

MOSFET - Power, N-Channel, SUPERFET® III, FRFET® 650 V, 20 A, 190 mΩ

NTMT190N65S3HF

Description

SUPERFET III MOSFET is onsemi'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 is very suitable for the various power systems for miniaturization and higher efficiency.

SUPERFET III FRFET MOSFET's optimized reverse recovery performance of body diode can remove additional components and improve system reliability.

The TDFN4 package is an ultra-slim surface-mount package (1 mm high) with a low profile and small footprint (8x8 mm²). SUPERFET III MOSFET in a TDFN4 package offers excellent switching performance due to lower parasitic source inductance and separated power and drive sources. TDFN4 offers Moisture Sensitivity Level 1 (MSL 1).

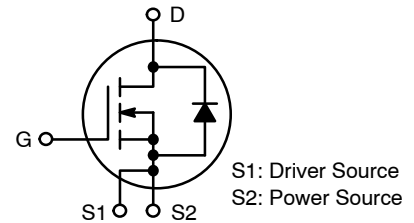
Features

- 700 V @ T_J = 150 °C
- Typ R_{DS(on)} = 159 mΩ
- Ultra Low Gate Charge (Typ. Q_g = 34 nC)
- Low Effective Output Capacitance (Typ. C_{oss(eff.)} = 316 pF)
- 100% Avalanche Tested
- These Devices are Pb-Free and are RoHS Compliant

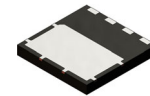
Applications

- Telecom / Server Power Supplies
- Industrial Power Supplies
- UPS / Solar
- Lighting / Charger / Adapter

| V _{DSS} | R _{DS(ON)} MAX | I _D MAX |
|------------------|-------------------------|--------------------|
| 650 V | 190 mΩ @ 10 V | 20 A |

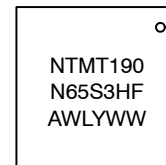


POWER MOSFET



TDFN4 8X8
CASE 520AB

MARKING DIAGRAM



NTMT190N65S3HF = Specific Device Code
A = Assembly Location
WL = Wafer Lot
Y = Year
WW = Work Week

ORDERING INFORMATION

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

NTMT190N65S3HF

ABSOLUTE MAXIMUM RATINGS (T_C = 25°C, Unless otherwise specified)

| Symbol | Parameter | Value | Unit |
|-----------------------------------|--|-------------------------------------|------|
| V _{DSS} | Drain to Source Voltage | 650 | V |
| V _{GSS} | Gate to Source Voltage | DC | ±30 |
| | | AC (f > 1 Hz) | ±30 |
| I _D | Drain Current | Continuous (T _C = 25°C) | 20 |
| | | Continuous (T _C = 100°C) | 12.7 |
| I _{DM} | Drain Current | Pulsed (Note 1) | 50 |
| E _{AS} | Single Pulsed Avalanche Energy (Note 2) | 220 | mJ |
| I _{AS} | Avalanche Current (Note 2) | 3.7 | A |
| E _{AR} | Repetitive Avalanche Energy (Note 1) | 1.62 | mJ |
| dv/dt | MOSFET dv/dt | 100 | V/ns |
| | Peak Diode Recovery dv/dt (Note 3) | 50 | |
| P _D | Power Dissipation | (T _C = 25°C) | 162 |
| | | Derate Above 25°C | 1.3 |
| T _J , T _{STG} | Operating and Storage Temperature Range | -55 to +150 | °C |
| T _L | Maximum Lead Temperature for Soldering, 1/8" from Case for 5 s | 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_{AS} = 3.7 A, R_G = 25 Ω starting T_J = 25°C
3. I_{SD} ≤ 10 A, di/dt ≤ 100 A/μs, V_{DD} ≤ 400 V, starting T_J = 25°C

THERMAL CHARACTERISTICS

| Symbol | Parameter | Value | Unit |
|------------------|--|-------|------|
| R _{θJC} | Thermal Resistance, Junction to Case, Max. | 0.77 | °C/W |
| R _{θJA} | Thermal Resistance, Junction to Ambient, Max. (Note 4) | 45 | |

4. Device on 1 in² pad 2 oz copper pad on 1.5 x 1.5 in. board of FR-4 material.

ORDERING INFORMATION

| Part Number | Top Marking | Package | Reel Size | Tape Width | Shipping† |
|----------------|----------------|---------|-----------|------------|--------------------|
| NTMT190N65S3HF | NTMT190N65S3HF | TDFN4 | 13" | 13.3 mm | 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.

