

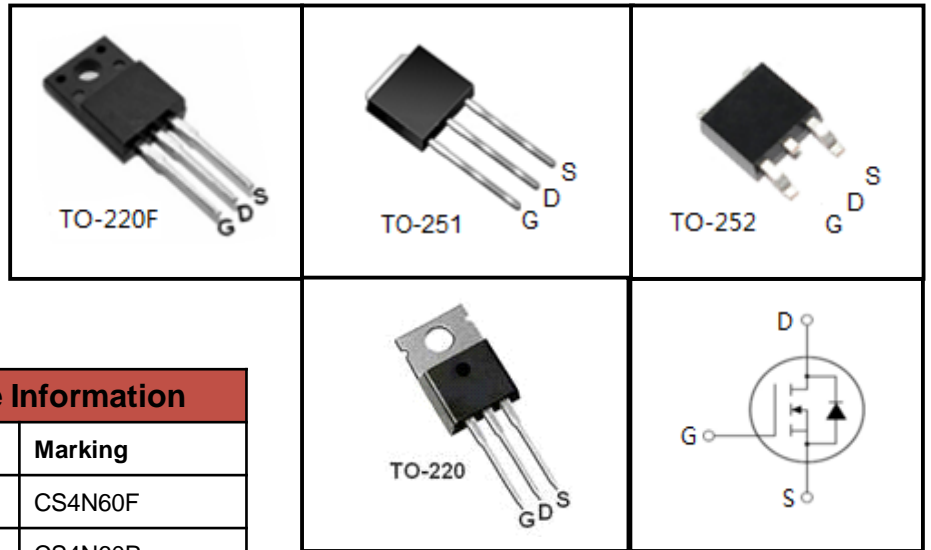
## 600V N-Channel MOSFET

### FEATURES

- Fast switching
- 100% avalanche tested
- Improved dv/dt capability

### APPLICATIONS

- Switch Mode Power Supply (SMPS)
- Uninterruptible Power Supply (UPS)
- Power Factor Correction (PFC)



### Device Marking and Package Information

Device	Package	Marking
CS4N60F	TO-220F	CS4N60F
CS4N60P	TO-220	CS4N60P
CS4N60U	TO-251	CS4N60U
CS4N60D	TO-252	CS4N60D

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

Parameter	Symbol	Value				Unit
		TO-220F	TO-220	TO-251	TO-252	
Drain-Source Voltage ( $V_{GS} = 0V$ )	$V_{DSS}$	600				V
Continuous Drain Current	$I_D$	4				A
Pulsed Drain Current (note1)	$I_{DM}$	16				A
Gate-Source Voltage	$V_{GSS}$	$\pm 20$				V
Single Pulse Avalanche Energy (note2)	$E_{AS}$	88				mJ
Avalanche Current (note1)	$I_{AS}$	4.2				A
Repetitive Avalanche Energy (note1)	$E_{AR}$	53				mJ
Power Dissipation ( $T_C = 25^{\circ}C$ )	$P_D$	20	25			W
Operating Junction and Storage Temperature Range	$T_J, T_{stg}$	-55~+150				$^{\circ}C$

### Thermal Resistance

Parameter	Symbol	Value				Unit
		TO-220F	TO-251	TO-252	TO-220	
Thermal Resistance, Junction-to-Case	R <sub>thJC</sub>	6.25	5			K/W
Thermal Resistance, Junction-to-Ambient	R <sub>thJA</sub>	62.5	60			

