



March 2009
SuperFET™

FCA35N60 600V N-Channel MOSFET

Features

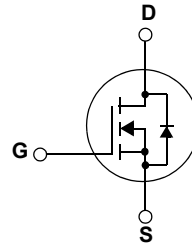
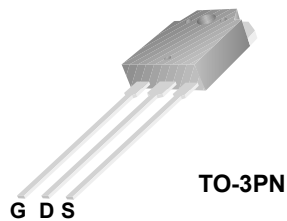
- 650V @ $T_J = 150^\circ\text{C}$
- Typ. $R_{DS(on)} = 0.079\Omega$
- Ultra low gate charge (Typ. $Q_g = 139\text{nC}$)
- Low effective output capacitance (Typ. $C_{oss-eff} = 340\text{pF}$)
- 100% avalanche tested



Description

SuperFET™ is Fairchild's proprietary, new generation of high voltage MOSFET family that is utilizing an advanced charge balance mechanism for outstanding low on-resistance and lower gate charge performance.

This advanced technology has been tailored to minimize conduction loss, provide superior switching performance, and withstand extreme dv/dt rate and higher avalanche energy. Consequently, SuperFET is very suitable for various AC/DC power conversion in switching mode operation for system miniaturization and higher efficiency.



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

Symbol	Parameter	Ratings	Units
V_{DSS}	Drain to Source Voltage	600	V
V_{GSS}	Gate-Source voltage	± 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	Peak Diode Recovery dv/dt	(Note 3)	V/ns
P_D	Power Dissipation	($T_C = 25^\circ\text{C}$)	W
		- Derate above 25°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 Purpose, 1/8" from Case for 5 Seconds	300	$^\circ\text{C}$

*Drain current limited by maximum junction temperature

Thermal Characteristics

Symbol	Parameter	Typ.	Max.	Units
$R_{\theta JC}$	Thermal Resistance, Junction to Case	-	0.4	$^\circ\text{C/W}$
$R_{\theta CS}$	Thermal Resistance, Case-to-Heat Sink	0.24	-	
$R_{\theta JA}$	Thermal Resistance, Junction to Ambient	-	42	

Package Marking and Ordering Information $T_C = 25^\circ\text{C}$ unless otherwise noted

Device Marking	Device	Package	Reel Size	Tape Width	Quantity
FCA35N60	FCA35N60	TO-3PN	-	-	30

Electrical Characteristics

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Units
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Off Characteristics

BV_{DSS}	Drain to Source Breakdown Voltage	$I_D = 250\mu\text{A}$, $V_{GS} = 0\text{V}$, $T_J = 25^\circ\text{C}$	600	-	-	V
		$I_D = 250\mu\text{A}$, $V_{GS} = 0\text{V}$, $T_J = 150^\circ\text{C}$	-	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	$V_{GS} = 0\text{V}$, $I_D = 16\text{A}$	-	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	
I_{GSS}	Gate to Body Leakage Current	$V_{GS} = \pm 30\text{V}$, $V_{DS} = 0\text{V}$	-	-	± 100	nA

On Characteristics

$V_{GS(th)}$	Gate Threshold Voltage	$V_{GS} = V_{DS}$, $I_D = 250\mu\text{A}$	3.0	-	5.0	V
$R_{DS(on)}$	Static Drain to Source On Resistance	$V_{GS} = 10\text{V}$, $I_D = 17.5\text{A}$	-	0.079	0.098	Ω
g_{FS}	Forward Transconductance	$V_{DS} = 40\text{V}$, $I_D = 17.5\text{A}$	-	28.8	-	S

