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December 2014

FDPF041N06BL1

N-Channel PowerTrench[®] MOSFET

60 V, 77 A, 4.1 mΩ

Features

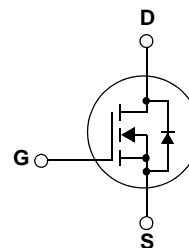
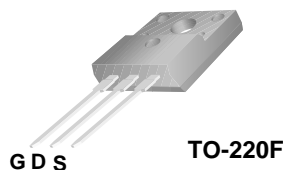
- $R_{DS(on)} = 3.5 \text{ m}\Omega$ (Typ.) @ $V_{GS} = 10 \text{ V}$, $I_D = 77 \text{ A}$
- Low FOM $R_{DS(on)} \cdot Q_G$
- Low Reverse Recovery Charge, Q_{rr}
- Soft Reverse Recovery Body Diode
- Enables Highly Efficiency in Synchronous Rectification
- Fast Switching Speed
- 100% UIL Tested
- RoHS Compliant

Description

This N-Channel MOSFET is produced using Fairchild Semiconductor's advanced PowerTrench[®] process that has been tailored to minimize the on-state resistance while maintaining superior switching performance.

Applications

- Synchronous Rectification for ATX / Server / Telecom PSU
- Battery Protection Circuit
- Motor Drives and Uninterruptible Power Supplies
- Renewable System



MOSFET Maximum Ratings $T_C = 25^\circ\text{C}$ unless otherwise noted*

| Symbol | Parameter | FDPF041N06BL1 | Unit |
|----------------|--|---|---------------------|
| V_{DSS} | Drain to Source Voltage | 60 | V |
| V_{GSS} | Gate to Source Voltage | ± 20 | V |
| I_D | Drain Current | - Continuous ($T_C = 25^\circ\text{C}$, Silicon Limited) | A |
| | | - Continuous ($T_C = 100^\circ\text{C}$, Silicon Limited) | |
| I_{DM} | Drain Current | - Pulsed (Note 1) | A |
| E_{AS} | Single Pulsed Avalanche Energy | (Note 2) | mJ |
| dv/dt | Peak Diode Recovery dv/dt | (Note 3) | V/ns |
| P_D | Power Dissipation | ($T_C = 25^\circ\text{C}$) | W |
| | | - Derate above 25°C | W/ $^\circ\text{C}$ |
| T_J, T_{STG} | Operating and Storage Temperature Range | -55 to +175 | $^\circ\text{C}$ |
| T_L | Maximum Lead Temperature for Soldering Purpose, 1/8" from Case for 5 Seconds | 300 | $^\circ\text{C}$ |

Thermal Characteristics

| Symbol | Parameter | FDPF041N06BL1 | Unit |
|-----------------|--|---------------|--------------------|
| $R_{\theta JC}$ | Thermal Resistance, Junction to Case, Max | 3.4 | $^\circ\text{C/W}$ |
| $R_{\theta JA}$ | Thermal Resistance, Junction to Ambient, Max | 62.5 | |

Package Marking and Ordering Information

| Device Marking | Device | Package | Packaging Type | Quantity |
|----------------|---------------|---------|----------------|----------|
| FDPF041N06BL1 | FDPF041N06BL1 | TO-220F | Tube | 50 |

Electrical Characteristics $T_C = 25^\circ\text{C}$ unless otherwise noted

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

Off Characteristics

| | | | | | | |
|--------------------------------------|---|---|----|------|-----------|---------------------------|
| BV_{DSS} | Drain to Source Breakdown Voltage | $I_D = 250\mu\text{A}$, $V_{GS} = 0\text{V}$ | 60 | - | - | V |
| $\frac{\Delta BV_{DSS}}{\Delta T_J}$ | Breakdown Voltage Temperature Coefficient | $I_D = 250\mu\text{A}$, Referenced to 25°C | - | 0.03 | - | $\text{V}/^\circ\text{C}$ |
| I_{DSS} | Zero Gate Voltage Drain Current | $V_{DS} = 48\text{V}$, $V_{GS} = 0\text{V}$ | - | - | 1 | μA |
| I_{GSS} | Gate to Body Leakage Current | $V_{GS} = \pm 20\text{V}$, $V_{DS} = 0\text{V}$ | - | - | ± 100 | nA |

