

# Dual Bias Resistor Transistors

## NPN and PNP Silicon Surface Mount

### Transistors with Monolithic Bias

### Resistor 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. These digital transistors are designed to replace a single device and its external resistor bias network. The BRT eliminates these individual components by integrating them into a single device. In the MUN5311DW1T1 series, two complementary BRT devices are housed in the SOT-363 package which is ideal for low power surface mount applications where board space is at a premium.

- Simplifies Circuit Design
- Reduces Board Space
- Reduces Component Count
- Available in 8 mm, 7 inch/3000 Unit Tape and Reel

**MAXIMUM RATINGS** ( $T_A = 25^\circ\text{C}$  unless otherwise noted, common for Q 1 and Q 2, – minus sign for Q 1 (PNP) omitted)

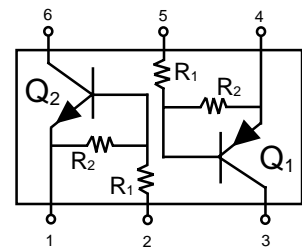
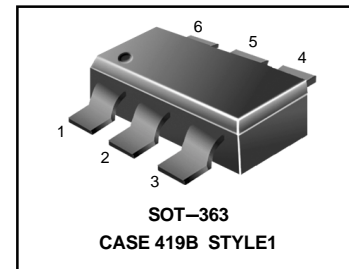
| Rating                    | Symbol    | Value | Unit |
|---------------------------|-----------|-------|------|
| Collector-Base Voltage    | $V_{CBO}$ | 50    | Vdc  |
| Collector-Emitter Voltage | $V_{CEO}$ | 50    | Vdc  |
| Collector Current         | $I_C$     | 100   | mAdc |

### THERMAL CHARACTERISTICS

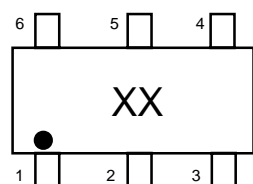
| Characteristic<br>(One Junction Heated)              | Symbol          | Max           | Unit                      |
|--|-----------------|---------------|---------------------------|
| Total Device Dissipation<br>$T_A = 25^\circ\text{C}$ | $P_D$           | 187 (Note 1.) | mW                        |
| Derate above $25^\circ\text{C}$                      |                 | 256 (Note 2.) |                           |
|  |                 | 1.5 (Note 1.) | mW/ $^\circ\text{C}$      |
|  |                 | 2.0 (Note 2.) |                           |
| Thermal Resistance –<br>Junction-to-Ambient          | $R_{\theta JA}$ | 670 (Note 1.) | $^\circ\text{C}/\text{W}$ |
|  |                 | 490 (Note 2.) |                           |
| Characteristic<br>(Both Junctions Heated)            | Symbol          | Max           | Unit                      |
| Total Device Dissipation<br>$T_A = 25^\circ\text{C}$ | $P_D$           | 250 (Note 1.) | mW                        |
| Derate above $25^\circ\text{C}$                      |                 | 385 (Note 2.) |                           |
|  |                 | 2.0 (Note 1.) | mW/ $^\circ\text{C}$      |
|  |                 | 3.0 (Note 2.) |                           |
| Thermal Resistance –<br>Junction-to-Ambient          | $R_{\theta JA}$ | 493 (Note 1.) | $^\circ\text{C}/\text{W}$ |
|  |                 | 325 (Note 2.) |                           |
| Thermal Resistance –<br>Junction-to-Lead             | $R_{\theta JL}$ | 188 (Note 1.) | $^\circ\text{C}/\text{W}$ |
|  |                 | 208 (Note 2.) |                           |
| Junction and Storage<br>Temperature                  | $T_J, T_{stg}$  | -55 to +150   | $^\circ\text{C}$          |

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

## MUN5311DW1T1 Series



### MARKING DIAGRAM



xx = Device Marking  
(See Page 2)

### DEVICE MARKING INFORMATION

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

**MUN5311DW1T1 Series**

**DEVICE MARKING AND RESISTOR VALUES**

| Device                 | Package | Marking | R <sub>1</sub> (K) | R <sub>2</sub> (K) | Shipping         |
|------------------------|---------|---------|--------------------|--------------------|------------------|
| MUN5311DW1T1           | SOT-363 | 11      | 10                 | 10                 | 3000/Tape & Reel |
| MUN5312DW1T1           | SOT-363 | 12      | 22                 | 22                 | 3000/Tape & Reel |
| MUN5313DW1T1           | SOT-363 | 13      | 47                 | 47                 | 3000/Tape & Reel |
| MUN5314DW1T1           | SOT-363 | 14      | 10                 | 47                 | 3000/Tape & Reel |
| MUN5315DW1T1 (Note 3.) | SOT-363 | 15      | 10                 | ∞                  | 3000/Tape & Reel |
| MUN5316DW1T1 (Note 3.) | SOT-363 | 16      | 4.7                | ∞                  | 3000/Tape & Reel |
| MUN5330DW1T1 (Note 3.) | SOT-363 | 30      | 1.0                | 1.0                | 3000/Tape & Reel |
| MUN5331DW1T1 (Note 3.) | SOT-363 | 31      | 2.2                | 2.2                | 3000/Tape & Reel |
| MUN5332DW1T1 (Note 3.) | SOT-363 | 32      | 4.7                | 4.7                | 3000/Tape & Reel |
| MUN5333DW1T1 (Note 3.) | SOT-363 | 33      | 4.7                | 47                 | 3000/Tape & Reel |
| MUN5334DW1T1 (Note 3.) | SOT-363 | 34      | 22                 | 47                 | 3000/Tape & Reel |
| MUN5335DW1T1 (Note 3.) | SOT-363 | 35      | 2.2                | 47                 | 3000/Tape & Reel |

**ELECTRICAL CHARACTERISTICS**

(T<sub>A</sub> = 25°C unless otherwise noted, common for Q<sub>1</sub> and Q<sub>2</sub>, – minus sign for Q<sub>1</sub> (PNP) omitted)

| Characteristic | Symbol | Min | Typ | Max | Unit |
|----------------|--------|-----|-----|-----|------|
|----------------|--------|-----|-----|-----|------|

**OFF CHARACTERISTICS**

|   |                      |                  |   |      |      |      |
|---|----------------------|------------------|---|------|------|------|
| 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 (V <sub>EB</sub> = 6.0 V, I <sub>C</sub> = 0)                   | MUN5311DW1T1         | I <sub>EBO</sub> | – | –    | 0.5  | mAdc |
|   | MUN5312DW1T1         |                  | – | –    | 0.2  |      |
|   | MUN5313DW1T1         |                  | – | –    | 0.1  |      |
|   | MUN5314DW1T1         |                  | – | –    | 0.2  |      |
|   | MUN5315DW1T1         |                  | – | –    | 0.9  |      |
|   | MUN5316DW1T1         |                  | – | –    | 1.9  |      |
|   | MUN5330DW1T1         |                  | – | –    | 4.3  |      |
|   | MUN5331DW1T1         |                  | – | –    | 2.3  |      |
|   | MUN5332DW1T1         |                  | – | –    | 1.5  |      |
|   | MUN5333DW1T1         |                  | – | –    | 0.18 |      |
| MUN5334DW1T1  |                      | –                | – | 0.13 |      |      |
| MUN5335DW1T1  |                      | –                | – | 0.2  |      |      |
| 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 4.) (I <sub>C</sub> = 2.0 mA, I <sub>B</sub> = 0) | V <sub>(BR)CEO</sub> | 50               | – | –    | Vdc  |      |

