

MUN2211T1 Series

Preferred Devices

Bias Resistor Transistors

NPN 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 SC-59 package which is designed for low power surface mount applications.

Features

- Simplifies Circuit Design
- Reduces Board Space
- Reduces Component Count
- Moisture Sensitivity Level: 1
- ESD Rating - Human Body Model: Class 1
- Machine Model: Class B
- The SC-59 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
- Pb-Free Packages are Available

MAXIMUM RATINGS ($T_A = 25^\circ\text{C}$ unless otherwise noted)

| Rating | Symbol | Value | Unit |
|---------------------------|-----------|-------|------|
| Collector-Base Voltage | V_{CB0} | 50 | Vdc |
| Collector-Emitter Voltage | V_{CE0} | 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 | 230 (Note 1) 338 (Note 2) 1.8 (Note 1) 2.7 (Note 2) | mW $^\circ\text{C/W}$ |
| Thermal Resistance, Junction-to-Ambient | $R_{\theta JA}$ | 540 (Note 1) 370 (Note 2) | $^\circ\text{C/W}$ |
| Thermal Resistance, Junction-to-Lead | $R_{\theta JL}$ | 264 (Note 1) 287 (Note 2) | $^\circ\text{C/W}$ |
| 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.

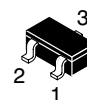
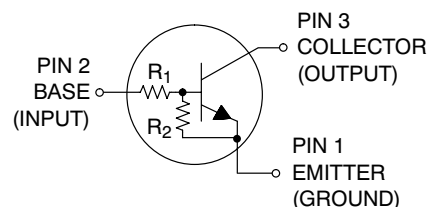
1. FR-4 @ Minimum Pad.
2. FR-4 @ 1.0 x 1.0 inch Pad.



ON Semiconductor®

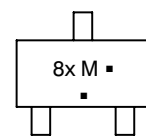
<http://onsemi.com>

NPN SILICON BIAS RESISTOR TRANSISTORS



SC-59
CASE 318D
STYLE 1

MARKING DIAGRAM



- 8x = Device Code (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

See detailed ordering and shipping information in the table on page 2 of this data sheet.

DEVICE MARKING INFORMATION

See specific marking information in the Device Marking and Resistor Values table on page 2 of this data sheet.

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

MUN2211T1 Series

DEVICE MARKING AND RESISTOR VALUES

| Device | Package | Marking | R1 (K) | R2 (K) | Shipping [†] |
|---------------------|--------------------|---------|--------|--------|-----------------------|
| MUN2211T1 | SC-59 | 8A | 10 | 10 | 3000/Tape & Reel |
| MUN2211T1G | SC-59 (Pb-Free) | 8A | 10 | 10 | 3000/Tape & Reel |
| MUN2211T3 | SC-59 | 8A | 10 | 10 | 10,000/Tape & Reel |
| MUN2211T3G | SC-59 (Pb-Free) | 8A | 10 | 10 | 10,000/Tape & Reel |
| MUN2212T1 | SC-59 | 8B | 22 | 22 | 3000/Tape & Reel |
| MUN2212T1G | SC-59 (Pb-Free) | 8B | 22 | 22 | 3000/Tape & Reel |
| MUN2213T1 | SC-59 | 8C | 47 | 47 | 3000/Tape & Reel |
| MUN2213T1G | SC-59 (Pb-Free) | 8C | 47 | 47 | 3000/Tape & Reel |
| MUN2214T1 | SC-59 | 8D | 10 | 47 | 3000/Tape & Reel |
| MUN2214T1G | SC-59 (Pb-Free) | 8D | 10 | 47 | 3000/Tape & Reel |
| MUN2214T3 | SC-59 | 8D | 10 | 47 | 10,000/Tape & Reel |
| MUN2214T3G | SC-59 (Pb-Free) | 8D | 10 | 47 | 10,000/Tape & Reel |
| MUN2215T1 | SC-59 | 8E | 10 | ∞ | 3000/Tape & Reel |
| MUN2215T1G | SC-59 (Pb-Free) | 8E | 10 | ∞ | 3000/Tape & Reel |
| MUN2216T1 | SC-59 | 8F | 4.7 | ∞ | 3000/Tape & Reel |
| MUN2216T1G | SC-59 (Pb-Free) | 8F | 4.7 | ∞ | 3000/Tape & Reel |
| MUN2230T1 | SC-59 | 8G | 1.0 | 1.0 | 3000/Tape & Reel |
| MUN2230T1G | SC-59 (Pb-Free) | 8G | 1.0 | 1.0 | 3000/Tape & Reel |
| MUN2231T1 (Note 3) | SC-59 | 8H | 2.2 | 2.2 | 3000/Tape & Reel |
| MUN2231T1G (Note 3) | SC-59 (Pb-Free) | 8H | 2.2 | 2.2 | 3000/Tape & Reel |
| MUN2232T1 | SC-59 | 8J | 4.7 | 4.7 | 3000/Tape & Reel |
| MUN2232T1G | SC-59 (Pb-Free) | 8J | 4.7 | 4.7 | 3000/Tape & Reel |
| MUN2233T1 | SC-59 | 8K | 4.7 | 47 | 3000/Tape & Reel |
| MUN2233T1G | SC-59 (Pb-Free) | 8K | 4.7 | 47 | 3000/Tape & Reel |
| MUN2234T1 (Note 3) | SC-59 | 8L | 22 | 47 | 3000/Tape & Reel |
| MUN2234T1G (Note 3) | SC-59 (Pb-Free) | 8L | 22 | 47 | 3000/Tape & Reel |
| MUN2236T1 | SC-59 | 8N | 100 | 100 | 3000/Tape & Reel |
| MUN2236T1G | SC-59 (Pb-Free) | 8N | 100 | 100 | 3000/Tape & Reel |
| MUN2237T1 | SC-59 | 8P | 47 | 22 | 3000/Tape & Reel |
| MUN2237T1G | SC-59 (Pb-Free) | 8P | 47 | 22 | 3000/Tape & Reel |
| MUN2240T1 (Note 3) | SC-59 | 8T | 47 | ∞ | 3000/Tape & Reel |
| MUN2240T1G (Note 3) | SC-59 (Pb-Free) | 8T | 47 | ∞ | 3000/Tape & Reel |
| MUN2241T1 (Note 3) | SC-59 | 8U | 100 | ∞ | 3000/Tape & Reel |
| MUN2241T1G (Note 3) | SC-59 (Pb-Free) | 8U | 100 | ∞ | 3000/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.

3. New devices. Updated curves to follow in subsequent data sheets.

MUN2211T1 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 |
| MUN2211T1, G | | - | - | 0.2 | |
| MUN2212T1, G | | - | - | 0.1 | |
| MUN2213T1, G | | - | - | 0.2 | |
| MUN2214T1, G | | - | - | 0.9 | |
| MUN2215T1, G | | - | - | 1.9 | |
| MUN2216T1, G | | - | - | 4.3 | |
| MUN2230T1, G | | - | - | 2.3 | |
| MUN2231T1, G | | - | - | 1.5 | |
| MUN2232T1, G | | - | - | 0.18 | |
| MUN2233T1, G | | - | - | 0.13 | |
| MUN2234T1, G | | - | - | 0.05 | |
| MUN2236T1, G | | - | - | 0.13 | |
| MUN2237T1, G | | - | - | 0.2 | |
| MUN2240T1, G | | - | - | 0.1 | |
| MUN2241T1, G | | - | - | | |
| Collector-Base Breakdown Voltage (I _C = 10 μA, I _E = 0) | V _{(BR)CBO} | 50 | - | - | Vdc |
| Collector-Emitter Breakdown Voltage (Note 4) (I _C = 2.0 mA, I _B = 0) | V _{(BR)CEO} | 50 | - | - | Vdc |

ON CHARACTERISTICS (Note 4)

| | | | | | |
|---|----------------------|-----|-----|------|-----|
| DC Current Gain (V _{CE} = 10 V, I _C = 5.0 mA) | h _{FE} | 35 | 60 | - | |
| MUN2211T1, G | | 60 | 100 | - | |
| MUN2212T1, G | | 80 | 140 | - | |
| MUN2213T1, G | | 80 | 140 | - | |
| MUN2214T1, G | | 160 | 350 | - | |
| MUN2215T1, G | | 160 | 350 | - | |
| MUN2216T1, G | | 3.0 | 5.0 | - | |
| MUN2230T1, G | | 8.0 | 15 | - | |
| MUN2231T1, G | | 15 | 30 | - | |
| MUN2232T1, G | | 80 | 200 | - | |
| MUN2233T1, G | | 80 | 150 | - | |
| MUN2234T1, G | | 80 | 150 | - | |
| MUN2236T1, G | | 80 | 140 | - | |
| MUN2237T1, G | | 160 | 350 | - | |
| MUN2240T1, G | | 160 | 350 | - | |
| MUN2241T1, G | | | | | |
| Collector-Emitter Saturation Voltage (I _C = 10 mA, I _B = 0.3 mA) | V _{CE(sat)} | - | - | 0.25 | Vdc |
| MUN2211T1, G | | - | - | 0.25 | |
| MUN2212T1, G | | - | - | 0.25 | |
| MUN2213T1, G | | - | - | 0.25 | |
| MUN2214T1, G | | - | - | 0.25 | |
| MUN2233T1, G | | - | - | 0.25 | |
| MUN2236T1, G | | - | - | 0.25 | |
| (I _C = 10 mA, I _B = 5 mA) | | - | - | 0.25 | |
| MUN2230T1, G | | - | - | 0.25 | |
| MUN2231T1, G | | - | - | 0.25 | |
| MUN2237T1, G | | - | - | 0.25 | |
| MUN2241T1, G | | - | - | 0.25 | |
| (I _C = 10 mA, I _B = 1 mA) | | - | - | 0.25 | |
| MUN2215T1, G | | - | - | 0.25 | |
| MUN2216T1, G | | - | - | 0.25 | |
| MUN2232T1, G | | - | - | 0.25 | |
| MUN2234T1, G | | - | - | 0.25 | |
| MUN2240T1, G | | - | - | 0.25 | |

