARACTERISTICS, At Ambient Temperature (T_A) = 25°C Unless Otherwise Specified

CHARACTERISTICS	SYMBOL	LIMITS				
		GES5401		GES5551		
		MIN.	MAX	MIN.	MAX	
Collector-Emitter Breakdown Voltage (1_C = 1 mA, I_B = 0)	$V_{(BR)ECO}$	–150	–	160	–	V
Collector-Base Breakdown Voltage (I_C = 100 μA, I_E = 0)	$V_{(BR)CBO}$	–160	–	180	–	V
Emiter-Base Breakdown Voltage (I_E = 10μA, I_C = 0)	$V_{(BR)EBO}$	–5	–	5	–	V
Collector-Cutoff Current (V_{CB} = –100 V, I_E = O)	I_{CBO}	–	50	–	–	nA
(V_{CB} = 120V, I_E = 0	I_{CBO}	–	–	–	50	nA
Emitter Cutoff Current (I_{EB} = 4V, I_C = O)	I_{EBO}	–	50	–	50	nA
Collector-Emitter Saturation Voltage (I_C = 10 mA, I_B = 1 mA)	V_{CE}(sat)	–	0.2	–	0.15	V
(I_C = 50mA, I_B = 5 mA)	V_{CE}(sat)	–	0.5	–	0.2	V
Base-Emitter Saturation Voltage (I_C = 10 mA, I_B = 1 mA)	V_{BE}(sat)	–	1	–	1	V
(I_C = 50mA, I_B = 5 mA)	V_{BE}(sat)	–	1	–	1	V

File Number **2094**

GES5401, GES5551

ELECTRICAL CHARACTERISTICS, At Ambient Temperature (T_A) = 25°C Unless Otherwise Specified (Cont'd)

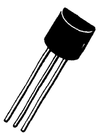
CHARACTERISTICS	SYMBOL	LIMITS				
		GES5401		GES5551		
		MIN.	MAX	MIN.	MAX	
DC Forward Current Transfer Ratio						
(V_{CE} = 5V, I_C = 1 mA	h_{FE}	50	–	80	–	–
(V_{CE} = 5V, I_C = 10 mA		60	240	80	250	
(V_{CE} = 5V, I_C = 50 mA		50	–	30	–	
Gain-Bandwidth Product (I_C = 20 mA, V_{CE} = 20 V, F = 20 MHZ)	F_T	50	–	50	–	MHZ

TERMINAL CONNECTIONS

Lead 1 - Emitter
Lead 2 - Base
Lead 3 - Collector

GES5810, GES5811, GES5812, GES5813

Silicon Transistors



TO-92

Features:
- *Excellent gain linearity over wide range of collector current: ≤ 500 mA*
- *High collector current rating: 1000 mA (pulsed)*
- *Epoxy encapsulation with proved reliability: excellent characteristic stability under environmental stresses, 85°C – 85%RH*

The GE/RCA GES5810, GES5812 NPN types and GES5811 and GES5813 PNP types are planar, passivated, epitaxial silicon transistors intended for wide range general purpose applications operating in audio and intermediat frequency ranges. PNP values are negative; observe proper polarity.

These types are supplied in JEDEC TO-92 package.

MAXIMUM RATINGS, *Absolute-Maximum Values:*

	GES5810 GES5812	GES5811 GES5813	
COLLECTOR TO EMITTER VOLTAGE (V_{CEO})	25	−25	V
COLLECTOR TO EMITTER VOLTAGE (V_{CES})	35	−35	V
EMITTER TO BASE VOLTAGE (V_{EBO})	5	−5	V
COLLECTOR TO BASE VOLTAGE (V_{CBO})	35	−35	V
CONTINUOUS COLLECTOR CURRENT (I_C)	750	−750	mA
COLLECTOR CURRENT (Pulsed)* (I_{CM})	1000	−1000	mA
TOTAL POWER DISSIPATION $T_A \leq 25°C$ (P_T)	1500		mW
DERATE FACTOR $T_A \geq 25°C$	4.55		mW/°C
OPERATING TEMPERATURE (T_J)	−65 to +135		°C
STORAGE TEMPERATURE (T_{STG})	−65 to +150		°C
LEAD TEMPERATURE, 1/16" ± 1/32" (1.58mm ± 0.8mm) from case for 10s max. (T_L)	+260		°C

*Pulsed conditions: 300 μs pulse width, ≤ 2% duty cycle.

File Number **2095**

GES5810, GES5811, GES5812, GES5813

ELECTRICAL CHARACTERISTICS, At Ambient Temperature (T_A) = 25°C Unless Otherwise Specified

CHARACTERISTICS	SYMBOL	LIMITS GES5810, GES5812 MIN.	LIMITS GES5810, GES5812 MAX	LIMITS GES5811, GES5813 MIN.	LIMITS GES5811, GES5813 MAX	UNITS
Collector-Emitter Breakdown Voltage (I_C = 10mA, I_B = 0)*	$V_{(BR)CEO}$	25	–	–25	–	
Emiter-Base Breakdown Voltage (I_E = 10μA, I_C = 0)	$V_{(BR)EBO}$	5	–	–5	–	
Collector-Emitter Breakdown Voltage (I_C = 10μA, V_{BE} = 0)	$V_{(BR)CES}$	35	–	–35	–	
Collector-Emitter Saturation Voltage (I_C = 500mA, I_B = 50mA)*	$V_{CE(SAT)}$	–	0.75	–	–0.75	V
Base-Emitter Saturation Voltage (I_C = 500mA, I_B = 50mA)*	$V_{BE(SAT)}$	–	1.2	–	–1.2	
Base-Emitter Voltage (I_C = 500mA, V_{CE} = 2V)*	V_{BE}	0.6	1.1	–0.6	–1.1	
Collector-Cutoff Current (V_{CB} = –25 V, I_E = O)	I_{CBO}	–	100	–	–100	nA
(V_{CB} = 25V, I_E = 0, T_A = 100°C)		–	15	–	–15	
Emitter-Base Reverse Current (V_{EB} = 5V, I_C = 0)	I_{EBO}	–	10	–	–10	μA
DC Forward Current Transfer Ratio		(GES5810, GES5811)		(GES5812, GES5813)		
(V_{CE} = 2V, I_C = 2mA)	h_{FE}	60	200	150	500	–
(V_{CE} = 2V, I_C = 500mA)*		45	–	60	–	
Emitter-Base Input Capacitance (V_{EB} = 0.5V, I = 0, f = 1MHz)	C_{eb}	–	55	–	55	pF
Collector-Base Output Capacitance (V_{CB} = 10 V, I_E =), f = 1MHz	C_{cb}	–	15	–	15	
Gain-Bandwidth Product		(GES5810, GES5811)		(GES5812, GES5813)		
(V_{CE} = 2 V, I_C = 50mA, F = 20 MHz)	f_T	100	–	135	–	MHz

*Pulsed conditions: 300μs pulse width, ≤ 2% duty cycle.

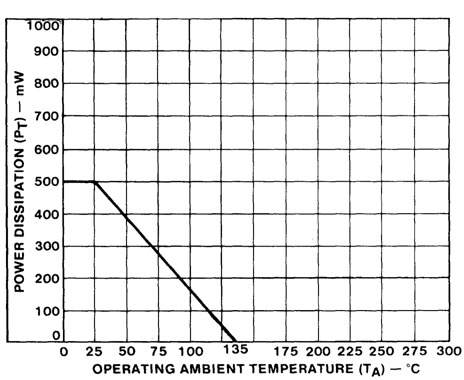


Fig. 1 – Derating curve for all types.

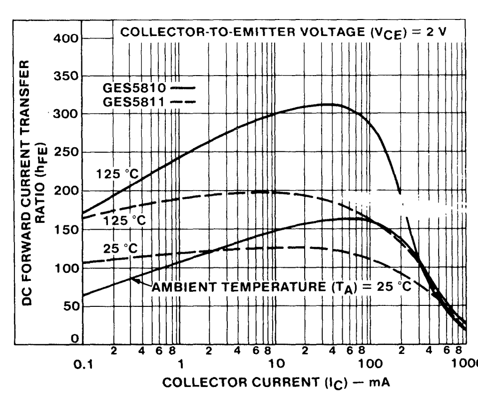


Fig. 2 – Typical dc forward-current transfer ratio characteristics for GES5810 and GES5811.

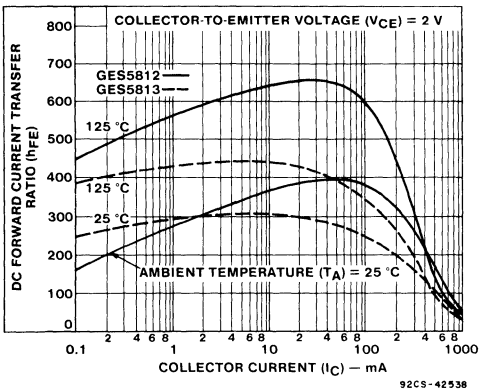


Fig. 3—Typical dc forward current transfer ratio characteristics for GES5812 and GES5813.

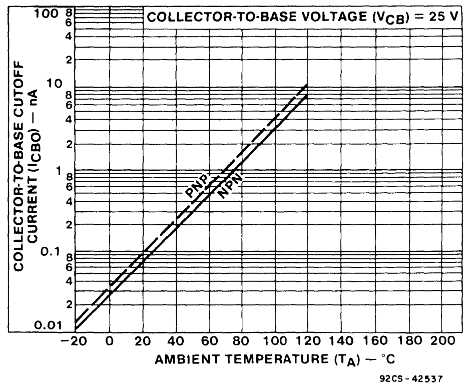


Fig. 4—Typical collector-to-base cutoff current characteristics for all types.

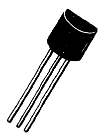
2

TERMINAL CONNECTIONS

Lead 1 - Emitter
Lead 2 - Base
Lead 3 - Collector

GES5814, GES5815, GES5816
GES5817, GES5818, GES5819

Silicon Transistors



TO-92

Features:
- *Excellent gain linearity over wide range of collector current: ≤ 500 mA*
- *High collector current rating: 1000 mA (pulsed)*
- *Epoxy encapsulation with proved reliability: excellent characteristics stability under environmental stresses, 85°C – 85#RH*

The GE/RCA GES5814, GES5816, and GES5818 NPN types and GES5815, GES5817, and GES5819 PNP types are planar, passivated, epitaxial silicon transistors intended for wide range general purpose applications operating in audio and intermediat frequency ranges. PNP values are negative; observe proper polarity.

These types are supplied in JEDEC TO-92 package.

MAXIMUM RATINGS, *Absolute-Maximum Values:*

	GES5814 GES5816 GES5818	GES5815 GES5817 GES5819	
COLLECTOR TO EMITTER VOLTAGE (V_{CEO})	40	−40	V
COLLECTOR TO EMITTER VOLTAGE (V_{CES})	50	−50	V
EMITTER TO BASE VOLTAGE (V_{EBO})	5	−5	V
COLLECTOR TO BASE VOLTAGE (V_{CBO})	50	−50	V
CONTINUOUS COLLECTOR CURRENT (I_C)	750	−750	mA
COLLECTOR CURRENT (Pulsed)* (I_{CM})	1000	−1000	mA
TOTAL POWER DISSIPATION $T_A \leq 25°C$ (P_T)	500		mW
DERATE FACTOR, $T_A > 25°C$	4.55		mW/°C
OPERATING TEMPERATURE (T_J)	−65° to +135		°C
STORAGE TEMPERATURE (T_{STG})	−65° to +150		°C
LEAD TEMPERATURE, 1/16" ± 1/32" (1.58mm ± 0.8mm) from case for 10s max (T_L)	+260		°C

TERMINAL CONNECTIONS

Lead 1 - Emitter
Lead 2 - Base
Lead 3 - Collector

File Number **2096**

GES5814, GES5815, GES5816
GES5817, GES5818, GES5819

ELECTRICAL CHARACTERISTICS, At Ambient Temperature (T_A) = 25°C Unless Otherwise Specified

CHARACTERISTICS	SYMBOL	LIMITS GES5814, GES5816, GES5818 MIN.	MAX	GES5815, GES5817, GES5819 MIN.	MAX	
Collector-Emitter Breakdown Voltage (I_C = 10mA, I_B = 0)	$V_{(BR)CEO}$	40	–	– 40	–	
Emiter-Base Breakdown Voltage (I_E = 10μA, I_C = 0)	$V_{(BR)EBO}$	5	–	– 5	–	
Collector-Emitter Breakdown Voltage (I_C = 10μA, V_{BE} = 0)	$V_{(BR)CES}$	50	–	– 50	–	
Collector-Emitter Saturation Voltage (I_C = 500mA, I_B = 50mA)*	$V_{CE(SAT)}$	–	0.75	–	– 0.75	V
Base-Emitter Saturation Voltage (I_C = 500mA, I_B = 50mA)*	$V_{BE(SAT)}$	–	1.2	–	– 1.2	
Base-Emitter Voltage (I_C = 500mA, V_{CE} = 2V)*	V_{BE}	0.6	1.1	– 0.6	– 1.1	
Collector-Cutoff Current (V_{CB} = – 25 V, I_E = O)	I_{CBO}	–	100	–	– 100	nA
(V_{CB} = 25V, I_E = 0, T_A = 100°C)		–	15	–	– 15	
Emitter-Base Reverse Current (V_{EB} = 5V, I_C = 0)	I_{EBO}	–	10	–	– 10	μA
DC Forward Current Transfer Ratio (V_{CE} = 2V, I_C = 2mA) GES5814, GES5815	h_{FE}	60 min.		160 max.		–
GES5816, GES5817		100 min.		200 max.		
GES5818, GES5819		150 min.		300 max.		
(V_{CE} = 2V, I_C = 500mA) GES5814, GES5815		20 min.				
GES5316, GES5817		25 min.				
GES5818, GES5819		25 min.				
Emitter-Base Input Capacitance (V_{EB} = 0.5V, I = 0, f = 1MHz)	C_{eb}	–	55	–	55	pF
Collector-Base Output Capacitance (V_{CB} = 10 V, I_E = 0, f = 1MHz	C_{cb}	–	15	–	15	
Gain-Bandwidth Product (V_{CE} = 2 V, I_C = 50mA, F = 20 MHz) GES5814, GES5815	f_T	100 min.				MHz
GES5816, GES5817		120 min.				
GES5818, GES5819		135 min.				

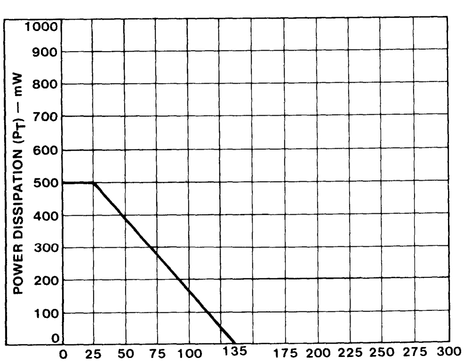


Fig. 1 – Derating curve for all types.

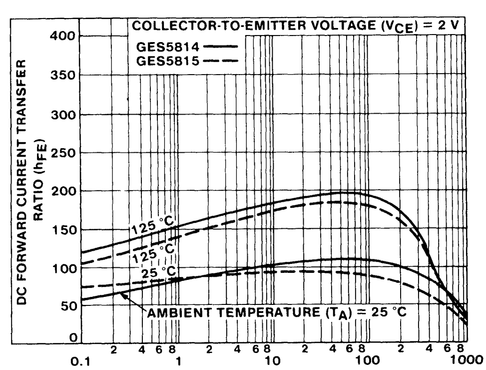


Fig. 2 – Typical dc forward-current transfer ratio characteristics for GES 5814 and GES 5815.

GES5814, GES5815, GES5816 GES5817, GES5818, GES5819

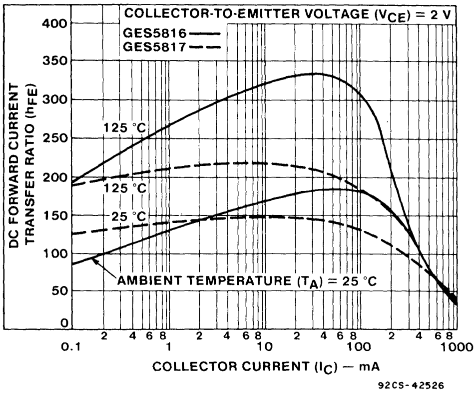


Fig. 3—Typical dc forward-current transfer ratio characteristics for GES5816, and GES5817.

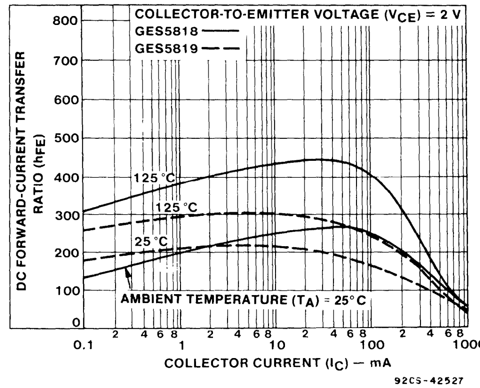


Fig. 4—Typical dc forward-current transfer ratio characteristics for GES5818 and GES5819.

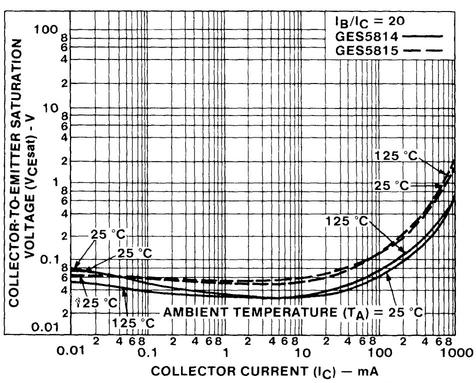


Fig. 5—Typical collector-to-emitter saturation voltage characteristics for GES5814 and GES5815 (h_{FE} = 20).

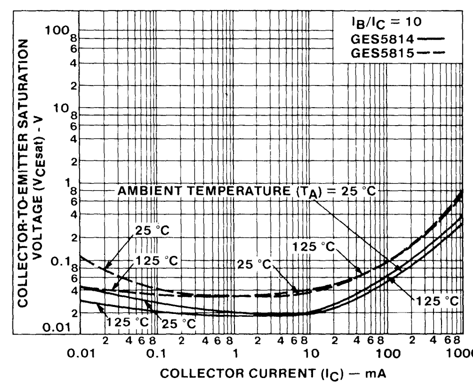


Fig. 6—Typical collector-to-emitter saturation voltage characteristics for GES5814 and GES5815 at h_{FE} = 10.

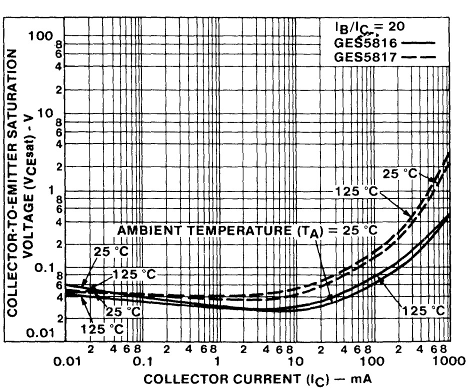


Fig. 7—Typical collector-to-emitter saturation voltage characteristics for GES5816 and GES5817 at h_{FE} = 20.

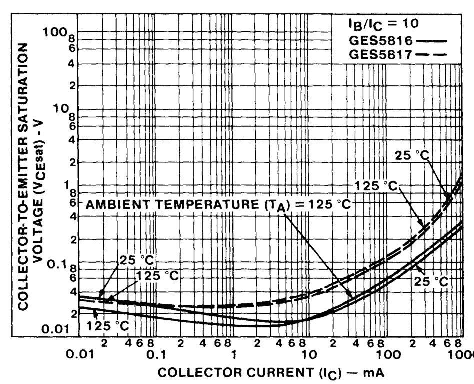


Fig. 8—Typical collector-to-emitter saturation voltage characteristics for GES5816 and GES5817 at h_{FE} = 10.

GES5814, GES5815, GES5816
GES5817, GES5818, GES5819

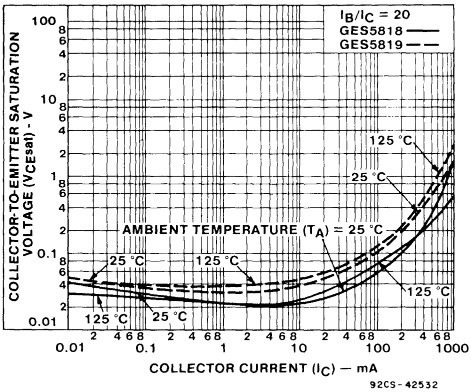


Fig. 9 — Typical collector-to-emitter saturation voltage characteristics for GES5818 and GES5819 at h_{FE} = 20.

