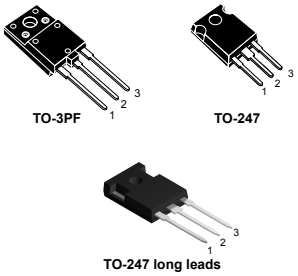
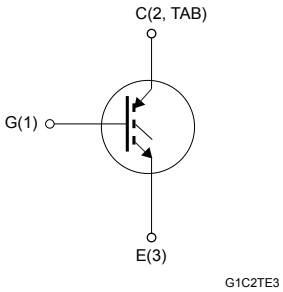
STGFW40H65FB, STGW40H65FB, STGWA40H65FB

Datasheet

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





Features

- Maximum junction temperature: T_J = 175 °C
- High speed switching series
- Minimized tail current
- Very low saturation voltage: $V_{CE(sat)}$ = 1.6 V (typ) @ I_C = 40 A
- Safe paralleling
- Tight parameter distribution
- Low thermal resistance

Applications

- Welding
- Power factor correction
- UPS
- Solar inverters
- Chargers

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
STGFW40H65FB
STGW40H65FB
STGWA40H65FB

1 Electrical ratings

Table 1. Absolute maximum ratings

Symbol	Parameter	Value		Unit
		TO-247, TO-247 long leads	TO-3PF	
V_{CES}	Collector-emitter voltage (V_{GE} = 0 V)	650		V
I_C	Continuous collector current at T_C = 25 °C	80		A
	Continuous collector current at T_C = 100 °C	40		
I_{CP} (1)	Pulsed collector current	160		A
V_{GE}	Gate-emitter voltage	±20		V
P_{TOT}	Total power dissipation at T_C = 25 °C	283	98.6	W
V_{ISO}	Insulation withstand voltage (RMS) from all three leads to external heat sink (t = 1 s; T_C = 25 °C)		3.5	kV
T_{STG}	Storage temperature range	-55 to 150		°C
T_J	Operating junction temperature range	-55 to 175		°C

1. *Pulse width is limited by maximum junction temperature.*

Table 2. Thermal data

Symbol	Parameter	Value		Unit
		TO-247, TO-247 long leads	TO-3PF	
R_{thJC}	Thermal resistance, junction-to-case	0.53	1.52	°C/W
R_{thJA}	Thermal resistance, junction-to-ambient	50		°C/W

2 Electrical characteristics

T_C = 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 = 40 A		1.6	2	V
		V_{GE} = 15 V, I_C = 40 A, T_J = 125 °C		1.7		
		V_{GE} = 15 V, I_C = 40 A, T_J = 175 °C		1.8		
$V_{GE(th)}$	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	-	5412	-	pF
C_{oes}	Output capacitance		-	198	-	
C_{res}	Reverse transfer capacitance		-	107	-	
Q_g	Total gate charge	V_{CC} = 520 V, I_C = 40 A, V_{GE} = 0 to 15 V (see Figure 27. Gate charge test circuit)	-	210	-	nC
Q_{ge}	Gate-emitter charge		-	39	-	
Q_{gc}	Gate-collector charge		-	82	-	

Table 5. 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 = 40 A, V_{GE} = 15 V, R_G = 5 Ω (see Figure 26. Test circuit for inductive load switching)	-	40	-	ns
t_r	Current rise time		-	13	-	
$(di/dt)_{on}$	Turn-on current slope		-	2413	-	A/µs
$t_{d(off)}$	Turn-off delay time		-	142	-	ns
t_f	Current fall time		-	27	-	
E_{on} (1)	Turn-on switching energy		-	498	-	µJ
E_{off} (2)	Turn-off switching energy		-	363	-	
E_{ts}	Total switching energy		-	861	-	
$t_{d(on)}$	Turn-on delay time	V_{CE} = 400 V, I_C = 40 A, V_{GE} = 15 V, R_G = 5 Ω, T_J = 175 °C (see Figure 26. Test circuit for inductive load switching)	-	38	-	ns
t_r	Current rise time		-	14	-	
$(di/dt)_{on}$	Turn-on current slope		-	2186	-	A/µs
$t_{d(off)}$	Turn-off delay time		-	141	-	ns
t_f	Current fall time		-	61	-	
E_{on} (1)	Turn-on switching energy		-	1417	-	µJ
E_{off} (2)	Turn-off switching energy		-	764	-	
E_{ts}	Total switching energy		-	2181	-	

1. *Including the reverse recovery of the external diode. The diode is the same of the co-packed STGW40H65DFB.*
2. *Including the tail of the collector current.*

2.1 Electrical characteristics (curves)

Figure 1. Power dissipation vs. case temperature for TO-247 and TO-247 long leads

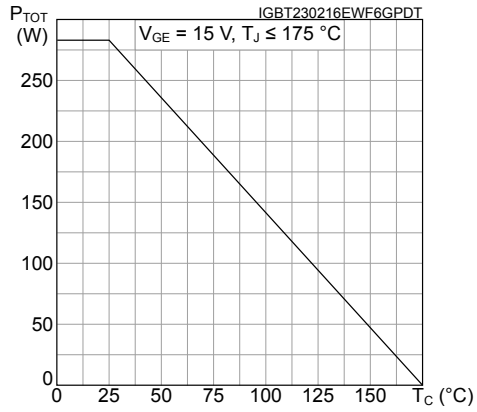


Figure 2. Collector current vs. case temperature for TO-247 and TO-247 long leads

