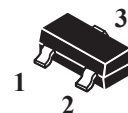
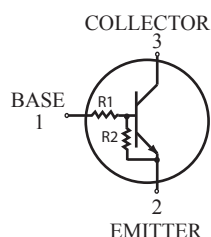


### Bias Resistor Transistor NPN Silicon

**(Pb)** Lead(Pb)-Free



**SOT-23**

### MAXIMUM RATINGS

| Rating                       | Symbol           | Value | Unit             |
|------------------------------|------------------|-------|------------------|
| Collector-Emitter Voltage    | V <sub>CEO</sub> | 50    | V <sub>dc</sub>  |
| Collector-Base Voltage       | V <sub>CBO</sub> | 50    | V <sub>dc</sub>  |
| Collector Current-Continuous | I <sub>C</sub>   | 100   | mA <sub>dc</sub> |

### THERMAL CHARACTERISTICS

| Characteristics                                                                       | Symbol                            | Value       | Unit          |
|---------------------------------------------------------------------------------------|-----------------------------------|-------------|---------------|
| Total Device Dissipation FR-5 Board (1)<br>T <sub>A</sub> = 25°C<br>Derate above 25°C | PD                                | 246<br>1.6  | mW<br>mW / °C |
| Thermal Resistance, Junction to Ambient (1)                                           | R <sub>θJA</sub>                  | 625         | °C / W        |
| Junction and Storage, Temperature                                                     | T <sub>J</sub> , T <sub>stg</sub> | -65 to +150 | °C            |

1. FR-4 @ minimum pad

### Device Marking and Resistor Values

| Device   | Marking | R1(k) | R2(k) | Device   | Marking | R1(k) | R2(k) |
|----------|---------|-------|-------|----------|---------|-------|-------|
| MMUN2211 | A8A     | 10    | 10    | MMUN2232 | A8J     | 4.7   | 4.7   |
| MMUN2212 | A8B     | 22    | 22    | MMUN2233 | A8K     | 4.7   | 47    |
| MMUN2213 | A8C     | 47    | 47    | MMUN2234 | A8L     | 22    | 47    |
| MMUN2214 | A8D     | 10    | 47    | MMUN2235 | A8M     | 2.2   | 47    |
| MMUN2215 | A8E     | 10    | ∞     | MMUN2238 | A8R     | 2.2   | ∞     |
| MMUN2216 | A8F     | 4.7   | ∞     | MMUN2241 | A8U     | 100   | ∞     |
| MMUN2230 | A8G     | 1.0   | 1.0   |          |         |       |       |
| MMUN2231 | A8H     | 2.2   | 2.2   |          |         |       |       |

## 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 |
| MMUN2211                                                                                       |                       | -   | -   | 0.2  |      |
| MMUN2212                                                                                       |                       | -   | -   | 0.1  |      |
| MMUN2213                                                                                       |                       | -   | -   | 0.2  |      |
| MMUN2214                                                                                       |                       | -   | -   | 0.9  |      |
| MMUN2215                                                                                       |                       | -   | -   | 1.9  |      |
| MMUN2216                                                                                       |                       | -   | -   | 4.3  |      |
| MMUN2230                                                                                       |                       | -   | -   | 2.3  |      |
| MMUN2231                                                                                       |                       | -   | -   | 1.5  |      |
| MMUN2232                                                                                       |                       | -   | -   | 0.18 |      |
| MMUN2233                                                                                       |                       | -   | -   | 0.13 |      |
| MMUN2234                                                                                       |                       | -   | -   | 0.2  |      |
| MMUN2235                                                                                       |                       | -   | -   | 4.0  |      |
| MMUN2238                                                                                       |                       | -   | -   | 0.1  |      |
| MMUN2241                                                                                       |                       | -   | -   |      |      |
| Collector-Base Breakdown Voltage (I <sub>C</sub> = 10 mA, I <sub>E</sub> = 0)                  | V <sub>(BR)</sub> CBO | 50  | -   | -    | Vdc  |
| Collector-Emitter Breakdown Voltage (Note 2.)<br>(I <sub>C</sub> = 2.0 mA, I <sub>B</sub> = 0) | V <sub>(BR)</sub> CEO | 50  | -   | -    | Vdc  |

