

NTLJD2104P

Power MOSFET

-12 V, -4.3 A, μ COOL™ Dual P-Channel, 2x2 mm, WDFN package

Features

- WDFN 2x2 mm Package with Exposed Drain Pads for Excellent Thermal Conduction
- Lowest $R_{DS(on)}$ in 2x2 mm Package
- Footprint Same as SC-88 Package
- Low Profile (<0.8 mm) for Easy Fit in Thin Environments
- Bidirectional Current Flow with Common Source Configuration
- These are Pb-Free Devices

Applications

- Optimized for Battery and Load Management Applications in Portable Equipment
- Li Ion Battery Charging and Protection Circuits
- Dual High Side Load Switch

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

| Parameter | | Symbol | Value | Unit |
|---|------------------------|--------------------------|------------|------------------|
| Drain-to-Source Voltage | | V_{DSS} | -12 | V |
| Gate-to-Source Voltage | | V_{GS} | ± 8.0 | V |
| Continuous Drain Current (Note 1) | Steady State | $T_J = 25^\circ\text{C}$ | -3.5 | A |
| | | $T_J = 85^\circ\text{C}$ | -2.5 | |
| | $t \leq 5$ s | $T_J = 25^\circ\text{C}$ | -4.3 | |
| Power Dissipation (Note 1) | Steady State | $T_J = 25^\circ\text{C}$ | 1.5 | W |
| | | $t \leq 5$ s | 2.3 | |
| Continuous Drain Current (Note 2) | Steady State | $T_J = 25^\circ\text{C}$ | -2.4 | A |
| | | $T_J = 85^\circ\text{C}$ | -1.7 | |
| | | $T_J = 25^\circ\text{C}$ | 0.7 | |
| Pulsed Drain Current | $t_p = 10 \mu\text{s}$ | I_{DM} | -20 | A |
| Operating Junction and Storage Temperature | | T_J, T_{STG} | -55 to 150 | $^\circ\text{C}$ |
| Source Current (Body Diode) (Note 2) | | I_S | -1.5 | A |
| Lead Temperature for Soldering Purposes (1/8" from case for 10 s) | | T_L | 260 | $^\circ\text{C}$ |

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.

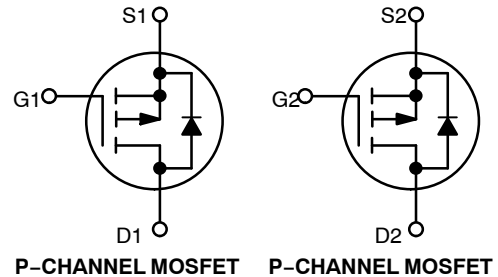
1. Surface Mounted on FR4 Board using 1 in sq pad size (Cu area = 1.127 in sq [2 oz] including traces).
2. Surface Mounted on FR4 Board using the minimum recommended pad size of 30 mm², 2 oz. Cu.



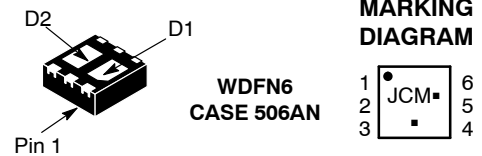
ON Semiconductor®

<http://onsemi.com>

| $V_{(BR)DSS}$ | $R_{DS(on)}$ TYP | I_D MAX |
|---------------|-------------------------|-----------|
| -12 V | 60 m Ω @ -4.5 V | -3.0 A |
| | 85 m Ω @ -2.5 V | -3.0 A |
| | 110 m Ω @ -1.8 V | -0.7 A |
| | 140 m Ω @ -1.5 V | -0.5 A |
| | 190 m Ω @ -1.3 V | -0.2 A |
| | 230 m Ω @ -1.2 V | -0.2 A |

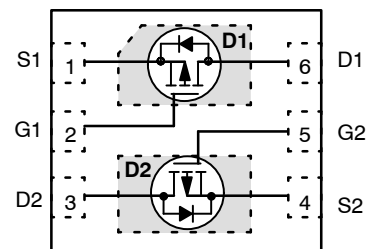


P-CHANNEL MOSFET P-CHANNEL MOSFET



JC = Specific Device Code
M = Date Code
■ = Pb-Free Package
(Note: Microdot may be in either location)

PIN CONNECTIONS



(Top View)

ORDERING INFORMATION

See detailed ordering and shipping information in the package dimensions section on page 3 of this data sheet.