On Characteristics

| | | | | | | |
|--------------|--------------------------------------|--|---|-----|-----|------------------|
| $V_{GS(th)}$ | Gate Threshold Voltage | $V_{GS} = V_{DS}$, $I_D = 250\mu\text{A}$ | 2 | - | 4 | V |
| $R_{DS(on)}$ | Static Drain to Source On Resistance | $V_{GS} = 10\text{V}$, $I_D = 77\text{A}$ | - | 3.5 | 4.1 | $\text{m}\Omega$ |
| g_{FS} | Forward Transconductance | $V_{DS} = 10\text{V}$, $I_D = 77\text{A}$ | - | 125 | - | S |

Dynamic Characteristics

| | | | | | | |
|---------------|-----------------------------------|--|---|------|------|----|
| C_{iss} | Input Capacitance | $V_{DS} = 30\text{V}$, $V_{GS} = 0\text{V}$ $f = 1\text{MHz}$ | - | 4280 | 5690 | pF |
| C_{oss} | Output Capacitance | | - | 1050 | 1400 | pF |
| C_{rss} | Reverse Transfer Capacitance | | - | 23 | - | pF |
| $C_{oss(er)}$ | Energy Related Output Capacitance | $V_{DS} = 30\text{V}$, $V_{GS} = 0\text{V}$ | - | 1787 | - | pF |
| $Q_{g(tot)}$ | Total Gate Charge at 10V | $V_{DS} = 30\text{V}$, $I_D = 100\text{A}$ $V_{GS} = 10\text{V}$ | - | 53 | 69 | nC |
| Q_{gs} | Gate to Source Gate Charge | | - | 23 | - | nC |
| Q_{gd} | Gate to Drain "Miller" Charge | | - | 8 | - | nC |
| $V_{plateau}$ | Gate Plateau Voltage | | - | 5.7 | - | V |
| Q_{sync} | Total Gate Charge Sync. | $V_{DS} = 0\text{V}$, $I_D = 50\text{A}$ (Note 5) | - | 48.6 | - | nC |
| Q_{oss} | Output Charge | $V_{DS} = 30\text{V}$, $V_{GS} = 0\text{V}$ | - | 63.8 | - | nC |

Switching Characteristics

| | | | | | | |
|--------------|------------------------------------|--|---|-----|----|----------|
| $t_{d(on)}$ | Turn-On Delay Time | $V_{DD} = 30\text{V}$, $I_D = 100\text{A}$ $V_{GS} = 10\text{V}$, $R_{GEN} = 4.7\Omega$ (Note 4) | - | 29 | 68 | ns |
| t_r | Turn-On Rise Time | | - | 22 | 54 | ns |
| $t_{d(off)}$ | Turn-Off Delay Time | | - | 38 | 86 | ns |
| t_f | Turn-Off Fall Time | | - | 11 | 32 | ns |
| ESR | Equivalent Series Resistance (G-S) | $f = 1\text{MHz}$ | - | 0.8 | - | Ω |

Drain-Source Diode Characteristics

| | | | | | | |
|-----------------|--|--|---|-----|------|----|
| I _S | Maximum Continuous Drain to Source Diode Forward Current | - | - | 77 | A | |
| I _{SM} | Maximum Pulsed Drain to Source Diode Forward Current | - | - | 308 | A | |
| V _{SD} | Drain to Source Diode Forward Voltage | V _{GS} = 0V, I _{SD} = 77A | - | - | 1.25 | V |
| t _{rr} | Reverse Recovery Time | V _{GS} = 0V, I _{SD} = 100A | - | 65 | - | ns |
| Q _{rr} | Reverse Recovery Charge | di _F /dt = 100A/μs | - | 63 | - | nC |

Notes:

1. Repetitive Rating: Pulse width limited by maximum junction temperature
2. $L = 3\text{mH}$, $I_{AS} = 15.6\text{A}$, Starting $T_J = 25^\circ\text{C}$
3. $I_{SD} \leq 100\text{A}$, $di/dt \leq 200\text{A}/\mu\text{s}$, $V_{DD} \leq BV_{DSS}$, Starting $T_J = 25^\circ\text{C}$
4. Essentially Independent of Operating Temperature Typical Characteristics
5. See the test circuit in page 8

