



STP40N20-STF40N20 STB40N20 - STW40N20

N-CHANNEL 200V - 0.038Ω - 40A TO-220/FP/TO-247/D²PAK
LOW GATE CHARGE STripFET™ MOSFET

Table 1: General Features

TYPE	V _{DSS}	R _{DS(on)}	I _D	P _w
STP40N20	200 V	< 0.045 Ω	40 A	160 W
STW40N20	200 V	< 0.045 Ω	40 A	160 W
STB40N20	200 V	< 0.045 Ω	40 A	160 W
STF40N20	200 V	< 0.045 Ω	40 A	40 W

- TYPICAL R_{DS(on)} = 0.038 Ω
- GATE CHARGE MINIMIZED
- VERY LOW INTRINSIC CAPACITANCES
- VERY GOOD MANUFACTURING REPEATABILITY
- EXCELLENT FIGURE OF MERIT (R_{DS}*Q_g)
- 100% AVALANCHE TESTED

DESCRIPTION

This MOSFET series realized with STMicroelectronics unique STripFET process has specifically been designed to minimize input capacitance and gate charge. It is therefore suitable as primary switch in advanced high-efficiency isolated DC-DC converters.

APPLICATIONS

- HIGH CURRENT, HIGH SPEED SWITCHING
- UPS

Table 2: Order Codes

SALES TYPE	MARKING	PACKAGE	PACKAGING
STP40N20	P40N20	TO-220	TUBE
STW40N20	W40N20	TO-247	TUBE
STB40N20	B40N20	D ² PAK	TAPE & REEL
STF40N20	F40N20	TO-220FP	TUBE

Figure 1: Package

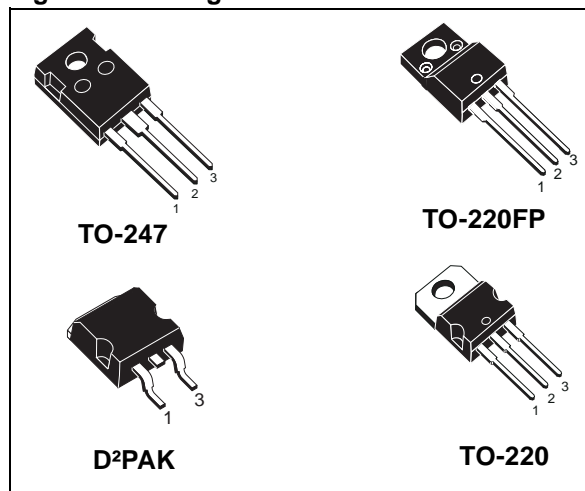


Figure 2: Internal Schematic Diagram

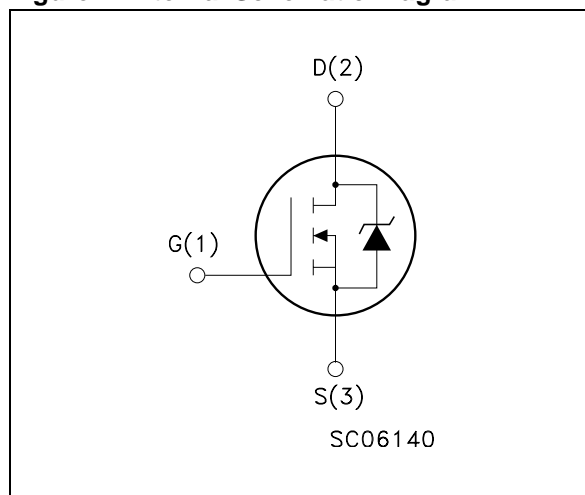


Table 3: Absolute Maximum ratings

Symbol	Parameter	Value		Unit
		TO-220/D ² PAK/ TO247	TO-220FP	
V _{DS}	Drain-source Voltage (V _{GS} = 0)	200		V
V _{DGR}	Drain-gate Voltage (R _{GS} = 20 kΩ)	200		V
V _{GS}	Gate- source Voltage	± 20		V
I _D	Drain Current (continuous) at T _C = 25°C	40		A
I _D	Drain Current (continuous) at T _C = 100°C	25		A
I _{DM} (●)	Drain Current (pulsed)	160		A
P _{TOT}	Total Dissipation at T _C = 25°C	160	40	W
	Derating Factor	1.28	0.32	W/°C
V _{ISO}	Insulation Withstand Voltage	--	2500	V
dv/dt (1)	Peak Diode Recovery voltage slope	12		V/ns
T _j T _{stg}	Operating Junction Temperature Storage Temperature	-55 to 150		°C

(●) Pulse width limited by safe operating area

(1) I_{SD} ≤ 40A, di/dt ≤ 200 A/μs, V_{DD} ≤ V_{(BR)DSS}, T_j ≤ T_{JMAX}.

