

MUN5111T1 Series

Preferred Devices

Bias Resistor Transistor

PNP Silicon Surface Mount Transistor with Monolithic Bias Resistor Network

This new series of digital transistors is designed to replace a single device and its external resistor bias network. The BRT (Bias Resistor Transistor) contains a single transistor with a monolithic bias network consisting of two resistors; a series base resistor and a base-emitter resistor. The BRT eliminates these individual components by integrating them into a single device. The use of a BRT can reduce both system cost and board space. The device is housed in the SC-70/SOT-323 package which is designed for low power surface mount applications.

- Simplifies Circuit Design
- Reduces Board Space
- Reduces Component Count
- The SC-70/SOT-323 package can be soldered using wave or reflow. The modified gull-winged leads absorb thermal stress during soldering eliminating the possibility of damage to the die.
- Available in 8 mm embossed tape and reel
Use the Device Number to order the 7 inch/3000 unit reel.
Replace "T1" with "T3" in the Device Number to order the 13 inch/10,000 unit reel.

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 | 202 (Note 1) 310 (Note 2) 1.6 (Note 1) 2.5 (Note 2) | mW $^\circ\text{C/W}$ |
| Thermal Resistance – Junction-to-Ambient | $R_{\theta JA}$ | 618 (Note 1) 403 (Note 2) | $^\circ\text{C/W}$ |
| Thermal Resistance – Junction-to-Lead | $R_{\theta JL}$ | 280 (Note 1) 332 (Note 2) | $^\circ\text{C/W}$ |
| Junction and Storage Temperature Range | T_J, T_{stg} | -55 to +150 | $^\circ\text{C}$ |

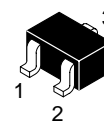
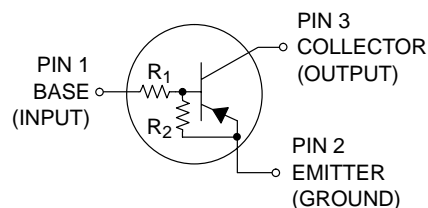
1. FR-4 @ Minimum Pad
2. FR-4 @ 1.0 x 1.0 inch Pad



ON Semiconductor®

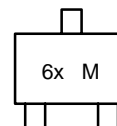
<http://onsemi.com>

PNP SILICON BIAS RESISTOR TRANSISTORS



SC-70/SOT-323
CASE 419
STYLE 3

MARKING DIAGRAM



6x = Specific Device Code
x = (See Marking Table)
M = Date Code

DEVICE MARKING INFORMATION

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

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

MUN511T1 Series

DEVICE MARKING AND RESISTOR VALUES

| Device | Package | Marking | R1 (K) | R2 (K) | Shipping |
|------------------------|---------------|---------|--------|--------|--|
| MUN5111T1 | SC-70/SOT-323 | 6A | 10 | 10 | 3000/Tape & Reel |
| MUN5112T1 | SC-70/SOT-323 | 6B | 22 | 22 | 3000/Tape & Reel |
| MUN5113T1 MUN5113T3 | SC-70/SOT-323 | 6C | 47 | 47 | 3000/Tape & Reel 10,000/Tape & Reel |
| MUN5114T1 | SC-70/SOT-323 | 6D | 10 | 47 | 3000/Tape & Reel |
| MUN5115T1 (Note 3) | SC-70/SOT-323 | 6E | 10 | ∞ | 3000/Tape & Reel |
| MUN5116T1 (Note 3) | SC-70/SOT-323 | 6F | 4.7 | ∞ | 3000/Tape & Reel |
| MUN5130T1 (Note 3) | SC-70/SOT-323 | 6G | 1.0 | 1.0 | 3000/Tape & Reel |
| MUN5131T1 (Note 3) | SC-70/SOT-323 | 6H | 2.2 | 2.2 | 3000/Tape & Reel |
| MUN5132T1 (Note 3) | SC-70/SOT-323 | 6J | 4.7 | 4.7 | 3000/Tape & Reel |
| MUN5133T1 (Note 3) | SC-70/SOT-323 | 6K | 4.7 | 47 | 3000/Tape & Reel |
| MUN5134T1 (Note 3) | SC-70/SOT-323 | 6L | 22 | 47 | 3000/Tape & Reel |
| MUN5135T1 (Note 3) | SC-70/SOT-323 | 6M | 2.2 | 47 | 3000/Tape & Reel |
| MUN5136T1 | SC-70/SOT-323 | 6N | 100 | 100 | 3000/Tape & Reel |
| MUN5137T1 | SC-70/SOT-323 | 6P | 47 | 22 | 3000/Tape & Reel |

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

MUN511T1 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 |
| MUN511T1 | | – | – | 0.2 | |
| MUN5112T1 | | – | – | 0.1 | |
| MUN5113T1 | | – | – | 0.2 | |
| MUN5114T1 | | – | – | 0.9 | |
| MUN5115T1 | | – | – | 1.9 | |
| MUN5116T1 | | – | – | 4.3 | |
| MUN5130T1 | | – | – | 2.3 | |
| MUN5131T1 | | – | – | 1.5 | |
| MUN5132T1 | | – | – | 0.18 | |
| MUN5133T1 | | – | – | 0.13 | |
| MUN5134T1 | | – | – | 0.2 | |
| MUN5135T1 | | – | – | 0.05 | |
| MUN5136T1 | | – | – | 0.13 | |
| MUN5137T1 | | – | – | | |
| 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 | – | |
| MUN5111T1 | | 60 | 100 | – | |
| MUN5112T1 | | 80 | 140 | – | |
| MUN5113T1 | | 80 | 140 | – | |
| MUN5114T1 | | 160 | 250 | – | |
| MUN5115T1 | | 160 | 250 | – | |
| MUN5116T1 | | 3.0 | 5.0 | – | |
| MUN5130T1 | | 8.0 | 15 | – | |
| MUN5131T1 | | 15 | 27 | – | |
| MUN5132T1 | | 80 | 140 | – | |
| MUN5133T1 | | 80 | 130 | – | |
| MUN5134T1 | | 80 | 140 | – | |
| MUN5135T1 | | 80 | 150 | – | |
| MUN5136T1 | | 80 | 140 | – | |
| MUN5137T1 | | | | | |
| Collector–Emitter Saturation Voltage (I _C = 10 mA, I _E = 0.3 mA) (I _C = 10 mA, I _B = 5 mA) MUN5130T1/MUN5131T1 (I _C = 10 mA, I _B = 1 mA) MUN5115T1/MUN5116T1/ MUN5132T1/MUN5133T1/MUN5134T1 | V _{CE(sat)} | – | – | 0.25 | Vdc |
| Output Voltage (on) (V _{CC} = 5.0 V, V _B = 2.5 V, R _L = 1.0 kΩ) | V _{OL} | – | – | 0.2 | Vdc |
| MUN5111T1 | | – | – | 0.2 | |
| MUN5112T1 | | – | – | 0.2 | |
| MUN5114T1 | | – | – | 0.2 | |
| MUN5115T1 | | – | – | 0.2 | |
| MUN5116T1 | | – | – | 0.2 | |
| MUN5130T1 | | – | – | 0.2 | |
| MUN5131T1 | | – | – | 0.2 | |
| MUN5132T1 | | – | – | 0.2 | |
| MUN5133T1 | | – | – | 0.2 | |
| MUN5134T1 | | – | – | 0.2 | |
| MUN5135T1 | | – | – | 0.2 | |
| (V _{CC} = 5.0 V, V _B = 3.5 V, R _L = 1.0 kΩ) | | – | – | 0.2 | |
| (V _{CC} = 5.0 V, V _B = 5.5 V, R _L = 1.0 kΩ) | | – | – | 0.2 | |
| (V _{CC} = 5.0 V, V _B = 4.0 V, R _L = 1.0 kΩ) | | – | – | 0.2 | |

