



# STGD6NC60HD

## N-CHANNEL 6A - 600V DPAK Very Fast PowerMESH™ IGBT

TARGET SPECIFICATION

**Table 1: General Features**

TYPE	V <sub>CES</sub>	V <sub>CE(sat)</sub> (Max) @25°C	I <sub>C</sub> @100°C
STGD6NC60HDT4	600 V	< 2.5 V	6 A

- LOWER ON-VOLTAGE DROP (V<sub>cesat</sub>)
- OFF LOSSES INCLUDE TAIL CURRENT
- LOSSES INCLUDE DIODE RECOVERY ENERGY
- LOWER C<sub>RES</sub>/C<sub>IES</sub> RATIO
- HIGH FREQUENCY OPERATION
- VERY SOFT ULTRA FAST RECOVERY ANTI PARALLEL DIODE
- 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<sub>fall</sub>) maintaining a low voltage drop.

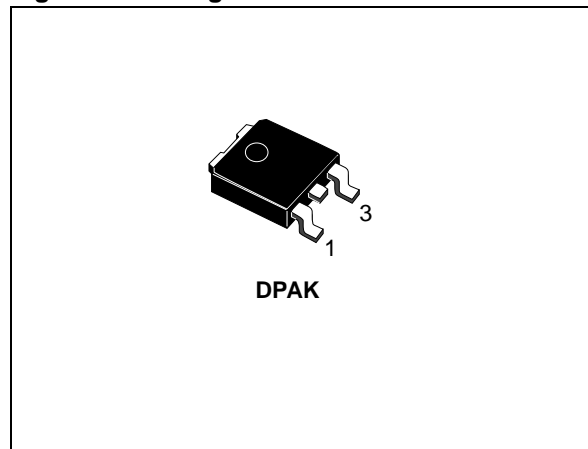
### APPLICATIONS

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

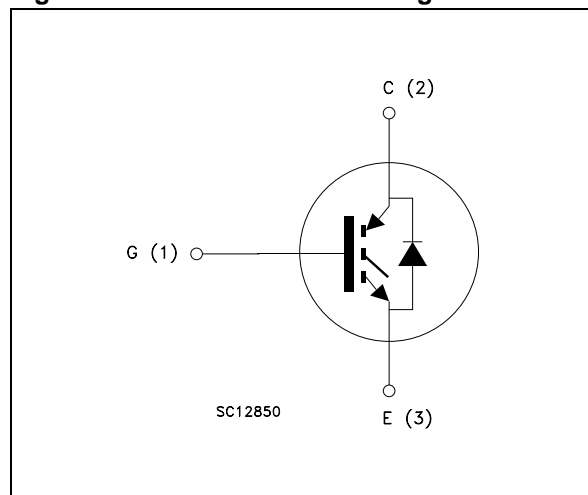
**Table 2: Order Code**

PART NUMBER	MARKING	PACKAGE	PACKAGING
STGD6NC60HDT4	GD6NC60HD	DPAK	TAPE & REEL

**Figure 1: Package**



**Figure 2: Internal Schematic Diagram**



**Table 3: Absolute Maximum ratings**

Symbol	Parameter	Value	Unit
V <sub>CES</sub>	Collector-Emitter Voltage (V <sub>GS</sub> = 0)	600	V
V <sub>ECR</sub>	Emitter-Collector Voltage	20	V
V <sub>GE</sub>	Gate-Emitter Voltage	±20	V
I <sub>C</sub>	Collector Current (continuous) at T <sub>C</sub> = 25°C (#)	10	A
I <sub>C</sub>	Collector Current (continuous) at T <sub>C</sub> = 100°C (#)	6	A
I <sub>CM</sub> (▣)	Collector Current (pulsed)	24	A
I <sub>F</sub>	Diode RMS Forward Current at T <sub>C</sub> = 25°C	TBD	A
P <sub>TOT</sub>	Total Dissipation at T <sub>C</sub> = 25°C	50	W
	Derating Factor	0.40	W/°C
T <sub>stg</sub>	Storage Temperature	- 55 to 150	°C
T <sub>j</sub>	Operating Junction Temperature		

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

**Table 4: Thermal Data**

		Min.	Typ.	Max.	
R <sub>thj-case</sub>	Thermal Resistance Junction-case			2.5	°C/W
R <sub>thj-amb</sub>	Thermal Resistance Junction-ambient			100	°C/W
T <sub>L</sub>	Maximum Lead Temperature for Soldering Purpose (1.6 mm from case, for 10 sec.)		275		°C

