

## STGW30NC60WD

#### 30 A, 600 V ultra fast IGBT

#### **Features**

- High frequency operation
- Lower C<sub>RES</sub> / C<sub>IES</sub> ratio (no cross-conduction susceptibility)
- Very soft ultra fast recovery antiparallel diode

#### **Applications**

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

#### **Description**

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

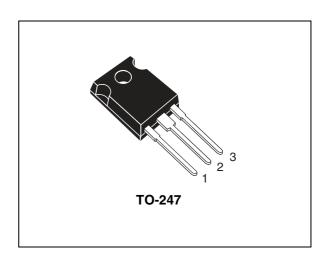


Figure 1. Internal schematic diagram

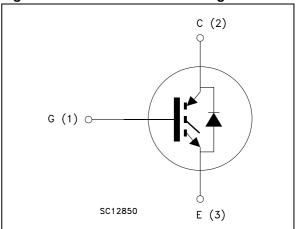


Table 1. Device summary

Order code	Marking	Package	Packaging
STGW30NC60WD	GW30NC60WD	TO-247	Tube

Contents STGW30NC60WD

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STGW30NC60WD Electrical ratings

# 1 Electrical ratings

Table 2. Absolute maximum ratings

Symbol	Parameter	Value	Unit
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 25 °C	60	Α
I <sub>C</sub> <sup>(1)</sup>	Collector current (continuous) at 100 °C	30	Α
I <sub>CP</sub> <sup>(2)</sup>	Collector current (pulsed)	150	Α
I <sub>CL</sub> <sup>(3)</sup>	Turn-off latching current	150	Α
V <sub>GE</sub>	Gate-emitter voltage	± 20	V
I <sub>F</sub>	Diode RMS forward current at T <sub>C</sub> = 25 °C	30	Α
I <sub>FSM</sub>	Surge not repetitive forward current t <sub>p</sub> = 10 ms sinusoidal	120	Α
P <sub>TOT</sub>	Total dissipation at T <sub>C</sub> = 25 °C	200	W
T <sub>stg</sub>	Storage temperature – 55 to 150		°C
T <sub>j</sub>	Operating junction temperature	- 33 10 130	

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. Pulse width limited by max junction temperature
- 3.  $V_{CLAMP}$  = 80% ( $V_{CES}$ ),  $V_{GE}$  = 15 V,  $R_{G}$  = 10  $\Omega$ ,  $T_{J}$  = 150 °C

Table 3. Thermal resistance

Symbol	Parameter	Value	Unit
R <sub>thj-case</sub>	Thermal resistance junction-case IGBT max.	0.63	°C/W
Thermal resistance junction-case diode max.		1.5	°C/W
R <sub>thj-amb</sub>	Thermal resistance junction-ambient max.	50	°C/W

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## 2 Electrical characteristics

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

Table 4. Static electrical characteristics

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	$V_{GE} = 15 \text{ V}, I_{C} = 20 \text{ A}$ $V_{GE} = 15 \text{ V}, I_{C} = 20 \text{ A}, T_{C} = 125 ^{\circ}\text{C}$		2.1 1.8	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 cut-off current (V <sub>GE</sub> = 0)	V <sub>CE</sub> = 600 V V <sub>CE</sub> = 600 V, T <sub>C</sub> = 125 °C			250 1	μA mA
I <sub>GES</sub>	Gate-emitter leakage current (V <sub>CE</sub> = 0)	V <sub>GE</sub> = ±20 V			± 100	nA
9 <sub>fs</sub>	Forward transconductance	V <sub>CE</sub> = 15 V <sub>,</sub> I <sub>C</sub> = 20 A		15		S

Table 5. Dynamic electrical characteristics

Symbol	Parameter	Test conditions	Min.	Тур.	Max.	Unit
C <sub>ies</sub> C <sub>oes</sub> C <sub>res</sub>	Input capacitance Output capacitance Reverse transfer capacitance	$V_{CE} = 25 \text{ V, f} = 1 \text{ MHz,}$ $V_{GE} = 0$		2080 175 52		pF pF pF
Q <sub>g</sub> Q <sub>ge</sub> Q <sub>gc</sub>	Total gate charge Gate-emitter charge Gate-collector charge	$V_{CE}$ = 390 V, $I_{C}$ = 20 A, $V_{GE}$ = 15 V, (see Figure 18)		102 17.5 47	140	nC nC nC

