

# **FQP10N60C / FQPF10N60C** **600V N-Channel MOSFET**

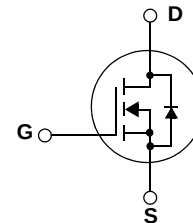
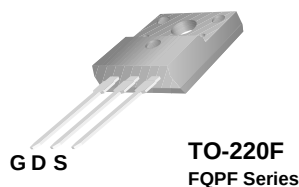
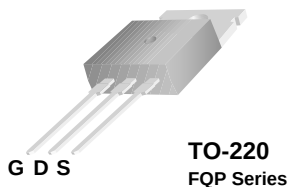
## **Features**

- 9.5A, 600V,  $R_{DS(on)} = 0.73\Omega$  @  $V_{GS} = 10\text{ V}$
- Low gate charge ( typical 44 nC)
- Low  $C_{rss}$  ( typical 18 pF)
- Fast switching
- 100% avalanche tested
- Improved dv/dt capability

## **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 switched mode power supplies, active power factor correction, electronic lamp ballasts based on half bridge topology.



## **Absolute Maximum Ratings**

| Symbol         | Parameter                                                                     | FQP10N60C   | FQPF10N60C | Units               |
|----------------|-------------------------------------------------------------------------------|-------------|------------|---------------------|
| $V_{DSS}$      | Drain-Source Voltage                                                          | 600         |            | V                   |
| $I_D$          | Drain Current - Continuous ( $T_C = 25^\circ\text{C}$ )                       | 9.5         | 9.5 *      | A                   |
|                | - Continuous ( $T_C = 100^\circ\text{C}$ )                                    | 5.7         | 5.7 *      | A                   |
| $I_{DM}$       | Drain Current - Pulsed (Note 1)                                               | 38          | 38 *       | A                   |
| $V_{GSS}$      | Gate-Source Voltage                                                           | $\pm 30$    |            | V                   |
| $E_{AS}$       | Single Pulsed Avalanche Energy (Note 2)                                       | 700         |            | mJ                  |
| $I_{AR}$       | Avalanche Current (Note 1)                                                    | 9.5         |            | A                   |
| $E_{AR}$       | Repetitive Avalanche Energy (Note 1)                                          | 15.6        |            | mJ                  |
| dv/dt          | Peak Diode Recovery dv/dt (Note 3)                                            | 4.5         |            | V/ns                |
| $P_D$          | Power Dissipation ( $T_C = 25^\circ\text{C}$ )                                | 156         | 50         | W                   |
|                | - Derate above $25^\circ\text{C}$                                             | 1.25        | 0.4        | W/ $^\circ\text{C}$ |
| $T_J, T_{STG}$ | Operating and Storage Temperature Range                                       | -55 to +150 |            | $^\circ\text{C}$    |
| $T_L$          | Maximum lead temperature for soldering purposes, 1/8" from case for 5 seconds | 300         |            | $^\circ\text{C}$    |

\* Drain current limited by maximum junction temperature.

## **Thermal Characteristics**

| Symbol          | Parameter                               | FQP10N60C | FQPF10N60C | Units              |
|-----------------|-----------------------------------------|-----------|------------|--------------------|
| $R_{\theta JC}$ | Thermal Resistance, Junction-to-Case    | 0.8       | 2.5        | $^\circ\text{C/W}$ |
| $R_{\theta CS}$ | Thermal Resistance, Case-to-Sink Typ.   | 0.5       | --         | $^\circ\text{C/W}$ |
| $R_{\theta JA}$ | Thermal Resistance, Junction-to-Ambient | 62.5      | 62.5       | $^\circ\text{C/W}$ |

## Package Marking and Ordering Information

| Device Marking | Device     | Package | Reel Size | Tape Width | Quantity |
|----------------|------------|---------|-----------|------------|----------|
| FQP10N60C      | FQP10N60C  | TO-220  | --        | --         | 50       |
| FQPF10N60C     | FQPF10N60C | TO-220F | --        | --         | 50       |

