

# FCP20N60 / FCPF20N60 600V N-Channel MOSFET

## Features

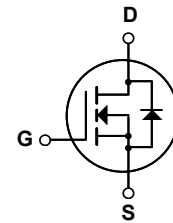
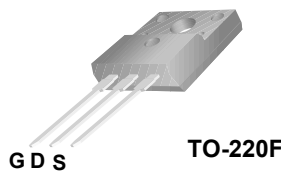
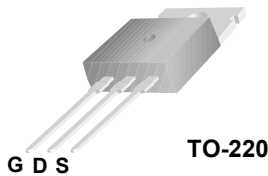
- 650V @ $T_J = 150^\circ\text{C}$
- Typ.  $R_{DS(on)} = 0.15\Omega$
- Ultra low gate charge (typ.  $Q_g = 75\text{nC}$ )
- Low effective output capacitance (typ.  $C_{oss\text{-}eff} = 165\text{pF}$ )
- 100% avalanche tested
- RoHS Compliant



## 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.



## Absolute Maximum Ratings

Symbol	Parameter	FCP20N60	FCPF20N60	Unit
$V_{DSS}$	Drain-Source Voltage	600		V
$I_D$	Drain Current	- Continuous ( $T_C = 25^\circ\text{C}$ )	20	20*
		- Continuous ( $T_C = 100^\circ\text{C}$ )	12.5	12.5*
$I_{DM}$	Drain Current - Pulsed (Note 1)	60	60*	A
$V_{GSS}$	Gate-Source voltage	$\pm 30$		V
$E_{AS}$	Single Pulsed Avalanche Energy (Note 2)	690		mJ
$I_{AR}$	Avalanche Current (Note 1)	20		A
$E_{AR}$	Repetitive Avalanche Energy (Note 1)	20.8		mJ
$dv/dt$	Peak Diode Recovery $dv/dt$ (Note 3)	4.5		V/ns
$P_D$	Power Dissipation ( $T_C = 25^\circ\text{C}$ )	- Derate above $25^\circ\text{C}$	208	39
			1.67	0.3
$T_J, T_{STG}$	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	FCP20N60	FCPF20N60	Unit
$R_{\theta JC}$	Thermal Resistance, Junction-to-Case	0.6	3.2	$^\circ\text{C}/\text{W}$
$R_{\theta JA}$	Thermal Resistance, Junction-to-Ambient	62.5	62.5	$^\circ\text{C}/\text{W}$

## Package Marking and Ordering Information

Device Marking	Device	Package	Reel Size	Tape Width	Quantity
FCP20N60	FCP20N60	TO-220	-	-	50
FCPF20N60	FCPF20N60	TO-220F	-	-	50

