

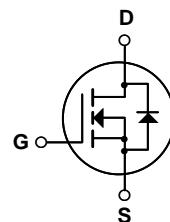
## **FQPF30N06L** 60V LOGIC N-Channel MOSFET

### General Description

These N-Channel enhancement mode power field effect transistors are produced using Fairchild's proprietary, planar stripe, DMOS technology. This advanced technology has been especially tailored to minimize on-state resistance, provide superior switching performance, and withstand high energy pulse in the avalanche and commutation mode. These devices are well suited for low voltage applications such as automotive, DC/DC converters, and high efficiency switching for power management in portable and battery operated products.

### Features

- 22.5A, 60V,  $R_{DS(on)} = 0.035\Omega$  @  $V_{GS} = 10$  V
- Low gate charge ( typical 15 nC)
- Low  $C_{RSS}$  ( typical 50 pF)
- Fast switching
- 100% avalanche tested
- Improved dv/dt capability
- 175°C maximum junction temperature rating



### Absolute Maximum Ratings

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

| Symbol         | Parameter   | FQPF30N06L  | Units               |
|----------------|---|-------------|---------------------|
| $V_{DSS}$      | Drain-Source Voltage  | 60          | V                   |
| $I_D$          | Drain Current - Continuous ( $T_C = 25^\circ\text{C}$ )                       | 22.5        | A                   |
|                | - Continuous ( $T_C = 100^\circ\text{C}$ )                                    | 15.9        | A                   |
| $I_{DM}$       | Drain Current - Pulsed  | (Note 1)    | A                   |
| $V_{GSS}$      | Gate-Source Voltage   | $\pm 20$    | V                   |
| $E_{AS}$       | Single Pulsed Avalanche Energy  | (Note 2)    | mJ                  |
| $I_{AR}$       | Avalanche Current   | (Note 1)    | A                   |
| $E_{AR}$       | Repetitive Avalanche Energy   | (Note 1)    | mJ                  |
| $dv/dt$        | Peak Diode Recovery $dv/dt$   | (Note 3)    | V/ns                |
| $P_D$          | Power Dissipation ( $T_C = 25^\circ\text{C}$ )                                | 38          | W                   |
|                | - Derate above $25^\circ\text{C}$   | 0.25        | W/ $^\circ\text{C}$ |
| $T_J, T_{STG}$ | Operating and Storage Junction Temperature Range                              | -55 to +175 | $^\circ\text{C}$    |
| $T_L$          | Maximum lead temperature for soldering purposes, 1/8" from case for 5 seconds | 300         | $^\circ\text{C}$    |

### Thermal Characteristics

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

## Electrical Characteristics

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

| Symbol                                       | Parameter                                 | Test Conditions   | Min | Typ  | Max  | Units                     |
|--|---|---|-----|------|------|---------------------------|
| <b>Off Characteristics</b>                   |   |   |     |      |      |                           |
| $\text{BV}_{\text{DSS}}$                     | Drain-Source Breakdown Voltage            | $V_{\text{GS}} = 0 \text{ V}$ , $I_D = 250 \mu\text{A}$         | 60  | --   | --   | V                         |
| $\Delta \text{BV}_{\text{DSS}} / \Delta T_J$ | Breakdown Voltage Temperature Coefficient | $I_D = 250 \mu\text{A}$ , Referenced to $25^\circ\text{C}$      | --  | 0.06 | --   | $\text{V}/^\circ\text{C}$ |
| $I_{\text{DSS}}$                             | Zero Gate Voltage Drain Current           | $V_{\text{DS}} = 60 \text{ V}$ , $V_{\text{GS}} = 0 \text{ V}$  | --  | --   | 1    | $\mu\text{A}$             |
|  |   | $V_{\text{DS}} = 48 \text{ V}$ , $T_C = 150^\circ\text{C}$      | --  | --   | 10   | $\mu\text{A}$             |
| $I_{\text{GSSF}}$                            | Gate-Body Leakage Current, Forward        | $V_{\text{GS}} = 20 \text{ V}$ , $V_{\text{DS}} = 0 \text{ V}$  | --  | --   | 100  | nA                        |
| $I_{\text{GSSR}}$                            | Gate-Body Leakage Current, Reverse        | $V_{\text{GS}} = -20 \text{ V}$ , $V_{\text{DS}} = 0 \text{ V}$ | --  | --   | -100 | nA                        |

