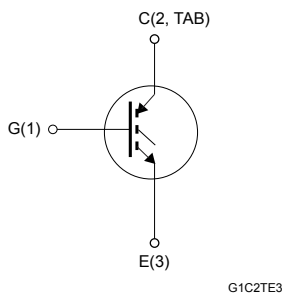
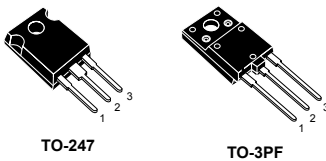


## Trench gate field-stop IGBT, V series 600 V, 20 A very high speed



### Features

- Maximum junction temperature:  $T_J = 175\text{ °C}$
- Tail-less switching off
- $V_{CE(sat)} = 1.8\text{ V (typ.) @ } I_C = 20\text{ A}$
- 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 ( $V_{GE} = 0\text{ V}$ )	600		V
$I_C$	Continuous collector current at $T_C = 25\text{ °C}$	40	40 <sup>(1)</sup>	A
	Continuous collector current at $T_C = 100\text{ °C}$	20	20 <sup>(1)</sup>	
$I_{CP}^{(2)}$	Pulsed collector current	80		A
$V_{GE}$	Gate-emitter voltage	±20		V
$P_{TOT}$	Total power dissipation at $T_C = 25\text{ °C}$	167	86.7	W
$V_{ISO}$	Insulation withstand voltage (RMS) from all three leads to external heat sink ( $t = 1\text{ s}$ , $T_C = 25\text{ °C}$ )		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

$T_J = 25\text{ °C}$  unless otherwise specified.

**Table 3. Static characteristics**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$V_{(BR)CES}$	Collector-emitter breakdown voltage	$V_{GE} = 0\text{ V}, I_C = 2\text{ mA}$	600			V
$V_{CE(sat)}$	Collector-emitter saturation voltage	$V_{GE} = 15\text{ V}, I_C = 20\text{ A}$		1.8	2.2	V
		$V_{GE} = 15\text{ V}, I_C = 20\text{ A}, T_J = 125\text{ °C}$		2.15		
		$V_{GE} = 15\text{ V}, I_C = 20\text{ A}, T_J = 175\text{ °C}$		2.3		
$V_{GE(th)}$	Gate threshold voltage	$V_{CE} = V_{GE}, I_C = 1\text{ mA}$	5	6	7	V
$I_{CES}$	Collector cut-off current	$V_{GE} = 0\text{ V}, V_{CE} = 600\text{ V}$			25	$\mu\text{A}$
$I_{GES}$	Gate-emitter leakage current	$V_{CE} = 0\text{ V}, V_{GE} = \pm 20\text{ V}$			250	$\mu\text{A}$

**Table 4. Dynamic characteristics**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$C_{ies}$	Input capacitance	$V_{CE} = 25\text{ V}, f = 1\text{ MHz}, V_{GE} = 0\text{ V}$	-	2800	-	pF
$C_{oes}$	Output capacitance		-	110	-	pF
$C_{res}$	Reverse transfer capacitance		-	64	-	pF
$Q_g$	Total gate charge	$V_{CC} = 480\text{ V}, I_C = 20\text{ A}, V_{GE} = 0\text{ to }15\text{ V}$ (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)**

