



STGP7NC60H - STGD7NC60H

N-CHANNEL 14A - 600V TO-220/DPAK

Very Fast PowerMESH™ IGBT

Table 1: General Features

TYPE	V _{CES}	V _{CE(sat)} (Max) @25°C	I _C @100°C
STGP7NC60H	600 V	< 2.5 V	14 A
STGD7NC60HT4	600 V	< 2.5 V	14 A

- LOWER ON-VOLTAGE DROP (V_{cesat})
- OFF LOSSES INCLUDE TAIL CURRENT
- LOWER C_{RES}/C_{IES} RATIO
- HIGH FREQUENCY OPERATION UP TO 70 KHz
- NEW GENERATION PRODUCTS WITH TIGHTER PARAMETER DISTRIBUTION

DESCRIPTION

Using the latest high voltage technology based on a patented strip layout, STMicroelectronics has designed an advanced family of IGBTs, the PowerMESH™ IGBTs, with outstanding performances. The suffix "H" identifies a family optimized for high frequency applications in order to achieve very high switching performances (reduced t_{fall}) maintaining a low voltage drop.

APPLICATIONS

- HIGH FREQUENCY INVERTERS
- SMPS AND PFC IN BOTH HARD SWITCH AND RESONANT TOPOLOGIES
- MOTOR DRIVERS

Figure 1: Package

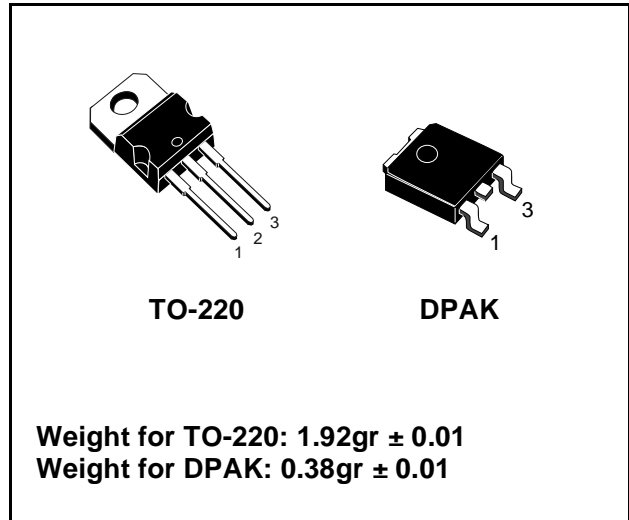


Figure 2: Internal Schematic Diagram

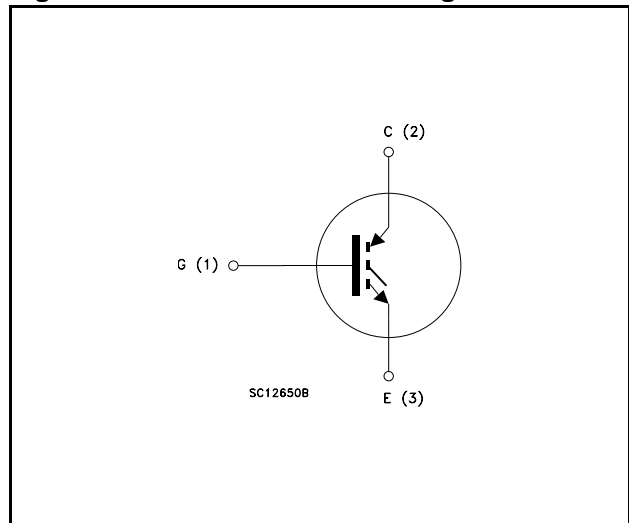


Table 2: Order Code

PART NUMBER	MARKING	PACKAGE	PACKAGING
STGP7NC60H	GP7NC60H	TO-220	TUBE
STGD7NC60HT4	D7NC60H	DPAK	TAPE & REEL

Table 3: Absolute Maximum ratings

Symbol	Parameter	Value		Unit
		TO-220	DPAK	
V _{CES}	Collector-Emitter Voltage (V _{GS} = 0)	600		V
V _{ECR}	Emitter-Collector Voltage	20		V
V _{GE}	Gate-Emitter Voltage	±20		V
I _C	Collector Current (continuous) at T _C = 25°C (#)	25		A
I _C	Collector Current (continuous) at T _C = 100°C (#)	14		A
I _{CM} (☒)	Collector Current (pulsed)	50		A
P _{TOT}	Total Dissipation at T _C = 25°C	80	70	W
	Derating Factor	0.64	0.56	W/°C
T _{stg}	Storage Temperature	- 55 to 150		°C
T _j	Operating Junction Temperature			

(☒) Pulse width limited by max. junction temperature.

