


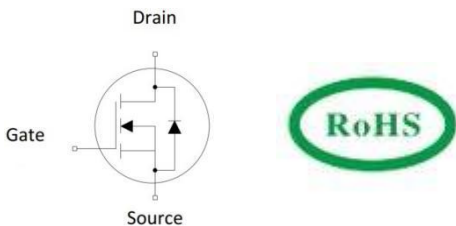


## N-channel 650V, 15A, 0.28Ω Super-Junction Power MOSFET

<p><b>Description</b></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><b>Features</b></p> <ul style="list-style-type: none"> <li>◆ Very low FOM <math>R_{DS(on)} \times Q_g</math></li> <li>◆ 100% UIS tested</li> <li>◆ RoHS compliant</li> </ul> <p><b>Applications</b></p> <ul style="list-style-type: none"> <li>◆ Power factor correction (PFC).</li> <li>◆ Switched mode power supplies (SMPS).</li> <li>◆ Uninterrupted power supply (UPS).</li> </ul>	<p><b>Product Summary</b></p> <table> <tr> <td><math>V_{DS} @ T_{j,25^\circ C}</math></td> <td>650V</td> </tr> <tr> <td><math>R_{DS(on),max}</math></td> <td>0.28Ω</td> </tr> <tr> <td><math>I_D</math></td> <td>15A</td> </tr> <tr> <td><math>Q_{g,typ}</math></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>	$V_{DS} @ T_{j,25^\circ C}$	650V	$R_{DS(on),max}$	0.28Ω	$I_D$	15A	$Q_{g,typ}$	26 nC
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### Marking information

Product	Package	Marking	Packing method
RMA65R280SN	TO-252	RMA65R280SN	Reel
RMG65R280SN	TO-251	RMG65R280SN	Tube
RMC65R280SN	TO-220F	RMC65R280SN	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 <sup>1)</sup>	$I_{DM}$	45	A
Gate-Source voltage	$V_{GSS}$	$\pm 30$	V
Avalanche energy, single pulse <sup>2)</sup>	$E_{AS}$	320	mJ
Avalanche current, repetitive <sup>3)</sup>	$I_{AR}$	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)	$T_{sold}$	260	260	°C

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

Parameter	Symbol	Test Condition	Min.	Typ.	Max.	Unit
<b>Static characteristics</b>						
Drain-source breakdown voltage	$BV_{DSS}$	$V_{GS}=0\text{ V}, I_D=250\mu\text{A}$	650	-	-	V
Gate threshold voltage	$V_{GS(th)}$	$V_{DS}=V_{GS}, I_D=250\mu\text{A}$	2.5		4.0	V
Drain cut-off current	$I_{DSS}$	$V_{DS}=650\text{ V}, V_{GS}=0\text{ V},$ $T_j = 25^\circ\text{C}$ $T_j = 125^\circ\text{C}$	- -	- 10	1	$\mu\text{A}$
Gate leakage current, Forward	$I_{GSSF}$	$V_{GS}=30\text{ V}, V_{DS}=0\text{ V}$	-	-	100	nA
Gate leakage current, Reverse	$I_{GSSR}$	$V_{GS}=-30\text{ V}, V_{DS}=0\text{ V}$	-	-	-100	nA
Drain-source on-state resistance	$R_{DS(on)}$	$V_{GS}=10\text{ V}, I_D=7.5\text{ A}$ $T_j = 25^\circ\text{C}$	- - -	0.24	0.28	$\Omega$
<b>Dynamic characteristics</b>						
Input capacitance	$C_{iss}$	$V_{DS} = 100\text{ V}, V_{GS} = 0\text{ V},$ $f = 1\text{ MHz}$	-	1126	-	pF
Output capacitance	$C_{oss}$		-	41	-	
Reverse transfer capacitance	$C_{rss}$		-	2.4	-	
Turn-on delay time	$t_{d(on)}$	$V_{DD} = 400\text{ V}, I_D = 7.5\text{ A}$ $R_G = 25\Omega, V_{GS}=10\text{ V}$	-	20	-	ns
Rise time	$t_r$		-	40	-	
Turn-off delay time	$t_{d(off)}$		-	95	-	
Fall time	$t_f$		-	43	-	
<b>Gate charge characteristics</b>						
Gate to source charge	$Q_{gs}$	$V_{DD}=520\text{ V}, I_D=7.5\text{ A},$ $V_{GS}=0\text{ to }10\text{ V}$	-	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
<b>Reverse diode characteristics</b>						
Diode forward voltage	$V_{SD}$	$V_{GS}=0\text{ V}, I_F=7.5\text{ A}$	-	0.85	-	V
Reverse recovery time	$t_{rr}$	$V_R=400\text{ V}, I_F=7.5\text{ A},$ $dI_F/dt=100\text{ A}/\mu\text{s}$	-	405	-	ns
Reverse recovery charge	$Q_{rr}$		-	4.0	-	$\mu\text{C}$
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

