

# DTC114E Series

Preferred Devices

## Bias Resistor Transistor

### NPN Silicon Surface Mount Transistor 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 TO-92 package which is designed for through hole applications.

#### MAXIMUM RATINGS ( $T_A = 25^\circ\text{C}$ 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                       |
| Total Power Dissipation<br>@ $T_A = 25^\circ\text{C}$ (Note 1.)<br>Derate above $25^\circ\text{C}$ | $P_D$     | 350<br>2.81 | mW<br>mW/ $^\circ\text{C}$ |

#### THERMAL CHARACTERISTICS

| Characteristic                                                  | Symbol          | Value       | Unit                      |
|-----------------------------------------------------------------|-----------------|-------------|---------------------------|
| Thermal Resistance, Junction to Ambient (surface mounted)       | $R_{\theta JA}$ | 357         | $^\circ\text{C}/\text{W}$ |
| Operating and Storage Temperature Range                         | $T_J, T_{stg}$  | -55 to +150 | $^\circ\text{C}$          |
| Maximum Temperature for Soldering Purposes, Time in Solder Bath | $T_L$           | 260<br>10   | $^\circ\text{C}$<br>Sec   |

#### DEVICE MARKING AND RESISTOR VALUES

| Device  | Marking | R1 (K) | R2 (K)   | Shipping |
|---------|---------|--------|----------|----------|
| DTC114E | DTC114E | 10     | 10       | 5000/Box |
| DTC124E | DTC124E | 22     | 22       |          |
| DTC144E | DTC144E | 47     | 47       |          |
| DTC114Y | DTC114Y | 10     | 47       |          |
| DTC114T | DTC114T | 10     | $\infty$ |          |
| DTC143T | DTC143T | 4.7    | $\infty$ |          |
| DTD113E | DTD113E | 1.0    | 1.0      |          |
| DTC123E | DTC123E | 2.2    | 2.2      |          |
| DTC143E | DTC143E | 4.7    | 4.7      |          |
| DTC143Z | DTC143Z | 4.7    | 47       |          |

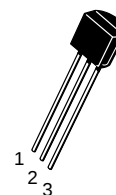
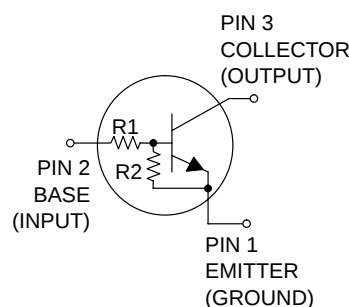
1. Device mounted on a FR-4 glass epoxy printed circuit board using the minimum recommended footprint.



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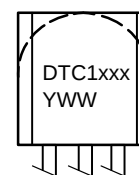
<http://onsemi.com>

### NPN SILICON BIAS RESISTOR TRANSISTOR



CASE 29  
TO-92 (TO-226)  
STYLE 1

#### MARKING DIAGRAM



DTC1 = Specific Device Code  
xxx = (See Table)  
Y = Year  
WW = Work Week

Preferred devices are recommended choices for future use and best overall value.

## DTC114E Series

### ELECTRICAL CHARACTERISTICS ( $T_A = 25^\circ\text{C}$ unless otherwise noted)

| Characteristic | Symbol | Min | Typ | Max | Unit |
|----------------|--------|-----|-----|-----|------|
|----------------|--------|-----|-----|-----|------|

#### OFF CHARACTERISTICS

|                                                                                        |               |    |   |      |      |
|----------------------------------------------------------------------------------------|---------------|----|---|------|------|
| Collector–Base Cutoff Current ( $V_{CB} = 50\text{ V}$ , $I_E = 0$ )                   | $I_{CBO}$     | –  | – | 100  | nAdc |
| Collector–Emitter Cutoff Current ( $V_{CE} = 50\text{ V}$ , $I_B = 0$ )                | $I_{CEO}$     | –  | – | 500  | nAdc |
| Emitter–Base Cutoff Current<br>( $V_{EB} = 6.0\text{ V}$ , $I_C = 0$ )                 | $I_{EBO}$     | –  | – | 0.5  | mAdc |
| DTC114E                                                                                |               | –  | – | 0.2  |      |
| DTC124E                                                                                |               | –  | – | 0.1  |      |
| DTC144E                                                                                |               | –  | – | 0.2  |      |
| DTC114Y                                                                                |               | –  | – | 0.9  |      |
| DTC114T                                                                                |               | –  | – | 1.9  |      |
| DTC143T                                                                                |               | –  | – | 4.3  |      |
| DTD113E                                                                                |               | –  | – | 2.3  |      |
| DTC123E                                                                                |               | –  | – | 1.5  |      |
| DTC143E                                                                                |               | –  | – | 0.18 |      |
| DTC143Z                                                                                |               | –  | – |      |      |
| Collector–Base Breakdown Voltage ( $I_C = 10\text{ }\mu\text{A}$ , $I_E = 0$ )         | $V_{(BR)CBO}$ | 50 | – | –    | Vdc  |
| Collector–Emitter Breakdown Voltage (Note 2.)<br>( $I_C = 2.0\text{ mA}$ , $I_B = 0$ ) | $V_{(BR)CEO}$ | 50 | – | –    | Vdc  |

