

## N-CHANNEL ENHANCEMENT MODE MOSFET

### General Description

RMP4N60 is an N-channel enhancement mode MOSFET, which uses the self-aligned planar process and improved terminal technology, reducing the conduction loss, enhancing the avalanche energy.

### MAIN CHARACTERISTICS

$V_{DSS}$	600	V
$I_D$	4.0	A
$R_{DS(ON)}$	2.0	$\Omega$
$C_{rSS}$	8	pF

### FEATURES

- Low  $C_{rSS}$
- Low gate charge
- Fast switching
- Improved ESD capability
- Improved  $dv/dt$  capability
- 100% avalanche energy test

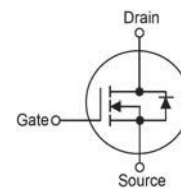
### APPLICATIONS

- High efficiency switch mode power supplies
- Electronic lamp ballasts
- UPS

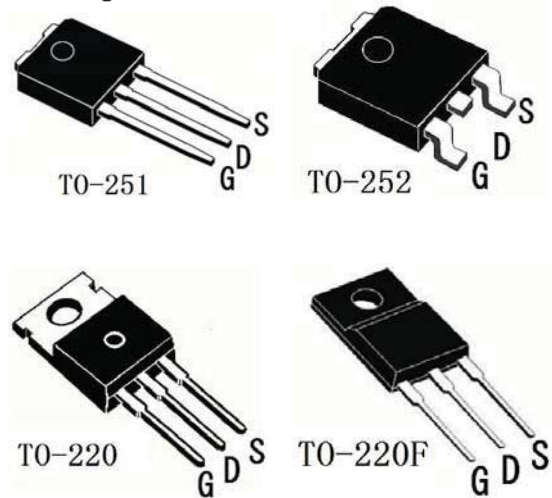
### Package Marking And Ordering Information

Device	Device Package	Marking
RMP4N60IP	TO-251	4N60
RMP4N60LD	TO-252	4N60
RMP4N60TI	TO-220F	4N60
RMP4N60T2	TO-220	4N60

### Symbol



### Package



## ABSOLUTE MAXIMUM RATINGS (Tc=25°C)

Parameter	Symbol		Value	Unit
Drain-Source Voltage	V <sub>DSS</sub>		600	V
Continues Drain Current	I <sub>D</sub>	Tc=25°C	4*	A
		Tc=100°C	2.5*	
Plused Drain Current <sup>(note 1)</sup>	I <sub>DM</sub>		16	A
Gate-to-Source Voltage	V <sub>GS</sub>		±30	V
Single Pulsed Avalanche Energy <sup>(note 2)</sup>	E <sub>AS</sub>		218	mJ
Avalanche Current <sup>(note 1)</sup>	I <sub>AR</sub>		4.0	A
Repetitive Avalanche Energy <sup>(note 1)</sup>	E <sub>AR</sub>		10	mJ
Peak Diode Recovery <sup>(note 3)</sup>	dv/dt		4.5	V/ns
Power Dissipation	P <sub>D</sub> Tc=25°C	TO-251/TO-252	51	W
		TO-220/TO-262	100	
		TO-220F	33	
Power Dissipation Derating Factor	P <sub>D(DF)</sub> Above 25°C	TO-251/TO-252	0.39	W/°C
		TO-220/TO-262	0.8	
		TO-220F	0.26	
Operating and Storage Temperature Range	T <sub>J</sub> , T <sub>STG</sub>		150, -55~ +150	°C
Maximum Temperature for Soldering	T <sub>L</sub>		300	°C

## THERMAL CHARACTERIATIC

Parameter	Symbol		Max	Unit
Thermal Resistance, Junction to Case	R <sub>th(j-c)</sub>	TO-251/TO-252	2.5	°C/W
		TO-220/TO-262	1.25	
		TO-220F	3.79	
Thermal Resistance, Junction to Ambient	R <sub>th(j-A)</sub>	TO-251/TO-252	83	°C/W
		TO-220/TO-262	62.5	
		TO-220F	62.5	

