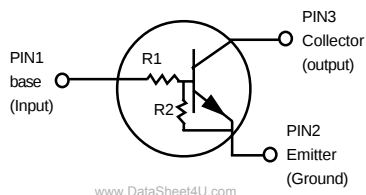


# Bias Resistor Transistor

## PNP 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 SOT-23 package which is designed for low power surface mount applications.

- \* Simplifies Circuit Design
- \* Reduces Board Space
- \* Reduces Component Count
- \* The SOT-23 package can be soldered using wave or reflow. The modified gull-winged leads absorb thermal stress during soldering eliminating the possibility of damage to the die.
- \* Available in 8 mm embossed tape and reel. Use the Device Number to order the 7 inch/3000 unit reel. Replace "T1" with "T3" in the Device Number to order the 13 inch/10,000 unit reel.



MMUN2211RLT1  
MMUN2212RLT1  
MMUN2213RLT1  
MMUN2214RLT1  
MMUN2215RLT1  
MMUN2230RLT1  
MMUN2231RLT1  
MMUN2232RLT1  
MMUN2233RL34

NPN SILICON  
BIAS RESISTOR  
TRANSISTOR



CASE 318-08, STYLE 6  
SOT- 23 (TO-236AB)

### 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 @ $T_A = 25^\circ\text{C}$ <sup>(1)</sup> | $P_D$     | 200   | mW                   |
| Derate above $25^\circ\text{C}$                                   |           | 1.6   | mW/ $^\circ\text{C}$ |

### THERMAL CHARACTERISTICS

| Rating                                                            | Symbol          | Value       | Unit                    |
|-------------------------------------------------------------------|-----------------|-------------|-------------------------|
| Thermal Resistance — Junction-to-Ambient (surface mounted)        | $R_{\theta JA}$ | 625         | $^\circ\text{C/W}$      |
| Operating and Storage Temperature Range                           | $T_J, T_{stg}$  | -65 to +150 | $^\circ\text{C}$        |
| Maximum Temperature for Soldering Purposes<br>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)   |
|-----------------------------|---------|--------|----------|
| MMUN2211RLT1                | A8A     | 10     | 10       |
| MMUN2212RLT1                | A8B     | 22     | 22       |
| MMUN2213RLT1                | A8C     | 47     | 47       |
| MMUN2214RLT1                | A8D     | 10     | 47       |
| MMUN2215RLT1 <sup>(2)</sup> | A8E     | 10     | $\infty$ |
| MMUN2216RLT1 <sup>(2)</sup> | A8F     | 4.7    | $\infty$ |
| MMUN2230RLT1 <sup>(2)</sup> | A8G     | 1      | 1        |
| MMUN2231RLT1 <sup>(2)</sup> | A8H     | 2.2    | 2.2      |
| MMUN2232RLT1 <sup>(2)</sup> | A8J     | 4.7    | 4.7      |
| MMUN2233RLT1 <sup>(2)</sup> | A8K     | 4.7    | 47       |
| MMUN2234RLT1 <sup>(2)</sup> | A8L     | 22     | 47       |

1. Device mounted on a FR-4 glass epoxy printed circuit board using the minimum recommended footprint.
2. New devices. Updated curves to follow in subsequent data sheets.

