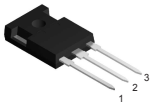
STGW60H65DFB, STGWA60H65DFB, STGWT60H65DFB

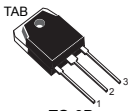
Datasheet

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

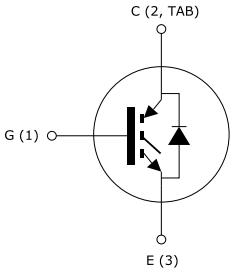
TO-247



TO-247 long leads



TO-3P



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 $V_{CE(sat)}$ temperature coefficient and very tight parameter distribution result in safer paralleling operation.

Product status link
STGW60H65DFB
STGWT60H65DFB
STGWA60H65DFB

1 Electrical ratings

Table 1. Absolute maximum ratings

Symbol	Parameter	Value	Unit
V_{CES}	Collector-emitter voltage (V_{GE} = 0 V)	650	V
I_C	Continuous collector current at T_C = 25 °C	80 (1)	A
	Continuous collector current at T_C = 100 °C	60	A
I_{CP} (2)(3)	Pulsed collector current	240	A
V_{GE}	Gate-emitter voltage	±20	V
	Transient gate-emitter voltage ($t_P \leq 10$ µs)	±30	V
I_F	Continuous forward current at T_C = 25 °C	80 (1)	A
	Continuous forward current at T_C = 100 °C	60	A
I_{FP} (2)(3)	Pulsed forward current	240	A
P_{TOT}	Total power dissipation at T_C = 25 °C	375	W
T_{STG}	Storage temperature range	-55 to 150	°C
T_J	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

2 Electrical characteristics

T_J = 25 °C unless otherwise specified

Table 3. Static characteristics

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$V_{(BR)CES}$	Collector-emitter breakdown voltage	V_{GE} = 0 V, I_C = 2 mA	650			V
$V_{CE(sat)}$	Collector-emitter saturation voltage	V_{GE} = 15 V, I_C = 60 A		1.60	2	V
		V_{GE} = 15 V, I_C = 60 A, T_J = 125 °C		1.75		
		V_{GE} = 15 V, I_C = 60 A, T_J = 175 °C		1.85		
V_F	Forward on-voltage	I_F = 60 A		2	2.6	V
		I_F = 60 A, T_J = 125 °C		1.7		
		I_F = 60 A, T_J = 175 °C		1.6		
$V_{GE(th)}$	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.	Typ.	Max.	Unit
C_{ies}	Input capacitance	V_{CE} = 25 V, f = 1 MHz, V_{GE} = 0 V	-	7792	-	pF
C_{oes}	Output capacitance		-	262	-	pF
C_{res}	Reverse transfer capacitance		-	158	-	pF
Q_g	Total gate charge	V_{CC} = 520 V, I_C = 60 A, V_{GE} = 0 to 15 V (see Figure 28. Gate charge test circuit)	-	306	-	nC
Q_{ge}	Gate-emitter charge		-	126	-	nC
Q_{gc}	Gate-collector charge		-	58	-	nC

Table 5. IGBT switching characteristics (inductive load)

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$t_{d(on)}$	Turn-on delay time	V_{CE} = 400 V, I_C = 60 A, R_G = 10 Ω, V_{GE} = 15 V (see Figure 27. Test circuit for inductive load switching)	-	66	-	ns
t_r	Current rise time		-	38	-	ns
$(di/dt)_{on}$	Turn-on current slope		-	1216	-	A/µs
$t_{d(off)}$	Turn-off delay time		-	210	-	ns
t_f	Current fall time		-	20	-	ns
E_{on} (1)	Turn-on switching energy		-	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	V_{CE} = 400 V, I_C = 60 A, R_G = 10 Ω, V_{GE} = 15 V, T_J = 175 °C (see Figure 27. Test circuit for inductive load switching)	-	59	-	ns
t_r	Current rise time		-	40	-	ns
$(di/dt)_{on}$	Turn-on current slope		-	1230	-	A/µs
$t_{d(off)}$	Turn-off-delay time		-	242	-	ns
t_f	Current fall time		-	147	-	ns
E_{on} (1)	Turn-on switching energy		-	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.*
2. *Including the tail of the collector current.*

Table 6. Diode switching characteristics (inductive load)

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
t_{rr}	Reverse recovery time	I_F = 60 A, V_R = 400 V, V_{GE} = 15 V, di/dt = 100 A/µs (see Figure 27. Test circuit for inductive load switching)	-	60	-	ns
Q_{rr}	Reverse recovery charge		-	99	-	nC
I_{rrm}	Reverse recovery current		-	3.3	-	A
dI_{rr}/dt	Peak rate of fall of reverse recovery current during t_b		-	187	-	A/µs
E_{rr}	Reverse recovery energy		-	68	-	µJ
t_{rr}	Reverse recovery time	I_F = 60 A, V_R = 400 V, V_{GE} = 15 V, di/dt = 100 A/µs, T_J = 175 °C (see Figure 27. Test circuit for inductive load switching)	-	310	-	ns
Q_{rr}	Reverse recovery charge		-	1550	-	nC
I_{rrm}	Reverse recovery current		-	10	-	A
dI_{rr}/dt	Peak rate of fall of reverse recovery current during t_b		-	59	-	A/µs
E_{rr}	Reverse recovery energy		-	674	-	µJ

