

## FCP11N60F/FCPF11N60F 600V N-Channel MOSFET

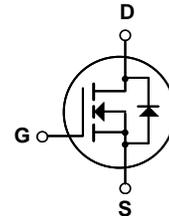
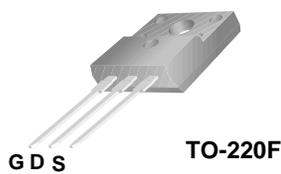
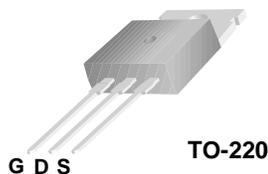
### Features

- 650V @ $T_J = 150^\circ\text{C}$
- Typ.  $R_{DS(on)} = 0.32\Omega$
- Fast Recovery Type ( $t_{rr} = 120\text{ns}$ )
- Ultra Low Gate Charge (typ.  $Q_g = 40\text{nC}$ )
- Low Effective Output Capacitance (typ.  $C_{oss\text{eff.}} = 95\text{pF}$ )
- 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.



### Absolute Maximum Ratings

Symbol	Parameter	FCP11N60F	FCPF11N60F	Units
$I_D$	Drain Current - Continuous ( $T_C = 25^\circ\text{C}$ ) - Continuous ( $T_C = 100^\circ\text{C}$ )	11	11 *	A
		7	7 *	A
$I_{DM}$	Drain Current - Pulsed (Note 1)	33	33 *	A
$V_{GSS}$	Gate-Source Voltage	$\pm 30$		V
$E_{AS}$	Single Pulsed Avalanche Energy (Note 2)	340		mJ
$I_{AR}$	Avalanche Current (Note 1)	11		A
$E_{AR}$	Repetitive Avalanche Energy (Note 1)	12.5		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 $25^\circ\text{C}$	125	36 *	W
		1.0	0.29 *	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 purposes, 1/8" from case for 5 seconds	300		$^\circ\text{C}$

\* Drain current limited by maximum junction temperature.

### Thermal Characteristics

Symbol	Parameter	FCP11N60F	FCPF11N60F	Units
$R_{\theta JC}$	Thermal Resistance, Junction-to-Case	1.0	3.5	$^\circ\text{C/W}$
$R_{\theta CS}$	Thermal Resistance, Case-to-Sink	0.5	--	$^\circ\text{C/W}$
$R_{\theta JA}$	Thermal Resistance, Junction-to-Ambient	62.5	62.5	$^\circ\text{C/W}$

## Package Marking and Ordering Information

Device Marking	Device	Package	Reel Size	Tape Width	Quantity
FCP11N60F	FCP11N60F	TO-220	--	--	50
FCPF11N60F	FCPF11N60F	TO-220F	--	--	50

