

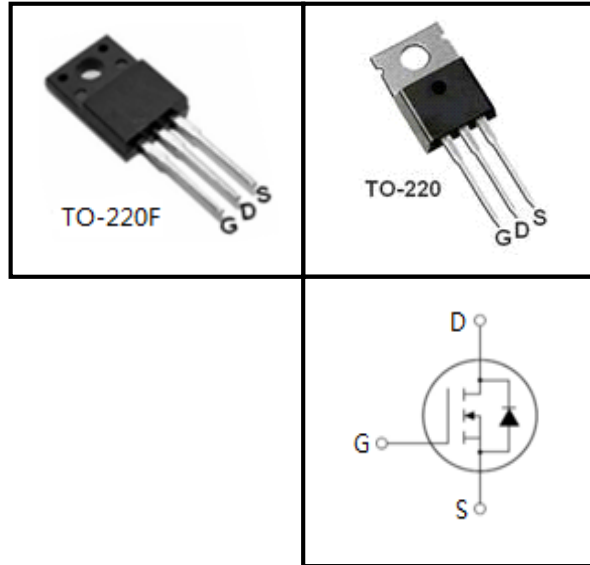
## 650V N-Channel MOSFET

### 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
CS13N65F	TO-220F	CS13N65F
CS13N65P	TO-220P	CS13N65P

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

Parameter	Symbol	Value		Unit
		TO-220F	TO-220	
Drain-Source Voltage ( $V_{GS} = 0V$ )	$V_{DSS}$	650		V
Continuous Drain Current	$I_D$	13		A
Pulsed Drain Current (note1)	$I_{DM}$	52		A
Gate-Source Voltage	$V_{GSS}$	$\pm 30$		V
Single Pulse Avalanche Energy (note2)	$E_{AS}$	387		mJ
Avalanche Current (note1)	$I_{AS}$	8.8		A
Repetitive Avalanche Energy (note1)	$E_{AR}$	232		mJ
Power Dissipation ( $T_C = 25^\circ\text{C}$ )	$P_D$	70	65	W
Operating Junction and Storage Temperature Range	$T_J, T_{stg}$	-55~+150		$^\circ\text{C}$

