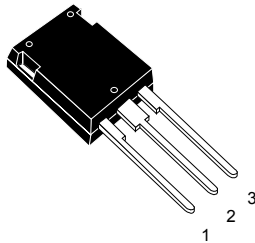
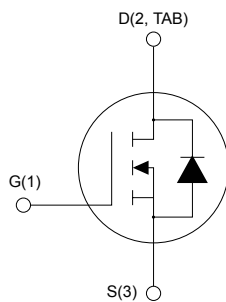


## N-channel 650 V, 14 mΩ typ., 130 A MDmesh M5 Power MOSFET in a Max247 package


**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

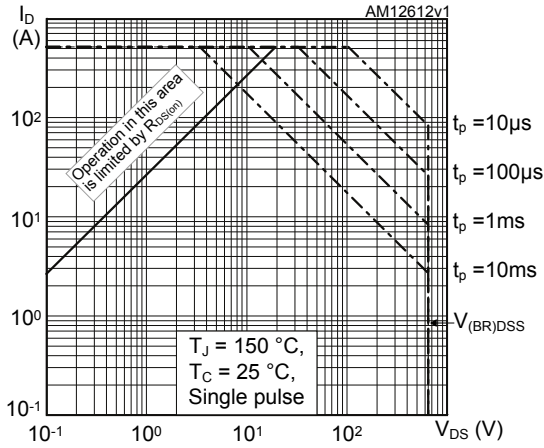


Figure 2. Normalized transient thermal impedance

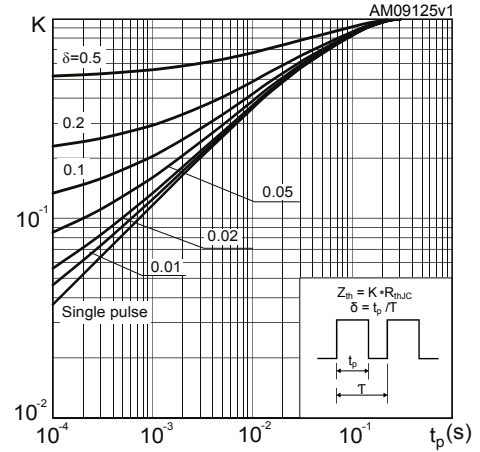


Figure 3. Typical output characteristics

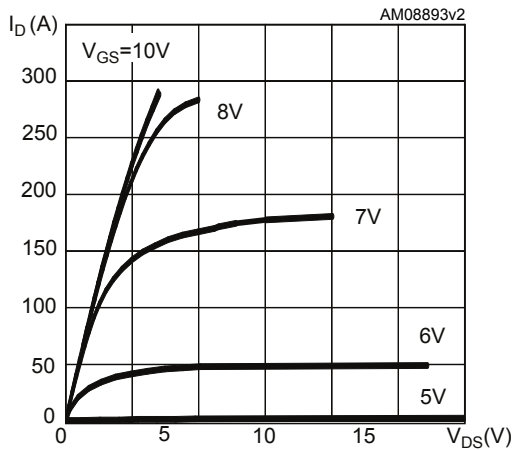


Figure 4. Typical transfer characteristics

