

## FQD20N06LE / FQU20N06LE

### 60V LOGIC N-Channel MOSFET

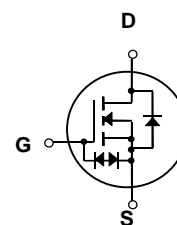
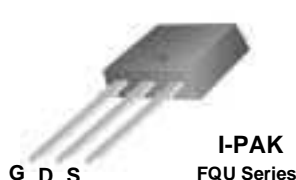
#### General Description

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 low voltage applications such as automotive, DC/DC converters, and high efficiency switching for power management in portable and battery operated products.

#### Features

- 17.2A, 60V,  $R_{DS(on)} = 0.06\Omega @ V_{GS} = 10V$
- Low gate charge ( typical 9.5 nC)
- Low  $C_{rss}$  ( typical 35 pF)
- Fast switching
- 100% avalanche tested
- Improved dv/dt capability
- 150°C maximum junction temperature rating
- Low level gate drive requirements allowing direct operation from logic drivers
- Built-in ESD Protection Diode



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

Symbol	Parameter	FQD20N06LE / FQU20N06LE	Units
V <sub>DSS</sub>	Drain-Source Voltage	60	V
I <sub>D</sub>	Drain Current - Continuous (T <sub>C</sub> = 25°C) - Continuous (T <sub>C</sub> = 100°C)	17.2	A
		10.9	A
I <sub>DM</sub>	Drain Current - Pulsed (Note 1)	68.8	A
V <sub>GSS</sub>	Gate-Source Voltage	± 20	V
E <sub>AS</sub>	Single Pulsed Avalanche Energy (Note 2)	170	mJ
I <sub>AR</sub>	Avalanche Current (Note 1)	17.2	A
E <sub>AR</sub>	Repetitive Avalanche Energy (Note 1)	3.8	mJ
dv/dt	Peak Diode Recovery dv/dt (Note 3)	7.0	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) - Derate above 25°C	38	W
		0.30	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	--	3.28	°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

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

Symbol	Parameter	Test Conditions	Min	Typ	Max	Units
<b>Off Characteristics</b>						
$BV_{DSS}$	Drain-Source Breakdown Voltage	$V_{GS} = 0\text{ V}, I_D = 250\ \mu\text{A}$	60	--	--	V
$\Delta BV_{DSS} / \Delta T_J$	Breakdown Voltage Temperature Coefficient	$I_D = 250\ \mu\text{A}$ , Referenced to $25^\circ\text{C}$	--	0.06	--	V/ $^\circ\text{C}$
$I_{DSS}$	Zero Gate Voltage Drain Current	$V_{DS} = 60\text{ V}, V_{GS} = 0\text{ V}$	--	--	1	$\mu\text{A}$
		$V_{DS} = 48\text{ V}, T_C = 125^\circ\text{C}$	--	--	10	$\mu\text{A}$
$I_{GSSF}$	Gate-Body Leakage Current, Forward	$V_{GS} = 20\text{ V}, V_{DS} = 0\text{ V}$	--	--	10	$\mu\text{A}$
$I_{GSSR}$	Gate-Body Leakage Current, Reverse	$V_{GS} = -20\text{ V}, V_{DS} = 0\text{ V}$	--	--	-10	$\mu\text{A}$

### On Characteristics

$V_{GS(th)}$	Gate Threshold Voltage	$V_{DS} = V_{GS}, I_D = 250\ \mu\text{A}$	1.0	--	2.5	V
$R_{DS(on)}$	Static Drain-Source On-Resistance	$V_{GS} = 10\text{ V}, I_D = 8.6\text{ A}$	--	0.046	0.06	$\Omega$
		$V_{GS} = 5\text{ V}, I_D = 8.6\text{ A}$	--	0.057	0.075	$\Omega$
$g_{FS}$	Forward Transconductance	$V_{DS} = 25\text{ V}, I_D = 8.6\text{ A}$ (Note 4)	--	11	--	S

### Dynamic Characteristics

$C_{iss}$	Input Capacitance	$V_{DS} = 25\text{ V}, V_{GS} = 0\text{ V},$ $f = 1.0\text{ MHz}$	--	506	665	pF
$C_{oss}$	Output Capacitance		--	175	230	pF
$C_{rss}$	Reverse Transfer Capacitance		--	35	45	pF

