

# FQP32N20C/FQPF32N20C

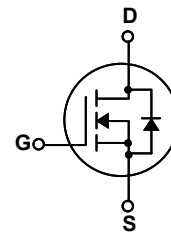
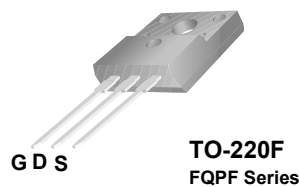
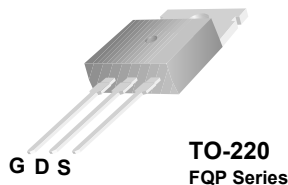
## 200V N-Channel MOSFET

### 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 high efficiency switching DC/DC converters, switch mode power supplies, DC-AC converters for uninterrupted power supplies and motor controls.

### Features

- 28A, 200V,  $R_{DS(on)} = 0.082\Omega @ V_{GS} = 10V$
- Low gate charge ( typical 82.5 nC)
- Low Crss ( typical 185 pF)
- Fast switching
- 100% avalanche tested
- Improved dv/dt capability



### Absolute Maximum Ratings T<sub>C</sub> = 25°C unless otherwise noted

| Symbol                            | Parameter   | FQP32N20C   | FQPF32N20C | Units |
|-----------------------------------|---|-------------|------------|-------|
| V <sub>DSS</sub>                  | Drain-Source Voltage  | 200         |            | V     |
| I <sub>D</sub>                    | Drain Current - Continuous (T <sub>C</sub> = 25°C)<br>- Continuous (T <sub>C</sub> = 100°C) | 28.0        | 28.0 *     | A     |
|                                   |   | 17.8        | 17.8 *     | A     |
| I <sub>DM</sub>                   | Drain Current - Pulsed (Note 1)   | 112         | 112 *      | A     |
| V <sub>GSS</sub>                  | Gate-Source Voltage   | ± 30        |            | V     |
| E <sub>AS</sub>                   | Single Pulsed Avalanche Energy (Note 2)   | 955         |            | mJ    |
| I <sub>AR</sub>                   | Avalanche Current (Note 1)  | 28.0        |            | A     |
| E <sub>AR</sub>                   | Repetitive Avalanche Energy (Note 1)  | 15.6        |            | mJ    |
| dv/dt                             | Peak Diode Recovery dv/dt (Note 3)  | 5.5         |            | V/ns  |
| P <sub>D</sub>                    | Power Dissipation (T <sub>C</sub> = 25°C)<br>- Derate above 25°C                            | 156         | 50         | W     |
|                                   |   | 1.25        | 0.4        | W/°C  |
| T <sub>J</sub> , T <sub>STG</sub> | Operating and Storage Temperature Range   | -55 to +150 |            | °C    |
| T <sub>L</sub>                    | Maximum lead temperature for soldering purposes,<br>1/8" from case for 5 seconds            | 300         |            | °C    |

\* Drain current limited by maximum junction temperature.

### Thermal Characteristics

| Symbol           | Parameter                               | FQP32N20C | FQPF32N20C | Units |
|------------------|---|-----------|------------|-------|
| R <sub>θJC</sub> | Thermal Resistance, Junction-to-Case    | 0.8       | 2.51       | °C/W  |
| R <sub>θJS</sub> | Thermal Resistance, Case-to-Sink Typ.   | 0.5       | --         | °C/W  |
| R <sub>θJA</sub> | Thermal Resistance, Junction-to-Ambient | 62.5      | 62.5       | °C/W  |

