

# MMUN2211LT1 Series

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

| Characteristic                                                                              | Symbol               | Min | Typ | Max  | Unit |
|---------------------------------------------------------------------------------------------|----------------------|-----|-----|------|------|
| <b>OFF CHARACTERISTICS</b>                                                                  |                      |     |     |      |      |
| Collector-Base Cutoff Current (V <sub>CB</sub> = 50 V, I <sub>E</sub> = 0)                  | I <sub>CBO</sub>     | -   | -   | 100  | nAdc |
| Collector-Emitter Cutoff Current (V <sub>CE</sub> = 50 V, I <sub>B</sub> = 0)               | I <sub>CEO</sub>     | -   | -   | 500  | nAdc |
| Emitter-Base Cutoff Current<br>(V <sub>EB</sub> = 6.0 V, I <sub>C</sub> = 0)                | I <sub>EBO</sub>     | -   | -   | 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 <sub>C</sub> = 10 μA, I <sub>E</sub> = 0)               | V <sub>(BR)CBO</sub> | 50  | -   | -    | Vdc  |
| Collector-Emitter Breakdown Voltage (Note 3), (I <sub>C</sub> = 2.0 mA, I <sub>B</sub> = 0) | V <sub>(BR)CEO</sub> | 50  | -   | -    | Vdc  |

## ON CHARACTERISTICS (Note 3)

|                                                                                           |                |                      |     |     |      |     |
|-------------------------------------------------------------------------------------------|----------------|----------------------|-----|-----|------|-----|
| DC Current Gain<br>(V <sub>CE</sub> = 10 V, I <sub>C</sub> = 5.0 mA)                      | MMUN2211LT1, G | h <sub>FE</sub>      | 35  | 60  | -    |     |
|                                                                                           | MMUN2212LT1, G |                      | 60  | 100 | -    |     |
|                                                                                           | MMUN2213LT1, G |                      | 80  | 140 | -    |     |
|                                                                                           | MMUN2214LT1, G |                      | 80  | 140 | -    |     |
|                                                                                           | MMUN2215LT1, G |                      | 160 | 350 | -    |     |
|                                                                                           | MMUN2216LT1, G |                      | 160 | 350 | -    |     |
|                                                                                           | MMUN2230LT1, G |                      | 3.0 | 5.0 | -    |     |
|                                                                                           | MMUN2231LT1, G |                      | 8.0 | 15  | -    |     |
|                                                                                           | MMUN2232LT1, G |                      | 15  | 30  | -    |     |
|                                                                                           | MMUN2233LT1, G |                      | 80  | 200 | -    |     |
|                                                                                           | MMUN2234LT1, G |                      | 80  | 150 | -    |     |
|                                                                                           | MMUN2238LT1, G |                      | 160 | 350 | -    |     |
|                                                                                           | MMUN2241LT1, G |                      | 160 | 350 | -    |     |
| Collector-Emitter Saturation Voltage<br>(I <sub>C</sub> = 10 mA, I <sub>B</sub> = 0.3 mA) | MMUN2211LT1, G | V <sub>CE(sat)</sub> | -   | -   | 0.25 | Vdc |
|                                                                                           | MMUN2212LT1, G |                      | -   | -   | 0.25 |     |
|                                                                                           | MMUN2213LT1, G |                      | -   | -   | 0.25 |     |
|                                                                                           | MMUN2214LT1, G |                      | -   | -   | 0.25 |     |
|                                                                                           | MMUN2233LT1, G |                      | -   | -   | 0.25 |     |
|                                                                                           | MMUN2234LT1, G |                      | -   | -   | 0.25 |     |
| (I <sub>C</sub> = 10 mA, I <sub>B</sub> = 1 mA)                                           | MMUN2215LT1, G |                      | -   | -   | 0.25 |     |
|                                                                                           | MMUN2216LT1, G |                      | -   | -   | 0.25 |     |
|                                                                                           | MMUN2232LT1, G |                      | -   | -   | 0.25 |     |
|                                                                                           | MMUN2238LT1, G |                      | -   | -   | 0.25 |     |
| (I <sub>C</sub> = 10 mA, I <sub>B</sub> = 5 mA)                                           | MMUN2230LT1, G |                      | -   | -   | 0.25 |     |
|                                                                                           | MMUN2231LT1, G |                      | -   | -   | 0.25 |     |
|                                                                                           | MMUN2241LT1, G |                      | -   | -   | 0.25 |     |

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

# MMUN2211LT1 Series

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

| Characteristic                                                                                     | Symbol          | Min   | Typ  | Max   | Unit |
|----------------------------------------------------------------------------------------------------|-----------------|-------|------|-------|------|
| <b>ON CHARACTERISTICS</b> (Note 4)                                                                 |                 |       |      |       |      |
| Output Voltage (on)<br>(V <sub>CC</sub> = 5.0 V, V <sub>B</sub> = 2.5 V, R <sub>L</sub> = 1.0 kΩ)  | V <sub>OL</sub> | -     | -    | 0.2   | Vdc  |
| MMUN2211LT1, G                                                                                     |                 | -     | -    | 0.2   |      |
| MMUN2212LT1, G                                                                                     |                 | -     | -    | 0.2   |      |
| MMUN2214LT1, G                                                                                     |                 | -     | -    | 0.2   |      |
| MMUN2215LT1, G                                                                                     |                 | -     | -    | 0.2   |      |
| MMUN2216LT1, G                                                                                     |                 | -     | -    | 0.2   |      |
| MMUN2230LT1, G                                                                                     |                 | -     | -    | 0.2   |      |
| MMUN2231LT1, G                                                                                     |                 | -     | -    | 0.2   |      |
| MMUN2232LT1, G                                                                                     |                 | -     | -    | 0.2   |      |
| MMUN2233LT1, G                                                                                     |                 | -     | -    | 0.2   |      |
| MMUN2234LT1, G                                                                                     |                 | -     | -    | 0.2   |      |
| MMUN2238LT1, G                                                                                     |                 | -     | -    | 0.2   |      |
| (V <sub>CC</sub> = 5.0 V, V <sub>B</sub> = 3.5 V, R <sub>L</sub> = 1.0 kΩ)                         |                 | -     | -    | 0.2   |      |
| MMUN2213LT1, G                                                                                     |                 | -     | -    | 0.2   |      |
| (V <sub>CC</sub> = 5.0 V, V <sub>B</sub> = 5.0 V, R <sub>L</sub> = 1.0 kΩ)                         |                 | -     | -    | 0.2   |      |
| MMUN2241LT1, G                                                                                     |                 | -     | -    | 0.2   |      |
| 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) | V <sub>OH</sub> | 4.9   | -    | -     | Vdc  |
| MMUN2211LT1, G                                                                                     |                 | 4.9   | -    | -     |      |
| MMUN2212LT1, G                                                                                     |                 | 4.9   | -    | -     |      |
| MMUN2213LT1, G                                                                                     |                 | 4.9   | -    | -     |      |
| MMUN2214LT1, G                                                                                     |                 | 4.9   | -    | -     |      |
| MMUN2233LT1, G                                                                                     |                 | 4.9   | -    | -     |      |
| (V <sub>CC</sub> = 5.0 V, V <sub>B</sub> = 0.05 V, R <sub>L</sub> = 1.0 kΩ)                        |                 | 4.9   | -    | -     |      |
| MMUN2230LT1, G                                                                                     |                 | 4.9   | -    | -     |      |
| MMUN2234LT1, G                                                                                     |                 | 4.9   | -    | -     |      |
| (V <sub>CC</sub> = 5.0 V, V <sub>B</sub> = 0.25 V, R <sub>L</sub> = 1.0 kΩ)                        |                 | 4.9   | -    | -     |      |
| MMUN2215LT1, G                                                                                     |                 | 4.9   | -    | -     |      |
| MMUN2216LT1, G                                                                                     |                 | 4.9   | -    | -     |      |
| MMUN2231LT1, G                                                                                     |                 | 4.9   | -    | -     |      |
| MMUN2232LT1, G                                                                                     |                 | 4.9   | -    | -     |      |
| MMUN2238LT1, G                                                                                     |                 | 4.9   | -    | -     |      |
| MMUN2241LT1, G                                                                                     |                 | 4.9   | -    | -     |      |
| Input Resistor                                                                                     | R1              | 7.0   | 10   | 13    | kΩ   |
| MMUN2211LT1, G                                                                                     |                 | 15.4  | 22   | 28.6  |      |
| MMUN2212LT1, G                                                                                     |                 | 32.9  | 47   | 61.1  |      |
| MMUN2213LT1, G                                                                                     |                 | 7.0   | 10   | 13    |      |
| MMUN2214LT1, G                                                                                     |                 | 7.0   | 10   | 13    |      |
| MMUN2215LT1, G                                                                                     |                 | 3.3   | 4.7  | 6.1   |      |
| MMUN2216LT1, G                                                                                     |                 | 0.7   | 1.0  | 1.3   |      |
| MMUN2230LT1, G                                                                                     |                 | 1.5   | 2.2  | 2.9   |      |
| MMUN2231LT1, G                                                                                     |                 | 3.3   | 4.7  | 6.1   |      |
| MMUN2232LT1, G                                                                                     |                 | 3.3   | 4.7  | 6.1   |      |
| MMUN2233LT1, G                                                                                     |                 | 3.3   | 4.7  | 6.1   |      |
| MMUN2234LT1, G                                                                                     |                 | 15.4  | 22   | 28.6  |      |
| MMUN2238LT1, G                                                                                     |                 | 1.54  | 2.2  | 2.88  |      |
| MMUN2241LT1, G                                                                                     |                 | 70    | 100  | 130   |      |
| Resistor Ratio                                                                                     | R1/R2           | 0.8   | 1.0  | 1.2   |      |
| MMUN2211LT1, G                                                                                     |                 | 0.8   | 1.0  | 1.2   |      |
| MMUN2212LT1, G                                                                                     |                 | 0.8   | 1.0  | 1.2   |      |
| MMUN2213LT1, G                                                                                     |                 | 0.8   | 1.0  | 1.2   |      |
| MMUN2214LT1, G                                                                                     |                 | 0.17  | 0.21 | 0.25  |      |
| MMUN2215LT1, G                                                                                     |                 | -     | -    | -     |      |
| MMUN2216LT1, G                                                                                     |                 | -     | -    | -     |      |
| MMUN2230LT1, G                                                                                     |                 | 0.8   | 1.0  | 1.2   |      |
| MMUN2231LT1, G                                                                                     |                 | 0.8   | 1.0  | 1.2   |      |
| MMUN2232LT1, G                                                                                     |                 | 0.8   | 1.0  | 1.2   |      |
| MMUN2233LT1, G                                                                                     |                 | 0.055 | 0.1  | 0.185 |      |
| MMUN2234LT1, G                                                                                     |                 | 0.38  | 0.47 | 0.56  |      |
| MMUN2238LT1, G                                                                                     |                 | -     | -    | -     |      |
| MMUN2241LT1, G                                                                                     |                 | -     | -    | -     |      |

