

# ON Semiconductor

## Is Now



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# MOSFET - Power, Dual N- & P-Channel, $\mu$ 8FL

100 V, 70 m $\Omega$ , 9.5 A,  
-100 V, 186 m $\Omega$ , -5 A

## NTTBC070NP10M5L

### Features

- Small Footprint (3 x 3 mm) for Compact Design
- Low  $R_{DS(on)}$  to Minimize Conduction Losses
- Low  $Q_G$  and Capacitance to Minimize Driver Losses
- These Devices are Pb-Free, Halogen Free/BFR Free and are RoHS Compliant

### Typical Applications

- Power Tools, Battery Operated Vacuums
- UAV/Drones, Material Handling
- Motor Drive, Home Automation

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

| Parameter                                                                                                   |                                                            |                            | Symbol            | Q1          | Q2       | Unit               |
|-------------------------------------------------------------------------------------------------------------|------------------------------------------------------------|----------------------------|-------------------|-------------|----------|--------------------|
| Drain-to-Source Breakdown Voltage                                                                           |                                                            |                            | $V_{(BR)DSS}$     | 100         | -100     | V                  |
| Gate-to-Source Voltage                                                                                      |                                                            |                            | $V_{GS}$          | $\pm 20$    | $\pm 20$ | V                  |
| Continuous Drain Current $R_{\theta JC}$ (Note 2)                                                           | Steady State                                               | $T_C = 25^{\circ}\text{C}$ | $I_D$             | 9.5         | -5       | A                  |
| Power Dissipation $R_{\theta JC}$ (Note 2)                                                                  |                                                            |                            | $P_D$             | 14          | 10       | W                  |
| Continuous Drain Current $R_{\theta JA}$ (Note 1, 2)                                                        | Steady State                                               | $T_A = 25^{\circ}\text{C}$ | $I_D$             | 3.5         | -2.2     | A                  |
| Power Dissipation $R_{\theta JA}$ (Note 1, 2)                                                               |                                                            |                            | $P_D$             | 1.9         | 1.9      | W                  |
| Pulsed Drain Current                                                                                        | $T_A = 25^{\circ}\text{C}$ , $t_p = 10\text{ }\mu\text{s}$ |                            | $I_{DM}$          | 33          | 33       | A                  |
| Operating Junction and Storage Temperature Range                                                            |                                                            |                            | $T_J$ , $T_{stg}$ | -55 to +150 |          | $^{\circ}\text{C}$ |
| Source Current (Body Diode)                                                                                 |                                                            |                            | $I_S$             | 12          | 8        | A                  |
| Single Pulse Drain-to-Source Avalanche Energy ( $I_L = 7.3\text{ A}$ , $7.8\text{ A}$ , $L = 1\text{ mH}$ ) |                                                            |                            | $E_{AS}$          | 26          | 30       | mJ                 |
| Lead Temperature Soldering Reflow for Soldering Purposes (1/8" from case for 10 s)                          |                                                            |                            | $T_L$             | 260         | 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<sup>2</sup> pad size, 1 oz Cu pad.
2. The entire application environment impacts the thermal resistance values shown, they are not constants and are only valid for the particular conditions noted.

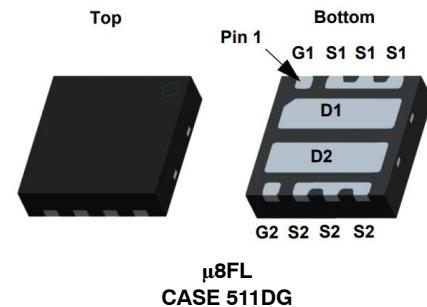
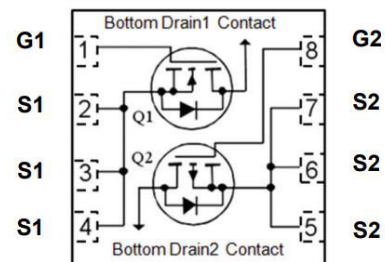


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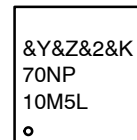
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| $V_{(BR)DSS}$ | $R_{DS(on)}$ MAX      | $I_D$ MAX |
|---------------|-----------------------|-----------|
| 100 V         | 70 m $\Omega$ @ 10 V  | 9.5 A     |
| -100 V        | 186 m $\Omega$ @ 10 V | -5 A      |

### Dual-Channel MOSFET



### MARKING DIAGRAM



&Y = ON Semiconductor Logo  
&Z = Assembly Plant Code  
&2 = Numeric Date Code  
&K = Lot Code  
70NP10M5L = Specific Device Code

### ORDERING INFORMATION

See detailed ordering and shipping information on page 10 of this data sheet.

### THERMAL CHARACTERISTICS

| Symbol          | Parameter                                   | Q1  | Q2   | Unit                        |
|-----------------|---------------------------------------------|-----|------|-----------------------------|
| $R_{\theta JC}$ | Junction-to-Case – Steady State (Note 3)    | 8.9 | 12.5 | $^{\circ}\text{C}/\text{W}$ |
| $R_{\theta JA}$ | Junction-to-Ambient – Steady State (Note 3) | 65  | 65   |                             |

3. The entire application environment impacts the thermal resistance values shown, they are not constants and are only valid for the particular conditions noted.

### ELECTRICAL CHARACTERISTICS (Q1, N-CHANNEL) ( $T_J = 25^{\circ}\text{C}$ unless otherwise noted)

| Parameter | Symbol | Test Conditions | Min | Typ | Max | Unit |
|-----------|--------|-----------------|-----|-----|-----|------|
|-----------|--------|-----------------|-----|-----|-----|------|

#### OFF CHARACTERISTICS

|                                                           |                     |                                                              |                             |    |           |                              |
|-----------------------------------------------------------|---------------------|--------------------------------------------------------------|-----------------------------|----|-----------|------------------------------|
| Drain-to-Source Breakdown Voltage                         | $V_{(BR)DSS}$       | $V_{GS} = 0\text{ V}, I_D = 250\text{ }\mu\text{A}$          | 100                         |    |           | V                            |
| Drain-to-Source Breakdown Voltage Temperature Coefficient | $V_{(BR)DSS} / T_J$ | $I_D = 250\text{ }\mu\text{A}$ , ref to $25^{\circ}\text{C}$ |                             | 70 |           | $\text{mV}/^{\circ}\text{C}$ |
| Zero Gate Voltage Drain Current                           | $I_{DSS}$           | $V_{GS} = 0\text{ V}, V_{DS} = 100\text{ V}$                 | $T_J = 25^{\circ}\text{C}$  |    | 1         | $\mu\text{A}$                |
|                                                           |                     |                                                              | $T_J = 125^{\circ}\text{C}$ |    | 100       |                              |
| Gate-to-Source Leakage Current                            | $I_{GSS}$           | $V_{DS} = 0\text{ V}, V_{GS} = \pm 20\text{ V}$              |                             |    | $\pm 100$ | nA                           |

