FAIRCHILD SEMICONDUCTOR®

March 2011

SupreMOS®

# FCA36N60NF

## N-Channel SupreMOS®, FRFET®,MOSFET

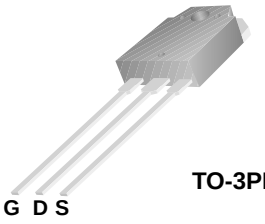
**600V, 36A, 95mΩ**

### Features

- $R_{DS(on)}$ = 80mΩ ( Typ.)@ $V_{GS}$ = 10V, $I_D$ = 18A
- Ultra Low Gate Charge ( Typ. Qg = 86nC)
- Low Effective Output Capacitance
- 100% Avalanche Tested
- RoHS Compliant

### Description

The SupreMOS® MOSFET, Fairchild's next generation of high voltage super-junction MOSFETs, employs a deep trench filling process that differentiates it from preceding multi-epi based technologies. By utilizing this advanced technology and precise process control, SupreMOS® provides world class Rsp, superior switching performance and ruggedness.
This SupreMOS® MOSFET fits the industry's AC-DC SMPS requirements for PFC, server/telecom power, FPD TV power, ATX power, and industrial power applications.

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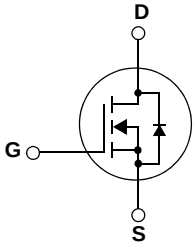



## MOSFET Maximum Ratings $T_C$ = 25°C unless otherwise noted*

| Symbol | Parameter | | | FCA36N60NF | Units |
|---|---|---|---|---|---|
| $V_{DSS}$ | Drain to Source Voltage | | | 600 | V |
| $V_{GSS}$ | Gate to Source Voltage | | | ±30 | V |
| $I_D$ | Drain Current | Continuous ($T_C$ = 25°C) | | 34.9 | A |
| | | Continuous ($T_C$ = 100°C) | | 22 | |
| $I_{DM}$ | Drain Current | Pulsed | (Note 1) | 104.7 | A |
| $E_{AS}$ | Single Pulsed Avalanche Energy | | (Note 2) | 1800 | mJ |
| $I_{AR}$ | Avalanche Current | | | 12 | A |
| $E_{AR}$ | Repetitive Avalanche Energy | | | 3.12 | mJ |
| dv/dt | Peak Diode Recovery dv/dt | | (Note 3) | 50 | V/ns |
| | MOSFET dv/dt Ruggedness | | | 100 | |
| $P_D$ | Power Dissipation | ($T_C$ = 25°C) | | 312 | W |
| | | Derate above 25°C | | 2.6 | W/°C |
| $T_J$, $T_{STG}$ | Operating and Storage Temperature Range | | | -55 to +150 | °C |
| $T_L$ | Maximum Lead Temperature for Soldering Purpose, 1/8" from Case for 5 Seconds | | | 300 | °C |

*Drain current limited by maximum junction temperature

## Thermal Characteristics

| Symbol | Parameter | FCA36N60NF | Units |
|---|---|---|---|
| $R_{\theta JC}$ | Thermal Resistance, Junction to Case | 0.40 | °C/W |
| $R_{\theta CS}$ | Thermal Resistance, Case to Heat Sink (Typical) | 0.24 | |
| $R_{\theta JA}$ | Thermal Resistance, Junction to Ambient | 40 | |

## Package Marking and Ordering Information $T_C = 25^oC$ unless otherwise noted

| Device Marking | Device | Package | Reel Size | Tape Width | Quantity |
|---|---|---|---|---|---|
| FCA36N60NF | FCA36N60NF | TO-3PN | - | - | 30 |

