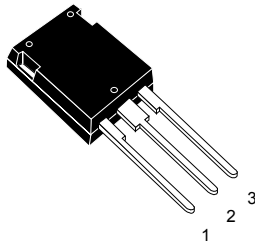
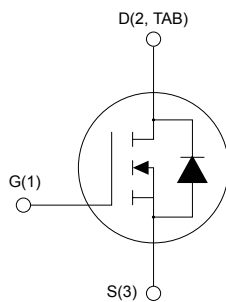


## N-channel 650 V, 14 mΩ typ., 130 A MDmesh M5 Power MOSFET in a Max247 package



Max247



AM01475v1\_no2en



### Features

Order code	$V_{DS}$ at $T_J$ max.	$R_{DS(on)}$ max.	$I_D$
STY139N65M5	710 V	17 mΩ	130 A

- Extremely low  $R_{DS(on)}$
- Low gate charge and input capacitance
- Excellent switching performance
- 100% avalanche tested

### Applications

- Switching applications

### Description

This device is an N-channel Power MOSFET based on the MDmesh M5 innovative vertical process technology combined with the well-known PowerMESH horizontal layout. The resulting product offers extremely low on-resistance, making it particularly suitable for applications requiring high power and superior efficiency.

#### Product status link

[STY139N65M5](#)

#### Product summary

<b>Order code</b>	STY139N65M5
<b>Marking</b>	139N65M5
<b>Package</b>	Max247
<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 $T_C = 25\text{ }^\circ\text{C}$	130	A
	Drain current (continuous) at $T_C = 100\text{ }^\circ\text{C}$	78	
$I_{DM}^{(1)}$	Drain current (pulsed)	520	A
$P_{TOT}$	Total power dissipation at $T_C = 25\text{ }^\circ\text{C}$	625	W
$I_{AR}$	Avalanche current, repetitive or not repetitive (pulse width limited by $T_J$ max.)	12	A
$E_{AS}$	Single pulse avalanche energy (starting $T_J = 25\text{ }^\circ\text{C}$ , $I_D = I_{AR}$ , $V_{DD} = 50\text{ V}$ )	2400	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.  $I_{SD} \leq 130\text{ A}$ ,  $di/dt \leq 400\text{ A}/\mu\text{s}$ ,  $V_{DS}(\text{peak}) < V_{(BR)DSS}$ ,  $V_{DD} = 400\text{ V}$ .

**Table 2. Thermal data**

Symbol	Parameter	Value	Unit
$R_{thJC}$	Thermal resistance, junction-to-case	0.2	$^\circ\text{C}/\text{W}$
$R_{thJA}$	Thermal resistance, junction-to-ambient	30	$^\circ\text{C}/\text{W}$

## 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	$V_{GS} = 0\text{ V}$ , $V_{DS} = 650\text{ V}$			10	$\mu\text{A}$
		$V_{GS} = 0\text{ V}$ , $V_{DS} = 650\text{ V}$ , $T_C = 125\text{ }^\circ\text{C}^{(1)}$			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	$V_{GS} = 10\text{ V}$ , $I_D = 65\text{ A}$		14	17	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	$V_{DS} = 100\text{ V}$ , $f = 1\text{ MHz}$ , $V_{GS} = 0\text{ V}$	-	15600	-	pF
$C_{oss}$	Output capacitance		-	365	-	pF
$C_{rss}$	Reverse transfer capacitance		-	9	-	pF
$C_{o(tr)}^{(1)}$	Equivalent capacitance time related	$V_{DS} = 0\text{ to }520\text{ V}$ , $V_{GS} = 0\text{ V}$	-	1559	-	pF
$C_{o(er)}^{(2)}$	Equivalent capacitance energy related		-	360	-	pF
$R_G$	Intrinsic gate resistance	$f = 1\text{ MHz}$ , $I_D = 0\text{ A}$	-	1.2	-	$\Omega$
$Q_g$	Total gate charge	$V_{DD} = 520\text{ V}$ , $I_D = 65\text{ A}$	-	363	-	nC
$Q_{gs}$	Gate-source charge	$V_{GS} = 0\text{ to }10\text{ V}$	-	88	-	nC
$Q_{gd}$	Gate-drain charge	(see Figure 14. Test circuit for gate charge behavior)	-	164	-	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	$V_{DD} = 400\text{ V}$ , $I_D = 80\text{ A}$ ,	-	295	-	ns
$t_{r(v)}$	Voltage rise time	$R_G = 4.7\text{ }\Omega$ , $V_{GS} = 10\text{ V}$	-	56	-	ns
$t_{f(i)}$	Current fall time	(see Figure 15. Test circuit for inductive load switching and diode recovery times and Figure 18. Switching time waveform)	-	37	-	ns
$t_{c(off)}$	Crossing time		-	84	-	ns