## ON CHARACTERISTICS (Note 2.)

|                                                                                                                                                                                                                                                                                  |          |                      |     |     |      |     |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------|----------------------|-----|-----|------|-----|
| DC Current Gain<br>(V <sub>CE</sub> = 10 V, I <sub>C</sub> = 5.0 mA)                                                                                                                                                                                                             | MMUN2211 | h <sub>FE</sub>      | 35  | 60  | -    |     |
|                                                                                                                                                                                                                                                                                  | MMUN2212 |                      | 60  | 100 | -    |     |
|                                                                                                                                                                                                                                                                                  | MMUN2213 |                      | 80  | 140 | -    |     |
|                                                                                                                                                                                                                                                                                  | MMUN2214 |                      | 80  | 140 | -    |     |
|                                                                                                                                                                                                                                                                                  | MMUN2215 |                      | 160 | 350 | -    |     |
|                                                                                                                                                                                                                                                                                  | MMUN2216 |                      | 160 | 350 | -    |     |
|                                                                                                                                                                                                                                                                                  | MMUN2230 |                      | 3.0 | 5.0 | -    |     |
|                                                                                                                                                                                                                                                                                  | MMUN2231 |                      | 8.0 | 15  | -    |     |
|                                                                                                                                                                                                                                                                                  | MMUN2232 |                      | 15  | 30  | -    |     |
|                                                                                                                                                                                                                                                                                  | MMUN2233 |                      | 80  | 200 | -    |     |
|                                                                                                                                                                                                                                                                                  | MMUN2234 |                      | 80  | 150 | -    |     |
|                                                                                                                                                                                                                                                                                  | MMUN2235 |                      | 80  | 140 | -    |     |
|                                                                                                                                                                                                                                                                                  | MMUN2238 |                      | 160 | 350 | -    |     |
|                                                                                                                                                                                                                                                                                  | MMUN2241 |                      | 160 | 350 | -    |     |
| Collector-Emitter Saturation Voltage (I <sub>C</sub> = 10 mA, I <sub>B</sub> = 0.3 mA)<br>(I <sub>C</sub> = 10 mA, I <sub>B</sub> = 5 mA) MMUN2230/MMUN2231<br>(I <sub>C</sub> = 10 mA, I <sub>B</sub> = 1 mA) MMUN2215/MMUN2216/MMUN2232<br>MMUN2233/MMUN2234/MMUN2235/MMUN2238 |          | V <sub>CE(sat)</sub> | -   | -   | 0.25 | Vdc |
| 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)                                                                                                                                                                                | MMUN2211 | V <sub>OL</sub>      | -   | -   | 0.2  | Vdc |
|                                                                                                                                                                                                                                                                                  | MMUN2212 |                      | -   | -   | 0.2  |     |
|                                                                                                                                                                                                                                                                                  | MMUN2213 |                      | -   | -   | 0.2  |     |
|                                                                                                                                                                                                                                                                                  | MMUN2214 |                      | -   | -   | 0.2  |     |
|                                                                                                                                                                                                                                                                                  | MMUN2215 |                      | -   | -   | 0.2  |     |
|                                                                                                                                                                                                                                                                                  | MMUN2216 |                      | -   | -   | 0.2  |     |
|                                                                                                                                                                                                                                                                                  | MMUN2230 |                      | -   | -   | 0.2  |     |
|                                                                                                                                                                                                                                                                                  | MMUN2231 |                      | -   | -   | 0.2  |     |
|                                                                                                                                                                                                                                                                                  | MMUN2232 |                      | -   | -   | 0.2  |     |
|                                                                                                                                                                                                                                                                                  | MMUN2233 |                      | -   | -   | 0.2  |     |
|                                                                                                                                                                                                                                                                                  | MMUN2234 |                      | -   | -   | 0.2  |     |
|                                                                                                                                                                                                                                                                                  | MMUN2235 |                      | -   | -   | 0.2  |     |
| (V <sub>CC</sub> = 5.0 V, V <sub>B</sub> = 3.5 V, R <sub>L</sub> = 1.0 kΩ)                                                                                                                                                                                                       | MMUN2238 |                      | -   | -   | 0.2  |     |
| (V <sub>CC</sub> = 5.0 V, V <sub>B</sub> = 5.0 V, R <sub>L</sub> = 1.0 kΩ)                                                                                                                                                                                                       | MMUN2241 |                      | -   | -   | 0.2  |     |

2. Pulse Test: Pulse Width < 300 ms, Duty Cycle < 2.0 %.

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

| Characteristic                                                                                                                                                                                                                                                                                                       | Symbol                         | Min                                                                                                | Typ                                                                                      | Max                                                                                              | Unit            |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------|----------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------|-----------------|
| <b>ON CHARACTERISTICS</b> (Note 2) (Continued)                                                                                                                                                                                                                                                                       |                                |                                                                                                    |                                                                                          |                                                                                                  |                 |
| Output Voltage (off) (V <sub>CC</sub> = 5.0 V, V <sub>B</sub> = 0.5 V, R <sub>L</sub> = 1.0 kΩ)<br>(V <sub>CC</sub> = 5.0 V, V <sub>B</sub> = 0.050 V, R <sub>L</sub> = 1.0 kΩ) MMUN2230<br>(V <sub>CC</sub> = 5.0 V, V <sub>B</sub> = 0.25 V, R <sub>L</sub> = 1.0 kΩ) MMUN2215<br>MMUN2216<br>MMUN2233<br>MMUN2238 | V <sub>OH</sub>                | 4.9                                                                                                | -                                                                                        | -                                                                                                | V <sub>dc</sub> |
| Input Resistor<br><br>MMUN2211<br>MMUN2212<br>MMUN2213<br>MMUN2214<br>MMUN2215<br>MMUN2216<br>MMUN2230<br>MMUN2231<br>MMUN2232<br>MMUN2233<br>MMUN2234<br>MMUN2235<br>MMUN2238<br>MMUN2241                                                                                                                           | R <sub>I</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<br>1.54<br>70 | 10<br>22<br>47<br>10<br>10<br>4.7<br>1.0<br>2.2<br>4.7<br>4.7<br>22<br>2.2<br>2.2<br>100 | 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<br>28.6<br>2.86<br>2.86<br>100 | kΩ              |
| Resistor Ratio<br>MMUN2211/MMUN2212/MMUN2213<br>MMUN2214<br>MMUN2215/MMUN2216/MMUN2238<br>MMUN2241<br>MMUN2230/MMUN2231/MMUN2232<br>MMUN2233<br>MMUN2234<br>MMUN2235                                                                                                                                                 | R <sub>1</sub> /R <sub>2</sub> | 0.8<br>0.17<br>-<br>-<br>0.8<br>0.055<br>0.38<br>0.038                                             | 1.0<br>0.21<br>-<br>-<br>1.0<br>0.1<br>0.47<br>0.047                                     | 1.2<br>0.25<br>-<br>-<br>1.2<br>0.185<br>0.56<br>0.056                                           |                 |

