# NSM6056MT1G

# NPN Transistor with Zener Diode

### Features

- These Devices are Pb−Free, Halogen Free/BFR Free and are RoHS Compliant

### Typical Applications

- Driving Circuit
- Switching Applications

**MAXIMUM RATINGS – NPN TRANSISTOR**

| Rating | Symbol | Value | Unit |
|---|---|---|---|
| Collector – Emitter Voltage | $V_{CEO}$ | 40 | V |
| Collector – Base Voltage | $V_{CBO}$ | 60 | V |
| Emitter – Base Voltage | $V_{EBO}$ | 6.0 | V |
| Collector Current – Continuous | $I_C$ | 600 | mA |
| Collector Current – Peak | $I_{CM}$ | 900 | mA |

**MAXIMUM RATINGS – ZENER DIODE**

| Rating | Symbol | Value | Unit |
|---|---|---|---|
| Forward Voltage @ $I_F$ = 10 mA | $V_F$ | 0.9 | V |

**THERMAL CHARACTERISTICS**

| Rating | Symbol | Max | Unit |
|---|---|---|---|
| Total Device Dissipation FR−5 Board, (Note 1) @ $T_A$ = 25°C | $P_D$ | 380 | mW |
| Thermal Resistance from Junction−to−Ambient | $R_{\theta JA}$ | 328 | °C/W |
| Junction and Storage Temperature Range | $T_J$, $T_{stg}$ | −55 to +150 | °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.

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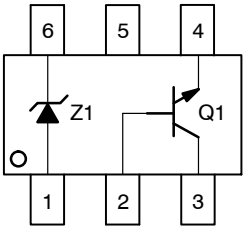
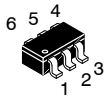
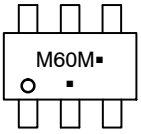
## NPN Transistor with Zener Diode




**SC−74**
**CASE 318F**

**MARKING DIAGRAM**




M60 = Device Code
M = Date Code*
▪ = Pb−Free Package

(Note: Microdot may be in either location)

*Date Code orientation may vary depending upon manufacturing location.

**ORDERING INFORMATION**

| Device | Package | Shipping† |
|---|---|---|
| NSM6056MT1G | SC−74 (Pb−Free) | 3000/Tape & Reel |

†For information on tape and reel specifications, including part orientation and tape sizes, please refer to our Tape and Reel Packaging Specification Brochure, BRD8011/D.

