# MMUN2111LT1 Series

**Preferred Devices**

# Bias Resistor Transistors

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

### Features

- 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.
- Pb−Free Packages are Available

**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 | $P_D$ | 246 (Note 1)<br>400 (Note 2)<br>1.5 (Note 1)<br>2.0 (Note 2) | mW<br><br>°C/W |
| Thermal Resistance,<br>Junction-to-Ambient | $R_{\theta JA}$ | 508 (Note 1)<br>311 (Note 2) | °C/W |
| Thermal Resistance,<br>Junction-to-Lead | $R_{\theta JL}$ | 174 (Note 1)<br>208 (Note 2) | °C/W |
| Junction and Storage,<br>Temperature Range | $T_J$, $T_{stg}$ | −55 to +150 | °C |

Maximum ratings are those values beyond which device damage can occur. Maximum ratings applied to the device are individual stress limit values (not normal operating conditions) and are not valid simultaneously. If these limits are exceeded, device functional operation is not implied, damage may occur and reliability may be affected.

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

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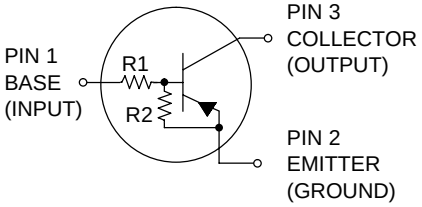



**MARKING DIAGRAM**


**SOT−23**
**CASE 318**
**STYLE 6**

A6x = Device Code
x = A − L (Refer to page 2)
M = Date Code*
▪ = Pb−Free Package

(Note: Microdot may be in either location)

*Date Code orientation may vary depending upon manufacturing location.

**ORDERING INFORMATION**

| Device | Package | Shipping† |
|---|---|---|
| MMUN21xxLT1 | SOT−23 | 3000/Tape & Reel |
| MMUN21xxLT1G | SOT−23<br>(Pb−Free) | 3000/Tape & Reel |
| MMUN21xxLT3 | SOT−23 | 10000/Tape & Reel |
| MMUN21xxLT3G | SOT−23<br>(Pb−Free) | 10000/Tape & Reel |

†For information on tape and reel specifications, including part orientation and tape sizes, please refer to our Tape and Reel Packaging Specifications Brochure, BRD8011/D.

**DEVICE MARKING INFORMATION**

See specific marking information in the device marking table on page 2 of this data sheet.

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

**DEVICE MARKING AND RESISTOR VALUES**

| Device* | Package | Marking | R1 (K) | R2 (K) | Shipping |
|---|---|---|---|---|---|
| MMUN2111LT1, G<br>MMUN2111LT3, G | SOT−23 | A6A | 10 | 10 | 3000/Tape & Reel<br>10,000/Tape & Reel |
| MMUN2112LT1, G | SOT−23 | A6B | 22 | 22 | 3000/Tape & Reel |
| MMUN2113LT1, G<br>MMUN2113LT3, G | SOT−23 | A6C | 47 | 47 | 3000/Tape & Reel<br>10,000/Tape & Reel |
| MMUN2114LT1, G | SOT−23 | A6D | 10 | 47 | 3000/Tape & Reel |
| MMUN2115LT1, G (Note 3) | SOT−23 | A6E | 10 | ∞ | 3000/Tape & Reel |
| MMUN2116LT1, G (Note 3) | SOT−23 | A6F | 4.7 | ∞ | 3000/Tape & Reel |
| MMUN2130LT1, G (Note 3) | SOT−23 | A6G | 1.0 | 1.0 | 3000/Tape & Reel |
| MMUN2131LT1, G (Note 3) | SOT−23 | A6H | 2.2 | 2.2 | 3000/Tape & Reel |
| MMUN2132LT1, G (Note 3) | SOT−23 | A6J | 4.7 | 4.7 | 3000/Tape & Reel |
| MMUN2133LT1, G (Note 3) | SOT−23 | A6K | 4.7 | 47 | 3000/Tape & Reel |
| MMUN2134LT1, G (Note 3) | SOT−23 | A6L | 22 | 47 | 3000/Tape & Reel |

*The “G’’ suffix indicates Pb−Free package available.
3. New devices. Updated curves to follow in subsequent data sheets.

