

### Features

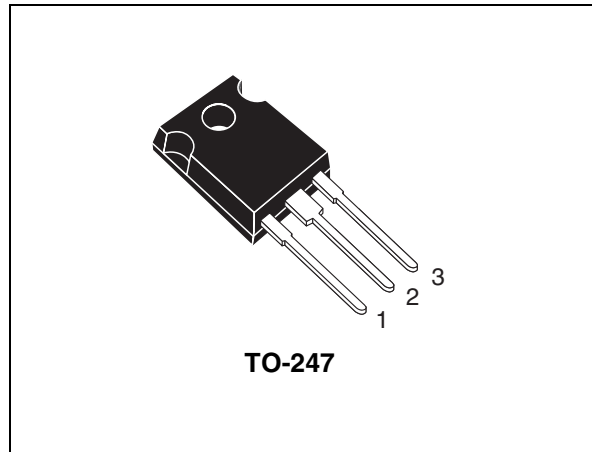
- Improved  $E_{off}$  at elevated temperature
- Low  $C_{RES} / C_{IES}$  ratio (no cross-conduction susceptibility)
- Ultra fast soft recovery antiparallel diode

### Applications

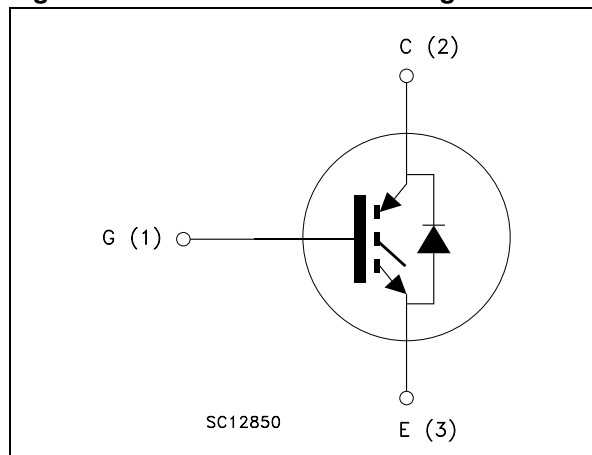
- Welding
- High frequency converters
- Power factor correction

### Description

The "HF" series is based on a new planar technology concept to yield an IGBT with tighter variation of switching energy ( $E_{off}$ ) versus temperature. Suffix "W" denotes a subset of products tailored to high switching frequency operation over 100 kHz.



**Figure 1. Internal schematic diagram**



**Table 1. Device summary**

Order code	Marking	Package	Packaging
STGW45HF60WD	GW45HF60WD	TO-247	Tube

# 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>	Continuous collector current at T <sub>C</sub> = 25 °C	70	A
I <sub>C</sub> <sup>(1)</sup>	Continuous collector current at T <sub>C</sub> = 100 °C	45	A
I <sub>CP</sub> <sup>(2)</sup>	Collector current (pulsed)	TBD	A
I <sub>CL</sub> <sup>(3)</sup>	Turn-off latching current	TBD	A
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	A
I <sub>FSM</sub>	Surge not repetitive forward current t <sub>p</sub> = 10 ms sinusoidal	120	A
P <sub>TOT</sub>	Total dissipation at T <sub>C</sub> = 25 °C	250	W
T <sub>stg</sub>	Storage temperature	- 55 to 150	°C
T <sub>j</sub>	Operating junction temperature		

1. Calculated according to the iterative formula:

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

- 2. Pulse width limited by maximum junction temperature and turn-off within RBSOA
- 3. V<sub>CLAMP</sub> = 80% (V<sub>CES</sub>), V<sub>GE</sub> = 15 V, R<sub>G</sub> = 10 Ω, T<sub>J</sub> = 150 °C

**Table 3. Thermal data**

Symbol	Parameter	Value	Unit
R <sub>thj-case</sub>	Thermal resistance junction-case IGBT	0.5	°C/W
	Thermal resistance junction-case diode	1.5	°C/W
R <sub>thj-amb</sub>	Thermal resistance junction-ambient	50	°C/W

