

FCP190N60E / FCPF190N60E

600V N-Channel MOSFET

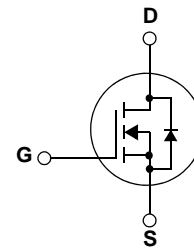
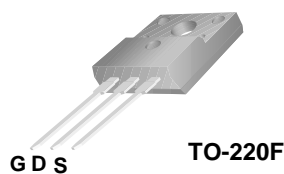
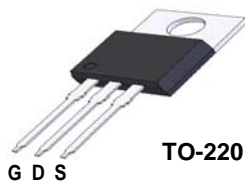
Features

- 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	± 20	V
		- AC ($f > 1\text{Hz}$)	± 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°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°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	μA
		$V_{DS} = 480V, T_C = 125^\circ\text{C}$	-	-	10	μA
I_{GSS}	Gate to Body Leakage Current	$V_{GS} = \pm 20V, V_{DS} = 0V$	-	-	± 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	Ω
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	-	Ω

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	-	μC

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

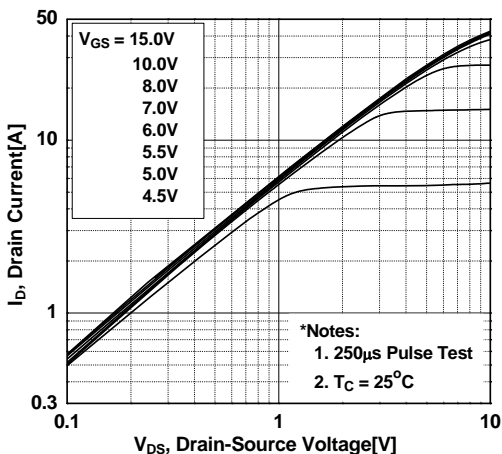


Figure 2. Transfer Characteristics

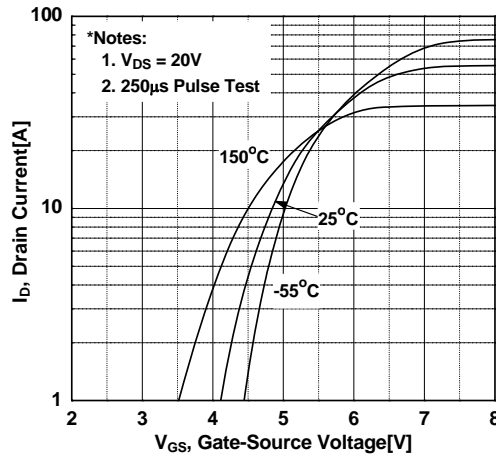


Figure 3. On-Resistance Variation vs. Drain Current and Gate Voltage

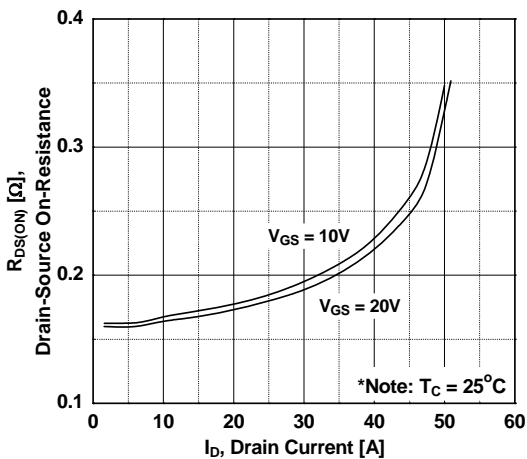


Figure 4. Body Diode Forward Voltage Variation vs. Source Current and Temperature