## MMUN2211RLT1 SERIES

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

| Characteristic                                                                                                                                                                                                                                                                                              | Symbol        | Min | Typ | Max  | Unit |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------|-----|-----|------|------|
| <b>OFF CHARACTERISTICS</b>                                                                                                                                                                                                                                                                                  |               |     |     |      |      |
| 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 |
| MMUN2211RLT1                                                                                                                                                                                                                                                                                                |               | -   | -   | 0.2  |      |
| MMUN2212RLT1                                                                                                                                                                                                                                                                                                |               | -   | -   | 0.1  |      |
| MMUN2213RLT1                                                                                                                                                                                                                                                                                                |               | -   | -   | 0.2  |      |
| MMUN2214RLT1                                                                                                                                                                                                                                                                                                |               | -   | -   | 0.9  |      |
| MMUN2215RLT1                                                                                                                                                                                                                                                                                                |               | -   | -   | 1.9  |      |
| MMUN2216RLT1                                                                                                                                                                                                                                                                                                |               | -   | -   | 4.3  |      |
| MMUN2230RLT1                                                                                                                                                                                                                                                                                                |               | -   | -   | 2.3  |      |
| MMUN2231RLT1                                                                                                                                                                                                                                                                                                |               | -   | -   | 1.5  |      |
| MMUN2232RLT1                                                                                                                                                                                                                                                                                                |               | -   | -   | 0.18 |      |
| MMUN2233RLT1                                                                                                                                                                                                                                                                                                |               | -   | -   | 0.13 |      |
| MMUN2234RLT1                                                                                                                                                                                                                                                                                                |               | -   | -   |      |      |
| Collector-Base Breakdown Voltage ( $I_C=10\text{mA}$ , $I_E=0$ )                                                                                                                                                                                                                                            | $V_{(BR)CBO}$ | 50  | -   | -    | Vdc  |
| Collector-Emitter Breakdown Voltage <sup>(3)</sup> ( $I_C=2.0\text{mA}$ , $I_B=0$ )                                                                                                                                                                                                                         | $V_{(BR)CEO}$ | 50  | -   | -    | Vdc  |
| <b>ON CHARACTERISTICS</b> <sup>(3)</sup>                                                                                                                                                                                                                                                                    |               |     |     |      |      |
| DC Current Gain<br>( $V_{CE} = 10\text{V}$ , $I_C = 5.0\text{mA}$ )                                                                                                                                                                                                                                         | $h_{FE}$      | 35  | 60  | -    |      |
| MMUN2211RLT1                                                                                                                                                                                                                                                                                                |               | 60  | 100 | -    |      |
| MMUN2212RLT1                                                                                                                                                                                                                                                                                                |               | 80  | 140 | -    |      |
| MMUN2213RLT1                                                                                                                                                                                                                                                                                                |               | 80  | 140 | -    |      |
| MMUN2214RLT1                                                                                                                                                                                                                                                                                                |               | 160 | 350 | -    |      |
| MMUN2215RLT1                                                                                                                                                                                                                                                                                                |               | 160 | 350 | -    |      |
| MMUN2216RLT1                                                                                                                                                                                                                                                                                                |               | 3.0 | 5.0 | -    |      |
| MMUN2230RLT1                                                                                                                                                                                                                                                                                                |               | 8.0 | 15  | -    |      |
| MMUN2231RLT1                                                                                                                                                                                                                                                                                                |               | 15  | 30  | -    |      |
| MMUN2232RLT1                                                                                                                                                                                                                                                                                                |               | 80  | 200 | -    |      |
| MMUN2233RLT1                                                                                                                                                                                                                                                                                                |               | 80  | 150 | -    |      |
| MMUN2234RLT1                                                                                                                                                                                                                                                                                                |               |     |     |      |      |
| Collector-Emitter Saturation Voltage ( $I_C=10\text{mA}$ , $I_E=0.3\text{mA}$ )<br>( $I_C = 10\text{mA}$ , $I_B = 5\text{mA}$ ) MMUN2230RLT1 MMUN2231RLT1<br>( $I_C = 10\text{mA}$ , $I_B = 1\text{mA}$ ) MMUN2215RLT1 MMUN2216RLT1<br>MMUN2232RLT1 MMUN2233RLT1 MMUN2234RLT1                               | $V_{CE(sat)}$ | -   | -   | 0.25 | Vdc  |
| Output Voltage (on)<br>( $V_{CC}=5.0\text{V}$ , $V_B=2.5\text{V}$ , $R_L=1.0\text{k}\Omega$ )                                                                                                                                                                                                               | $V_{OL}$      | -   | -   | 0.2  | Vdc  |
| MMUN2211RLT1                                                                                                                                                                                                                                                                                                |               | -   | -   | 0.2  |      |
| MMUN2212RLT1                                                                                                                                                                                                                                                                                                |               | -   | -   | 0.2  |      |
| MMUN2214RLT1                                                                                                                                                                                                                                                                                                |               | -   | -   | 0.2  |      |
| MMUN2215RLT1                                                                                                                                                                                                                                                                                                |               | -   | -   | 0.2  |      |
| MMUN2216RLT1                                                                                                                                                                                                                                                                                                |               | -   | -   | 0.2  |      |
| MMUN2230RLT1                                                                                                                                                                                                                                                                                                |               | -   | -   | 0.2  |      |
| MMUN2231RLT1                                                                                                                                                                                                                                                                                                |               | -   | -   | 0.2  |      |
| MMUN2232RLT1                                                                                                                                                                                                                                                                                                |               | -   | -   | 0.2  |      |
| MMUN2233RLT1                                                                                                                                                                                                                                                                                                |               | -   | -   | 0.2  |      |
| MMUN2234RLT1                                                                                                                                                                                                                                                                                                |               | -   | -   | 0.2  |      |
| ( $V_{CC} = 5.0\text{V}$ , $V_B=3.5\text{V}$ , $R_L= 1.0\text{k}\Omega$ ) MMUN2213RLT1                                                                                                                                                                                                                      |               | -   | -   | 0.2  |      |
| Output Voltage(off) ( $V_{CC}=5.0\text{V}$ , $V_B=0.5\text{V}$ , $R_L=1.0\text{k}\Omega$ )<br>( $V_{CC}=5.0\text{V}$ , $V_B=0.050\text{V}$ , $R_L=1.0\text{k}\Omega$ ) MMUN2230RLT1<br>( $V_{CC}=5.0\text{V}$ , $V_B=0.25\text{V}$ , $R_L=1.0\text{k}\Omega$ ) MMUN2215RLT1<br>MMUN2216RLT1<br>MMUN2233RLT1 | $V_{OH}$      | 4.9 | -   | -    | Vdc  |

