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May 2014

# FCA36N60NF

## N-Channel SupreMOS<sup>®</sup> FRFET<sup>®</sup> MOSFET

600 V, 34.9 A, 95 mΩ

### Features

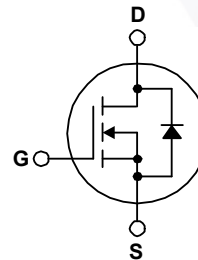
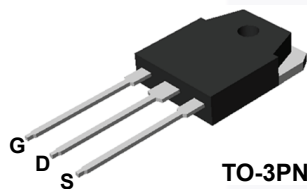
- $R_{DS(on)} = 80 \text{ m}\Omega$  (Typ.) @  $V_{GS} = 10\text{V}$ ,  $I_D = 18 \text{ A}$
- Ultra Low Gate Charge (Typ.  $Q_g = 86 \text{ nC}$ )
- Low Effective Output Capacitance (Typ.  $C_{oss(eff.)} = 338 \text{ pF}$ )
- 100% Avalanche Tested
- RoHS Compliant

### Application

- Solar Inverter
- AC-DC Power Supply

### Description

The SupreMOS<sup>®</sup> MOSFET is Fairchild Semiconductor's next generation of high voltage super-junction (SJ) technology employing a deep trench filling process that differentiates it from the conventional SJ MOSFETs. This advanced technology and precise process control provides lowest  $R_{sp}$  on-resistance, superior switching performance and ruggedness. SupreMOS MOSFET is suitable for high frequency switching power converter applications such as PFC, server/telecom power, FPD TV power, ATX power and industrial power applications. SupreMOS FRFET<sup>®</sup> MOSFET's optimized body diode reverse recovery performance can remove additional component and improve system reliability.



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

Symbol	Parameter	FCA36N60NF	Unit
$V_{DSS}$	Drain to Source Voltage	600	V
$V_{GSS}$	Gate to Source Voltage	$\pm 30$	V
$I_D$	Drain Current	Continuous ( $T_C = 25^\circ\text{C}$ )	A
		Continuous ( $T_C = 100^\circ\text{C}$ )	
$I_{DM}$	Drain Current	Pulsed (Note 1)	A
$E_{AS}$	Single Pulsed Avalanche Energy	(Note 2)	mJ
$I_{AR}$	Avalanche Current	(Note 1)	A
$E_{AR}$	Repetitive Avalanche Energy	(Note 1)	mJ
dv/dt	MOSFET dv/dt	100	V/ns
	Peak Diode Recovery dv/dt	(Note 3)	
$P_D$	Power Dissipation	( $T_C = 25^\circ\text{C}$ )	W
		Derate Above $25^\circ\text{C}$	$W/^\circ\text{C}$
$T_J, T_{STG}$	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	$^\circ\text{C}$

### Thermal Characteristics

Symbol	Parameter	FCA36N60NF	Unit
$R_{\theta JC}$	Thermal Resistance, Junction to Case, Max.	0.40	$^\circ\text{C/W}$
$R_{\theta CS}$	Thermal Resistance, Case to Heat Sink, Typ.	0.24	
$R_{\theta JA}$	Thermal Resistance, Junction to Ambient, Max.	40	

## Package Marking and Ordering Information

Part Number	Top Mark	Package	Packing Method	Reel Size	Tape Width	Quantity
FCA36N60NF	FCA36N60NF	TO-3PN	Tube	N/A	N/A	30 units

## Electrical Characteristics

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

$BV_{DSS}$	Drain to Source Breakdown Voltage	$I_D = 1 \text{ mA}$ , $V_{GS} = 0 \text{ V}$ , $T_J = 25^\circ\text{C}$	600	-	-	V
$\Delta BV_{DSS} / \Delta T_J$	Breakdown Voltage Temperature Coefficient	$I_D = 1 \text{ mA}$ , Referenced to $25^\circ\text{C}$	-	0.60	-	$V/^\circ\text{C}$
$I_{DSS}$	Zero Gate Voltage Drain Current	$V_{DS} = 480 \text{ V}$ , $V_{GS} = 0 \text{ V}$ $T_J = 125^\circ\text{C}$	-	-	10 100	$\mu\text{A}$
$I_{GSS}$	Gate to Body Leakage Current	$V_{GS} = \pm 30 \text{ V}$ , $V_{DS} = 0 \text{ V}$	-	-	$\pm 100$	nA

