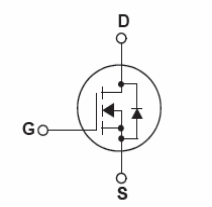
Truesemi

September, 2013

SJ-FET

TSP65R300S1 / TSA_K65R300S1/TSF65R300S1
650V N-Channel MOSFET

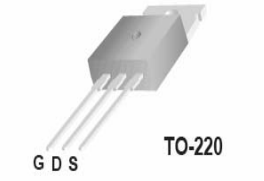


Description

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

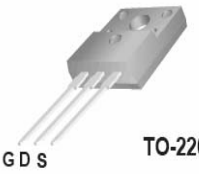
- 700V @TJ = 150 ℃
- Typ. RDS(on) = 0.27Ω
- Ultra Low Gate Charge (typ. Qg = 43nC)
- 100% avalanche tested



TO-220


TO-247


TO-3P



TO-220F

Absolute Maximum Ratings

Symbol	Parameter	TSP65R300S1	TSA_K65R300S1	TSF65R300S1	Unit
V_{DSS}	Drain-Source Voltage	650			V
I_D	Drain Current -Continuous (TC = 25℃) -Continuous (TC = 100℃)	15 9.4	15 9.4	15* 9.4*	A
I_{DM}	Drain Current - Pulsed (Note 1)	45	45	45*	A
V_{GSS}	Gate-Source voltage	±30			V
E_{AS}	Single Pulsed Avalanche Energy (Note 2)	9			mJ
I_{AR}	Avalanche Current (Note 1)	3			A
E_{AR}	Repetitive Avalanche Energy (Note 1)	4.5			mJ
dv/dt	Peak Diode Recovery dv/dt (Note 3)	15			V/ns
P_D	Power Dissipation (TC = 25℃) -Derate above 25℃	156	156	34	W W/℃
T_J, T_{STG}	Operating and Storage Temperature Range	-55 to +150			℃
T_L	Maximum Lead Temperature for Soldering Purpose, 1/8" from Case for 5 Seconds	300			℃

* Drain current limited by maximum junction temperature.

Thermal Characteristics

Symbol	Parameter	TSP65R300S1	TSA_K65R300S1	TSF65R300S1	Unit
$R_{\theta JC}$	Thermal Resistance, Junction-to-Case	0.6	0.8	3.6	℃/W
$R_{\theta CS}$	Thermal Resistance, Case-to-Sink Typ.	0.5		--	℃/W
$R_{\theta JA}$	Thermal Resistance, Junction-to-Ambient	62	62	80	℃/W

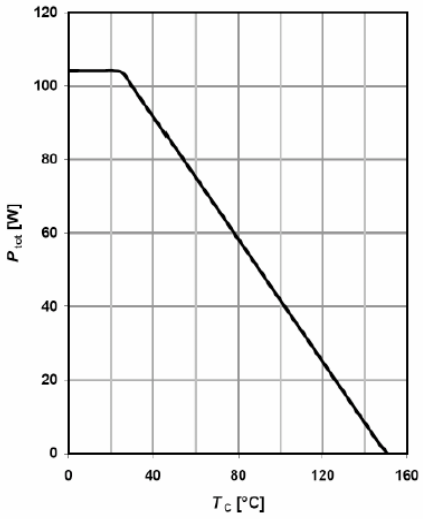
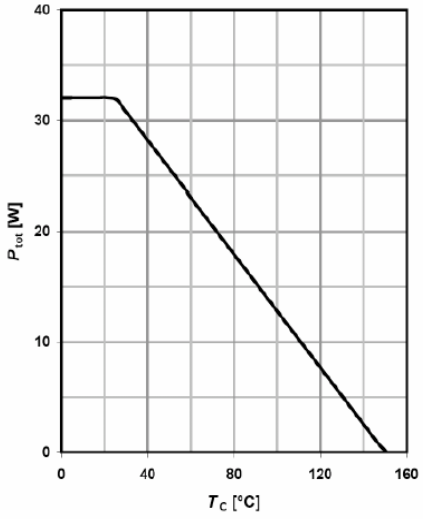
Electrical Characteristics TC = 25℃ unless otherwise noted