## On Characteristics

|                     |                                   |  |     |       |       |          |
|---------------------|-----------------------------------|--|-----|-------|-------|----------|
| $V_{\text{GS(th)}}$ | Gate Threshold Voltage            | $V_{\text{DS}} = V_{\text{GS}}$ , $I_D = 250 \mu\text{A}$        | 1.0 | --    | 2.5   | V        |
| $R_{\text{DS(on)}}$ | Static Drain-Source On-Resistance | $V_{\text{GS}} = 10 \text{ V}$ , $I_D = 11.3 \text{ A}$          | --  | 0.027 | 0.035 | $\Omega$ |
|                     |                                   | $V_{\text{GS}} = 5 \text{ V}$ , $I_D = 11.3 \text{ A}$           | --  | 0.035 | 0.045 |          |
| $g_{\text{FS}}$     | Forward Transconductance          | $V_{\text{DS}} = 25 \text{ V}$ , $I_D = 11.3 \text{ A}$ (Note 4) | --  | 22    | --    | S        |

## Dynamic Characteristics

|                  |                              |   |    |     |      |    |
|------------------|------------------------------|---|----|-----|------|----|
| $C_{\text{iss}}$ | Input Capacitance            | $V_{\text{DS}} = 25 \text{ V}$ , $V_{\text{GS}} = 0 \text{ V}$ ,<br>$f = 1.0 \text{ MHz}$ | -- | 800 | 1040 | pF |
| $C_{\text{oss}}$ | Output Capacitance           |   | -- | 270 | 350  | pF |
| $C_{\text{rss}}$ | Reverse Transfer Capacitance |   | -- | 50  | 65   | pF |

## Switching Characteristics

|                     |                     |  |    |     |     |    |
|---------------------|---------------------|--|----|-----|-----|----|
| $t_{\text{d(on)}}$  | Turn-On Delay Time  | $V_{\text{DD}} = 30 \text{ V}$ , $I_D = 16 \text{ A}$ ,<br>$R_G = 25 \Omega$             | -- | 15  | 40  | ns |
| $t_r$               | Turn-On Rise Time   |  | -- | 210 | 430 | ns |
| $t_{\text{d(off)}}$ | Turn-Off Delay Time |  | -- | 60  | 130 | ns |
| $t_f$               | Turn-Off Fall Time  |  | -- | 110 | 230 | ns |
| $Q_g$               | Total Gate Charge   | $V_{\text{DS}} = 48 \text{ V}$ , $I_D = 32 \text{ A}$ ,<br>$V_{\text{GS}} = 5 \text{ V}$ | -- | 15  | 20  | nC |
| $Q_{\text{gs}}$     | Gate-Source Charge  |  | -- | 3.5 | --  | nC |
| $Q_{\text{gd}}$     | Gate-Drain Charge   |  | -- | 8.5 | --  | nC |

## Drain-Source Diode Characteristics and Maximum Ratings

|                 |   |   |    |      |     |    |
|-----------------|---|---|----|------|-----|----|
| $I_S$           | Maximum Continuous Drain-Source Diode Forward Current | --  | -- | 22.5 | A   |    |
| $I_{\text{SM}}$ | Maximum Pulsed Drain-Source Diode Forward Current     | --  | -- | 90   | A   |    |
| $V_{\text{SD}}$ | Drain-Source Diode Forward Voltage                    | $V_{\text{GS}} = 0 \text{ V}$ , $I_S = 22.5 \text{ A}$  | -- | --   | 1.5 | V  |
| $t_{\text{rr}}$ | Reverse Recovery Time                                 | $V_{\text{GS}} = 0 \text{ V}$ , $I_S = 32 \text{ A}$ ,<br>$dI_F / dt = 100 \text{ A}/\mu\text{s}$ | -- | 60   | --  | ns |
| $Q_{\text{rr}}$ | Reverse Recovery Charge                               | (Note 4)  | -- | 90   | --  | nC |

