



May 2001

**QFET™**

# FQPF45N03L

## 30V LOGIC N-Channel MOSFET

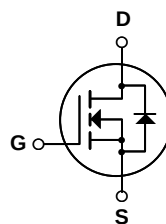
### General Description

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 DC/DC converters, high efficiency switching for power management in portable and battery operated products.

### Features

- 29A, 30V,  $R_{DS(on)} = 0.018\Omega$  @  $V_{GS} = 10V$
- Low gate charge ( typical 15 nC)
- Low  $C_{rss}$  ( typical 105 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                                                                                             | FQPF45N03L  | Units |
|----------------|-------------------------------------------------------------------------------------------------------|-------------|-------|
| $V_{DSS}$      | Drain-Source Voltage                                                                                  | 30          | V     |
| $I_D$          | Drain Current - Continuous ( $T_C = 25^\circ\text{C}$ )<br>- Continuous ( $T_C = 100^\circ\text{C}$ ) | 29          | A     |
|                |                                                                                                       | 20.5        | A     |
| $I_{DM}$       | Drain Current - Pulsed (Note 1)                                                                       | 116         | A     |
| $V_{GSS}$      | Gate-Source Voltage                                                                                   | $\pm 20$    | V     |
| $E_{AS}$       | Single Pulsed Avalanche Energy (Note 2)                                                               | 200         | mJ    |
| $I_{AR}$       | Avalanche Current (Note 1)                                                                            | 29          | A     |
| $E_{AR}$       | Repetitive Avalanche Energy (Note 1)                                                                  | 3.1         | mJ    |
| dv/dt          | Peak Diode Recovery dv/dt (Note 3)                                                                    | 7.0         | V/ns  |
| $P_D$          | Power Dissipation ( $T_C = 25^\circ\text{C}$ )<br>- Derate above $25^\circ\text{C}$                   | 31          | W     |
|                |                                                                                                       | 0.21        | W/°C  |
| $T_J, T_{STG}$ | Operating and Storage Temperature Range                                                               | -55 to +175 | °C    |
| $T_L$          | Maximum lead temperature for soldering purposes,<br>1/8" from case for 5 seconds                      | 300         | °C    |

### Thermal Characteristics

| Symbol          | Parameter                               | Typ | Max  | Units |
|-----------------|-----------------------------------------|-----|------|-------|
| $R_{\theta JC}$ | Thermal Resistance, Junction-to-Case    | --  | 4.84 | °C/W  |
| $R_{\theta JA}$ | Thermal Resistance, Junction-to-Ambient | --  | 62.5 | °C/W  |

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

| Symbol | Parameter | Test Conditions | Min | Typ | Max | Units |
|--------|-----------|-----------------|-----|-----|-----|-------|
|--------|-----------|-----------------|-----|-----|-----|-------|

**Off Characteristics**

|                                |                                           |                                                                   |    |      |      |                     |
|--------------------------------|-------------------------------------------|-------------------------------------------------------------------|----|------|------|---------------------|
| $BV_{DSS}$                     | Drain-Source Breakdown Voltage            | $V_{GS} = 0\text{ V}, I_D = 250\text{ }\mu\text{A}$               | 30 | --   | --   | V                   |
| $\Delta BV_{DSS} / \Delta T_J$ | Breakdown Voltage Temperature Coefficient | $I_D = 250\text{ }\mu\text{A}$ , Referenced to $25^\circ\text{C}$ | -- | 0.03 | --   | V/ $^\circ\text{C}$ |
| $I_{DSS}$                      | Zero Gate Voltage Drain Current           | $V_{DS} = 30\text{ V}, V_{GS} = 0\text{ V}$                       | -- | --   | 1    | $\mu\text{A}$       |
|                                |                                           | $V_{DS} = 24\text{ V}, T_C = 150^\circ\text{C}$                   | -- | --   | 10   | $\mu\text{A}$       |
| $I_{GSSF}$                     | Gate-Body Leakage Current, Forward        | $V_{GS} = 20\text{ V}, V_{DS} = 0\text{ V}$                       | -- | --   | 100  | nA                  |
| $I_{GSSR}$                     | Gate-Body Leakage Current, Reverse        | $V_{GS} = -20\text{ V}, V_{DS} = 0\text{ V}$                      | -- | --   | -100 | nA                  |

