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June 2014

FCA47N60 / FCA47N60_F109

N-Channel SuperFET[®] MOSFET

600 V, 47 A, 70 mΩ

Features

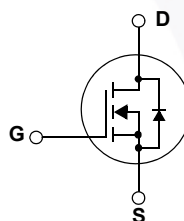
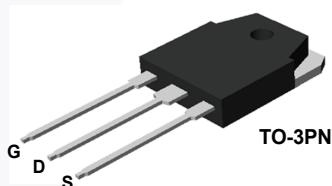
- 650 V @ $T_J = 150^\circ\text{C}$
- Typ. $R_{DS(on)} = 58\text{ m}\Omega$
- Ultra Low Gate Charge (Typ. $Q_g = 210\text{ nC}$)
- Low Effective Output Capacitance (Typ. $C_{oss(eff.)} = 420\text{ pF}$)
- 100% Avalanche Tested

Application

- Solar Invertor
- AC-DC Power Supply

Description

SuperFET[®] 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 technology is tailored to minimize conduction loss, provide superior switching performance, dv/dt rate and higher avalanche energy. Consequently, SuperFET MOSFET is very suitable for the switching power applications such as PFC, server/telecom power, FPD TV power, ATX power and industrial power applications.



Absolute Maximum Ratings

Symbol	Parameter	FCA47N60	FCA47N60_F109	Unit
V_{DSS}	Drain-Source Voltage		600	V
I_D	Drain Current	- Continuous ($T_C = 25^\circ\text{C}$)	47	A
		- Continuous ($T_C = 100^\circ\text{C}$)	29.7	A
I_{DM}	Drain Current		141	A
V_{GSS}	Gate-Source voltage		± 30	V
E_{AS}	Single Pulsed Avalanche Energy		1800	mJ
I_{AR}	Avalanche Current		47	A
E_{AR}	Repetitive Avalanche Energy		41.7	mJ
dv/dt	Peak Diode Recovery dv/dt		4.5	V/ns
P_D	Power Dissipation	($T_C = 25^\circ\text{C}$)	417	W
		- Derate above 25°C	3.33	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 Purpose, 1/8" from Case for 5 Seconds		300	$^\circ\text{C}$

Thermal Characteristics

Symbol	Parameter	Typ.	Max.	Unit
$R_{\theta JC}$	Thermal Resistance, Junction-to-Case, Max.	--	0.3	$^\circ\text{C}/\text{W}$
$R_{\theta JA}$	Thermal Resistance, Junction-to-Ambient, Max.	--	41.7	$^\circ\text{C}/\text{W}$

Package Marking and Ordering Information

Device Marking	Device	Package	Reel Size	Tape Width	Quantity
FCA47N60	FCA47N60	TO-3PN	-	-	30
FCA47N60	FCA47N60_F109	TO-3PN	-	-	30

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-Source Breakdown Voltage	$V_{GS} = 0\text{ V}, I_D = 250\ \mu\text{A}, T_J = 25^\circ\text{C}$	600	--	--	V
		$V_{GS} = 0\text{ V}, I_D = 250\ \mu\text{A}, T_J = 150^\circ\text{C}$	--	650	--	V
$\Delta BV_{DSS} / \Delta T_J$	Breakdown Voltage Temperature Coefficient	$I_D = 250\ \mu\text{A}$, Referenced to 25°C	--	0.6	--	V/ $^\circ\text{C}$
BV_{DS}	Drain-Source Avalanche Breakdown Voltage	$V_{GS} = 0\text{ V}, I_D = 47\text{ A}$	--	700	--	V
I_{DSS}	Zero Gate Voltage Drain Current	$V_{DS} = 600\text{ V}, V_{GS} = 0\text{ V}$	--	--	1	μA
		$V_{DS} = 480\text{ V}, T_C = 125^\circ\text{C}$	--	--	10	μA
I_{GSSF}	Gate-Body Leakage Current, Forward	$V_{GS} = 30\text{ V}, V_{DS} = 0\text{ V}$	--	--	100	nA
I_{GSSR}	Gate-Body Leakage Current, Reverse	$V_{GS} = -30\text{ V}, V_{DS} = 0\text{ V}$	--	--	-100	nA