## Specifications $T_J = 25^{\circ}\text{C}$ , unless otherwise noted

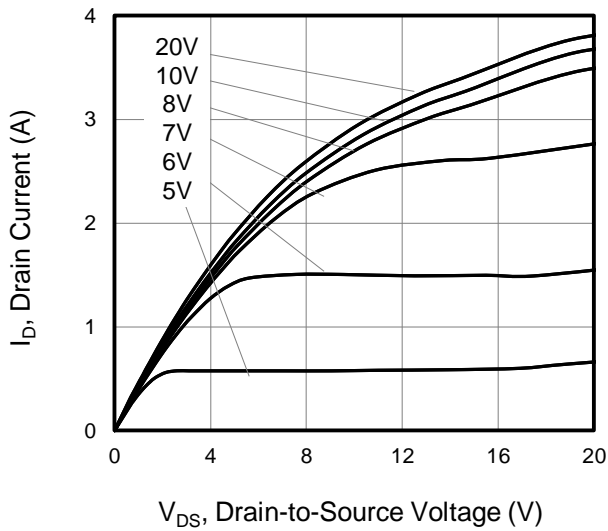
Parameter	Symbol	Test Conditions	Value			Unit
			Min.	Typ.	Max.	
Static						
Drain-Source Breakdown Voltage	V <sub>(BR)DSS</sub>	V <sub>GS</sub> = 0V, I <sub>D</sub> = 250μA	600	--	--	V
Zero Gate Voltage Drain Current	I <sub>DSS</sub>	V <sub>DS</sub> = 600V, V <sub>GS</sub> = 0V, T <sub>J</sub> = 25°C	--	--	1	μA
Gate-Source Leakage	I <sub>GSS</sub>	V <sub>GS</sub> = ±20V	--	--	±100	nA
Gate-Source Threshold Voltage	V <sub>GS(th)</sub>	V <sub>DS</sub> = V <sub>GS</sub> , I <sub>D</sub> = 250μA	3.0	--	4.0	V
Drain-Source On-Resistance (Note3)	R <sub>DS(on)</sub>	V <sub>GS</sub> = 10V, I <sub>D</sub> = 2.0A	--	1.8	2.2	Ω
Dynamic						
Input Capacitance	C <sub>iss</sub>	V <sub>GS</sub> = 0V, V <sub>DS</sub> = 25V, f = 1.0MHz	--	537	--	pF
Output Capacitance	C <sub>oss</sub>		--	55	--	
Reverse Transfer Capacitance	C <sub>rss</sub>		--	5	--	
Total Gate Charge	Q <sub>g</sub>	V <sub>DD</sub> = 480V, I <sub>D</sub> = 4.0A, V <sub>GS</sub> = 10V	--	16	--	nC
Gate-Source Charge	Q <sub>gs</sub>		--	3	--	
Gate-Drain Charge	Q <sub>gd</sub>		--	8	--	
Turn-on Delay Time	t <sub>d(on)</sub>	V <sub>DD</sub> = 250V, I <sub>D</sub> =4.0A, R <sub>G</sub> = 25 Ω	--	36	--	ns
Turn-on Rise Time	t <sub>r</sub>		--	15	--	
Turn-off Delay Time	t <sub>d(off)</sub>		--	90	--	
Turn-off Fall Time	t <sub>f</sub>		--	17	--	
Drain-Source Body Diode Characteristics						
Continuous Body Diode Current	I <sub>S</sub>	T <sub>C</sub> = 25 °C	--	--	4	A
Pulsed Diode Forward Current	I <sub>SM</sub>		--	--	16	
Body Diode Voltage	V <sub>SD</sub>	T <sub>J</sub> = 25°C, I <sub>SD</sub> = 2.0A, V <sub>GS</sub> = 0V	--	--	1.4	V
Reverse Recovery Time	t <sub>rr</sub>	V <sub>GS</sub> = 0V, I <sub>S</sub> = 4.0A, di <sub>F</sub> /dt =100A /μs	--	510	--	ns
Reverse Recovery Charge	Q <sub>rr</sub>		--	1.28	--	μC

### Notes

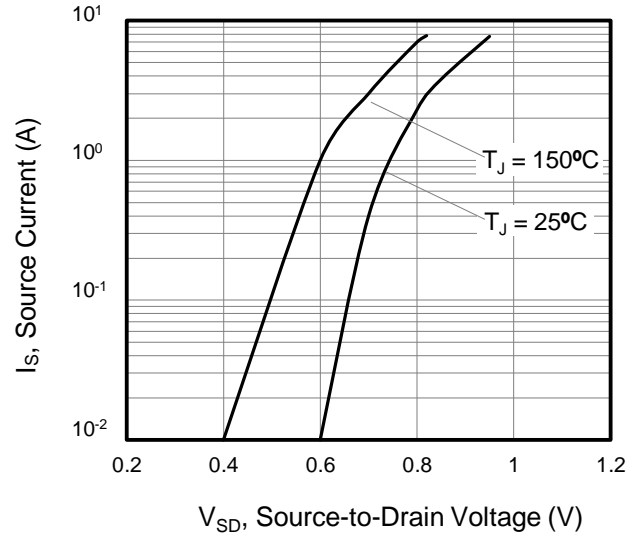
1. Repetitive Rating: Pulse width limited by maximum junction temperature
2.  $L = 10.0mH, V_{DD} = 50V, R_G = 25\Omega$ , Starting  $T_J = 25^{\circ}\text{C}$
3. Pulse Test: Pulse width  $\leq 300\mu s$ , Duty Cycle  $\leq 1\%$

**Typical Characteristics**  $T_J = 25^\circ\text{C}$ , unless otherwise noted

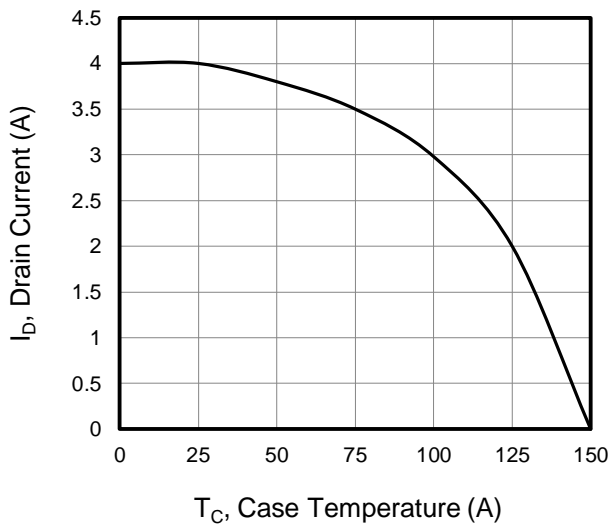
**Figure 1. Output Characteristics ( $T_J = 25^\circ\text{C}$ )**



