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# FCA47N60F

## N-Channel SuperFET® FRFET® MOSFET

### 600 V, 47 A, 73 mΩ

### Features

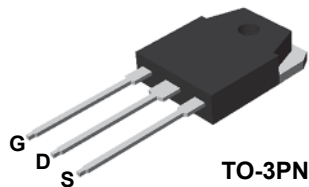
- 650 V @  $T_J = 150\text{ }^\circ\text{C}$
- Typ.  $R_{DS(on)} = 62\text{ m}\Omega$
- Fast Recovery Time (Typ.  $T_{rr} = 240\text{ ns}$ )
- Ultra Low Gate Charge (Typ.  $Q_g = 210\text{ nC}$ )
- Low Effective Output Capacitance (Typ.  $C_{oss(eff.)} = 420\text{ pF}$ )
- 100% Avalanche Tested
- RoHS Compliant

### Applications

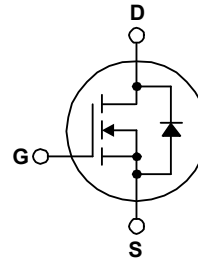
- Solar Inverter
- AC-DC Power Supply

### Description

SuperFET® MOSFET is ON 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. SuperFET FRFET® MOSFET's optimized body diode reverse recovery performance can remove additional component and improve system reliability.



TO-3PN



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

Symbol	Parameter		FCA47N60F	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	- Pulsed (Note 1)	141	A
$V_{GSS}$	Gate-Source voltage		$\pm 30$	V
$E_{AS}$	Single Pulsed Avalanche Energy (Note 2)		1800	mJ
$I_{AR}$	Avalanche Current (Note 1)		47	A
$E_{AR}$	Repetitive Avalanche Energy (Note 1)		41.7	mJ
$dv/dt$	Peak Diode Recovery $dv/dt$ (Note 3)		50	V/ns
$P_D$	Power Dissipation	( $T_C = 25^\circ\text{C}$ )	417	W
		- Derate Above $25^\circ\text{C}$	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, 1/8" from Case for 5 Seconds		300	$^\circ\text{C}$

### Thermal Characteristics

Symbol	Parameter	FCA47N60F	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

Part Number	Top Mark	Package	Packing Method	Reel Size	Tape Width	Quantity
FCA47N60F	FCA47N60F	TO-3PN	Tube	N/A	N/A	30 units

