


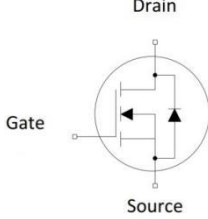



N-channel 650V, 15A, 0.28Ω Super-Junction Power MOSFET

<p>Description</p> <p>Super-junction power MOSFET is a revolutionary technology for high voltage power MOSFET , designed according to the SJ principle. The resulting device has extremely low on resistance,making it especially suitable for applications which require superior power density and outstanding efficiency.</p> <p>Features</p> <ul style="list-style-type: none"> ◆ Very low FOM $R_{DS(on)} \times Q_g$ ◆ 100% UIS tested ◆ RoHS compliant <p>Applications</p> <ul style="list-style-type: none"> ◆ Power factor correction (PFC). ◆ Switched mode power supplies (SMPS). ◆ Uninterrupted power supply (UPS). 	<p>Product Summary</p> <table> <tr> <td>$V_{DS} @ T_{j,25^\circ C}$</td><td>650V</td></tr> <tr> <td>$R_{DS(on),max}$</td><td>0.28Ω</td></tr> <tr> <td>I_D</td><td>15A</td></tr> <tr> <td>$Q_{g,typ}$</td><td>26 nC</td></tr> </table> <div style="display: flex; justify-content: space-around; align-items: center;"> <div style="text-align: center;">  <p>TO-252</p> </div> <div style="text-align: center;">  <p>TO-251</p> </div> <div style="text-align: center;">  <p>TO-220F</p> </div> </div> <div style="text-align: center; margin-top: 20px;">  <p>N-Channel MOSFET</p> </div> <div style="text-align: center; margin-top: 20px;">  </div>	$V_{DS} @ T_{j,25^\circ C}$	650V	$R_{DS(on),max}$	0.28Ω	I_D	15A	$Q_{g,typ}$	26 nC
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I_D	15A								
$Q_{g,typ}$	26 nC								

Marking information

Product	Package	Marking	Packing method
HMS13N65K	TO-252	HMS13N65K	Reel
HMS13N65I	TO-251	HMS13N65I	Tube
HMS13N65F	TO-220F	HMS13N65F	Tube

Absolute Maximum Ratings

Parameter	Symbol	Value	Unit
Drain-Source Voltage	V_{DSS}	650	V
Continuous drain current ($T_C = 25^\circ C$)	I_D	15	A
($T_C = 100^\circ C$)		9	A
Pulsed drain current ¹⁾	I_{DM}	45	A
Gate-Source voltage	V_{GSS}	± 30	V
Avalanche energy, single pulse ²⁾	E_{AS}	320	mJ
Avalanche current, repetitive ³⁾	I_{AR}	2.2	A
Power Dissipation TO-252 /TO-251 ($T_C = 25^\circ C$)	P_D	132	W
- Derate above 25°C		1.06	W/°C
Power Dissipation TO-220F ($T_C = 25^\circ C$)	P_D	34	W
- Derate above 25°C		0.27	W/°C
Operating and Storage Temperature Range	T_J, T_{STG}	-55 to +150	°C
Continuous diode forward current	I_S	15	A

Diode pulse current	$I_{S,pulse}$	45	A
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Thermal Characteristics

Parameter	Symbol	Value		Unit
		TO252/TO-251	TO-220F	
Thermal Resistance, Junction-to-Case	$R_{\theta JC}$	0.93	3.4	°C/W
Thermal Resistance, Junction-to-Ambient	$R_{\theta JA}$	106	58	°C/W
Soldering temperature, wave soldering only allowed at leads. (1.6mm from case for 10s)	T_{solder}	260	260	°C