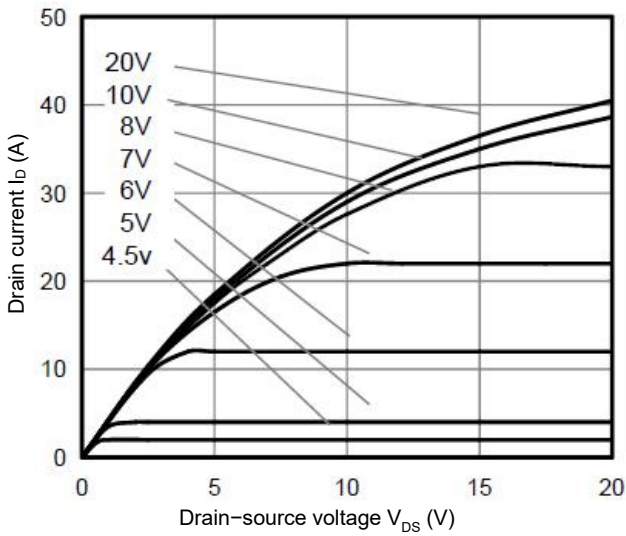


Figure 2. Transfer Characteristics

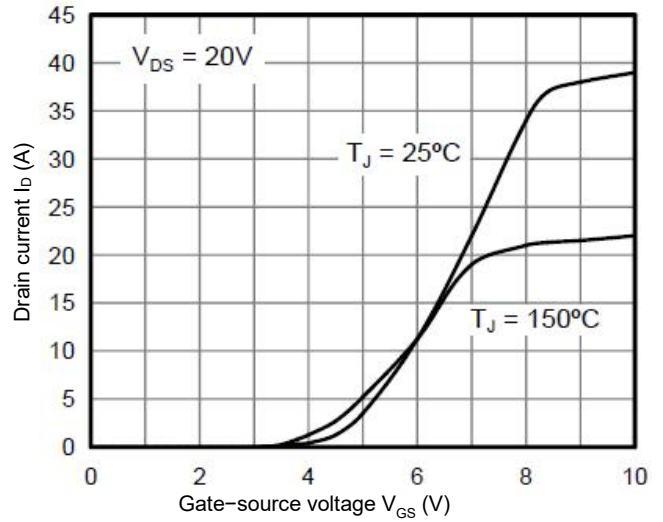


Figure 3. On-Resistance vs. Drain Current

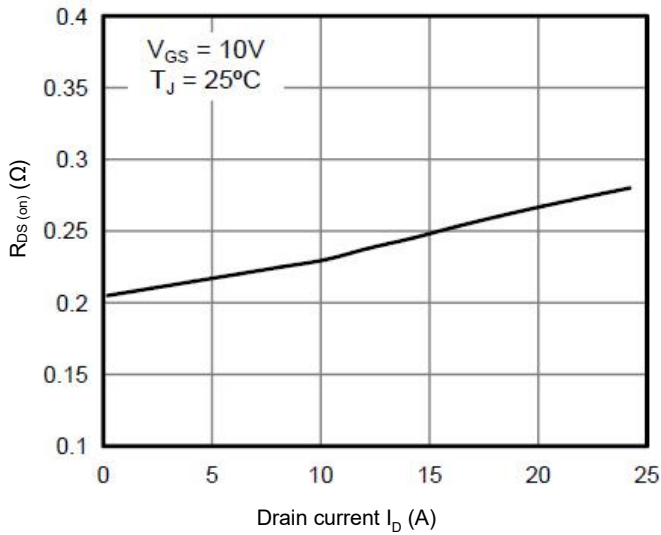


Figure 4. Capacitance Characteristics

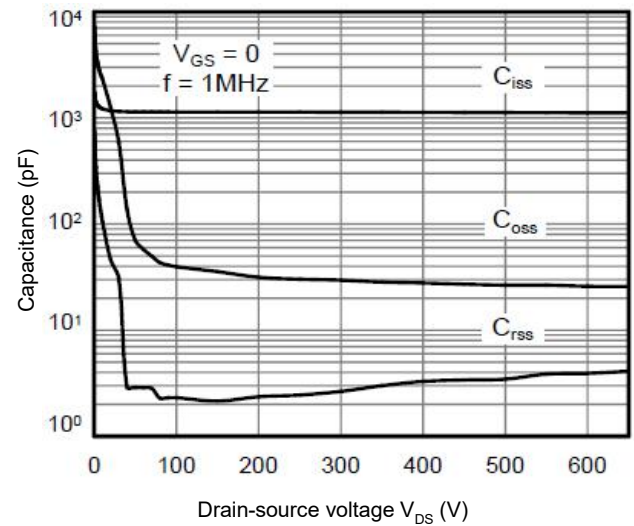