Table 4: Thermal Data

		TO-220/ D ² PAK	TO-247	TO-220FP	
R _{thj-case}	Thermal Resistance Junction-case Max	0.78		3.1	°C/W
R _{thj-amb}	Thermal Resistance Junction-ambient Max	62.5	50	62.5	°C/W
T _l	Maximum Lead Temperature For Soldering Purpose	300			°C

Table 5: Avalanche Characteristics

Symbol	Parameter	Max Value	Unit
I _{AR}	Avalanche Current, Repetitive or Not-Repetitive (pulse width limited by T _j max)	40	A
E _{AS}	Single Pulse Avalanche Energy (starting T _j = 25 °C, I _D = I _{AR} , V _{DD} = 50 V)	230	mJ

ELECTRICAL CHARACTERISTICS ($T_{CASE} = 25^{\circ}C$ UNLESS OTHERWISE SPECIFIED)**Table 6: On/Off**

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
$V_{(BR)DSS}$	Drain-source Breakdown Voltage	$I_D = 1mA, V_{GS} = 0$	200			V
I_{DSS}	Zero Gate Voltage Drain Current ($V_{GS} = 0$)	$V_{DS} = \text{Max Rating}$ $V_{DS} = \text{Max Rating}, T_C = 125^{\circ}C$			1 10	μA μA
I_{GSS}	Gate-body Leakage Current ($V_{DS} = 0$)	$V_{GS} = \pm 20V$			± 100	nA
$V_{GS(th)}$	Gate Threshold Voltage	$V_{DS} = V_{GS}, I_D = 250 \mu A$	2	3	4	V
$R_{DS(on)}$	Static Drain-source On Resistance	$V_{GS} = 10V, I_D = 20 A$		0.038	0.045	Ω

Table 7: Dynamic

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
$g_{fs} (1)$	Forward Transconductance	$V_{DS} = 15 V, I_D = 20 A$		30		S
C_{iss} C_{oss} C_{rss}	Input Capacitance Output Capacitance Reverse Transfer Capacitance	$V_{DS} = 25V, f = 1 \text{ MHz}, V_{GS} = 0$		2500 510 78		pF pF pF
$t_{d(on)}$ t_r $t_{d(off)}$ t_f	Turn-on Delay Time Rise Time Turn-off Delay Time Fall Time	$V_{DD} = 100 V, I_D = 20 A,$ $R_G = 4.7 \Omega, V_{GS} = 10 V$ (Resistive Load see, Figure 19)		20 44 74 22		ns ns ns ns
Q_g Q_{gs} Q_{gd}	Total Gate Charge Gate-Source Charge Gate-Drain Charge	$V_{DD} = 160V, I_D = 40 A,$ $V_{GS} = 10V$		75 13.2 35.5		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)				40 160	A A
$V_{SD} (1)$	Forward On Voltage	$I_{SD} = 20 A, V_{GS} = 0$			1.5	V
t_{rr} Q_{rr} I_{RRM}	Reverse Recovery Time Reverse Recovery Charge Reverse Recovery Current	$I_{SD} = 20 A, di/dt = 100A/\mu s$ $V_{DD} = 100V, T_j = 25^{\circ}C$ (see test circuit, Figure 20)		192 922 9.6		ns nC A
t_{rr} Q_{rr} I_{RRM}	Reverse Recovery Time Reverse Recovery Charge Reverse Recovery Current	$I_{SD} = 20 A, di/dt = 100A/\mu s$ $V_{DD} = 100V, T_j = 150^{\circ}C$ (see test circuit, Figure 20)		242 1440 11.9		ns nC A

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

(2) Pulse width limited by safe operating area.

