

# FCP190N60E / FCPF190N60E

## 600V N-Channel MOSFET

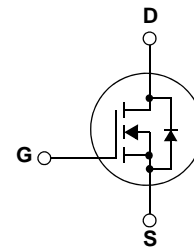
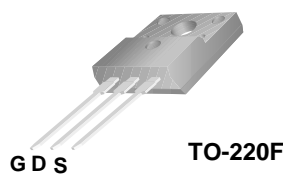
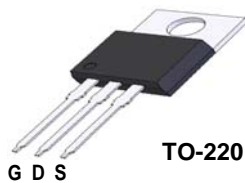
### Features

- 650V @ $T_J = 150^\circ\text{C}$
- Max.  $R_{DS(on)} = 190\text{m}\Omega$
- Ultra Low Gate Charge (Typ.  $Q_g = 63\text{nC}$ )
- Low Effective Output Capacitance (Typ.  $C_{oss,eff} = 178\text{pF}$ )
- 100% Avalanche Tested

### Description

SuperFET®II is, Fairchild's proprietary, new generation of high voltage MOSFET family that is utilizing an advanced charge balance mechanism for outstanding low on-resistance and lower gate charge performance.

This advanced technology has been tailored to minimize conduction loss, provide superior switching performance, and withstand extreme  $dv/dt$  rate and higher avalanche energy. Consequently, SuperFET®II is very suitable for various AC/DC power conversion in switching mode operation for system miniaturization and higher efficiency.



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

Symbol	Parameter	FCP190N60E	FCPF190N60E	Units
$V_{DSS}$	Drain to Source Voltage	600		V
$V_{GSS}$	Gate to Source Voltage	- DC	$\pm 20$	V
		- AC ( $f > 1\text{Hz}$ )	$\pm 30$	V
$I_D$	Drain Current	-Continuous ( $T_C = 25^\circ\text{C}$ )	20.6	20.6*
		-Continuous ( $T_C = 100^\circ\text{C}$ )	13.1	13.1*
$I_{DM}$	Drain Current	- Pulsed (Note 1)	61.8	61.8*
$E_{AS}$	Single Pulsed Avalanche Energy (Note 2)	400		mJ
$I_{AR}$	Avalanche Current (Note 1)	4.0		A
$E_{AR}$	Repetitive Avalanche Energy (Note 1)	2.1		mJ
$dv/dt$	Peak Diode Recovery $dv/dt$ (Note 3)	20		V/ns
	MOSFET $dv/dt$	100		
$P_D$	Power Dissipation	( $T_C = 25^\circ\text{C}$ )	208	39
		- Derate above $25^\circ\text{C}$	1.67	0.31
$T_J, T_{STG}$	Operating and Storage Temperature Range	-55 to +150		$^\circ\text{C}$
$T_L$	Maximum Lead Temperature for Soldering Purpose, 1/8" from Case for 5 Seconds	300		$^\circ\text{C}$

\*Drain current limited by maximum junction temperature

### Thermal Characteristics

Symbol	Parameter	FCP190N60E	FCPF190N60E	Units
$R_{\theta JC}$	Thermal Resistance, Junction to Case	0.6	3.2	$^\circ\text{C/W}$
$R_{\theta CS}$	Thermal Resistance, Case to Heat Sink (Typical)	0.5	0.5	
$R_{\theta JA}$	Thermal Resistance, Junction to Ambient	62.5	62.5	

## Package Marking and Ordering Information

Device Marking	Device	Package	Reel Size	Tape Width	Quantity
FCP190N60E	FCP190N60E	TO-220	-	-	50
FCPF190N60E	FCPF190N60E	TO-220F	-	-	50

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

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Units
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### Off Characteristics

$BV_{DSS}$	Drain to Source Breakdown Voltage	$V_{GS} = 0V, I_D = 10mA, T_J = 25^\circ\text{C}$	600	-	-	V
		$V_{GS} = 0V, I_D = 10mA, T_J = 150^\circ\text{C}$	650	-	-	V
$\frac{\Delta BV_{DSS}}{\Delta T_J}$	Breakdown Voltage Temperature Coefficient	$I_D = 10mA$ , Referenced to $25^\circ\text{C}$	-	0.67	-	$V/^\circ\text{C}$
$BV_{DS}$	Drain-Source Avalanche Breakdown Voltage	$V_{GS} = 0V, I_D = 20A$	-	700	-	V
$I_{DSS}$	Zero Gate Voltage Drain Current	$V_{DS} = 480V, V_{GS} = 0V$	-	-	1	$\mu\text{A}$
		$V_{DS} = 480V, T_C = 125^\circ\text{C}$	-	-	10	$\mu\text{A}$
$I_{GSS}$	Gate to Body Leakage Current	$V_{GS} = \pm 20V, V_{DS} = 0V$	-	-	$\pm 100$	nA

