



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

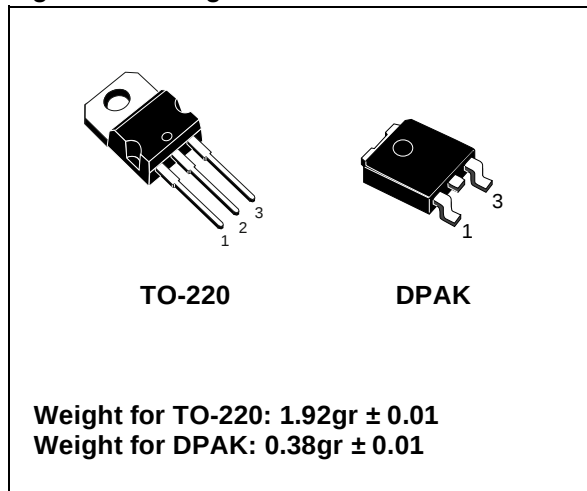


Figure 2: Internal Schematic Diagram

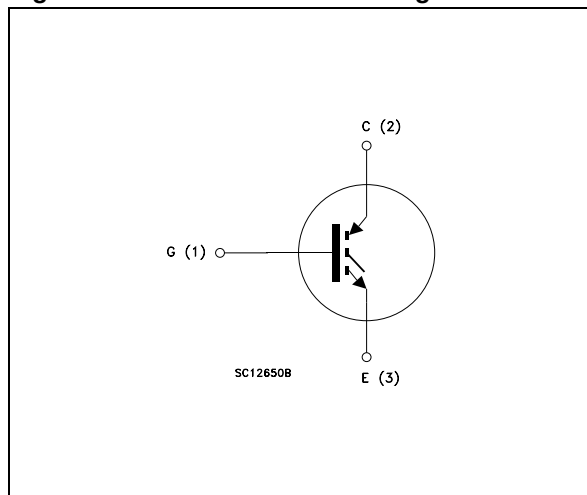


Table 2: Order Code

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 $T_C = 25^\circ\text{C}$ (#)	25		A
I_C	Collector Current (continuous) at $T_C = 100^\circ\text{C}$ (#)	14		A
$I_{CM} (\square)$	Collector Current (pulsed)	50		A
P_{TOT}	Total Dissipation at $T_C = 25^\circ\text{C}$	80	70	W
	Derating Factor	0.64	0.56	W/ $^\circ\text{C}$
T_{stg}	Storage Temperature	– 55 to 150		$^\circ\text{C}$
T_j	Operating Junction Temperature			

($\square$) Pulse width limited by max. junction temperature.

Table 4: Thermal Data

			Min.	Typ.	Max.	
Rthj-case	Thermal Resistance Junction-case	TO-220			1.56	$^\circ\text{C/W}$
		DPAK			1.78	
Rthj-amb	Thermal Resistance Junction-ambient	TO-220			62.5	$^\circ\text{C/W}$
		DPAK			100	
T_L	Maximum Lead Temperature for Soldering Purpose (1.6 mm from case, for 10 sec.)	TO-220		300		$^\circ\text{C}$
		DPAK		275		

