



May 2000

**QFET™**

# FQB16N25 / FQI16N25

## 250V N-Channel MOSFET

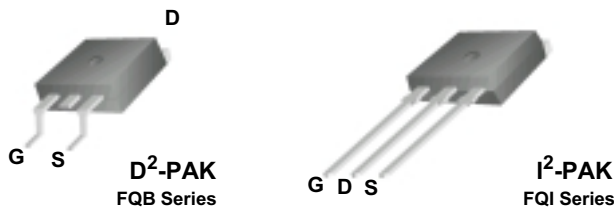
### General Description

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 supply.

### Features

- 16A, 250V,  $R_{DS(on)} = 0.23\Omega @ V_{GS} = 10V$
- Low gate charge ( typical 27 nC)
- Low Crss ( typical 23 pF)
- Fast switching
- 100% avalanche tested
- Improved dv/dt capability



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

| Symbol                            | Parameter   | FQB16N25 / FQI16N25 | Units |
|-----------------------------------|---|---------------------|-------|
| V <sub>DSS</sub>                  | Drain-Source Voltage  | 250                 | V     |
| I <sub>D</sub>                    | Drain Current - Continuous (T <sub>C</sub> = 25°C)                            | 16                  | A     |
|                                   | - Continuous (T <sub>C</sub> = 100°C)   | 10                  | A     |
| I <sub>DM</sub>                   | Drain Current - Pulsed (Note 1)   | 64                  | A     |
| V <sub>GSS</sub>                  | Gate-Source Voltage   | ± 30                | V     |
| E <sub>AS</sub>                   | Single Pulsed Avalanche Energy (Note 2)                                       | 560                 | mJ    |
| I <sub>AR</sub>                   | Avalanche Current (Note 1)  | 16                  | A     |
| E <sub>AR</sub>                   | Repetitive Avalanche Energy (Note 1)  | 14.2                | mJ    |
| dv/dt                             | Peak Diode Recovery dv/dt (Note 3)  | 5.5                 | V/ns  |
| P <sub>D</sub>                    | Power Dissipation (T <sub>A</sub> = 25°C) *                                   | 3.13                | W     |
|                                   | Power Dissipation (T <sub>C</sub> = 25°C)                                     | 142                 | W     |
|                                   | - Derate above 25°C   | 1.14                | 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, 1/8" from case for 5 seconds | 300                 | °C    |

### Thermal Characteristics

| Symbol           | Parameter                                 | Typ | Max  | Units |
|------------------|---|-----|------|-------|
| R <sub>θJC</sub> | Thermal Resistance, Junction-to-Case      | --  | 0.88 | °C/W  |
| R <sub>θJA</sub> | Thermal Resistance, Junction-to-Ambient * | --  | 40   | °C/W  |
| R <sub>θJA</sub> | Thermal Resistance, Junction-to-Ambient   | --  | 62.5 | °C/W  |

\* When mounted on the minimum pad size recommended (PCB Mount)

## 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            | $V_{GS} = 0\text{ V}, I_D = 250\ \mu\text{A}$               | 250 | --   | --   | V                         |
| $\Delta BV_{DSS} / \Delta T_J$ | Breakdown Voltage Temperature Coefficient | $I_D = 250\ \mu\text{A}$ , Referenced to $25^\circ\text{C}$ | --  | 0.22 | --   | $\text{V}/^\circ\text{C}$ |
| $I_{DSS}$                      | Zero Gate Voltage Drain Current           | $V_{DS} = 250\text{ V}, V_{GS} = 0\text{ V}$                | --  | --   | 1    | $\mu\text{A}$             |
|                                |   | $V_{DS} = 200\text{ V}, T_C = 125^\circ\text{C}$            | --  | --   | 10   | $\mu\text{A}$             |
| $I_{GSSF}$                     | 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            | $V_{DS} = V_{GS}, I_D = 250\ \mu\text{A}$           | 3.0 | --   | 5.0  | V        |
| $R_{DS(on)}$ | Static Drain-Source On-Resistance | $V_{GS} = 10\text{ V}, I_D = 8.0\text{ A}$          | --  | 0.18 | 0.23 | $\Omega$ |
| $g_{FS}$     | Forward Transconductance          | $V_{DS} = 50\text{ V}, I_D = 8.0\text{ A}$ (Note 4) | --  | 18   | --   | S        |