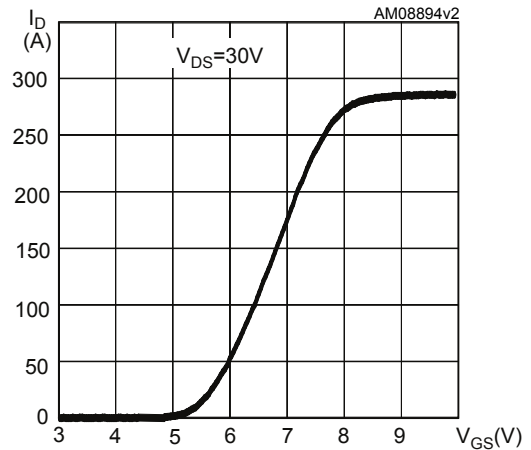


Figure 5. Normalized breakdown voltage vs temperature

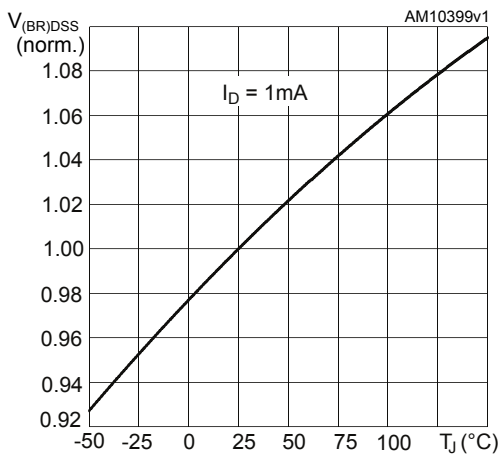
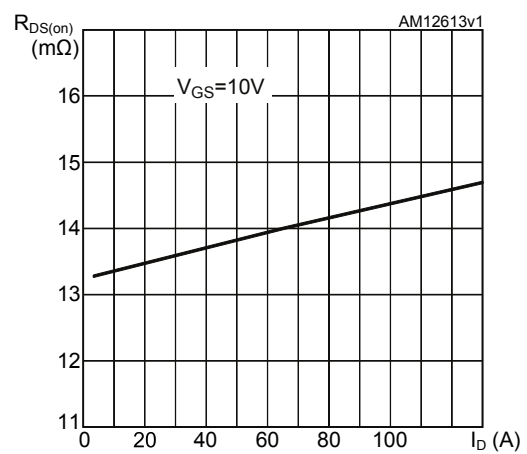
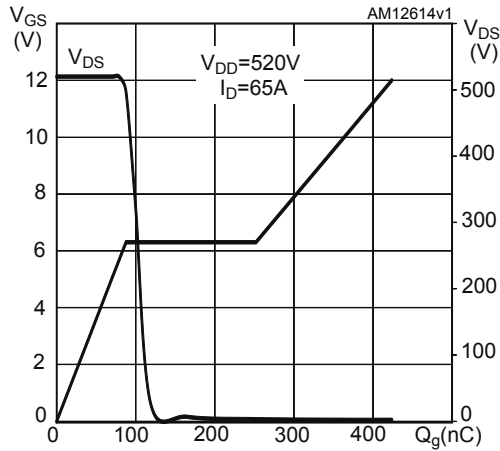


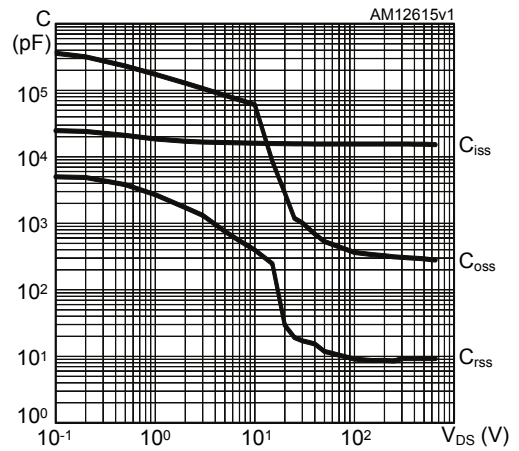
Figure 6. Typical drain-source on-resistance



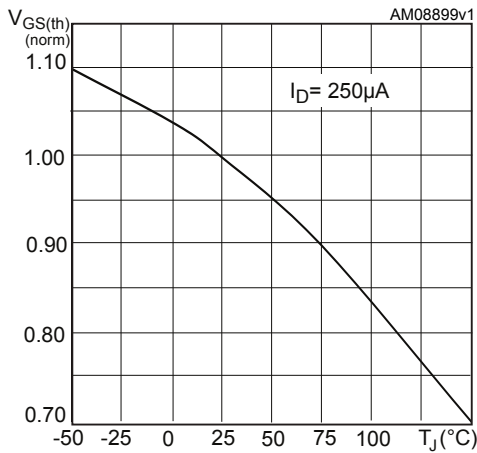
**Figure 7. Typical gate charge characteristics**



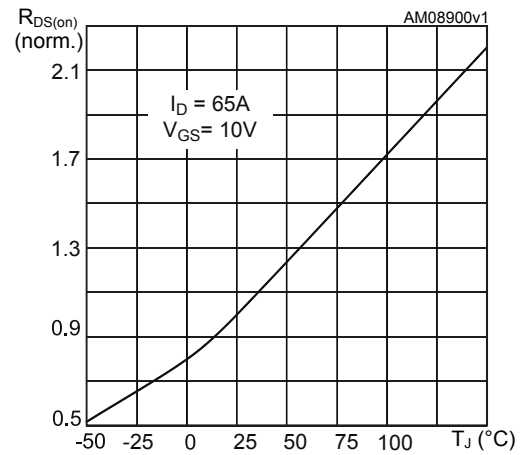
**Figure 8. Typical capacitance characteristics**



