

## FQB1N60 / FQI1N60

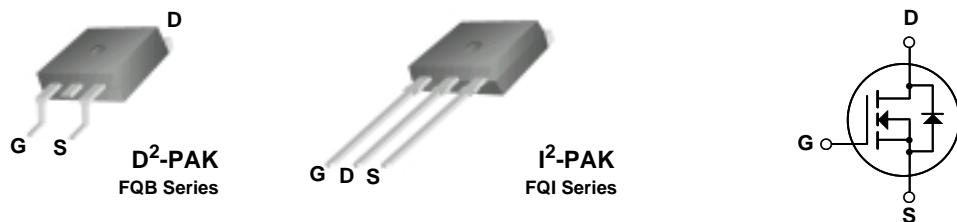
### 600V N-Channel MOSFET

#### 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.

#### Features

- 1.2A, 600V,  $R_{DS(on)} = 11.5\Omega$  @  $V_{GS} = 10\text{ V}$
- Low gate charge ( typical 5.0 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	FQB1N60 / FQI1N60	Units
$V_{DSS}$	Drain-Source Voltage	600	V
$I_D$	Drain Current - Continuous ( $T_C = 25^\circ\text{C}$ )	1.2	A
	- Continuous ( $T_C = 100^\circ\text{C}$ )	0.76	A
$I_{DM}$	Drain Current - Pulsed	(Note 1)	A
$V_{GSS}$	Gate-Source Voltage	$\pm 30$	V
$E_{AS}$	Single Pulsed Avalanche Energy	(Note 2)	mJ
$I_{AR}$	Avalanche Current	(Note 1)	A
$E_{AR}$	Repetitive Avalanche Energy	(Note 1)	mJ
$dv/dt$	Peak Diode Recovery $dv/dt$	(Note 3)	V/ns
$P_D$	Power Dissipation ( $T_A = 25^\circ\text{C}$ ) *	3.13	W
	Power Dissipation ( $T_C = 25^\circ\text{C}$ )	40	W
	- Derate above $25^\circ\text{C}$	0.32	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	--	3.13	$^\circ\text{C}/\text{W}$
$R_{\theta JA}$	Thermal Resistance, Junction-to-Ambient *	--	40	$^\circ\text{C}/\text{W}$
$R_{\theta JA}$	Thermal Resistance, Junction-to-Ambient	--	62.5	$^\circ\text{C}/\text{W}$