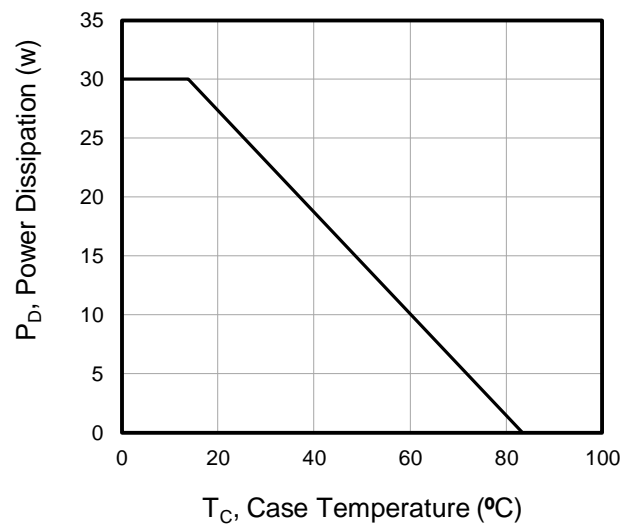
**Figure 2. Body Diode Forward Voltage**



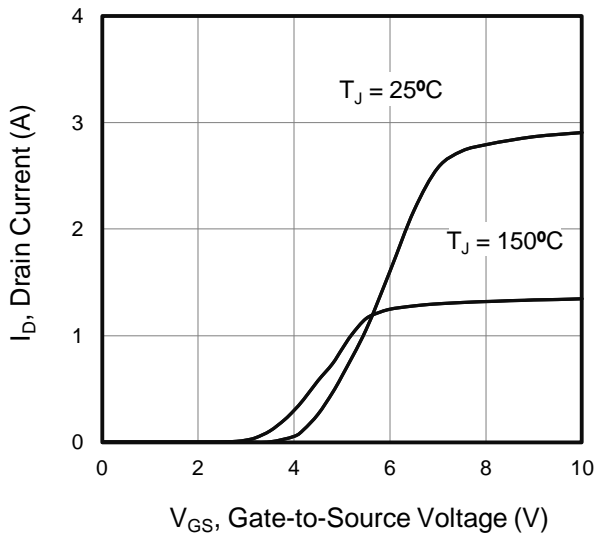
**Figure 3. Drain Current vs. Temperature**



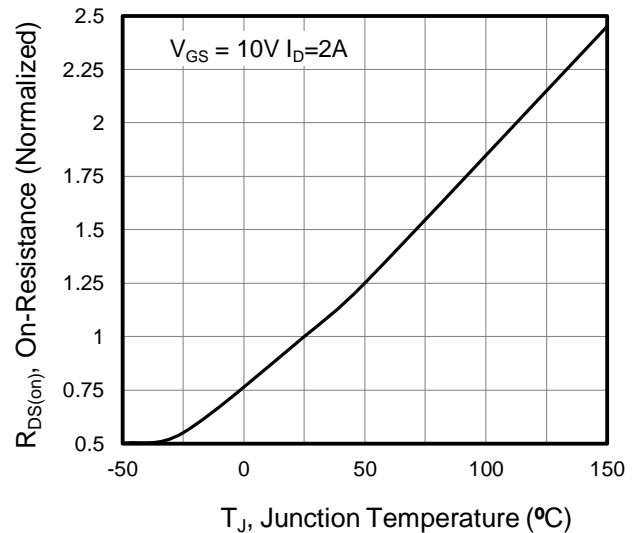
**Figure 4. Power Dissipation vs. Temperature**



