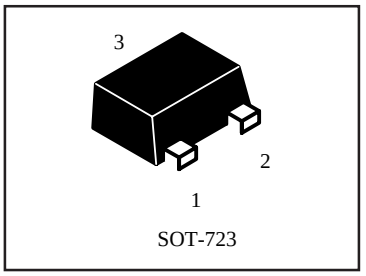
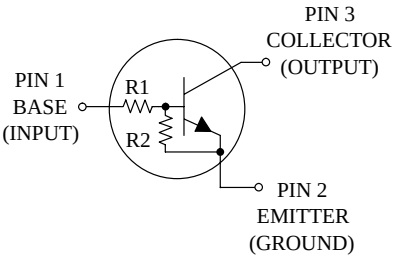
# Bias Resistor Transistors

## NPN Silicon Surface Mount Transistors
## With Monolithic Bias Resistor Network

This new series of digital transistors is designed to replace a single device and its external resistor bias network. The BRT (Bias Resistor Transistor) contains a single transistor with a monolithic bias network consisting of two resistors; a series base resistor and a base-emitter resistor. The BRT eliminates these individual components by integrating them into a single device. The use of a BRT can reduce both system cost and board space. The device is housed in the SOT-723 package which is designed for low power surface mount applications.

- Simplifies Circuit Design
- Reduces Board Space
- Reduces Component Count
- The SOT-723 Package can be Soldered using Wave or Reflow.
- Available in 4 mm, 8000 Unit Tape & Reel




MAXIMUM RATINGS ($T_A$ = 25 C unless otherwise noted)

| Rating | Symbol | Value | Unit |
|---|---|---|---|
| Collector-Base Voltage | $V_{CBO}$ | 50 | Vdc |
| Collector-Emitter Voltage | $V_{CEO}$ | 50 | Vdc |
| Collector Current | $I_C$ | 100 | mAdc |

THERMAL CHARACTERISTICS

| Characteristic | Symbol | Max | Unit |
|---|---|---|---|
| Total Device Dissipation<br>$T_A$ = 25 C<br>Derate above 25 C | $P_D$ | 260 (Note 1)<br>600 (Note 2)<br>2.0 (Note 1)<br>4.8 (Note 2) | mW<br><br>mW/ C |
| Thermal Resistance –<br>Junction-to-Ambient | $R_{\theta JA}$ | 480 (Note 1)<br>205 (Note 2) | C/W |
| Junction Temperature | $T_J$ | 150 | C |
| Storage Temperature Range | Tstg | –55 to +150 | C |

1. FR–4 @ Minimum Pad
2. FR–4 @ 1.0 x 1.0 inch Pad

DEVICE MARKING AND RESISTOR VALUES

| Device | Marking | R1 (K) | R2 (K) | Package | Shipping |
|---|---|---|---|---|---|
| DTC701T5G | 23 | 4.7 | 4.7 | SOT−723 | 8000/Tape & Reel |
| DTC702T5G | 8A | 10 | 10 | | |
| DTC703T5G | 8B | 22 | 22 | | |
| DTC704T5G | 8C | 47 | 47 | | |
| DTC705T5G | 8M | 2.2 | 47 | | |
| DTC706T5G | 8K | 4.7 | 47 | | |
| DTC707T5G | 8D | 10 | 47 | | |
| DTC708T5G | 8L | 22 | 47 | | |
| DTC709T5G | 8P | 47 | 22 | | |
| DTC710T5G | 03 | 4.7 | ∞ | | |
| DTC711T5G | 04 | 10 | ∞ | | |
| DTC714T5G | 8T | 47 | ∞ | | |
| DTC717T5G | 8H | 2.2 | 2.2 | | |
| DTC722T5G | 8N | 100 | 100 | | |