**ELECTRICAL CHARACTERISTICS (T<sub>CASE</sub> = 25°C UNLESS OTHERWISE SPECIFIED)**
**Table 5: Main Parameters**

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
V <sub>BR(CES)</sub>	Collector-Emitter Breakdown Voltage	I <sub>C</sub> = 1 mA, V <sub>GE</sub> = 0	600			V
I <sub>CES</sub>	Collector cut-off Current (V <sub>GE</sub> = 0)	V <sub>CE</sub> = Max Rating, T <sub>C</sub> = 25 °C V <sub>CE</sub> = Max Rating, T <sub>C</sub> = 125 °C			10 1	μA mA
I <sub>GES</sub>	Gate-Emitter Leakage Current (V <sub>CE</sub> = 0)	V <sub>GE</sub> = ± 20V, V <sub>CE</sub> = 0			±100	nA
V <sub>GE(th)</sub>	Gate Threshold Voltage	V <sub>CE</sub> = V <sub>GE</sub> , I <sub>C</sub> = 250 μA	3.75		5.75	V
V <sub>CE(sat)</sub>	Collector-Emitter Saturation Voltage	V <sub>GE</sub> = 15V, I <sub>C</sub> = 3 A V <sub>GE</sub> = 15V, I <sub>C</sub> = 3 A, T <sub>C</sub> = 125°C		1.9 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	$V_{CE} = 15 \text{ V}$ , $I_C = 3 \text{ A}$		TBD		S
$C_{ies}$	Input Capacitance	$V_{CE} = 25 \text{ V}$ , $f = 1 \text{ MHz}$ , $V_{GE} = 0$		320		pF
$C_{oes}$	Output Capacitance			28		pF
$C_{res}$	Reverse Transfer Capacitance			7.2		pF
$Q_g$ $Q_{ge}$ $Q_{gc}$	Total Gate Charge Gate-Emitter Charge Gate-Collector Charge	$V_{CE} = 390 \text{ V}$ , $I_C = 3 \text{ A}$ , $V_{GE} = 15 \text{ V}$ (see Figure 5)		15 TBD TBD	TBD	nC nC nC
$I_{CL}$	Turn-Off SOA Minimum Current	$V_{clamp} = 480 \text{ V}$ , $T_j = 150^\circ\text{C}$ $R_G = 10 \Omega$ , $V_{GE} = 15 \text{ V}$	TBD			A

(1) Pulsed: Pulse duration= 300  $\mu\text{s}$ , 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	$V_{CC} = 390 \text{ V}$ , $I_C = 3 \text{ A}$ $R_G = 10 \Omega$ , $V_{GE} = 15\text{V}$ , $T_j = 25^\circ\text{C}$ (see Figure 3)		TBD TBD TBD		ns ns A/ $\mu\text{s}$
$t_{d(on)}$ $t_r$ $(di/dt)_{on}$	Turn-on Delay Time Current Rise Time Turn-on Current Slope	$V_{CC} = 390 \text{ V}$ , $I_C = 3 \text{ A}$ $R_G = 10 \Omega$ , $V_{GE} = 15\text{V}$ , $T_j = 125^\circ\text{C}$ (see Figure 3)		TBD TBD TBD		ns ns A/ $\mu\text{s}$

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	$V_{CC} = 390 \text{ V}$ , $I_C = 3 \text{ A}$ , $R_G = 10 \Omega$ , $V_{GE} = 15 \text{ V}$ $T_j = 25^\circ\text{C}$ (see Figure 3)		TBD TBD 70		ns ns ns
$t_r(V_{off})$ $t_{d(off)}$ $t_f$	Off Voltage Rise Time Turn-off Delay Time Current Fall Time	$V_{CC} = 390 \text{ V}$ , $I_C = 3 \text{ A}$ , $R_G = 10 \Omega$ , $V_{GE} = 15 \text{ V}$ $T_j = 125^\circ\text{C}$ (see Figure 3)		TBD TBD TBD		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	$V_{CC} = 390 \text{ V}$ , $I_C = 3 \text{ A}$ $R_G = 10 \Omega$ , $V_{GE} = 15\text{V}$ , $T_j = 25^\circ\text{C}$ (see Figure 3)		TBD TBD TBD		$\mu\text{J}$ $\mu\text{J}$ $\mu\text{J}$
$E_{on}$ (2) $E_{off}$ (3) $E_{ts}$	Turn-on Switching Losses Turn-off Switching Loss Total Switching Loss	$V_{CC} = 390 \text{ V}$ , $I_C = 3 \text{ A}$ $R_G = 10 \Omega$ , $V_{GE} = 15\text{V}$ , $T_j = 125^\circ\text{C}$ (see Figure 3)		TBD TBD TBD		$\mu\text{J}$ $\mu\text{J}$ $\mu\text{J}$

(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.