## Electrical Characteristics

| Symbol | Parameter | Test Conditions | Min. | Typ. | Max. | Units |
|---|---|---|---|---|---|---|
| **Off Characteristics** | | | | | | |
| $BV_{DSS}$ | Drain to Source Breakdown Voltage | $I_D$ = 1mA, $V_{GS}$ = 0V, $T_J = 25^oC$ | 600 | - | - | V |
| $\frac{\Delta BV_{DSS}}{\Delta T_J}$ | Breakdown Voltage Temperature Coefficient | $I_D$ = 1mA, Referenced to $25^oC$ | - | 0.60 | - | $V/^oC$ |
| $I_{DSS}$ | Zero Gate Voltage Drain Current | $V_{DS}$ = 480V, $V_{GS}$ = 0V | - | - | 10 | μA |
| | | $T_J = 125^oC$ | - | - | 100 | |
| $I_{GSS}$ | Gate to Body Leakage Current | $V_{GS}$ = ±30V, $V_{DS}$ = 0V | - | - | ±100 | nA |
| **On Characteristics** | | | | | | |
| $V_{GS(th)}$ | Gate Threshold Voltage | $V_{GS} = V_{DS}$, $I_D$ = 250μA | 3.0 | 3.7 | 5.0 | V |
| $R_{DS(on)}$ | Static Drain to Source On Resistance | $V_{GS}$ = 10V, $I_D$ = 18A | - | 80 | 95 | mΩ |
| $g_{FS}$ | Forward Transconductance | $V_{DS}$ = 20V, $I_D$ = 18A | - | 39 | - | S |
| **Dynamic Characteristics** | | | | | | |
| $C_{iss}$ | Input Capacitance | $V_{DS}$ = 100V, $V_{GS}$ = 0V, f = 1MHz | - | 3191 | 4245 | pF |
| $C_{oss}$ | Output Capacitance | | - | 145 | 195 | pF |
| $C_{rss}$ | Reverse Transfer Capacitance | | - | 5 | 8 | pF |
| $C_{oss}$ | Output Capacitance | $V_{DS}$ = 380V, $V_{GS}$ = 0V, f = 1MHz | - | 81 | - | pF |
| $C_{oss}$eff. | Effective Output Capacitance | $V_{DS}$ = 0V to 480V, $V_{GS}$ = 0V | - | 338 | - | pF |
| $Q_{g(tot)}$ | Total Gate Charge at 10V | $V_{DS}$ = 380V, $I_D$ = 18A, $V_{GS}$ = 10V (Note 4) | - | 86 | 112 | nC |
| $Q_{gs}$ | Gate to Source Gate Charge | | - | 16 | - | nC |
| $Q_{gd}$ | Gate to Drain “Miller” Charge | | - | 36 | - | nC |
| ESR | Equivalent Series Resistance (G-S) | Drain Open, f=1MHz | - | 1.2 | - | Ω |
| **Switching Characteristics** | | | | | | |
| $t_{d(on)}$ | Turn-On Delay Time | $V_{DD}$ = 380V, $I_D$ = 18A, $R_G$ = 4.7Ω (Note 4) | - | 27 | 64 | ns |
| $t_r$ | Turn-On Rise Time | | - | 17 | 44 | ns |
| $t_{d(off)}$ | Turn-Off Delay Time | | - | 92 | 194 | ns |
| $t_f$ | Turn-Off Fall Time | | - | 4 | 18 | ns |
| **Drain-Source Diode Characteristics** | | | | | | |
| $I_S$ | Maximum Continuous Drain to Source Diode Forward Current | | - | - | 36 | A |
| $I_{SM}$ | Maximum Pulsed Drain to Source Diode Forward Current | | - | - | 108 | A |
| $V_{SD}$ | Drain to Source Diode Forward Voltage | $V_{GS}$ = 0V, $I_{SD}$ = 18A | - | - | 1.2 | V |
| $t_{rr}$ | Reverse Recovery Time | $V_{GS}$ = 0V, $I_{SD}$ = 18A, $dI_F/dt$ = 100A/μs | - | 166 | - | ns |
| $Q_{rr}$ | Reverse Recovery Charge | | - | 1.3 | - | μC |

**Notes:**

1. Repetitive Rating: Pulse width limited by maximum junction temperature
2. $I_{AS}$ = 12A, $R_G$ = 25Ω, Starting $T_J$ = 25°C
3. $I_{SD} \le$ 36A, di/dt ≤ 1200A/μs, $V_{DD} \le$ 380V, Starting $T_J$ = 25°C
4. Essentially Independent of Operating Temperature Typical Characteristics