**Figure 5. Transfer Characteristics**

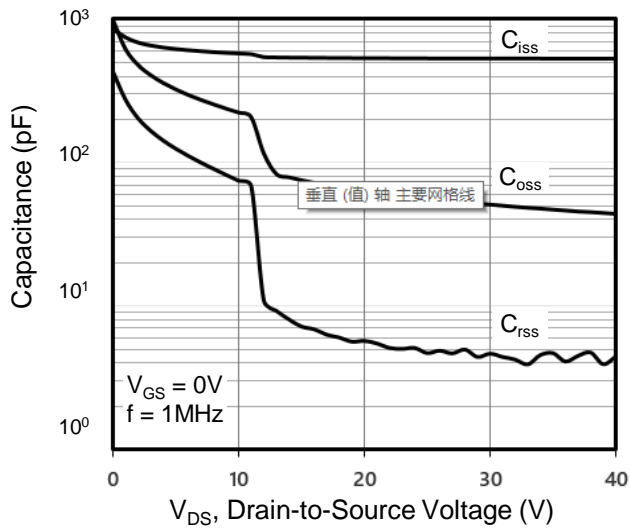


**Figure 6. On-Resistance vs. Temperature**

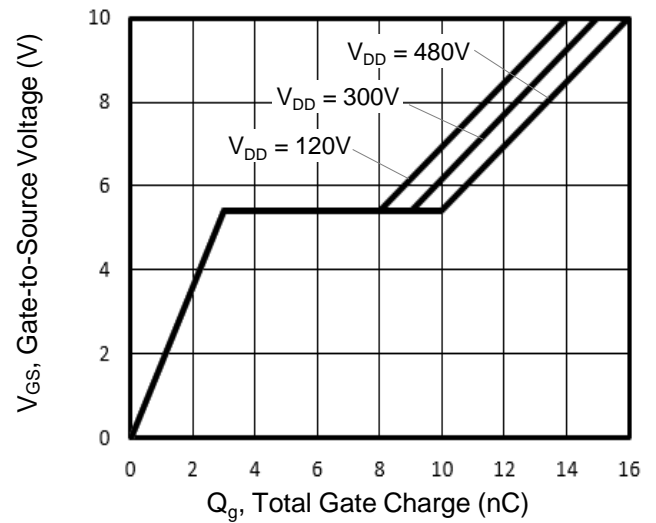


**Typical Characteristics**  $T_J = 25^\circ\text{C}$ , unless otherwise noted

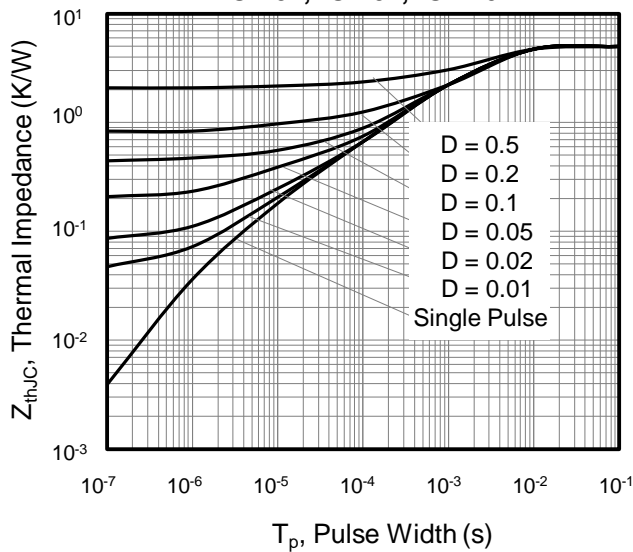
