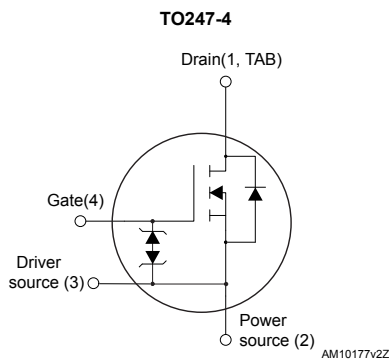
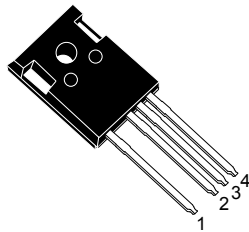



# Automotive N-channel 650 V, 33 mΩ typ., 72 A MDmesh DM6 Power MOSFET in a TO247-4 package



## Features

Order code	$V_{DS}$	$R_{DS(on)}$ max.	$I_D$
STW68N65DM6-4AG	650 V	39 mΩ	72 A

- Designed for automotive applications 
- Fast-recovery body diode
- Lower  $R_{DS(on)}$  per area vs previous generation
- Low gate charge, input capacitance and resistance
- 100% avalanche tested
- Extremely high dv/dt ruggedness
- Excellent switching performance thanks to the extra driving source pin
- Zener-protected

## Applications

- Switching applications

## Description

This high-voltage N-channel Power MOSFET is part of the MDmesh DM6 fast-recovery diode series. Compared with the previous MDmesh fast generation, DM6 combines very low recovery charge ( $Q_{rr}$ ), recovery time ( $t_{rr}$ ) and excellent improvement in  $R_{DS(on)}$  per area with one of the most effective switching behaviors available in the market for the most demanding high-efficiency bridge topologies and ZVS phase-shift converters.

### Product status link

[STW68N65DM6-4AG](#)

### Product summary

<b>Order code</b>	STW68N65DM6-4AG
<b>Marking</b>	68N65DM6AG
<b>Package</b>	TO247-4
<b>Packing</b>	Tube

# 1 Electrical ratings

**Table 1. Absolute maximum ratings**

Symbol	Parameter	Value	Unit
$V_{GS}$	Gate-source voltage	$\pm 25$	V
$I_D$	Drain current (continuous) at $T_C = 25\text{ }^\circ\text{C}$	72	A
$I_D$	Drain current (continuous) at $T_C = 100\text{ }^\circ\text{C}$	46	A
$I_{DM}^{(1)}$	Drain current (pulsed)	280	A
$P_{TOT}$	Total power dissipation at $T_C = 25\text{ }^\circ\text{C}$	480	W
$dv/dt^{(2)}$	Peak diode recovery voltage slope	100	V/ns
$di/dt^{(2)}$	Peak diode recovery current slope	1000	A/ $\mu\text{s}$
$dv/dt^{(3)}$	MOSFET $dv/dt$ ruggedness	100	V/ns
$T_{STG}$	Storage temperature range	-55 to 150	$^\circ\text{C}$
$T_J$	Operating junction temperature range		$^\circ\text{C}$

1. Pulse width limited by safe operating area.
2.  $I_{SD} \leq 72\text{ A}$ ,  $V_{DS} (\text{peak}) < V_{(BR)DSS}$ ,  $V_{DD} = 400\text{ V}$ .
3.  $V_{DS} \leq 520\text{ V}$ .

**Table 2. Thermal data**

Symbol	Parameter	Value	Unit
$R_{thj-case}$	Thermal resistance junction-case	0.26	$^\circ\text{C/W}$
$R_{thj-amb}$	Thermal resistance junction-ambient	50	$^\circ\text{C/W}$

**Table 3. Avalanche characteristics**

Symbol	Parameter	Value	Unit
$I_{AR}$	Avalanche current, repetitive or not repetitive ( $t_p$ limited by $T_J \text{ max}$ )	9	A
$E_{AS}$	Single pulse avalanche energy (starting $T_J = 25\text{ }^\circ\text{C}$ , $I_D = I_{AR}$ )	1.9	J