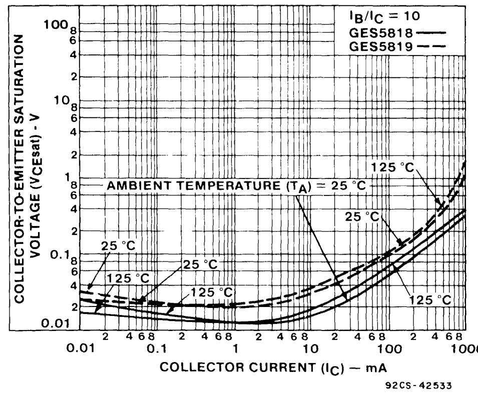


Fig. 10 — Typical collector-to-emitter saturation voltage characteristics for GES5818 and GES5819 at h_{FE} = 10.

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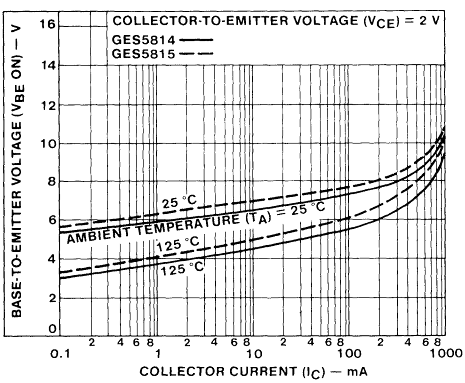


Fig. 11 — Typical base-to-emitter voltage characteristics for GES5814 and GES5815.

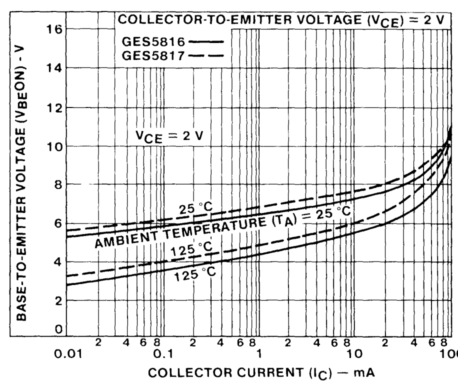


Fig. 12 — Typical base-to-emitter voltage characteristics for GES5816 and GES5817.

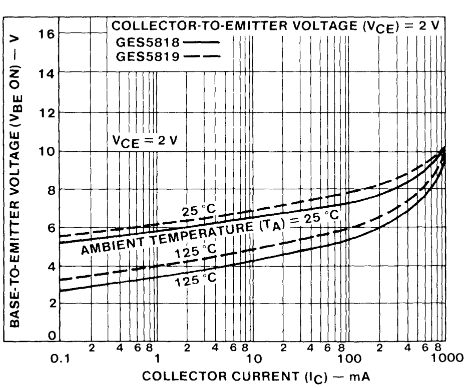


Fig. 13 — Typical base-to-emitter voltage characteristics for GES5818 and GES5819.

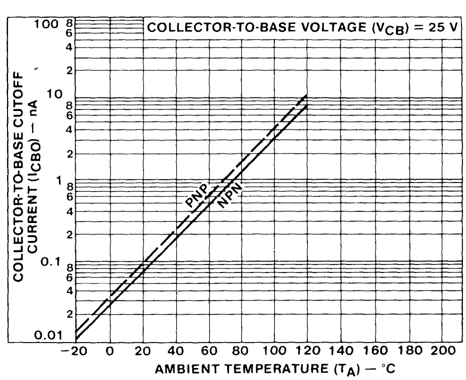
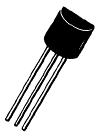


Fig. 14 — Typical collector-to-base cutoff current characteristics for all types.

MPS3638, MPS3638A

Silicon Transistors



TO-92

The GE/RCA MPS3638 and 3638A are planar epitaxial passivated PNP silicon transistors intended for general purpose applications. The units feature low collector saturation voltage, controlled current gain and excellent frequency response. These types are supplied in JEDEC TO-92 package.

MAXIMUM RATINGS, *Absolute-Maximum Values:*

COLLECTOR TO EMITTER VOLTAGE (V_{CEO})	−25 V
EMITTER TO BASE VOLTAGE (V_{EBO})	−4 V
COLLECTOR TO BASE VOLTAGE (V_{CBO})	−25 V
CONTINUOUS COLLECTOR CURRENT (I_C)	−350 mA
COLLECTOR CURRENT (Pulsed)*	−700 mA
TOTAL POWER DISSIPATION ($T_A \leq 25°C$)	360 mW
TOTAL POWER DISSIPATION ($T_C \leq 25°C$)	700 mW
DERATE FACTOR ($T_A > 25°C$)	3.6 mW/°C
DERATE FACTOR ($T_C > 25°C$)	7 mW/°C
OPERATING TEMPERATURE (T_J)	−65° to +125 °C
STORAGE TEMPERATURE (T_{STG})	−65° to +150 °C
LEAD TEMPERATURE, 1/16" ± 1/32" (1.58mm ± 0.8mm) from case at 10s max. (T_L)	+260 °C

*Pulse conditions: 10μs pulse width, 2% duty cycle.

File Number **2078**

MPS3638, MPS3638A

ELECTRICAL CHARACTERISTICS, At Ambient Temperature (T_A) = 25°C Unless Otherwise Specified

CHARACTERISTICS	SYMBOL	LIMITS						UNITS
		MPS3638			MPS3638A			
		MIN.	TYP.	MAX.	MIN.	TYP.	MAX	
Collector-Emitter Breakdown Voltage (I_C = 10 mA, I_B = 0)	$V_{(BR)CEO}$	-25	–	–	-25	–	–	V
Collector-Base Breakdown Voltage (I_C = 100 µA, I_E = 0)*	$V_{(BR)CBO}$	-25	–	–	-25	–	–	
Emitter-Base Breakdown Voltage (I_E = 10 µA, I_C = 0)	$V_{(BR)EBO}$	-4	–	–	-4	–	–	
Collector Cutoff Current (V_{CE} = 15V, V_{BE} = 0)	I_{CES}	–	–	-35	–	–	-35	nA
(V_{CB} = -15V, V_{BE} = 0, T_A = 100°C)		–	–	-10	–	–	-10	
DC Forward Current Transfer Ratio (I_C = -1mA, V_{CE} = -10V)	h_{FE}	–	–	–	80	–	–	–
(I_C = -10mA, V_{CE} = -10V)*		20	–	–	100	–	–	
(I_C = -50mA, V_{CE} = -1V)*		30	70	–	100	–	–	
(I_C = -300mA, V_{CE} = 2V)*		20	40	–	20	50	–	
Collector-Emitter Saturation Voltage (I_C = -50mA, I_B = 2.5mA)*	$V_{CE(SAT)}$	–	–	-0.25	–	–	-0.25	V
(I_C = -300mA, I_B = -30mA)*		–	–	-1	–	–	-1	
Base-Emitter Saturation Voltage (I_C = -50mA, I_B = 2.5mA)*	$V_{BE(SAT)}$	–	–	-1.1	–	–	-1.1	
(I_C = -300mA, I_B = -30mA)*		-0.8	–	-0.2	–	-0.8–	-0.2	
Small-Signal Forward Current Transfer Ratio (I_C = -10mA, V_{CE} = -10V, f = 1kHz)	h_{fe}	25	–	–	100	–	–	–
Output Capacitance, Common Base (V_{CB} = -10V, f = 1MHz)	C_{cb}	–	–	10	–	–	10	pF
Input Capacitance, Common Base (V_{EB} = -0.5V, f = 1MHz)	C_{eb}	–	–	35	–	–	35	
Gain Bandwidth Product (V_{CE} = -3V, I_C = -50mA)	f_T	–	100	–	–	100	–	MHz

*Pulse conditions: 300µs pulse width, 2% duty cycle.

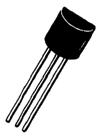
TERMINAL CONNECTIONS

Lead 1 - Emitter
Lead 2 - Base
Lead 3 - Collector

2

MPS6531, MPS6532, MPS6534

Silicon Transistors



TO-92

The GE/RCA MPS 6531, MPS6532 are NPN and MPS6534 is a PNP planar epitaxial passivated silicon transistors designed for general purpose switching and amplifier applications. PNP values are negative; observe proper polarity. These types are supplied in JEDEC TO-92 package.

MAXIMUM RATINGS, *Absolute-Maximum Values:*

	MPS6531	MPS6532	MPS6534	UNITS
COLLECTOR TO EMITTER VOLTAGE (V_{CEO})	40	30	40	V
EMITTER TO BASE VOLTAGE (V_{EBO})	5	5	4	V
COLLECTOR TO BASE VOLTAGE (V_{CBO})	60	50	40	V
CONTINUOUS COLLECTOR CURRENT (I_C)	600	600	600	mA
TOTAL POWER DISSIPATION $T_A \leq 25°C$ (P_T)	350	350	350	mW
TOTAL POWER DISSIPATION $T_C \leq 25°C$ (P_T)	1	1	1	W
DERATE FACTOR, $T_A > 25°C$	2.8	2.8	2.8	mW/°C
DERATE FACTOR, $T_C > 25°C$	8	8	8	mW/°C
OPERATING TEMPERATURE (T_J)		−55 to +150		°C
STORAGE TEMPERATURE (T_{STG})		−65 to +150		°C
LEAD TEMPERATURE 1/16" ± 1/32" (1.58mm ± 0.8mm) from case at 10s max. (T_L)		+260		°C

File Number **2079**

MPS6531, MPS6532, MPS6534

ELECTRICAL CHARACTERISTICS, At Ambient Temperature (T_A) = 25°C Unless Otherwise Specified

CHARACTERISTICS	SYMBOL	LIMITS						UNITS
		MPS6531		MPS6532		MPS6534		
		MIN.	MAX.	MIN.	MAX	MIN.	MAX.	
Collector-Emitter Breakdown Voltage (I_C = 10mA, I_B = 0)	$V_{(BR)ECO}$	40	—	—	—	– 40	—	V
(I_C = 10mA, V_{BE} = 0)		—	—	30	—	—	—	V
Collector-Base Breakdown Voltage (I_C = 10μA, I_E = 0)	$V_{(BR)CBO}$	60	—	50	—	– 40	—	V
Emitter-Base Breakdown Voltage (I_E = 10μA, I_C = 0)	$V_{(BR)EBO}$	5	—	5	—	– 4	—	V
Collector-Cutoff Current (V_{CB} = 30V, I_E = 0)(V_{CB} = 40V for 6531)	I_{CBO}	—	50	—	—	—	– 50	nA
(V_{CB} = 20V, I_E = 0)(V_{CB} = 30V for 6532)	I_{CBO}	—	—	—	100	—	—	nA
(V_{CB} = 30V, I_E = 0, T_C = 60°C)(V_{CB} = 40V for 6531)	I_{CBO}	—	2	—	—	—	– 2	μA
(V_{CB} = 20V, I_E = 0, T_A = 60°C)(V_{CB} = 30V for 6532)	I_{CBO}	—	—	—	5	—	—	μA
Emitter-Base Reverse Current (V_{EB} = 4V, I_C = 0)	I_{EBO}	—	100	—	100	—	—	nA
(V_{EB} = 3V, I_C = 0)	I_{EBO}	—	—	—	—	—	– 100	nA
DC Forward Current Transfer Ratio (V_{CE} = 1.0V, I_C = 10mA)	h_{FE}	60	—	—	—	60	—	—
(V_{CE} = 1.0V, I_C = 100mA)*	h_{FE}	90	270	30	—	90	270	—
(V_{CE} = 10V, I_C = 500mA)*	h_{FE}	25	—	—	—	25	—	—
Collector-Emitter Saturation Voltage (I_C = 100mA, I_B = 10mA)*	$V_{CE(SAT)}$	—	0.3	—	0.5	—	– 1.2	V
Base-Emitter Saturation Voltage (I_C = 100mA, I_B = 10mA)*	$V_{BE(SAT)}$	—	1.2	—	1	—	– 1.2	V
Collector-Base Capacitance Voltage (V_{CE} = 10V, I_E = 0, f = 1MHz)	C_{cb}	—	5	—	5	—	6	pF

*Pulse condition: ≤300μs pulse width, 2% duty cycle.

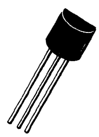
2

TERMINAL CONNECTIONS

Lead 1 - Emitter
Lead 2 - Base
Lead 3 - Collector

MPS-A05, A06, A55, A56

Silicon Transistors



TO-92

The GE/RCA MPS-A05, 06 NPN types and MPS-A55, 56 PNP types are planar epitaxial passivated silicon transistors designed for medium current general purpose amplifier applications. PNP values are negative; observe proper polarity. These types are supplied in JEDEC TO-92 package.

MAXIMUM RATINGS, *Absolute-Maximum Values:*

	MPS-A05 MPS-A55	MPS-A06 MPS-A56	
COLLECTOR TO EMITTER VOLTAGE (V_{CEO})	60	80	V
EMITTER TO BASE VOLTAGE (V_{EBO})	4	4	V
COLLECTOR TO BASE VOLTAGE (V_{CBO})	60	80	V
CONTINUOUS COLLECTOR CURRENT (I_C)	500		mA
TOTAL POWER DISSIPATION $T_A \leq 25°C$ (P_T)	625		W
TOTAL POWER DISSIPATION $T_C \leq 25°C$ (P_T)	1.5		W
DERATE FACTOR, $T_A > 25°C$	5		mW/°C
DERATE FACTOR, $T_C > 25°C$	12		mW/°C
OPERATING TEMPERATURE (T_J)	− 55 to + 150		°C
STORAGE TEMPERATURE (T_{STG})	− 55 to + 150		°C
LEAD TEMPERATURE 1/16" ± 1/32" (1.58mm ± 0.8mm) from case at 10s max. (T_L)	+ 230		°C

File Number **2072**

ELECTRICAL CHARACTERISTICS, At Ambient Temperature (T_A) = 25°C Unless Otherwise Specified

CHARACTERISTICS	SYMBOL	LIMITS MPS-A05,A55 MIN.	MAX.	MPS-A06,56 MIN.	MAX	UNITS
Collector-Emitter Breakdown Voltage (I_C = 1mA, I_B = 0)*	$V_{(BR)ECO}$	60	–	80	–	V
Collector-Base Breakdown Voltage (I_C = 100μA, I_E = 0)	$V_{(BR)CBO}$	60	–	80	–	V
Emitter-Base Breakdown Voltage (I_E = 100μA, I_C = 0)	$V_{(BR)EBO}$	4	–	4	–	V
Collector-Cutoff Current (V_{CB} = 60V, I_E = 0)	I_{CBO}	–	100	–	–	nA
(V_{CB} = 80V, I_E = 0)		–	–	–	100	nA
(V_{CE} = 60V, I_B = 0)	I_{CEO}	–	100	–	100	nA
DC Forward Current Transistor Ratio (V_{CE} = 1V, I_C = 10mA)	h_{FE}	50	–	50	–	–
(V_{CE} = 1V, I_C = 10mA)*		50	–	50	–	–
Collector-Emitter Saturation Voltage (I_C = 100mA, I_B = 10mA)*	$V_{CE(SAT)}$	–	0.25	–	0.25	V
Base-Emitter Saturation Voltage (I_C = 100mA, I_B = 10mA)	$V_{BE(SAT)}$	–	1	–	1	V
Base-Emitter Voltage (V_{CE} = 1V, I_C = 100mA)	$V_{BE(ON)}$	–	1	–	1	V
		MPS-A05, A06		MPS-A55, A56		–
Collector-Base Capacitance (V_{cb} = 10V, I_E = 0, f = 1MHz)	C_{cb}	–	12	–	12	pF
Gain Bandwidth (V_{CE} = 5V, I_C = 30mA, f = 50MHz)	f_{FE}	5	80	–	50	–

*Pulse condtions: ≤ 300μs pulse width, ≤ 2% duty cycle

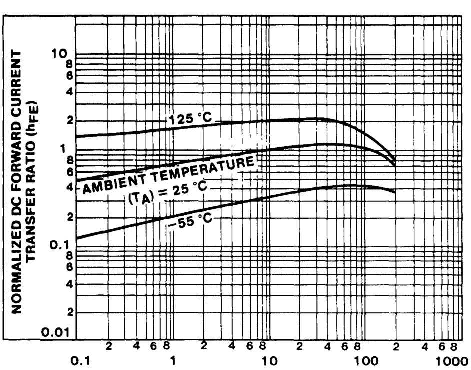


Fig. 1 – Normalized dc forward-current transfer ratio characteristics for MPS-A05 and MPS-A06.

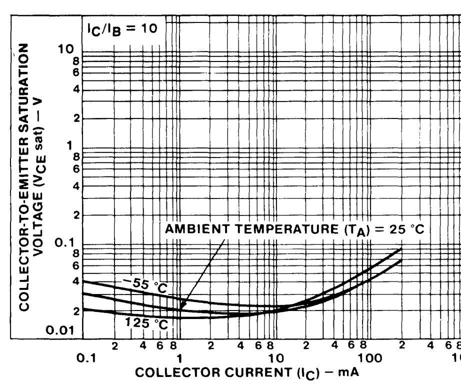


Fig. 2 – Typical collector-to-emitter saturation voltage characteristics for MPS-A05 and MPS-A06.

MPS-A05, A06, A55, A56

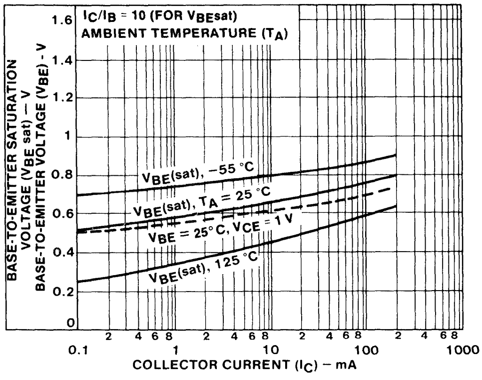


Fig. 3—Typical base-to-emitter saturation voltage characteristics for MPS-A05, MPS-A06.

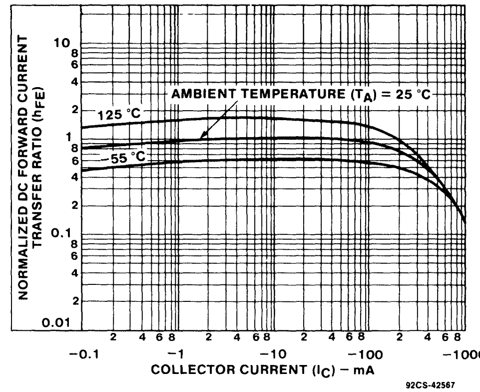


Fig. 4—Normalized dc forward-current transfer ratio characteristics for MPS-A55 and MPS-A56.

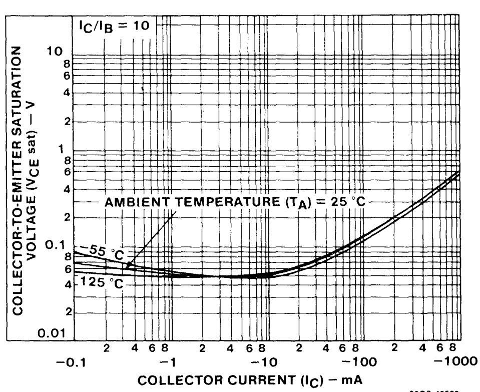


Fig. 5—Typical collector-to-emitter saturation voltage characteristics for MPS-A55 and MPS-A56.

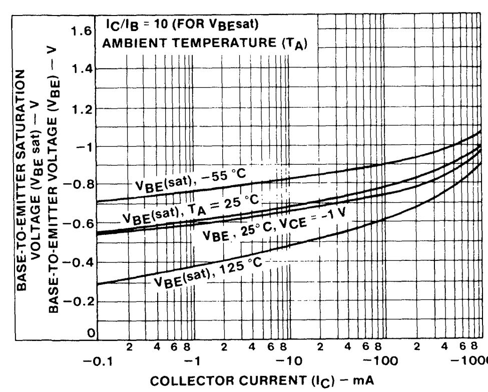


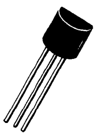
Fig. 6—Typical base-to-emitter saturation voltage and base-to-emitter voltage characteristics for MPS-A55 and MPS-A56.

