



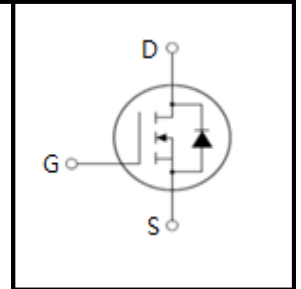
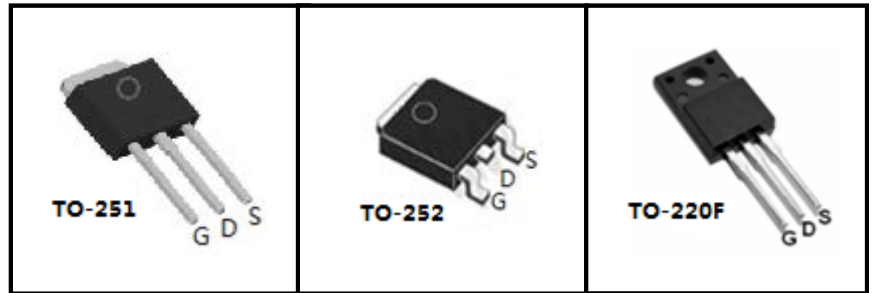
## 650V Super-Junction Power MOSFET

### FEATURES

- Very low FOM  $R_{DS(on)} \times Q_g$
- 100% avalanche tested
- RoHS compliant

### APPLICATIONS

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



### Device Marking and Package Information

Device	Package	Marking
TPU65R940C	TO-251	65R940C
TPA65R940C	TO-220F	65R940C
TPD65R940C	TO-252	65R940C

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

Parameter	Symbol	Value		Unit
		TO-251, TO-252	TO-220F	
Drain-Source Voltage ( $V_{GS} = 0V$ )	$V_{DSS}$	650		V
Continuous Drain Current	$I_D$	4		A
Pulsed Drain Current (note1)	$I_{DM}$	12		A
Gate-Source Voltage	$V_{GSS}$	$\pm 30$		V
Single Pulse Avalanche Energy (note2)	$E_{AS}$	45		mJ
Avalanche Current (note1)	$I_{AR}$	3		A
Repetitive Avalanche Energy (note1)	$E_{AR}$	0.15		mJ
Power Dissipation ( $T_C = 25^\circ\text{C}$ )	$P_D$	36.8	31.3	W
Operating Junction and Storage Temperature Range	$T_J, T_{stg}$	-55~+150		$^\circ\text{C}$

### Thermal Resistance

Parameter	Symbol	Value		Unit
		TO-251, TO-252	TO-220F	
Thermal Resistance, Junction-to-Case	$R_{thJC}$	3.4	4.0	$^\circ\text{C/W}$
Thermal Resistance, Junction-to-Ambient	$R_{thJA}$	62	80	



