

# FCP600N60Z / FCPF600N60Z

## N-Channel SuperFET® II MOSFET

600 V, 7.4 A, 600 mΩ

### Features

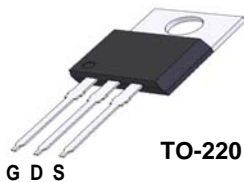
- 650 V @T<sub>J</sub> = 150°C
- Max. R<sub>DS(on)</sub> = 600 mΩ
- Ultra Low Gate Charge (Typ. Q<sub>g</sub> = 20 nC)
- Low Effective Output Capacitance (Typ. C<sub>oss,eff</sub> = 74 pF)
- 100% Avalanche Tested
- ESD Improved Capacity

### Description

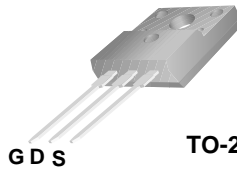
SuperFET® II MOSFET is Fairchild Semiconductor®'s first generation of high voltage super-junction (SJ) MOSFET family that is utilizing charge balance technology for outstanding low on-resistance and lower gate charge performance. This advanced technology is tailored to minimize conduction loss, provide superior switching performance, and withstand extreme dv/dt rate and higher avalanche energy. Consequently, SuperFET II MOSFET is suitable for various AC/DC power conversion for system miniaturization and higher efficiency.

### Applications

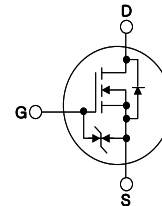
- LCD / LED / PDP TV and Monitor Lighting
- Solar Inverter
- AC-DC Power Supply



TO-220



TO-220F



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

Symbol	Parameter	FCP600N60Z	FCPF600N60Z	Unit
V <sub>DSS</sub>	Drain to Source Voltage	600		V
V <sub>GSS</sub>	Gate to Source Voltage	- DC	±20	V
		- AC (f > 1 Hz)	±30	V
I <sub>D</sub>	Drain Current	- Continuous (T <sub>C</sub> = 25°C)	7.4	7.4*
		- Continuous (T <sub>C</sub> = 100°C)	4.7	4.7*
I <sub>DM</sub>	Drain Current - Pulsed (Note 1)	22.2	22.2*	A
E <sub>AS</sub>	Single Pulsed Avalanche Energy (Note 2)	135		mJ
I <sub>AR</sub>	Avalanche Current (Note 1)	1.5		A
E <sub>AR</sub>	Repetitive Avalanche Energy (Note 1)	0.89		mJ
dv/dt	Peak Diode Recovery dv/dt (Note 3)	20		V/ns
	MOSFET dv/dt	100		V/ns
P <sub>D</sub>	Power Dissipation (T <sub>C</sub> = 25°C)	89	28	W
		- Derate above 25°C	0.71	0.22
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 Purpose, 1/8" from Case for 5 Seconds	300		°C

\*Drain current limited by maximum junction temperature

### Thermal Characteristics

Symbol	Parameter	FCP600N60Z	FCPF600N60Z	Unit
R <sub>θJC</sub>	Thermal Resistance, Junction to Case	1.4	4.5	°C/W
R <sub>θJA</sub>	Thermal Resistance, Junction to Ambient	62.5	62.5	

## Package Marking and Ordering Information

Device Marking	Device	Package	Reel Size	Tape Width	Quantity
FCP600N60Z	FCP600N60Z	TO-220	-	-	50
FCPF600N60Z	FCPF600N60Z	TO-220F	-	-	50

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

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

$BV_{DSS}$	Drain to Source Breakdown Voltage	$V_{GS} = 0\text{ V}, I_D = 10\text{ mA}, T_J = 25^\circ\text{C}$	600	-	-	V
		$V_{GS} = 0\text{ V}, I_D = 10\text{ mA}, T_J = 150^\circ\text{C}$	650	-	-	V
$\frac{\Delta BV_{DSS}}{\Delta T_J}$	Breakdown Voltage Temperature Coefficient	$I_D = 10\text{ mA}$ , Referenced to $25^\circ\text{C}$	-	0.67	-	$\text{V}/^\circ\text{C}$
$BV_{DS}$	Drain-Source Avalanche Breakdown Voltage	$V_{GS} = 0\text{ V}, I_D = 7.4\text{ A}$	-	700	-	V
$I_{DSS}$	Zero Gate Voltage Drain Current	$V_{DS} = 480\text{ V}, V_{GS} = 0\text{ V}$	-	-	1	$\mu\text{A}$
		$V_{DS} = 480\text{ V}, T_C = 125^\circ\text{C}$	-	-	10	
$I_{GSS}$	Gate to Body Leakage Current	$V_{GS} = \pm 20\text{ V}, V_{DS} = 0\text{ V}$	-	-	$\pm 10$	$\mu\text{A}$