**Figure 7. Capacitance**



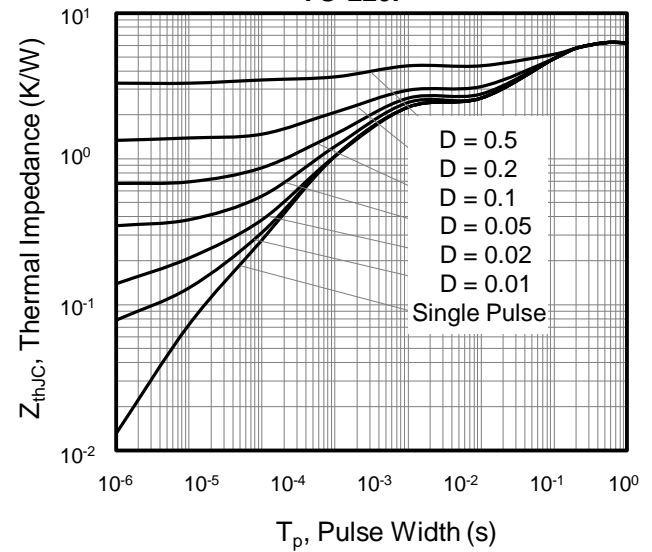
**Figure 8. Gate Charge**

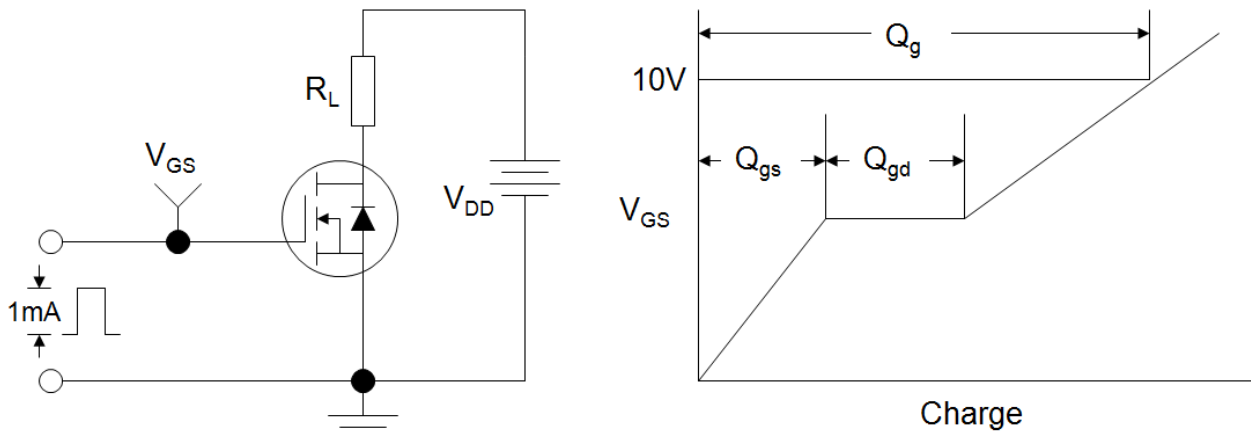
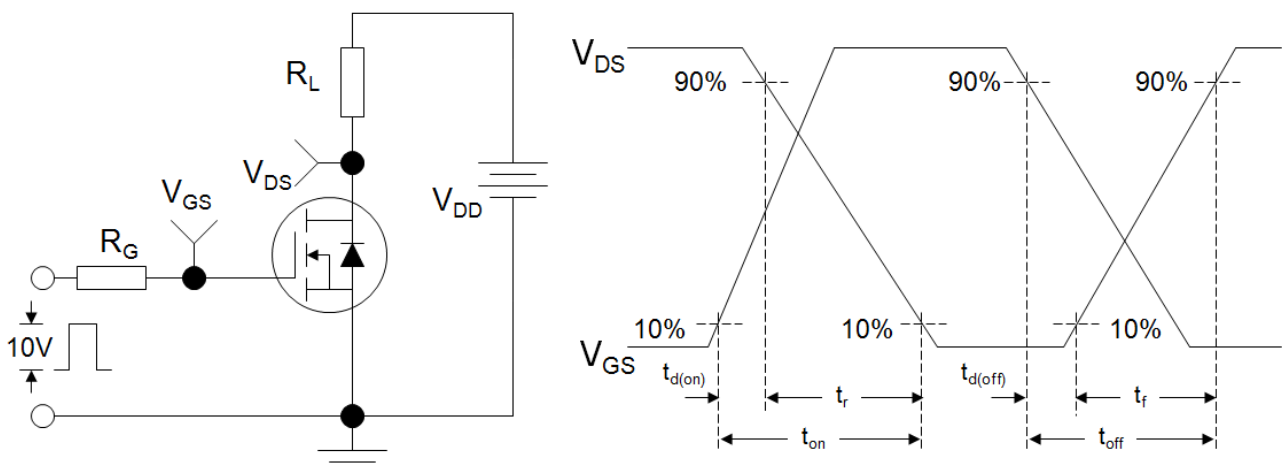
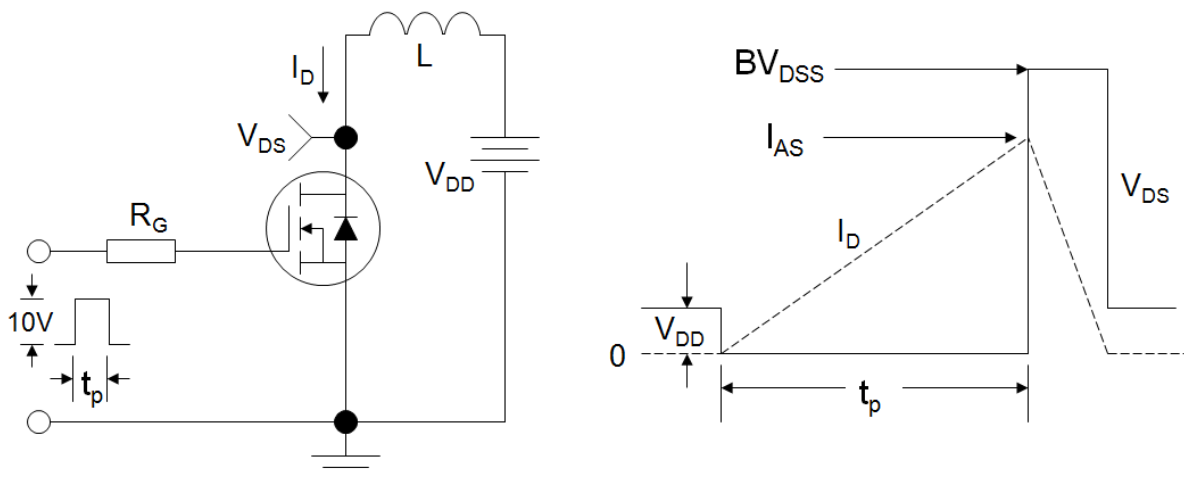