### Switching Characteristics

$t_{d(on)}$	Turn-On Delay Time	$V_{DD} = 30\text{ V}, I_D = 10.5\text{ A},$ $R_G = 25\ \Omega$	--	13	39	ns
$t_r$	Turn-On Rise Time		--	220	453	ns
$t_{d(off)}$	Turn-Off Delay Time		--	45	103	ns
$t_f$	Turn-Off Fall Time		(Note 4, 5)	--	100	214
$Q_g$	Total Gate Charge	$V_{DS} = 48\text{ V}, I_D = 21\text{ A},$ $V_{GS} = 5\text{ V}$	--	9.5	13	nC
$Q_{gs}$	Gate-Source Charge		--	2.5	--	nC
$Q_{gd}$	Gate-Drain Charge		(Note 4, 5)	--	5.5	--

### Drain-Source Diode Characteristics and Maximum Ratings

$I_S$	Maximum Continuous Drain-Source Diode Forward Current	--	--	17.2	A	
$I_{SM}$	Maximum Pulsed Drain-Source Diode Forward Current	--	--	68.8	A	
$V_{SD}$	Drain-Source Diode Forward Voltage	$V_{GS} = 0\text{ V}, I_S = 17.2\text{ A}$	--	--	1.5	V
$t_{rr}$	Reverse Recovery Time	$V_{GS} = 0\text{ V}, I_F = 21\text{ A},$	--	64	--	ns
$Q_{rr}$	Reverse Recovery Charge	$di_F / dt = 100\text{ A}/\mu\text{s}$ (Note 4)	--	105	--	nC

#### Notes:

1. Repetitive Rating : Pulse width limited by maximum junction temperature
2.  $L = 670\ \mu\text{H}, I_{AS} = 17.2\text{ A}, V_{DD} = 25\text{ V}, R_G = 25\ \Omega$ , Starting  $T_J = 25^\circ\text{C}$
3.  $I_{SD} \leq 21\text{ A}, di/dt \leq 300\text{ A}/\mu\text{s}, V_{DD} \leq BV_{DSS}$ , 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