On Characteristics

$V_{GS(th)}$	Gate Threshold Voltage	$V_{DS} = V_{GS}, I_D = 250\ \mu\text{A}$		3.0	--	5.0
$R_{DS(on)}$	Static Drain-Source On-Resistance	$V_{GS} = 10\text{ V}, I_D = 23.5\text{ A}$		--	0.058	0.07
g_{FS}	Forward Transconductance	$V_{DS} = 40\text{ V}, I_D = 23.5\text{ A}$		--	40	--
$V_{GS(th)}$	Gate Threshold Voltage	$V_{DS} = V_{GS}, I_D = 250\ \mu\text{A}$		3.0	--	5.0

Dynamic Characteristics

C_{iss}	Input Capacitance	$V_{DS} = 25\text{ V}, V_{GS} = 0\text{ V}, f = 1.0\text{ MHz}$	--	5900	8000	pF
C_{oss}	Output Capacitance		--	3200	4200	pF
C_{riss}	Reverse Transfer Capacitance		--	250	--	pF
C_{oss}	Output Capacitance	$V_{DS} = 480\text{ V}, V_{GS} = 0\text{ V}, f = 1.0\text{ MHz}$	--	160	--	pF
$C_{oss\text{ eff.}}$	Effective Output Capacitance	$V_{DS} = 0\text{ V to } 400\text{ V}, V_{GS} = 0\text{ V}$	--	420	--	pF

Switching Characteristics

$t_{d(on)}$	Turn-On Delay Time	$V_{DD} = 300\text{ V}, I_D = 47\text{ A}$ $R_G = 25\ \Omega$	(Note 4)	--	185	430	ns
t_r	Turn-On Rise Time			--	210	450	ns
$t_{d(off)}$	Turn-Off Delay Time	$V_{DS} = 480\text{ V}, I_D = 47\text{ A}$ $V_{GS} = 10\text{ V}$	(Note 4)	--	520	1100	ns
t_f	Turn-Off Fall Time			--	75	160	ns
Q_g	Total Gate Charge	$V_{DS} = 480\text{ V}, I_D = 47\text{ A}$ $V_{GS} = 10\text{ V}$	(Note 4)	--	210	270	nC
Q_{gs}	Gate-Source Charge			--	38	--	nC
Q_{gd}	Gate-Drain Charge			--	110	--	nC

Drain-Source Diode Characteristics

I_S	Maximum Continuous Drain-Source Diode Forward Current		--	--	47	A	
I_{SM}	Maximum Pulsed Drain-Source Diode Forward Current		--	--	141	A	
V_{SD}	Drain-Source Diode Forward Voltage	$V_{GS} = 0\text{ V}, I_S = 47\text{ A}$		--	--	1.4	V
t_{rr}	Reverse Recovery Time	$V_{GS} = 0\text{ V}, I_S = 47\text{ A}$ $di/dt = 100\text{ A}/\mu\text{s}$	(Note 4)	--	590	--	ns
Q_{rr}	Reverse Recovery Charge			--	25	--	μC

Notes:

1. Repetitive Rating: Pulse-width limited by maximum junction temperature.
2. $I_{AS} = 18\text{ A}, R_G = 25\ \Omega$, starting $T_J = 25^\circ\text{C}$
3. $I_{SD} \leq 47\text{ A}, di/dt \leq 200\text{ A}/\mu\text{s}, V_{DD} = 380\text{ V}$, starting $T_J = 25^\circ\text{C}$
4. Essentially independent of operating temperature typical characteristics.