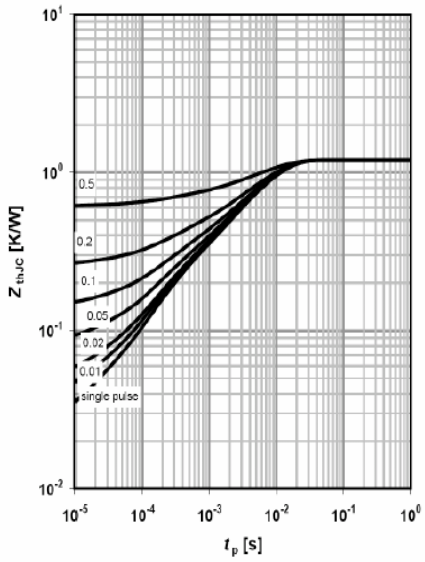
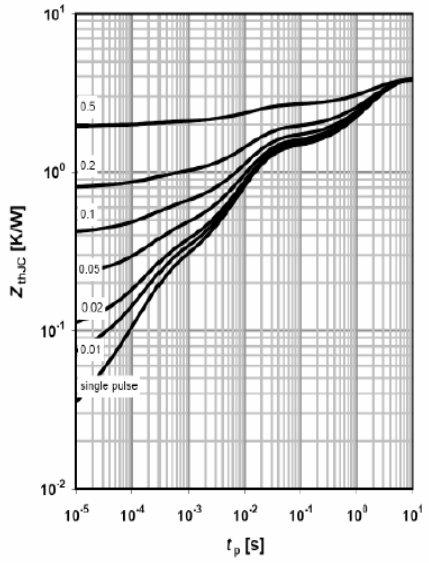
Symbol	Parameter	Conditions	Min	Typ	Max	Unit
Off Characteristics						
BV_{DSS}	Drain-Source Breakdown Voltage	V_{GS} = 0V, I_D = 250μA, T_J = 25℃	650	--	--	V
		V_{GS} = 0V, I_D = 250μA, T_J = 150℃	--	700	--	V
ΔBV_{DSS} / ΔT_J	Breakdown Voltage Temperature Coefficient	I_D = 250μA, Referenced to 25℃	--	0.6	--	V/℃
I_{DSS}	Zero Gate Voltage Drain Current	V_{DS} = 650V, V_{GS} = 0V V_{DS} = 480V, T_C = 125℃	--	--	1 10	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	--	4.5	V
$R_{DS(on)}$	Static Drain-Source On-Resistance	V_{GS} = 10V, I_D = 7.5A	--	0.27	0.30	Ω
g_{FS}	Forward Transconductance	V_{DS} = 40V, I_D = 7.5A (Note 4)	--	16	--	S
Rg	Gate resistance	f=1 MHz, open drain	--	3.5	--	Ω
Dynamic Characteristics						
C_{iss}	Input Capacitance	V_{DS} = 25V, V_{GS} = 0V, f = 1.0MHz	--	800	--	pF
C_{oss}	Output Capacitance		--	180	--	pF
C_{rss}	Reverse Transfer Capacitance		--	8	--	pF
Switching Characteristics						
$t_{d(on)}$	Turn-On Delay Time	V_{DD} = 400V, I_D = 6.5A R_G = 20Ω (Note 4, 5)	--	13	--	ns
t_r	Turn-On Rise Time		--	11	--	ns
$t_{d(off)}$	Turn-Off Delay Time		--	100	--	ns
t_f	Turn-Off Fall Time		--	12	--	ns
Q_g	Total Gate Charge	V_{DS} = 480V, I_D = 6.5A V_{GS} = 10V (Note 4, 5)	--	43	--	nC
Q_{gs}	Gate-Source Charge		--	5	--	nC
Q_{gd}	Gate-Drain Charge		--	22	--	nC
Drain-Source Diode Characteristics and Maximum Ratings						
I_S	Maximum Continuous Drain-Source Diode Forward Current		--	--	12	A
I_{SM}	Maximum Pulsed Drain-Source Diode Forward Current		--	--	40	A
V_{SD}	Drain-Source Diode Forward Voltage	V_{GS} = 0V, I_S = 6.5A	--	--	1.5	V
t_{rr}	Reverse Recovery Time	V_{GS} = 0V, I_S =6.5 dI_F/dt =100A/μs (Note 4)	--	345	--	ns
Q_{rr}	Reverse Recovery Charge		--	4.5	--	μC

NOTES:

1. Repetitive Rating: Pulse width limited by maximum junction temperature
2. L=0.5mH, I_{AS}=6.5A, VDD=150V, Starting TJ=25 ℃
3. I_{SD}≤10A, di/dt ≤ 200A/us, V_{DD} ≤ BV_{DSS}, Starting TJ = 25 ℃
4. Pulse Test: Pulse width ≤ 300us, Duty Cycle ≤ 2%
5. Essentially Independent of Operating Temperature Typical Characteristics

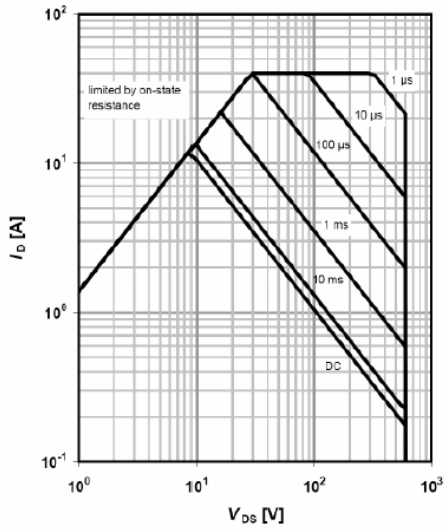
Typical Performance Characteristics

Power dissipation TO-220, TO-247, TO-262, TO-263	Power dissipation TO-220 FullPAK
	
$P_{tot} = f(T_C)$	$P_{tot} = f(T_C)$

Max. transient thermal impedance TO-220, TO-247, TO-262, TO-263	Max. transient thermal impedance TO-220 FullPAK
	
$Z_{(thJC)}$=f(tp); parameter: D=t_p/T	$Z_{(thJC)}$=f(tp); parameter: D=t_p/T

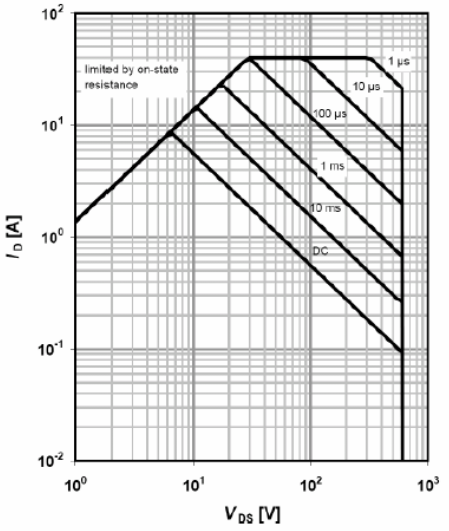
Typical Performance Characteristics

Safe operating area T_C=25 °C
TO-220, TO-247, TO-262, TO-263



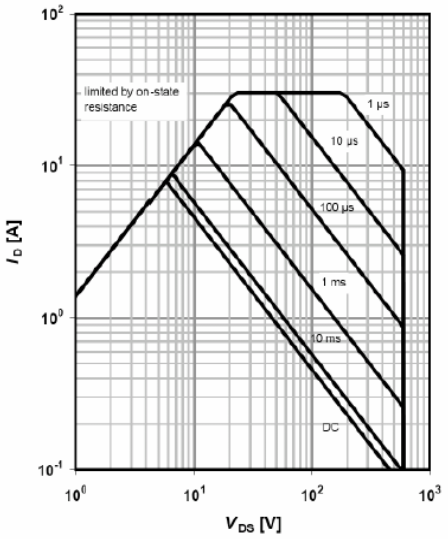
I_D=f(V_{DS}); T_C=25 °C; D=0; parameter t_p

