

N-Channel Super Junction Power MOSFET II

General Description

The series of devices use advanced super junction technology and design to provide excellent $R_{DS(ON)}$ with low gate charge. This super junction MOSFET fits the industry's AC-DC SMPS requirements for PFC, AC/DC power conversion, and industrial power applications.

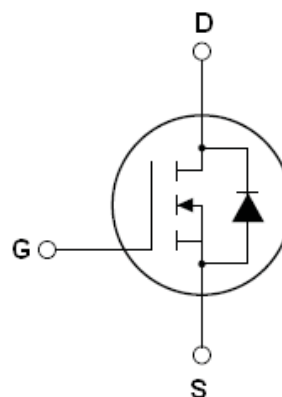
Features

- New technology for high voltage device
- Low on-resistance and low conduction losses
- Small package
- Ultra Low Gate Charge cause lower driving requirements
- 100% Avalanche Tested
- ROHS compliant

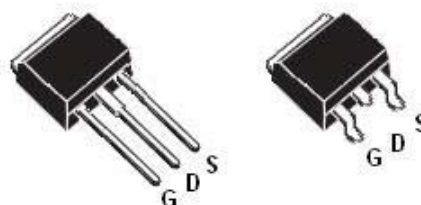
Application

- Power factor correction (PFC)
- Switched mode power supplies(SMPS)
- Uninterruptible Power Supply (UPS)

V_{DS}	650	V
$R_{DS(ON) MAX}$	1200	m Ω
I_D	4	A



Schematic diagram



TO-251

TO-252

Package Marking And Ordering Information

Device	Device Package	Marking
RM4N650IP	TO-251	4N650
RM4N650LD	TO-252	4N650

Table 1. Absolute Maximum Ratings ($T_c=25^\circ\text{C}$)

Parameter	Symbol	Value	Unit
Drain-Source Voltage ($V_{GS}=0V$)	V_{DS}	650	V
Gate-Source Voltage ($V_{DS}=0V$)	V_{GS}	± 30	V
Continuous Drain Current at $T_c=25^\circ\text{C}$	$I_D (DC)$	4	A
Continuous Drain Current at $T_c=100^\circ\text{C}$	$I_D (DC)$	2.5	A
Pulsed drain current ^(Note 1)	$I_{DM} (pulse)$	12	A
Maximum Power Dissipation ($T_c=25^\circ\text{C}$)	P_D	46	W
Derate above 25°C		0.37	W/ $^\circ\text{C}$
Single pulse avalanche energy ^(Note2)	E_{AS}	130	mJ
Avalanche current ^(Note 1)	I_{AR}	2	A
Repetitive Avalanche energy, t_{AR} limited by T_{jmax} ^(Note 1)	E_{AR}	0.2	mJ

Parameter	Symbol	Value	Unit
Drain Source voltage slope, $V_{DS} \leq 480V$,	dv/dt	50	V/ns
Reverse diode dv/dt, $V_{DS} \leq 480V, I_{SD} < I_D$	dv/dt	15	V/ns
Operating Junction and Storage Temperature Range	T_J, T_{STG}	-55...+150	°C

Table 2. Thermal Characteristic

Parameter	Symbol	Value	Unit
Thermal Resistance, Junction-to-Case (Maximum)	R_{thJC}	2.7	°C/W
Thermal Resistance, Junction-to-Ambient (Maximum)	R_{thJA}	75	°C/W

Table 3. Electrical Characteristics (TA=25°C unless otherwise noted)

