



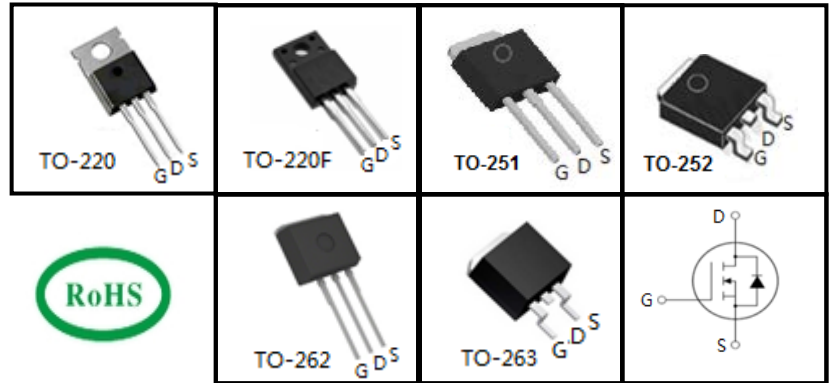
600V Super-Junction Power MOSFET

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	TPP60R950C	TPA60R950C	TPU60R950C	TPD60R950C	TPC60R950C	TPB60R950C
Package	TO-220	TO-220F	TO-251	TO-252	TO-262	TO-263
Marking	60R950C	60R950C	60R950C	60R950C	60R950C	60R950C

Absolute Maximum Ratings $T_C = 25^\circ\text{C}$, unless otherwise noted				
Parameter	Symbol	Value		Unit
		TO-220, TO-251, TO-252 TO-262, TO-263	TO-220F	
Drain-Source Voltage ($V_{GS} = 0\text{V}$)	V_{DSS}	600		V
Continuous Drain Current	I_D	4		A
Pulsed Drain Current (note1)	I_{DM}	12		A
Gate-Source Voltage	V_{GSS}	± 30		V
Single Pulse Avalanche Energy (note2)	E_{AS}	110		mJ
Avalanche Current (note1)	I_{AR}	2		A
Repetitive Avalanche Energy (note1)	E_{AR}	0.09		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-220, TO-251, TO-252 TO-262, TO-263	TO-220F	
Thermal Resistance, Junction-to-Case	R_{thJC}	3.4	4.0	$^\circ\text{C/W}$
Thermal Resistance, Junction-to-Ambient	R_{thJA}	75	80	



Specifications $T_J = 25^\circ\text{C}$, unless otherwise noted						
Parameter	Symbol	Test Conditions	Value			Unit
			Min.	Typ.	Max.	
Static						
Drain-Source Breakdown Voltage	$V_{(BR)DSS}$	$V_{GS} = 0V, I_D = 250\mu A$	600	--	--	V
Zero Gate Voltage Drain Current	I_{DSS}	$V_{DS} = 600V, V_{GS} = 0V, T_J = 25^\circ\text{C}$	--	--	1	μA
		$V_{DS} = 600V, V_{GS} = 0V, T_J = 150^\circ\text{C}$	--	--	100	
Gate-Source Leakage	I_{GSS}	$V_{GS} = \pm 30V$	--	--	± 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)	$R_{DS(on)}$	$V_{GS} = 10V, I_D = 2A$	--	0.78	0.92	Ω
Forward Transconductance (Note3)	g_{fs}	$V_{DS} = 10V, I_D = 2A$	--	3	--	S
Dynamic						
Input Capacitance	C_{iss}	$V_{GS} = 0V,$ $V_{DS} = 50V,$ $f = 1.0\text{MHz}$	--	350	--	μF
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	$t_{d(on)}$	$V_{DD} = 400V, I_D = 4A,$ $R_G = 25\Omega$	--	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	--	
Drain-Source Body Diode Characteristics						
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	--	μC
Peak Reverse Recovery Current	I_{rrm}		--	9.9	--	A