Table 4: Thermal Data

			Min.	Typ.	Max.	
R _{thj-case}	Thermal Resistance Junction-case	TO-220			1.56	°C/W
		DPAK			1.78	
R _{thj-amb}	Thermal Resistance Junction-ambient	TO-220			62.5	°C/W
		DPAK			100	
T _L	Maximum Lead Temperature for Soldering Purpose (1.6 mm from case, for 10 sec.)	TO-220		300		°C
		DPAK		275		

ELECTRICAL CHARACTERISTICS (T_{CASE} =25°C UNLESS OTHERWISE SPECIFIED)

Table 5: Main Parameters

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
V _{BR(CES)}	Collector-Emitter Breakdown Voltage	I _C = 1 mA, V _{GE} = 0	600			V
I _{CES}	Collector cut-off Current (V _{GE} = 0)	V _{CE} = Max Rating, T _C = 25 °C V _{CE} = Max Rating, T _C = 125 °C			10 1	μA mA
I _{GES}	Gate-Emitter Leakage Current (V _{CE} = 0)	V _{GE} = ± 20V , V _{CE} = 0			±100	nA
V _{GE(th)}	Gate Threshold Voltage	V _{CE} = V _{GE} , I _C = 250 μA	3.75		5.75	V
V _{CE(sat)}	Collector-Emitter Saturation Voltage	V _{GE} = 15V, I _C = 7 A V _{GE} = 15V, I _C = 7 A, T _C = 125°C		1.85 1.7	2.5	V V

(#) Calculated according to the iterative formula:

$$I_C(T_C) = \frac{T_{JMAX} - T_C}{R_{THJ-C} \times V_{CESAT(MAX)}(T_C, I_C)}$$

ELECTRICAL CHARACTERISTICS (CONTINUED)

Table 6: Dynamic

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
g_{fs} (1)	Forward Transconductance	$V_{CE} = 15 \text{ V}$, $I_C = 7 \text{ A}$		4.30		S
C_{ies}	Input Capacitance	$V_{CE} = 25 \text{ V}$, $f = 1 \text{ MHz}$, $V_{GE} = 0$		720		pF
C_{oes}	Output Capacitance			81		pF
C_{res}	Reverse Transfer Capacitance			17		pF
Q_g	Total Gate Charge	$V_{CE} = 390 \text{ V}$, $I_C = 7 \text{ A}$, $V_{GE} = 15 \text{ V}$ (see Figure 21)		35	48	nC
Q_{ge}	Gate-Emitter Charge			7		nC
Q_{gc}	Gate-Collector Charge			16		nC
I_{CL}	Turn-Off SOA Minimum Current	$V_{clamp} = 480 \text{ V}$, $T_J = 150^\circ\text{C}$ $R_G = 10 \Omega$, $V_{GE} = 15 \text{ V}$	50			A

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

Table 7: Switching On

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
$t_{d(on)}$	Turn-on Delay Time	$V_{CC} = 390 \text{ V}$, $I_C = 7 \text{ A}$ $R_G = 10 \Omega$, $V_{GE} = 15 \text{ V}$, $T_J = 25^\circ\text{C}$ (see Figure 18)		18.5		ns
t_r	Current Rise Time			8.5		ns
$(di/dt)_{on}$	Turn-on Current Slope			1060		A/ μs
$t_{d(on)}$	Turn-on Delay Time	$V_{CC} = 390 \text{ V}$, $I_C = 7 \text{ A}$ $R_G = 10 \Omega$, $V_{GE} = 15 \text{ V}$, $T_J = 125^\circ\text{C}$ (see Figure 19)		18.5		ns
t_r	Current Rise Time			7		ns
$(di/dt)_{on}$	Turn-on Current Slope			1000		A/ μs

Table 8: Switching Off

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
$t_r(V_{off})$	Off Voltage Rise Time	$V_{CC} = 390 \text{ V}$, $I_C = 7 \text{ A}$, $R_G = 10 \Omega$, $V_{GE} = 15 \text{ V}$ $T_J = 25^\circ\text{C}$ (see Figure 19)		27		ns
$t_{d(off)}$	Turn-off Delay Time			72		ns
t_f	Current Fall Time			60		ns
$t_r(V_{off})$	Off Voltage Rise Time	$V_{CC} = 390 \text{ V}$, $I_C = 7 \text{ A}$, $R_G = 10 \Omega$, $V_{GE} = 15 \text{ V}$ $T_J = 125^\circ\text{C}$ (see Figure 19)		56		ns
$t_{d(off)}$	Turn-off Delay Time			116		ns
t_f	Current Fall Time			105		ns

Table 9: Switching Energy

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
E_{on} (2)	Turn-on Switching Losses	$V_{CC} = 390 \text{ V}$, $I_C = 7 \text{ A}$ $R_G = 10 \Omega$, $V_{GE} = 15 \text{ V}$, $T_J = 25^\circ\text{C}$ (see Figure 19)		95	125	μJ
E_{off} (3)	Turn-off Switching Loss			115	150	μJ
E_{ts}	Total Switching Loss			210	275	μJ
E_{on} (2)	Turn-on Switching Losses	$V_{CC} = 390 \text{ V}$, $I_C = 7 \text{ A}$ $R_G = 10 \Omega$, $V_{GE} = 15 \text{ V}$, $T_J = 125^\circ\text{C}$ (see Figure 19)		140		μJ
E_{off} (3)	Turn-off Switching Loss			215		μJ
E_{ts}	Total Switching Loss			355		μJ

2) E_{on} is the turn-on losses when a typical diode is used in the test circuit in figure 2. If the IGBT is offered in a package with a co-pack diode, the co-pack diode is used as external diode. IGBTs & DIODE are at the same temperature (25°C and 125°C)

(3) Turn-off losses include also the tail of the collector current.