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

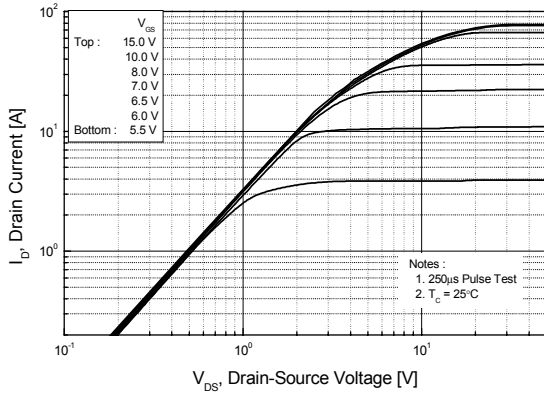
Symbol	Parameter	Conditions	Min	Typ	Max	Units
<b>Off Characteristics</b>						
BV <sub>DSS</sub>	Drain-Source Breakdown Voltage	V <sub>GS</sub> = 0V, I <sub>D</sub> = 250μA, T <sub>J</sub> = 25°C	600	--	--	V
		V <sub>GS</sub> = 0V, I <sub>D</sub> = 250μA, T <sub>J</sub> = 150°C	--	650	--	V
$\frac{\Delta BV_{DSS}}{\Delta T_J}$	Breakdown Voltage Temperature Coefficient	I <sub>D</sub> = 250μA, Referenced to 25°C	--	0.6	--	V/°C
BV <sub>DS</sub>	Drain-Source Avalanche Breakdown Voltage	V <sub>GS</sub> = 0V, I <sub>D</sub> = 20A	--	700	--	V
I <sub>DSS</sub>	Zero Gate Voltage Drain Current	V <sub>DS</sub> = 600V, V <sub>GS</sub> = 0V	--	--	1	μA
		V <sub>DS</sub> = 480V, T <sub>C</sub> = 125°C	--	--	10	μA
I <sub>GSSF</sub>	Gate-Body Leakage Current, Forward	V <sub>GS</sub> = 30V, V <sub>DS</sub> = 0V	--	--	100	nA
I <sub>GSSR</sub>	Gate-Body Leakage Current, Reverse	V <sub>GS</sub> = -30V, V <sub>DS</sub> = 0V	--	--	-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> = 250μA	3.0	--	5.0	V
R <sub>DS(on)</sub>	Static Drain-Source On-Resistance	V <sub>GS</sub> = 10V, I <sub>D</sub> = 10A	--	0.15	0.19	Ω
g <sub>FS</sub>	Forward Transconductance	V <sub>DS</sub> = 40V, I <sub>D</sub> = 10A (Note 4)	--	17	--	S
<b>Dynamic Characteristics</b>						
C <sub>ISS</sub>	Input Capacitance	V <sub>DS</sub> = 25V, V <sub>GS</sub> = 0V, f = 1.0MHz	--	2370	3080	pF
C <sub>OSS</sub>	Output Capacitance		--	1280	1665	pF
C <sub>rSS</sub>	Reverse Transfer Capacitance		--	95	--	pF
C <sub>OSS</sub>	Output Capacitance	V <sub>DS</sub> = 480V, V <sub>GS</sub> = 0V, f = 1.0MHz	--	65	85	pF
C <sub>OSS eff.</sub>	Effective Output Capacitance	V <sub>DS</sub> = 0V to 400V, V <sub>GS</sub> = 0V	--	165	--	pF
<b>Switching Characteristics</b>						
t <sub>d(on)</sub>	Turn-On Delay Time	V <sub>DD</sub> = 300V, I <sub>D</sub> = 20A R <sub>G</sub> = 25Ω  (Note 4, 5)	--	62	135	ns
t <sub>r</sub>	Turn-On Rise Time		--	140	290	ns
t <sub>d(off)</sub>	Turn-Off Delay Time		--	230	470	ns
t <sub>f</sub>	Turn-Off Fall Time		--	65	140	ns
Q <sub>g</sub>	Total Gate Charge	V <sub>DS</sub> = 480V, I <sub>D</sub> = 20A V <sub>GS</sub> = 10V  (Note 4, 5)	--	75	98	nC
Q <sub>gs</sub>	Gate-Source Charge		--	13.5	18	nC
Q <sub>gd</sub>	Gate-Drain Charge		--	36	--	nC
<b>Drain-Source Diode Characteristics and Maximum Ratings</b>						
I <sub>S</sub>	Maximum Continuous Drain-Source Diode Forward Current		--	--	20	A
I <sub>SM</sub>	Maximum Pulsed Drain-Source Diode Forward Current		--	--	60	A
V <sub>SD</sub>	Drain-Source Diode Forward Voltage	V <sub>GS</sub> = 0V, I <sub>S</sub> = 20A	--	--	1.4	V
t <sub>rr</sub>	Reverse Recovery Time	V <sub>GS</sub> = 0V, I <sub>S</sub> = 20A di <sub>f</sub> /dt = 100A/μs  (Note 4)	--	530	--	ns
Q <sub>rr</sub>	Reverse Recovery Charge		--	10.5	--	μC

### Notes:

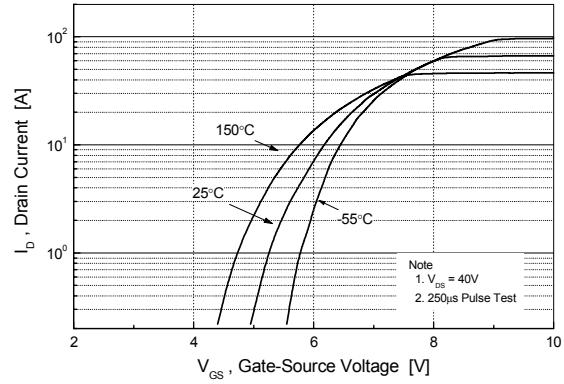
1. Repetitive Rating: Pulse width limited by maximum junction temperature
2. I<sub>AS</sub> = 10A, V<sub>DD</sub> = 50V, R<sub>G</sub> = 25Ω, Starting T<sub>J</sub> = 25°C
3. I<sub>SD</sub> ≤ 20A, di<sub>f</sub>/dt ≤ 200A/μs, V<sub>DD</sub> ≤ BV<sub>DSS</sub>, Starting T<sub>J</sub> = 25°C
4. Pulse Test: Pulse width ≤ 300μs, Duty Cycle ≤ 2%
5. Essentially Independent of Operating Temperature Typical Characteristics