**NPN TRANSISTOR – ELECTRICAL CHARACTERISTICS** ($T_A$ = 25°C unless otherwise noted)

| Characteristic | | Symbol | Min | Max | Unit |
|---|---|---|---|---|---|
| **OFF CHARACTERISTICS** | | | | | |
| Collector – Emitter Breakdown Voltage (Note 3) | ($I_C$ = 1.0 mAdc, $I_B$ = 0) | $V_{(BR)CEO}$ | 40 | – | Vdc |
| Collector – Base Breakdown Voltage | ($I_C$ = 0.1 mAdc, $I_E$ = 0) | $V_{(BR)CBO}$ | 60 | – | Vdc |
| Emitter – Base Breakdown Voltage | ($I_E$ = 0.1 mAdc, $I_C$ = 0) | $V_{(BR)EBO}$ | 6.0 | – | Vdc |
| Base Cutoff Current | ($V_{CE}$ = 35 Vdc, $V_{EB}$ = 0.4 Vdc) | $I_{BEV}$ | – | 0.1 | μAdc |
| Collector Cutoff Current | ($V_{CE}$ = 35 Vdc, $V_{EB}$ = 0.4 Vdc) | $I_{CEX}$ | – | 0.1 | μAdc |
| **ON CHARACTERISTICS** (Note 3) | | | | | |
| DC Current Gain | | $h_{FE}$ | | | – |
| | ($I_C$ = 0.1 mAdc, $V_{CE}$ = 1.0 Vdc) | | 20 | – | |
| | ($I_C$ = 1.0 mAdc, $V_{CE}$ = 1.0 Vdc) | | 40 | – | |
| | ($I_C$ = 10 mAdc, $V_{CE}$ = 1.0 Vdc) | | 80 | – | |
| | ($I_C$ = 150 mAdc, $V_{CE}$ = 1.0 Vdc) | | 100 | 300 | |
| | ($I_C$ = 500 mAdc, $V_{CE}$ = 2.0 Vdc) | | 40 | – | |
| Collector – Emitter Saturation Voltage | | $V_{CE(sat)}$ | | | Vdc |
| | ($I_C$ = 150 mAdc, $I_B$ = 15 mAdc) | | – | 0.4 | |
| | ($I_C$ = 500 mAdc, $I_B$ = 50 mAdc) | | – | 0.75 | |
| Base – Emitter Saturation Voltage | | $V_{BE(sat)}$ | | | Vdc |
| | ($I_C$ = 150 mAdc, $I_B$ = 15 mAdc) | | 0.75 | 0.95 | |
| | ($I_C$ = 500 mAdc, $I_B$ = 50 mAdc) | | – | 1.2 | |
| **SMALL–SIGNAL CHARACTERISTICS** | | | | | |
| Current – Gain – Bandwidth Product | ($I_C$ = 20 mAdc, $V_{CE}$ = 10 Vdc, f = 100 MHz) | $f_T$ | 250 | – | MHz |
| Collector–Base Capacitance | ($V_{CB}$ = 5.0 Vdc, $I_E$ = 0, f = 1.0 MHz) | $C_{cb}$ | – | 6.5 | pF |
| Emitter–Base Capacitance | ($V_{EB}$ = 0.5 Vdc, $I_C$ = 0, f = 1.0 MHz) | $C_{eb}$ | – | 30 | pF |
| Input Impedance | ($I_C$ = 1.0 mAdc, $V_{CE}$ = 10 Vdc, f = 1.0 kHz) | $h_{ie}$ | 1.0 | 15 | kΩ |
| Voltage Feedback Ratio | ($I_C$ = 1.0 mAdc, $V_{CE}$ = 10 Vdc, f = 1.0 kHz) | $h_{re}$ | 0.1 | 8.0 | X $10^{-4}$ |
| Small – Signal Current Gain | ($I_C$ = 1.0 mAdc, $V_{CE}$ = 10 Vdc, f = 1.0 kHz) | $h_{fe}$ | 40 | 500 | – |
| Output Admittance | ($I_C$ = 1.0 mAdc, $V_{CE}$ = 10 Vdc, f = 1.0 kHz) | $h_{oe}$ | 1.0 | 30 | μmhos |
| **SWITCHING CHARACTERISTICS** | | | | | |
| Delay Time | ($V_{CC}$ = 30 Vdc, $V_{EB}$ = 2.0 Vdc, $I_C$ = 150 mAdc, $I_{B1}$ = 15 mAdc) | $t_d$ | – | 15 | ns |
| Rise Time | | $t_r$ | – | 20 | |
| Storage Time | ($V_{CC}$ = 30 Vdc, $I_C$ = 150 mAdc, $I_{B1}$ = $I_{B2}$ = 15 mAdc) | $t_s$ | – | 225 | ns |
| Fall Time | | $t_f$ | – | 30 | |

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

**ZENER DIODE – ELECTRICAL CHARACTERISTICS** ($V_F$ = 0.9 Max @ $I_F$ = 10 mA for all types)

| Device | Test Current Izt mA | Zener Voltage VZ | | $Z_{ZK}$ $I_Z$ = 0.5 mA Ω Max | $Z_{ZT}$ $I_Z$ = IZT @ 10% Mod Ω Max | Max IR @ VR | | $d_{VZ}$/dt (mV/k) @ $I_{ZT1}$ = 5 mA | | C pF Max @ $V_R$ = 0 f = 1 MHz |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Min | Max | | | μA | V | Min | Max | |
| NSM6056MT1G | 5.0 | 5.49 | 5.73 | 200 | 40 | 1.0 | 2.0 | –2.0 | 2.5 | 200 |