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

MUN2211T1 Series

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

| Characteristic | Symbol | Min | Typ | Max | Unit | |
|--|--|--------------------------------|--|--|--|-----|
| ON CHARACTERISTICS (Note 5) (Continued) | | | | | | |
| Output Voltage (on) (V _{CC} = 5.0 V, V _B = 2.5 V, R _L = 1.0 kΩ) | MUN2211T1, G MUN2212T1, G MUN2214T1, G MUN2215T1, G MUN2216T1, G MUN2230T1, G MUN2231T1, G MUN2232T1, G MUN2233T1, G MUN2234T1, G (V _{CC} = 5.0 V, V _B = 3.5 V, R _L = 1.0 kΩ) MUN2213T1, G MUN2240T1, G (V _{CC} = 5.0 V, V _B = 5.5 V, R _L = 1.0 kΩ) MUN2236T1, G (V _{CC} = 5.0 V, V _B = 4.0 V, R _L = 1.0 kΩ) MUN2237T1, G (V _{CC} = 5.0 V, V _B = 5.0 V, R _L = 1.0 kΩ) MUN2241T1, G | V _{OL} | - | - | 0.2 | Vdc |
| Output Voltage (off) (V _{CC} = 5.0 V, V _B = 0.5 V, R _L = 1.0 kΩ) | MUN2211T1, G MUN2212T1, G MUN2213T1, G MUN2214T1, G MUN2233T1, G MUN2234T1, G (V _{CC} = 5.0 V, V _B = 0.050 V, R _L = 1.0 kΩ) MUN2230T1, G (V _{CC} = 5.0 V, V _B = 0.25 V, R _L = 1.0 kΩ) MUN2215T1, G MUN2216T1, G MUN2231T1, G MUN2232T1, G MUN2236T1, G MUN2237T1, G MUN2240T1, G MUN2241T1, G | V _{OH} | 4.9 | - | - | Vdc |
| Input Resistor | MUN2211T1, G MUN2212T1, G MUN2213T1, G MUN2214T1, G MUN2215T1, G MUN2216T1, G MUN2230T1, G MUN2231T1, G MUN2232T1, G MUN2233T1, G MUN2234T1, G MUN2236T1, G MUN2237T1, G MUN2240T1, G MUN2241T1, G | R ₁ | 7.0 15.4 32.9 7.0 7.0 3.3 0.7 1.5 3.3 3.3 15.4 70 32.9 32.9 70 | 10 22 47 10 10 4.7 1.0 2.2 4.7 4.7 22 100 47 47 100 | 13 28.6 61.1 13 13 6.1 1.3 2.9 6.1 6.1 28.6 130 61.1 61.1 130 | kΩ |
| Resistor Ratio | MUN2211T1, G MUN2212T1, G MUN2213T1, G MUN2214T1, G MUN2215T1, G MUN2216T1, G MUN2230T1, G MUN2231T1, G MUN2232T1, G MUN2233T1, G MUN2234T1, G MUN2236T1, G MUN2237T1, G MUN2240T1, G MUN2241T1, G | R ₁ /R ₂ | 0.8 0.8 0.8 0.17 - - 0.8 0.8 0.8 0.8 0.055 0.38 0.8 1.7 - - | 1.0 1.0 1.0 0.21 - - 1.0 1.0 1.0 1.0 0.12 0.47 1.0 2.15 - - | 1.2 1.2 1.2 0.25 - - 1.2 1.2 1.2 1.2 0.185 0.56 1.2 2.6 - - | |