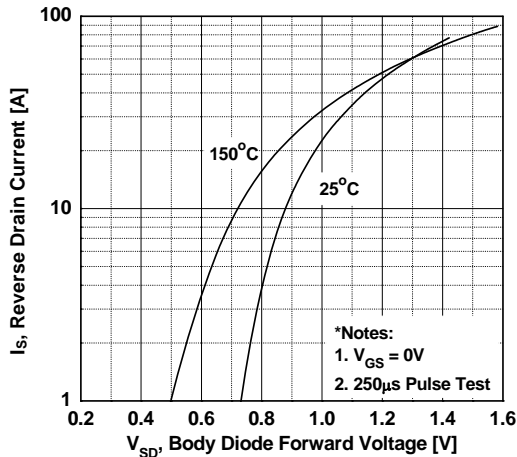


Figure 5. Capacitance Characteristics

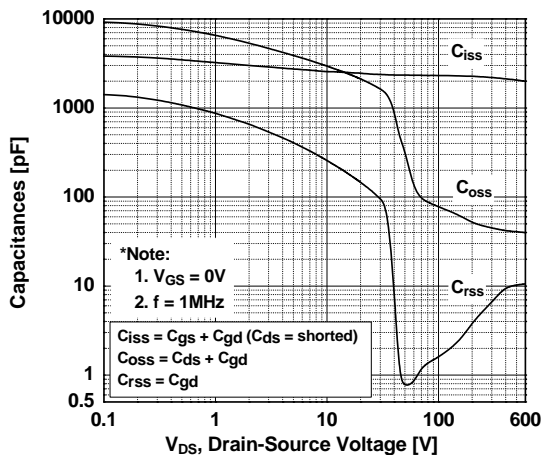
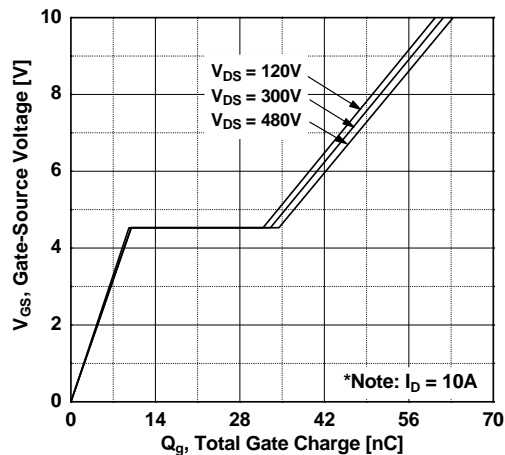


Figure 6. Gate Charge Characteristics



Typical Performance Characteristics (Continued)