## TYPICAL ELECTRICAL CHARACTERISTICS – NPN TRANSISTOR

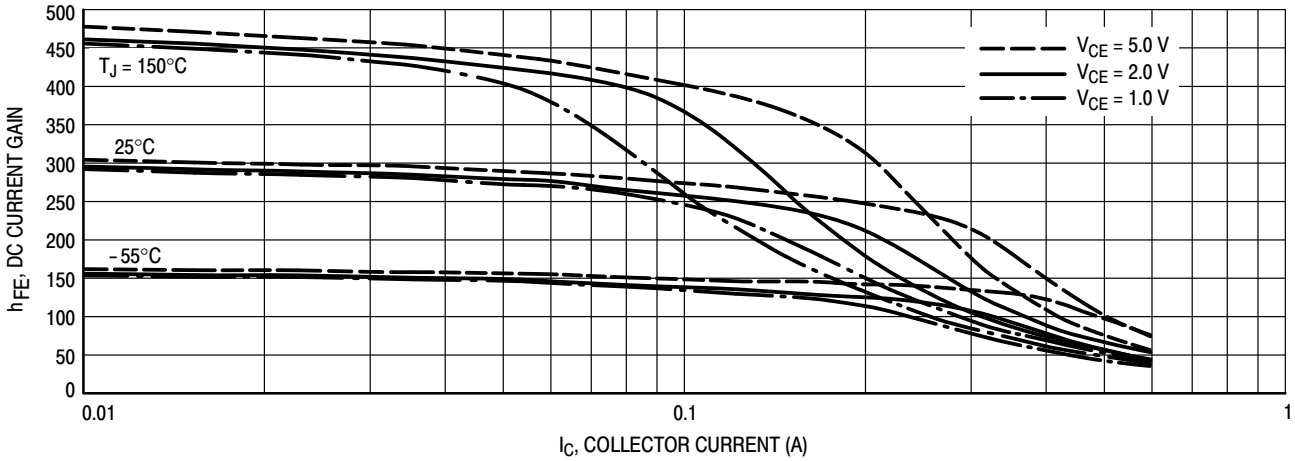



**Figure 1. DC Current Gain**

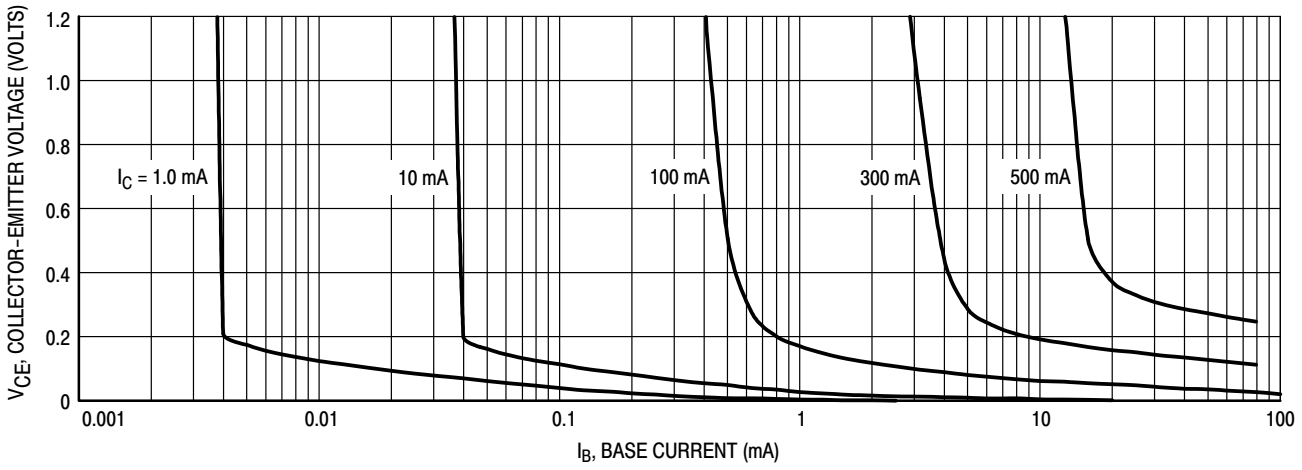



**Figure 2. Collector Saturation Region**

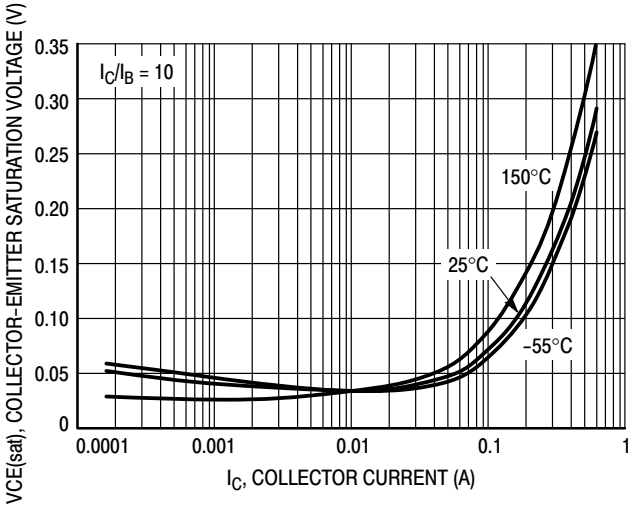



**Figure 3. Collector−Emitter Saturation Voltage vs. Collector Current**

## TYPICAL ELECTRICAL CHARACTERISTICS – NPN TRANSISTOR

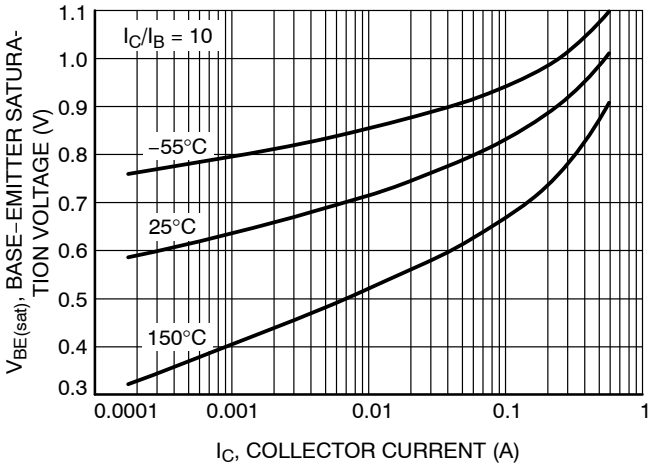



**Figure 4. Base−Emitter Saturation Voltage vs. Collector Current**

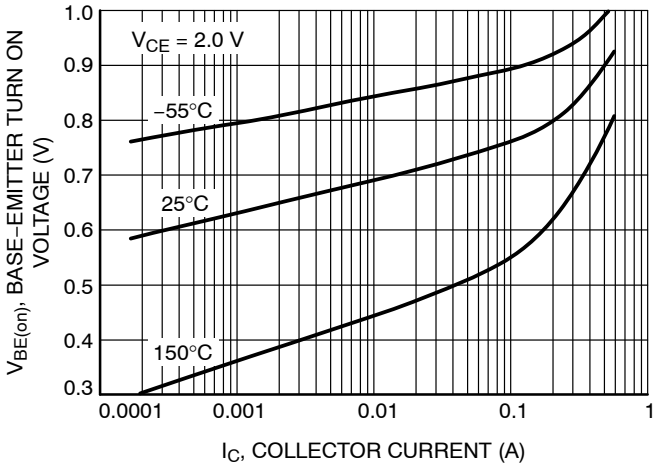



**Figure 5. Base−Emitter Turn On Voltage vs. Collector Current**

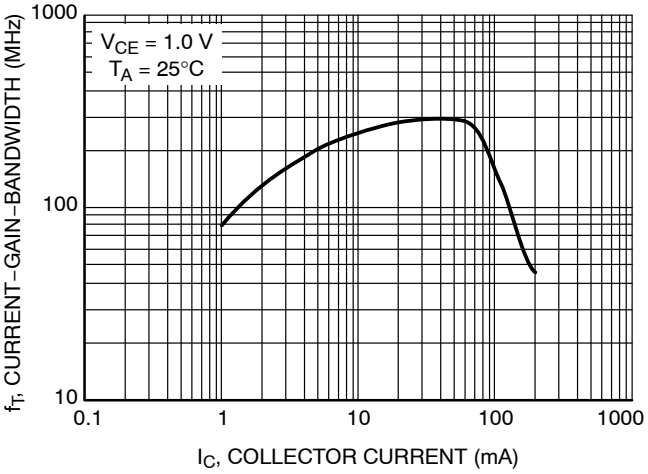



