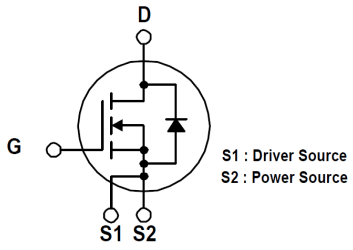
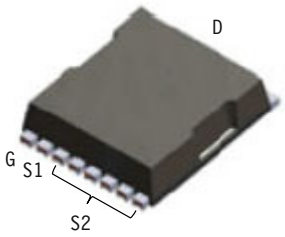
# Silicon Carbide (SiC) MOSFET – EliteSiC, 33 mohm, 650 V, M2, TOLL

# NTBL045N065SC1

| $V_{DSS}$ | $R_{DS(ON)}$ MAX | $I_D$ MAX |
|---|---|---|
| 650 V | 50 mΩ @ 18 V | 73 A |




**N−Channel MOSFET**




**H−PSOF8L**
**CASE 100DC**

### Features

- Typ. $R_{DS(on)}$ = 33 mΩ @ $V_{GS}$ = 18 V
  Typ. $R_{DS(on)}$ = 45 mΩ @ $V_{GS}$ = 15 V
- Ultra Low Gate Charge ($Q_{G(tot)}$ = 105 nC)
- Low Effective Output Capacitance ($C_{oss}$ = 162 pF)
- 100% Avalanche Tested
- $T_J$ = 175°C
- RoHS Compliant

### Typical Applications

- SMPS (Switching Mode Power Supplies)
- Solar Inverters
- UPS (Uninterruptable Power Supplies)
- Energy Storage

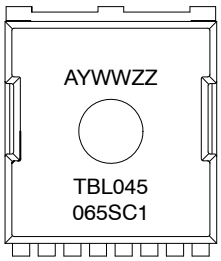
**MAXIMUM RATINGS** ($T_J$ = 25°C unless otherwise noted)

| Parameter | | | Symbol | Value | Unit |
|---|---|---|---|---|---|
| Drain−to−Source Voltage | | | $V_{DSS}$ | 650 | V |
| Gate−to−Source Voltage | | | $V_{GS}$ | −8/+22.6 | V |
| Recommended Operation Values of Gate − Source Voltage | | $T_C$ < 175°C | $V_{GSop}$ | −5/+18 | V |
| Continuous Drain Current (Note 2) | Steady State | $T_C$ = 25°C | $I_D$ | 73 | A |
| Power Dissipation (Note 2) | Steady State | $T_C$ = 25°C | $P_D$ | 348 | W |
| Continuous Drain Current (Notes 1, 2) | Steady State | $T_C$ = 100°C | $I_D$ | 51 | A |
| Power Dissipation (Notes 1, 2) | Steady State | $T_C$ = 100°C | $P_D$ | 174 | W |
| Pulsed Drain Current (Note 3) | | $T_C$ = 25°C | $I_{DM}$ | 182 | A |
| Operating Junction and Storage Temperature Range | | | $T_J$, $T_{stg}$ | −55 to +175 | °C |
| Source Current (Body Diode) | | | $I_S$ | 75 | A |
| Single Pulse Drain−to−Source Avalanche Energy ($I_L$ = 12 $A_{pk}$, L = 1 mH) (Note 4) | | | $E_{AS}$ | 72 | mJ |
| Maximum Lead Temperature for Soldering, 1/8″ from Case for 10 Seconds | | | $T_L$ | 260 | °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 a FR−4 board using1 in2 pad of 2 oz copper.
2. The entire application environment impacts the thermal resistance values shown, they are not constants and are only valid for the particular conditions noted.
3. Repetitive rating, limited by max junction temperature.
4. $E_{AS}$ of 72 mJ is based on starting $T_J$ = 25°C; L = 1 mH, $I_{AS}$ = 12 A, $V_{DD}$ = 50 V, $V_{GS}$ = 18 V.

### MARKING DIAGRAM




| | |
|---|---|
| A | = Assembly Location |
| Y | = Year |
| WW | = Work Week |
| ZZ | = Assembly Lot Code |
| TBL045065SC1 | = Specific Device Code |

### ORDERING INFORMATION

See detailed ordering and shipping information on page 6 of this data sheet.

