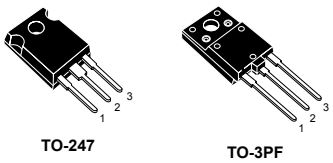
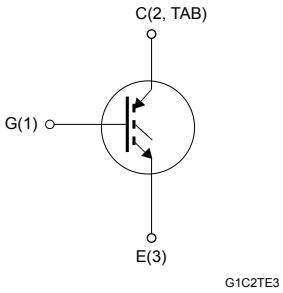
STGFW20V60F, STGW20V60F

Datasheet

Trench gate field-stop IGBT, V series 600 V, 20 A very high speed



TO-247 TO-3PF



Features

- Maximum junction temperature: T_J = 175 °C
- Tail-less switching off
- $V_{CE(sat)}$ = 1.8 V (typ.) @ I_C = 20 A
- Tight parameter distribution
- Safe paralleling
- Low thermal resistance

Applications

- Photovoltaic inverters
- Uninterruptible power supply
- Welding
- Power factor correction
- Very 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 V series IGBTs, which represent an optimum compromise between conduction and switching losses to maximize the efficiency of very high frequency converters. Furthermore, the positive $V_{CE(sat)}$ temperature coefficient and very tight parameter distribution result in safer paralleling operation.

Product status links
STGFW20V60F
STGW20V60F

Product summary	
Order code	**STGFW20V60F**
Marking	GFW20V60F
Package	TO-3PF
Packing	Tube
Order code	**STGW20V60F**
Marking	GW20V60F
Package	TO-247
Packing	Tube

1 Electrical ratings

Table 1. Absolute maximum ratings

Symbol	Parameter	Value		Unit
		TO-247	TO-3PF	
V_{CES}	Collector-emitter voltage (V_{GE} = 0 V)	600		V
I_C	Continuous collector current at T_C = 25 °C	40	40(1)	A
	Continuous collector current at T_C = 100 °C	20	20(1)	
I_{CP}(2)	Pulsed collector current	80		A
V_{GE}	Gate-emitter voltage	±20		V
P_{TOT}	Total power dissipation at T_C = 25 °C	167	86.7	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		

1. *Limited by maximum junction temperature.*
2. *Pulse width limited by maximum junction temperature.*

Table 2. Thermal data

Symbol	Parameter	Value		Unit
		TO-247	TO-3PF	
R_{thJC}	Thermal resistance, junction-to-case	0.90	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	600			V
$V_{CE(sat)}$	Collector-emitter saturation voltage	V_{GE} = 15 V, I_C = 20 A		1.8	2.2	V
		V_{GE} = 15 V, I_C = 20 A, T_J = 125 °C		2.15		
		V_{GE} = 15 V, I_C = 20 A, T_J = 175 °C		2.3		
$V_{GE(th)}$	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} = 600 V			25	µA
I_{GES}	Gate-emitter leakage current	V_{CE} = 0 V, V_{GE} = ±20 V			250	µA

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	-	2800	-	pF
C_{oes}	Output capacitance		-	110	-	pF
C_{res}	Reverse transfer capacitance		-	64	-	pF
Q_g	Total gate charge	V_{CC} = 480 V, I_C = 20 A, V_{GE} = 0 to 15 V (see Figure 25. Gate charge test circuit)	-	116	-	nC
Q_{ge}	Gate-emitter charge		-	24	-	nC
Q_{gc}	Gate-collector charge		-	50	-	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 = 20 A, R_G = 10 Ω, V_{GE} = 15 V (see Figure 24. Test circuit for inductive load switching)	-	38	-	ns
t_r	Current rise time		-	10	-	ns
$(di/dt)_{on}$	Turn-on current slope		-	1556	-	A/µs
$t_{d(off)}$	Turn-off-delay time		-	149	-	ns
t_f	Current fall time		-	15	-	ns
E_{on} (1)	Turn-on switching energy		-	200	-	µJ
E_{off} (2)	Turn-off switching energy		-	130	-	µJ
E_{ts}	Total switching energy		-	330	-	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 24. Test circuit for inductive load switching)	-	37	-	ns
t_r	Current rise time		-	12	-	ns
$(di/dt)_{on}$	Turn-on current slope		-	1340	-	A/µs
$t_{d(off)}$	Turn-off-delay time		-	150	-	ns
t_f	Current fall time		-	23	-	ns
E_{on} (1)	Turn-on switching energy		-	430	-	µJ
E_{off} (2)	Turn-off switching energy		-	210	-	µJ
E_{ts}	Total switching energy		-	640	-	µJ