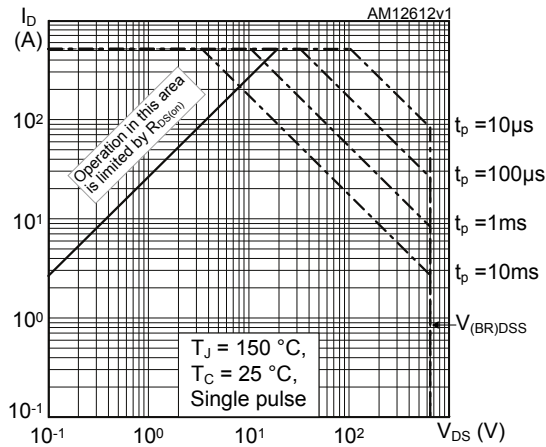
**Table 6. Source-drain diode**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$I_{SD}$	Source-drain current		-		130	A
$I_{SDM}^{(1)}$	Source-drain current (pulsed)		-		520	A
$V_{SD}^{(2)}$	Forward on voltage	$I_{SD} = 130 \text{ A}$ , $V_{GS} = 0 \text{ V}$	-		1.5	V
$t_{rr}$	Reverse recovery time	$I_{SD} = 130 \text{ A}$ , $di/dt = 100 \text{ A}/\mu\text{s}$ ,	-	570		ns
$Q_{rr}$	Reverse recovery charge	$V_{DD} = 100 \text{ V}$	-	15		$\mu\text{C}$
$I_{RRM}$	Reverse recovery current	(see Figure 15. Test circuit for inductive load switching and diode recovery times)	-	53		A
$t_{rr}$	Reverse recovery time	$I_{SD} = 130 \text{ A}$ , $di/dt = 100 \text{ A}/\mu\text{s}$ ,	-	720		ns
$Q_{rr}$	Reverse recovery charge	$V_{DD} = 100 \text{ V}$ , $T_J = 150 \text{ }^\circ\text{C}$	-	24		$\mu\text{C}$
$I_{RRM}$	Reverse recovery current	(see Figure 15. Test circuit for inductive load switching and diode recovery times)	-	68		A

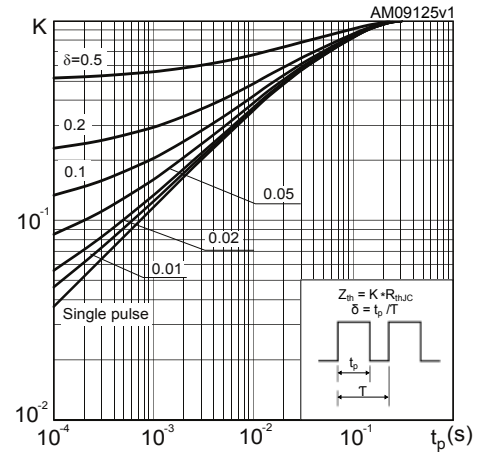
1. Pulse width is limited by safe operating area.
2. Pulsed: pulse duration = 300  $\mu\text{s}$ , duty cycle 1.5%.