## THERMAL CHARACTERISTICS

| Parameter | Symbol | Max | Units |
|---|---|---|---|
| Junction−to−Case − Steady State (Note 2) | $R_{\theta JC}$ | 0.43 | °C/W |
| Junction−to−Ambient − Steady State (Notes 1, 2) | $R_{\theta JA}$ | 43 | °C/W |

## ELECTRICAL CHARACTERISTICS ($T_J$ = 25°C unless otherwise stated)

| Parameter | Symbol | Test Condition | | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|---|
| **OFF CHARACTERISTICS** | | | | | | | |
| Drain−to−Source Breakdown Voltage | $V_{(BR)DSS}$ | $V_{GS}$ = 0 V, $I_D$ = 1 mA | | 650 | | | V |
| Drain−to−Source Breakdown Voltage Temperature Coefficient | $V_{(BR)DSS}/T_J$ | $I_D$ = 20 mA, refer to 25°C | | | 0.15 | | V/°C |
| Zero Gate Voltage Drain Current | $I_{DSS}$ | $V_{GS}$ = 0 V, $V_{DS}$ = 650 V | $T_J$ = 25°C | | | 10 | μA |
| | | | $T_J$ = 175°C | | | 1 | mA |
| Gate−to−Source Leakage Current | $I_{GSS}$ | $V_{GS}$ = +18/−5 V, $V_{DS}$ = 0 V | | | | 250 | nA |
| **ON CHARACTERISTICS** | | | | | | | |
| Gate Threshold Voltage | $V_{GS(TH)}$ | $V_{GS}$ = $V_{DS}$ , $I_D$ = 8 mA | | 1.8 | 2.8 | 4.3 | V |
| Recommended Gate Voltage | $V_{GOP}$ | | | −5 | | +18 | V |
| Drain−to−Source On Resistance | $R_{DS(on)}$ | $V_{GS}$ = 15 V, $I_D$ = 25 A, $T_J$ = 25°C | | | 45 | | mΩ |
| | | $V_{GS}$ = 18 V, $I_D$ = 25 A, $T_J$ = 25°C | | | 33 | 50 | |
| | | $V_{GS}$ = 18 V, $I_D$ = 25 A, $T_J$ = 175°C | | | 40 | | |
| Forward Transconductance | $g_{FS}$ | $V_{DS}$ = 10 V, $I_D$ = 25 A | | | 16 | | S |
| **CHARGES, CAPACITANCES & GATE RESISTANCE** | | | | | | | |
| Input Capacitance | $C_{ISS}$ | $V_{GS}$ = 0 V, f = 1 MHz, $V_{DS}$ = 325 V | | | 1870 | | pF |
| Output Capacitance | $C_{OSS}$ | | | | 162 | | |
| Reverse Transfer Capacitance | $C_{RSS}$ | | | | 14 | | |
| Total Gate Charge | $Q_{G(TOT)}$ | $V_{GS}$ = −5/18 V, $V_{DS}$ = 520 V, $I_D$ = 25 A | | | 105 | | nC |
| Gate−to−Source Charge | $Q_{GS}$ | | | | 27 | | |
| Gate−to−Drain Charge | $Q_{GD}$ | | | | 30 | | |
| Gate−Resistance | $R_G$ | f = 1 MHz | | | 3.1 | | Ω |
| **SWITCHING CHARACTERISTICS** | | | | | | | |
| Turn−On Delay Time | $t_{d(ON)}$ | $V_{GS}$ = −5/18 V, $V_{DS}$ = 400 V, $I_D$ = 25 A, $R_G$ = 2.2 Ω, Inductive Load | | | 13 | | ns |
| Rise Time | $t_r$ | | | | 14 | | |
| Turn−Off Delay Time | $t_{d(OFF)}$ | | | | 26 | | |
| Fall Time | $t_f$ | | | | 7 | | |
| Turn−On Switching Loss | $E_{ON}$ | | | | 47 | | μJ |
| Turn−Off Switching Loss | $E_{OFF}$ | | | | 33 | | |
| Total Switching Loss | $E_{TOT}$ | | | | 80 | | |
| **SOURCE−DRAIN DIODE CHARACTERISTICS** | | | | | | | |
| Continuous Source−Drain Diode Forward Current | $I_{SD}$ | $V_{GS}$ = −5 V, $T_J$ = 25°C | | | | 75 | A |
| Pulsed Source−Drain Diode Forward Current (Note 3) | $I_{SDM}$ | $V_{GS}$ = −5 V, $T_J$ = 25°C | | | | 182 | A |
| Forward Diode Voltage | $V_{SD}$ | $V_{GS}$ = −5 V, $I_{SD}$ = 25 A, $T_J$ = 25°C | | | 4.4 | | V |

