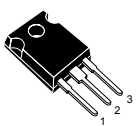
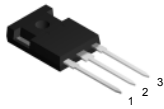


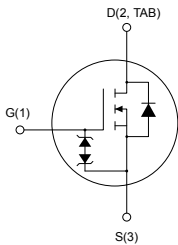
## N-channel 600 V, 60 mΩ typ., 46 A MDmesh DM6 Power MOSFETs in a TO-247 and TO-247 long leads packages



TO-247



TO-247 long leads



AM01476v1\_lab



### Features

Order code	$V_{DS}$	$R_{DS(on)}$ max.	$I_D$
STW65N60DM6	600 V	71 mΩ	46 A
STWA65N60DM6			

- 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
- Zener-protected

### Applications

- Switching applications

### Description

These high-voltage N-channel Power MOSFETs are 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 links

[STW65N60DM6](#)
[STWA65N60DM6](#)

#### Product summary

Order code	STW65N60DM6
Marking	65N60DM6
Package	TO-247
Packing	Tube
Order code	STWA65N60DM6
Marking	65N60DM6
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 $T_C = 25\text{ }^\circ\text{C}$	46	A
	Drain current (continuous) at $T_C = 100\text{ }^\circ\text{C}$	29	
$I_{DM}^{(1)}$	Drain current (pulsed)	140	A
$P_{TOT}$	Total power dissipation at $T_C = 25\text{ }^\circ\text{C}$	368	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.  $I_{SD} \leq 46\text{ A}$ ,  $V_{DS}(\text{peak}) < V_{(BR)DSS}$ ,  $V_{DD} = 400\text{ V}$ .

3.  $V_{DS} \leq 480\text{ V}$ .

**Table 2. Thermal data**

Symbol	Parameter	Value	Unit
$R_{thJC}$	Thermal resistance, junction-to-case	0.34	$^\circ\text{C/W}$
$R_{thJA}$	Thermal resistance, junction-to-ambient	50	$^\circ\text{C/W}$

**Table 3. Avalanche characteristics**

Symbol	Parameter	Value	Unit
$I_{AR}$	Avalanche current, repetitive or not repetitive (pulse width limited by $T_J$ max)	6	A
$E_{AS}$	Single pulse avalanche energy (starting $T_J = 25\text{ }^\circ\text{C}$ , $I_D = I_{AR}$ ; $V_{DD} = 50\text{ V}$ )	900	mJ

## 2 Electrical characteristics

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

**Table 4. On/off states**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$V_{(BR)DSS}$	Drain-source breakdown voltage	$V_{GS} = 0\text{ V}$ , $I_D = 1\text{ mA}$	600			V
$I_{DSS}$	Zero gate voltage drain current	$V_{GS} = 0\text{ V}$ , $V_{DS} = 600\text{ V}$			1	$\mu\text{A}$
		$V_{GS} = 0\text{ V}$ , $V_{DS} = 600\text{ V}$ , $T_C = 125\text{ °C}^{(1)}$			100	
$I_{GSS}$	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	4.00	4.75	V
$R_{DS(on)}$	Static drain-source on resistance	$V_{GS} = 10\text{ V}$ , $I_D = 23\text{ A}$		60	71	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	$V_{DS} = 100\text{ V}$ , $f = 1\text{ MHz}$ , $V_{GS} = 0\text{ V}$	-	2500	-	pF
$C_{oss}$	Output capacitance		-	125	-	pF
$C_{riss}$	Reverse transfer capacitance		-	4	-	pF
$C_{oss\ eq}^{(1)}$	Equivalent output capacitance	$V_{DS} = 0\text{ to }480\text{ V}$ , $V_{GS} = 0\text{ V}$	-	204	-	pF
$R_G$	Intrinsic gate resistance	$f = 1\text{ MHz}$ , $I_D = 0\text{ A}$	-	1.7	-	$\Omega$
$Q_g$	Total gate charge	$V_{DD} = 480\text{ V}$ , $I_D = 42\text{ A}$ , $V_{GS} = 0\text{ to }10\text{ V}$ (see Figure 14. Test circuit for gate charge behavior)	-	65.2	-	nC
$Q_{gs}$	Gate-source charge		-	16.8	-	nC
$Q_{gd}$	Gate-drain charge		-	30.2	-	nC