## Electrical Characteristics T<sub>C</sub> = 25°C unless otherwise noted

Symbol	Parameter	Conditions	Min.	Typ.	Max.	Unit
<b>Off Characteristics</b>						
BV <sub>DSS</sub>	Drain-Source Breakdown Voltage	V <sub>GS</sub> = 0 V, I <sub>D</sub> = 250 μA, T <sub>J</sub> = 25°C	600	--	--	V
		V <sub>GS</sub> = 0 V, I <sub>D</sub> = 250 μA, T <sub>J</sub> = 150°C	--	650	--	V
ΔBV <sub>DSS</sub> / ΔT <sub>J</sub>	Breakdown Voltage Temperature Coefficient	I <sub>D</sub> = 250 μA, Referenced to 25°C	--	0.6	--	V/°C
BV <sub>DS</sub>	Drain to Source Avalanche Breakdown Voltage	V <sub>GS</sub> = 0 V, I <sub>D</sub> = 47 A	--	700	--	V
I <sub>DSS</sub>	Zero Gate Voltage Drain Current	V <sub>DS</sub> = 600 V, V <sub>GS</sub> = 0 V,	--	--	10	μA
		V <sub>DS</sub> = 480 V, T <sub>C</sub> = 125°C	--	--	100	μA
I <sub>GSSF</sub>	Gate-Body Leakage Current, Forward	V <sub>GS</sub> = 30 V, V <sub>DS</sub> = 0 V	--	--	100	nA
I <sub>GSSR</sub>	Gate-Body Leakage Current, Reverse	V <sub>GS</sub> = -30 V, V <sub>DS</sub> = 0 V	--	--	-100	nA
<b>On Characteristics</b>						
V <sub>GS(th)</sub>	Gate Threshold Voltage	V <sub>DS</sub> = V <sub>GS</sub> , I <sub>D</sub> = 250 μA	3.0	--	5.0	V
R <sub>DS(on)</sub>	Static Drain-Source On-Resistance	V <sub>GS</sub> = 10 V, I <sub>D</sub> = 23.5 A	--	0.062	0.073	Ω
g <sub>FS</sub>	Forward Transconductance	V <sub>DS</sub> = 20 V, I <sub>D</sub> = 23.5 A	--	40	--	S
<b>Dynamic Characteristics</b>						
C <sub>iss</sub>	Input Capacitance	V <sub>DS</sub> = 25 V, V <sub>GS</sub> = 0 V, f = 1 MHz	--	5900	8000	pF
C <sub>oss</sub>	Output Capacitance		--	3200	4200	pF
C <sub>rss</sub>	Reverse Transfer Capacitance		--	250	--	pF
C <sub>oss</sub>	Output Capacitance	V <sub>DS</sub> = 480 V, V <sub>GS</sub> = 0 V, f = 1 MHz	--	160	--	pF
C <sub>oss(eff.)</sub>	Effective Output Capacitance	V <sub>DS</sub> = 0 V to 400 V, V <sub>GS</sub> = 0 V	--	420	--	pF
<b>Switching Characteristics</b>						
t <sub>d(on)</sub>	Turn-On Delay Time	V <sub>DD</sub> = 300 V, I <sub>D</sub> = 47 A, V <sub>GS</sub> = 10 V, R <sub>G</sub> = 25 Ω	--	185	430	ns
t <sub>r</sub>	Turn-On Rise Time		--	210	450	ns
t <sub>d(off)</sub>	Turn-Off Delay Time		--	520	1100	ns
t <sub>f</sub>	Turn-Off Fall Time		(Note 4)	--	75	160
Q <sub>g</sub>	Total Gate Charge	V <sub>DS</sub> = 480 V, I <sub>D</sub> = 47 A, V <sub>GS</sub> = 10 V	--	210	270	nC
Q <sub>gs</sub>	Gate-Source Charge		--	38	--	nC
Q <sub>gd</sub>	Gate-Drain Charge		(Note 4)	--	110	--
<b>Drain-Source Diode Characteristics and Maximum Ratings</b>						
I <sub>S</sub>	Maximum Continuous Drain-Source Diode Forward Current		--	--	47	A
I <sub>SM</sub>	Maximum Pulsed Drain-Source Diode Forward Current		--	--	141	A
V <sub>SD</sub>	Drain-Source Diode Forward Voltage	V <sub>GS</sub> = 0 V, I <sub>S</sub> = 47 A	--	--	1.4	V
t <sub>rr</sub>	Reverse Recovery Time	V <sub>GS</sub> = 0 V, I <sub>S</sub> = 47 A, di/dt = 100 A/μs	--	240	--	ns
Q <sub>rr</sub>	Reverse Recovery Charge		--	2.04	--	μC

**Notes:**

1. Repetitive rating: pulse-width limited by maximum junction temperature.
2. I<sub>AS</sub> = 18 A, V<sub>DD</sub> = 50 V, R<sub>G</sub> = 25 Ω, starting T<sub>J</sub> = 25°C.
3. I<sub>SD</sub> ≤ 47 A, di/dt ≤ 1200 A/μs, V<sub>DD</sub> ≤ BV<sub>DSS</sub>, starting T<sub>J</sub> = 25°C.
4. Essentially independent of operating temperature typical characteristics.

