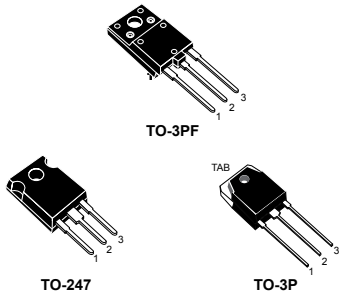
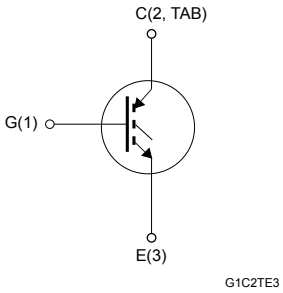
STGFW20H65FB, STGW20H65FB, STGWT20H65FB

Datasheet

Trench gate field-stop 650 V, 20 A high speed HB series IGBT





Features

- Maximum junction temperature: T_J = 175 °C
- High speed switching series
- Minimized tail current
- $V_{CE(sat)}$ = 1.55 V (typ.) @ I_C = 20 A
- Tight parameters distribution
- Safe paralleling
- Low thermal resistance

Applications

- Photovoltaic inverters
- Power factor correction
- Welding
- 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 $V_{CE(sat)}$ temperature coefficient and very tight parameter distribution result in safer paralleling operation.

Product status links
STGFW20H65FB
STGW20H65FB
STGWT20H65FB

1 Electrical ratings

Table 1. Absolute maximum ratings

Symbol	Parameter	Value		Unit
		TO-247, TO-3P	TO-3PF	
V_{CES}	Collector-emitter voltage (V_{GE} = 0 V)	650		V
I_C	Continuous collector current at T_C = 25 °C	40		A
	Continuous collector current at T_C = 100 °C	20		A
I_{CP}(1)	Pulsed collector current	80		A
V_{GE}	Gate-emitter voltage	±20		V
V_{ISO}	Insulation withstand voltage (RMS) from all three leads to external heat sink (t = 1 s, T_C = 25 °C)		3.5	kV
P_{TOT}	Total power dissipation at T_C = 25 °C	168	86.7	W
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-3P	TO-3PF	
R_{thJC}	Thermal resistance, junction-to-case	0.9	1.73	°C/W
R_{thJA}	Thermal resistance, junction-to-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 = 20 A		1.55	2.00	V
		V_{GE} = 15 V, I_C = 20 A, T_J = 125 °C		1.65		
		V_{GE} = 15 V, I_C = 20 A, T_J = 175 °C		1.75		
$V_{GE(th)}$	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	-	2764	-	pF
C_{oes}	Output capacitance		-	80	-	pF
C_{res}	Reverse transfer capacitance		-	60	-	pF
Q_g	Total gate charge	V_{CC} = 520 V, I_C = 20 A, V_{GE} = 0 to 15 V (see Figure 26. Gate charge test circuit)	-	120	-	nC
Q_{ge}	Gate-emitter charge		-	20	-	nC
Q_{gc}	Gate-collector charge		-	50	-	nC

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 = 20 A, R_G = 10 Ω, V_{GE} = 15 V (see Figure 25. Test circuit for inductive load switching)	-	30	-	ns
t_r	Current rise time		-	11	-	ns
$(di/dt)_{on}$	Turn-on current slope		-	1400	-	A/µs
$t_{d(off)}$	Turn-off delay time		-	139	-	ns
t_f	Current fall time		-	20	-	ns
E_{on} (1)	Turn-on switching energy		-	77	-	µJ
E_{off} (2)	Turn-off switching energy		-	170	-	µJ
E_{ts}	Total switching energy		-	247	-	µJ
$t_{d(on)}$	Turn-on delay time	V_{CE} = 400 V, I_C = 20 A, R_G = 10 Ω, V_{GE} = 15 V, T_J = 175 °C (see Figure 25. Test circuit for inductive load switching)	-	29	-	ns
t_r	Current rise time		-	12	-	ns
$(di/dt)_{on}$	Turn-on current slope		-	1352	-	A/µs
$t_{d(off)}$	Turn-off-delay time		-	147	-	ns
t_f	Current fall time		-	38	-	ns
E_{on} (1)	Turn-on switching energy		-	88	-	µJ
E_{off} (2)	Turn-off switching energy		-	353	-	µJ
E_{ts}	Total switching energy		-	441	-	µJ

1. *Including the reverse recovery of the external SiC diode STPSC206W.*
2. *Including the tail of the collector current.*

2.1 Electrical characteristics (curves)

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

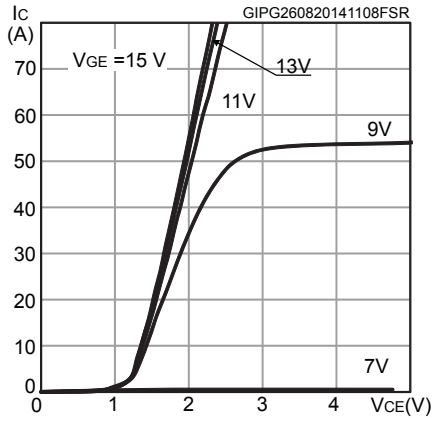


Figure 2. Output characteristics (T_J = 175°C)

