

# MOSFET - Power, Single N-Channel, TOLL

## 40 V, 0.57 mΩ, 300 A



ON Semiconductor®

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## NVBL50D5N04C

### Features

- Low  $R_{DS(on)}$  to Minimize Conduction Losses
- Low  $Q_G$  and Capacitance to Minimize Driver Losses
- AEC-Q101 Qualified and PPAP Capable
- Small Footprint (TOLL) for Compact Design
- These Devices are Pb-Free, Halogen Free/BFR Free and are RoHS Compliant

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

| Parameter  | Symbol   | Value                     | Unit             |   |
|--|--|---------------------------|------------------|---|
| Drain-to-Source Voltage  | $V_{DS}$                                       | 40                        | V                |   |
| Gate-to-Source Voltage   | $V_{GS}$                                       | +20/-16                   | V                |   |
| Continuous Drain Current $R_{\theta JC}$ (Notes 1, 3)  | Steady State                                   | $T_C = 25^\circ\text{C}$  | $I_D$ 300        | A |
|  |  | $T_C = 100^\circ\text{C}$ | 300              |   |
| Power Dissipation $R_{\theta JC}$ (Note 1)   | Steady State                                   | $T_C = 25^\circ\text{C}$  | $P_D$ 198.4      | W |
|  |  | $T_C = 100^\circ\text{C}$ | 97.4             |   |
| Continuous Drain Current $R_{\theta JA}$ (Notes 1, 2, 3)                                       | Steady State                                   | $T_A = 25^\circ\text{C}$  | $I_D$ 65         | A |
|  |  | $T_A = 100^\circ\text{C}$ | 46               |   |
| Power Dissipation $R_{\theta JA}$ (Notes 1, 2)   | Steady State                                   | $T_A = 25^\circ\text{C}$  | $P_D$ 4.3        | W |
|  |  | $T_A = 100^\circ\text{C}$ | 2.1              |   |
| Pulsed Drain Current   | $T_A = 25^\circ\text{C}, t_p = 10 \mu\text{s}$ | $I_{DM}$ 4700             | A                |   |
| Operating Junction and Storage Temperature Range   | $T_J, T_{stg}$                                 | -55 to +175               | $^\circ\text{C}$ |   |
| Source Current (Body Diode)  | $I_S$  | 170                       | A                |   |
| Single Pulse Drain-to-Source Avalanche Energy ( $I_{L(pk)} = 55 \text{ A}, L = 1 \text{ mH}$ ) | $E_{AS}$                                       | 1512                      | mJ               |   |
| Lead Temperature for Soldering Purposes (1/8" from case for 10 s)                              | $T_L$  | 260                       | $^\circ\text{C}$ |   |

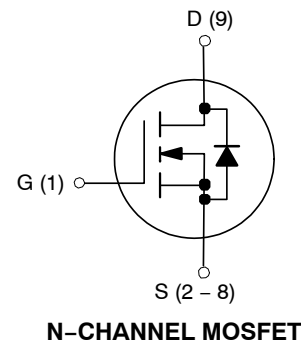
Stresses exceeding those listed in the Maximum Ratings table may damage the device. If any of these limits are exceeded, device functionality should not be assumed, damage may occur and reliability may be affected.

### THERMAL RESISTANCE MAXIMUM RATINGS

| Parameter                                   | Symbol          | Value | Unit                      |
|---|-----------------|-------|---------------------------|
| Junction-to-Case - Steady State             | $R_{\theta JC}$ | 0.77  | $^\circ\text{C}/\text{W}$ |
| Junction-to-Ambient - Steady State (Note 2) | $R_{\theta JA}$ | 35    |                           |

1. The entire application environment impacts the thermal resistance values shown, they are not constants and are only valid for the particular conditions noted. Current is limited by bondwire configuration.
2. Surface-mounted on FR4 board using a 650 mm<sup>2</sup>, 2 oz. Cu pad.
3. Maximum current for pulses as long as 1 second is higher but is dependent on pulse duration and duty cycle.

| $V_{(BR)DSS}$ | $R_{DS(ON) MAX}$ | $I_D MAX$ |
|---------------|------------------|-----------|
| 40 V          | 0.57 mΩ @ 10 V   | 300 A     |



**H-PSOF8L  
CASE 100CU**

### ORDERING INFORMATION

| Device          | Package            | Shipping†          |
|-----------------|--------------------|--------------------|
| NVBL50D5N04CTXG | H-PSOF8L (Pb-Free) | 2000 / 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.