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

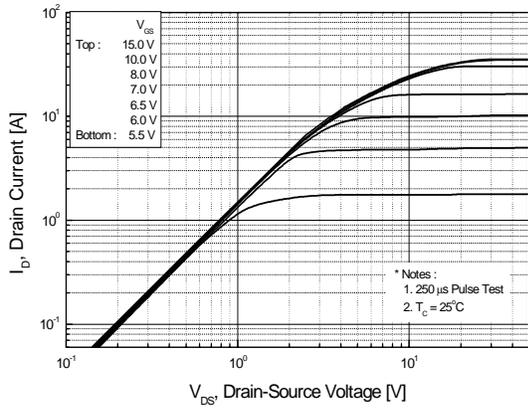
Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Units	
<b>Off Characteristics</b>							
BV <sub>DSS</sub>	Drain-Source Breakdown Voltage	V <sub>GS</sub> = 0 V, I <sub>D</sub> = 250 μA, T <sub>J</sub> = 25°C	600	--	--	V	
		V <sub>GS</sub> = 0 V, I <sub>D</sub> = 250 μA, T <sub>J</sub> = 150°C	--	650	--	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-Source Avalanche Breakdown Voltage	V <sub>GS</sub> = 0 V, I <sub>D</sub> = 11 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> = 5.5 A	--	0.32	0.38	Ω	
g <sub>FS</sub>	Forward Transconductance	V <sub>DS</sub> = 40 V, I <sub>D</sub> = 5.5 A (Note 4)	--	9.7	--	S	
<b>Dynamic Characteristics</b>							
C <sub>iss</sub>	Input Capacitance	V <sub>DS</sub> = 25 V, V <sub>GS</sub> = 0 V, f = 1.0 MHz	--	1148	1490	pF	
C <sub>oss</sub>	Output Capacitance		--	671	870	pF	
C <sub>rss</sub>	Reverse Transfer Capacitance		--	63	82	pF	
C <sub>oss</sub>	Output Capacitance	V <sub>DS</sub> = 480 V, V <sub>GS</sub> = 0 V, f = 1.0 MHz	--	35	--	pF	
C <sub>oss eff.</sub>	Effective Output Capacitance	V <sub>DS</sub> = 0V to 480 V, V <sub>GS</sub> = 0 V	--	95	--	pF	
<b>Switching Characteristics</b>							
t <sub>d(on)</sub>	Turn-On Delay Time	V <sub>DD</sub> = 300 V, I <sub>D</sub> = 11 A, R <sub>G</sub> = 25 Ω	--	34	80	ns	
t <sub>r</sub>	Turn-On Rise Time		--	98	205	ns	
t <sub>d(off)</sub>	Turn-Off Delay Time		--	119	250	ns	
t <sub>f</sub>	Turn-Off Fall Time		(Note 4, 5)	--	56	120	ns
Q <sub>g</sub>	Total Gate Charge	V <sub>DS</sub> = 480 V, I <sub>D</sub> = 11 A, V <sub>GS</sub> = 10 V	--	40	52	nC	
Q <sub>gs</sub>	Gate-Source Charge		(Note 4, 5)	--	7.2	--	nC
Q <sub>gd</sub>	Gate-Drain Charge		(Note 4, 5)	--	21	--	nC
<b>Drain-Source Diode Characteristics and Maximum Ratings</b>							
I <sub>S</sub>	Maximum Continuous Drain-Source Diode Forward Current		--	--	11	A	
I <sub>SM</sub>	Maximum Pulsed Drain-Source Diode Forward Current		--	--	33	A	
V <sub>SD</sub>	Drain-Source Diode Forward Voltage	V <sub>GS</sub> = 0 V, I <sub>S</sub> = 11 A	--	--	1.4	V	
t <sub>rr</sub>	Reverse Recovery Time	V <sub>GS</sub> = 0 V, I <sub>S</sub> = 11 A, di <sub>F</sub> / dt = 100 A/μs (Note 4)	--	120	--	ns	
Q <sub>rr</sub>	Reverse Recovery Charge		--	0.8	--	μC	

### Notes:

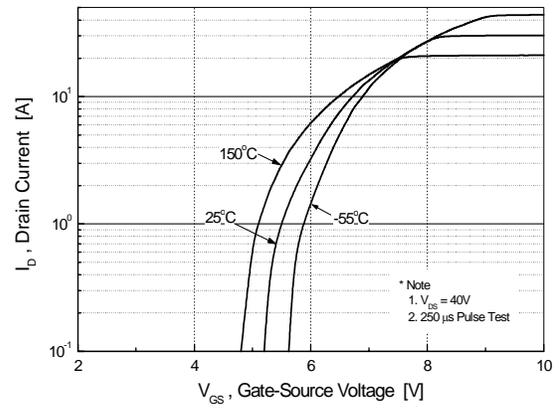
1. Repetitive Rating : Pulse width limited by maximum junction temperature
2. I<sub>AS</sub> = 5.5A, V<sub>DD</sub> = 50V, R<sub>G</sub> = 25 Ω, Starting T<sub>J</sub> = 25°C
3. I<sub>SD</sub> ≤ 11A, di/dt ≤ 200A/μs, V<sub>DD</sub> ≤ BV<sub>DSS</sub>, Starting T<sub>J</sub> = 25°C
4. Pulse Test : Pulse width ≤ 300μs, Duty cycle ≤ 2%
5. Essentially independent of operating temperature