Figure 3: Safe Operating Area For TO-220/
D²PAK

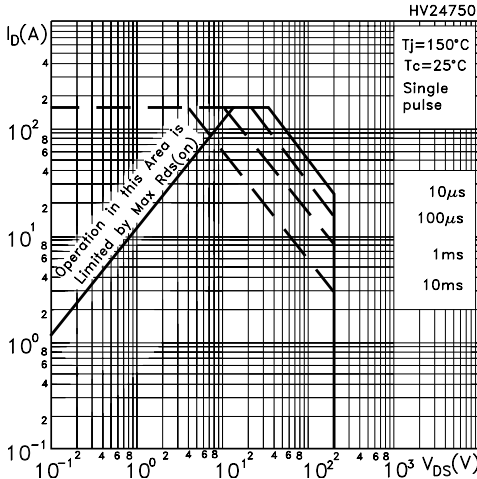


Figure 4: Safe Operating Area For TO-247

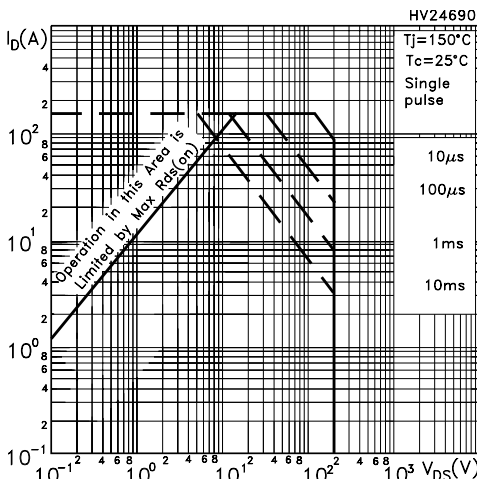


Figure 5: Safe Operating Area For TO-220FP

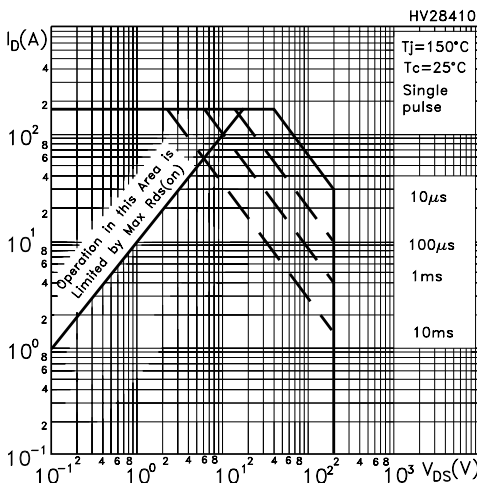


Figure 6: Thermal Impedance For TO-220/
D²PAK

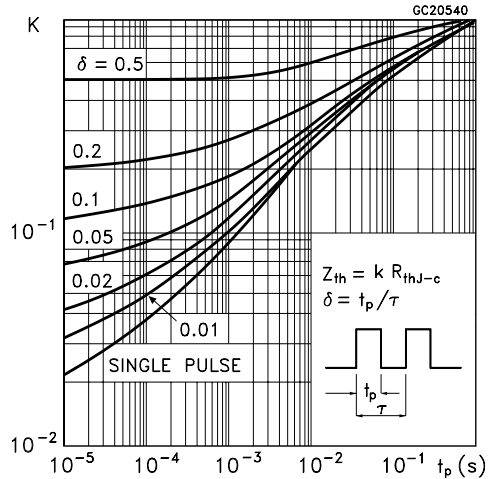


Figure 7: Thermal Impedance For TO-247

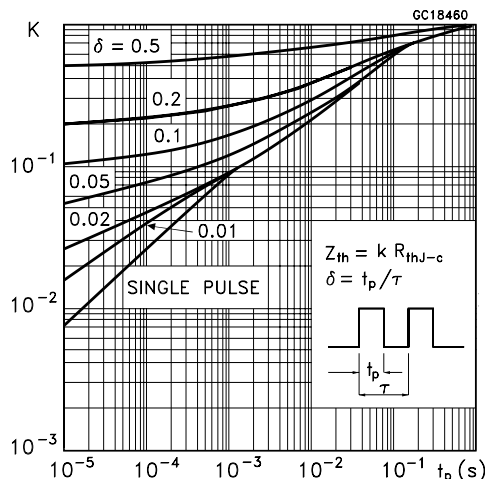


