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FAIRCHILD SEMICONDUCTOR®

November 2013

# FCB11N60

## N-Channel SuperFET® MOSFET

### 600 V, 11 A, 380 mΩ

## Features

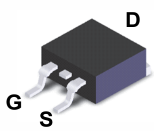
- 650V @ $T_J$ = 150°C
- Typ. $R_{DS(on)}$ = 320 mΩ
- Ultra Low Gate Charge (Typ. $Q_g$ = 40 nC)
- Low Effective Output Capacitance (Typ. $C_{oss(eff.)}$ = 95 pF)
- 100% Avalanche Tested
- RoHS Compliant

## Application

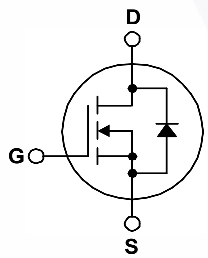
- Lighting
- Solar Inverter
- AC-DC Power Supply

## Description

SuperFET® MOSFET is Fairchild Semiconductor's first generation of high voltage super-junction (SJ) MOSFET family that is utilizing charge balance technology for outstanding low on-resistance and lower gate charge performance. This technology is tailored to minimize conduction loss, provide superior switching performance, dv/dt rate and higher avalanche energy. Consequently, SuperFET MOSFET is very suitable for the switching power applications such as PFC, server/telecom power, FPD TV power, ATX power and industrial power applications.




$D^2$-PAK




## MOSFET Maximum Ratings $T_C$ = 25°C unless otherwise noted.

| Symbol | Parameter | | FCB11N60TM | Unit |
|---|---|---|---|---|
| $V_{DSS}$ | Drain to Source Voltage | | 600 | V |
| $I_D$ | Drain Current | - Continuous ($T_C$ = 25°C) | 11 | A |
| | | - Continuous ($T_C$ = 100°C) | 7 | |
| $I_{DM}$ | Drain Current | - Pulsed (Note 1) | 33 | A |
| $V_{GSS}$ | Gate to Source Voltage | | ±30 | V |
| $E_{AS}$ | Single Pulsed Avalanche Energy (Note 2) | | 340 | mJ |
| $I_{AR}$ | Avalanche Current (Note 1) | | 11.0 | A |
| $E_{AR}$ | Repetitive Avalanche Energy (Note 1) | | 12.5 | mJ |
| dv/dt | Peak Diode Recovery dv/dt (Note 3) | | 4.5 | V/ns |
| $P_D$ | Power Dissipation | ($T_C$ = 25°C) | 125 | W |
| | | - Derate Above 25°C | 1.0 | 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 Seconds | | 300 | °C |

## Thermal Characteristics

| Symbol | Parameter | FCB11N60TM | Unit |
|---|---|---|---|
| $R_{\theta JC}$ | Thermal Resistance, Junction to Case, Max. | 1.0 | °C/W |
| $R_{\theta JA}$ | Thermal Resistance, Junction to Ambient (1 $in^2$ Pad of 2-oz Copper), Max. | 40 | |
| $R_{\theta JA}$ | Thermal Resistance, Junction to Ambient (Minimum Pad of 2-oz Copper), Max. | 62.5 | |

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## Package Marking and Ordering Information

| Part Number | Top Mark | Package | Packing Method | Reel Size | Tape Width | Quantity |
|---|---|---|---|---|---|---|
| FCB11N60TM | FCB11N60 | $D^2$-PAK | Tape and Reel | 330 mm | 24 mm | 800 units |

## Electrical Characteristics $T_C$ = 25°C unless otherwise noted.

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

### Off Characteristics

| Symbol | Parameter | Test Conditions | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| $BV_{DSS}$ | Drain to Source Breakdown Voltage | $V_{GS}$ = 0 V, $I_D$ = 250 µA, $T_C$ = 25°C | 600 | - | - | V |
| | | $V_{GS}$ = 0 V, $I_D$ = 250 µA, $T_C$ = 150°C | - | 650 | - | V |
| $\Delta BV_{DSS} / \Delta T_J$ | Breakdown Voltage Temperature Coefficient | $I_D$ = 250 µA, Referenced to 25°C | - | 0.6 | - | V/°C |
| $BV_{DS}$ | Drain-Source Avalanche Breakdown Voltage | $V_{GS}$ = 0 V, $I_D$ = 11 A | - | 700 | - | V |
| $I_{DSS}$ | Zero Gate Voltage Drain Current | $V_{DS}$ = 600 V, $V_{GS}$ = 0 V | - | - | 1 | µA |
| | | $V_{DS}$ = 480 V, $V_{GS}$ = 0 V, $T_C$ = 125°C | - | - | 10 | |
| $I_{GSS}$ | Gate to Body Leakage Current | $V_{GS}$ = ±30 V, $V_{DS}$ = 0 V | - | - | ±100 | nA |

