



# STB140NF75 STP140NF75 STB140NF75-1

N-CHANNEL 75V - 0.0065 Ω -120A D<sup>2</sup>PAK/I<sup>2</sup>PAK/TO-220  
STripFET™ II POWER MOSFET

AUTOMOTIVE SPECIFIC

TYPE	V <sub>DSS</sub>	R <sub>DS(on)</sub>	I <sub>D</sub>
STB140NF75	75 V	<0.0075 Ω	120 A(**)
STP140NF75	75 V	<0.0075 Ω	120 A(**)
STB140NF75-1	75 V	<0.0075 Ω	120 A(**)

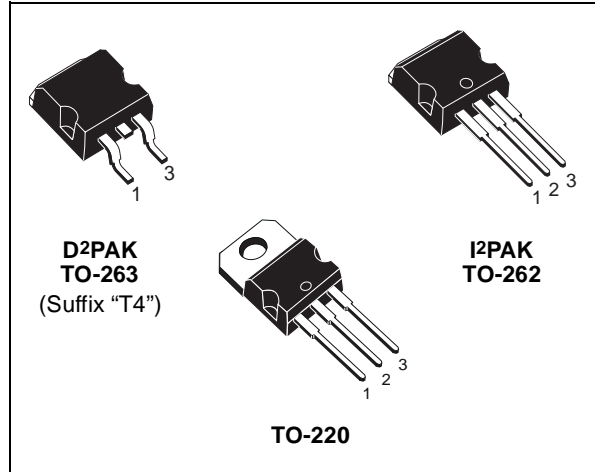
- TYPICAL R<sub>DS(on)</sub> = 0.0065 Ω
- SURFACE-MOUNTING D<sup>2</sup>PAK (TO-263) POWER PACKAGE

## DESCRIPTION

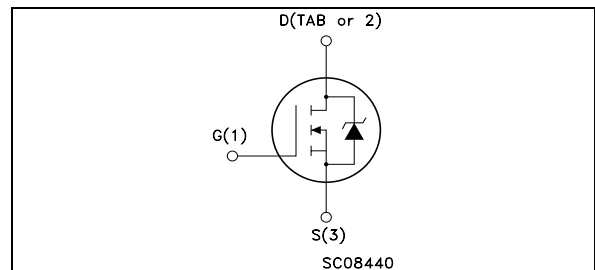
This Power MOSFET is the latest development of STMicroelectronics unique "Single Feature Size™" strip-based process. The resulting transistor shows extremely high packing density for low on-resistance, rugged avalanche characteristics and less critical alignment steps therefore a remarkable manufacturing reproducibility.

## APPLICATIONS

- HIGH CURRENT, HIGH SWITCHING SPEED
- SOLENOID AND RELAY DRIVERS
- AUTOMOTIVE 42V BATTERY DRIVERS



## INTERNAL SCHEMATIC DIAGRAM



## Ordering Information

SALES TYPE	MARKING	PACKAGE	PACKAGING
STB140NF75T4	B140NF75	D <sup>2</sup> PAK	TAPE & REEL
STP140NF75	P140NF75	TO-220	TUBE
STB140NF75-1	B140NF75	I <sup>2</sup> PAK	TUBE

## ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value	Unit
V <sub>DS</sub>	Drain-source Voltage (V <sub>GS</sub> = 0)	75	V
V <sub>DGR</sub>	Drain-gate Voltage (R <sub>GS</sub> = 20 kΩ)	75	V
V <sub>GS</sub>	Gate- source Voltage	± 20	V
I <sub>D</sub> (**)	Drain Current (continuous) at T <sub>C</sub> = 25°C	120	A
I <sub>D</sub>	Drain Current (continuous) at T <sub>C</sub> = 100°C	100	A
I <sub>DM</sub> (●)	Drain Current (pulsed)	480	A
P <sub>tot</sub>	Total Dissipation at T <sub>C</sub> = 25°C	310	W
	Derating Factor	2.08	W/°C
dv/dt (1)	Peak Diode Recovery voltage slope	10	V/ns
E <sub>AS</sub> (2)	Single Pulse Avalanche Energy	750	mJ
T <sub>stg</sub>	Storage Temperature	-55 to 175	°C
T <sub>j</sub>	Operating Junction Temperature		

(●) Pulse width limited by safe operating area.  
(\*\*) Current Limited by Package

(1) I<sub>SD</sub> ≤ 120A, di/dt ≤ 400A/μs, V<sub>DD</sub> ≤ V<sub>(BR)DSS</sub>, T<sub>j</sub> ≤ T<sub>JMAX</sub>  
(2) Starting T<sub>j</sub> = 25 °C, I<sub>D</sub> = 60 A, V<sub>DD</sub> = 30V

## STB140NF75 STP140NF75 STB150NF75-1

### THERMAL DATA

Rthj-case	Thermal Resistance Junction-case	Max	0.48	°C/W
Rthj-amb	Thermal Resistance Junction-ambient	Max	62.5	°C/W
Rthj-pcb	Thermal Resistance Junction-pcb	Max	see curve on page 6	°C/W
T <sub>I</sub>	Maximum Lead Temperature For Soldering Purpose (for 10 sec. 1.6 mm from case)		300	°C

### ELECTRICAL CHARACTERISTICS (T<sub>case</sub> = 25 °C unless otherwise specified)

#### OFF

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
V <sub>(BR)DSS</sub>	Drain-source Breakdown Voltage	I <sub>D</sub> = 250 μA V <sub>GS</sub> = 0	75			V
I <sub>DSS</sub>	Zero Gate Voltage Drain Current (V <sub>GS</sub> = 0)	V <sub>DS</sub> = Max Rating V <sub>DS</sub> = Max Rating T <sub>C</sub> = 125°C			1 10	μA μA
I <sub>GSS</sub>	Gate-body Leakage Current (V <sub>DS</sub> = 0)	V <sub>GS</sub> = ± 20 V			±100	nA

#### ON (\*)

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
V <sub>GS(th)</sub>	Gate Threshold Voltage	V <sub>DS</sub> = V <sub>GS</sub> I <sub>D</sub> = 250 μA	2		4	V
R <sub>DS(on)</sub>	Static Drain-source On Resistance	V <sub>GS</sub> = 10 V I <sub>D</sub> = 70 A		0.0065	0.0075	Ω

#### DYNAMIC

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
g <sub>fs</sub> (*)	Forward Transconductance	V <sub>DS</sub> = 15 V I <sub>D</sub> = 70 A		160		S
C <sub>iss</sub> C <sub>oss</sub> C <sub>rss</sub>	Input Capacitance Output Capacitance Reverse Transfer Capacitance	V <sub>DS</sub> = 25V, f = 1 MHz, V <sub>GS</sub> = 0		5000 960 310		pF pF pF

