

STGW40NC60WD

40 A - 600 V - ultra fast IGBT

Features

- Low C_{RES} / C_{IES} ratio (no cross conduction susceptibility)
- IGBT co-packaged with ultra fast free-wheeling diode
- High frequency operation

Applications

- High frequency inverters, UPS
- Motor drivers
- HF, SMPS and PFC in both hard switch and resonant topologies
- Welding
- Induction heating



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

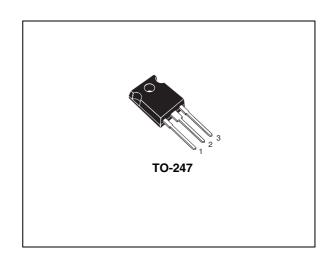


Figure 1. Internal schematic diagram

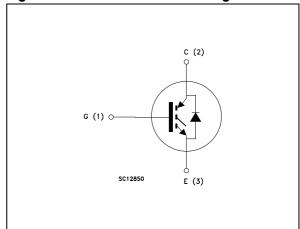


Table 1. Device summary

Order code	Marking	Package	Packaging
STGW40NC60WD	GW40NC60WD	TO-247	Tube

Contents STGW40NC60WD

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STGW40NC60WD Electrical ratings

1 Electrical ratings

Table 2. Absolute maximum ratings

Symbol	Parameter	Value	Unit
V _{CES}	Collector-emitter voltage (V _{GE} = 0)	600	٧
I _C ⁽¹⁾	Collector current (continuous) at 25 °C	70	Α
I _C ⁽¹⁾	Collector current (continuous) at 100 °C	40	Α
I _{CL} (2)	Turn-off latching current	230	Α
I _{CP} ⁽³⁾	Pulsed collector current	230	Α
V _{GE}	Gate-emitter voltage	±20	V
I _F	Diode RMS forward current at T _C =25 °C	30	Α
I _{FSM}	Surge non repetitive forward current (tp=10 ms sinusoidal)	120	А
P _{TOT}	Total dissipation at T _C = 25 °C	250	W
T _j	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_{CES}), Tj = 150 °C, R_G = 10 Ω , V_{GE}= 15 V
- 3. Pulse width limited by max. junction temperature allowed

Table 3. Thermal resistance

Symbol	Parameter	Value	Unit
R _{thj-case}	Thermal resistance junction-case max (IGBT)	0.5	°C/W
R _{thj-case}	Thermal resistance junction-case max (diode)	1.5	°C/W
R _{thj-amb}	Thermal resistance junction-ambient max	50	°C/W

Electrical characteristics STGW40NC60WD

2 Electrical characteristics

(T_{CASE}=25 $^{\circ}$ C unless otherwise specified)

Table 4. Static

Symbol	Parameter	Test conditions	Min.	Тур.	Max.	Unit
V _{(BR)CES}	Collector-emitter breakdown voltage (V _{GE} = 0)	I _C = 1 mA	600			٧
V _{CE(sat)}	Collector-emitter saturation voltage	V _{GE} = 15 V, I _C = 30 A V _{GE} = 15 V, I _C = 30 A, T _C =125 °C		2.1 1.9	2.5	V V
V _{GE(th)}	Gate threshold voltage	$V_{CE} = V_{GE}$, $I_{C} = 250\mu A$	3.75		5.75	V
I _{CES}	Collector-emitter cut-off current (V _{GE} = 0)	V _{GE} = 600 V V _{GE} = 600 V, T _C =125 °C			500 5	μA mA
I _{GES}	Gate-emitter cut-off current (V _{CE} = 0)	V _{GE} = ± 20 V			±100	nA
9 _{fs}	Forward transconductance	V _{CE} = 15 V _, I _C = 30 A		20		S

Table 5. Dynamic

Symbol	Parameter	Test conditions	Min.	Тур.	Max.	Unit
C _{ies} C _{oes} C _{res}	Input capacitance Output capacitance Reverse transfer capacitance	V _{CE} = 25 V, f = 1 MHz, V _{GE} = 0		2900 298 59		pF pF pF
Q _g Q _{ge} Q _{gc}	Total gate charge Gate-emitter charge Gate-collector charge	V_{CE} = 390 V, I_{C} = 30 A, V_{GE} = 15 V (see Figure 18)		126 16 46		nC nC nC

Table 6. Switching on/off (inductive load)