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ELECTRICAL CHARACTERISTICS (T_C = 25°C unless otherwise noted)

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

OFF CHARACTERISTICS

| | | | | | | |
|--------------------------------------|---|--|-----|------|------|------|
| BV _{DSS} | Drain to Source Breakdown Voltage | V _{GS} = 0 V, I _D = 1 mA, T _J = 25°C | 650 | – | – | V |
| | | V _{GS} = 0 V, I _D = 1 mA, T _J = 150°C | 700 | – | – | V |
| ΔBV _{DSS} / ΔT _J | Breakdown Voltage Temperature Coefficient | I _D = 10 mA, referenced to 25°C | – | 0.65 | – | V/°C |
| I _{DSS} | Zero Gate Voltage Drain Current | V _{DS} = 650 V, V _{GS} = 0 V | – | – | 10 | μA |
| | | V _{DS} = 520 V, T _C = 125 °C | – | 15 | | |
| I _{GSS} | Gate to Source Leakage Current | V _{GS} = ±30 V, V _{DS} = 0 V | – | – | ±100 | nA |

ON CHARACTERISTICS

| | | | | | | |
|---------------------|--------------------------------------|--|-----|-----|-----|----|
| V _{GS(th)} | Gate Threshold Voltage | V _{GS} = V _{DS} , I _D = 0.43 mA | 3.0 | – | 5.0 | V |
| R _{DS(on)} | Static Drain to Source On Resistance | V _{GS} = 10 V, I _D = 10 A | – | 159 | 190 | mΩ |
| g _{FS} | Forward Transconductance | V _{DS} = 20 V, I _D = 10 A | – | 11 | – | S |

DYNAMIC CHARACTERISTICS

| | | | | | | |
|------------------------|-----------------------------------|---|---|------|---|----|
| C _{iss} | Input Capacitance | V _{DS} = 400 V, V _{GS} = 0 V, f = 1 MHz | – | 1610 | – | pF |
| C _{oss} | Output Capacitance | | – | 30 | – | pF |
| C _{oss(eff.)} | Effective Output Capacitance | V _{DS} = 0 V to 400 V, V _{GS} = 0 V | – | 316 | – | pF |
| C _{oss(er.)} | Energy Related Output Capacitance | V _{DS} = 0 V to 400 V, V _{GS} = 0 V | – | 59 | – | pF |
| Q _{g(tot)} | Total Gate Charge at 10 V | V _{DS} = 400 V, I _D = 10 A, V _{GS} = 10 V (Note 5) | – | 34 | – | nC |
| Q _{gs} | Gate to Source Gate Charge | | – | 11 | – | nC |
| Q _{gd} | Gate to Drain “Miller” Charge | | – | 13 | – | nC |
| ESR | Equivalent Series Resistance | f = 1 MHz | – | 4.1 | – | Ω |

SWITCHING CHARACTERISTICS

| | | | | | | |
|---------------------|---------------------|---|---|-----|---|----|
| t _{d(on)} | Turn-On Delay Time | V _{DD} = 400 V, I _D = 10 A, V _{GS} = 10 V, R _{GEN} = 4.7 Ω (Note 5) | – | 22 | – | ns |
| t _r | Rise Time | | – | 13 | – | ns |
| t _{d(off)} | Turn-Off Delay Time | | – | 53 | – | ns |
| t _f | Fall Time | | – | 3.3 | – | ns |

SOURCE-DRAIN DIODE CHARACTERISTICS

| | | | | | | |
|-----------------|--|---|---|-----|-----|----|
| I _S | Maximum Continuous Source to Drain Diode Forward Current | – | – | 20 | A | |
| I _{SM} | Maximum Pulsed Source to Drain Diode Forward Current | – | – | 50 | A | |
| V _{SD} | Source to Drain Diode Forward Voltage | V _{GS} = 0 V, I _{SD} = 10 A | – | – | 1.3 | V |
| t _{rr} | Reverse Recovery Time | V _{GS} = 0 V, I _{SD} = 10 A, di _F /dt = 100 A/μs | – | 72 | – | ns |
| Q _{rr} | Reverse Recovery Charge | | – | 255 | – | 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.

