

FEATURES

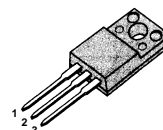
- Advanced New Design
- Avalanche Rugged Technology
- Rugged Gate Oxide Technology
- Very Low Intrinsic Capacitances
- Excellent Switching Characteristics
- Unrivalled Gate Charge: 6.0nC (Typ.)
- Extended Safe Operating Area
- Lower $R_{DS(ON)}$: 2.06 Ω (Typ.)

$$BV_{DSS} = -200V$$

$$R_{DS(ON)} = 2.7\Omega$$

$$I_D = -2.2A$$

TO-220F



1. Gate 2. Drain 3. Source

ABSOLUTE MAXIMUM RATINGS

| Symbol | Characteristics | Value | Units |
|----------------|---|-------------|------------------|
| V_{DSS} | Drain-to-Source Voltage | -200 | V |
| I_D | Continuous Drain Current ($T_C = 25^\circ\text{C}$) | -2.2 | A |
| | Continuous Drain Current ($T_C = 100^\circ\text{C}$) | -1.39 | |
| I_{DM} | Drain Current-Pulsed ① | -8.8 | A |
| V_{GS} | Gate-to-Source Voltage | ± 30 | V |
| E_{AS} | Single Pulsed Avalanche Energy ② | 150 | mJ |
| I_{AR} | Avalanche Current ① | -2.2 | A |
| E_{AR} | Repetitive Avalanche Energy ① | 3.2 | mJ |
| dv/dt | Peak Diode Recovery dv/dt ③ | -5.5 | V/ns |
| P_D | Total Power Dissipation ($T_C = 25^\circ\text{C}$) | 32 | W |
| | Linear Derating Factor | 0.26 | |
| T_J, T_{STG} | Operating Junction and Storage Temperature Range | -55 to +150 | $^\circ\text{C}$ |
| T_L | Maximum Lead Temp. for Soldering Purposes, 1/8" from case for 5-seconds | 300 | |

THERMAL RESISTANCE

| Symbol | Characteristics | Typ. | Max. | Units |
|-----------------|---------------------|------|------|---------------------------|
| $R_{\theta JC}$ | Junction-to-Case | - | 3.9 | $^\circ\text{C}/\text{W}$ |
| $R_{\theta JA}$ | Junction-to-Ambient | - | 62.5 | |

ELECTRICAL CHARACTERISTICS ($T_C = 25^\circ\text{C}$ unless otherwise specified)

| Symbol | Characteristics | Min. | Typ. | Max. | Units | Test Conditions |
|------------------------|---|------|-------|------|---------------------|---|
| BV_{DSS} | Drain-Source Breakdown Voltage | -200 | - | - | V | $V_{GS}=0V, I_D=-250\mu A$ |
| $\Delta BV/\Delta T_J$ | Breakdown Voltage Temp. Coeff. | - | -0.18 | - | V/ $^\circ\text{C}$ | $I_D=-250\mu A$, See Fig 7 |
| $V_{GS(th)}$ | Gate Threshold Voltage | -3.0 | - | -5.0 | V | $V_{DS}=-5V, I_D=-250\mu A$ |
| I_{GSS} | Gate-Source Leakage, Forward | - | - | -100 | nA | $V_{GS}=-30V$ |
| | Gate-Source Leakage, Reverse | - | - | 100 | | $V_{GS}=30V$ |
| I_{DSS} | Drain-to-Source Leakage Current | - | - | -1 | μA | $V_{DS}=-200V$ |
| | | - | - | -10 | | $V_{DS}=-160V, T_C=125^\circ\text{C}$ |
| $R_{DS(on)}$ | Static Drain-Source On-State Resistance | - | 2.06 | 2.7 | Ω | $V_{GS}=-10V, I_D=-1.1A$ ④ |
| g_{fs} | Forward Transconductance | - | 1.15 | - | S | $V_{DS}=-40V, I_D=-1.1A$ ④ |
| C_{iss} | Input Capacitance | - | 190 | 250 | pF | $V_{GS}=0V, V_{DS}=-25V$ $f=1\text{MHz}$ See Fig 5 |
| C_{oss} | Output Capacitance | - | 45 | 60 | | |
| C_{rss} | Reverse Transfer Capacitance | - | 7.5 | 10 | | |
| $t_{d(on)}$ | Turn-On Delay Time | - | 8.5 | 25 | ns | $V_{DD}=-100V, I_D=-2.8A$ $R_G=50\Omega$ See Fig 13 ④ ⑤ |
| t_r | Rise Time | - | 35 | 80 | | |
| $t_{d(off)}$ | Turn-Off Delay Time | - | 12 | 35 | | |
| t_f | Fall Time | - | 25 | 60 | | |
| Q_g | Total Gate Charge | - | 6.0 | 8.0 | nC | $V_{DS}=-160V, V_{GS}=-10V$ $I_D=-2.8A$ See Fig 6 & Fig 12 ④ ⑤ |
| Q_{gs} | Gate-Source Charge | - | 1.7 | - | | |
| Q_{gd} | Gate-Drain (Miller) Charge | - | 2.9 | - | | |