**ELECTRICAL CHARACTERISTICS** (continued)

**SWITCHING ON**

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
$t_{d(on)}$ $t_r$	Turn-on Delay Time Rise Time	$V_{DD} = 38\text{ V}$ $I_D = 70\text{ A}$ $R_G = 4.7\ \Omega$ $V_{GS} = 10\text{ V}$ (Resistive Load, Figure 3)		30 140		ns ns
$Q_g$ $Q_{gs}$ $Q_{gd}$	Total Gate Charge Gate-Source Charge Gate-Drain Charge	$V_{DD}=60\text{ V}$ $I_D=120\text{ A}$ $V_{GS}= 10\text{ V}$ (see test circuit, Figure 4)		160 28 70	218	nC nC nC

**SWITCHING OFF**

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
$t_{d(off)}$ $t_f$	Turn-off Delay Time Fall Time	$V_{DD} = 38\text{ V}$ $I_D = 70\text{ A}$ $R_G = 4.7\ \Omega$ , $V_{GS} = 10\text{ V}$ (Resistive Load, Figure 3)		130 90		ns ns

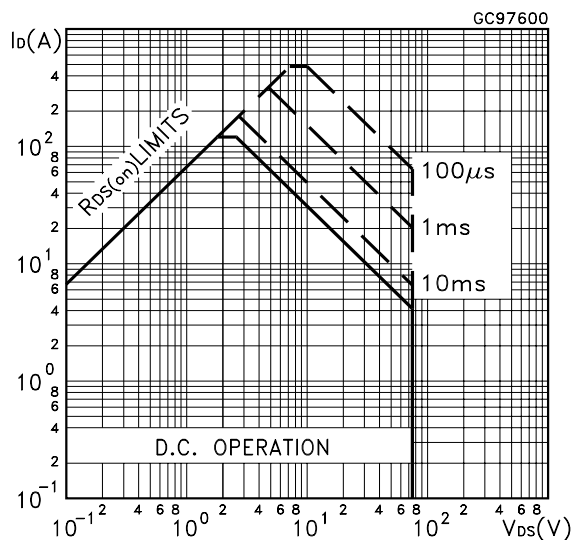
**SOURCE DRAIN DIODE**

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
$I_{SD}$ $I_{SDM} (\bullet)$	Source-drain Current Source-drain Current (pulsed)				120 480	A A
$V_{SD} (*)$	Forward On Voltage	$I_{SD} = 120\text{ A}$ $V_{GS} = 0$			1.5	V
$t_{rr}$ $Q_{rr}$ $I_{RRM}$	Reverse Recovery Time Reverse Recovery Charge Reverse Recovery Current	$I_{SD} = 120\text{ A}$ $di/dt = 100\text{ A}/\mu\text{s}$ $V_{DD} = 35\text{ V}$ $T_j = 150^\circ\text{C}$ (see test circuit, Figure 5)		115 450 8		ns nC A

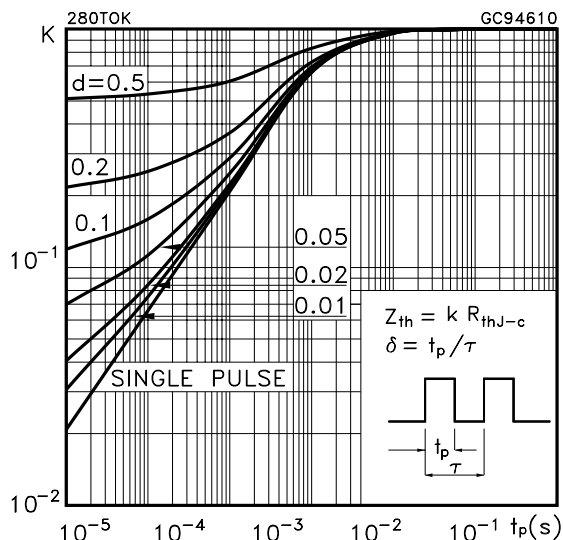
(\*)Pulsed: Pulse duration = 300  $\mu\text{s}$ , duty cycle 1.5 %.

( $\bullet$ )Pulse width limited by safe operating area.

**Safe Operating Area**

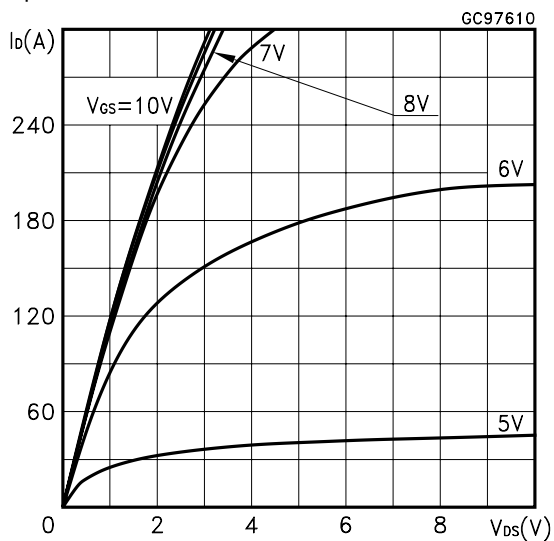


**Thermal Impedance**

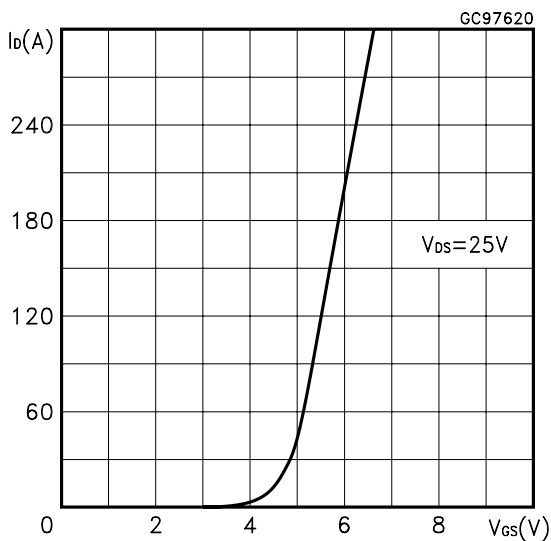


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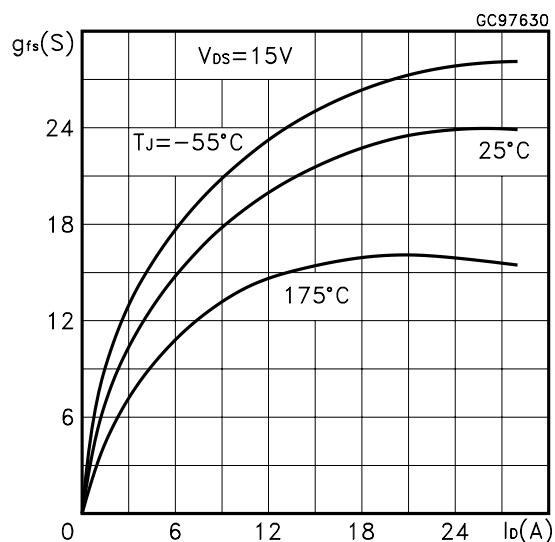
Output Characteristics



