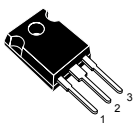
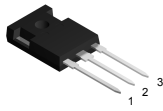


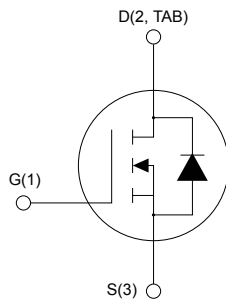
## N-channel 650 V, 24 mΩ typ., 84 A MDmesh M5 PowerMOSFETs in TO-247 and TO-247 long leads packages



TO-247



TO-247 long leads



AM01475v1\_noZen



### Features

Order codes	V <sub>DS</sub>	R <sub>DS(on)</sub> max.	I <sub>D</sub>
STW88N65M5	650 V	29 mΩ	84 A
STWA88N65M5			

- Higher V<sub>DSS</sub> rating
- Higher dv/dt capability
- Excellent switching performance
- Easy to drive
- 100% avalanche tested

### Applications

- High efficiency switching applications:
  - Servers
  - PV inverters
  - Telecom infrastructure
  - Multi kW battery chargers

### Description

These devices are N-channel Power MOSFETs based on the MDmesh M5 innovative vertical process technology combined with the well-known PowerMESH horizontal layout. The resulting products offer extremely low on-resistance, making them particularly suitable for applications requiring high power and superior efficiency.

#### Product status links

[STW88N65M5](#)
[STWA88N65M5](#)

#### Product summary

Order code	STW88N65M5
Marking	88N65M5
Package	TO-247
Packing	Tube
Order code	STWA88N65M5
Marking	88N65M5
Package	TO-247 long leads
Packing	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 $T_C = 25\text{ }^\circ\text{C}$	84	A
	Drain current (continuous) at $T_C = 100\text{ }^\circ\text{C}$	50.5	
$I_{DM}^{(1)}$	Drain current (pulsed)	336	A
$P_{TOT}$	Total power dissipation at $T_C = 25\text{ }^\circ\text{C}$	450	W
$I_{AR}$	Avalanche current, repetitive or not repetitive (pulse width limited by $T_J$ max.)	15	A
$E_{AS}$	Single pulse avalanche energy (starting $T_J = 25\text{ }^\circ\text{C}$ , $I_D = I_{AR}$ , $V_{DD} = 50\text{ V}$ )	2000	mJ
$dv/dt^{(2)}$	Peak diode recovery voltage slope	15	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 is limited by safe operating area.

2.  $I_{SD} \leq 84\text{ A}$ ,  $di/dt \leq 400\text{ A}/\mu\text{s}$ ,  $V_{DS} (\text{peak}) < V_{(BR)DSS}$ ,  $V_{DD} = 400\text{ V}$ .

**Table 2. Thermal data**

Symbol	Parameter	Value	Unit
$R_{thJC}$	Thermal resistance, junction-to-case	0.28	$^\circ\text{C}/\text{W}$
$R_{thJA}$	Thermal resistance, junction-to-ambient	50	$^\circ\text{C}/\text{W}$

## 2 Electrical characteristics

$T_C = 25\text{ }^\circ\text{C}$  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	$V_{GS} = 0\text{ V}$ , $V_{DS} = 650\text{ V}$			1	$\mu\text{A}$
		$V_{GS} = 0\text{ V}$ , $V_{DS} = 650\text{ V}$ , $T_C = 125\text{ }^\circ\text{C}^{(1)}$			100	
$I_{GSS}$	Gate-body leakage current	$V_{DS} = 0\text{ V}$ , $V_{GS} = \pm 25\text{ V}$			$\pm 100$	nA
$V_{GS(th)}$	Gate threshold voltage	$V_{DS} = V_{GS}$ , $I_D = 250\text{ }\mu\text{A}$	3	4	5	V
$R_{DS(on)}$	Static drain-source on-resistance	$V_{GS} = 10\text{ V}$ , $I_D = 42\text{ A}$		24	29	m $\Omega$