Electrical Characteristics $T_c = 25^\circ\text{C}$ unless otherwise noted

Parameter	Symbol	Test Condition	Min.	Typ.	Max.	Unit
Static characteristics						
Drain-source breakdown voltage	BV _{DSS}	V _{GS} =0 V, I _D =250uA	650	-	-	V
Gate threshold voltage	V _{GS(th)}	V _{DS} =V _{GS} , I _D =250uA	2.5		4.0	V
Drain cut-off current	I _{DSS}	V _{DS} =650 V, V _{GS} =0 V, T _j = 25°C T _j = 125°C	- -	- 10	1	μA
Gate leakage current, Forward	I _{GSSF}	V _{GS} =30 V, V _{DS} =0 V	-	-	100	nA
Gate leakage current, Reverse	I _{GSSR}	V _{GS} =-30 V, V _{DS} =0 V	-	-	-100	nA
Drain-source on-state resistance	R _{DS(on)}	V _{GS} =10 V, I _D =7.5 A T _j = 25°C	- - -	0.24	0.28	Ω
Dynamic characteristics						
Input capacitance	C _{iss}	V _{DS} = 100 V, V _{GS} = 0 V, f = 1MHz	-	1126	-	pF
Output capacitance	C _{oss}		-	41	-	
Reverse transfer capacitance	C _{rss}		-	2.4	-	
Turn-on delay time	t _{d(on)}	V _{DD} = 400V, I _D = 7.5A R _G = 25Ω, V _{GS} =10V	-	20	-	ns
Rise time	t _r		-	40	-	
Turn-off delay time	t _{d(off)}		-	95	-	
Fall time	t _f		-	43	-	
Gate charge characteristics						
Gate to source charge	Q _{gs}	V _{DD} =520 V, I _D =7.5A, V _{GS} =0 to 10 V	-	3.6	-	nC
Gate to drain charge	Q _{gd}		-	10.5	-	
Gate charge total	Q _g		-	26	-	
Gate plateau voltage	V _{plateau}		-	5.5	-	V
Reverse diode characteristics						
Diode forward voltage	V _{SD}	V _{GS} =0 V, I _F =7.5A	-	0.85	-	V
Reverse recovery time	t _{rr}	V _R =400 V, I _F =7.5A, dI _F /dt=100 A/μs	-	405	-	ns
Reverse recovery charge	Q _{rr}		-	4.0	-	μC
Peak reverse recovery current	I _{rrm}		-	21	-	A

Notes:

1. Limited by maximum junction temperature, maximum duty cycle is 0.75.
2. $I_{AS} = 4A$, $V_{DD} = 50V$, Starting $T_j = 25^{\circ}C$.

