



# STP200NF04 STB200NF04 - STB200NF04-1

N-CHANNEL 40V - 120 A - 3.3 mΩ TO-220/D<sup>2</sup>PAK/I<sup>2</sup>PAK  
STripFET™II MOSFET

**Table 1: General Features**

Type	V <sub>DSS</sub>	R <sub>DS(on)</sub>	I <sub>D</sub>	P <sub>w</sub>
STB200NF04	40 V	< 0.0037 Ω	120 A	310 W
STB200NF04-1	40 V	< 0.0037 Ω	120 A	310 W
STP200NF04	40 V	< 0.0037 Ω	120 A	310 W

- STANDARD THRESHOLD DRIVE
- 100% AVALANCHE TESTED

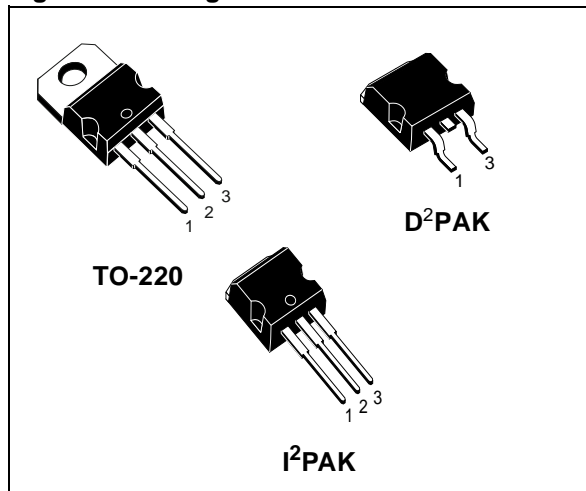
## DESCRIPTION

This 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.

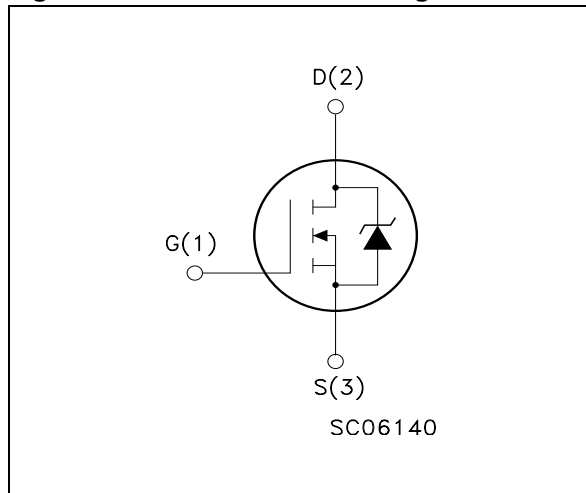
## APPLICATIONS

- HIGH CURRENT, HIGH SWITCHING SPEED
- AUTOMOTIVE

**Figure 1: Package**



**Figure 2: Internal Schematic Diagram**



**Table 2: Order Codes**

SALES TYPE	MARKING	PACKAGE	PACKAGING
STB200NF04T4	B200NF04	D <sup>2</sup> PAK	TAPE & REEL
STB200NF04-1	B200NF04	I <sup>2</sup> PAK	TUBE
STP200NF04	P200NF04	TO-220	TUBE

**Table 3: Absolute Maximum ratings**

Symbol	Parameter	Value	Unit
$V_{DS}$	Drain-source Voltage ( $V_{GS} = 0$ )	40	V
$V_{DGR}$	Drain-gate Voltage ( $R_{GS} = 20\text{ k}\Omega$ )	40	V
$V_{GS}$	Gate- source Voltage	$\pm 20$	V
$I_D$ (#)	Drain Current (continuous) at $T_C = 25^\circ\text{C}$	120	A
$I_D$ (#)	Drain Current (continuous) at $T_C = 100^\circ\text{C}$	120	A
$I_{DM}$ (•)	Drain Current (pulsed)	480	A
$P_{TOT}$	Total Dissipation at $T_C = 25^\circ\text{C}$	310	W
	Derating Factor	2.07	W/°C
dv/dt (1)	Peak Diode Recovery voltage slope	1.5	V/ns
$E_{AS}$ (2)	Single Pulse Avalanche Energy	1.3	J
$T_j$ $T_{stg}$	Operating Junction Temperature Storage Temperature	-55 to 175	°C

(•) Pulse width limited by safe operating area

(1)  $I_{SD} \leq 120\text{A}$ ,  $di/dt \leq 500\text{A}/\mu\text{s}$ ,  $V_{DD} \leq V_{(BR)DSS}$ ,  $T_j \leq T_{JMAX}$ .