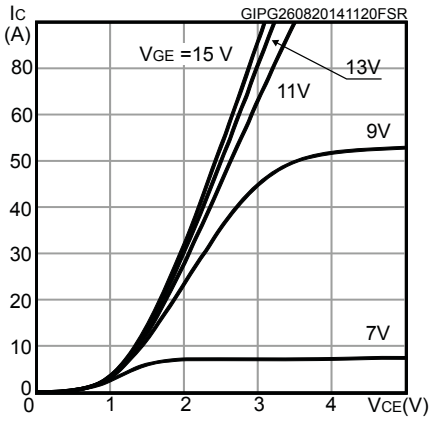


Figure 3. Transfer characteristics

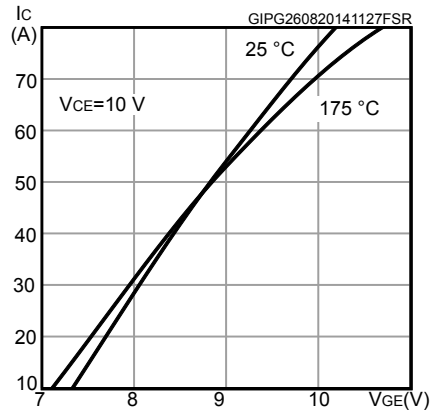


Figure 4. Collector current vs case temperature for TO-247 and TO-3P

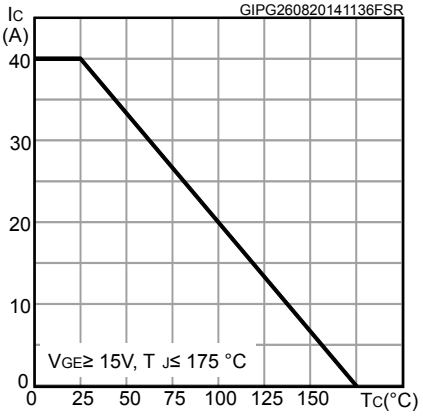


Figure 5. Collector current vs case temperature for TO-3PF

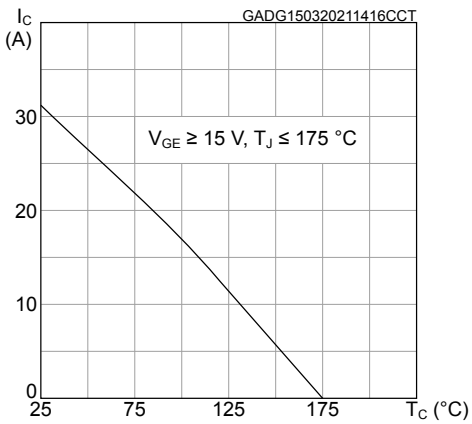


Figure 6. $V_{CE(sat)}$ vs junction temperature

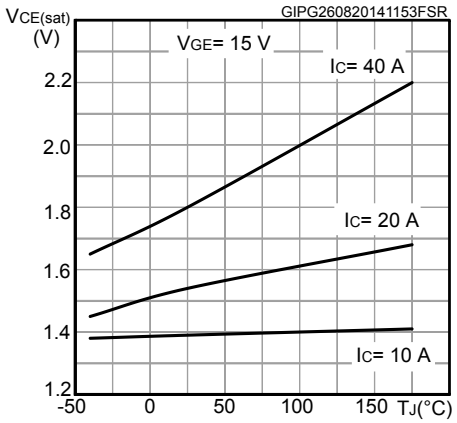


Figure 7. Power dissipation vs case temperature for TO-247 and TO-3P

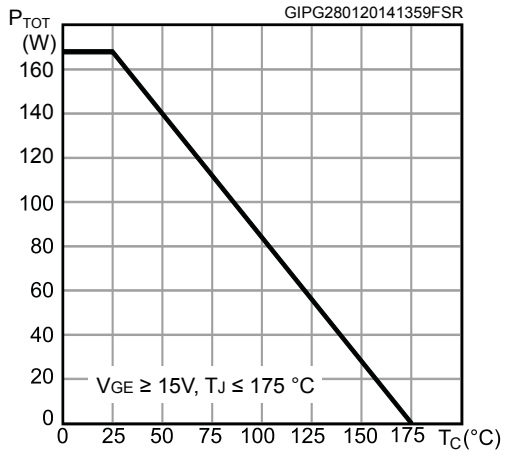