Electrical Characteristics Diagrams

Figure 1. Output Characteristics

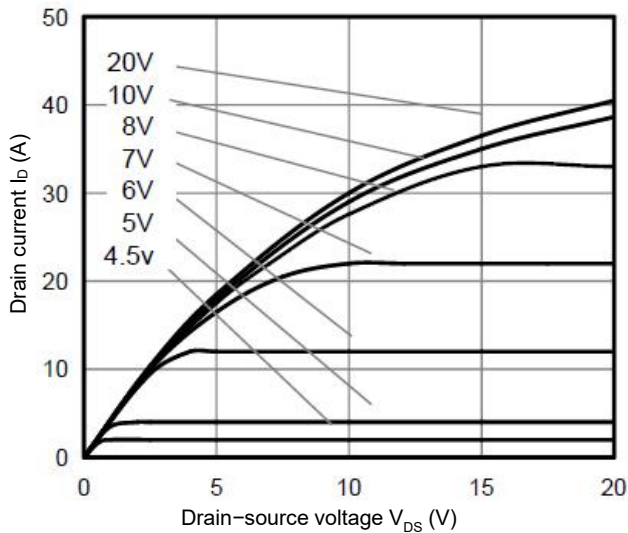


Figure 2. Transfer Characteristics

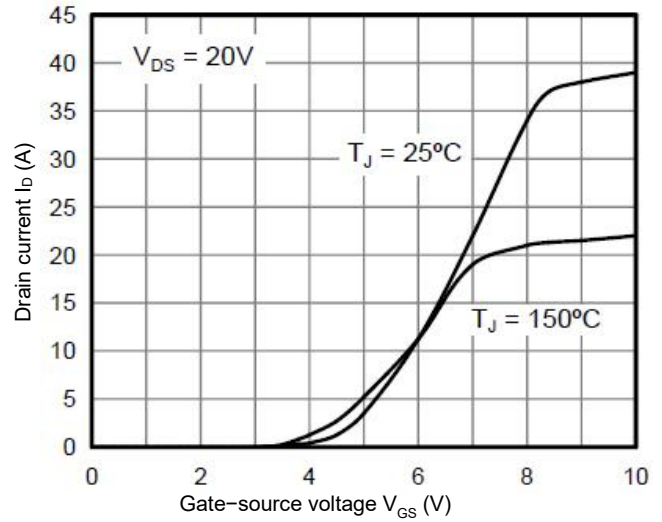


Figure 3. On-Resistance vs. Drain Current

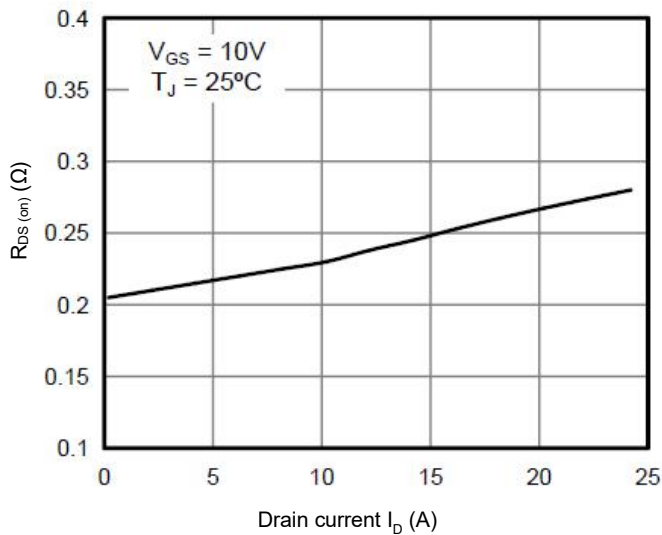