### On Characteristics

$V_{GS(th)}$	Gate Threshold Voltage	$V_{GS} = V_{DS}, I_D = 250\text{ }\mu\text{A}$	2.5	-	3.5	V
$R_{DS(on)}$	Static Drain to Source On Resistance	$V_{GS} = 10\text{ V}, I_D = 3.7\text{ A}$	-	0.51	0.6	$\Omega$
$g_{FS}$	Forward Transconductance	$V_{DS} = 20\text{ V}, I_D = 3.7\text{ A}$	-	6.7	-	S

### Dynamic Characteristics

$C_{iss}$	Input Capacitance	$V_{DS} = 25\text{ V}, V_{GS} = 0\text{ V}$ $f = 1\text{ MHz}$	-	840	1120	pF
$C_{oss}$	Output Capacitance		-	630	840	pF
$C_{rss}$	Reverse Transfer Capacitance		-	30	45	pF
$C_{oss}$	Output Capacitance	$V_{DS} = 380\text{ V}, V_{GS} = 0\text{ V}, f = 1.0\text{ MHz}$	-	16.5	-	pF
$C_{oss\text{ eff.}}$	Effective Output Capacitance	$V_{DS} = 0\text{ V to } 480\text{ V}, V_{GS} = 0\text{ V}$	-	74	-	pF
$Q_{g(tot)}$	Total Gate Charge at 10V	$V_{DS} = 380\text{ V}, I_D = 3.7\text{ A}$ $V_{GS} = 10\text{ V}$	-	20	26	nC
$Q_{gs}$	Gate to Source Gate Charge		-	3.4	-	nC
$Q_{gd}$	Gate to Drain "Miller" Charge		(Note 4)	-	7.5	-
ESR	Equivalent Series Resistance	Drain open	-	2.89	-	$\Omega$

### Switching Characteristics

$t_{d(on)}$	Turn-On Delay Time	$V_{DD} = 380\text{ V}, I_D = 3.7\text{ A}$ $V_{GS} = 10\text{ V}, R_G = 4.7\text{ }\Omega$	-	13	36	ns
$t_r$	Turn-On Rise Time		-	7	24	ns
$t_{d(off)}$	Turn-Off Delay Time		-	39	88	ns
$t_f$	Turn-Off Fall Time		(Note 4)	-	9	28

### Drain-Source Diode Characteristics

$I_S$	Maximum Continuous Drain to Source Diode Forward Current	-	-	7.4	A	
$I_{SM}$	Maximum Pulsed Drain to Source Diode Forward Current	-	-	22.2	A	
$V_{SD}$	Drain to Source Diode Forward Voltage	$V_{GS} = 0\text{ V}, I_{SD} = 3.7\text{ A}$	-	-	1.2	V
$t_{rr}$	Reverse Recovery Time	$V_{GS} = 0\text{ V}, I_{SD} = 3.7\text{ A}$	-	200	-	ns
$Q_{rr}$	Reverse Recovery Charge	$di_F/dt = 100\text{ A}/\mu\text{s}$	-	2.3	-	$\mu\text{C}$

#### Notes:

1. Repetitive Rating: Pulse width limited by maximum junction temperature
2.  $I_{AS} = 1.5\text{ A}, V_{DD} = 50\text{ V}, R_G = 25\text{ }\Omega$ , Starting  $T_J = 25^\circ\text{C}$
3.  $I_{SD} \leq 3.7\text{ A}, di/dt \leq 200\text{ A}/\mu\text{s}, V_{DD} \leq BV_{DSS}$ , Starting  $T_J = 25^\circ\text{C}$
4. Essentially Independent of Operating Temperature Typical Characteristics