## Typical Performance Characteristics

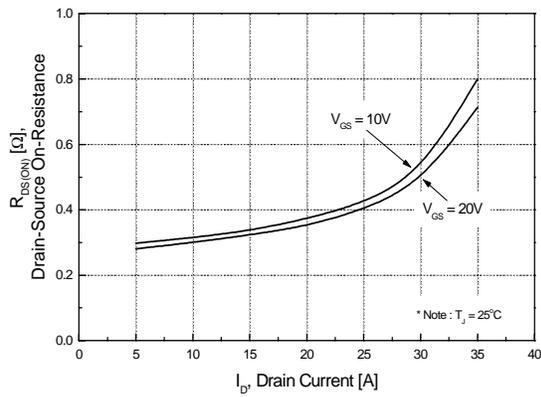
**Figure 1. On-Region Characteristics**



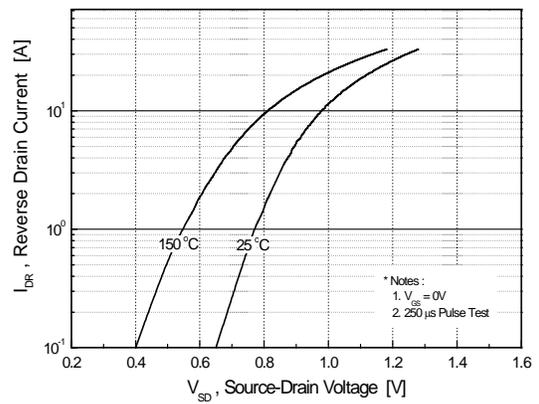
**Figure 2. Transfer Characteristics**



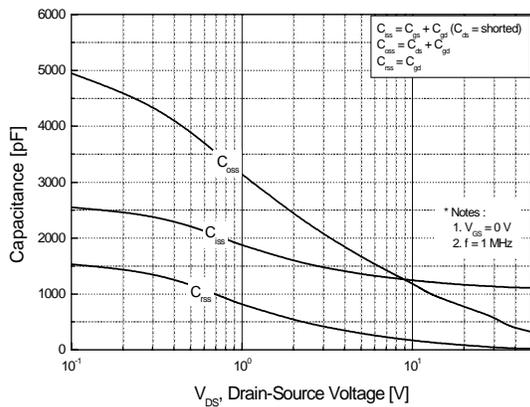
**Figure 3. On-Resistance Variation vs. Drain Current and Gate Voltage**



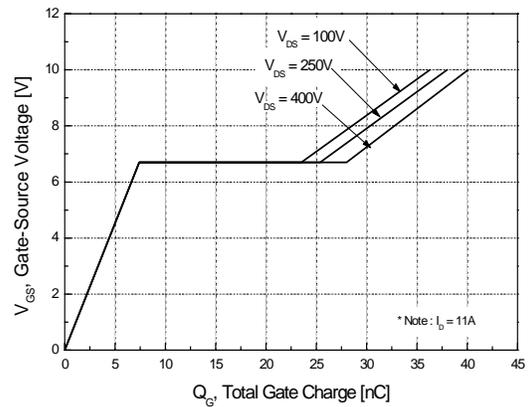
**Figure 4. Body Diode Forward Voltage Variation vs. Source Current and Temperature**



