

MMUN2211LT1 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 SOT-23 package which is designed for low power surface mount applications.

Features

- Simplifies Circuit Design
- Reduces Board Space and Component Count
- Pb-Free Packages are Available

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 |

THERMAL CHARACTERISTICS

| Characteristic | Symbol | Max | Unit |
|---|-----------------|--|-------------------------------------|
| Total Device Dissipation $T_A = 25^\circ\text{C}$ Derate above 25°C | P_D | 246 (Note 1) 400 (Note 2) 1.5 (Note 1) 2.0 (Note 2) | mW $^\circ\text{C}/\text{W}$ |
| Thermal Resistance, Junction-to-Ambient | $R_{\theta JA}$ | 508 (Note 1) 311 (Note 2) | $^\circ\text{C}/\text{W}$ |
| Thermal Resistance, Junction-to-Lead | $R_{\theta JL}$ | 174 (Note 1) 208 (Note 2) | $^\circ\text{C}/\text{W}$ |
| Junction and Storage Temperature Range | T_J, T_{stg} | -55 to +150 | $^\circ\text{C}$ |

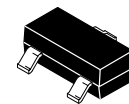
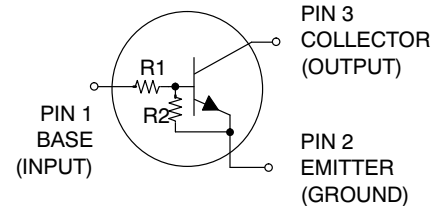
Stresses exceeding Maximum Ratings may damage the device. Maximum Ratings are stress ratings only. Functional operation above the Recommended Operating Conditions is not implied. Extended exposure to stresses above the Recommended Operating Conditions may affect device reliability.

1. FR-4 @ minimum pad
2. FR-4 @ 1.0 x 1.0 inch pad



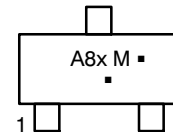
ON Semiconductor®

<http://onsemi.com>



SOT-23
CASE 318
STYLE 6

MARKING DIAGRAM



A8x = Specific Device Code
M = Date Code
▪ = Pb-Free Package
(Note: Microdot may be in either location)

ORDERING INFORMATION

See detailed ordering and shipping information in the package dimensions section on page 16 of this data sheet.

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

MMUN2211LT1 Series

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) | I _{EBO} | - | - | 0.5 | mAdc |
| MMUN2211LT1, G | | - | - | 0.2 | |
| MMUN2212LT1, G | | - | - | 0.1 | |
| MMUN2213LT1, G | | - | - | 0.2 | |
| MMUN2214LT1, G | | - | - | 0.9 | |
| MMUN2215LT1, G | | - | - | 1.9 | |
| MMUN2216LT1, G | | - | - | 4.3 | |
| MMUN2230LT1, G | | - | - | 2.3 | |
| MMUN2231LT1, G | | - | - | 1.5 | |
| MMUN2232LT1, G | | - | - | 0.18 | |
| MMUN2233LT1, G | | - | - | 0.13 | |
| MMUN2234LT1, G | | - | - | 4.0 | |
| MMUN2238LT1, G | | - | - | 0.1 | |
| MMUN2241LT1, G | | - | - | | |
| 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) | MMUN2211LT1, G MMUN2212LT1, G MMUN2213LT1, G MMUN2214LT1, G MMUN2215LT1, G MMUN2216LT1, G MMUN2230LT1, G MMUN2231LT1, G MMUN2232LT1, G MMUN2233LT1, G MMUN2234LT1, G MMUN2238LT1, G MMUN2241LT1, G | h _{FE} | 35 60 80 80 160 160 3.0 8.0 15 80 80 160 160 | 60 100 140 140 350 350 5.0 15 30 200 150 350 350 | - - - - - - - - - - - - - | |
| Collector-Emitter Saturation Voltage (I _C = 10 mA, I _B = 0.3 mA) | MMUN2211LT1, G MMUN2212LT1, G MMUN2213LT1, G MMUN2214LT1, G MMUN2233LT1, G MMUN2234LT1, G | V _{CE(sat)} | - - - - - - | - - - - - - | 0.25 0.25 0.25 0.25 0.25 0.25 | Vdc |
| (I _C = 10 mA, I _B = 1 mA) | MMUN2215LT1, G MMUN2216LT1, G MMUN2232LT1, G MMUN2238LT1, G | | - - - - | - - - - | 0.25 0.25 0.25 0.25 | |
| (I _C = 10 mA, I _B = 5 mA) | MMUN2230LT1, G MMUN2231LT1, G MMUN2241LT1, G | | - - - | - - - | 0.25 0.25 0.25 | |

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

MMUN2211LT1 Series

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

| Characteristic | Symbol | Min | Typ | Max | Unit |
|--|-----------------|-----|-----|-----|------|
| ON CHARACTERISTICS (Note 4) | | | | | |
| Output Voltage (on) (V _{CC} = 5.0 V, V _B = 2.5 V, R _L = 1.0 kΩ) | V _{OL} | - | - | 0.2 | Vdc |
| MMUN2211LT1, G | | | | | |
| MMUN2212LT1, G | | | | | |
| MMUN2214LT1, G | | | | | |
| MMUN2215LT1, G | | | | | |
| MMUN2216LT1, G | | | | | |
| MMUN2230LT1, G | | | | | |
| MMUN2231LT1, G | | | | | |
| MMUN2232LT1, G | | | | | |
| MMUN2233LT1, G | | | | | |
| MMUN2234LT1, G | | | | | |
| MMUN2238LT1, G | | | | | |
| (V _{CC} = 5.0 V, V _B = 3.5 V, R _L = 1.0 kΩ) | | | | | |
| (V _{CC} = 5.0 V, V _B = 5.0 V, R _L = 1.0 kΩ) | | | | | |
| MMUN2213LT1, G | | | | | |
| MMUN2241LT1, G | | | | | |
| Output Voltage (off) (V _{CC} = 5.0 V, V _B = 0.5 V, R _L = 1.0 kΩ) | V _{OH} | 4.9 | - | - | Vdc |
| MMUN2212LT1, G | | | | | |
| MMUN2213LT1, G | | | | | |
| MMUN2214LT1, G | | | | | |
| MMUN2233LT1, G | | | | | |
| (V _{CC} = 5.0 V, V _B = 0.05 V, R _L = 1.0 kΩ) | | | | | |
| MMUN2230LT1, G | | | | | |
| MMUN2234LT1, G | | | | | |
| (V _{CC} = 5.0 V, V _B = 0.25 V, R _L = 1.0 kΩ) | | | | | |
| MMUN2215LT1, G | | | | | |
| MMUN2216LT1, G | | | | | |
| MMUN2231LT1, G | | | | | |
| MMUN2232LT1, G | | | | | |
| MMUN2238LT1, G | | | | | |
| MMUN2241LT1, G | | | | | |
| 4.9 | | | | | |
| 4.9 | | | | | |
| Input Resistor | | R1 | 7.0 | 10 | |
| MMUN2212LT1, G | | | | | |
| MMUN2213LT1, G | | | | | |
| MMUN2214LT1, G | | | | | |
| MMUN2215LT1, G | | | | | |
| MMUN2216LT1, G | | | | | |
| MMUN2230LT1, G | | | | | |
| MMUN2231LT1, G | | | | | |
| MMUN2232LT1, G | | | | | |
| MMUN2233LT1, G | | | | | |
| MMUN2234LT1, G | | | | | |
| MMUN2238LT1, G | | | | | |
| MMUN2241LT1, G | | | | | |
| 15.4 | | | | | |
| 32.9 | | | | | |
| 7.0 | | | | | |
| 7.0 | | | | | |
| 3.3 | | | | | |
| 0.7 | | | | | |
| 1.5 | | | | | |
| 3.3 | | | | | |
| 3.3 | | | | | |
| 15.4 | | | | | |
| 1.54 | | | | | |
| 70 | | | | | |
| 22 | | | | | |
| 47 | | | | | |
| 10 | | | | | |
| 10 | | | | | |
| 4.7 | | | | | |
| 1.0 | | | | | |
| 2.2 | | | | | |
| 4.7 | | | | | |
| 4.7 | | | | | |
| 28.6 | | | | | |
| 2.88 | | | | | |
| 130 | | | | | |
| Resistor Ratio | R1/R2 | 0.8 | 1.0 | 1.2 | |
| MMUN2212LT1, G | | | | | |
| MMUN2213LT1, G | | | | | |
| MMUN2214LT1, G | | | | | |
| MMUN2215LT1, G | | | | | |
| MMUN2216LT1, G | | | | | |
| MMUN2230LT1, G | | | | | |
| MMUN2231LT1, G | | | | | |
| MMUN2232LT1, G | | | | | |
| MMUN2233LT1, G | | | | | |
| MMUN2234LT1, G | | | | | |
| MMUN2238LT1, G | | | | | |
| MMUN2241LT1, G | | | | | |
| 0.8 | | | | | |
| 0.17 | | | | | |
| - | | | | | |
| - | | | | | |
| 0.8 | | | | | |
| 0.8 | | | | | |
| 0.8 | | | | | |
| 0.8 | | | | | |
| 0.055 | | | | | |
| 0.38 | | | | | |
| - | | | | | |
| - | | | | | |
| 1.0 | | | | | |
| 1.0 | | | | | |
| 1.0 | | | | | |
| 1.0 | | | | | |
| - | | | | | |
| - | | | | | |
| 1.0 | | | | | |
| 1.0 | | | | | |
| 1.0 | | | | | |
| 1.0 | | | | | |
| 0.1 | | | | | |
| 0.47 | | | | | |
| - | | | | | |
| - | | | | | |
| 1.2 | | | | | |
| 1.2 | | | | | |
| 1.2 | | | | | |
| 0.25 | | | | | |
| - | | | | | |
| - | | | | | |
| 1.2 | | | | | |
| 1.2 | | | | | |
| 1.2 | | | | | |
| 1.2 | | | | | |
| 0.185 | | | | | |
| 0.56 | | | | | |
| - | | | | | |
| - | | | | | |