\* 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	$V_{GS} = 0 \text{ V}$ , $I_D = 250 \mu\text{A}$	600	--	--	V
$\Delta BV_{DSS} / \Delta T_J$	Breakdown Voltage Temperature Coefficient	$I_D = 250 \mu\text{A}$ , Referenced to $25^\circ\text{C}$	--	0.4	--	$\text{V}/^\circ\text{C}$
$I_{DSS}$	Zero Gate Voltage Drain Current	$V_{DS} = 600 \text{ V}$ , $V_{GS} = 0 \text{ V}$	--	--	10	$\mu\text{A}$
		$V_{DS} = 480 \text{ V}$ , $T_C = 125^\circ\text{C}$	--	--	100	$\mu\text{A}$
$I_{GSSF}$	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>						
$V_{GS(\text{th})}$	Gate Threshold Voltage	$V_{DS} = V_{GS}$ , $I_D = 250 \mu\text{A}$	3.0	--	5.0	V
$R_{DS(\text{on})}$	Static Drain-Source On-Resistance	$V_{GS} = 10 \text{ V}$ , $I_D = 0.6 \text{ A}$	--	9.3	11.5	$\Omega$
$g_{FS}$	Forward Transconductance	$V_{DS} = 50 \text{ V}$ , $I_D = 0.6 \text{ A}$ (Note 4)	--	0.9	--	S
<b>Dynamic Characteristics</b>						
$C_{iss}$	Input Capacitance	$V_{DS} = 25 \text{ V}$ , $V_{GS} = 0 \text{ V}$ , $f = 1.0 \text{ MHz}$	--	120	150	pF
$C_{oss}$	Output Capacitance		--	20	25	pF
$C_{rss}$	Reverse Transfer Capacitance		--	3	4	pF
<b>Switching Characteristics</b>						
$t_{d(\text{on})}$	Turn-On Delay Time	$V_{DD} = 300 \text{ V}$ , $I_D = 1.2 \text{ A}$ , $R_G = 25 \Omega$	--	5	20	ns
$t_r$	Turn-On Rise Time		--	25	60	ns
$t_{d(\text{off})}$	Turn-Off Delay Time		--	7	25	ns
$t_f$	Turn-Off Fall Time		--	25	60	ns
$Q_g$	Total Gate Charge	$V_{DS} = 480 \text{ V}$ , $I_D = 1.2 \text{ A}$ , $V_{GS} = 10 \text{ V}$	--	5	6	nC
$Q_{gs}$	Gate-Source Charge		--	1	--	nC
$Q_{gd}$	Gate-Drain Charge		--	2.6	--	$\mu\text{C}$
<b>Drain-Source Diode Characteristics and Maximum Ratings</b>						
$I_S$	Maximum Continuous Drain-Source Diode Forward Current	--	--	1.2	A	
$I_{SM}$	Maximum Pulsed Drain-Source Diode Forward Current	--	--	4.8	A	
$V_{SD}$	Drain-Source Diode Forward Voltage	$V_{GS} = 0 \text{ V}$ , $I_S = 1.2 \text{ A}$	--	--	1.4	V
$t_{rr}$	Reverse Recovery Time	$V_{GS} = 0 \text{ V}$ , $I_S = 1.2 \text{ A}$ , $dI_F / dt = 100 \text{ A}/\mu\text{s}$	--	160	--	ns
$Q_{rr}$	Reverse Recovery Charge		--	0.3	--	$\mu\text{C}$

**Notes:**

1. Repetitive Rating : Pulse width limited by maximum junction temperature
2.  $L = 64\text{mH}$ ,  $I_{AS} = 1.2\text{A}$ ,  $V_{DD} = 50\text{V}$ ,  $R_G = 25 \Omega$ , Starting  $T_J = 25^\circ\text{C}$
3.  $I_{SD} \leq 1.2\text{A}$ ,  $dI/dt \leq 200\text{A}/\mu\text{s}$ ,  $V_{DD} \leq BV_{DSS}$ , 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