## Electrical Characteristics

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

| Symbol                         | Parameter                                 | Test Conditions   | Min | Typ  | Max  | Units                     |
|--------------------------------|---|---|-----|------|------|---------------------------|
| <b>Off Characteristics</b>     |   |   |     |      |      |                           |
| $BV_{DSS}$                     | Drain-Source Breakdown Voltage            | $V_{GS} = 0\text{ V}, I_D = 250\ \mu\text{A}$               | 200 | --   | --   | V                         |
| $\Delta BV_{DSS} / \Delta T_J$ | Breakdown Voltage Temperature Coefficient | $I_D = 250\ \mu\text{A}$ , Referenced to $25^\circ\text{C}$ | --  | 0.24 | --   | $\text{V}/^\circ\text{C}$ |
| $I_{DSS}$                      | Zero Gate Voltage Drain Current           | $V_{DS} = 200\text{ V}, V_{GS} = 0\text{ V}$                | --  | --   | 10   | $\mu\text{A}$             |
|                                |   | $V_{DS} = 160\text{ V}, T_C = 125^\circ\text{C}$            | --  | --   | 100  | $\mu\text{A}$             |
| $I_{GSSF}$                     | Gate-Body Leakage Current, Forward        | $V_{GS} = 30\text{ V}, V_{DS} = 0\text{ V}$                 | --  | --   | 100  | nA                        |
| $I_{GSSR}$                     | Gate-Body Leakage Current, Reverse        | $V_{GS} = -30\text{ V}, V_{DS} = 0\text{ V}$                | --  | --   | -100 | nA                        |

### On Characteristics

|              |                                   |  |     |       |       |          |
|--------------|-----------------------------------|--|-----|-------|-------|----------|
| $V_{GS(th)}$ | Gate Threshold Voltage            | $V_{DS} = V_{GS}, I_D = 250\ \mu\text{A}$          | 2.0 | --    | 4.0   | V        |
| $R_{DS(on)}$ | Static Drain-Source On-Resistance | $V_{GS} = 10\text{ V}, I_D = 14\text{ A}$          | --  | 0.068 | 0.082 | $\Omega$ |
| $g_{FS}$     | Forward Transconductance          | $V_{DS} = 40\text{ V}, I_D = 14\text{ A}$ (Note 4) | --  | 20    | --    | S        |

### Dynamic Characteristics

|            |                              |  |    |      |      |    |
|------------|------------------------------|--|----|------|------|----|
| $C_{iss}$  | Input Capacitance            | $V_{DS} = 25\text{ V}, V_{GS} = 0\text{ V},$<br>$f = 1.0\text{ MHz}$ | -- | 1700 | 2220 | pF |
| $C_{oss}$  | Output Capacitance           |  | -- | 400  | 520  | pF |
| $C_{riss}$ | Reverse Transfer Capacitance |  | -- | 185  | 245  | pF |

### Switching Characteristics

|              |                     |   |             |      |      |     |
|--------------|---------------------|---|-------------|------|------|-----|
| $t_{d(on)}$  | Turn-On Delay Time  | $V_{DD} = 100\text{ V}, I_D = 32\text{ A},$<br>$R_G = 25\ \Omega$     | --          | 25   | 60   | ns  |
| $t_r$        | Turn-On Rise Time   |   | --          | 270  | 550  | ns  |
| $t_{d(off)}$ | Turn-Off Delay Time |   | --          | 245  | 500  | ns  |
| $t_f$        | Turn-Off Fall Time  |   | (Note 4, 5) | --   | 210  | 430 |
| $Q_g$        | Total Gate Charge   | $V_{DS} = 160\text{ V}, I_D = 32\text{ A},$<br>$V_{GS} = 10\text{ V}$ | --          | 82.5 | 110  | nC  |
| $Q_{gs}$     | Gate-Source Charge  |   | --          | 10.5 | --   | nC  |
| $Q_{gd}$     | Gate-Drain Charge   |   | (Note 4, 5) | --   | 44.5 | --  |

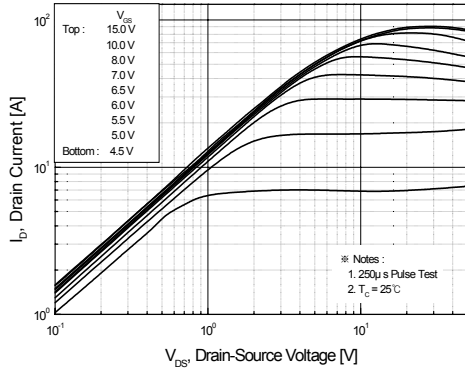
### Drain-Source Diode Characteristics and Maximum Ratings

|          |   |  |    |      |     |               |
|----------|---|--|----|------|-----|---------------|
| $I_S$    | Maximum Continuous Drain-Source Diode Forward Current | --   | -- | 28   | A   |               |
| $I_{SM}$ | Maximum Pulsed Drain-Source Diode Forward Current     | --   | -- | 112  | A   |               |
| $V_{SD}$ | Drain-Source Diode Forward Voltage                    | $V_{GS} = 0\text{ V}, I_S = 28\text{ A}$   | -- | --   | 1.5 | V             |
| $t_{rr}$ | Reverse Recovery Time                                 | $V_{GS} = 0\text{ V}, I_S = 32\text{ A},$<br>$di_F / dt = 100\text{ A}/\mu\text{s}$ (Note 4) | -- | 265  | --  | ns            |
| $Q_{rr}$ | Reverse Recovery Charge                               |  | -- | 2.73 | --  | $\mu\text{C}$ |