## Typical Performance Characteristics

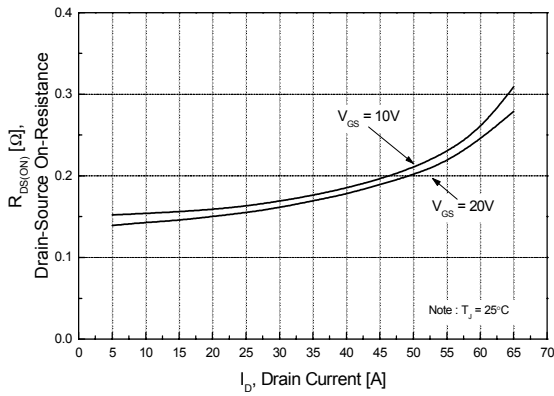
**Figure 1. On-Region Characteristics**



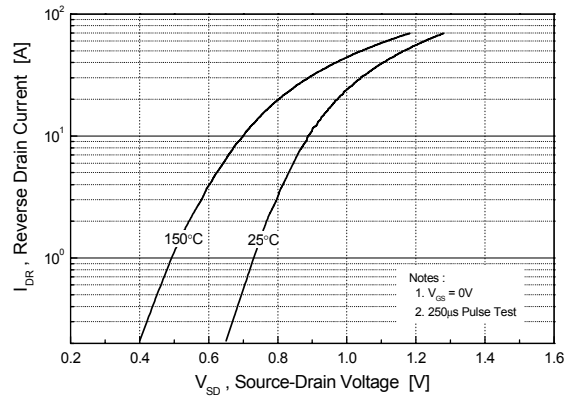
**Figure 2. Transfer Characteristics**



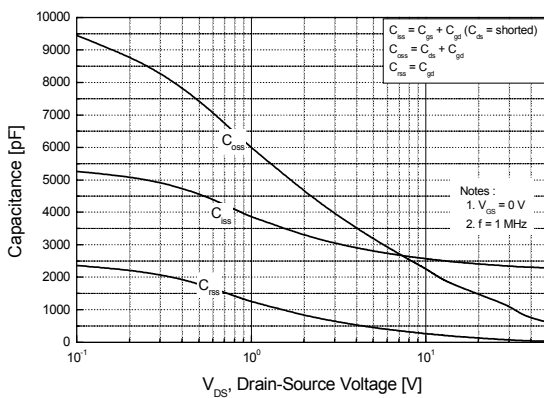
**Figure 3. On-Resistance Variation vs. Drain Current and Gate Voltage**



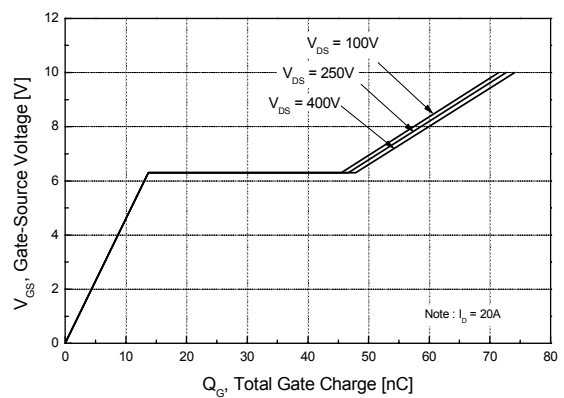
**Figure 4. Body Diode Forward Voltage Variation vs. Source Current and Temperature**