**ELECTRICAL CHARACTERISTICS** ($T_J$ = 25°C unless otherwise stated)

| Parameter | Symbol | Test Condition | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|
| **SOURCE−DRAIN DIODE CHARACTERISTICS** | | | | | | |
| Reverse Recovery Time | $t_{RR}$ | $V_{GS}$ = −5/18 V, $I_{SD}$ = 25 A, $dI_S/dt$ = 1000 A/μs | | 20 | | ns |
| Reverse Recovery Charge | $Q_{RR}$ | | | 108 | | nC |
| Reverse Recovery Energy | $E_{REC}$ | | | 4.5 | | μJ |
| Peak Reverse Recovery Current | $I_{RRM}$ | | | 11 | | A |
| Charge time | Ta | | | 11 | | ns |
| Discharge time | Tb | | | 8.5 | | ns |

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

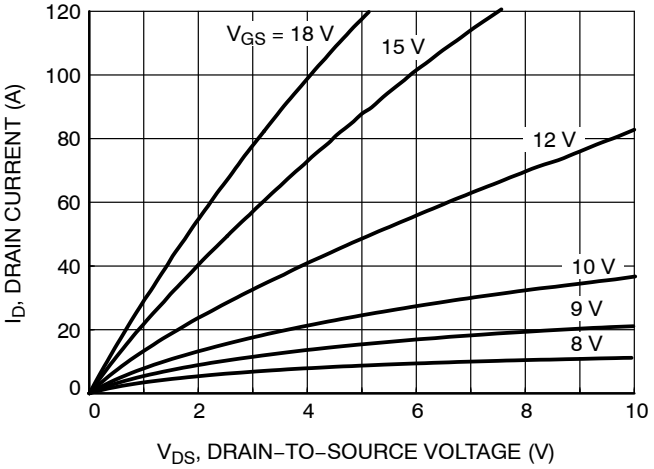



**Figure 1. On−Region Characteristics**

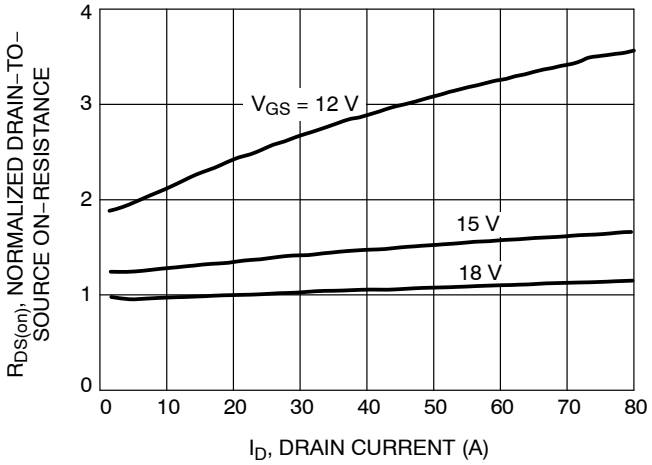



**Figure 2. Normalized On−Resistance vs. Drain Current and Gate Voltage**

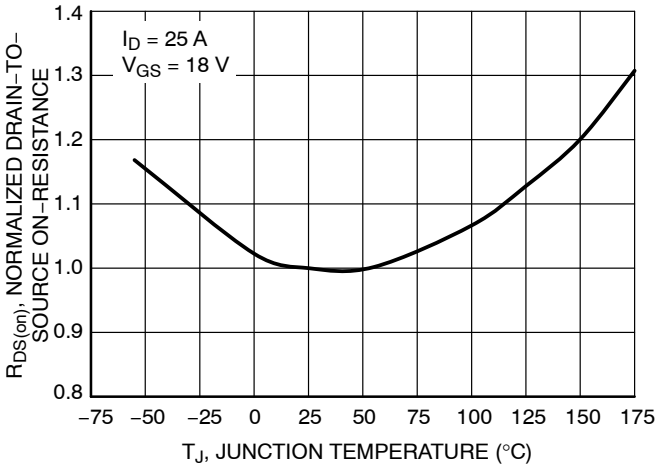



**Figure 3. On−Resistance Variation with Temperature**

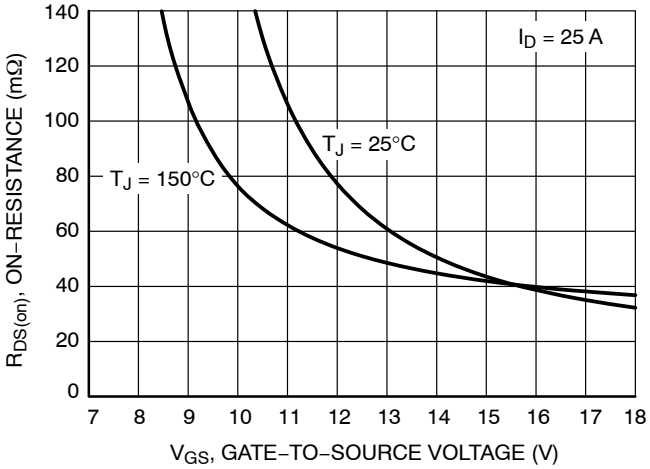



**Figure 4. On−Resistance vs. Gate−to−Source Voltage**

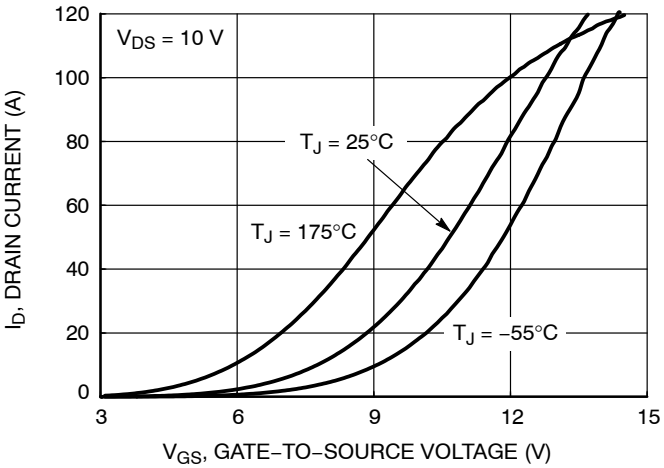



**Figure 5. Transfer Characteristics**

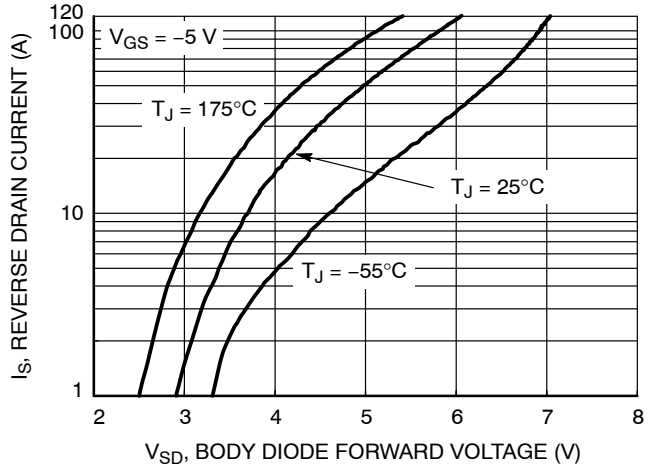