## 2 Electrical characteristics

( $T_J = 25\text{ °C}$  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	$V_{GE} = 15\text{ V}$ , $I_C = 30\text{ A}$ $V_{GE} = 15\text{ V}$ , $I_C = 30\text{ A}$ , $T_J = 125\text{ °C}$		1.9 TBD	2.5	V V
$V_{GE(th)}$	Gate threshold voltage	$V_{CE} = V_{GE}$ , $I_C = 1\text{ mA}$	3.75		5.75	V
$I_{CES}$	Collector cut-off current ( $V_{GE} = 0$ )	$V_{CE} = 600\text{ V}$ $V_{CE} = 600\text{ V}$ , $T_J = 125\text{ °C}$			500 5	$\mu\text{A}$ mA
$I_{GES}$	Gate-emitter leakage current ( $V_{CE} = 0$ )	$V_{GE} = \pm 20\text{ V}$			$\pm 100$	nA
$g_{fs}$	Forward transconductance	$V_{CE} = 15\text{ V}$ , $I_C = 30\text{ A}$		TBD		S

**Table 5. Dynamic**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$C_{ies}$	Input capacitance	$V_{CE} = 25\text{ V}$ , $f = 1\text{ MHz}$ , $V_{GE} = 0$	-	TBD	-	pF
$C_{oes}$	Output capacitance			TBD		pF
$C_{res}$	Reverse transfer capacitance			TBD		pF
$Q_g$	Total gate charge	$V_{CE} = 390\text{ V}$ , $I_C = 30\text{ A}$ , $V_{GE} = 15\text{ V}$ , <i>Figure 3</i>	-	TBD	-	nC
$Q_{ge}$	Gate-emitter charge			TBD		nC
$Q_{gc}$	Gate-collector charge			TBD		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	$V_{CC} = 390\text{ V}$ , $I_C = 30\text{ A}$ $R_G = 4.7\ \Omega$ , $V_{GE} = 15\text{ V}$ , <i>Figure 2</i>	-	TBD TBD TBD	-	ns ns A/ $\mu$ s
$t_{d(on)}$ $t_r$ $(di/dt)_{on}$	Turn-on delay time Current rise time Turn-on current slope	$V_{CC} = 390\text{ V}$ , $I_C = 30\text{ A}$ $R_G = 4.7\ \Omega$ , $V_{GE} = 15\text{ V}$ , $T_J = 125\text{ }^\circ\text{C}$ <i>Figure 2</i>	-	TBD TBD TBD	-	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	$V_{CC} = 390\text{ V}$ , $I_C = 30\text{ A}$ , $R_{GE} = 4.7\ \Omega$ , $V_{GE} = 15\text{ V}$ <i>Figure 2</i>	-	TBD TBD TBD	-	ns ns ns
$t_r(V_{off})$ $t_{d(off)}$ $t_f$	Off voltage rise time Turn-off delay time Current fall time	$V_{CC} = 390\text{ V}$ , $I_C = 30\text{ A}$ , $R_{GE} = 4.7\ \Omega$ , $V_{GE} = 15\text{ V}$ , $T_J = 125\text{ }^\circ\text{C}$ <i>Figure 2</i>	-	TBD TBD TBD	-	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	$V_{CC} = 390\text{ V}$ , $I_C = 30\text{ A}$ $R_G = 4.7\ \Omega$ , $V_{GE} = 15\text{ V}$ , <i>Figure 4</i>	-	300 330 630		$\mu$ J $\mu$ J $\mu$ J
$E_{on}^{(1)}$ $E_{off}$ $E_{ts}$	Turn-on switching losses Turn-off switching losses Total switching losses	$V_{CC} = 390\text{ V}$ , $I_C = 30\text{ A}$ $R_G = 4.7\ \Omega$ , $V_{GE} = 15\text{ V}$ , $T_J = 125\text{ }^\circ\text{C}$ <i>Figure 4</i>	-	550 550 1100	800	$\mu$ J $\mu$ J $\mu$ J