Parameter	Symbol	Condition	Min	Typ	Max	Unit
On/off states						
Drain-Source Breakdown Voltage	BV _{DSS}	V _{GS} =0V I _D =250μA	650			V
Zero Gate Voltage Drain Current(Tc=25℃)	I _{DSS}	V _{DS} =650V,V _{GS} =0V			1	μA
Zero Gate Voltage Drain Current(Tc=125℃)	I _{DSS}	V _{DS} =650V,V _{GS} =0V			50	μA
Gate-Body Leakage Current	I _{GSS}	V _{GS} =±30V,V _{DS} =0V			±100	nA
Gate Threshold Voltage	V _{GS(th)}	V _{DS} =V _{GS} ,I _D =250μA	2.5	3	3.5	V
Drain-Source On-State Resistance	R _{DS(ON)}	V _{GS} =10V, I _D =2.5A		1000	1200	mΩ
Dynamic Characteristics						
Forward Transconductance	g _{FS}	V _{DS} = 20V, I _D = 2.5A		4		S
Input Capacitance	C _{iss}	V _{DS} =50V,V _{GS} =0V, F=1.0MHz		280		PF
Output Capacitance	C _{oss}			26		PF
Reverse Transfer Capacitance	C _{rss}			2.3		PF
Total Gate Charge	Q _g	V _{DS} =480V,I _D =4A, V _{GS} =10V		6.5	10	nC
Gate-Source Charge	Q _{gs}			1.3		nC
Gate-Drain Charge	Q _{gd}			2.5		nC
Intrinsic gate resistance	R _G	f = 1 MHz open drain		2.5		Ω
Switching times						
Turn-on Delay Time	t _{d(on)}	V _{DD} =380V,I _D =2.5A, R _G =20Ω,V _{GS} =10V		6		nS
Turn-on Rise Time	t _r			3		nS
Turn-Off Delay Time	t _{d(off)}			48	60	nS
Turn-Off Fall Time	t _f			8	15	nS
Source- Drain Diode Characteristics						
Source-drain current(Body Diode)	I _{SD}	T _C =25℃			4	A
Pulsed Source-drain current(Body Diode)	I _{SDM}				12	A
Forward On Voltage	V _{SD}	T _j =25℃,I _{SD} =4A,V _{GS} =0V		1	1.3	V
Reverse Recovery Time	t _{rr}	T _j =25℃,I _F =4A,di/dt=100A/μs		150		nS
Reverse Recovery Charge	Q _{rr}			0.85		uC
Peak reverse recovery current	I _{rrm}			11		A

Notes: 1.Repetitive Rating: Pulse width limited by maximum junction temperature

2. $T_J=25^\circ C, V_{DD}=50V, V_G=10V, R_G=25\Omega$

RATING AND CHARACTERISTICS CURVES (RM4N650IP/LD)