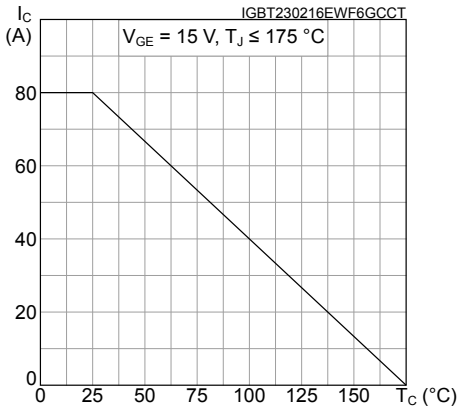


Figure 3. Power dissipation vs. case temperature for TO-3PF

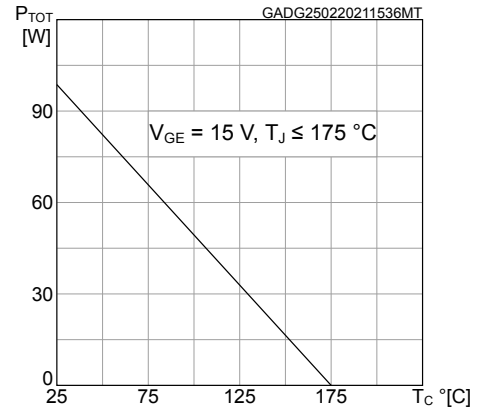


Figure 4. Collector current vs. case temperature for TO-3PF

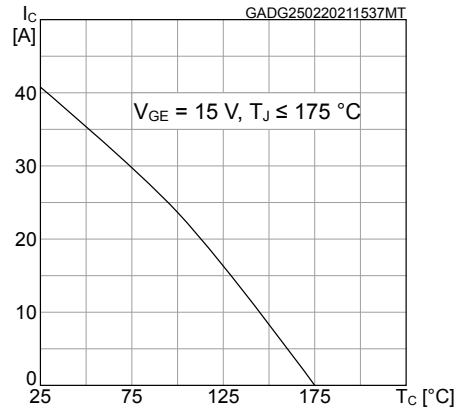


Figure 5. Output characteristics (T_J = 25 °C)

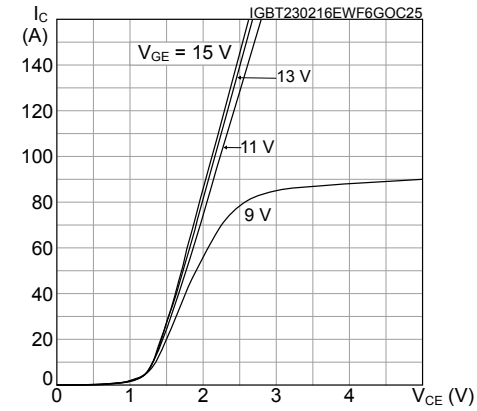


Figure 6. Output characteristics (T_J = 175 °C)

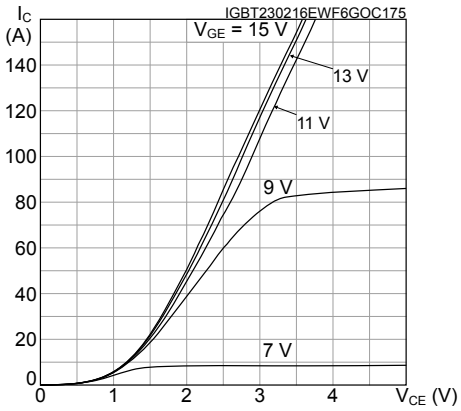


Figure 7. $V_{CE(sat)}$ vs. junction temperature

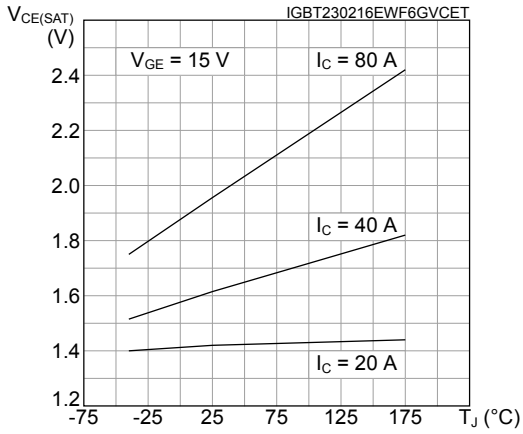


Figure 8. $V_{CE(sat)}$ vs. collector current

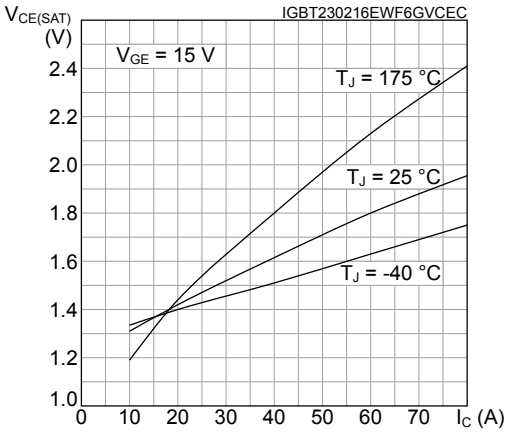


Figure 9. Collector current vs. switching frequency for TO-247 and TO-247 long leads

