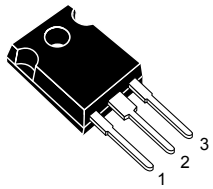
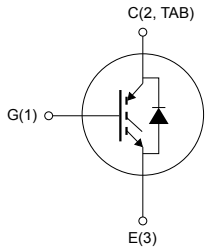
STGW20H60DF

Datasheet

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 °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 °C	40	A
	Continuous collector current at T_C = 100 °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 °C	40	A
	Continuous forward current at T_C = 100 °C	20	
I_{FP}	Pulsed forward current	80	A
P_{TOT}	Total power dissipation at T_C = 25 °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 °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 V, I_C = 2 mA	600	-	-	V
$V_{CE(sat)}$	Collector-emitter saturation voltage	V_{GE} = 15 V, I_C= 20 A	-	1.6	2.0	V
		V_{GE} = 15 V, I_C = 20 A, T_J = 125 °C	-	1.75	-	
		V_{GE} = 15 V, I_C = 20 A, T_J = 175 °C	-	1.8	-	
$V_{GE(th)}$	Gate threshold voltage	V_{CE} = V_{GE}, I_C = 1 mA	5	6	7	V
I_{CES}	Collector cut-off current	V_{CE} = 600 V, V_{GE} = 0 V	-	-	25	µA
I_{GES}	Gate-emitter leakage current	V_{GE} = ±20 V, V_{CE} = 0 V	-	-	±250	nA

Table 4. Dynamic

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
C_{ies}	Input capacitance	V_{CE} = 25 V, f = 1 MHz, V_{GE} = 0 V	-	2750	-	pF
C_{oes}	Output capacitance			110		
C_{res}	Reverse transfer capacitance			65		
Q_g	Total gate charge	V_{CC} = 400 V, I_C = 20 A, V_{GE} = 0 to 15 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 V, I_C = 20 A, R_G = 10 Ω, V_{GE} = 15 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 V, I_C = 20 A, R_G = 10 Ω, V_{GE} = 15 V, T_J = 175 °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} ≤ 360 V, V_{GE} = 15 V, R_G = 10 Ω	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 A	-	1.8	2.2	V
		I_F = 20 A, T_J = 175 °C	-	1.3	-	
t_{rr}	Reverse recovery time	V_r = 60 V; I_F = 20 A; di_F/dt = 100 A/µs	-	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 V; I_F = 20 A; di_F/dt = 100 A/µs, T_J = 175 °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

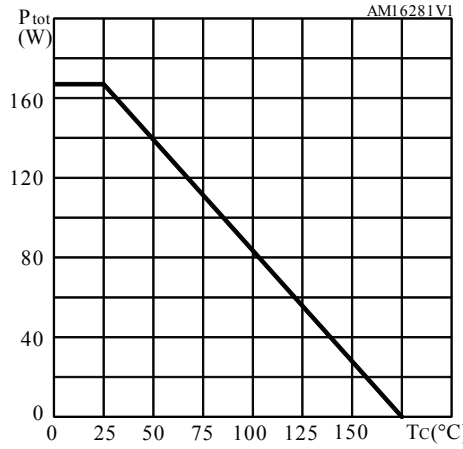


Figure 2. Collector current vs case temperature

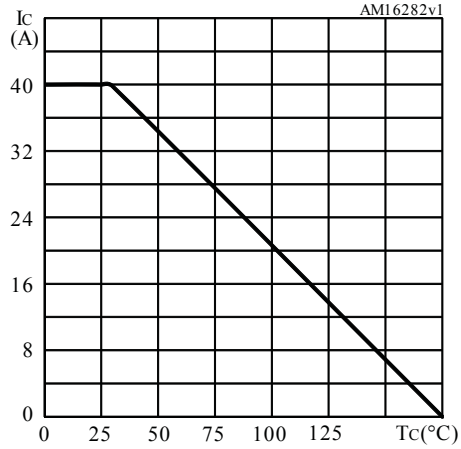


Figure 3. Output characteristics (T_J = 25°C)