## 2 Electrical characteristics

$T_C = 25\text{ }^\circ\text{C}$  unless otherwise specified

**Table 4. 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	$\mu\text{A}$
		$V_{GS} = 0\text{ V}$ , $V_{DS} = 650\text{ V}$ , $T_C = 125\text{ }^\circ\text{C}^{(1)}$			300	
$I_{GSS}$	Gate-body leakage current	$V_{DS} = 0\text{ V}$ , $V_{GS} = \pm 25\text{ V}$			$\pm 5$	$\mu\text{A}$
$V_{GS(th)}$	Gate threshold voltage	$V_{DS} = V_{GS}$ , $I_D = 250\text{ }\mu\text{A}$	3.25	4	4.75	V
$R_{DS(on)}$	Static drain-source on resistance	$V_{GS} = 10\text{ V}$ , $I_D = 36\text{ A}$		33	39	$\text{m}\Omega$

1. Defined by design, not subject to production test.

**Table 5. Dynamic characteristics**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$C_{iss}$	Input capacitance	$V_{DS} = 100\text{ V}$ , $f = 1\text{ MHz}$ , $V_{GS} = 0\text{ V}$	-	5900	-	$\text{pF}$
$C_{oss}$	Output capacitance		-	260	-	
$C_{riss}$	Reverse transfer capacitance		-	2.6	-	
$C_{oss\text{ eq.}}^{(1)}$	Equivalent output capacitance	$V_{DS} = 0\text{ to }520\text{ V}$ , $V_{GS} = 0\text{ V}$	-	867	-	
$R_G$	Intrinsic gate resistance	$f = 1\text{ MHz}$ , $I_D = 0\text{ A}$	-	1.4	-	$\Omega$
$Q_g$	Total gate charge	$V_{DD} = 520\text{ V}$ , $I_D = 72\text{ A}$ , $V_{GS} = 0\text{ to }10\text{ V}$ (see Figure 14. Test circuit for gate charge behavior)	-	118	-	$\text{nC}$
$Q_{gs}$	Gate-source charge		-	37	-	
$Q_{gd}$	Gate-drain charge		-	48	-	

1.  $C_{oss\text{ eq}}$  is defined as a constant equivalent capacitance giving the same charging time as  $C_{oss}$  when  $V_{DS}$  increases from 0 to 80%  $V_{DSS}$ .

**Table 6. Switching times**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$t_{d(on)}$	Turn-on delay time	$V_{DD} = 325\text{ V}$ , $I_D = 36\text{ A}$ , $R_G = 4.7\text{ }\Omega$ , $V_{GS} = 10\text{ V}$	-	34	-	ns
$t_r$	Rise time		-	16	-	ns
$t_{d(off)}$	Turn-off delay time	(see Figure 13. Switching times test circuit for resistive load and Figure 18. Switching time waveform)	-	92	-	ns
$t_f$	Fall time		-	10	-	ns

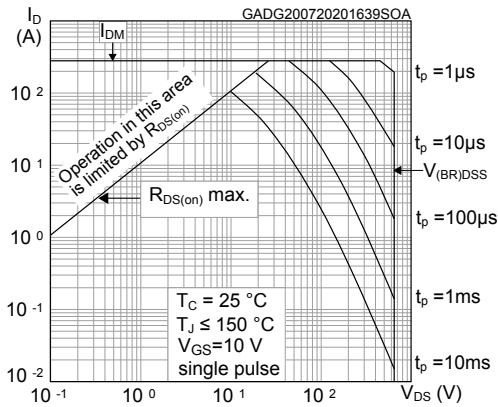
**Table 7. Source-drain diode**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$I_{SD}$	Source-drain current		-		72	A
$I_{SDM}^{(1)}$	Source-drain current (pulsed)		-		280	A
$V_{SD}^{(2)}$	Forward on voltage	$V_{GS} = 0\text{ V}$ , $I_{SD} = 72\text{ A}$	-		1.6	V
$t_{rr}$	Reverse recovery time	$I_{SD} = 72\text{ A}$ , $di/dt = 100\text{ A}/\mu\text{s}$ , $V_{DD} = 60\text{ V}$ (see Figure 15. Test circuit for inductive load switching and diode recovery times)	-	142	-	ns
$Q_{rr}$	Reverse recovery charge		-	0.9	-	$\mu\text{C}$
$I_{RRM}$	Reverse recovery current		-	10.6	-	A
$t_{rr}$	Reverse recovery time	$I_{SD} = 72\text{ A}$ , $di/dt = 100\text{ A}/\mu\text{s}$ , $V_{DD} = 60\text{ V}$ , $T_J = 150\text{ }^\circ\text{C}$ (see Figure 15. Test circuit for inductive load switching and diode recovery times)	-	310	-	ns
$Q_{rr}$	Reverse recovery charge		-	4.5	-	$\mu\text{C}$
$I_{RRM}$	Reverse recovery current		-	26	-	A