Figure 8: Thermal Impedance For TO-220FP

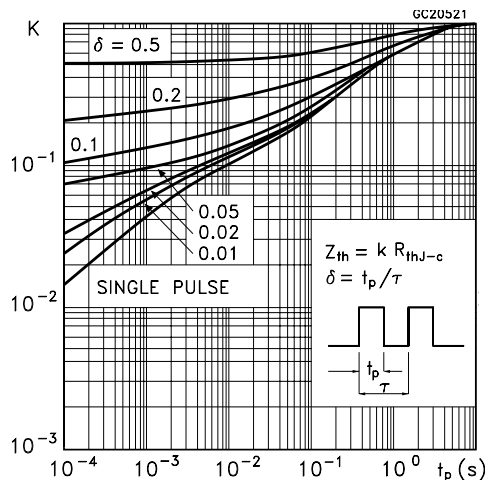


Figure 9: Output Characteristics

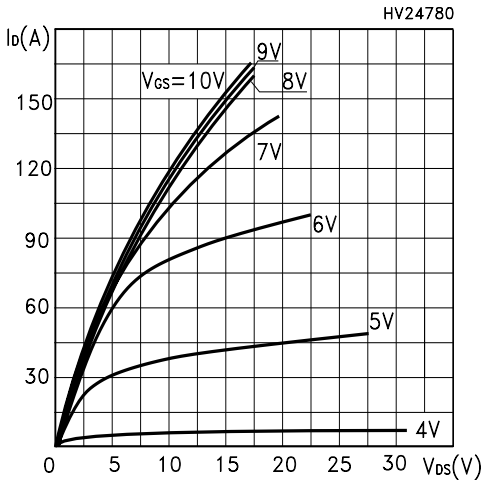


Figure 10: Transconductance

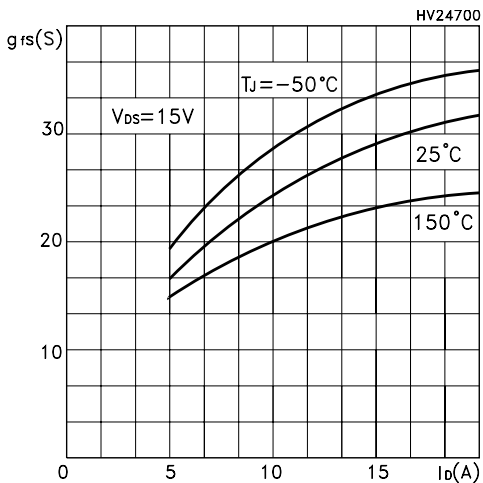


Figure 11: Gate Charge vs Gate-source Voltage

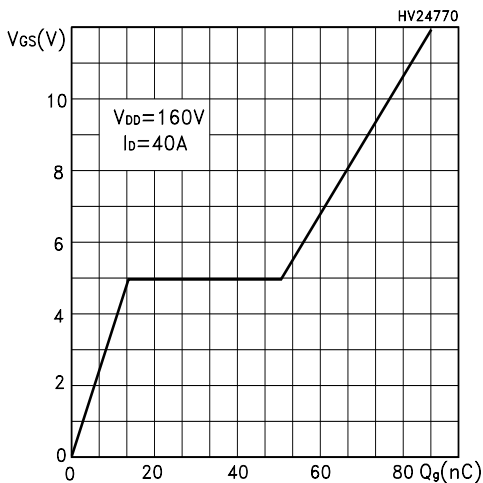


Figure 12: Transfer Characteristics

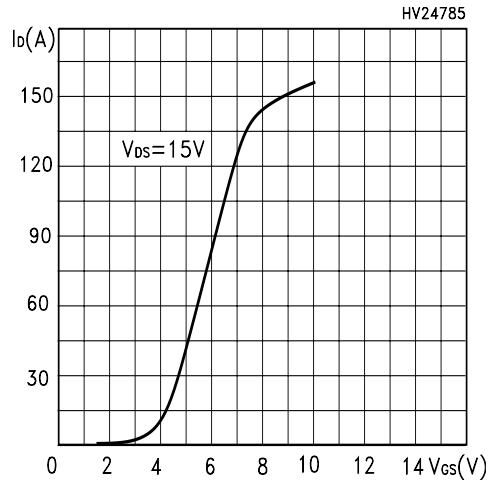


Figure 13: Static Drain-source On Resistance