## Electrical Characteristics T<sub>C</sub> = 25°C unless otherwise noted

| Symbol                                                 | Parameter                                             | Test Conditions                                                                         | Min | Typ  | Max  | Units |
|--------------------------------------------------------|-------------------------------------------------------|-----------------------------------------------------------------------------------------|-----|------|------|-------|
| Off Characteristics                                    |                                                       |                                                                                         |     |      |      |       |
| BV <sub>DSS</sub>                                      | Drain-Source Breakdown Voltage                        | V <sub>GS</sub> = 0 V, I <sub>D</sub> = 250 μA                                          | 600 | --   | --   | V     |
| ΔBV <sub>DSS</sub> /<br>ΔT <sub>J</sub>                | Breakdown Voltage Temperature Coefficient             | I <sub>D</sub> = 250 μA, Referenced to 25°C                                             | --  | 0.7  | --   | V/°C  |
| I <sub>DSS</sub>                                       | Zero Gate Voltage Drain Current                       | V <sub>DS</sub> = 600 V, V <sub>GS</sub> = 0 V                                          | --  | --   | 1    | μA    |
|                                                        |                                                       | V <sub>DS</sub> = 480 V, T <sub>C</sub> = 125°C                                         | --  | --   | 10   | μA    |
| I <sub>GSSF</sub>                                      | Gate-Body Leakage Current, Forward                    | V <sub>GS</sub> = 30 V, V <sub>DS</sub> = 0 V                                           | --  | --   | 100  | nA    |
| I <sub>GSSR</sub>                                      | Gate-Body Leakage Current, Reverse                    | V <sub>GS</sub> = -30 V, V <sub>DS</sub> = 0 V                                          | --  | --   | -100 | nA    |
| On Characteristics                                     |                                                       |                                                                                         |     |      |      |       |
| V <sub>GS(th)</sub>                                    | Gate Threshold Voltage                                | V <sub>DS</sub> = V <sub>GS</sub> , I <sub>D</sub> = 250 μA                             | 2.0 | --   | 4.0  | V     |
| R <sub>DS(on)</sub>                                    | Static Drain-Source On-Resistance                     | V <sub>GS</sub> = 10 V, I <sub>D</sub> = 4.75 A                                         | --  | 0.6  | 0.73 | Ω     |
| g <sub>FS</sub>                                        | Forward Transconductance                              | V <sub>DS</sub> = 40 V, I <sub>D</sub> = 4.75 A (Note 4)                                | --  | 8.0  | --   | S     |
| Dynamic Characteristics                                |                                                       |                                                                                         |     |      |      |       |
| C <sub>iSS</sub>                                       | Input Capacitance                                     | V <sub>DS</sub> = 25 V, V <sub>GS</sub> = 0 V, f = 1.0 MHz                              | --  | 1570 | 2040 | pF    |
| C <sub>oSS</sub>                                       | Output Capacitance                                    |                                                                                         | --  | 166  | 215  | pF    |
| C <sub>rSS</sub>                                       | Reverse Transfer Capacitance                          |                                                                                         | --  | 18   | 24   | pF    |
| Switching Characteristics                              |                                                       |                                                                                         |     |      |      |       |
| t <sub>d(on)</sub>                                     | Turn-On Delay Time                                    | V <sub>DD</sub> = 300 V, I <sub>D</sub> = 9.5A, R <sub>G</sub> = 25 Ω (Note 4, 5)       | --  | 23   | 55   | ns    |
|                                                        | Turn-On Rise Time                                     |                                                                                         | --  | 69   | 150  | ns    |
| t <sub>d(off)</sub>                                    | Turn-Off Delay Time                                   |                                                                                         | --  | 144  | 300  | ns    |
| t <sub>f</sub>                                         | Turn-Off Fall Time                                    |                                                                                         | --  | 77   | 165  | ns    |
| Q <sub>g</sub>                                         | Total Gate Charge                                     | V <sub>DS</sub> = 480 V, I <sub>D</sub> = 9.5A, V <sub>GS</sub> = 10 V (Note 4, 5)      | --  | 44   | 57   | nC    |
| Q <sub>gs</sub>                                        | Gate-Source Charge                                    |                                                                                         | --  | 6.7  | --   | nC    |
| Q <sub>gd</sub>                                        | Gate-Drain Charge                                     |                                                                                         | --  | 18.5 | --   | nC    |
| Drain-Source Diode Characteristics and Maximum Ratings |                                                       |                                                                                         |     |      |      |       |
| I <sub>S</sub>                                         | Maximum Continuous Drain-Source Diode Forward Current |                                                                                         | --  | --   | 9.5  | A     |
| I <sub>SM</sub>                                        | Maximum Pulsed Drain-Source Diode Forward Current     |                                                                                         | --  | --   | 38   | A     |
| V <sub>SD</sub>                                        | Drain-Source Diode Forward Voltage                    | V <sub>GS</sub> = 0 V, I <sub>S</sub> = 9.5 A                                           | --  | --   | 1.4  | V     |
| t <sub>rr</sub>                                        | Reverse Recovery Time                                 | V <sub>GS</sub> = 0 V, I <sub>S</sub> = 9.5 A, dI <sub>F</sub> / dt = 100 A/μs (Note 4) | --  | 420  | --   | ns    |
| Q <sub>rr</sub>                                        | Reverse Recovery Charge                               |                                                                                         | --  | 4.2  | --   | μC    |