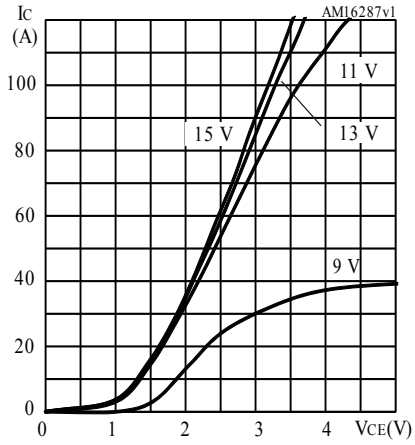


Figure 4. Output characteristics (T_J = 175°C)

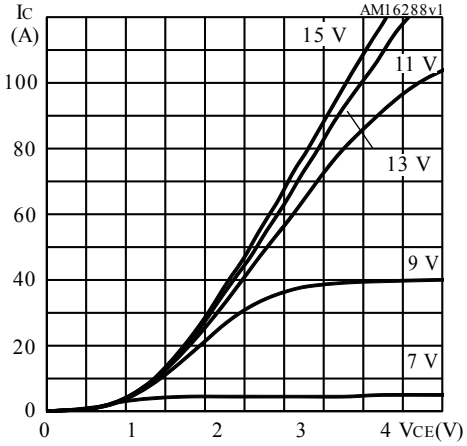


Figure 5. Collector current vs. switching frequency

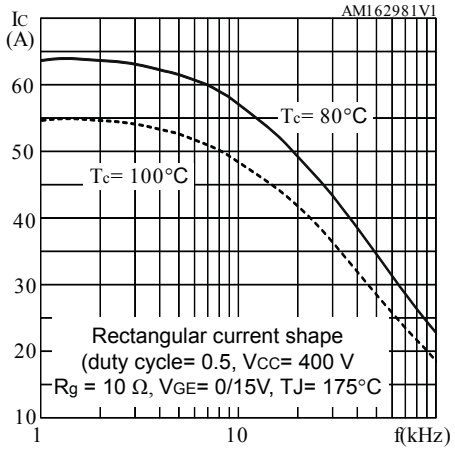


Figure 6. Capacitance variation

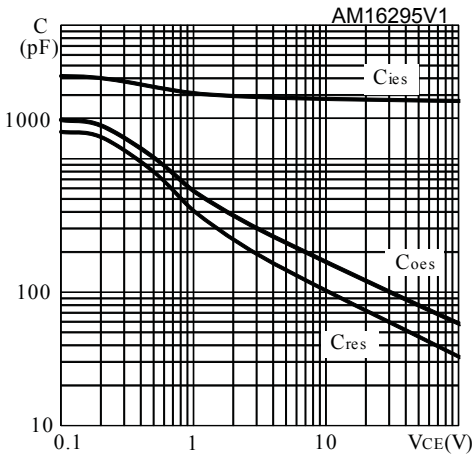


Figure 7. $V_{CE(sat)}$ vs junction temperature

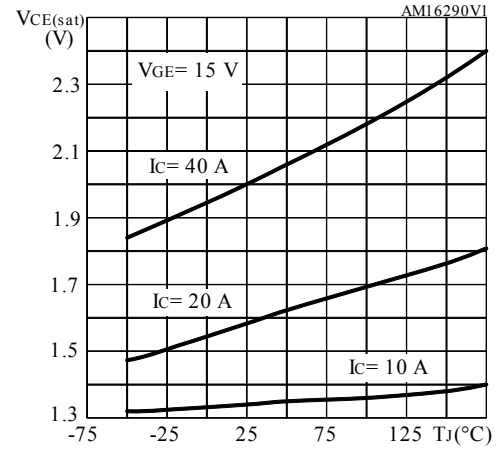


Figure 8. $V_{CE(sat)}$ vs collector current

