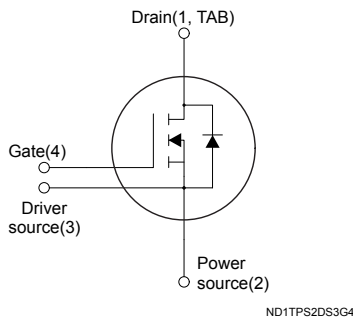
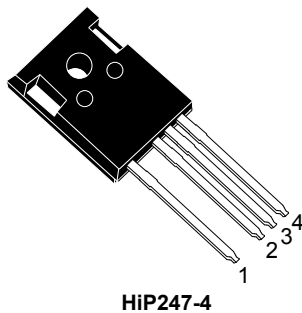


## Silicon carbide Power MOSFET 650 V, 18 mΩ typ., 119 A in an HiP247-4 package



## Features

Order code	V <sub>DS</sub>	R <sub>DS(on)</sub> max.	I <sub>D</sub>
SCTWA90N65G2V-4	650 V	24 mΩ	119 A

- High speed switching performance
- Very high operating junction temperature capability (T<sub>J</sub> = 200 °C)
- Very fast and robust intrinsic body diode
- Extremely low gate charge and input capacitances
- Source sensing pin for increased efficiency

## Applications

- Switching mode power supply
- DC-DC converters
- Industrial motor control

## Description

This silicon carbide Power MOSFET device has been developed using ST's advanced and innovative 2<sup>nd</sup> generation SiC MOSFET technology. The device features remarkably low on-resistance per unit area and very good switching performance. The variation of switching loss is almost independent of junction temperature.

## Product status link

[SCTWA90N65G2V-4](#)

## Product summary

Order code	SCTWA90N65G2V-4
Marking	SCT90N65G2V
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	
$I_D$	Drain current (continuous) at $T_C = 25\text{ °C}$	119	A
	Drain current (continuous) at $T_C = 100\text{ °C}$	90	
$I_{DM}^{(1)}$	Drain current (pulsed)	220	A
$P_{TOT}$	Total power dissipation at $T_C = 25\text{ °C}$	565	W
$T_{stg}$	Storage temperature range	-55 to 200	°C
$T_j$	Operating junction temperature range		°C

1. Pulse width is limited by safe operating area.

**Table 2. Thermal data**

Symbol	Parameter	Value	Unit
$R_{thJC}$	Thermal resistance, junction-to-case	0.31	°C/W
$R_{thJA}$	Thermal resistance, junction-to-ambient	40	°C/W

## 2 Electrical characteristics

( $T_{CASE} = 25\text{ °C}$  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	$V_{DS} = 650\text{ V}, V_{GS} = 0\text{ V}$			10	$\mu\text{A}$
$I_{GSS}$	Gate-body leakage current	$V_{DS} = 0\text{ V}, V_{GS} = -10\text{ to }22\text{ V}$			$\pm 100$	nA
$V_{GS(th)}$	Gate threshold voltage	$V_{DS} = V_{GS}, I_D = 1\text{ mA}$	1.9	3.2	5.0	V
$R_{DS(on)}$	Static drain-source on-resistance	$V_{GS} = 18\text{ V}, I_D = 50\text{ A}$		18	24	m $\Omega$
		$V_{GS} = 18\text{ V}, I_D = 50\text{ A}, T_J = 200\text{ °C}$		30		

**Table 4. Dynamic, based on HiP247 package option**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$C_{iss}$	Input capacitance	$V_{DS} = 400\text{ V}, f = 1\text{ MHz}, V_{GS} = 0\text{ V}$	-	3380	-	pF
$C_{oss}$	Output capacitance		-	294	-	
$C_{riss}$	Reverse transfer capacitance		-	49	-	
$Q_g$	Total gate charge	$V_{DD} = 400\text{ V}, I_D = 50\text{ A},$ $V_{GS} = -5\text{ V to }18\text{ V}$	-	157	-	nC
$Q_{gs}$	Gate-source charge		-	43	-	
$Q_{gd}$	Gate-drain charge		-	42	-	
$R_g$	Gate input resistance	$f = 1\text{ MHz}, I_D = 0\text{ A}$	-	1	-	$\Omega$