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

TYPICAL ELECTRICAL CHARACTERISTICS - MMUN2211LT1

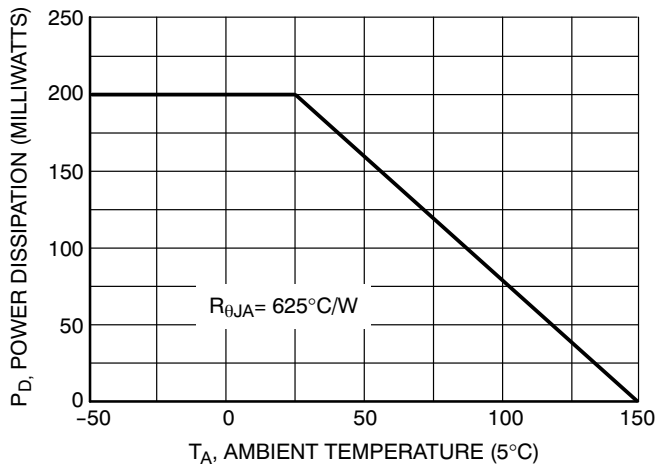


Figure 1. Derating Curve

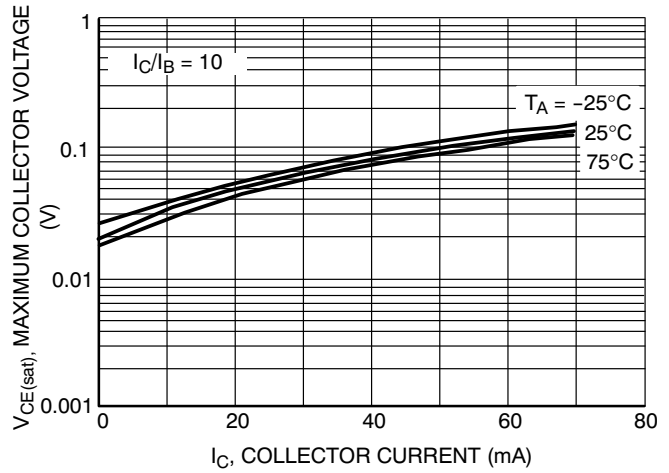


Figure 2.  $V_{CE(sat)}$  vs.  $I_C$

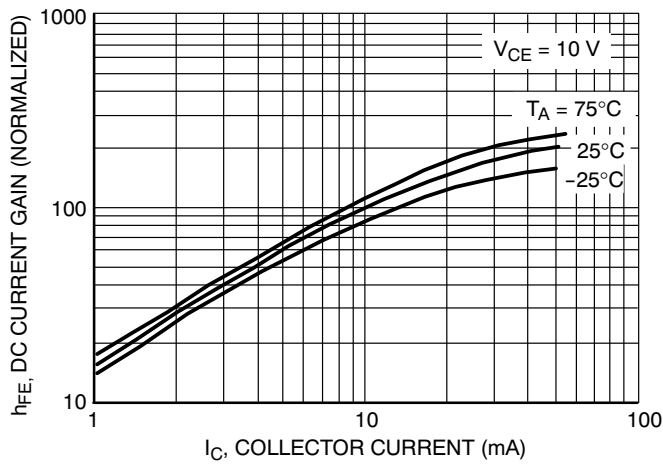


Figure 3. DC Current Gain

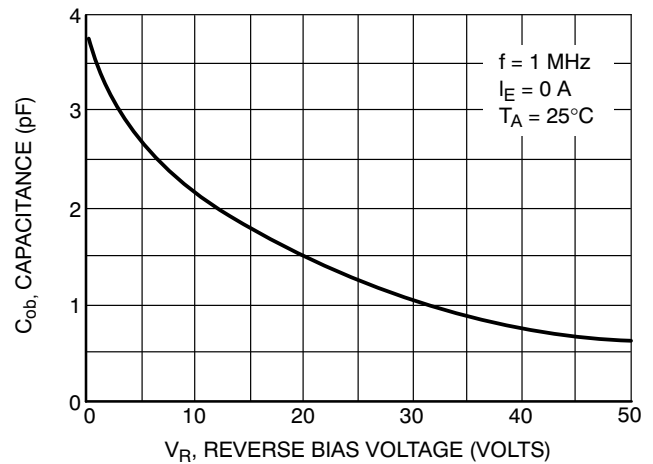


Figure 4. Output Capacitance

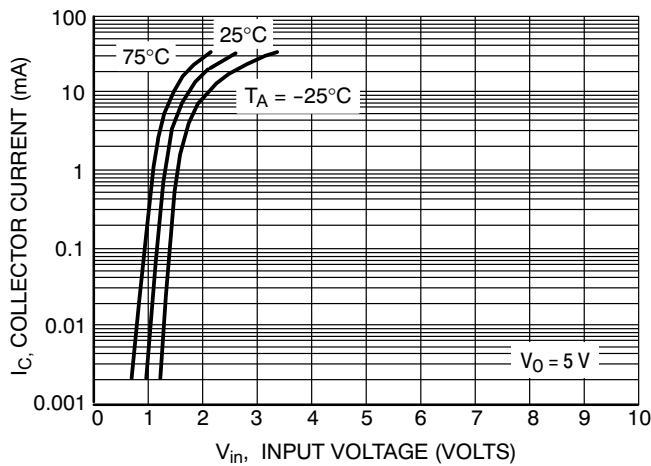


Figure 5. Output Current vs. Input Voltage

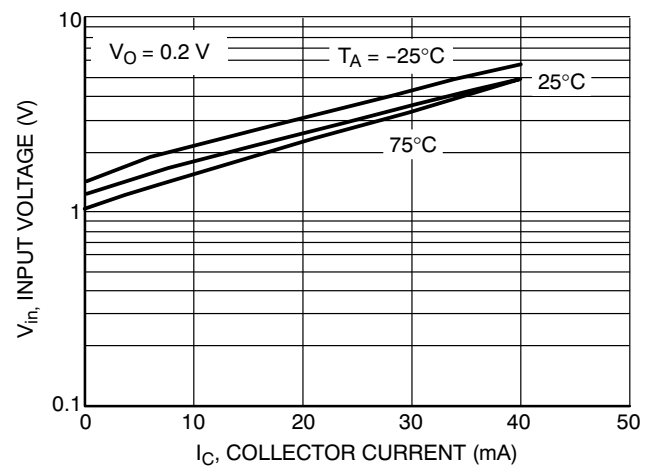


Figure 6. Input Voltage vs. Output Current

TYPICAL ELECTRICAL CHARACTERISTICS – MMUN2212LT1

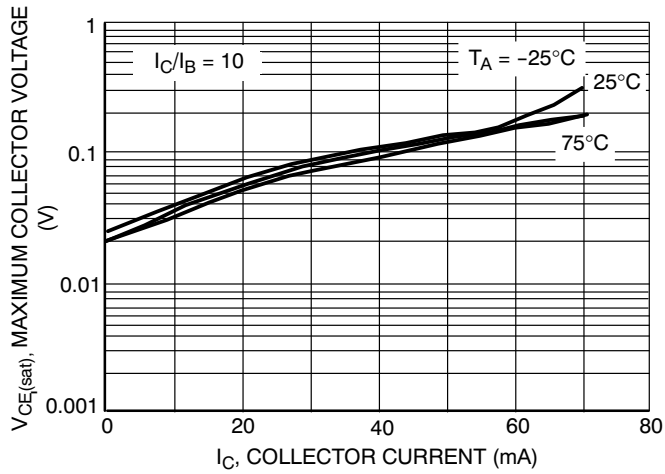


Figure 7.  $V_{CE(sat)}$  vs.  $I_C$

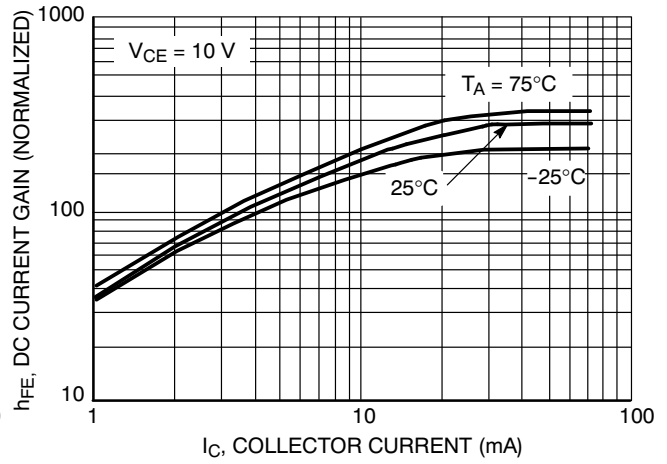


Figure 8. DC Current Gain

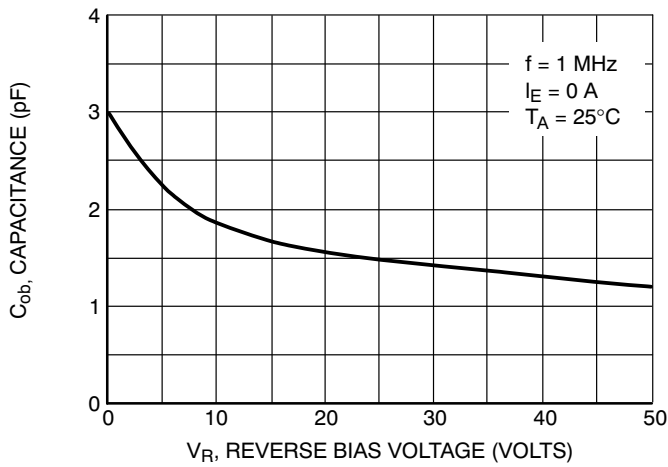


Figure 9. Output Capacitance

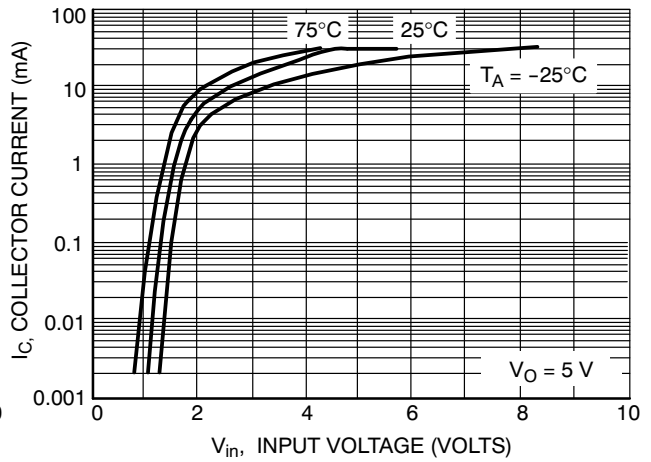