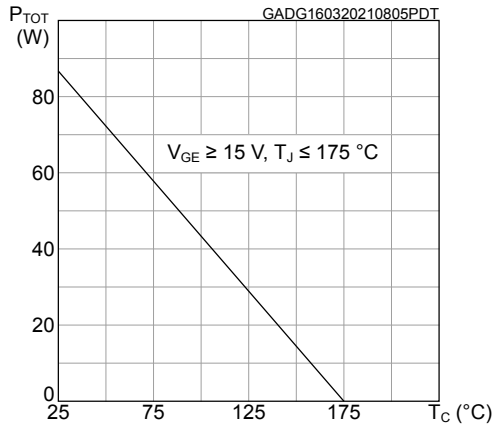
Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$t_{d(on)}$	Turn-on delay time	$V_{CE} = 400\text{ V}$ , $I_C = 20\text{ A}$ , $R_G = 10\ \Omega$ , $V_{GE} = 15\text{ V}$ (see Figure 24. Test circuit for inductive load switching)	-	38	-	ns
$t_r$	Current rise time		-	10	-	ns
$(di/dt)_{on}$	Turn-on current slope		-	1556	-	A/ $\mu$ s
$t_{d(off)}$	Turn-off-delay time		-	149	-	ns
$t_f$	Current fall time		-	15	-	ns
$E_{on}^{(1)}$	Turn-on switching energy		-	200	-	$\mu$ J
$E_{off}^{(2)}$	Turn-off switching energy		-	130	-	$\mu$ J
$E_{ts}$	Total switching energy		-	330	-	$\mu$ J
$t_{d(on)}$	Turn-on delay time		$V_{CE} = 400\text{ V}$ , $I_C = 20\text{ A}$ , $R_G = 10\ \Omega$ , $V_{GE} = 15\text{ V}$ , $T_J = 175\text{ }^\circ\text{C}$ (see Figure 24. Test circuit for inductive load switching)	-	37	-
$t_r$	Current rise time	-		12	-	ns
$(di/dt)_{on}$	Turn-on current slope	-		1340	-	A/ $\mu$ s
$t_{d(off)}$	Turn-off-delay time	-		150	-	ns
$t_f$	Current fall time	-		23	-	ns
$E_{on}^{(1)}$	Turn-on switching energy	-		430	-	$\mu$ J
$E_{off}^{(2)}$	Turn-off switching energy	-		210	-	$\mu$ J
$E_{ts}$	Total switching energy	-		640	-	$\mu$ J

1. Including the reverse recovery of the diode. The diode is the same of the copacked STGW20V60DF.

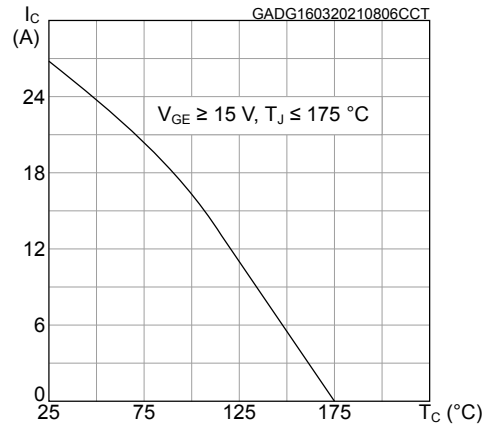
2. Including the tail of the collector current.

## 2.1 Electrical characteristics (curves)

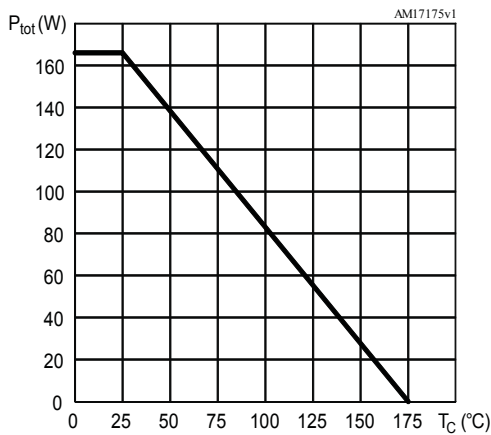
**Figure 1. Power dissipation vs case temperature for TO-3PF**



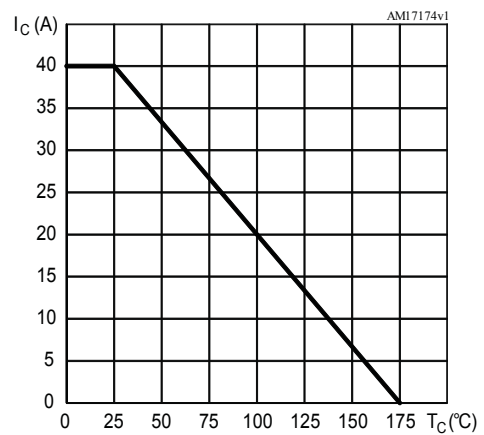
**Figure 2. Collector current vs case temperature for TO-3PF**