Dynamic Characteristics

C_{iss}	Input Capacitance	$V_{DS} = 25\text{V}$, $V_{GS} = 0\text{V}$ $f = 1\text{MHz}$	-	4990	6640	pF
C_{oss}	Output Capacitance		-	2380	3170	pF
C_{rss}	Reverse Transfer Capacitance		-	140	-	pF
C_{oss}	Output Capacitance	$V_{DS} = 480\text{V}$, $V_{GS} = 0\text{V}$, $f = 1.0\text{MHz}$	-	113	-	pF
$C_{oss \text{ eff.}}$	Effective Output Capacitance	$V_{DS} = 0\text{V to } 480\text{V}$, $V_{GS} = 0\text{V}$	-	340	-	pF
Q_g	Total Gate Charge at 10V	$V_{DS} = 480\text{V}$, $I_D = 35\text{A}$ $V_{GS} = 10\text{V}$ (Note 4)	-	139	181	nC
Q_{gs}	Gate to Source Gate Charge		-	31	-	nC
Q_{gd}	Gate to Drain "Miller" Charge		-	69	-	nC
ESR	Equivalent Series Resistance (G-S)	Drain Open, $F = 1\text{MHz}$	-	1.4	-	Ω

Switching Characteristics

$t_{d(on)}$	Turn-On Delay Time	$V_{DD} = 300\text{V}$, $I_D = 35\text{A}$ $R_G = 4.7\Omega$ (Note 4)	-	34	78	ns
t_r	Turn-On Rise Time		-	120	250	ns
$t_{d(off)}$	Turn-Off Delay Time		-	105	220	ns
t_f	Turn-Off Fall Time		-	73	155	ns

Drain-Source Diode Characteristics

I _S	Maximum Continuous Drain to Source Diode Forward Current		-	-	35	A
I _{SM}	Maximum Pulsed Drain to Source Diode Forward Current		-	-	105	A
V _{SD}	Drain to Source Diode Forward Voltage	V _{GS} = 0V, I _{SD} = 35A	-	-	1.4	V
t _{rr}	Reverse Recovery Time	V _{GS} = 0V, I _{SD} = 35A	-	614	-	ns
Q _{rr}	Reverse Recovery Charge	dI _F /dt = 100A/μs	-	16.3	-	μC

Notes:

- 1: Repetitive Rating: Pulse width limited by maximum junction temperature
- 2: $I_{AS} = 17.5\text{A}$, $V_{DD} = 50\text{V}$, $R_G = 25\Omega$, Starting $T_J = 25^\circ\text{C}$
- 3: $I_{SD} \leq 35\text{A}$, $di/dt \leq 200\text{A}/\mu\text{s}$, $V_{DD} \leq BV_{DSS}$, Starting $T_J = 25^\circ\text{C}$
- 4: Essentially Independent of Operating Temperature Typical Characteristics