### Notes:

1. Repetitive Rating : Pulse width limited by maximum junction temperature
2. L = 14.2mH, I<sub>AS</sub> = 9.5 A, V<sub>DD</sub> = 50V, R<sub>G</sub> = 25 Ω, Starting T<sub>J</sub> = 25°C
3. I<sub>SD</sub> ≤ 9.5A, di/dt ≤ 200A/μs, V<sub>DD</sub> ≤ BV<sub>DSS</sub>, Starting T<sub>J</sub> = 25°C
4. Pulse Test : Pulse width ≤ 300μs, Duty cycle ≤ 2%
5. Essentially independent of operating temperature

## Typical Performance Characteristics

Figure 1. On-Region Characteristics

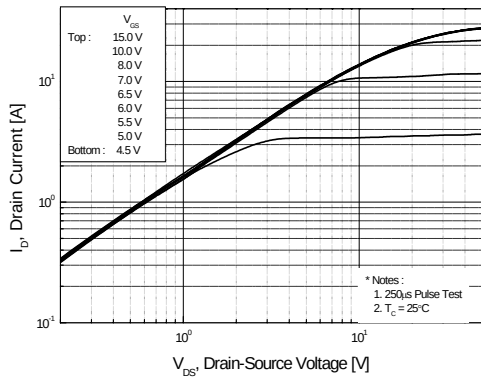


Figure 2. Transfer Characteristics

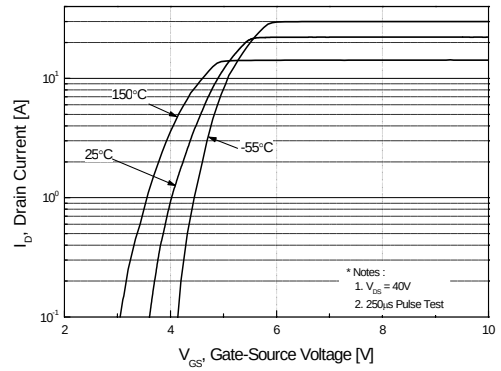


Figure 3. On-Resistance Variation vs. Drain Current and Gate Voltage

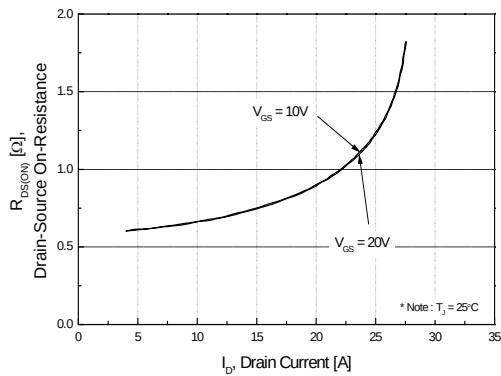


Figure 4. Body Diode Forward Voltage Variation vs. Source Current and Temperature

