



May 2000

QFET™

FQD1N50B / FQU1N50B

500V N-Channel MOSFET

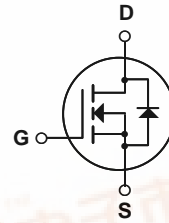
General Description

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 switch mode power supply, power factor correction, electronic lamp ballast based on half bridge.

Features

- 1.1A, 500V, $R_{DS(on)} = 9.0\Omega$ @ $V_{GS} = 10V$
- Low gate charge (typical 4.0 nC)
- Low C_{rss} (typical 3.0 pF)
- Fast switching
- 100% avalanche tested
- Improved dv/dt capability



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

Symbol	Parameter	FQD1N50 / FQU1N50	Units
V_{DSS}	Drain-Source Voltage	500	V
I_D	Drain Current - Continuous ($T_C = 25^\circ\text{C}$) - Continuous ($T_C = 100^\circ\text{C}$)	1.1	A
		0.7	A
I_{DM}	Drain Current - Pulsed (Note 1)	4.4	A
V_{GSS}	Gate-Source Voltage	± 30	V
E_{AS}	Single Pulsed Avalanche Energy (Note 2)	80	mJ
I_{AR}	Avalanche Current (Note 1)	1.1	A
E_{AR}	Repetitive Avalanche Energy (Note 1)	2.5	mJ
dv/dt	Peak Diode Recovery dv/dt (Note 3)	4.5	V/ns
P_D	Power Dissipation ($T_A = 25^\circ\text{C}$) *	2.5	W
	Power Dissipation ($T_C = 25^\circ\text{C}$)	25	W
	- Derate above 25°C	0.2	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	--	5.0	$^\circ\text{C}/\text{W}$
$R_{\theta JA}$	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	
Off Characteristics							
BV_{DSS}	Drain-Source Breakdown Voltage	$V_{GS} = 0\text{ V}, I_D = 250\ \mu\text{A}$	500	--	--	V	
$\frac{\Delta BV_{DSS}}{\Delta T_J}$	Breakdown Voltage Temperature Coefficient	$I_D = 250\ \mu\text{A}$, Referenced to 25°C	--	0.5	--	$\text{V}/^\circ\text{C}$	
I_{DSS}	Zero Gate Voltage Drain Current	$V_{DS} = 500\text{ V}, V_{GS} = 0\text{ V}$	--	--	1	μA	
		$V_{DS} = 400\text{ V}, T_C = 125^\circ\text{C}$	--	--	10	μA	
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	$V_{DS} = V_{GS}, I_D = 250\ \mu\text{A}$	2.3	3.0	3.7	V	
		$V_{DS} = V_{GS}, I_D = 250\text{ mA}$	3.6	4.3	5.0	V	
$R_{DS(on)}$	Static Drain-Source On-Resistance	$V_{GS} = 10\text{ V}, I_D = 0.55\text{ A}$	--	6.8	9.0	Ω	
g_{FS}	Forward Transconductance	$V_{DS} = 50\text{ V}, I_D = 0.55\text{ A}$ (Note 4)	--	0.98	--	S	
Dynamic Characteristics							
C_{iss}	Input Capacitance	$V_{DS} = 25\text{ V}, V_{GS} = 0\text{ V},$ $f = 1.0\text{ MHz}$	--	115	150	pF	
C_{oss}	Output Capacitance		--	20	30	pF	
C_{rss}	Reverse Transfer Capacitance		--	3	4	pF	
Switching Characteristics							
$t_{d(on)}$	Turn-On Delay Time	$V_{DD} = 250\text{ V}, I_D = 1.4\text{ A},$ $R_G = 25\ \Omega$	--	5	20	ns	
t_r	Turn-On Rise Time		--	25	60	ns	
$t_{d(off)}$	Turn-Off Delay Time		--	8	25	ns	
t_f	Turn-Off Fall Time		(Note 4, 5)	--	20	50	ns
Q_g	Total Gate Charge		$V_{DS} = 400\text{ V}, I_D = 1.4\text{ A},$ $V_{GS} = 10\text{ V}$	--	4.0	5.5	nC
Q_{gs}	Gate-Source Charge	(Note 4, 5)	--	1.1	--	nC	
Q_{gd}	Gate-Drain Charge		--	2.2	--	nC	
Drain-Source Diode Characteristics and Maximum Ratings							
I_S	Maximum Continuous Drain-Source Diode Forward Current		--	--	1.4	A	
I_{SM}	Maximum Pulsed Drain-Source Diode Forward Current		--	--	4.4	A	
V_{SD}	Drain-Source Diode Forward Voltage	$V_{GS} = 0\text{ V}, I_S = 1.4\text{ A}$	--	--	1.4	V	
t_{rr}	Reverse Recovery Time	$V_{GS} = 0\text{ V}, I_S = 1.4\text{ A},$	--	170	--	ns	
Q_{rr}	Reverse Recovery Charge	$di_F / dt = 100\text{ A}/\mu\text{s}$ (Note 4)	--	0.4	--	μC	