Figure1. Safe operating area

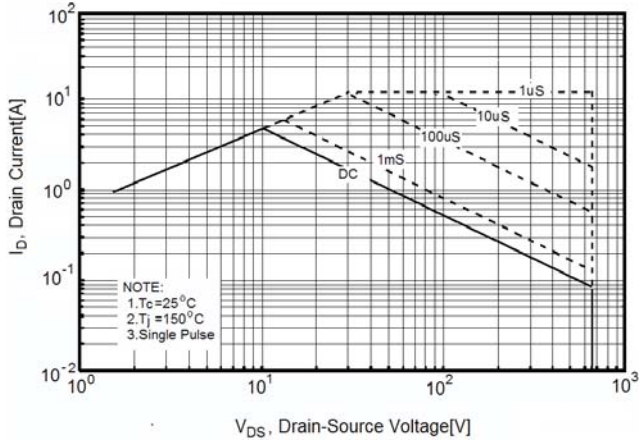


Figure2. Source-Drain Diode Forward Voltage

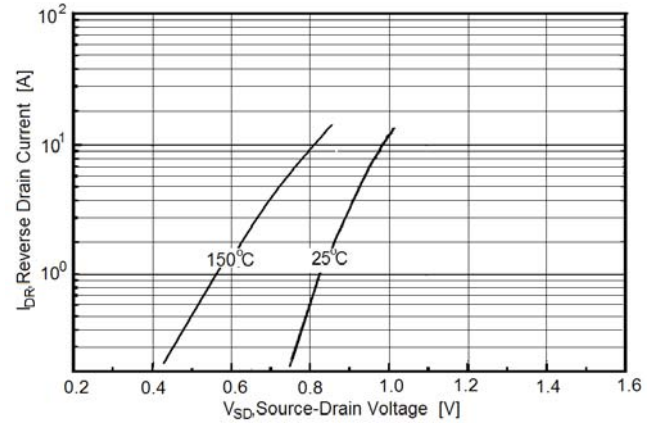


Figure3. Output characteristics

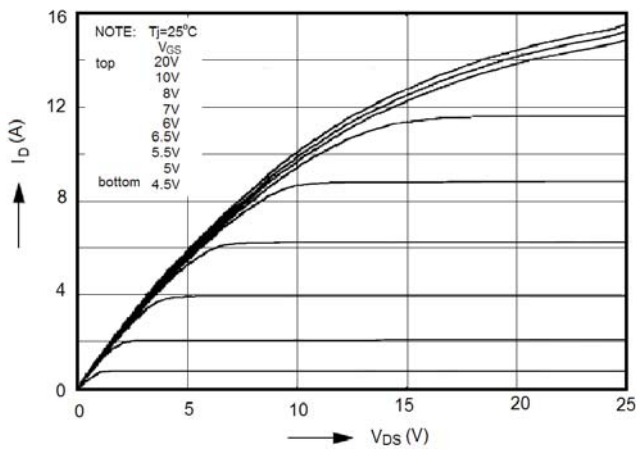


Figure4. Transfer characteristics

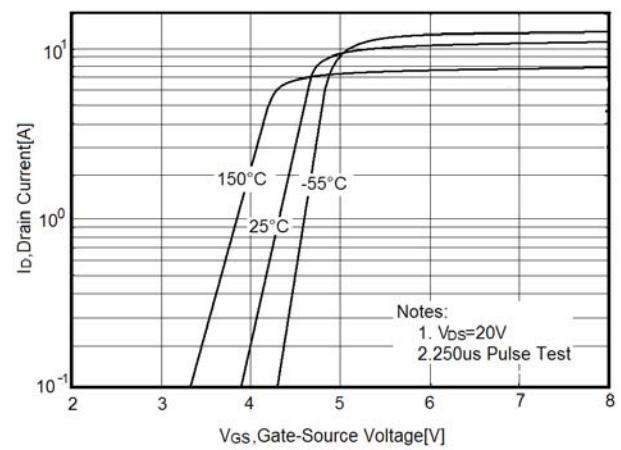


Figure5. Static drain-source on resistance

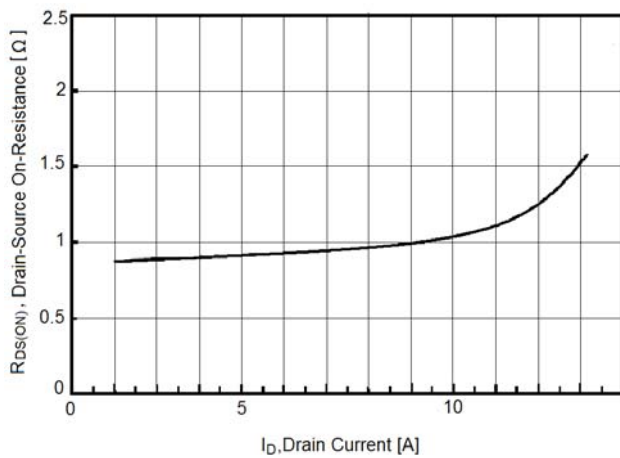
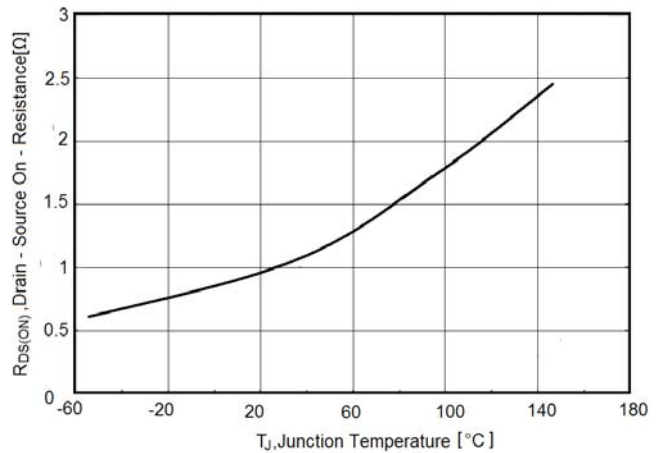


