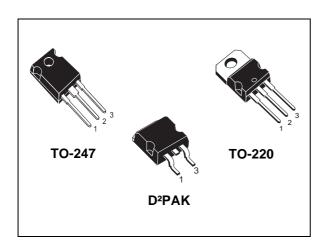


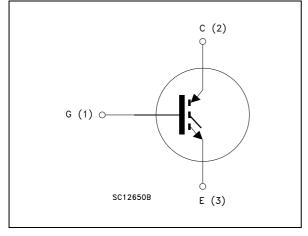
# STGB20NC60V, STGP20NC60V, STGW20NC60V

30 A - 600 V - very fast IGBT

**Datasheet - production data** 



#### Figure 1. Internal schematic diagram



### Features

- High frequency operation up to 50 kHz
- Lower C<sub>RES</sub> / C<sub>IES</sub> ratio (no cross-conduction susceptibility)
- High current capability

### **Applications**

- High frequency inverters
- UPS, motor drivers
- HF, SMPS and PFC in both hard switch and resonant topologies

### Description

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

#### Table 1. Device summary

Order codes	Marking	Package	Packaging
STGB20NC60V	GB20NC60V	D²PAK	Tape and reel
STGP20NC60V	GP20NC60V	TO-220	Tube
STGW20NC60V	GW20NC60V	TO-247	Tube

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# 1 Electrical ratings

Symbol	Parameter	Value	Unit
V <sub>CES</sub>	Collector-emitter voltage ( $V_{GE} = 0$ )	600	V
I <sub>C</sub> <sup>(1)</sup>	Collector current (continuous) at 25 °C	60	Α
I <sub>C</sub> <sup>(1)</sup>	Collector current (continuous) at 100 °C	30	Α
I <sub>CL</sub> <sup>(2)</sup>	Turn-off latching current	100	Α
I <sub>CP</sub> <sup>(3)</sup>	Pulsed collector current	100	Α
$V_{GE}$	Gate-emitter voltage	± 20	V
P <sub>TOT</sub>	Total dissipation at $T_C = 25 \ ^{\circ}C$	200	W
Тj	Operating junction temperature	– 55 to 150	°C

1. Calculated according to the iterative formula:

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

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

3. Pulse width limited by max junction temperature allowed

			Valu			
	Symbol	Parameter	TO-247	TO-220 D²PAK	Unit	
ſ	R <sub>thj-case</sub> Thermal resistance junction-case max 0.62		2	°C/W		
ſ	R <sub>thj-amb</sub>	Thermal resistance junction-ambient max	50	62.5	°C/W	

#### Table 3. Thermal resistance



## 2 Electrical characteristics

(T<sub>CASE</sub>=25°C unless otherwise specified)

-								
Symbol	Parameter	Test conditions	Min.	Тур.	Max.	Unit		
V <sub>(BR)CES</sub>	Collector-emitter breakdown voltage (V <sub>GE</sub> = 0)	I <sub>C</sub> = 1 mA	600			V		
V <sub>CE(sat)</sub>	Collector-emitter saturation voltage	$V_{GE}$ =15 V, I <sub>C</sub> = 20 A V <sub>GE</sub> =15 V, I <sub>C</sub> = 20 A,T <sub>C</sub> = 125 °C		1.8 1.7	2.5	V V		
V <sub>GE(th)</sub>	Gate threshold voltage	$V_{CE}$ = $V_{GE}$ , $I_C$ = 250 $\mu$ A	3.75		5.75	V		
I <sub>CES</sub>	Collector-emitter cut-off current (V <sub>GE</sub> = 0)	V <sub>CE</sub> = 600 V V <sub>CE</sub> = 600 V, Tc=125 °C			10 1	μA mA		
I <sub>GES</sub>	Gate-emitter cut-off current (V <sub>CE</sub> = 0)	V <sub>GE</sub> = ±20 V			± 100	nA		
9 <sub>fs</sub> <sup>(1)</sup>	Forward transconductance	V <sub>CE</sub> = 15 V <sub>,</sub> I <sub>C</sub> = 20 A		15		S		

Table 4. Static electrica	al characteristics
---------------------------	--------------------

1. Pulse duration =  $300 \ \mu$ s, duty cycle 1.5%

Symbol	Parameter	Test conditions	Min.	Тур.	Max.	Unit
C <sub>ies</sub>	Input capacitance		-	2200	-	pF
C <sub>oes</sub>	Output capacitance	V <sub>CE</sub> = 25 V, f = 1 MHz,	-	225	-	pF
C <sub>res</sub>	Reverse transfer capacitance	V <sub>GE</sub> =0	-	50	-	pF
Qg	Total gate charge	V <sub>CE</sub> = 390 V, I <sub>C</sub> = 20 A,	-	100	-	nC
Q <sub>ge</sub>	Gate-emitter charge	V <sub>GE</sub> = 15 V,	-	16	-	nC
Q <sub>gc</sub>	Gate-collector charge	(see Figure 17)	-	45	-	nC