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

MUN2211T1 Series

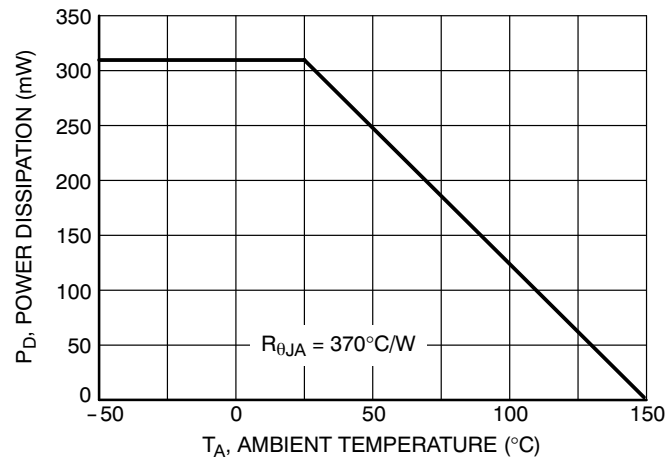


Figure 1. Derating Curve

MUN2211T1 Series

TYPICAL ELECTRICAL CHARACTERISTICS - MUN2211T1

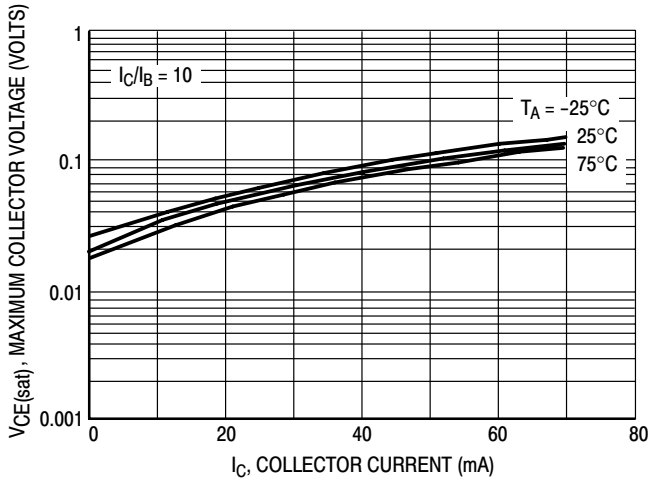


Figure 2. $V_{CE(sat)}$ versus I_C

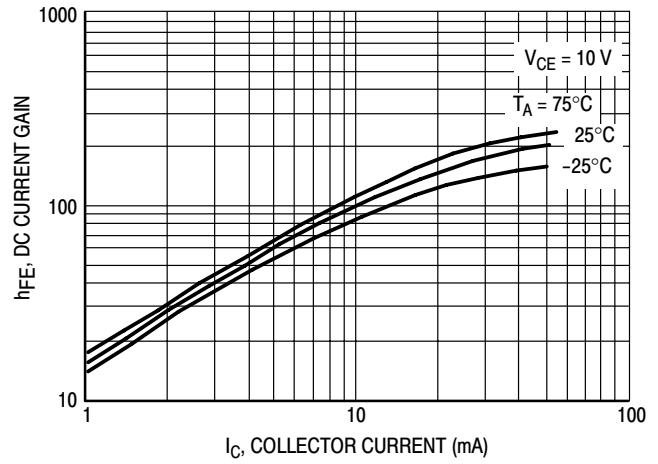


Figure 3. DC Current Gain

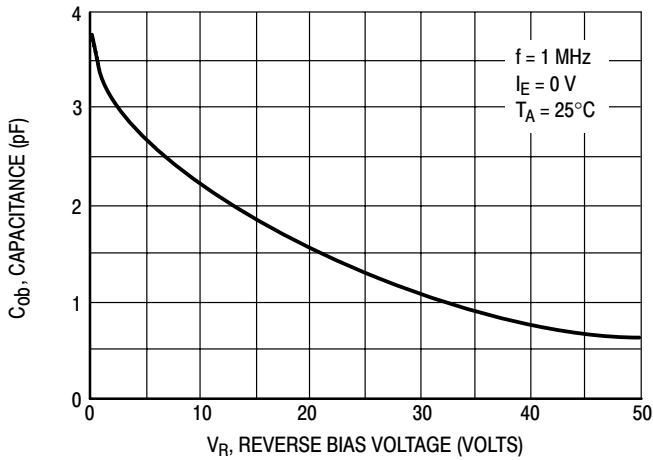


Figure 4. Output Capacitance

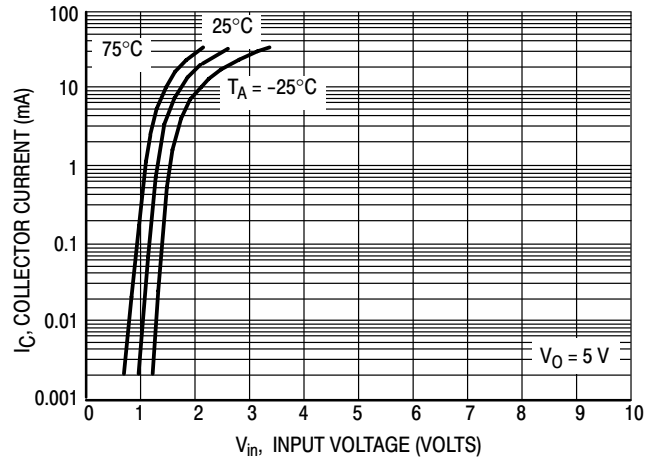


Figure 5. Output Current versus Input Voltage

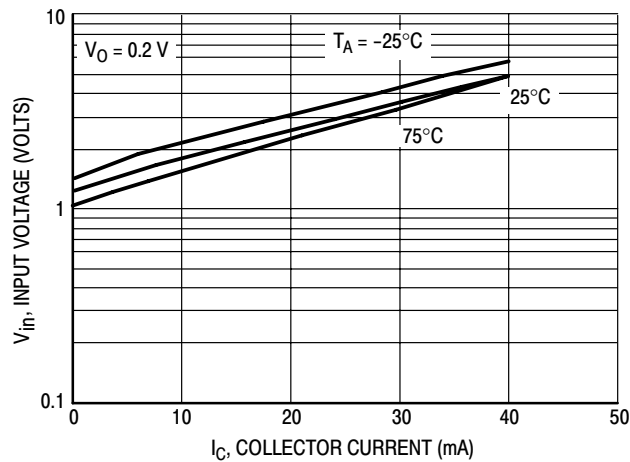


Figure 6. Input Voltage versus Output Current

MUN2211T1 Series

TYPICAL ELECTRICAL CHARACTERISTICS - MUN2212T1

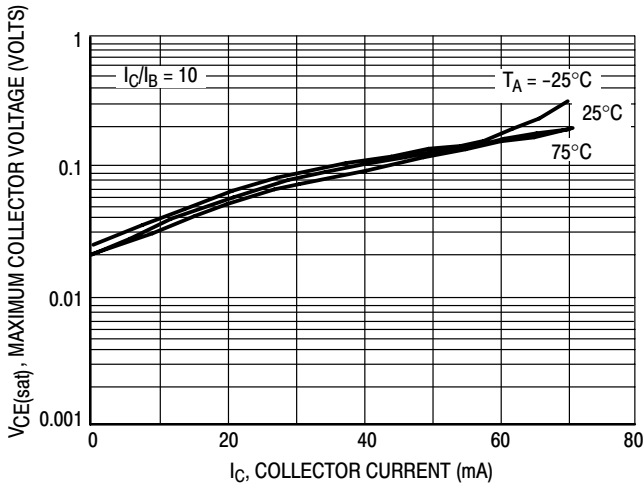


Figure 7. $V_{CE(sat)}$ versus I_C

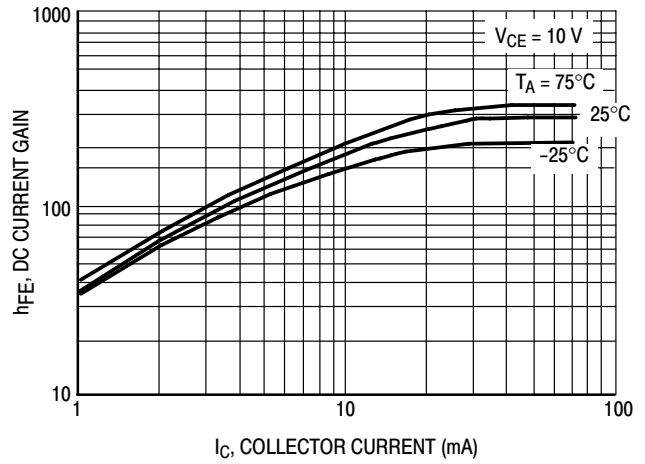


Figure 8. DC Current Gain

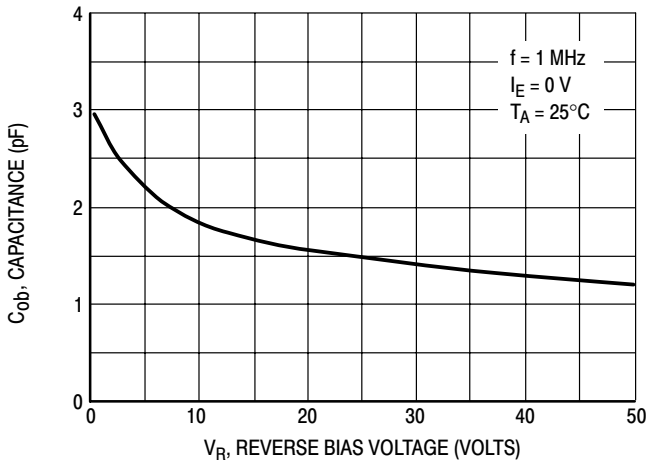


Figure 9. Output Capacitance

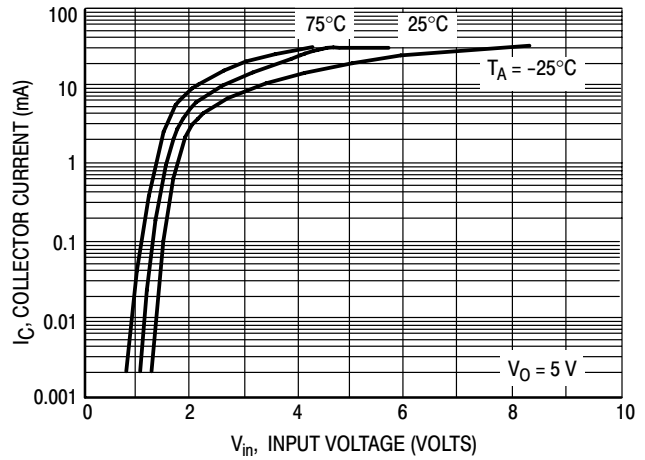


Figure 10. Output Current versus Input Voltage

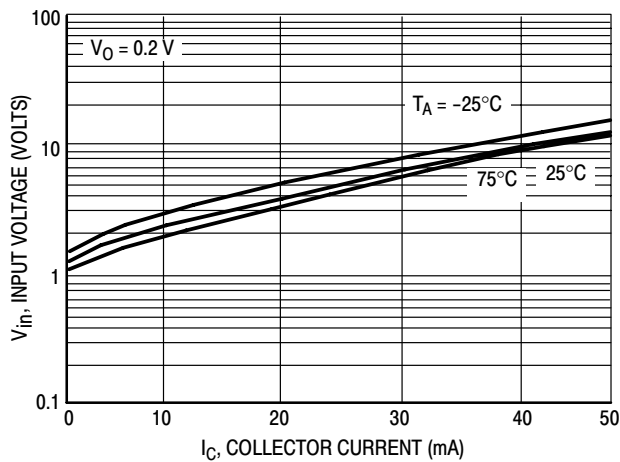


Figure 11. Input Voltage versus Output Current

MUN2211T1 Series