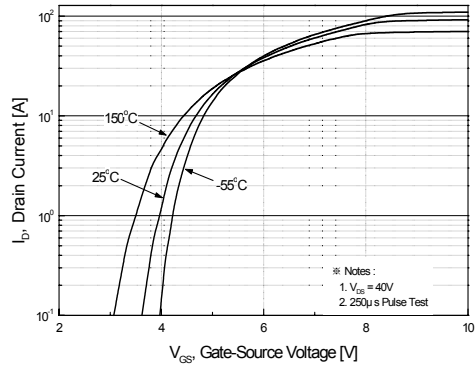
#### Notes:

1. Repetitive Rating : Pulse width limited by maximum junction temperature
2.  $L = 1.4\text{ mH}, I_{AS} = 32\text{ A}, V_{DD} = 50\text{ V}, R_G = 25\ \Omega$ , Starting  $T_J = 25^\circ\text{C}$
3.  $I_{SD} \leq 28\text{ A}, di/dt \leq 300\text{ A}/\mu\text{s}, V_{DD} \leq BV_{DSS}$ , Starting  $T_J = 25^\circ\text{C}$
4. Pulse Test : Pulse width  $\leq 300\ \mu\text{s}$ , Duty cycle  $\leq 2\%$
5. Essentially independent of operating temperature

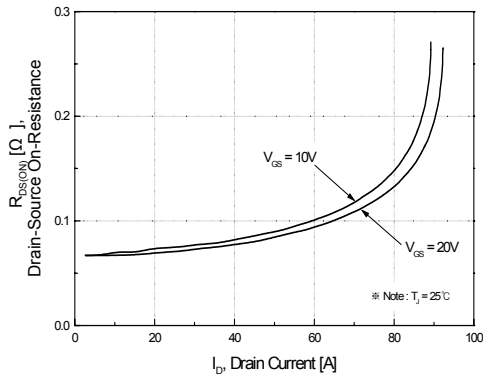
## Typical Characteristics



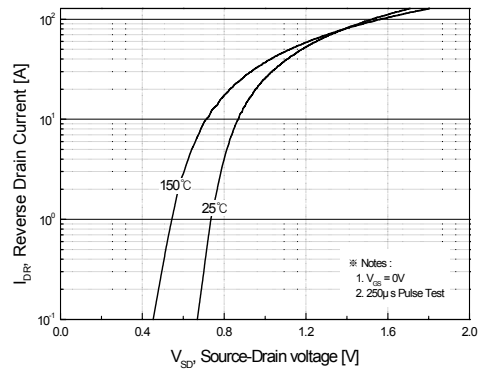
**Figure 1. On-Region Characteristics**



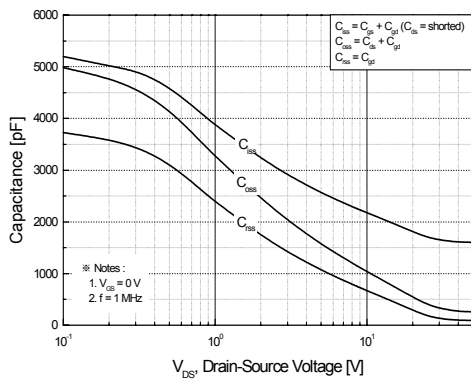
**Figure 2. Transfer Characteristics**



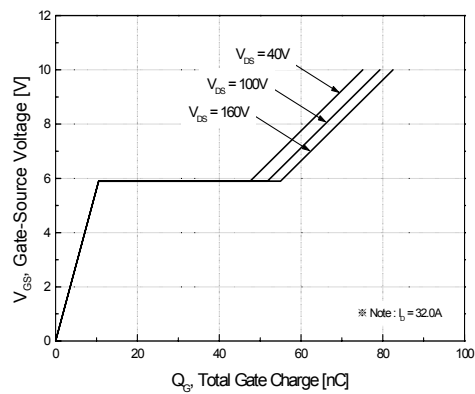
**Figure 3. On-Resistance Variation vs. Drain Current and Gate Voltage**