\* Drain current limited by maximum junction temperature

## ELECTRICAL CHARACTERISTICS

Off-Characteristics						
Parameter	Symbol	Tests Conditions	Min	Type	Max	Unit
Drain-Source Breakdown Voltage	$BV_{DSS}$	$I_D=250\mu A, V_{GS}=0V$	600	-	-	V
Breakdown Voltage Temperature Coefficient	$\frac{\Delta BV_{DSS}}{\Delta T_J}$	$I_D=250\mu A$ , referenced to $25^\circ C$	-	0.7	-	V/ $^\circ C$
Zero Gate Voltage Drain Current	$I_{DSS}$	$V_{DS}=600V, V_{GS}=0V, T_C=25^\circ C$	-	-	1	$\mu A$
		$V_{DS}=480V, T_C=125^\circ C$	-	-	10	
Gate-body leakage current, forward	$I_{GSSF}$	$V_{DS}=0V, V_{GS}=30V$	-	-	100	nA
Gate-body leakage current, reverse	$I_{GSSR}$	$V_{DS}=0V, V_{GS}=-30V$	-	-	-100	nA

On-Characteristics						
Parameter	Symbol	Tests Conditions	Min	Type	Max	Unit
Gate Threshold Voltage	$V_{GS(th)}$	$V_{DS} = V_{GS}, I_D=250\mu A$	2.0	-	4.0	V
Static Drain-Source On-Resistance	$R_{DS(on)}$	$V_{GS}=10V, I_D=2.0A$	-	2.0	2.5	$\Omega$
Forward Transconductance	$g_s$	$V_{DS} = 40V, I_D=2.0A$ (note4)	-	4.0	-	S

Dynamic Characteristics						
Parameter	Symbol	Tests Conditions	Min	Type	Max	Unit
Input capacitance	$C_{iss}$	$V_{DS}=25V, V_{GS}=0V,$ $f=1.0MHz$	-	580	720	pF
Output capacitance	$C_{oss}$		-	54	70	pF
Reverse transfer capacitance	$C_{rss}$		-	8	10	pF

Switching Characteristics						
Parameter	Symbol	Tests Conditions	Min	Type	Max	Unit
Turn-On delay time	$t_{d(on)}$	$V_{DD}=300V, I_D=4A, R_G=25\Omega$ (note 4, 5)	-	16	42	ns
Turn-On rise time	$t_r$		-	48	112	ns
Turn-Off delay time	$t_{d(off)}$		-	48	105	ns
Turn-Off Fall time	$t_f$		-	38	86	ns
Total Gate Charge	$Q_g$	$V_{DS}=480V, I_D=4A, V_{GS}=10V$ (note 4, 5)	-	15	20	nC
Gate-Source charge	$Q_{gs}$		-	2.8	-	nC
Gate-Drain charge	$Q_{gd}$		-	6.8	-	nC

Drain-Source Diode Characteristics and Maximum Ratings						
Parameter	Symbol	Tests Conditions	Min	Type	Max	Unit
Maximum Continuous Drain-Source Diode Forward Current		$I_S$	-	-	4	A
Maximum Pulsed Drain-Source Diode Forward Current		$I_{SM}$	-	-	16	A
Drain-Source Diode Forward Voltage	$V_{SD}$	$V_{GS}=0V, I_S=4A$	-	-	1.4	V
Reverse recovery time	$t_{rr}$	$V_{GS}=0V, I_S=4A$ $di/dt=100A/\mu s$ (note 4)	-	320	-	ns
Reverse recovery charge	$Q_{rr}$		-	2.4	-	$\mu C$

Notes:

- 1: Pulse width limited by maximum junction temperature
- 2:  $L=25mH, I_{AS}=4A, V_{DD}=50V, R_G=25\Omega$ , Starting  $T_J = 25^\circ C$
- 3:  $I_{SD} \leq 4A, di/dt \leq 300A/\mu s, V_{DD} \leq BV_{DSS}$ , Starting  $T_J = 25^\circ C$
- 4: Pulse Test: Pulse Width  $\leq 300\mu s$ , Duty Cycle  $\leq 2\%$
- 5: Essentially independent of operating temperature