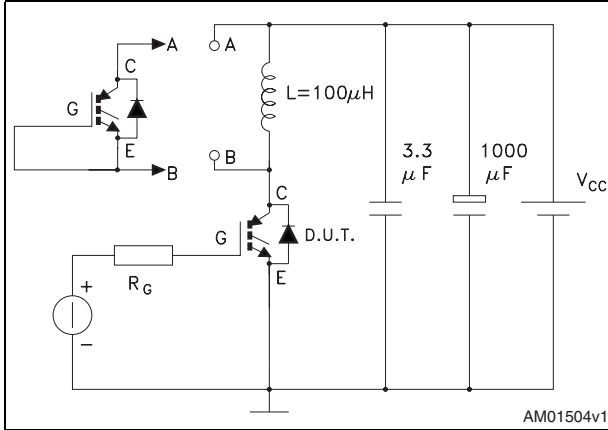
1.  $E_{on}$  is the turn-on losses when a typical diode is used in the test circuit in *Figure 4*. If the IGBT is offered in a package with a co-pak diode, the co-pak diode is used as external diode. IGBTs & Diode are at the same temperature (25 °C and 125 °C).  $E_{on}$  include diode recovery energy.

**Table 8. Collector-emitter diode**

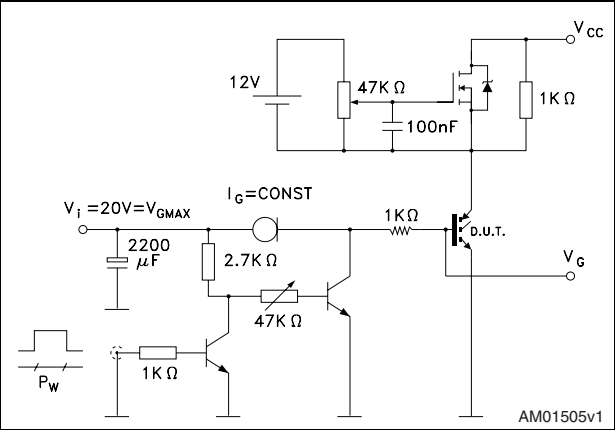
Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$V_F$	Forward on-voltage	$I_F = 30\text{ A}$ $I_F = 30\text{ A}$ , $T_J = 125\text{ }^\circ\text{C}$	-	1.6 1.4	-	V V
$t_{rr}$ $Q_{rr}$ $I_{rrm}$	Reverse recovery time Reverse recovery charge Reverse recovery current	$I_F = 30\text{ A}$ , $V_R = 50\text{ V}$ , $di/dt = 100\text{ A}/\mu\text{s}$ (see <i>Figure 5</i> )	-	45 56 2.55	-	ns nC A
$t_{rr}$ $Q_{rr}$ $I_{rrm}$	Reverse recovery time Reverse recovery charge Reverse recovery current	$I_F = 30\text{ A}$ , $V_R = 50\text{ V}$ , $di/dt = 100\text{ A}/\mu\text{s}$ $T_J = 125\text{ }^\circ\text{C}$ , (see <i>Figure 5</i> )	-	100 290 5.8	-	ns nC A

### 3 Test circuits

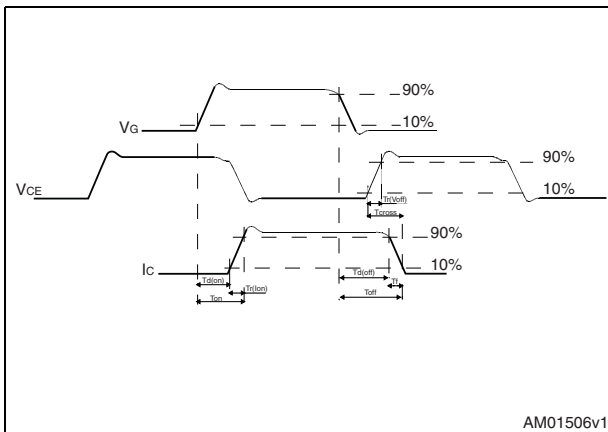
**Figure 2. Test circuit for inductive load switching**