TYPICAL ELECTRICAL CHARACTERISTICS - MUN2213T1

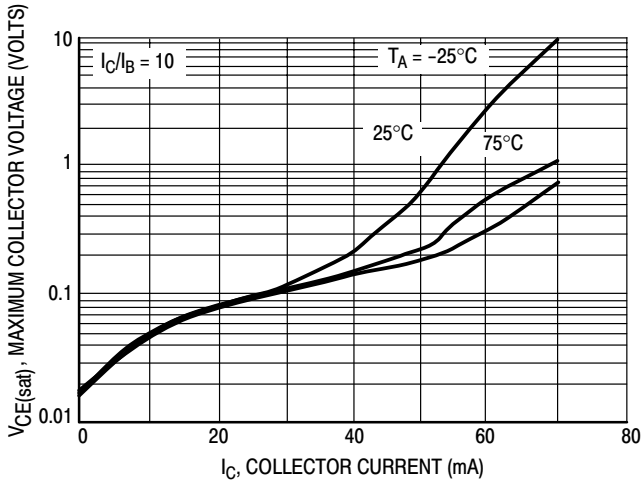


Figure 12. $V_{CE(sat)}$ versus I_C

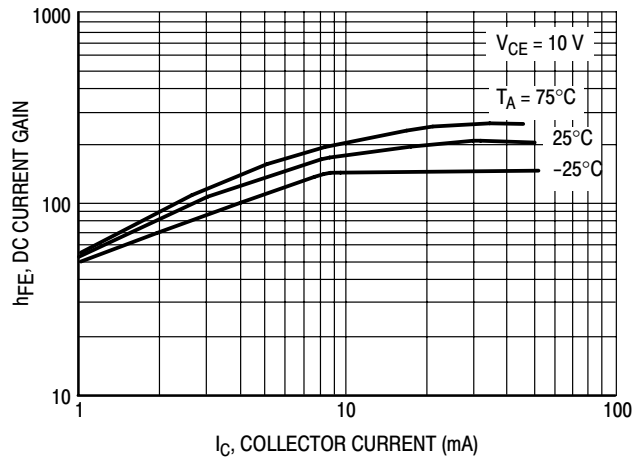


Figure 13. DC Current Gain

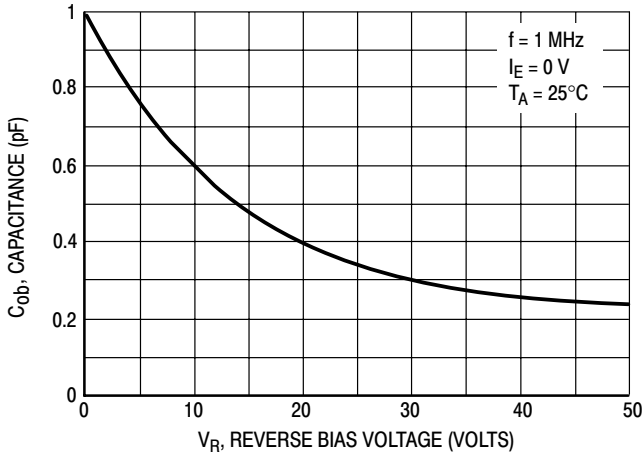


Figure 14. Output Capacitance

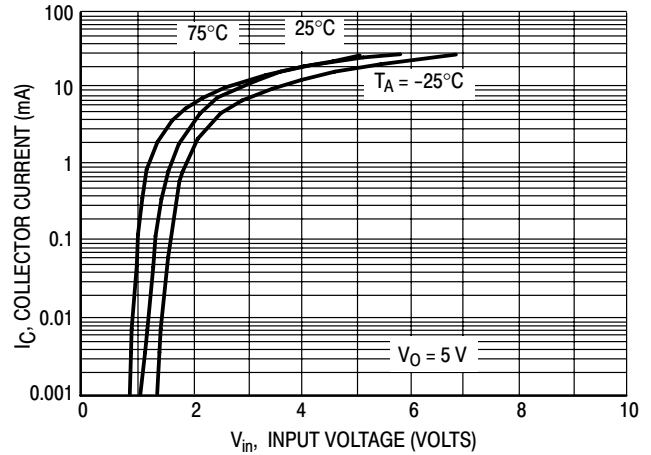


Figure 15. Output Current versus Input Voltage

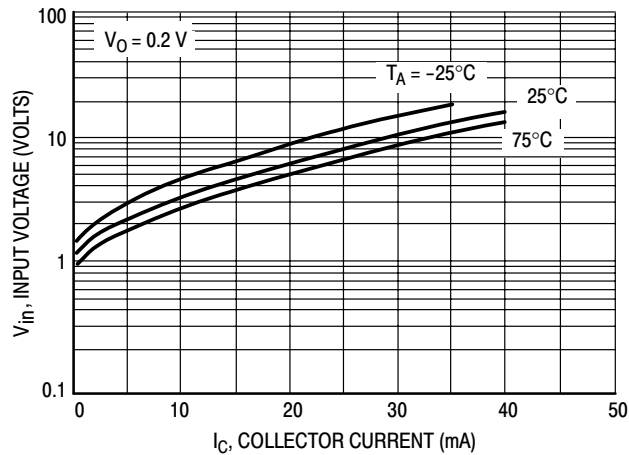


Figure 16. Input Voltage versus Output Current

MUN2211T1 Series

TYPICAL ELECTRICAL CHARACTERISTICS - MUN2214T1

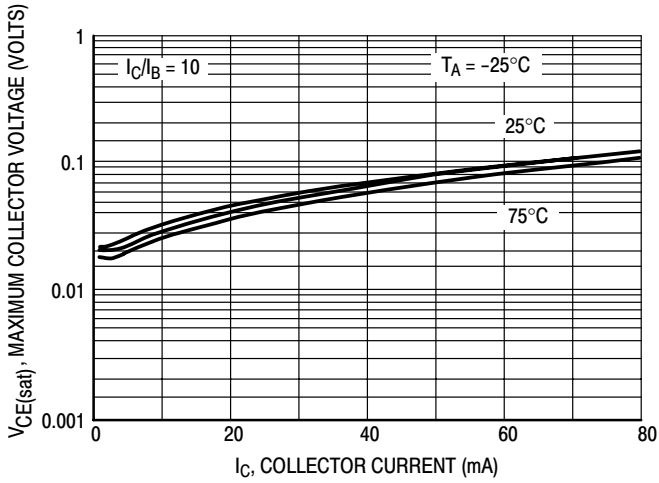


Figure 17. $V_{CE(sat)}$ versus I_C

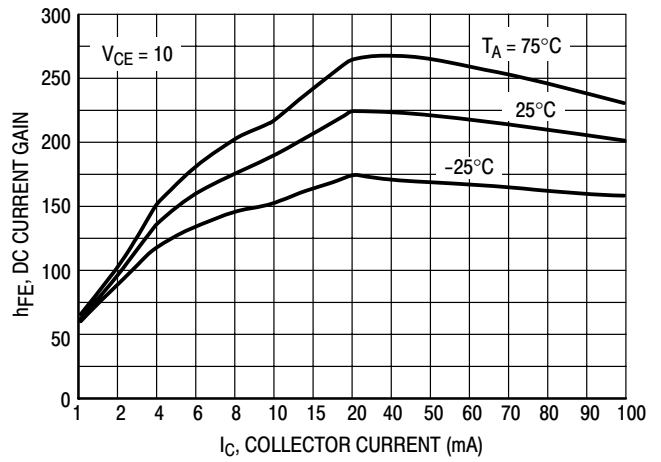


Figure 18. DC Current Gain

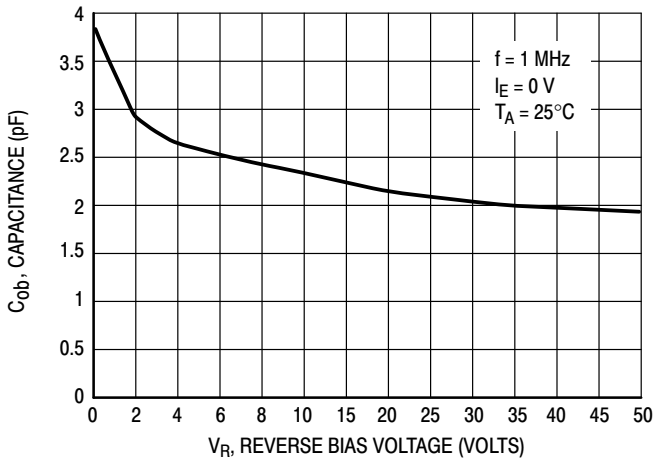


Figure 19. Output Capacitance

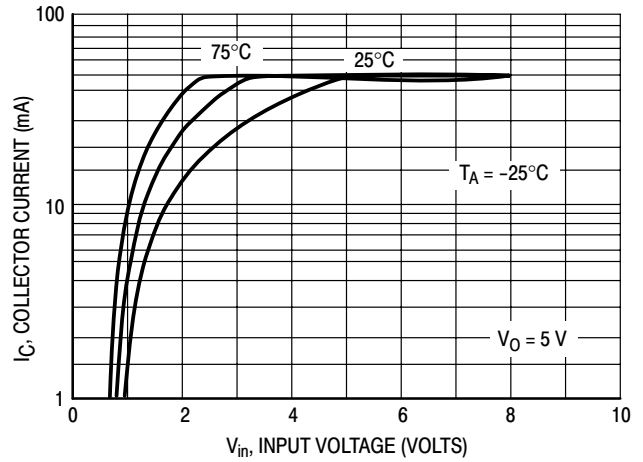


Figure 20. Output Current versus Input Voltage

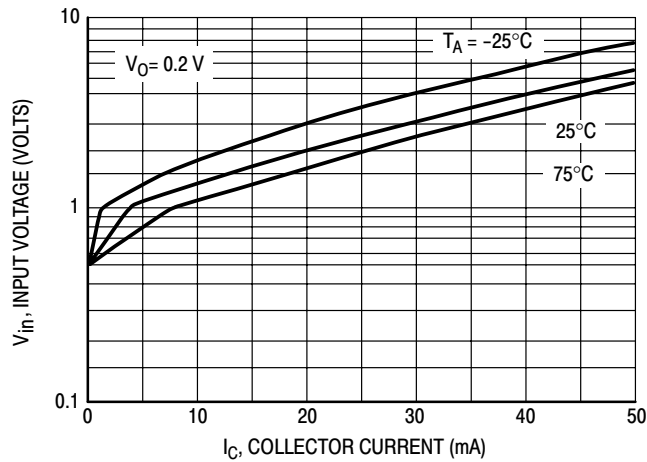


Figure 21. Input Voltage versus Output Current

MUN2211T1 Series

TYPICAL ELECTRICAL CHARACTERISTICS — MUN2215T1

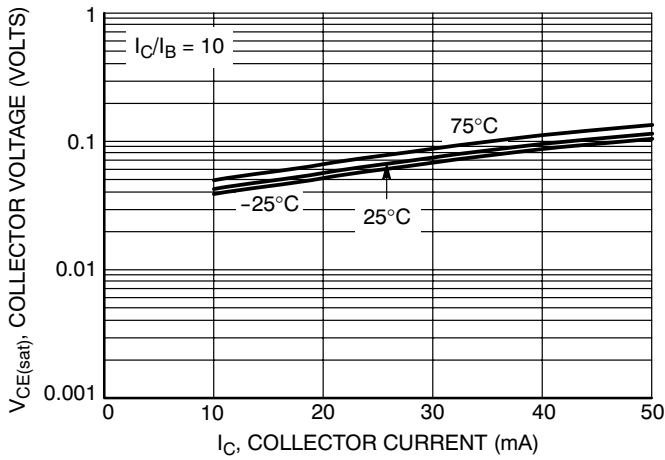


Figure 22. $V_{CE(sat)}$ versus I_C

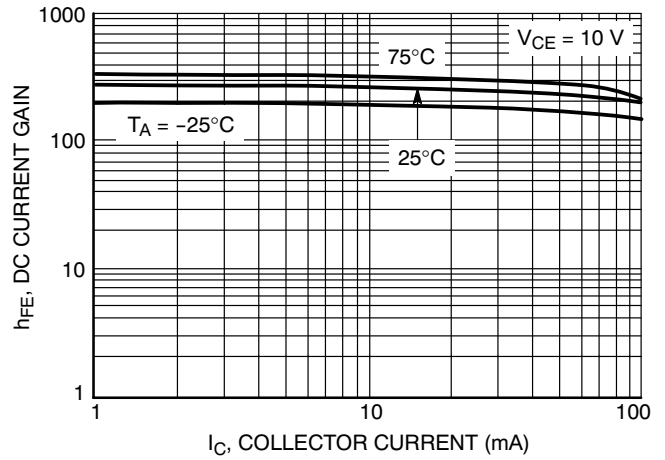


