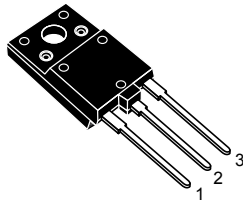
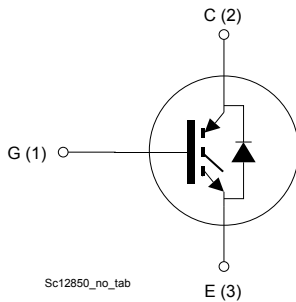


Trench gate field-stop IGBT, V series 600 V, 20 A very high speed



TO-3PF



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
- Very fast soft recovery antiparallel diode

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 link

[STGFW20V60DF](#)

Product summary

Order code	STGFW20V60DF
Marking	G20V60DF
Package	TO-3PF
Packing	Tube

1 Electrical ratings

Table 1. Absolute maximum ratings

Symbol	Parameter	Value	Unit
V_{CES}	Collector-emitter voltage ($V_{GE} = 0\text{ V}$)	600	V
I_C	Continuous collector current at $T_C = 25\text{ °C}$	40	A
	Continuous collector current at $T_C = 100\text{ °C}$	20	A
$I_{CP}^{(1)}$	Pulsed collector current	80	A
V_{GE}	Gate-emitter voltage	± 20	V
I_F	Continuous forward current at $T_C = 25\text{ °C}$	40	A
	Continuous forward current at $T_C = 100\text{ °C}$	20	A
$I_{FP}^{(1)}$	Pulsed forward current	80	A
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
P_{TOT}	Total power dissipation at $T_C = 25\text{ °C}$	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
R_{thJC}	Thermal resistance, junction-to-case IGBT	1.73	°C/W
	Thermal resistance, junction-to-case diode	2.55	
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_F	Forward on-voltage	$I_F = 20\text{ A}$		1.7	2.2	V
		$I_F = 20\text{ A}, T_J = 125\text{ °C}$		1.55		
		$I_F = 20\text{ A}, T_J = 175\text{ °C}$		1.3		
$V_{GE(th)}$	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	μA
I_{GES}	Gate-emitter leakage current	$V_{CE} = 0\text{ V}, V_{GE} = \pm 20\text{ V}$			250	μA

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 28. 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 27. 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	$V_{CE} = 400\text{ V}$, $I_C = 20\text{ A}$, $R_G = 10\ \Omega$, $V_{GE} = 15\text{ V}$, $T_J = 175\text{ }^\circ\text{C}$ (see Figure 27. 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.
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	$I_F = 20\text{ A}$, $V_R = 400\text{ V}$, $V_{GE} = 15\text{ V}$, $di/dt = 1000\text{ A}/\mu\text{s}$ (see Figure 27. Test circuit for inductive load switching)	-	40		ns
Q_{rr}	Reverse recovery charge		-	320		nC
I_{rrm}	Reverse recovery current		-	16		A
dI_{rr}/dt	Peak rate of fall of reverse recovery current during t_b		-	910		A/ μs
E_{rr}	Reverse recovery energy		-	115		μJ
t_{rr}	Reverse recovery time	$I_F = 20\text{ A}$, $V_R = 400\text{ V}$, $V_{GE} = 15\text{ V}$, $di/dt = 1000\text{ A}/\mu\text{s}$, $T_J = 175\text{ }^\circ\text{C}$ (see Figure 27. Test circuit for inductive load switching)	-	72		ns
Q_{rr}	Reverse recovery charge		-	930		nC
I_{rrm}	Reverse recovery current		-	26		A
dI_{rr}/dt	Peak rate of fall of reverse recovery current during t_b		-	530		A/ μs
E_{rr}	Reverse recovery energy		-	307		μJ