(2) Starting  $T_j = 25^\circ\text{C}$ ,  $I_d = 60\text{A}$ ,  $V_{DD} = 30\text{V}$

(#) Current Limited by Package

**Table 4: Thermal Data**

		TO-220 / I <sup>2</sup> PAK / D <sup>2</sup> PAK	
Rthj-case	Thermal Resistance Junction-case Max	0.48	°C/W
Rthj-pcb	Thermal Resistance Junction-pcb Max	(see Figure 17)	°C/W
Rthj-amb	Thermal Resistance Junction-ambient (Free air) Max	62.5	°C/W
$T_l$	Maximum Lead Temperature For Soldering Purpose	300	°C

**ELECTRICAL CHARACTERISTICS ( $T_{CASE} = 25^\circ\text{C}$  UNLESS OTHERWISE SPECIFIED)**
**Table 5: On/Off**

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
$V_{(BR)DSS}$	Drain-source Breakdown Voltage	$I_D = 250\ \mu\text{A}$ , $V_{GS} = 0$	40			V
$I_{DSS}$	Zero Gate Voltage Drain Current ( $V_{GS} = 0$ )	$V_{DS} = \text{Max Rating}$ $V_{DS} = \text{Max Rating}$ , $T_C = 125^\circ\text{C}$			1 10	$\mu\text{A}$ $\mu\text{A}$
$I_{GSS}$	Gate-body Leakage Current ( $V_{DS} = 0$ )	$V_{GS} = \pm 20\text{V}$			$\pm 100$	nA
$V_{GS(th)}$	Gate Threshold Voltage	$V_{DS} = V_{GS}$ , $I_D = 250\ \mu\text{A}$	2		4	V
$R_{DS(on)}$	Static Drain-source On Resistance	$V_{GS} = 10\text{V}$ , $I_D = 90\text{A}$		3.3	3.7	m $\Omega$

## ELECTRICAL CHARACTERISTICS (CONTINUED)

Table 6: Dynamic

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
$g_{fs}$ (1)	Forward Transconductance	$V_{DS} = 15\text{ V}$ , $I_D = 90\text{ A}$		150		S
$C_{iss}$ $C_{oss}$ $C_{rss}$	Input Capacitance Output Capacitance Reverse Transfer Capacitance	$V_{DS} = 25\text{ V}$ , $f = 1\text{ MHz}$ , $V_{GS} = 0$		5100 1600 600		pF pF pF

Table 7: Switching On/Off

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
$t_{d(on)}$ $t_r$ $t_{d(off)}$ $t_f$	Turn-on Delay Time Rise Time Turn-off Delay Time Fall Time	$V_{DD} = 20\text{ V}$ , $I_D = 90\text{ A}$ $R_G = 4.7\Omega$ , $V_{GS} = 10\text{ V}$ (see Figure 20)		30 320 140 120		ns ns ns ns
$Q_g$ $Q_{gs}$ $Q_{gd}$	Total Gate Charge Gate-Source Charge Gate-Drain Charge	$V_{DD} = 20\text{ V}$ , $I_D = 120\text{ A}$ , $V_{GS} = 10\text{ V}$ (see Figure 23)		170 30 62	210	nC nC nC

Table 8: Source Drain Diode

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
$I_{SD}$ $I_{SDM}$ (2)	Source-drain Current Source-drain Current (pulsed)				120 480	A A
$V_{SD}$ (1)	Forward On Voltage	$I_{SD} = 120\text{ A}$ , $V_{GS} = 0$			1.3	V
$t_{rr}$ $Q_{rr}$ $I_{RRM}$	Reverse Recovery Time Reverse Recovery Charge Reverse Recovery Current	$I_{SD} = 120\text{ A}$ , $di/dt = 100\text{ A}/\mu\text{s}$ $V_{DD} = 30\text{ V}$ , $T_j = 150^\circ\text{C}$ (see Figure 21)		85 190 4.5		ns nC A

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

(2) Pulse width limited by safe operating area.

