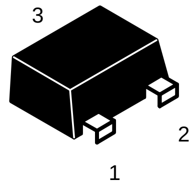
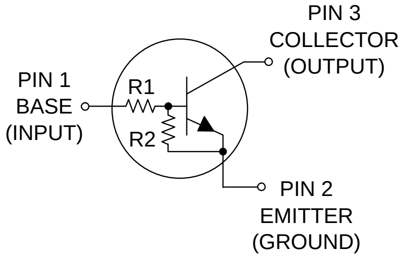
# Bias Resistor Transistors NPN Silicon
# DTC114EM3T5G Series
# S-DTC114EM3T5G Series

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
- These are Pb-Free Devices.
- S- Prefix for Automotive and Other Applications Requiring Unique Site and Control Change Requirements; AEC-Q101 Qualified and PPAP Capable.




**SOT-723**




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

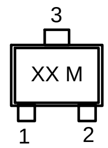
| Rating | Symbol | Value | Unit |
|---|---|---|---|
| Collector-Base Voltage | $V_{CBO}$ | 50 | Vdc |
| Collector-Emitter Voltage | $V_{CEO}$ | 50 | Vdc |
| Collector Current | $I_C$ | 100 | mAdc |

**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 – 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

**MARKING DIAGRAM**




xx = Specific Device Code
M = Date Code

### DEVICE MARKING AND RESISTOR VALUES

| Device | | Marking | R1 (K) | R2 (K) | Package | Shipping |
|---|---|---|---|---|---|---|
| DTC114EM3T5G | S-DTC114EM3T5G | 8A | 10 | 10 | SOT−723 | 8000/Tape & Reel |
| DTC124EM3T5G | S-DTC124EM3T5G | 8B | 22 | 22 | | |
| DTC144EM3T5G | S-DTC144EM3T5G | 8C | 47 | 47 | | |
| DTC114YM3T5G | S-DTC114YM3T5G | 8D | 10 | 47 | | |
| DTC114TM3T5G | S-DTC114TM3T5G | 94 | 10 | ∞ | | |
| DTC143TM3T5G | S-DTC143TM3T5G | 8F | 4.7 | ∞ | | |
| DTC123EM3T5G | S-DTC123EM3T5G | 8H | 2.2 | 2.2 | | |
| DTC143EM3T5G | S-DTC143EM3T5G | 8J | 4.7 | 4.7 | | |
| DTC143ZM3T5G | S-DTC143ZM3T5G | 8K | 4.7 | 47 | | |
| DTC124XM3T5G | S-DTC124XM3T5G | 8L | 22 | 47 | | |
| DTC123JM3T5G | S-DTC123JM3T5G | 8M | 2.2 | 47 | | |
| DTC115EM3T5G | S-DTC115EM3T5G | 8N | 100 | 100 | | |
| DTC144WM3T5G | S-DTC144WM3T5G | 8P | 47 | 22 | | |
| DTC144TM3T5G | S-DTC144TM3T5G | 8T | 47 | ∞ | | |

**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) | DTC114EM3T5G | $I_{EBO}$ | − | − | 0.5 | mAdc |
| | DTC124EM3T5G | | − | − | 0.2 | |
| | DTC144EM3T5G | | − | − | 0.1 | |
| | DTC114YM3T5G | | − | − | 0.2 | |
| | DTC114TM3T5G | | − | − | 0.9 | |
| | DTC143TM3T5G | | − | − | 1.9 | |
| | DTC123EM3T5G | | − | − | 2.3 | |
| | DTC143EM3T5G | | − | − | 1.5 | |
| | DTC143ZM3T5G | | − | − | 0.18 | |
| | DTC124XM3T5G | | − | − | 0.13 | |
| | DTC123JM3T5G | | − | − | 0.2 | |
| | DTC115EM3T5G | | − | − | 0.05 | |
| | DTC144WM3T5G | | − | − | 0.13 | |
| | DTC144TM3T5G | | − | − | 0.2 | |
| 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) | DTC114EM3T5G | $h_{FE}$ | 35 | 60 | − | |
| | DTC124EM3T5G | | 60 | 100 | − | |
| | DTC144EM3T5G | | 80 | 140 | − | |
| | DTC114YM3T5G | | 80 | 140 | − | |
| | DTC114TM3T5G | | 160 | 350 | − | |
| | DTC143TM3T5G | | 160 | 350 | − | |
| | DTC123EM3T5G | | 8.0 | 15 | − | |
| | DTC143EM3T5G | | 15 | 30 | − | |
| | DTC143ZM3T5G | | 80 | 200 | − | |
| | DTC124XM3T5G | | 80 | 150 | − | |
| | DTC123JM3T5G | | 80 | 140 | − | |
| | DTC115EM3T5G | | 80 | 150 | − | |
| | DTC144WM3T5G | | 80 | 140 | − | |
| | DTC144TM3T5G | | 160 | 350 | − | |
| Collector−Emitter Saturation Voltage ($I_C$ = 10 mA, $I_B$ = 0.3 mA)<br>($I_C$ = 10 mA, $I_B$ = 5 mA)<br>($I_C$ = 10 mA, $I_B$ = 1 mA) | <br>DTC123EM3T5G<br>DTC143TM3T5G/DTC114TM3T5G/<br>DTC143EM3T5G/DTC143ZM3T5G/<br>DTC124XM3T5G/DTC144TM3T5G | $V_{CE(sat)}$ | − | − | 0.25 | Vdc |
| Output Voltage (on) | | $V_{OL}$ | | | | Vdc |
| ($V_{CC}$ = 5.0 V, $V_B$ = 2.5 V, $R_L$ = 1.0 kΩ) | DTC114EM3T5G | | − | − | 0.2 | |
| | DTC124EM3T5G | | − | − | 0.2 | |
| | DTC114YM3T5G | | − | − | 0.2 | |
| | DTC114TM3T5G | | − | − | 0.2 | |
| | DTC143TM3T5G | | − | − | 0.2 | |
| | DTC123EM3T5G | | − | − | 0.2 | |
| | DTC143EM3T5G | | − | − | 0.2 | |
| | DTC143ZM3T5G | | − | − | 0.2 | |
| | DTC124XM3T5G | | − | − | 0.2 | |
| | DTC123JM3T5G | | − | − | 0.2 | |
| ($V_{CC}$ = 5.0 V, $V_B$ = 3.5 V, $R_L$ = 1.0 kΩ) | DTC144EM3T5G | | − | − | 0.2 | |
| | DTC144TM3T5G | | − | − | 0.2 | |
| ($V_{CC}$ = 5.0 V, $V_B$ = 5.5 V, $R_L$ = 1.0 kΩ) | DTC115EM3T5G | | − | − | 0.2 | |
| ($V_{CC}$ = 5.0 V, $V_B$ = 4.0 V, $R_L$ = 1.0 kΩ) | DTC144WM3T5G | | − | − | 0.2 | |