## Typical Performance Characteristics

**Figure 1. On-Region Characteristics**

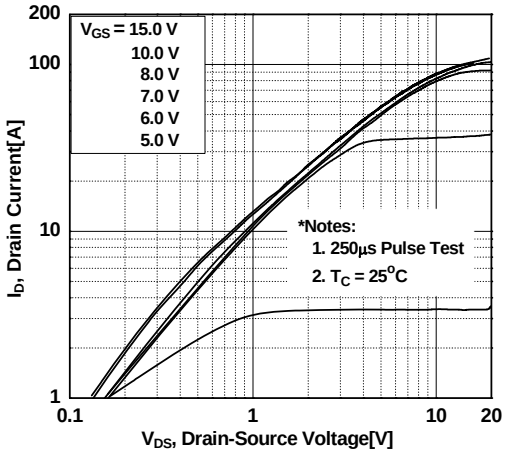



**Figure 2. Transfer Characteristics**

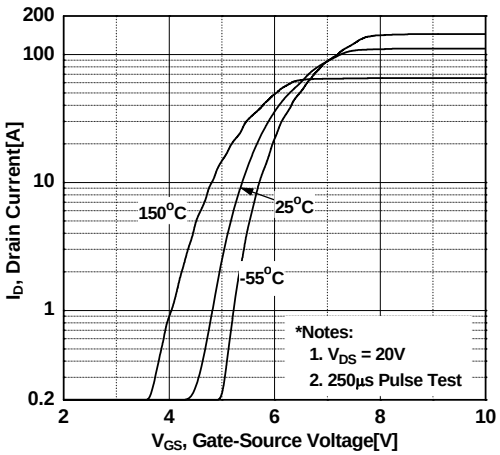



**Figure 3. On-Resistance Variation vs. Drain Current and Gate Voltage**

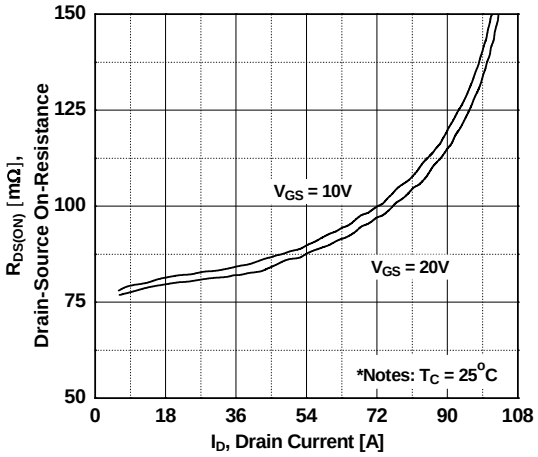



**Figure 4. Body Diode Forward Voltage Variation vs. Source Current and Temperature**

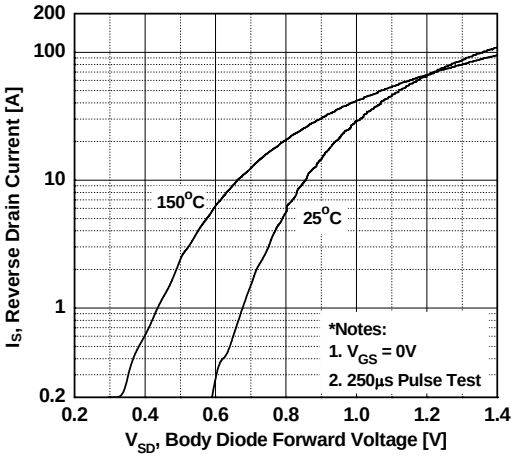



**Figure 5. Capacitance Characteristics**

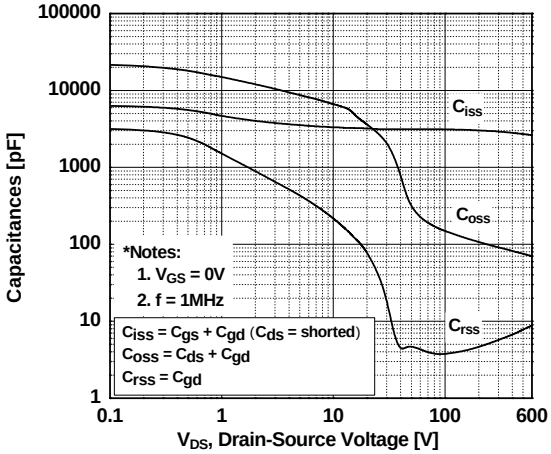
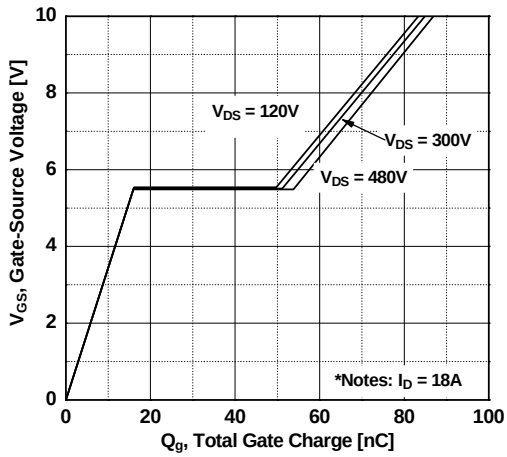