**Figure 5. Capacitance Characteristics**

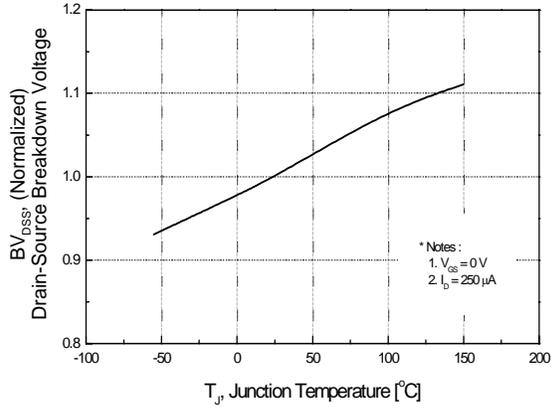


**Figure 6. Gate Charge Characteristics**

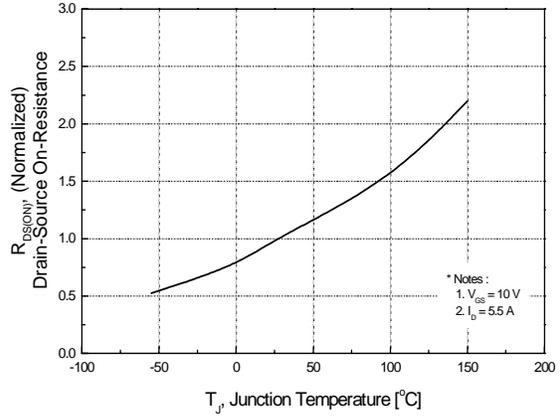


**Typical Performance Characteristics** (Continued)

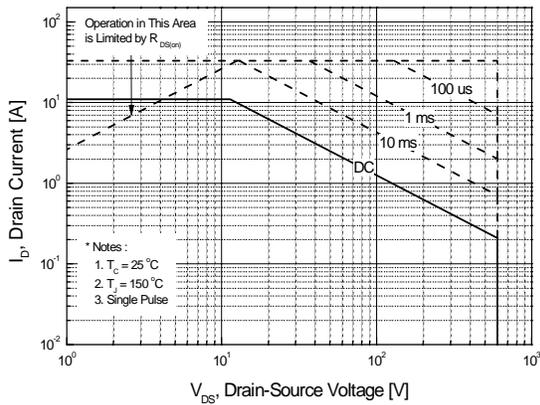
**Figure 7. Breakdown Voltage Variation vs. Temperature**



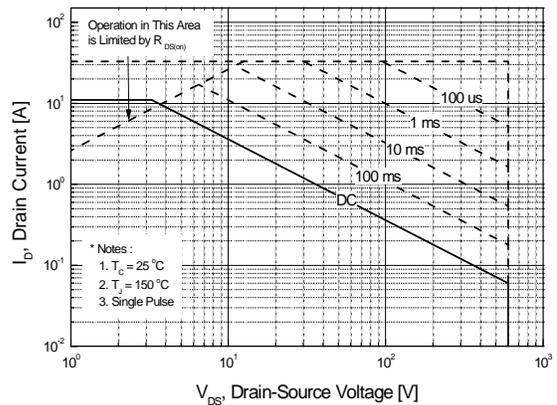
**Figure 8. On-Resistance Variation vs. Temperature**



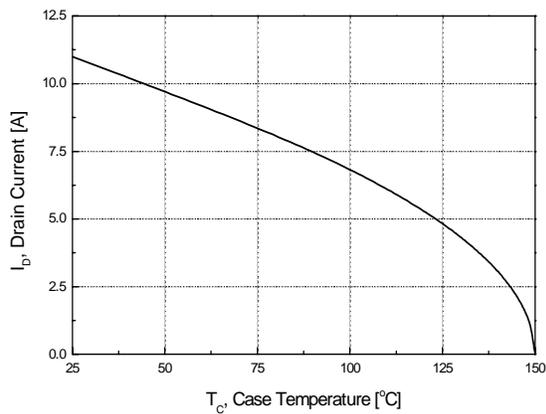
**Figure 9-1. Safe Operating Area for FCP11N60F**



**Figure 9-2. Safe Operating Area for FCPF11N60F**



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



Typical Performance Characteristics (Continued)

