

# MOSFET - Power, N-Channel, SUPERFET® III, Easy-drive 650 V, 70 mΩ, 44 A NTBL070N65S3

## Description

SUPERFET III MOSFET is ON Semiconductor’s brand-new high voltage super-junction (SJ) MOSFET family that is utilizing charge balance technology for outstanding low on-resistance and lower gate charge performance. This advanced technology is tailored to minimize conduction loss provide superior switching performance, and withstand extreme dv/dt rate. Consequently, SUPERFET III MOSFET Easy-drive series helps manage EMI issues and allows for easier design implementation.

The TOLL package offers improved thermal performance and excellent switching performance thanks to Kelvin Source configuration and lower parasitic source inductance. TOLL offers Moisture Sensitivity Level 1 (MSL 1).

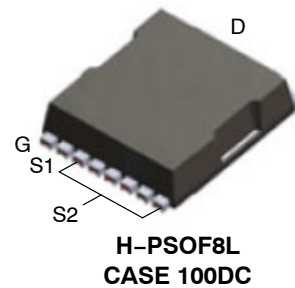
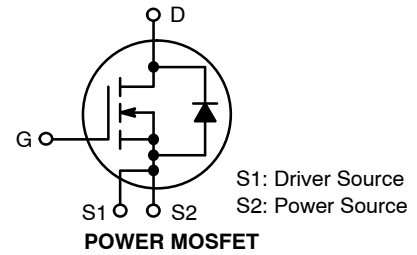
## Features

- 700 V @  $T_J = 150^\circ\text{C}$
- Typ.  $R_{DS(on)} = 57\text{ m}\Omega$
- Ultra Low Gate Charge (Typ.  $Q_G = 82\text{ nC}$ )
- Low Effective Output Capacitance (Typ.  $C_{OSS(eff.)} = 724\text{ pF}$ )
- 100% Avalanche Tested
- Kelvin Source Configuration and Low Parasitic Source Inductance
- MSL1 Qualified
- These Devices are Pb-Free, Halogen Free/BFR Free and are RoHS Compliant

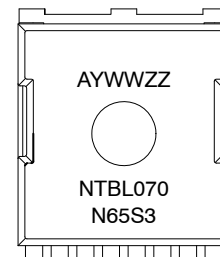
## Typical Applications

- Telecom / Server Power Supplies
- Industrial Power Supplies
- UPS / Solar

| $BV_{DSS}$ | $R_{DS(on)}\text{ MAX}$ | $I_D\text{ MAX}$ |
|------------|-------------------------|------------------|
| 650 V      | 70 mΩ @ 10 V            | 44 A             |



## MARKING DIAGRAM



|              |                        |
|--------------|------------------------|
| A            | = Assembly Location    |
| Y            | = Year                 |
| WW           | = Work Week            |
| ZZ           | = Assembly Lot Code    |
| NTBL070N65S3 | = Specific Device Code |

## ORDERING INFORMATION

See detailed ordering and shipping information on page 2 of this data sheet.

# NTBL070N65S3

## ABSOLUTE MAXIMUM RATINGS (T<sub>C</sub> = 25°C, Unless otherwise specified)

| Symbol                            | Parameter  |                                     | Value       | Unit |
|-----------------------------------|--|-------------------------------------|-------------|------|
| V <sub>DSS</sub>                  | Drain to Source Voltage  |                                     | 650         | V    |
| V <sub>GSS</sub>                  | Gate to Source Voltage   | DC                                  | ±30         | V    |
|                                   |  | AC (f > 1 Hz)                       | ±30         | V    |
| I <sub>D</sub>                    | Drain Current  | Continuous (T <sub>C</sub> = 25°C)  | 44          | A    |
|                                   |  | Continuous (T <sub>C</sub> = 100°C) | 28          | A    |
| I <sub>DM</sub>                   | Pulsed Drain Current   | Pulsed (Note 1)                     | 110         | A    |
| E <sub>AS</sub>                   | Single Pulsed Avalanche Energy (Note 2)                              |                                     | 214         | mJ   |
| E <sub>AR</sub>                   | Repetitive Avalanche (Note 1)  |                                     | 3.12        | mJ   |
| dv/dt                             | MOSFET dv/dt   |                                     | 100         | V/ns |
|                                   | Peak Diode Recovery dv/dt (Note 3)                                   |                                     | 20          | V/ns |
| P <sub>D</sub>                    | Power Dissipation  | (T <sub>C</sub> = 25°C)             | 312         | W    |
|                                   |  | Derate Above 25°C                   | 2.5         | W/°C |
| T <sub>J</sub> , T <sub>STG</sub> | Operating and Storage Temperature Range                              |                                     | -55 to +150 | °C   |
| T <sub>L</sub>                    | Maximum Lead Temperature for Soldering, 1/8" from Case for 5 Seconds |                                     | 300         | °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. Repetitive rating; pulse-width limited by maximum junction temperature.
2. I<sub>AS</sub> = 4.8 A, R<sub>G</sub> = 25 Ω, starting T<sub>J</sub> = 25°C.
3. I<sub>SD</sub> < 22 A, di/dt ≤ 200 A/μs, VDD ≤ BVDSS, starting T<sub>J</sub> = 25°C.