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

MUN511T1 Series

ELECTRICAL CHARACTERISTICS ($T_A = 25^\circ\text{C}$ unless otherwise noted) (Continued)

| Characteristic | Symbol | Min | Typ | Max | Unit |
|---|-----------|---|---|--|------------------|
| Output Voltage (off) ($V_{CC} = 5.0\text{ V}$, $V_B = 0.5\text{ V}$, $R_L = 1.0\text{ k}\Omega$) ($V_{CC} = 5.0\text{ V}$, $V_B = 0.050\text{ V}$, $R_L = 1.0\text{ k}\Omega$) ($V_{CC} = 5.0\text{ V}$, $V_B = 0.25\text{ V}$, $R_L = 1.0\text{ k}\Omega$) | V_{OH} | 4.9 | – | – | Vdc |
| MUN5130T1 MUN5115T1 MUN5116T1 MUN5131T1 MUN5132T1 | | | | | |
| Input Resistor | R1 | 7.0 | 10 | 13 | $\text{k}\Omega$ |
| MUN5111T1 MUN5112T1 MUN5113T1 MUN5114T1 MUN5115T1 MUN5116T1 MUN5130T1 MUN5131T1 MUN5132T1 MUN5133T1 MUN5134T1 MUN5135T1 MUN5136T1 MUN5137T1 | | 15.4 32.9 7.0 7.0 3.3 0.7 1.5 3.3 3.3 15.4 1.54 70 32.9 | 22 47 10 10 4.7 1.0 2.2 4.7 4.7 22 2.2 100 47 | 28.6 61.1 13 13 6.1 1.3 2.9 6.1 6.1 28.6 2.86 130 61.1 | |
| Resistor Ratio | R_1/R_2 | 0.8 | 1.0 | 1.2 | |
| MUN5111T1/MUN5112T1/MUN5113T1/ MUN5136T1 MUN5114T1 MUN5115T1/MUN5116T1 MUN5130T1/MUN5131T1/MUN5132T1 MUN5133T1 MUN5134T1 MUN5135T1 MUN5137T1 | | 0.17 – 0.8 0.055 0.38 0.038 1.7 | 0.21 – 1.0 0.1 0.47 0.047 2.1 | 0.25 – 1.2 0.185 0.56 0.056 2.6 | |