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

## TYPICAL ELECTRICAL CHARACTERISTICS

### MMUN2211

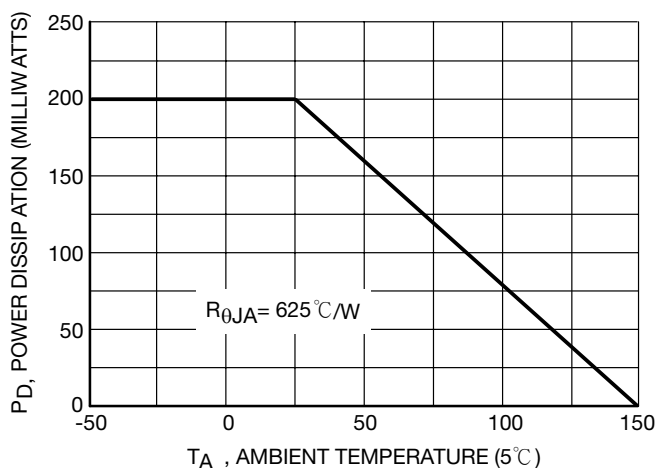


Figure 1. Derating Curve

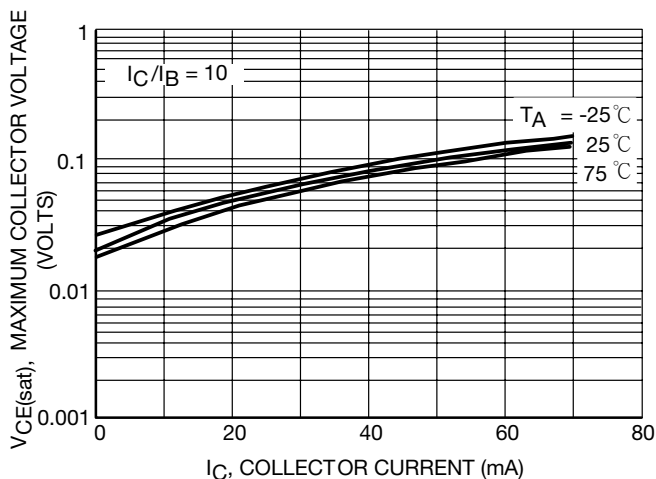


Figure 2. V<sub>CE(sat)</sub> vs. I<sub>C</sub>

# TYPICAELECTRICAL CHARACTERISTICS

## MMUN2212

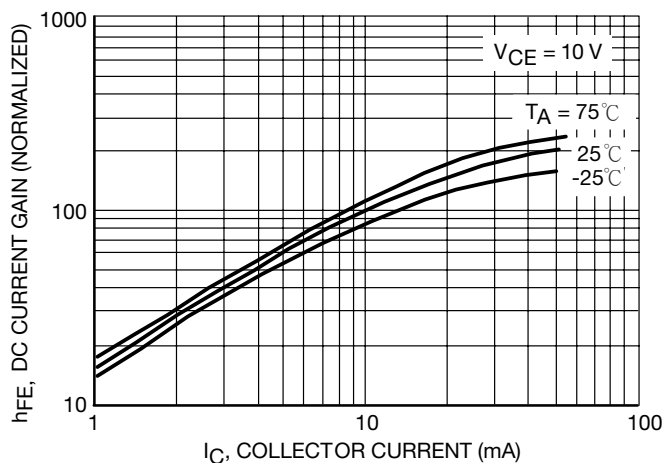


Figure 3. DC Current Gain

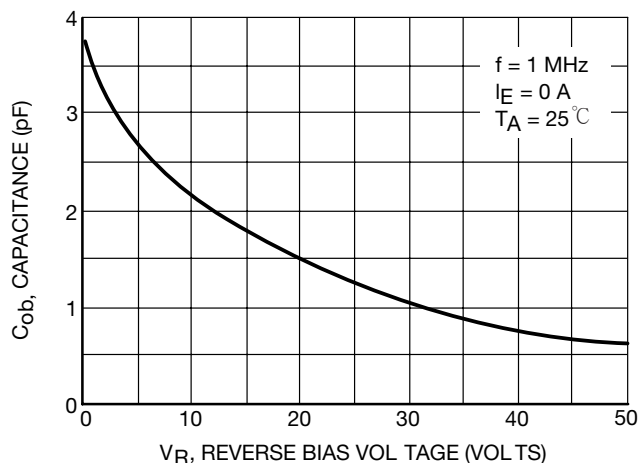


Figure 4. Output Capacitance

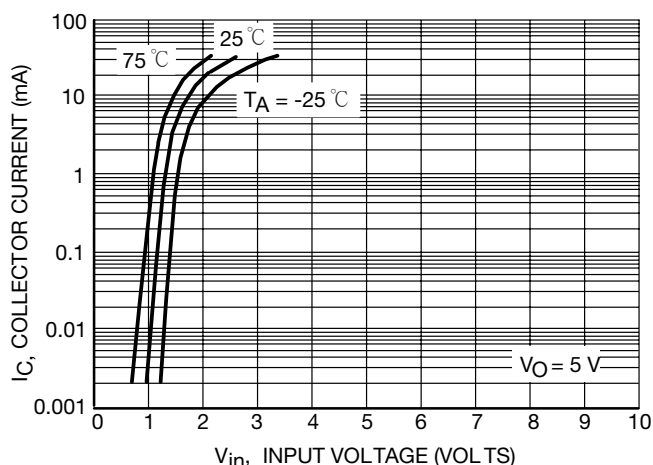