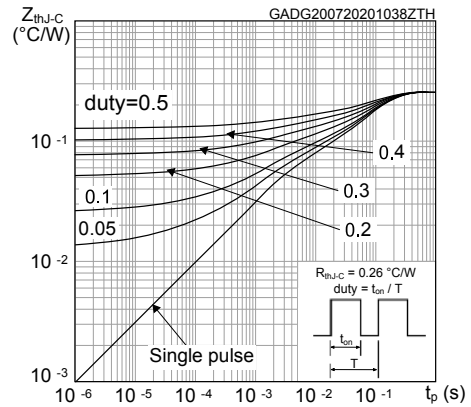
1. Pulse width is limited by safe operating area.
2. Pulsed: pulse duration = 300  $\mu\text{s}$ , duty cycle 1.5%.

## 2.1 Electrical characteristics (curves)

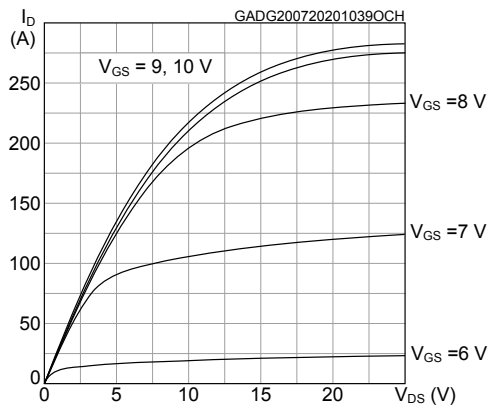
**Figure 1. Safe operating area**



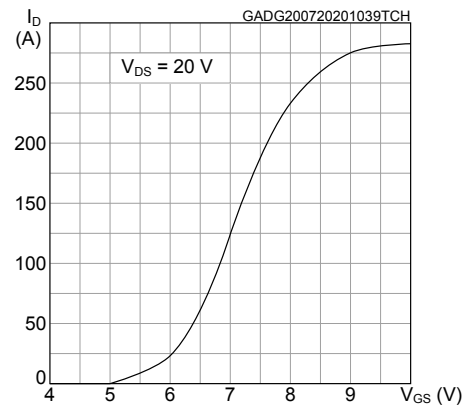
**Figure 2. Maximum transient thermal impedance**



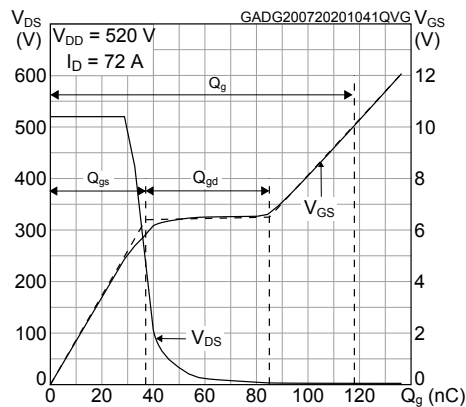
**Figure 3. Typical output characteristics**



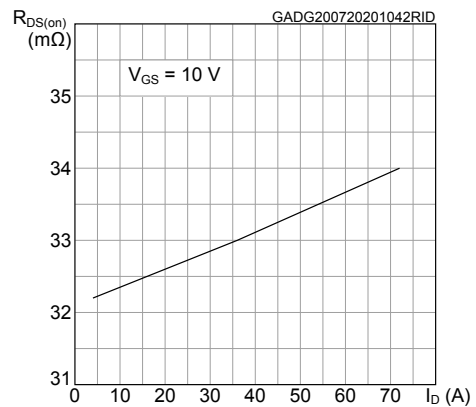
**Figure 4. Typical transfer characteristics**