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

## MMUN2211RLT1 SERIES

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

| Characteristic                    |                                        | Symbol | Min   | Typ  | Max   | Unit       |
|-----------------------------------|----------------------------------------|--------|-------|------|-------|------------|
| ON CHARACTERISTICS <sup>(3)</sup> |                                        |        |       |      |       |            |
| Input Resistor                    | MMUN2211RLT1                           | R1     | 7.0   | 10   | 13    | k $\Omega$ |
|                                   | MMUN2212RLT1                           |        | 15.4  | 22   | 28.6  |            |
|                                   | MMUN2213RLT1                           |        | 32.9  | 47   | 61.1  |            |
|                                   | MMUN2214RLT1                           |        | 7.0   | 10   | 13    |            |
|                                   | MMUN2215RLT1                           |        | 7.0   | 10   | 13    |            |
|                                   | MMUN2216RLT1                           |        | 3.3   | 4.7  | 6.1   |            |
|                                   | MMUN2230RLT1                           |        | 0.7   | 1.0  | 1.3   |            |
|                                   | MMUN2231RLT1                           |        | 1.5   | 2.2  | 2.9   |            |
|                                   | MMUN2232RLT1                           |        | 3.3   | 4.7  | 6.1   |            |
|                                   | MMUN2233RLT1                           |        | 3.3   | 4.7  | 6.1   |            |
| MMUN2234RLT1                      |                                        | 15.4   | 22    | 28.6 |       |            |
| Resistor Ratio                    | MMUN2211RLT1 MMUN2212RLT1 MMUN2213RLT1 | R1/R2  | 0.8   | 1.0  | 1.2   |            |
|                                   | MMUN2214RLT1                           |        | 0.17  | 0.21 | 0.25  |            |
|                                   | MMUN2215RLT1 MMUN2216RLT1              |        | —     | —    | —     |            |
|                                   | MMUN2230RLT1 MMUN2231RLT1 MMUN2232RLT1 |        | 0.8   | 1.0  | 1.2   |            |
|                                   | MMUN2233RLT1                           |        | 0.055 | 0.1  | 0.185 |            |
|                                   | MMUN2234RLT1                           |        | 0.38  | 0.47 | 0.56  |            |