Figure 3: Safe Operating Area

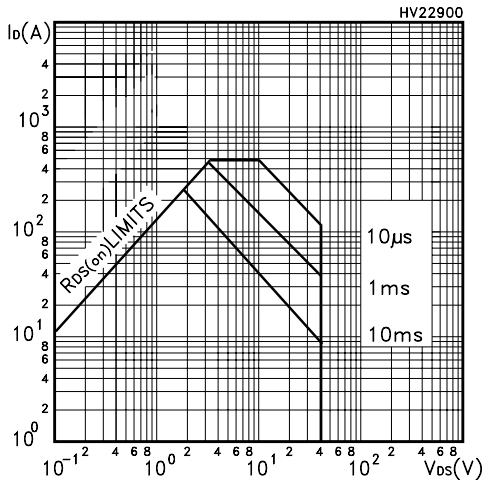


Figure 4: Output Characteristics

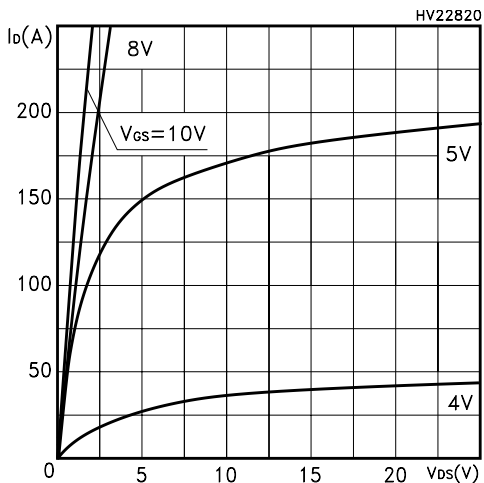


Figure 5: Transconductance

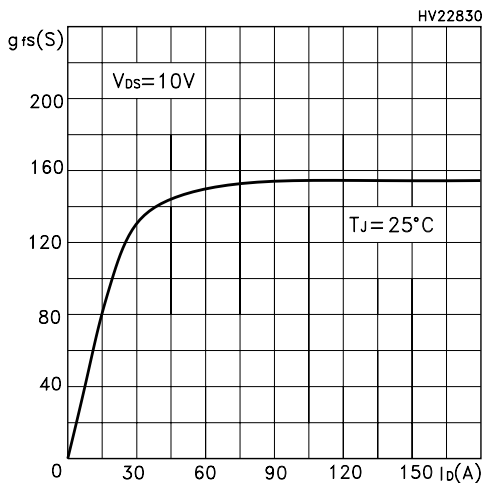


Figure 6: Thermal Impedance

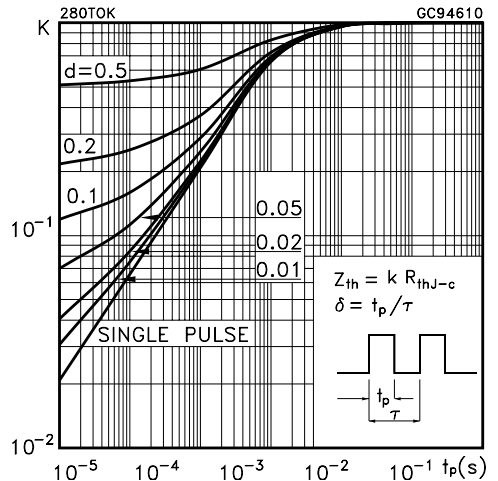


Figure 7: Transfer Characteristics

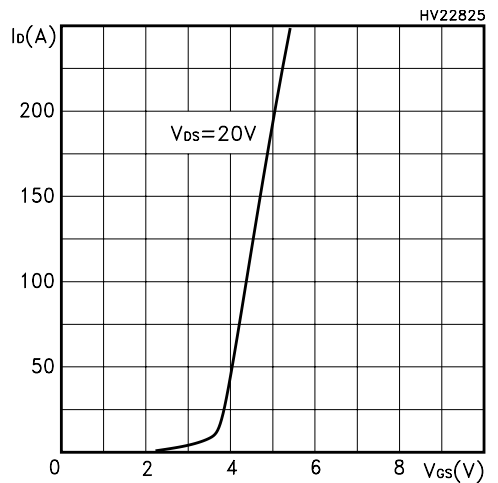


Figure 8: Static Drain-source On Resistance

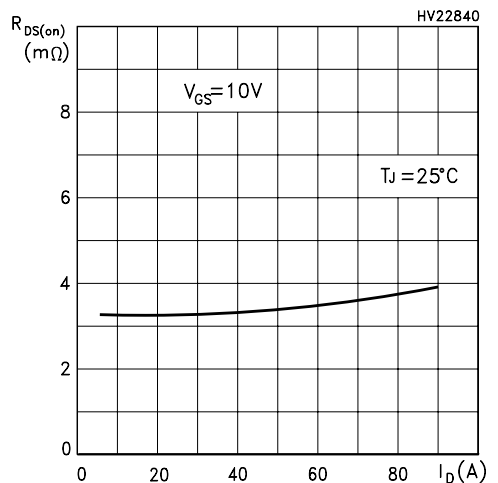


Figure 9: Gate Charge vs Gate-source Voltage

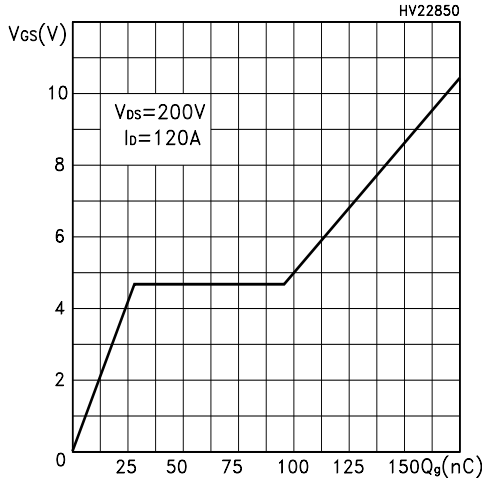


Figure 10: Normalized Gate Threshold Voltage vs Temperature

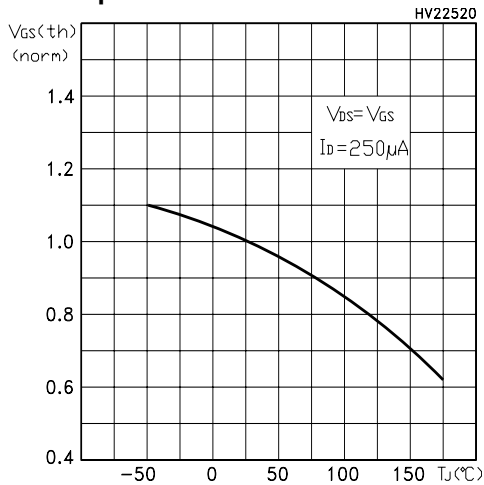