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THERMAL RESISTANCE RATINGS

| Parameter | Symbol | Max | Unit |
|---|-----------------|-----|------|
| SINGLE OPERATION (SELF-HEATED) | | | |
| Junction-to-Ambient – Steady State (Note 3) | $R_{\theta JA}$ | 83 | °C/W |
| Junction-to-Ambient – Steady State Min Pad (Note 4) | $R_{\theta JA}$ | 177 | |
| Junction-to-Ambient – $t \leq 5$ s (Note 3) | $R_{\theta JA}$ | 54 | |
| DUAL OPERATION (EQUALLY HEATED) | | | |
| Junction-to-Ambient – Steady State (Note 3) | $R_{\theta JA}$ | 58 | °C/W |
| Junction-to-Ambient – Steady State Min Pad (Note 4) | $R_{\theta JA}$ | 133 | |
| Junction-to-Ambient – $t \leq 5$ s (Note 3) | $R_{\theta JA}$ | 40 | |

- Surface Mounted on FR4 Board using 1 in sq pad size (Cu area = 1.127 in sq [2 oz] including traces).
- Surface Mounted on FR4 Board using the minimum recommended pad size (30 mm², 2 oz Cu).

MOSFET ELECTRICAL CHARACTERISTICS ($T_J = 25^\circ\text{C}$ unless otherwise noted)

| Parameter | Symbol | Test Conditions | Min | Typ | Max | Unit |
|---|-------------------|---|--------------------------|------|-----------|---------|
| OFF CHARACTERISTICS | | | | | | |
| Drain-to-Source Breakdown Voltage | $V_{(BR)DSS}$ | $V_{GS} = 0$ V, $I_D = -250$ μ A | -12 | | | V |
| Drain-to-Source Breakdown Voltage Temperature Coefficient | $V_{(BR)DSS}/T_J$ | $I_D = -250$ μ A, Ref to 25°C | | -7.0 | | mV/°C |
| Zero Gate Voltage Drain Current | I_{DSS} | $V_{DS} = -12$ V, $V_{GS} = 0$ V | $T_J = 25^\circ\text{C}$ | | -1.0 | μ A |
| | | | $T_J = 85^\circ\text{C}$ | | -10 | |
| Gate-to-Source Leakage Current | I_{GSS} | $V_{DS} = 0$ V, $V_{GS} = \pm 8.0$ V | | | ± 100 | nA |

ON CHARACTERISTICS (Note 5)

| | | | | | | |
|--|------------------|--|-------|------|------|------------|
| Gate Threshold Voltage | $V_{GS(TH)}$ | $V_{GS} = V_{DS}$, $I_D = -250$ μ A | -0.35 | -0.6 | -0.8 | V |
| Gate Threshold Temperature Coefficient | $V_{GS(TH)}/T_J$ | | | 2.4 | | mV/°C |
| Drain-to-Source On-Resistance | $R_{DS(on)}$ | $V_{GS} = -4.5$ V, $I_D = -3.0$ A | | 60 | 90 | m Ω |
| | | $V_{GS} = -2.5$ V, $I_D = -3.0$ A | | 85 | 120 | |
| | | $V_{GS} = -1.8$ V, $I_D = -0.7$ A | | 110 | 150 | |
| | | $V_{GS} = -1.5$ V, $I_D = -0.5$ A | | 140 | 200 | |
| | | $V_{GS} = -1.3$ V, $I_D = -0.2$ A | | 190 | | |
| Forward Transconductance | g_{FS} | $V_{DS} = -10$ V, $I_D = -3.0$ A | | 6.0 | | S |