### Notes:

1. Repetitive Rating : Pulse width limited by maximum junction temperature
2.  $L = 810\mu\text{H}$ ,  $I_{AS} = 22.5\text{A}$ ,  $V_{DD} = 25\text{V}$ ,  $R_G = 25\Omega$ , Starting  $T_J = 25^\circ\text{C}$
3.  $I_{SD} \leq 32\text{A}$ ,  $dI/dt \leq 300\text{A}/\mu\text{s}$ ,  $V_{DD} \leq \text{BV}_{\text{DSS}}$ , 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

## Typical Characteristics

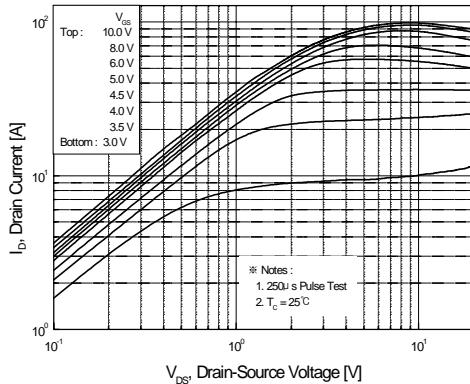


Figure 1. On-Region Characteristics

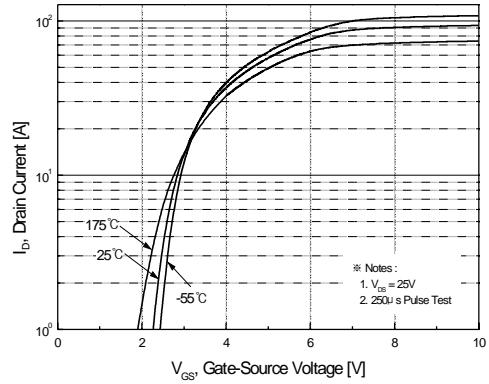


Figure 2. Transfer Characteristics

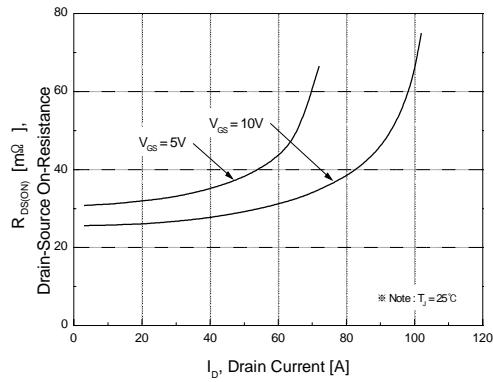


Figure 3. On-Resistance Variation vs. Drain Current and Gate Voltage

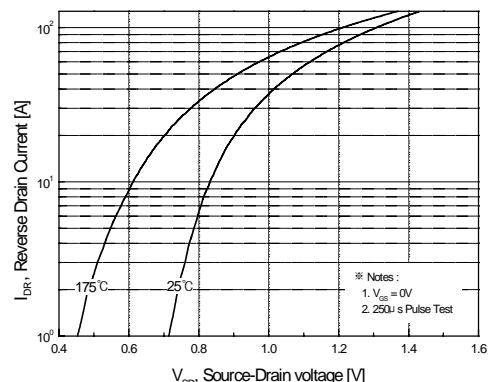


Figure 4. Body Diode Forward Voltage Variation vs. Source Current and Temperature