Figure 5. Output Current vs. Input Voltage

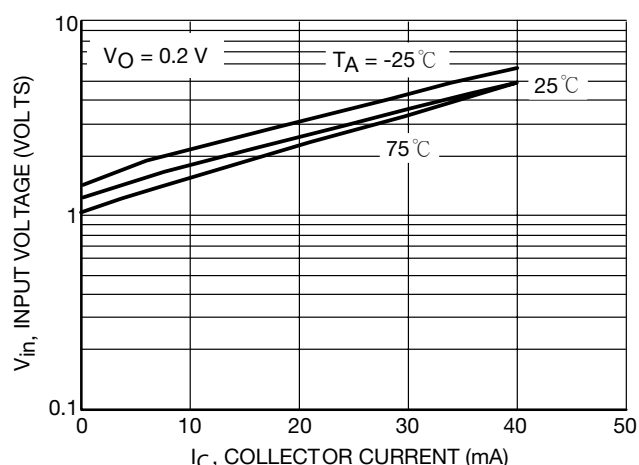


Figure 6. Input Voltage vs. Output Current

## MMUN2211

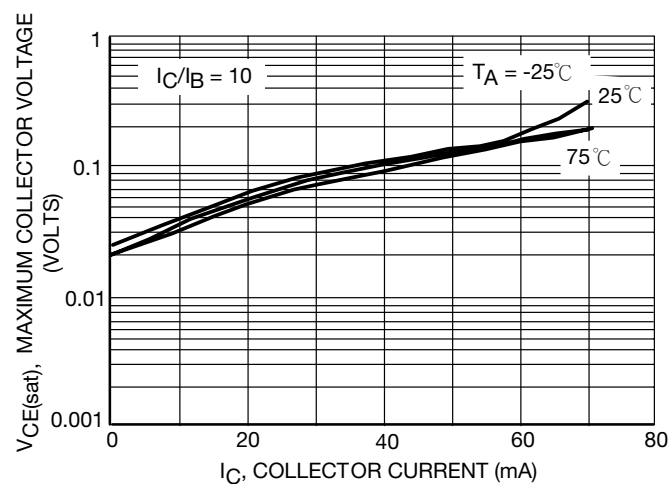


Figure 7. VCE(sat) vs. IC

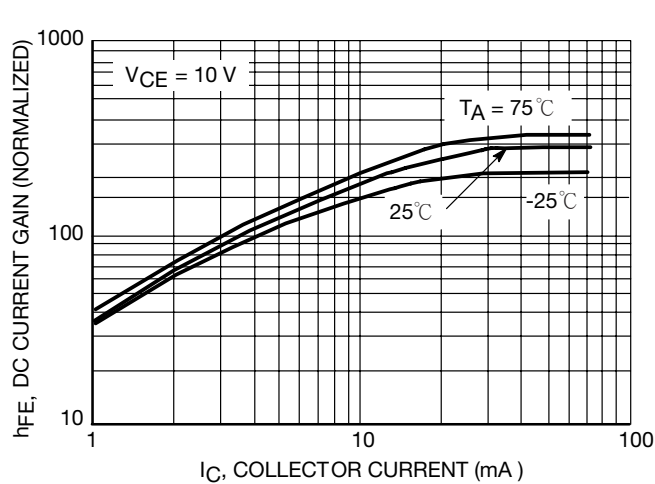
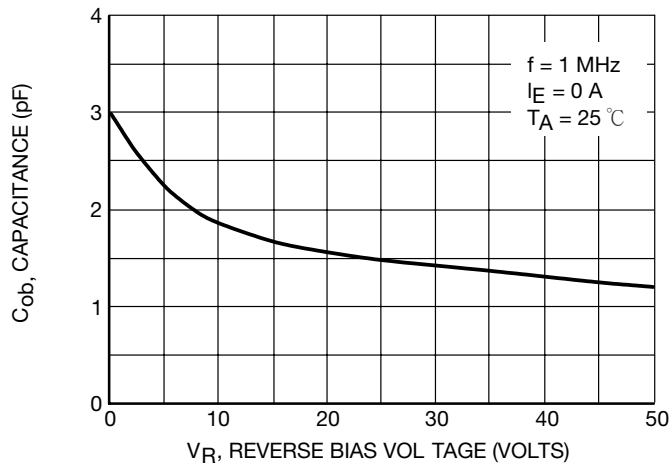
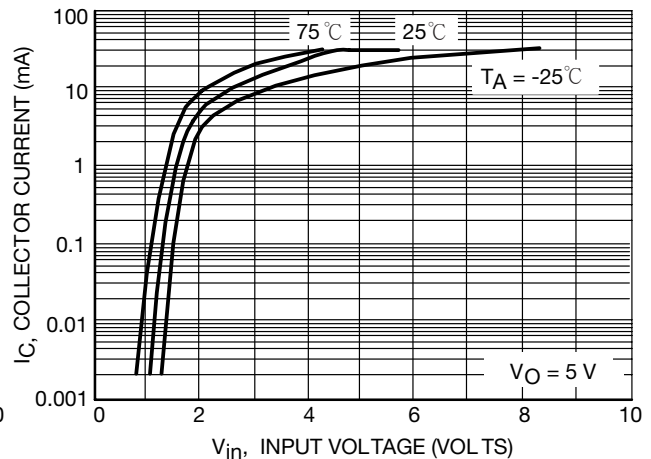


Figure 8. DC Current Gain

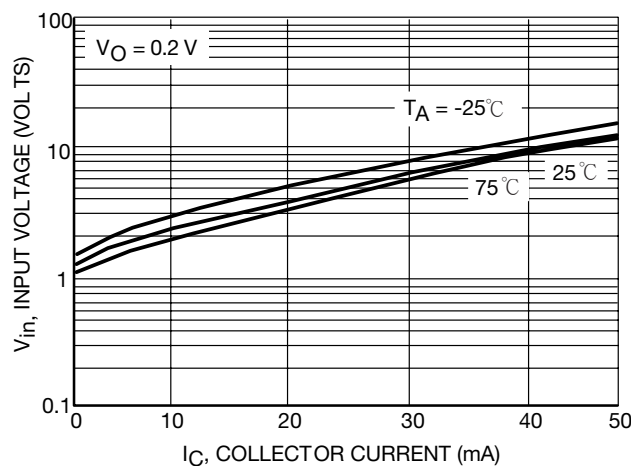
**TYPICAL ELECTRICAL CHARACTERISTICS**  
**MMUN2212**



