

# FCP600N60Z / FCPF600N60Z

## N-Channel SuperFET® II MOSFET

600 V, 7.4 A, 600 mΩ

### Features

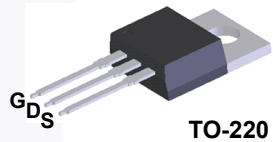
- 650 V @  $T_J = 150^\circ\text{C}$
- Typ.  $R_{DS(on)} = 510\text{ m}\Omega$
- Ultra Low Gate Charge (Typ.  $Q_g = 20\text{ nC}$ )
- Low Effective Output Capacitance (Typ.  $C_{oss(eff.)} = 74\text{ pF}$ )
- 100% Avalanche Tested
- ESD Improved Capacity
- RoHS Compliant

### Applications

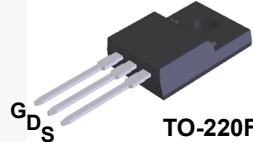
- LCD / LED / PDP TV and Monitor Lightning
- Solar Inverter
- AC-DC Power Supply

### Description

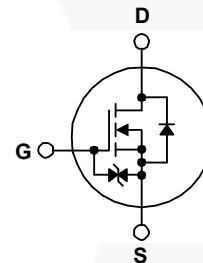
SuperFET® II MOSFET is Fairchild Semiconductor's brand-new high voltage super-junction (SJ) MOSFET family that is utilizing charge balance technology for outstanding low on-resistance and lower gate charge performance. This technology is tailored to minimize conduction loss, provide superior switching performance, dv/dt rate and higher avalanche energy. Consequently, SuperFET II MOSFET is very suitable for the switching power applications such as PFC, server/telecom power, FPD TV power, ATX power and industrial power applications.



TO-220



TO-220F



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

Symbol	Parameter	FCP600N60Z	FCPF600N60Z	Unit
$V_{DSS}$	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 ( $T_C = 25^\circ\text{C}$ )	7.4	7.4*
		- Continuous ( $T_C = 100^\circ\text{C}$ )	4.7	4.7*
$I_{DM}$	Drain Current	- Pulsed (Note 1)	22.2	22.2*
$E_{AS}$	Single Pulsed Avalanche Energy (Note 2)	135		mJ
$I_{AR}$	Avalanche Current (Note 1)	1.5		A
$E_{AR}$	Repetitive Avalanche Energy (Note 1)	0.89		mJ
dv/dt	MOSFET dv/dt	100		V/ns
	Peak Diode Recovery dv/dt (Note 3)	20		
$P_D$	Power Dissipation	( $T_C = 25^\circ\text{C}$ )	89	28
		- Derate Above $25^\circ\text{C}$	0.71	0.22
$T_J, T_{STG}$	Operating and Storage Temperature Range	-55 to +150		$^\circ\text{C}$
$T_L$	Maximum Lead Temperature for Soldering, 1/8" from Case for 5 Seconds	300		$^\circ\text{C}$

\*Drain current limited by maximum junction temperature.

### Thermal Characteristics

Symbol	Parameter	FCP600N60Z	FCPF600N60Z	Unit
$R_{\theta JC}$	Thermal Resistance, Junction to Case, Max.	1.4	4.5	$^\circ\text{C}/\text{W}$
$R_{\theta JA}$	Thermal Resistance, Junction to Ambient, Max.	62.5	62.5	

## Package Marking and Ordering Information

Part Number	Top Mark	Package	Packing Method	Reel Size	Tape Width	Quantity
FCP600N60Z	FCP600N60Z	TO-220	Tube	N/A	N/A	50 units
FCPF600N60Z	FCPF600N60Z	TO-220F	Tube	N/A	N/A	50 units

## 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	-	-	
$\Delta BV_{DSS} / \Delta T_J$	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 to Source Avalanche Breakdown Voltage	$V_{GS} = 0\text{ V}, I_D = 7.4\text{ A}$	-	700	-	V
$I_{DSS}$	Zero Gate Voltage Drain Current	$V_{DS} = 600\text{ V}, V_{GS} = 0\text{ V}$	-	-	1	$\mu\text{A}$
		$V_{DS} = 480\text{ V}, T_C = 125^\circ\text{C}$	-	1.32	-	
$I_{GSS}$	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	$V_{GS} = V_{DS}, I_D = 250\ \mu\text{A}$	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	$V_{DS} = 380\text{ V}, V_{GS} = 0\text{ V}, f = 1\text{ MHz}$	-	16.5	-	pF
$C_{oss(eff.)}$	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	$f = 1\text{ MHz}$	-	2.89	-	$\Omega$