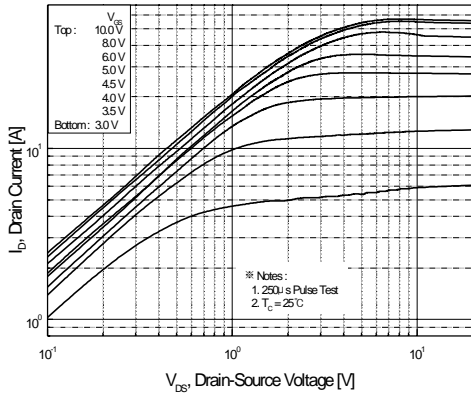


Figure 1. On-Region Characteristics

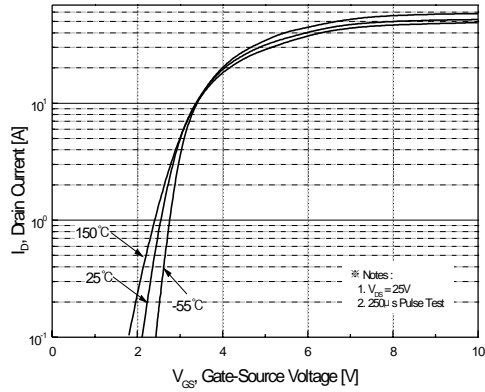


Figure 2. Transfer Characteristics

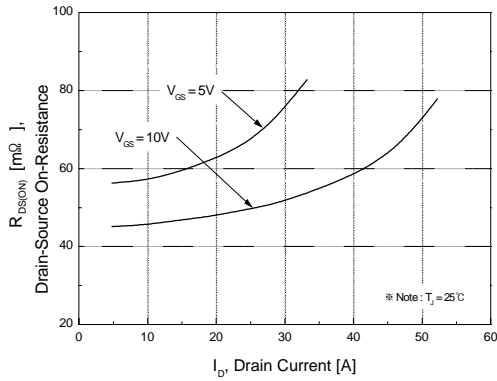


Figure 3. On-Resistance Variation vs. Drain Current and Gate Voltage

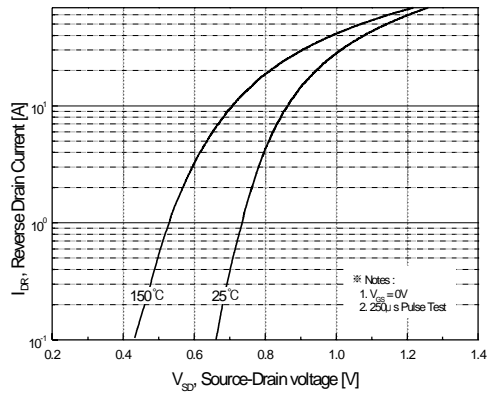


Figure 4. Body Diode Forward Voltage Variation vs. Source Current and Temperature

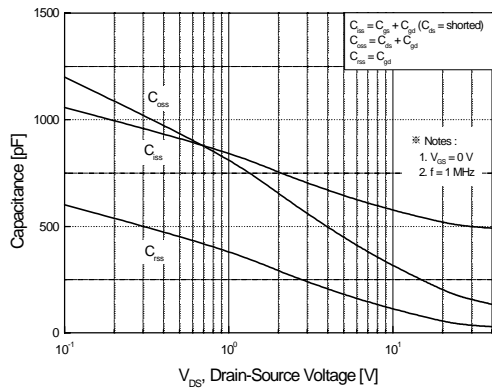


Figure 5. Capacitance Characteristics

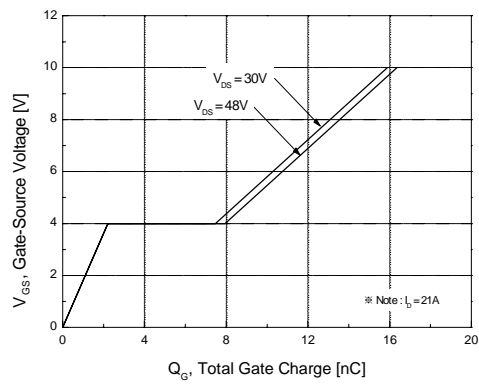
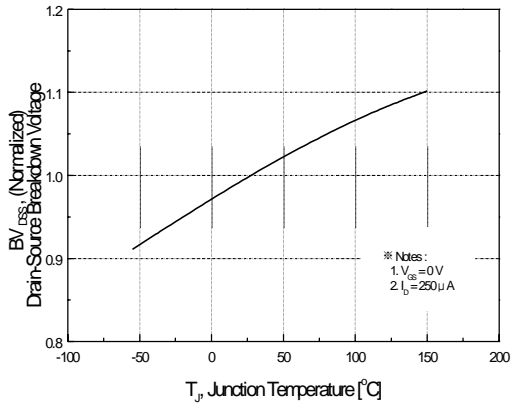
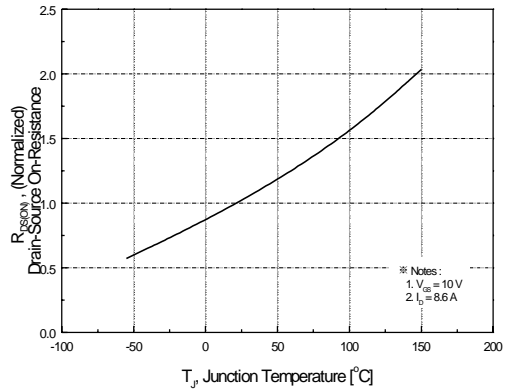


Figure 6. Gate Charge Characteristics

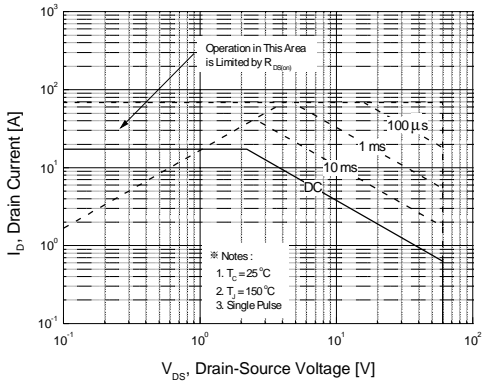
**Typical Characteristics** (Continued)