**Figure 9. Output Capacitance**

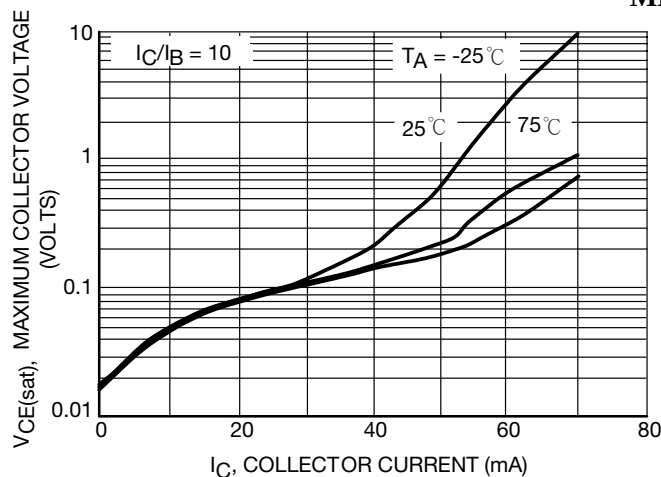


**Figure 10. Output Current vs. Input Voltage**

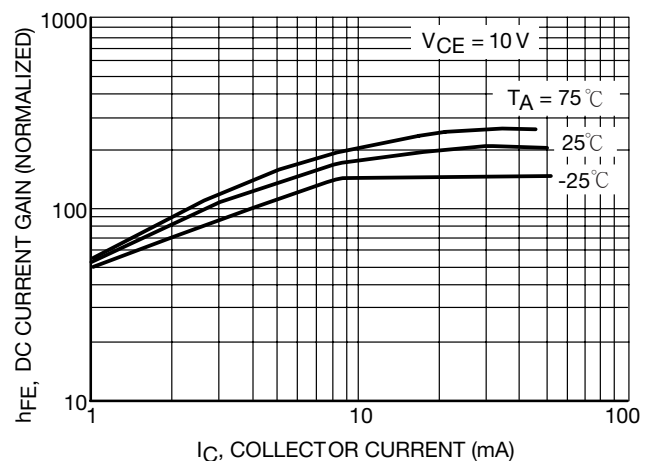


**Figure 11. Input V voltage vs. Output Current**

**MMUN2213**



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



**Figure 13. DC Current Gain**

# TYPICAL ELECTRICAL CHARACTERISTICS

## MMUN2213

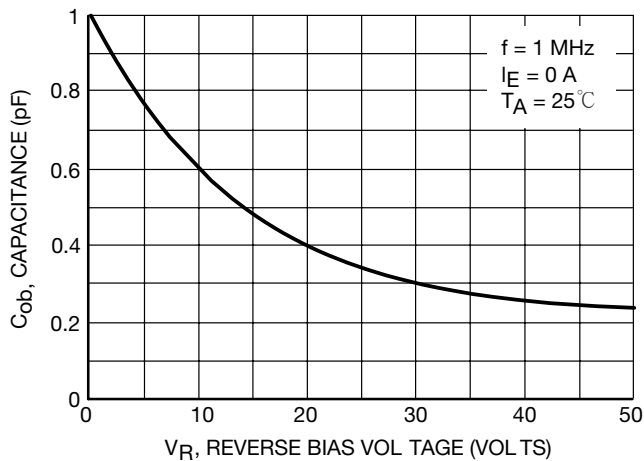


Figure 14. Output Capacitance

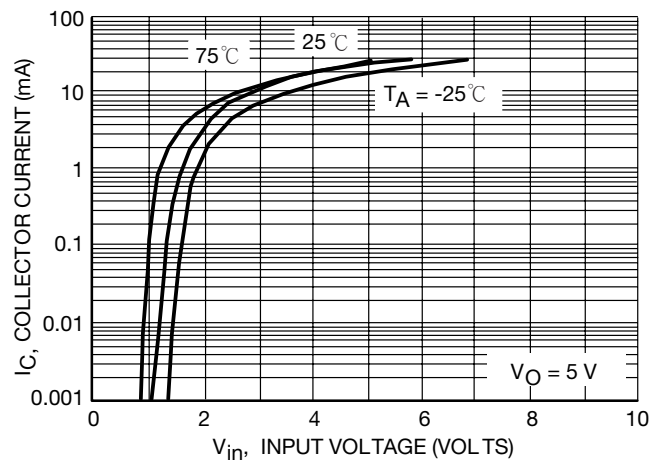