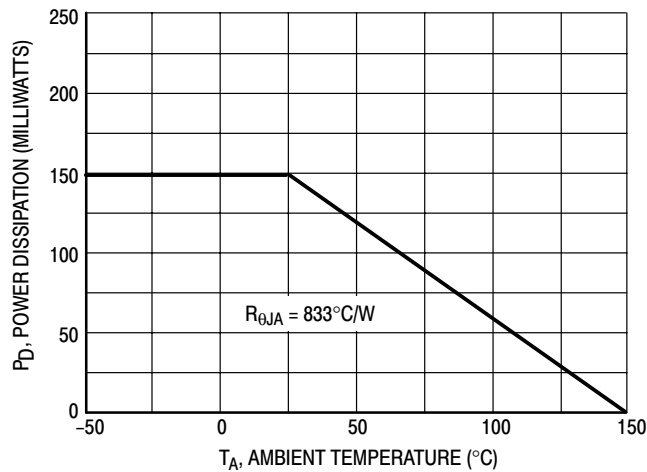


Figure 1. Derating Curve

MUN511T1 Series

TYPICAL ELECTRICAL CHARACTERISTICS – MUN511T1

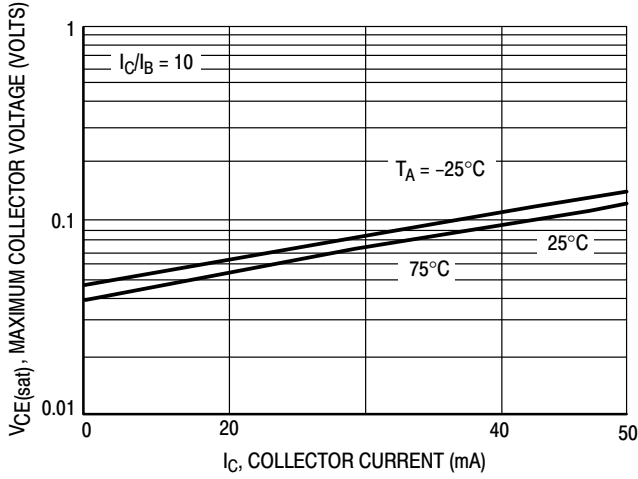


Figure 2. $V_{CE(sat)}$ versus I_C

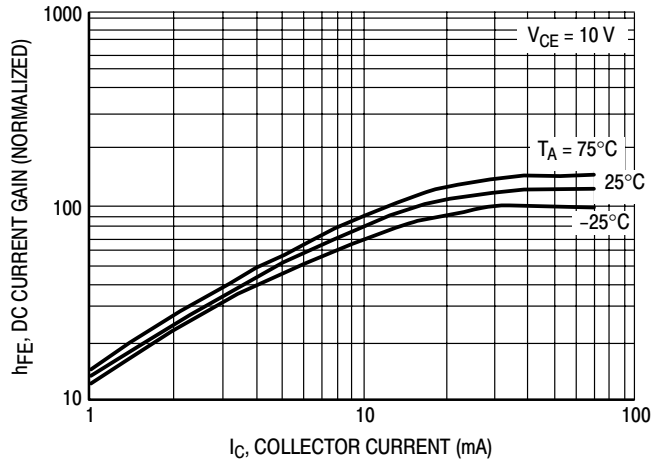


Figure 3. DC Current Gain

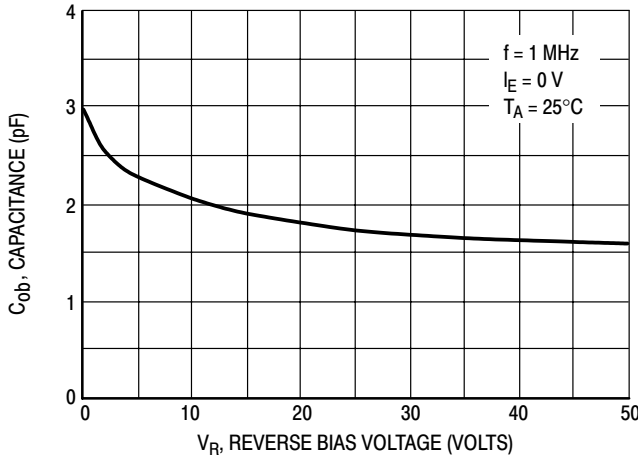


Figure 4. Output Capacitance

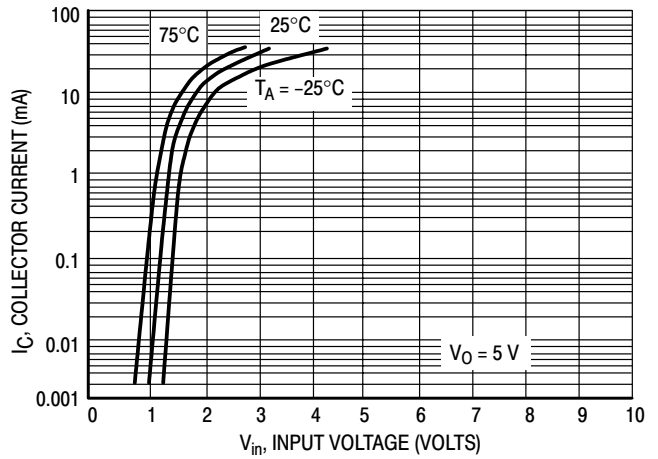


Figure 5. Output Current versus Input Voltage

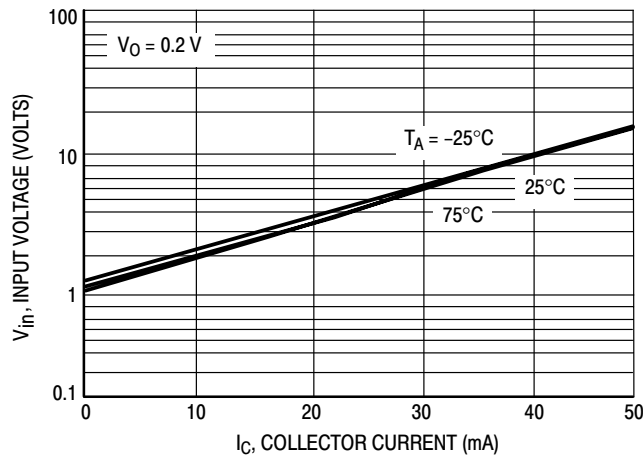


Figure 6. Input Voltage versus Output Current

MUN511T1 Series

TYPICAL ELECTRICAL CHARACTERISTICS – MUN511T1

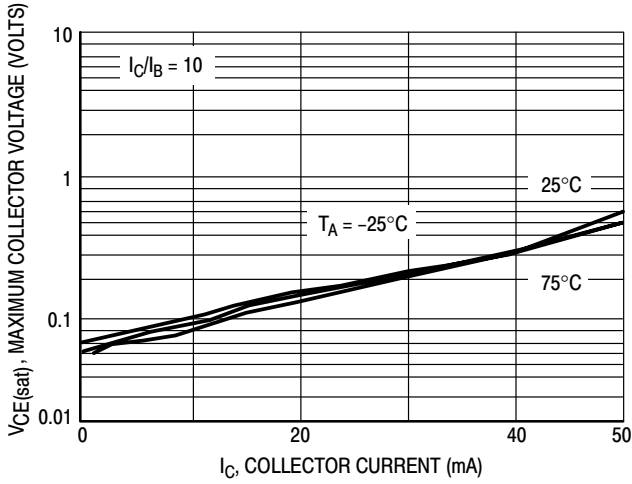


Figure 7. $V_{CE(sat)}$ versus I_C

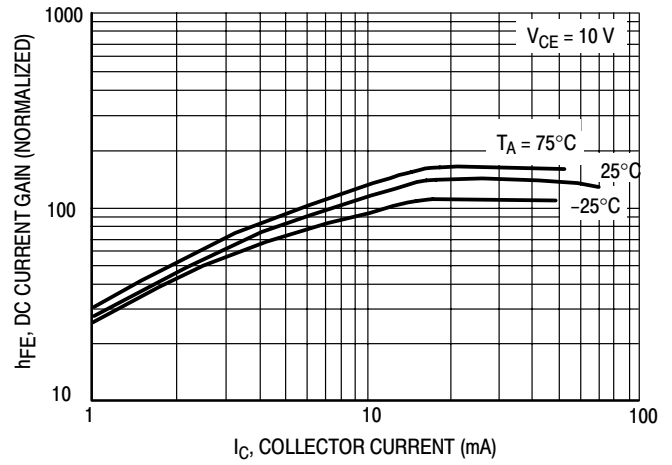


Figure 8. DC Current Gain

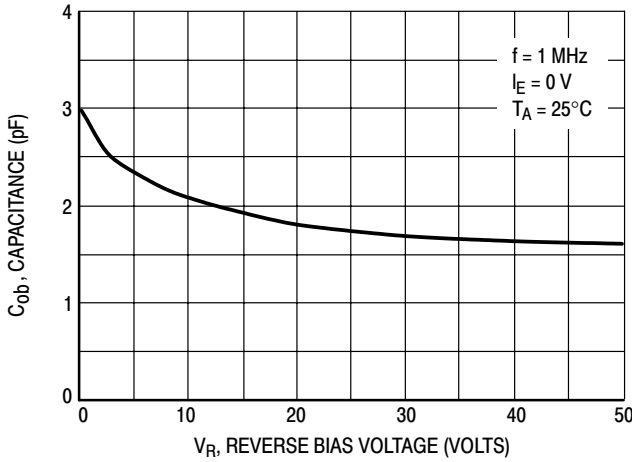


Figure 9. Output Capacitance