2.1 Electrical characteristics (curves)

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

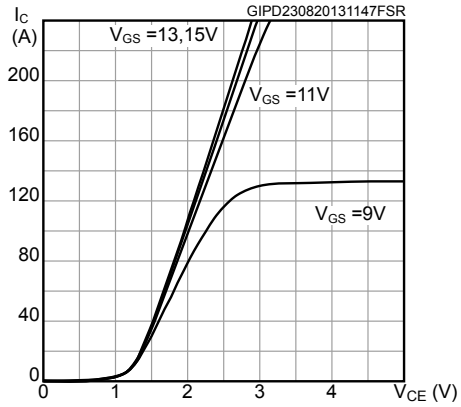


Figure 2. Output characteristics (T_J = 175 °C)

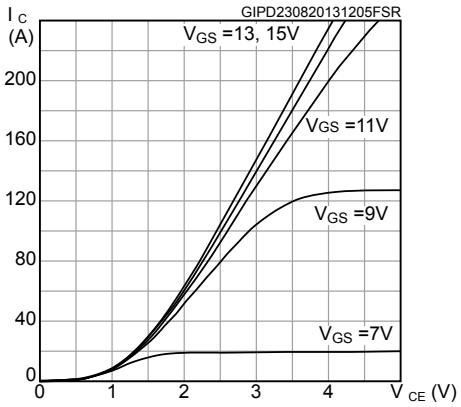


Figure 3. Transfer characteristics

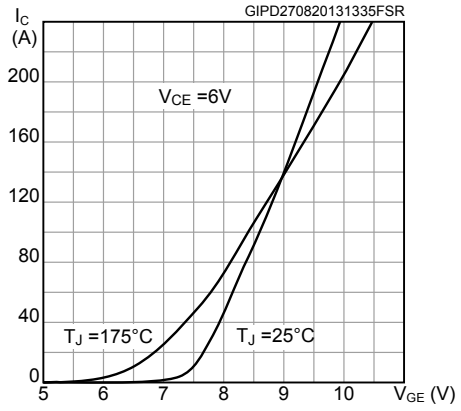


Figure 4. Collector current vs case temperature

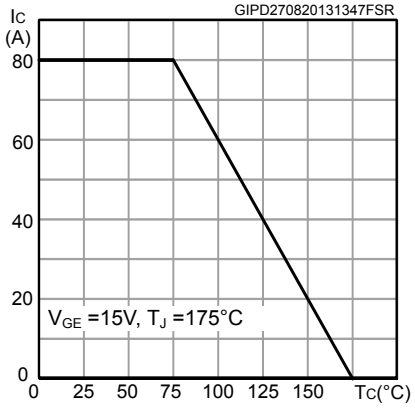


Figure 5. Power dissipation vs case temperature

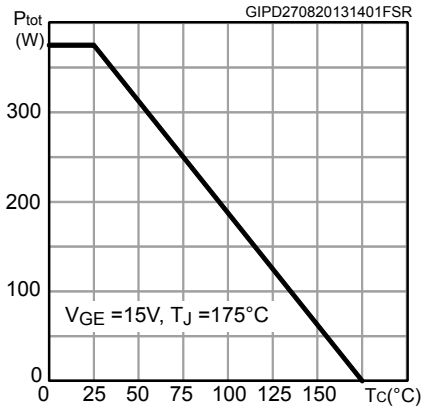


Figure 6. $V_{CE(sat)}$ vs junction temperature

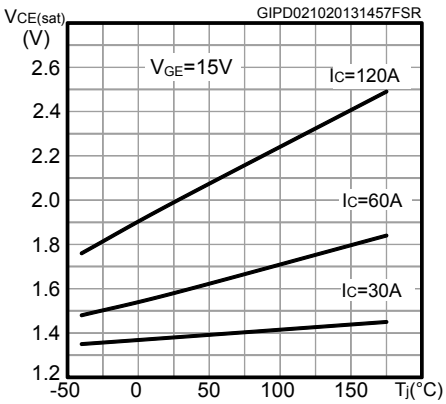