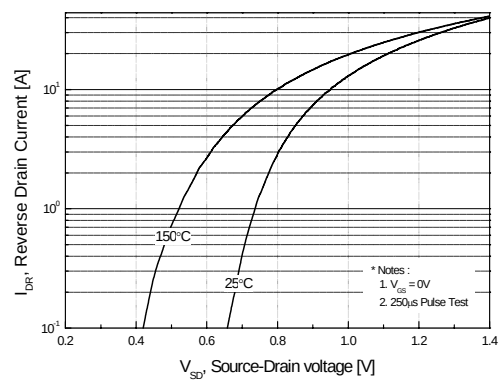


Figure 5. Capacitance Characteristics

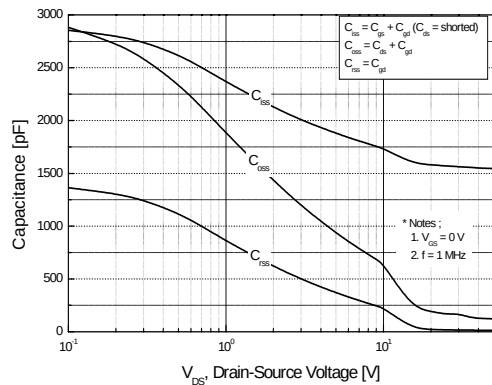
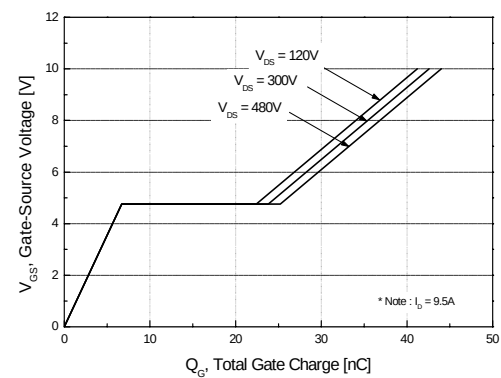
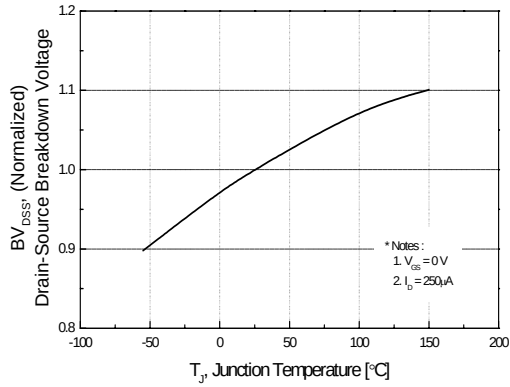


Figure 6. Gate Charge Characteristics

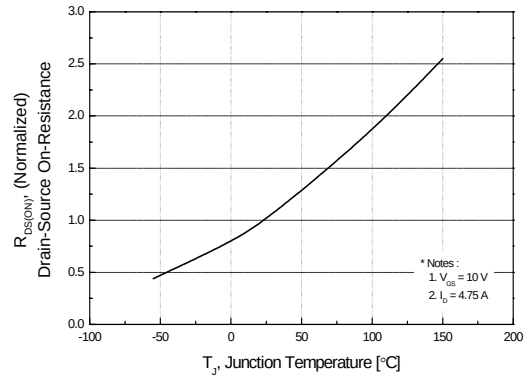


## Typical Performance Characteristics (Continued)

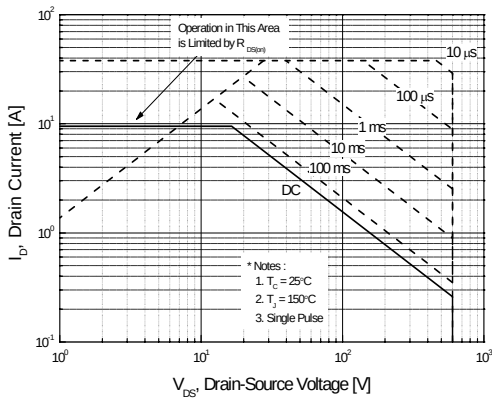
**Figure 7. Breakdown Voltage Variation vs. Temperature**



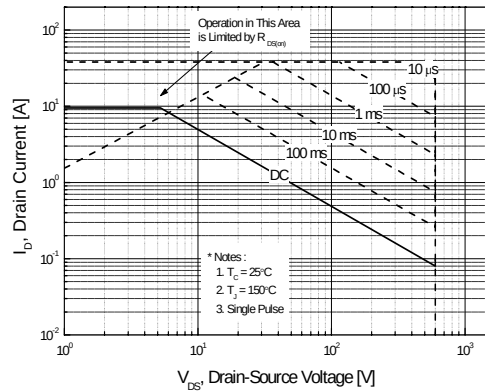
**Figure 8. On-Resistance Variation vs. Temperature**



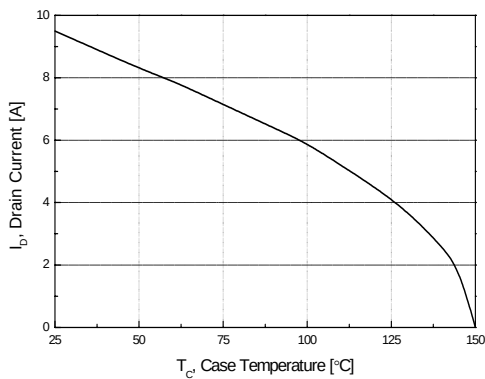
**Figure 9-1. Maximum Safe Operating Area for FQP10N60C**