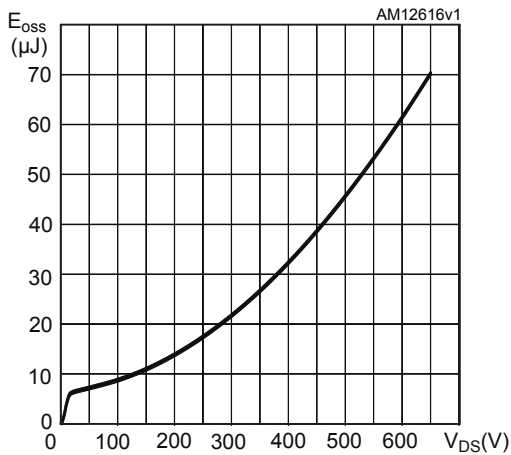
**Figure 9. Normalized gate threshold vs temperature**



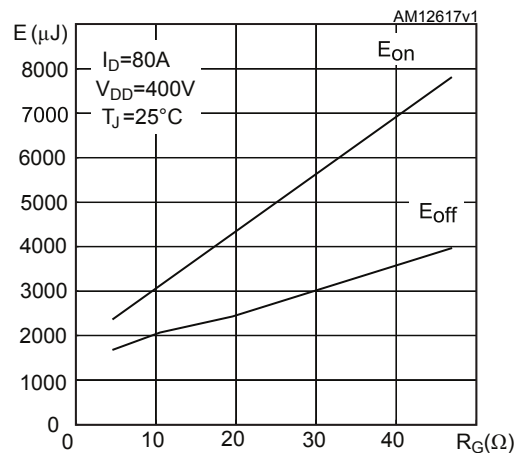
**Figure 10. Normalized on-resistance vs temperature**



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

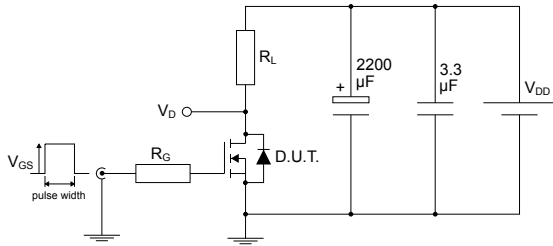


**Figure 12. Typical switching energy vs gate resistance**

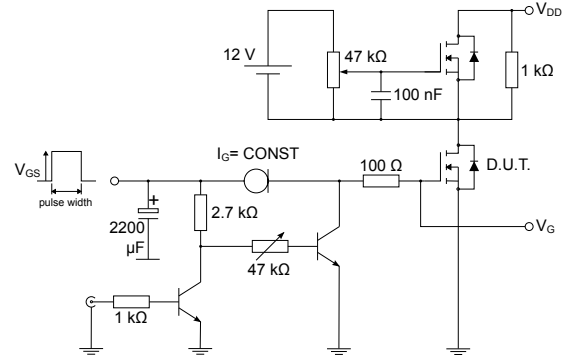


Note:  $E_{on}$  including reverse recovery of a SiC diode.

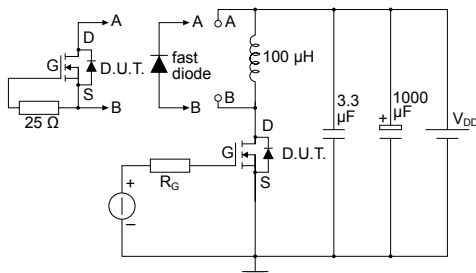
### 3 Test circuits

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


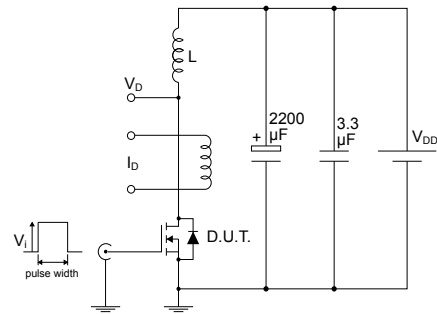
AM01468v1

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


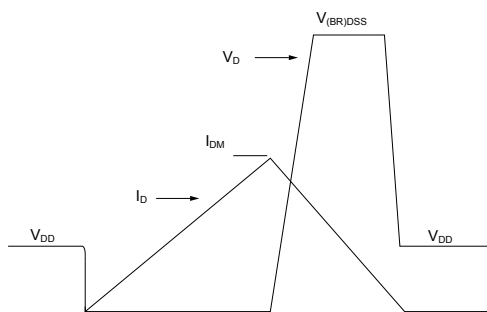
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**Figure 15. Test circuit for inductive load switching and diode recovery times**