Figure 5. Gate Charge Characteristics

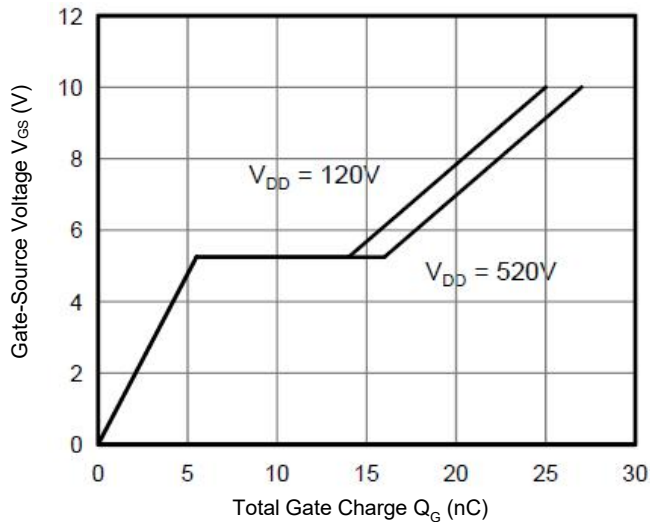


Figure 6. Body Diode Forward Voltage

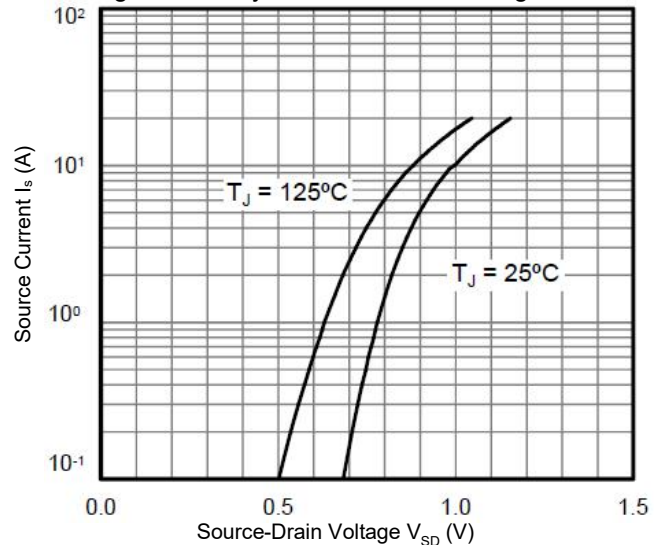


Figure 7. Breakdown Voltage vs. Temperature

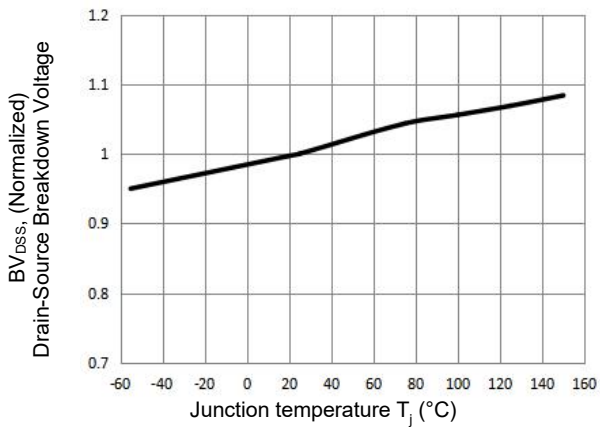


Figure 8. On-Resistance vs. Temperature

