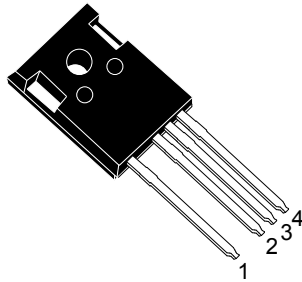
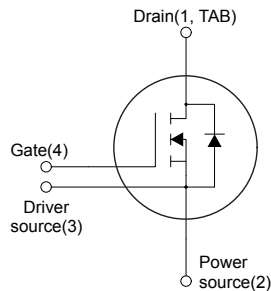


Automotive-grade silicon carbide Power MOSFET 650 V, 45 mΩ typ., 30 A in an HiP247-4 package



HiP247-4


ND1TPS2DS3G4



Features

Order code	V _{DS}	R _{DS(on)} typ.	I _D
SCT040W65G3-4AG	650 V	45 mΩ	30 A

- AEC-Q101 qualified 
- Very fast and robust intrinsic body diode
- Extremely low gate charge and input capacitance
- Very high operating junction temperature capability (T_J = 200 °C)
- Source sensing pin for increased efficiency

Applications

- Main inverter (electric traction)
- DC/DC converter for EV/HEV
- On board charger (OBC)

Description

This silicon carbide Power MOSFET device has been developed using ST's advanced and innovative 3rd generation SiC MOSFET technology. The device features a very low R_{DS(on)} over the entire temperature range combined with low capacitances and very high switching operations, which improve application performance in frequency, energy efficiency, system size and weight reduction.

Product status link

[SCT040W65G3-4AG](#)

Product summary

Order code	SCT040W65G3-4AG
Marking	SCT040W65G3
Package	HiP247-4
Packing	Tube

1 Electrical ratings

Table 1. Absolute maximum ratings

Symbol	Parameter	Value	Unit
V_{DS}	Drain-source voltage	650	V
V_{GS}	Gate-source voltage	-10 to 22	V
	Gate-source voltage (recommended operating values)	-5 to 18	
	Gate-source transient voltage, $t_p < 1 \mu s$, $t \leq 10$ hours over lifetime	-11 to 25	
$I_D^{(1)}$	Drain current (continuous) at $T_C = 25 \text{ }^\circ\text{C}$	30	A
	Drain current (continuous) at $T_C = 100 \text{ }^\circ\text{C}$	30	
$I_{DM}^{(2)}$	Drain current (pulsed)	160	A
P_{TOT}	Total power dissipation at $T_C = 25 \text{ }^\circ\text{C}$	240	W
T_{stg}	Storage temperature range	-55 to 200	$^\circ\text{C}$
T_J	Operating junction temperature range		$^\circ\text{C}$

- I_D is limited by package.
- Pulse width is limited by safe operating area.

Table 2. Thermal data

Symbol	Parameter	Value	Unit
R_{thJC}	Thermal resistance, junction-to-case	0.73	$^\circ\text{C/W}$
R_{thJA}	Thermal resistance, junction-to-ambient	40	$^\circ\text{C/W}$

2 Electrical characteristics

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

Table 3. On/off states

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$V_{(BR)DSS}$	Drain-source breakdown voltage	$V_{GS} = 0\text{ V}$, $I_D = 1\text{ mA}$	650			V
I_{DSS}	Zero gate voltage drain current	$V_{GS} = 0\text{ V}$, $V_{DS} = 650\text{ V}$			10	μA
I_{GSS}	Gate-body leakage current	$V_{DS} = 0\text{ V}$, $V_{GS} = -10\text{ to }22\text{ V}$			± 100	nA
$V_{GS(th)}$	Gate threshold voltage	$V_{DS} = V_{GS}$, $I_D = 1\text{ mA}$	1.8	3.0	4.2	V
$R_{DS(on)}$	Static drain-source on-resistance	$V_{GS} = 15\text{ V}$, $I_D = 20\text{ A}$		60		m Ω
		$V_{GS} = 18\text{ V}$, $I_D = 20\text{ A}$		45	63	
		$V_{GS} = 18\text{ V}$, $I_D = 20\text{ A}$, $T_J = 200\text{ °C}$		61		