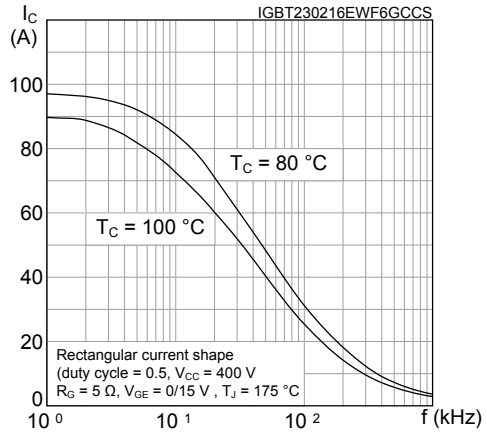


Figure 10. Collector current vs. switching frequency for TO-3PF

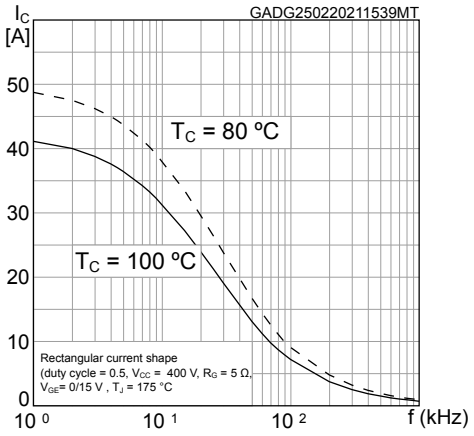


Figure 11. Forward bias safe operating area for TO-247 and TO-247 long leads

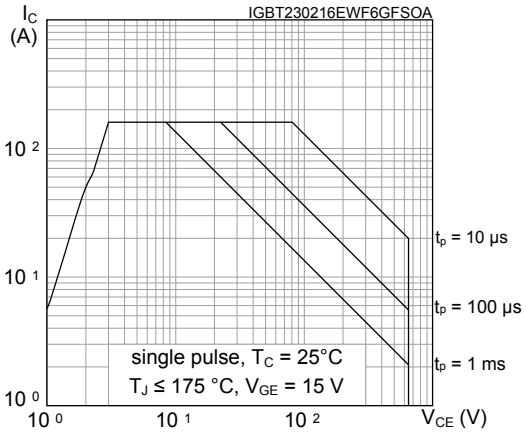


Figure 12. Forward bias safe operating area for TO-3PF

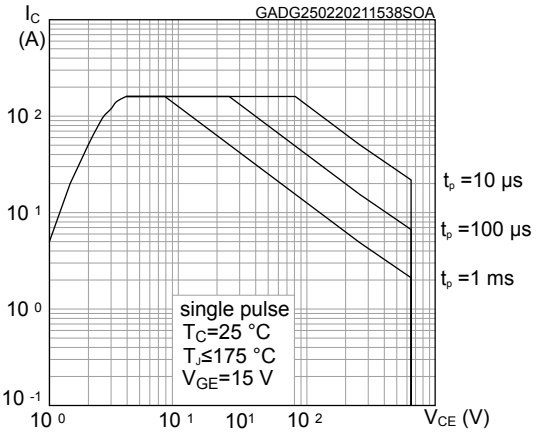


Figure 13. Transfer characteristics

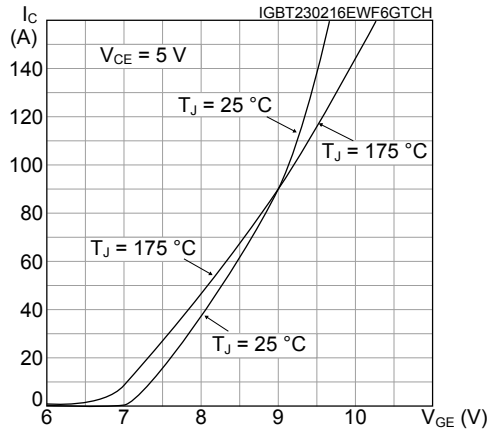


Figure 14. Normalized $V_{GE(th)}$ vs. junction temperature