**Figure 5. Capacitance Characteristics**

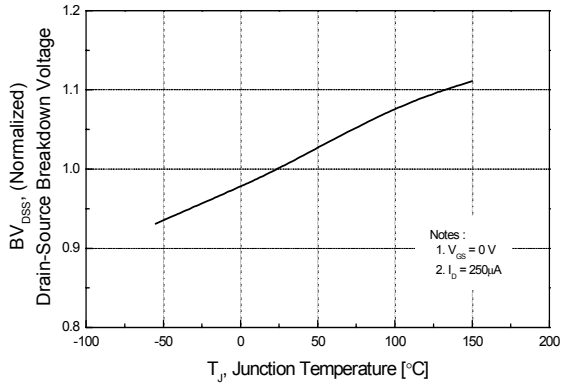


**Figure 6. Gate Charge Characteristics**

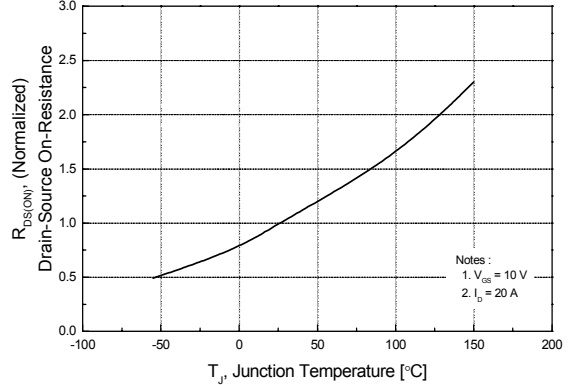


**Typical Performance Characteristics** (Continued)

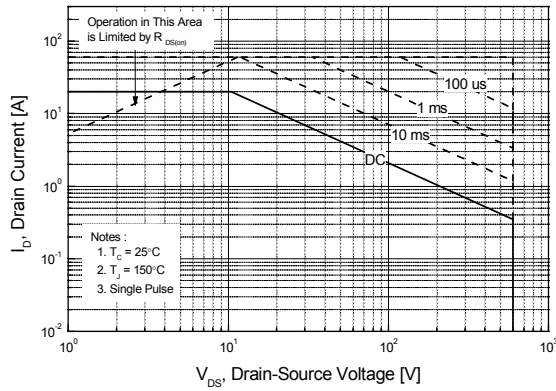
**Figure 7. Breakdown Voltage Variation vs. Temperature**



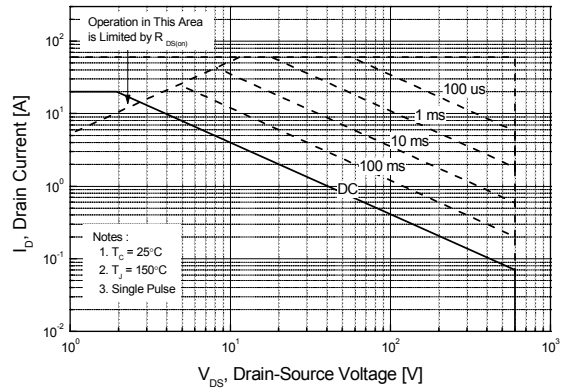
**Figure 8. On-Resistance Variation vs. Temperature**



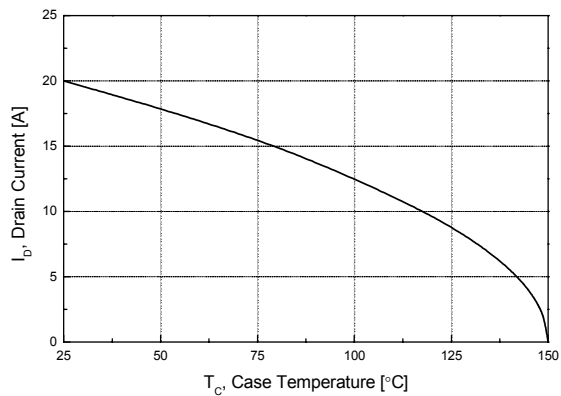
**Figure 9-1. Maximum Safe Operating Area for FCP20N60**



**Figure 9-2. Maximum Safe Operating Area for FCPF20N60**



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



Typical Performance Characteristics (Continued)