#### ON CHARACTERISTICS

|                                            |                    |                                                             |     |      |     |                              |
|--------------------------------------------|--------------------|-------------------------------------------------------------|-----|------|-----|------------------------------|
| Gate Threshold Voltage                     | $V_{GS(TH)}$       | $V_{GS} = V_{DS}, I_D = 24\text{ }\mu\text{A}$              | 1.0 |      | 3.0 | V                            |
| Negative Threshold Temperature Coefficient | $V_{GS(TH)} / T_J$ | $I_D = 24\text{ }\mu\text{A}$ , ref to $25^{\circ}\text{C}$ |     | 7.1  |     | $\text{mV}/^{\circ}\text{C}$ |
| Drain-to-Source On Resistance              | $R_{DS(on)}$       | $V_{GS} = 10\text{ V}, I_D = 1.3\text{ A}$                  |     | 47   | 70  | $\text{m}\Omega$             |
|                                            |                    | $V_{GS} = 4.5\text{ V}, I_D = 1.0\text{ A}$                 |     | 67   | 102 |                              |
| Forward Transconductance                   | $g_{FS}$           | $V_{DS} = 5\text{ V}, I_D = 4\text{ A}$                     |     | 6.2  |     | S                            |
| Gate-Resistance                            | $R_G$              | $T_A = 25^{\circ}\text{C}$                                  |     | 0.74 |     | $\Omega$                     |

#### CHARGES & CAPACITANCES

|                              |              |                                                                   |  |     |  |             |
|------------------------------|--------------|-------------------------------------------------------------------|--|-----|--|-------------|
| Input Capacitance            | $C_{ISS}$    | $V_{GS} = 0\text{ V}, f = 1\text{ MHz}, V_{DS} = 50\text{ V}$     |  | 252 |  | $\text{pF}$ |
| Output Capacitance           | $C_{OSS}$    |                                                                   |  | 64  |  |             |
| Reverse Transfer Capacitance | $C_{RSS}$    |                                                                   |  | 3   |  |             |
| Total Gate Charge            | $Q_{G(TOT)}$ | $V_{GS} = 4.5\text{ V}, V_{DS} = 50\text{ V}, I_D = 1.3\text{ A}$ |  | 3   |  | $\text{nC}$ |
| Threshold Gate Charge        | $Q_{G(TH)}$  |                                                                   |  | 0.6 |  |             |
| Gate-to-Source Charge        | $Q_{GS}$     |                                                                   |  | 1.0 |  |             |
| Gate-to-Drain Charge         | $Q_{GD}$     |                                                                   |  | 1.1 |  |             |
| Total Gate Charge            | $Q_{G(TOT)}$ | $V_{GS} = 10\text{ V}, V_{DD} = 50\text{ V}, I_D = 1.3\text{ A}$  |  | 5.6 |  | $\text{nC}$ |
| Plateau Voltage              | $V_{GP}$     |                                                                   |  | 2.6 |  |             |

#### SWITCHING CHARACTERISTICS

|                     |              |                                                                                          |  |      |  |    |
|---------------------|--------------|------------------------------------------------------------------------------------------|--|------|--|----|
| Turn-On Delay Time  | $t_{d(ON)}$  | $V_{GS} = 10\text{ V}, V_{DS} = 50\text{ V}, I_D = 1.3\text{ A}, R_G = 6\text{ }\Omega$  |  | 5.3  |  | ns |
| Rise Time           | $t_r$        |                                                                                          |  | 2.5  |  |    |
| Turn-Off Delay Time | $t_{d(OFF)}$ |                                                                                          |  | 12.4 |  |    |
| Fall Time           | $t_f$        |                                                                                          |  | 7.5  |  |    |
| Turn-On Delay Time  | $t_{d(ON)}$  | $V_{GS} = 4.5\text{ V}, V_{DS} = 50\text{ V}, I_D = 1.3\text{ A}, R_G = 6\text{ }\Omega$ |  | 7.6  |  | ns |
| Rise Time           | $t_r$        |                                                                                          |  | 7.6  |  |    |
| Turn-Off Delay Time | $t_{d(OFF)}$ |                                                                                          |  | 10.4 |  |    |
| Fall Time           | $t_f$        |                                                                                          |  | 9    |  |    |

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## ELECTRICAL CHARACTERISTICS (Q1, N-CHANNEL) ( $T_J = 25^\circ\text{C}$ unless otherwise noted) (continued)

| Parameter                  | Symbol   | Test Conditions                                                                       | Min                       | Typ  | Max | Unit |
|----------------------------|----------|---------------------------------------------------------------------------------------|---------------------------|------|-----|------|
| <b>OFF CHARACTERISTICS</b> |          |                                                                                       |                           |      |     |      |
| Forward Diode Voltage      | $V_{SD}$ | $V_{GS} = 0\text{ V}$ ,<br>$I_S = 1.3\text{ A}$                                       | $T_J = 25^\circ\text{C}$  | 0.75 | 1.2 | V    |
|                            |          |                                                                                       | $T_J = 125^\circ\text{C}$ | 0.6  |     |      |
| Reverse Recovery Time      | $t_{RR}$ | $V_{GS} = 0\text{ V}$ , $dI_S/dt = 50\text{ A}/\mu\text{s}$ ,<br>$I_S = 1.2\text{ A}$ |                           | 28   |     | ns   |
| Charge Time                | $t_a$    |                                                                                       |                           | 13   |     |      |
| Discharge Time             | $t_b$    |                                                                                       |                           | 15   |     |      |
| Reverse Recovery Charge    | $Q_{RR}$ |                                                                                       |                           | 8    |     | nC   |

Product parametric performance is indicated in the Electrical Characteristics for the listed test conditions, unless otherwise noted. Product performance may not be indicated by the Electrical Characteristics if operated under different conditions.