1. *Including the reverse recovery of the diode. The diode is the same of the copacked STGW20V60DF.*
2. *Including the tail of the collector current.*

2.1 Electrical characteristics (curves)

Figure 1. Power dissipation vs case temperature for TO-3PF

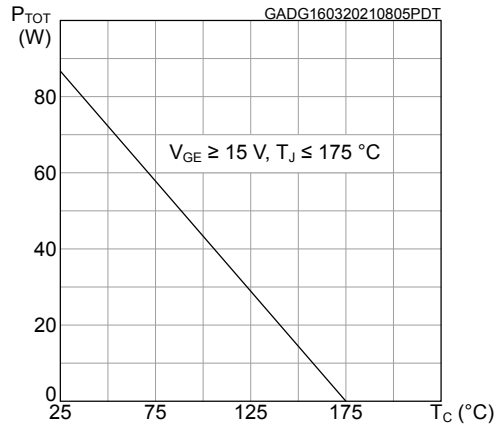


Figure 2. Collector current vs case temperature for TO-3PF

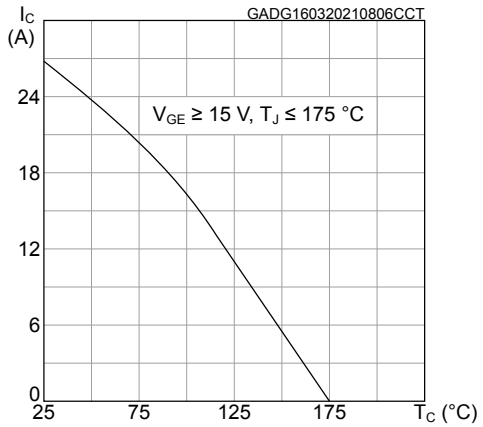


Figure 3. Power dissipation vs case temperature for TO-247

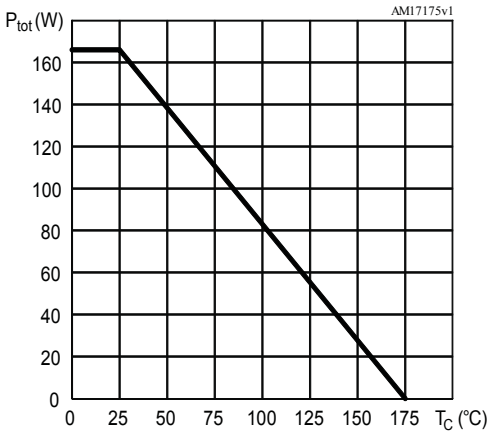


Figure 4. Collector current vs case temperature for TO-247

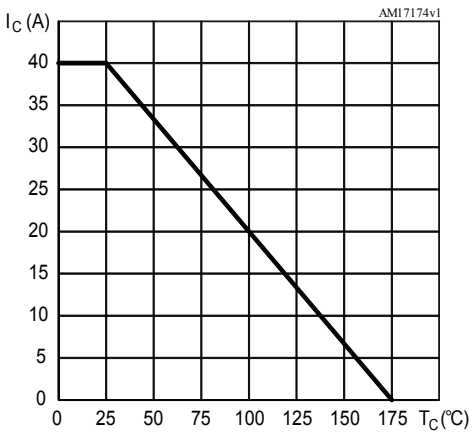


Figure 5. Output characteristics (T_J = 25 °C)

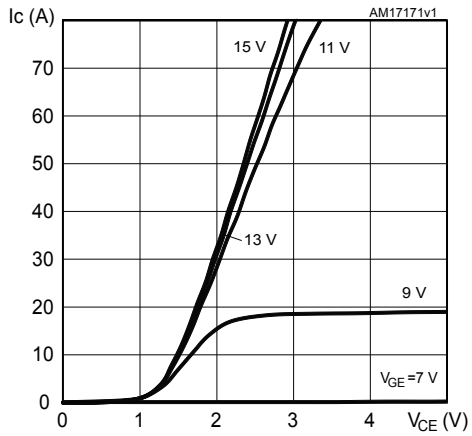


Figure 6. Output characteristics (T_J = 175 °C)