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

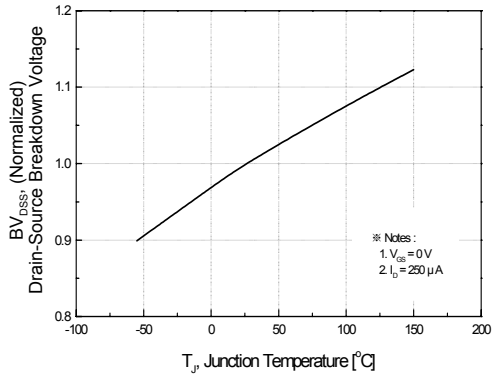


**Figure 5. Capacitance Characteristics**

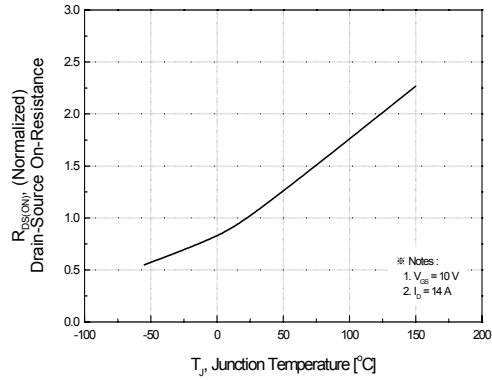


**Figure 6. Gate Charge Characteristics**

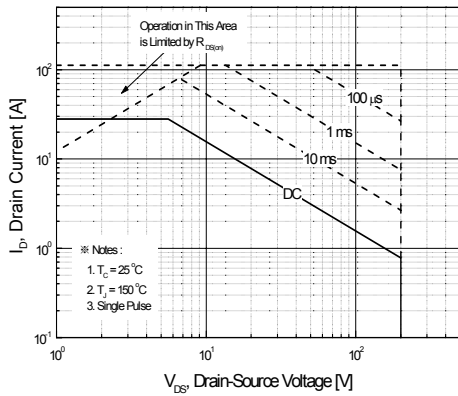
**Typical Characteristics** (Continued)



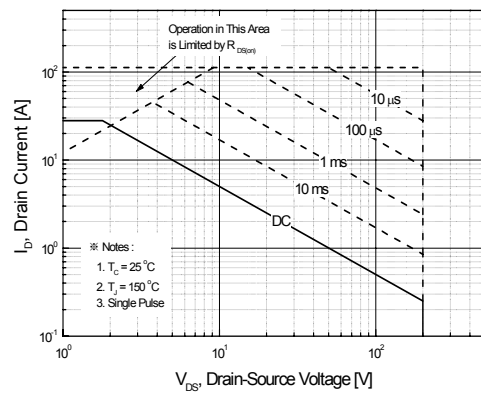
**Figure 7. Breakdown Voltage Variation vs Temperature**



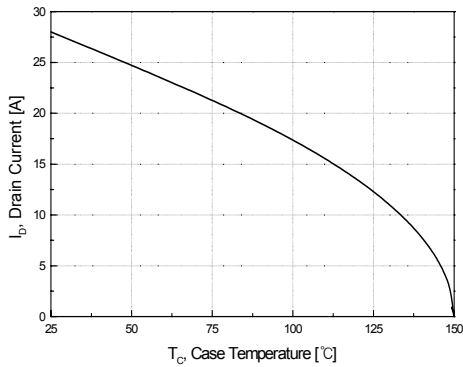
**Figure 8. On-Resistance Variation vs Temperature**



**Figure 9-1. Maximum Safe Operating Area for FQP32N20C**



**Figure 9-2. Maximum Safe Operating Area for FQPF32N20C**



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

Typical Characteristics (Continued)