Figure 11: Dource-Drain Diode Forward Characteristics

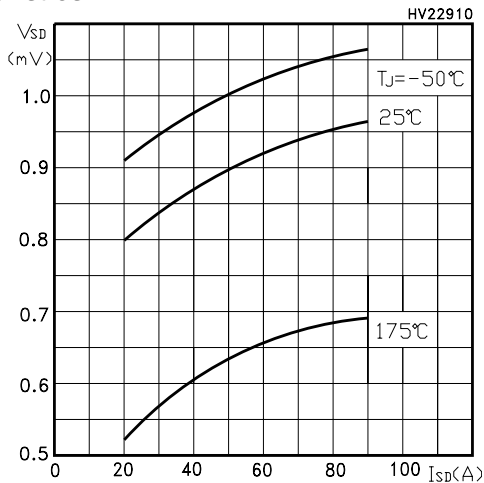


Figure 12: Capacitance Variations

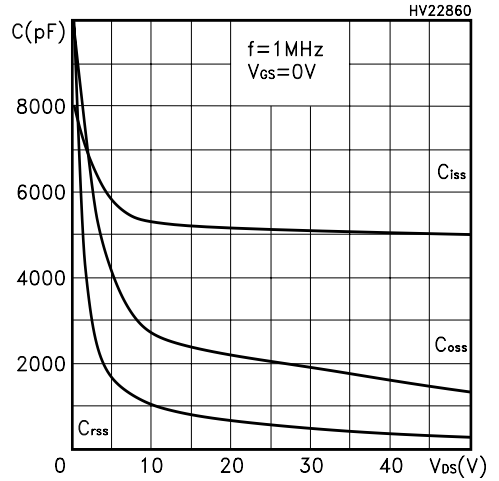


Figure 13: Normalized On Resistance vs Temperature

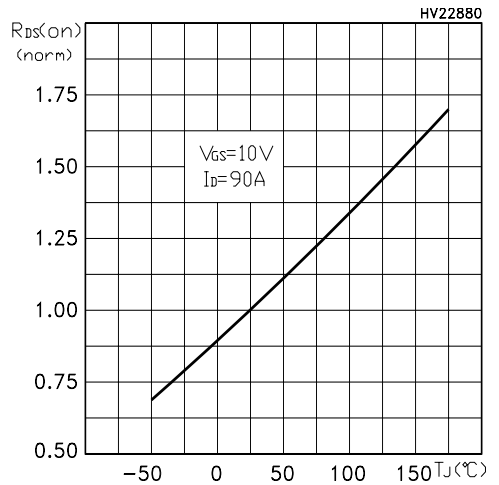


Figure 14: Normalized Breakdown Voltage vs Temperature

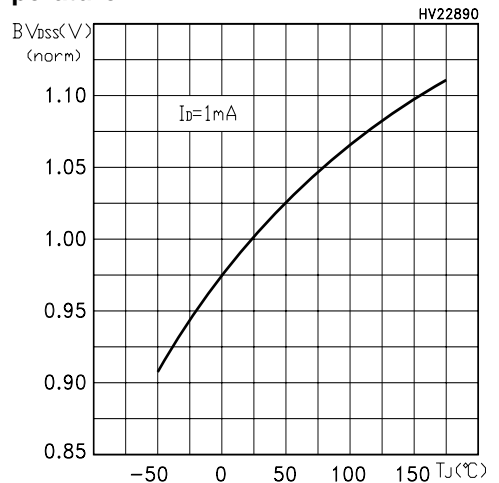


Figure 15: Thermal Resistance Rthj-a vs PCB Copper Area

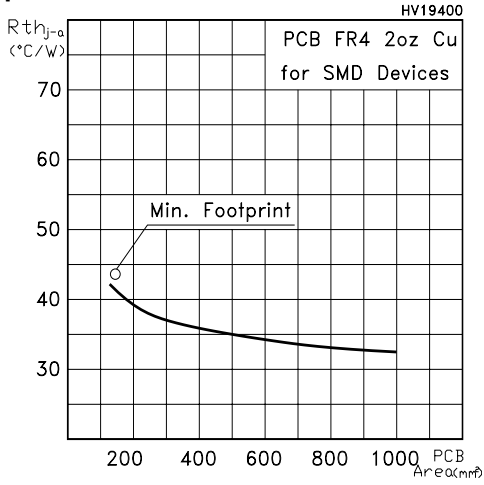


Figure 16: Max Power Dissipation vs PCB Copper Area

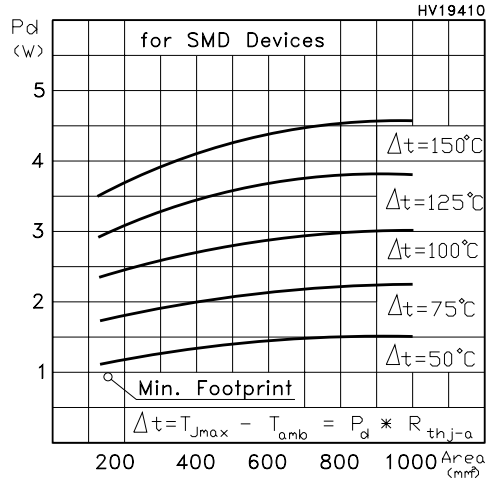
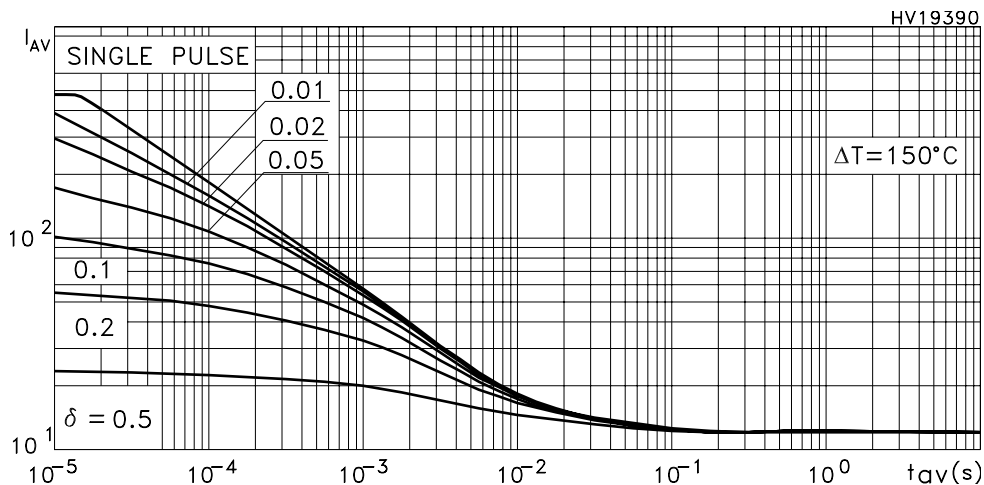


Figure 17: Allowable  $I_{AV}$  vs. Time in Avalanche