5. Essentially independent of operating temperature typical characteristics.

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TYPICAL CHARACTERISTICS

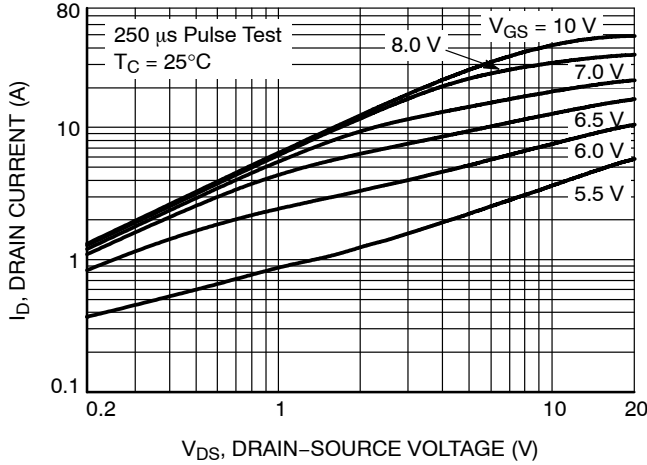


Figure 1. On-Region Characteristics

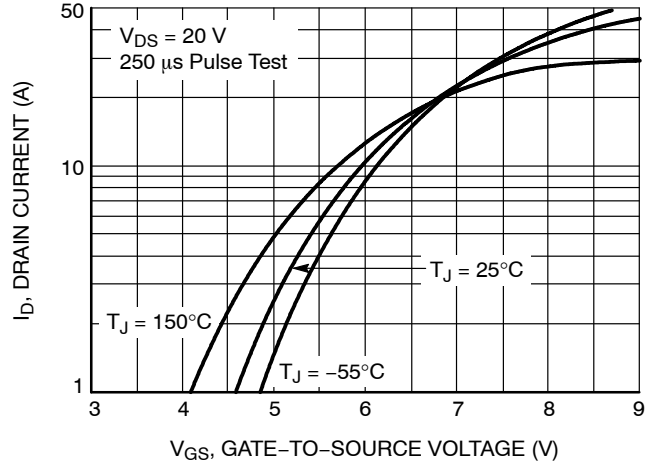


Figure 2. Transfer Characteristics

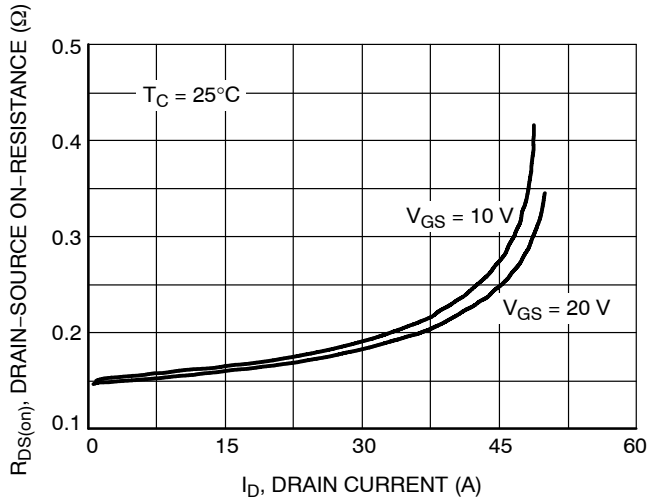


Figure 3. On-Resistance Variation vs. Drain Current and Gate Voltage

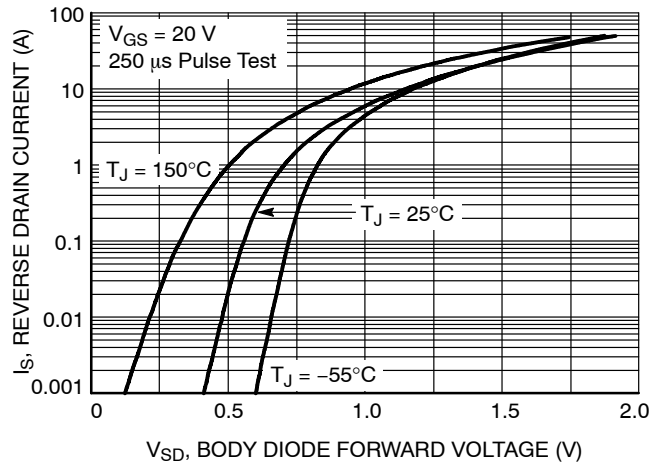


Figure 4. Body Diode Forward Voltage Variation vs. Source Current and Temperature