Figure 3: Output Characteristics

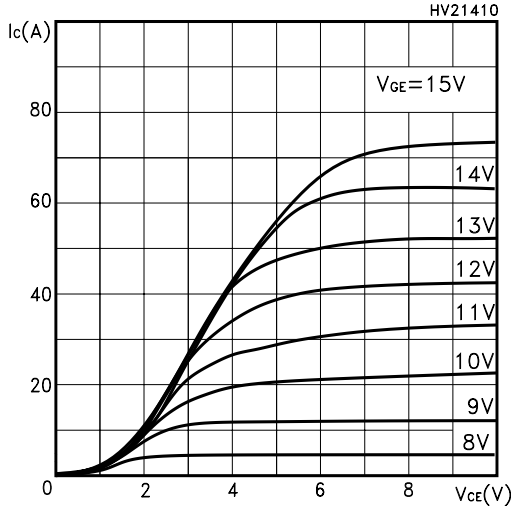


Figure 4: Transconductance

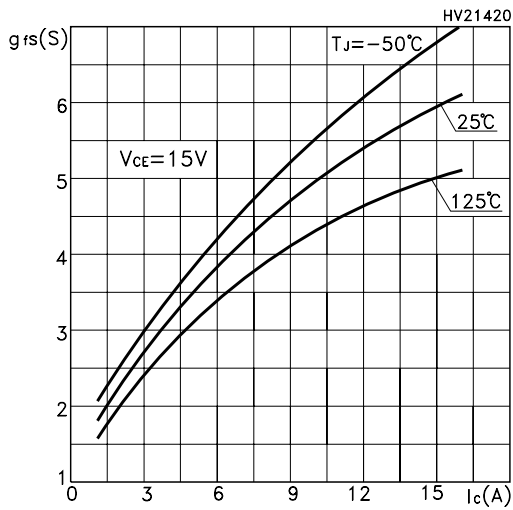


Figure 5: Collector-Emitter On Voltage vs Collector Current

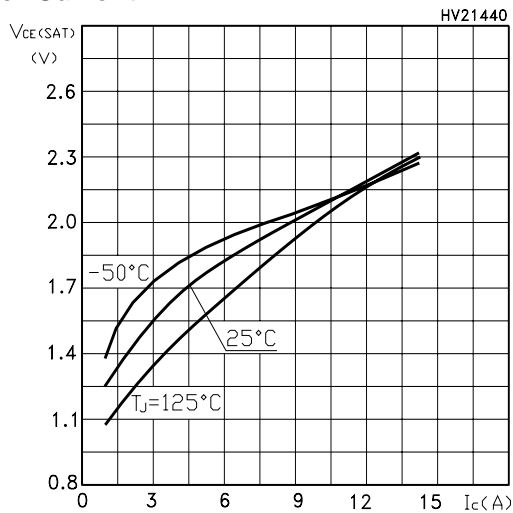


Figure 6: Transfer Characteristics

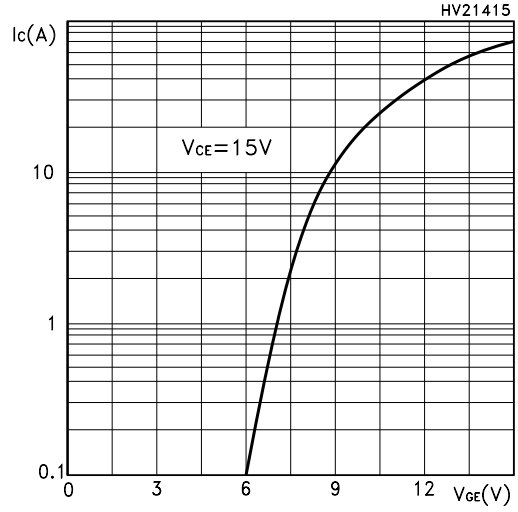


Figure 7: Collector-Emitter On Voltage vs Temperature

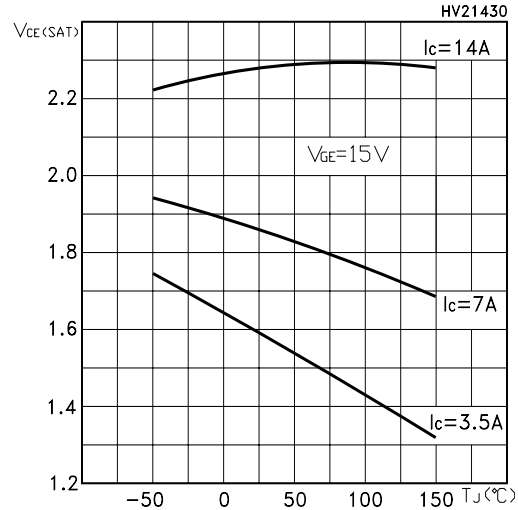


Figure 8: Normalized Gate Threshold vs Temperature

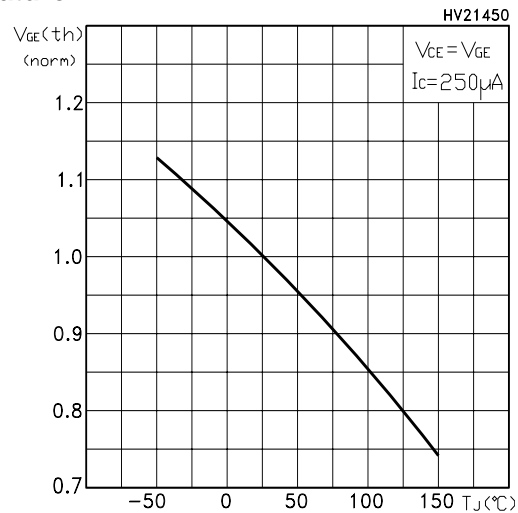


Figure 9: Normalized Breakdown Voltage vs Temperature