Figure 11-1. Transient Thermal Response Curve for FCP20N60

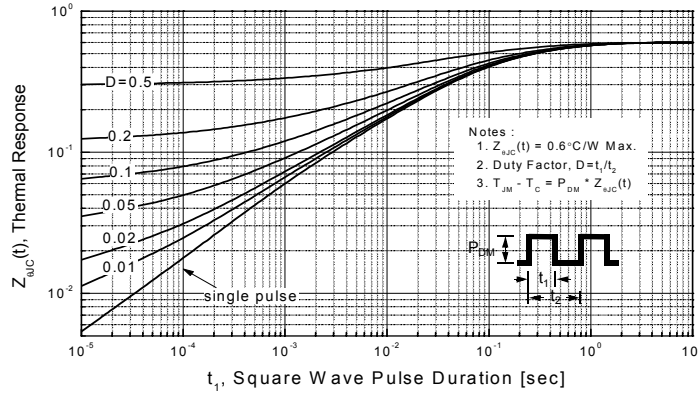
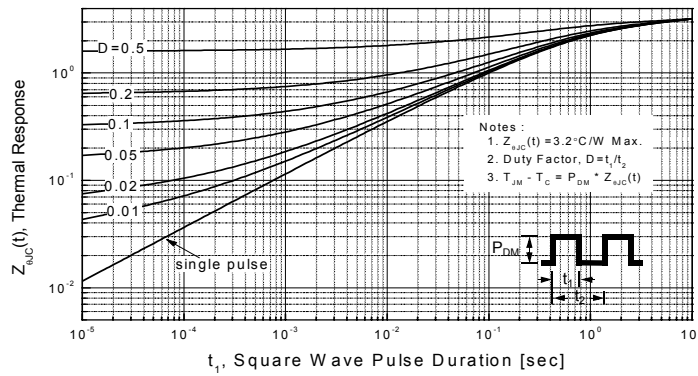
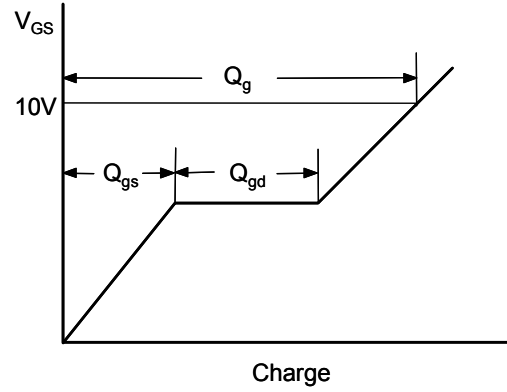
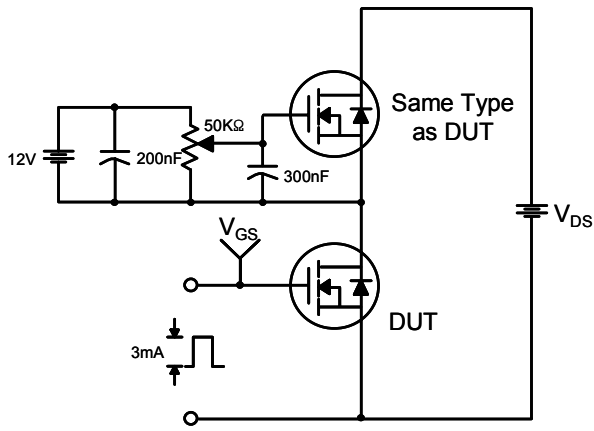


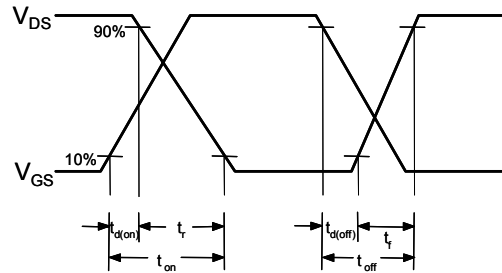
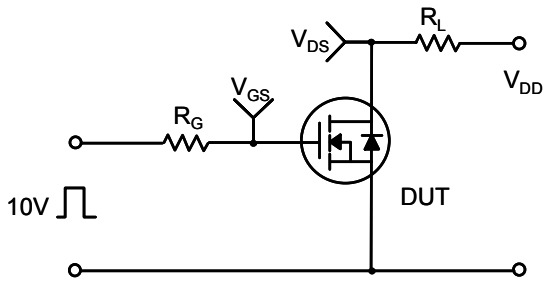
Figure 11-2. Transient Thermal Response Curve for FCPF20N60



