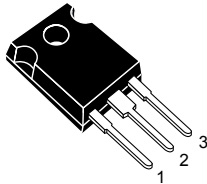
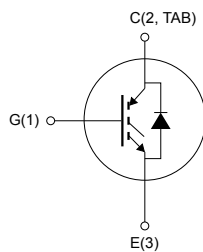


Trench gate field-stop 600 V, 20 A high speed IGBT in a TO-247 package


TO-247


NG1E3C2T



Features

- Maximum junction temperature: $T_J = 175\text{ }^{\circ}\text{C}$
- High speed switching
- Tight parameter distribution
- Safe paralleling
- Low thermal resistance
- Short-circuit rated
- Soft and fast recovery antiparallel diode

Applications

- Industrial motor control
- PFC converters, single phase input
- Uninterruptable power supplies (UPS)

Description

This device is an IGBT developed using an advanced proprietary trench gate field-stop structure. This device is part of the H series of IGBTs, which represents an optimum compromise between conduction and switching losses to maximize the efficiency of high switching frequency converters. Furthermore, a slightly positive $V_{CE(sat)}$ temperature coefficient and very tight parameter distribution result in safer paralleling operation.

Product status link

[STGW20H60DF](#)

Product summary

Order code	STGW20H60DF
Marking	GW20H60DF
Package	TO-247
Packing	Tube

1 Electrical ratings

Table 1. Absolute maximum ratings

Symbol	Parameter	Value	Unit
V_{CES}	Collector-emitter voltage ($V_{GE} = 0$)	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	
$I_{CP}^{(1)}$	Pulsed collector current	80	A
V_{GE}	Gate-emitter voltage	± 20	V
I_F	Continuous forward current $T_C = 25\text{ °C}$	40	A
	Continuous forward current at $T_C = 100\text{ °C}$	20	
I_{FP}	Pulsed forward current	80	A
P_{TOT}	Total power dissipation at $T_C = 25\text{ °C}$	167	W
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 and turn-off within RBSOA.

Table 2. Thermal data

Symbol	Parameter	Value	Unit
R_{thJC}	Thermal resistance, junction-to-case, IGBT	0.9	°C/W
R_{thJC}	Thermal resistance, junction-to-case, diode	2.5	°C/W
R_{thJA}	Thermal resistance, junction-to-ambient	50	°C/W

2 Electrical characteristics

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

Table 3. Static

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	$V_{GE} = 15\text{ V}$, $I_C = 20\text{ A}$	-	1.6	2.0	V
		$V_{GE} = 15\text{ V}$, $I_C = 20\text{ A}$, $T_J = 125\text{ °C}$	-	1.75	-	
		$V_{GE} = 15\text{ V}$, $I_C = 20\text{ A}$, $T_J = 175\text{ °C}$	-	1.8	-	
$V_{GE(th)}$	Gate threshold voltage	$V_{CE} = V_{GE}$, $I_C = 1\text{ mA}$	5	6	7	V
I_{CES}	Collector cut-off current	$V_{CE} = 600\text{ V}$, $V_{GE} = 0\text{ V}$	-	-	25	μA
I_{GES}	Gate-emitter leakage current	$V_{GE} = \pm 20\text{ V}$, $V_{CE} = 0\text{ V}$	-	-	± 250	nA

Table 4. Dynamic

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
C_{ies}	Input capacitance	$V_{CE} = 25\text{ V}$, $f = 1\text{ MHz}$, $V_{GE} = 0\text{ V}$	-	2750	-	pF
C_{oes}	Output capacitance			110		
C_{res}	Reverse transfer capacitance			65		
Q_g	Total gate charge	$V_{CC} = 400\text{ V}$, $I_C = 20\text{ A}$, $V_{GE} = 0\text{ to }15\text{ V}$ (see the Figure 20. Gate charge test circuit)	-	115	-	nC
Q_{ge}	Gate-emitter charge			22		
Q_{gc}	Gate-collector charge			45		

Table 5. Switching characteristics (inductive load)