2.1 Electrical characteristics (curves)

Figure 1. Power dissipation vs case temperature

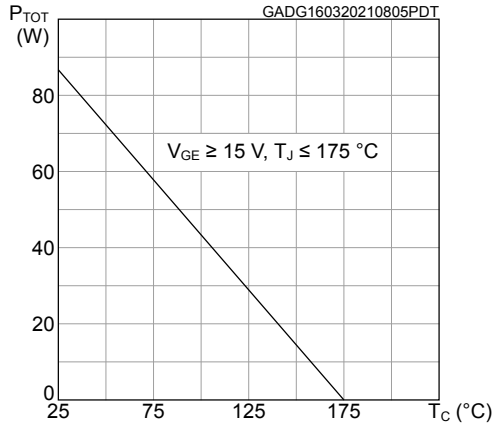


Figure 2. Collector current vs case temperature

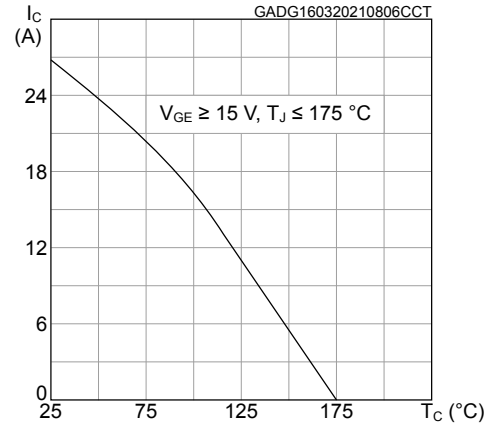


Figure 3. Output characteristics (T_J = 25 °C)

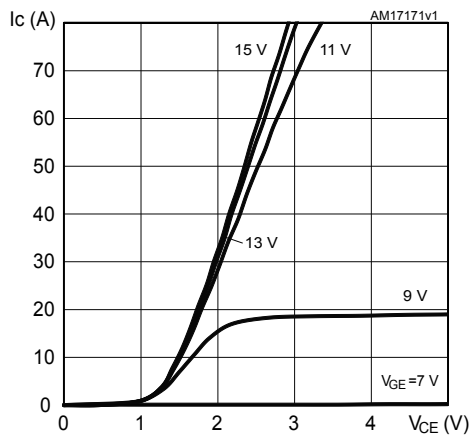


Figure 4. Output characteristics (T_J = 175 °C)