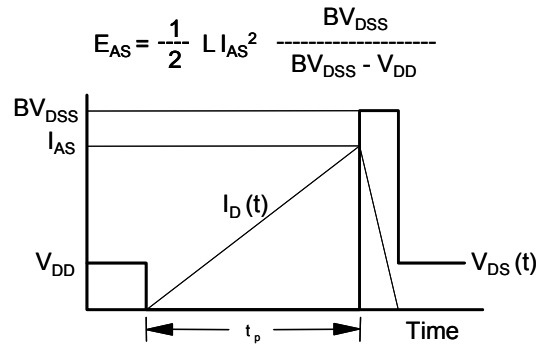
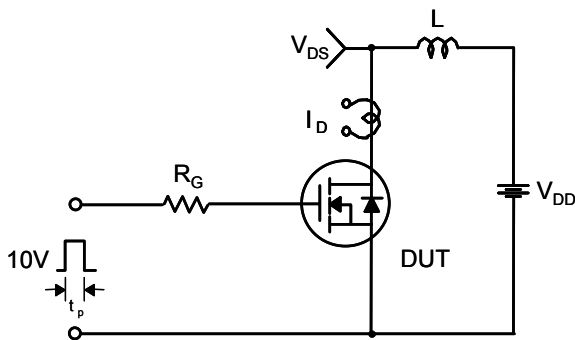
**Gate Charge Test Circuit & Waveform**



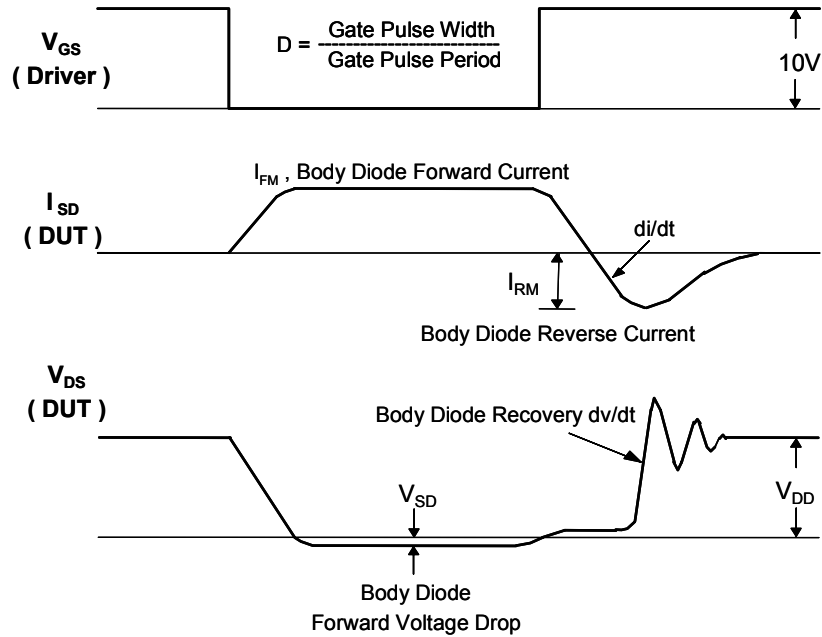
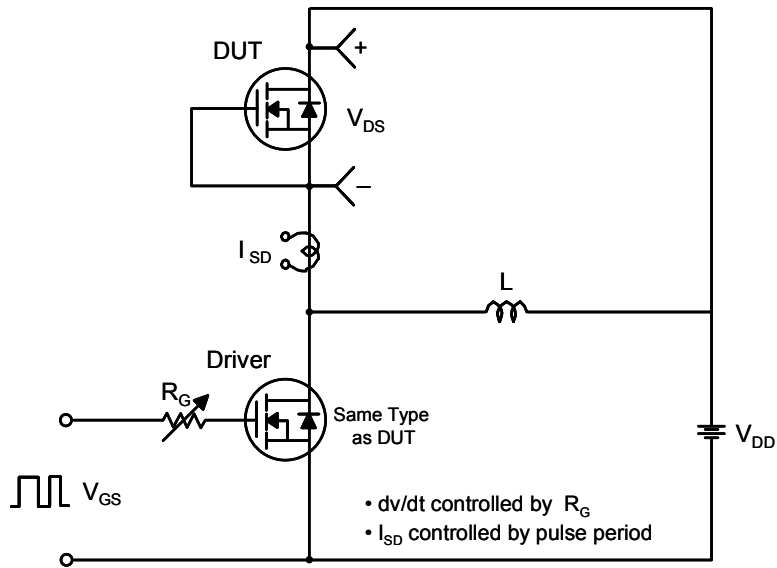
**Resistive Switching Test Circuit & Waveforms**