1.  $C_{oss\ eq}$  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**

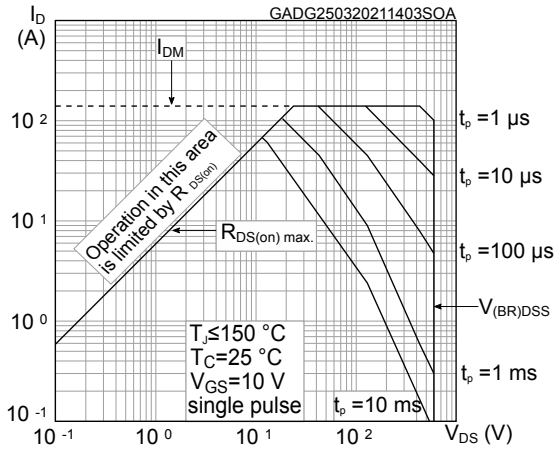
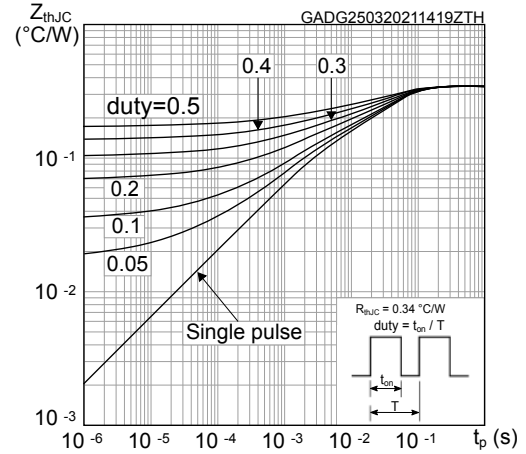
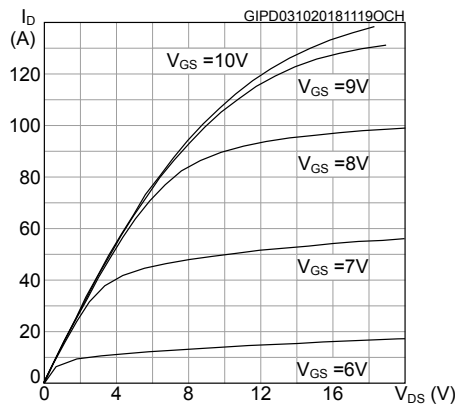
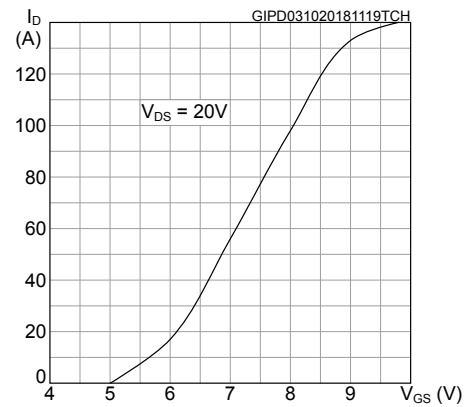
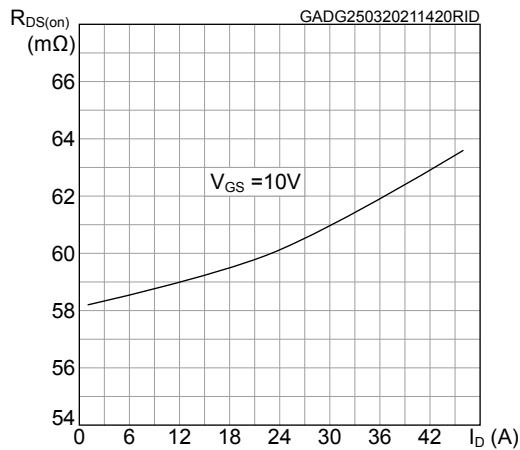
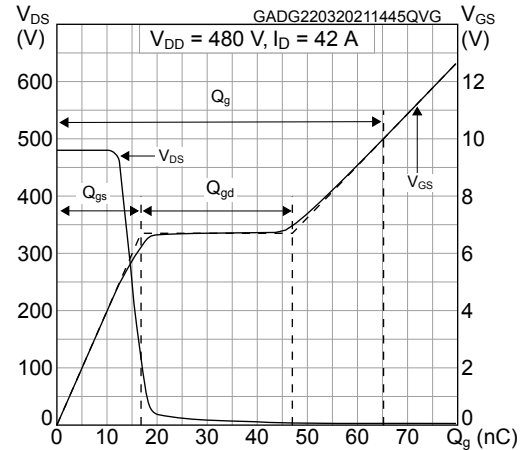
Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$t_{d(on)}$	Turn-on delay time	$V_{DD} = 300\text{ V}$ , $I_D = 19\text{ A}$ , $R_G = 4.7\text{ }\Omega$ , $V_{GS} = 10\text{ V}$	-	21	-	ns
$t_r$	Rise time		-	22	-	ns
$t_{d(off)}$	Turn-off delay time	(see Figure 13. Test circuit for resistive load switching times and Figure 18. Switching time waveform)	-	56	-	ns
$t_f$	Fall time		-	9	-	ns