### Thermal Resistance

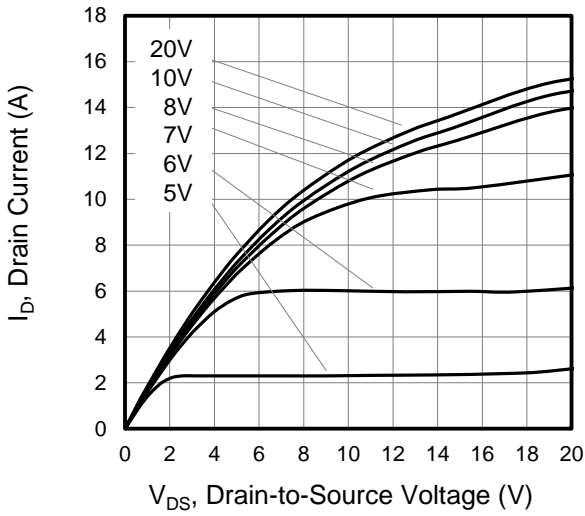
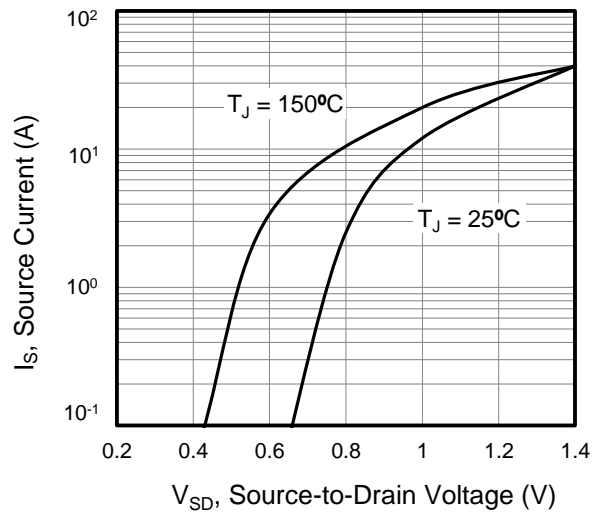
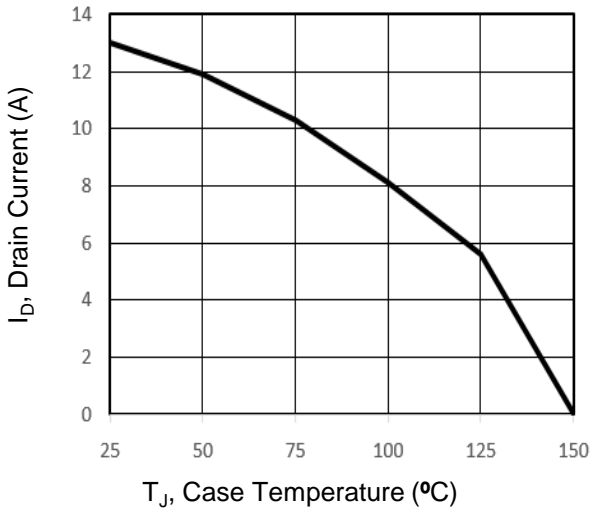
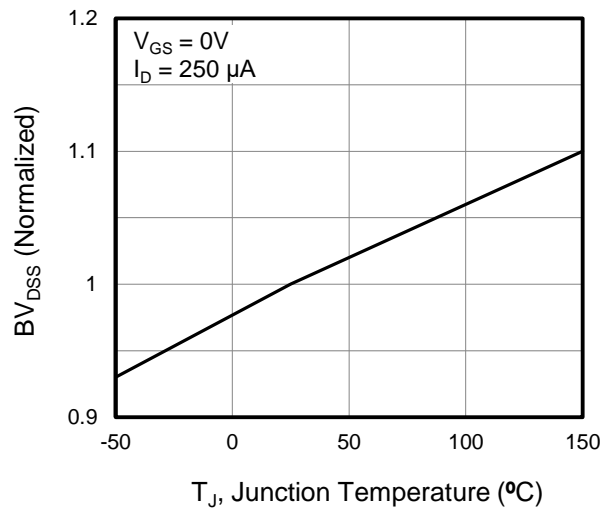
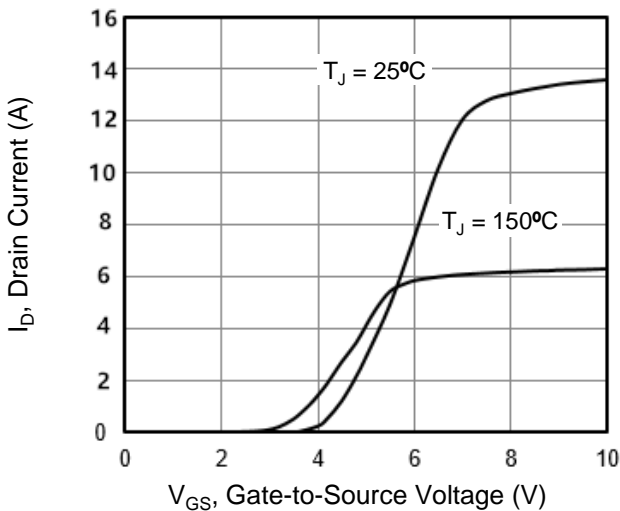
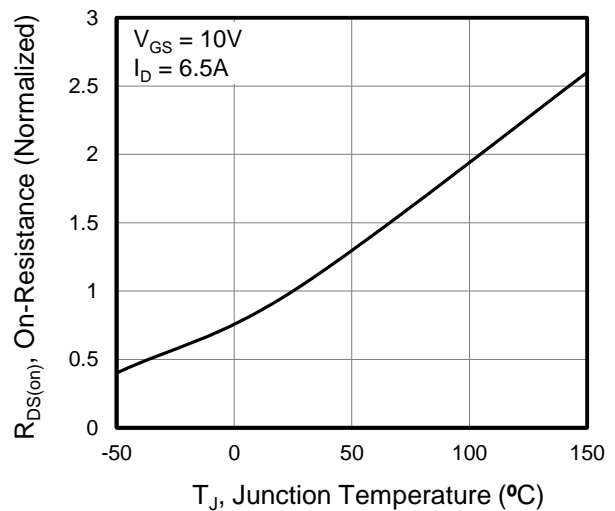
Parameter	Symbol	Value		Unit
		TO-220F	TO-220	
Thermal Resistance, Junction-to-Case	$R_{thJC}$	1.78	0.89	K/W
Thermal Resistance, Junction-to-Ambient	$R_{thJA}$	62.5	60	