Figure6. $R_{DS(ON)}$ vs Junction Temperature



RATING AND CHARACTERISTICS CURVES (RM4N650IP/LD)

Figure7. BV_{DSS} vs Junction Temperature

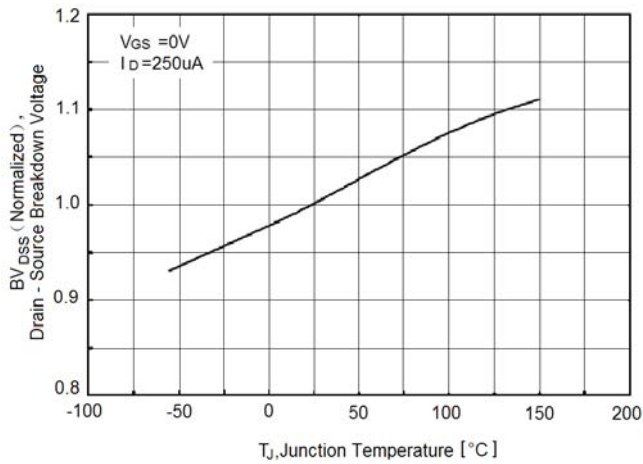


Figure8. Maximum I_D vs Junction Temperature

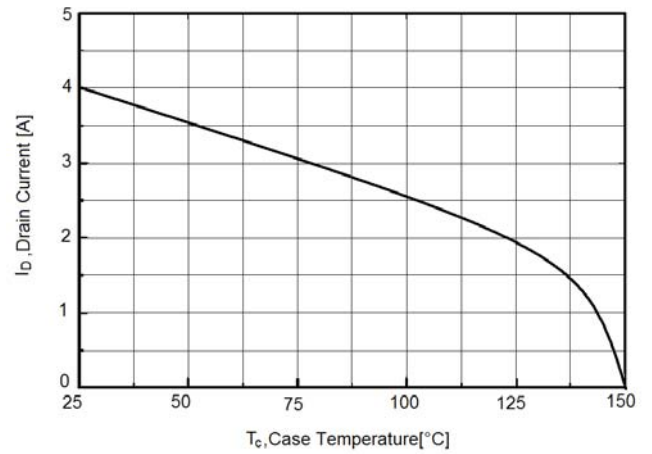


Figure9. Gate charge waveforms

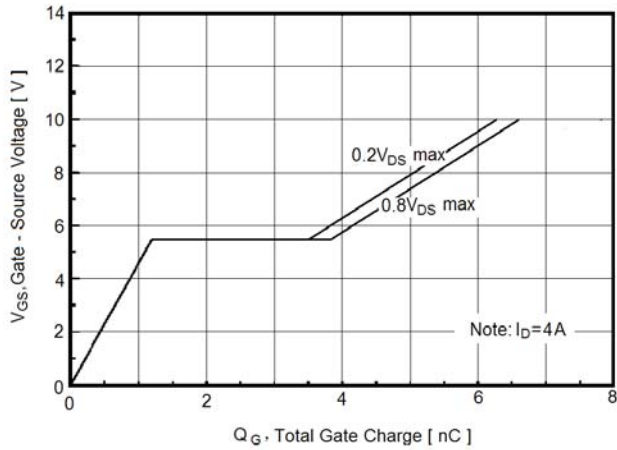