Typical Characteristics

Figure 1. On-Region Characteristics

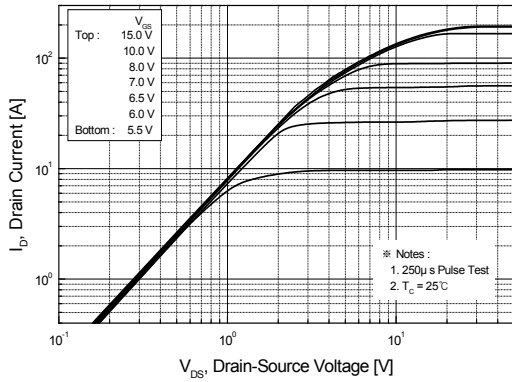


Figure 2. Transfer Characteristics

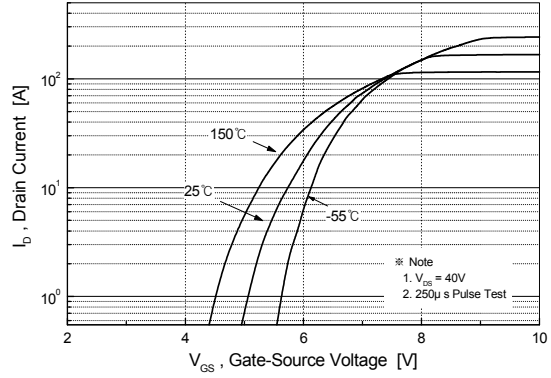


Figure 3. On-Resistance Variation vs. Drain Current and Gate Voltage

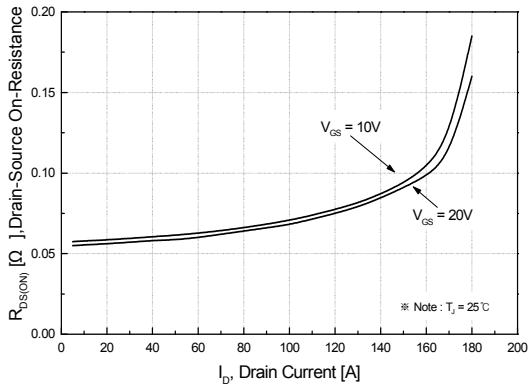


Figure 4. Body Diode Forward Voltage Variation vs. Source Current and Temperature

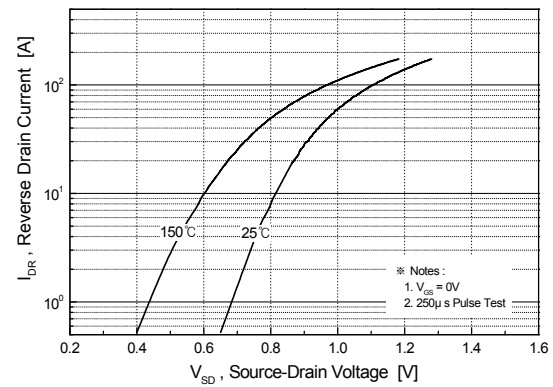


Figure 5. Capacitance Characteristics

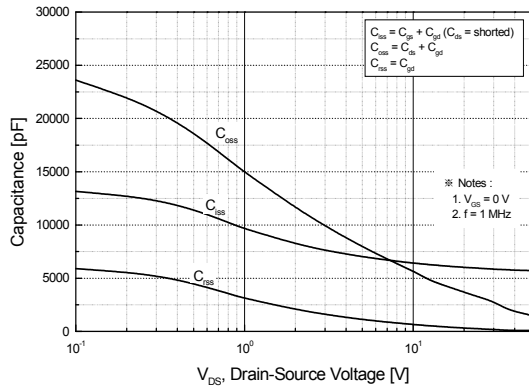
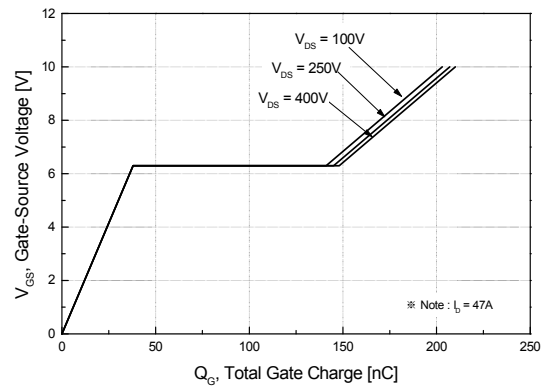