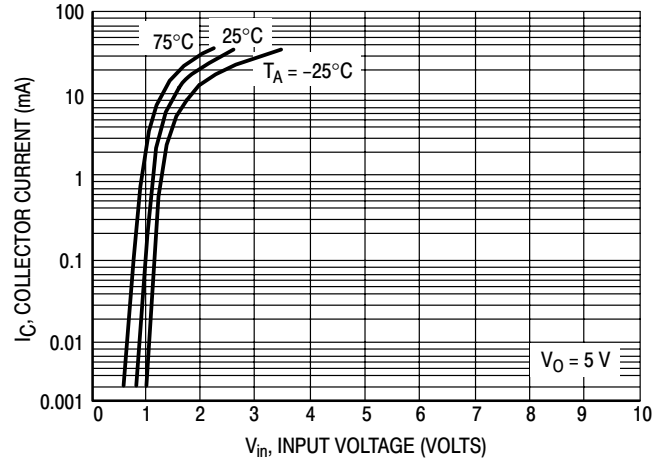


Figure 10. Output Current versus Input Voltage

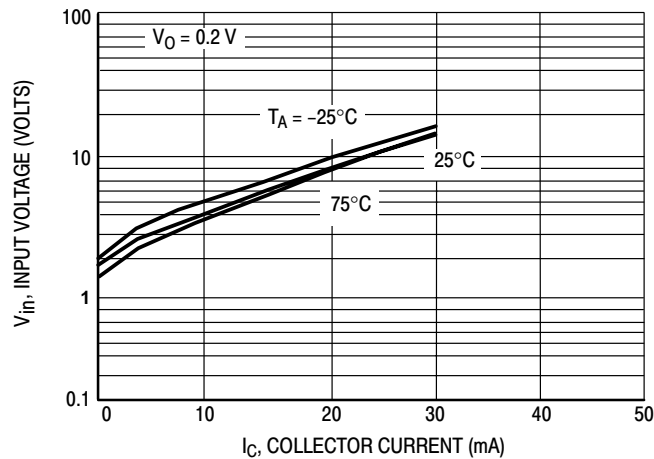


Figure 11. Input Voltage versus Output Current

MUN511T1 Series

TYPICAL ELECTRICAL CHARACTERISTICS – MUN5113T1

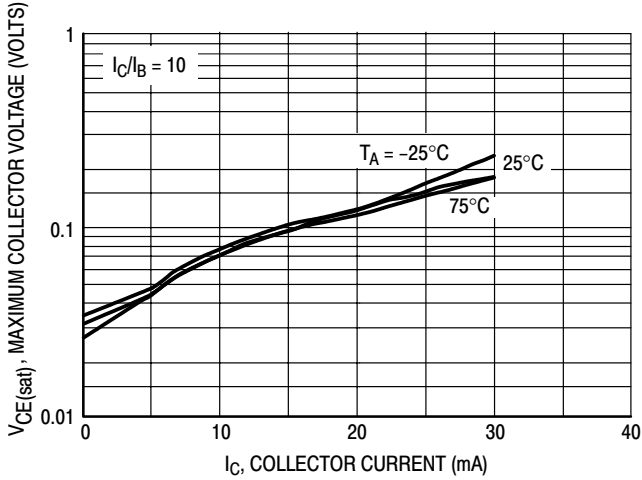


Figure 12. $V_{CE(sat)}$ versus I_C

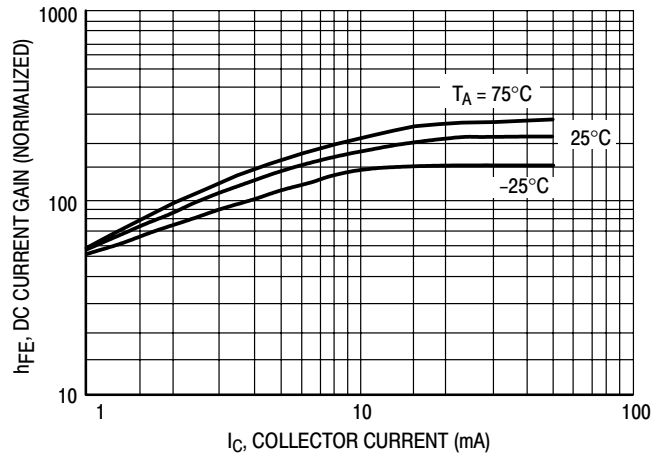


Figure 13. DC Current Gain

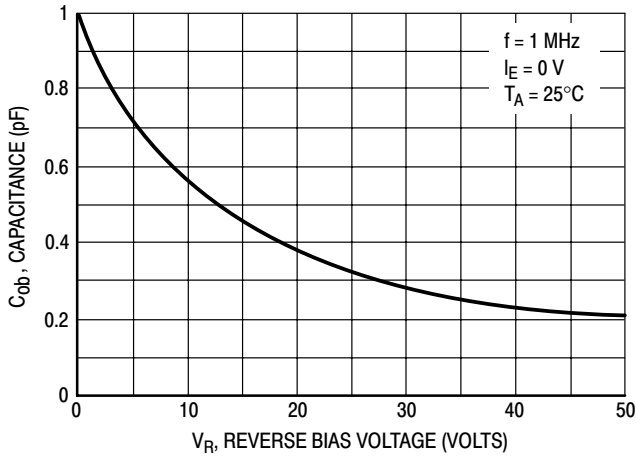


Figure 14. Output Capacitance

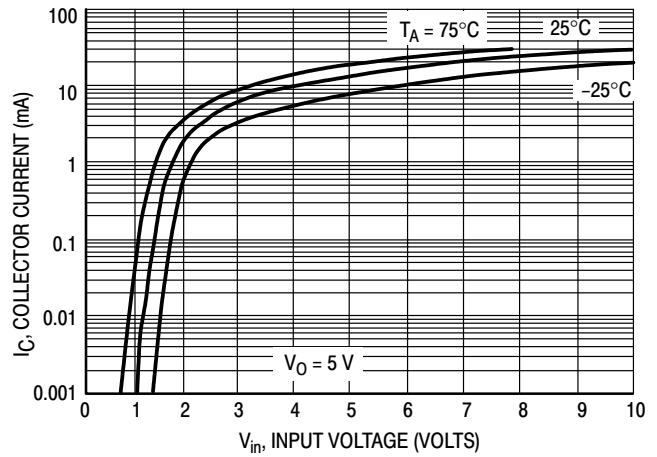


Figure 15. Output Current versus Input Voltage

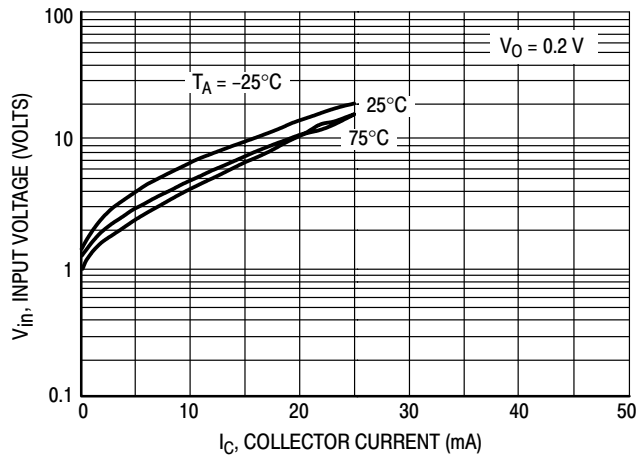


Figure 16. Input Voltage versus Output Current

MUN5111T1 Series

TYPICAL ELECTRICAL CHARACTERISTICS – MUN5114T1

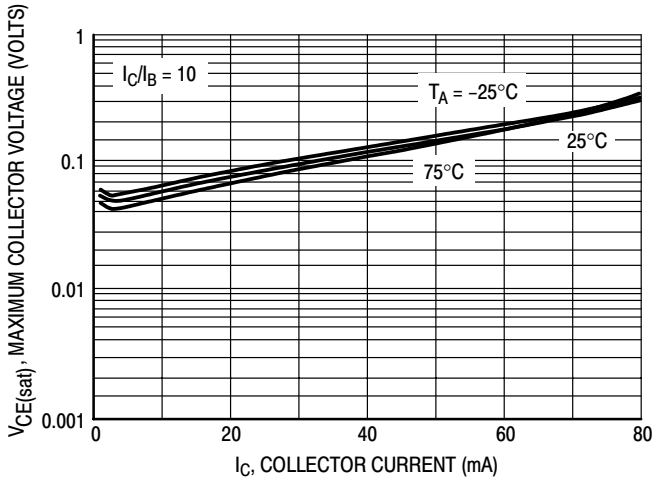


Figure 17. $V_{CE(sat)}$ versus I_C

