



May 2000

**QFET™**

# FQD5N30 / FQU5N30

## 300V N-Channel MOSFET

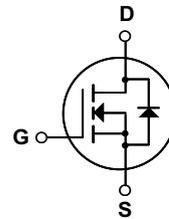
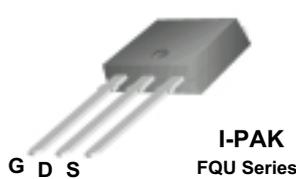
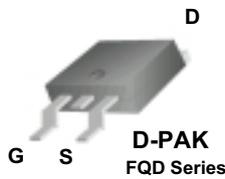
### General Description

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

- 4.4A, 300V,  $R_{DS(on)} = 0.9\Omega @ V_{GS} = 10V$
- Low gate charge ( typical 9.8 nC)
- Low Crss ( typical 9.5 pF)
- Fast switching
- 100% avalanche tested
- Improved dv/dt capability



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

| Symbol                            | Parameter   | FQD5N30 / FQU5N30 | Units |
|-----------------------------------|---|-------------------|-------|
| V <sub>DSS</sub>                  | Drain-Source Voltage  | 300               | V     |
| I <sub>D</sub>                    | Drain Current - Continuous (T <sub>C</sub> = 25°C)                            | 4.4               | A     |
|                                   | - Continuous (T <sub>C</sub> = 100°C)   | 2.78              | A     |
| I <sub>DM</sub>                   | Drain Current - Pulsed (Note 1)   | 17.6              | A     |
| V <sub>GSS</sub>                  | Gate-Source Voltage   | ± 30              | V     |
| E <sub>AS</sub>                   | Single Pulsed Avalanche Energy (Note 2)                                       | 340               | mJ    |
| I <sub>AR</sub>                   | Avalanche Current (Note 1)  | 4.4               | A     |
| E <sub>AR</sub>                   | Repetitive Avalanche Energy (Note 1)  | 4.5               | mJ    |
| dv/dt                             | Peak Diode Recovery dv/dt (Note 3)  | 4.5               | V/ns  |
| P <sub>D</sub>                    | Power Dissipation (T <sub>A</sub> = 25°C) *                                   | 2.5               | W     |
|                                   | Power Dissipation (T <sub>C</sub> = 25°C)                                     | 45                | W     |
|                                   | - Derate above 25°C   | 0.36              | 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      | --  | 2.78 | °C/W  |
| R <sub>θJA</sub> | Thermal Resistance, Junction-to-Ambient * | --  | 50   | °C/W  |
| R <sub>θJA</sub> | Thermal Resistance, Junction-to-Ambient   | --  | 110  | °C/W  |

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

## 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  | 300 | --   | --   | V    |
| ΔBV <sub>DSS</sub> / ΔT <sub>J</sub> | Breakdown Voltage Temperature Coefficient | I <sub>D</sub> = 250 μA, Referenced to 25°C     | --  | 0.26 | --   | V/°C |
| I <sub>DSS</sub>                     | Zero Gate Voltage Drain Current           | V <sub>DS</sub> = 300 V, V <sub>GS</sub> = 0 V  | --  | --   | 1    | μA   |
|                                      |   | V <sub>DS</sub> = 240 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 | 3.0 | --   | 5.0 | V |
| R <sub>DS(on)</sub> | Static Drain-Source On-Resistance | V <sub>GS</sub> = 10 V, I <sub>D</sub> = 2.2 A              | --  | 0.68 | 0.9 | Ω |
| g <sub>FS</sub>     | Forward Transconductance          | V <sub>DS</sub> = 50 V, I <sub>D</sub> = 2.2 A (Note 4)     | --  | 2.9  | --  | S |

### Dynamic Characteristics

|                  |                              |   |    |     |     |    |
|------------------|------------------------------|---|----|-----|-----|----|
| C <sub>iss</sub> | Input Capacitance            | V <sub>DS</sub> = 25 V, V <sub>GS</sub> = 0 V,<br>f = 1.0 MHz | -- | 330 | 430 | pF |
| C <sub>oss</sub> | Output Capacitance           |   | -- | 70  | 90  | pF |
| C <sub>rss</sub> | Reverse Transfer Capacitance |   | -- | 9.5 | 13  | pF |