#### ON CHARACTERISTICS (Note 2.)

|                                                                                                                                                                                                                                                                             |                                                                                                                                                                                            |               |                                                              |                                                                 |                                                                    |     |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------|--------------------------------------------------------------|-----------------------------------------------------------------|--------------------------------------------------------------------|-----|
| DC Current Gain<br>( $V_{CE} = 10\text{ V}$ , $I_C = 5.0\text{ mA}$ )                                                                                                                                                                                                       | DTC114E<br>DTC124E<br>DTC144E<br>DTC114Y<br>DTC114T<br>DTC143T<br>DTD113E<br>DTC123E<br>DTC143E<br>DTC143Z                                                                                 | $h_{FE}$      | 35<br>60<br>80<br>80<br>160<br>160<br>3.0<br>8.0<br>15<br>80 | 60<br>100<br>140<br>140<br>350<br>350<br>5.0<br>15<br>30<br>200 | –<br>–<br>–<br>–<br>–<br>–<br>–<br>–<br>–<br>–                     |     |
| Collector–Emitter Saturation Voltage<br>( $I_C = 10\text{ mA}$ , $I_E = 0.3\text{ mA}$ ) DTC144E/DTC114Y<br>DTD113E/DTC143E<br>( $I_C = 10\text{ mA}$ , $I_B = 5\text{ mA}$ ) DTC123E<br>( $I_C = 10\text{ mA}$ , $I_B = 1\text{ mA}$ ) DTC114T/DTC143T/<br>DTC143Z/DTC124E |                                                                                                                                                                                            | $V_{CE(sat)}$ | –                                                            | –                                                               | 0.25                                                               | Vdc |
| Output Voltage (on)<br>( $V_{CC} = 5.0\text{ V}$ , $V_B = 2.5\text{ V}$ , $R_L = 1.0\text{ k}\Omega$ )                                                                                                                                                                      | DTC114E<br>DTC124E<br>DTC114Y<br>DTC114T<br>DTC143T<br>DTD113E<br>DTC123E<br>DTC143E<br>DTC143Z<br>( $V_{CC} = 5.0\text{ V}$ , $V_B = 3.5\text{ V}$ , $R_L = 1.0\text{ k}\Omega$ ) DTC144E | $V_{OL}$      | –<br>–<br>–<br>–<br>–<br>–<br>–<br>–<br>–<br>–               | –<br>–<br>–<br>–<br>–<br>–<br>–<br>–<br>–<br>–                  | 0.2<br>0.2<br>0.2<br>0.2<br>0.2<br>0.2<br>0.2<br>0.2<br>0.2<br>0.2 | Vdc |

2. Pulse Test: Pulse Width < 300  $\mu\text{s}$ , Duty Cycle < 2.0%

## DTC114E Series

### ELECTRICAL CHARACTERISTICS (T<sub>A</sub> = 25°C unless otherwise noted) (Continued)

| Characteristic                                                                                                                                                                                                                                                       |                         | Symbol                         | Min   | Typ  | Max   | Unit            |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------|--------------------------------|-------|------|-------|-----------------|
| Output Voltage (off)<br>(V <sub>CC</sub> = 5.0 V, V <sub>B</sub> = 0.5 V, R <sub>L</sub> = 1.0 kΩ)<br><br>(V <sub>CC</sub> = 5.0 V, V <sub>B</sub> = 0.05 V, R <sub>L</sub> = 1.0 kΩ)<br>(V <sub>CC</sub> = 5.0 V, V <sub>B</sub> = 0.25 V, R <sub>L</sub> = 1.0 kΩ) | DTC114E                 | V <sub>OH</sub>                | 4.9   | —    | —     | V <sub>dc</sub> |
|                                                                                                                                                                                                                                                                      | DTC124E                 |                                |       |      |       |                 |
|                                                                                                                                                                                                                                                                      | DTC144E                 |                                |       |      |       |                 |
|                                                                                                                                                                                                                                                                      | DTC114Y                 |                                |       |      |       |                 |
|                                                                                                                                                                                                                                                                      | DTC123E                 |                                |       |      |       |                 |
|                                                                                                                                                                                                                                                                      | DTC143E                 |                                |       |      |       |                 |
|                                                                                                                                                                                                                                                                      | DTD113E                 |                                |       |      |       |                 |
|                                                                                                                                                                                                                                                                      | DTC114T                 |                                |       |      |       |                 |
|                                                                                                                                                                                                                                                                      | DTC143T                 |                                |       |      |       |                 |
|                                                                                                                                                                                                                                                                      | DTC143Z                 |                                |       |      |       |                 |
| Input Resistor                                                                                                                                                                                                                                                       | DTC114E                 | R <sub>1</sub>                 | 7.0   | 10   | 13    | kΩ              |
|                                                                                                                                                                                                                                                                      | DTC124E                 |                                | 15.4  | 22   | 28.6  |                 |
|                                                                                                                                                                                                                                                                      | DTC144E                 |                                | 32.9  | 47   | 61.1  |                 |
|                                                                                                                                                                                                                                                                      | DTC114Y                 |                                | 7.0   | 10   | 13    |                 |
|                                                                                                                                                                                                                                                                      | DTC114T                 |                                | 7.0   | 10   | 13    |                 |
|                                                                                                                                                                                                                                                                      | DTC143T                 |                                | 3.3   | 4.7  | 6.1   |                 |
|                                                                                                                                                                                                                                                                      | DTD113E                 |                                | 0.7   | 1.0  | 1.3   |                 |
|                                                                                                                                                                                                                                                                      | DTC123E                 |                                | 1.5   | 2.2  | 2.9   |                 |
|                                                                                                                                                                                                                                                                      | DTC143E                 |                                | 3.3   | 4.7  | 6.1   |                 |
|                                                                                                                                                                                                                                                                      | DTC143Z                 |                                | 3.3   | 4.7  | 6.1   |                 |
| Resistor Ratio                                                                                                                                                                                                                                                       | DTC114E/DTC124E/DTC144E | R <sub>1</sub> /R <sub>2</sub> | 0.8   | 1.0  | 1.2   |                 |
|                                                                                                                                                                                                                                                                      | DTC114Y                 |                                | 0.17  | 0.21 | 0.25  |                 |
|                                                                                                                                                                                                                                                                      | DTC114T/DTC143T         |                                | —     | —    | —     |                 |
|                                                                                                                                                                                                                                                                      | DTD113E/DTC123E/DTC143E |                                | 0.8   | 1.0  | 1.2   |                 |
|                                                                                                                                                                                                                                                                      | DTC143Z                 |                                | 0.055 | 0.1  | 0.185 |                 |