CHARGES, CAPACITANCES AND GATE RESISTANCE

| | | | | | | |
|------------------------------|--------------|---|--|------|-----|----------|
| Input Capacitance | C_{ISS} | $V_{GS} = 0$ V, $f = 1.0$ MHz, $V_{DS} = -6.0$ V | | 467 | | pF |
| Output Capacitance | C_{OSS} | | | 125 | | |
| Reverse Transfer Capacitance | C_{RSS} | | | 79 | | |
| Total Gate Charge | $Q_{G(TOT)}$ | $V_{GS} = -4.5$ V, $V_{DS} = -6.0$ V, $I_D = -3.0$ A | | 5.5 | 8.0 | nC |
| Threshold Gate Charge | $Q_{G(TH)}$ | | | 0.3 | | |
| Gate-to-Source Charge | Q_{GS} | | | 0.8 | | |
| Gate-to-Drain Charge | Q_{GD} | | | 1.5 | | |
| Gate Resistance | R_G | | | 12.2 | | Ω |

- Pulse Test: Pulse Width ≤ 300 μ s, Duty Cycle $\leq 2\%$.
- Switching characteristics are independent of operating junction temperatures.

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MOSFET ELECTRICAL CHARACTERISTICS ($T_J = 25^\circ\text{C}$ unless otherwise noted)

| Parameter | Symbol | Test Conditions | Min | Typ | Max | Unit |
|---|--------------|---|-----|------|-----|------|
| SWITCHING CHARACTERISTICS (Note 6) | | | | | | |
| Turn-On Delay Time | $t_{d(ON)}$ | $V_{GS} = -4.5\text{ V}, V_{DD} = -6.0\text{ V},$ $I_D = -3.0\text{ A}, R_G = 2.0\ \Omega$ | | 6.6 | | ns |
| Rise Time | t_r | | | 12.3 | | |
| Turn-Off Delay Time | $t_{d(OFF)}$ | | | 14 | | |
| Fall Time | t_f | | | 16.2 | | |

DRAIN-SOURCE DIODE CHARACTERISTICS

| | | | | | | | |
|--------------------------|----------|---|--------------------------|-----|-------|------|----|
| Forward Recovery Voltage | V_{SD} | $V_{GS} = 0\text{ V}, I_S = -1.0\text{ A}$ | $T_J = 25^\circ\text{C}$ | | -0.7 | -1.0 | V |
| | | | $T_J = 85^\circ\text{C}$ | | -0.65 | | |
| Reverse Recovery Time | t_{RR} | $V_{GS} = 0\text{ V}, d_{ISD}/d_t = 100\text{ A}/\mu\text{s},$ $I_S = -1.0\text{ A}$ | | 23 | 45 | ns | |
| Charge Time | t_a | | | 8.0 | | | |
| Discharge Time | t_b | | | 15 | | | |
| Reverse Recovery Time | Q_{RR} | | | 10 | 20 | | nC |

5. Pulse Test: Pulse Width $\leq 300\ \mu\text{s}$, Duty Cycle $\leq 2\%$.

6. Switching characteristics are independent of operating junction temperatures.

ORDERING INFORMATION

| Device | Package | Shipping [†] |
|---------------|--------------------|-----------------------|
| NTLJD2104PTBG | WDFN6 (Pb-Free) | 3000 / Tape & Reel |
| NTLJD2104PTAG | WDFN6 (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.

