STGW20NC60VD

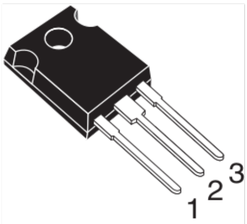
30 A, 600 V, very fast IGBT

Features

- High current capability
- High frequency operation up to 50 KHz
- Very soft ultra fast recovery antiparallel diode

Description

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



TO-247

Applications

- High frequency inverters, UPS
- Motor drive
- SMPS and PFC in both hard switch and resonant topologies

Figure 1. Internal schematic diagram

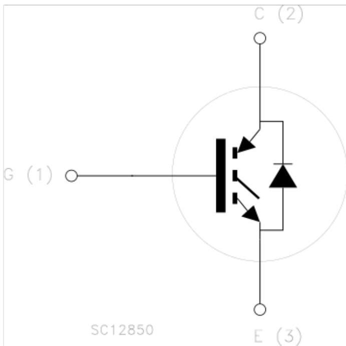


Table 1. Device summary

Order code	Marking	Package	Packaging
STGW20NC60VD	GW20NC60VD	TO-247	Tube

Contents

1 Electrical ratings

Table 2. Absolute maximum ratings

Symbol	Parameter	Value	Unit
V_{CES}	Collector-emitter voltage (V_{GE} = 0)	600	V
I_C (1)	Continuous collector current at Tc= 25°C	60	A
I_C (1)	Continuous collector current at Tc= 100°C	30	A
I_{CP} (2)	Pulsed collector current	150	A
I_{CL} (3)	Turn-off latching current	100	A
V_{GE}	Gate-emitter voltage	± 20	V
I_F	Diode RMS forward current at Tc=25°C	30	A
I_{FSM}	Surge not repetitive forward current tp = 10 ms sinusoidal	120	A
P_{TOT}	Total dissipation at T_C = 25°C	200	W
T_j	Operating junction temperature	– 55 to 150	°C
T_{stg}	Storage temperature		

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 maximum junction temperature and turn-off within RBSOA.
3. V_{clamp} = 80 % V_{CES}, T_J = 150 °C, R_G = 10 Ω, V_{GE} = 15 V.

Table 3. Thermal data

Symbol	Parameter	Value	Unit
$R_{thj-case}$	Thermal resistance junction-case IGBT	0.63	°C/W
	Thermal resistance junction-case diode	1.5	°C/W
$R_{thj-amb}$	Thermal resistance junction-ambient	50	°C/W

2 Electrical characteristics

(T_j =25°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 mA	600			V
$V_{CE(sat)}$	Collector-emitter saturation voltage	V_{GE}=15 V, I_C=20 A V_{GE}=15 V, I_C=20 A,T_j=125 °C		1.8 1.7	2.5	V V
$V_{GE(th)}$	Gate threshold voltage	V_{CE}= V_{GE}, I_C= 250 µA	3.75		5.75	V
I_{CES}	Collector-cut-off current (V_{GE} = 0)	V_{CE} = 600 V V_{CE}=600 V, T_j= 125 °C			250 1	µA mA
I_{GES}	Gate-emitter leakage current (V_{CE} = 0)	V_{GE} = ± 20V			±100	nA
g_{fs}	Forward transconductance	V_{CE} = 15 V, I_C= 20 A		15		S

Table 5. Dynamic

Symbol	Parameter	Test conditions	Min.	Typ.	Max	Unit
C_{ies} C_{oes} C_{res}	Input capacitance Output capacitance Reverse transfer capacitance	V_{CE} = 25V, f = 1 MHz, V_{GE}= 0	-	2200 225 50		pF pF pF
Q_g Q_{ge} Q_{gc}	Total gate charge Gate-emitter charge Gate-collector charge	V_{CE} = 390V, I_C = 20A, V_{GE} = 15V, *(see Figure 18)*	-	100 16 45	140	nC nC nC

Table 6. Switching on/off (inductive load)