**Table 5. Switching energy (inductive load), based on HiP247 package option**

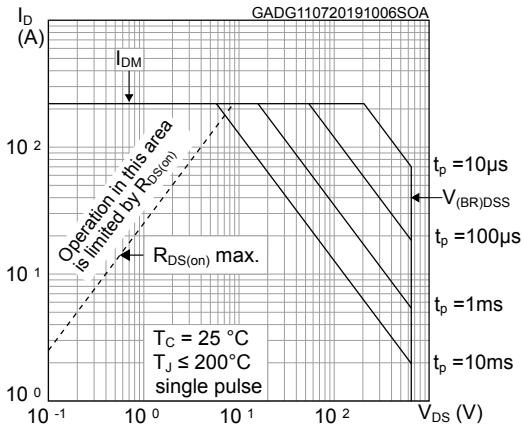
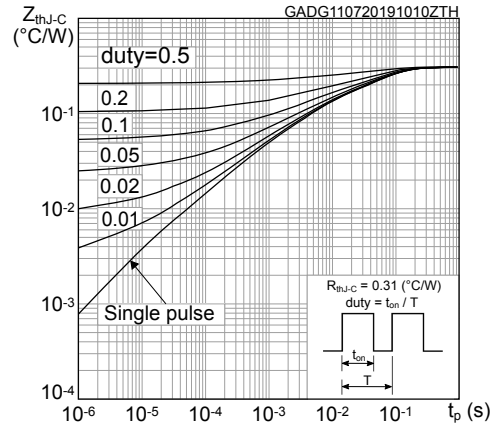
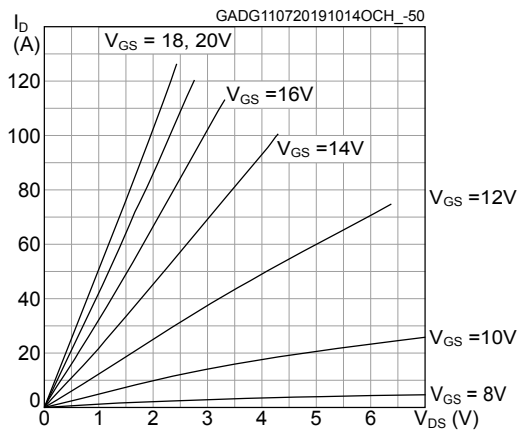
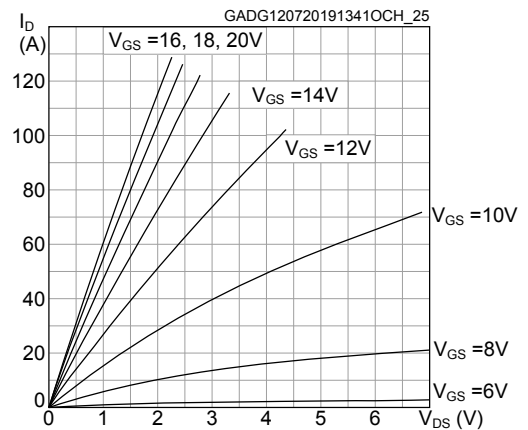
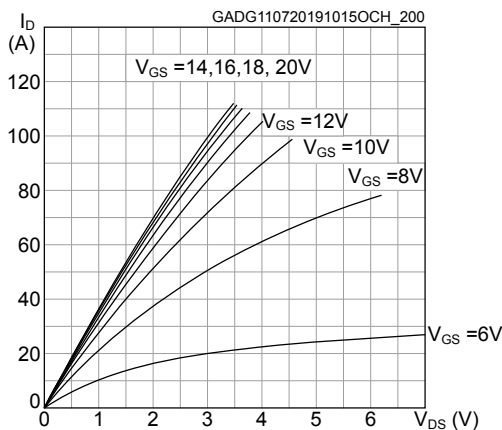
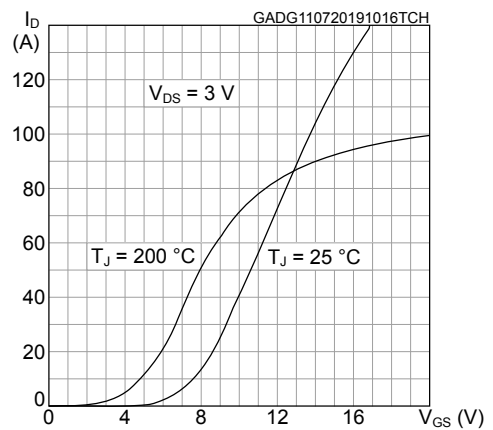
Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$E_{on}$	Turn-on switching energy	$V_{DD} = 400\text{ V}, I_D = 50\text{ A}, R_G = 2.2\text{ }\Omega,$ $V_{GS} = -5\text{ to }18\text{ V}$	-	130	-	$\mu\text{J}$
$E_{off}$	Turn-off switching energy		-	210	-	
$E_{on}$	Turn-on switching energy	$V_{DD} = 400\text{ V}, I_D = 50\text{ A}, R_G = 2.2\text{ }\Omega,$ $V_{GS} = -5\text{ to }18\text{ V}, T_J = 200\text{ °C}$	-	135	-	
$E_{off}$	Turn-off switching energy		-	200	-	