3. New resistor combinations. Updated curves to follow in subsequent data sheets.

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

**MUN5311DW1T1 Series**

**ELECTRICAL CHARACTERISTICS**

(T<sub>A</sub> = 25°C unless otherwise noted, common for Q<sub>1</sub> and Q<sub>2</sub>, – minus sign for Q<sub>1</sub> (PNP) omitted)  
(Continued)

| Characteristic  | Symbol  | Min             | Typ | Max  | Unit |
|---|---|-----------------|-----|------|------|
| <b>ON CHARACTERISTICS</b> (Note 5.)   |   |                 |     |      |      |
| DC Current Gain<br>(V <sub>CE</sub> = 10 V, I <sub>C</sub> = 5.0 mA)                            | MUN5311DW1T1  | h <sub>FE</sub> | 35  | 60   | –    |
|   | MUN5312DW1T1  |                 | 60  | 100  | –    |
|   | MUN5313DW1T1  |                 | 80  | 140  | –    |
|   | MUN5314DW1T1  |                 | 80  | 140  | –    |
|   | MUN5315DW1T1  |                 | 160 | 350  | –    |
|   | MUN5316DW1T1  |                 | 160 | 350  | –    |
|   | MUN5330DW1T1  |                 | 3.0 | 5.0  | –    |
|   | MUN5331DW1T1  |                 | 8.0 | 15   | –    |
|   | MUN5332DW1T1  |                 | 15  | 30   | –    |
|   | MUN5333DW1T1  |                 | 80  | 200  | –    |
|   | MUN5334DW1T1  |                 | 80  | 150  | –    |
|   | MUN5335DW1T1  |                 | 80  | 140  | –    |
| Collector-Emitter Saturation Voltage<br>(I <sub>C</sub> = 10 mA, I <sub>B</sub> = 0.3 mA)       | V <sub>CE(sat)</sub>  | –               | –   | 0.25 | Vdc  |
| (I <sub>C</sub> = 10 mA, I <sub>B</sub> = 5 mA)   | MUN5330DW1T1/MUN5331DW1T1   |                 |     |      |      |
| (I <sub>C</sub> = 10 mA, I <sub>B</sub> = 1 mA)   | MUN5315DW1T1/MUN5316DW1T1<br>MUN5332DW1T1/MUN5333DW1T1/MUN5334DW1T1 |                 |     |      |      |
| Output Voltage (on)<br>(V <sub>CC</sub> = 5.0V, V <sub>B</sub> = 2.5V, R <sub>L</sub> = 1.0 kΩ) | V <sub>OL</sub>   |                 |     |      | Vdc  |
|   | MUN5311DW1T1  | –               | –   | 0.2  |      |
|   | MUN5312DW1T1  | –               | –   | 0.2  |      |
|   | MUN5314DW1T1  | –               | –   | 0.2  |      |
|   | MUN5315DW1T1  | –               | –   | 0.2  |      |
|   | MUN5316DW1T1  | –               | –   | 0.2  |      |
|   | MUN5330DW1T1  | –               | –   | 0.2  |      |
|   | MUN5331DW1T1  | –               | –   | 0.2  |      |
|   | MUN5332DW1T1  | –               | –   | 0.2  |      |
|   | MUN5333DW1T1  | –               | –   | 0.2  |      |
|   | MUN5334DW1T1  | –               | –   | 0.2  |      |
|   | MUN5335DW1T1  | –               | –   | 0.2  |      |
| (V <sub>CC</sub> = 5.0V, V <sub>B</sub> = 3.5 V, R <sub>L</sub> = 1.0kΩ)                        | MUN5313DW1T1  | –               | –   | 0.2  |      |

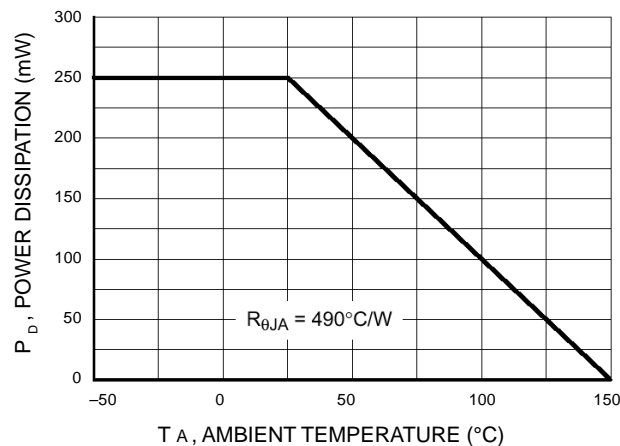
**MUN5311DW1T1 Series**

**ELECTRICAL CHARACTERISTICS**

(T<sub>A</sub> = 25°C unless otherwise noted, common for Q<sub>1</sub> and Q<sub>2</sub>, – minus sign for Q<sub>1</sub> (PNP) omitted)  
(Continued)

| Characteristic  | Symbol                          | Min  | Typ   | Max   | Unit |
|---|---------------------------------|--|---|---|------|
| <b>ON CHARACTERISTICS</b> (Note 5.)   |                                 |  |   |   |      |
| Output Voltage (off)<br>(V <sub>CC</sub> =5.0V, V <sub>B</sub> =0.5V, R <sub>L</sub> =1.0kΩ)<br>(V <sub>CC</sub> =5.0V, V <sub>B</sub> =0.050V, R <sub>L</sub> =1.0kΩ) MUN5330DW1T1<br>(V <sub>CC</sub> =5.0V, V <sub>B</sub> =0.25V, R <sub>L</sub> =1.0kΩ) MUN5315DW1T1<br>MUN5316DW1T1<br>MUN5333DW1T1 | V <sub>OH</sub>                 | 4.9  | –   | –   | Vdc  |
| Input Resistor<br>MUN5311DW1T1<br>MUN5312DW1T1<br>MUN5313DW1T1<br>MUN5314DW1T1<br>MUN5315DW1T1<br>MUN5316DW1T1<br>MUN5330DW1T1<br>MUN5331DW1T1<br>MUN5332DW1T1<br>MUN5333DW1T1<br>MUN5334DW1T1<br>MUN5335DW1T1  | R <sub>1</sub>                  | 7.0<br>15.4<br>32.9<br>7.0<br>7.0<br>3.3<br>0.7<br>1.5<br>3.3<br>3.3<br>15.4<br>1.54 | 10<br>22<br>47<br>10<br>10<br>4.7<br>1.0<br>2.2<br>4.7<br>4.7 | 13<br>28.6<br>61.1<br>13<br>13<br>6.1<br>1.3<br>2.9<br>6.1<br>6.1 | kΩ   |
| Resistor Ratio<br>MUN5311DW1T1/MUN5312DW1T1/MUN5313DW1T1<br>MUN5314DW1T1<br>MUN5315DW1T1/MUN5316DW1T1<br>MUN5330DW1T1/MUN5331DW1T1/MUN5332DW1T1<br>MUN5333DW1T1<br>MUN5334DW1T1<br>MUN5335DW1T1   | R <sub>1</sub> / R <sub>2</sub> | 0.8<br>0.17<br>–<br>0.8<br>0.055<br>0.38<br>0.038                                    | 1.0<br>0.21<br>–<br>1.0<br>0.1<br>0.47<br>0.047               | 1.2<br>0.25<br>–<br>1.2<br>0.185<br>0.56<br>0.056                 |      |