Notes:

1. Repetitive Rating : Pulse width limited by maximum junction temperature
2. $L = 120\text{mH}, I_{AS} = 1.1\text{ A}, V_{DD} = 50\text{ V}, R_G = 25\ \Omega$, Starting $T_J = 25^\circ\text{C}$
3. $I_{SD} \leq 1.4\text{ A}, di/dt \leq 200\text{ A}/\mu\text{s}, V_{DD} \leq BV_{DSS}$, 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

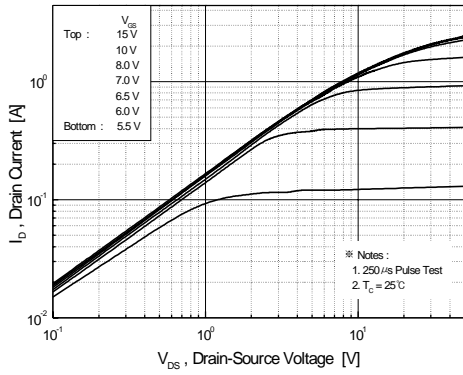


Figure 1. On-Region Characteristics.

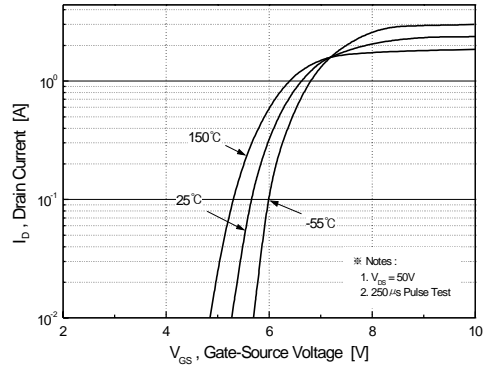


Figure 2. Transfer Characteristics.

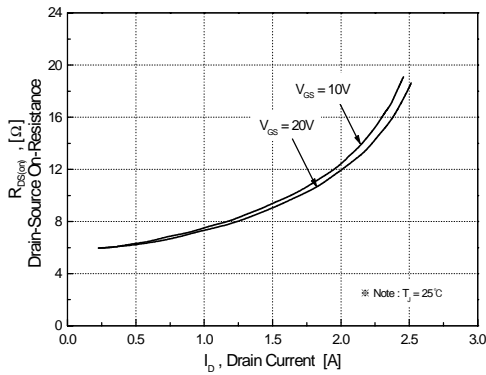


Figure 3. On-Resistance Variation vs Drain Current and Gate Voltage.