### On Characteristics

$V_{GS(th)}$	Gate Threshold Voltage	$V_{GS} = V_{DS}, I_D = 250\mu\text{A}$	2.5	-	3.5	V
$R_{DS(on)}$	Static Drain to Source On Resistance	$V_{GS} = 10V, I_D = 10A$	-	0.16	0.19	$\Omega$
$g_{FS}$	Forward Transconductance	$V_{DS} = 20V, I_D = 10A$	-	20	-	S

### Dynamic Characteristics

$C_{iss}$	Input Capacitance	$V_{DS} = 25V, V_{GS} = 0V$ $f = 1\text{MHz}$	-	2385	3175	pF
$C_{oss}$	Output Capacitance		-	1795	2396	pF
$C_{rss}$	Reverse Transfer Capacitance		-	110	165	pF
$C_{oss}$	Output Capacitance	$V_{DS} = 380V, V_{GS} = 0V, f = 1.0\text{MHz}$	-	42	-	pF
$C_{oss \text{ eff.}}$	Effective Output Capacitance	$V_{DS} = 0V \text{ to } 480V, V_{GS} = 0V$	-	178	-	pF
$Q_{g(tot)}$	Total Gate Charge at 10V	$V_{DS} = 380V, I_D = 10A$ $V_{GS} = 10V$	-	63	82	nC
$Q_{gs}$	Gate to Source Gate Charge		-	10	-	nC
$Q_{gd}$	Gate to Drain "Miller" Charge		(Note 4)	-	24	-
ESR	Equivalent Series Resistance	Drain open	-	5	-	$\Omega$

### Switching Characteristics

$t_{d(on)}$	Turn-On Delay Time	$V_{DD} = 380V, I_D = 10A$ $V_{GS} = 10V, R_G = 4.7\Omega$	-	23	56	ns
$t_r$	Turn-On Rise Time		-	14	38	ns
$t_{d(off)}$	Turn-Off Delay Time		-	101	212	ns
$t_f$	Turn-Off Fall Time		(Note 4)	-	15	40

### Drain-Source Diode Characteristics

$I_S$	Maximum Continuous Drain to Source Diode Forward Current	-	-	20.6	A	
$I_{SM}$	Maximum Pulsed Drain to Source Diode Forward Current	-	-	61.8	A	
$V_{SD}$	Drain to Source Diode Forward Voltage	$V_{GS} = 0V, I_{SD} = 10A$	-	-	1.2	V
$t_{rr}$	Reverse Recovery Time	$V_{GS} = 0V, I_{SD} = 10A$	-	308	-	ns
$Q_{rr}$	Reverse Recovery Charge	$di_F/dt = 100A/\mu\text{s}$	-	4.8	-	$\mu\text{C}$

#### Notes:

1. Repetitive Rating: Pulse width limited by maximum junction temperature
2.  $I_{AS} = 4A, V_{DD} = 50V, R_G = 25\Omega$ , Starting  $T_J = 25^\circ\text{C}$
3.  $I_{SD} \leq 10A, di/dt \leq 200A/\mu\text{s}, V_{DD} \leq BV_{DSS}$ , Starting  $T_J = 25^\circ\text{C}$
4. Essentially Independent of Operating Temperature Typical Characteristics