Notes

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



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

Figure 1. Output Characteristics

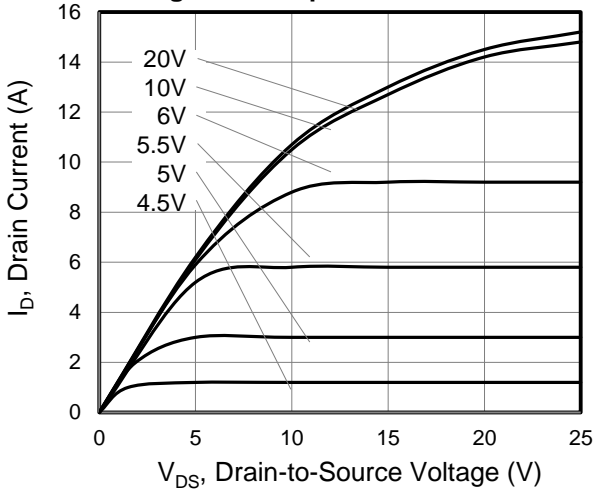


Figure 2. Transfer Characteristics

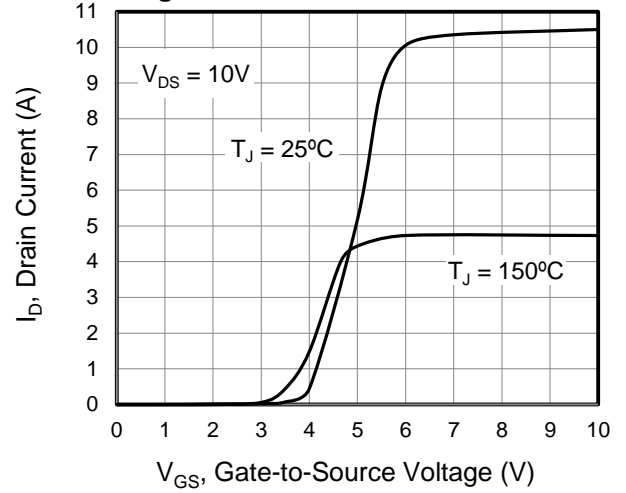


Figure 3. On-Resistance vs. Drain Current

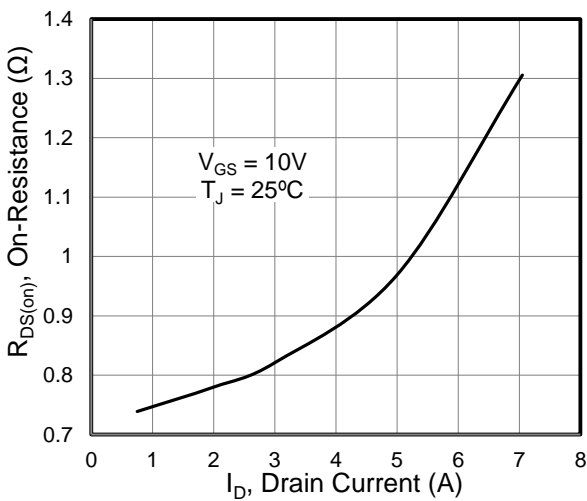


Figure 4. Capacitance

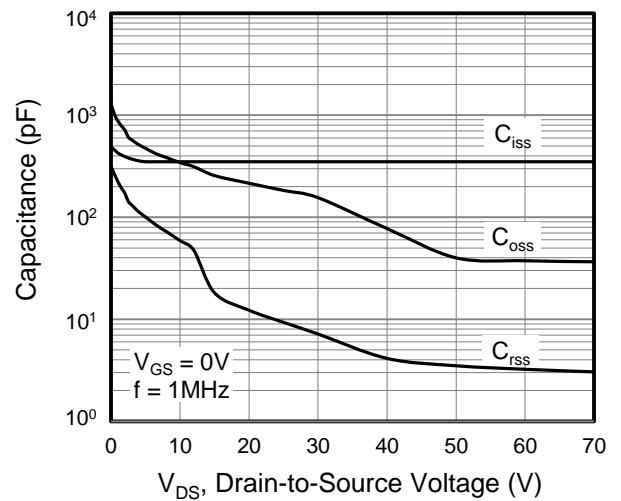


Figure 5. Gate Charge

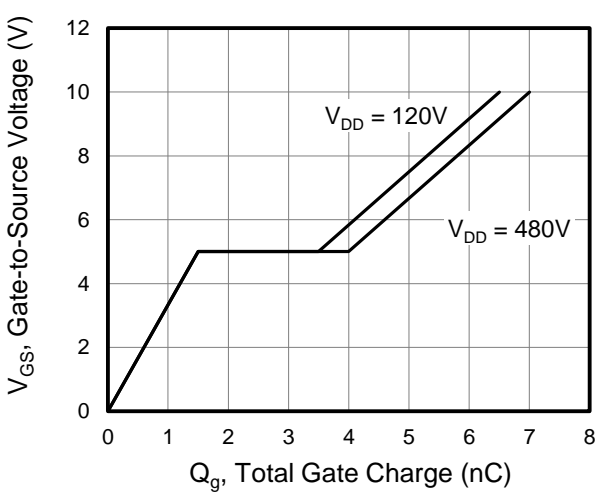
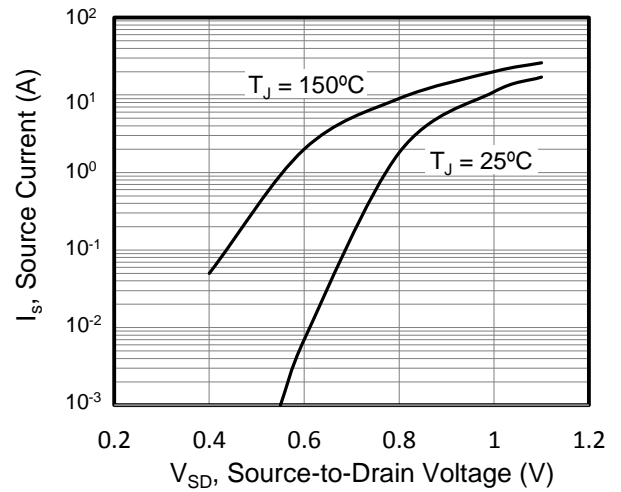


