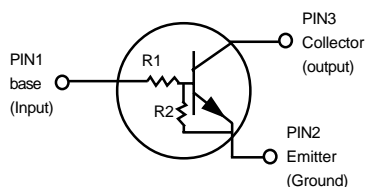


Bias Resistor Transistor

PNP Silicon Surface Mount Transistor with Monolithic Bias Resistor Network

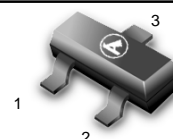
This new series of digital transistors is designed to replace a single device and its external resistor bias network. The BRT (Bias Resistor Transistor) contains a single transistor with a monolithic bias network consisting of two resistors; a series base resistor and a base-emitter resistor. The BRT 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°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°C ⁽¹⁾ | P _D | 200 | mW |
| Derate above 25°C | | 1.6 | mW/°C |

THERMAL CHARACTERISTICS

| Rating | Symbol | Value | Unit |
|---|-----------------------------------|-------------|-----------|
| Thermal Resistance — Junction-to-Ambient (surface mounted) | R _{θJA} | 625 | °C/W |
| Operating and Storage Temperature Range | T _J , T _{stg} | -65 to +150 | °C |
| Maximum Temperature for Soldering Purposes Time in Solder Bath | T _L | 260 10 | °C 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 ⁽²⁾ | A8E | 10 | ∞ |
| MMUN2216RLT1 ⁽²⁾ | A8F | 4.7 | ∞ |
| MMUN2230RLT1 ⁽²⁾ | A8G | 1 | 1 |
| MMUN2231RLT1 ⁽²⁾ | A8H | 2.2 | 2.2 |
| MMUN2232RLT1 ⁽²⁾ | A8J | 4.7 | 4.7 |
| MMUN2233RLT1 ⁽²⁾ | A8K | 4.7 | 47 |
| MMUN2234RLT1 ⁽²⁾ | 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 | |
|--|--|----------|------|------|------|-----|
| 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 ($V_{EB} = 6.0\text{V}, I_C = 0$) | MMUN2211RLT1 | - | - | 0.5 | mAdc | |
| | MMUN2212RLT1 | - | - | 0.2 | | |
| | MMUN2213RLT1 | - | - | 0.1 | | |
| | MMUN2214RLT1 | - | - | 0.2 | | |
| | MMUN2215RLT1 | - | - | 0.9 | | |
| | MMUN2216RLT1 | - | - | 1.9 | | |
| | MMUN2230RLT1 | - | - | 4.3 | | |
| | MMUN2231RLT1 | - | - | 2.3 | | |
| | MMUN2232RLT1 | - | - | 1.5 | | |
| | MMUN2233RLT1 | - | - | 0.18 | | |
| MMUN2234RLT1 | - | - | 0.13 | | | |
| Collector-Base Breakdown Voltage ($I_C=10\text{mA}, I_E=0$) | $V_{(BR)CBO}$ | 50 | - | - | Vdc | |
| Collector-Emitter Breakdown Voltage ⁽³⁾ ($I_C=2.0\text{mA}, I_B=0$) | $V_{(BR)CEO}$ | 50 | - | - | Vdc | |
| ON CHARACTERISTICS ⁽³⁾ | | | | | | |
| DC Current Gain ($V_{CE} = 10\text{V}, I_C = 5.0\text{mA}$) | MMUN2211RLT1 | h_{FE} | 35 | 60 | - | |
| | MMUN2212RLT1 | | 60 | 100 | - | |
| | MMUN2213RLT1 | | 80 | 140 | - | |
| | MMUN2214RLT1 | | 80 | 140 | - | |
| | MMUN2215RLT1 | | 160 | 350 | - | |
| | MMUN2216RLT1 | | 160 | 350 | - | |
| | MMUN2230RLT1 | | 3.0 | 5.0 | - | |
| | MMUN2231RLT1 | | 8.0 | 15 | - | |
| | MMUN2232RLT1 | | 15 | 30 | - | |
| | MMUN2233RLT1 | | 80 | 200 | - | |
| | MMUN2234RLT1 | | 80 | 150 | - | |
| Collector-Emitter Saturation Voltage ($I_C=10\text{mA}, I_E=0.3\text{mA}$) ($I_C = 10\text{mA}, I_B = 5\text{mA}$) MMUN2230RLT1 MMUN2231RLT1 ($I_C = 10\text{mA}, I_B = 1\text{mA}$) MMUN2215RLT1 MMUN2216RLT1 MMUN2232RLT1 MMUN2233RLT1 MMUN2234RLT1 | $V_{CE(sat)}$ | - | - | 0.25 | Vdc | |
| Output Voltage (on) ($V_{CC}=5.0\text{V}, V_B=2.5\text{V}, R_L=1.0\text{k}\Omega$) | MMUN2211RLT1 | V_{OL} | - | - | 0.2 | Vdc |
| | 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)($V_{CC}=5.0\text{V}, V_B=0.5\text{V}, R_L=1.0\text{k}\Omega$) ($V_{CC}=5.0\text{V}, V_B=0.05\text{V}, R_L=1.0\text{k}\Omega$) ($V_{CC}=5.0\text{V}, V_B=0.25\text{V}, R_L=1.0\text{k}\Omega$) | MMUN2230RLT1 | V_{OH} | 4.9 | - | - | Vdc |
| | MMUN2215RLT1 | | | | | |
| | MMUN2216RLT1 | | | | | |
| | MMUN2233RLT1 | | | | | |