## ELECTRICAL CHARACTERISTICS (Q2, P-CHANNEL) ( $T_J = 25^\circ\text{C}$ unless otherwise noted)

| Parameter                                                 | Symbol              | Test Conditions                                             | Min                       | Typ | Max       | Unit                 |
|-----------------------------------------------------------|---------------------|-------------------------------------------------------------|---------------------------|-----|-----------|----------------------|
| <b>OFF CHARACTERISTICS</b>                                |                     |                                                             |                           |     |           |                      |
| Drain-to-Source Breakdown Voltage                         | $V_{(BR)DSS}$       | $V_{GS} = 0\text{ V}$ , $I_D = -250\text{ }\mu\text{A}$     | -100                      |     |           | V                    |
| Drain-to-Source Breakdown Voltage Temperature Coefficient | $V_{(BR)DSS} / T_J$ | $I_D = -250\text{ }\mu\text{A}$ , ref to $25^\circ\text{C}$ |                           | 60  |           | mV/ $^\circ\text{C}$ |
| Zero Gate Voltage Drain Current                           | $I_{DSS}$           | $V_{GS} = 0\text{ V}$ , $V_{DS} = -100\text{ V}$            | $T_J = 25^\circ\text{C}$  |     | -1        | $\mu\text{A}$        |
|                                                           |                     |                                                             | $T_J = 125^\circ\text{C}$ |     | -100      |                      |
| Gate-to-Source Leakage Current                            | $I_{GSS}$           | $V_{DS} = 0\text{ V}$ , $V_{GS} = \pm 20\text{ V}$          |                           |     | $\pm 100$ | nA                   |

## ON CHARACTERISTICS

|                                            |                    |                                                            |      |      |      |                      |
|--------------------------------------------|--------------------|------------------------------------------------------------|------|------|------|----------------------|
| Gate Threshold Voltage                     | $V_{GS(TH)}$       | $V_{GS} = V_{DS}$ , $I_D = -40\text{ }\mu\text{A}$         | -2.0 |      | -4.0 | V                    |
| Negative Threshold Temperature Coefficient | $V_{GS(TH)} / T_J$ | $I_D = -40\text{ }\mu\text{A}$ , ref to $25^\circ\text{C}$ |      | 6.6  |      | mV/ $^\circ\text{C}$ |
| Drain-to-Source On Resistance              | $R_{DS(on)}$       | $V_{GS} = -10\text{ V}$ , $I_D = -2.2\text{ A}$            |      | 146  | 186  | m $\Omega$           |
|                                            |                    | $V_{GS} = -6\text{ V}$ , $I_D = -1.4\text{ A}$             |      | 178  | 284  |                      |
| Forward Transconductance                   | $g_{FS}$           | $V_{DS} = 5\text{ V}$ , $I_D = -4\text{ A}$                |      | 5.9  |      | S                    |
| Gate-Resistance                            | $R_G$              | $T_A = 25^\circ\text{C}$                                   |      | 1.75 |      | $\Omega$             |

## CHARGES & CAPACITANCES

|                              |              |                                                                           |  |     |  |    |
|------------------------------|--------------|---------------------------------------------------------------------------|--|-----|--|----|
| Input Capacitance            | $C_{ISS}$    | $V_{GS} = 0\text{ V}$ , $f = 1\text{ MHz}$ , $V_{DS} = -50\text{ V}$      |  | 256 |  | pF |
| Output Capacitance           | $C_{OSS}$    |                                                                           |  | 63  |  |    |
| Reverse Transfer Capacitance | $C_{RSS}$    |                                                                           |  | 3   |  |    |
| Total Gate Charge            | $Q_{G(TOT)}$ | $V_{GS} = -10\text{ V}$ , $V_{DS} = -50\text{ V}$ , $I_D = -2.2\text{ A}$ |  | 7.3 |  | nC |
| Threshold Gate Charge        | $Q_{G(TH)}$  |                                                                           |  | 1.5 |  |    |
| Gate-to-Source Charge        | $Q_{GS}$     |                                                                           |  | 2.4 |  |    |
| Gate-to-Drain Charge         | $Q_{GD}$     |                                                                           |  | 1.2 |  |    |
| Total Gate Charge            | $Q_{G(TOT)}$ | $V_{GS} = -6\text{ V}$ , $V_{DD} = -50\text{ V}$ , $I_D = -2.2\text{ A}$  |  | 4.6 |  | nC |
| Plateau Voltage              | $V_{GP}$     |                                                                           |  | 4.5 |  | V  |

## SWITCHING CHARACTERISTICS

|                     |              |                                                                                                        |  |      |  |    |
|---------------------|--------------|--------------------------------------------------------------------------------------------------------|--|------|--|----|
| Turn-On Delay Time  | $t_{d(ON)}$  | $V_{GS} = -10\text{ V}$ , $V_{DS} = -50\text{ V}$ , $I_D = -2.2\text{ A}$ ,<br>$R_G = 6\text{ }\Omega$ |  | 8.9  |  | ns |
| Rise Time           | $t_r$        |                                                                                                        |  | 3.6  |  |    |
| Turn-Off Delay Time | $t_{d(OFF)}$ |                                                                                                        |  | 13.2 |  |    |
| Fall Time           | $t_f$        |                                                                                                        |  | 3.4  |  |    |

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## ELECTRICAL CHARACTERISTICS (Q2, P-CHANNEL) ( $T_J = 25^\circ\text{C}$ unless otherwise noted) (continued)

| Parameter           | Symbol       | Test Conditions                                                                          | Min | Typ  | Max | Unit |
|---------------------|--------------|------------------------------------------------------------------------------------------|-----|------|-----|------|
| Turn-On Delay Time  | $t_{d(ON)}$  | $V_{GS} = -6\text{ V}, V_{DS} = -50\text{ V}, I_D = -2.2\text{ A},$<br>$R_G = 6\ \Omega$ |     | 10.8 |     | ns   |
| Rise Time           | $t_r$        |                                                                                          |     | 4.8  |     |      |
| Turn-Off Delay Time | $t_{d(OFF)}$ |                                                                                          |     | 10   |     |      |
| Fall Time           | $t_f$        |                                                                                          |     | 4.1  |     |      |

### OFF CHARACTERISTICS

|                         |                 |                                                                                   |                        |  |       |      |    |
|-------------------------|-----------------|-----------------------------------------------------------------------------------|------------------------|--|-------|------|----|
| Forward Diode Voltage   | V <sub>SD</sub> | V <sub>GS</sub> = 0 V,<br>I <sub>S</sub> = -2.2 A                                 | T <sub>J</sub> = 25°C  |  | -0.86 | -1.2 | V  |
|                         |                 |                                                                                   | T <sub>J</sub> = 125°C |  | -0.72 |      |    |
| Reverse Recovery Time   | t <sub>RR</sub> | V <sub>GS</sub> = 0 V, dI <sub>S</sub> /dt = 100 A/μs,<br>I <sub>S</sub> = -1.1 A |                        |  | 34    |      | ns |
| Charge Time             | t <sub>a</sub>  |                                                                                   |                        |  | 27    |      |    |
| Discharge Time          | t <sub>b</sub>  |                                                                                   |                        |  | 7     |      |    |
| Reverse Recovery Charge | Q <sub>RR</sub> |                                                                                   |                        |  | 53    |      | nC |

Product parametric performance is indicated in the Electrical Characteristics for the listed test conditions, unless otherwise noted. Product performance may not be indicated by the Electrical Characteristics if operated under different conditions.