**Figure 9. Transient Thermal Impedance  
TO-251, TO-252, TO-220**

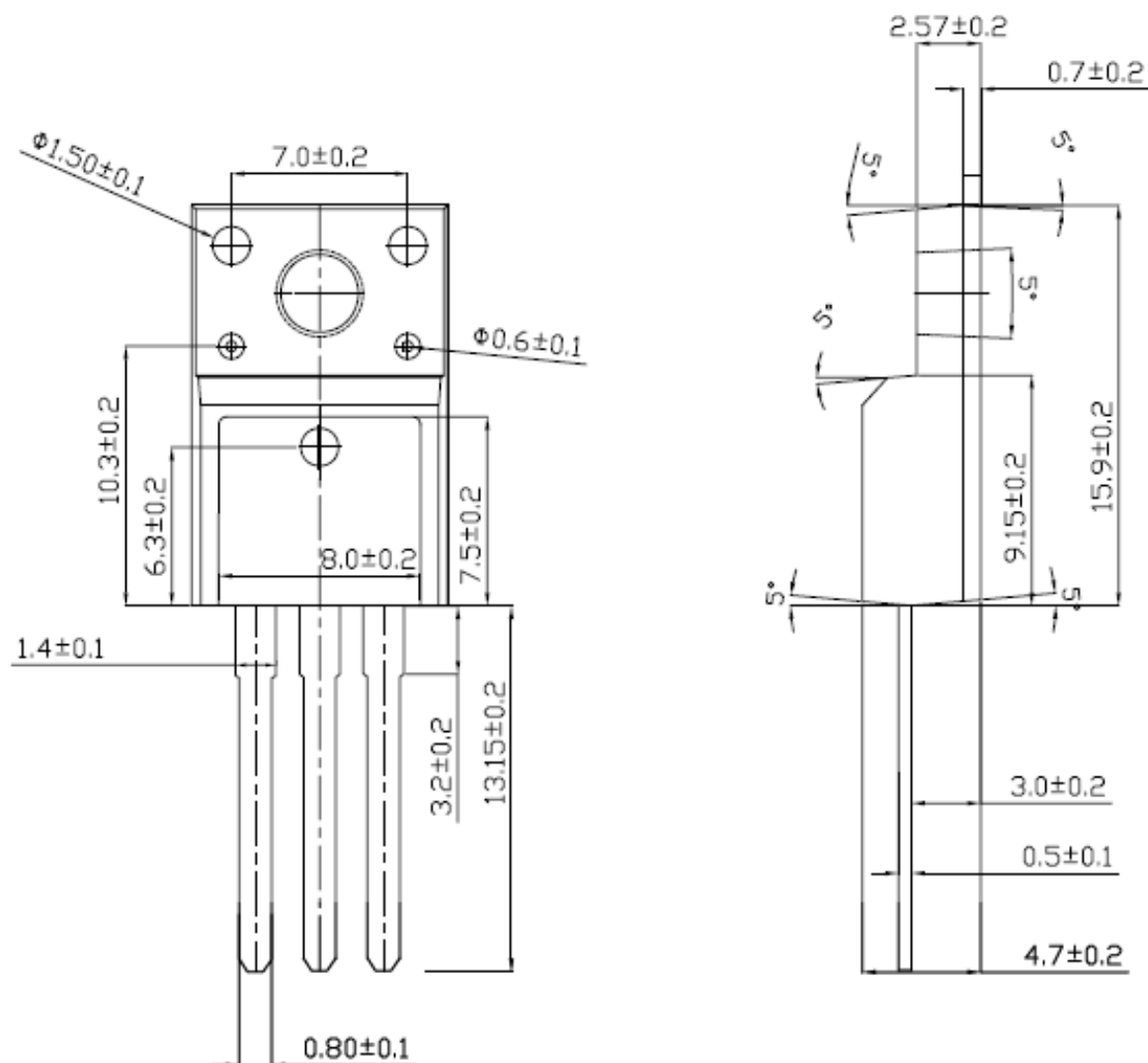


**Figure 10. Transient Thermal Impedance  
TO-220F**

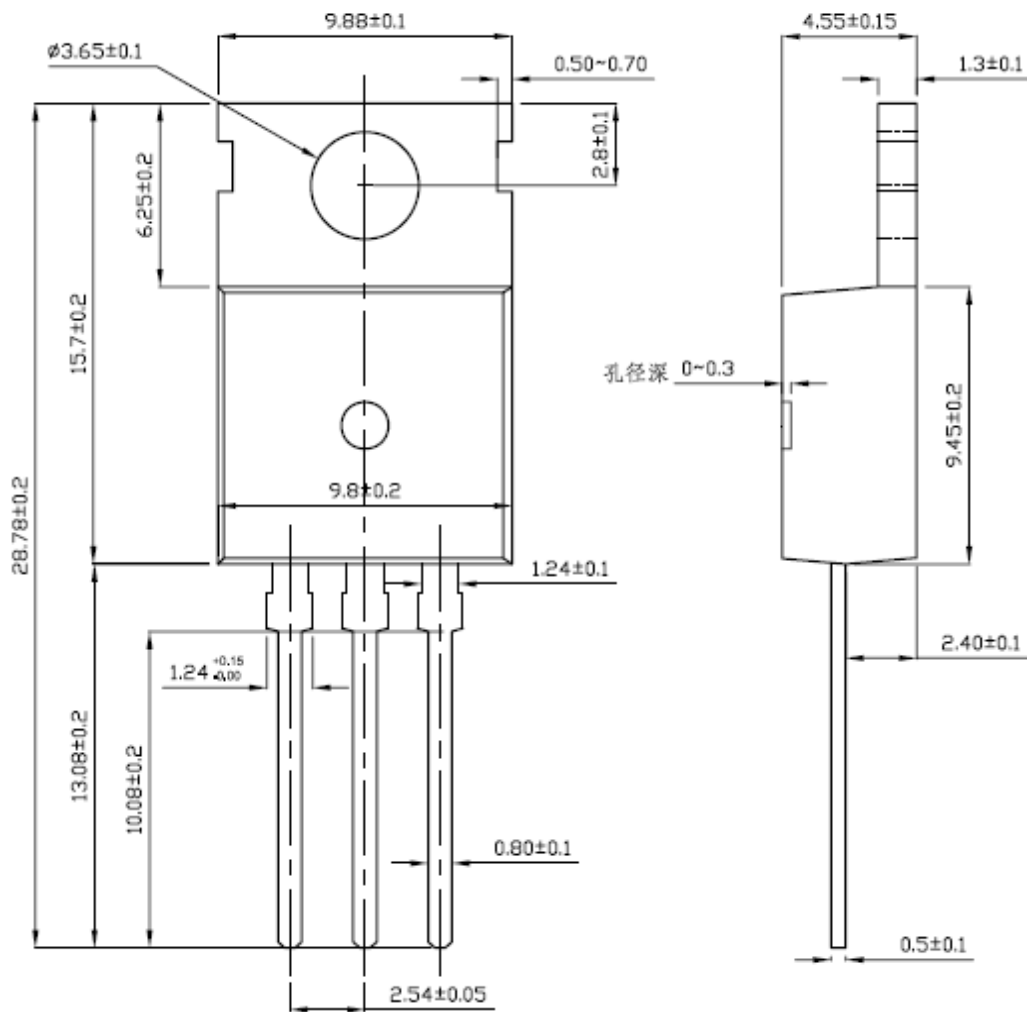