3. Pulse Test: Pulse Width < 300 μs , 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 ⁽³⁾ | | | | | | |
| Input Resistor | MMUN2211RLT1 | R1 | 7.0 | 10 | 13 | k Ω |
| | 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 μs , Duty Cycle < 2.0%.

MMUN2211RLT1 SERIES

TYPICAL ELECTRICAL CHARACTERISTICS
MMUN2211RLT1

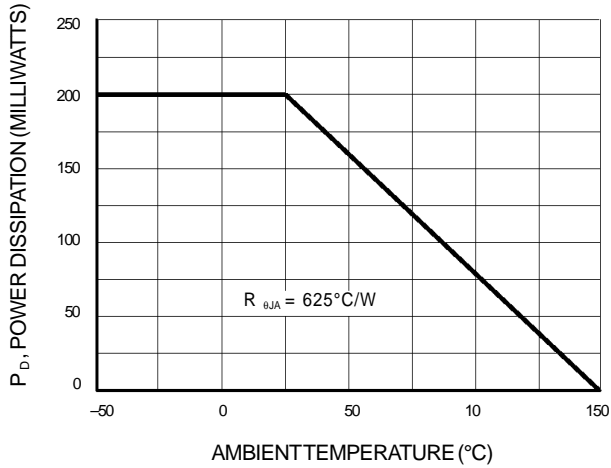


Figure 1. Derating Curve

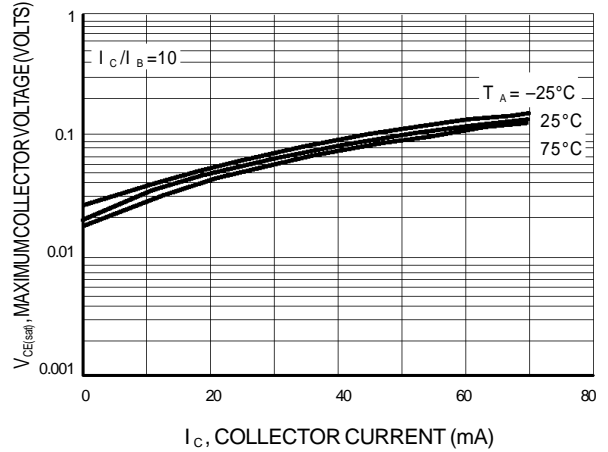