Figure 6. Body Diode Forward Voltage





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

Figure 7. On-Resistance vs. Junction Temperature

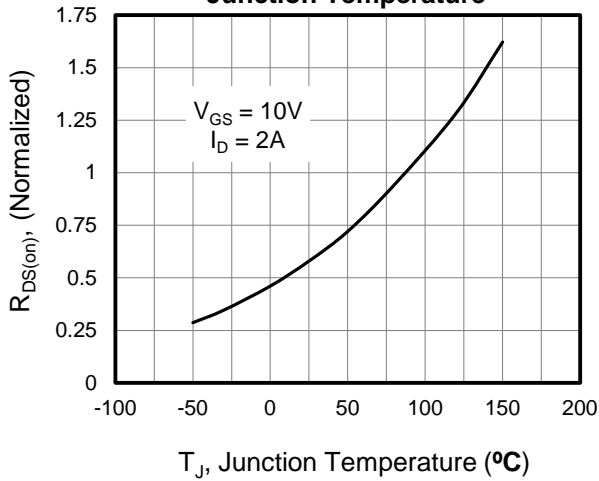


Figure 8. Threshold Voltage vs. Junction Temperature

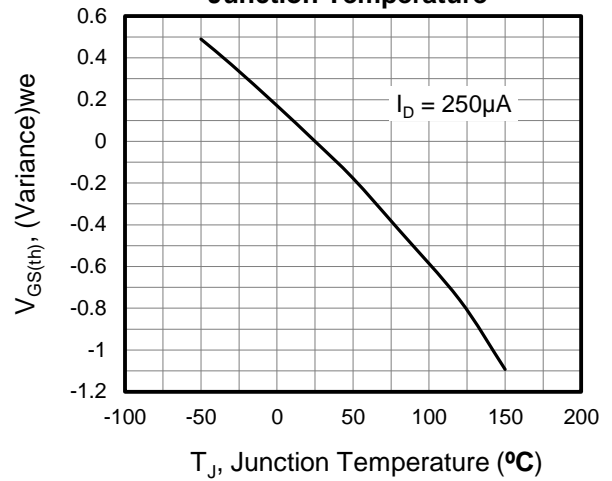


Figure 9. Transient Thermal Impedance TO-220,TO-251,TO-252,TO-262,TO-263

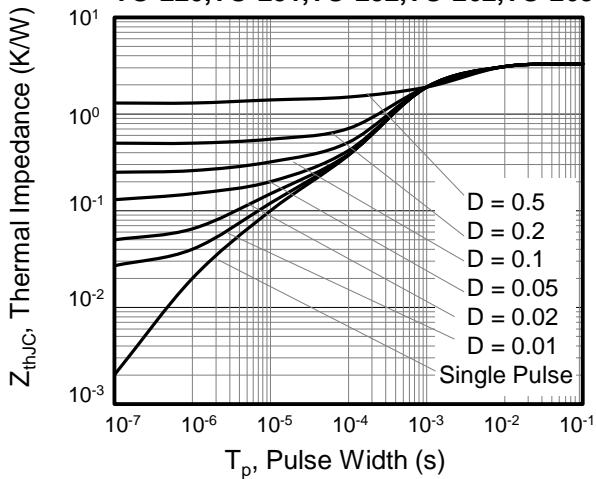


Figure 10. Transient Thermal Impedance TO-220F

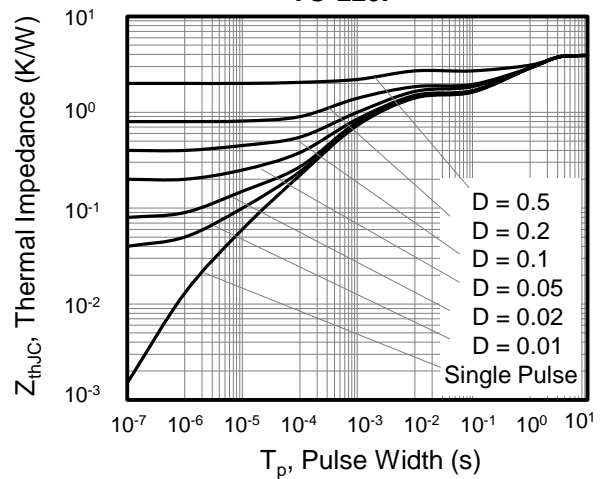