### On Characteristics

| Symbol | Parameter | Test Conditions | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| $V_{GS(th)}$ | Gate Threshold Voltage | $V_{GS}$ = $V_{DS}$, $I_D$ = 250 µA | 3.0 | - | 5.0 | V |
| $R_{DS(on)}$ | Static Drain to Source On Resistance | $V_{GS}$ = 10 V, $I_D$ = 5.5 A | - | 0.32 | 0.38 | Ω |
| $g_{FS}$ | Forward Transconductance | $V_{DS}$ = 40 V, $I_D$ = 5.5 A | - | 9.7 | - | S |

### Dynamic Characteristics

| Symbol | Parameter | Test Conditions | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| $C_{iss}$ | Input Capacitance | $V_{DS}$ = 25 V, $V_{GS}$ = 0 V, f = 1.0 MHz | - | 1148 | 1490 | pF |
| $C_{oss}$ | Output Capacitance | | - | 671 | 870 | pF |
| $C_{rss}$ | Reverse Transfer Capacitance | | - | 63 | - | pF |
| $C_{oss}$ | Output Capacitance | $V_{DS}$ = 480 V, $V_{GS}$ = 0 V, f = 1 MHz | - | 35 | - | pF |
| $C_{oss(eff.)}$ | Effective Output Capacitance | $V_{DS}$ = 0 V to 400 V, $V_{GS}$ = 0 V | - | 95 | - | pF |

### Switching Characteristics

| Symbol | Parameter | Test Conditions | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| $t_{d(on)}$ | Turn-On Delay Time | $V_{DD}$ = 300 V, $I_D$ = 11 A, $V_{GS}$ = 10 V, $R_G$ = 25 Ω (Note 4) | - | 34 | 80 | ns |
| $t_r$ | Turn-On Rise Time | | - | 98 | 205 | ns |
| $t_{d(off)}$ | Turn-Off Delay Time | | - | 119 | 250 | ns |
| $t_f$ | Turn-Off Fall Time | | - | 56 | 120 | ns |
| $Q_{g(tot)}$ | Total Gate Charge at 10V | $V_{DS}$ = 480 V, $I_D$ = 11 A, $V_{GS}$ = 10 V (Note 4) | - | 40 | 52 | nC |
| $Q_{gs}$ | Gate to Source Gate Charge | | - | 7.2 | - | nC |
| $Q_{gd}$ | Gate to Drain "Miller" Charge | | - | 21 | - | nC |

### Drain-Source Diode Characteristics

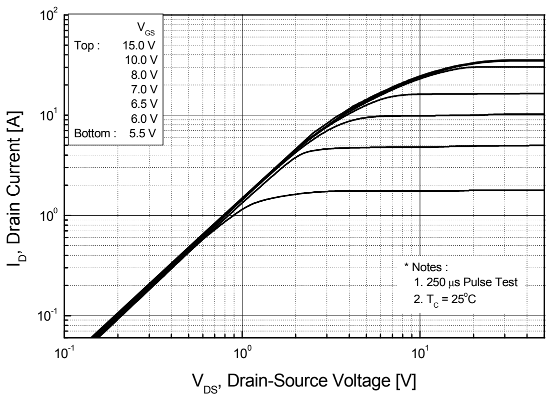
| Symbol | Parameter | Test Conditions | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| $I_S$ | Maximum Continuous Drain to Source Diode Forward Current | | - | - | 11 | A |
| $I_{SM}$ | Maximum Pulsed Drain to Source Diode Forward Current | | - | - | 33 | A |
| $V_{SD}$ | Drain to Source Diode Forward Voltage | $V_{GS}$ = 0 V, $I_{SD}$ = 11 A | - | - | 1.4 | V |
| $t_{rr}$ | Reverse Recovery Time | $V_{GS}$ = 0 V, $I_{SD}$ = 11 A, $dI_F/dt$ = 100 A/µs | - | 390 | - | ns |
| $Q_{rr}$ | Reverse Recovery Charge | | - | 5.7 | - | µC |

