



September, 2013

SJ-FET

RTF80R500S/RTP80R500S/RTB80R500S/RTT80R500S 800V N-Channel MOSFET

Description

SJ-FET is new generation of high voltage MOSFET family that is utilizing an advanced charge balance mechanism for outstanding low on-resistance and lower gate charge performance. This advanced technology has been tailored to minimize conduction loss, provide superior switching performance, and withstand extreme dv/dt rate and higher avalanche energy. SJ-FET is suitable for various AC/DC power conversion in switching mode operation for higher efficiency.

Features

- Multi-Epi process SJ-FET
- 850V @T_J = 150°C
- Typ. R_{DS(on)} = 0.48Ω
- Ultra Low Gate Charge (typ. Q_g = 13nC)
- 100% avalanche tested

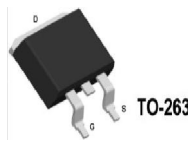
RTF80R500S



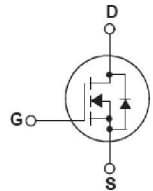
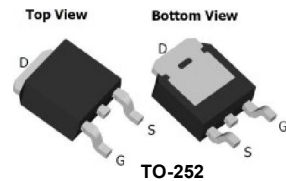
RTP80R500S



RTB80R500S



RTT80R500S



Absolute Maximum Ratings

Symbol	Parameter	RTP_B_T80R500S	RTF80R500S	Unit
V _{DSS}	Drain-Source Voltage	800		V
I _D	Drain Current -Continuous (TC = 25°C) -Continuous (TC = 100°C)	10.5* 6.7*		A
I _{DM}	Drain Current - Pulsed (Note 1)	30*		A
V _{GSS}	Gate-Source voltage	±30		V
E _{AS}	Single Pulsed Avalanche Energy (Note 2)	210		mJ
I _{AR}	Avalanche Current (Note 1)	1.8		A
E _{AR}	Repetitive Avalanche Energy (Note 1)	0.32		mJ
dv/dt	Peak Diode Recovery dv/dt (Note 3)	15		V/ns
dV _{ds} /dt	Drain Source voltage slope (V _{ds} =640V)	50		V/ns
P _D	Power Dissipation (TC = 25°C)	83	31	W
T _J , T _{STG}	Operating and Storage Temperature Range	-55 to +150		°C
T _L	Maximum Lead Temperature for Soldering Purpose, 1/8" from Case for 5 Seconds	300		°C

* Drain current limited by maximum junction temperature. Maximum duty cycle D=0.75.

Thermal Characteristics

Symbol	Parameter	RTP_B_T80R500S	RTF80R500S	Unit
R _{θJC}	Thermal Resistance, Junction-to-Case	1.5	4.0	°C/W
R _{θCS}	Thermal Resistance, Case-to-Sink Typ.	0.5	-	°C/W
R _{θJA}	Thermal Resistance, Junction-to-Ambient	62	80	°C/W



Electrical Characteristics TC = 25°C unless otherwise noted

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
Off Characteristics						
BV _{DSS}	Drain-Source Breakdown Voltage	V _{GS} = 0V, I _D = 250μA, T _J = 25°C	800	-	-	V
		V _{GS} = 0V, I _D = 250μA, T _J = 150°C	-	850	-	V
ΔBV _{DSS} /ΔT _J	Breakdown Voltage Temperature Coefficient	I _D = 250μA, Referenced to 25°C	-	0.6	-	V/°C
I _{DSS}	Zero Gate Voltage Drain Current	V _{DS} = 800V, V _{GS} = 0V -T _J = 150°C	-	- 10	1 -	μA μA
I _{GSSF}	Gate-Body Leakage Current, Forward	V _{GS} = 30V, V _{DS} = 0V	-	-	100	nA
I _{GSSR}	Gate-Body Leakage Current, Reverse	V _{GS} = -30V, V _{DS} = 0V	-	-	-100	nA
On Characteristics						
V _{GS(th)}	Gate Threshold Voltage	V _{DS} = V _{GS} , I _D = 250μA	2.5	3.5	4.5	V
R _{DS(on)}	Static Drain-Source On-Resistance	V _{GS} = 10V, I _D = 5.5A (TO-220F/TO-220/TO-263)	-	0.48	0.52	Ω
		V _{GS} = 10V, I _D = 5.5A (TO-252)	-	0.51	0.55	Ω
g _{FS}	Forward Transconductance	V _{DS} = 40V, I _D = 11A	-	9	-	S
Dynamic Characteristics						
C _{iss}	Input Capacitance	V _{DS} = 25V, V _{GS} = 0V, f = 1MHz	-	630	-	pF
C _{oss}	Output Capacitance		-	180	-	pF
C _{rss}	Reverse Transfer Capacitance		-	11	-	pF
Switching Characteristics						
t _{d(on)}	Turn-On Delay Time	V _{DD} = 400V, I _D = 5.5A, R _G = 25Ω(Note 4)	-	28	-	ns
t _r	Turn-On Rise Time		-	19	-	ns
t _{d(off)}	Turn-Off Delay Time		-	65	-	ns
t _f	Turn-Off Fall Time		-	19	-	ns
Q _g	Total Gate Charge	V _{DS} = 450V, I _D = 5.5A, V _{GS} = 10V (Note 4)	-	13	-	nC
Q _{gs}	Gate-Source Charge		-	3.4	-	nC
Q _{gd}	Gate-Drain Charge		-	4.9	-	nC
Drain-Source Diode Characteristics and Maximum Ratings						
I _S	Maximum Continuous Drain-Source Diode Forward Current		-	-	11	A
I _{SM}	Maximum Pulsed Drain-Source Diode Forward Current		-	-	30	A
V _{SD}	Drain-Source Diode Forward Voltage	V _{GS} = 0V, I _S = 11A	-	0.9	1.5	V
t _{rr}	Reverse Recovery Time	V _R = 400V, V _{GS} = 0V, I _F = 11A, di _F /dt = 100A/μs	-	600	-	ns
Q _{rr}	Reverse Recovery Charge		-	7.2	-	μC
I _{rrm}	Peak reverse recovery Current		-	22	-	A

NOTES:

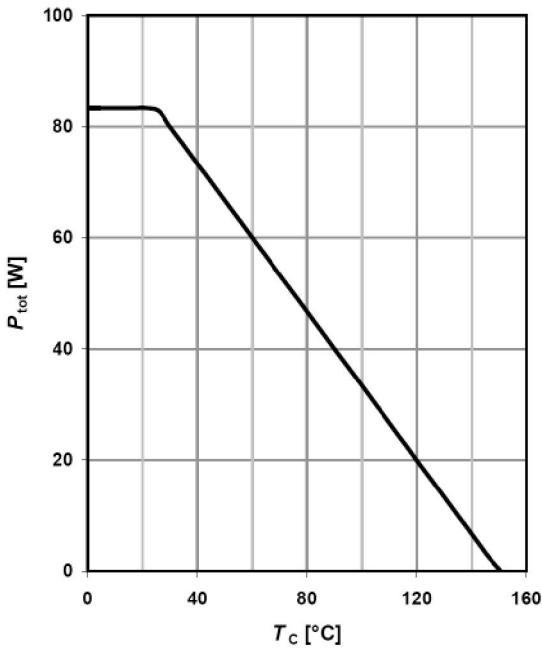
1. Repetitive Rating: Pulse width limited by maximum junction temperature
2. I_{AS} = 1.8A, V_{DD} = 50V, Starting T_J = 25°C
3. I_{SD} ≤ I_D, di_F/dt ≤ 200A/μs, V_{DD} ≤ BV_{DSS}, Starting T_J = 25°C
4. Essentially Independent of Operating Temperature Typical Characteristics



Typical Performance Characteristics

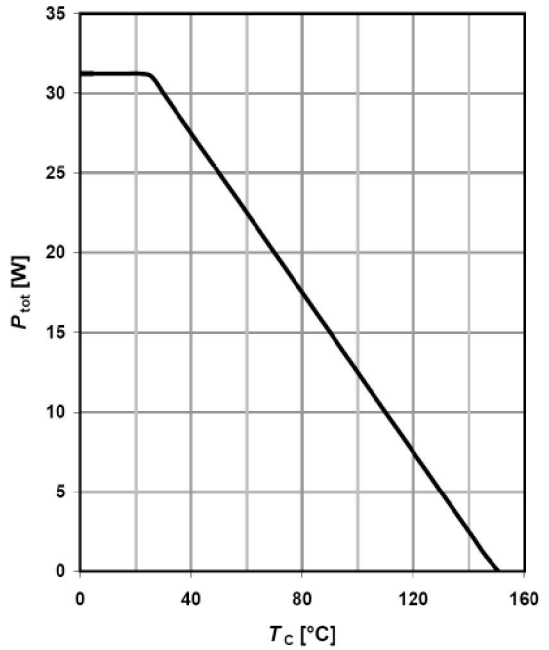
Power dissipation

$P_{tot}=f(T_c)$; TO-220,TO-252,TO-263



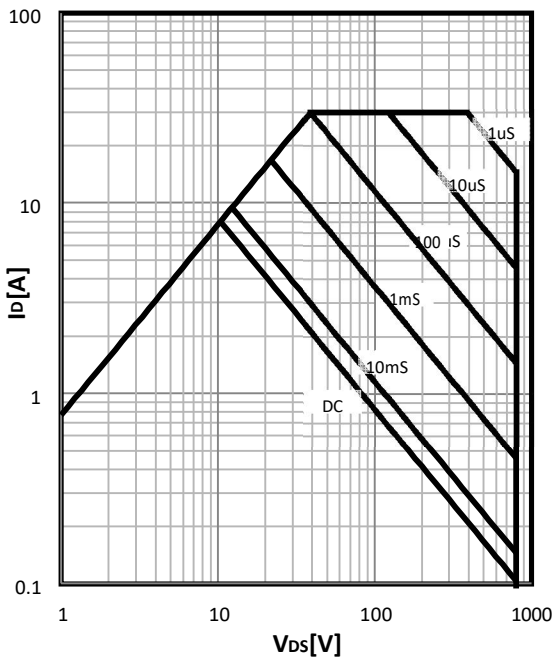
Power dissipation

$P_{tot}=f(T_c)$; TO-220FullPAK



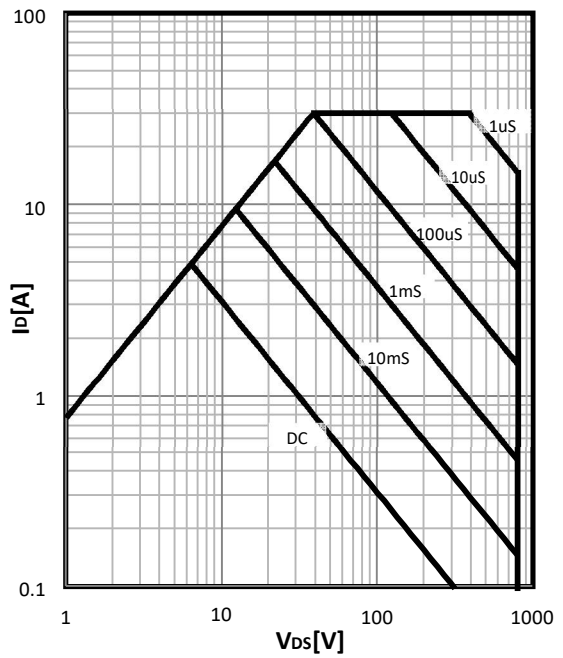
Safe Operating area $T_c=25^\circ\text{C}$