TERMINAL CONNECTIONS

Lead 1 - Emitter
Lead 2 - Base
Lead 3 - Collector

MPS-A12

Silicon Darlington Transistors



TO-92

The GE/RCA MPS-A12 is a planar epitaxial passivated NPN silicon Darlington transistor designed for preamplifier input applications where high impedance is a requirement. This type is supplied in JEDEC TO-92 package.

MAXIMUM RATINGS, *Absolute-Maximum Values:*

COLLECTOR TO EMITTER VOLTAGE (V_{CEO}) . . . . . 20 V
COLLECTOR TO BASE VOLTAGE (V_{CBO}) . . . . . 20 V
EMITTER TO BASE VOLTAGE (V_{EBO}). . . . . 4 V
CONTINUOUS COLLECTOR CURRENT (I_C) . . . . . 500 mA
TOTAL POWER DISSIPATION ($T_A \leq 25°C$. . . . . 625 mW
DERATING FACTOR ($T_A > 25°C$ . . . . . 5 mW/°C
OPERATING TEMPERATURE (T_J) . . . . . −55 to +150°C
STORAGE TEMPERATURE (T_{STG}). . . . . −55° to +150°C
LEAD TEMPERATURE, 1/16" ± 1/32" (1.58mm ± 0.8mm) from case for 10s max. (T_L) . . . . . +230°C

ELECTRICAL CHARACTERISTICS, At Ambient Temperature (T_A) = 25°C Unless Otherwise Specified

CHARACTERISTICS	SYMBOL	LIMITS MIN.	LIMITS MAX.	UNITS
Collector-Emitter Breakdown Voltage (I_C = 100μA)	BV_{CES}	20	–	V
Collector Cutoff Current (V_{CE} = 15Vdc, V_{BE} = 0)	I_{CES}	–	100	nA
Collector Cutoff Current (V_{CB} = 15Vdc, I_E = 0)	I_{CBO}	–	100	
Emitter Cutoff Current (V_{EB} = 10Vdc, I_C = 0)	I_{EBO}	–	100	
DC Forward Current Transfer Ratio (I_C = 10 mAdc, V_{CE} = 5V)	h_{FE}	20,000	–	–
Small-Signal Current Transfer Ratio (I_C = 10 mAdc, V_{CE} = 5 Vdc, f = 1 kHz)	h_{fe}	20,000	–	–
Collector-Emitter Saturation Voltage (I_C = 10 mAdc, I_B = 0.01 mA)	$V_{CE(SAT)}$	–	1	V
Base-Emitter On-Voltage (I_C = 10 mAdc, V_{CE} = 5V)	$V_{BE(ON)}$	–	1.4	
Output Admittance (V_{CB} = 10Vdc, I_E = 0, f = 100 kHz)	C_{cb}	–	8	pF

File Number **2073**

MPS-A12

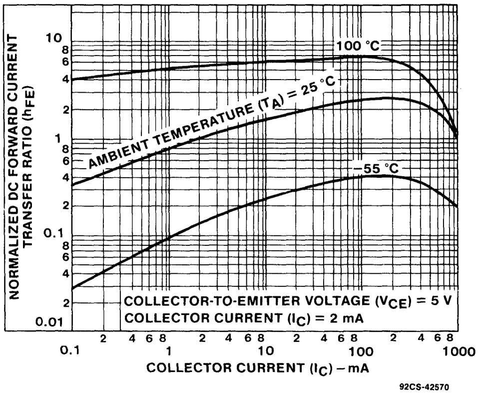


Fig. 1 – Normalized dc forward-current transfer ratio characteristics.

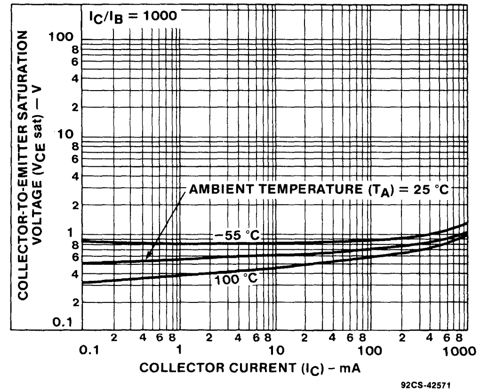


Fig. 2 – Typical collector-to-emitter saturation voltage characteristics.

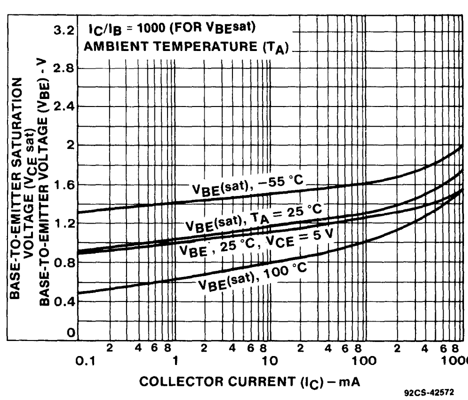


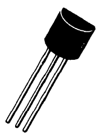
Fig. 3 – Typical base-to-emitter saturation voltage and base-to-emitter voltage characteristics.

TERMINAL CONNECTIONS

Lead 1 - Emitter
Lead 2 - Base
Lead 3 - Collector

MPS-A13, MPS-A14

Silicon Darlington Transistors



TO-92

The GE/RCA MPS-A13 and A14 are planar epitaxial passivated NPN silicon Darlington transistors designed for preamplifier input applications where high impedance is a requirement. These types are supplied in JEDEC TO-92 package.

MAXIMUM RATINGS, *Absolute-Maximum Values:*

COLLECTOR TO EMITTER VOLTAGE (V_{CEO}) .... 30 V
COLLECTOR TO BASE VOLTAGE (V_{CBO}) .... 30 V
EMITTER TO BASE VOLTAGE (V_{EBO}) .... 10 V
CONTINUOUS COLLECTOR CURRENT (I_C) .... 500 mA
TOTAL POWER DISSIPATION ($T_A \leq 25°C$) (P_T) .... 625 mW
TOTAL POWER DISSIPATION ($T_C \leq 25°C$) (P_T) .... 1.5 W
DERATE FACTOR ($T_A \leq 25°C$) (P_T) .... 5 mW/°C
DERATE FACTOR ($T_C \leq 25°C$) (P_T) .... 12 mW/°C
OPERATING TEMPERATURE (T_J) .... −55° to +150°C
STORAGE TEMPERATURE (T_{STG}) .... −55° to +150°C
LEAD TEMPERATURE, 1/16" ± 1/32" (1.58mm ± 0.8mm) from case for 10s max. (T_L) .... +230°C

ELECTRICAL CHARACTERISTICS, At Ambient Temperature (T_A) = 25°C Unless Otherwise Specified

CHARACTERISTICS	SYMBOL	LIMITS MIN.	TYP.	MAX.	UNITS
Collector-Emitter Breakdown Voltage (I_C = 100μA, I_B = 0)	BV_{CES}	30	–	–	V
Collector Cutoff Current (V_{CB} = 30V, I_E = 0)	I_{CBO}	–	–	100	nA
Emitter Cutoff Current (V_{BE} = 10V, I_C = 0)	I_{EBO}	–	–	100	
DC Forward Current Transfer Ratio (I_C = 10 mA, V_{CE} = 5V)* MPS-A13	h_{FE}	5,000	–	–	
MPS-A14		10,000	–	–	
DC Forward Current Transfer Ratio (I_C = 100 mA, V_{CE} = 5V)* MPS-A13	h_{FE}	10,000	–	–	
MPS-A14		20,000	–	–	
Collector-Emitter Saturation Voltage (I_C = 100 mA, I_B = 0.1 mA)*	$V_{CE(sat)}$	–	0.75	1.5	V
Base-Emitter On-Voltage (I_C = 100 mA, V_{CE} = 5 V)	$V_{BE(ON)}$	–	1.29	2	
Small-Signal Current Gain (I_C = 30 mA, V_{CE} = 10V, f = 20 MHz)	h_{fe}	4	–	–	MHz
Output Capacitance (V_{CB} = 10 V, I_E = 0, f = 100kHz)	C_{cb}	–	5.4	8	pF
Noise Figure (I_C = 10 mA, V_{CE} = 5 V, R_S = 100 kΩ, f = 1 kHz)	NF	–	2	–	dB

*Pulse conditions: ≤ 300μs pulse width, ≤ 2 % duty cycle

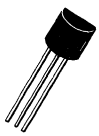
TERMINAL CONNECTIONS

Lead 1 - Emitter
Lead 2 - Base
Lead 3 - Collector

File Number **2074**

MPS-A42, A43, MPS-A92, A93

Complimentary High Voltage Silicon Transistors



TO-92

The GE/RCA MPS-A42, A43 NPN types and the MPS-A92, A93 PNP types are complementary planar epitaxial silicon transistors designed for high voltage switching and amplifier applications. PNP values are negative observe proper polarity. These types are supplied in JEDEC TO-92 package.

MAXIMUM RATINGS, *Absolute-Maximum Values:*

	MPS-A43,A93	MPS-A42,A92	
COLLECTOR TO EMITTER VOLTAGE (V_{CEO})	200	300	V
EMITTER TO BASE VOLTAGE (V_{EBO})	6	6	V
COLLECTOR TO BASE VOLTAGE (V_{CBO})	200	300	V
CONTINUOUS COLLECTOR CURRENT (I_C)	500	500	mA
TOTAL POWER DISSIPATION ($T_C \leq 25°C$)(P_T)	1500		mW
TOTAL POWER DISSIPATION ($T_A \leq 25°C$) (P_T)	625		mW
DERATE FACTOR $T_C \geq 25°C$	12		mW/°C
DERATE FACTOR $T_A \geq 25°C$	5		mW/°C
OPERATING TEMPERATURE (T_J)	−55 to +150		°C
STORAGE TEMPERATURE (T_{STG})	−55 to +150		°C
LEAD TEMPERATURE, 1/16" ± 1/32" (1.58mm ± 0.8mm) from case at 10s max. (T_L)	+260		°C

File Number **2075**

MPS-A42, A43, MPS-A92, A93

ELECTRICAL CHARACTERISTICS, At Ambient Temperature (T_A) = 25°C Unless Otherwise Specified

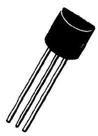
CHARACTERISTICS	SYMBOL	LIMITS								UNITS
		MPS-A42		MPS-A43		MPS-A92		MPS-A93		
		MIN.	MAX.	MIN.	MAX	MIN.	MAX.	MIN.	MAX	
Collector-Emitter Breakdown Voltage (I_C = 10 mA, I_B = 0)	BV_{CEO}	300	–	200	–	300	–	200	–	V
Collector-Base Breakdown Voltage (I_C = 100μA, I_E = 0)	BV_{CBO}	300	–	200	–	300	–	200	–	V
Collector Cutoff Current (V_{CB} = 160V, I_E = 0)	I_{CBO}	–	–	–	100	–	–	–	250	nA
(V_{CB} = 200V, I_E = 0)		–	100	–	–	–	250	–	–	
Emitter Cutoff Current (V_{EB} = 4V, I_C = 0)	I_{EBO}	–	–	–	100	–	–	–	–	nA
(V_{EB} = 6V, I_C = 0)		–	100	–	–	–	–	–	–	
(V_{EB} = 3V, I_C = 0)		–	–	–	–	–	100	–	100	
DC Forward Current Transfer Ratio (V_{CE} = 10V, I_C = 10mA)	h_{FE}	40	–	40	–	40	–	40	–	–
(V_{CE} = 10V, I_C = 30mA)		40	–	50	200	25	–	30	150	
(V_{CE} = 10V, I_C = 1mA)		25	–	25	–	25	–	25	–	
Collector-Emitter Saturation Voltage (I_C = 20A, I_B = 2mA)	$V_{CE(SAT)}$	–	0.5	–	0.5	–	0.4	–	0.4	V
Base Emitter Saturation Voltage (I_C = 20mA, I_B = 2mA)	$V_{BE(SAT)}$	–	0.9	–	0.9	–	0.9	–	0.9	V
Gain Bandwidth Product (V_{CE} = 10V, I_C = 20mA, f = 20 MHz)	f_T	50	–	50	–	50	–	50	–	MHz

TERMINAL CONNECTIONS

Lead 1 - Emitter
Lead 2 - Base
Lead 3 - Collector

MPS-A63, MPS-A64

Silicon Darlington Transistors



TO-92

The GE/RCA MPS-A63 and A64 are planar epitaxial passivated PNP silicon Darlington transistors designed for preamplifier input applications where high impedance is a requirement. These types are supplied in JEDEC TO-92 package.

MAXIMUM RATINGS, *Absolute-Maximum Values:*

COLLECTOR TO EMITTER VOLTAGE (V_{CEO})	−30 V
COLLECTOR TO BASE VOLTAGE (V_{CBO})	−30 V
EMITTER TO BASE VOLTAGE (V_{EBO})	−10 V
CONTINUOUS COLLECTOR CURRENT (I_C)	−300 mA
TOTAL POWER DISSIPATION ($T_A \leq 25°C$) (P_T)	625 mW
TOTAL POWER DISSIPATION ($T_C \leq 25°C$) (P_T)	1500 mW
DERATE FACTOR ($T_A \geq 25°C$) (P_T)	5 mW/°C
DERATE FACTOR ($T_C \geq 25°C$) (P_T)	12 mW/°C
OPERATING TEMPERATURE (T_J)	−65° to +150°C
STORAGE TEMPERATURE (T_{STG})	−55° to +150°C
LEAD TEMPERATURE, 1/16" ± 1/32" (1.58mm ± 0.8mm) from case for 10s max. (T_L)	+260°C

File Number **2076**

MPS-A63, MPS-A64

ELECTRICAL CHARACTERISTICS, At Ambient Temperature (T_A) = 25°C Unless Otherwise Specified

CHARACTERISTICS	SYMBOL	LIMITS			UNITS
		MIN.	TYP.	MAX.	
Collector-Emitter Breakdown Voltage (I_C = 100μA, I_B = 0)	BV_{CES}	30	–	–	V
Collector Cutoff Current (V_{CB} = 30V, I_E = 0)	I_{CBO}	–	–	-100	nA
Emitter Cutoff Current (V_{BE} = 10V, I_C = 0)	I_{EBO}	–	–	-100	nA
DC Forward Current Transfer Ratio (I_C = 10 mA, V_{CE} = 5V)* MPS-A63	h_{FE}	–	5,000	–	–
MPS-A64		–	10,000	–	
DC Forward Current Transfer Ratio (I_C = 100 mA, V_{CE} = 5V)* MPS-A63		–	10,000	–	
MPS-A64		–	20,000	–	
Small Signal Current Gain (I_C = 10 mA, V_{CE} = 5 V, f = 1 kHz)	h_{fe}	–	35	–	–
Collector-Emitter Saturation Voltage (I_C = 100 mA, I_B = 0.1 mA)*	$V_{CE(SAT)}$	–	-0.8	-1.5	V
Base-Emitter On-Voltage (I_C = 100 mA, V_{CE} = 10 V)	$V_{BE(ON)}$	–	-1.25	-2	V
Gain—Bandwidth Product (I_C = 100 mA, V_{CE} = 5V, f = 100 MHz)	f_T	125	–	–	MHz
Output Capacitance (V_{CB} = 10 V, I_E = 0, f = 100kHz)	C_{eb}	–	4	–	pF
Noise Figure (I_C = 1 mA, V_{CE} = 5 V, I_S = 100 kΩ, f = 1 kHz)	NF		2	–	dB

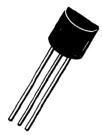
*Pulse conditions: ≤ 300μs pulse width, ≤ 2 % duty cycle

TERMINAL CONNECTIONS

Lead 1 - Emitter
Lead 2 - Base
Lead 3 - Collector

MPS-A65

Silicon Darlington Transistors



TO-92

The GE/RCA MPS-A65 is a planar epitaxial passivated PNP silicon Darlington transistor designed for preamplifier input applications where high impedance is a requirement. These types are supplied in JEDEC TO-92 package.

MAXIMUM RATINGS, *Absolute-Maximum Values:*

COLLECTOR TO EMITTER VOLTAGE (V_{CES}) . . . . . 30 V
EMITTER TO BASE VOLTAGE (V_{EBO}) . . . . . 8 V
COLLECTOR TO BASE VOLTAGE (V_{CBO}) . . . . . 30 V
CONTINUOUS COLLECTOR CURRENT (I_C) . . . . . 300 mA
TOTAL POWER DISSIPATION ($T_A \leq 25°C$) (P_T) . . . . . 625 mW
TOTAL POWER DISSIPATION ($T_C \leq 25°C$) (P_T) . . . . . 1500 mW
DERATE FACTOR ($T_A \geq 25°C$) (P_T) . . . . . 5 mW/°C
DERATE FACTOR ($T_C \geq 25°C$) (P_T) . . . . . 12 mW/°C
OPERATING TEMPERATURE (T_J) . . . . . −55° to +150°C
STORAGE TEMPERATURE (T_{STG}) . . . . . −55° to +150°C
LEAD TEMPERATURE, 1/16" ± 1/32" (1.58mm ± 0.8mm) from case for 10s max. (T_L) . . . . . +230°C

ELECTRICAL CHARACTERISTICS, At Ambient Temperature (T_A) = 25°C Unless Otherwise Specified

CHARACTERISTICS	SYMBOL	LIMITS			UNITS
		MIN.	TYP.	MAX.	
Collector-Emitter Breakdown Voltage (I_C = 100μA, I_B = 0)	BV_{CES}	30	–	–	V
Collector Cutoff Current (V_{CB} = 30V, I_E = 0)	I_{CBO}	–	–	100	nA
Emitter Cutoff Current (V_{BE} = 8V, I_C = 0)	I_{EBO}	–	–	100	
DC Forward Current Transfer Ratio I_C = 10mA, V_{CE} = 5V*	h_{FE}	50,000	–	–	–
I_C = 100mA, V_{CE} = 5V*		20,000	–	–	
Collector-Emitter Saturation Voltage (I_C = 100 mA, I_B = 0.1 mA)	$V_{CE(SAT)}$	–	0.9	1.5	V
Base-Emitter On-Voltage (I_C = 100 mA, V_{CE} = 5 V)*	$V_{BE(ON)}$	–	1.45	2	
Gain-Bandwidth Product (I_C = 100 mA, V_{CE} = 10V, f = 50 MHz)	f_T	100	125	–	MHz
Output Capacitance (I_{CB} = 10 mA, I_E = 0, f = 100MHz)	C_{cb}	–	2.5	–	pF
Noise Figure (I_C = 1 mA, V_{CE} = 5 V, R_S = 100 kΩ, f = 1 kHz)	NF		2	–	dB

*Pulse conditions: ≤ 300μs pulse width, ≤ 2 % duty cycle

File Number **2077**

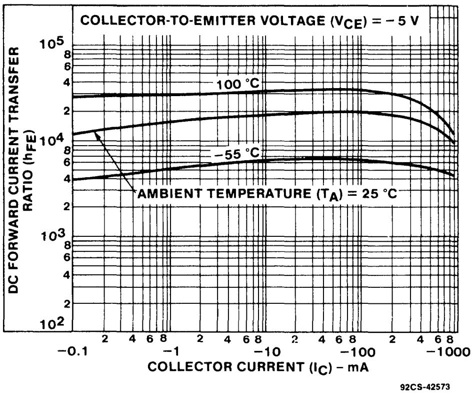


Fig. 1 — Typical dc forward-current transfer ratio characteristics.

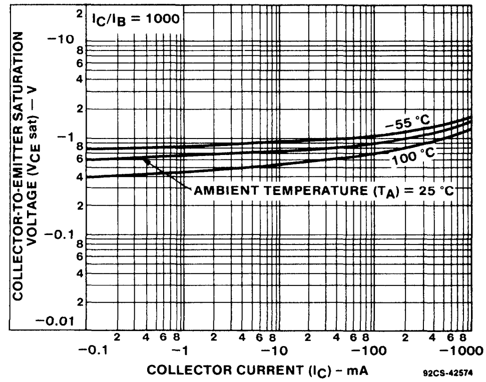


Fig. 2 — Typical collector-to-emitter saturation voltage characteristics.