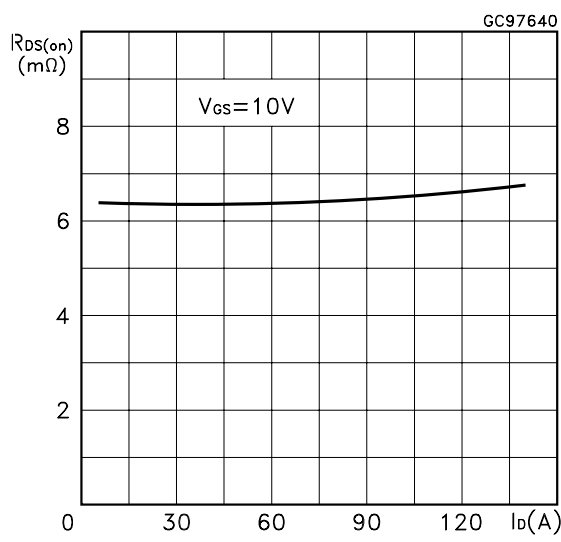
Transfer Characteristics



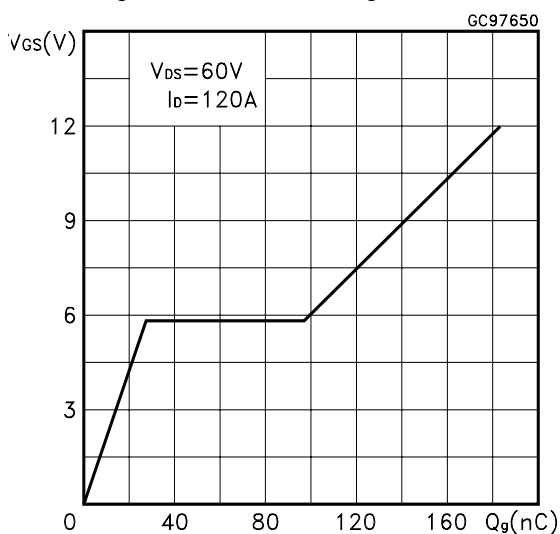
Transconductance



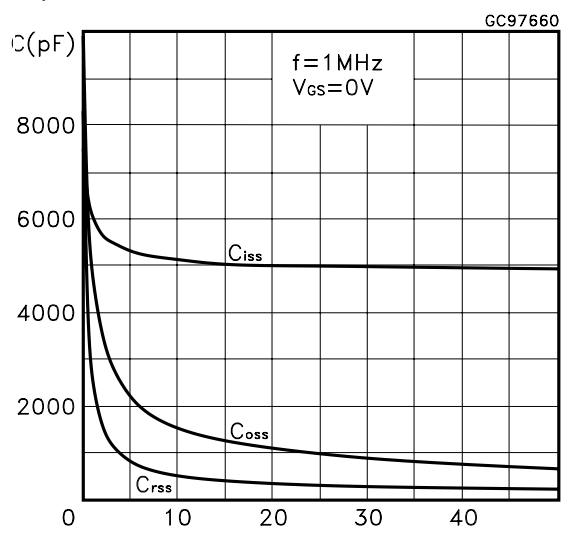
Static Drain-source On Resistance



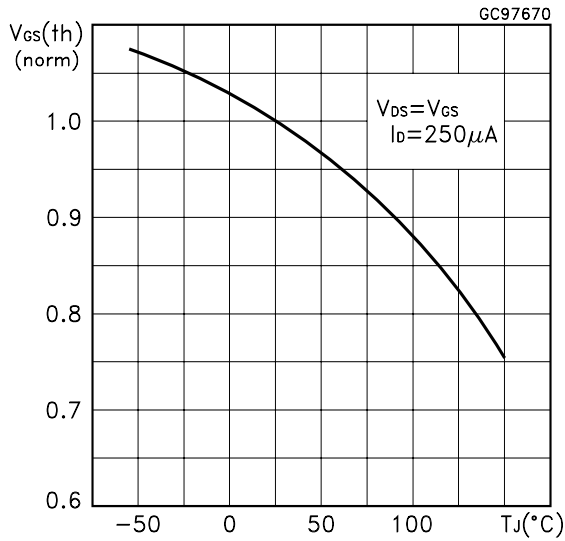
Gate Charge vs Gate-source Voltage



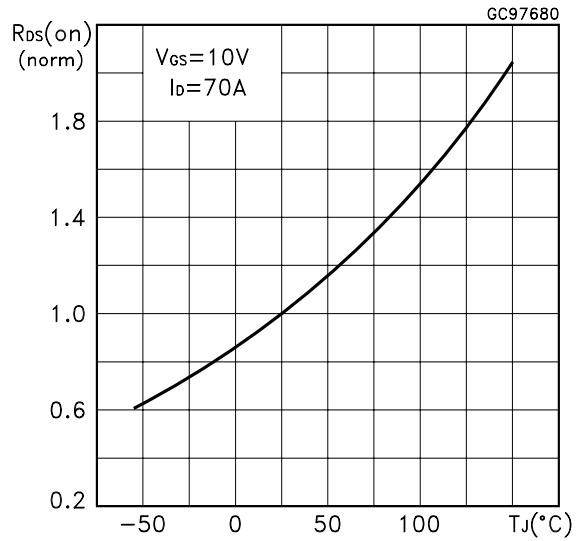
Capacitance Variations



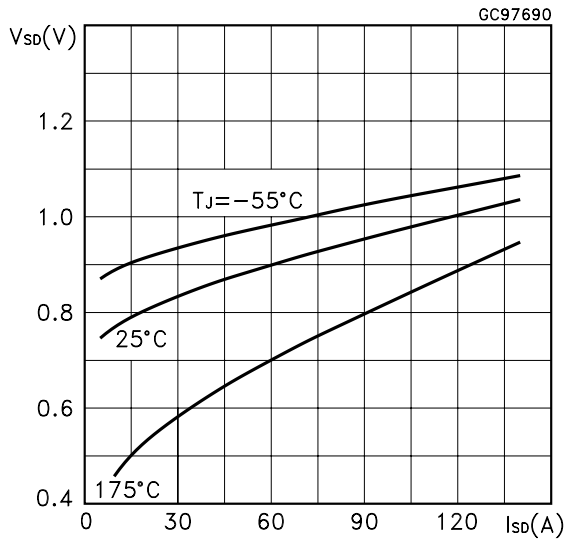
Normalized Gate Threshold Voltage vs Temperature