Specifications $T_J = 25^\circ\text{C}$ , unless otherwise noted						
Parameter	Symbol	Test Conditions	Value			Unit
			Min.	Typ.	Max.	
<b>Static</b>						
Drain-Source Breakdown Voltage	$V_{(BR)DSS}$	$V_{GS} = 0V, I_D = 250\mu\text{A}$	650	--	--	V
Zero Gate Voltage Drain Current	$I_{DSS}$	$V_{DS} = 650V, V_{GS} = 0V, T_J = 25^\circ\text{C}$	--	--	1	$\mu\text{A}$
Gate-Source Leakage	$I_{GSS}$	$V_{GS} = \pm 30V$	--	--	$\pm 100$	nA
Gate-Source Threshold Voltage	$V_{GS(th)}$	$V_{DS} = V_{GS}, I_D = 250\mu\text{A}$	3.0	--	4.0	V
Drain-Source On-Resistance (Note3)	$R_{DS(on)}$	$V_{GS} = 10V, I_D = 6.5A$	--	0.52	0.65	$\Omega$
<b>Dynamic</b>						
Input Capacitance	$C_{iss}$	$V_{GS} = 0V,$ $V_{DS} = 25V,$ $f = 1.0\text{MHz}$	--	1779	--	pF
Output Capacitance	$C_{oss}$		--	183	--	
Reverse Transfer Capacitance	$C_{rss}$		--	25	--	
Total Gate Charge	$Q_g$	$V_{DD} = 520V, I_D = 13A,$ $V_{GS} = 10V$	--	62	--	nC
Gate-Source Charge	$Q_{gs}$		--	9	--	
Gate-Drain Charge	$Q_{gd}$		--	32	--	
Turn-on Delay Time	$t_{d(on)}$	$V_{DD} = 325V, I_D = 13A,$ $R_G = 25\Omega$	--	49	--	ns
Turn-on Rise Time	$t_r$		--	38	--	
Turn-off Delay Time	$t_{d(off)}$		--	245	--	
Turn-off Fall Time	$t_f$		--	114	--	
<b>Drain-Source Body Diode Characteristics</b>						
Continuous Body Diode Current	$I_S$	$T_C = 25^\circ\text{C}$	--	--	13	A
Pulsed Diode Forward Current	$I_{SM}$		--	--	52	
Body Diode Voltage	$V_{SD}$	$T_J = 25^\circ\text{C}, I_{SD} = 6.5A, V_{GS} = 0V$	--	--	1.4	V
Reverse Recovery Time	$t_{rr}$	$V_{GS} = 0V, I_S = 13A,$ $di_F/dt = 100A/\mu\text{s}$	--	582	--	ns
Reverse Recovery Charge	$Q_{rr}$		--	3.5	--	$\mu\text{C}$