**Figure 6. Gate Charge Characteristics**



## Typical Performance Characteristics (Continued)

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

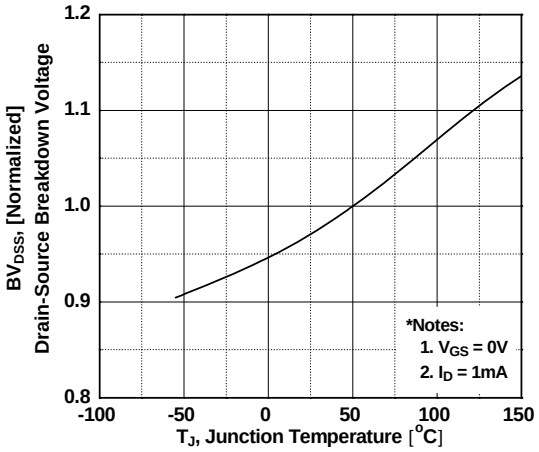



**Figure 8. On-Resistance Variation vs. Temperature**

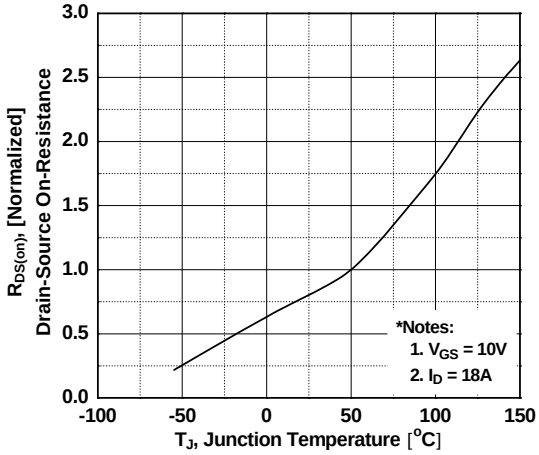