Figure 7. $V_{CE(sat)}$ vs collector current

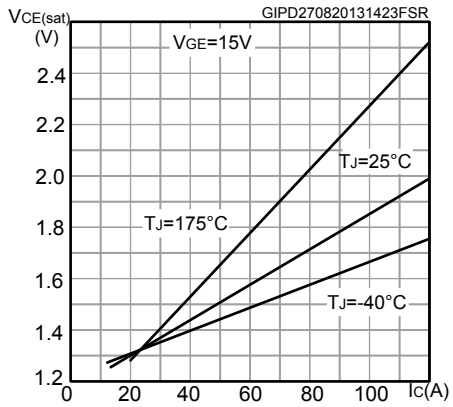


Figure 8. Forward bias safe operating area

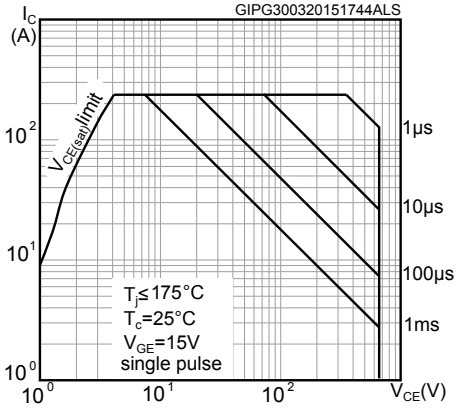


Figure 9. Diode V_F vs forward current

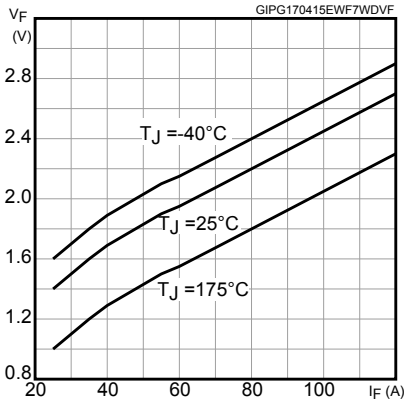


Figure 10. Normalized $V_{(BR)CES}$ vs junction temperature

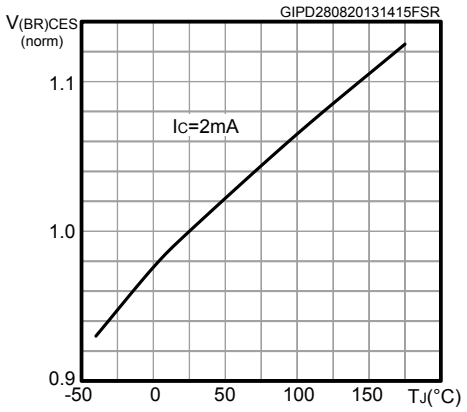


Figure 11. Normalized $V_{GE(th)}$ vs junction temperature

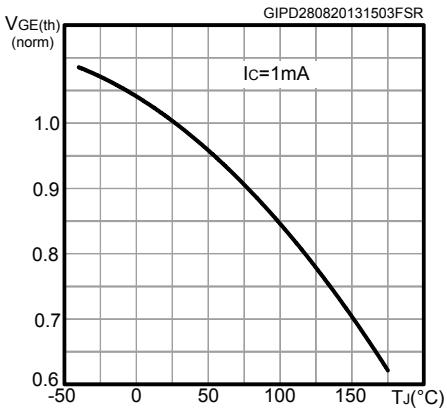


Figure 12. Gate charge vs gate-emitter voltage

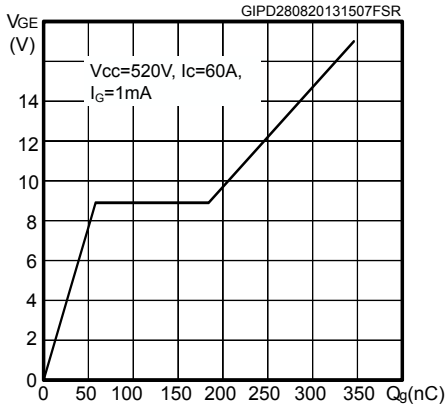


Figure 13. Switching energy vs temperature