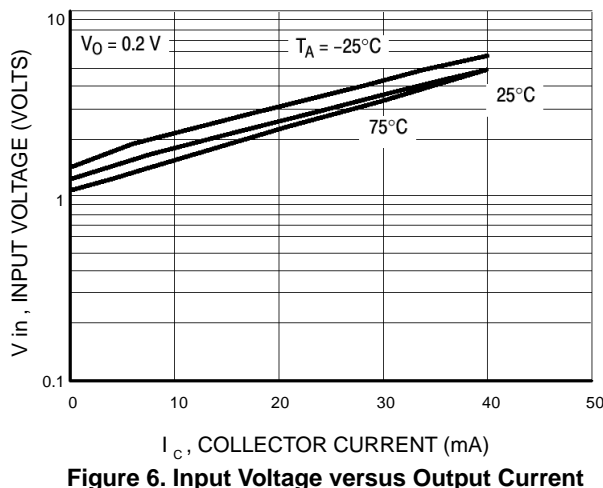
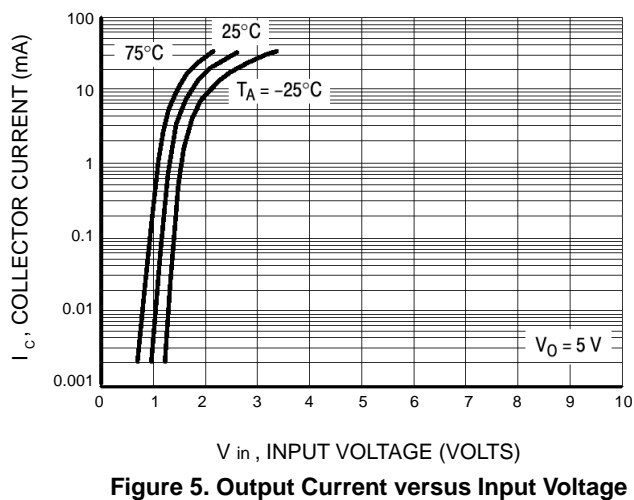
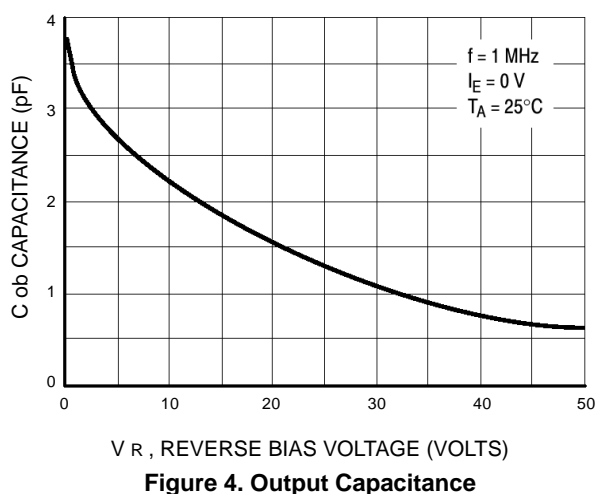
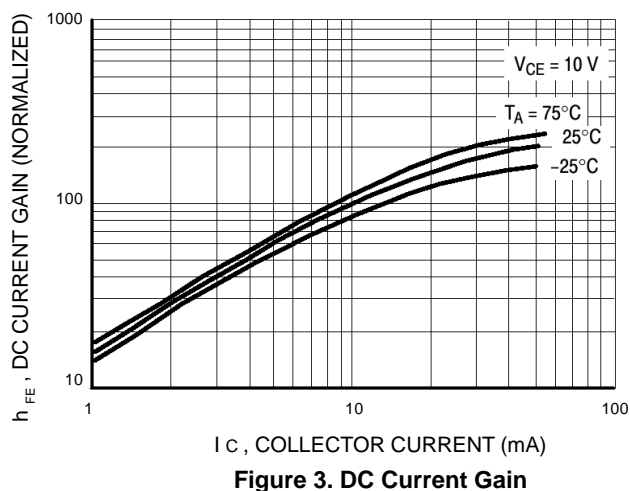
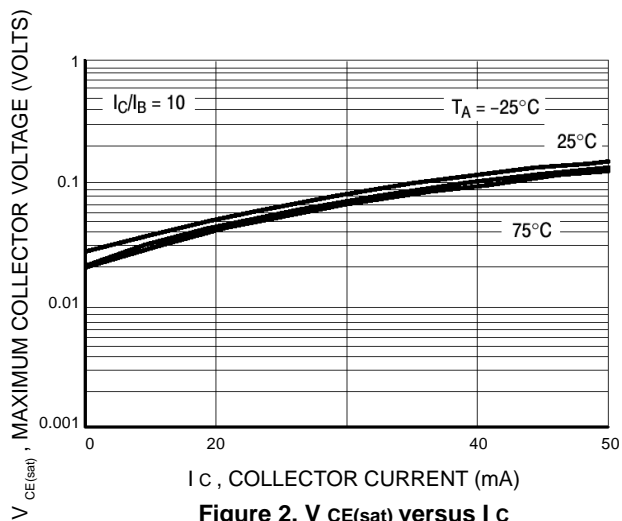
5. Pulse Test: Pulse Width < 300 μs, Duty Cycle < 2.0%



**Figure 1. Derating Curve**

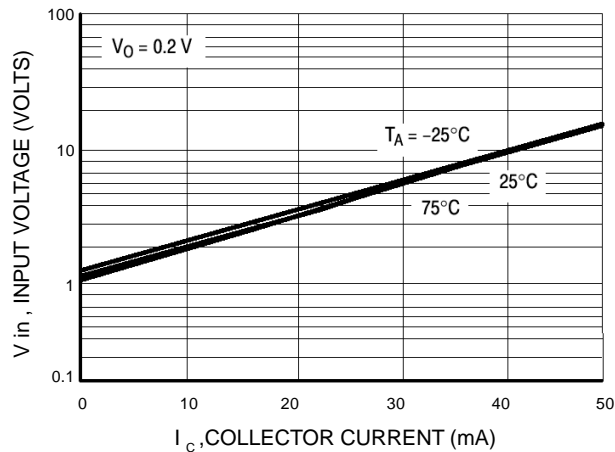
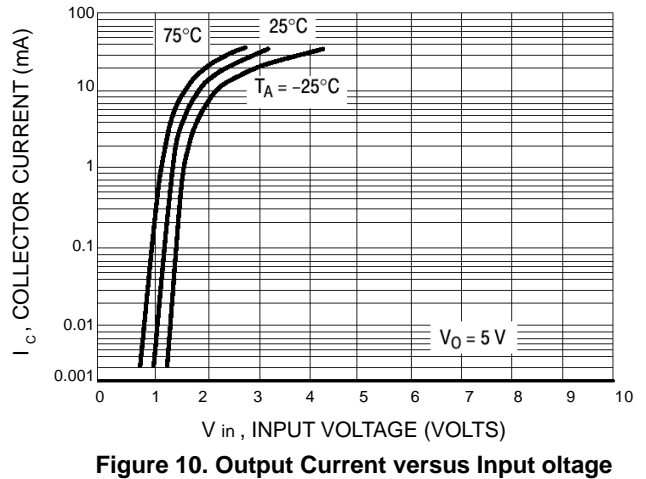
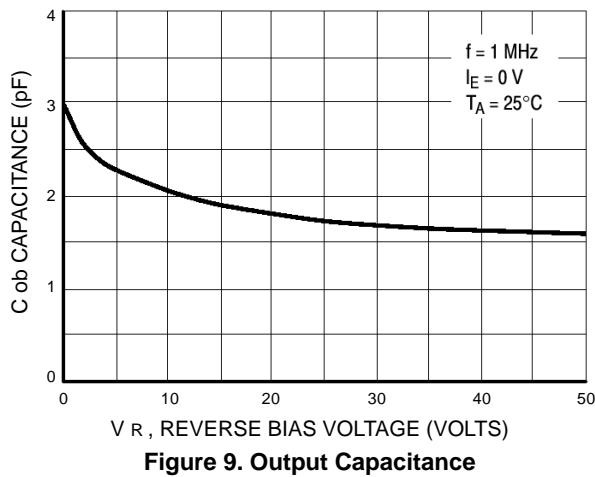
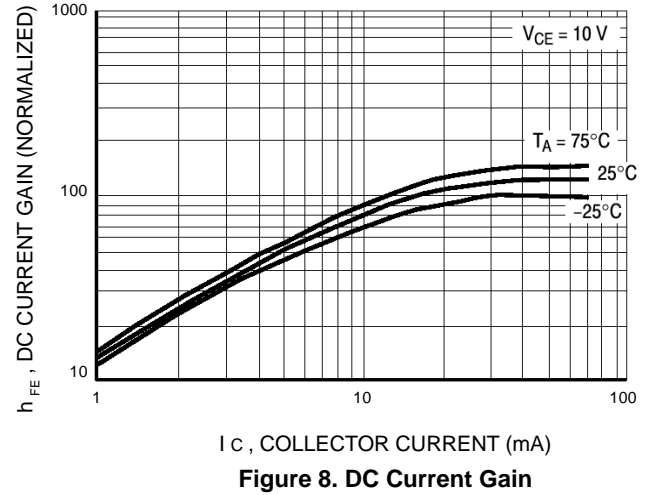
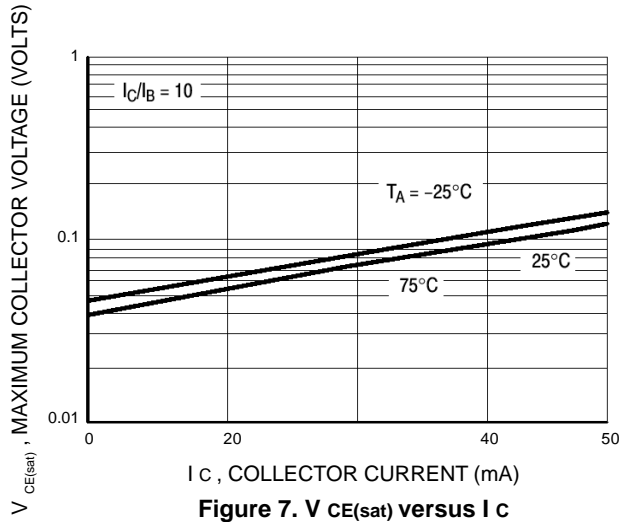
MUN5311DW1T1 Series