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	$V_{(BR)DSS}$	$V_{GS} = 0V, I_D = 250\mu A$	650	--	--	V
Zero Gate Voltage Drain Current	$I_{DSS}$	$V_{DS} = 650V, V_{GS} = 0V, T_J = 25^\circ\text{C}$	--	--	1	$\mu A$
		$V_{DS} = 650V, V_{GS} = 0V, T_J = 150^\circ\text{C}$	--	--	100	
Gate-Source Leakage	$I_{GSS}$	$V_{GS} = \pm 30V$	--	--	$\pm 100$	nA
Gate-Source Threshold Voltage	$V_{GS(th)}$	$V_{DS} = V_{GS}, I_D = 250\mu A$	2.5	--	4	V
Drain-Source On-Resistance (Note3)	$R_{DS(on)}$	$V_{GS} = 10V, I_D = 2A$	--	0.85	0.94	$\Omega$
Forward Transconductance (Note3)	$g_{fs}$	$V_{DS} = 10V, I_D = 2A$	--	3	--	S
<b>Dynamic</b>						
Input Capacitance	$C_{iss}$	$V_{GS} = 0V,$ $V_{DS} = 50V,$ $f = 1.0\text{MHz}$	--	350	--	$\mu F$
Output Capacitance	$C_{oss}$		--	40	--	
Reverse Transfer Capacitance	$C_{rss}$		--	3.5	--	
Total Gate Charge	$Q_g$	$V_{DD} = 480V, I_D = 4A,$ $V_{GS} = 10V$	--	7	--	nC
Gate-Source Charge	$Q_{gs}$		--	1.5	--	
Gate-Drain Charge	$Q_{gd}$		--	2.5	--	
Turn-on Delay Time	$t_{d(on)}$	$V_{DD} = 300V, I_D = 4A,$ $R_G = 25\Omega$	--	6.6	--	ns
Turn-on Rise Time	$t_r$		--	5.2	--	
Turn-off Delay Time	$t_{d(off)}$		--	41	--	
Turn-off Fall Time	$t_f$		--	13.6	--	
<b>Drain-Source Body Diode Characteristics</b>						
Continuous Body Diode Current	$I_S$	$T_C = 25^\circ\text{C}$	--	--	3.9	A
Pulsed Diode Forward Current	$I_{SM}$		--	--	12	
Body Diode Voltage	$V_{SD}$	$T_J = 25^\circ\text{C}, I_{SD} = 4A, V_{GS} = 0V$	--	0.9	1.2	V
Reverse Recovery Time	$t_{rr}$	$V_R = 480V, I_F = I_S,$ $di_F/dt = 100A/\mu s$	--	226	--	ns
Reverse Recovery Charge	$Q_{rr}$		--	1.3	--	$\mu C$
Peak Reverse Recovery Current	$I_{rrm}$		--	9.9	--	A

**Notes**

1. Repetitive Rating: Pulse width limited by maximum junction temperature
2.  $I_{AS} = 3A, V_{DD} = 50V, R_G = 25\Omega, \text{Starting } T_J = 25^\circ\text{C}$
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