**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 | MMUN2111LT1 | $I_{EBO}$ | − | − | 0.5 | mAdc |
| ($V_{EB}$ = 6.0 V, $I_C$ = 0) | MMUN2112LT1 | | − | − | 0.2 | |
| | MMUN2113LT1 | | − | − | 0.1 | |
| | MMUN2114LT1 | | − | − | 0.2 | |
| | MMUN2115LT1 | | − | − | 0.9 | |
| | MMUN2116LT1 | | − | − | 1.9 | |
| | MMUN2130LT1 | | − | − | 4.3 | |
| | MMUN2131LT1 | | − | − | 2.3 | |
| | MMUN2132LT1 | | − | − | 1.5 | |
| | MMUN2133LT1 | | − | − | 0.18 | |
| | MMUN2134LT1 | | − | − | 0.13 | |
| Collector-Base Breakdown Voltage ($I_C$ = 10 μA, $I_E$ = 0) | | $V_{(BR)CBO}$ | 50 | − | − | Vdc |
| Collector-Emitter Breakdown Voltage (Note 4)<br>($I_C$ = 2.0 mA, $I_B$ = 0) | | $V_{(BR)CEO}$ | 50 | − | − | Vdc |

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

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

| Characteristic | | Symbol | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|
| **ON CHARACTERISTICS** (Note 5) | | | | | | |
| DC Current Gain | MMUN2111LT1 | $h_{FE}$ | 35 | 60 | – | |
| ($V_{CE}$ = 10 V, $I_C$ = 5.0 mA) | MMUN2112LT1 | | 60 | 100 | – | |
| | MMUN2113LT1 | | 80 | 140 | – | |
| | MMUN2114LT1 | | 80 | 140 | – | |
| | MMUN2115LT1 | | 160 | 250 | – | |
| | MMUN2116LT1 | | 160 | 250 | – | |
| | MMUN2130LT1 | | 3.0 | 5.0 | – | |
| | MMUN2131LT1 | | 8.0 | 15 | – | |
| | MMUN2132LT1 | | 15 | 27 | – | |
| | MMUN2133LT1 | | 80 | 140 | – | |
| | MMUN2134LT1 | | 80 | 130 | – | |
| Collector-Emitter Saturation Voltage | | $V_{CE(sat)}$ | – | – | 0.25 | Vdc |
| ($I_C$ = 10 mA, $I_E$ = 0.3 mA) | | | | | | |
| ($I_C$ = 10 mA, $I_B$ = 5 mA) | MMUN2130LT1/MMUN2131LT1 | | | | | |
| ($I_C$ = 10 mA, $I_B$ = 1 mA) | MMUN2115LT1/MMUN2116LT1/ MMUN2132LT1/MMUN2133LT1/MMUN2134LT1 | | | | | |
| Output Voltage (on) | | $V_{OL}$ | | | | Vdc |
| ($V_{CC}$ = 5.0 V, $V_B$ = 2.5 V, $R_L$ = 1.0 kΩ) | MMUN2111LT1 | | – | – | 0.2 | |
| | MMUN2112LT1 | | – | – | 0.2 | |
| | MMUN2114LT1 | | – | – | 0.2 | |
| | MMUN2115LT1 | | – | – | 0.2 | |
| | MMUN2116LT1 | | – | – | 0.2 | |
| | MMUN2130LT1 | | – | – | 0.2 | |
| | MMUN2131LT1 | | – | – | 0.2 | |
| | MMUN2132LT1 | | – | – | 0.2 | |
| | MMUN2133LT1 | | – | – | 0.2 | |
| | MMUN2134LT1 | | – | – | 0.2 | |
| ($V_{CC}$ = 5.0 V, $V_B$ = 3.5 V, $R_L$ = 1.0 kΩ) | MMUN2113LT1 | | – | – | 0.2 | |
| Output Voltage (off) | | $V_{OH}$ | 4.9 | – | – | Vdc |
| ($V_{CC}$ = 5.0 V, $V_B$ = 0.5 V, $R_L$ = 1.0 kΩ) | | | | | | |
| ($V_{CC}$ = 5.0 V, $V_B$ = 0.25 V, $R_L$ = 1.0 kΩ) | MMUN2115LT1 | | | | | |
| | MMUN2116LT1 | | | | | |
| | MMUN2131LT1 | | | | | |
| | MMUN2132LT1 | | | | | |
| ($V_{CC}$ = 5.0 V, $V_B$ = 0.050 V, $R_L$ = 1.0 kΩ) | MMUN2130LT1 | | | | | |
| Input Resistor | MMUN2111LT1 | R1 | 7.0 | 10 | 13 | k Ω |
| | MMUN2112LT1 | | 15.4 | 22 | 28.6 | |
| | MMUN2113LT1 | | 32.9 | 47 | 61.1 | |
| | MMUN2114LT1 | | 7.0 | 10 | 13 | |
| | MMUN2115LT1 | | 7.0 | 10 | 13 | |
| | MMUN2116LT1 | | 3.3 | 4.7 | 6.1 | |
| | MMUN2130LT1 | | 0.7 | 1.0 | 1.3 | |
| | MMUN2131LT1 | | 1.5 | 2.2 | 2.9 | |
| | MMUN2132LT1 | | 3.3 | 4.7 | 6.1 | |
| | MMUN2133LT1 | | 3.3 | 4.7 | 6.1 | |
| | MMUN2134LT1 | | 15.4 | 22 | 28.6 | |
| Resistor Ratio | MMUN2111LT1/MMUN2112LT1/MMUN2113LT1 | $R_1/R_2$ | 0.8 | 1.0 | 1.2 | |
| | MMUN2114LT1 | | 0.17 | 0.21 | 0.25 | |
| | MMUN2115LT1/MMUN2116LT1 | | – | – | – | |
| | MMUN2130LT1/MMUN2131LT1/MMUN2132LT1 | | 0.8 | 1.0 | 1.2 | |
| | MMUN2133LT1 | | 0.055 | 0.1 | 0.185 | |