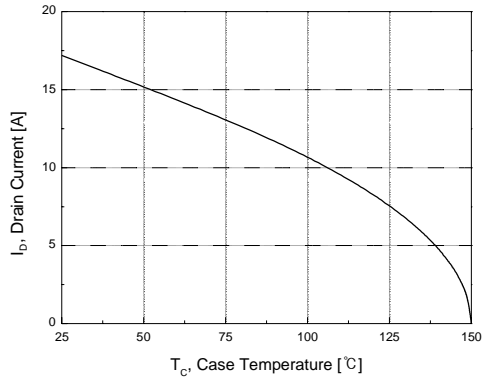
**Figure 7. Breakdown Voltage Variation vs. Temperature**



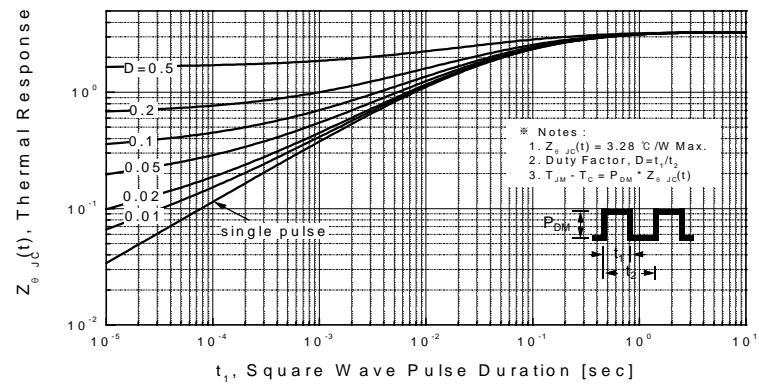
**Figure 8. On-Resistance Variation vs. Temperature**