### On Characteristics

$V_{GS(th)}$	Gate Threshold Voltage	$V_{GS} = V_{DS}$ , $I_D = 250 \mu\text{A}$	3.0	3.7	5.0	V
$R_{DS(on)}$	Static Drain to Source On Resistance	$V_{GS} = 10 \text{ V}$ , $I_D = 18 \text{ A}$	-	80	95	$\text{m}\Omega$
$g_{FS}$	Forward Transconductance	$V_{DS} = 20 \text{ V}$ , $I_D = 18 \text{ A}$	-	39	-	S

### Dynamic Characteristics

$C_{iss}$	Input Capacitance	$V_{DS} = 100 \text{ V}$ , $V_{GS} = 0 \text{ V}$ , $f = 1 \text{ MHz}$	-	3191	4245	pF
$C_{oss}$	Output Capacitance		-	145	195	pF
$C_{rss}$	Reverse Transfer Capacitance		-	5	8	pF
$C_{oss}$	Output Capacitance	$V_{DS} = 380 \text{ V}$ , $V_{GS} = 0 \text{ V}$ , $f = 1 \text{ MHz}$	-	81	-	pF
$C_{oss,eff.}$	Effective Output Capacitance	$V_{DS} = 0 \text{ V}$ to $480 \text{ V}$ , $V_{GS} = 0 \text{ V}$	-	338	-	pF
$Q_{g(tot)}$	Total Gate Charge at 10V	$V_{DS} = 380 \text{ V}$ , $I_D = 18 \text{ A}$ , $V_{GS} = 10 \text{ V}$ (Note 4)	-	86	112	nC
$Q_{gs}$	Gate to Source Gate Charge		-	16	-	nC
$Q_{gd}$	Gate to Drain "Miller" Charge		-	36	-	nC
ESR	Equivalent Series Resistance (G-S)	$f = 1 \text{ MHz}$	-	1.2	-	$\Omega$

### Switching Characteristics

$t_{d(on)}$	Turn-On Delay Time	$V_{DD} = 380 \text{ V}$ , $I_D = 18 \text{ A}$ , $V_{GS} = 10 \text{ V}$ , $R_G = 4.7 \Omega$ (Note 4)	-	27	64	ns
$t_r$	Turn-On Rise Time		-	17	44	ns
$t_{d(off)}$	Turn-Off Delay Time		-	92	194	ns
$t_f$	Turn-Off Fall Time		-	4	18	ns

### Drain-Source Diode Characteristics

I <sub>S</sub>	Maximum Continuous Drain to Source Diode Forward Current	-	-	36	A	
I <sub>SM</sub>	Maximum Pulsed Drain to Source Diode Forward Current	-	-	108	A	
V <sub>SD</sub>	Drain to Source Diode Forward Voltage	V <sub>GS</sub> = 0 V, I <sub>SD</sub> = 18 A	-	-	1.2	V
t <sub>rr</sub>	Reverse Recovery Time	V <sub>GS</sub> = 0 V, I <sub>SD</sub> = 18 A, dI <sub>F</sub> /dt = 100 A/μs	-	166	-	ns
Q <sub>rr</sub>	Reverse Recovery Charge		-	1.3	-	μC

#### Notes:

1. Repetitive rating: pulse-width limited by maximum junction temperature.
2.  $I_{AS} = 12 \text{ A}$ ,  $R_G = 25 \Omega$ , starting  $T_J = 25^\circ\text{C}$ .
3.  $I_{SD} \leq 36 \text{ A}$ ,  $di/dt \leq 1200 \text{ A}/\mu\text{s}$ ,  $V_{DD} = 380 \text{ V}$ , starting  $T_J = 25^\circ\text{C}$ .
4. Essentially independent of operating temperature typical characteristics.