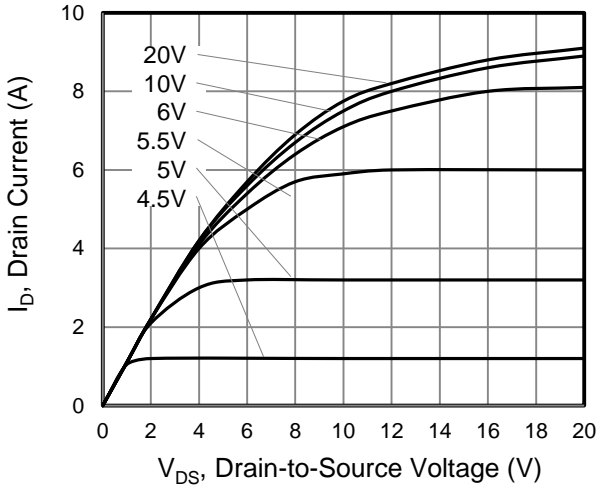


Figure 2. Transfer Characteristics

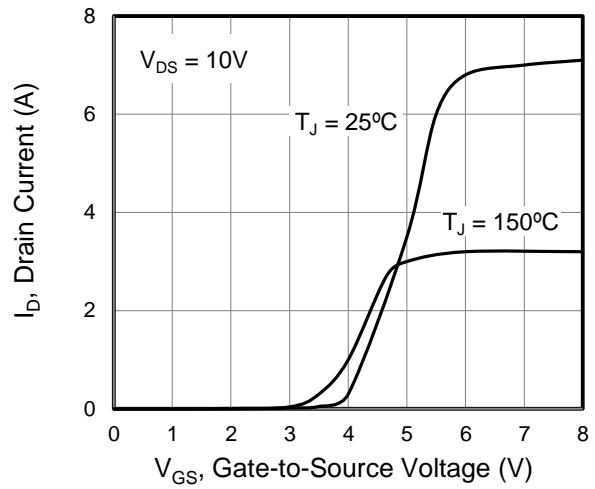


Figure 3. On-Resistance vs. Drain Current

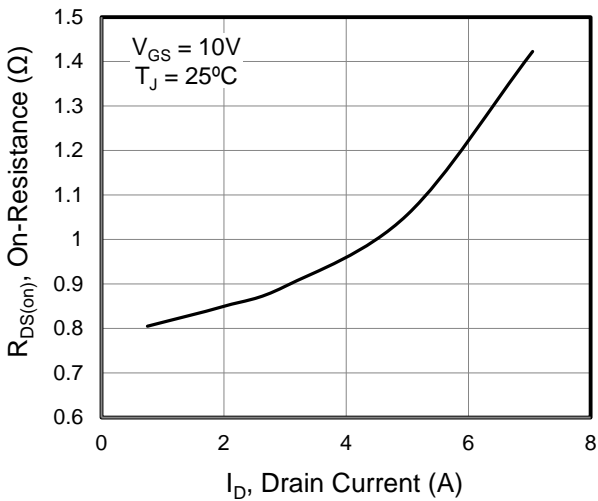


Figure 4. Capacitance

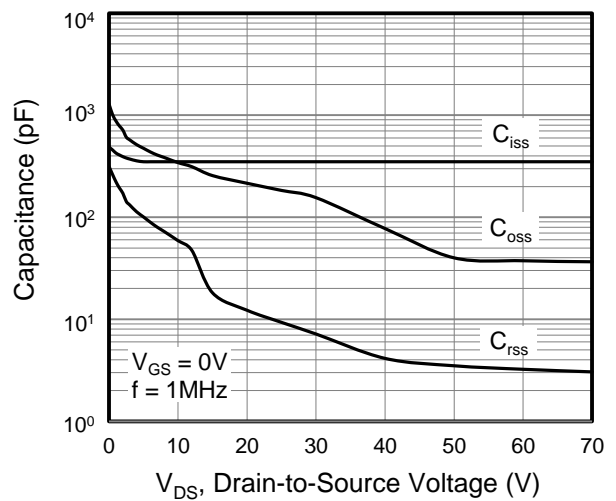


Figure 5. Gate Charge

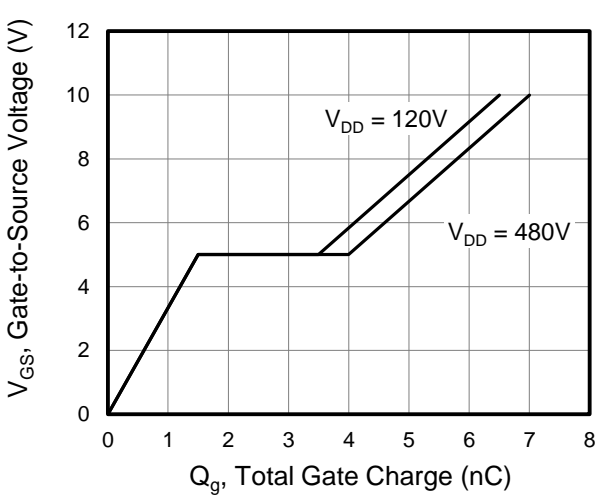
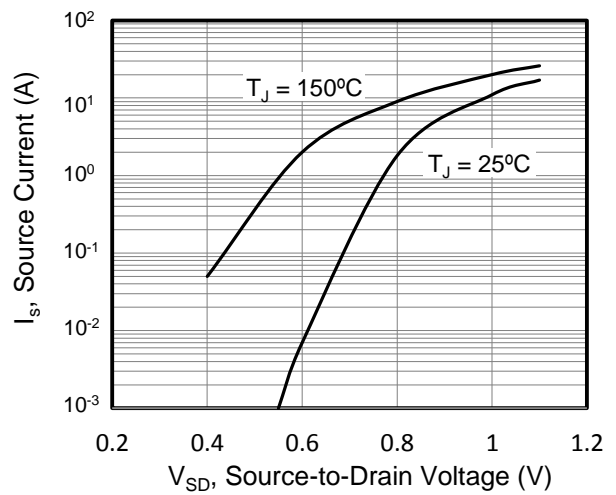