## THERMAL CHARACTERISTICS

| Symbol           | Parameter  | Value | Unit |
|------------------|--|-------|------|
| R <sub>θJC</sub> | Thermal Resistance, Junction-to-Case, Steady State             | 0.37  | °C/W |
| R <sub>θJA</sub> | Thermal Resistance, Junction-to-Ambient, Steady State (Note 4) | 43    |      |

4. Device on 1 in<sup>2</sup>, 2 oz copper pad on 1.5 x 1.5 in. board of FR-4 material.

## PACKAGE MARKING AND ORDERING INFORMATION

| Device       | Device Marking | Package  | Reel Size | Tape Width | Quantity   |
|--------------|----------------|----------|-----------|------------|------------|
| NTBL070N65S3 | NTBL070N65S3   | H-PSOF8L | 13 mm     | 24 mm      | 2000 Units |

†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](#).

# NTBL070N65S3

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

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

### OFF CHARACTERISTICS

|                                      |   |  |     |      |      |      |
|--------------------------------------|---|--|-----|------|------|------|
| BV <sub>DSS</sub>                    | Drain-to-Source Breakdown Voltage         | V <sub>GS</sub> = 0 V, I <sub>D</sub> = 1 mA, T <sub>J</sub> = 25°C    | 650 | -    | -    | V    |
|                                      |   | V <sub>GS</sub> = 0 V, I <sub>D</sub> = 1 mA, T <sub>J</sub> = 150°C   | 700 | -    | -    | V    |
| ΔBV <sub>DSS</sub> / ΔT <sub>J</sub> | Breakdown Voltage Temperature Coefficient | I <sub>D</sub> = 1 mA, Referenced to 25°C                              | -   | 0.72 | -    | V/°C |
| I <sub>DSS</sub>                     | Zero Gate Voltage Drain Current           | V <sub>DS</sub> = 650 V, V <sub>GS</sub> = 0 V                         | -   | -    | 1    | μA   |
|                                      |   | V <sub>DS</sub> = 520 V, V <sub>GS</sub> = 0 V, T <sub>c</sub> = 125°C | -   | 3.4  | -    |      |
| I <sub>GSS</sub>                     | Gate to Body Leakage Current              | V <sub>GS</sub> = ±30 V, V <sub>DS</sub> = 0 V                         | -   | -    | ±100 | nA   |

### ON CHARACTERISTICS

|                     |                                      |  |     |    |     |    |
|---------------------|--------------------------------------|--|-----|----|-----|----|
| V <sub>GS(th)</sub> | Gate to Source Threshold Voltage     | V <sub>GS</sub> = V <sub>DS</sub> , I <sub>D</sub> = 1.0 mA          | 2.5 | -  | 4.5 | V  |
| R <sub>DS(on)</sub> | Static Drain to Source On Resistance | V <sub>GS</sub> = 10 V, I <sub>D</sub> = 22 A, T <sub>J</sub> = 25°C | -   | 57 | 70  | mΩ |
| g <sub>FS</sub>     | Forward Transconductance             | V <sub>DS</sub> = 20 V, I <sub>D</sub> = 22 A                        | -   | 26 | -   | S  |

