# FCB199N65S3

# MOSFET – Power, N-Channel, SUPERFET III, Easy Drive

## 650 V, 14 A, 199 mΩ

### 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 advance 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 various power system miniaturization and higher efficiency.

### Features

- 700 V @ $T_J$ = 150°C
- Typ. $R_{DS(on)}$ = 170 mΩ
- Ultra Low Gate Charge (Typ. $Q_g$ = 30 nC)
- Low Effective Output Capacitance (Typ. $C_{oss(eff.)}$ = 277 pF)
- 100% Avalanche Tested
- These Devices are Pb−Free and are RoHS Compliant

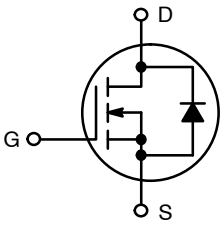
### Applications

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

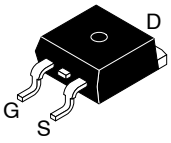
**ON Semiconductor®**

www.onsemi.com

| $V_{DSS}$ | $R_{DS(ON)}$ MAX | $I_D$ MAX |
|---|---|---|
| 650 V | 199 mΩ @ 10 V | 14 A |

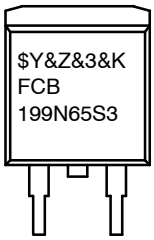



**POWER MOSFET**




**D²−PAK**
**CASE 418AJ**

### MARKING DIAGRAM




| | |
|---|---|
| $Y | = ON Semiconductor Logo |
| &Z | = Assembly Plant Code |
| &3 | = Data Code (Year & Week) |
| &K | = Lot |
| FCB199N65S3 | = Specific Device Code |

### ORDERING INFORMATION

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

**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 | V |
| | | AC (f > 1 Hz) | ±30 | V |
| $I_D$ | Drain Current | Continuous ($T_C$ = 25°C) | 14 | A |
| | | Continuous ($T_C$ = 100°C) | 9 | |
| $I_{DM}$ | Drain Current | Pulsed (Note 1) | 35 | A |
| $E_{AS}$ | Single Pulsed Avalanche Energy (Note 2) | | 76 | mJ |
| $I_{AS}$ | Avalanche Current (Note 1) | | 2.5 | A |
| $E_{AR}$ | Repetitive Avalanche Energy (Note 1) | | 0.98 | mJ |
| dv/dt | MOSFET dv/dt | | 100 | V/ns |
| | Peak Diode Recovery dv/dt (Note 3) | | 20 | |
| $P_D$ | Power Dissipation | ($T_C$ = 25°C) | 98 | W |
| | | Derate Above 25°C | 0.79 | W/°C |
| $T_J$, $T_{STG}$ | 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. $I_{AS}$ = 2.5 A, $R_G$ = 25 Ω, starting $T_J$ = 25°C.
3. $I_{SD}$ ≤ 7 A, di/dt ≤ 200 A/μs, $V_{DD}$ ≤ 400 V, starting $T_J$ = 25°C.

**THERMAL CHARACTERISTICS**

| Symbol | Parameter | Value | Unit |
|---|---|---|---|
| $R_{\theta JC}$ | Thermal Resistance, Junction to Case, Max. | 1.27 | °C/W |
| | Thermal Resistance, Junction to Ambient, Max. (Note 4) | 40 | |

4. Device on 1 $in^2$ pad 2 oz copper pad on 1.5 x 1.5 in. board of FR−4 material.

**PACKAGE MARKING AND ORDERING INFORMATION**

| Part Number | Top Marking | Package | Reel Size | Tape Width | Shipping† |
|---|---|---|---|---|---|
| FCB199N65S3 | FCB199N65S3 | $D^2$−PAK | 330 mm | 24 mm | 800 / 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.