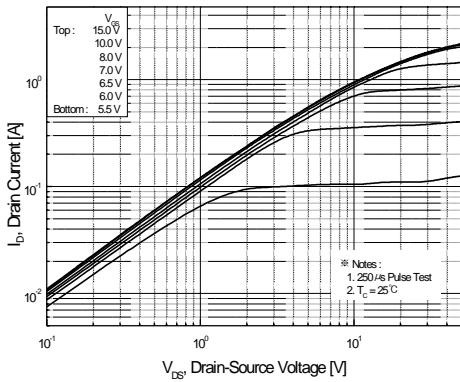


Figure 1. On-Region Characteristics

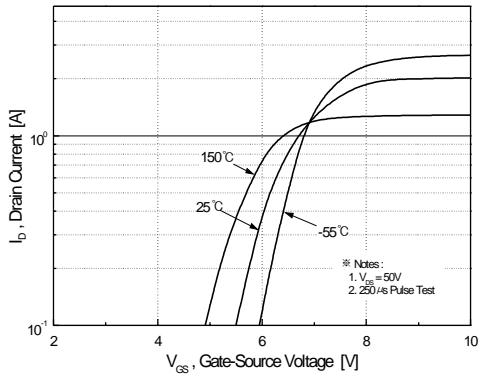


Figure 2. Transfer Characteristics

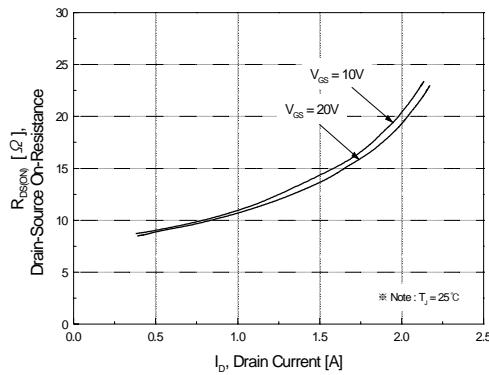


Figure 3. On-Resistance Variation vs.  
Drain Current and Gate Voltage

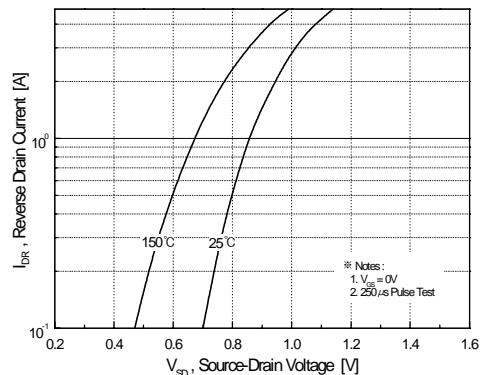


Figure 4. Body Diode Forward Voltage  
Variation vs. Source Current  
and Temperature

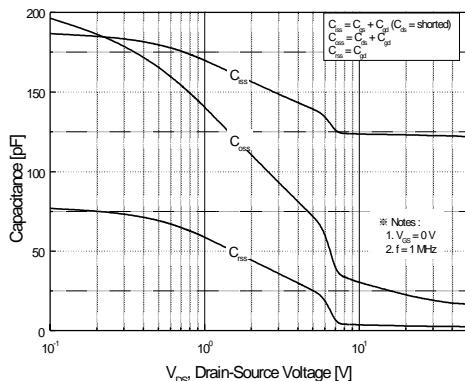


Figure 5. Capacitance Characteristics

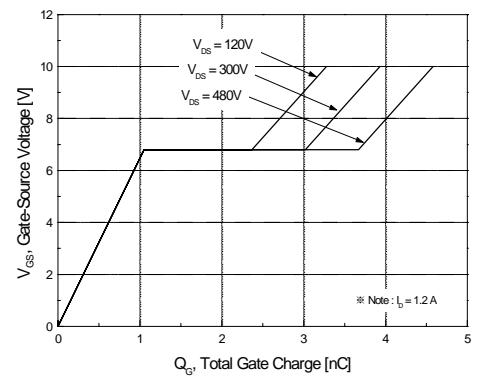
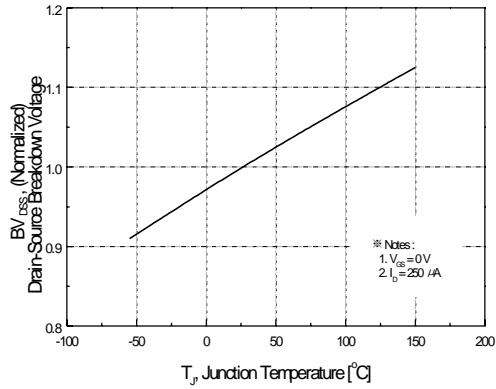
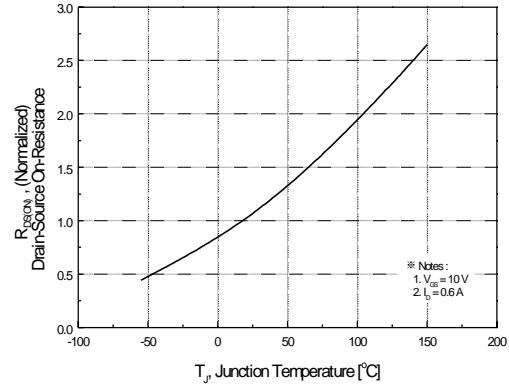


Figure 6. Gate Charge Characteristics

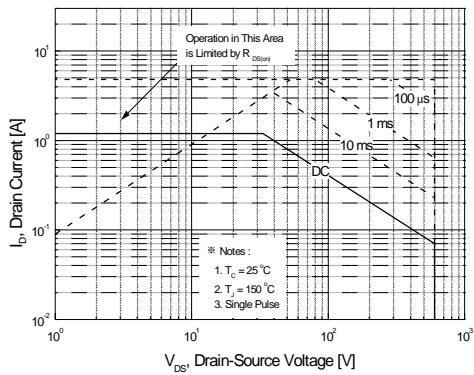
## Typical Characteristics (Continued)