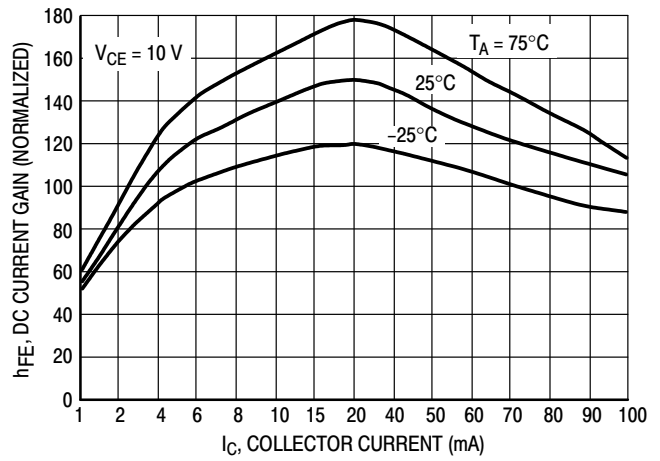


Figure 18. DC Current Gain

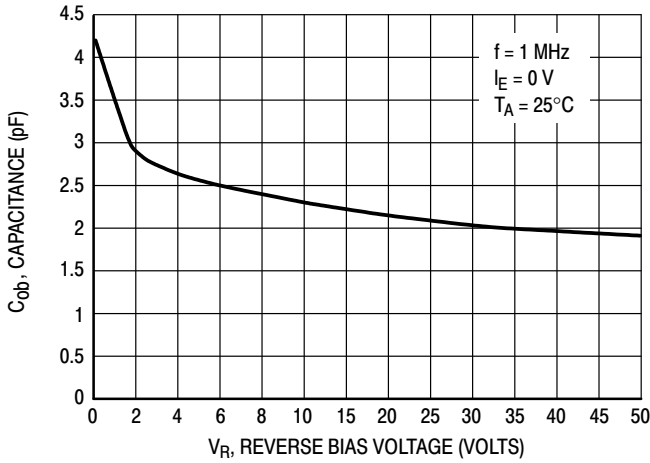


Figure 19. Output Capacitance

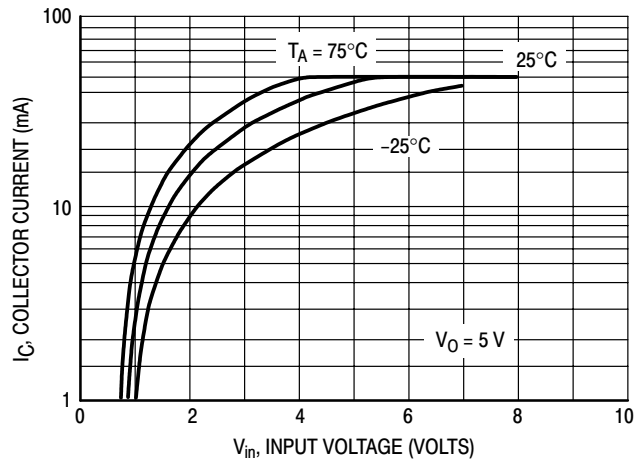


Figure 20. Output Current versus Input Voltage

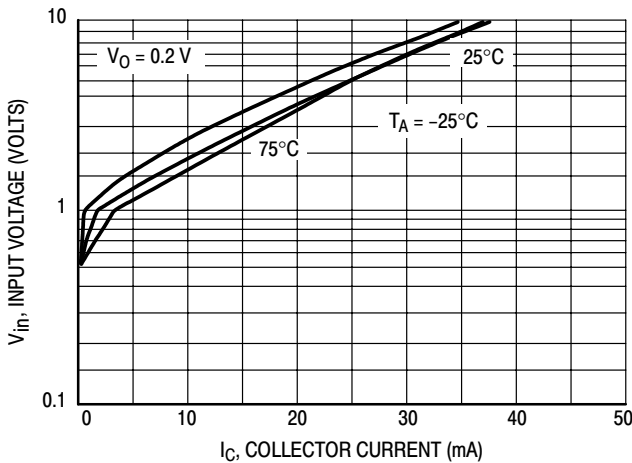


Figure 21. Input Voltage versus Output Current

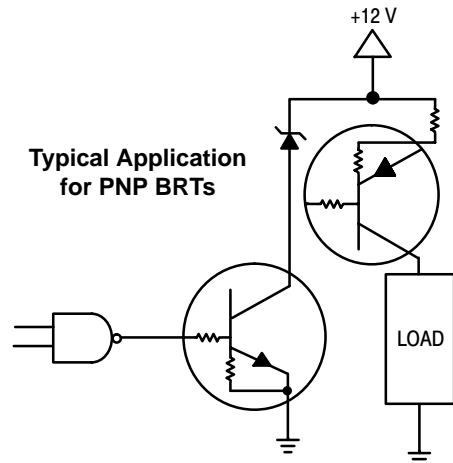


Figure 22. Inexpensive, Unregulated Current Source

MUN511T1 Series

TYPICAL ELECTRICAL CHARACTERISTICS — MUN5132T1

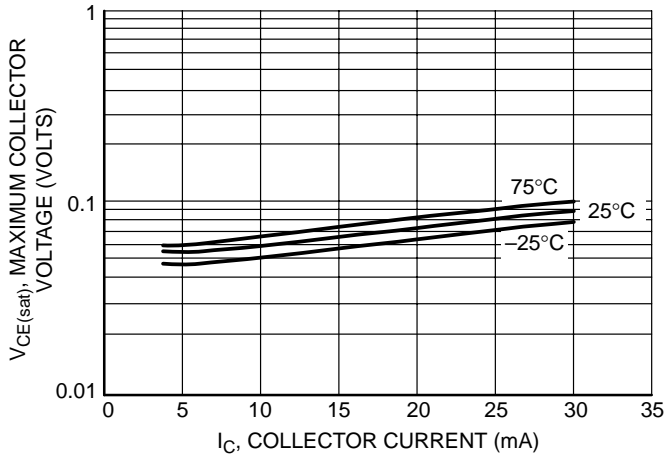


Figure 23. Maximum Collector Voltage versus Collector Current

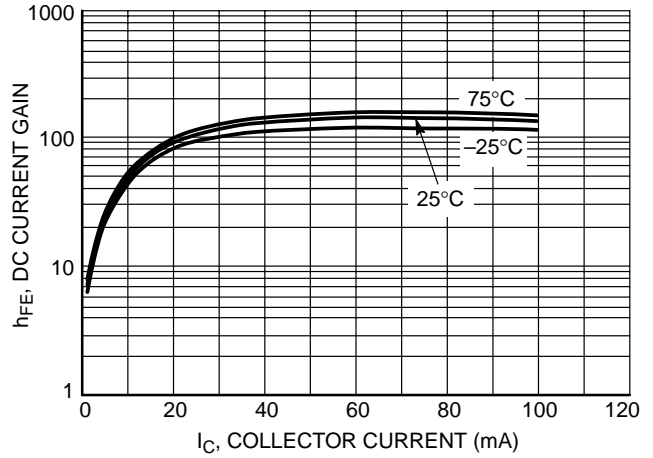


Figure 24. DC Current Gain

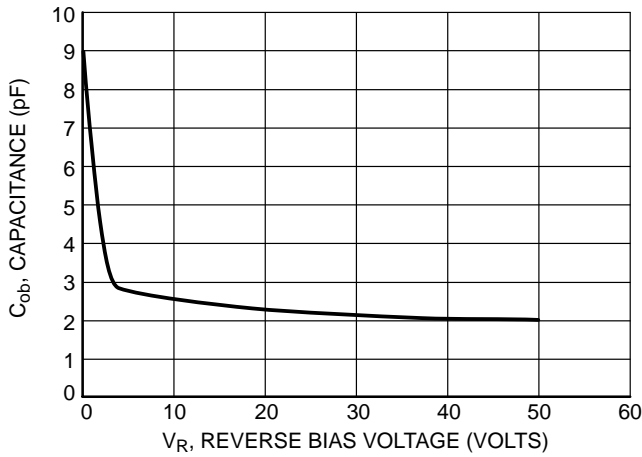


Figure 25. Output Capacitance

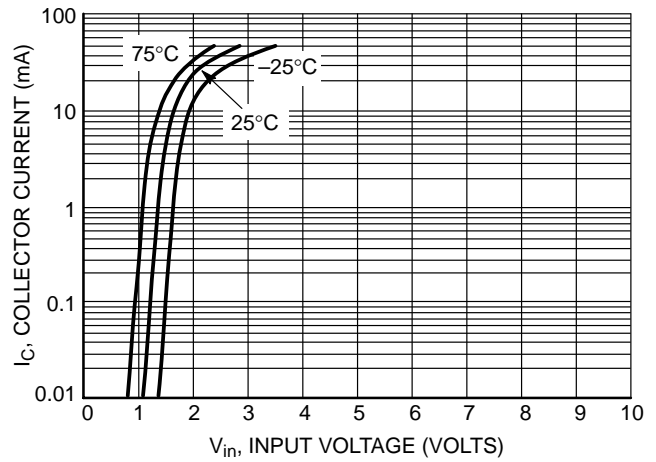


Figure 26. Output Current versus Input Voltage