TYPICAL CHARACTERISTICS – N-CHANNEL

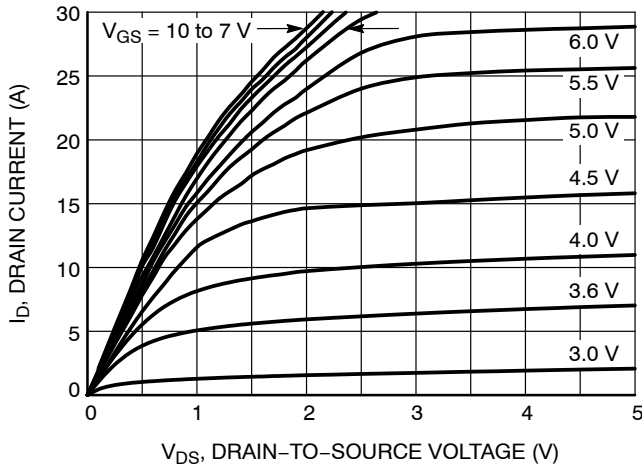


Figure 1. On-Region Characteristics

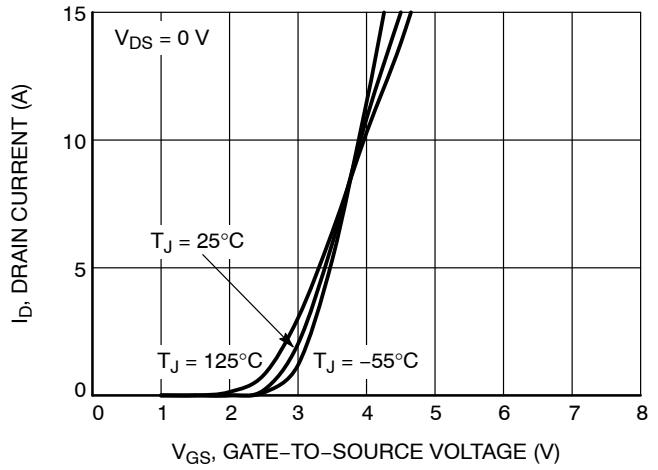


Figure 2. Transfer Characteristics

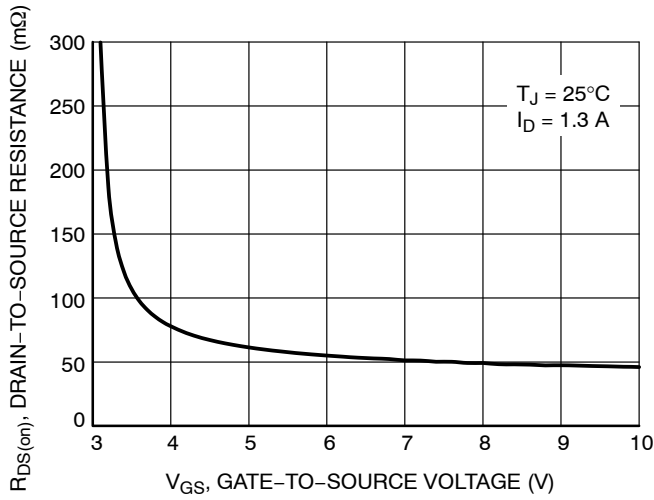


Figure 3. On-Resistance vs. Gate-to-Source Voltage

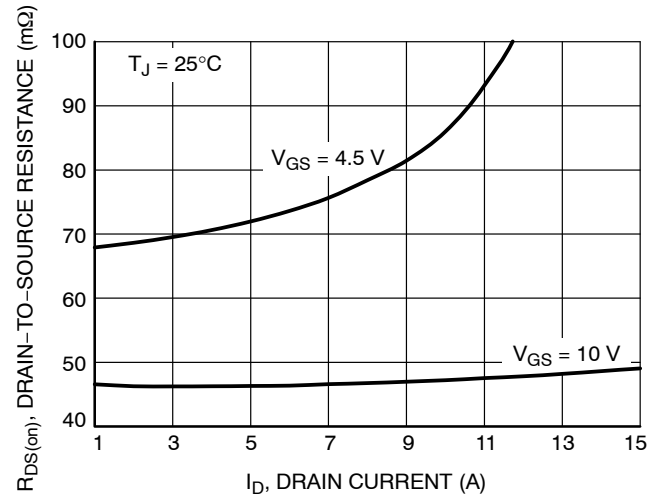


Figure 4. On-Resistance vs. Drain Current

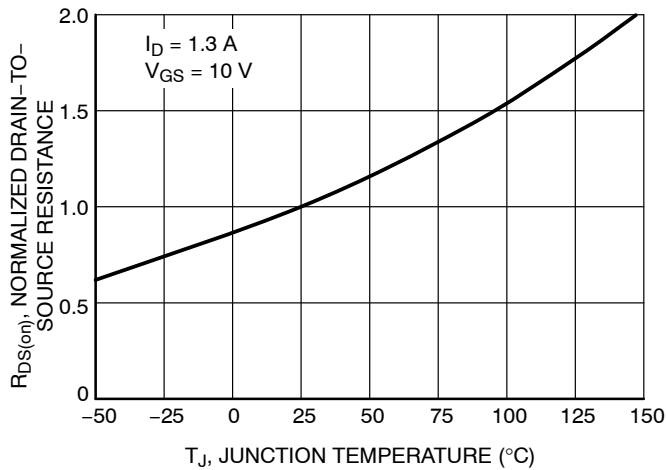


Figure 5. On-Resistance Variation with Temperature

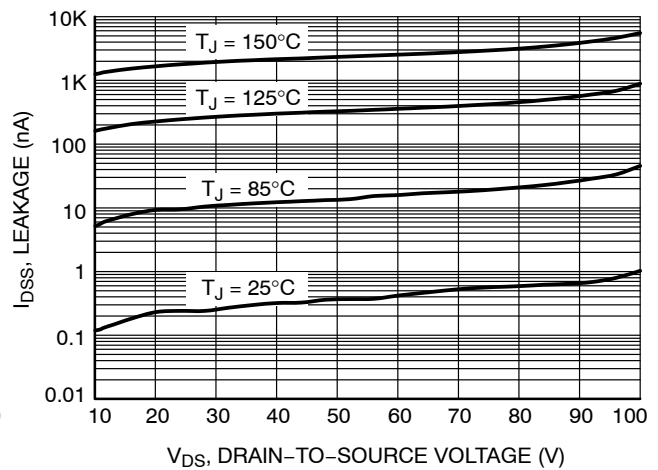


Figure 6. Drain-to-Source Leakage Current vs. Voltage

TYPICAL CHARACTERISTICS – N-CANNEL