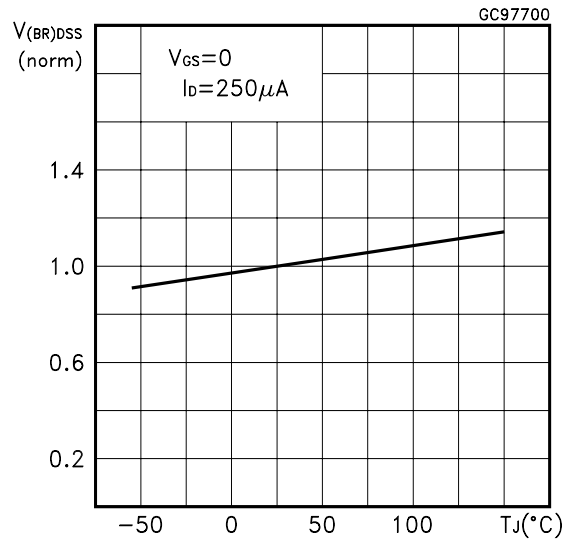
Normalized on Resistance vs Temperature



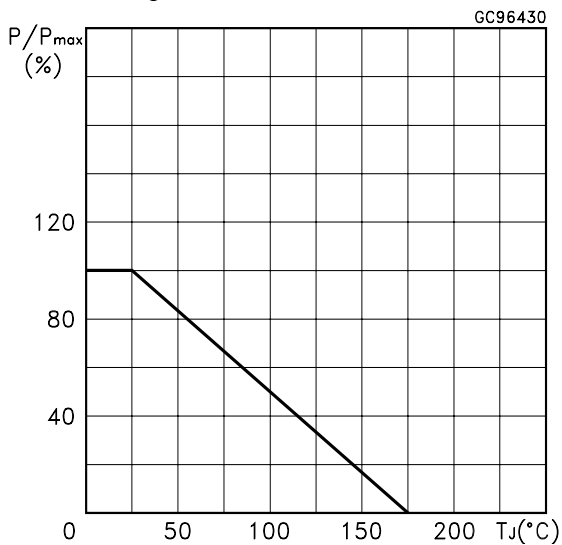
Source-drain Diode Forward Characteristics



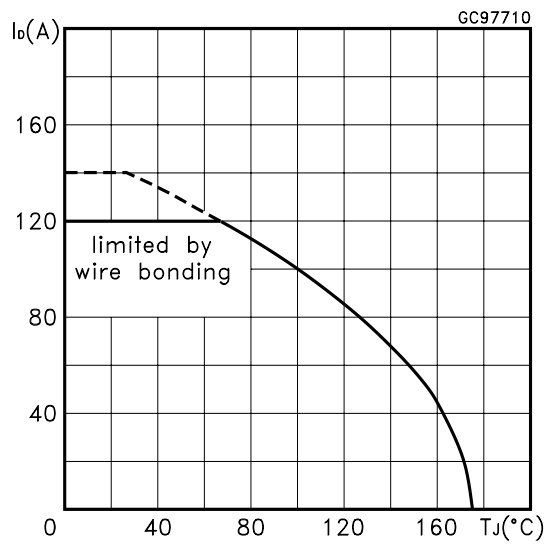
Normalized Breakdown Voltage vs Temperature.



Power Derating vs Tc

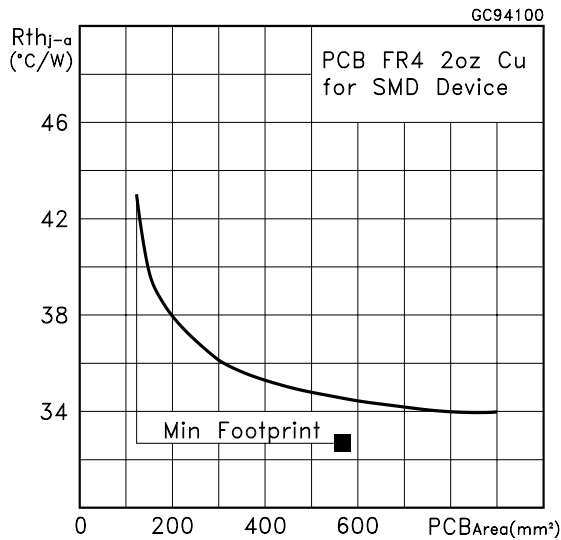


Max Id Current vs Tc.

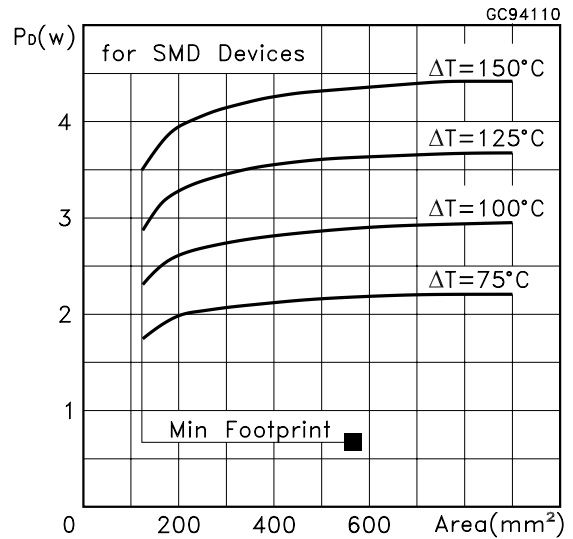


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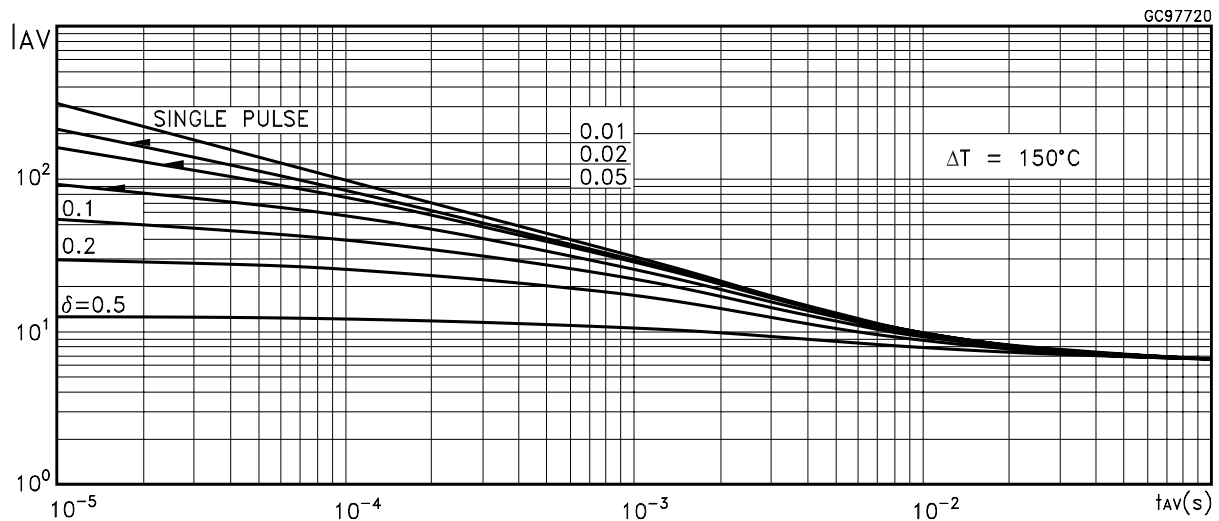
Thermal Resistance Rthj-a vs PCB Copper Area