Typical Performance Characteristics

Figure 1. On-Region Characteristics

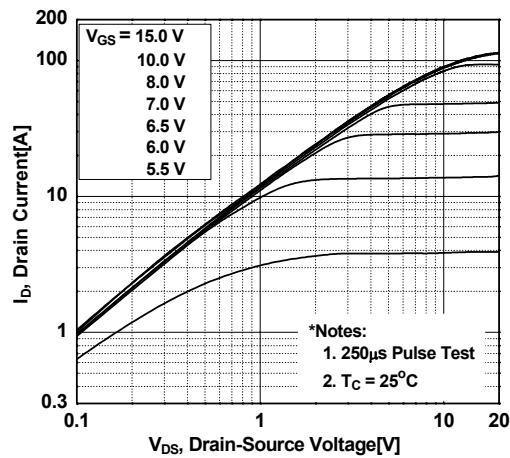


Figure 2. Transfer Characteristics

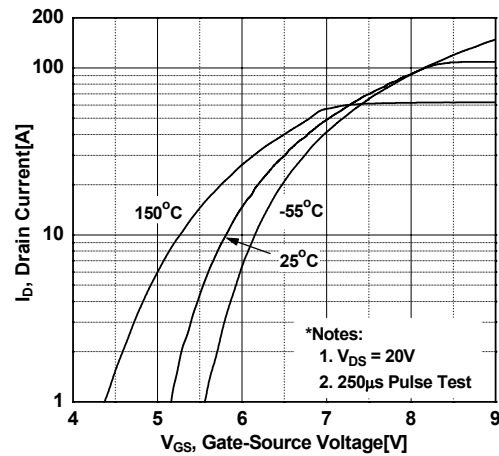


Figure 3. On-Resistance Variation vs. Drain Current and Gate Voltage

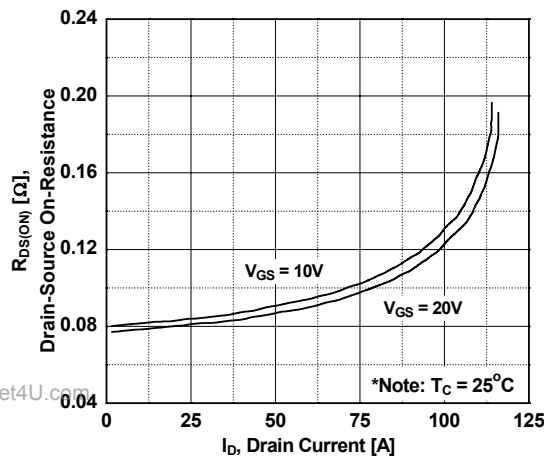


Figure 4. Body Diode Forward Voltage Variation vs. Source Current and Temperature

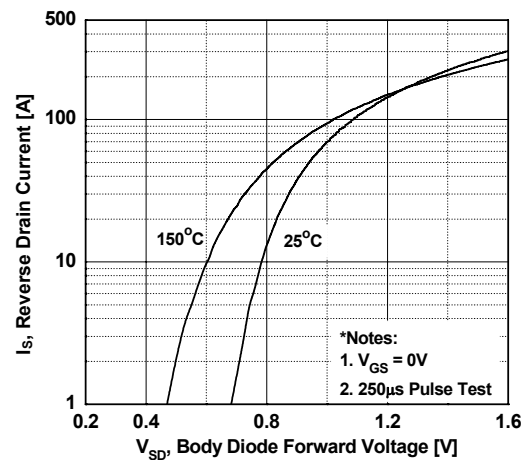


Figure 5. Capacitance Characteristics

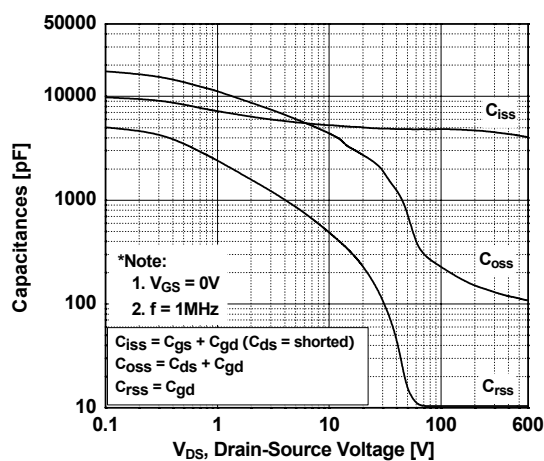
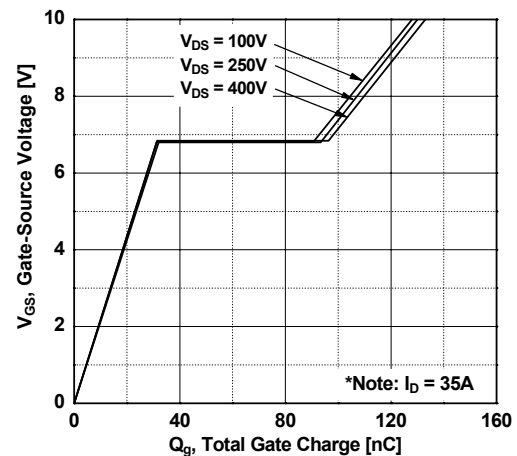


Figure 6. Gate Charge Characteristics



Typical Performance Characteristics (Continued)