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  $25^\circ C$ , at fixed  $I_{AV}$ , the following equation must be applied:

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

Where:

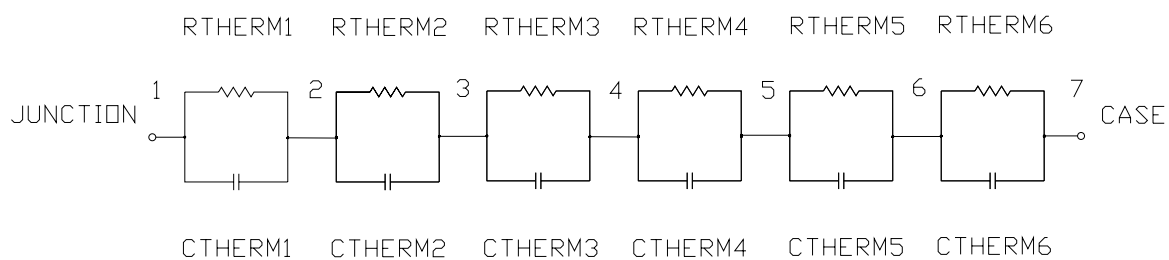
$Z_{th} = K * R_{th}$  is the value coming from Normalized Thermal Response at fixed pulse width equal to  $T_{AV}$ .

**SPICE THERMAL MODEL**

**Table 9: 6th Order RC Network**

Parameter	Node	Value
CTHERM1	1 - 2	1.4958E-3
CTHERM2	2 - 3	3.5074E-2
CTHERM3	3 - 4	5.939E-2
CTHERM4	4 - 5	9.7411E-2
CTHERM5	5 - 6	8.8596E-2
CTHERM6	6 - 7	8.2755E-1
R THERM1	1 - 2	0.0384
R THERM2	2 - 3	0.0624
R THERM3	3 - 4	0.072
R THERM4	4 - 5	0.0912
R THERM5	5 - 6	0.1008
R THERM6	6 - 7	0.1152