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

| Symbol | Parameter | Test Conditions | 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 |
| $\Delta BV_{DSS}/\Delta T_J$ | Breakdown Voltage Temperature Coefficient | $I_D$ = 1 mA, Referenced to 25°C | | 0.6 | | V/°C |
| $I_{DSS}$ | Zero Gate Voltage Drain Current | $V_{DS}$ = 650 V, $V_{GS}$ = 0 V | | | 1 | μA |
| | | $V_{DS}$ = 520 V, $T_C$ = 125°C | | 0.89 | | |
| $I_{GSS}$ | Gate to Body Leakage Current | $V_{GS}$ = ±30 V, $V_{DS}$ = 0 V | | | ±100 | nA |
| **ON CHARACTERISTICS** | | | | | | |
| $V_{GS(th)}$ | Gate Threshold Voltage | $V_{GS}$ = $V_{DS}$, $I_D$ = 0.36 mA | 2.5 | | 4.5 | V |
| $R_{DS(on)}$ | Static Drain to Source On Resistance | $V_{GS}$ = 10 V, $I_D$ = 7 A | | 170 | 199 | mΩ |
| $g_{FS}$ | Forward Transconductance | $V_{DS}$ = 20 V, $I_D$ = 7 A | | 10 | | S |
| **DYNAMIC CHARACTERISTICS** | | | | | | |
| $C_{iss}$ | Input Capacitance | $V_{DS}$ = 400 V, $V_{GS}$ = 0 V, f = 1 MHz | | 1225 | | pF |
| $C_{oss}$ | Output Capacitance | | | 30 | | pF |
| $C_{oss(eff.)}$ | Effective Output Capacitance | $V_{DS}$ = 0 V to 400 V, $V_{GS}$ = 0 V | | 277 | | pF |
| $C_{oss(er.)}$ | Energy Related Output Capacitance | $V_{DS}$ = 0 V to 400 V, $V_{GS}$ = 0 V | | 43 | | pF |
| $Q_{g(tot)}$ | Total Gate Charge at 10 V | $V_{DS}$ = 400 V, $I_D$ = 7 A, $V_{GS}$ = 10 V (Note 5) | | 30 | | nC |
| $Q_{gs}$ | Gate to Source Gate Charge | | | 7.4 | | nC |
| $Q_{gd}$ | Gate to Drain “Miller” Charge | | | 13 | | nC |
| ESR | Equivalent Series Resistance | f = 1 MHz | | 7 | | Ω |
| **SWITCHING CHARACTERISTICS** | | | | | | |
| $t_{d(on)}$ | Turn-On Delay Time | $V_{DD}$ = 400 V, $I_D$ = 7 A, $V_{GS}$ = 10 V, $R_g$ = 4.7 Ω (Note 5) | | 19 | | ns |
| $t_r$ | Turn-On Rise Time | | | 23 | | ns |
| $t_{d(off)}$ | Turn-Off Delay Time | | | 52 | | ns |
| $t_f$ | Turn-Off Fall Time | | | 15 | | ns |
| **SOURCE-DRAIN DIODE CHARACTERISTICS** | | | | | | |
| $I_S$ | Maximum Continuous Source to Drain Diode Forward Current | | | | 14 | A |
| $I_{SM}$ | Maximum Pulsed Source to Drain Diode Forward Current | | | | 35 | A |
| $V_{SD}$ | Source to Drain Diode Forward Voltage | $V_{GS}$ = 0 V, $I_{SD}$ = 7 A | | | 1.2 | V |
| $t_{rr}$ | Reverse Recovery Time | $V_{DD}$ = 400 V, $I_{SD}$ = 7 A, $dI_F/dt$ = 100 A/μs | | 256 | | ns |
| $Q_{rr}$ | Reverse Recovery Charge | | | 3.5 | | 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 PERFORMANCE CHARACTERISTICS