# NVBLS0D5N04C

**Table 1. ELECTRICAL CHARACTERISTICS** ( $T_J = 25^\circ\text{C}$  unless otherwise noted)

| Parameter   | Symbol            | Test Conditions   | Min                       | Typ   | Max       | Units                |
|---|-------------------|---|---------------------------|-------|-----------|----------------------|
| <b>OFF CHARACTERISTICS</b>                                |                   |   |                           |       |           |                      |
| Drain-to-Source Breakdown Voltage                         | $V_{(BR)DSS}$     | $I_D = 250\ \mu\text{A}$ , $V_{GS} = 0\ \text{V}$   | 40                        |       |           | V                    |
| Drain-to-Source Breakdown Voltage Temperature Coefficient | $V_{(BR)DSS}/T_J$ |   |                           | 21.3  |           | mV/ $^\circ\text{C}$ |
| Zero Gate Voltage Drain Current                           | $I_{DSS}$         | $V_{DS} = 40\ \text{V}$ , $V_{GS} = 0\ \text{V}$  | $T_J = 25^\circ\text{C}$  |       | 1         | $\mu\text{A}$        |
|   |                   |   | $T_J = 175^\circ\text{C}$ |       | 1         | $\text{mA}$          |
| Gate-to-Source Leakage Current                            | $I_{GSS}$         | $V_{DS} = 0\ \text{V}$ , $V_{GS} = +20/-16\ \text{V}$   |                           |       | $\pm 100$ | $\text{nA}$          |
| <b>ON CHARACTERISTICS</b> (Note 4)                        |                   |   |                           |       |           |                      |
| Gate Threshold Voltage                                    | $V_{GS(th)}$      | $V_{GS} = V_{DS}$ , $I_D = 475\ \mu\text{A}$  | 2                         | 2.8   | 4         | V                    |
| Threshold Temperature Coefficient                         | $V_{GS(th)}/T_J$  |   |                           | -7.4  |           | mV/ $^\circ\text{C}$ |
| Drain-to-Source On Resistance                             | $R_{DS(on)}$      | $V_{GS} = 10\ \text{V}$ , $I_D = 50\ \text{A}$  |                           | 0.5   | 0.57      | $\text{m}\Omega$     |
| <b>CHARGES, CAPACITANCES &amp; GATE RESISTANCE</b>        |                   |   |                           |       |           |                      |
| Input Capacitance   | $C_{iss}$         | $V_{GS} = 0\ \text{V}$ , $V_{DS} = 25\ \text{V}$ , $f = 1\ \text{MHz}$                              |                           | 12600 |           | $\text{pF}$          |
| Output Capacitance  | $C_{oss}$         |   |                           | 6705  |           | $\text{pF}$          |
| Reverse Transfer Capacitance                              | $C_{rss}$         |   |                           | 227   |           | $\text{pF}$          |
| Gate Resistance   | $R_g$             | $V_{GS} = 0.5\ \text{V}$ , $f = 1\ \text{MHz}$  |                           | 1.8   |           | $\Omega$             |
| Total Gate Charge   | $Q_{G(tot)}$      | $V_{GS} = 10\ \text{V}$ , $V_{DS} = 20\ \text{V}$ , $I_D = 50\ \text{A}$                            |                           | 185   |           | $\text{nC}$          |
| Threshold Gate Charge                                     | $Q_{G(th)}$       | $V_{GS} = 0\ \text{to}\ 2\ \text{V}$  |                           | 22    |           | $\text{nC}$          |
| Gate-to-Source Gate Charge                                | $Q_{gs}$          | $V_{DD} = 32\ \text{V}$ , $I_D = 50\ \text{A}$  |                           | 48    |           | $\text{nC}$          |
| Gate-to-Drain "Miller" Charge                             | $Q_{gd}$          |   |                           | 38    |           | $\text{nC}$          |
| Plateau Voltage   | $V_{GP}$          |   |                           | 4.2   |           | V                    |
| <b>SWITCHING CHARACTERISTICS</b> (Note 5)                 |                   |   |                           |       |           |                      |
| Turn-On Delay Time  | $t_{d(on)}$       | $V_{GS} = 10\ \text{V}$ , $V_{DD} = 20\ \text{V}$ ,<br>$I_D = 50\ \text{A}$ , $R_{GEN} = 6\ \Omega$ |                           | 40    |           | $\text{ns}$          |
| Turn-On Rise Time   | $t_r$             |   |                           | 84    |           | $\text{ns}$          |
| Turn-Off Delay Time                                       | $t_{d(off)}$      |   |                           | 164   |           | $\text{ns}$          |
| Turn-Off Fall Time  | $t_f$             |   |                           | 81    |           | $\text{ns}$          |
| <b>DRAIN-SOURCE DIODE CHARACTERISTICS</b>                 |                   |   |                           |       |           |                      |
| Source-to-Drain Diode Voltage                             | $V_{SD}$          | $I_{SD} = 50\ \text{A}$ , $V_{GS} = 0\ \text{V}$  |                           | 0.76  | 1.2       | V                    |
| Reverse Recovery Time                                     | $t_{rr}$          | $V_{GS} = 0\ \text{V}$ , $dI_S/dt = 100\ \text{A}/\mu\text{s}$ ,<br>$I_S = 50\ \text{A}$            |                           | 108   |           | $\text{ns}$          |
| Charge Time   | $t_a$             |   |                           | 62    |           | $\text{ns}$          |
| Discharge Time  | $t_b$             |   |                           | 46    |           | $\text{ns}$          |
| Reverse Recovery Charge                                   | $Q_{rr}$          |   |                           | 288   |           | $\text{nC}$          |

