



# STGD10NC60SD STGF10NC60SD

10 A - 600 V fast IGBT

## Features

- Very low on-voltage drop ( $V_{CE(sat)}$ )
- Very soft ultra fast antiparallel diode
- Minimum power losses at 5 kHz in hard switching
- Optimized performance for medium operating frequencies

## Application

- Medium frequency motor control

## Description

This IGBT utilizes the advanced PowerMESH™ process resulting in an excellent trade-off between switching performance and low on-state behavior.

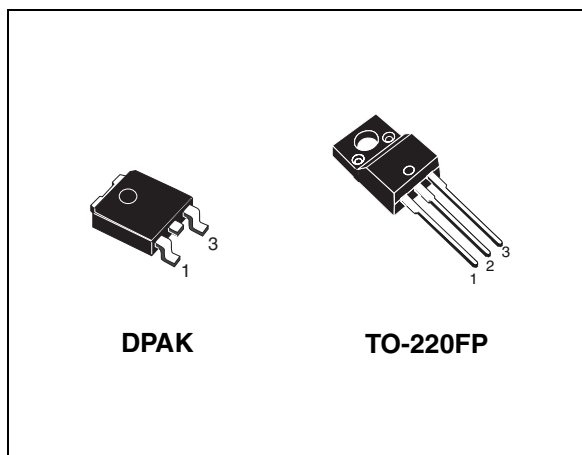


Figure 1. Internal schematic diagram

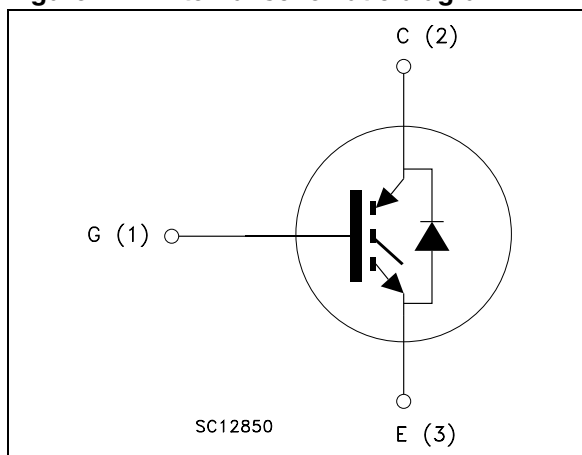


Table 1. Device summary

Order codes	Marking	Package	Packaging
STGD10NC60SDT4	GD10NC60SD	DPAK	Tape and reel
STGF10NC60SD	GF10NC60SD	TO-220FP	Tube

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# 1 Electrical ratings

**Table 2. Absolute maximum ratings**

Symbol	Parameter	Value		Unit
		DPAK	TO-220FP	
V <sub>CES</sub>	Collector-emitter voltage (V <sub>GE</sub> = 0)	600		V
I <sub>C</sub> <sup>(1)</sup>	Collector current (continuous) at T <sub>C</sub> = 25°C	18	10	A
I <sub>C</sub> <sup>(1)</sup>	Collector current (continuous) at T <sub>C</sub> = 100°C	10	5	A
I <sub>CL</sub> <sup>(2)</sup>	Turn-off latching current	14		A
I <sub>CP</sub> <sup>(3)</sup>	Pulsed collector current	25		A
I <sub>F</sub>	Diode RMS forward current at T <sub>C</sub> =25 °C	10		A
I <sub>FSM</sub>	Surge non repetitive forward current t <sub>p</sub> = 10 ms sinusoidal	20		A
V <sub>GE</sub>	Gate-emitter voltage	±20		V
P <sub>TOT</sub>	Total dissipation at T <sub>C</sub> = 25 °C	60	25	W
T <sub>j</sub>	Operating junction temperature	-55 to 150		°C

1. Calculated according to the iterative formula:

$$I_C(T_C) = \frac{T_{j(max)} - T_C}{R_{thj-c} \times V_{CE(sat)(max)}(T_{j(max)}, I_C(T_C))}$$