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$t_{d(on)}$	Turn-on delay time	$V_{CE} = 400\text{ V}$, $I_C = 20\text{ A}$, $R_G = 10\text{ }\Omega$, $V_{GE} = 15\text{ V}$ (see the Figure 19. Test circuit for inductive load switching and Figure 21. Switching waveform)	-	42.5	-	ns
t_r	Current rise time			11.9		
$(di/dt)_{on}$	Turn-on current slope			1345		A/ μs
$t_{r(Voff)}$	Off voltage rise time			20		ns
$t_{d(off)}$	Turn-off delay time			177		
t_f	Current fall time			55		
$t_{d(on)}$	Turn-on delay time	$V_{CE} = 400\text{ V}$, $I_C = 20\text{ A}$, $R_G = 10\text{ }\Omega$, $V_{GE} = 15\text{ V}$, $T_J = 175\text{ °C}$ (see the Figure 19. Test circuit for inductive load switching and Figure 21. Switching waveform)	-	42.5	-	ns
t_r	Current rise time			13.4		
$(di/dt)_{on}$	Turn-on current slope			1180		A/ μs
$t_{r(Voff)}$	Off voltage rise time			26		ns
$t_{d(off)}$	Turn-off delay time			173		
t_f	Current fall time			86		
t_{sc}	Short-circuit withstand time	$V_{CC} \leq 360\text{ V}$, $V_{GE} = 15\text{ V}$, $R_G = 10\text{ }\Omega$	3	5	-	μs

Table 6. Switching energy (inductive load)

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
E _{on} ⁽¹⁾	Turn-on switching energy	V _{CE} = 400 V, I _C = 20 A, R _G = 10 Ω, V _{GE} = 15 V	-	209	-	μJ
E _{off} ⁽²⁾	Turn-off switching energy			261		
E _{ts}	Total switching energy			470		
E _{on} ⁽¹⁾	Turn-on switching energy	V _{CE} = 400 V, I _C = 20 A, R _G = 10 Ω, V _{GE} = 15 V, T _J = 175 °C		480		
E _{off} ⁽²⁾	Turn-off switching energy			416		
E _{ts}	Total switching energy			896		

1. Including the reverse recovery of the diode.

2. Including the tail of the collector current.

Table 7. Collector-emitter diode

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
V_F	Forward on-voltage	$I_F = 20\text{ A}$	-	1.8	2.2	V
		$I_F = 20\text{ A}$, $T_J = 175\text{ }^\circ\text{C}$	-	1.3	-	
t_{rr}	Reverse recovery time	$V_r = 60\text{ V}$; $I_F = 20\text{ A}$; $di_F/dt = 100\text{ A}/\mu\text{s}$	-	90	-	ns
Q_{rr}	Reverse recovery charge		-	110	-	nC
I_{rrm}	Reverse recovery current		-	2.4	-	A
t_{rr}	Reverse recovery time	$V_{CC} = 400\text{ V}$; $I_F = 20\text{ A}$; $di_F/dt = 100\text{ A}/\mu\text{s}$, $T_J = 175\text{ }^\circ\text{C}$	-	180	-	ns
Q_{rr}	Reverse recovery charge		-	466	-	nC
I_{rrm}	Reverse recovery current		-	5.2	-	A