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.

4. Pulse Test: pulse width  $\leq 300\ \mu\text{s}$ , duty cycle  $\leq 2\%$ .

5. Switching characteristics are independent of operating junction temperatures

# NVBLS0D5N04C

## TYPICAL CHARACTERISTICS

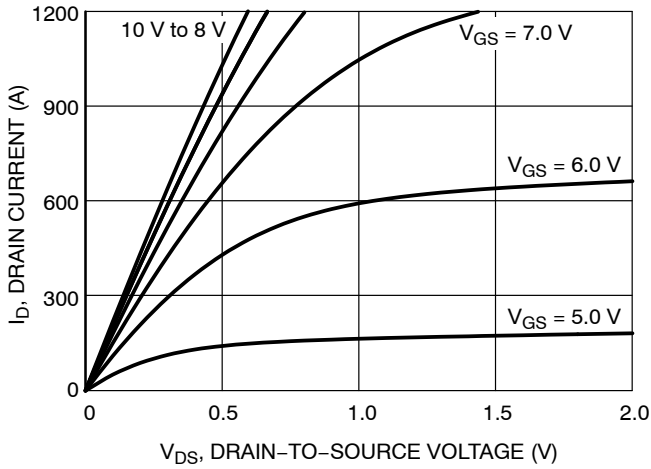


Figure 1. On-Region Characteristics

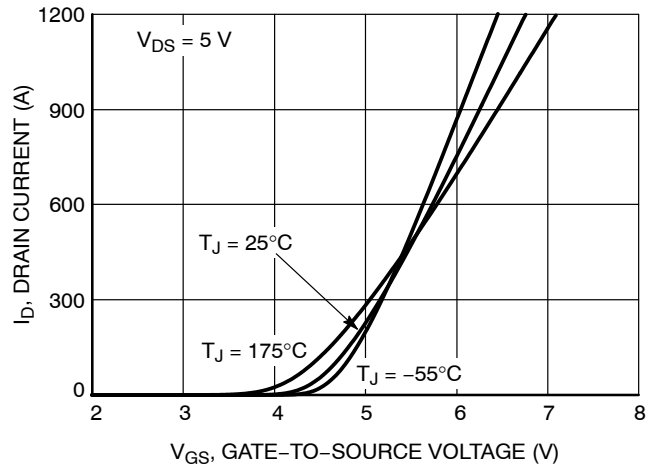