Safe operating area T_C=25 °C
TO-220 FullPAK



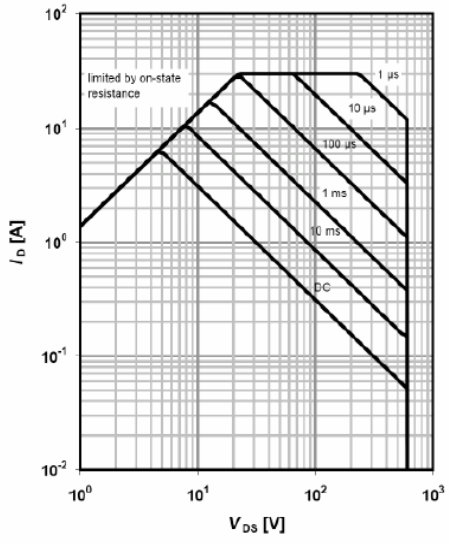
I_D=f(V_{DS}); T_C=25 °C; D=0; parameter t_p

Safe operating area T_C=80 °C
TO-220, TO-247, TO-262, TO-263



I_D=f(V_{DS}); T_C=80 °C; D=0; parameter t_p

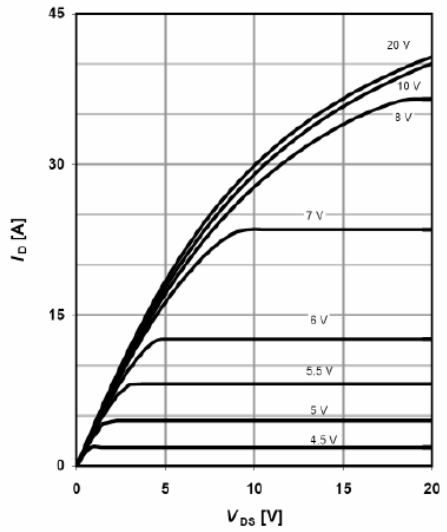
Safe operating area T_C=80 °C
TO-220 FullPAK



I_D=f(V_{DS}); T_C=80 °C; D=0; parameter t_p

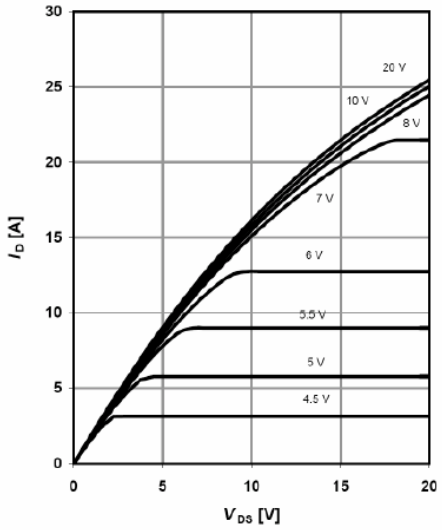
Typical Performance Characteristics

Typ. output characteristics T_j=25 °C



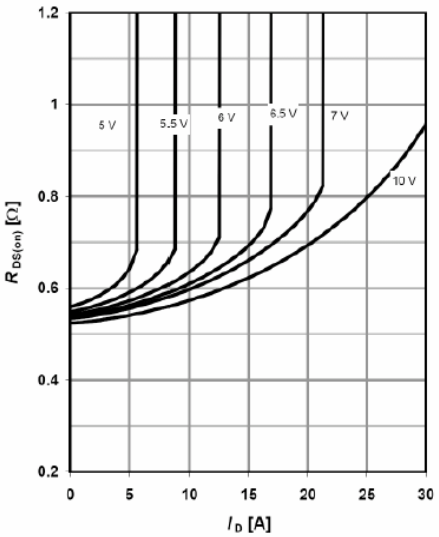
I_D=f(V_{DS}); T_j=25 °C; parameter: V_{GS}

Typ. output characteristics T_j=125 °C



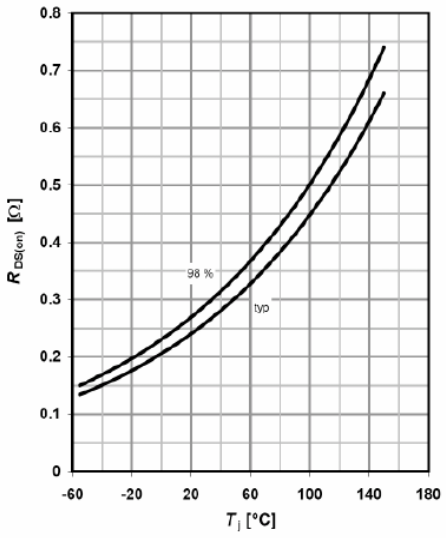
I_D=f(V_{DS}); T_j=125 °C; parameter: V_{GS}