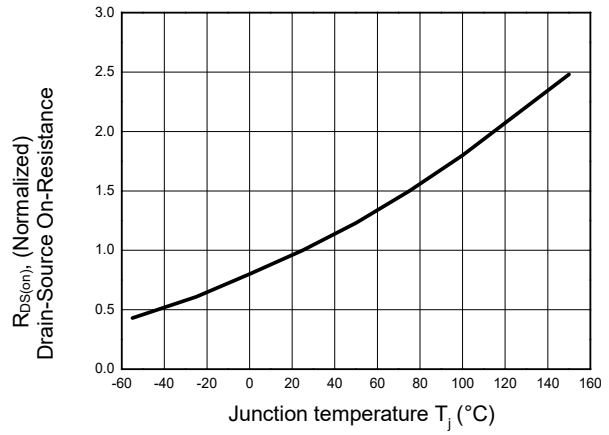


Figure 9. Maximum Safe Operating Area  
TO-252/TO-251

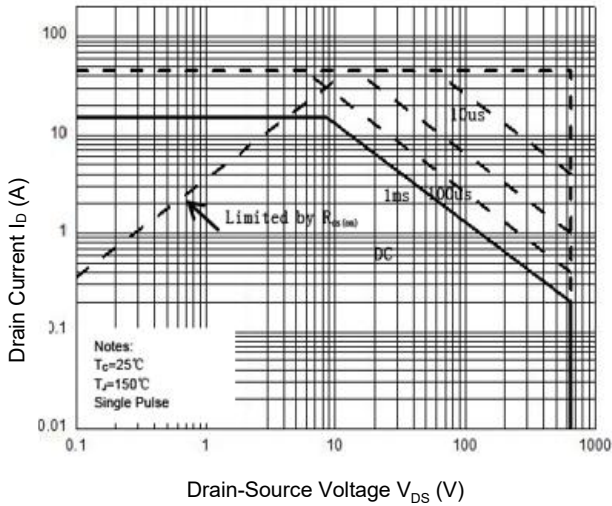
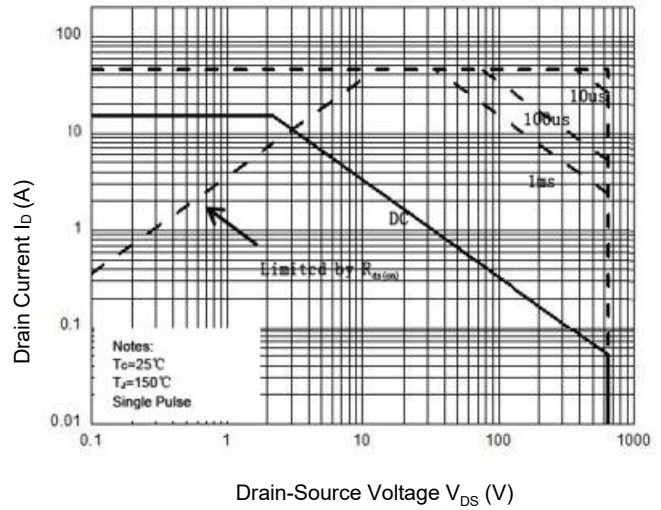
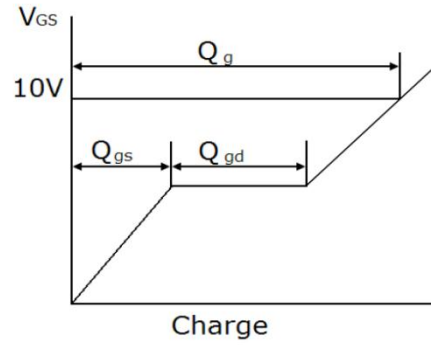
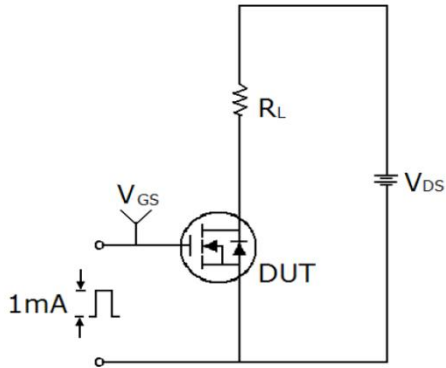