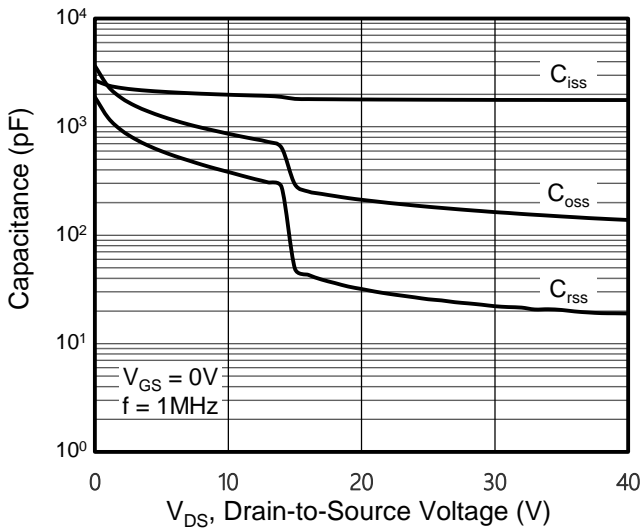
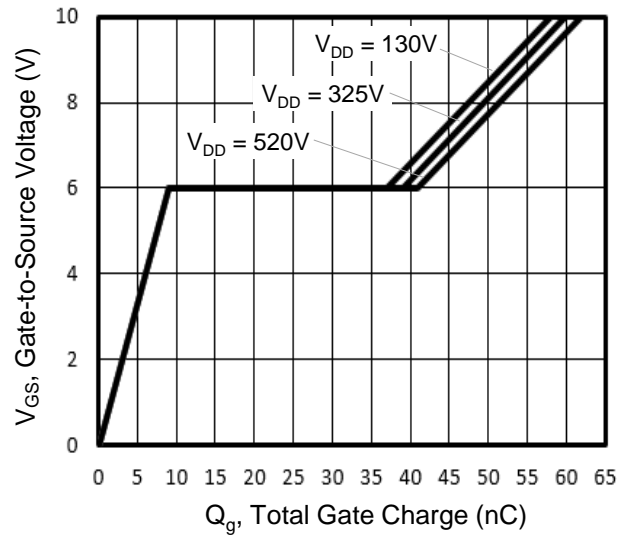
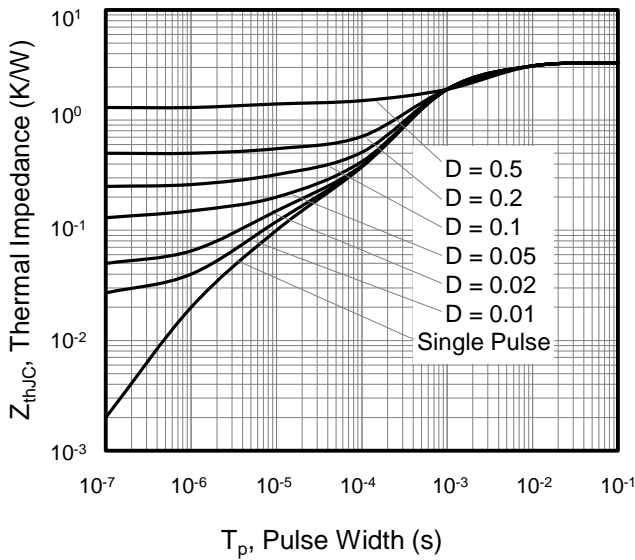
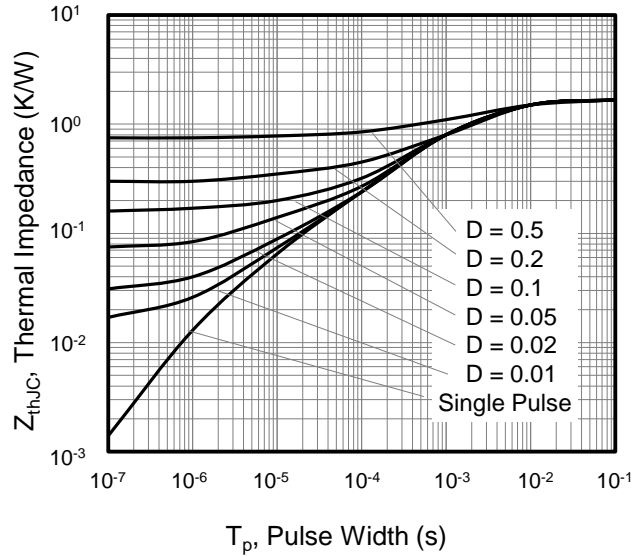
**Notes**