**Figure 6. Diode Forward Voltage vs. Current**

## TYPICAL CHARACTERISTICS

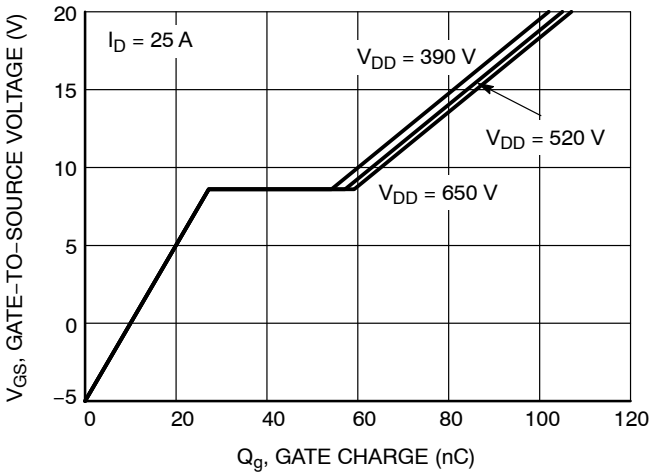



**Figure 7. Gate−to−Source Voltage vs. Total Charge**

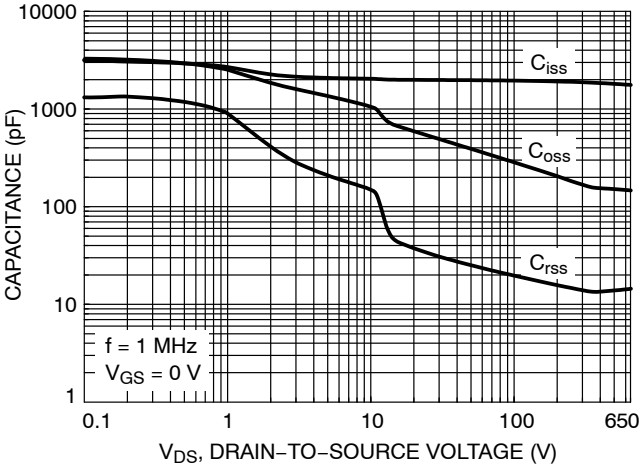



**Figure 8. Capacitance vs. Drain−to−Source Voltage**

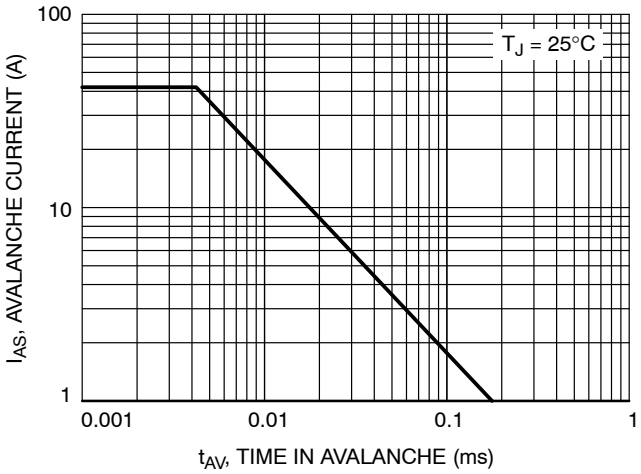



**Figure 9. Unclamped Inductive Switching Capability**

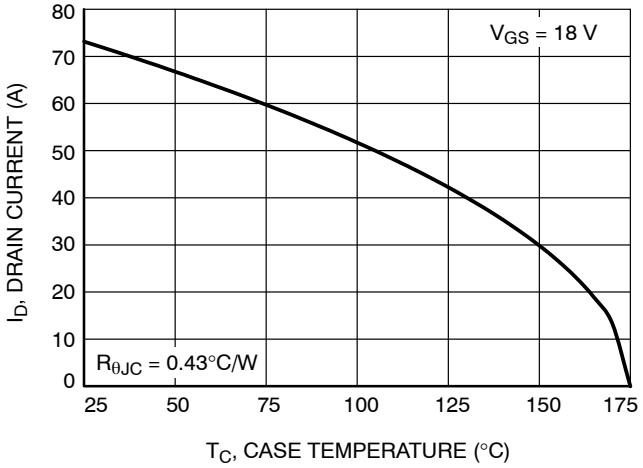



**Figure 10. Maximum Continuous Drain Current vs. Case Temperature**

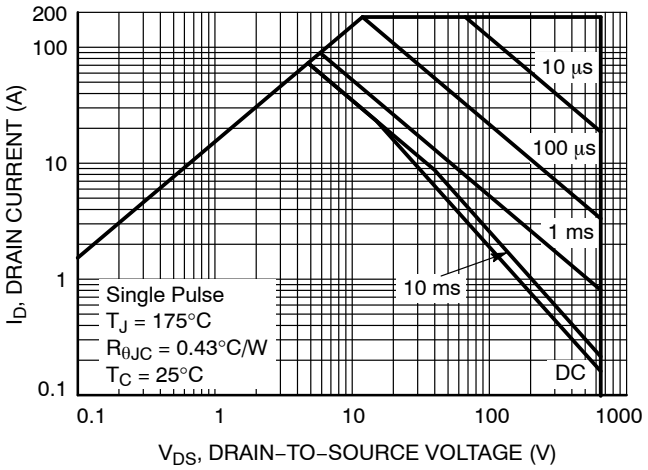