Table 4. Dynamic

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
C_{iss}	Input capacitance	$V_{DS} = 400\text{ V}$, $f = 1\text{ MHz}$, $V_{GS} = 0\text{ V}$	-	860	-	pF
C_{oss}	Output capacitance		-	92	-	pF
C_{riss}	Reverse transfer capacitance		-	13	-	pF
Q_g	Total gate charge	$V_{DD} = 400\text{ V}$, $V_{GS} = -5\text{ to }18\text{ V}$, $I_D = 30\text{ A}$	-	37.5	-	nC
Q_{gs}	Gate-source charge		-	11.3	-	nC
Q_{gd}	Gate-drain charge		-	13.1	-	nC
R_g	Gate input resistance	$f = 1\text{ MHz}$, $I_D = 0\text{ A}$	-	1.4	-	Ω

Table 5. Switching energy (inductive load)

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
E_{on}	Turn-on switching energy	$V_{DD} = 400\text{ V}$, $I_D = 20\text{ A}$,	-	82	-	μJ
E_{off}	Turn-off switching energy	$R_G = 15\text{ }\Omega$, $V_{GS} = -5\text{ V to }18\text{ V}$	-	75	-	μJ

Table 6. Switching times

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$t_{d(on)}$	Turn-on delay time	$V_{DD} = 400\text{ V}$, $I_D = 20\text{ A}$, $R_G = 15\text{ }\Omega$, $V_{GS} = -5\text{ to }18\text{ V}$	-	13	-	ns
t_r	Rise time		-	7.4	-	ns
$t_{d(off)}$	Turn-off delay time		-	29.6	-	ns
t_f	Fall time		-	19	-	ns

Table 7. Reverse SiC diode characteristics

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$I_{SD}^{(1)}$	Continuous diode forward current	$T_C = 25\text{ }^\circ\text{C}$	-		30	A
		$T_C = 100\text{ }^\circ\text{C}$	-		30	
V_{SD}	Diode forward voltage	$I_{SD} = 20\text{ A}$, $V_{GS} = 0\text{ V}$	-	2.8		V
t_{rr}	Reverse recovery time	$I_{SD} = 20\text{ A}$, $di/dt = 1000\text{ A}/\mu\text{s}$, $V_{DD} = 400\text{ V}$	-	16		ns
Q_{rr}	Reverse recovery charge		-	83		nC
I_{RRM}	Reverse recovery current		-	9		A