Table 10: Collector-Emitter Diode

Symbol	Parameter	Test Condition	Min.	Typ.	Max.	Unit
$V_f$	Forward On-Voltage	$I_f = 1.5 \text{ A}$ $I_f = 1.5 \text{ A}, T_j = 125 \text{ }^\circ\text{C}$		1.6 1.3	2.1	V V
$t_{rr}$ $t_a$ $Q_{rr}$ $I_{rrm}$ $S$	Reverse Recovery Time Reverse Recovery Charge Reverse Recovery Current Softness factor of the diode	$I_f = 1.5 \text{ A}, V_R = 40 \text{ V},$ $T_j = 25 \text{ }^\circ\text{C}, di/dt = 100 \text{ A}/\mu\text{s}$ (see Figure 6)		TBD TBD TBD TBD TBD		ns ns nC A A
$t_{rr}$ $t_a$ $Q_{rr}$ $I_{rrm}$ $S$	Reverse Recovery Time Reverse Recovery Charge Reverse Recovery Current Softness factor of the diode	$I_f = 1.5 \text{ A}, V_R = 40 \text{ V},$ $T_j = 125 \text{ }^\circ\text{C}, di/dt = 100 \text{ A}/\mu\text{s}$ (see Figure 6)		TBD TBD TBD TBD TBD		ns ns nC A A