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

MMUN2211LT1 Series

TYPICAL ELECTRICAL CHARACTERISTICS - MMUN2211LT1

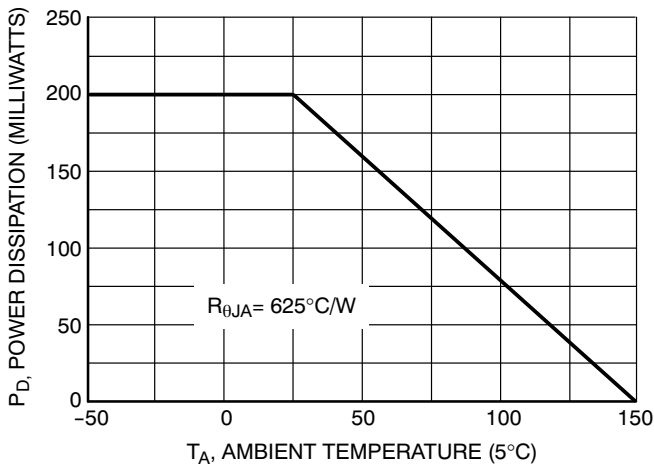


Figure 1. Derating Curve

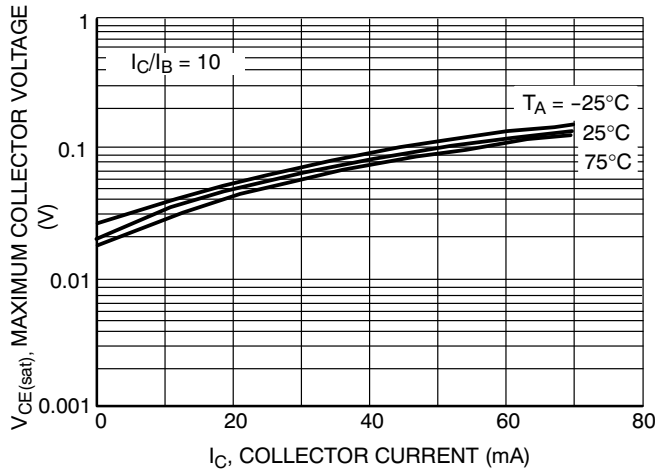


Figure 2. V_{CE(sat)} vs. I_C

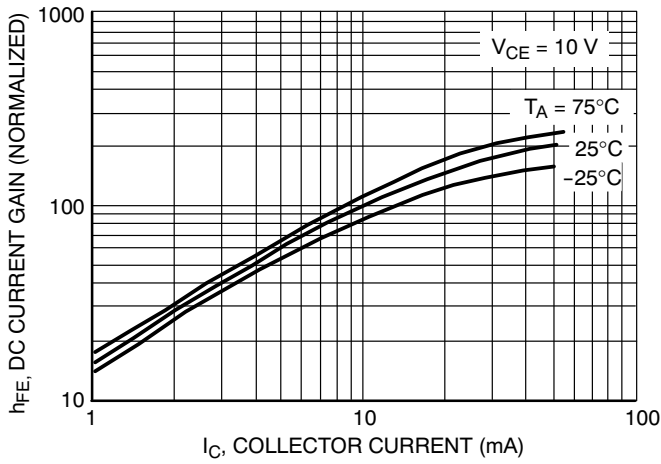


Figure 3. DC Current Gain

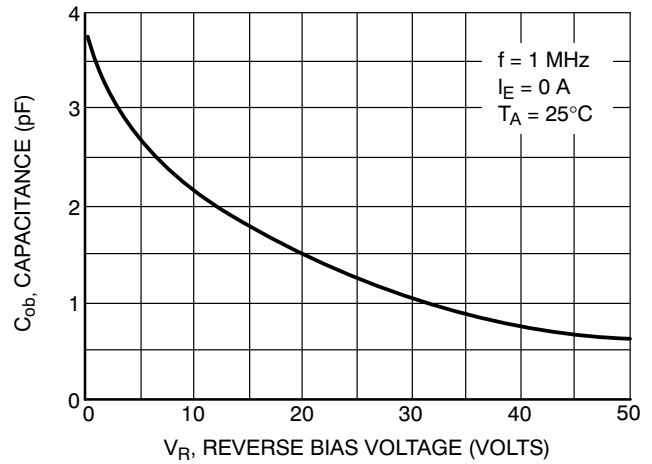


Figure 4. Output Capacitance

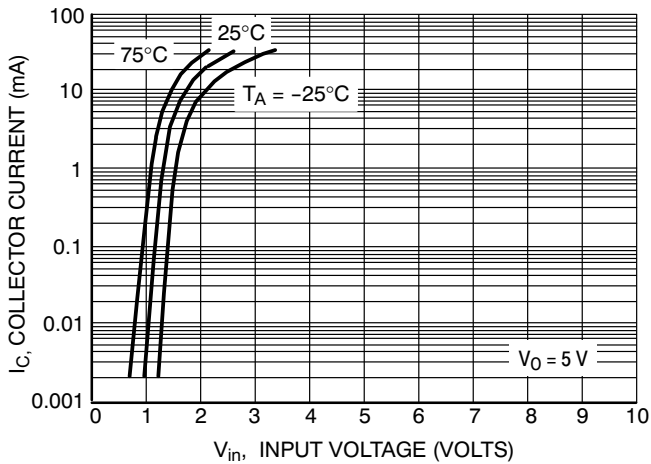


Figure 5. Output Current vs. Input Voltage

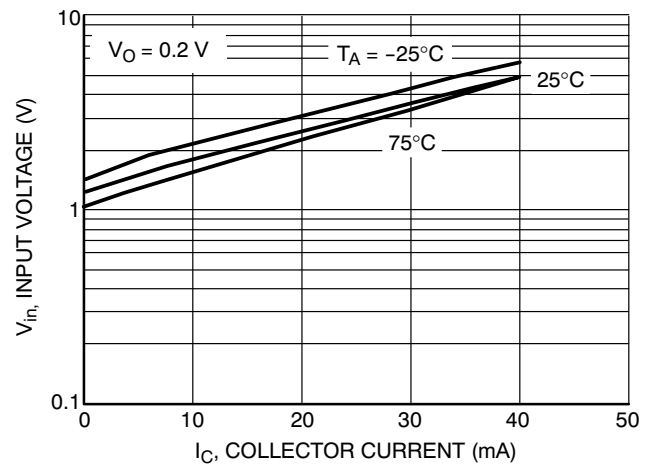


Figure 6. Input Voltage vs. Output Current

MMUN2211LT1 Series

TYPICAL ELECTRICAL CHARACTERISTICS - MMUN2212LT1

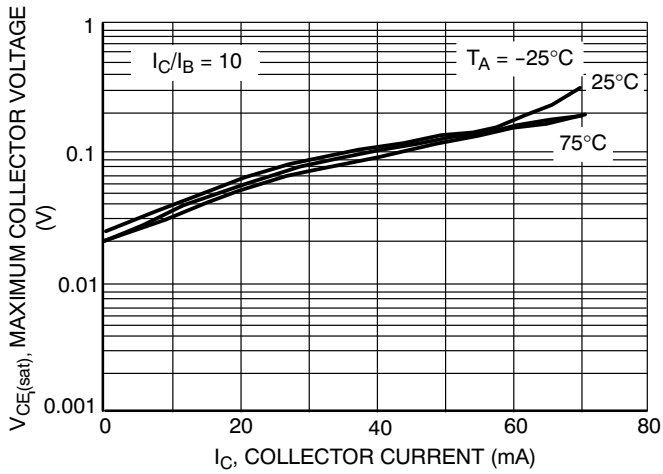


Figure 7. $V_{CE(sat)}$ vs. I_C

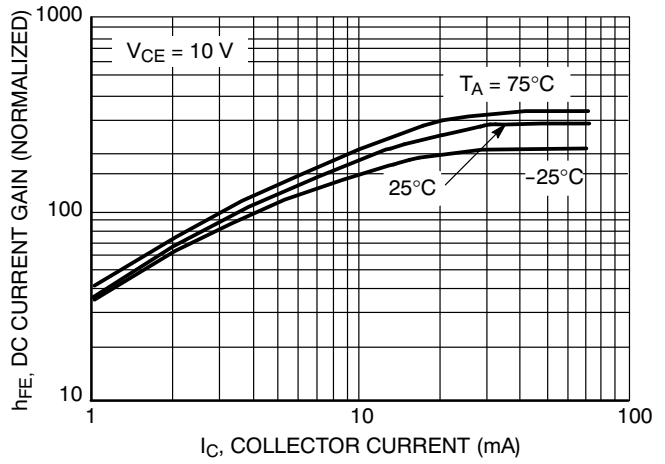


Figure 8. DC Current Gain

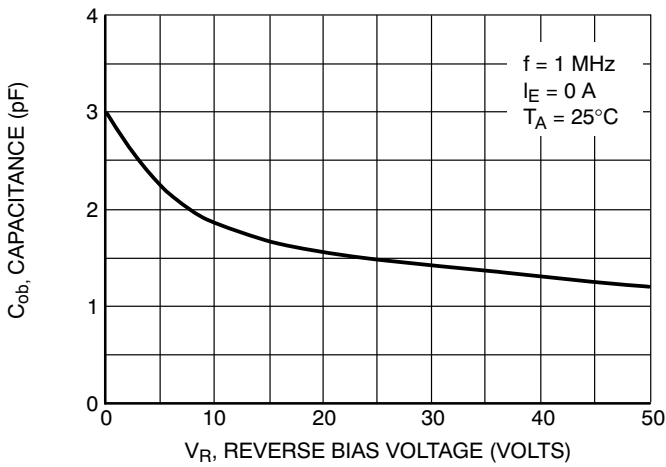


Figure 9. Output Capacitance

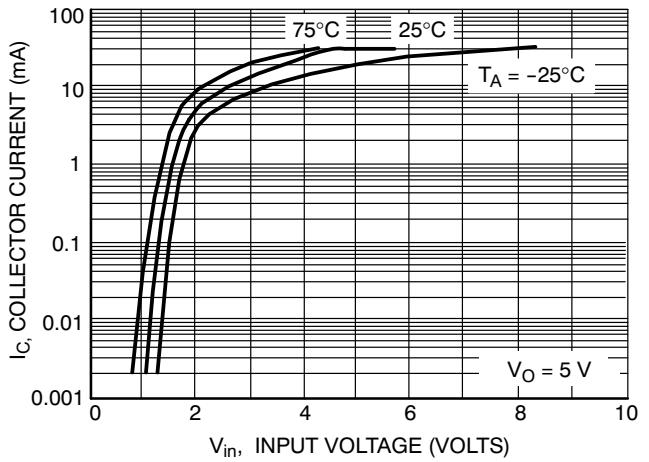


Figure 10. Output Current vs. Input Voltage

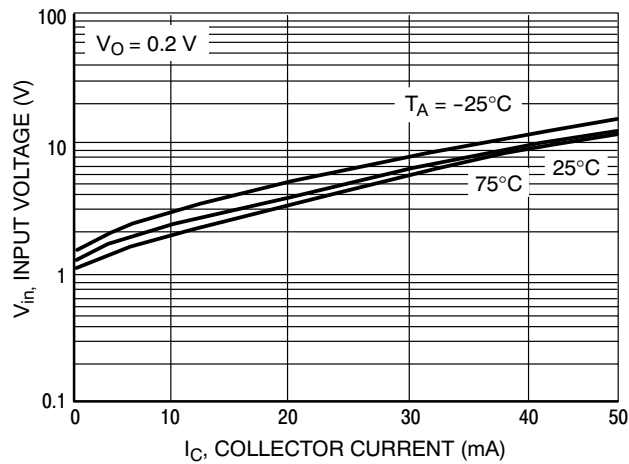


Figure 11. Input Voltage vs. Output Current

MMUN2211LT1 Series

TYPICAL ELECTRICAL CHARACTERISTICS - MMUN2213LT1

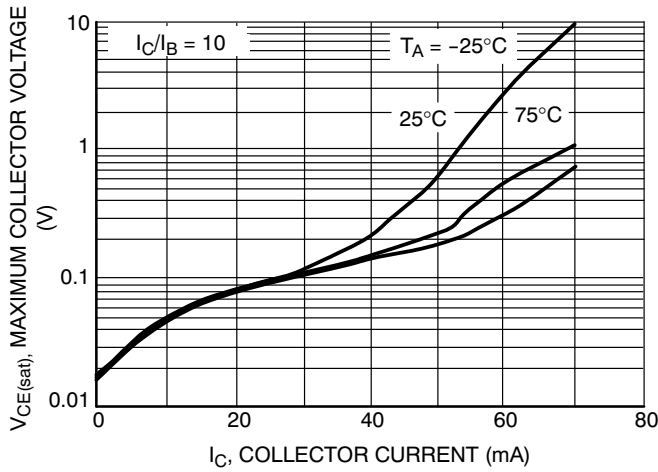