## 2.1 Electrical characteristics (curves)

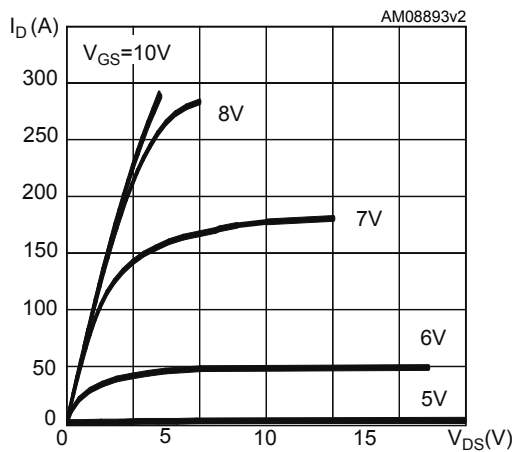
**Figure 1. Safe operating area**



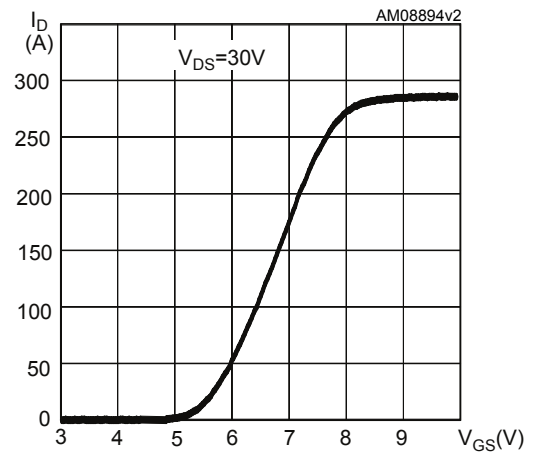
**Figure 2. Normalized transient thermal impedance**



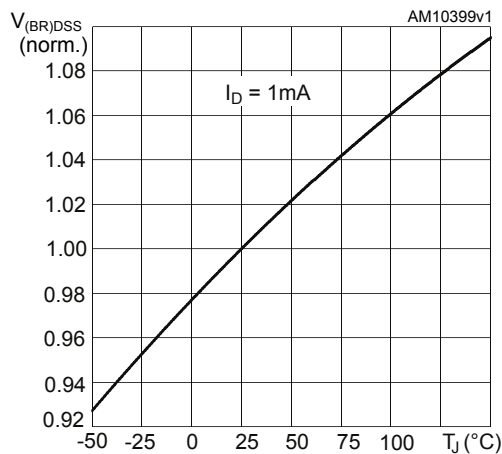
**Figure 3. Typical output characteristics**



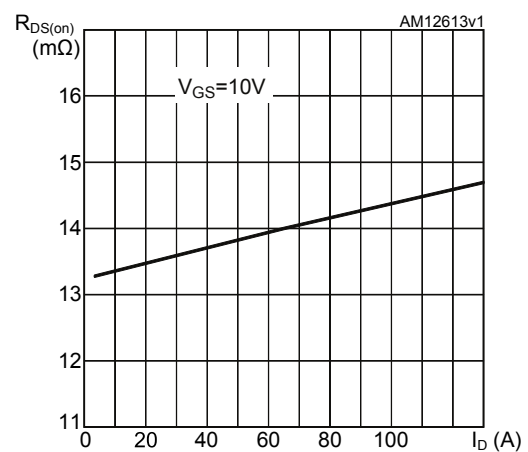
**Figure 4. Typical transfer characteristics**



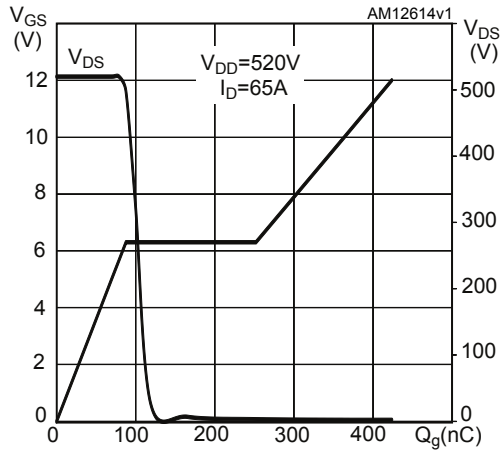
**Figure 5. Normalized breakdown voltage vs temperature**



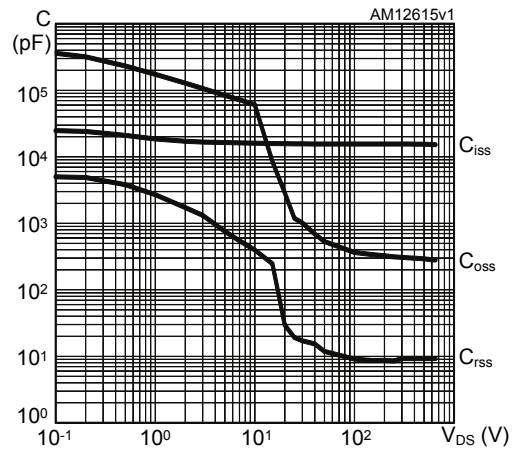
**Figure 6. Typical drain-source on-resistance**