Figure 6. Body Diode Forward Voltage





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

Figure 7. On-Resistance vs. Junction Temperature

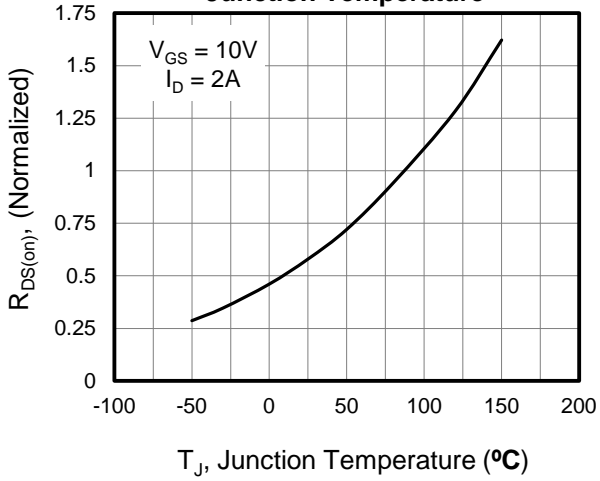


Figure 8. Threshold Voltage vs. Junction Temperature

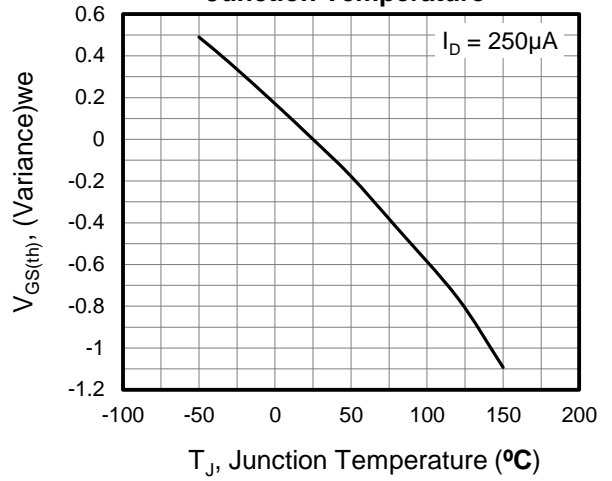


Figure 9. Transient Thermal Impedance TO-251,TO-252

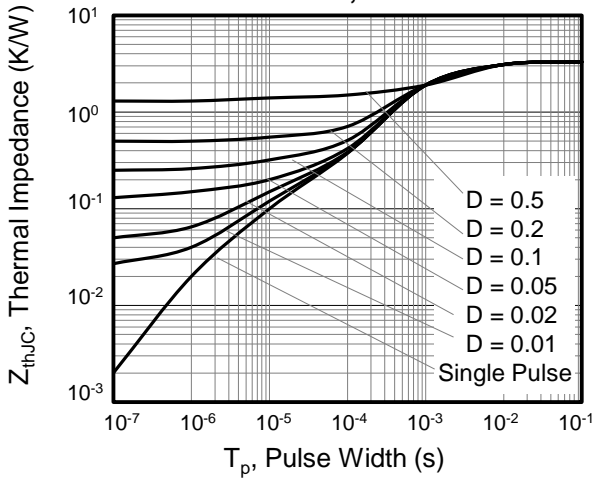


Figure 10. Transient Thermal Impedance TO-220F

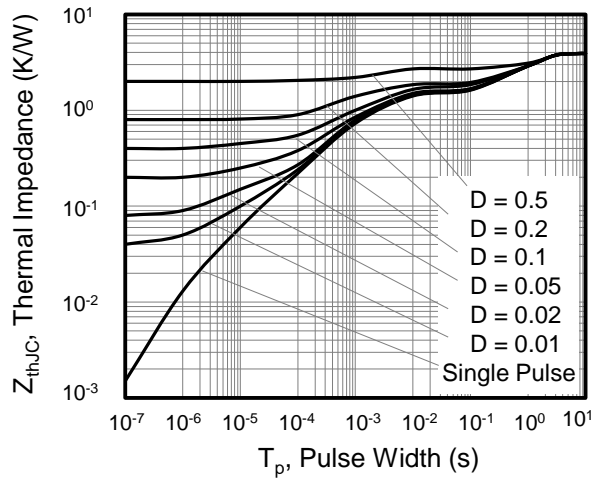