**Notes:**

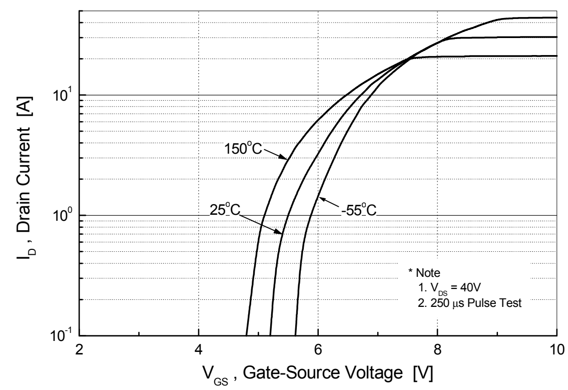
1. Repetitive rating: pulse-width limited by maximum junction temperature.
2. $I_{AS}$ = 5.51 A, $V_{DD}$ = 50 V, $R_G$ = 25 Ω, starting $T_J$ = 25°C.
3. $I_{SD}$ ≤ 11 A, di/dt ≤ 200 A/µs, $V_{DD}$ ≤ $BV_{DSS}$, starting $T_J$ = 25°C.
4. Essentially independent of operating temperature typical characteristics.

## Typical Performance Characteristics

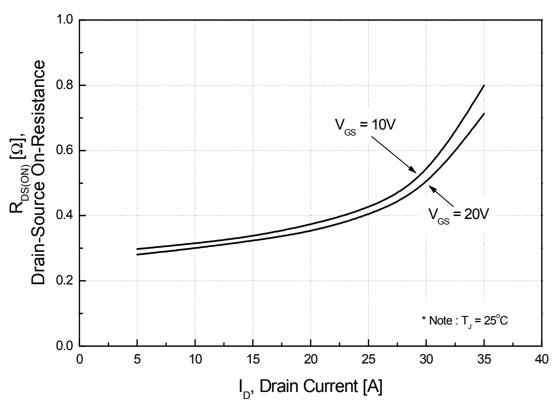
### Figure 1. On-Region Characteristics



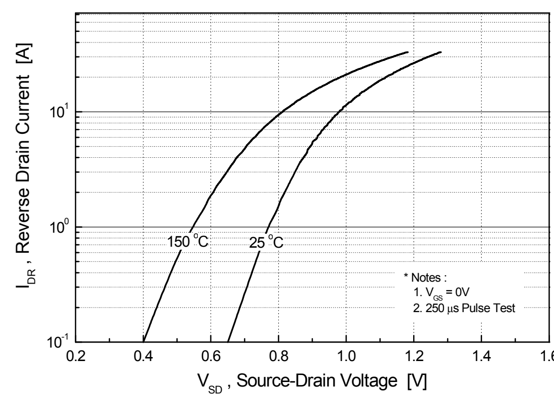

### Figure 2. Transfer Characteristics



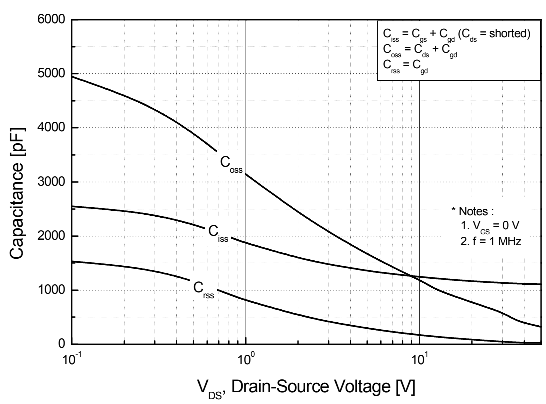