Figure 11-1. Transient Thermal Response Curve for FCP11N60F

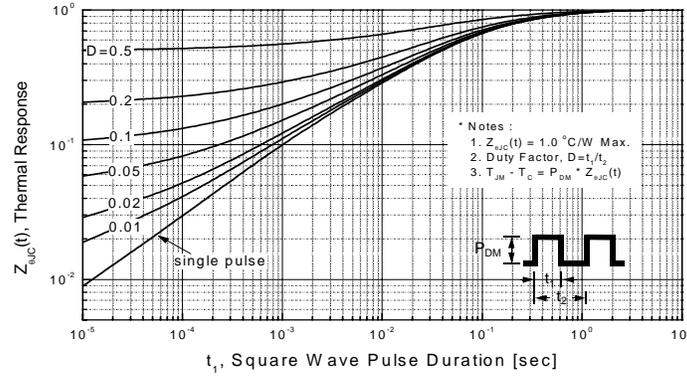
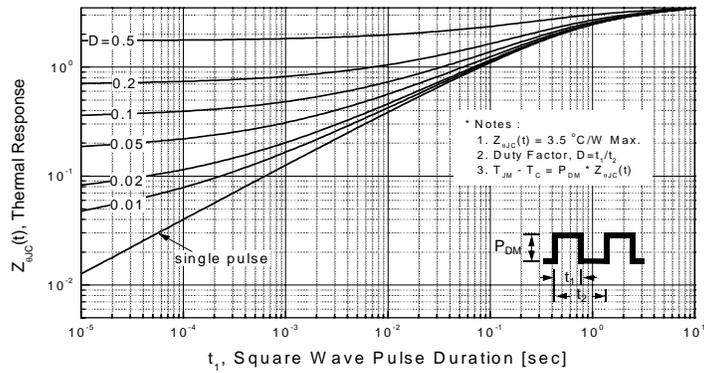
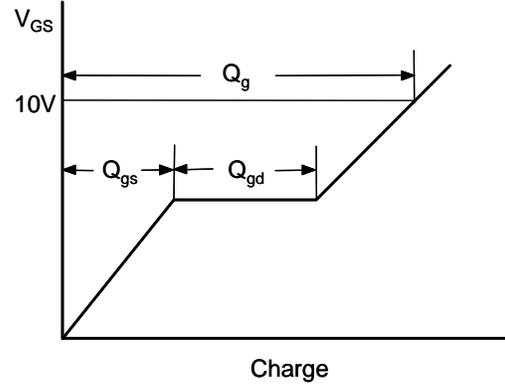
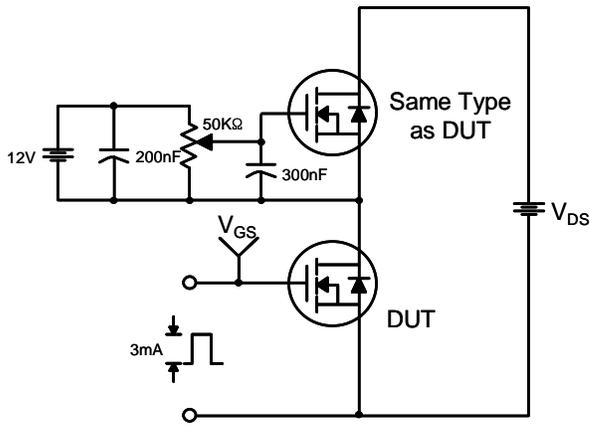


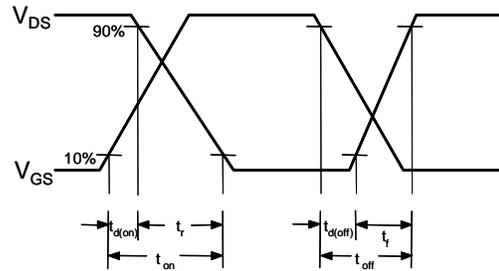
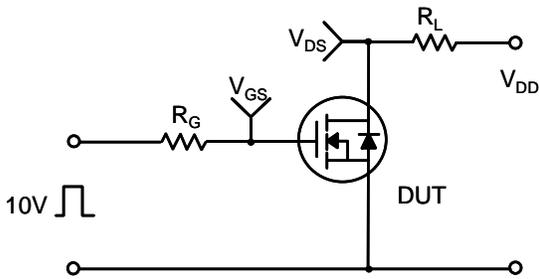
Figure 11-2. Transient Thermal Response Curve for FCPF11N60F



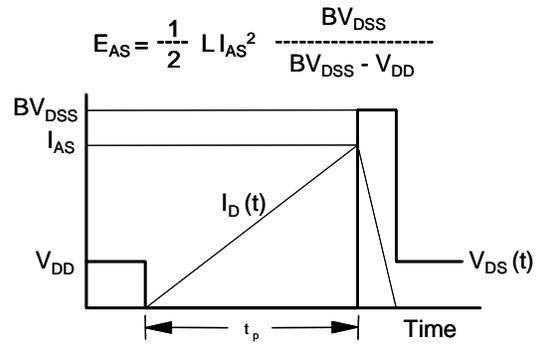
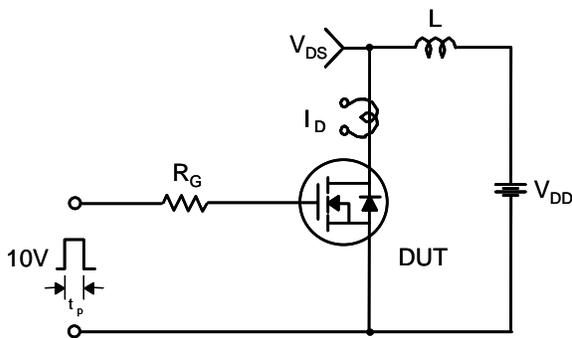
**Gate Charge Test Circuit & Waveform**