## Typical Performance Characteristics

Figure 1. On-Region Characteristics

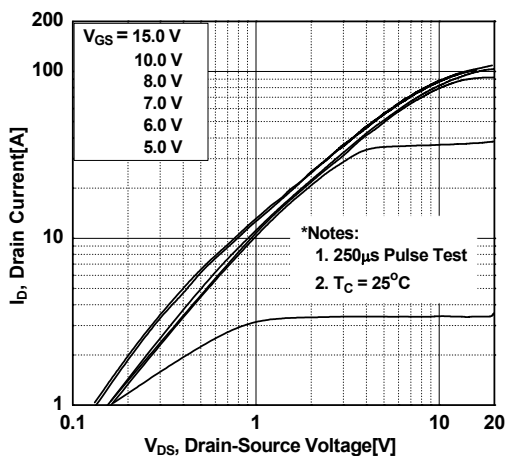


Figure 2. Transfer Characteristics

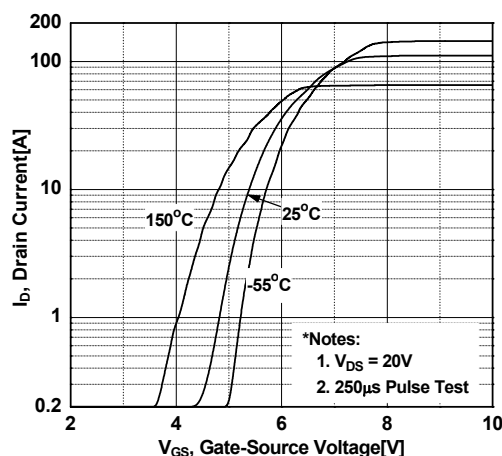


Figure 3. On-Resistance Variation vs. Drain Current and Gate Voltage

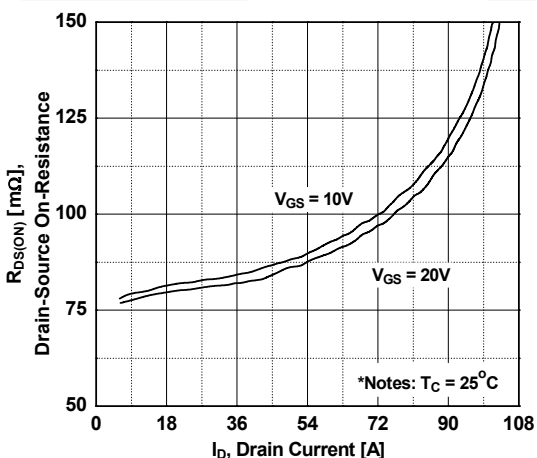


Figure 4. Body Diode Forward Voltage Variation vs. Source Current and Temperature