3. Pulse Test: Pulse Width < 300 μs, 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 kΩ) | | $V_{OH}$ | 4.9 | – | – | Vdc |
| ($V_{CC}$ = 5.0 V, $V_B$ = 0.25 V, $R_L$ = 1.0 kΩ) | DTC143TM3T5G | | | | | |
| | DTC143ZM3T5G | | | | | |
| | DTC114TM3T5G | | | | | |
| | DTC144TM3T5G | | | | | |
| Input Resistor | DTC114EM3T5G | R1 | 7.0 | 10 | 13 | kΩ |
| | DTC124EM3T5G | | 15.4 | 22 | 28.6 | |
| | DTC144EM3T5G | | 32.9 | 47 | 61.1 | |
| | DTC114YM3T5G | | 7.0 | 10 | 13 | |
| | DTC114TM3T5G | | 7.0 | 10 | 13 | |
| | DTC143TM3T5G | | 3.3 | 4.7 | 6.1 | |
| | DTC123EM3T5G | | 1.5 | 2.2 | 2.9 | |
| | DTC143EM3T5G | | 3.3 | 4.7 | 6.1 | |
| | DTC143ZM3T5G | | 3.3 | 4.7 | 6.1 | |
| | DTC124XM3T5G | | 15.4 | 22 | 28.6 | |
| | DTC123JM3T5G | | 1.54 | 2.2 | 2.86 | |
| | DTC115EM3T5G | | 70 | 100 | 130 | |
| | DTC144WM3T5G | | 32.9 | 47 | 61.1 | |
| | DTC144TM3T5G | | 32.9 | 47 | 61.1 | |
| Resistor Ratio | | $R_1/R_2$ | | | | |
| | DTC114EM3T5G/DTC124EM3T5G/DTC144EM3T5G/ DTC115EM3T5G /DTC114YM3T5G | | 0.8 | 1.0 | 1.2 | |
| | DTC143TM3T5G/DTC114TM3T5G/DTC144TM3T5G | | 0.17 | 0.21 | 0.25 | |
| | DTC123EM3T5G/DTC143EM3T5G DTC143ZM3T5G | | – | – | – | |
| | DTC124XM3T5G | | 0.8 | 1.0 | 1.2 | |
| | DTC123JM3T5G | | 0.055 | 0.1 | 0.185 | |
| | DTC144WM3T5G | | 0.38 | 0.47 | 0.56 | |
| | | | 0.038 | 0.047 | 0.056 | |
| | | | 1.7 | 2.1 | 2.6 | |
| Input voltage ($V_{CC}$ = 5.0 V, $I_O$ = 100 μA) | DTC123JM3T5G | $V_{I(off)}$ | – | – | 0.5 | V |
| Input voltage ($V_O$ = 0.3 V, $I_O$ = 5 mA) | DTC123JM3T5G | $V_{I(on)}$ | 1.1 | – | – | V |