Figure A: Gate Charge Test Circuit and Waveform



Figure B: Resistive Switching Test Circuit and Waveform

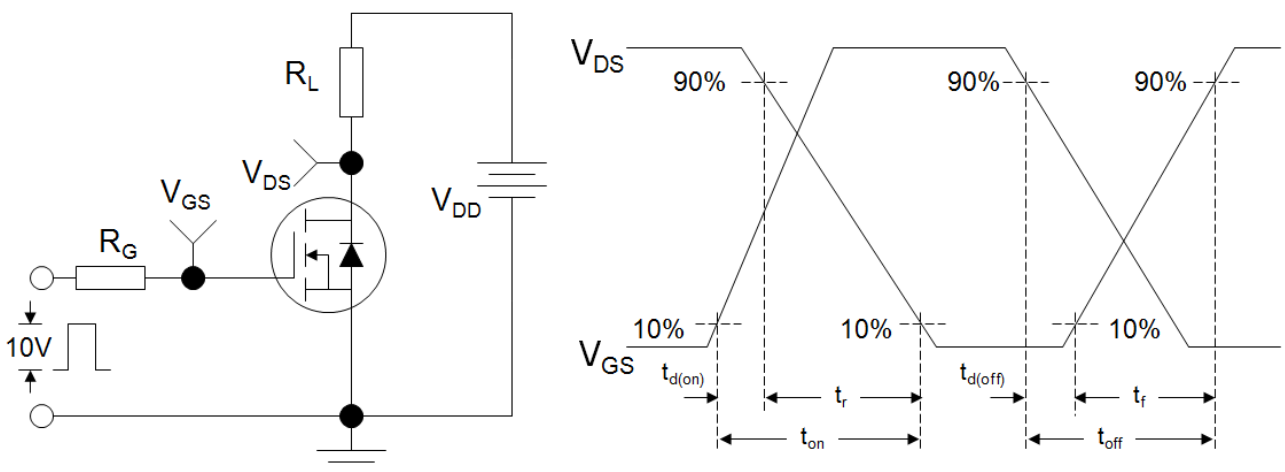
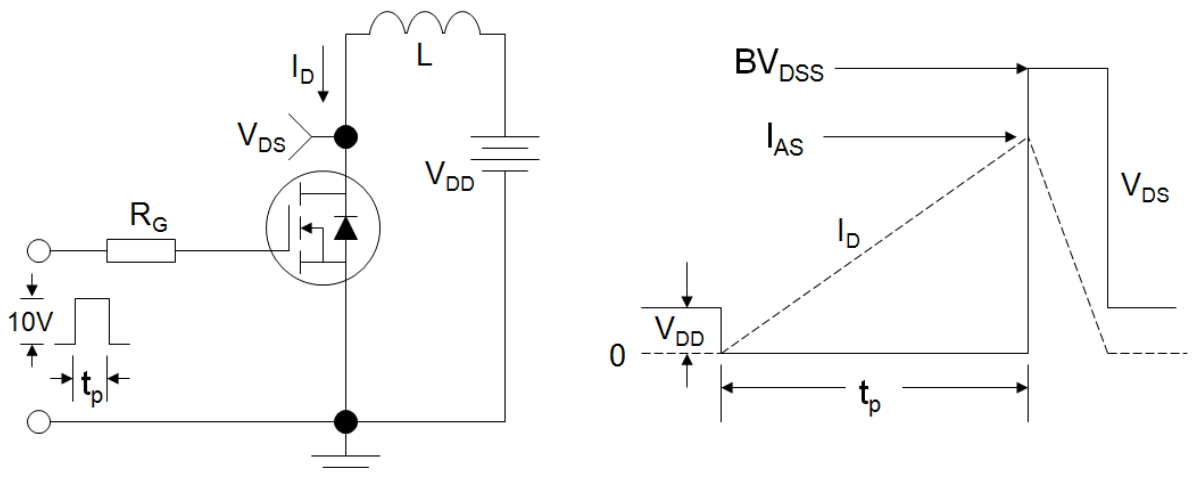
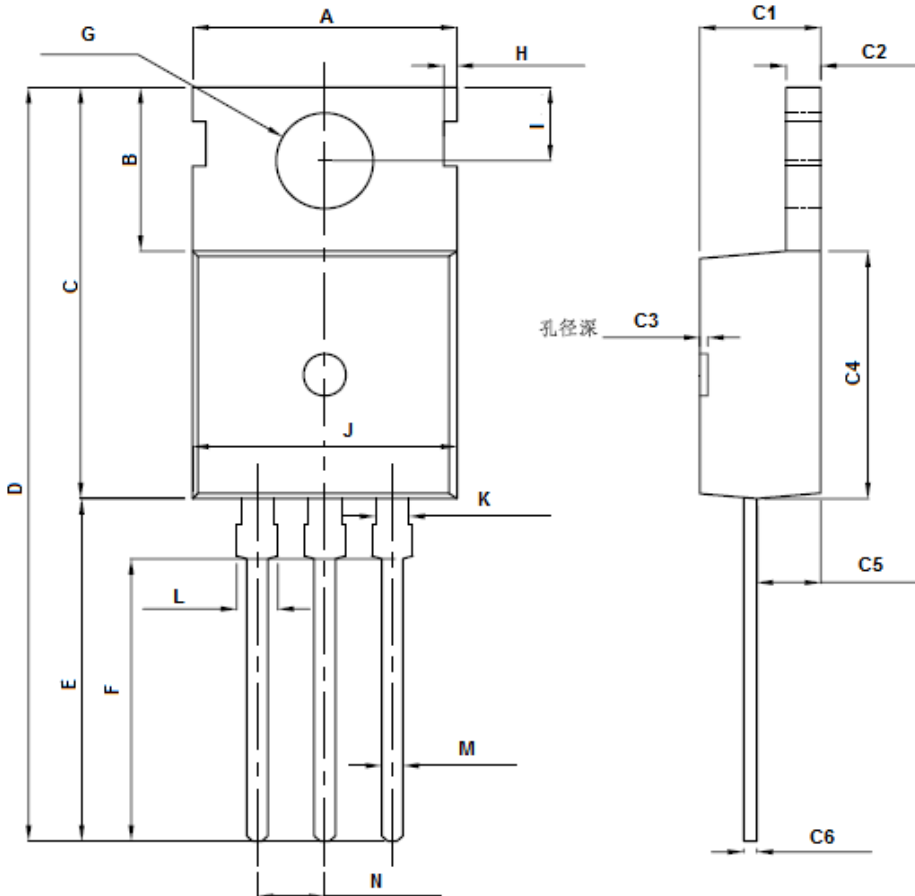