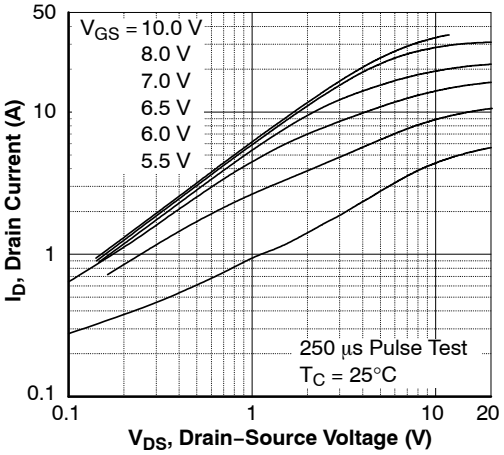



**Figure 1. On−Region Characteristics**

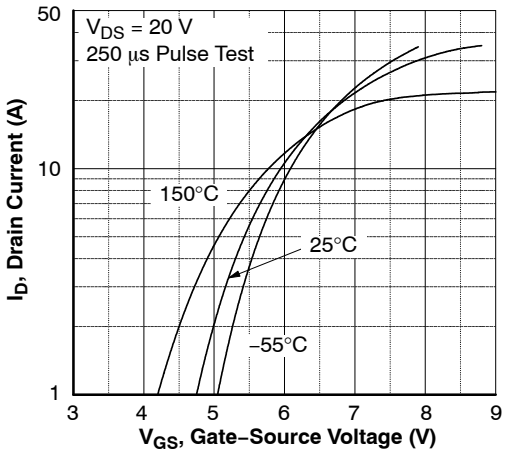



**Figure 2. Transfer Characteristics**

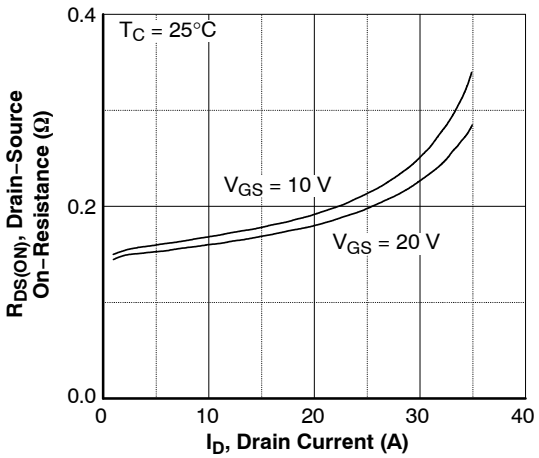



**Figure 3. On−Resistance Variation vs. Drain Current and Gate Voltage**

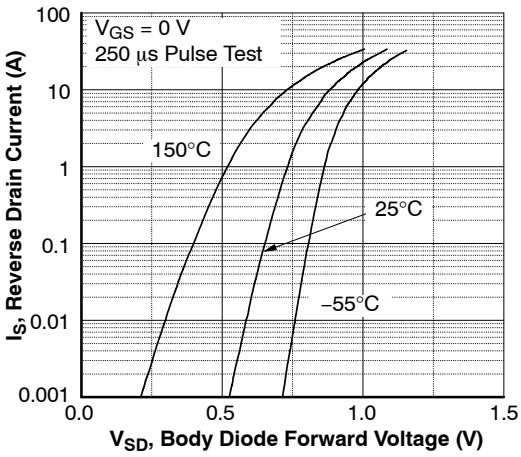



**Figure 4. Body Diode Forward Voltage Variation vs. Source Current and Temperature**

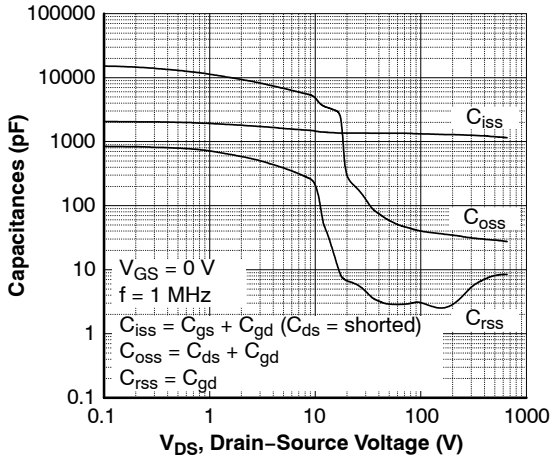