Figure 2. Transfer Characteristics

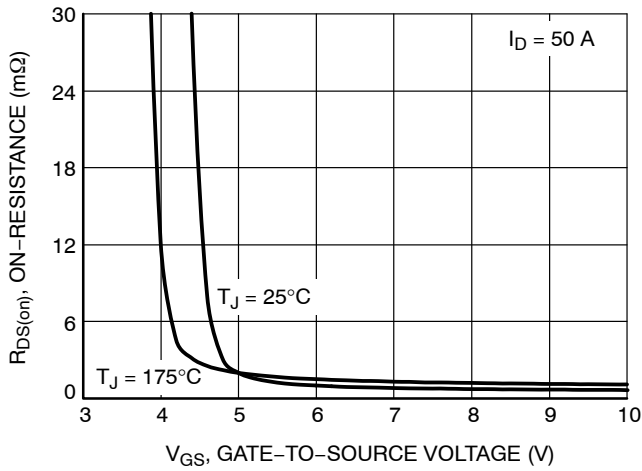


Figure 3. On-Resistance vs. Gate-to-Source Voltage

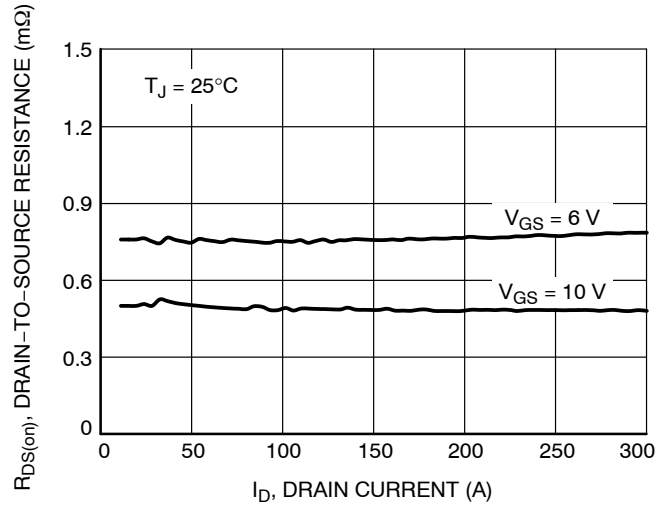


Figure 4. On-Resistance vs. Drain Current and Gate Voltage

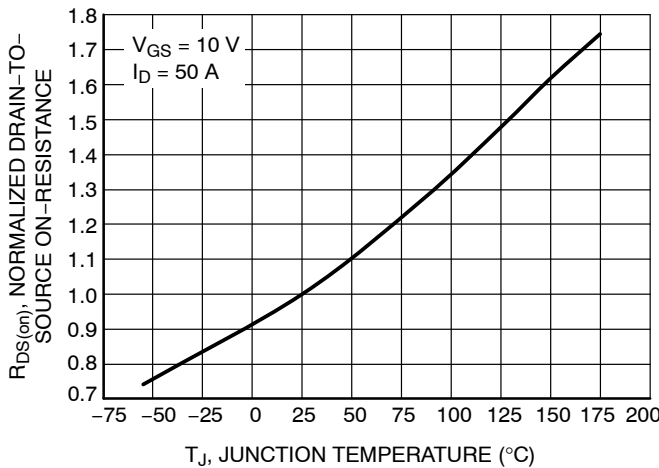


Figure 5. On-Resistance Variation with Temperature