**On Characteristics**

|              |                                   |                                                      |     |        |       |          |
|--------------|-----------------------------------|------------------------------------------------------|-----|--------|-------|----------|
| $V_{GS(th)}$ | Gate Threshold Voltage            | $V_{DS} = V_{GS}, I_D = 250\text{ }\mu\text{A}$      | 1.0 | --     | 2.5   | V        |
| $R_{DS(on)}$ | Static Drain-Source On-Resistance | $V_{GS} = 10\text{ V}, I_D = 14.5\text{ A}$          | --  | 0.0136 | 0.018 | $\Omega$ |
|              |                                   | $V_{GS} = 5\text{ V}, I_D = 14.5\text{ A}$           | --  | 0.0192 | 0.025 | $\Omega$ |
| $g_{FS}$     | Forward Transconductance          | $V_{DS} = 15\text{ V}, I_D = 14.5\text{ A}$ (Note 4) | --  | 21     | --    | S        |

**Dynamic Characteristics**

|           |                              |                                                                      |    |     |      |    |
|-----------|------------------------------|----------------------------------------------------------------------|----|-----|------|----|
| $C_{iss}$ | Input Capacitance            | $V_{DS} = 25\text{ V}, V_{GS} = 0\text{ V},$<br>$f = 1.0\text{ MHz}$ | -- | 780 | 1000 | pF |
| $C_{oss}$ | Output Capacitance           |                                                                      | -- | 420 | 550  | pF |
| $C_{rss}$ | Reverse Transfer Capacitance |                                                                      | -- | 105 | 140  | pF |

**Switching Characteristics**

|              |                     |                                                                                         |    |     |     |    |
|--------------|---------------------|-----------------------------------------------------------------------------------------|----|-----|-----|----|
| $t_{d(on)}$  | Turn-On Delay Time  | $V_{DD} = 15\text{ V}, I_D = 22.5\text{ A},$<br>$R_G = 25\text{ }\Omega$<br>(Note 4, 5) | -- | 15  | 40  | ns |
| $t_r$        | Turn-On Rise Time   |                                                                                         | -- | 130 | 270 | ns |
| $t_{d(off)}$ | Turn-Off Delay Time |                                                                                         | -- | 7.5 | 25  | ns |
| $t_f$        | Turn-Off Fall Time  |                                                                                         | -- | 60  | 130 | ns |
| $Q_g$        | Total Gate Charge   | $V_{DS} = 24\text{ V}, I_D = 45\text{ A},$<br>$V_{GS} = 5\text{ V}$<br>(Note 4, 5)      | -- | 15  | 20  | nC |
| $Q_{gs}$     | Gate-Source Charge  |                                                                                         | -- | 5.0 | --  | nC |
| $Q_{gd}$     | Gate-Drain Charge   |                                                                                         | -- | 8.0 | --  | nC |

**Drain-Source Diode Characteristics and Maximum Ratings**

|                 |                                                       |                                               |    |    |     |    |
|-----------------|-------------------------------------------------------|-----------------------------------------------|----|----|-----|----|
| I <sub>S</sub>  | Maximum Continuous Drain-Source Diode Forward Current |                                               | -- | -- | 29  | A  |
| I <sub>SM</sub> | Maximum Pulsed Drain-Source Diode Forward Current     |                                               | -- | -- | 116 | A  |
| V <sub>SD</sub> | Drain-Source Diode Forward Voltage                    | V <sub>GS</sub> = 0 V, I <sub>S</sub> = 29 A  | -- | -- | 1.5 | V  |
| t <sub>rr</sub> | Reverse Recovery Time                                 | V <sub>GS</sub> = 0 V, I <sub>S</sub> = 45 A, | -- | 35 | --  | ns |
| Q <sub>rr</sub> | Reverse Recovery Charge                               | dI <sub>F</sub> / dt = 100 A/μs (Note 4)      | -- | 30 | --  | nC |