Table 6. Switching on/off (inductive load)

Symbol	Parameter	Test conditions	Min.	Тур.	Max.	Unit
t <sub>d(on)</sub> t <sub>r</sub> (di/dt) <sub>on</sub>	Turn-on delay time Current rise time Turn-on current slope	$V_{CC}$ = 390 V, $I_{C}$ = 20 A $R_{G}$ = 10 $\Omega$ V <sub>GE</sub> = 15 V, (see Figure 17)		29.5 12 1640		ns ns A/µs
t <sub>d(on)</sub> t <sub>r</sub> (di/dt) <sub>on</sub>	Turn-on delay time Current rise time Turn-on current slope	$V_{CC} = 390 \text{ V}, I_{C} = 20 \text{ A}$ $R_{G} = 10 \Omega V_{GE} = 15 \text{ V},$ $T_{C} = 125 \text{ °C} \text{ (see Figure 17)}$		29 13.5 1600		ns ns A/µs
t <sub>r</sub> (V <sub>off</sub> ) t <sub>d</sub> ( <sub>off</sub> ) t <sub>f</sub>	Off voltage rise time Turn-off delay time Current fall time	$V_{CC}$ = 390 V, $I_{C}$ = 20 A, $R_{GE}$ = 10 $\Omega$ $V_{GE}$ = 15 V (see Figure 17)		19.5 118 27		ns ns ns
t <sub>r</sub> (V <sub>off</sub> ) t <sub>d</sub> ( <sub>off</sub> ) t <sub>f</sub>	Off voltage rise time Turn-off delay time Current fall time	$V_{CC} = 390 \text{ V}, I_{C} = 20 \text{ A},$ $R_{GE} = 10 \Omega, V_{GE} = 15 \text{ V},$ $T_{C} = 125 ^{\circ}\text{C}$ (see Figure 17)		46 151 38		ns ns ns

Table 7. Switching energy (inductive load)

Symbol	Parameter	Test conditions	Min.	Тур.	Max.	Unit
E <sub>on</sub> <sup>(1)</sup> E <sub>off</sub> E <sub>ts</sub>	Turn-on switching losses Turn-off switching losses Total switching losses	$V_{CC}$ = 390 V, $I_{C}$ = 20 A $R_{G}$ = 10 $\Omega$ $V_{GE}$ = 15 V, (see Figure 19)		305 181 486		µJ µJ µJ
E <sub>on</sub> <sup>(1)</sup> E <sub>off</sub> E <sub>ts</sub>	Turn-on switching losses Turn-off switching losses Total switching losses	$V_{CC} = 390 \text{ V}, I_{C} = 20 \text{ A}$ $R_{G} = 10 \Omega V_{GE} = 15 \text{ V},$ $T_{C} = 125^{\circ}\text{C} \text{ (see Figure 19)}$		455 355 810		μJ μJ μJ

Eon is the tun-on losses when a typical diode is used in the test circuit in Figure 19. If the IGBT is offered
in a package with a co-pak diode, the co-pack diode is used as external diode. IGBTs & Diode are at the
same temperature (25°C and 125°C). Eon include diode recovery energy.