## Dynamic Characteristics

|           |                              |  |    |     |      |    |
|-----------|------------------------------|--|----|-----|------|----|
| $C_{iss}$ | Input Capacitance            | $V_{DS} = 25\text{ V}, V_{GS} = 0\text{ V},$<br>$f = 1.0\text{ MHz}$ | -- | 920 | 1200 | pF |
| $C_{oss}$ | Output Capacitance           |  | -- | 190 | 250  | pF |
| $C_{rss}$ | Reverse Transfer Capacitance |  | -- | 23  | 30   | pF |

## Switching Characteristics

|              |                     |   |   |     |     |     |    |
|--------------|---------------------|---|---|-----|-----|-----|----|
| $t_{d(on)}$  | Turn-On Delay Time  | $V_{DD} = 125\text{ V}, I_D = 16\text{ A},$<br>$R_G = 25\ \Omega$ | --  | 17  | 45  | ns  |    |
| $t_r$        | Turn-On Rise Time   |   | --  | 140 | 290 | ns  |    |
| $t_{d(off)}$ | Turn-Off Delay Time |   | (Note 4, 5)   | --  | 45  | 100 | ns |
| $t_f$        | Turn-Off Fall Time  |   | (Note 4, 5)   | --  | 75  | 160 | ns |
| $Q_g$        | Total Gate Charge   |   | $V_{DS} = 200\text{ V}, I_D = 16\text{ A},$<br>$V_{GS} = 10\text{ V}$ | --  | 27  | 35  | nC |
| $Q_{gs}$     | Gate-Source Charge  | (Note 4, 5)   | --  | 5.8 | --  | nC  |    |
| $Q_{gd}$     | Gate-Drain Charge   | (Note 4, 5)   | --  | 15  | --  | nC  |    |

## Drain-Source Diode Characteristics and Maximum Ratings

|          |   |   |    |     |     |               |
|----------|---|---|----|-----|-----|---------------|
| $I_S$    | Maximum Continuous Drain-Source Diode Forward Current | --  | -- | 16  | A   |               |
| $I_{SM}$ | Maximum Pulsed Drain-Source Diode Forward Current     | --  | -- | 64  | A   |               |
| $V_{SD}$ | Drain-Source Diode Forward Voltage                    | $V_{GS} = 0\text{ V}, I_S = 16\text{ A}$  | -- | --  | 1.5 | V             |
| $t_{rr}$ | Reverse Recovery Time                                 | $V_{GS} = 0\text{ V}, I_S = 16\text{ A},$<br>$di_F / dt = 100\text{ A}/\mu\text{s}$ | -- | 190 | --  | ns            |
| $Q_{rr}$ | Reverse Recovery Charge                               | (Note 4)  | -- | 1.2 | --  | $\mu\text{C}$ |

### Notes:

1. Repetitive Rating : Pulse width limited by maximum junction temperature
2.  $L = 3.5\text{ mH}, I_{AS} = 16\text{ A}, V_{DD} = 50\text{ V}, R_G = 25\ \Omega$ , Starting  $T_J = 25^\circ\text{C}$
3.  $I_{SD} \leq 16\text{ A}, di/dt \leq 300\text{ A}/\mu\text{s}, V_{DD} \leq BV_{DSS}$ , 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