**Notes:**

1. Repetitive Rating : Pulse width limited by maximum junction temperature
2.  $L = 240\text{ }\mu\text{H}$ ,  $I_{AS} = 29\text{ A}$ ,  $V_{DD} = 15\text{ V}$ ,  $R_G = 25\text{ }\Omega$ , Starting  $T_J = 25^\circ\text{C}$
3.  $I_{SD} \leq 45\text{ A}$ ,  $dI/dt \leq 300\text{ A}/\mu\text{s}$ ,  $V_{DD} \leq BV_{DSS}$ , Starting  $T_J = 25^\circ\text{C}$
4. Pulse Test : Pulse width  $\leq 300\text{ }\mu\text{s}$ , Duty cycle  $\leq 2\%$
5. Essentially independent of operating temperature

## Typical Characteristics

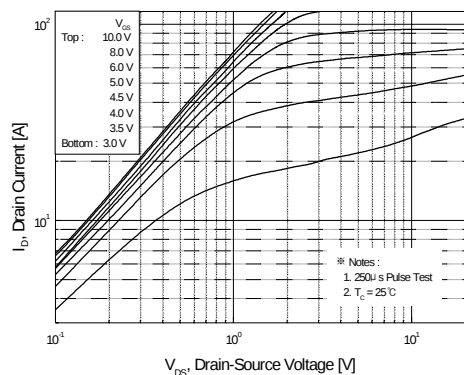


Figure 1. On-Region Characteristics

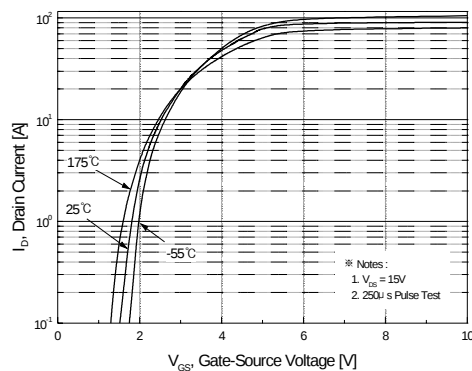


Figure 2. Transfer Characteristics

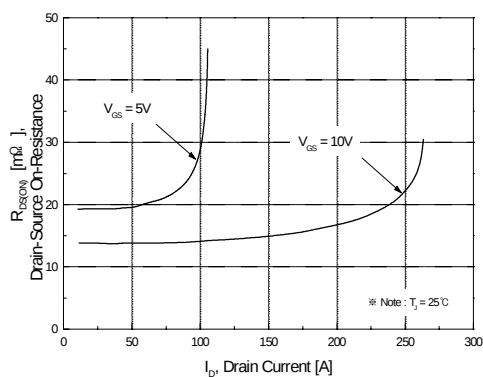


Figure 3. On-Resistance Variation vs. Drain Current and Gate Voltage

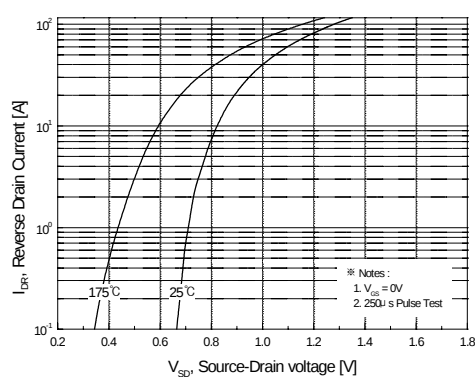


Figure 4. Body Diode Forward Voltage Variation vs. Source Current and Temperature

