



December 2000

QFET™

# FQD4P25 / FQU4P25

## 250V P-Channel MOSFET

### General Description

These P-Channel enhancement mode power field effect transistors are produced using Fairchild's proprietary, planar stripe, DMOS technology.

This advanced technology is especially tailored to minimize on-state resistance, provide superior switching performance, and withstand a high energy pulse in the avalanche and commutation modes. These devices are well suited for high efficiency switching DC/DC converters.

### Features

- -3.1A, -250V,  $R_{DS(on)} = 2.1\Omega @ V_{GS} = -10V$
- Low gate charge ( typical 10 nC)
- Low  $C_{rss}$  ( typical 10.3 pF)
- Fast switching
- 100% avalanche tested
- Improved dv/dt capability



### Absolute Maximum Ratings $T_C = 25^\circ\text{C}$ unless otherwise noted

Symbol	Parameter	FQD4P25 / FQU4P25	Units
$V_{DSS}$	Drain-Source Voltage	-250	V
$I_D$	Drain Current - Continuous ( $T_C = 25^\circ\text{C}$ ) - Continuous ( $T_C = 100^\circ\text{C}$ )	-3.1	A
		-1.96	A
$I_{DM}$	Drain Current - Pulsed (Note 1)	-12.4	A
$V_{GSS}$	Gate-Source Voltage	$\pm 30$	V
$E_{AS}$	Single Pulsed Avalanche Energy (Note 2)	280	mJ
$I_{AR}$	Avalanche Current (Note 1)	-3.1	A
$E_{AR}$	Repetitive Avalanche Energy (Note 1)	4.5	mJ
dv/dt	Peak Diode Recovery dv/dt (Note 3)	-5.5	V/ns
$P_D$	Power Dissipation ( $T_A = 25^\circ\text{C}$ ) *	2.5	W
	Power Dissipation ( $T_C = 25^\circ\text{C}$ )	45	W
	- Derate above $25^\circ\text{C}$	0.36	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	$^\circ\text{C}$

### Thermal Characteristics

Symbol	Parameter	Typ	Max	Units
$R_{\theta JC}$	Thermal Resistance, Junction-to-Case	--	2.78	$^\circ\text{C}/\text{W}$
$R_{\theta JA}$	Thermal Resistance, Junction-to-Ambient *	--	50	$^\circ\text{C}/\text{W}$
$R_{\theta JA}$	Thermal Resistance, Junction-to-Ambient	--	110	$^\circ\text{C}/\text{W}$

\*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 $25^\circ\text{C}$	--	-0.21	--	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
<b>On Characteristics</b>						
$V_{GS(th)}$	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	$V_{GS} = -10\text{ V}, I_D = -1.55\text{ A}$	--	1.63	2.1	$\Omega$
$g_{FS}$	Forward Transconductance	$V_{DS} = -40\text{ V}, I_D = -1.55\text{ A}$ (Note 4)	--	2.0	--	S
<b>Dynamic Characteristics</b>						
$C_{iss}$	Input Capacitance	$V_{DS} = -25\text{ V}, V_{GS} = 0\text{ V},$ $f = 1.0\text{ MHz}$	--	325	420	pF
$C_{oss}$	Output Capacitance		--	65	85	pF
$C_{rss}$	Reverse Transfer Capacitance		--	10	13	pF
<b>Switching Characteristics</b>						
$t_{d(on)}$	Turn-On Delay Time	$V_{DD} = -125\text{ V}, I_D = -4.0\text{ A},$ $R_G = 25\ \Omega$  (Note 4, 5)	--	9.5	30	ns
$t_r$	Turn-On Rise Time		--	60	130	ns
$t_{d(off)}$	Turn-Off Delay Time		--	14	40	ns
$t_f$	Turn-Off Fall Time		--	27	65	ns
$Q_g$	Total Gate Charge	$V_{DS} = -200\text{ V}, I_D = -4.0\text{ A},$ $V_{GS} = -10\text{ V}$  (Note 4, 5)	--	10.3	14	nC
$Q_{gs}$	Gate-Source Charge		--	2.7	--	nC
$Q_{gd}$	Gate-Drain Charge		--	5.2	--	nC
<b>Drain-Source Diode Characteristics and Maximum Ratings</b>						
$I_S$	Maximum Continuous Drain-Source Diode Forward Current		--	--	-3.1	A
$I_{SM}$	Maximum Pulsed Drain-Source Diode Forward Current		--	--	-12.4	A
$V_{SD}$	Drain-Source Diode Forward Voltage	$V_{GS} = 0\text{ V}, I_S = -3.1\text{ A}$	--	--	-5.0	V
$t_{rr}$	Reverse Recovery Time	$V_{GS} = 0\text{ V}, I_S = -4.0\text{ A},$ $dI_F / dt = 100\text{ A}/\mu\text{s}$ (Note 4)	--	140	--	ns
$Q_{rr}$	Reverse Recovery Charge		--	0.64	--	$\mu\text{C}$