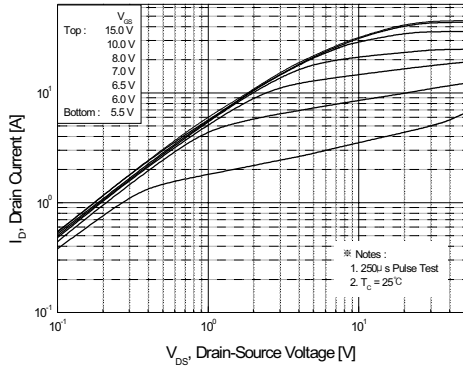


Figure 1. On-Region Characteristics

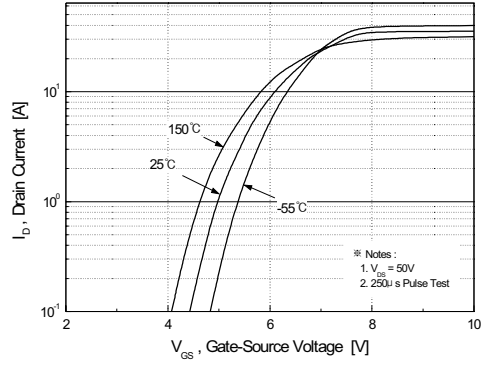


Figure 2. Transfer Characteristics

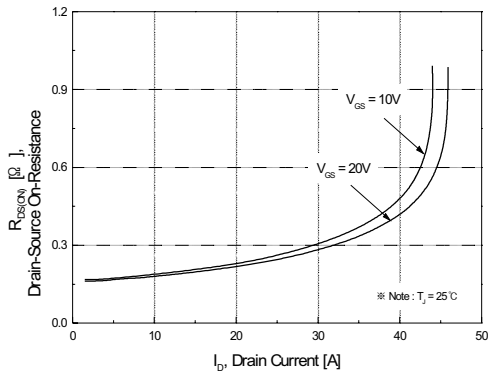


Figure 3. On-Resistance Variation vs. Drain Current and Gate Voltage

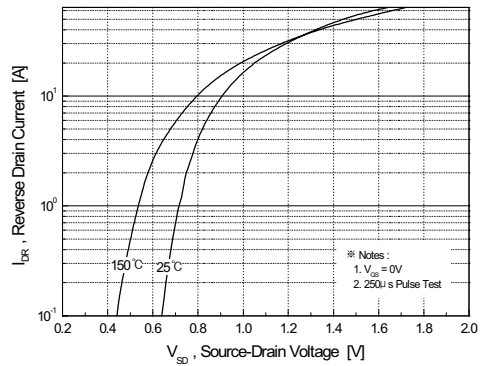


Figure 4. Body Diode Forward Voltage Variation vs. Source Current and Temperature