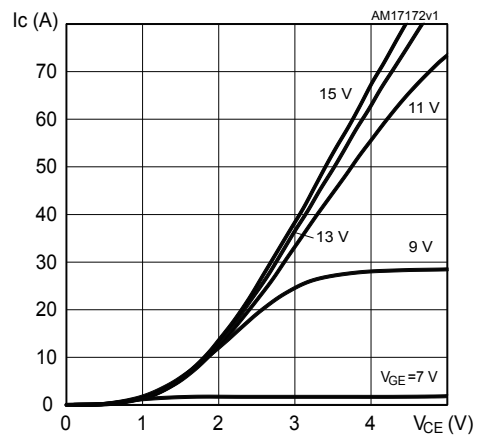


Figure 5. V_{CE(sat)} vs junction temperature

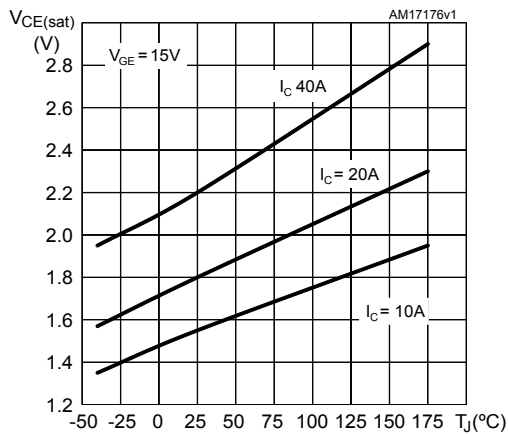


Figure 6. V_{CE(sat)} vs collector current

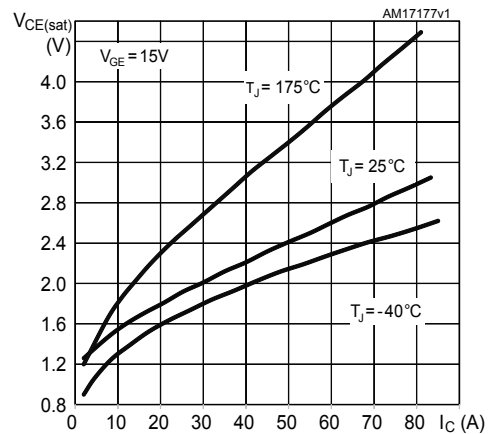


Figure 7. Transfer characteristics

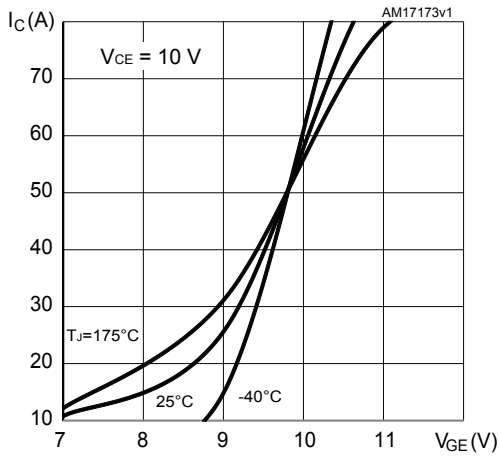


Figure 8. Diode V_F vs forward current

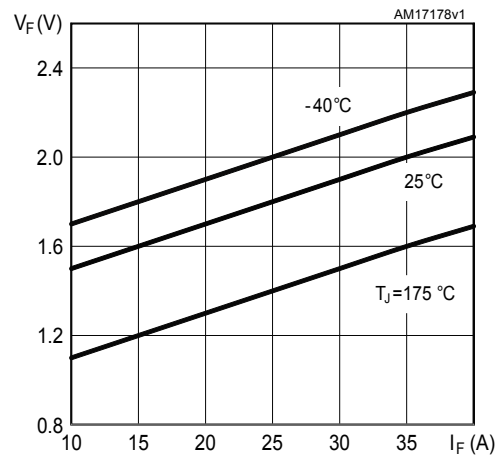


Figure 9. Normalized $V_{GE(th)}$ vs junction temperature

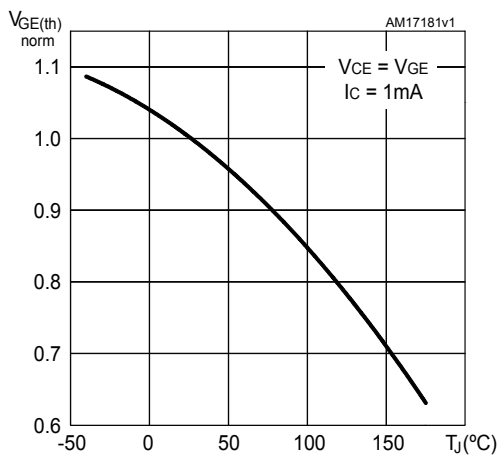