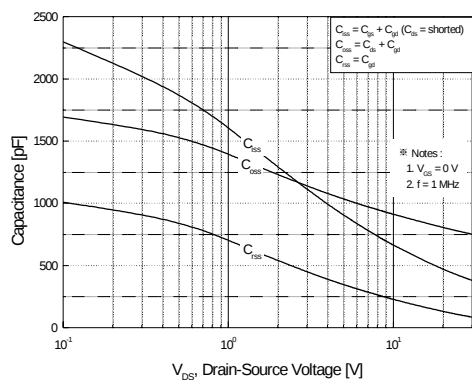


Figure 5. Capacitance Characteristics

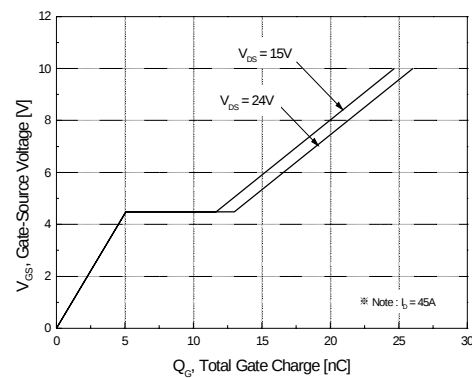


Figure 6. Gate Charge Characteristics

## Typical Characteristics (Continued)

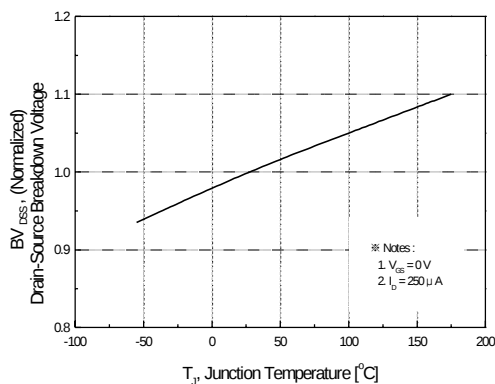


Figure 7. Breakdown Voltage Variation vs. Temperature

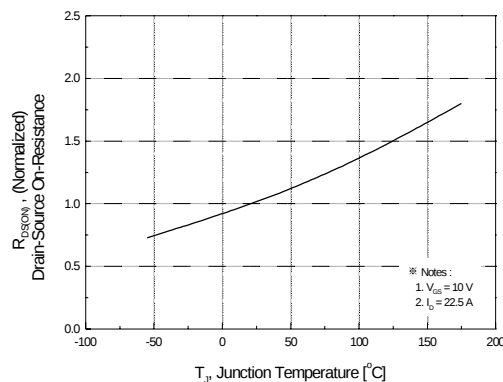


Figure 8. On-Resistance Variation vs. Temperature

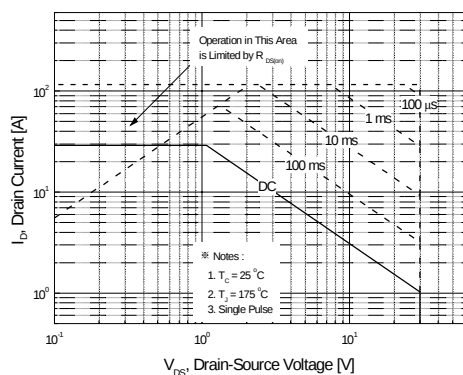


Figure 9. Maximum Safe Operating Area

