

# NSM3005NZ

## Small Signal BJT and MOSFET

30 V, 500 mA, PNP BJT with 20 V, 224 mA, N-Channel MOSFET

### Features

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

### Typical Applications

- Portable Devices

#### Q1 MAXIMUM RATINGS ( $T_J = 25^\circ\text{C}$ unless otherwise specified)

| Parameter                 | Symbol    | Value | Unit |
|---------------------------|-----------|-------|------|
| Collector-Emitter Voltage | $V_{CEO}$ | 30    | V    |
| Collector-Base Voltage    | $V_{CBO}$ | 40    | V    |
| Emitter-Base Voltage      | $V_{EBO}$ | 5.0   | V    |
| Collector Current         | $I_C$     | 500   | mA   |
| Base Current              | $I_B$     | 50    | mA   |

#### Q2 MAXIMUM RATINGS ( $T_J = 25^\circ\text{C}$ unless otherwise specified)

| Parameter                         | Symbol                 | Value                    | Unit  |     |    |                          |
|-----------------------------------|------------------------|--------------------------|-------|-----|----|--------------------------|
| Drain-to-Source Voltage           | $V_{DSS}$              | 20                       | V     |     |    |                          |
| Gate-to-Source Voltage            | $V_{GS}$               | $\pm 8$                  | V     |     |    |                          |
| Continuous Drain Current (Note 1) | Steady State           | $T_A = 25^\circ\text{C}$ | $I_D$ | 224 | mA |                          |
|                                   |                        | $T_A = 85^\circ\text{C}$ |       |     |    | 162                      |
|                                   |                        | $t \leq 5 \text{ s}$     |       |     |    | $T_A = 25^\circ\text{C}$ |
| Pulsed Drain Current              | $T_p = 10 \mu\text{s}$ | $I_{DM}$                 | 673   | mA  |    |                          |
| Source Current (Body Diode)       | $I_S$                  | 120                      | mA    |     |    |                          |

### THERMAL CHARACTERISTICS

| Parameter  | Symbol                   | Value      | Unit                    |
|--|--------------------------|------------|-------------------------|
| Thermal Resistance<br>Junction-to-Ambient (Note 1)<br>Total Power Dissipation @ $T_A = 25^\circ\text{C}$ | $R_{\theta JA}$<br>$P_D$ | 245<br>0.8 | $^\circ\text{C/W}$<br>W |
| Operating Junction and Storage Temperature   | $T_J, T_{STG}$           | -55 to 150 | $^\circ\text{C}$        |
| Lead Temperature for Soldering Purposes<br>(1/8" from case for 10 s)                                     | $T_L$                    | 260        | $^\circ\text{C}$        |

Stresses exceeding those listed in the Maximum Ratings table may damage the device. If any of these limits are exceeded, device functionality should not be assumed, damage may occur and reliability may be affected.

1. Surface mounted on FR4 board using 1 in sq pad size (Cu. area = 1.127 in sq [1 oz] including traces).



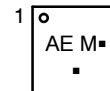
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### MARKING DIAGRAM



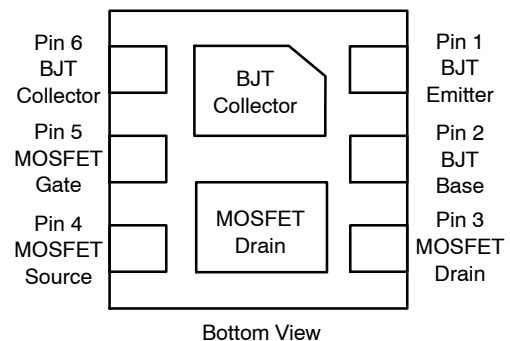
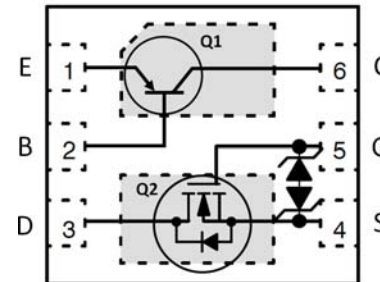
UDFN6  
CASE 517AT  
 $\mu\text{COOL}^{\text{TM}}$



AE = Specific Device Code  
M = Date Code  
▪ = Pb-Free Package

(Note: Microdot may be in either location)  
\*Date Code orientation may vary depending upon manufacturing location.

### PIN CONNECTIONS



### ORDERING INFORMATION

| Device       | Package         | Shipping†          |
|--------------|-----------------|--------------------|
| NSM3005NZTAG | UDFN6 (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 Specifications Brochure, BRD8011/D.