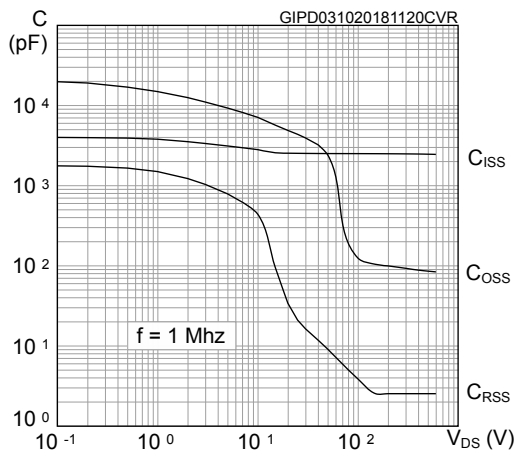
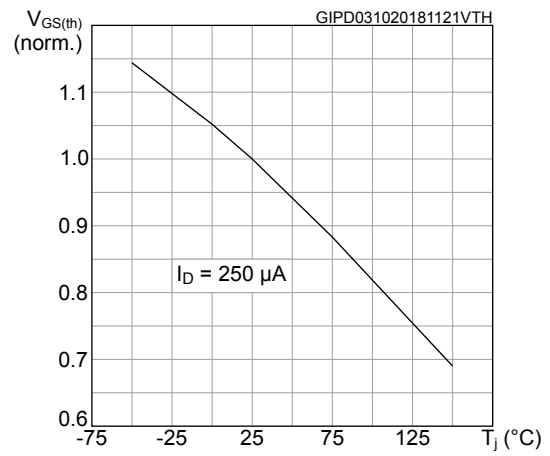
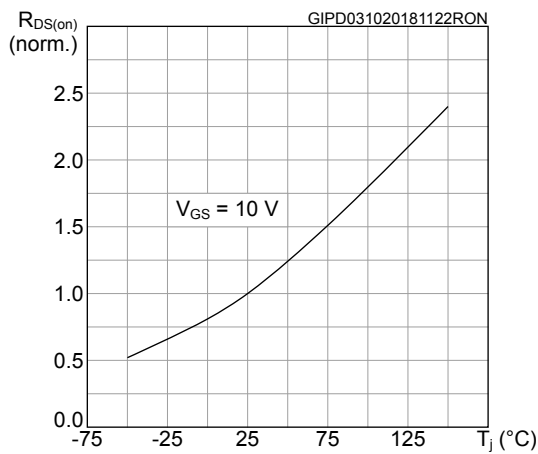
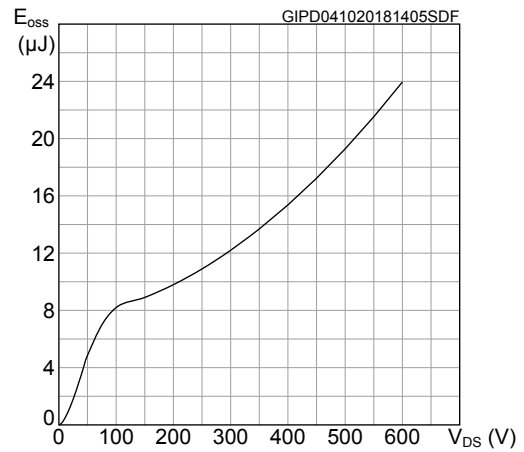
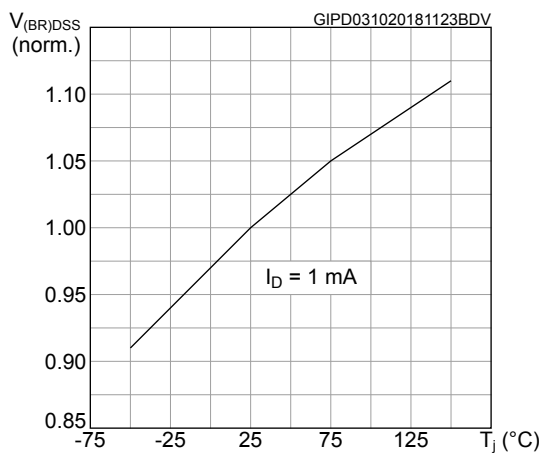
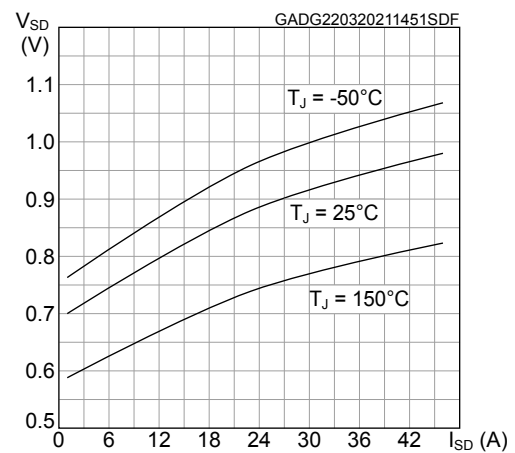
**Table 7. Source drain diode**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$I_{SD}$	Source-drain current		-		46	A
$I_{SDM}^{(1)}$	Source-drain current (pulsed)		-		140	A
$V_{SD}^{(2)}$	Forward on voltage	$V_{GS} = 0\text{ V}$ , $I_{SD} = 46\text{ A}$	-		1.6	V
$t_{rr}$	Reverse recovery time	$I_{SD} = 38\text{ A}$ , $di/dt = 100\text{ A}/\mu\text{s}$ ,	-	116		ns
$Q_{rr}$	Reverse recovery charge	$V_{DD} = 60\text{ V}$	-	0.58		$\mu\text{C}$
$I_{RRM}$	Reverse recovery current	(see Figure 15. Test circuit for inductive load switching and diode recovery times)	-	10		A
$t_{rr}$	Reverse recovery time	$I_{SD} = 38\text{ A}$ , $di/dt = 100\text{ A}/\mu\text{s}$ ,	-	208		ns
$Q_{rr}$	Reverse recovery charge	$V_{DD} = 60\text{ V}$ , $T_J = 150\text{ }^\circ\text{C}$	-	1.98		$\mu\text{C}$
$I_{RRM}$	Reverse recovery current	(see Figure 15. Test circuit for inductive load switching and diode recovery times)	-	19		A