Max Power Dissipation vs PCB Copper Area



**Allowable Iav vs. Time in Avalanche**



The previous curve gives the safe operating area for unclamped inductive loads, single pulse or repetitive, under the following conditions:

$$P_{D(AVE)} = 0.5 * (1.3 * BV_{DSS} * I_{AV})$$

$$E_{AS(AR)} = P_{D(AVE)} * t_{AV}$$

Where:

- $I_{AV}$  is the Allowable Current in Avalanche
- $P_{D(AVE)}$  is the Average Power Dissipation in Avalanche (Single Pulse)
- $t_{AV}$  is the Time in Avalanche

To derate above 25 °C, at fixed  $I_{AV}$ , the following equation must be applied:

$$I_{AV} = 2 * (T_{jmax} - T_{CASE}) / (1.3 * BV_{DSS} * Z_{th})$$

Where:

$Z_{th} = K * R_{th}$  is the value coming from Normalized Thermal Response at fixed pulse width equal to  $T_{AV}$ .



**SPICE THERMAL MODEL**

Parameter	Node	Value
CTHERM1	7 - 6	$1.49 \cdot 10^{-3}$
CTHERM2	6 - 5	$3.50 \cdot 10^{-2}$
CTHERM3	5 - 4	$5.94 \cdot 10^{-2}$
CTHERM4	4 - 3	$9.74 \cdot 10^{-2}$
CTHERM5	3 - 2	$8.86 \cdot 10^{-2}$
CTHERM6	2 - 1	$8.27 \cdot 10^{-1}$
R THERM1	7 - 6	0.0384
R THERM2	6 - 5	0.0624
R THERM3	5 - 4	0.072
R THERM4	4 - 3	0.0912
R THERM5	3 - 2	0.1008
R THERM6	2 - 1	0.1152