**ELECTRICAL CHARACTERISTICS** ($T_A$ = 25 C unless otherwise noted)

| Characteristic | | Symbol | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|
| **OFF CHARACTERISTICS** | | | | | | |
| Collector−Base Cutoff Current ($V_{CB}$ = 50 V, $I_E$ = 0) | | $I_{CBO}$ | − | − | 100 | nAdc |
| Collector−Emitter Cutoff Current ($V_{CE}$ = 50 V, $I_B$ = 0) | | $I_{CEO}$ | − | − | 500 | nAdc |
| Emitter−Base Cutoff Current ($V_{EB}$ = 6.0 V, $I_C$ = 0 ) | DTC701 | $I_{EBO}$ | − | − | 1.5 | mAdc |
| | DTC702 | | − | − | 0.5 | |
| | DTC703 | | − | − | 0.2 | |
| | DTC704 | | − | − | 0.1 | |
| | DTC705 | | − | − | 0.2 | |
| | DTC706 | | − | − | 0.18 | |
| | DTC707 | | − | − | 0.2 | |
| | DTC708 | | − | − | 0.13 | |
| | DTC709 | | − | − | 0.13 | |
| | DTC710 | | − | − | 1.9 | |
| | DTC711 | | − | − | 0.9 | |
| | DTC714 | | − | − | 0.2 | |
| | DTC717 | | − | − | 2.3 | |
| | DTC722 | | − | − | 0.05 | |
| Collector−Base Breakdown Voltage ($I_C$ = 10 μA, $I_E$ = 0) | | $V_{(BR)CBO}$ | 50 | − | − | Vdc |
| Collector−Emitter Breakdown Voltage (Note 3) ($I_C$ = 2.0 mA, $I_B$ = 0) | | $V_{(BR)CEO}$ | 50 | − | − | Vdc |
| **ON CHARACTERISTICS** (Note 3) | | | | | | |
| DC Current Gain ($V_{CE}$ = 10 V, $I_C$ = 5.0 mA) | DTC701 | $h_{FE}$ | 15 | 30 | − | |
| | DTC702 | | 35 | 60 | − | |
| | DTC703 | | 60 | 100 | − | |
| | DTC704 | | 80 | 140 | − | |
| | DTC705 | | 80 | 140 | − | |
| | DTC706 | | 80 | 200 | − | |
| | DTC707 | | 80 | 140 | − | |
| | DTC708 | | 80 | 150 | − | |
| | DTC709 | | 80 | 140 | − | |
| | DTC710 | | 160 | 350 | − | |
| | DTC711 | | 160 | 350 | − | |
| | DTC714 | | 160 | 350 | − | |
| | DTC717 | | 8.0 | 15 | − | |
| | DTC722 | | 80 | 150 | − | |
| Collector−Emitter Saturation Voltage ($I_C$ = 10 mA, $I_B$ = 0.3 mA) ($I_C$ = 10 mA, $I_B$ = 1 mA) | DTC701 / DTC706 / DTC708 / DTC710 / DTC711 / DTC714 | $V_{CE(sat)}$ | − | − | 0.25 | Vdc |
| ($I_C$ = 10 mA, $I_B$ = 5 mA) | DTC717 | | | | | |
| Output Voltage (on) | | $V_{OL}$ | | | | Vdc |
| ($V_{CC}$ = 5.0 V, $V_B$ = 2 5 V, $R_L$ = 1.0 k Ω) | DTC701 | | − | − | 0.2 | |
| | DTC702 | | − | − | 0.2 | |
| | DTC703 | | − | − | 0.2 | |
| | DTC705 | | − | − | 0.2 | |
| | DTC706 | | − | − | 0.2 | |
| | DTC707 | | − | − | 0.2 | |
| | DTC708 | | − | − | 0.2 | |
| | DTC710 | | − | − | 0.2 | |
| | DTC711 | | − | − | 0.2 | |
| | DTC717 | | − | − | 0.2 | |
| ($V_{CC}$ = 5.0 V, $V_B$ = 3 5 V, $R_L$ = 1.0 k Ω) | DTC704 | | − | − | 0.2 | |
| | DTC714 | | − | − | 0.2 | |
| ($V_{CC}$ = 5.0 V, $V_B$ = 4.0 V, $R_L$ = 1.0 k Ω) | DTC709 | | − | − | 0.2 | |
| ($V_{CC}$ = 5.0 V, $V_B$ = 5 5 V, $R_L$ = 1.0 k Ω) | DTC722 | | − | − | 0.2 | |

3. Pulse Test: Pulse Width < 300μs, Duty Cycle < 2.0%.

**ELECTRICAL CHARACTERISTICS** ($T_A$ = 25 C unless otherwise noted)

| Characteristic | Symbol | Min | Typ | Max | Unit |
|---|---|---|---|---|---|
| **ON CHARACTERISTICS** (Note 4) | | | | | |
| Characteristic | Symbol | Min | Typ | Max | Unit |
| Output Voltage (off) ($V_{CC}$ = 5.0 V, $V_B$ = 0.5 V, $R_L$ = 1.0 k Ω)<br>($V_{CC}$ = 5.0 V, $V_B$ = 0 25 V, $R_L$ = 1.0 k Ω )<br>DTC706<br>DTC710<br>DTC711<br>DTC714 | $V_{OH}$ | 4.9 | – | – | Vdc |
| r o t s i s e R t u p n I DTC701 | R1 | 3.3 | 4.7 | 6.1 | kΩ |
| DTC702 | | 7.0 | 10 | 13 | |
| DTC703 | | 15.4 | 22 | 28.6 | |
| DTC704 | | 32.9 | 47 | 61.1 | |
| DTC705 | | 1.54 | 2 2 | 2.86 | |
| DTC706 | | 3.3 | 4.7 | 6.1 | |
| DTC707 | | 7.0 | 10 | 13 | |
| DTC708 | | 15.4 | 22 | 28.6 | |
| DTC709 | | 32.9 | 47 | 61.1 | |
| DTC710 | | 3.3 | 4.7 | 6.1 | |
| DTC711 | | 7.0 | 10 | 13 | |
| DTC714 | | 32.9 | 47 | 61.1 | |
| DTC717 | | 1.5 | 2.2 | 2.9 | |
| DTC722 | | 70 | 100 | 130 | |
| Resistor Ratio | $R_1/R_2$ | | | | |
| DTC701 / DTC717 | | 0.8 | 1.0 | 1.2 | |
| DTC702 / DTC703 / DTC704 / DTC722 | | 0.8 | 1.0 | 1.2 | |
| DTC705 | | 0.038 | 0.047 | 0.056 | |
| DTC706 | | 0.055 | 0.1 | 0.185 | |
| DTC707 | | 0.17 | 0.21 | 0.25 | |
| DTC708 | | 0.38 | 0.47 | 0.56 | |
| DTC709 | | 1.7 | 2.1 | 2.6 | |
| DTC710 / DTC711 / DTC714 | | – | – | – | |

