



STP200NF04

STB200NF04 - STB200NF04-1

N-CHANNEL 40V - 120 A - 3.3 mΩ TO-220/D²PAK/I²PAK
STripFET™II MOSFET

Table 1: General Features

Type	V _{DSS}	R _{DS(on)}	I _D	P _w
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

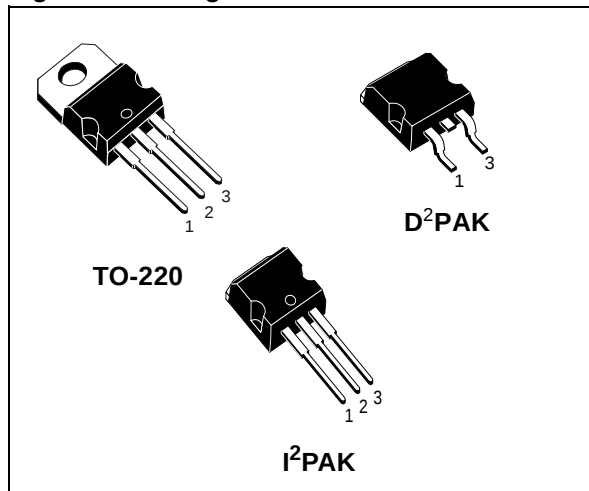


Figure 2: Internal Schematic Diagram

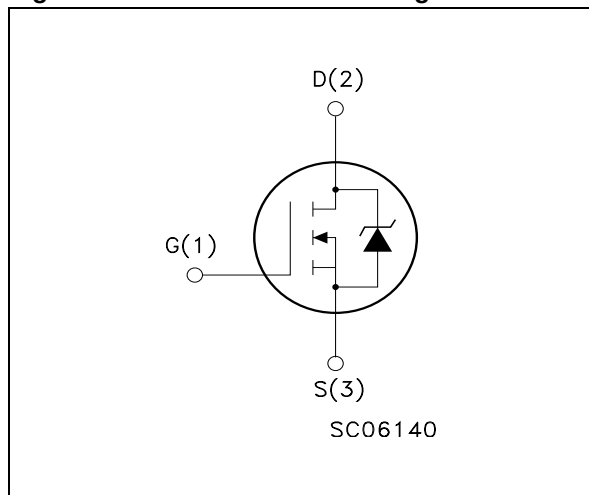


Table 2: Order Codes

SALES TYPE	MARKING	PACKAGE	PACKAGING
STB200NF04T4	B200NF04	D ² PAK	TAPE & REEL
STB200NF04-1	B200NF04	I ² 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	± 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/ $^\circ\text{C}$
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	$^\circ\text{C}$

(•) 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 ² PAK / D ² PAK	
Rthj-case	Thermal Resistance Junction-case Max	0.48	$^\circ\text{C}/\text{W}$
Rthj-pcb	Thermal Resistance Junction-pcb Max	(see Figure 17)	$^\circ\text{C}/\text{W}$
Rthj-amb	Thermal Resistance Junction-ambient (Free air) Max	62.5	$^\circ\text{C}/\text{W}$
T_l	Maximum Lead Temperature For Soldering Purpose	300	$^\circ\text{C}$

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	$I_D = 250\text{ }\mu\text{A}$, $V_{GS} = 0$	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	μA μA
I_{GSS}	Gate-body Leakage Current ($V_{DS} = 0$)	$V_{GS} = \pm 20\text{V}$			± 100	nA
$V_{GS(th)}$	Gate Threshold Voltage	$V_{DS} = V_{GS}$, $I_D = 250\text{ }\mu\text{A}$	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 Ω

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}	Input Capacitance	$V_{DS} = 25\text{ V}$, $f = 1\text{ MHz}$, $V_{GS} = 0$		5100		pF
C_{oss}	Output Capacitance			1600		pF
C_{rss}	Reverse Transfer Capacitance			600		pF

Table 7: Switching On/Off

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

Table 8: Source Drain Diode

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

(1) Pulsed: Pulse duration = 300 μs , duty cycle 1.5 %.

(2) Pulse width limited by safe operating area.