Figure 15. Output Current vs. Input Voltage

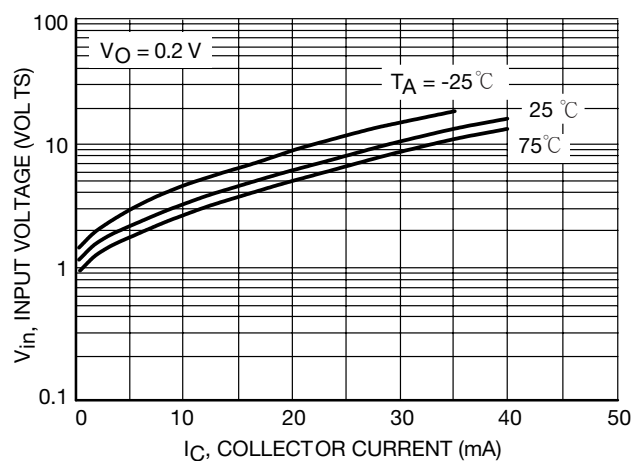


Figure 16. Input Voltage vs. Output Current

## MMUN2214

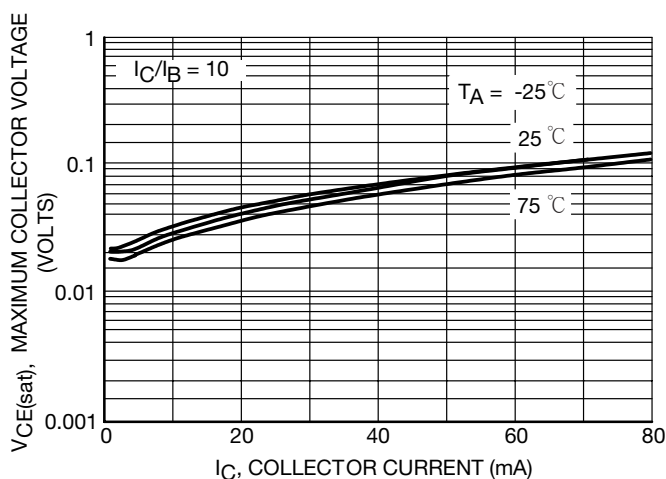


Figure 17.  $V_{CE(sat)}$  vs.  $I_C$

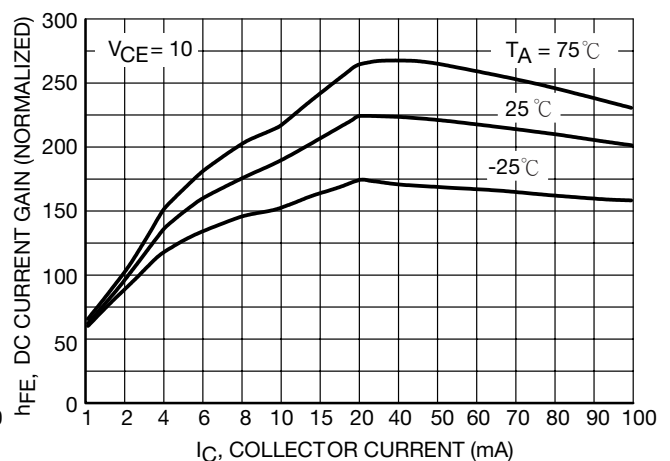
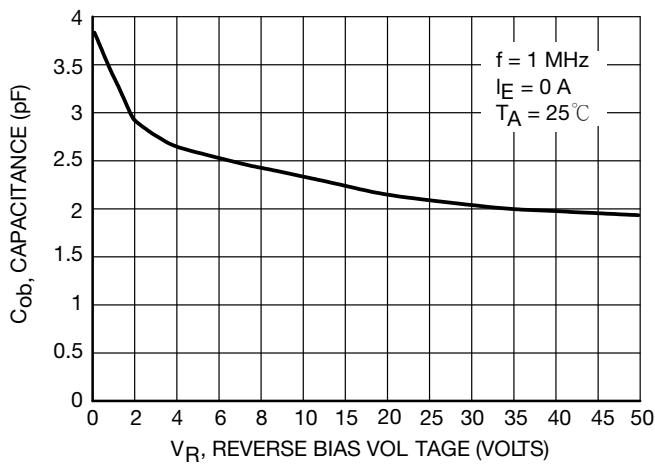
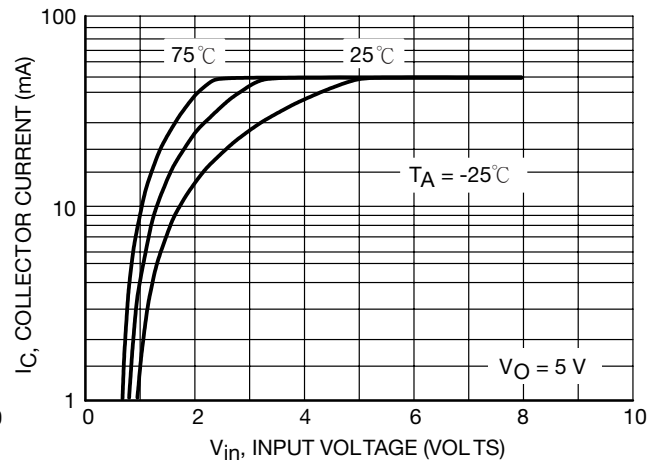
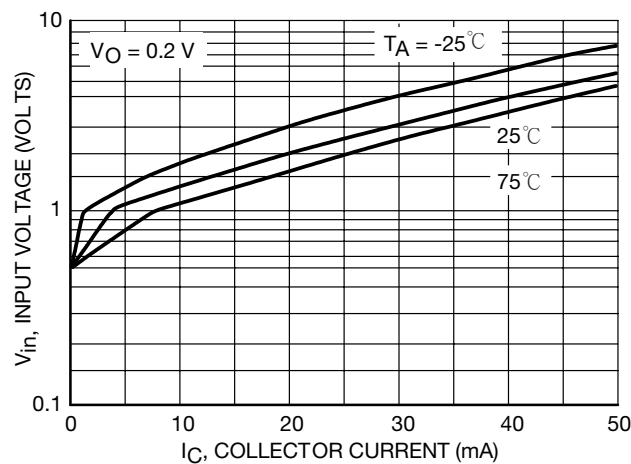
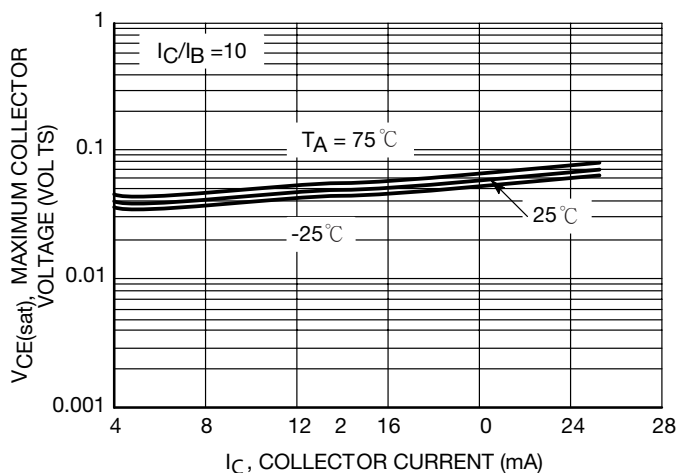
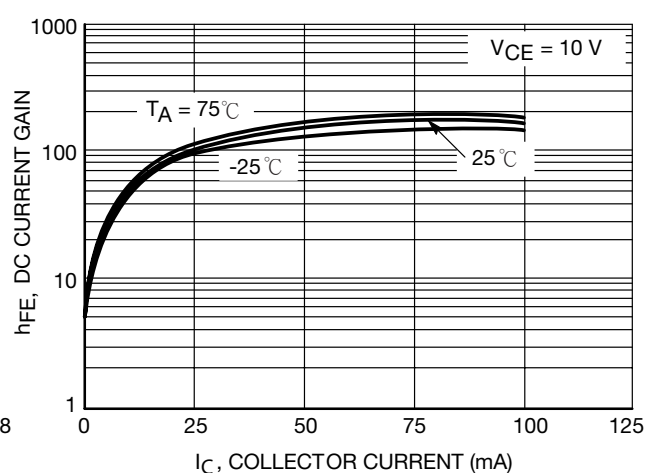
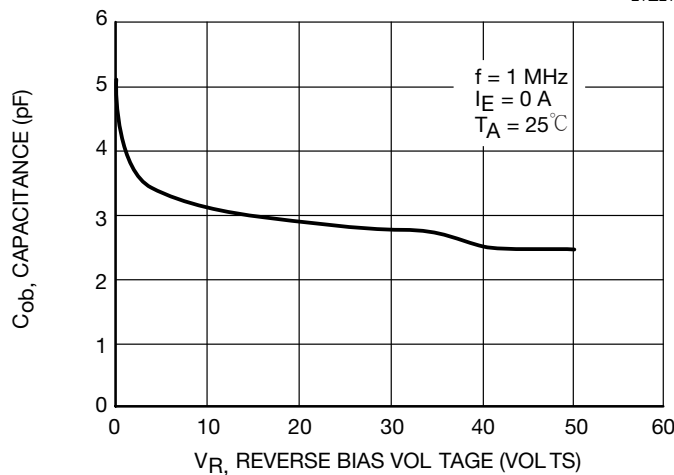