Typical Performance Characteristics

Figure 1. On-Region Characteristics

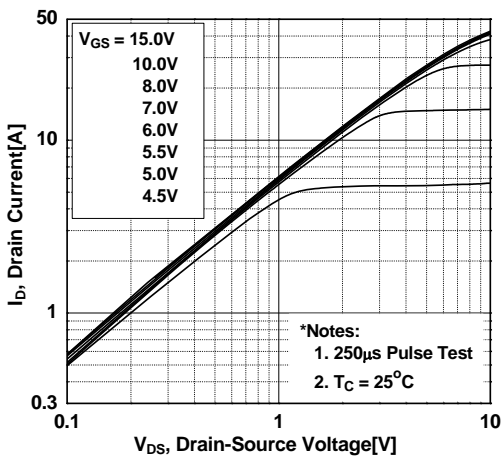


Figure 2. Transfer Characteristics

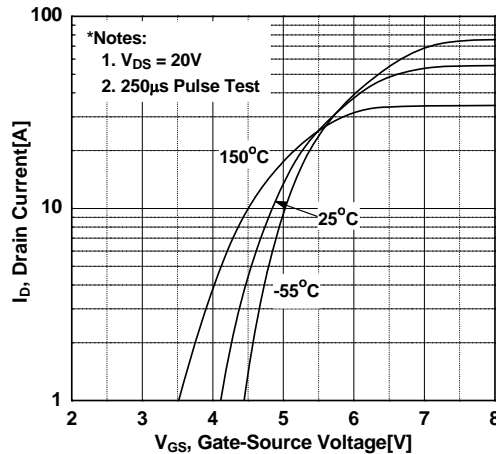


Figure 3. On-Resistance Variation vs. Drain Current and Gate Voltage

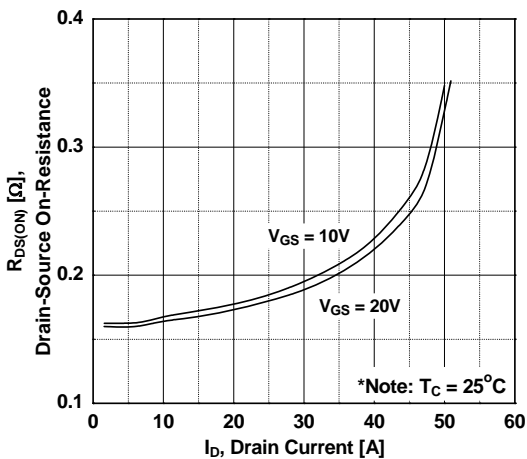


Figure 4. Body Diode Forward Voltage Variation vs. Source Current and Temperature

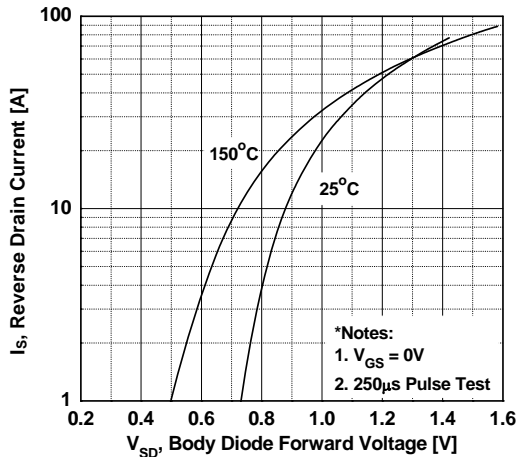


Figure 5. Capacitance Characteristics

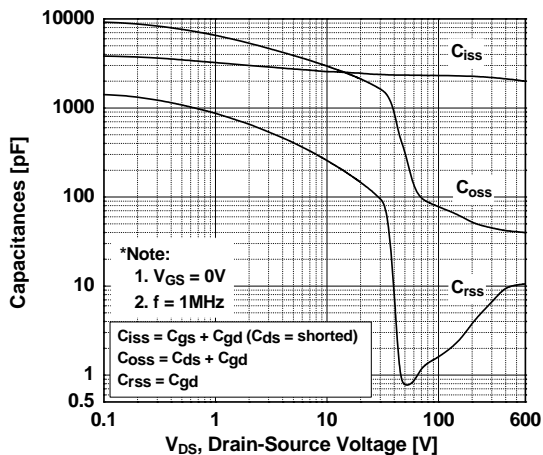
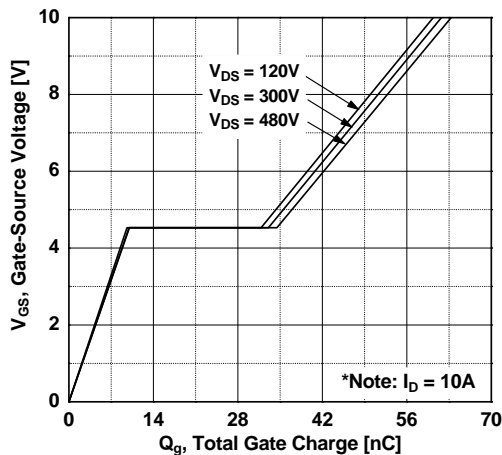
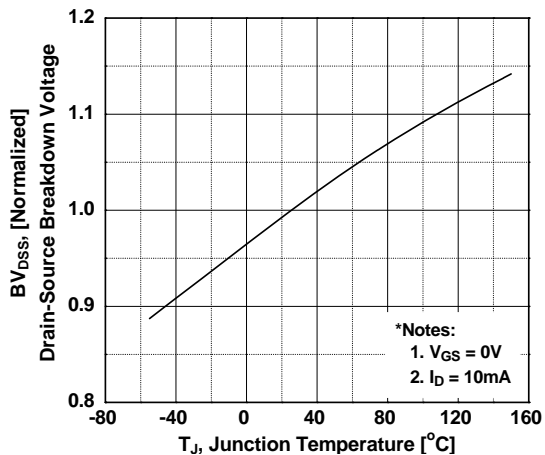