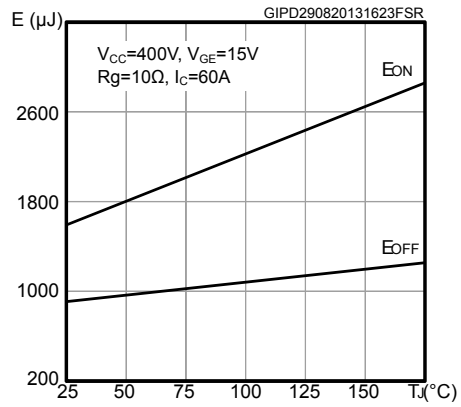


Figure 14. Switching energy vs gate resistance

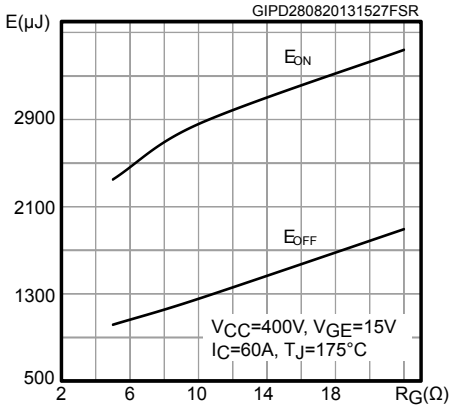


Figure 15. Switching energy vs collector current

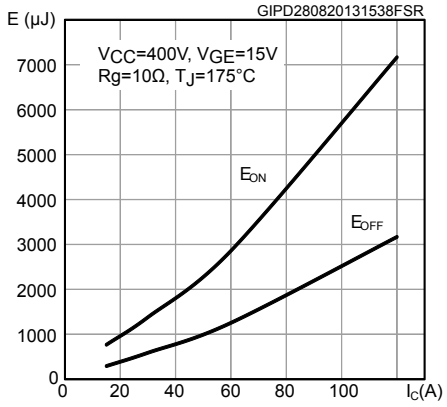


Figure 16. Switching energy vs collector emitter voltage

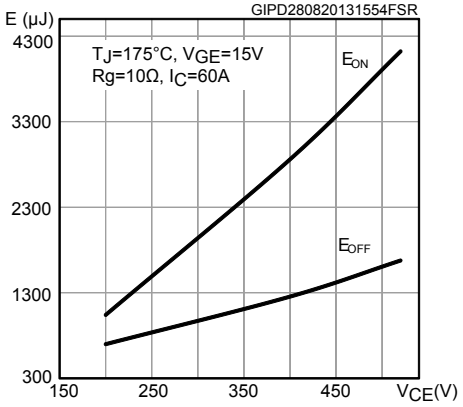


Figure 17. Switching times vs collector current

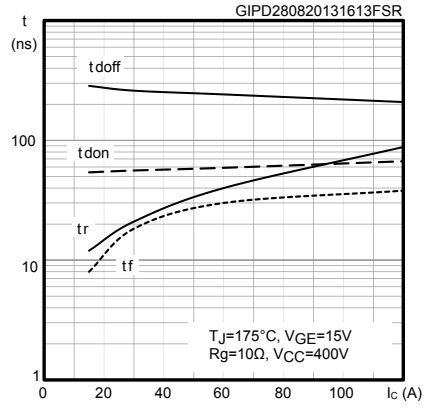


Figure 18. Switching times vs gate resistance

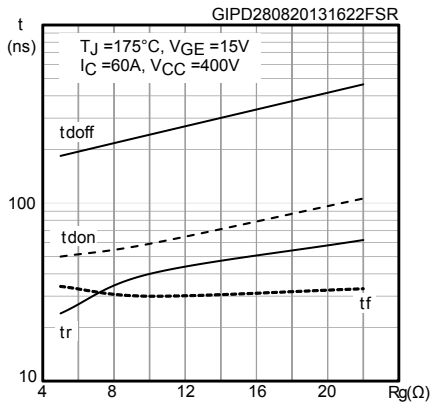


Figure 19. Reverse recovery current vs diode current slope

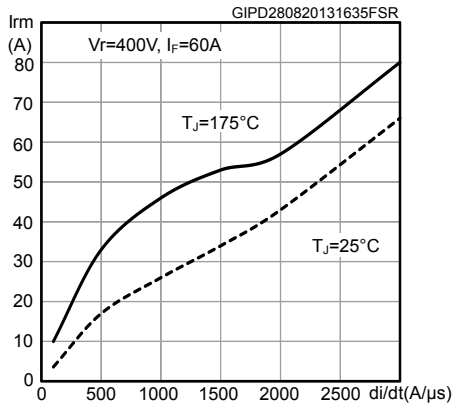