### Switching Characteristics

$t_{d(on)}$	Turn-On Delay Time	$V_{DD} = 380\text{ V}, I_D = 3.7\text{ A}, V_{GS} = 10\text{ V}, R_G = 4.7\ \Omega$	-	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	$V_{GS} = 0\text{ V}, I_{SD} = 3.7\text{ A}, di_F/dt = 100\text{ A}/\mu\text{s}$	-	200	-	ns
$Q_{rr}$	Reverse Recovery Charge		-	2.3	-	$\mu\text{C}$

#### Notes:

1. Repetitive rating: pulse-width limited by maximum junction temperature.
2.  $I_{AS} = 1.5\text{ A}, V_{DD} = 50\text{ V}, R_G = 25\ \Omega$ , 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

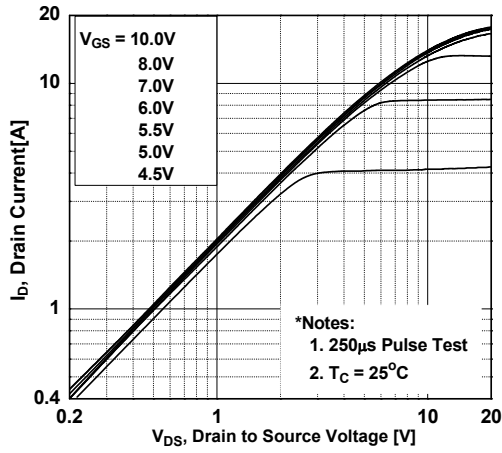


Figure 2. Transfer Characteristics

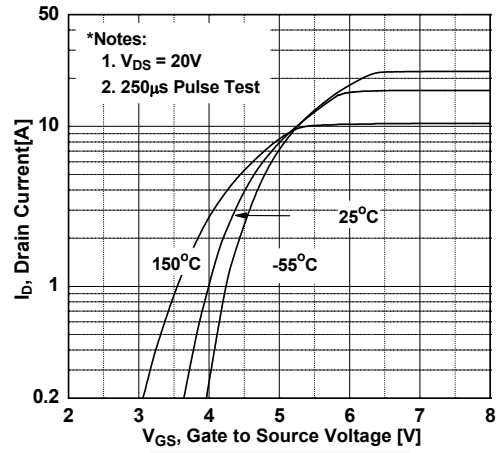


Figure 3. On-Resistance Variation vs. Drain Current and Gate Voltage

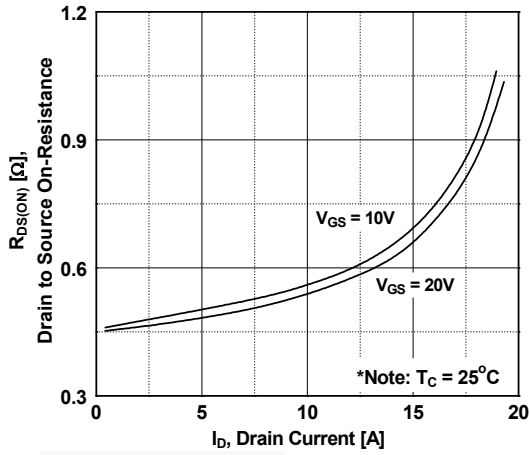


Figure 4. Body Diode Forward Voltage Variation vs. Source Current and Temperature