Figure 4. Capacitance Characteristics

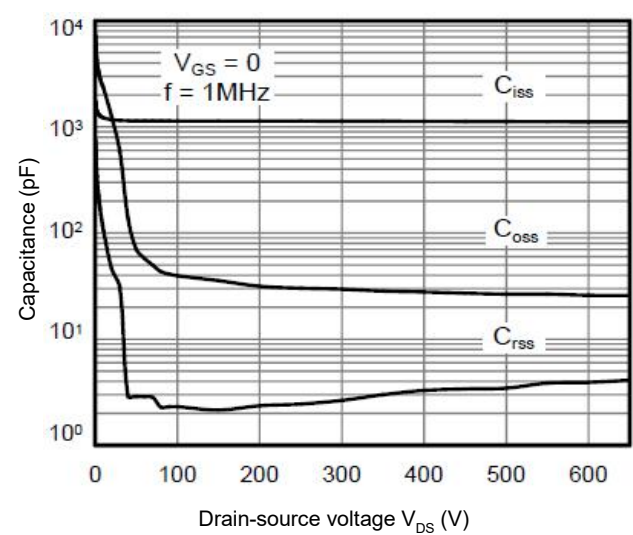


Figure 5. Gate Charge Characteristics

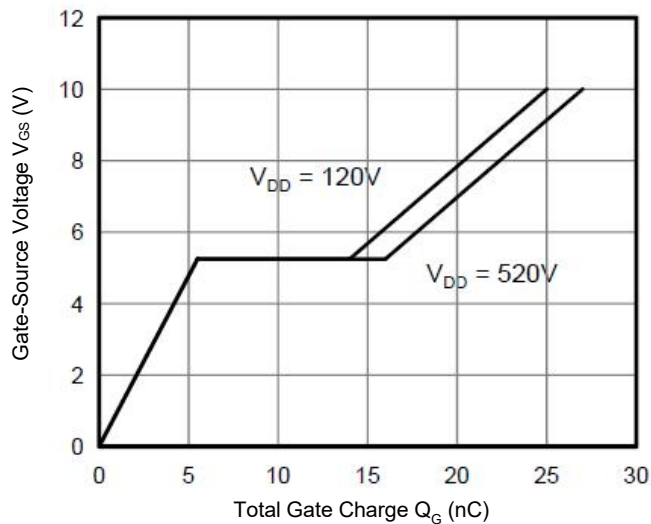


Figure 6. Body Diode Forward Voltage

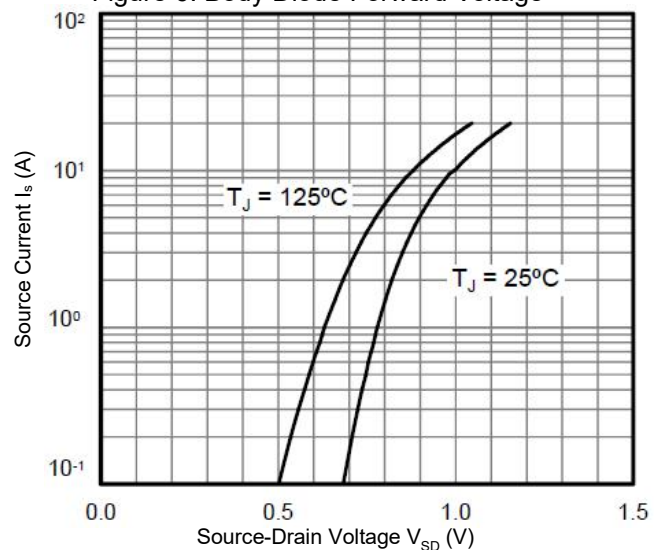


Figure 7. Breakdown Voltage vs. Temperature