Figure 2. $V_{CE(sat)}$ versus I_C

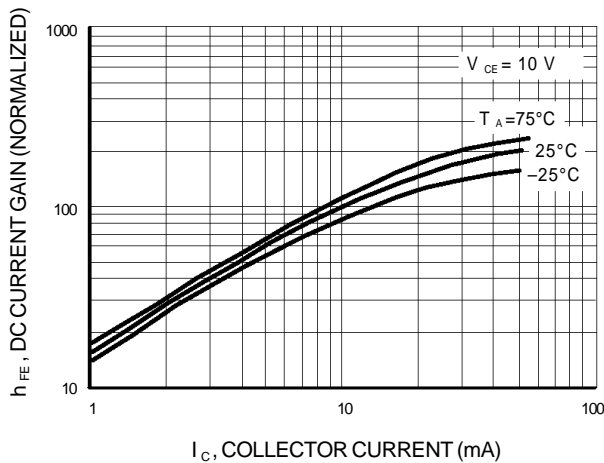


Figure 3. DC Current Gain

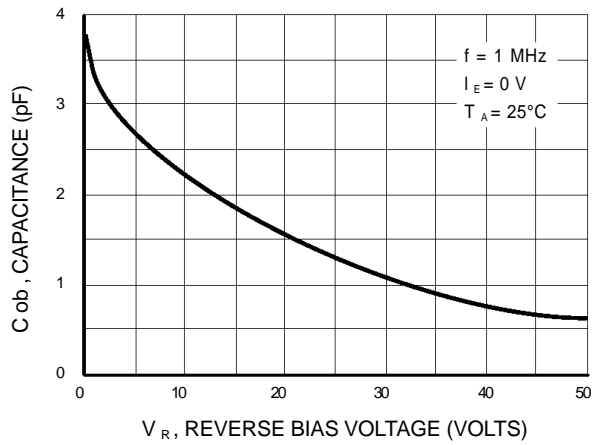


Figure 4. Output Capacitance

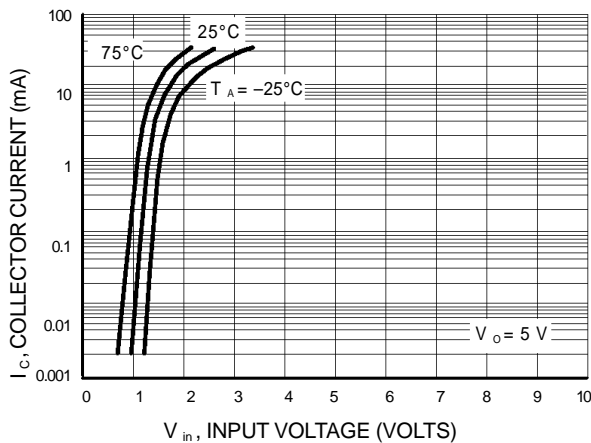


Figure 5. $V_{CE(sat)}$ versus I_C

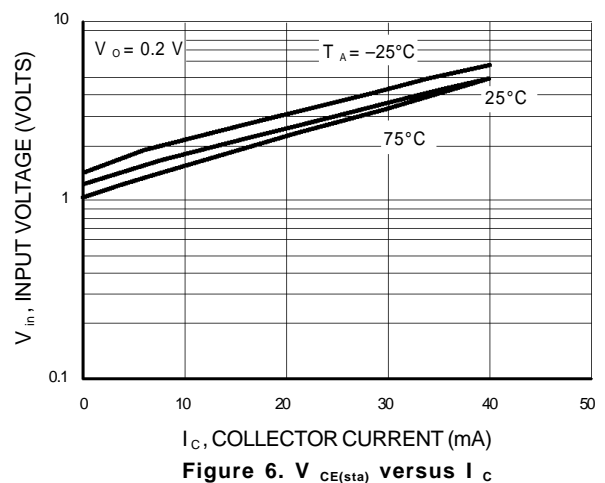


Figure 6. $V_{CE(sat)}$ versus I_C

MMUN2211RLT1 SERIES

TYPICAL ELECTRICAL CHARACTERISTICS
MMUN2212RLT1