Figure 23. DC Current Gain

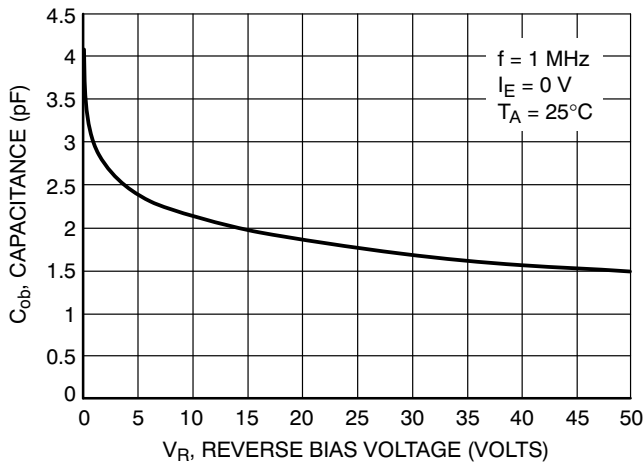


Figure 24. Output Capacitance

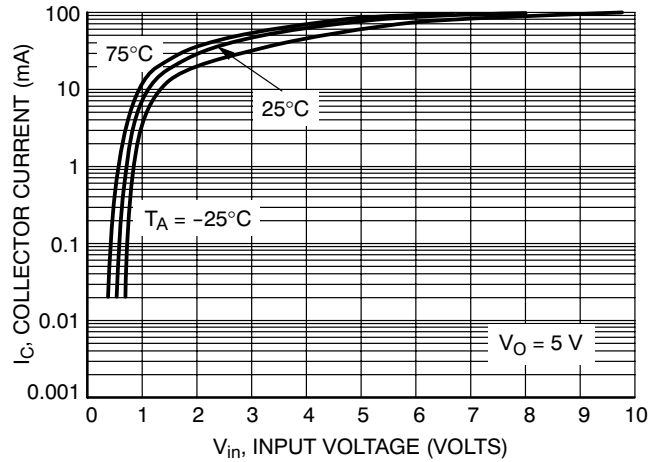


Figure 25. Output Current versus Input Voltage

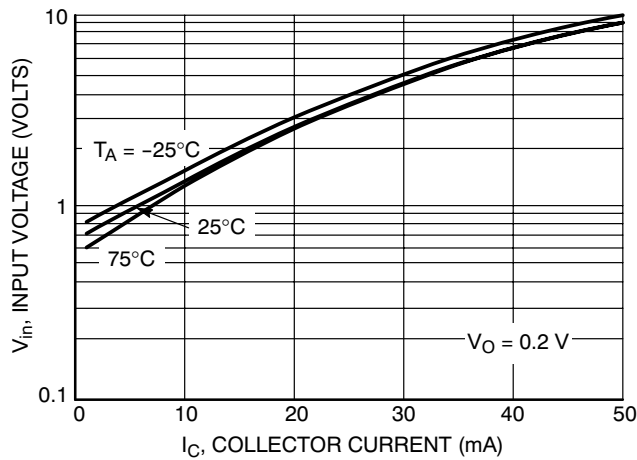


Figure 26. Input Voltage versus Output Current

MUN2211T1 Series

TYPICAL ELECTRICAL CHARACTERISTICS — MUN2216T1

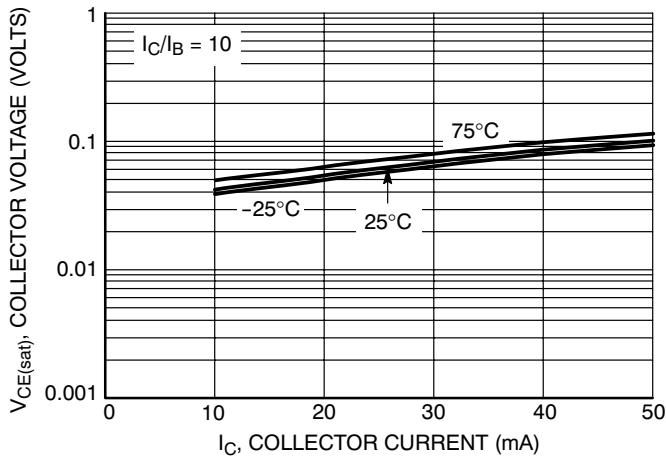


Figure 27. $V_{CE(sat)}$ versus I_C

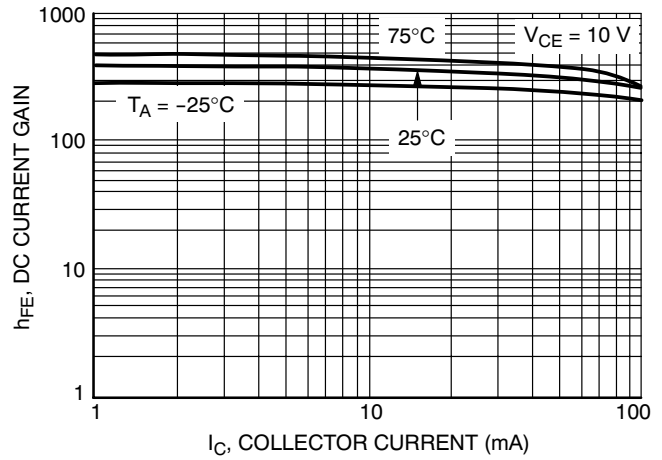


Figure 28. DC Current Gain

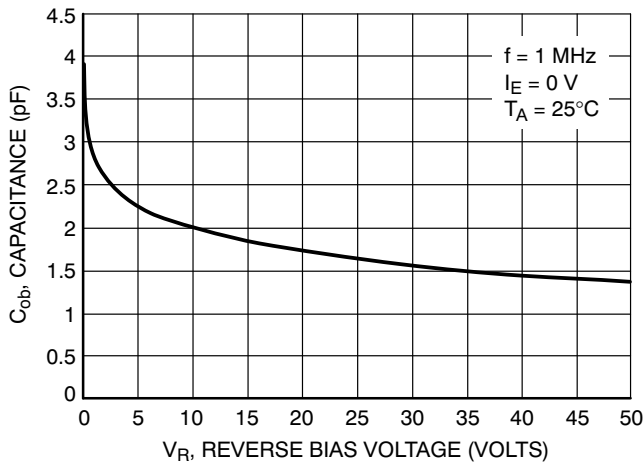


Figure 29. Output Capacitance

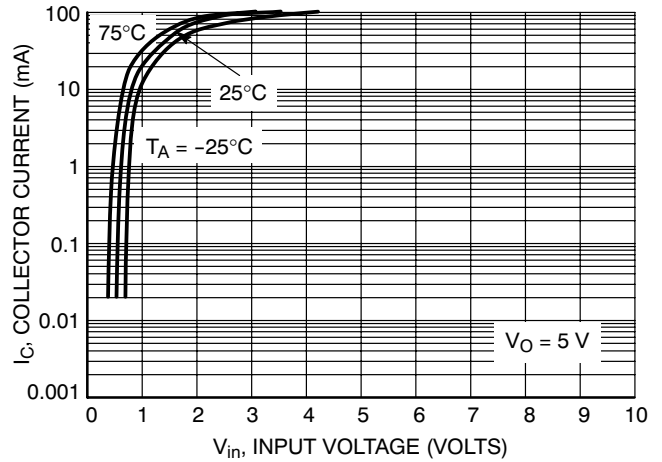


Figure 30. Output Current versus Input Voltage

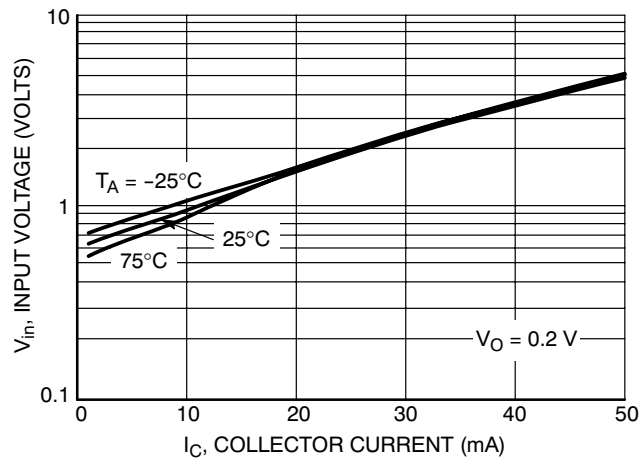


Figure 31. Input Voltage versus Output Current

MUN2211T1 Series

TYPICAL ELECTRICAL CHARACTERISTICS — MUN2230T1

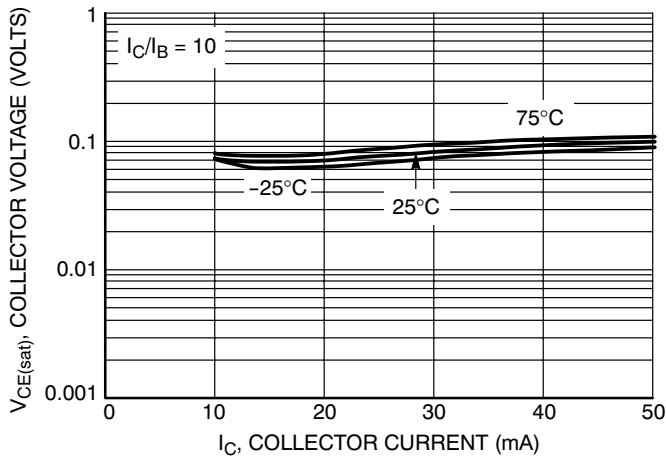


Figure 32. $V_{CE(sat)}$ versus I_C

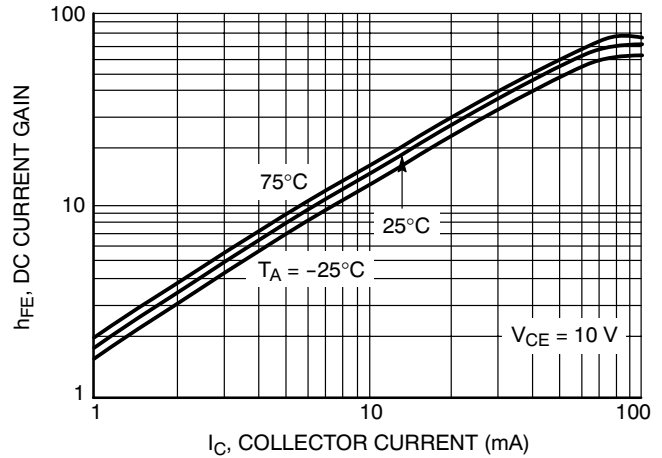


Figure 33. DC Current Gain

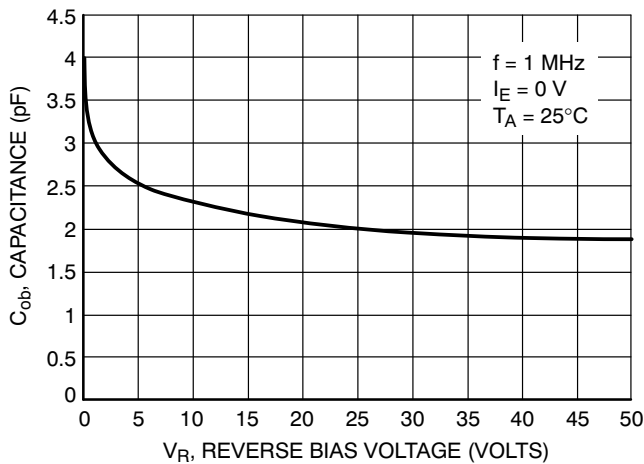


Figure 34. Output Capacitance

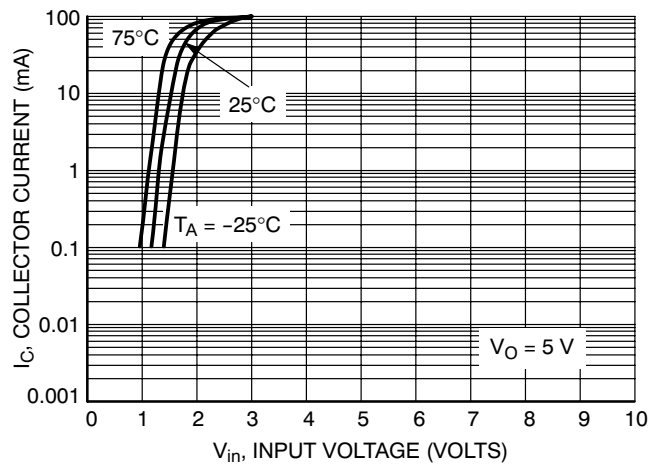


Figure 35. Output Current versus Input Voltage