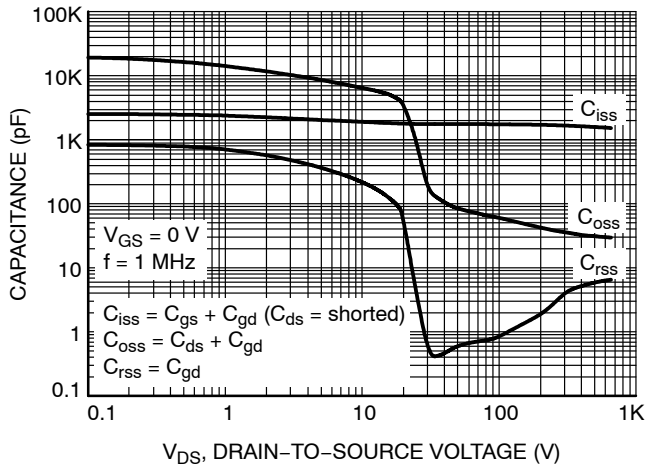


Figure 5. Capacitance Characteristics

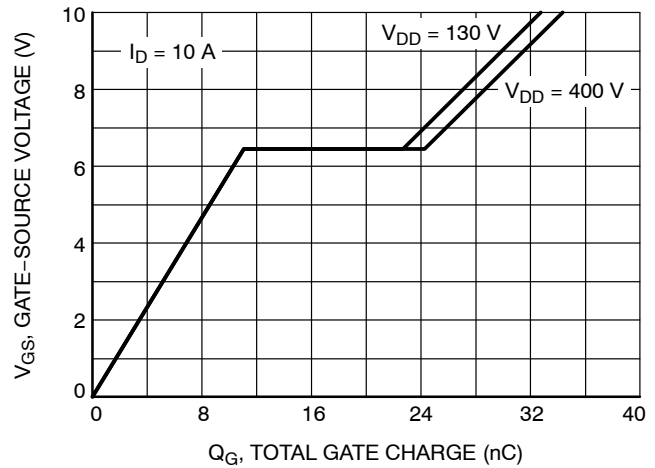


Figure 6. Gate Charge Characteristics

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TYPICAL CHARACTERISTICS

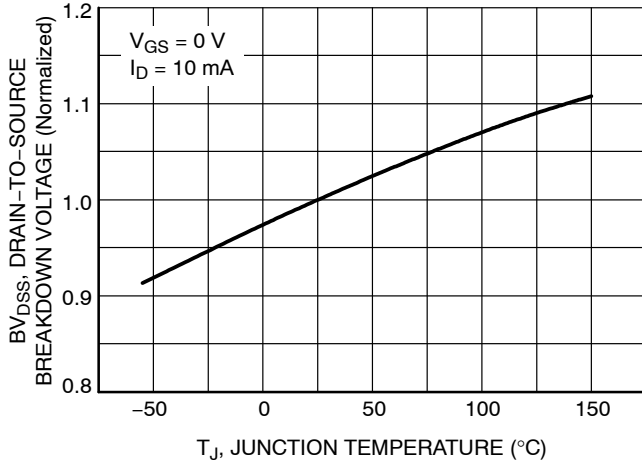


Figure 7. Breakdown Voltage Variation vs. Temperature

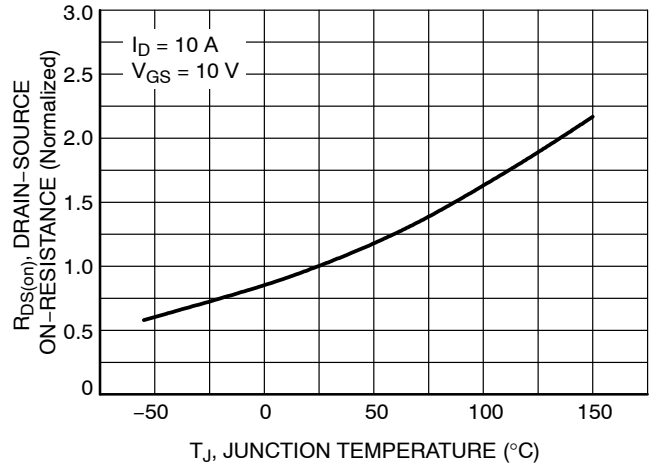


Figure 8. On-Resistance Variation vs. Temperature

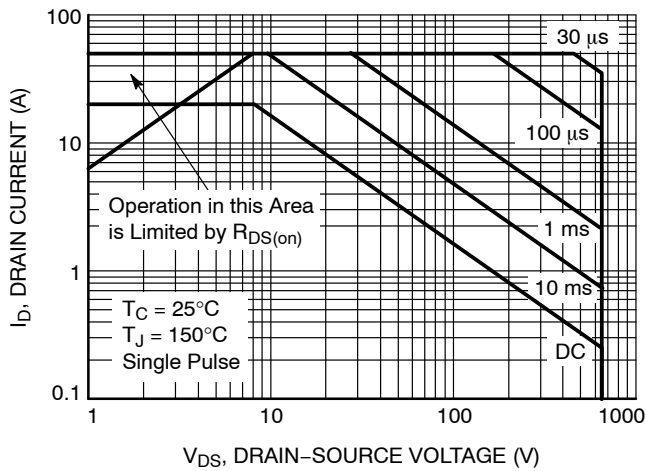