## Typical Performance Characteristics

Figure 1. On-Region Characteristics

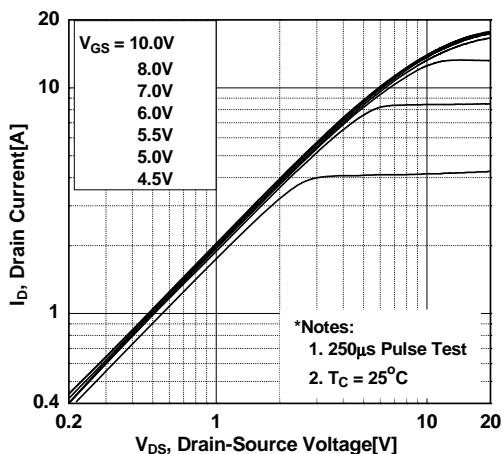


Figure 2. Transfer Characteristics

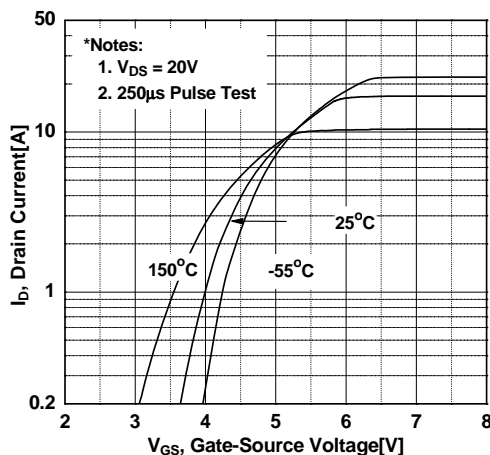


Figure 3. On-Resistance Variation vs. Drain Current and Gate Voltage

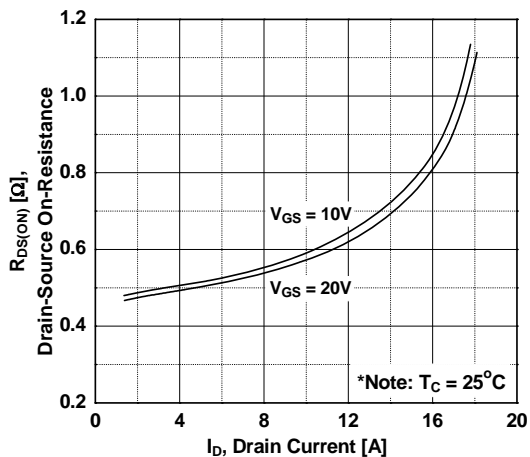


Figure 4. Body Diode Forward Voltage Variation vs. Source Current and Temperature

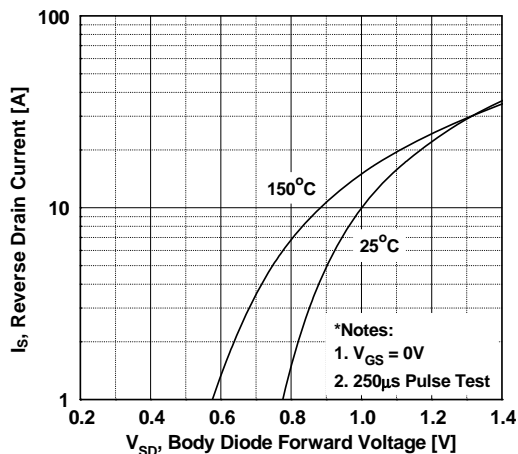


Figure 5. Capacitance Characteristics

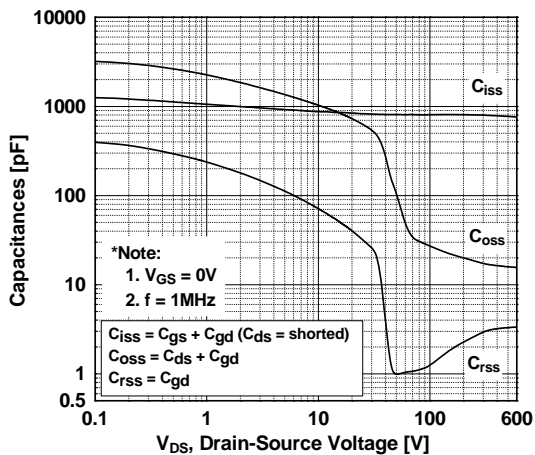
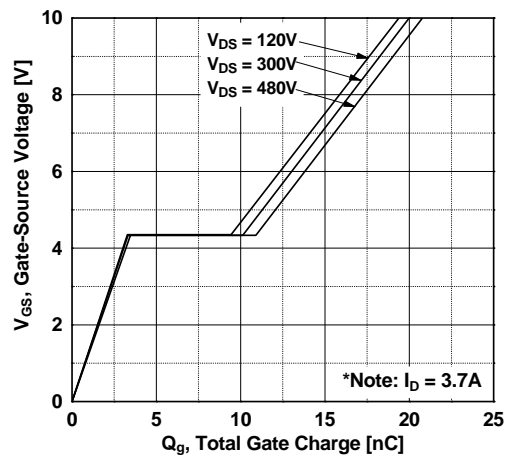
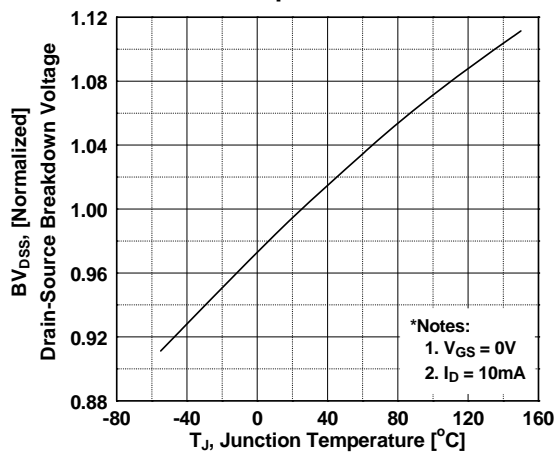