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

TYPICAL ELECTRICAL CHARACTERISTICS

MMUN2211RLT1

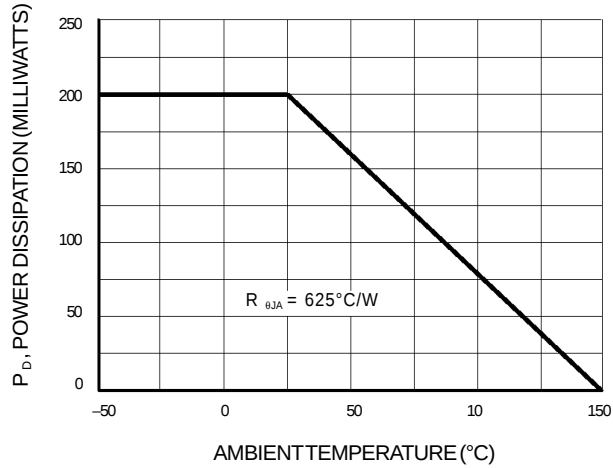


Figure 1. Derating Curve

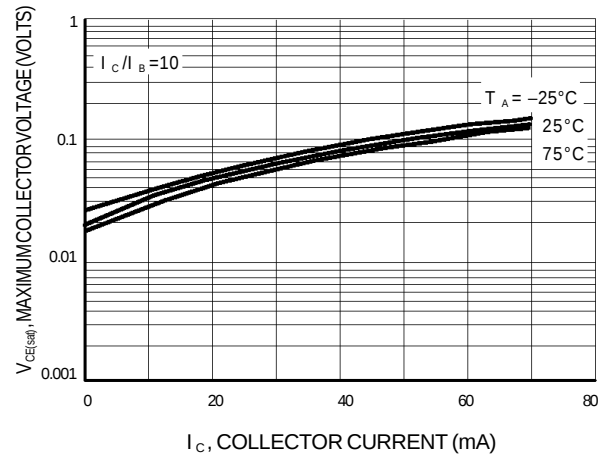


Figure 2.  $V_{CE(sat)}$  versus  $I_C$

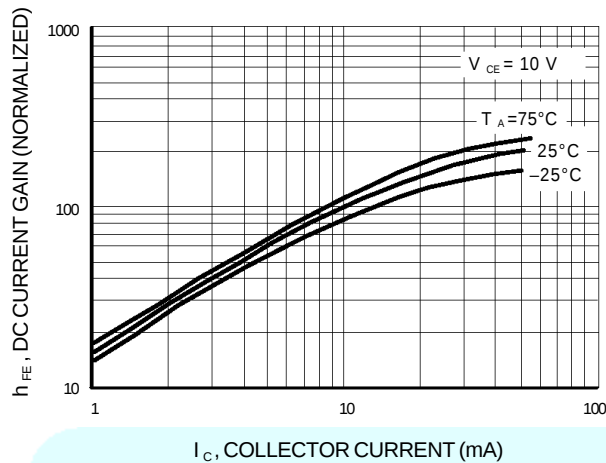


Figure 3. DC Current Gain

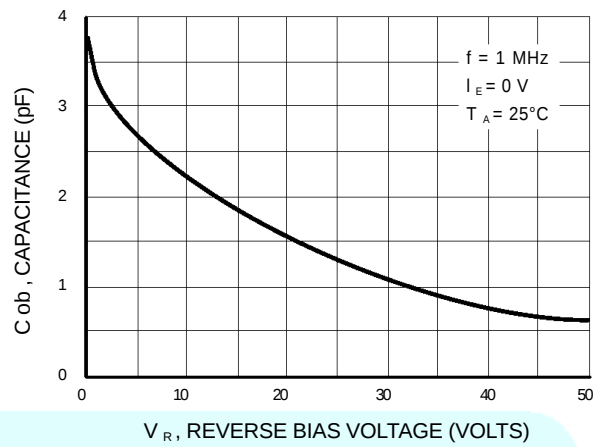


Figure 4. Output Capacitance

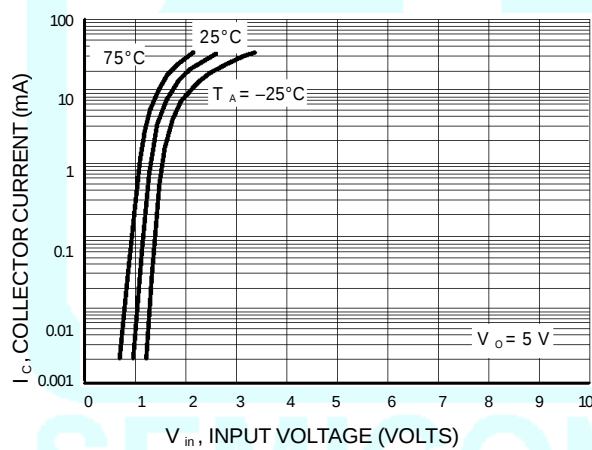