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$t_{d(on)}$ t_r $(di/dt)_{onf}$	Turn-on delay time Current rise time Turn-on current slope	V_{CC}=390 V, I_C= 20 A, R_G=3.3 Ω, V_{GE}=15V *(see Figure 17)*	-	31 11 1600	-	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 V, I_C= 20 A, R_G=3.3 Ω, V_{GE}=15 V T_j=125°C *(see Figure 17)*	-	31 11.5 1500	-	ns ns A/µs
$t_{r(Voff)}$ $t_{d(off)}$ t_f	Off voltage rise time Turn-off delay time Current fall time	V_{CC}=390 V, I_C= 20 A, R_G=3.3 Ω, V_{GE}=15 V *(see Figure 17)*	-	28 100 75	-	ns ns ns
$t_{r(Voff)}$ $t_{d(off)}$ t_f	Off voltage rise time Turn-off delay time Current fall time	V_{CC}=390 V, I_C= 20 A, R_G=3.3 Ω, V_{GE}=15 V T_j=125°C *(see Figure 17)*	-	66 150 130	-	ns ns ns

Table 7. Switching energy (inductive load)

Symbol	Parameter	Test conditions	Min	Typ.	Max	Unit
E_{on} (1) E_{off} E_{ts}	Turn-on switching losses Turn-off switching losses Total switching losses	V_{CC}=390 V, I_C= 20 A, R_G=3.3 Ω, V_{GE}=15 V, *(see Figure 19)*	-	220 330 550	300 450 750	µJ µJ µJ
E_{on} (1) E_{off} E_{ts}	Turn-on switching losses Turn-off switching losses Total switching losses	V_{CC}=390 V, I_C= 20 A, R_G=3.3 Ω, V_{GE}=15 V, Tj= 125°C *(see Figure 19)*	-	450 770 1220		µJ µJ µJ

1. Eon is the turn-on losses when a typical diode is used in the test circuit in *Figure 19*. 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).

Table 8. Collector-emitter diode

Symbol	Parameter	Test conditions	Min	Typ.	Max	Unit
V_F	Forward on-voltage	I_F = 20 A I_F = 20 A, T_j = 125°C	-	2 1.6	-	V V
t_{rr} Q_{rr} I_{rrm}	Reverse recovery time Reverse recovery charge Reverse recovery current	I_F = 20 A, V_R = 40 V, T_j = 25°C, di/dt =100 A/µs *(see Figure 20)*	-	44 66 3	-	ns nC A
t_{rr} Q_{rr} I_{rrm}	Reverse recovery time Reverse recovery charge Reverse recovery current	I_F = 2 0A, V_R = 40 V, T_j = 125°C, di/dt =100 A/µs *(see Figure 20)*	-	88 237 5.4	-	ns nC A