**Notes:**

1. Repetitive Rating : Pulse width limited by maximum junction temperature
2.  $L = 46.6\text{ mH}, I_{AS} = -3.1\text{ A}, V_{DD} = -50\text{ V}, R_G = 25\ \Omega$ , Starting  $T_J = 25^\circ\text{C}$
3.  $I_{SD} \leq -4.0\text{ A}, di/dt \leq 300\text{ A}/\mu\text{s}, V_{DD} \leq BV_{DSS}$ , 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

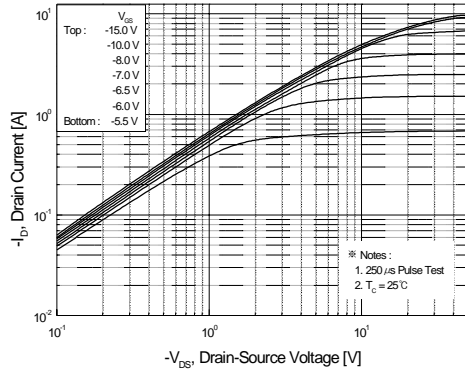


Figure 1. On-Region Characteristics

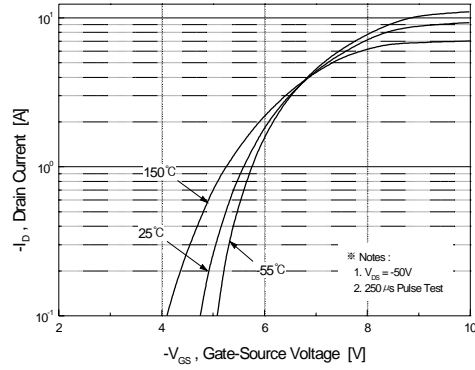


Figure 2. Transfer Characteristics

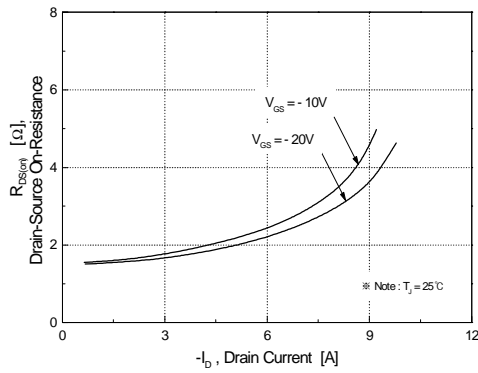


Figure 3. On-Resistance Variation vs. Drain Current and Gate Voltage

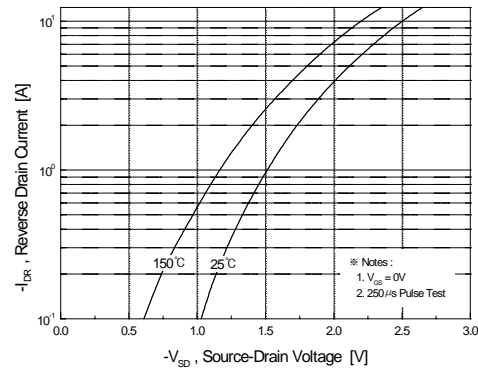


Figure 4. Body Diode Forward Voltage Variation vs. Source Current and Temperature

