

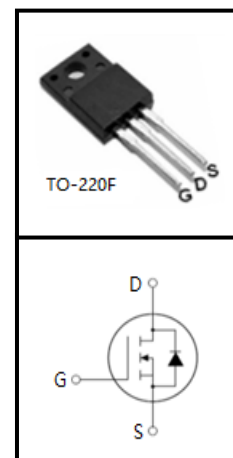
## 650V N-Channel MOSFET

### 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
CS4N65F-B	TO-220F	CS4N65F-B

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

Parameter	Symbol	Value	Unit
Drain-Source Voltage ( $V_{GS} = 0V$ )	$V_{DSS}$	650	V
Continuous Drain Current	$I_D$	4	A
Pulsed Drain Current (note1)	$I_{DM}$	16	A
Gate-Source Voltage	$V_{GSS}$	$\pm 30$	V
Single Pulse Avalanche Energy (note2)	$E_{AS}$	80	mJ
Avalanche Current (note1)	$I_{AS}$	4	A
Repetitive Avalanche Energy (note1)	$E_{AR}$	0.32	mJ
Power Dissipation ( $T_C = 25^\circ\text{C}$ )	$P_D$	62.5	W
Operating Junction and Storage Temperature Range	$T_J, T_{stg}$	-55~+150	$^\circ\text{C}$

### Thermal Resistance

Parameter	Symbol	Value	Unit
Thermal Resistance, Junction-to-Case	$R_{thJC}$	2	$^\circ\text{C/W}$
Thermal Resistance, Junction-to-Ambient	$R_{thJA}$	43.8	

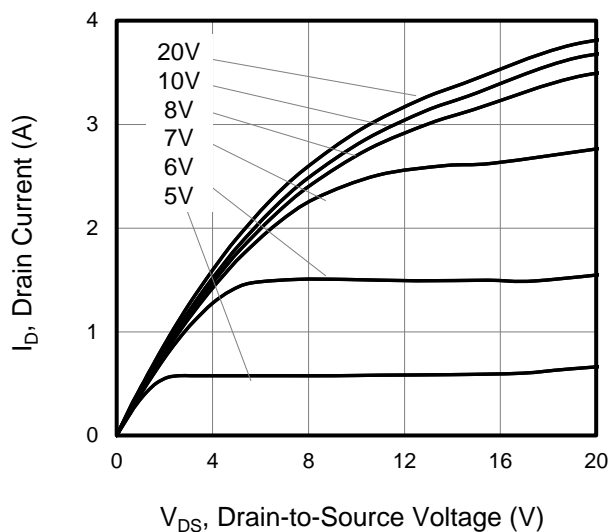
Specifications T <sub>J</sub> = 25°C, unless otherwise noted						
Parameter	Symbol	Test Conditions	Value			Unit
			Min.	Typ.	Max.	
Static						
Drain-Source Breakdown Voltage	V <sub>(BR)DSS</sub>	V <sub>GS</sub> = 0V, I <sub>D</sub> = 250μA	650	--	--	V
Zero Gate Voltage Drain Current	I <sub>DSS</sub>	V <sub>DS</sub> = 650V, V <sub>GS</sub> = 0V, T <sub>J</sub> = 25°C	--	--	1	μA
Gate-Source Leakage	I <sub>GSS</sub>	V <sub>GS</sub> = ±30V	--	--	±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> = 2A	--	2	2.4	Ω
Dynamic						
Input Capacitance	C <sub>iss</sub>	V <sub>GS</sub> = 0V, V <sub>DS</sub> = 25V, f = 1.0MHz	--	545	--	pF
Output Capacitance	C <sub>oss</sub>		--	53	--	
Reverse Transfer Capacitance	C <sub>rss</sub>		--	4.5	--	
Total Gate Charge	Q <sub>g</sub>	V <sub>DD</sub> = 520V, I <sub>D</sub> = 4A, V <sub>GS</sub> = 10V	--	15	--	nC
Gate-Source Charge	Q <sub>gs</sub>		--	3	--	
Gate-Drain Charge	Q <sub>gd</sub>		--	7	--	
Turn-on Delay Time	t <sub>d(on)</sub>	V <sub>DD</sub> = 325V, I <sub>D</sub> =4A, R <sub>G</sub> = 25 Ω	--	36	--	ns
Turn-on Rise Time	t <sub>r</sub>		--	13	--	
Turn-off Delay Time	t <sub>d(off)</sub>		--	80	--	
Turn-off Fall Time	t <sub>f</sub>		--	24	--	
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> = 4A, di <sub>F</sub> /dt =100A /μs	--	550	--	ns
Reverse Recovery Charge	Q <sub>rr</sub>		--	1.38	--	μC