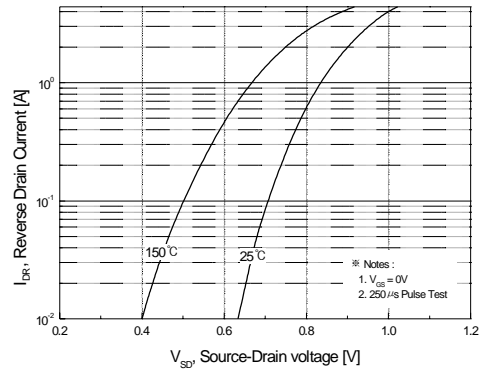


Figure 4. Body Diode Forward Voltage Variation with Source Current and Temperature.

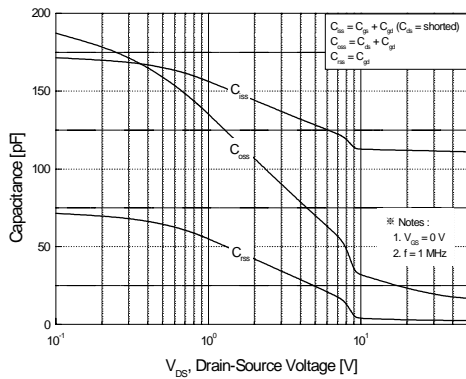


Figure 5. Capacitance Characteristics.

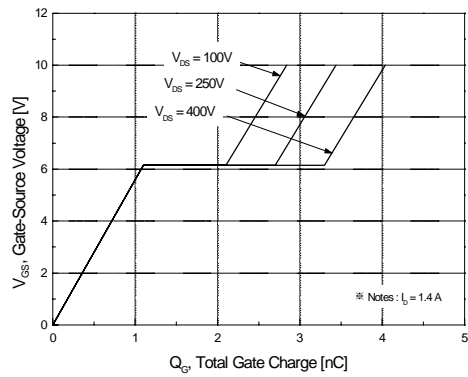


Figure 6. Gate-Charge Characteristics.

Typical Characteristics (Continued)

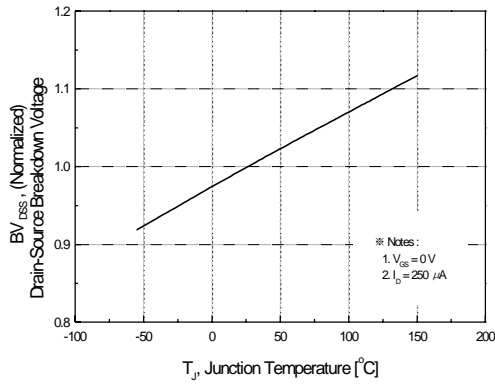


Figure 7. Breakdown Voltage Variation vs Temperature.

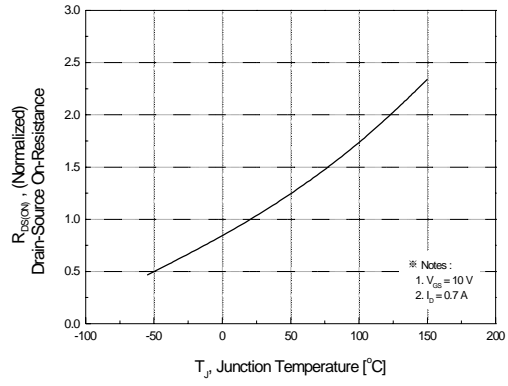


Figure 8. On-Resistance Variation vs Temperature.

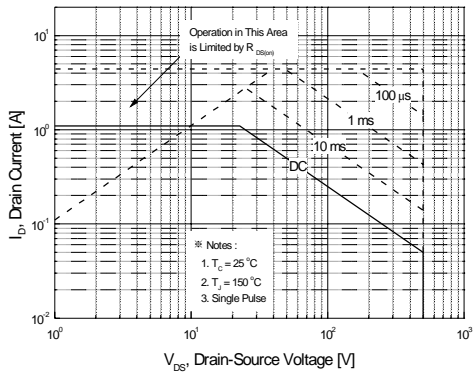


Figure 9. Maximum Safe Operating Area.