Figure 6. Gate Charge Characteristics

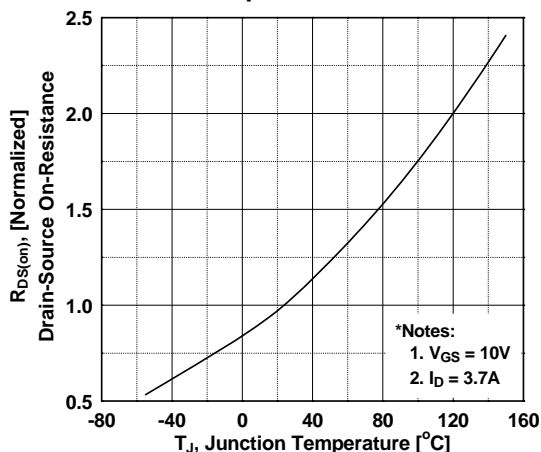


**Typical Performance Characteristics** (Continued)

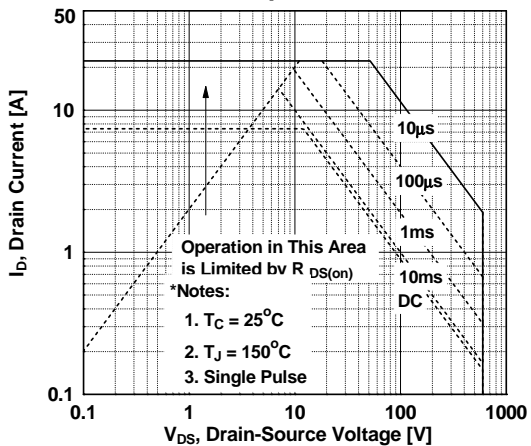
**Figure 7. Breakdown Voltage Variation vs. Temperature**



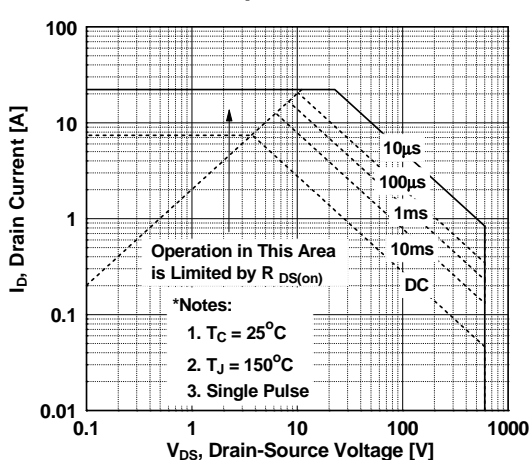
**Figure 8. On-Resistance Variation vs. Temperature**



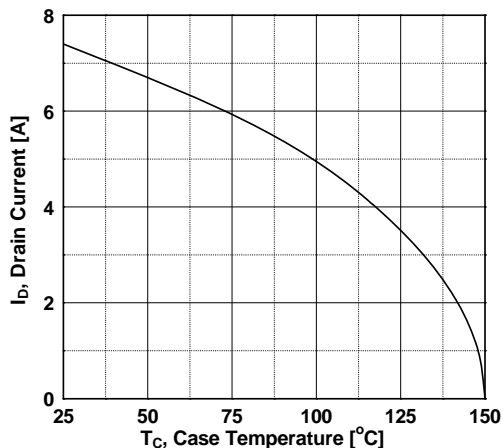
**Figure 9. Maximum Safe Operating Area vs. Case Temperature - FCP600N60Z**



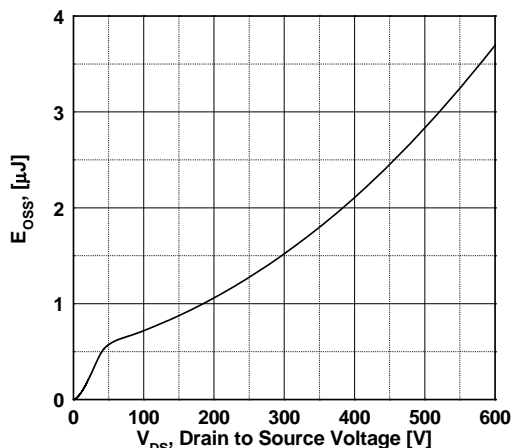
**Figure 10. Maximum Safe Operating Area vs. Case Temperature - FCP600N60Z**