#### Table 5. Dynamic electrical characteristics



•			,	-	Cumbel Decempton Test conditions Min Tun May Unit						
Symbol	Parameter	Test conditions	Min.	Тур.	Max.	Unit					
t <sub>d(on)</sub>	Turn-on delay time	V <sub>CC</sub> = 390 V, I <sub>C</sub> = 20 A	-	31	-	ns					
t <sub>r</sub>	Current rise time	$R_{G}$ = 3.3 $\Omega$ , $V_{GE}$ = 15 V,	-	11	-	ns					
(di/dt)on	Turn-on current slope	(see Figure 16)	-	1600	-	A/µs					
t <sub>d(on)</sub>	Turn-on delay time	V <sub>CC</sub> = 390 V, I <sub>C</sub> = 20 A	-	31	-	ns					
t <sub>r</sub>	Current rise time	R <sub>G</sub> = 3.3 Ω, V <sub>GE</sub> = 15 V, T <sub>C</sub> = 125 °C <i>(see Figure 16)</i>	-	11.5	-	ns					
(di/dt)on	Turn-on current slope		-	1500	-	A/µs					
t <sub>r(Voff)</sub>	Off voltage rise time	V <sub>cc</sub> = 390 V, I <sub>C</sub> = 20 A,	-	28	-	ns					
t <sub>d(off)</sub>	Turn-off delay time	$R_{G} = 3.3 \Omega, V_{GE} = 15 V$	-	100	-	ns					
t <sub>f</sub>	Current fall time	(see Figure 18)	-	75	-	ns					
t <sub>r(Voff)</sub>	Off voltage rise time	$V_{cc} = 390 \text{ V}, I_C = 20 \text{ A},$ $R_G=3.3 \Omega, V_{GE} = 15 \text{ V},$ $T_C=125 \text{ °C} (see Figure 18)$	-	66	-	ns					
t <sub>d(off)</sub>	Turn-off delay time		-	150	-	ns					
t <sub>f</sub>	Current fall time		-	130	-	ns					

Table 6. Switching on/off (inductive load)

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

Symbol	Parameter	Test conditions	Min.	Тур.	Max.	Unit
E <sub>on</sub>	Turn-on switching losses	V <sub>CC</sub> = 390 V, I <sub>C</sub> = 20 A	-	220	-	μJ
E <sub>off</sub> <sup>(1)</sup>	Turn-off switching losses	$R_G = 3.3 \Omega$ , $V_{GE} = 15 V$ , (see Figure 18)	-	330	-	μJ
E <sub>ts</sub>	Total switching losses		-	550	-	μJ
E <sub>on</sub>	Turn-on switching losses	$V_{CC} = 390 \text{ V}, \text{ I}_{C} = 20 \text{ A}$ $\text{R}_{G} = 3.3 \ \Omega, \text{ V}_{GE} = 15 \text{ V},$	-	450	-	μJ
E <sub>off</sub> <sup>(1)</sup>	Turn-off switching losses		-	770	-	μJ
E <sub>ts</sub>	Total switching losses	T <sub>C</sub> = 125 °C <i>(see Figure 18)</i>	-	1220	-	μJ