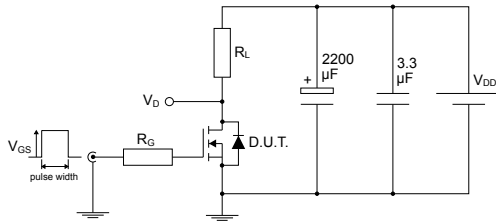
1. Pulse width is limited by safe operating area.
2. Pulsed: pulse duration = 300  $\mu\text{s}$ , duty cycle 1.5%.

## 2.1 Electrical characteristics curves

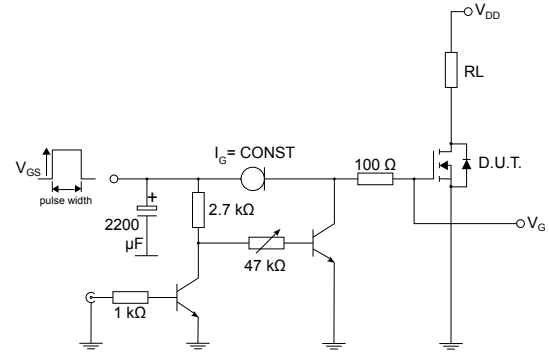
**Figure 1. Safe operating area**

**Figure 2. Maximum transient thermal impedance**

**Figure 3. Typical output characteristics**

**Figure 4. Typical output characteristics**

**Figure 5. Typical drain-source on-resistance**

**Figure 6. Typical gate charge characteristics**


**Figure 7. Typical capacitance characteristics**

**Figure 8. Normalized gate threshold vs temperature**

**Figure 9. Normalized on resistance vs temperature**

**Figure 10. Typical output capacitance stored energy**

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

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


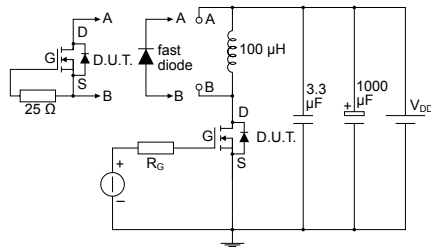
### 3 Test circuits

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


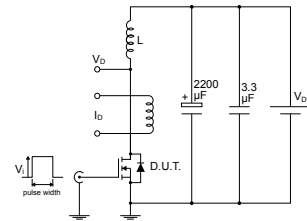
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**Figure 14. Test circuit for gate charge behavior**


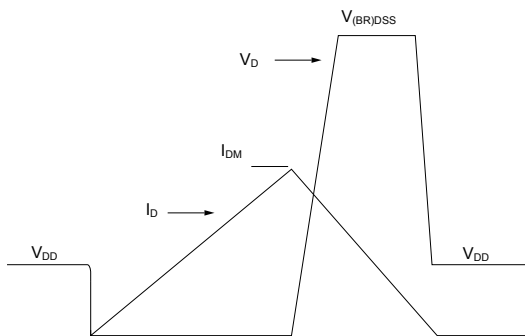
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**Figure 15. Test circuit for inductive load switching and diode recovery times**


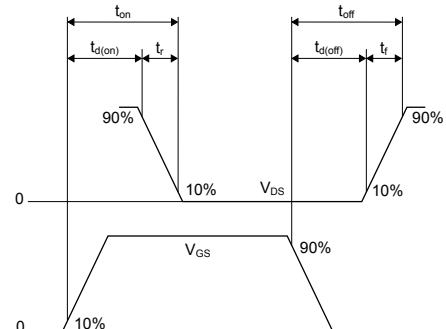
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**Figure 16. Unclamped inductive load test circuit**


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**Figure 17. Unclamped inductive waveform**


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**Figure 18. Switching time waveform**