Typical Performance Characteristics

Figure 1. On-Region Characteristics

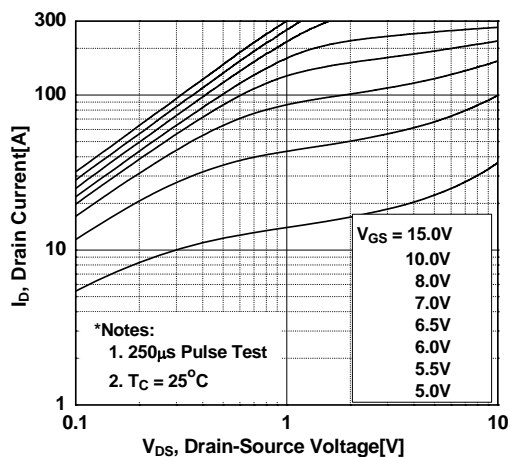


Figure 2. Transfer Characteristics

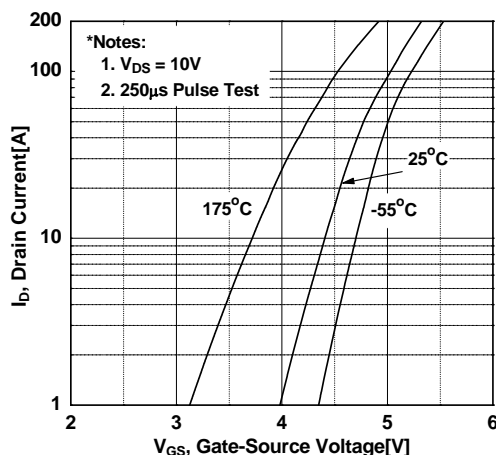


Figure 3. On-Resistance Variation vs. Drain Current and Gate Voltage

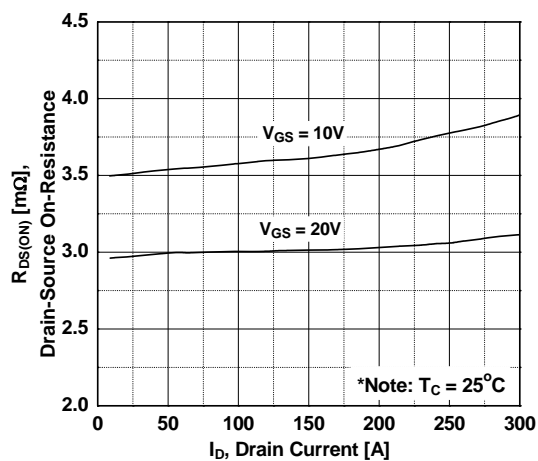


Figure 4. Body Diode Forward Voltage Variation vs. Source Current and Temperature

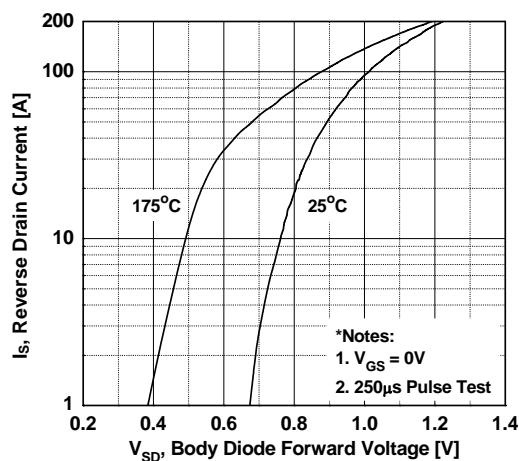


Figure 5. Capacitance Characteristics

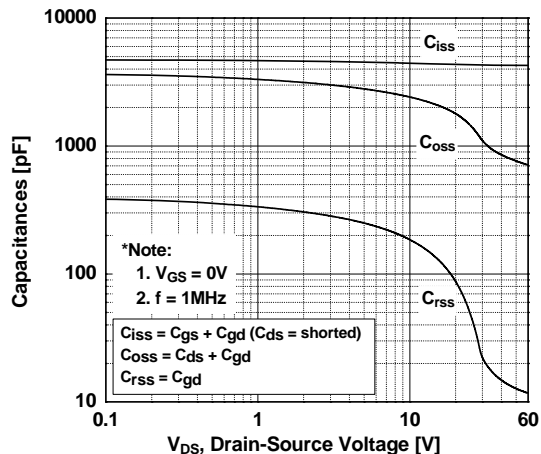
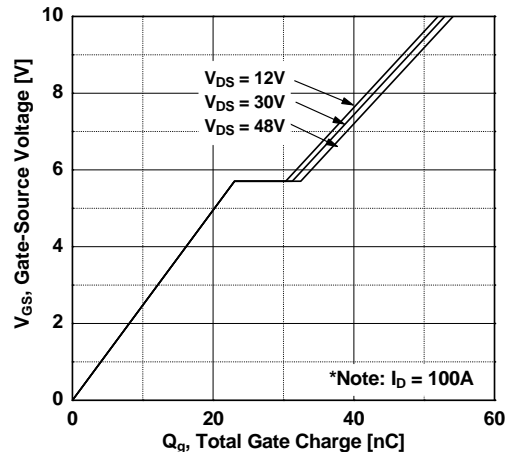