## Typical Performance Characteristics

Figure 1. On-Region Characteristics

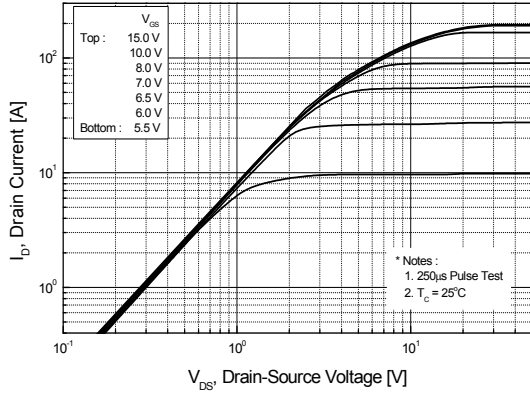


Figure 2. Transfer Characteristics

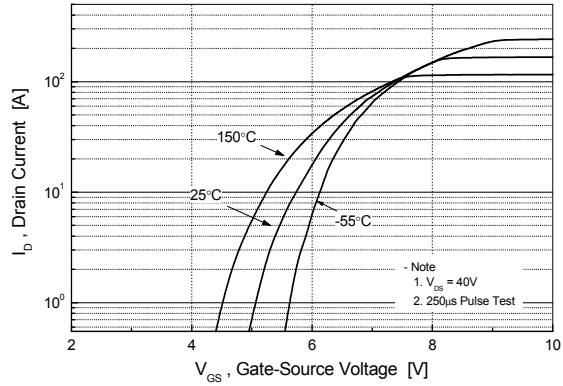


Figure 3. On-Resistance Variation vs. Drain Current and Gate Voltage

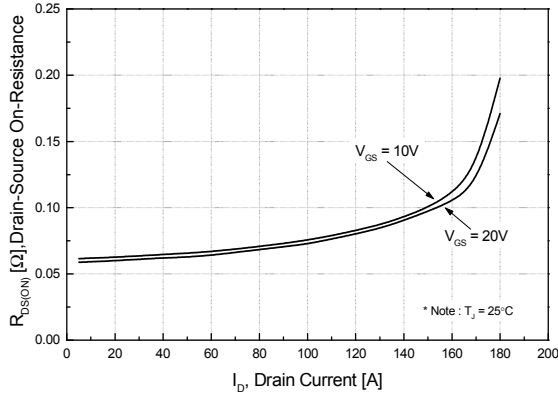


Figure 4. Body Diode Forward Voltage Variation vs. Source Current and Temperature

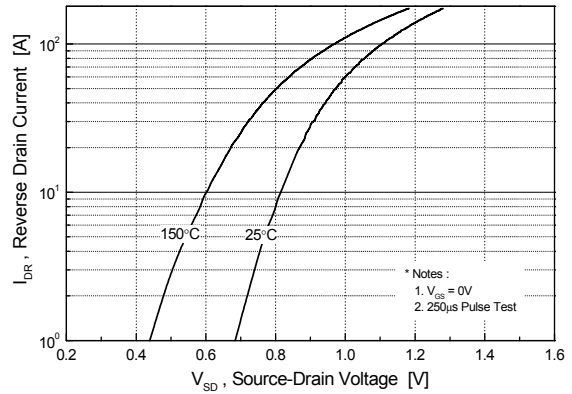


Figure 5. Capacitance Characteristics

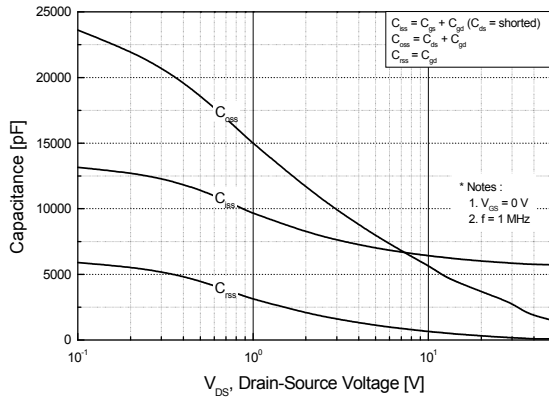
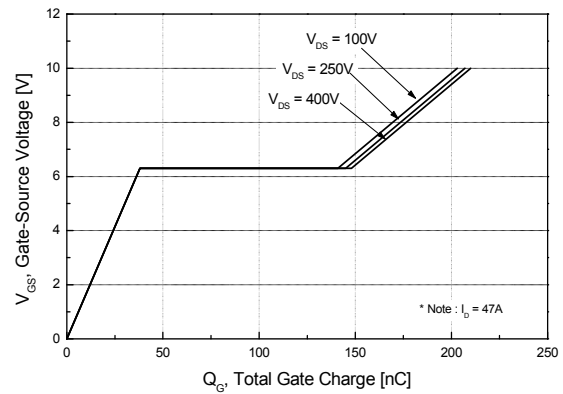
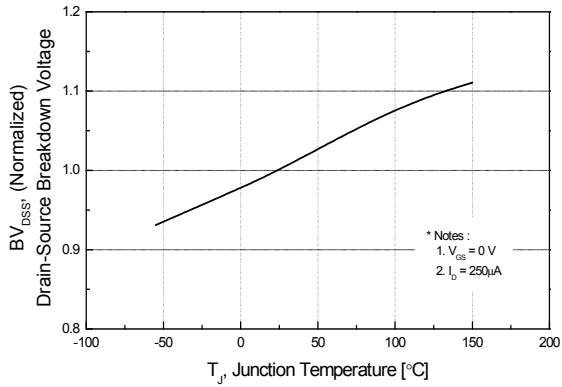