**Notes**

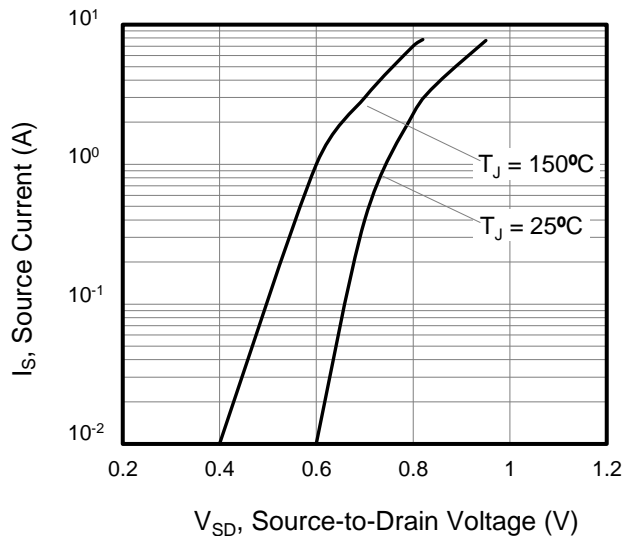
1. Repetitive Rating: Pulse width limited by maximum junction temperature
2.  $L = 10.0\text{mH}, V_{DD} = 50V, R_G = 25\Omega$ , Starting  $T_J = 25^{\circ}\text{C}$
3. Pulse Test: Pulse width  $\leq 300\mu s$ , Duty Cycle  $\leq 1\%$

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

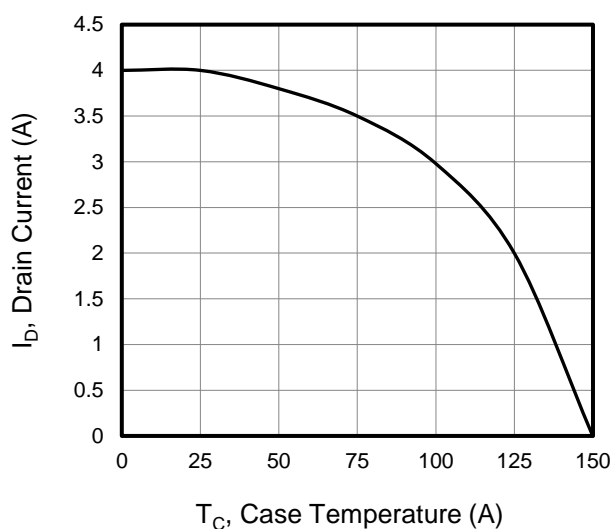
**Figure 1. Output Characteristics ( $T_J = 25^\circ\text{C}$ )**



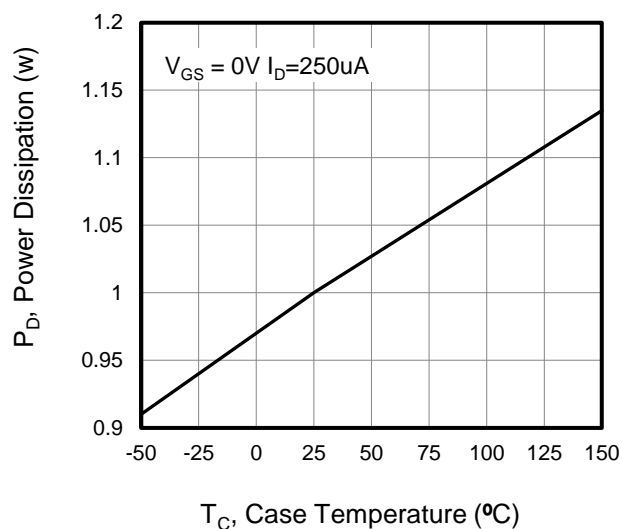
**Figure 2. Body Diode Forward Voltage**



