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ON Semiconductor®

# FCPF190N60-F152

## N-Channel SuperFET® II MOSFET 600 V, 20.2 A, 199 mΩ

### Features

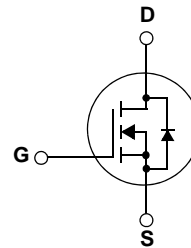
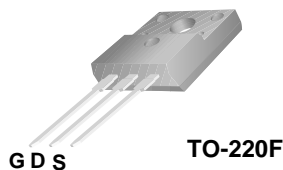
- 650 V @  $T_J = 150^\circ\text{C}$
- Max.  $R_{DS(on)} = 199\text{ m}\Omega$
- Ultra low gate charge (typ.  $Q_g = 57\text{ nC}$ )
- Low effective output capacitance (typ.  $C_{oss,eff} = 160\text{ pF}$ )
- 100% avalanche tested

### Description

SuperFET®II 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 advanced technology is tailored to minimize conduction loss, provide superior switching performance, and withstand extreme dv/dt rate and higher avalanche energy. Consequently, SuperFET®II MOSFET is suitable for various AC/DC power conversion for system miniaturization and higher efficiency.

### Applications

- LCD / LED / PDP TV Lighting
- Solar Inverter
- AC-DC Power Supply



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


Symbol	Parameter	FCPF190N60-F152	Unit
$V_{DSS}$	Drain to Source Voltage	600	V
$V_{GSS}$	Gate to Source Voltage	-DC	$\pm 20$
		-AC (f > 1Hz)	$\pm 30$
$I_D$	Drain Current	-Continuous ( $T_C = 25^\circ\text{C}$ )	20.2*
		-Continuous ( $T_C = 100^\circ\text{C}$ )	12.7*
$I_{DM}$	Drain Current	- Pulsed (Note 1)	60.6*
$E_{AS}$	Single Pulsed Avalanche Energy	(Note 2)	400
$I_{AR}$	Avalanche Current	(Note 1)	4.0
$E_{AR}$	Repetitive Avalanche Energy	(Note 1)	2.1
dv/dt	Peak Diode Recovery dv/dt	(Note 3)	20
	MOSFET dv/dt		100
$P_D$	Power Dissipation	( $T_C = 25^\circ\text{C}$ )	39
		- Derate above $25^\circ\text{C}$	0.31
$T_J, T_{STG}$	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	FCPF190N60-F152	Unit
$R_{\theta JC}$	Thermal Resistance, Junction to Case	3.2	$^\circ\text{C/W}$
$R_{\theta CS}$	Thermal Resistance, Case to Heat Sink (Typical)	0.5	
$R_{\theta JA}$	Thermal Resistance, Junction to Ambient	62.5	

## Package Marking and Ordering Information

Device Marking	Device	Package	Eco Status	Packaging Type	Quantity
FCPF190N60	FCPF190N60-F152	TO-220F	Green 	Tube	50

## 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 to Source Breakdown Voltage	$V_{GS} = 0V, I_D = 10mA, T_J = 25^\circ\text{C}$	600	-	-	V
		$V_{GS} = 0V, I_D = 10mA, T_J = 150^\circ\text{C}$	650	-	-	V
$\frac{\Delta BV_{DSS}}{\Delta T_J}$	Breakdown Voltage Temperature Coefficient	$I_D = 10mA$ , Referenced to $25^\circ\text{C}$	-	0.67	-	$V/^\circ\text{C}$
$BV_{DS}$	Drain-Source Avalanche Breakdown Voltage	$V_{GS} = 0V, I_D = 20A$	-	700	-	V
$I_{DSS}$	Zero Gate Voltage Drain Current	$V_{DS} = 480V, V_{GS} = 0V$	-	-	10	$\mu\text{A}$
		$V_{DS} = 480V, T_C = 125^\circ\text{C}$	-	-	10	$\mu\text{A}$
$I_{GSS}$	Gate to Body Leakage Current	$V_{GS} = \pm 20V, V_{DS} = 0V$	-	-	$\pm 100$	nA

### On Characteristics

$V_{GS(th)}$	Gate Threshold Voltage	$V_{GS} = V_{DS}, I_D = 250\mu\text{A}$	2.5	-	3.5	V
$R_{DS(on)}$	Static Drain to Source On Resistance	$V_{GS} = 10V, I_D = 10A$	-	0.17	0.199	$\Omega$
$g_{FS}$	Forward Transconductance	$V_{DS} = 20V, I_D = 10A$	-	21	-	S