**Figure A: Gate Charge Test Circuit and Waveform**

**Figure B: Resistive Switching Test Circuit and Waveform**

**Figure C: Unclamped Inductive Switching Test Circuit and Waveform**


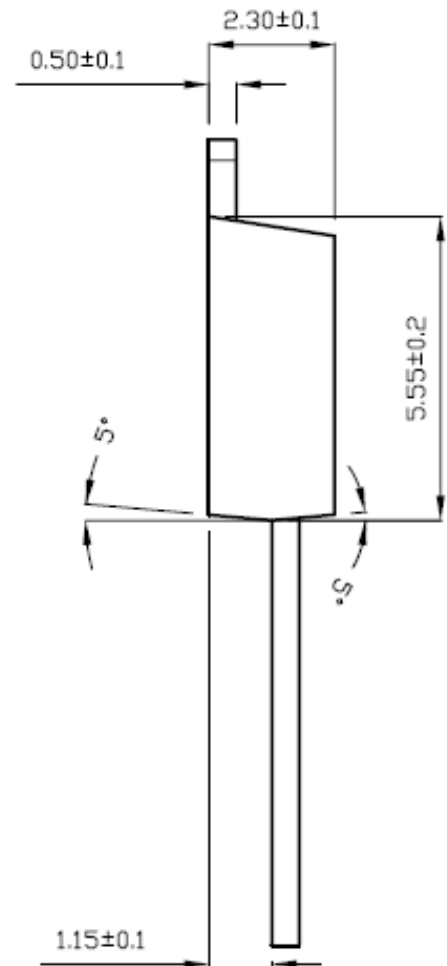
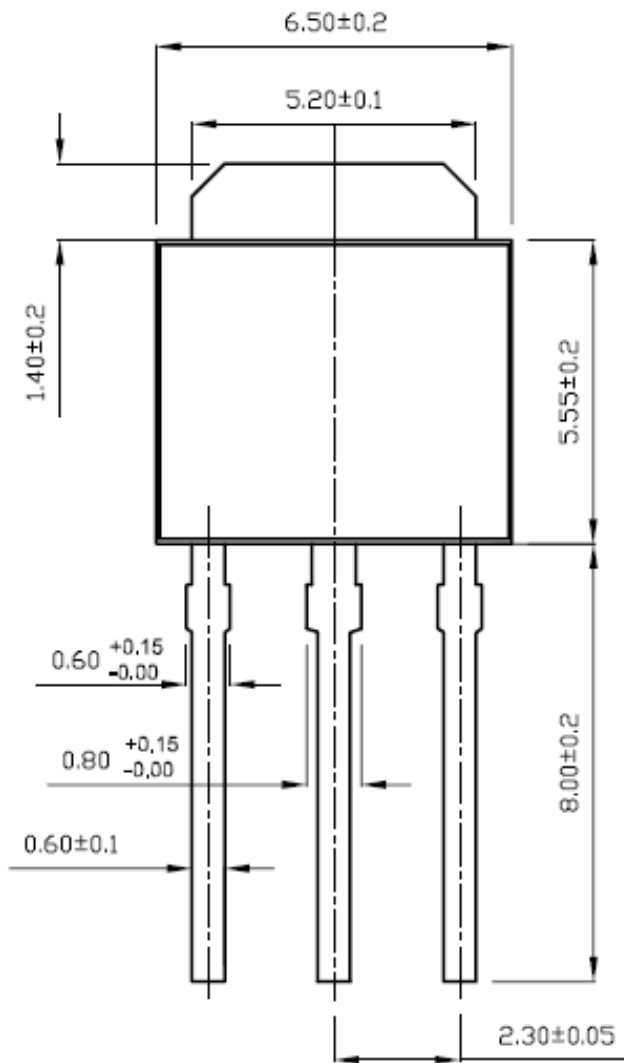
# TO-220F