Figure 7. Breakdown Voltage Variation vs. Temperature

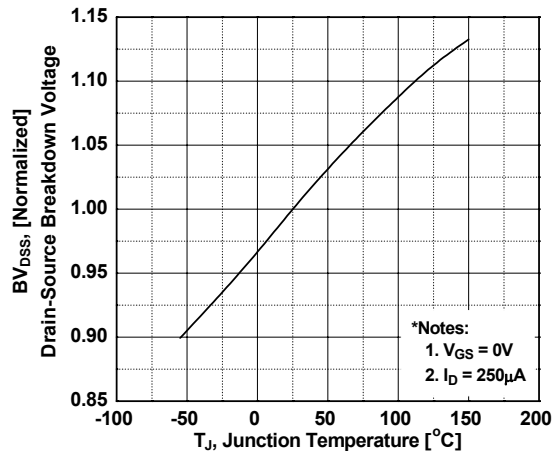


Figure 8. On-Resistance Variation vs. Temperature

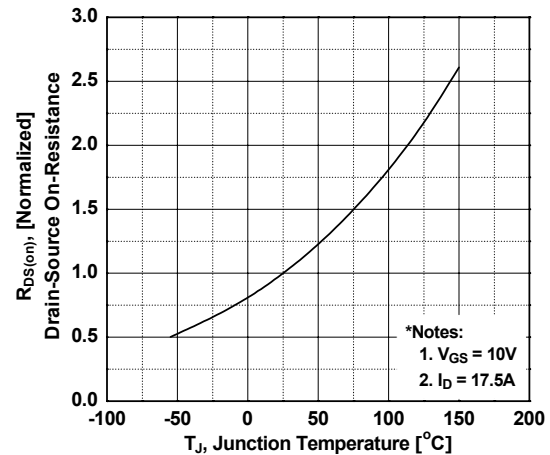


Figure 9. Maximum Safe Operating Area

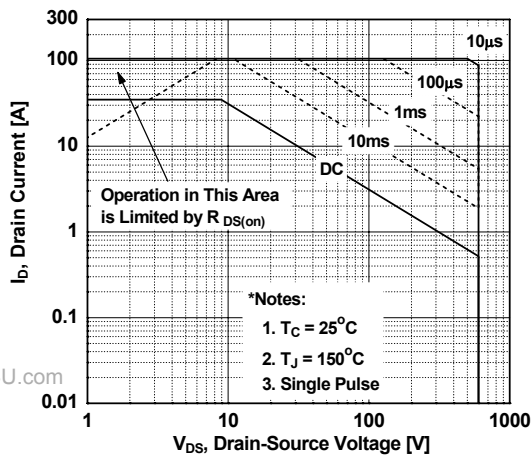