Figure 7. Breakdown Voltage Variation vs. Temperature

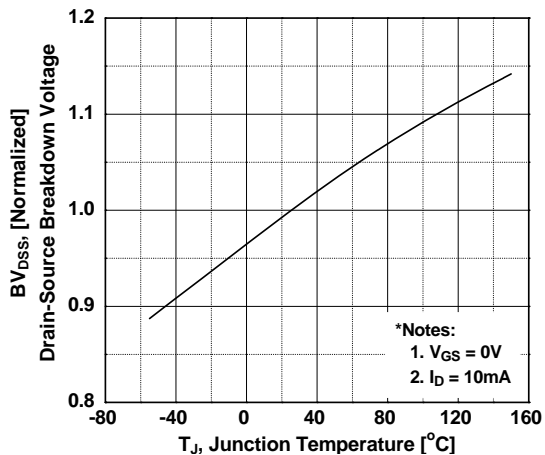


Figure 8. On-Resistance Variation vs. Temperature

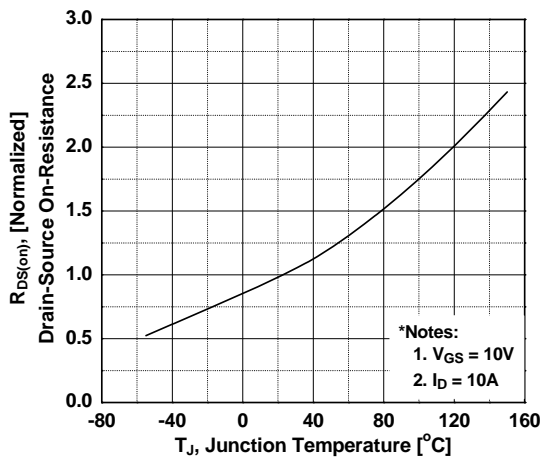


Figure 9. Maximum Safe Operating Area vs. Case Temperature - FCP190N60E

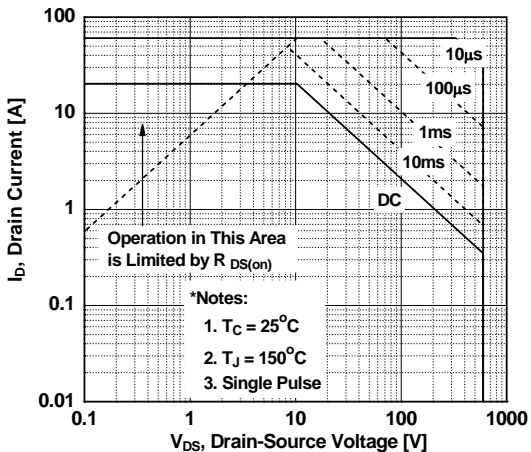


Figure 10. Maximum Safe Operating Area vs. Case Temperature - FCPF190N60E

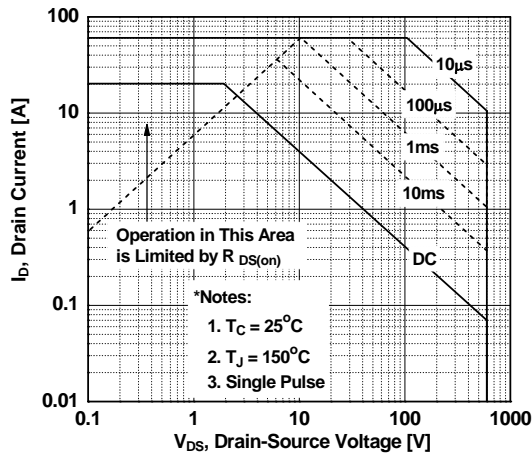


Figure 11. Maximum Drain Current

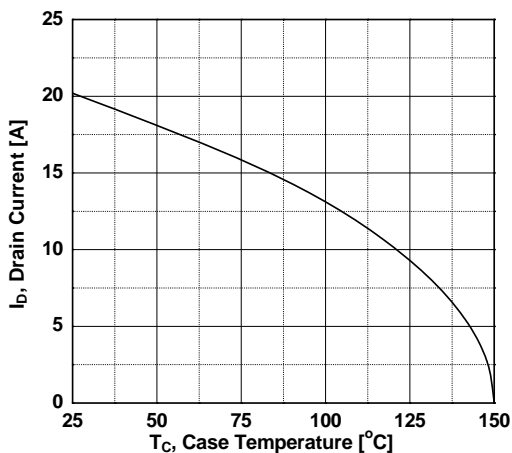
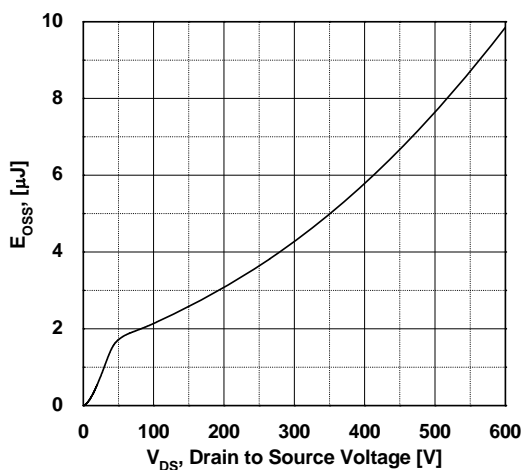


Figure 12. E_oss vs. Drain to Source Voltage Switching Capability



Typical Performance Characteristics (Continued)