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

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
$V_{BR(CES)}$	Collector-Emitter Breakdown Voltage	$I_C = 1\text{ mA}$, $V_{GE} = 0$	600			V
I_{CES}	Collector cut-off Current ($V_{GE} = 0$)	$V_{CE} = \text{Max Rating}$, $T_C = 25^\circ\text{C}$ $V_{CE} = \text{Max Rating}$, $T_C = 125^\circ\text{C}$			10 1	μA mA
I_{GES}	Gate-Emitter Leakage Current ($V_{CE} = 0$)	$V_{GE} = \pm 20\text{ V}$, $V_{CE} = 0$			± 100	nA
$V_{GE(th)}$	Gate Threshold Voltage	$V_{CE} = V_{GE}$, $I_C = 250\text{ }\mu\text{A}$	3.75		5.75	V
$V_{CE(sat)}$	Collector-Emitter Saturation Voltage	$V_{GE} = 15\text{ V}$, $I_C = 7\text{ A}$ $V_{GE} = 15\text{ V}$, $I_C = 7\text{ A}$, $T_C = 125^\circ\text{C}$		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 Q_{ge} Q_{gc}	Total Gate Charge Gate-Emitter Charge Gate-Collector Charge	$V_{CE} = 390\text{ V}$, $I_C = 7\text{ A}$, $V_{GE} = 15\text{ V}$ (see Figure 21)		35 7 16	48	nC nC 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
$t_{d(on)}$ t_r $(di/dt)_{on}$	Turn-on Delay Time Current Rise Time Turn-on Current Slope	$V_{CC} = 390\text{ V}$, $I_C = 7\text{ A}$ $R_G = 10\ \Omega$, $V_{GE} = 15\text{ V}$, $T_J = 25^\circ\text{C}$ (see Figure 18)		18.5 8.5 1060		ns ns A/ μs
$t_{d(on)}$ t_r $(di/dt)_{on}$	Turn-on Delay Time Current Rise Time Turn-on Current Slope	$V_{CC} = 390\text{ V}$, $I_C = 7\text{ A}$ $R_G = 10\ \Omega$, $V_{GE} = 15\text{ V}$, $T_J = 125^\circ\text{C}$ (see Figure 19)		18.5 7 1000		ns ns A/ μs

Table 8: Switching Off

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
$t_r(V_{off})$ $t_{d(off)}$ t_f	Off Voltage Rise Time Turn-off Delay Time Current Fall 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 72 60		ns ns ns
$t_r(V_{off})$ $t_{d(off)}$ t_f	Off Voltage Rise Time Turn-off Delay Time Current Fall 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)		56 116 105		ns ns ns