Figure 6. Gate Charge Characteristics



Typical Performance Characteristics (Continued)

Figure 7. Breakdown Voltage Variation vs. Temperature

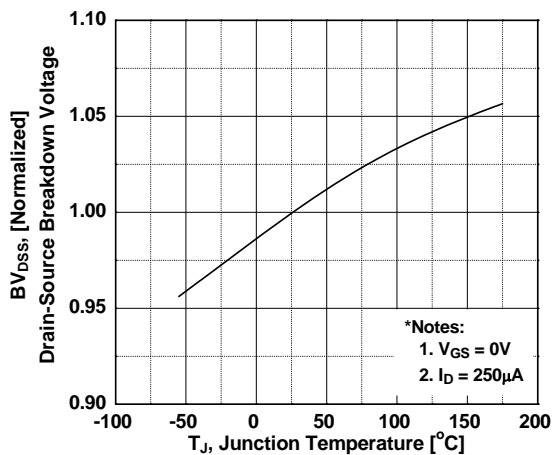


Figure 8. On-Resistance Variation vs. Temperature

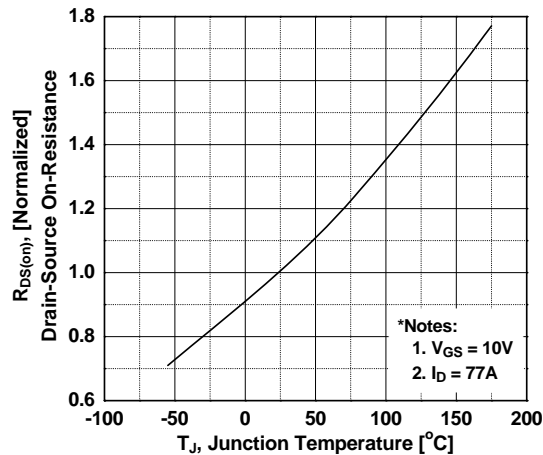


Figure 9. Maximum Safe Operating Area vs. Case Temperature

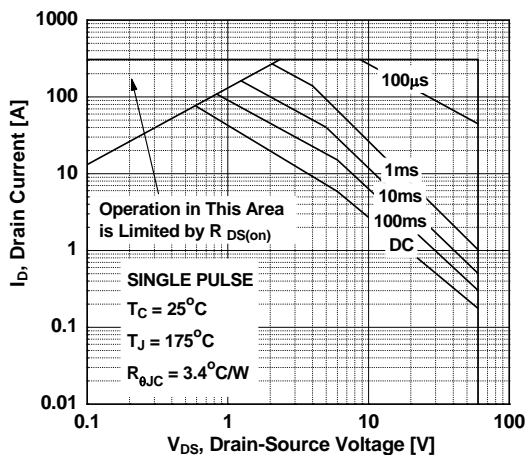