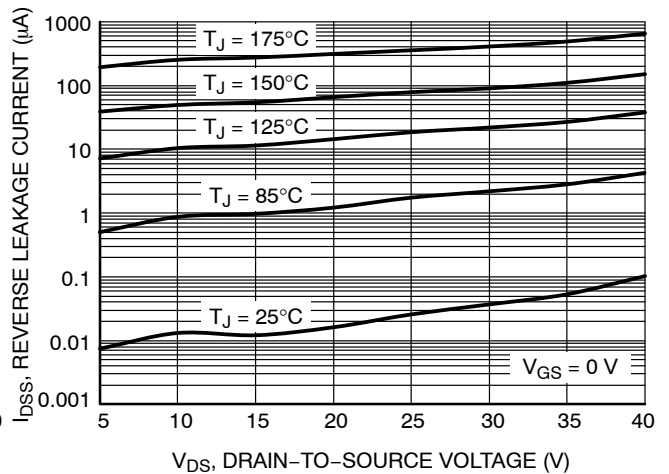


Figure 6. Drain-to-Source Leakage Current vs. Voltage

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## TYPICAL CHARACTERISTICS

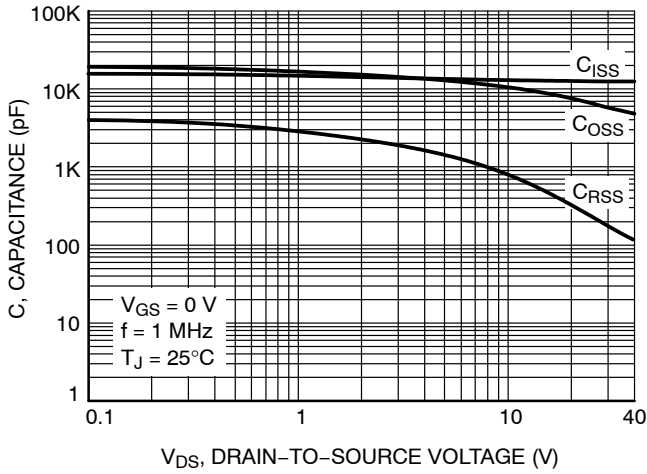


Figure 7. Capacitance Variation

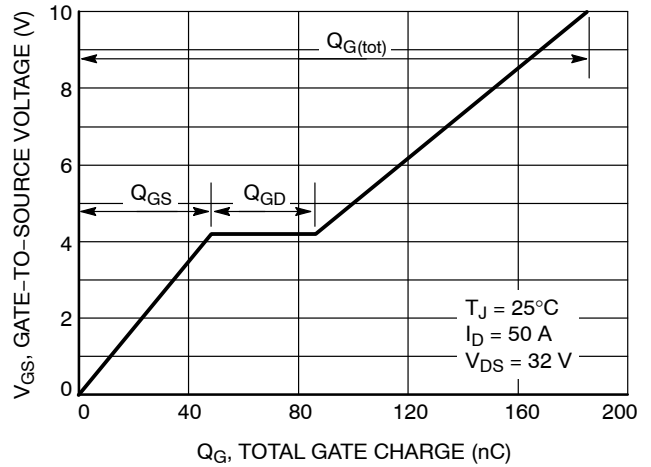


Figure 8. Gate-to-Source Voltage vs. Total Charge

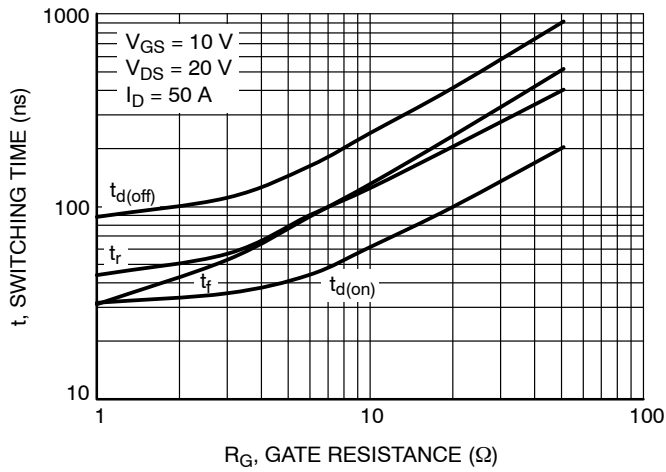