### DYNAMIC CHARACTERISTICS

|                        |                                   |   |   |       |   |    |
|------------------------|-----------------------------------|---|---|-------|---|----|
| C <sub>iss</sub>       | Input Capacitance                 | V <sub>DS</sub> = 400 V, V <sub>GS</sub> = 0 V, f = 1 MHz                       | - | 3300  | - | pF |
| C <sub>oss</sub>       | Output Capacitance                |   | - | 72.8  | - | pF |
| C <sub>rss</sub>       | Reverse Transfer Capacitance      |   | - | 14.6  | - | pF |
| C <sub>oss(eff.)</sub> | Effective Output Capacitance      | V <sub>DS</sub> = 0 V to 400 V, V <sub>GS</sub> = 0 V                           | - | 724   | - | pF |
| C <sub>oss(er.)</sub>  | Energy Related Output Capacitance | V <sub>DS</sub> = 0 V to 400 V, V <sub>GS</sub> = 0 V                           | - | 104   | - | pF |
| Q <sub>g(tot)</sub>    | Total Gate Charge                 | V <sub>DS</sub> = 400 V, V <sub>GS</sub> = 10 V, I <sub>D</sub> = 22 A (Note 5) | - | 82.0  | - | nC |
| Q <sub>gs</sub>        | Gate to Source Gate Charge        |   | - | 21    | - | nC |
| Q <sub>gd</sub>        | Gate to Drain "Miller" Charge     |   | - | 34.0  | - | nC |
| R <sub>G</sub>         | Gate Resistance                   | f = 1 MHz   | - | 0.685 | - | mΩ |

### SWITCHING CHARACTERISTICS

|                     |                     |   |   |    |   |    |
|---------------------|---------------------|---|---|----|---|----|
| t <sub>d(on)</sub>  | Turn-On Delay Time  | V <sub>DD</sub> = 400 V, I <sub>D</sub> = 22 A, V <sub>GS</sub> = 10 V, R <sub>G</sub> = 4.7 Ω (Note 5) | - | 27 | - | ns |
| t <sub>r</sub>      | Turn-On Rise Time   |   | - | 24 | - | ns |
| t <sub>d(off)</sub> | Turn-Off Delay Time |   | - | 74 | - | ns |
| t <sub>f</sub>      | Fall Time           |   | - | 13 | - | ns |

### DRAIN-SOURCE DIODE CHARACTERISTICS

|                 |  |  |   |     |     |    |
|-----------------|--|--|---|-----|-----|----|
| I <sub>S</sub>  | Maximum Continuous Drain to Source Diode Forward Current |  | - | -   | 44  | A  |
| I <sub>SM</sub> | Maximum Pulsed Drain to Source Diode Forward Current     |  | - | -   | 110 | A  |
| V <sub>SD</sub> | Drain to Source Diode Forward Voltage                    | V <sub>GS</sub> = 0 V, I <sub>SD</sub> = 22 A                                | - | -   | 1.2 | V  |
| t <sub>rr</sub> | Reverse Recovery Time                                    | V <sub>GS</sub> = 0 V, I <sub>SD</sub> = 22 A dI <sub>F</sub> /dt = 100 A/μs | - | 449 | -   | nS |
| Q <sub>rr</sub> | Reverse Recovery Charge                                  |  | - | 9.5 | -   | μC |

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.

5. Essentially independent of operating temperature typical characteristics.

TYPICAL CHARACTERISTICS ( $T_C = 25^\circ\text{C}$  unless otherwise noted)