# DTC114E Series

## TYPICAL ELECTRICAL CHARACTERISTICS DTC114E

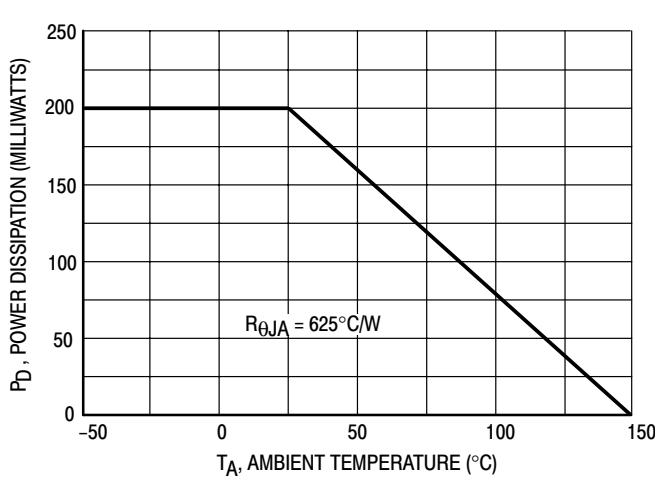


Figure 1. Derating Curve

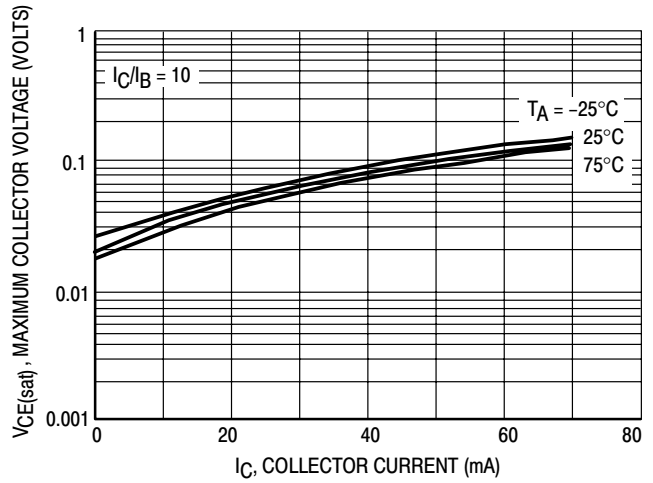


Figure 2.  $V_{CE(sat)}$  versus  $I_C$

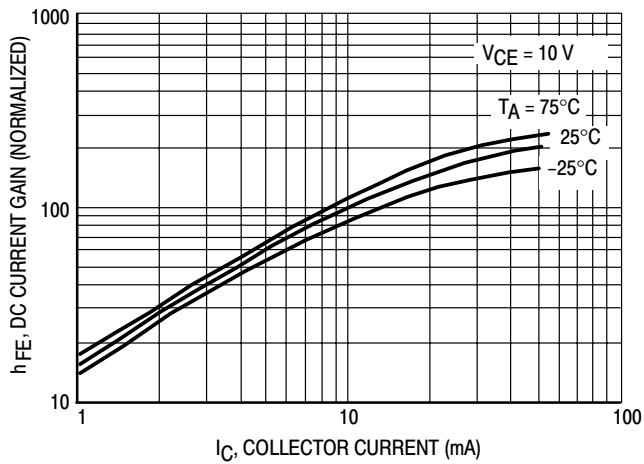


Figure 3. DC Current Gain

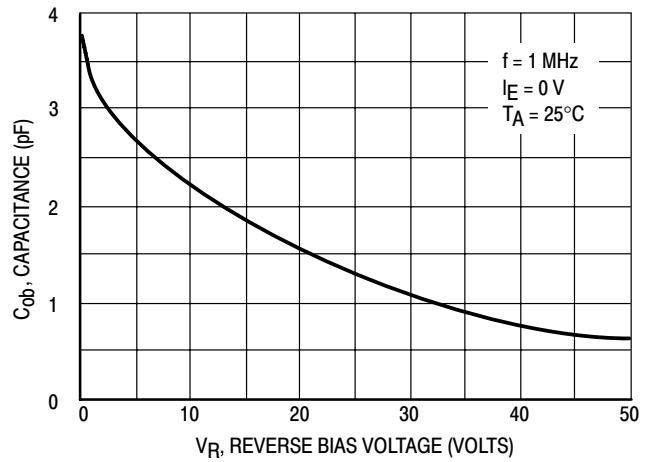


Figure 4. Output Capacitance

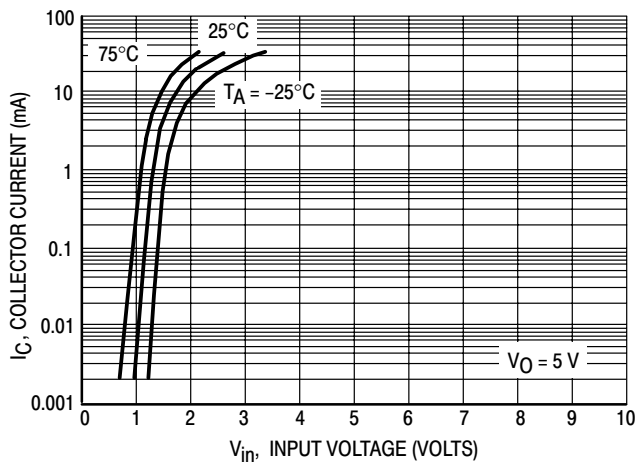


Figure 5.  $V_{CE(sat)}$  versus  $I_C$

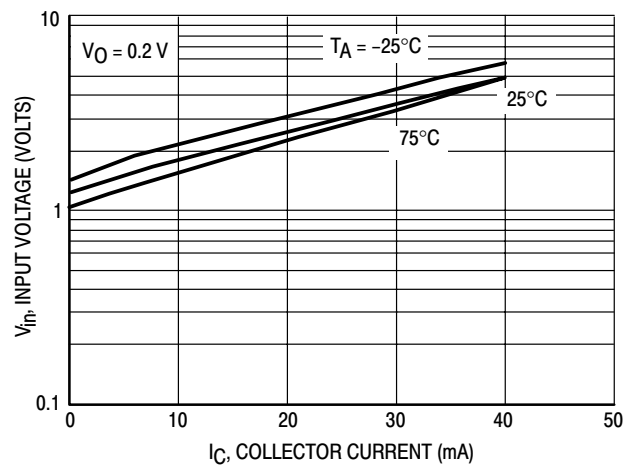


Figure 6.  $V_{CE(sat)}$  versus  $I_C$

# DTC114E Series

## TYPICAL ELECTRICAL CHARACTERISTICS DTC124E

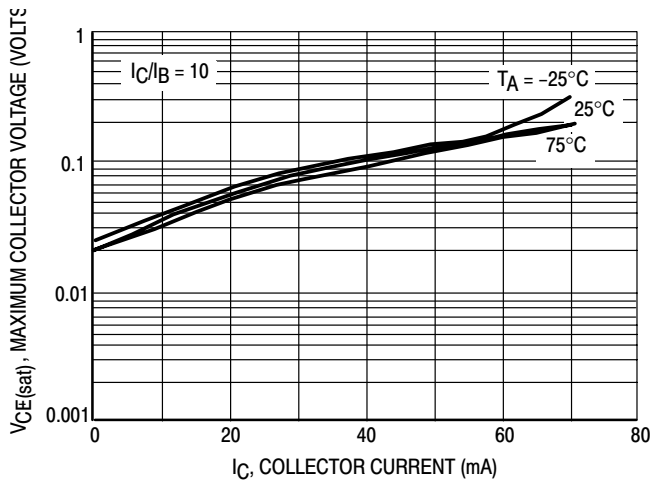