Figure 9. Maximum Safe Operating Area

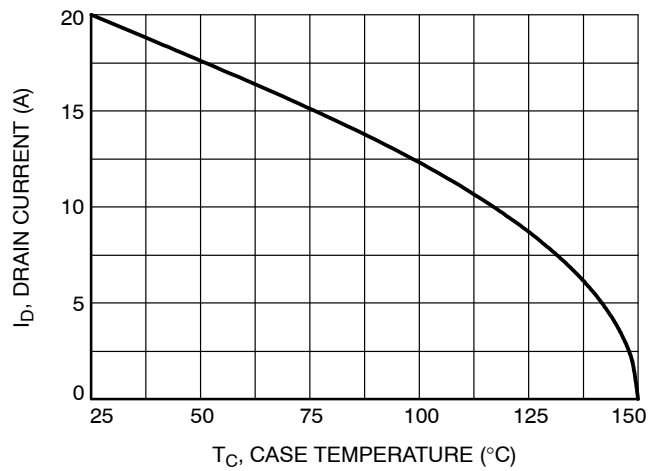


Figure 10. Maximum Drain Current vs. Case Temperature

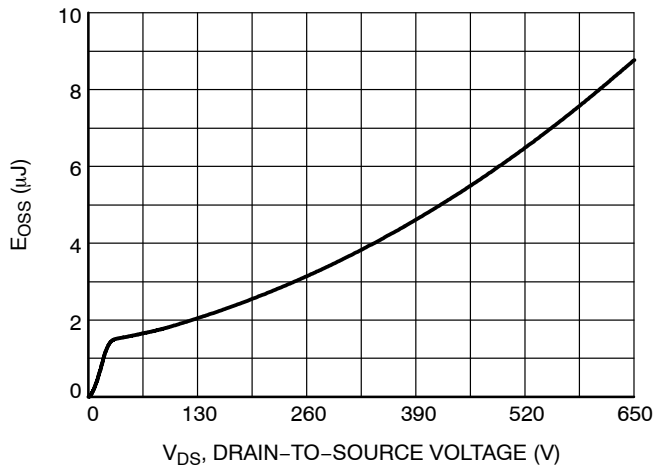


Figure 11. E_{OSS} vs. Drain-to-Source Voltage

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TYPICAL CHARACTERISTICS

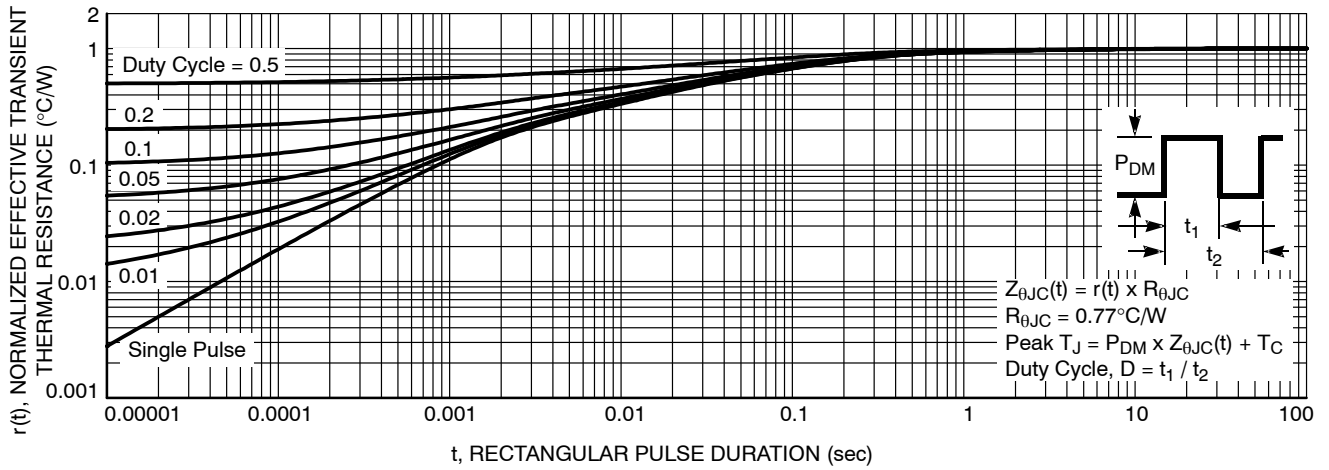


Figure 12. Transient Thermal Response Curve

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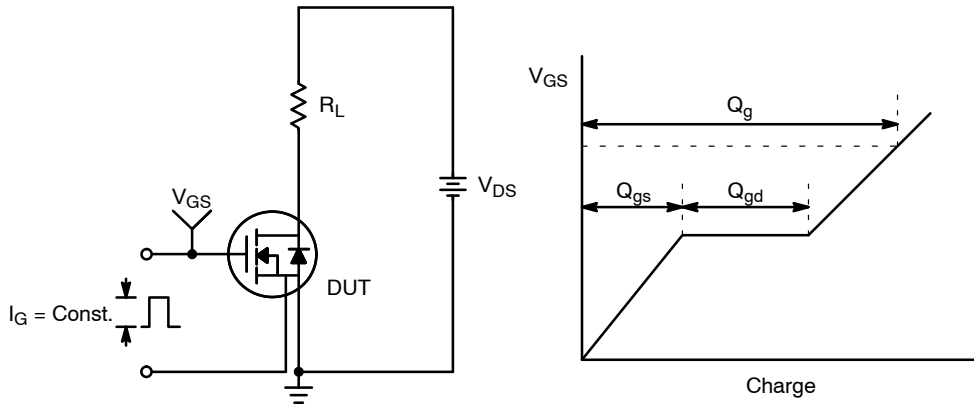