2.1 Electrical characteristics (curves)

Figure 2. Output characteristics

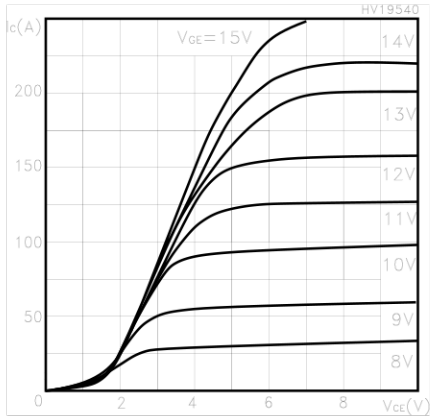


Figure 3. Transfer characteristics

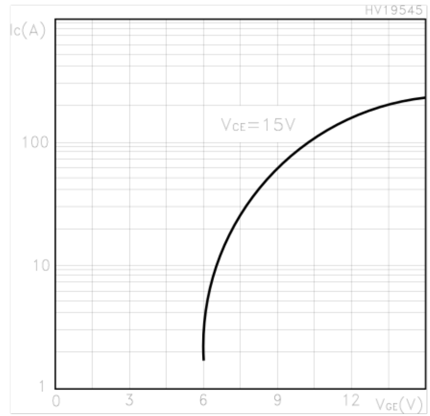


Figure 4. Transconductance

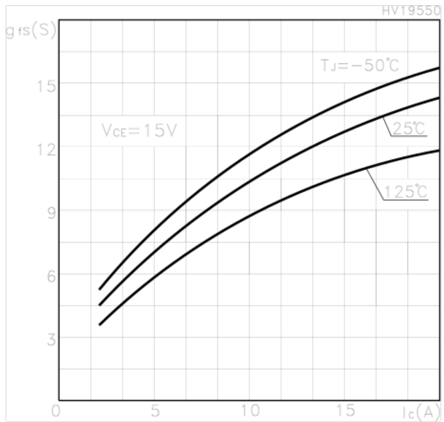


Figure 5. Collector-emitter on voltage vs temperature

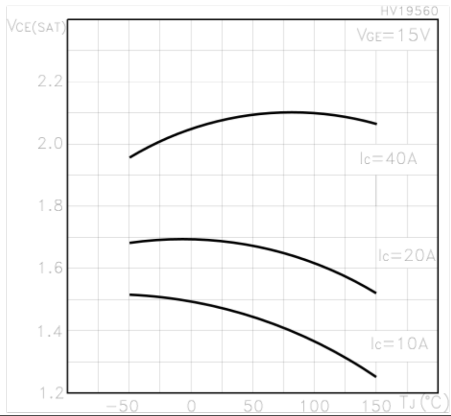


Figure 6. Collector-emitter on voltage vs collector current

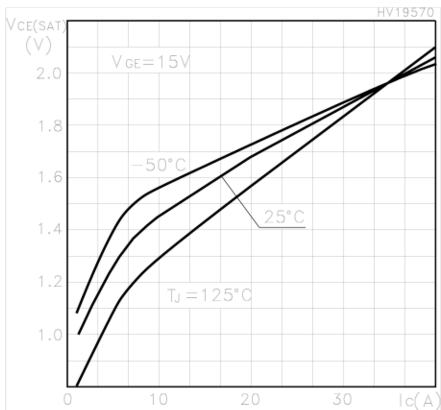


Figure 7. Normalized gate threshold vs temperature

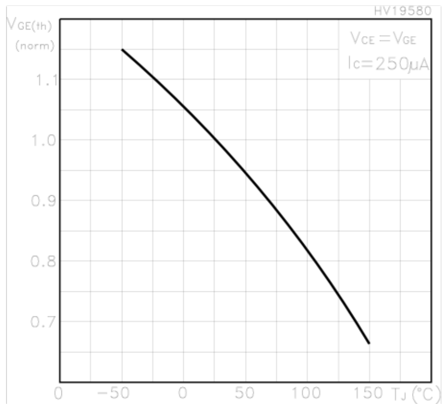


Figure 8. Normalized breakdown voltage vs temperature

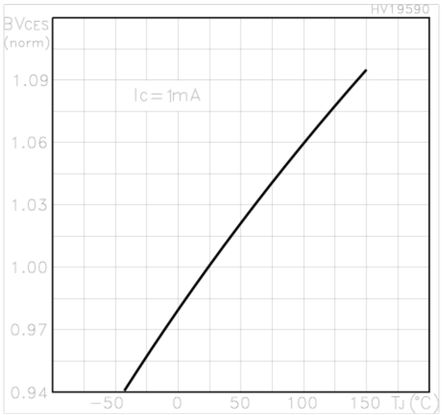