Figure 10. Output Current vs. Input Voltage

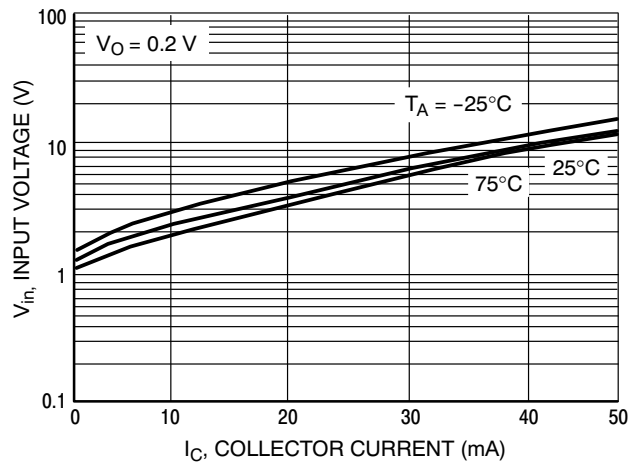


Figure 11. Input Voltage vs. Output Current

TYPICAL ELECTRICAL CHARACTERISTICS – MMUN2213LT1

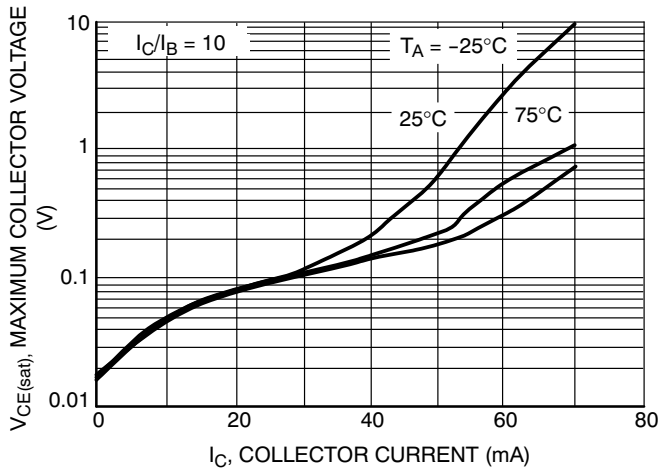


Figure 12.  $V_{CE(sat)}$  vs.  $I_C$

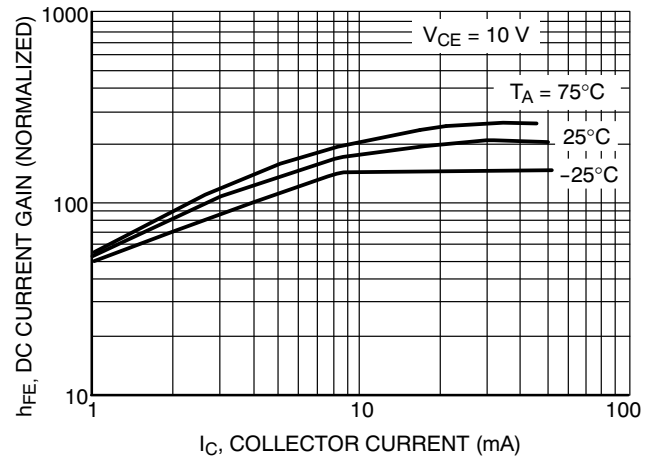


Figure 13. DC Current Gain

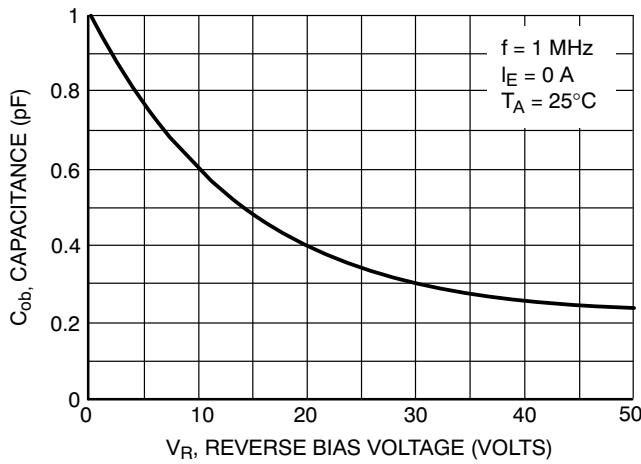


Figure 14. Output Capacitance

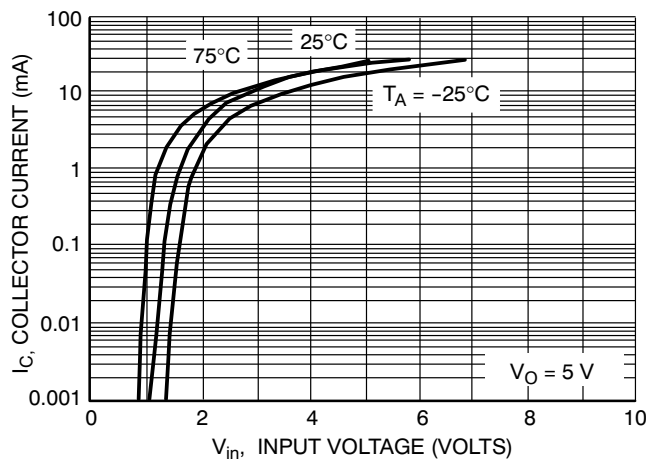


Figure 15. Output Current vs. Input Voltage

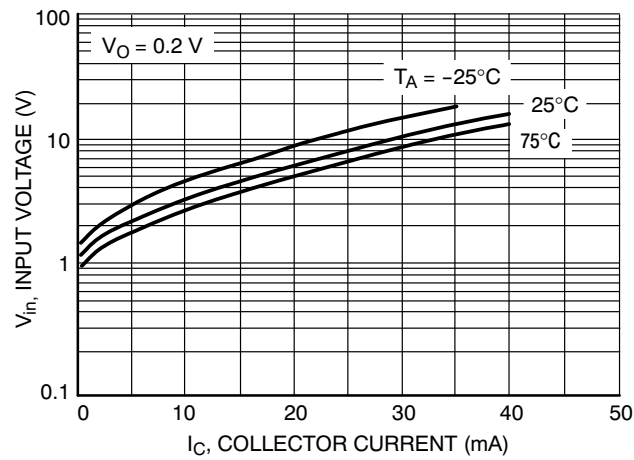


Figure 16. Input Voltage vs. Output Current

TYPICAL ELECTRICAL CHARACTERISTICS - MMUN2214LT1

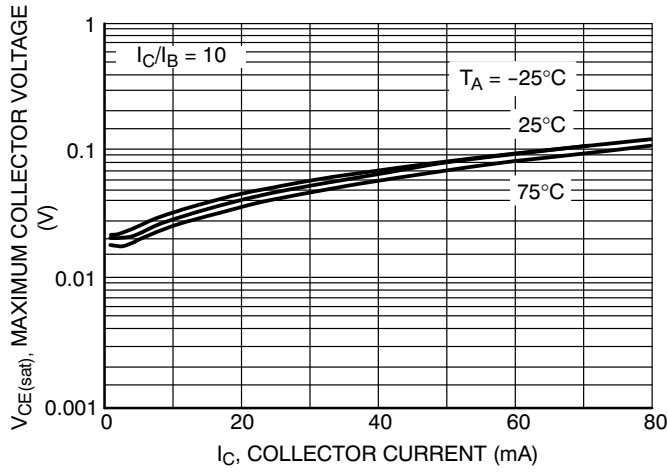


Figure 17.  $V_{CE(sat)}$  vs.  $I_C$

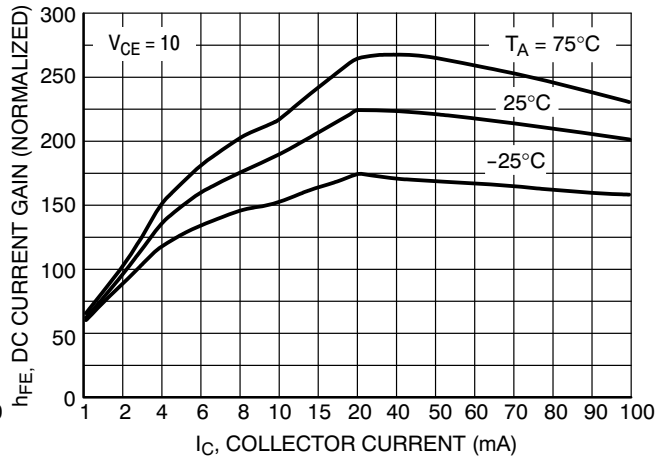


Figure 18. DC Current Gain

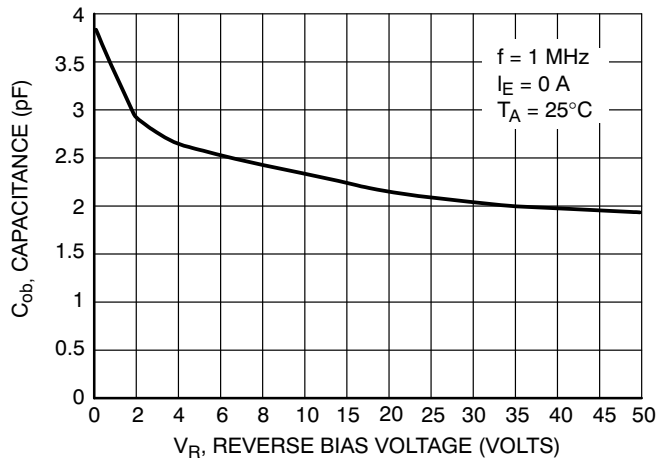


Figure 19. Output Capacitance

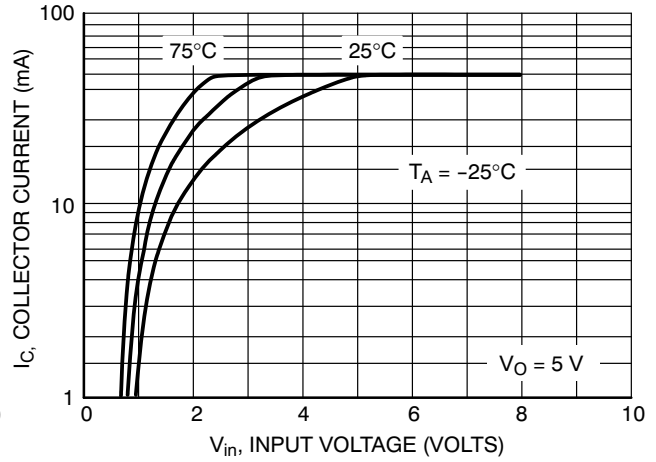


Figure 20. Output Current vs. Input Voltage