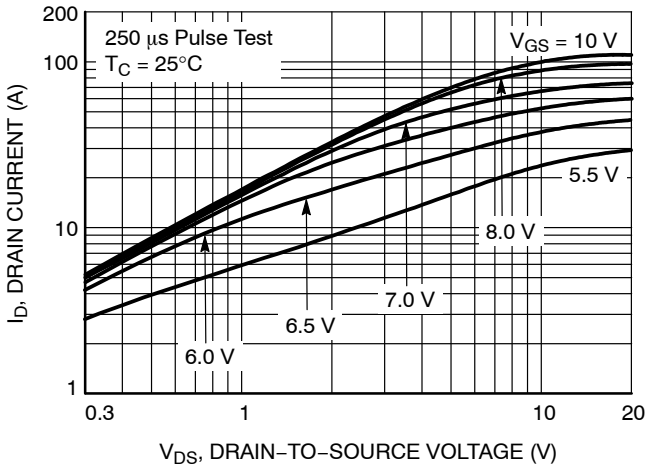


Figure 1. On-Region Characteristics

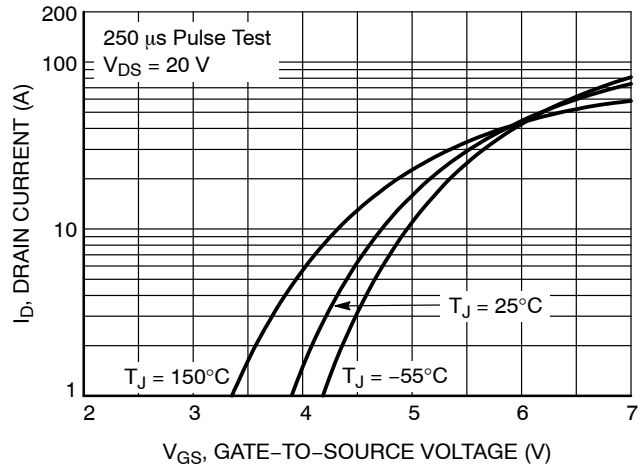


Figure 2. Transfer Characteristics

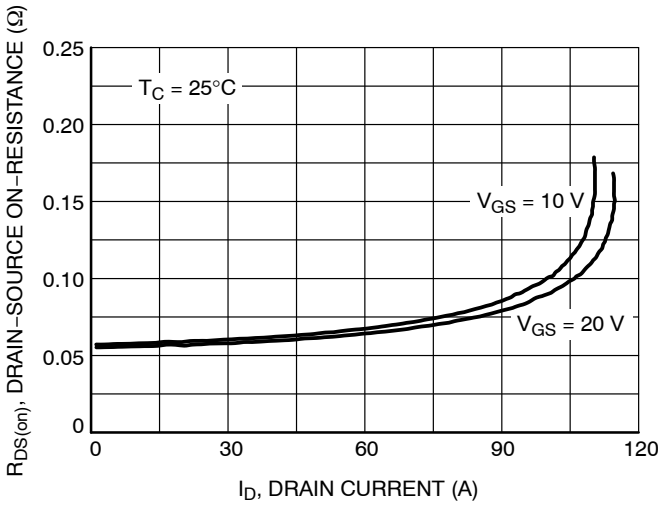


Figure 3. On-Resistance Variation vs. Drain Current and Gate Voltage

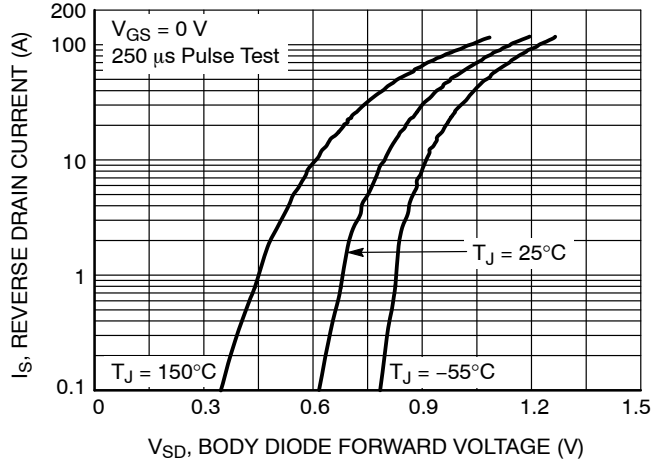


Figure 4. Body Diode Forward Voltage Variation vs. Source Current and Temperature