Table 9: Switching Energy

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

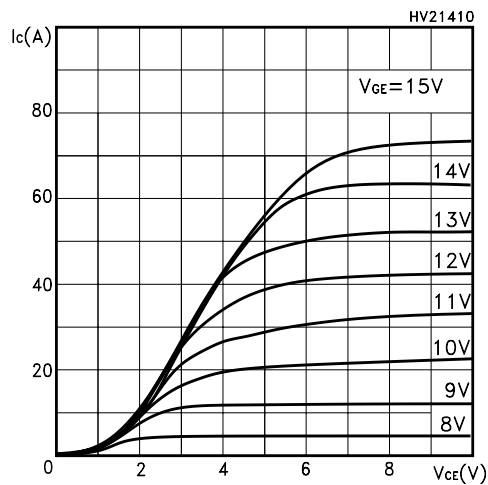


Figure 4: Transconductance

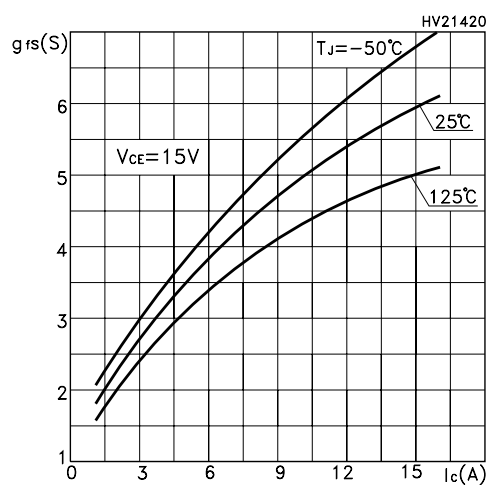


Figure 5: Collector-Emitter On Voltage vs Collector Current

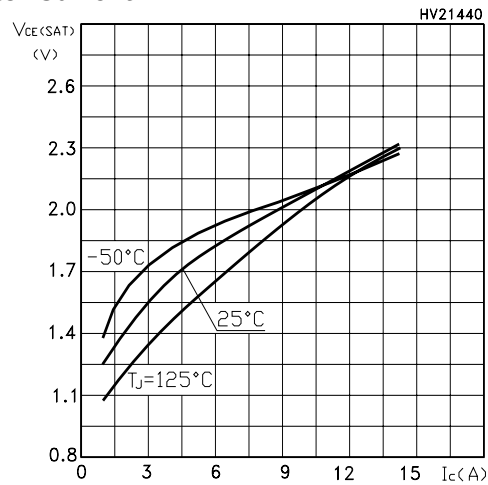


Figure 6: Transfer Characteristics

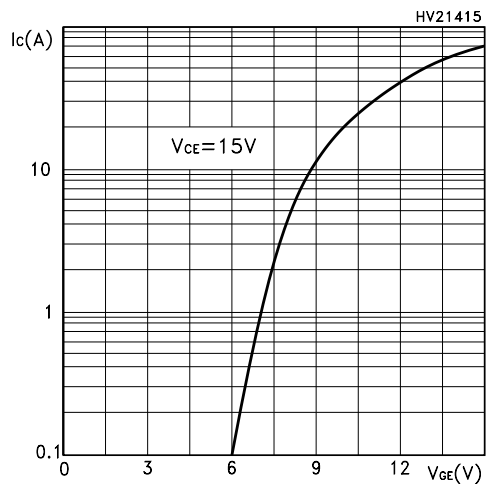