### Figure 3. On-Resistance Variation vs. Drain Current and Gate Voltage



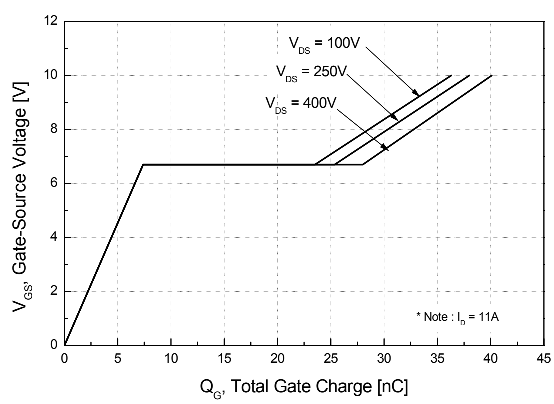

### Figure 4. Body Diode Forward Voltage Variation vs. Source Current and Temperatue




### Figure 5. Capacitance Characteristics

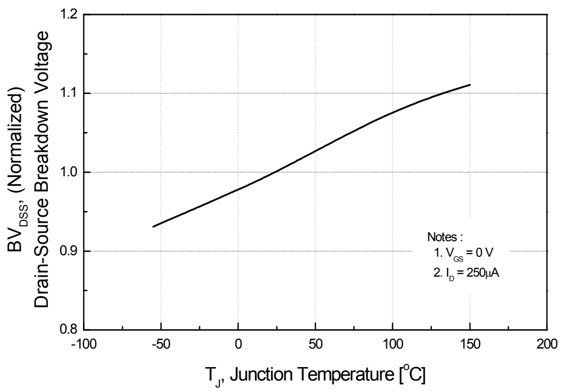



### Figure 6. Gate Charge Characteristics

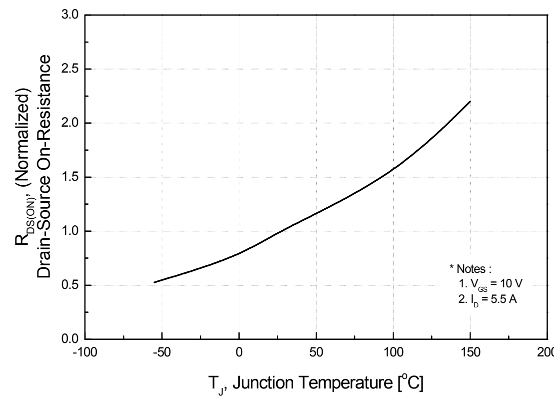


## Typical Performance Characteristics (Continued)

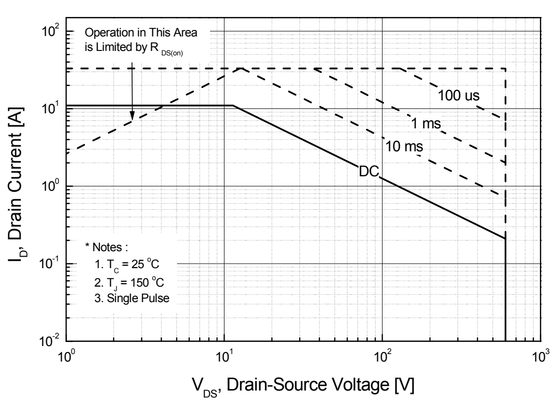
### Figure 7. Breakdown Voltage Variation vs. Temperature