**Figure 18: Schematic of 6th Order RC Network**



SC16500-B



Figure 19: Unclamped Inductive Load Test Circuit

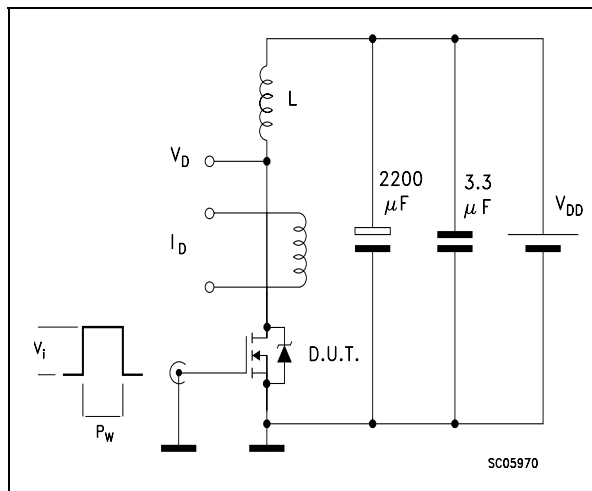


Figure 20: Switching Times Test Circuit For Resistive Load

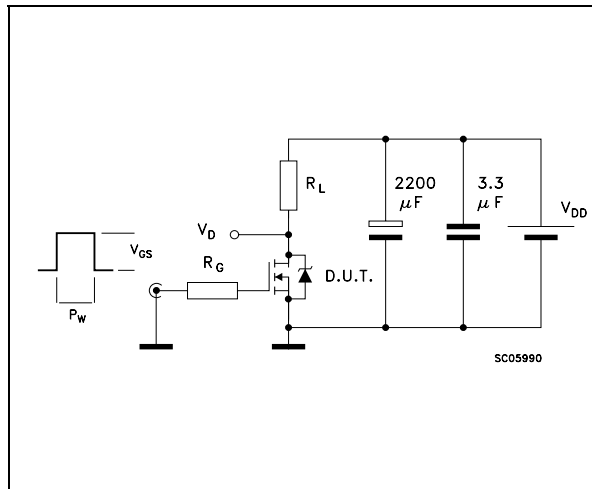


Figure 21: Test Circuit For Inductive Load Switching and Diode Recovery Times

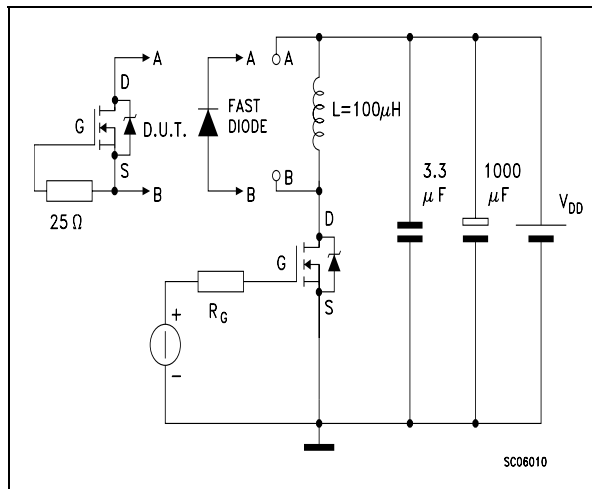


Figure 22: Unclamped Inductive Waferform

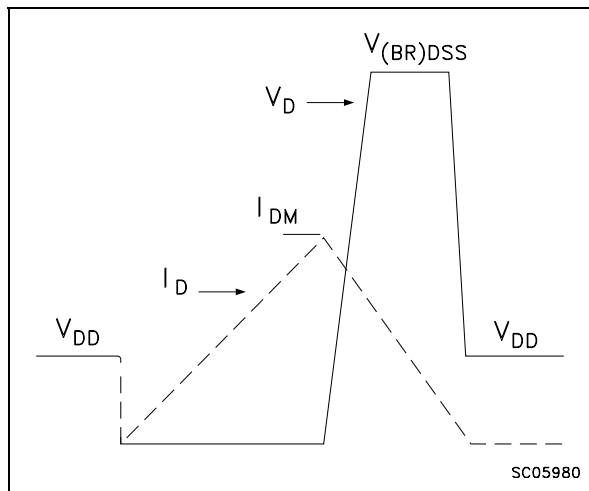
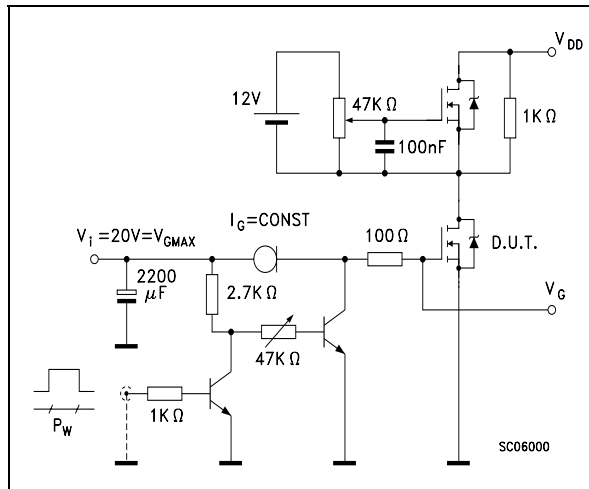
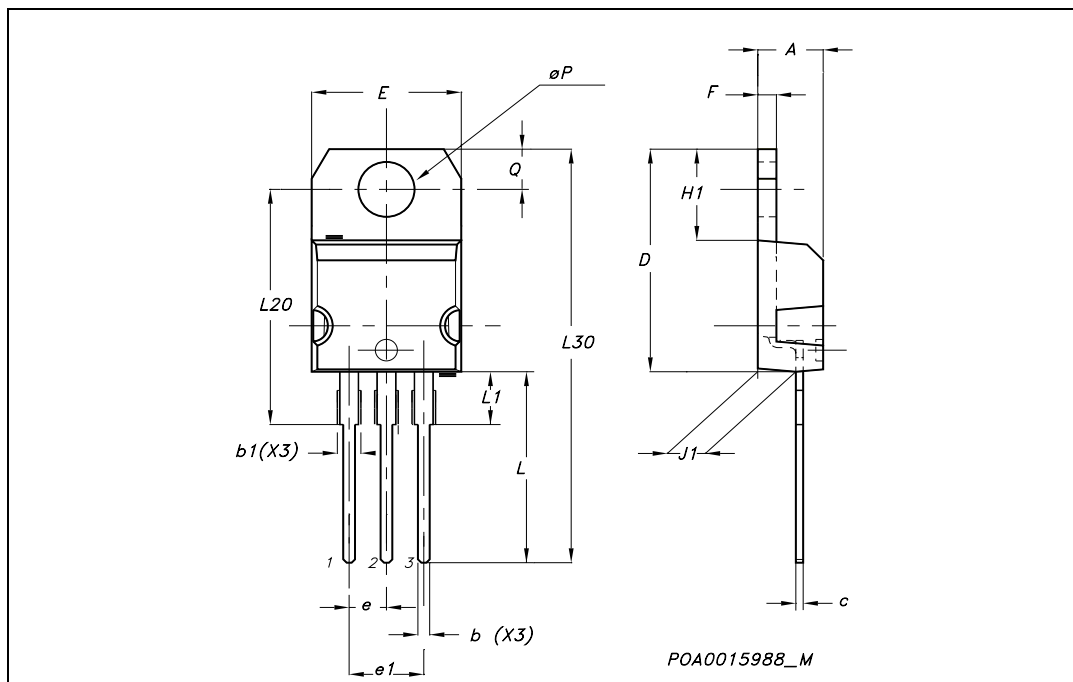