Figure 10. Normalized $V_{(BR)CES}$ vs junction temperature

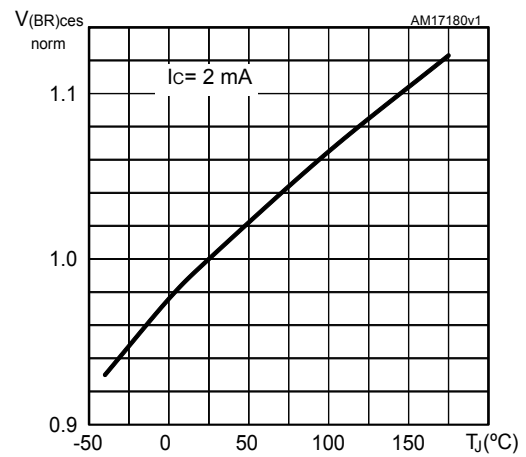


Figure 11. Capacitance variations

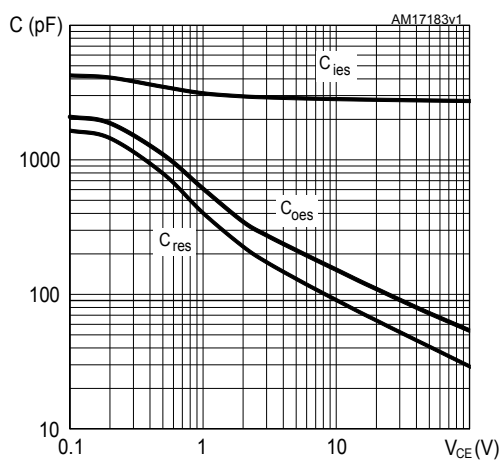


Figure 12. Gate charge vs gate-emitter voltage

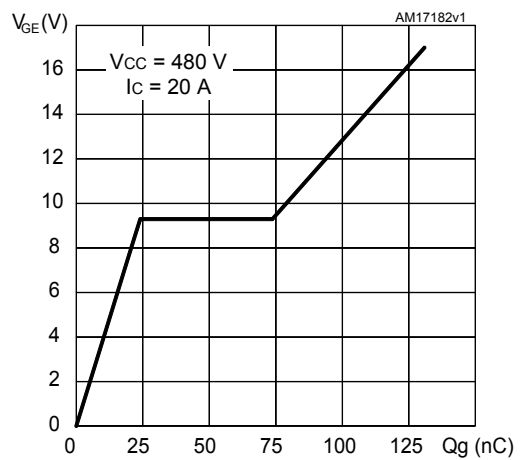


Figure 13. Switching energy vs collector current

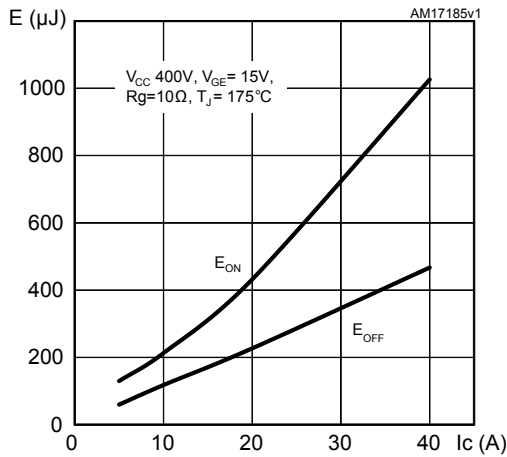


Figure 14. Switching energy vs gate resistance

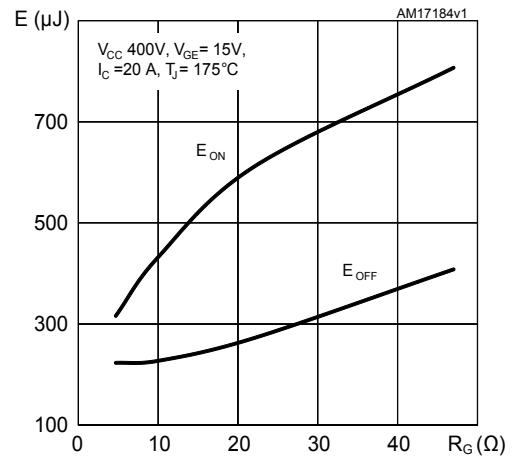


Figure 15. Switching energy vs junction temperature