# NSM3005NZ

## Q1 ELECTRICAL CHARACTERISTICS (T<sub>J</sub> = 25°C unless otherwise specified)

| Parameter                            | Symbol               | Test Condition                                   | Min | Typ | Max | Unit |
|--------------------------------------|----------------------|--|-----|-----|-----|------|
| <b>OFF CHARACTERISTICS</b>           |                      |  |     |     |     |      |
| Collector–Base Breakdown Voltage     | V <sub>(BR)CBO</sub> | I <sub>C</sub> = 100 μA                          | 40  | –   | –   | V    |
| Collector–Emitter Breakdown Voltage  | V <sub>(BR)CEO</sub> | I <sub>C</sub> = 10 mA                           | 30  | –   | –   | V    |
| Emitter–Base Breakdown Voltage       | V <sub>(BR)EBO</sub> | I <sub>E</sub> = 100 μA                          | 5.0 | –   | –   | V    |
| Collector Cutoff Current             | I <sub>CBO</sub>     | V <sub>CB</sub> = 25 V, I <sub>E</sub> = 0 A     | –   | –   | 1.0 | μA   |
| Emitter Cutoff Current               | I <sub>EBO</sub>     | V <sub>EB</sub> = 5.0 V, I <sub>C</sub> = 0 A    | –   | –   | 10  | μA   |
| <b>ON CHARACTERISTICS (Note 2)</b>   |                      |  |     |     |     |      |
| DC Current Gain                      | h <sub>FE</sub>      | V <sub>CE</sub> = 3.0 V, I <sub>C</sub> = 30 mA  | 20  | –   | 100 |      |
|                                      |                      | V <sub>CE</sub> = 3.0 V, I <sub>C</sub> = 100 mA | 20  | –   | 100 |      |
|                                      |                      | V <sub>CE</sub> = 3.0 V, I <sub>C</sub> = 500 mA | 20  | –   | 100 |      |
| Collector–Emitter Saturation Voltage | V <sub>CE(sat)</sub> | I <sub>C</sub> = 500 mA, I <sub>B</sub> = 50 mA  | –   | –   | 0.4 | V    |
| Base–Emitter Saturation Voltage      | V <sub>BE(sat)</sub> | I <sub>C</sub> = 500 mA, I <sub>B</sub> = 50 mA  | –   | –   | 1.1 | V    |
| Base–Emitter Turn–On Voltage         | V <sub>BE(on)</sub>  | V <sub>CE</sub> = 1.0 V, I <sub>C</sub> = 500 mA | –   | –   | 1.0 | V    |

## Q2 ELECTRICAL CHARACTERISTICS (T<sub>J</sub> = 25°C unless otherwise specified)

| Parameter   | Symbol                               | Test Condition   | Min | Typ  | Max  | Unit  |
|---|--------------------------------------|--|-----|------|------|-------|
| <b>OFF CHARACTERISTICS</b>                                |                                      |  |     |      |      |       |
| Drain–to–Source Breakdown Voltage                         | V <sub>(BR)DSS</sub>                 | V <sub>GS</sub> = 0 V, I <sub>D</sub> = 250 μA                       | 20  | –    | –    | V     |
| Drain–to–Source Breakdown Voltage Temperature Coefficient | V <sub>(BR)DSS</sub> /T <sub>J</sub> | I <sub>D</sub> = –250 μA, ref to 25°C                                | –   | 19   | –    | mV/°C |
| Zero Gate Voltage Drain Current                           | I <sub>DSS</sub>                     | V <sub>GS</sub> = 0 V, V <sub>DS</sub> = 16 V, T <sub>J</sub> = 25°C | –   | –    | 1.0  | μA    |
| Gate–to–Source Leakage Current                            | I <sub>GSS</sub>                     | V <sub>DS</sub> = 0 V, V <sub>GS</sub> = ±8.0 V                      | –   | –    | ±2.0 | μA    |
| <b>ON CHARACTERISTICS (Note 2)</b>                        |                                      |  |     |      |      |       |
| Gate Threshold Voltage                                    | V <sub>GS(TH)</sub>                  | V <sub>GS</sub> = V <sub>DS</sub> , I <sub>D</sub> = 250 μA          | 0.4 | –    | 1.0  | V     |
| Negative Threshold Temperature Coefficient                | V <sub>GS(TH)</sub> /T <sub>J</sub>  | –  | –   | 1.9  | –    | mV/°C |
| Drain–to–Source On Resistance                             | R <sub>DS(ON)</sub>                  | V <sub>GS</sub> = 4.5 V, I <sub>D</sub> = 100 mA                     | –   | 0.65 | 1.4  | Ω     |
|   |                                      | V <sub>GS</sub> = 2.5 V, I <sub>D</sub> = 50 mA                      | –   | 0.9  | 1.9  |       |
|   |                                      | V <sub>GS</sub> = 1.8 V, I <sub>D</sub> = 20 mA                      | –   | 1.1  | 2.2  |       |
|   |                                      | V <sub>GS</sub> = 1.5 V, I <sub>D</sub> = 10 mA                      | –   | 1.4  | 4.3  |       |
| Forward Transconductance                                  | g <sub>FS</sub>                      | V <sub>DS</sub> = 5.0 V, I <sub>D</sub> = 100 mA                     | –   | 0.56 | –    | S     |