# RATING AND CHARACTERISTICS CURVES (RMP4N60IP THRU RMP4N60T2)

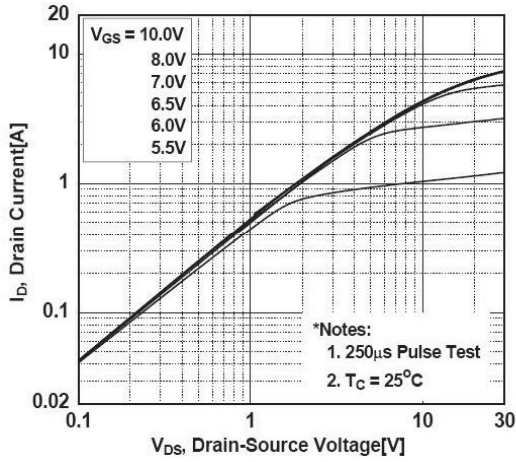


Fig. 1 On-State Characteristics

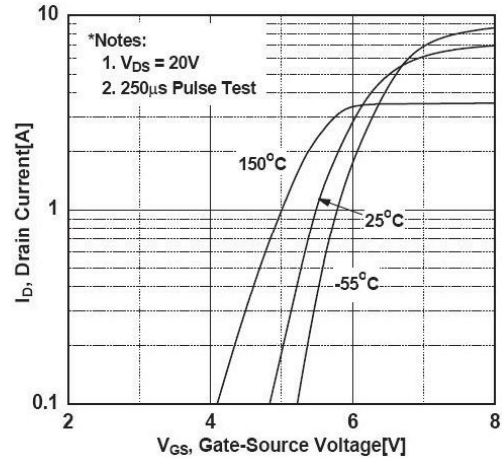


Fig. 2 Transfer Characteristics

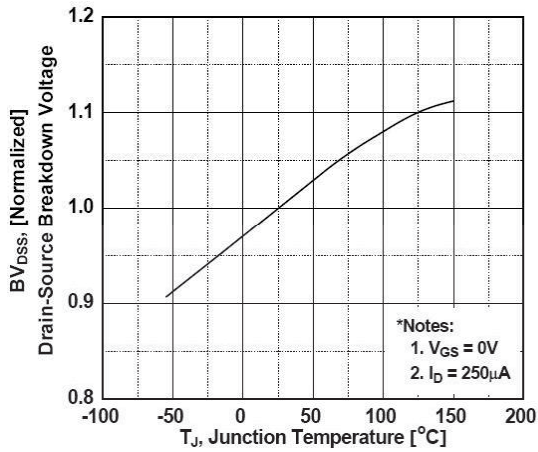


Fig. 3 Breakdown Voltage Variation vs Temperature

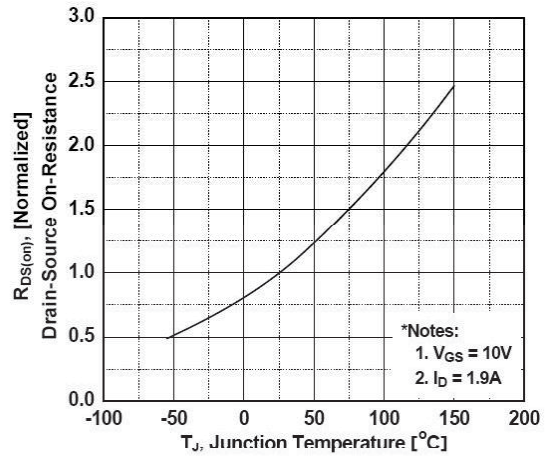


Fig. 4 On-Resistance Variation vs Temperature

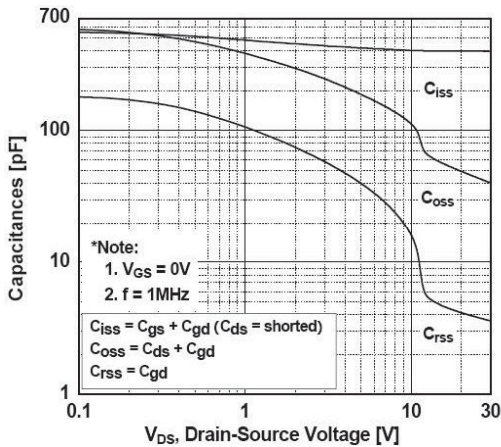