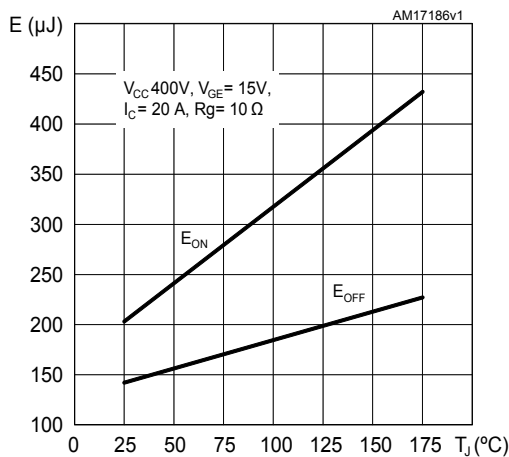


Figure 16. Switching energy vs collector emitter voltage

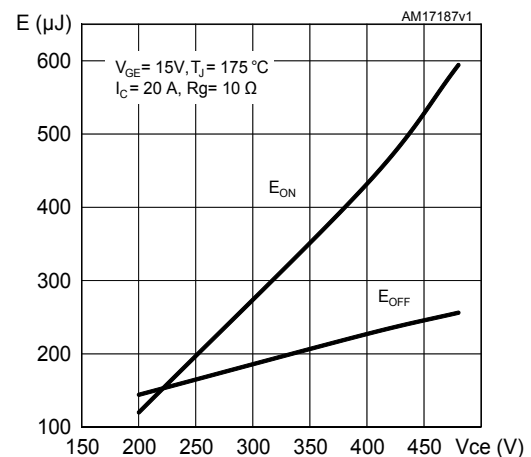


Figure 17. Switching times vs collector current

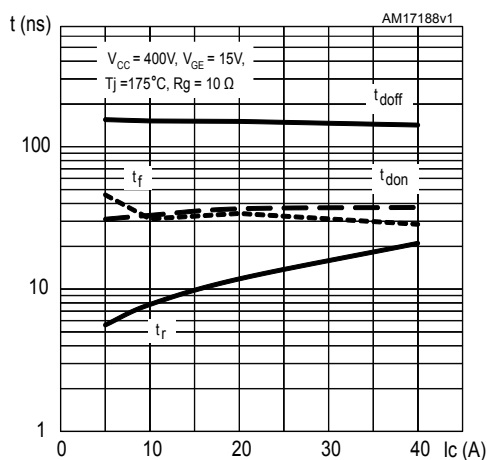


Figure 18. Switching times vs gate resistance

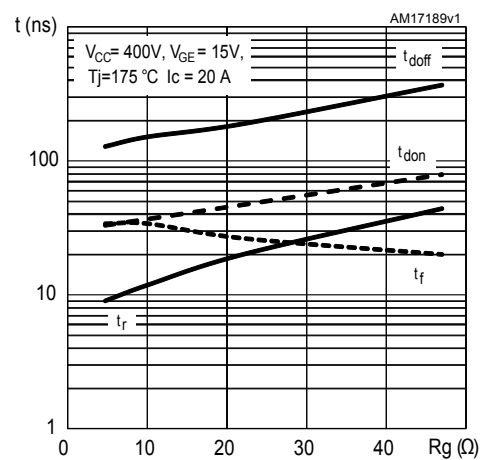


Figure 19. Reverse recovery current vs diode current slope

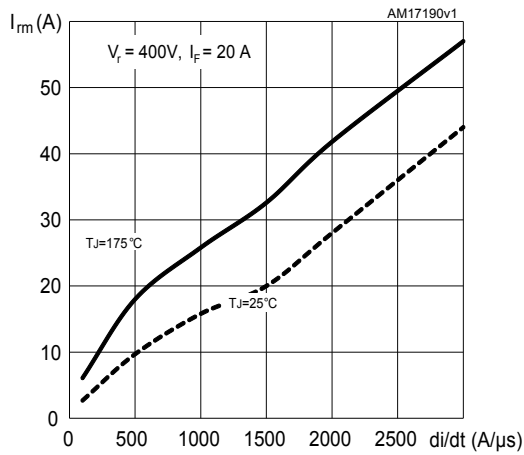


Figure 20. Reverse recovery time vs diode current slope

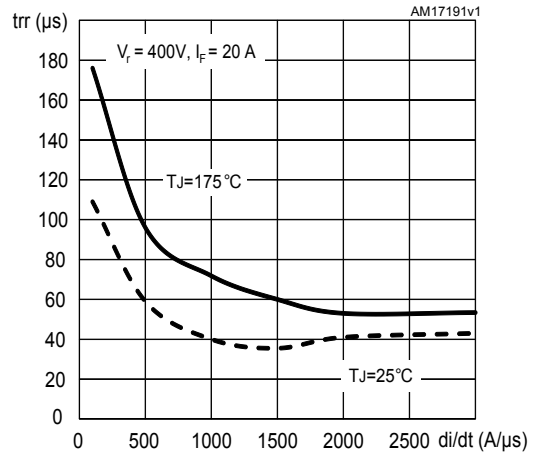


