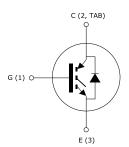


STGW60H65DFB, STGWA60H65DFB, STGWT60H65DFB

Datasheet

Trench gate field-stop 650 V, 60 A high speed HB series IGBT







Product status link
STGW60H65DFB
STGWT60H65DFB
STGWA60H65DFB

Features

- Maximum junction temperature: T_J = 175 °C
- · High speed switching series
- · Minimized tail current
- Low saturation voltage: V_{CE(sat)} = 1.6 V (typ.) @ I_C = 60 A
- · Tight parameter distribution
- · Safe paralleling
- Positive V_{CE(sat)} temperature coefficient
- · Low thermal resistance
- · Very fast soft recovery antiparallel diode

Applications

- · Photovoltaic inverters
- · High-frequency converters

Description

These devices are IGBTs developed using an advanced proprietary trench gate field-stop structure. These devices are part of the new HB series of IGBTs, which represent an optimum compromise between conduction and switching loss to maximize the efficiency of any frequency converter. Furthermore, the slightly positive $V_{\text{CE(sat)}}$ temperature coefficient and very tight parameter distribution result in safer paralleling operation.



1 Electrical ratings

Table 1. Absolute maximum ratings

Symbol	Parameter	Value	Unit
V _{CES}	Collector-emitter voltage (V _{GE} = 0 V)	650	V
1.	Continuous collector current at T _C = 25 °C	80 (1)	Α
I _C	Continuous collector current at T _C = 100 °C	60	Α
I _{CP} (2)(3)	Pulsed collector current	240	Α
\/	Gate-emitter voltage	±20	V
V_{GE}	Transient gate-emitter voltage (t _P ≤ 10 μs)	±30	V
1-	Continuous forward current at T _C = 25 °C	80 (1)	Α
I _F	Continuous forward current at T _C = 100 °C	60	Α
I _{FP} (2)(3)	Pulsed forward current	240	Α
P _{TOT}	Total power dissipation at T _C = 25 °C	375	W
T _{STG}	Storage temperature range	-55 to 150	°C
TJ	Operating junction temperature range	-55 to 175	°C

- 1. Current level is limited by bond wires.
- 2. Pulse width is limited by maximum junction temperature.
- 3. Defined by design, not subject to production test.

Table 2. Thermal data

Symbol	Parameter	Value	Unit
R _{thJC}	Thermal resistance junction-case IGBT	0.4	°C/W
R _{thJC}	Thermal resistance junction-case diode	1.14	°C/W
R _{thJA}	Thermal resistance junction-ambient	50	°C/W

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2 Electrical characteristics

T_J = 25 °C unless otherwise specified

Table 3. Static characteristics

Symbol	Parameter	Test conditions	Min.	Тур.	Max.	Unit
V _{(BR)CES}	Collector-emitter breakdown voltage	$V_{GE} = 0 \text{ V}, I_{C} = 2 \text{ mA}$	650			V
		V _{GE} = 15 V, I _C = 60 A		1.60	2	
V _{CE(sat)}	Collector-emitter saturation voltage	V _{GE} = 15 V, I _C = 60 A, T _J = 125 °C		1.75		V
		V _{GE} = 15 V, I _C = 60 A, T _J = 175 °C		1.85		
		I _F = 60 A		2	2.6	
V_{F}	V _F Forward on-voltage	I _F = 60 A, T _J = 125 °C		1.7		V
		I _F = 60 A, T _J = 175 °C		1.6		
V _{GE(th)}	Gate threshold voltage	$V_{CE} = V_{GE}$, $I_C = 1 \text{ mA}$	5	6	7	V
I _{CES}	Collector cut-off current	V _{GE} = 0 V, V _{CE} = 650 V			25	μA
I _{GES}	Gate-emitter leakage current	V _{CE} = 0 V, V _{GE} = ±20 V			±250	nA