Figure 3: Safe Operating Area

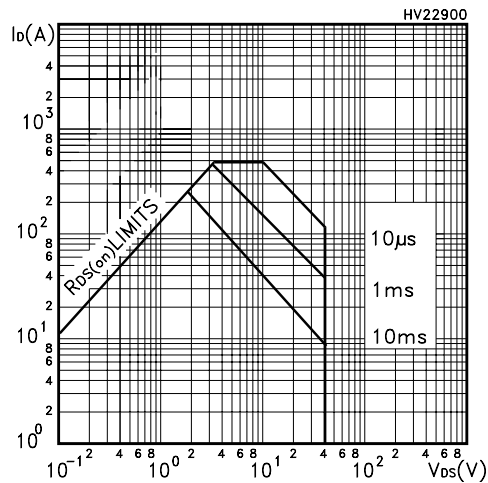


Figure 4: Output Characteristics

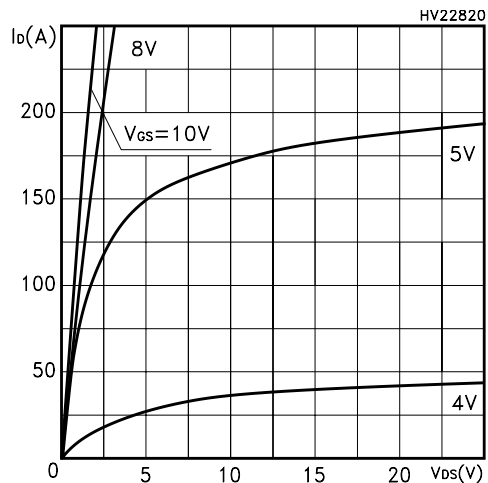


Figure 5: Transconductance

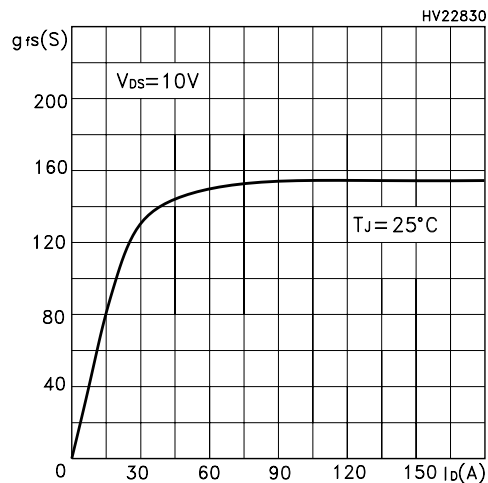


Figure 6: Thermal Impedance

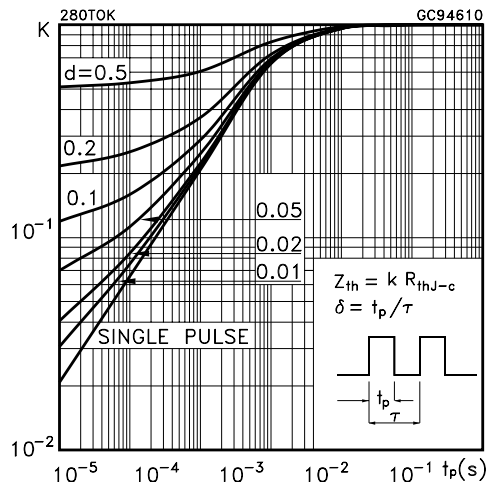


Figure 7: Transfer Characteristics

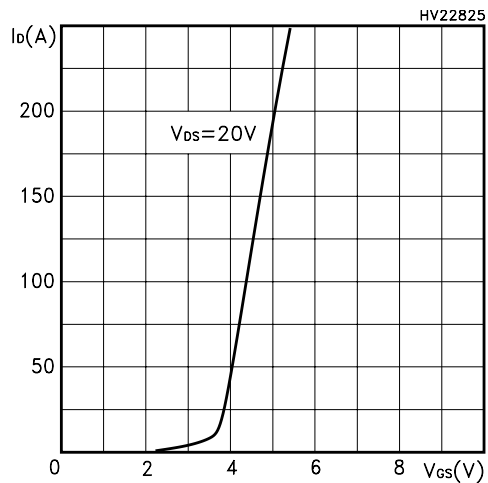


Figure 8: Static Drain-source On Resistance

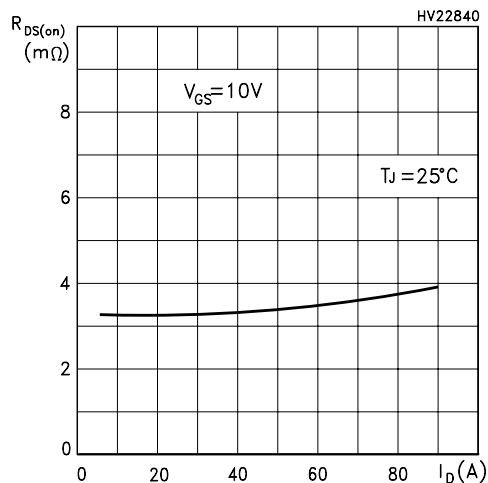