Figure 21. Reverse recovery charge vs diode current slope

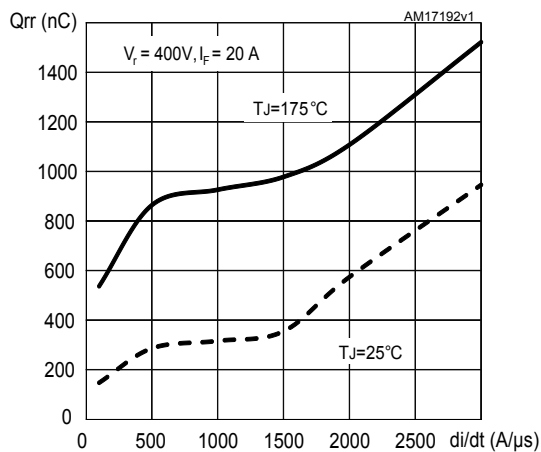


Figure 22. Reverse recovery energy vs diode current slope

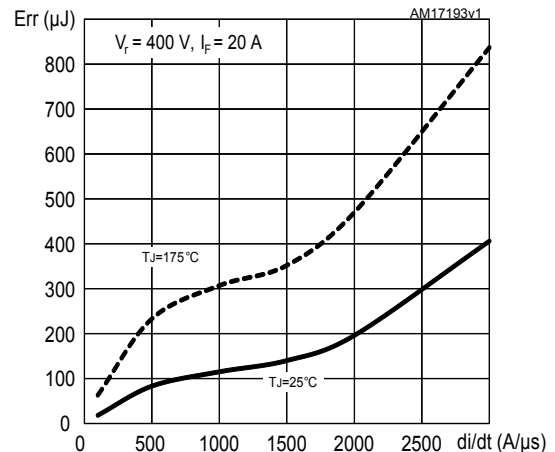


Figure 23. Safe operating area

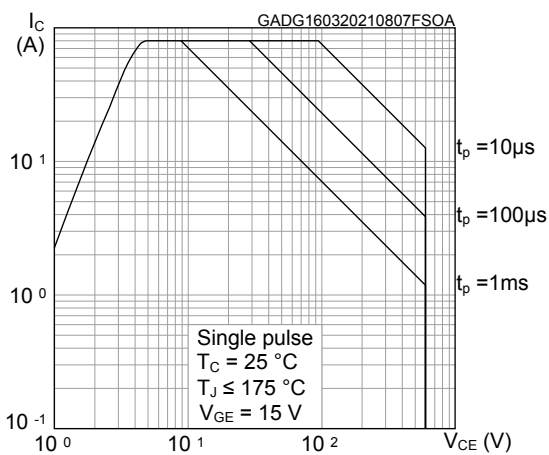


Figure 24. Collector current vs switching frequency

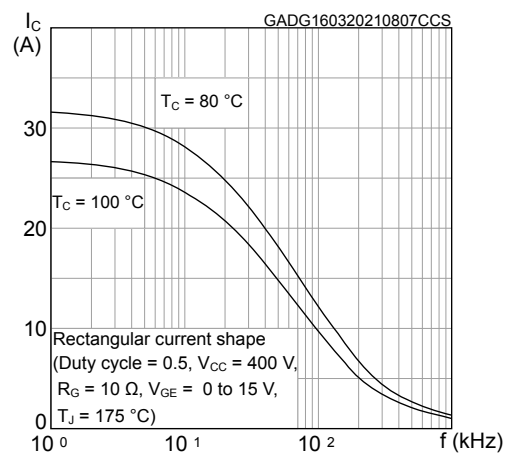


Figure 25. Thermal impedance for IGBT

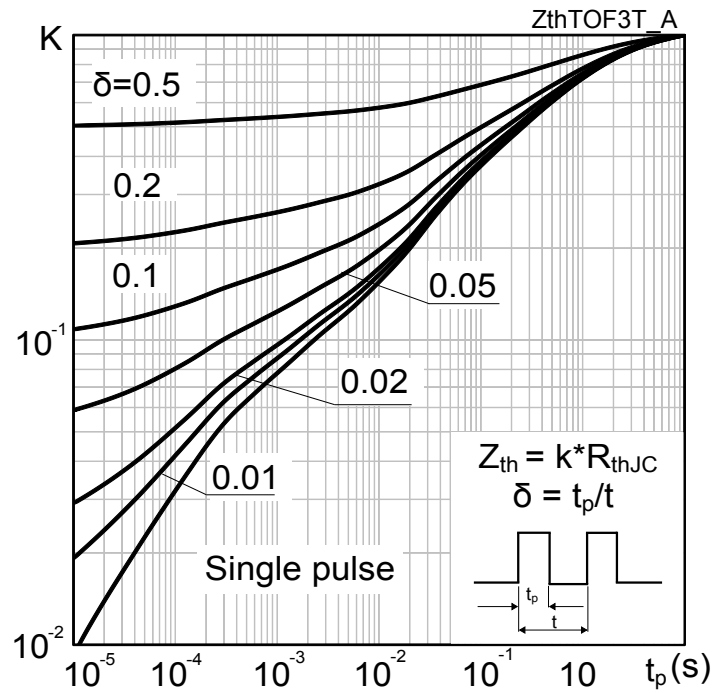
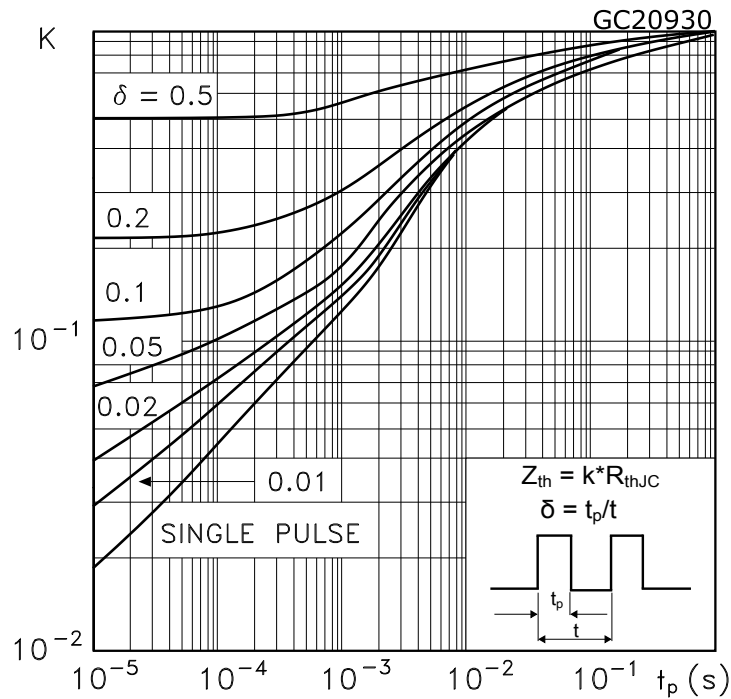