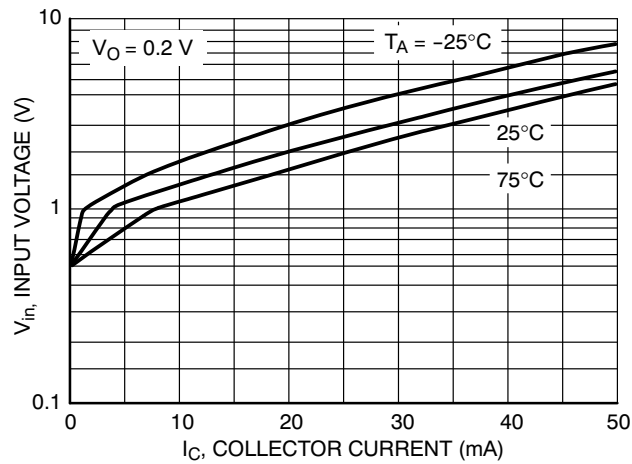


Figure 21. Input Voltage vs. Output Current

TYPICAL ELECTRICAL CHARACTERISTICS - MMUN2215LT1

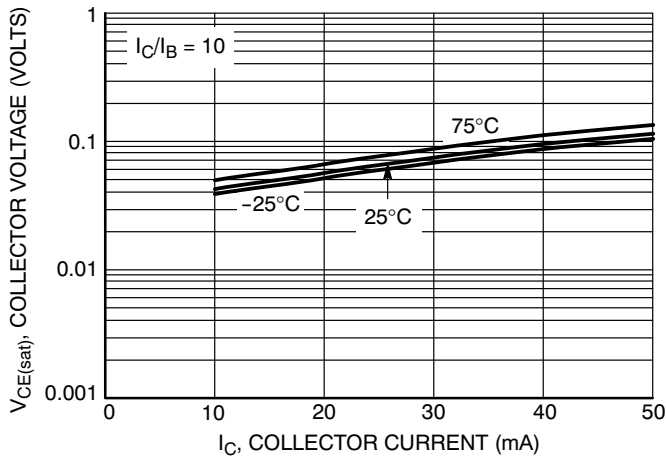


Figure 22.  $V_{CE(sat)}$  versus  $I_C$

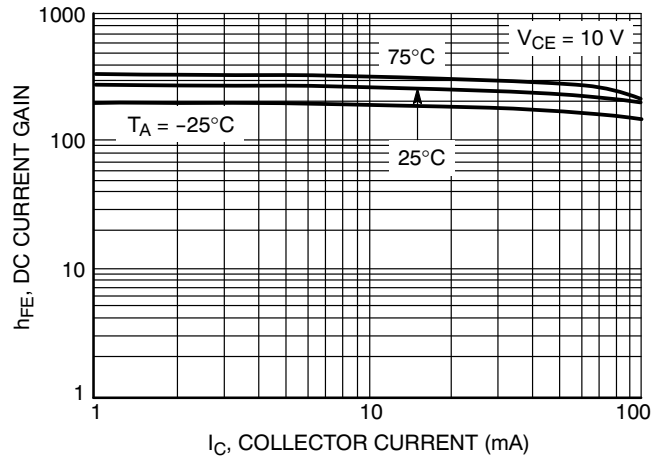


Figure 23. DC Current Gain

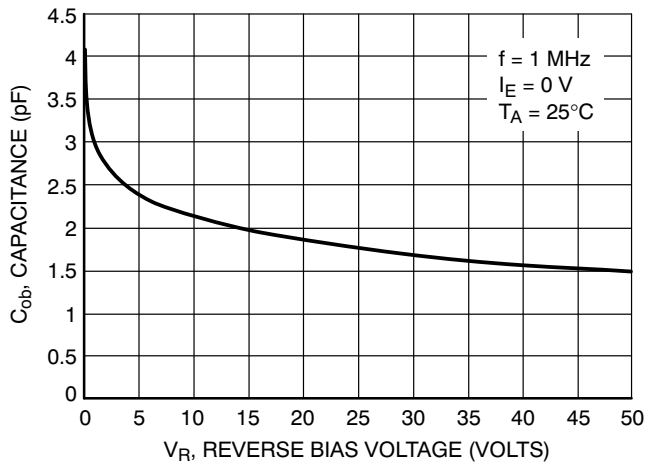


Figure 24. Output Capacitance

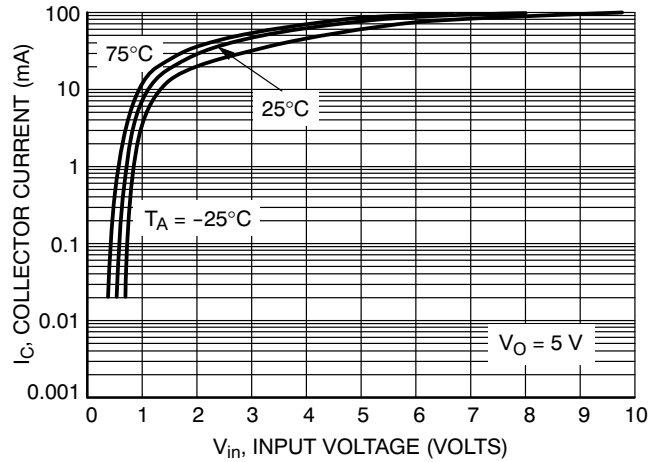


Figure 25. Output Current versus Input Voltage

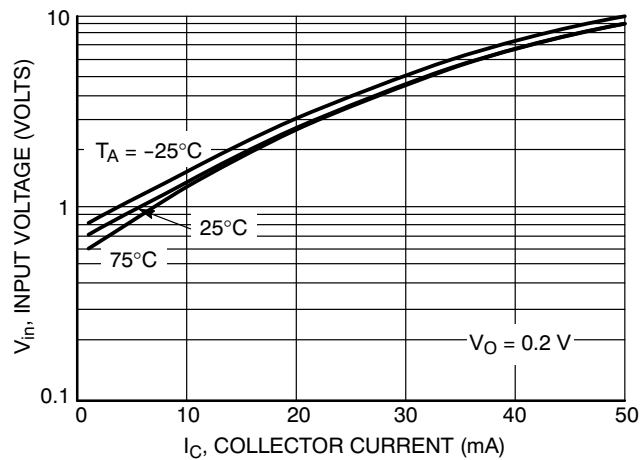


Figure 26. Input Voltage versus Output Current

TYPICAL ELECTRICAL CHARACTERISTICS — MMUN2216LT1

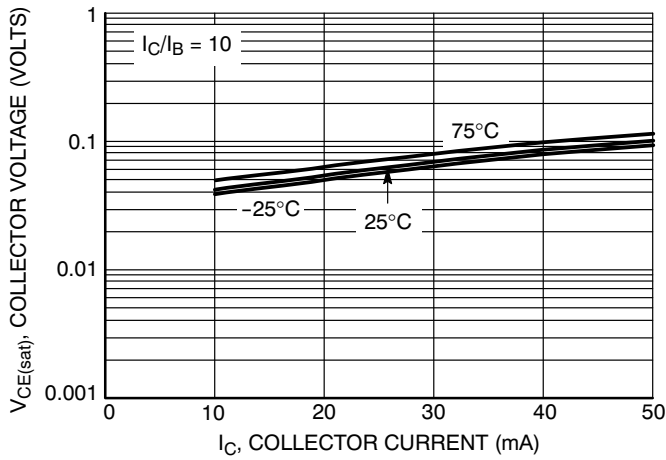


Figure 27.  $V_{CE(sat)}$  versus  $I_C$

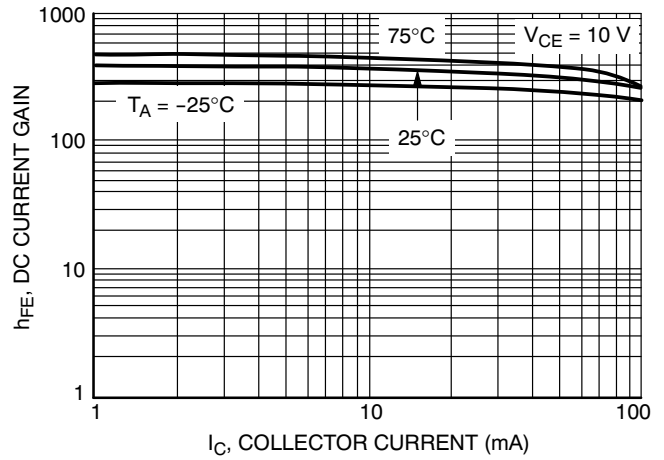


Figure 28. DC Current Gain

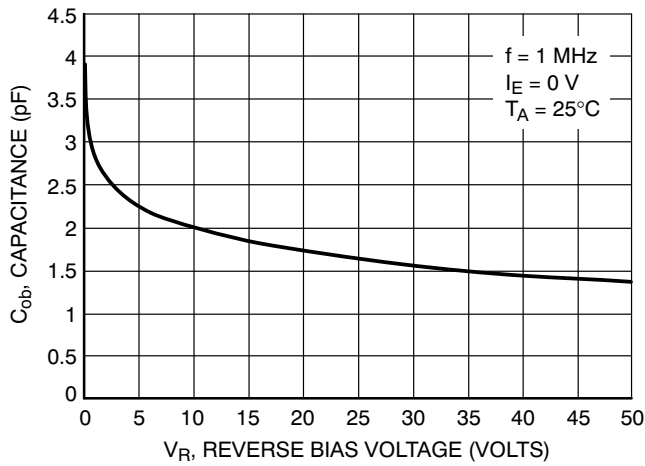


Figure 29. Output Capacitance

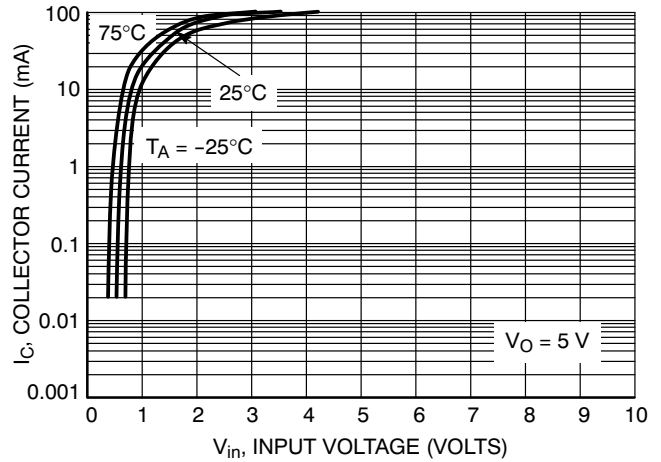