Figure 20. Reverse recovery time vs diode current slope

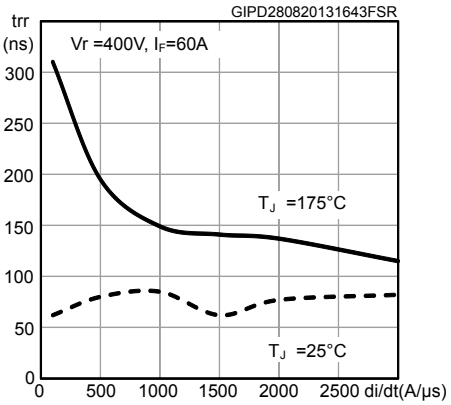


Figure 21. Reverse recovery charge vs diode current slope

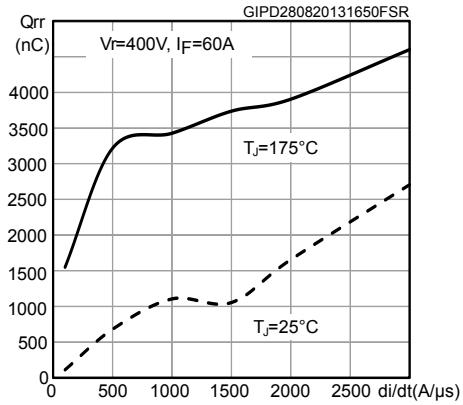


Figure 22. Reverse recovery energy vs diode current slope

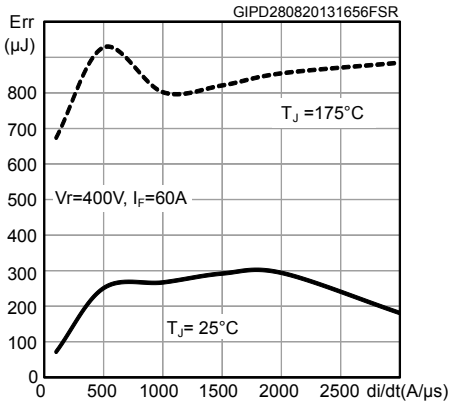


Figure 23. Capacitance variations

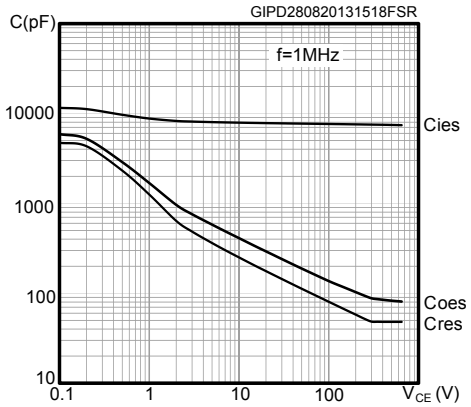


Figure 24. Collector current vs switching frequency

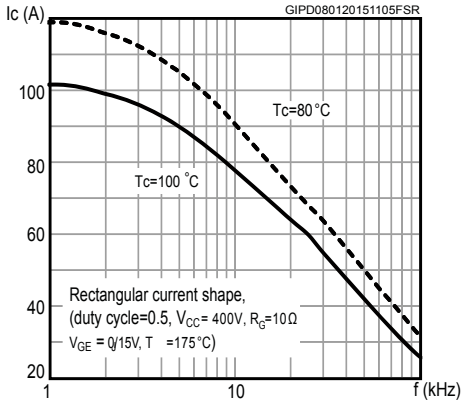


Figure 25. Thermal impedance for IGBT

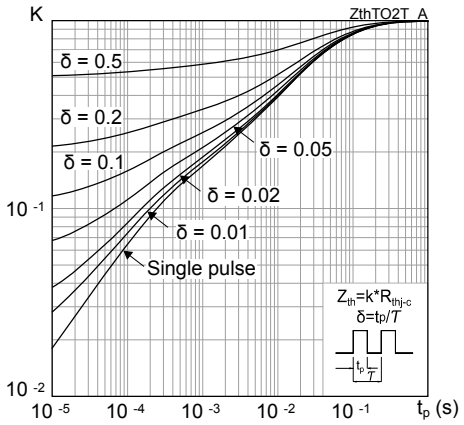
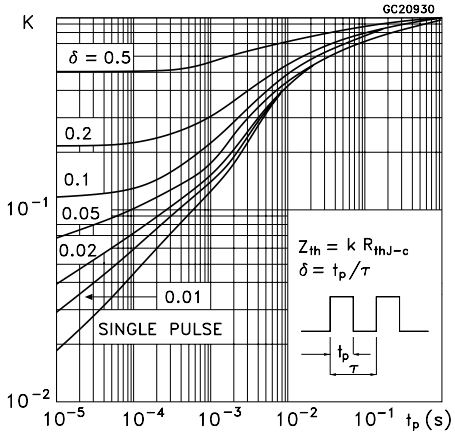