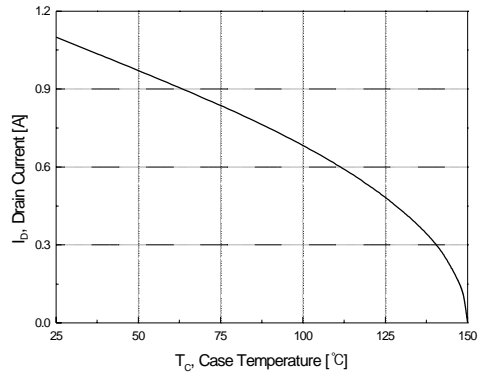


Figure 10. Maximum Drain Current vs Case Temperature.

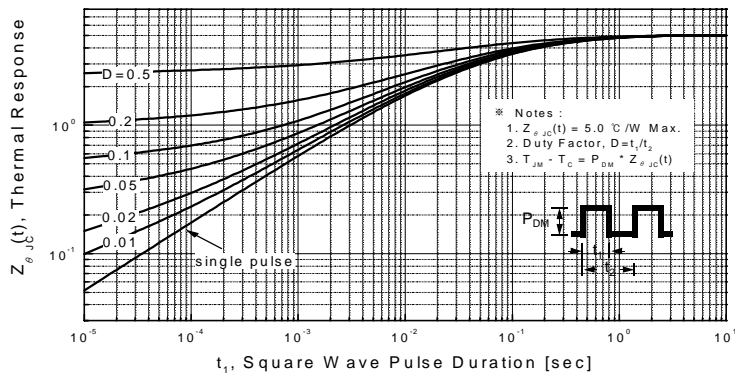
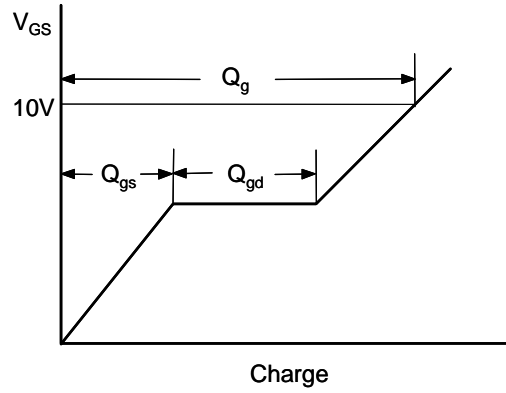
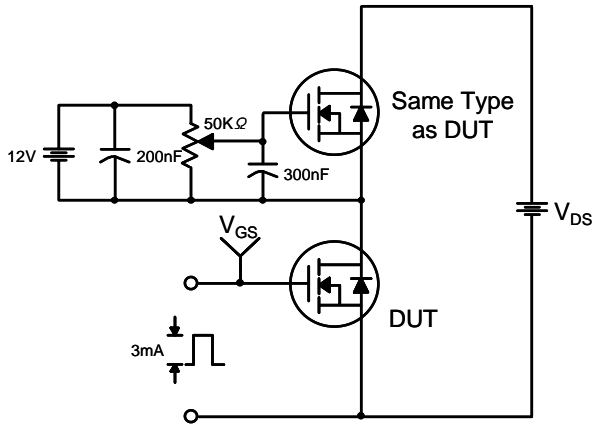


Figure 11. Transient Thermal Response Curve.

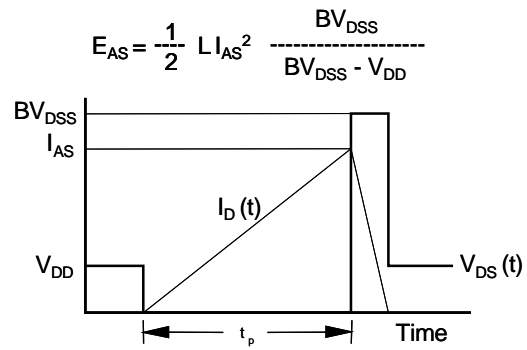
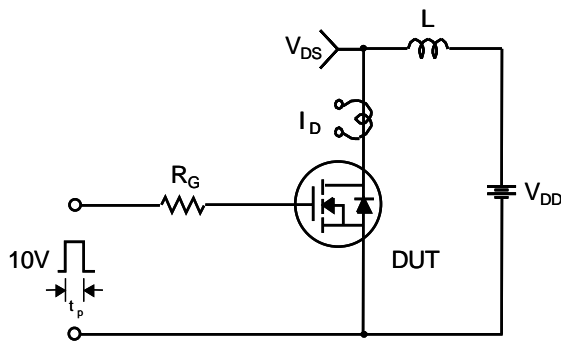
Gate Charge Test Circuit & Waveform