1. Specified by design, not tested in production.

**Table 4. Dynamic**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$C_{iss}$	Input capacitance	$V_{DS} = 100\text{ V}$ , $f = 1\text{ MHz}$ , $V_{GS} = 0\text{ V}$	-	8825	-	pF
$C_{oss}$	Output capacitance		-	223	-	pF
$C_{rss}$	Reverse transfer capacitance		-	11	-	pF
$C_{o(tr)}^{(1)}$	Equivalent capacitance time related	$V_{DS} = 0\text{ to }520\text{ V}$ , $V_{GS} = 0\text{ V}$	-	778	-	pF
$C_{o(er)}^{(2)}$	Equivalent capacitance energy related		-	202	-	pF
$R_G$	Intrinsic gate resistance	$f = 1\text{ MHz}$ , $I_D = 0\text{ A}$	-	1.79	-	$\Omega$
$Q_g$	Total gate charge	$V_{DD} = 520\text{ V}$ , $I_D = 42\text{ A}$	-	204	-	nC
$Q_{gs}$	Gate-source charge	$V_{GS} = 0\text{ to }10\text{ V}$	-	51	-	nC
$Q_{gd}$	Gate-drain charge	(see Figure 15. Test circuit for gate charge behavior)	-	84	-	nC

- $C_{o(tr)}$  is an equivalent capacitance that provides the same charging time as  $C_{oss}$  while  $V_{DS}$  is rising from 0 V to the stated value.
- $C_{o(er)}$  is an equivalent capacitance that provides the same stored energy as  $C_{oss}$  while  $V_{DS}$  is rising from 0 V to the stated value.

**Table 5. Switching times**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$t_{d(v)}$	Voltage delay time	$V_{DD} = 400\text{ V}$ , $I_D = 56\text{ A}$ ,	-	141	-	ns
$t_{r(v)}$	Voltage rise time	$R_G = 4.7\text{ }\Omega$ , $V_{GS} = 10\text{ V}$	-	16	-	ns
$t_{f(i)}$	Current fall time	(see Figure 16. Test circuit for inductive load switching and diode recovery times and Figure 19. Switching time waveform)	-	29	-	ns
$t_{c(off)}$	Crossing time		-	56	-	ns

**Table 6. Source-drain diode**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$I_{SD}$	Source-drain current		-		84	A
$I_{SDM}^{(1)}$	Source-drain current (pulsed)		-		336	A
$V_{SD}^{(2)}$	Forward on voltage	$I_{SD} = 84 \text{ A}, V_{GS} = 0 \text{ V}$	-		1.5	V
$t_{rr}$	Reverse recovery time	$I_{SD} = 84 \text{ A}, di/dt = 100 \text{ A}/\mu\text{s},$	-	544		ns
$Q_{rr}$	Reverse recovery charge	$V_{DD} = 100 \text{ V}$	-	14		$\mu\text{C}$
$I_{RRM}$	Reverse recovery current	(see Figure 16. Test circuit for inductive load switching and diode recovery times)	-	50		A
$t_{rr}$	Reverse recovery time	$I_{SD} = 84 \text{ A}, di/dt = 100 \text{ A}/\mu\text{s},$	-	660		ns
$Q_{rr}$	Reverse recovery charge	$V_{DD} = 100 \text{ V}, T_J = 150 \text{ }^\circ\text{C}$	-	20		$\mu\text{C}$
$I_{RRM}$	Reverse recovery current	(see Figure 16. Test circuit for inductive load switching and diode recovery times)	-	60		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