4. Pulse Test: Pulse Width < 300 μs, Duty Cycle < 2.0%.

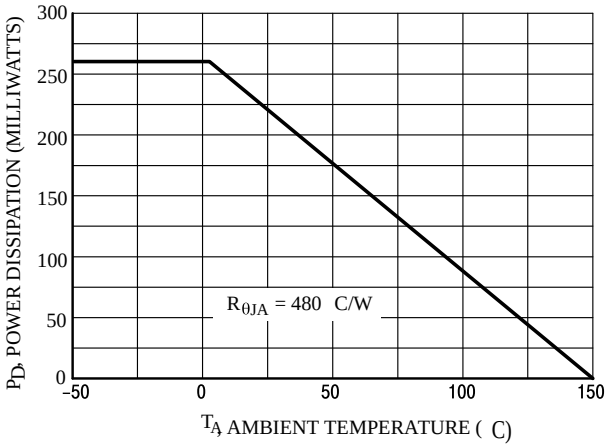



Figure 1. Derating Curve

## TYPICAL ELECTRICAL CHARACTERISTICS − DTC702

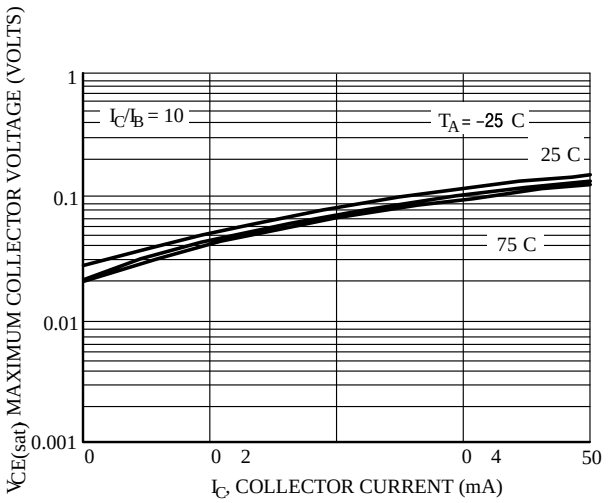



Figure 2. $V_{CE(sat)}$ versus $I_C$

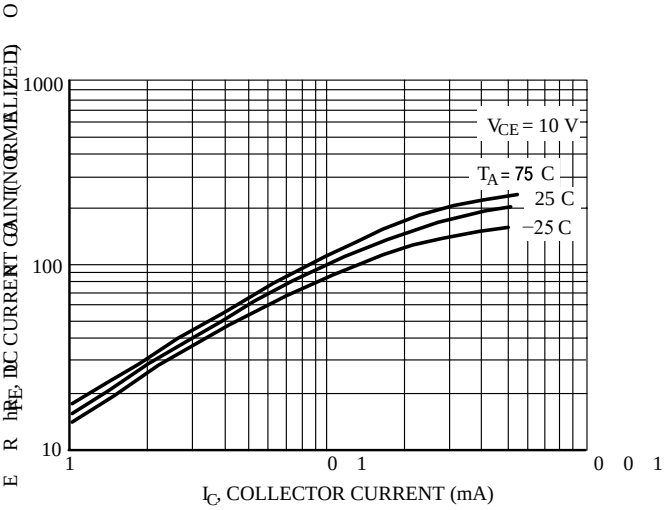



Figure 3. DC Current Gain

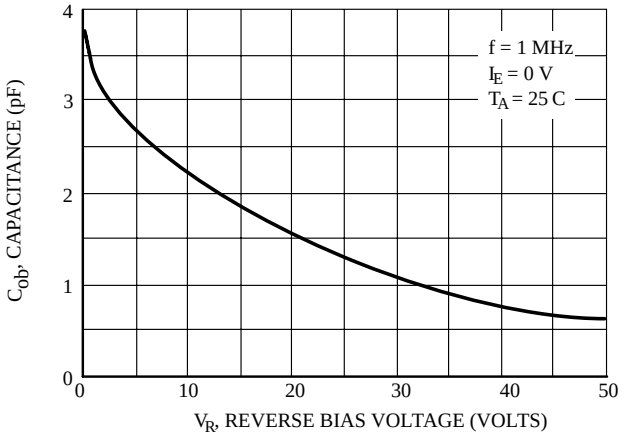



Figure 4. Output Capacitance

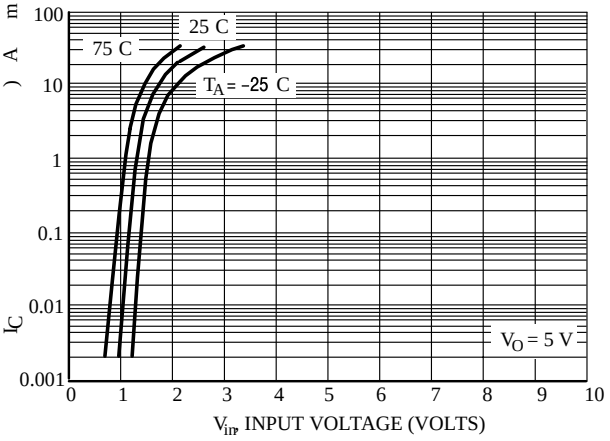



Figure 5. Output Current versus Input Voltage

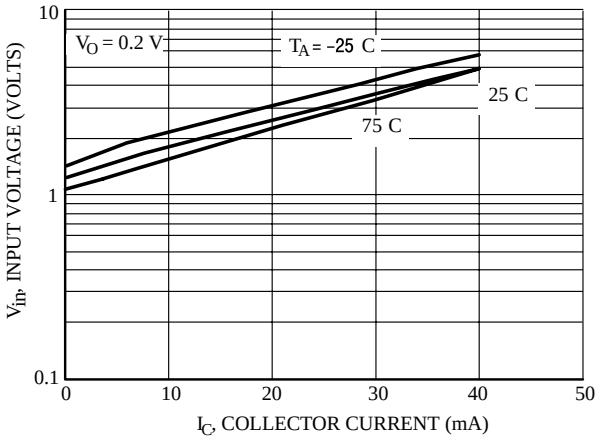



Figure 6. Input Voltage versus Output Current