### Switching Characteristics

|                     |                     |  |   |     |     |    |
|---------------------|---------------------|--|---|-----|-----|----|
| t <sub>d(on)</sub>  | Turn-On Delay Time  | V <sub>DD</sub> = 150 V, I <sub>D</sub> = 5.4 A,<br>R <sub>G</sub> = 25 Ω<br><br>(Note 4, 5) | --  | 11  | 32  | ns |
| t <sub>r</sub>      | Turn-On Rise Time   |  | --  | 55  | 120 | ns |
| t <sub>d(off)</sub> | Turn-Off Delay Time |  | --  | 17  | 45  | ns |
| t <sub>f</sub>      | Turn-Off Fall Time  |  | --  | 27  | 65  | ns |
| Q <sub>g</sub>      | Total Gate Charge   |  | V <sub>DS</sub> = 240 V, I <sub>D</sub> = 5.4 A,<br>V <sub>GS</sub> = 10 V<br><br>(Note 4, 5) | --  | 9.8 | 13 |
| Q <sub>gs</sub>     | Gate-Source Charge  |  | --  | 2.4 | --  | nC |
| Q <sub>gd</sub>     | Gate-Drain Charge   |  | --  | 5.1 | --  | nC |

### Drain-Source Diode Characteristics and Maximum Ratings

|                 |   |  |    |      |     |    |
|-----------------|---|--|----|------|-----|----|
| I <sub>S</sub>  | Maximum Continuous Drain-Source Diode Forward Current | --   | -- | 4.4  | A   |    |
| I <sub>SM</sub> | Maximum Pulsed Drain-Source Diode Forward Current     | --   | -- | 17.6 | A   |    |
| V <sub>SD</sub> | Drain-Source Diode Forward Voltage                    | V <sub>GS</sub> = 0 V, I <sub>S</sub> = 4.4 A  | -- | --   | 1.5 | V  |
| t <sub>rr</sub> | Reverse Recovery Time                                 | V <sub>GS</sub> = 0 V, I <sub>S</sub> = 5.4 A,<br>di <sub>F</sub> / dt = 100 A/μs (Note 4) | -- | 130  | --  | ns |
| Q <sub>rr</sub> | Reverse Recovery Charge                               |  | -- | 0.6  | --  | μC |

#### Notes:

1. Repetitive Rating : Pulse width limited by maximum junction temperature
2. L = 29.3mH, I<sub>AS</sub> = 4.4A, V<sub>DD</sub> = 50V, R<sub>G</sub> = 25 Ω, Starting T<sub>J</sub> = 25°C
3. I<sub>SD</sub> ≤ 5.4A, 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 Characteristics