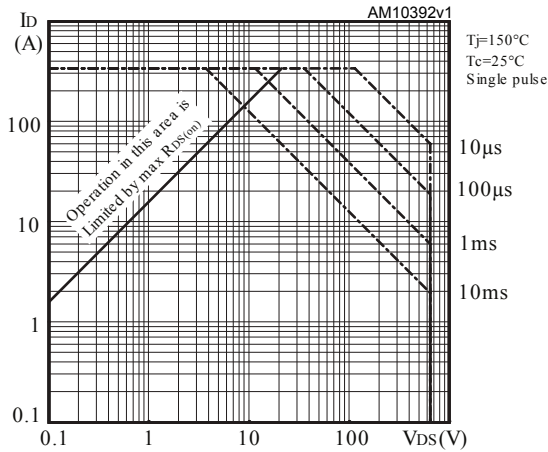


Figure 2. Normalized transient thermal impedance

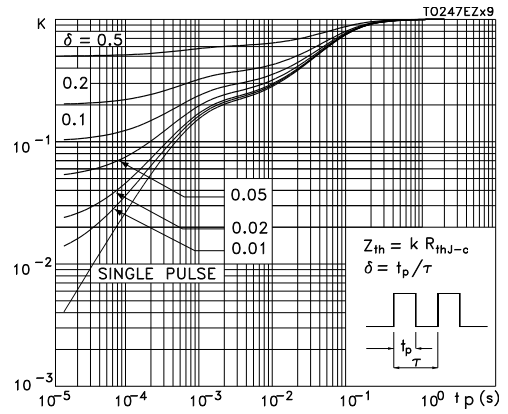


Figure 3. Typical output characteristics

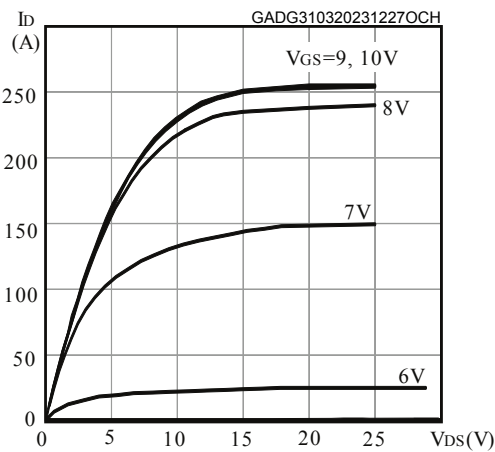


Figure 4. Typical transfer characteristics

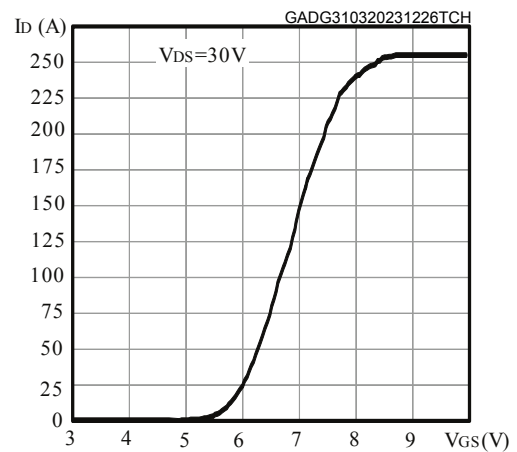


Figure 5. Normalized breakdown voltage vs temperature

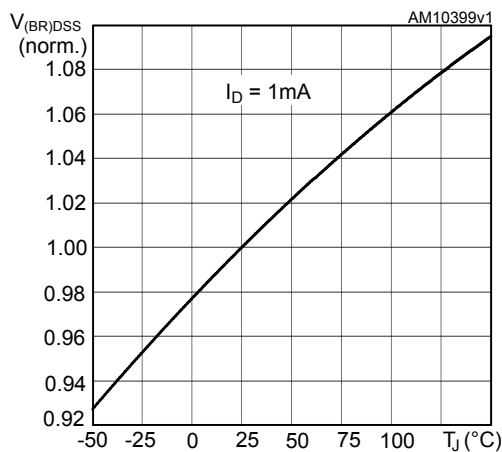


Figure 6. Typical drain-source on-resistance