Figure 7.  $V_{CE(sat)}$  versus  $I_C$

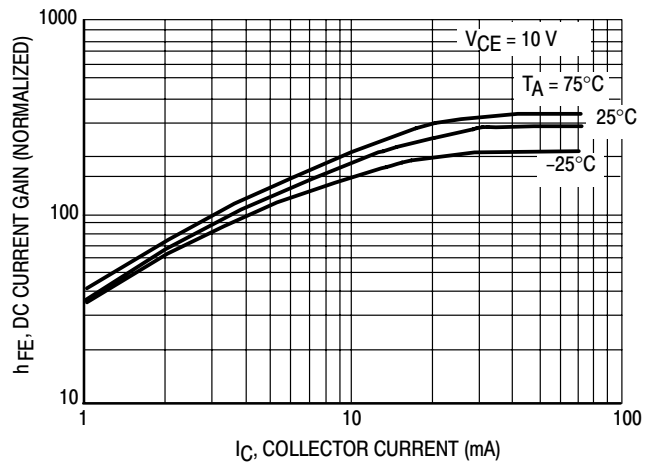


Figure 8. DC Current Gain

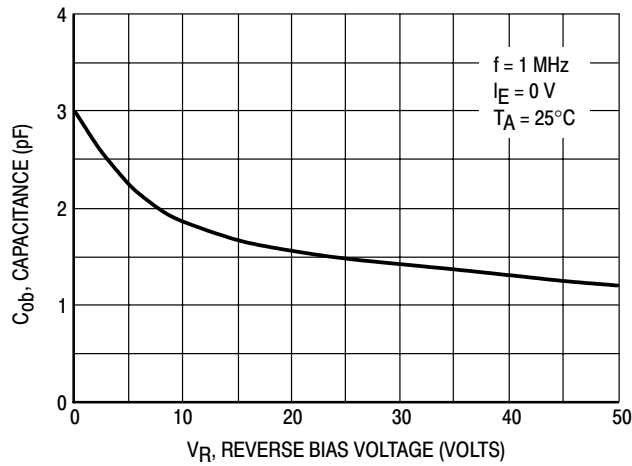


Figure 9. Output Capacitance

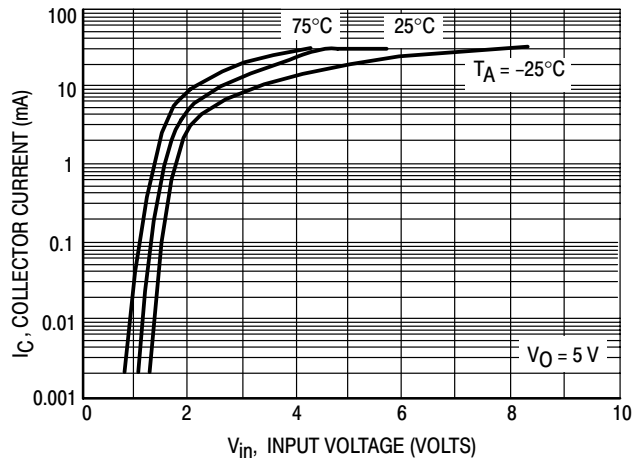


Figure 10. Output Current versus Input Voltage

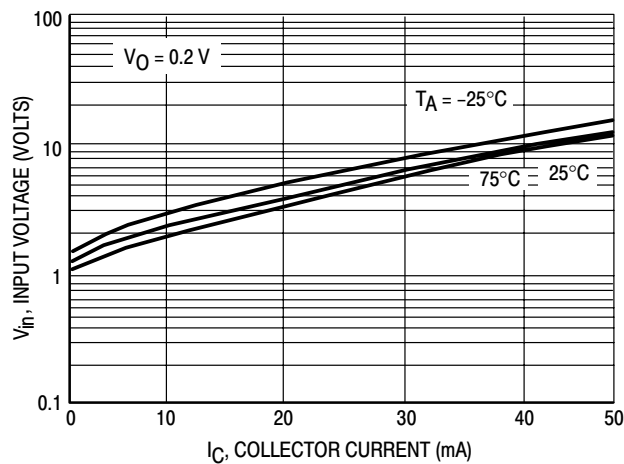


Figure 11. Input Voltage versus Output Current

# DTC114E Series

## TYPICAL ELECTRICAL CHARACTERISTICS DTC144E

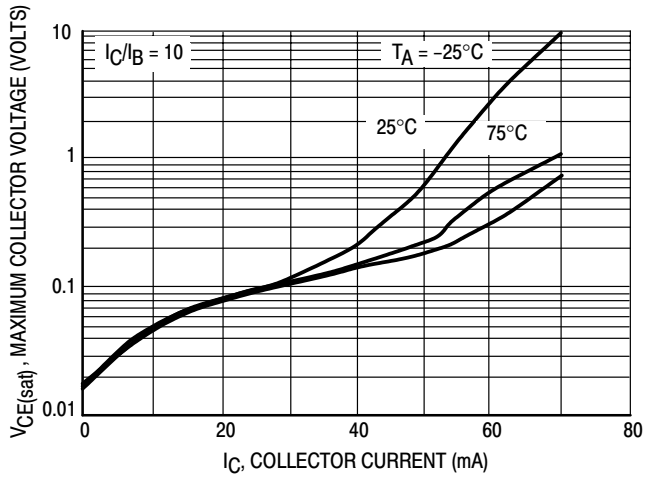


Figure 12.  $V_{CE(sat)}$  versus  $I_C$

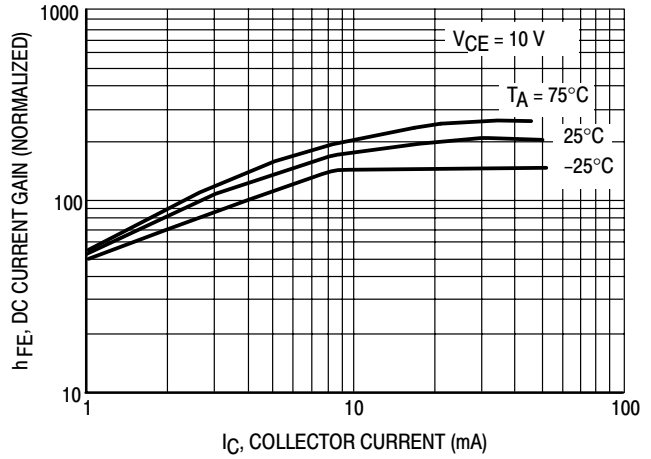