**Figure 9. Maximum Safe Operating Area**

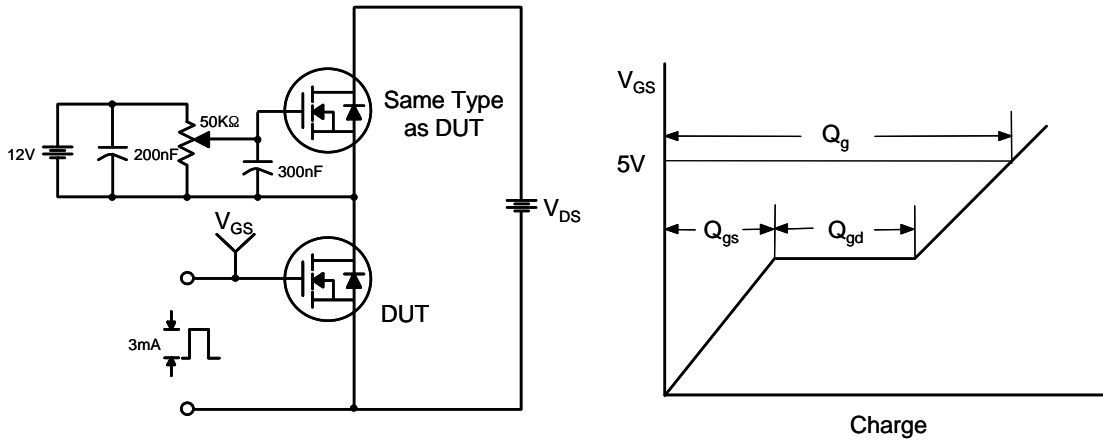


**Figure 10. Maximum Drain Current vs. Case Temperature**

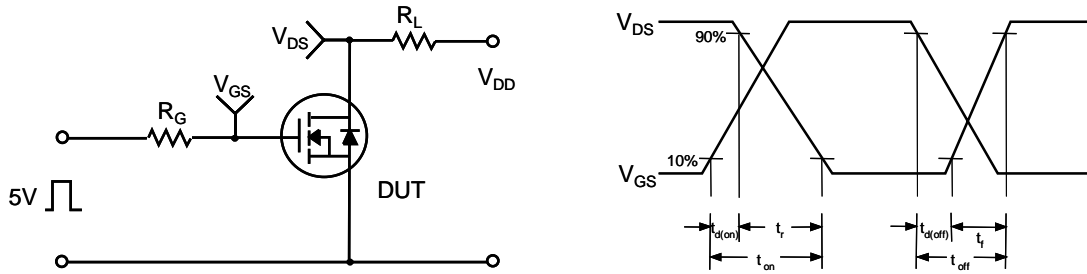


**Figure 11. Transient Thermal Response Curve**

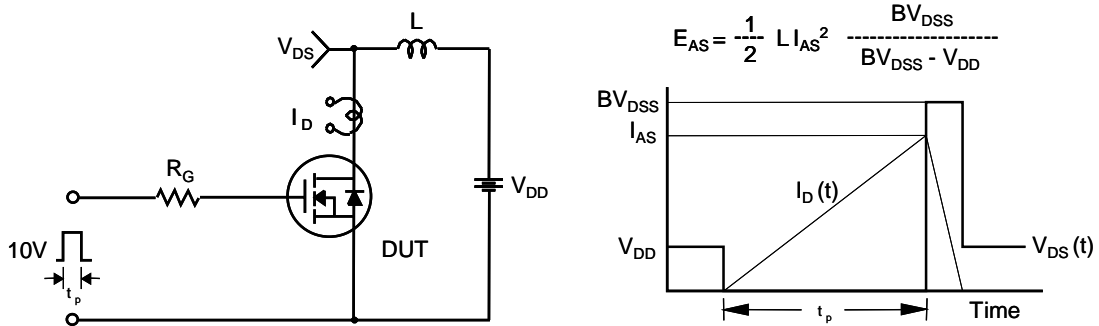
**Gate Charge Test Circuit & Waveform**



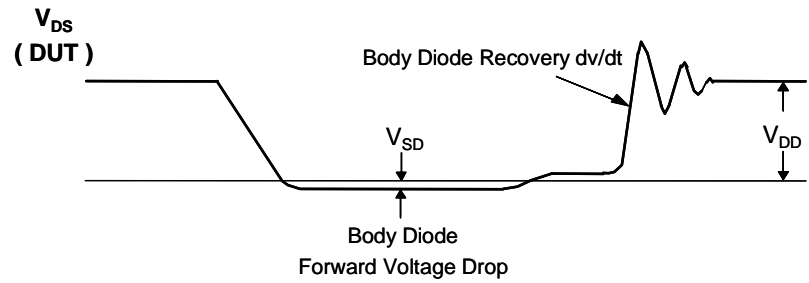
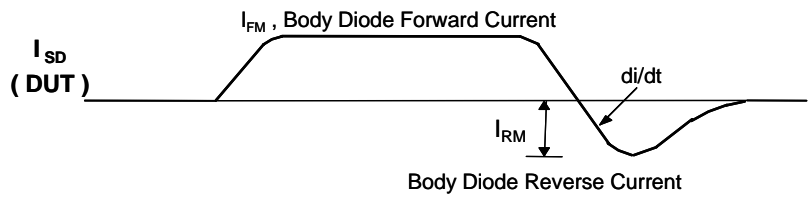
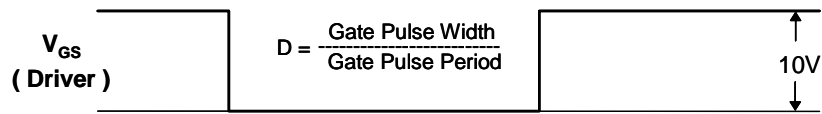
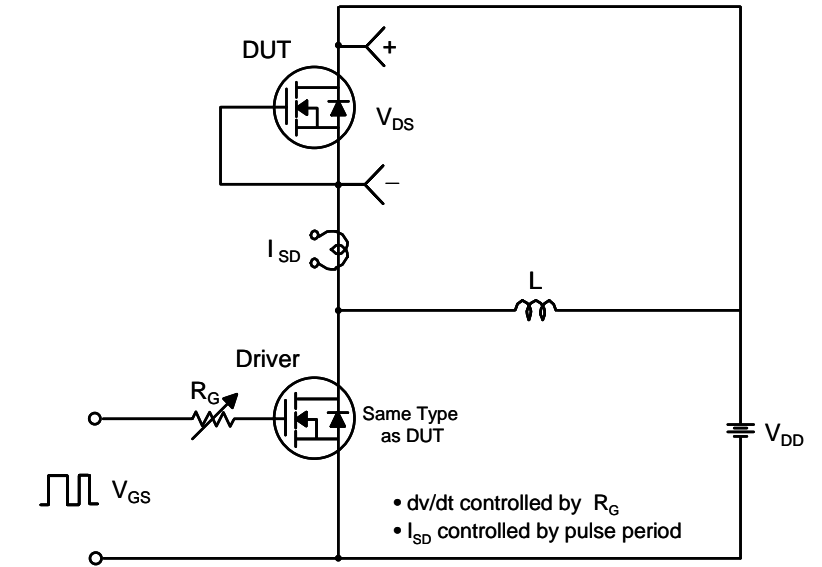
**Resistive Switching Test Circuit & Waveforms**