2. V<sub>clamp</sub> = 80%,(V<sub>CES</sub>), T<sub>j</sub> =150 °C, R<sub>G</sub> = 10 Ω, V<sub>GE</sub> = 15 V

3. Pulse width limited by maximum permissible junction temperature and turn-off within RBSOA

**Table 3. Thermal data**

Symbol	Parameter	Value		Unit
		DPAK	TO-220FP	
R <sub>thj-case</sub>	Thermal resistance junction-case IGBT	2.08	5	°C/W
	Thermal resistance junction-case diode	4.5		°C/W
R <sub>thj-amb</sub>	Thermal resistance junction-ambient	100	62.5	°C/W

## 2 Electrical characteristics

( $T_J=25^\circ\text{C}$  unless otherwise specified)

**Table 4. Static**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$V_{(BR)CES}$	Collector-emitter breakdown voltage ( $V_{GE}=0$ )	$I_C=1\text{ mA}$	600			V
$V_{CE(sat)}$	Collector-emitter saturation voltage	$V_{GE}=15\text{ V}, I_C=5\text{ A}$ $V_{GE}=15\text{ V}, I_C=5\text{ A}, T_J=125^\circ\text{C}$		1.45 1.3	1.65	V V
$V_{GE(th)}$	Gate threshold voltage	$V_{CE}=V_{GE}, I_C=250\text{ }\mu\text{A}$	3.75		5.75	V
$I_{CES}$	Collector cut-off current ( $V_{GE}=0$ )	$V_{CE}=600\text{ V}$ $V_{CE}=600\text{ V}, T_J=125^\circ\text{C}$			150 1	$\mu\text{A}$ mA
$I_{GES}$	Gate-emitter leakage ( $V_{CE}=0$ )	$V_{GE}=\pm 20\text{ V}$			$\pm 100$	nA
$g_{fs}$	Forward transconductance	$V_{CE}=15\text{ V}, I_C=5\text{ A}$		3.5		S

**Table 5. Dynamic**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$C_{ies}$	Input capacitance	$V_{CE}=25\text{ V}, f=1\text{ MHz}, V_{GE}=0$	-	365	-	pF
$C_{oes}$	Output capacitance			44		pF
$C_{res}$	Reverse transfer capacitance			8		pF
$Q_g$	Total gate charge	$V_{CE}=390\text{ V}, I_C=5\text{ A},$ $V_{GE}=15\text{ V}$	-	17	-	nC
$Q_{ge}$	Gate-emitter charge	<i>Figure 3</i>		3		nC
$Q_{gc}$	Gate-collector charge			7		nC

**Table 6. Switching on/off (inductive load)**

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	$V_{CC} = 390\text{ V}$ , $I_C = 5\text{ A}$ $R_G = 10\ \Omega$ , $V_{GE} = 15\text{ V}$ , <i>Figure 4</i>	-	19 4 1330	-	ns ns A/ $\mu$ s
$t_{d(on)}$ $t_r$ $(di/dt)_{on}$	Turn-on delay time Current rise time Turn-on current slope	$V_{CC} = 390\text{ V}$ , $I_C = 5\text{ A}$ $R_G = 10\ \Omega$ , $V_{GE} = 15\text{ V}$ , $T_J = 125^\circ\text{C}$ <i>Figure 4</i>	-	18 4.5 1000	-	ns ns A/ $\mu$ s
$t_r(V_{off})$ $t_{d(off)}$ $t_f$	Off voltage rise time Turn-off delay time Current fall time	$V_{CC} = 390\text{ V}$ , $I_C = 5\text{ A}$ , $R_G = 10\ \Omega$ , $V_{GE} = 15\text{ V}$ , <i>Figure 4</i>	-	100 160 205	-	ns ns ns
$t_r(V_{off})$ $t_{d(off)}$ $t_f$	Off voltage rise time Turn-off delay time Current fall time	$V_{CC} = 390\text{ V}$ , $I_C = 5\text{ A}$ , $R_G = 10\ \Omega$ , $V_{GE} = 15\text{ V}$ , $T_J = 125^\circ\text{C}$ <i>Figure 4</i>	-	165 250 310	-	ns ns ns