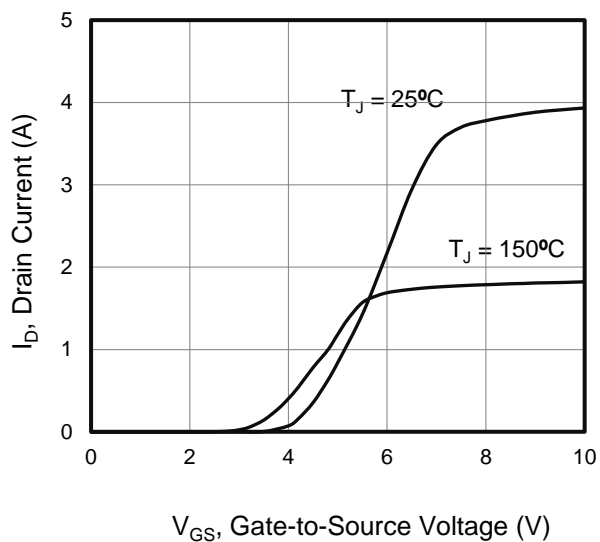
**Figure 3. Drain Current vs. Temperature**



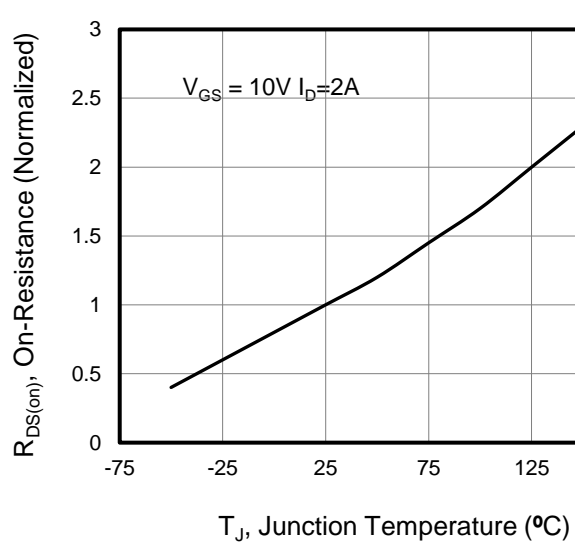
**Figure 4.  $BV_{DSS}$  Variation vs. Temperature**