**Unclamped Inductive Switching Test Circuit & Waveforms**

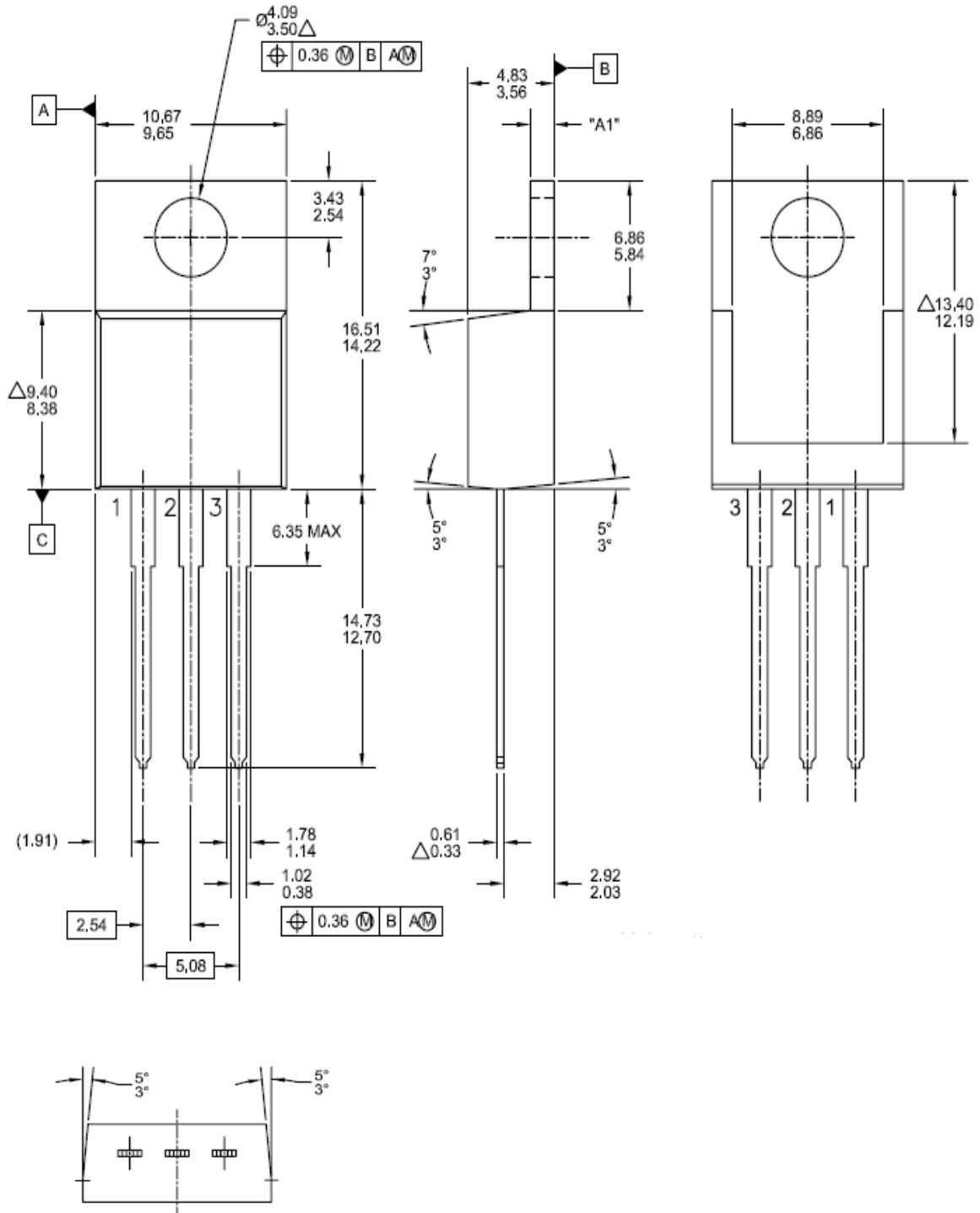


Peak Diode Recovery dv/dt Test Circuit & Waveforms



Mechanical Dimensions

TO - 220

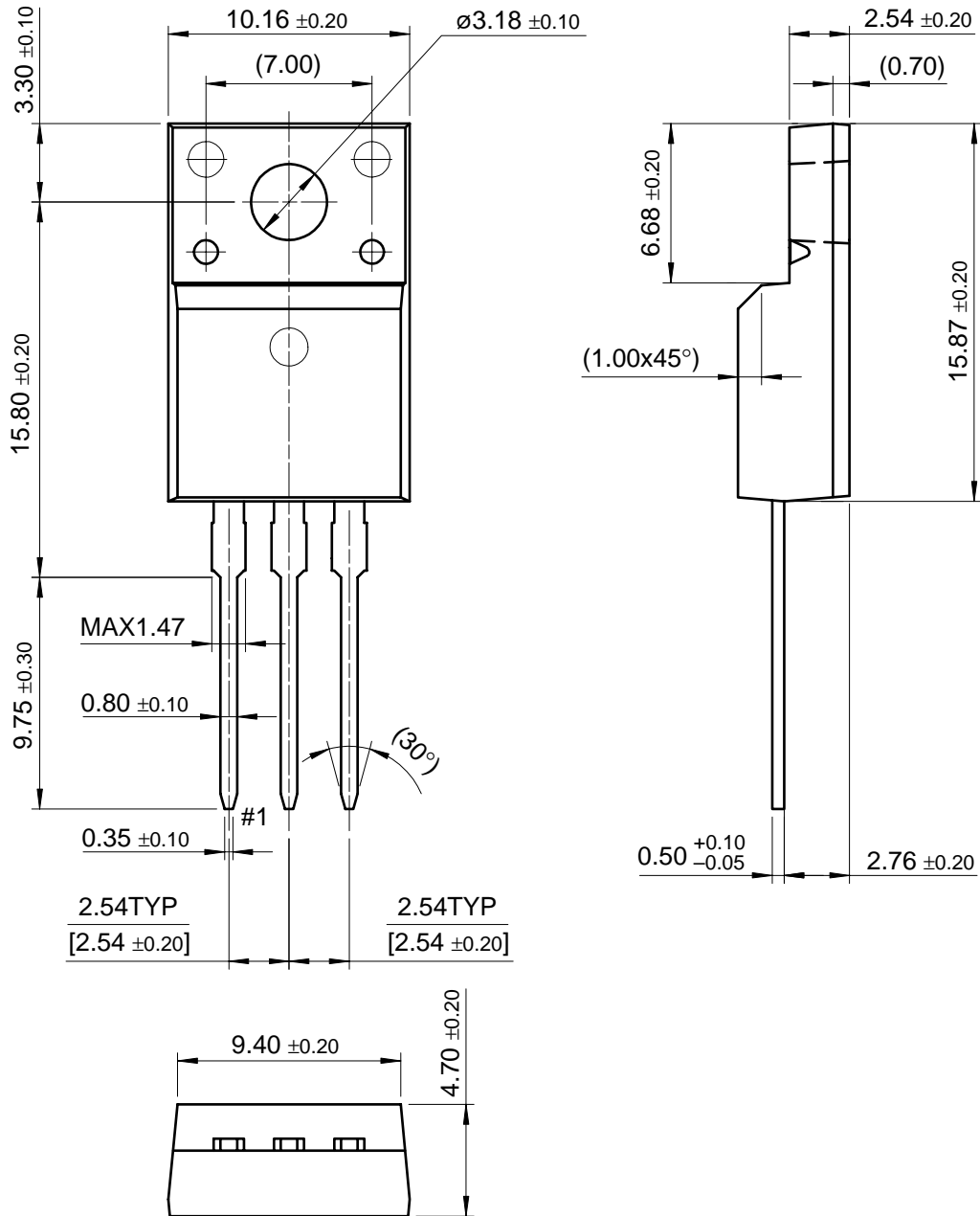


Dimensions in Millimeters



Mechanical Dimensions (Continued)

TO-220F






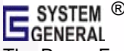
FCP20N60 / FCPF20N60 600V N-Channel MOSFET

Dimensions in Millimeters



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