Figure 6. Gate Charge Characteristics

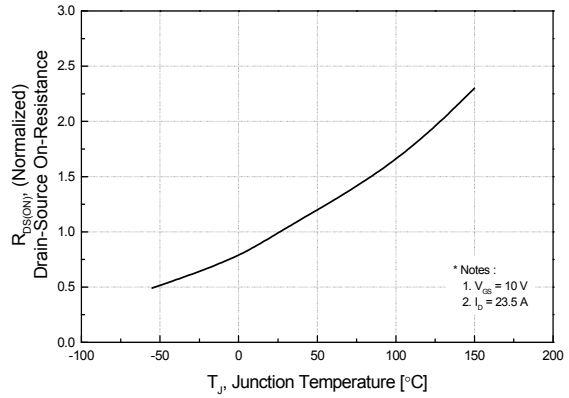


## Typical Performance Characteristics (Continued)

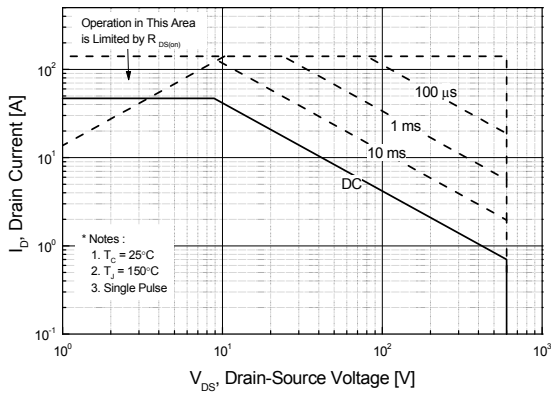
**Figure 7. Breakdown Voltage Variation vs. Temperature**



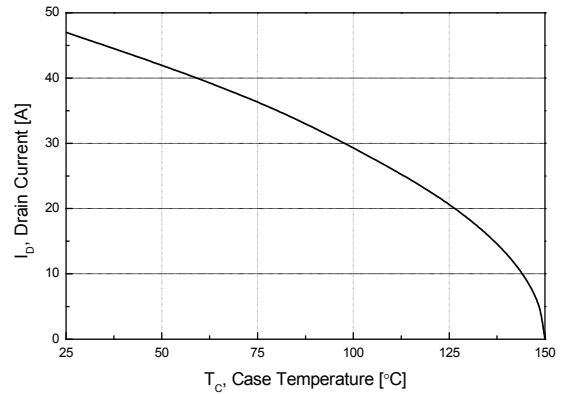
**Figure 8. On-Resistance Variation vs. Temperature**