Figure 13. Transient Thermal Response Curve - FCP190N60E

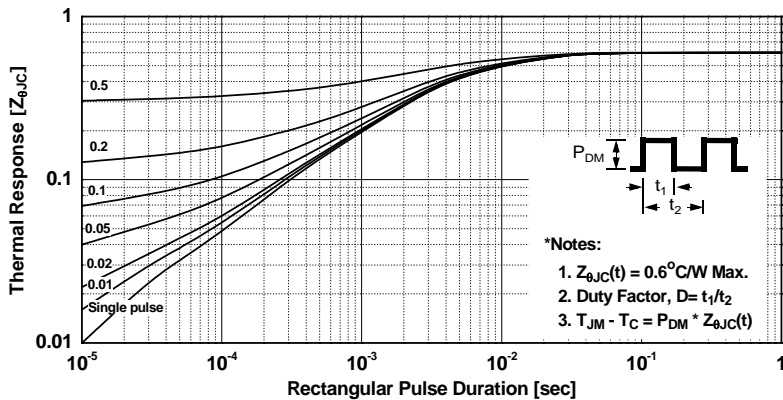
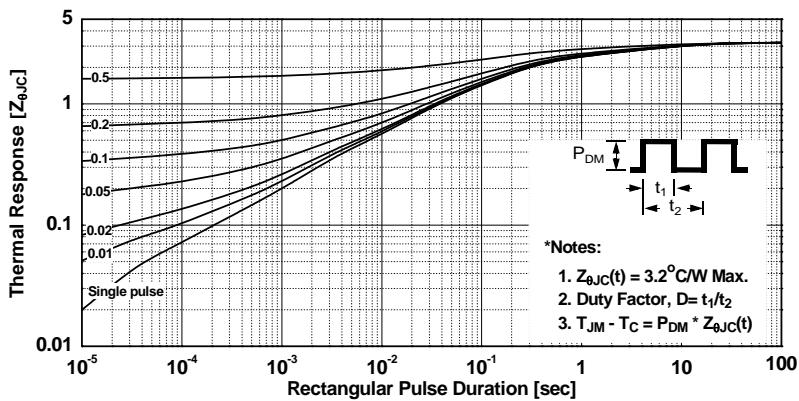


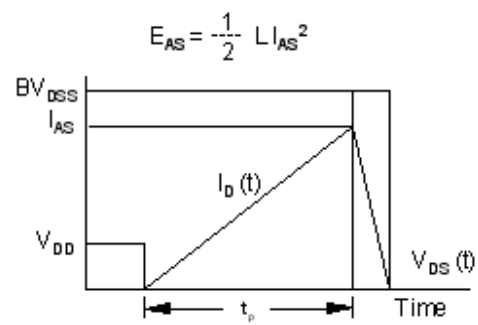
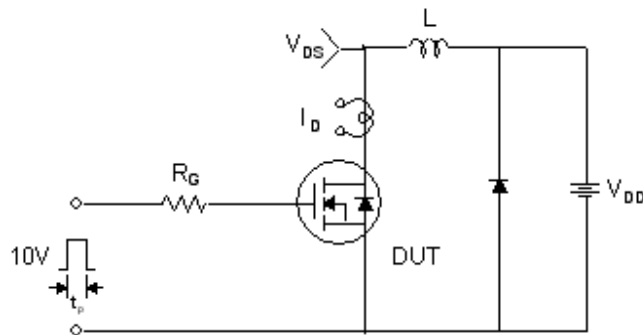
Figure 14. Transient Thermal Response Curve - FCPF190N60E