Figure 9. Resistive Switching Time Variation vs. Gate Resistance

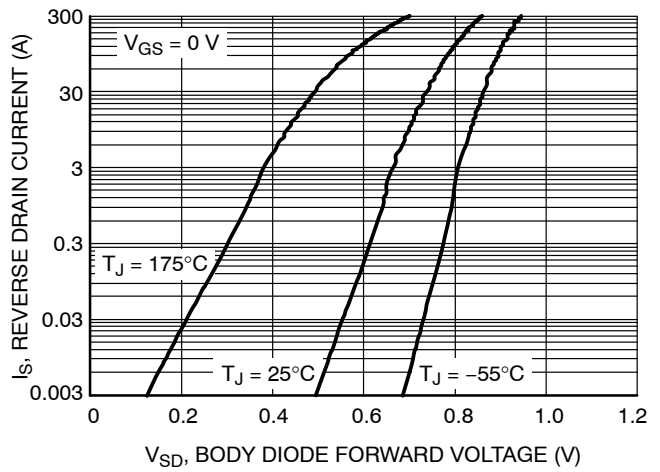


Figure 10. Diode Forward Voltage vs. Current

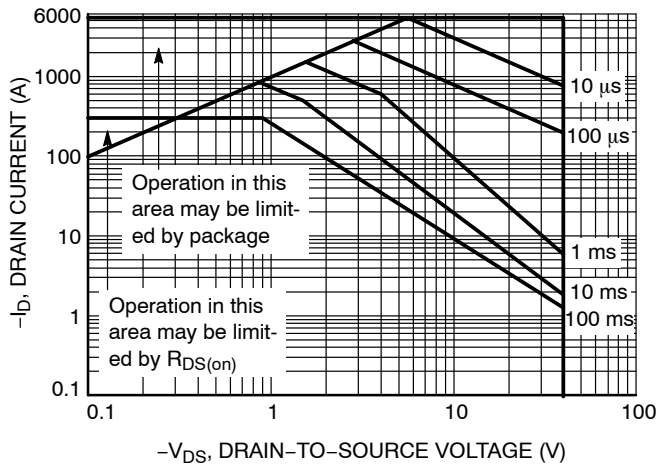


Figure 11. Forward Biased Safe Operating Area

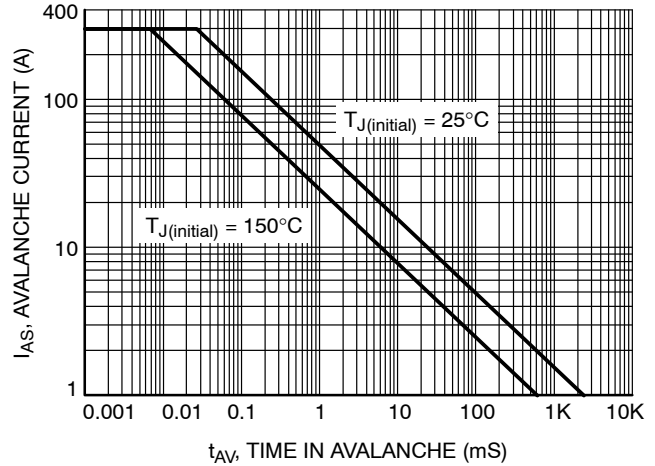


Figure 12. Maximum Drain Current vs. Time in Avalanche