Figure 7: Collector-Emitter On Voltage vs Temperature

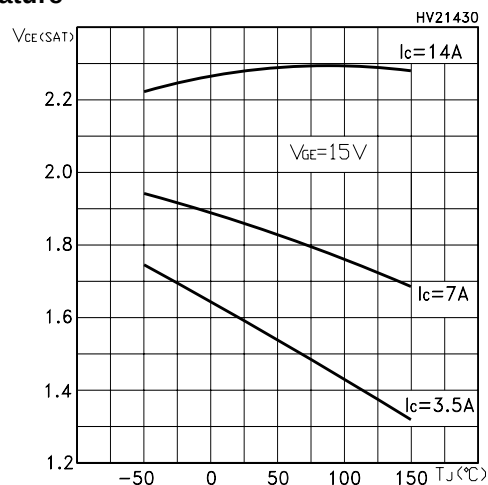


Figure 8: Normalized Gate Threshold vs Temperature

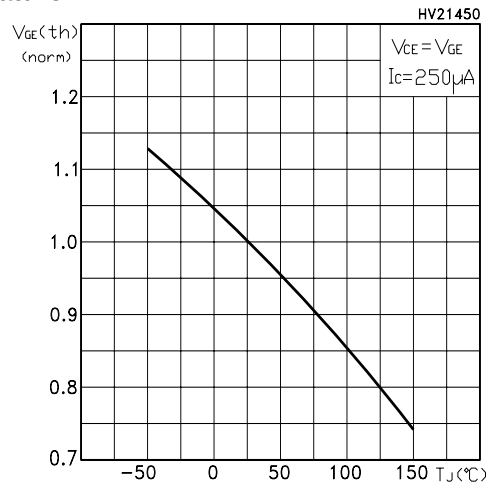


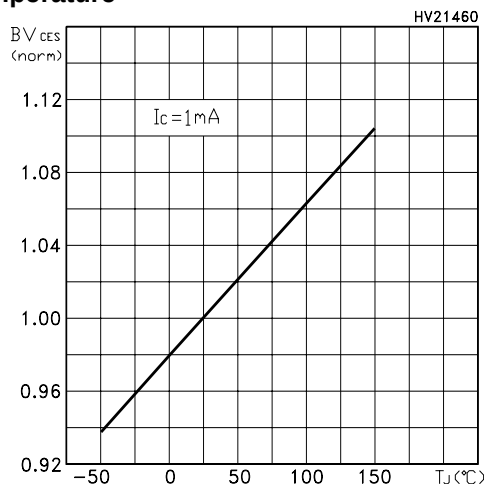
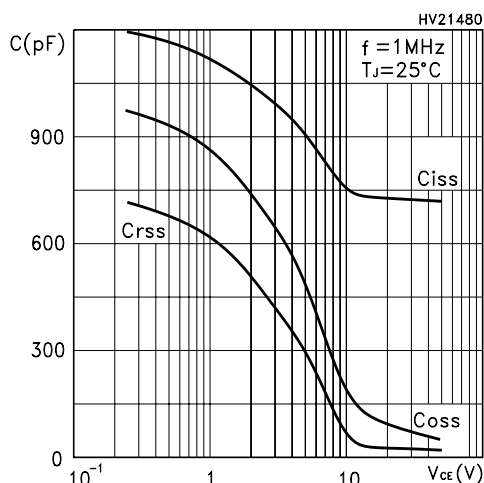
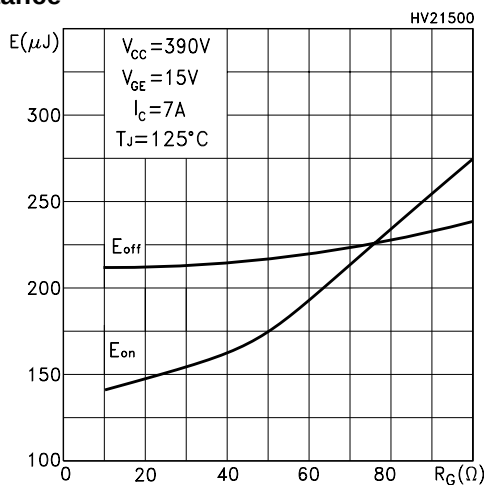
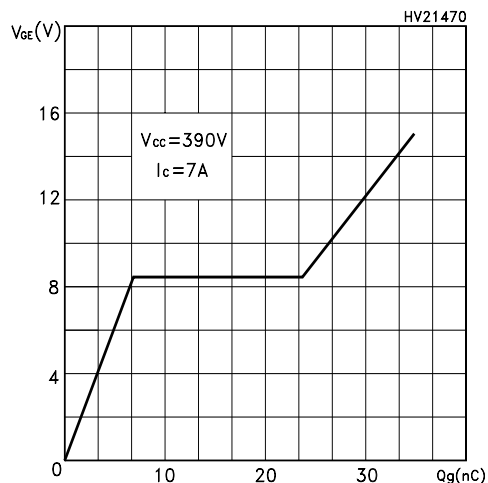