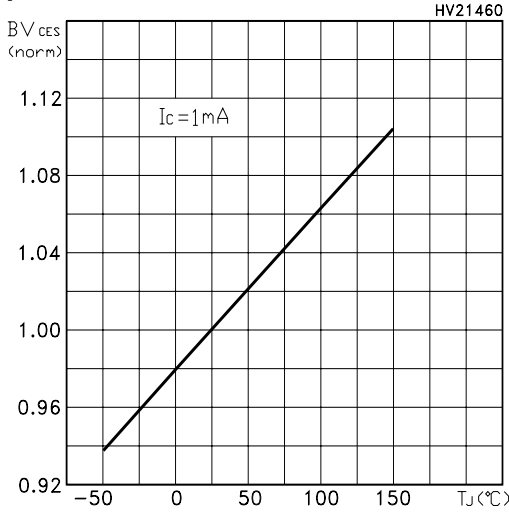


Figure 10: Capacitance Variations

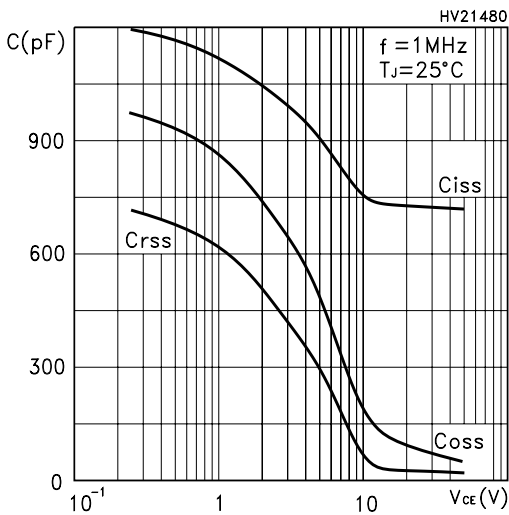


Figure 11: Total Switching Losses vs Gate Resistance

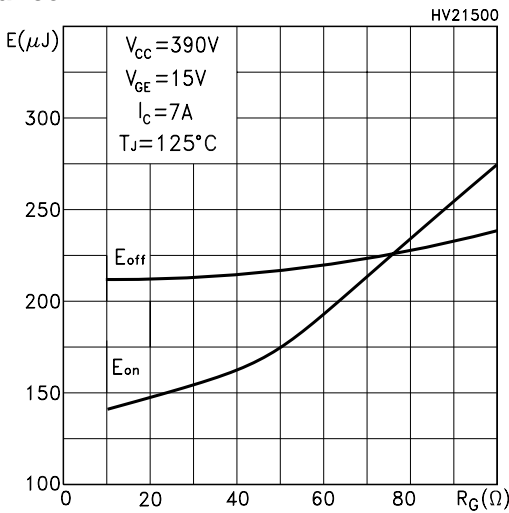


Figure 12: Gate Charge vs Gate-Emitter Voltage

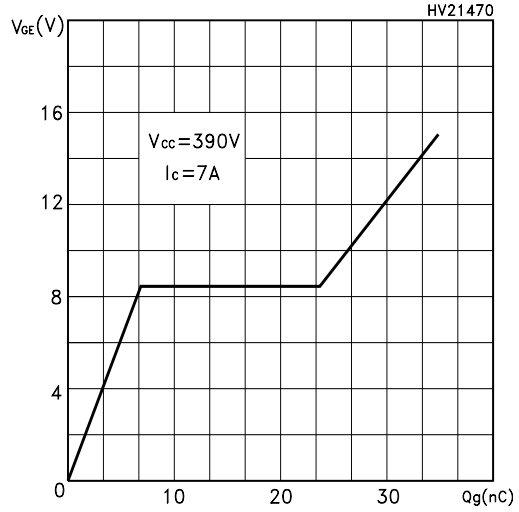


Figure 13: Total Switching Losses vs Temperature

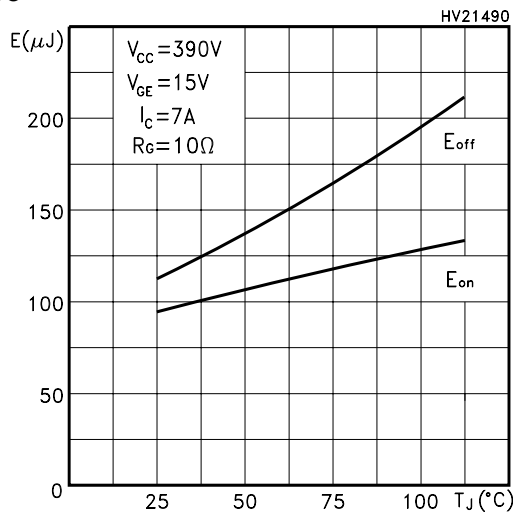


Figure 14: Total Switching Losses vs Collector Current

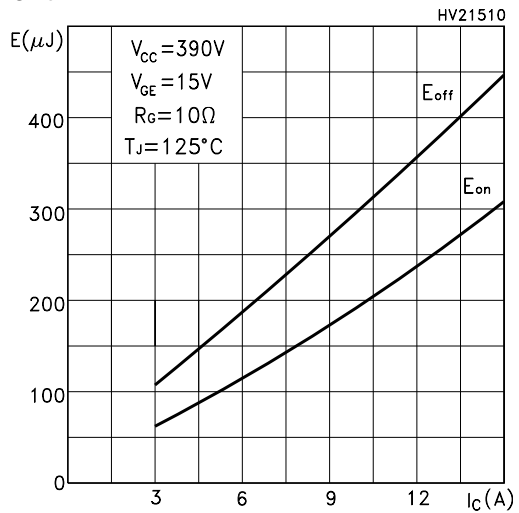


Figure 15: Thermal Impedance for TO-220

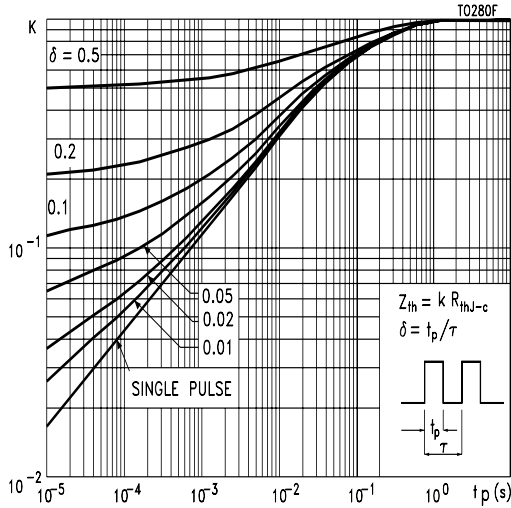


Figure 16: Thermal Impedance for DPAK