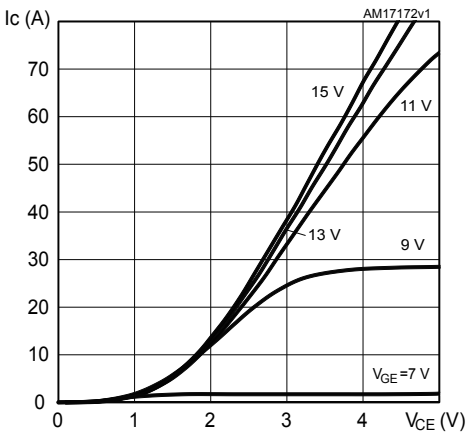


Figure 7. $V_{CE}(sat)$ vs junction temperature

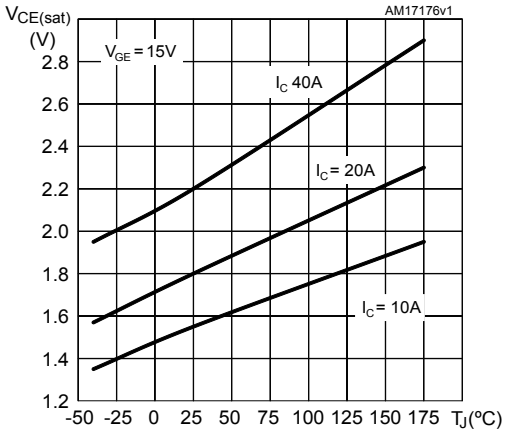


Figure 8. $V_{CE}(sat)$ vs collector current

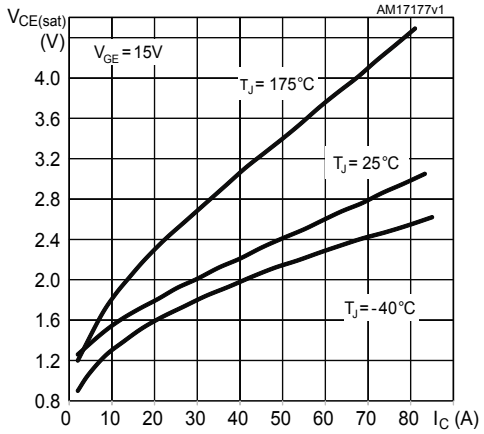


Figure 9. Safe operating area for TO-3PF

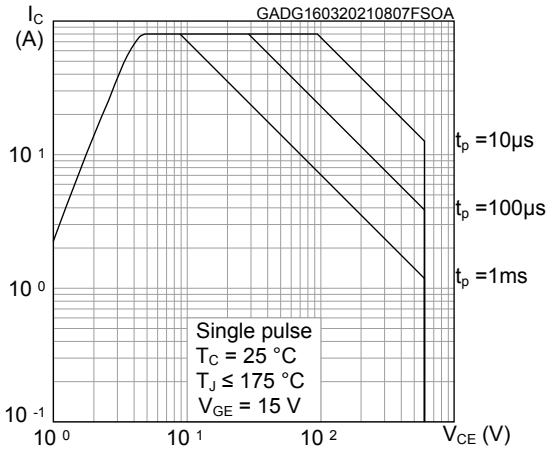


Figure 10. Safe operating area for TO-247

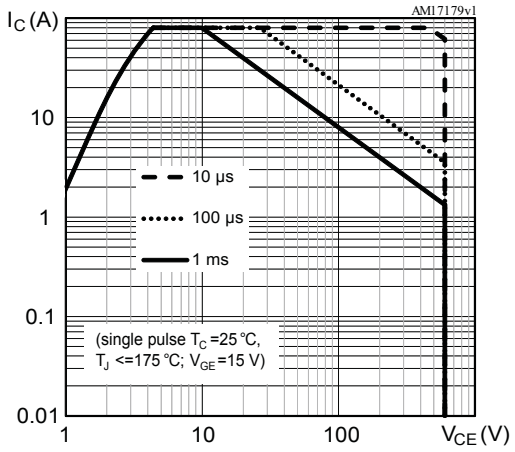


Figure 11. Normalized $V_{GE(th)}$ vs junction temperature

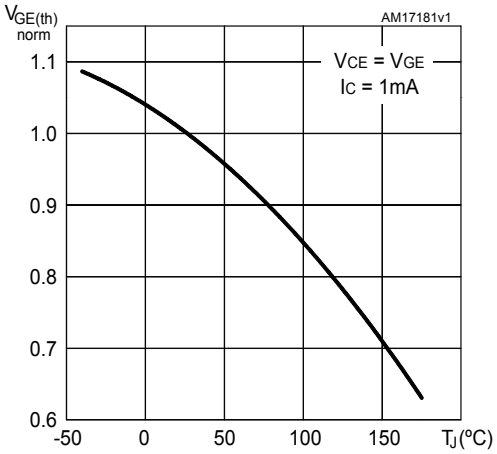