SOURCE-DRAIN DIODE RATINGS AND CHARACTERISTICS

| Symbol | Characteristics | Min. | Typ. | Max. | Units | Test Conditions |
|----------|---------------------------|------|------|------|---------------|---|
| I_S | Continuous Source Current | - | - | -2.2 | A | Integral reverse pn-diode in the MOSFET |
| I_{SM} | Pulsed-Source Current ① | - | - | -8.8 | | |
| V_{SD} | Diode Forward Voltage ④ | - | - | -5.0 | V | $T_J=25^\circ\text{C}, I_S=-2.2A, V_{GS}=0V$ |
| t_{rr} | Reverse Recovery Time | - | 100 | - | ns | $T_J=25^\circ\text{C}, I_F=-2.8A, V_{DD}=-160V$ |
| Q_{rr} | Reverse Recovery Charge | - | 0.34 | - | μC | $di_F/dt=100A/\mu\text{s}$ ④ |

Notes:

- ① Repetitive Rating: Pulse Width Limited by Maximum Junction Temperature
- ② $L=46.5\text{mH}, I_{AS}=-2.2A, V_{DD}=-50V, R_G=25\Omega$, Starting $T_J=25^\circ\text{C}$
- ③ $I_{SD} \leq -2.8A, di/dt \leq 300A/\mu\text{s}, V_{DD} \leq BV_{DSS}$, Starting $T_J=25^\circ\text{C}$
- ④ Pulse Test: Pulse Width $\leq 300\mu\text{s}$, Duty Cycle $\leq 2\%$
- ⑤ Essentially Independent of Operating Temperature