Figure 9: Gate Charge vs Gate-source Voltage

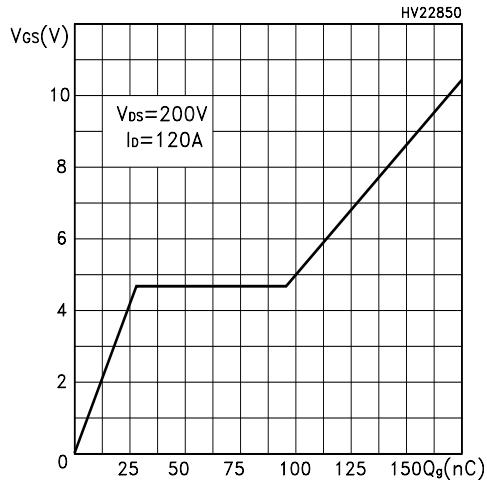


Figure 10: Normalized Gate Threshold Voltage vs Temperature

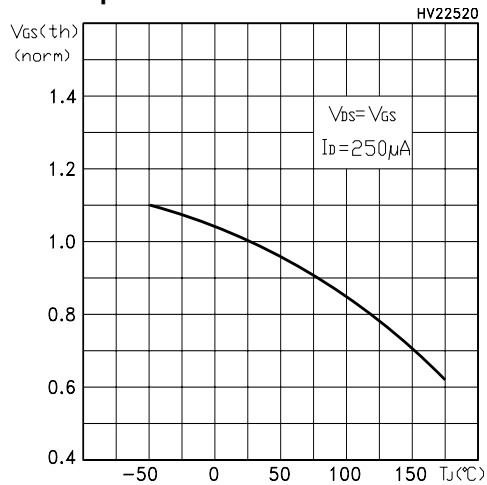


Figure 11: Dource-Drain Diode Forward Characteristics

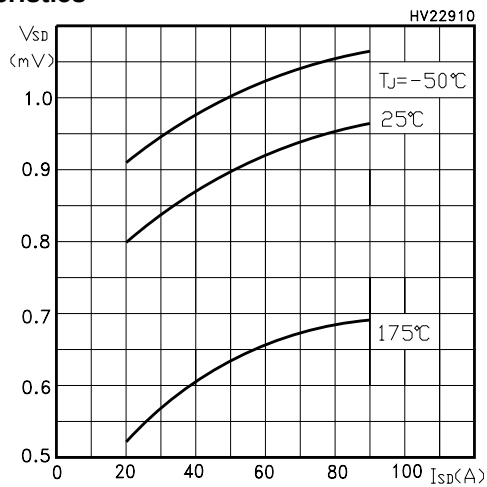


Figure 12: Capacitance Variations

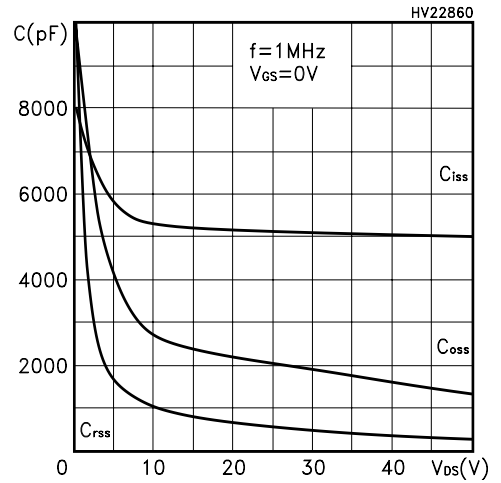


Figure 13: Normalized On Resistance vs Temperature

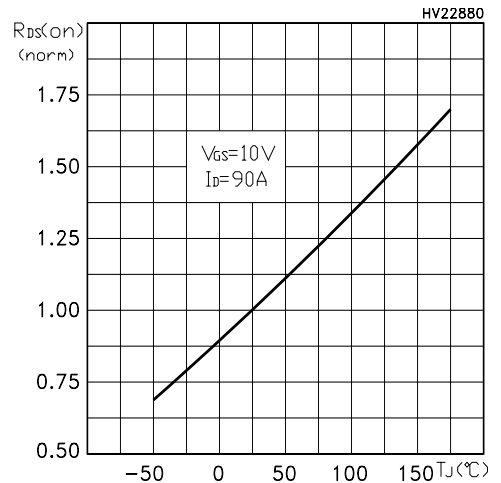


