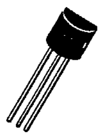
# 2N4400, 2N4401, 2N4402, 2N4403

## 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<br>2N4401 | 2N4402<br>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

T-35-15

**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) | $h_{FE}$ | 20 | – | 40 | – | 30 | – | 60 | – | – |
| ($V_{CE}$ = 1V, $I_C$ = 10mA) | $h_{FE}$ | 40 | – | 80 | – | 50 | – | 100 | – | – |
| ($V_{CE}$ = 2V, $I_C$ = 150mA)* | $h_{FE}$ | 50 | 150 | 100 | 300 | 50 | 150 | 100 | 300 | – |
| ($V_{CE}$ = 2V, $I_C$ = 500mA)* | $h_{FE}$ | 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)* | $V_{CE(SAT)}$ | – | 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)* | $V_{BE(SAT)}$ | – | 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) | $C_{cb}$ | – | – | – | – | – | 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%.

# 2N4400, 2N4401, 2N4402, 2N4403

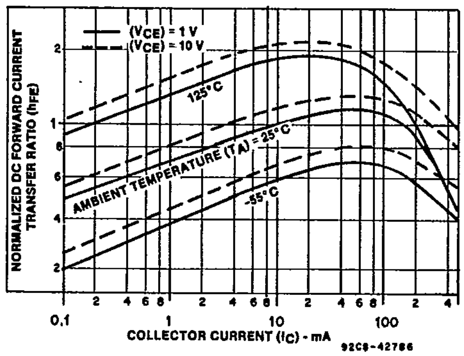



*Fig. 1 — Normalized dc forward current transfer ratio characteristics for 2N4400 and 2N4401.*

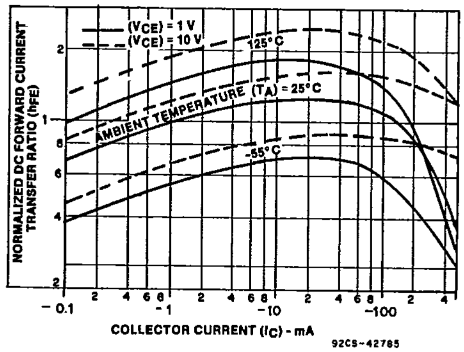



*Fig. 2 — Normalized dc forward current transfer ratio characteristics for 2N4402 and 2N4403.*

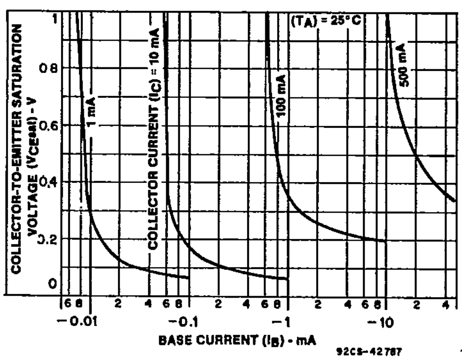



*Fig. 3 — Typical collector-to-emitter saturation voltage characteristics 2N4400 and 2N4401.*

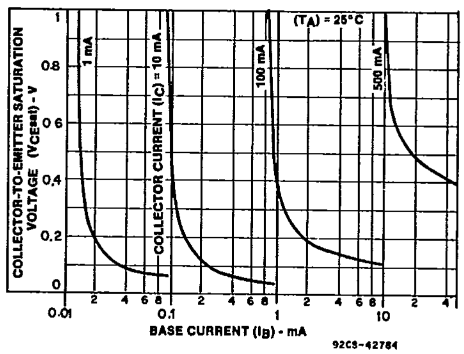



*Fig. 4 — Typical collector-to-emitter saturation voltage characteristics 2N4402 and 2N4403.*

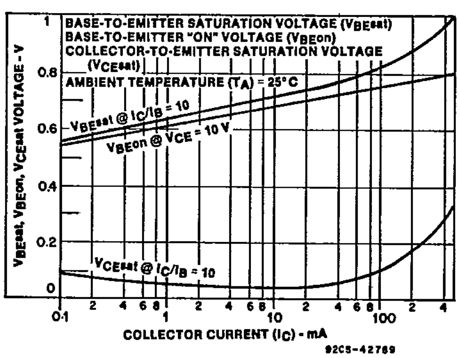



*Fig. 5 — Typical $V_{BE}^{sat}$, $V_{BE}^{on}$, and $V_{CE}^{sat}$ voltage characteristics for all types. (PNP voltage and current values are negative)*

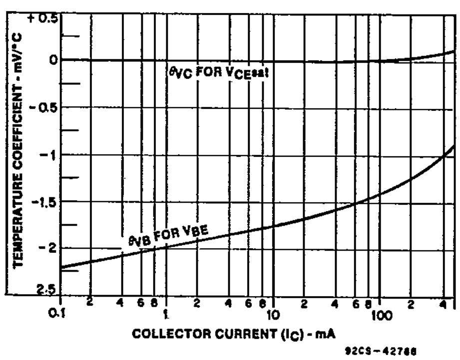
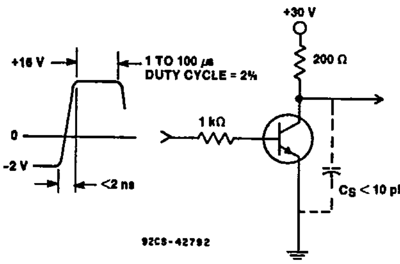
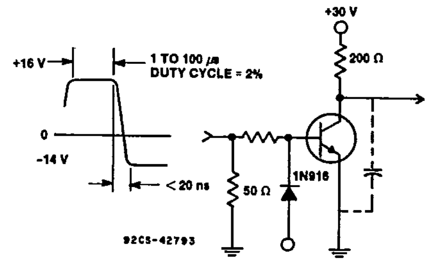



*Fig. 6 — Typical temperature coefficient characteristics for all types. (PNP voltage and current values are negative)*

## 2N4400, 2N4401, 2N4402, 2N4403

T-35-15

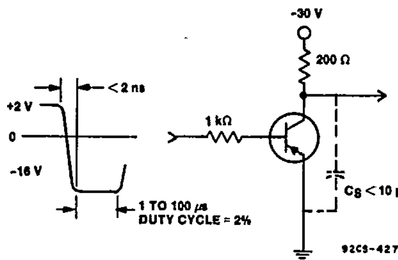


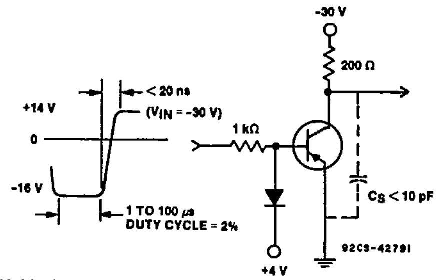




SCOPE RISE TIME < 4 ns.
$C_S$ = TOTAL SHUNT CAPACITANCE OF TEST JIGS, CONNECTORS AND OSCILLOSCOPE.

*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**