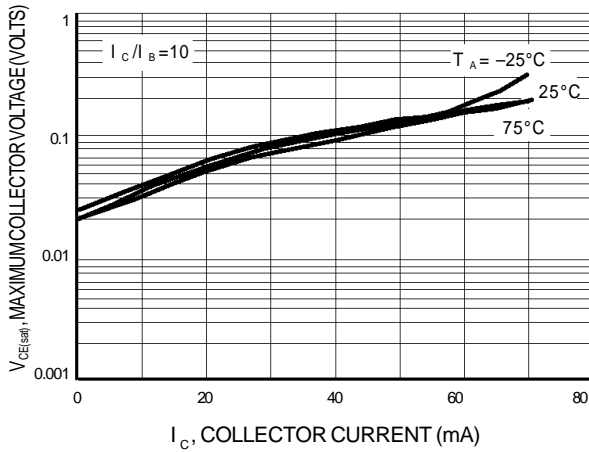


Figure 7. $V_{CE(sat)}$ versus I_C

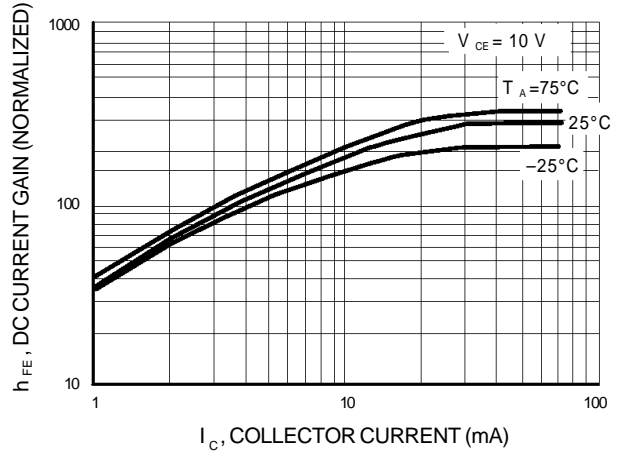


Figure 8. DC Current Gain

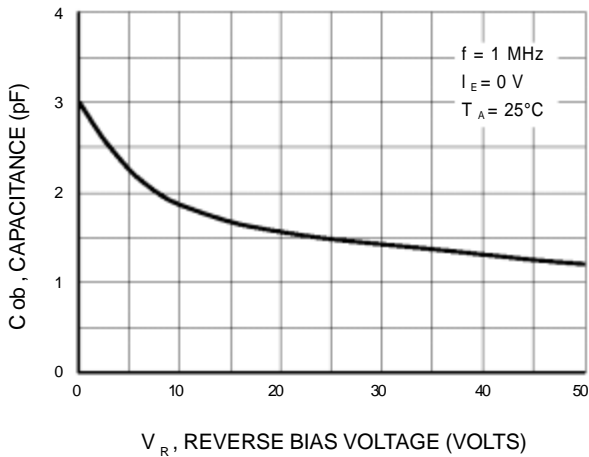


Figure 9. Output Capacitance

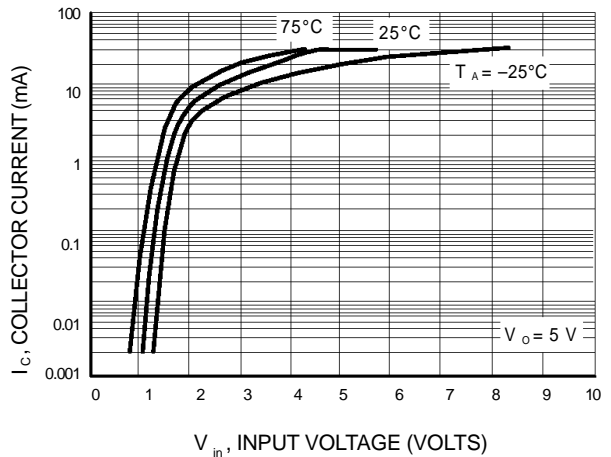


Figure 10. Output Current versus Input Voltage

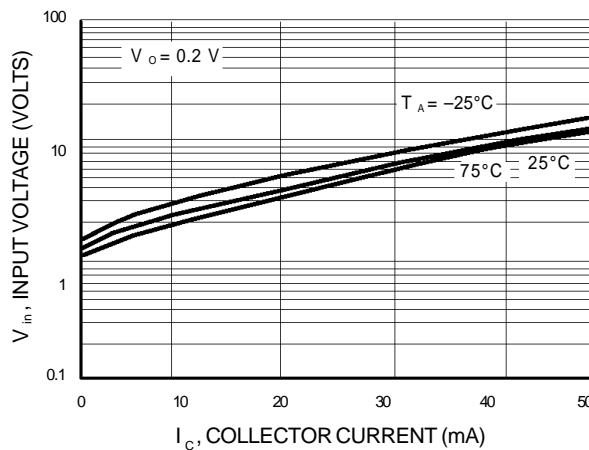


Figure 11. Input Voltage versus Output Current

MMUN2211RLT1 SERIES