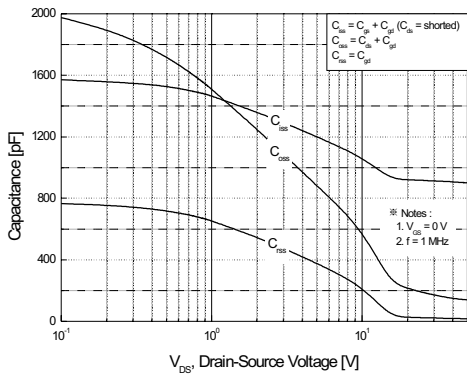


Figure 5. Capacitance Characteristics

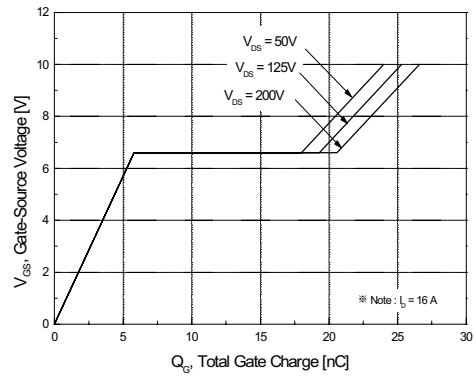
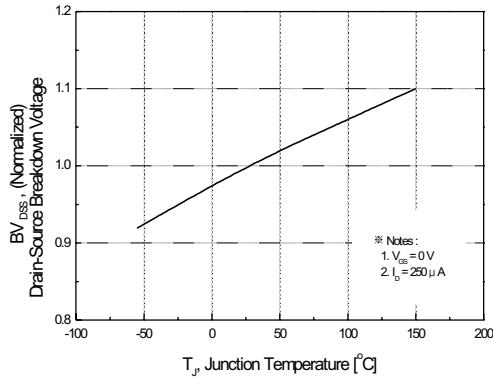
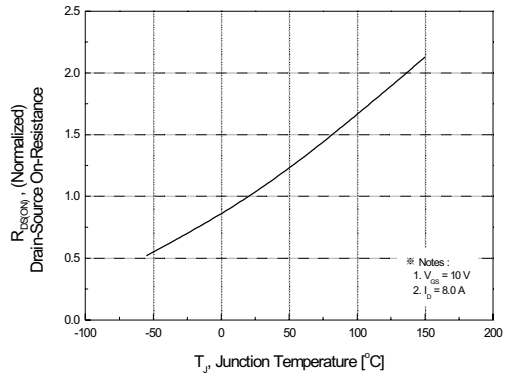


Figure 6. Gate Charge Characteristics

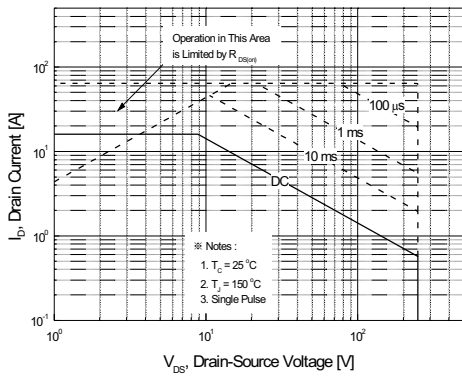
**Typical Characteristics** (Continued)



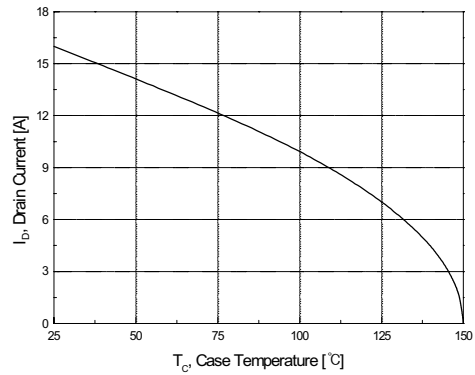
**Figure 7. Breakdown Voltage Variation vs. Temperature**



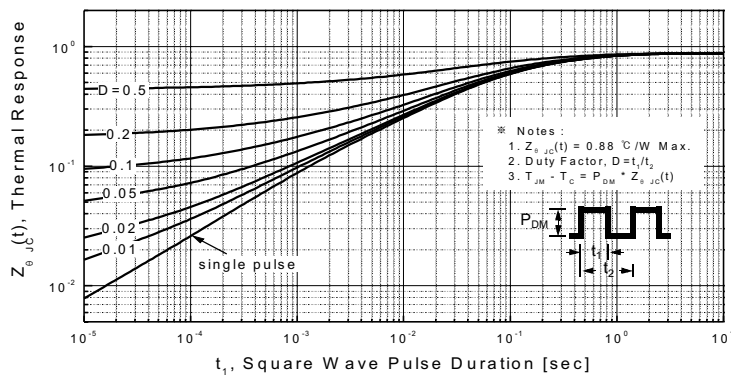
**Figure 8. On-Resistance Variation vs. Temperature**