Figure 10. Maximum Drain Current

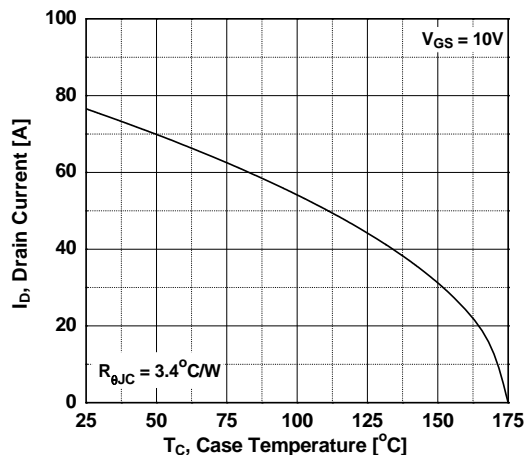


Figure 11. E_oss vs. Drain to Source Voltage

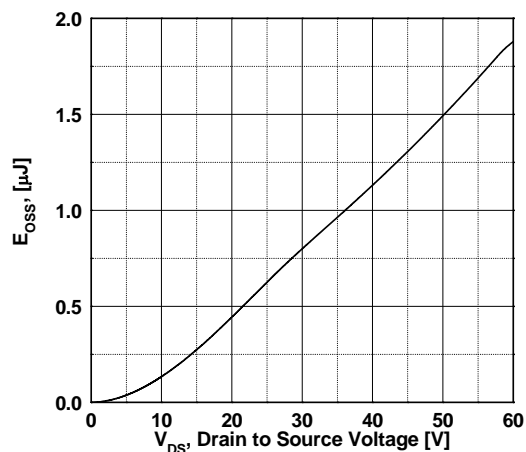
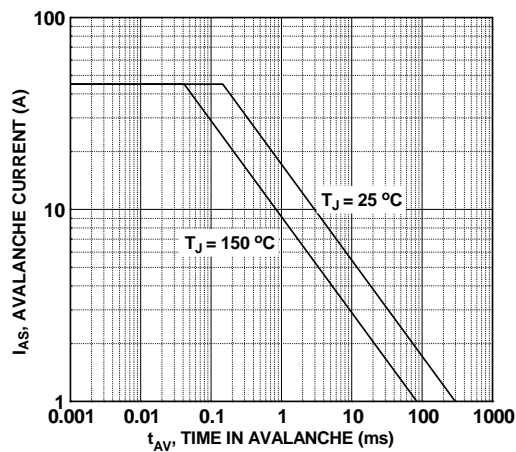
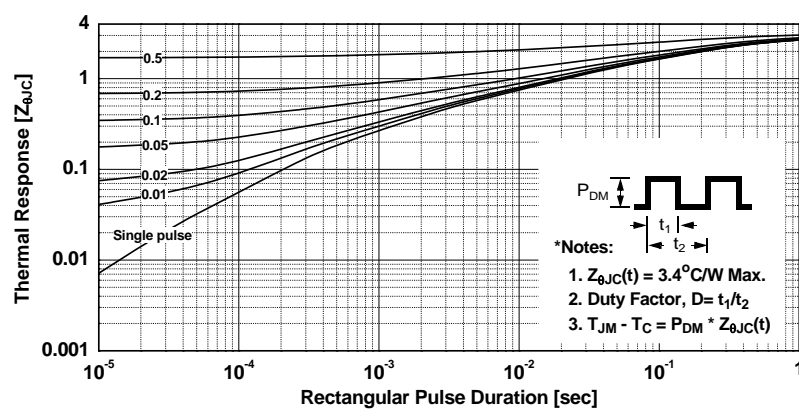


Figure 12. Unclamped Inductive Switching Capability

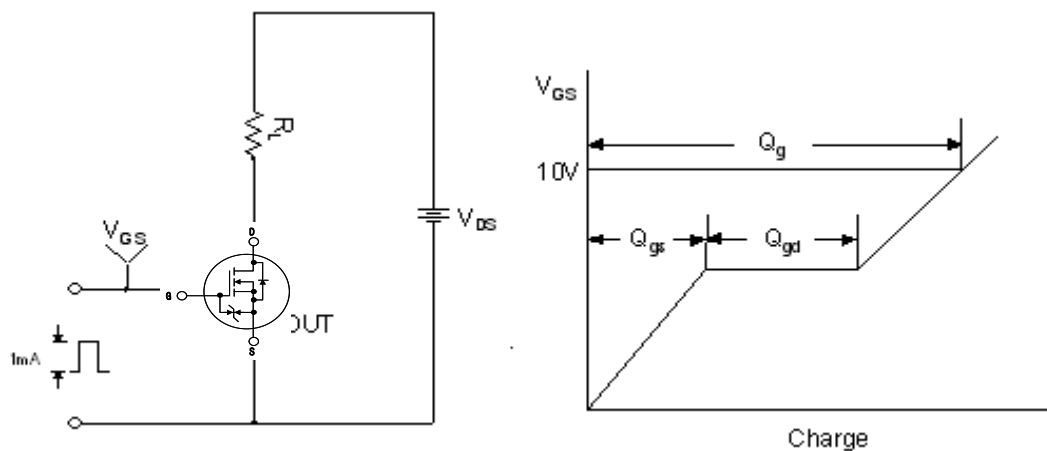


Typical Performance Characteristics (Continued)