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## TYPICAL CHARACTERISTICS

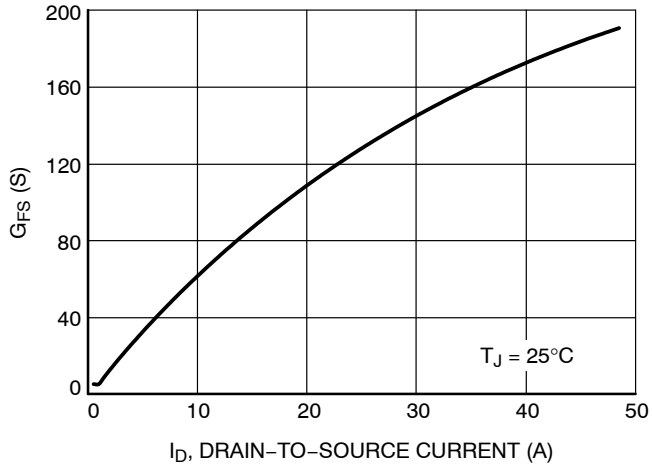


Figure 13.  $G_{FS}$  vs.  $I_D$

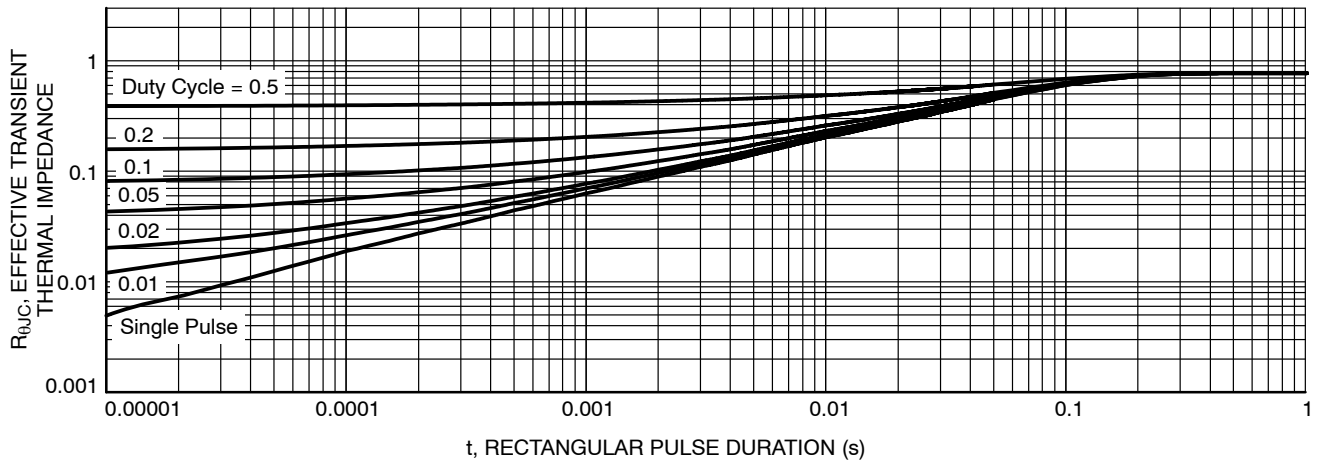


Figure 14. Transient Thermal Impedance

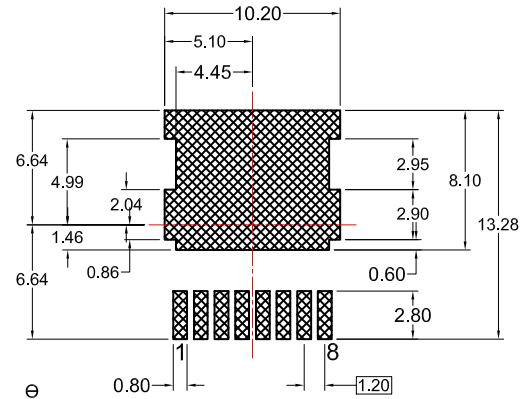
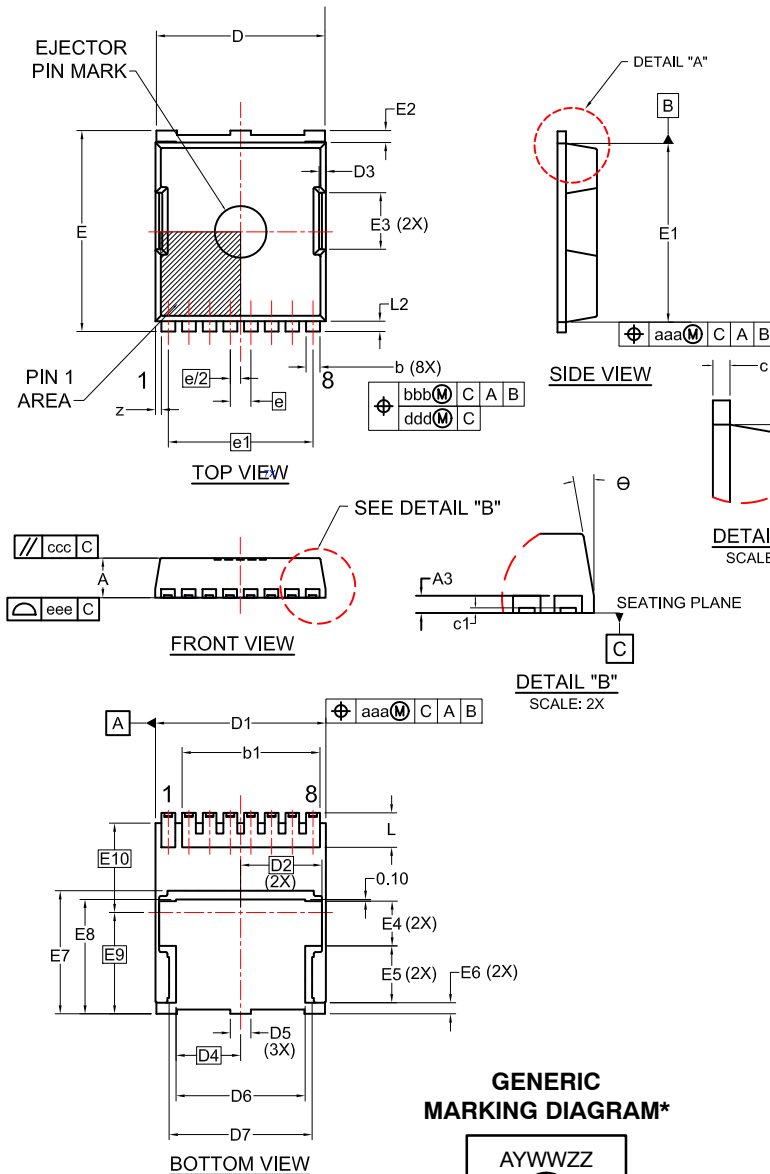
# MECHANICAL CASE OUTLINE PACKAGE DIMENSIONS