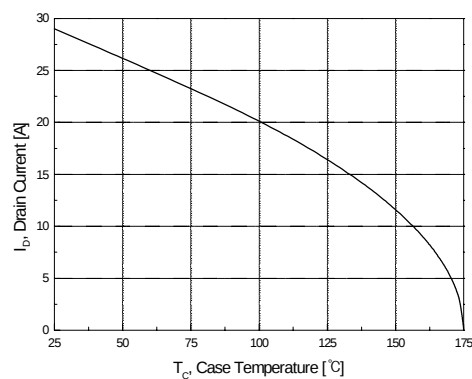


Figure 10. Maximum Drain Current vs. Case Temperature

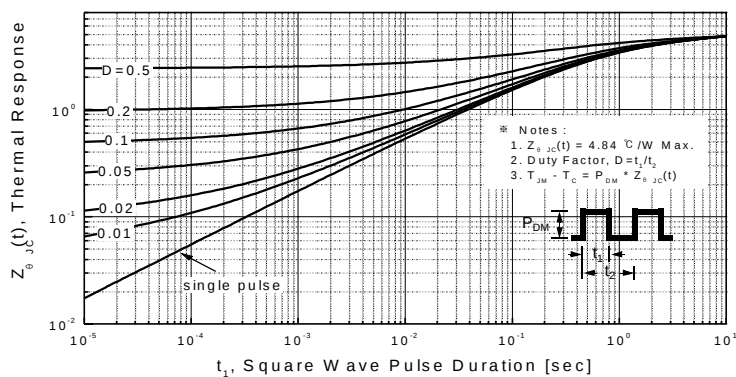
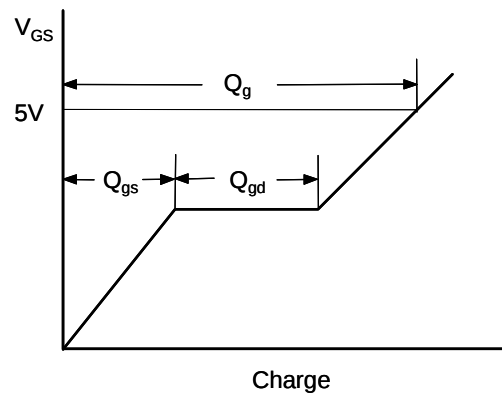
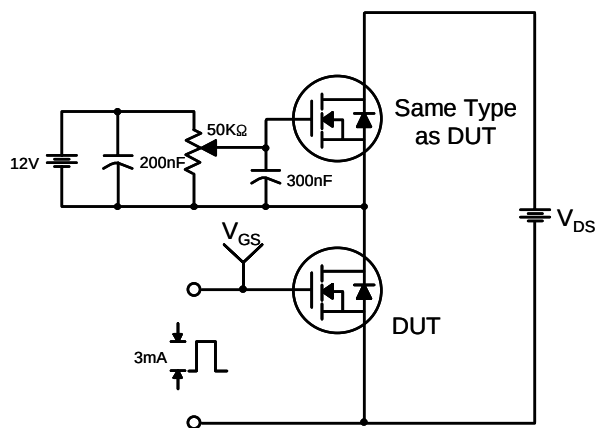
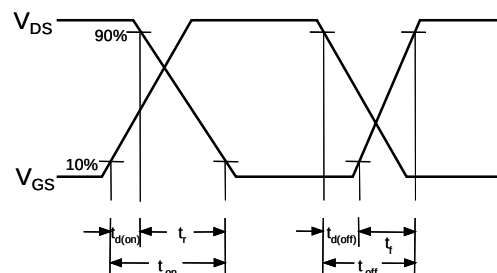
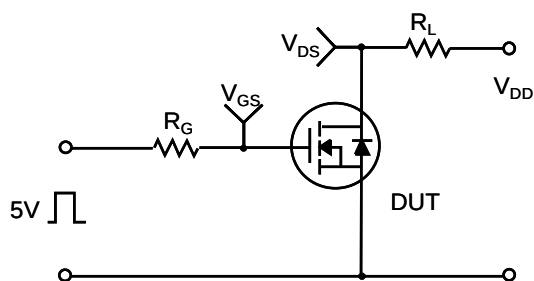


Figure 11. Transient Thermal Response Curve

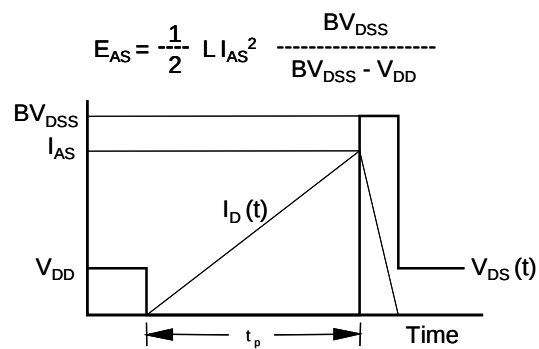
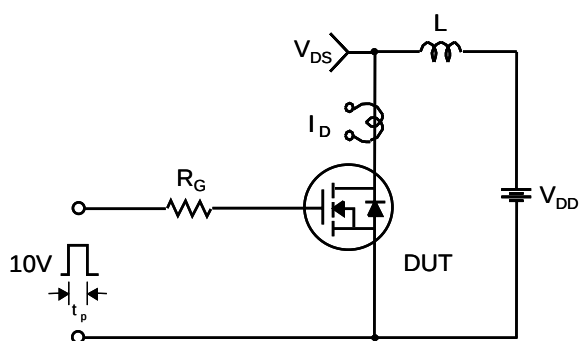
### Gate Charge Test Circuit & Waveform