Fig. 5 Capacitance Characteristics

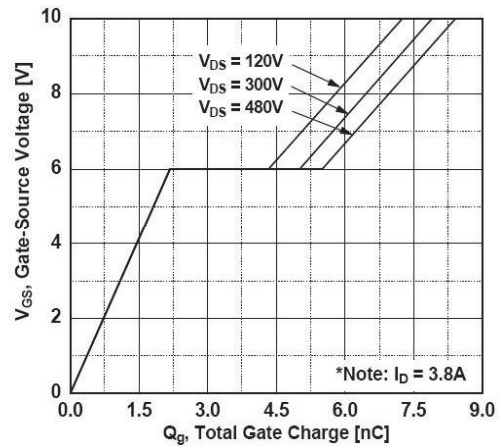


Fig. 6 Gate Charge Characteristics



# RATING AND CHARACTERISTICS CURVES (RMP4N60IP THRU RMP4N60T2)

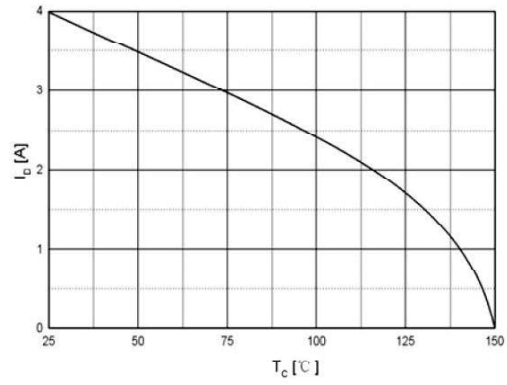
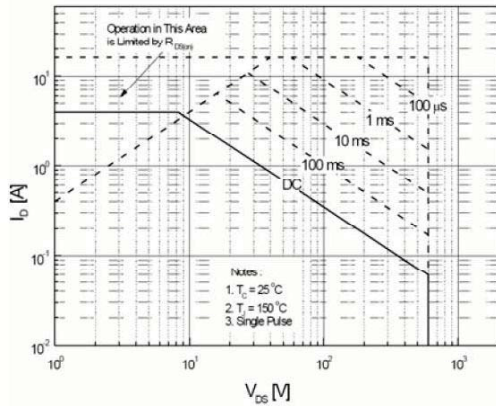


Fig. 7 Maximum Safe Operating Area

Fig. 8 Maximum Drain Current vs Case Temperature

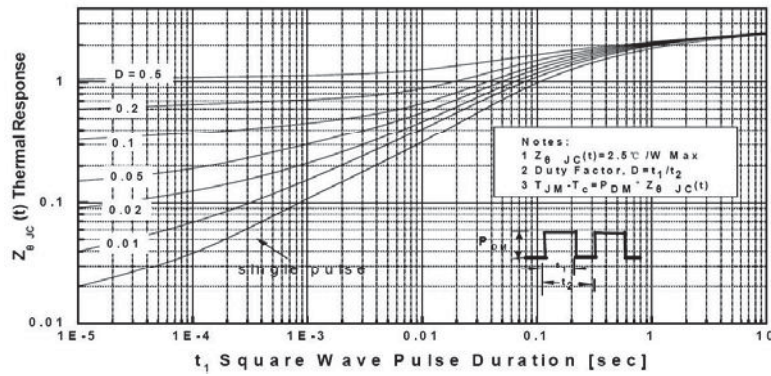


Fig. 9 Transient Thermal Response Curve (TO-251/TO-252)