Figure C: Unclamped Inductive Switching Test Circuit and Waveform





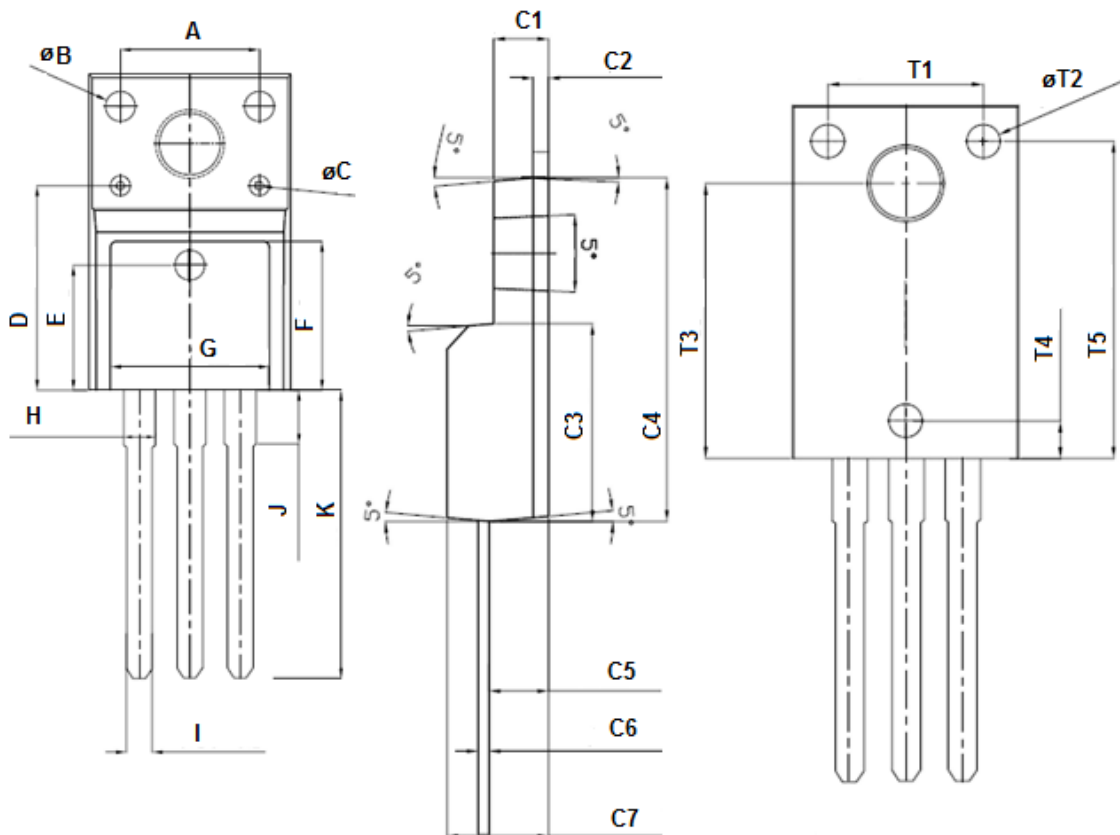
TO-220



Unit: mm		
Symbol	Min.	Max.
A	9.78	9.98
B	6.05	6.45
C	15.50	15.90
D	28.58	28.98
E	12.88	13.28
F	9.88	10.28
G	3.55	3.75
H	0.50	0.70
I	2.70	2.90
J	9.60	10.00
K	1.14	1.34
L	1.24	1.39
M	0.70	0.90
C1	4.40	4.70
C2	1.20	1.40
C3	0.00	0.30
C4	9.25	9.65
C5	2.30	2.50
C6	0.40	0.60



TO-220F

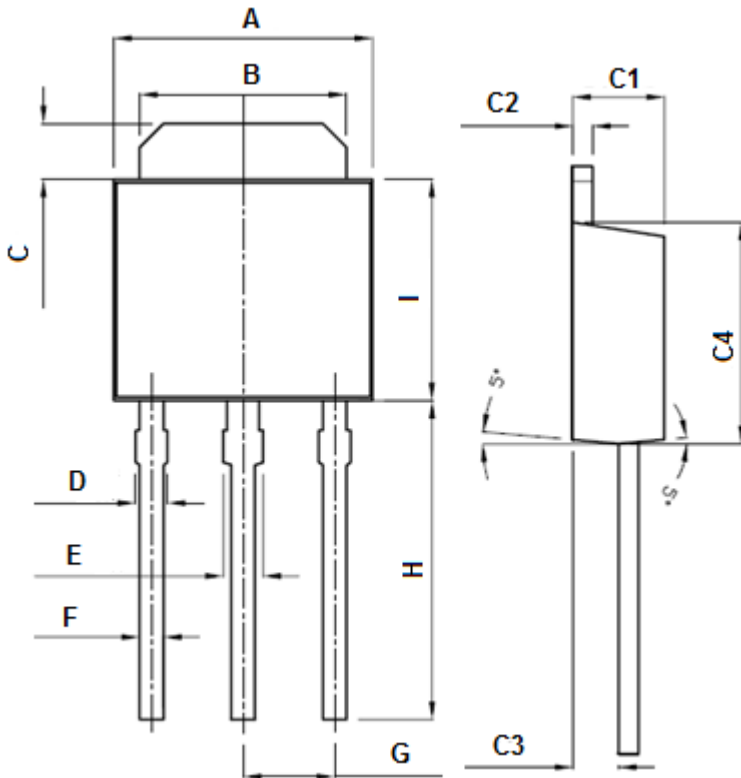


Unit: mm		
Symbol	Min.	Max.
A	6.80	7.20
B	1.40	1.60
C	0.50	0.70
D	10.10	10.50
E	6.10	6.50
F	7.30	7.70
G	7.80	8.20
H	1.30	1.50
I	0.70	0.90
J	3.00	3.40
K	12.95	13.35

Unit: mm		
Symbol	Min.	Max.
C1	2.37	2.77
C2	0.50	0.90
C3	8.95	9.35
C4	15.70	16.10
C5	2.80	3.20
C6	0.40	0.60
C7	4.50	4.90
T1	6.80	7.20
T2	1.40	1.60
T3	12.30	12.50
T4	1.40	1.80
T5	14.10	14.50