1. I_{SD} is limited by package.

2.1 Electrical characteristics (curves)

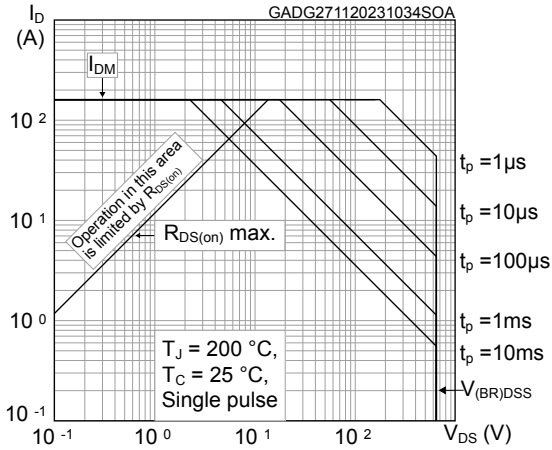
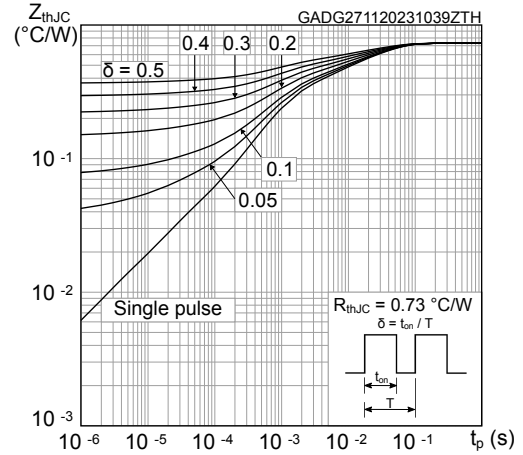
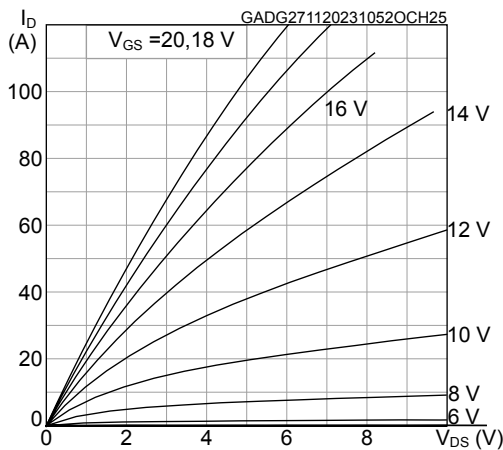
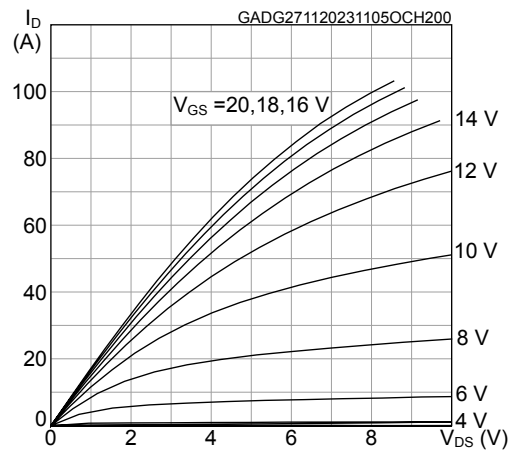
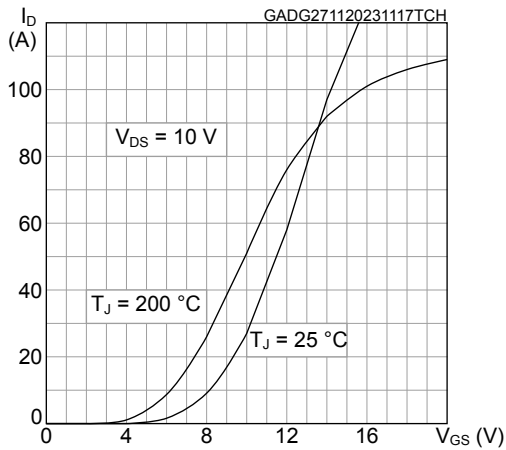
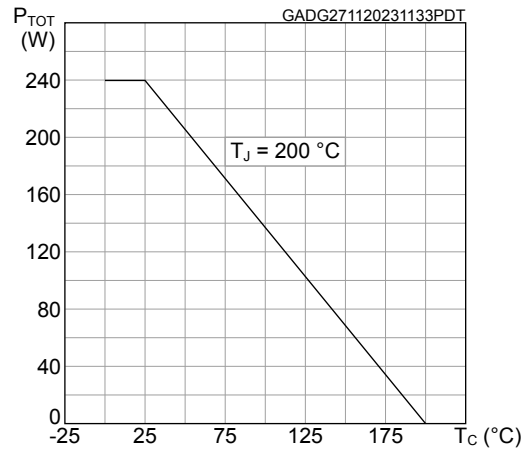
Figure 1. Safe operating area

Figure 2. Maximum transient thermal impedance

Figure 3. Typical output characteristics (T_J = 25 °C)

Figure 4. Typical output characteristics (T_J = 200 °C)