Figure 30. Output Current versus Input Voltage

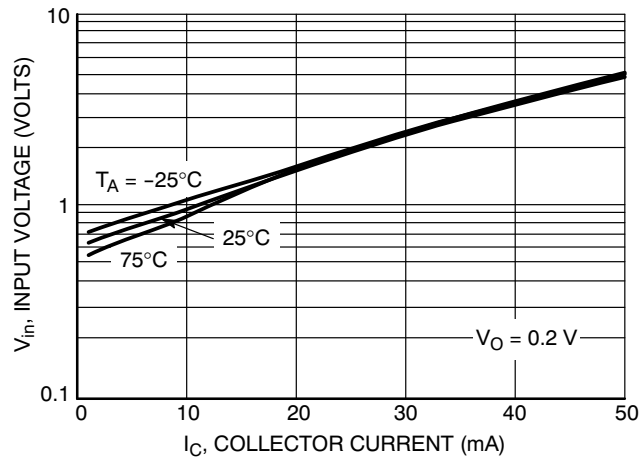


Figure 31. Input Voltage versus Output Current

TYPICAL ELECTRICAL CHARACTERISTICS — MMUN2230LT1

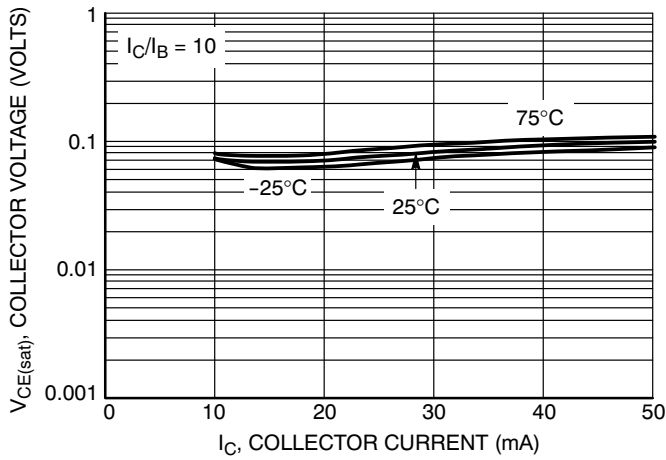


Figure 32.  $V_{CE(sat)}$  versus  $I_C$

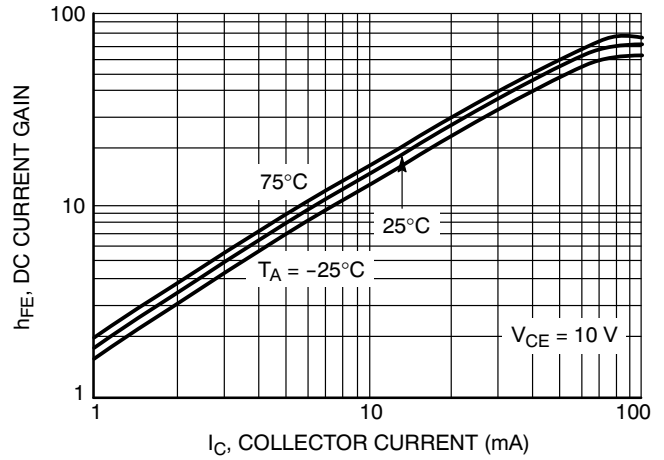


Figure 33. DC Current Gain

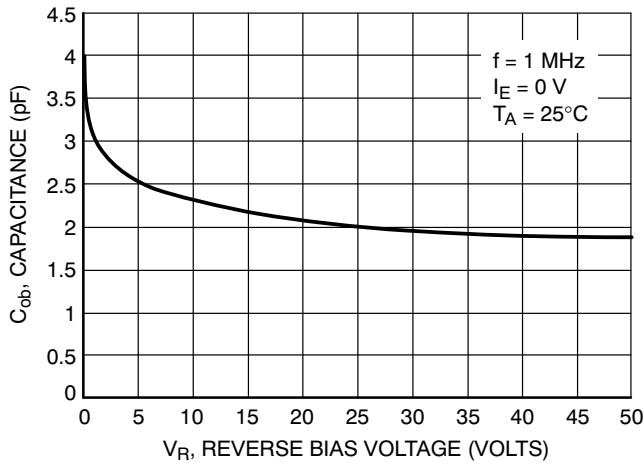


Figure 34. Output Capacitance

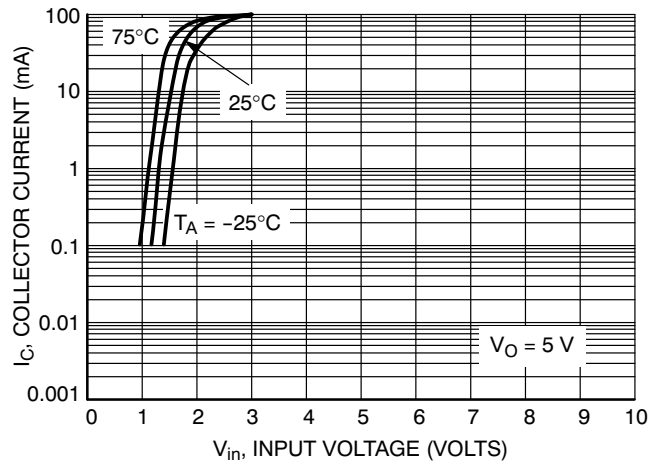


Figure 35. Output Current versus Input Voltage

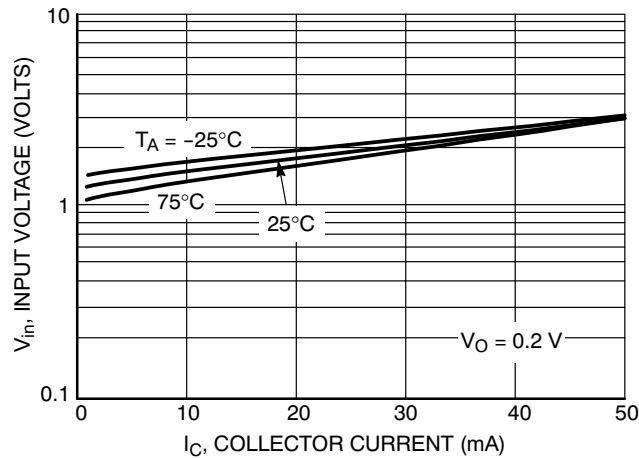


Figure 36. Input Voltage versus Output Current

TYPICAL ELECTRICAL CHARACTERISTICS — MMUN2231LT1

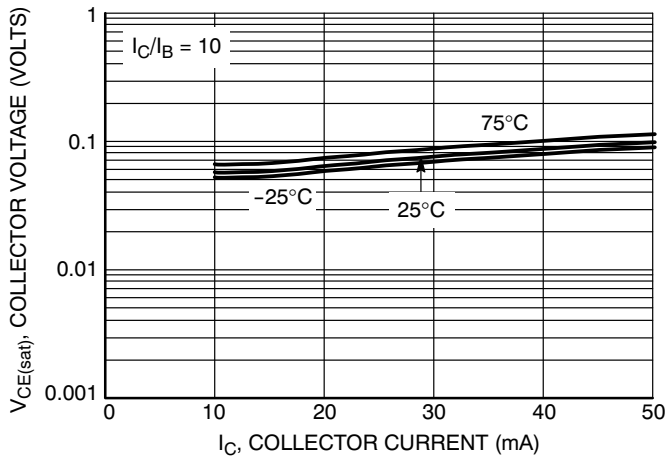


Figure 37.  $V_{CE(sat)}$  versus  $I_C$

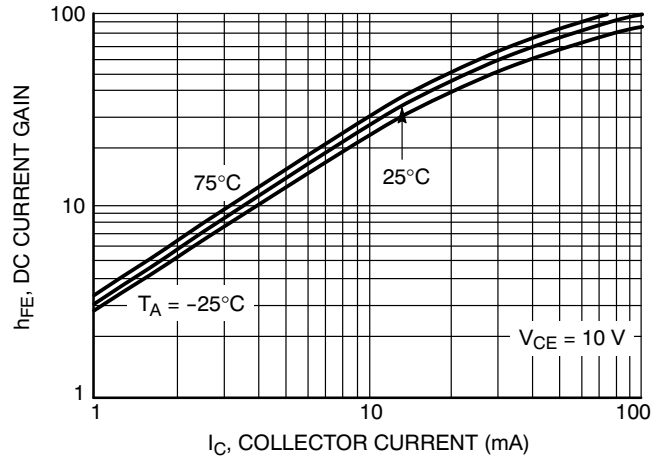


Figure 38. DC Current Gain

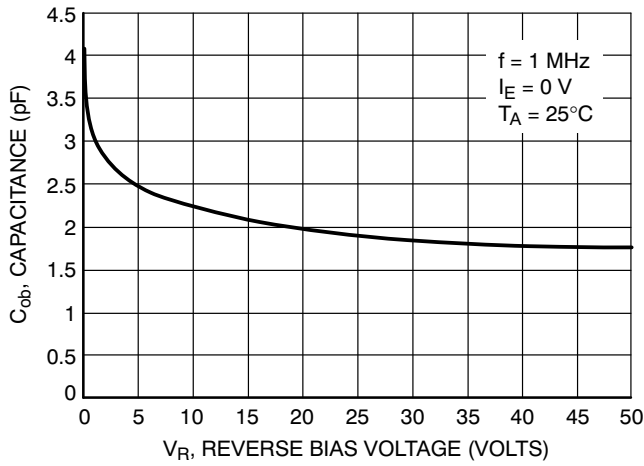


Figure 39. Output Capacitance

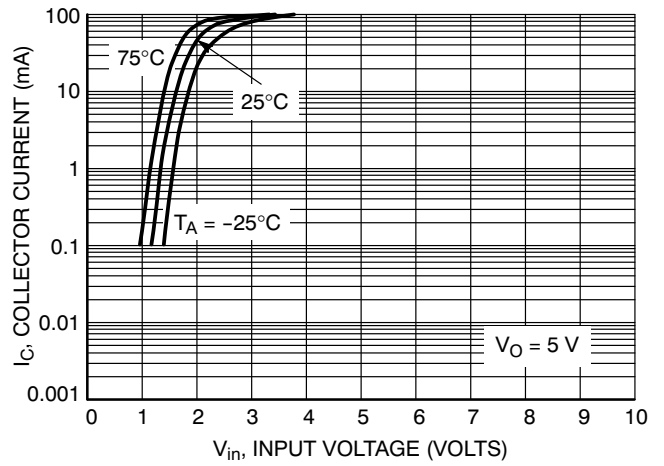