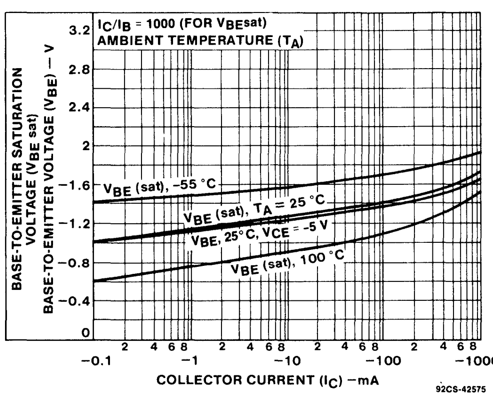


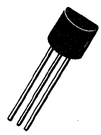
Fig. 3 — Typical base-to-emitter saturation voltage and base-to-emitter voltage characteristics.

TERMINAL CONNECTIONS

Lead 1 - Emitter
Lead 2 - Base
Lead 3 - Collector

MPS-L01, MPS-L51

Silicon Transistors



TO-92

The GE/RCA MPS-L01 NPN type and the MPS-L51 PNP type are planar epitaxial silicon transistors designed for general-purpose, high-voltage amplifier applications. PNP values are negative; observe proper polarity. These types are supplied in JEDEC TO-92 package.

MAXIMUM RATINGS, *Absolute-Maximum Values:*

	MPS-L01	MPS-L51	
COLLECTOR TO EMITTER VOLTAGE (V_{CEO})	120	100	V
EMITTER TO BASE VOLTAGE (V_{EBO})	5	4	V
COLLECTOR TO BASE VOLTAGE (V_{CBO})	140	100	V
CONTINUOUS COLLECTOR CURRENT (I_C)	150	600	mA
TOTAL POWER DISSIPATION $T_C \leq 25°C$ (P_T)	1500	1500	mW
TOTAL POWER DISSIPATION $T_A \leq 25°C$ (P_T)	625	625	mW
DERATE FACTOR, $T_C > 25°C$	12	12	mW/°C
DERATE FACTOR, $T_A > 25°C$	5	5	mW/°C
OPERATING TEMPERATURE (T_J)	−55C to +150		°C
STORAGE TEMPERATURE (T_{STG})	−65C to +150		°C
LEAD TEMPERATURE 1/16" ± 1/32" (1.58mm ± 0.8mm) from case at 10s max. (T_L)	+260		°C

File Number **2071**

MPS-L01, MPS-L51

ELECTRICAL CHARACTERISTICS, At Ambient Temperature (T_A) = 25°C Unless Otherwise Specified

CHARACTERISTICS	SYMBOL	LIMITS				UNITS
		MPS-L01		MPS-L51		
		MIN.	MAX.	MIN.	MAX	
Collector-Emitter Breakdown Voltage (I_C = 1mA, I_B = 0)*	BV_{CEO}	120	–	100	–	V
Collector-Base Breakdown Voltage (I_C = 100μA, I_E = 0)	BV_{CBO}	140	–	100	–	V
Emitter-Base Breakdown Voltage (I_E = 10μA, I_C = 0)	BV_{EBO}	5	–	4	–	V
DC Forward Current Transfer Ratio (I_C = 50mA, V_{CE} = 5V)	h_{FE}	–	–	40	250	–
(I_C = 10mA, V_{CE} = 5V)		50	300	–	–	–
Collector Saturation Voltage (I_C = 10mA, I_B = 1mA)	$V_{CE(SAT)}$	–	0.2	–	0.25	V
(I_C = 50mA, I_B = 5mA)		–	0.3	–	0.3	V
Base-Emitter Saturation Voltage (I_C = 10mA, I_B = 1mA)	$V_{BE(SAT)}$	–	1.2	–	1.2	V
(I_C = 50mA, I_B = 5mA)		–	1.4	–	1.2	V
Gain-Bandwidth Product (I_C = 10mA, V_{CE} = 10V, f = 100MHz)	f_T	60	–	60	–	MHz
Output Capacitance (V_{CB} = 10V, I_E = 0, f = 1 MHz)	C_{ob}	–	8	–	8	pF

*Pulse condition: 300μs pulse width, 2% duty cycle.

2

TERMINAL CONNECTIONS

Lead 1 - Emitter
Lead 2 - Base
Lead 3 - Collector

Unijunction Transistors and Switches Technical Data

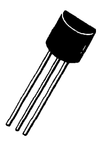
3

Unijunction Transistors and Switches Selector Guide

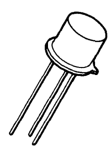
Type	Structure	I_F [Max.] mA	V_R [Min.] V	V_S or η	Package	File No.	Page No.
2N4870	UJT	50	30	0.56-0.75	TO-92	1949	108
2N4871	UJT	50	30	0.7-0.85	TO-92	1949	108
GES2646	UJT	50	30	0.56-0.75	TO-92	2047	103
GES2647	UJT	50	30	0.68-0.82	TO-92	2047	103
GET4870	UJT	50	30	0.56-0.75	TO-18	1949	108
GET4871	UJT	50	30	0.7-0.85	TO-18	1949	108
2N2646	UJT	500	30	0.56-0.75	TO-18	2047	103
2N2647	UJT	500	30	0.68-0.82	TO-18	2047	103
2N4987	SUS	175	30	6.0-10.0	TO-98	2049	115
2N4990	SUS	175	30	7.0-9.0	TO-98	2049	115
2N4988	SUS	175	30	7.5-9.0	TO-98	2049	115
2N4989	SUS	175	30	7.5-8.2	TO-98	2049	115
2N6027	PUT	150	40	0.2-1.6	TO-98	2050	122
2N6028	PUT	150	40	0.2-0.6	TO-98	2050	122
GES6027	PUT	150	40	0.2-1.6	TO-92	2050	122
GES6028	PUT	150	40	0.2-0.6	TO-92	2050	122
2N4991	SBS	175	—	6.0-10.0	TO-98	2048	111
2N4992	SBS	175	—	7.5-9.0	TO-98	2048	111

2N2646, 2N2647, GES2646, GES2647

Silicon Unijunction Transistors



TO-92



TO-18

The GE/RCA 2N2646, GES2646 and 2N2647, GES2647 silicon-unijunction transistors have an entirely new structure resulting in lower saturation voltage, peak-point current and valley current as well as a much higher base-one peak pulse voltage. In addition, these devices are much faster switches.

The 2N2646 and GES2646 are intended for general purpose industrial applications where circuit economy is of primary importance, and is ideal for use in firing circuits for Silicon Controlled Rectifiers and other applications where a guaranteed minimum pulse amplitude is required. The 2N2647 and GES2647 are intended for applications where a low emitter leakage current and a low peak point emitter current (trigger current) are required (i.e., long timing applications), and also for triggering high power SCR's. These types are supplied in JEDEC TO-18 package (2N2646, 2N2647) and in JEDEC TO-92 packages (GES2646, GES2647).

3

MAXIMUM RATINGS, *Absolute-Maximum Values:*

EMITTER REVERSE VOLTAGE	30 V
INTERBASE VOLTAGE	35 V
RMS EMITTER CURRENT	50 mA
PEAK EMITTER CURRENT (Note 1)	2 A
POWER DISSIPATION (Note 2)	300 mW
OPERATING TEMPERATURE RANGE	−65° to +125°C
STORAGE TEMPERATURE RANGE	−65° to +150°C

NOTES:
1. Capacitor discharge — 10μF or less, 30 V or less.
2. Derate 3 mW/°C increase in ambient temperature. The total power dissipation (available power to Emitter and Base-Two) must be limited by the external circuitry.

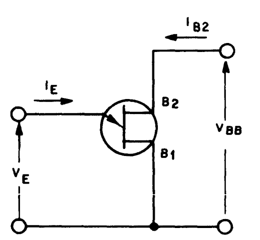


Fig. 1 — Unijunction transistor symbol and nomenclature used for current and voltage circuit.

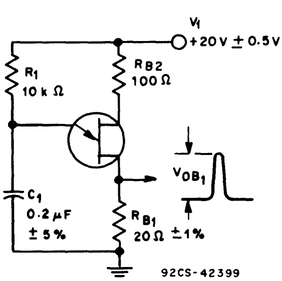


Fig. 2 — Typical base-1 peak-pulse voltage circuit.

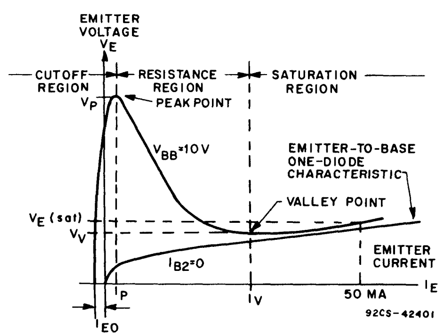


Fig. 3 — Static emitter characteristics waveforms.

File Number **2047**

2N2646, 2N2647, GES2646, GES2647

ELECTRICAL CHARACTERISTICS, At Ambient Temperature (T_A) = 25°C Unless Otherwise Specified

CHARACTERISTICS	SYMBOL	LIMITS 2N2646,GES2646 MIN.	TYP.	MAX.	2N2647,GES2647 MIN.	TYP.	MAX	UNITS
Intrinsic Standoff Ratio (V_{BB} = 10 V)	η	0.56	0.69	0.75	0.68	0.77	0.82	–
Interbase Resistance (V_{BB} = 3 V, I_E = 0)	R_{BBO}	4.7	6.7	9.1	4.7	6.7	9.1	kΩ
Emitter Saturation Voltage (V_{BB} = 10 V, I_E = 50 mA)	$V_E(sat)$	–	2	–	–	2	–	V
Modulated Interbase Current (V_{BB} = 10 V, I_E = 50 mA	$I_{B2}(mod)$	–	24	–	–	27	–	mA
Emitter Reverse Current (V_{B2E} = 30 V, I_{B1} = 0)	I_{EO}	–	0.001	12	–	0.001	0.2	μA
Peak Point Emitter Current (V_{BB} = 25 V)	I_P	–	0.8	5	–	1	2	
Valley Point Current (V_{BB} = 20 V, R_{B2} = 100 Ω)	I_V	4	5	–	8	9	18	mA
Base-One Peak Pulse Voltage (Note 1)(Fig. 2)	V_{OB1}	3	8.5	–	6	9.5	–	V

NOTES:

1. The Base-1 peak pulse voltage is measured in the circuit below. This specification on the 2N2646 and 2N2647 is used to ensure a minimum pulse amplitude for applications in SCR firing circuits and other types of pulse circuits.
2. SCR firing conditions—see Figs. 19, 20, 21, and 22.

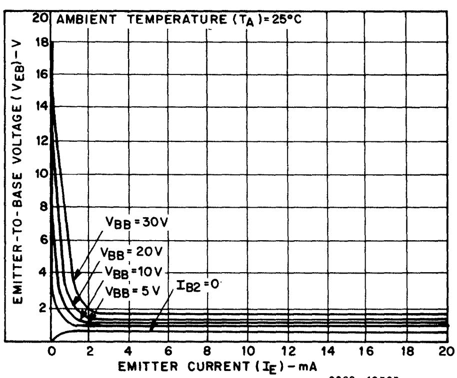


Fig. 4—Typical static emitter characteristics.

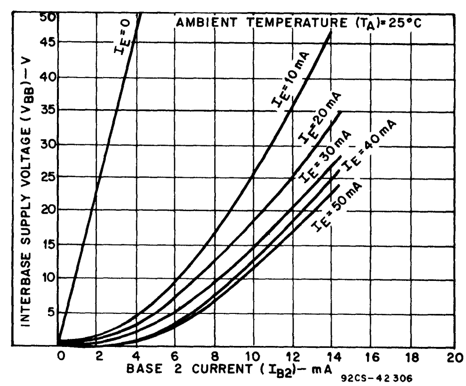


Fig. 5—Typical static interbase characteristics

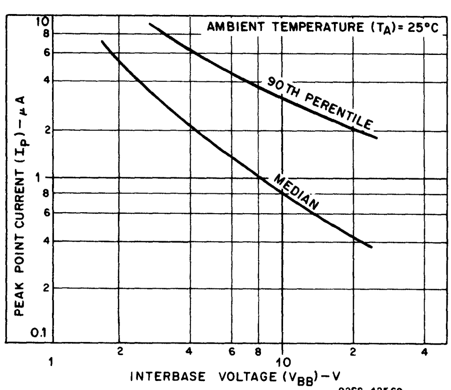


Fig. 6—Typical peak point current characteristics.

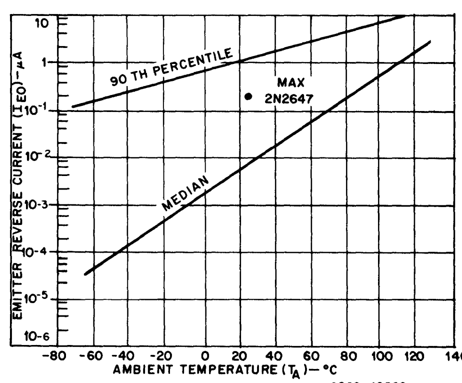


Fig. 7—Typical emitter reverse current characteristics.

2N2646, 2N2647, GES2646, GES2647

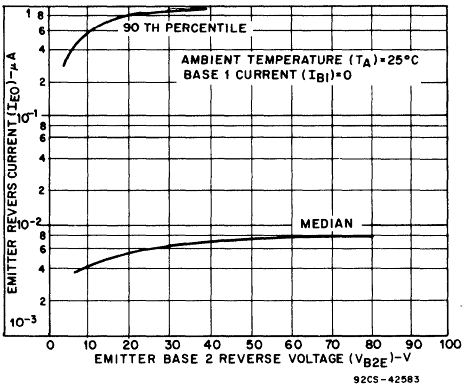


Fig. 8 — Typical emitter reverse current characteristics.

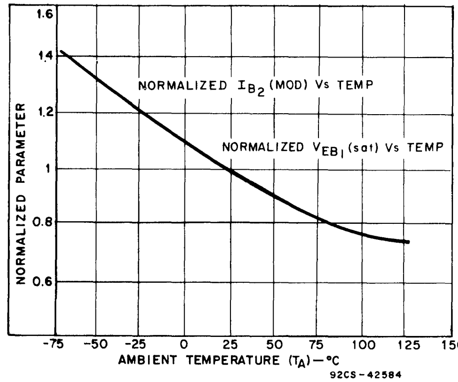


Fig. 9 — Normalized base-2 current and base-1 saturation voltage characteristic.

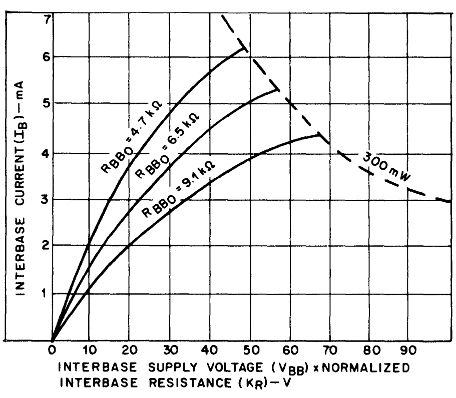


Fig. 10 — Typical interbase characteristics.
Interbase characteristics at any junction temperature may be determined by dividing the horizontal scale by K_R, see Fig. 11.

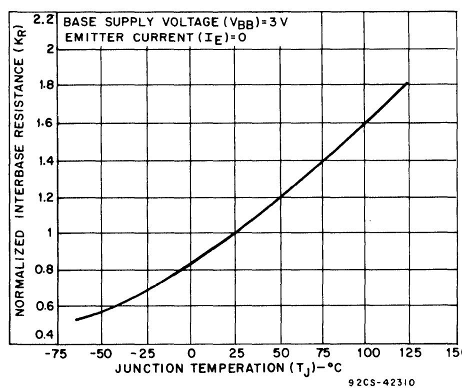


Fig. 11 — Normalized interbase resistance characteristic.

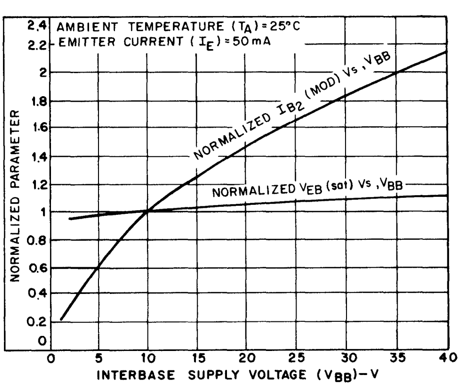


Fig. 12 — Normalized base-2 current and base-1 saturation voltage characteristics.

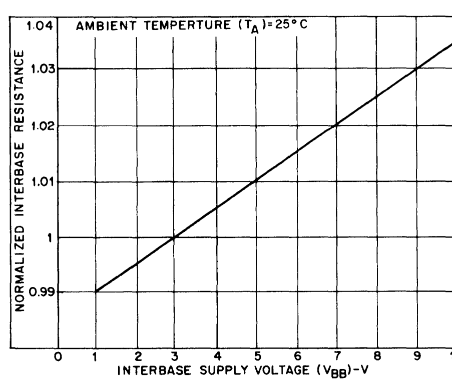


Fig. 13 — Normalized interbase resistance characteristic.

3

2N2646, 2N2647, GES2646, GES2647

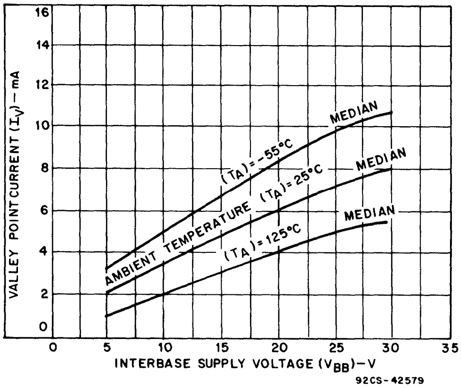


Fig. 14 – Valley point current vs. base voltage, for 2N2646 only.

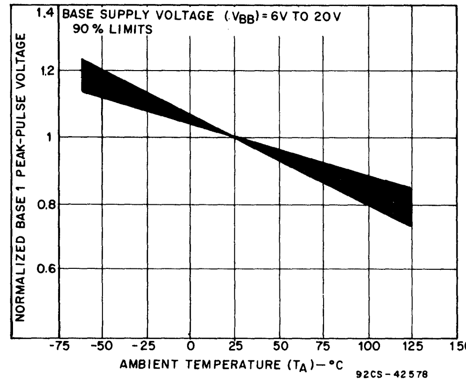


Fig. 15 – Normalized base 1 peak-pulse voltage vs. ambient temperature.

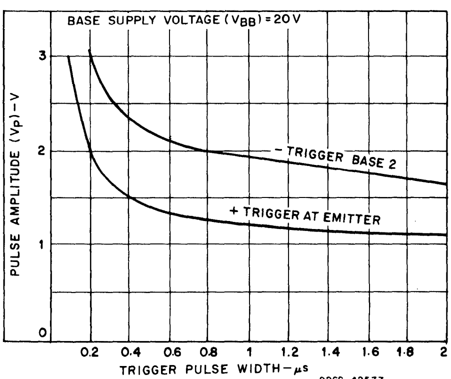


Fig. 16 – Minimum trigger pulse amplitude vs. trigger pulse width for turn-on of unijunction transistor

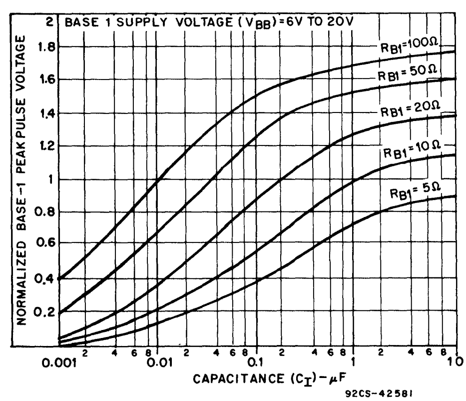


Fig. 17 – Normalized base 1 peak pulse voltage vs. capacitance.

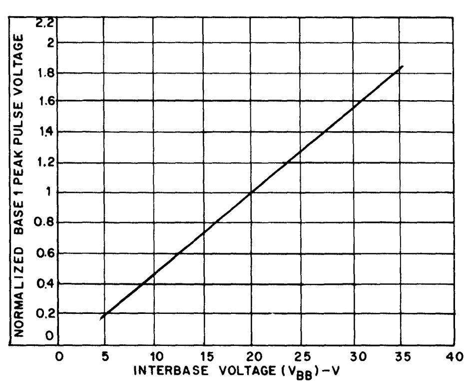


Fig. 18 – Normalized base 1 peak pulse voltage vs. interbase voltage.