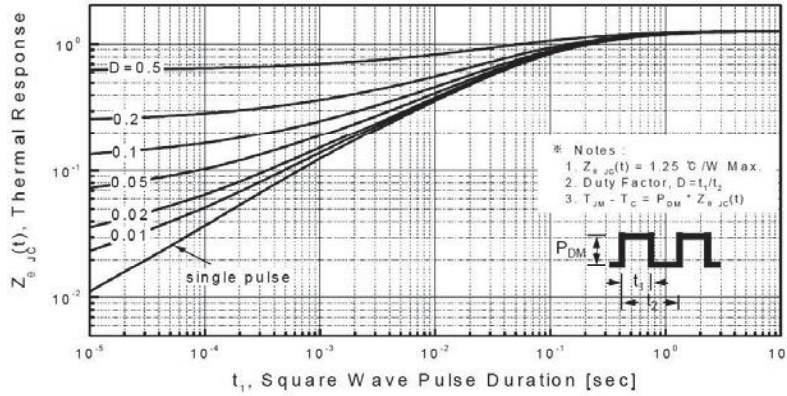
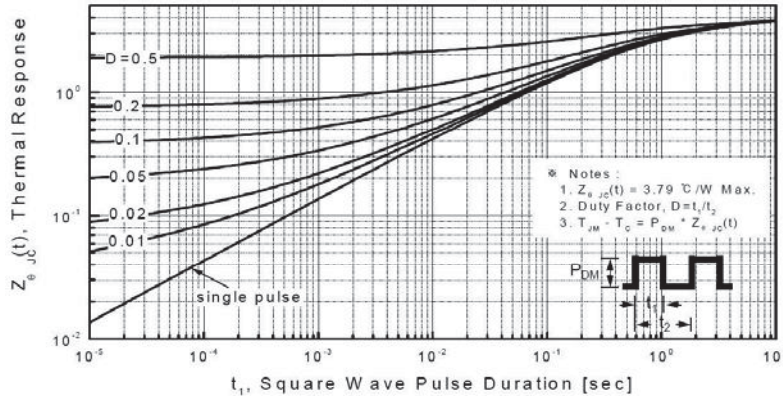


Fig. 10 Transient Thermal Response Curve (TO-220/TO-262)