**Figure 5. Capacitance Characteristics**

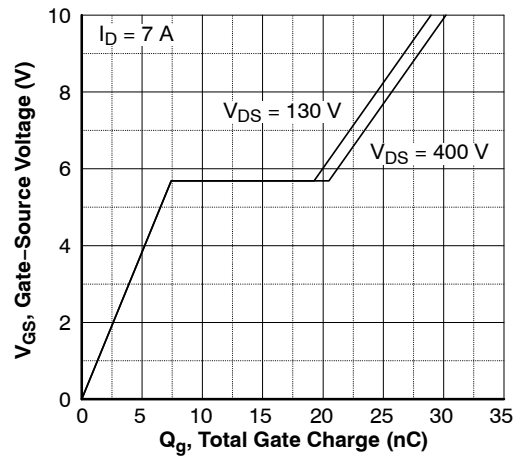



**Figure 6. Gate Charge Characteristics**

## TYPICAL PERFORMANCE CHARACTERISTICS (Continued)

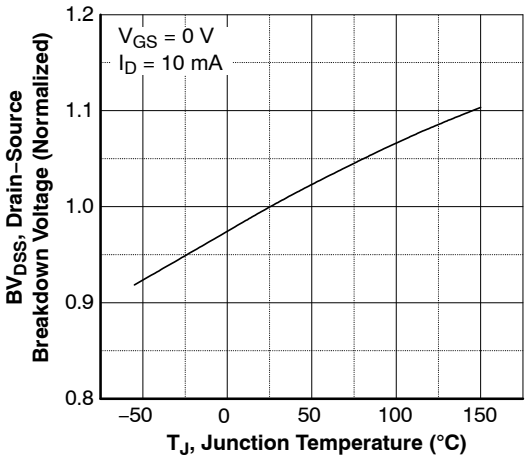



**Figure 7. Breakdown Voltage Variation vs. Temperature**

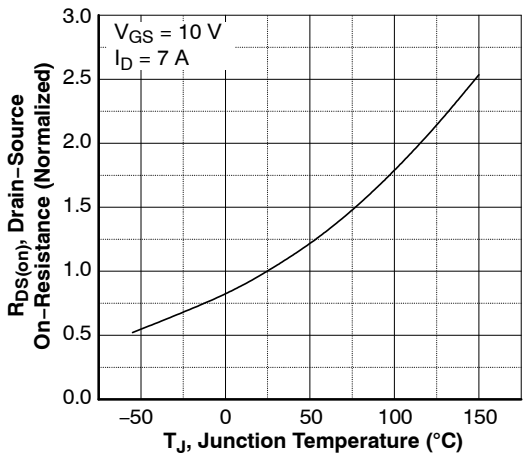



**Figure 8. On−Resistance Variation vs. Temperature**

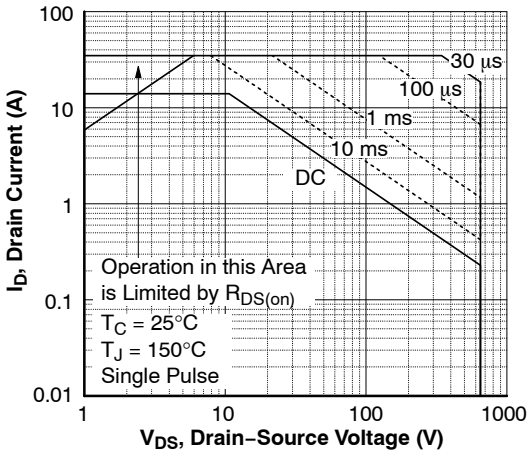



**Figure 9. Maximum Safe Operating Area**

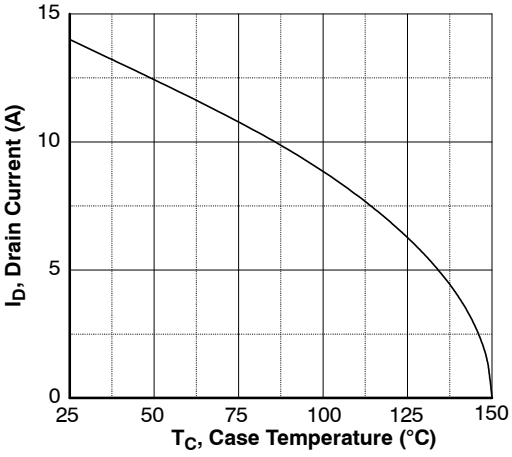