Fig 1. Output Characteristics

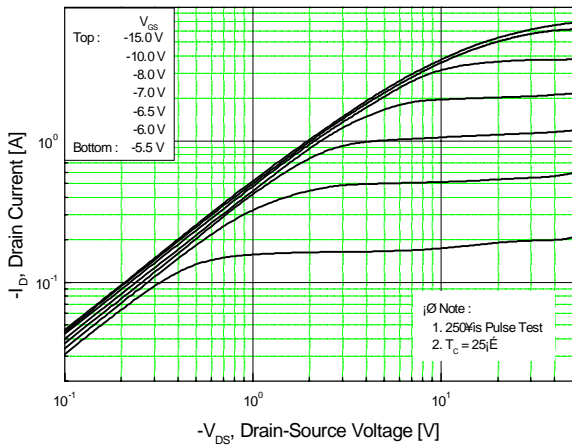


Fig 2. Transfer Characteristics

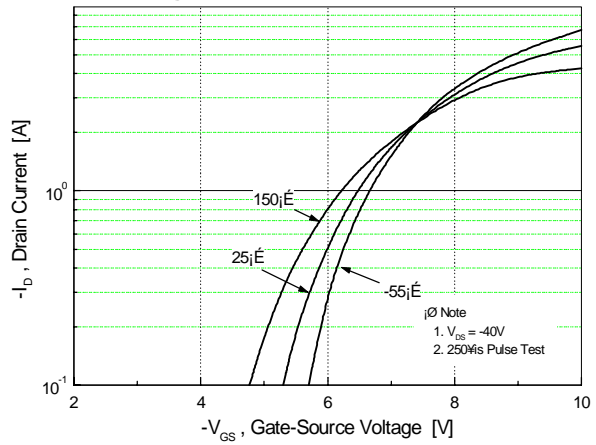


Fig 3. On-Resistance vs. Drain Current

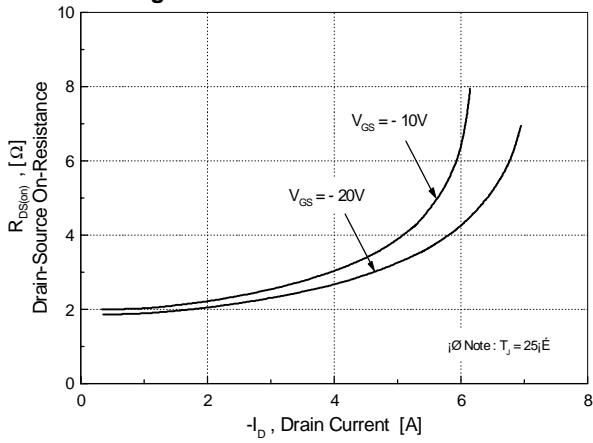


Fig 4. Source-Drain Diode Forward Voltage

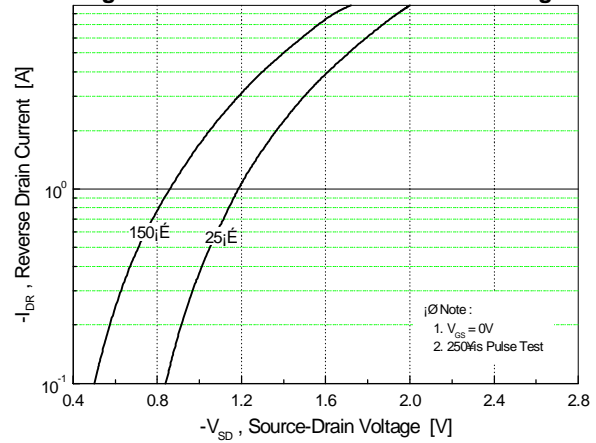