Figure 40. Output Current versus Input Voltage

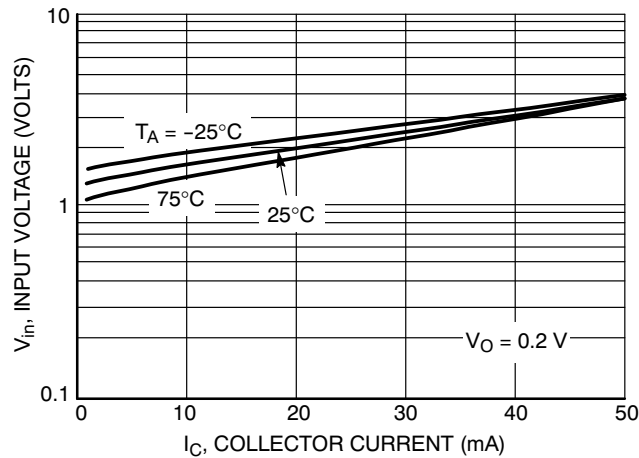


Figure 41. Input Voltage versus Output Current

TYPICAL ELECTRICAL CHARACTERISTICS – MMUN2232LT1

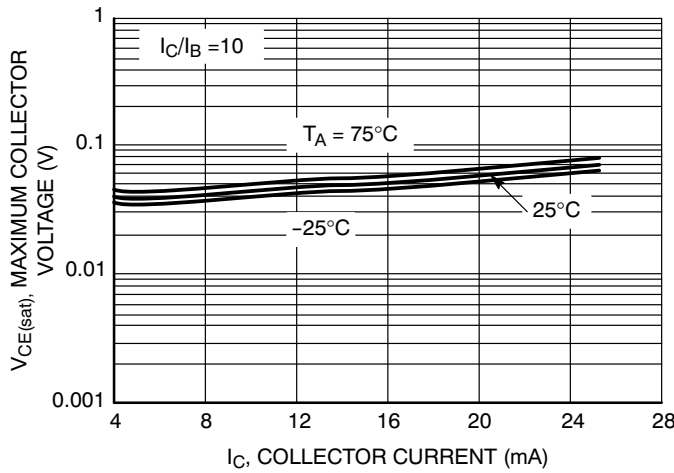


Figure 42.  $V_{CE(sat)}$  vs.  $I_C$

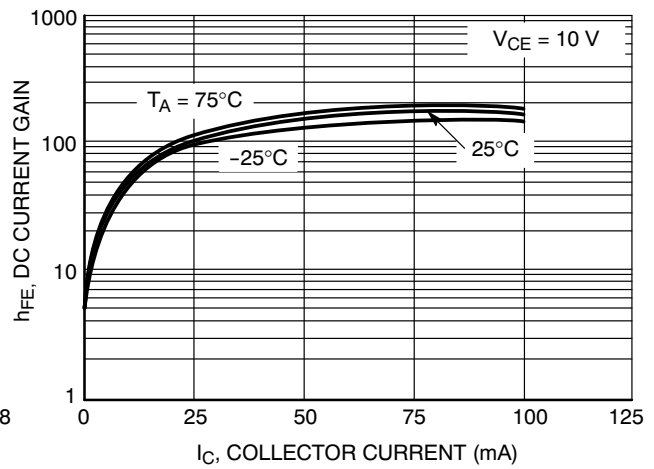


Figure 43. DC Current Gain

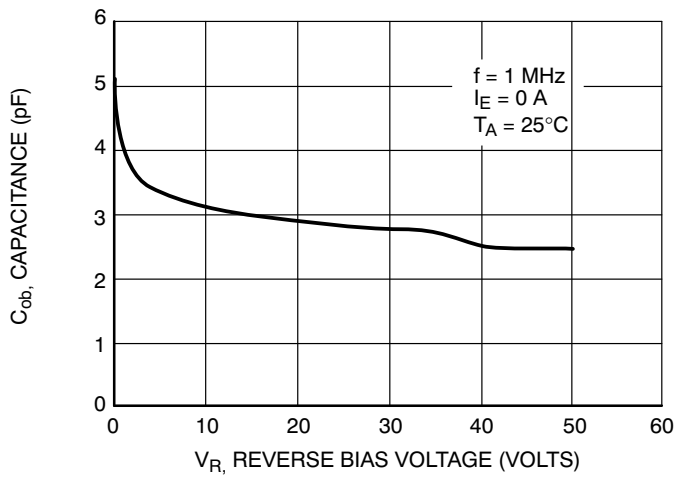


Figure 44. Output Capacitance

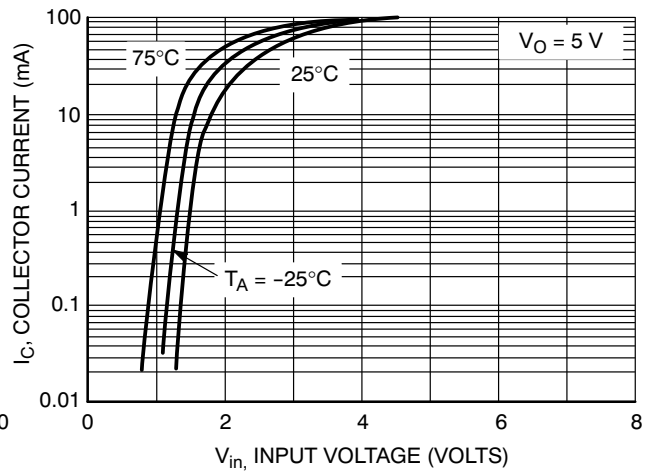


Figure 45. Output Current vs. Input Voltage

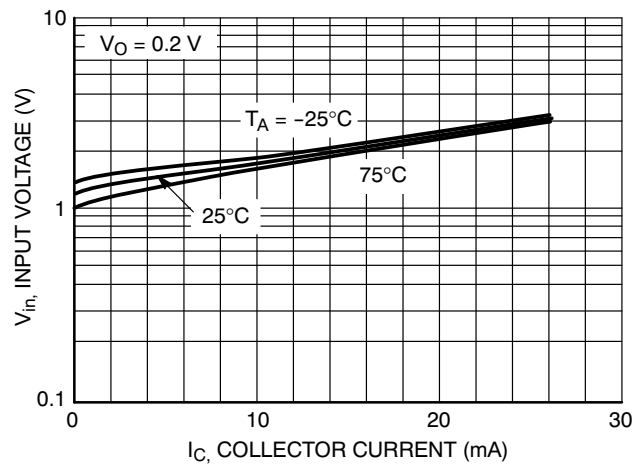


Figure 46. Output Voltage vs. Input Current

TYPICAL ELECTRICAL CHARACTERISTICS – MMUN2233LT1

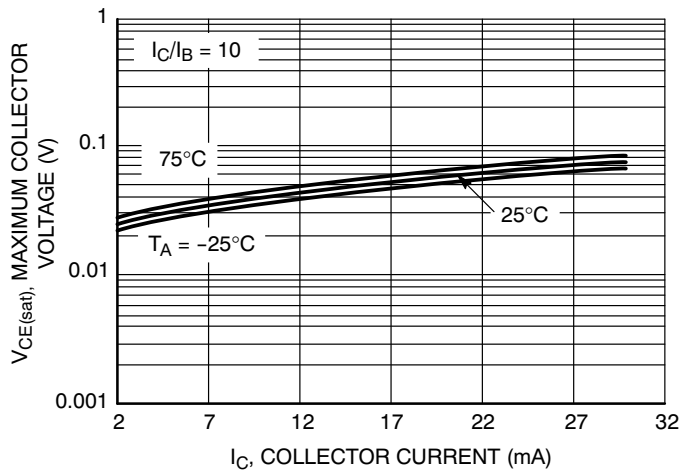


Figure 47.  $V_{CE(sat)}$  vs.  $I_C$

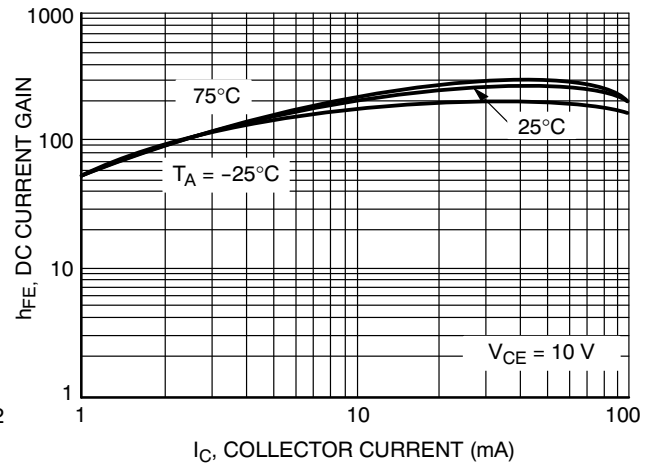


Figure 48. DC Current Gain

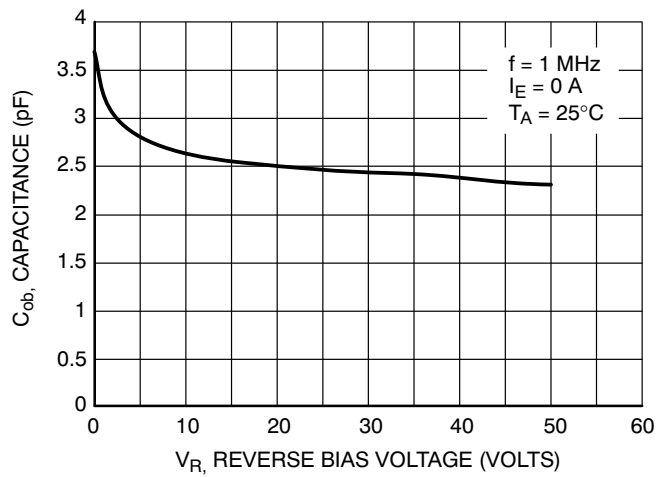


Figure 49. Output Capacitance

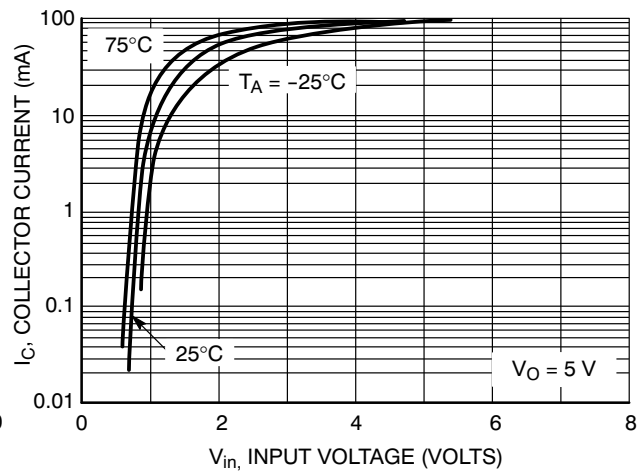