**Figure 10. Maximum Drain Current vs. Case Temperature**

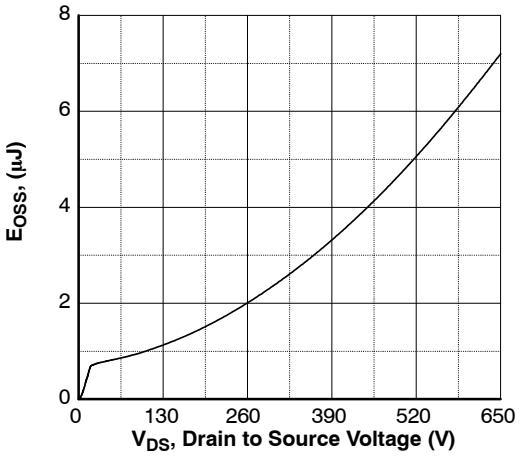



**Figure 11. $E_{OSS}$ vs. Drain to Source Voltage**

## TYPICAL PERFORMANCE CHARACTERISTICS (Continued)

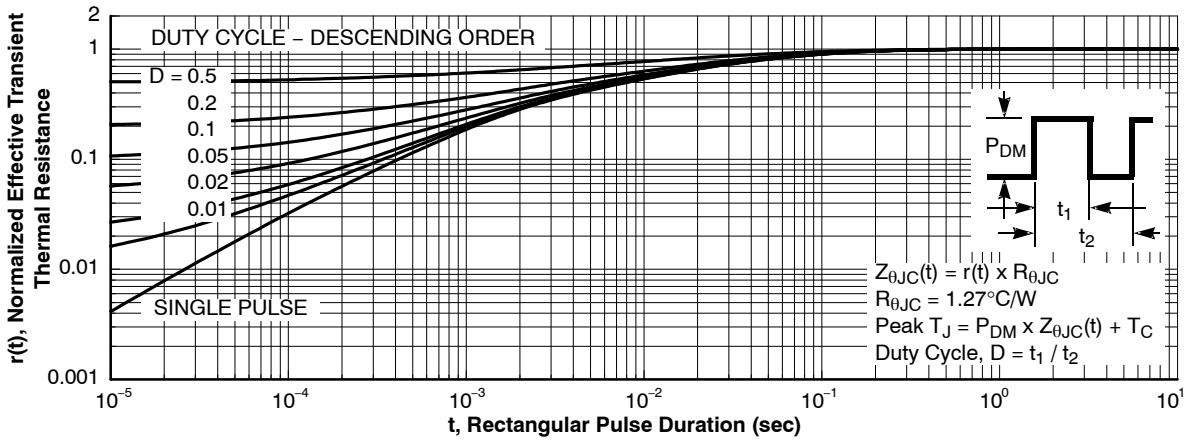



**Figure 12. Transient Thermal Response Curve**

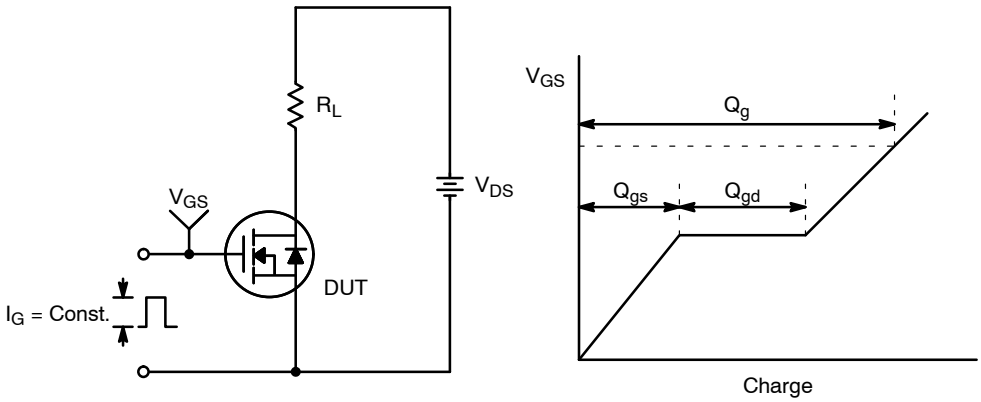



**Figure 13. Gate Charge Test Circuit & Waveform**

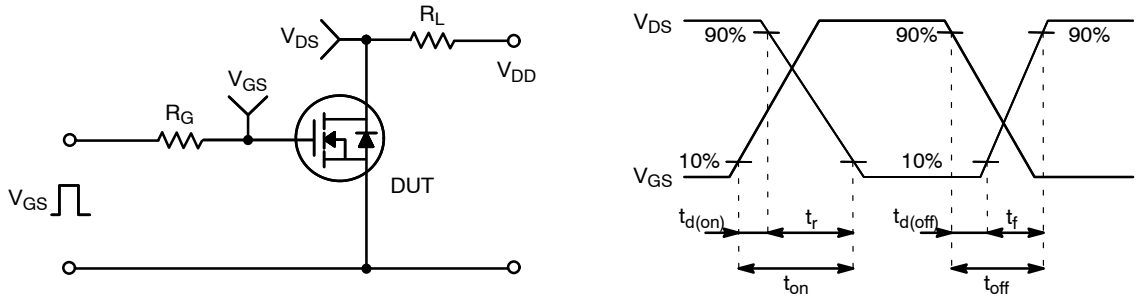



**Figure 14. Resistive Switching Test Circuit & Waveforms**

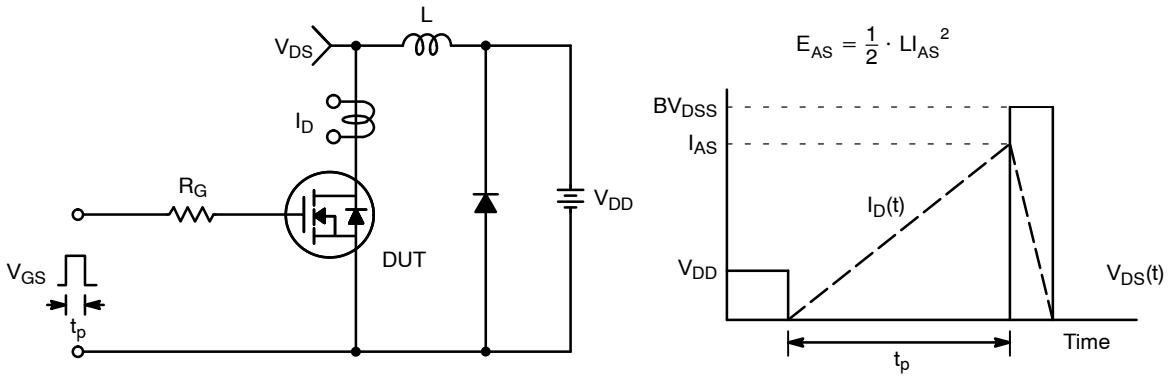