TYPICAL ELECTRICAL CHARACTERISTICS – MUN5311DW1T1 NPN TRANSISTOR



MUN5311DW1T1 Series

TYPICAL ELECTRICAL CHARACTERISTICS – MUN5311DW1T1 PNP TRANSISTOR



MUN5311DW1T1 Series

TYPICAL ELECTRICAL CHARACTERISTICS – MUN5312DW1T1 NPN TRANSISTOR

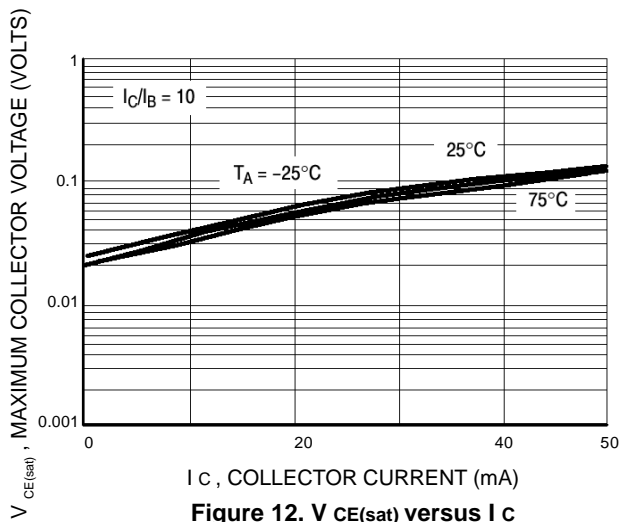


Figure 12.  $V_{CE(sat)}$  versus  $I_C$

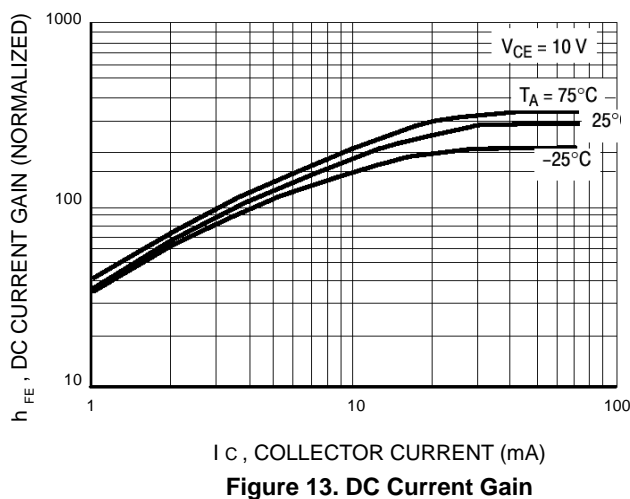


Figure 13. DC Current Gain