2.1 Electrical characteristics (curves)

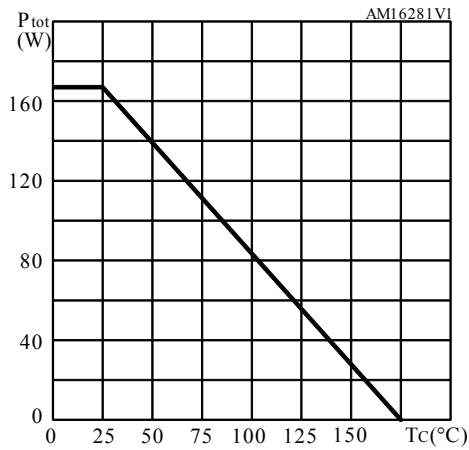
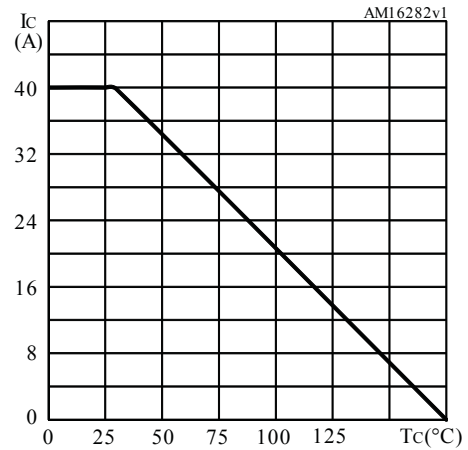
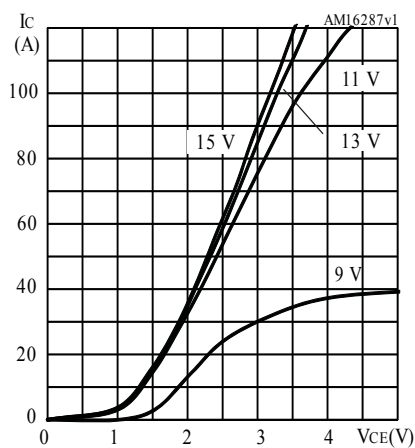
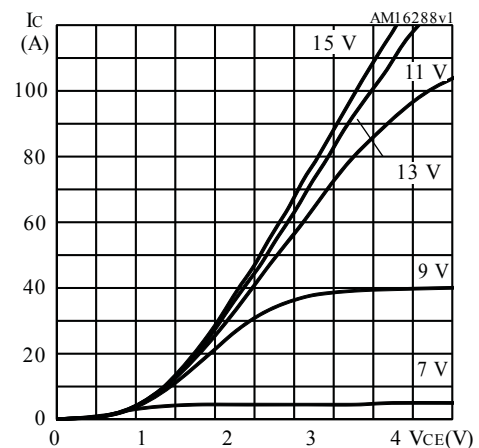
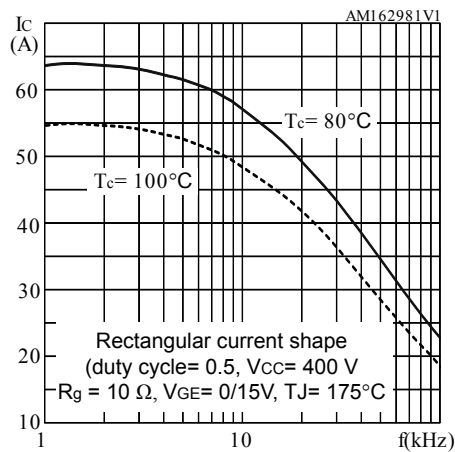
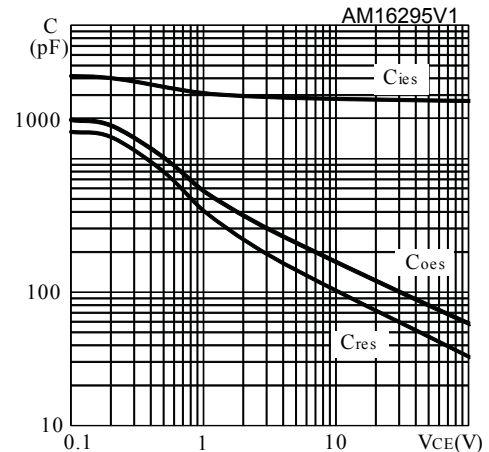
Figure 1. Total power dissipation vs temperature

Figure 2. Collector current vs case temperature

Figure 3. Output characteristics ($T_J = 25^\circ\text{C}$)

Figure 4. Output characteristics ($T_J = 175^\circ\text{C}$)