Figure 5.  $V_{CE(sat)}$  versus  $I_C$

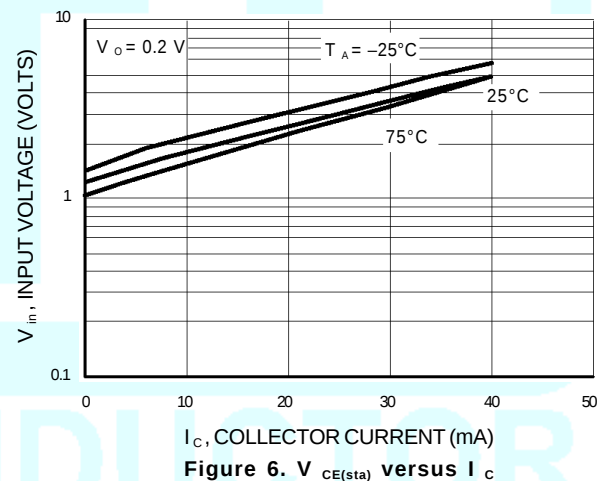
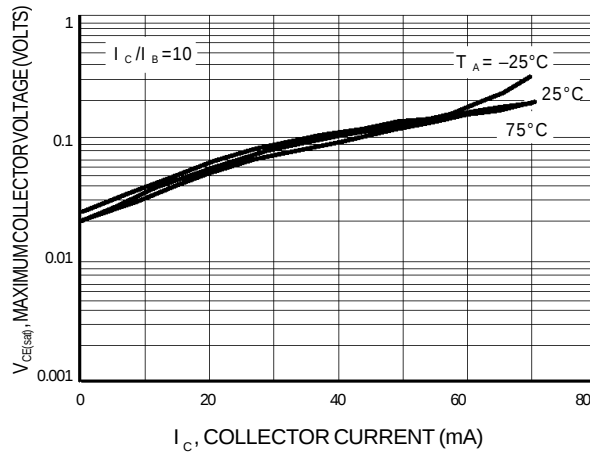


Figure 6.  $V_{CE(sat)}$  versus  $I_C$

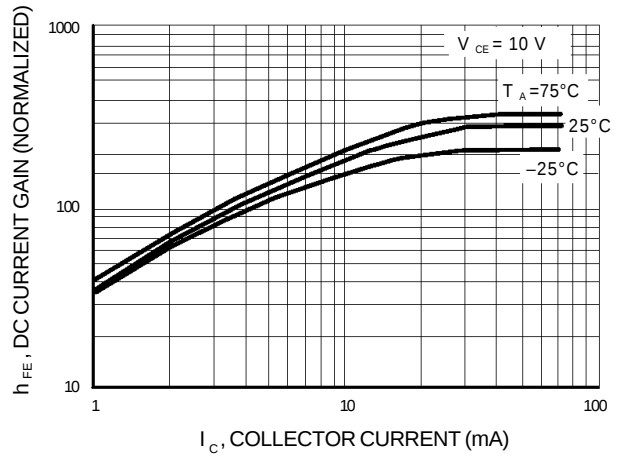
**MMUN2211RLT1 SERIES**

**TYPICAL ELECTRICAL CHARACTERISTICS**

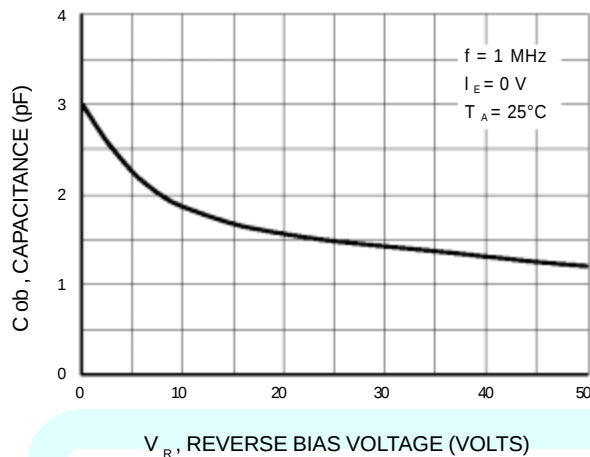
**MMUN2212RLT1**



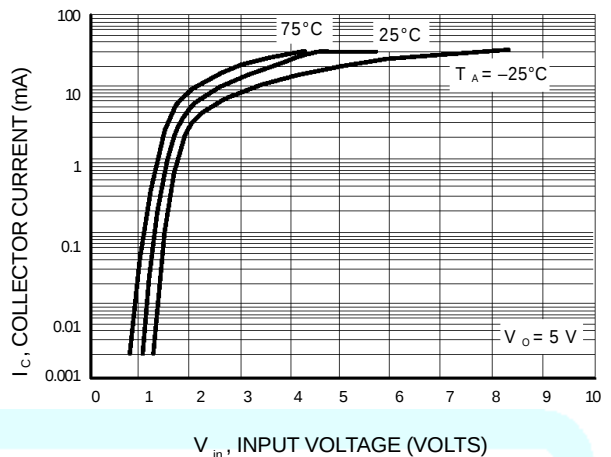
**Figure 7.  $V_{CE(sat)}$  versus  $I_C$**