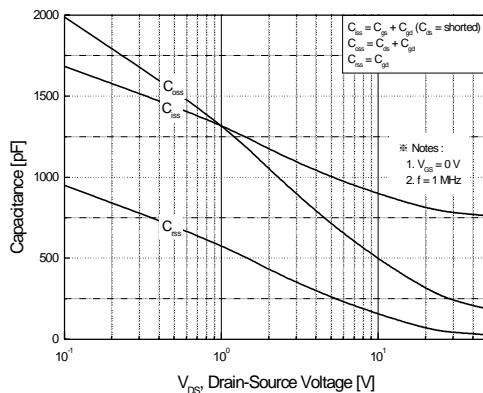


Figure 5. Capacitance Characteristics

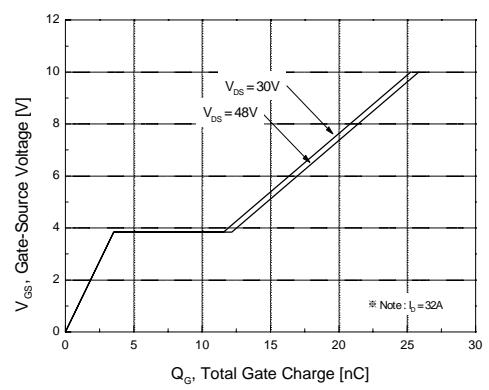
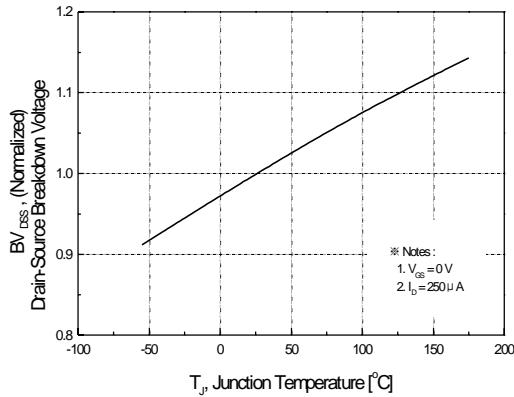
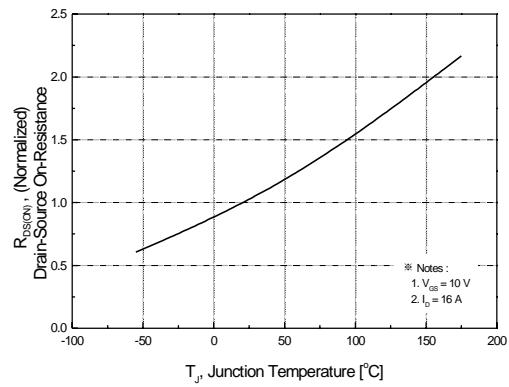


Figure 6. Gate Charge Characteristics

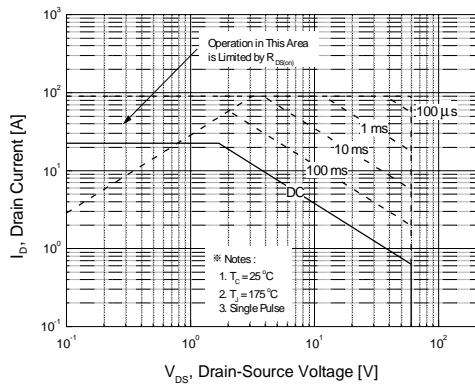
## Typical Characteristics (Continued)



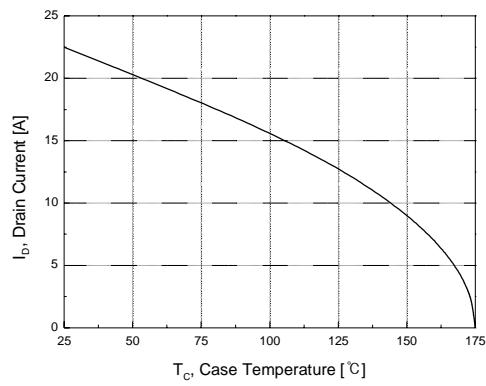
**Figure 7. Breakdown Voltage Variation vs. Temperature**