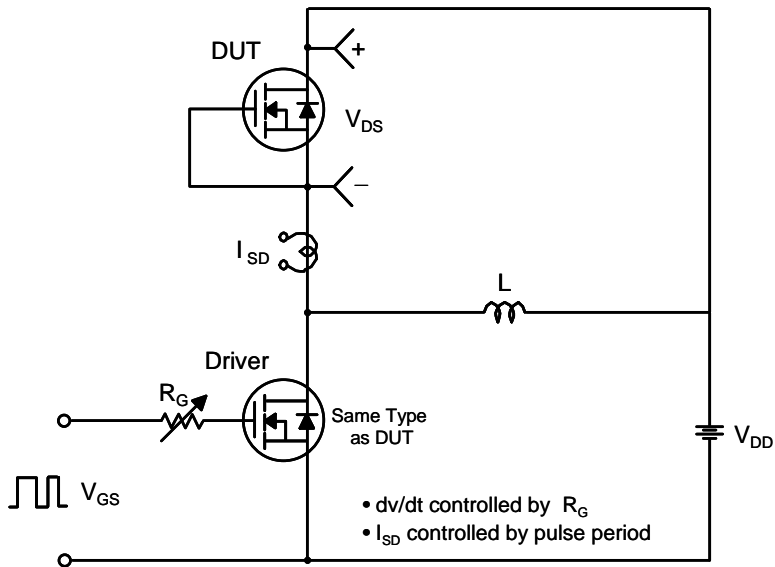
Gate Charge Test Circuit & Waveform

Resistive Switching Test Circuit & Waveforms

Unclamped Inductive Switching Test Circuit & Waveforms

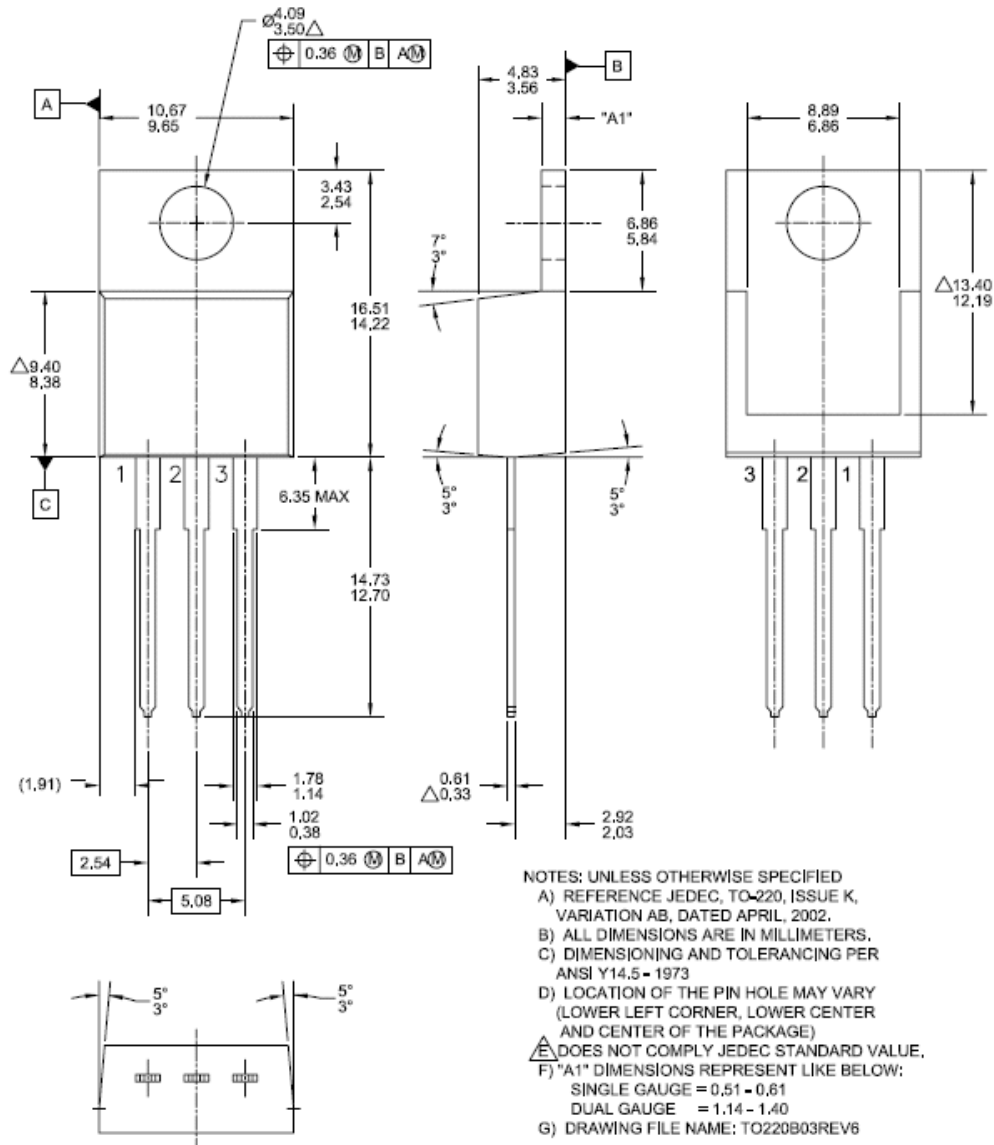


Peak Diode Recovery dv/dt Test Circuit & Waveforms



