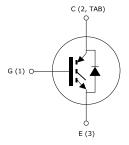




Trench gate field-stop 650 V, 40 A high speed HB series IGBT







Product status link

STGWT40H65DFB

Product summary				
Order code	STGWT40H65DFB			
Marking	GWT40H65DFB			
Package	TO-3P			
Packing	Tube			

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 = 40 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

This device is an IGBT developed using an advanced proprietary trench gate field-stop structure. The device is part of the new HB series of IGBTs, which represents an optimum compromise between conduction and switching loss to maximize the efficiency of any frequency converter. Furthermore, the slightly positive $V_{\text{CE}(\text{sat})}$ 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	Α
I _C	Continuous collector current at T _C = 100 °C	40	А
I _{CP} (1)	Pulsed collector current	160	Α
V _{GE}	Gate-emitter voltage	±20	V
V GE	Transient gate-emitter voltage	±30	V
IF	Continuous forward current at T _C = 25 °C	80	Α
'-	Continuous forward current at T _C = 100 °C	40	A
I _{FP} (1)	Pulsed forward current	160	Α
P _{TOT}	Total power dissipation at T _C = 25 °C	283	W
T _{STG}	Storage temperature range	- 55 to 150	°C
T _J	Operating junction temperature range	- 55 to 175	C

^{1.} Pulse width limited by maximum junction temperature.

Table 2. Thermal data

Symbol	Parameter	Value	Unit
R _{thJC}	Thermal resistance junction-case IGBT	0.53	
R _{thJC}	Thermal resistance junction-case diode	1.14	°C/W
R _{thJA}	Thermal resistance junction-ambient	50	

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2 Electrical characteristics

 T_C = 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 V, I _C = 2 mA	650			V
		V _{GE} = 15 V, I _C = 40 A		1.6	2	
V _{CE(sat)}	Collector-emitter saturation voltage	V _{GE} = 15 V, I _C = 40 A, T _J = 125 °C		1.7		V
		V _{GE} = 15 V, I _C = 40 A, T _J = 175 °C		1.8		
	Forward on-voltage	I _F = 40 A		1.7	2.45	V
V_{F}		I _F = 40 A, T _J = 125 °C		1.4		
		I _F = 40 A, T _J = 175 °C		1.3		
V _{GE(th)}	Gate threshold voltage	V _{CE} = V _{GE} , I _C = 1 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		-	5412	-	
C _{oes}	Output capacitance	V _{CE} = 25 V, f = 1 MHz, V _{GE} = 0 V	-	198	-	pF
C _{res}	Reverse transfer capacitance		-	107	-	
Qg	Total gate charge	V _{CC} = 520 V, I _C = 40 A, V _{GE} = 0	-	210	-	
Q _{ge}	Gate-emitter charge	to 15 V (see Figure 29. Gate charge test circuit)	-	39	-	nC
Q _{gc}	Gate-collector charge		-	82	-	

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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			40	-	
t _r	Current rise time			13	-	ns
(di/dt) _{on}	Turn-on current slope			2413	-	A/µs
t _{d(off)}	Turn-off-delay time	V_{CE} = 400 V, I_{C} = 40 A, V_{GE} = 15 V, R_{G} = 5 Ω (see		142	-	
t _f	Current fall time	Figure 28. Test circuit for inductive load switching)		27	-	ns
E _{on} (1)	Turn-on switching energy	- inductive load switching)		498	-	
E _{off} (2)	Turn-off switching energy			363	-	μJ
E _{ts}	Total switching energy			861	-	
t _{d(on)}	Turn-on delay time			38	-	
t _r	Current rise time			14	-	ns
(di/dt) _{on}	Turn-on current slope			2186	-	A/µs
t _{d(off)}	Turn-off-delay time	V_{CE} = 400 V, I_{C} = 40 A, V_{GE} = 15 V, R_{G} = 5 Ω T _J = 175 °C		141	-	
t _f	Current fall time	(see Figure 28. Test circuit for		61	-	ns
E _{on} (1)	Turn-on switching energy	inductive load switching)		1417	-	
E _{off} (2)	Turn-off switching energy			764	-	μJ
E _{ts}	Total switching energy			2181	-	•

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

Table 6. Diode switching characteristics (inductive load)