1. Turn-off losses include also the tail of the collector current.



### 2.1 Electrical characteristics (curves)

#### Figure 2. Output characteristics

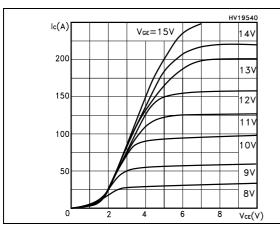


Figure 4. Transconductance

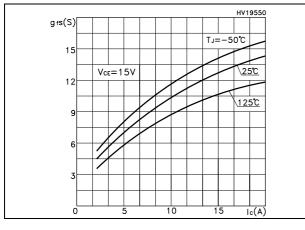


Figure 6. Gate charge vs gate-source voltage

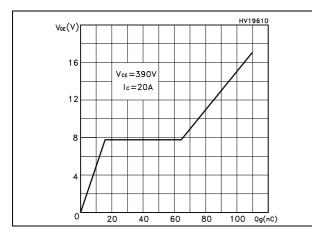


Figure 3. Transfer characteristics

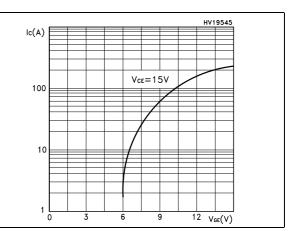


Figure 5. Collector-emitter on voltage vs temperature

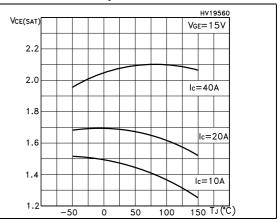


Figure 7. Capacitance variations

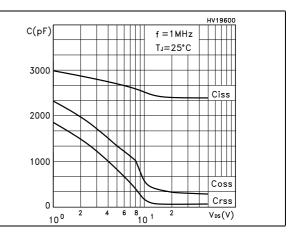




Figure 8. Normalized gate threshold voltage vs temperature

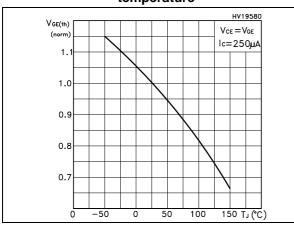


Figure 10. Normalized breakdown voltage vs temperature

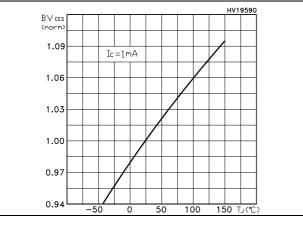


Figure 9. Collector-emitter on voltage vs collector current

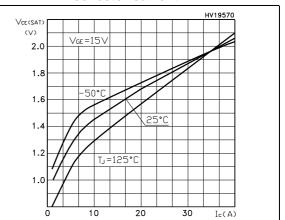


Figure 11. Switching losses vs temperature

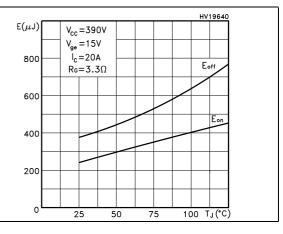
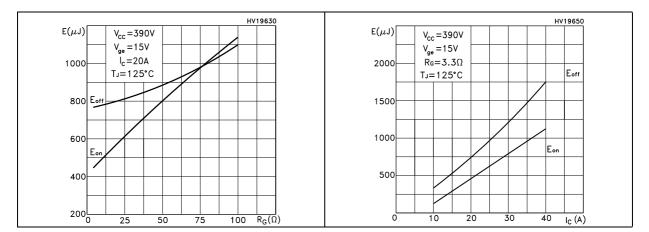


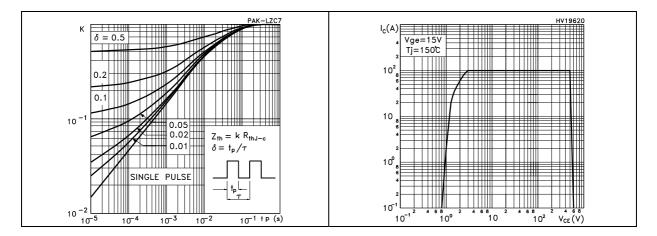
Figure 12. Switching losses vs gate resistance Figure 13. Switching losses vs collector current