Figure 10. Maximum Safe Operating Area  
TO-220F

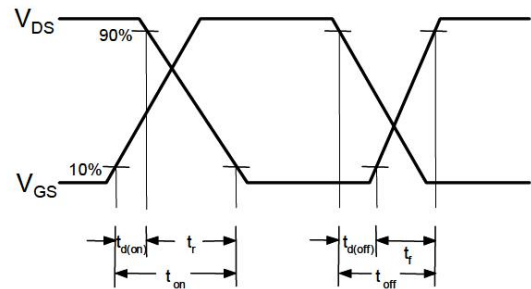
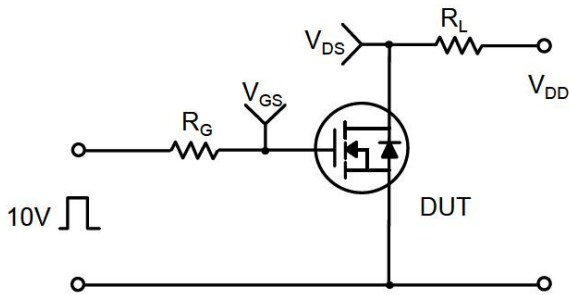


**Test Circuits**

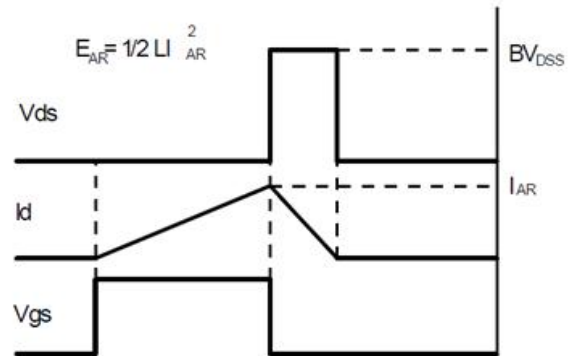
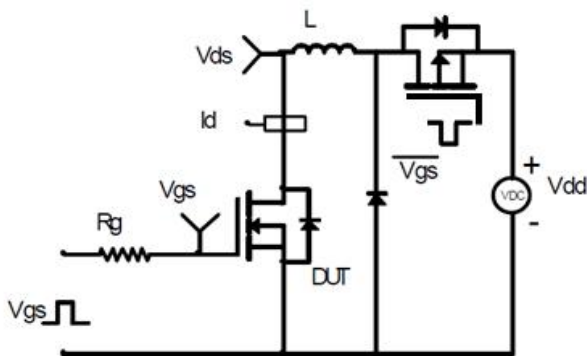
**Gate Charge Test Circuit & Waveform**