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

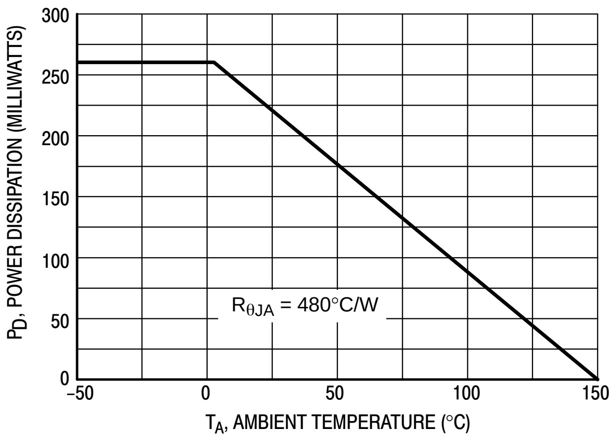



**Figure 1. Derating Curve**

## TYPICAL ELECTRICAL CHARACTERISTICS − DTC114EM3T5G

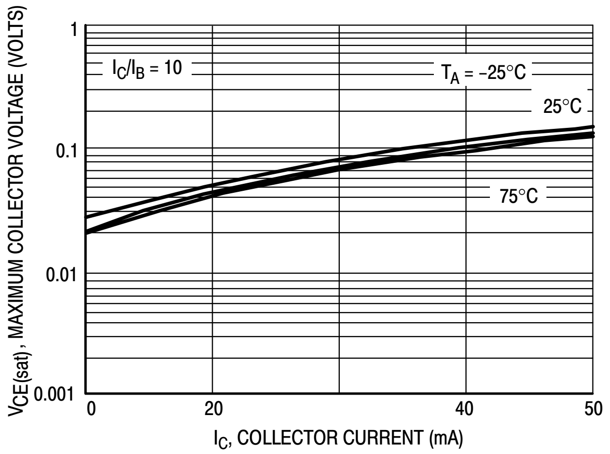



**Figure 2. $V_{CE(sat)}$ versus $I_C$**

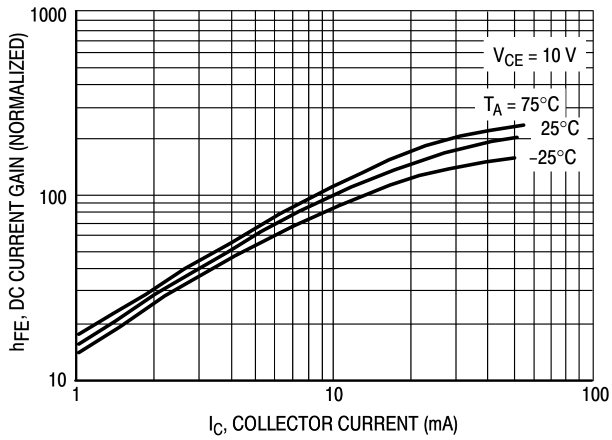



**Figure 3. DC Current Gain**

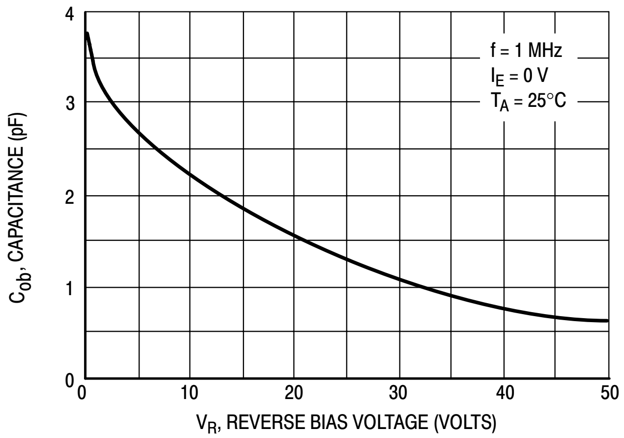



**Figure 4. Output Capacitance**

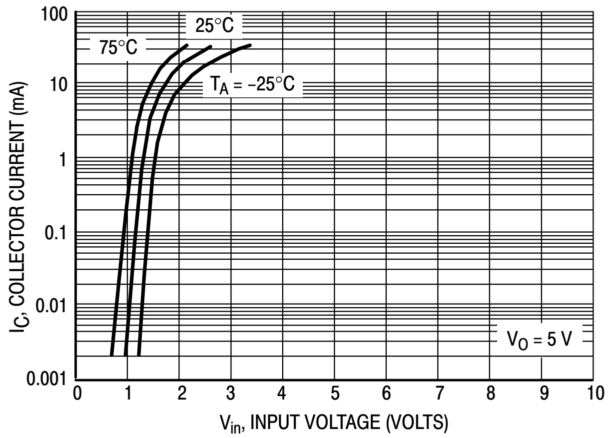



**Figure 5. Output Current versus Input Voltage**

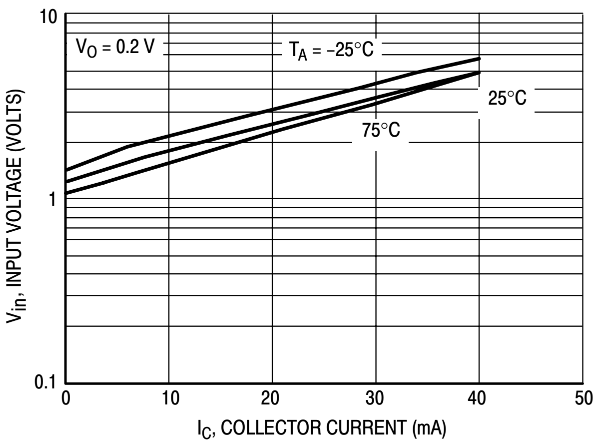



**Figure 6. Input Voltage versus Output Current**

## TYPICAL ELECTRICAL CHARACTERISTICS − DTC124EM3T5G

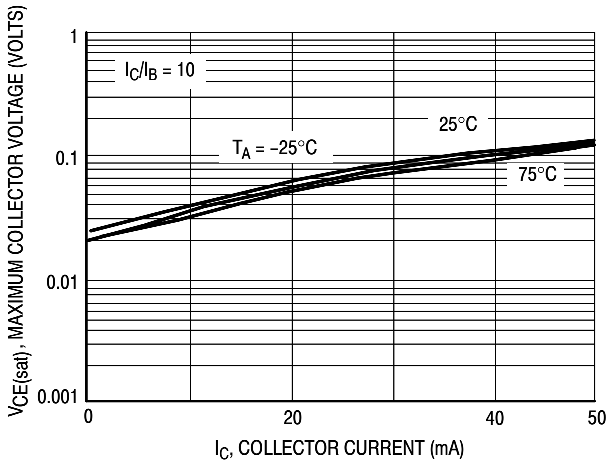



**Figure 7. $V_{CE(sat)}$ versus $I_C$**

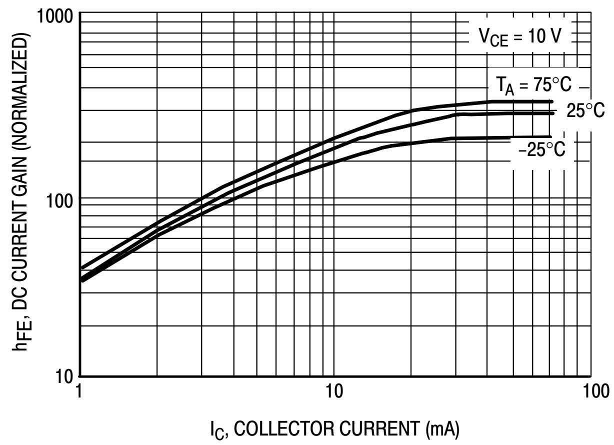



**Figure 8. DC Current Gain**

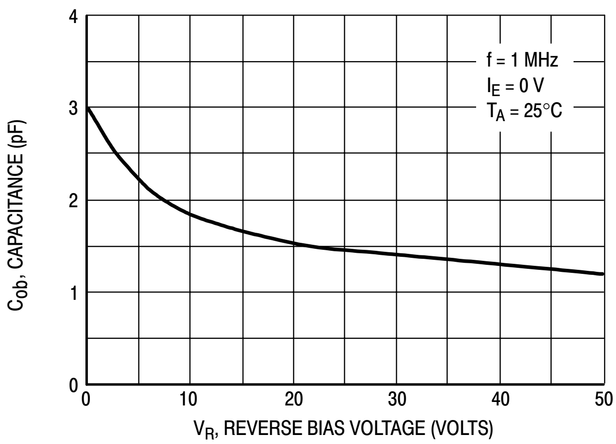