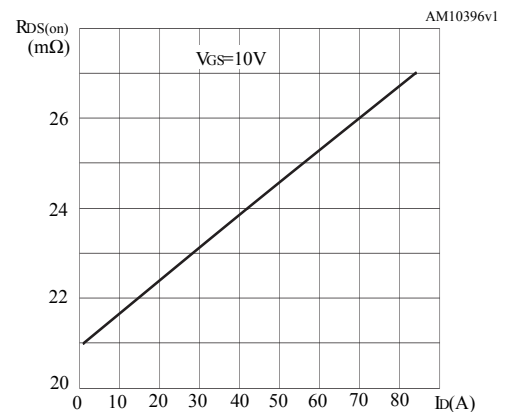


Figure 7. Typical reverse diode forward characteristics

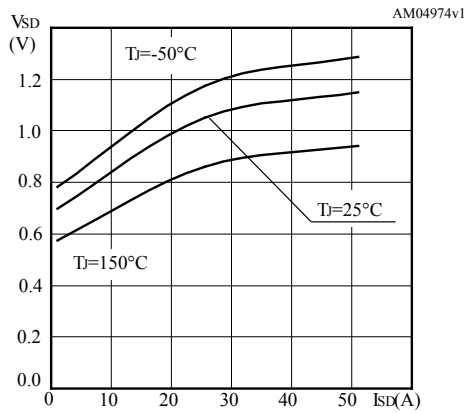


Figure 8. Typical gate charge characteristics

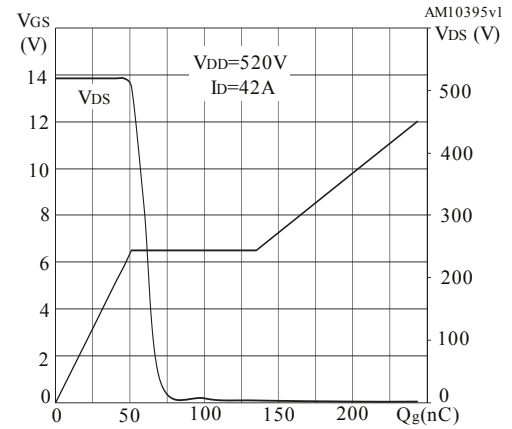


Figure 9. Typical capacitance characteristics

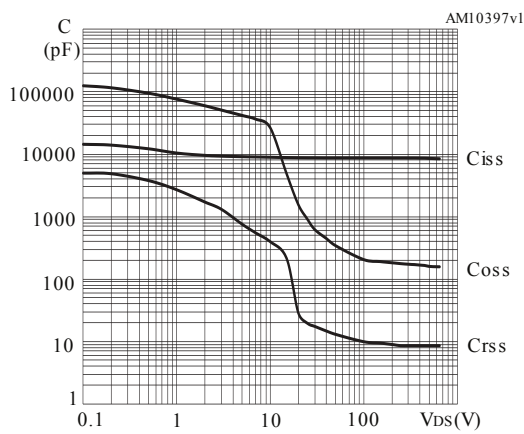


Figure 10. Normalized gate threshold vs temperature

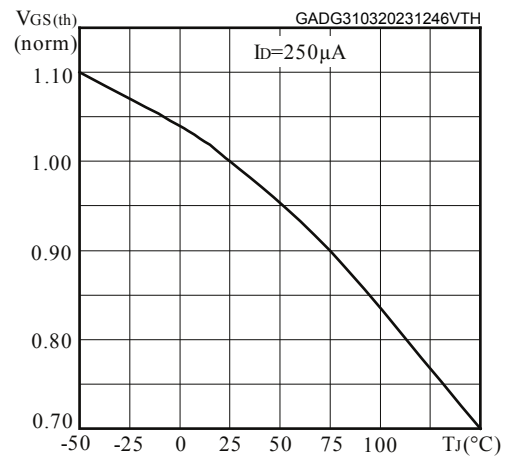