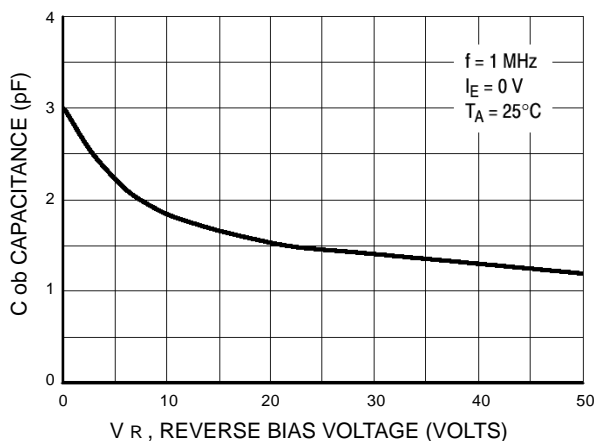


Figure 14. Output Capacitance

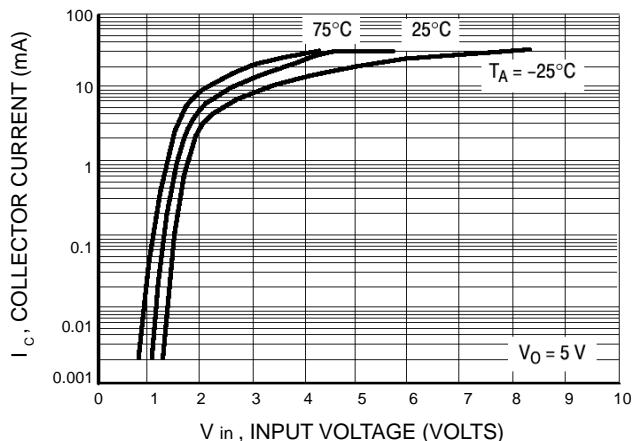


Figure 15. Output Current versus Input Voltage

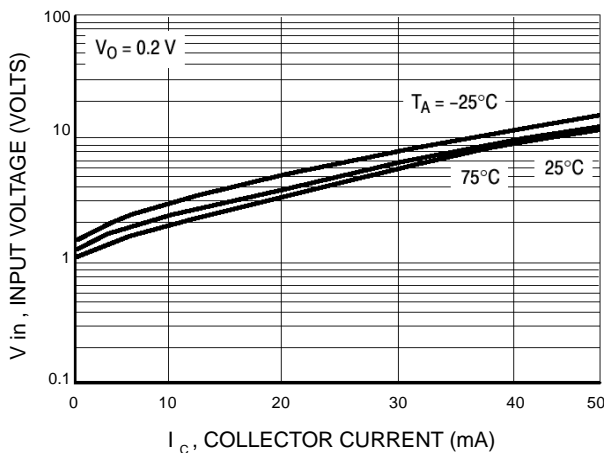
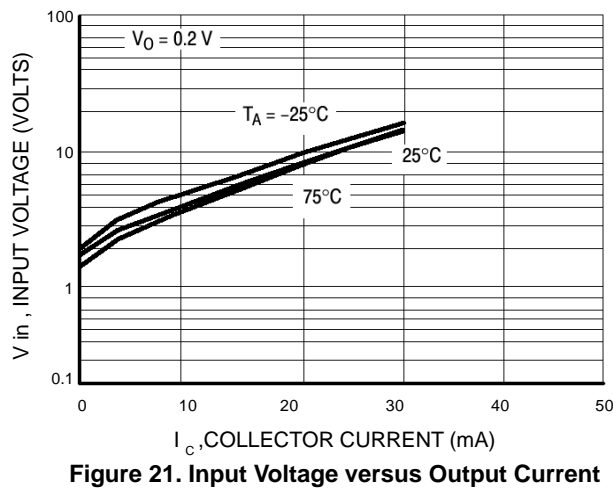
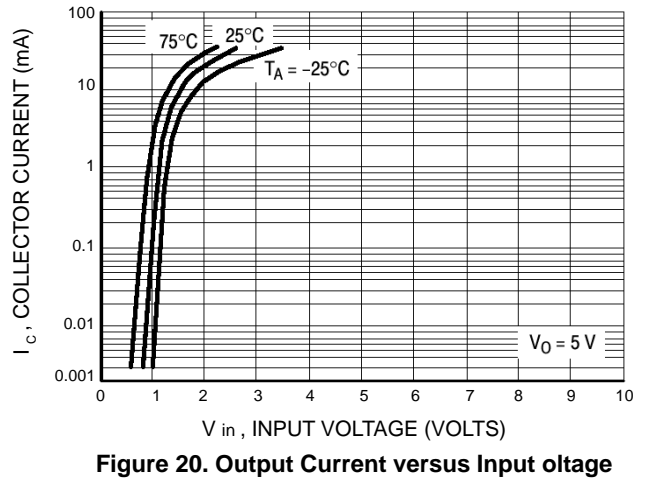
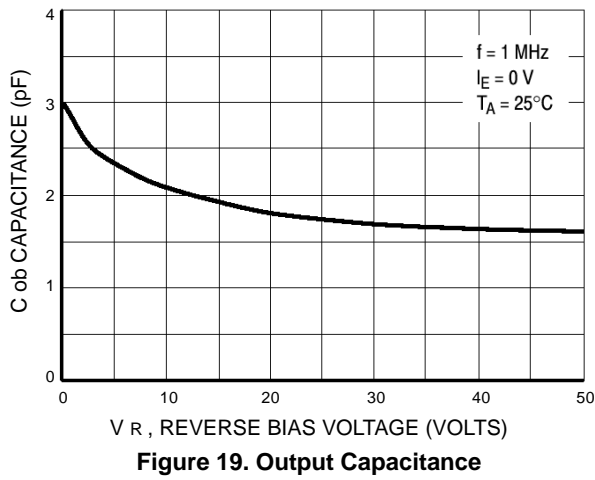
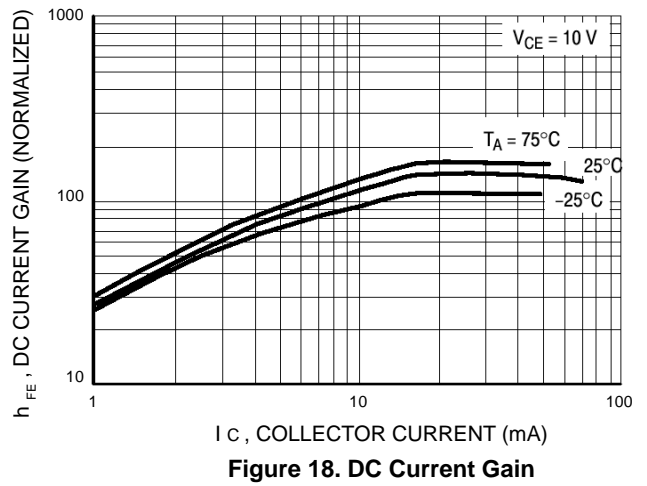
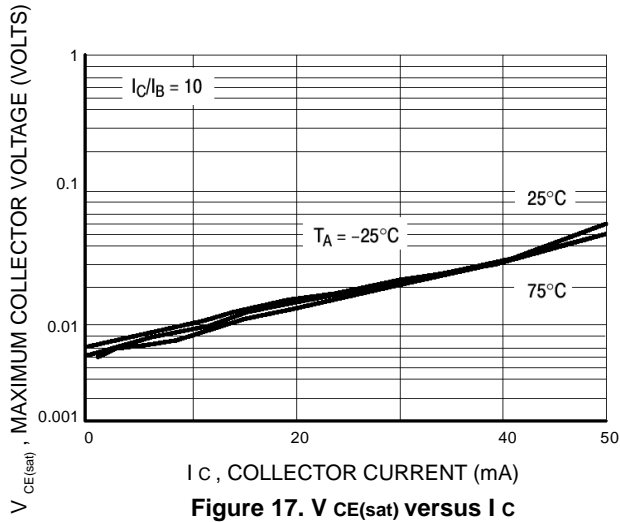