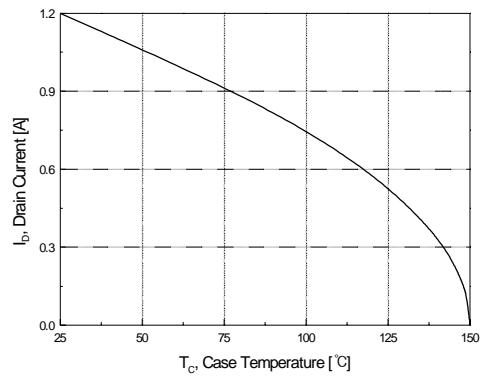
**Figure 7. Breakdown Voltage Variation vs. Temperature**



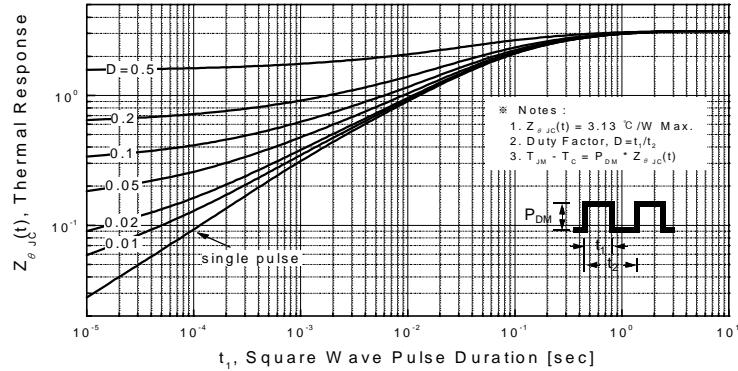
**Figure 8. On-Resistance Variation vs. Temperature**



**Figure 9. Maximum Safe Operating Area**

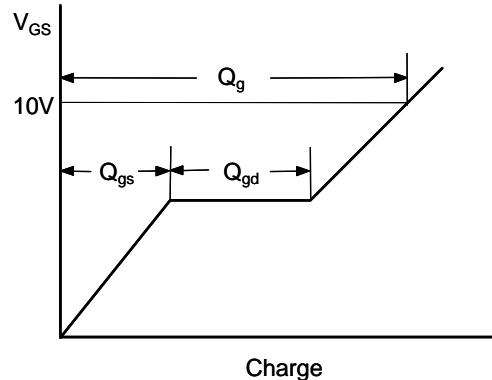
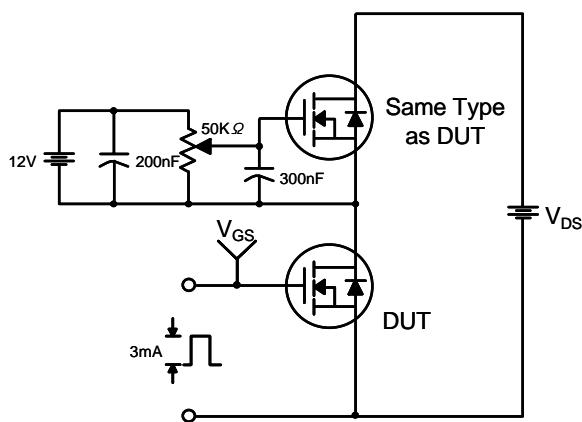


**Figure 10. Maximum Drain Current vs. Case Temperature**

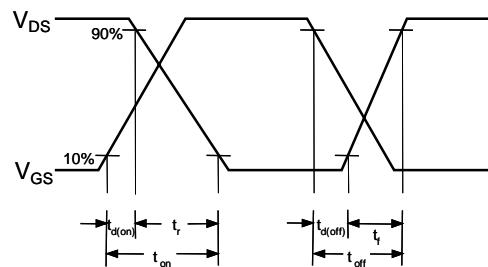
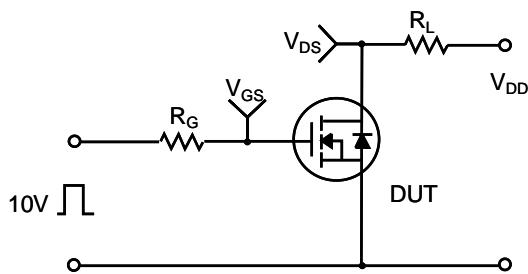