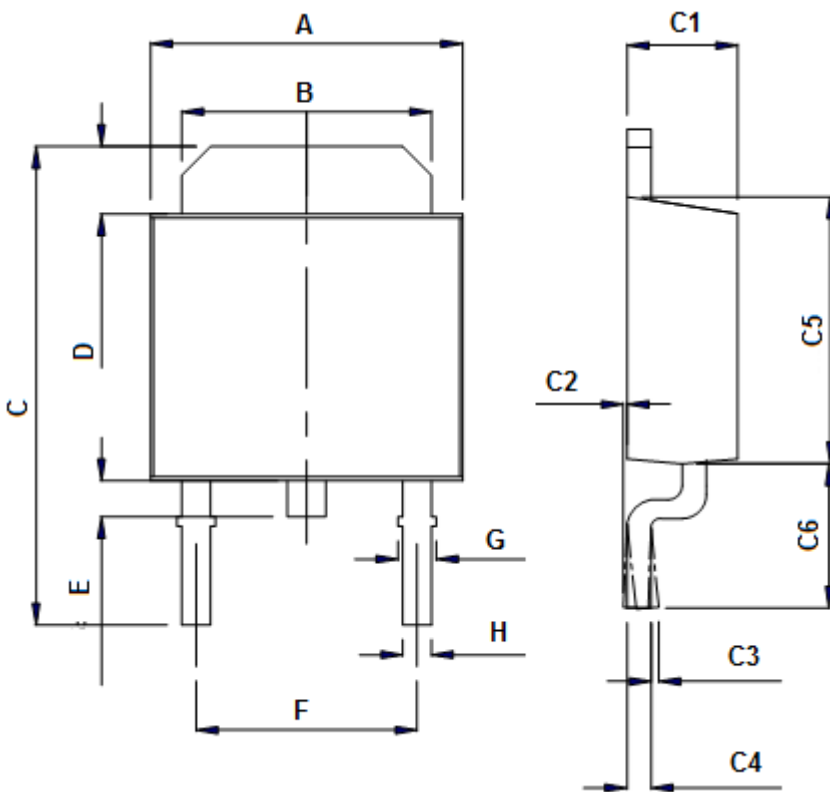
TO-251



Unit: mm		
Symbol	Min.	Max.
A	6.30	6.70
B	5.10	5.30
C	1.20	1.60
D	0.60	0.75
E	0.80	0.95
F	0.50	0.70
G	2.25	2.35
H	7.80	8.20
I	5.35	5.75
C1	2.20	2.40
C2	0.40	0.60
C3	1.05	1.25
C4	5.35	5.75



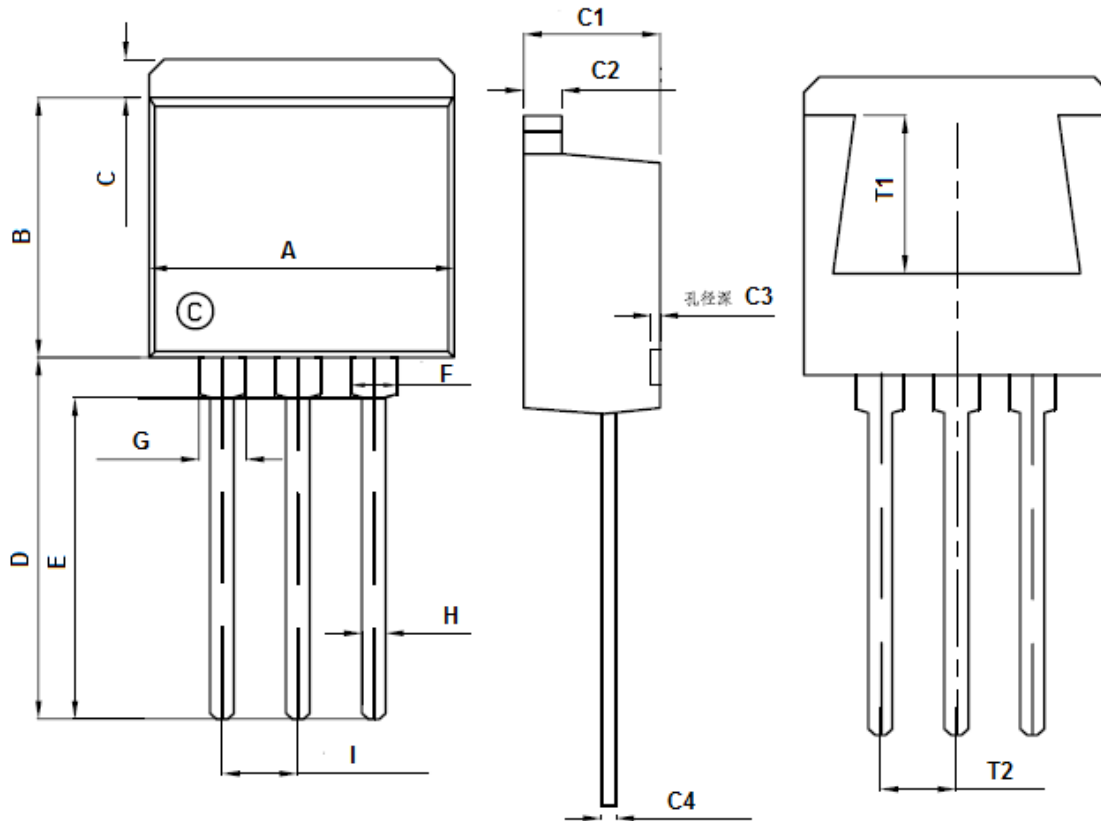
TO-252



Unit: mm		
Symbol	Min.	Max.
A	6.30	6.70
B	5.10	5.30
C	9.50	9.90
D	1.20	1.60
E	0.60	0.90
F	4.50	4.70
G	0.60	0.75
H	0.40	0.80
C1	2.20	2.40
C2	0.00	0.10
C3	0.00	0.05
C4	0.40	0.60
C5	5.35	5.75
C6	2.55	2.95