$I_D=f(V_{DS})$; $D=0$; parameter t_p ; TO-220,TO-252,TO-263



Safe Operating area $T_c=25^\circ\text{C}$

$I_D=f(V_{DS})$; $D=0$; parameter t_p ; TO-220FullPAK

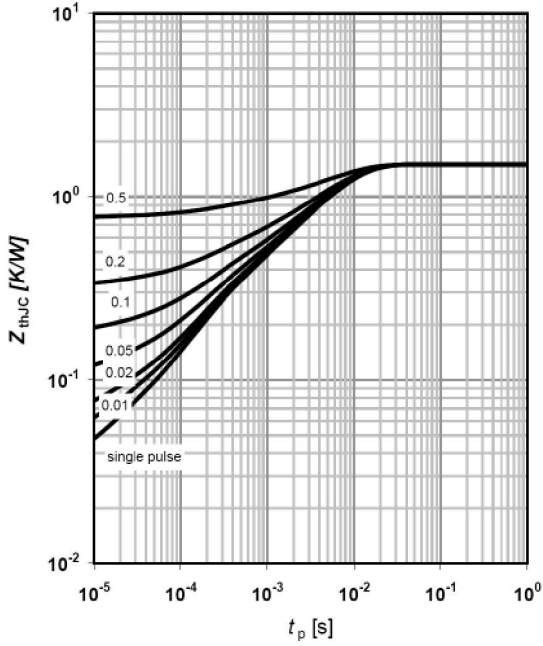




Typical Performance Characteristics

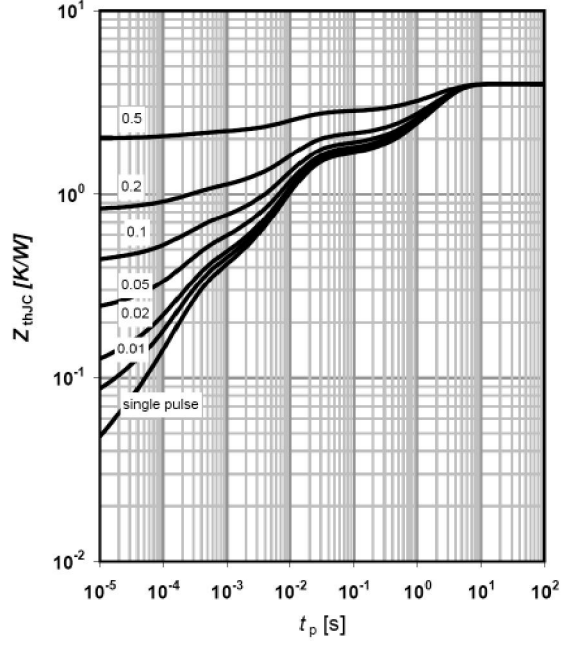
Max. Transient thermal impedance

$Z_{th(jc)} = f(t_p)$; Parameter: $D = t_p/T$; TO-220, TO-252, TO-263



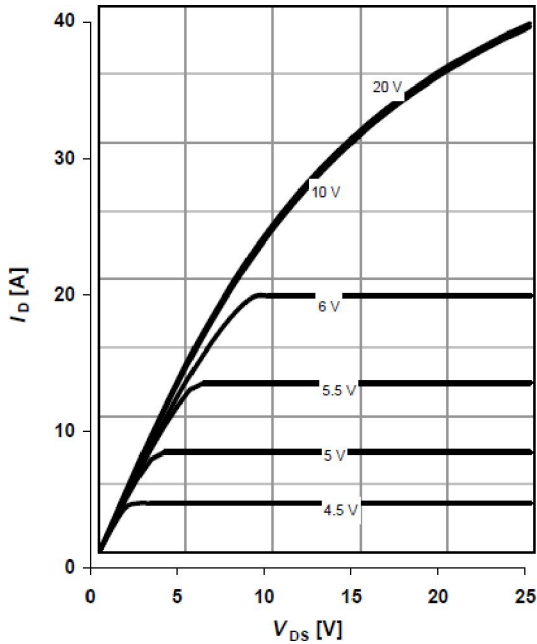
Max. Transient thermal impedance

$Z_{th(jc)} = f(t_p)$; Parameter: $D = t_p/T$; TO-220FullPAK



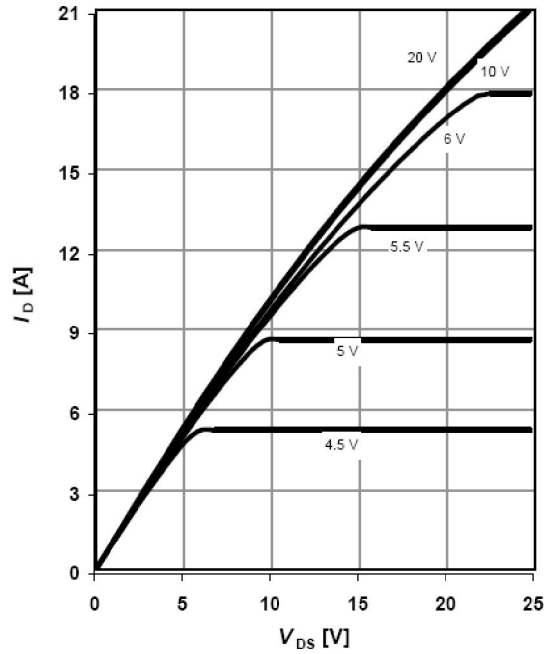
Typ. output characteristics

$I_D = f(V_{DS})$; $T_j = 25^\circ C$; $t_p = 10 \mu s$; parameter: VGS



Typ. output characteristics

$I_D = f(V_{DS})$; $T_j = 150^\circ C$; $t_p = 10 \mu s$; parameter: VGS

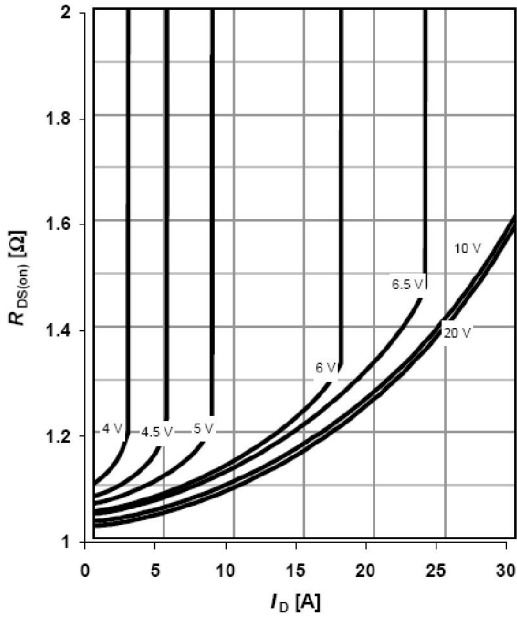