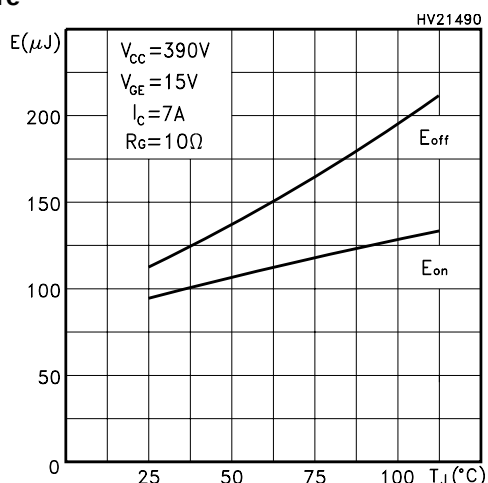
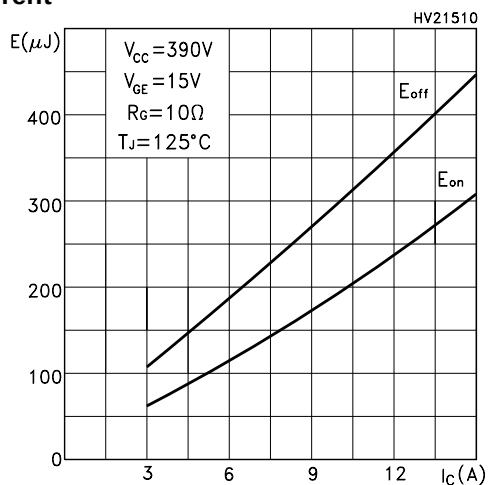
Figure 9: Normalized Breakdown Voltage vs Temperature**Figure 10: Capacitance Variations****Figure 11: Total Switching Losses vs Gate Resistance****Figure 12: Gate Charge vs Gate-Emitter Voltage****Figure 13: Total Switching Losses vs Temperature****Figure 14: Total Switching Losses vs Collector Current**