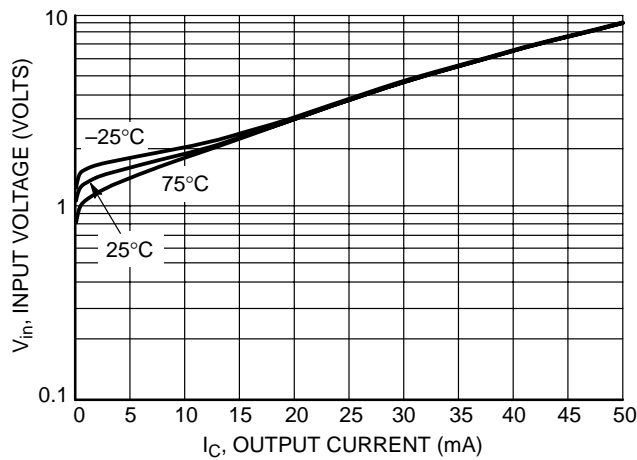


Figure 27. Input Voltage versus Output Current

MUN5111T1 Series

TYPICAL ELECTRICAL CHARACTERISTICS — MUN5136T1

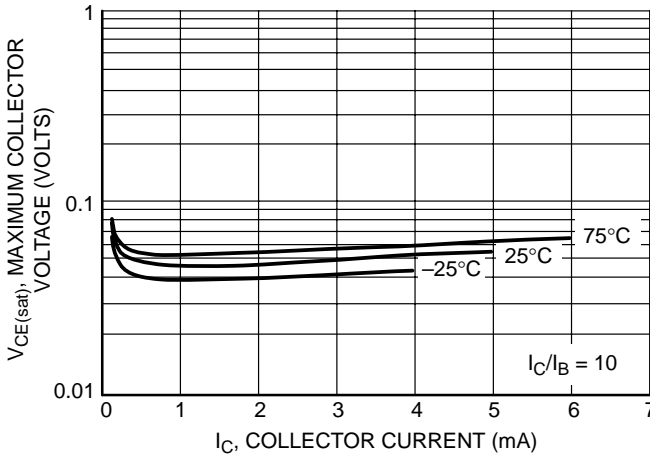


Figure 28. Maximum Collector Voltage versus Collector Current

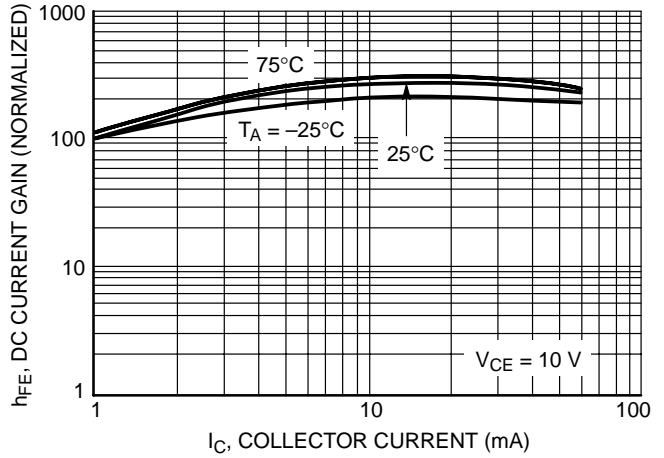


Figure 29. DC Current Gain

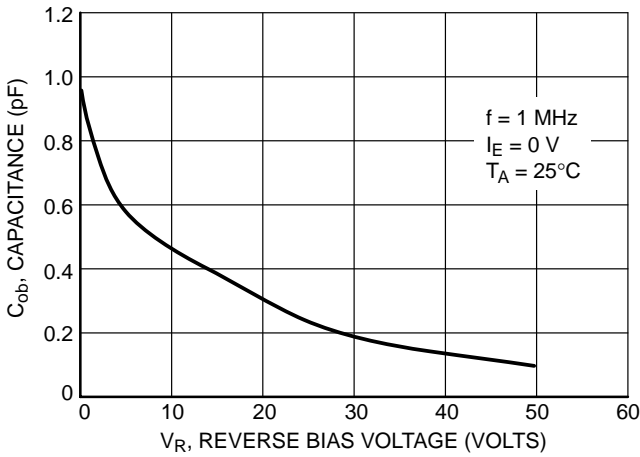


Figure 30. Output Capacitance

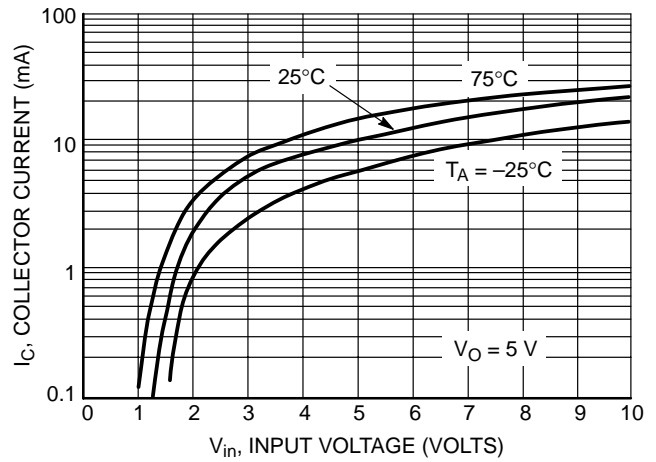


Figure 31. Output Current versus Input Voltage

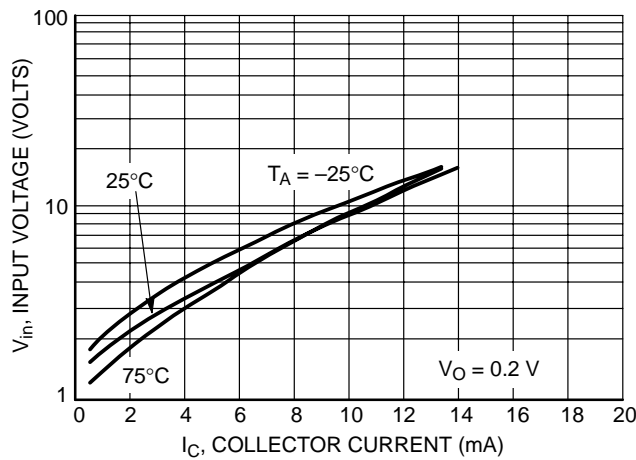


Figure 32. Input Voltage versus Output Current

MUN511T1 Series

TYPICAL ELECTRICAL CHARACTERISTICS — MUN5137T1

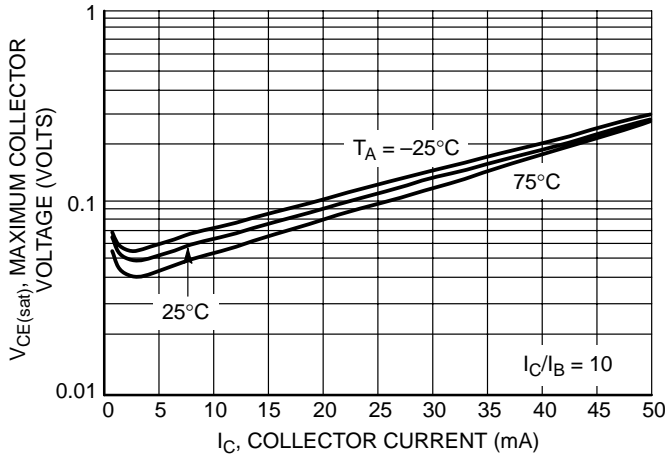


Figure 33. Maximum Collector Voltage versus Collector Current

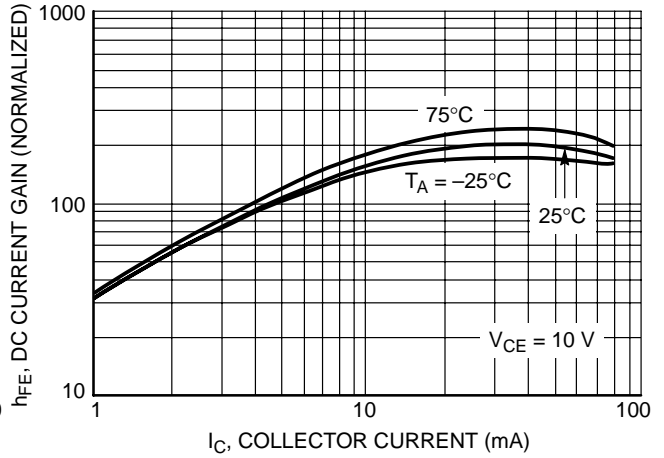