Typical Performance Characteristics

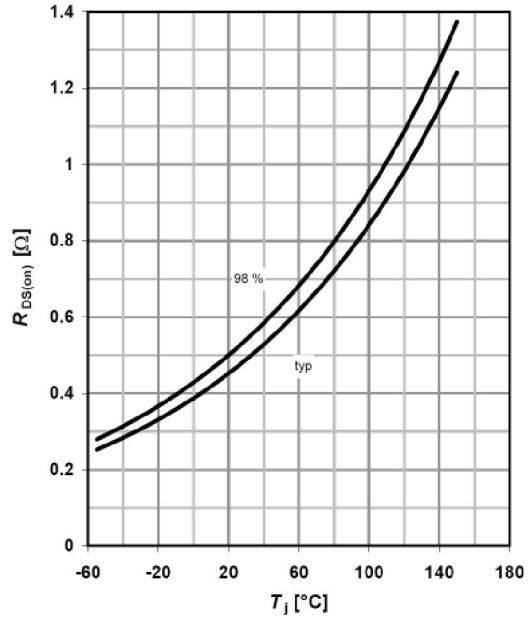
Typ. drain-source on-state resistance

$R_{DS(on)}=f(I_D)$; $T_j=150\text{ }^\circ\text{C}$; parameter: VGS



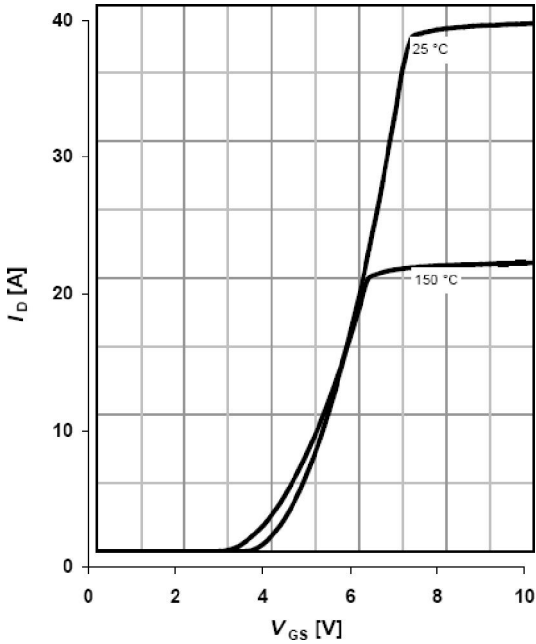
Drain-source on-state resistance

$R_{DS(on)}=f(T_j)$; $I_D=5.5\text{A}$; $V_{GS}=10\text{V}$



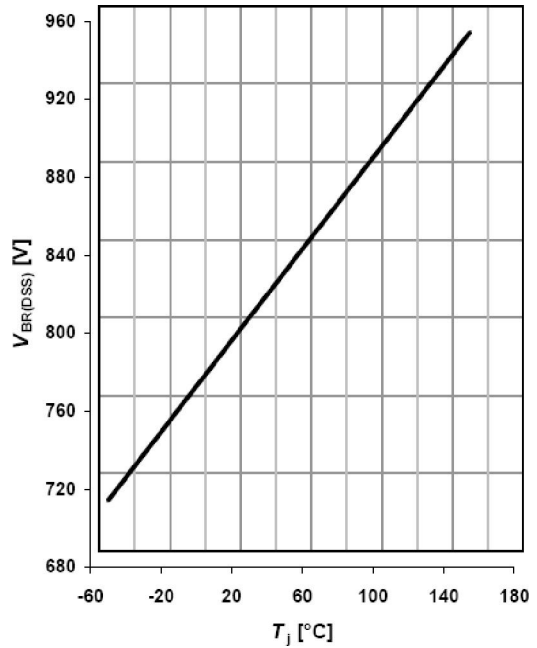
Typ. transfer characteristics

$I_D=f(V_{GS})$; $|V_{DS}|>2|I_D|R_{DS(on)max}$; $t_p=10\mu\text{s}$; parameter: T_j



Drain-source breakdown voltage

$V_{BR(DSS)}=f(T_j)$; $I_D=0.25\text{mA}$

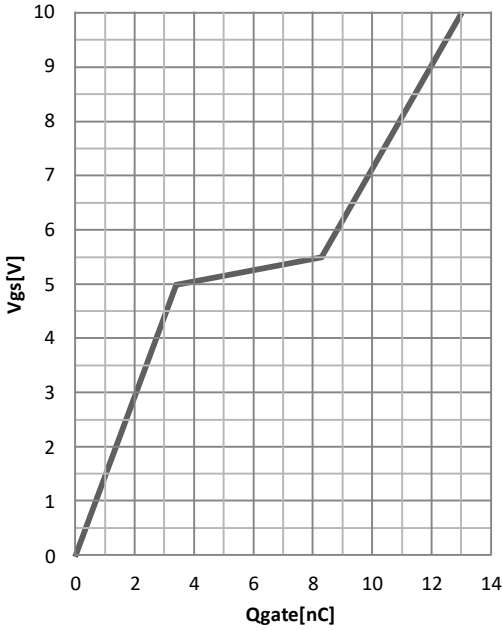




Typical Performance Characteristics

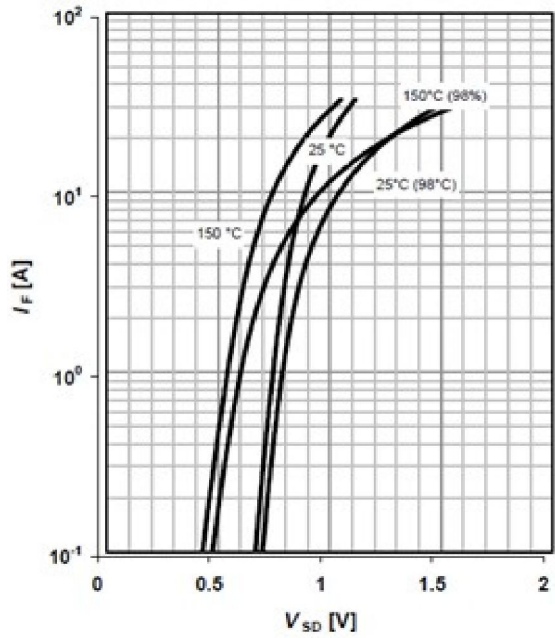
Typ. Gate charge

$V_{GS}=f(Q_{gate}); I_D=5.5A$ pulsed



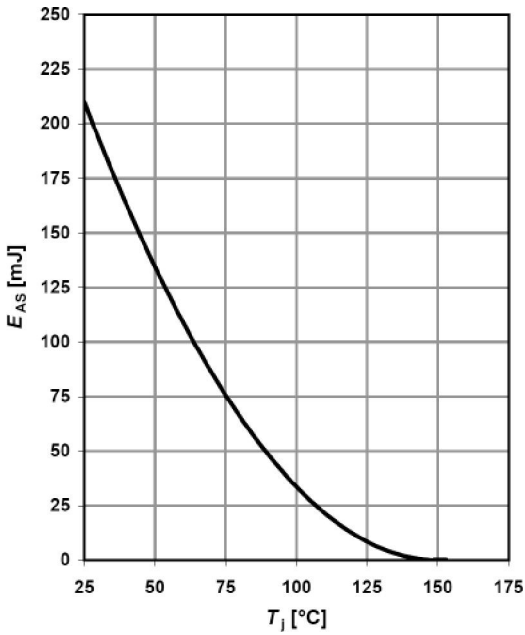
Forward characteristics of reverse diode