### Dynamic Characteristics

$C_{iss}$	Input Capacitance	$V_{DS} = 25V, V_{GS} = 0V$ $f = 1\text{MHz}$	-	2220	2950	pF
$C_{oss}$	Output Capacitance		-	1630	2165	pF
$C_{rfs}$	Reverse Transfer Capacitance		-	85	128	pF
$C_{oss}$	Output Capacitance	$V_{DS} = 380V, V_{GS} = 0V, f = 1\text{MHz}$	-	42	-	pF
$C_{oss \text{ eff.}}$	Effective Output Capacitance	$V_{DS} = 0V \text{ to } 480V, V_{GS} = 0V$	-	160	-	pF
$Q_{g(tot)}$	Total Gate Charge at 10V	$V_{DS} = 380V, I_D = 10A$ $V_{GS} = 10V$	-	57	74	nC
$Q_{gs}$	Gate to Source Gate Charge		-	9	-	nC
$Q_{gd}$	Gate to Drain "Miller" Charge		(Note 4)	-	21	-
ESR	Equivalent Series Resistance	$f = 1\text{MHz}$	-	1	-	$\Omega$

### Switching Characteristics

$t_{d(on)}$	Turn-On Delay Time	$V_{DD} = 380V, I_D = 10A$ $V_{GS} = 10V, R_g = 4.7\Omega$	-	20	50	ns
$t_r$	Turn-On Rise Time		-	10	30	ns
$t_{d(off)}$	Turn-Off Delay Time		-	64	138	ns
$t_f$	Turn-Off Fall Time		(Note 4)	-	5	20

### Drain-Source Diode Characteristics

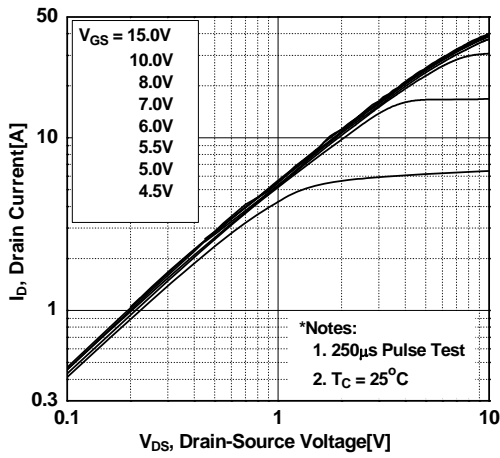
$I_S$	Maximum Continuous Drain to Source Diode Forward Current	-	-	20.2	A	
$I_{SM}$	Maximum Pulsed Drain to Source Diode Forward Current	-	-	60.6	A	
$V_{SD}$	Drain to Source Diode Forward Voltage	$V_{GS} = 0V, I_{SD} = 10A$	-	-	1.2	V
$t_{rr}$	Reverse Recovery Time	$V_{GS} = 0V, I_{SD} = 10A$	-	280	-	ns
$Q_{rr}$	Reverse Recovery Charge	$di_F/dt = 100A/\mu\text{s}$	-	3.8	-	$\mu\text{C}$

#### Notes:

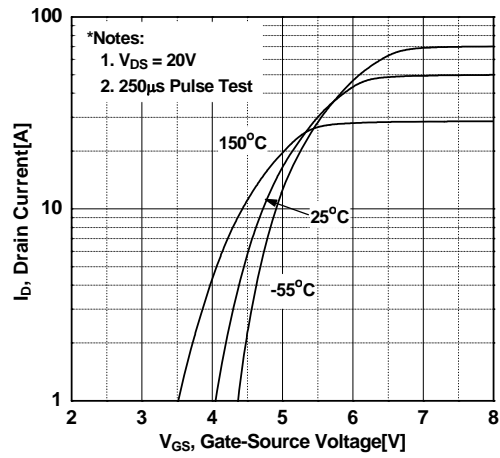
1. Repetitive Rating: Pulse width limited by maximum junction temperature
2.  $I_{AS} = 4A, V_{DD} = 50V, R_G = 25\Omega$ , Starting  $T_J = 25^\circ\text{C}$
3.  $I_{SD} \leq 10A, di/dt \leq 200A/\mu\text{s}, V_{DD} \leq BV_{DSS}$ , Starting  $T_J = 25^\circ\text{C}$
4. Essentially Independent of Operating Temperature Typical Characteristics