Typ. drain-source on-state resistance



$R_{DS(on)}$=f(I_D); T_j=125 °C; parameter: V_{GS}

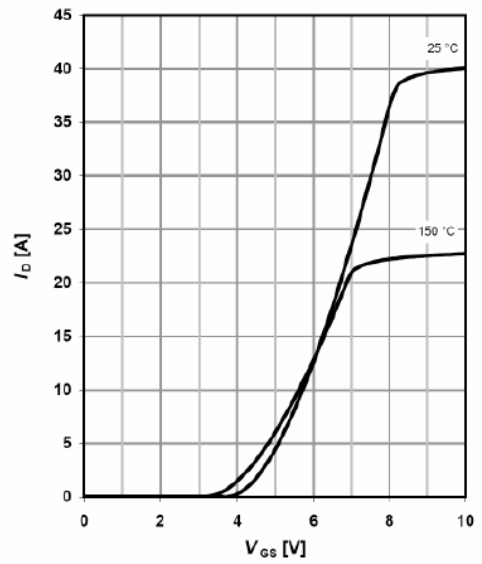
Drain-source on-state resistance



$R_{DS(on)}$=f(T_j); I_D=6.5 A; V_{GS}=10 V

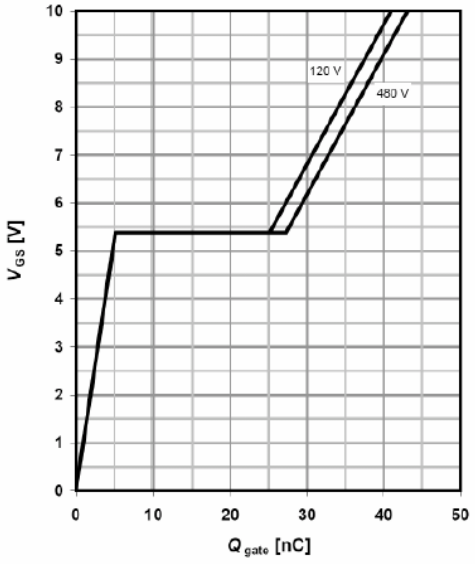
Typical Performance Characteristics

Typ. transfer characteristics



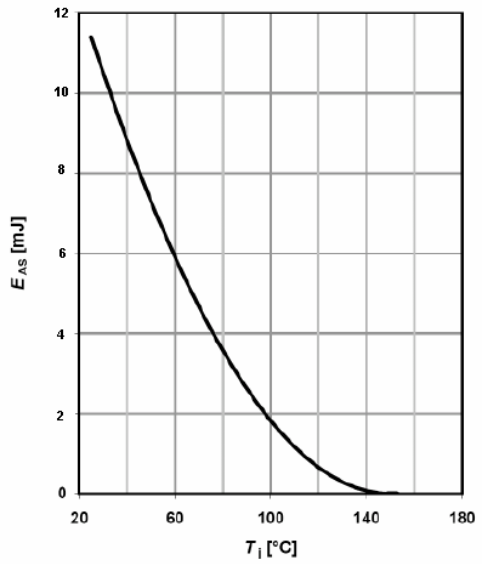
$I_D=f(V_{GS})$; $V_{DS}=20V$

Typ. gate charge



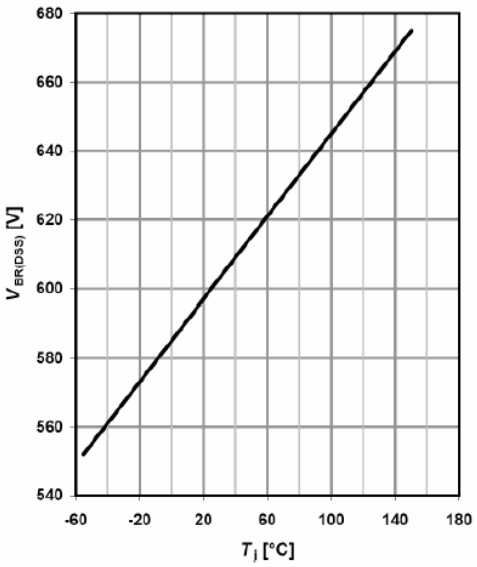
$V_{GS}=f(Q_{gate})$, $I_D=6.5A$ pulsed

Avalanche energy



$E_{AS}=f(T_j)$; I_D= 6.5 A; V_{DD}=50 V

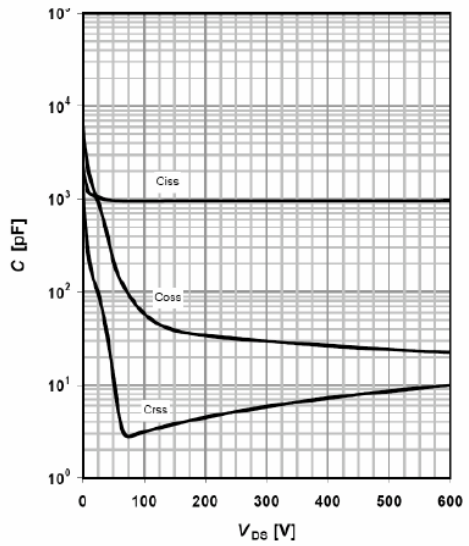