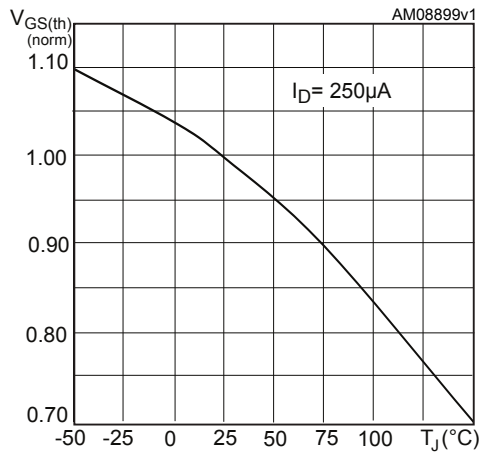
**Figure 7. Typical gate charge characteristics**



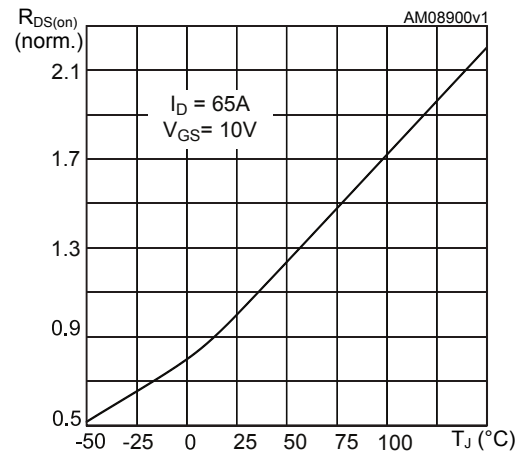
**Figure 8. Typical capacitance characteristics**



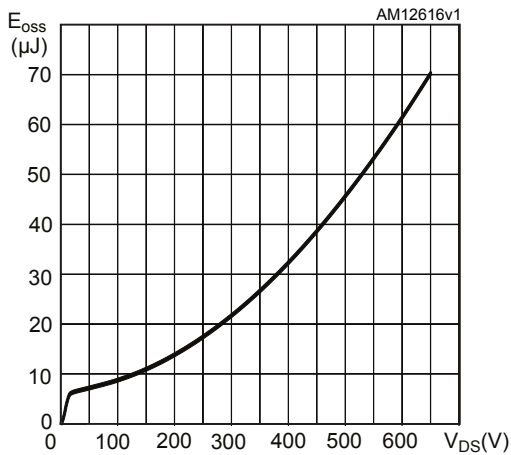
**Figure 9. Normalized gate threshold vs temperature**



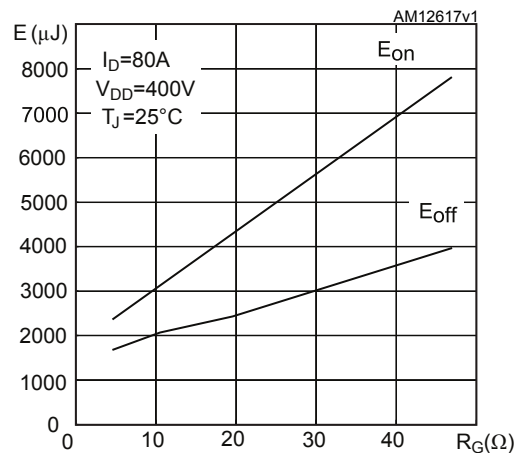
**Figure 10. Normalized on-resistance vs temperature**



**Figure 11. Typical output capacitance stored energy**

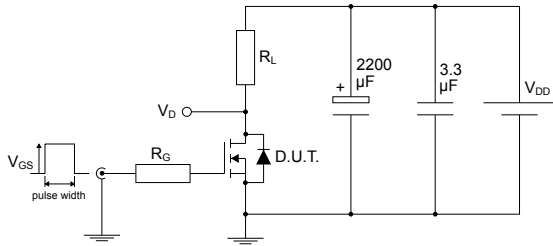


**Figure 12. Typical switching energy vs gate resistance**

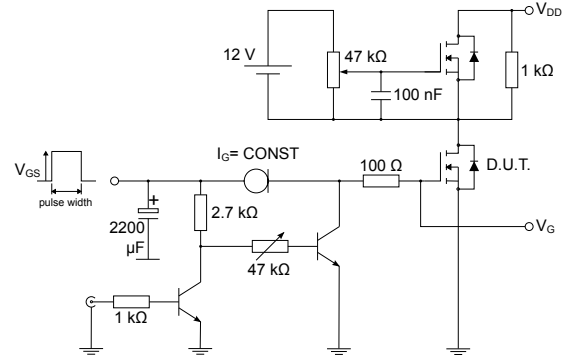


Note:  $E_{on}$  including reverse recovery of a SiC diode.