Figure 12. $V_{CE(sat)}$ vs. I_C

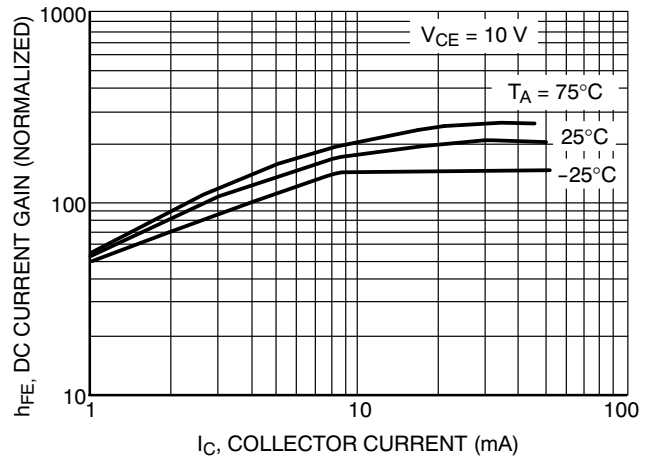


Figure 13. DC Current Gain

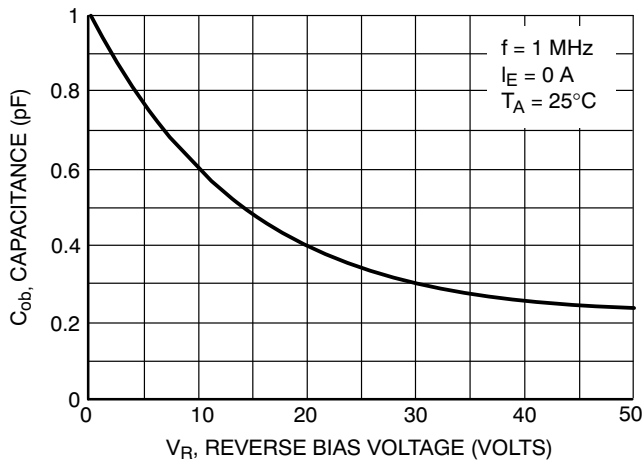


Figure 14. Output Capacitance

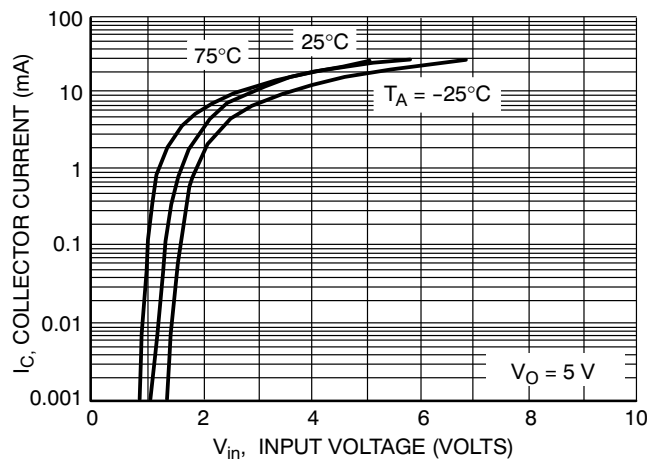


Figure 15. Output Current vs. Input Voltage

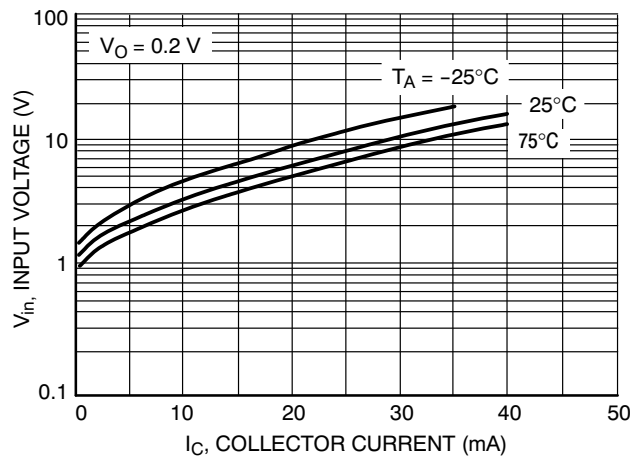


Figure 16. Input Voltage vs. Output Current

MMUN2211LT1 Series

TYPICAL ELECTRICAL CHARACTERISTICS - MMUN2214LT1

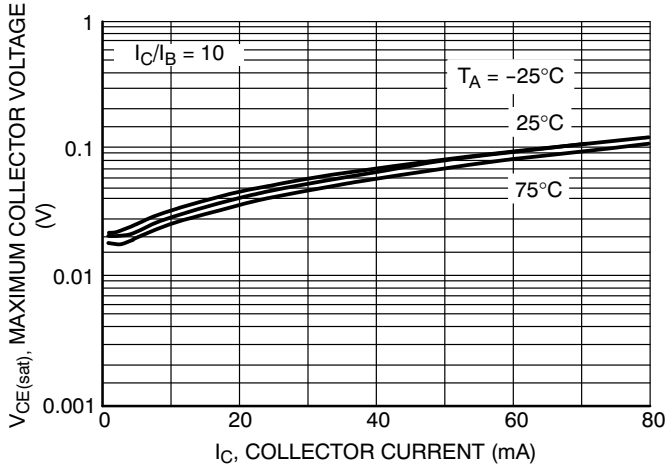


Figure 17. $V_{CE(sat)}$ vs. I_C

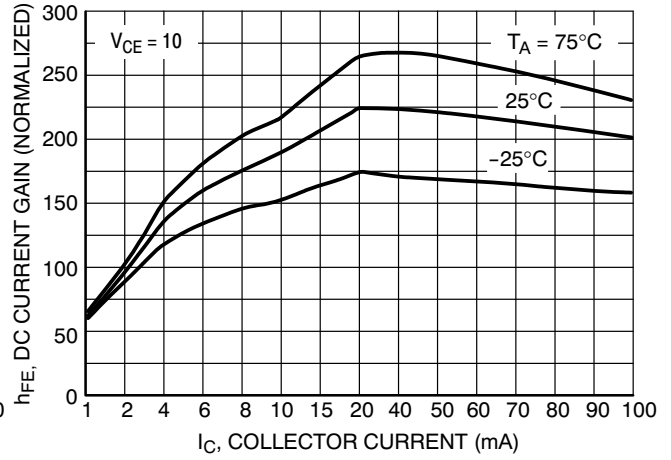


Figure 18. DC Current Gain

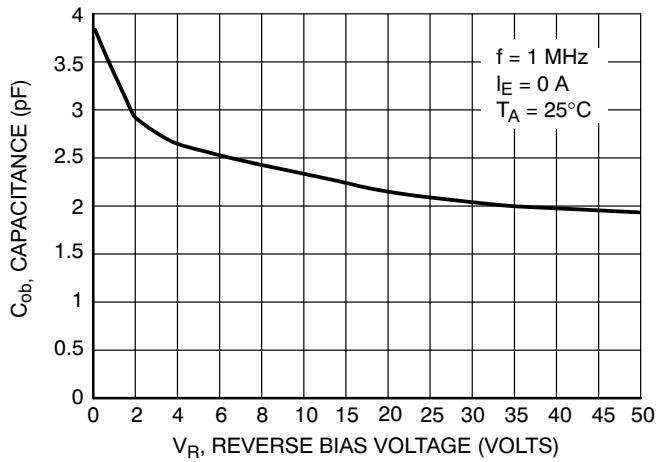


Figure 19. Output Capacitance

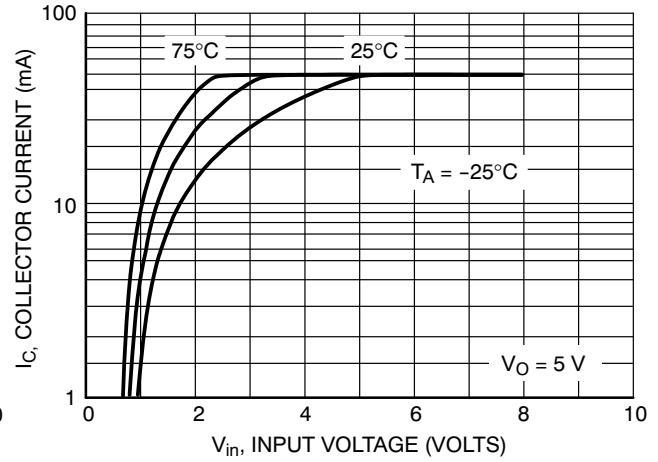


Figure 20. Output Current vs. Input Voltage

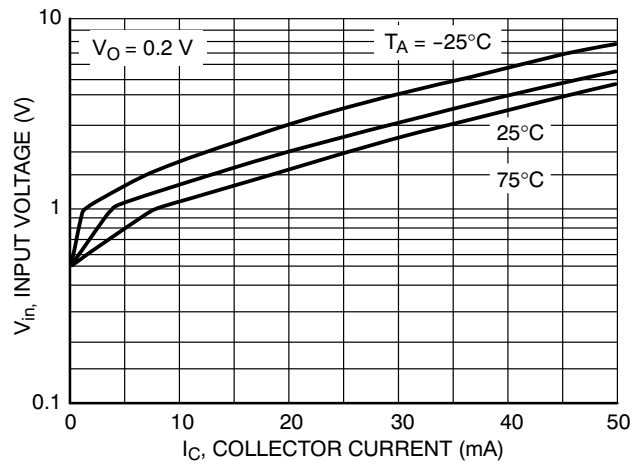


Figure 21. Input Voltage vs. Output Current

TYPICAL ELECTRICAL CHARACTERISTICS - MMUN2215LT1

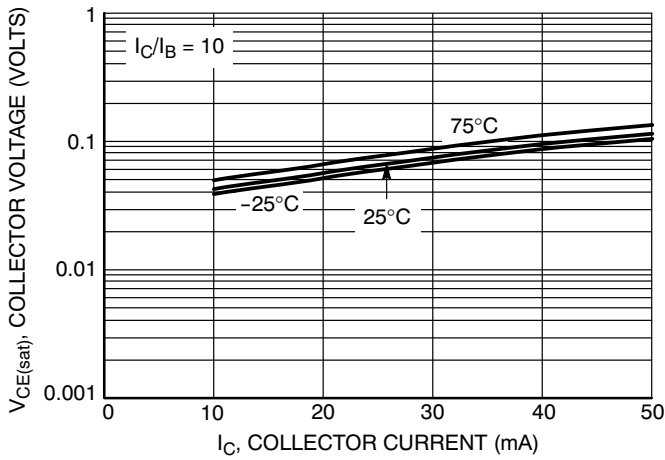


Figure 22. $V_{CE(sat)}$ versus I_C

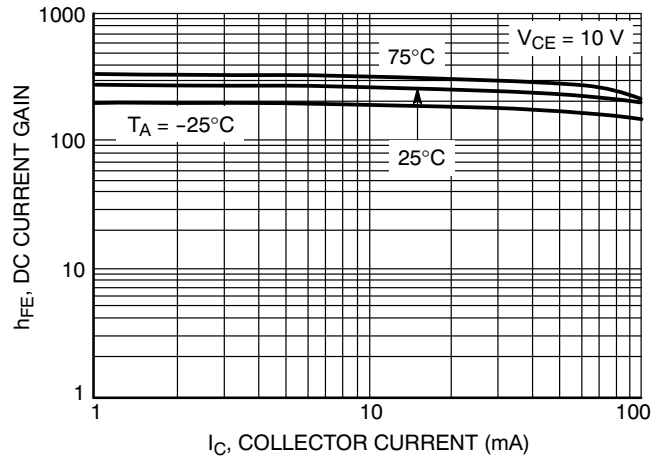


Figure 23. DC Current Gain

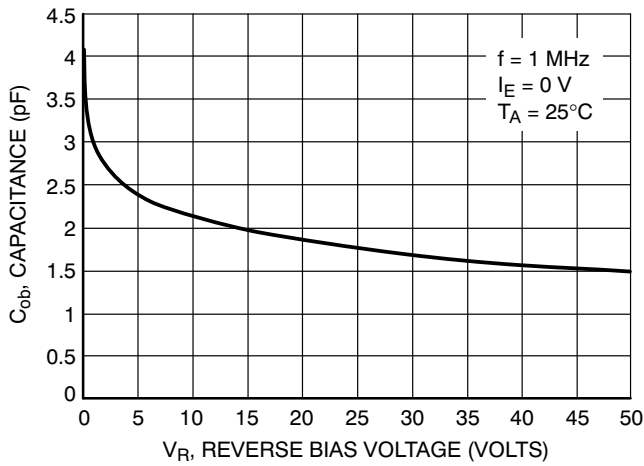


Figure 24. Output Capacitance

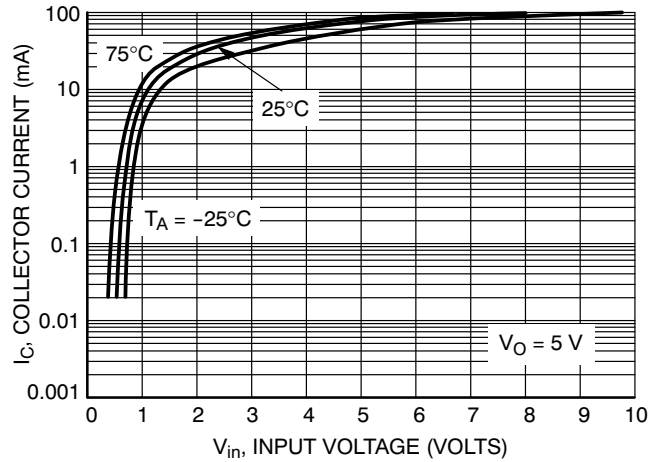