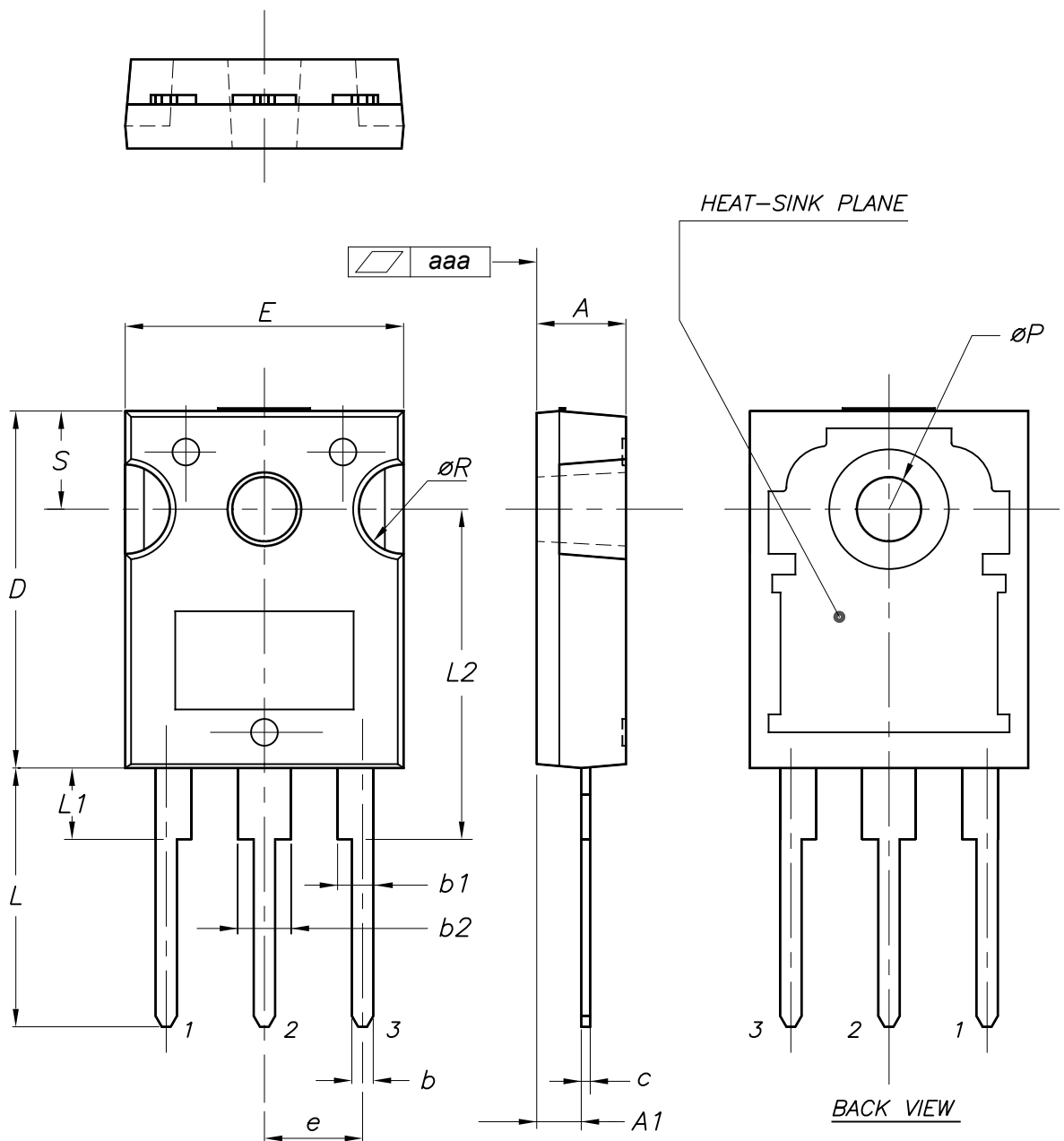
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## 4 Package information