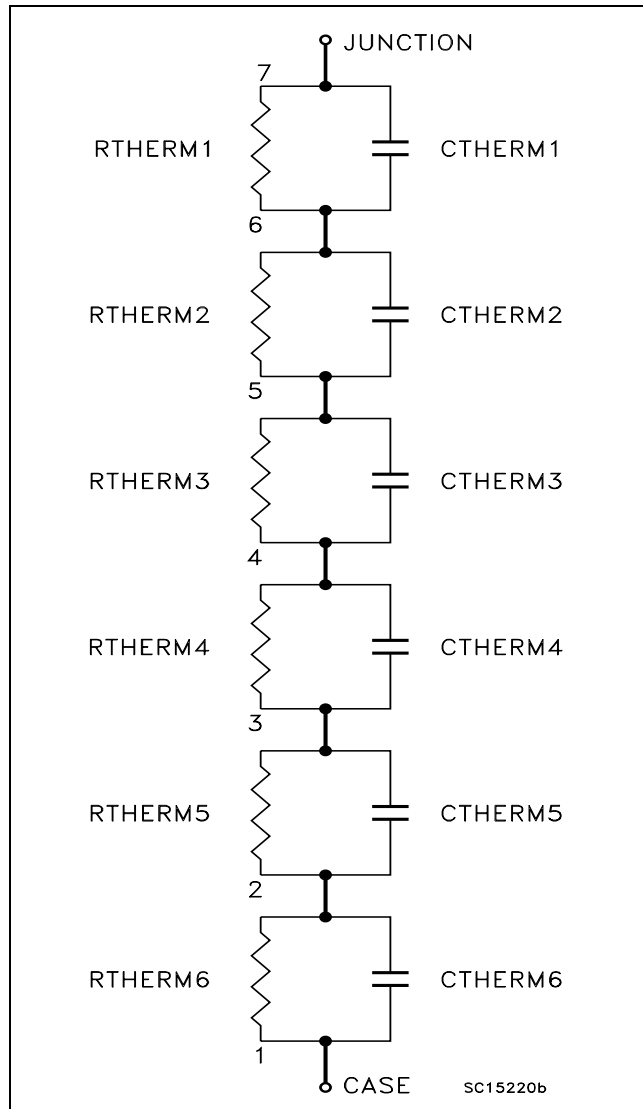


Fig. 1: Unclamped Inductive Load Test Circuit

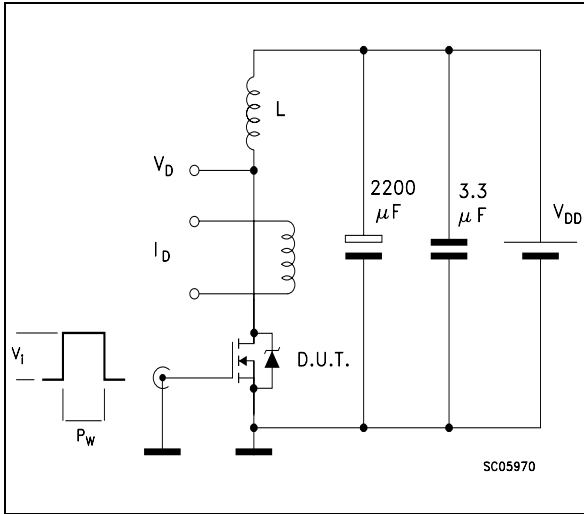


Fig. 2: Unclamped Inductive Waveform

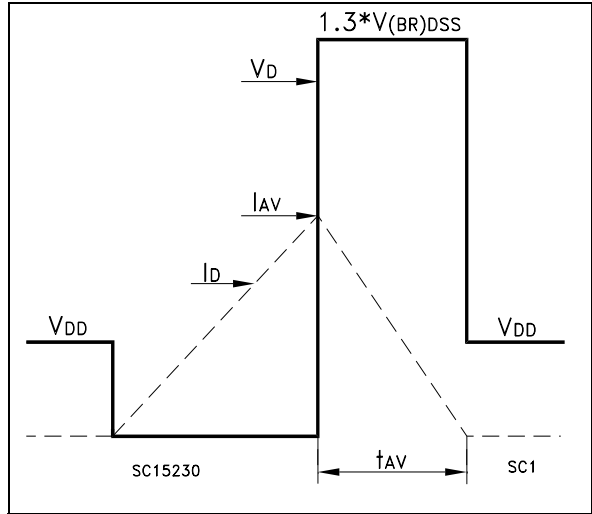


Fig. 3: Switching Times Test Circuits For Resistive Load

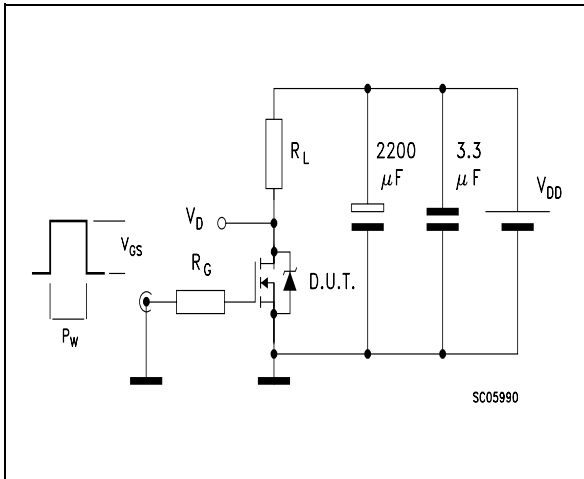


Fig. 3.1: Switching Time Waveform

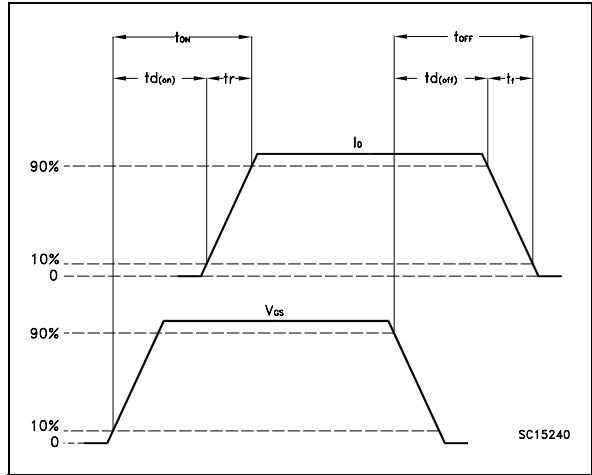


Fig. 4: Gate Charge Test Circuit

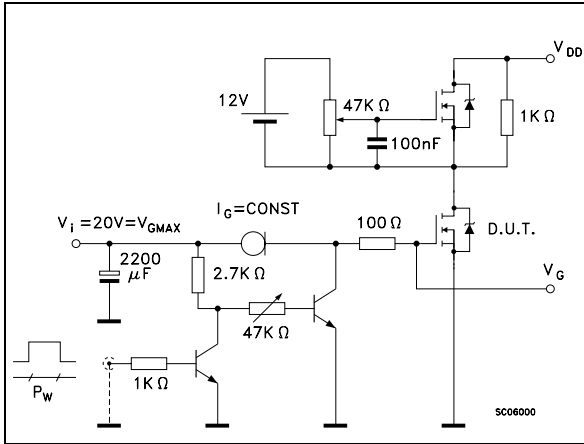


Fig. 4.1: Gate Charge Test Waveform

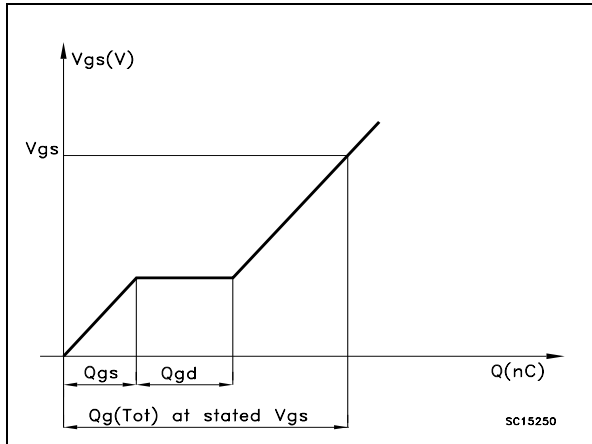




Fig. 5: Diode Switching Test Circuit

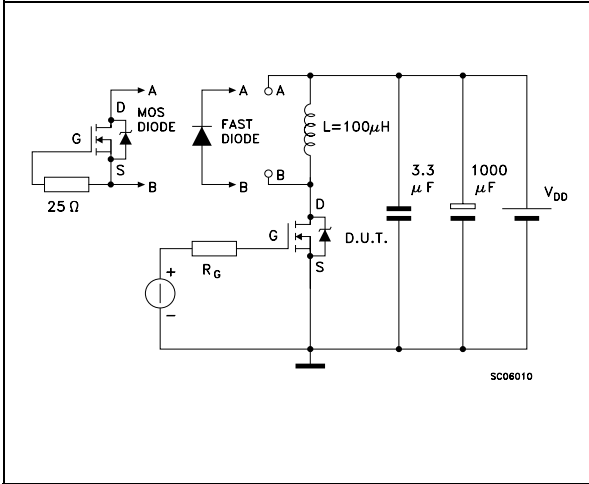
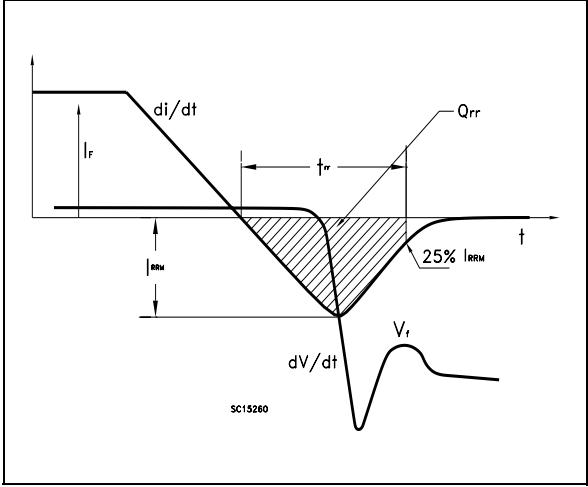
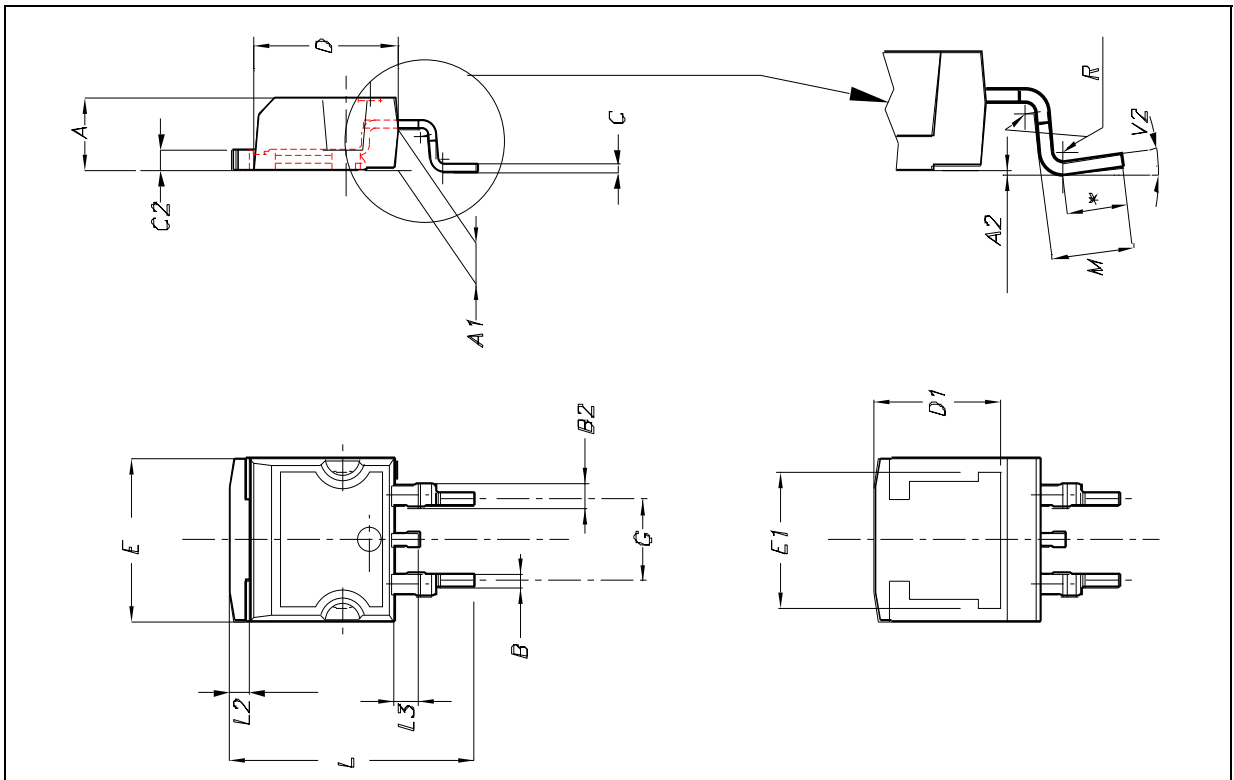