**Figure 11. Transient Thermal Response Curve**

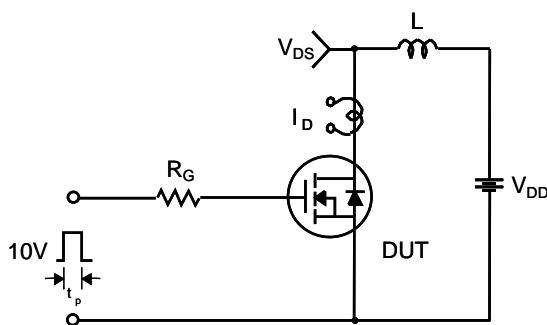
## Gate Charge Test Circuit & Waveform



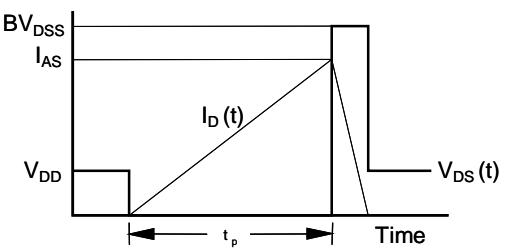
## Resistive Switching Test Circuit & Waveforms



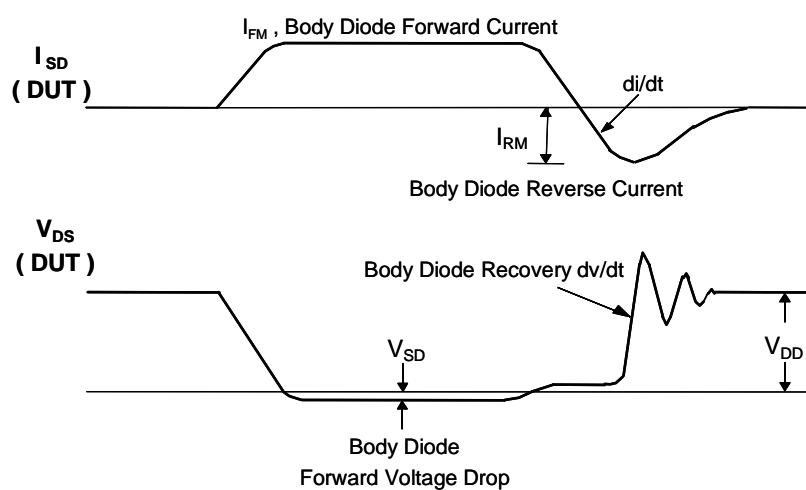
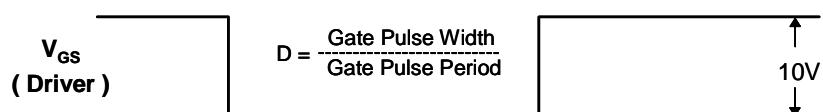
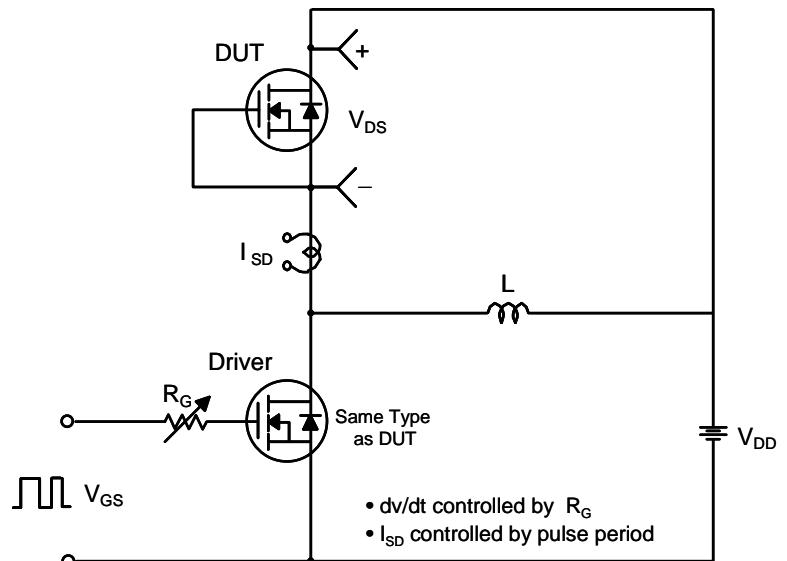
## Unclamped Inductive Switching Test Circuit & Waveforms