**Figure 9. Maximum Safe Operating Area**

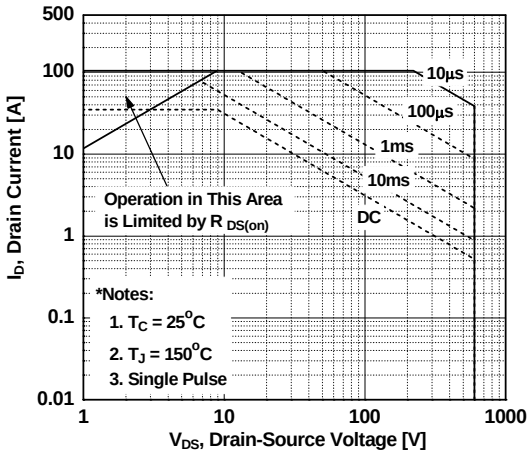



**Figure 10. Maximum Drain Current vs. Case Temperature**

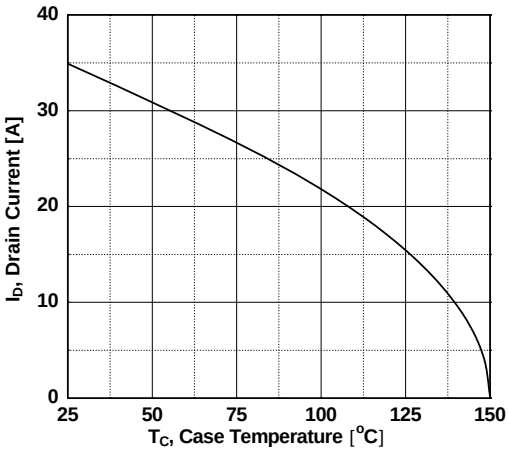
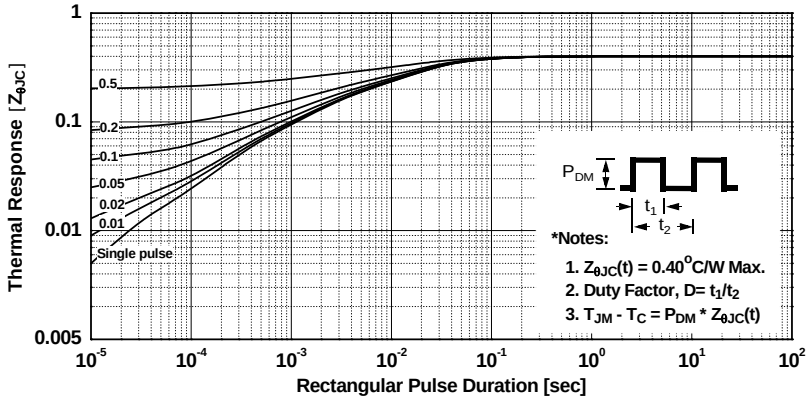
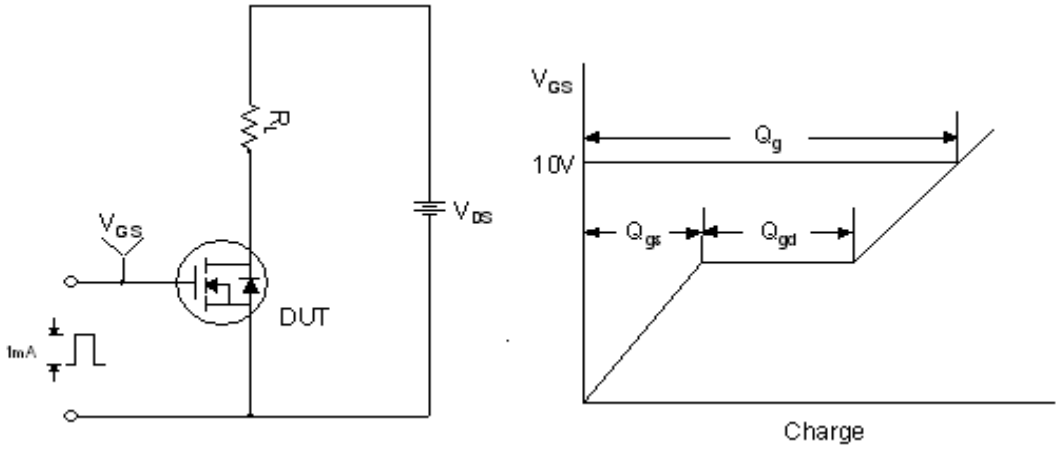