Figure 3: Test Circuit for Inductive Load Switching

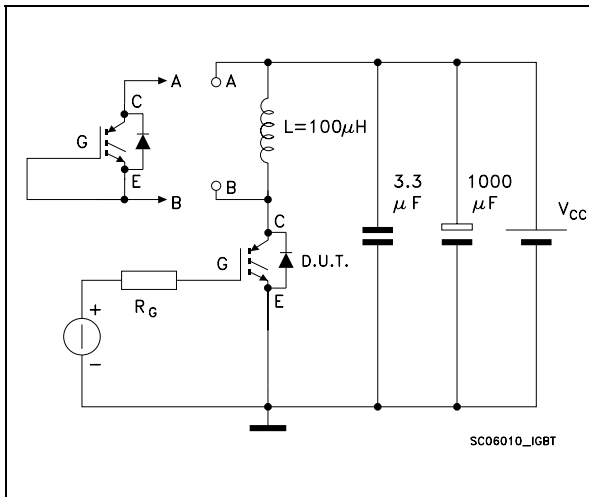


Figure 4: Switching Waveforms

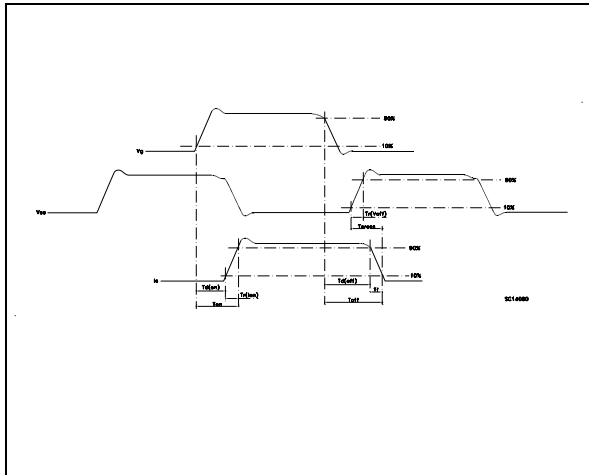


Figure 5: Gate Charge Test Circuit

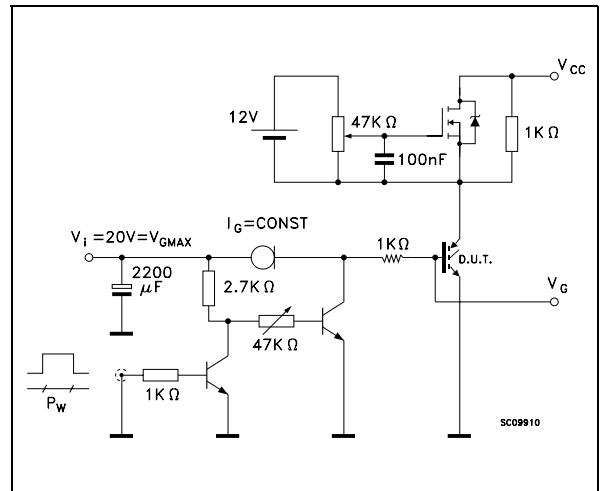
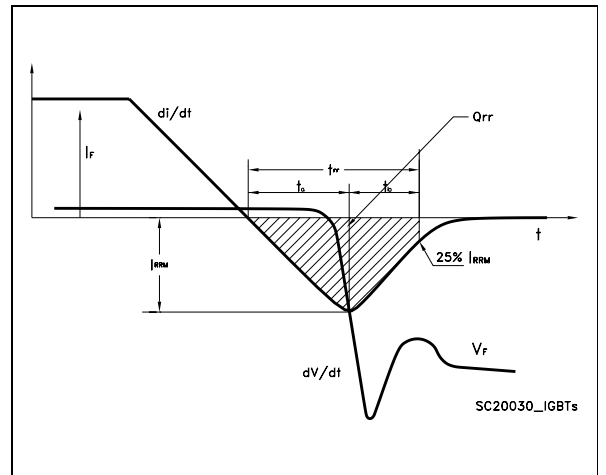
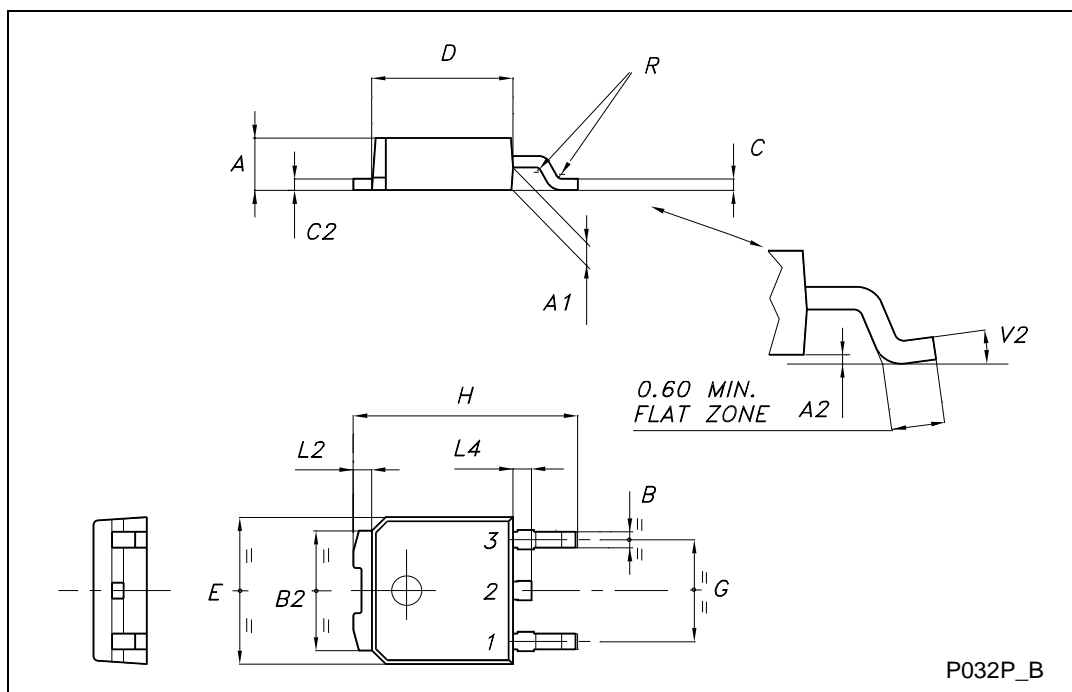


Figure 6: Diode Recovery Time Waveforms



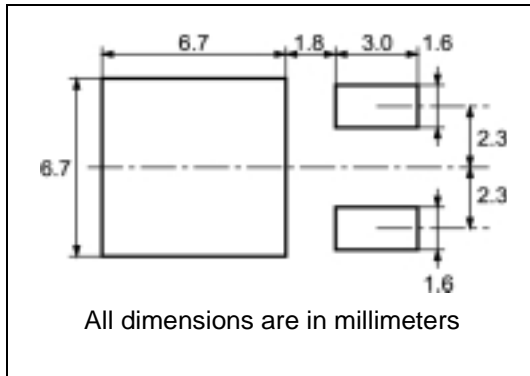
TO-252 (DPAK) MECHANICAL DATA

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°



P032P\_B

**DPAK FOOTPRINT**



**TAPE AND REEL SHIPMENT**

**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

BASE QTY	BULK QTY
2500	2500

**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

**Table 11: Revision History**

<b>Date</b>	<b>Revision</b>	<b>Description of Changes</b>
14-Jun-2005	1	First release



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