Symbol	Parameter	Test conditions	Min.	Тур.	Max.	Unit
t _{d(on)} t _r (di/dt) _{on}	Turn-on delay time Current rise time Turn-on current slope	V_{CC} = 390 V, I_{C} = 30 A R_{G} = 10 Ω , V_{GE} = 15 V (see Figure 17)		33 12 2600		ns ns A/µs
t _{d(on)} t _r (di/dt) _{on}	Turn-on delay timE Current rise time Turn-on current slope	$V_{CC} = 390 \text{ V}, I_{C} = 30 \text{ A}$ $R_{G} = 10 \Omega, V_{GE} = 15 \text{ V},$ $T_{C} = 125 ^{\circ}\text{C}$ (see Figure 17)		32 14 2300		ns ns A/µs
$t_r(V_{off})$ $t_d(_{off})$ t_f	Off voltage rise time Turn-off delay time Current fall time	V_{CC} = 390 V, I_{C} = 30 A, R_{GE} = 10 Ω , V_{GE} =15 V (see Figure 17)		26 168 36		ns ns ns
t _r (V _{off}) t _d (_{off}) t _f	Off voltage rise time Turn-off delay time Current fall time	$V_{CC} = 390 \text{ V}, I_{C} = 30 \text{ A},$ $R_{GE} = 10 \Omega, V_{GE} = 15 \text{ V},$ $T_{C} = 125 \text{ °C (see Figure 17)}$		54 213 67		ns ns ns

Table 7. Switching energy (inductive load)

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Symbol	Parameter	Test conditions	Min	Тур.	Max	Unit
E _{on} ⁽¹⁾ E _{off} ⁽²⁾ E _{ts}	Turn-on switching losses Turn-off switching losses Total switching losses	V_{CC} = 390 V, I_{C} = 30 A R_{G} = 10 Ω , V_{GE} = 15 V (see Figure 17)		302 349 651		μJ μJ μJ
E _{on} ⁽¹⁾ E _{off} ⁽²⁾ E _{ts}	Turn-on switching losses Turn-off switching losses Total switching losses	$V_{CC} = 390 \text{ V}, I_{C} = 30 \text{ A}$ $R_{G} = 10 \Omega, V_{GE} = 15 \text{ V},$ $T_{C} = 125 ^{\circ}\text{C}$ (see Figure 17)		553 750 1303		μJ μJ μJ

Eon is the turn-on losses when a typical diode is used in the test circuit in figure 2 Eon include diode recovery energy. 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)

^{2.} Turn-off losses include also the tail of the collector current

Electrical characteristics STGW40NC60WD

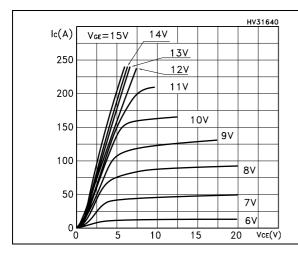
Table 8. Collector-emitter diode

Symbol	Parameter	Test conditions	Min	Тур.	Max	Unit
V _F	Forward on-voltage	I _F = 30 A I _F = 30 A, T _C = 125 °C		2.4 1.8		V V
t _{rr} Q _{rr} I _{rrm}	Reverse recovery time Reverse recovery charge Reverse recovery current	$I_F = 30 \text{ A}, V_R = 50 \text{ V},$ di/dt =100 A/ μ s (see Figure 20)		45 56 2.55		ns nC A
t _{rr} Q _{rr} I _{rrm}	Reverse recovery time Reverse recovery charge Reverse recovery current	I_F = 30 A, V_R = 50 V, T_C = 125 °C, di/dt =100 A/ μ s (see Figure 20)		100 290 5.8		ns nC A

2.1 Electrical characteristics (curves)

Figure 2. Output characteristics

Figure 3. Transfer characteristics



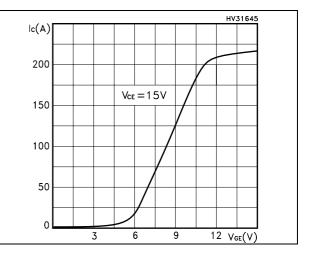
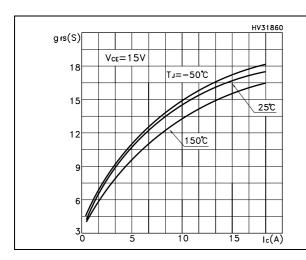


Figure 4. Transconductance

Figure 5. Collector-emitter on voltage vs temperature



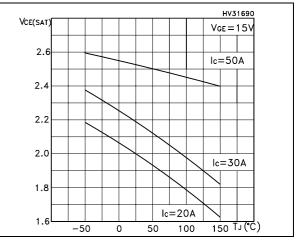
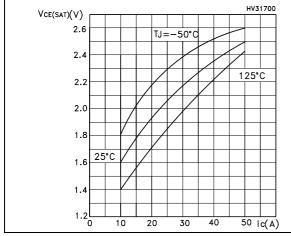
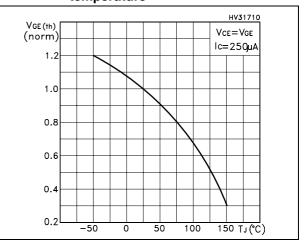


Figure 6. Collector-emitter on voltage vs collector current

Figure 7. Normalized gate threshold vs temperature





Electrical characteristics STGW40NC60WD

Figure 8. Normalized breakdown voltage vs Figure 9. Gate charge vs gate-emitter voltage temperature