Figure 16. Input Voltage versus Output Current

MUN5311DW1T1 Series

TYPICAL ELECTRICAL CHARACTERISTICS – MUN5312DW1T1 PNP TRANSISTOR





MUN5311DW1T1 Series

TYPICAL ELECTRICAL CHARACTERISTICS – MUN5313DW1T1 NPN TRANSISTOR

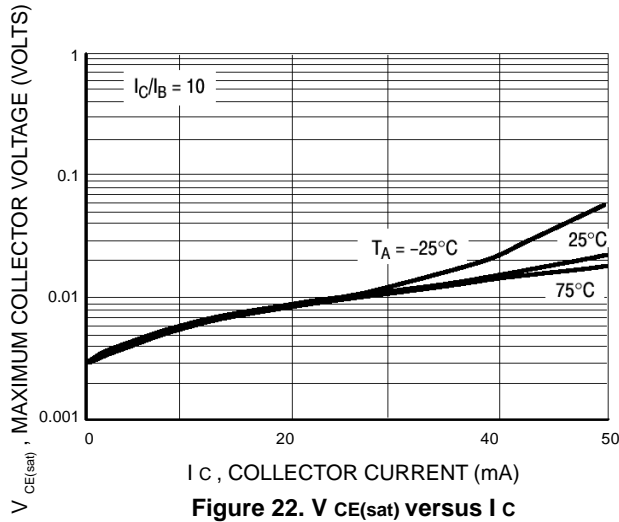


Figure 22.  $V_{CE(sat)}$  versus  $I_C$

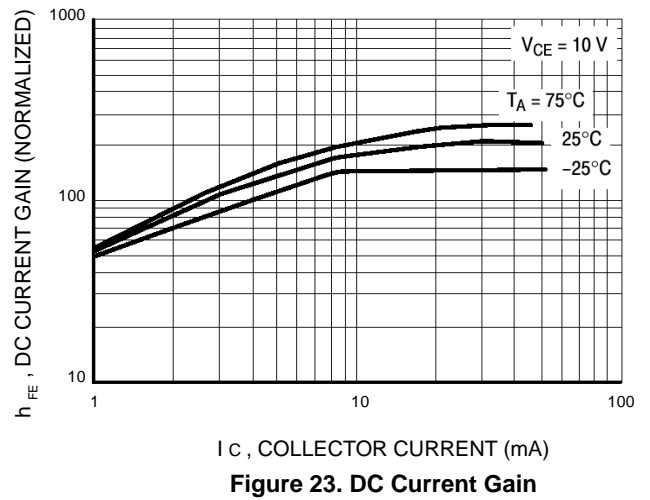


Figure 23. DC Current Gain

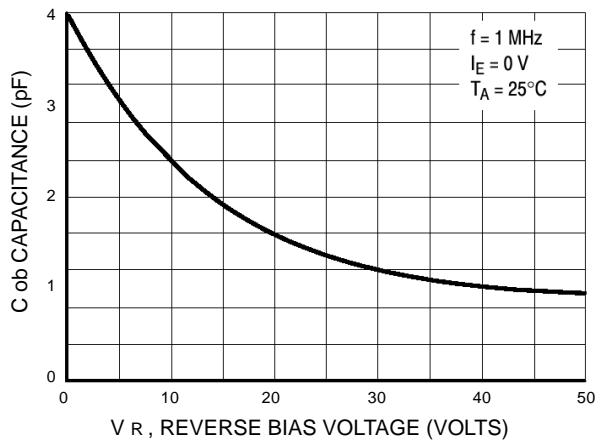


Figure 24. Output Capacitance

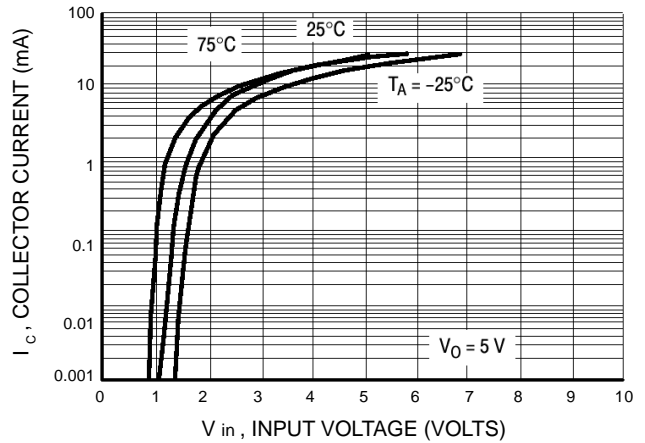


Figure 25. Output Current versus Input Voltage

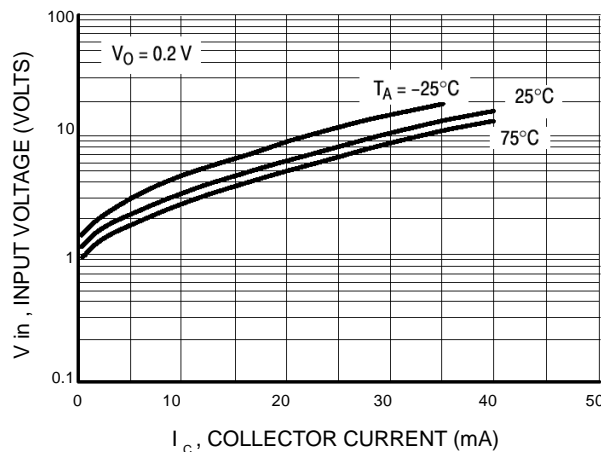


Figure 26. Input Voltage versus Output Current