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 TO-247 package information

Figure 19. TO-247 package outline



0075325\_10

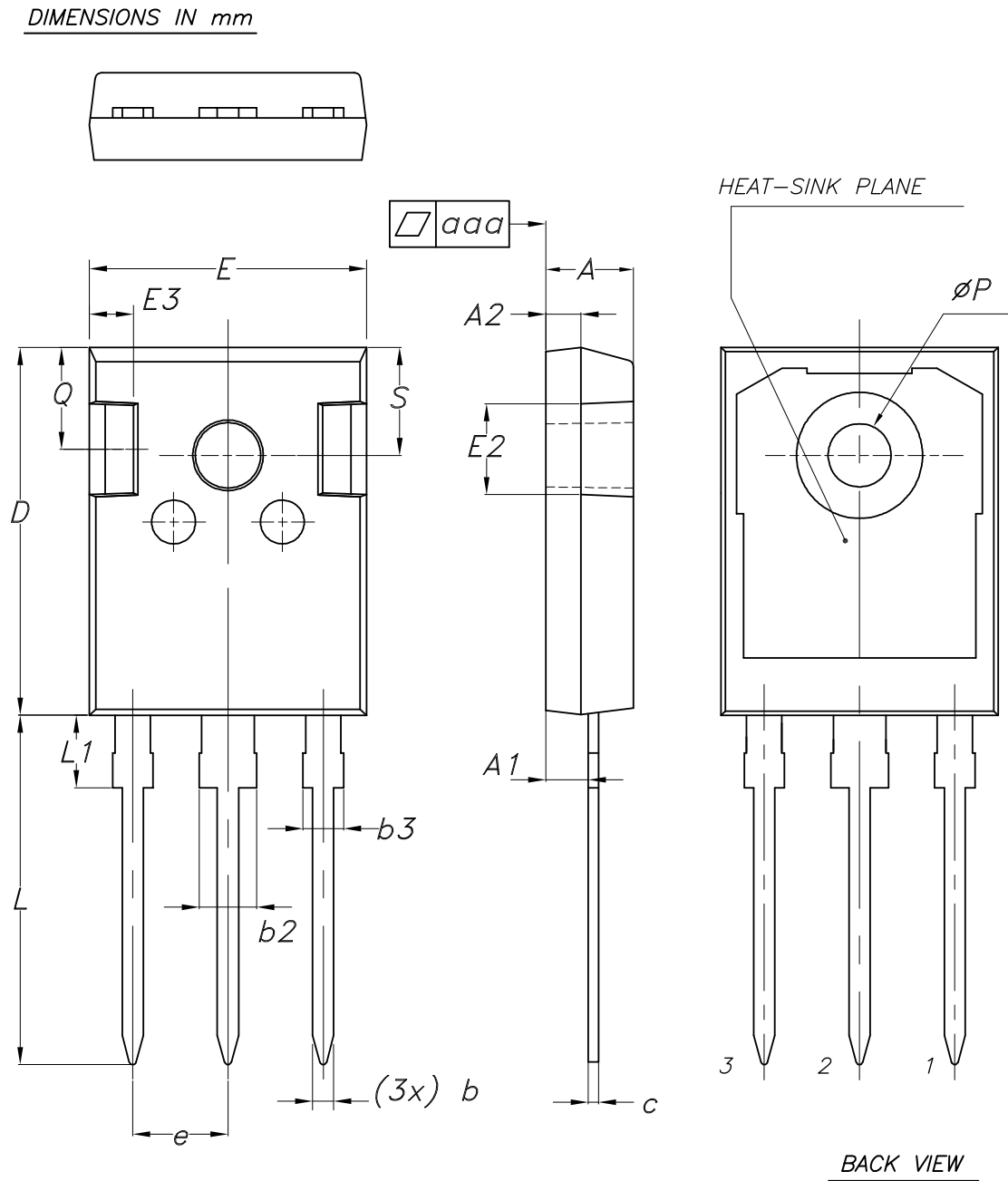


Table 8. TO-247 package mechanical data

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 20. TO-247 long leads package outline



8463846\_3

**Table 9. 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 10. Document revision history**

Date	Version	Changes
02-Nov-2017	1	Initial release.
03-Oct-2018	2	Removed maturity status indication from cover page. The document status is production data. Updated title and features in cover page. Updated <i>Updated Section 1 Electrical ratings, Section 2 Electrical characteristics.</i> Added <i>Section 2.1 Electrical characteristics curves.</i> Minor text changes.
17-Jun-2020	3	Updated <i>Table 1. Absolute maximum ratings.</i>
31-Mar-2021	4	Updated <i>Table 1. Absolute maximum ratings, Table 2. Thermal data, Table 4. On/off states, Table 7. Source drain diode, Figure 1. Safe operating area, Figure 2. Maximum transient thermal impedance and Figure 6. Gate charge vs gate-source voltage.</i>
21-May-2021	5	Updated <i>Section 4.2 TO-247 long leads package information.</i> Minor text changes.

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## Contents

<b>1</b>	<b>Electrical ratings</b> .....	<b>2</b>
<b>2</b>	<b>Electrical characteristics</b> .....	<b>3</b>
<b>2.1</b>	<b>Electrical characteristics curves</b> .....	<b>5</b>
<b>3</b>	<b>Test circuits</b> .....	<b>7</b>
<b>4</b>	<b>Package information</b> .....	<b>8</b>
<b>4.1</b>	<b>TO-247 package information</b> .....	<b>8</b>
<b>4.2</b>	<b>TO-247 long leads package information</b> .....	<b>10</b>
	<b>Revision history</b> .....	<b>12</b>

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