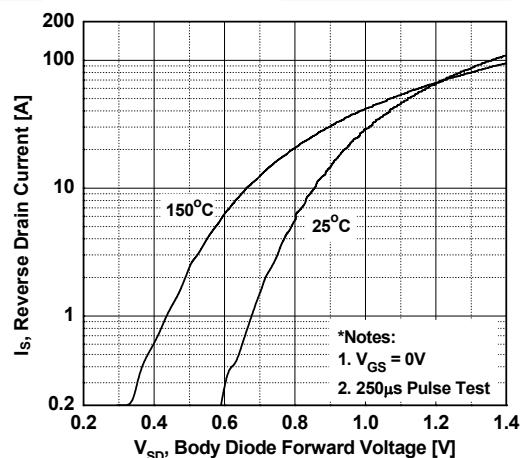


Figure 5. Capacitance Characteristics

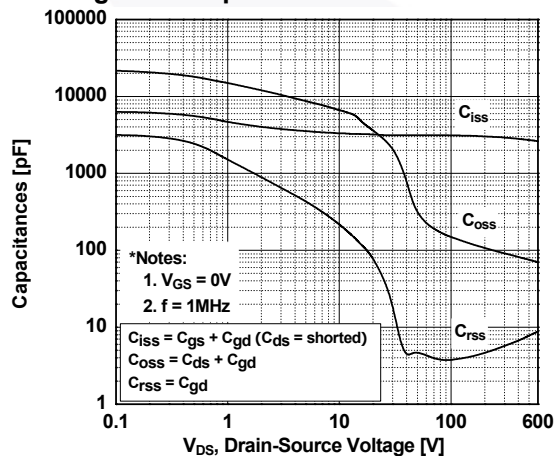
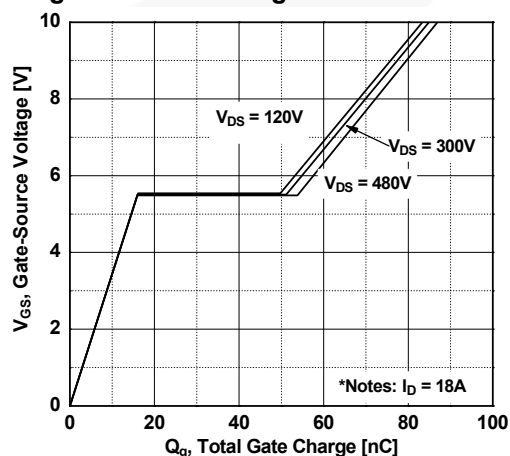