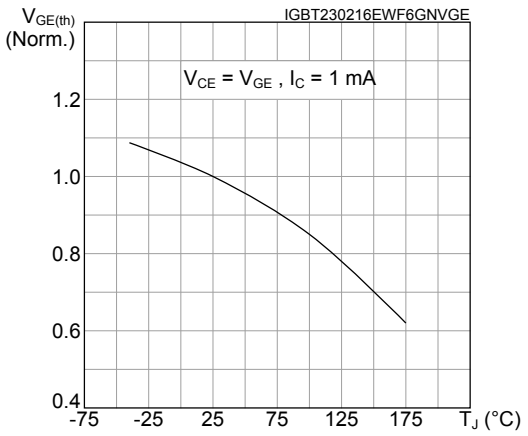


Figure 15. Normalized $V_{(BR)CES}$ vs. junction temperature

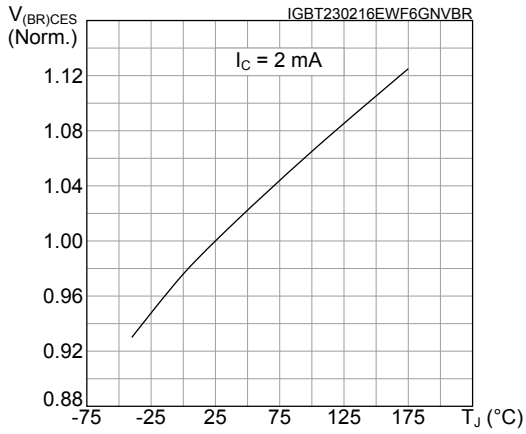


Figure 16. Capacitance variation

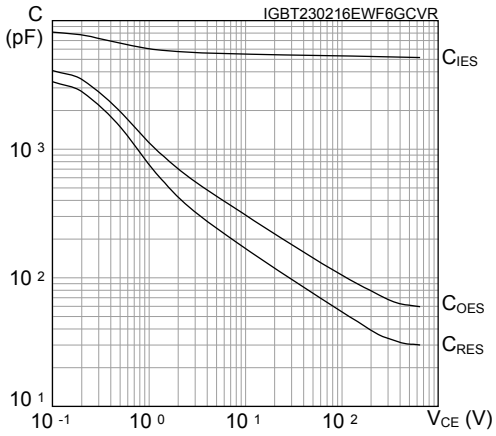


Figure 17. Gate charge vs. gate-emitter voltage

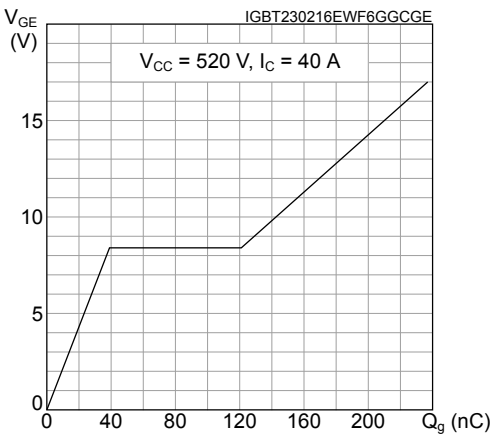


Figure 18. Switching energy vs. collector current

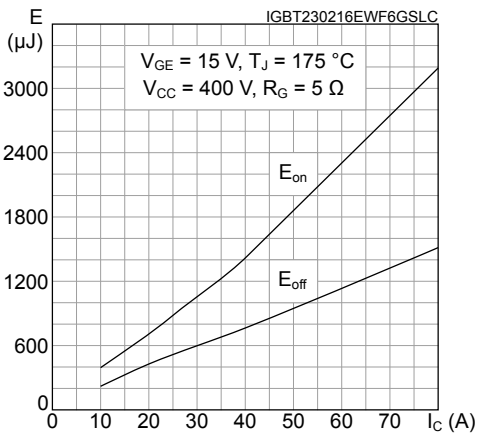


Figure 19. Switching energy vs. gate resistance

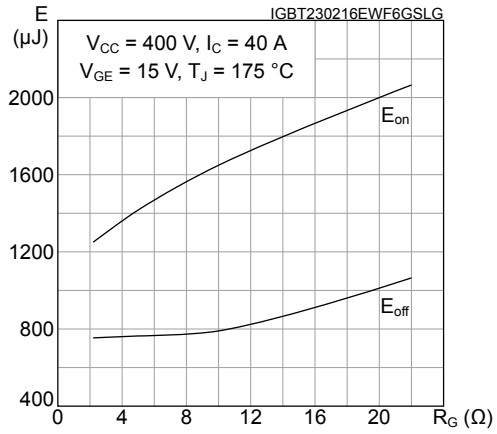