Figure 18. DC Current Gain

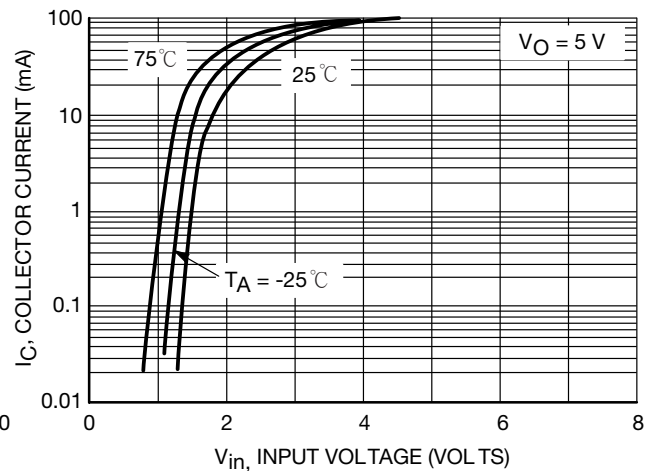
**TYPICAL ELECTRICAL CHARACTERISTICS**
**MMUN2214**

**Figure 19. Output Capacitance**

**Figure 20. Output Current vs. Input Voltage**

**Figure 21. Input Voltage vs. Output Current**
**MMUN2232**

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

**Figure 23. DC Current Gain**

**TYPICAL ELECTRICAL CHARACTERISTICS**

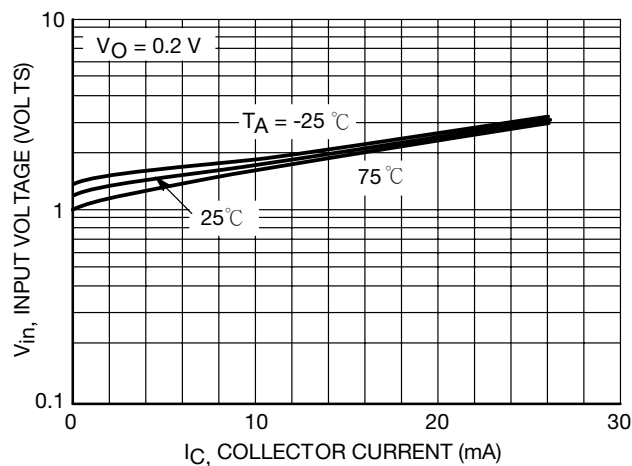
**MMUN2232**



**Figure 24. Output Capacitance**

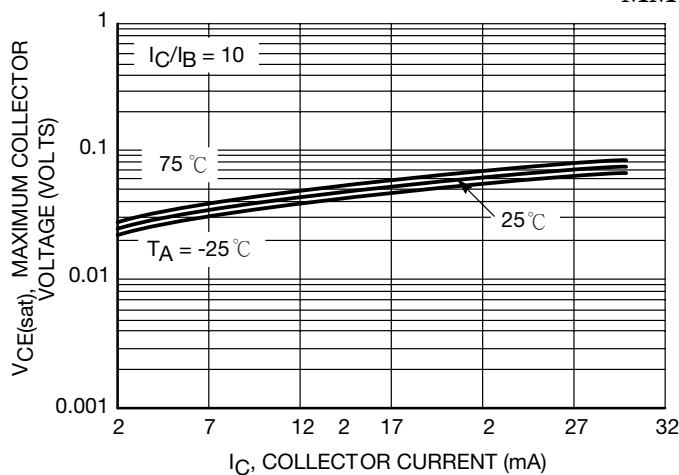


**Figure 25. Output Current vs. Input Voltage**

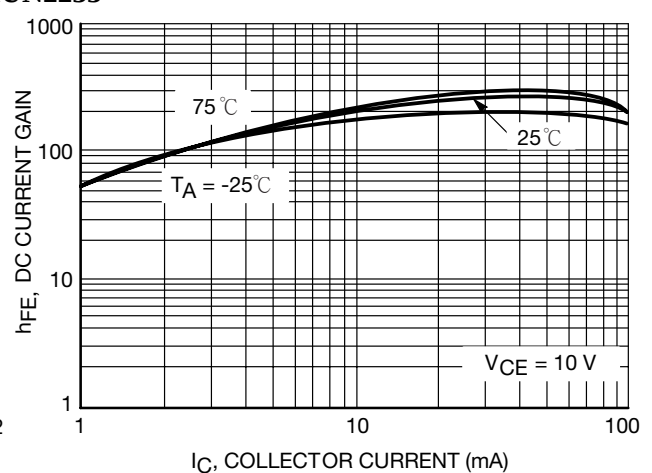


**Figure 26. Output Voltage vs. Input Current**

**MMUN2233**



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

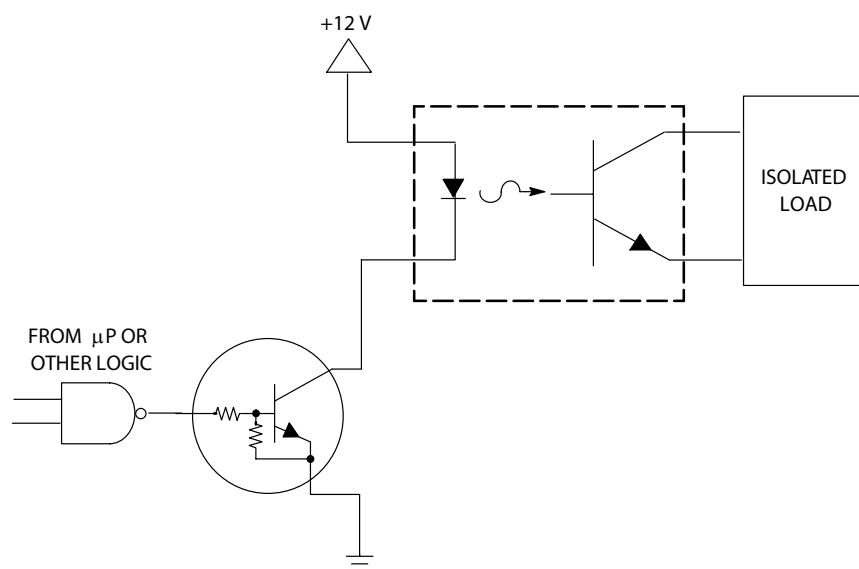