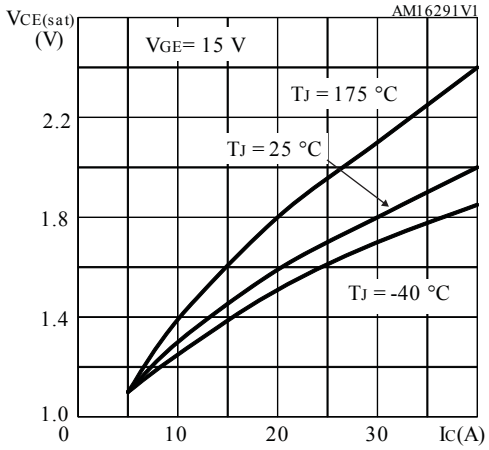


Figure 9. Forward bias safe operating area

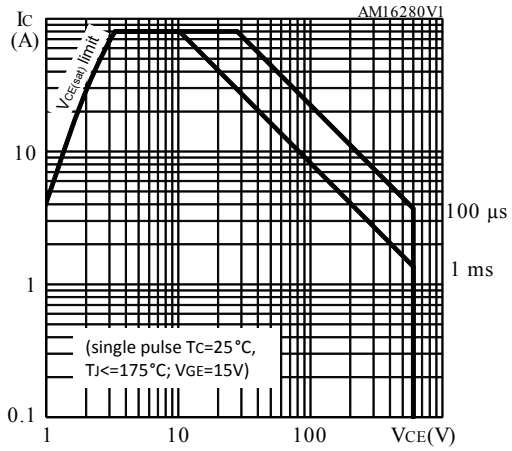


Figure 10. Thermal impedance for IGBT

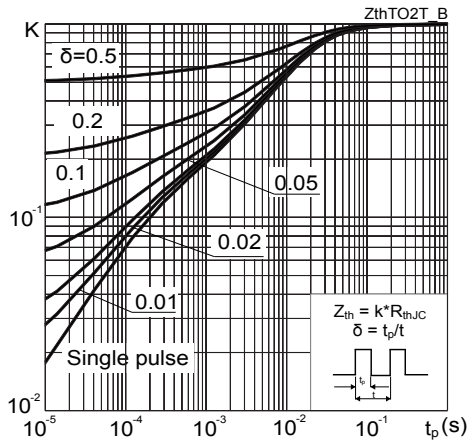


Figure 11. Transfer characteristics

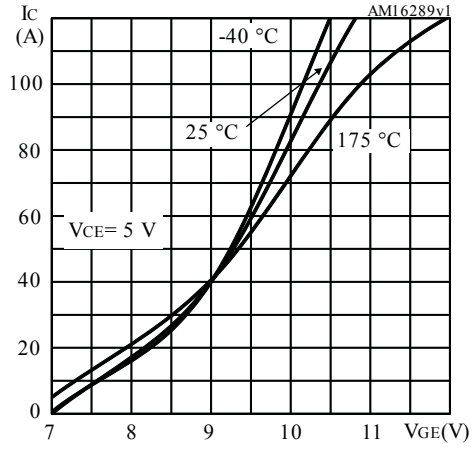


Figure 12. Diode V_F vs forward current

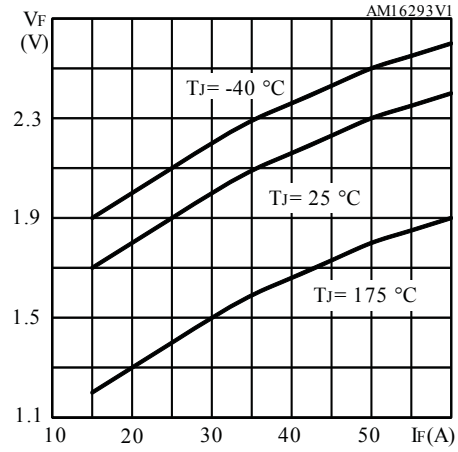


Figure 13. Normalized $V_{GE(th)}$ vs junction temperature