Figure 50. Output Current vs. Input Voltage

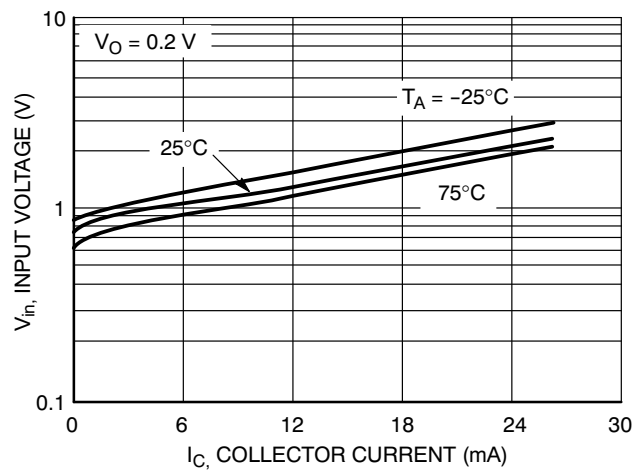


Figure 51. Input Voltage vs. Output Current

TYPICAL ELECTRICAL CHARACTERISTICS — MMUN2234LT1

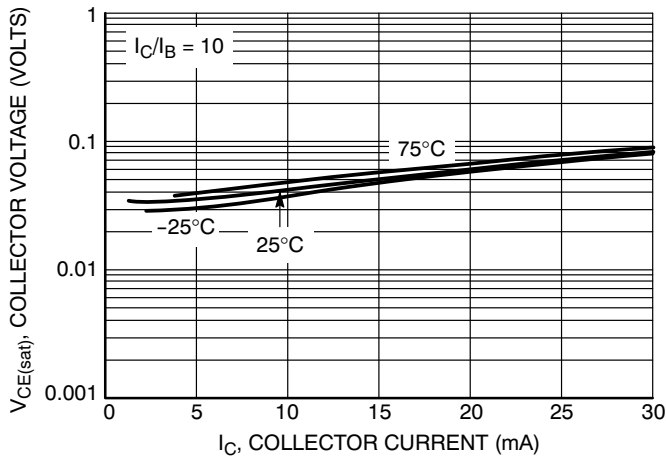


Figure 52.  $V_{CE(sat)}$  versus  $I_C$

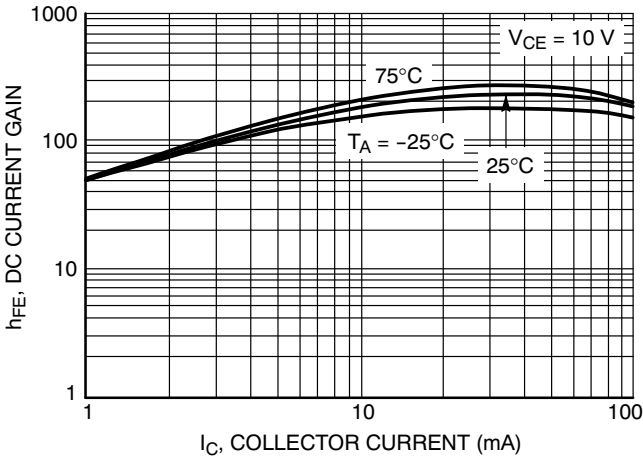


Figure 53. DC Current Gain

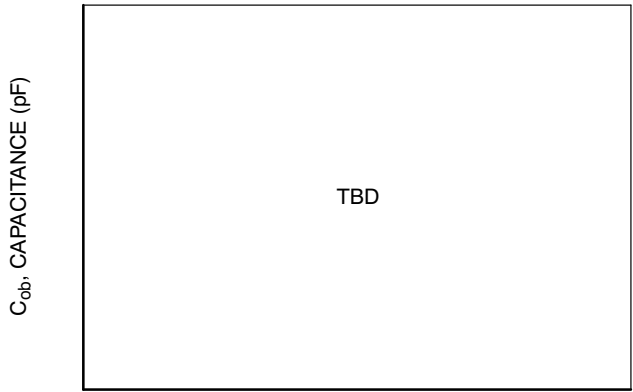


Figure 54. Output Capacitance

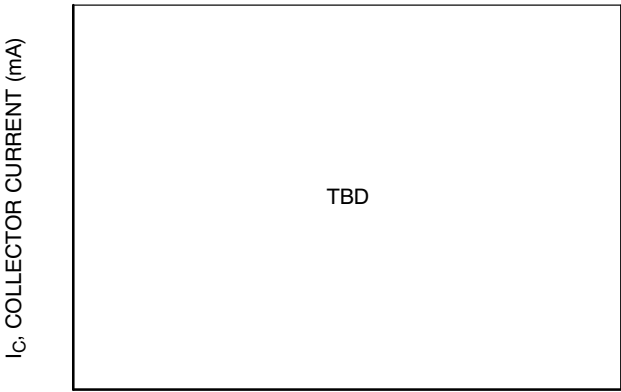


Figure 55. Output Current versus Input Voltage

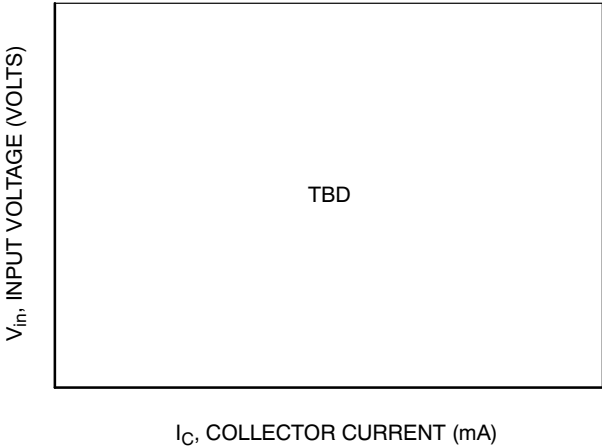


Figure 56. Input Voltage versus Output Current

## MMUN2211LT1 Series

### TYPICAL APPLICATIONS FOR NPN BRTs

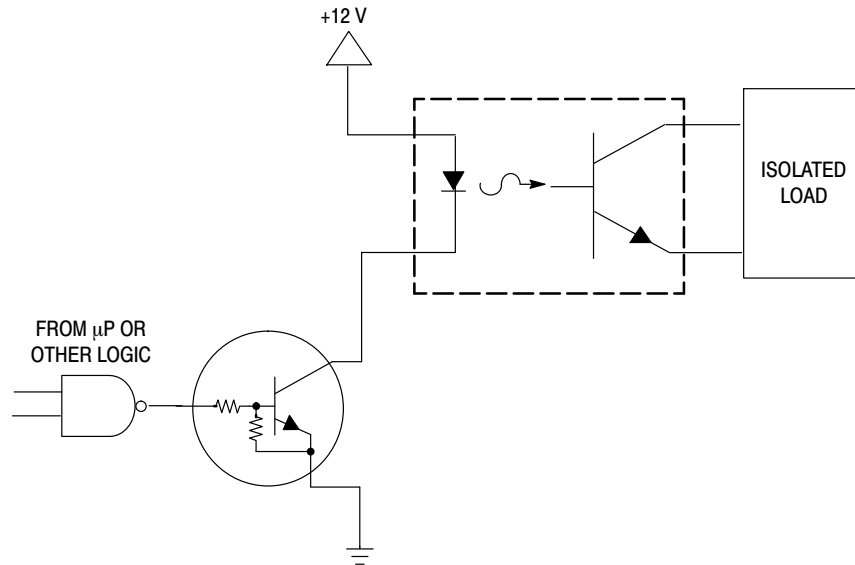


Figure 57. Level Shifter: Connects 12 or 24 Volt Circuits to Logic

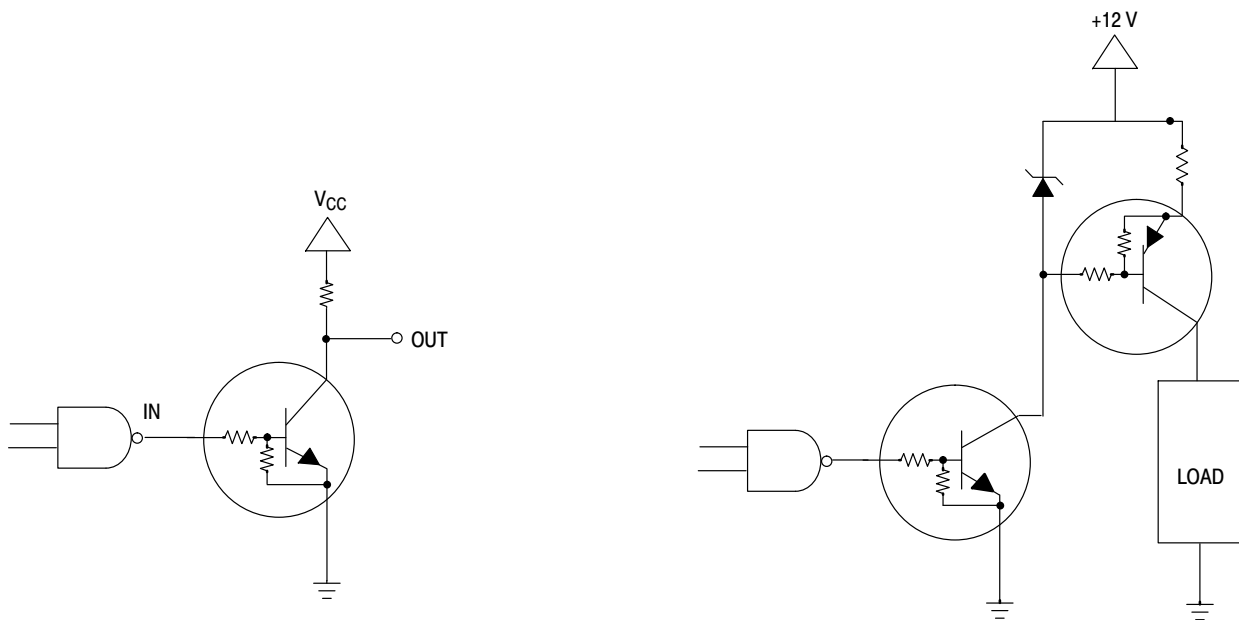


Figure 58. Open Collector Inverter: Inverts the Input Signal

Figure 59. Inexpensive, Unregulated Current Source