Figure 5. Collector current vs. switching frequency

Figure 6. Capacitance variation


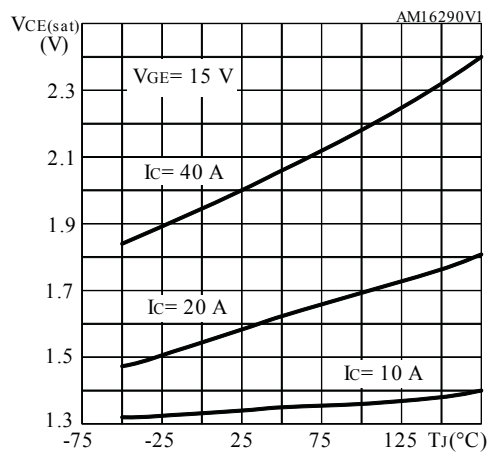
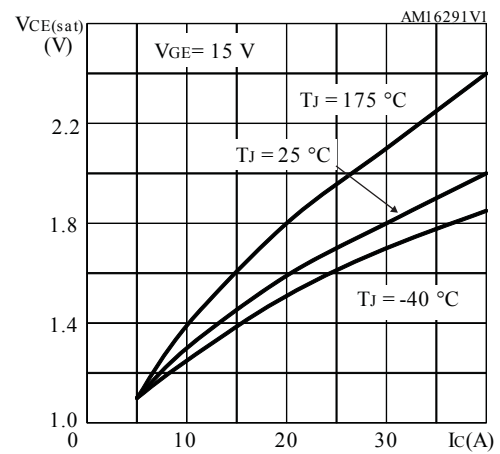
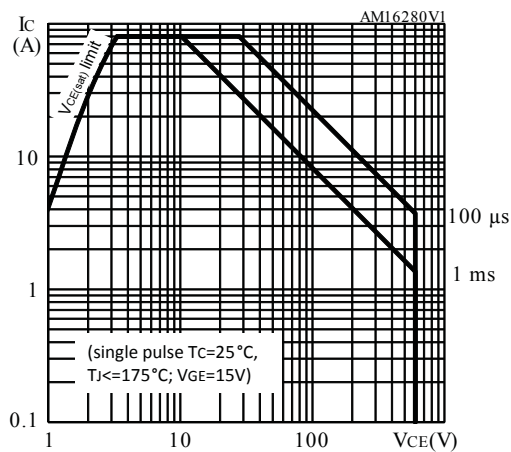
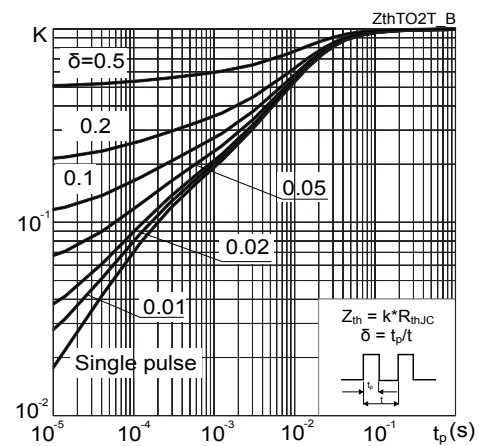
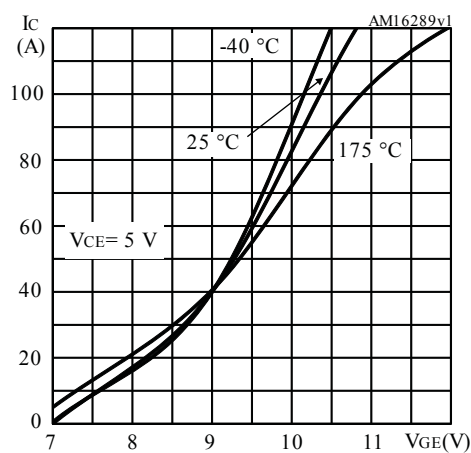
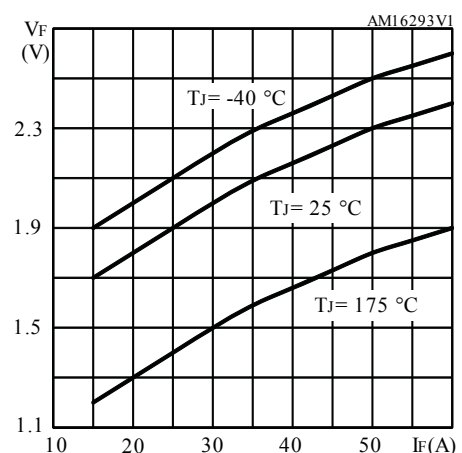