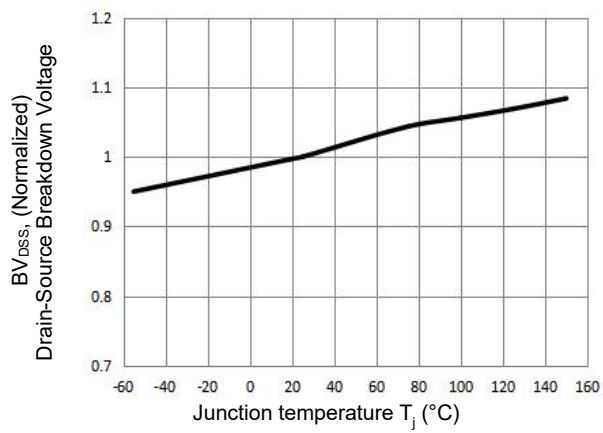


Figure 8. On-Resistance vs. Temperature

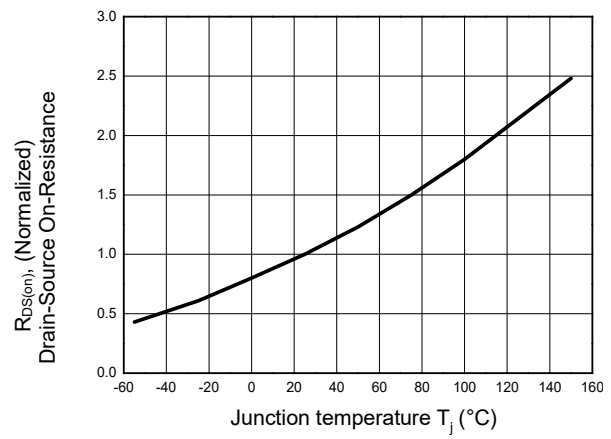


Figure 9. Maximum Safe Operating Area
TO-252/TO-251

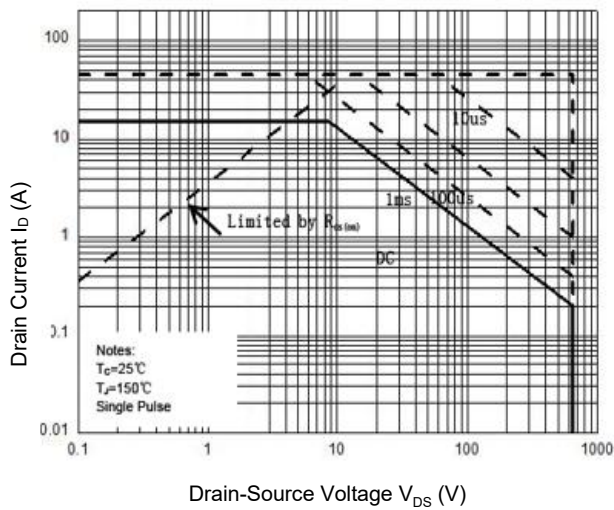
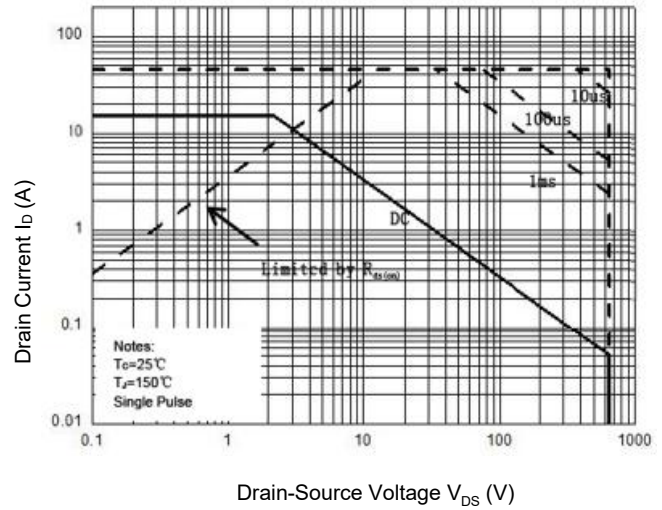
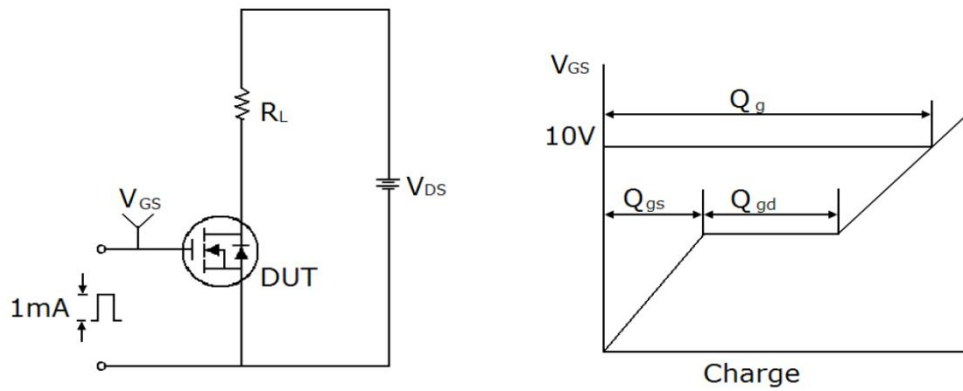