Table 4. Dynamic characteristics

Symbol	Parameter	Test conditions	Min.	Тур.	Max.	Unit
C _{ies}	Input capacitance		-	7792	-	pF
C _{oes}	Output capacitance	$V_{CE} = 25 \text{ V, f} = 1 \text{ MHz,}$ $V_{GE} = 0 \text{ V}$		262	-	pF
C _{res}	Reverse transfer capacitance			158	-	pF
Qg	Total gate charge	V _{CC} = 520 V, I _C = 60 A,	-	306	-	nC
Q _{ge}	Gate-emitter charge	V _{GE} = 0 to 15 V	-	126	-	nC
Q _{gc}	Gate-collector charge	(see Figure 28. Gate charge test circuit)	-	58	-	nC

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Table 5. IGBT switching characteristics (inductive load)

Symbol	Parameter	Test conditions	Min.	Тур.	Max.	Unit
t _{d(on)}	Turn-on delay time		-	66	-	ns
t _r	Current rise time		-	38	-	ns
(di/dt) _{on}	Turn-on current slope	V _{CE} = 400 V, I _C = 60 A,	-	1216	-	A/µs
t _{d(off)}	Turn-off delay time	$R_G = 10 \Omega$	-	210	-	ns
t _f	Current fall time	V _{GE} = 15 V (see Figure 27. Test circuit for inductive load	-	20	-	ns
E _{on} (1)	Turn-on switching energy	switching)	-	1590	-	μJ
E _{off} (2)	Turn-off switching energy		-	900	-	μJ
E _{ts}	Total switching energy		-	2490	-	μJ
t _{d(on)}	Turn-on delay time		-	59	-	ns
t _r	Current rise time		-	40	-	ns
(di/dt) _{on}	Turn-on current slope	V _{CE} = 400 V,	-	1230	-	A/µs
t _{d(off)}	Turn-off-delay time	$I_C = 60 \text{ A}, R_G = 10 \Omega,$	-	242	-	ns
t _f	Current fall time	V _{GE} = 15 V, T _J = 175 °C	-	147	-	ns
E _{on} (1)	Turn-on switching energy	(see Figure 27. Test circuit for inductive load switching)	-	2860	-	μJ
E _{off} (2)	Turn-off switching energy		-	1255	-	μJ
E _{ts}	Total switching energy		-	4115	-	μJ

^{1.} Including the reverse recovery of the diode.

Table 6. Diode switching characteristics (inductive load)

Symbol	Parameter	Test conditions	Min.	Тур.	Max.	Unit
t _{rr}	Reverse recovery time		-	60	-	ns
Q _{rr}	Reverse recovery charge	I _F = 60 A, V _R = 400 V,	-	99	-	nC
I _{rrm}	Reverse recovery current	V _{GE} = 15 V, di/dt = 100 A/μs	-	3.3	-	Α
dI _{rr} /dt	Peak rate of fall of reverse recovery current during t _b	(see Figure 27. Test circuit for inductive load switching)	-	187	-	A/µs
E _{rr}	Reverse recovery energy		-	68	-	μJ
t _{rr}	Reverse recovery time	L = 60 A V = 400 V	-	310	-	ns
Q _{rr}	Reverse recovery charge	$I_F = 60 \text{ A}, V_R = 400 \text{ V},$ $V_{GE} = 15 \text{ V},$	-	1550	-	nC
I _{rrm}	Reverse recovery current	di/dt = 100 A/μs,	-	10	-	А
dI _{rr} /dt	Peak rate of fall of reverse recovery current during t _b	T _J = 175 °C (see Figure 27. Test circuit	-	59	-	A/µs
Err	Reverse recovery energy	for inductive load switching)	-	674	-	μJ

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^{2.} Including the tail of the collector current.