$I_F=f(V_{DS});$ parameter: T_J



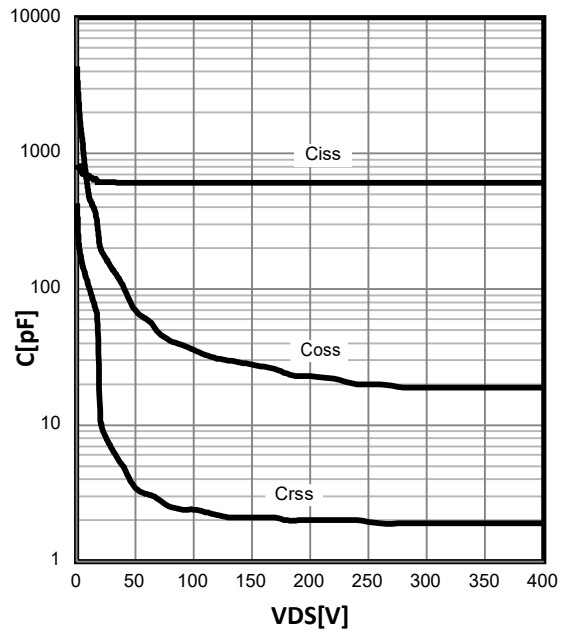
Avalanche energy

$E_{AS}=f(T_J); V_{DD}=50V$



Typ. Capacitances

$C=f(V_{DS}); V_{GS}=0 V; f=1 MHz$

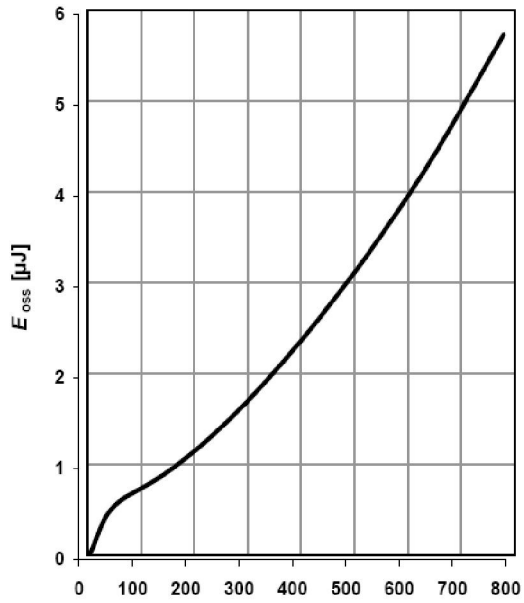




Typical Performance Characteristics

Typ. Coss stored energy

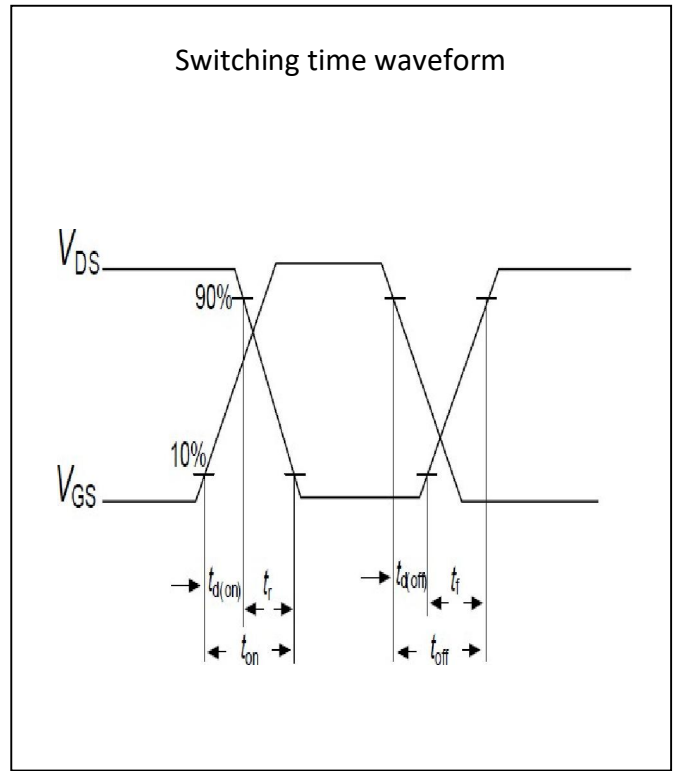
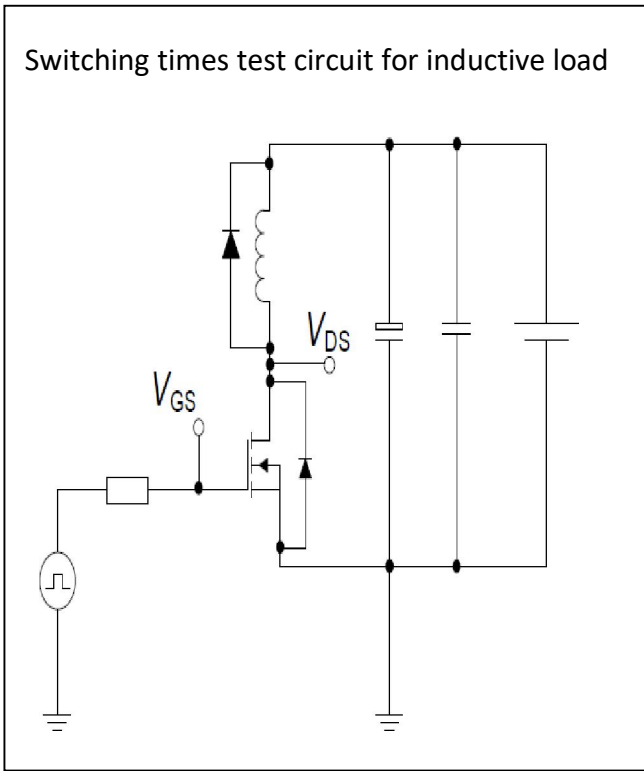
$$E_{oss} = f(V_{DS})$$