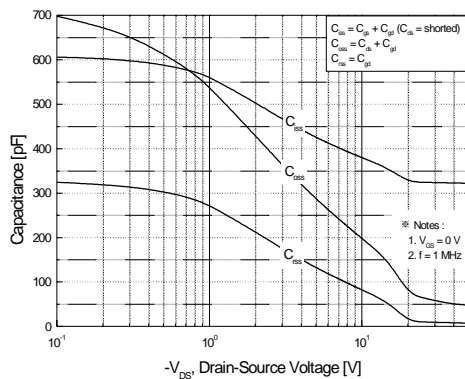


Figure 5. Capacitance Characteristics

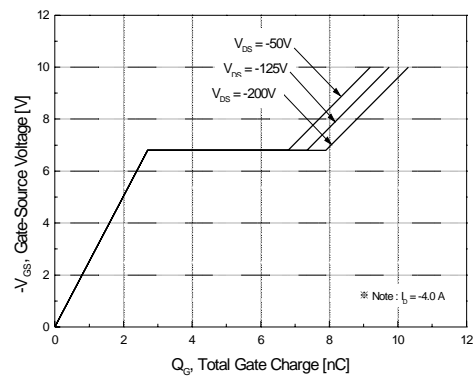
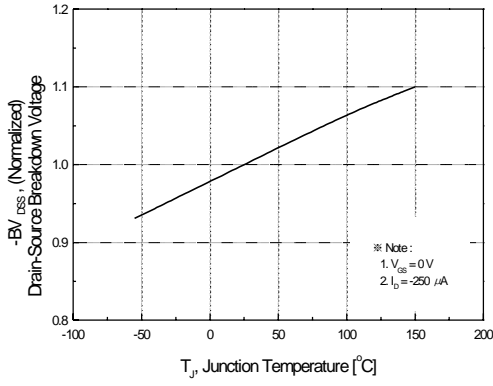
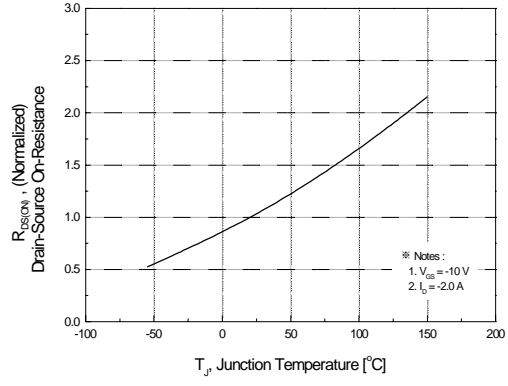


Figure 6. Gate Charge Characteristics

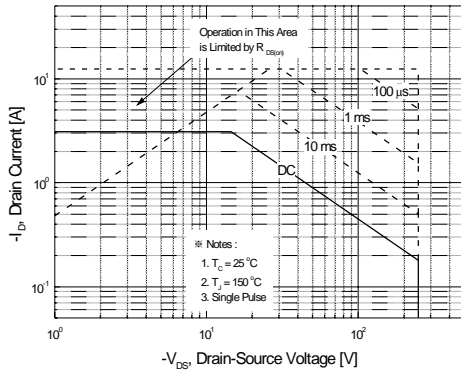
**Typical Characteristics** (Continued)



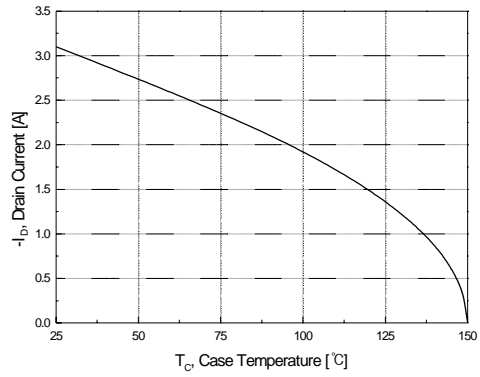
**Figure 7. Breakdown Voltage Variation vs. Temperature**