Drain-source breakdown voltage



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

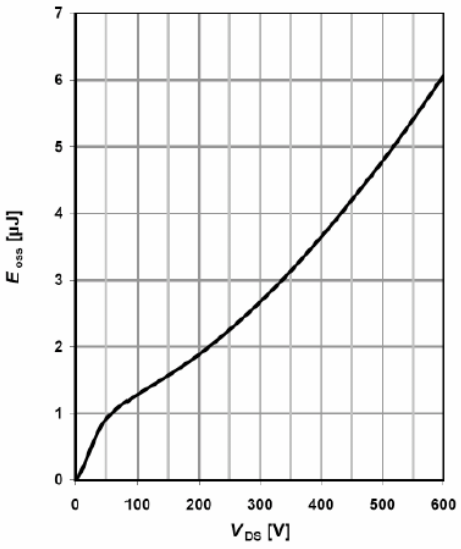
Typical Performance Characteristics

Typ. capacitances



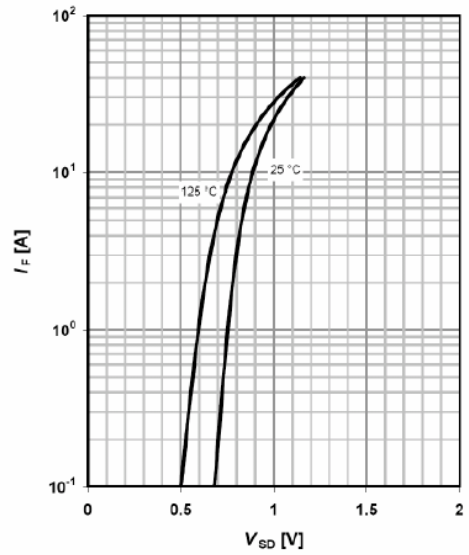
C=f(V_{DS}); V_{GS}=0 V; f=1 MHz

Typ. C_{oss} stored energy



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

Forward characteristics of reverse diode

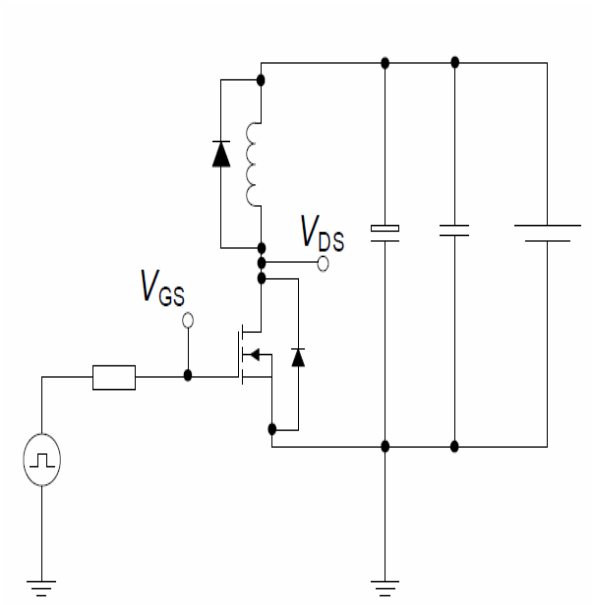


I_F=f(V_{SD}); parameter: T_j

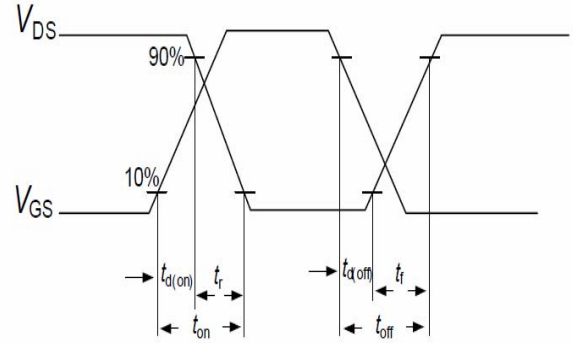
Test circuits

Switching times test circuit and waveform for inductive load

