Signal Transistors

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

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2N4400, 2N4401, 2N4402, 2N4403

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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	–	V
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	–	V
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	nA
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	V
(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	V
(I_C = 500mA, I_B = 50mA)*		–	1.2	–	1.2	–	–0.75	–	–0.75	V
Collector-Base Capacitance (V_{CB} = 5V, I_E = 0, f = 1 MHz)	C_{cb}	–	6.5	–	6.5	–	–	–	–	pF
(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	pF
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	ns
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	ns
Fall Time (I_{B1} = I_{B2} = 15 mA) (V_{CE} = 30 V, I_C = 150 mA)	t_f	–	30	–	30	–	30	–	30	ns

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

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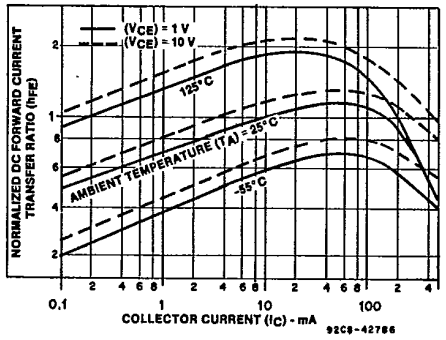

Fig. 1—Normalized dc forward current transfer ratio characteristics for 2N4400 and 2N4401.

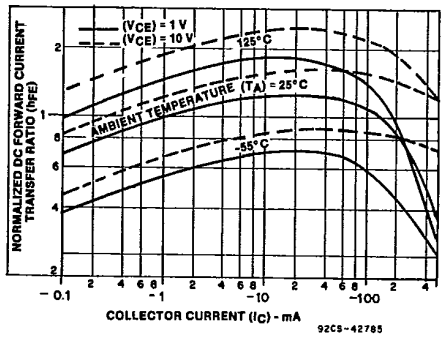

Fig. 2—Normalized dc forward current transfer ratio characteristics for 2N4402 and 2N4403.

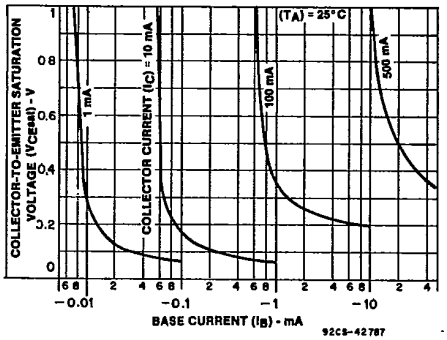

Fig. 3—Typical collector-to-emitter saturation voltage characteristics 2N4400 and 2N4401.

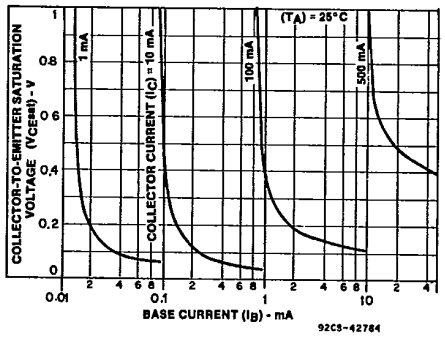

Fig. 4—Typical collector-to-emitter saturation voltage characteristics 2N4402 and 2N4403.

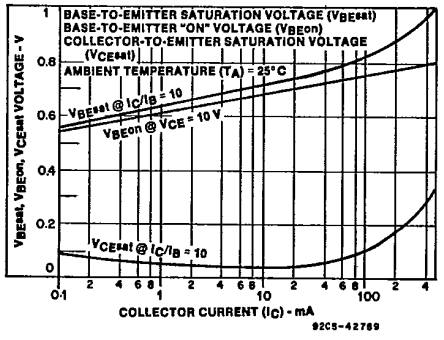

Fig. 5—Typical $V_{BE^{sat}}$, $V_{BE^{on}}$, and $V_{CE^{sat}}$ voltage characteristics for all types. (PNP voltage and current values are negative)

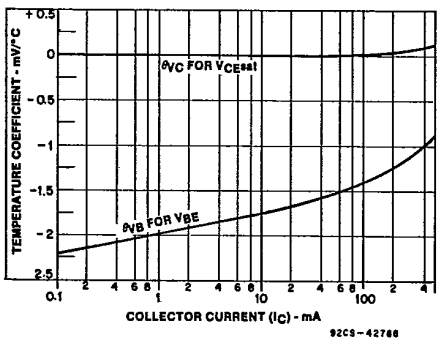

Fig. 6—Typical temperature coefficient characteristics for all types. (PNP voltage and current values are negative)

2N4400, 2N4401, 2N4402, 2N4403

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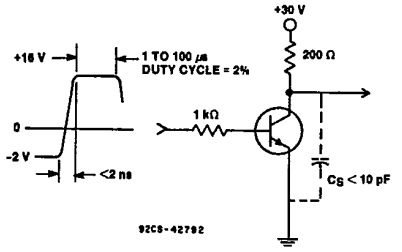
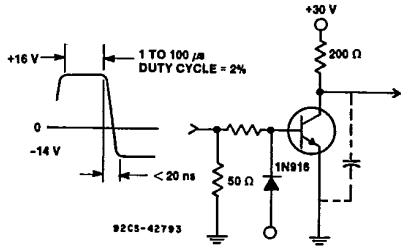
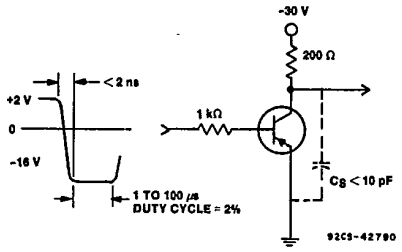


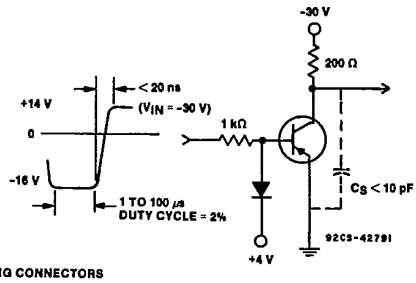


SCOPE RISE TIME < 4 ns.
C_S = TOTAL SHUNT CAPACITANCE OF TEST JIGS, CONNECTORS AND OSCILLOSCOPE.

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