Figure10. Capacitance

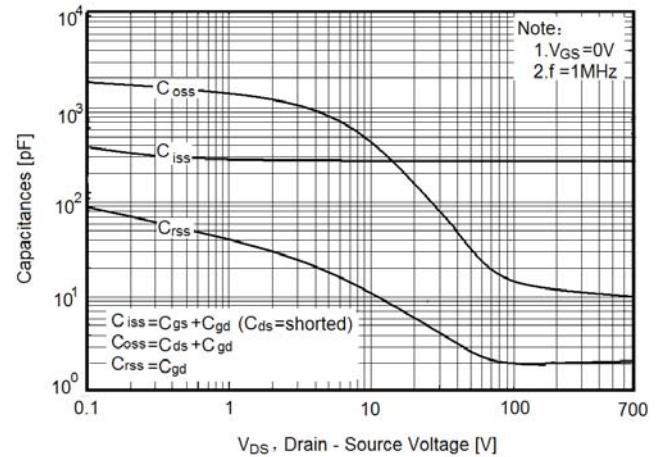
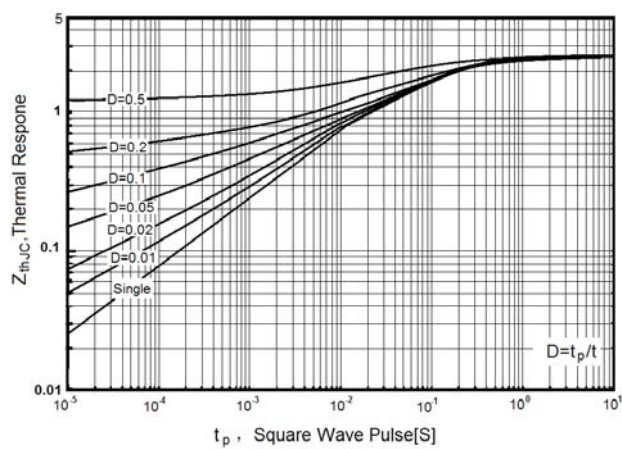
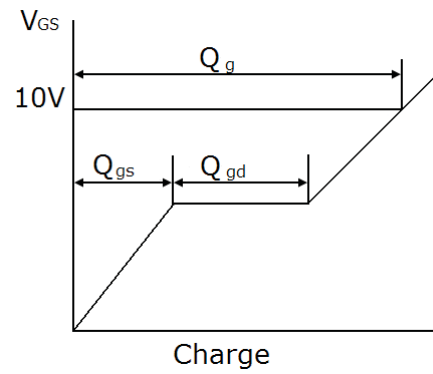
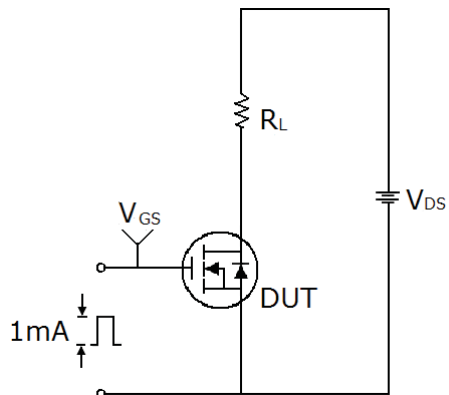


Figure11. Transient Thermal Impedance

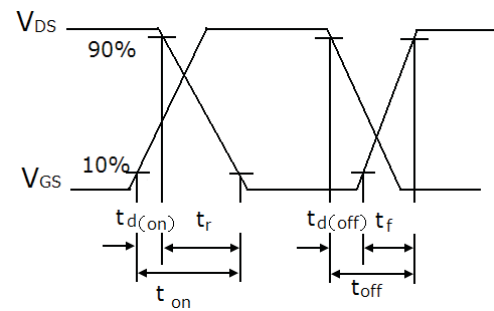
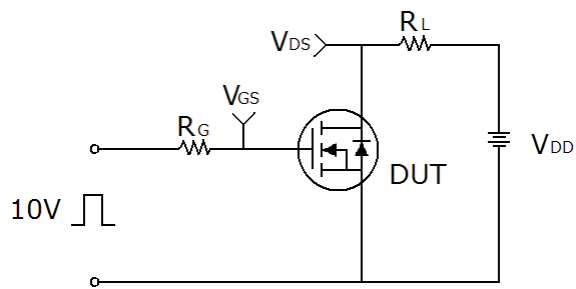