Figure 11. Normalized on-resistance vs temperature

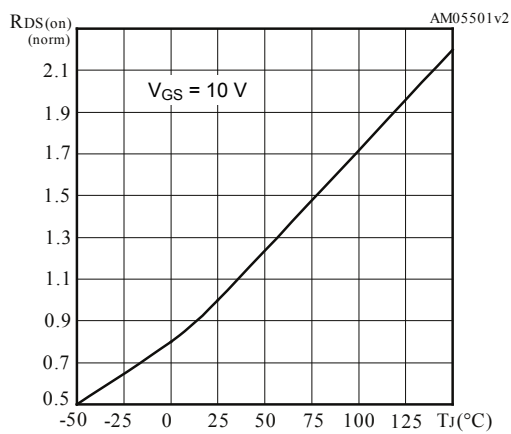
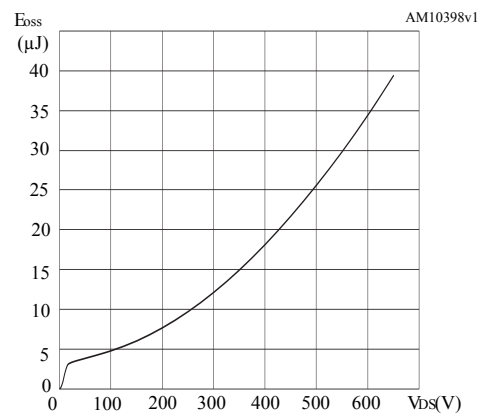
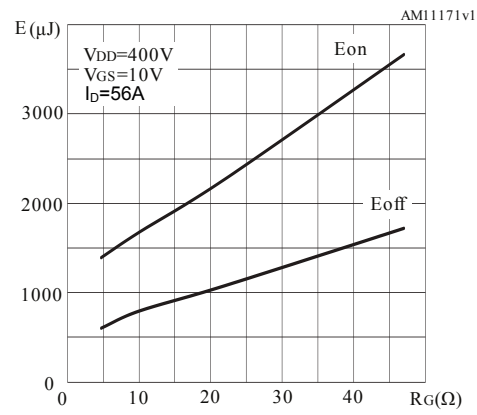


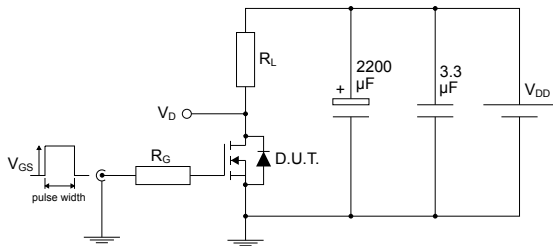
Figure 12. Typical output capacitance stored energy



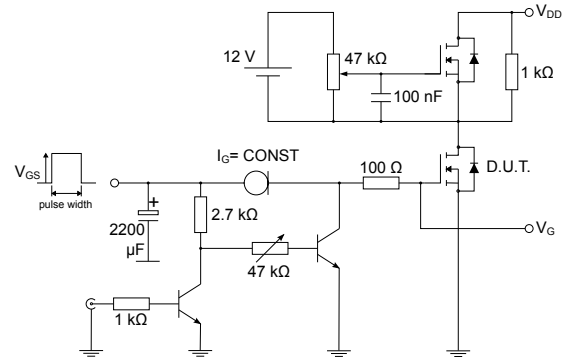
**Figure 13. Typical switching energy vs gate resistance**


Note:  $E_{on}$  including reverse recovery of a SiC diode.