Fig 5. Capacitance vs. Drain-Source Voltage

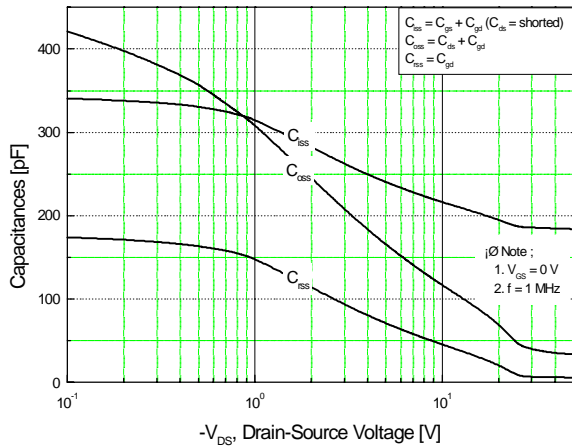


Fig 6. Gate Charge vs. Gate-Source Voltage

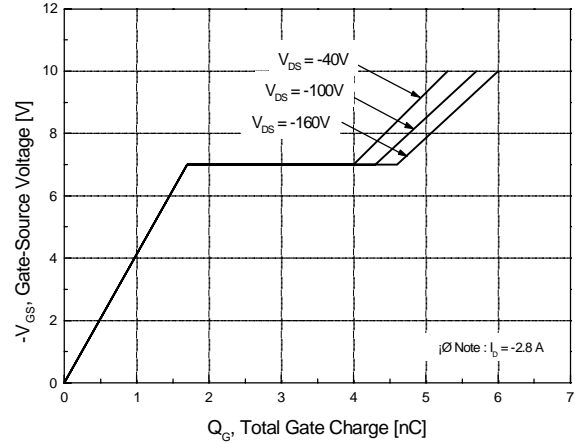


Fig 7. Breakdown Voltage vs. Temperature

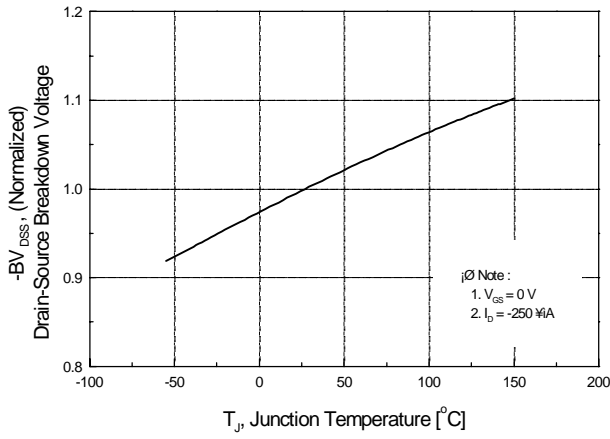


Fig 8. On-Resistance vs. Temperature