**Figure 6. Current−Gain−Bandwidth Product**

## TYPICAL ELECTRICAL CHARACTERISTICS – ZENER DIODE

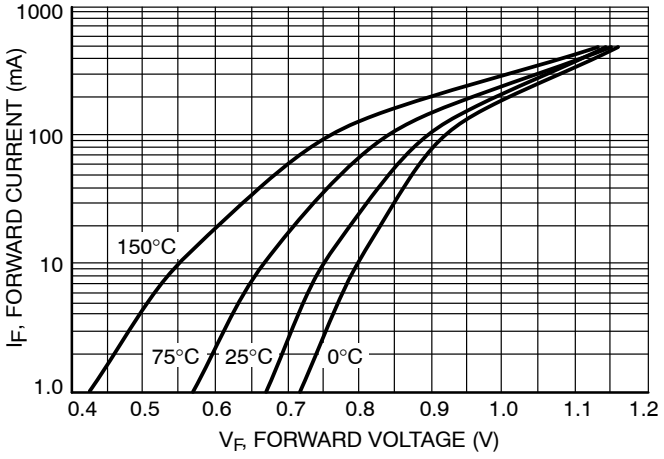
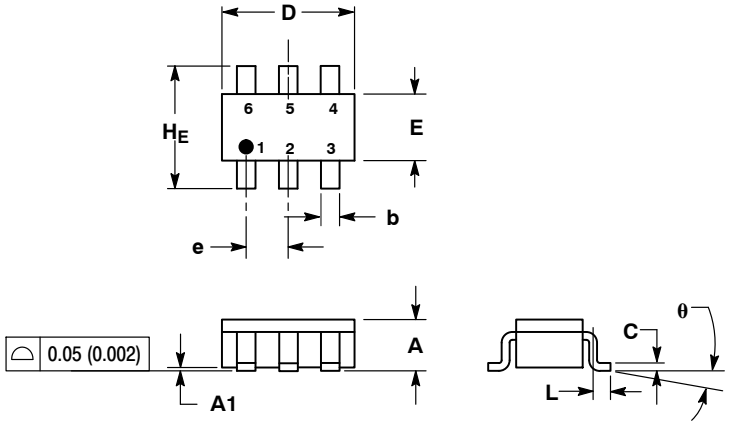



**Figure 7. Typical Forward Voltage**

# NSM6056MT1G

## PACKAGE DIMENSIONS

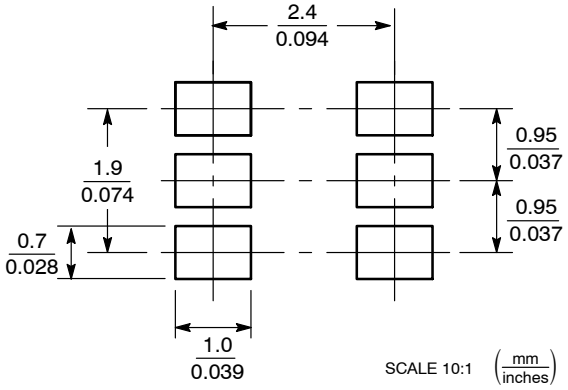
**SC−74**
CASE 318F−05
ISSUE M




NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH.
3. MAXIMUM LEAD THICKNESS INCLUDES LEAD FINISH THICKNESS. MINIMUM LEAD THICKNESS IS THE MINIMUM THICKNESS OF BASE MATERIAL.
4. 318F−01, −02, −03 OBSOLETE. NEW STANDARD 318F−04.

| | MILLIMETERS | | | INCHES | | |
|---|---|---|---|---|---|---|
| DIM | MIN | NOM | MAX | MIN | NOM | MAX |
| A | 0.90 | 1.00 | 1.10 | 0.035 | 0.039 | 0.043 |
| A1 | 0.01 | 0.06 | 0.10 | 0.001 | 0.002 | 0.004 |
| b | 0.25 | 0.37 | 0.50 | 0.010 | 0.015 | 0.020 |
| c | 0.10 | 0.18 | 0.26 | 0.004 | 0.007 | 0.010 |
| D | 2.90 | 3.00 | 3.10 | 0.114 | 0.118 | 0.122 |
| E | 1.30 | 1.50 | 1.70 | 0.051 | 0.059 | 0.067 |
| e | 0.85 | 0.95 | 1.05 | 0.034 | 0.037 | 0.041 |
| L | 0.20 | 0.40 | 0.60 | 0.008 | 0.016 | 0.024 |
| $H_E$ | 2.50 | 2.75 | 3.00 | 0.099 | 0.108 | 0.118 |
| θ | 0° | – | 10° | 0° | – | 10° |

## 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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