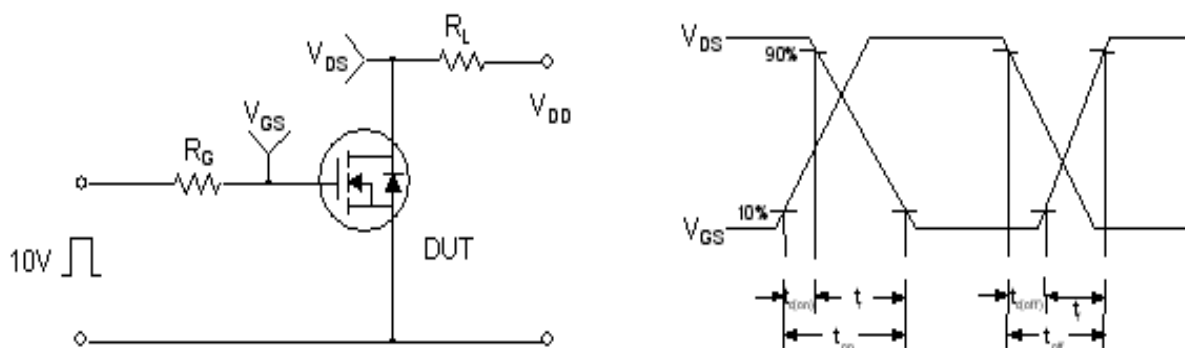
Figure 13. Transient Thermal Response Curve



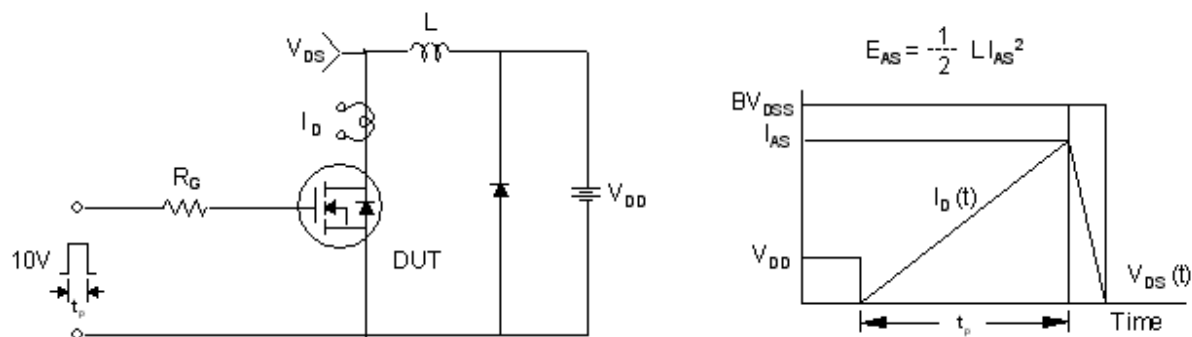
Gate Charge Test Circuit & Waveform



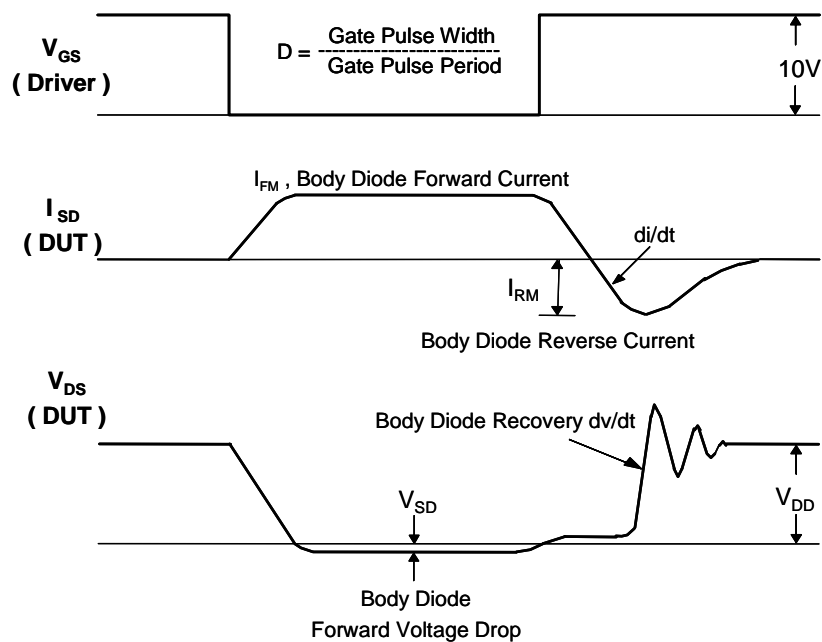
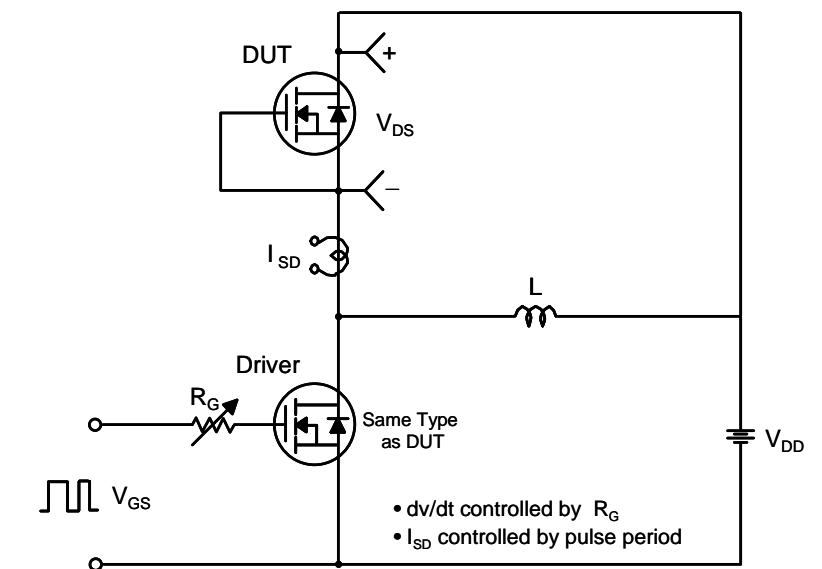
Resistive Switching Test Circuit & Waveforms