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Table 8. Collector-emitter diode

Symbol	Parameter	Test conditions	Min.	Тур.	Max.	Unit
V <sub>F</sub>	Forward on-voltage	I <sub>F</sub> = 20 A I <sub>F</sub> = 20 A, T <sub>C</sub> = 125 °C		2.6 1.6		V V
t <sub>rr</sub> Q <sub>rr</sub> I <sub>rrm</sub>	Reverse recovery time Reverse recovery charge Reverse recovery current	$I_F = 20 \text{ A}, V_R = 50 \text{ V},$ di/dt = 100 A/ $\mu$ s (see Figure 20)		40 50 2.5		ns nC A
t <sub>rr</sub> Q <sub>rr</sub> I <sub>rrm</sub>	Reverse recovery time Reverse recovery charge Reverse recovery current	$I_F$ = 20 A,V <sub>R</sub> = 50 V, $T_C$ =125 °C, di/dt = 100 A/ $\mu$ s (see Figure 20)		80 180 4.5		ns nC A

#### 2.1 Electrical characteristics (curves)

Figure 2. Output characteristics

Figure 3. Transfer characteristics

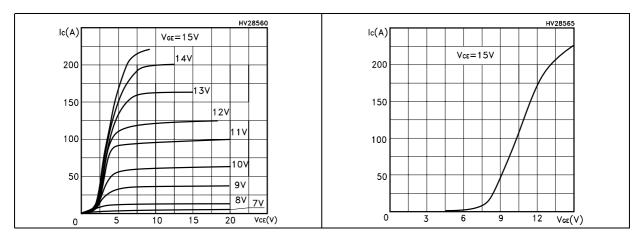


Figure 4. Transconductance

Figure 5. Collector-emitter on voltage vs temperature

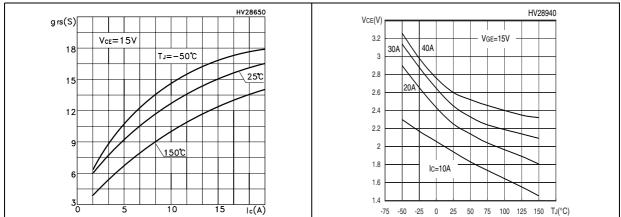
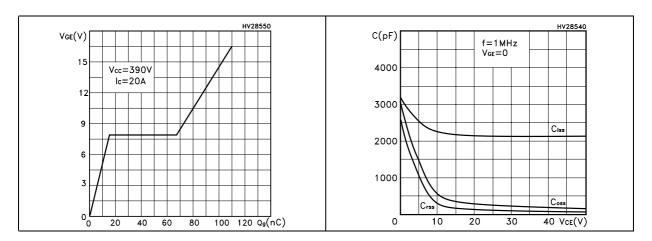


Figure 6. Gate charge vs gate-source voltage Figure 7. Capacitance variations



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Figure 8. Normalized gate threshold voltage Figure 9. Collector-emitter on voltage vs vs temperature collector current

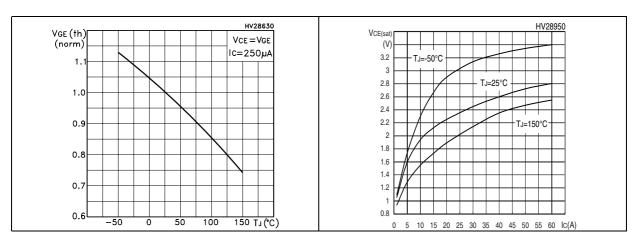


Figure 10. Normalized breakdown voltage vs Figure 11. Switching losses vs temperature temperature

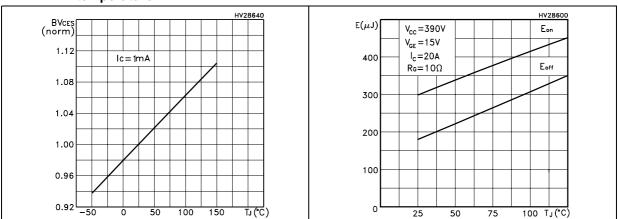
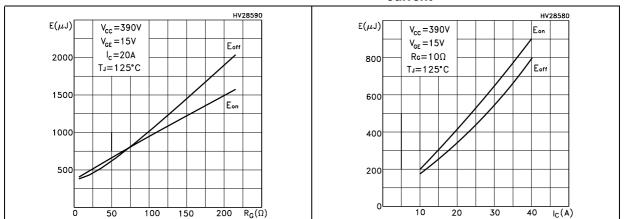


Figure 12. Switching losses vs gate resistance Figure 13. Switching losses vs collector current