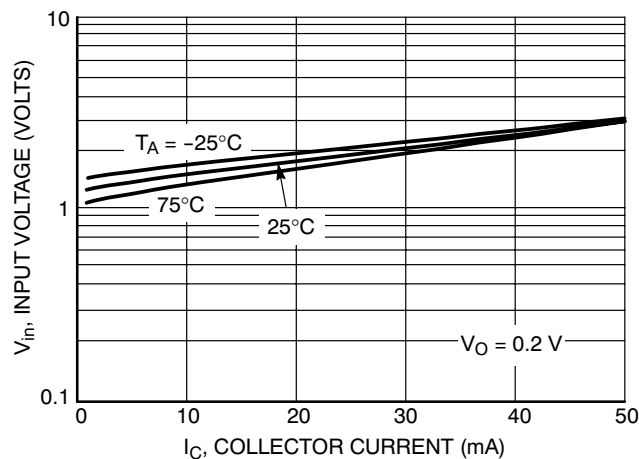


Figure 36. Input Voltage versus Output Current

MUN2211T1 Series

TYPICAL ELECTRICAL CHARACTERISTICS — MUN2232T1

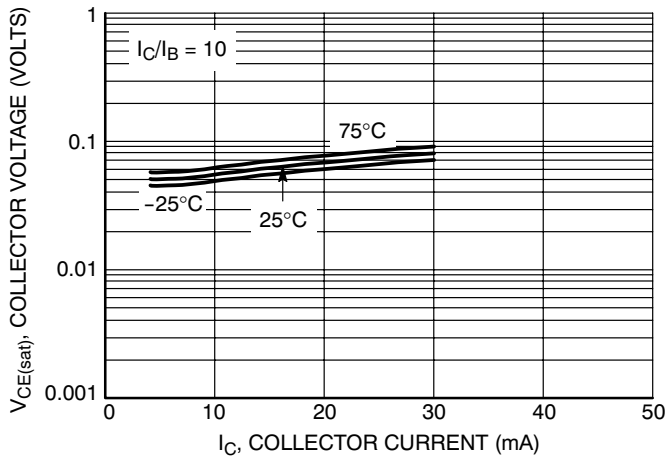


Figure 37. $V_{CE(sat)}$ versus I_C

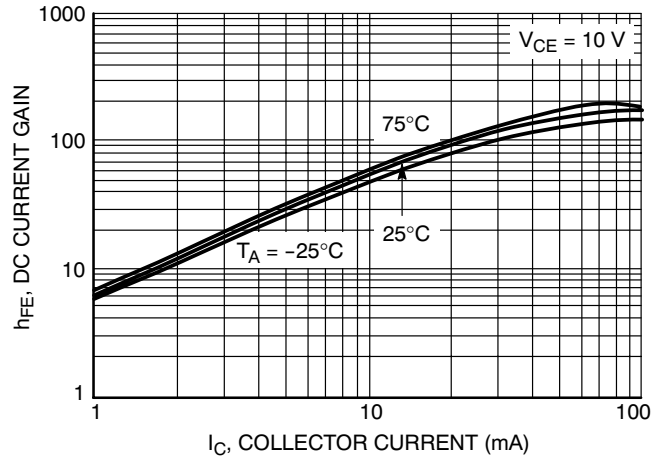


Figure 38. DC Current Gain

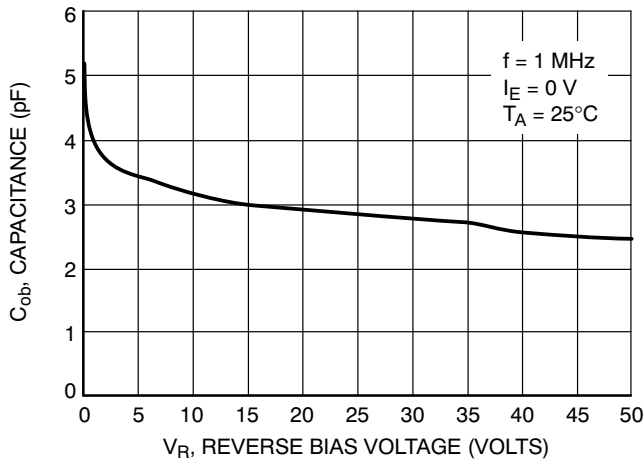


Figure 39. Output Capacitance

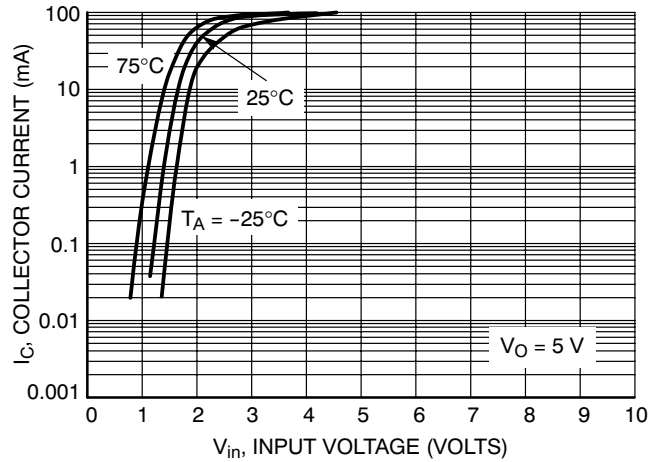


Figure 40. Output Current versus Input Voltage

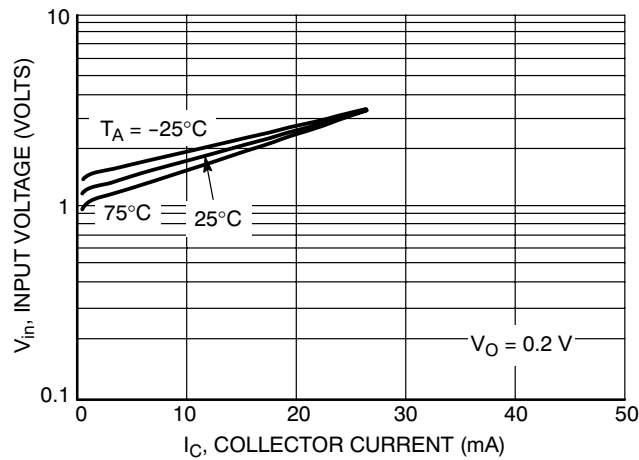


Figure 41. Input Voltage versus Output Current

MUN2211T1 Series

TYPICAL ELECTRICAL CHARACTERISTICS — MUN2233T1

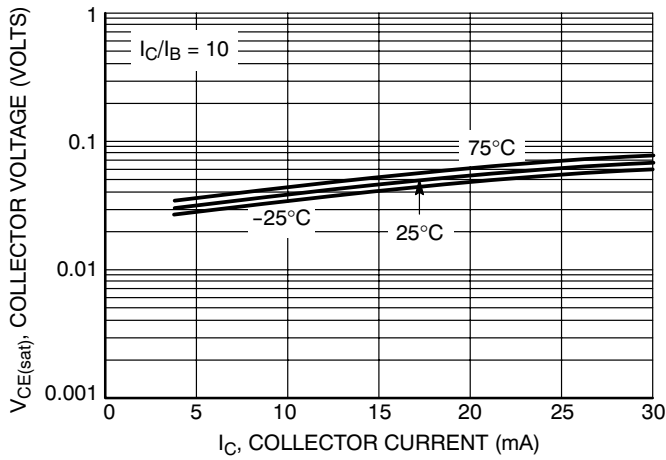


Figure 42. $V_{CE(sat)}$ versus I_C

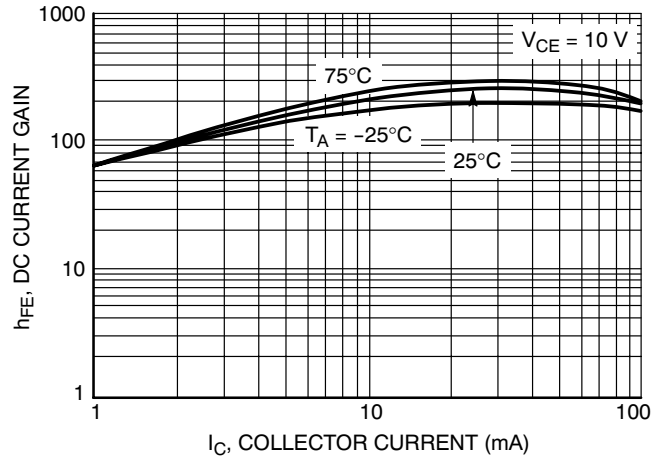


Figure 43. DC Current Gain

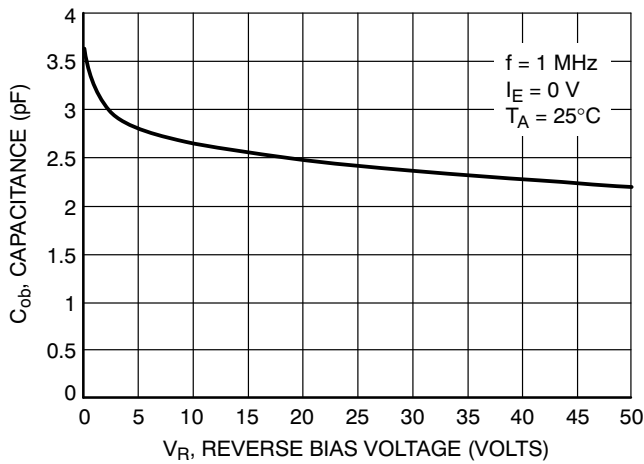


Figure 44. Output Capacitance

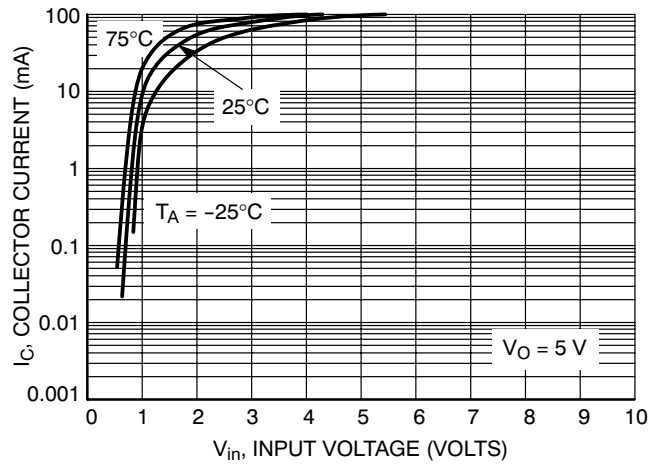


Figure 45. Output Current versus Input Voltage

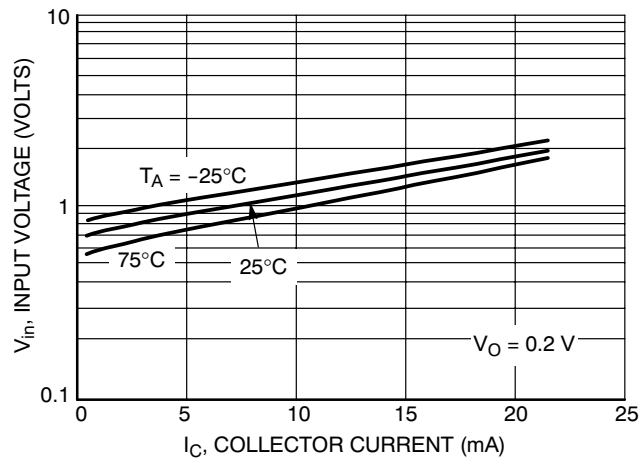


Figure 46. Input Voltage versus Output Current

MUN2211T1 Series

TYPICAL ELECTRICAL CHARACTERISTICS - MUN2236T1