**Figure 9. Maximum Safe Operating Area**

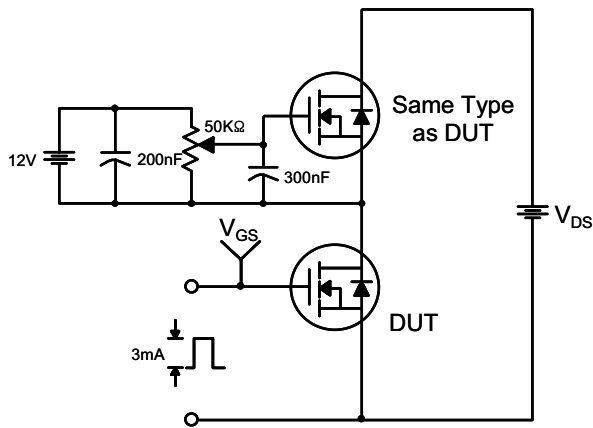


**Figure 10. Maximum Drain Current vs. Case Temperature**

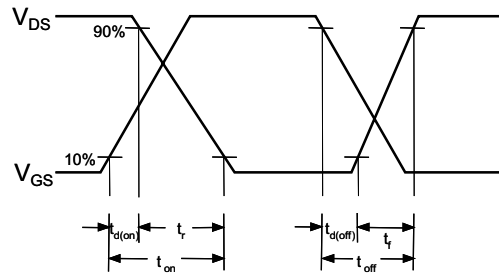
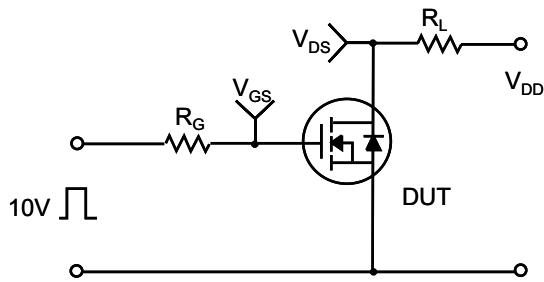


**Figure 11. Transient Thermal Response Curve**

Gate Charge Test Circuit & Waveform



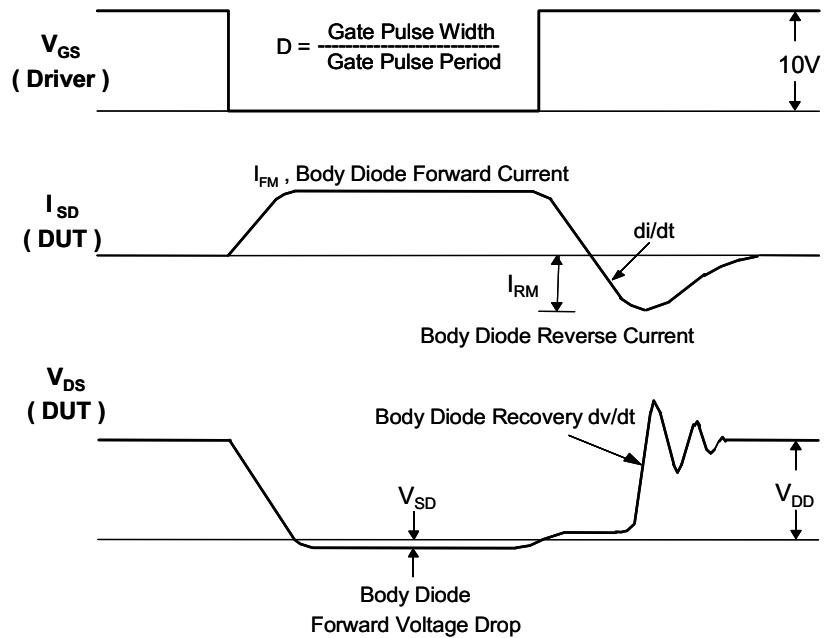
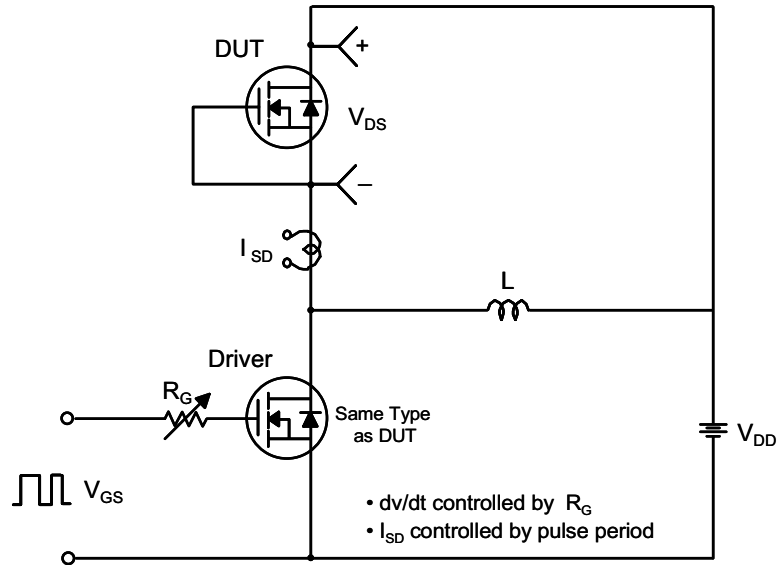
Resistive Switching Test Circuit & Waveforms