Figure 8. Power dissipation vs case temperature for TO-3PF

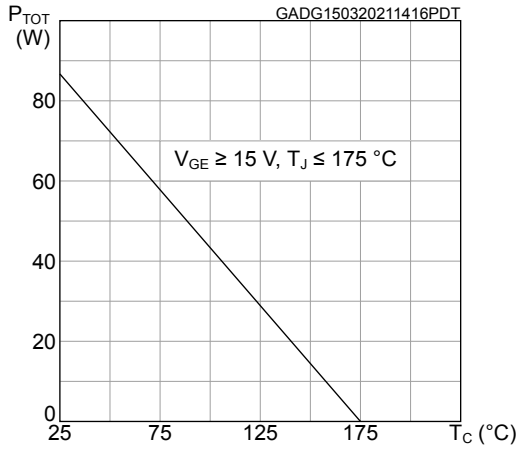


Figure 9. Forward bias safe operating area for TO-247 and TO-3P

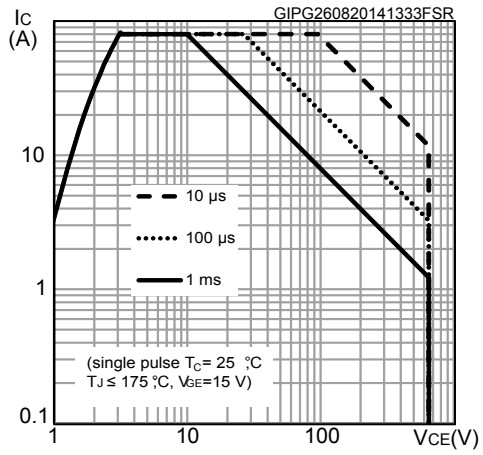


Figure 10. Forward bias safe operating area for TO-3PF

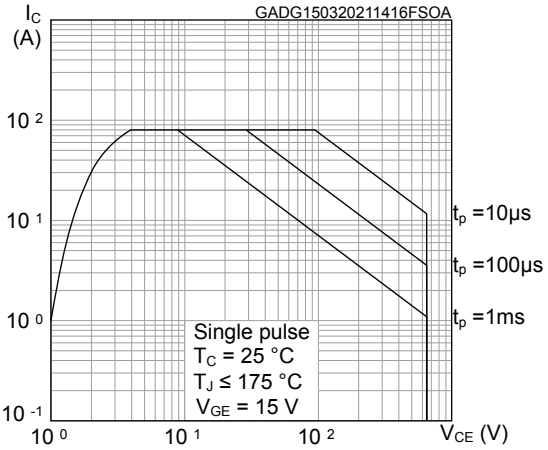


Figure 11. Collector current vs. switching frequency for TO-247 and TO-3P

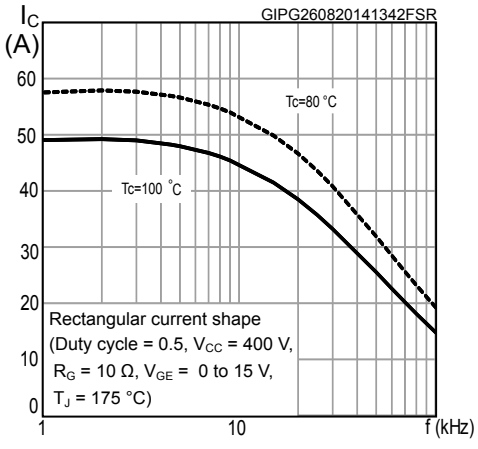


Figure 12. Collector current vs. switching frequency for TO-3PF

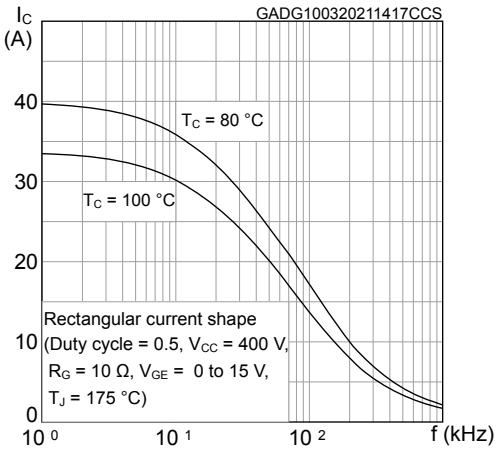