**Figure 11. Safe Operating Area**

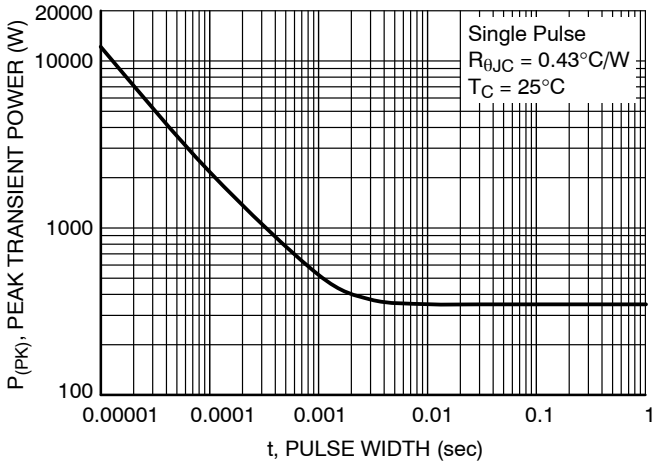



**Figure 12. Single Pulse Maximum Power Dissipation**

## TYPICAL CHARACTERISTICS

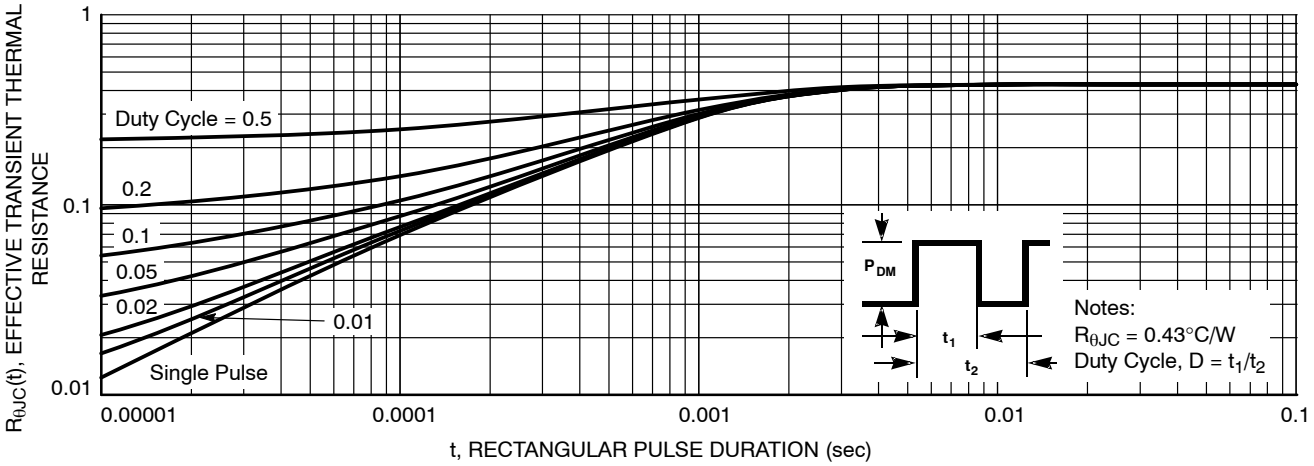


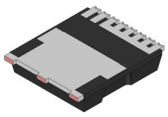

**Figure 13. Transient Thermal Impedance**

### DEVICE ORDERING INFORMATION

| Device | Package | Shipping† |
|---|---|---|
| NTBL045N065SC1 | H−PSOF8L | 2000 / Tape & Reel |

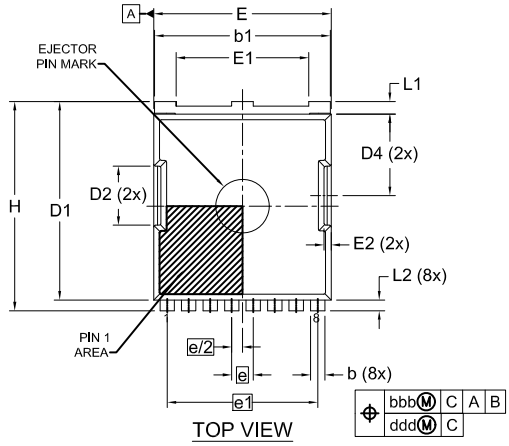
†For information on tape and reel specifications, including part orientation and tape sizes, please refer to our Tape and Reel Packaging Specifications Brochure, BRD8011/D.