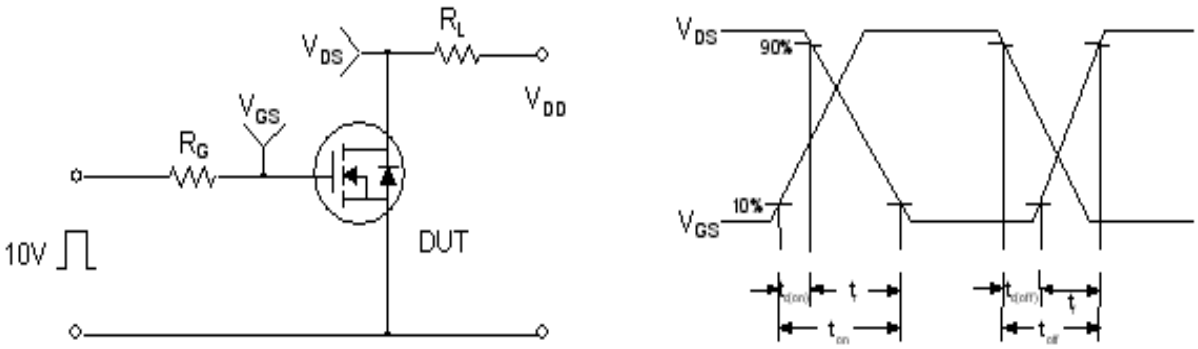

**Figure 11. Transient Thermal Response Curve**



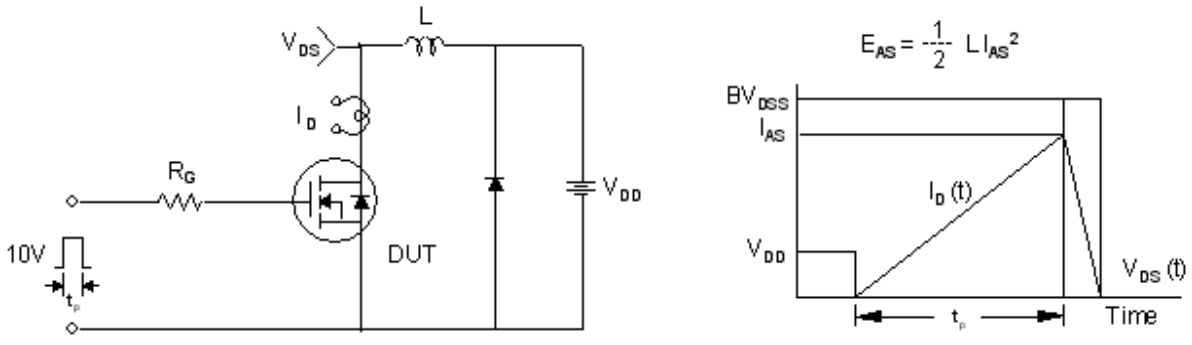
**Gate Charge Test Circuit & Waveform**



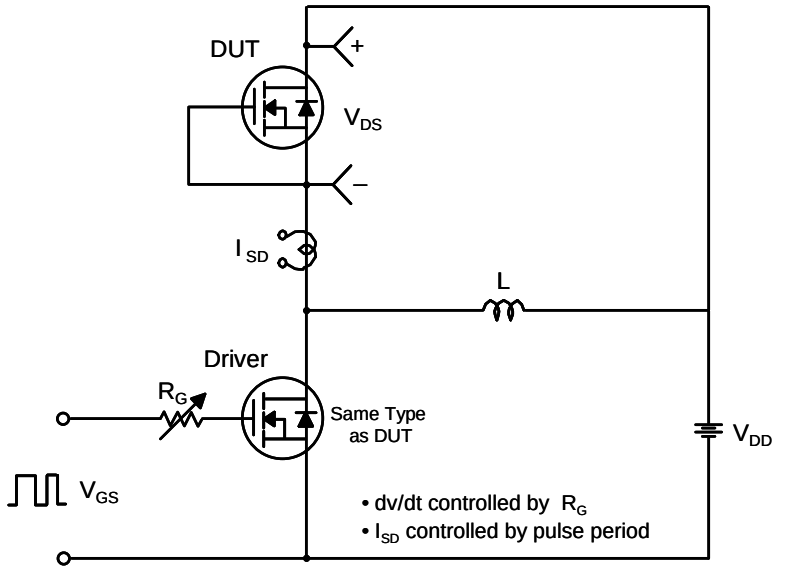

**Resistive Switching Test Circuit & Waveforms**

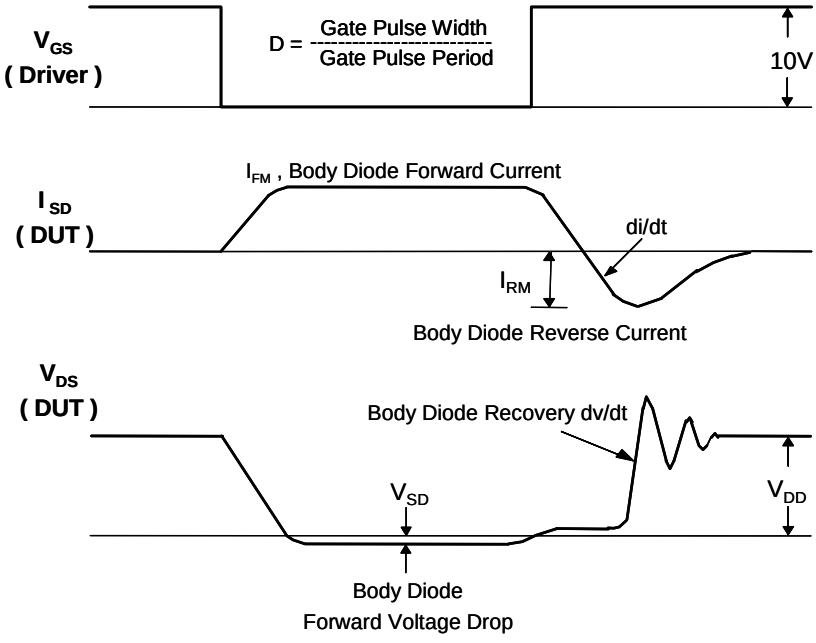