Figure 10. Maximum Drain Current vs. Case Temperature

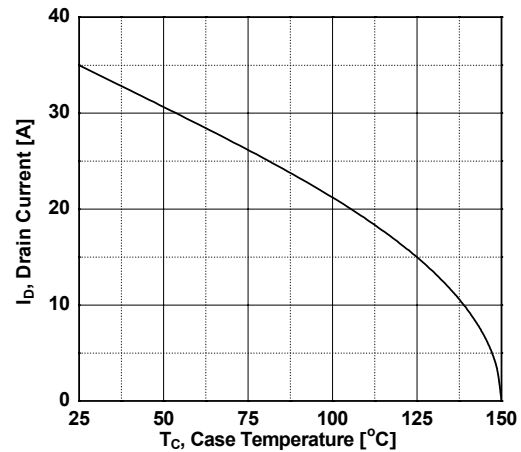
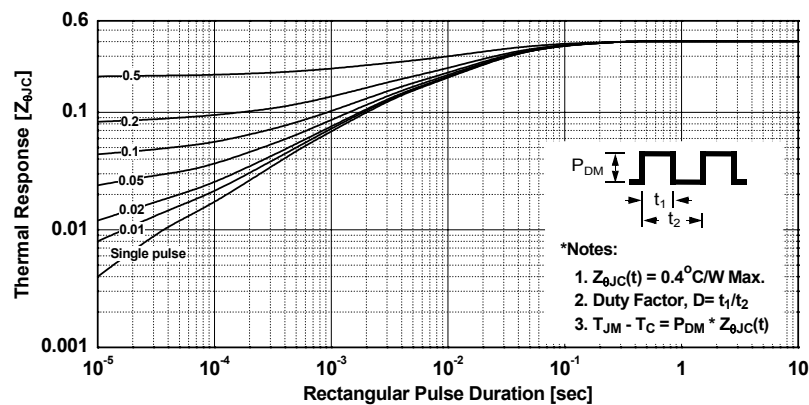
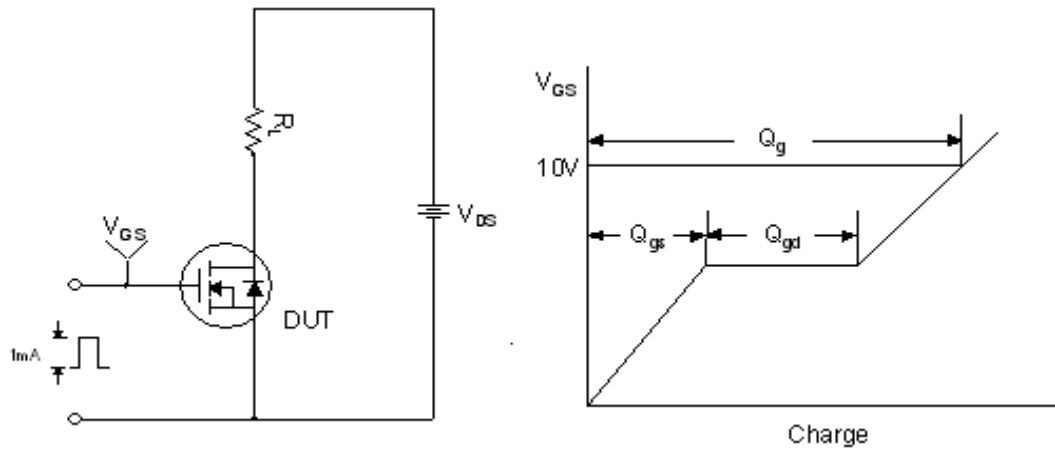


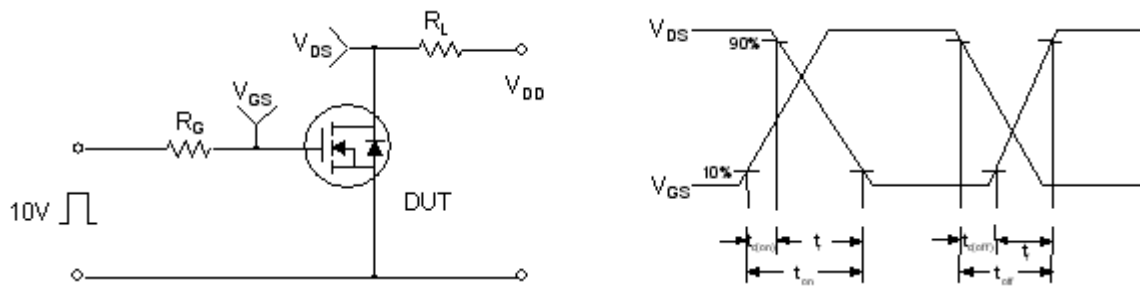
Figure 11. Transient Thermal Response Curve