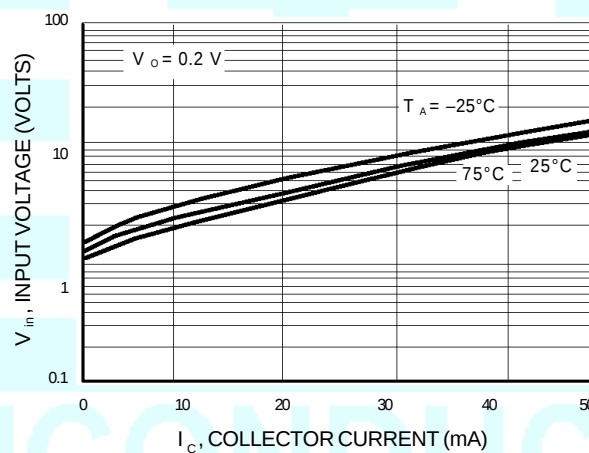
**Figure 8. DC Current Gain**



**Figure 9. Output Capacitance**



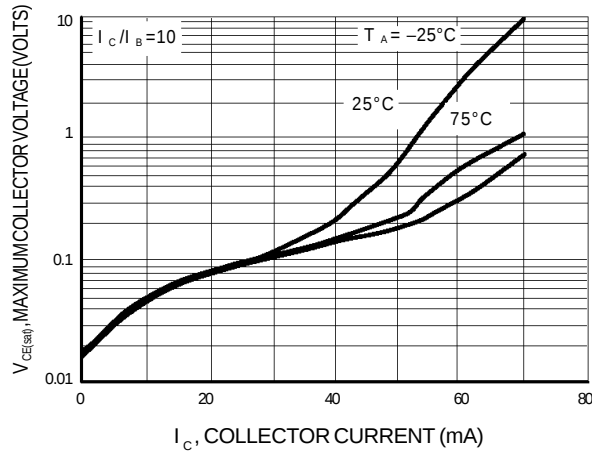
**Figure 10. Output Current versus Input Voltage**



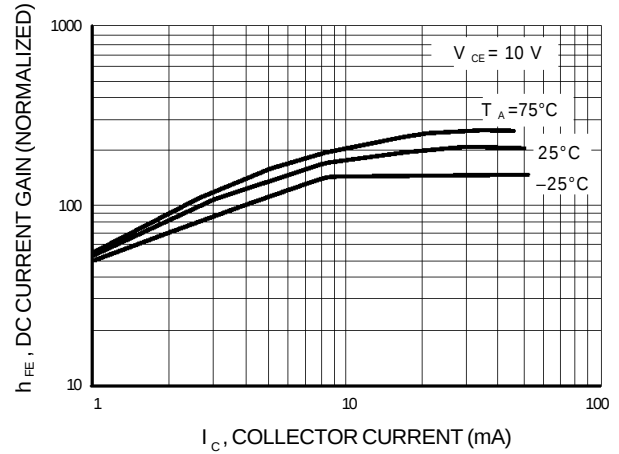
**Figure 11. Input Voltage versus Output Current**