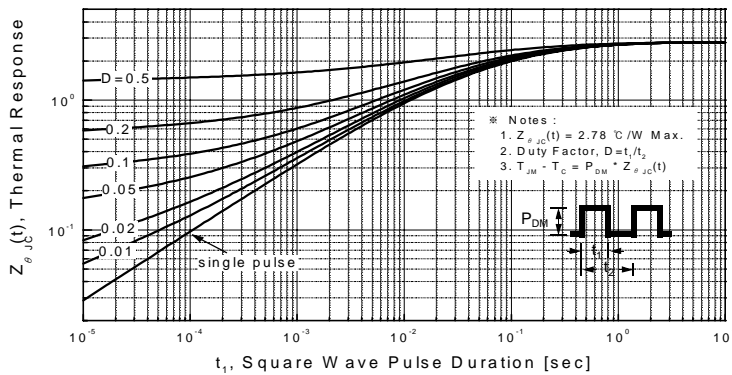
**Figure 8. On-Resistance Variation vs. Temperature**



**Figure 9. Maximum Safe Operating Area**

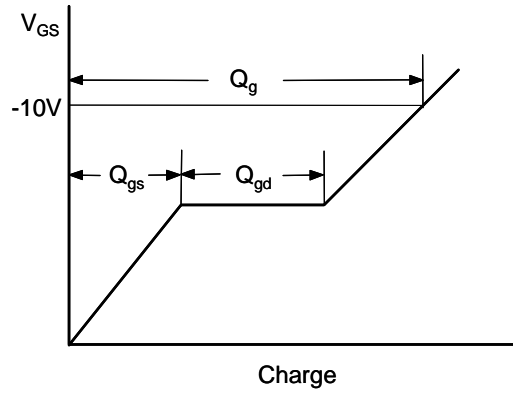
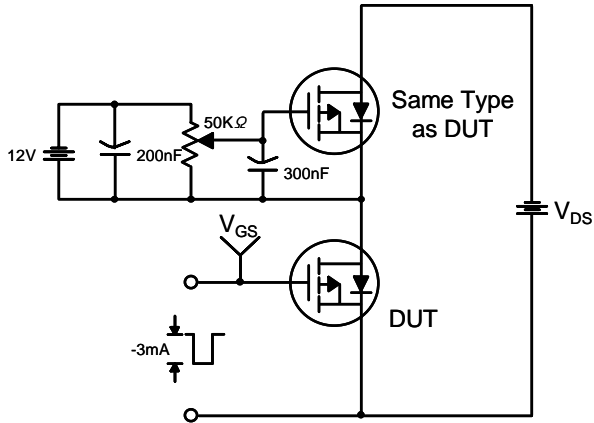


**Figure 10. Maximum Drain Current vs. Case Temperature**

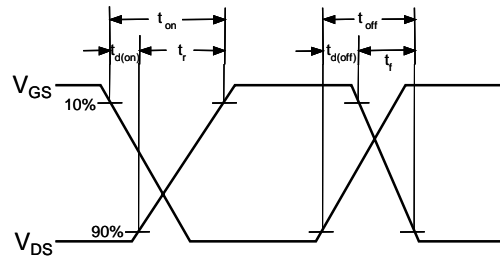
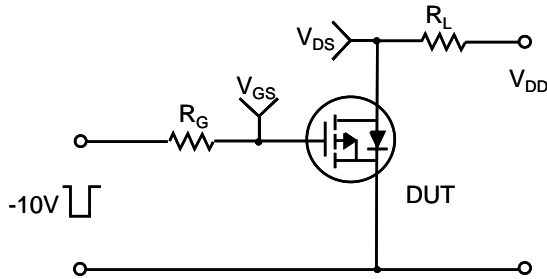