## Typical Performance Characteristics

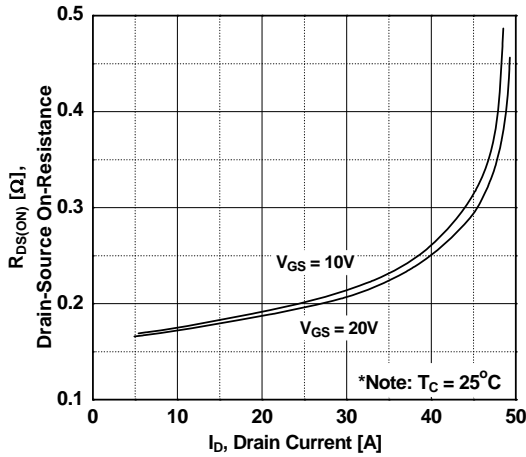
**Figure 1. On-Region Characteristics**



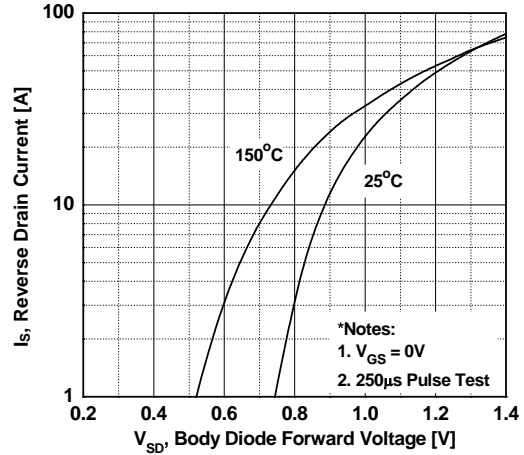
**Figure 2. Transfer Characteristics**



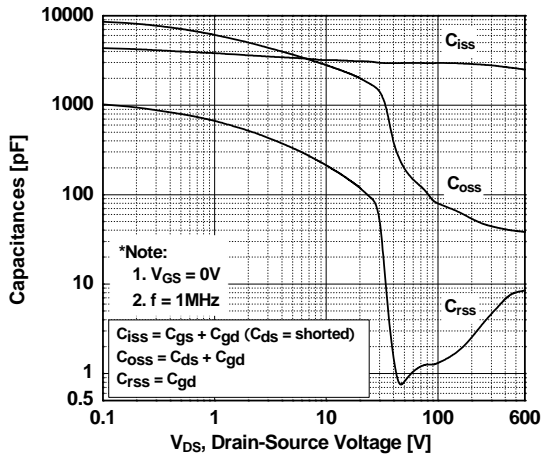
**Figure 3. On-Resistance Variation vs. Drain Current and Gate Voltage**



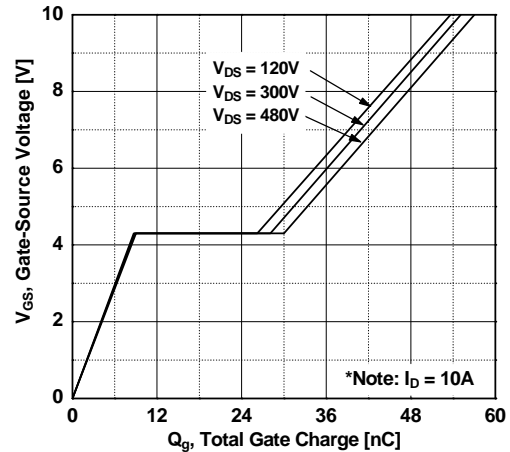
**Figure 4. Body Diode Forward Voltage Variation vs. Source Current and Temperature**