**Figure 9-2. Maximum Safe Operating Area for FQPF10N60C**

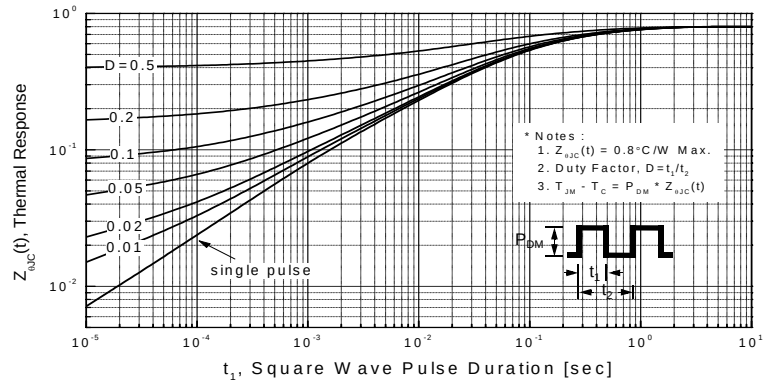


**Figure 10. Maximum Drain Current vs. Case Temperature**

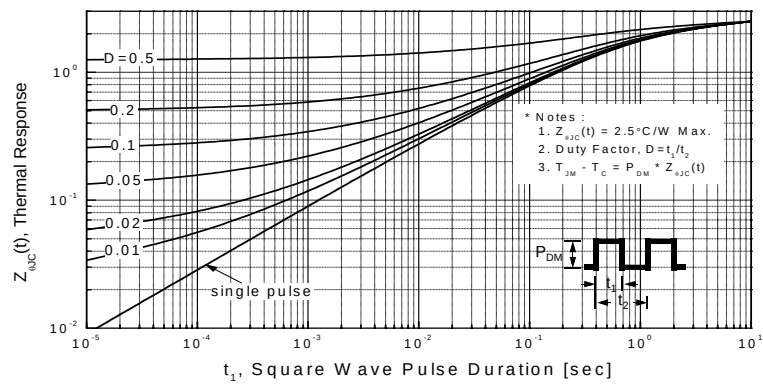


## Typical Performance Characteristics (Continued)

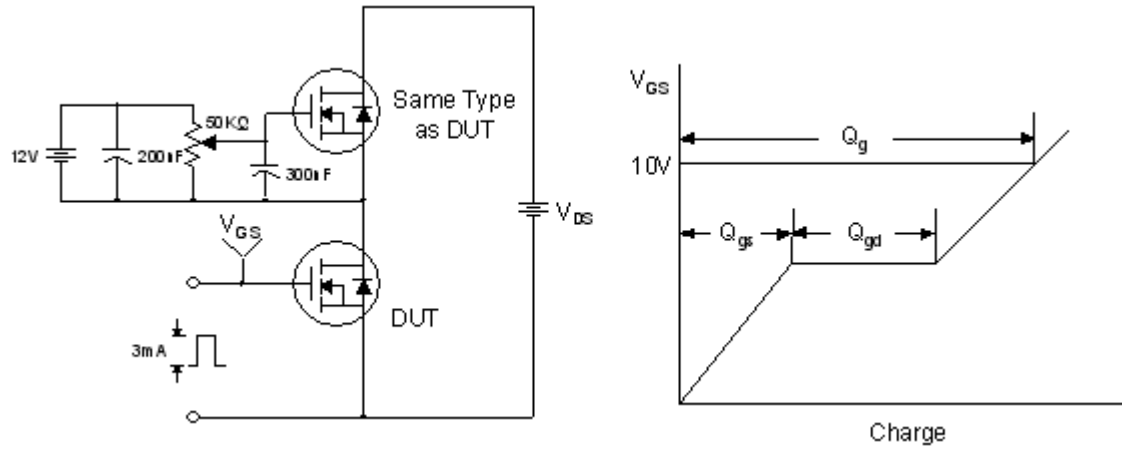
**Figure 11-1. Transient Thermal Response Curve for FQP10N60C**



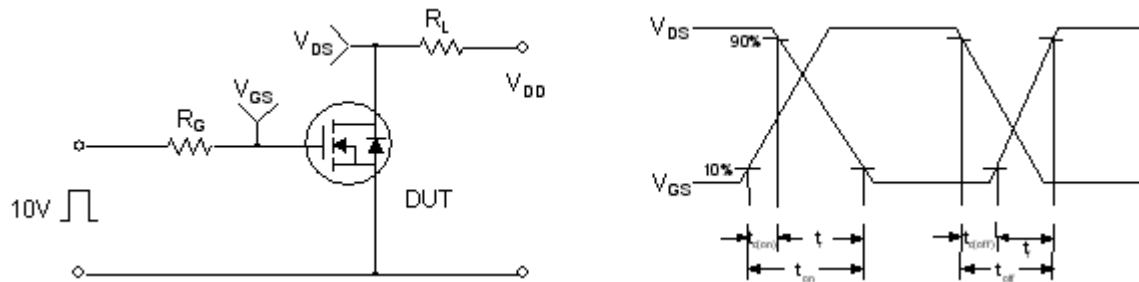
**Figure 11-2. Transient Thermal Response Curve for FQPF10N60C**