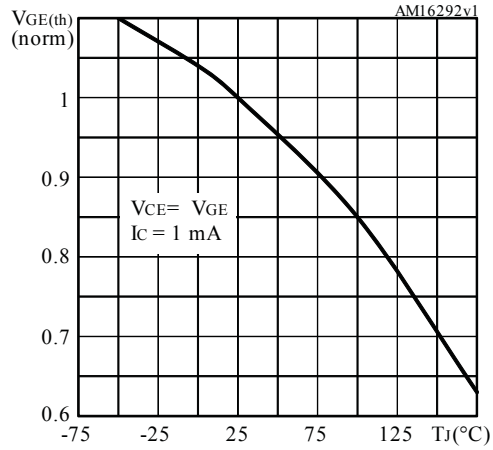


Figure 14. Short-circuit time and current vs V_{GE}

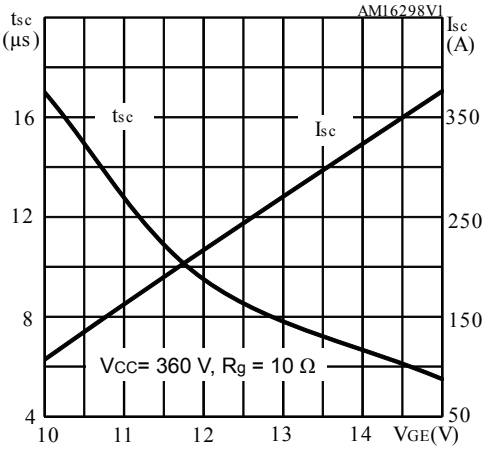


Figure 15. Gate charge vs. gate-emitter voltage

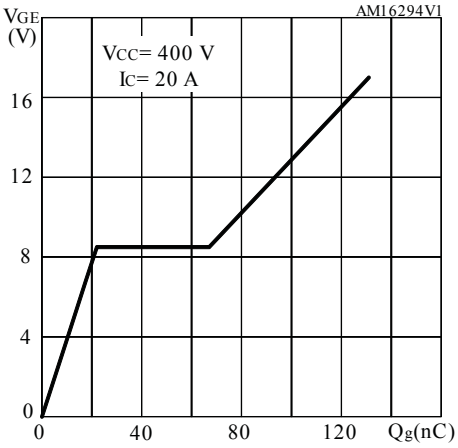


Figure 16. Switching energy vs collector current

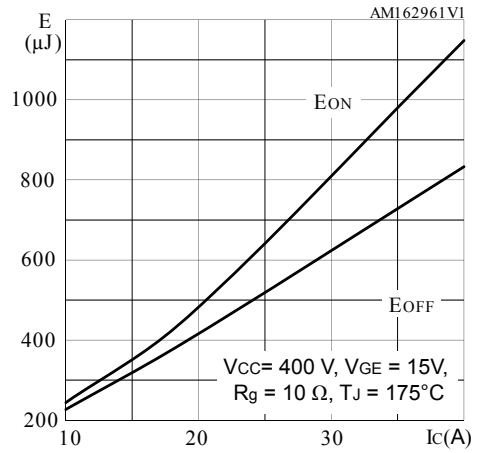


Figure 17. Switching energy vs gate resistance

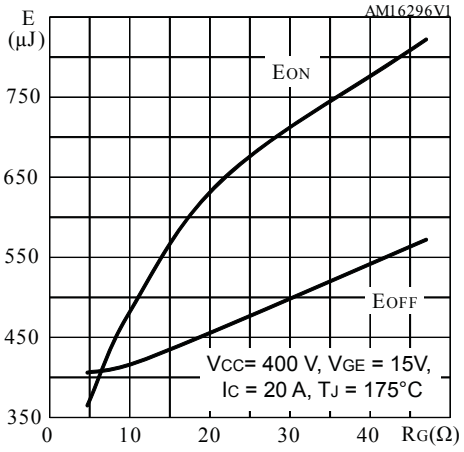
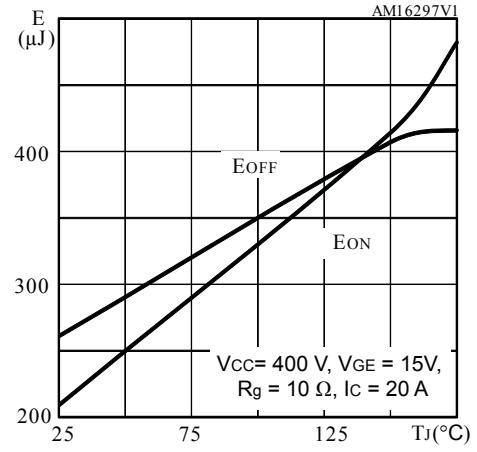