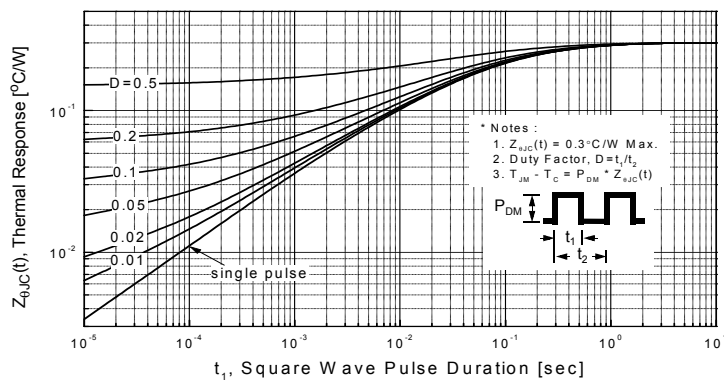
**Figure 9. Safe Operating Area**



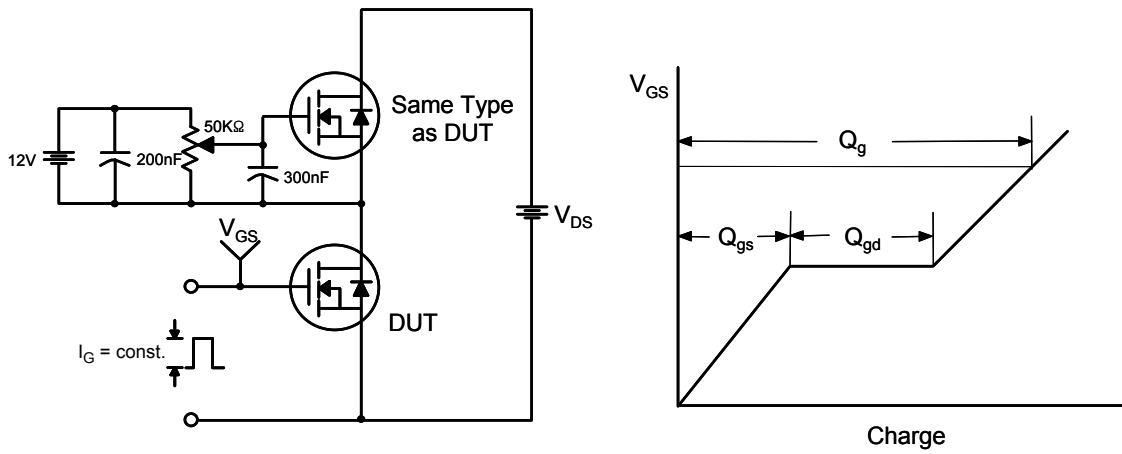
**Figure 10. Maximum Drain Current vs. Case Temperature**



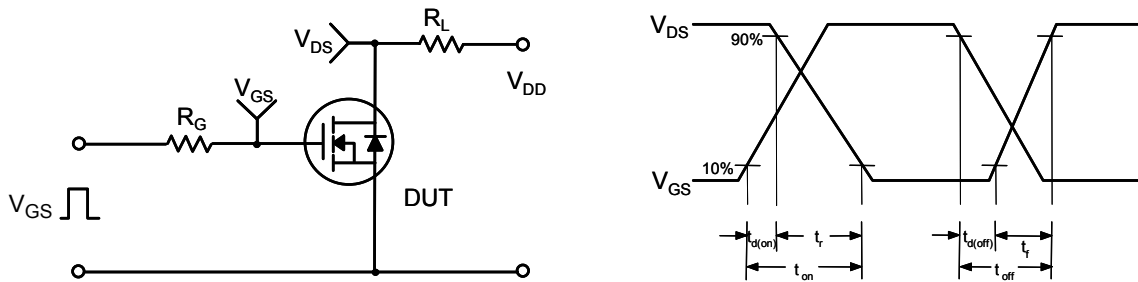
**Figure 11. Transient Thermal Response Curve**