2.1 Electrical characteristics (curves)

Figure 1. Output characteristics (T_J = 25 °C)

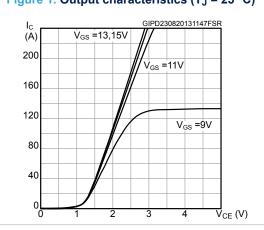


Figure 2. Output characteristics (T_J = 175 °C)

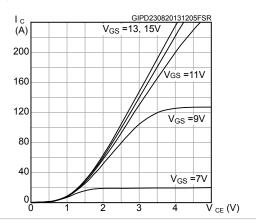


Figure 3. Transfer characteristics

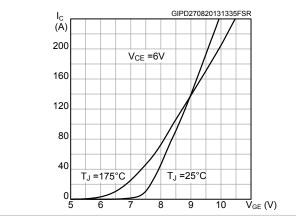


Figure 4. Collector current vs case temperature

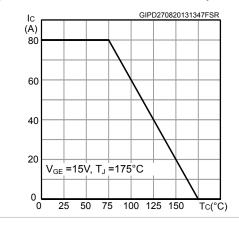


Figure 5. Power dissipation vs case temperature

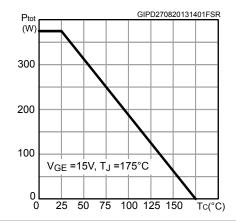
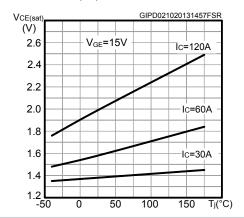


Figure 6. V_{CE(sat)} vs junction temperature



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Figure 7. V_{CE(sat)} vs collector current

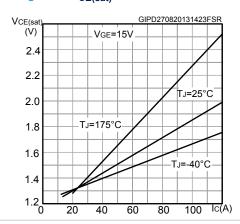


Figure 8. Forward bias safe operating area

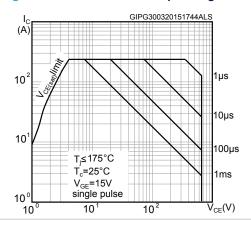


Figure 9. Diode V_F vs forward current

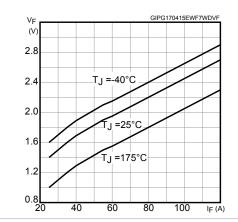


Figure 10. Normalized $V_{(BR)CES}$ vs junction temperature

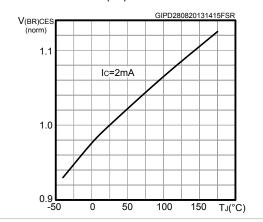


Figure 11. Normalized V_{GE(th)} vs junction temperature

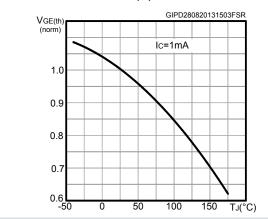
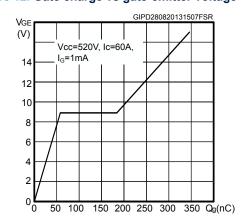


Figure 12. Gate charge vs gate-emitter voltage



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Figure 13. Switching energy vs temperature

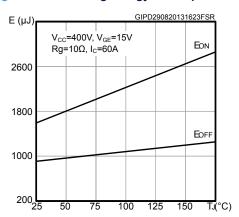


Figure 14. Switching energy vs gate resistance

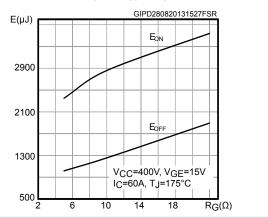


Figure 15. Switching energy vs collector current

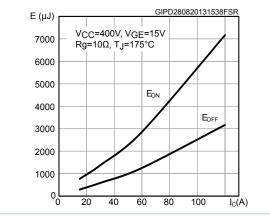


Figure 16. Switching energy vs collector emitter voltage

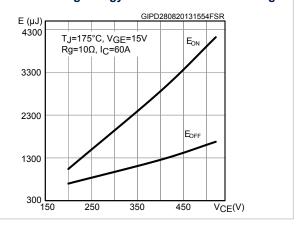


Figure 17. Switching times vs collector current

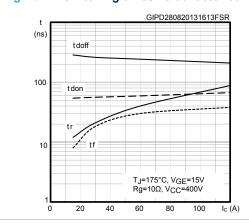
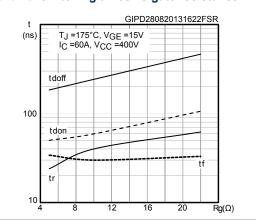