Switching times test circuit for inductive load

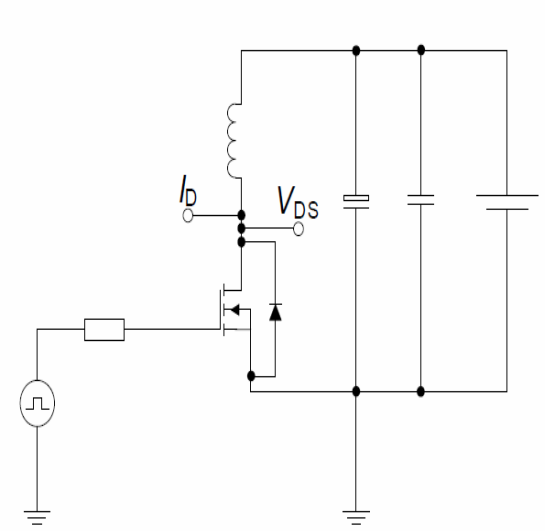


Switching time waveform

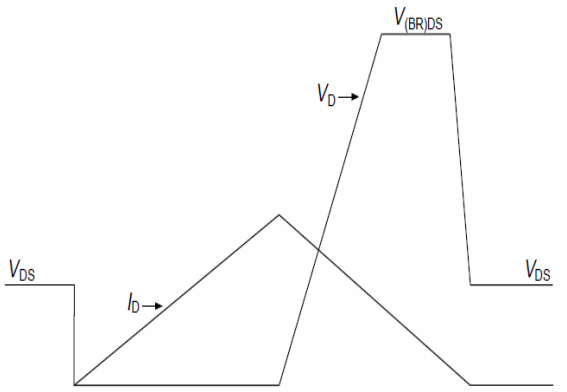


Unclamped inductive load test circuit and waveform

Unclamped inductive load test circuit



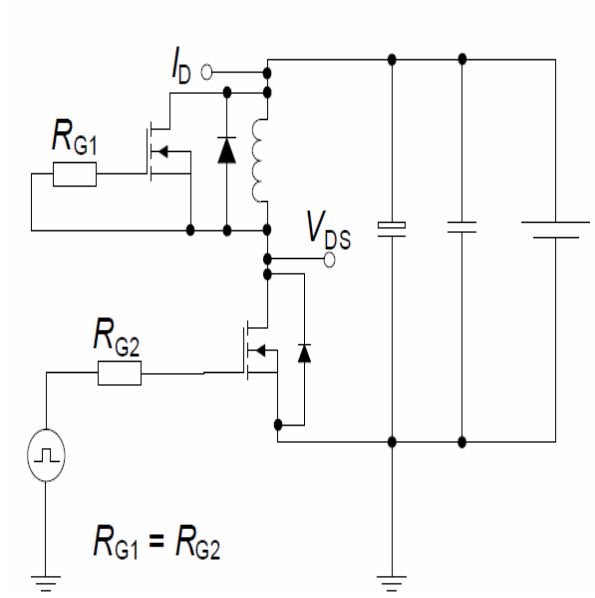
Unclamped inductive waveform



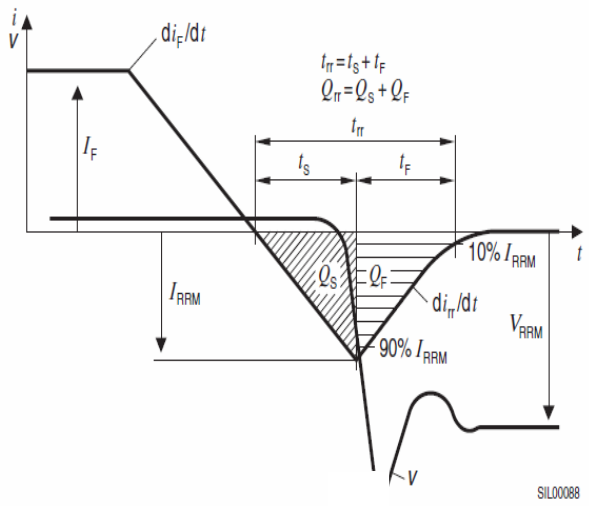
Test circuits

Test circuit and waveform for diode characteristics

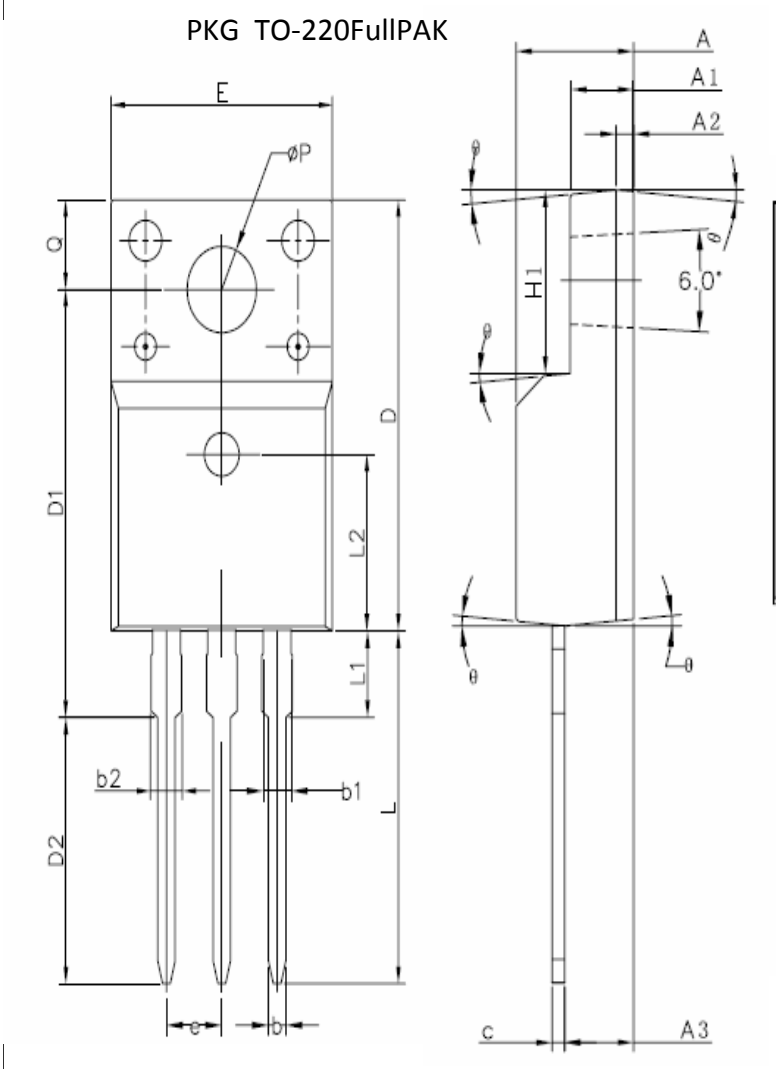
Test circuit for diode characteristics



Diode recovery waveform

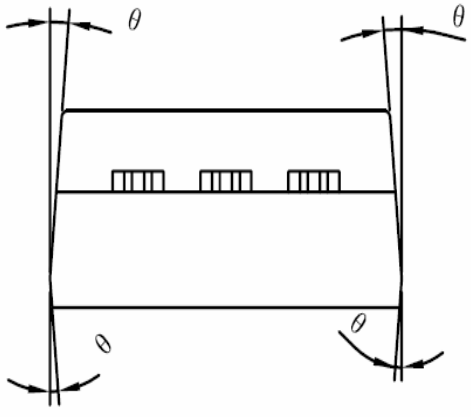