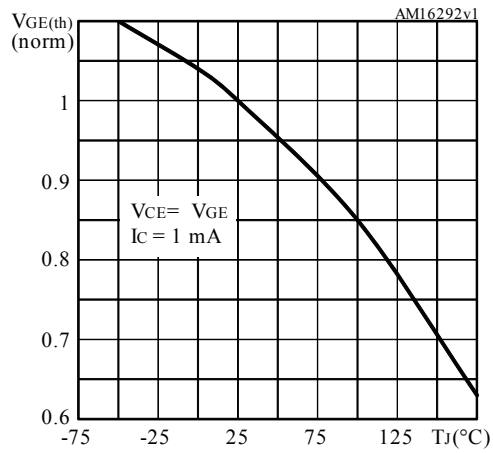
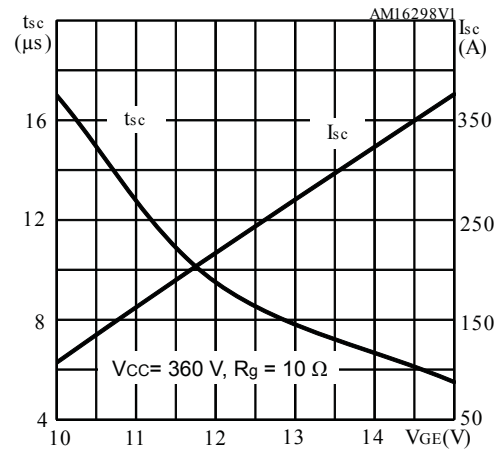
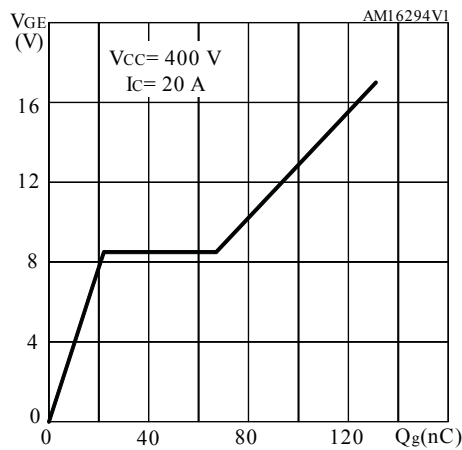
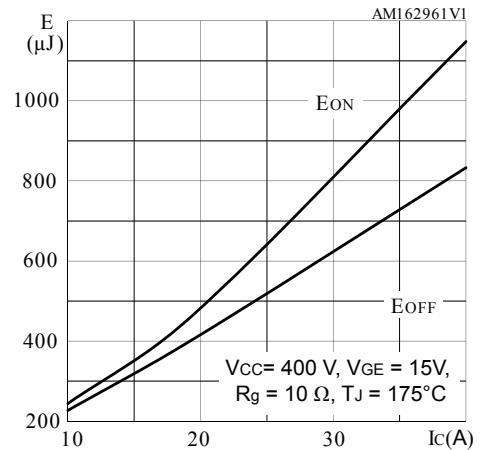
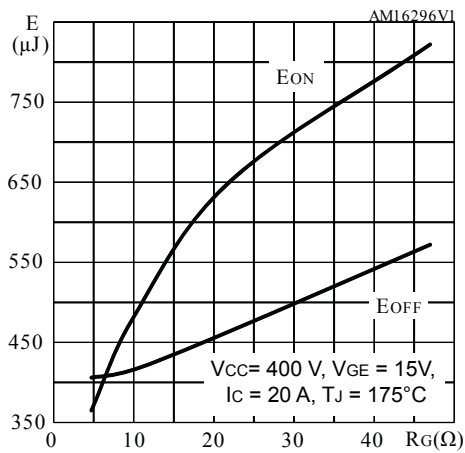
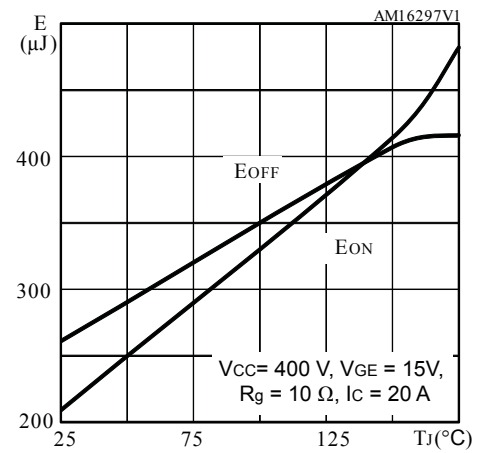
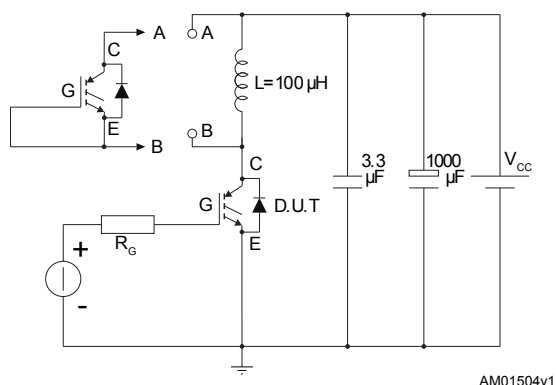
Figure 7. $V_{CE(sat)}$ vs junction temperature