Figure 26. Thermal impedance for diode



3 Test circuits

Figure 27. Test circuit for inductive load switching

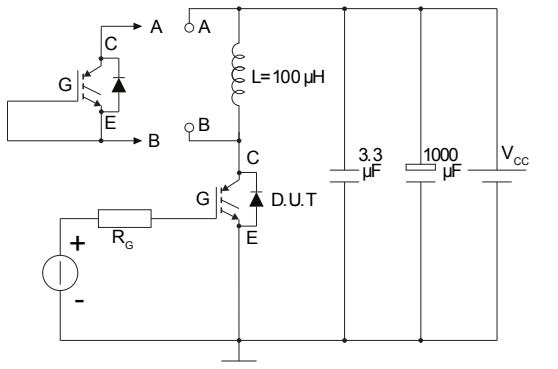


Figure 28. Gate charge test circuit

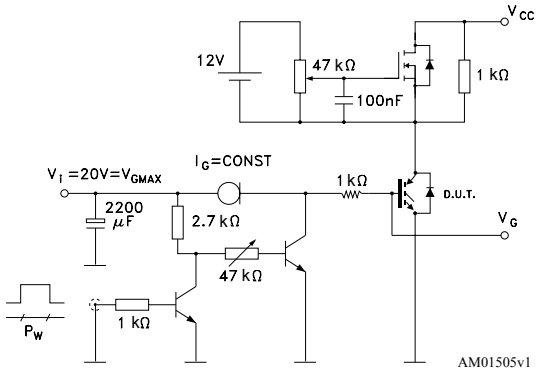


Figure 29. Switching waveform

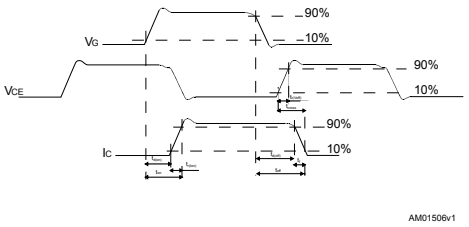
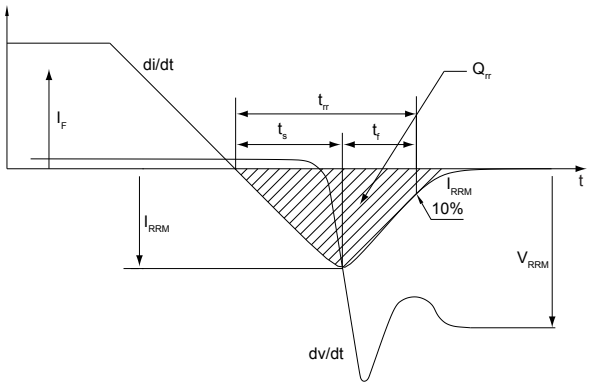


Figure 30. Diode reverse recovery waveform

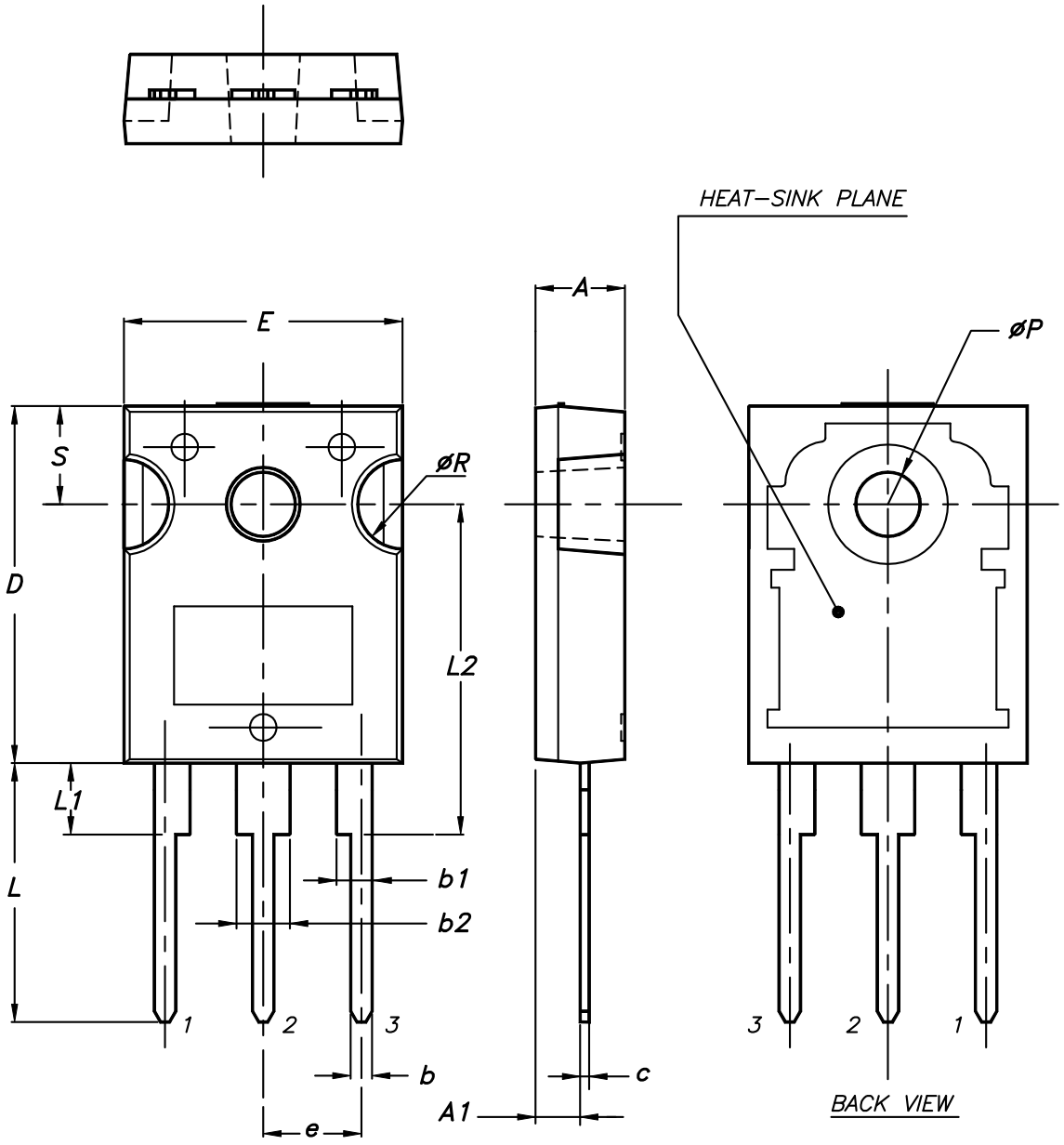


4 Package information

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-247 package information

Figure 31. **TO-247 package outline**



0075325_9

Table 7. **TO-247 package 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	5.30	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