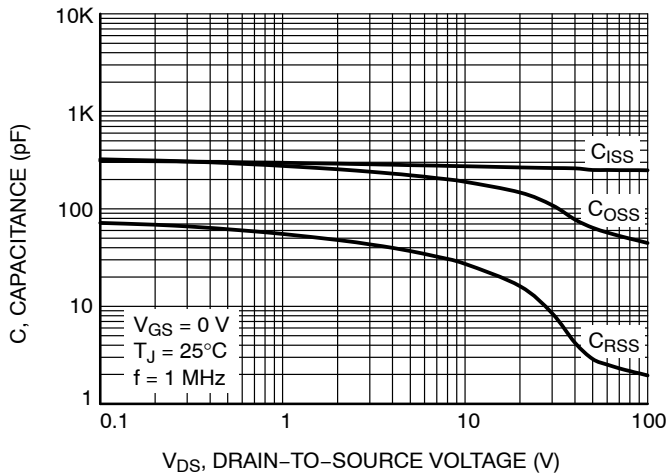


Figure 7. Capacitance Variation

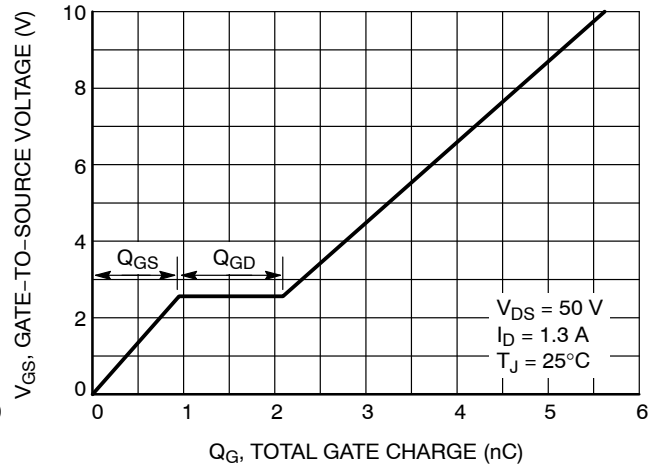


Figure 8. Gate-to-Source Voltage vs. Total Charge

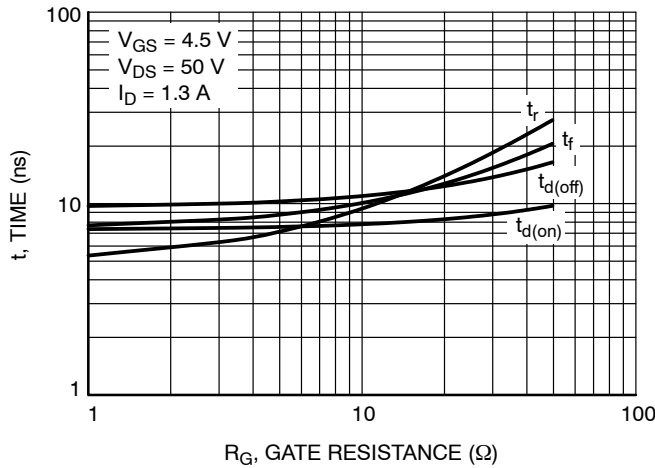


Figure 9. Resistive Switching Time Variation vs. Gate Resistance

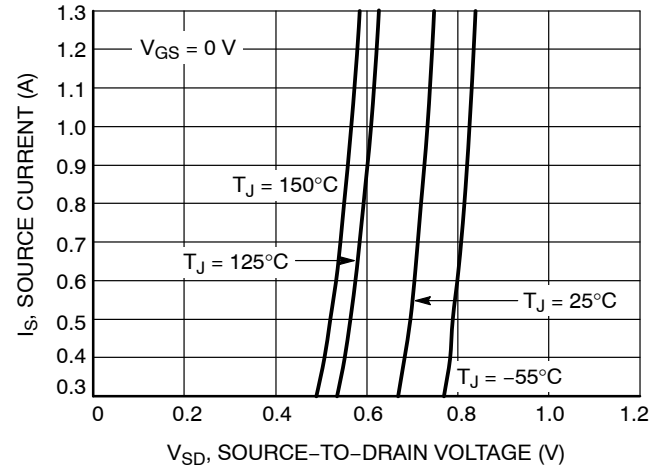


Figure 10. Diode Forward Voltage vs. Current

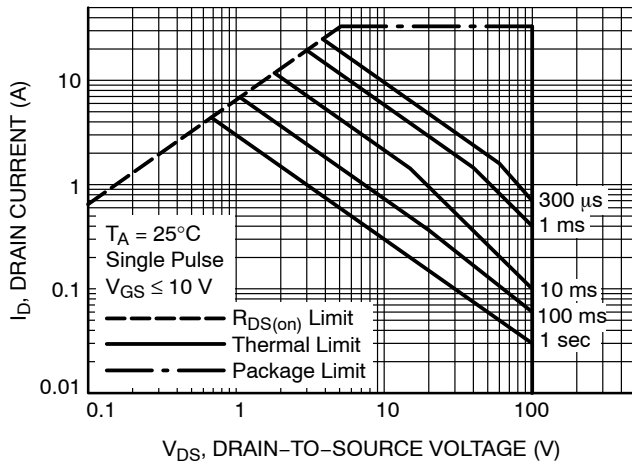


Figure 11. Safe Operating Area

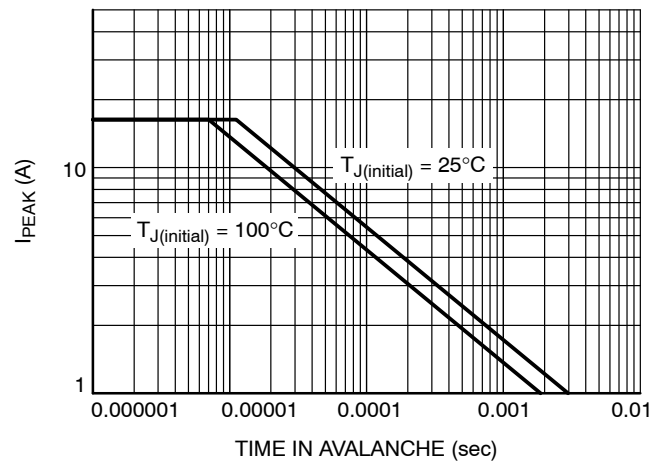


Figure 12.  $I_{PEAK}$  vs. Time in Avalanche

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## TYPICAL CHARACTERISTICS – N-CHANNEL