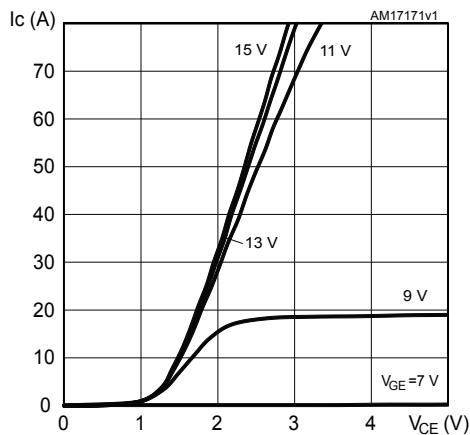
**Figure 3. Power dissipation vs case temperature for TO-247**



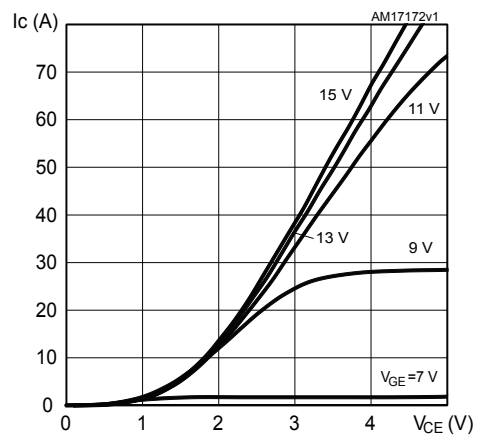
**Figure 4. Collector current vs case temperature for TO-247**

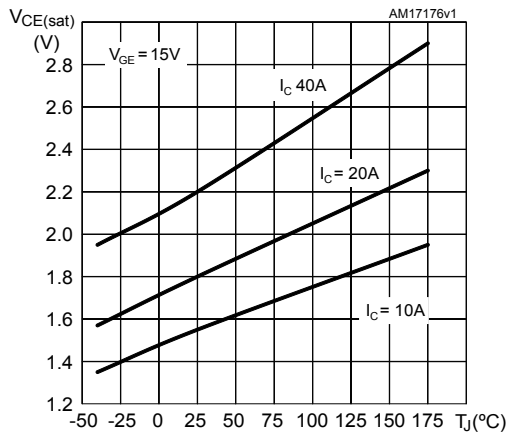