## TEST CIRCUITS AND WAVEFORMS

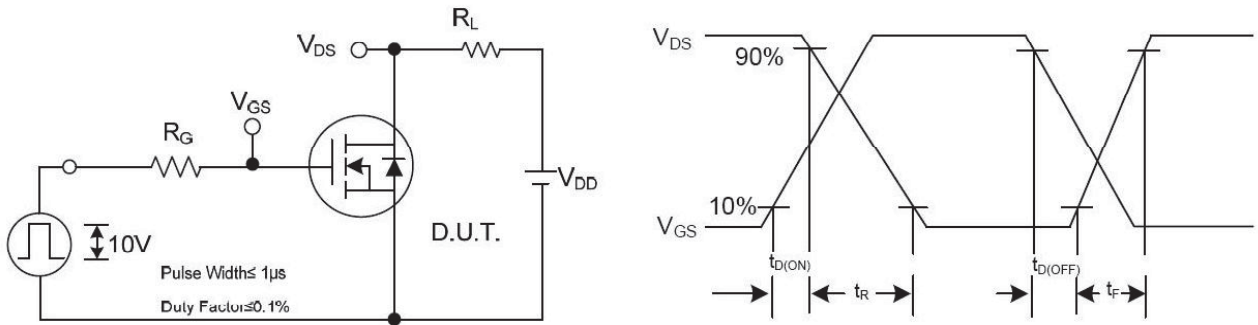


Fig.12 Resistive Switching Test Circuit & Waveforms

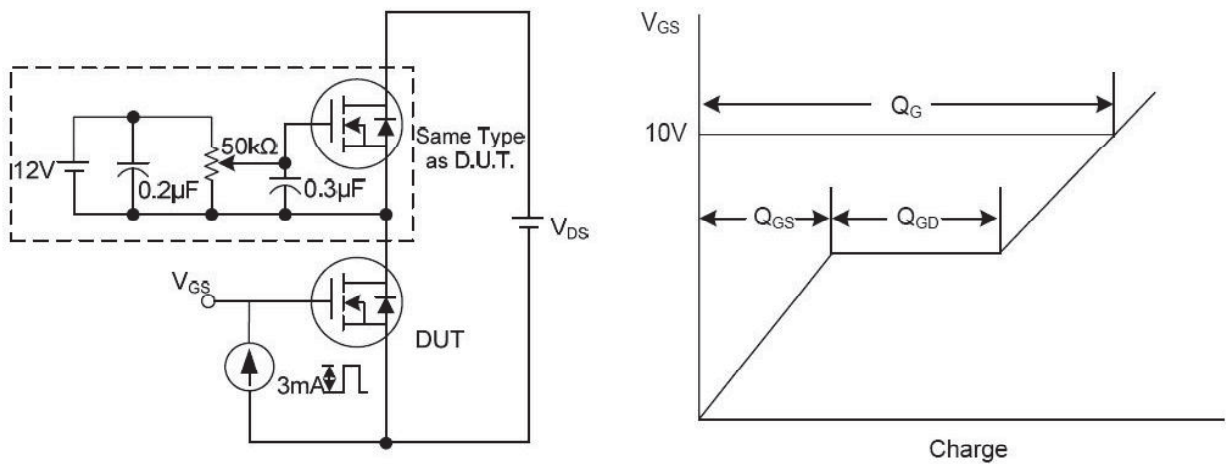


Fig.13 Gate Charge Test Circuit & Waveform

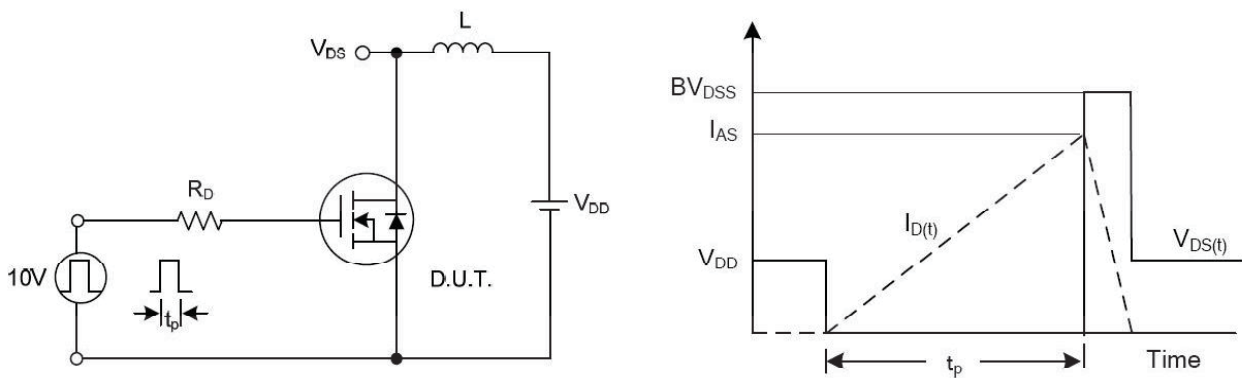
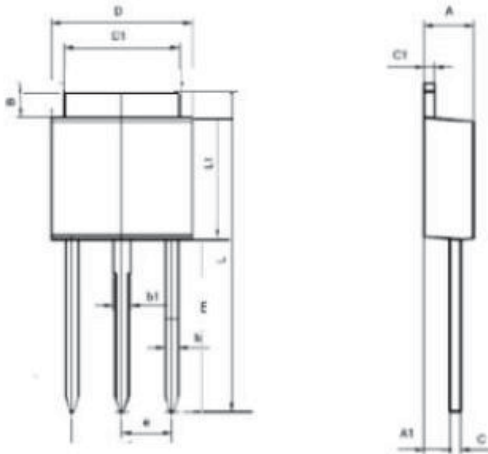