Figure 13. DC Current Gain

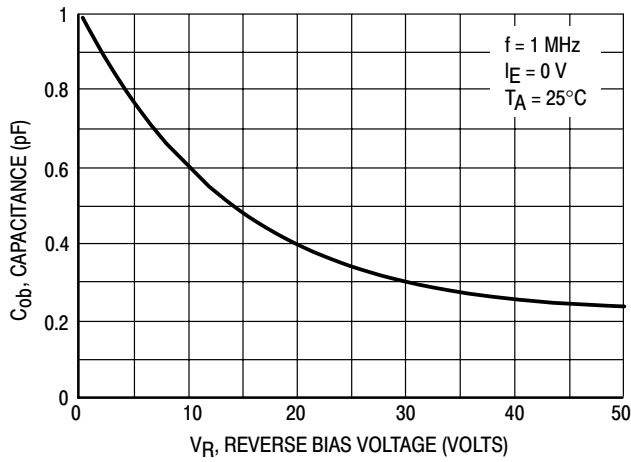


Figure 14. Output Capacitance

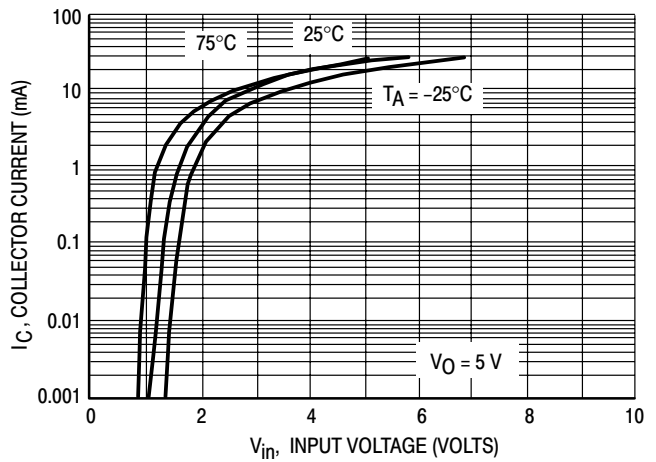


Figure 15. Output Current versus Input Voltage

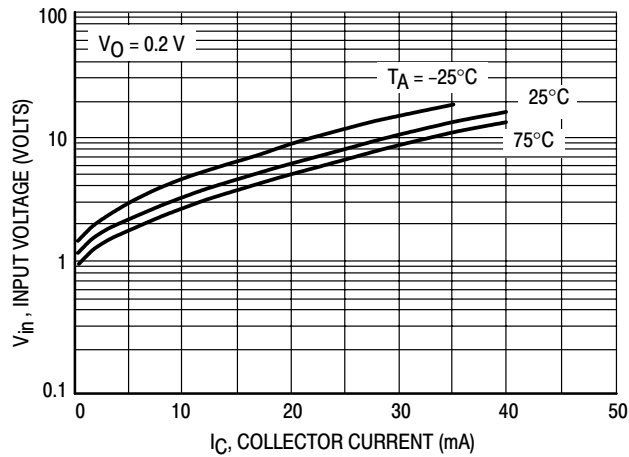


Figure 16. Input Voltage versus Output Current

# DTC114E Series

## TYPICAL ELECTRICAL CHARACTERISTICS DTC114Y

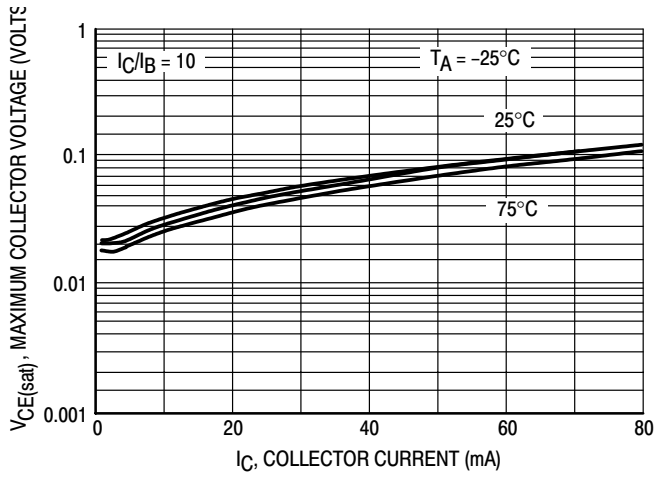


Figure 17.  $V_{CE(sat)}$  versus  $I_C$

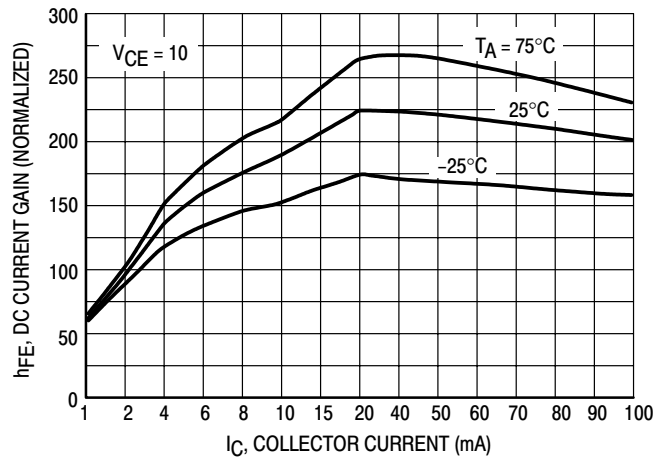


Figure 18. DC Current Gain

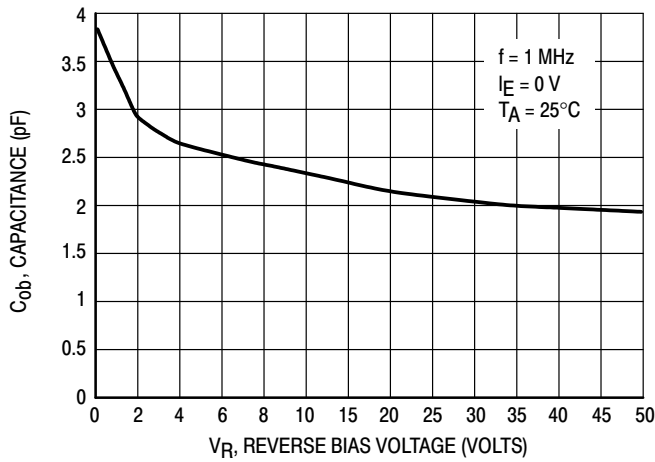


Figure 19. Output Capacitance