Figure 26. Thermal impedance for diode



3 Test circuits

Figure 27. Test circuit for inductive load switching

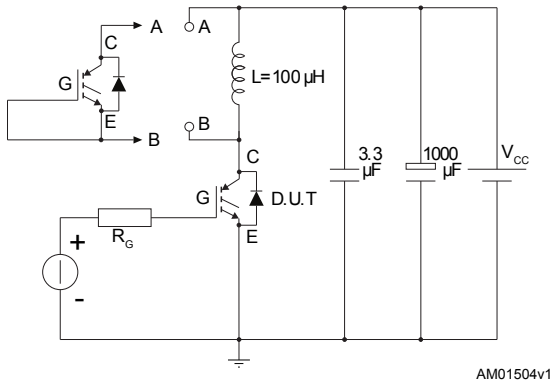


Figure 28. Gate charge test circuit

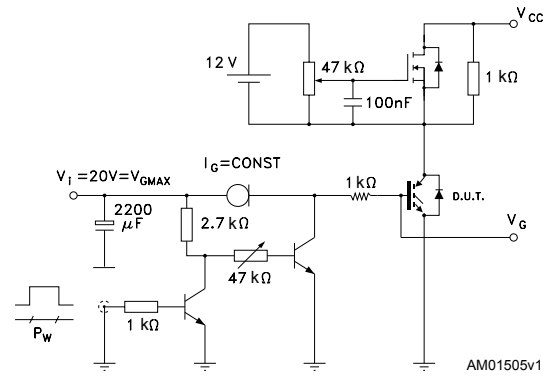


Figure 29. Switching waveform

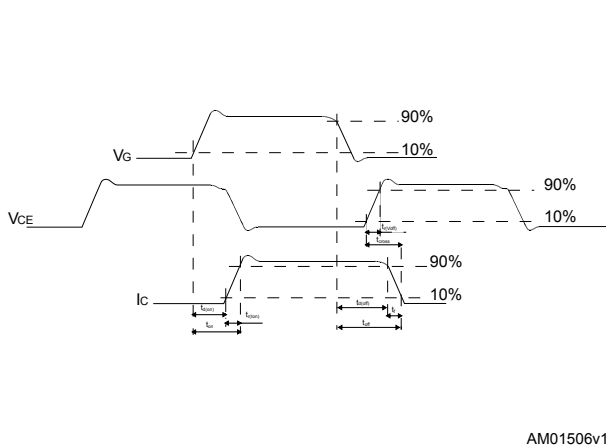
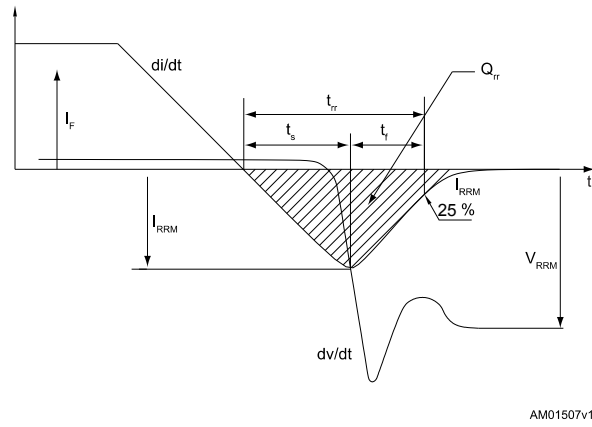