Figure 20. Switching energy vs. temperature

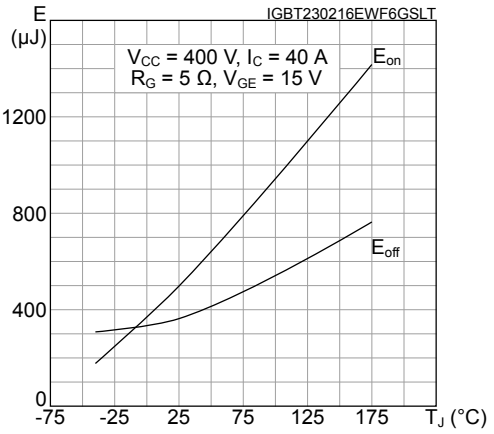


Figure 21. Switching energy vs. collector emitter voltage

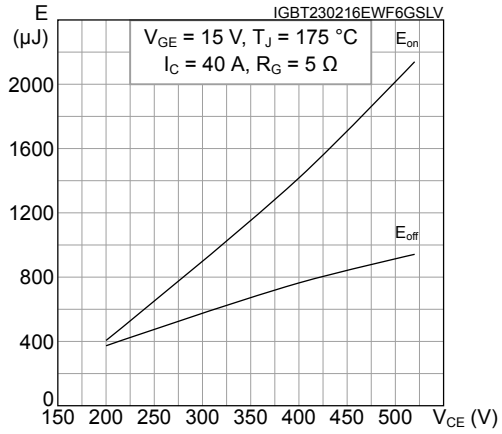


Figure 22. Switching times vs. collector current

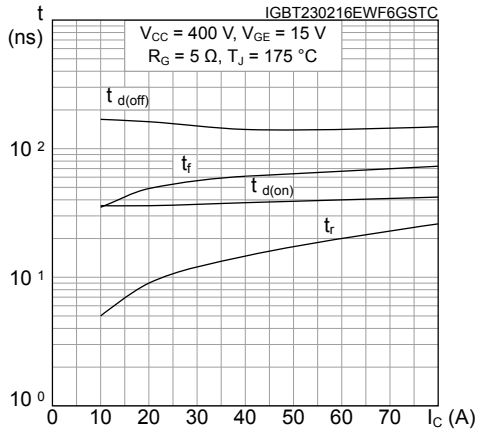


Figure 23. Switching times vs. gate resistance

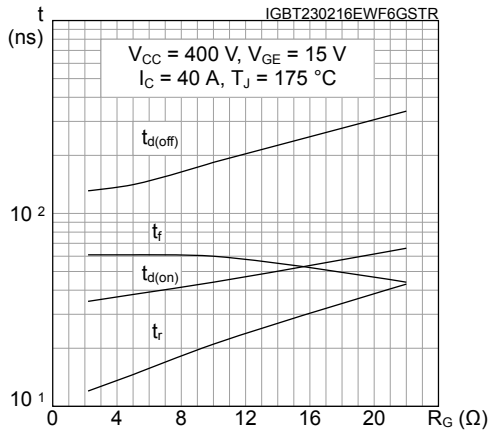


Figure 24. Thermal impedance for TO-247 and TO-247 long leads

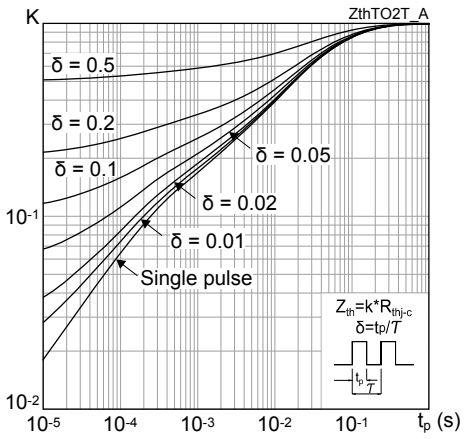
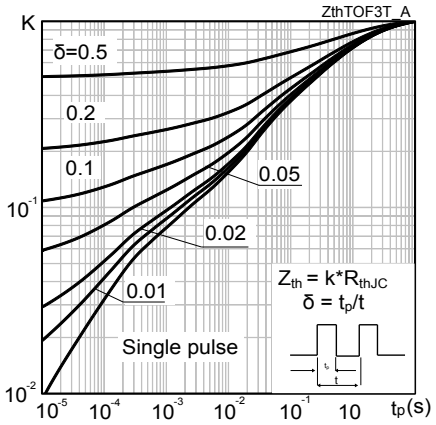