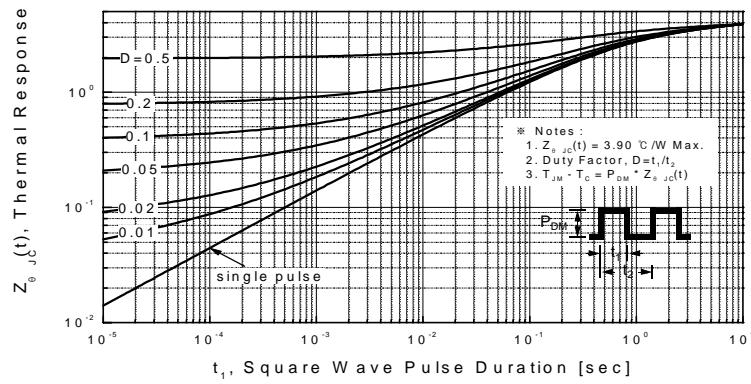
**Figure 8. On-Resistance Variation vs. Temperature**



**Figure 9. Maximum Safe Operating Area**

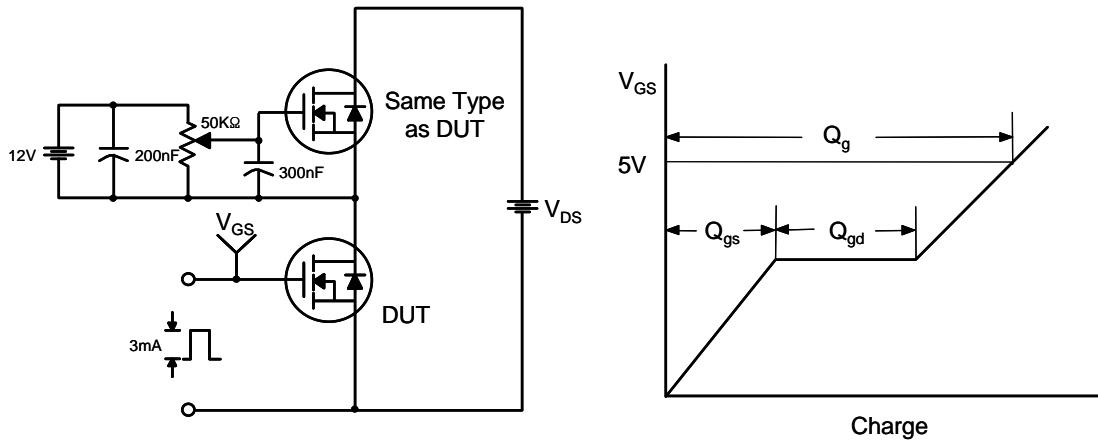


**Figure 10. Maximum Drain Current vs. Case Temperature**

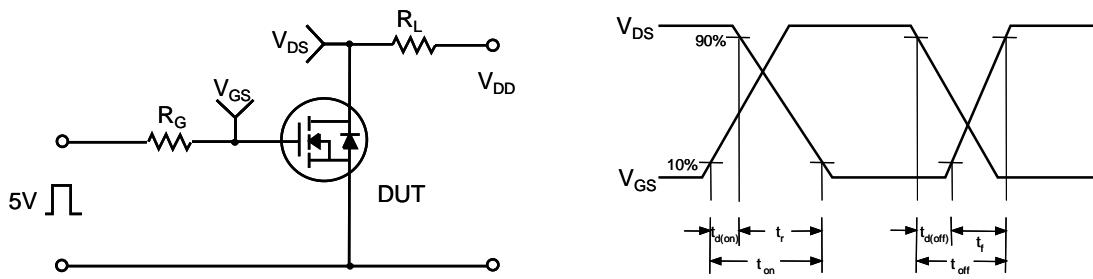