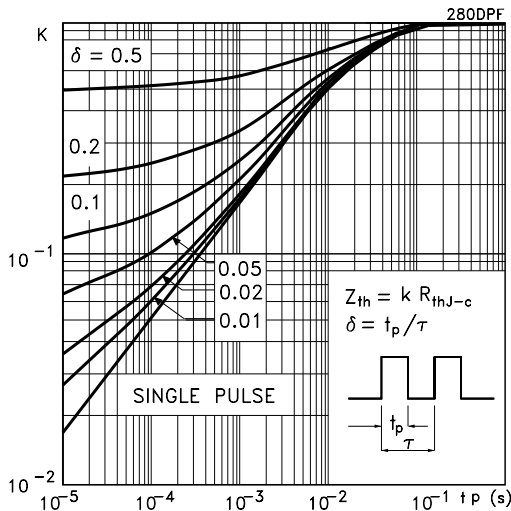


Figure 17: Turn-Off SOA

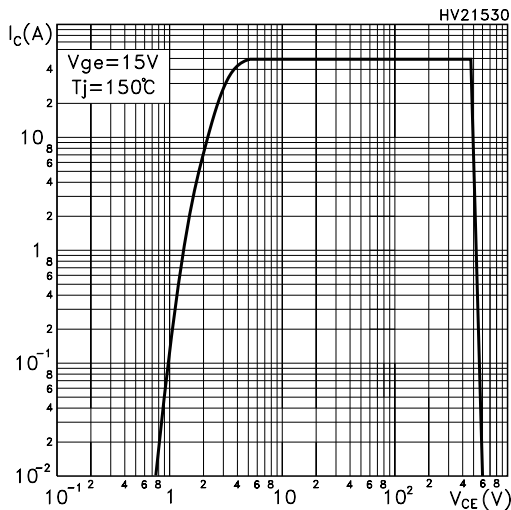
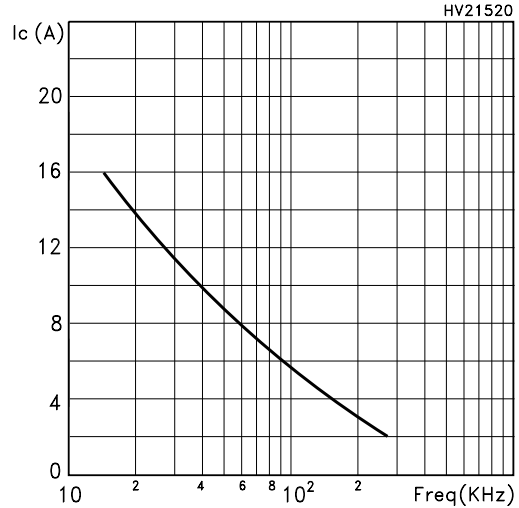


Figure 18: Ic vs Frequency



For a fast IGBT suitable for high frequency applications, the typical collector current vs. maximum operating frequency curve is reported. That frequency is defined as follows:

$$f_{MAX} = (P_D - P_C) / (E_{ON} + E_{OFF})$$

1) The maximum power dissipation is limited by maximum junction to case thermal resistance:

$$P_D = \Delta T / R_{THJ-C}$$

considering $\Delta T = T_J - T_C = 125^\circ C - 75^\circ C = 50^\circ C$

2) The conduction losses are:

$$P_C = I_C * V_{CE(SAT)} * \delta$$

with 50% of duty cycle, V_{CESAT} typical value @ 125°C.

3) Power dissipation during ON & OFF commutations is due to the switching frequency:

$$P_{SW} = (E_{ON} + E_{OFF}) * freq.$$

4) Typical values @ 125°C for switching losses are used (test conditions: $V_{CE} = 390V$, $V_{GE} = 15V$, $R_G = 3.3 \text{ Ohm}$). Furthermore, diode recovery energy is included in the E_{ON} (see note 2), while the tail of the collector current is included in the E_{OFF} measurements (see note 3).