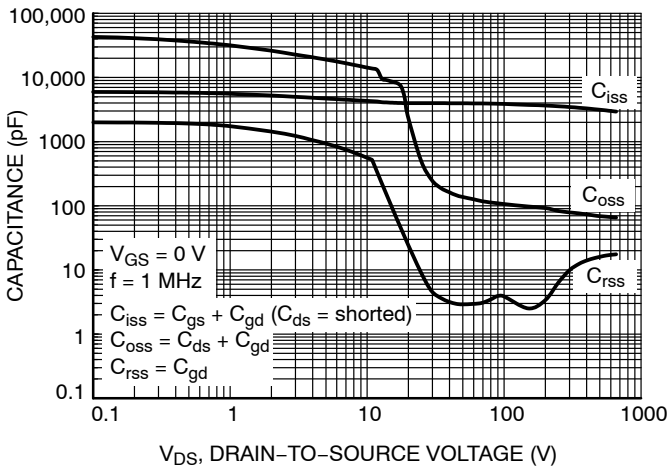


Figure 5. Capacitance Characteristics

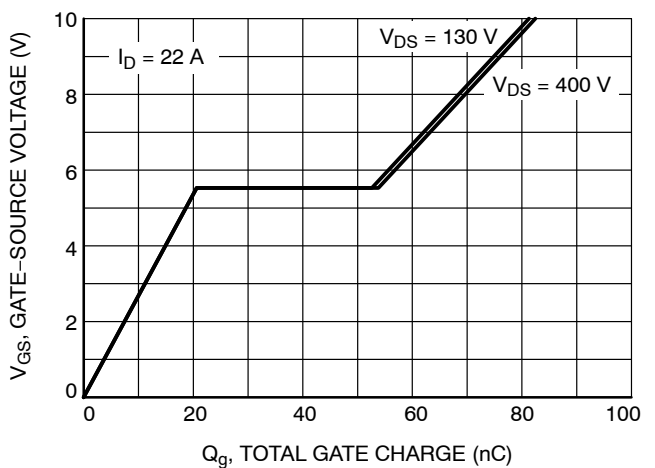
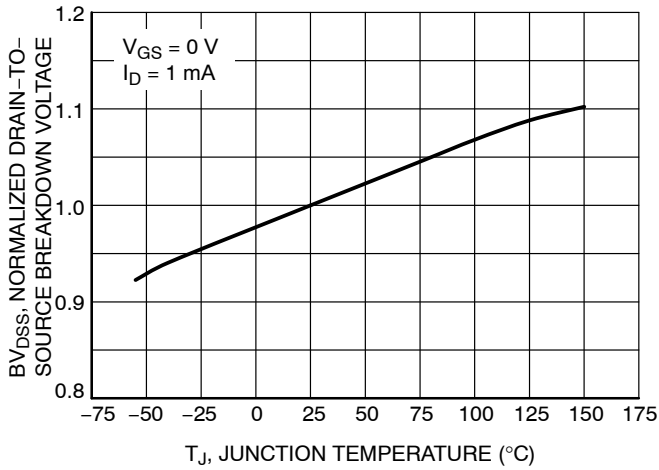


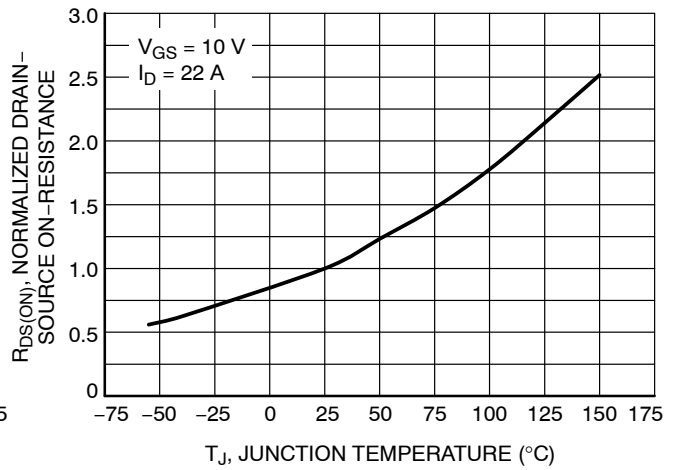
Figure 6. Gate Charge Characteristics

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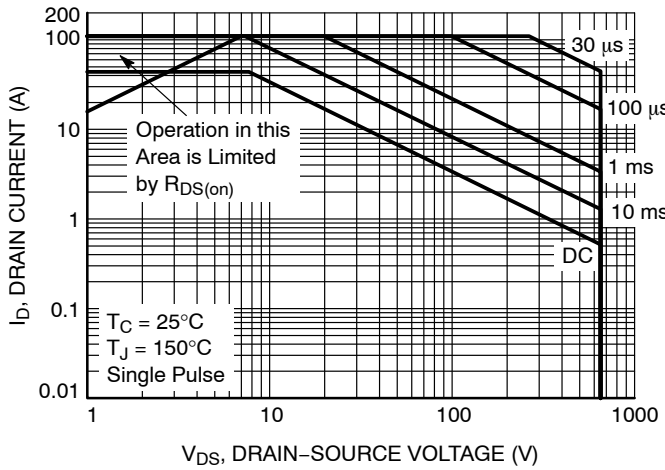
## TYPICAL CHARACTERISTICS ( $T_C = 25^\circ\text{C}$ unless otherwise noted)



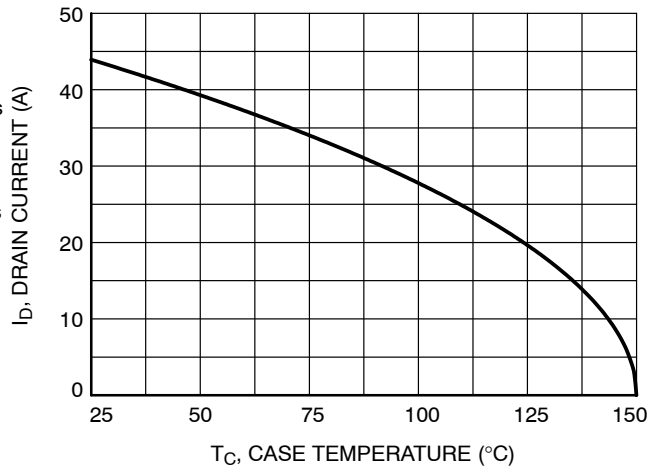
**Figure 7. Breakdown Voltage Variation vs. Temperature**