Figure 34. DC Current Gain

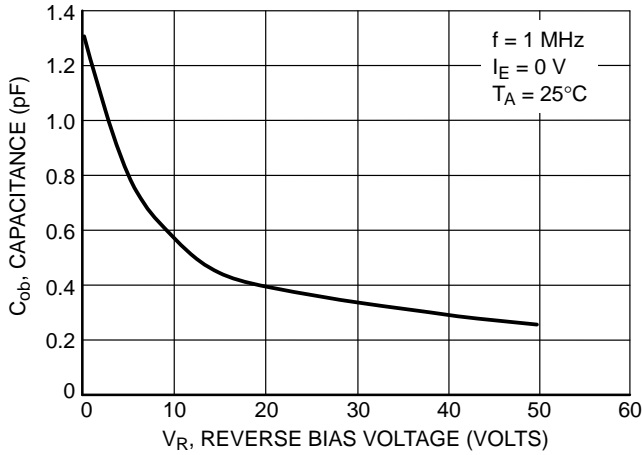


Figure 35. Output Capacitance

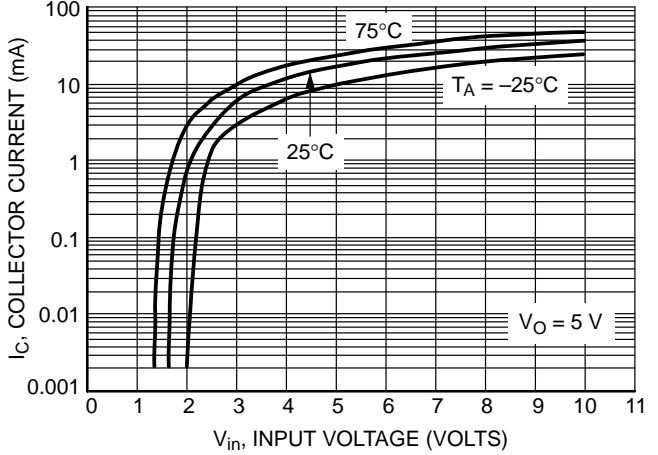


Figure 36. Output Current versus Input Voltage

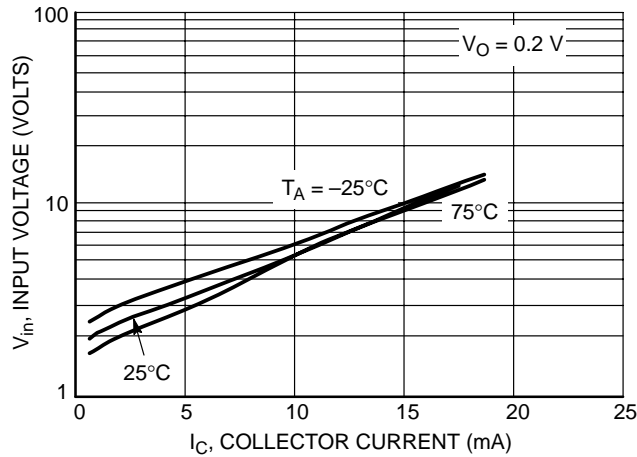


Figure 37. Input Voltage versus Output Current

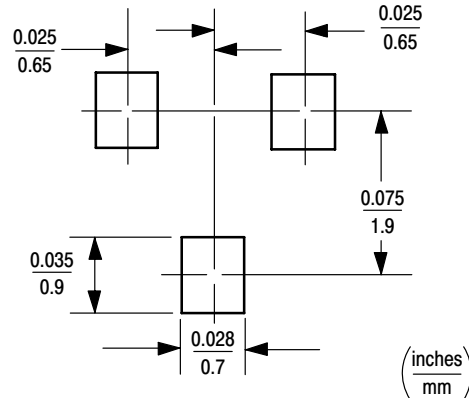
MUN511T1 Series

INFORMATION FOR USING THE SC-70/SOT-323 SURFACE MOUNT PACKAGE

MINIMUM RECOMMENDED FOOTPRINT FOR SURFACE MOUNTED APPLICATIONS

Surface mount board layout is a critical portion of the total design. The footprint for the semiconductor packages must be the correct size to insure proper solder connection

interface between the board and the package. With the correct pad geometry, the packages will self align when subjected to a solder reflow process.