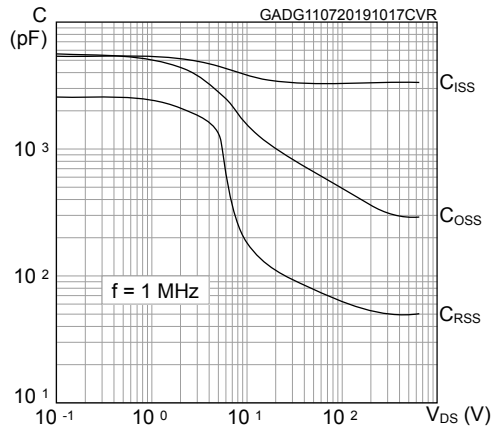
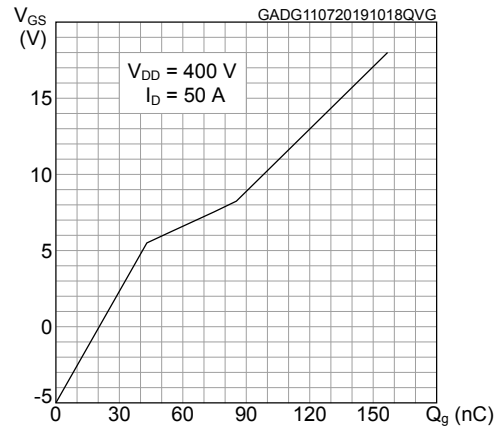
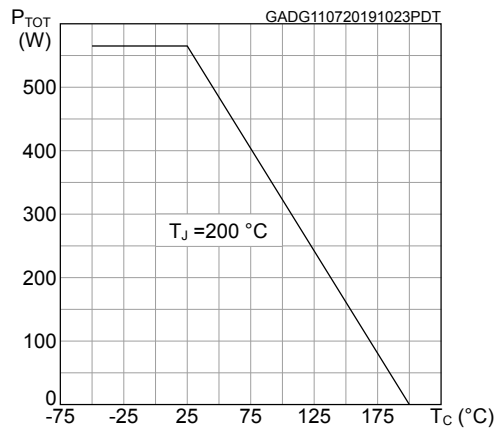
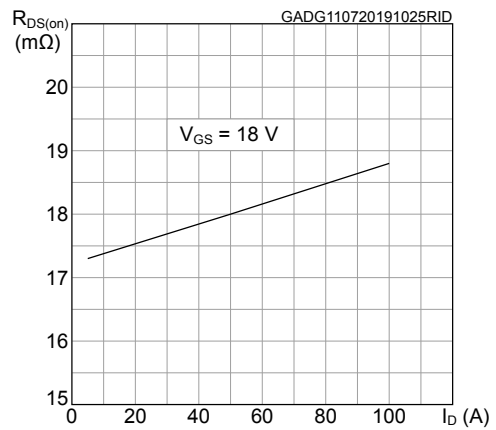
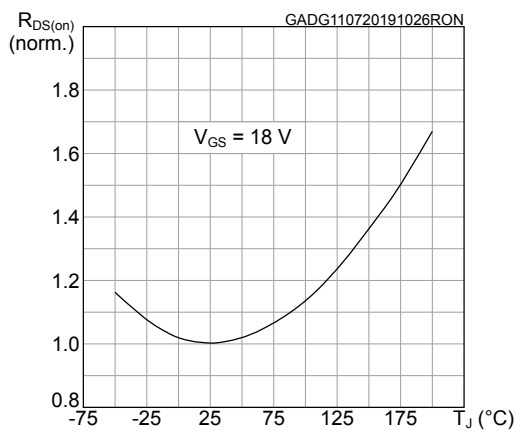
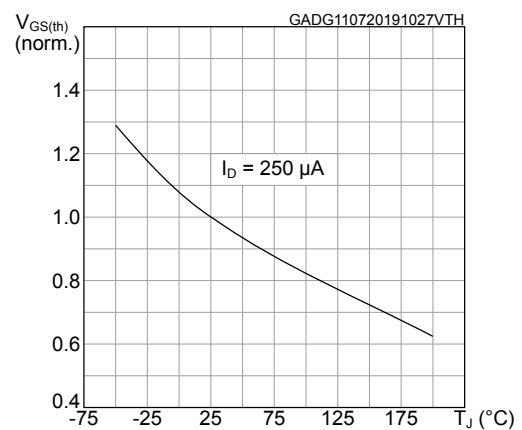
**Table 6. Switching times, based on HiP247 package option**