Figure 5. Typical transfer characteristics

Figure 6. Total power dissipation


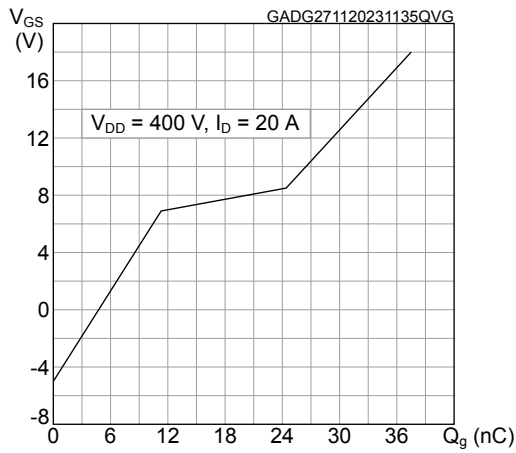
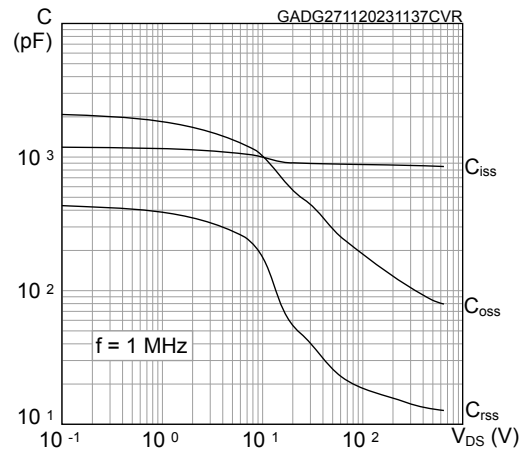
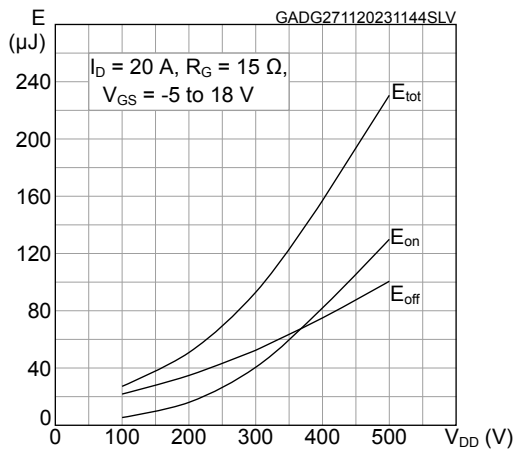
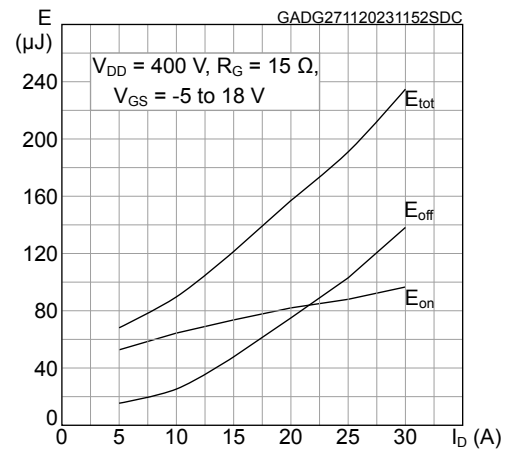
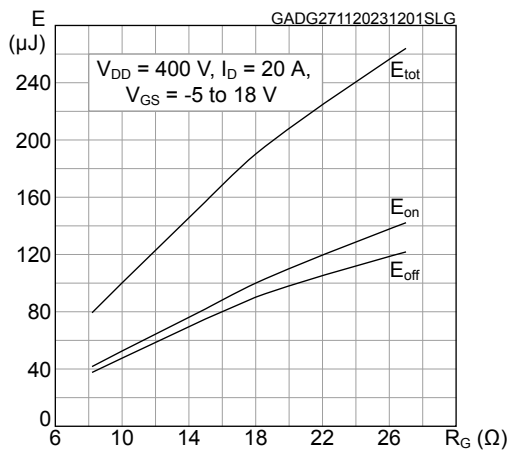