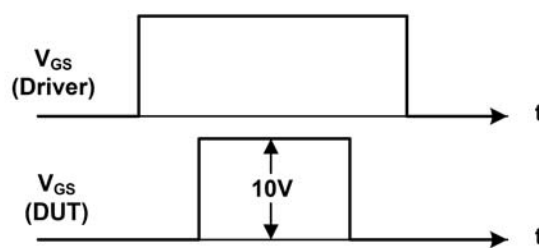
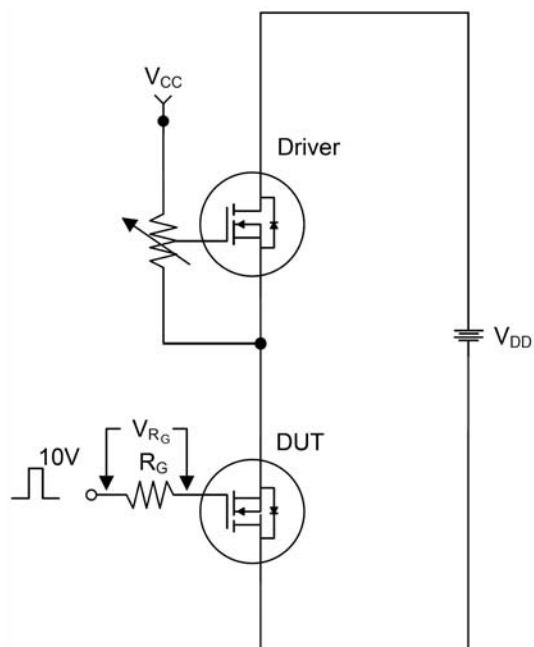
Unclamped Inductive Switching Test Circuit & Waveforms