TYPICAL ELECTRICAL CHARACTERISTICS

MMUN2213RLT1

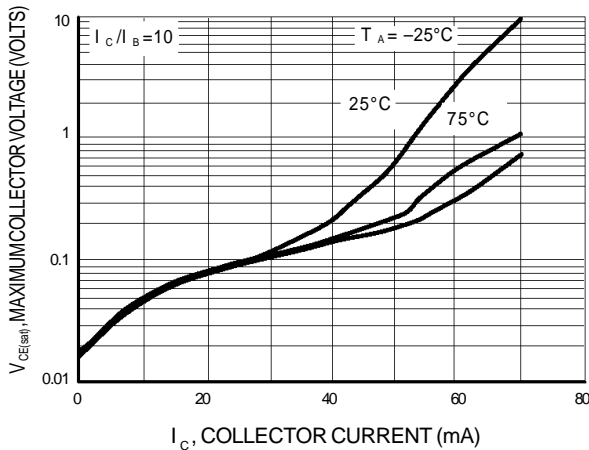


Figure 12. $V_{CE(sat)}$ versus I_C

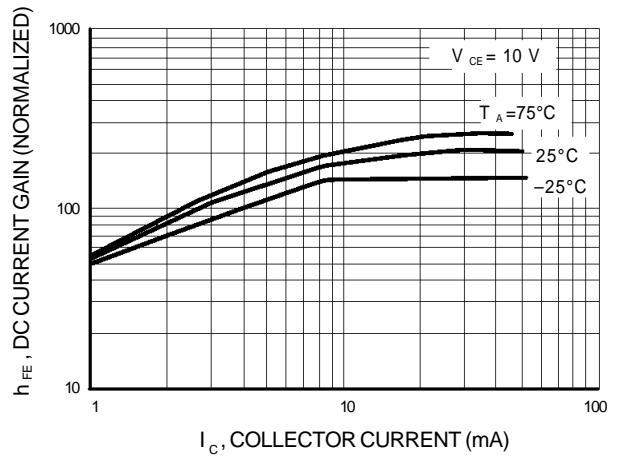


Figure 13. DC Current Gain

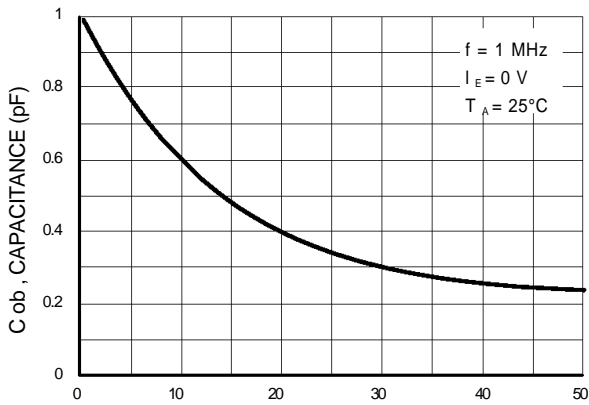


Figure 14. Output Capacitance

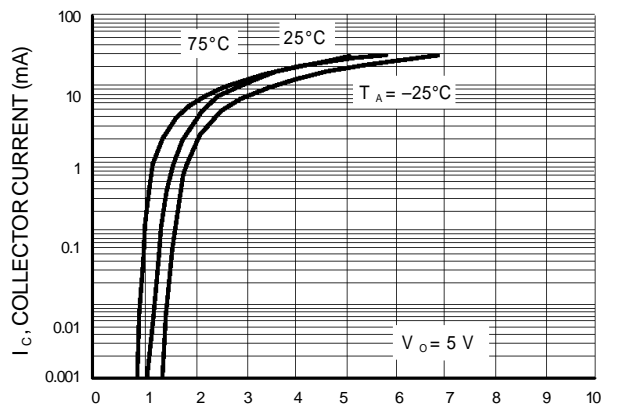


Figure 15. Output Current versus Input Voltage

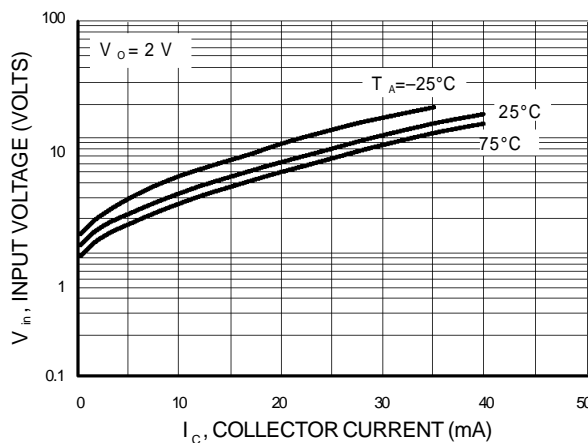