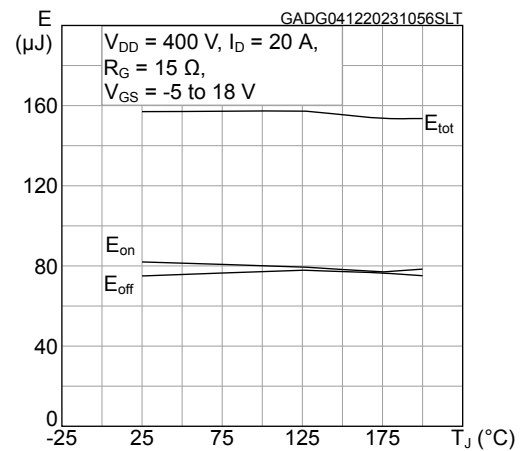
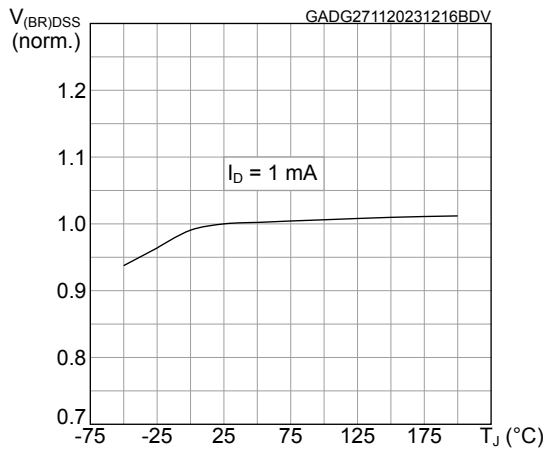
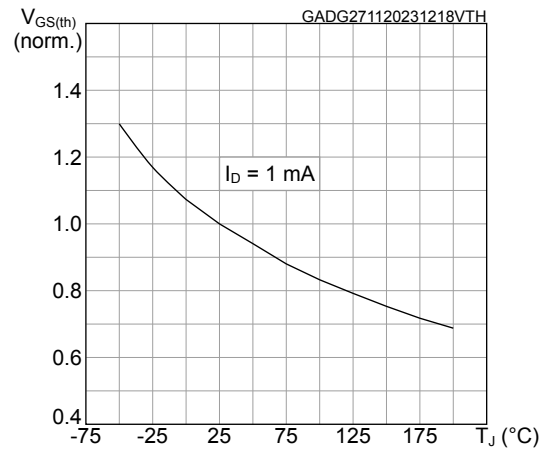
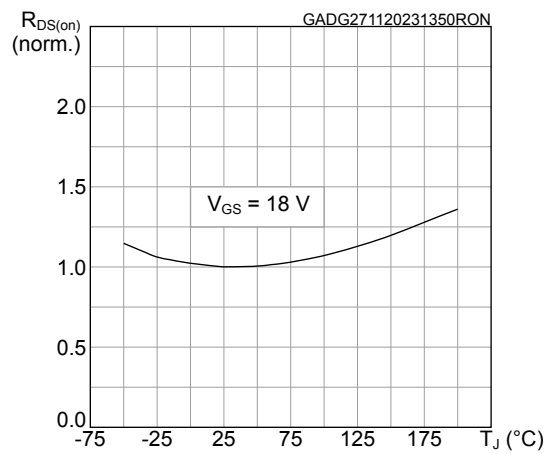
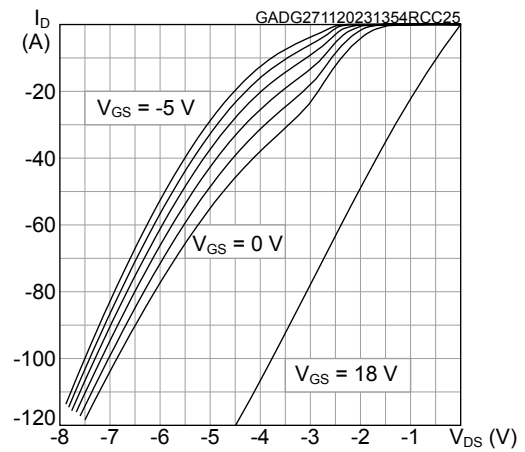
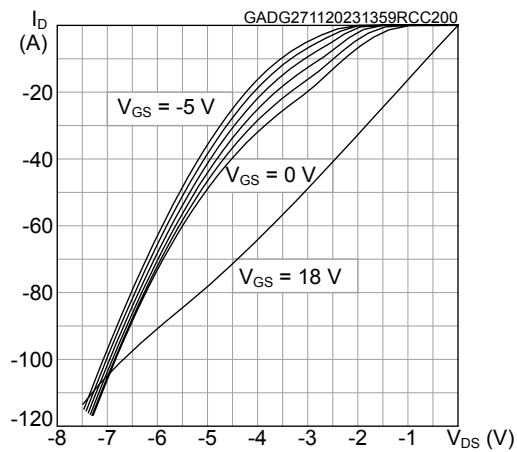
Figure 7. Typical gate charge characteristics