Figure 25. Output Current versus Input Voltage

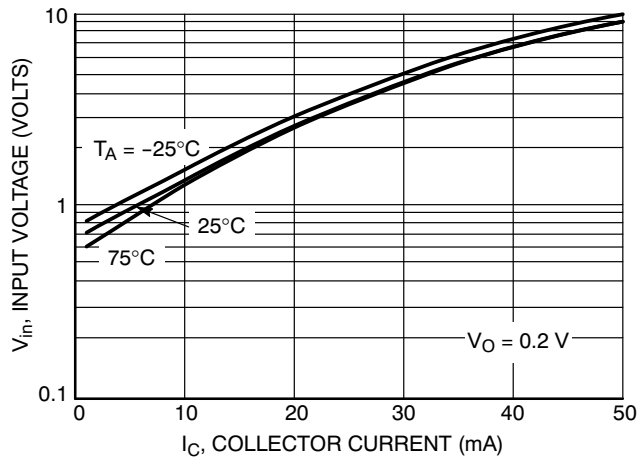


Figure 26. Input Voltage versus Output Current

MMUN2211LT1 Series

TYPICAL ELECTRICAL CHARACTERISTICS — MMUN2216LT1

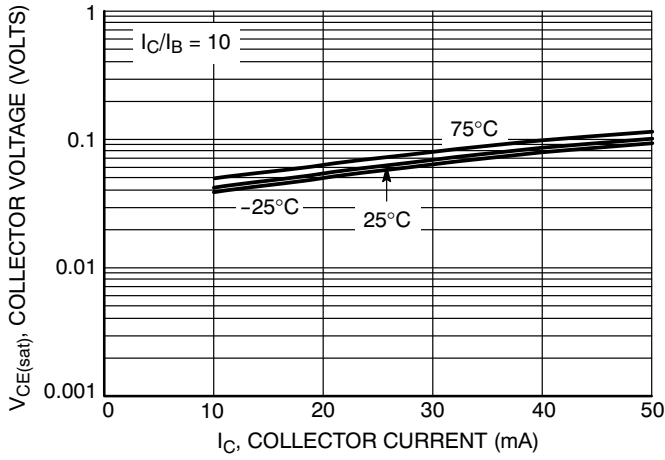


Figure 27. $V_{CE(sat)}$ versus I_C

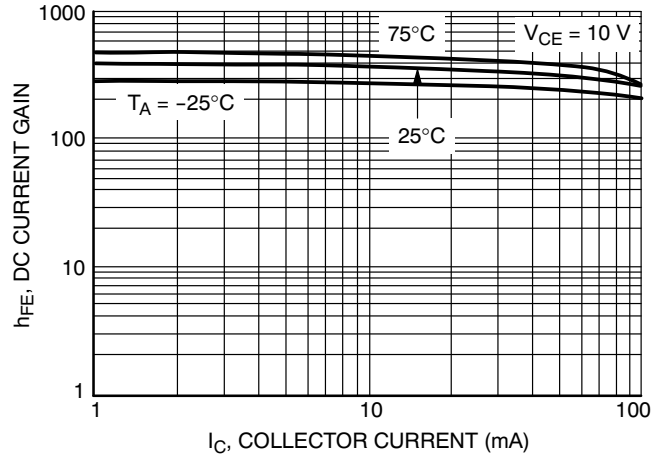


Figure 28. DC Current Gain

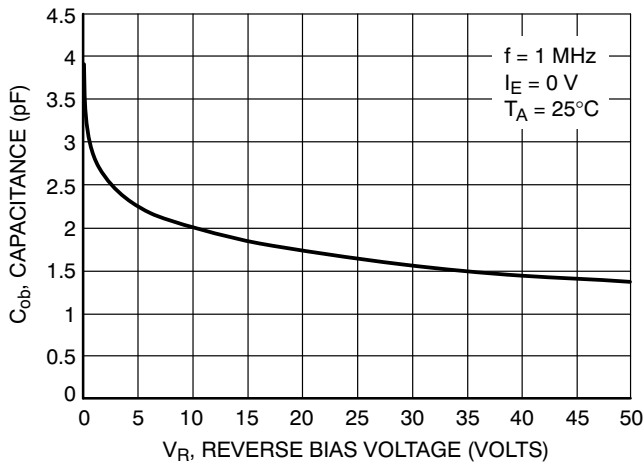


Figure 29. Output Capacitance

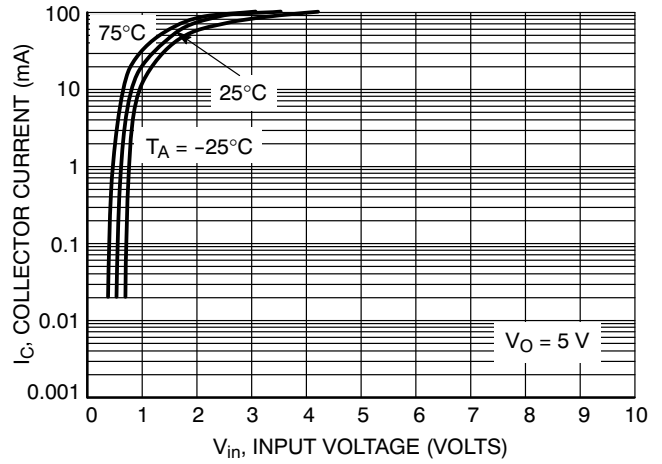


Figure 30. Output Current versus Input Voltage

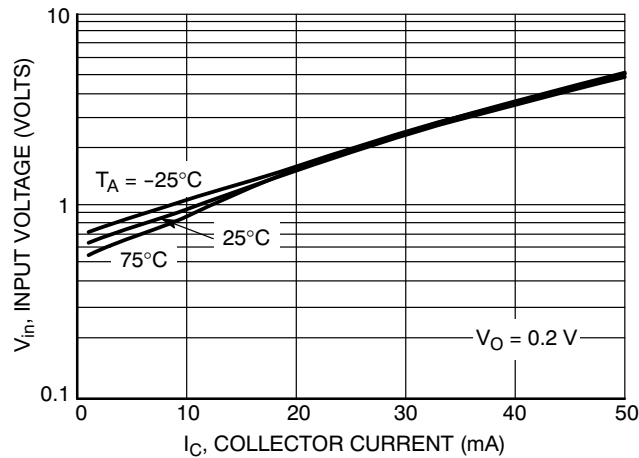


Figure 31. Input Voltage versus Output Current

TYPICAL ELECTRICAL CHARACTERISTICS — MMUN2230LT1

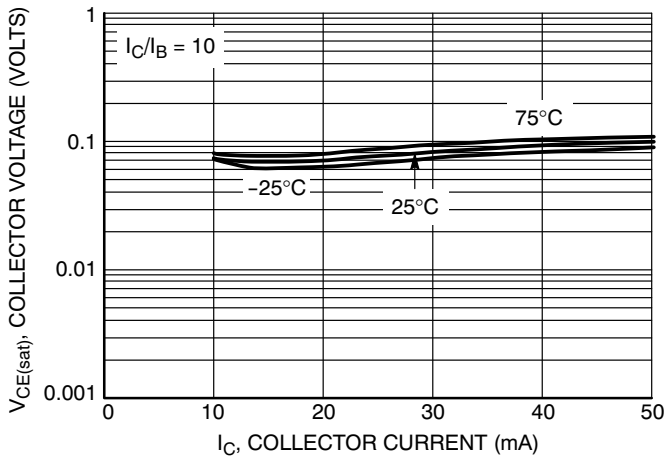


Figure 32. $V_{CE(sat)}$ versus I_C

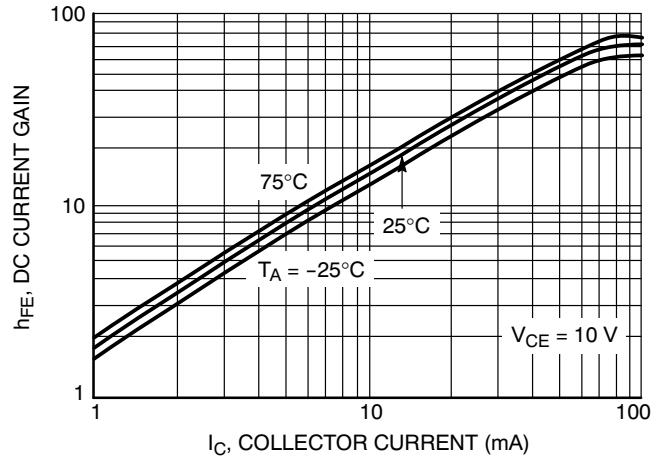


Figure 33. DC Current Gain

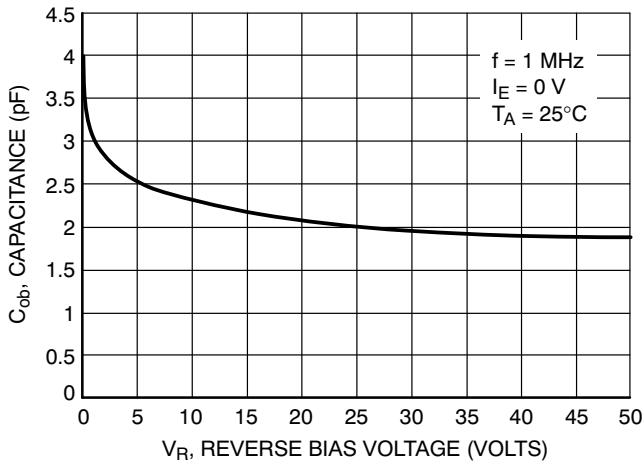


Figure 34. Output Capacitance

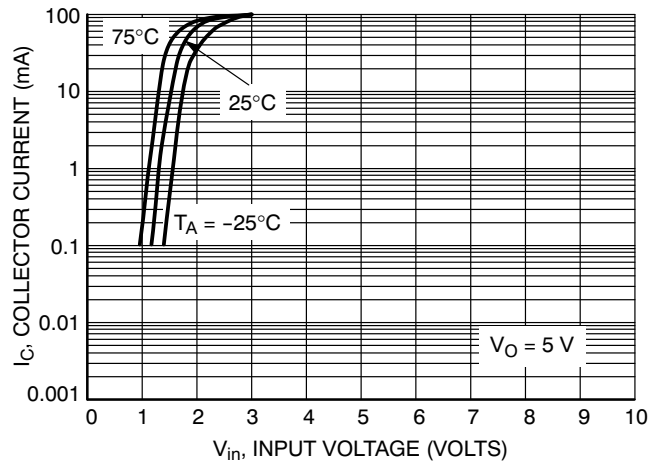


Figure 35. Output Current versus Input Voltage

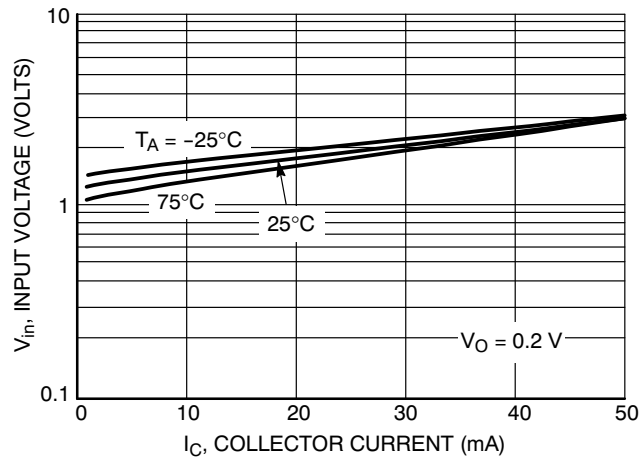


Figure 36. Input Voltage versus Output Current

MMUN2211LT1 Series

TYPICAL ELECTRICAL CHARACTERISTICS — MMUN2231LT1

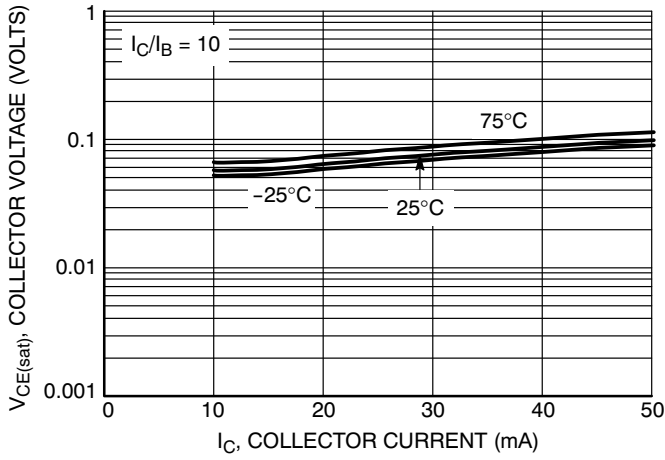