**Figure 9. Output Capacitance**

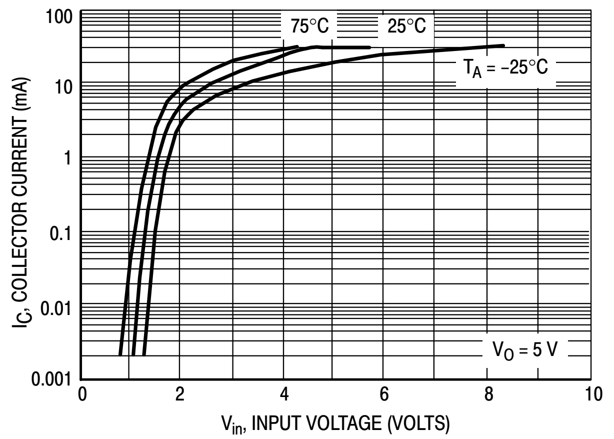



**Figure 10. Output Current versus Input Voltage**

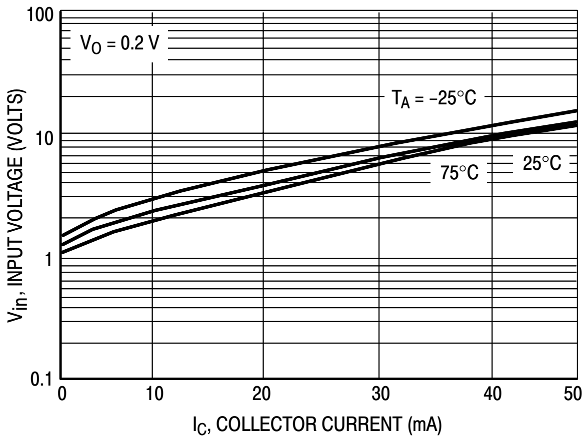



**Figure 11. Input Voltage versus Output Current**

## TYPICAL ELECTRICAL CHARACTERISTICS – DTC144EM3T5G

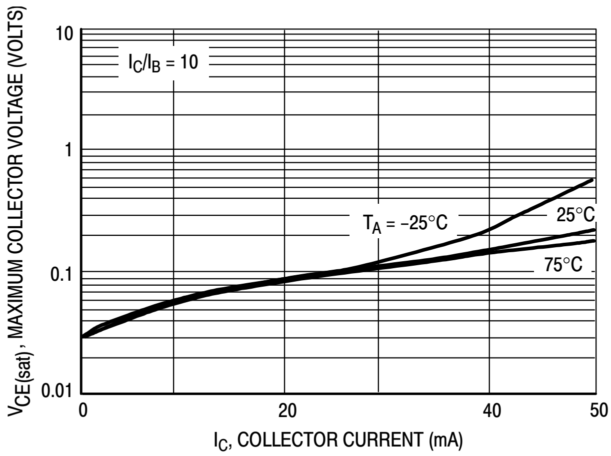



Figure 12. $V_{CE(sat)}$ versus $I_C$

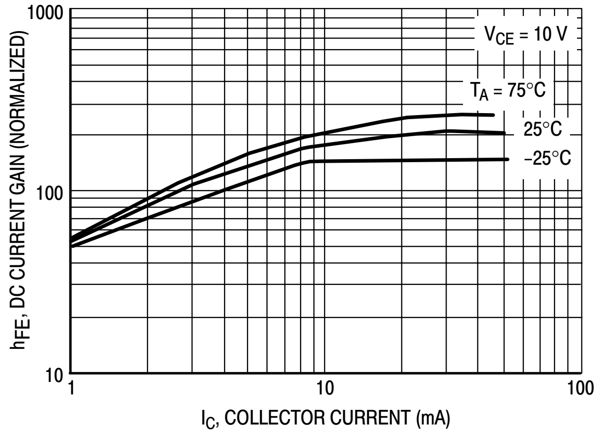



Figure 13. DC Current Gain

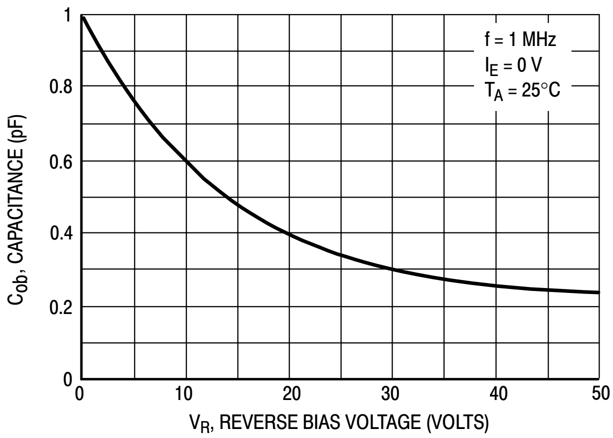



Figure 14. Output Capacitance

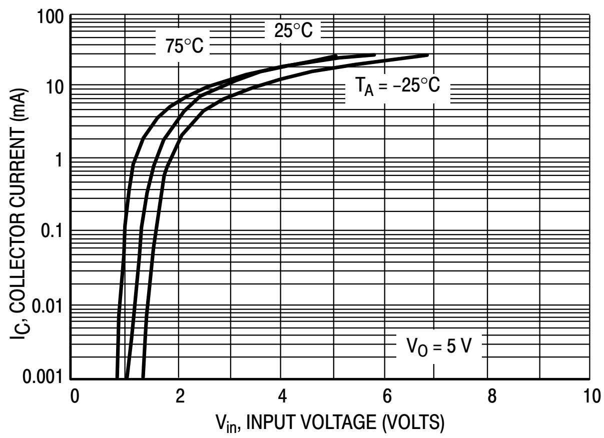



Figure 15. Output Current versus Input Voltage

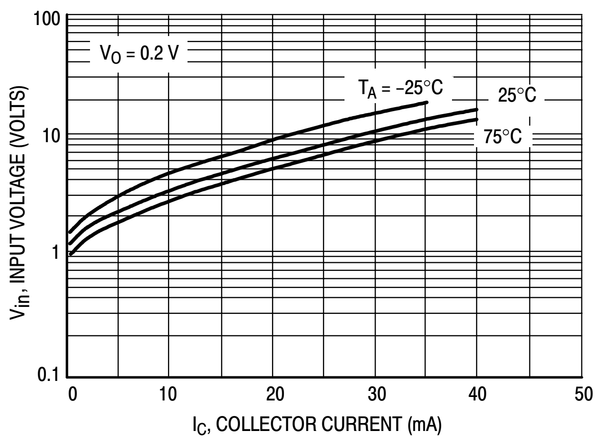



Figure 16. Input Voltage versus Output Current

## TYPICAL ELECTRICAL CHARACTERISTICS − DTC114YM3T5G

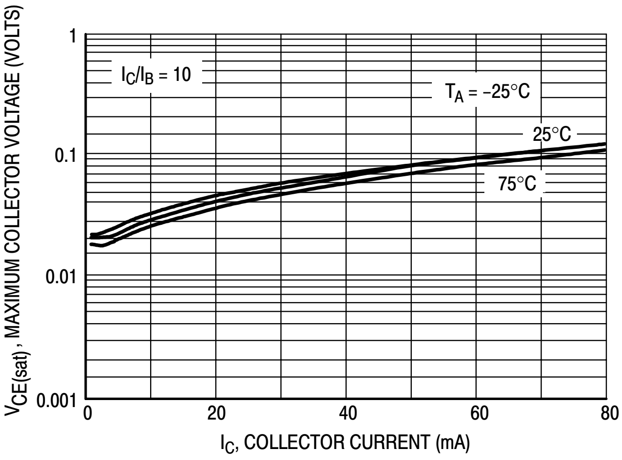



Figure 17. $V_{CE(sat)}$ versus $I_C$

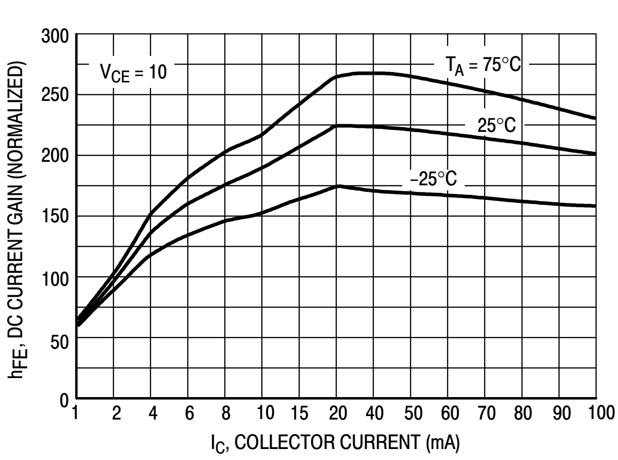