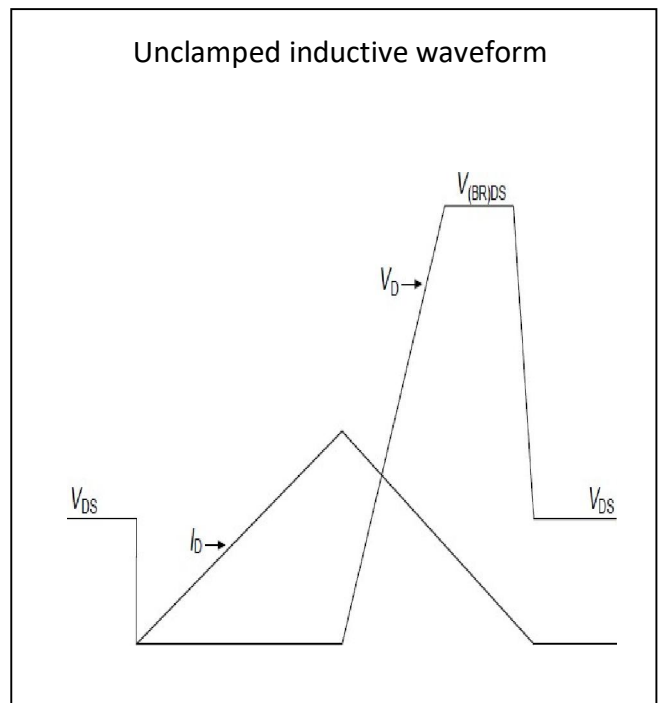
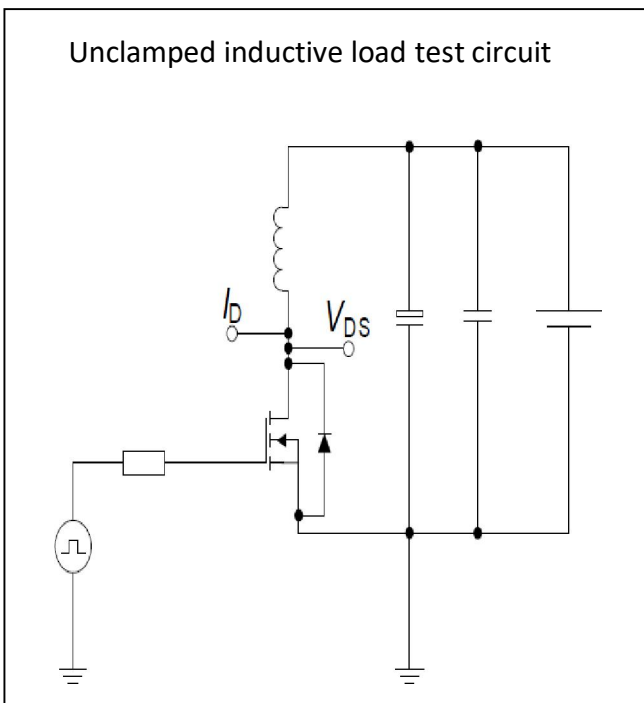