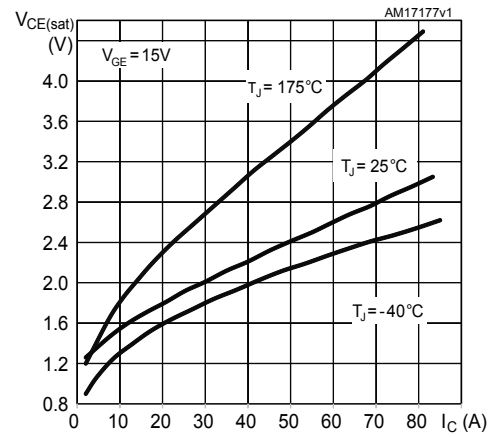
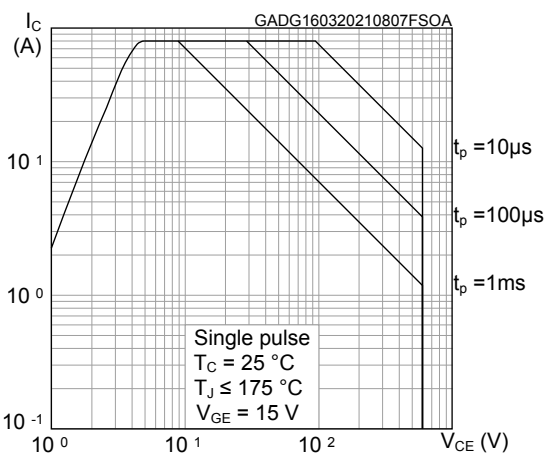
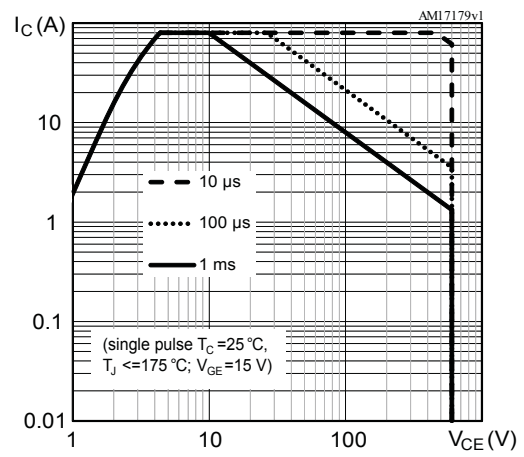
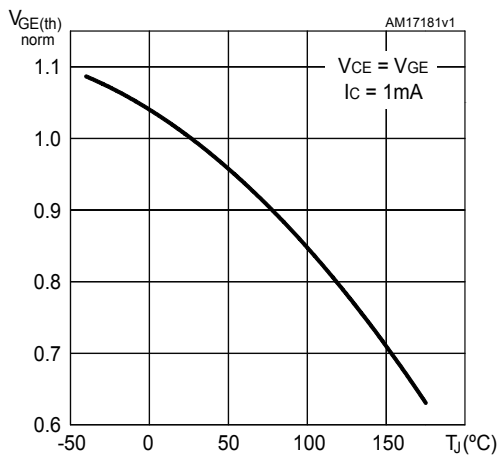
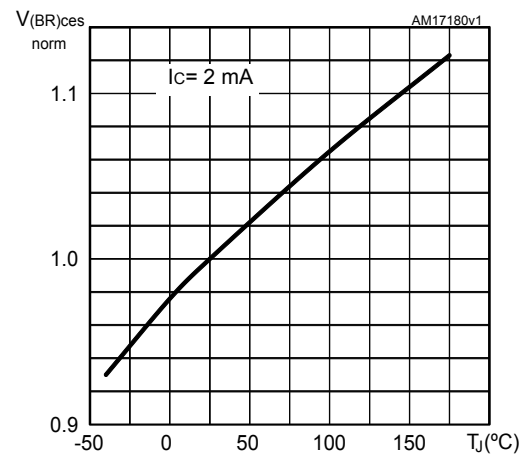