Figure 13. Normalized $V_{GE(th)}$ vs junction temperature

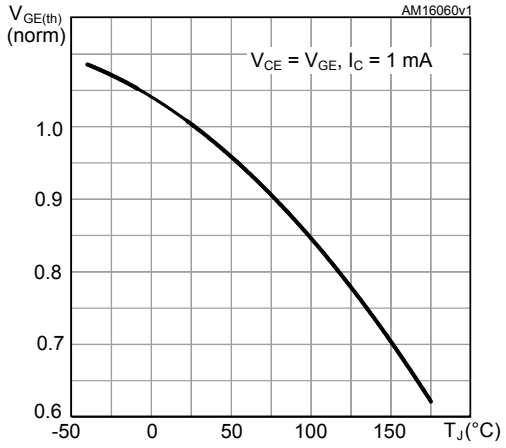


Figure 14. Normalized $V_{(BR)CES}$ vs junction temperature

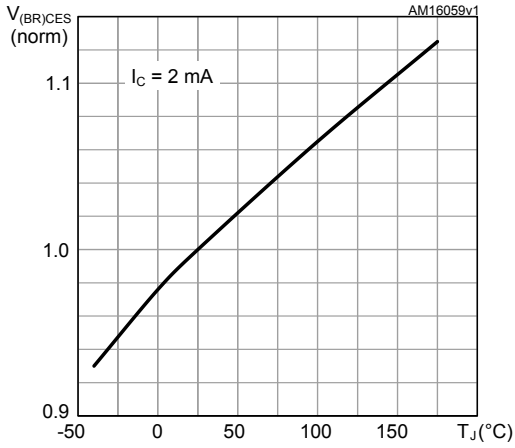


Figure 15. Switching energy vs temperature

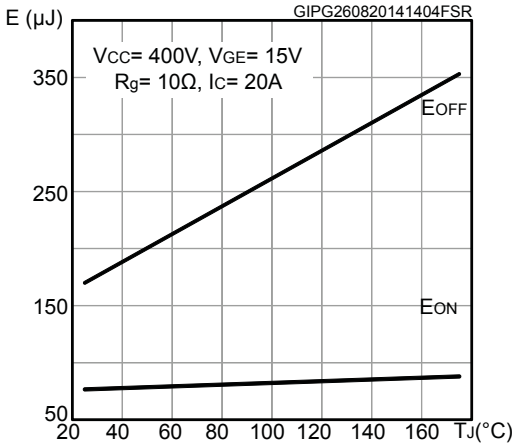


Figure 16. Switching energy vs gate resistance

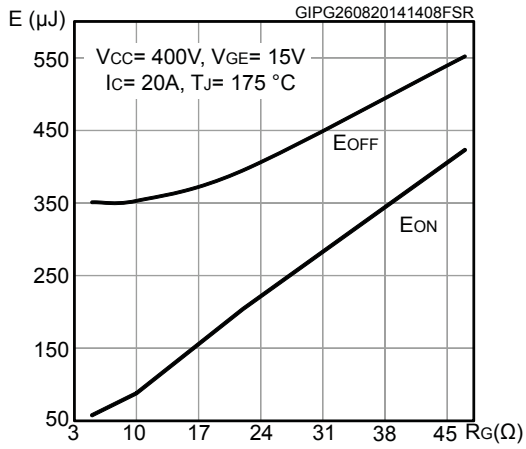


Figure 17. Switching energy vs collector current

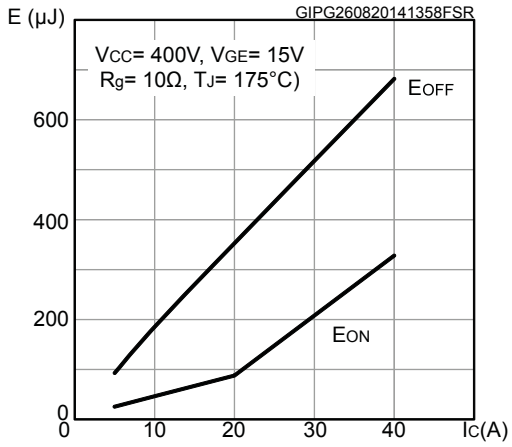


Figure 18. Switching energy vs collector emitter voltage