TYPICAL ELECTRICAL CHARACTERISTICS − DTC703

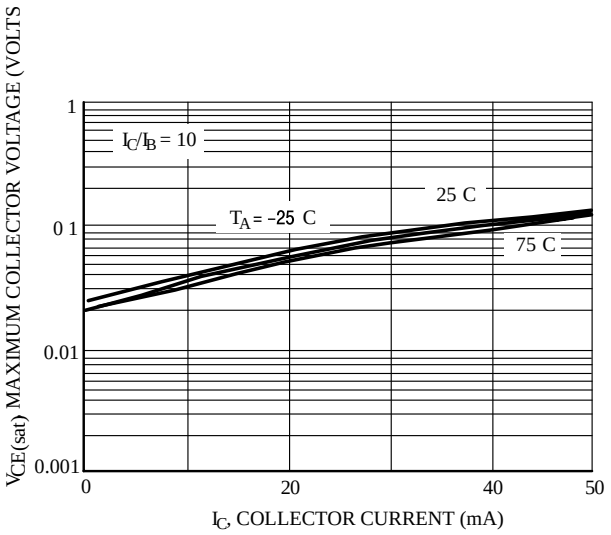



Figure 7. $V_{CE(sat)}$ versus $I_C$

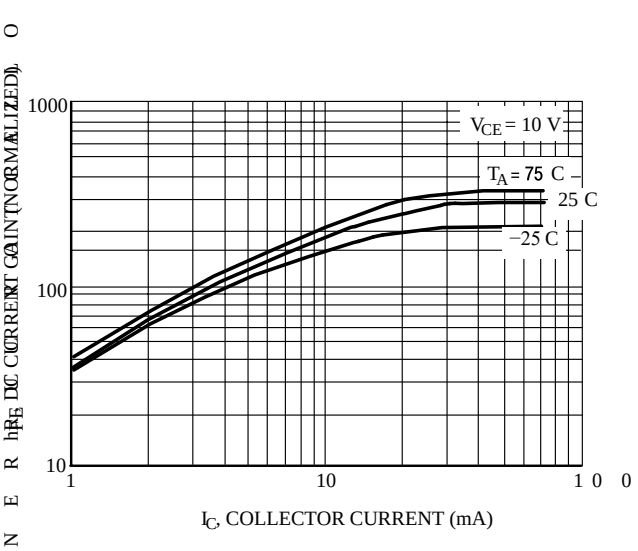



Figure 8. DC Current Gain

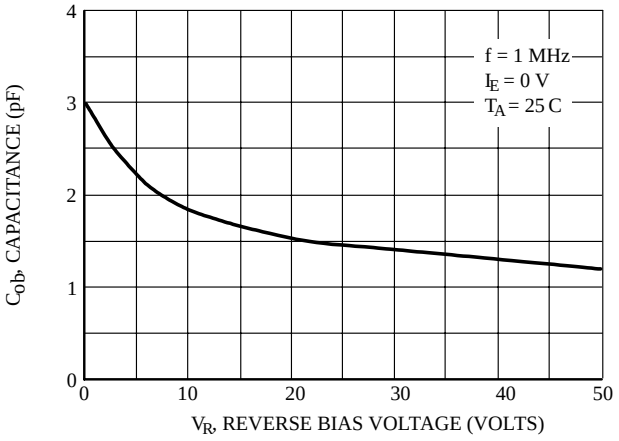



Figure 9. Output Capacitance

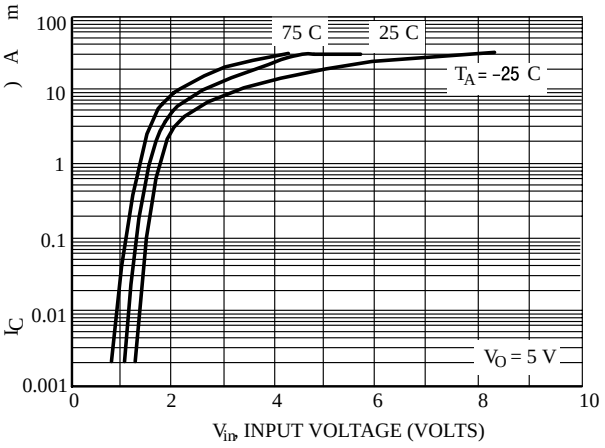



Figure 10. Output Current versus Input Voltage

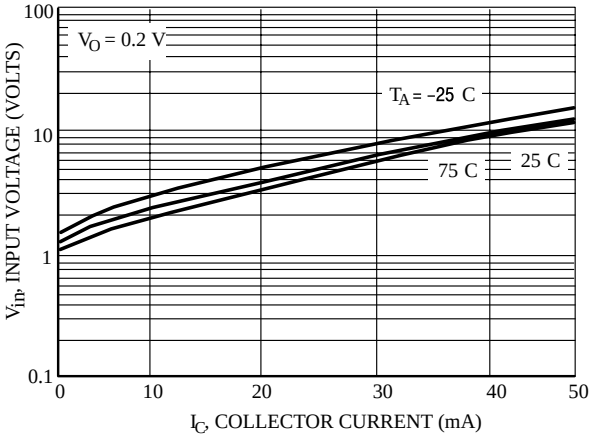



Figure 11. Input Voltage versus Output Current

## TYPICAL ELECTRICAL CHARACTERISTICS − DTC704

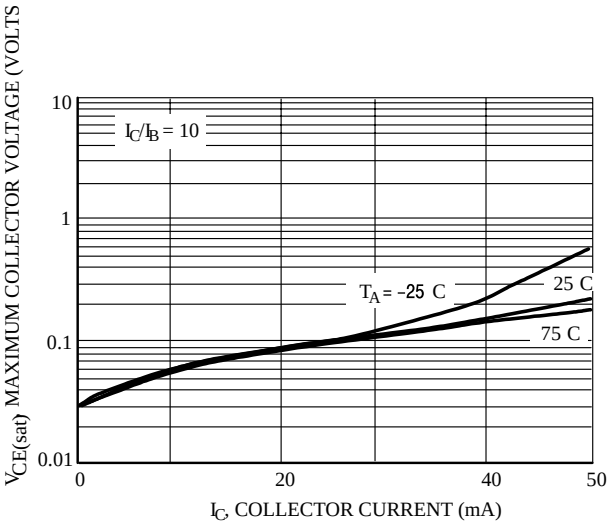