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

## TYPICAL ELECTRICAL CHARACTERISTICS
## MMUN2111LT1

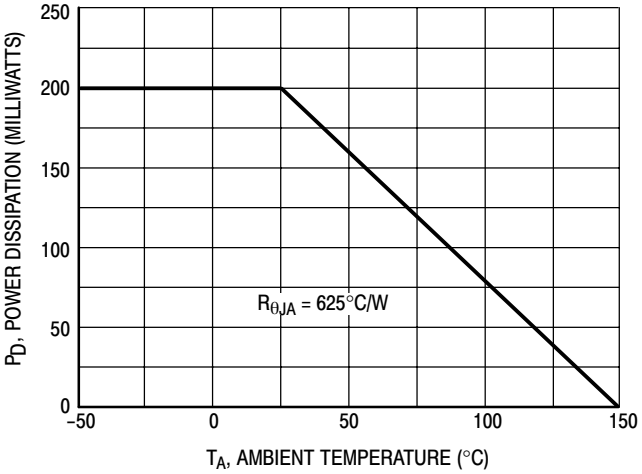



**Figure 1. Derating Curve**

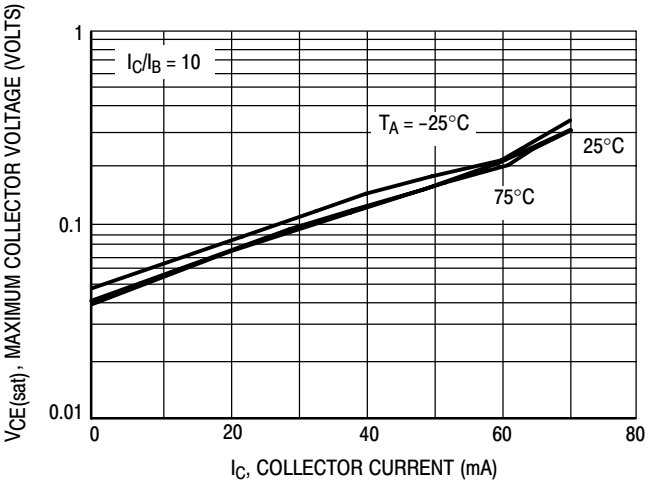



**Figure 2. $V_{CE(sat)}$ versus $I_C$**

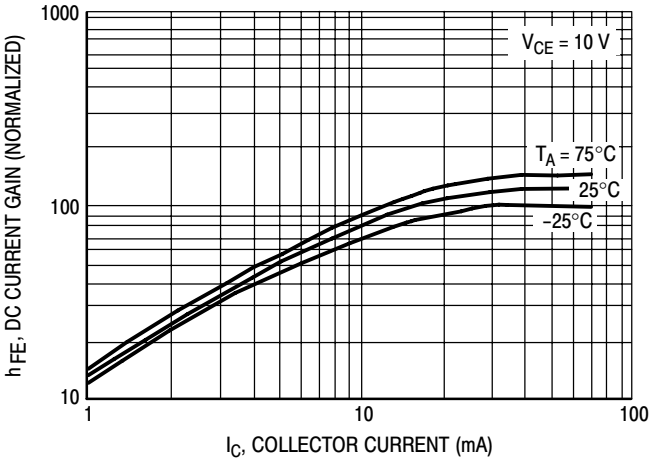



**Figure 3. DC Current Gain**

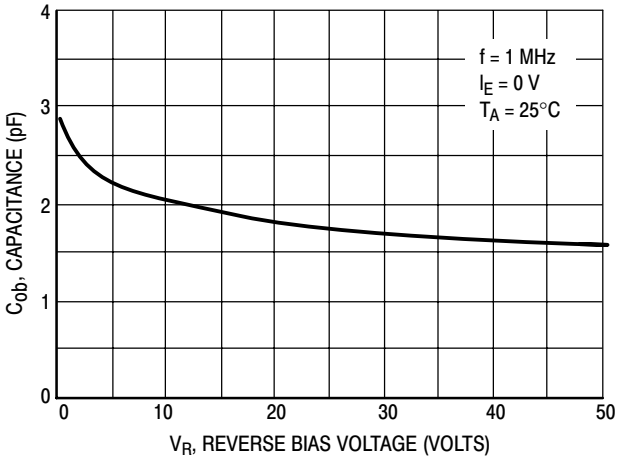



**Figure 4. Output Capacitance**

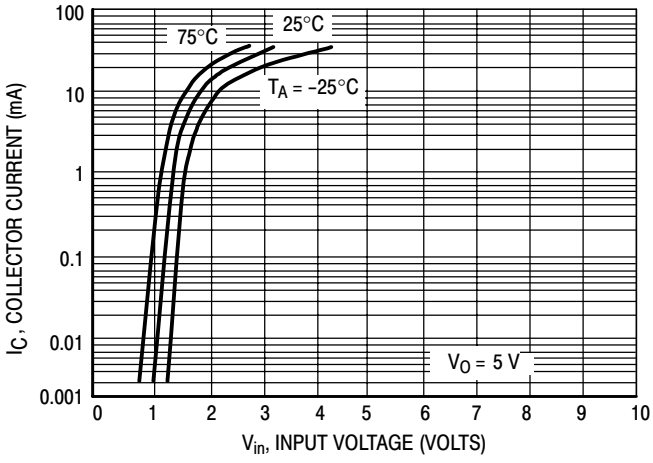



**Figure 5. Output Current versus Input Voltage**

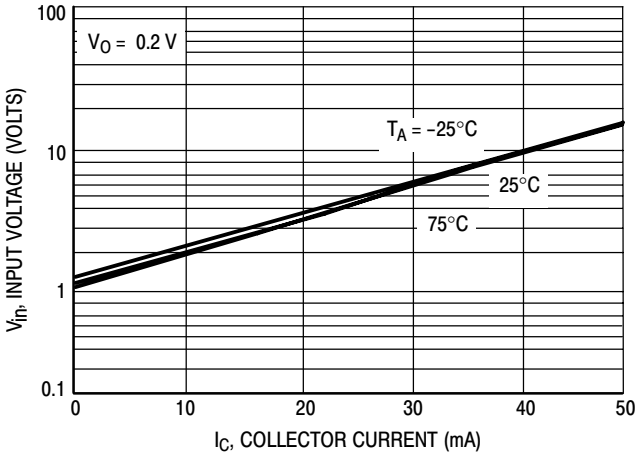