**Figure 12. Gate Charge Test Circuit & Waveform**



**Figure 13. Resistive Switching Test Circuit & Waveforms**



**Figure 14. Unclamped Inductive Switching Test Circuit & Waveforms**

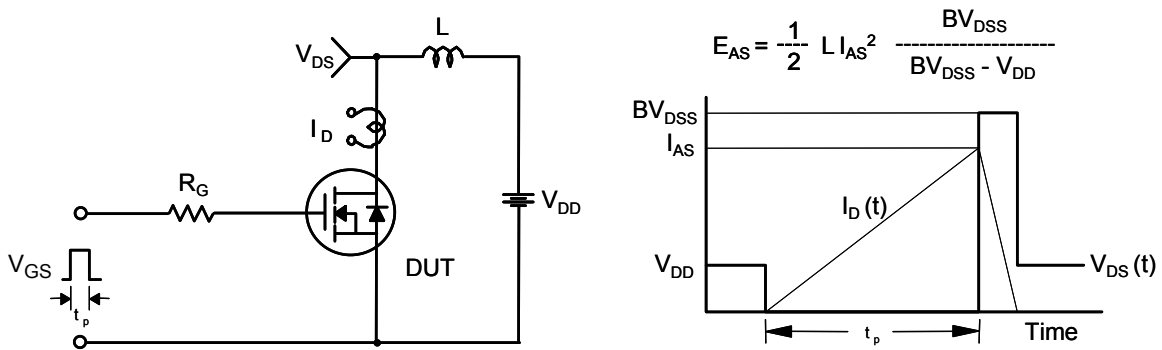
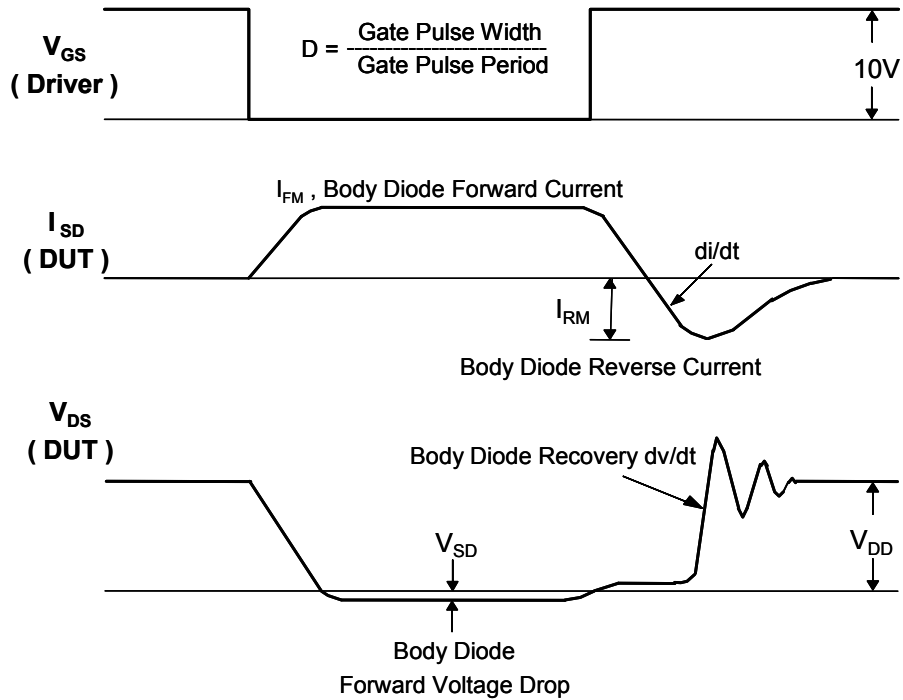