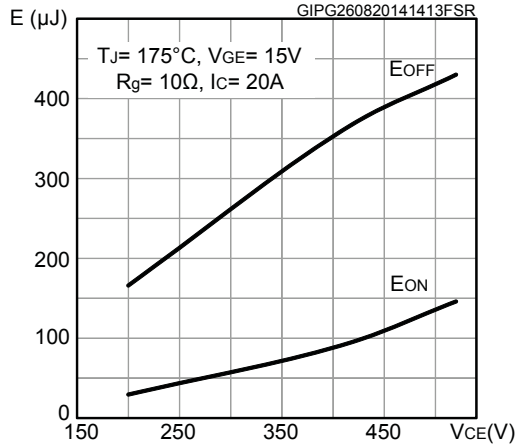


Figure 19. Switching times vs collector current

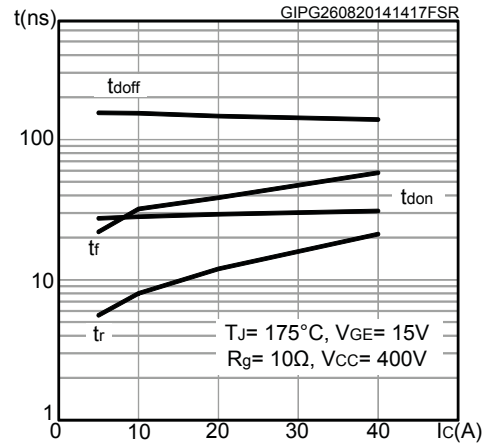


Figure 20. Switching times vs gate resistance

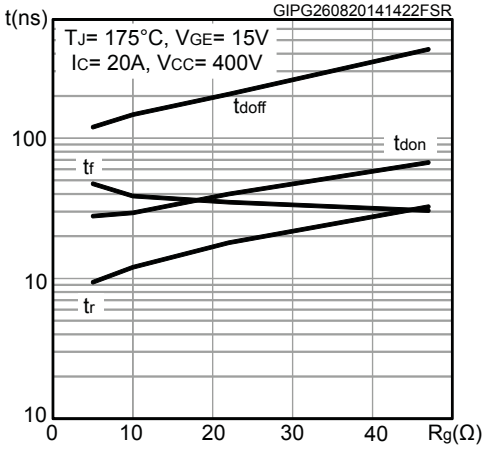


Figure 21. Capacitance variations

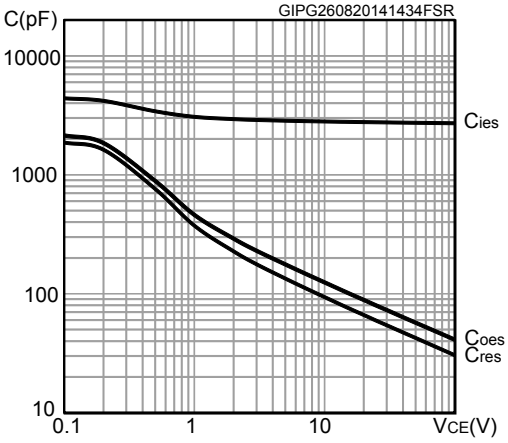


Figure 22. Gate charge vs gate-emitter voltage

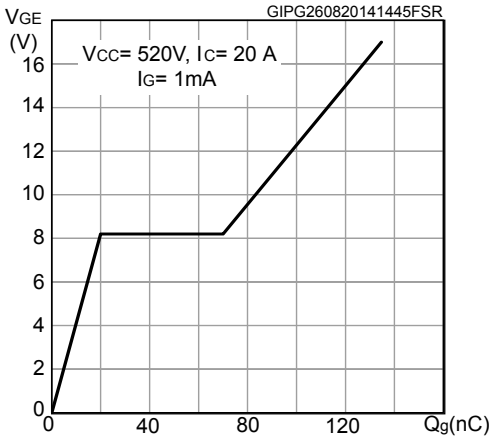


Figure 23. Thermal impedance for TO-247 and TO-3P

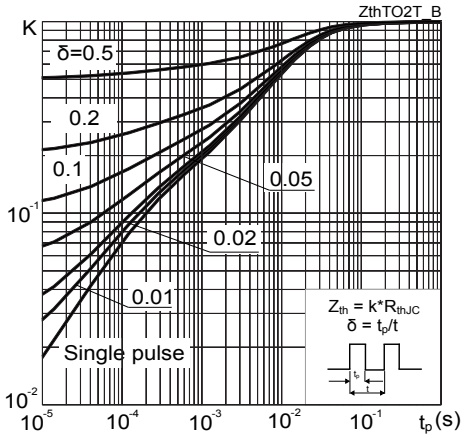
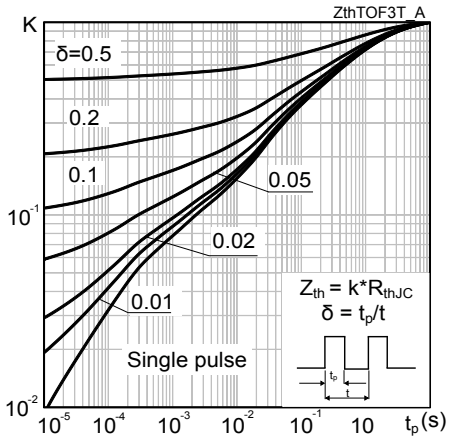