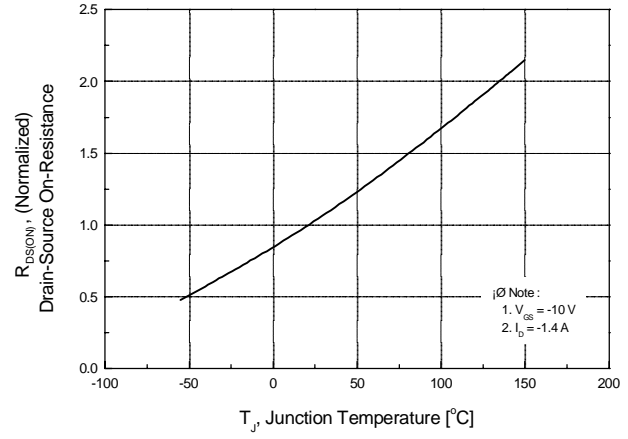


Fig 9. Max. Safe Operating Area

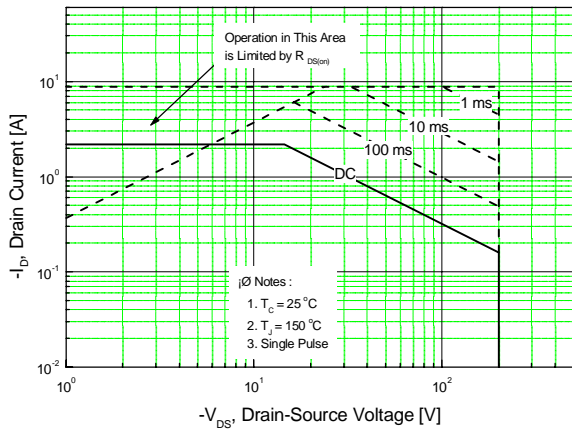


Fig 10. Max. Drain Current vs. Case Temperature

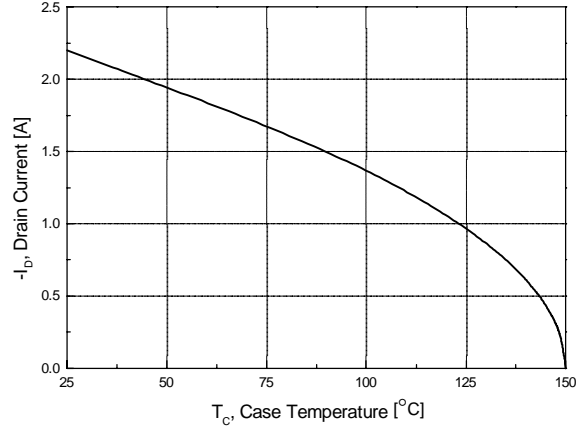


Fig 11. Thermal Response

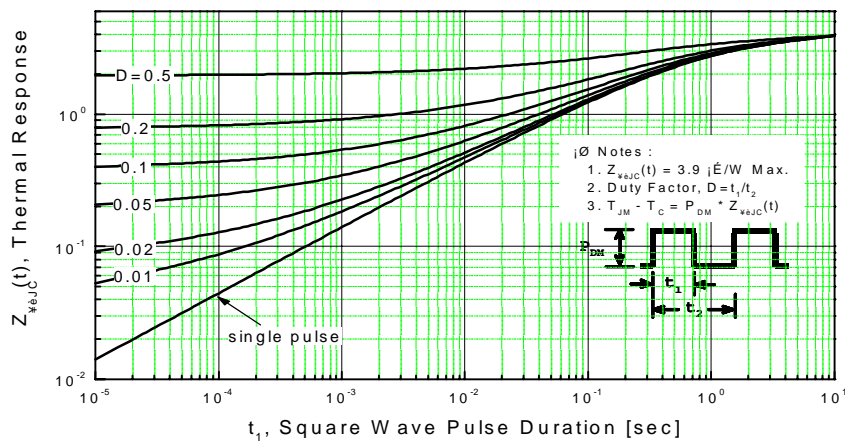


Fig 12. Gate Charge Test Circuit & Waveform