## CHARGES AND CAPACITANCES

|                              |                     |   |   |      |   |    |
|------------------------------|---------------------|---|---|------|---|----|
| Input Capacitance            | C <sub>ISS</sub>    | f = 1.0 MHz, V <sub>GS</sub> = 0 V,<br>V <sub>DS</sub> = 15 V               | – | 15.8 | – | pF |
| Output Capacitance           | C <sub>OSS</sub>    |   | – | 3.5  | – |    |
| Reverse Transfer Capacitance | C <sub>RSS</sub>    |   | – | 2.4  | – |    |
| Total Gate Charge            | Q <sub>G(TOT)</sub> | V <sub>GS</sub> = 4.5 V, V <sub>DS</sub> = 15 V;<br>I <sub>D</sub> = 200 mA | – | 0.70 | – | nC |
| Threshold Gate Charge        | Q <sub>G(TH)</sub>  |   | – | 0.05 | – |    |
| Gate–to–Source Charge        | Q <sub>GS</sub>     |   | – | 0.14 | – |    |
| Gate–to–Drain Charge         | Q <sub>GD</sub>     |   | – | 0.10 | – |    |

## SWITCHING CHARACTERISTICS, V<sub>GS</sub> = 4.5 V (Note 3)

|                     |                     |   |   |     |   |    |
|---------------------|---------------------|---|---|-----|---|----|
| Turn–On Delay Time  | t <sub>d(ON)</sub>  | V <sub>GS</sub> = 4.5 V, V <sub>DD</sub> = 15 V,<br>I <sub>D</sub> = 200 mA, R <sub>G</sub> = 2 Ω | – | 18  | – | ns |
| Rise Time           | t <sub>r</sub>      |   | – | 35  | – |    |
| Turn–Off Delay Time | T <sub>d(OFF)</sub> |   | – | 201 | – |    |
| Fall Time           | t <sub>f</sub>      |   | – | 110 | – |    |

## DRAIN–SOURCE DIODE CHARACTERISTICS

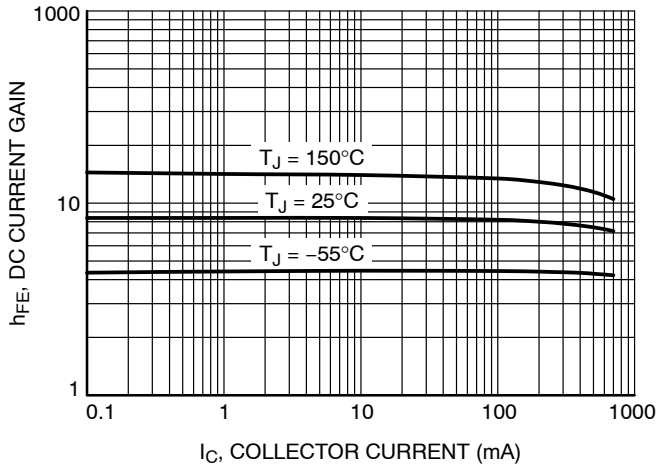
|                       |                 |   |   |      |     |   |
|-----------------------|-----------------|---|---|------|-----|---|
| Forward Diode Voltage | V <sub>SD</sub> | V <sub>GS</sub> = 0 V, I <sub>S</sub> = 10 mA | – | 0.55 | 1.0 | V |
|-----------------------|-----------------|---|---|------|-----|---|