Figure 24. Thermal impedance for in TO-3PF



3 Test circuits

Figure 25. **Test circuit for inductive load switching**

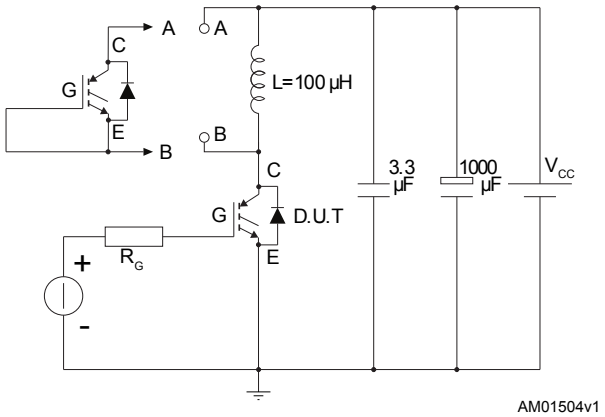


Figure 26. **Gate charge test circuit**

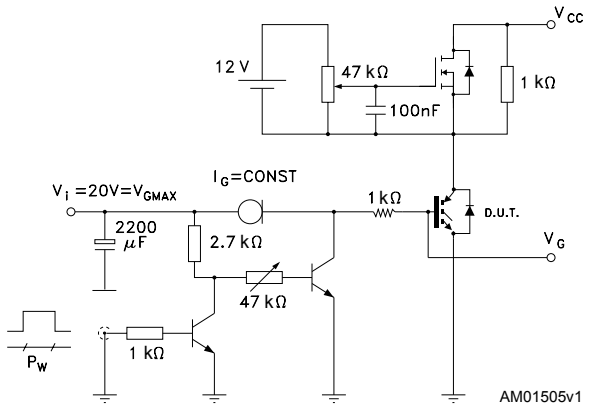
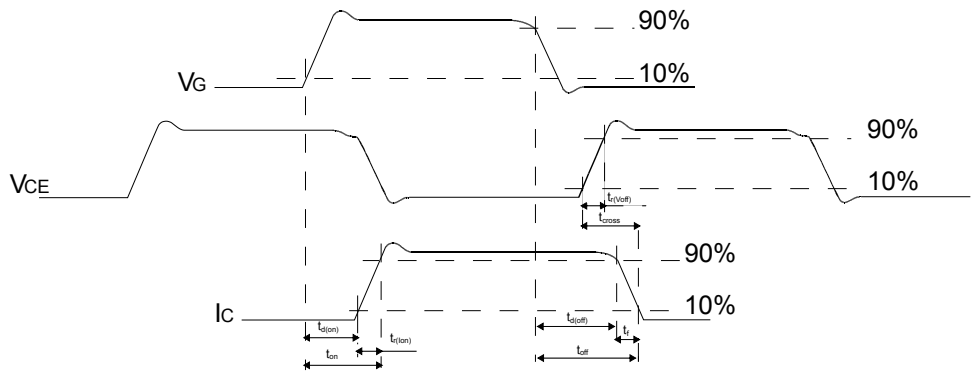