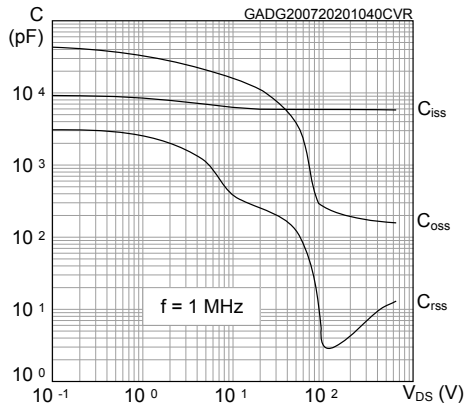
**Figure 5. Typical gate charge characteristics**



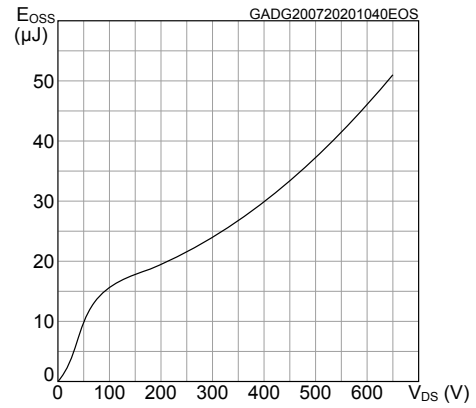
**Figure 6. Typical drain-source on-resistance**



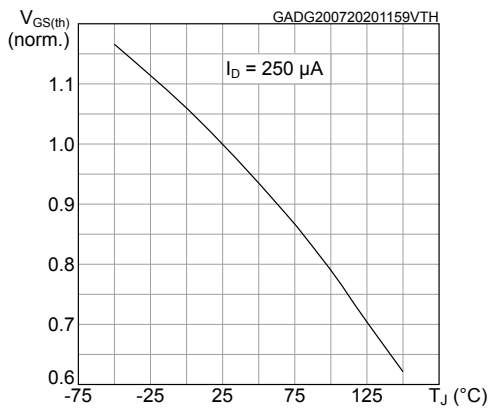
**Figure 7. Typical capacitance characteristics**



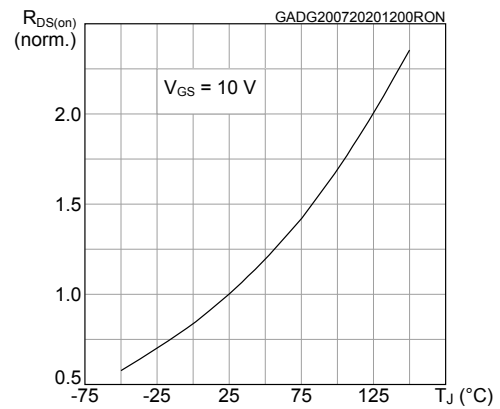
**Figure 8. Typical output capacitance stored energy**



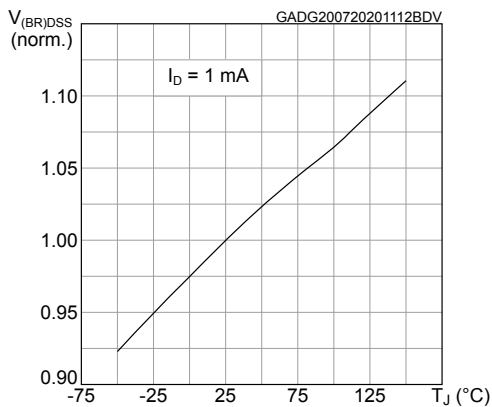
**Figure 9. Normalized gate threshold vs temperature**



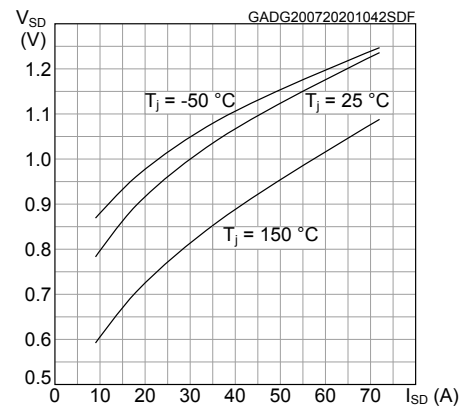
**Figure 10. Normalized on-resistance vs temperature**



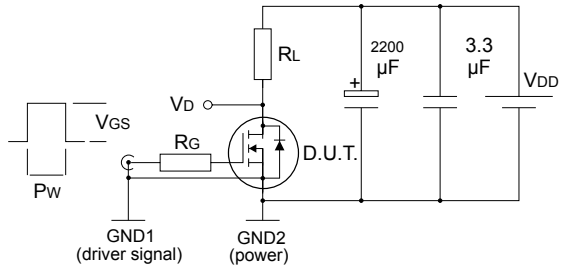
**Figure 11. Normalized breakdown voltage vs temperature**