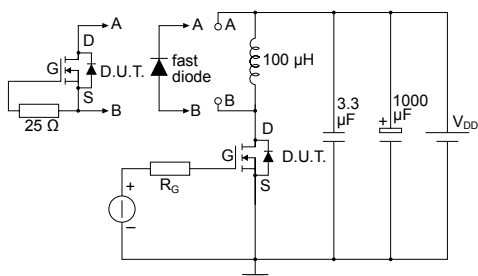
### 3 Test circuits

**Figure 14. Test circuit for resistive load switching times**


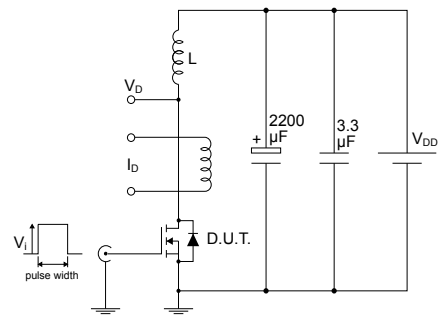
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**Figure 15. Test circuit for gate charge behavior**


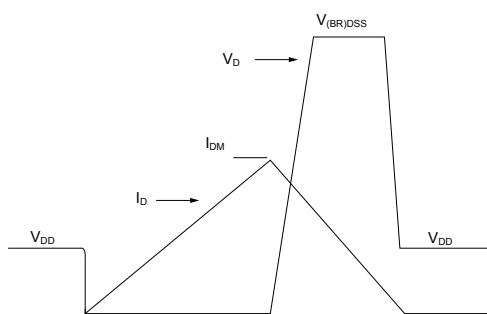
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**Figure 16. Test circuit for inductive load switching and diode recovery times**


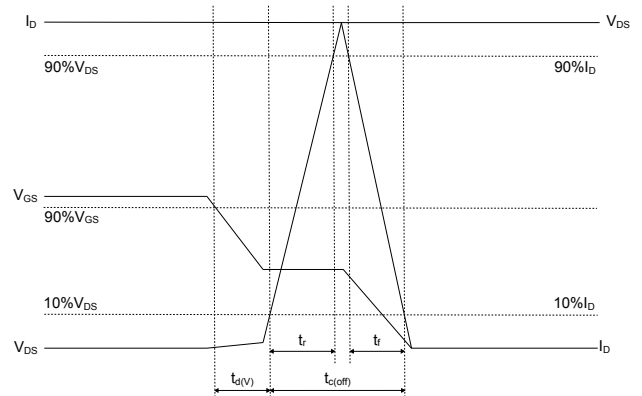
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**Figure 17. Unclamped inductive load test circuit**