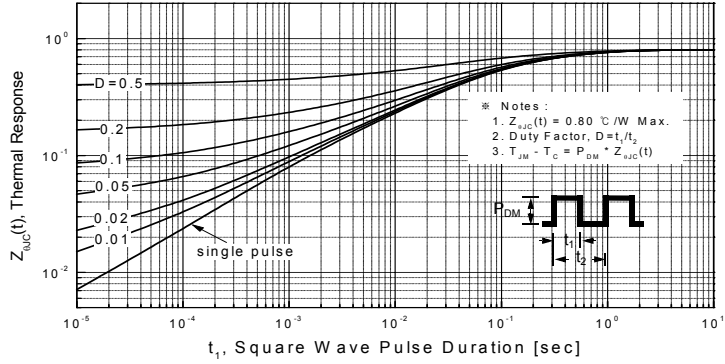


Figure 11-1. Transient Thermal Response Curve for FQP32N20C

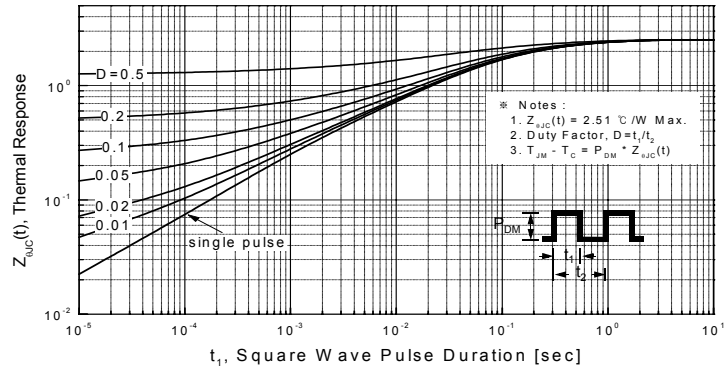
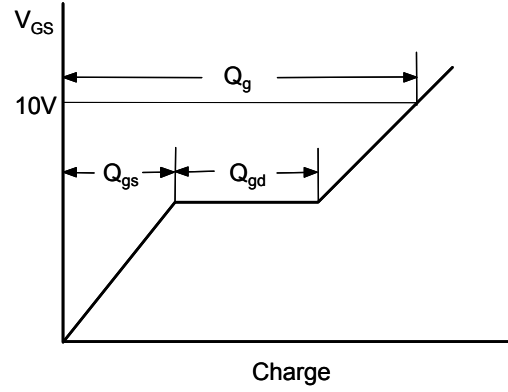
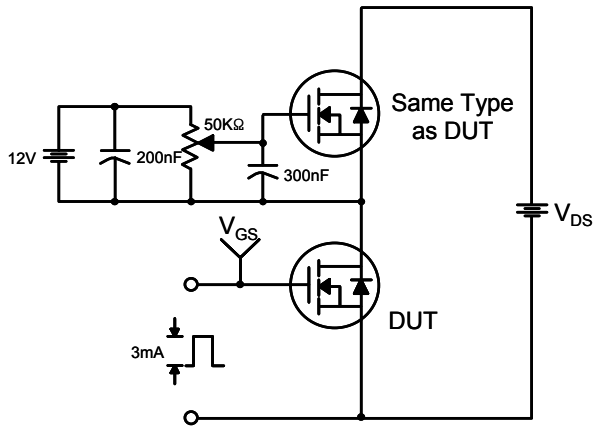
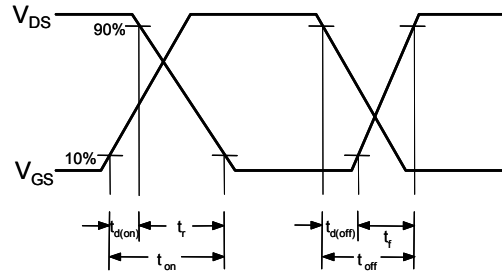
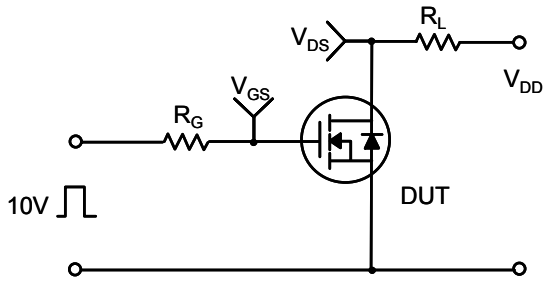