Figure 30. Diode reverse recovery waveform

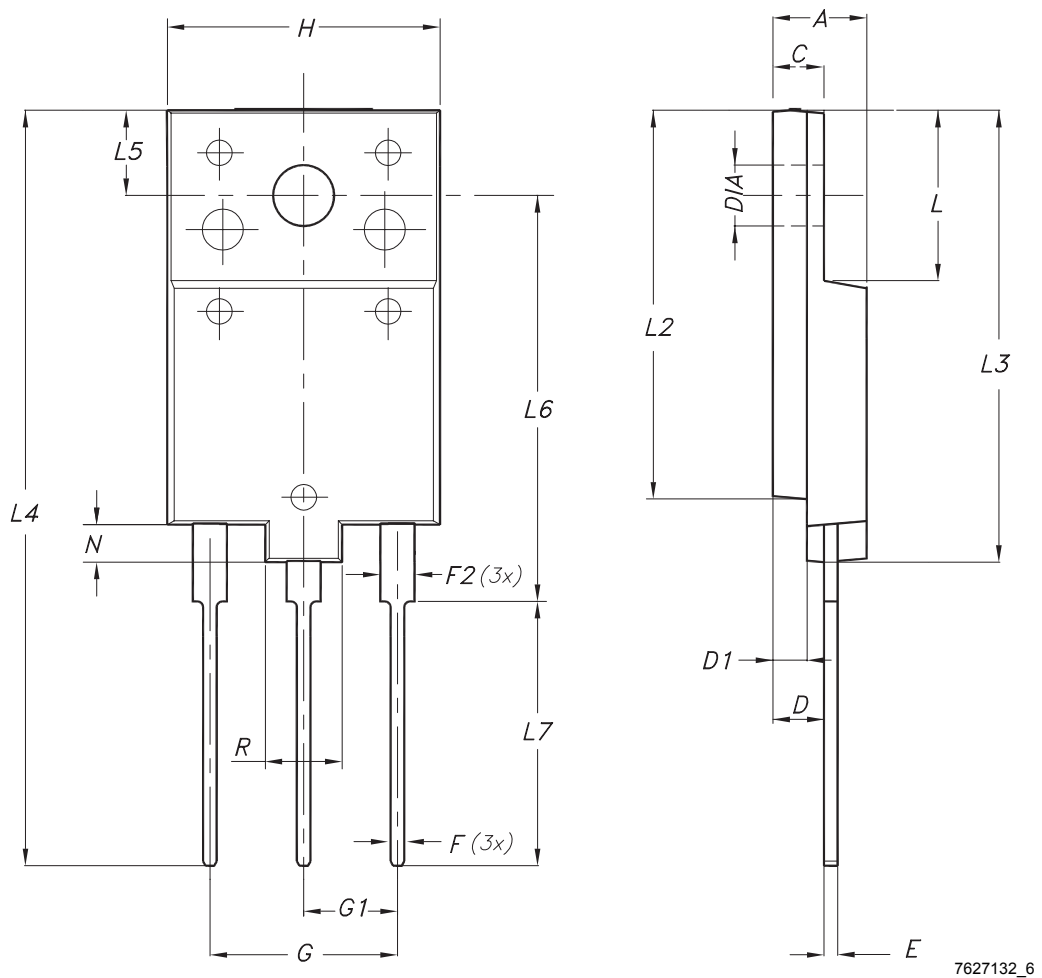


4 Package information

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-3PF package information

Figure 31. TO-3PF package outline



7627132_6

Table 7. 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

Revision history

Table 8. Document revision history

Date	Version	Changes
28-Mar-2014	1	Initial release
14-Feb-2017	2	Updated <i>Table 1: "Device summary"</i> . Minor text changes
19-Mar-2021	3	Updated <i>Features</i> in cover page. Updated <i>Section 1 Electrical ratings</i> . Updated <i>Figure 1. Power dissipation vs case temperature</i> , <i>Figure 2. Collector current vs case temperature</i> , <i>Figure 23. Safe operating area</i> and added <i>Figure 24. Collector current vs switching frequency</i> . Minor text changes.

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