**Figure 6. Input Voltage versus Output Current**

## TYPICAL ELECTRICAL CHARACTERISTICS
## MMUN2112LT1

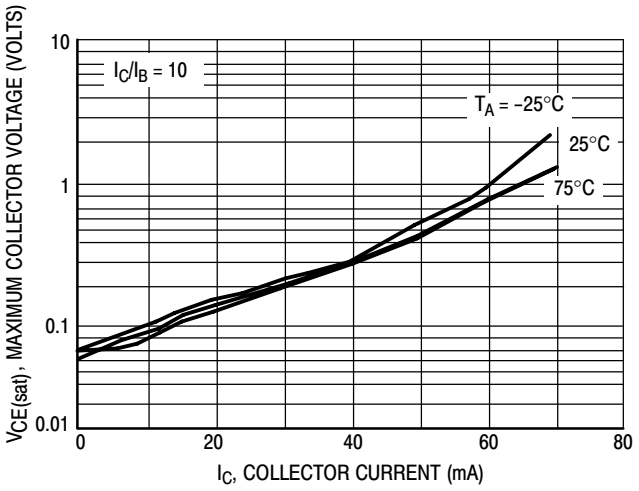



**Figure 7. $V_{CE(sat)}$ versus $I_C$**

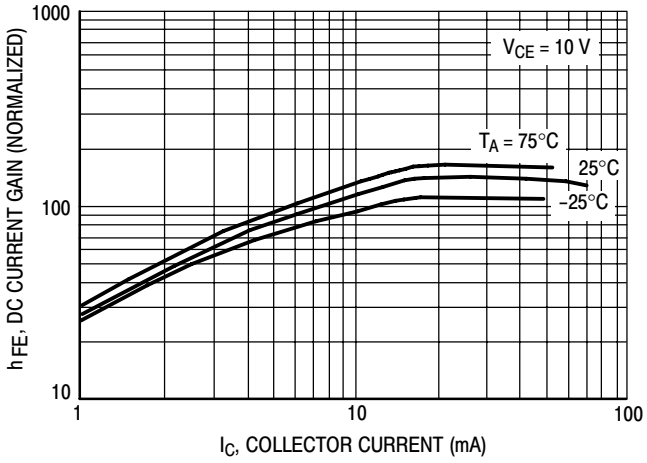



**Figure 8. DC Current Gain**

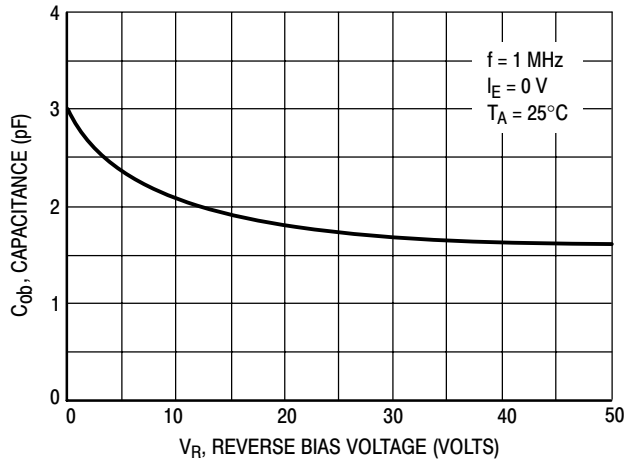



**Figure 9. Output Capacitance**

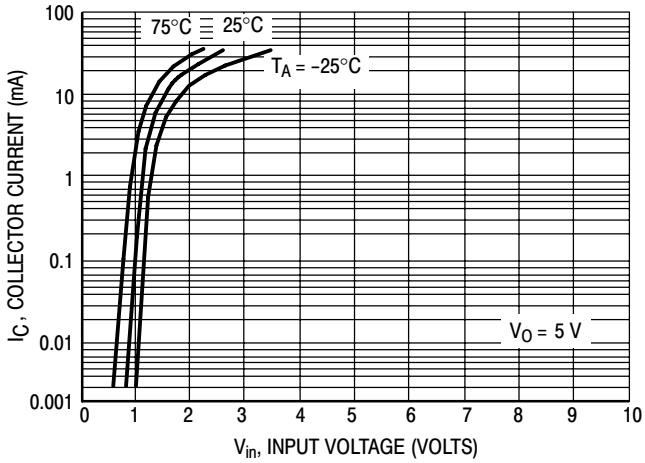



**Figure 10. Output Current versus Input Voltage**

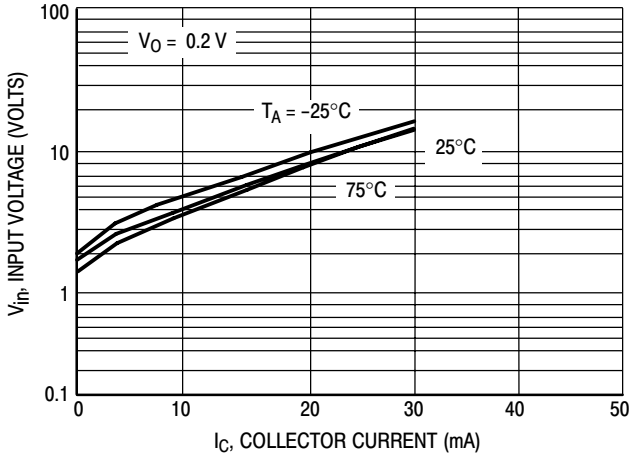



**Figure 11. Input Voltage versus Output Current**

## TYPICAL ELECTRICAL CHARACTERISTICS
## MMUN2113LT1

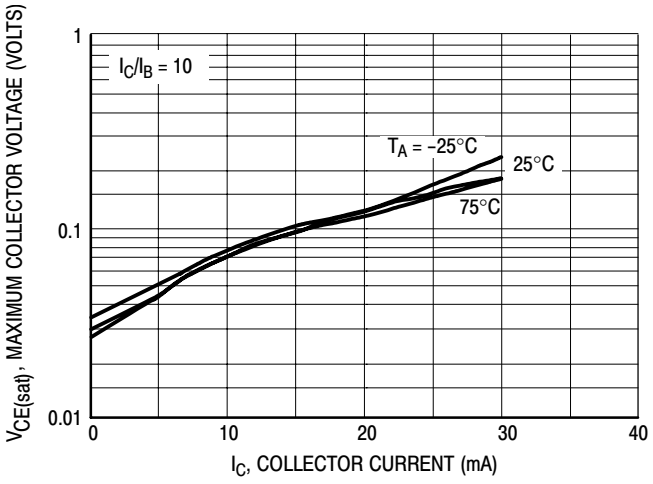