**Figure 11. Transient Thermal Response Curve**

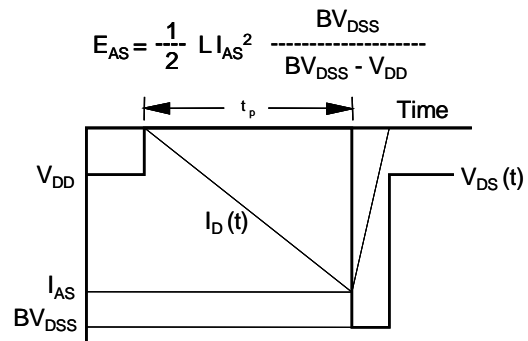
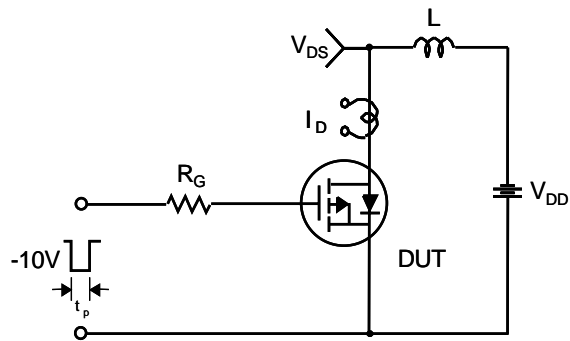
**Gate Charge Test Circuit & Waveform**



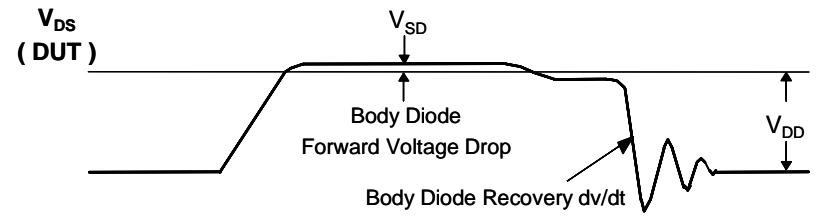
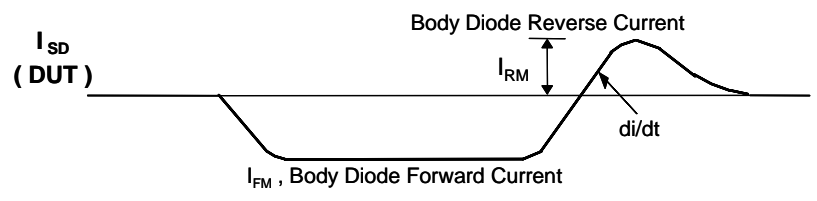
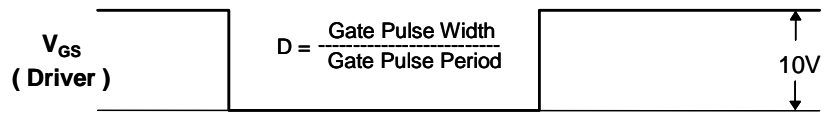
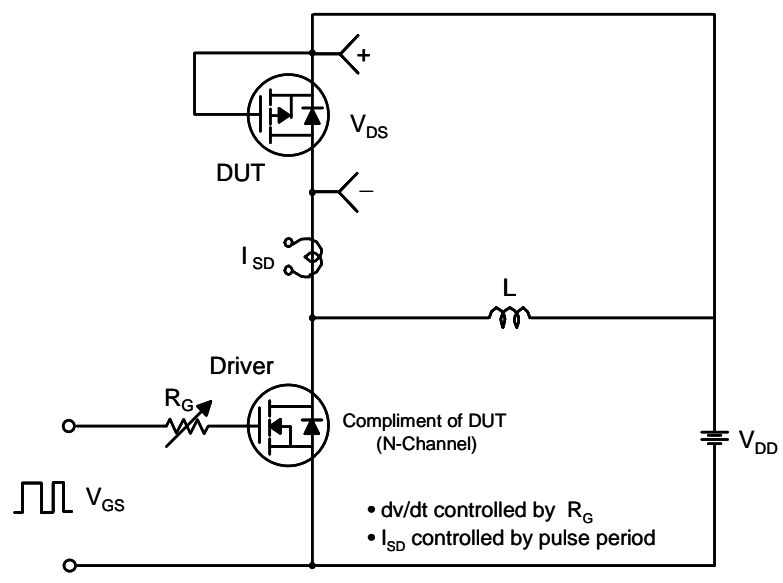
**Resistive Switching Test Circuit & Waveforms**