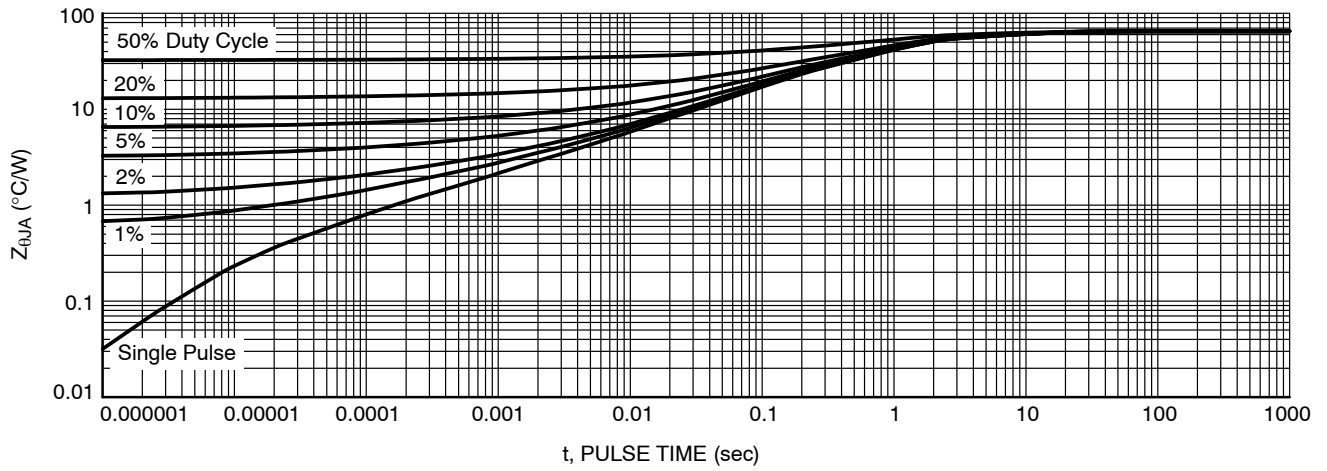


Figure 13. Junction-to-Ambient Transient Thermal Response

TYPICAL CHARACTERISTICS – P-CHANNEL

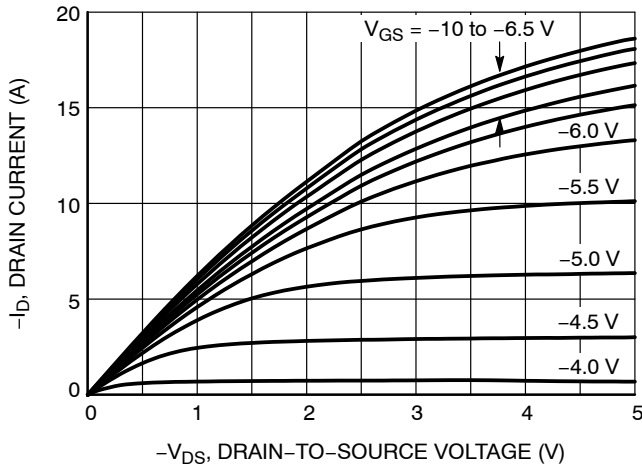


Figure 14. On-Region Characteristics

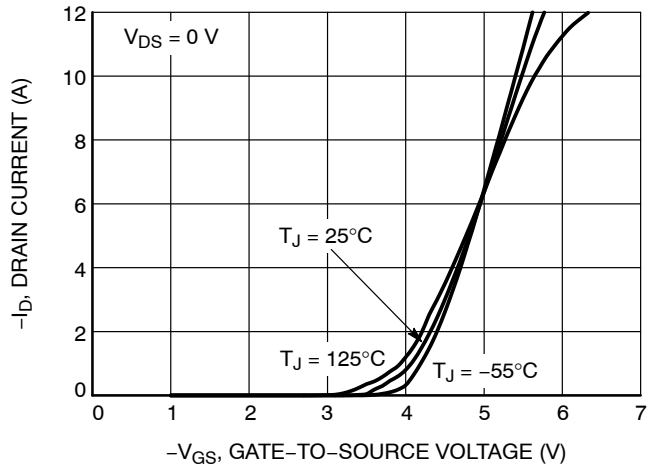


Figure 15. Transfer Characteristics

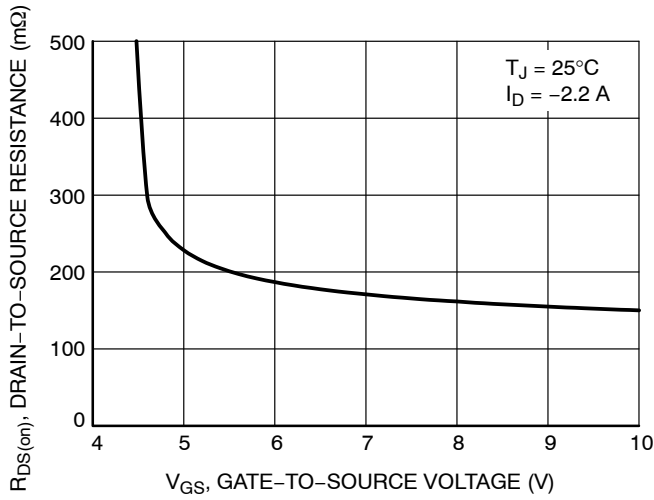


Figure 16. On-Resistance vs. Gate-to-Source Voltage

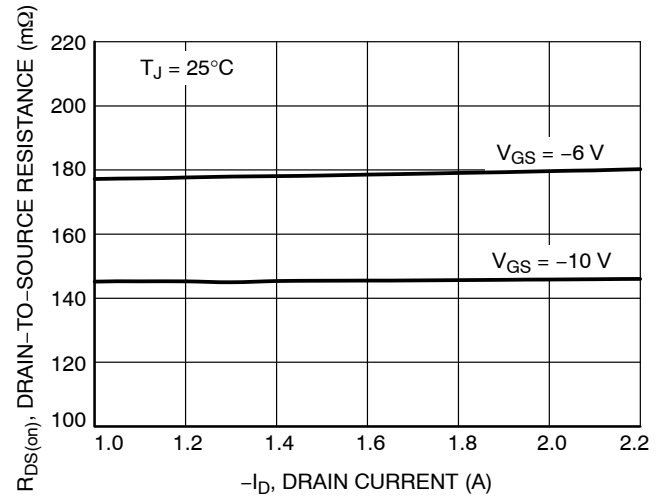


Figure 17. On-Resistance vs. Drain Current

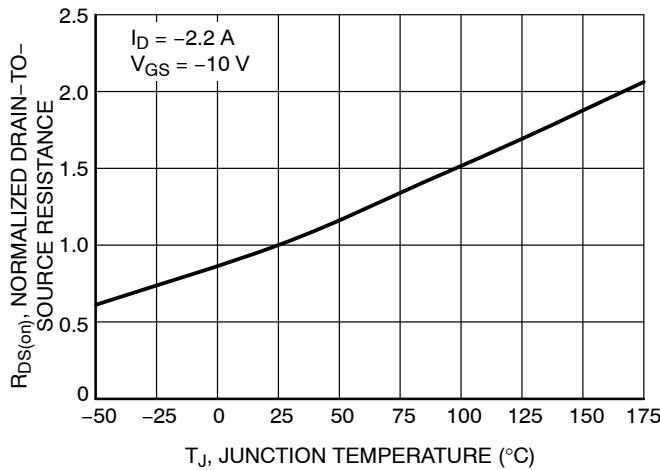


Figure 18. On-Resistance Variation with Temperature

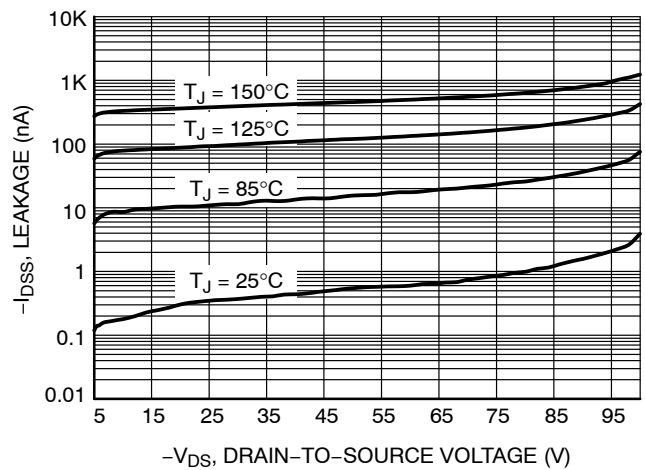


Figure 19. Drain-to-Source Leakage Current vs. Voltage

TYPICAL CHARACTERISTICS – P-CHANNEL

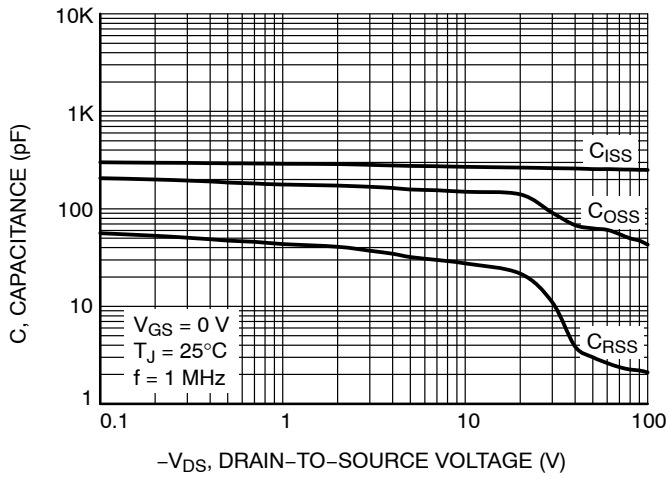


Figure 20. Capacitance Variation

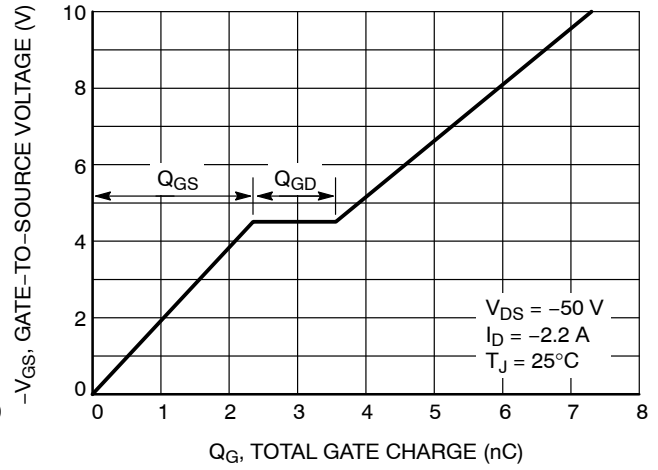


Figure 21. Gate-to-Source Voltage vs. Total Charge

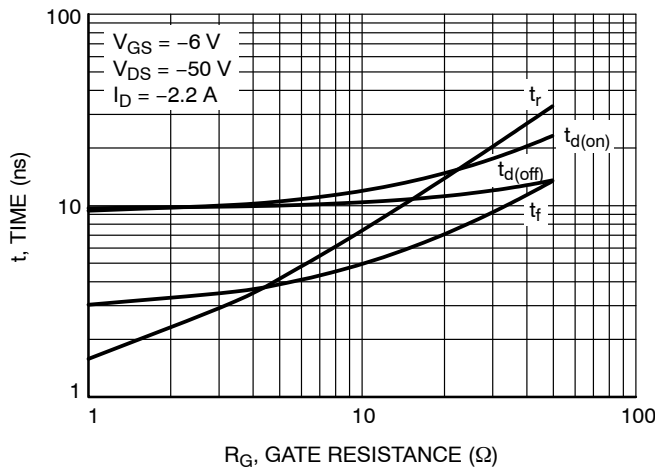


Figure 22. Resistive Switching Time Variation vs. Gate Resistance

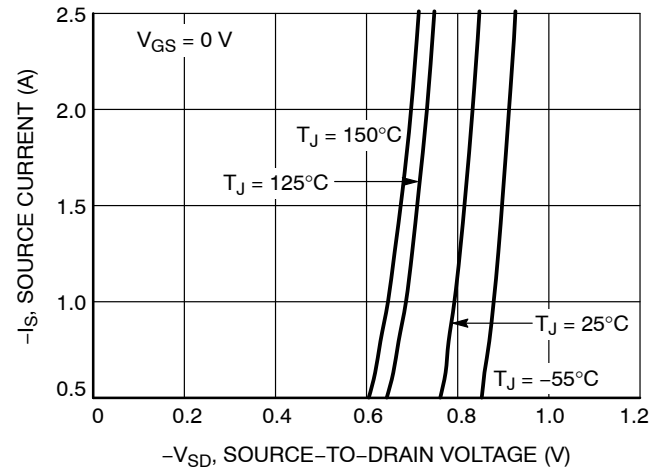


Figure 23. Diode Forward Voltage vs. Current