Figure A: Gate Charge Test Circuit and Waveform

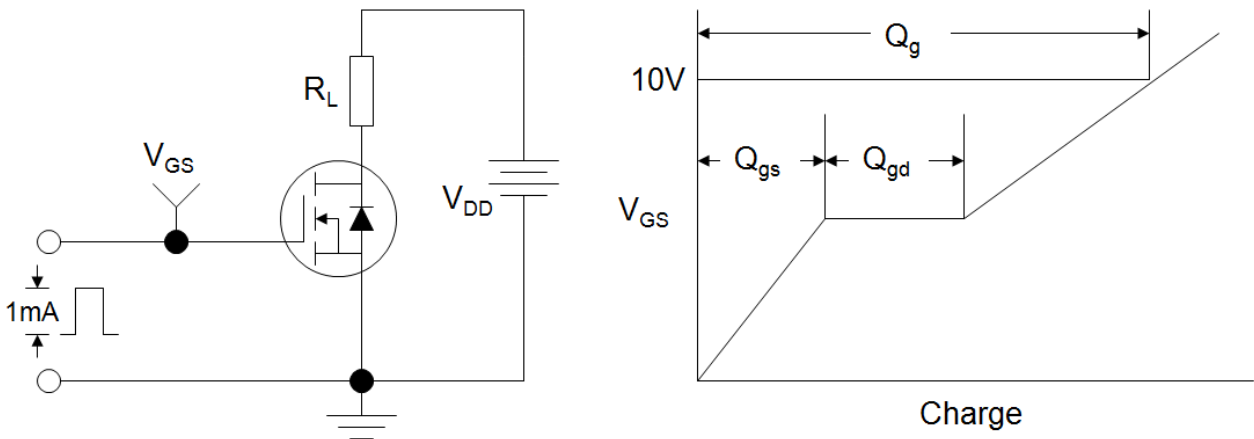


Figure B: Resistive Switching Test Circuit and Waveform

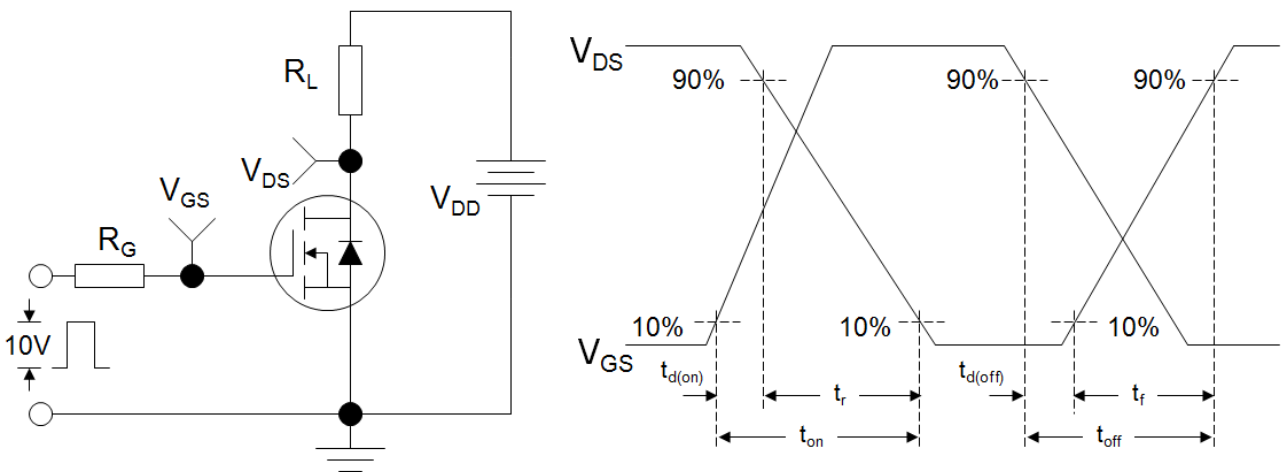
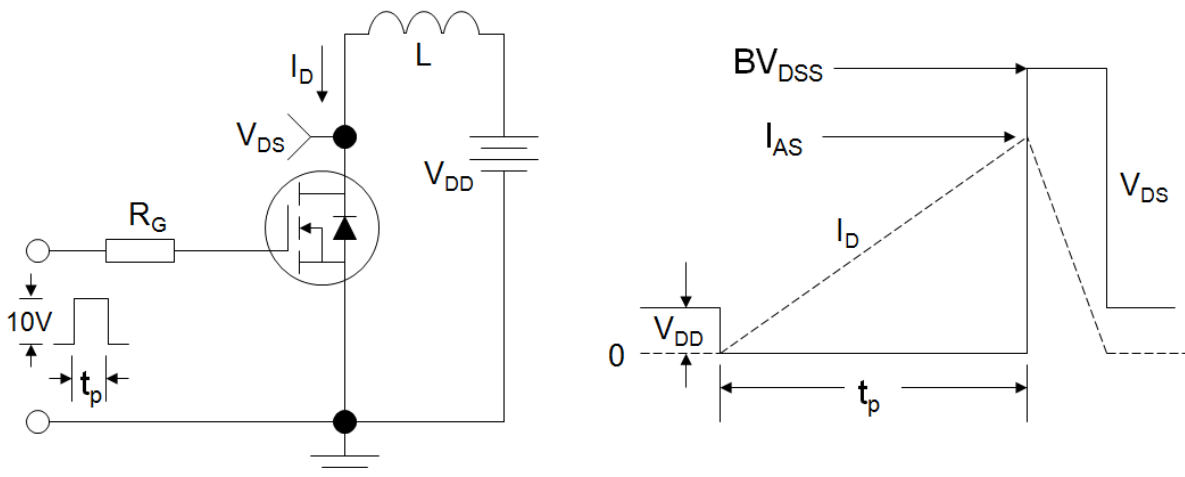
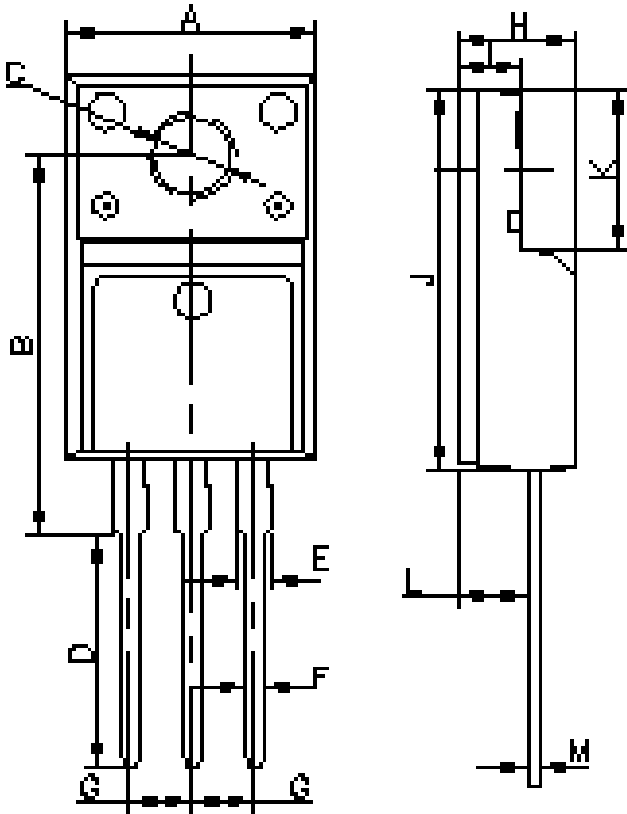