**Figure 12. $V_{CE(sat)}$ versus $I_C$**

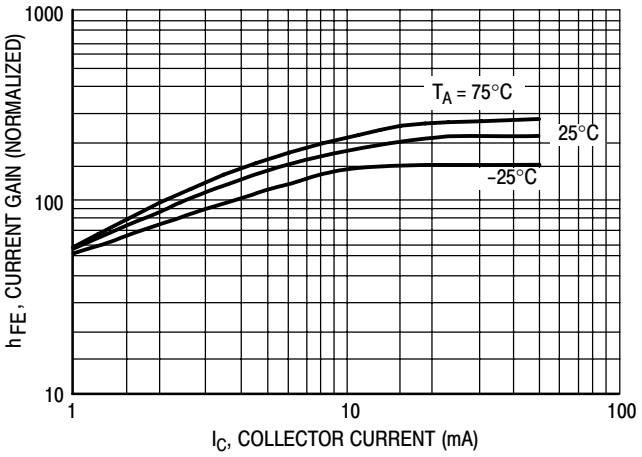



**Figure 13. DC Current Gain**

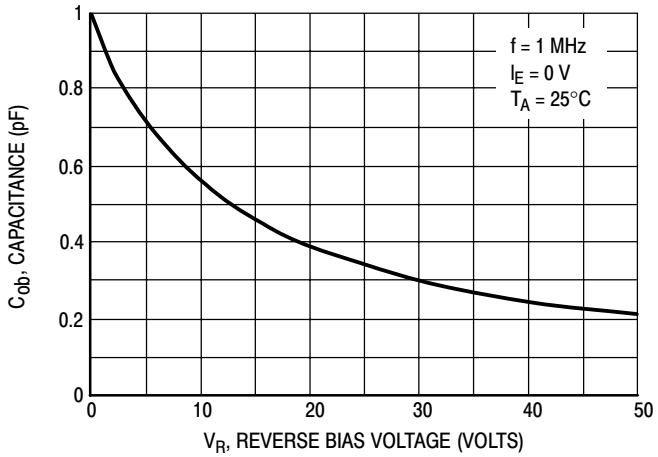



**Figure 14. Output Capacitance**

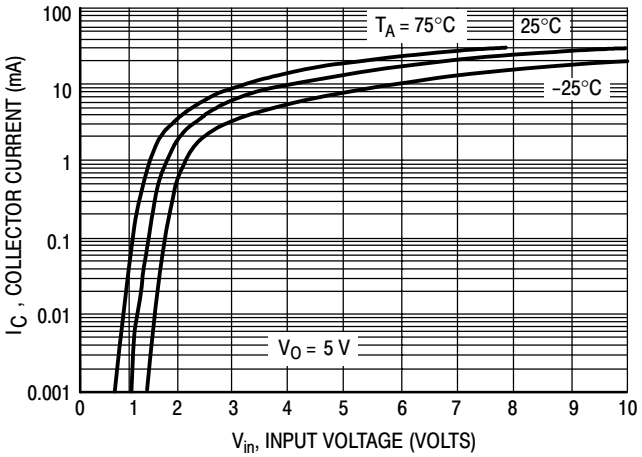



**Figure 15. Output Current versus Input Voltage**

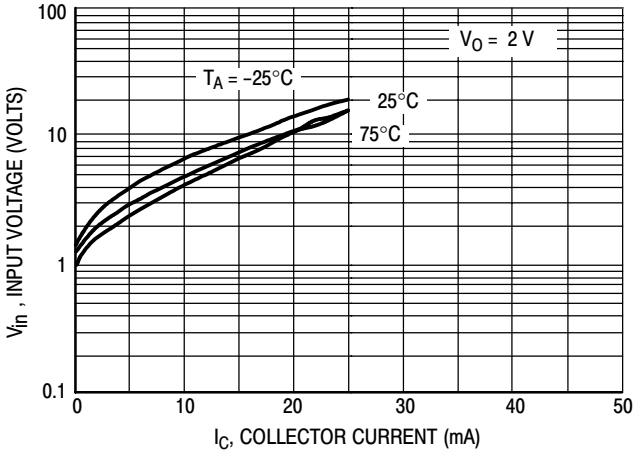



**Figure 16. Input Voltage versus Output Current**

## TYPICAL ELECTRICAL CHARACTERISTICS
## MMUN2114LT1

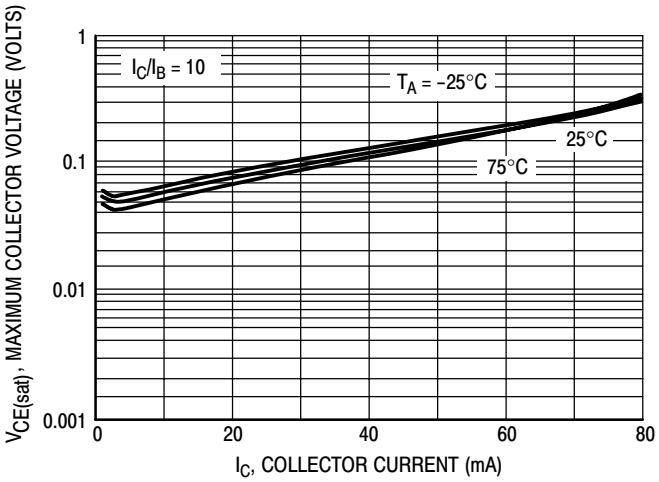



**Figure 17. $V_{CE(sat)}$ versus $I_C$**

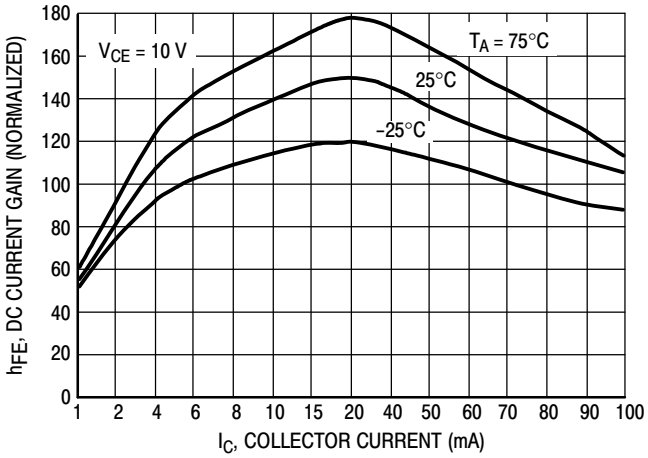



**Figure 18. DC Current Gain**

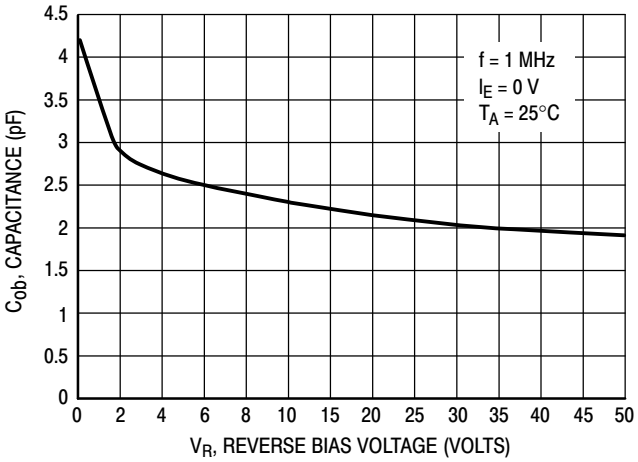