Figure 6. Gate Charge Characteristics



## Typical Performance Characteristics (Continued)

Figure 7. Breakdown Voltage Variation vs. Temperature

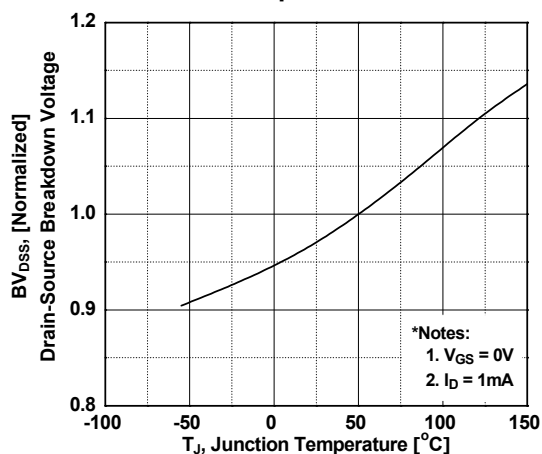


Figure 8. On-Resistance Variation vs. Temperature

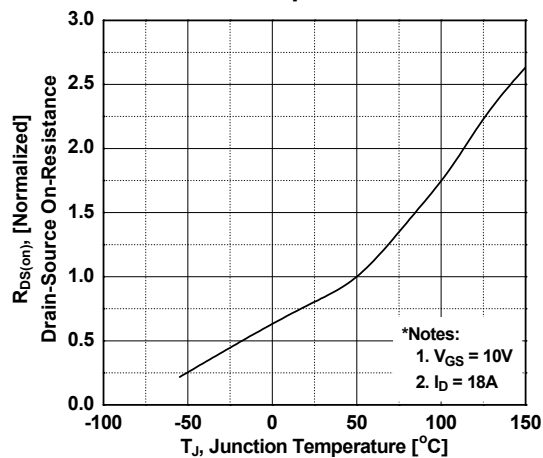


Figure 9. Maximum Safe Operating Area

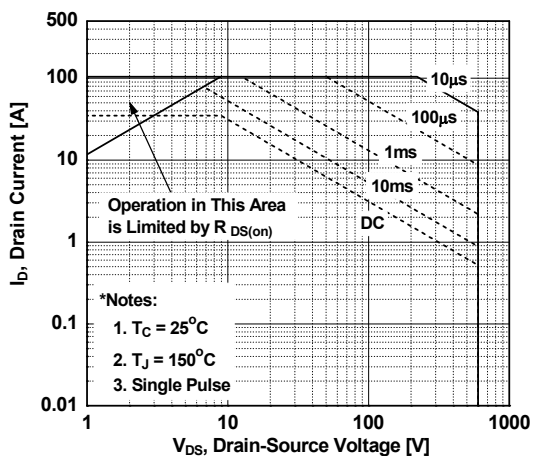


Figure 10. Maximum Drain Current vs. Case Temperature

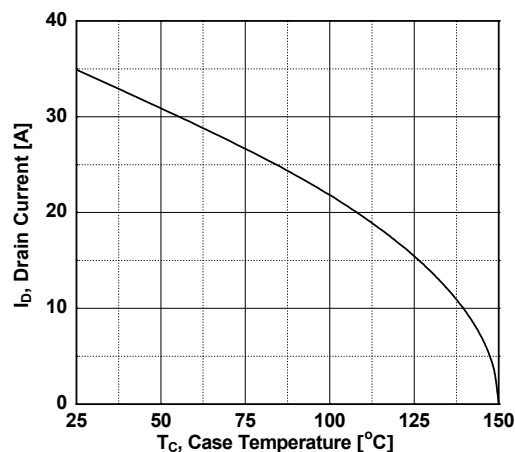
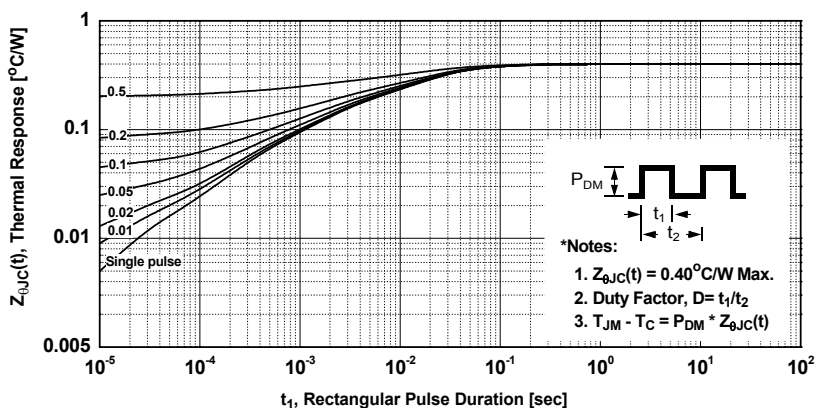