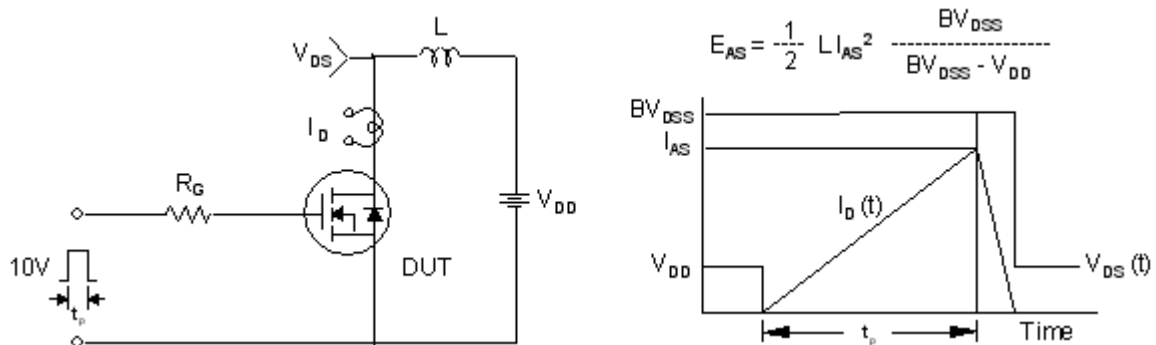
Gate Charge Test Circuit & Waveform



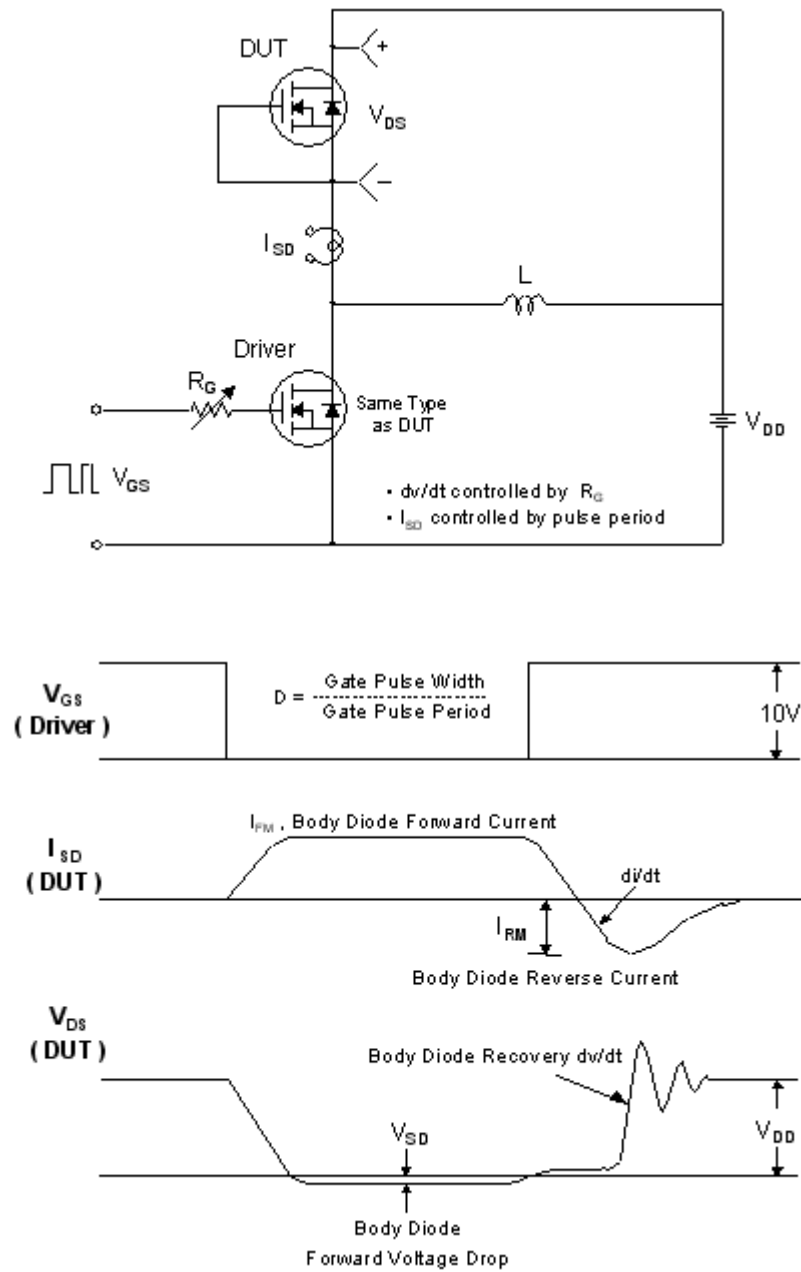
Resistive Switching Test Circuit & Waveforms