PKG TO-220FullPAK

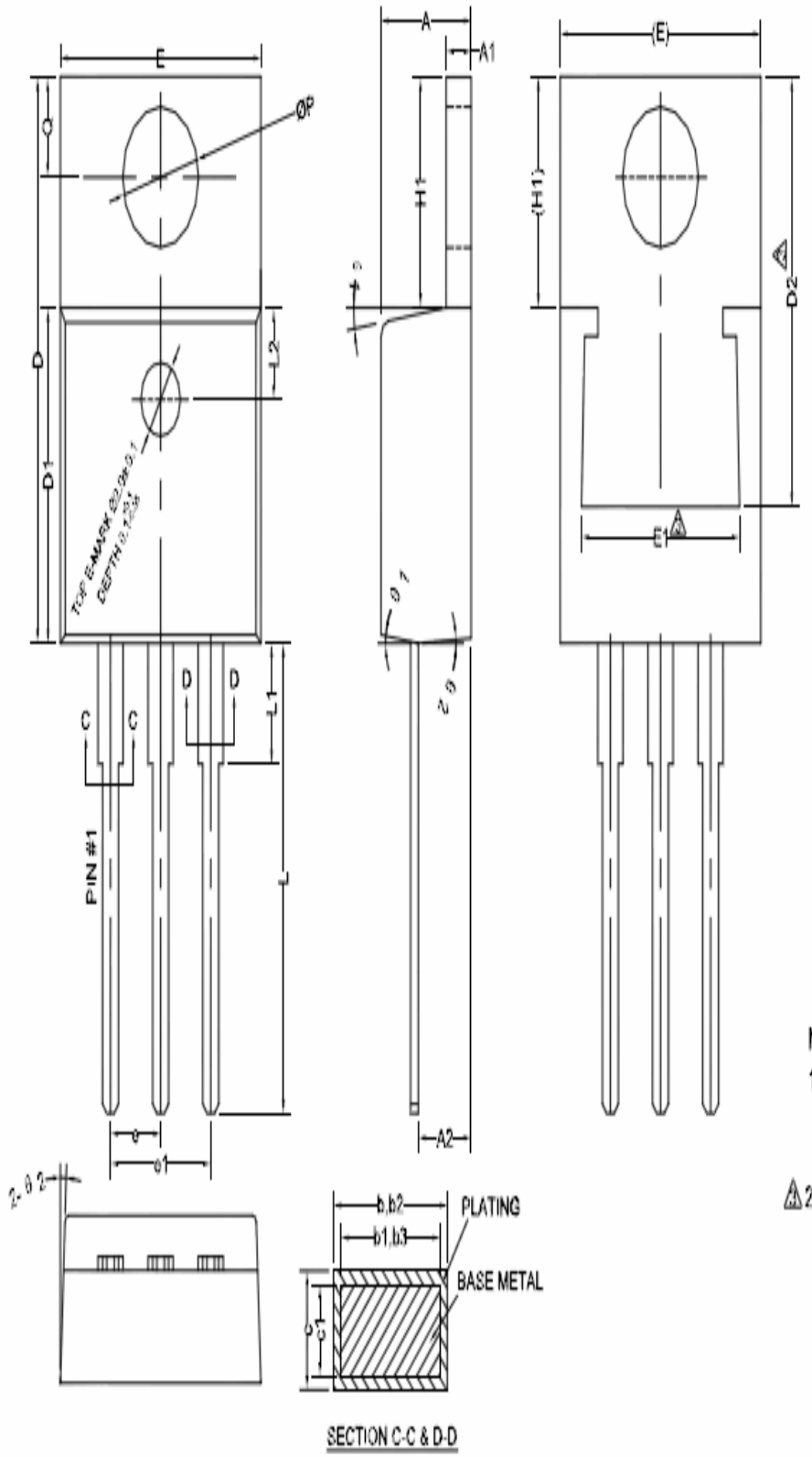


COMMON DIMENSIONS
(UNITS OF MEASURE=MILLIMETER)

SYMBOL	MIN	NOM	MAX
A	4.50	4.70	4.90
A1	2.34	2.54	2.74
A2		0.70 REF	
A3	2.56	2.76	2.96
b	0.70	–	0.90
b1	1.18	–	1.38
b2	–	–	1.47
c	0.45	0.50	0.60
D	15.67	15.87	16.07
D1	15.55	15.75	15.95
D2	9.60	9.80	10.0
E	9.96	10.16	10.36
e		2.54BSC	
H1	6.48	6.68	6.88
	12.68	12.98	13.28
L1	–	–	3.50
L2		6.50REF	
øP	3.08	3.18	3.28
Q	3.20	–	3.40
θ	3°	5°	7°



PKG TO-220



SECTION C-C & D-D

COMMON DIMENSIONS

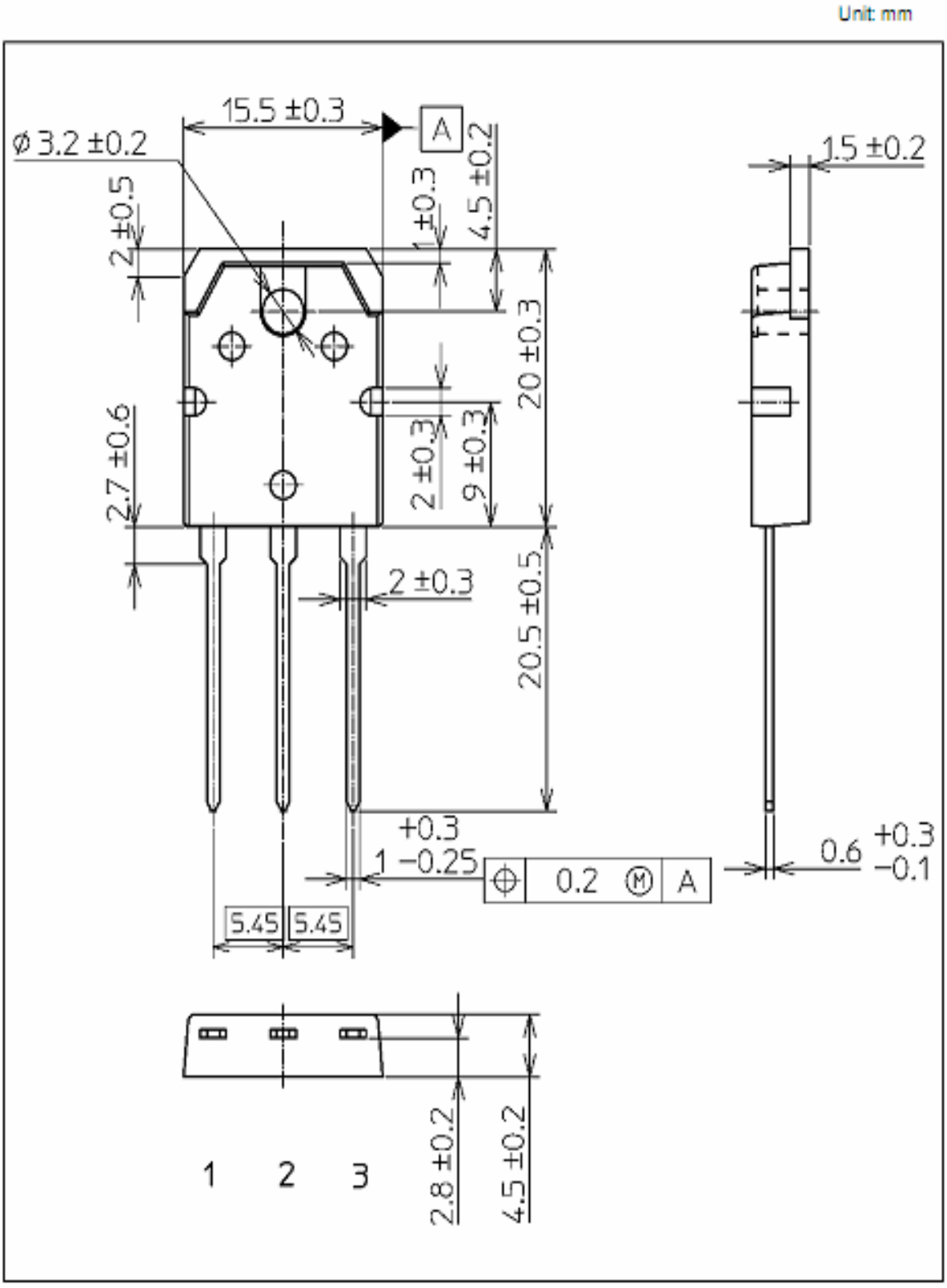
(UNITS OF MEASURE=MILLIMETER)