Figure 37. $V_{CE(sat)}$ versus I_C

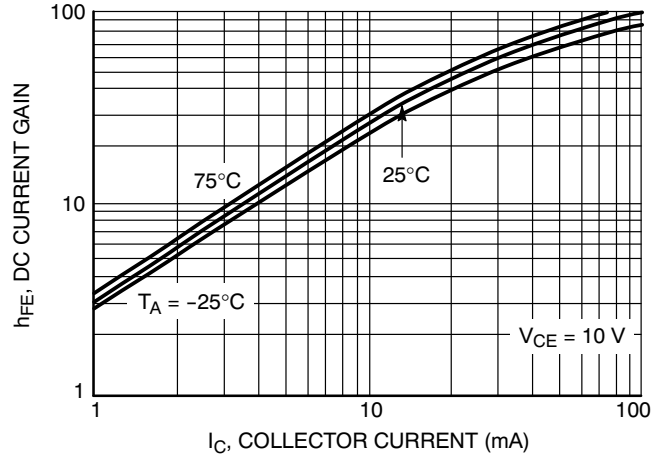


Figure 38. DC Current Gain

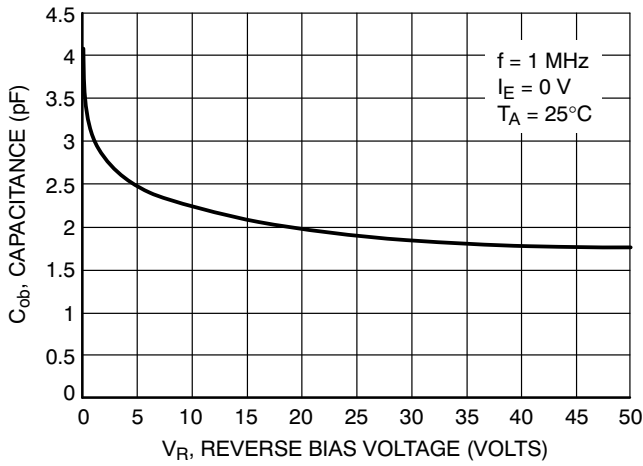


Figure 39. Output Capacitance

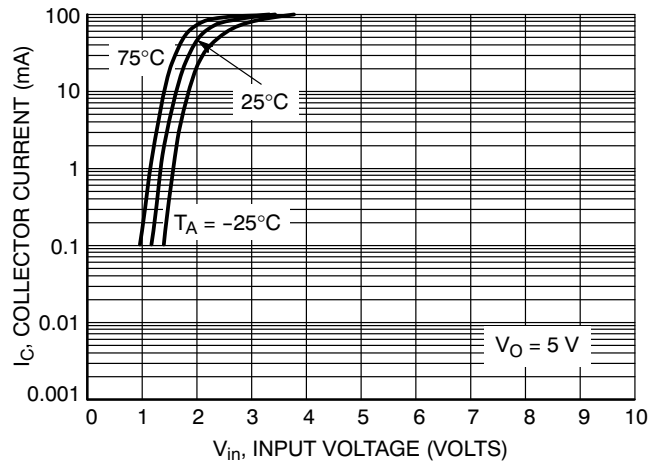


Figure 40. Output Current versus Input Voltage

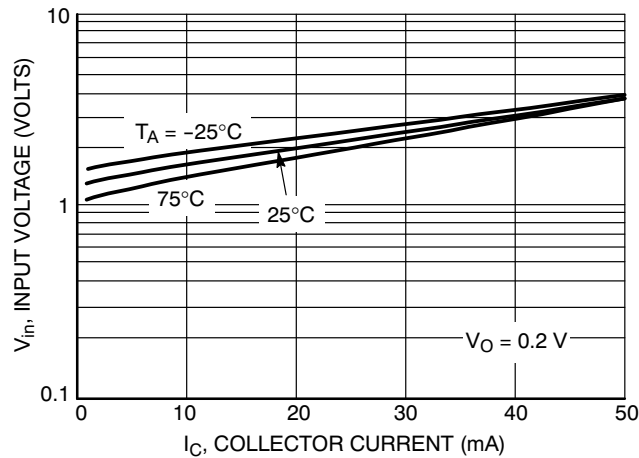


Figure 41. Input Voltage versus Output Current

MMUN2211LT1 Series

TYPICAL ELECTRICAL CHARACTERISTICS - MMUN2232LT1

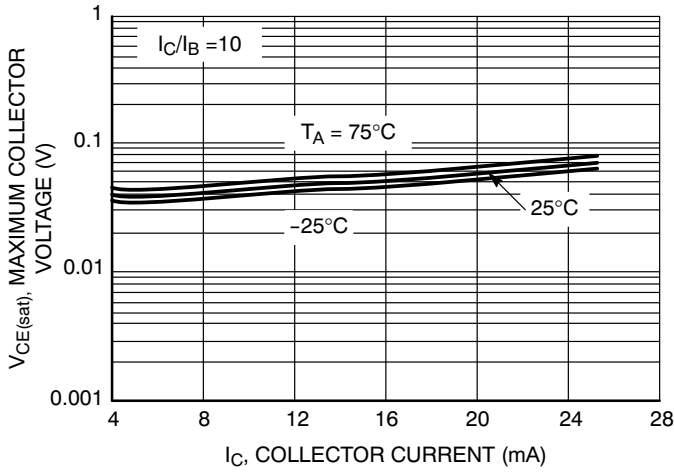


Figure 42. $V_{CE(sat)}$ vs. I_C

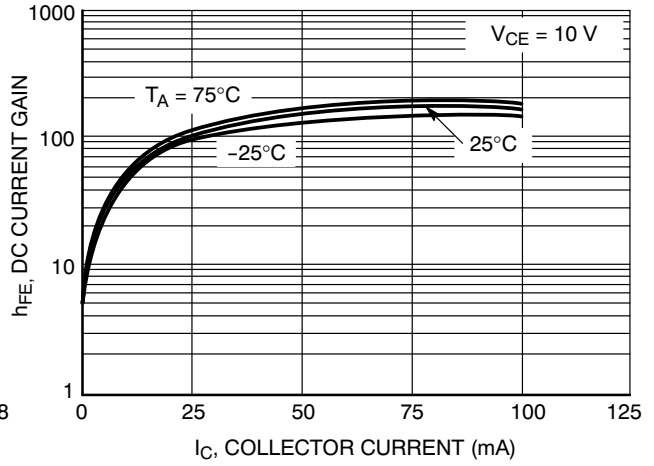


Figure 43. DC Current Gain

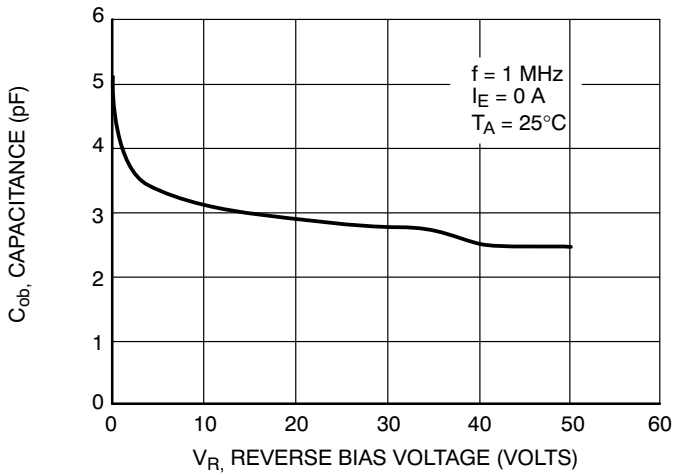


Figure 44. Output Capacitance

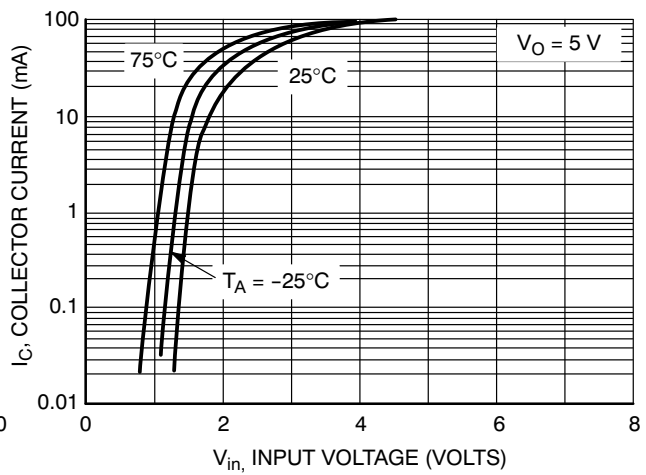


Figure 45. Output Current vs. Input Voltage

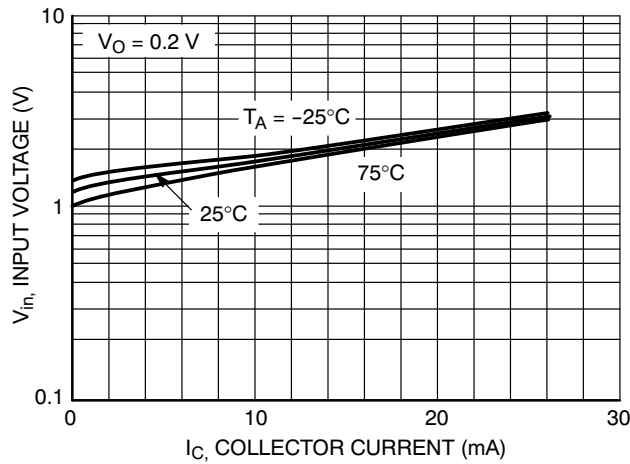


Figure 46. Output Voltage vs. Input Current

MMUN2211LT1 Series

TYPICAL ELECTRICAL CHARACTERISTICS - MMUN2233LT1

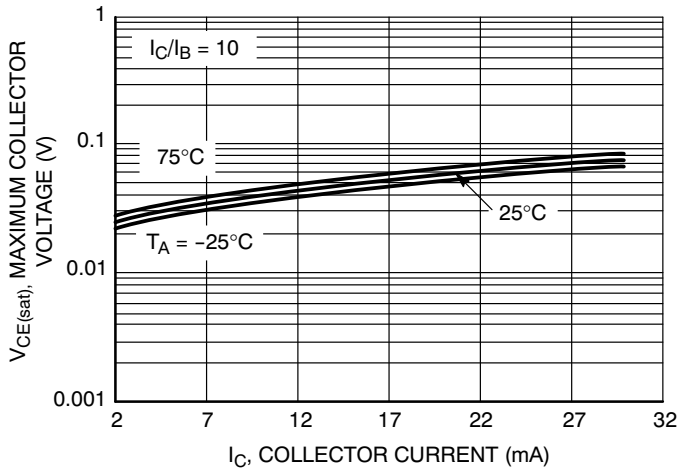


Figure 47. $V_{CE(sat)}$ vs. I_C

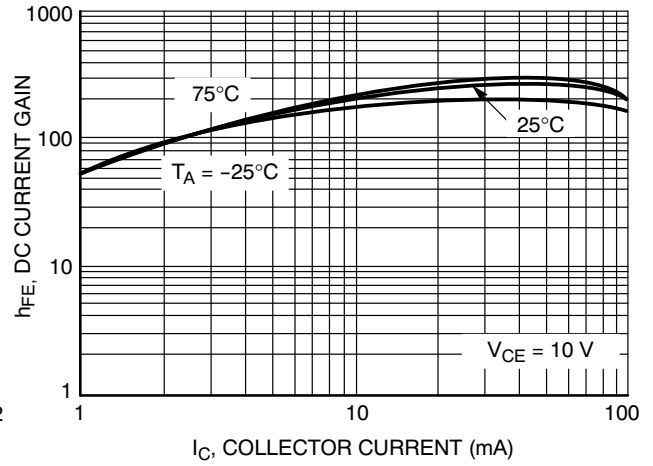


Figure 48. DC Current Gain

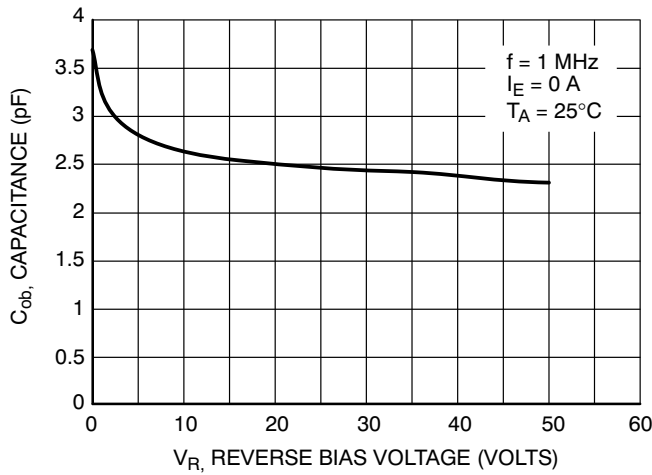


Figure 49. Output Capacitance

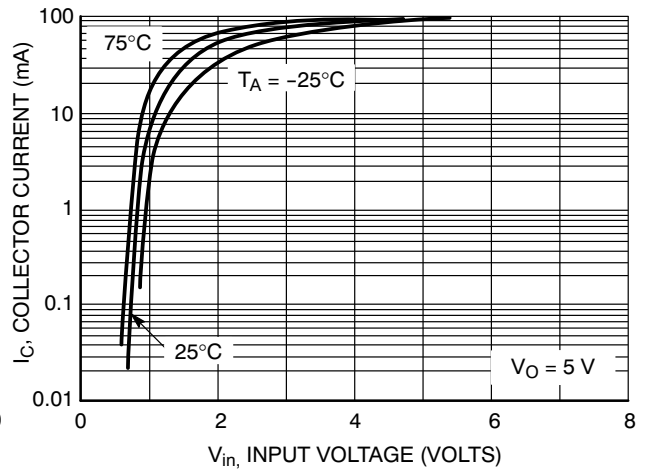