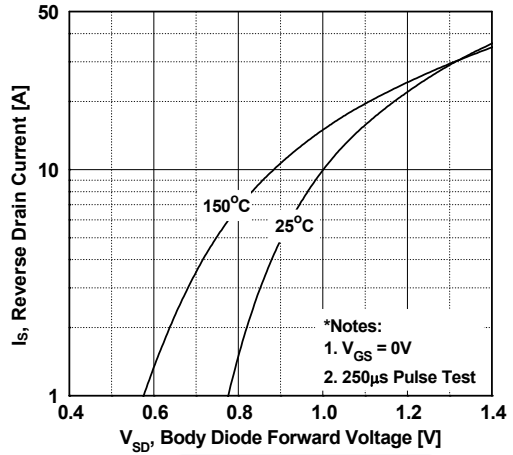


Figure 5. Capacitance Characteristics

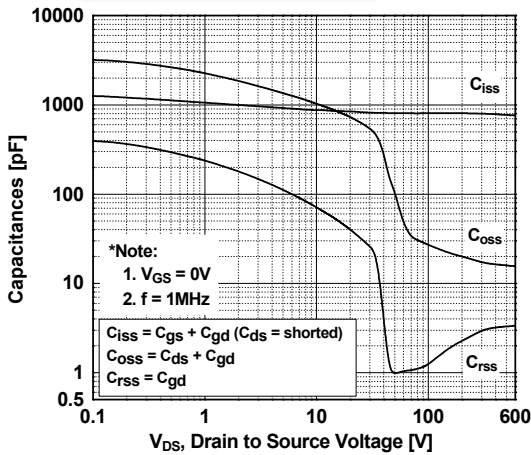
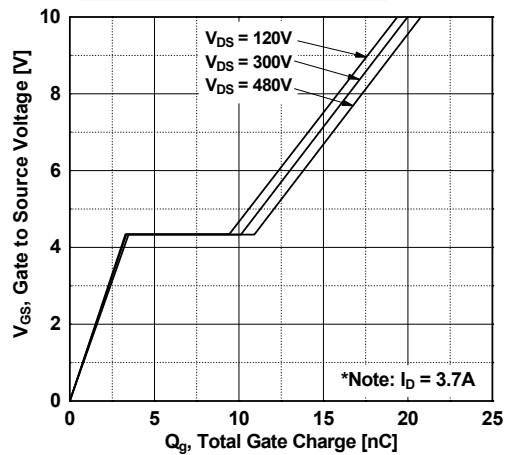
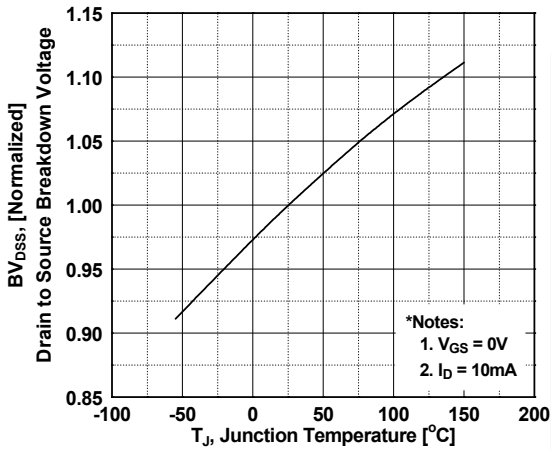


Figure 6. Gate Charge Characteristics

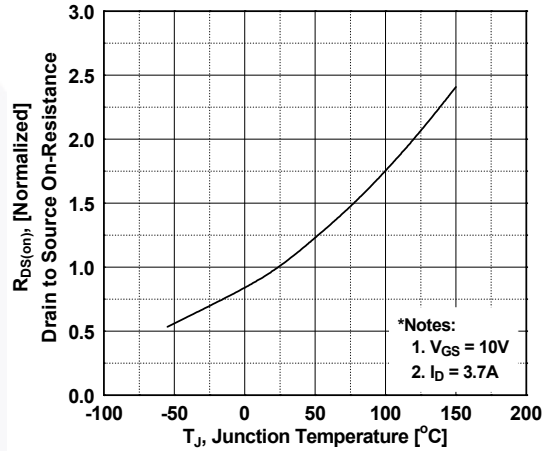


**Typical Performance Characteristics** (Continued)

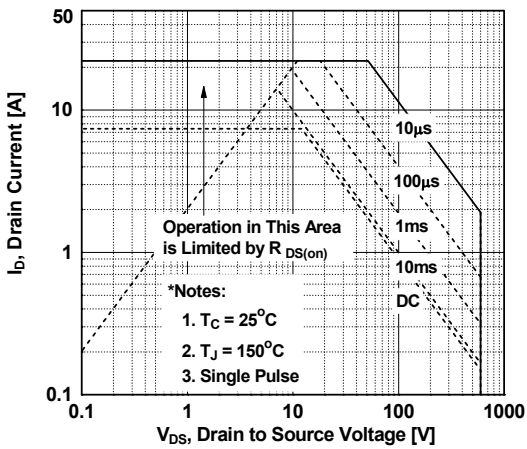
**Figure 7. Breakdown Voltage Variation vs. Temperature**