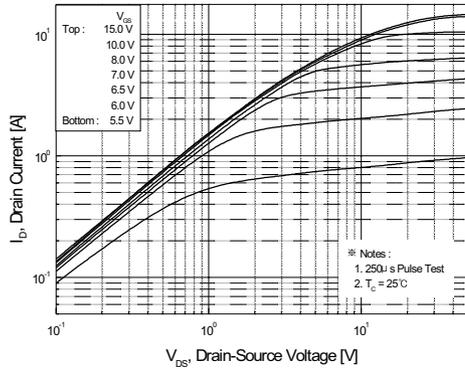


Figure 1. On-Region Characteristics

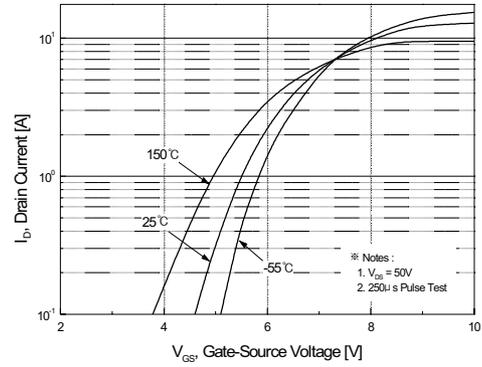


Figure 2. Transfer Characteristics

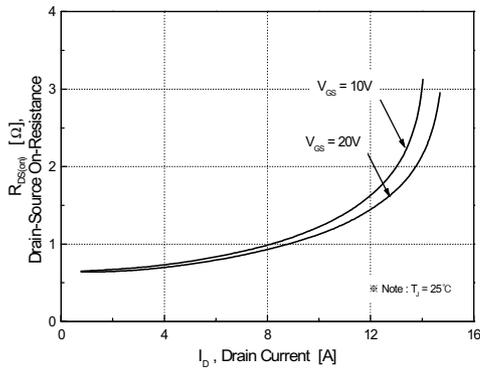


Figure 3. On-Resistance Variation vs. Drain Current and Gate Voltage

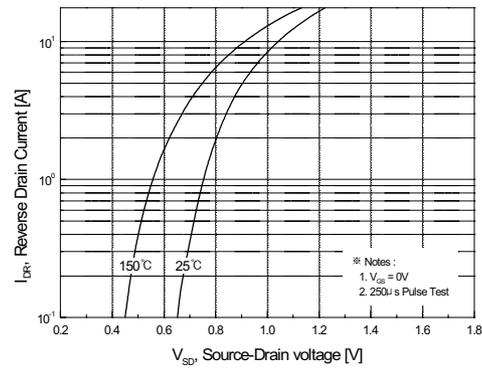


Figure 4. Body Diode Forward Voltage Variation vs. Source Current and Temperature

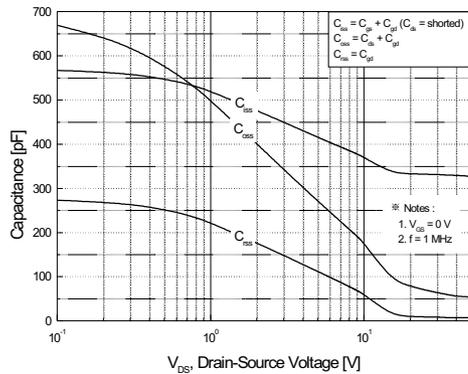


Figure 5. Capacitance Characteristics

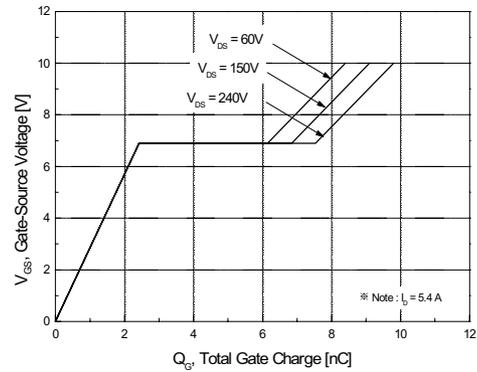
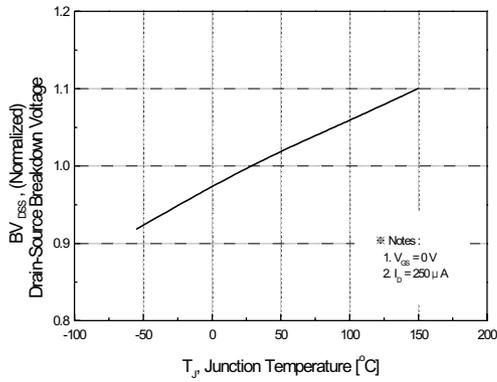
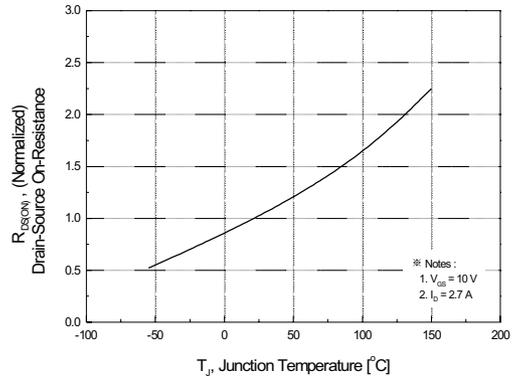