Figure 10. Maximum Safe Operating Area
TO-220F

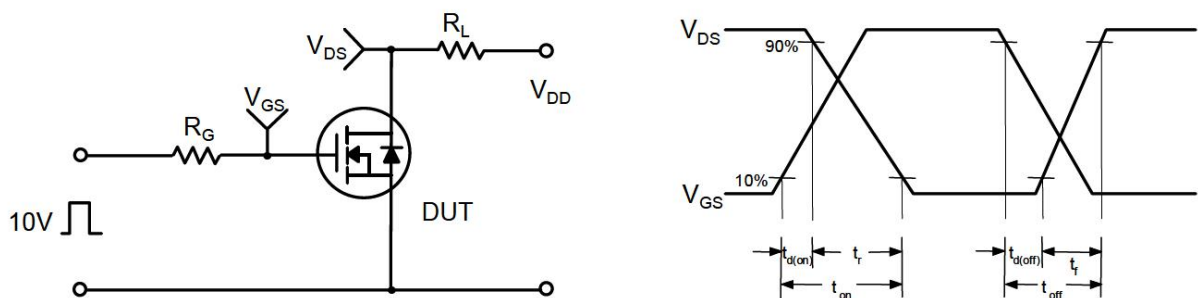


Test Circuits

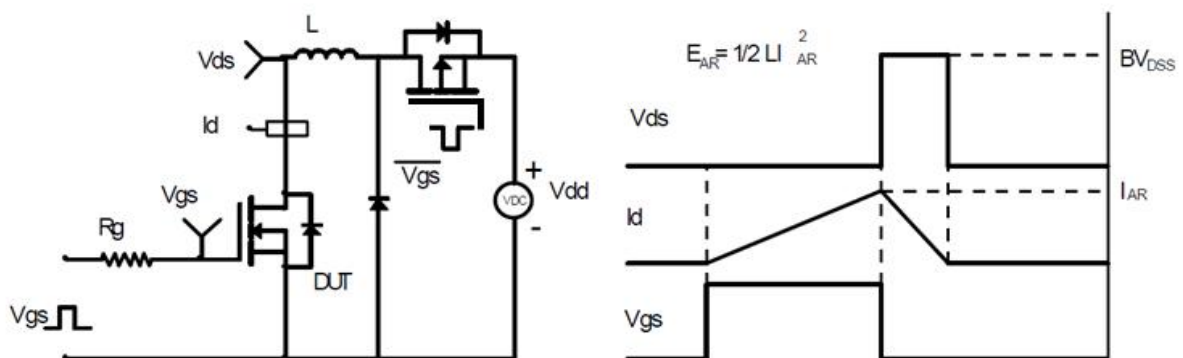
Gate Charge Test Circuit & Waveform



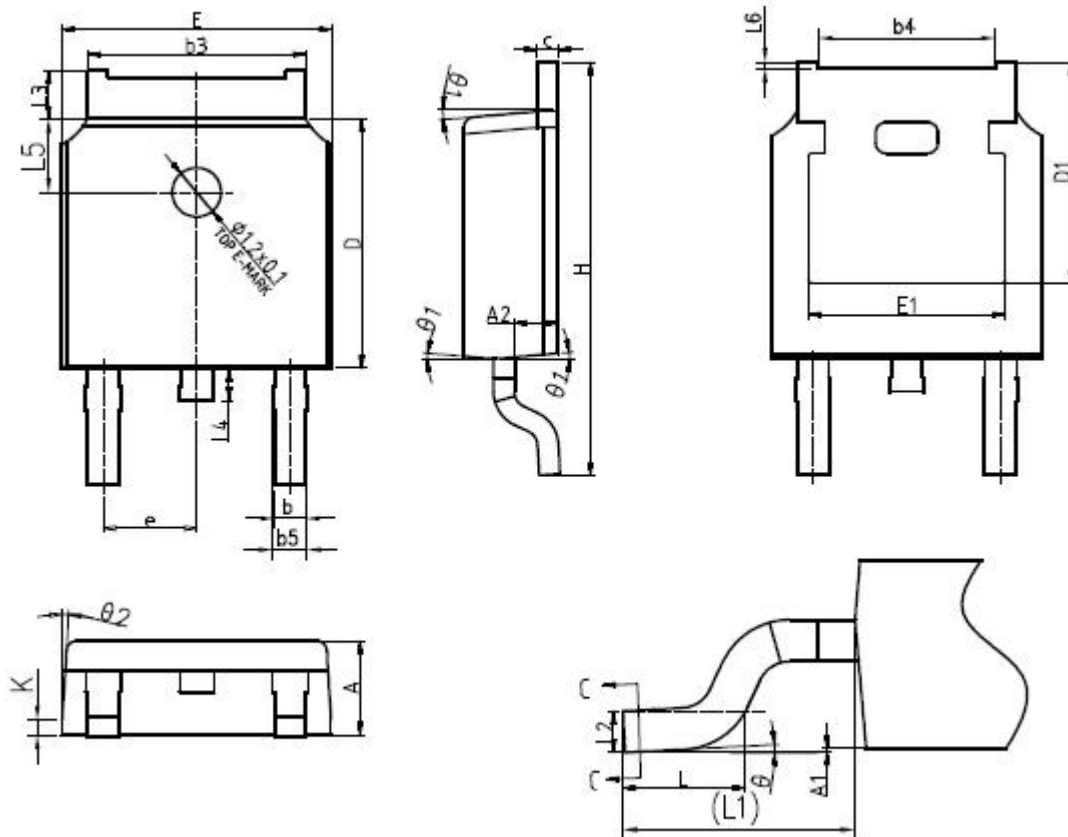
Switching Test Circuit & Waveform



Unclamped Inductive Switching Test Circuit & Waveform