TYPICAL CHARACTERISTICS

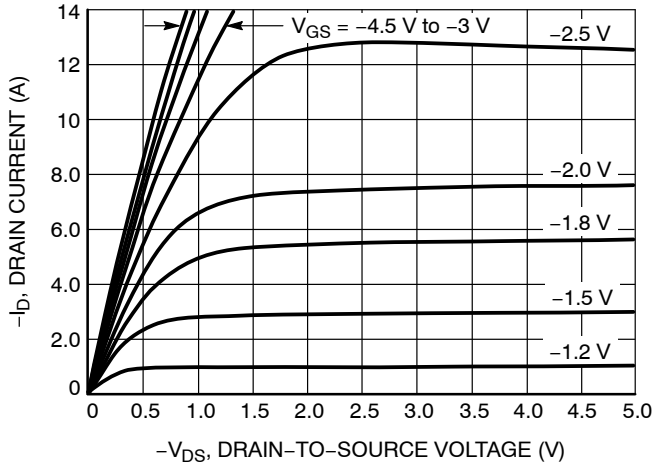


Figure 1. On-Region Characteristics

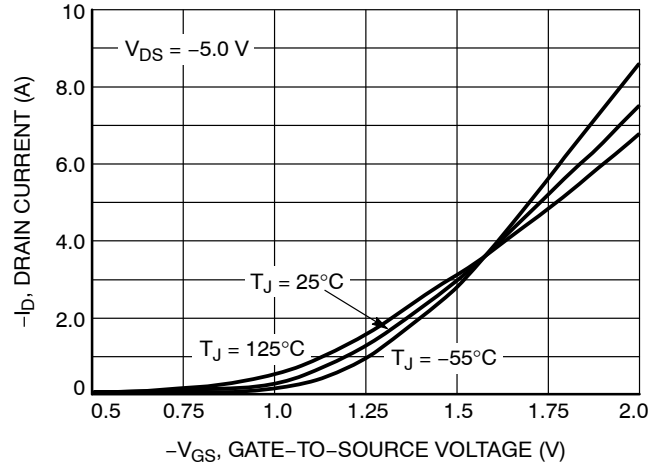


Figure 2. Transfer Characteristics

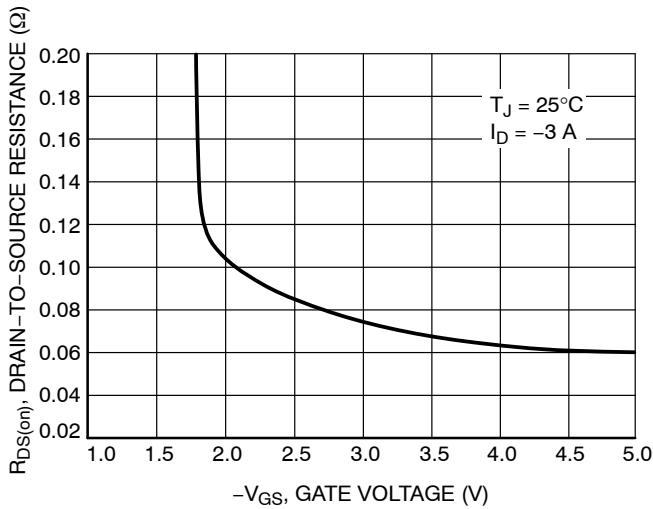


Figure 3. On-Resistance vs. Gate-to-Source Voltage

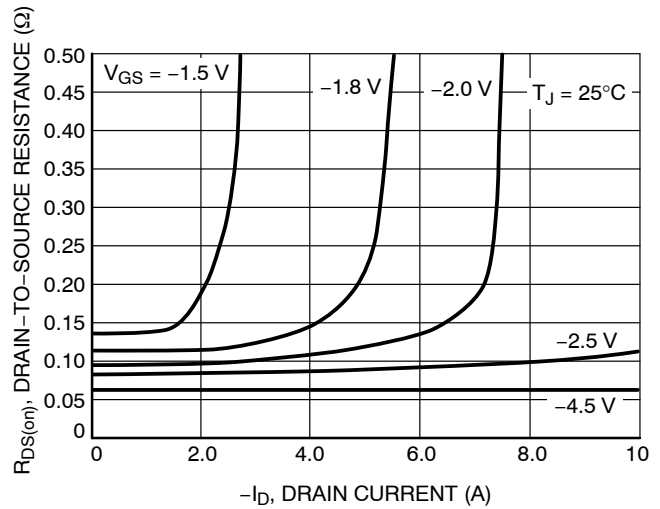


Figure 4. On-Resistance vs. Drain Current and Gate Voltage