**Figure 5. Capacitance Characteristics**

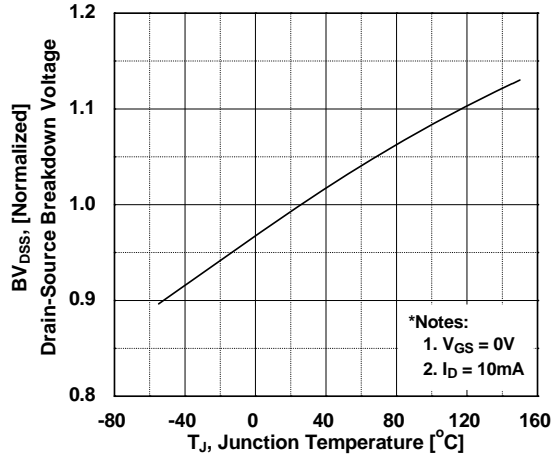


**Figure 6. Gate Charge Characteristics**

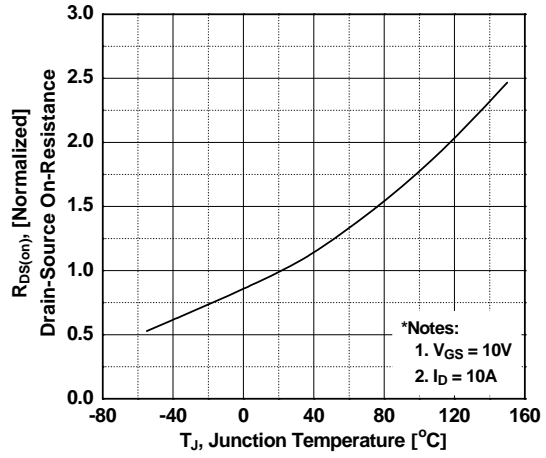


**Typical Performance Characteristics** (Continued)

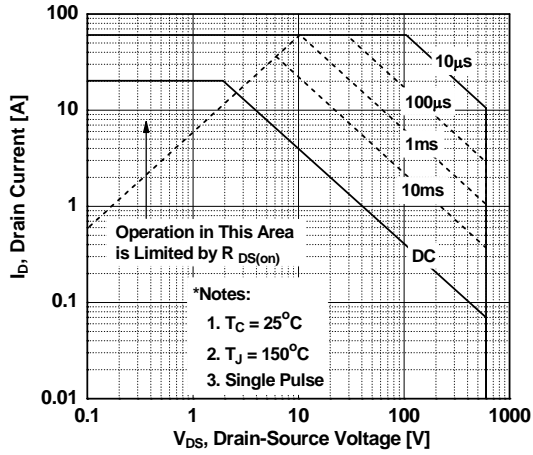
**Figure 7. Breakdown Voltage Variation vs. Temperature**



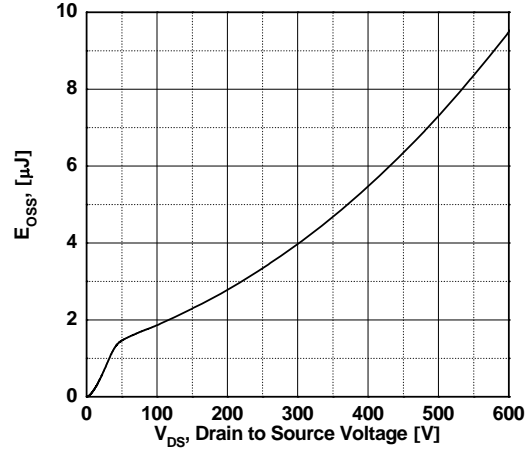
**Figure 8. On-Resistance Variation vs. Temperature**



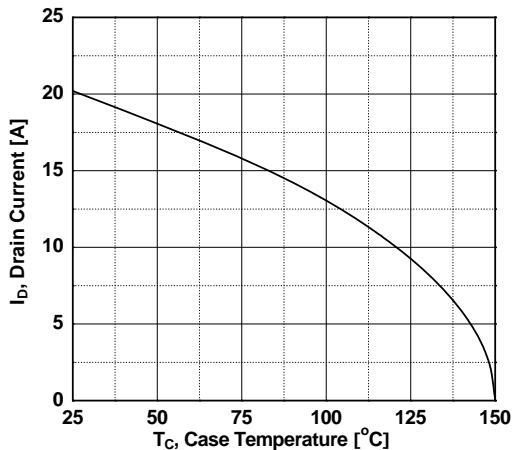
**Figure 9. Maximum Safe Operating Area vs. Case Temperature**