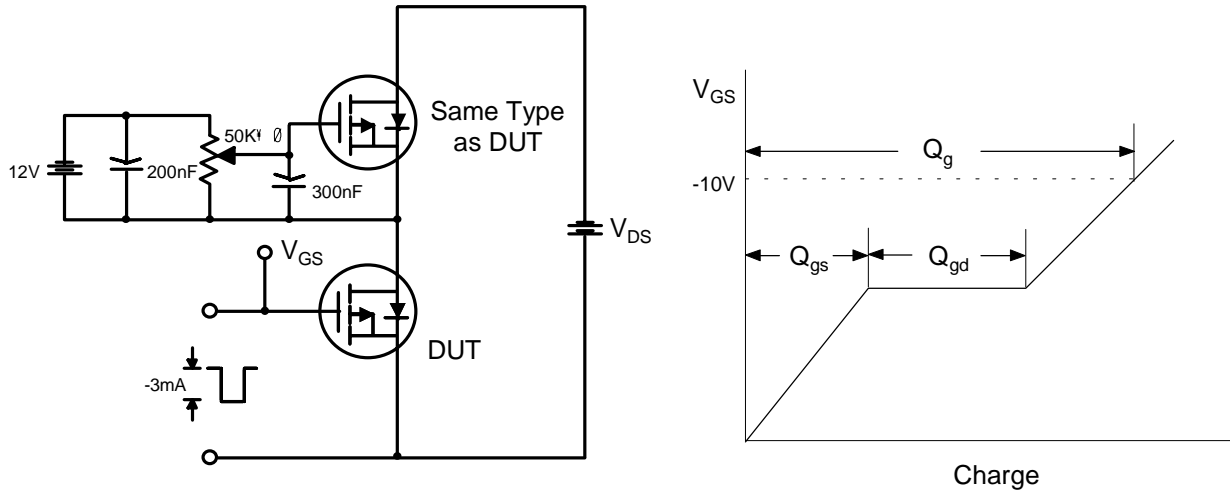


Fig 13. Resistive Switching Test Circuit & Waveforms

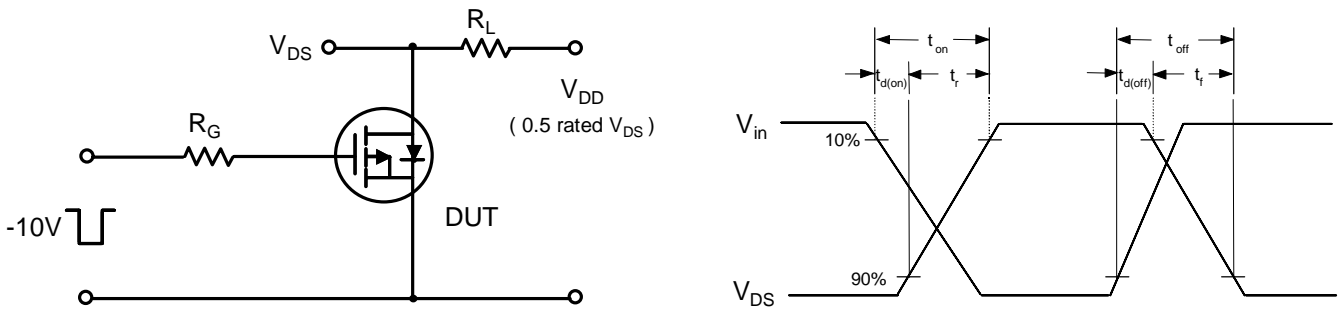


Fig 14. Unclamped Inductive Switching Test Circuit & Waveforms

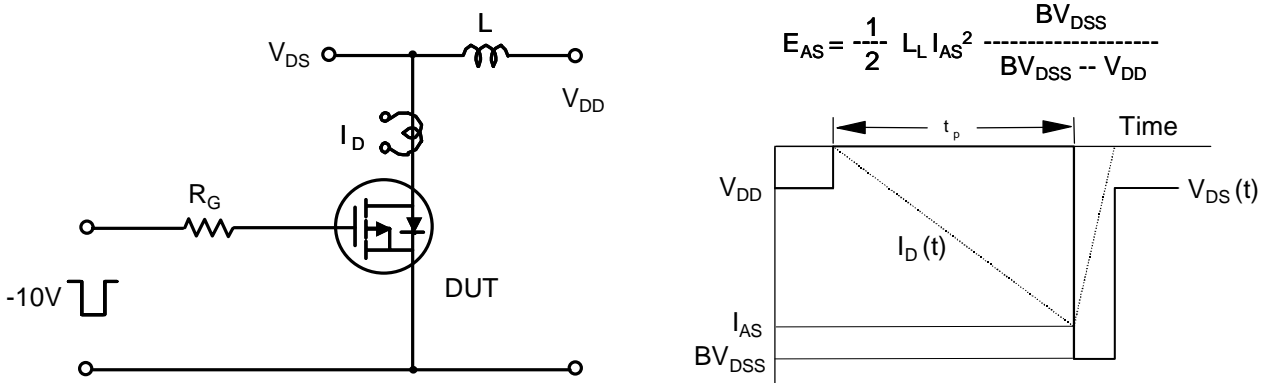
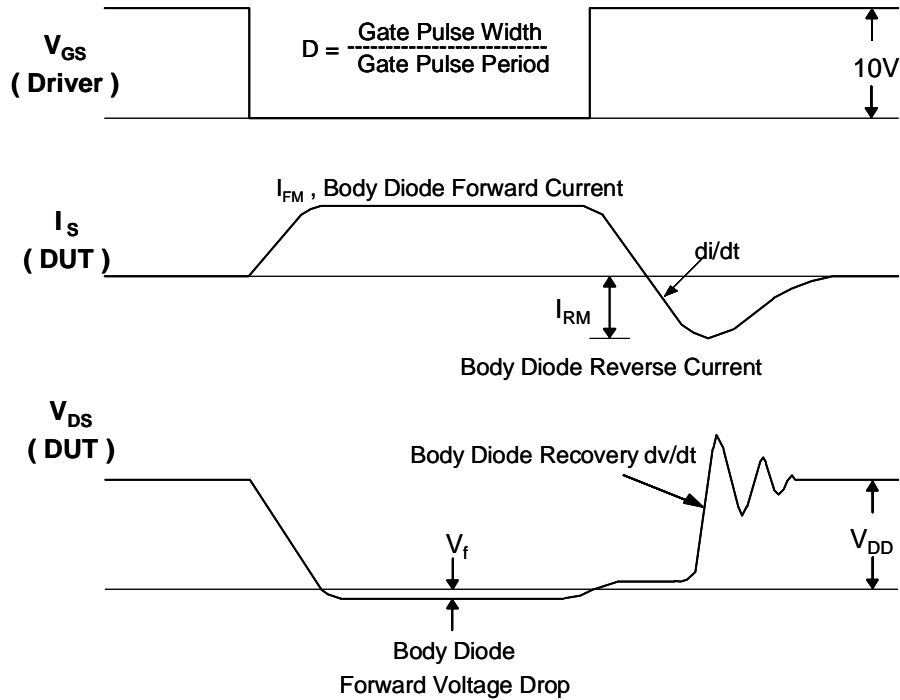