Fig. 5.1: Diode Recovery Times Waveform



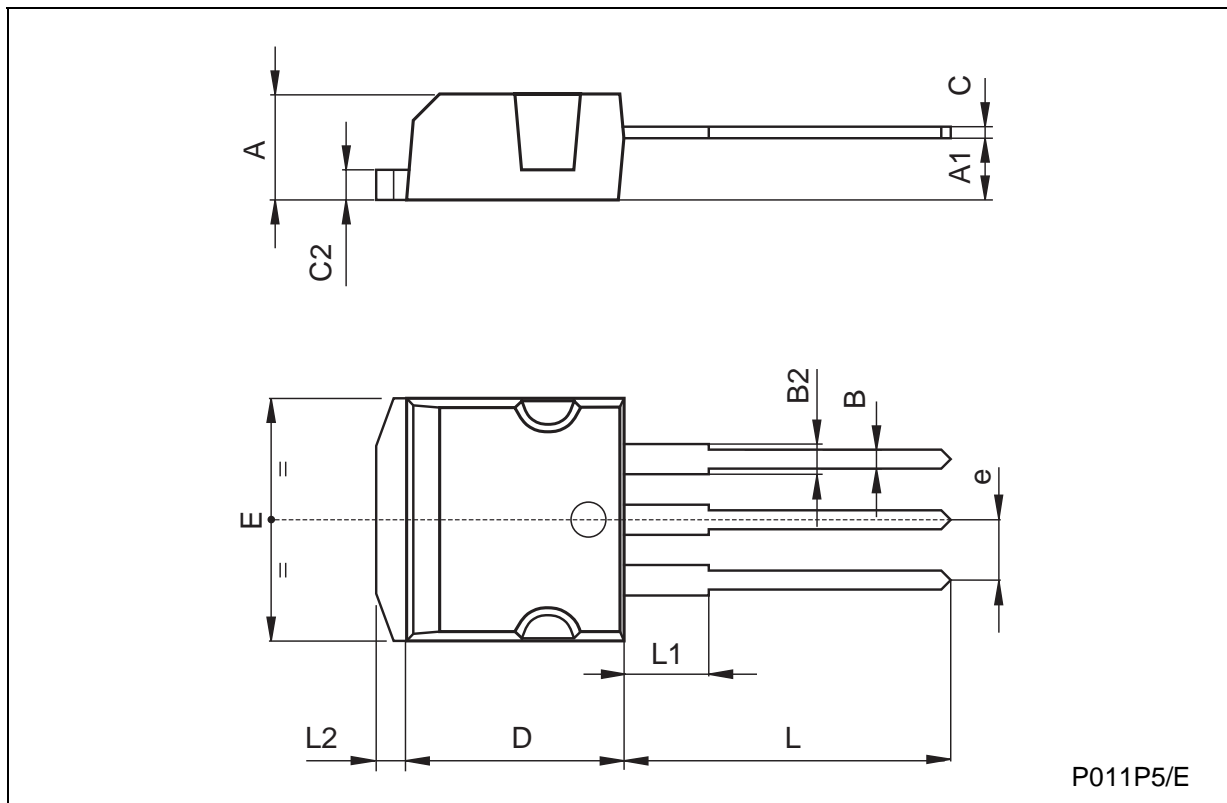
**D<sup>2</sup>PAK MECHANICAL DATA**

DIM.	mm.			inch.		
	MIN.	TYP.	MAX.	MIN.	TYP.	TYP.
A	4.4		4.6	0.173		0.181
A1	2.49		2.69	0.098		0.106
A2	0.03		0.23	0.001		0.009
B	0.7		0.93	0.028		0.037
B2	1.14		1.7	0.045		0.067
C	0.45		0.6	0.018		0.024
C2	1.21		1.36	0.048		0.054
D	8.95		9.35	0.352		0.368
D1		8			0.315	
E	10		10.4	0.394		0.409
E1		8.5			0.334	
G	4.88		5.28	0.192		0.208
L	15		15.85	0.591		0.624
L2	1.27		1.4	0.050		0.055
L3	1.4		1.75	0.055		0.069
M	2.4		3.2	0.094		0.126
R		0.4			0.015	
V2	0°		8°	0°		8°