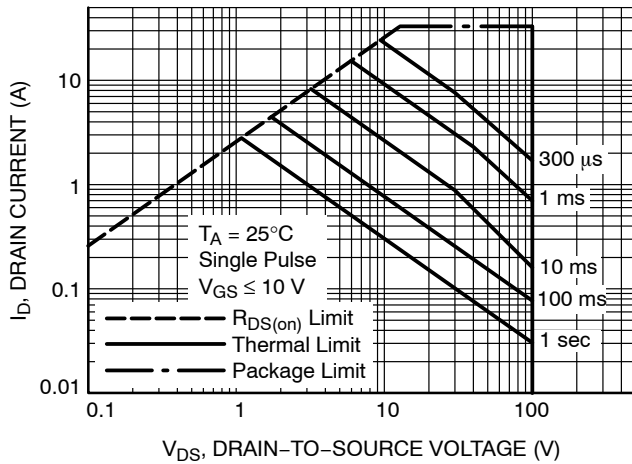


Figure 24. Safe Operating Area

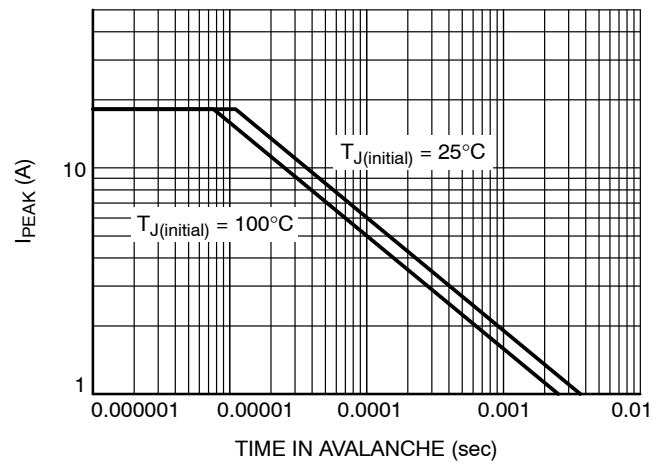
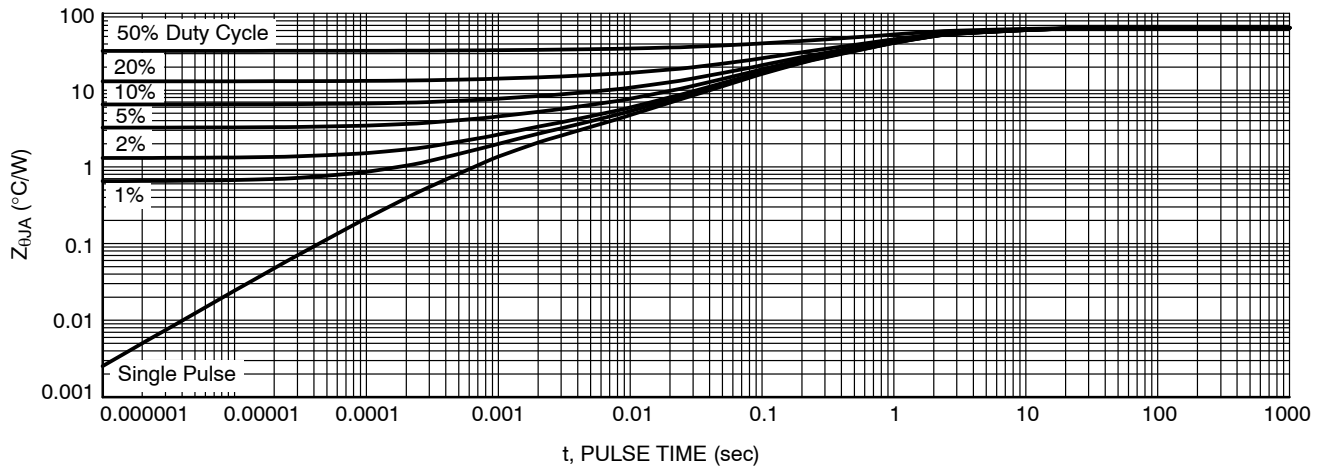


Figure 25.  $I_{PEAK}$  vs. Time in Avalanche

# NTTBC070NP10M5L

## TYPICAL CHARACTERISTICS – P-CHANNEL



**Figure 26. Junction-to-Ambient Transient Thermal Response**

### ORDERING INFORMATION

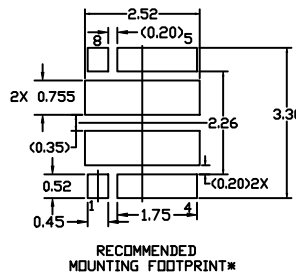
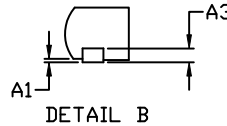
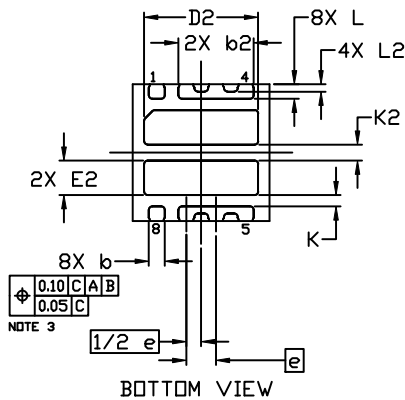
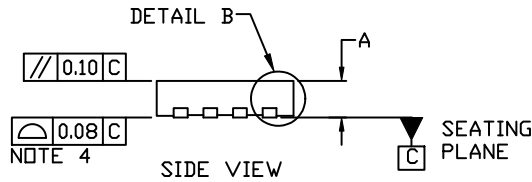
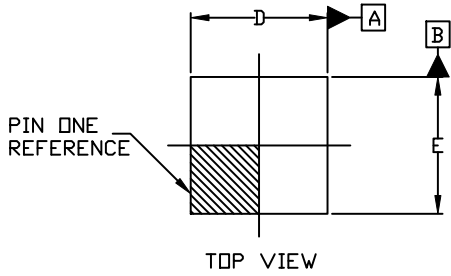
| Device          | Device Marking | Package                             | Shipping (Qty / Packing) <sup>†</sup> |
|-----------------|----------------|-------------------------------------|---------------------------------------|
| NTTBC070NP10M5L | 70NP10M5L      | $\mu$ 8FL<br>(Pb-Free/Halogen Free) | 3000 / Tape & Reel                    |

<sup>†</sup>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.

# NTTBC070NP10M5L

## PACKAGE DIMENSIONS

WDFN8 3x3, 0.65P  
CASE 511DG  
ISSUE A