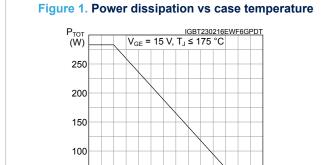
Symbol	Parameter	Test conditions	Min.	Тур.	Max.	Unit
t _{rr}	Reverse recovery time		-	62	-	ns
Q _{rr}	Reverse recovery charge		-	99	-	nC
I _{rrm}	Reverse recovery current	$I_F = 40 \text{ A}, V_R = 400 \text{ V}, V_{GE} = 15 \text{ V}$ di/dt = 100 A/µs (see Figure 28.	-	3.3	-	Α
dl _{rr} /dt	Peak rate of fall of reverse recovery current during t _b	di/dt = 100 A/µs (see Figure 28. Test circuit for inductive load switching)	-	187	-	A/µs
Err	Reverse recovery energy		-	68	-	μJ
t _{rr}	Reverse recovery time		-	310	-	ns
Q _{rr}	Reverse recovery charge	I _F = 40 A, V _R = 400 V,	-	1550	-	nC
I _{rrm}	Reverse recovery current	V _{GE} = 15 V, T _J = 175 °C di/	-	10	-	Α
dl _{rr} /dt	Peak rate of fall of reverse recovery current during t _b	dt = 100 A/µs (see Figure 28. Test circuit for inductive load switching)	-	70	-	A/µs
Err	Reverse recovery energy		-	674	-	μJ

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



2.1 Electrical characteristics (curves)



100 125

150

50

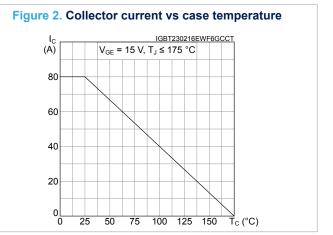


Figure 3. Output characteristics (T_J = 25 °C)

(A)

(A)

(BBT230216EWF6GOC25

(A)

140

120

100

80

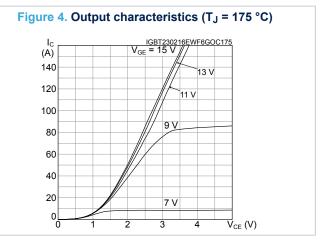
60

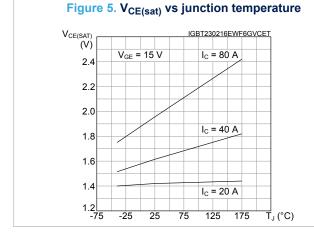
40

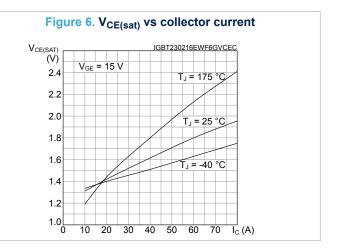
20

0

1 2 3 4 V_{CE} (V)







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Figure 7. Collector current vs switching frequency

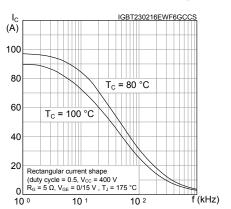


Figure 8. Forward bias safe operating area

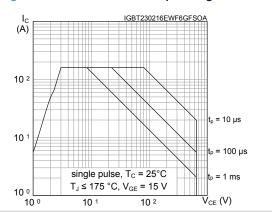


Figure 9. Transfer characteristics

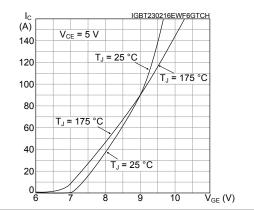


Figure 10. Diode V_F vs forward current

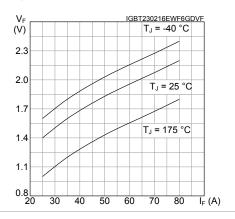


Figure 11. Normalized V_{GE(th)} vs junction temperature

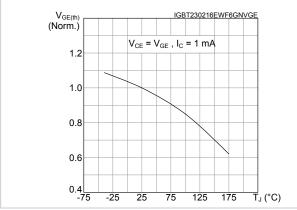
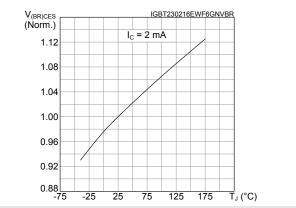


Figure 12. Normalized V_{(BR)CES} vs junction temperature



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C (pF) Cles Coes Cres

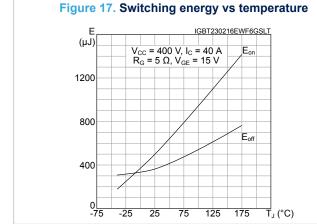
10 º

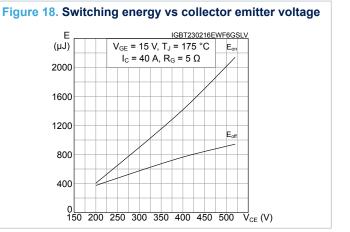
10¹

10²

10 -1

Ŭ_{CE} (V)





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Figure 19. Switching times vs collector current