**Table 7. Switching energy (inductive load)**

Symbol	Parameter	Test conditions	Min	Typ.	Max	Unit
$E_{on}^{(1)}$ $E_{off}^{(2)}$ $E_{ts}$	Turn-on switching losses Turn-off switching losses Total switching losses	$V_{CC} = 390\text{ V}$ , $I_C = 5\text{ A}$ $R_G = 10\ \Omega$ , $V_{GE} = 15\text{ V}$ , <i>Figure 2</i>	-	50 290 340	-	$\mu$ J $\mu$ J $\mu$ J
$E_{on}^{(1)}$ $E_{off}^{(2)}$ $E_{ts}$	Turn-on switching losses Turn-off switching losses Total switching losses	$V_{CC} = 390\text{ V}$ , $I_C = 5\text{ A}$ $R_G = 10\ \Omega$ , $V_{GE} = 15\text{ V}$ , $T_J = 125^\circ\text{C}$ <i>Figure 2</i>	-	73 485 558	-	$\mu$ J $\mu$ J $\mu$ J

- $E_{on}$  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 and diode are at the same temperature
- Turn-off losses included also include also the tail of the collector current

**Table 8. Collector-emitter diode**

Symbol	Parameter	Test conditions	Min	Typ.	Max.	Unit
$V_F$	Forward on-voltage	$I_F = 5\text{ A}$ $I_F = 5\text{ A}$ , $T_J = 125^\circ\text{C}$	-	2 1.6	-	V V
$t_{rr}$ $Q_{rr}$ $I_{rrm}$	Reverse recovery time Reverse recovery charge Reverse recovery current	$I_F = 5\text{ A}$ , $V_R = 40\text{ V}$ , $di/dt = 100\text{ A}/\mu\text{s}$ <i>Figure 5</i>	-	22 14 1.3	-	ns nC A
$t_{rr}$ $Q_{rr}$ $I_{rrm}$	Reverse recovery time Reverse recovery charge Reverse recovery current	$I_F = 5\text{ A}$ , $V_R = 40\text{ V}$ , $T_J = 125^\circ\text{C}$ , $di/dt = 100\text{ A}/\mu\text{s}$ <i>(Figure 5)</i>	-	35 40 2.2	-	ns nC A