Figure 12. Normalized $V_{(BR)CES}$ vs junction temperature

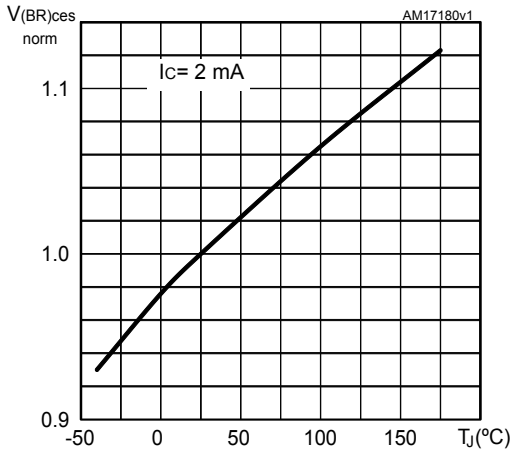


Figure 13. Capacitance variations

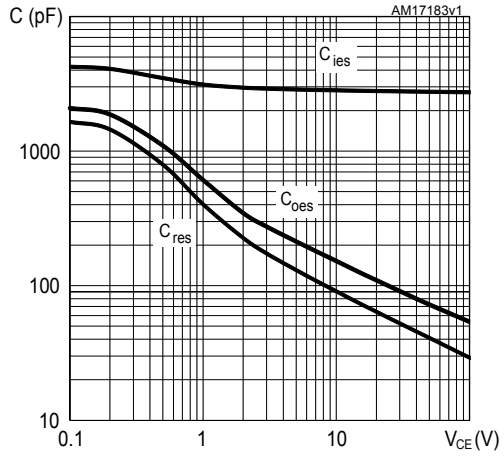


Figure 14. Gate charge vs gate-emitter voltage

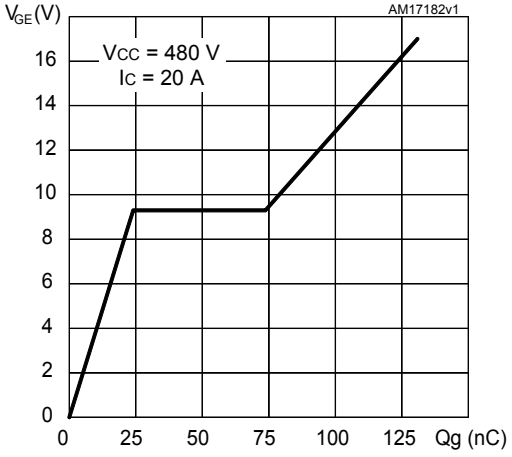


Figure 15. Switching energy vs collector current

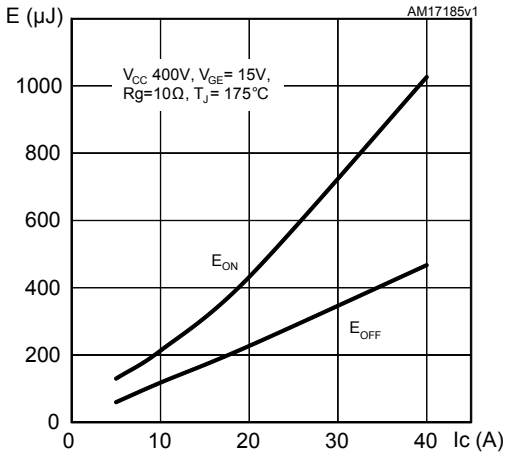


Figure 16. Switching energy vs gate resistance

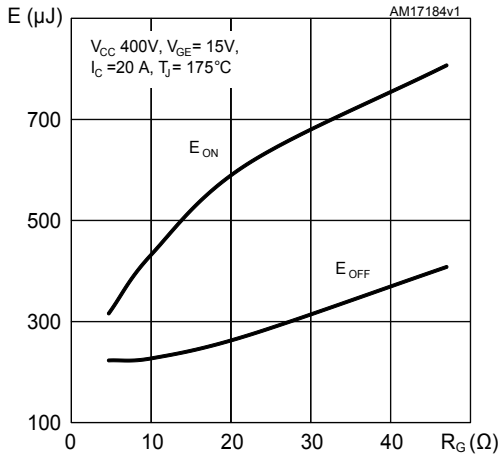


Figure 17. Switching energy vs junction temperature