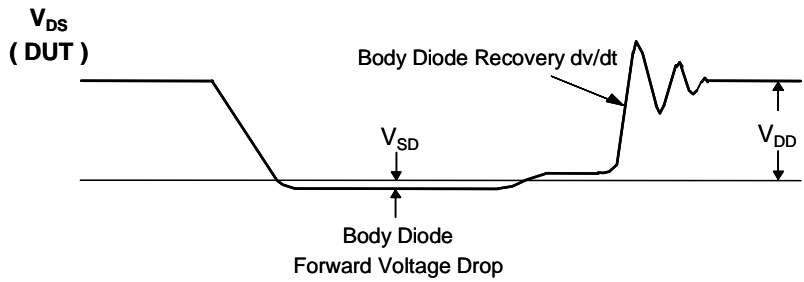
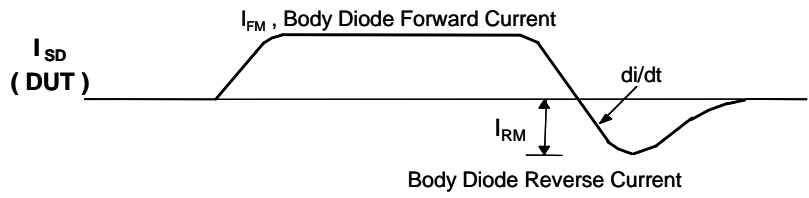
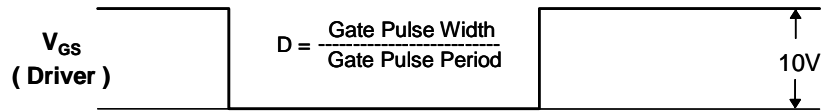
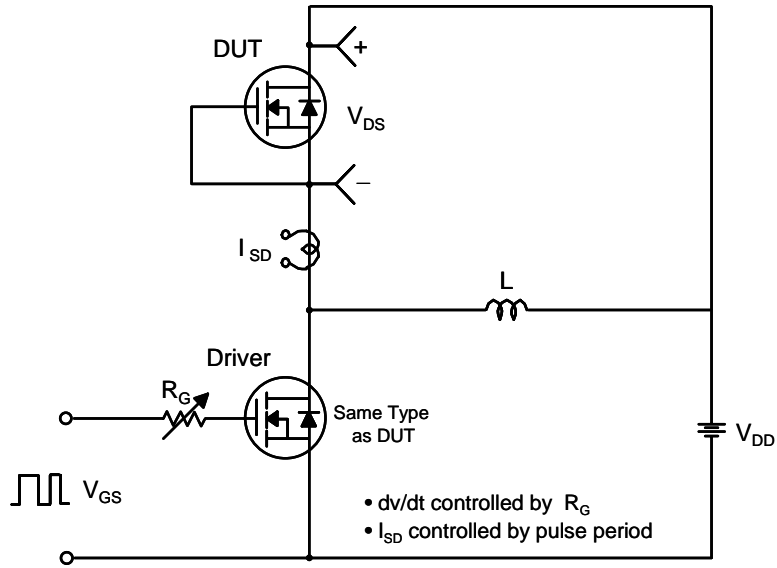
Resistive Switching Test Circuit & Waveforms