### Resistive Switching Test Circuit & Waveforms



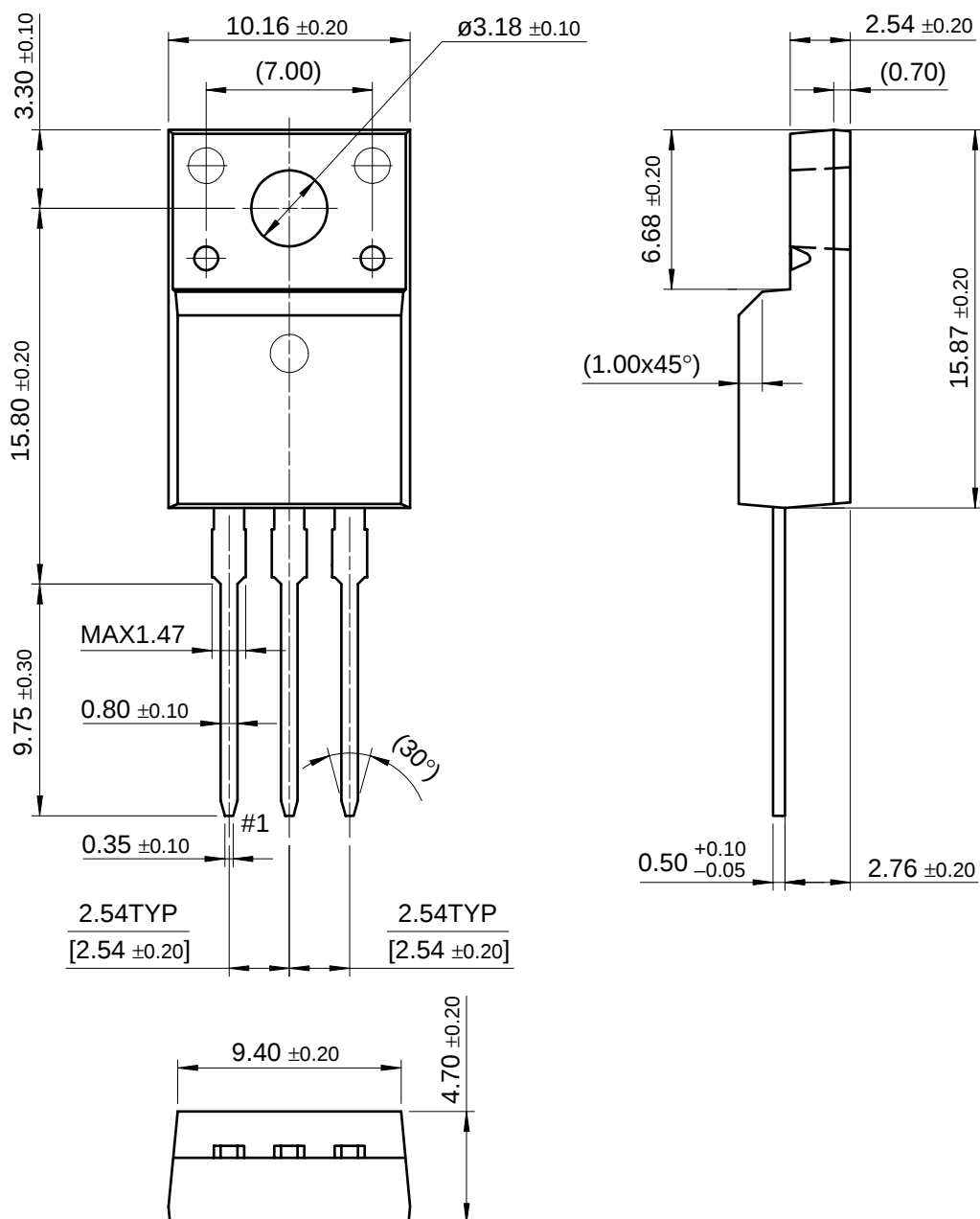
### Unclamped Inductive Switching Test Circuit & Waveforms



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

Package Dimensions

TO-220F



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| EnSigna™             | MicroFET™           | SLIENT SWITCHER <sup>®</sup> |                       |
| FACT™                | MICROWIRE™          | SMART START™                 |                       |
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