**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 - FCP600N60Z

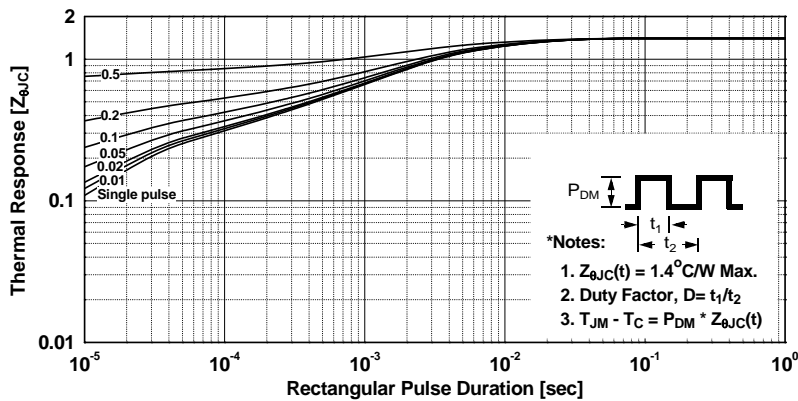
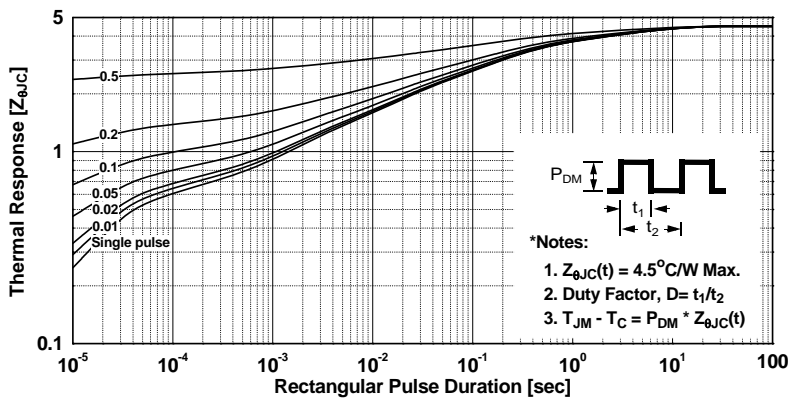
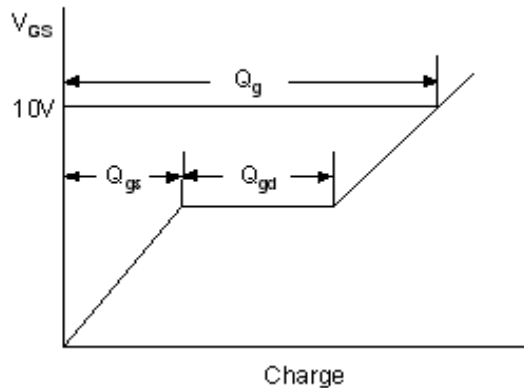
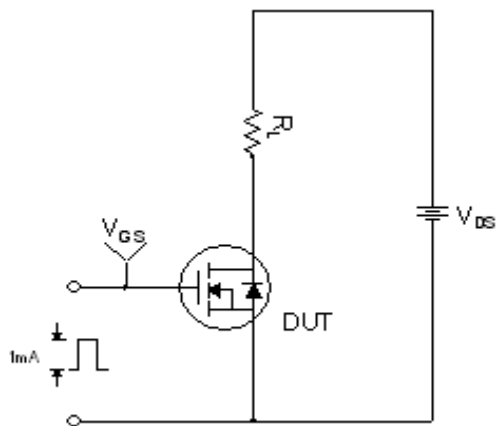