Figure 18. Switching energy vs temperature



3 Test circuits

Figure 19. Test circuit for inductive load switching

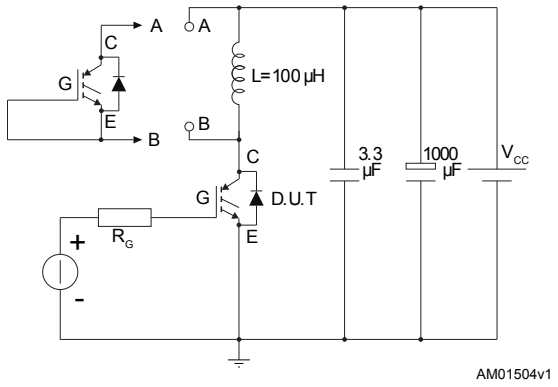


Figure 20. Gate charge test circuit

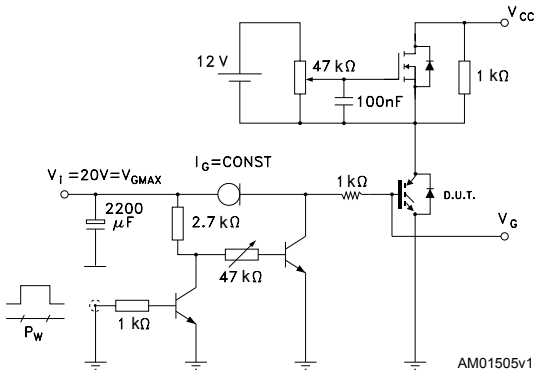


Figure 21. Switching waveform

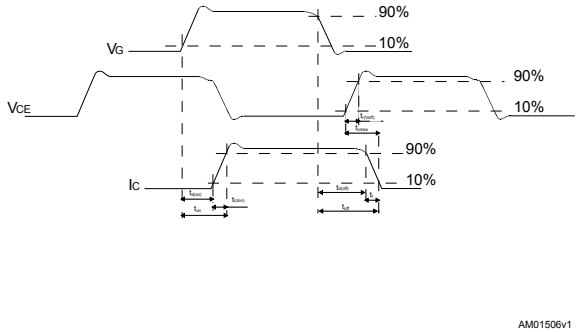
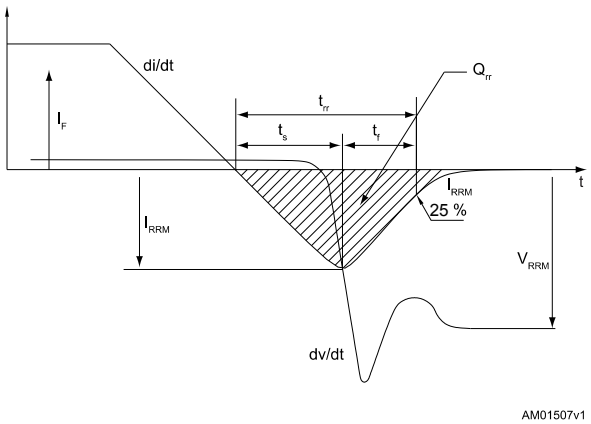