MUN5311DW1T1 Series

TYPICAL ELECTRICAL CHARACTERISTICS – MUN5313DW1T1 PNP TRANSISTOR

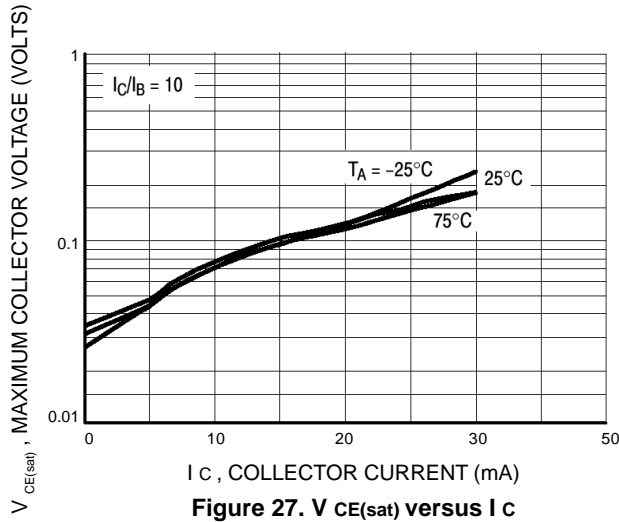


Figure 27.  $V_{CE(sat)}$  versus  $I_c$

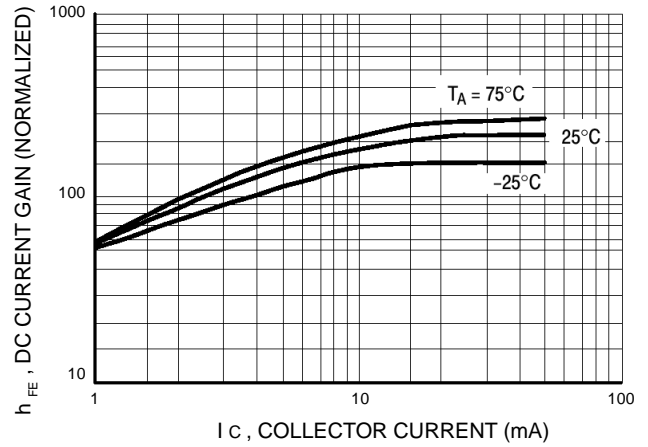


Figure 28. DC Current Gain

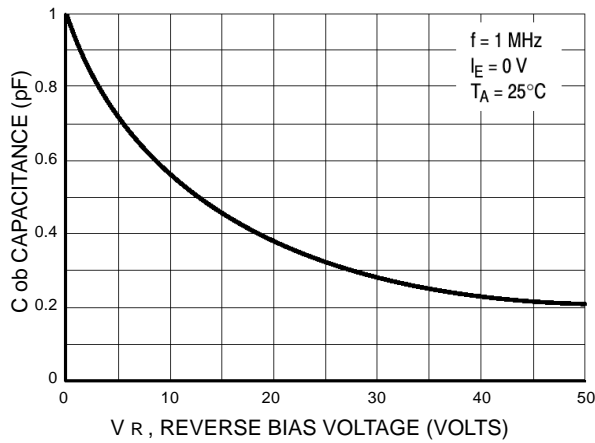


Figure 29. Output Capacitance

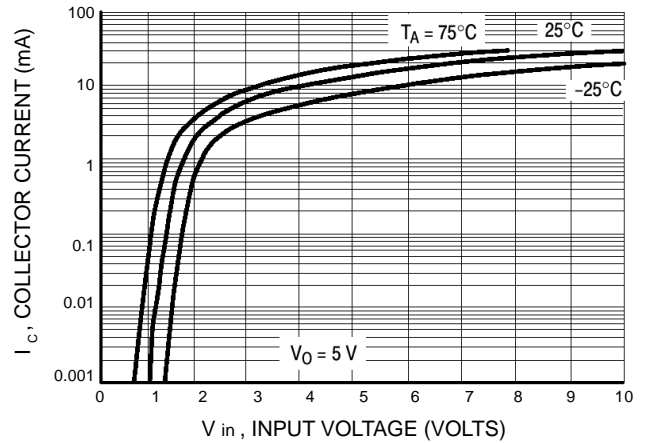


Figure 30. Output Current versus Input Voltage

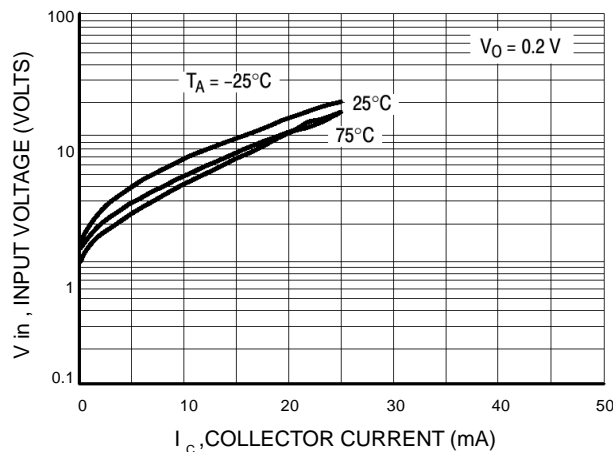
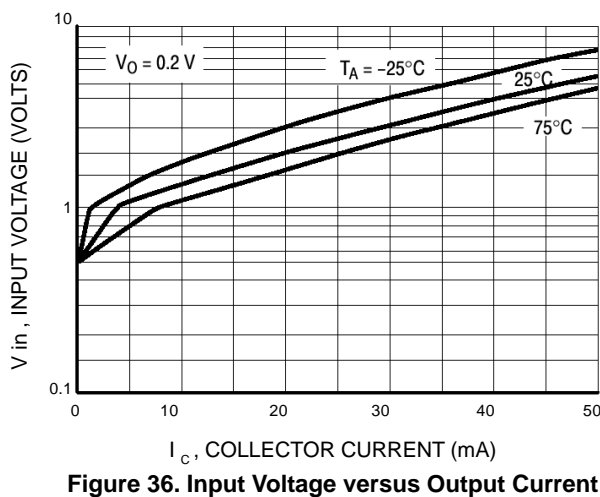
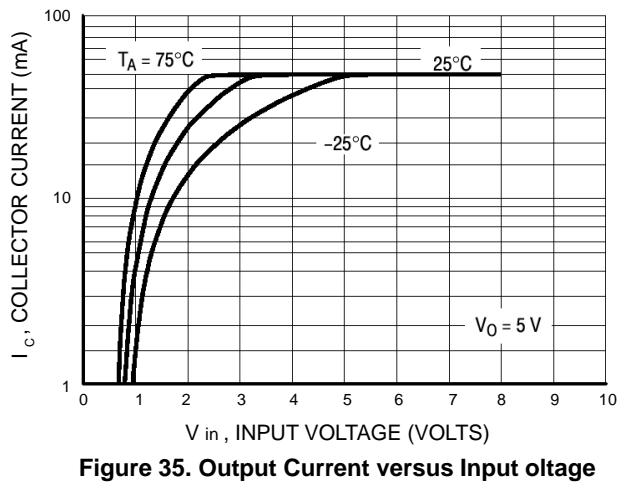
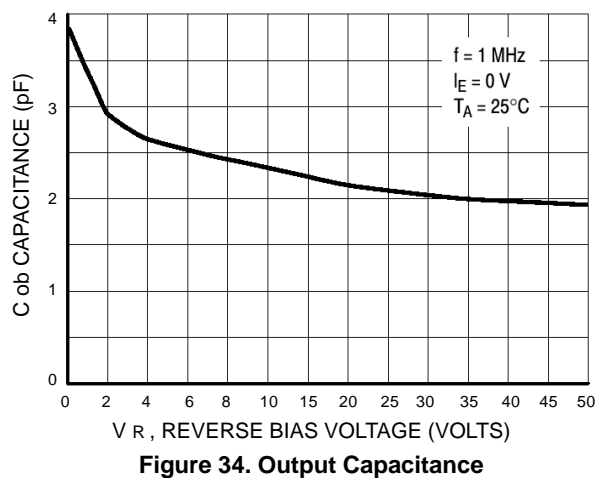
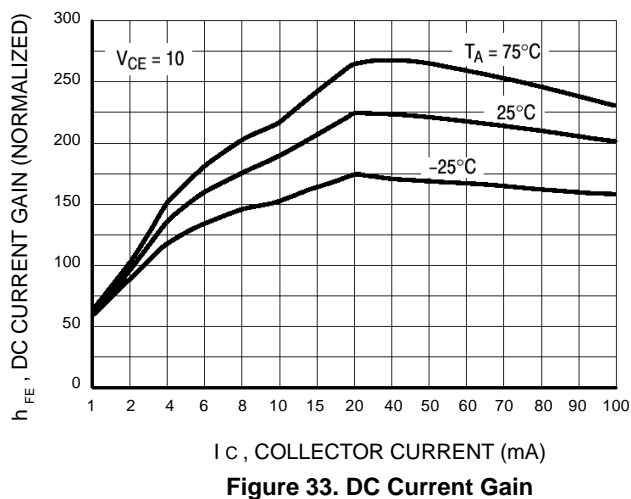
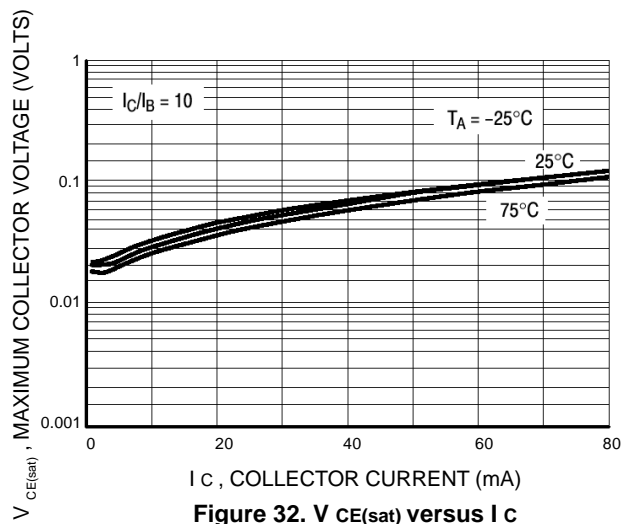