Test circuits

Switching times test circuit and waveform for inductive load

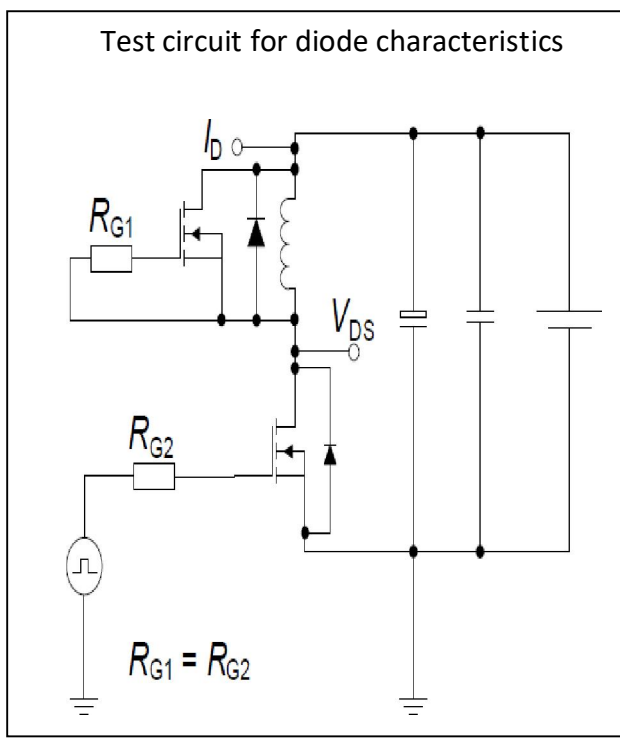


Unclamped inductive load test circuit and waveform

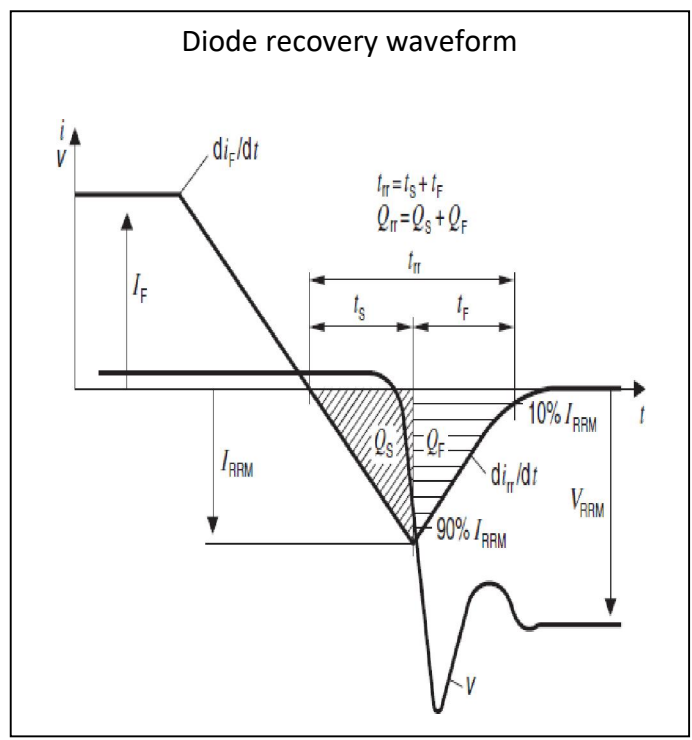


Test circuit and waveform for diode characteristics

Test circuit for diode characteristics



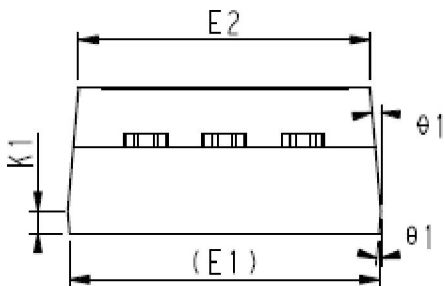
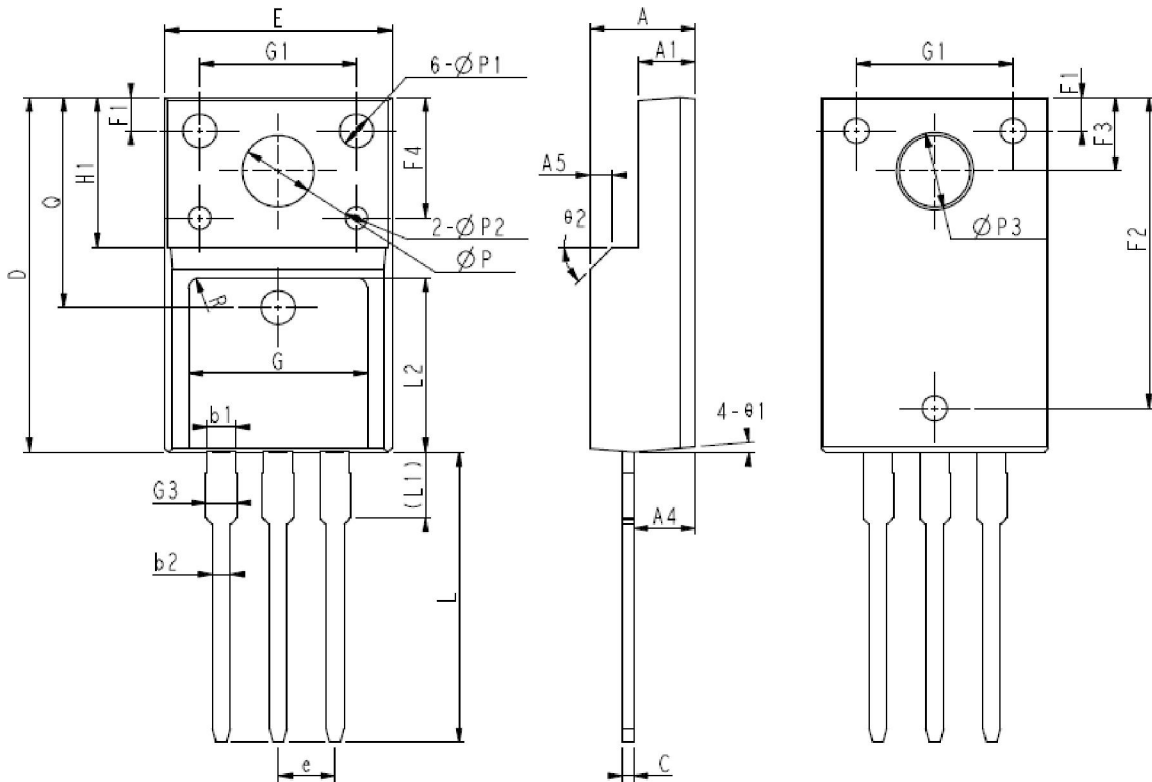
Diode recovery waveform





Package Outline

TO-220 Full PAK



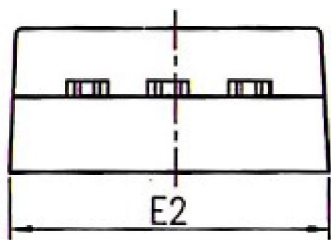
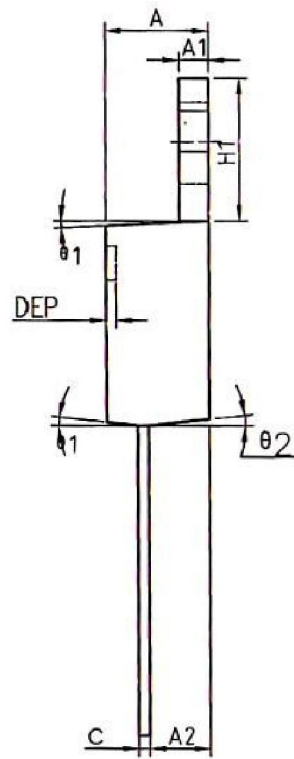
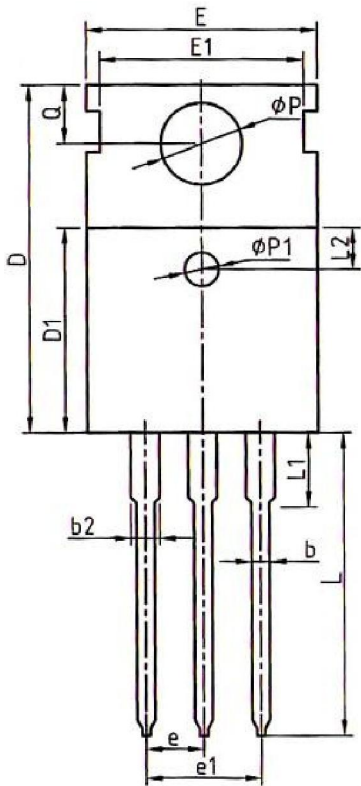
COMMON DIMENSIONS

SYMBOL	MM		
	MIN	NOM	MAX
E	10.00	10.16	10.32
E1	9.94	10.04	10.14
E2	9.36	9.46	9.56
A	4.50	4.70	4.90
A1	2.34	2.54	2.74
A4	2.66	2.76	2.86
A5	1.00REF		
c	0.45	0.50	0.60
D	15.67	15.87	16.07
Q	9.40REF		
H1	6.70REF		
e	2.54BSC		
ΦP	3.18REF		
L	12.78	12.98	13.18
L1	2.83	2.93	3.03
L2	7.70	7.80	7.90
$\Phi P1$	1.40	1.50	1.60
$\Phi P2$	0.95	1.00	1.05
$\Phi P3$	3.45REF		
$\theta 1$	3°	5°	7°
$\theta 2$	-	45°	-
F1	1.00	1.50	2.00
F2	13.80	13.90	14.00
F3	3.20	3.30	3.40
F4	5.30	5.40	5.50
G	7.80	8.00	8.20
G1	6.90	7.00	7.10
G3	1.25	1.35	1.45
b1	1.23	1.28	1.38
b2	0.75	0.80	0.90
K1	0.65	0.70	0.75
R	0.50REF		