**TYPICAL ELECTRICAL CHARACTERISTICS**

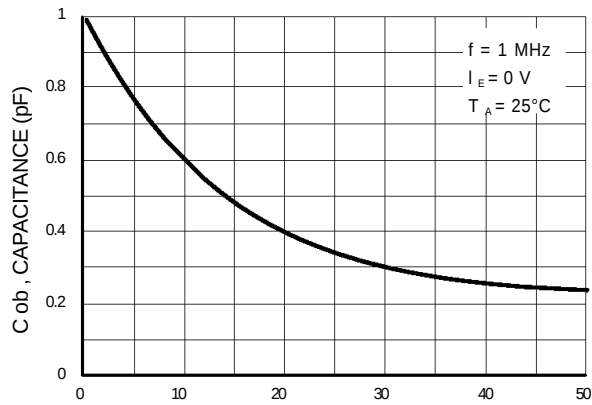
**MMUN2213RLT1**



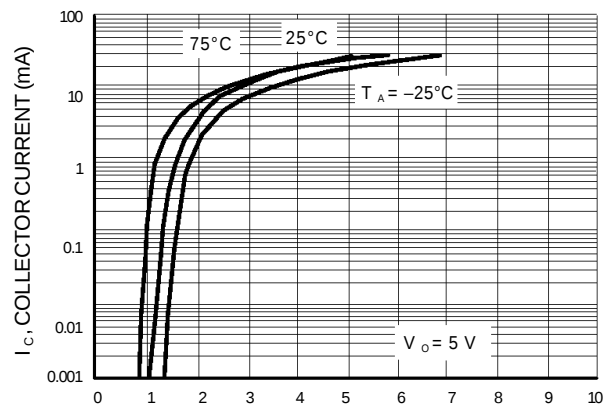
**Figure 12.  $V_{CE(sat)}$  versus  $I_C$**



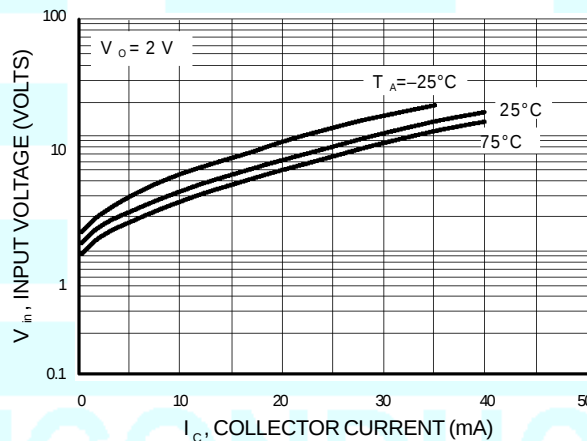
**Figure 13. DC Current Gain**



**Figure 14. Output Capacitance**

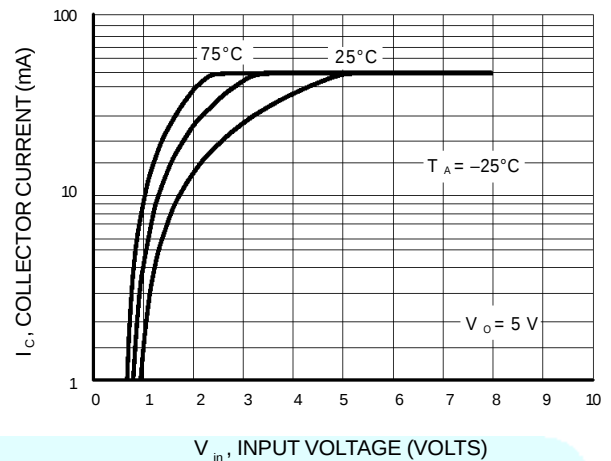
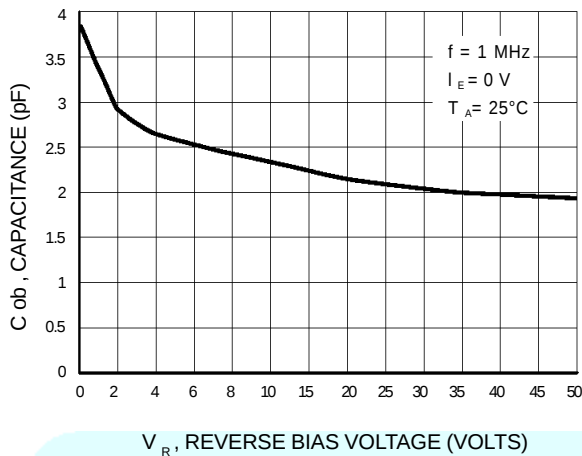
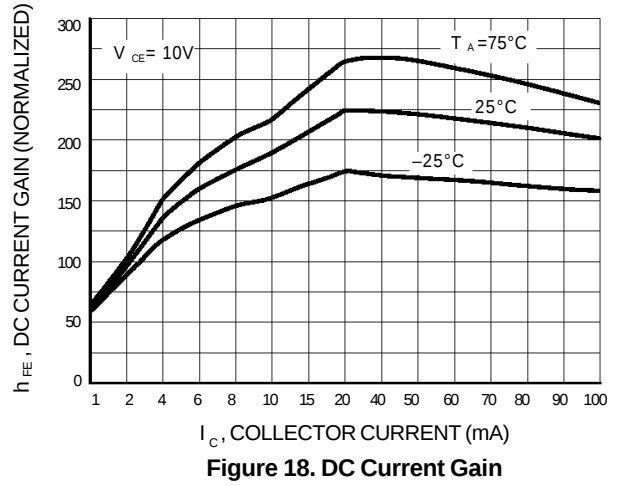
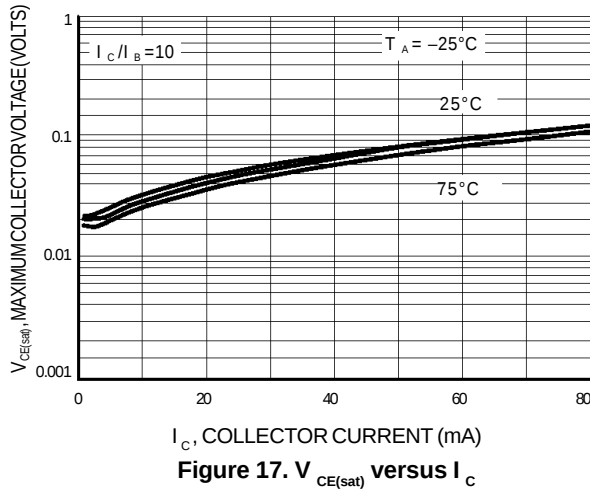