Figure 6. Gate Charge Characteristics

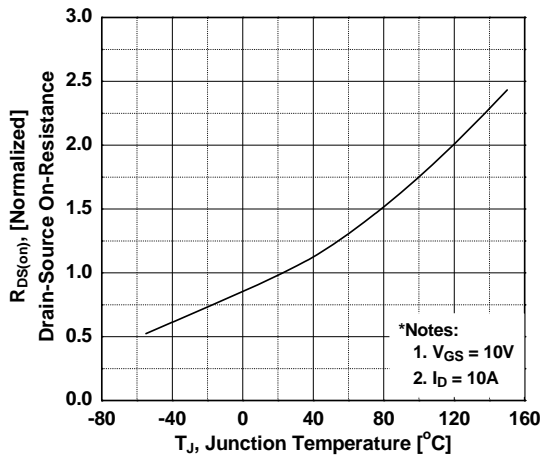


**Typical Performance Characteristics** (Continued)

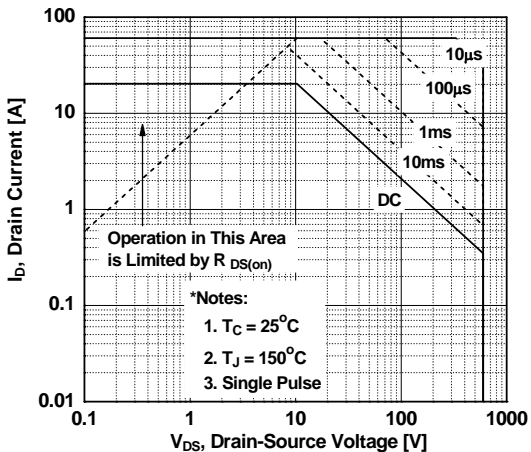
**Figure 7. Breakdown Voltage Variation vs. Temperature**



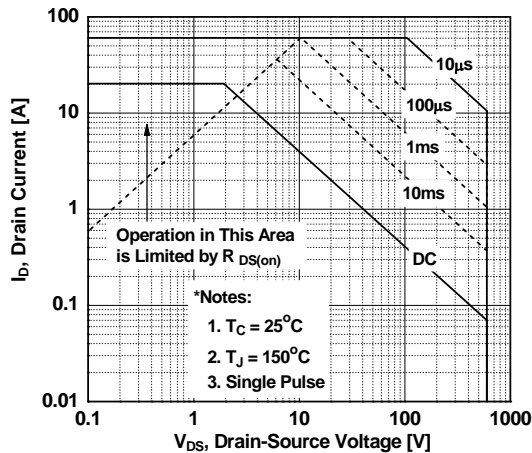
**Figure 8. On-Resistance Variation vs. Temperature**



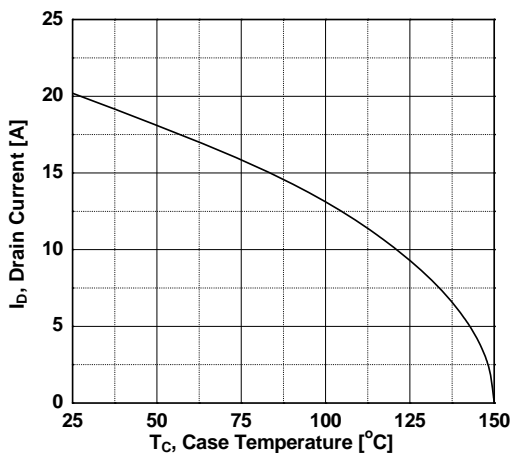
**Figure 9. Maximum Safe Operating Area vs. Case Temperature - FCP190N60E**