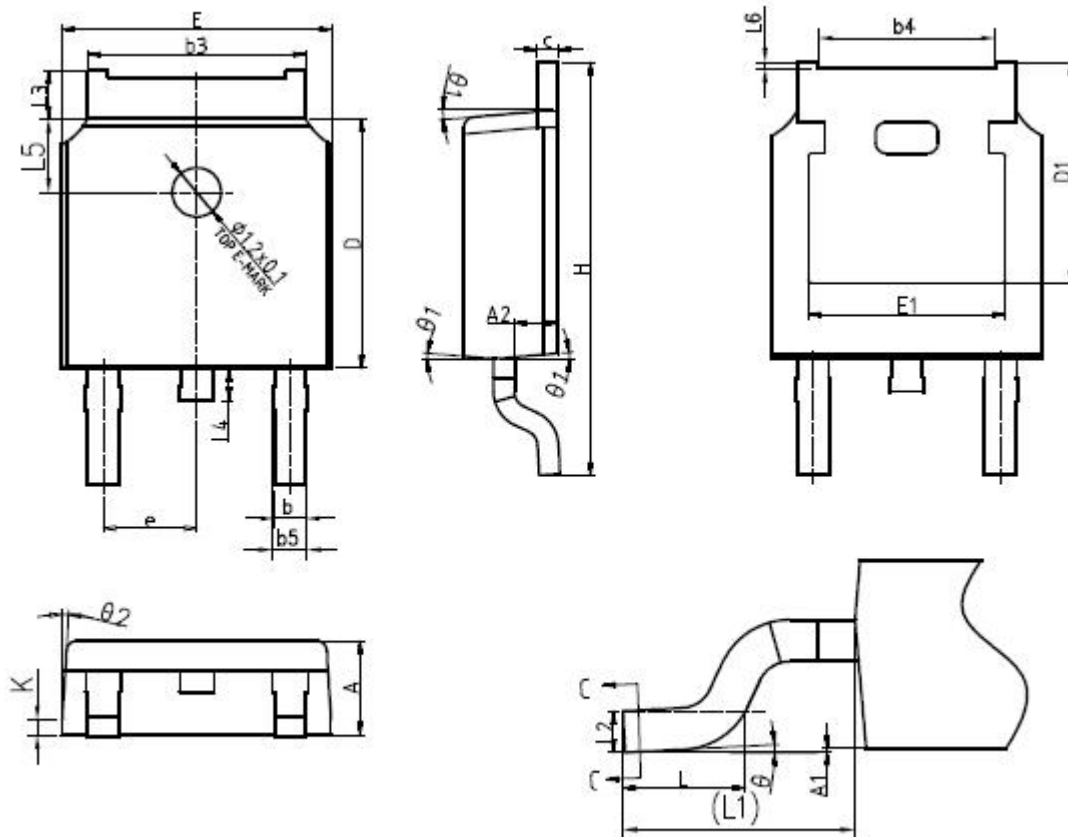
**Switching Test Circuit & Waveform**



**Unclamped Inductive Switching Test Circuit & Waveform**



Mechanical Dimensions for TO-252

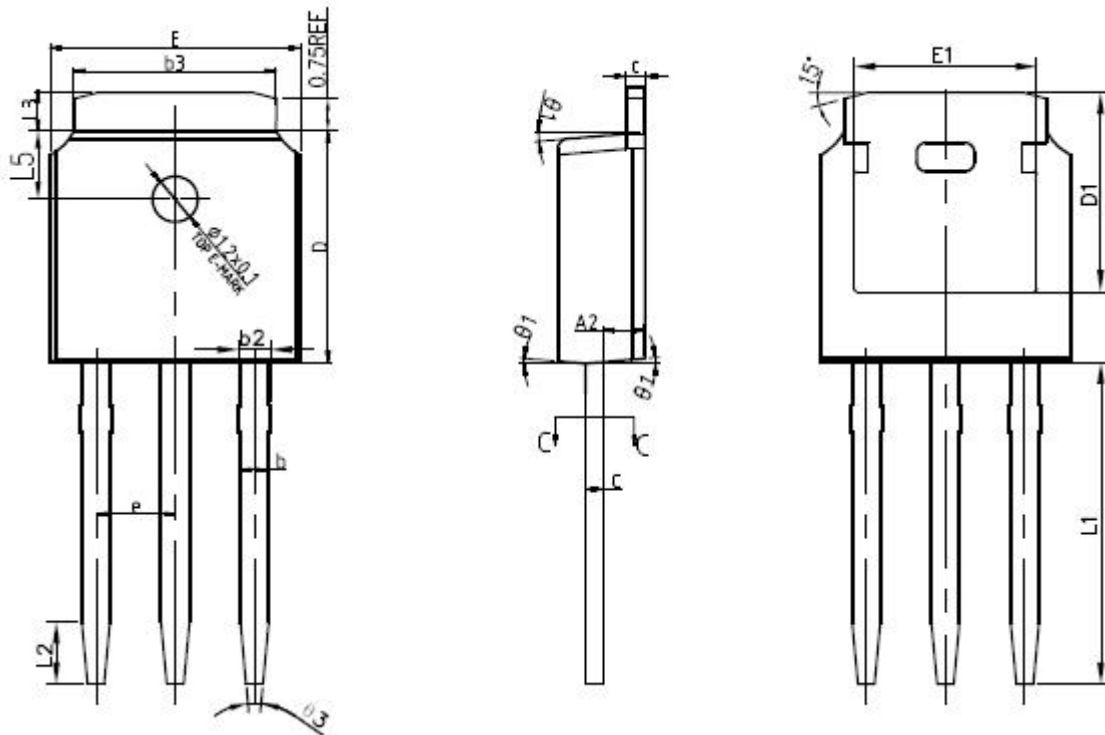


单位: mm

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		