2. Pulsed Condition: Pulse Width = 300 msec, Duty Cycle ≤ 2%.

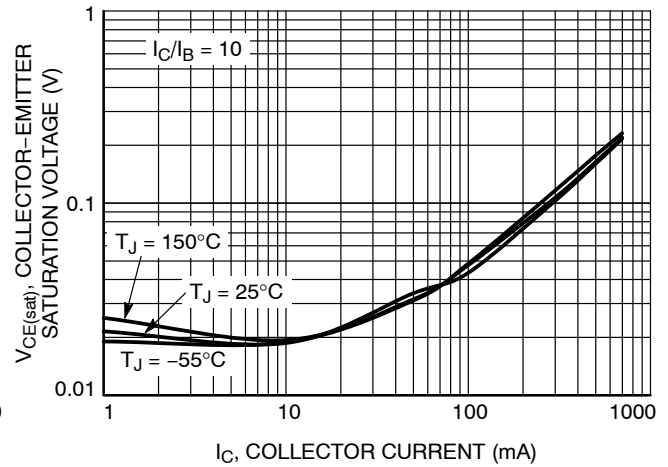
3. Switching characteristics are independent of operating junction temperatures.

# NSM3005NZ

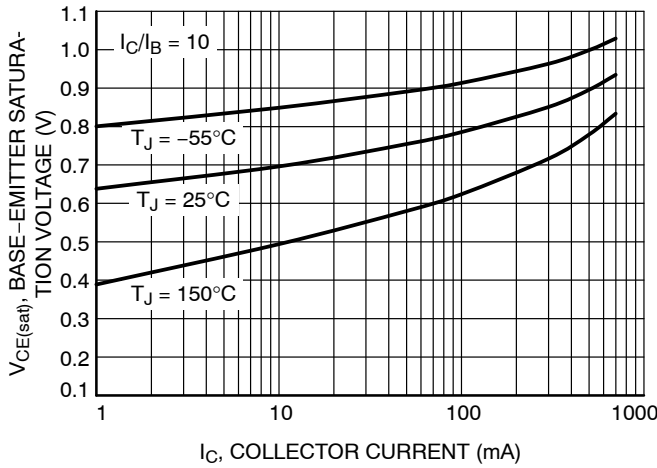
## TYPICAL CHARACTERISTICS – Q1



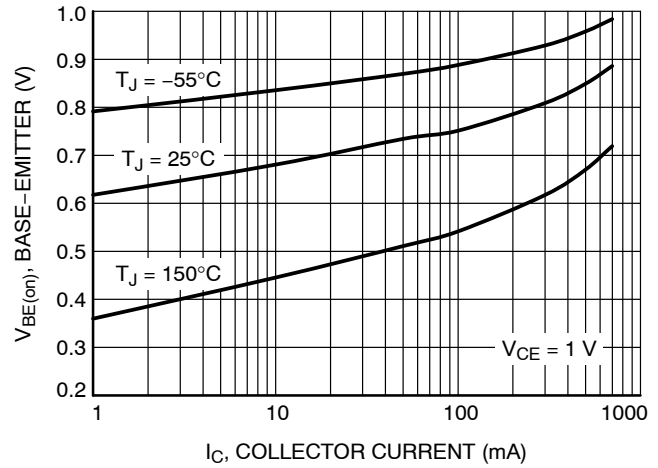
**Figure 1. PNP DC Current Gain vs. Collector Current**