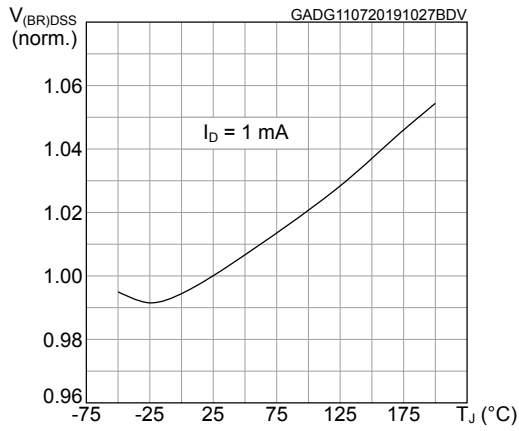
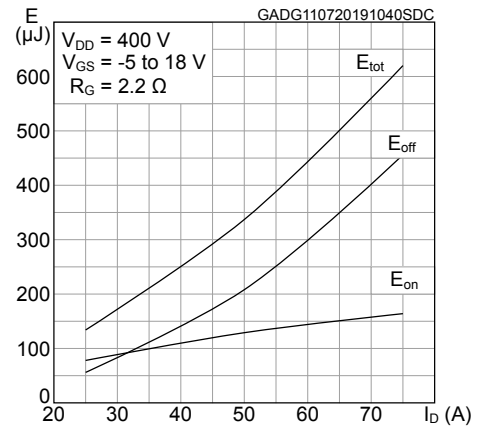
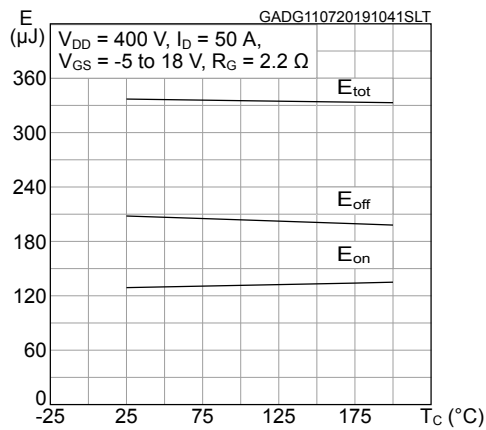
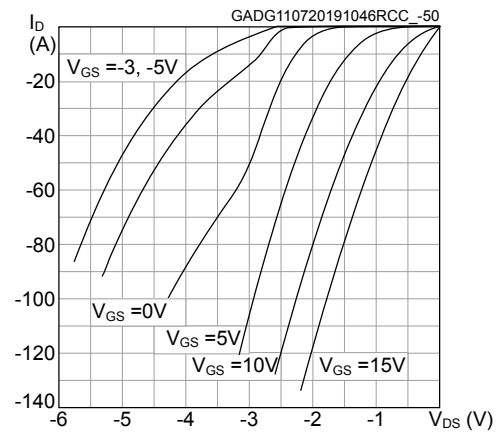
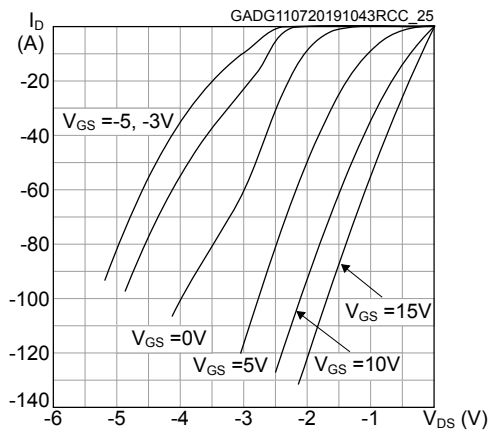
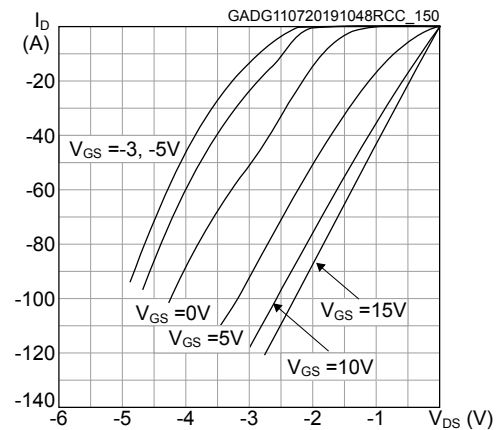
Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$t_{d(on)}$	Turn-on delay time	$V_{DD} = 400\text{ V}$ , $I_D = 50\text{ A}$ , $R_G = 2.2\ \Omega$ , $V_{GS} = -5\text{ V to }18\text{ V}$ ,	-	26	-	ns
$t_f$	Fall time		-	16	-	
$t_{d(off)}$	Turn-off delay time		-	58	-	
$t_r$	Rise time		-	38	-	