**Figure 11. Transient Thermal Response Curve**

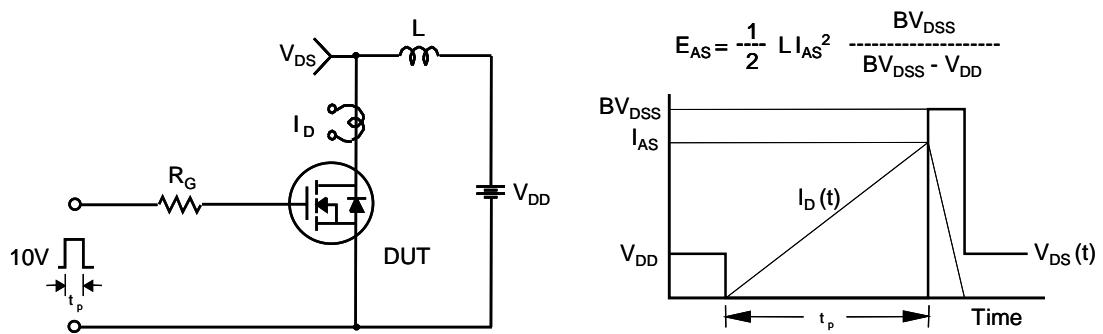
Gate Charge Test Circuit & Waveform

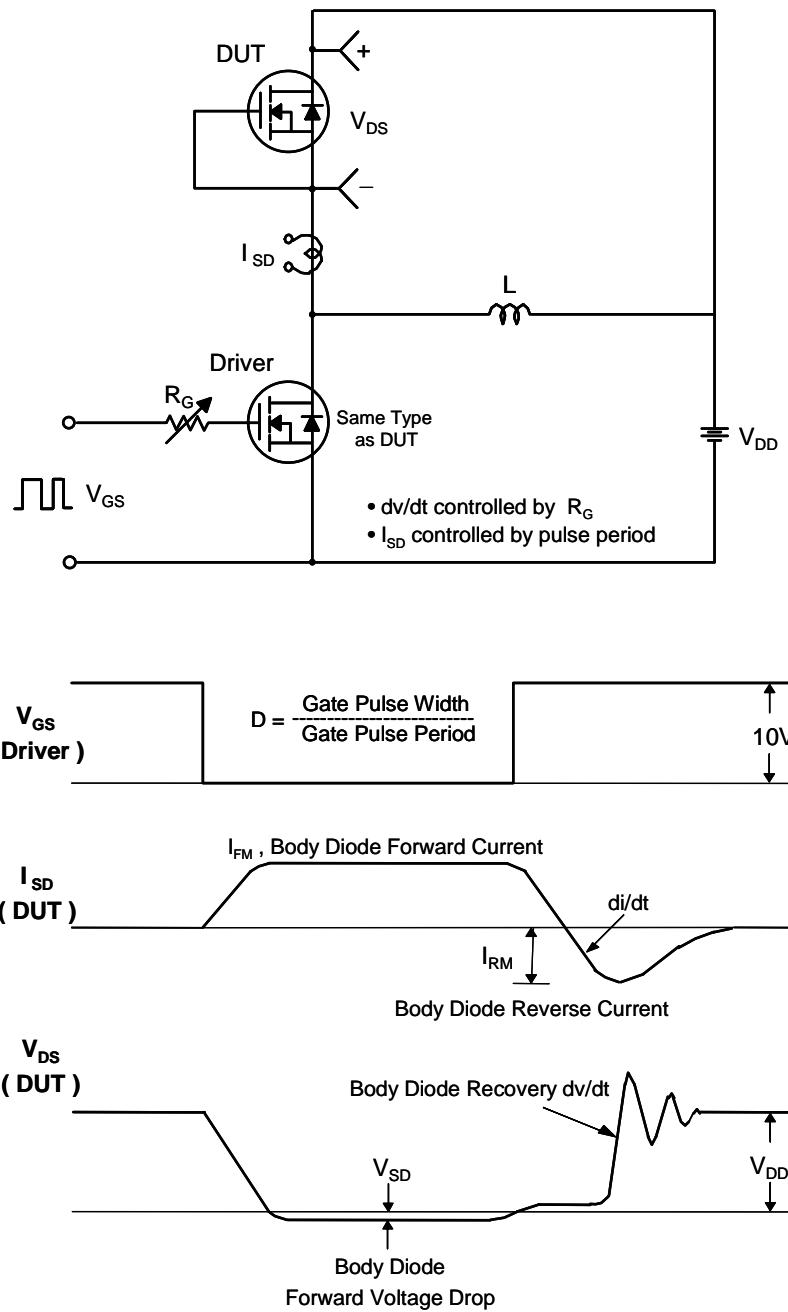


Resistive Switching Test Circuit & Waveforms