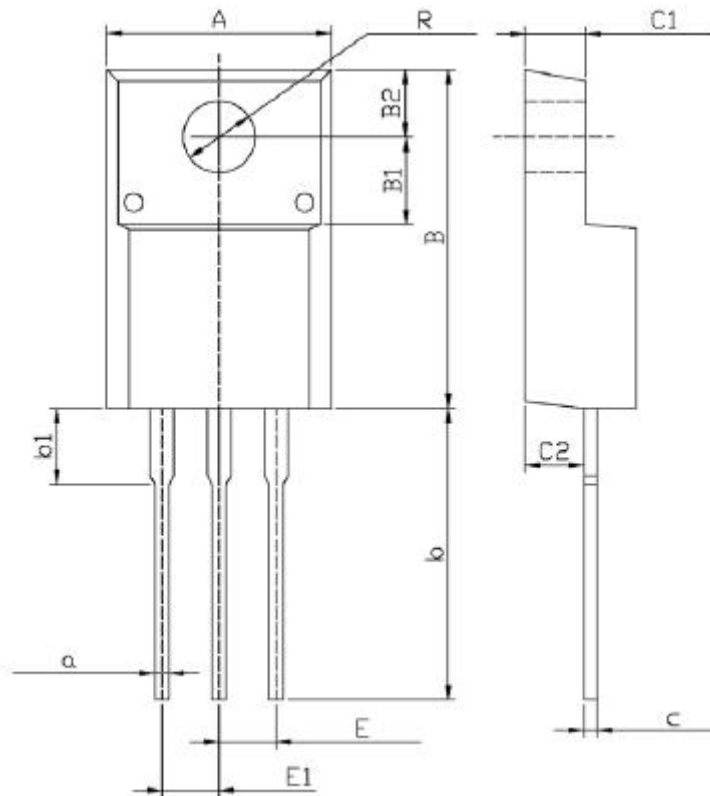
Mechanical Dimensions for TO-251



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
* $\theta 1$	5°	7°	9°
$\theta 2$	5°	7°	9°
$\theta 3$	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