**Figure 10. E<sub>oss</sub> vs. Drain to Source Voltage Switching Capability**

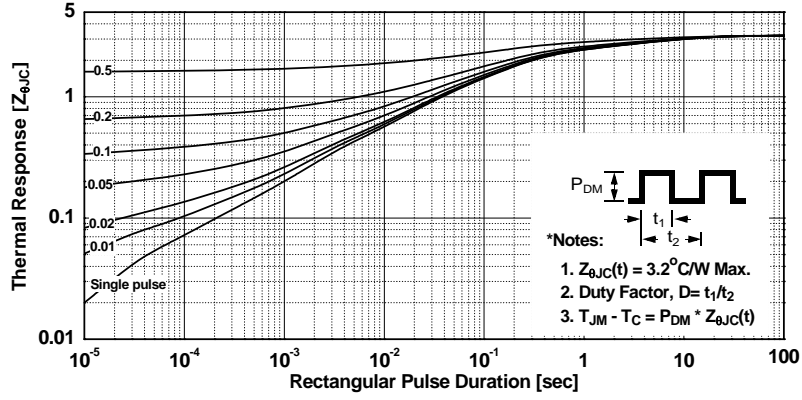


**Figure 11. Maximum Drain Current**

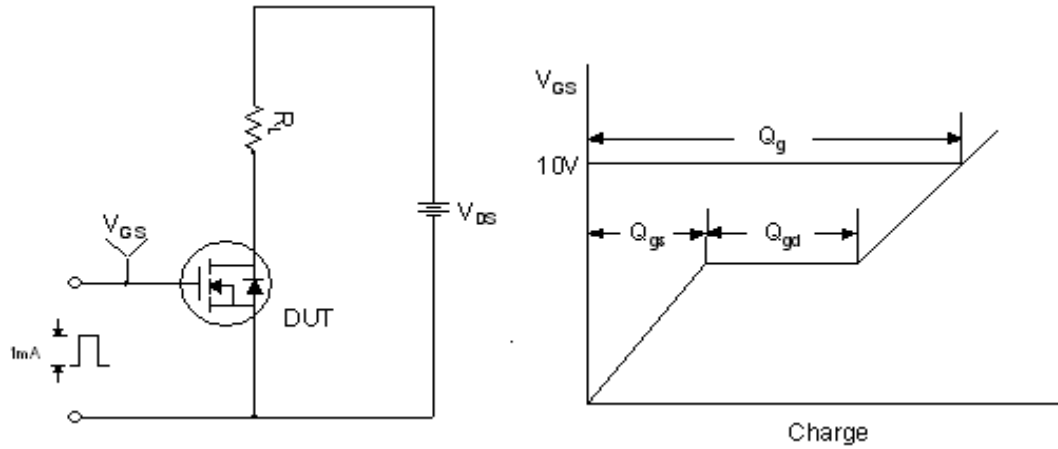


Typical Performance Characteristics (Continued)

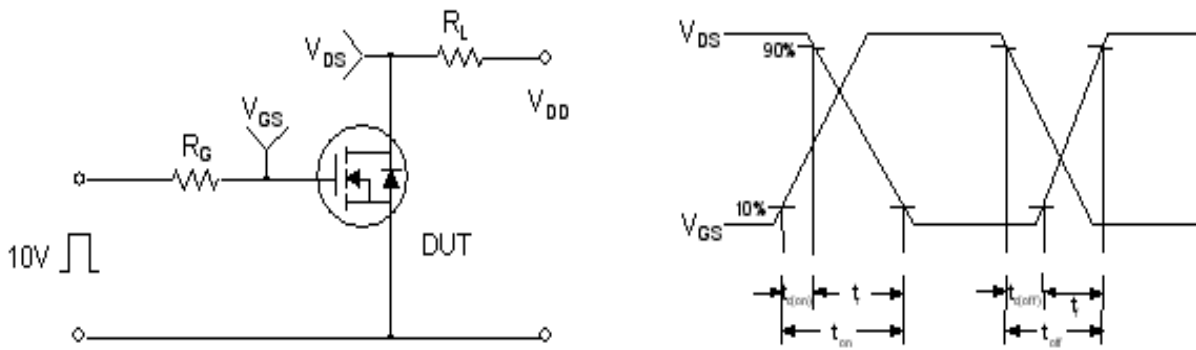
Figure 12. Transient Thermal Response Curve