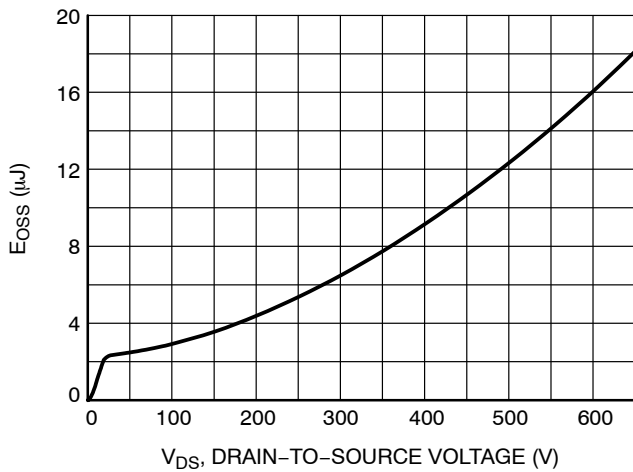
**Figure 8. On-Resistance Variation vs. Temperature**



**Figure 9. Maximum Safe Operating Area**



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



**Figure 11.  $E_{OSS}$  vs. Drain to Source Voltage**

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## TYPICAL CHARACTERISTICS ( $T_C = 25^\circ\text{C}$ unless otherwise noted)