**Unclamped Inductive Switching Test Circuit & Waveforms**

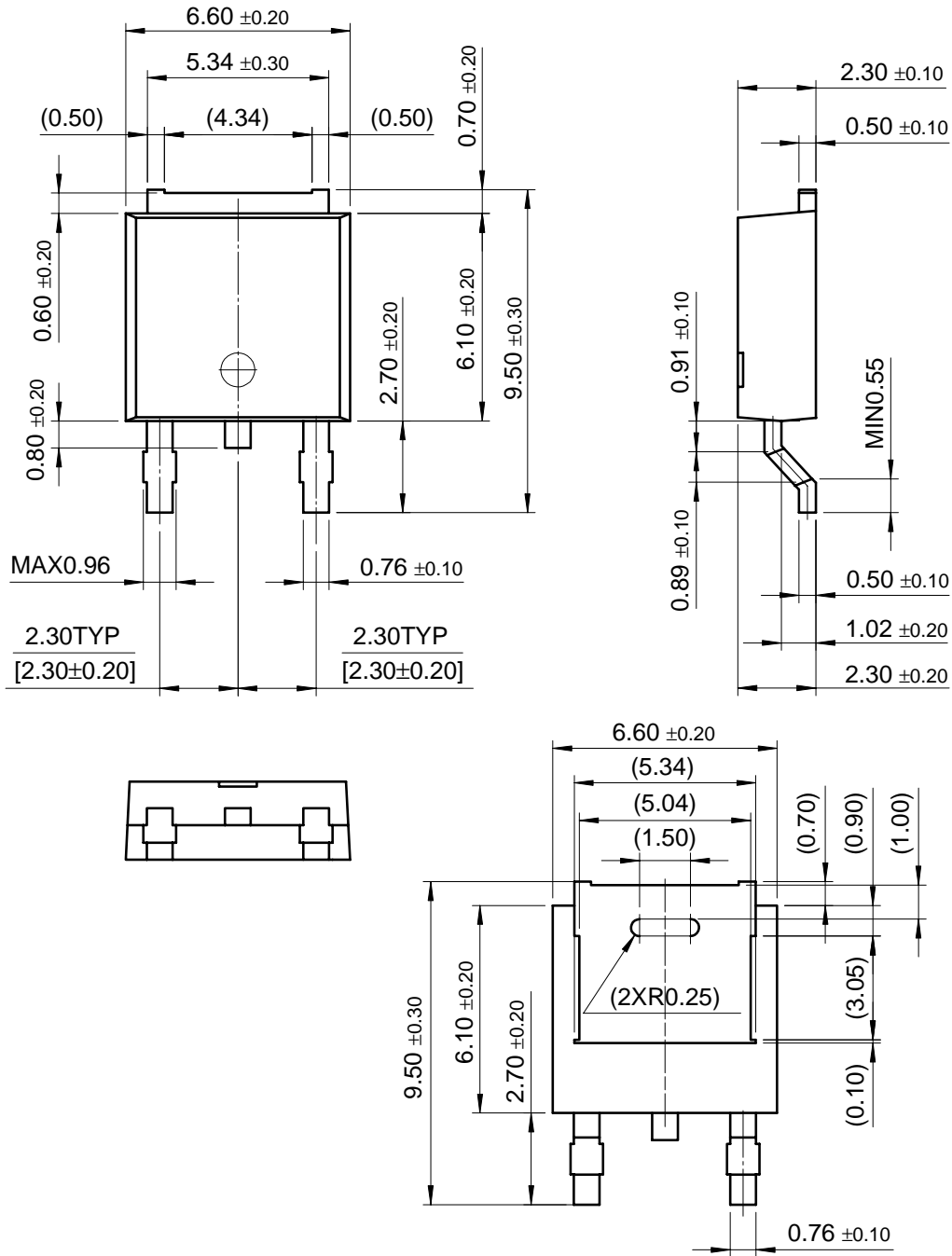


Peak Diode Recovery dv/dt Test Circuit & Waveforms



Package Dimensions