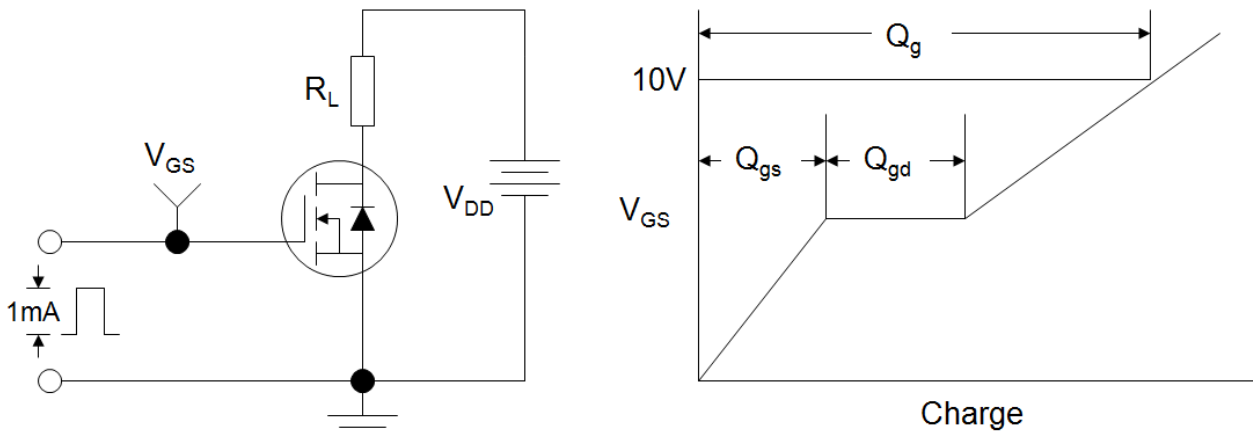
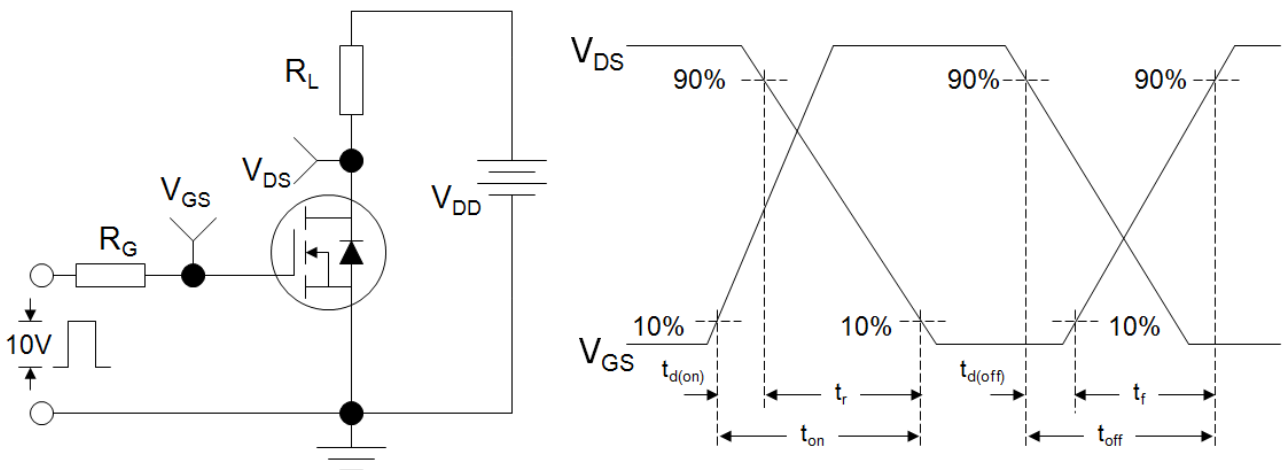
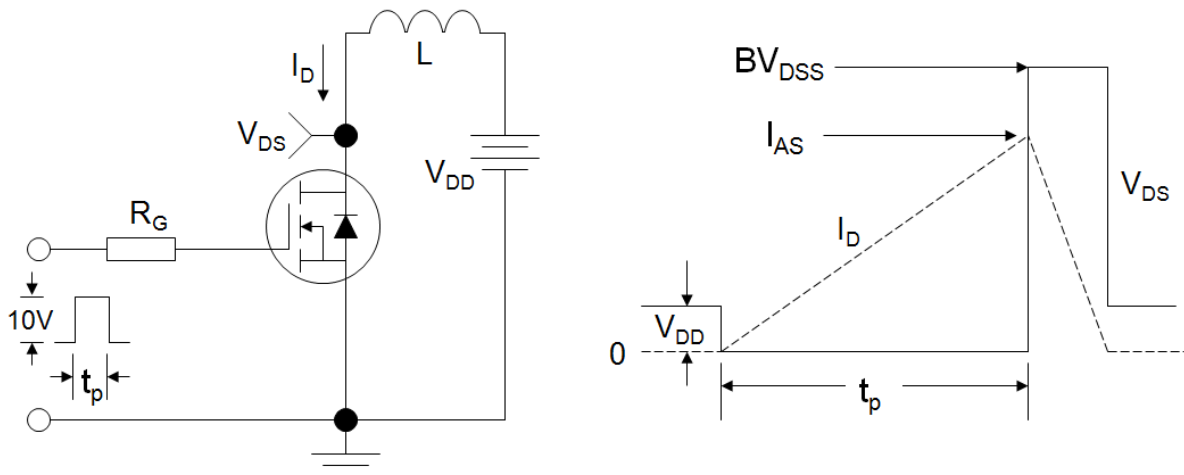
1. Repetitive Rating: Pulse width limited by maximum junction temperature
2.  $L = 10.0\text{mH}, V_{DD} = 50V, R_G = 25\Omega$ , Starting  $T_J = 25^\circ\text{C}$
3. Pulse Test: Pulse width  $\leq 300\mu\text{s}$ , Duty Cycle  $\leq 1\%$