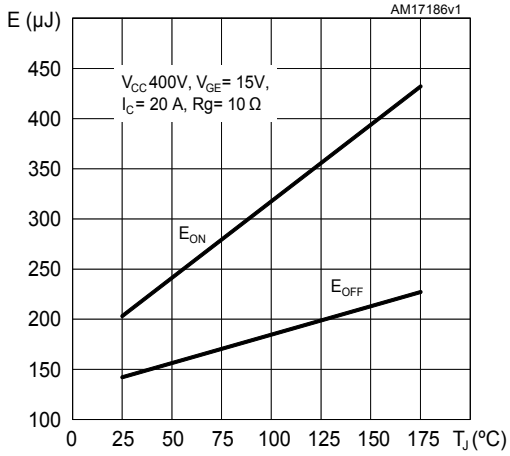


Figure 18. Switching energy vs collector emitter voltage

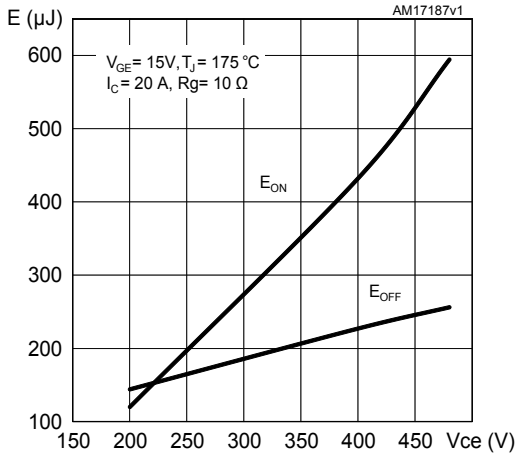


Figure 19. Switching times vs collector current

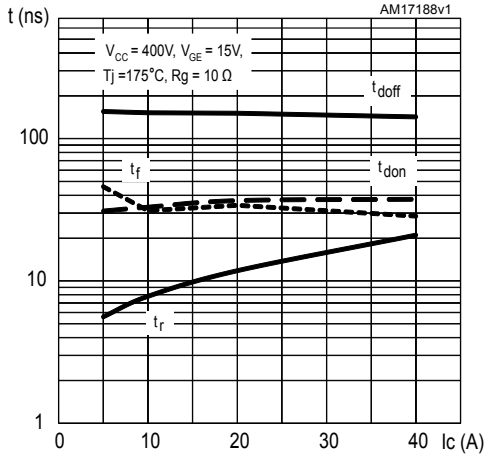


Figure 20. Switching times vs gate resistance

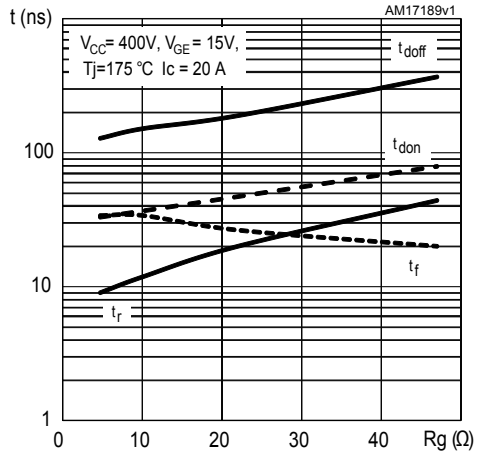


Figure 21. Transfer characteristics

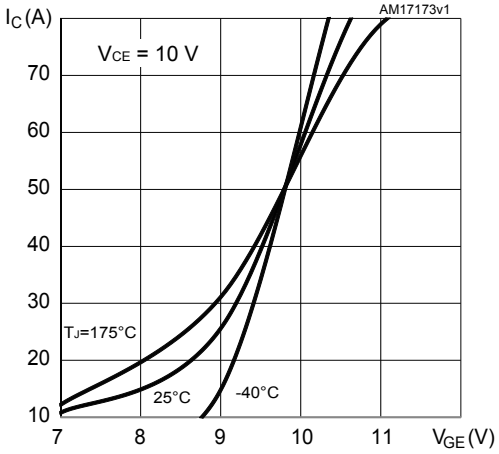


Figure 22. **Thermal impedance for TO-3PF**

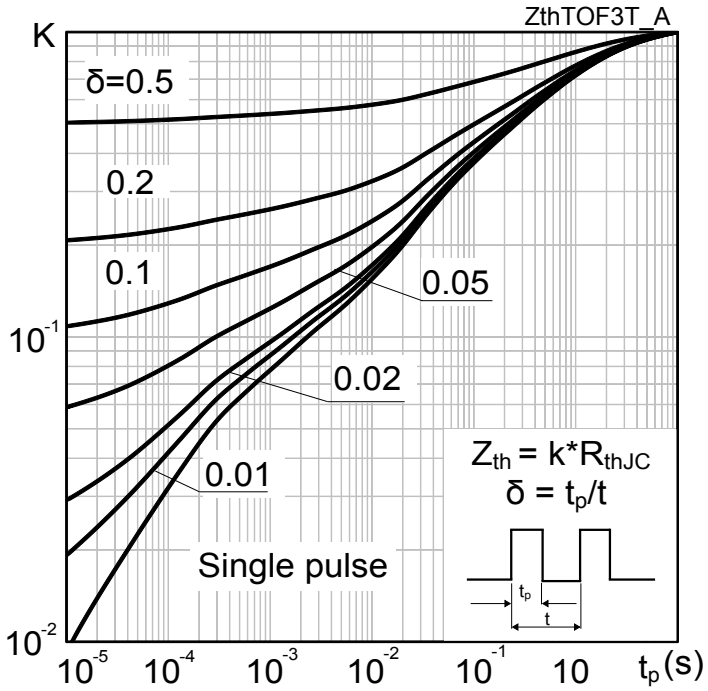
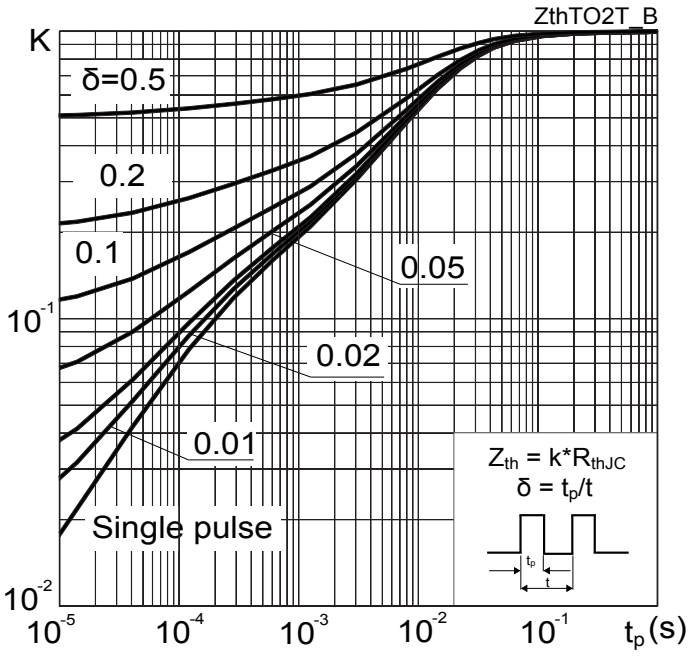