Fig.14 Unclamped Inductive Switching Test Circuit & Waveforms

## PACKAGE MECHANICAL DATA

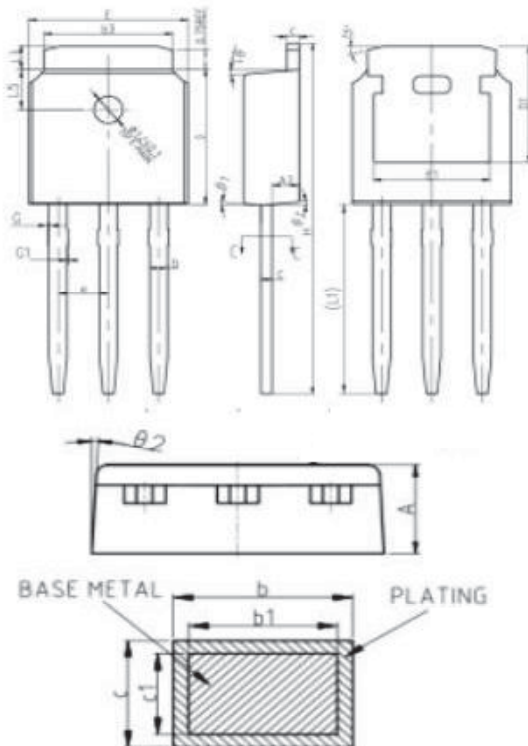
T0-251 (2)



单位: MM

SYMBOL	MILLIMETERS		SYMBOL	MILLIMETERS	
	Min	Max		Min	Max
A	2.0	2.6	E	8.0	9.6
B	0.9	1.3	L	14.25	17.25
C	0.4	0.6	b1	0.69	0.92
D	5.8	6.8	c1	0.4	0.6
L1	5.7	6.2	D1	4.8	5.8
A1	1.0	1.3	b	0.64	0.89
e	2.28 TYP				

T0-251 (3)