Unclamped Inductive Switching Test Circuit & Waveforms

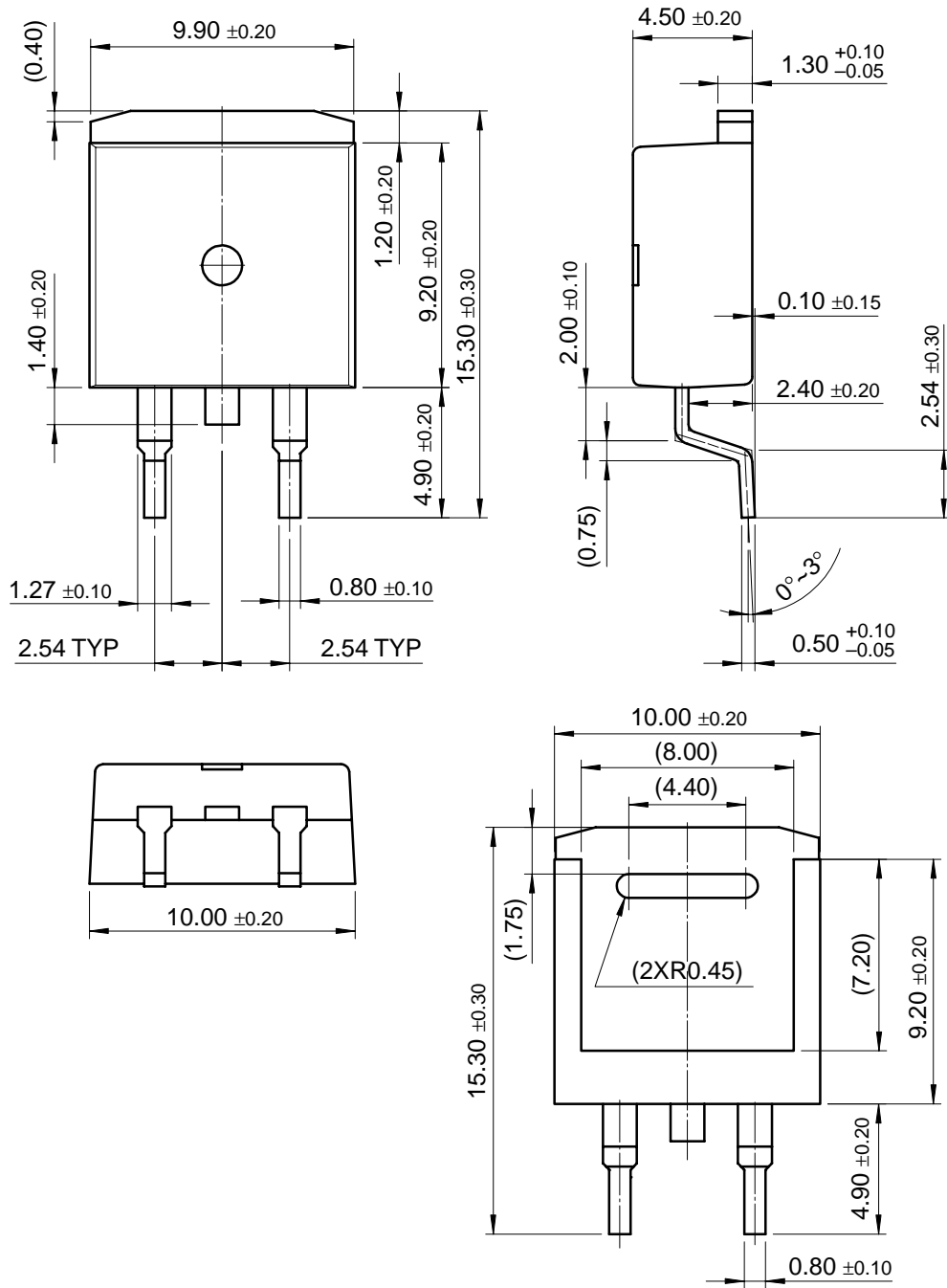


Peak Diode Recovery dv/dt Test Circuit & Waveforms



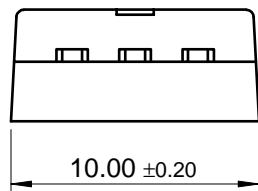