Figure 13. Gate Charge Test Circuit & Waveform

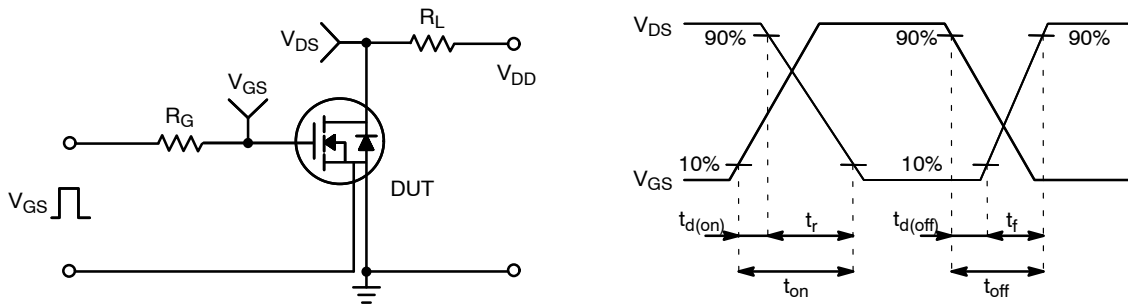


Figure 14. Resistive Switching Test Circuit & Waveforms

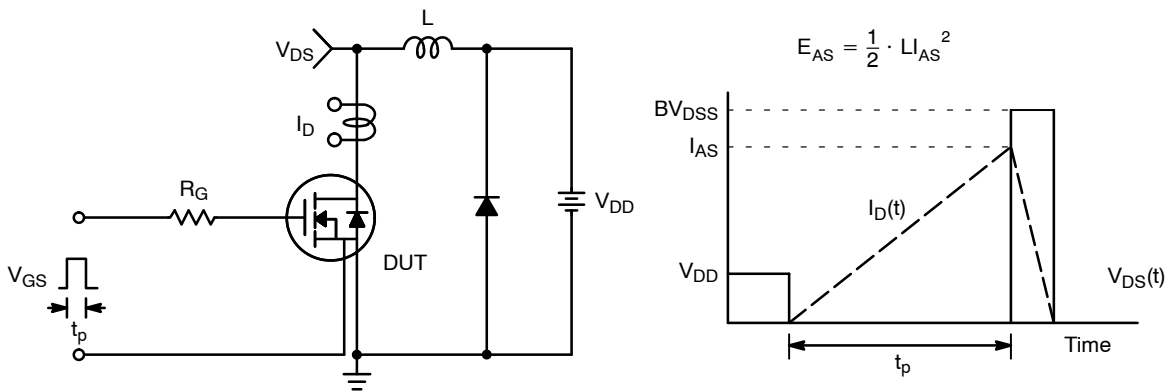