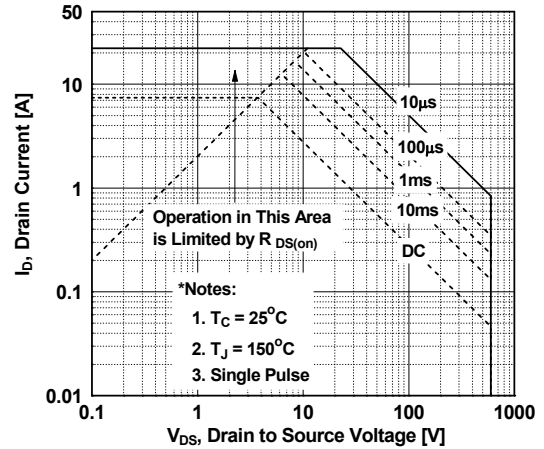
**Figure 8. On-Resistance Variation vs. Temperature**



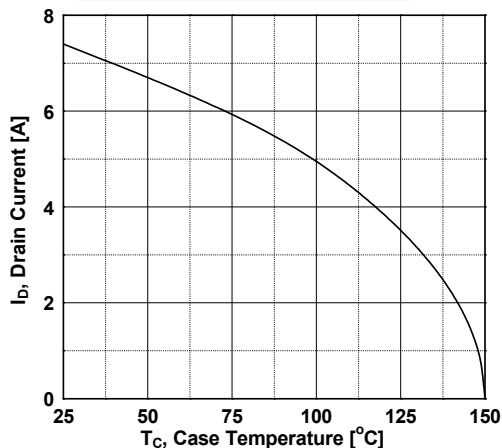
**Figure 9. Maximum Safe Operating Area for FCP600N60Z**



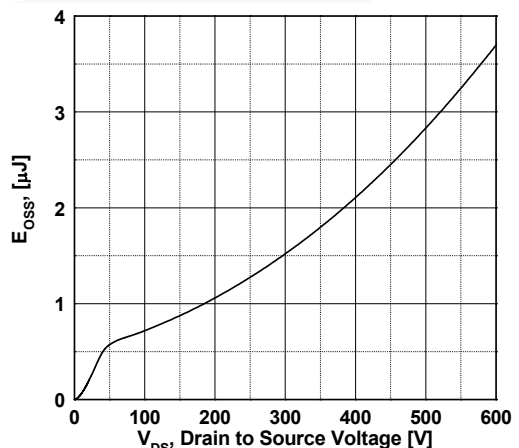
**Figure 10. Maximum Safe Operating Area for FCPF600N60Z**



**Figure 11. Maximum Drain Current vs. Case Temperature**



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



Typical Performance Characteristics (Continued)