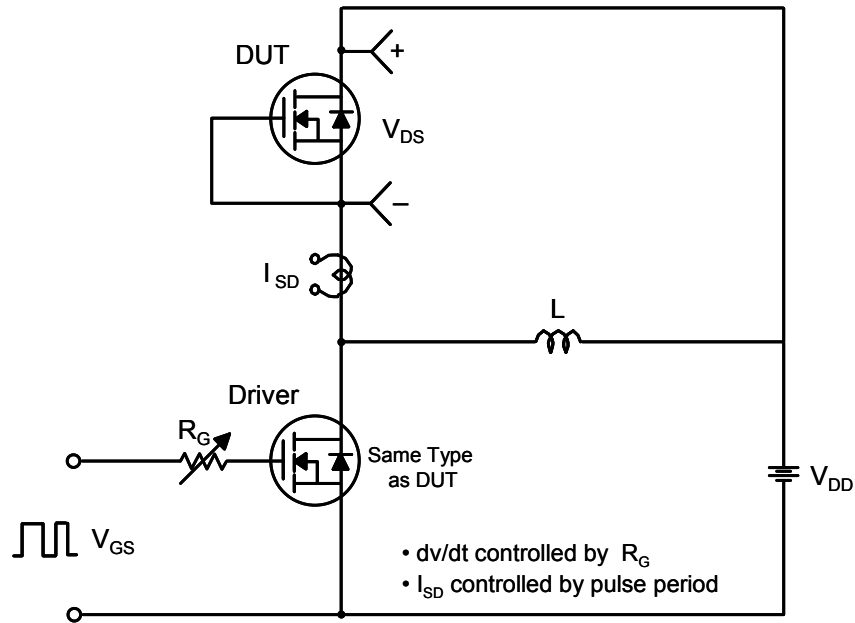
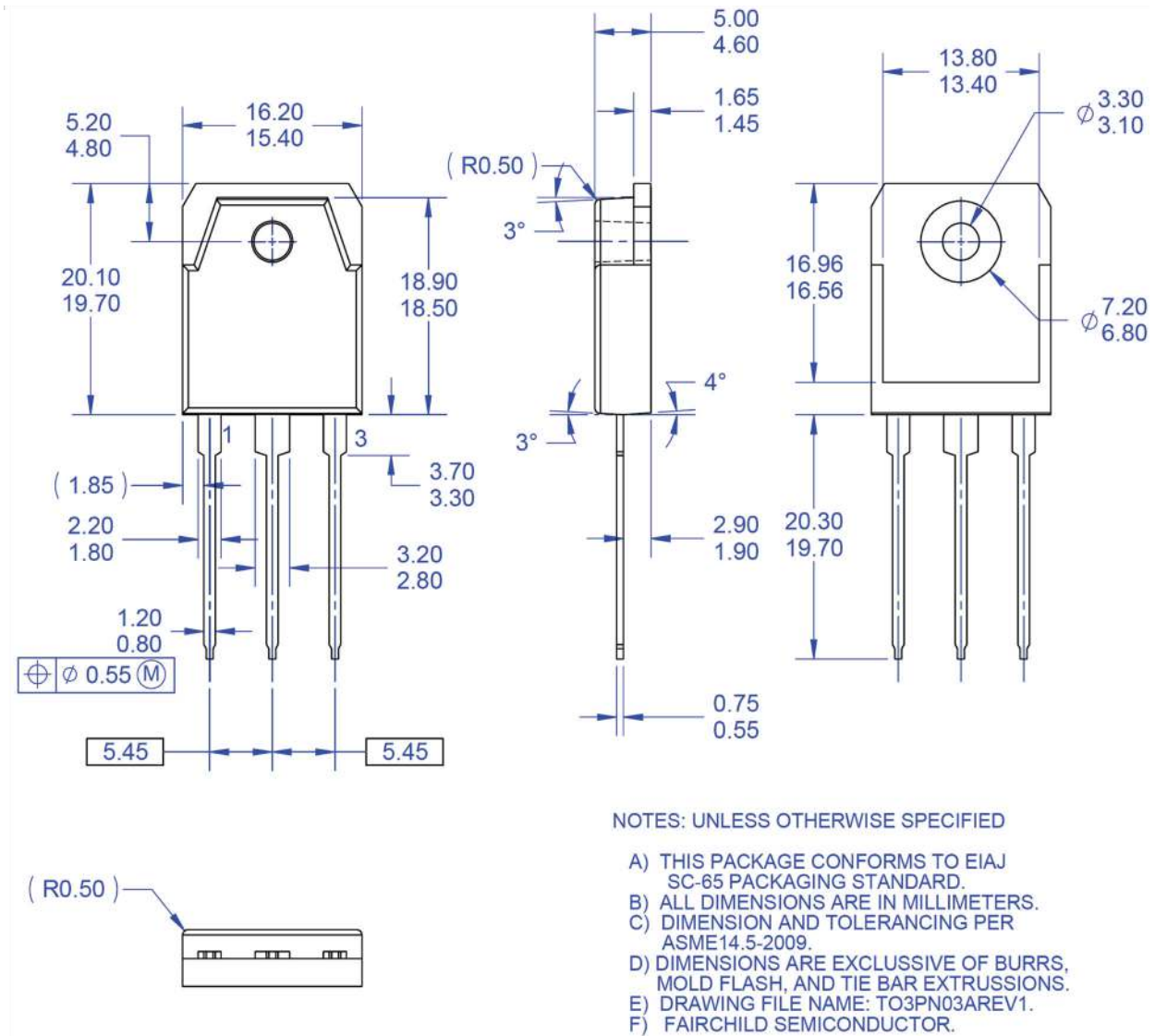


Figure 15. Peak Diode Recovery dv/dt Test Circuit & Waveforms



## Mechanical Dimensions




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

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