Figure 9. Gate charge vs gate-emitter voltage

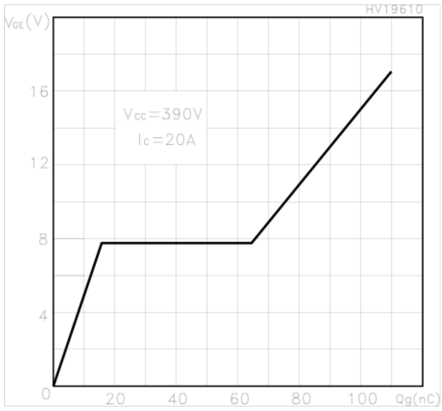


Figure 10. Capacitance variations

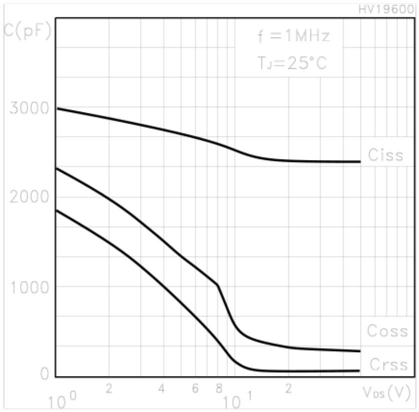


Figure 11. Switching losses vs temperature

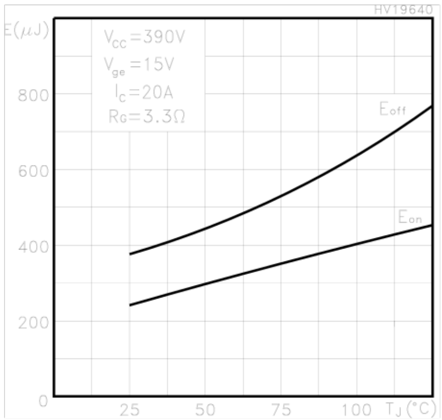


Figure 12. Switching losses vs gate resistance

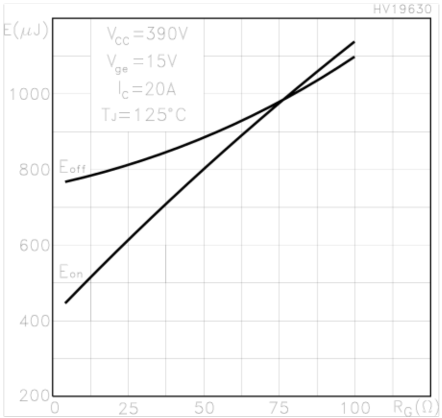


Figure 13. Switching losses vs collector current

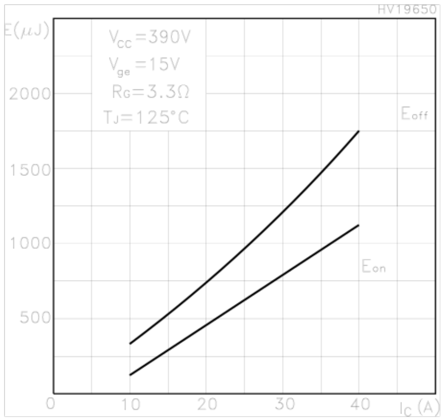


Figure 14. Thermal impedance

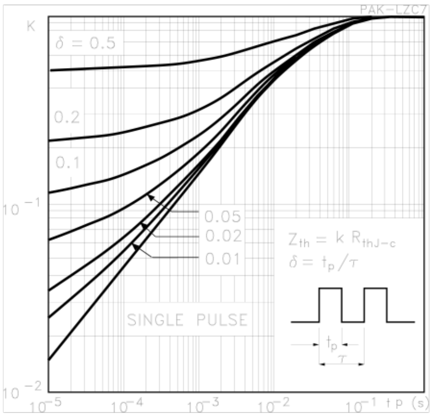


Figure 15. Turn-off SOA

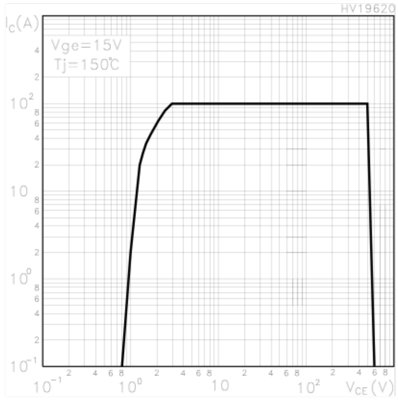
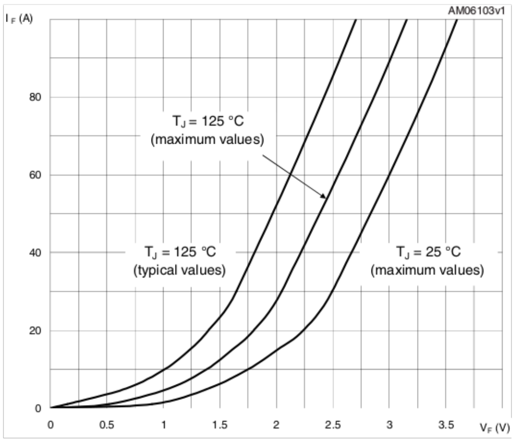