# MMUN2211LT1 Series

## ORDERING INFORMATION

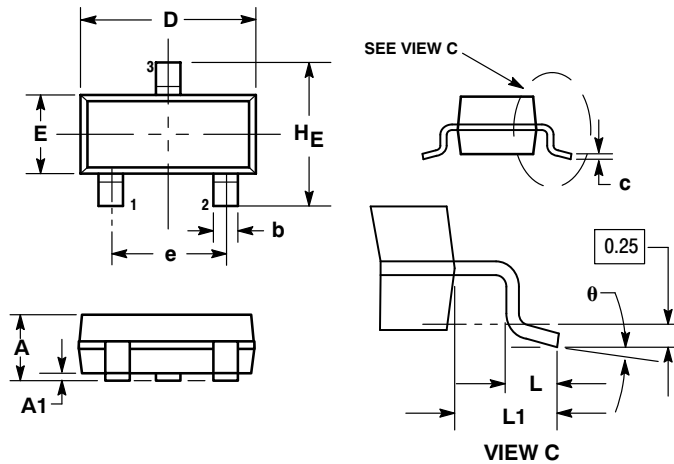
| Device       | Marking | R1(k) | R2(k) | Package             | Shipping <sup>†</sup> |
|--------------|---------|-------|-------|---------------------|-----------------------|
| MMUN2211LT1  | A8A     | 10    | 10    | SOT-23              | 3000 / Tape & Reel    |
| MMUN2211LT1G |         | 10    |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

<sup>†</sup>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:

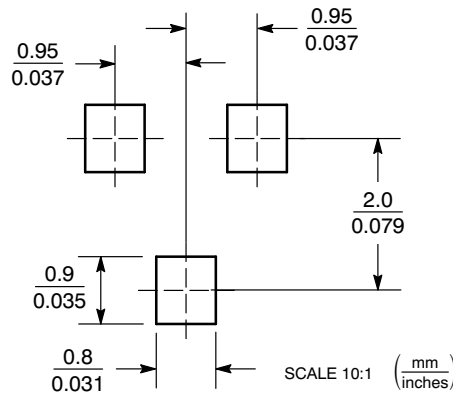
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH.
3. MAXIMUM LEAD THICKNESS INCLUDES LEAD FINISH THICKNESS. MINIMUM LEAD THICKNESS IS THE MINIMUM THICKNESS OF BASE MATERIAL.
4. 318-01 THRU -07 AND -09 OBSOLETE, NEW STANDARD 318-08.

| 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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