4.2 TO-247 long leads package information

Figure 32. **TO-247 long leads package outline**

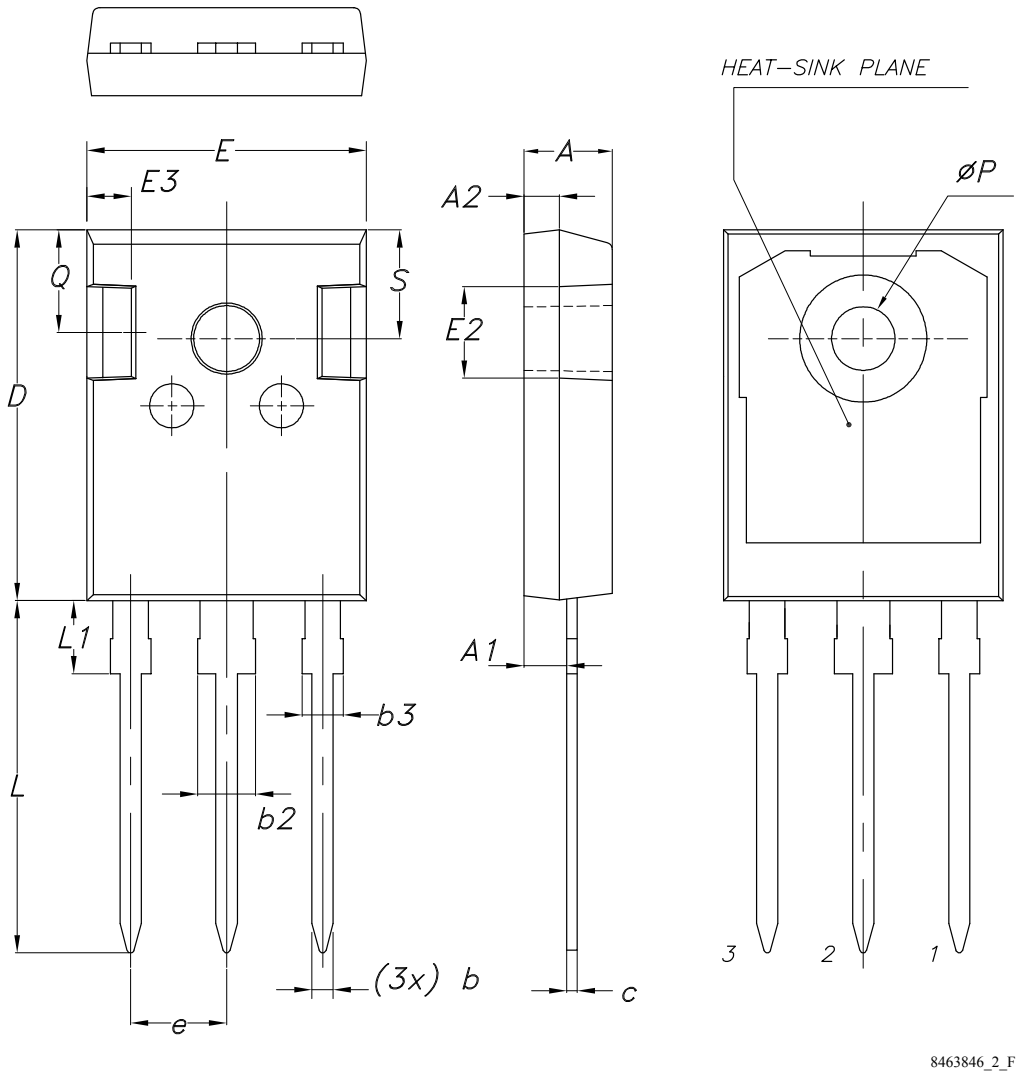


Table 8. **TO-247 long leads package mechanical data**

Dim.	mm		
	Min.	Typ.	Max.
A	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
c	0.59		0.66
D	20.90	21.00	21.10
E	15.70	15.80	15.90
E2	4.90	5.00	5.10
E3	2.40	2.50	2.60
e	5.34	5.44	5.54
L	19.80	19.92	20.10
L1			4.30
P	3.50	3.60	3.70
Q	5.60		6.00
S	6.05	6.15	6.25