### 3 Test circuits

Figure 2. Test circuit for inductive load switching

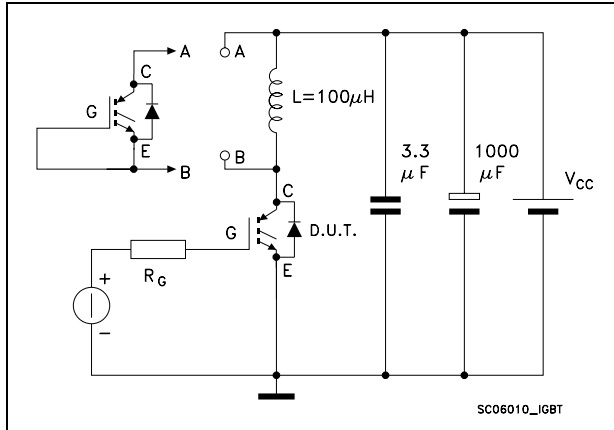


Figure 3. Gate charge test circuit

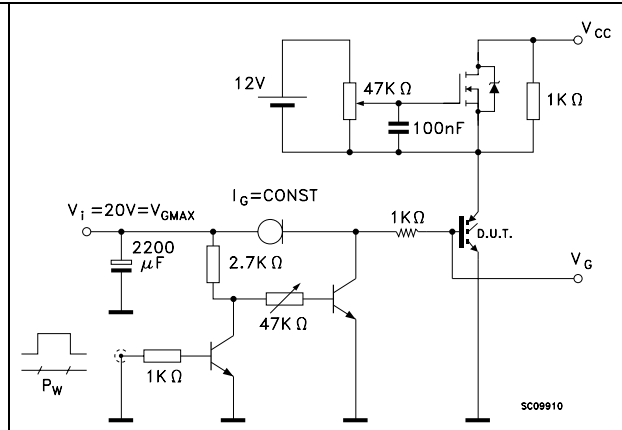


Figure 4. Switching waveforms

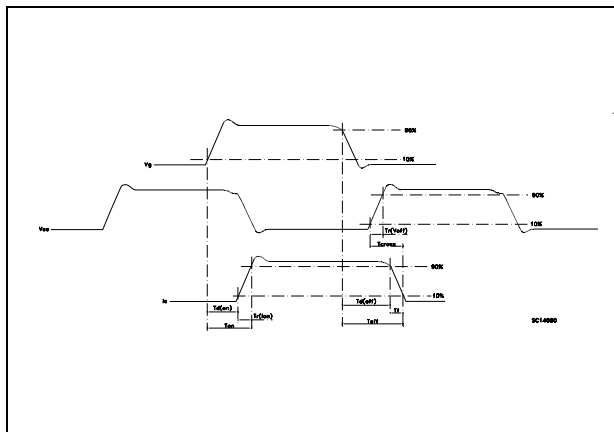
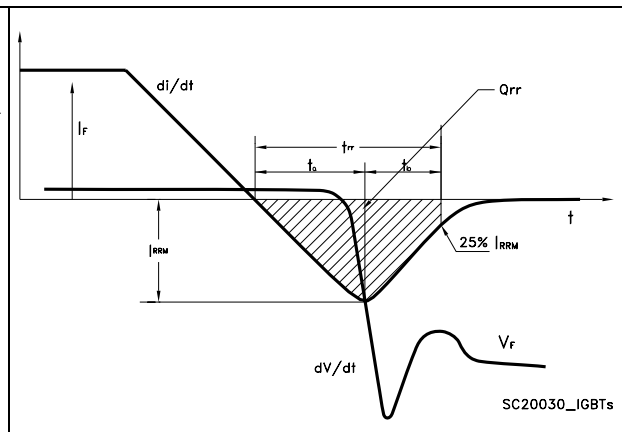


Figure 5. Diode recovery time waveform

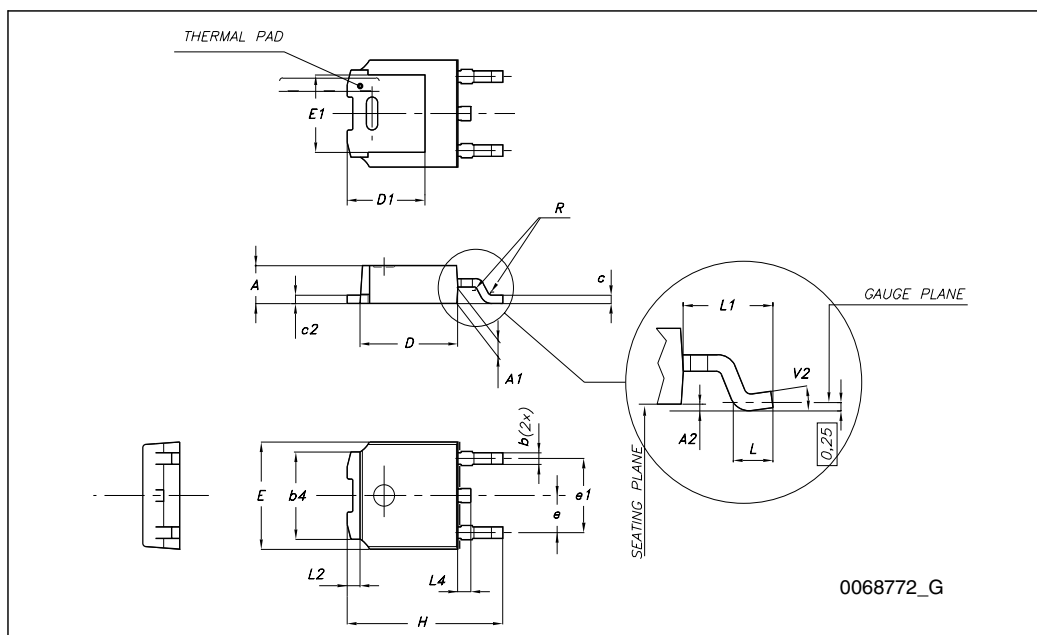


## 4 Package mechanical data

In order to meet environmental requirements, ST offers these devices in different grades of ECOPACK® packages, depending on their level of environmental compliance. ECOPACK® specifications, grade definitions and product status are available at: [www.st.com](http://www.st.com). ECOPACK is an ST trademark.