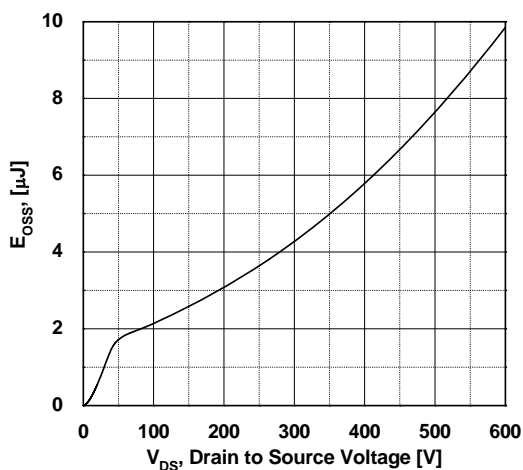
**Figure 10. Maximum Safe Operating Area vs. Case Temperature - FCPF190N60E**



**Figure 11. Maximum Drain Current**



**Figure 12. E\_oss vs. Drain to Source Voltage Switching Capability**



Typical Performance Characteristics (Continued)

Figure 13. Transient Thermal Response Curve - FCP190N60E

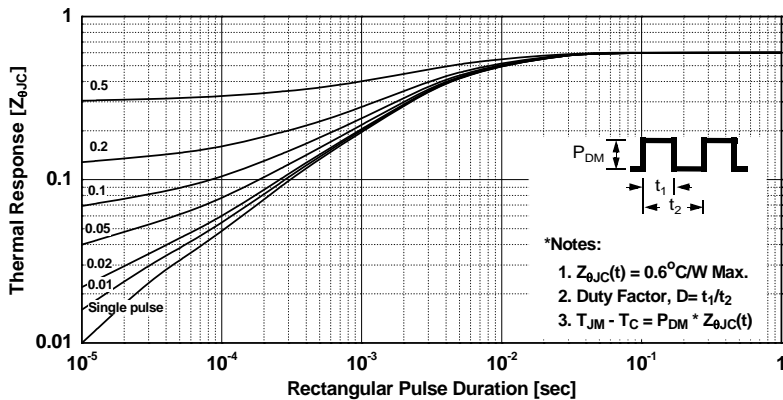
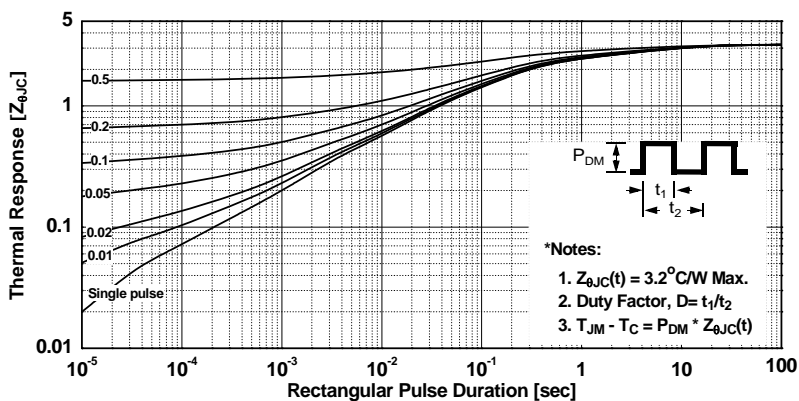
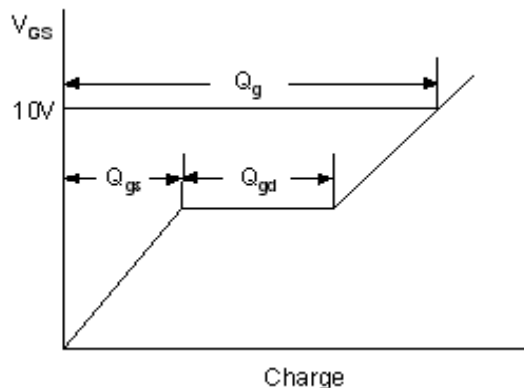
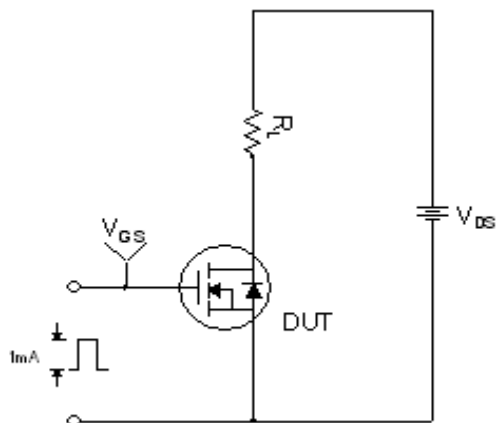