4.3 TO-3P package information

Figure 33. **TO-3P package outline**

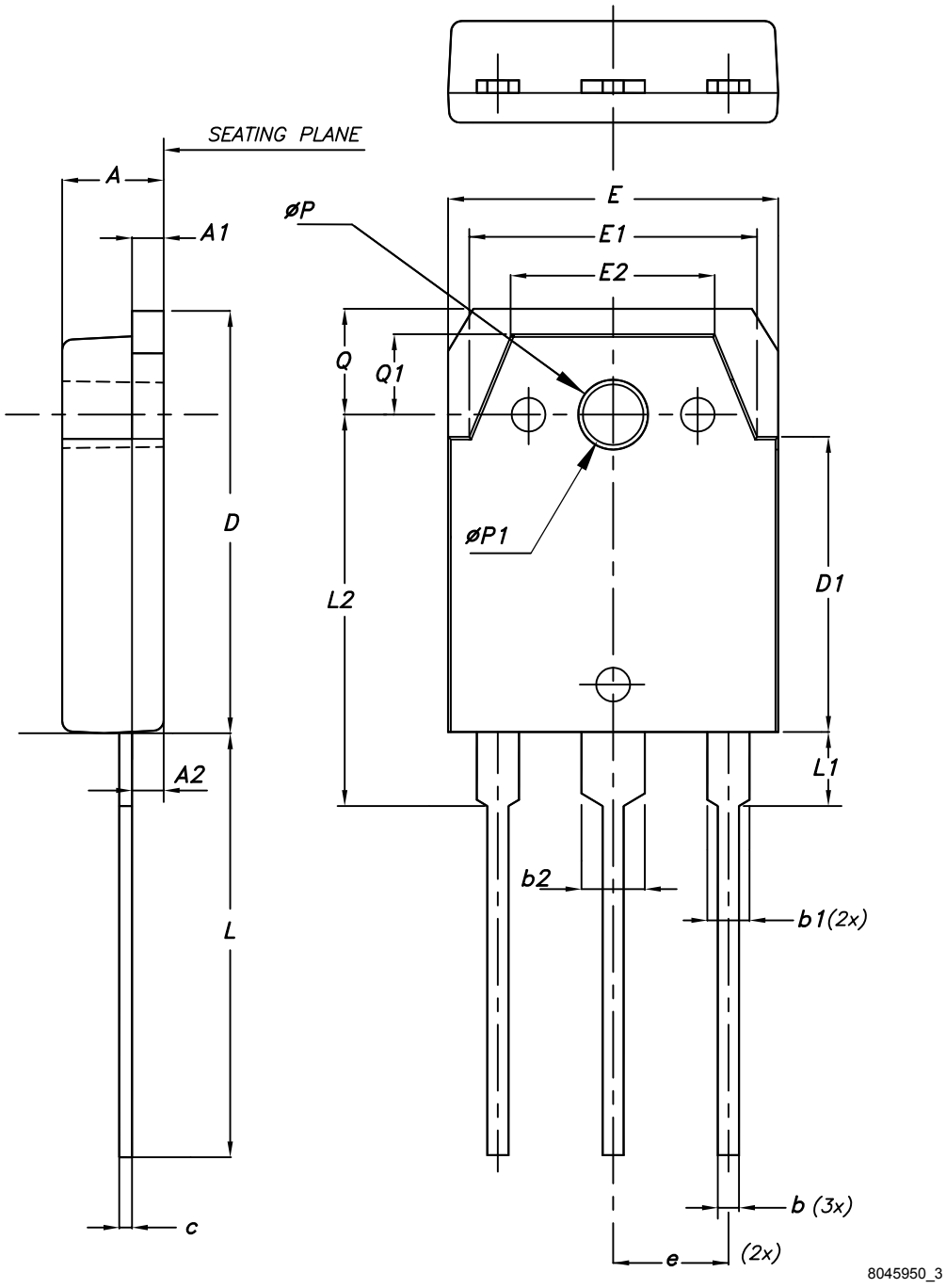


Table 9. **TO-3P package mechanical data**

Dim.	mm		
	Min.	Typ.	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
c	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
e	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

Revision history

Table 11. **Document revision history**

Date	Revision	Changes
12-Mar-2013	1	Initial release.
30-Aug-2013	2	Document status promoted from preliminary to production data. Added *Section 2.1: Electrical characteristics (curves)*.
31-Oct-2013	3	Updated $V_{CE(sat)}$ in *Table 4: Static characteristics*.
24-Feb-2014	4	Updated title and description in cover page.
09-Jan-2015	5	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. collector current*, *Figure 18: Switching times vs collector current*, *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.
23-Mar-2015	6	Text edits throughout document. In document, added new order code STGWA60H65DFB in TO-247 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*
17-Apr-2015	7	Text edits throughout document. In *Section 2: Electrical characteristics:* - updated *Table 4: Static characteristics* - updated *Table 6: IGBT switching characteristics (inductive load)* In *Section 2.1: Electrical characteristics (curves):* - updated *Figure 3* and *Figure 9*
22-Jul-2019	8	Updated Table 1. Absolute maximum ratings. Minor text changes.

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