Figure 8. Typical capacitance characteristics

Figure 9. Typical switching energy vs supply voltage

Figure 10. Typical switching energy vs drain current

Figure 11. Typical switching energy vs gate resistance

Figure 12. Typical switching energy vs temperature


Figure 13. Normalized breakdown voltage vs temperature

Figure 14. Normalized gate threshold vs temperature

Figure 15. Normalized on-resistance vs temperature

Figure 16. Typical reverse conduction characteristics ($T_J = 25^\circ\text{C}$)

Table 8.
Figure 17. Typical reverse conduction characteristics ($T_J = 200^\circ\text{C}$)


3 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.

3.1 HiP247-4 package information

Figure 18. HiP247-4 package outline

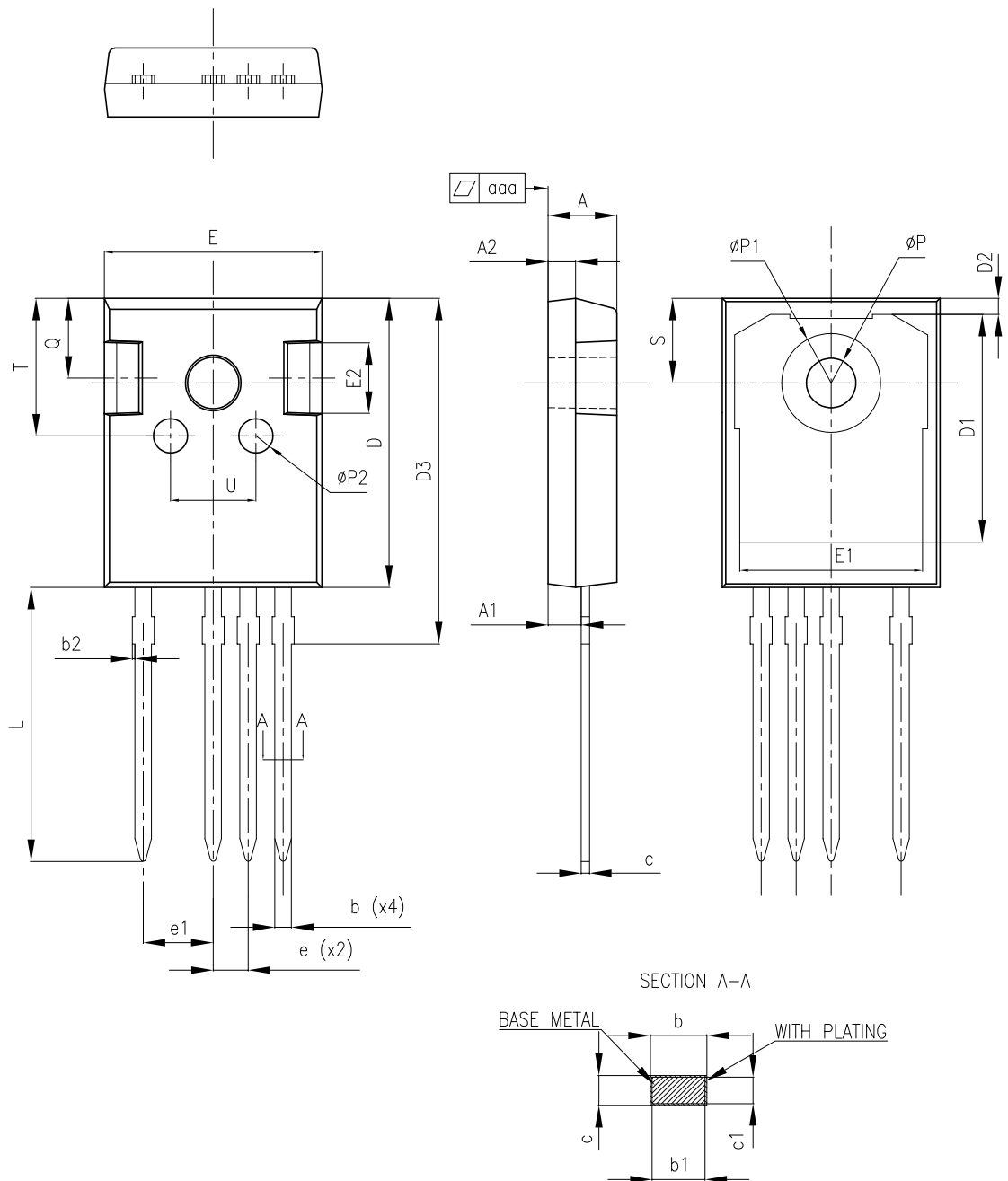


Table 9. HiP247-4 mechanical data

Dim.	mm		
	Min.	Typ.	Max.
A	4.90	5.00	5.10
A1	2.31	2.41	2.51
A2	1.90	2.00	2.10
b	1.16		1.29
b1	1.15	1.20	1.25
b2	0		0.20
c	0.59		0.66
c1	0.58	0.60	0.62
D	20.90	21.00	21.10
D1	16.25	16.55	16.85
D2	1.05	1.20	1.35
D3	24.97	25.12	25.27
E	15.70	15.80	15.90
E1	13.10	13.30	13.50
E2	4.90	5.00	5.10
E3	2.40	2.50	2.60
e	2.44	2.54	2.64
e1	4.98	5.08	5.18
L	19.80	19.92	20.10
P	3.50	3.60	3.70
P1			7.40
P2	2.40	2.50	2.60
Q	5.60		6.00
S		6.15	
T	9.80		10.20
U	6.00		6.40
aaa		0.04	0.10

Revision history

Table 10. Document revision history

Date	Revision	Changes
04-Dec-2023	1	First release.

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