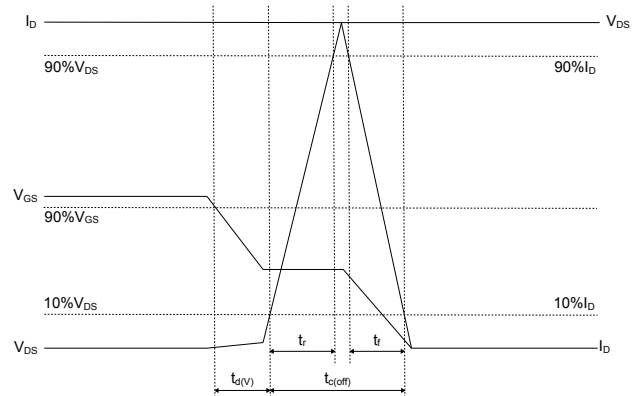
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**Figure 16. Unclamped inductive load test circuit**


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**Figure 17. Unclamped inductive waveform**


AM01472v1

**Figure 18. Switching time waveform**


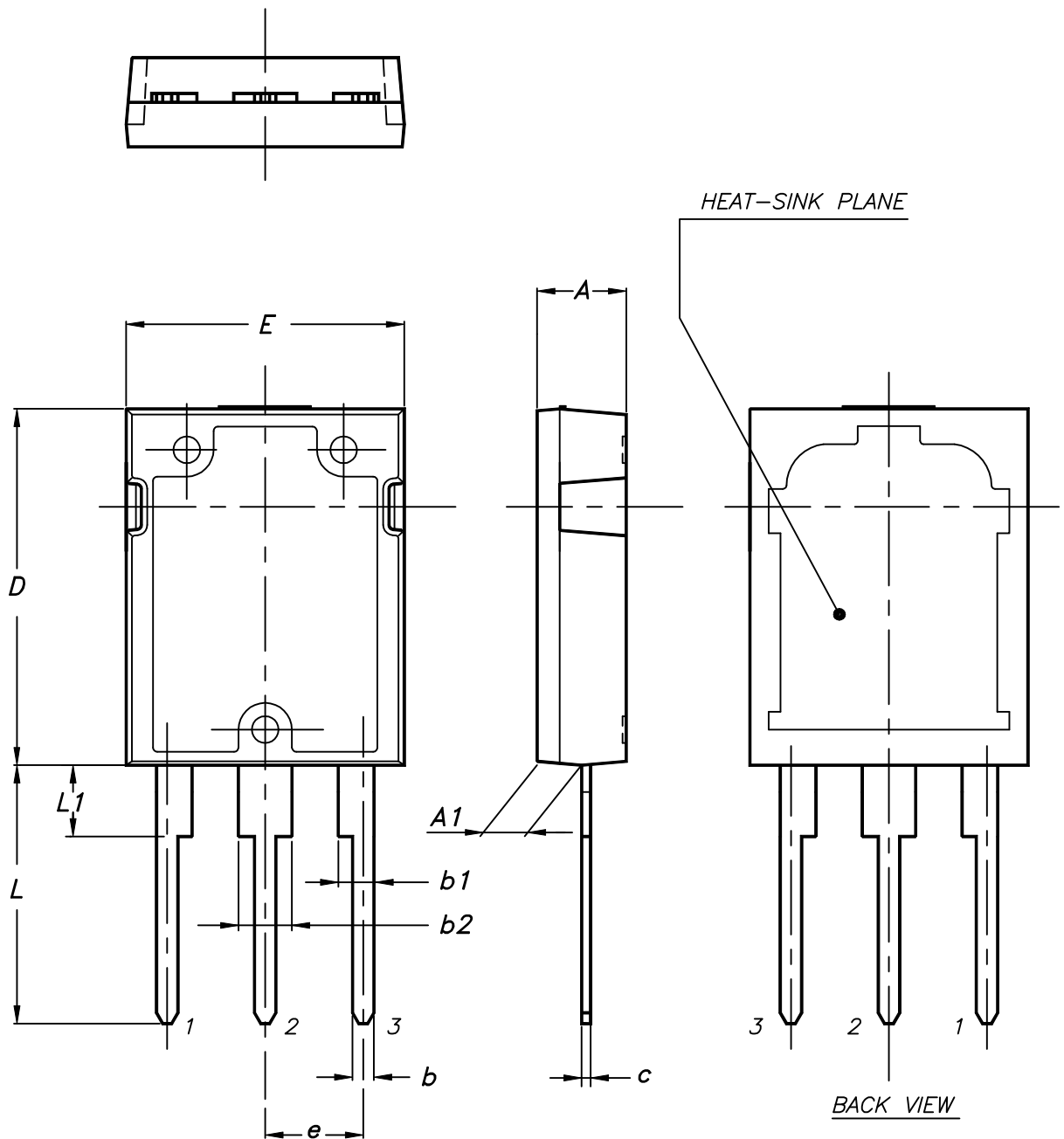
AM05540v2

## 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</i> . <a href="#">Absolute maximum ratings</a> and updated <i>Table 2</i> . <a href="#">Thermal data</a> . Minor text changes.

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