**Figure 5. Output characteristics ( $T_J = 25$  °C)**



**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**


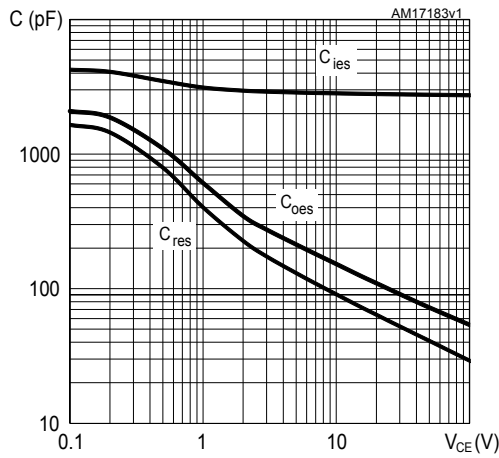
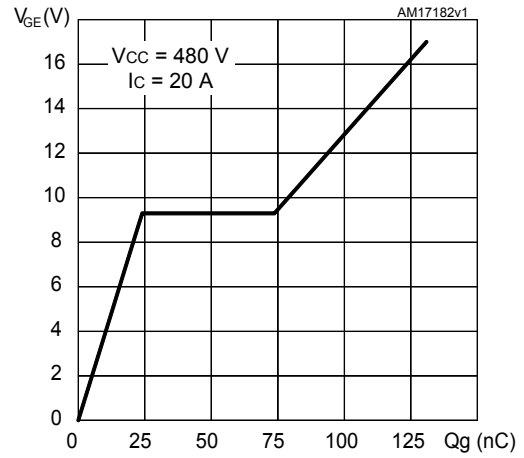
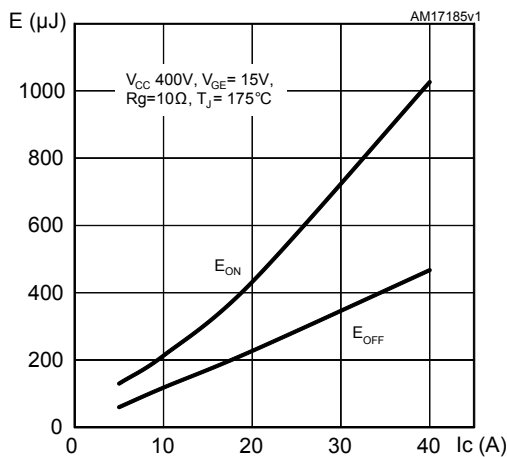
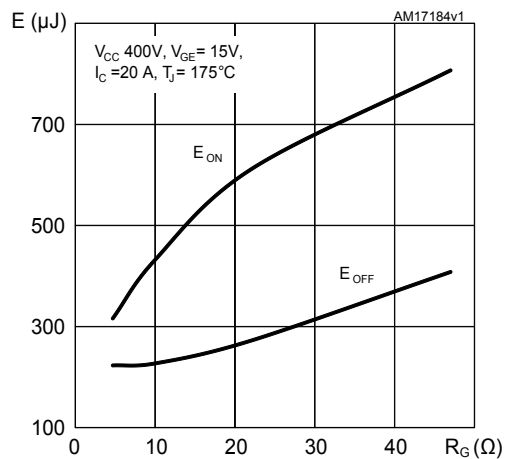
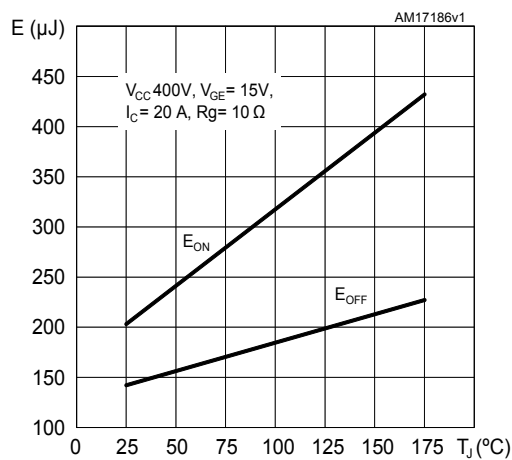
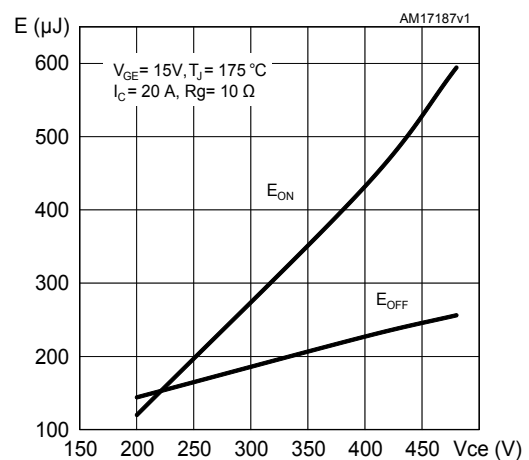
**Figure 13. Capacitance variations**