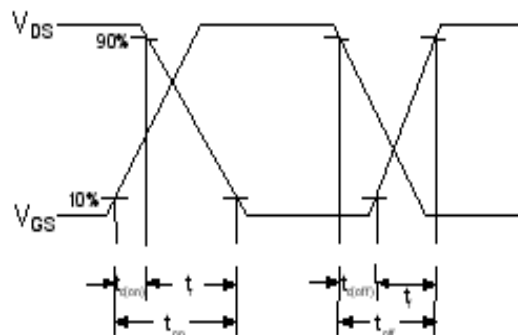
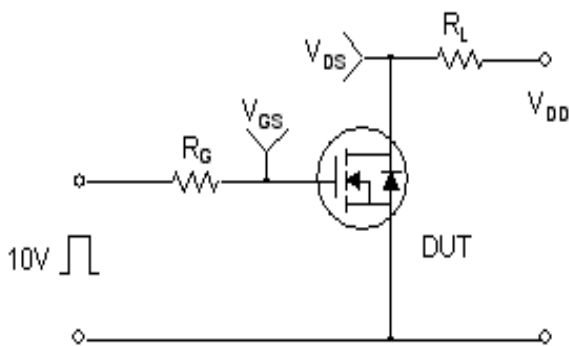
Figure 14. Transient Thermal Response Curve - FCPF190N60E



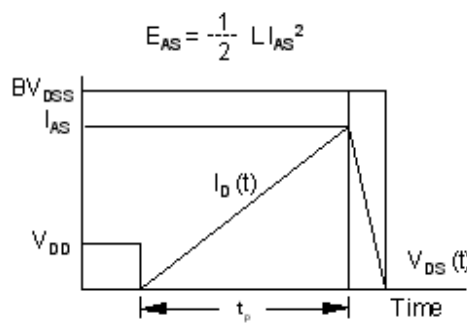
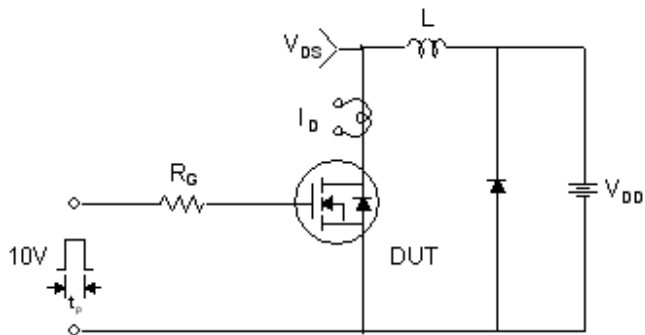
**Gate Charge Test Circuit & Waveform**



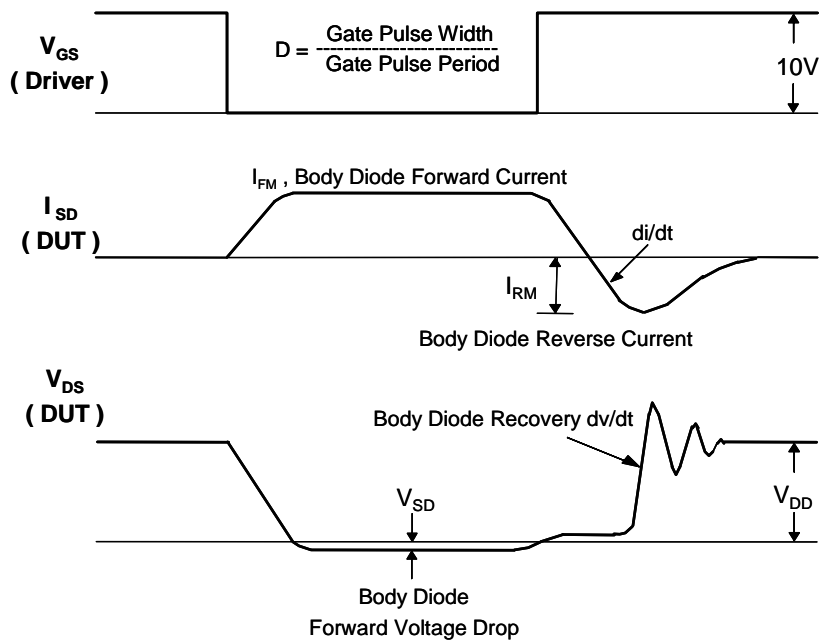
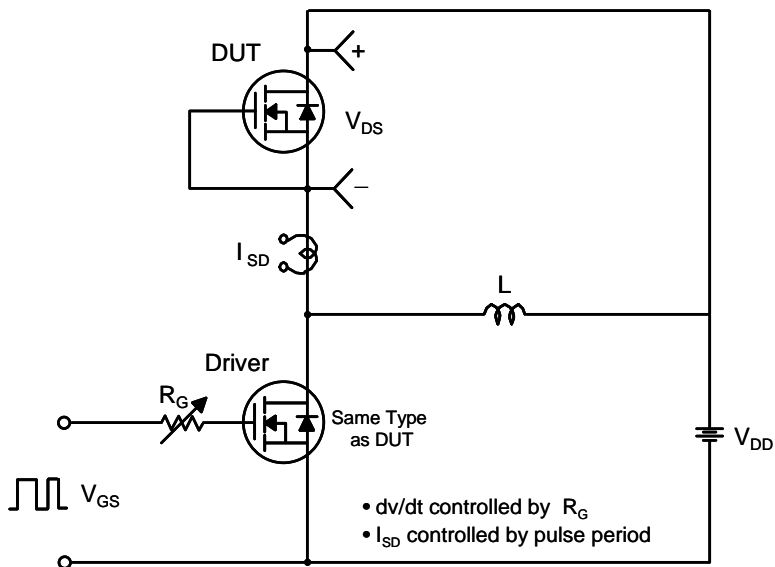
**Resistive Switching Test Circuit & Waveforms**