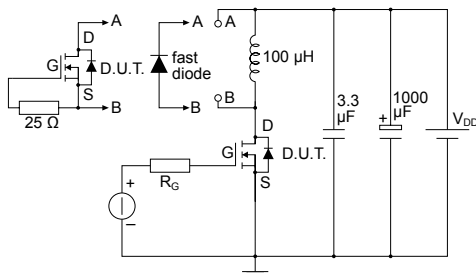
### 3 Test circuits

**Figure 13. Test circuit for resistive load switching times**


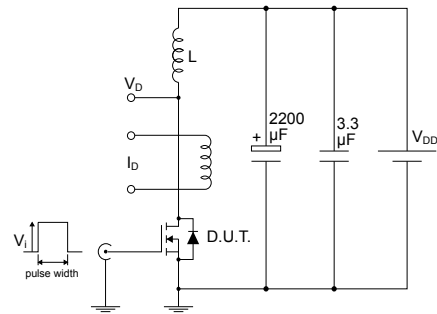
AM01468v1

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


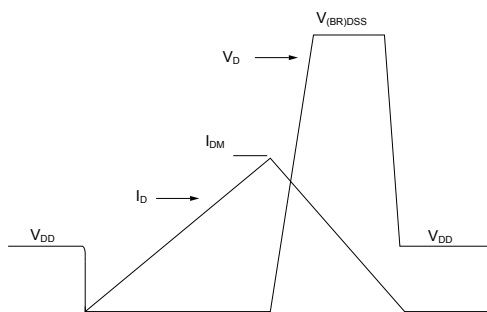
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**Figure 15. Test circuit for inductive load switching and diode recovery times**


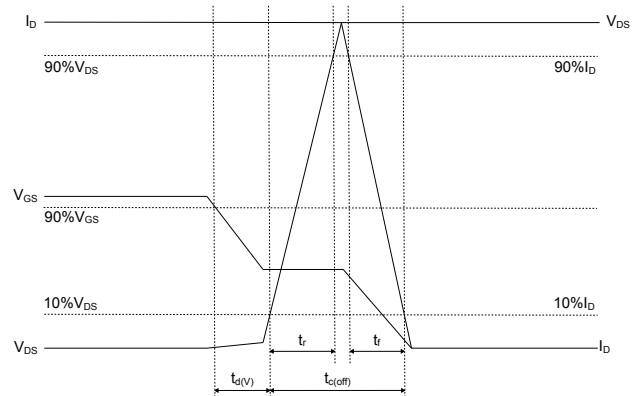
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**Figure 16. Unclamped inductive load test circuit**


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**Figure 17. Unclamped inductive waveform**