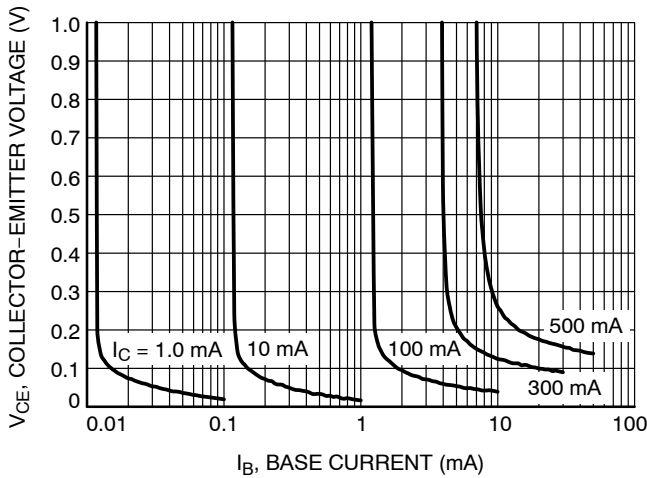
**Figure 2. PNP VCE vs. IC**



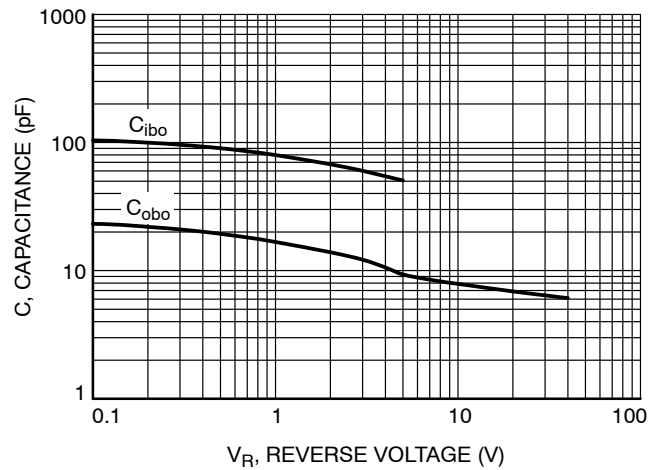
**Figure 3. PNP VBE(sat) vs. IC**



**Figure 4. PNP VBE(on) vs. IC**



**Figure 5. PNP VCE vs. IB**



**Figure 6. PNP Capacitance**

# NSM3005NZ

## TYPICAL CHARACTERISTICS – Q2

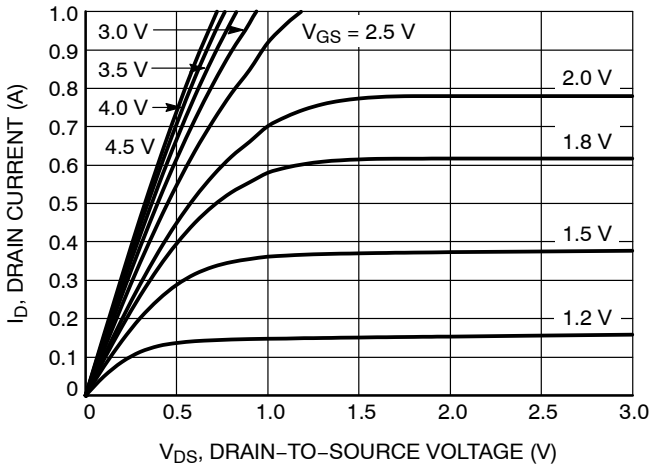


Figure 7. On-Region Characteristics

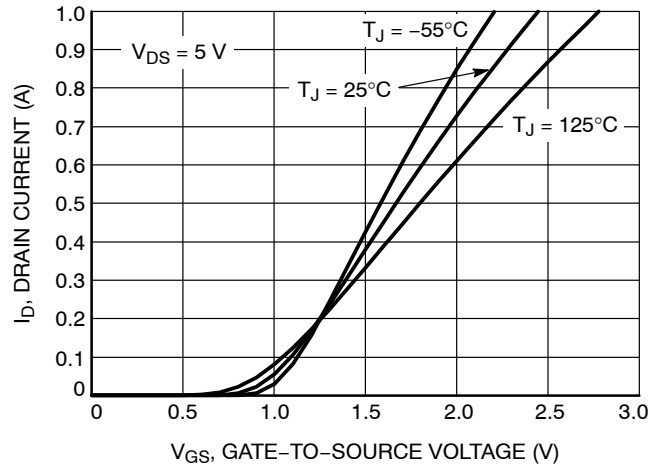