Figure 16. Input Voltage versus Output Current

MMUN2211RLT1 SERIES

TYPICAL ELECTRICAL CHARACTERISTICS
MMUN2214RLT1

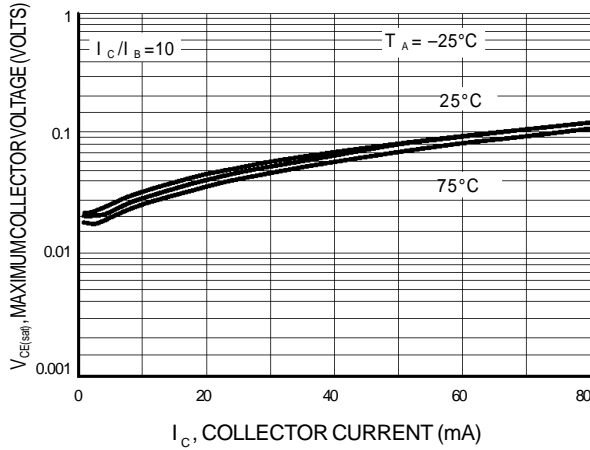


Figure 17. $V_{CE(sat)}$ versus I_C

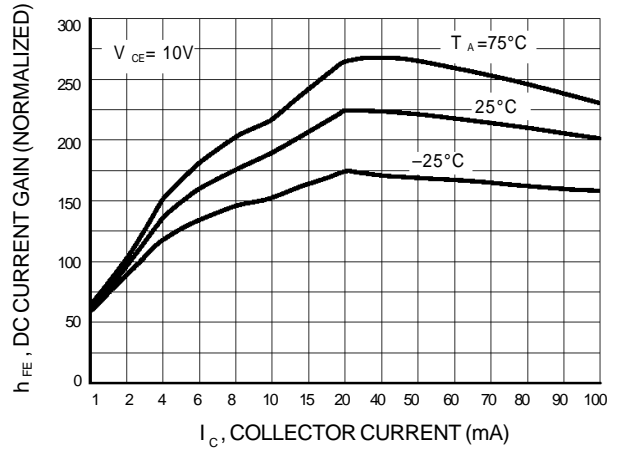


Figure 18. DC Current Gain

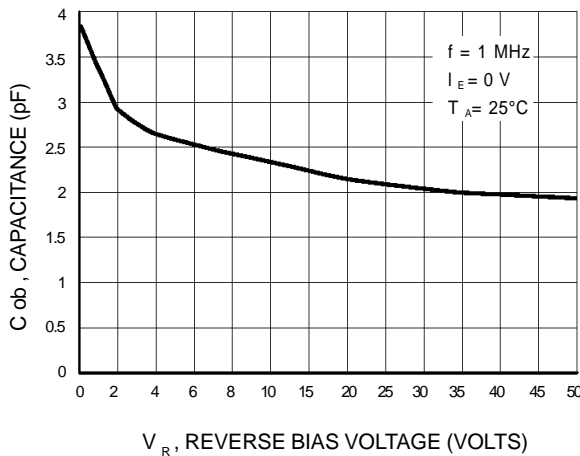


Figure 19. Output Capacitance

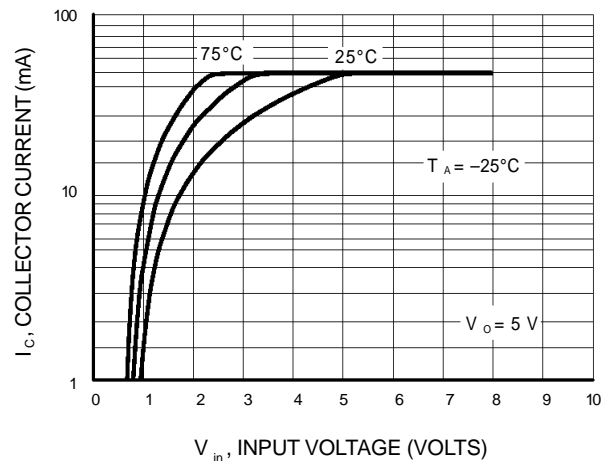


Figure 20. Output Current versus Input Voltage