Package Outline

TO-220



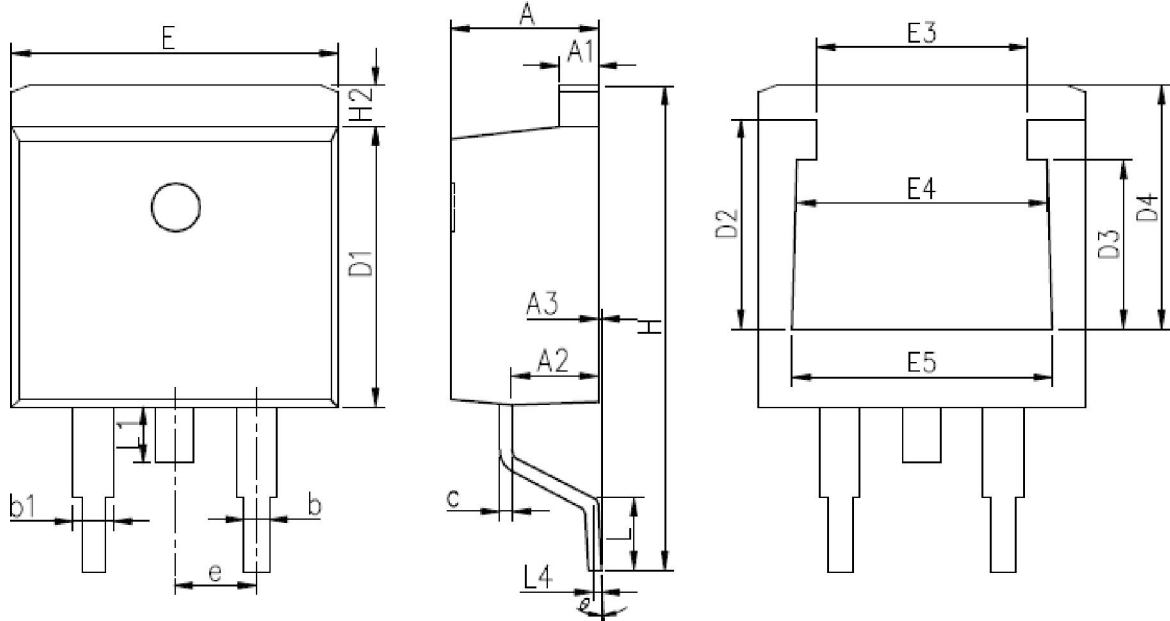
COMMON DIMENSIONS

SYMBOL	MM		
	MIN	NDM	MAX
A	4.40	4.57	4.70
A1	1.27	1.30	1.37
A2	2.35	2.40	2.50
b	0.77	0.80	0.90
b2	1.17	1.27	1.36
c	0.48	0.50	0.56
D	15.40	15.60	15.80
D1	9.00	9.10	9.20
DEP	0.05	0.10	0.20
E	9.80	10.00	10.20
E1	-	8.70	-
E2	9.80	10.00	10.20
$\phi P1$	1.40	1.50	1.60
e	2.54BSC		
e1	5.08BSC		
H1	6.40	6.50	6.60
L	12.75	13.50	13.65
L1	-	3.10	3.30
L2	2.50REF		
ϕP	3.50	3.60	3.63
Q	2.73	2.80	2.87
$\theta 1$	5°	7°	9°
$\theta 2$	1°	3°	5°
$\theta 3$	1°	3°	5°



Package Outline

TO-263



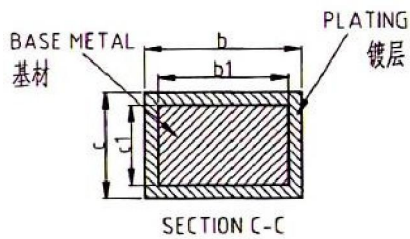
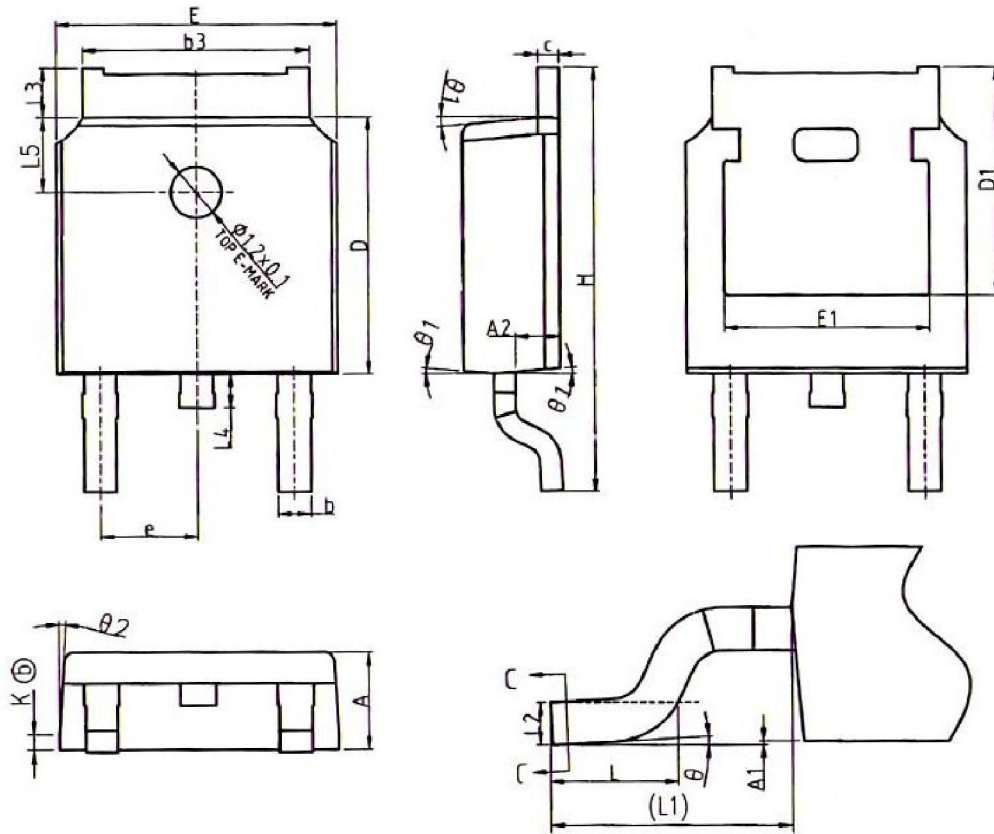
COMMON DIMENSIONS

SYMBOL	MM		
	MIN	NOM	MAX
A	4.27	4.57	4.87
A1	1.22	1.27	1.42
A2	2.39	2.69	2.99
A3	0.00	0.13	0.20
b	0.70	0.81	1.01
b1	1.17	1.27	1.50
c	0.30	0.38	0.53
D1	8.40	8.70	9.00
D2	5.33	6.33	6.63
D3	4.54	5.54	5.84
D4	6.60	7.60	8.00
E	9.88	10.16	10.50
E2	9.80	10.10	10.40
E3	4.94	5.94	6.24
E4	6.67	7.67	7.97
E5	7.06	8.06	8.36
e	2.54 BSC		
H	14.70	15.10	15.50
H2	1.00	1.27	1.50
L	2.00	2.30	2.60
L1	1.35	1.55	1.75
L4	0.25 BSC		
θ	0°	5°	9°



Package Outline

TO-252



COMMON DIMENSIONS

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
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	9.90	10.10	10.30
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
θ	0°	-	8°
$\theta 1$	5°	7°	9°
$\theta 2$	5°	7°	9°
K	0.40REF		



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