Figure 14: Normalized Breakdown Voltage vs Temperature

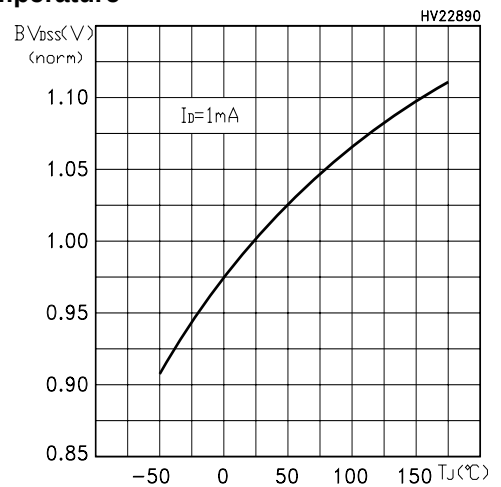


Figure 15: Thermal Resistance Rthj-a vs PCB Copper Area

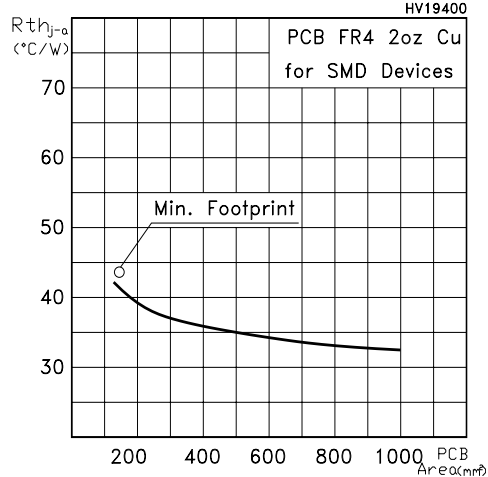


Figure 16: Max Power Dissipation vs PCB Copper Area

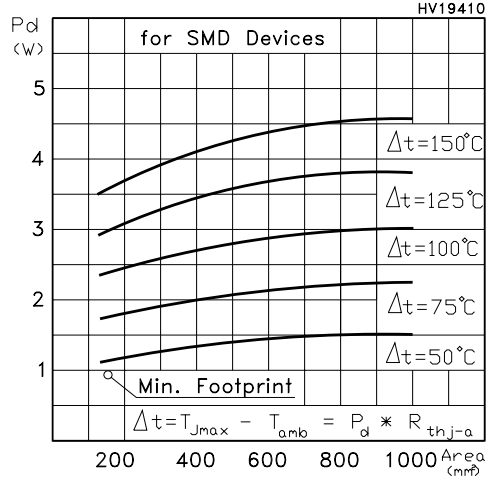
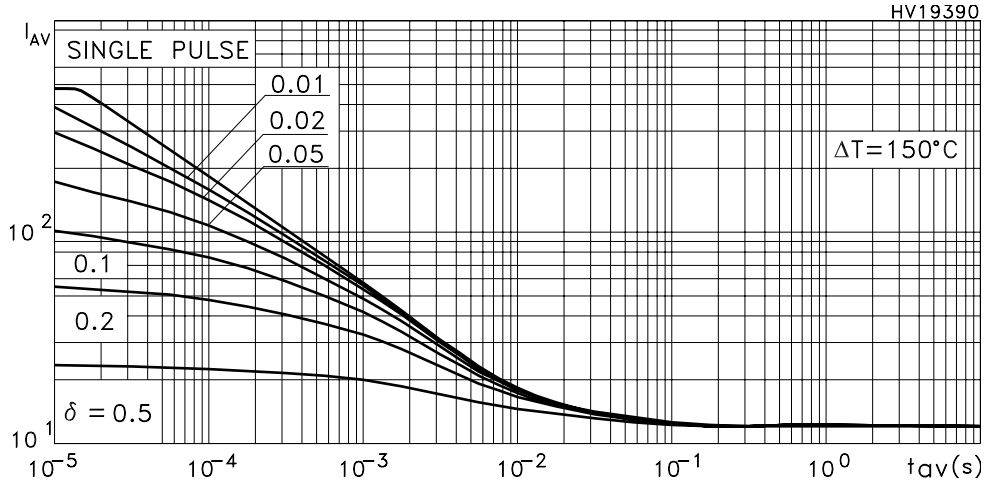


Figure 17: Allowable I_{AV} vs. Time in Avalanche



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°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:

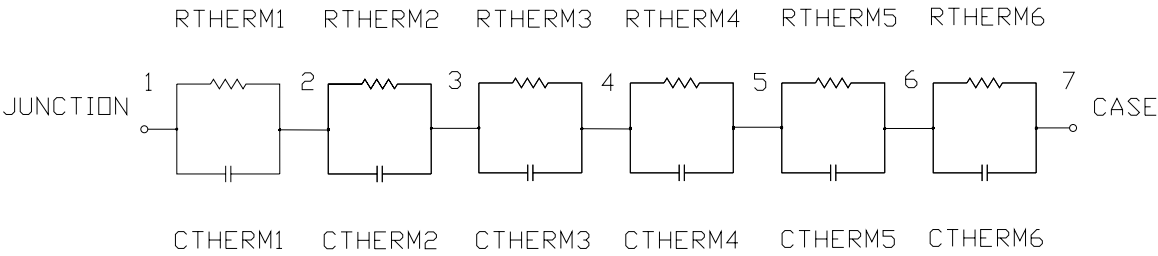
$Z_{th} = K * R_{th}$ is the value coming from Normalized Thermal Response at fixed pulse width equal to T_{AV} .

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
RTHERM1	1 - 2	0.0384
RTHERM2	2 - 3	0.0624
RTHERM3	3 - 4	0.072
RTHERM4	4 - 5	0.0912
RTHERM5	5 - 6	0.1008
RTHERM6	6 - 7	0.1152