Figure 18. Switching times vs gate resistance



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Figure 19. Reverse recovery current vs diode current slope

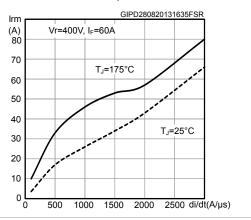


Figure 20. Reverse recovery time vs diode current slope

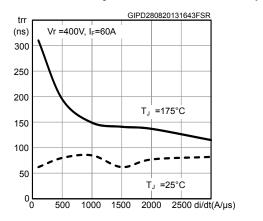


Figure 21. Reverse recovery charge vs diode current slope

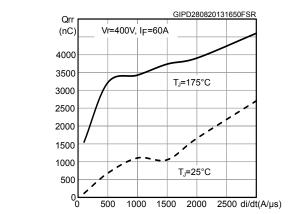


Figure 22. Reverse recovery energy vs diode current slope

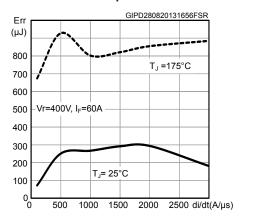


Figure 23. Capacitance variations

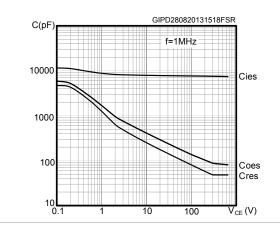
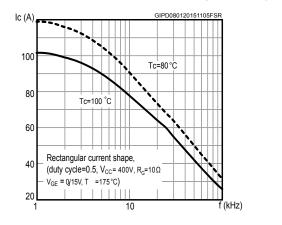


Figure 24. Collector current vs switching frequency



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Figure 25. Thermal impedance for IGBT

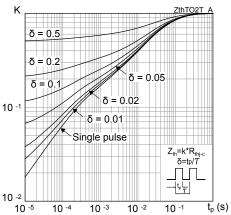
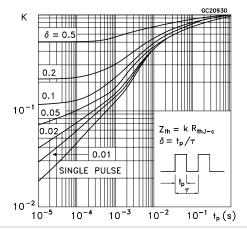


Figure 26. Thermal impedance for diode

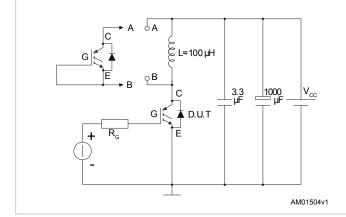


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3 Test circuits

Figure 27. Test circuit for inductive load switching



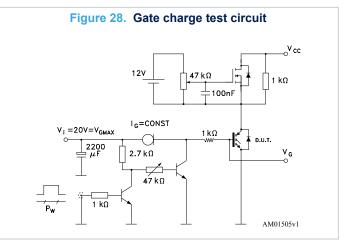
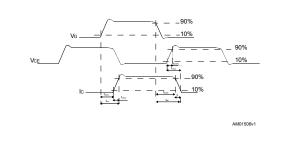
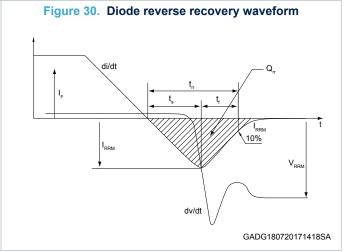