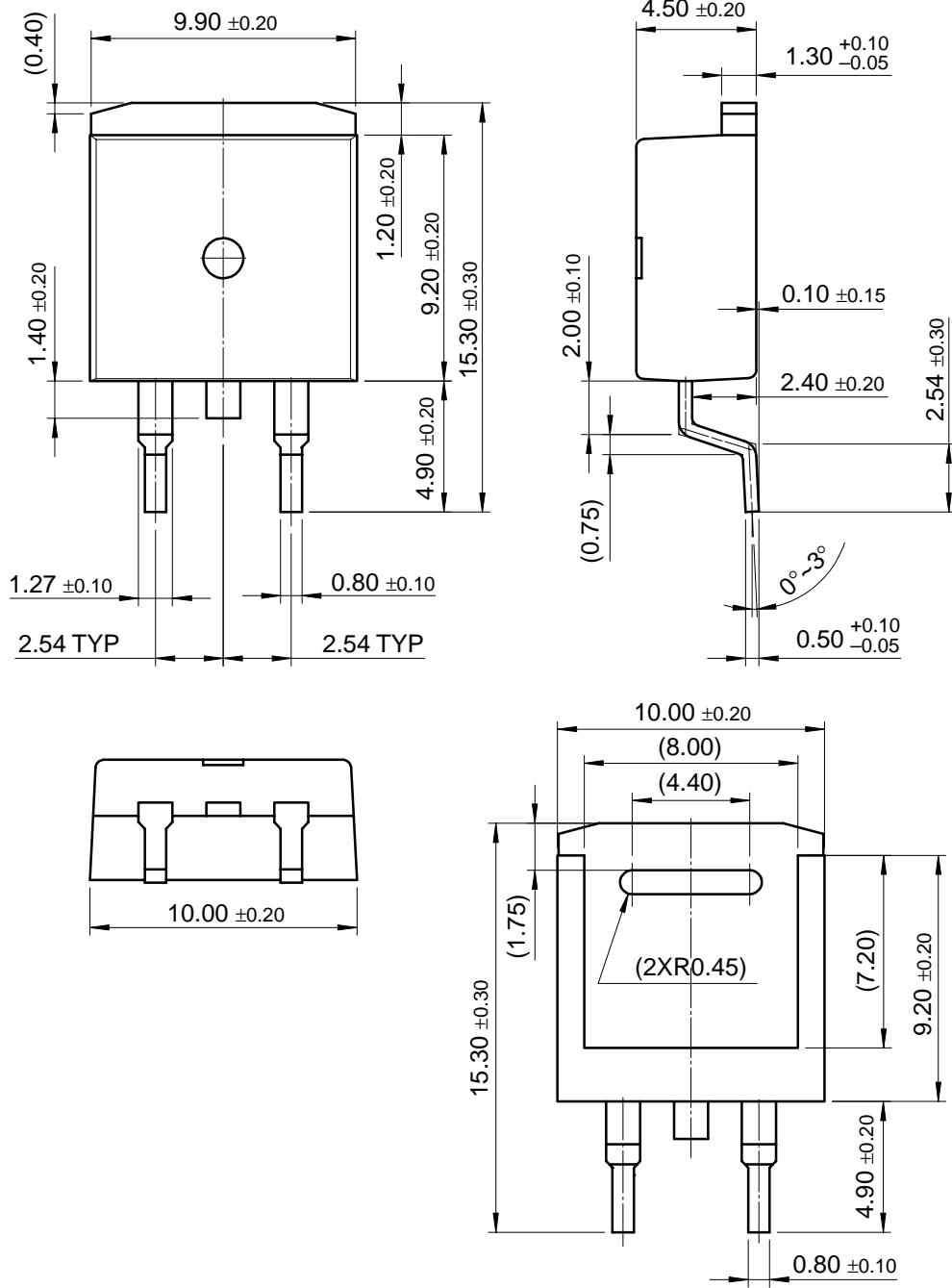
$$E_{AS} = \frac{1}{2} L I_{AS}^2 \frac{BV_{DSS}}{BV_{DSS} - V_{DD}}$$