Figure 25. Thermal impedance for TO-3PF



3 Test circuits

Figure 26. Test circuit for inductive load switching

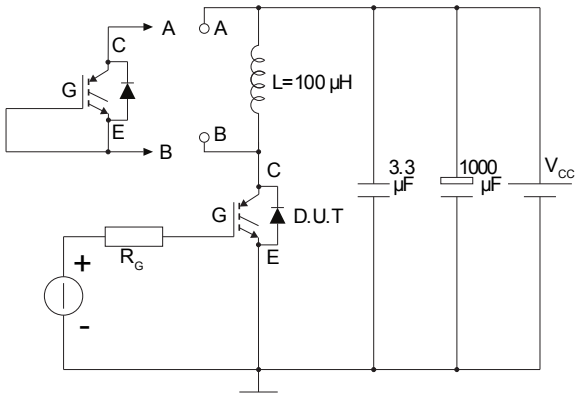


Figure 27. Gate charge test circuit

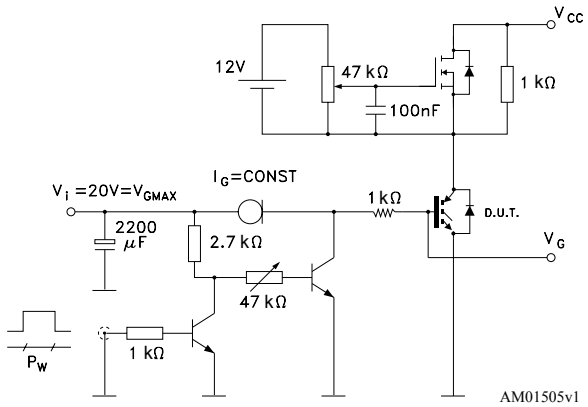
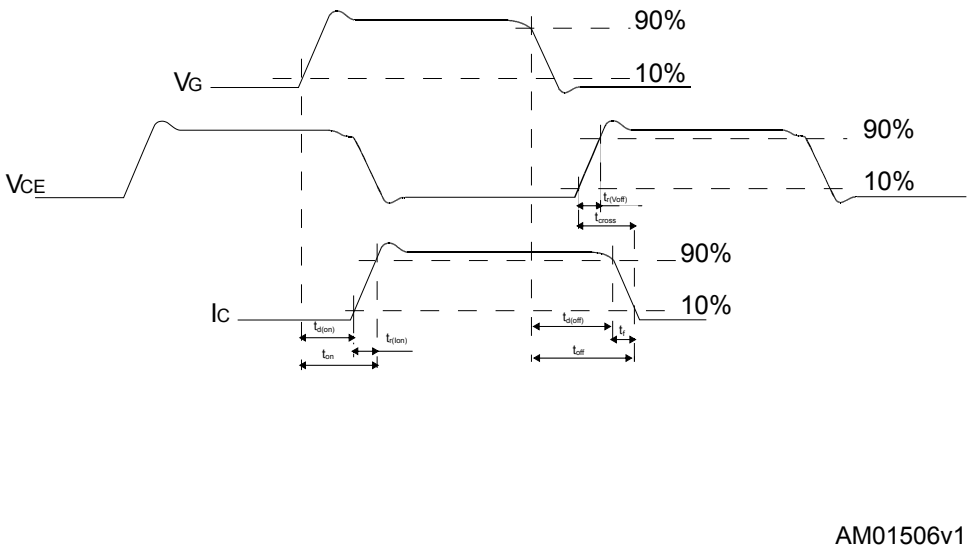