# MECHANICAL CASE OUTLINE
## PACKAGE DIMENSIONS

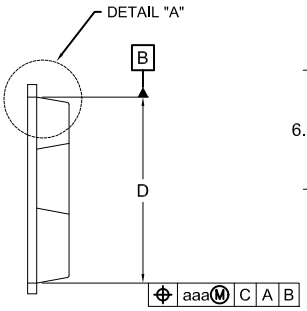


**H−PSOF8L 9.90x11.68, 1.20P**
CASE 100DC
ISSUE A

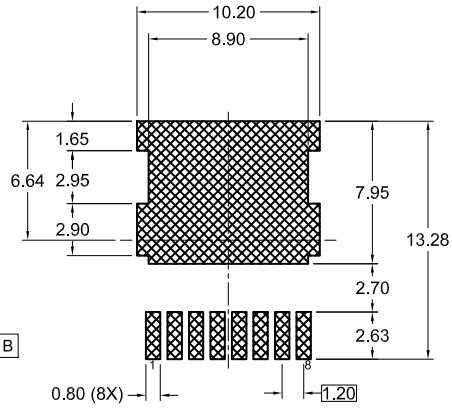
DATE 18 MAY 2023




TOP VIEW

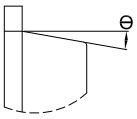



SIDE VIEW

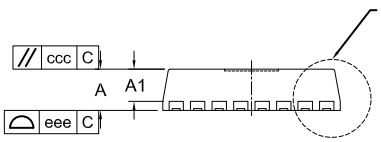



LAND PATTERN RECOMMENDATION

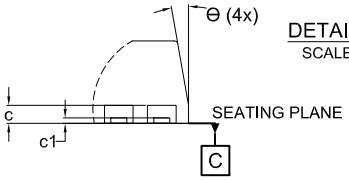
*FOR ADDITIONAL INFORMATION ON OUR PB-FREE STRATEGY AND SOLDERING DETAILS, PLEASE DOWNLOAD THE ON SEMICONDUCTOR SOLDERING AND MOUNTING TECHNIQUES REFERENCE MANUAL, SOLDERRM/D.