Figure 19: Test Circuit for Inductive Load Switching

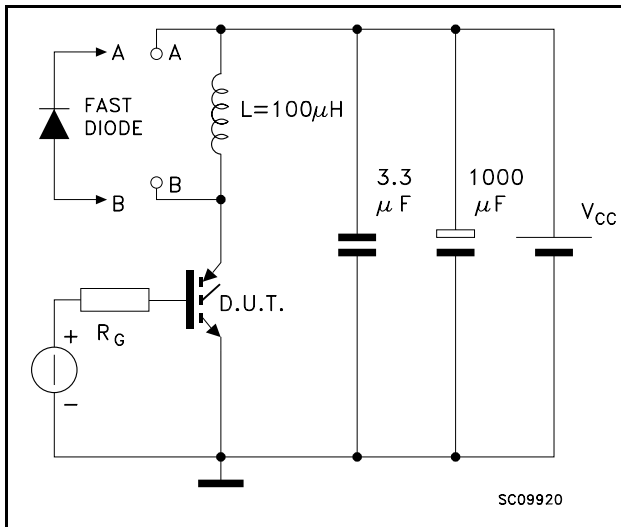


Figure 21: Gate Charge Test Circuit

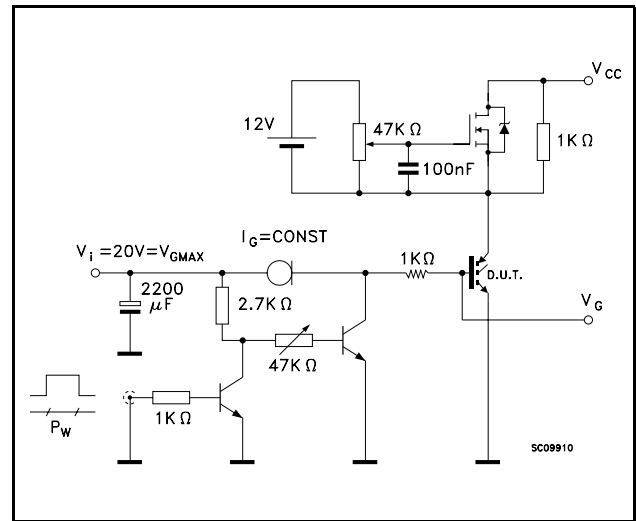
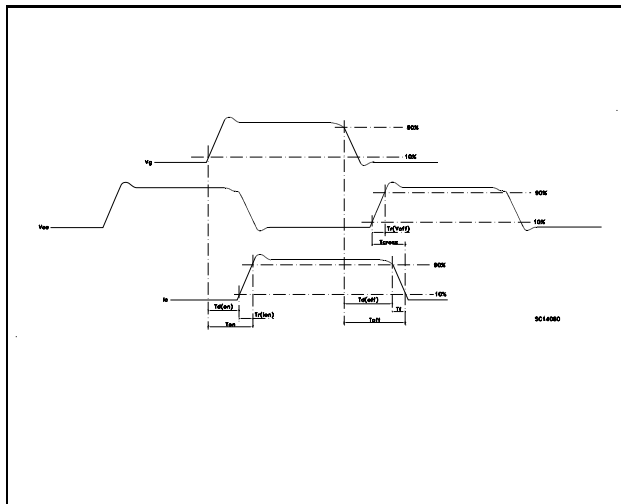
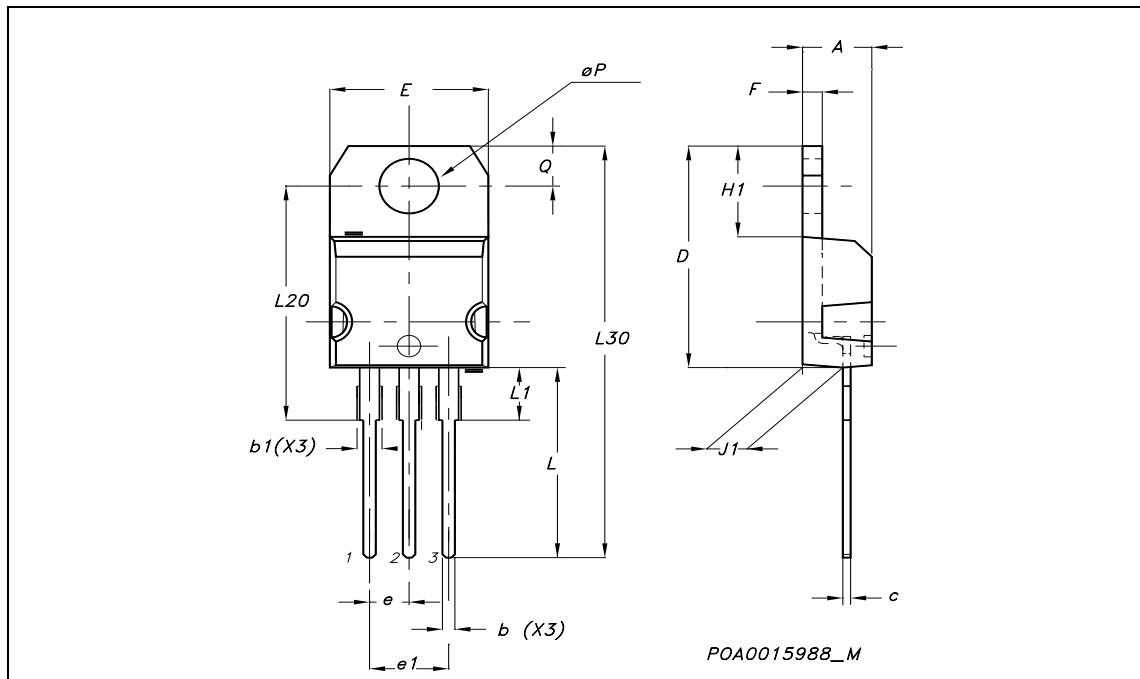