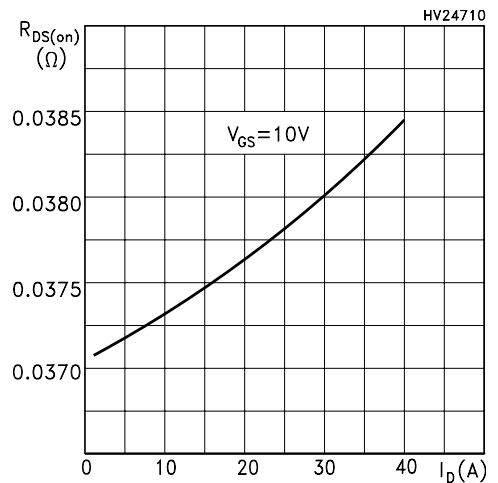


Figure 14: Capacitance Variations

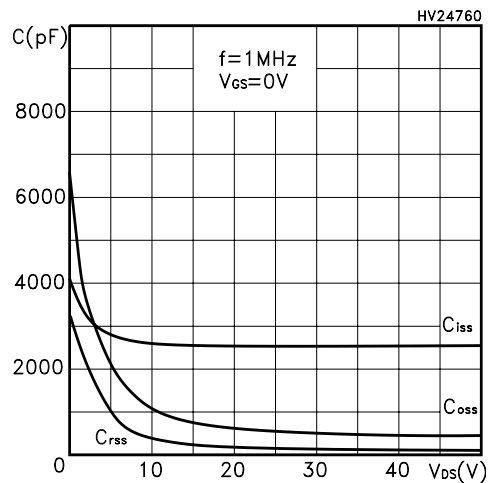


Figure 15: Normalized Gate Threshold Voltage vs Temperature

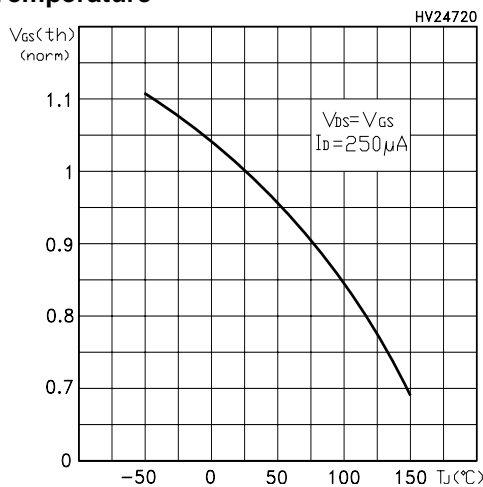


Figure 17: Normalized On Resistance vs Temperature

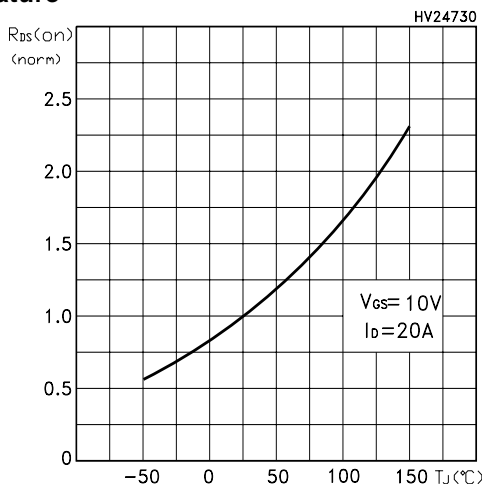


Figure 16: Source-Drain Forward Characteristics

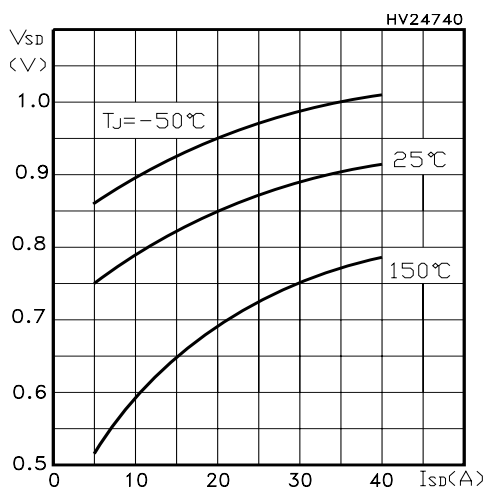


Figure 18: Unclamped Inductive Load Test Circuit