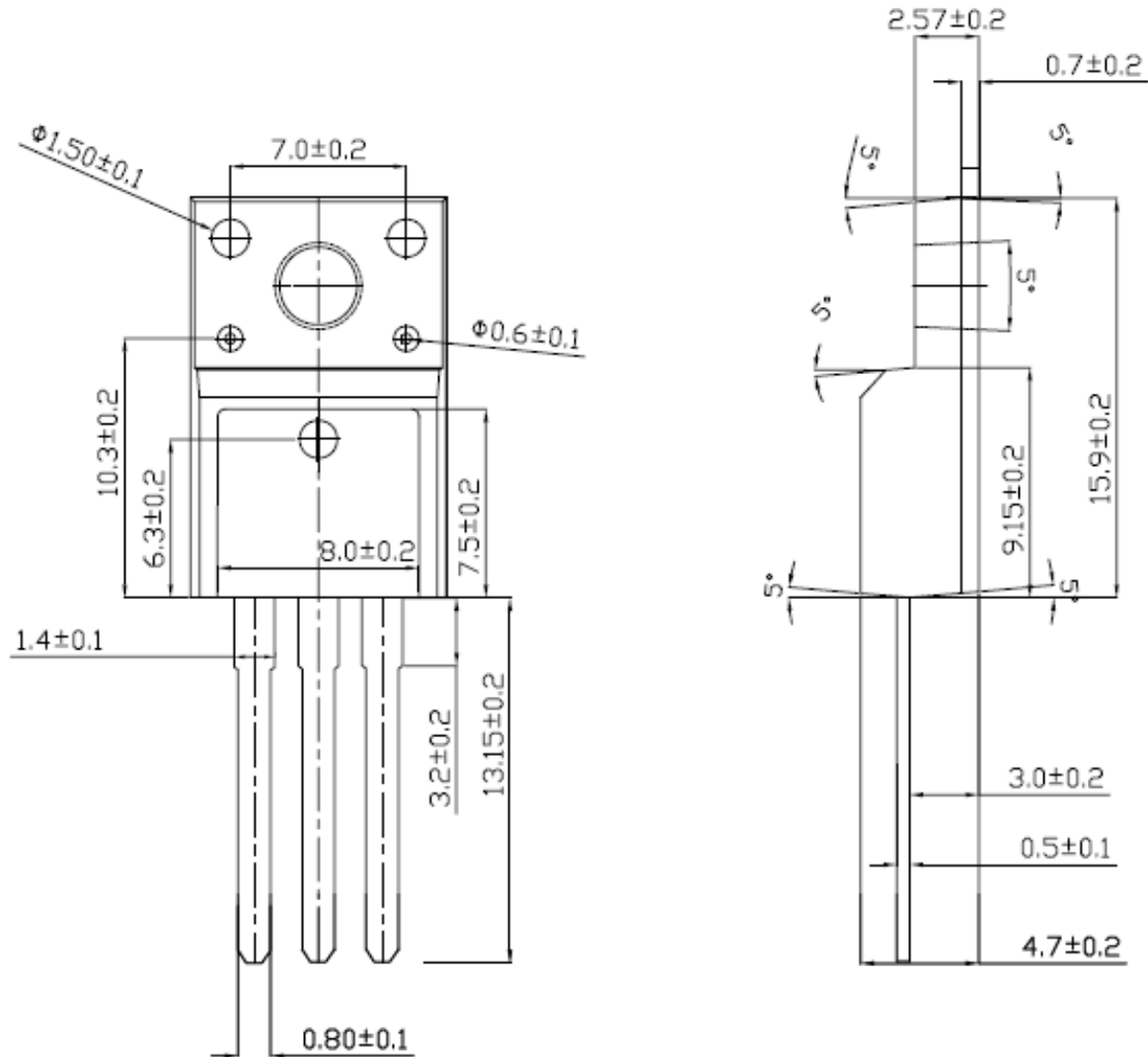
**Typical Characteristics**  $T_J = 25^\circ\text{C}$ , unless otherwise noted