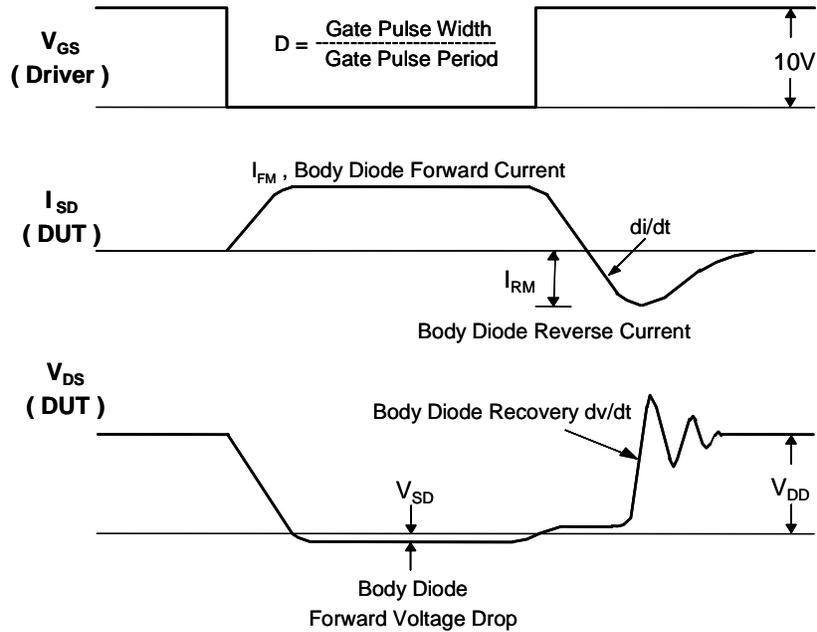
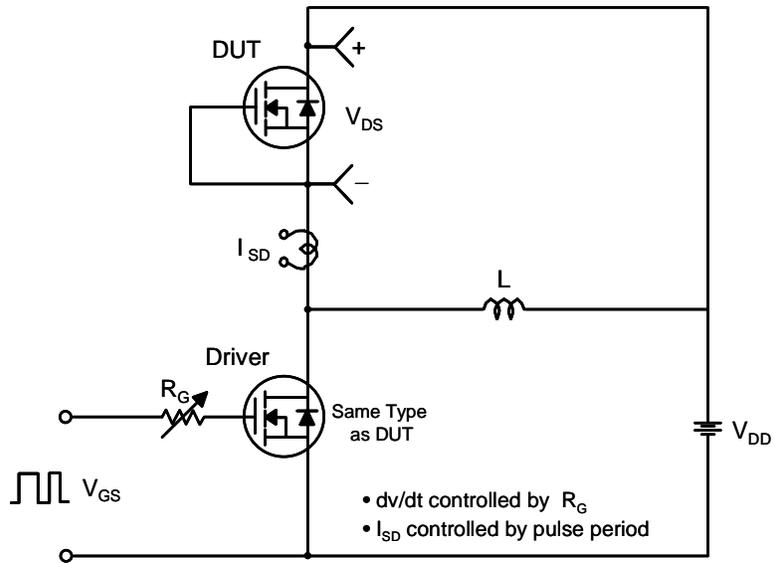
**Resistive Switching Test Circuit & Waveforms**