Figure 50. Output Current vs. Input Voltage

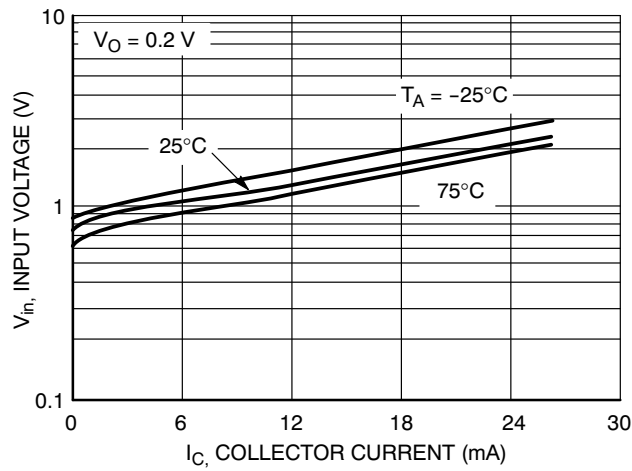


Figure 51. Input Voltage vs. Output Current

MMUN2211LT1 Series

TYPICAL ELECTRICAL CHARACTERISTICS — MMUN2234LT1

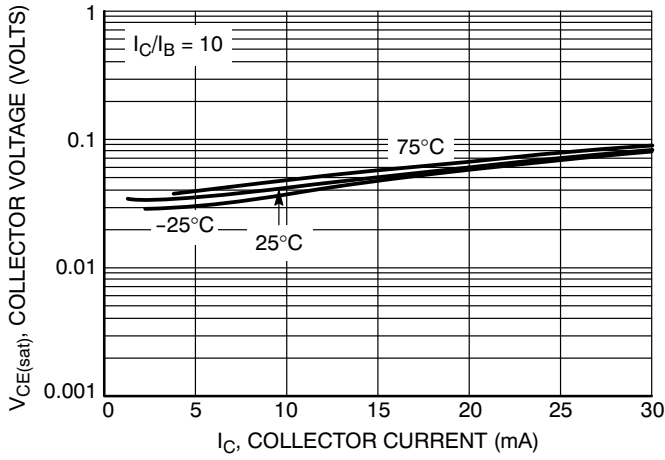


Figure 52. $V_{CE(sat)}$ versus I_C

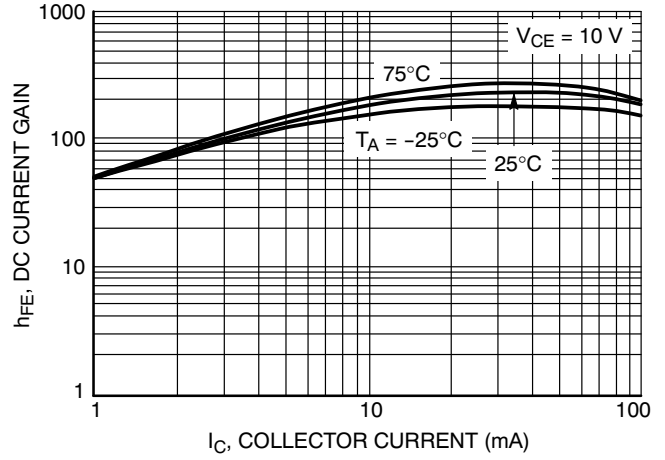


Figure 53. DC Current Gain

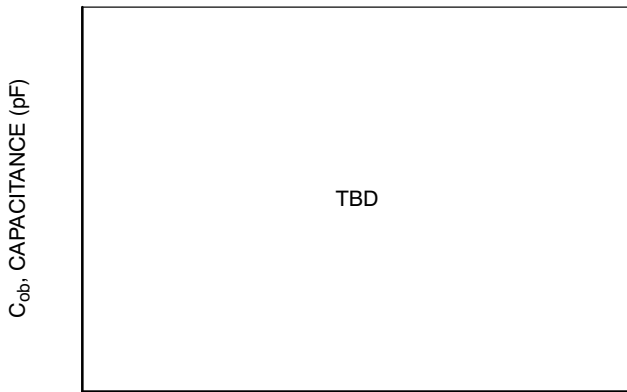


Figure 54. Output Capacitance

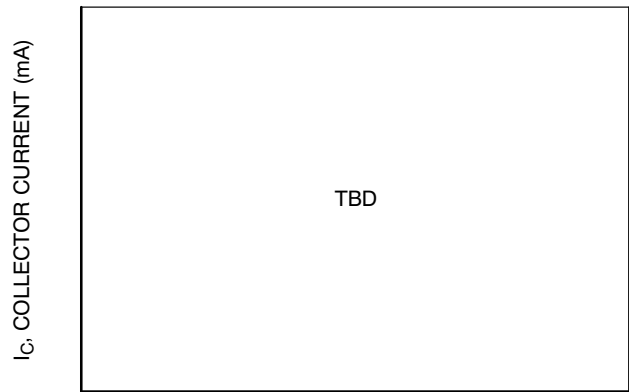


Figure 55. Output Current versus Input Voltage

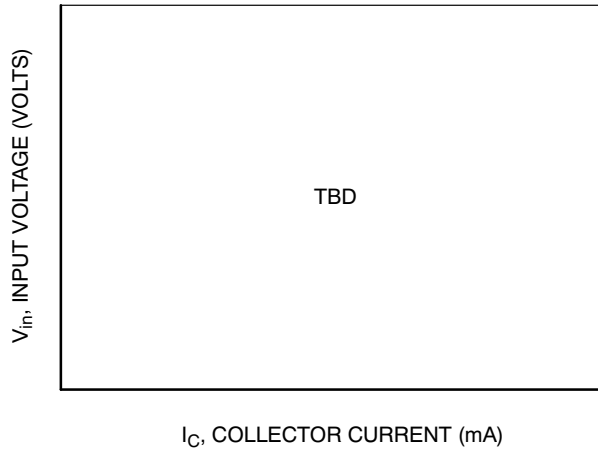


Figure 56. Input Voltage versus Output Current

MMUN2211LT1 Series

TYPICAL APPLICATIONS FOR NPN BRTs

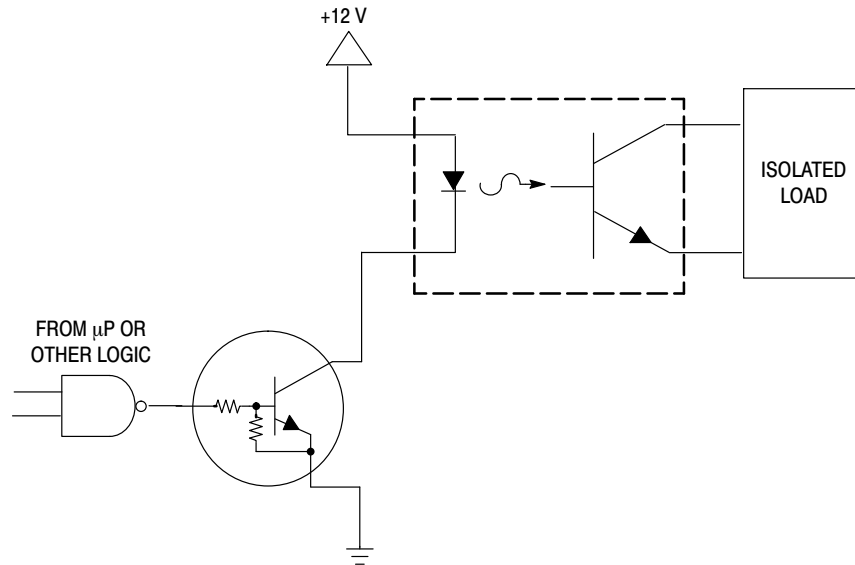


Figure 57. Level Shifter: Connects 12 or 24 Volt Circuits to Logic

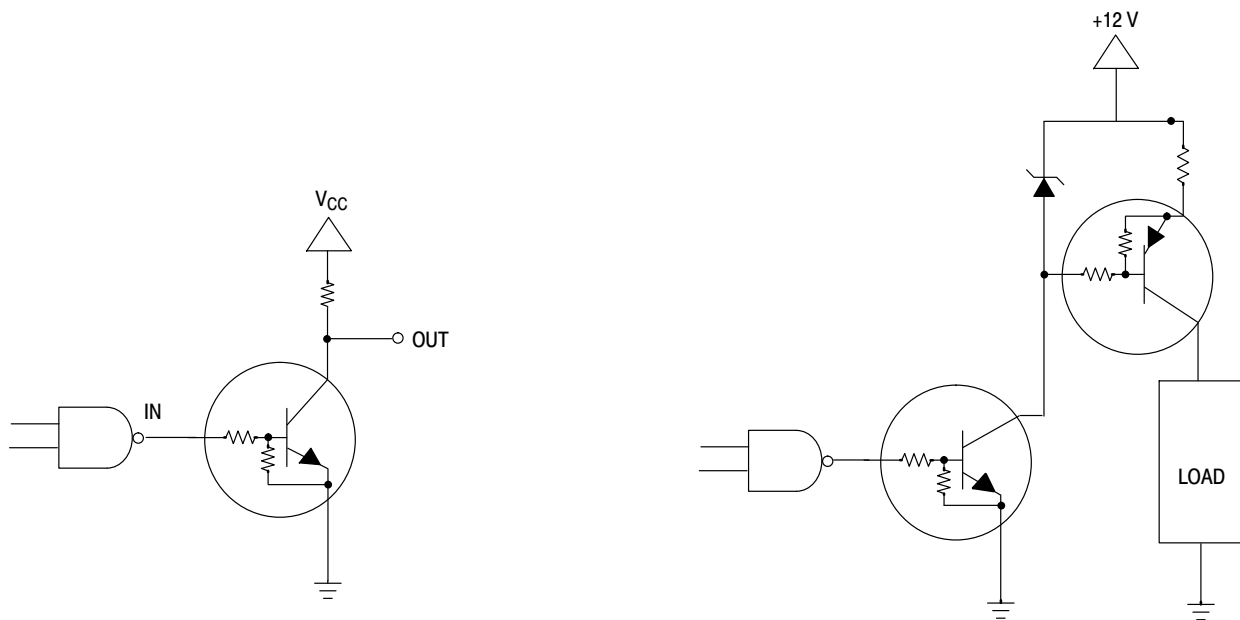


Figure 58. Open Collector Inverter: Inverts the Input Signal

Figure 59. Inexpensive, Unregulated Current Source

MMUN2211LT1 Series

ORDERING INFORMATION

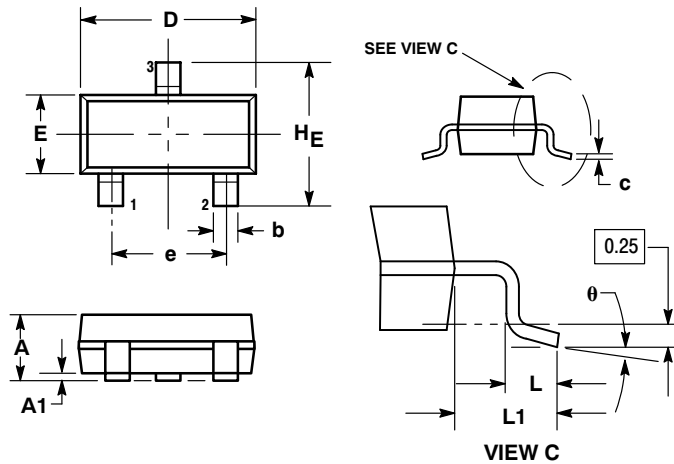
| Device | Marking | R1(k) | R2(k) | Package | Shipping [†] |
|--------------|---------|-------|-------|---------------------|-----------------------|