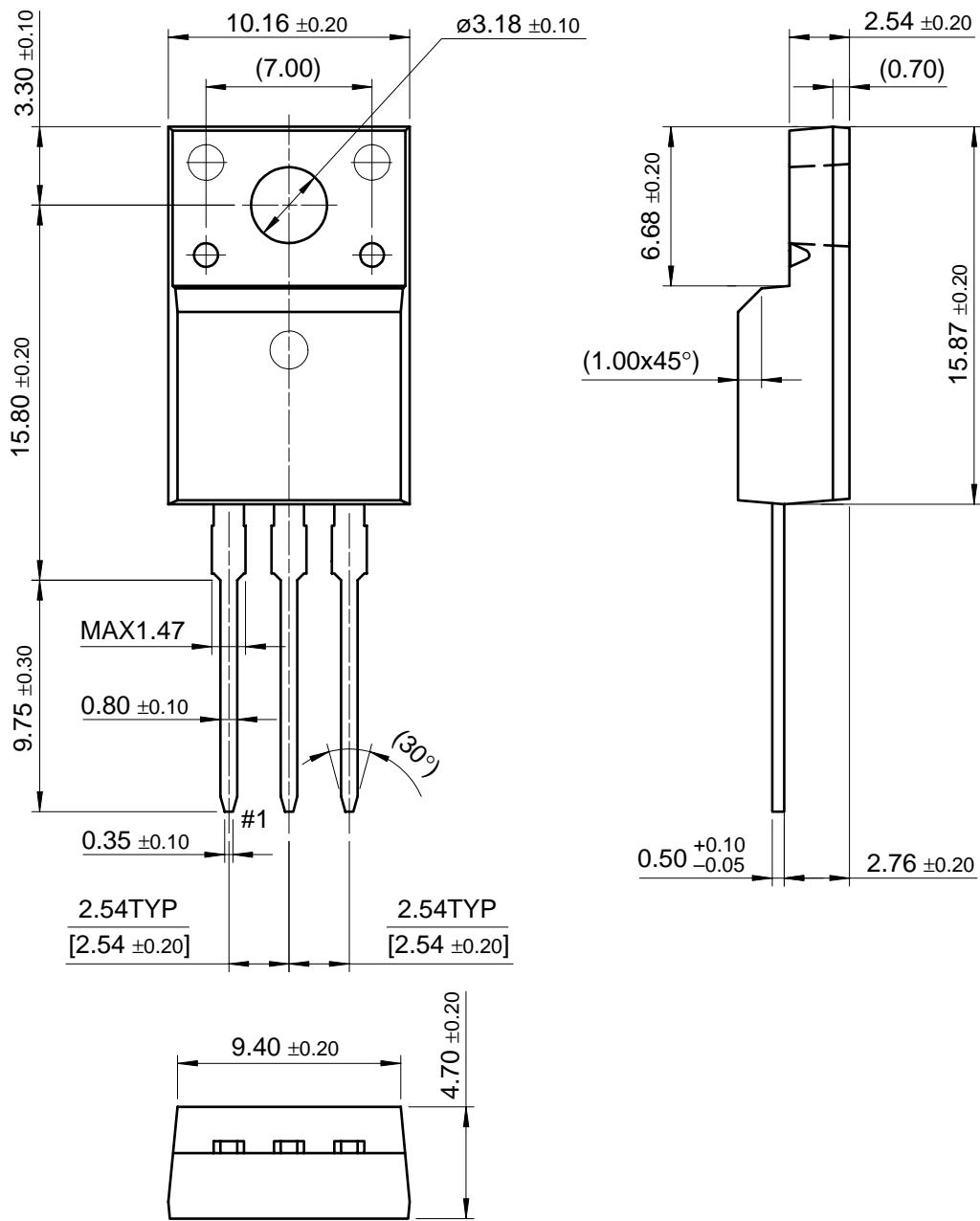
Unclamped Inductive Switching Test Circuit & Waveforms



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

## Package Dimensions

## TO-220F



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