Figure 23: Gate Charge Test Circuit



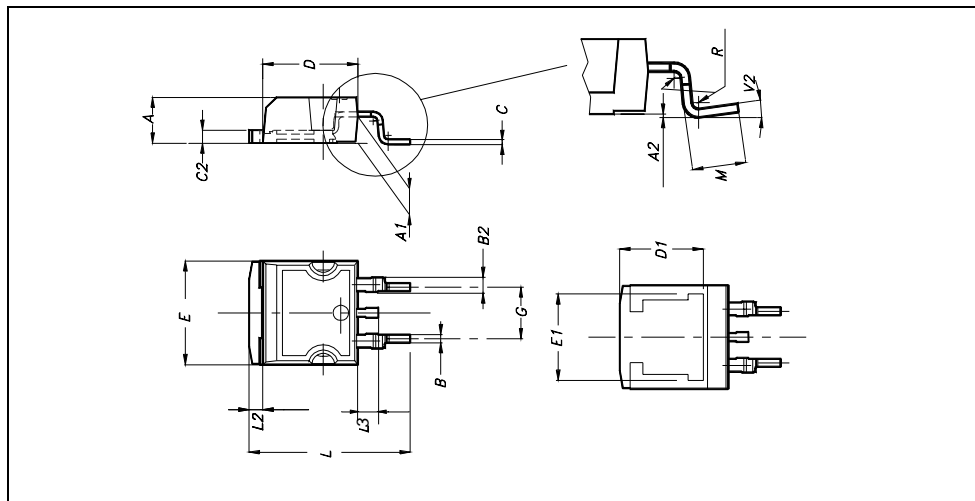
**TO-220 MECHANICAL DATA**

DIM.	mm.			inch		
	MIN.	TYP	MAX.	MIN.	TYP.	MAX.
A	4.40		4.60	0.173		0.181
b	0.61		0.88	0.024		0.034
b1	1.15		1.70	0.045		0.066
c	0.49		0.70	0.019		0.027
D	15.25		15.75	0.60		0.620
E	10		10.40	0.393		0.409
e	2.40		2.70	0.094		0.106
e1	4.95		5.15	0.194		0.202
F	1.23		1.32	0.048		0.052
H1	6.20		6.60	0.244		0.256
J1	2.40		2.72	0.094		0.107
L	13		14	0.511		0.551
L1	3.50		3.93	0.137		0.154
L20		16.40			0.645	
L30		28.90			1.137	
øP	3.75		3.85	0.147		0.151
Q	2.65		2.95	0.104		0.116