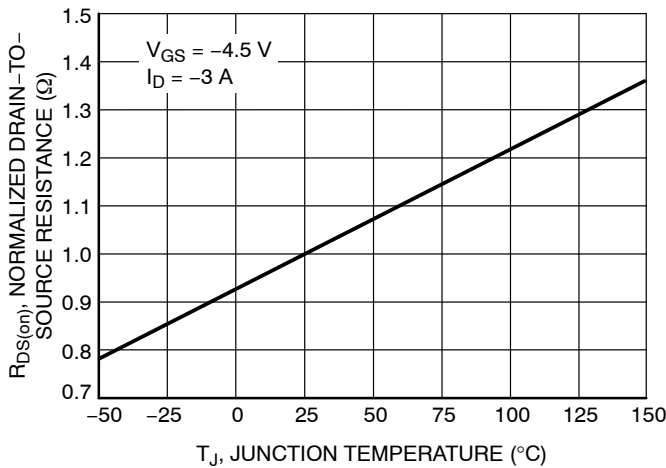


Figure 5. On-Resistance Variation with Temperature

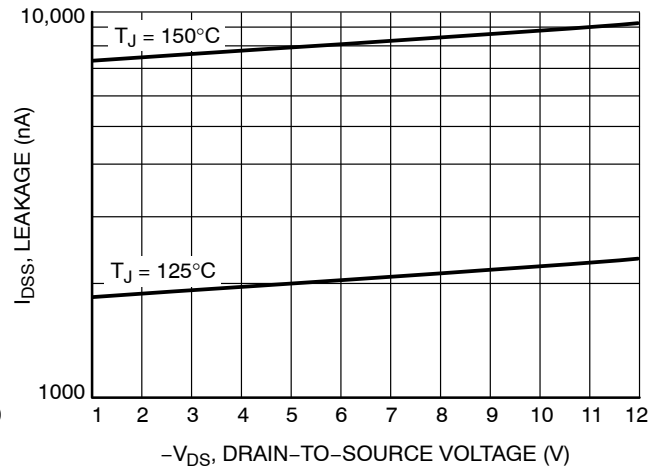


Figure 6. Drain-to-Source Leakage Current vs. Voltage

TYPICAL CHARACTERISTICS

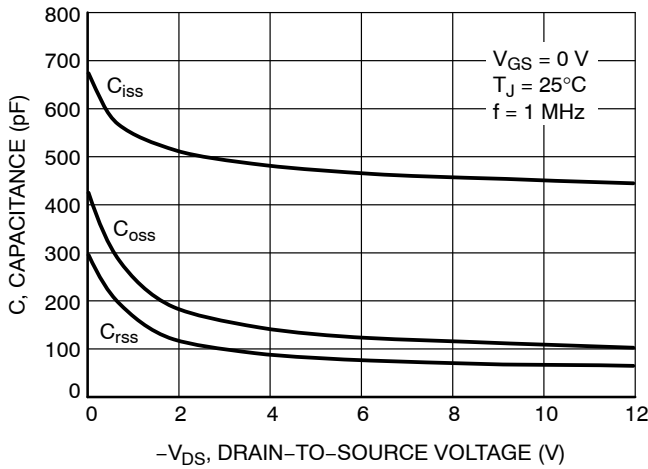


Figure 7. Capacitance Variation

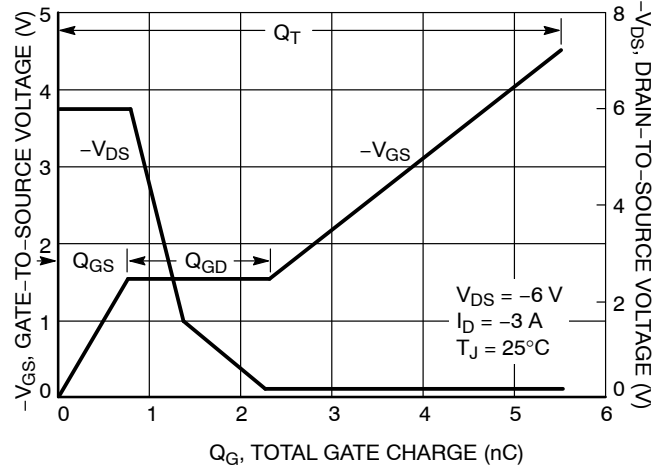