**Figure 5. Transfer Characteristics**

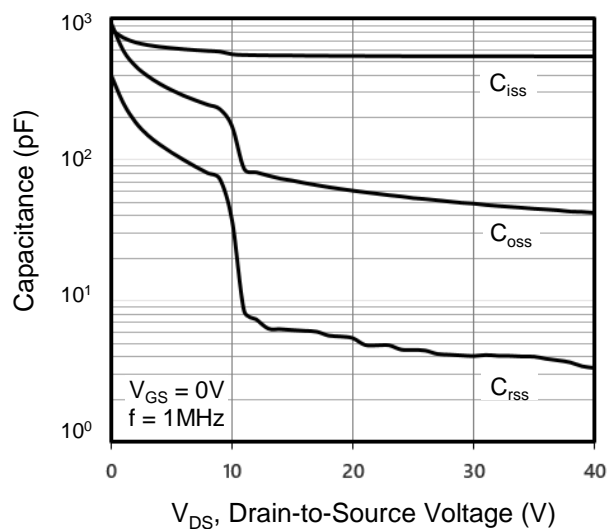


**Figure 6. On-Resistance vs. Temperature**

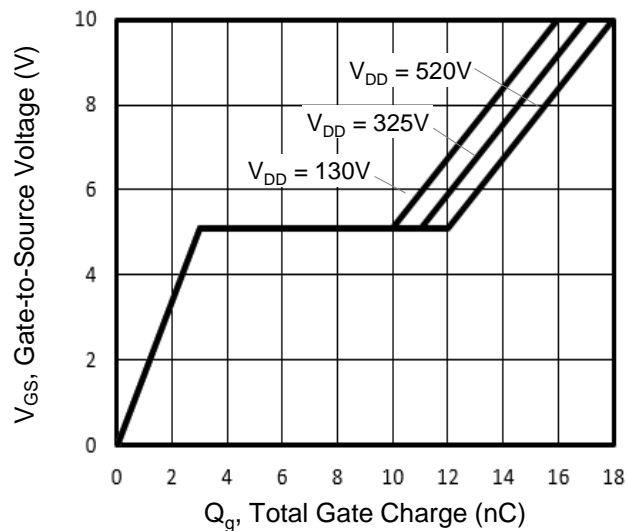


**Typical Characteristics**  $T_J = 25^\circ\text{C}$ , unless otherwise noted

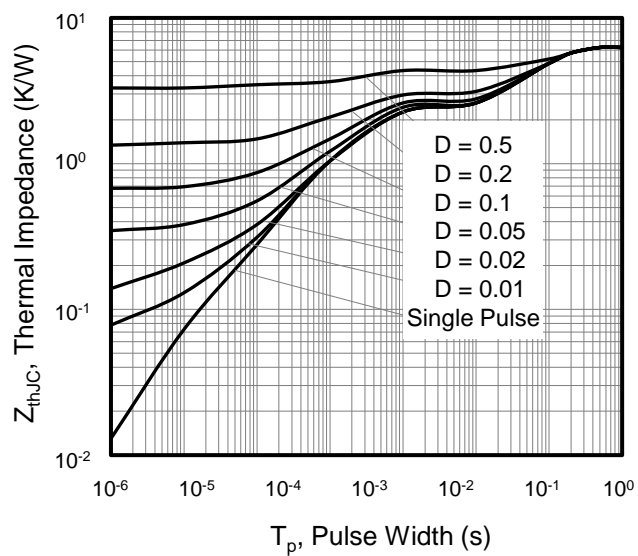
**Figure 7. Capacitance**

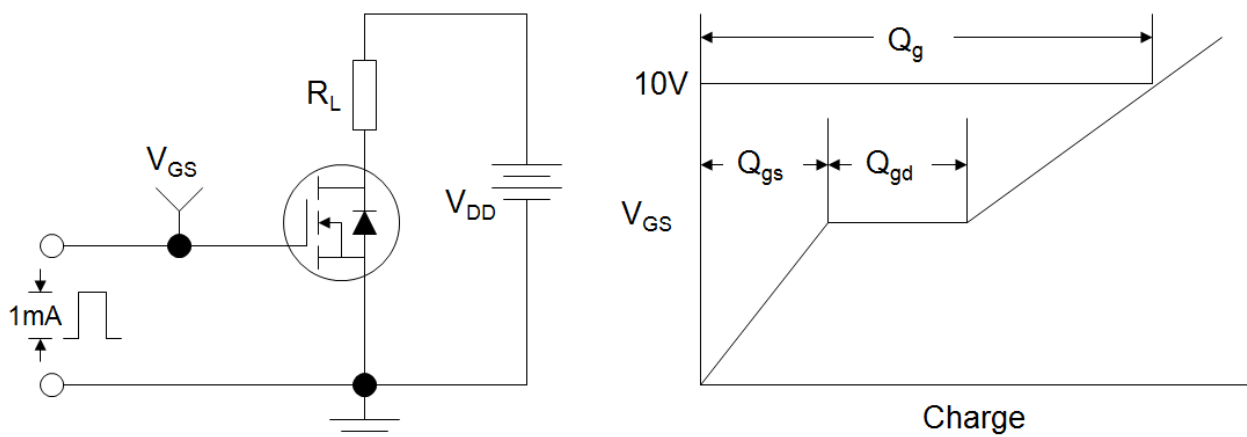
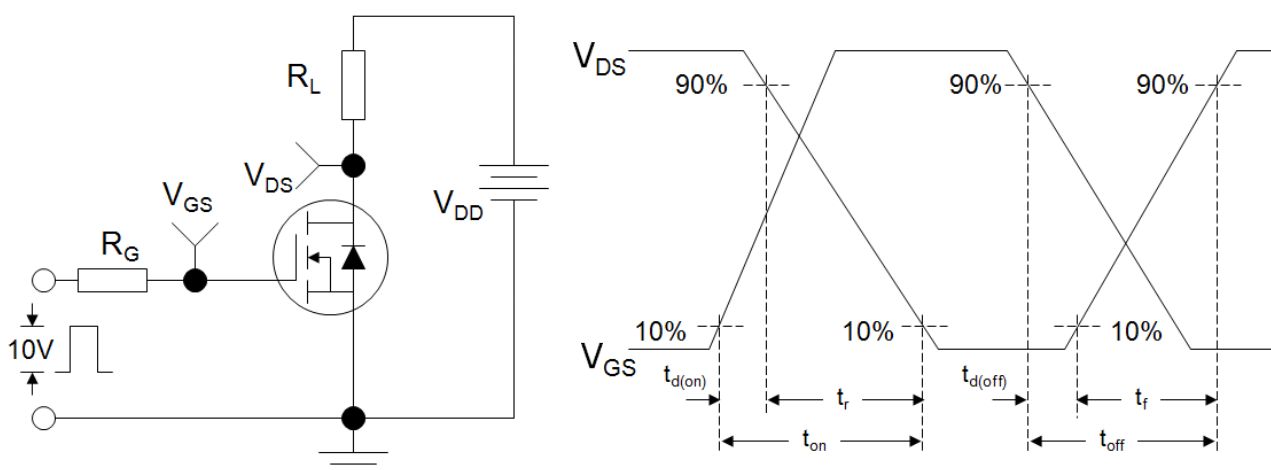
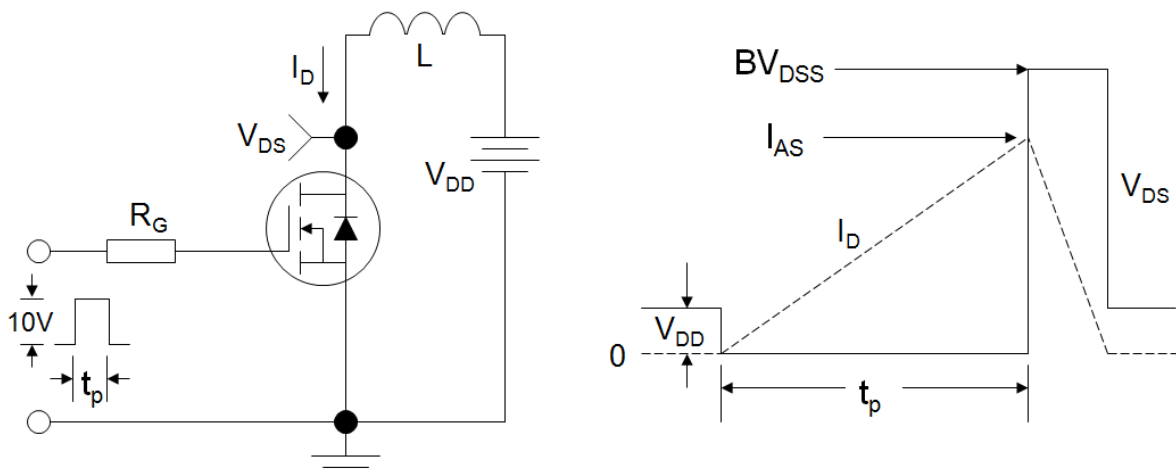