Figure 15: Thermal Impedance for TO-220

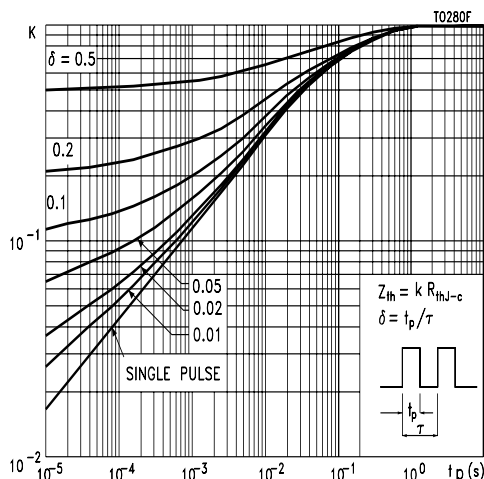


Figure 16: Thermal Impedance for DPAK

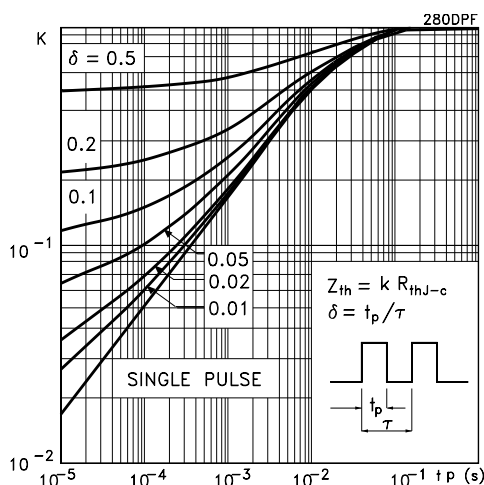


Figure 17: Turn-Off SOA

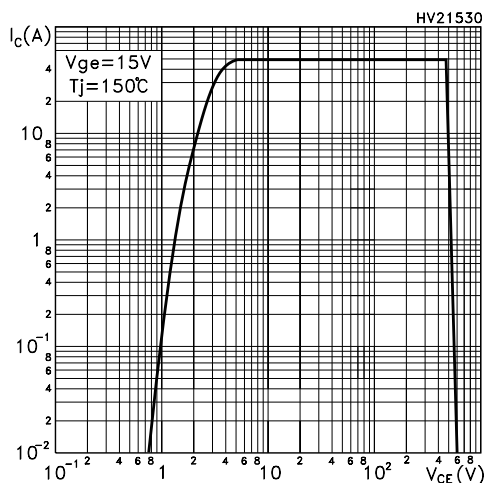
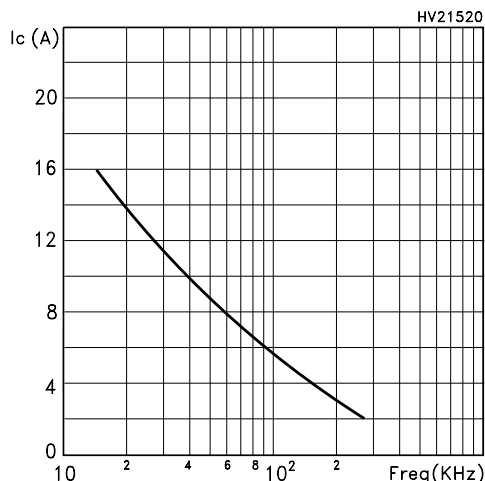