Figure 8. Gate-to-Source and Drain-to-Source Voltage vs. Total Charge

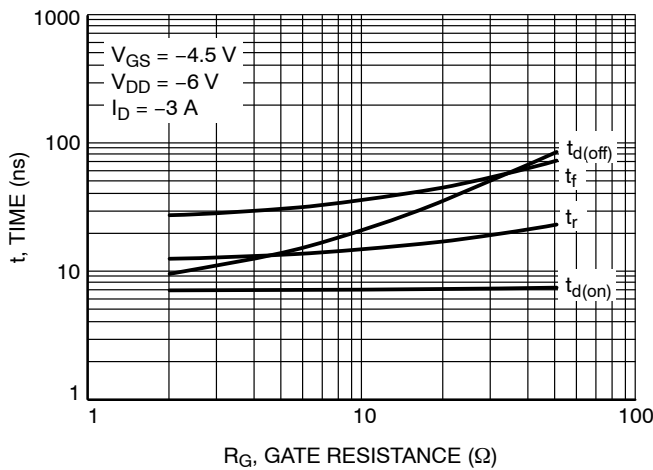


Figure 9. Resistive Switching Time Variation vs. Gate Resistance

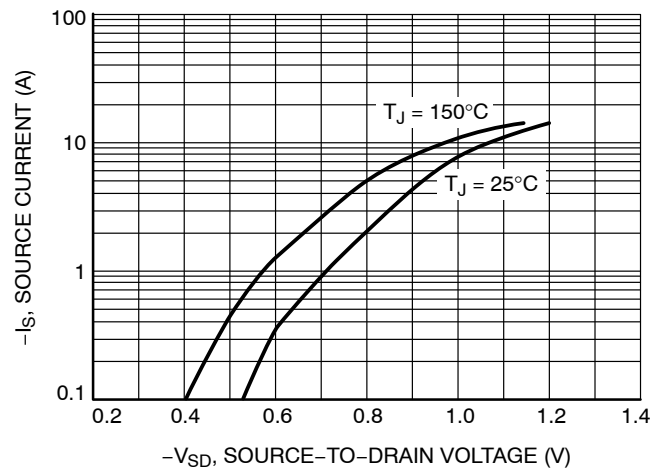


Figure 10. Diode Forward Voltage vs. Current

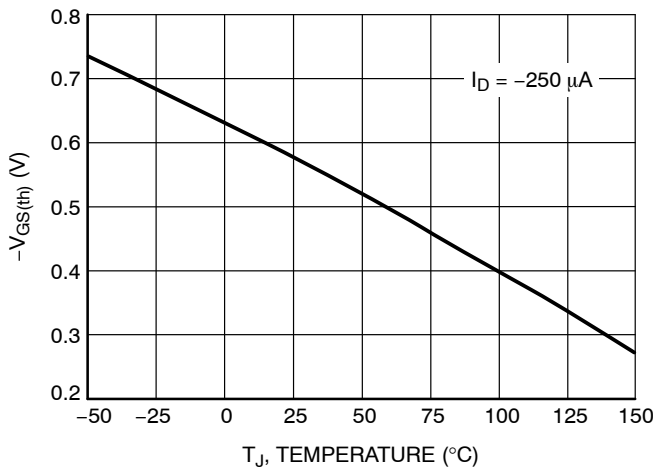


Figure 11. Threshold Voltage