Figure 18: Schematic of 6th Order RC Network



SC16500-B

Figure 19: Unclamped Inductive Load Test Circuit

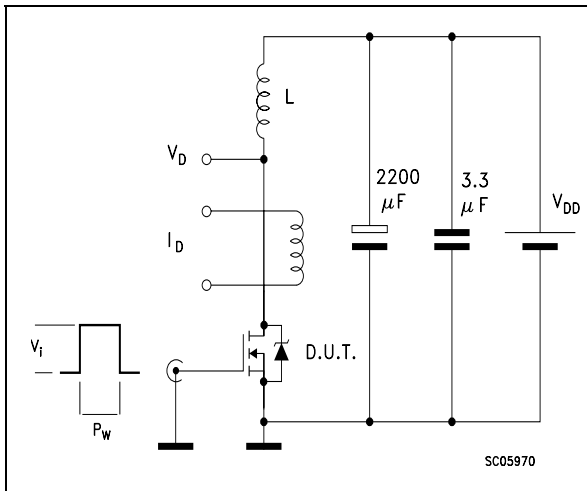


Figure 20: Switching Times Test Circuit For Resistive Load

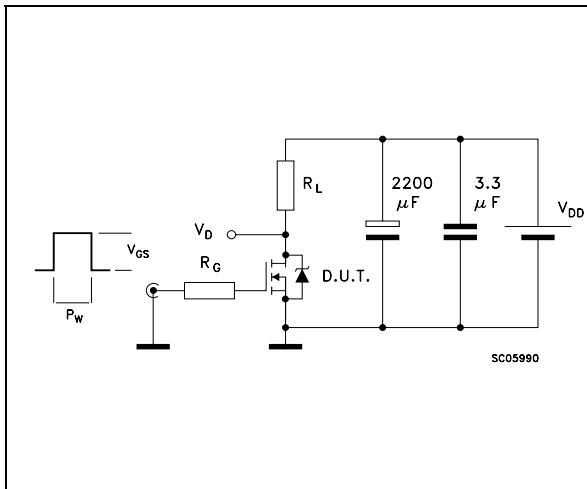


Figure 21: Test Circuit For Inductive Load Switching and Diode Recovery Times

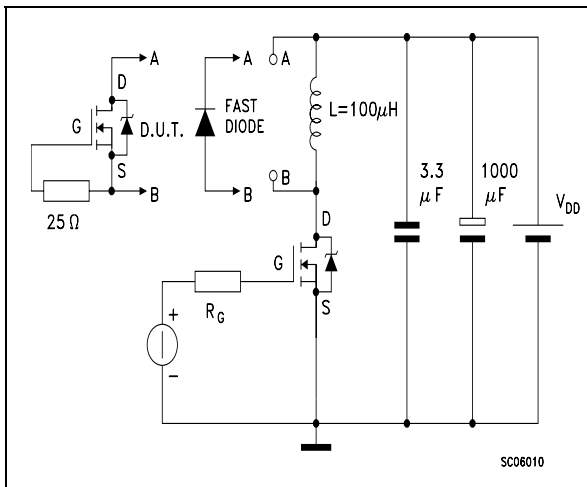


Figure 22: Unclamped Inductive Waform

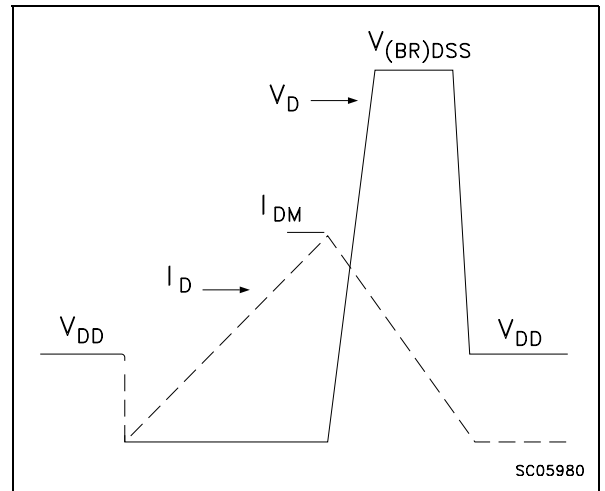
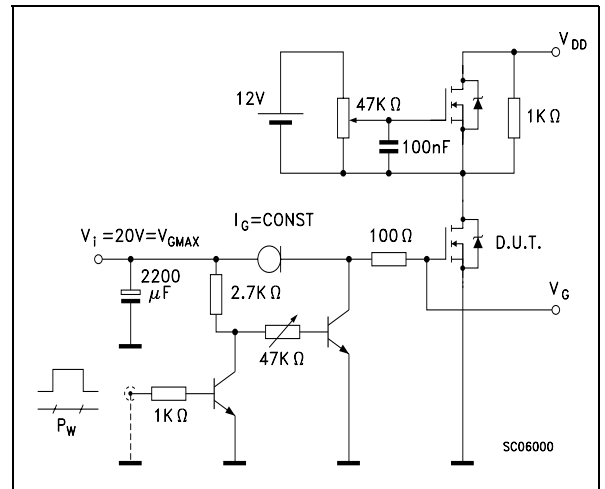
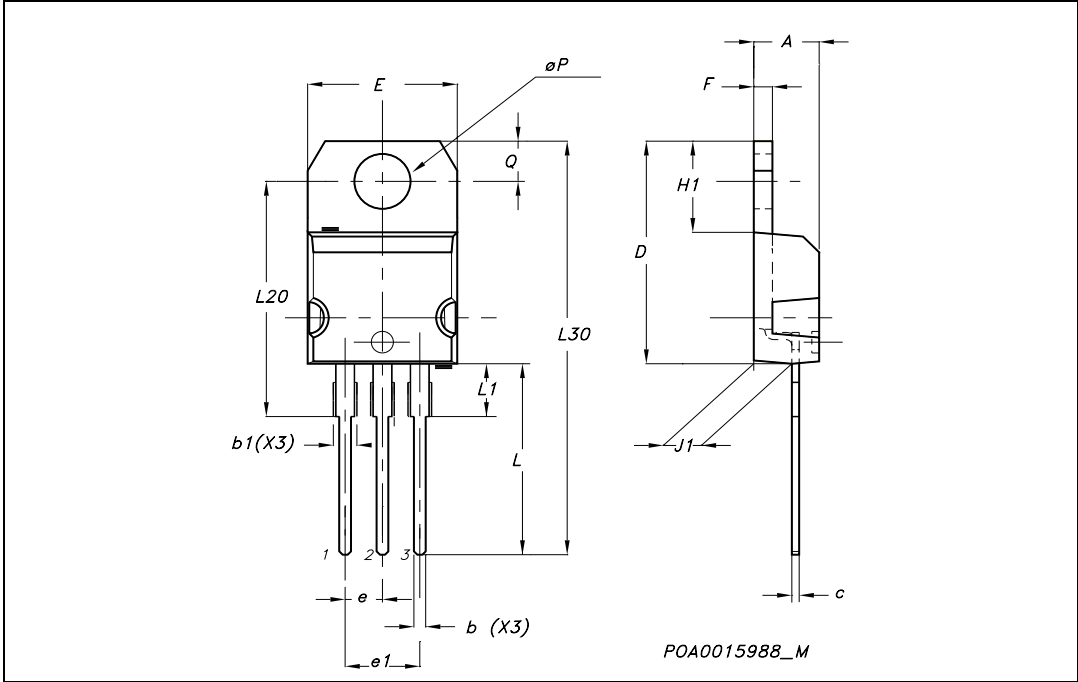