Figure 8. Transfer Characteristics

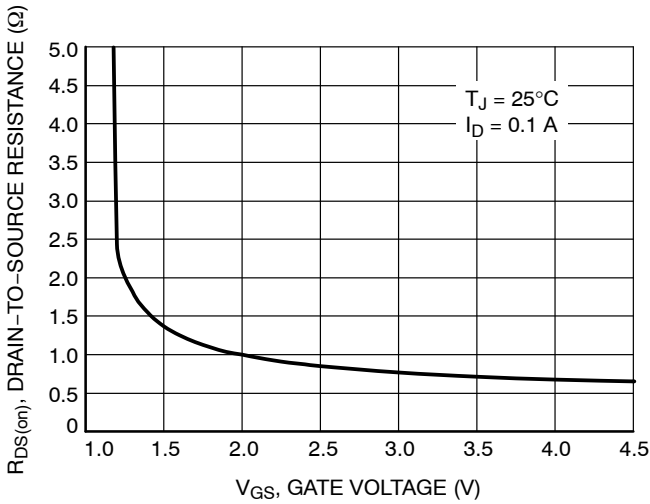


Figure 9. On-Resistance vs. Gate-to-Source Voltage

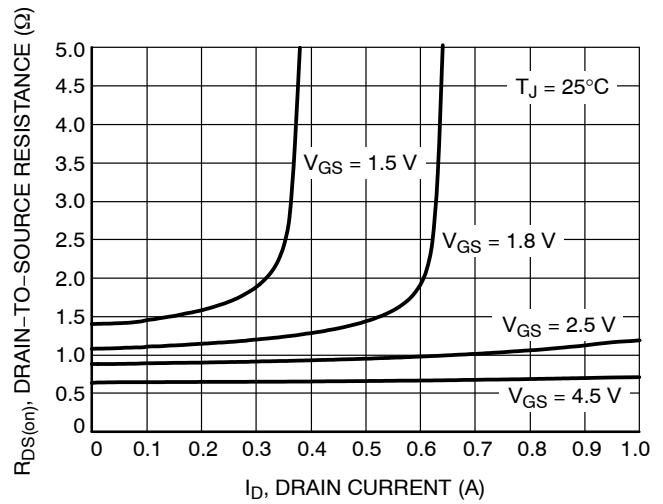


Figure 10. On-Resistance vs. Drain Current and Gate Voltage

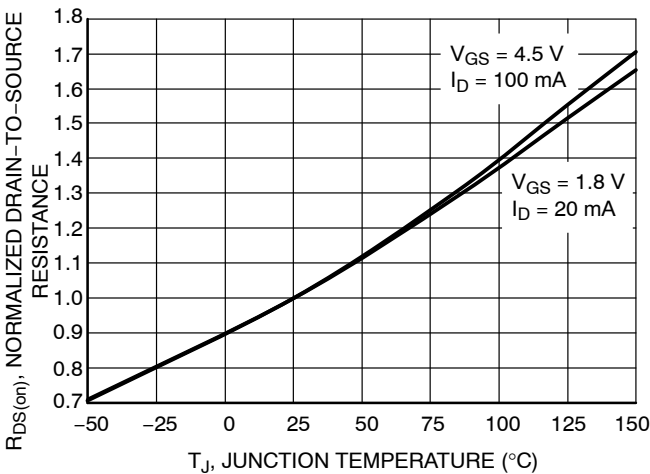


Figure 11. On-Resistance Variation with Temperature

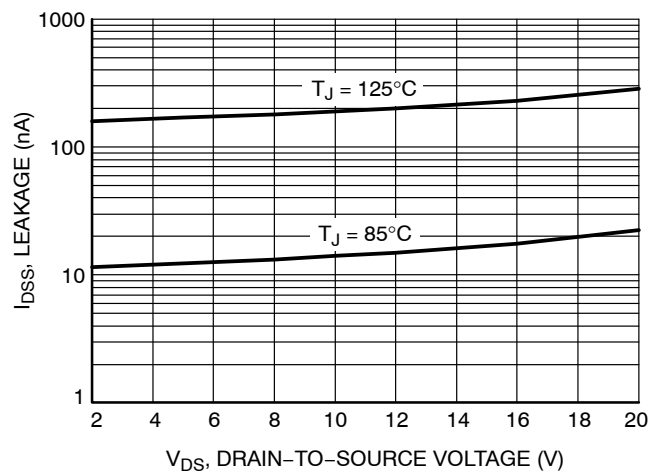
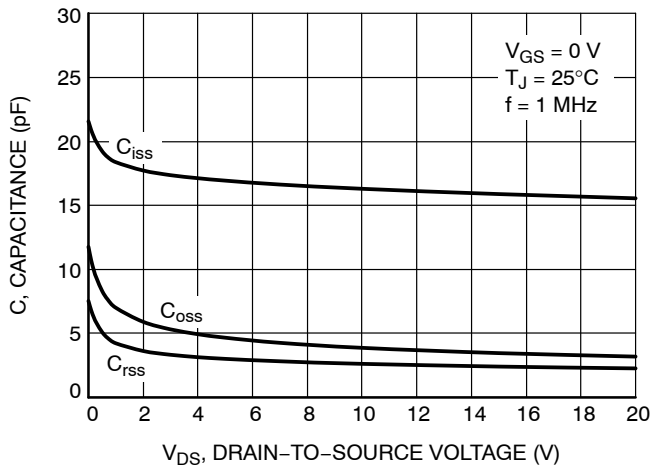