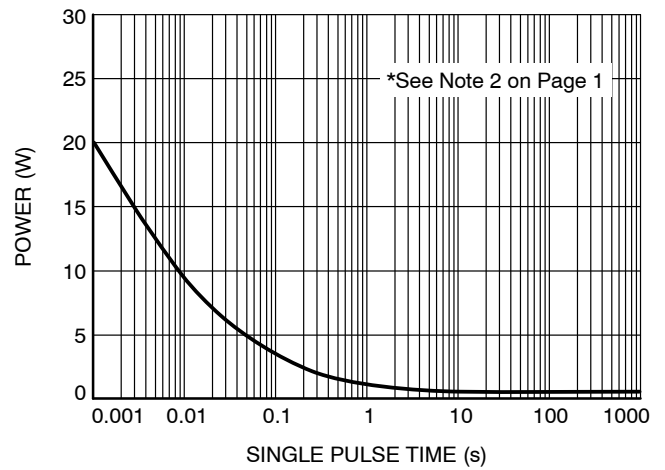


Figure 12. Single Pulse Maximum Power Dissipation

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TYPICAL CHARACTERISTICS

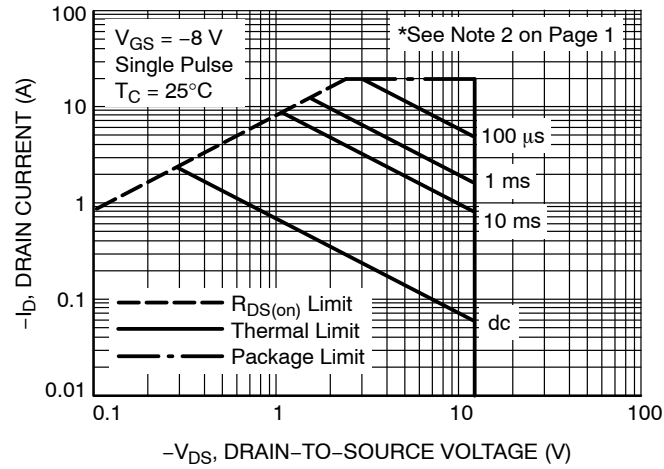


Figure 13. Maximum Rated Forward Biased Safe Operating Area

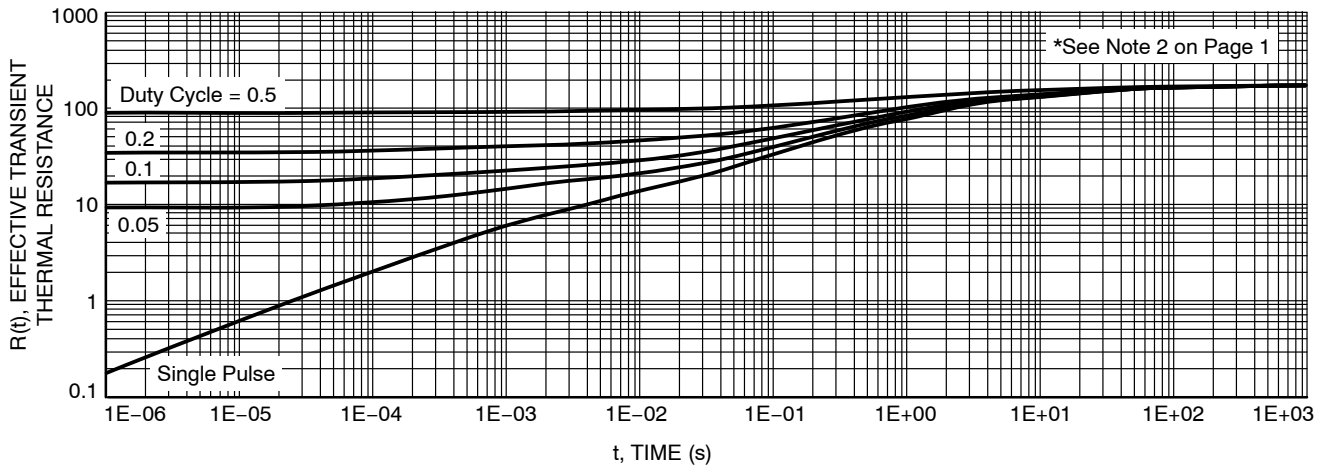
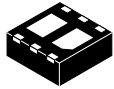