Figure 6. Gate Charge Characteristics

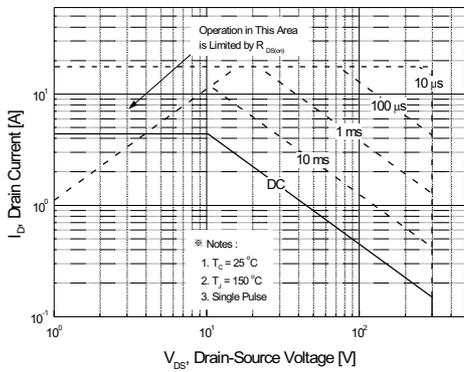
**Typical Characteristics** (Continued)



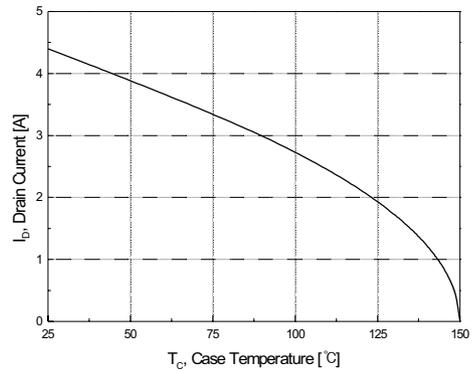
**Figure 7. Breakdown Voltage Variation vs. Temperature**



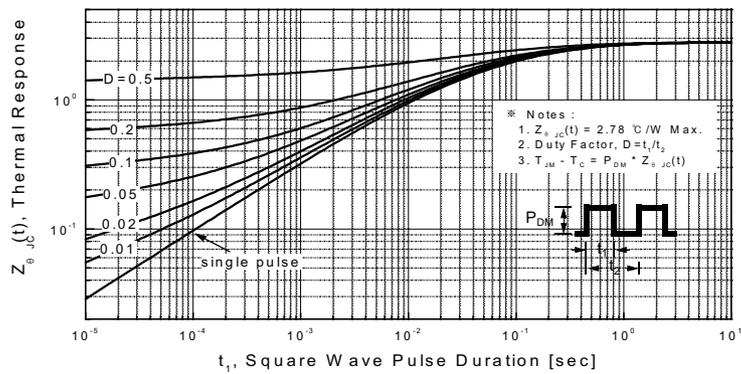
**Figure 8. On-Resistance Variation vs. Temperature**



**Figure 9. Maximum Safe Operating Area**



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

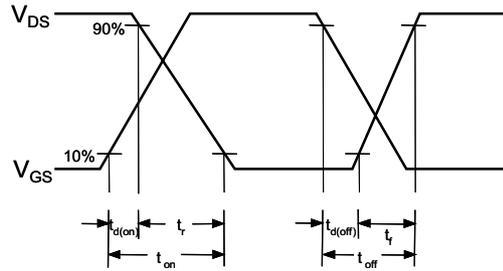


**Figure 11. Transient Thermal Response Curve**

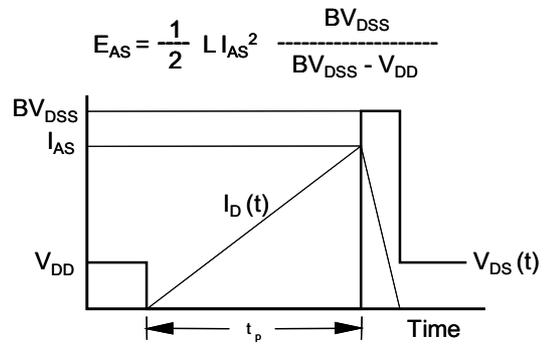
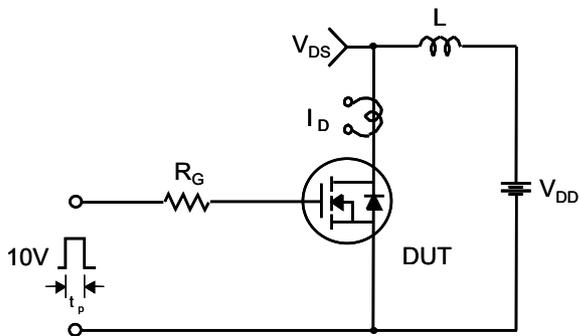
Gate Charge Test Circuit & Waveform