Figure 18: Ic vs Frequency



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 $\Delta T = T_J - T_C = 125^\circ\text{C} - 75^\circ\text{C} = 50^\circ\text{C}$

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:

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

4) Typical values @ 125°C for switching losses are used (test conditions: $V_{CE} = 390\text{V}$, $V_{GE} = 15\text{V}$, $R_G = 3.3\text{ Ohm}$). 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

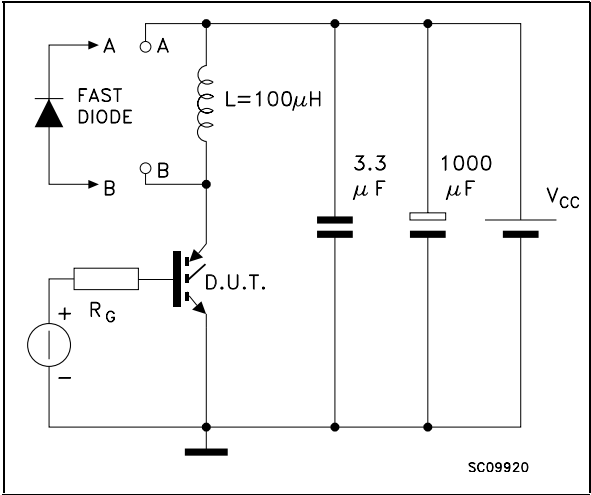


Figure 20: Switching Waveforms

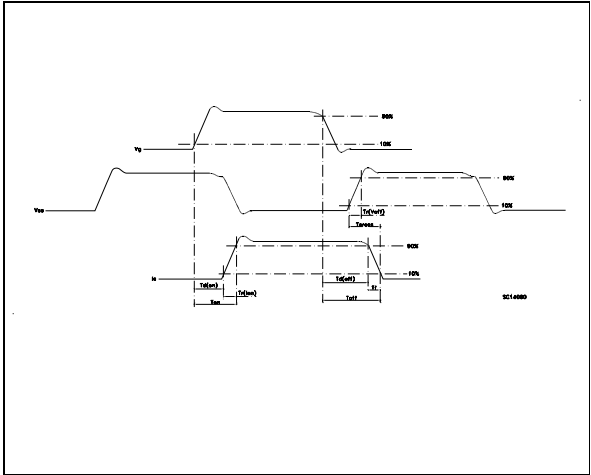
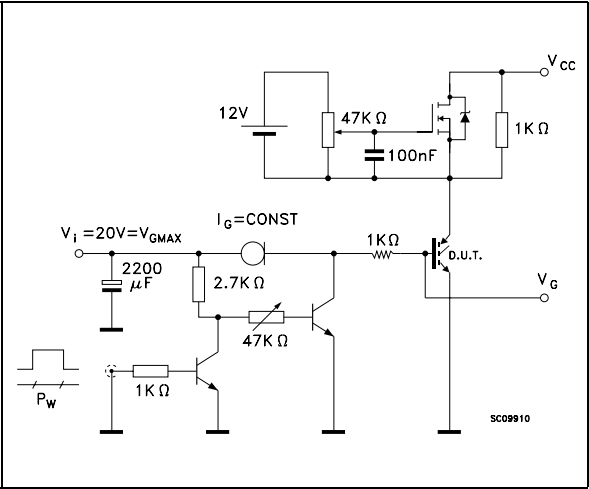
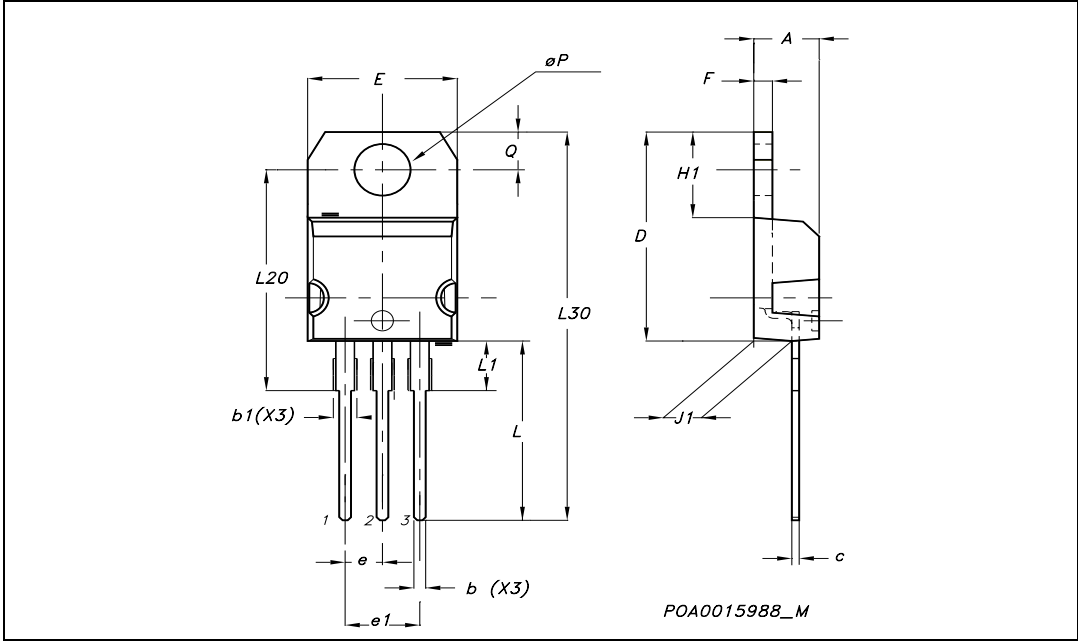