**Figure 28. DC Current Gain**

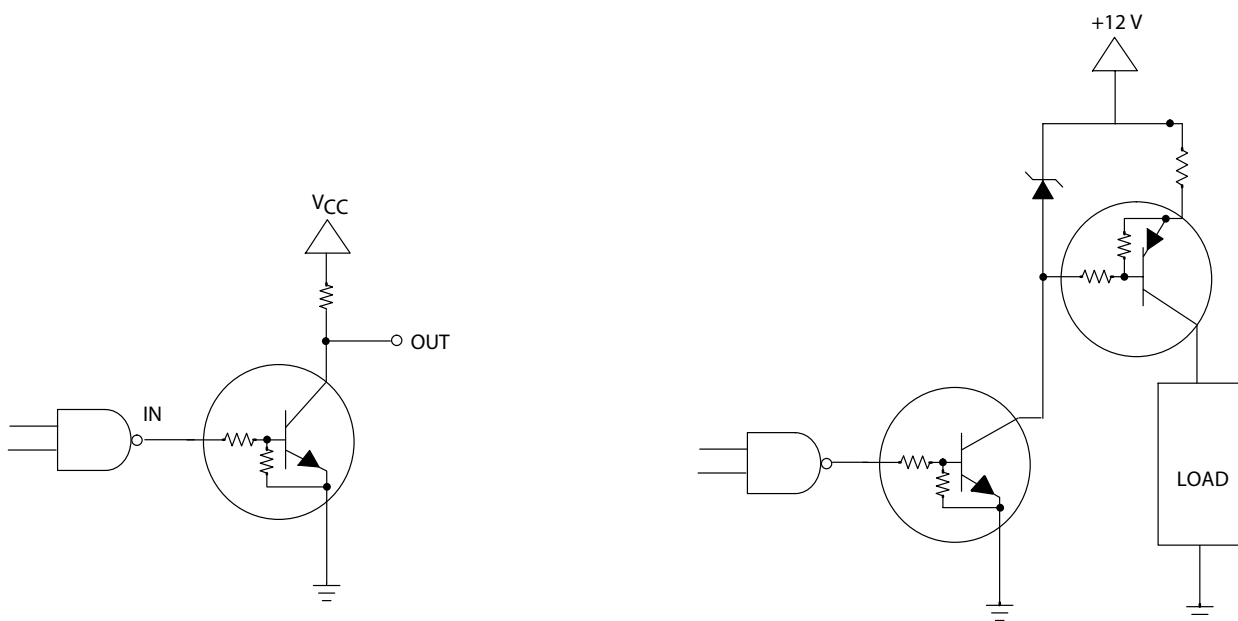


## MMUN2211 Series

### TYPICAL APPLICATIONS FOR NPN BJT's



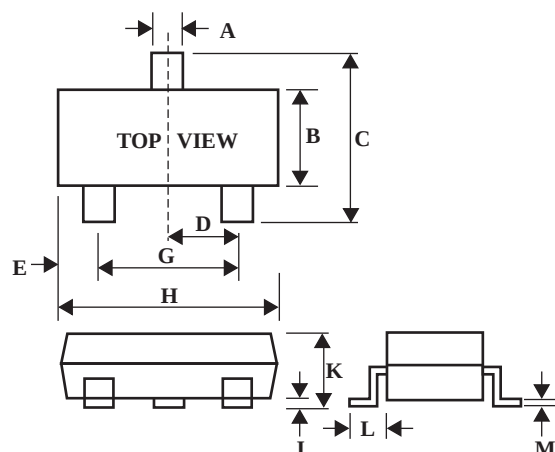
**Figure 32. Level Shifter: Connects 12 or 24 Volt Circuits to Logic**



**Figure 33. Open Collector Inverter: Inverts the Input Signal**

**Figure 34. Inexpensive, Unregulated Current Source**

## SOT-23 Package Outline Dimension



| SOT-23 |       |      |
|--------|-------|------|
| Dim    | Min   | Max  |
| A      | 0.35  | 0.51 |
| B      | 1.19  | 1.40 |
| C      | 2.10  | 3.00 |
| D      | 0.85  | 1.05 |
| E      | 0.46  | 1.00 |
| G      | 1.70  | 2.10 |
| H      | 2.70  | 3.10 |
| J      | 0.01  | 0.13 |
| K      | 0.89  | 1.10 |
| L      | 0.30  | 0.61 |
| M      | 0.076 | 0.25 |