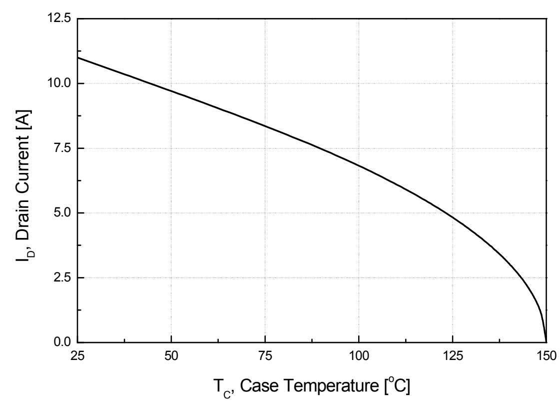

### Figure 8. On-Resistance Variation vs. Temperature



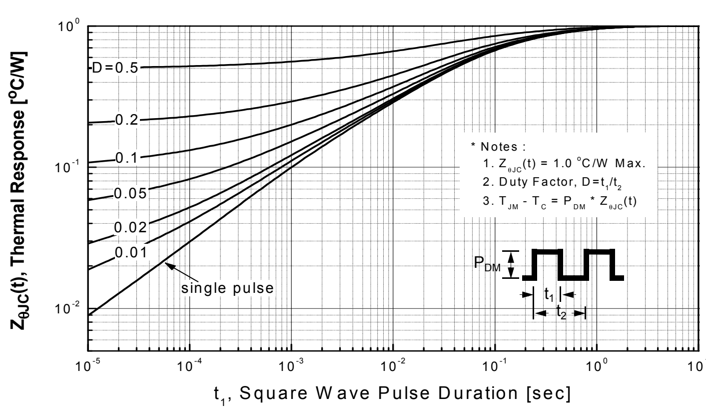

### Figure 9. Maximum Safe Operating Area




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




### Figure 11. Transient Thermal Response Curve



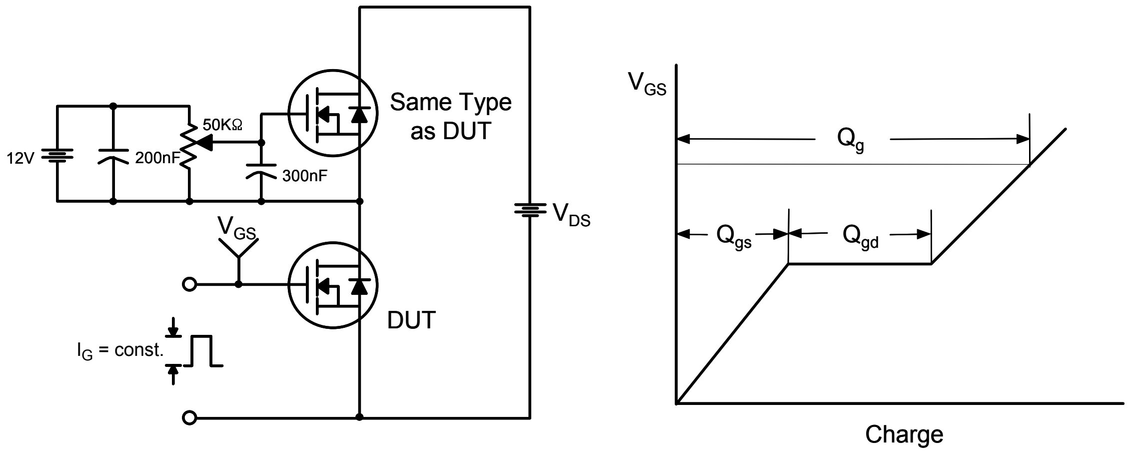



**Figure 12. Gate Charge Test Circuit & Waveform**

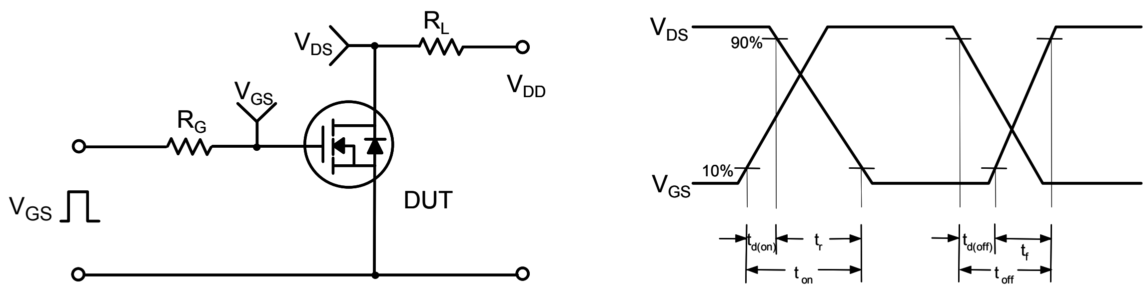



**Figure 13. Resistive Switching Test Circuit & Waveforms**

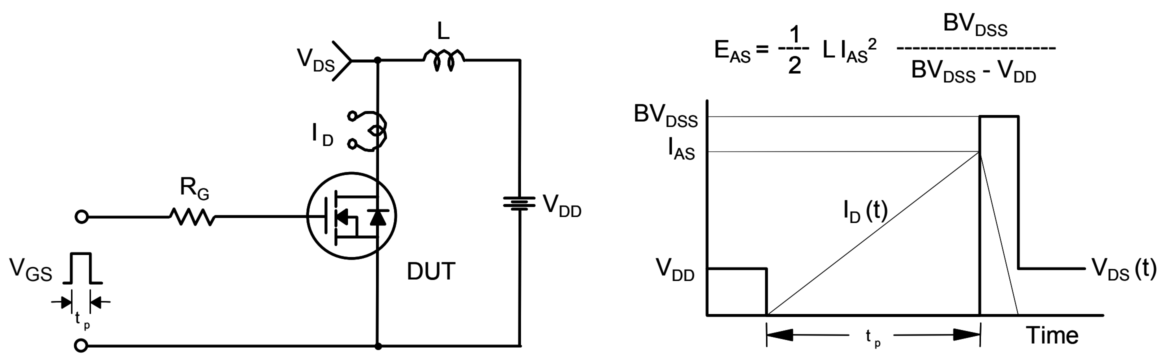



**Figure 14. Unclamped Inductive Switching Test Circuit & Waveforms**

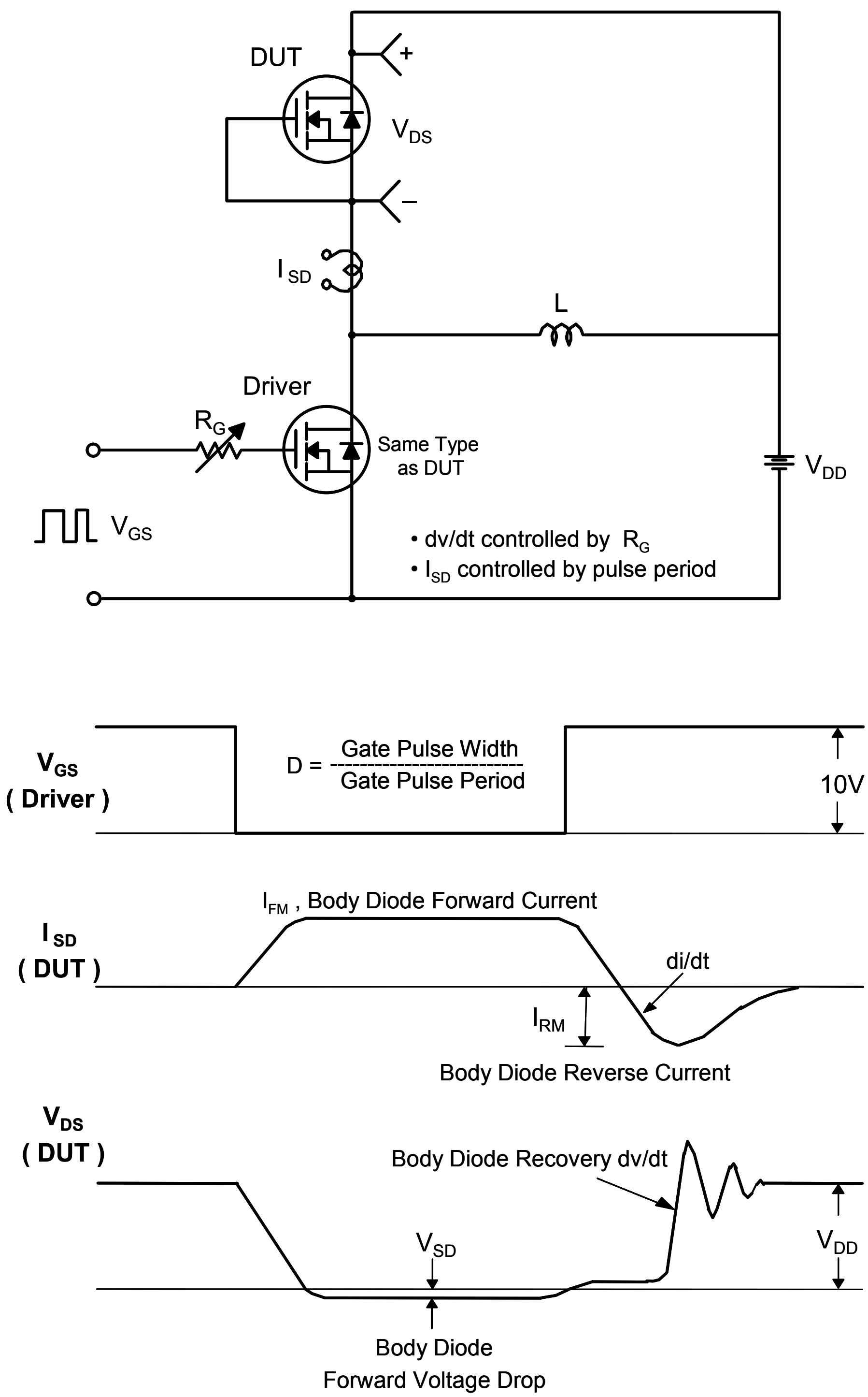