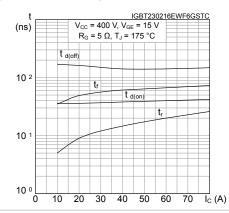


Figure 20. Switching times vs gate resistance

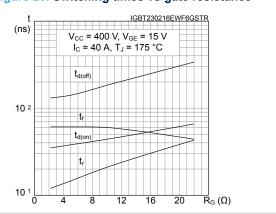


Figure 21. Reverse recovery current vs diode current slope

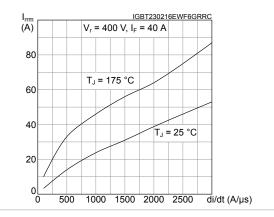


Figure 22. Reverse recovery time vs diode current slope

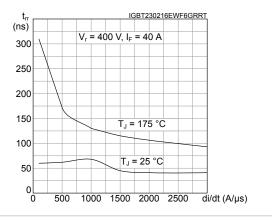


Figure 23. Reverse recovery charge vs diode current slope

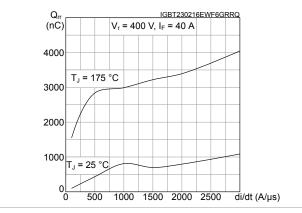
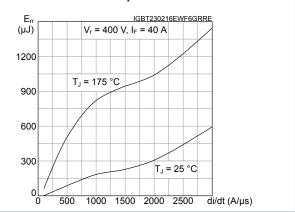


Figure 24. Reverse recovery energy vs diode current slope



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Figure 25. Thermal impedance for IGBT

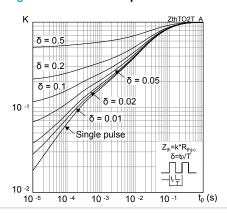
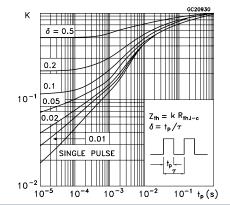


Figure 26. Thermal impedance for diode



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3 Test circuits

Figure 27. Test circuit for inductive load switching

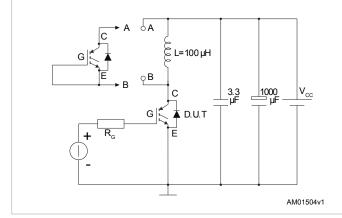


Figure 28. Gate charge test circuit

V₁ = 20V = V_{CMAX}

V₂₂₀₀

1 kΩ

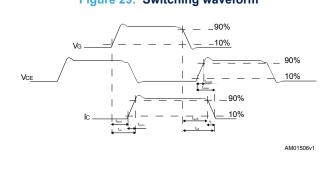
V₁ = 20V = V_{CMAX}

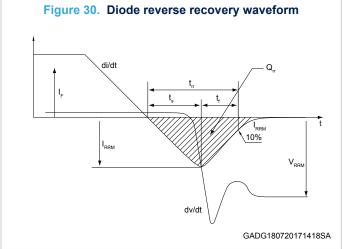
V₂₂₀₀

1 kΩ

AM01505v1

Figure 29. Switching waveform





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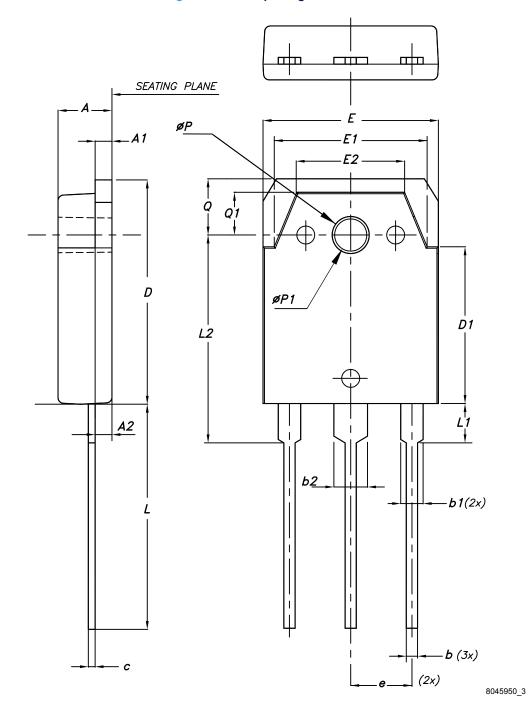


4 Package information

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.

4.1 TO-3P package information

Figure 31. TO-3P package outline



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Table 7. TO-3P package mechanical data

Dim.	mm				
Dilli.	Min.	Тур.	Max.		
A	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		
Е	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		

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Revision history

Table 8. Document revision history

Date	Revision	Changes		
06-Jun-2016	1	itial version. Part number previously included in datasheet DocID024363.		
		Removed maturity status indication from cover page. The document status is production data.		
19-Jun-2019	2	Updated title in cover page.		
19-3011-2019		Updated Table 1. Absolute maximum ratings.		
		Minor text changes.		

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