**Figure 8. Gate Charge**

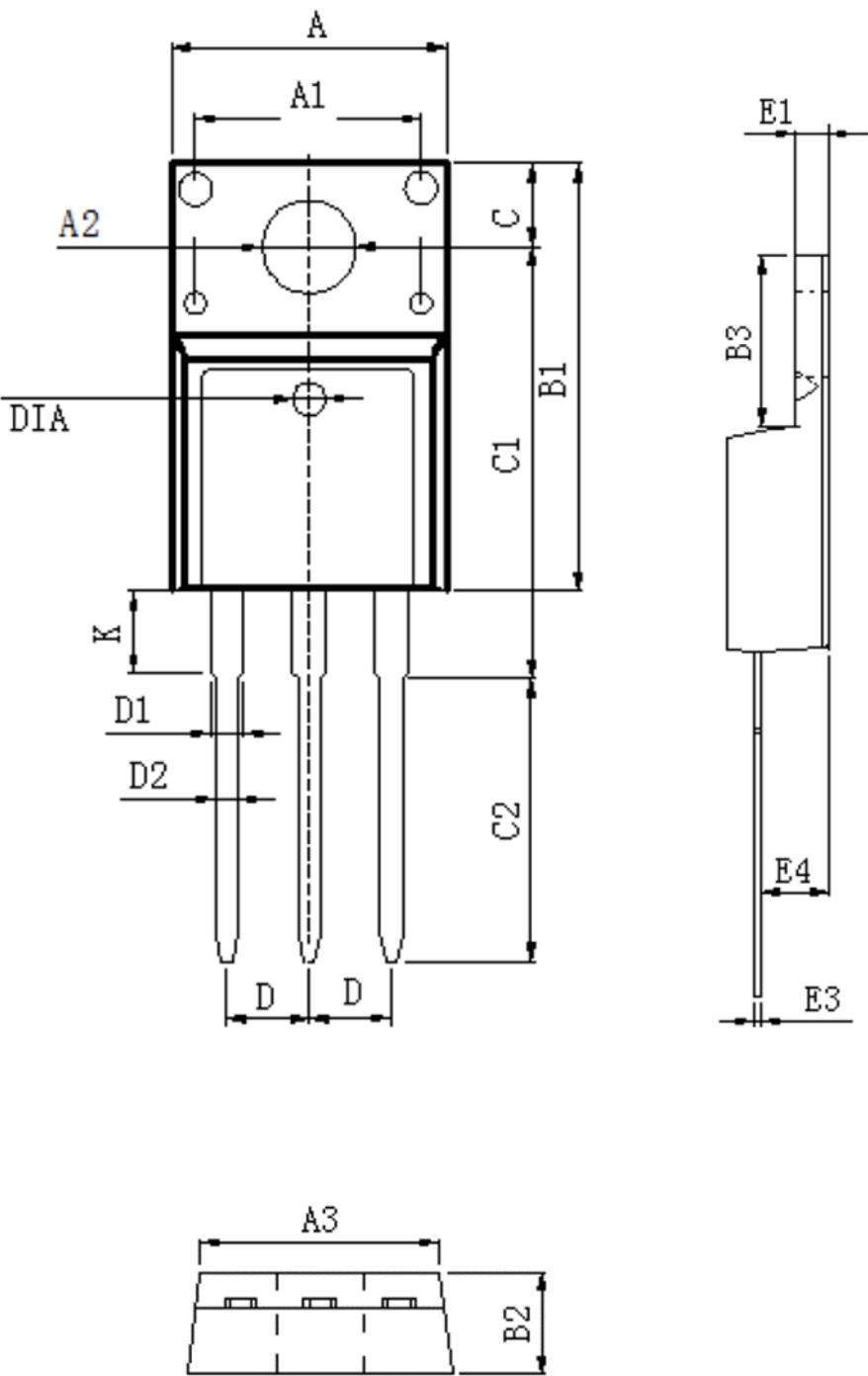


**Figure 9. Transient Thermal Impedance**



**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**



SYMBOLS	MILLIMETERS	
	MIN	MAX
A	9.96	10.36
A1	6.90	7.10
A2	3.10	3.50
A3	9.30	9.70
C	3.10	3.50
B1	15.57	16.17
B2	4.60	4.80
B3	6.28	7.08
C1	12.27	12.87
C2	9.52	10.52
D1	1.20	1.35
D2	0.70	0.90
K	2.80	3.40
E1	2.44	2.64
E3	0.40	0.60
E4	2.46	3.06
D	2.49	2.59

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