Figure 29. Switching waveform





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4 Package information

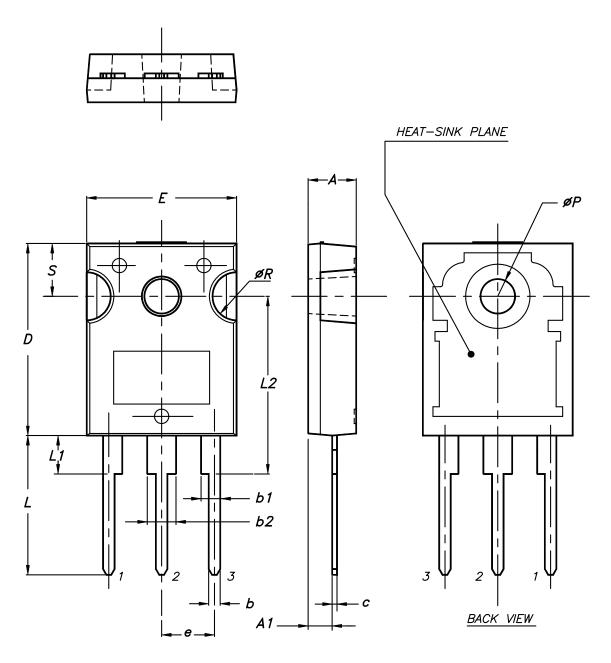
In order to meet environmental requirements, ST offers these devices in different grades of ECOPACK packages, depending on their level of environmental compliance. ECOPACK specifications, grade definitions and product status are available at: www.st.com. ECOPACK is an ST trademark.

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4.1 TO-247 package information

Figure 31. TO-247 package outline



0075325_9



Table 7. TO-247 package mechanical data

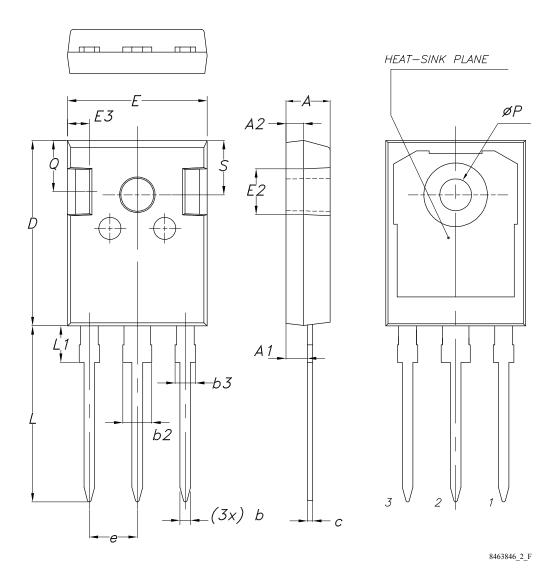
Dim		mm	
Dim.	Min.	Тур.	Max.
А	4.85		5.15
A1	2.20		2.60
b	1.0		1.40
b1	2.0		2.40
b2	3.0		3.40
С	0.40		0.80
D	19.85		20.15
Е	15.45		15.75
е	5.30	5.45	5.60
L	14.20		14.80
L1	3.70		4.30
L2		18.50	
ØP	3.55		3.65
ØR	4.50		5.50
S	5.30	5.50	5.70

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4.2 TO-247 long leads package information

Figure 32. TO-247 long leads package outline



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Table 8. TO-247 long leads package mechanical data