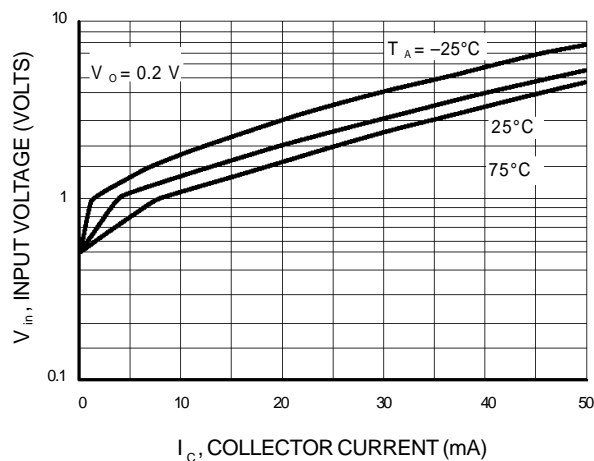


Figure 21. Input Voltage versus Output Current

MMUN2211RLT1 SERIES

TYPICAL APPLICATIONS FOR NPN BRTs

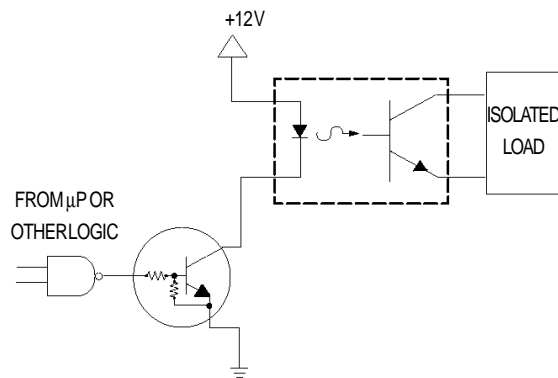


Figure 22. Level Shifter: Connects 12 or 24 Volt Circuits to Logic

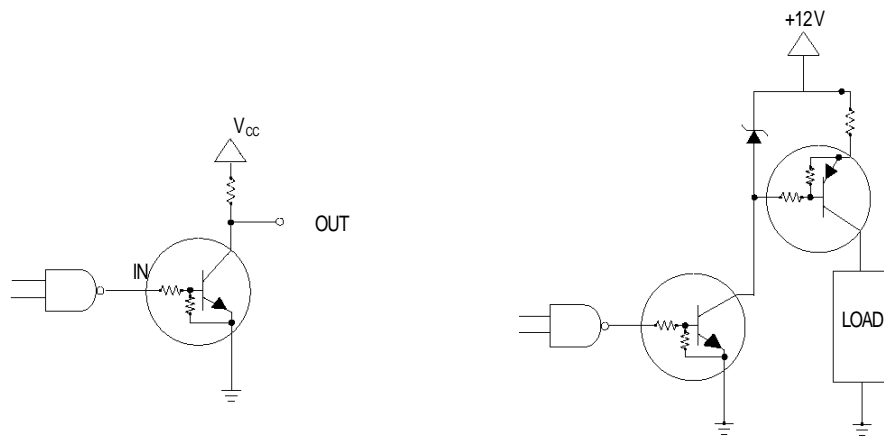


Figure 23. Open Collector Inverter: Inverts the Input Signal

Figure 24. Inexpensive, Unregulated Current Source