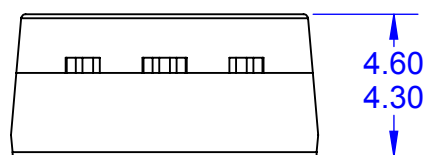
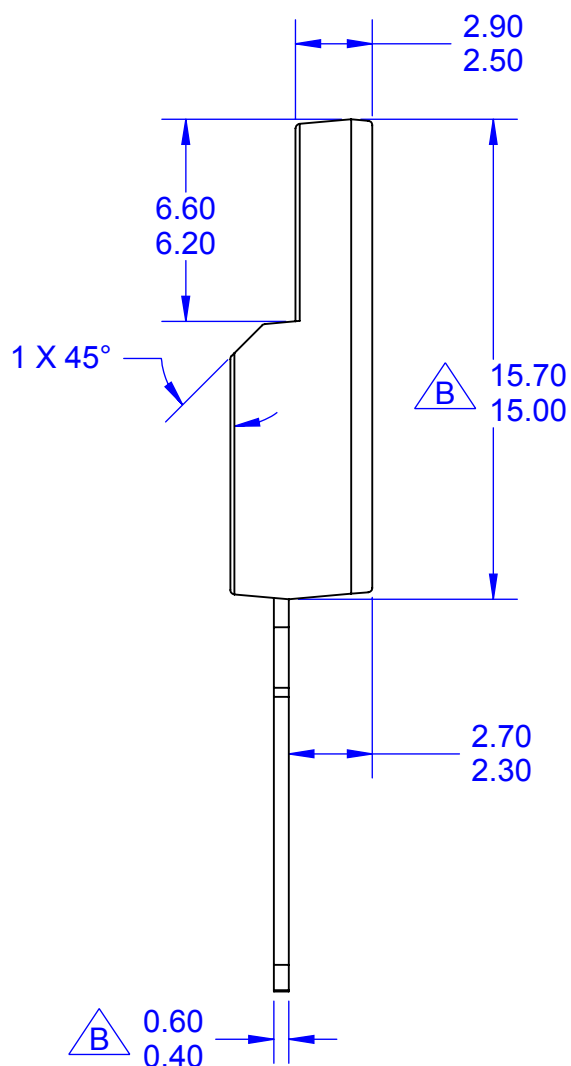
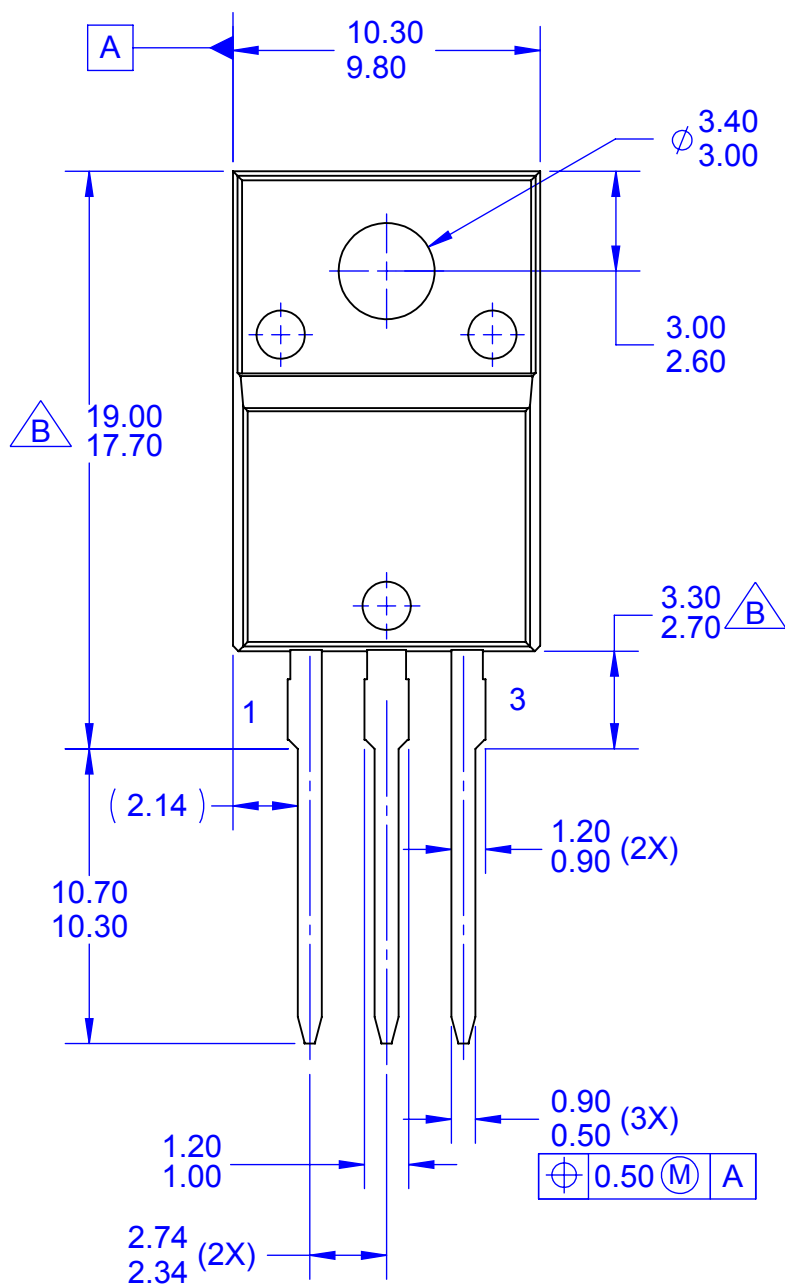
Peak Diode Recovery dv/dt Test Circuit & Waveforms



Total Gate Charge Q_{sync} . Test Circuit & Waveforms



$$Q_{sync} = \frac{1}{R_G} \cdot \int V_{R_G}(t) dt$$



NOTES:

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