Figure 18. DC Current Gain

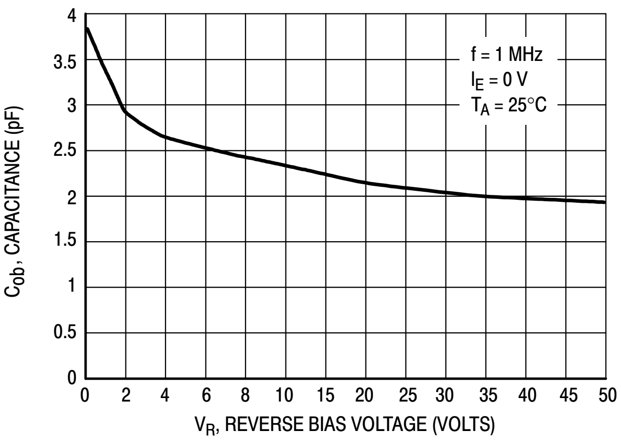



Figure 19. Output Capacitance

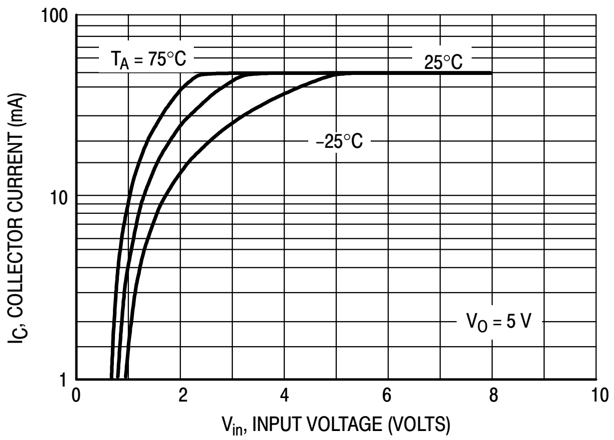



Figure 20. Output Current versus Input Voltage

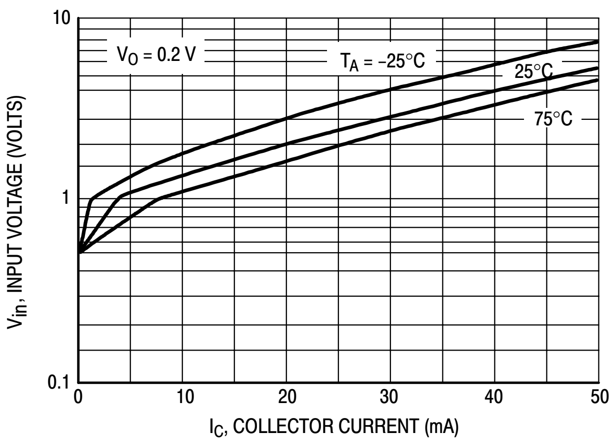



Figure 21. Input Voltage versus Output Current

## TYPICAL ELECTRICAL CHARACTERISTICS – DTC143ZM3T5G

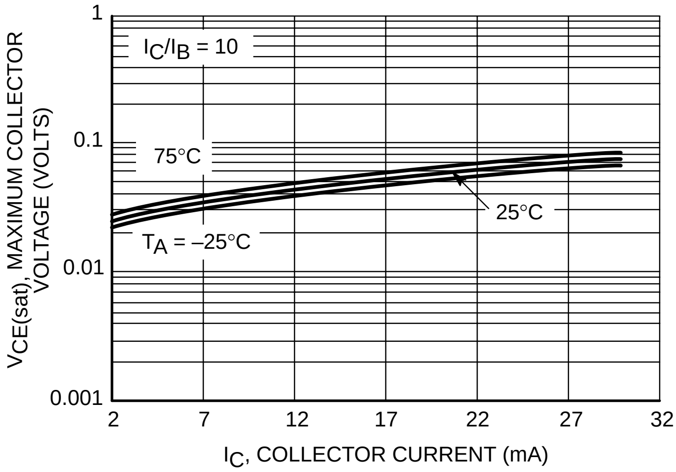



**Figure 27. $V_{CE(sat)}$ vs. $I_C$**

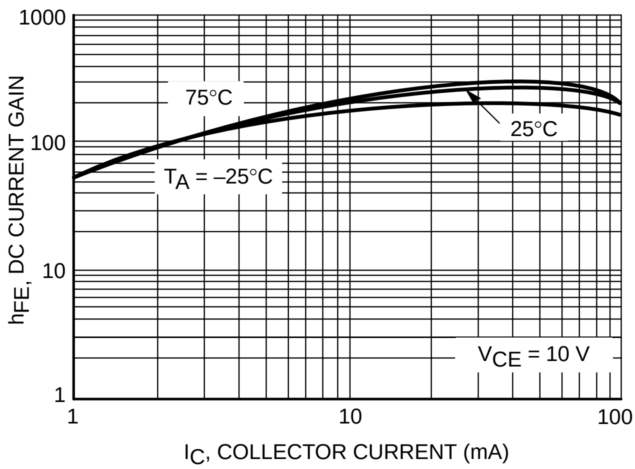



**Figure 28. DC Current Gain**

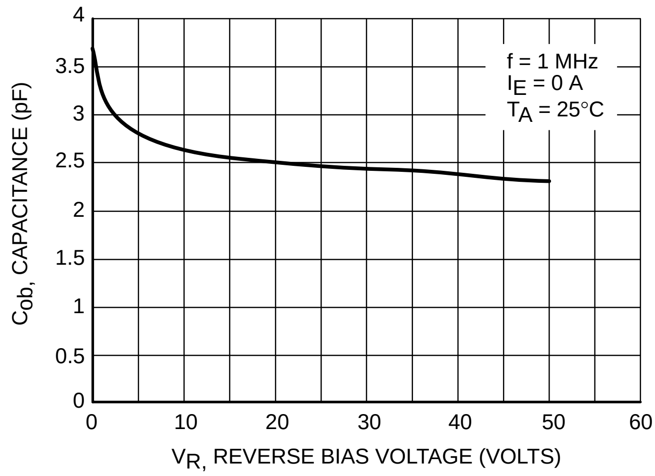



**Figure 29. Output Capacitance**

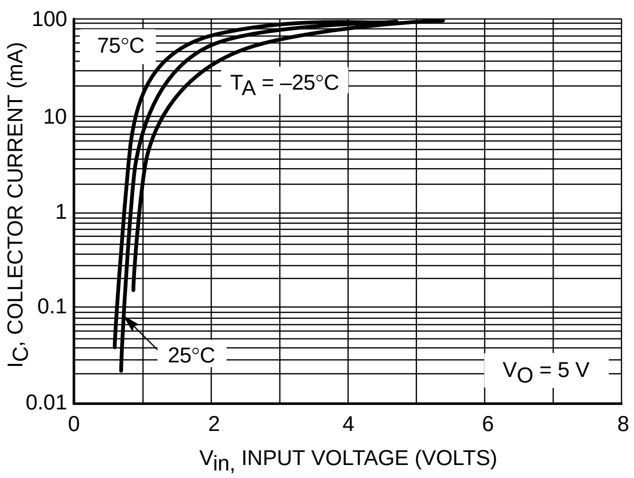



**Figure 30. Output Current vs. Input Voltage**

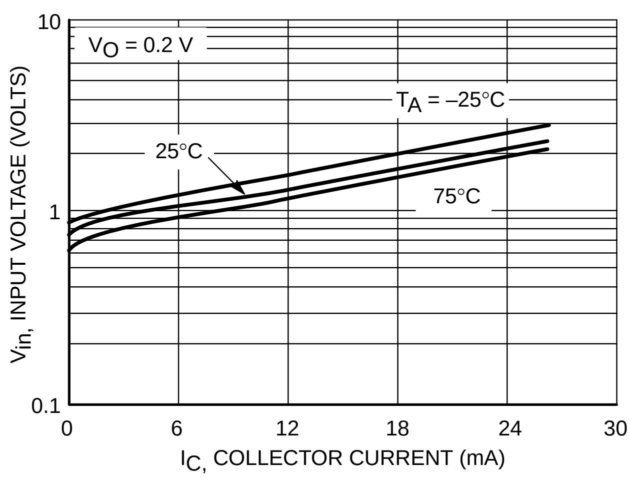



**Figure 31. Input Voltage vs. Output Current**

## TYPICAL APPLICATIONS FOR NPN BRTs

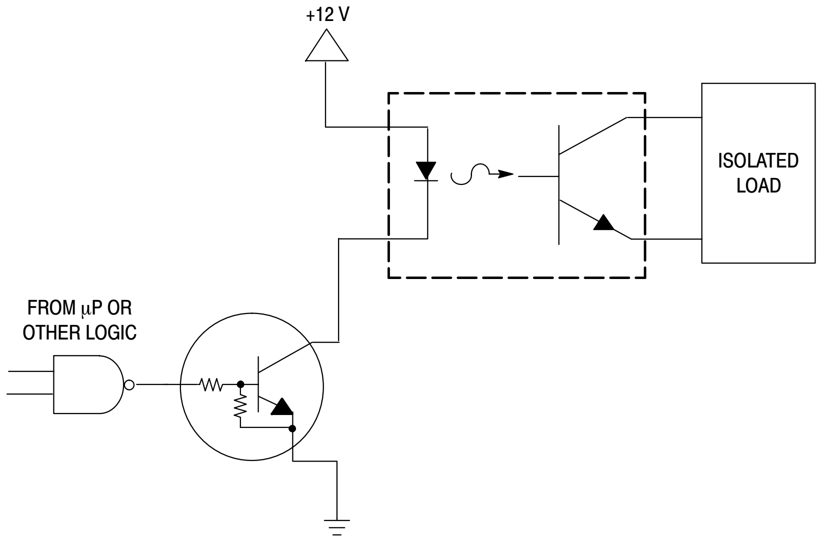