SYMBOL	MIN	NOM	MAX
A	4.40	4.57	4.70
A1	1.22	-	1.32
A2	2.59	2.69	2.79
b	0.77	-	0.90
b1	0.76	0.81	0.86
b2	1.23	-	1.36
b3	1.22	1.27	1.32
c	0.34	-	0.47
c1	0.33	0.38	0.43
D	15.15	15.45	15.75
D1	9.05	9.15	9.25
⚠ D2	11.40	-	12.88
E	9.96	10.16	10.36
⚠ E1	8.66	-	8.89
⚠ e	2.44	2.54	2.64
⚠ e1	5	5.08	5.18
H1	6.10	6.30	6.50
⚠ L	12.70	-	13.12
L1	-	-	3.90
L2	2.50REF		
ØP	3.80	3.84	3.88
Q	2.60	-	2.90
θ1	5°	7°	9°
θ2	1°	3°	5°

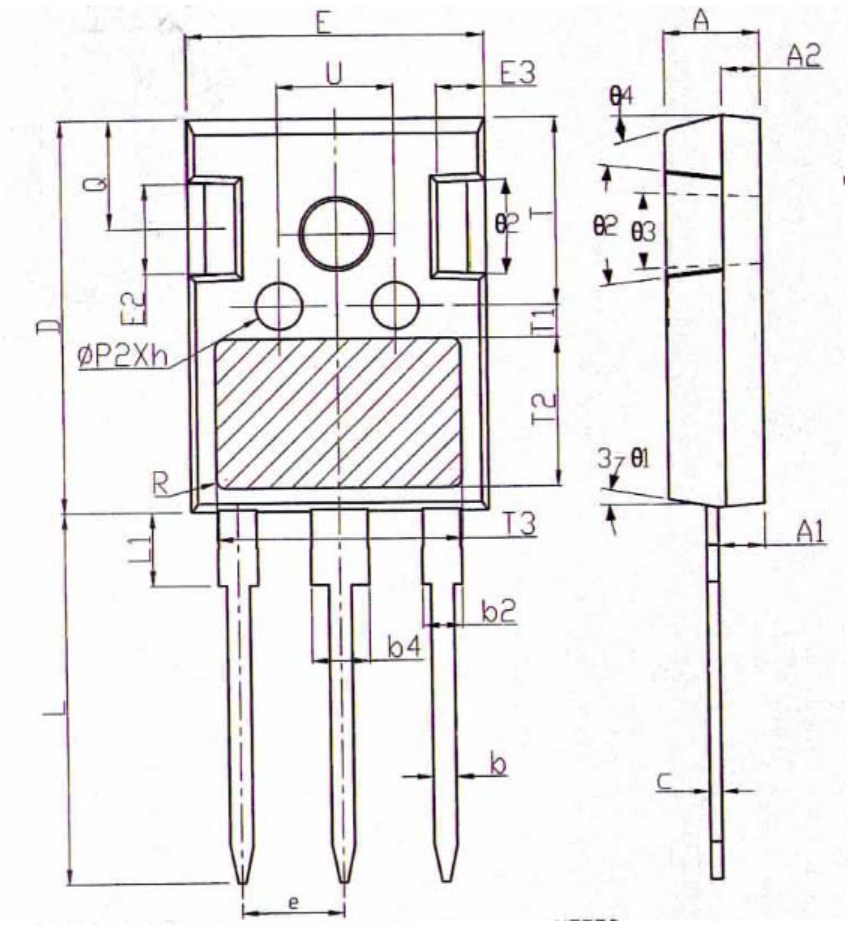
NOTES:

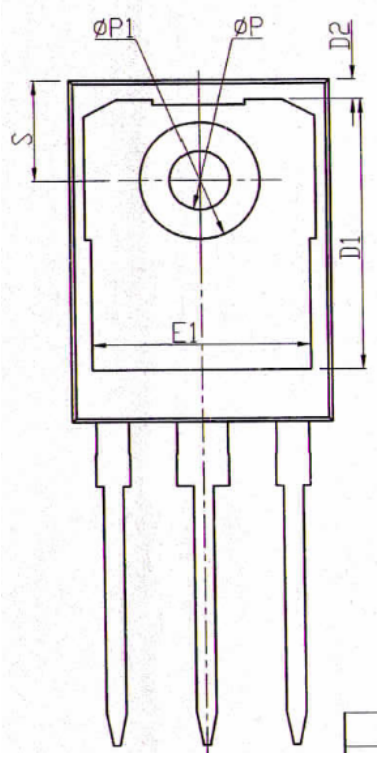
1. ALL DIMENSIONS REFER TO JEDEC STANDARD TO-220 AB DO NOT INCLUDE MOLD FLASH OR PROTRUSIONS.
2. ⚠ 'D2' AND 'E1' ARE VARIABLES DEPENDING ON DIE PAD SIZES.

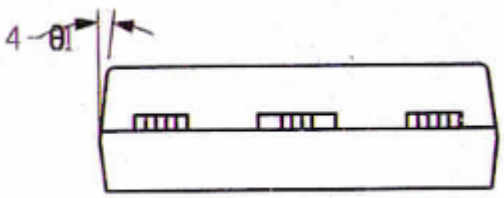
PKG TO-3P



PKG TO-247







COMMON DIMENSIONS

SYMBOL	MIN	NOM	MAX
A	4.90	5.00	5.10
A1	2.31	2.41	2.51
A2	1.90	2.00	2.10
b	1.16	1.21	1.26
b2	1.96	2.01	2.06
b4	2.96	3.01	3.06
c	0.59	0.61	0.66
D	20.90	21.00	21.10
D1	16.25	16.55	16.85
D2	1.05	1.20	1.35
E	15.70	15.80	15.90
E1	13.10	13.30	13.50
E2	4.90	5.00	5.10
E3	2.40	2.50	2.60
e	5.44BSC		
h	0.05	0.10	0.15
L	19.80	19.92	20.10
L1	-	-	4.30
ΦP	3.50	3.60	3.70
ΦP1	-	-	7.30
ΦP2	2.40	2.50	2.60
Q	5.60	5.80	6.00
S	6.15BSC		
R	0.50REF		
T	9.80	-	10.20
T1	1.65REF		
T2	8.00REF		
T3	12.80REF		
U	6.00	-	6.40
θ1	6°	7°	8°
θ2	4°	5°	6°
θ3	1°	-	1.5°
θ4	14°	15°	16°