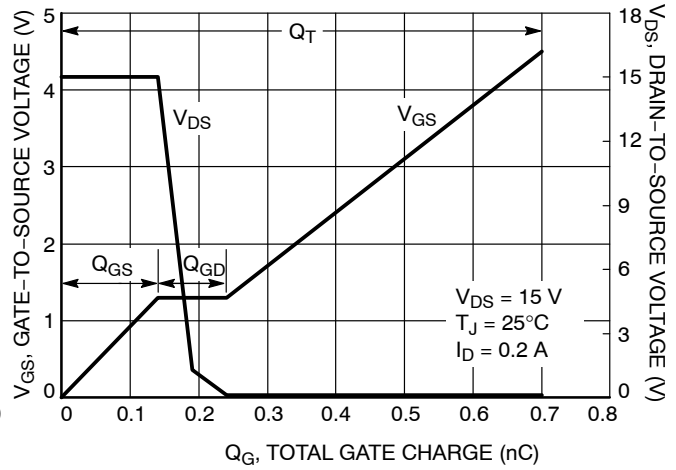
Figure 12. Drain-to-Source Leakage Current vs. Voltage

# NSM3005NZ

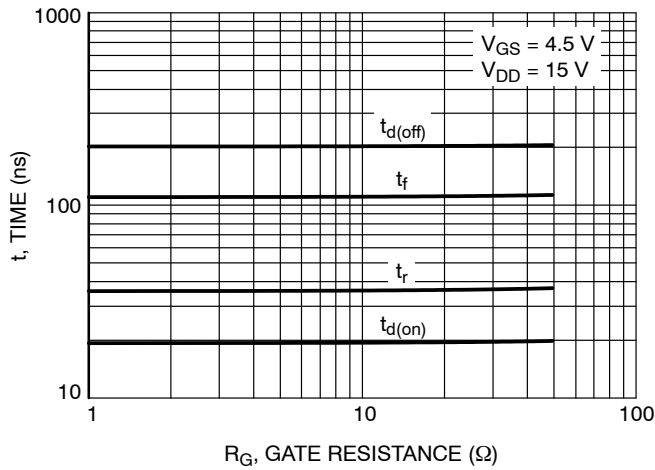
## TYPICAL CHARACTERISTICS – Q2



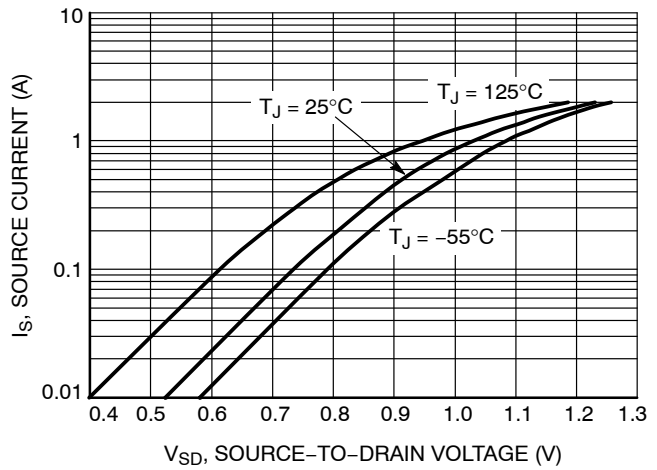
**Figure 13. Capacitance Variation**



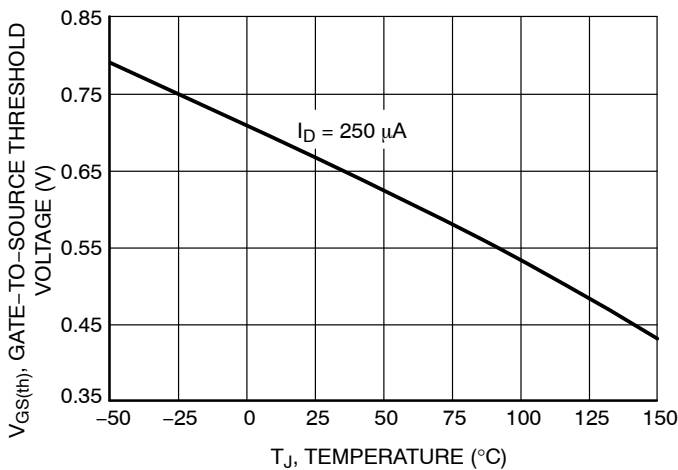
**Figure 14. Gate-to-Source and Drain-to-Source Voltage vs. Total Charge**