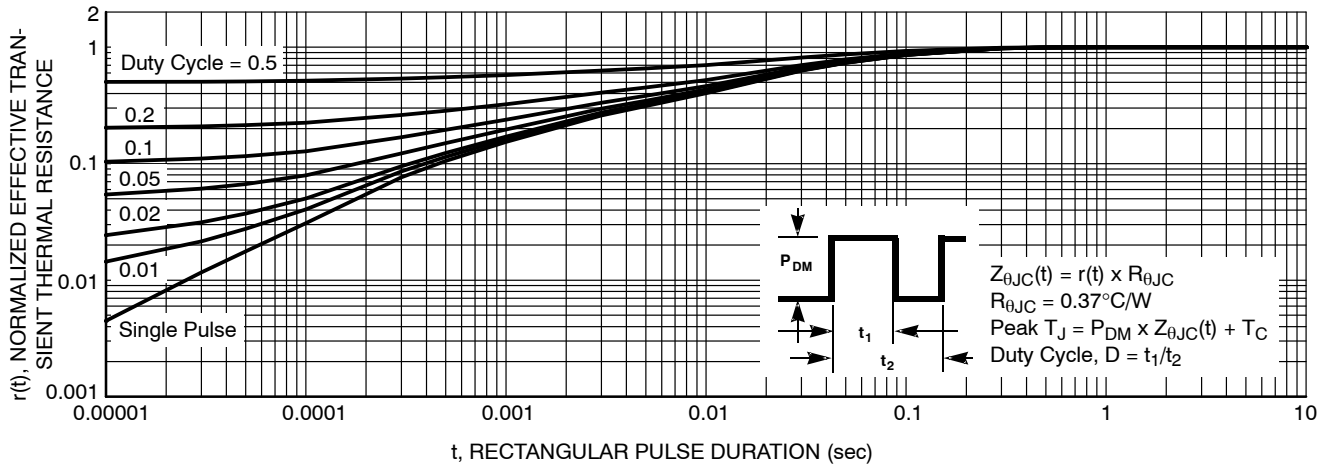


Figure 12. Transient Thermal Impedance

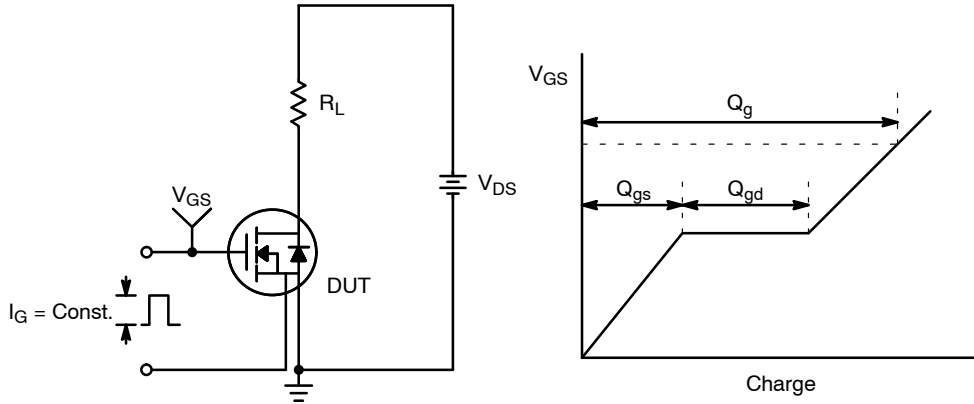


Figure 13. Gate Charge Test Circuit & Waveform



Figure 14. Resistive Switching Test Circuit & Waveforms



Figure 15. Unclamped Inductive Switching Test Circuit & Waveforms

NTBL070N65S3

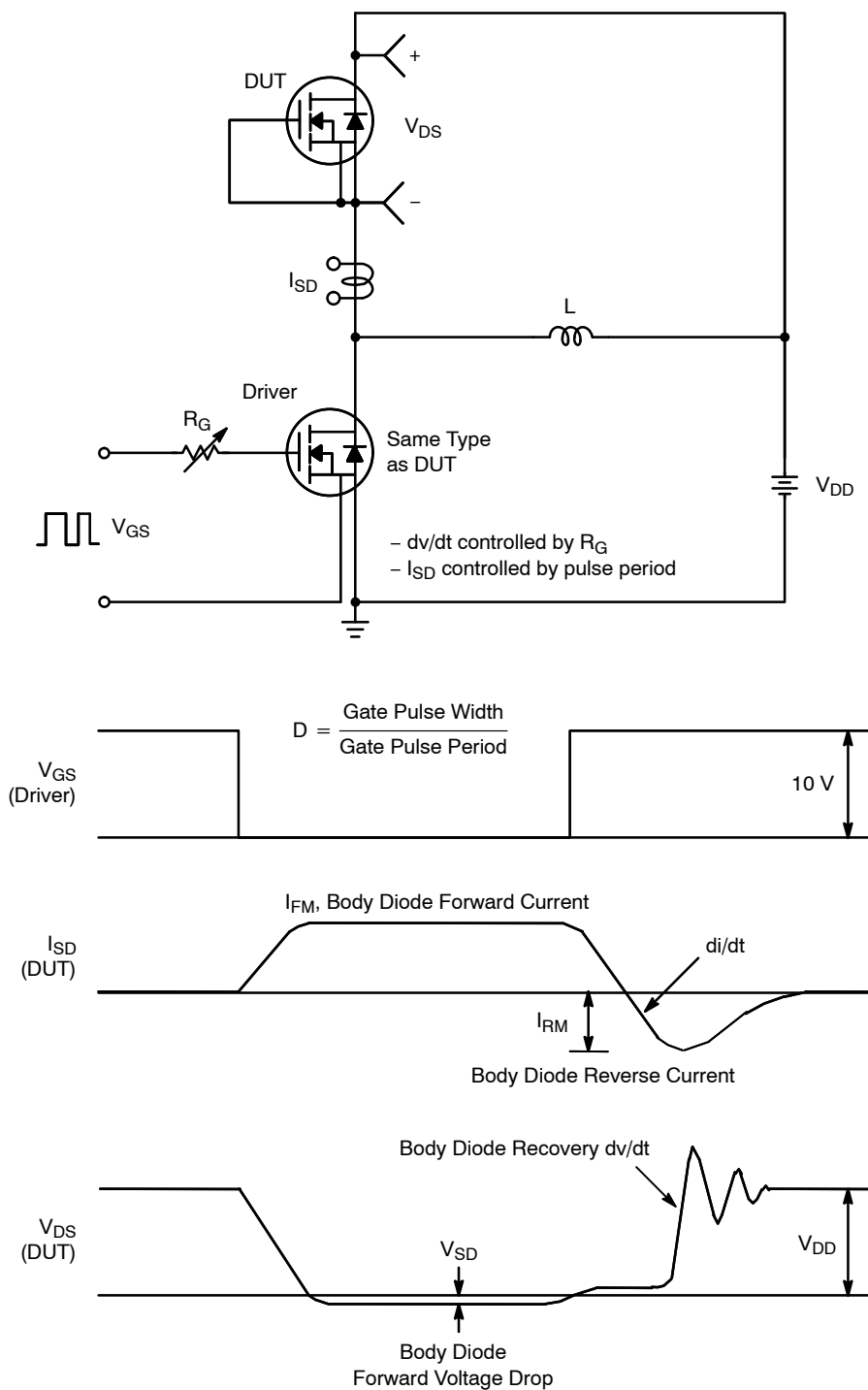
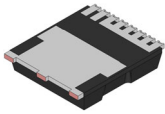