**Figure 15. Output Current versus Input Voltage**



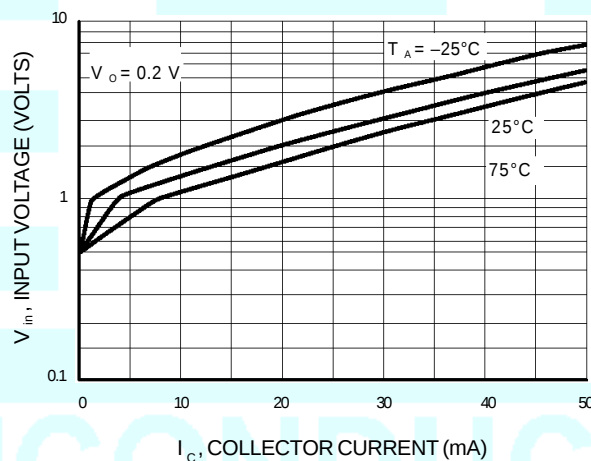
**Figure 16. Input Voltage versus Output Current**

TYPICAL ELECTRICAL CHARACTERISTICS  
MMUN2214RLT1

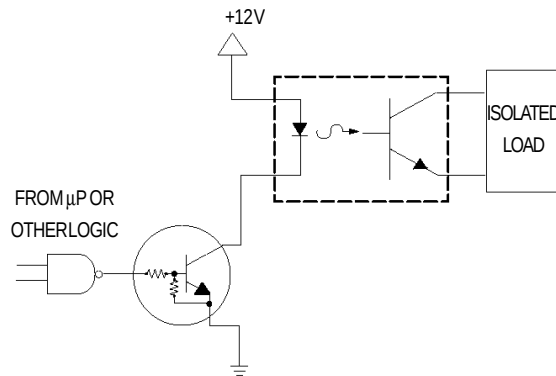


**Figure 19. Output Capacitance**

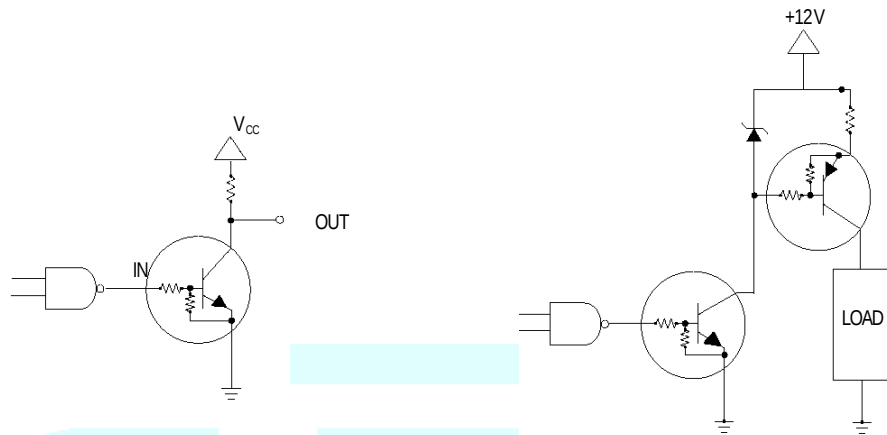
**Figure 20. Output Current versus Input Voltage**



**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**