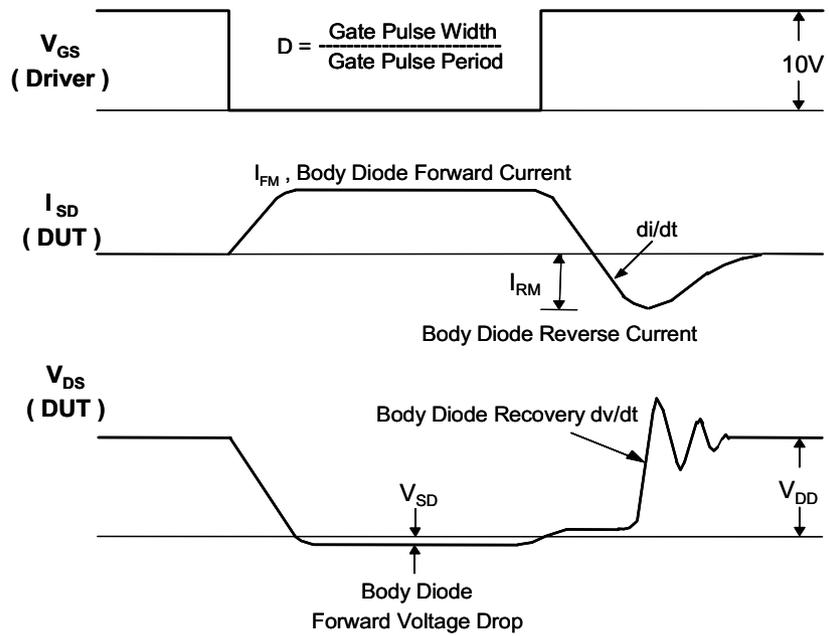
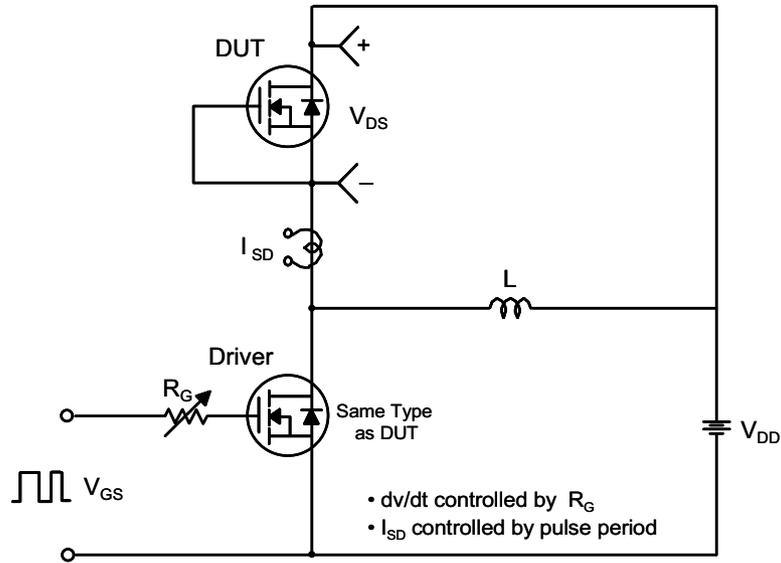
Resistive Switching Test Circuit & Waveforms