Figure 16. Emitter-collector diode characteristics



3 Test circuits

Figure 17. Test circuit for inductive load switching

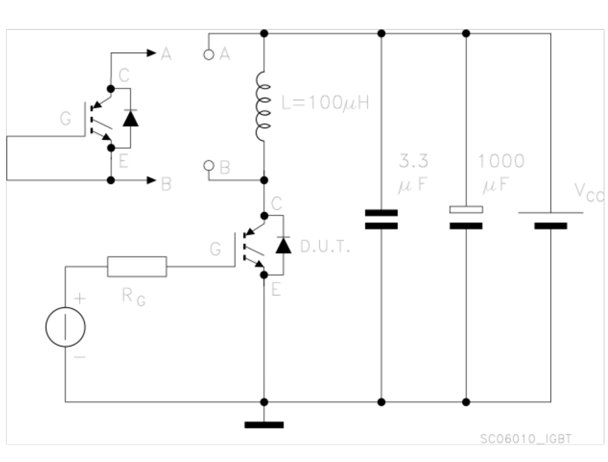


Figure 18. Gate charge test circuit

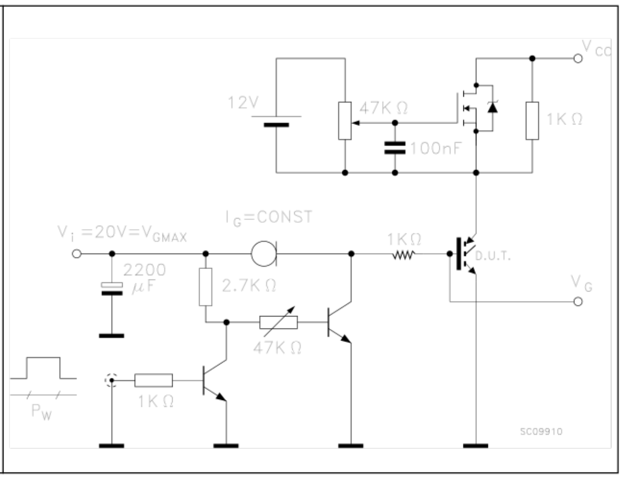


Figure 19. Switching waveforms

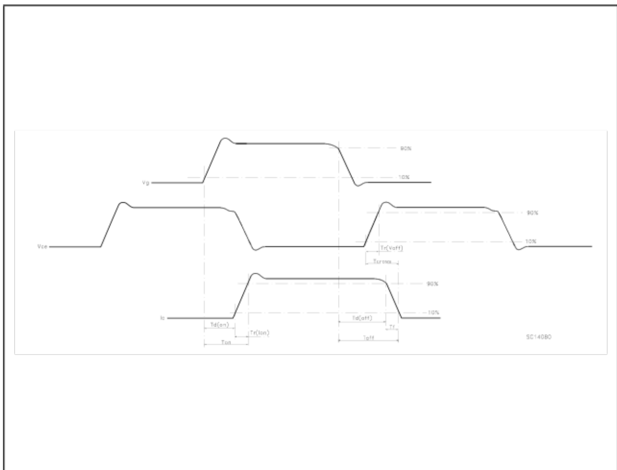
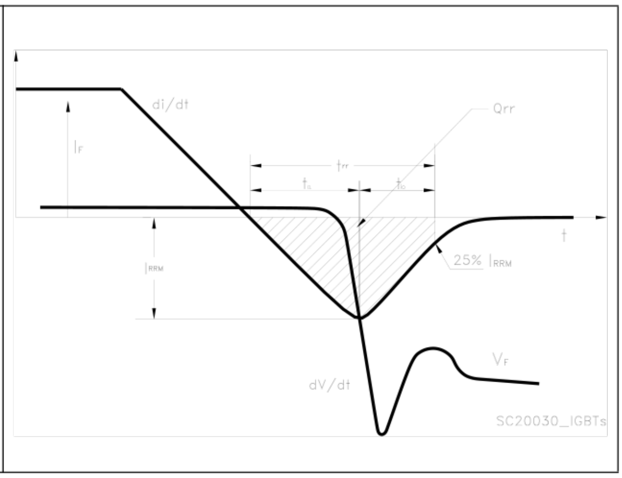


Figure 20. Diode recovery times waveform

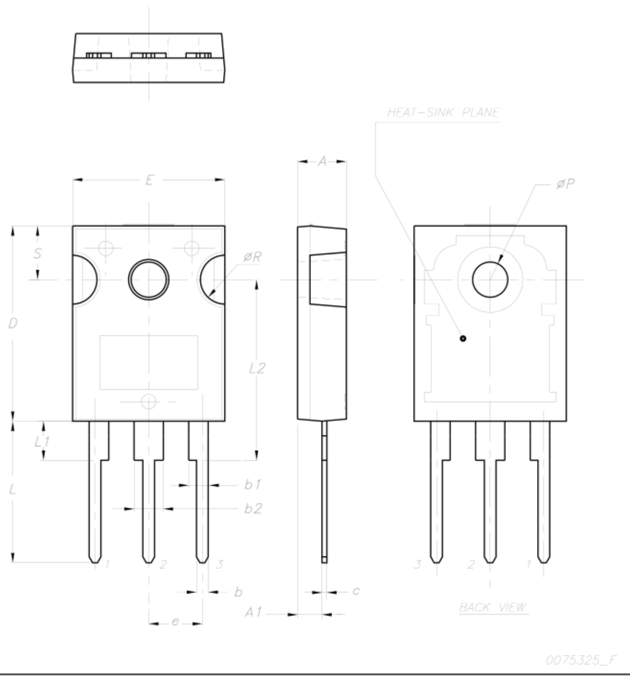


4 Package mechanical data

In order to meet environmental requirements, ST offers these devices in 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. ECOPACK is an ST trademark.

TO-247 mechanical data

Dim.	mm.		
	Min.	Typ.	Max.
A	4.85		5.15
A1	2.20		2.60
b	1.0		1.40
b1	2.0		2.40
b2	3.0		3.40
c	0.40		0.80
D	19.85		20.15
E	15.45		15.75
e		5.45	
L	14.20		14.80
L1	3.70		4.30
L2		18.50	
øP	3.55		3.65
øR	4.50		5.50
S		5.50	



5 Revision history

Table 9. Revision history

Date	Revision	Changes
12-Jul-2004	4	Stylesheet updated. Added switching losses maximum values in *Table 7: Switching energy (inductive load)*. Inserted *Figure 20: Diode recovery times waveform*.
09-Mar-2010	5	Inserted I_{FSM} parameter on *Table 2: Absolute maximum ratings*. Updated *Figure 16: Emitter-collector diode characteristics* and package mechanical data. Minor text changes to improve readability.