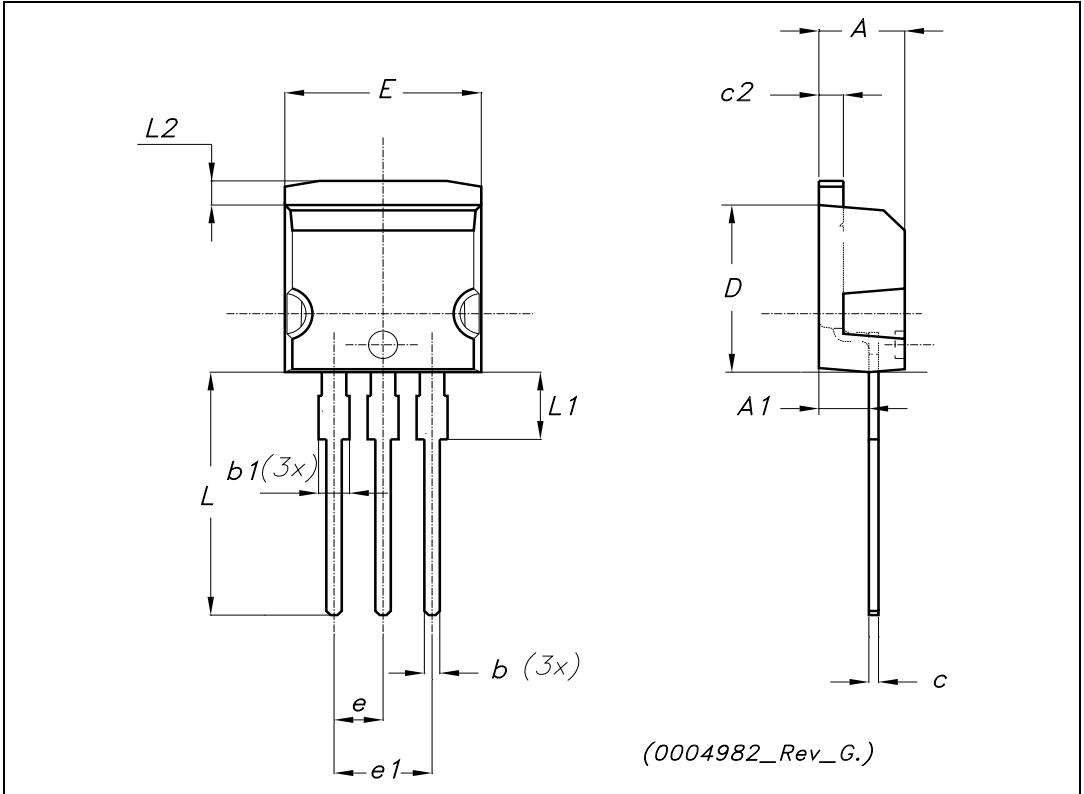
**D<sup>2</sup>PAK MECHANICAL DATA**

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
A2	0.03		0.23	0.001		0.009
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
D1		8			0.315	
E	10		10.4	0.393		
E1		8.5			0.334	
G	4.88		5.28	0.192		0.208
L	15		15.85	0.590		0.625
L2	1.27		1.4	0.050		0.055
L3	1.4		1.75	0.055		0.068
M	2.4		3.2	0.094		0.126
R		0.4			0.015	
V2	0°		4°			

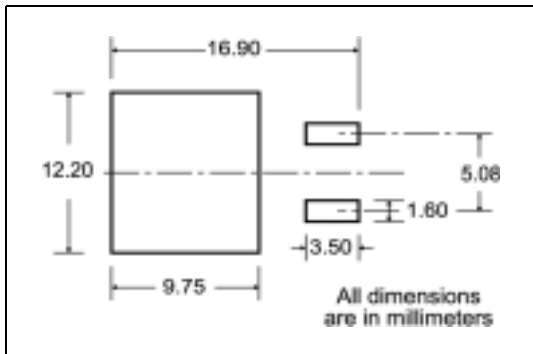


**TO-262 (I<sup>2</sup>PAK) MECHANICAL DATA**

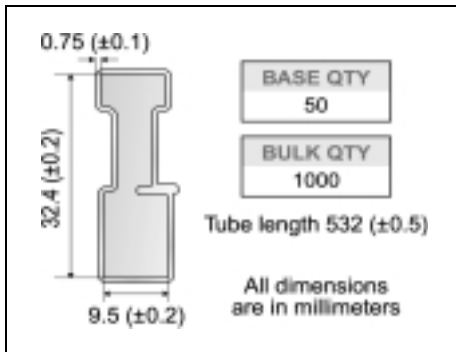
DIM.	mm.			inch		
	MIN.	TYP	MAX.	MIN.	TYP.	MAX.
A	4.40		4.60	0.173		0.181
A1	2.40		2.72	0.094		0.107
b	0.61		0.88	0.024		0.034
b1	1.14		1.70	0.044		0.066
c	0.49		0.70	0.019		0.027
c2	1.23		1.32	0.048		0.052
D	8.95		9.35	0.352		0.368
e	2.40		2.70	0.094		0.106
e1	4.95		5.15	0.194		0.202
E	10		10.40	0.393		0.410
L	13		14	0.511		0.551
L1	3.50		3.93	0.137		0.154
L2	1.27		1.40	0.050		0.055



**D<sup>2</sup>PAK FOOTPRINT**



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



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

**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

**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

\* on sales type

**Table 10: Revision History**

Date	Revision	Description of Changes
28-Sep-2004	2	New Stylesheet. No Content Change
11-Oct-2004	3	Final datasheet

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