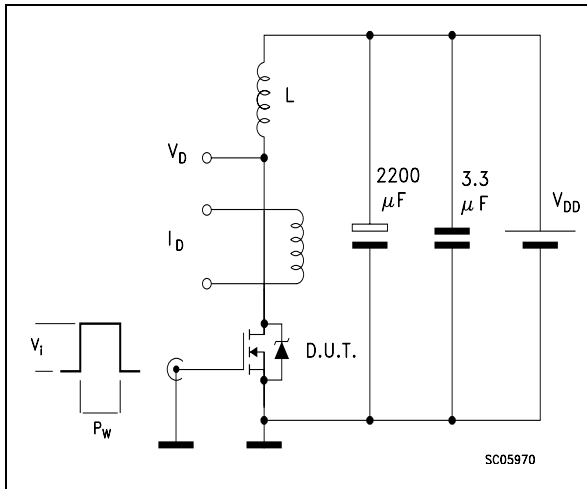


Figure 19: Switching Times Test Circuit For Resistive Load

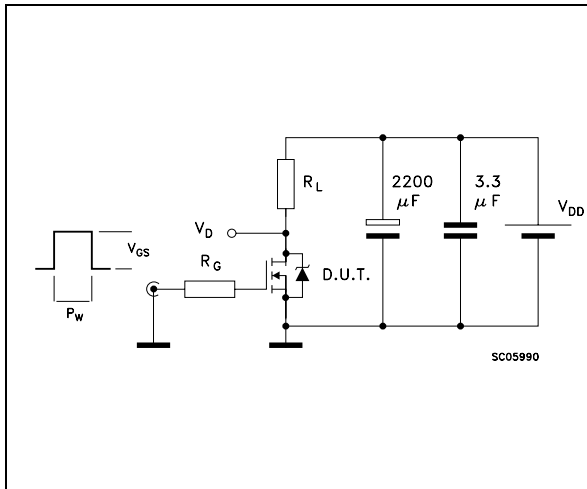


Figure 20: Test Circuit For Inductive Load Switching and Diode Recovery Times

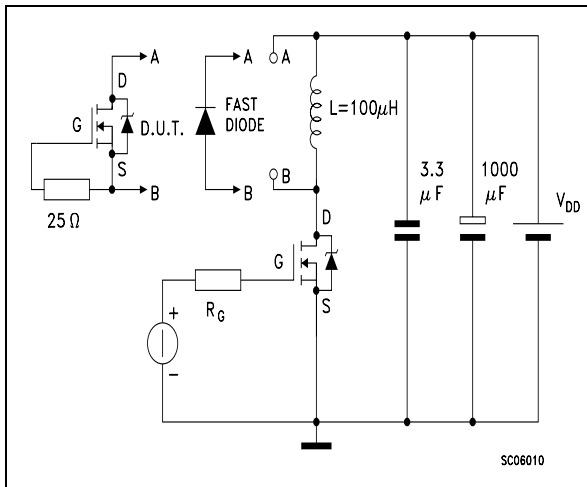


Figure 21: Unclamped Inductive Waform

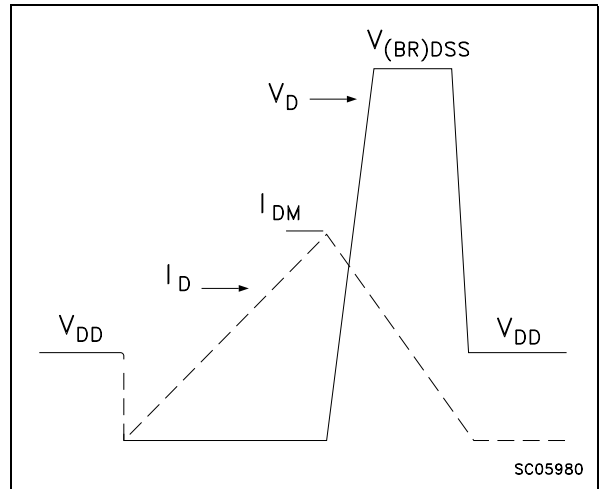
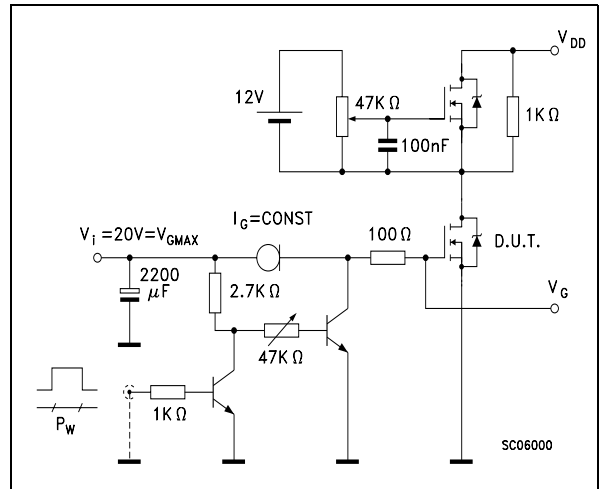
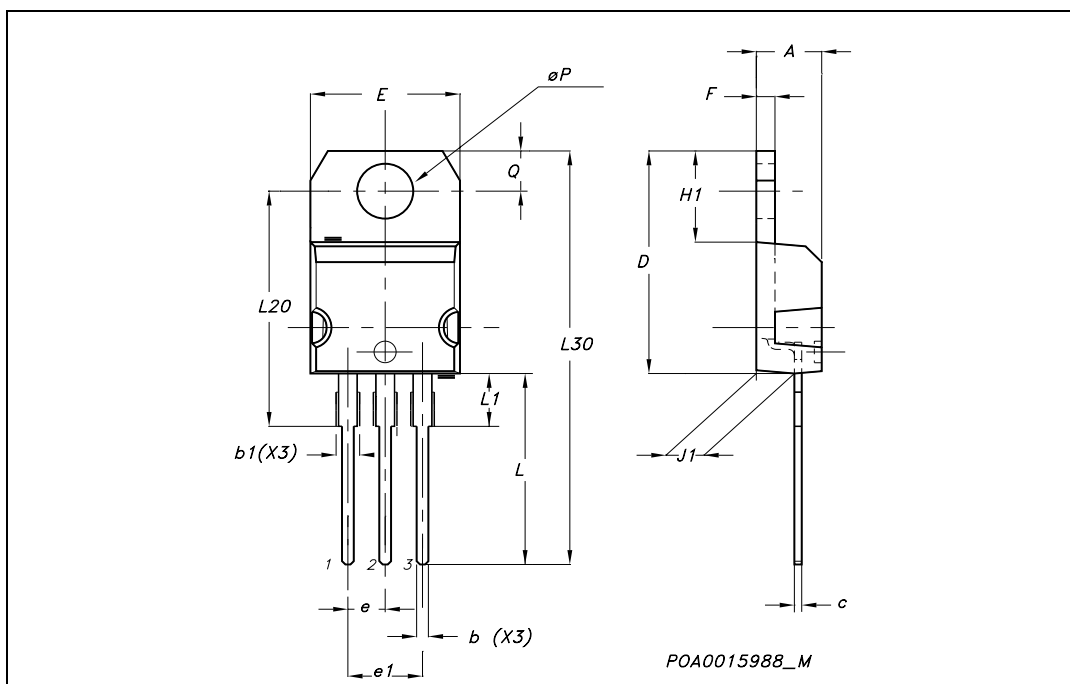