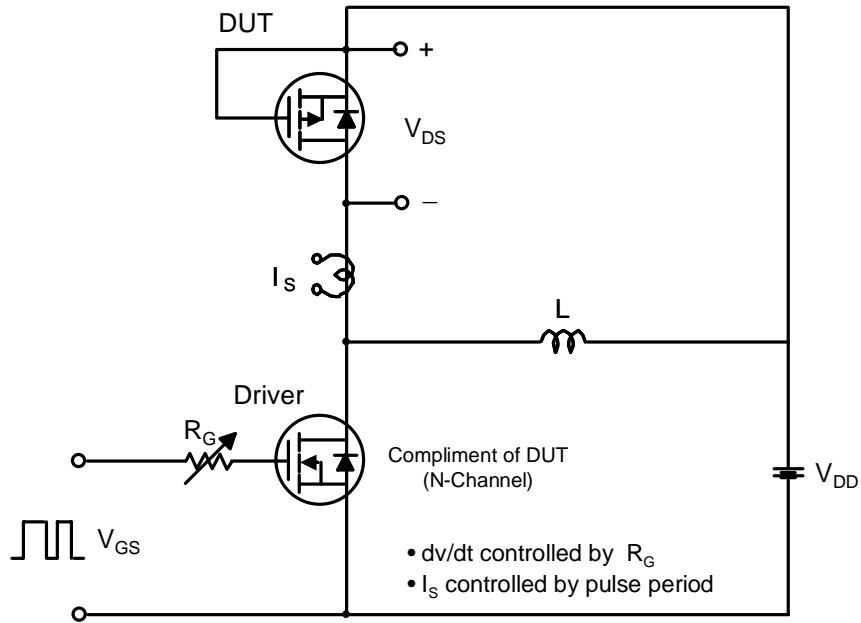
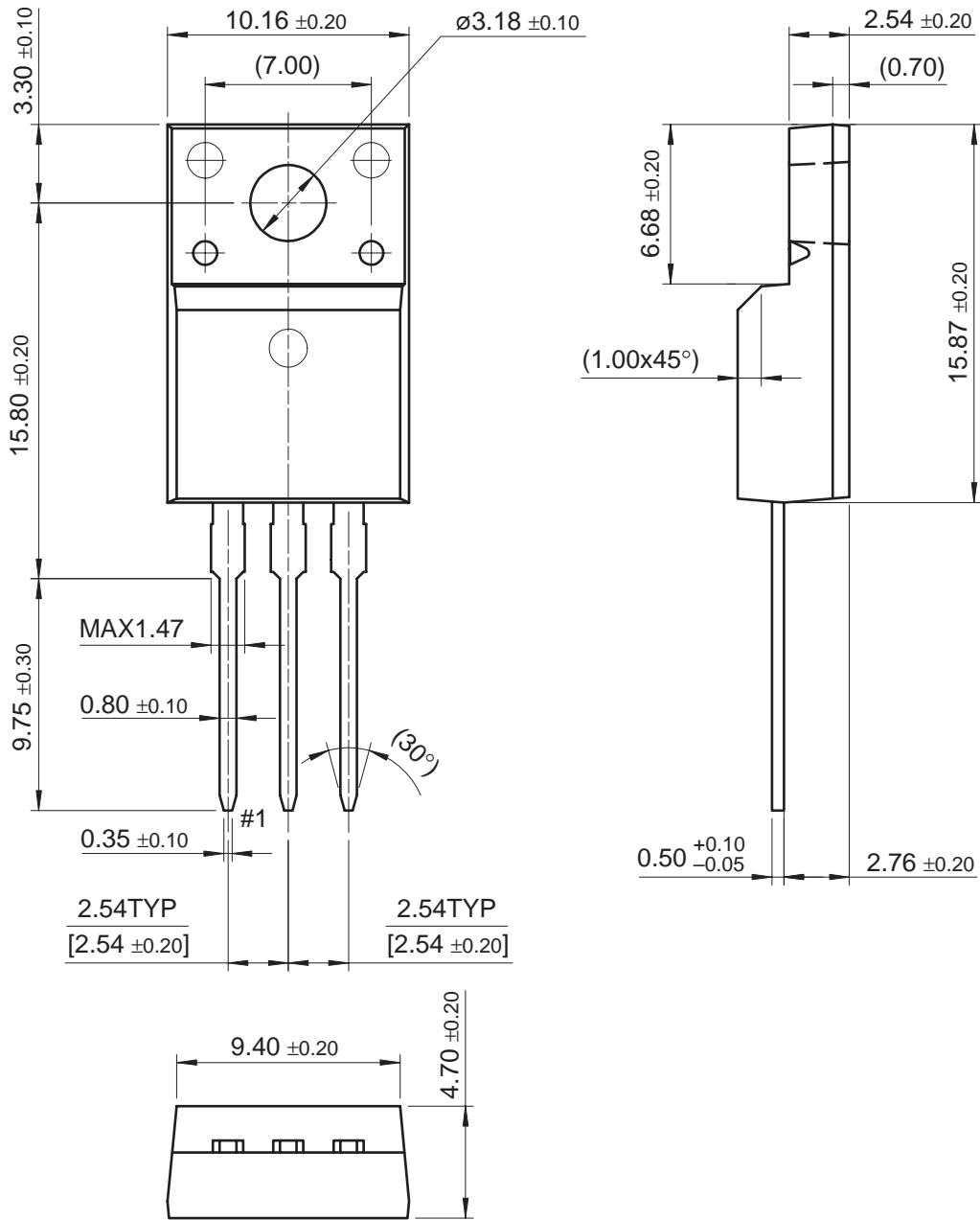


Fig 15. Peak Diode Recovery dv/dt Test Circuit & Waveforms



TO-220F Package Dimensions

TO-220F (FS PKG CODE AQ)



Dimensions in Millimeters

September 1999, Rev B

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