#### Figure 14. Thermal impedance

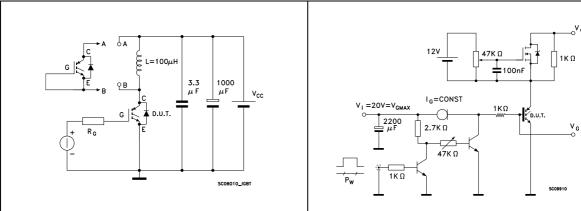
Figure 15. Turn-off SOA



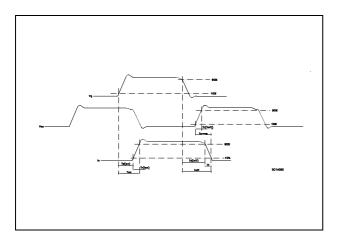


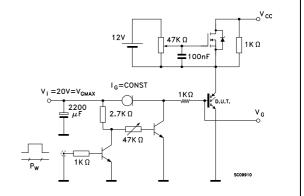
#### **Test circuits** 3

Figure 16. Test circuit for inductive load switching



### Figure 18. Switching waveform





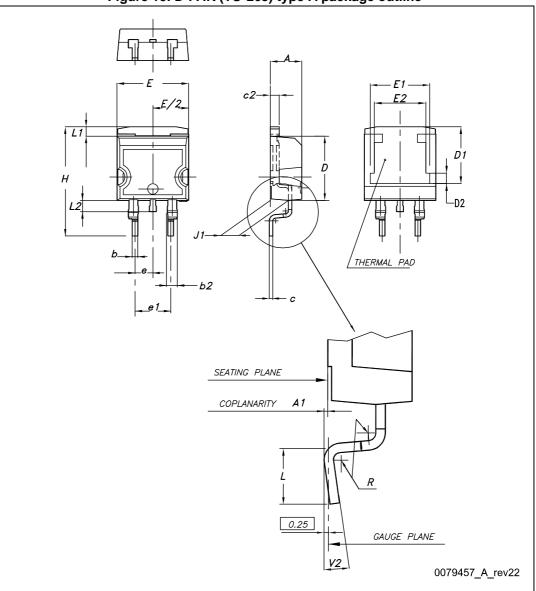
#### Figure 17. Gate charge test circuit



## 4 Package information

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

## 4.1 D<sup>2</sup>PAK type A package information



#### Figure 19. D<sup>2</sup>PAK (TO-263) type A package outline



Dim		mm	
Dim. —	Min.	Тур.	Max.
А	4.40		4.60
A1	0.03		0.23
b	0.70		0.93
b2	1.14		1.70
с	0.45		0.60
c2	1.23		1.36
D	8.95		9.35
D1	7.50	7.75	8.00
D2	1.10	1.30	1.50
E	10		10.40
E1	8.50	8.70	8.90
E2	6.85	7.05	7.25
е		2.54	
e1	4.88		5.28
н	15		15.85
J1	2.49		2.69
L	2.29		2.79
L1	1.27		1.40
L2	1.30		1.75
R		0.4	
V2	0°		8°