For additional information on our Pb-free strategy and soldering details, please download the ON Semiconductor Soldering and Mounting Techniques Reference Manual, SOLDERRM/D.

### NOTES:

1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 2009.
2. CONTROLLING DIMENSION: MILLIMETERS
3. DIMENSION *b* APPLIES TO PLATED TERMINALS AND IS MEASURED BETWEEN 0.15 AND 0.30MM FROM THE TERMINAL TIP.
4. COPLANARITY APPLIES TO THE EXPOSED PAD AS WELL AS THE TERMINALS.

| DIM | MILLIMETERS |      |      |
|-----|-------------|------|------|
|     | MIN.        | NOM. | MAX. |
| A   | 0.70        | 0.75 | 0.80 |
| A1  | 0.00        | ---  | 0.05 |
| A3  | 0.20 REF    |      |      |
| b   | 0.30        | 0.35 | 0.40 |
| b2  | 1.65 REF    |      |      |
| D   | 2.90        | 3.00 | 3.10 |
| D2  | 2.45        | 2.50 | 2.55 |
| E   | 2.90        | 3.00 | 3.10 |
| E2  | 1.40        | 1.50 | 1.60 |
| e   | 0.65 BSC    |      |      |
| K   | 0.25        | ---  | ---  |
| K2  | 0.35 REF    |      |      |
| L   | 0.27        | 0.32 | 0.37 |
| L2  | 0.163 REF   |      |      |

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