Figure 28. Switching waveform



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-3PF package information

Figure 29. TO-3PF package outline

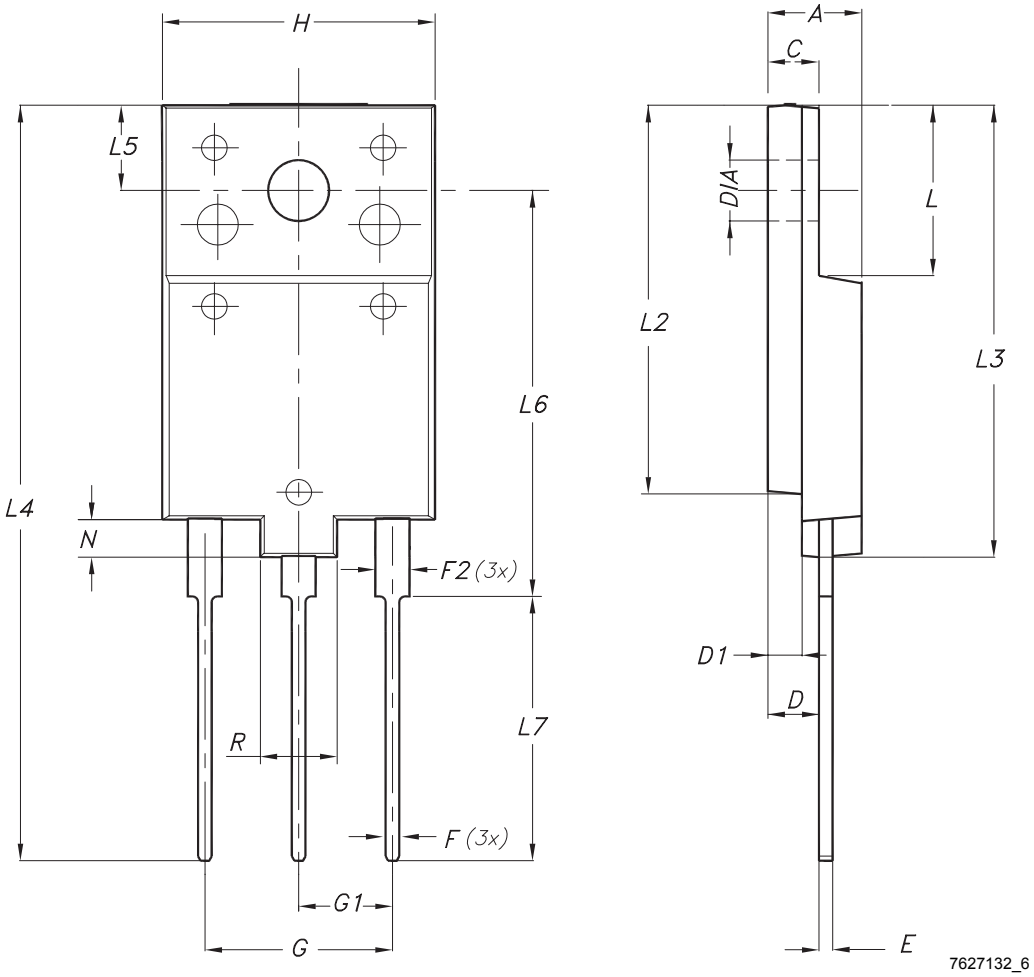
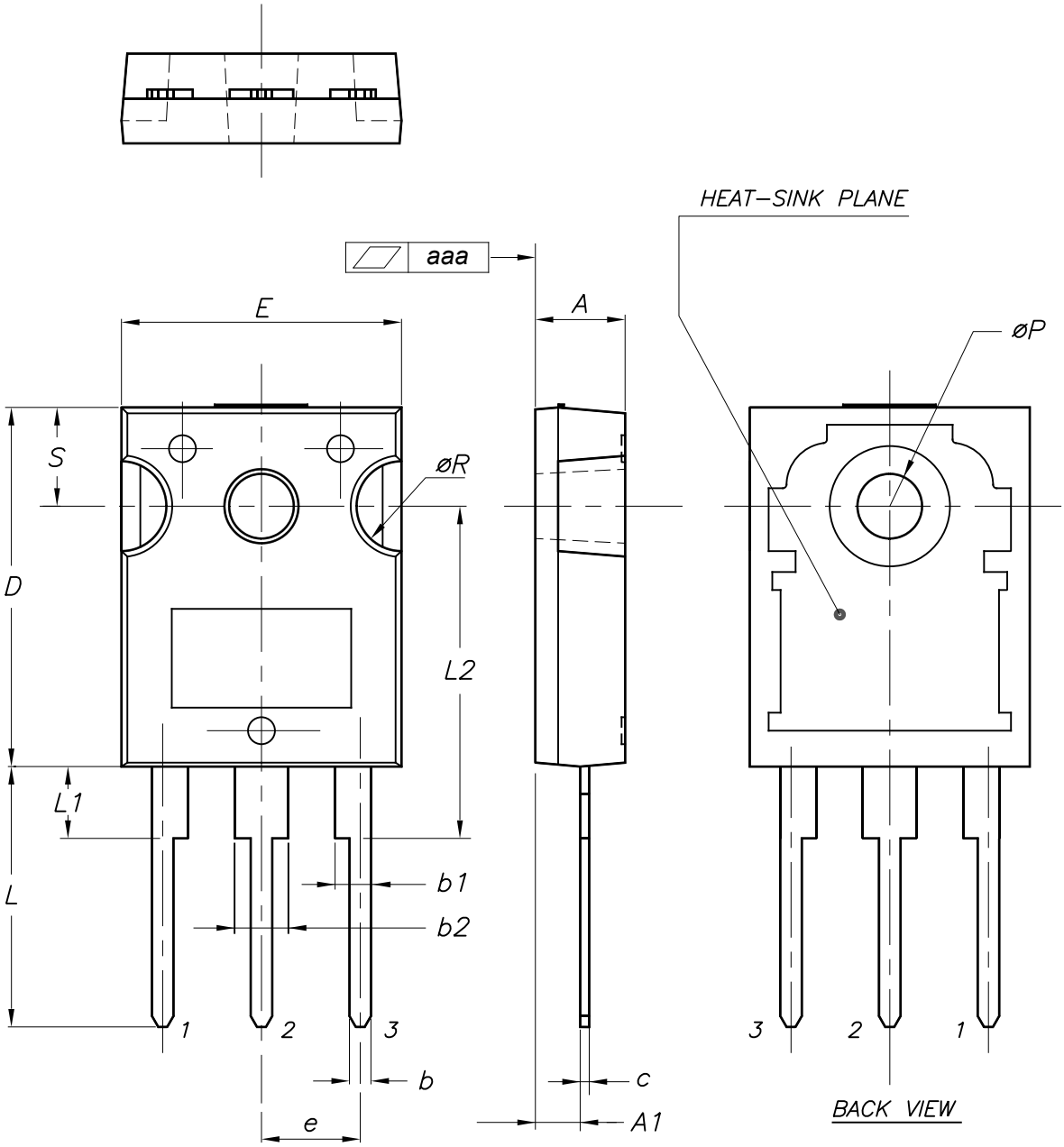


Table 6. **TO-3PF mechanical data**

Dim.	mm		
	Min.	Typ.	Max.
A	5.30		5.70
C	2.80		3.20
D	3.10		3.50
D1	1.80		2.20
E	0.80		1.10
F	0.65		0.95
F2	1.80		2.20
G	10.30		11.50
G1		5.45	
H	15.30		15.70
L	9.80	10.00	10.20
L2	22.80		23.20
L3	26.30		26.70
L4	43.20		44.40
L5	4.30		4.70
L6	24.30		24.70
L7	14.60		15.00
N	1.80		2.20
R	3.80		4.20
Dia	3.40		3.80