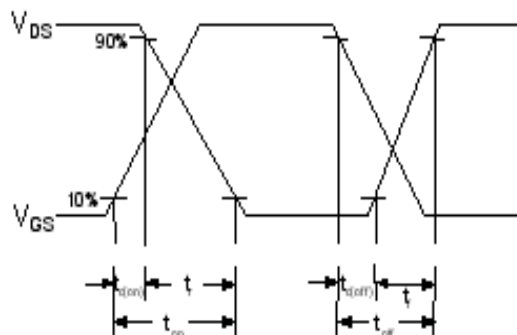
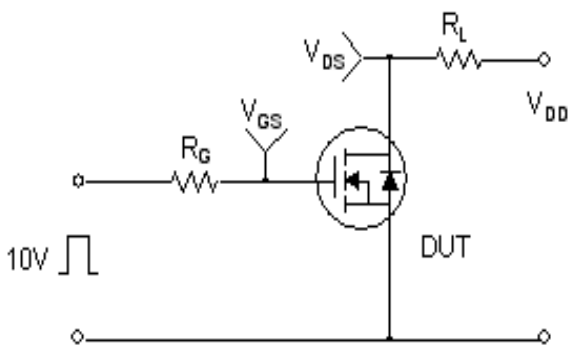
Figure 14. Transient Thermal Response Curve - FCPF600N60Z



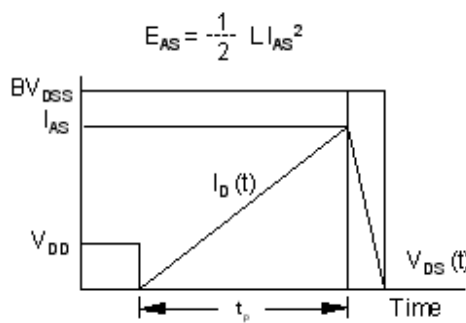
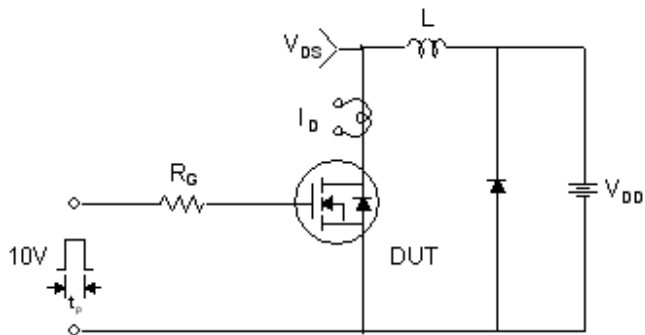
**Gate Charge Test Circuit & Waveform**



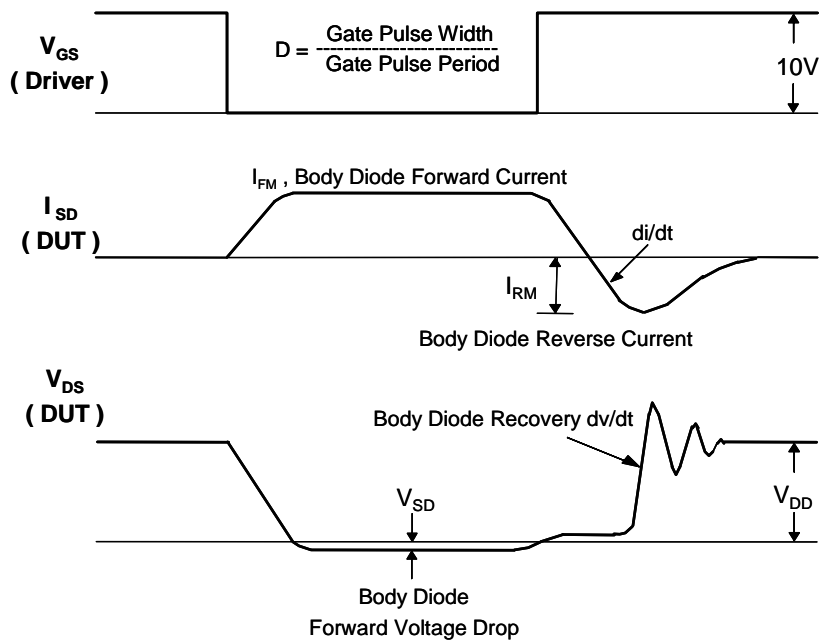
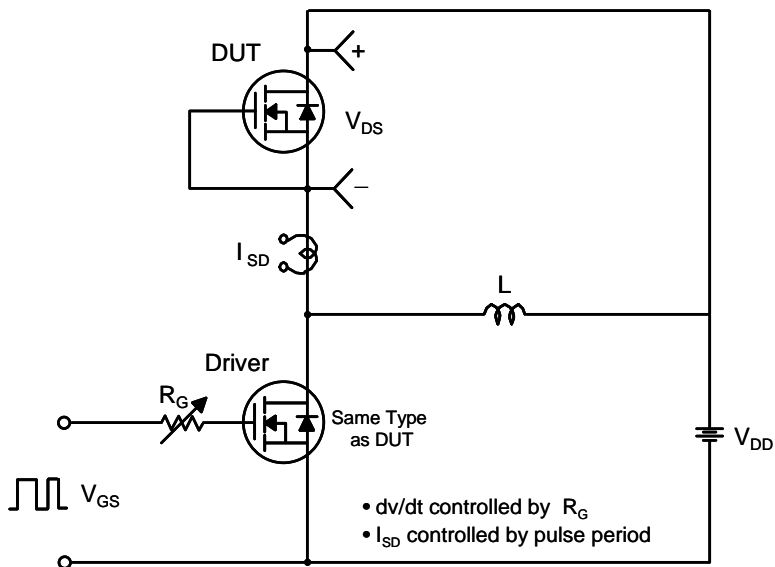
**Resistive Switching Test Circuit & Waveforms**