Figure 20: Switching Waveforms



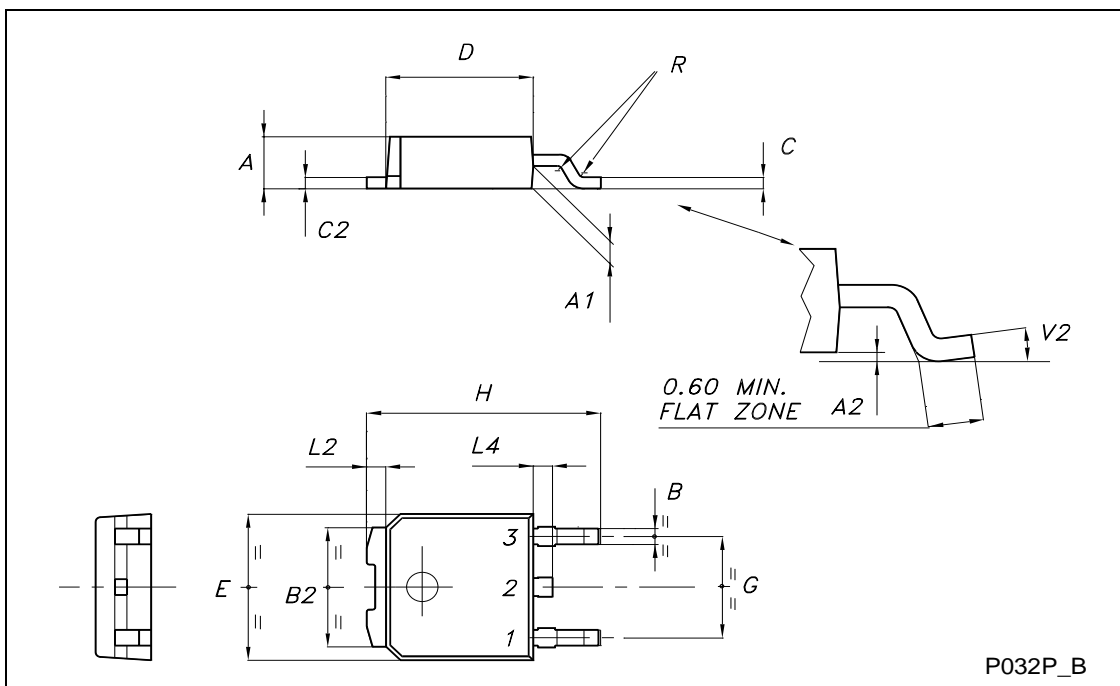
TO-220 MECHANICAL DATA

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	
∅P	3.75		3.85	0.147		0.151
Q	2.65		2.95	0.104		0.116

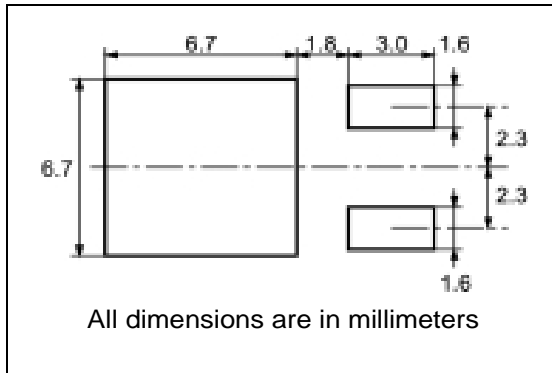


TO-252 (DPAK) MECHANICAL DATA

DIM.	mm			inch		
	MIN.	TYP.	MAX.	MIN.	TYP.	MAX.
A	2.20		2.40	0.087		0.094
A1	0.90		1.10	0.035		0.043
A2	0.03		0.23	0.001		0.009
B	0.64		0.90	0.025		0.035
B2	5.20		5.40	0.204		0.213
C	0.45		0.60	0.018		0.024
C2	0.48		0.60	0.019		0.024
D	6.00		6.20	0.236		0.244
E	6.40		6.60	0.252		0.260
G	4.40		4.60	0.173		0.181
H	9.35		10.10	0.368		0.398
L2		0.8			0.031	
L4	0.60		1.00	0.024		0.039
V2	0°		8°	0°		0°



DPAK 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

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	16.4	18.4	0.645	0.724
N	50		1.968	
T		22.4		0.881

TAPE MECHANICAL DATA

DIM.	mm		inch	
	MIN.	MAX.	MIN.	MAX.
A0	6.8	7	0.267	0.275
B0	10.4	10.6	0.409	0.417
B1		12.1		0.476
D	1.5	1.6	0.059	0.063
D1	1.5		0.059	
E	1.65	1.85	0.065	0.073
F	7.4	7.6	0.291	0.299
K0	2.55	2.75	0.100	0.108
P0	3.9	4.1	0.153	0.161
P1	7.9	8.1	0.311	0.319
P2	1.9	2.1	0.075	0.082
R	40		1.574	
W	15.7	16.3	0.618	0.641

10 pitches cumulative tolerance on tape ± 0.2 mm

Center line of cavity

User Direction of Feed

Bending radius R min.

FEED DIRECTION

TRL

For machine reel, only including shaft and radii concentric around Re

Table 10: Revision History

Date	Revision	Description of Changes
20-Aug-2004	1	New datasheet
09-Jun-2005	2	Modified title

Information furnished is believed to be accurate and reliable. However, STMicroelectronics assumes no responsibility for the consequences of use of such information nor for any infringement of patents or other rights of third parties which may result from its use. No license is granted by implication or otherwise under any patent or patent rights of STMicroelectronics. Specifications mentioned in this publication are subject to change without notice. This publication supersedes and replaces all information previously supplied. STMicroelectronics products are not authorized for use as critical components in life support devices or systems without express written approval of STMicroelectronics.

The ST logo is a registered trademark of STMicroelectronics
All other names are the property of their respective owners

© 2005 STMicroelectronics - All Rights Reserved

STMicroelectronics group of companies

Australia - Belgium - Brazil - Canada - China - Czech Republic - Finland - France - Germany - Hong Kong - India - Israel - Italy - Japan -
Malaysia - Malta - Morocco - Singapore - Spain - Sweden - Switzerland - United Kingdom - United States of America