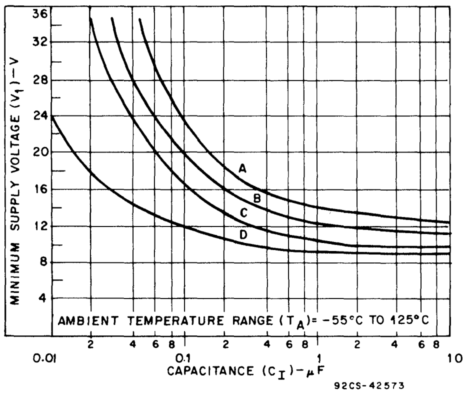
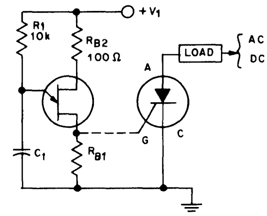


Fig. 19 — Minimum supply voltage characteristics. See Fig. 20 for circuit and curve data.



CURVE	SCR TYPE	R_{B1}	V_1(MAX)
A	C35,C36	27 Ω ± 10%	35 V
B	C35,C36	47 Ω ± 10%	20 V
B	C10,C11	27 Ω ± 10%	32 V
C	C10,C11	47 Ω ± 10%	18 V
C	C35,C36	SPRAGUE 11Z12 PULSE TRANS.	35 V
D	C10,C11		35 V

NOTE:
C35-2N681-92
C36-2N1842-50
C10-2N1770A-77A
C11-2N1770-78

92CS-42571

Fig. 20 — Circuit for minimum supply voltage curves, Fig. 19.

3

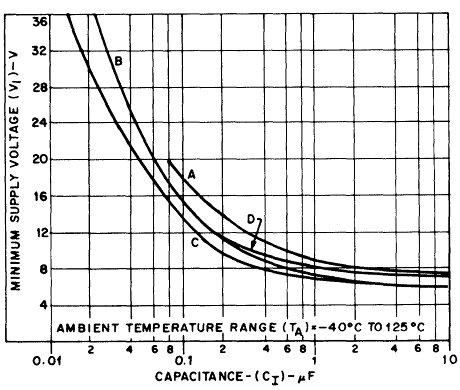
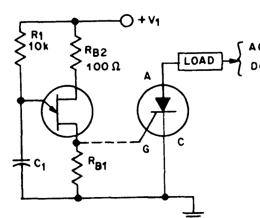


Fig. 21 — Minimum supply voltage characteristics. See Fig. 22 for circuit and curve data.

CURVE	SCR TYPE	R_{B1}	V_I(MAX)
B	C60(2N2023-30)	27 Ω ± 10%	35 V
C	C52(2N1792-98)	47 Ω ± 10%	20 V
C	C50(2N1909-16) C45 AND C46 SC30,40,50 AND 140 SERIES	PULSE TRANS. PE2231	35 V



92CS-42572

Fig. 22 — Circuit for minimum supply voltage curves, Fig. 21.

TERMINAL CONNECTIONS

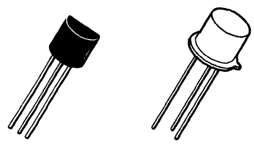
TO-92
Lead 1 - Emitter
Lead 2 - Base 1
Lead 3 - Base 2

TERMINAL CONNECTIONS

TO-18
Lead 1 - Emitter
Lead 2 - Base 1
Lead 4 - Base 2

2N4870, 2N4871, GET4870, GET4871

Silicon Unijunction Transistors



TO-92 TO-18

The GE/RCA 2N4870, 2N4871, and GET4870, GET4871 are unijunction silicon transistors intended for general-purpose industrial applications where circuit economy is of primary importance. The 2N4870, 1 and GET4870, 1 are ideal for use in firing circuits for silicon controlled rectifiers, timing circuits, relaxation oscillators and other typical unijunction transistor applications. These unijunction transistors are supplied in JEDEC TO-92 package (2N4870, 2N4871) and in JEDEC TO-18 package (GET4870, GET4871).

MAXIMUM RATINGS, *Absolute-Maximum Values:*

EMITTER REVERSE VOLTAGE	30 V
INTERBASE VOLTAGE	35 V
RMS EMITTER CURRENT	50 mA
PEAK EMITTER CURRANT (Note 1)	1.5 A
POWER DISSIPATION (Note 2)	300 mW
OPERATING TEMPERATURE RANGE	−65° to +125°C
STORAGE TEMPERATURE RANGE	−65° to +150°C

NOTES:
1. Duty cycle ≤ 1% PRR = 10 PPS.
2. Derate 3 mW/°C increase in ambient temperature. The total power dissipation (available power to Emitter and Base-Two) must be limited by the external circuitry.

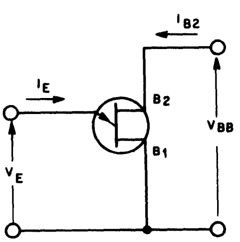


Fig. 1 — Unijunction transistor symbol and nomenclature used for current and voltage circuit.

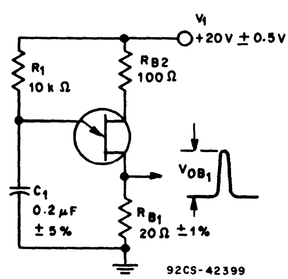


Fig. 2 — Typical base-1 peak-pulse voltage circuit.

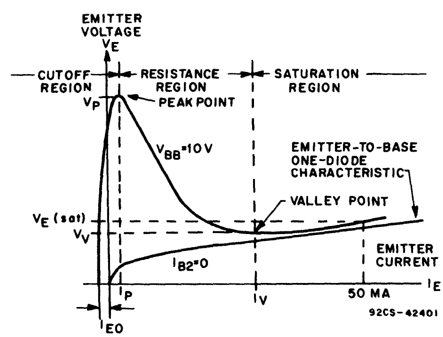


Fig. 3 — Static emitter characteristics waveforms.

File Number **1949**

2N4870, 2N4871, GET4870, GET4871

ELECTRICAL CHARACTERISTICS, At Ambient Temperature (T_A) = 25°C Unless Otherwise Specified

CHARACTERISTICS	SYMBOL	LIMITS						UNITS
		2N4870			2N4871			
		MIN.	TYP.	MAX.	MIN.	TYP.	MAX	
Intrinsic Standoff Ratio (V_{BB} = 10 V)(Note 1)	η	0.56	—	0.75	0.7	—	0.85	—
Interbase Resistance (V_{BB} = 3 V, I_E = 0)	R_{BBO}	4	6	9.1	4	6	9.1	kΩ
Emitter Saturation Voltage (V_{BB} = 10 V, I_E = 50 mA)	V_E(sat)	—	2.5	—	—	2.5	—	V
Modulated Interbase Current (V_{BB} = 10 V, I_E = 50 mA	I_{B2}(mod)	—	2.2	—	—	2.7	—	mA
Emitter Reverse Current (V_{B2} = 30 V, I_{B1} = 0)	I_{EO}	—	0.05	1	—	0.05	1	μA
Peak Point Emitter Current (V_{BB} = 25 V)	I_P	—	1	5	—	1	5	
Valley Point Current (V_{BB} = 20 V, R_{B2} = 100 Ω)	I_V	2	5	—	4	7	—	mA
Base-One Peak Pulse Voltage (Note 2)(Fig. 2)	V_{OB1}	3	6	—	5	8	—	V

NOTES:

1. The intrinsic standoff ratio, η, is essentially constant with temperature and interbase voltage.
   η is defined by the equation:
   $V_P = \eta V_{BB} + V_D$
   Where V_P = Peat Point Emitter Voltage
   V_{BB} = Interbase Voltage
   V_D = Junction diode Drop (Approx. 0.5 V)
2. The Base-1 Peak Pulse Voltage is measured in the circuit below. This specification is used to ensure a minimum pulse amplitude for applications in SCR firing circuits and other types of pulse circuits.

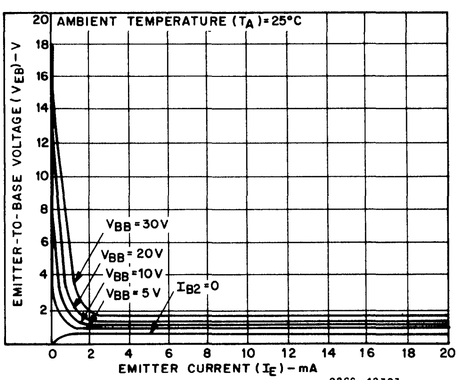


Fig. 4 — Typical static emitter characteristics.

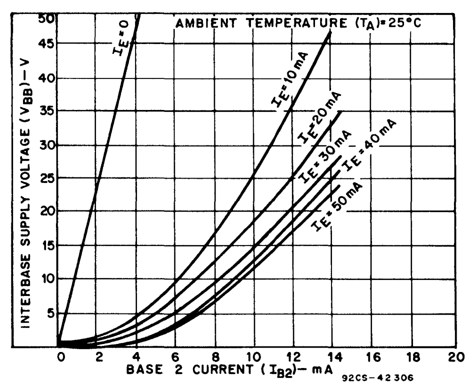


Fig. 5 — Typical static interbase characteristics.

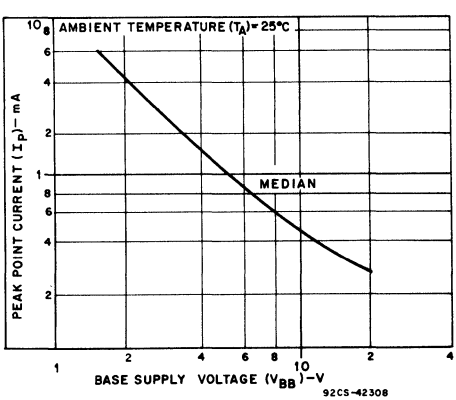


Fig. 6 — Typical peak point current characteristic.

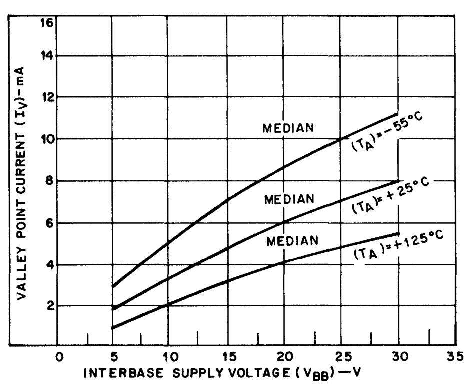


Fig. 7 — Typical valley point current characteristic.

2N4870, 2N4871, GET4870, GET4871

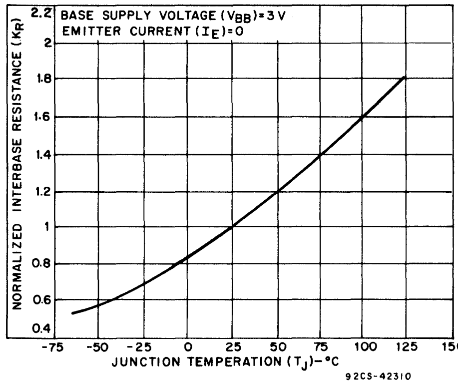


Fig. 8 — Normalized interbase resistance characteristic.

TERMINAL CONNECTIONS

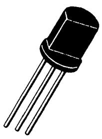
TO-92
Lead 1 - Emitter
Lead 2 - Base 1
Lead 3 - Base 2

TERMINAL CONNECTIONS

TO-18
Lead 1 - Emitter
Lead 2 - Base 1
Lead 4 - Base 2

2N4991, 2N4992

Silicon Bilateral Switch



TO-98

The GE/RCA 2N4991, 2N4992 SBSs are planar monolithic silicon integrated circuits having the electrical characteristics of a bilateral thyristor. The device is designed to switch at 8V with a 0.02%/°C temperature coefficient and excellently matched characteristics in both directions. A gate lead is provided to eliminate rate effect and to obtain trigggering at lower voltages.

The silicon bilateral switches are specifically designed and characterized for applications where stability of switching voltage over a wide temperature range and well matched bilateral characteristics are an asset. They are ideally suited for half wave and full wave triggering in low voltage SCR and Triac phase control circuits. These types are supplied in JEDEC TO-98 package

Devices in TO-98 package are supplied with and without seating flange (see Dimensional Outline).

MAXIMUM RATINGS, *Absolute-Maximum Values:*

PEAK RECURRENT FORWARD CURRENT (1% duty cycle, 10 μs pulse width, T_A = 100°C) .... 1 A
PEAK NON-RECURRENT FORWARD CURRENT (10 μs pulse width) .... 5 A
DC FORWARD ANODE CURRENT (Note 1) .... 175 mA
DC GATE CURRENT (Notes 1 and 2) .... 5 mA
POWER DISSIPATION (Note 1) .... 300 mW
OPERATING JUNCTION TEMPERATURE RANGE .... −55° to +125°C
STORAGE TEMPERATURE RANGE .... −65° to +150°C

NOTES:
1. Derate linearly to zero at 125°C.
2. This rating applicable only in OFF state.
   Maximum gate current in conducting state limited by maximum power rating.

TERMINAL CONNECTIONS

Lead 1 - Anode 1
Lead 2 - Gate
Lead 3 - Anode 2

File Number **2048**

2N4991, 2N4992

ELECTRICAL CHARACTERISTICS, At Ambient Temperature (T_A) = 25°C Unless Otherwise Specified

CHARACTERISTICS	SYMBOL	LIMITS						UNITS
		2N4991			2N4992			
		MIN.	TYP.	MAX.	MIN.	TYP.	MAX	
Forward Voltage Drop (on state)(I_F = 175 mA)	V_F	—	—	1.7	—	—	1.7	V
Switching Voltage	V_S	6	—	10	7.5	—	9	
Forward Current (off state)								
(V_F = 5V, T_A = 25°C)	I_B	—	—	1	—	—	0.1	μA
(V_F = 5V, T_A = 85°C	I_B	—	—	10	—	—	10	
Switching Current	I_S	—	—	500	—	—	120	
Absolute Switching Voltage Difference	$\|V_{S2}-V_{S1}\|$	—	—	0.5	—	—	0.2	V
Absolute Switching Current Difference	$\|I_{S2}-I_{S1}\|$	—	—	100	—	—	10	μA
Holding Current	I_H	—	—	1.5	—	—	0.5	mA
Forward Gate Current to Trigger (V_F = 5V., RL = 1kΩ)	I_{GF}	—	—	—	—	—	100	μA
Temperature Coefficient of Switching Voltage (T_A = −55°C to +85°C	T_C	—	±0.02	—	—	±0.05	—	%/°C
Turn-on Time (See Circuit 10)	t_{on}	—	—	1	—	—	1	μs
Turn-off Time (See Circuit 11)	t_{off}	—	—	30	—	—	30	
Peak Pulse Voltage (See Circuit 12)	V_O	3.5	—	—	3.5	—	—	V

NOTES:

1. This device is a symmetrical negative resistance diode. All electrical limits shown apply in either direction of current flow.

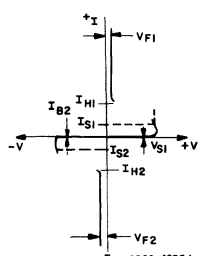


Fig. 1 — Static characteristics waveform.

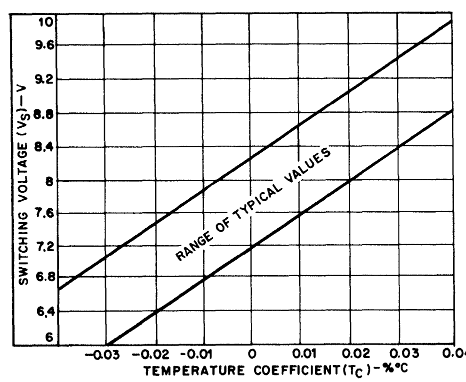


Fig. 2 — Typical switching voltage characteristics.

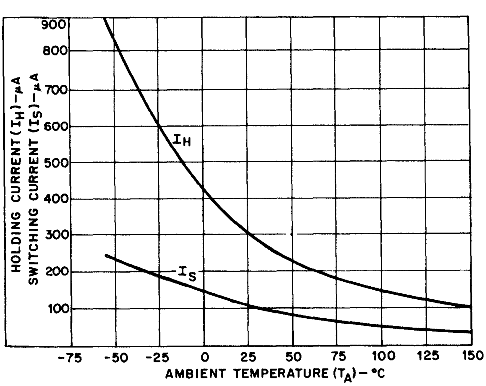


Fig. 3 — Typical holding and switching current characteristics.

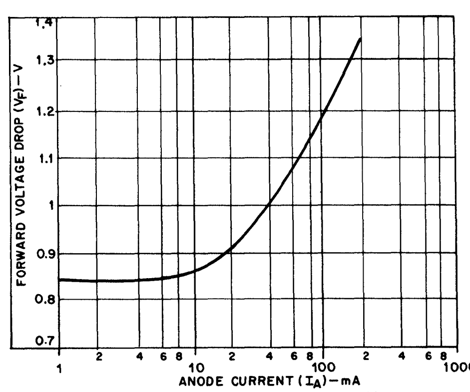


Fig. 4 — Typical forward voltage drop characteristic.

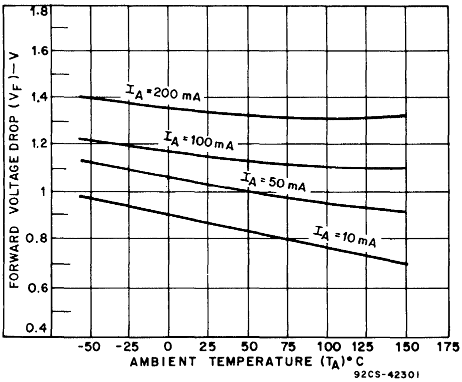


Fig. 5 — Typical forward voltage drop characteristic.

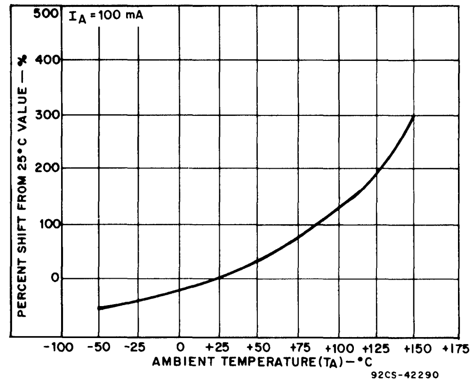


Fig. 6 — Typical turn-off time shift characteristic.

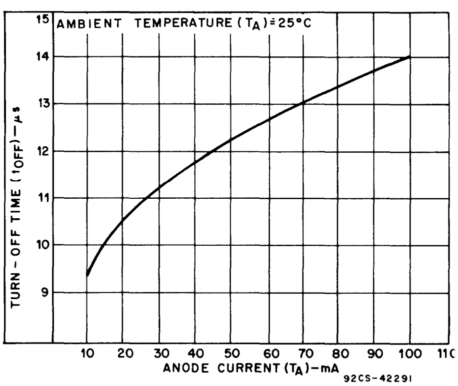


Fig. 7 — Typical turn-off time characteristic.

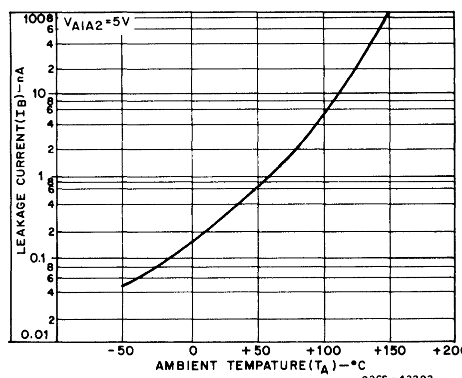


Fig. 8 — Typical leakage current characteristic.