Figure 16. Peak Diode Recovery  $dv/dt$  Test Circuit & Waveforms

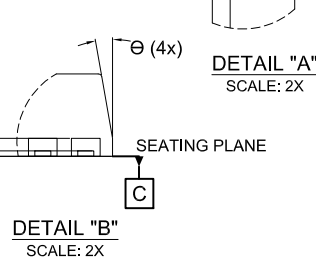
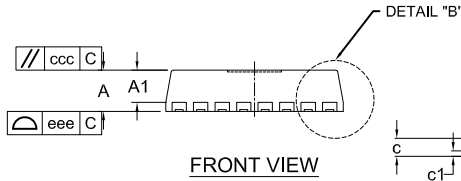
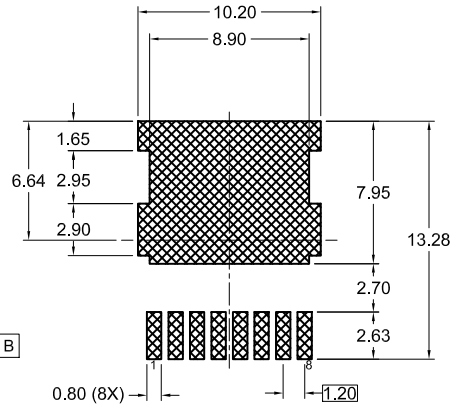
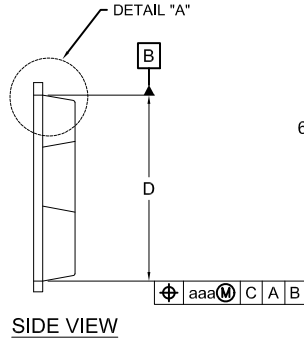
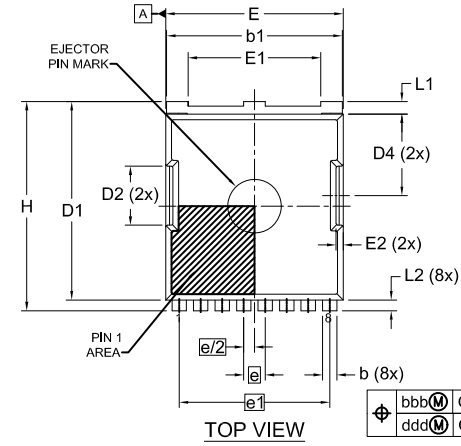


# MECHANICAL CASE OUTLINE PACKAGE DIMENSIONS

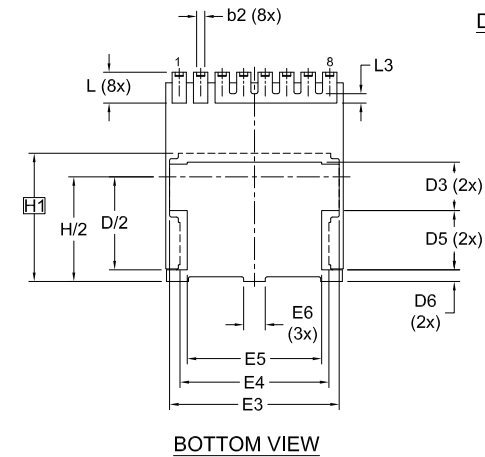


**H-PSOF8L 9.90x11.68, 1.20P**  
CASE 100DC  
ISSUE A

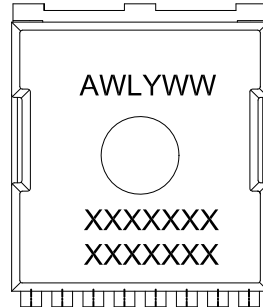
DATE 18 MAY 2023



DETAIL "B"  
SCALE: 2X



### GENERIC MARKING DIAGRAM\*



A = ASSY LOCATION  
WL = WAFER LOT CODE  
Y = YEAR CODE  
WW = WORK WEEK CODE  
XXXXXXXX = DEVICE CODE  
XXXXXXXX = 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  |
| theta | 0°          | ---   | 12°   |
| aaa   | 0.20        |       |       |
| bbb   | 0.25        |       |       |
| ccc   | 0.20        |       |       |
| ddd   | 0.20        |       |       |
| eee   | 0.10        |       |       |

|                         |                                   |   |
|-------------------------|-----------------------------------|---|
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