**Unclamped Inductive Switching Test Circuit & Waveforms**

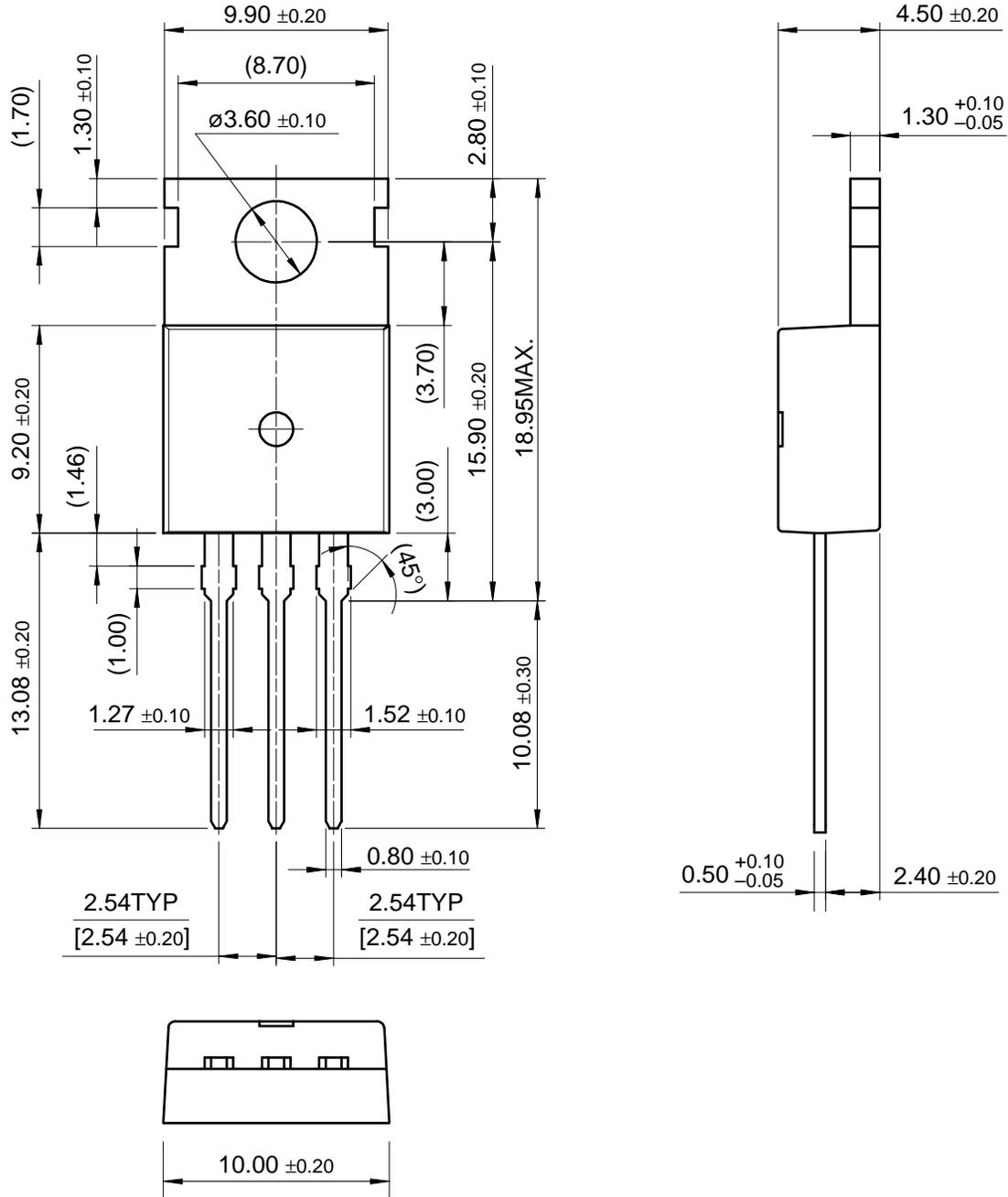


Peak Diode Recovery dv/dt Test Circuit & Waveforms



Mechanical Dimensions

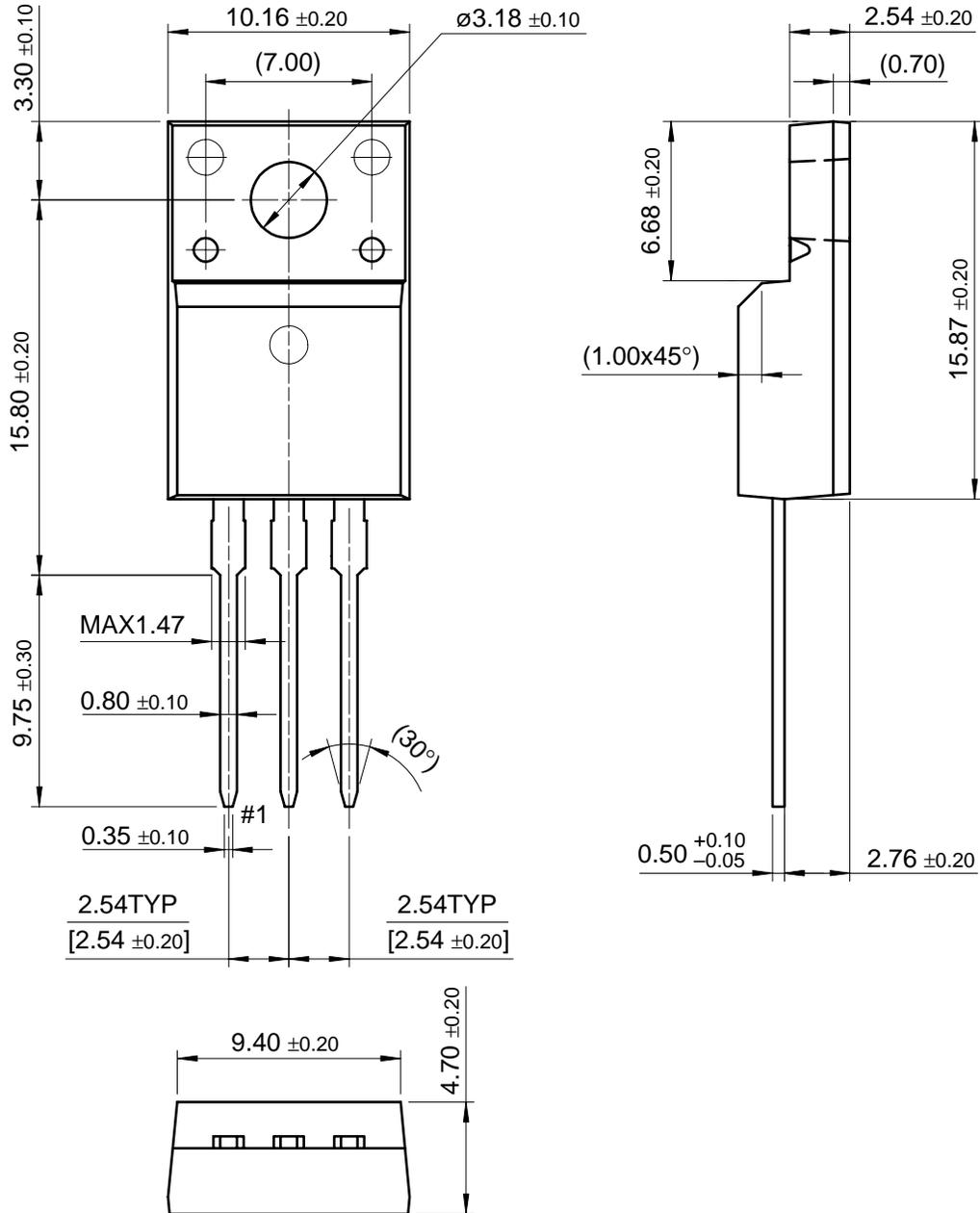
TO-220



Dimensions in Millimeters

Mechanical Dimensions (Continued)

TO-220F



Dimensions in Millimeters

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Bottomless™	FPS™	MICROCOUPLER™	QFET <sup>®</sup>	TinyLogic <sup>®</sup>
Build it Now™	FRFET™	MicroFET™	QS™	TINYOPTO™
CoolFET™	GlobalOptoisolator™	MicroPak™	QT Optoelectronics™	TruTranslation™
CROSSVOLT™	GTO™	MICROWIRE™	Quiet Series™	UHC™
DOME™	HiSeC™	MSX™	RapidConfigure™	UltraFET <sup>®</sup>
EcoSPARK™	I <sup>2</sup> C™	MSXPro™	RapidConnect™	UniFET™
E <sup>2</sup> CMOST™	i-Lo™	OCX™	μSerDes™	VCX™
EnSigna™	ImpliedDisconnect™	OCXPro™	SILENT SWITCHER <sup>®</sup>	Wire™
FACT™	IntelliMAX™	OPTOLOGIC <sup>®</sup>	SMART START™	
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		PowerEdge™	SuperSOT™-6	

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