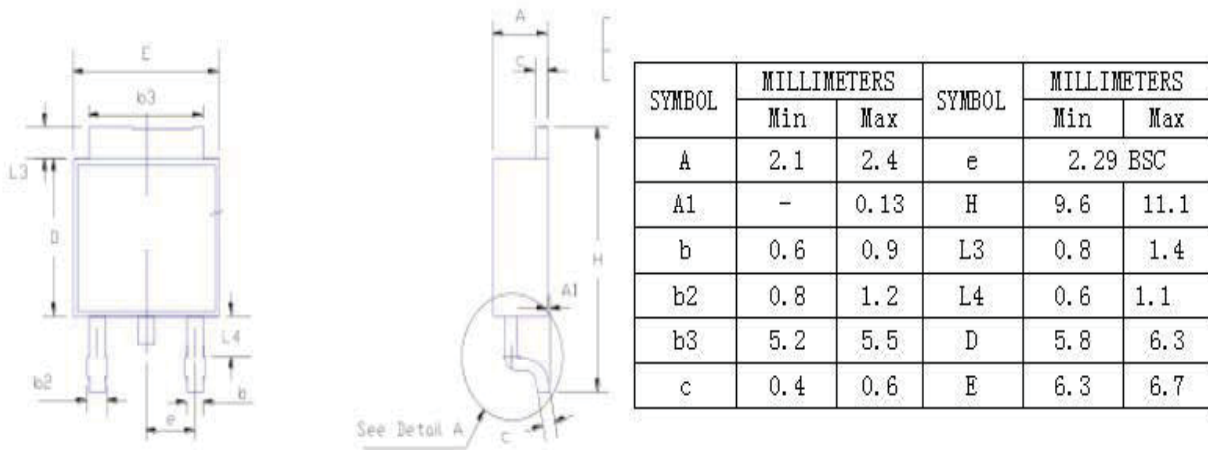


COMMON DIMENSIONS

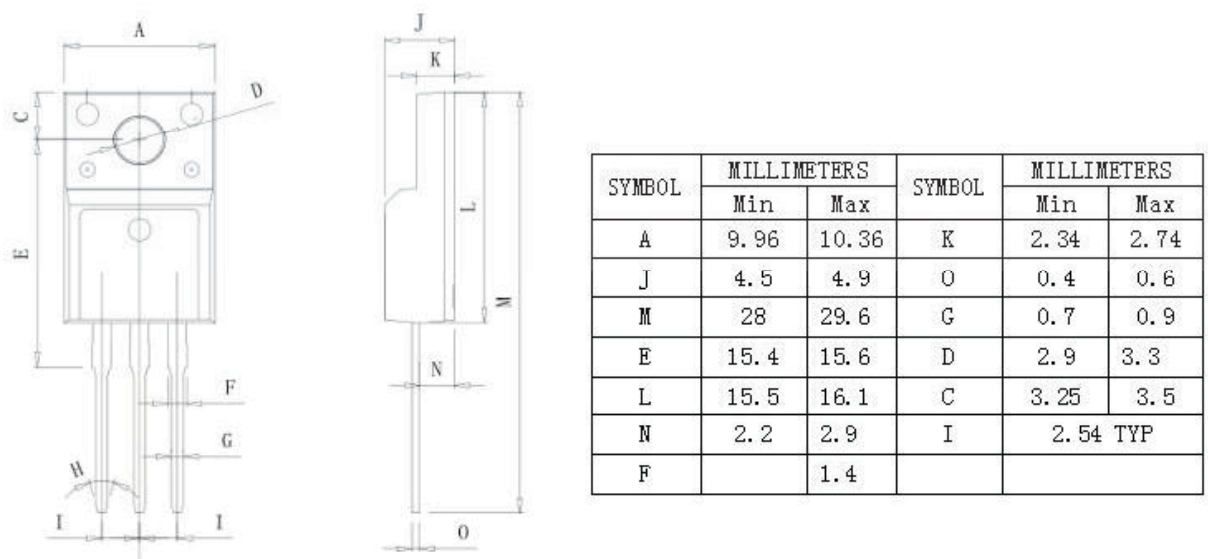
SYMBOL	MM		
	MIN	NOM	MAX
A	2.20	2.30	2.38
A2	0.97	1.07	1.17
b	0.72	0.78	0.85
b1	0.71	0.76	0.81
b3	5.23	5.33	5.46
c	0.47	0.53	0.58
c1	0.46	0.51	0.56
D	6.00	6.10	6.20
D1	5.30REF		
E	6.50	6.60	6.70
E1	4.70	4.83	4.92
e	2.286BSC		
H	16.10	16.40	16.60
L1	9.20	9.40	9.60
L3	0.90	1.02	1.25
L5	1.70	1.80	1.90
θ 1	5°	7°	9°
θ 2	5°	7°	9°



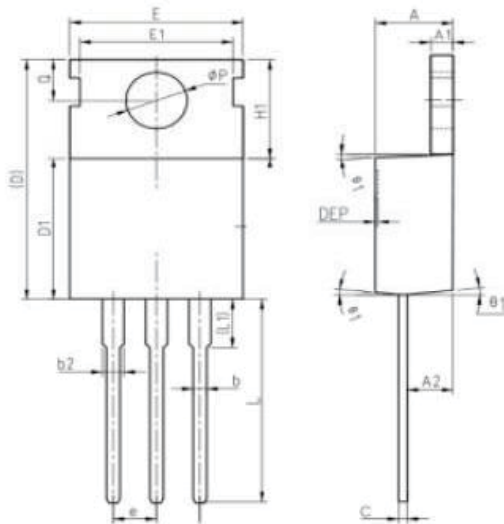
T0-252 (2)



T0-220F



T0-220A



SYMBOL	MILLIMETERS		SYMBOL	MILLIMETERS	
	Min	Max		Min	Max
A	4.2	4.8	C	0.4	0.6
D1	8.9	9.4	b	0.7	0.9
E	9.7	10.3	A1	1.2	1.4
H1	6.3	6.9	Q	2.7	2.9
b2	1.27	1.43	A2	2.3	2.5
$\phi P$	3.6	3.9	e	2.54 TYP	
D	15.5	15.7			