Figure 11. Transient Thermal Response Curve



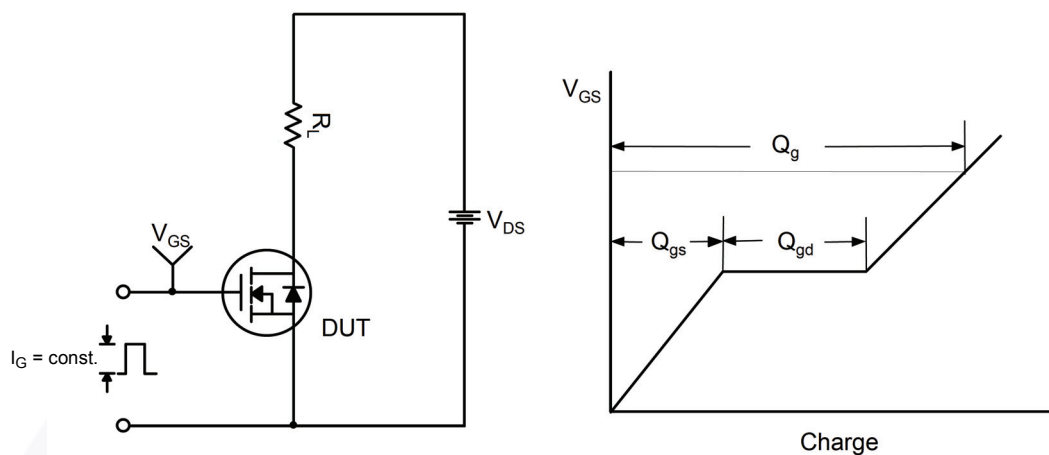


Figure 12. Gate Charge Test Circuit & Waveform



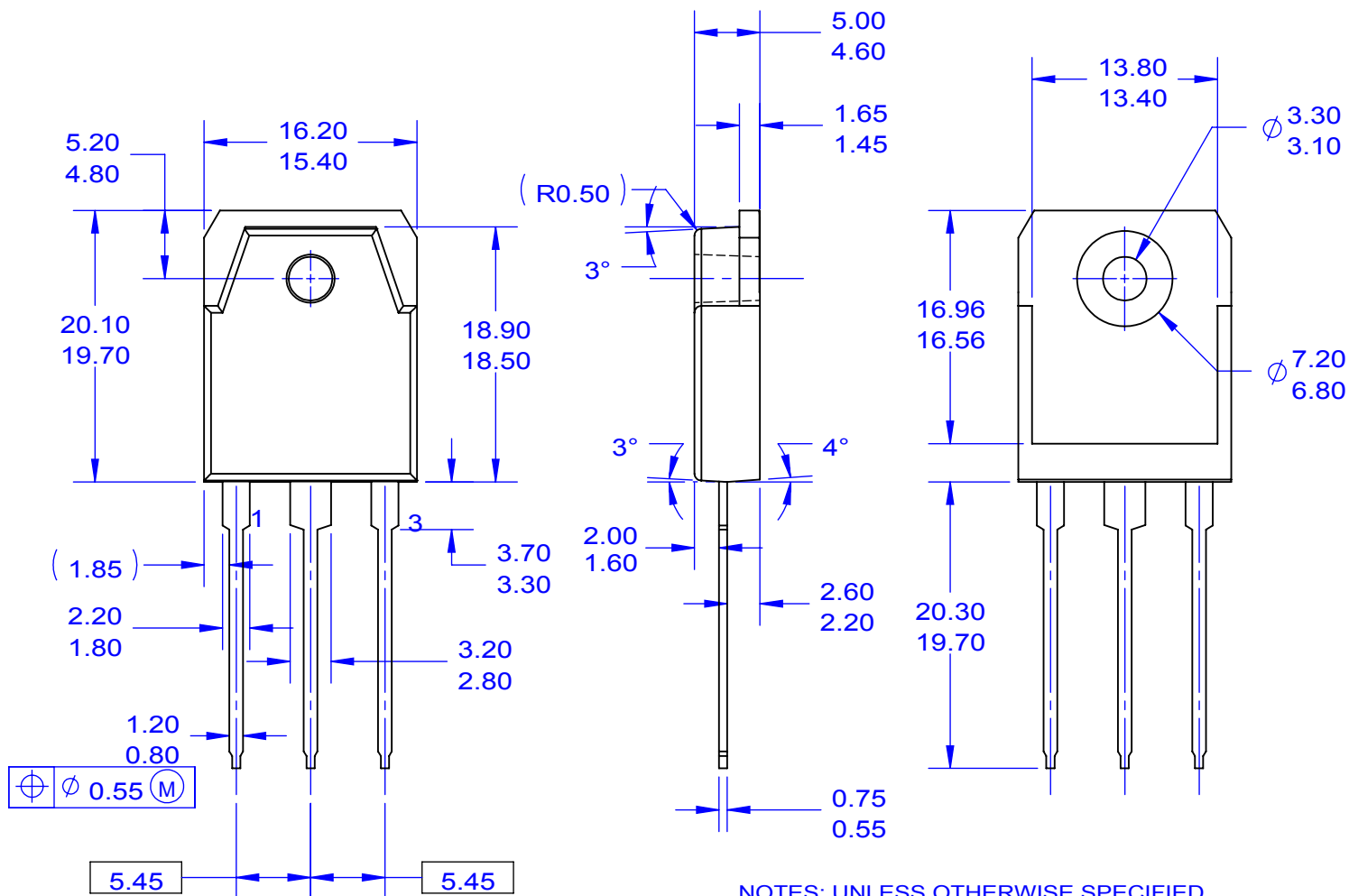
Figure 13. Resistive Switching Test Circuit & Waveforms



Figure 14. Unclamped Inductive Switching Test Circuit & Waveforms

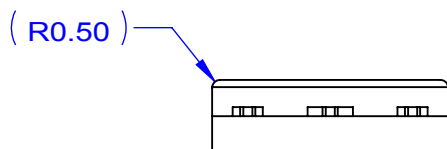


Figure 15. Peak Diode Recovery  $dv/dt$  Test Circuit & Waveforms



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