Figure 22. Diode reverse recovery waveform



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

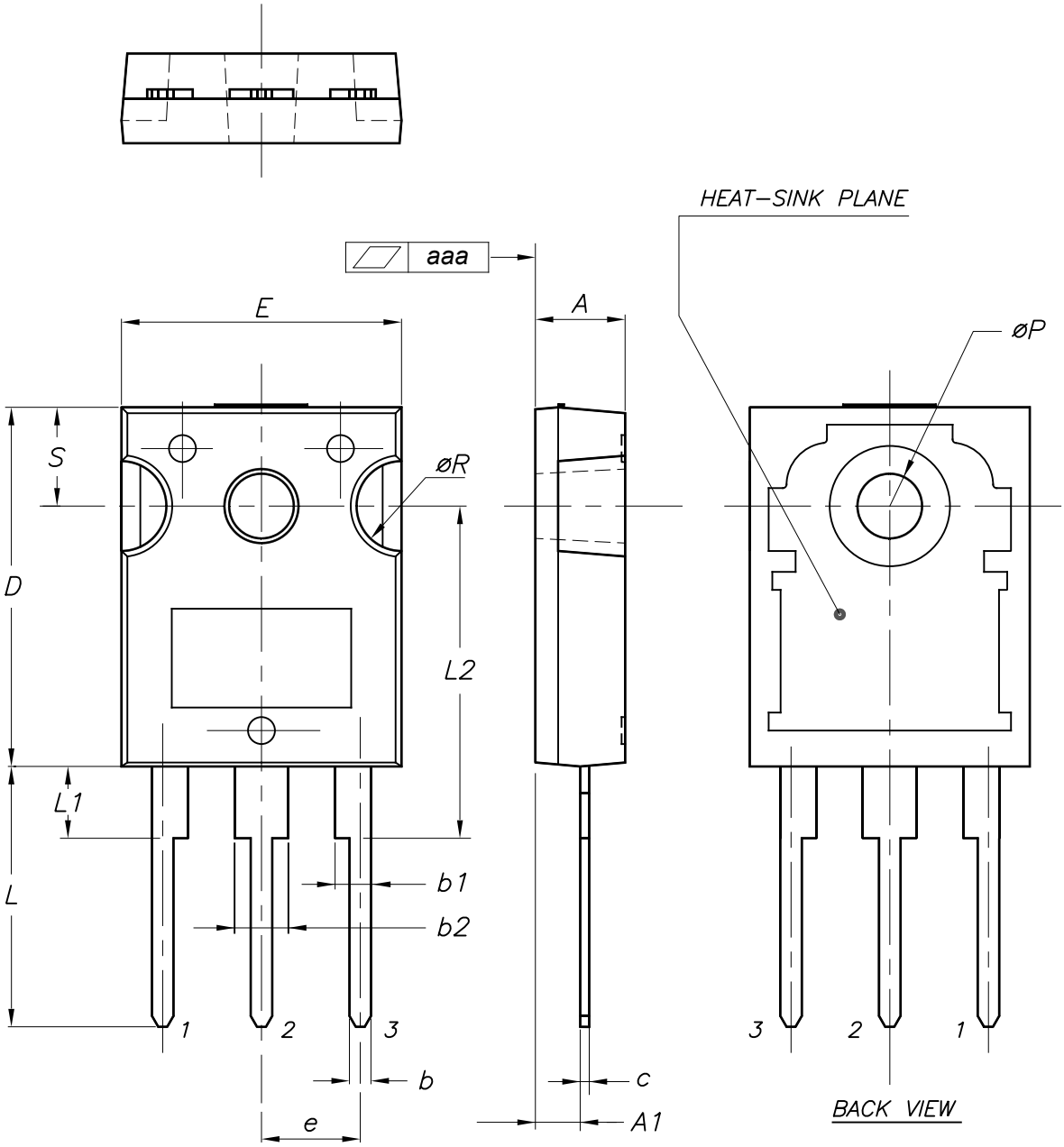


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Table 8. **TO-247 package mechanical data**

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.

Contents