## TO-220

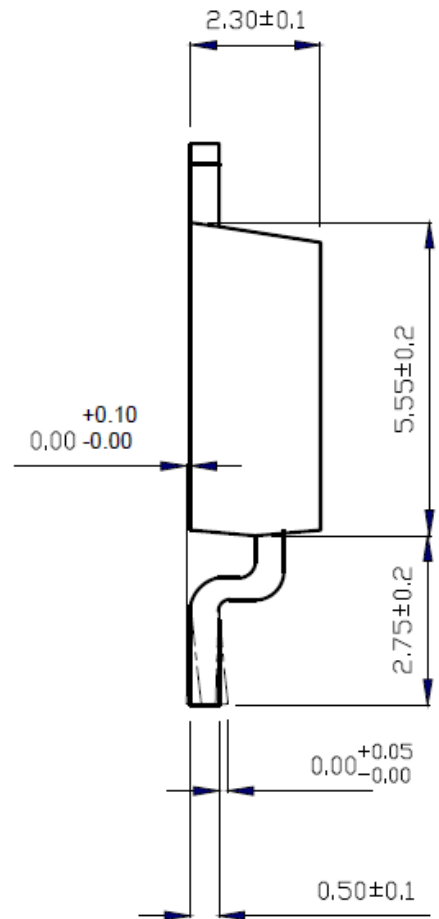
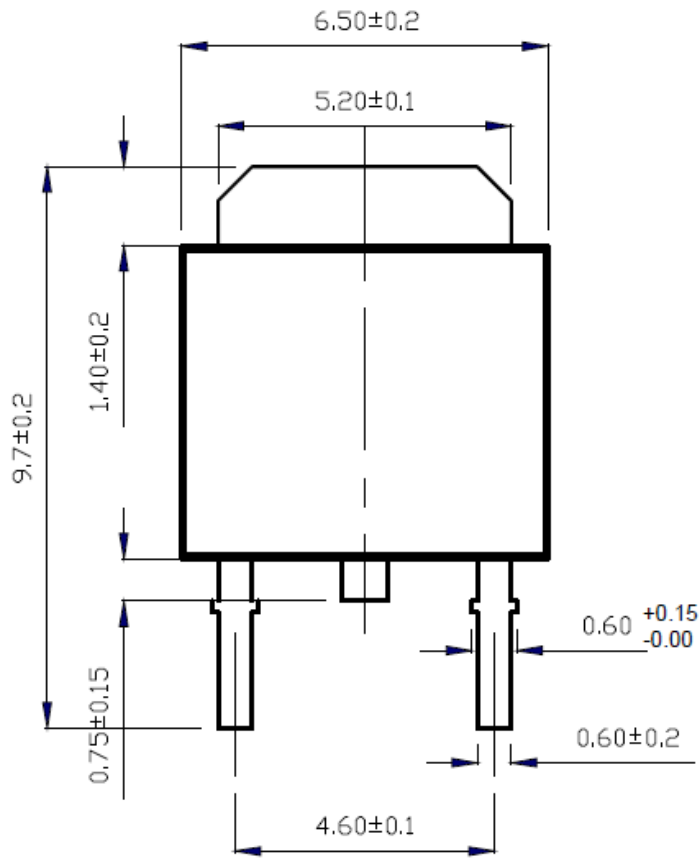


**TO-251**





**TO-252**



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