## TO-252 (DPAK) mechanical data

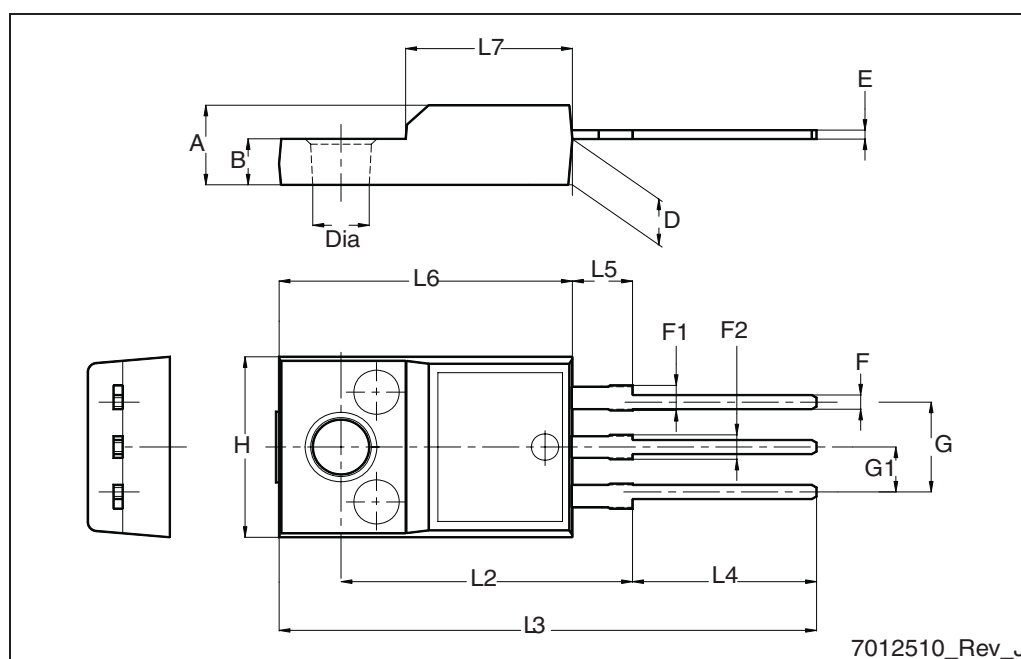
DIM.	mm.		
	min.	typ	max.
A	2.20		2.40
A1	0.90		1.10
A2	0.03		0.23
b	0.64		0.90
b4	5.20		5.40
c	0.45		0.60
c2	0.48		0.60
D	6.00		6.20
D1		5.10	
E	6.40		6.60
E1		4.70	
e		2.28	
e1	4.40		4.60
H	9.35		10.10
L	1		
L1		2.80	
L2		0.80	
L4	0.60		1
R		0.20	
V2	0°		8°





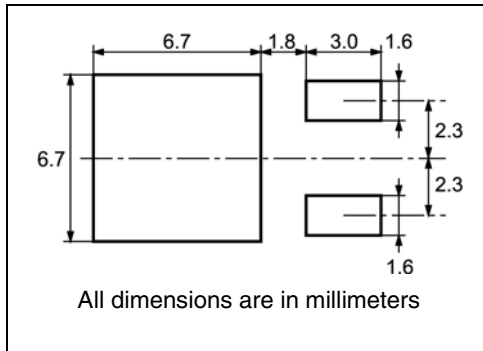
## TO-220FP mechanical data

Dim.	mm		
	Min.	Typ.	Max.
A	4.4		4.6
B	2.5		2.7
D	2.5		2.75
E	0.45		0.7
F	0.75		1
F1	1.15		1.70
F2	1.15		1.5
G	4.95		5.2
G1	2.4		2.7
H	10		10.4
L2		16	
L3	28.6		30.6
L4	9.8		10.6
L5	2.9		3.6
L6	15.9		16.4
L7	9		9.3
Dia	3		3.2



# 5 Packaging mechanical data

## DPAK FOOTPRINT



## TAPE AND REEL SHIPMENT

40 mm min. Access hole at slot location

Full radius

Tape slot in core for tape start 25mm min. width

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

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

TOP COVER TAPE

10 pitches cumulative tolerance on tape +/- 0.2 mm

Center line of cavity

User Direction of Feed

FEED DIRECTION

Bending radius R min.

## 6 Revision history

**Table 9. Document revision history**

Date	Revision	Changes
06-Jul-2009	1	Initial release

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