TO-262

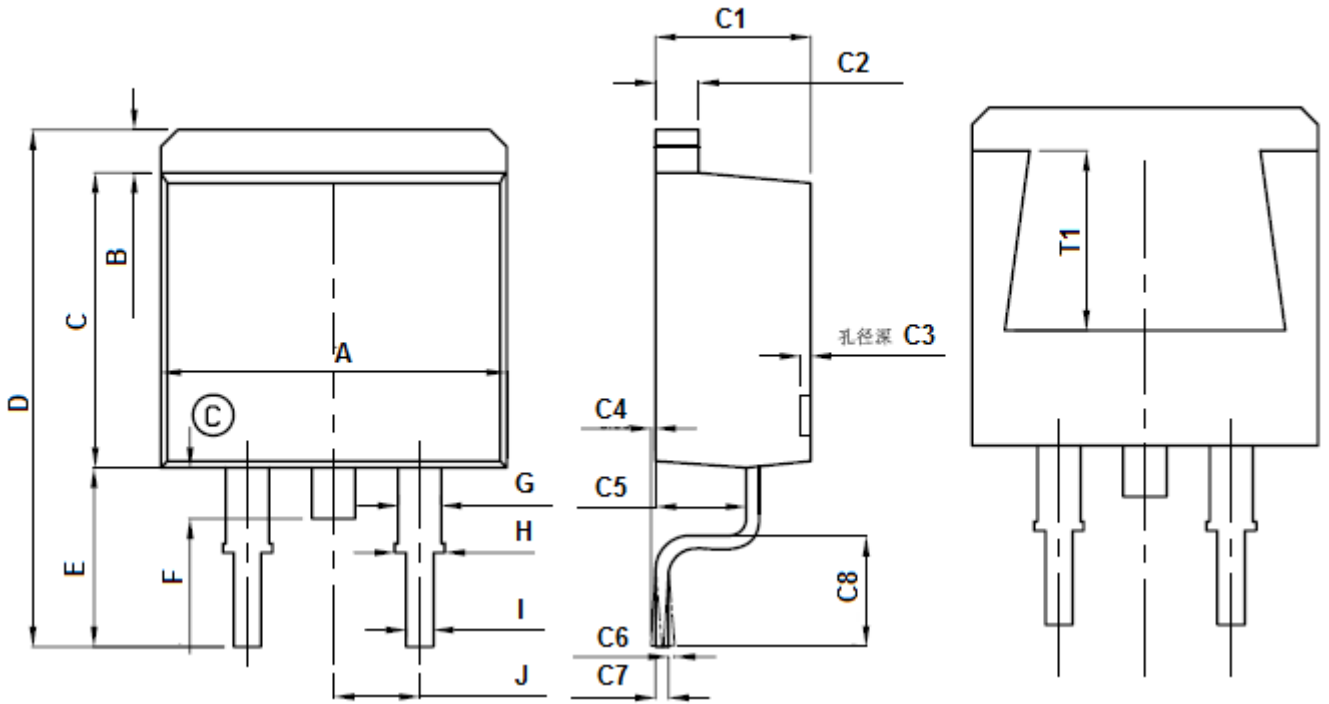


Unit: mm		
Symbol	Min.	Max.
A	9.90	10.30
B	8.50	8.90
C	1.17	1.37
D	13.30	13.70
E	9.88	10.28
F	1.14	1.34
G	1.24	1.39
H	0.70	0.90
I	2.49	2.59

Unit: mm		
Symbol	Min.	Max.
C1	4.47	4.67
C2	1.17	1.37
C3	0.00	0.30
C4	0.40	0.60
T1	5.60REF	
T2	2.49	2.59



TO-263



Unit: mm		
Symbol	Min.	Max.
A	9.90	10.30
B	1.17	1.37
C	8.50	8.90
D	15.05	15.45
E	5.08	5.48
F	1.30	1.70
G	1.17	1.37
H	1.27	1.42
I	0.61	1.02
J	2.49	2.59

Unit: mm		
Symbol	Min.	Max.
C1	4.47	4.67
C2	1.17	1.37
C3	0.00	0.30
C4	0.00	0.15
C5	2.60	2.80
C6	0.00	0.10
C7	0.28	0.49
C8	2.45	2.75
T1	5.60REF	



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