Test circuit

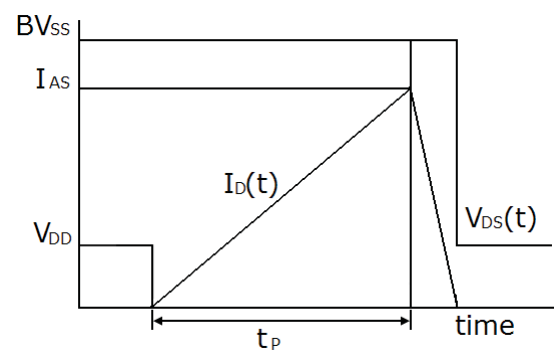
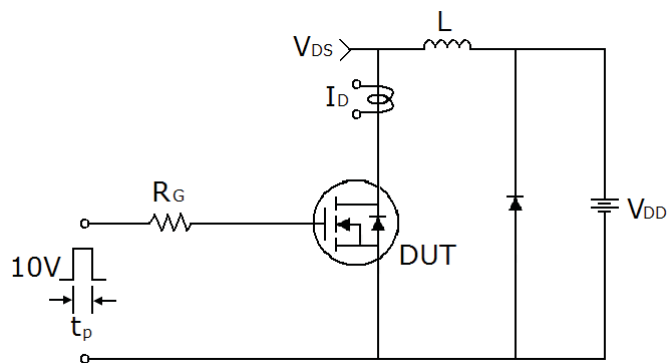
1) Gate charge test circuit & Waveform



2) Switch Time Test Circuit:



3) Unclamped Inductive Switching Test Circuit & Waveforms





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Marking on the body



← Rectron Logo

4 N 6 5 0 ← Part No.

1 6 X X

Year – Code

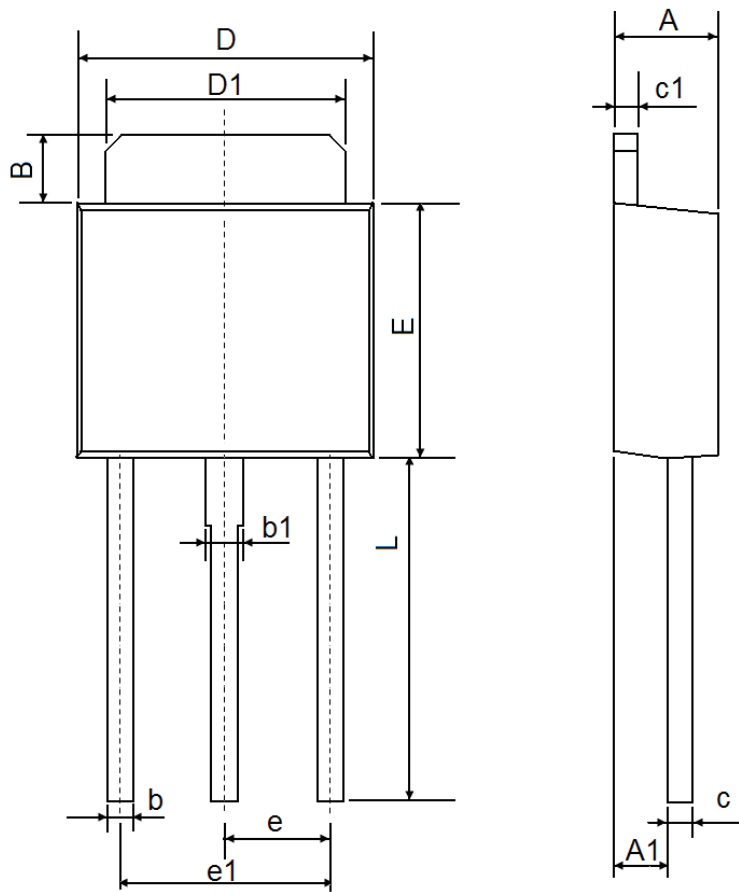
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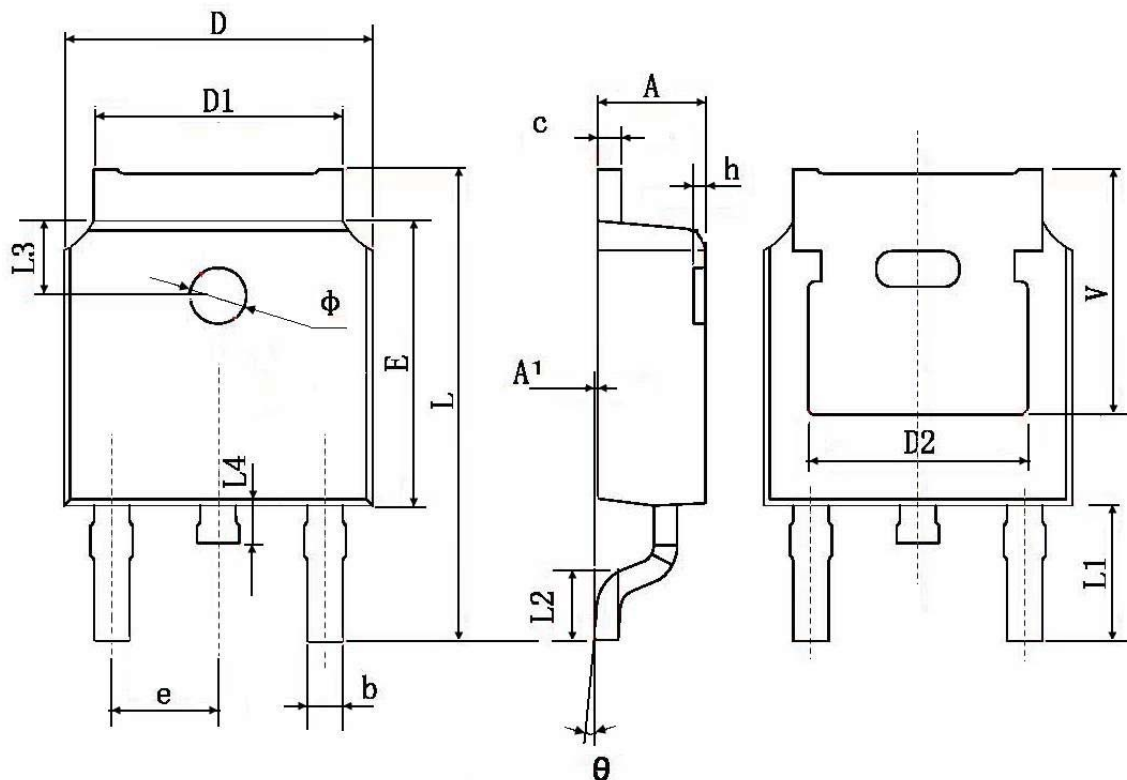
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TO-251 Package Information



Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min.	Max.	Min.	Max.
A	2.200	2.400	0.087	0.094
A1	1.050	1.350	0.042	0.054
B	1.350	1.650	0.053	0.065
b	0.500	0.700	0.020	0.028
b1	0.700	0.900	0.028	0.035
c	0.430	0.580	0.017	0.023
c1	0.430	0.580	0.017	0.023
D	6.350	6.650	0.250	0.262
D1	5.200	5.400	0.205	0.213
E	5.400	5.700	0.213	0.224
e	2.300 TYP.		0.091 TYP.	
e1	4.500	4.700	0.177	0.185
L	7.500	7.900	0.295	0.311

TO-252 Package Information



Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min.	Max.	Min.	Max.
A	2.200	2.400	0.087	0.094
A1	0.000	0.127	0.000	0.005
b	0.660	0.860	0.026	0.034
c	0.460	0.580	0.018	0.023
D	6.500	6.700	0.256	0.264
D1	5.100	5.460	0.201	0.215
D2	4.830 TYP.		0.190 TYP.	
E	6.000	6.200	0.236	0.244
e	2.186	2.386	0.086	0.094
L	9.800	10.400	0.386	0.409
L1	2.900 TYP.		0.114 TYP.	
L2	1.400	1.700	0.055	0.067
L3	1.600 TYP.		0.063 TYP.	
L4	0.600	1.000	0.024	0.039
Φ	1.100	1.300	0.043	0.051
θ	0°	8°	0°	8°
h	0.000	0.300	0.000	0.012
V	5.350 TYP.		0.211 TYP.	

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