Mechanical Dimensions for TO-252

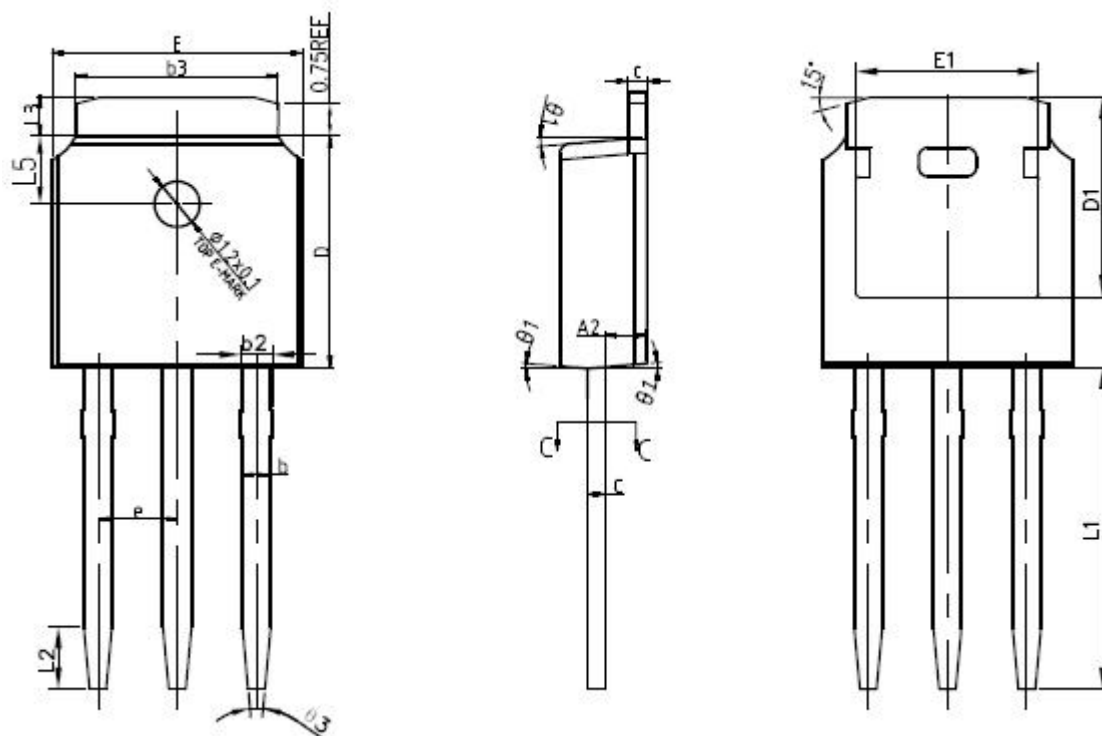


单位: mm

SYMBOL	mm		
	MIN	NOM	MAX
*A	2.20	2.30	2.38
*A1	0.00	-	0.10
A2	0.97	1.07	1.17
*b	0.72	0.78	0.85
b1	0.71	0.76	0.81
*b3	5.23	5.33	5.46
b4	4.27	4.32	4.37
b5	0.72	0.88	0.93
*c	0.47	0.53	0.58
c1	0.46	0.51	0.56
*D	6.00	6.10	6.20
D1	5.30REF		