**Table 7. Reverse SiC diode characteristics, based on HiP247 package option**

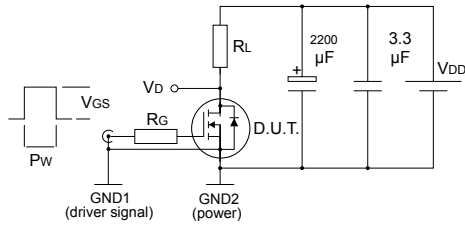
Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$V_{SD}$	Forward on voltage	$I_F = 30\text{ A}$ , $V_{GS} = 0\text{ V}$	-	2.5	-	V
$t_{rr}$	Reverse recovery time	$I_F = 50\text{ A}$ , $di/dt = 4000\text{ A}/\mu\text{s}$ ,	-	17	-	ns
$Q_{rr}$	Reverse recovery charge	$V_{GS} = V_{GS} = -5\text{ V to }18\text{ V}$ ,	-	308	-	nC
$I_{RRM}$	Reverse recovery current	$V_{DD} = 400\text{ V}$ , $T_J = 25\text{ }^\circ\text{C}$	-	30	-	A

**2.1 Electrical characteristics (curves), based on HiP247 package option**
**Figure 1. Safe operating area**

**Figure 2. Maximum transient thermal impedance**

**Figure 3. Typical output characteristics ( $T_J = -50^\circ\text{C}$ )**

**Figure 4. Typical output characteristics ( $T_J = 25^\circ\text{C}$ )**

**Figure 5. Typical output characteristics ( $T_J = 200^\circ\text{C}$ )**

**Figure 6. Typical transfer characteristics**


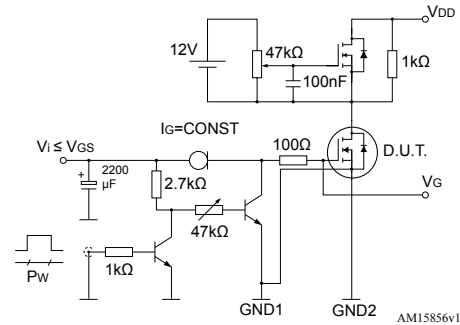
**Figure 7. Typical capacitances**

**Figure 8. Typical gate charge**

**Figure 9. Maximum total power dissipation**

**Figure 10. Typical drain-source on-resistance**

**Figure 11. Normalized on-resistance vs temperature**