Figure 15. Unclamped Inductive Switching Test Circuit & Waveforms

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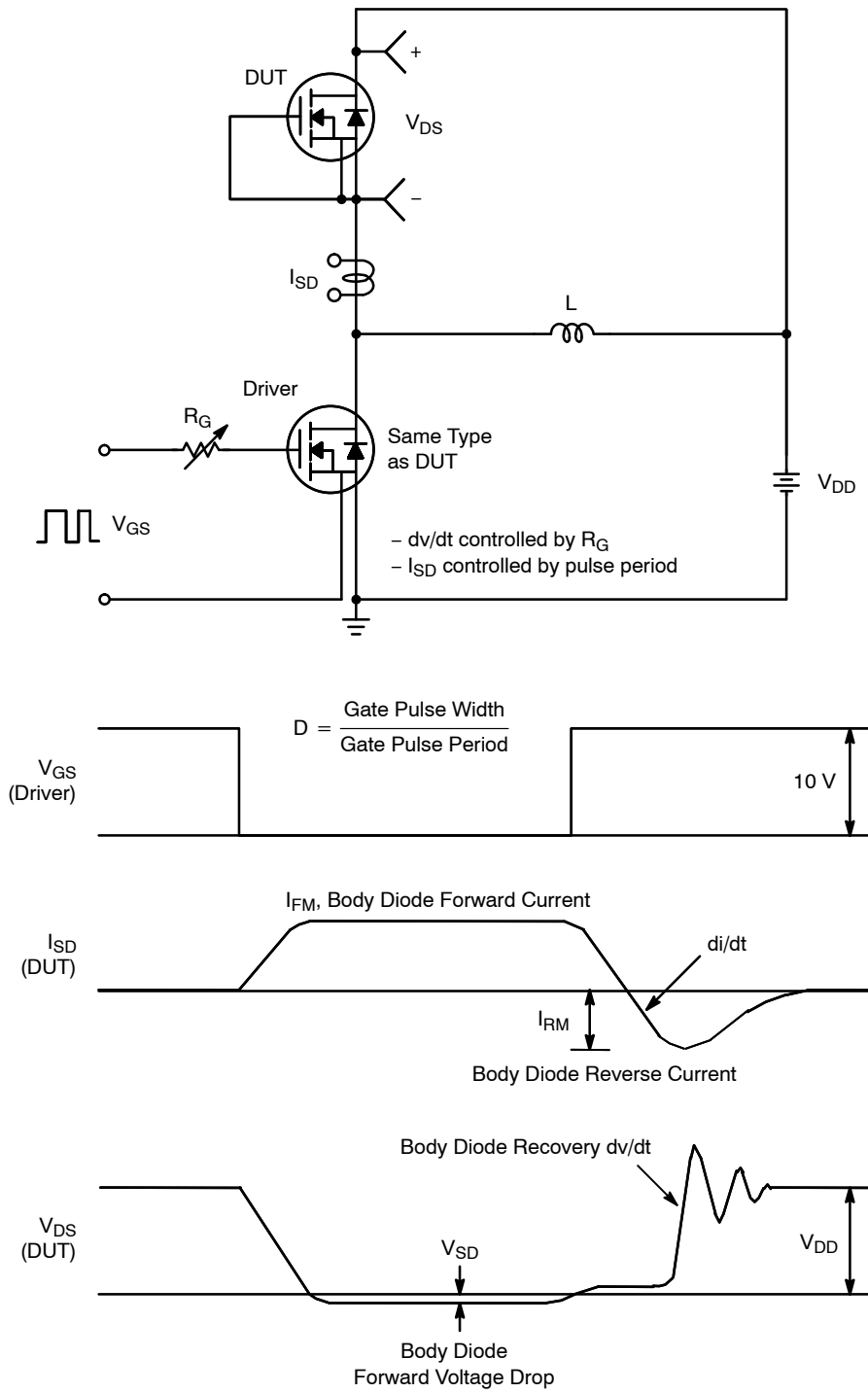
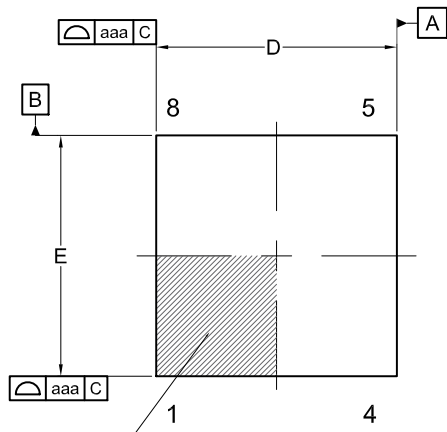