Peak Diode Recovery dv/dt Test Circuit & Waveforms

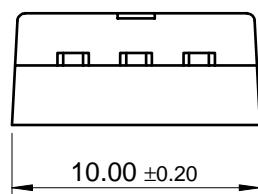
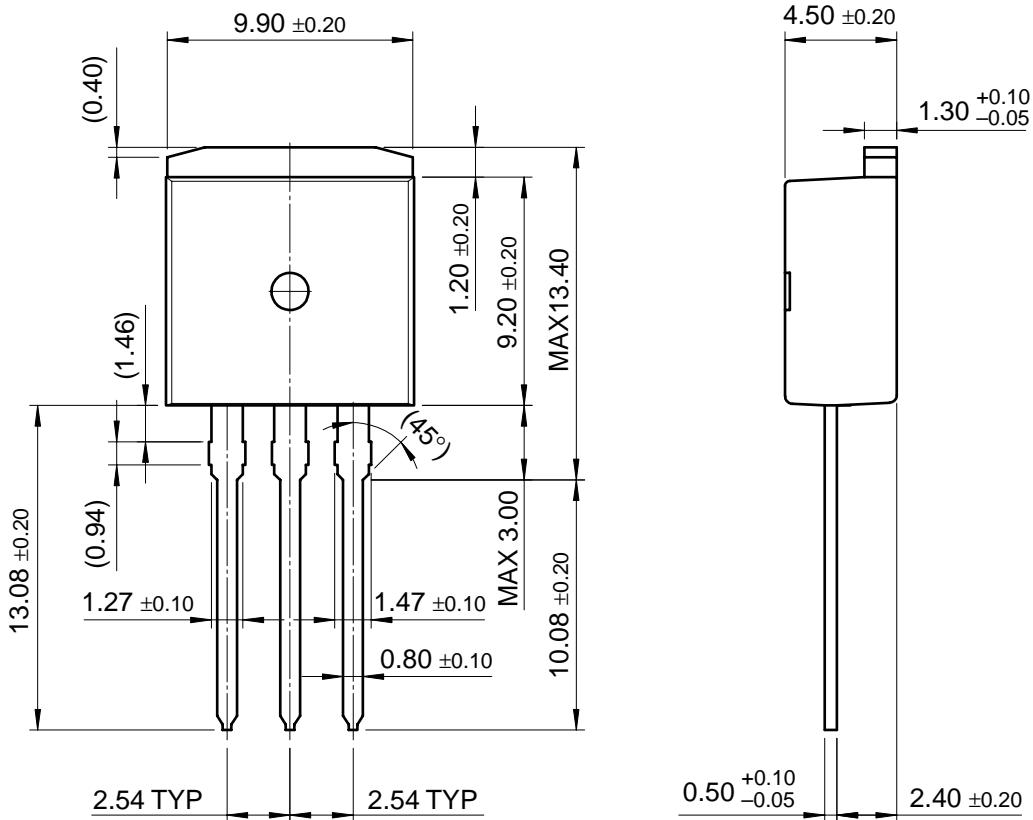


## Package Dimensions

D<sup>2</sup>PAK

**Package Dimensions** (Continued)

**I<sup>2</sup>PAK**



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