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

Figure 9. Forward bias safe operating area

Figure 10. Thermal impedance for IGBT

Figure 11. Transfer characteristics

Figure 12. Diode V_F vs forward current


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

Figure 14. Short-circuit time and current vs V_{GE}

Figure 15. Gate charge vs. gate-emitter voltage

Figure 16. Switching energy vs collector current

Figure 17. Switching energy vs gate resistance

Figure 18. Switching energy vs temperature


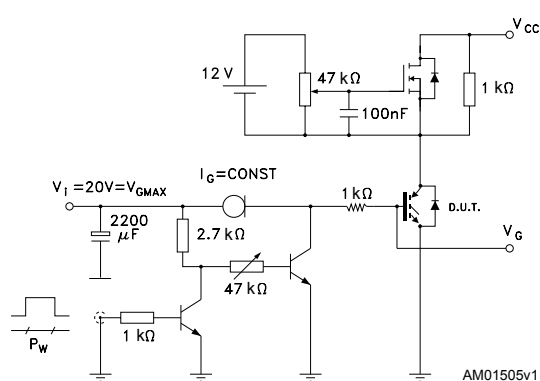
3 Test circuits

Figure 19. Test circuit for inductive load switching



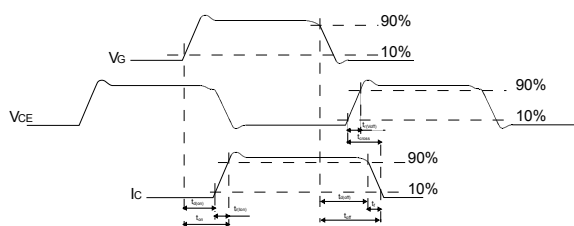
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Figure 20. Gate charge test circuit



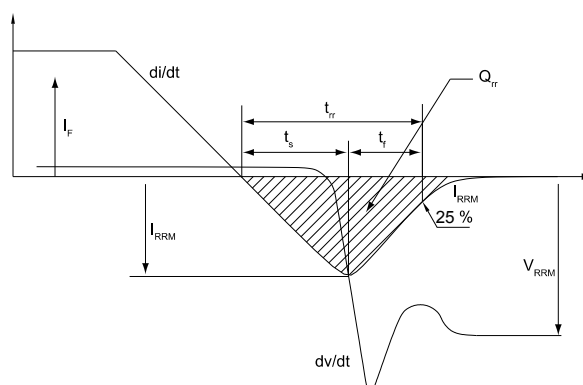
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Figure 21. Switching waveform



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Figure 22. Diode reverse recovery waveform