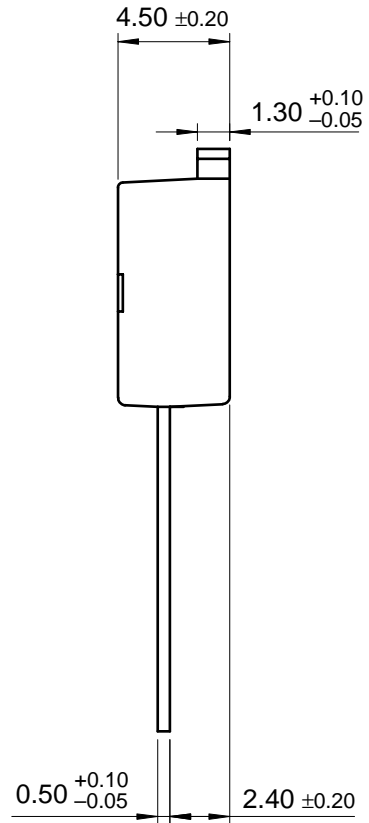
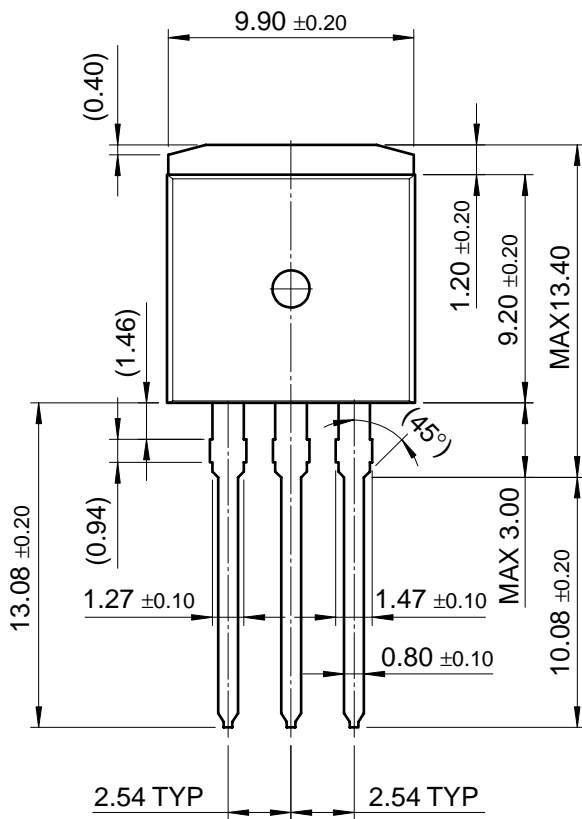
Package Dimensions

D<sup>2</sup>PAK



Package Dimensions (Continued)

# I<sup>2</sup>PAK



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