Figure 27. **Switching waveform**



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 28. TO-3PF package outline

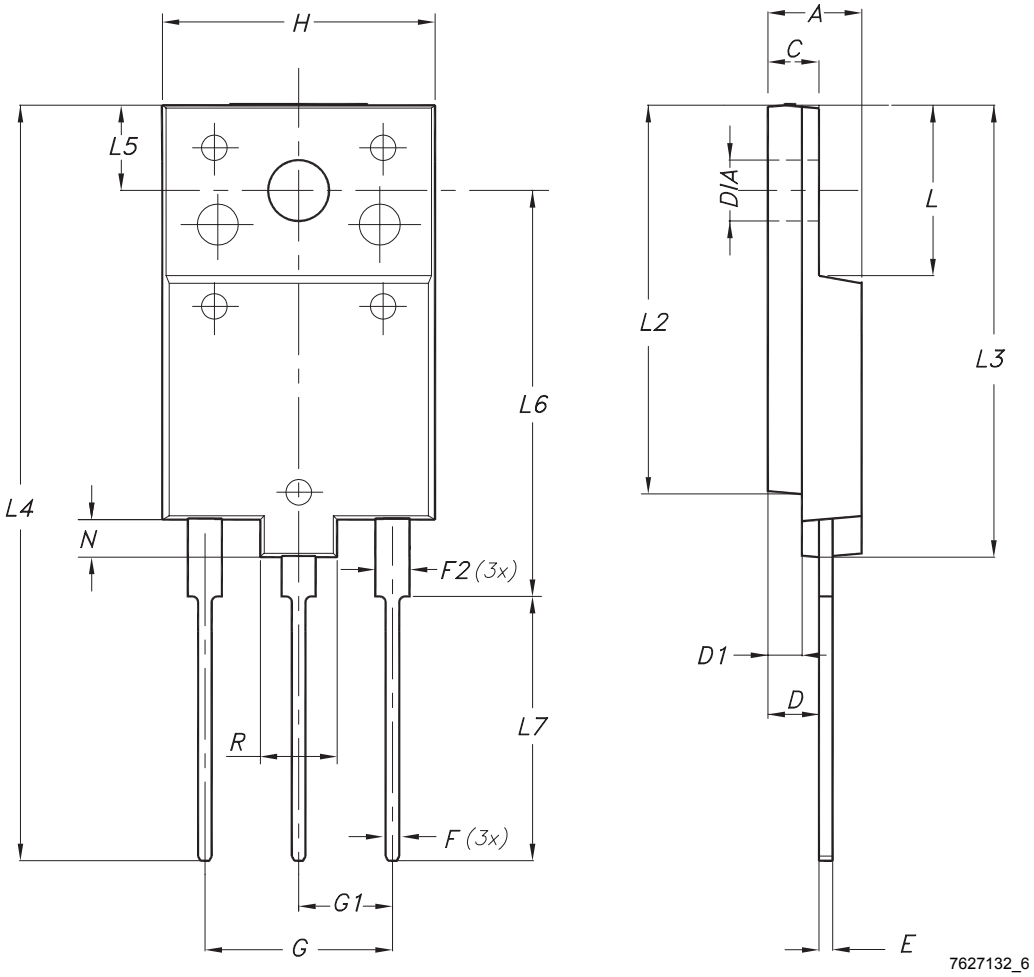
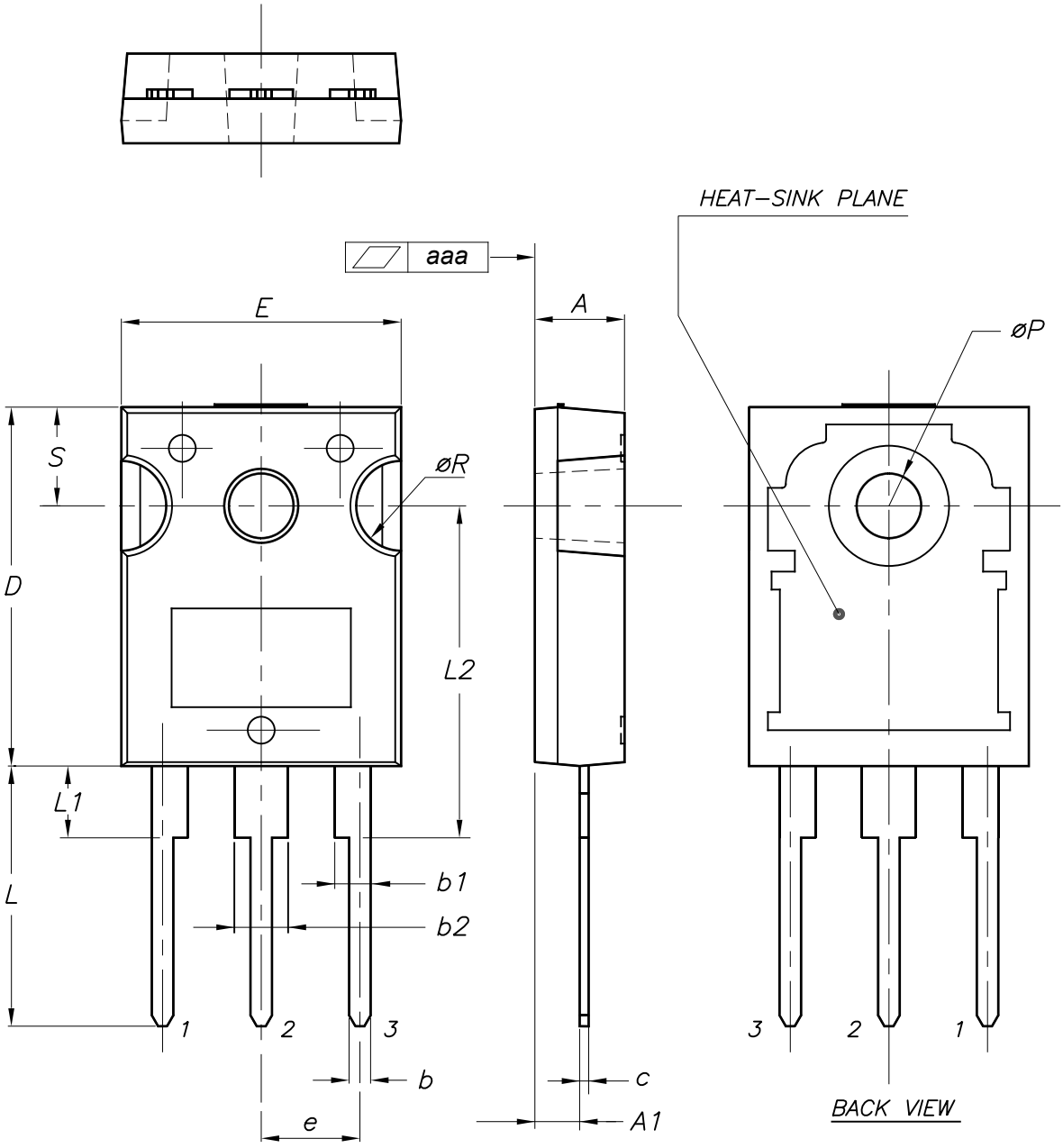


Table 6. **TO-3PF mechanical data**

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 29. **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-3P package information