Figure 13. Transient Thermal Response Curve for FCP600N60Z

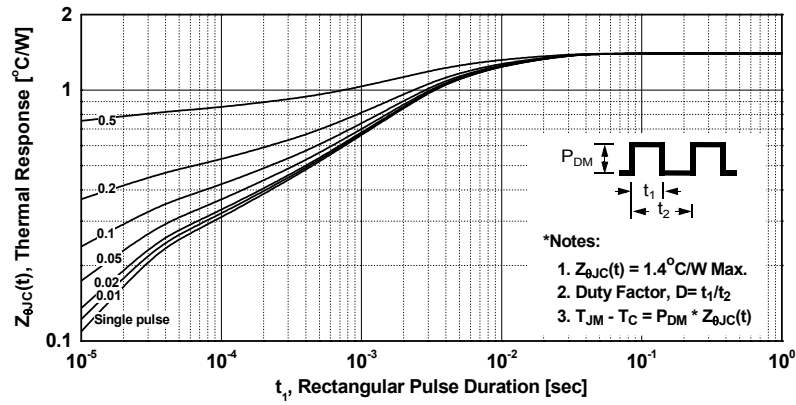
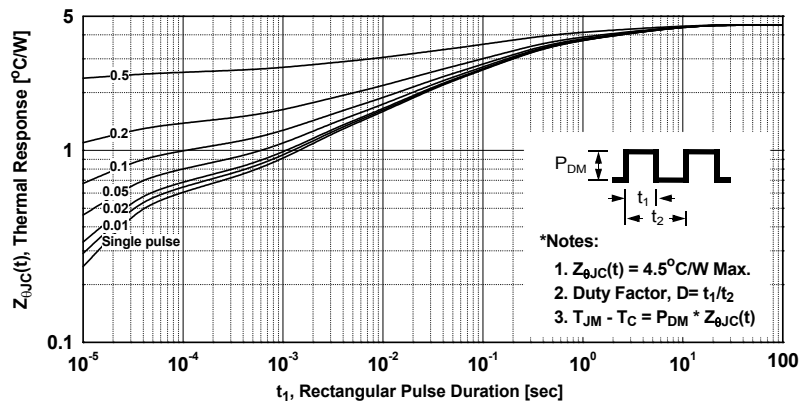