Table 8. D<sup>2</sup>PAK (TO-263) type A mechanical data



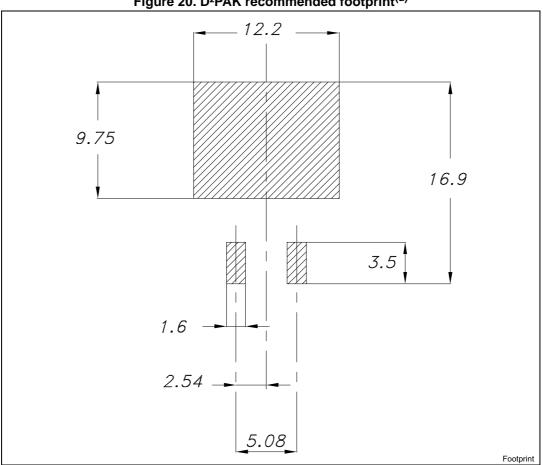


Figure 20. D<sup>2</sup>PAK recommended footprint<sup>(a)</sup>

a. All dimension are in millimeters



#### 4.2 TO-220 type A package information

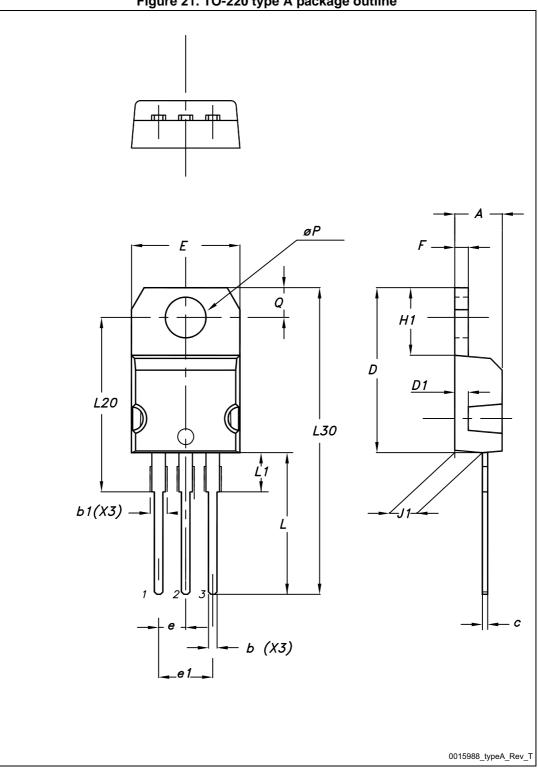


Figure 21. TO-220 type A package outline

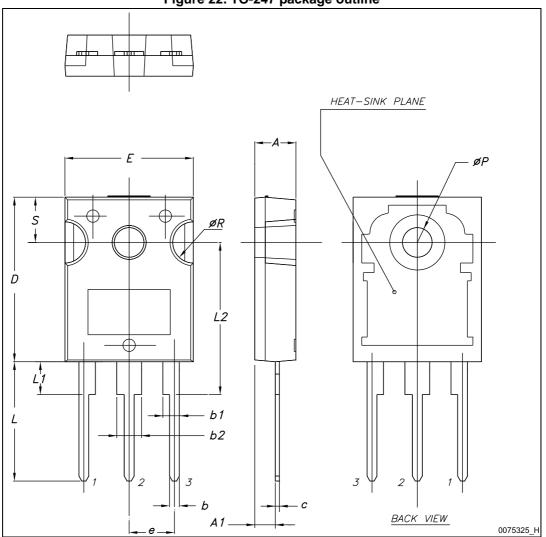


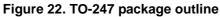
		mm	
Dim.	Min.	Тур.	Max.
A	4.40		4.60
b	0.61		0.88
b1	1.14		1.70
С	0.48		0.70
D	15.25		15.75
D1		1.27	
E	10		10.40
е	2.40		2.70
e1	4.95		5.15
F	1.23		1.32
H1	6.20		6.60
J1	2.40		2.72
L	13		14
L1	3.50		3.93
L20		16.40	
L30		28.90	
øP	3.75		3.85
Q	2.65		2.95

Table 9. TO-220 type A package mechanical data



## 4.3 TO-247 package information







Dim.	mm.					
	Min.	Тур.	Max.			
А	4.85		5.15			
A1	2.20		2.60			
b	1.0		1.40			
b1	2.0		2.40			
b2	3.0		3.40			
С	0.40		0.80			
D	19.85		20.15			
E	15.45		15.75			
е	5.30	5.45	5.60			
L	14.20		14.80			
L1	3.70		4.30			
L2		18.50				
ØP	3.55		3.65			
ØR	4.50		5.50			
S	5.30	5.50	5.70			

Table 10. TO-247 package mechanical data

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## 5 Packing information

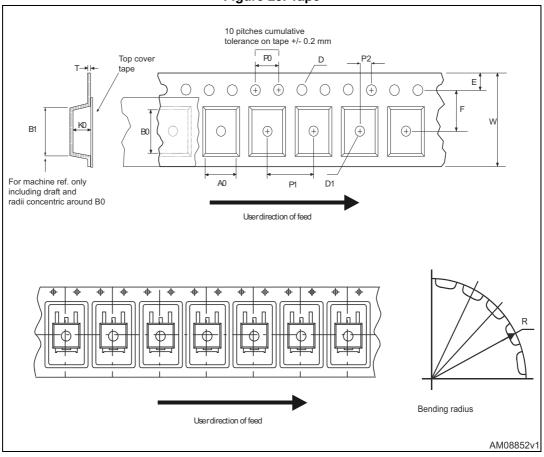
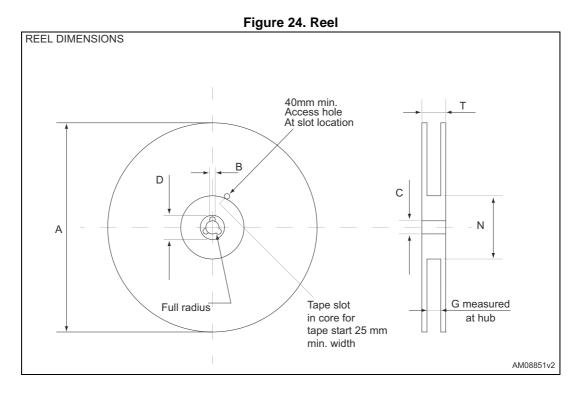


Figure 23. Tape





Таре			Reel		
Dim.	r	nm	Dim.	mm	
	Min.	Max.		Min.	Max.
A0	10.5	10.7	А		330
B0	15.7	15.9	В	1.5	
D	1.5	1.6	С	12.8	13.2
D1	1.59	1.61	D	20.2	
E	1.65	1.85	G	24.4	26.4
F	11.4	11.6	Ν	100	
K0	4.8	5.0	Т		30.4
P0	3.9	4.1			
P1	11.9	12.1		Base qty	1000
P2	1.9	2.1		Bulk qty	1000
R	50				
Т	0.25	0.35			
W	23.7	24.3			



# 6 Revision history

Date	Revision	Changes
07-Jun-2004	4	Stylesheet update. No content change
14-May-2008	5	Inserted D <sup>2</sup> PAK
18-Jun-2015	6	Updated Table 1: Device summary. Updated Section 4: Package information and Section 5: Packing information.

Table 12. Document revision history



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