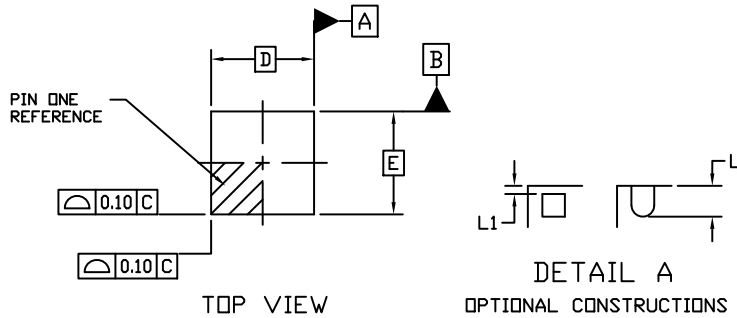
Figure 14. FET Thermal Response

MECHANICAL CASE OUTLINE PACKAGE DIMENSIONS



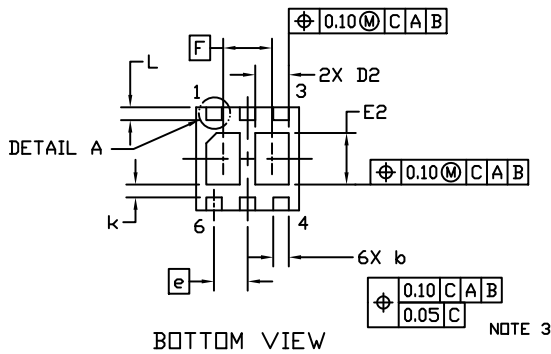
WDFN6 2x2, 0.65P
CASE 506AN
ISSUE H

DATE 25 JAN 2022

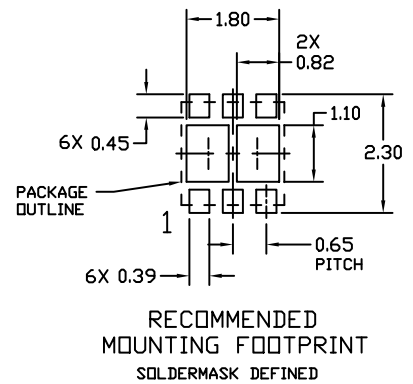


NOTES:

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 THE TERMINAL TIP.
4. COPLANARITY APPLIES TO THE EXPOSED PADS AS WELL AS THE TERMINALS.



| DIM | MILLIMETERS | |
|----------|-------------|------|
| | MIN. | MAX. |
| A | 0.70 | 0.80 |
| A1 | 0.00 | 0.05 |
| A3 | 0.20 REF | |
| <i>b</i> | 0.25 | 0.35 |
| D | 2.00 BSC | |
| D2 | 0.57 | 0.77 |
| E | 2.00 BSC | |
| E2 | 0.90 | 1.10 |
| <i>e</i> | 0.65 BSC | |
| F | 0.95 BSC | |
| <i>k</i> | 0.25 REF | |
| L | 0.20 | 0.30 |
| L1 | --- | 0.10 |



GENERIC MARKING DIAGRAM*



XX = Specific Device Code
M = Date Code

*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. Some products may not follow the Generic Marking.

| | | |
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