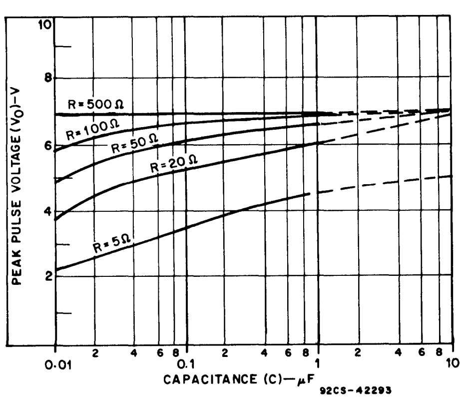


Fig. 9 — Typical peak pulse voltage characteristics. (See circuit, Fig. 12)

TEST CIRCUITS

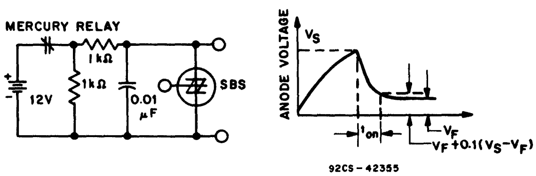


Fig. 10—Turn-on time test circuit and waveform.

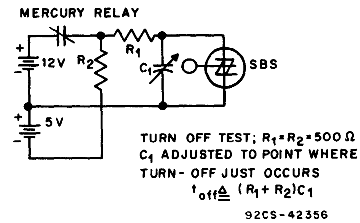


Fig. 11—Turn-off time test circuit.

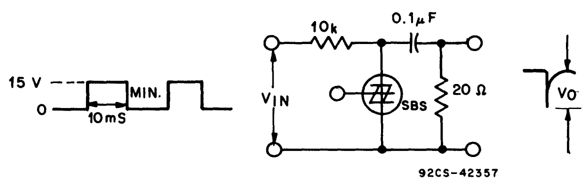


Fig. 12—Peak pulse voltage test circuit and waveforms. (See Fig. 9 for curve)

APPLICATION IN HYSTERESIS-FREE PHASE CONTROL CIRCUIT

The circuit in Figure 13 is a simple hysteresis-free phase control circuit intended for lamp dimming and similar applications. The circuit requires only one RC phase lag network. To avoid the hysteresis (or "snap-on") effect, the capacitor, C, is reset to approximately 0 volts at the end of every positive half cycle (for pot values such that no power is applied to the load). This is accomplished using the gate lead. At the end of the positive half, as the line voltage drops below the capacitor voltage, gate current flows from C out through the gate, D1 and 47kΩ resistor. The SBS fires and discharges C to 0 volts. In the negative half cycle diodes D2 and D1 clamp the gate voltage to ground and block the flow of gate current respectively. Electrical requirements of D1 and D2 are easily met. Any diode with $V_R > 10$ volts works fine. Forward conductance must be fairly good since the voltage across D2 at 3mA must be smaller than the drop across the Triac gate, the SBS gate, and D1 at the trigger current of the SBS.

Figure 14 shows the excellent degree of phase control available in the circuit. For the worst case unit, ϕmax = 155° (V_S = 7.5 volts, I_S = 120μA).

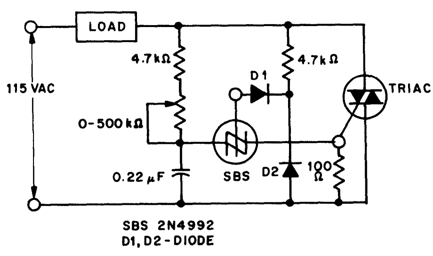


Fig. 13—Typical phase-control circuit for lamp dimming and similar applications.

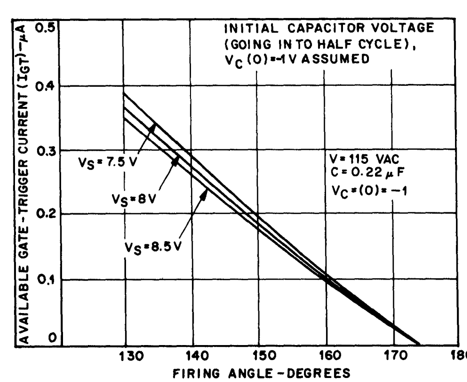
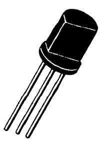


Fig. 14—Typical gate-trigger current characteristic.

2N4987, 2N4988, 2N4989, 2N4990



TO-98

Silicon Unilateral Switch

Applications:
- SCR Triggers
- Frequency Drivers
- Ring Counters
- Cross Point Switching
- Over-Voltage Sensors

The GE/RCA 2N4987-90 SUSs are planar monolithic silicon integrated circuits having thyristor electrical characteristics closely approximating those of an "ideal" four layer diode. The device is designed to switch at 8 V with a 0.02%/°C temperature coefficient. A gate lead is provided to eliminate rate effect, obtain trigggering information at lower voltages and to obtain transient free wave forms.

Silicon Unilateral Switches are specifically designed and characterized for use in monostable and bistable applications where low cost is of prime importance. These types are supplied in JEDEC TO-98 package.

Devices in TO-98 package are supplied with and without seating flange (see Dimensional Outline).

MAXIMUM RATINGS, *Absolute-Maximum Values:*

PEAK REVERSE VOLTAGE	30 V
PEAK RECURRENT FORWARD CURRENT (1% duty cycle, 10μs pulse width, T_A = 100°C)	1 A
PEAK NON-RECURRENT FORWARD CURRENT (10μs pulse width)	5 A
DC FORWARD ANODE CURRENT (Note 1)	175 mA
DC GATE CURRENT (Notes 1 and 2)	5 mA
POWER DISSIPATION (Note 1)	300 mW
JUNCTION TEMPERATURE RANGE	− 65° to + 125°C
STORAGE TEMPERATURE RANGE	− 65° to + 150°C

NOTES:
1. Derate linearly to zero at 125°C.
2. This rating applicable only in OFF state.
   Maximum gate current in conducting state limited by maximum power rating.

File Number **2049**

2N4987, 2N4988, 2N4989, 2N4990

ELECTRICAL CHARACTERISTICS, At Ambient Temperature (T_A) = 25°C Unless Otherwise Specified

CHARACTERISTICS	SYMBOL	LIMITS												UNITS
		2N4987			2N4988			2N4989			2N4990			
		MIN.	TYP.	MAX.	MIN.	TYP.	MAX	MIN.	TYP.	MAX	MIN.	TYP.	MAX	
Forward Voltage Drop (on state) (I_F = 175 mA)	V_F	–	–	1.5	–	–	1.5	–	–	1.5	–	–	1.5	V
Forward Switching Voltage	V_S	6	–	10	7.5	–	9	7.5	–	8.2	7	–	9	
Forward Current (off state) (V_F = 5V, T_A = 25°C)	I_B	–	–	0.1	–	–	0.1	–	–	0.1	–	–	0.1	
(V_F = 5V, T_A = 100°C)	I_B	–	–	10	–	–	10	–	–	10	–	–	10	μA
Forward Switching Current	I_S	–	–	500	–	–	150	–	–	300	–	–	200	mA
Reverse Current (V_R = −30V, T_A = 25°C)	I_R	–	–	0.1	–	–	0.1	–	–	0.1	–	–	0.1	
(V_R = −30V, T_A = 100°C)	I_R	–	–	10	–	–	10	–	–	10	–	–	10	μA
Holding Current	I_H	–	–	1.5	–	–	0.5	–	–	1	–	–	0.75	mA
Temperature Coefficient of Switching Voltage (T_A = −55°C to +100°C)	T_C	–	±0.02			±0.05			±0.02			±0.02		%/°C
Turn-on Time (See Circuit 10)	t_{on}	–	–	1	–	–	1	–	–	1	–	–	1	
Turn-off Time (See Circuit 12)	t_{off}	–	–	25	–	–	25	–	–	25	–	–	25	μs
Peak Pulse Voltage (See Circuit 14)	V_O	3.5	–	–	3.5	–	–	–	–	–	–	–	–	V
Capacitance (0V., f = 1 MHz)	C	–	2.5	–	–	2.5	–	–	2.5	–	–	2.5	–	pF

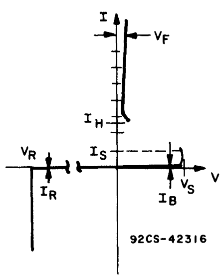


Fig. 1 — Static characteristics waveform.

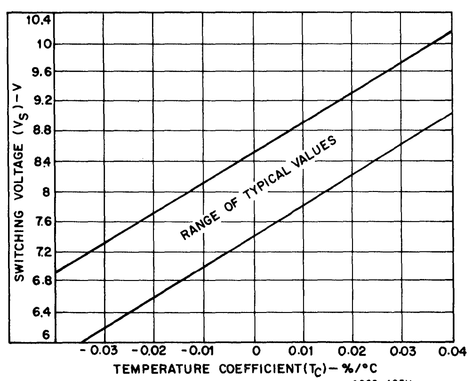


Fig. 2 — Typical switching voltage characteristics.

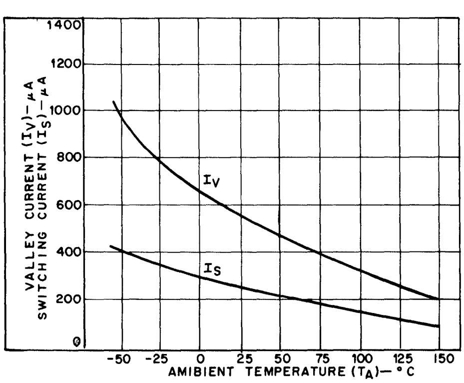


Fig. 3 — Typical valley and switching current characteristics.

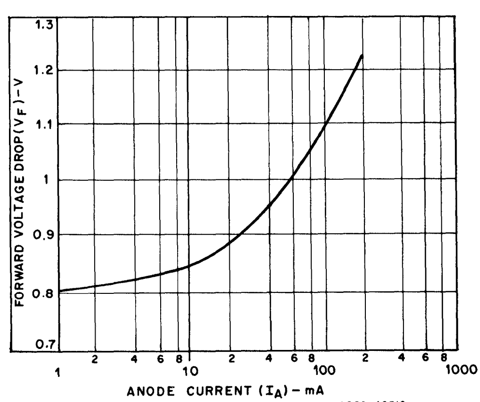


Fig. 4 — Typical forward voltage drop characteristic.

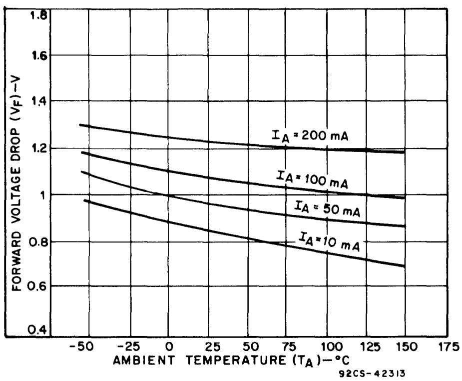


Fig. 5 — Typical forward voltage drop characteristics.

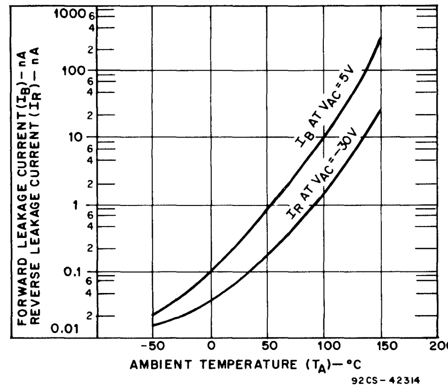


Fig. 6 — Typical forward and reverse leakage current characteristics.

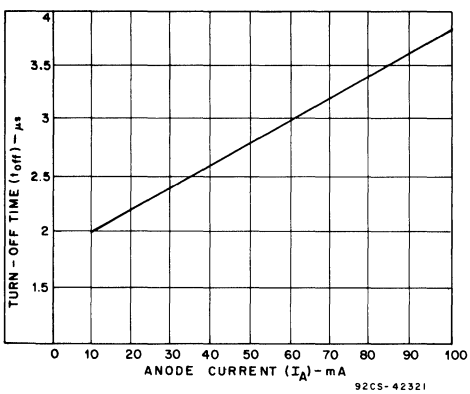


Fig. 7 — Typical turn-off time characteristics.

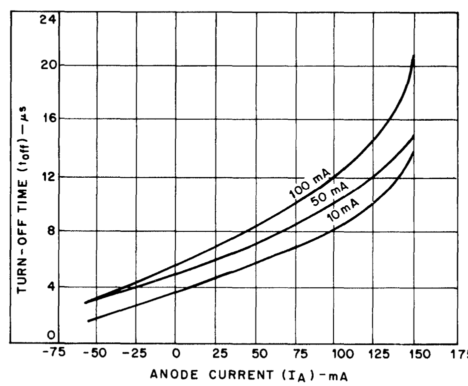


Fig. 8 — Typical turn-off time characteristics.

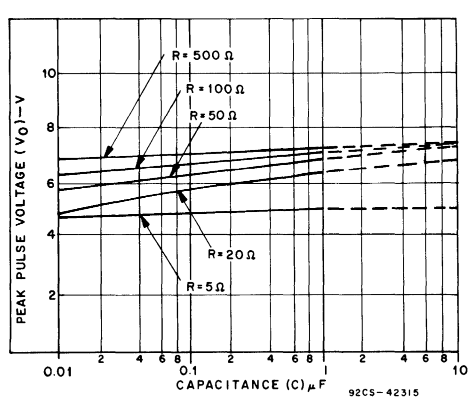


Fig. 9 — Typical peak pulse voltage characteristics.
(See circuit, Fig. 12)

2N4987, 2N4988, 2N4989, 2N4990

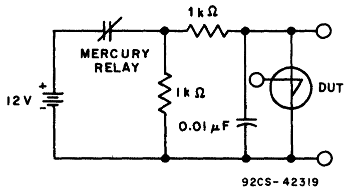


Fig. 10 — Turn-on time test circuit.

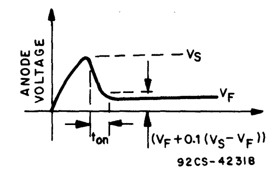


Fig. 11 — Turn-on time test circuit (Fig. 10) waveform.

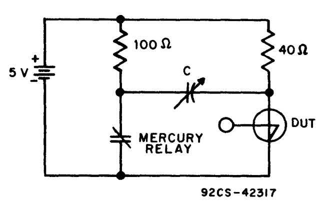


Fig. 12 — Turn-off time test circuit.

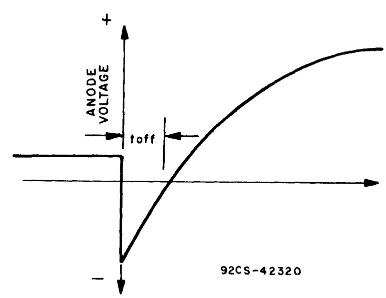


Fig. 13 — Turn-off time test circuit (Fig. 12) waveform.

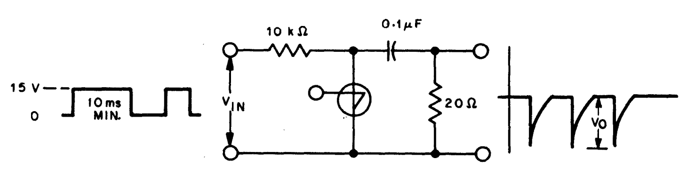


Fig. 14 — Peak pulse voltage test circuit and waveforms.

APPLICATIONS

Uses fewer components than transistor flip flops. Output at "B" gives transient free waveform.

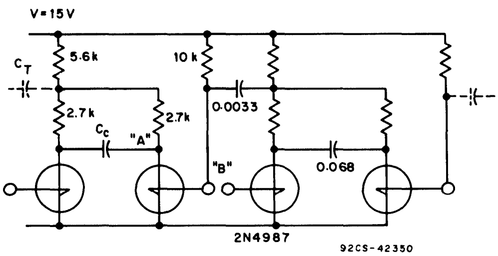


Fig. 15—Binary divider chain circuit.

Switching action of the 2N4990 allows smaller capacitors to be used while achieving reliable thyristor triggering.

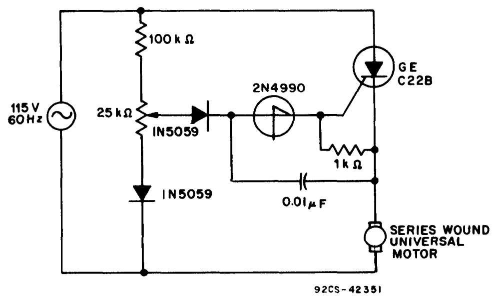


Fig. 16—Motor speed control circuit.

SUS is used to generate a rapid rise or fall time by using energy stored in a capacitor.

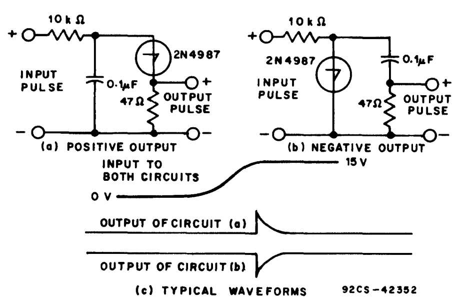


Fig. 17—Pulse sharpeners circuit.

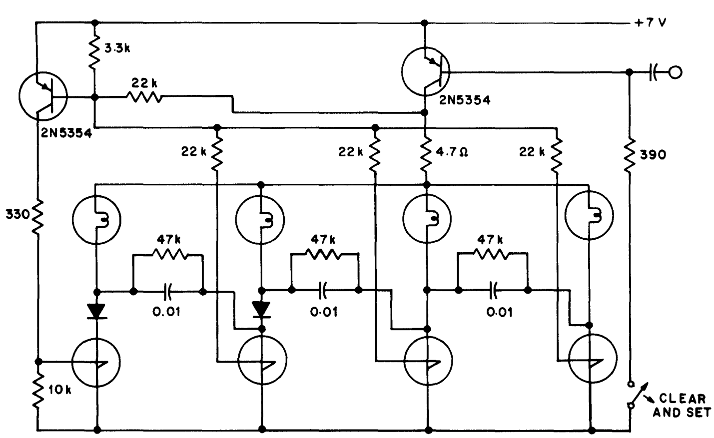


Fig. 18—Ring counter for incandescent lamps circuits.

2N4987, 2N4988, 2N4989, 2N4990

APPLICATIONS (Cont'd)

For overvoltages, SCR turns on and blows fuse. For rapidly rising voltages, circuit triggers between 13.2 & 14 volts. For slowly increasing voltages, circuit triggers between 14 & 17 volts.

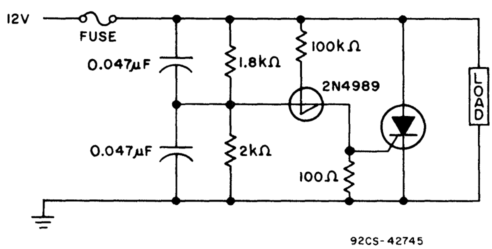


Fig. 19 – Overvoltage protection circuit.

Capacitor charges until switching voltage is reached. When SUS switches on, inductor causes current to ring. When current thru SUS drops below holding current, device turns off and cycle repeats.

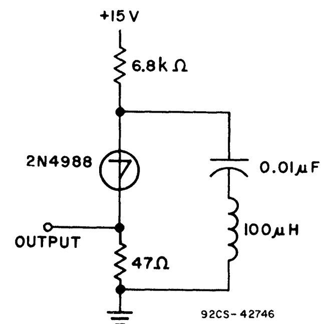


Fig. 20 – 10 kHz oscillator circuit.

Spikes in center of sawtooth are eliminated in this circuit by triggering at gate.

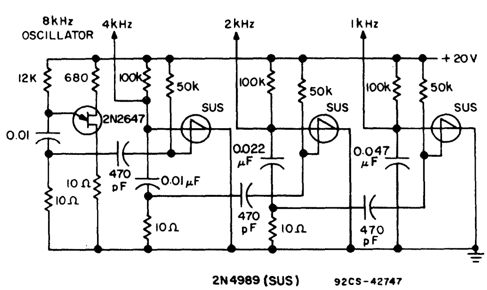


Fig. 21 – Frequency divider circuit (with transient-free output).

Sawtooth Output from each stage is one half frequency of preceding stage.

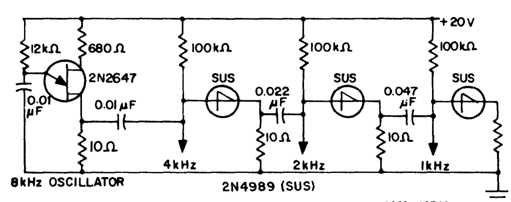


Fig. 22 – Frequency divider chain circuit.