Figure 14. Transient Thermal Response Curve for FCPF600N60Z



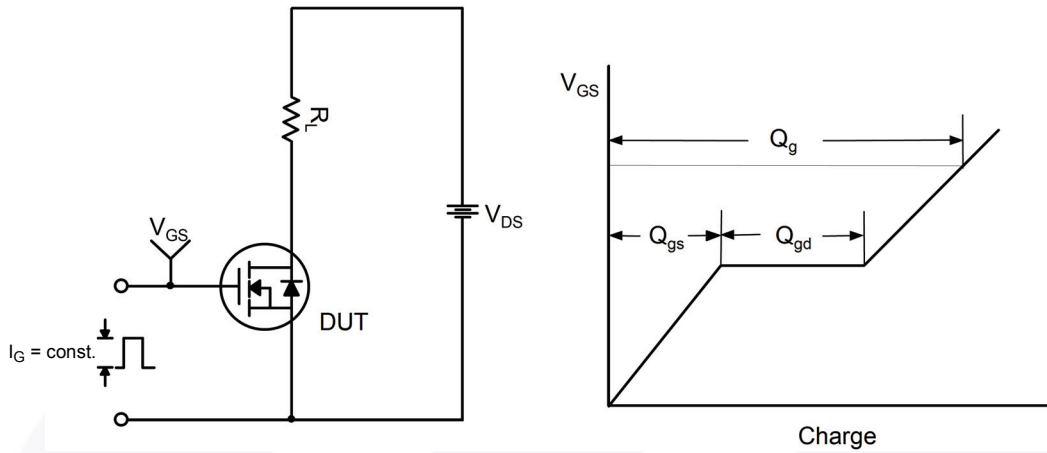


Figure 15. Gate Charge Test Circuit & Waveform



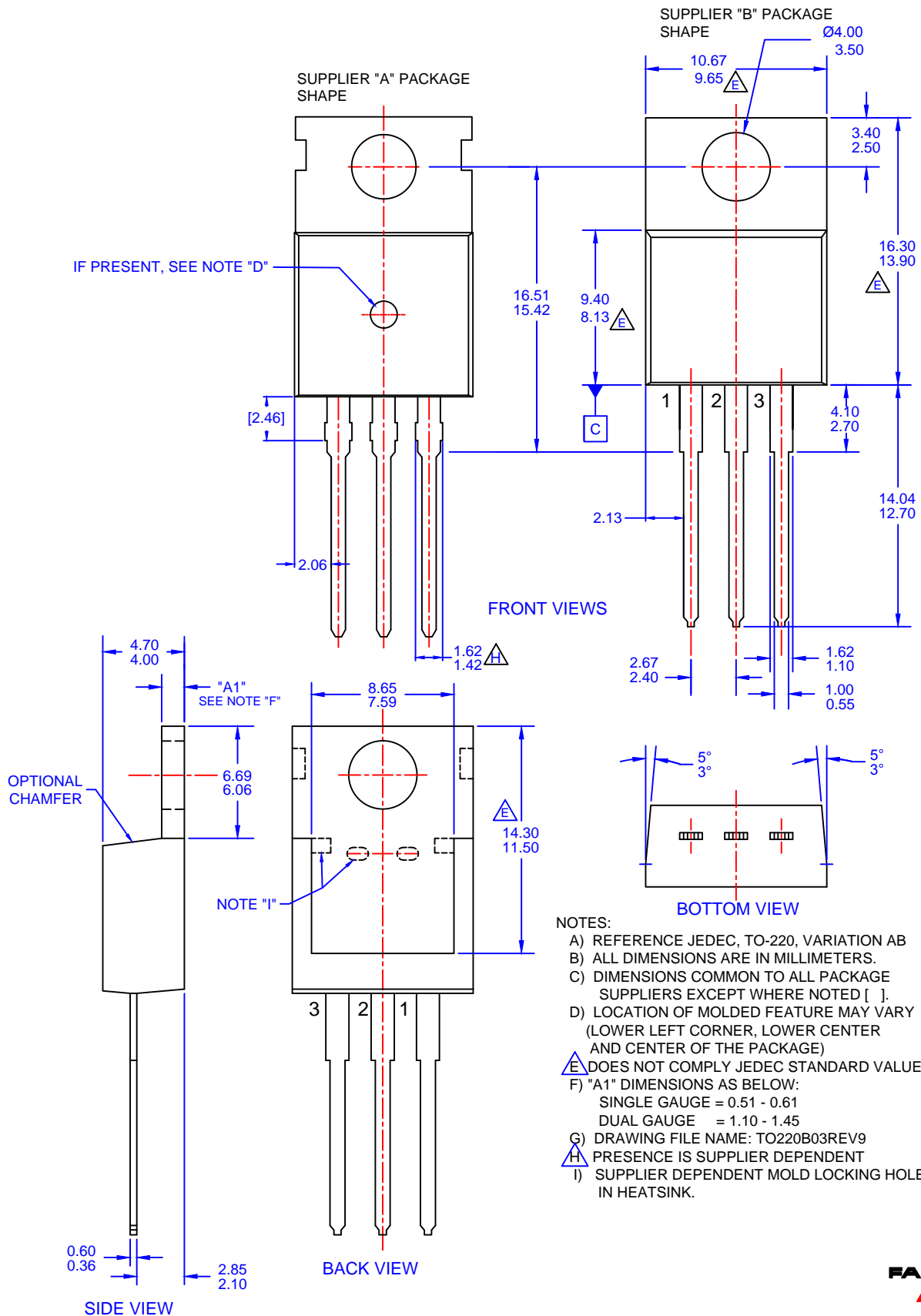
Figure 16. Resistive Switching Test Circuit & Waveforms