Figure C: Unclamped Inductive Switching Test Circuit and Waveform





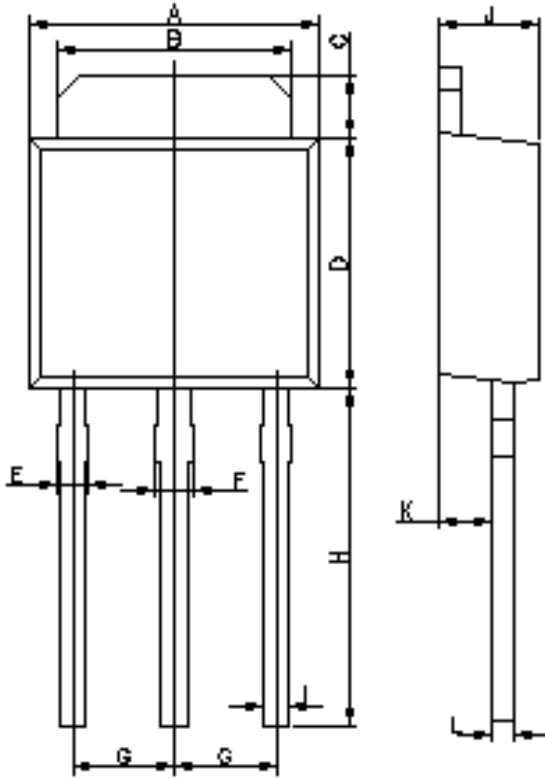
### TO-220F



Unit: mm		
Symbol	Min.	Max.
A	9.96	10.36
B	15.5	16.1
C	3.08	3.28
D	12.64	13.24
E	1.18	1.58
F	0.7	0.9
G	2.39	2.69
H	4.5	4.9
I	2.34	2.74
J	15.67	16.07
K	6.5	6.9
L	2.56	2.96
M	0.4	0.6



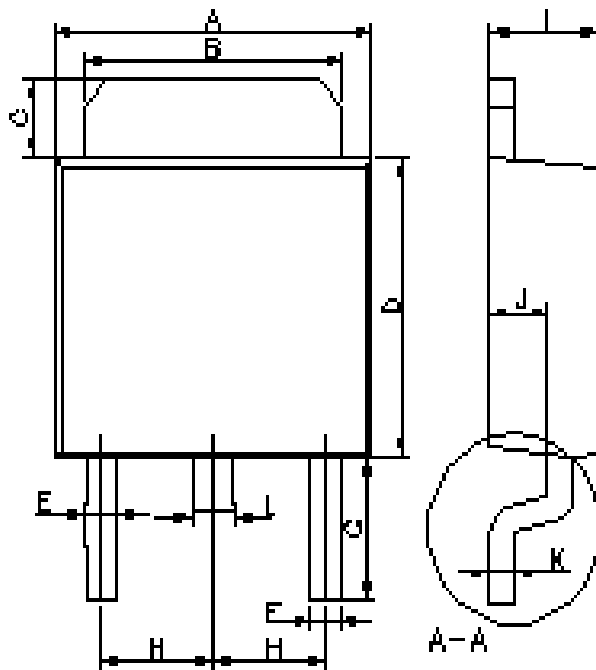
## TO-251



Unit: mm		
Symbol	Min.	Max.
A	6.40	6.80
B	5.15	5.45
C	1.45	1.75
D	5.40	5.80
E	0.45	0.85
F	0.65	1.05
G	2.10	2.50
H	7.20	7.80
I	0.50	0.70
J	2.10	2.50
K	1.05	1.35
L	0.40	0.60



## TO-252



Unit: mm		
Symbol	Min.	Max.
A	6.40	6.80
B	5.15	5.45
C	1.45	1.75
D	5.40	5.80
E	0.50	0.90
F	0.50	0.70
G	2.40	3.00
H	2.15	2.45
I	2.10	2.50
J	1.05	1.35
K	0.40	0.60
L	0.75	1.05





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