**Figure 19. Output Capacitance**

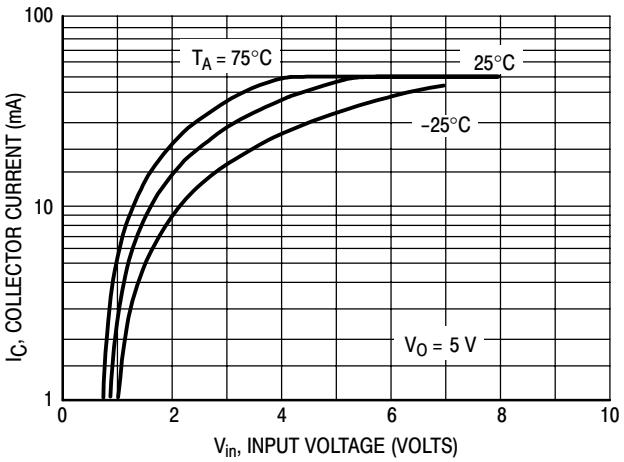



**Figure 20. Output Current versus Input Voltage**

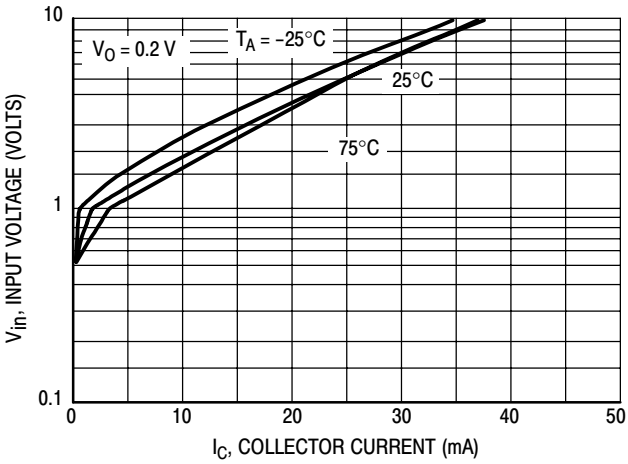



**Figure 21. Input Voltage versus Output Current**

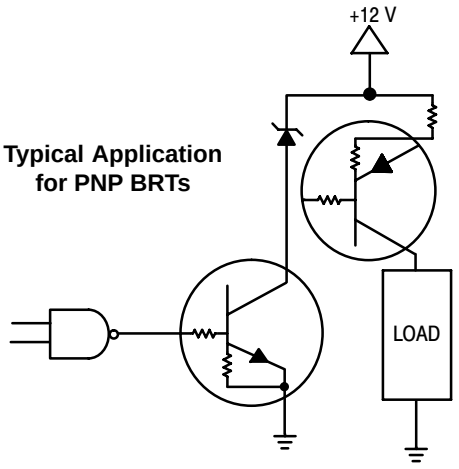
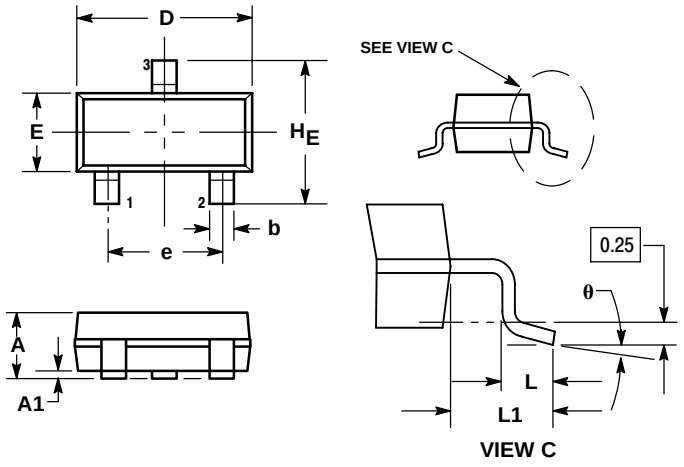



**Figure 22. Inexpensive, Unregulated Current Source**

## PACKAGE DIMENSIONS

**SOT−23**
**TO−236AB**
CASE 318−08
ISSUE AM

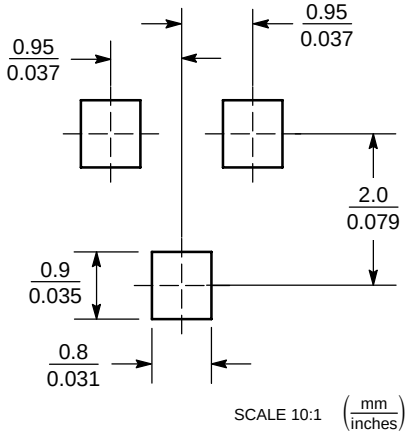



NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH.