Figure 31. Input Voltage versus Output Current

MUN5311DW1T1 Series

TYPICAL ELECTRICAL CHARACTERISTICS – MUN5314DW1T1 NPN TRANSISTOR



MUN5311DW1T1 Series

TYPICAL ELECTRICAL CHARACTERISTICS – MUN5314DW1T1 PNP TRANSISTOR

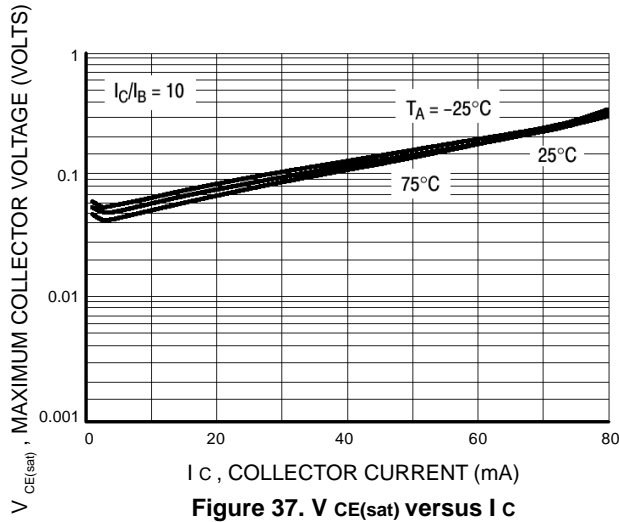


Figure 37.  $V_{CE(sat)}$  versus  $I_C$

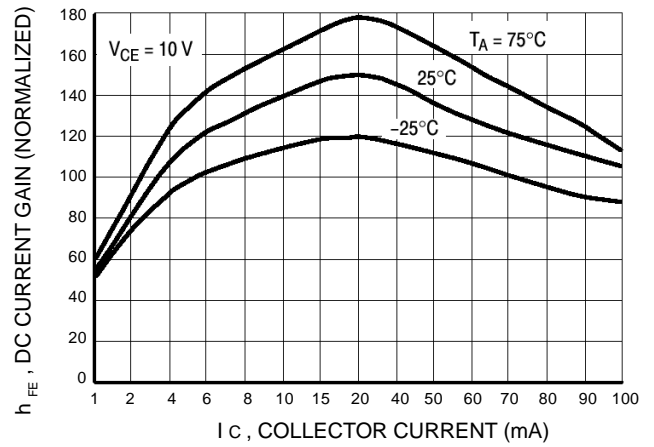


Figure 38. DC Current Gain

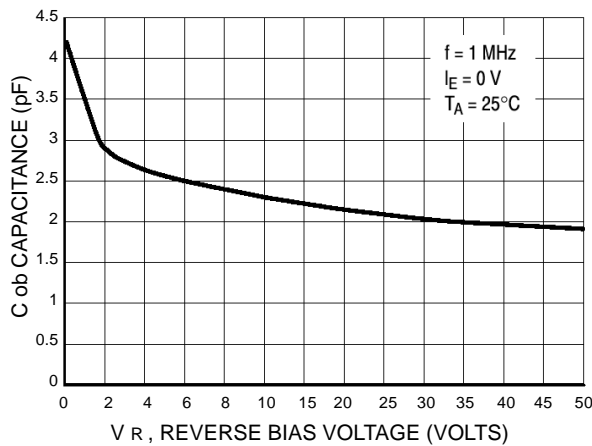


Figure 39. Output Capacitance

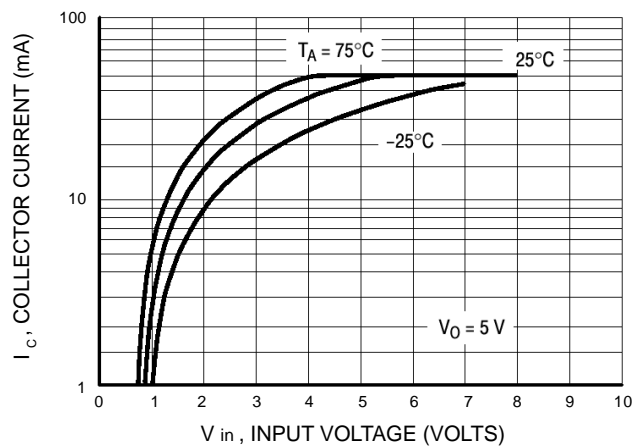


Figure 40. Output Current versus Input Voltage

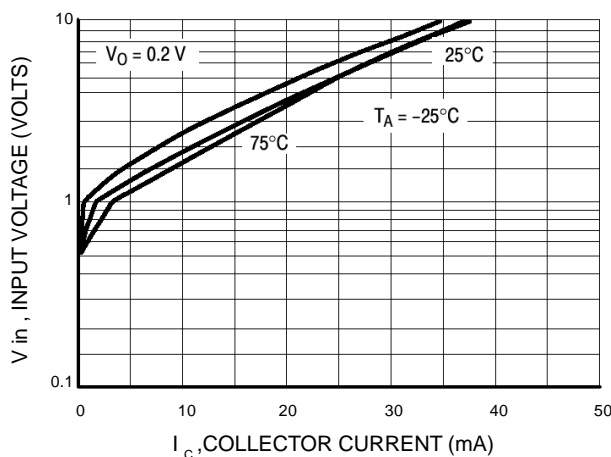


Figure 41. Input Voltage versus Output Current

MUN5311DW1T1 Series

TYPICAL ELECTRICAL CHARACTERISTICS – MUN5315DW1T1

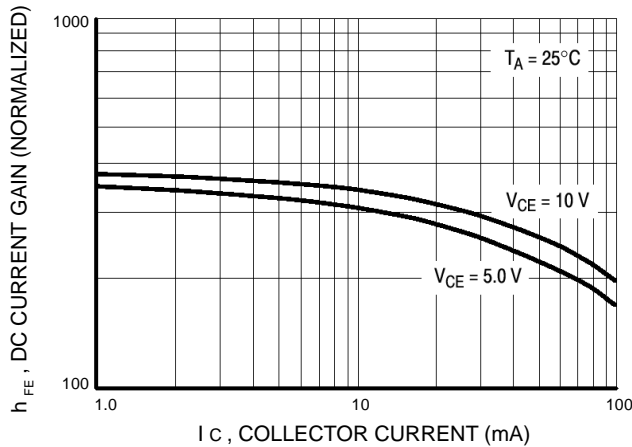


Figure 42. DC Current Gain-PNP

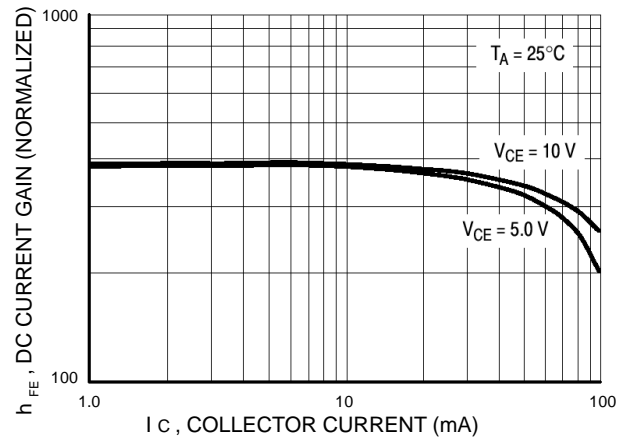


Figure 43. DC Current Gain-NPN

TYPICAL ELECTRICAL CHARACTERISTICS – MUN5316DW1T1

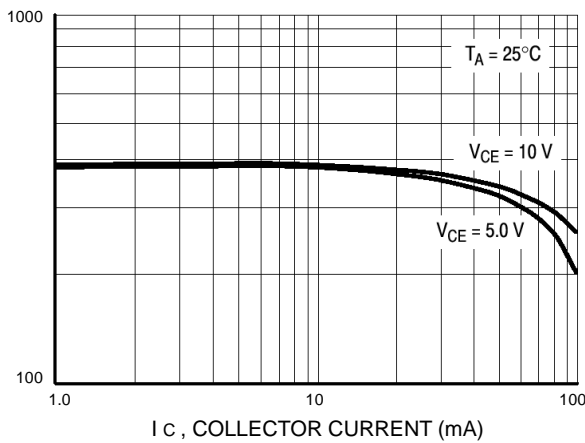


Figure 44. DC Current Gain-PNP

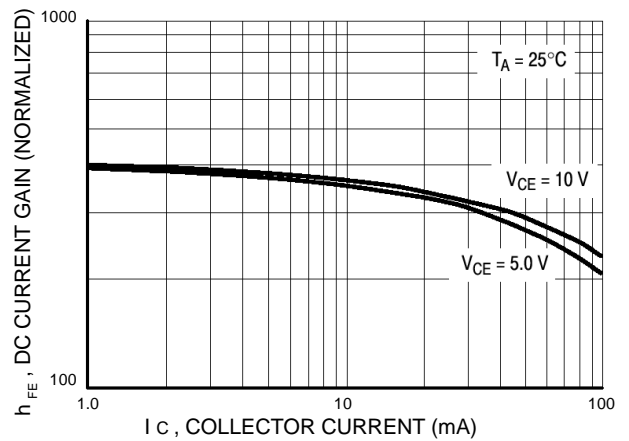


Figure 45. DC Current Gain-NPN