Unclamped Inductive Switching Test Circuit & Waveforms

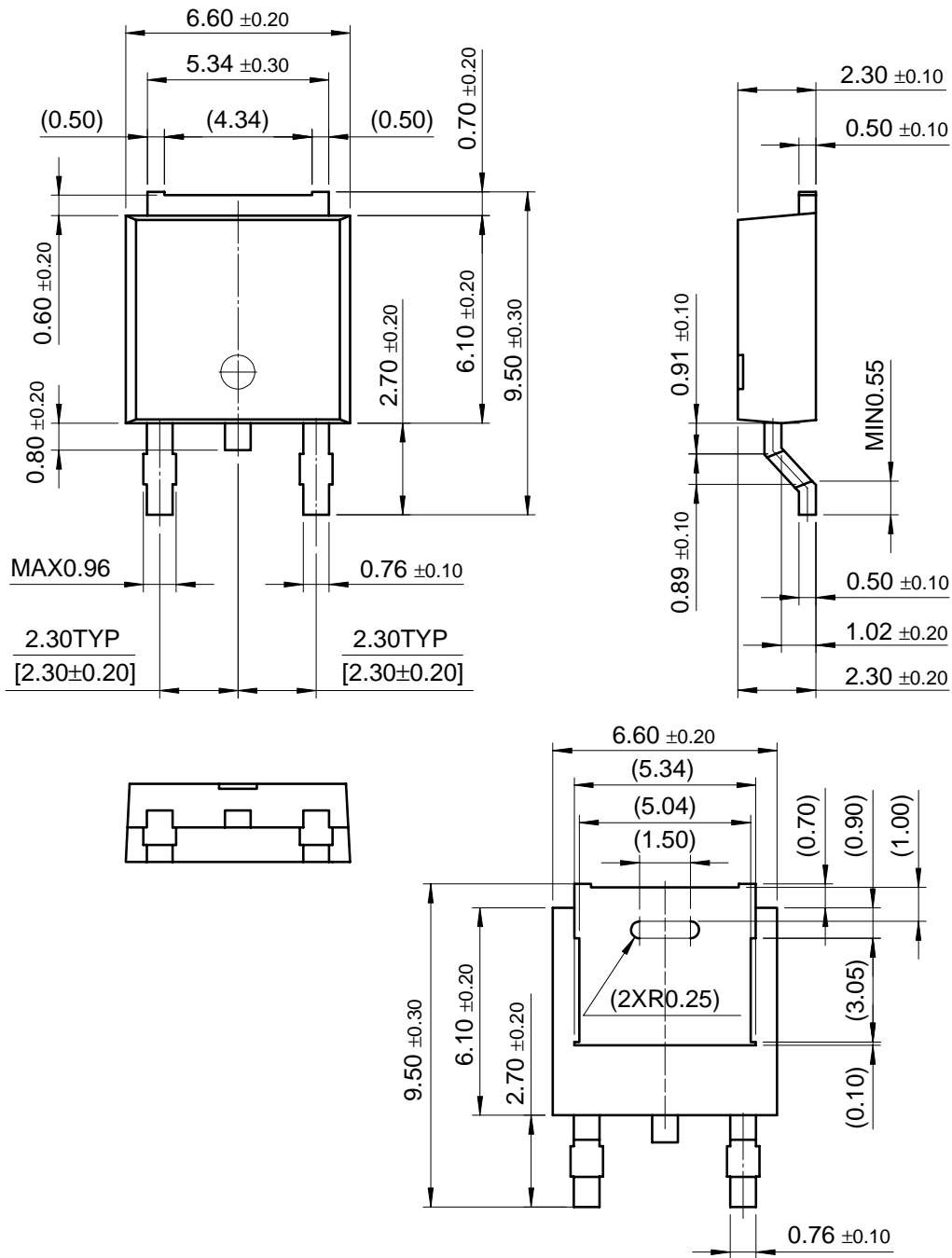


Peak Diode Recovery dv/dt Test Circuit & Waveforms