Figure 11-2. Transient Thermal Response Curve for FQPF32N20C

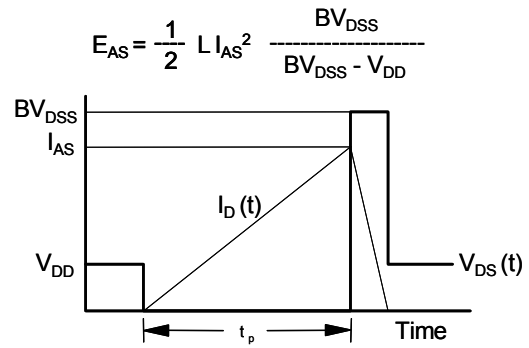
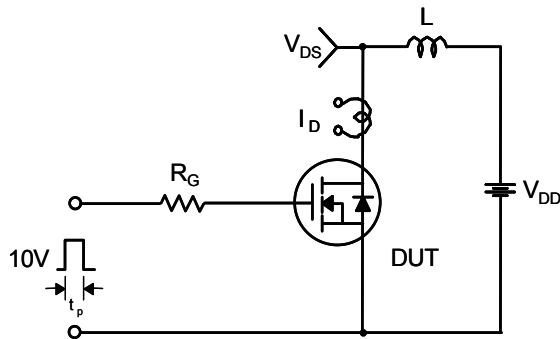
**Gate Charge Test Circuit & Waveform**



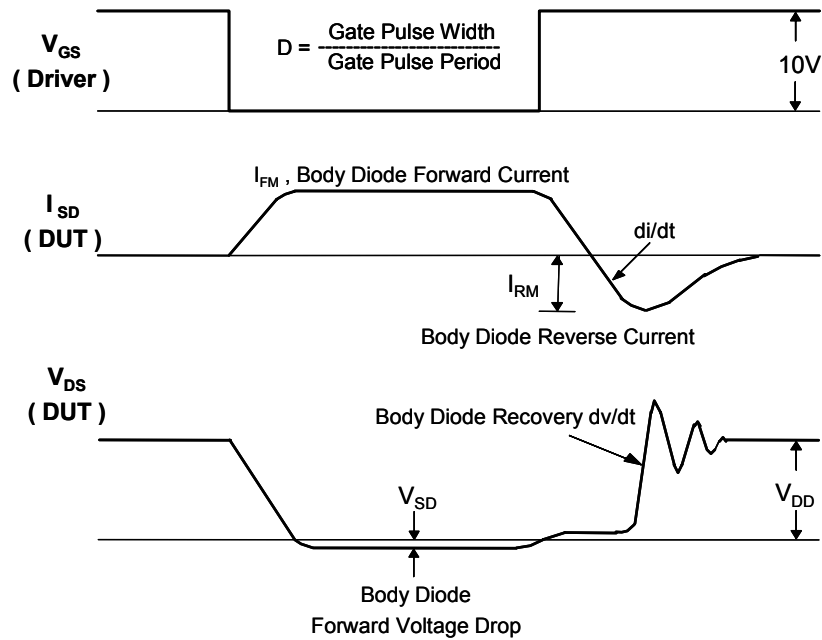
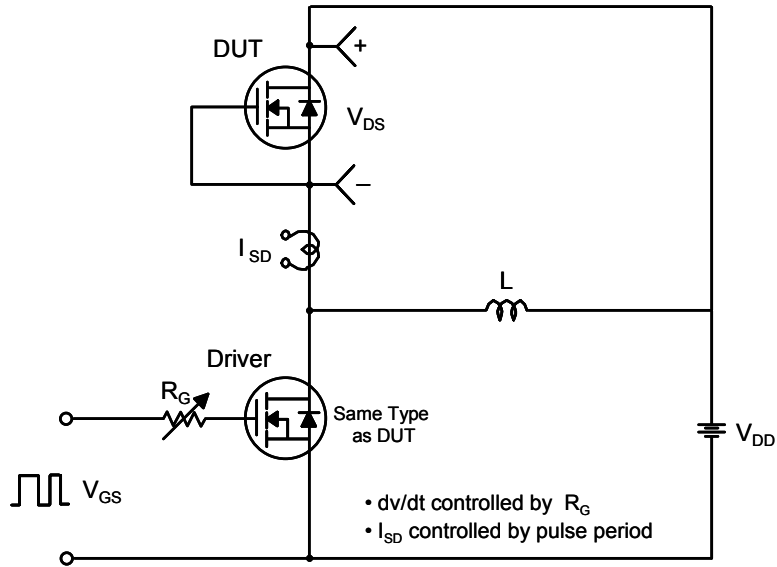
**Resistive Switching Test Circuit & Waveforms**