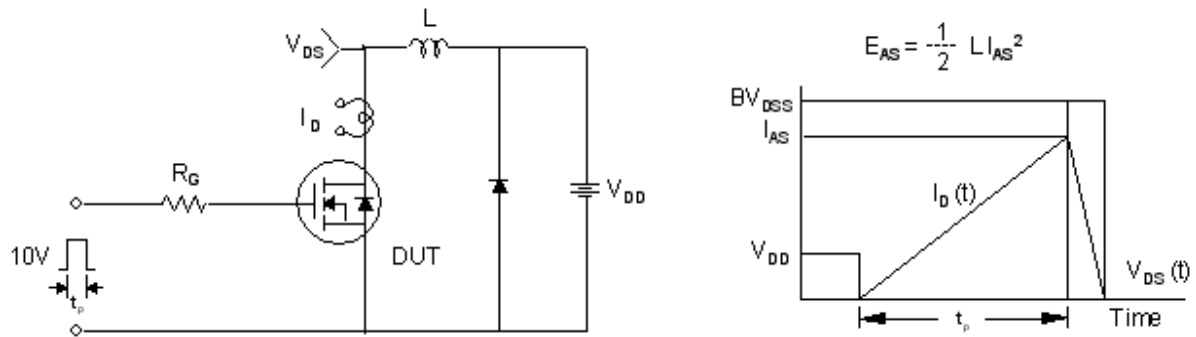
**Gate Charge Test Circuit & Waveform**



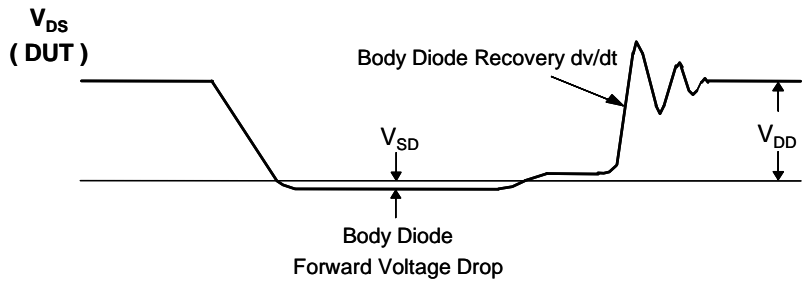
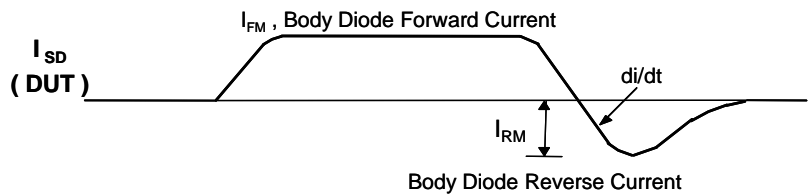
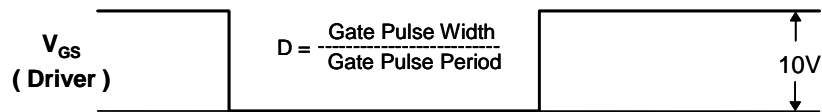
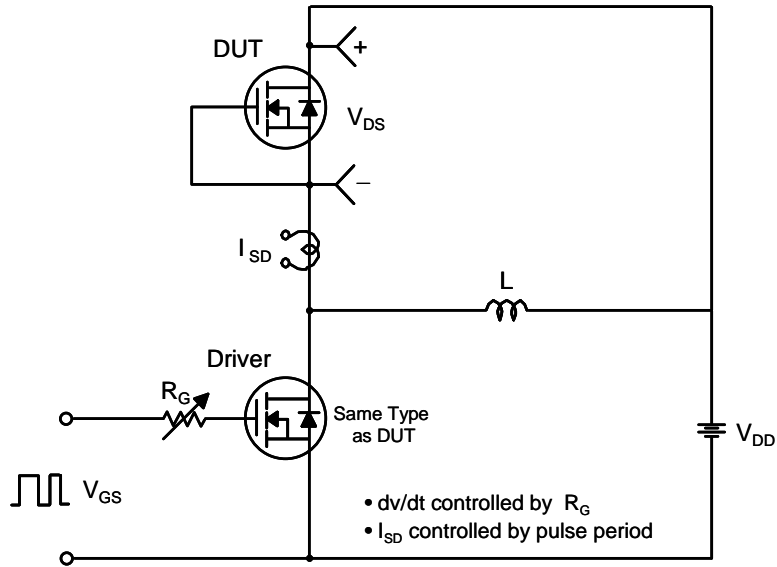
**Resistive Switching Test Circuit & Waveforms**