Figure 23: Gate Charge Test Circuit



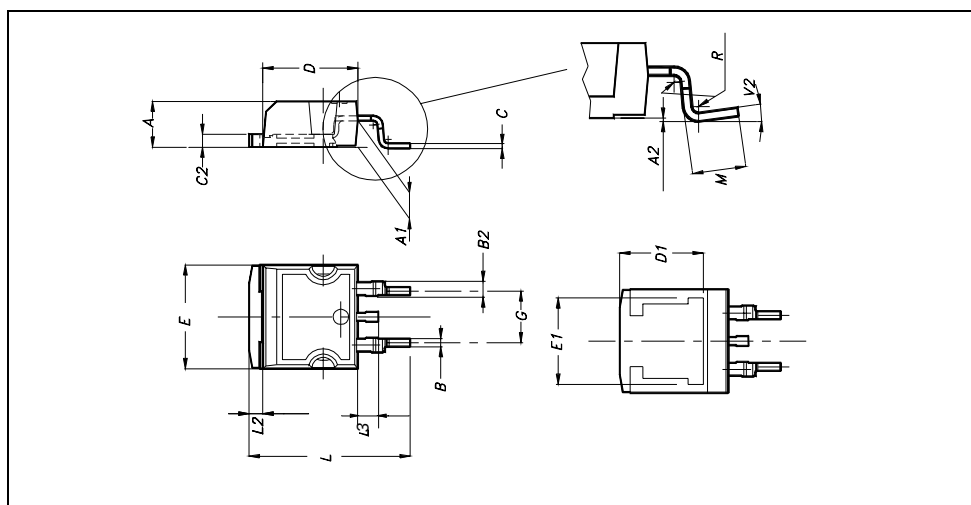
TO-220 MECHANICAL DATA

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



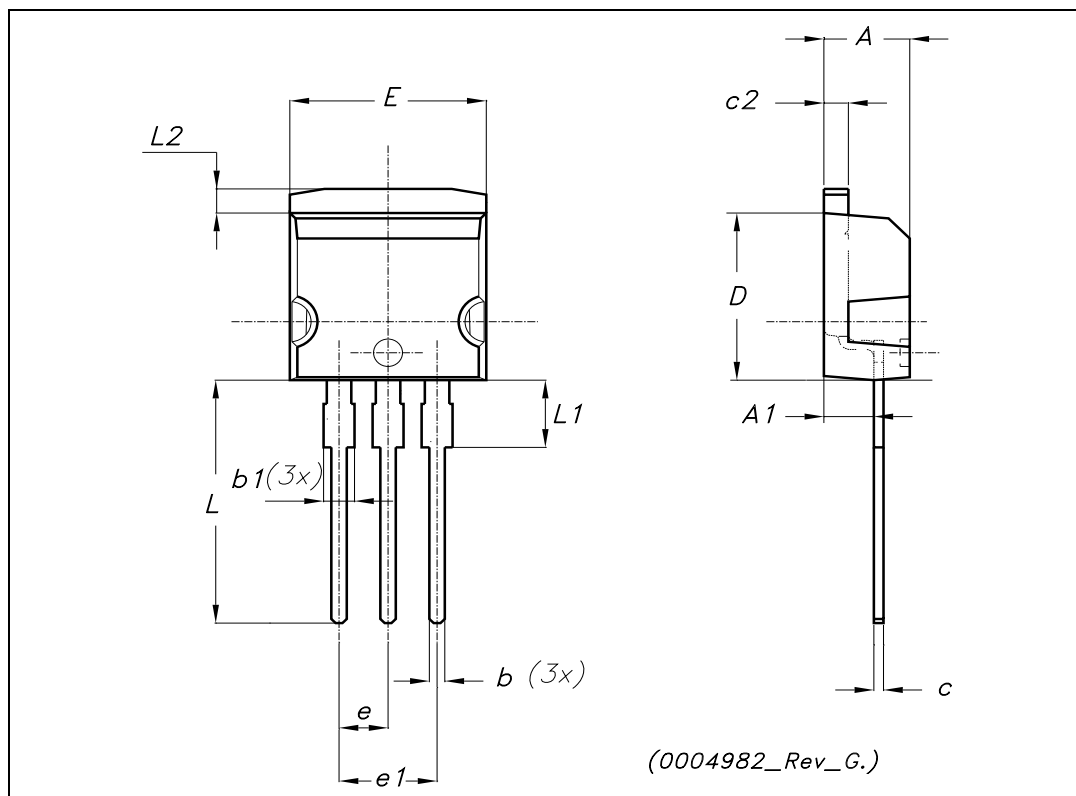
D²PAK MECHANICAL DATA

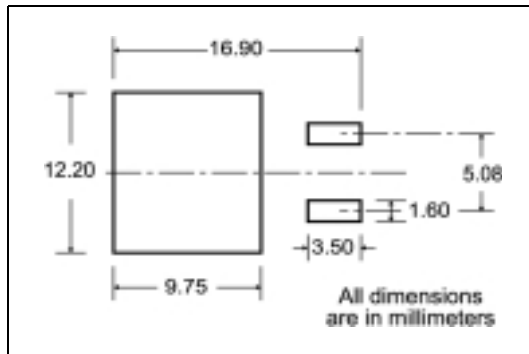
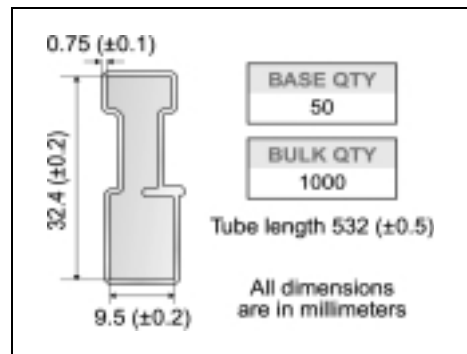
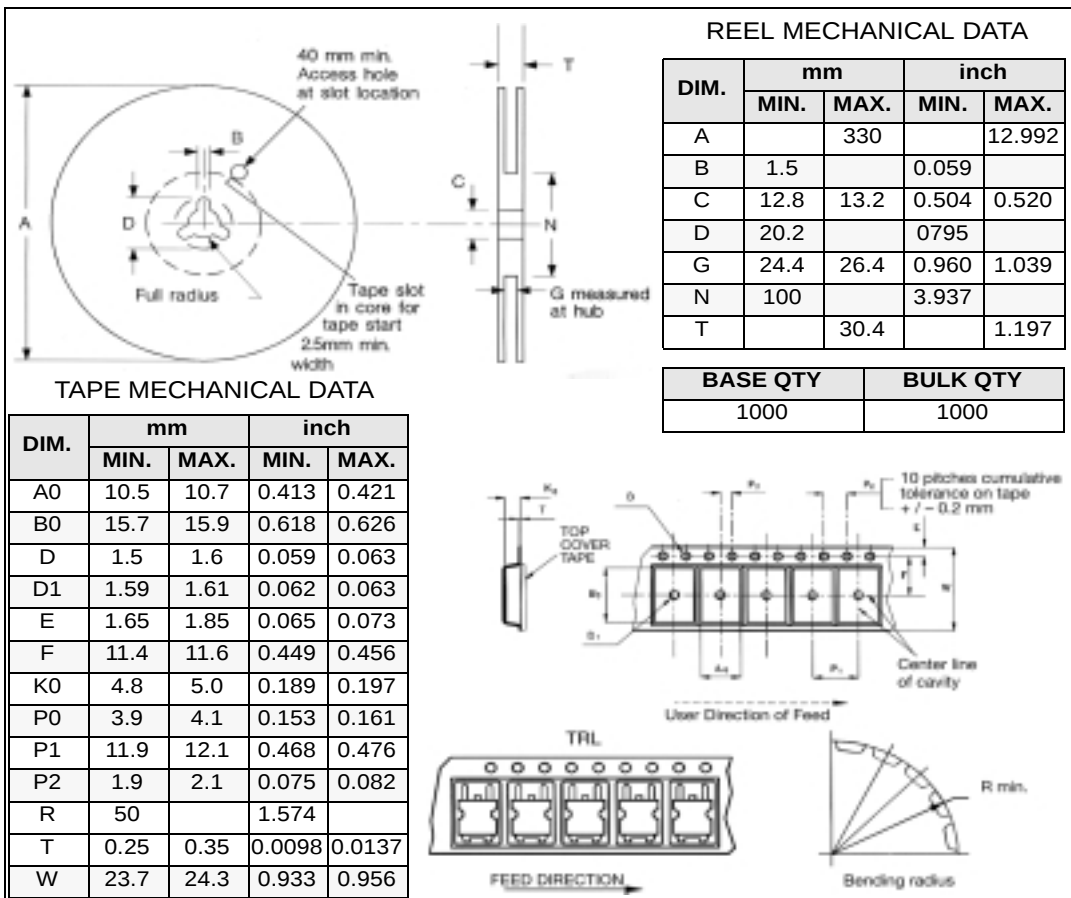
DIM.	mm.			inch		
	MIN.	TYP	MAX.	MIN.	TYP.	MAX.
A	4.4		4.6	0.173		0.181
A1	2.49		2.69	0.098		0.106
A2	0.03		0.23	0.001		0.009
B	0.7		0.93	0.027		0.036
B2	1.14		1.7	0.044		0.067
C	0.45		0.6	0.017		0.023
C2	1.23		1.36	0.048		0.053
D	8.95		9.35	0.352		0.368
D1		8			0.315	
E	10		10.4	0.393		
E1		8.5			0.334	
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 (I²PAK) 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



D²PAK FOOTPRINT**TUBE SHIPMENT (no suffix)*****TAPE AND REEL SHIPMENT (suffix "T4")***

* 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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