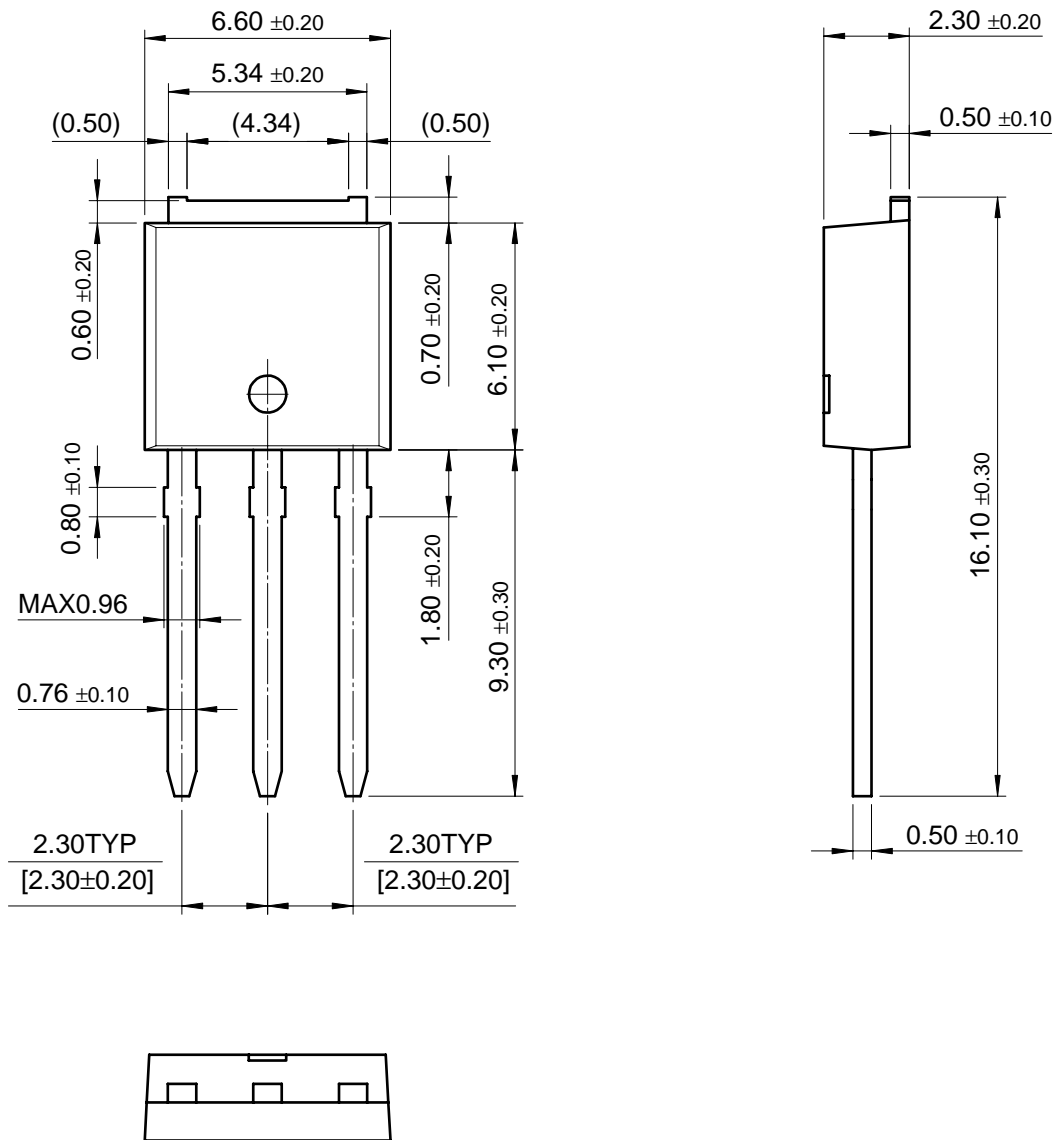
Package Dimensions

DPAK



Package Dimensions (Continued)

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