ON Semiconductor®



## H-PSOF8L 11.68x9.80 CASE 100CU ISSUE A

DATE 06 JAN 2020



**LAND PATTERN RECOMMENDATION**  
\*FOR ADDITIONAL INFORMATION ON OUR PB-FREE STRATEGY AND SOLDERING DETAILS, PLEASE DOWNLOAD THE ON SEMICONDUCTOR SOLDERING AND MOUNTING TECHNIQUES REFERENCE MANUAL, SOLDERM/D.

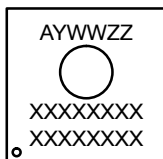
**NOTES:**

1. PACKAGE STANDARD REFERENCE: JEDEC MO-299, ISSUE A.
2. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 2009.
3. CONTROLLING DIMENSION: MILLIMETERS.
4. COPLANARITY APPLIES TO THE EXPOSED WELL AS THE TERMINALS.
5. DIMENSIONS D1 AND E1 DO NOT INCLUDE MOLD FLASH, PROTRUSIONS, OR GATE BURRS.
6. SEATING PLANE IS DEFINED BY THE TERMINALS. "A1" IS DEFINED AS THE DISTANCE FROM THE SEATING PLANE TO THE LOWEST POINT ON THE PACKAGE BODY.

| DIM | MILLIMETERS |       |       |
|-----|-------------|-------|-------|
|     | MIN.        | NOM.  | MAX.  |
| A   | 2.20        | 2.30  | 2.40  |
| A3  | 0.40        | 0.50  | 0.60  |
| b   | 0.70        | 0.80  | 0.90  |
| b1  | 8.00 REF    |       |       |
| c   | 0.40        | 0.50  | 0.60  |
| c1  | 0.10        | --    | --    |
| D   | 9.70        | 9.80  | 9.90  |
| D1  | 9.80        | 9.90  | 10.00 |
| D2  | 4.73 BSC    |       |       |
| D3  | 0.40 REF    |       |       |
| D4  | 3.75 BSC    |       |       |
| D5  | --          | 1.20  | --    |
| D6  | 7.40        | 7.50  | 7.60  |
| D7  | (8.30)      |       |       |
| E   | 11.58       | 11.68 | 11.78 |
| E1  | 10.28       | 10.38 | 10.48 |
| E2  | 0.60        | 0.70  | 0.80  |
| E3  | 3.30 REF    |       |       |
| E4  | --          | 2.60  | --    |

| DIM | MILLIMETERS |      |      |
|-----|-------------|------|------|
|     | MIN.        | NOM. | MAX. |
| e   | 1.20 BSC    |      |      |
| e/2 | 0.60 BSC    |      |      |
| e1  | 8.40 BSC    |      |      |
| K   | 1.50        | 1.57 | 1.70 |
| L   | 1.90        | 2.00 | 2.10 |
| L2  | 0.50        | 0.60 | 0.70 |
| z   | 0.35 REF    |      |      |
| θ   | 0°          | --   | 12°  |
| aaa | 0.20        |      |      |
| bbb | 0.25        |      |      |
| ccc | 0.20        |      |      |
| ddd | 0.20        |      |      |
| eee | 0.10        |      |      |
| E5  | --          | 3.30 | --   |
| E6  | --          | 0.65 | --   |
| E7  | 7.15 REF    |      |      |
| E8  | 6.55        | 6.65 | 6.75 |
| E9  | 5.89 BSC    |      |      |
| E10 | 5.19 BSC    |      |      |

### GENERIC MARKING DIAGRAM\*



A = Assembly Location  
Y = Year  
WW = Work Week  
ZZ = Assembly Lot Code  
XXXX = Specific Device 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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| <b>DESCRIPTION:</b>     | <b>H-PSOF8L 11.68x9.80</b> | <b>PAGE 1 OF 1</b>   |

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