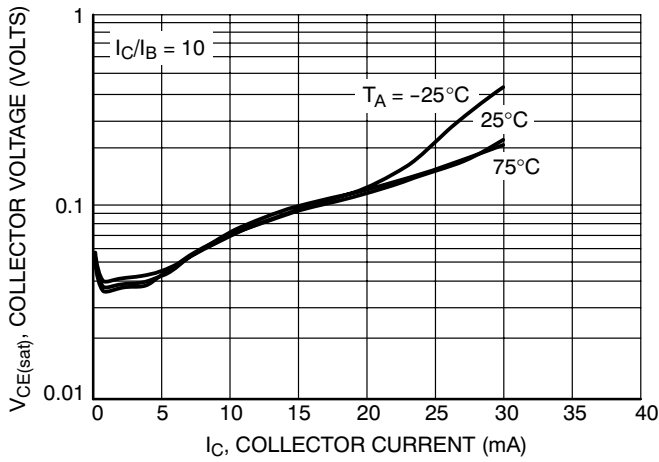


Figure 47. $V_{CE(sat)}$ versus I_C

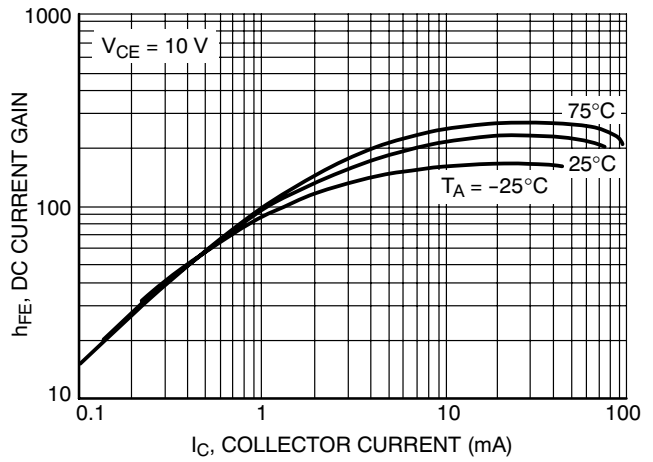


Figure 48. DC Current Gain

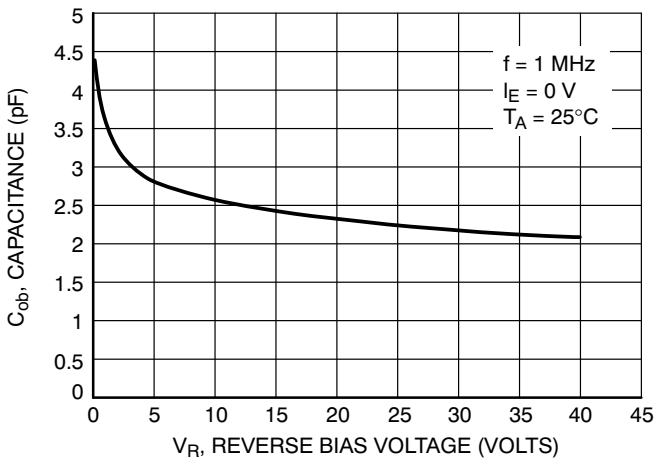


Figure 49. Output Capacitance

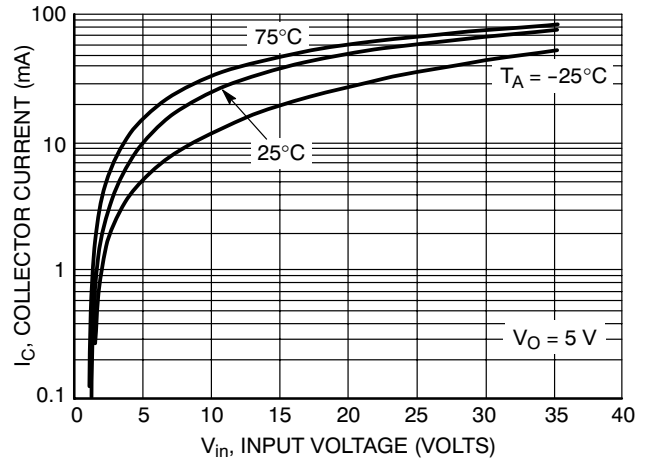


Figure 50. Output Current versus Input Voltage

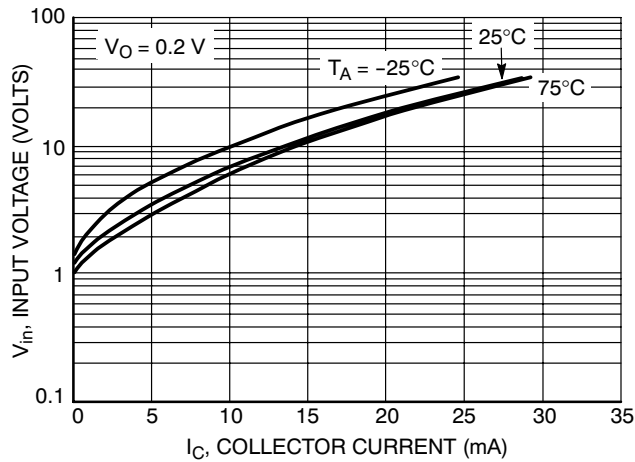


Figure 51. Input Voltage versus Output Current

MUN2211T1 Series

TYPICAL ELECTRICAL CHARACTERISTICS - MUN2237T1

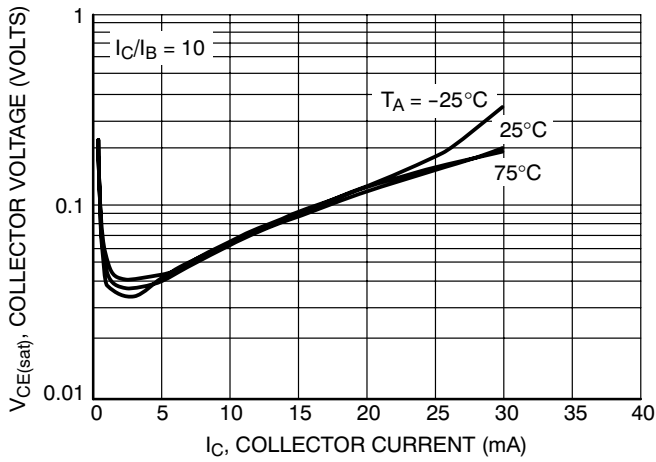


Figure 52. $V_{CE(sat)}$ versus I_C

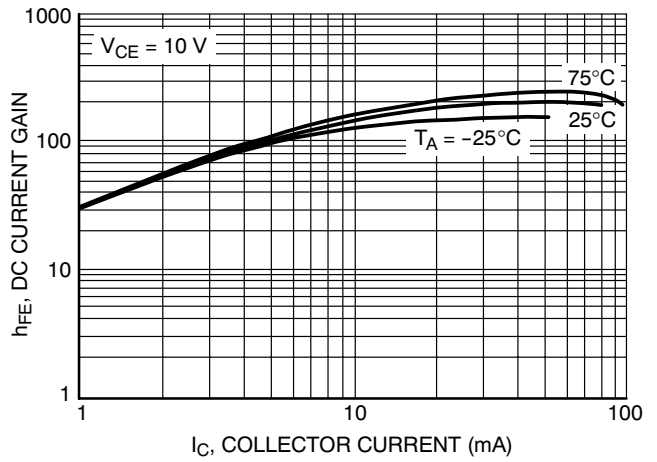


Figure 53. DC Current Gain

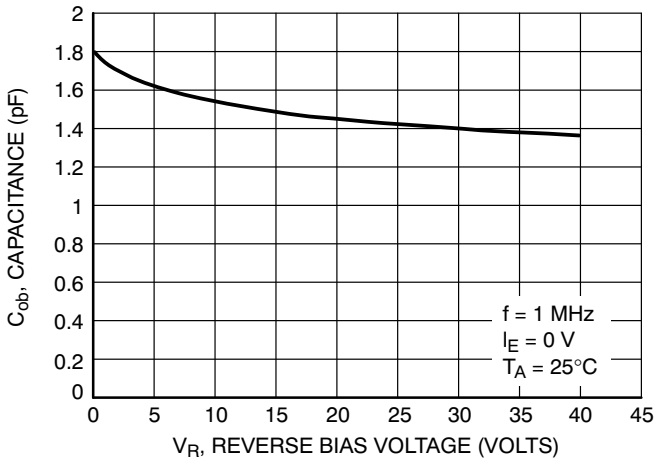


Figure 54. Output Capacitance

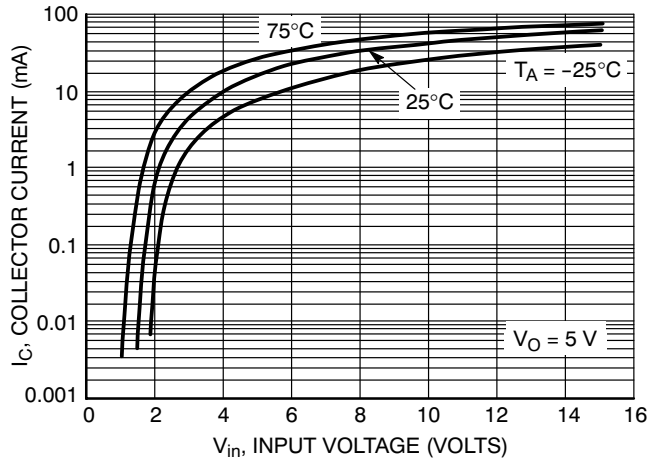


Figure 55. Output Current versus Input Voltage

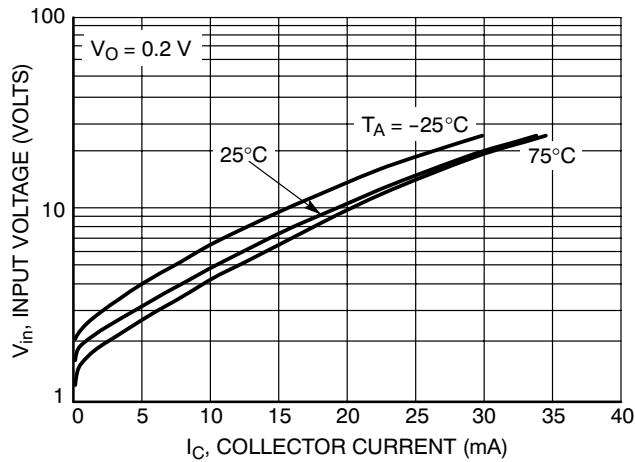


Figure 56. Input Voltage versus Output Current

MUN2211T1 Series

TYPICAL APPLICATIONS FOR NPN BRTs

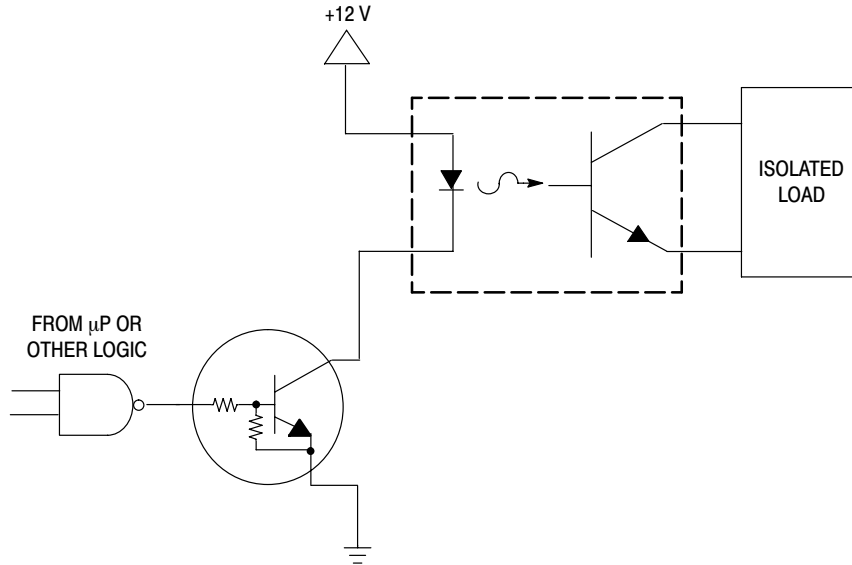


Figure 57. Level Shifter: Connects 12 or 24 Volt Circuits to Logic

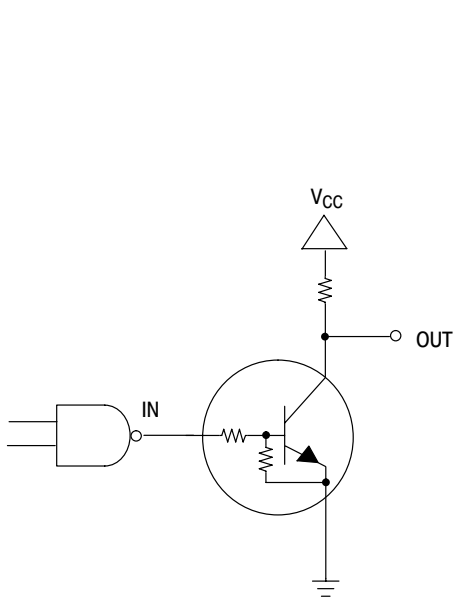