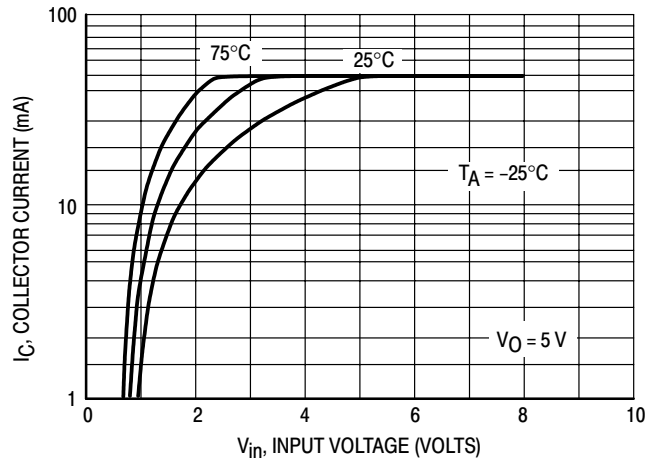


Figure 20. Output Current versus Input Voltage

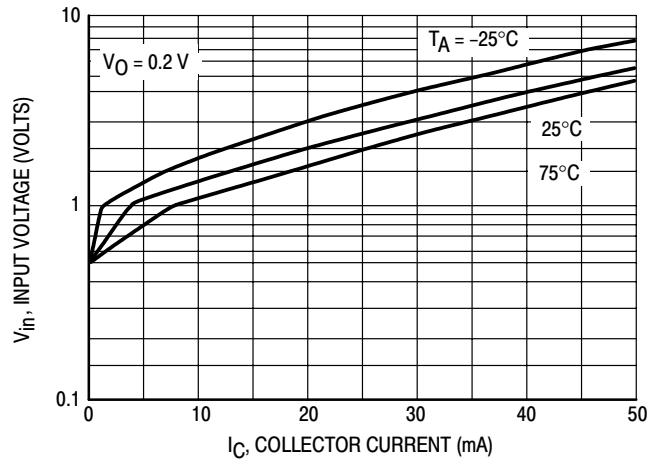


Figure 21. Input Voltage versus Output Current

## DTC114E Series

### TYPICAL APPLICATIONS FOR NPN BRTs

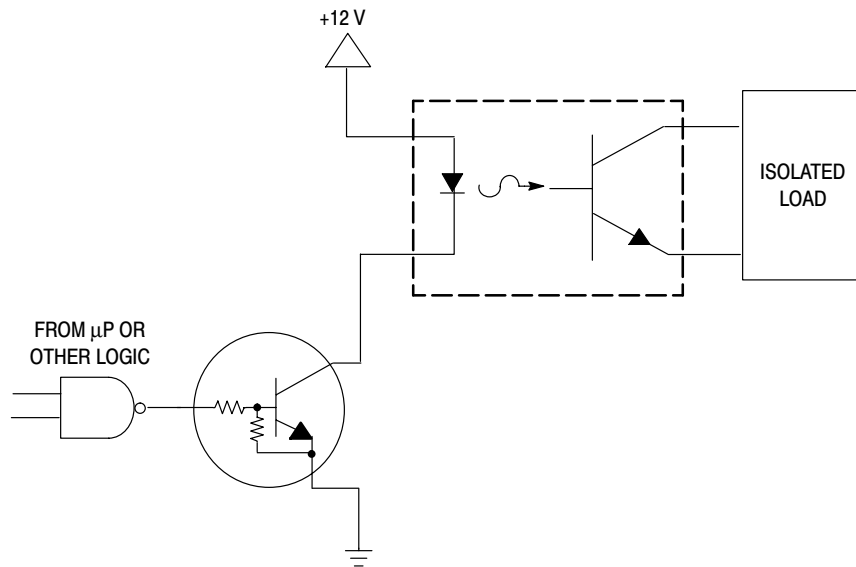


Figure 22. Level Shifter: Connects 12 or 24 Volt Circuits to Logic

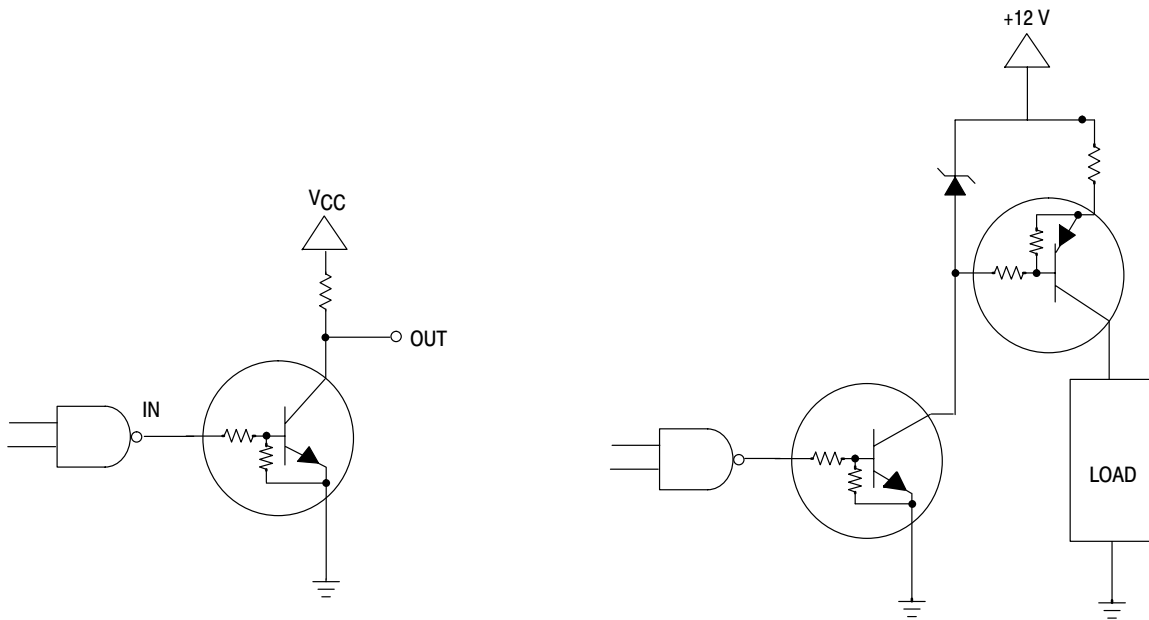


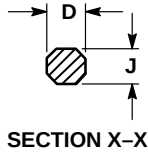
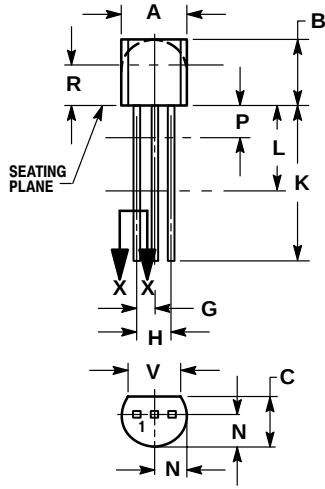
Figure 23. Open Collector Inverter: Inverts the Input Signal

Figure 24. Inexpensive, Unregulated Current Source