Figure 6. Gate Charge Characteristics



Typical Characteristics (Continued)

Figure 7. Breakdown Voltage Variation vs. Temperature

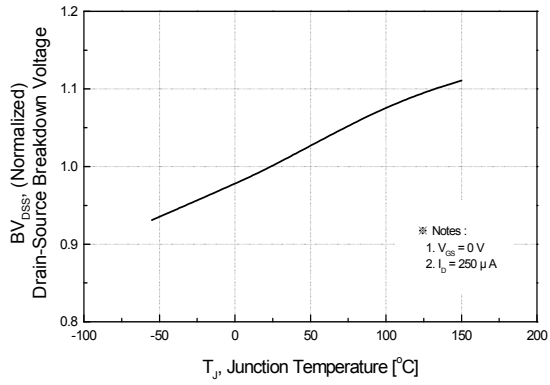


Figure 8. On-Resistance Variation vs. Temperature

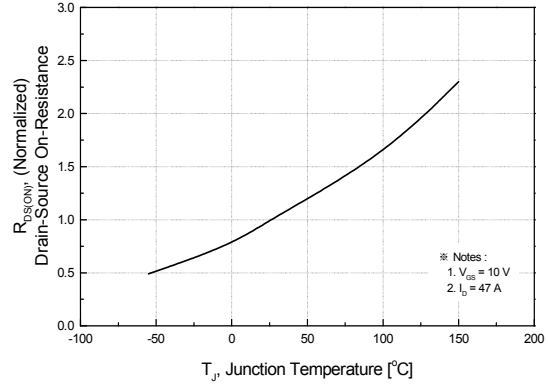


Figure 9. Safe Operating Area

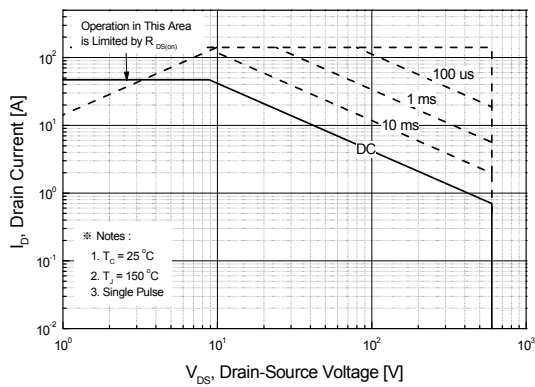