Figure 23. **Thermal data for TO-247**



3 Test circuits

Figure 24. Test circuit for inductive load switching

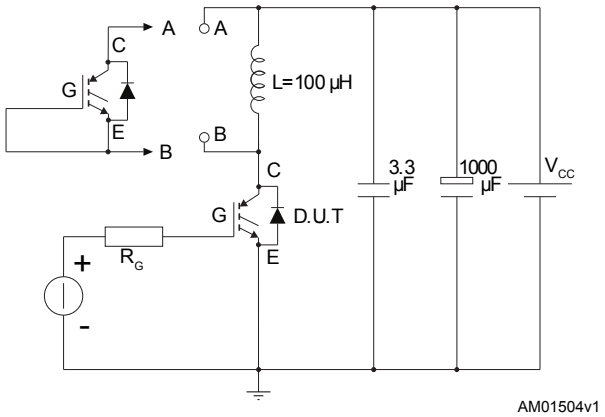


Figure 25. Gate charge test circuit

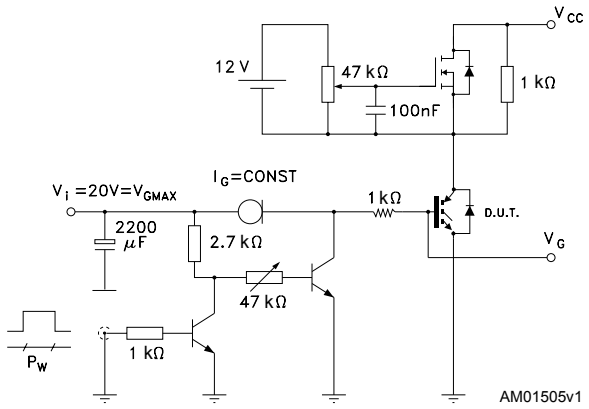
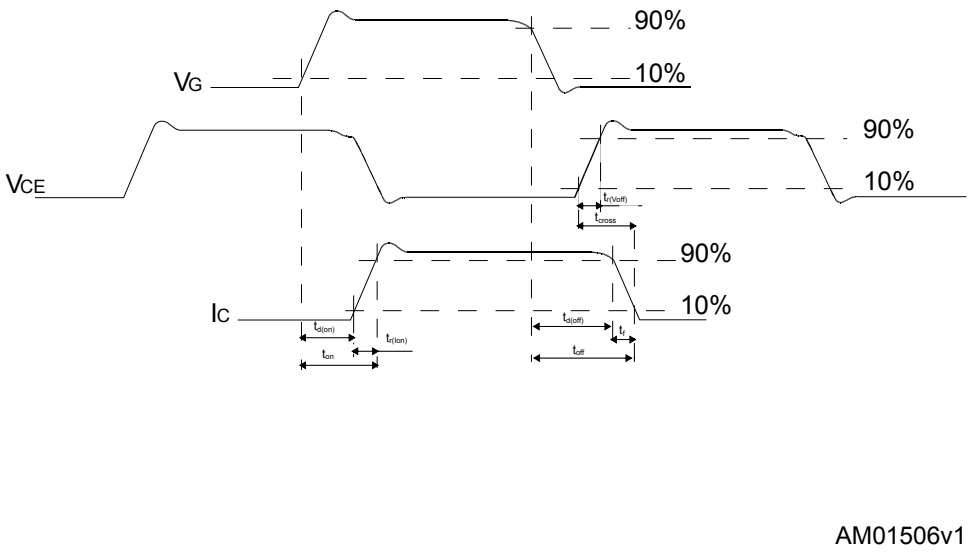