**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

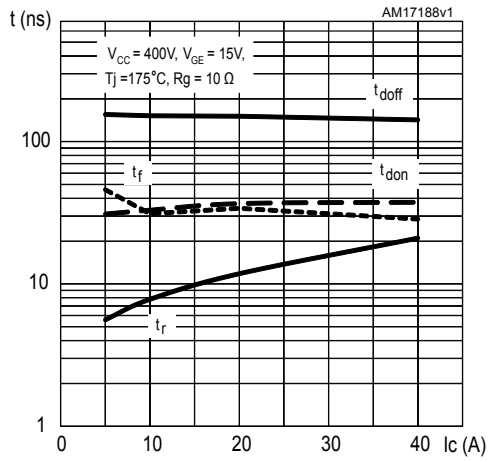


Figure 20. Switching times vs gate resistance

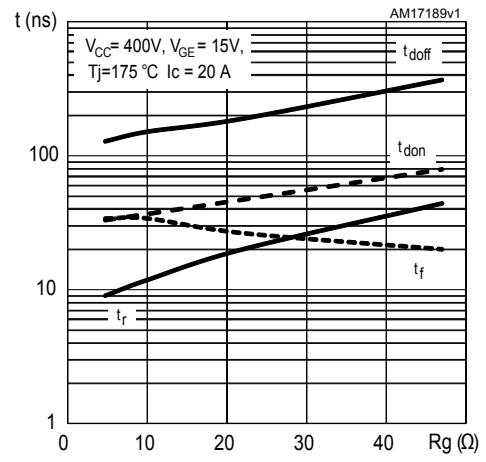
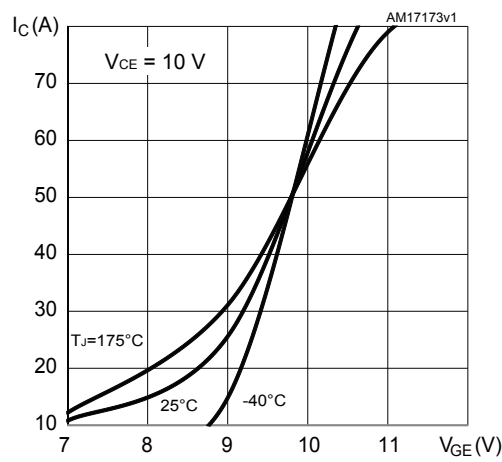
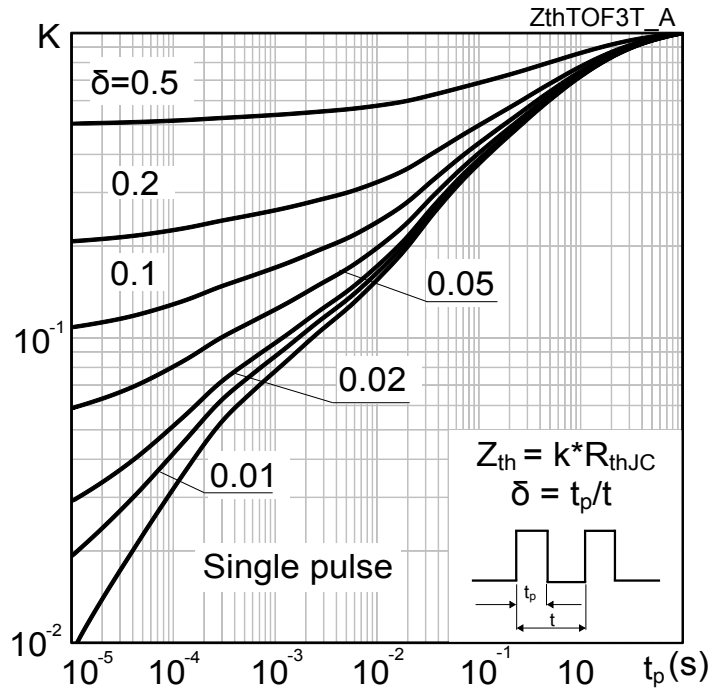
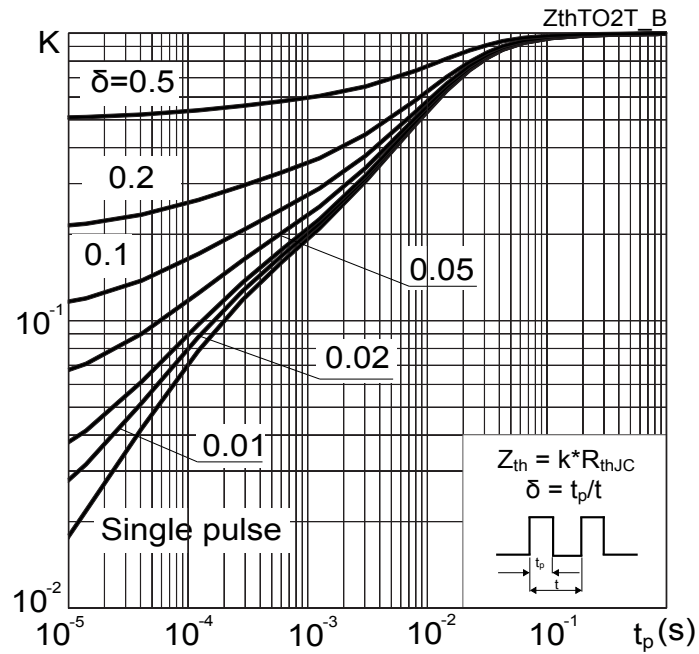