**Figure 12. Normalized gate threshold voltage vs temperature**


**Figure 13. Normalized breakdown voltage vs temperature**

**Figure 14. Typical switching energy vs drain current**

**Figure 15. Typical switching energy vs temperature**

**Figure 16. Typical reverse conduction characteristics (Tj = -50 °C)**

**Figure 17. Typical reverse conduction characteristics (Tj = 25 °C)**

**Figure 18. Typical reverse conduction characteristics (Tj = 150 °C)**


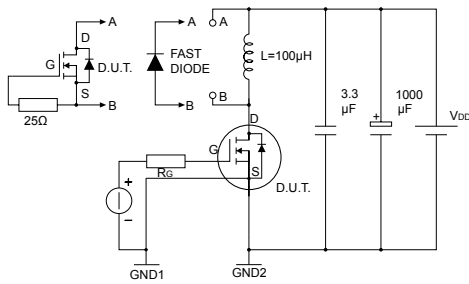
### 3 Test circuits

**Figure 19. Switching times test circuit for resistive load**


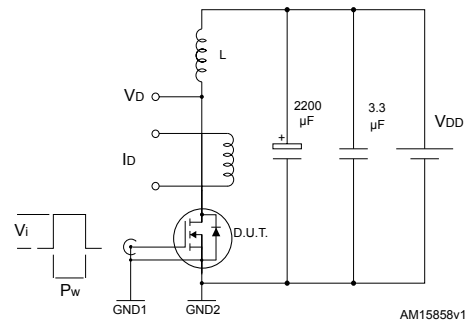
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**Figure 20. Test circuit for gate charge behavior**


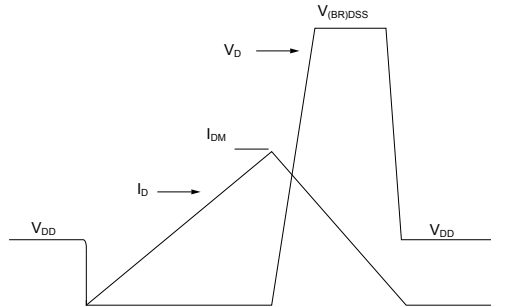
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**Figure 21. Test circuit for inductive load switching and diode recovery times**


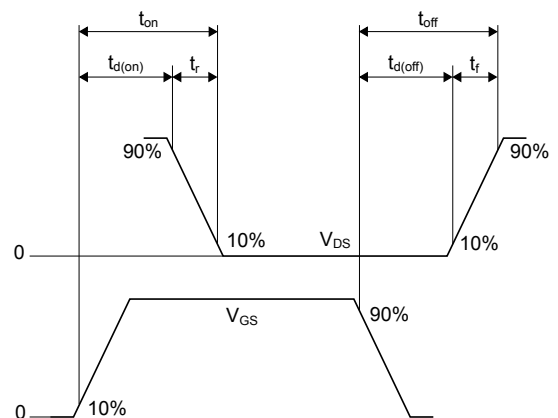
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**Figure 22. Unclamped inductive load test circuit**


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**Figure 23. Unclamped inductive waveform**


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**Figure 24. Switching time waveform**