Figure 16. Peak Diode Recovery dv/dt Test Circuit & Waveforms

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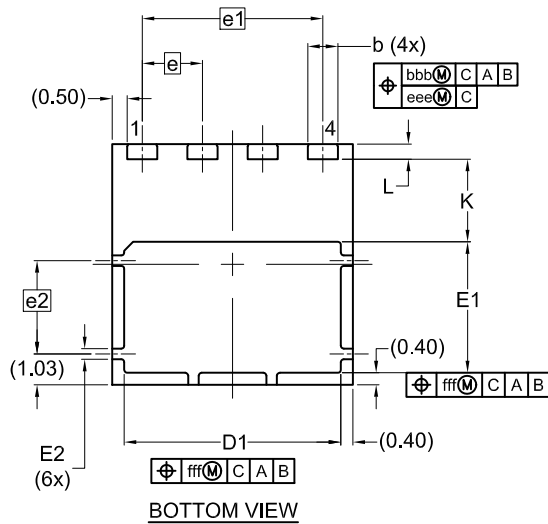
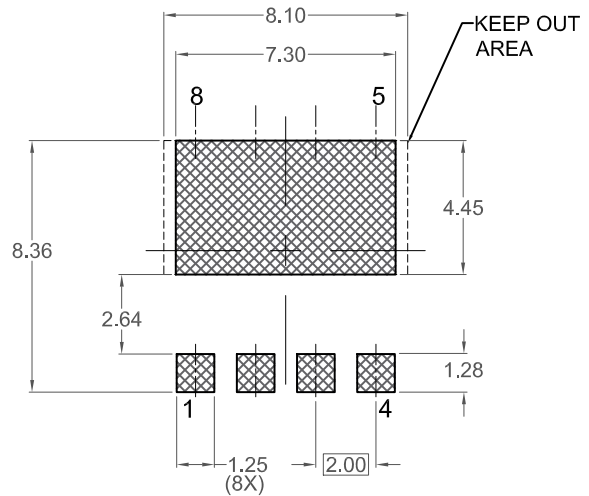
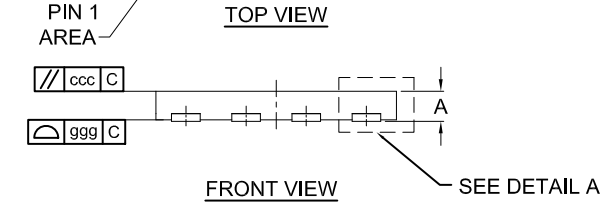
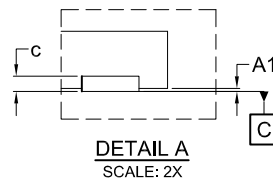
PACKAGE DIMENSIONS

TDFN4 8x8, 2P
CASE 520AB
ISSUE O



- NOTES: UNLESS OTHERWISE SPECIFIED
 A) DOES NOT FULLY CONFORM TO JEDEC REGISTRATION MO-220.
 B) ALL DIMENSIONS ARE IN MILLIMETERS.
 C) DIMENSIONS DO NOT INCLUDE BURRS OR MOLD FLASH. MOLD FLASH OR BURRS DOES NOT EXCEED 0.10MM.
 D) IT IS RECOMMENDED TO HAVE NO TRACES OR VIAS WITHIN THE KEEP OUT AREA.

| DIM | MILLIMETERS | | |
|-----|-------------|------|------|
| | MIN. | NOM. | MAX. |
| A | 0.90 | 1.00 | 1.10 |
| A1 | 0.00 | --- | 0.05 |
| b | 0.90 | 1.00 | 1.10 |
| c | 0.10 | 0.20 | 0.30 |
| D | 7.90 | 8.00 | 8.10 |
| D1 | 7.10 | 7.20 | 7.30 |
| E | 7.90 | 8.00 | 8.10 |
| E1 | 4.25 | 4.35 | 4.45 |
| E2 | 0.15 | 0.25 | 0.35 |
| e | 2.00 BSC | | |
| e1 | 6.00 BSC | | |
| e2 | 3.10 BSC | | |
| K | (2.75) | | |
| L | 0.40 | 0.50 | 0.60 |
| aaa | 0.10 | | |
| bbb | 0.10 | | |
| ccc | 0.05 | | |
| eee | 0.05 | | |
| fff | 0.10 | | |
| ggg | 0.15 | | |



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

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