2N4987, 2N4988, 2N4989, 2N4990

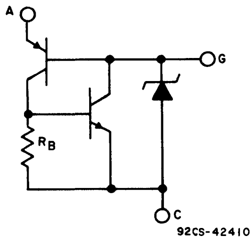


Fig. 23—Equivalent circuit.

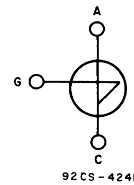


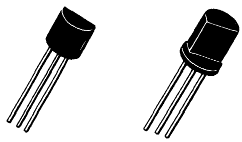
Fig. 24—Circuit Symbol.

TERMINAL CONNECTIONS

Lead 1 - Anode
Lead 2 - Gate
Lead 3 - Cathode

2N6027, 2N6028, GES6027, GES6028

Programmable Unijunction Transistor



TO-92 TO-98

Features:
- Planar Passivated Structure
- Low Leakage Current
- Low Peak Point Current
- Low Forward Voltage
- Fast, High Energy Trigger Pulse
- Programmable η
- Programmable R_{BB}
- Programmable I_P
- Programmable I_V
- Low Cost

Applications:
- SCR Trigger
- Pulse and Timing Circuits
- Oscillators
- Sensing Circuits
- Sweep Circuits

The GE/RCA 2N6027, 2N6028 and GES6027, GES6028 PUTS are PNP three-terminal planar passivated devices available in the standard plastic TO-98 and TO-92 packages. The terminals are designated as anode, anode gate and cathode.

The devices have been characterized as Programmable Unijunction Transistors (PUT), offering many advantages over conventional unijunction transistors. The designer can select R_1 and R_2 to program unijunction characteristics such as η, R_{BB}, I_P and I_V to meet his particular needs.

PUTs are specifically characterized for long interval timers and other applications requiring low leakage and low peak point current. PUTs similar types have been characterized for general use wherein the low peak point current of the 2N6028 and others is not essential. Applications of the PUT include timers, high gain phase control circuits and relaxation oscillators.

Operation of the PUT as a unijunction is easily understood. Figure 1(a) shows a basic unijunction circuit. Figure 2(a) shows identically the same circuit except that the unijunction transistor is replaced by the PUT plus resistors R_1 and R_2. Comparing the equivalent circuits of Figure 1(b) and 2(b), it is seen that both circuits have a diode connected to a voltage divider. When this diode becomes forward biased in the unijunction transistor, R_1 becomes strongly modulated to a lower resistance value. This generates a negative resistance characteristic between the emitter E and base one (B_1. For the PUT, the resistors R_1 and R_2 control the voltage at which the diode (anode to gate) becomes forward biased. After the diode conducts, the regeneration inherent in a PNPN device causes the PUT to switch on. This generates a negative resistance characteristic from anode to cathode (Figure 2(b) simulating the modulation of R_1 for a conventional unijunction.

Resistors R_{B2} and R_{B1} (Figure 1(a)) are generally unnecessary when the PUT replaces a conventional UJT. This is illustrated in Figure 2(c). Resistor R_{B1} is often used to bypass the interbase current of the unijunction which would otherwise trigger the SCR. Since R_1 in the case of the PUT, can be returned directly to ground there is not current to bypass at the SCR gate. Resistor R_{B2} is used for temperature compensation and for limiting the dissipation in the UJT during capacitor discharge. Since R_2 (Figure 2) is *not* modulated, R_{B2} can be absorbed into it.

These types are supplied in JEDEC TO-92 package (GES6027, GES6028) and in JEDEC TO-98 package (2N6027, 2N6028).

Devices in TO-98 package are supplied with and without seating flange (see Dimensional Outline).

File Number **2050**

2N6027, 2N6028, GES6027, GES6028

MAXIMUM RATINGS, *Absolute-Maximum Values:*

GATE-CATHODE FORWARD VOLTAGE*	+100V
GATE-CATHODE REVERSE VOLTAGE*	−100V
GATE-ANODE REVERSE VOLTAGE*	+100V
ANODE-CATHODE VOLTAGE*	±100V
DC ANODE CURRENT* (Note 1)	150 mA
PEAK ANODE, RECURRENT FORWARD	
(100μs pulse width, 1% duty cycle)	1 A
(20μs pulse width, 1% duty cycle)*	2 A
PEAK ANODE, NON-RECURRENT FORWARD (10μsec)	5 A
GATE CURRENT*	±20 mA
CAPACITIVE DISCHARGE ENERGY (Note 2)	250μJ
DISSIPATION (Total Average Power)(Note 1)	300 mW
OPERATING AMBIENT TEMPERATURE RANGE (Note 1)	−50° to +100°C

* In accordance with JEDEC registration data format.
NOTES:
1. Derate currents and powers 1%/°C above 25°C.
2. E = 1/2 CV^2 capacitor discharge energy with no current limiting

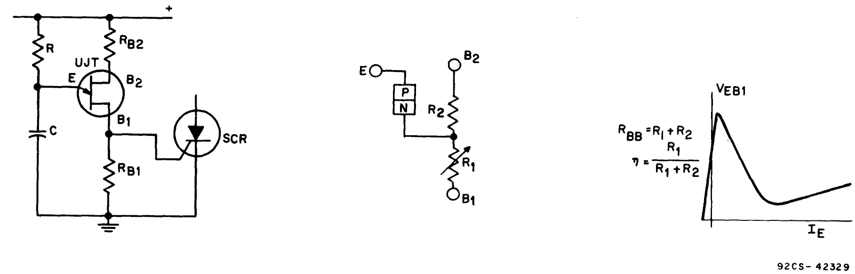
3

ELECTRICAL CHARACTERISTICS, At Ambient Temperature (T_A) = 25°C Unless Otherwise Specified

CHARACTERISTICS	SYMBOL	LIMITS				UNITS
		2N6027 GES6027		2N6028 GES6028		
		MIN.	MAX.	MIN.	MAX	
Forward Voltage* (I_F = 50mA)	V_F	–	1.5	–	1.5	V
Pulse Output Voltage*	V_O	6	–	6	–	
Offset Voltage* (V_S = 10 V) R_G = MΩ	V_T	0.2	1.6	0.2	1.6	
R_G = 10 kΩ		0.2	0.6	0.2	0.6	
Peak Current* (V_S = 10 V) R_G = 1 MΩ	I_P	–	2	–	0.15	μA
R_G = 10kΩ		–	5	–	1	
Valley Current* (V_S = 10V) R_G = 1 MΩ	I_V	–	50	–	25	
R_G = 10 kΩ		70	–	25	–	
R_G = 200 Ω		1.5	–	1	–	mA
Anode Gate-Anode Leakage Current (V_S = 40 V)* T = 25°C	I_{GAO}	–	10	–	10	nA
T = 75°C		–	100	–	100	
Gate to Cathode Leakage Current V_S = 40 V, Anode-cathode short	I_{GKS}	–	100	–	100	
Pulse Voltage Rate of Rise	t_r	–	80	–	80	ns

*In accordance with JEDEC registration data format.

2N6027, 2N6028, GES6027, GES6028



Typical circuit

(a)

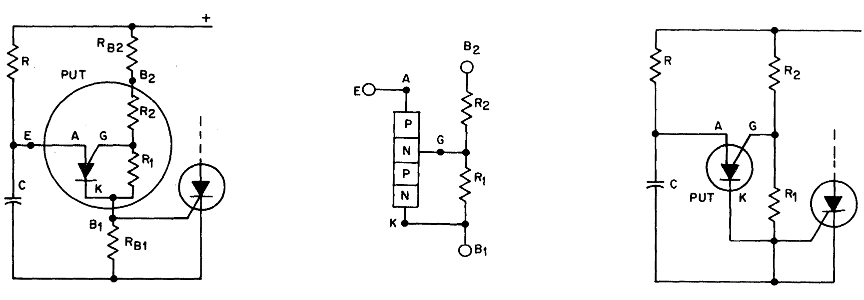
Unijunction transistor equivalent circuit

(b)

Negative resistance characteristic

(c)

Fig. 1 — Unijunction transistor



Programmable unijunction transistor replacing unijunction transistor in typical circuit, Fig. 1, a.

(a)

Programmable unijunction transistor equivalent circuit

(b)

Simplified, typical circuit, Fig. 1, a utilizing programmable unijunction transistor.

(c)

Fig. 2 — Programmable unijunction transistor equivalent of unijunction transistor.

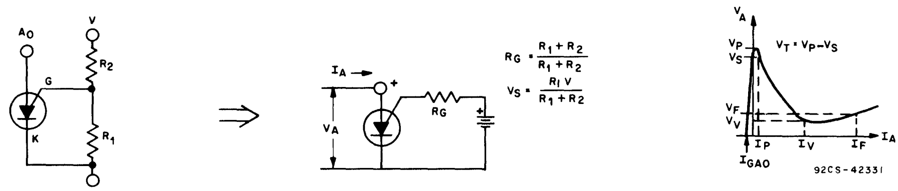


Fig. 3—Offset voltage, peak current, and voltage current measurement circuits and waveform.

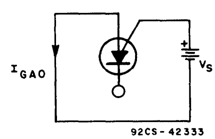


Fig. 4—Anode gate-anode leakage current measurement circuit.

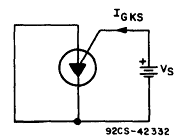


Fig. 5—Gate to cathode leakage current measurement circuit.

Fig. 6—Pulse output voltage and pulse voltage rate-of-rise measurement circuit and waveform.

2N6027, 2N6028, GES6027, GES6028

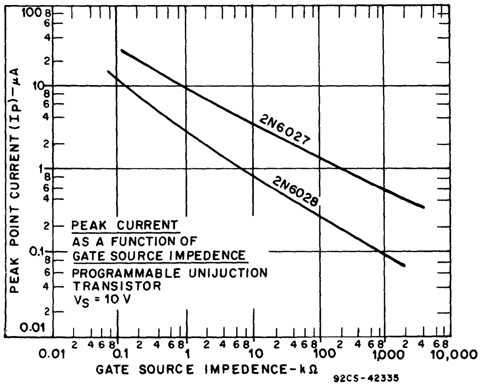


Fig. 7—Typical peak point current characteristics.

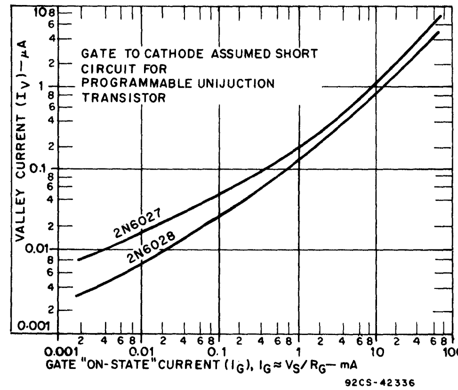


Fig. 8—Typical valley current characteristics.

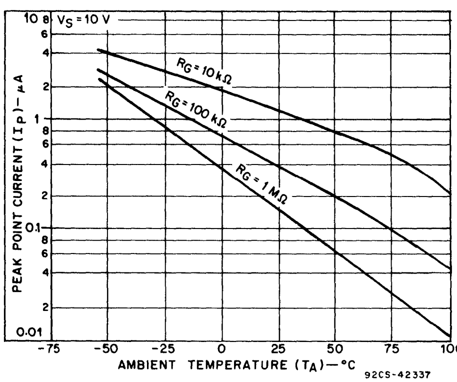


Fig. 9—Typical peak point current characteristics.

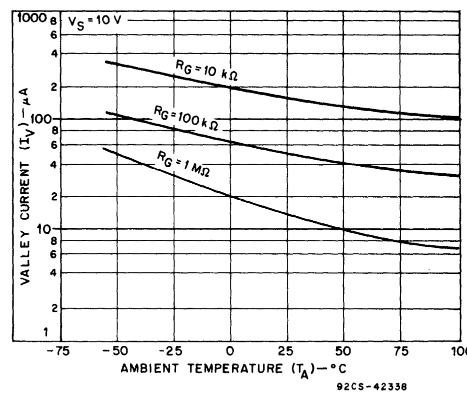


Fig. 10—Typical valley current characteristics.

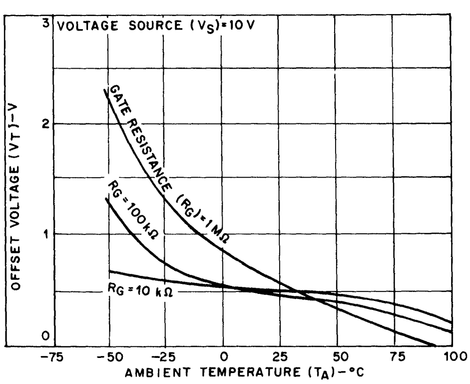


Fig. 11—Typical offset voltage characteristics.

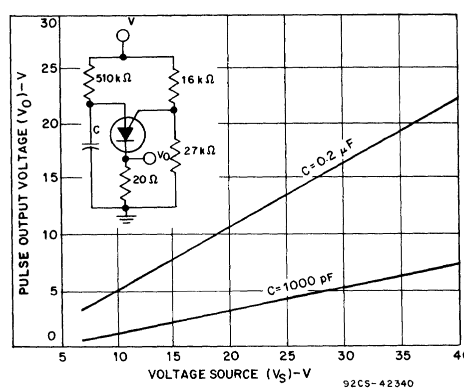
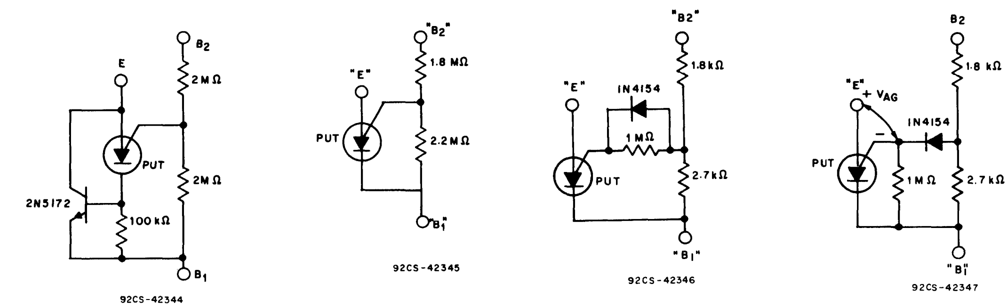


Fig. 12—Typical pulse voltage characteristics.

2N6027, 2N6028, GES6027, GES6028

Here are four ways to use the PUT as a unijunction. Note the flexibility due to "programmability." Applications from long time interval latching timers to wide range relaxation oscillators are possible.



Low Ip; very high Iv, temperature and V_{BB} compensation

Low Ip and Iv

Low Ip; medium Iv, temperature, V_G compensation

Low Ip, medium Iv

Fig. 13 — Typical programmable unijunction transistor circuits.

This sampling circuit lowers the effective peak current of the output PUT, Q2. By allowing the capacitor to charge with high gate voltage and periodically lowering gate voltage, when Q1 fires, the timing reistor can be a value which supplies a much lower current than I_P. The triggering requirement here is that minimum charge to trigger flow through the timing resistor during the period of the Q1 oscillator. This is not capacitor size dependent, only capacitor leakage and stability dependent.

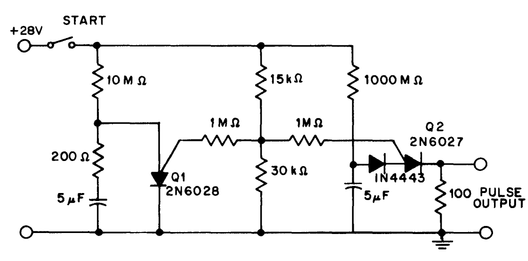


Fig. 14 — Hour time-delay sampling circuit.

Here is a handy circuit which operates as an oscillator *and* a timer. The 2N6028 is normally on due to excess holding current through the 100 kohm resistor. When the switch is momentarily closed, the 10 μF capacitor is charged to a full 15 volts and 2N6028 starts oscillating (1.8 Meg and 820 pF). The circuit latches when 2N2926 zener breaks down again.

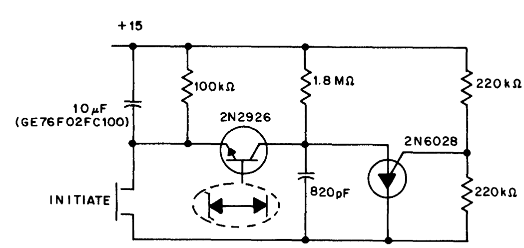


Fig. 15 — 1-second, 1kHz oscillator circuit.

TERMINAL CONNECTIONS

TO-92 and TO-98 Packages
Lead 1 - Anode
Lead 2 - Gate
Lead 3 - Cathode

Silicon Rectifiers Technical Data

4

Ultra-Fast-Recovery Rectifier Selector Guide and Data

Type	Reverse Voltage V_{RRM} V_{pk}	Avg. Forward Current I_F A	@ T_C °C	Surge Current I_{FSM} A	Rev. Rec. Time t_{rr} ns	Junction Capacitance C_J pF	Package	File No.	Page No.
BYW51-100	100	2 x 8*	125	100	35	40	TO-220AB	1412	—
BYW51-150	150	2 x 8*	125	100	35	40	TO-220AB	1412	—
BYW51-200	200	2 x 8*	125	100	35	40	TO-220AB	1412	—
MUR-810	100	8	125	100	35	40	TO-220AC	1355	—
MUR-815	150	8	125	100	35	40	TO-220AC	1355	—
MUR-820	200	8	125	100	35	40	TO-220AC	1355	—
MUR-840	400	8	150	100	60	—	TO-220AC	2091	—
MUR-850	500	8	150	100	60	—	TO-220AC	2091	—
MUR-860	600	8	150	100	60	—	TO-220AC	2091	—
MUR-1610CT	100	2 x 8*	125	100	35	40	TO-220AB	1885	—
MUR-1615CT	150	2 x 8*	125	100	35	40	TO-220AB	1885	—
MUR-1620CT	200	2 x 8*	125	100	60	40	TO-220AB	1885	—
RUR-D1610	100	2 x 16†	125	275	35	80	TO-204AA	1383	—
RUR-D1615	150	2 x 16†	125	275	35	80	TO-204AA	1383	—
RUR-D1620	200	2 x 16†	125	275	35	80	TO-204AA	1383	—

*8 A average per junction †16 A average per junction

Axial-Lead Rectifiers
Ultra-Fast-Recovery Rectifier Selector Guide and Data

Type	Reverse Voltage V_{RRM} V_{pk}	Avg. Fwd. Current I_O A	@ T_A °C	Forward Current Pk. Surge I_{FSM} A	Forward Current Peak I_{FM} A	Fwd. Volt. T_A=25°C V_{FM} V	Rev. Rec. Time t_{rr} ns	Package	File No.	Page No.
GE1001	50	1	75	30	1	0.975	25	DO-204AP	—	—
GE1002	100	1	75	30	1	0.975	35	DO-204AP	—	—
GE1003	150	1	75	30	1	0.975	25	DO-204AP	—	—
GE1101	50	2.5	75	50	2	0.975	25	DO-204AP	—	—
GE1102	100	2.5	75	50	2	0.975	25	DO-204AP	—	—
GE1103	150	2.5	75	50	2	0.975	25	DO-204AP	—	—
GE1301	50	6	75	150	6	0.925	30	GE-4	—	—
GE1302	100	6	75	150	6	0.925	30	GE-4	—	—
GE1303	150	6	75	150	6	0.925	30	GE-4	—	—
A214F	50	2	55	50	5	0.95	35	DO-204AP	—	—
A214A	100	2	55	50	5	0.95	35	DO-204AP	—	—
A214G	150	2	55	50	5	0.95	35	DO-204AP	—	—
A214B	200	2	55	50	5	0.95	35	DO-204AP	—	—
A315F	50	3	55	150	5	0.95	35	GE-4	—	—
A315A	100	3	55	150	5	0.95	35	GE-4	—	—
A315G	150	3	55	150	5	0.95	35	GE-4	—	—
A315B	200	3	55	150	5	0.95	35	GE-4	—	—
GE1004	200	1	75	30	1	0.975	40	DO-204AP	—	—
GE1104	200	2	50	20	1	1.25	50	DO-204AP	—	—
GE1304	200	5	50	70	3	1.25	50	GE-4	—	—