4.2 TO-247 package information

Figure 30. **TO-247 package outline**



0075325_10

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
aaa		0.04	0.10

4.3 TO-247 long leads package information

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

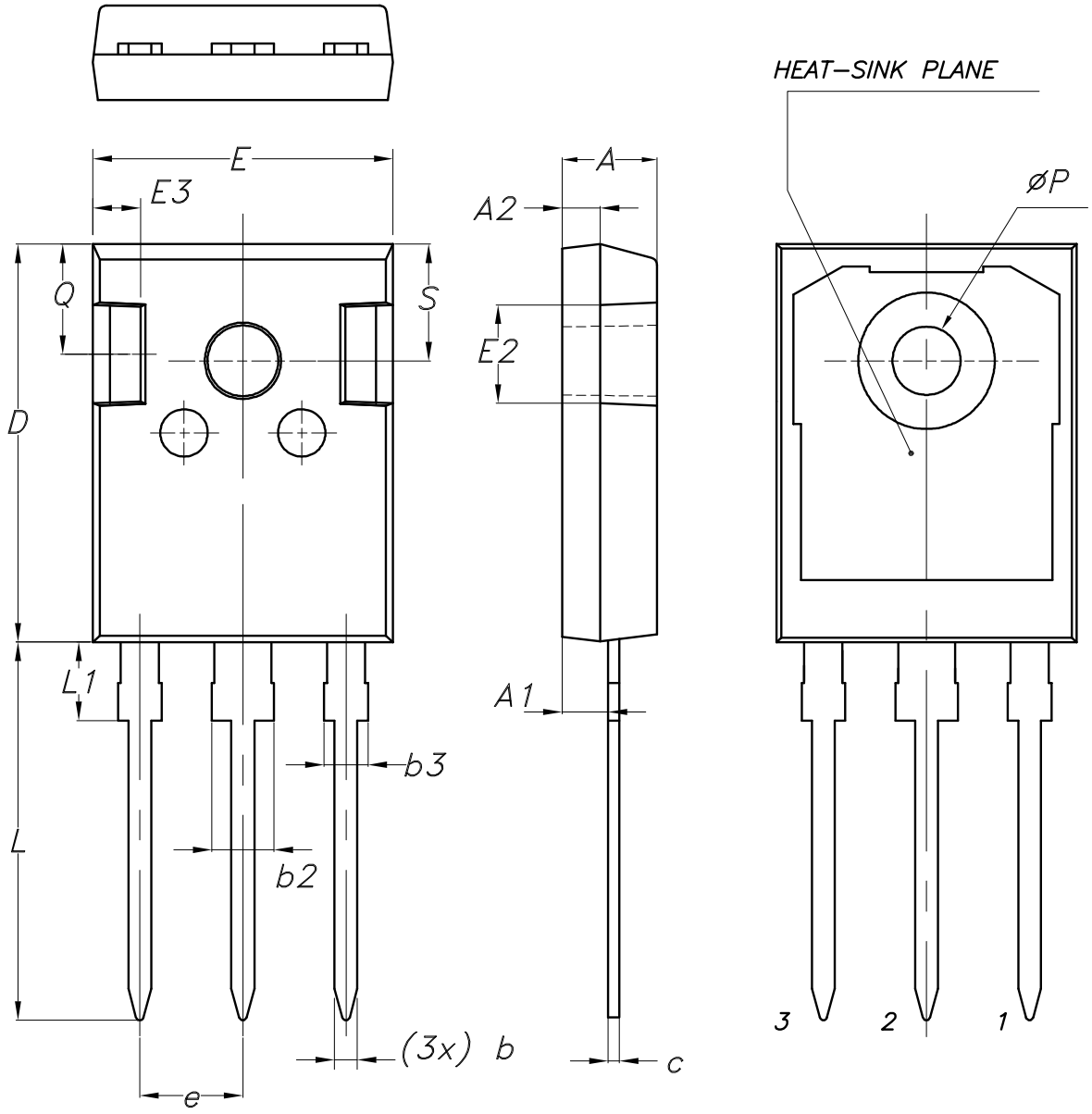


Table 8. **TO-247 long leads package mechanical data**

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

5 Ordering information

Table 9. **Order codes**

Order code	Marking	Package	Packing
STGFW40H65FB	GFW40H65FB	TO-3PF	Tube
STGW40H65FB	GW40H65FB	TO-247	
STGWA40H65FB	GWA40H65FB	TO-247 long leads	

Revision history

Table 10. **Document revision history**

Date	Revision	Changes
30-Aug-2013	1	Initial release
11-Sep-2013	2	Document status changed from preliminary to production data. Inserted *Section 2.1: Electrical characteristics (curves)*.
28-Feb-2014	3	Updated title and description in cover page.
05-Mar-2014	4	Updated units in *Table 6: Switching characteristics (inductive load)*.
11-Apr-2014	5	Added part number and references for the device in a TO-3PF package.
03-Nov-2016	6	Added device in TO-247 long leads and updated the document accordingly. Updated *Section 2.1: Electrical characteristics (curves)* and *Section 4.3: TO-247 long leads, package information*. Minor text changes.
21-Mar-2017	7	Updated *Table 1: "Device summary"*. Added *Figure 26: "Thermal impedance for TO-3PF"*. Minor text changes
09-Mar-2021	8	The part number STGWT40H65FB has been removed and the document has been updated accordingly. Updated title in cover page. Updated Section 1 Electrical ratings and Section 2.1 Electrical characteristics (curves). Minor text changes

Contents

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