**Figure 15. Unclamped Inductive Switching Test Circuit & Waveforms**

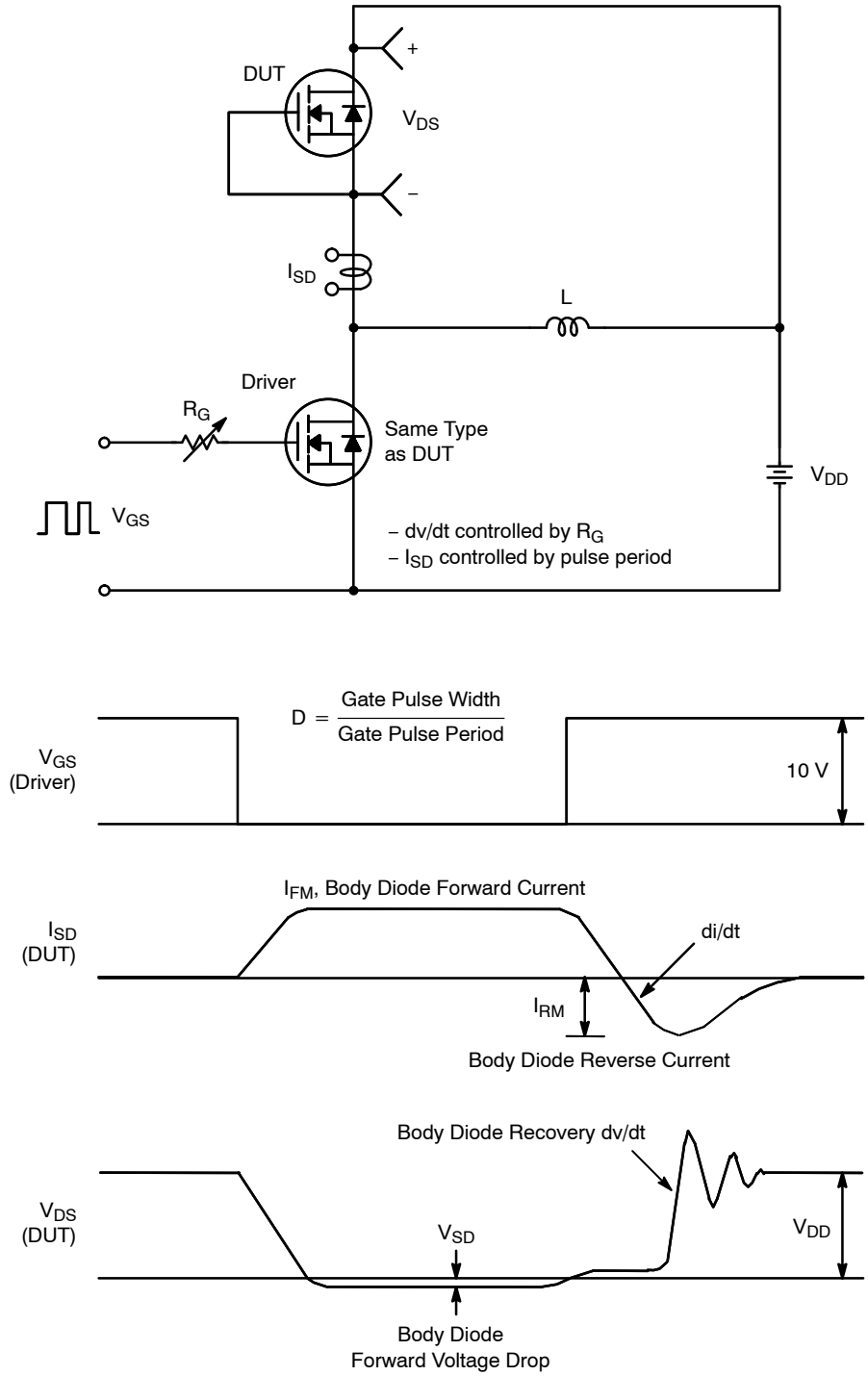
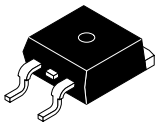



**Figure 16. Peak Diode Recovery dv/dt Test Circuit & Waveforms**

# MECHANICAL CASE OUTLINE
## PACKAGE DIMENSIONS

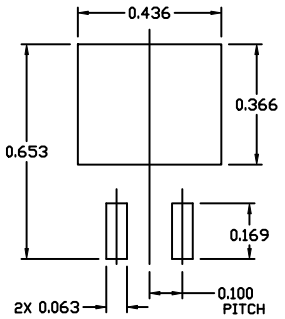
ON Semiconductor®



**SCALE 1:1**

**D²PAK–3 (TO–263, 3–LEAD)**
CASE 418AJ
ISSUE D

DATE 13 AUG 2019

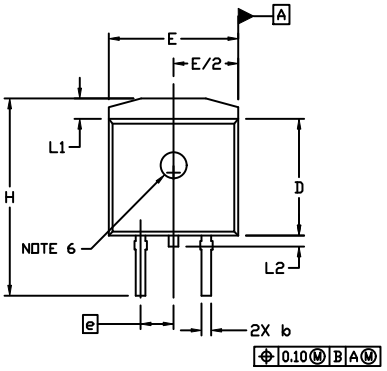