Figure 12. $V_{CE(sat)}$ versus $I_C$

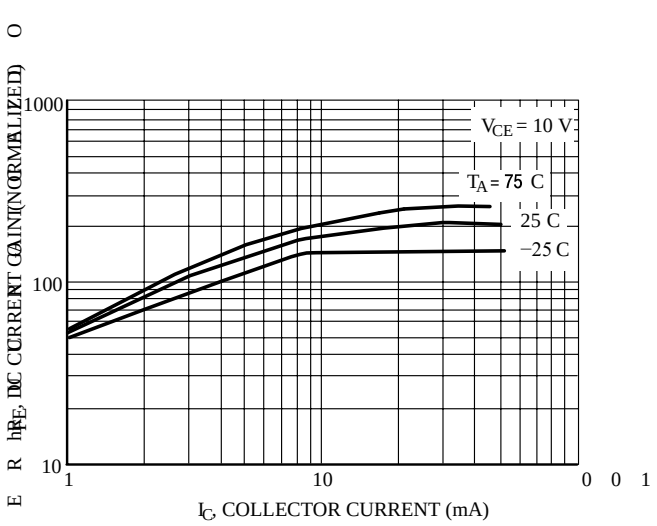



Figure 13. DC Current Gain

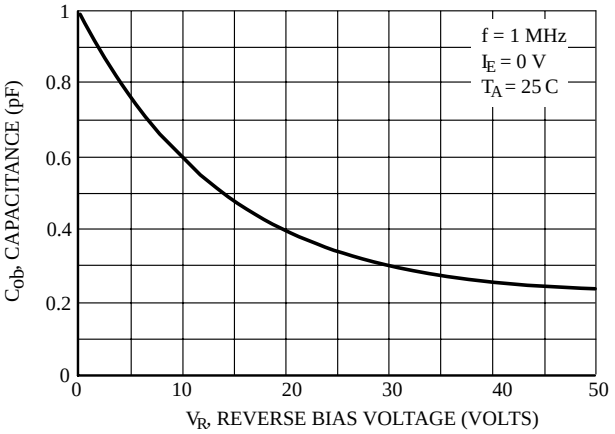



Figure 14. Output Capacitance

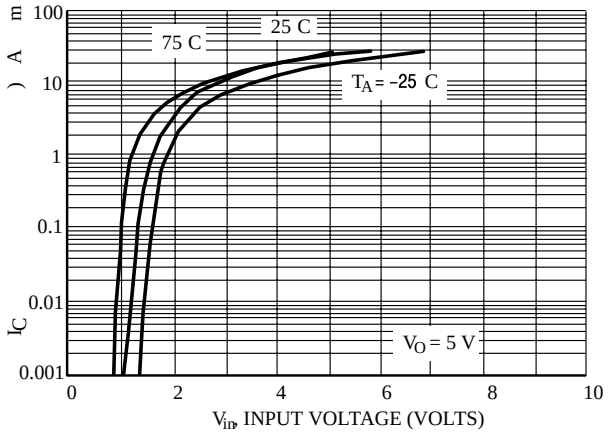



Figure 15. Output Current versus Input Voltage

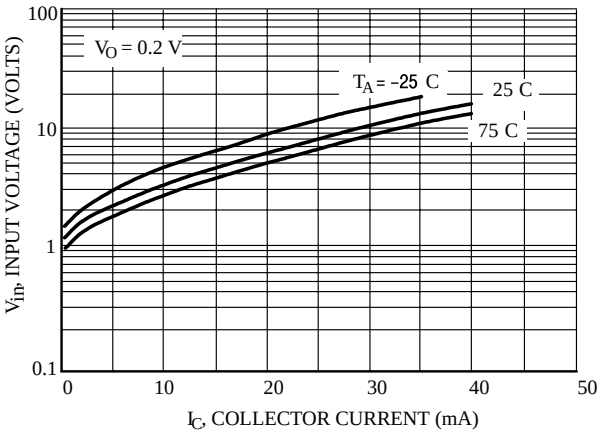



Figure 16. Input Voltage versus Output Current

## TYPICAL ELECTRICAL CHARACTERISTICS − DTC707

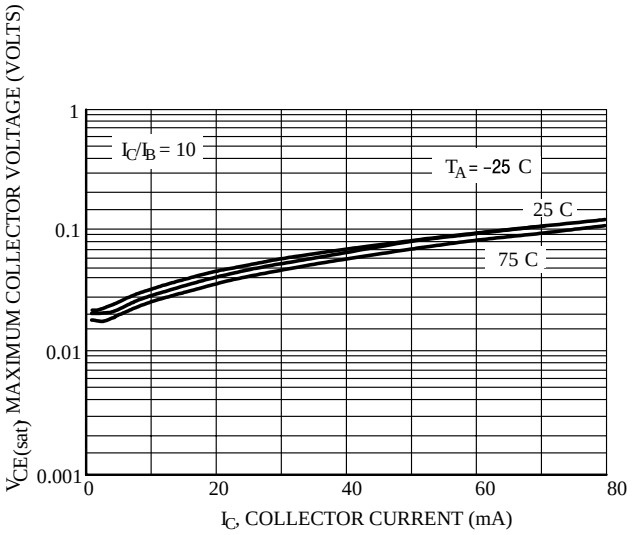



Figure 17. $V_{CE(sat)}$ versus $I_C$

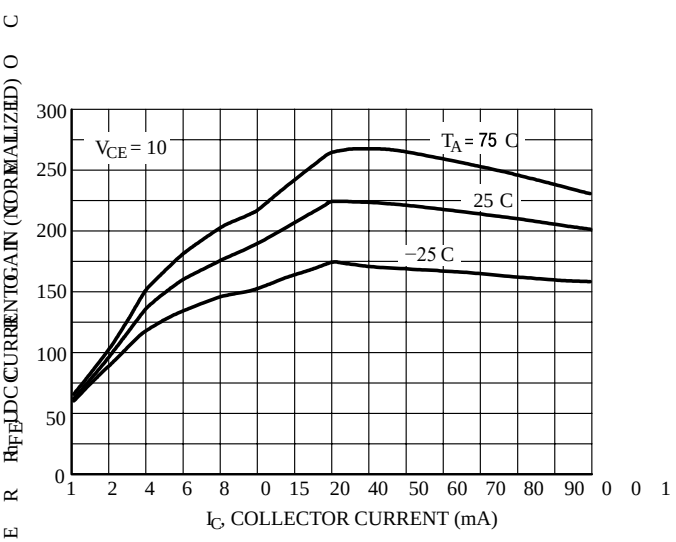