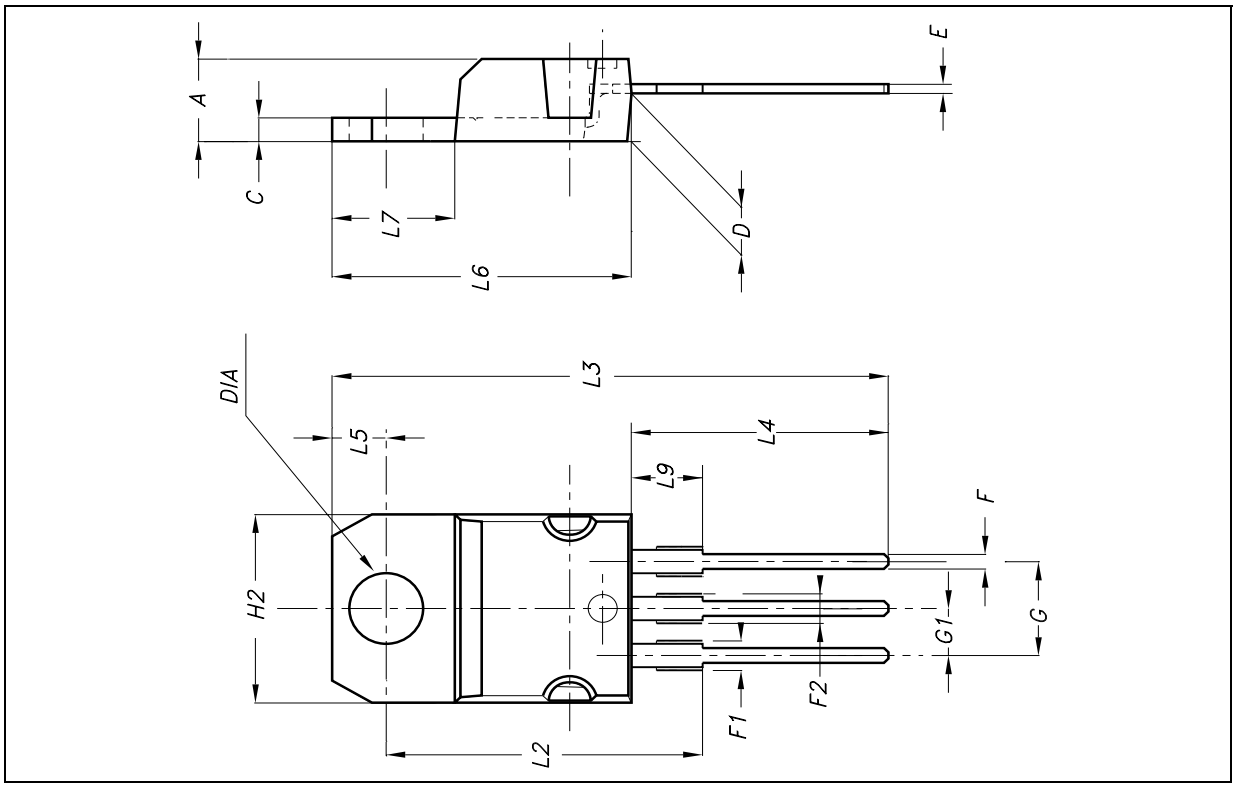
**TO-262 (I<sup>2</sup>PAK) MECHANICAL DATA**

DIM.	mm			inch		
	MIN.	TYP.	MAX.	MIN.	TYP.	MAX.
A	4.4		4.6	0.173		0.181
A1	2.49		2.69	0.098		0.106
B	0.7		0.93	0.027		0.036
B2	1.14		1.7	0.044		0.067
C	0.45		0.6	0.017		0.023
C2	1.23		1.36	0.048		0.053
D	8.95		9.35	0.352		0.368
e	2.4		2.7	0.094		0.106
E	10		10.4	0.393		0.409
L	13.1		13.6	0.515		0.531
L1	3.48		3.78	0.137		0.149
L2	1.27		1.4	0.050		0.055

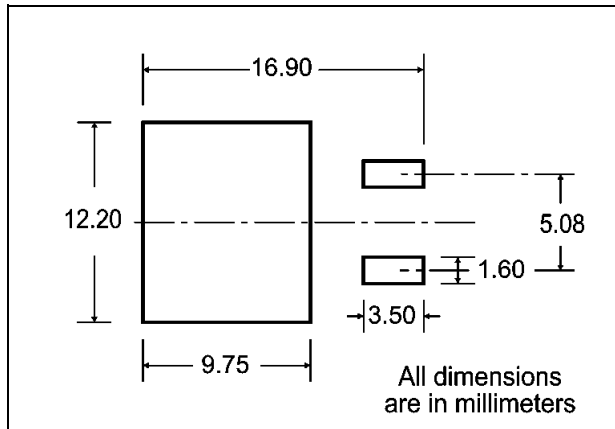


**TO-220 MECHANICAL DATA**

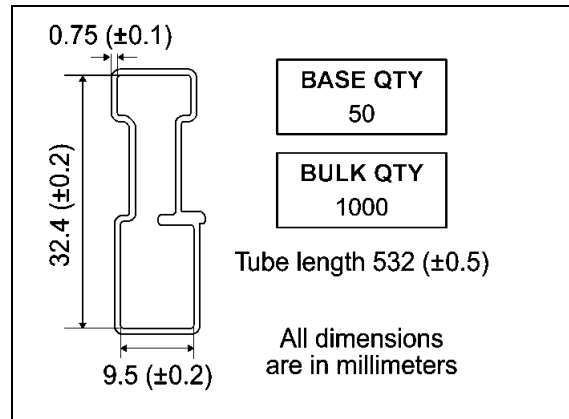
DIM.	mm.			inch.		
	MIN.	TYP.	MAX.	MIN.	TYP.	TYP.
A	4.4		4.6	0.173		0.181
C	1.23		1.32	0.048		0.051
D	2.40		2.72	0.094		0.107
E	0.49		0.70	0.019		0.027
F	0.61		0.88	0.024		0.034
F1	1.14		1.70	0.044		0.067
F2	1.14		1.70	0.044		0.067
G	4.95		5.15	0.194		0.203
G1	2.40		2.70	0.094		0.106
H2	10		10.40	0.393		0.409
L2		16.40			0.645	
L3		28.90			1.137	
L4	13		14	0.511		0.551
L5	2.65		2.95	0.104		0.116
L6	15.25		15.75	0.600		0.620
L7	6.20		6.60	0.244		0.260
L9	3.50		3.93	0.137		0.154
DIA	3.75		3.85	0.147		0.151



**D2PAK FOOTPRINT**



**TUBE SHIPMENT (no suffix)\***



**TAPE AND REEL SHIPMENT (suffix "T4")\***

40 mm min. Access hole at slot location

Full radius

Tape slot in core for tape start 2.5mm min. width

G measured at hub

**REEL MECHANICAL DATA**

DIM.	mm		inch	
	MIN.	MAX.	MIN.	MAX.
A		330		12.992
B	1.5		0.059	
C	12.8	13.2	0.504	0.520
D	20.2		0.795	
G	24.4	26.4	0.960	1.039
N	100		3.937	
T		30.4		1.197

BASE QTY	BULK QTY
1000	1000

**TAPE MECHANICAL DATA**

DIM.	mm		inch	
	MIN.	MAX.	MIN.	MAX.
A0	10.5	10.7	0.413	0.421
B0	15.7	15.9	0.618	0.626
D	1.5	1.6	0.059	0.063
D1	1.59	1.61	0.062	0.063
E	1.65	1.85	0.065	0.073
F	11.4	11.6	0.449	0.456
K0	4.8	5.0	0.189	0.197
P0	3.9	4.1	0.153	0.161
P1	11.9	12.1	0.468	0.476
P2	1.9	2.1	0.075	0.082
R	50		1.574	
T	0.25	0.35	0.0098	0.0137
W	23.7	24.3	0.933	0.956

10 pitches cumulative tolerance on tape +/- 0.2 mm

Center line of cavity

User Direction of Feed

FEED DIRECTION

Bending radius R min.

\* on sales type



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