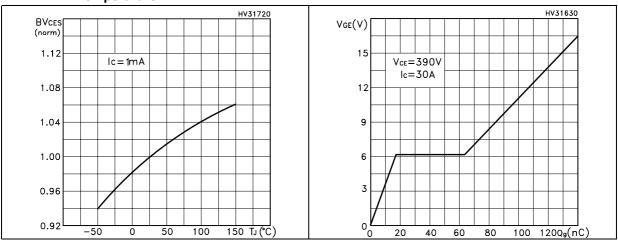


Figure 10. Capacitance variations

Figure 11. Switching losses vs temperature

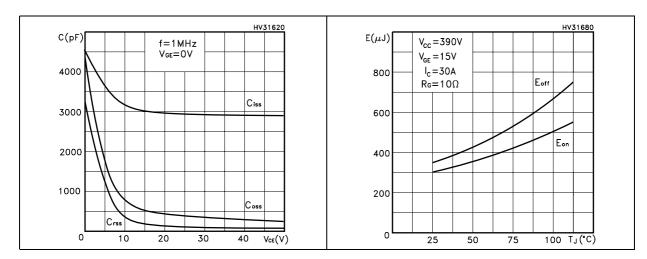


Figure 12. Switching losses vs gate resistance Figure 13. Switching losses vs collector current

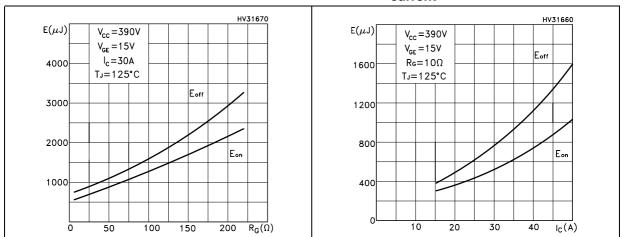
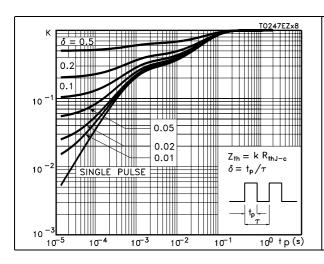


Figure 14. Thermal impedance

Figure 15. Turn-off SOA



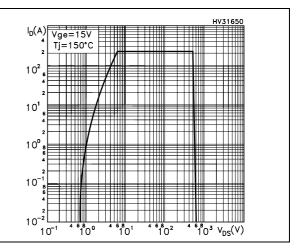
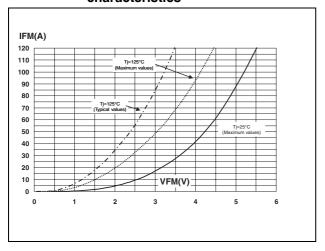


Figure 16. Emitter-collector diode characteristics



Test circuit STGW40NC60WD

3 Test circuit

Figure 17. Test circuit for inductive load switching

Figure 18. Gate charge test circuit

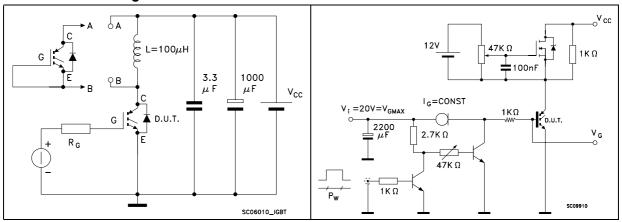
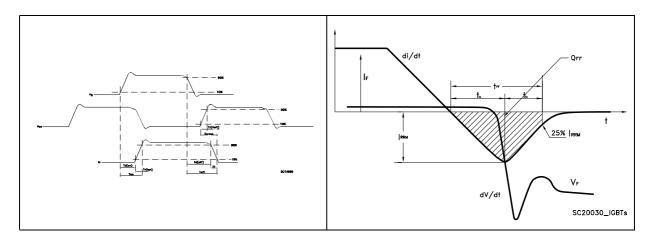


Figure 19. Switching waveforms

Figure 20. Diode recovery times waveform



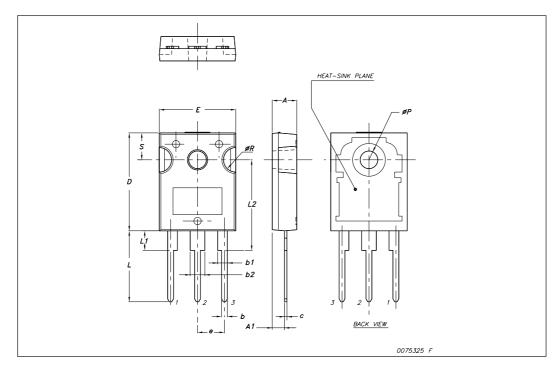
4 Package mechanical data

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: www.st.com

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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	



STGW40NC60WD Revision history

5 Revision history

Table 9. Document revision history

Date	Revision	Changes
8-Jun-2006	1	First release
08-Nov-2006	2	Modified <i>Dynamic</i>
01-Feb-2008	3	Updated <i>Table 7</i>
09-Jul-2008	4	Added new feature

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