Unclamped Inductive Switching Test Circuit & Waveforms

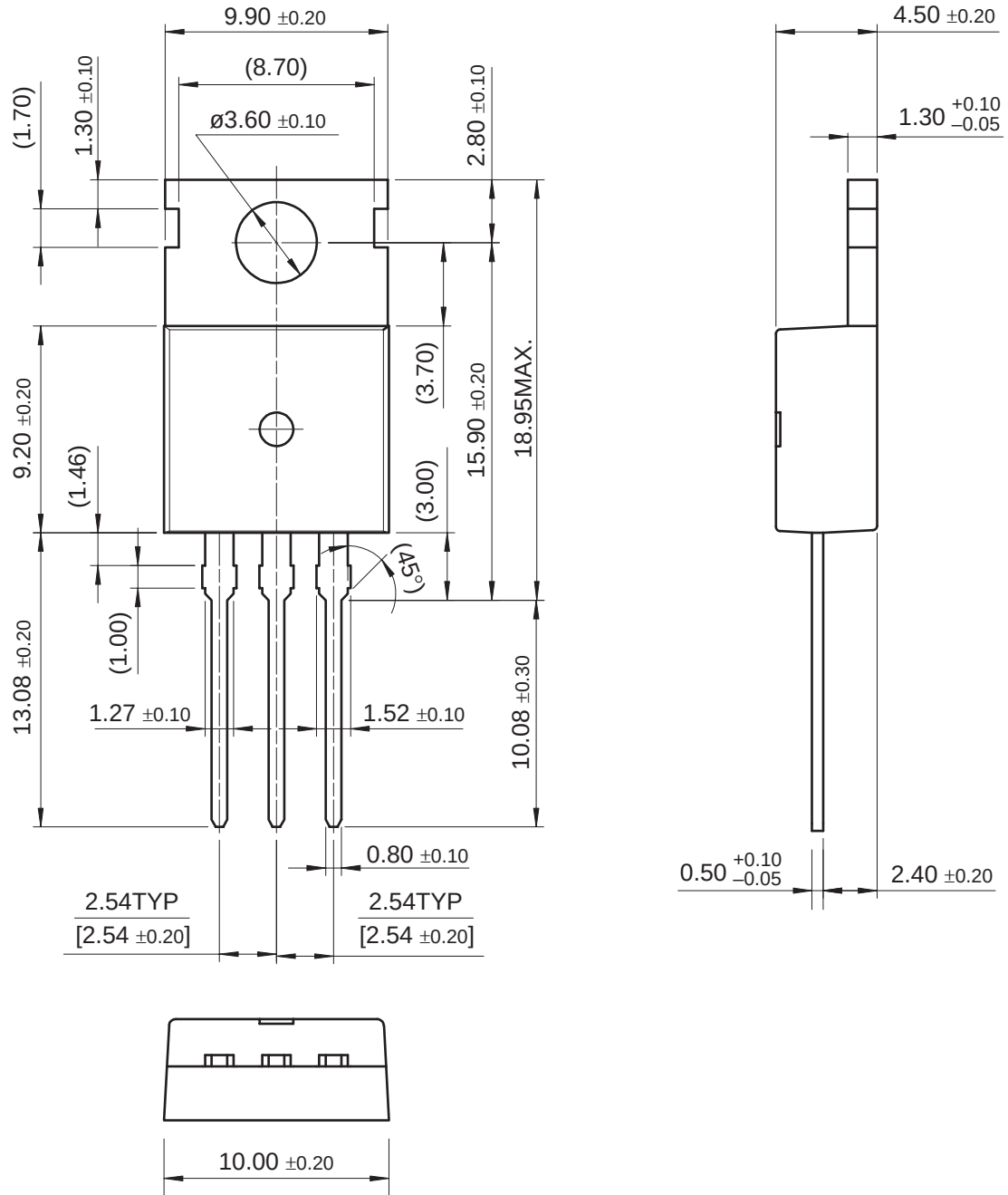


# Peak Diode Recovery dv/dt Test Circuit & Waveforms



# Mechanical Dimensions

## TO-220