Figure 22. Level Shifter: Connects 12 or 24 Volt Circuits to Logic

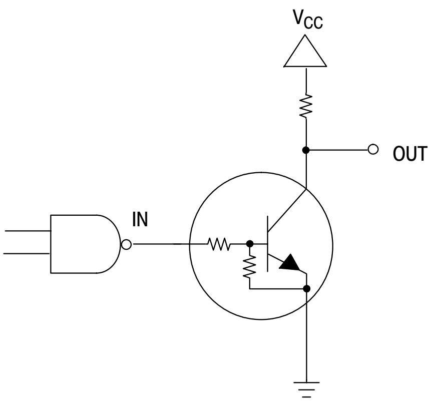



Figure 23. Open Collector Inverter: Inverts the Input Signal

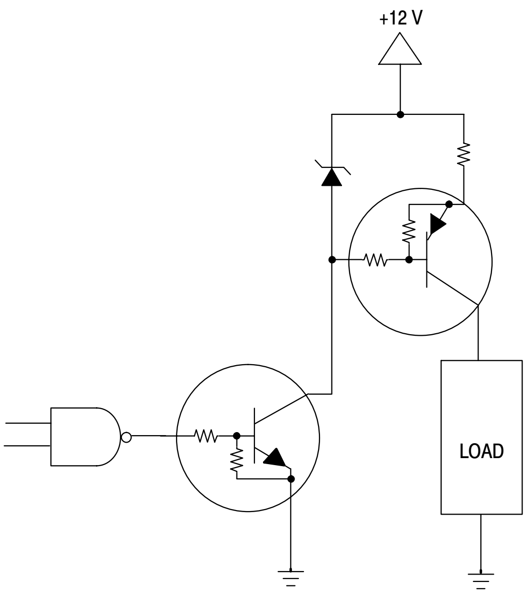
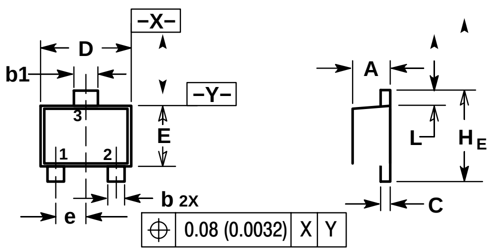



Figure 24. Inexpensive, Unregulated Current Source

## PACKAGE DIMENSIONS

**SOT−723**

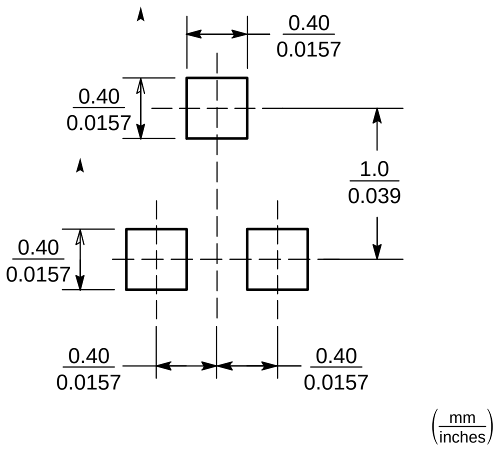



NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: MILLIMETERS.
3. MAXIMUM LEAD THICKNESS INCLUDES LEAD FINISH. MINIMUM LEAD THICKNESS IS THE MINIMUM THICKNESS OF BASE MATERIAL.
4. DIMENSIONS D AND E DO NOT INCLUDE MOLD FLASH, PROTRUSIONS OR GATE BURRS.

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

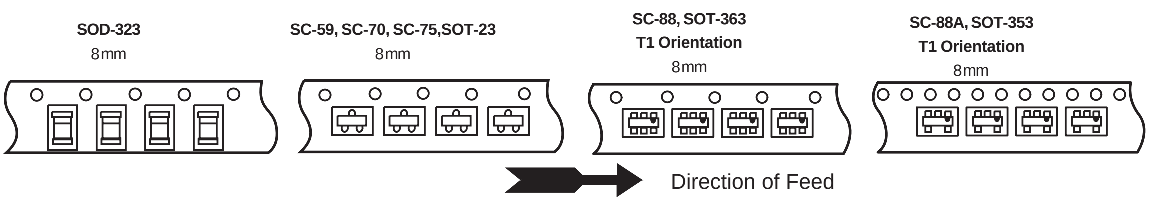


# Tape & Reel and Packaging Specifications for Small-Signal Transistors, FETs and Diodes

Embossed Tape and Reel is used to facilitate automatic pick and place equipment feed requirements. The tape is used as the shipping container for various products and requires a minimum of handling. The antistatic/conductive tape provides a secure cavity for the product when sealed with the “peel–back” cover tape.

- Two Reel Sizes Available (7"and 13",)
- Used for Automatic Pick and Place Feed Systems
- Minimizes Product Handling
- EIA 481, –1, –2
- SOT–23, SC–70/SOT–323, SC–89, SC–88/SOT–363, SC–88A/SOT–353, SOD–323, SOD-523 in 8 mm Tape

Use the standard device title and add the required suffix as listed in the option table below (Table 1). Note that the individual reels have a finite number of devices depending on the type of product contained in the tape. Also note the minimum lot size is one full reel for each line item, and orders are required to be in increments of the single reel quantity.