Figure 18. DC Current Gain

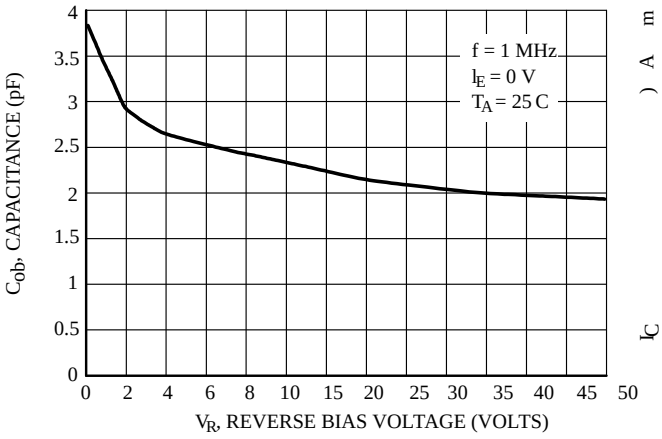



Figure 19. Output Capacitance

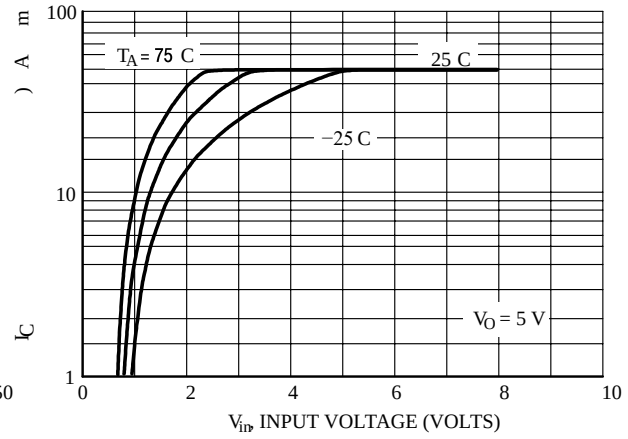



Figure 20. Output Current versus Input Voltage

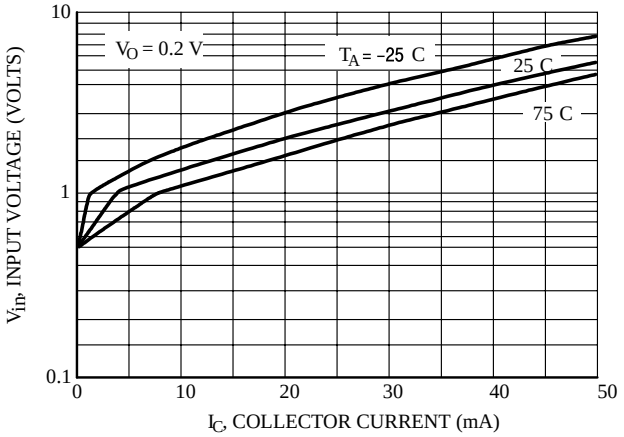



Figure 21. Input Voltage versus Output Current

**TYPICAL APPLICATIONS FOR NPN BRTs**

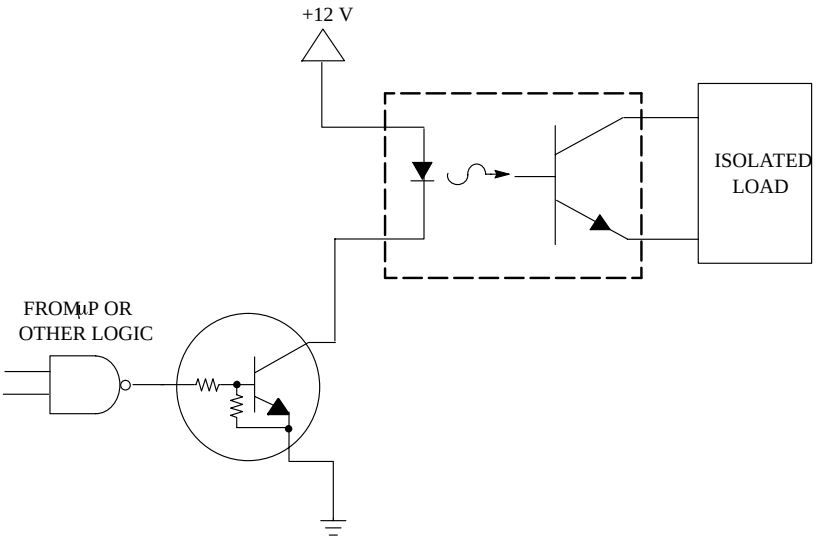



Figure 22. Level Shifter: Connects 12 or 24 Volt Circuits to Logic

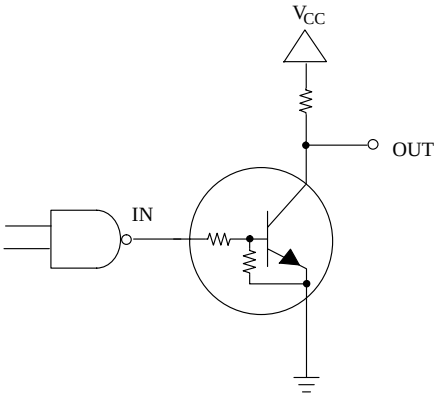



Figure 23. Open Collector Inverter:
Inverts the Input Signal

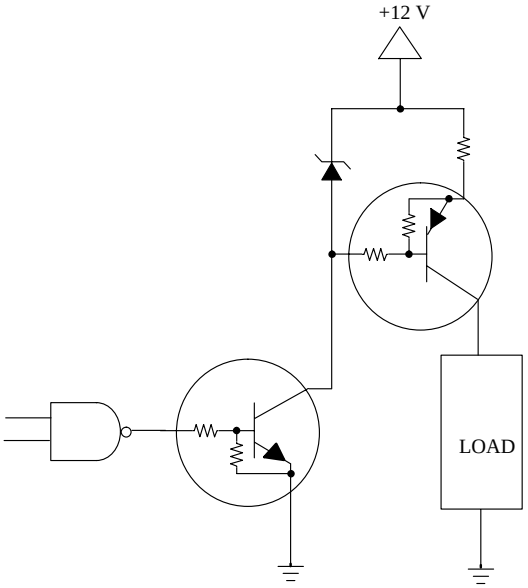