**Unclamped Inductive Switching Test Circuit & Waveforms**

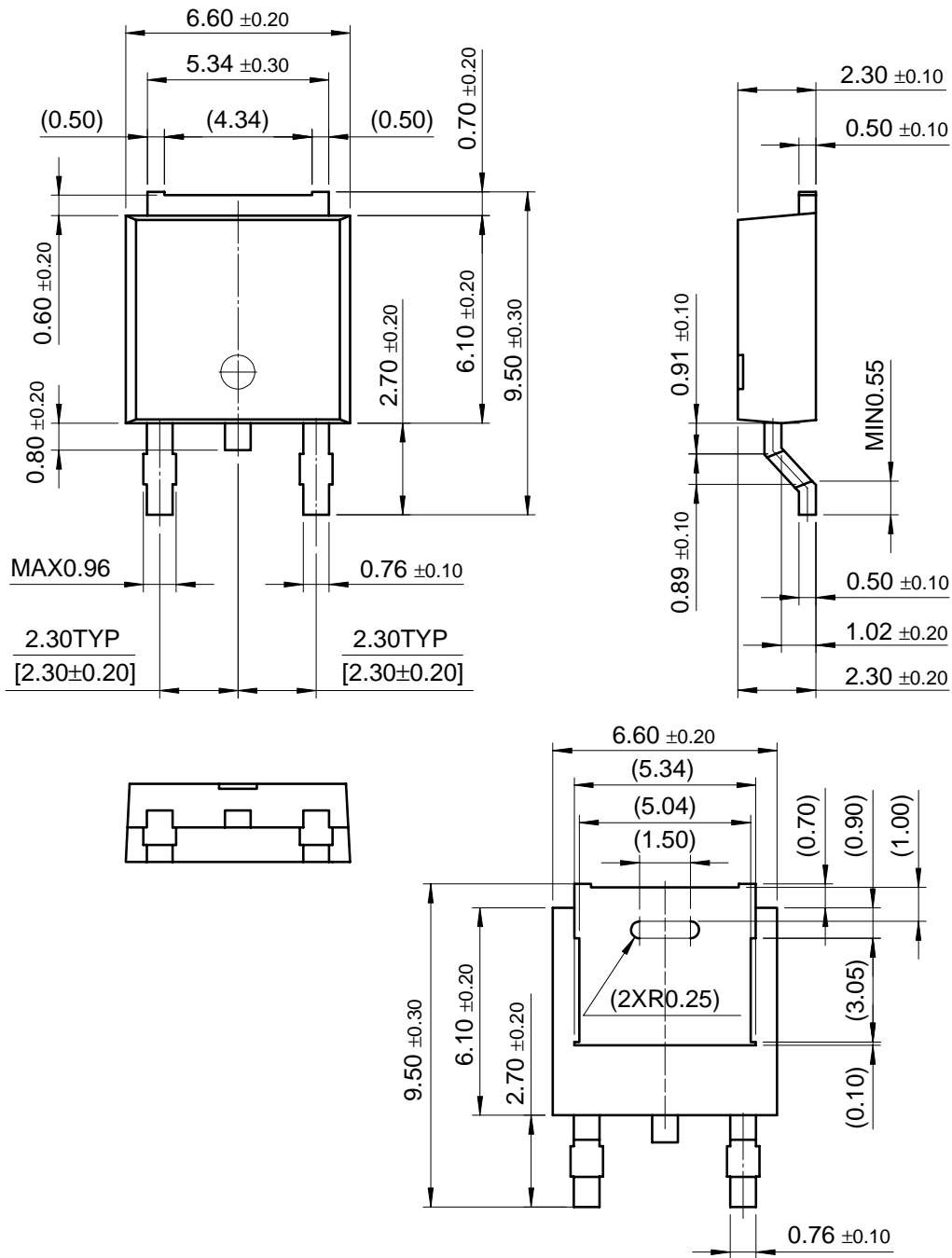


Peak Diode Recovery dv/dt Test Circuit & Waveforms