Figure 10. Maximum Drain Current vs. Case Temperature

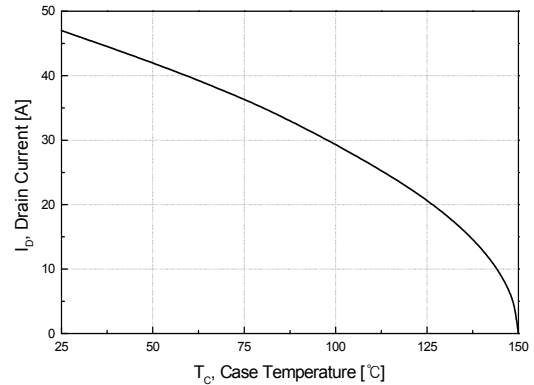


Figure 11. Transient Thermal Response Curve

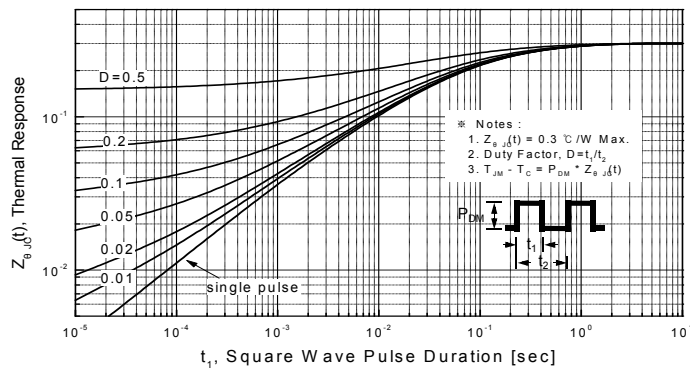


Figure 12. Gate Charge Test Circuit & Waveform

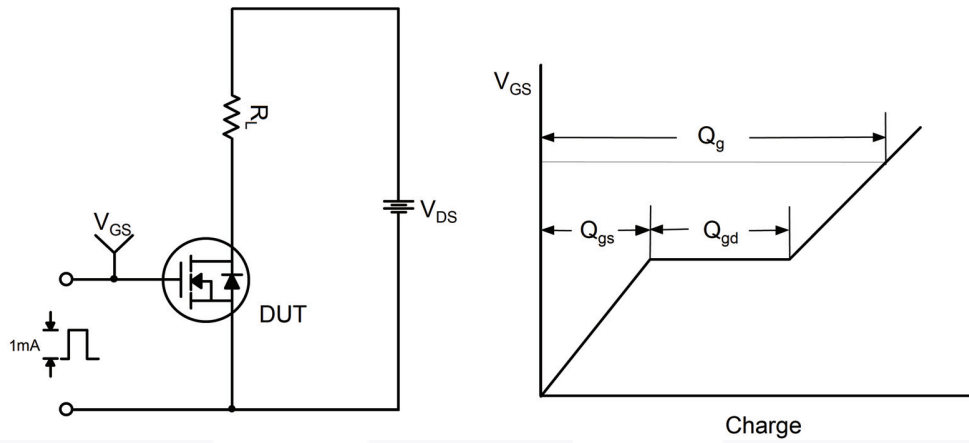


Figure 13. Resistive Switching Test Circuit & Waveforms

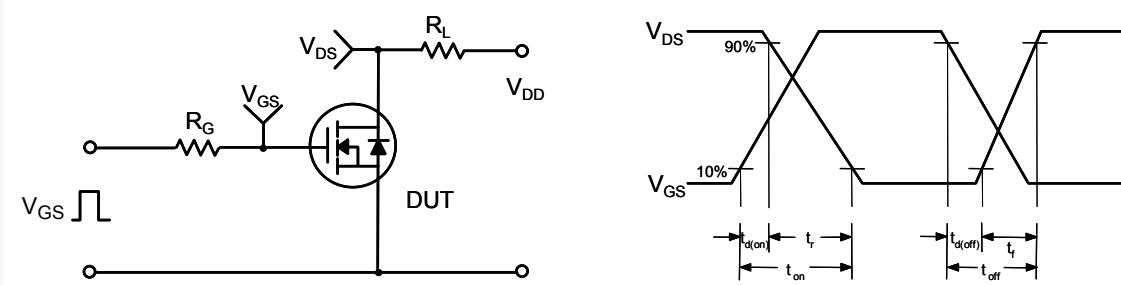