**Figure 15. Resistive Switching Time Variation vs. Gate Resistance**



**Figure 16. Diode Forward Voltage vs. Current**



**Figure 17. Threshold Voltage**

# MECHANICAL CASE OUTLINE

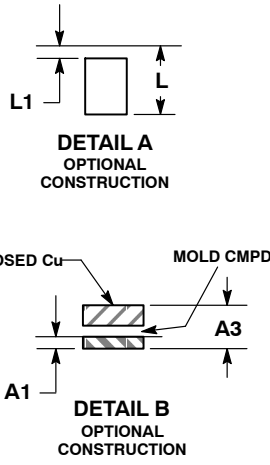
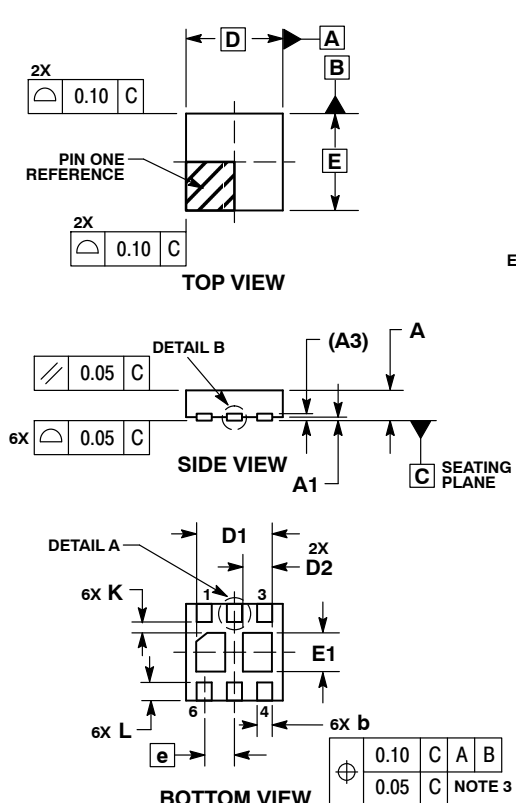
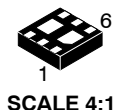
## PACKAGE DIMENSIONS



### UDFN6 1.6x1.6, 0.5P

CASE 517AT-01  
ISSUE O

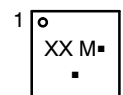
DATE 02 SEP 2008



- NOTES:
1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 1994.
  2. CONTROLLING DIMENSION: MILLIMETERS.
  3. DIMENSION b APPLIES TO PLATED TERMINAL AND IS MEASURED BETWEEN 0.15 AND 0.30 mm FROM TERMINAL.
  4. COPLANARITY APPLIES TO THE EXPOSED PAD AS WELL AS THE TERMINALS.

| MILLIMETERS |      |      |
|-------------|------|------|
| DIM         | MIN  | MAX  |
| A           | 0.45 | 0.55 |
| A1          | 0.00 | 0.05 |
| A3          | 0.13 | REF  |
| b           | 0.20 | 0.30 |
| D           | 1.60 | BSC  |
| E           | 1.60 | BSC  |
| e           | 0.50 | BSC  |
| D1          | 1.14 | 1.34 |
| D2          | 0.38 | 0.58 |
| E1          | 0.54 | 0.74 |
| K           | 0.20 | ---  |
| L           | 0.15 | 0.35 |
| L1          | ---  | 0.10 |

### GENERIC MARKING DIAGRAM\*



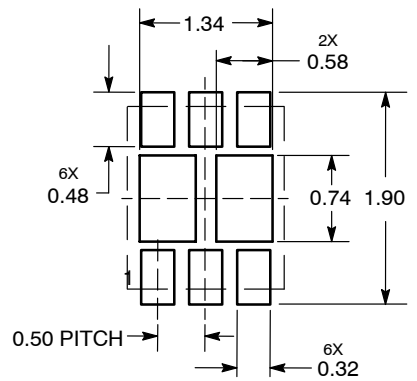
- XX = Specific Device Code
- M = Date Code
- = Pb-Free Package

(Note: Microdot may be in either location)

\*This information is generic. Please refer to device data sheet for actual part marking.

Pb-Free indicator, "G" or microdot "▪", may or may not be present.

### SOLDERMASK DEFINED MOUNTING FOOTPRINT\*



DIMENSIONS: MILLIMETERS

\*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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| <b>DESCRIPTION:</b>     | <b>6 PIN UDFN, 1.6X1.6, 0.5P</b> | <b>PAGE 1 OF 1</b>   |

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