Unclamped Inductive Switching Test Circuit & Waveforms

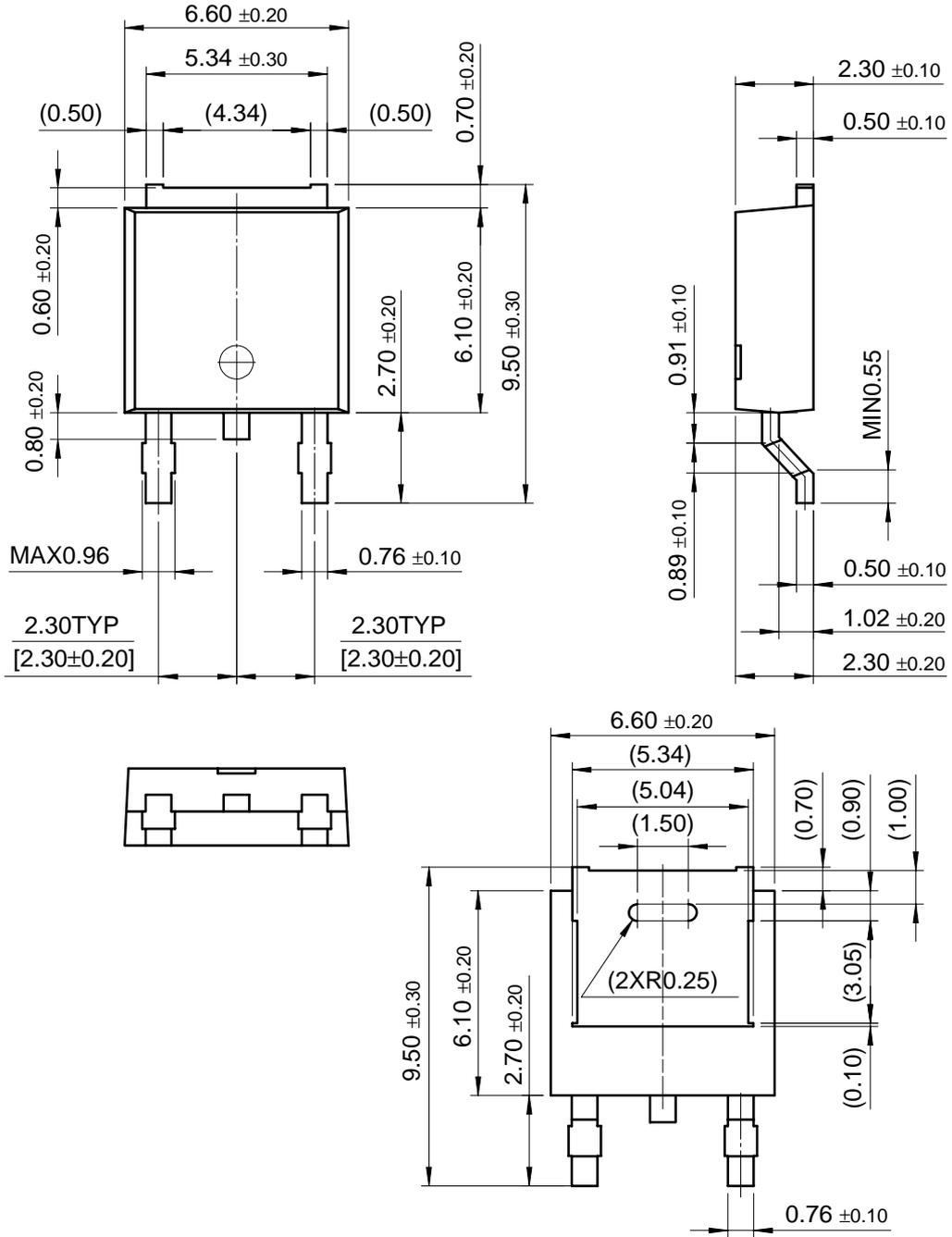


Peak Diode Recovery dv/dt Test Circuit & Waveforms



Package Dimensions

DPAK





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