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Figure 14. Thermal impedance

Figure 15. Turn-off SOA

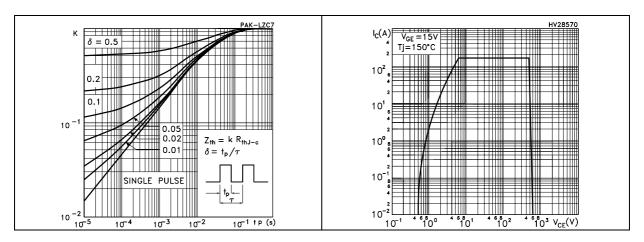
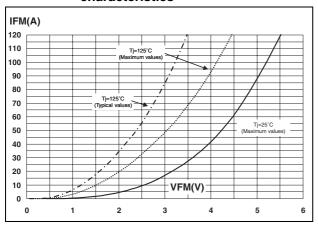


Figure 16. Emitter-collector diode characteristics



Test circuit STGW30NC60WD

## 3 Test circuit

Figure 17. Test circuit for inductive load switching

Figure 18. Gate charge test circuit

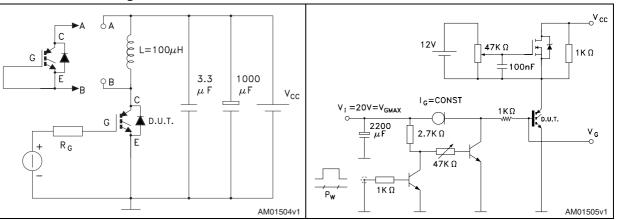
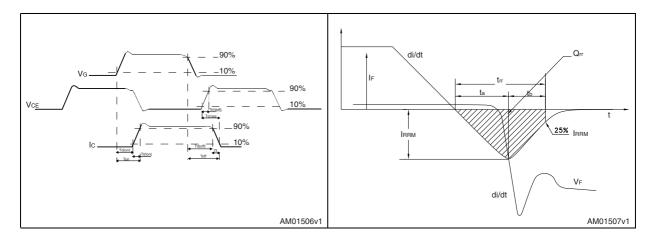


Figure 19. Switching waveform

Figure 20. Diode recovery time waveform



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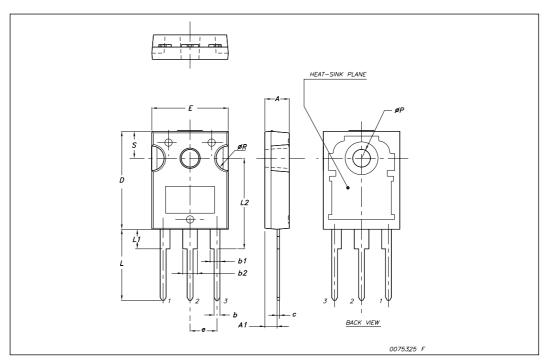
## 4 Package mechanical data

In order to meet environmental requirements, ST offers these devices in ECOPACK® packages. These packages have a Lead-free second level interconnect. The category of second level interconnect is marked on the package and on the inner box label, in compliance with JEDEC Standard JESD97. The maximum ratings related to soldering conditions are also marked on the inner box label. ECOPACK is an ST trademark. ECOPACK specifications are available at: <a href="https://www.st.com">www.st.com</a>

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#### **TO-247 Mechanical data**

Dim.		mm.	
Dilli.	Min.	Тур	Max.
Α	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
Е	15.45		15.75
е		5.45	
L	14.20		14.80
L1	3.70		4.30
L2		18.50	
øΡ	3.55		3.65
øR	4.50		5.50
S		5.50	



STGW30NC60WD Revision history

# 5 Revision history

Table 9. Document revision history

Date	Revision	Changes
21-Nov-2005	1	Initial release.
29-Nov-2005	2	Modified Figure 5 and Figure 6
06-Mar-2006	3	New template
12-Jul-2007	4	Corrected Figure 11, Figure 12, Figure 13
11-Nov-2008	5	Figure 16 has been updated.

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