SC-70/SOT-323 POWER DISSIPATION

The power dissipation of the SC-70/SOT-323 is a function of the pad size. This can vary from the minimum pad size for soldering to the pad size given for maximum power dissipation. Power dissipation for a surface mount device is determined by $T_{J(max)}$, the maximum rated junction temperature of the die, $R_{\theta JA}$, the thermal resistance from the device junction to ambient; and the operating temperature, T_A . Using the values provided on the data sheet, P_D can be calculated as follows.

$$P_D = \frac{T_{J(max)} - T_A}{R_{\theta JA}}$$

The values for the equation are found in the maximum ratings table on the data sheet. Substituting these values into

the equation for an ambient temperature T_A of 25°C, one can calculate the power dissipation of the device which in this case is 200 milliwatts.

$$P_D = \frac{150^\circ\text{C} - 25^\circ\text{C}}{0.625^\circ\text{C/W}} = 200 \text{ milliwatts}$$

The 0.625°C/W assumes the use of the recommended footprint on a glass epoxy printed circuit board to achieve a power dissipation of 200 milliwatts. Another alternative would be to use a ceramic substrate or an aluminum core board such as Thermal Clad®. Using a board material such as Thermal Clad, a higher power dissipation of 300 milliwatts can be achieved using the same footprint.

SOLDERING PRECAUTIONS

The melting temperature of solder is higher than the rated temperature of the device. When the entire device is heated to a high temperature, failure to complete soldering within a short time could result in device failure. Therefore, the following items should always be observed in order to minimize the thermal stress to which the devices are subjected.

- Always preheat the device.
- The delta temperature between the preheat and soldering should be 100°C or less.*
- When preheating and soldering, the temperature of the leads and the case must not exceed the maximum temperature ratings as shown on the data sheet. When using infrared heating with the reflow soldering method, the difference should be a maximum of 10°C.

- The soldering temperature and time should not exceed 260°C for more than 10 seconds.
- When shifting from preheating to soldering, the maximum temperature gradient should be 5°C or less.
- After soldering has been completed, the device should be allowed to cool naturally for at least three minutes. Gradual cooling should be used as the use of forced cooling will increase the temperature gradient and result in latent failure due to mechanical stress.
- Mechanical stress or shock should not be applied during cooling

* Soldering a device without preheating can cause excessive thermal shock and stress which can result in damage to the device.

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SOLDER STENCIL GUIDELINES

Prior to placing surface mount components onto a printed circuit board, solder paste must be applied to the pads. A solder stencil is required to screen the optimum amount of solder paste onto the footprint. The stencil is made of brass or stainless steel with a typical thickness of 0.008 inches.

The stencil opening size for the surface mounted package should be the same as the pad size on the printed circuit board, i.e., a 1:1 registration.

TYPICAL SOLDER HEATING PROFILE

For any given circuit board, there will be a group of control settings that will give the desired heat pattern. The operator must set temperatures for several heating zones, and a figure for belt speed. Taken together, these control settings make up a heating “profile” for that particular circuit board. On machines controlled by a computer, the computer remembers these profiles from one operating session to the next. Figure 7 shows a typical heating profile for use when soldering a surface mount device to a printed circuit board. This profile will vary among soldering systems but it is a good starting point. Factors that can affect the profile include the type of soldering system in use, density and types of components on the board, type of solder used, and the type of board or substrate material being used. This profile shows temperature versus time.

The line on the graph shows the actual temperature that might be experienced on the surface of a test board at or near a central solder joint. The two profiles are based on a high density and a low density board. The Vitronics SMD310 convection/infrared reflow soldering system was used to generate this profile. The type of solder used was 62/36/2 Tin Lead Silver with a melting point between 177–189°C. When this type of furnace is used for solder reflow work, the circuit boards and solder joints tend to heat first. The components on the board are then heated by conduction. The circuit board, because it has a large surface area, absorbs the thermal energy more efficiently, then distributes this energy to the components. Because of this effect, the main body of a component may be up to 30 degrees cooler than the adjacent solder joints.

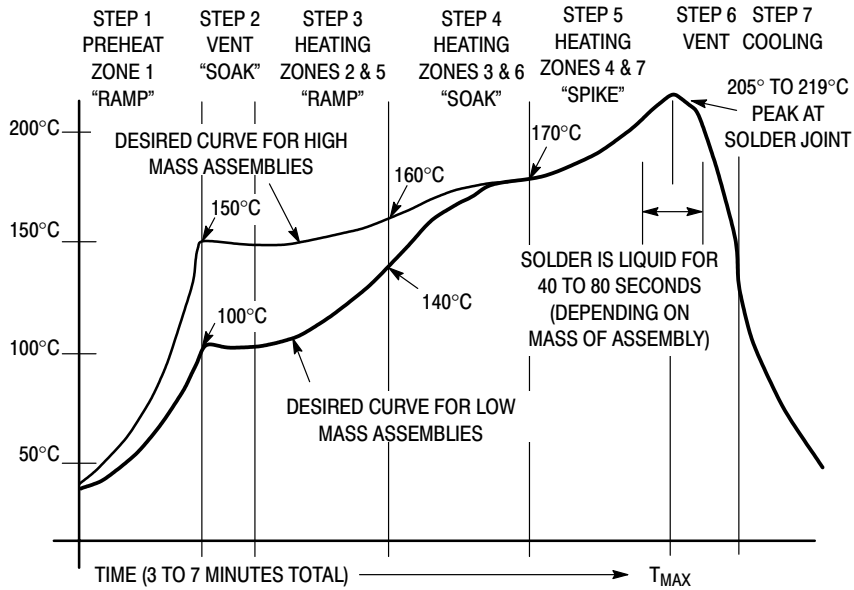
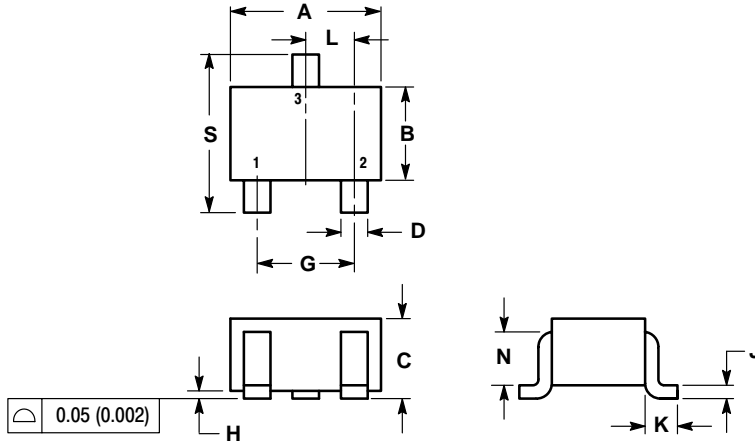


Figure 38. Typical Solder Heating Profile

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PACKAGE DIMENSIONS

SC-70/SOT-323
CASE 419-04
ISSUE L



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


| DIM | INCHES | | MILLIMETERS | |
|-----|-----------|-------|-------------|------|
| | MIN | MAX | MIN | MAX |
| A | 0.071 | 0.087 | 1.80 | 2.20 |
| B | 0.045 | 0.053 | 1.15 | 1.35 |
| C | 0.032 | 0.040 | 0.80 | 1.00 |
| D | 0.012 | 0.016 | 0.30 | 0.40 |
| G | 0.047 | 0.055 | 1.20 | 1.40 |
| H | 0.000 | 0.004 | 0.00 | 0.10 |
| J | 0.004 | 0.010 | 0.10 | 0.25 |
| K | 0.017 REF | | 0.425 REF | |
| L | 0.026 BSC | | 0.650 BSC | |
| N | 0.028 REF | | 0.700 REF | |
| S | 0.079 | 0.095 | 2.00 | 2.40 |

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

Notes

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