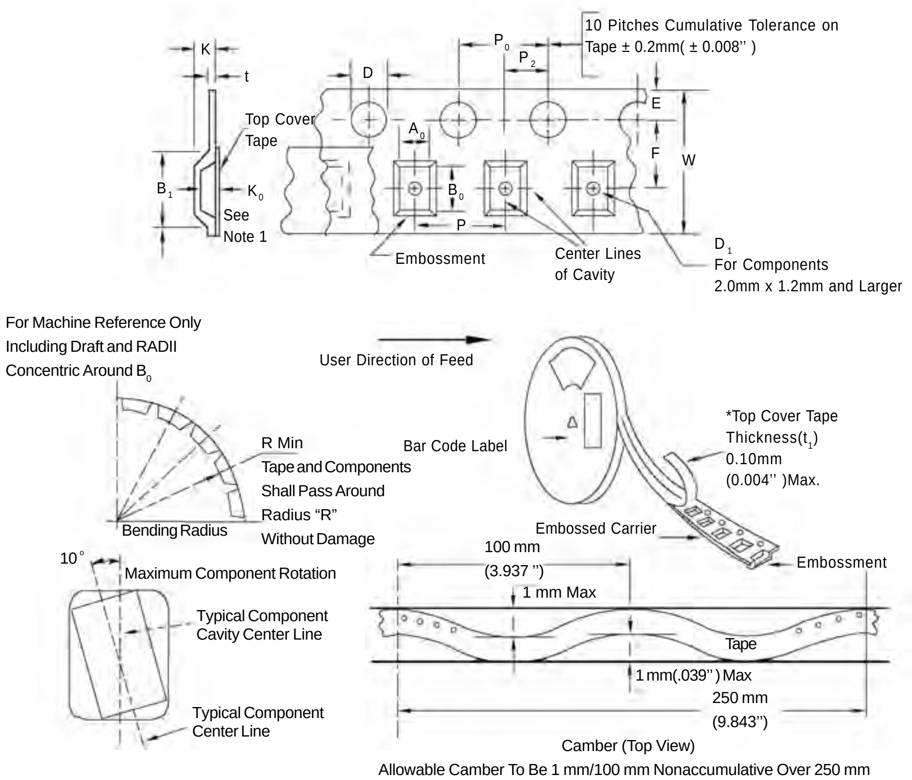



Typical Reel Orientations

## Table 1. EMBOSSED TAPE AND REEL ORDERING INFORMATION

| Package | Tape Width (mm) | Pitch mm | Reel Size mm(inch) | Devices Per Reel and Minimum Order Quantity | Device Suffix |
|---|---|---|---|---|---|
| SOT–23 | 8 | 4 | 178 | (7) | 3,000 T1 |
| | 8 | | 330 | (13) | 10,000 T3 |
| SC–70/SOT–323 | 8 | 4 | 178 | (7) | 3,000 T1 |
| | 8 | | 330 | (13) | 10,000 T3 |
| SC–89 | 8 | 4 | 178 | (7) | 3,000 T1 |
| | 8 | | 330 | (13) | 10,000 T3 |
| SC–88/SOT-363 | 8 | 4 | 178 | (7) | 3,000 T1 |
| | 8 | | 330 | (13) | 10,000 T3 |
| SC–88A/SOT-353 | 8 | 4 | 178 | (7) | 3,000 T1 |
| | 8 | | 330 | (13) | 10,000 T3 |
| SOD-323 | 8 | 4 | 178 | (7) | 3,000 T1 |
| | 8 | | 330 | (13) | 10,000 T3 |
| SOD-523 | 8 | 4 | 178 | (7) | 3,000 T1 |
| | 8 | | 330 | (13) | 10,000 T3 |

# EMBOSSED TAPE AND REEL DATA FOR DISCRETES
## CARRIER TAPE SPECIFICATIONS




DIMENSIONS

| Tape Size | $B_1$ Max | D | $D_1$ | E | F | K | $P_0$ | $P_2$ | RMin | TMax | WMax |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 8mm | 4.55mm (.179") | 1.5+0.1mm - 0.0 | 1.0Min (.039") | 1.75±0.1mm (.069±.004) | 3.5±0.05mm (.138±.002") | 2.4mmMax (.094") | 4.0 ± 0.1mm (.157±.004'') | 2.0±0.1mm (.079±.002") | 25mm (.98") | 0.6mm (.024") | 8.3mm (.327") |
| 12mm | 8.2mm (.323") | (.059+.004" - 0.0) | 1.5mmMin (.060") | | 5.5±0.05mm (.217±.002") | 6.4mmMax (.252") | | | 30mm (1.18") | | 12±.30mm (.470±.012") |
| 16mm | 12.1mm (.476") | | | | 7.5±0.10mm (.295±.004") | 7.9mmMax (.311") | | | | | 16.3mm (.642") |
| 24mm | 20.1mm (.791") | | | | 11.5±0.1mm (.453±.004") | 11.9mmMax (.468") | | | | | 24.3mm (.957") |

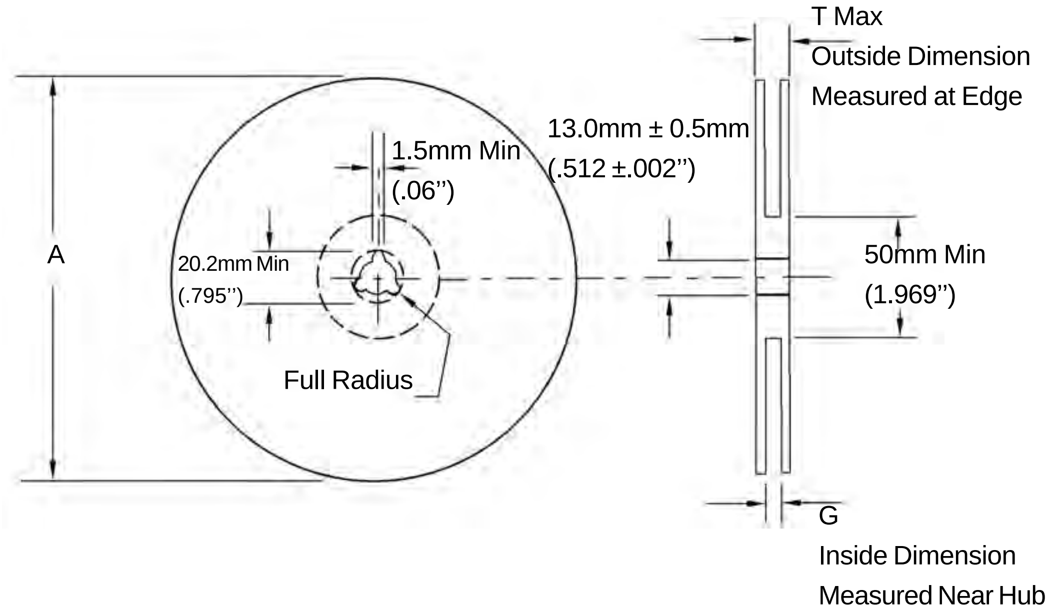
Metric dimensions govern - English are in parentheses for reference only.

NOTE 1: $A_0$, $B_0$, and $K_0$ are determined by component size. The clearance between the components and the cavity must be within .05 mm min. to.50 mm max.,

NOTE 2: the component cannot rotate more than 10 ° within the determined cavity.

NOTE 3: If $B_1$ exceeds 4.2 mm (.165") for 8 mm embossed tape, the tape may not feed through all tape feeders.

# EMBOSSED TAPE AND REEL DATA FOR DISCRETES




| Size | A Max | G | T Max |
|---|---|---|---|
| 8 mm | 330mm (12.992") | 8.4mm+1.5mm, -0.0 (.33"+.059", -0.00) | 14.4mm (.56") |
| 12mm | 330mm (12.992") | 12.4mm+2.0mm, -0.0 (.49 "+ .079", -0.00) | 18.4mm (.72") |
| 16mm | 360mm (14.173") | 16.4mm+2.0mm, -0.0 (.646"+.078", -0.00) | 22.4mm (.882") |
| 24 mm | 360mm (14.173") | 24.4mm+2.0mm, -0.0 (.961"+.070", -0.00) | 30.4mm (1.197") |

Reel Dimensions

Metric Dimensions Govern — English are in parentheses for reference only

Storage Conditions

Temperature: 5 to 40 Deg.C (20 to 30 Deg. C is preferred)
Humidity: 30 to 80 RH (40 to 60 is preferred )
Recommended Period: One year after manufacturing
(This recommended period is for the soldering condition only. The characteristics and reliabilities of the products are not restricted to this limitation)