| MMUN2211LT1 | A8A | 10 | 10 | SOT-23 | 3000 / Tape & Reel |
| MMUN2211LT1G | | 10 | 10 | SOT-23 (Pb-Free) | |
| MMUN2211LT3 | | 10 | 10 | SOT-23 | 10,000 / Tape & Reel |
| MMUN2211LT3G | | 10 | 10 | SOT-23 (Pb-Free) | |
| MMUN2212LT1 | A8B | 22 | 22 | SOT-23 | 3000 / Tape & Reel |
| MMUN2212LT1G | | 22 | 22 | SOT-23 (Pb-Free) | |
| MMUN2213LT1 | A8C | 47 | 47 | SOT-23 | |
| MMUN2213LT1G | | 47 | 47 | SOT-23 (Pb-Free) | |
| MMUN2214LT1 | A8D | 10 | 47 | SOT-23 | |
| MMUN2214LT1G | | 10 | 47 | SOT-23 (Pb-Free) | |
| MMUN2215LT1 | A8E | 10 | ∞ | SOT-23 | |
| MMUN2215LT1G | | 10 | ∞ | SOT-23 (Pb-Free) | |
| MMUN2216LT1 | A8F | 4.7 | ∞ | SOT-23 | |
| MMUN2216LT1G | | 4.7 | ∞ | SOT-23 (Pb-Free) | |
| MMUN2230LT1 | A8G | 1.0 | 1.0 | SOT-23 | |
| MMUN2230LT1G | | 1.0 | 1.0 | SOT-23 (Pb-Free) | |
| MMUN2231LT1 | A8H | 2.2 | 2.2 | SOT-23 | |
| MMUN2231LT1G | | 2.2 | 2.2 | SOT-23 (Pb-Free) | |
| MMUN2232LT1 | A8J | 4.7 | 4.7 | SOT-23 | |
| MMUN2232LT1G | | 4.7 | 4.7 | SOT-23 (Pb-Free) | |
| MMUN2233LT1 | A8K | 4.7 | 47 | SOT-23 | |
| MMUN2233LT1G | | 4.7 | 47 | SOT-23 (Pb-Free) | |
| MMUN2234LT1 | A8L | 22 | 47 | SOT-23 | |