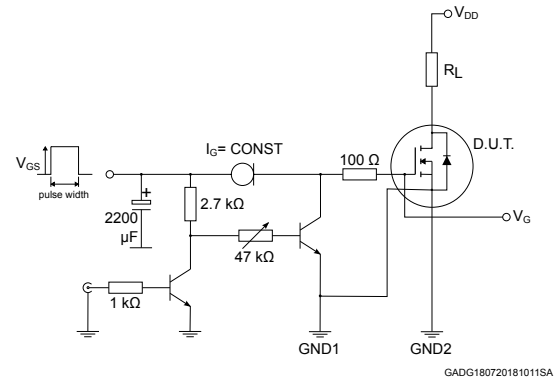
**Figure 12. Typical reverse diode forward characteristics**



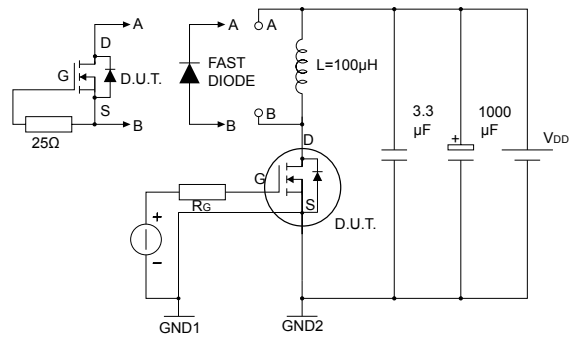
### 3 Test circuits

**Figure 13. Switching times test circuit for resistive load**


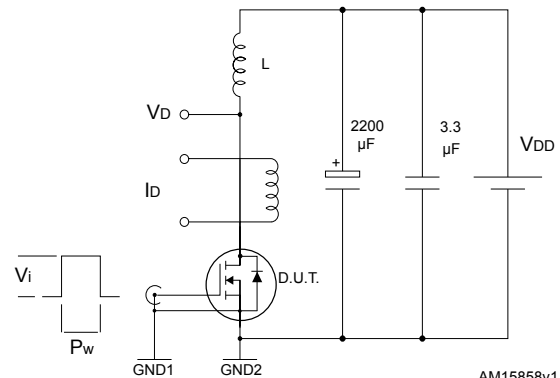
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**Figure 14. Test circuit for gate charge behavior**


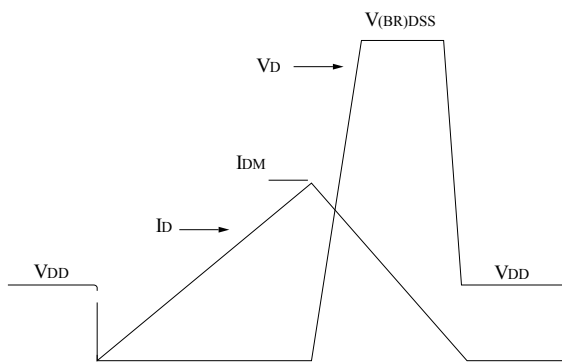
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**Figure 15. Test circuit for inductive load switching and diode recovery times**


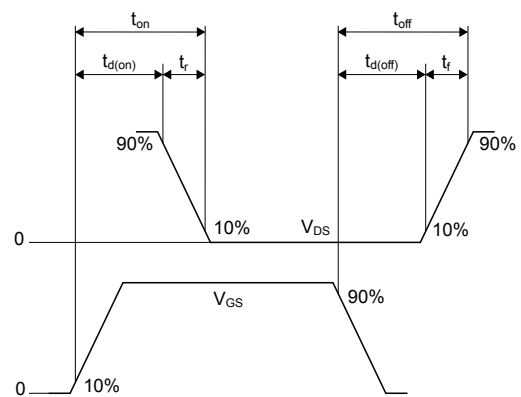
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**Figure 16. Unclamped inductive load test circuit**


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**Figure 17. Unclamped inductive waveform**


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**Figure 18. Switching time waveform**