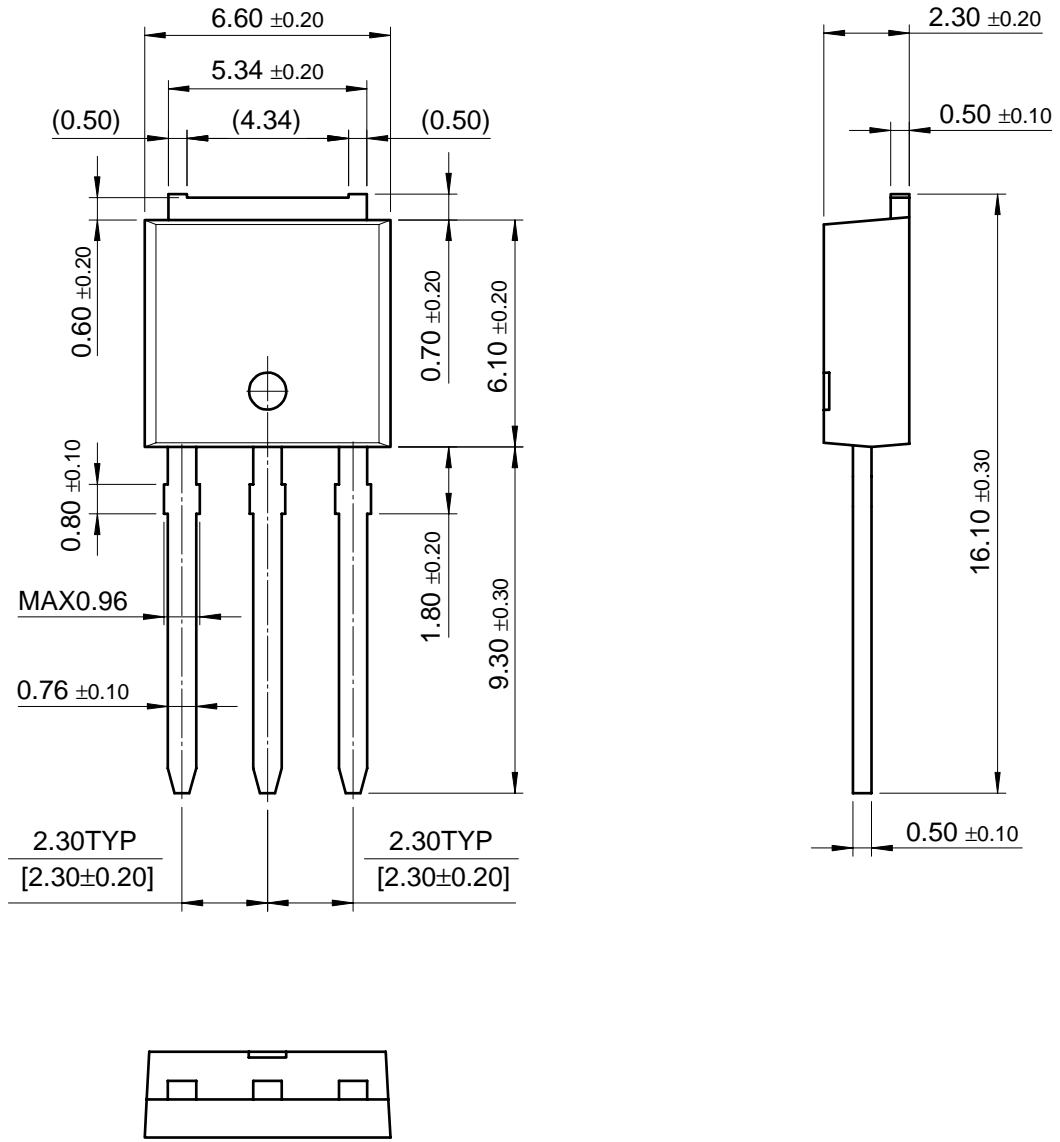
Package Dimensions

DPAK



Package Dimensions (Continued)

IPAK





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