**Unclamped Inductive Switching Test Circuit & Waveforms**

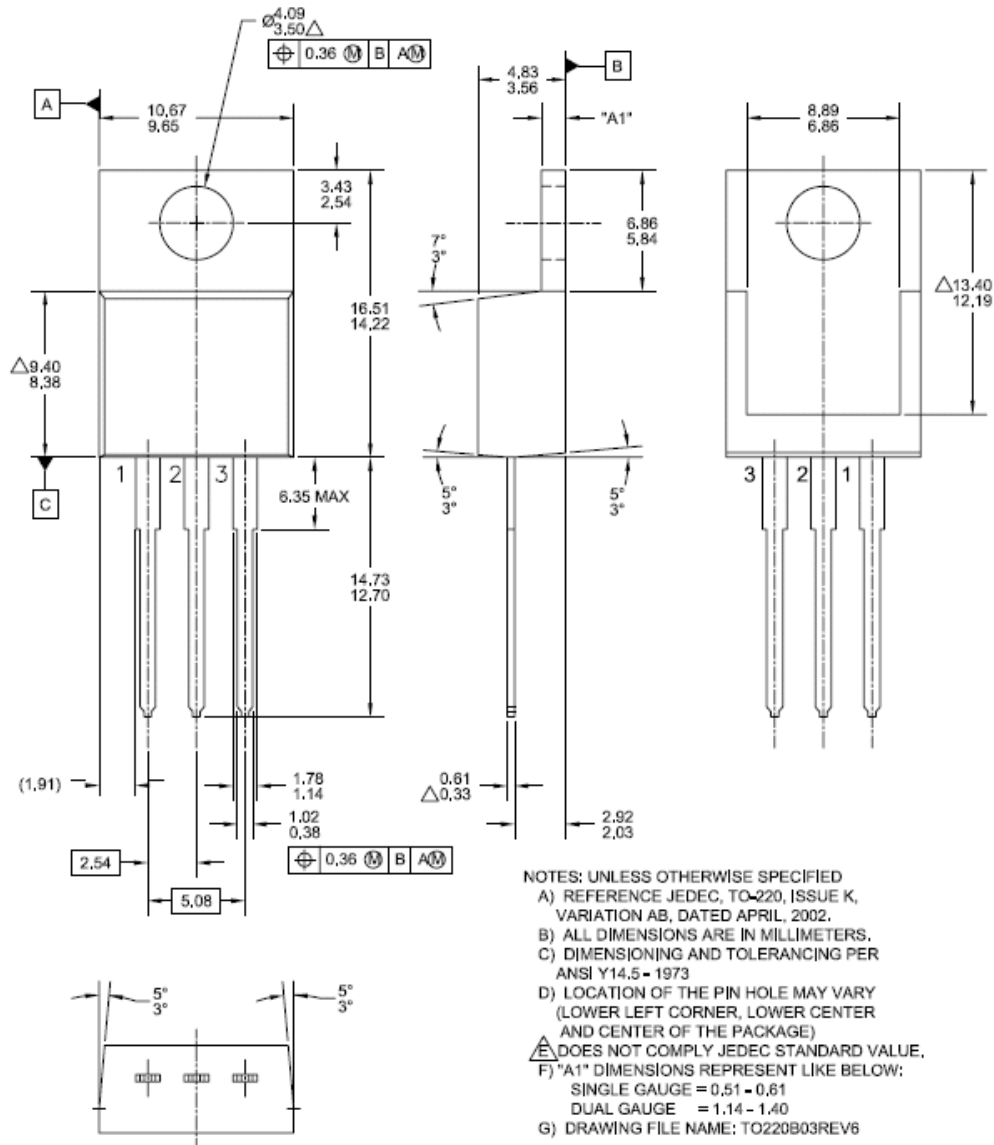


Peak Diode Recovery dv/dt Test Circuit & Waveforms



Mechanical Dimensions

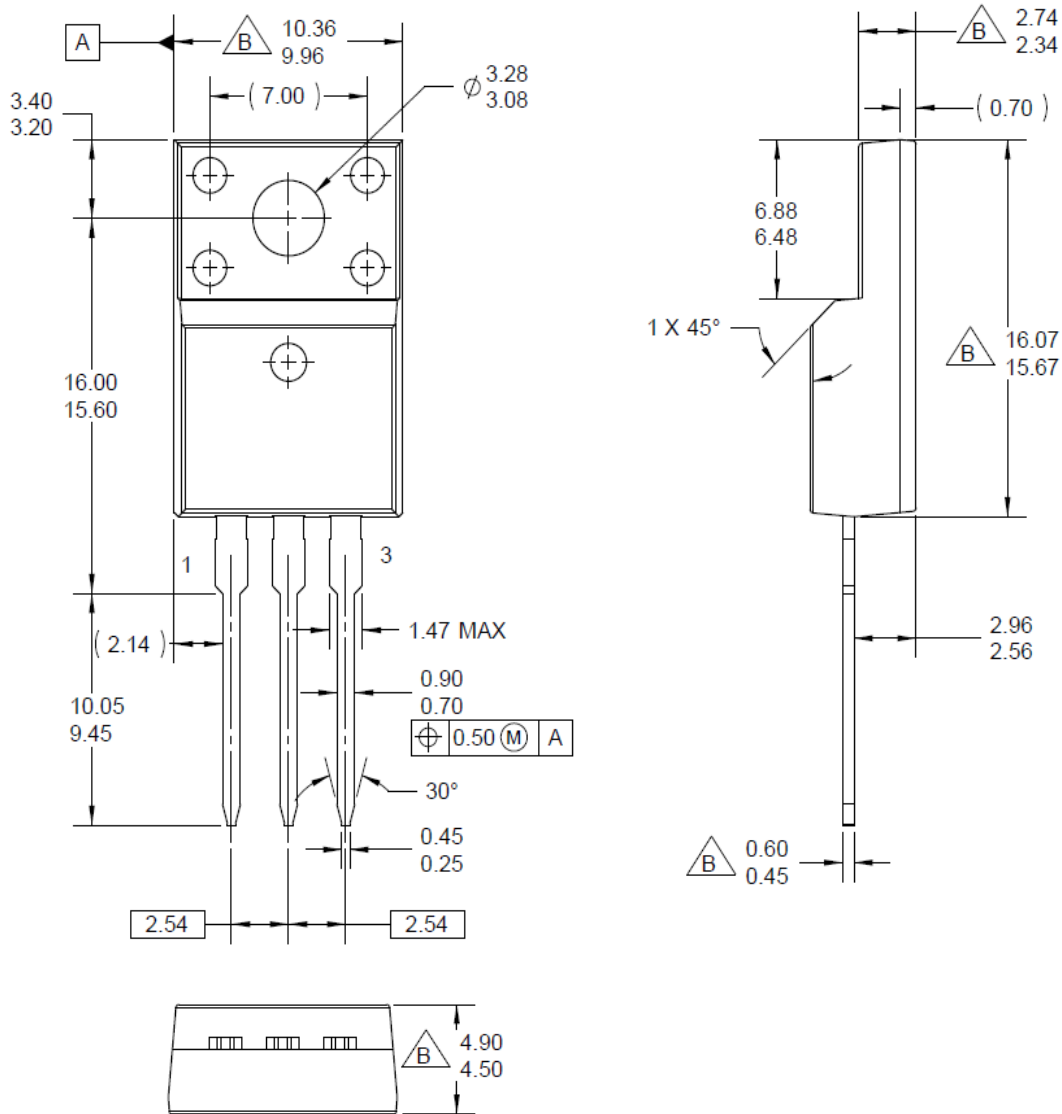
TO-220AB





**Package Dimensions**

**TO-220F (Retractable)**



\* Front/Back Side Isolation Voltage : AC 2500V

Dimensions in Millimeters



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Rev. I61