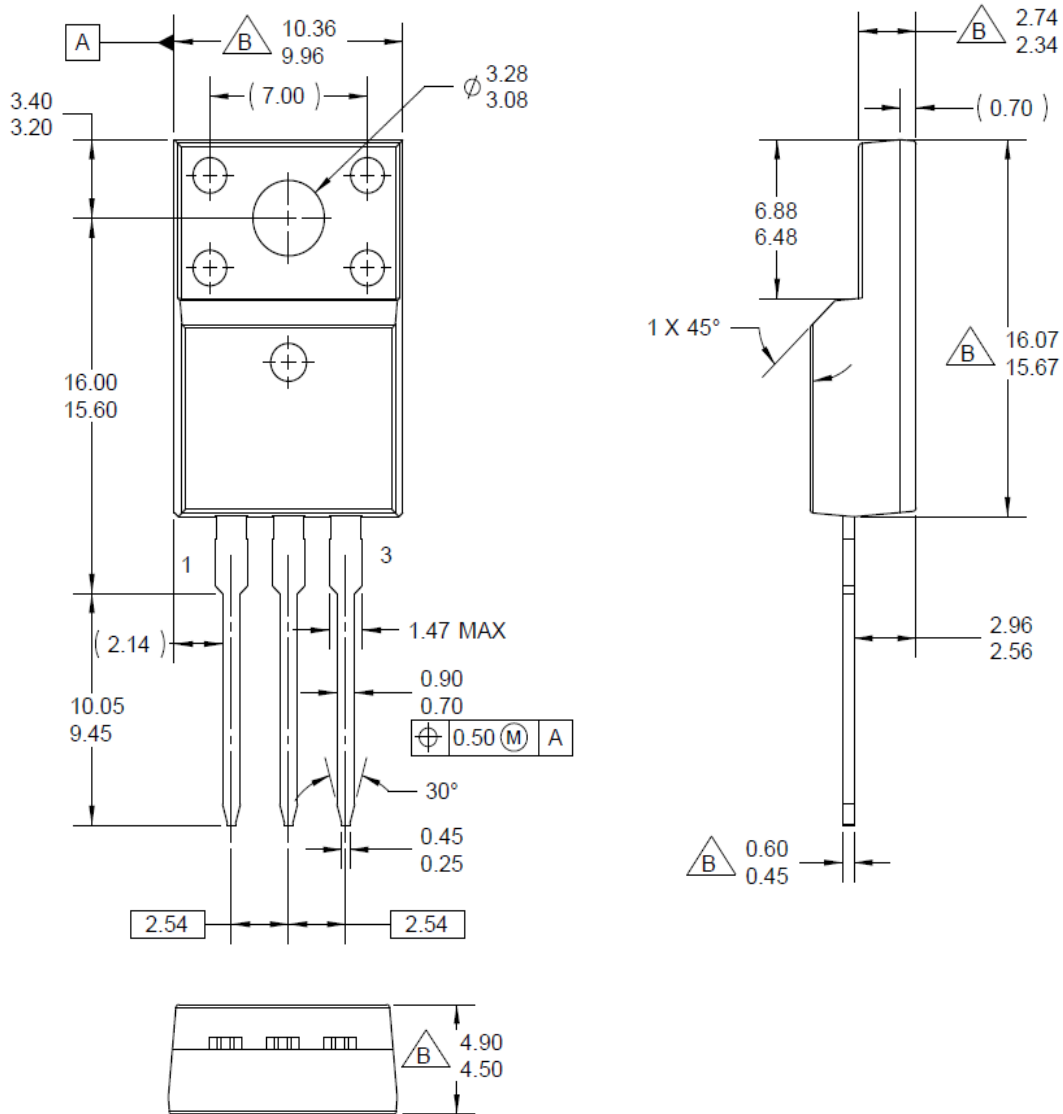
Mechanical Dimensions

TO-220AB



Package Dimensions

TO-220F (Retractable)







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

Dimensions in Millimeters



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