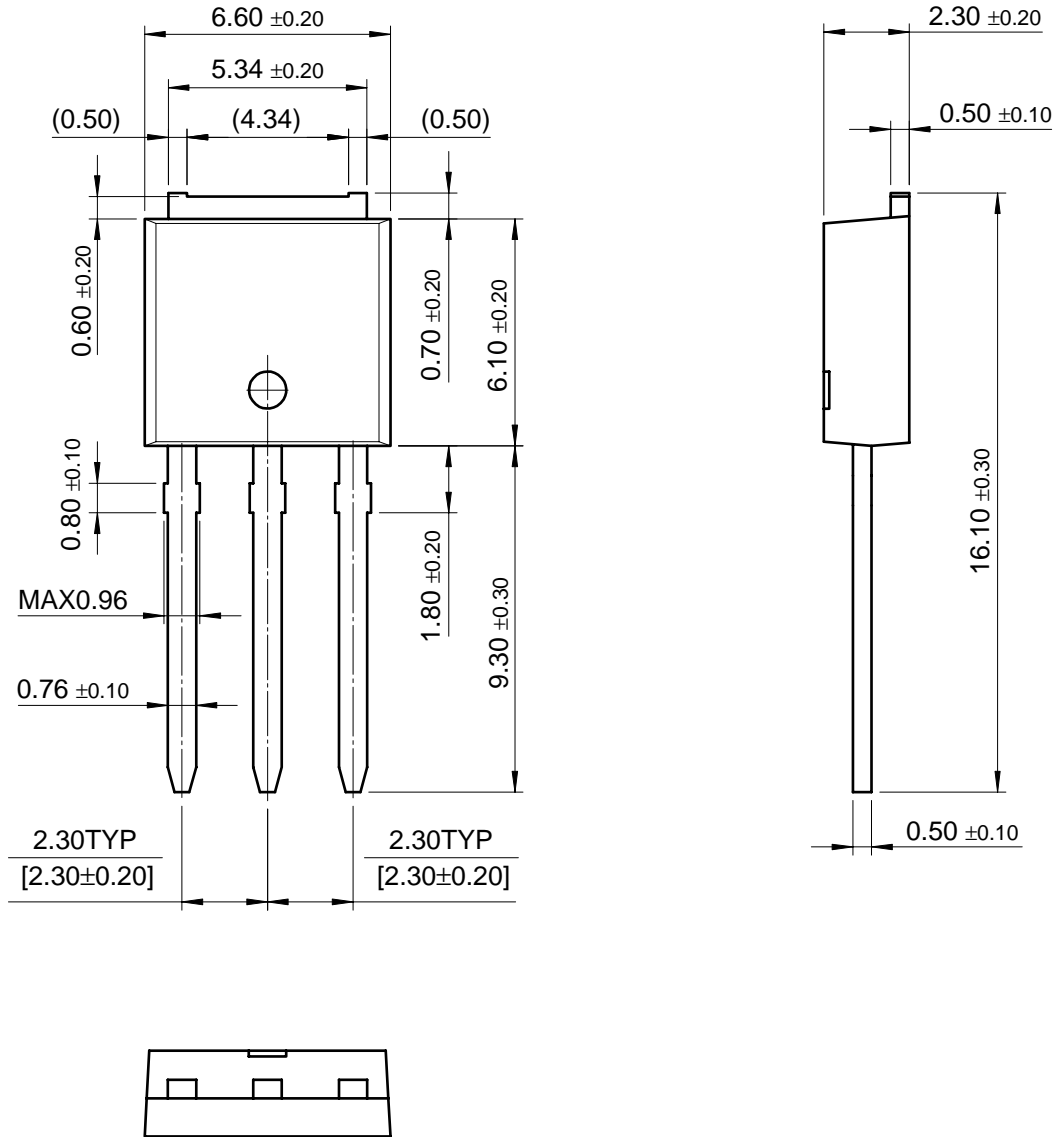
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Package Dimensions (Continued)

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