**Unclamped Inductive Switching Test Circuit & Waveforms**



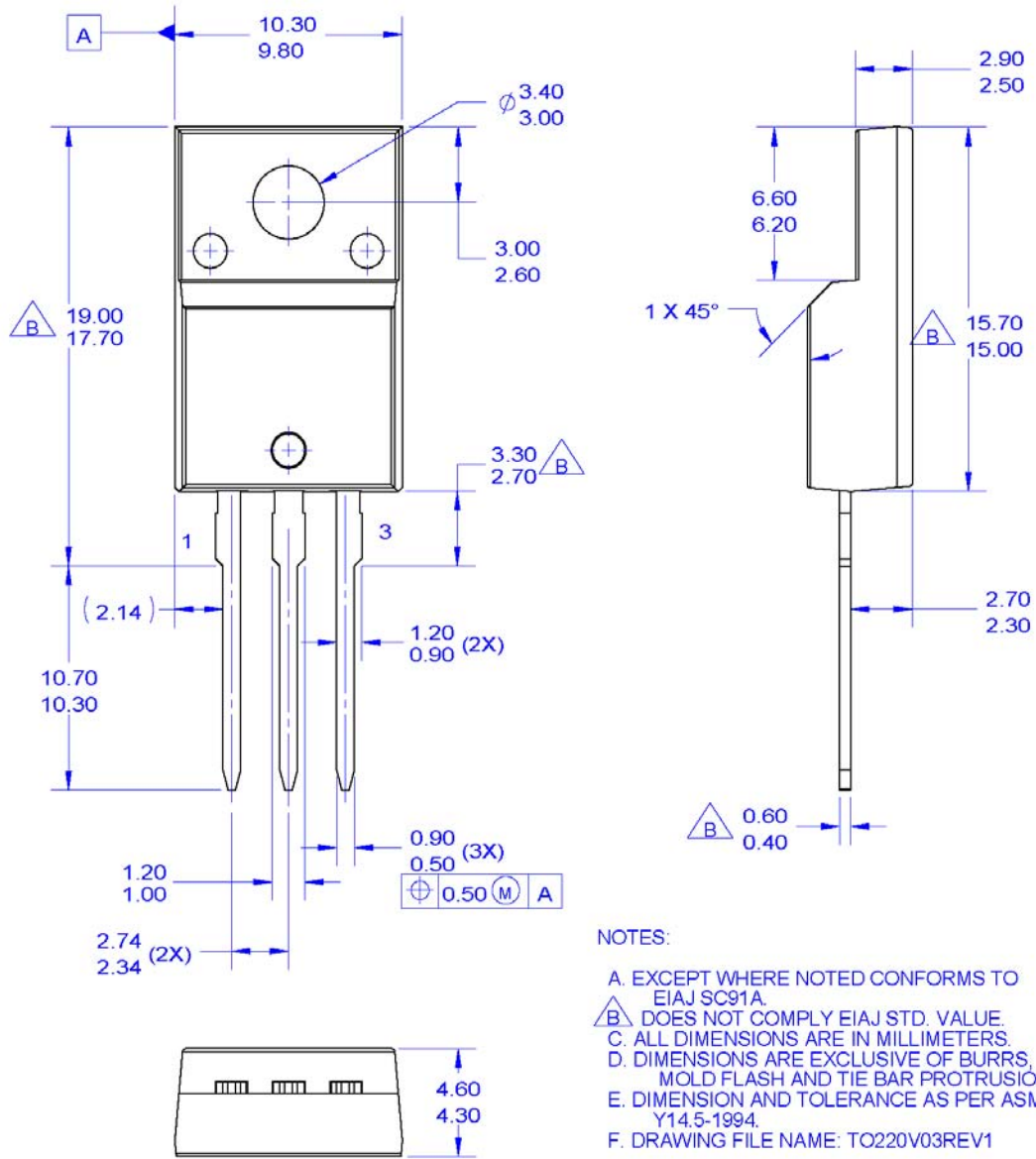
Peak Diode Recovery dv/dt Test Circuit & Waveforms





**Mechanical Dimensions**

**TO-220F**



**\* Front/Back Side Isolation Voltage : AC 2500V**

**TO-220, MOLDED, 3LD, FULL PACK, EIAJ SC91**

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