| MMUN2234LT1G | | 22 | 47 | SOT-23 (Pb-Free) | |
| MMUN2234LT3 | | 22 | 47 | SOT-23 | 10,000 / Tape & Reel |
| MMUN2234LT3G | | 22 | 47 | SOT-23 (Pb-Free) | |
| MMUN2238LT1 | A8R | 2.2 | ∞ | SOT-23 | 3000 / Tape & Reel |
| MMUN2238LT1G | | 2.2 | ∞ | SOT-23 (Pb-Free) | |
| MMUN2241LT1 | A8U | 100 | ∞ | SOT-23 | |
| MMUN2241LT1G | | 100 | ∞ | SOT-23 (Pb-Free) | |

[†]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.

MMUN2211LT1 Series

PACKAGE DIMENSIONS

SOT-23 (TO-236)
CASE 318-08
ISSUE AN



NOTES:

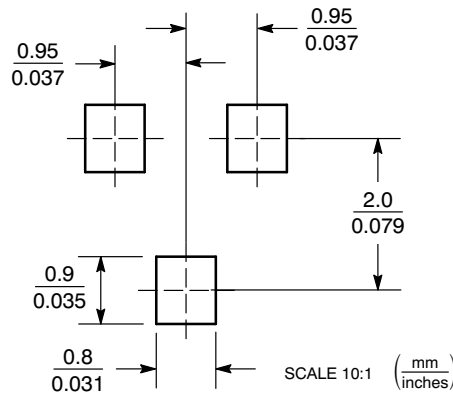
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH.
3. MAXIMUM LEAD THICKNESS INCLUDES LEAD FINISH THICKNESS. MINIMUM LEAD THICKNESS IS THE MINIMUM THICKNESS OF BASE MATERIAL.
4. 318-01 THRU -07 AND -09 OBSOLETE, NEW STANDARD 318-08.

| DIM | MILLIMETERS | | | INCHES | | |
|-----|-------------|------|------|--------|-------|-------|
| | 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 |
| HE | 2.10 | 2.40 | 2.64 | 0.083 | 0.094 | 0.104 |

STYLE 6:

- PIN 1. BASE
- EMITTER
- COLLECTOR

SOLDERING FOOTPRINT*



*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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