3. MAXIMUM LEAD THICKNESS INCLUDES LEAD FINISH THICKNESS. MINIMUM LEAD THICKNESS IS THE MINIMUM THICKNESS OF BASE MATERIAL.
4. 318−01 THRU −07 AND −09 OBSOLETE, NEW STANDARD 318−08.

| | MILLIMETERS | | | INCHES | | |
|---|---|---|---|---|---|---|
| DIM | MIN | NOM | MAX | MIN | NOM | MAX |
| A | 0.89 | 1.00 | 1.11 | 0.035 | 0.040 | 0.044 |
| A1 | 0.01 | 0.06 | 0.10 | 0.001 | 0.002 | 0.004 |
| b | 0.37 | 0.44 | 0.50 | 0.015 | 0.018 | 0.020 |
| c | 0.09 | 0.13 | 0.18 | 0.003 | 0.005 | 0.007 |
| D | 2.80 | 2.90 | 3.04 | 0.110 | 0.114 | 0.120 |
| E | 1.20 | 1.30 | 1.40 | 0.047 | 0.051 | 0.055 |
| e | 1.78 | 1.90 | 2.04 | 0.070 | 0.075 | 0.081 |
| L | 0.10 | 0.20 | 0.30 | 0.004 | 0.008 | 0.012 |
| L1 | 0.35 | 0.54 | 0.69 | 0.014 | 0.021 | 0.029 |
| $H_E$ | 2.10 | 2.40 | 2.64 | 0.083 | 0.094 | 0.104 |

STYLE 6:
PIN 1. BASE
2. EMITTER
3. COLLECTOR

## SOLDERING FOOTPRINT*




SCALE 10:1 $\left(\frac{\text{mm}}{\text{inches}}\right)$

*For additional information on our Pb−Free strategy and soldering details, please download the ON Semiconductor Soldering and Mounting Techniques Reference Manual, SOLDERRM/D.



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**Email**: orderlit@onsemi.com

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**MMUN2111LT1/D**