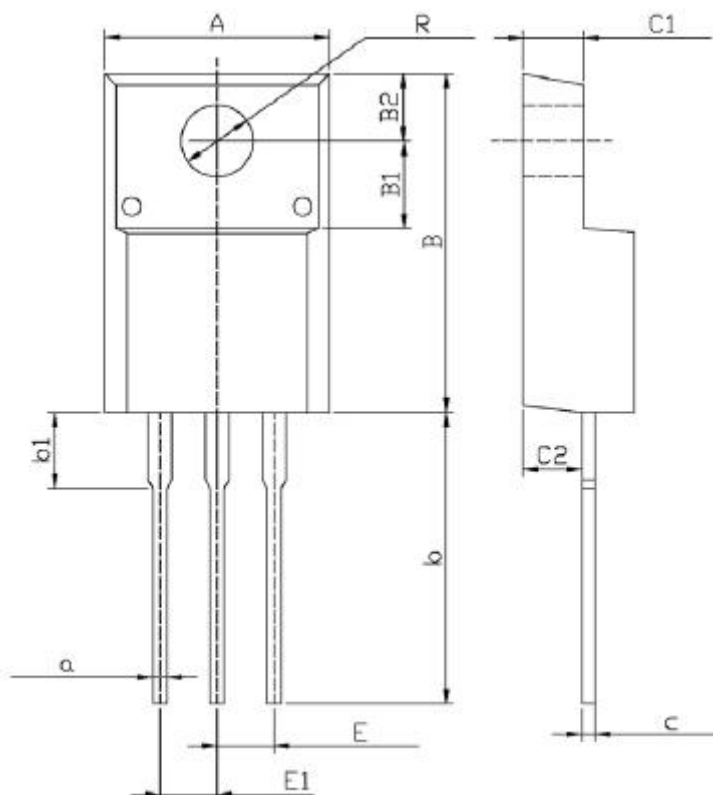
*E	6.50	6.60	6.70
E1	4.70	4.83	4.92
*e	2.286BSC		
L	1.40	1.50	1.70
L1	2.90REF		
L2	0.51BSC		
*L3	0.90	-	1.25
*L4	0.60	0.80	1.00
L5	1.70	1.80	1.90
L6	0	0.047	0.123
θ	0°	-	8°
*θ1	5°	7°	9°
θ2	5°	7°	9°
K	0.40REF		

Mechanical Dimensions for TO-251



SYMBOL	MM		
	MIN	NOM	MAX
*A	2.20	2.30	2.38
*A2	0.97	1.07	1.17
*b	0.72	0.78	0.85
b1	0.71	0.76	0.81
*b2	0.72	0.88	0.95
*b3	5.23	5.33	5.46
*c	0.47	0.53	0.58
c1	0.46	0.51	0.56
*D	6.00	6.10	6.20
D1	5.30REF		
*E	6.50	6.60	6.70
E1	4.70	4.83	4.92
*e	2.286BSC		
*L1	9.20	9.40	9.60
L2	1.25	1.35	1.45
*L3	0.90	1.02	1.25
L5	1.70	1.80	1.90
*0 1	5°	7°	9°
0 2	5°	7°	9°
0 3	11°	13°	15°
K	0.40REF		

Mechanical Dimensions for TO-220F



Symbol	Dimensions In Millimeters		Symbol	Dimensions In Millimeters	
	Min	Max		Min	Max
C	4.3	4.7	b1	2.9	3.9
A	9.7	10.3	a	0.55	0.75
B	14.7	15.3	E	2.29	2.79
B1	3.8	4.0	E1	2.29	2.79
B2	2.9	3.1	C1	2.5	2.9
R	3.0	3.4	C2	2.5	2.7
b	12.5	13.5	C	0.5	0.7