**Unclamped Inductive Switching Test Circuit & Waveforms**

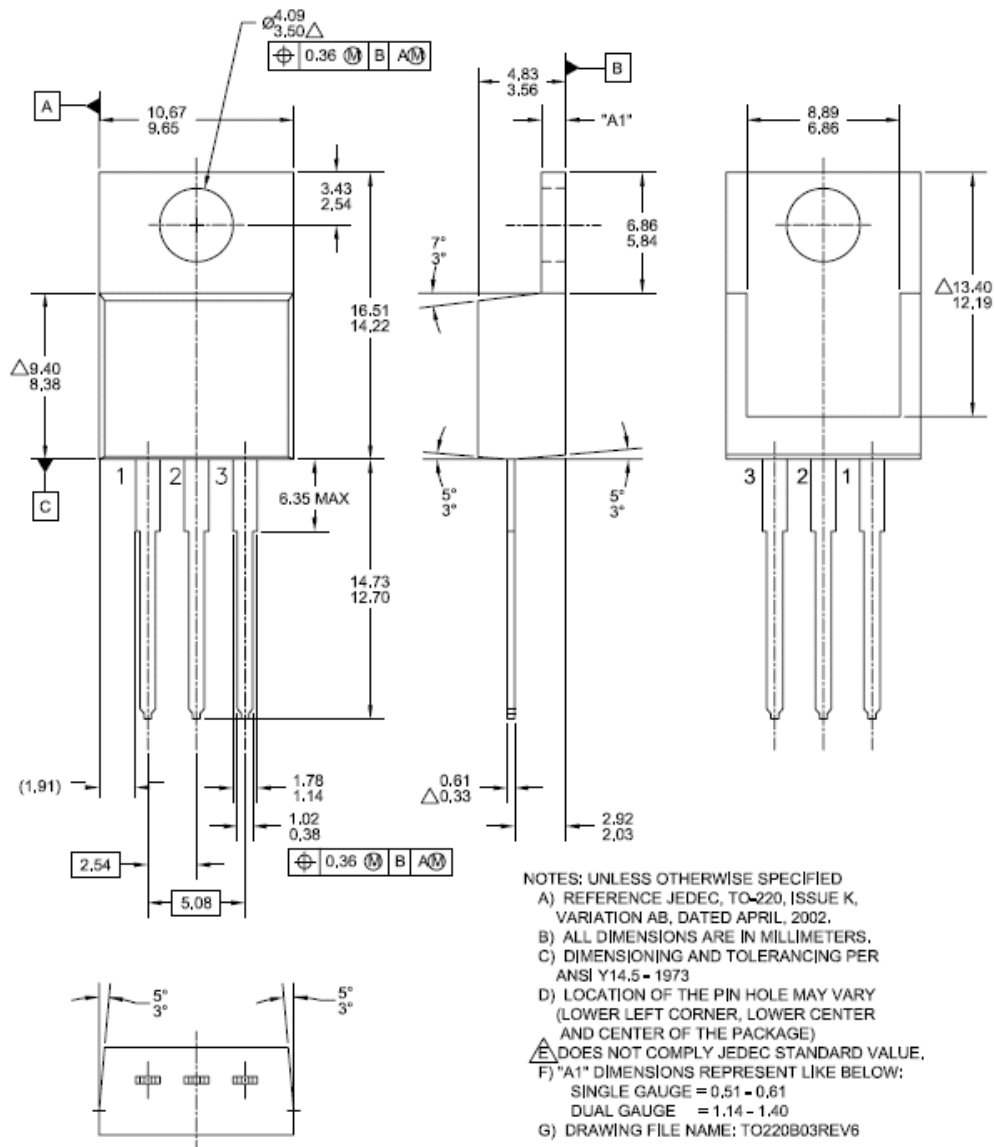


Peak Diode Recovery dv/dt Test Circuit & Waveforms



Mechanical Dimensions

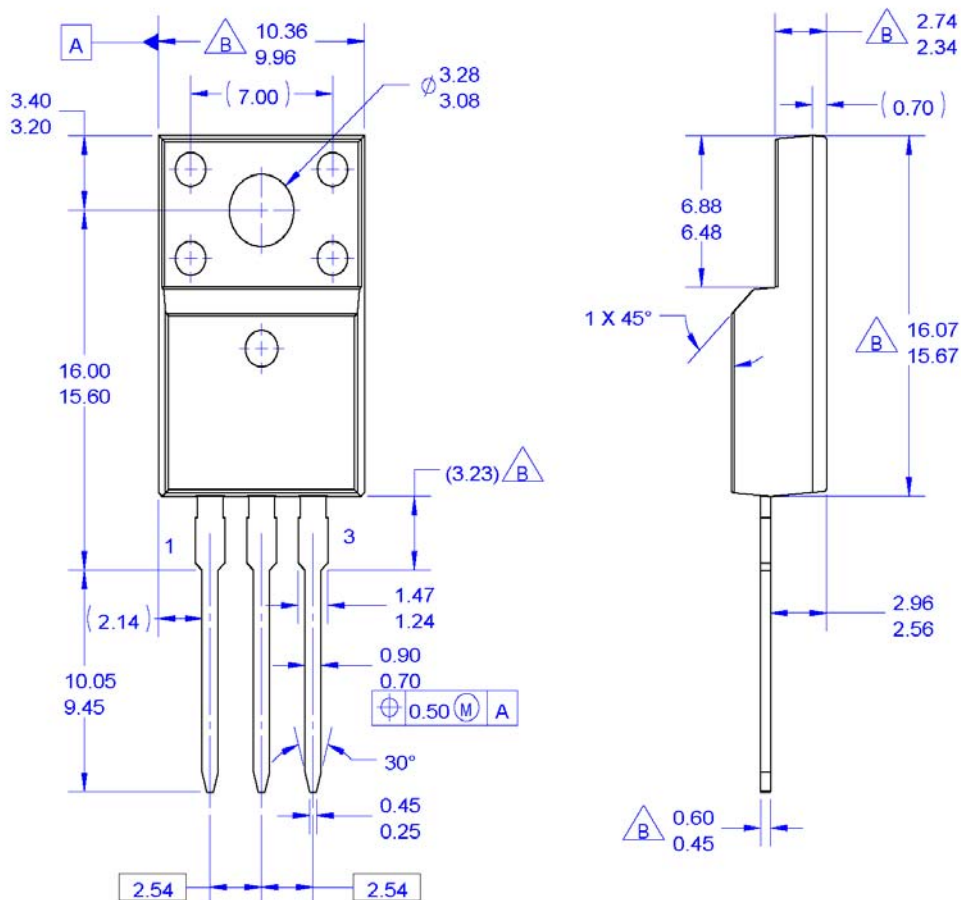
TO-220AB





**Package Dimensions**

**TO-220F (Retractable)**



**NOTES:**

- A. EXCEPT WHERE NOTED CONFORMS TO EIAJ SC91A.
- B. DOES NOT COMPLY EIAJ STD. VALUE.
- C. ALL DIMENSIONS ARE IN MILLIMETERS.
- D. DIMENSIONS ARE EXCLUSIVE OF BURRS, MOLD FLASH AND TIE BAR PROTRUSIONS.
- E. DIMENSION AND TOLERANCE AS PER ASME Y14.5-1994.
- F. DRAWING FILE NAME: TO220M03REV3






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

Dimensions in Millimeters



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| AccuPower™  | F-PFST™   | PowerTrench®  |  |
| AX-CAP®*  | FRFET®  | PowerXS™  | TinyBoost™  |
| BitSiC™   | Global Power Resource <sup>SM</sup>             | Programmable Active Droop™  | TinyBuck™   |
| Build it Now™   | Green Bridge™                                   | QFET®   | TinyCalc™   |
| CorePLUS™   | Green FPS™                                      | QS™   | TinyLogic®  |
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| FAST®   | OptoHit™  | SupreMOS®   | VoltagePlus™  |
| FastvCore™  | OPTOLOGIC®                                      | SynCFET™  | XST™  |
| FETBench™   | OPTOPLANAR®                                     |   |   |

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Datasheet Identification	Product Status	Definition
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Preliminary	First Production	Datasheet contains preliminary data; supplementary data will be published at a later date. Fairchild Semiconductor reserves the right to make changes at any time without notice to improve design.
No Identification Needed	Full Production	Datasheet contains final specifications. Fairchild Semiconductor reserves the right to make changes at any time without notice to improve the design.
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