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

**Figure 2. Body Diode Forward Voltage**

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

**Figure 4.  $BV_{DSS}$  Variation vs. Temperature**

**Figure 5. Transfer Characteristics**

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


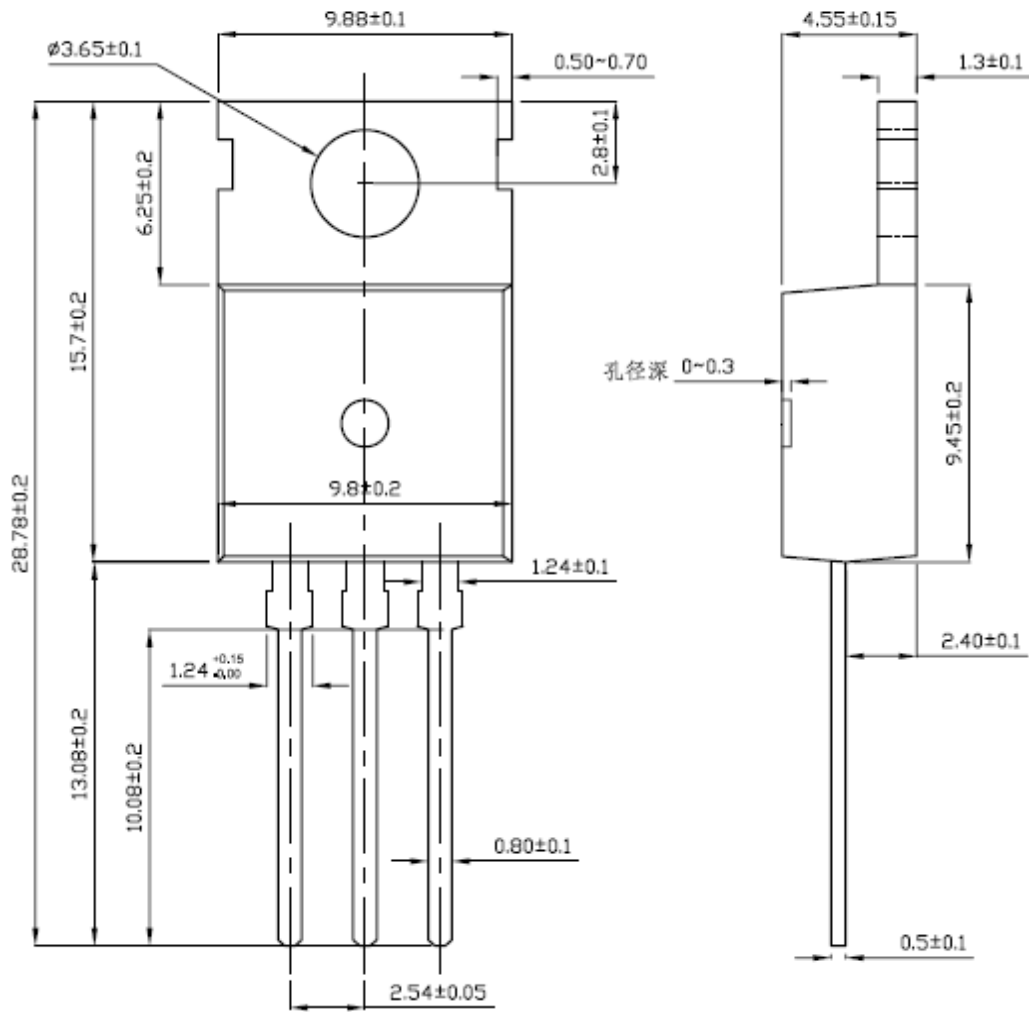
**Typical Characteristics**  $T_J = 25^\circ\text{C}$ , unless otherwise noted

**Figure 7. Capacitance**

**Figure 8. Gate Charge**

**Figure 9. Transient Thermal Impedance TO-220F**

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


**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**



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