Figure 17. Unclamped Inductive Switching Test Circuit & Waveforms

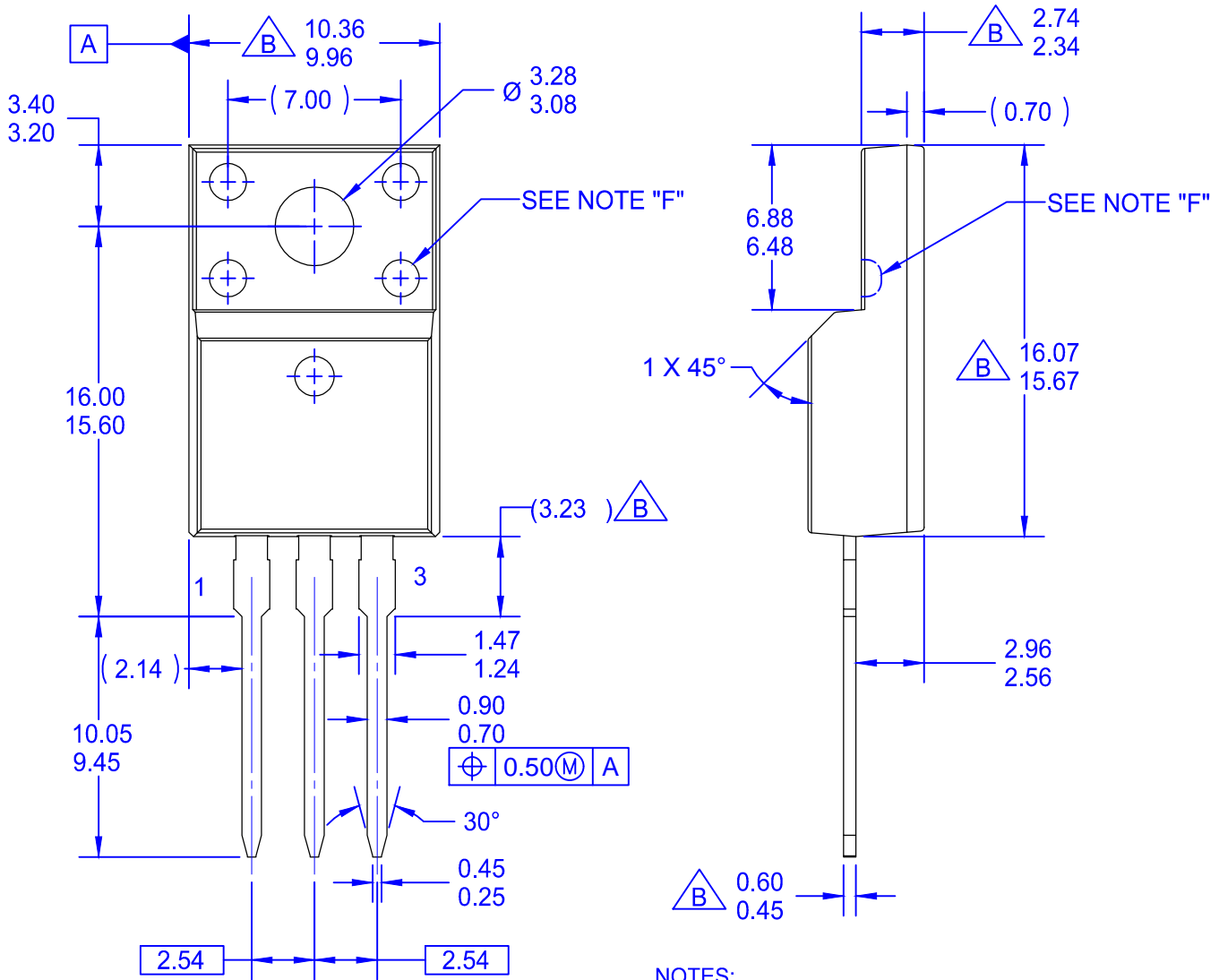


Figure 18. Peak Diode Recovery  $dv/dt$  Test Circuit & Waveforms



- NOTES:
- A) REFERENCE JEDEC, TO-220, VARIATION AB
  - B) ALL DIMENSIONS ARE IN MILLIMETERS.
  - C) DIMENSIONS COMMON TO ALL PACKAGE SUPPLIERS EXCEPT WHERE NOTED [ ].
  - D) LOCATION OF MOLDED FEATURE MAY VARY (LOWER LEFT CORNER, LOWER CENTER AND CENTER OF THE PACKAGE)
  - E) DOES NOT COMPLY JEDEC STANDARD VALUE.
  - F) "A1" DIMENSIONS AS BELOW:  
 SINGLE GAUGE = 0.51 - 0.61  
 DUAL GAUGE = 1.10 - 1.45
  - G) DRAWING FILE NAME: TO220B03REV9
  - H) PRESENCE IS SUPPLIER DEPENDENT
  - I) SUPPLIER DEPENDENT MOLD LOCKING HOLES IN HEATSINK.





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. OPTION 1 - WITH SUPPORT PIN HOLE.  
OPTION 2 - NO SUPPORT PIN HOLE.
- G. DRAWING FILE NAME: TO220M03REV4





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RapidConfigure™  
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SmartMax™  
SMART START™  
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TinyPower™  
TinyPWM™  
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**Definition of Terms**

Datasheet Identification	Product Status	Definition
Advance Information	Formative / In Design	Datasheet contains the design specifications for product development. Specifications may change in any manner without notice.
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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