AM01471v1

**Figure 18. Unclamped inductive waveform**


AM01472v1

**Figure 19. Switching time waveform**


AM05540v2

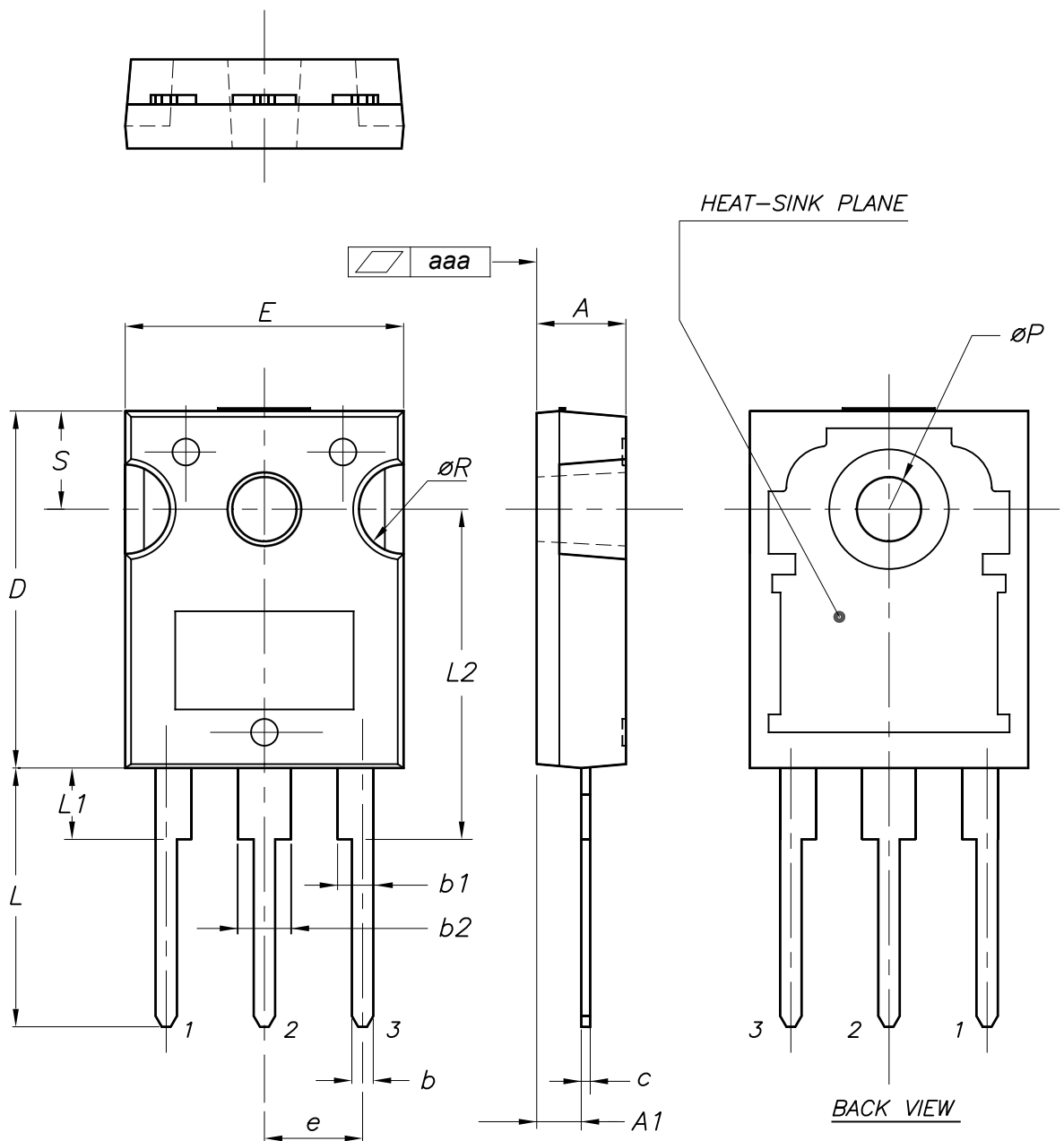


## 4 Package information

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 TO-247 package information

Figure 20. TO-247 package outline



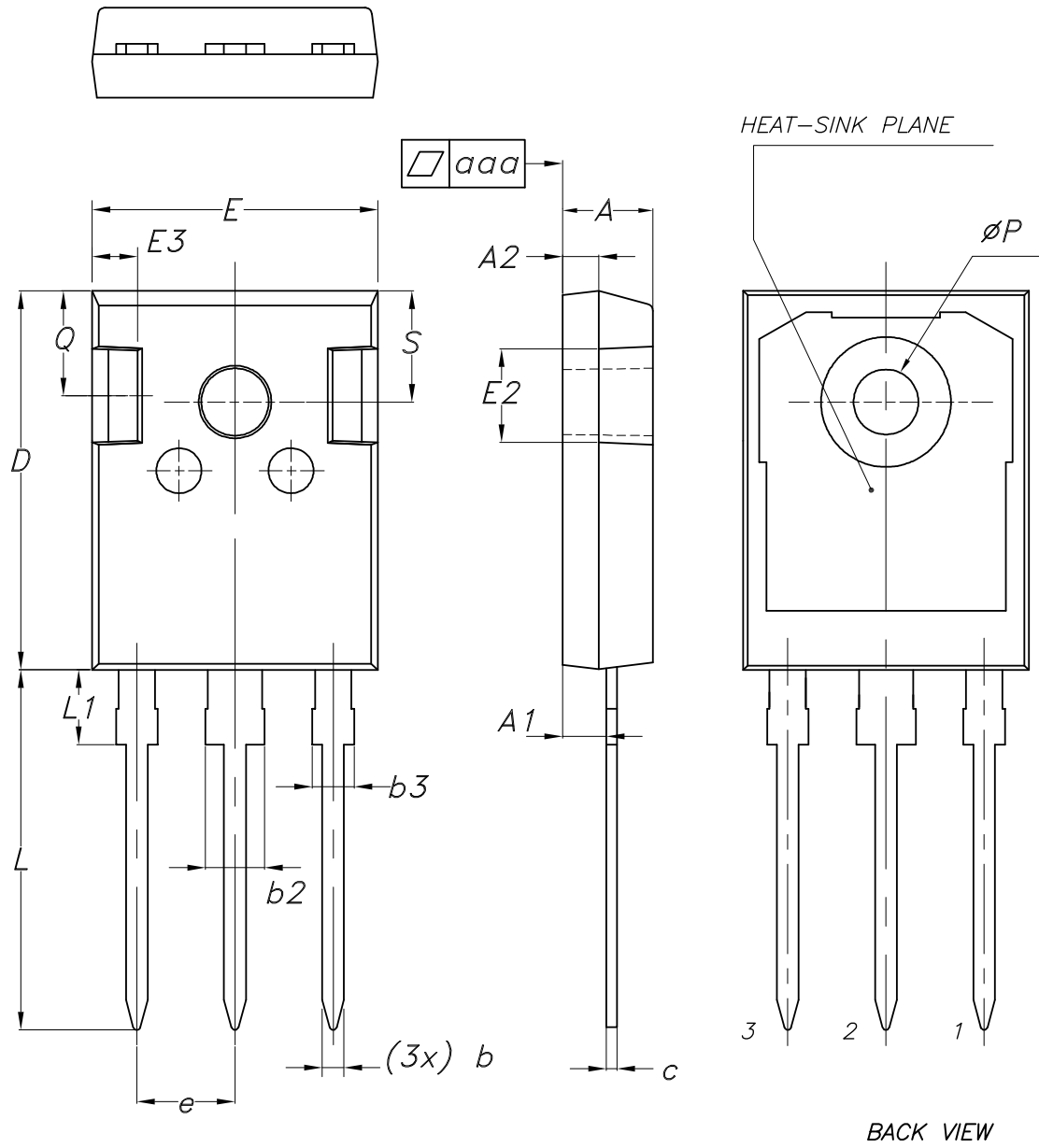
0075325\_10

Table 7. 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

## 4.2 TO-247 long leads package information

Figure 21. TO-247 long leads package outline



8463846\_4

**Table 8. TO-247 long leads package 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		1.26
b2			3.25
b3			2.25
c	0.59		0.66
D	20.90	21.00	21.10
E	15.70	15.80	15.90
E2	4.90	5.00	5.10
E3	2.40	2.50	2.60
e	5.34	5.44	5.54
L	19.80	19.92	20.10
L1			4.30
P	3.50	3.60	3.70
Q	5.60		6.00
S	6.05	6.15	6.25
aaa		0.04	0.10

## Revision history

**Table 9. Document revision history**

Date	Revision	Changes
23-Nov-2011	1	First release.
09-Dec-2011	2	Document status promoted from preliminary data to datasheet.
12-Jun-2012	3	Updated title on the cover page.
30-Nov-2012	4	Added new part number: STWA88N65M5 Updated: <i>Section 4: Package mechanical data</i>
16-Jul-2014	5	– Updated: <i>Figure 4 and 5</i> – Minor text changes
12-Apr-2023	6	Modified title and <a href="#">Features</a> Updated <a href="#">Section 4 Package information</a> Minor text changes



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