AM01472v1

**Figure 18. Switching time waveform**


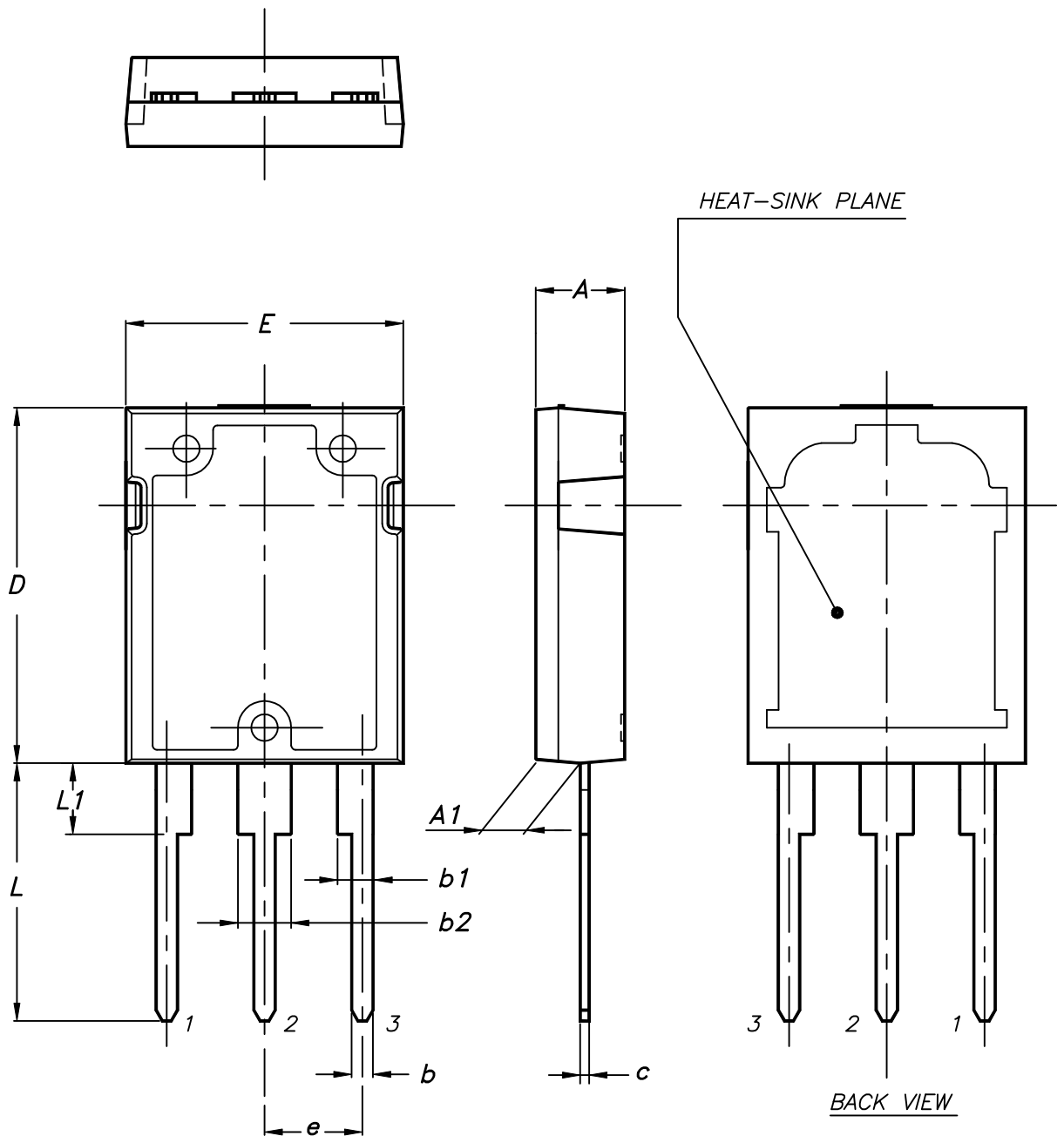
AM05540v2

## 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 Max247 package information

Figure 19. Max247 package outline



0094330\_5



**Table 7. Max247 package mechanical data**

Dim.	mm		
	Min.	Typ.	Max.
A	4.70	-	5.30
A1	2.20	-	2.60
b	1.00	-	1.40
b1	2.00	-	2.40
b2	3.00	-	3.40
c	0.40	-	0.80
D	19.70	-	20.30
e	5.35	-	5.55
E	15.30	-	15.90
L	14.20	-	15.20
L1	3.70	-	4.30

## Revision history

**Table 8. Document revision history**

Date	Revision	Changes
09-Mar-2012	1	First release.
04-Apr-2012	2	Inserted new <i>Section 2.1: Electrical characteristics (curves)</i> . Updated <i>Section 4: Package mechanical data</i> .
19-Apr-2012	3	Document promoted from preliminary data to production data. Updated <i>Section 4: Package mechanical data</i> .
24-Jan-2013	4	– Minor text changes – Modified: $I_{AR}$ $E_{AS}$ values on <i>Table 2</i>
18-Jul-2022	5	Updated title, <a href="#">Internal schematic</a> , <a href="#">Features</a> and <a href="#">Description</a> on cover page. Updated $I_{AR}$ value in <i>Table 1. Absolute maximum ratings</i> and updated <i>Table 2. Thermal data</i> . Minor text changes.

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