Figure 26. Switching waveform



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 27. TO-3PF package outline

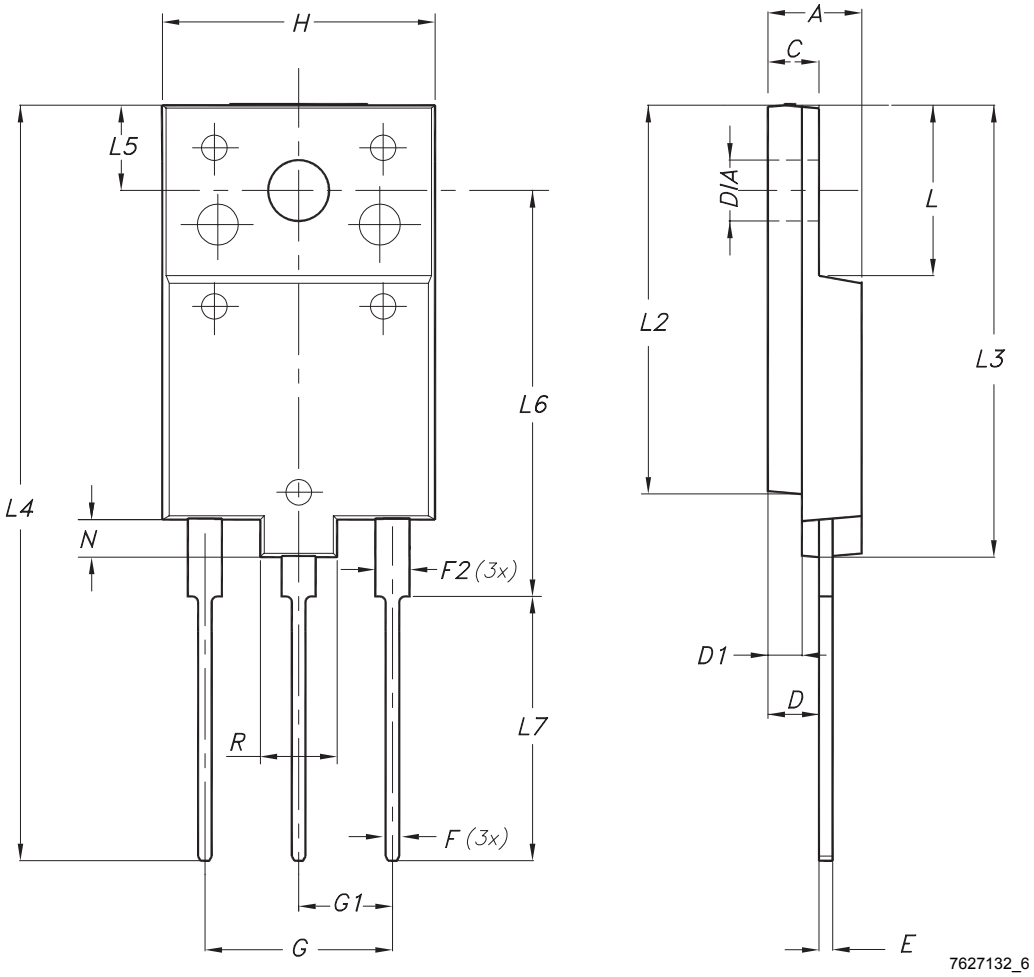
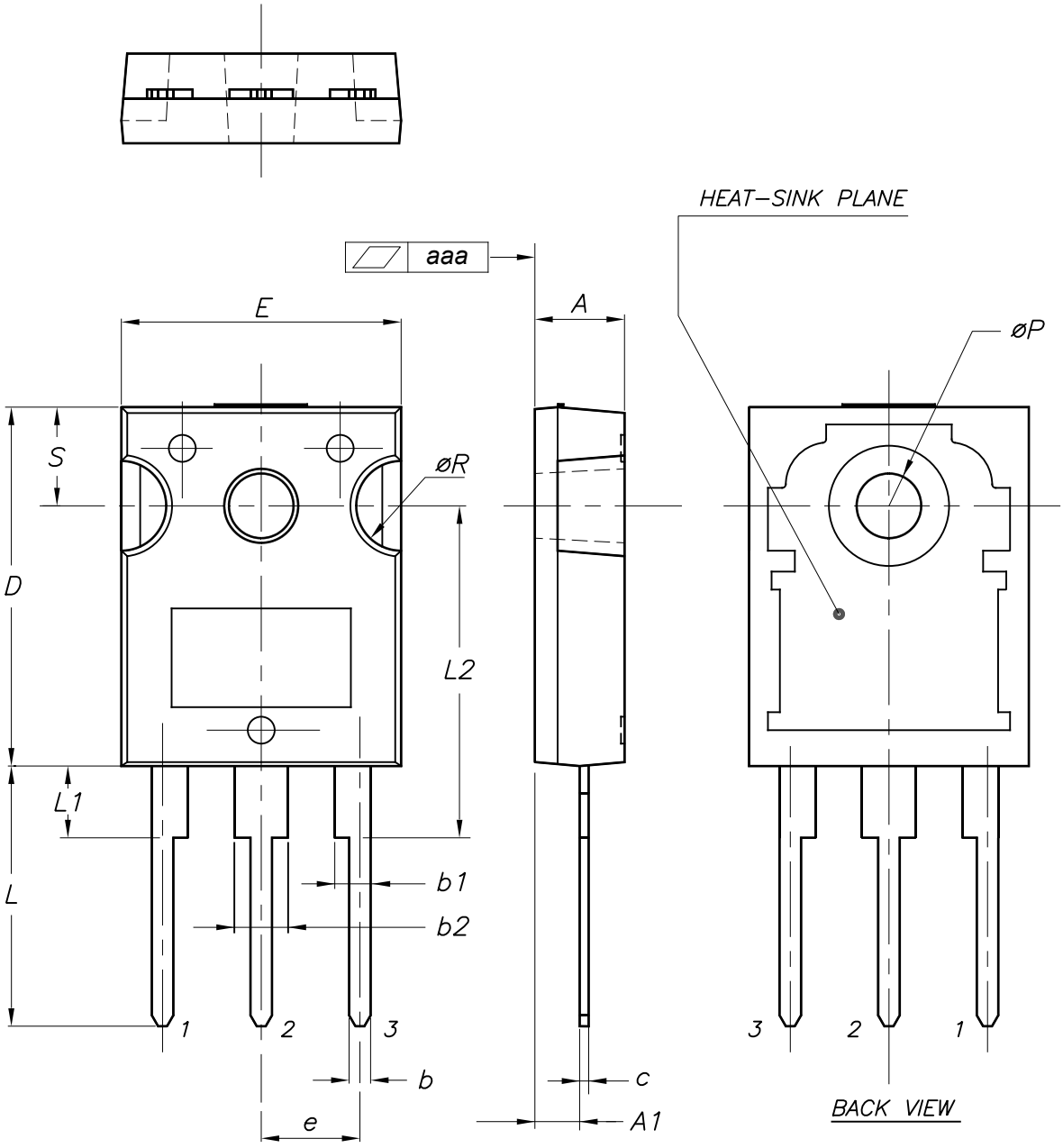


Table 6. **TO-3PF mechanical data**

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 28. **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

Revision history

Table 8. **Document revision history**

Date	Version	Changes
11-Jul-2013	1	Initial release.
23-Mar-2021	2	The part number STGWT20V60F have been removed and the document updated accordingly. Updated title and Features in cover page. Updated Section 1 Electrical ratings. Updated Figure 1. Power dissipation vs case temperature for TO-3PF, Figure 2. Collector current vs case temperature for TO-3PF and Figure 9. Safe operating area for TO-3PF. Updated Section 4.2 TO-247 package information. Minor text changes.

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