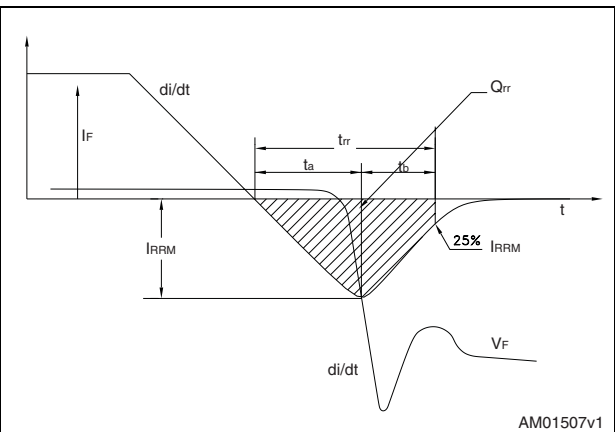
**Figure 3. Gate charge test circuit**



**Figure 4. Switching waveform**



**Figure 5. Diode recovery time waveform**

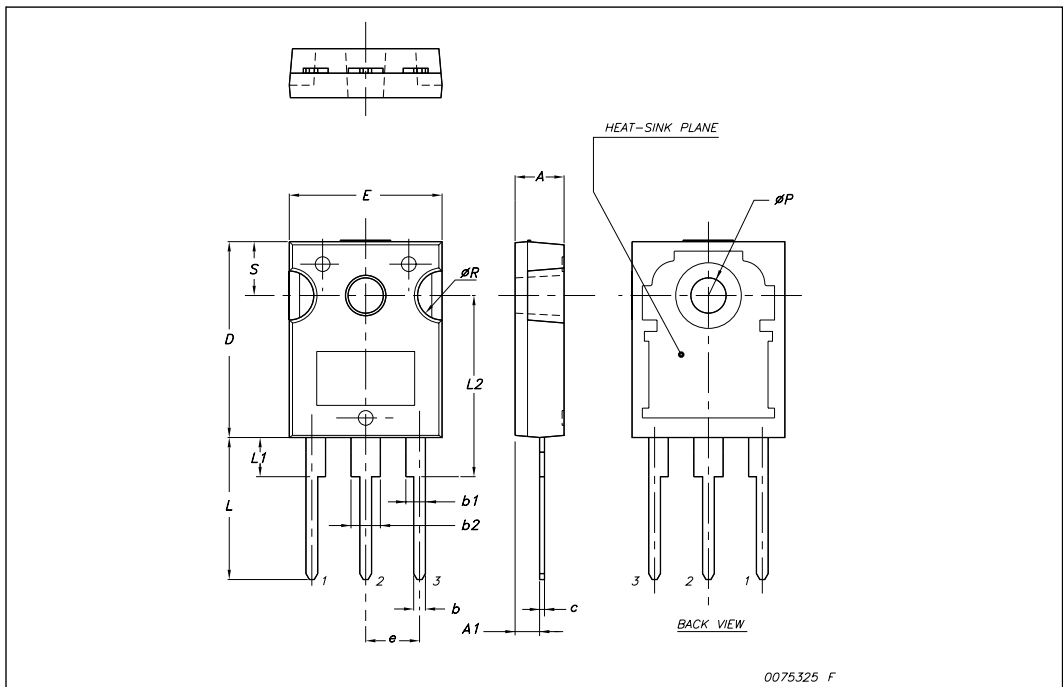


## 4 Package mechanical data

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-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. Document revision history**

Date	Revision	Changes
16-Apr-2009	1	Initial release.
04-Aug-2009	2	– Modified $I_C$ value on Test conditions <a href="#">Table 4</a> – Modified $R_G$ value on Test conditions <a href="#">Table 6</a> and <a href="#">Table 7</a>



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