Figure 30. **TO-3P package outline**

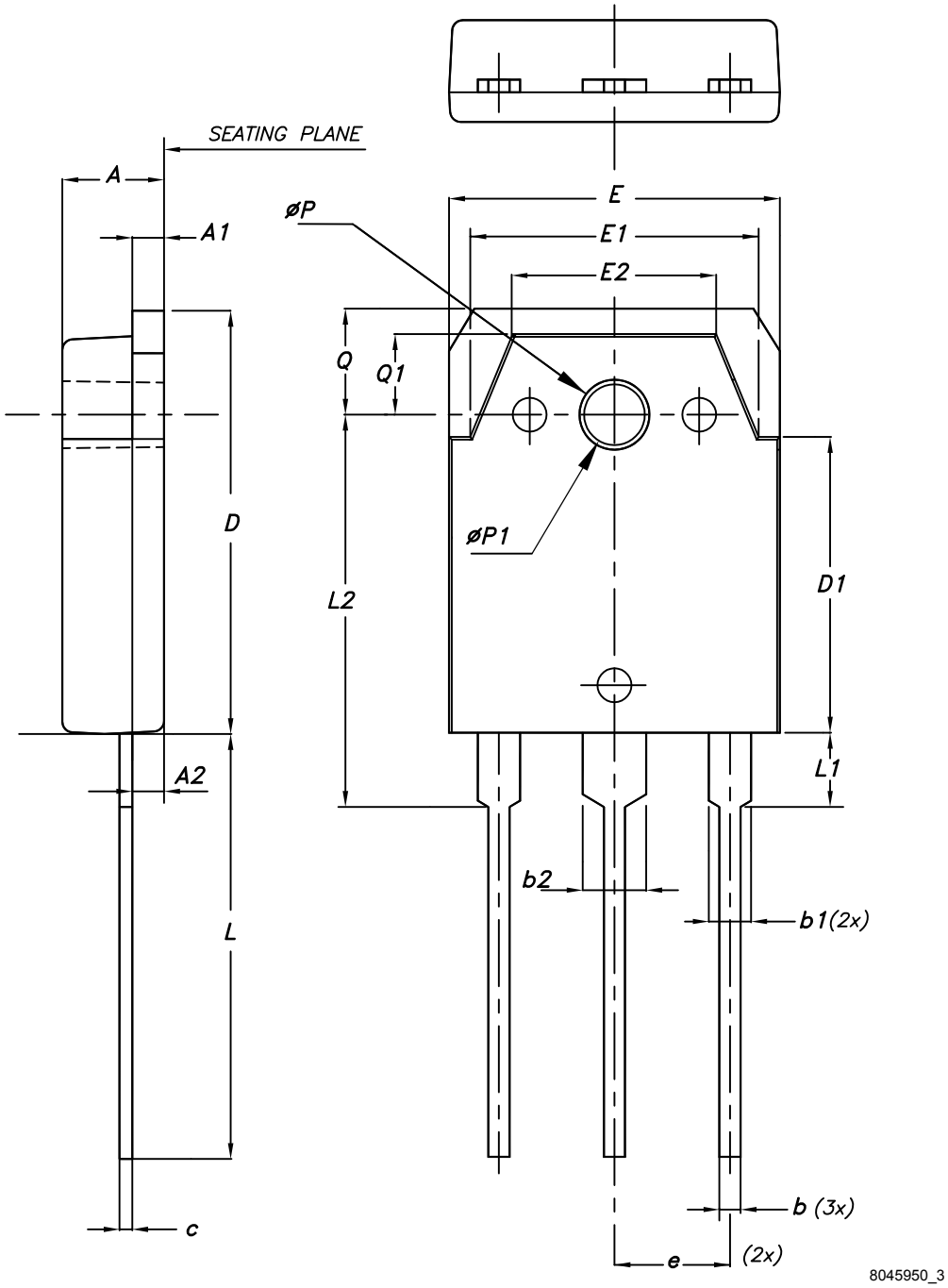


Table 8. **TO-3P package mechanical data**

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 9. **Order codes**

Order code	Marking	Package	Packing
STGFW20H65FB	G20H65FB	TO-3PF	Tube
STGW20H65FB	GW20H65FB	TO-247	
STGWT20H65FB	GWT20H65FB	TO-3P	

Revision history

Table 10. **Document revision history**

Date	Revision	Changes
28-Aug-2014	1	Initial release.
15-Apr-2020	2	Updated applications in cover page. Updated *Table 9. Order codes*. Minor text changes.
16-Mar-2021	3	Updated Section 1 Electrical ratings. Updated Figure 5. Collector current vs case temperature for TO-3PF, Figure 8. Power dissipation vs case temperature for TO-3PF, Figure 10. Forward bias safe operating area for TO-3PF and Figure 12. Collector current vs. switching frequency for TO-3PF. Updated Section 4.2 TO-247 package information. Minor text changes.

Contents