Gate Charge Test Circuit & Waveform

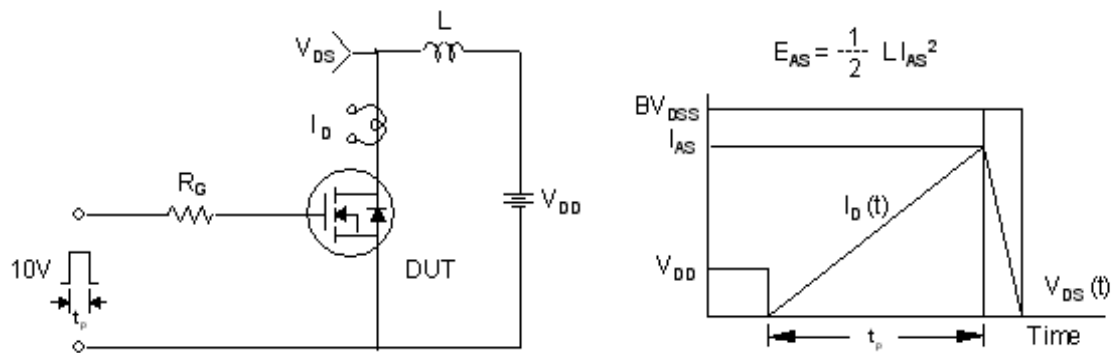


Resistive Switching Test Circuit & Waveforms

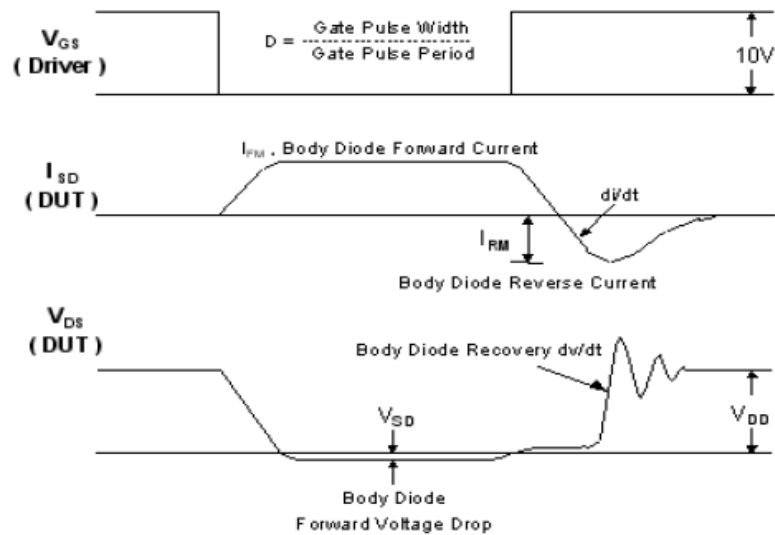
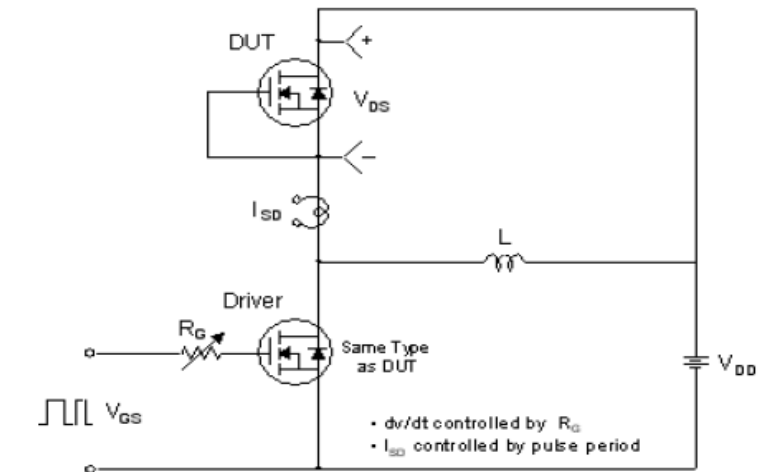


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Unclamped Inductive Switching Test Circuit & Waveforms