Figure 21: Gate Charge Test Circuit



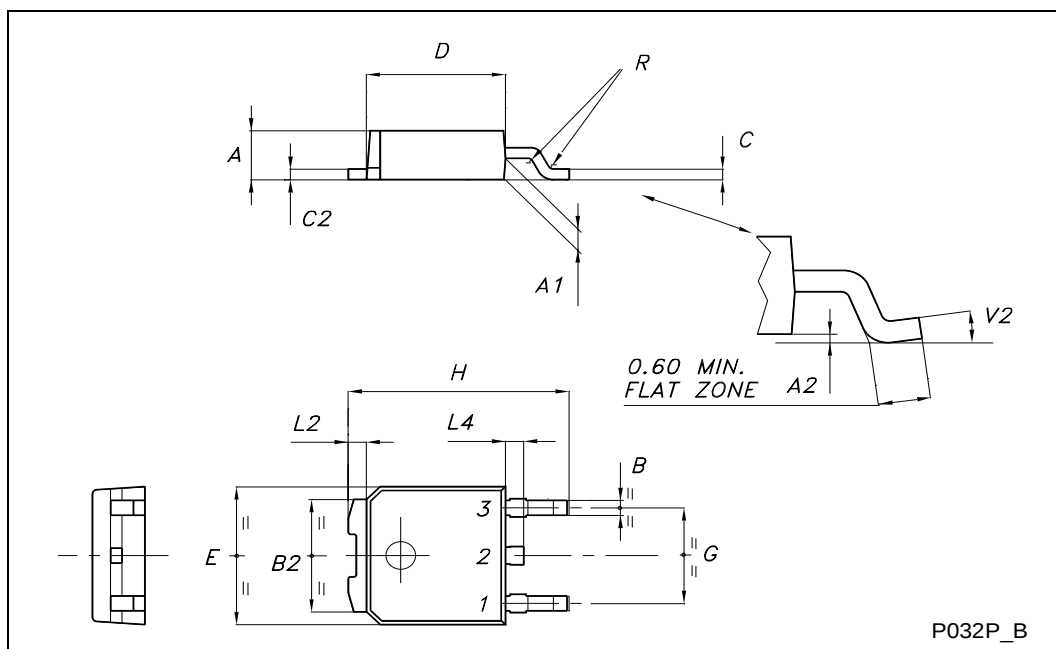
TO-220 MECHANICAL DATA

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

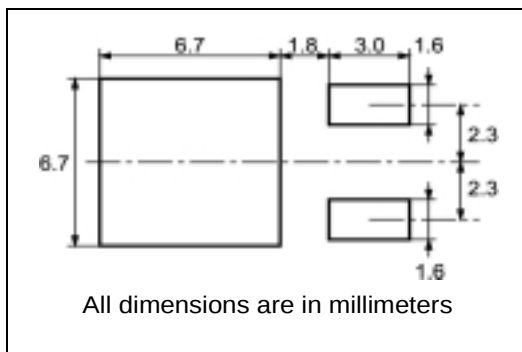


TO-252 (DPAK) MECHANICAL DATA

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

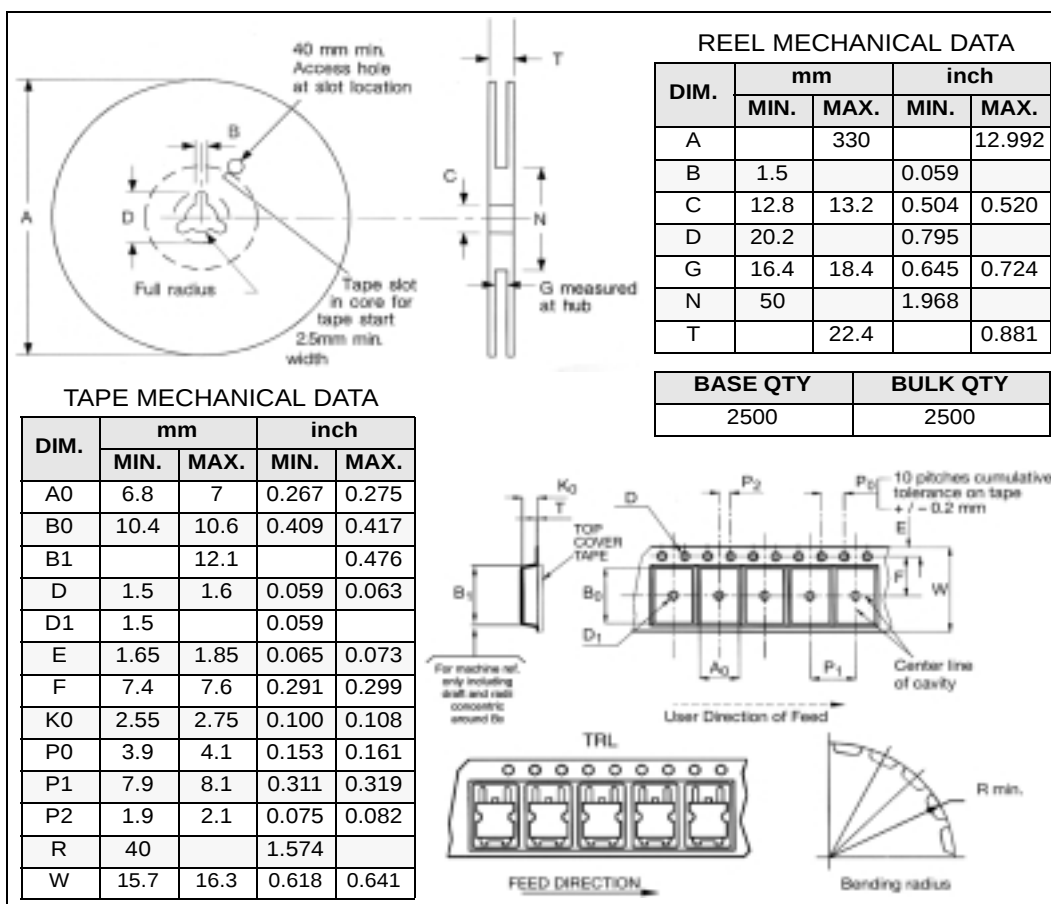


Table 10: Revision History

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

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