**Unclamped Inductive Switching Test Circuit & Waveforms**



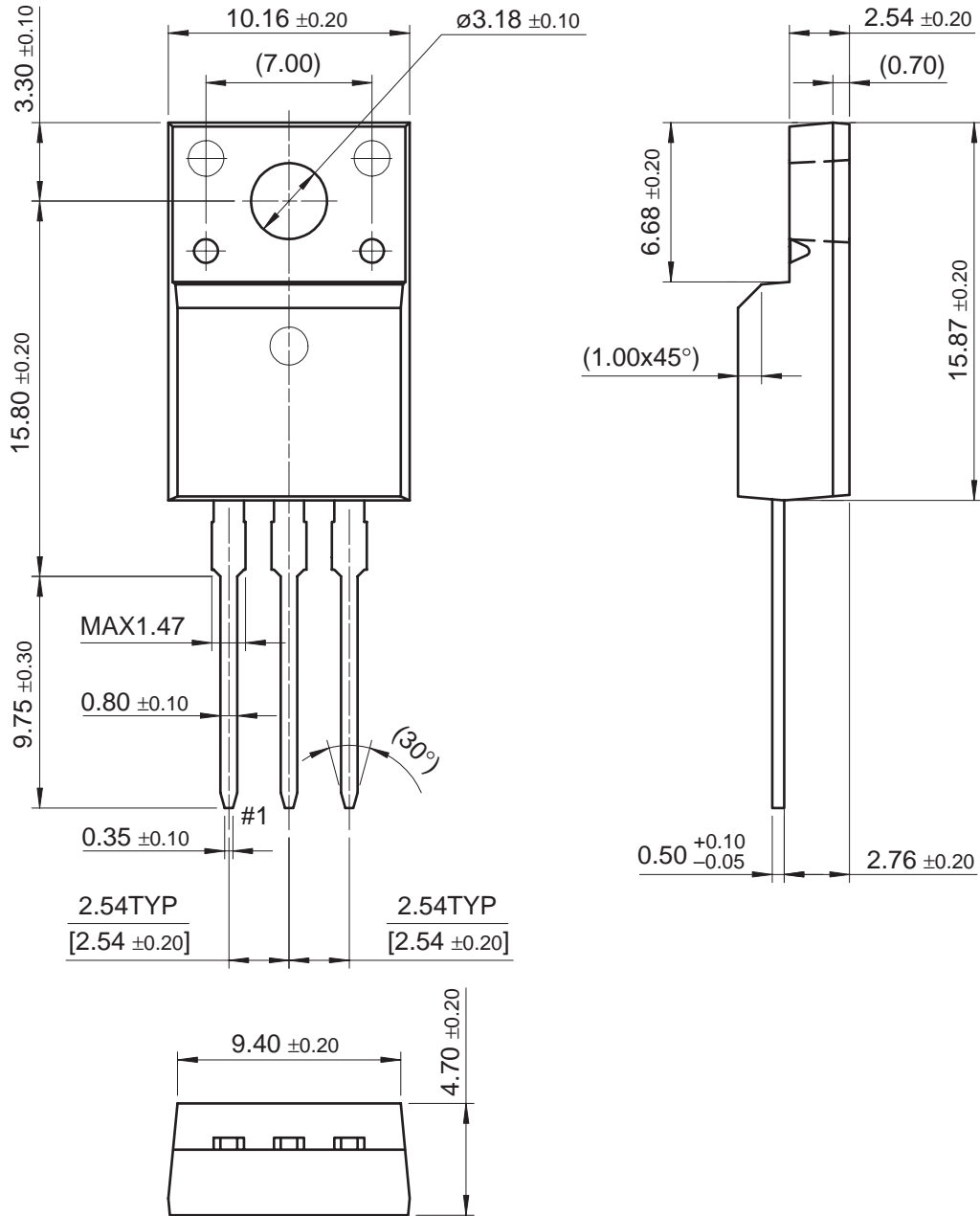
Peak Diode Recovery dv/dt Test Circuit & Waveforms





Package Dimensions (Continued)

TO-220F



FQP32N20C/FQPF32N20C

Dimensions in Millimeters

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