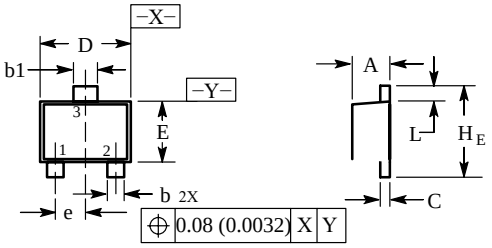



Figure 24. Inexpensive, Unregulated Current Source

## PACKAGE DIMENSIONS

SOT−723

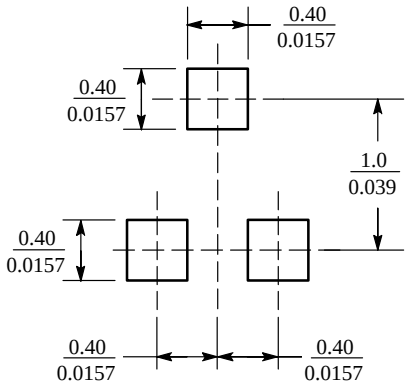



NOTES:
1 DIMENSIONING AND TOLERANCING PER ANSI Y14 5M, 1982
2 CONTROLLING DIMENSION: MILLIMETERS
3 MAXIMUM LEAD THICKNESS INCLUDES LEAD FINISH MINIMUM LEAD THICKNESS IS THE MINIMUM THICKNESS OF BASE MATERIAL
4 DIMENSIONS D AND E DO NOT INCLUDE MOLD FLASH, PROTRUSIONS OR GATE BURRS

PIN 1 BASE
2 EMITTER
3 COLLECTOR

| | MILLIMETERS | | | INCHES | | |
|---|---|---|---|---|---|---|
| DIM | MIN | NOM | MAX | MIN | NOM | MAX |
| A | 0 45 | 0 50 | 0 55 | 0 018 | 0 020 | 0 022 |
| b | 0 15 | 0 20 | 0 27 | 0 0059 | 0 0079 | 0 0106 |
| b1 | 0 25 | 0 3 | 0 35 | 0 010 | 0 012 | 0 014 |
| C | 0 07 | 0 12 | 0 17 | 0 0028 | 0 0047 | 0 0067 |
| D | 1 15 | 1 20 | 1 25 | 0 045 | 0 047 | 0 049 |
| E | 0 75 | 0 80 | 0 85 | 0 03 | 0 032 | 0 034 |
| e | 0 40 BSC | | | 0 016 BSC | | |
| $H_E$ | 1 15 | 1 20 | 1 25 | 0 045 | 0 047 | 0 049 |
| L | 0 15 | 0 20 | 0 25 | 0 0059 | 0 0079 | 0 0098 |

SOLDERING FOOTPRINT




$\left(\frac{mm}{inches}\right)$