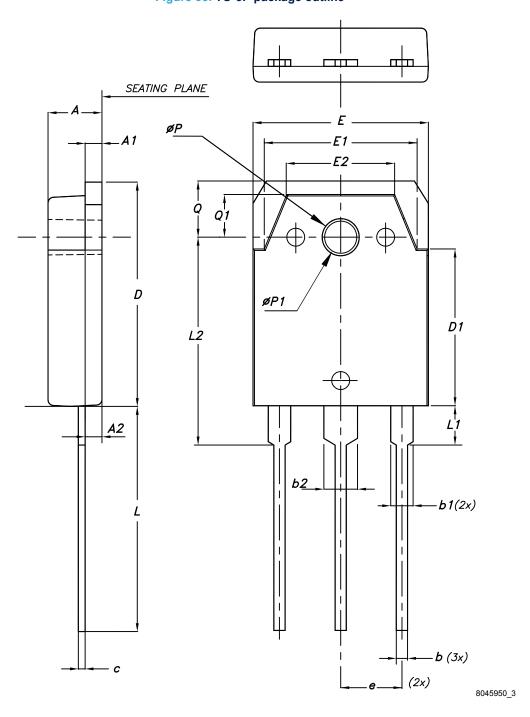
Dim.		mm	
Dilli.	Min.	Тур.	Max.
А	4.90	5.00	5.10
A1	2.31	2.41	2.51
A2	1.90	2.00	2.10
b	1.16		1.26
b2			3.25
b3			2.25
С	0.59		0.66
D	20.90	21.00	21.10
Е	15.70	15.80	15.90
E2	4.90	5.00	5.10
E3	2.40	2.50	2.60
е	5.34	5.44	5.54
L	19.80	19.92	20.10
L1			4.30
Р	3.50	3.60	3.70
Q	5.60		6.00
S	6.05	6.15	6.25

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4.3 TO-3P package information

Figure 33. TO-3P package outline



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Table 9. TO-3P package mechanical data

Dim.		mm	
DIM.	Min.	Тур.	Max.
Α	4.60	4.80	5.00
A1	1.45	1.50	1.65
A2	1.20	1.40	1.60
b	0.80	1.00	1.20
b1	1.80	2.00	2.20
b2	2.80	3.00	3.20
С	0.55	0.60	0.75
D	19.70	19.90	20.10
D1	13.70	13.90	14.10
E	15.40	15.60	15.80
E1	13.40	13.60	13.80
E2	9.40	9.60	9.90
е	5.15	5.45	5.75
L	19.80	20.00	20.20
L1	3.30	3.50	3.70
L2	18.20	18.40	18.60
ØP	3.30	3.40	3.50
ØP1	3.10	3.20	3.30
Q	4.80	5.00	5.20
Q1	3.60	3.80	4.00



5 Ordering information

Table 10. Order codes

Order code	Marking	Package	Packing
STGW60H65DFB	GW60H65DFB	TO-247	Tube
STGWA60H65DFB	G60H65DFB	TO-247 long leads	Tube
STGWT60H65DFB	GWT60H65DFB	TO-3P	Tube

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Revision history

Table 11. Document revision history

Date	Revision	Changes
12-Mar-2013	1	Initial release.
20 Aug 2012	2	Document status promoted from preliminary to production data.
30-Aug-2013	2	Added Section 2.1: Electrical characteristics (curves).
31-Oct-2013	3	Updated V _{CE(sat)} in <i>Table 4: Static characteristics</i> .
24-Feb-2014	4	Updated title and description in cover page.
		Updated features in cover page, Table 2: Absolute maximum ratings,
		and Table 6: IGBT switching characteristics (inductive load).
		Updated Figure 5: Collector current vs. case temperature, Figure 6:
		Power dissipation vs. case temperature, Figure 8: VCE(sat) vs.
00 1 0015	_	collector current, Figure 18: Switching times vs collector current,
09-Jan-2015	5	Figure 19: Switching times vs gate resistance and Figure 20:
		Reverse recovery current vs. diode current slope.
		Added Figure 25: Collector current vs. switching frequency.
		Updated Section 4: Package information.
		Minor text changes.
		Text edits throughout document.
		In document, added new order code STGWA60H65DFB in TO-247
23-Mar-2015	6	long leads package, with accompanying information and data.
		In Section 2.1: Electrical characteristics (curves):
		- updated Figure 2, Figure 3, Figure 4, Figure 7, Figure 9
		Text edits throughout document.
		In Section 2: Electrical characteristics:
47 4 0045	7	- updated Table 4: Static characteristics
17-Apr-2015	7	- updated Table 6: IGBT switching characteristics (inductive load)
		In Section 2.1: Electrical characteristics (curves):
		- updated Figure 3 and Figure 9
22 101 2040	0	Updated Table 1. Absolute maximum ratings.
22-Jul-2019	8	Minor text changes.

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