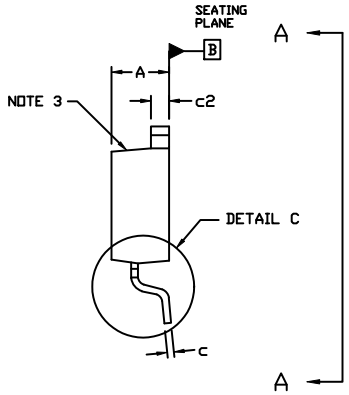

RECOMMENDED
MOUNTING FOOTPRINT

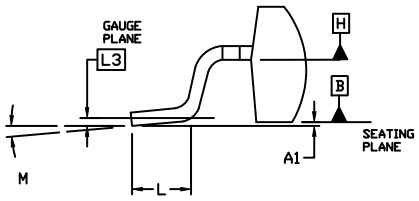
NOTES:

1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 1994.
2. CONTROLLING DIMENSION: INCHES
3. CHAMFER OPTIONAL.
4. DIMENSIONS D AND E DO NOT INCLUDE MOLD FLASH. MOLD FLASH SHALL NOT EXCEED 0.005 PER SIDE. THESE DIMENSIONS ARE MEASURED AT THE OUTERMOST EXTREMES OF THE PLASTIC BODY AT DATUM H.
5. THERMAL PAD CONTOUR IS OPTIONAL WITHIN DIMENSIONS E, L1, D1, AND E1.
6. OPTIONAL MOLD FEATURE.