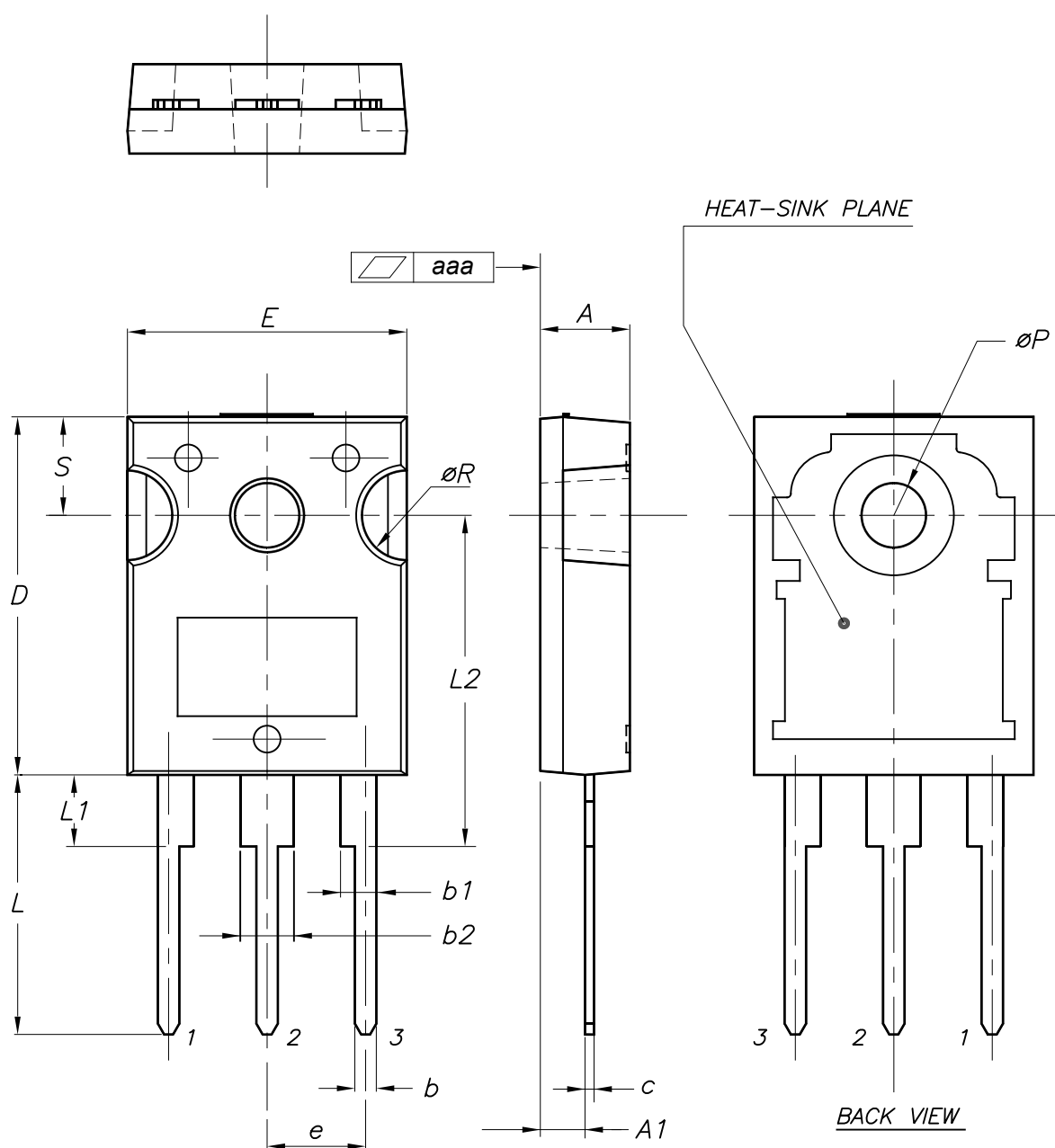
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4 Package information

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-247 package information

Figure 23. TO-247 package outline



0075325_10

Table 8. 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 9. Document revision history

Date	Version	Changes
06-Jun-2013	1	First release.
25-Jun-2024	2	Removed part number STGWT20H60DF. Updated Section 4: Package information .

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