Figure 21. Transfer characteristics





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

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


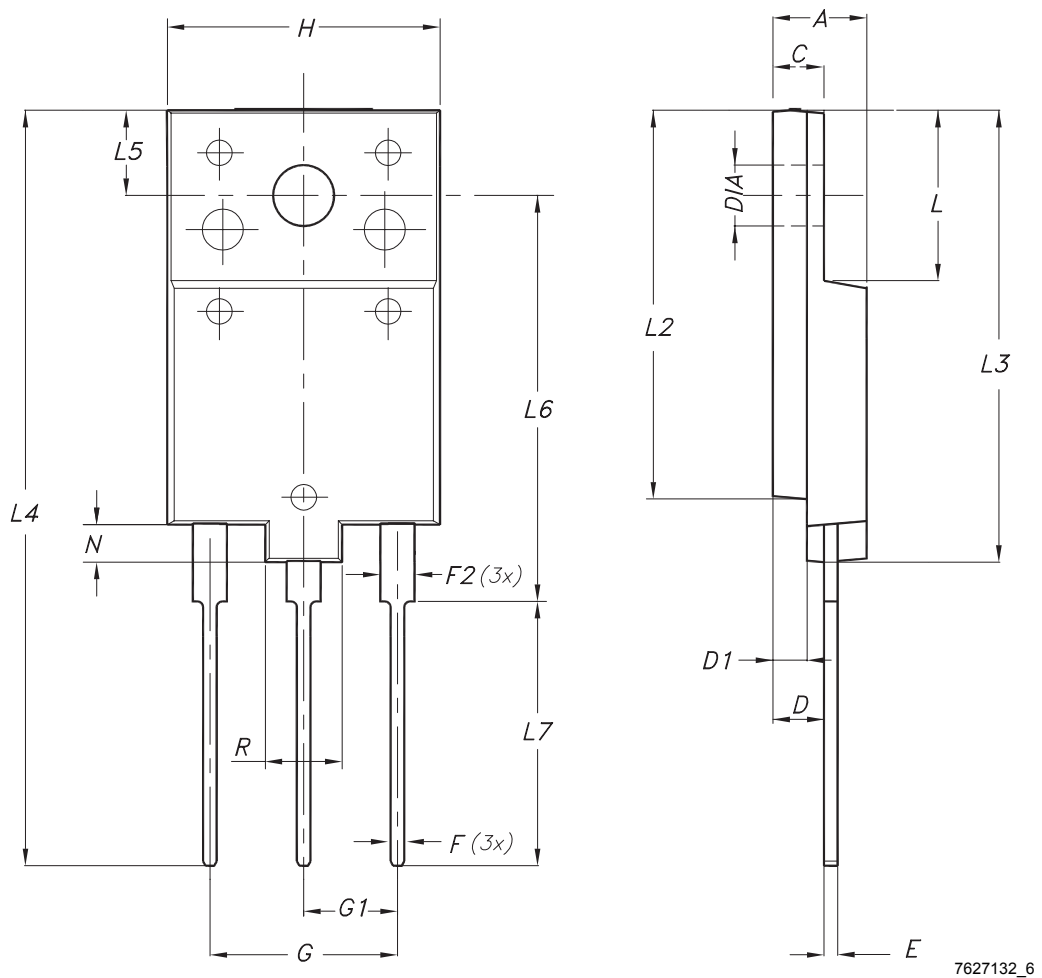


## 4 Package information

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](http://www.st.com). ECOPACK is an ST trademark.