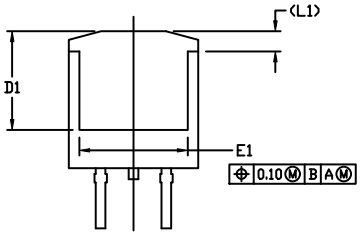
| DIM | INCHES MIN. | INCHES MAX. | MILLIMETERS MIN. | MILLIMETERS MAX. |
|---|---|---|---|---|
| A | 0.160 | 0.190 | 4.06 | 4.83 |
| A1 | 0.000 | 0.010 | 0.00 | 0.25 |
| b | 0.020 | 0.039 | 0.51 | 0.99 |
| c | 0.012 | 0.029 | 0.30 | 0.74 |
| c2 | 0.045 | 0.065 | 1.14 | 1.65 |
| D | 0.330 | 0.380 | 8.38 | 9.65 |
| D1 | 0.260 | --- | 6.60 | --- |
| E | 0.380 | 0.420 | 9.65 | 10.67 |
| E1 | 0.245 | --- | 6.22 | --- |
| e | 0.100 BSC | | 2.54 BSC | |
| H | 0.575 | 0.625 | 14.60 | 15.88 |
| L | 0.070 | 0.110 | 1.78 | 2.79 |
| L1 | --- | 0.066 | --- | 1.68 |
| L2 | --- | 0.070 | --- | 1.78 |
| L3 | 0.010 BSC | | 0.25 BSC | |
| M | -8° | 8° | -8° | 8° |



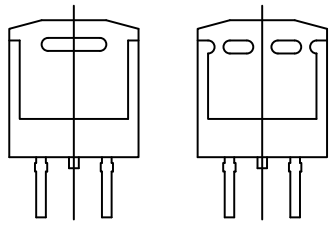




DETAIL C
TIP LEADFORM
ROTATED 90° CW

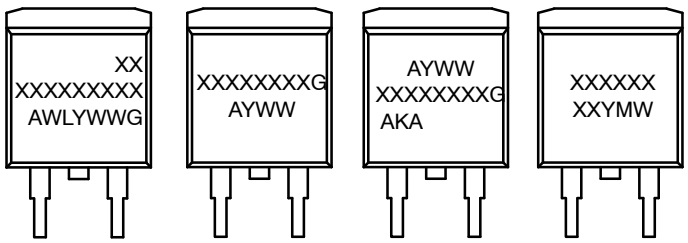



VIEW A–A



VIEW A–A
OPTIONAL CONSTRUCTIONS

**GENERIC MARKING DIAGRAMS***




**IC** **Standard** **Rectifier** **SSG**

XXXXXX = Specific Device Code
A = Assembly Location
WL = Wafer Lot
Y = Year
WW = Work Week
W = Week Code (SSG)
M = Month Code (SSG)
G = Pb–Free Package
AKA = Polarity Indicator

*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.

| | | |
|---|---|---|
| **DOCUMENT NUMBER:** | **98AON56370E** | Electronic versions are uncontrolled except when accessed directly from the Document Repository. Printed versions are uncontrolled except when stamped “CONTROLLED COPY” in red. |
| **DESCRIPTION:** | **D²PAK–3 (TO–263, 3–LEAD)** | **PAGE 1 OF 1** |

## PUBLICATION ORDERING INFORMATION

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**Fax**: 303−675−2176 or 800−344−3867 Toll Free USA/Canada
**Email**: orderlit@onsemi.com

**N. American Technical Support**: 800−282−9855 Toll Free USA/Canada
**Europe, Middle East and Africa Technical Support:**
Phone: 421 33 790 2910

**ON Semiconductor Website**: **www.onsemi.com**

**Order Literature**: http://www.onsemi.com/orderlit

For additional information, please contact your local Sales Representative

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