Axial-Lead Rectifiers
Fast-Recovery Rectifier Selector Guide and Data

Type	Reverse Voltage V_{RRM} V_{pk}	Avg. Fwd. Current I_O A	@ T_A °C	Forward Current Pk. Surge I_{FSM} A	Forward Current Peak I_{FM} A	Fwd. Volt. T_A=25°C V_{FM} V	Rev. Rec. Time t_{rr} ns	Package	File No.	Page No.
A114F	50	1	75	40	1	1.1	200	DO-204AP	—	—
A114A	100	1	75	40	1	1.1	200	DO-204AP	—	—
A114B	200	1	75	40	1	1.1	200	DO-204AP	—	—
A114C	300	1	75	40	1	1.1	200	DO-204AP	—	—
A114D	400	1	75	40	1	1.1	200	DO-204AP	—	—
A114E	500	1	75	40	1	1.1	200	DO-204AP	—	—
A114M	600	1	75	40	1	1.1	200	DO-204AP	—	—
A115F	50	3	55	110	5	1.1	200	GE-3	—	—
A115A	100	3	55	110	5	1.1	200	GE-3	—	—
A115B	200	3	55	110	5	1.1	200	GE-3	—	—
A115C	300	3	55	110	5	1.1	200	GE-3	—	—
A115D	400	3	55	110	5	1.1	200	GE-3	—	—
A115E	500	3	55	110	5	1.1	200	GE-3	—	—
A115M	600	3	55	110	5	1.1	200	GE-3	—	—

Axial-Lead Rectifiers
General Purpose Rectifier Selector Guide and Data

Type	Reverse Voltage V_{RRM} V_{pk}	Avg. Fwd. Current I_O A	@ T_A °C	Forward Current Pk. Surge I_{FSM} A	Forward Current Peak I_{FM} A	Fwd. Volt. T_A=25°C V_{FM} V	Rev. Rec. Time t_{rr} μs	Package	File No.	Page No.
1N4245	200	1	55	25	1	1.2	5	DO-204AP	2093	—
1N4246	400	1	55	25	1	1.2	5	DO-204AP	2093	—
1N4247	600	1	55	25	1	1.2	5	DO-204AP	2093	—
1N4248	800	1	55	25	1	1.2	5	DO-204AP	2093	—
1N4249	1000	1	55	25	1	1.2	5	DO-204AP	2092	—
1N5624	200	3	70	125	5	1.1	5	GE-3	—	—
1N5625	400	3	70	125	5	1.1	5	GE-3	—	—
1N5626	600	3	70	125	5	1.1	5	GE-3	—	—
1N5627	800	3	70	125	5	1.1	5	GE-3	—	—
A15F	50	3	70	125	5	1.1	5	GE-3	—	—
A15A	100	3	70	125	5	1.1	5	GE-3	—	—
1N5059	200	1	100	50	1	1.2	6	DO-204AP	—	—
1N5060	400	1	100	50	1	1.2	6	DO-204AP	—	—
1N5061	600	1	100	50	1	1.2	6	DO-204AP	—	—
IN5062	800	1	100	50	1	1.2	6	DO-204AP	—	—
A14F	50	1	100	50	2.5	1.25	6	DO-204AP	—	—
A14A	100	1	100	50	2.5	1.25	6	DO-204AP	—	—
A14C	300	1	100	50	2.5	1.25	6	DO-204AP	—	—
A14E	500	1	100	50	2.5	1.25	6	DO-204AP	—	—
A14P	1000	1	100	50	2.5	1.25	6	DO-204AP	—	—
GER4001	50	1	75	30	1	1.1	6	DO-204AP	—	—
GER4002	100	1	75	30	1	1.1	6	DO-204AP	—	—
GER4003	200	1	75	30	1	1.1	6	DO-204AP	—	—
GER4004	400	1	75	30	1	1.1	6	DO-204AP	—	—
GER4005	600	1	75	30	1	1.1	6	DO-204AP	—	—
GER4006	800	1	75	30	1	1.1	6	DO-204AP	—	—
GER4007	1000	1	75	30	1	1.1	6	DO-204AP	—	—

Full-Wave Bridge Rectifiers Selector Guide and Data

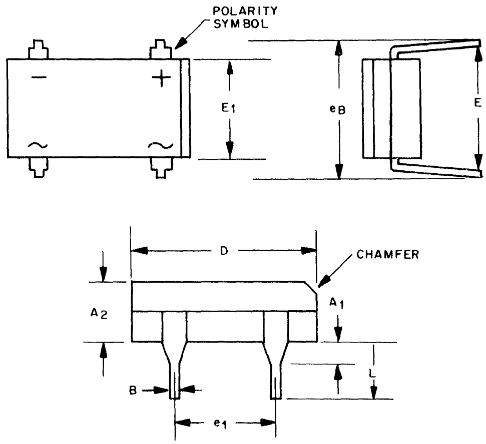
Type	Reverse Voltage V_{RRM} V_{pk}	Avg. Fwd. Current I_O A	@ T_A °C	Forward Current Pk. Surge I_{FSM} A	Peak I_{FM} A	Fwd. Volt. T_A=25°C V_{FM} V	Package	File No.	Page No.
DB1F	50	1	40	50	1	1.1	BR-4	2097	—
DB1A	100	1	40	50	1	1.1	BR-4	2097	—
DB1B	200	1	40	50	1	1.1	BR-4	2097	—
DB1D	400	1	40	50	1	1.1	BR-4	2097	—
DB1M	600	1	40	50	1	1.1	BR-4	2097	—
DB1N	800	1	40	50	1	1.1	BR-4	2097	—
DB1P	1000	1	40	50	1	1.1	BR-4	2097	—

Dimensional Outlines and Hardware

5

Dimensional Outlines

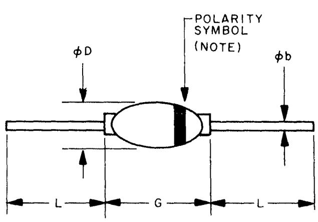
BR-4



SYMBOL	INCHES		MILLIMETERS		NOTES
	MIN.	MAX.	MIN.	MAX.	
A_1	0.060 TYP.		1.5 TYP.		
A_2	0.125	0.135	3.2	3.4	
B	0.016	0.020	4.1	5.1	
D	0.355	0.365	9.0	9.3	
E	0.300	0.350	7.6	8.9	
E_1	0.245	0.255	6.2	6.5	
e_1	0.195	0.205	5.0	5.2	
e_B	0.290	0.310	7.4	7.9	
L	0.155	0.165	3.9	4.2	

92CS-42582

DO-204AP



SYMBOL	INCHES		MILLIMETERS		NOTES
	MIN.	MAX.	MIN.	MAX.	
φb	0.028	0.034	0.71	0.86	
φD	0.100	0.150	2.5	3.8	
G	—	0.240	—	6.1	
L	1.000	—	25.4	—	

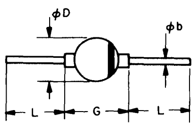
92CS-42583

NOTE:

COLOR BAND (POLARITY SYMBOL) INDICATES CATHODE CONNECTION.

Dimensional Outlines

GE-3



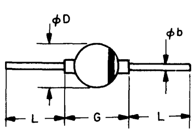
SYMBOL	INCHES		MILLIMETERS		NOTES
	MIN.	MAX.	MIN.	MAX.	
ϕb	0.048	0.052	1.2	1.3	
ϕD	0.170	0.250	4.3	6.3	
G	—	0.300	—	7.6	
L	1	—	25.4	—	

92CS-42648

NOTE:

COLOR BAND (POLARITY SYMBOL) INDICATES CATHODE CONNECTION.

GE-4



SYMBOL	INCHES		MILLIMETERS		NOTES
	MIN.	MAX.	MIN.	MAX.	
ϕb	0.037	0.042	0.94	1.07	
ϕD	0.115	0.180	2.9	4.6	
G	—	0.300	—	7.6	
L	1	—	25.4	—	

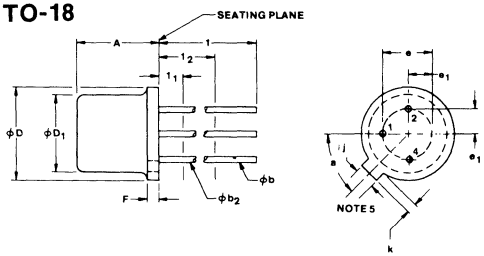
92CS-42647

NOTE:

COLOR BAND (POLARITY SYMBOL) INDICATES CATHODE CONNECTION.

Dimensional Outlines

TO-18



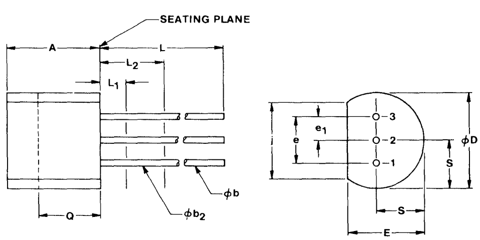
SYMBOL	INCHES		MILLIMETERS		NOTES
	MIN.	MAX.	MIN.	MAX.	
A	0.170	0.210	4.32	5.33	
φb	0.016	0.021	0.406	0.533	1
φb_2	0.016	0.019	0.406	0.483	1
φD	0.209	0.230	5.31	5.84	
φD_1	0.178	0.195	4.52	4.95	
e	0.100 T.P.		2.54 T.P.		2, 4
e_1	0.050 T.P.		1.27 T.P.		2, 4
F	—	0.030	—	0.762	
j	0.036	0.046	0.914	1.17	4
k	0.028	0.048	0.711	1.22	3
l	0.500	—	12.70	—	1
l_1	—	0.050	—	1.27	1
l_2	0.250	—	6.35	—	1
α	45° T.P.				5

92CS-42998

NOTES:

1. (Three leads) φb_2 applies between l_1 and l_2. φb applies between l_2 and 0.5 in. (12.70 mm) from seating plane. Diameter is uncontrolled in l_1 and beyond 0.5 in. (12.70 mm) from seating plane.
2. Leads having maximum diameter 0.019 in. (0.483 mm) measured in gauging plane 0.054 in. (1.37 mm) + 0.001 in. (0.025 mm) - 0.000 in. (0.000 mm) below the seating plane of the device shall be within 0.007 in. (0.178 mm) of their true positions relative to a maximum-width tab.
3. Measured from maximum diameter of the actual device.
4. The device may be measured by direct methods or by the gauge and gauging procedure described on gauge drawing GS-2.
5. Tab centerline.

TO-92



SYMBOL	INCHES		MILLIMETERS		NOTES
	MIN.	MAX.	MIN.	MAX.	
A	0.170	0.210	4.58	5.33	
φb	0.016	0.021	0.407	0.533	1, 3
φb_2	0.016	0.019	0.407	0.482	3
φD	0.175	0.205	4.96	5.20	
E	0.125	0.165	3.94	4.19	
e	0.095	0.105	2.42	2.66	
e_1	0.045	0.055	1.15	1.39	
j	0.135	—	3.43	—	
L	0.500	—	12.70	—	1, 3
L_1	—	0.050	—	1.27	3
L_2	0.250	—	6.35	—	3
Q	0.115	—	2.93	—	2
S	0.080	0.105	2.42	2.66	

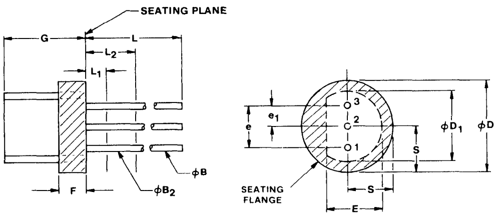
92CS-42575

NOTES:

1. Three leads.
2. Contour of the package beyond this zone is uncontrolled.
3. (Three leads) φb_2 applies between L_1 and L_2. φb applies between L_2 and 0.5 in. (12.70 mm) from seating plane. Diameter is uncontrolled in L_1 and beyond 0.5 in. (12.70 mm) from seating plane.

Dimensional Outlines

TO-98



NOTES:

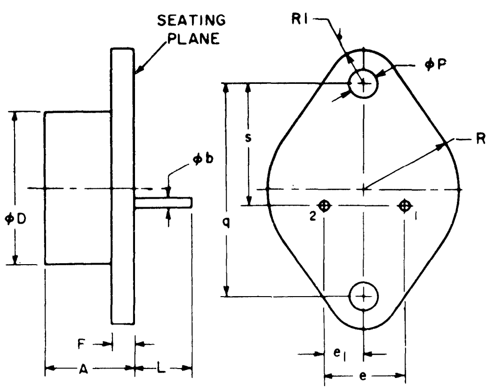
1. **(Three leads) ϕB_2 applies between L_1 and L_2. ϕB applies between L_2 and 0.5 in. (12.70 mm) from seating plane. Diameter is uncontrolled in L_1 and beyond 0.5 in. (12.70 mm) from seating plane.**

Devices in TO-98 package are supplied with and without seating flange

SYMBOL	INCHES		MILLIMETERS		NOTES
	MIN.	MAX.	MIN.	MAX.	
ϕD	0.190	0.205	4.83	5.20	
ϕD_1	0.165	0.190	4.20	4.82	
ϕB	0.016	0.021	0.407	0.533	1
ϕB_2	0.016	0.019	0.407	0.482	
E	0.110	0.140	2.80	3.55	
e	0.095	0.105	2.42	2.66	
e_1	0.045	0.055	1.15	1.39	
F	0.055	0.075	1.40	1.90	
G	0.200	0.265	5.08	6.73	
L	0.500	—	12.70	—	1
L_1	—	0.050	—	1.27	1
L_2	0.250	—	6.35	—	1
S	0.085	0.115	2.16	2.92	

92CS-42576

TO-204AA



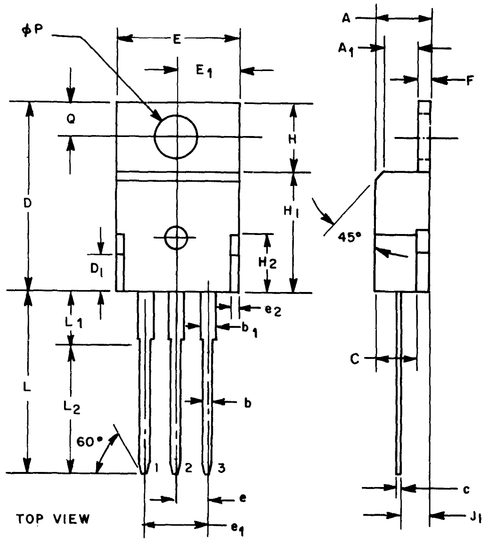
SYMBOL	INCHES		MILLIMETERS		NOTE
	MIN.	MAX.	MIN.	MAX.	
A	0.250	0.450	6.4	11.4	
ϕb	0.038	0.043	0.966	1.092	
ϕD	—	0.875	—	22.22	
e	0.420	0.440	10.67	11.17	
e_1	0.205	0.225	5.21	5.71	
F	—	0.135	—	3.42	
L	0.312	—	7.93	—	
ϕP	0.151	0.161	3.84	4.08	
q	1.187 BSC		30.15 BSC		
R	—	0.525	—	13.33	
R_1	—	0.188	—	4.77	
s	0.655	0.675	16.64	17.14	

92CS-37249R1

5

Dimensional Outlines

TO-220AB

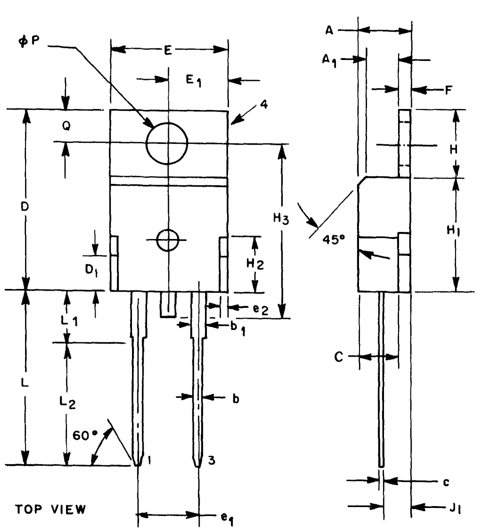


NOTES:
1. Position of lead to be measured 0.250-0.255 in. (6.350-6.477 mm) from case.

SYMBOL	INCHES		MILLIMETERS	
	MIN.	MAX.	MIN.	MAX.
A	0.140	0.190	3.56	4.82
A_1	0.080	0.085	2.03	2.16
b	0.020	0.045	0.51	1.14
b_1	0.045	0.070	1.14	1.77
C	—	0.125	—	3.18
c	0.015	0.025	0.38	0.63
D	0.560	0.625	14.23	15.87
D_1	—	0.100	—	2.54
E	0.380	0.420	9.66	10.66
e	0.090	0.110	2.29	2.79
e_1	0.190	0.210	4.83	5.33
e_2	—	0.030	—	0.76
F	0.045	0.055	1.14	1.39
H	0.230	0.270	5.85	6.85
H_1	0.355	0.370	9.02	9.40
H_2	—	0.160	—	4.06
J_1	0.080	0.115	2.04	2.92
L	0.500	0.562	12.70	14.27
L_1	—	0.250	—	6.35
L_2	0.400	0.410	10.16	10.41
φP	0.139	0.161	3.531	4.089
Q	0.100	0.120	2.54	3.04

92CS-34697R1

TO-220AC



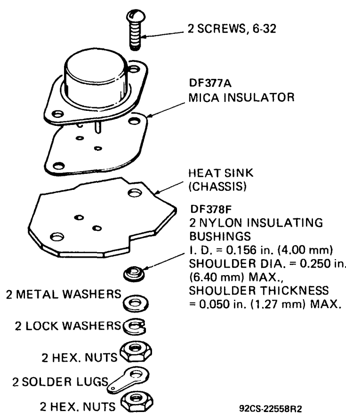
NOTES:
1. Position of lead to be measured 0.250-0.255 in. (6.350-6.477 mm) from case.

SYMBOL	INCHES		MILLIMETERS	
	MIN.	MAX.	MIN.	MAX.
A	0.140	0.190	3.56	4.82
A_1	0.080	0.085	2.03	2.16
b	0.020	0.045	0.51	1.14
b_1	0.045	0.070	1.14	1.77
C	—	0.125	—	3.18
c	0.015	0.025	0.38	0.63
D	0.560	0.625	14.23	15.87
D_1	—	0.100	—	2.54
E	0.380	0.420	9.66	10.66
e_1	0.190	0.210	4.83	5.33
e_2	—	0.030	—	0.76
F	0.045	0.055	1.14	1.39
H	0.230	0.270	5.85	6.85
H_1	0.355	0.370	9.02	9.40
H_2	—	0.160	—	4.06
H_3	—	0.600	—	15.24
J_1	0.080	0.115	2.04	2.92
L	0.500	0.562	12.70	14.27
L_1	—	0.250	—	6.35
L_2	0.400	0.410	10.16	10.41
φP	0.139	0.161	3.531	4.089
Q	0.100	0.120	2.54	3.04

92CS-34830R1

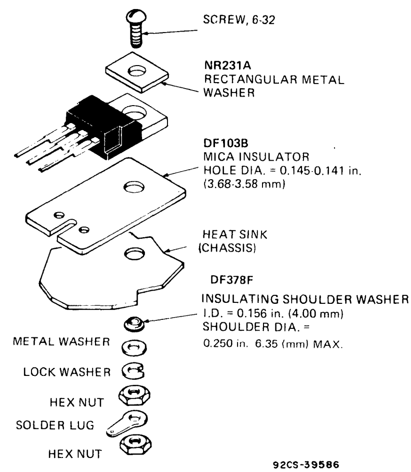
Suggested Mounting Hardware

TO-204AA



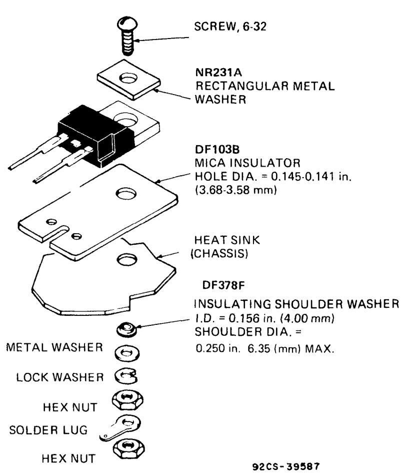
NOTE: MAXIMUM TORQUE APPLIED TO MOUNTING FLANGE IS 12 in.-lbs. (0.14 kgf m).

TO-220AB



NOTE MAXIMUM TORQUE APPLIED TO MOUNTING FLANGE IS 8 in.-lb. (0.09 kgf m)

TO-220AC



NOTE. MAXIMUM TORQUE APPLIED TO MOUNTING FLANGE IS 8 in.-lb. (0.09 kgf m)

GE/RCA/Intersil Semiconductors

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