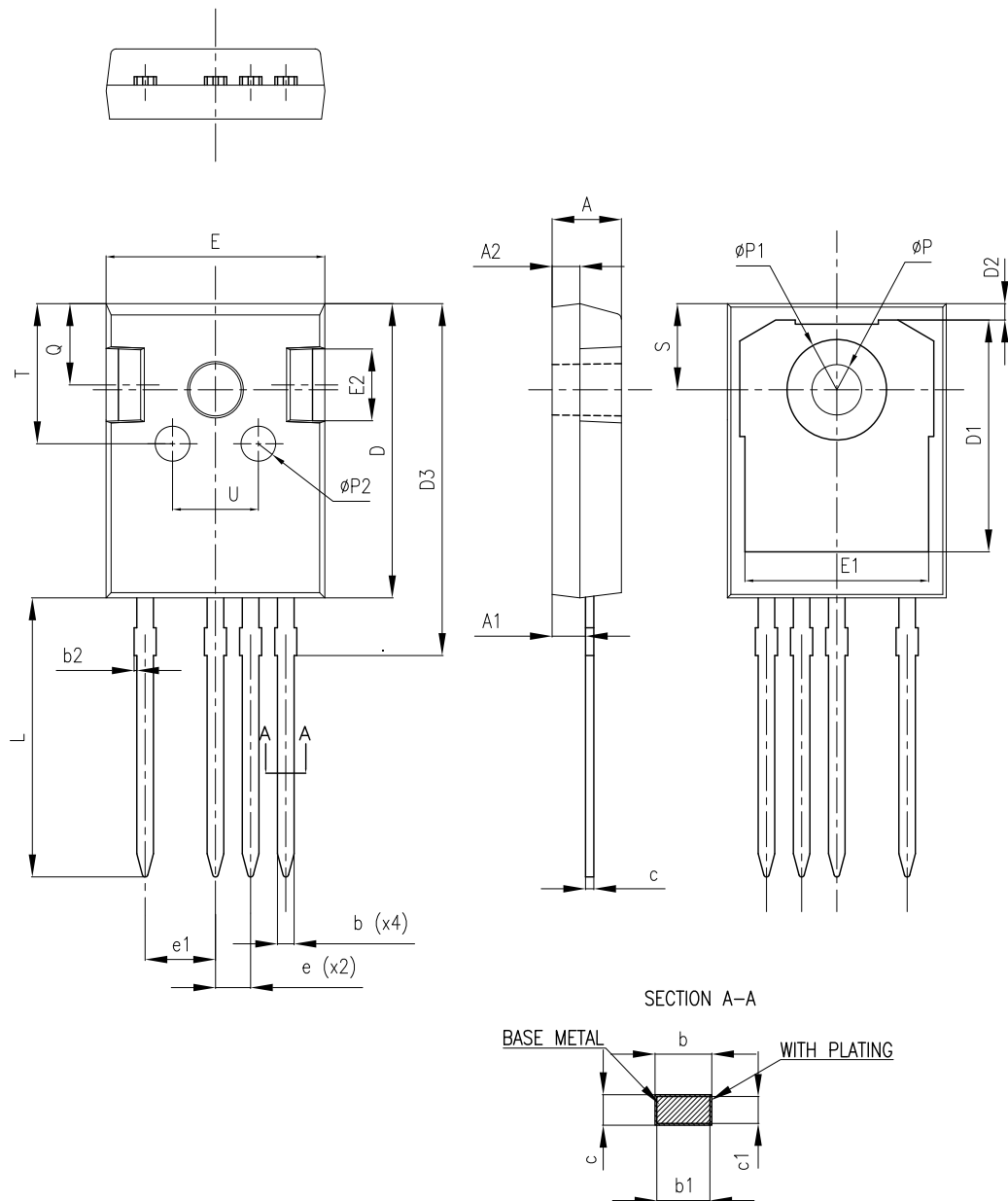
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## 4 Package information

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 TO247-4 package information

Figure 19. TO247-4 package outline



8405626\_2



**Table 8. TO247-4 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	Version	Changes
21-Apr-2020	1	First release.
20-Jul-2020	2	Modified Table 1. Absolute maximum ratings, Table 3. Avalanche characteristics, Table 4. On/off states, Table 5. Dynamic characteristics, Table 6. Switching times and Table 7. Source-drain diode. Added Section 2.1 Electrical characteristics (curves). Minor text changes.

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