Figure 22: Gate Charge Test Circuit



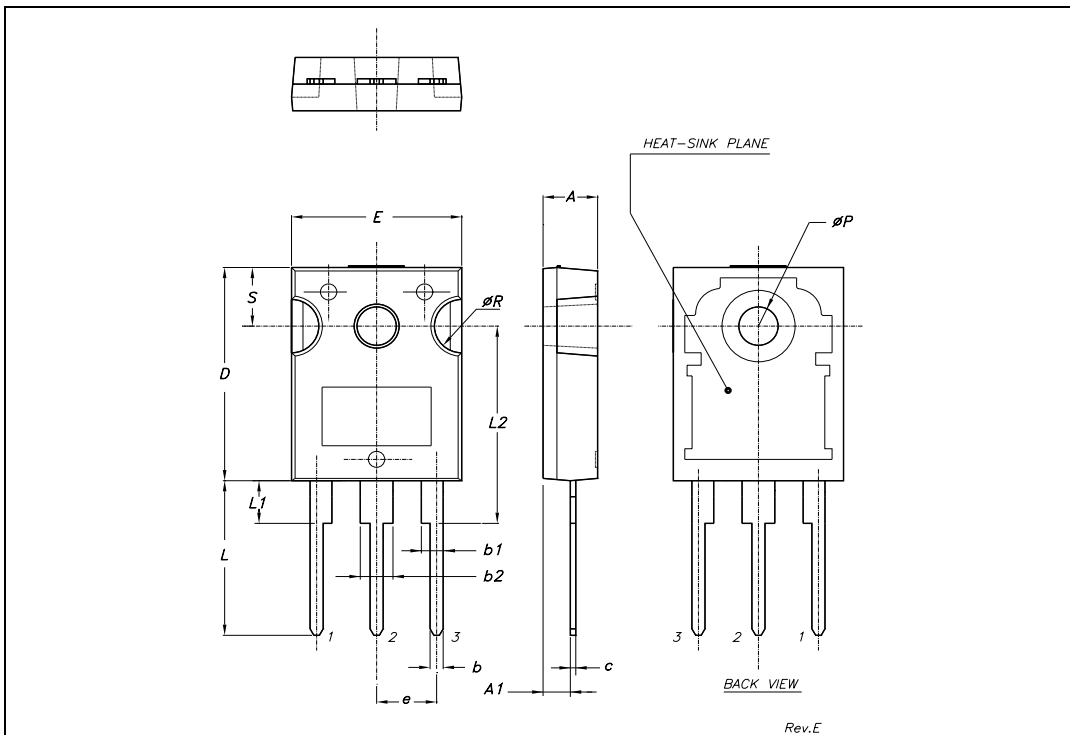
TO-220 MECHANICAL DATA

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



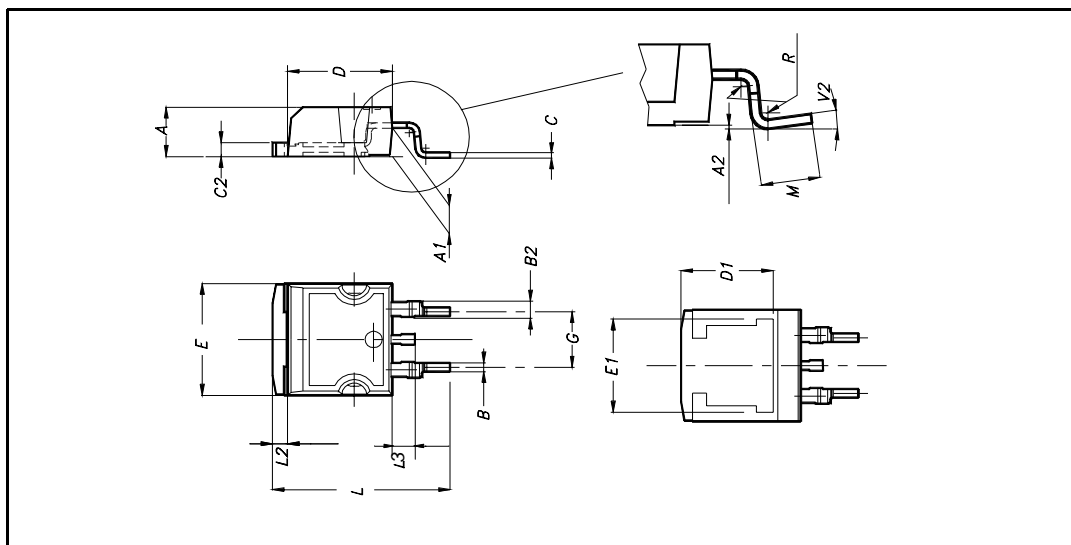
TO-247 MECHANICAL DATA

DIM.	mm.			inch		
	MIN.	TYP	MAX.	MIN.	TYP.	MAX.
A	4.85		5.15	0.19		0.20
A1	2.20		2.60	0.086		0.102
b	1.0		1.40	0.039		0.055
b1	2.0		2.40	0.079		0.094
b2	3.0		3.40	0.118		0.134
c	0.40		0.80	0.015		0.03
D	19.85		20.15	0.781		0.793
E	15.45		15.75	0.608		0.620
e		5.45			0.214	
L	14.20		14.80	0.560		0.582
L1	3.70		4.30	0.14		0.17
L2		18.50			0.728	
øP	3.55		3.65	0.140		0.143
øR	4.50		5.50	0.177		0.216
S		5.50			0.216	