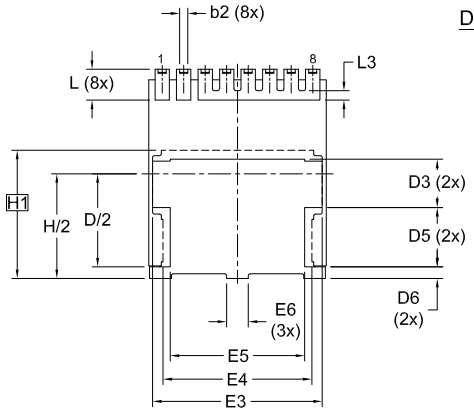

DETAIL "A"
SCALE: 2X




FRONT VIEW

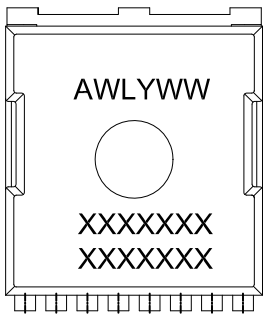



DETAIL "B"
SCALE: 2X




BOTTOM VIEW

GENERIC MARKING DIAGRAM*




A = ASSY LOCATION
WL = WAFER LOT CODE
Y = YEAR CODE
WW = WORK WEEK CODE
XXXXXXX = DEVICE CODE
XXXXXXX = DEVICE CODE

*THIS INFORMATION IS GENERIC. PLEASE REFER TO DEVICE DATA SHEET FOR ACTUAL PART MARKING.

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 |
| A1 | 1.70 | 1.80 | 1.90 |
| b | 0.70 | 0.80 | 0.90 |
| b1 | 9.70 | 9.80 | 9.90 |
| b2 | 0.35 | 0.45 | 0.55 |
| c | 0.40 | 0.50 | 0.60 |
| c1 | 0.10 | --- | --- |
| D | 10.28 | 10.38 | 10.48 |
| D/2 | 5.09 | 5.19 | 5.29 |
| D1 | 10.98 | 11.08 | 11.18 |
| D2 | 3.20 | 3.30 | 3.40 |
| D3 | 2.60 | 2.70 | 2.80 |
| D4 | 4.45 | 4.55 | 4.65 |
| D5 | 3.20 | 3.30 | 3.40 |
| D6 | 0.55 | 0.65 | 0.75 |
| E | 9.80 | 9.90 | 10.00 |
| E1 | 7.30 | 7.40 | 7.50 |
| E2 | 0.30 | 0.40 | 0.50 |
| E3 | 9.36 | 9.46 | 9.56 |

| DIM | MILLIMETERS | | |
|---|---|---|---|
| | MIN. | NOM. | MAX. |
| E4 | 8.20 | 8.30 | 8.40 |
| E5 | 7.40 | 7.50 | 7.60 |
| E6 | 1.10 | 1.20 | 1.30 |
| e | | 1.20 BSC | |
| e/2 | | 0.60 BSC | |
| e1 | | 8.40 BSC | |
| H | 11.58 | 11.68 | 11.78 |
| H/2 | 5.74 | 5.84 | 5.94 |
| H1 | | 7.15 BSC | |
| L | 1.63 | 1.73 | 1.83 |
| L1 | 0.60 | 0.70 | 0.80 |
| L2 | 0.50 | 0.60 | 0.70 |
| L3 | 0.70 | 0.80 | 0.90 |
| θ | 0° | --- | 12° |
| aaa | | 0.20 | |
| bbb | | 0.25 | |
| ccc | | 0.20 | |
| ddd | | 0.20 | |
| eee | | 0.10 | |

| | | |
|---|---|---|
| **DOCUMENT NUMBER:** | **98AON80466G** | Electronic versions are uncontrolled except when accessed directly from the Document Repository. Printed versions are uncontrolled except when stamped "CONTROLLED COPY" in red. |
| **DESCRIPTION:** | **H−PSOF8L 9.90x11.68, 1.20P** | **PAGE 1 OF 1** |

## ADDITIONAL INFORMATION

**TECHNICAL PUBLICATIONS**:
**Technical Library:** www.onsemi.com/design/resources/technical−documentation
**onsemi Website:** www.onsemi.com

**ONLINE SUPPORT**: www.onsemi.com/support
**For additional information, please contact your local Sales Representative at** www.onsemi.com/support/sales