Figure 58. Open Collector Inverter:
Inverts the Input Signal

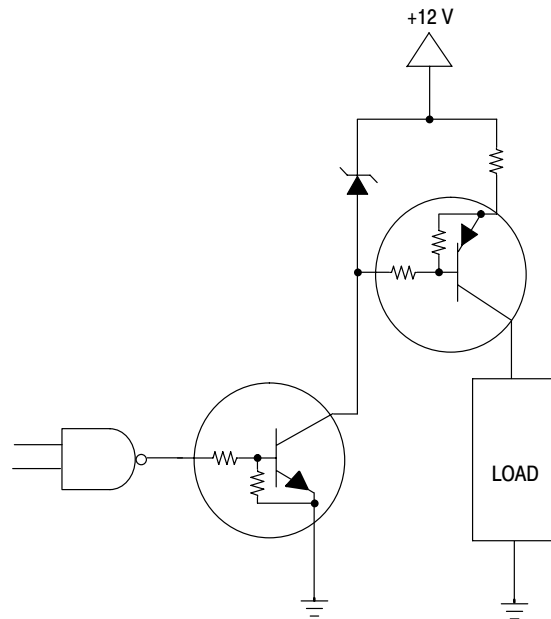
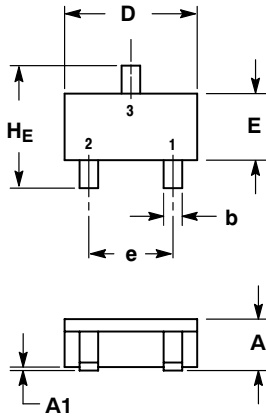


Figure 59. Inexpensive, Unregulated Current Source

MUN2211T1 Series

PACKAGE DIMENSIONS

SC-59
CASE 318D-04
ISSUE G



NOTES:

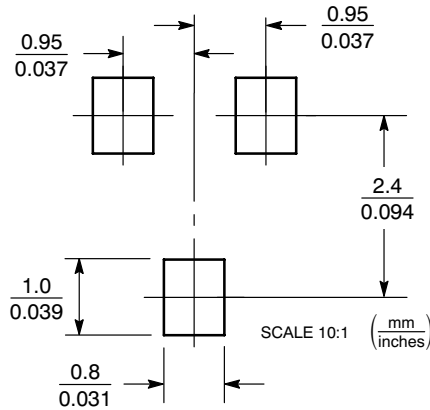
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: MILLIMETER.

| DIM | MILLIMETERS | | | INCHES | | |
|-----|-------------|------|------|--------|-------|-------|
| | MIN | NOM | MAX | MIN | NOM | MAX |
| A | 1.00 | 1.15 | 1.30 | 0.039 | 0.045 | 0.051 |
| A1 | 0.01 | 0.06 | 0.10 | 0.001 | 0.002 | 0.004 |
| b | 0.35 | 0.43 | 0.50 | 0.014 | 0.017 | 0.020 |
| c | 0.09 | 0.14 | 0.18 | 0.003 | 0.005 | 0.007 |
| D | 2.70 | 2.90 | 3.10 | 0.106 | 0.114 | 0.122 |
| E | 1.30 | 1.50 | 1.70 | 0.051 | 0.059 | 0.067 |
| e | 1.70 | 1.90 | 2.10 | 0.067 | 0.075 | 0.083 |
| L | 0.20 | 0.40 | 0.60 | 0.008 | 0.016 | 0.024 |
| HE | 2.50 | 2.80 | 3.00 | 0.099 | 0.110 | 0.118 |


STYLE 1:

1. EMITTER
2. BASE
3. 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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