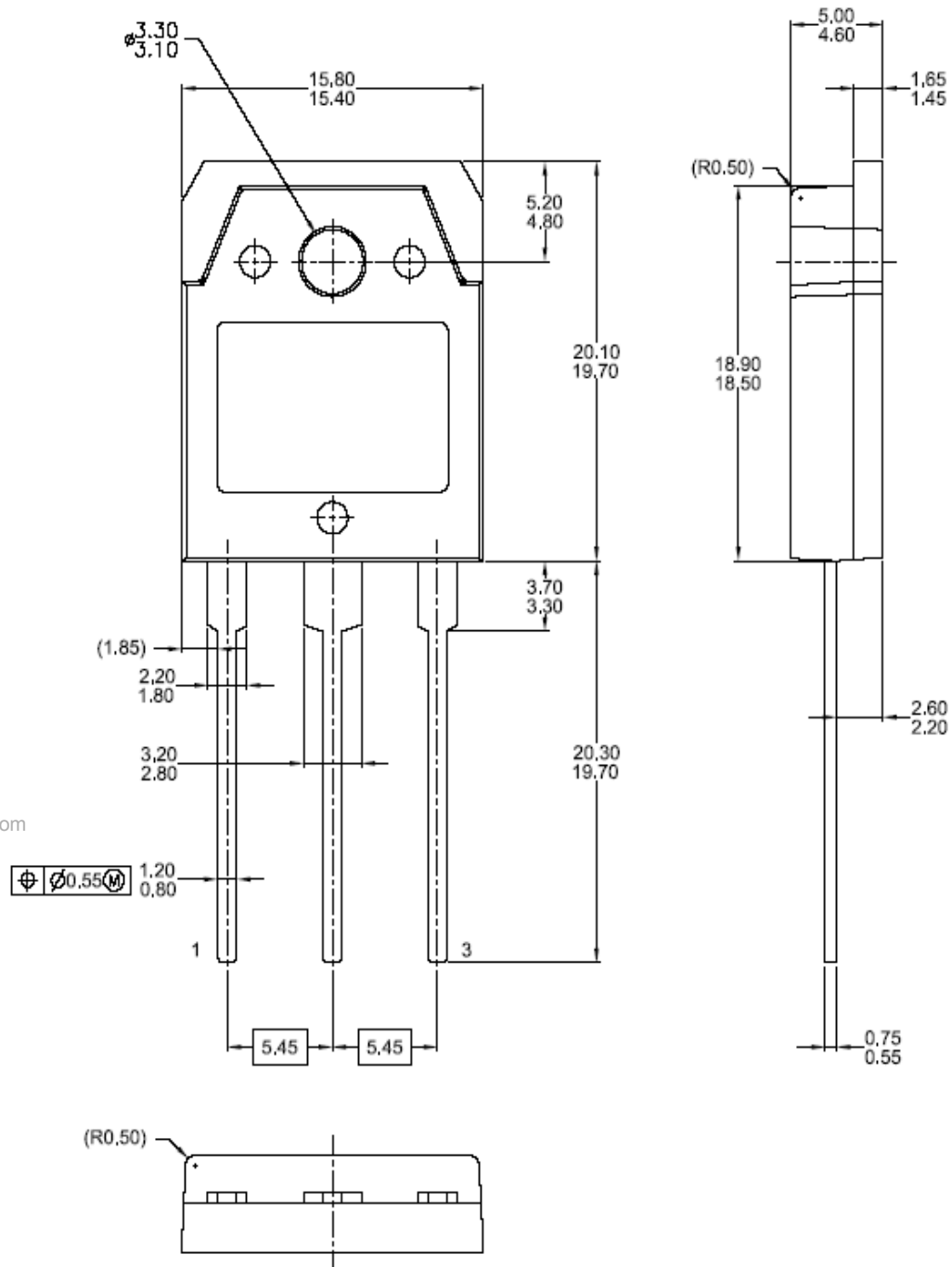


Peak Diode Recovery dv/dt Test Circuit & Waveforms



Mechanical Dimensions

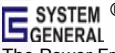
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