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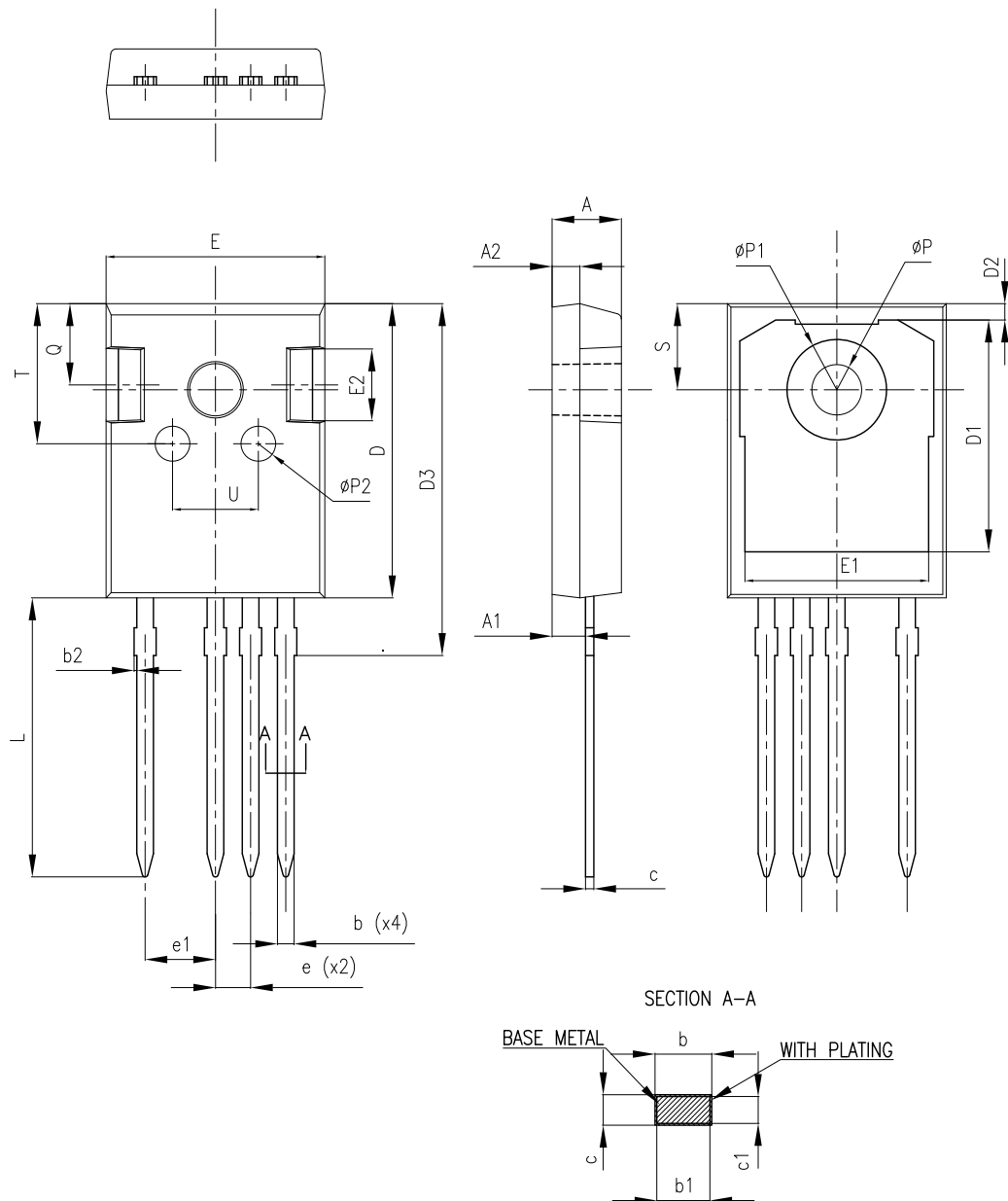


## 4 Package information

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 HiP247-4 package information

Figure 25. HiP247-4 package outline



8405626\_2

Table 8. 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

## Revision history

**Table 9. Document revision history**

Date	Revision	Changes
25-Nov-2020	1	First release.

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