# DTC114E Series

## PACKAGE DIMENSIONS

TO-92  
TO-226AA  
CASE 29-11  
ISSUE AL



### NOTES:

1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH.
3. CONTOUR OF PACKAGE BEYOND DIMENSION R IS UNCONTROLLED.
4. LEAD DIMENSION IS UNCONTROLLED IN P AND BEYOND DIMENSION K MINIMUM.

| DIM | INCHES |       | MILLIMETERS |       |
|-----|--------|-------|-------------|-------|
|     | MIN    | MAX   | MIN         | MAX   |
| A   | 0.175  | 0.205 | 4.45        | 5.20  |
| B   | 0.170  | 0.210 | 4.32        | 5.33  |
| C   | 0.125  | 0.165 | 3.18        | 4.19  |
| D   | 0.016  | 0.021 | 0.407       | 0.533 |
| G   | 0.045  | 0.055 | 1.15        | 1.39  |
| H   | 0.095  | 0.105 | 2.42        | 2.66  |
| J   | 0.015  | 0.020 | 0.39        | 0.50  |
| K   | 0.500  | ---   | 12.70       | ---   |
| L   | 0.250  | ---   | 6.35        | ---   |
| N   | 0.080  | 0.105 | 2.04        | 2.66  |
| P   | ---    | 0.100 | ---         | 2.54  |
| R   | 0.115  | ---   | 2.93        | ---   |
| V   | 0.135  | ---   | 3.43        | ---   |

### STYLE 1:

- PIN 1. EMITTER
- BASE
- COLLECTOR

## **Notes**

## **Notes**

## DTC114E Series

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