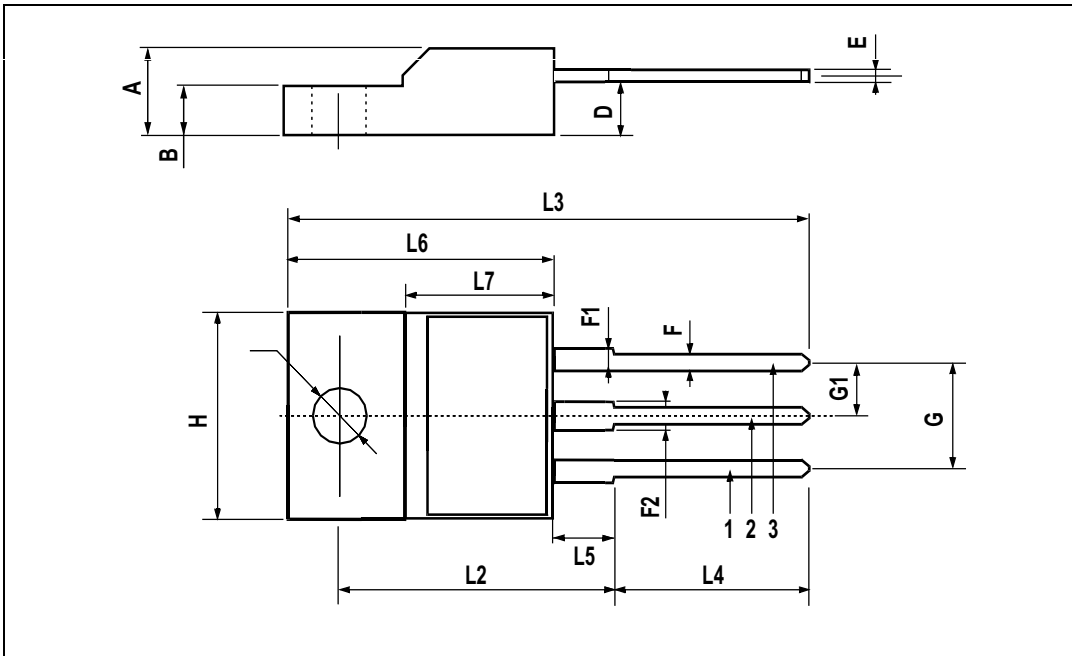
D²PAK MECHANICAL DATA

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°			

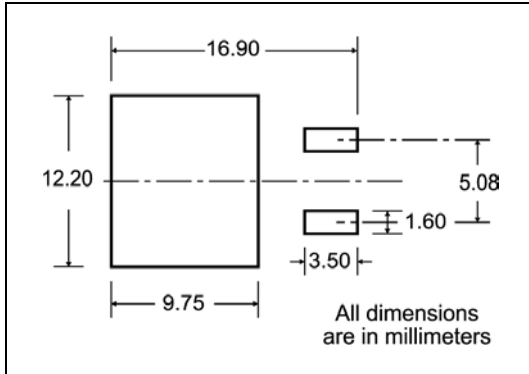


TO-220FP MECHANICAL DATA

DIM.	mm.			inch		
	MIN.	TYP	MAX.	MIN.	TYP.	MAX.
A	4.4		4.6	0.173		0.181
B	2.5		2.7	0.098		0.106
D	2.5		2.75	0.098		0.108
E	0.45		0.7	0.017		0.027
F	0.75		1	0.030		0.039
F1	1.15		1.7	0.045		0.067
F2	1.15		1.7	0.045		0.067
G	4.95		5.2	0.195		0.204
G1	2.4		2.7	0.094		0.106
H	10		10.4	0.393		0.409
L2		16			0.630	
L3	28.6		30.6	1.126		1.204
L4	9.8		10.6	.0385		0.417
L5	2.9		3.6	0.114		0.141
L6	15.9		16.4	0.626		0.645
L7	9		9.3	0.354		0.366
∅	3		3.2	0.118		0.126



D²PAK FOOTPRINT



TAPE AND REEL SHIPMENT

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

TOP COVER TAPE

Center line of cavity

User Direction of Feed

Bending radius R min.

FEED DIRECTION

TRL

* on sales type

Table 9: Revision History

Date	Revision	Description of Changes
27-Sep-2004	1	First Release.
03-Feb-2005	2	Complete Version
03-Jun-2005	3	Update with D ² PAK
27-Oct-2005	4	Inserted TO-220FP

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