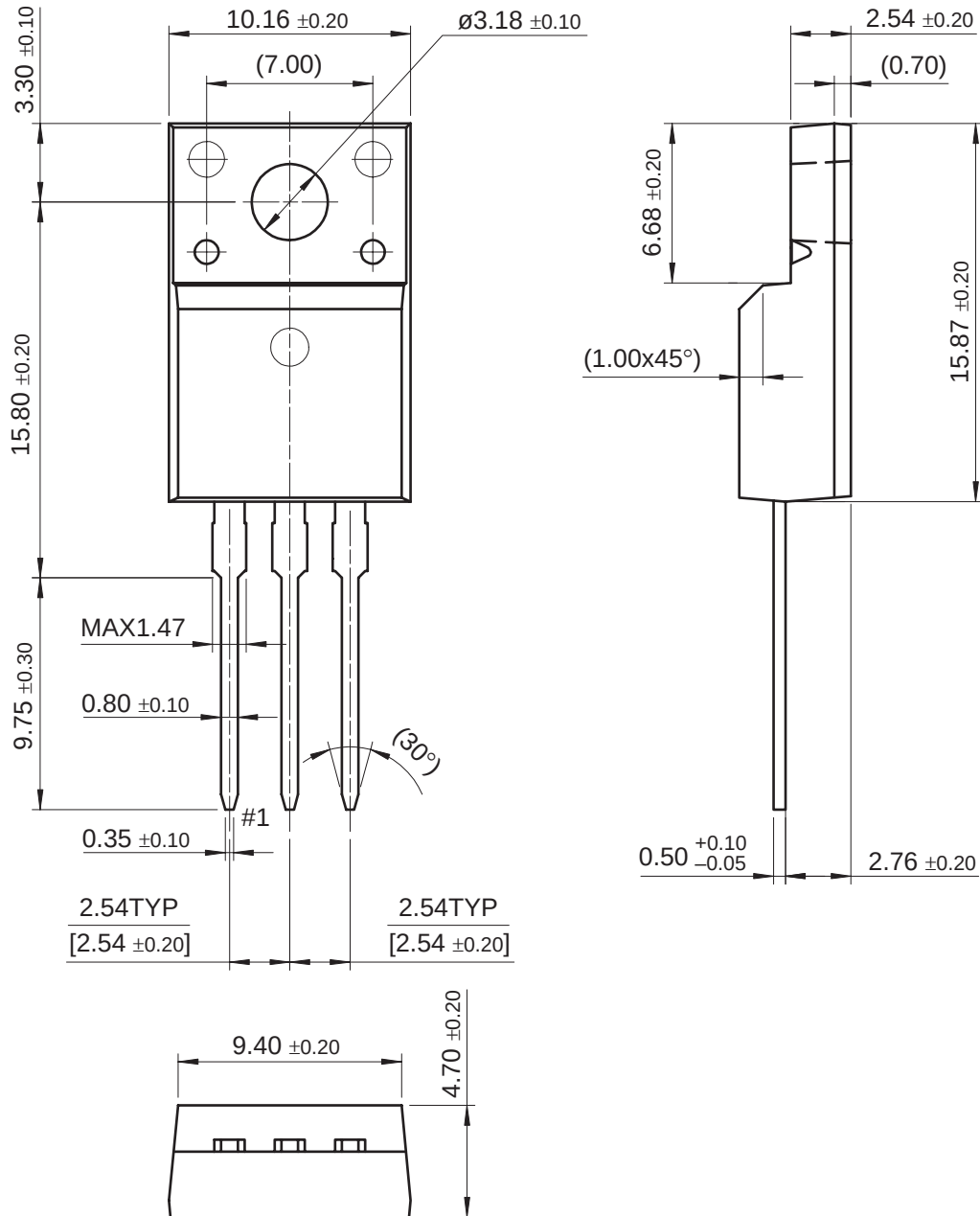


Dimensions in Millimeters



**Mechanical Dimensions** (Continued)

**TO-220F**



Dimensions in Millimeters



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