**Figure 15. Peak Diode Recovery dv/dt Test Circuit & Waveforms**

## Mechanical Dimensions

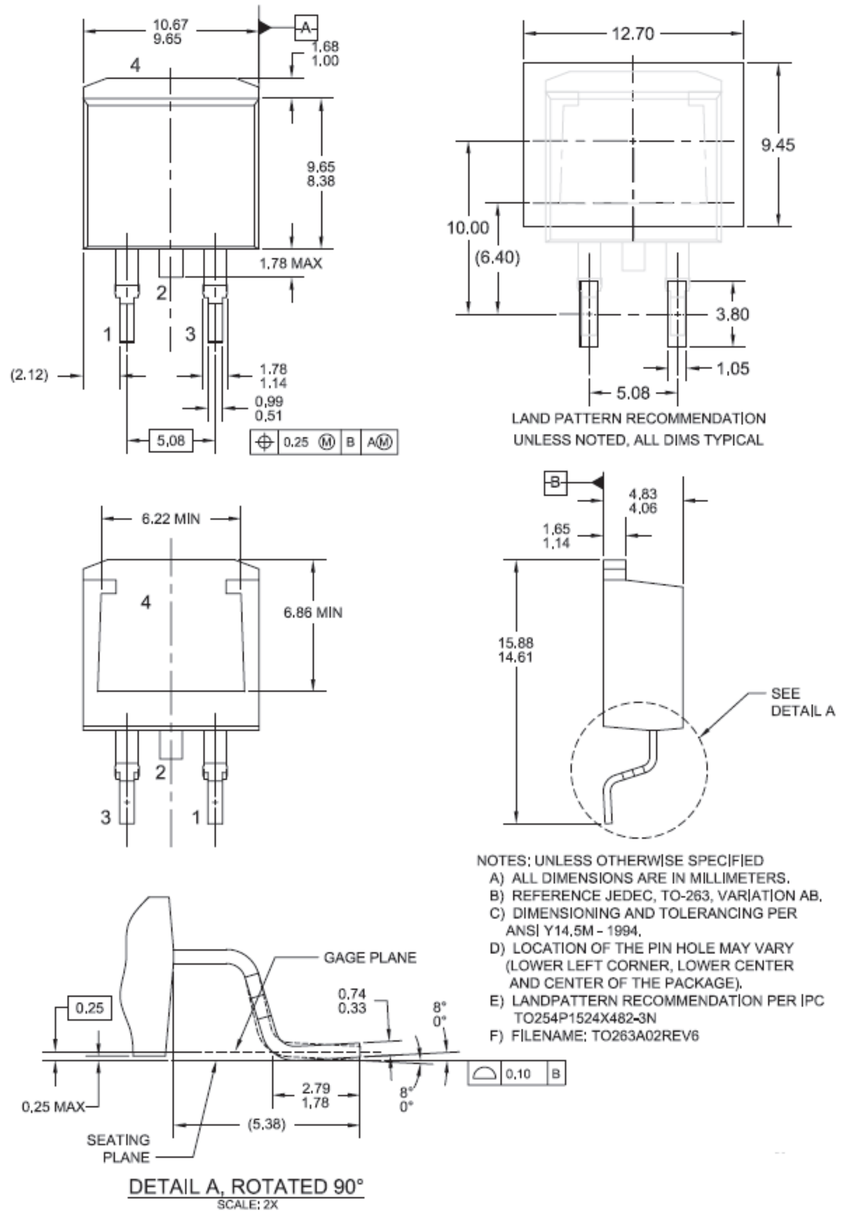



**Figure 16. TO263 ($D^2$PAK), Molded, 2-Lead, Surface Mount**

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- При необходимости вся продукция военного и аэрокосмического назначения проходит испытания и сертификацию в лаборатории (по согласованию с заказчиком);
- Поставка специализированных компонентов военного и аэрокосмического уровня качества (Xilinx, Altera, Analog Devices, Intersil, Interpoint, Microsemi, Actel, Aeroflex, Peregrine, VPT, Syfer, Eurofarad, Texas Instruments, MS Kennedy, Miteq, Cobham, E2V, MA-COM, Hittite, Mini-Circuits, General Dynamics и др.);

Компания «Океан Электроники» является официальным дистрибьютором и эксклюзивным представителем в России одного из крупнейших производителей разъемов военного и аэрокосмического назначения **«JONHON»**, а так же официальным дистрибьютором и эксклюзивным представителем в России производителя высокотехнологичных и надежных решений для передачи СВЧ сигналов **«FORSTAR»**.

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ВЧ соединители, коаксиальные кабели, кабельные сборки и микроволновые компоненты:

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