**Unclamped Inductive Switching Test Circuit & Waveforms**



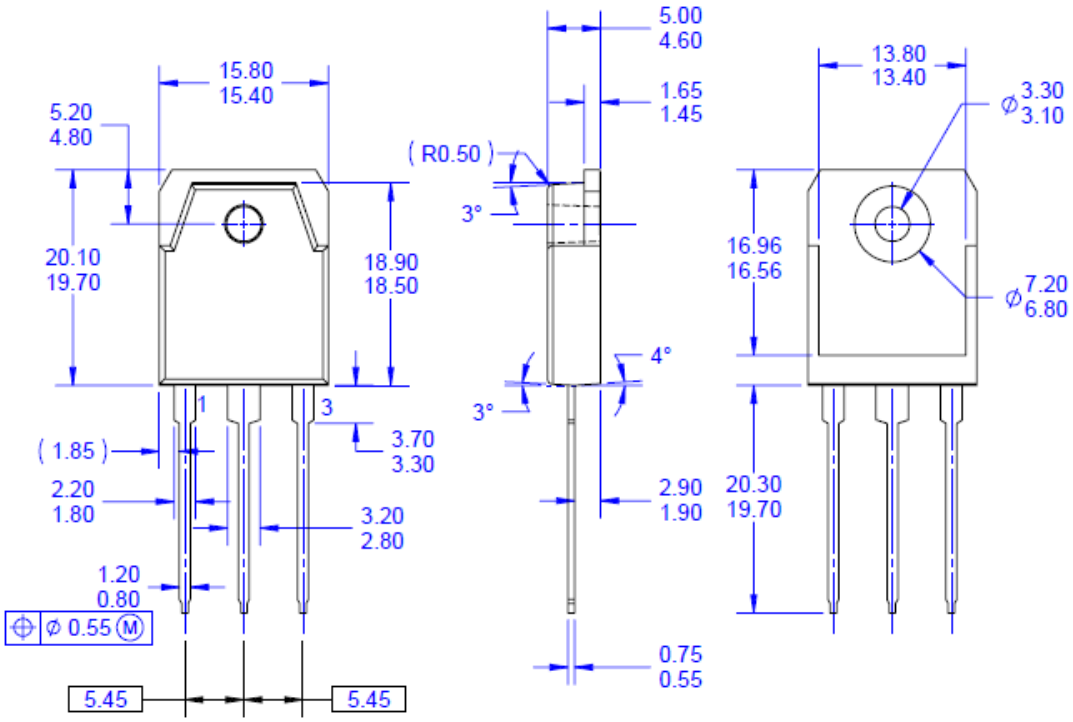
**Peak Diode Recovery dv/dt Test Circuit & Waveforms**

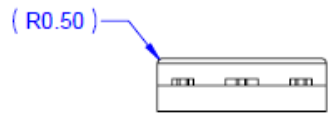


## Mechanical Dimensions

# TO-3PN

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