### 4.1 TO-3PF package information

Figure 27. TO-3PF package outline

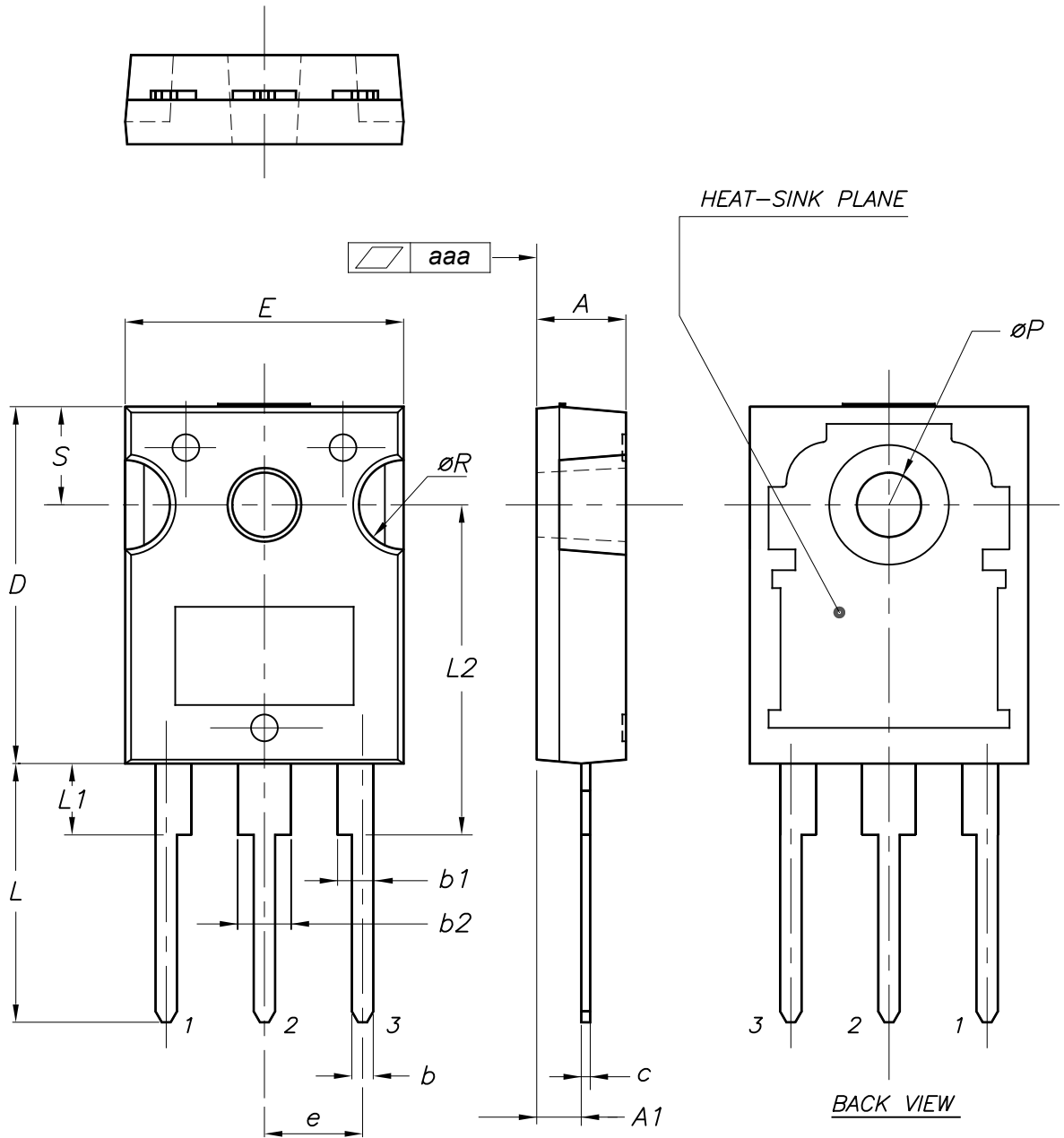


**Table 6. TO-3PF mechanical data**

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	<p>The part number STGWT20V60F have been removed and the document updated accordingly.</p> <p>Updated title and <a href="#">Features</a> in cover page.</p> <p>Updated <a href="#">Section 1</a> Electrical ratings.</p> <p>Updated <a href="#">Figure 1</a>. Power dissipation vs case temperature for TO-3PF, <a href="#">Figure 2</a>. Collector current vs case temperature for TO-3PF and <a href="#">Figure 9</a>. Safe operating area for TO-3PF.</p> <p>Updated <a href="#">Section 4.2</a> TO-247 package information.</p> <p>Minor text changes.</p>

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