Figure 14. Unclamped Inductive Switching Test Circuit & Waveforms

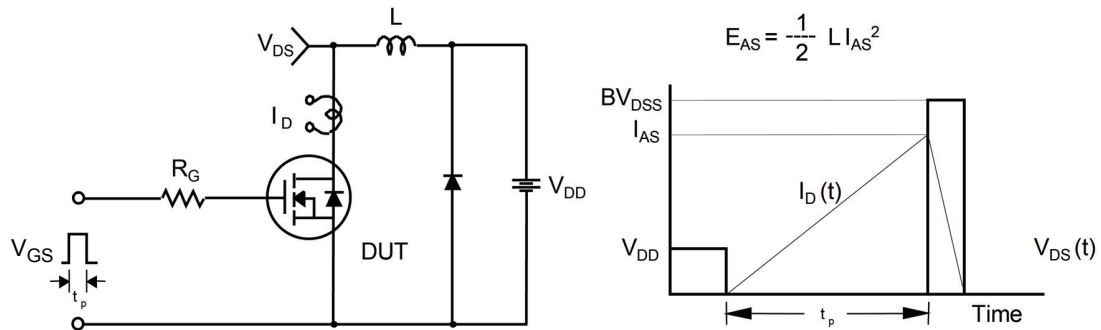
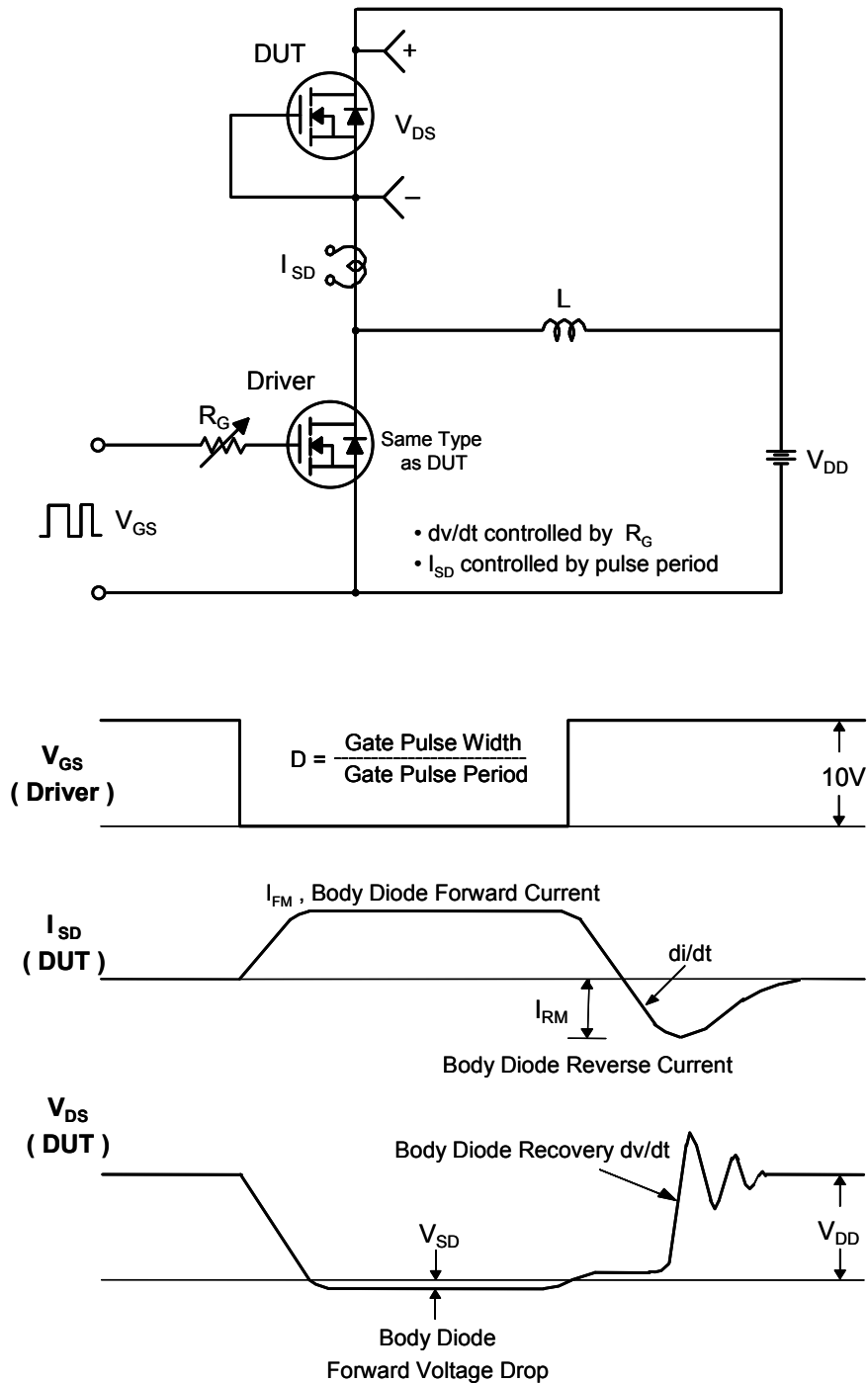
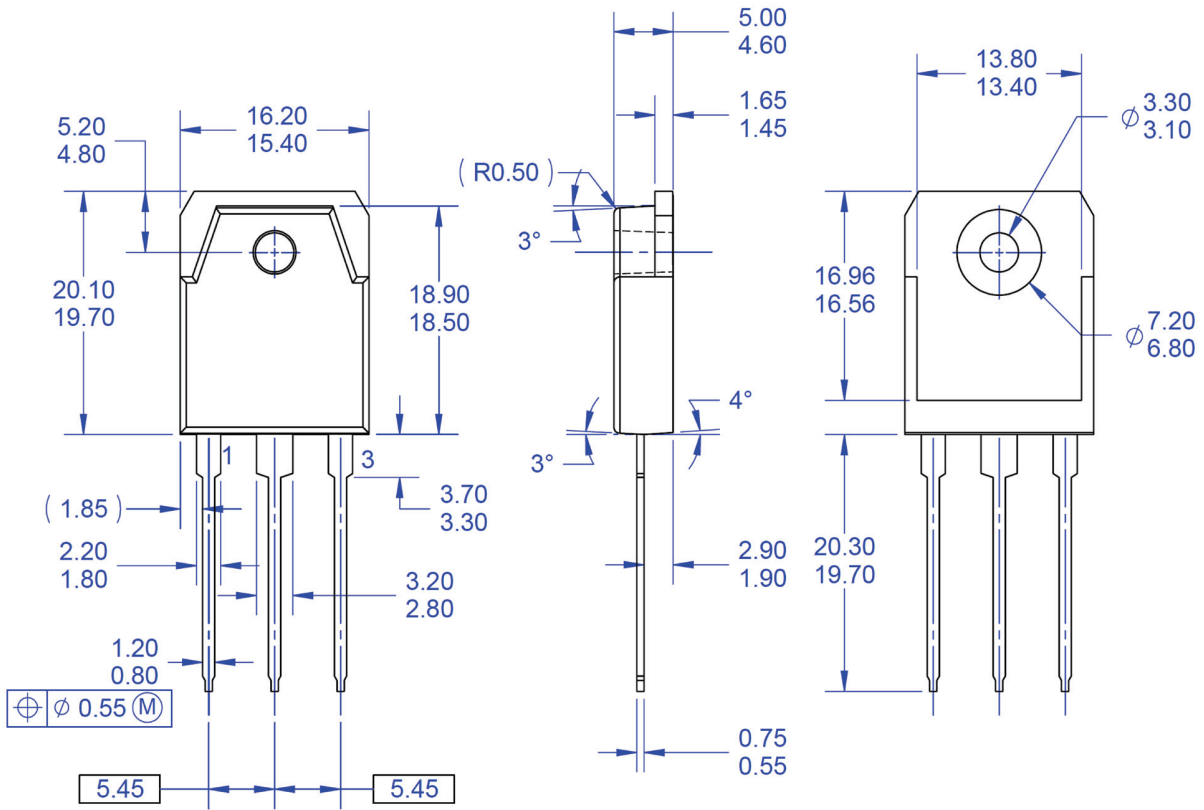


Figure 15. Peak Diode Recovery dv/dt Test Circuit & Waveforms



Mechanical Dimensions



NOTES: UNLESS OTHERWISE SPECIFIED

- A) THIS PACKAGE CONFORMS TO EIAJ SC-65 PACKAGING STANDARD.
- B) ALL DIMENSIONS ARE IN MILLIMETERS.
- C) DIMENSION AND TOLERANCING PER ASME14.5-2009.
- D) DIMENSIONS ARE EXCLUSIVE OF BURRS, MOLD FLASH, AND TIE BAR EXTRUSIONS.
- E) DRAWING FILE NAME: TO3PN03AREV1.
- F) FAIRCHILD SEMICONDUCTOR.

Figure 16. TO3PN, 3-Lead, Plastic, EIAJ SC-65

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